Economic and Social Impact of ICT in the Pacific

2015

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Cover photograph: Students from Tonga's Tailulu College making the most of new high-speed broadband services at 2013 World Telecommunication and Information Society Day celebrations in the Tongan capital, Nuku'alofa. Photo: Tom Perry / World Bank.

Note: Unless otherwise noted, conversion to United States dollars based on annual average exchange rates sourced from the World Bank.

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Abbreviations

ADSL	Asymmetric Digital Subscriber Line
ATH	Amalgamated Telecommunication Holdings Limited
Capex	Capital Expenditure
FJD	Fiji Dollar
FTR	Fixed Termination Rate
Gbit/s	Gigabits per second
GDP	Gross Domestic Product
GFCF	Gross Fixed Capital Formation
HIES	Household Income and Expenditure Survey
ICT	Information and Communication Technology
ITU	International Telecommunication Union
IVR	Interactive voice response
kbit/s	Kilobits per second
Mbit/s	Megabits per second
ms	Millisecond
MTR	Mobile Termination Rate
OECD	Organization for Economic Cooperation and Development
SIM	Subscriber Identity Module
SMS	Short Message Service
TCC	Tonga Communications Corporation
TCL	Tonga Cable Limited
TVL	Telecom Vanuatu Limited
US$	United States Dollar. All conversions based on annual average exchange rates unless otherwise noted.
USP	University of the South Pacific
USSD	Unstructured Supplementary Service Data
WDI	World Bank's World Development Indicators

1 Introduction
and Executive Summary

The Information and Communication Technology (ICT) sector in a number of Pacific Island Countries (PICs) has undergone significant liberalisation and privatisation over the last decade leading to a rapid increase in access to mobile voice and data networks. Additionally, international bandwidth has increased due to the deployment of undersea fibre optic cables. Increased access to ICTs may lead, through various mechanisms, to social and economic benefits:

- **Labour force productivity:** Improved education and workforce skills and higher degrees of specialisation.
- **Entrepreneurship:** New domestic and international business opportunities through access to new markets but also from specialisation, division of labour and new combinations of products and services.
- **Financial intermediation:** Enhanced access to financial services such as mobile money, micro insurance, micro venture capital, unlocking the entrepreneurial potential of the unbanked and reducing the cost of transactions through point of sale systems, online banking and mobile banking.
- **Innovation:** Enables new organisational models and business processes.
- **Transaction cost:** Enhanced speed and quality of information flows result in higher price transparency, reduced transaction costs within households, businesses and public institutions and also enhances transactions between these entities.
- **Service delivery:** Electronic service delivery increases transparency, reducing opportunities for bribery and saves time and money for citizens and businesses

The impacts of these developments in the Pacific region have not been widely documented. This report summarises the findings of studies conducted in Fiji, Samoa, Solomon Islands, Tonga and Vanuatu on behalf of the Pacific Region Infrastructure Facility (PRIF).

The report highlights impacts or the lack thereof, to derive possible intervention points for donors, policy makers, regulators and operators. The concept of the 'mobile ecosystem' is used in this report to go beyond the purely technological and infrastructural dimensions of ICTs and incorporates factors such as pricing that support analysis of how increased usage and integration into new and innovative business models can contribute to economic growth. This report contends that this approach is critical to transform the South Pacific into a dynamic and robust economy that takes full advantage of the mobile sector.

The regional comparative report and country reports include:
- recent ICT developments in the region, highlighting impacts on coverage, pricing and access
- macro-economic impacts, direct and indirect
- impacts for agriculture, education, health, tourism, government, financial services and other sectors.
- analysis of the mobile ecosystem to understand the differences in impacts and how mobile integration is essential for service delivery and business processes beyond voice.

Conclusions

Liberalisation of the telecommunications sector, strongly supported by development partners, has driven competition in the South Pacific leading to increased network rollout and falling prices. This in turn has dramatically *impacted ICT access*. Average mobile coverage in the countries studied jumped from less than half the population in 2005 to 93 per cent in 2014, a basket of mobile calls declined by a third between 2005 and 2014 and penetration of cell phones in households rose from 49% in 2007 to 86% in 2013.

Recent connectivity to submarine cables has resulted in an explosion of capacity. International Internet bandwidth jumped over 1,500% between 2007 and 2014 rising from less than 100 Mbit/s to over 1 Gbit/s (excluding Fiji which had already connected to submarine cable in 2000). The region is still coming to grips with the novelty of abundant bandwidth, enhanced coverage and cheaper tariffs. There is considerable scope for widening Internet take-up across the South Pacific and boosting mobile penetration in the Solomon Islands and Vanuatu.

While fixed and mobile voice had some *indirect economic impact*, the bulk of impact is likely to stem from mobile broadband. Fixed broadband is a niche product for most countries in the region and the vast majority of Internet users access the Internet via mobile phone or a laptop and desktop using dongles. The upgrade to 3G is still quite new in the

South Pacific and Fiji is the only country with commercial 4G mobility services. In the Solomon Islands, a large number of rural base stations only support voice services. This means that the real impact from mobile broadband is only beginning to happen and will only be measurable several years into the future.

Direct economic impacts are noticeable with the size and contribution of the communications sector usually increasing following the introduction of competition. In general, the share of the communications sector in the countries is on par with OECD nations, influenced by the greater role that communications plays in island economies.

In terms of *impacts in different sectors*, most of the countries have devoted resources to connecting government agencies but less so to schools and health. Four of the five countries have deployed government networks with development assistance. Few citizen-oriented services are delivered electronically. Most governments are focused on internal processes and the use of ICTs for citizen and business services has not been a priority. There are some examples of mobile services such as text alerts for severe weather, ferry schedules, voting locations and status of pension fund accounts.

Important sectors such as tourism and remittances, which contribute significantly to GDP, are making use of ICTs. All of the countries have tourist web sites marketing a range of accommodations, increasing exposure for locally run establishments. Mobile operators are also benefitting from tourists, almost a million in 2013, bringing their phones and buying local SIM cards or using roaming services. All of the countries now have mobile money or banking services. Mobile money has expanded financial inclusion and reduced overseas money transfer costs.

Apart from Fiji, there are no quantitative and methodological rigorous studies highlighting the impact of using ICTs in different sectors in the countries studied. One reason is that improvement in connectivity and widespread access to ICTs in the region is relatively recent. Another reason is that there are few relevant applications affecting citizens at a significant scale. This should be qualified by the fact that some users will quickly grasp how to use ICTs, particularly mobile phones, to reduce information disparities and generate income. Examples of impact studies from other countries suggest they could be replicated in the region if resources were devoted to this area, particularly collecting necessary data and carrying out surveys.

Limited financial and human capacity is a major impediment to the use of ICT across different sectors. Most government officials expressed interest in the use of ICTs in their sector to develop innovative and impactful applications. However, they often lacked budget--a number of ministries do not have funding for a web site--and technical expertise--most ministries had just a few IT experts if any. Many also cited the high cost of delivering mobile applications as an impediment. Another challenge is reliance on overseas developers who do not understand the local context or leave without transferring the needed skills.

Development assistance for ICT in sectors outside government is scarce and relevant impact monitoring infrequent. Apart from the construction of government networks, there have been few significant development projects incorporating ICTs in different sectors. The main exception is support for the SchoolNet program in Samoa. Most other interventions have typically been small projects that rarely scale up beyond the pilot stage. Development agencies generally do not incorporate impact assessments that concretely measure benefits to targeted groups into the project.

The mobile ecosystem and integration analysis found that there are still a number of market barriers inhibiting development of income generating and public service delivery applications. These will need to be addressed if mobile services are to have wider social and economic impacts in the region.

Recommendations for governments, operators and the development community

The region has experienced a first wave of rapid growth in ICT access, particularly mobile communications. It now needs to leverage growing access by introducing a second wave of transformational initiatives primarily revolving around electronic applications and services as well as sustaining sector liberalization. Based on the findings of this report, governments, operators and the development community might consider supporting the recommended interventions, detailed in pages 64 to 66, in order to grow and strengthen the ICT ecosystem in the South Pacific and improve measurement of impacts.

Several interventions have crosscutting elements that merit strengthening with assistance from development partners. These mainly revolve around capacity development and include:

i) reinforcing institutions within government agencies involved with the regulatory and policymaking areas of ICT as well as those responsible for coordinating public service delivery;

ii) developing basic digital literacy among the general public; and

iii) elevating ICT skills for creation of relevant applications and services and to participate in the ICT-enabled employment sphere which is now possible with the arrival of submarine cables in the South Pacific.

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2 Impact of Sector Reform

A wave of telecommunication sector reform has swept the South Pacific. Countries have revamped antiquated telecommunication laws, introduced competition and established sector regulators. This chapter examines the impact these reforms have had on expanding access to ICTs in the region.

2.1 Sector Liberalisation

All of the countries have taken steps to create a more competitive telecommunications sector. This has involved new legislation permitting competition, creation of sector regulators and special arrangements to end exclusivities of the incumbent operators. By 2009, all except Tonga had a regulator.

Table 2.1: Telecommunication laws and regulators in the South Pacific

Country	Law	Regulator (year established)
Fiji	Telecommunications Promulgation of 2008	Telecommunications Authority of Fiji (TAF) (2008)
Samoa	Telecommunications Act of 2005	Office of the Regulator (OOR) (2006)
Solomon Islands	Telecommunications Act of 2009	Telecommunications Commission of the Solomon Islands (TCSI) (2009)
Tonga	2000 Communications Act	None
Vanuatu	Telecommunications and Radiocommunications Regulation Act of 2009	Telecommunications and Radiocommunications Regulator (TRR) (2008)
Source: Adapted from regulator websites.		

Development assistance has been instrumental in this process. Australia and the World Bank have provided direct support, in partnership, to Pacific governments, as summarized in Table 2.2, plus advisory and technical assistance on ICT policy, legislation and regulatory reforms.

Table 2.2: Development partner grants for telecom reform in the South Pacific

Country	Partner	Project Title	Amount (US$ m)	Year
Fiji	World Bank	Institutionalising the Monitoring of Telecommunications Reform	0.5	2009
Solomon Islands	Australia	Telecommunications and ICT Development Project	2.74	2010
Solomon Islands	World Bank	Telecommunications and ICT Development Project	3.25	2010
Samoa	World Bank	Telecommunications and Postal Sector Reform Project	4.5	2002
Vanuatu	Australia & World Bank	Telecommunications & ICT Technical Assistance Project (2 phases)	2.81 2.73	2008 2012
Source: Adapted from World Bank and DFAT. Note: these are recipient-executed grants.				

New market entrants that requested financial assistance have been supported with loans from international financial institutions. This includes funding from the International Finance Corporation (IFC) amounting to US$ 57 million for Digicel operations in Fiji, Samoa, Tonga and Vanuatu and ADB (Private sector operations department) support to Bmobile for expansion of services in the Solomon Islands.

Table 2.3: International financial institution loans to mobile operators

Country	Agency	Project Title	Amount (US$ m)	Year
Fiji	IFC	Digicel	22.9	2009
Samoa	IFC	Digicel Samoa	8.2	2007
Samoa	IFC	Digicel Samoa 2	10.5	2009
Tonga	IFC	Digicel Tonga	6.8	2009
Vanuatu	IFC	Digicel Vanuatu	9.0	2009
Solomon Islands	ADB	Bmobile expansion	See Note	2011
Note: An equity investment (up to US$9 million and loan (up to US$40 million) was proposed for bmobile, headquartered in Papua New Guinea. No breakdown is available about the proportion invested in the Solomon Islands. Source: Adapted from IFC and ADB.				

Creation of the groundwork for a competitive telecommunications environment opened the door for competition, particularly in the mobile market. Tonga was the only one of the countries with more than one mobile operator before the reforms. By 2010, all of the countries had introduced competition in their mobile markets.

Table 2.4: Number of facilities-based mobile network operators in the South Pacific

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Tonga	2	2	2†	2	2	2	2	2	2	2
Samoa	1	1	2	2	2	2	2	2	2	2
Fiji‡	1	1	1	2	2	2	2	2	2	2
Vanuatu	1	1	1	2	2	2	2	2	2	2
Solomon Islands	1	1	1	1	1	2	2	2	2	2
Note: † Digicel acquired TonFon in December 2007. ‡ Inkk Mobile operates as a Mobile Virtual Network Operator (MVNO) using the network of Vodafone Fiji. Source: PRIF analysis.										

2.2   Network rollout, pricing and access

Introduction of competition in the region has had an amazing impact on ICT prices and network coverage, unleashing unprecedented growth in mobile and Internet access. Investment in mobile networks has rapidly expanded coverage. In 2005, on average, less than half the population in the countries lived within range of a mobile signal.[1] This had more than doubled by 2014 to 93% (Figure 2.1).

Figure 2.1: Mobile coverage, 2G, % of population
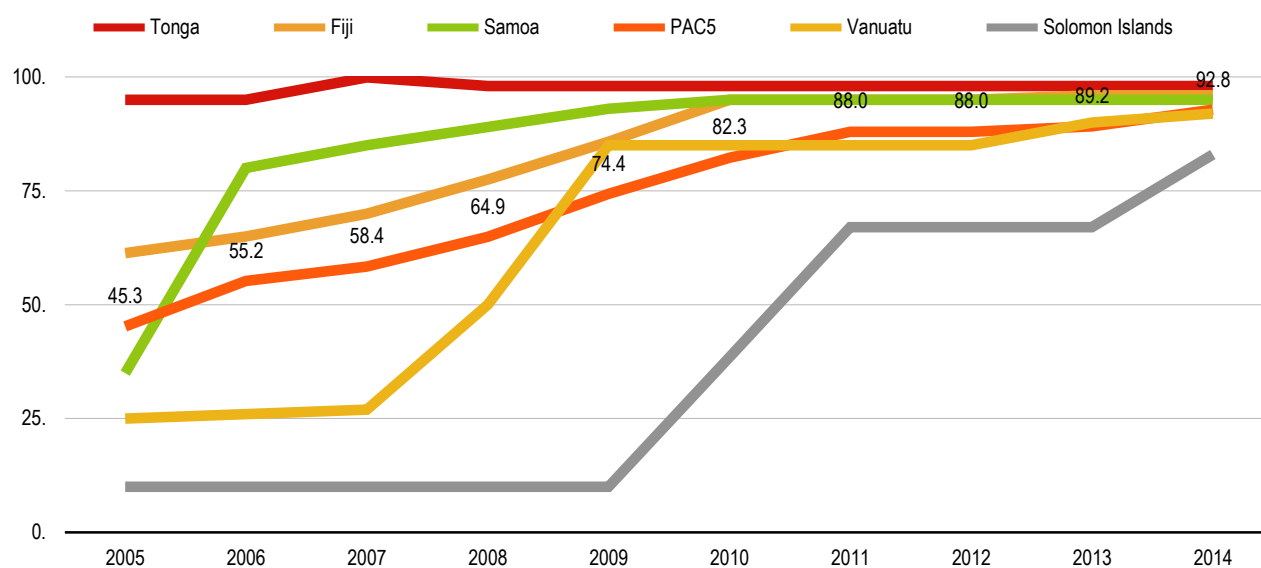
Source: Adapted from operators and regulators.

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[1] Note that regional averages used in the chapter refer to simple averages to avoid the impact that the significantly larger populated countries of Fiji and Solomon Islands would have on the analysis.

Competition in mobile markets has driven down prices. An average monthly basket of mobile calls and texts in the region declined by a third between 2005 and 2014 from US$28 to US$18. Affordability has increased; the mobile basket accounted for 19% of income in 2005 compared to only 6.7% in 2014. Price reductions usually took place one to two years before the arrival of new market entrants as incumbents prepared for competition. Significant price declines are generally one-off. Since the introduction of competition, published prices have remained same or even increased with affordability gains in line with increases in per capita income. The flat prices may be explained somewhat by widespread promotions throughout the region. There is scope for further price reductions to reach the level in Tonga where a monthly mobile basket is 3.0% of per capita income. Household income and expenditure surveys conducted in the region show spending on communications to average between 3.2% and 6.0% of monthly household income.

Figure 2.2: Mobile basket (% of per capita income)[2]
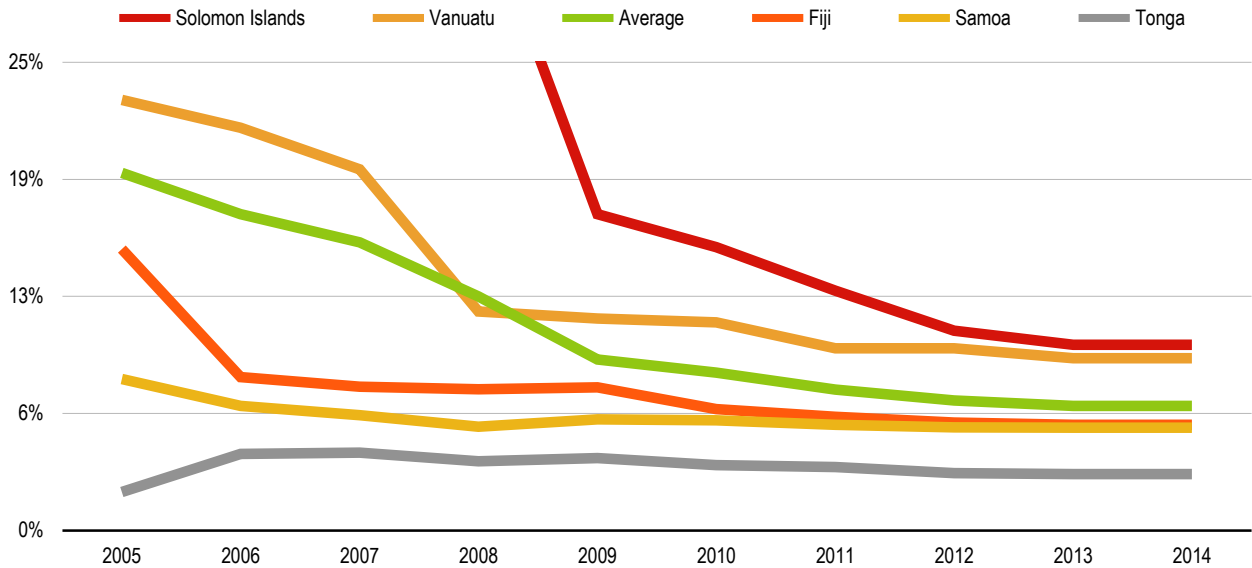
Increased mobile coverage and falling prices has driven uptake. In 2007, less than half the households in the countries studied had a mobile phone. By 2013, this had grown 75% with penetration rising to 86% of households (Figure 2.3). In Fiji, Samoa and Tonga, household cell phones were almost ubiquitous with penetration rates over 95% and the remaining barrier tied to coverage.

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[2] Note: The mobile basket is based on OECD methodology consisting of 30 calls per month distributed over different time periods to different networks (on-net, off-net and landline) and 100 text messages.
Source: Adapted from operators.

Figure 2.3: Percentage of households with a mobile phone
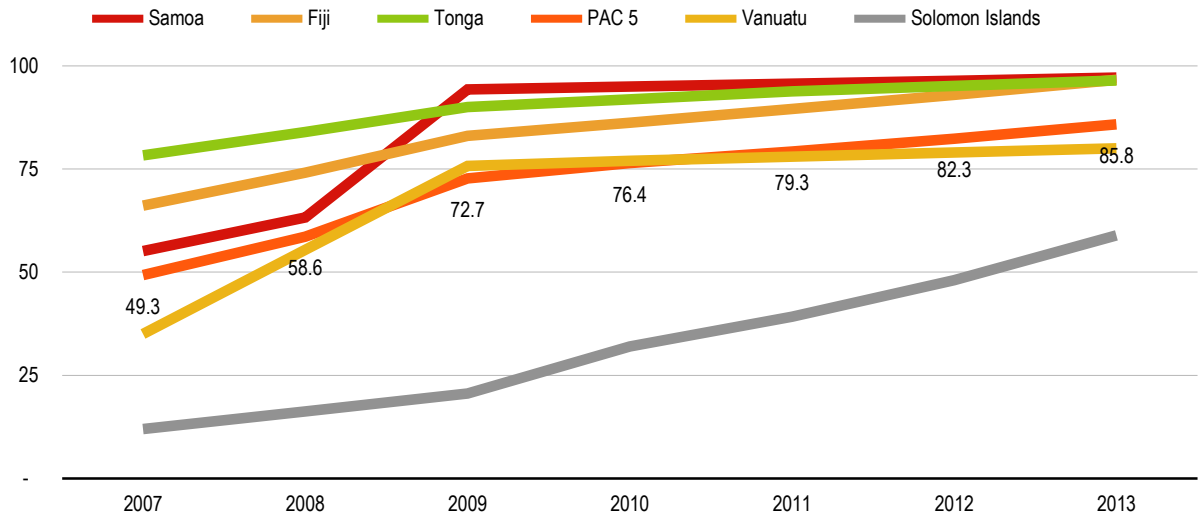
In contrast, fixed lines in homes have declined. According to the latest survey data, mobile phones penetration in households exceeded fixed lines by almost four to one.

Figure 2.4: Households with a telephone in the South Pacific (latest survey data 2009-2013)
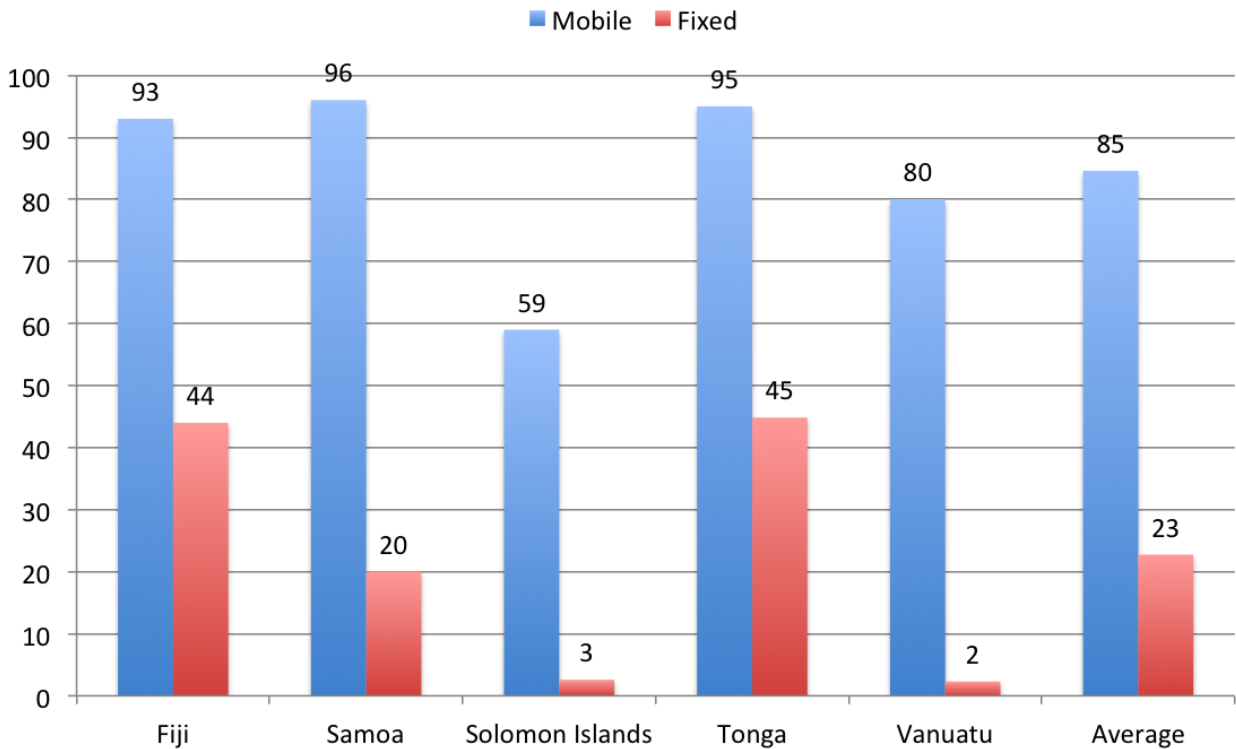
Source: Adapted from national statistical offices.

The deployment of undersea fibre optic cables has led to an explosion of international Internet bandwidth in the region, triggering Internet price drops and boosting quality. The South Pacific countries have had to rely on expensive satellite connectivity, constraining the take-up of Internet services. This changed in 2000 when Fiji became the first South Pacific nation to connect to undersea cable. This was a result of the decision to route the Southern Cross cable, running from Australia to the United States, close to Fiji. In 2009, Samoa gained access to limited fibre optic capacity via a spur to American Samoa with onward connectivity to the United States and is now planning to invest in a new cable to Fiji to be commissioned in 2016. In 2013 and 2014, cables were launched from Tonga and Vanuatu with termination in Fiji enabling onward connectivity to Southern Cross. The Solomon Islands is planning to deploy a submarine cable to Australia with the launch anticipated 2016.

Table 2.5: Submarine cable networks in the South Pacific

Cable	Ready for Service	Cable Length (km)	Owners	Landing Points
Southern Cross	Nov-00	30,500	Telecom New Zealand, SingTel Optus, Verizon	Australia; United States (Hawaii & mainland); Fiji; New Zealand
Samoa-American Samoa (SAS)	May-09	250	American Samoa Government, Elandia	Samoa; American Samoa; Hawaii
Samoa-Fiji	2016	1,300	Samoa Submarine Cable company (in process of establishment)	Samoa; Fiji
Tonga Cable	Aug-13	827	Tonga Cable Ltd	Tonga (Tongatapu); Fiji
Interchange Cable Network 1 (ICN1)	Jan-14	1,238	Interchange Ltd., Vanuatu Post Ltd, Vanuatu National Provident Fund	Vanuatu; Fiji
Solomons Oceanic Cable Network	Mar-16	2,850	Solomon Islands National Provident Fund, Solomon Telekom Company Limited	Solomon Islands; Australia
Source: Adapted from TeleGeography, Submarine Cable Map.				

The launch of undersea fibre optic cables has had a sharp impact on international Internet bandwidth in the region. In 2007, total capacity in the region excluding Fiji was less than 100 Mbit/s. By 2014, it exceeded 1 Gbit/s. Particularly impressive is the sharp rise in capacity and access in Tonga and Vanuatu following deployment of their submarine cables. This has come about through a sharp fall in wholesale prices as operators move from previous reliance on satellite to undersea fibre optic cable.

Figure 2.5: International Internet bandwidth, Mbit/s
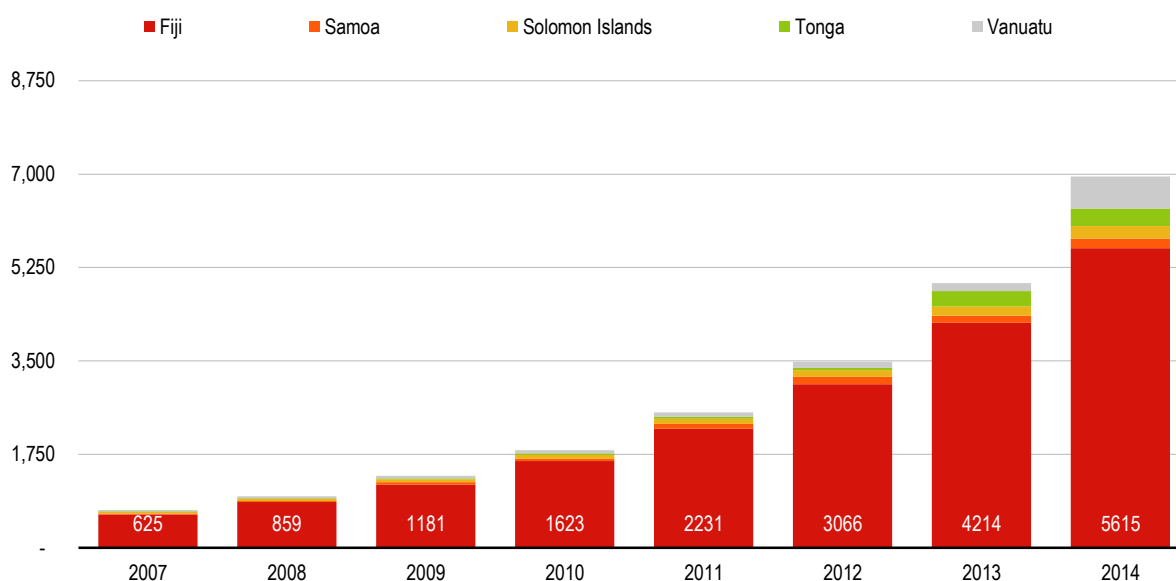
Figure 2.6: International Internet bandwidth, Index 2007=100
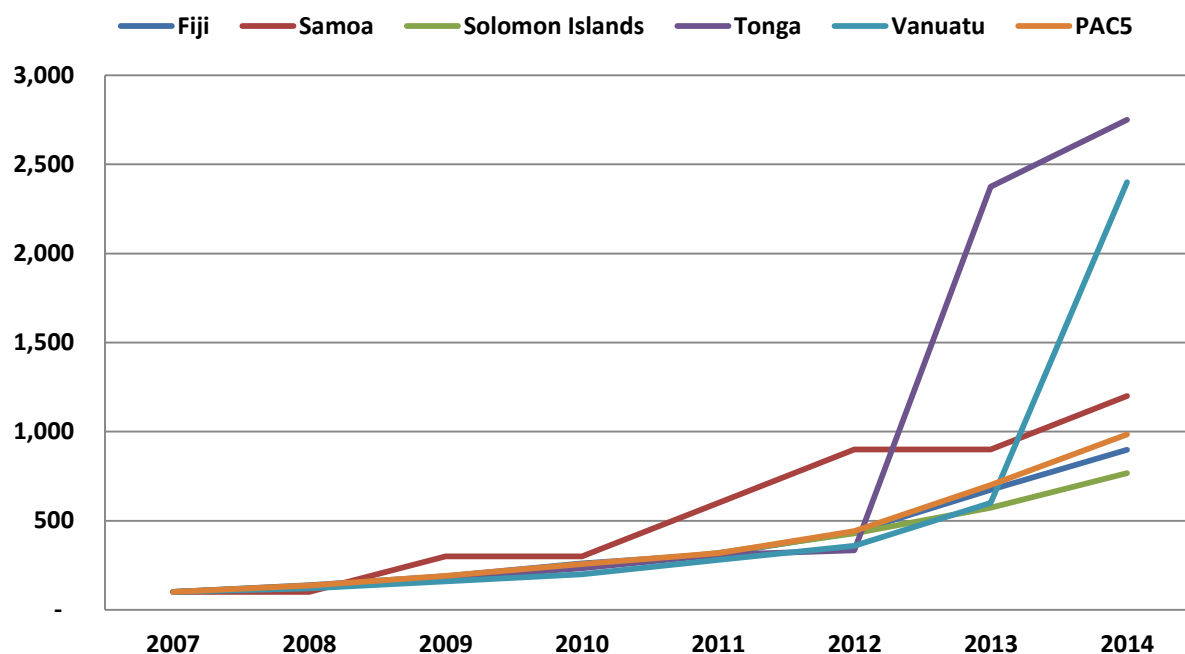
Source: Adapted from World Bank, SOCC and TAF.

Mobile data networks are driving Internet take-up. Internet use has exploded since the launch of mobile competition, because of the expanded potential for access through narrowband 2G (e.g., GPRS, EDGE) and broadband 3G technology. In general, Internet access is available from wherever there is 2G coverage, which stood at 93% on average in the region in 2014 (there are some exceptions particularly Solomon Islands where not all 2G base stations support data).

Mobile broadband has been recently launched in a number of South Pacific countries. The first network was introduced in November 2008 in Fiji and the most recent in December 2013 in Tonga. All of the networks are based on 3G WCDMA technology, typically deploying high-speed upgrades with theoretical download speeds from 14 Mbit/s (HSDPA) to 42 Mbit/s (HSPA). Actual speeds received by users in the region are much lower with the velocity influenced by the device used, distance from base station, network traffic, backhaul and other factors.[3]

4G LTE networks are starting to emerge in the region. LTE offers performance equivalent to or even better than mass market wired broadband solutions available in the region. The ITU's LTE standard, IMT-Advanced, calls for low mobility download speeds of 1 Gbit/s although achievement of these speeds is still some way off.[4] Tests conducted over a live LTE network found download speeds of 36 Mbit/s some nine times faster than 3G.[5] Fiji's mobile operators have commercially launched 4G networks. In Vanuatu, there is a fixed 4G offering in the capital Port Vila and in Samoa, the government is using 4G for fixed wireless on its network.

The launch of 3G and 4G networks is boosting performance. Average download speeds for Vodafone Fiji subscribers increased over 500% in three years (Figure 2.7). By 2014, the average download speed was 12 Mbit/s and 5 Mbit/s for uploads.

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[3] World Bank. 2012. *Broadband Strategies Handbook*.
[4] See: http://www.itu.int/ITU-R/index.asp?category=information&rlink=imt-advanced&lang=en
[5] See: http://www.businesswire.com/news/home/20110412006511/en/Epitiro-Confirms-'Real-World'-LTE-Broadband-Voice#.VLONAsbtXfg

Figure 2.7: Average upload and download speeds in Kbit/s for Vodafone Fiji
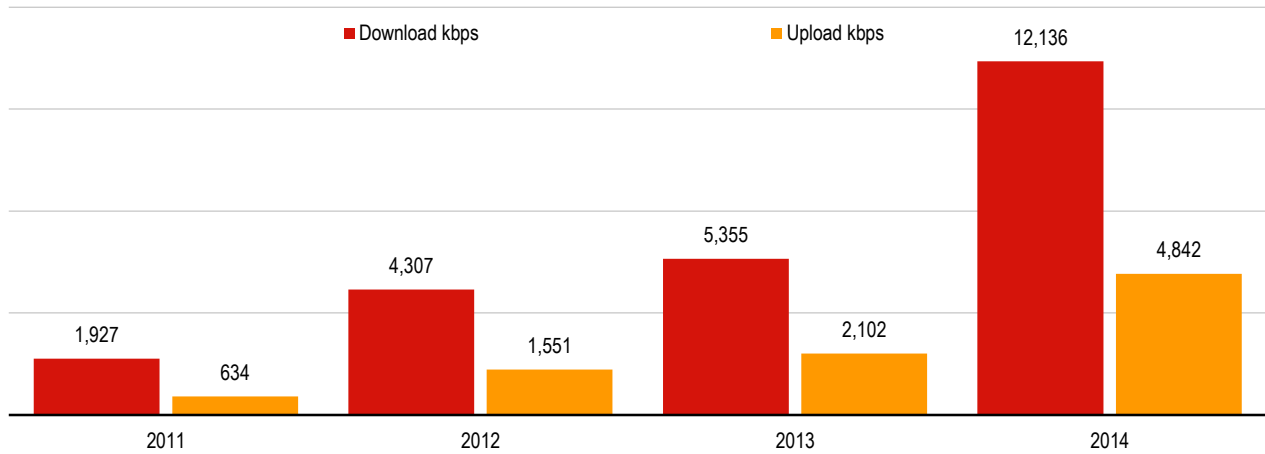
Source: Ookla

Mobile broadband pricing is more affordable and flexible compared to fixed. The competitive impact of mobile broadband has driven down broadband costs across the region. While the average fixed broadband monthly subscription was US$ 688 in 2008, it had dropped to US$ 103 by 2014, a reduction of 85% caused by the pressure of new mobile broadband offerings (Figure 2.8). At US$ 44 per month, average mobile broadband prices are 57% cheaper than entry-level fixed broadband plans in the region and the former provides much more flexibility. A fixed broadband subscription requires a monthly subscription whereas a mobile data subscription can be obtained for just one day. Users can take a mobile broadband dongle with them to connect to their laptop while on the move whereas a wired broadband connection can only be used in one location.

Figure 2.8: Entry-level broadband prices, 1GB minimum data, US$, published in Nov 2014
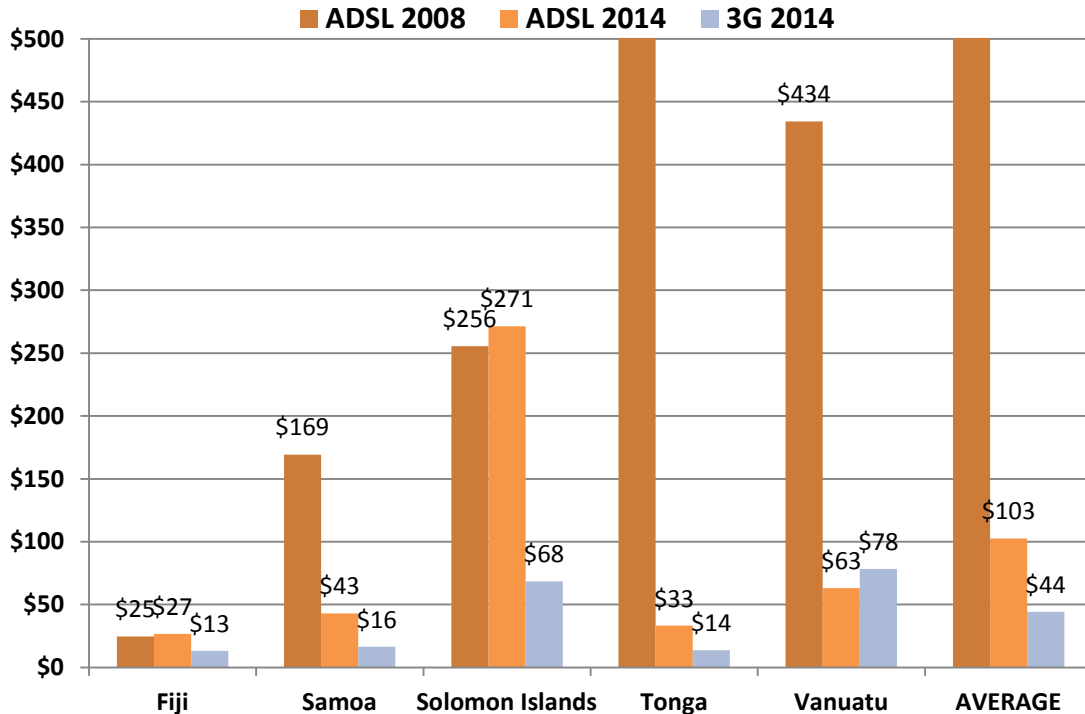
Source: Adapted from operator web sites.

Given its novelty, mobile broadband penetration rates are still relatively low. At the end of 2013, they ranged from less than one in Tonga to 17 per cent of the population in Fiji. Nevertheless, by the end of 2013, mobile broadband already exceeded fixed in every country but Tonga who only launched 3G in December of that year.

Figure 2.9: Broadband subscriptions in the South Pacific
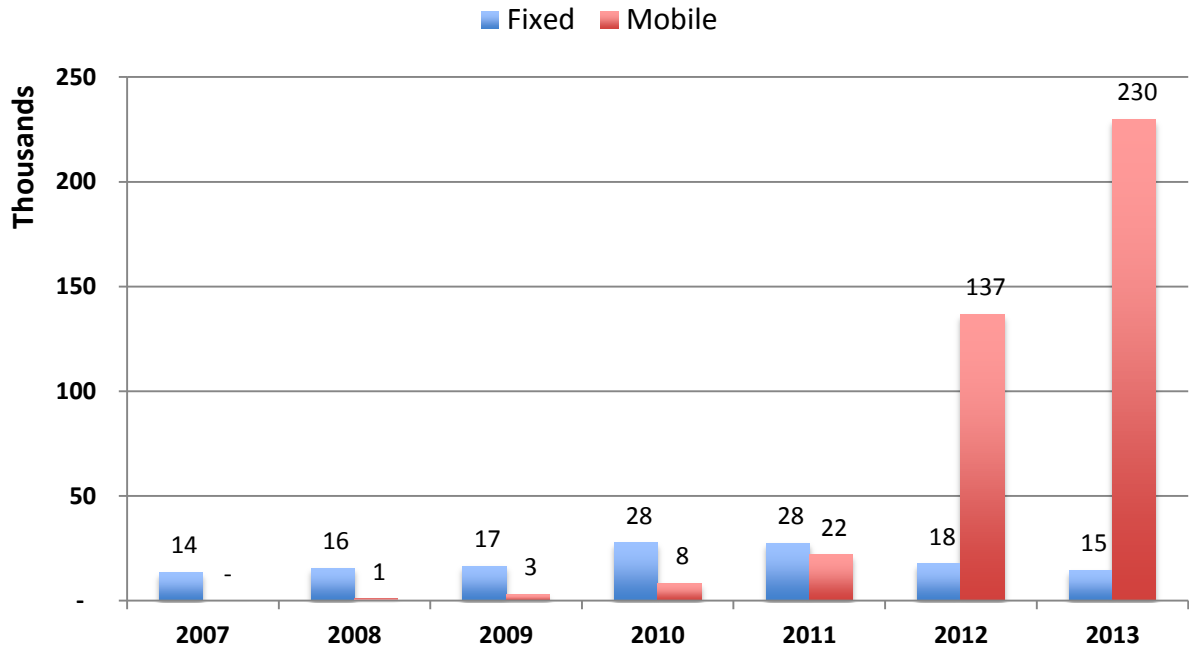
Source: Adapted from World Bank and GSMA.

The rise of mobile Internet is driving sharp rise in Internet use particularly social media. In every country, use of social media, especially Facebook, was widely cited as the main use of the Internet. Big distances in the Pacific drive this as well as close family ties and the large number of people from these countries living abroad. Social media provides a virtual way to stay in touch through the sharing of pictures and videos. Trends in Facebook use can be measured to some extent due the availability of data for all countries for March 2011 and December 2014 extracted directly from the Facebook Ad engine. The number of Facebook users in the region grew over two and half times during this period from 157,000 to 457,000 and penetration rose from 8 per cent of the population to 20 percent.

Figure 2.10: Facebook penetration in the South Pacific (March 2011 and December 2014)
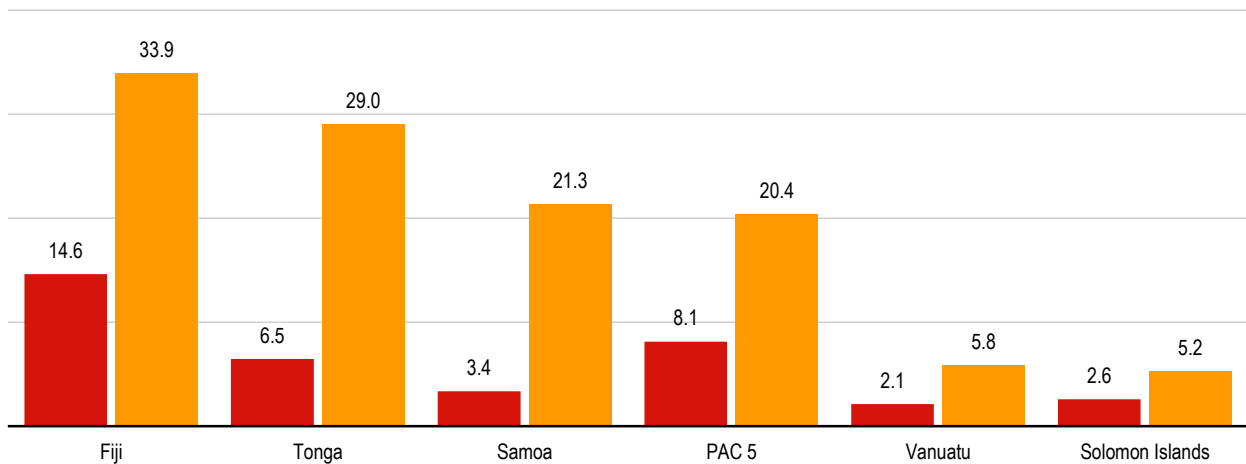
Source: Adapted from Facebook

The rise in Facebook users has been driven by wider access to mobile in the region--over 80% of Facebook users in the region use their cell phones to access the social network-- triggering unprecedented changes in the ways views are shared and spawning a new "digital generation":

"This influx of mobile phones in the Pacific Islands has occurred at the same time as another global phenomenon sweeping the world, the rise of social media, and the Pacific's growing mobile phone penetration has helped fuel social media uptake. Access to social media communities is enabling Pacific Islanders to connect with one another, form online networks, share content, project opinion, promote debate and coordinate activities in ways that were

unimaginable just a few years ago. This has resulted in the emergence of a Pacific 'digital generation' of activists, thinkers, informers and influencers."[6]

2.3 Observations

Liberalisation of the telecommunications sector, strongly supported by development partners, had driven competition leading to increased network roll-out and falling prices. This in turn has spurred a huge rise in ICT access in the region. Average mobile coverage in the countries studied jumped from less than half the population in 2005 to 93 percent in 2014, a basket of mobile calls declined by a third between 2005 and 2014 and penetration of cell phones in households rose from 49% in 2007 to 93% in 2014.

Submarine cables have driven an explosion of capacity. International Internet bandwidth jumped over 1,500% between 2007 and 2014 rising from less than 100 Mbit/s to over 1 Gbit/s (excluding Fiji which had already connected to submarine cable in 2000).

The region is still coming to grasp with the novelty of abundant bandwidth, enhanced coverage and cheaper tariffs. There is considerable scope for widening Internet take-up across the South Pacific and boosting mobile penetration in the Solomon Islands and Vanuatu.

Some trends are noticeable in ownership of operators in the South Pacific countries studied. First new international entrants have entered the market. This includes Digicel (Fiji, Samoa, Tonga and Vanuatu), BlueSky (Samoa) and Bmobile from Papua New Guinea (Solomon Islands). Second is the rise of national pension funds as shareholders in telecommunication operators and submarine cable systems (58% of ATH Group and 49% of Vodafone in Fiji and over 97% of Telekom and 51% of Solomons Oceanic Cable Co (SOCC) in the Solomon Islands). It is not yet clear how these changes will pan out. The new foreign-owned operators that have entered the market are smaller and privately held compared to the large, publicly listed operators that have left. This affects transparency and the capability to draw on the significant financial and technical resources of a large telecommunication multinational. Transparency is also an issue with national pension fund ownership given the need for independent regulation to foster competitive, efficient and innovative markets. The impact of competition could negatively influence the shareholdings of government retirement funds.

The growing availability of mobile communications has significant impact for users ranging from enhanced contact with family members, avoidance of travel costs, increased security, etc. A 2011 survey conducted in Vanuatu asked respondents how mobile telephones have benefitted them across four areas (Figure 2.11). One third reported that telephones had helped with social networks through more frequent contact with family and friends, improved group coordination and increased support. The area with the lowest impact was access to specialised information and services likely due to the lack of mobile applications in these areas. Respondents in the 2011 People's Survey conducted in the Solomon Islands reported that communications was the second most significant change (after no change) in their life with a "major impact on many ... communities". The survey also notes negative impacts such as already limited household income diverted to paying for mobile services and access to offensive content.

Figure 2.11: Vanuatu, Impact of mobile telephones, 2011[7]: Telephones have helped household "a lot"

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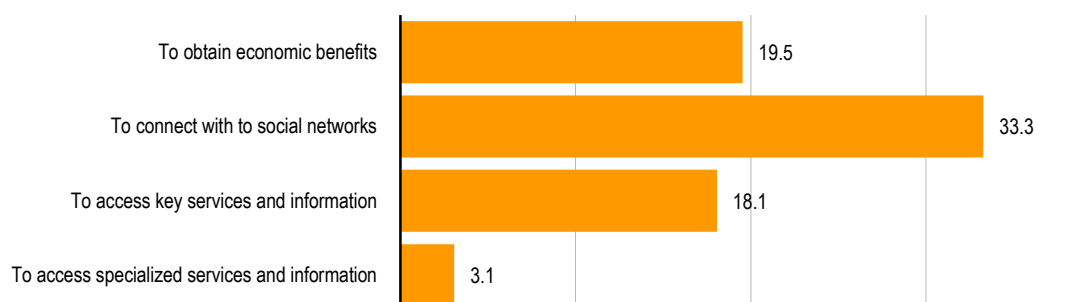
[6] See: http://www.lowyinstitute.org/publications/digital-islands-how-pacifics-ict-revolution-transforming-region
[7] Source: Adapted from O'Connor, Seini, Naemon, and Sijapati-Basnett. 2012. Net Effects: Social and Economic Impacts of Telecommunications and Internet in Vanuatu: Research Findings Report 2011.

Figure 2.12: Solomon Islands: What was the most significant change in your life in the last year? 2011
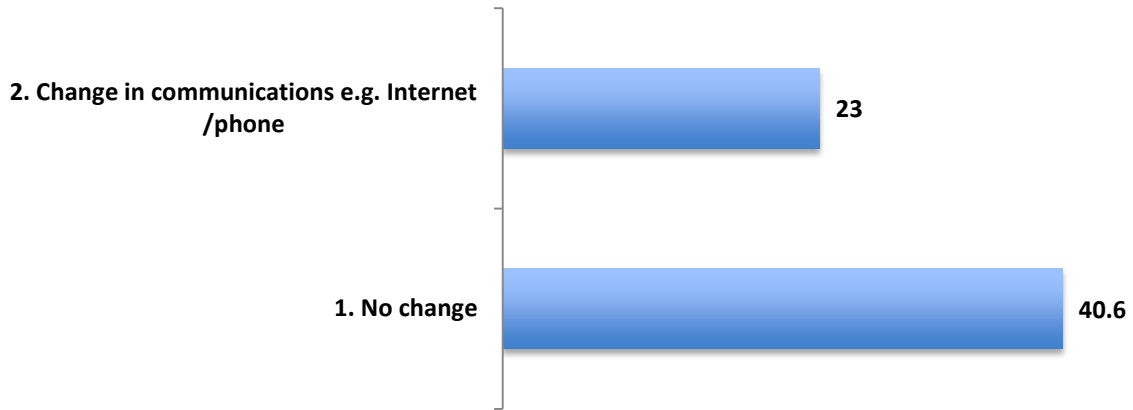
Source: Adapted from RAMSI, 2011 People's Survey

The telecommunications revolution in the region has had a dramatic impact on spreading access to ICT services. Subsequent chapters look at how this increase in ICT access is affecting the economy and creating the potential for improving service delivery in government, agriculture, health, finance and education. Though the initial foundation to create an enabling regulatory environment has been laid, bottlenecks remain including the need to deepen competition, encourage cost-based wholesale prices and ensure that the benefits of ICTs spread to all citizens. These issues are examined are examined later in the report.

3 Macroeconomic Impact

While the direct impacts of ICTs can be obtained from national accounts in the form of GDP contribution and share of employees, the indirect effects are difficult to determine rigorously, in particular when effect sizes are required. While a two way causality between economic growth and broadband penetration is undisputed and supported by economic theory and anecdotal evidence, the exact amount that an economy grows for a specific increase in penetration or use needs to be determined by econometric models that account for the two way causality. The modelling requires either a cross section of data, i.e. data for several countries or time series data going back long enough to provide at least 30 observations.

- Country specific modeling: Evidence for country specific models are based on changes in ICT contribution affected by the penetration or use in the chosen country and are thus more appropriate for policy and regulatory purposes.
- Cross section modeling: Evidence for the magnitude of impact for the cross section of countries is an average across the included countries.
- Panel data modeling: Is a combination of time series data and cross country analysis that also allows one to derive country specific results.

Three main types of models have been utilised to measure the impact of ICT on the economy:

- Simultaneous Equation model: Röller and Waverman (2001) developed a model for measuring the impact of fixed line penetration on GDP based on panel data. It was later expanded to model the impact of mobile penetration (Waverman et al, 2005) and broadband Koutroumpis, (2009). Katz and Koutroumpis, (2012a, 2012b) used the same approach for country specific study for Senegal and the Philippines.
- Endogenous growth model: Waverman et al, 2005 used an endogenous growth model to measure the impact of mobile penetration on economic growth. This approach was also used by Qiang et al. (2009) for fixed line, mobile and fixed broadband and by GSMA (2014).
- Autoregressive distributed lag (ARDL) specifications: Kumar et al (2014) uses an ARDL to link fixed-line penetration to output per worker in Pacific small island states.

This chapter first discusses data availability and then presents effect sizes from the most influential papers in the arena of ICT impact assessment and transfers and applies these to the five Pacific countries covered in this study for fixed-line, mobile and fixed broadband. Direct impacts highlighting the contribution of the ICT sector to the economy are then reviewed.

3.1 Data Availability

Generally, the main obstacle to modelling the indirect impacts of ICTs in the Pacific is data availability. The only telecommunication operator in the five countries that publishes annual financial reports is Fiji's ATH Group. Data for other operators are either unverifiable media statements or subject to non-disclosure agreements. Digicel did provide capital expenditure (CAPEX) figures on condition that their figures were only reported in aggregate or relative terms.

A second complication for determining indirect impacts is that the direct impacts need to be separated out. Modelling the indirect impact of the ICT sector on Gross Domestic Product (GDP), for example, means excluding capital expenditure (CAPEX) from GDP figures, since CAPEX is a direct input into GDP. The CAPEX figure could only be reliably established for Fiji.

Table 3.1: Data Checklist

		Fiji	Vanuatu	Tonga	Samoa	Solomon Islands
Capital Stock	NSO	No	No	No	No	No
Gross fixed capital formation	NSO	Annual 2005-2012	Annual: 1998-2012	Annual 2002-2012	No	Annual 2007-2012
	From operators	2000-2013 ATH and Digicel	2007-14 Digicel only	2007-14 Digicel only	2007-14 Digicel only	No
GDP	NSO	Annual: 2008-2013	Annual: 1998-2012	Annual 1993-2012	Quarterly	Anual 2007-2012
Labour force with secondary education	NSO	Estimates for selected years based on Labour Force and HIES surveys				
Labour force	NSO	For same years based on labour force surveys and census				

An attempt to replicate some of the studies mentioned in the previous section has been made without success. The number of small Pacific island states is generally too small (10) for a simple cross section study such as the one from Qiang et al. (2009). Country specific models based on the simultaneous equation approach such as the Katz and Koutroumpis, (2012a, 2012b) papers could not be implemented due to data limitations.

- Samoa, the only country among the five with quarterly GDP data does not have any data on Gross Fixed Capital Formation (GFCF).
- Telecommunication sector capital expenditure (CAPEX) could only be reliably established for Fiji by combining published annual report data from the ATH group with annualised CAPEX figures for Digicel. Neither the World Development Indicator (WDI) database nor ITU has recent investment figures except from Vanuatu for 2009 to 2012.
- The global financial crisis of 2007 to 2009 meant a reduction in GDP growth around the world and even negative GDP growth, while subscriber numbers were steadily increasing. Economic efficiencies from higher mobile penetration and 3G and 4G upgrades may be masked by the lower GDP growth.

Figure 3.1: World's GDP growth compared to global mobile subscriptions
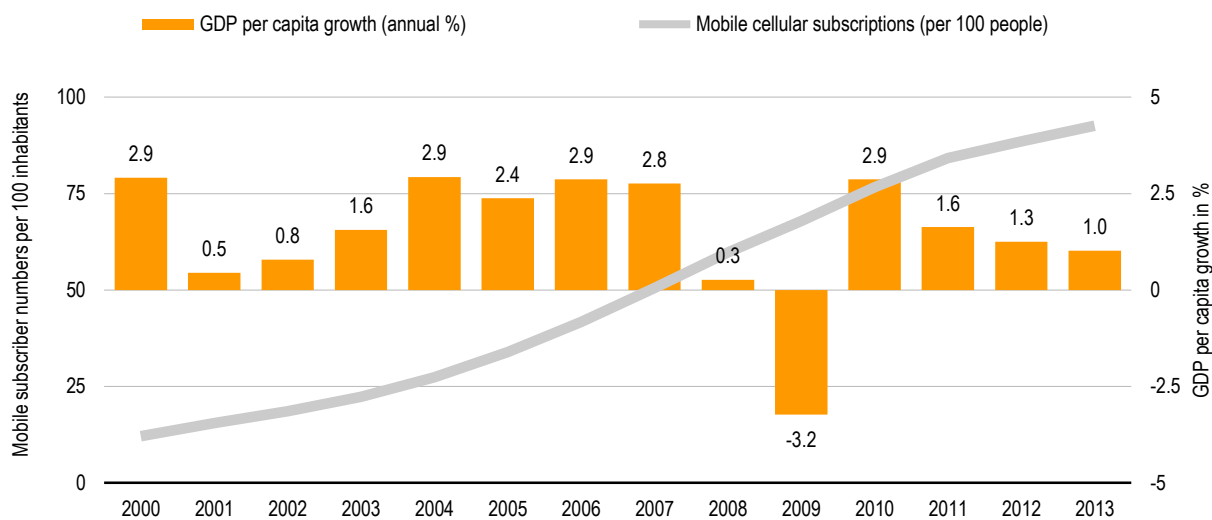
The five Pacific island states included in this study are among the smallest nations in the world and their economic output is not only affected by global events but also reacts sensitively to domestic events such as political and weather disturbances due to the size of the economy. The following figures display the number of mobile subscribers plotted against GDP per capita growth for each of the five countries.

Figure 3.2: Fiji's GDP growth compared to mobile subscriber numbers
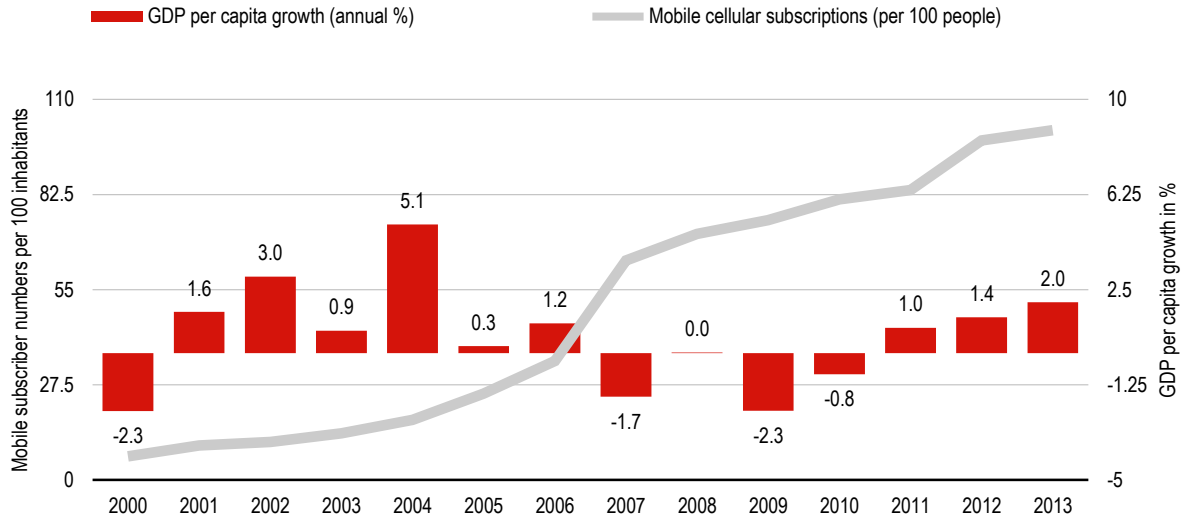
Source: WDI 2014

The figure above compares the per capita GDP growth to the mobile subscriber numbers per 100 inhabitants for Fiji for the period 2000 to 2013. Fiji experienced declining in per capita GDP in 2000, 2007, 2009 and 2008 while mobile subscriber numbers increased steadily.

Figure 3.3: Samoa's GDP growth compared to mobile subscriber numbers
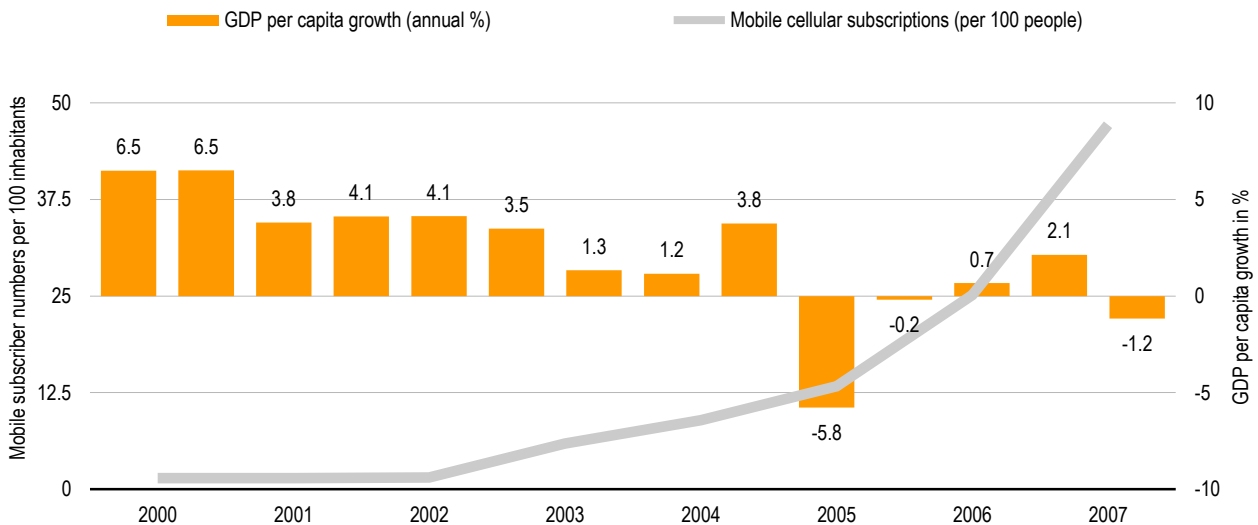
Source: WDI 2014

A similar story arises for Samoa. While per capita GDP growth declined from 2000 to 2007, the mobile subscriber numbers increased exponentially. More recent mobile subscriber numbers than 2007 were not available from WDI or ITU.

Figure 3.4: Solomon Island's GDP growth compared to mobile subscriber numbers
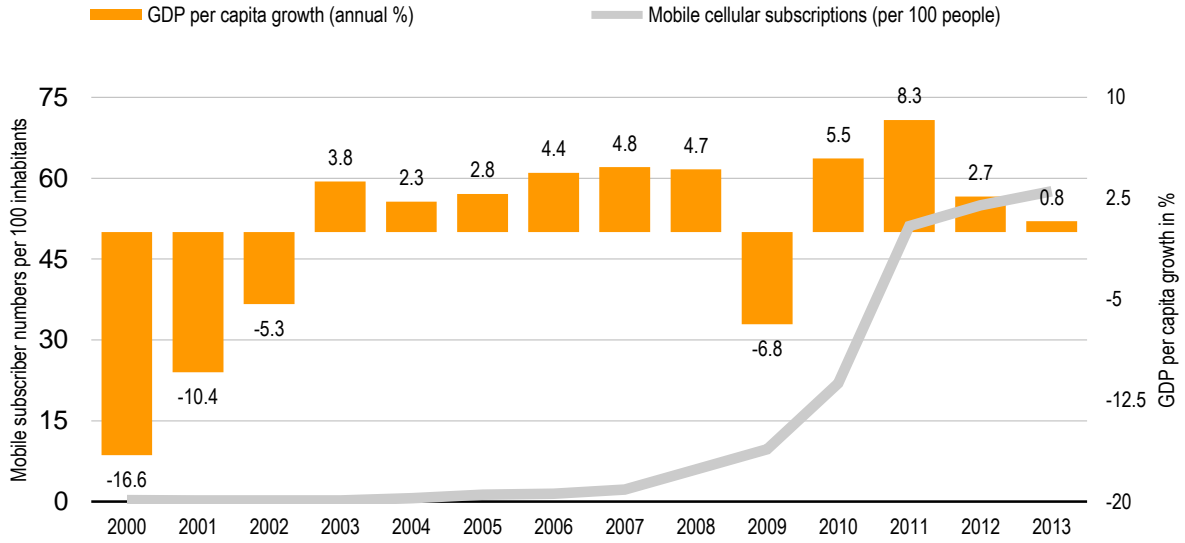
Source: WDI 2014

Solomon Islands came out of a recession with declining negative per capita growth from 2000 to 2002. Mobile penetration only picked up with the introduction of sector reform, which coincided with the effects of the global financial crisis leading to a decline in GDP per capita of -6.8% in 2009, the year with the fastest mobile subscriber number growth.

Figure 3.5: Tonga's GDP growth compared to mobile subscriber numbers
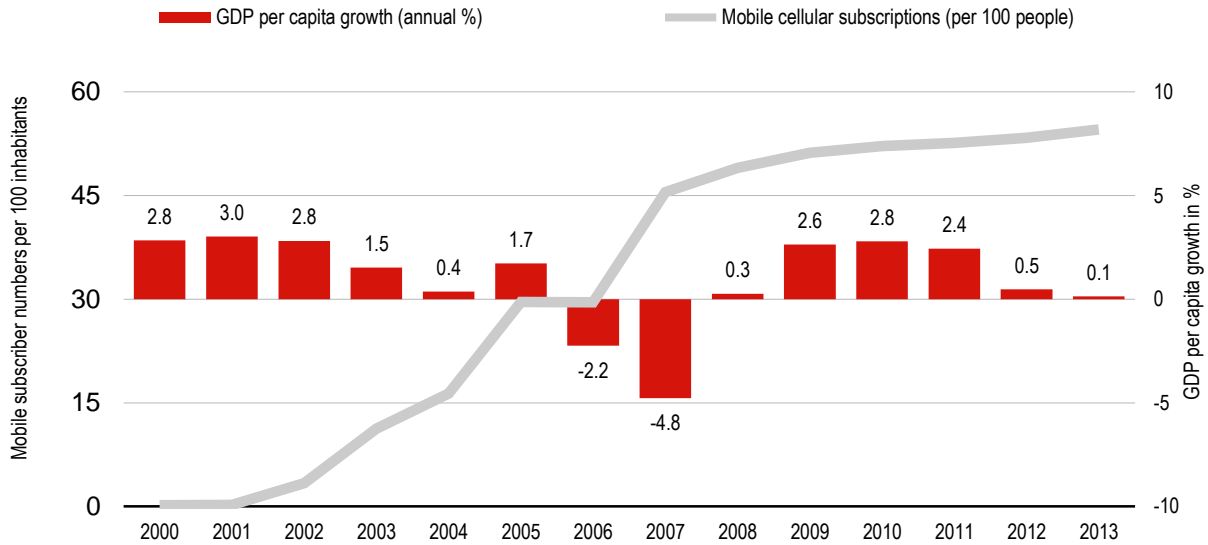
Source: WDI 2014

Tonga too saw the fastest growth in mobile penetration while GDP per capita growth was negative in 2007.

Figure 3.6: Vanuatu's GDP growth compared to mobile subscriber numbers
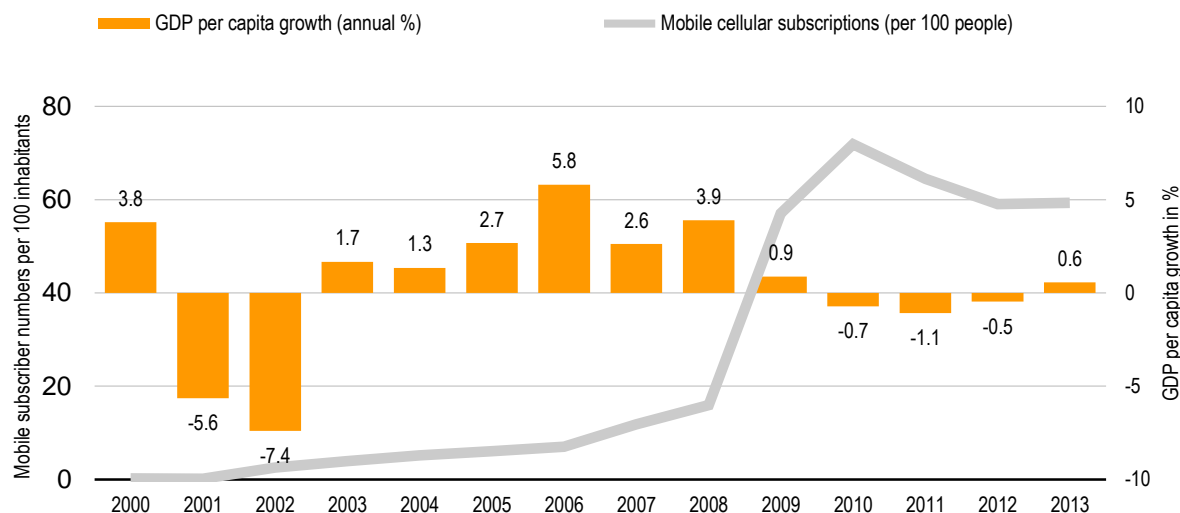
Source: WDI 2014

Vanuatu's mobile subscriber numbers are somewhat in line with developments between 2010 and 2013 but otherwise also are unrelated to GDP per capita growth.

What is clear from the brief descriptive discussion and data availability issues discussed above is that it is very difficult to determine the gain in economic efficiency through ICTs for the selected countries. The study thus focuses on transferring the effect sizes of other studies to the Pacific countries in the next section.

3.2   Applying Effect Sizes to the Pacific

The evidence of most studies presented in the introductory section is based on country comparisons, i.e. cross section analysis. This means that the effect size is an average across all countries. The actual impact will be different from country to country. However, one can combine the average effect size with the actual penetration rates to obtain a reasonable estimate.

3.2.1   Fixed Line

Röller and Waverman (2001) modelled the impact of fixed-line penetration on economic growth for 21 OECD countries over a 20-year period, 1970-1990. The analysis is conducted by a four-equation model consisting of:

- Aggregate production function,
- Demand for telecommunications infrastructure function,
- Supply of telecommunications investment function, and
- Telecommunications infrastructure production function.

The aggregate production function is modelling GDP including telecommunication. The effect size thus models direct and indirect impact together.

Qiang et al. (2009) used a cross-sectional endogenous growth model that was initially developed by Barro (1991) and then applied by Waverman, Meschi, and Fuss (2005) to test for the impact of mobile penetration on economic growth in developing countries. The endogenous technical change approach by Qiang et al. (2009) uses period averages and initial values and not annual data and is thus suffers, to a lesser extent, from data unavailability. The effect sizes of both studies are displayed in Table 3.2.

Table 3.2: Economic models for fixed line penetration

Authors	Model	Data	Dependent Variable	Effect Size
Röller and Waverman (2001)	Simultaneous equation model	21 OECD countries over a 20 year period (1970-1990).	GDP	1% increase in penetration rate leads to a 0.15% increase in GDP growth. (impact might be relatively insignificant for low penetration rates, below 40%)
Kumar et al (2014	Autoregressive distributed lag (ARDL)	Small Pacific Island States, 1979 to 2012 perpetual inventory method to estimate capital stock	Output per worker	1% increase in telecommunication penetrations leads to an increase of 0.33% in the short-run and 0.43% in the long-run to output per worker
Qiang et al. (2009)	Endogenous growth model	1980-2006 for 66 high income countries	Average GDP per capita growth	10% increase in fixed line penetration leads to an additional 0.43% per capita GDP growth
		1980-2006 for the remaining 120 countries (low and middle income)		10% increase in fixed line penetration leads to an additional 0.73% GDP per capita growth

The table below shows the average effect size of the Röller and Waverman (2001) model for fixed-line penetration in Fiji, Samoa, the Solomon Islands, Tonga and Vanuatu. Fixed-line penetration has been declining in the region since about 2005. The contribution to GDP growth was not included in the table for declining penetration rates since fixed-lines would have been replaced by mobiles and the decline in fixed-line penetration would not have led to a decline in GDP growth.

Table 3.3: Impact of fixed-line penetration on GDP (Röller and Waverman model)

Year	Main line subscriptions per 100 inhabitants (WDI)					Additional GDP growth				
	Fiji	Samoa	Solomon Islands	Tonga	Vanuatu	Fiji	Samoa	Solomon Islands	Tonga	Vanuatu
1990	5.82	2.52	1.5	4.6	1.77					
1991	6.2	2.54	1.51	5.33	2.02	0.06%	0.00%	0.00%	0.11%	0.04%
1992	6.66	3.93	1.56	5.75	2.3	0.07%	0.21%	0.01%	0.06%	0.04%
1993	7.15	4.25	1.61	6.19	2.55	0.07%	0.05%	0.01%	0.07%	0.04%
1994	7.77	4.38	1.72	6.75	2.69	0.09%	0.02%	0.02%	0.08%	0.02%
1995	8.35	4.58	1.81	6.89	2.51	0.09%	0.03%	0.01%	0.02%	-0.03%
1996	8.92	4.82	1.95	8.09	2.6	0.09%	0.04%	0.02%	0.18%	0.01%
1997	9.05	4.91	2.03	7.56	2.74	0.02%	0.01%	0.01%	-0.08%	0.02%
1998	9.61	4.9	2.02	8.76	2.9	0.08%	0.00%	0.00%	0.18%	0.02%
1999	10.1	4.89	2.03	9.34	3.03	0.07%	0.00%	0.00%	0.09%	0.02%
2000	10.65	4.88	1.86	9.9	3.59	0.08%	0.00%	-0.02%	0.08%	0.08%
2001	11.32	5.51	1.74	10.96	3.57	0.10%	0.09%	-0.02%	0.16%	0.00%
2002	11.95	6.67	1.52	11.3	3.41	0.09%	0.17%	-0.03%	0.05%	-0.02%
2003	12.48	7.48	1.4	12.04	3.29	0.08%	0.12%	-0.02%	0.11%	-0.02%
2004	12.82	9.17	1.52	12.96	3.31	0.05%	0.25%	0.02%	0.14%	0.00%
2005	13.68	10.84	1.58	13.62	3.33	0.13%	0.25%	0.01%	0.10%	0.00%
2006	13.89		1.58	18.15	3.49	0.03%		0.00%	0.68%	0.03%
2007	14.59		1.58	20.56	4.01	0.10%		0.00%	0.36%	0.08%
2008	15.3		1.59	24.81	4.61	0.11%		0.00%	0.64%	0.09%
2009	16.05		1.59	29.94	3.13	0.11%		0.00%	0.77%	
Average						0.08%	0.08%	0.00%	0.20%	0.02%

Generally, fixed-line penetration across all five countries has been low and the impact estimates need to be interpreted carefully since none of the countries achieved the 40% threshold established in the Röller and Waverman (2001) study as the critical mass barrier. Tonga is the only country with a reasonable penetration, yet still below 30%. Fixed-line adoption may have contributed on average up to a fifth of a per cent each year to the GDP growth for the period 1990 to 2009 in Tonga.

Transferring the effect size from Qiang et al. (2009) to the Pacific reveals how little the GDP per capita in US$ impact fixed-line penetration is likely to have had for the period 1990 to 2009. Since then fixed-line penetration has been in decline.

Table 3.4: Impact of fixed-line penetration on GDP (Qiang model)

	Fiji	Samoa	Solomon Islands	Tonga	Vanuatu
Fixed-line penetration per 100 inhabitants in 1990	5.82	2.52	1.5	4.6	1.77
Fixed-line penetration per 100 inhabitants in 2009	16.05	10.84	1.59	29.94	3.13
Change in fixed-line penetration	10.22	8.32	0.09	25.33	1.35
GDP per Capita US$ current price in 1990	1,836	688	970	1,193	1,080
GDP per Capita US$ current price in 2013	4,572	3,647	1,954	4,427	3,303
GDP per Capita growth in US$	2,736	2,959	983	3,234	2,222
Effect size for 10% increase	0.73%	0.73%	0.73%	0.73%	0.73%
GDP per capita growth factor for penetration change	0.75%	0.61%	0.01%	1.85%	0.10%
Per Capita GDP growth through mobile penetration increase in US$	13.7	4.2	0.1	22.1	1.1

Source: WDI database | Samoa's fixed line penetration for 2005 instead of 2009

3.2.2   Mobile

Based on the rationale that the role of mobile telephones in the 2000s in developing countries is similar to that of fixed telephones in OECD countries in the 1990's, Waverman et al (2005) replicate the study of Röller and Waverman (2001) to investigate the impact of mobile telephony on middle and lower income economies globally. However, due to data limitations for developing countries they used subsequently an endogenous growth model for lower and upper income countries. The findings suggest that in low-income countries an additional 10% mobile penetration rate would lead to 0.59 % higher GDP growth.

Table 3.5: Mobile economic impact models

Authors	Model	Data	Dependent Variable	Effect Size
Waverman et al (2005)	Simultaneous equation model	38 developing countries for period 1996 to 2003	GDP	The impact of penetration on output depends on the level of penetration.
Qiang et al. (2009)	Endogenous growth model	1980-2006 for 66 high income countries	Average GDP per capita growth	10% increase in mobile subscribers leads to an additional 0.61% per capita GDP growth
		1980-2006 for120 low and middle income countries		10% increase in mobile subscribers leads to an additional 0.81% GDP per capita growth

Qiang et al. (2009) used a similar model to test for the impact of mobile penetration as well. Both studies derive similar results of about 0.6% higher per capita GDP growth for a 10% increase in mobile penetration.

Table 3.6: Results from Waverman et al. (2005) applied to South Pacific nations

		Fiji	Samoa	Solomon Islands	Tonga	Vanuatu
Mobile penetration per 100 inhabitants in 2005		24.92	13.34	1.28	29.59	6.06
Mobile penetration per 100 inhabitants in 2014		142.4	124.7	60.6	67.4	67.3
Change in mobile penetration		117.48	111.36	59.32	37.81	61.24
GDP per Capita US$ current price in 2005		3,656	2,291	882	2,623	1,886
GDP per Capita US$ current price in 2013		4,572	3,647	1,954	4,427	3,303
GDP per Capita growth in US$		916	1,356	1,072	1,804	1,416
Waverman et al (2005)	Effect size for 10% increase	0.59%	0.59%	0.59%	0.59%	0.59%
	GDP per capita growth factor for penetration change	6.93%	6.57%	3.50%	2.23%	3.61%
	Per Capita GDP growth through mobile penetration increase in US$	253	151	31	59	68
Qiang et al. (2009)	Effect size for 10% increase	0.81%	0.81%	0.81%	0.81%	0.81%
	GDP per capita growth factor for penetration change	9.5%	9.0%	4.8%	3.1%	5.0%
	Per Capita GDP growth through mobile penetration increase in US$	348	207	42	80	94

The table above applies the average effect size to the mobile penetration rates for the five countries and the figure below displays the additional GDP per capita in US$ from mobile penetration increases for the period 2005 to 2014.

The additional GDP per capita in Fiji due to higher mobile preparation rates is approximately between US$253 to US$348 for the period 2005-2014. The other countries benefited less due to lower penetration increases (effect size is the same). It needs to be stressed that these are crude estimates and it is unlikely that increases in mobile penetration is having the same effect in all countries.

3.2.3 Broadband

Koutroumpis (2009) uses a simultaneous equation model to investigate how broadband penetration affects economic growth, similar to the study by Röller and Waverman (2001). The simultaneous equation model is based on a production function framework that endogenises telecommunications investment.

Table 3.7: Fixed broadband models

Authors	Model	Data	Dependent Variable	Effect Size
Koutroumpis (2009)	Simultaneous equation model	2003-2006 for 15 European countries	GDP	An increase in broadband penetration of 10% yields 0.38% increase in GDP growth
Qiang et al. (2009)	Endogenous growth model	1980-2006 for 66 high income countries	Average GDP per capita growth	10% increase in broadband penetration leads to an additional 1.21% GDP per capita growth
	Endogenous growth model	1980-2006 for the remaining 120 countries (low and middle income)	Average GDP per capita growth	10% increase in broadband penetration leads to an additional 1.38% GDP per capita growth

Qiang et al. (2009) also apply the model they used for fixed-lines and mobiles to broadband subscribers, which actually are fixed broadband subscribers (WDI database the variable BBND). The results are not directly comparable to Koutroumpis (2009) and Katz & Koutroumpis (2012a) since Qiang et al. (2009) model the impact on per capita GDP and the former on GDP.

Table 3.8: Mobile broadband models

Authors	Model	Data	Dependent Variable	Effect Size
Katz & Koutroumpis (2012b)	Simultaneous equation model	Philipines 2000 - 2010	GDP	Mobile broadband contributed an annual 0.32% to GDP during the period 2000 to 2010

Katz and Koutroumpis (2012a and 2012b) apply the same methodology using time series data for the Philippines and Senegal. They recognise the inadequacy of using fixed broadband in the Philippines due to very low penetration (below 2.5% in 2011) and ran the same model for mobile broadband. They find that mobile broadband contributed an annual 0.32% to GDP during the period 2000 to 2010, representing 6.9% of GDP growth. They further find that since 2005, this impact almost doubled reaching 0.61% of GDP and 7.3% of economic growth. The higher productivity gains for 2005 to 2010 are most likely the result of 3G network rollout and the occurrence of mobile computing in the form of smart phones. The results from the Katz and Koutroumpis (2012b) study cannot easily be transferred to the Pacific countries covered here though the trends will be similar. The bias will be less when transferring an effect size of a 120-country study compared to transferring it from a single country study.

3.3 Direct Macro Economic Impact

The direct impact of telecommunications on GDP is captured in current and constant prices in the national accounts. Depending on the classification scheme used (International Standard Industrial Classification of All Economic Activities (ISIC) 3.1 or 4) [8] the GDP contributions can be broken down into communication and information or just telecommunications. ISIC 3.1 classifies post and telecommunications as a subset of Transport, storage and communications. ISIC 4 includes the following divisions: Publishing activities; Motion picture, video and television

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[8] http://unstats.un.org/unsd/cr/registry/regcst.asp?Cl=17

programme production, sound recording and music publishing activities; Programming and broadcasting activities; Telecommunications; Computer programming, consultancy and related activities; and Information service activities.

Fiji and Vanuatu compile data using the wider ISIC 4 measure whereas the remaining countries only compile data for the value-added of the communications sector (ISIC 3.1). The table below shows the GDP contribution of communication and information (ISIC 4) (and for some countries, ISIC 3.1) for five OECD countries as a guide to evaluate the contributions of the five selected countries in this study. While the communication sector in Australia and New Zealand only contributed about 3-3.5% to GDP in current prices, the contributions were higher for Japan and the USA. In Australia and the United States, the telecommunications sector contributes around 2% to GDP.

Table 3.9: Share of GDP in current prices

		2007	2008	2009	2010	2011	2012	2013
Communication and Information	Australia	...	4.3%	4.1%	4.1%	3.7%	3.5%	3.5%
	Korea	4.0%	3.8%	3.8%	3.6%	3.5%	3.5%	3.5%
	Japan	5.3%	5.4%	5.6%	5.4%	5.5%	5.5%	...
	New Zealand	3.3%	3.1%	3.0%	2.9%	...	...	...
	United States	4.9%	5.0%	4.9%	4.9%	4.7%	4.6%	4.6%
Telecommunications services	Australia		2.3%	2.2%	2.3%	2.1%	2.0%	2.0%
	United States†	2.6%	2.6%	2.6%	2.5%	2.3%	2.3%	2.3%

Note:† Broadcasting and telecommunications
Source: Adapted from Australian Bureau of Statistics, United States Bureau of Economic Analysis and OECD StatExtracts.

3.3.1   Fiji

Digicel winning the license bid in December 2007 and starting operations in October 2008 led to a boost in investment in the telecommunications sector, not only through Digicel's investment but also substantially higher investments across the ATH Group. Digicel's initial investment was million FJD115 (US$72 million using 2008 exchange rate) and the market entry required Vodafone to respond with network upgrades and expansion. Vodafone launched its 3G network in November 2008 taking first mover advantage from Digicel, which only launched 3G in August 2011. Telecommunications sector capital expenditure rose sharply in 2007 and has generally remained at a higher level than years before 2007.

Figure 3.7: Fiji Communication and Information contribution to GDP

	2008 Constant Prices	Current Prices

(2008) 5.8% / 4.9% (2009) 7.8% / 6.5% (2010) 7.4% / 5.8% (2011) 7.3% / 5.3% (2012) 7.5% / 5.3% (2013) 7.5% / 5.1%
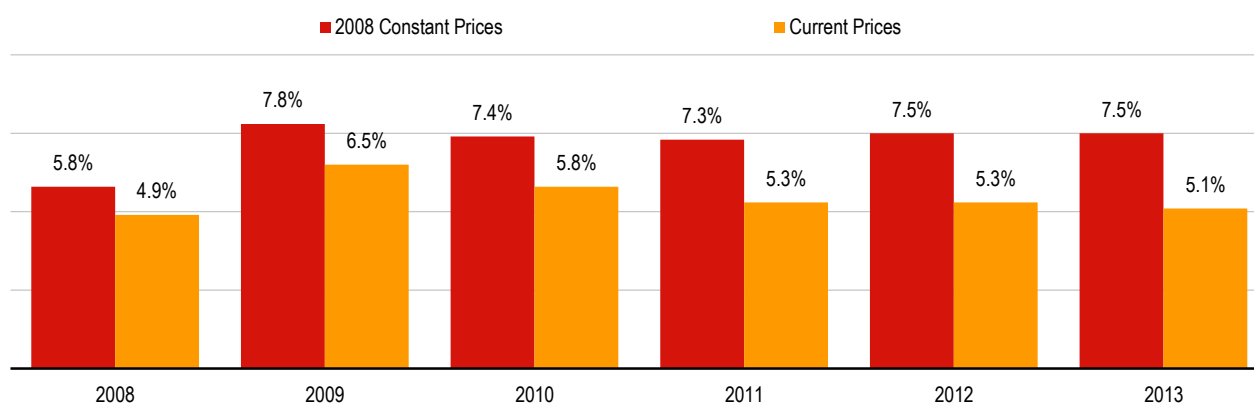
Figure 3.8: Fiji Telecommunication sector capital expenditure in million FJD for financial years ending in March
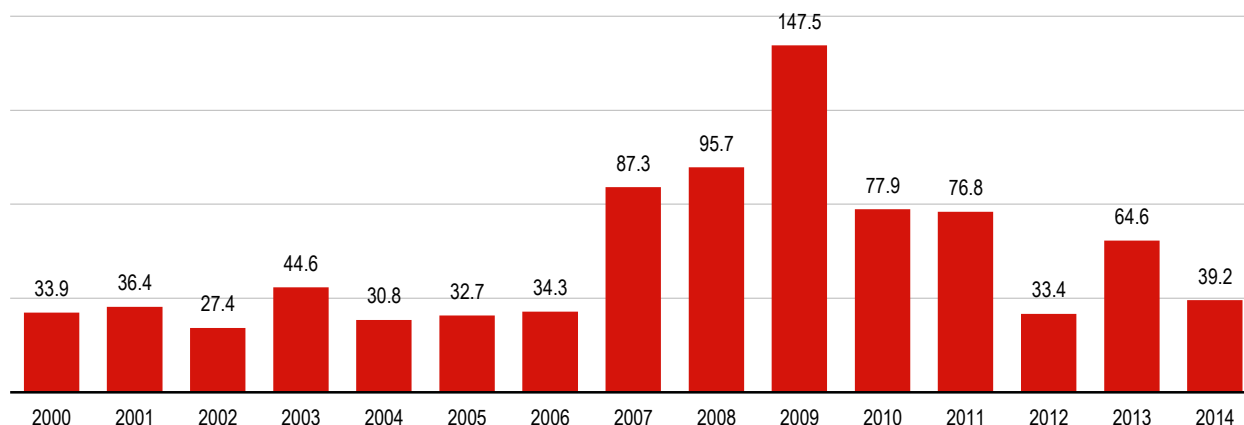
Vodafone invested FJD70 million or US$38.2 million for the 3G upgrade in 2008 and Digicel's US$ 6 million for its 3G upgrade in 2011.[9] [10] Another spike in CAPEX is expected for the financial year ending in March 2015 due to Digicel's[11] 4G upgrade in August 2014. Vodafone had upgraded to 4G already in December 2013.[12] It is this type of competition between two strong and responsive competitors that is behind the success of Fiji's telecommunication sector.

3.3.2   Samoa

Samoa is the only one of the five countries that compiles quarterly GDP data. The NSO does not collect Gross Fixed Capital Formation (GFCF). Agriculture and fisheries made up 10% of GDP in 2013 and construction 11%.[13] The biggest share of the GDP is commerce with 32%. The value added of the communications sector was Tala 74 (US$ 32) million in 2013 or 4% of GDP (current prices). The communications sector contribution rose sharply following the entry of Digicel in 2007 but has declined following it peak of 2010 (when it stood at 5.7%). According to the NSO, the communications sector contributed 0.4% of the 1.1% increase in real GDP in 2013.

Figure 3.9: Samoa communication contribution to GDP in current prices and as share of GDP
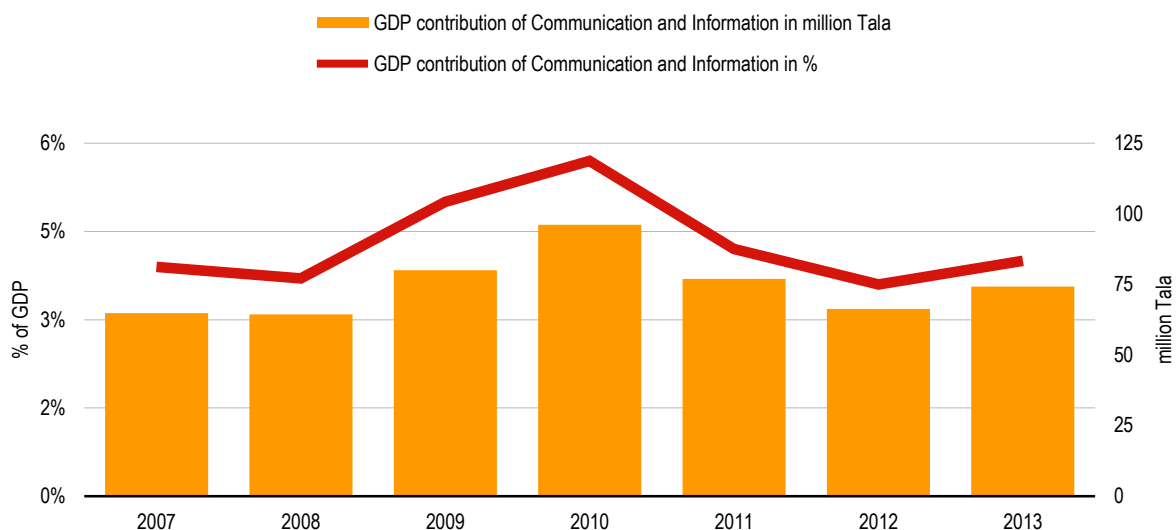
Digicel's CAPEX as a per cent contribution to GDP peaked at 0.8% in 2007, the year it entered the market. It declined in subsequent years until there was an uptake in 2012 and 2013 due to deployment of its 3G network. Note that it is not possible to assess Digicel's investment within total investment in the economy because the NSO does not compile Gross

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[9] http://www.digicelfiji.com/en/about/sponsorships/digicel-launches-superb-broadband-services
[10] https://www.telegeography.com/products/commsupdate/articles/2008/11/19/vodafone-fiji-launches-3g-network/
[11] http://www.digicelfiji.com/en/about/news/digicel-launches-fijis-biggest-4g-network
[12] http://www.fiji.gov.fj/Media-Center/Speeches/LAUNCHING-OF-VODAFONE'S-4G-LTE-NETWORK---PM-Bainim.aspx
[13] Samoa Bureau of Statistics. "GDP 2009 Rebase." Press Release. 23 May 2014.

Fixed Capital Formation. Neither is it possible to analyse total communications sector Capex since such data for other operators including BlueSky were not publicly available.

Figure 3.10: Digicel Samoa Capex expressed as share of GDP contribution of the ICT sector to GDP
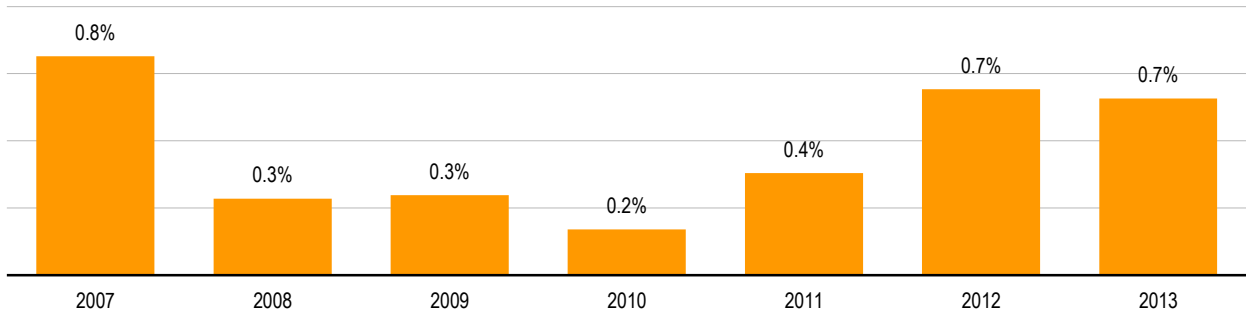
3.3.3   Solomon Islands

The GDP contribution of the communications sector in Solomon has been below 3%. In 2012 current prices: Agriculture & Fisheries & Forestry made up 27.7%, and industry 15.6%. The low sector contribution is matched by low penetration rates and likely the consequence of insufficient competition that will be explored in the next chapter.

Figure 3.11: Solomon Islands communication contribution to GDP
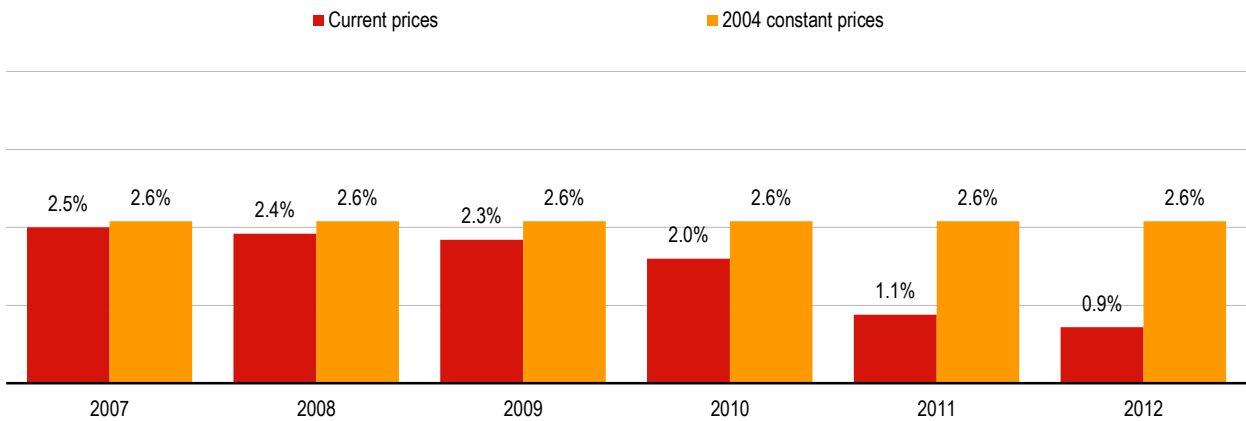
3.3.4   Tonga

Tonga reports GDP data for financial years ending in June.[14] In the 2012-13 financial year the agricultural sector including fishing and forestry contributed around one third of GDP (current prices). In contrast, the communication sector contribution to GDP was below 2.5% until Digicel's market entry but in 2012/13 stood at 3.0% The GDP contribution is expected to have increased for the financial year July 2013 to June 2014 due to a surge in mobile data use following the launch of 3G networks.

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[14] The Tonga Department of Statistics kindly assisted the study by creating a data set of the communications sector value-added, which is normally combined with transport in its publicly available data.

Figure 3.12: Tonga communication contribution to GDP in constant 2011-12 prices
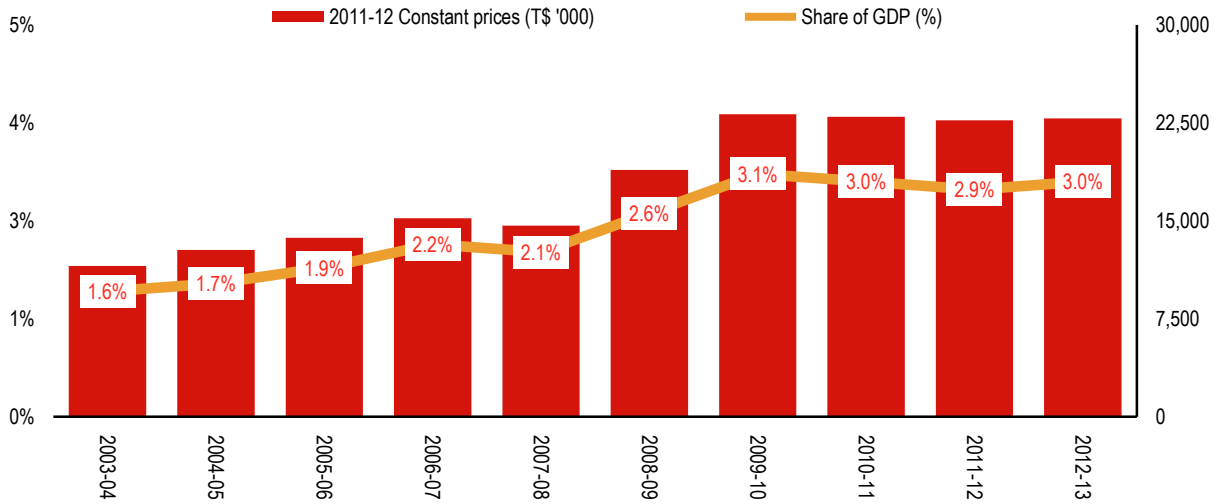
3.3.5 Vanuatu

The contribution of the communication and information sector had been fairly constant at around 4% until the introduction of mobile competition in 2008. Surprisingly, there are drops in the GDP contribution (current and constant prices) in 2010 and 2012.

Figure 3.13: Vanuatu communication and information contribution to GDP
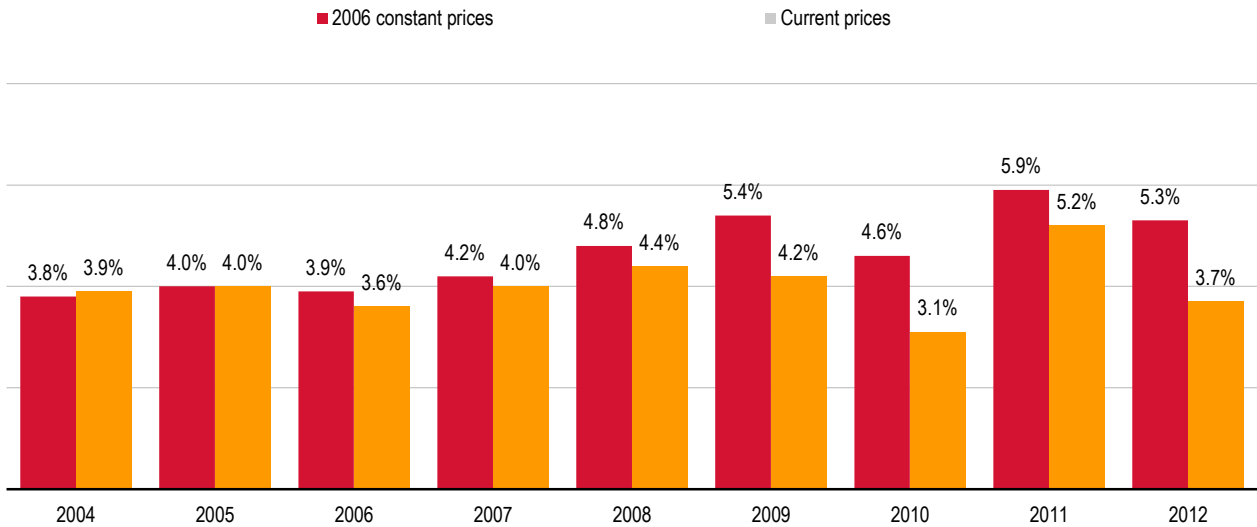
The chart below displays a breakdown of the GDP contribution of the communication and information sector. Telecommunications makes up the major part. The chart also confirms that the dips in GDP contribution are due to lower contributions of the telecommunication sector. Publishing and printing dipped at the same time most likely linked to the telecommunication sector drop, with the mobile operators being among the top companies for advertisement.

Figure 3.14: Vanuatu communication and information contribution to GDP broken down into categories (Current prices)
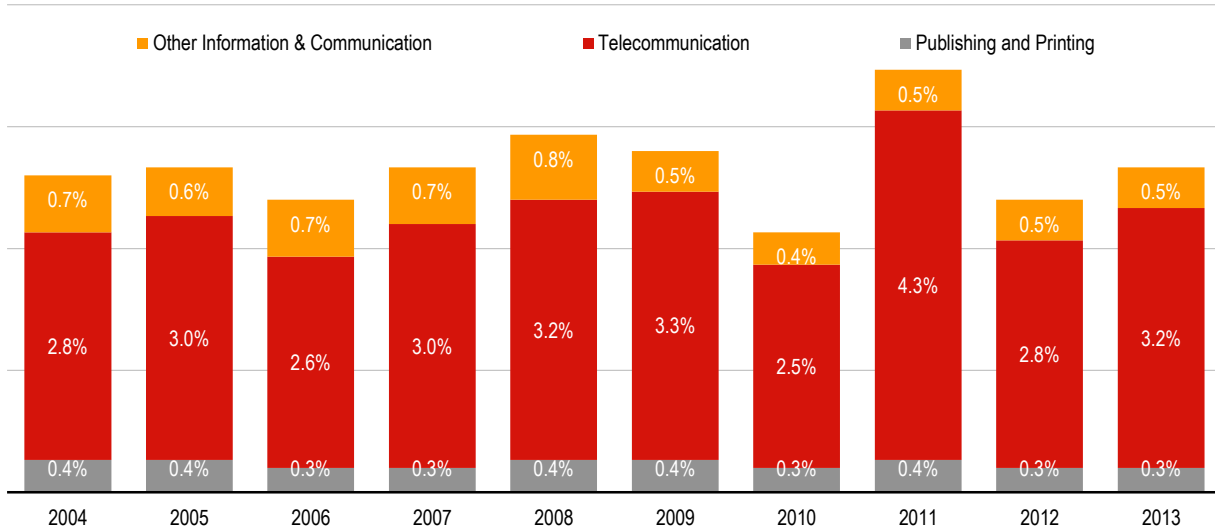
Further, it is confirmed that the GDP share is actually caused by a decrease in the telecommunication sector value added and not a spike in GDP (see figure below).

Figure 3.15: Vanuatu communication and information value added broken down into categories in million Vatu (current prices)
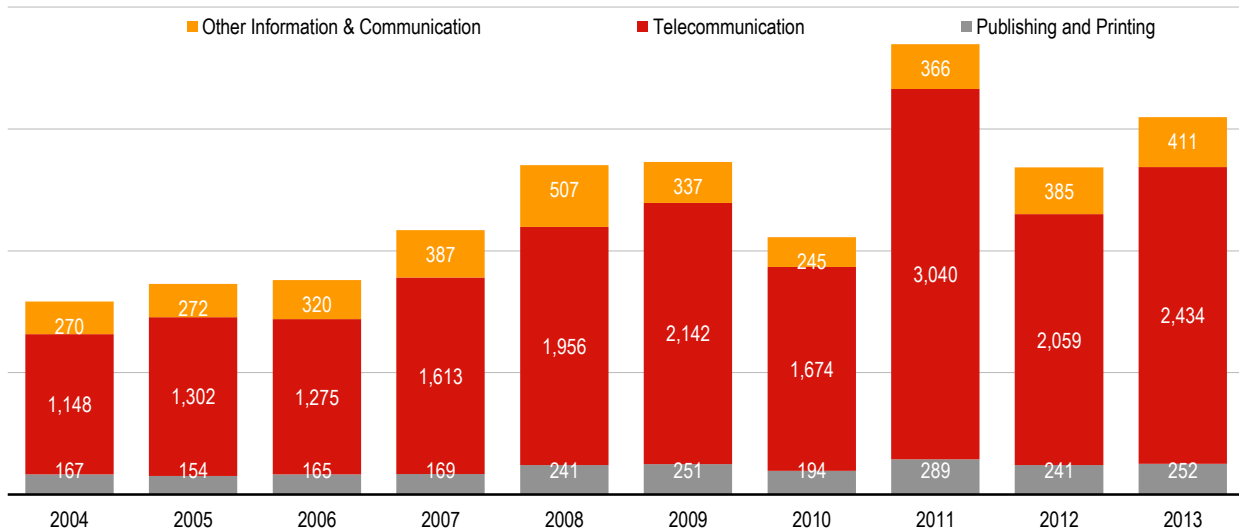
The most likely explanation for the dips in GDP contribution, or spikes for that matter, is the wave of mobile technology investments. The market entry of Digicel meant a more than doubling of telecommunication investment for that year. The 3G upgrade of Digicel meant another major boost in 2011 and 2012.[15]

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[15] CAPEX figures for TVL were not available.

Figure 3.16: Digicel Vanuatu Capex contribution to GFCF and information and communications
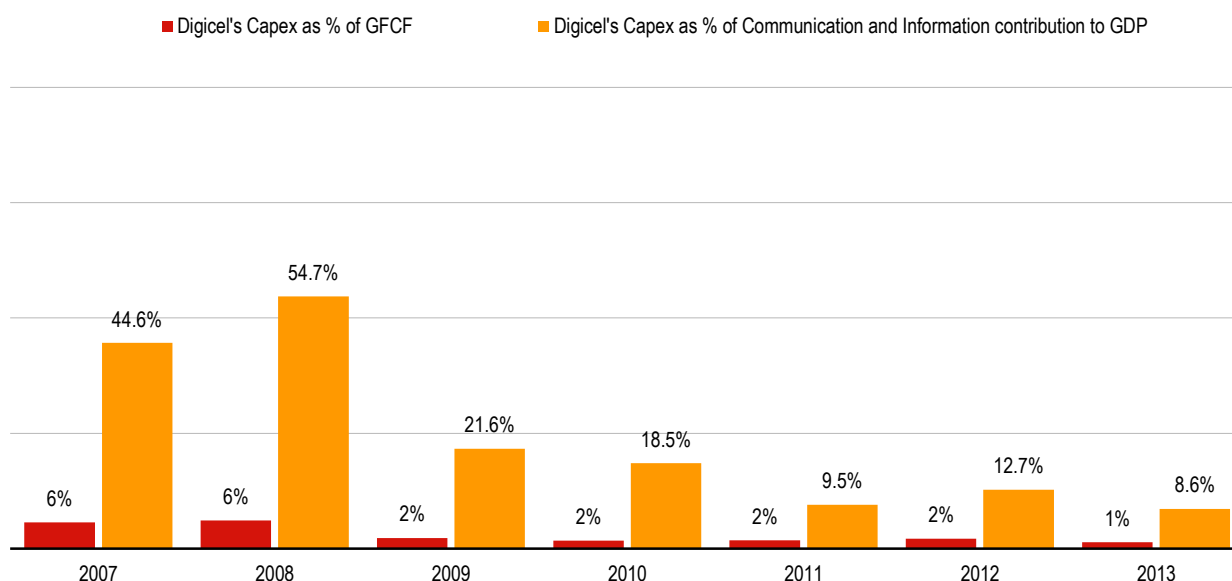
The figure above displays the Capex for Digicel expressed as share of Gross Fixed Capital Formation (GFCF) and as a percentage of the contribution of the communication and information sector to GDP. Digicel's market entry led to a significant increase in GFCF for the years of 2007 and 2008.

3.4   Employment

Like the economic impacts discussed above, ICT also affects employment. This happens in three ways: 1) direct employment in the sector 2) indirect employment such as contractors supplying the sector, prepaid card vendors, etc. and 3) opportunities for ICT-enabled work.

Unlike the impact of ICTs on economic growth, there are few studies on the impact on employment. Those that do exist consider the broadband impact and have mainly been conducted using data for the United States (see table below). The findings suggest a positive impact but with varying employment growth estimates ranging from 0.2 per cent to 5.3 per cent for every 1 per cent increase in penetration. Unfortunately, similar to the data limitations for the economic impacts, it is not possible to assess the indirect impact of ICT on employment in the region. Therefore this section briefly summarizes the status of direct employment in the telecom sector in the South Pacific.

Table 3.10: Studies of broadband impact on employment

Institution	Data	Effect
Brookings Institution, 2007	48 states for the period 2003-2005	For every 1% point increase in broadband penetration in a state, employment is projected to increase by 0.2 to 0.3% per year "assuming the economy is not already at 'full employment'"
Ohio University, 2009	46 states during the period 2001-2005	Positive employment generation effect varying by industry
MIT, 2006	Zip codes for the period 1999-2002	Broadband availability increases employment by 1.5%
Connected Nation, 2007	Disaggregated county data for state of Kentucky for 2003-4	An increase in broadband penetration of 1% contributes to total employment growth ranging from 0.14% to 5.32% depending on the industry

Source: Katz 2012.

In Fiji, direct employment in the telecommunication sector was 2,358 in 2011.[16] This was 0.68% of total formal employment in the country. Computer programming, information services and related activities employment was 411. Fiji has been keen to tap into the global outsourcing market. A study by the World Bank estimates this type of ICT-employment could create 1,936 to 5,809 direct jobs (World Bank 2015).

In Samoa, BlueSky had 160 staff and Digicel 110 in November 2014 roughly 1% of paid employment in the country. A planned second submarine cable will enhance the potential for ICT-enabled jobs with the Asian Development Bank noting: "It will also open up new business opportunities such as business process outsourcing thus creating employment opportunities."[17]

In the Solomon Islands, the two main telecommunication operators had around 460 staff between them in 2014. This figure is equivalent to 0.8% of the salaried work force in the country (based on 2009 Census, the latest year available). In addition, the operators supplement the income of hundreds of small shop owners who sell airtime.

In Tonga, the two main telecommunication operators have around 400 employees combined and generate other employment for equipment vendors and airtime resellers. Launch of the submarine cable creates the potential for ICT-enabled work in Tonga. According to a study on the prospects for Business Process Outsourcing (BPO) there were 179 people working as "information and communication technicians" and over 100 post-secondary graduates in fields related to BPO in 2012.[18] A call centre was established in 2013 and handles TCC's help line.[19] Current potential for BPO services in the country is constrained by inadequate computer-related legislation, insufficient IT industry accreditation and limited BPO experience. There are moves underway to remedy this and according to a World Bank study, Tonga is well positioned to take advantages of global outsourcing services leading to direct job growth (World Bank 2015).

In Vanuatu the telecommunications sector in 2013 provided direct employment for some 370 people.[20] This is 1.4% of the total National Provident Fund (NPF) registered employment. In 2014, direct employment reached 430 active jobs making up 1.7 % of the total NPF registered employees in Vanuatu. This is an increase by 0.3% as compared to 2013 telecommunications employment data. Apart from the registered employment, the sector also provides additional jobs to Ni-Vanuatu citizens across the nation including subcontractors, street vendors, resellers and infrastructure caretakers.

3.5 Observations

Several studies that measure the indirect impact of ICT on economic growth have been discussed in this chapter and effect sizes extracted. These studies could not be replicated for the South Pacific for various reasons including the recent introduction of broadband services, the lack of sufficient data observations and some critical national accounts data not collected by all countries (particularly Gross Fixed Capital Formation, capital stock and consistent labour force series). However, the effect sizes could be applied to get an idea of the hypothetical economic growth. While fixed and mobile voice had some indirect impact, the bulk of the impact is likely to stem from mobile broadband.

The upgrade to 3G is still quite new in the countries and only Fiji has started the migration to 4G on a significant scale. This means that the real impact from mobile broadband is only beginning to happen and will only be measurable several years into the future. In order to measure the impacts and guide policy makers and regulators data needs to be collected. Regulators would ideally monitor subscriber numbers and prices over quarterly periods and require all licensees to furnish the regulator with audited financial statements. Statistical agencies will also need to expand their data collected in order to compile a complete set of quarterly GDP statistics.

The size of the telecommunications sector on a per capita basis has increased in all of the countries except the Solomon Islands since the introduction of competition (Figure 3.17).

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[16] Fiji Bureau of Statistics. 2014. *Information and Communication 2011*.
[17] http://www.adb.org/sites/default/files/project-document/158126/47320-001-ipsa.pdf
[18] Commonwealth Secretariat. 2013. *Leveraging the Investment in Broadband Infrastructure for Tonga's Economic Development*.
[19] Matangi Tonga. "Princess launches call centre for telecommunications in Tonga." *Islands Business*. 1 March 2013.
http://www.islandsbusiness.com/news/tonga/479/princess-launches-call-centre-for-telecommunicatio/
[20] See "Market Indicators for Telecommunications" at: http://www.trr.vu/index.php/en/telecom-industry/market-and-competition/market-indicators-for-telecommunications

Figure 3.17: Information & communication value added per inhabitant, current prices in USD
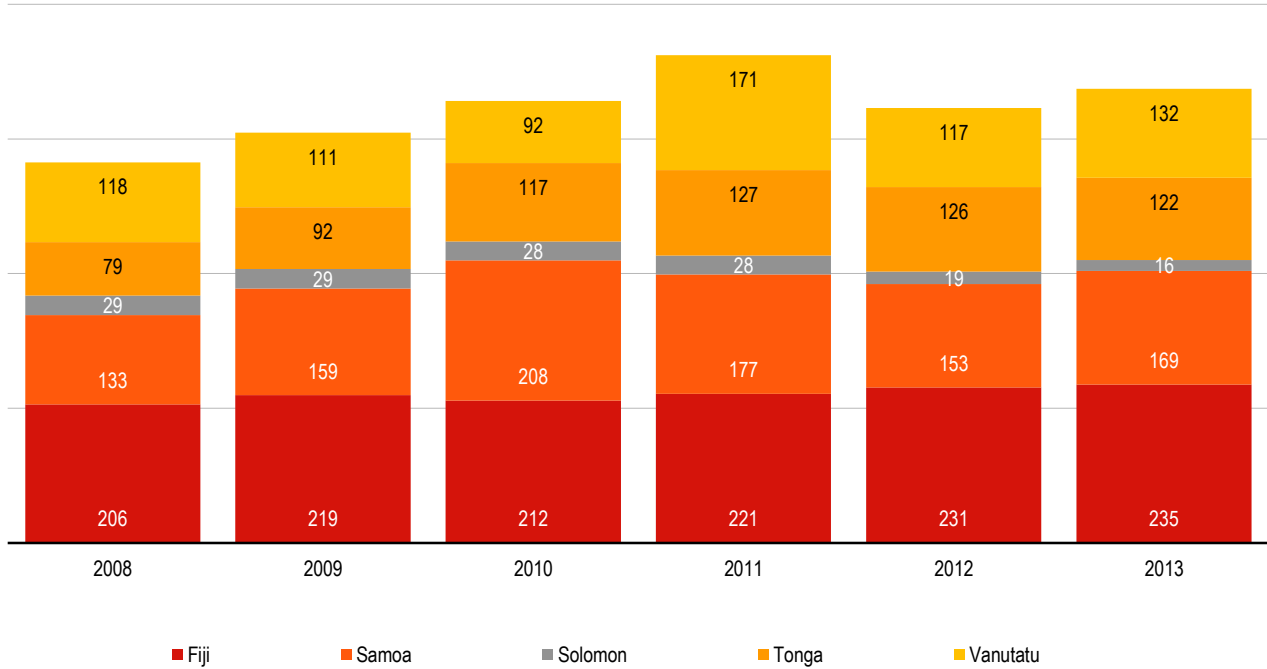
Note: Data for Fiji and Vanuatu refer to information and communication whereas the figures for the other countries refer to communications.

The direct contribution of the telecommunication sector to employment is relatively low in the region ranging between 1-2%. However there is considerable downstream indirect employment created for equipment vendors, airtime resellers, construction workers and within the advertising sector. Deployment of submarine cables provides an opportunity for the South Pacific to the participate in the global information economy with the potential of generating ICT-enabled outsourcing employment

4 Sector Impacts

This chapter looks at the use of ICTs in different sectors and assesses impacts.

4.1   Agriculture & Fishery

The agriculture and fishing sector accounts for a significant share of the economy in terms of GDP and employment in countries such as the Solomon Islands, Tonga and Vanuatu.

Table 4.1: Value-added and employment in the agricultural sector

Countries	Agriculture sector value added (US$ m)					Agricultural employment		
	Year	Agriculture	Fishing	Forestry	Total	% of GDP	Year	Employed	% of total paid employment
Fiji	2011	$263	$84	$24	$371	10%	2007	1,193	1%
Samoa	2013	$29	$38		$66	10%	2012	1,851	5%
Solomon Islands	2012	$156	$35	$81	$273	28%	2009	33,693	41%
Tonga	2012	$62	$12	$2	$75	17%	2011	9,731	29%
Vanuatu	2013	$186	$5	$9	$200	25%	2010	5,840	17%
PAC 5		$695	$174	$117	$986			52,308	19%

Note: Current prices. Employment refers to those working for wages or salaries.
Source: Adapted from national statistical offices.

The agriculture and fishing sector could benefit from ICT-enabled services in several areas. Information services could be provided through bulk SMS services or on request via premium SMS services. Information on market prices, disease outbreak and agricultural or fishing specific weather forecasts are among such services deployed in Africa (Esselaar and Stork 2014). Mobile applications have been developed in Nigeria aiming to reduce input costs for farmers by cutting out the middlemen in procurement of fertilizers. Benefits accrue from access to additional markets, enhanced pricing information for both inputs and outputs and better production through information about improved techniques and minimising impact of diseases and pests. Two studies illustrate the impact of mobile phone coverage on agricultural livelihoods through their ability to quickly provide pricing information in different markets.

Aker (2010) analyses the impact of mobile coverage on grain prices in Niger. The author found that the introduction of cell phones reduced price dispersion across grain markets, with a larger increase for those markets that were farther apart and over time. The use of cell phones reduces travel and opportunity costs resulting in better information and quicker trader intervention to differences in grain prices. The study was based on three datasets:

- Prices, transaction costs, agricultural production and rainfall including monthly grain (millet and sorghum) price data over a ten-year period (1996-2006) across 42 domestic and cross-border markets;
- Panel survey of traders, farmers, transporters and market resource persons comprised of 395 traders and 205 farmers located in 35 markets across six geographic regions including information on commercial operations during the 2004-2007 grain marketing seasons; and
- Detailed information on the rollout of cell phone coverage between 2001-2006.

The introduction of cell phones was found to cause a 3 per cent reduction in consumer prices.

Jensen (2007) found that the rollout of mobile coverage in fishing villages in southern India increased the proportion of fishermen who ventured beyond their home markets to sell their catches as coverage became available. Profits rose by

8% on average and consumer prices fell by 4% on average. Data for the study was from weekly surveys in three northern districts of 300 sardine fishing units between September 1996 and May 2001.

These studies rely on surveys that do not exist for the countries under review but would not be difficult to replicate. Further, they are not based on a specific mobile phone intervention but rather on farmers, fishers and traders grasping the utility of cellphones to quickly obtain information, saving travel and opportunity costs. It is possible that similar impacts are occurring in the countries studied given that mobile phones are increasingly prevalent in rural areas (and typically outnumber radio ownership, 2). Agricultural price data is collected by some of the countries but would be need to be supplemented by special surveys of the relevant population to access impact of mobile phones in information asymmetry.

Table 4.2: Agricultural price information and mobile phones in rural households

Country	Ministry	Web site	Price information		% of rural households with:‡	
			Collected	Available on web site	Mobile phone	Radio
Fiji	Ministry of Agriculture	www.agriculture.gov.fj	Yes	Yes	72	...
Samoa	Ministry of Agriculture and Fisheries	www.maf.gov.ws	Yes†	Yes	95	81
Solomon Islands	Ministry of Agriculture	NA	No	No	...	...
	Ministry of Fisheries and Marine Resources	NA	Yes	No		
Tonga	Ministry of Agriculture and Food, Forests and Fisheries	www.mafff.gov.to	Yes	No	93	80
Vanuatu	Ministry of Agriculture, Livestock Forestry, Fisheries and Biosecurity	NA	No	No	73	27

Note: ‡ = Latest available data. † = By the national statistical agency. NA = Not Available.

4.1.1 Fiji

In Fiji, the Ministry of Agriculture collects and compiles information relevant for farmers. Its agents take down pricing information for over 30 products from various markets around the country that is disseminated via radio and the ministry's web site.[21] Tablet computers are used to collect the information.[22] The ministry also compiles information about growing techniques, dealing with plant diseases and similar information that is printed and distributed to farmers through agricultural extension offices and via its web site. The ministry also has a Facebook page and YouTube channel (although there was no content posted on the latter at the time of this report). The Ministry would like to spread pricing information via mobile text messages in order to leverage the high cell phone penetration among farmers and get information to them more quickly. This has been delayed due to high costs. For example, the cost charged by a mobile operator to send 200,000 text messages a month would cost FJ$ 0.6 per message (US$ 6,243 per month).

The ministry also has a help desk that receives queries by phone, email, fax and post. According to data from the first quarter of 2011, the vast majority of contact was via email. Farmers contacted the help desk the most, but there were also inquiries from a range of other parties. Several mobile-based initiatives aimed at enhancing agricultural livelihoods for farmers are in various stages of piloting or recently launched. None has reached significant scale and impacts are yet to be measured:

- Fiji Makete is a service for farmers to sell products to potential buyers.[23] Digicel Fiji, in partnership with F1 Mobile Solutions was originally involved in developing the platform.[24] The application allows farmers to use simple menus on their mobile phones to access information about market pricing for their crops and sell their produce.
- The Fiji Crop and Livestock Council (FCLC) is piloting a system that sends alerts to different groups. This allows FCLC to send text messages targeted to audiences in defined locations. Messages also include tips providing information on growing crops.
- The Vodafone ATH Fiji Foundation developed a mobile application aimed at farmers called mFarmacy. It provides information about improving growing techniques including advice in innovative areas such as organic farming, aquaculture, and herbal and medicinal plants.

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[21] Ministry of Agriculture. Market Watch. 11 April 2014. http://www.agriculture.gov.fj/images/docs/publications/market-watch/market-watch-issue-2-jul-11-2014.pdf
[22] ITC News. 2014. "ICTs and e-solutions can reap benefits for Fijian farmers: Harvesting mobile technology for agri-business," March 28. http://www.intracen.org/news/ICTs-and-e-solutions-can-reap-benefits-for-farmers-Harvesting-mobile-technology-for-agri-business/.
[23] http://fijimakete.com.fj/about.php
[24] http://www.digicelfiji.com/en/about/news/digicel-teams-up-with-f1-to-make-fiji-makete-a-reality http://www.digicelfiji.com/en/about/news/digicel-teams-up-with-f1-to-make-fiji-makete-a-reality

4.1.2 Samoa

In Samoa, the Ministry of Agriculture and Fisheries (MAF) ICT initiatives have focused on connecting its own departments and enhancing administrative processes. The main outreach program for farmers is disseminating information about crops primarily via radio. There are plans to develop a call centre for farmers and fishermen. The ministry's web site was receiving 370 visits a month in November 2014; its Facebook page received almost an equal number of "Likes" (377) at the time of this report. The Bureau of Statistics publishes monthly price data on its web site with prices, volumes and number of sellers for around a dozen agricultural products available at local markets around Apia.[25] This information is disseminated by MAF in its radio broadcasts. Following Tropical Cyclone Evan in December 2012, the government developed an electronic voucher program to distribute cash to farmers and fishers. To date, close to 4,000 farmers and fishers have each received between $300 and $500 through the e-voucher system, in partnership with Digicel Samoa. The Samoan NGO Women in Business Development Inc. (WIBDI) has been working on a smartphone app to help organic farmers.[26] Initially aimed at field staff, the idea is then to disseminate the app to the farmers themselves. The app provides helpful advice to farmers such as when to harvest and information about organic fertilizers and pesticides. Finding programmers to develop the app has been a challenge and WIBDI has had to resort to locating developers overseas. Coordination is difficult and software developers abroad are unfamiliar with local contexts.

4.1.3 Solomon Islands

Though the Solomon Islands Ministry of Agriculture recognises the potential of ICT in the sector, little has been achieved due to a lack of capacity and funding. The ministry does not have a web site although it has an internal server and information can be accessed from the ministry's intranet. It produces a once a week 15-minute radio show on different agricultural topics. Exposure to such programs is extremely limited with less than 1% of those with a radio listening to agricultural programs in 2013 (2013 People's Survey).

Extension offices in provincial capitals are connected to the Internet and email is used to exchange information with the ministry. Connectivity is weak at lower levels and most extension workers lack electricity let alone computers. The ministry would like to equip extension workers with smartphones and tablets to share information with farmers. This is particularly relevant since graphical and video information could be provided, deemed to have greater impact given the number of languages and low literacy in rural areas.

The Ministry of Fisheries and Marine Resources (MFMR) is comparatively advanced in its use of ICT. Tablets are used to input fish prices from markets in Honiara and Gizo. The data is directly transferred from the tablets to the ministry's Integrated Fisheries Information Management System (IFIMS) for analysis. There is a MoU with Solomon Telekom to receive a discount on Internet access. Tablets are also used to monitor fishing. Staff go out on boats to observe and input data such as catches, take digital photos and record locations using GPS as well as monitor illegal, unreported and unregulated (IUU) fishing. MFMR also has a fishing surveillance system where the locations of all fishing vessels are plotted on maps and monitored by staff at headquarters using special computer software.

4.1.4 Tonga

In Tonga, the Ministry of Agriculture and Food, Forests and Fisheries (MAFFF) main method for disseminating information to farmers and fishermen is via three radio programs a week. MAFFF makes limited use of television due to lower coverage and higher costs although audio-visual dissemination is more effective. Experts are tapped to share knowledge in areas such as diseases, pests, growing techniques, etc. on the programs. They would like to go into the field and record best practice but budget is restricted and they lack the equipment to do so. They also lack qualified journalists.

Price information is collected by ministry staff on a weekly basis and disseminated via radio but not on the web site. The Ministry of Agriculture has a web site and the fisheries division has their own web site where a variety of information is disseminated. A local firm, Pasifika Solutions, supports the web sites.

The ministry currently receives many calls about import regulations and would like to upload relevant information to the website. There was a project to build up a database of agricultural information to respond to queries from farmers and fishermen. The idea was for farmers and fishermen to call or text a call centre, including sending photos if their cell phones have that capability. The database would be consulted for appropriate remedies. Ten mobile phones were provided to extension workers to kick-start the project, which was supported by the Secretariat of the Pacific Community Land Resources Division.[27] Despite the high prevalence of mobile phones in rural areas, the initiative did not advance beyond the pilot stage.

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[25] Samoa Bureau of Statistics. Local Market Survey October 2014.
http://www.sbs.gov.ws/index.php?option=com_advlisting&view=download&fileId=1391&Itemid=164
[26] http://www.radioaustralia.net.au/international/radio/program/pacific-beat/samoa-develops-smartphone-app-to-help-organic-farmers/1206602
[27] See: SPC. 2014. "Pacific agriculture and forestry leaders encouraged to embrace 'e-agriculture.'" Accessed November 22.
https://www.spc.int/fr/liste-de-diffusion/571-pacific-agriculture-and-forestry-leaders-encouraged-to-embrace-e-agriculture.html

In fisheries, mobile phones have been mainly used for safety. Fisherman can be warned more easily if there is bad weather approaching or if they have a problem while out at sea. Mobiles are also used by fisherman to warn each other when they are fishing out of season and law enforcement officials are nearby. At the same time, digital cameras and GPS are used by Fisheries Rangers to monitor illegal fishing.[28]

Australia's Queens Foods is collaborating with Digicel to deliver mobile services to vanilla farmers on the island of Vava'u.[29] The Queen Vanilla Growers Association has been set up grouping some 280 organic vanilla farmers in an attempt to revive Tonga's vanilla industry. All growers will purchase mobile phones to improve communications by sending group messages and have access to mobile money to pay growers monthly maintenance payments. Queen Fine Foods is completing certification for "Fair Trade" and "Organics" and are funding this for the farmers.[30] Historically Vava'u has produced high quality vanilla and the initiative is seen as an opportunity to help farmers secure an export pipeline to Australia.

4.1.5   Vanuatu

Although there is much enthusiasm ICTs, the Ministry of Agriculture, Livestock Forestry, Fisheries and Biosecurity in Vanuatu presently lacks the capacity and budget to develop e-services. For example, the ministry does not have any IT staff and lacks a web site.[31] The headquarters in Port Vila and offices in provincial headquarters are however connected to the government network. The ministry sponsors a weekly "talk back show" on Radio Vanuatu where experts field questions from listeners calling in. It also distributes a monthly newspaper to interested farmers through agricultural extension workers.

Given that the 2009 Census shows mobile phones far outnumbering radios in rural households, cell phones have a wider reach for spreading and receiving agricultural information. The ministry would like to leverage this more widely to send text messages with pricing and marketing information to empower farmers, foresters and fishers with timely information. Cell broadcasting has been used to alert relevant populations about livestock fairs. In the area of biosecurity, high quality images of plant diseases are being transmitted over the Internet to New Zealand for remote diagnosis.[32] There have been some development initiatives to boost the use of ICTs in agriculture.

Lionfish, a Vanuatu company, is looking to develop agricultural information systems for local farmers.[33] This includes making pricing data available through mobile telephones.

The Secretariat of the Pacific Community (SPC), in collaboration with the Technical Centre for Agricultural and Rural Cooperation (CTA), held a workshop in Vanuatu in October 2014 on use of Web 2.0 and social media to promote networking and information exchange in the agriculture sector.[34]

4.1.6   Summary

The status of ICT in the agriculture and fishing sector in the countries studied varies. In general, ICT use is limited to ministry web sites and radio shows to disseminate pricing and other information. There are just a few examples of mobile applications such as the conditional e-cash program in Samoa with most of the rest in pilot stage. Other innovative applications are rare.

4.2   Tourism

Tourism plays an important role in most of the region's economies. Direct impacts are significant with almost a million tourists visiting the five countries in 2013 generating US$ 1.5 billion of spending and contributing to around a fifth of GDP. Size of the tourism sector varies across the countries with a bigger impact in Fiji, Samoa and Vanuatu compared to the Solomon Islands and Tonga.

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[28] http://www.tongafish.org/index.php?option=com_content&view=article&id=136:fafanewequipment&catid=113&lang=en&Itemid=484
[29] Tora, Iliesa. 2014. "Digicel Help Vanilla Farmers in Vava'u." Tonga Daily News, January 31. http://www.tongadailynews.to/?p=3223.
[30] http://www.queen.com.au/tonga-vanilla-programs/
[31] The Department of Forests does have a web site at: http://forestry.gov.vu
[32] https://www.spc.int/en/about-spc/structure/956-spc-fiji-and-new-zealand-collaborate-to-train-fiji-and-tuvalu-biosecurity-officers.html
[33] http://www.certlink.org/a/lionfish-ltd
[34] http://www.cta.int/en/article/2014-10-17/web-20-and-social-media-spread-like-wildfire-in-vanuatu.html

Table 4.3: Tourism in the South Pacific, 2013

	Tourist arrivals	% of population	Tourism receipts (US$ m)	% of GDP
Fiji	657,706	76%	$726	23%
Samoa	130,400	68%	$481	28%
Solomon Islands	24,431	4%	$54	5%
Tonga	47,967	46%	$66	8%
Vanuatu	110,109	43%	$167	23%
PAC 5	970,613	48%	$1,495	18%
Source: Adapted from Fiji Bureau of Statistics, Reserve Bank of Fiji, IMF, Solomon Islands National Statistics Office, National Reserve Bank of Tonga, Vanuatu National Statistics Office, World Travel & Tourism Office.				

The full extent of impacts cannot be assessed due to the lack of a tourism satellite account. Tourism is not a sector defined in the ISIC classification but rather an activity that straddles several sectors including transport, and accommodation.

Research on the economic impacts from the use of ICT in tourism is limited. McMaster et al. (2004) studied the economic impact of the Internet to market small-scale tourist accommodations in Fiji, Samoa and Tonga, This included interviews with resort owners or managers. A pilot website was created, and following changes to the site, visible differences were noted with the number of visitors to the website increasing dramatically. However an actual increase in tourists caused by the web site visits was not measured.

An econometric study looking at the impact of both tourism and ICT on the Fijian economy found that each percentage point increase in telecommunication penetration contributes 1.1% to GDP growth and each percentage point increase in tourism receipts as a per cent of GDP contributes 0.23% (Kumar and Kumar, 2012). The study, using annual data for 1980-2008, also found causalities from capital stock to ICT and ICT to tourism, concluding that ICT investment and tourism are "crucial for Fiji's growth".

Given the importance of the tourism sector, it is not surprising that all of the countries have a tourism agency with a web site. The Samoa Tourism Authority (STA) web site (www.samoa.travel) includes an accommodation portal with full e-commerce functionality. This allows STA to market smaller properties that would find it difficult to be listed on large travel directories due to fees and other requirements. These smaller properties are often beach "fales" run by Samoan households aimed at budget conscious tourists. The portal not only has a description of the accommodation but also provides and online payment facility, something that smaller tourist businesses run by Samoans lack. When these properties are contacted via email, they send clients to the STA site to pay. Some 70 places to stay are listed on the site with 190 orders a year. The STA provides training for accommodation owners on how to upload information to the system. According to the STA, their site generates the most traffic in the Samoan tourism industry.

The STA has been using a New Zealand company, Electric Art, for its software development needs due to a lack of in-country capacity.

One interesting initiative is an online video campaign Electronic Arts ran for STA. The video was aimed at New Zealanders and aired on five sites (YouTube, Facebook, Stuff.co.nz, TVNZ On Demand and Mediaworks On Demand). According to Electric Art, the video was played over 350,000 times generating more than 10,000 clicks, which sold a significant number of travel packages.[35] However, statistics on New Zealand tourists do not show any noticeable increase in the period following the video campaign (see figure below).

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[35] http://www.electricart.co.nz/p1080/samoa-tourism-online-video-campaign

Figure 4.1: Visitor arrivals in Samoa from New Zealand, January 2012-October 2014
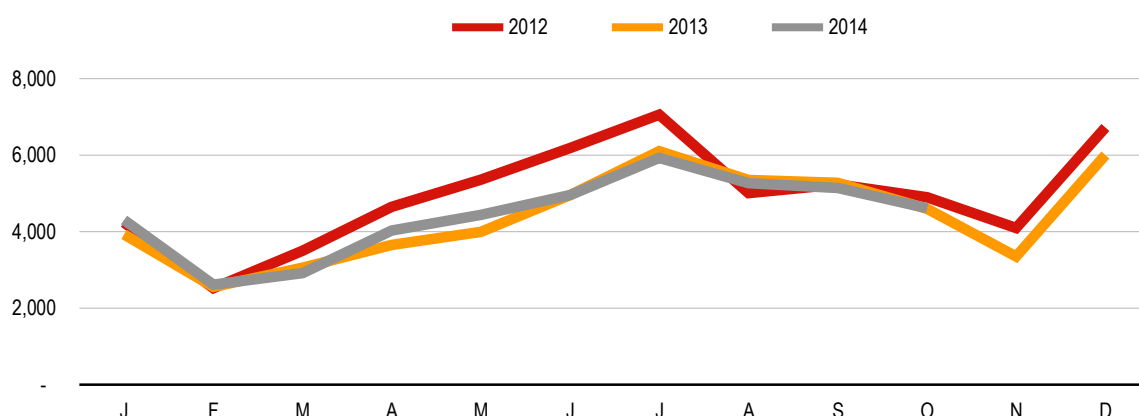
Source: Adapted from Samoa Bureau of Statistics

Another area where tourism has a significant impact is for the mobile operators. According to Vodafone Fiji, in 2004, 80% of tourists from Australia and New Zealand brought their phone with them of which 90% roamed onto its network. However, this is prior to launch of 3G networks in the region and it is likely that today many tourists to the region are purchasing local SIM cards given the price difference compared to international roaming.

Table 4.4: Roaming versus local rates, Samoa, US$, November 2014

	Roamer with a United States SIM	Samoa SIM rates
Local call (per minute)	0.20	0.19 (Peak)
Text message	0.50	0.09
Data (per MB)	15.0	0.02
Source: Adapted from Digicel (1 day bundle for data) and T-Mobile USA.		

4.2.1   Summary

Tourism is arguably the most digitised sector in the region. All of the countries have tourism websites and many accommodations are listed on global broker travel sites. Mobile operators have also tapped into the region's significant tourist market by making SIM cards aimed at visitors available on arrival at kiosks in airports. There is significant potential to tap ICTs for making a greater contribution to tourism particularly for SMEs. This includes developing systems that would link local companies to hotel supply chains, creating e-commerce applications for local communities to advertise and sell tourist-related services and making greater use of digital technologies such as online marketing and smartphone apps.

4.3   Government

ICTs improve government processes and are a prerequisite for enabling web-based or mobile- based public service delivery. This makes the public administration more efficient, increases transparency of procedures and saves time and money for citizens by reducing the need to travel to government offices.

There are few studies showing indirect impacts of e-government on the economy. Some studies illustrate the time and cost savings to citizens from implementing electronic service delivery. Bhatia et al. (2009) examined the difference between manual and computerised services in India interviewing 240-250 citizens at 8 service centres about the costs of accessing services, including the number and cost of trips required to complete a service, the amount of bribes paid to complete the service satisfactorily, and the waiting time at the service centre. It found that the number of trips required per user fell by 0.75 trips per user with waiting times decreasing between 16-96 minutes. For business, the World Bank publishes the number of days, procedures and costs of carrying out transactions with the government in its Doing Business series. It finds that using online systems significantly reduces the time and cost of starting a business. Using data from 70 economies for 2013, it found that the number of days to start a business was just over 10 days in countries with online systems compared to more than 25 days in economies without (World Bank 2014).

In the case of citizen e-services, there are so few in the region that at this stage it would be largely fruitless to survey their impact. Going forward, if these services are developed, the case of India offers a straightforward methodology for calculating impacts. In the case of business, recent information from Tonga illustrates the impact that implementation of an online system can have on the time to register a company. Following the launch of its free online company registration system in December 2014, the number of days to start a business dropped from 14 days to one (Figure).[36]

Figure 4.2: Number of days to start a business
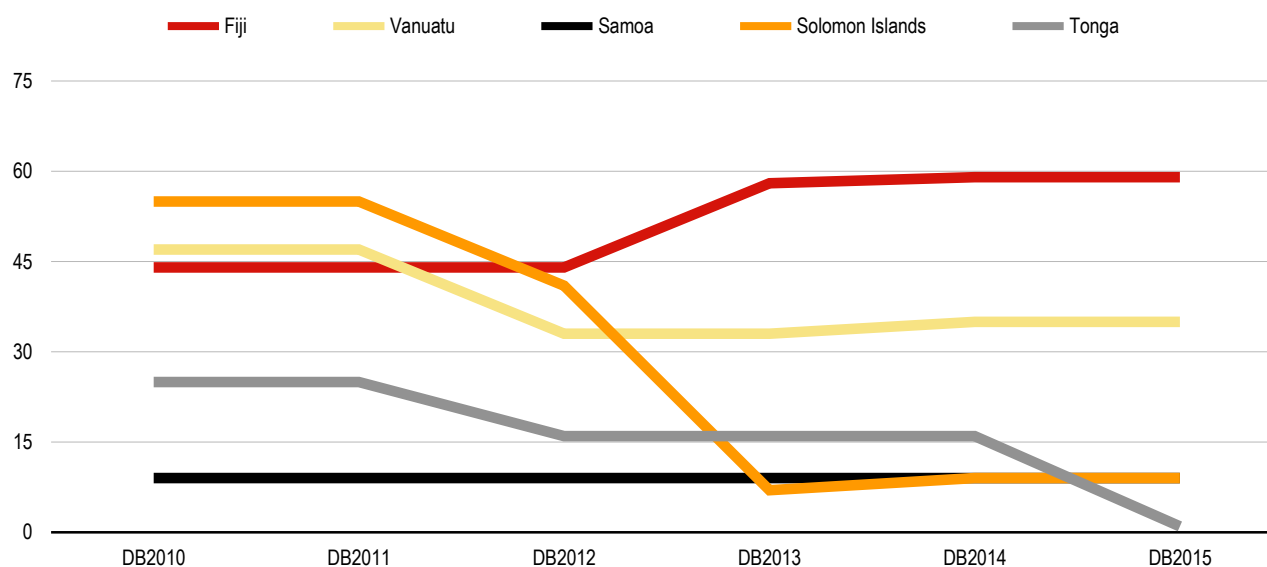
Source: Adapted from World Bank Doing Business and Tonga Ministry of Commerce, Tourism and Labour

The region has mainly focused on connecting government offices through backbone networks to support internal processes. Development assistance has played a key role with three networks financed through assistance from China and one from Australia.

Table 4.5: Government networks in the South Pacific

Country	Government network	Development partner
Fiji	Fiji Government Network (GOVNET)	RMB 145 (US$18) million loan from China EXIM Bank (2004)
Samoa	Samoa National Broadband Highway (SNBH)	$US20.5 million loan from China EXIM Bank (2011)
Solomon Islands	Solomon Islands Government (SIG) Connect Network	AUS$3.25 million grant from Regional Assistance Mission to Solomon Islands (RAMSI) (2011)
Tonga	Not Available	
Vanuatu	Government Broadband Network	US$29.5 million loan from China EXIM Bank (2009)

4.3.1 Fiji

Fiji's e-government Master Plan was released in 2007. The Peoples Republic of China, through its EXIM bank granted a loan of RMB 145 (US$18) million for the project. The Department of Information Technology and Computing Services (ITCS) under the Ministry of Finance is responsible for implementing the plan. The two main components are development of the Government Information Infrastructure (GOVNET) and deployment of Government services online via an e-Government portal. To date, the main accomplishment has been the development of GOVNET, linking most government agencies in Suva as well as some in other locations. The network backbone is fibre in Suva and wireless technology to other parts of the country. It allows the government's some 36,000 civil servants to exchange information electronically. In addition, the government also has a state-of-the-art data centre.

The development of online services for business and citizens has progressed at a slower pace. One challenge has been the lack of a central citizen and business registrar with each agency maintaining their own. In addition, ministries have

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[36] Asian Development Bank. 2014. "Tonga's Innovative Online Business Registry Goes Live – ADB." November 28.
http://www.adb.org/news/tonga-s-innovative-online-business-registry-goes-live-adb.

developed their own applications with little sharing across government and different software systems. If government IT experts move ministries they often have to learn a new system. This environment means that businesses and citizens must go to each ministry for each type of service.

In an effort to streamline the system, ITCS has been working on a flagship application for Investment Fiji. The aim is to create a single window for foreign investors covering registration and all other process to operate a business in Fiji. This is badly needed with the World Bank estimating that it takes 11 procedures, two months and costs a fifth of per capita income to register a business in the country.

A second application in the pipeline is automation of land registration process for indigenous Fijians. Another is streamlining applications for birth, marriage and death certificates. Government Service Centres (GSC) located in Lautoka, Labasa, Nausori and Suva have been established to fulfil citizen requests for government services.[37] They are connected to GOVNET providing notary services, information about government services including civil registrations and can assist with online applications for scholarships and exam results. There are hopes to also include the network of post offices as government service centres. There is also a government call centre.

4.3.2 Samoa

In Samoa, the primary focus of government use of ICTs has been to enhance connectivity for ministries and offices in order to carry out administrative processes more efficiently. The Samoa National Broadband Highway (SNBH) was officially launched in 2014 to connect all government ministries and their agencies as well as hospitals and schools.[38] Government to citizen and business online applications or services delivered to mobile phones have as yet not received much attention. Some applications have been brought online such as customs declarations. However, areas such as tax payments remain offline. Requests for documents such as birth, marriage or death certificates must be made in person at government offices in Apia entailing travel costs and time for citizens. Samoa has implemented some ICT-based reforms to facilitate businesses activities.

In 2011, the land registry was computerised reducing the time required to register property by four months. However, in general most business interactions with government remain manual. One important bulk SMS application is the disaster warning system. Text messages are sent to key leaders such as village mayors, church ministers, teachers and others who in turn inform the public. SMS broadcasts would risk congesting the network and the target approach safeguards that key people get the information reliably.

4.3.3 Solomon Islands

In the Solomon Islands, a WiMAX metropolitan area network (MAN) has been implemented for government offices in Honiara. The AUD 3.25 million project was financed by the Australian government[39] and is managed by the Ministry of Finance ICT Support Unit (ICTSU). The government SIG Connect network links around 85 government offices and was completed in May 2014. In addition to Internet access, the network provides government staff with official email addresses and virus protection. There are few examples of public e- or m-services in the Solomon Islands.

One exception is the 2014 election. A biometric voter registration (BVR) system was used to photograph and fingerprint citizens with information stored in a database. A text message campaign was used to inform the public about candidates, voting procedures and locations of polling stations. The Electoral Commission cited the importance of the BVR system for registering over 80% of the eligible voting population.[40]

4.3.4 Tonga

Government connectivity varies in Tonga. Most ministries in Nuku'alofa are connected to the Internet with each making its own arrangement with an ISP. Some are using wireless, some ADSL and some are connected by fibre optic cable. Most ministries have a web site with the government portal hosted in MICT offices. There is a Freedom of Information policy with a website providing some information and links to relevant ministries describing their work and contact details.[41]

There has been a proposal to create a government network with a data centre since 2002 but it has stalled due to a lack of funding. Because there is no government network inter-linking the various ministries and standard software and data exchange, e-government applications aimed at citizens and businesses lag.

Some effort is devoted to digitising documents to speed up workflows. But the ability to pay taxes on line and carry out web requests for documents such as birth/marriage/death certificates does not exist. Obtaining government documents

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[37] http://www.fiji.gov.fj/Media-Center/Press-Releases/GOVERNMENT-SERVICE-CENTRES-PRAISED.aspx

[38] http://www.samoaobserver.ws/other/science-a-technology/4385-44m-network-takes-off

[39] http://www.cbo.net.au/2013/07/cbo-completes-solomon-islands-government-rollout/

[40] See: "SIEC Releases Provisional Voters List" at http://www.siec.gov.sb/index.php/journalist/18-siec-releases-provisional-voters-list

[41] http://www.foi.gov.to/index.php/other-agencies

such as civil records entails a visit to government offices to file a request and a wait of at least several days before receiving them.

Most e-services aimed at business and the public at large are developed by the private sector. Mobile alerts from the Tonga Power Limited and Air New Zealand advise customers of power outages, overdue bills and flight information. Some utility payments can be made using mobile money or mobile banking applications.

A significant improvement in the business environment took place in December 2014. All processes for registering a business including name, certificate of incorporation, business license and registration with tax authority are integrated into a single online window. Payment for all related fees can be made online using a credit card. The Registrar of Companies has installed two kiosks for people who do not have access to a computer to carry out the process. The new integrated process will reduce the time to register a firm from 16 days to less than 1, placing Tonga among the countries with the fastest business registration process in the world.

4.3.5   Vanuatu

In Vanuatu, the Office of the Government Chief Information Officer (OGCIO) is the entity responsible for government ICT. In 2008, it launched an e-Government project featuring construction of a government backbone network financed through a US$29.5 million loan from China's Export-Import Bank[42] with Huawei as the lead contractor.[43] The network connects the six provincial capitals via microwave and satellite with local access through fibre optic cable. There are also two data centres and disaster recovery capability. The backbone is the country's third largest after the two main telecom operators. An agreement is in place for each to utilise one of the three networks in case of outages and there are plans for the government to provide wholesale services over its backbone. Around half of the some 7,000 government employees use the network. It offers VoIP and video-conferencing services, substantially reducing communications costs although no precise figures are available. There are several applications available on the government network, mainly involving financial management. A smartphone version is to be launched providing staff with access to services from anywhere with mobile broadband coverage.

Vanuatu has greatly improved birth registration in the last few years by the roll-out of IT connectivity to provincial centres and the development of a national database:[44] Birth registration rates for children aged under 1 increased from 35% to 57% between 2013 and 2014, for example.

There are presently no e-services available over the central government network for business or citizens but this is planned over the next several years. There are several mobile applications aimed at citizens developed by different organisations. For example, the Vanuatu Ferry uses SMS broadcasts to advise on its schedules. The National Provident Fund allows its some 21,000 contributing members to use mobile phones to check balances and receive text alerts whenever there is a contribution to their account.

4.3.6   Summary

One benefit of government networks is the cost savings to the public administration by lowering communication costs and reducing the need for travel. Although some of the countries implementing government networks mentioned that the networks saved money, there were no objective data to support this claim. Countries were also not able to provide basic internationally standardised data on use of ICTs in the government sector that would allow progress to be monitored. The Partnership for Measuring ICT for Development collects proposes core indicators for that purpose.[45] None of the visited countries collects this data systematically.

The level of citizen services that are electronically delivered is limited in the countries studied. The Partnership for Measuring ICT for Development has identified ten core services for citizens with four levels of electronic delivery. An evaluation of the service delivery level is shown in the table below.

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[42] http://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/9172.pdf
[43] http://www.alphacomputer-dz.com/alphadays/galerie/presentation2/Huawei/01%20Datacom%20Solution/Solutions/Huawei_e-Government_Cases.pdf
[44] http://www.spc.int/prism/images/CRVS_Posters/Vanuatu%20FINAL.pdf
[45] http://unstats.un.org/unsd/statcom/doc12/2012-12ICT-E.pdf

Table 4.6: Core citizen services and level of electronic delivery

	Fiji	Samoa	Solomon Islands	Tonga	Vanuatu
Enroll to vote for the first time in government elections	Level 3 www.electionsfiji.gov.fj	Level 1 www.oec.gov.ws	Level 1 www.siec.gov.sb	Level 2 www.tongaelections.com	NA USAID maintains a portal
Complete and lodge personal income tax return, least complex situation	Level 2 www.frca.org.fj/taxation-forms-tax-returns/	Level 4 eTax: http://set.revenue.gov.ws	Level 2 www.ird.gov.sb	Level 2 www.revenue.gov.to	Level 2 https://customsinlandrevenue.gov.vu (income is not taxable)
Renew an international passport	Level 2 www.immigration.gov.fj	Level 2 www.samoaimmigration.gov.ws	Level 2 www.commerce.gov.sb	Level 2 www.tongaconsul.com/	Level 1 https://governmentofvanuatu.gov.vu/internal-affairs.html
Renew a driver's license	Level 2 www.ltafiji.com	Level 1 www.lta.gov.ws	Level 2 www.ird.gov.sb	Level 2 www.transport.gov.to	Level 1 https://customsinlandrevenue.gov.vu
Obtain a copy of a birth certificate	Level 3 www.bdm.gov.fj	www.mjca.gov.ws (Webpage was down)	NA	Level 1 http://www.foi.gov.to/index.php/ministries/justice	Level 1 https://governmentofvanuatu.gov.vu/internal-affairs.html
Obtain a copy of a marriage certificate	www.egov.gov.fj (Webpage was down)		NA		
Rating	Level 1: Obtain information from publicly accessible websites Level 2: Request printed forms or download forms from publicly accessible websites Level 3: Fill in online forms available on publicly accessible websites Level 4: Undertake the complete process, via publicly accessible websites.				

4.4   Education

The use of ICTs in education can potentially generate a number of benefits for the Pacific region where the quality and availability of teachers varies. ICTs enable e-learning, online educational content and videoconferences of lectures among other things. Low cost computing devices are making dissemination of hardware to students more cost-effective and a number of countries in the world have launched programs including in the Pacific region. Wider access to computers and the Internet in schools can improve digital literacy and prepare students for eventual employment in the ICT sector.

Several studies have investigated the link between ICTs and educational outcomes including use of mobile phones, computers and computer assisted learning. Aker et al. (2012) demonstrated the impact of mobile phones on literacy in Niger. Students using mobile phones in treatment villages had test scores that were 0.19-0.26 standard deviations higher than those in standard adult education classes. Spiezia (2010) investigated whether computers affected student performances using data for 33 countries from the 2006 OECD Programme for International Student Assessment (PISA). The frequency of computer use was found to have significant impact on science scores. However, the impact was larger when the computer was used at home rather than at school questioning the effectiveness of educational policies aimed at promoting computer use at school as a tool for learning. Research from China examined the impact of Computer Assisted Learning (CAL) on 2,741 students in 72 rural schools (Mo et al. 2014). The study found that a CAL program that was implemented for one year and a half among third and fifth grade students increased student standardised math scores by 0.25 standard deviations for third graders and 0.26 standard deviations for fifth graders.

The progression of ICTs in schools has mainly proceeded in an uncoordinated manner in the Pacific. None of the countries has an ICT in education plan and the availability of computers and Internet access is often implemented through donor assistance. The focus is typically on use of computers by administrative staff and to compile educational statistics.

4.4.1 Fiji

Recognising the importance of computer science, a curriculum for secondary schools was developed in Fiji as far back as 1996.[46] However, by 2003, it had only been implemented in a little over half the secondary schools in the country. Allocation of ICTs in schools has mostly progressed on an ad-hoc basis. Recent data is not available on school connectivity. In 2002, 86 (55%) of the 156 secondary schools in Fiji offered CS/IT education. Around a fifth of secondary schools had Internet access and most were in urban areas.

There are several ad-hoc initiatives to put computers and Internet in schools. This includes the TAF and Department of Communications telecentre program where some schools stay open after hours to serve the community. Another example is the Share, Engage and Educate (SEE) project providing over 200 computers as well as robotic kits, digital cameras and data projectors to schools, with the equipment donated by individuals and the Queensland University of Technology in Australia.[47]

Given the uncoordinated manner of these initiatives and the lack of a clear strategy regarding incorporation of e-learning into the curriculum it is not clear how impactful they have been. At a minimum, students that have access to ICT learn how to use them. In terms of educational outcomes, there are few studies available for Fiji. Most are anecdotal and none employ rigorous ex ante and ex post or control group methodology.

4.4.2 Samoa

In Samoa, several ICT initiatives have been deployed in the educational sector including e-learning, computer labs and distribution of laptops. These have mainly been implemented as separate projects. The SchoolNet project was supported by the ADB with the aim of incorporating e-learning in secondary schools. The Ministry has been progressively installing computers in schools with student to computer ratios improving between 2008 and 2014 from 139 to 62 in primary schools and 26 to 13 in secondary school. An OLPC program was also piloted (see 4.4.6).

Parallel to the SchoolNet, Samoa has been continually increasing the number of computers in primary and secondary schools. Unlike the SchoolNet equipment consisting of thin clients connected to servers in learning enters in secondary schools, the computer labs use Windows-based computers and are installed in both primary and secondary schools. By 2014, there were 607 in primary schools and 1,153 in secondary schools. Fourteen secondary schools had a computer science curriculum for Years 12 and 13 in the 2014 school year. Computer science is one of the Year 12 exam subjects and in 2014, 1,083 students took the exam. One would assume a relationship between rising school computer penetration and test scores and that is somewhat the case with a slight rise in exam scores over the past few years in tandem with the increase in the number of computers (Figure). However, in 2013, test scores plummeted raising questions about the link between school computers and computer science proficiency.

Figure 4.3: Computers in Samoan secondary schools
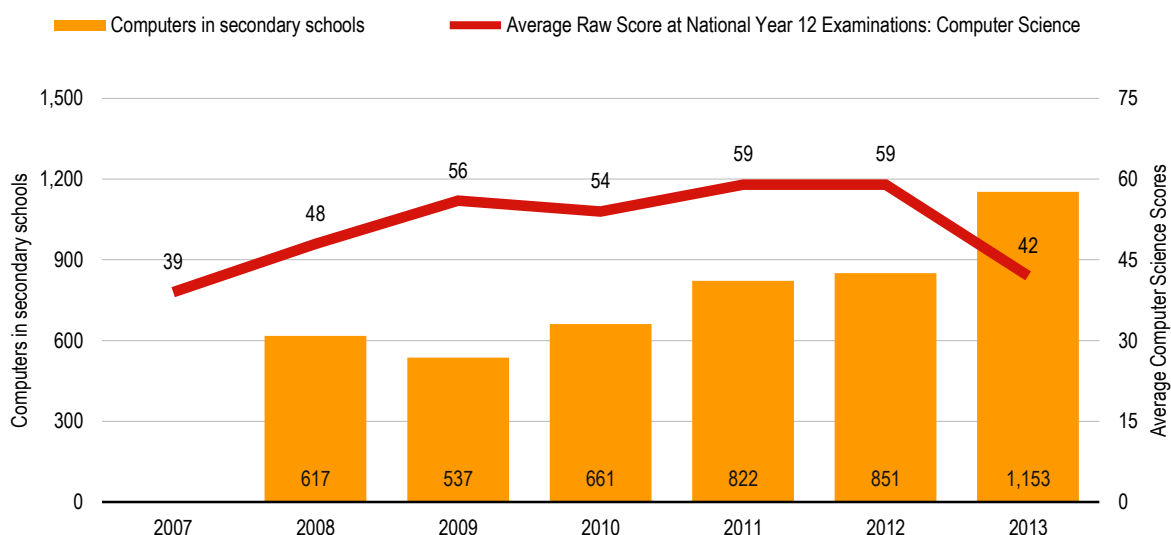
Source: Education Statistical Digest 2013

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[46] http://www.usp.ac.fj/jica/ict_research/documents/pdf_files/ICT%20in%20Secondary%20Education%20in%20the%20Pacific%20Region.pdf.
[47] http://theseeproject.org/2014/04/10/the-2013-see-project-report/.

4.4.3   Solomon Islands

In the Solomon Islands, the Ministry of Education and Human Resources Development uses the Solomon Islands Education Management Information System (SIEMIS) to capture key information about schools, teachers and students. Surveys are sent out to schools once a year. Very few are returned in electronic format and most are sent by mail or personally delivered to the ministry.

4.4.4   Tonga

In Tonga, ICT in education has been mainly focused on strengthening school administration and decision-making through better collection and exchange of electronic records. The Ministry of Education and Training is developing an Educational Management Information System (EMIS). It has been working with a system originally provided by UNESCO but it is hard to adapt to local context and the ministry suffers from a lack of technological resources and capability. The ministry is currently looking to replace the system with a cloud-based system.[48]

All secondary schools are connected to the Internet using TCC. The ministry is not sure whether the schools are provided an educational discount for the Internet access. Most secondary and primary schools have computers primarily from donations. For example, a local bakery recently donated 100. This presents maintenance challenges given the variety of models and software versions. Nevertheless, the ministry tries to staff schools with at least one person who has computer experience.

There is no formal e-learning program due to a lack of budget, equipment and expertise. This would be very relevant for the country due to the shortage of teachers, particularly for some subjects such as physics.

There is one example of using mobile phones for homework. Students were to text their teacher the daily answer to a quiz. The teacher received too many texts to the experiment was ended.

Computer science is included in the curriculum in secondary schools. Post-secondary educational institutions in Tonga offer computer science courses including USP and the Tonga Institute of Higher Education (TIHE). Some church schools have diploma programs, as do private companies. The Tonga Chamber of Commerce offers two-week training programs in office applications such as Excel, Word, etc. This is coordinated through the Tonga Business Enterprise Centre with assistance from the New Zealand government and aims to build up business skills in the country.

USP has contracted bandwidth on the submarine cable. This will enable it to offer higher quality and improved functionality for its e-learning and joint lectures across campuses and countries.

4.4.5   Vanuatu

In Vanuatu, ICT integration in the educational sector has been limited. Until now, there has been no formal government support for ICTs in schools. Internet access and computers needs to be purchased from limited school budgets. As a result, connectivity varies tremendously across urban and rural and primary and secondary schools. A survey carried out among school officials attending a workshop in Port Vila in January 2013, identified three types of schools according to computer availability: those with computer labs (37%), those with a few computers used by teachers or administrators (37%), and those with no computers (26%).[49] Given that the survey was not nationally representative and slanted towards urban areas, the majority of schools in the country do not have computers. Only around five percent of students in the surveyed schools have access to ICTs and could be considered computer literate with the shortage of computers, around 1 per 200 students, a major obstacle. There are no schools with computers well integrated into the learning process. Most of the respondents indicated that ICTs in education are given low or very low priority and the two main obstacles are lack of electricity and lack of trained staff.

The government is planning to deploy Internet access, computer labs and tablet computers to select schools during a first phase of the Universal Access Program. The program is supported by the Australian government's Governance for Growth (GfG) program and is implemented in coordination with the Ministry of Education, TRR and OGCIO.[50]

4.4.6   One Laptop per child

All of the countries have been involved in the One Laptop per Child (OLPC) initiative.[51] For this most part the experience has not been successful in terms of translating from a pilot to wide-scale implementation. Impact evaluations are limited,

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[48] http://triesten.com/products/iskool/
[49] OGCIO, Ministry of Education, and TRR. 2013. The First Survey of ICT Usage in the Vanuatu Schools.
http://ogcio.gov.vu/images/pdf/First%20Survey%20of%20ICT%20Usage%20in%20Schools%20Final%20Final.pdf.
[50] TRR. 2014. "A new dawn in education - ICT enabler," October.
http://www.trr.vu/attachments/article/410/a_new_dawn_in_education_ict_enabler_final.pdf.
[51] http://one.laptop.org

anecdotal, and qualitative.[52] The pilots may also have come too early, before there was adequate connectivity to support the computers in rural areas. There are also issues about the OLPC itself in terms of the bundled software's contextual relevance, support and maintenance.

- Fiji: The Ministry of Education has recently launched a One Laptop per Child project. This is somewhat surprising given that the program has been around for years. As the experience from the other Pacific countries shows, OLPC has issues about the contextual relevance of the applications it comes bundled with and today, cheaper and possibly more relevant alternatives are available in the form of tablet computers.
- Samoa: In 2009, a pilot commenced involving the provision of OLPCs to two primary schools in Savaii. In May 2010 48 XO-1.0 laptops were deployed to Laumoli Primary School and 27 XO-1.0 laptops to Paia Primary school children plus additional laptops for teachers.[53] Despite initial enthusiasm for the project, it has not been completely successful and the laptops are rarely used today. The laptops were mainly used for students to learn how to use computers rather than being incorporated into e-learning. Challenges included technical issues and isolation of the schools.
- Solomon Islands: A One Laptop per Child (OLPC) trial began in July 2008 at three primary schools in Marovo Lagoon, Western Province (Sombiro, Batuna and Patukae). Some 375 XO laptops were distributed to students and teachers. The Australian Council for Educational Research (ACER) was commissioned by the Ministry of Education and Human Resources Development (MEHRD) to undertake an evaluation of the trial.[54] The evaluation consisted mainly of qualitative interviews with teachers, students, parents and community members. An MEHRD monitoring and evaluation framework was used to evaluate the program (Table 4.7). Despite the relatively positive findings, the program was not scaled up.
- Tonga: There was a One Laptop Per Child (OLPC) pilot for primary schools introduced several years ago. It was not successful due to several issues: teachers were not provided adequate training, content was not localised (children are not normally exposed to classes in English until Class 3) and after the trial, it was expected that the beneficiaries would pay $100 per laptop.
- Vanuatu: In July 2008, 25 XO laptops were provided to the Wan Smol Bag (WSB) in Port Vila. At one point, it was anticipated that this would be scaled-up to a nationwide project but that never materialised.[55,56]

Table 4.7: OPLC evaluation in Solomon Islands

	MEHRD Objective	ACER Finding
1	Raise awareness about OLPC and the objectives of the trial	In general, awareness has been raised about the OLPC program, its vision and its functions
2	Assess the impact of OLPC in the area of teaching and learning	Evidence to date indicates that there has been a positive impact in the pilot schools and that this should continue to strengthen
3	Assess the impact of OLPC on enrolment or attendance (Objective 3)	Teachers and parents believe that the program is positively influencing student attendance
4	Assess the impact of OLPC in delivering/producing new curriculum materials/learning content (Objective 4)	The OLPC program is leading to an increasing demand for the development of new and appropriate curriculum materials
5	Assess if OLPC/XO technology is technically feasible and sustainable (Objective 5)	While there are some 'teething' and other difficulties with the technology, and a need for further technical support, the program is proving to be both feasible and sustainable
6	Assess the impact of capacity building for teachers (and learners) in the OLPC project	While teachers have indicated a need for further and ongoing training and professional learning opportunities, the program has increased their professional capacity.
7	Assess the impact of OLPC on student learning, and school environment	The program is regarded in a positive light by schools and their communities.
8	Assess the impact of OLPC/XO technology on the community	There is considerable interest and involvement in the program by the school communities.
Source: Australian Council for Educational Research.		

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[52] For an example of a quantitative evaluation of an OLPC program and impacts on student performance see: Mo, Di, Johan Swinnen, Linxiu Zhang, Hongmei Yi, Qinghe Qu, Matthew Boswell, and Scott Rozelle. 2013. "Can One-to-One Computing Narrow the Digital Divide and the Educational Gap in China? The Case of Beijing Migrant Schools." *World Development* 46 (C): 14–29.
[53] Tabitha Roder and Tom Parker. 2010. *Volunteers Report - Samoa olpc deployments visit.*
http://wiki.laptop.org/images/0/0a/Volunteers_report_August_2010_-_olpc_Samoa_deployments.pdf
[54] Australian Council for Educational Research. 2010. *Evaluation of One Laptop Per Child (OLPC) Trial project in the Solomon Islands.*
http://wiki.laptop.org/images/0/0b/SolomonIslandsOLPCTrialsEvaluationByACER2010.pdf.
[55] "OLPC Vanuatu" at: http://wiki.laptop.org/go/OLPC_Vanuatu
[56] TRR. "OLPC is an education project, not a laptop project." http://www.trr.vu/attachments/article/91/OLPC_PRESS_RELEASE.pdf

4.4.7 University of the South Pacific (USP)

The University of the South Pacific (USP), headquartered in Suva, serves 12 countries in the region via distance learning. Its satellite-based USPNet was established in 1973 and today around half the students are using distance education via applications such as audio and video conferencing and Internet access. The network has been progressively upgraded to increase capacity. This is important given that the highest attrition rates are in countries with poor bandwidth. Recently, USP has purchased dark fibre on submarine cable networks in the Marshall Islands, Tonga and Vanuatu. Improved connectivity will support sophisticated distance learning applications and link students and professors in these countries to international educational research networks.

The Japan International Cooperation Agency (JICA) has supported USP with development assistance funding over the years. It carried out a 2009 evaluation of its technical cooperation program.[57] The evaluation noted an increase of 120% in computer science graduates and availability of 350 Distance and Flexible Learning courses (DFL). Three indicators were tracked to measure overall project goals: 1) There was an increase in the number of applicants for higher education and continuing education though specific figures were not mentioned; 2) In terms of an increase in qualified jobs for computer science graduates, it was noted that many are employed by IT-related firms, banks and educational institutions without specifying a specific number; and 3) five papers were published by international academic journals. The Japanese evaluation considered the overall impact of the project to be low.

4.4.8 Summary

Few of the countries were able to provide transparent and comparable statistics on the penetration of computers and Internet in schools. None was able to provide the Partnership for Measuring ICT for Development Core Indicators on Education.[58] As a result, it is difficult to have a reliable portrait of ICT availability in primary and secondary schools let alone their impact.

Ministries of education get in contact with public schools on a regular basis for administrative purposes. It would thus be fairly easy to establish a base line and monitor progress annually.

4.5 Health

ICT affects the health sector in various ways. It improves internal processes, increasing efficiency and lowering costs. Mobile phones can be used to alert patients about taking medicine, online health information can be made available to citizens and diagnostic information can be transmitted over broadband networks for experts to analyse.

Impact studies on ICT and health include Whitacre (2011) who collected data from 24 rural hospitals in the United States finding telemedicine services contributed an annual average savings of US$522,000. Four impacts from telemedicine were modelled:

- cost savings from not having to hire medical experts compared to using telemedicine;
- cost savings for patients from not having to travel to specialists;
- lost income from patients who have to travel for diagnosis and
- increased income for laboratories and pharmacies because patient is treated locally.

In a Kenyan study, Lester et al. (2010) found that patients who received reminder text messages had significantly improved antiretroviral therapy (ART) adherence compared with control individuals. Patients from three HIV clinics were divided into two groups: one that received the text message (273 patients) and a control group (265) and interviewed at 6 month and 12 month intervals.

Replicating these studies to analyse impact of use of ICT in health sector is not immediately possible in the countries studied. On the one hand, there is only one known telemedicine application among the countries involving a Fijian and Indian hospital. The potential is great however, with the launch of undersea fibre optic cables that have significantly boosted bandwidth, making it possible to transmit high-quality images.[59] Mobile applications aimed at patients for most part do not exist. Some NGOs have piloted text alerts in the health sphere but these have had limited success due to SMS prices and the reluctance of operators to provide discounts for bulk SMS services for the health sector. Another challenge for developing health applications is the shortage of programmers.

Authorities in the countries studied have stated that health information systems have helped to improve health outcomes but lack the concrete evidence and models to prove this. For example, the Ministry of Health in Fiji tracks almost 90 indicators but there is no research using these indicators to show how ICTs impact health outcomes. According to the

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[57] See "Summary of Evaluation" at: http://www2.jica.go.jp/en/evaluation/pdf/2008_0603429_4.pdf
[58] Partnership for Measuring ICT for Development at: http://unstats.un.org/unsd/statcom/doc12/2012-12-ICT-E.pdf
[59] "This fiber optic cable will allow our doctors to communicate more easily with health workers on other islands also with doctors overseas. We are planning live surgery with overseas partners, getting a live feed to what is happening here in Tonga, and directing the doctors in complicated surgery..." Faster Internet in Tonga = Better Healthcare. 2013.
https://www.youtube.com/watch?v=GWclQJh2HKQ&feature=youtube_gdata_player.

Ministry of Health in Tonga, the HIS has improved health outcomes through more efficient management of patient information but there is a lack of long time series and models to prove the correlation. Indirect impacts include reduced waiting times for doctors through improved scheduling.

A macro-level study carried out by Fijian researchers looked at the relationship between output per worker, health expenditure and ICTs (Kumar and Singh 2014). The premise is that better health outcomes result in higher productivity. The study found that each percentage point increase in telephone penetration results in a 0.9% increase in worker output in the short-run and 0.62% in the long run.

4.5.1   Fiji

In Fiji, the Ministry of Health is keen about the potential of ICTs for promoting wellness in the country. Many of its agencies throughout the country are connected to the government backbone network including all hospitals with more than 30 beds.

The Ministry faces challenges connecting all establishments due to high costs; it is trying to negotiate with operators to bring down the charges. Some existing connections suffer from quality issues as they are using bandwidth of between 256 Kbit/s to 2 Mbit/s, deemed insufficient for growing traffic. The network is mainly used for administrative applications such as email and sharing information and supports videoconferencing to exchange information among medical staff.
The ministry currently has one telemedicine application that holds great promise for scaling up throughout the country. Scans from an MRI are transmitted to Sahyadri hospital in India where diagnosis is provided within 24 hours. This is carried out on average for four patients a day.

The Vodafone ATH Fiji Foundation mHealth service uses SMS to provide information about kidney diseases, cancer, sex education, physical fitness, diabetes and high blood pressure. The Foundation works with a group of doctors to provide information. The application has some 50,000 subscribers.

4.5.2   Samoa

Samoa's Ministry of Health is in the process of developing an e-health strategy. Meanwhile the main hospital in Apia and eight district hospitals are connected to the government network facilitating exchange of information. Previously nurses had to bring written files to Apia to be incorporated into the ministry's databases.

There are no applications aimed at citizens such as use of mobile phones for reminders and appointments. One challenge with existing systems is the shortage of programmers both in house as well as freelance in the country. As a result, some information systems have had to be abandoned since the original software developers left the country. The University of Auckland is planning to introduce a tobacco cessation program based around the mobile phone mCessation application used in New Zealand and the United Kingdom.[60] They aim to deliver the program to 100 participants and carry out an evaluation study assessing its impact on smoking cessation.

4.5.3   Solomon Islands

Reporting for the District Health Information System (DHIS) has been enhanced with the use of ICT. It has improved data entry and access to health information at provinces and headquarters. The Ministry of Health and Medical Services (MHMS) is on the government network and some provincial units have Internet access used to send data for DHIS. The ministry uses msupply (see Vanuatu) for pharmaceutical inventories and early work using tablets is underway looking at ways to use ICT for more immediate stock management of pharmaceuticals and medical supplies across the country. The Karisma[61] radiology system for medical imaging allows x-rays to be instantaneously available to doctors on the wards. An MS Access inpatient administration database is in place but is being replaced by an interim admission, discharge and transfer (ADT) module for patient data collection at the hospital.

The national hospital is now planning to develop an integrated patient information management system that will link with provincial hospitals, pharmaceutical, radiology and the public health system (DHIS2). This project will require significant ICT input and support.

4.5.4   Tonga

In Tonga, the main ICT intervention in health is computerising internal processes. The country's Health Information System (HIS) is advanced. Developed with World Bank assistance, system maintenance is outsourced reducing the need for skilled staff. Out of 944 staff in the ministry, only four are in IT. The HIS has undergone continual improvements with the focus currently on integrating databases to reduce duplication. All four hospitals are connected to the Internet and networked to the HIS. In addition the seven health centres on the island of Tongatapu are connected. It has been a challenge to provide reliable connectivity to the seven health centres in the outer islands due to the expense. The

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[60] University of New Zealand. "Pacific mCessation."
[61] http://www.kestral.com.au/karisma-features.html

ministry has been making optimising its use of bandwidth such as not sending radiology images back and forth but instead accessing from the central server.[62]

4.5.5   Vanuatu

Vanuatu has recently moved to the use of the District Health Information System (DHIS) for its key health application (as has Solomon Islands). A focus has been on improving communications links among the various health institutions across the country. There are six hospitals, one in each province. Five are linked to the government network with a minimum bandwidth of 2 Mbit/s. The remaining hospital is currently without a connection but a survey has been completed and connection to the government network is scheduled in the coming months. An audit is being finalised to gauge the status of connectivity in health centres and dispensaries with a view to determining needs. A two-year contract for provision of communication services will be established in 2015, which will provide devices with data and voice communications in around half of the health centres. Improved connectivity among the different health institutions will improve the timeliness and quality of data supplied to DHIS. The paper-based system results in inefficiency as the forms are either posted to the provincial hospitals or delivered by the health facility staff.

A further inefficiency arises from connection outages at the hospitals requiring provincial level staff to make a journey from the hospitals to Internet access centres. This results in a lower level of compliance for providing needed information than would be the case with better connectivity. The DHIS is being enhanced with a dashboard that shows key health indicators at a glance. Data should become more timely and reliable following improvements to national connectivity. The "mSupply" application is now well established in four of the six provinces and links inventories of medical goods including pharmaceuticals in a database. This supports better monitoring and distribution in the provinces and reduces storage of drugs that have expired. There are plans to expand mSupply to the remaining provinces that do not have servers in their hospitals. Improved ICT through the government systems has enabled the roll out of Financial Service Bureaus (provincial branches of the Ministry of Finance & Economic Management) in each province enabling more timely flow of funds.

4.5.6   Summary

The use of ICTs in health is particularly relevant in the Pacific region where many areas lack sufficient doctors and nurses. The primary use of ICTs in the countries studied has been on refining health information systems. Enhanced national connectivity is enabling health offices to improve their ability to provision health statistics and saves costs and time by not having to travel to deliver information. ICTs are also being used for internal logistical functions such as improving stock management and delivery of pharmaceutical supplies.

4.6   Financial services

Mobile technology can play a key role in supporting and enabling financial services. These include mobile money and mobile remittances, crucial to the financially excluded. This is particularly relevant in the Pacific region, which, according to the GSMA is "... one of the least banked areas on the planet with nearly 80% of people in the region with no access to formal financial services. Diverse geographies, poor infrastructure, low literacy and subsistence livelihoods all contribute to low financial service participation and mean that millions of people are only transacting in cash."[63]

Although all of the countries studied now have mobile money or banking services, they have been implemented relatively recently (table 4.8). Digicel launched its Mobile Money service in all of the countries it is active in (in Vanuatu, this is in collaboration with a local bank), Vodafone has also launched a mobile money service in Fiji while in the Solomon Islands, banks are driving the use of mobile phones for banking transactions.

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[62] http://www.cse-global.com/Solutions/Healthcare.html
[63] Highet, Catherine. 2013. "Addressing the Gender Gap for Mobile Financial Services in the Pacific." Mobile for Development, November 26. http://www.gsma.com/mobilefordevelopment/addressing-the-gender-gap-for-mobile-financial-services-in-the¬pacific.

Table 4.8: Mobile money and banking services in the South Pacific

Country	Service	Launch	Users†	Mobile operator or bank led
Fiji	M-Paisa (Vodafone)	June 2010	367,835	Mobile
	Mobile money (Digicel)	July 2010	83,960	Mobile
Samoa	Mobile money Digicel	2011	8,687	Mobile
Solomon Islands	banking on the go (Westpac)	2013	15,127	Bank
	goMoney (ANZ)	2013		
	Branchless Banking (BSP)	2013		
Tonga	Mobile money (Digicel)	January 2011	19,576	Mobile
Vanuatu	Isi Mani (Digicel & NBV)	May 2013	7,886	Both
Note:	† Data for Solomon Islands refers to 2013 and for all other countries to September 2011.			
Source:	Adapted from mobile money/banking operators and PFIP			

Studies looking at the impact of mobile money and banking services have generally cited their potential for expanding financial inclusion and reducing transaction costs. In a macro level analysis using data from 1976 to 2010, Kumar (2013) investigated the interaction of ICTs and remittances in the Philippines and their effect on income and found a positive relationship. In particular, ICTs have a greater impact on the flow of remittances if they are used to lower transaction fees. Mbiti et al. (2011) analysed the economic impact of mobile money in Kenya and found its use decreases prices of competing money transfer services and increases levels of financial inclusion.

One challenge with examining the impact of mobile money/banking in the region is the recent introduction of these services. This precludes time series econometric analysis requiring substantial observations. Alternatively, one can look at the short-term impacts in terms of financial inclusion and reducing the price of transferring money. Among the indicators useful for studying financial inclusion would be metrics on the proportion of users and how this compares to existing bank accounts. Here it is important to distinguish between online banking services that can only be used on smartphones with Internet access as opposed to mobile banking services that are designed to work on any phone including those with just 2G mobile coverage. In terms of transaction costs, impacts could be measured by comparing the price of mobile money/banking to alternative methods.

The lack of precise and comparable data on the number of active mobile money/banking accounts as well as traditional bank accounts in the region makes it difficult to assess how the former services are widening financial inclusion in the countries studied.

4.6.1 Fiji

Fiji is relatively well banked compared to the other countries studied with only around 10% of the population unbanked.[64] Since launch of the Vodafone M-PAiSA service, over 300,000 customers have enrolled, of which 40,000 are active customers. Digicel does not publicly disclose the number of active subscribers it has. According to a survey carried out by PFIP in 2012, seven per cent of those with a cell phone were using mobile money services.[65] Take-up of mobile money faces significant barriers with 80% of those surveyed saying they preferred cash to mobile money, less than 50% trusted mobile money and around 60% found mobile money to be expensive. Over 40% replied that the main benefit of mobile money is convenience with 37% stating that it saves time.

Mobile money increases the number of agents and hence locations for cash transactions. This benefits consumers by widening the circle of locations where they can either load their mobile wallets or withdraw payments they have received. According to the Reserve Bank of Fiji, there has been a noticeable increase in cash-in/-out points and banking agents in the country because of mobile money initiatives. The number of cash-in/-out access points per 10,000 adults jumped from 1.8 in 2011 to 11.3 in 2013 and the number of agents per 10,000 adults rose from 0.7 to 10.2 over the same period (Figure 4.4) .[66]

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[64] PFIP. "Fiji on Target to Reach Unbanked Population." *Press Release.* 2011. http://www.pfip.org/media-centre/press-releases/2011/fiji-on-target-to-reach-unbanked-population.html
[65] Subramanian, Ramanathan. 2012. *Mobile Money Attitudes and Perception Omnibus Survey.*
http://www.pfip.org/resources/presentations?&page=3.
[66] Reserve Bank of Fiji. October 2014. The Fiji Economy. http://www.rbf.gov.fj/getattachment/Home/Chartbook-tables-Oct14.pdf.aspx

Figure 4.4: Number of cash-in/cash-out access points and agents per 10,000 adults

Source: Reserve Bank of Fiji
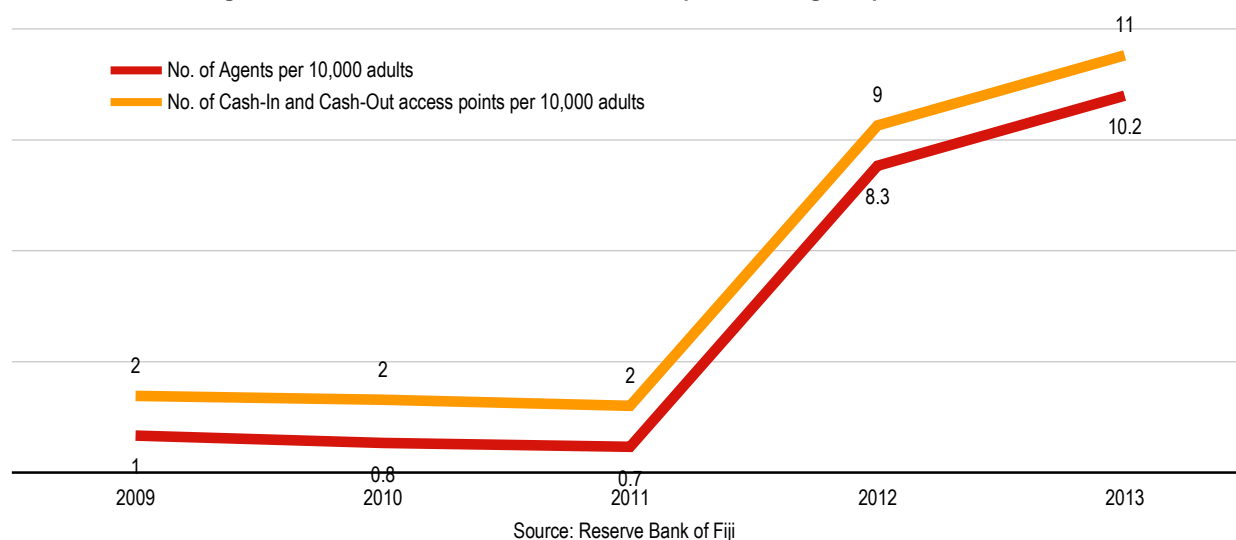
4.6.2 Samoa

Digicel launched its mobile money product in Samoa in 2011. Take-up has been slow and it is estimated that only around 1-2% of subscribers are using the service. The main barrier appears to be a lack of confidence in mobile wallets compared to cash. Mobile banking services from ANZ, NBS and Westpac can also be accessed from mobile phones, further reducing the need to use a mobile operator's mobile money services. According to the Central Bank of Samoa, during the 2011-2012 financial year, SAT$0.8 million was created in mobile money accounts served by 57 cash-in/out agents.[67]

4.6.3 Solomon Islands

According to the 2011 People's Survey in the Solomon Islands, only a quarter of the population had a bank account.[68] Financial inclusion is therefore a key development priority for the Solomon Islands. Given the rapid recent growth in cell phones in the country, they hold tremendous potential for reducing the unbanked. Banking using mobile phones was launched in 2013 by three financial institutions providing services over the network of Solomon Telekom (Westpac "banking on the go", ANZ "goMoney" and BSP "Branchless Banking"). The services use Unstructured Supplementary Services Data (USSD), which works on 99% of handsets and do not require Internet access.[69] It allows clients to use their cell phones to transfer money to bank accounts, check balances, pay bills and top up their prepaid balances.

The impact of mobile money has been immediate since launch in 2013. According to the Central Bank of the Solomon Islands, 15,127 branchless banking accounts were opened in the country in 2013 (Table)[70] This accounted for almost half of all new bank accounts that year helping towards the financial inclusion goal of 70,000 new bank accounts between 2011 and 2015.

Table 4.9: Solomon Islands, Number of new accounts at commercial banks

	2011	2012	2013
Total new deposit accounts opened at bank branches	8,235	21,896	16,788
Total new accounts opened using branchless banking channels	0	0	15,127
Total new accounts opened each year	8,235	21,896	31,915
Total year to date	8,235	30,131	62,046
Source: Central Bank of Solomon Islands.			

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[67] Central Bank of Samoa. *2011-12 Annual Report*. http://www.cbs.gov.ws/index.php/media/publications/annual-reports/
[68] Regional Assistance Mission to Solomon Islands (RAMSI). 2012. *People's Survey 2011*.http://www.ramsi.org/wp-content/uploads/2014/07/People-Survey-2011-summary-FINAL-WEB-90fc70c7-e1f8-4b04-8d07-c1cbee3f30d9-0.pdf
[69] https://www.clickatell.com/clickatell-products/enterprise-products/ussd/
[70] Central Bank of the Solomon Islands. *Annual Report 2013*.

4.6.4   Tonga

Tonga could benefit from greater financial inclusion with around 60% of the population not having bank accounts in 2011.[71] Digicel launched its Mobile Money service in January 2011. It supports transfer of money including remittances from overseas as well as bill payment. Digicel collaborates with the Development Bank of Tonga for processing cash deposits and retrievals. In May 2012 Digicel launched its "Beep and Go" service based on NFC technology. This allows users to simply swipe their phone across a POS terminal to pay. It was available at some 50 merchants in Nuku'alofa at launch with plans to extend the service. Around 10% of Digicel's customer base was using the mobile money platform in November 2014.

4.6.5   Vanuatu

According to the Alliance for Financial Inclusion, only around a third of the population has a bank account in Vanuatu.[72] Digicel has launched mobile banking services in partnership with the National Bank of Vanuatu (NBV). The "Isi Mani" service is linked to the user's NBV account from which online banking services are available. Isi Mani has had modest uptake mainly because it has not been successful in obtaining permission to offer international remittance transfers. In 2014, Digicel further partnered with ANZ Vanuatu for the utilisation of Digicel network to enable the banking service, known as the "*goMoney*". This service enables users to view their ANZ account balance, transfer of money and do purchases through the mobile phone. In addition to branchless banking/mobile money deployments, Vanuatu has taken other steps to deepen financial inclusion with the support of the Pacific Financial Inclusion Programme.[73]

4.6.6   International Remittances

The use of mobile money to transfer money from abroad is considerably cheaper compared to banks or conventional money transfer operators (MTO). This is important in the region where there are a large number of citizens living abroad. Digicel has partnered with KlickEx Pacific to enable transfers to mobile phone users in Fiji, Samoa and Tonga. The price is NZ$3 to transfer NZ$200 to any of these countries. This is much lower compared to the average cost of using banks and other money transfer operators (Table). Remittance fees are 85% cheaper with mobile money services compared to the average for banks and 60-65% cheaper compared to mobile transfer averages. Mobile money transfers are not possible in Solomon Islands or Vanuatu where remittances make up a much smaller portion of GDP and where average remittance fees are much higher than the other three countries. According to the World Bank, almost US$500 million was remitted to the region in 2014 or an average of 9% of GDP. Assuming that the transfers were conducted in increments of NZ$200 (US$166) the total cost for the remittances based on average bank/MTO fees would be US$34 million compared to US$7 million for mobile money. Using only mobile money would result in a remittance fee saving of US$ 26 million.[74]

Table 4.10: Cost of remittances

	Fiji	Samoa	Solomon Islands	Tonga	Vanuatu
Migrant remittance inflows (US$ million) (2014 estimate)	262	138	16	61	22
Remittances as a share of GDP in 2013 (%)	6.4%	23.8%	1.5%	12.8%	2.6%
Cost of sending NZ$200:					
Bank average	20.50	20.50	19.56	20.00	20.10
Money Transfer Operator	8.49	7.53	26.00	7.50	16.75
Mobile Money	3.00 (KlickEx) 8.00 (M-Paisa)	3.00 (KlickEx)	NA	3.00 (KlickEx)	NA
Note: NA = Not available Source: Adapted from World Bank and SendMoneyPacific.					

4.6.7   Summary

Several impacts may be observed in the future:

- One would expect more regular and lower denomination transfers with lower transaction cost and more convenience for cash out and cash in.
- Impact of increase in access to formal financial services through mobile money linked to bank accounts.
- Increase of money flow efficiency through domestic mobile money transfers.

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[71] "Digicel and VeriFone combine to launch unique Mobile Wallet payments service in Tonga." *Press Release*. 14 May 2012. http://www.digicelpacific.com/en/media-center/press-releases/digicel-verifone-combine-to-launch-unique-mobile-wallet-payment-service
[72] Sanford, Caitlin, Lanna Lome-Ieremia, and Sameer Chand. 2013. "New Financial Inclusion Data from the Pacific Islands." *Alliance for Financial Inclusion (AFI)*, October 23. http://www.afi-global.org/blog/2013/10/24/new-financial-inclusion-data-pacific-islands.
[73] See "Highlights of financial inclusion achievements in Vanuatu" at: http://www.pfip.org/about/where-we-work-1/vanuatu/
[74] See: "Migration & Remittances Data" at: http://go.worldbank.org/092X1CHHD0

While a critical mass of mobile money users may not yet have been reached, it would still be important to plan impact assessments and collect baseline data systematically.

4.7   Observations

Most of the countries have devoted resources to connecting government agencies but less so to schools and health. Four of the five countries have deployed government networks with development assistance. These mainly connect government agencies in the capital—generally using fibre optic—with wireless access in provincial capitals. Schools and health agencies, particularly those outside urban areas, suffer from poor connectivity.

Few citizen-oriented services are delivered electronically. Most governments are focused on internal processes and the use of ICTs for citizen and business services has not been a priority. There are some examples of mobile services particularly text alerts for severe weather, ferry schedules, voting locations and status of pension fund accounts.

Important sectors such as tourism and remittances, which contribute significantly to GDP, are making use of ICTs. All of the countries have a tourist web sites marketing a range of accommodations, many operated by local SMEs. This can increase exposure to these lodgings, particularly where they may not be advertised on global hotel search sites. Mobile operators are also benefitting from tourists, almost a million in 2013, bringing their phones and buying local SIM cards or using roaming services. All of the countries now have mobile money or banking services. Mobile banking has expanded financial inclusion in the Solomon Islands where around half of new bank accounts opened in 2013 were branchless. Overseas money transfer costs are significantly less using mobile money compared to other alternatives. This facility is available in Fiji, Samoa and Tonga but not Solomon Islands or Vanuatu.

There are few studies on impacts of ICT in the region. Apart from Fiji, there are no quantitative and methodological rigorous studies highlighting the impact of using ICTs in different sectors in the countries studied. One reason is that improvement in connectivity and use of ICTs is relatively recent. Another reason is that there are few relevant applications affecting citizens at a significant scale. However, this should be qualified by the fact that some users will quickly grasp how to use ICTs, particularly mobile phones, to reduce information disparities and generate income. Examples of impact studies from other countries suggest they could be replicated in the region if resources were devoted to this area, particularly collecting necessary data and carrying out surveys. Support for carrying out impact surveys should be considered in future development assistance projects.

Limited financial and human capacity is a major impediment to use of ICT across different sectors. Most government officials expressed interest in the use of ICTs in their sector to develop innovative and impactful applications. However, they often lacked budget--a number of ministries do not have funding for a web site--and technical expertise--most ministries had just a few IT experts if any. Many also cited the high cost of delivering mobile applications as an impediment. Another challenge is reliance on overseas developers who do not understand the local context or leave without transferring the needed skills.

Development assistance for ICT in sectors outside government is scarce and relevant impact monitoring infrequent. Apart from the construction of government networks, there have been few significant development projects incorporating ICTs in different sectors. The main exception is support for the SchoolNet program in Samoa. Most other interventions have typically been small projects that rarely scale up beyond the pilot stage. Development agencies generally do not incorporate impact assessments that concretely measure benefits to targeted groups into the project.

5 Mobile Ecosystem and Integration

The region's widespread use of wireless networks for voice and Internet service compared to fixed technologies makes a well-functioning mobile ecosystem essential for long term growth and sustainability. A healthy mobile ecosystem enables cost effectiveness for creating applications or what is referred to as mobile integration. This chapter identifies the components that make up the mobile ecosystem and the performance of each of the countries. It then examines how better mobile integration in the region could boost the development of mobile applications and services.

5.1   Mobile Ecosystem

The health of the ICT ecosystem can be assessed through examination of performance across five categories: infrastructure, access, usage, affordability and competition. Various implications follow based on the results of the assessment of the mobile ecosystem. For example, if mobile prices are too high the cause is often insufficient competition. Competitive bottlenecks include high market concentration, monopoly control over essential facilities and above cost, mobile termination rates (MTRs).[75] Retail prices could be reduced by safeguarding fair competition through lowering MTRs to the cost of an efficient operator. The consequence would be higher usage and greater mobile penetration because more people could then afford to use mobile phones.

The ecosystem influenced by the market structure resulting from the laws of a country and market conduct is the result of regulatory intervention or lack thereof. An example of regulatory intervention is the prescription of cost based termination rates by the regulator of a country. The drafting of a new telecommunications law is an example of an intervention addressing failure in the structure of the market (i.e., number of licensees) and institutional arrangements (such as the regulatory institutions whose purpose it is to monitor the delivery of services). A healthy mobile ecosystem means that mobiles can be deployed more effectively for social and economic development.

Figure 5.1: Mobile Ecosystem
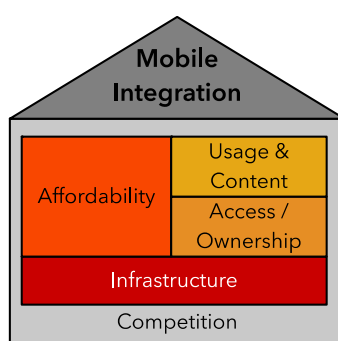
This section conceptualises the mobile ecosystem as an interconnected, multilayered ecosystem of communications networks, services, applications, and users.[76] An ecosystem approach enables the identification of linkages between different elements in the system, and reveals how the effective functioning of one part of the system is dependent on the

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[75] MTRs are the wholesale rates that mobile operators charge each other to terminate calls from another network.
[76] Kim, Y. Kelly, T. Raja, S. 2010. Building Broadband: Strategies for the Developing World, available at http://www.infodev.org/infodev-files/resource/InfodevDocuments_1045.pdf

successful functioning of other parts.[77] The environment created by each element of the ecosystem and the relationships between these elements, determines how conducive the overall environment is to investment that is needed to drive the growth of the sector. It explains whether people have access to, and can afford, mobile technology and supports the process of determining what interventions are likely to succeed, given the composition of the ecosystem. The mobile ecosystem is captured by five components or building blocks:

- Affordability: In the ecosystem framework (Figure), affordability carries more weight than the other components because it is a key indicator of the level of competition in the sector. The price of mobile voice and data services are the starting point for any assessment of the health of a country's ecosystem. If mobile voice and data prices are high in a country in comparison to other nations that it is being benchmarked to, then the causes of high prices need to be assessed. In most countries, the mobile voice market is maturing and prices have been in steady decline. In comparison, mobile data is a rapidly growing market and prices are far more volatile. In countries where both voice and data prices are high, there are usually significant obstacles to competition.
- Competition: The competition component impacts - and is impacted by - the other components since it is at the heart of any ecosystem outcome. Fair competition in the sector leads to reasonable returns on investment for operators and affordable prices for end users. Competition is evaluated by a concentration measure and wholesale prices such as mobile termination rates.[78]
- Infrastructure: Mobile networks require significant investment and fair competition provides an incentive for private sector operators to invest in infrastructure. Both the extent and quality of infrastructure available in a country is of importance. The degree of infrastructure can be measured by indicators such as network coverage, which captures the proportion of the population with access to a mobile signal. Indicators such as broadband speeds can measure the quality of infrastructure.
- Access and ownership: The category of access and ownership can be defined by a set of indicators about ICT subscriptions and ownership of ICT devices. Access and ownership is linked to affordability because lower prices means greater access.
- Usage and content: Usage measures the consumption of mobile services such as voice and Internet. Content is a difficult indicator to assess because of the global nature of the Internet: content is consumed from around the world. But local content remains a critical indicator of usage. Here, local content is measured by the number of domains that are purchased in a country and the number of Facebook users.

The five building blocks are combined to provide insight into the potential application of mobile to development. For example, is there an opportunity in the country to deliver services and to receive payment via mobile money? Is smartphone penetration sufficiently advanced for sophisticated mobile applications? Or should the focus remain on basic forms of communication such as SMS or USSD that target basic and feature phones? [79] This report calls this Mobile Integration and is the outcome of the five building blocks. Mobile Integration sits on top of the pyramid and the possibilities for integrating mobile into programs are dependent upon the signals given by each of the previous building blocks.

5.2   Affordability

The affordability component measures the cost of using mobile voice and data services. Given the complexity of mobile charges (i.e., on net calls, off net calls, peak and off peak, text messages) a price basket normalises different mobile prices as a way to compare countries and to determine if prices are affordable. The Organization for Economic Co-operation and Development (OECD) has developed a price benchmarking basket methodology. The price baskets used here are based on the latest OECD basket definition for prepaid users and include 40 calls and 60 SMS (OECD 2010). The basket definition specifies the duration and distribution of calls across time and across networks with local currency prices converted to US dollars using current exchange rates.

Although prices have dropped since the introduction of competition, mobile prepaid voice is still relatively expensive in the region. The OECD basket costs between US$11 (Tonga TCC) to US$ 29 (Digicel Vanuatu). Two dozen African countries are cheaper than the least expensive price of the five countries in this study.[80] The same basket only costs US$ 1.45 in Kenya and US$2.25 in Ghana. Compared to Small Island Developing States (SIDS) in African countries for which price baskets are available, most of the South Pacific is still expensive: the basket in Mauritius is US$4 and in three other African SIDS the price is $14-15; only Cape Verde has a high basket price at US$27 (simular to Vanuatu).

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[77] Research ICT Africa, 2014. How Ordinary People Got Connected Despite the Connected People, available at
https://itunes.apple.com/ca/book/how-ordinary-people-got-connected/id926120458?mt=11
[78] Mobile Termination Rates (MTRs) are wholesale prices (per minute) that operators charge each other to terminate calls on their network.
[79] Basic phones and feature phones are aimed at users who want a low price phone that does not have all the options on a higher priced phone. Basic phones do not include high-speed Internet access and feature phones do not include all of the capability of a smartphone.
[80] http://www.researchictafrica.net/prices/Fair_Mobile_PrePaid.php

Figure 5.2: OECD mobile monthly price basket, November 2014, US$

Tonga TTC	11
Tonga Digicel	14
Fiji Digicel	15
Solomon Islands Our Telekom	17
Fiji Vodafone	19
Samoa BlueSky	20
Samoa Digicel	21
Solomon Islands Bemobile	21
Vanuatu Telecom	27
Vanuatu Digicel	29
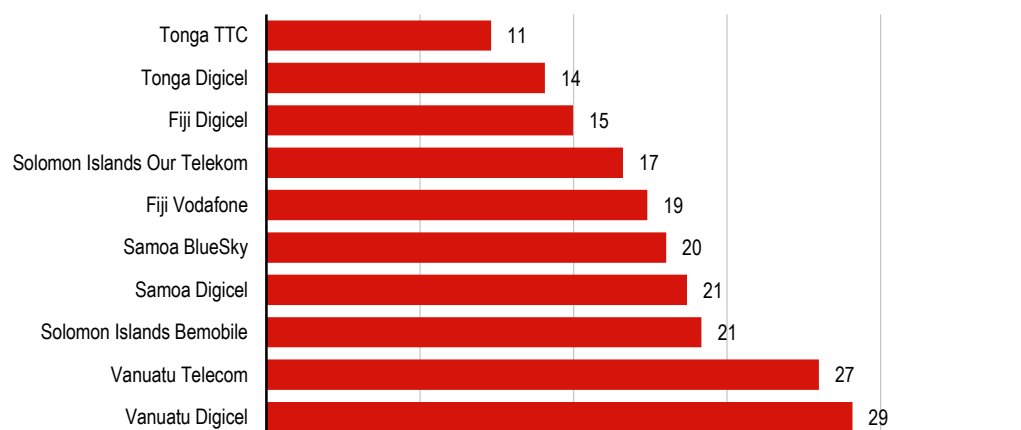
Note: Basket consists of 40 calls and 60 SMS.
Source: Operator web sites.

Like the mobile price basket, the mobile broadband price basket shows comparisons within and between countries for mobile broadband services. The basket consists of a prepaid data package of 1 GB (i.e. no long term contracts or discounts), valid for at least 30 days. If no operator provides a 1 GB bundle, smaller data packages are collated to make up 1 GB. The cost of the modem is excluded. This methodology is consistent with the ITU basket published in December 2014.[81]

Fiji has by far the lowest prices. Reasons include considerable capacity on the Southern Cross cable, large market size and widespread coverage of mobile broadband. 1 GB at Digicel Vanuatu costs more than 10 times what it costs at Digicel Fiji.

There are remarkable price differences between Tonga and Vanuatu. Although both countries have a submarine cable linking them to Fiji, the wholesale cost per Mbit/s between Tonga and Fiji is around US$450 on average while the costs between Vanuatu and Fiji are only US$330. The wholesale price for international connectivity are thus lower in Vanuatu compared to Tonga and retail prices are still six times more expensive for Digicel Vanuatu compared to Digicel Tonga. The likely explanation for such stark differences is insufficient competition in Vanuatu. Ineffective competition may lead to a suboptimal utilisation and thus high unit costs compared to a higher utilisation. The hypothesis of insufficient competition will be explored in more detail in subsequent sections.

Figure 5.3: Price of 1GB mobile prepaid broadband, November 2014, US$

Fiji Vodafone	4
Fiji Digicel	6
Tonga TTC	13
Tonga Digicel	13
Samoa Digicel	17
Samoa BlueSky	22
Solomon Islands Bemobile	58
Vanuatu Telecom	64
Solomon Islands Our Telekom	69
Vanuatu Digicel	79
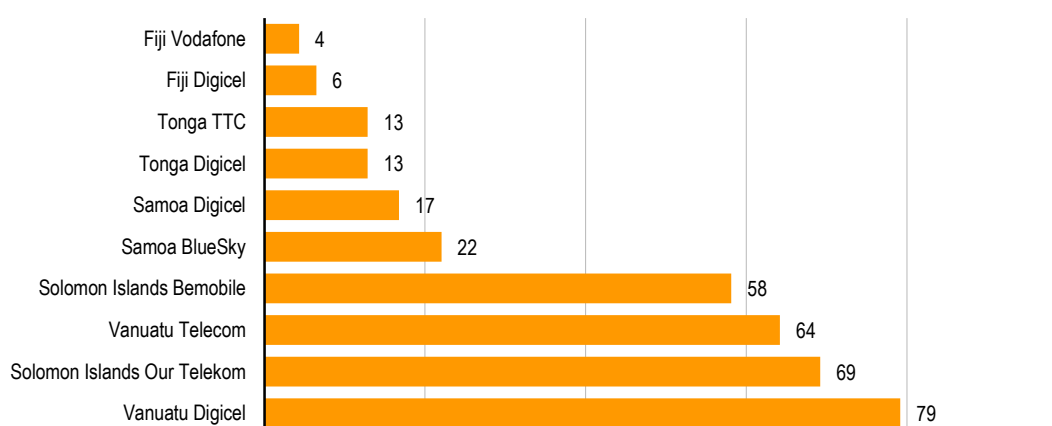
Source: Operator web sites.

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[81] http://www.itu.int/en/ITU-D/Statistics/Documents/publications/mis2014/MIS2014_without_Annex_4.pdf

Other factors may include higher cost for domestic data transmission due to differences in network coverage and spectrum availability. This high cost would show in annual financial reports. However, neither TVL nor Digital publish annual financial reports or report on any financial indicators so that this cannot be established.

5.2.1   Access

The access category consists of a set of mobile voice and broadband penetration indicators. Affordability, competition and the level of coverage all influence access.

Groups such as the GSMA and ITU, and the operators themselves generally report access estimates based on the number of active SIM cards rather than the number of actual owners of a mobile phone. The problem with subscription data is that they can include multiple SIM cards (including some that may no longer be used) and subscriptions for "machines" such as ATMS. Therefore penetration figures are misleading and can exceed 100 per cent of the population. A more telling way of measuring access is to use nationally representative household surveys in order to establish unique users. However, these surveys usually only capture mobile and Internet access at the household level and not for individuals. Unfortunately, dedicated ICT household surveys are not carried out in the region and therefore the most common indicator of access is the number of active SIM cards rather than the preferred indicator, the number of individuals owning a mobile phone.

Table 5.1: Mobile subscriptions

	Active SIM cards in 2013	Active SIM per 100 Inhabitants in 2013	Active SIM cards Nov 2014	Active SIM per 100 Inhabitants
Fiji	891,004	101.13	1,254,509	142.4
Samoa	167,400	88.6	237,411	124.7
Solomon Islands	323,105	57.57	340,192	60.6
Tonga	57,500	54.59	71,000	67.4
Vanuatu	150,000	59.34	170,000	67.3
	WDI 2014 (Samoa 2012 ITU figure)		PRIF Mission	

Source: 2013 from World Bank and 2014 from data provided during PRIF mission.

Mobile broadband is relatively recent in most of the countries in the region. Fiji was the first to launch a 3G network in 2008. There was a hiatus of three years before networks were launched Samoa, Solomon Islands and Vanuatu. Tonga was the last to launch 3G in December 2013. Given Fiji's large lead, it is no surprise that it tops the region in subscriptions and penetration and Vodafone has converted all of its base stations to be 3G-capable.

Table 5.2: Broadband subscribers

	Fixed Broadband subscribers 2013	Fixed Broadband user per 100	ADSL subscribers Nov 2014	Mobile Broadband subscriptions Q2 2014
Fiji	10,535	1.20	15,000 (ADSL and leased line customers	300,000
Samoa	200	0.11		
Solomon Islands	1,884	0.34	1,350.00	58,000
Tonga	1,700	1.61	800 (400 households)	
Vanuatu	300	0.12		
Sources	WDI 2014		PRIF mission	Fiji: ATH Solomon Islands: GSMA

It is clear from the data that fixed broadband is mostly a business access facility and that mobile is the primary form of Internet access in the Pacific. Those with fixed broadband access are very likely to use mobile broadband as well. Fiji and Tonga have the highest fixed broadband penetration. In Tonga, however, fixed broadband seems to be declining. TCC stated they only had about 800 ADSL customers in November 2014, of which half were business users, compared to the WDI figure for 2013 of 1,700 fixed broadband subscribers.

5.2.2   Usage and Content

Usage and content reflect the degree to which ICT networks are used and the availability of local content. Usage can be measured in different ways such as minutes of voice usage, text messages sent and data traffic generated. These key

usage performance indicators published by many operators around the world, were not available for any of the telecommunications operators in the region. Therefore usage could not be measured.

It is difficult to measure the amount of local content available to users. Ideally, this would include the number of local Internet sites or the number of pages with local content. However, these statistics are difficult to obtain. Instead, three other indicators are used as proxies for content:

- Top-level country domains: This measures the number of websites that are using the top-level domain of a country, such as .fj for Fiji and .ws for Samoa. One drawback is that popular web sites in the country could be using other domain names (e.g., .com). On the other hand, this indicator would likely give some indication of availability of government content since most public institutions use the country's domain name for websites.
- Secure Internet servers: This measures Internet sites that use encrypted technology and generally oriented towards financial and e-commerce applications.
- Facebook users: The penetration of Facebook users reflects both usage and user content driven through its social media platform.

The low number of top-level domains in Fiji is surprising, especially because the figure for Samoa is very high. This may have several causes. Local companies may prefer different domains instead of using the country domain such as .COM or some other domain name. .WS may also be popular for some reason (like .TV). There also maybe factors linked to the issuing of top-level domain names such as restrictive or costly registration.

Table 5.3: Content indicators

	Domains	Domains per 10,000 inhabitants	Facebook Users Nov 2013	Facebook Users /100 inhabitants, Nov 2013
Fiji	83	0.94	250,000	28.4%
Samoa	15,526	815.56	40,000	21.0%
Solomon Islands	25	0.45	30,000	5.3%
Tonga	955	90.67	30,000	28.5%
Vanuatu	184	7.28	15,000	5.9%
Sources	Webhosting.info, available at http://www.webhosting.info/domains/country_stats/		Facebook Ad engine (https://www.facebook.com/advertising) accessed Jan 2015	

Vanuatu ranks first number of secure servers, which can be attributed to the favourable tax regime for online business, given that income for individuals and businesses are not taxed. The decline in secure servers may be an indication of connectivity issues that persisted before Vanuatu was connected with a submarine cable to Fiji. Secure servers are useful for measuring the extent of ICT adoption by financial services and presence of e-commerce.

Figure 5.4: Secure Internet servers (per 1 million people)

Source: World Bank[82]

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[82] http://data.worldbank.org/indicator/IT.NET.SECR.P6
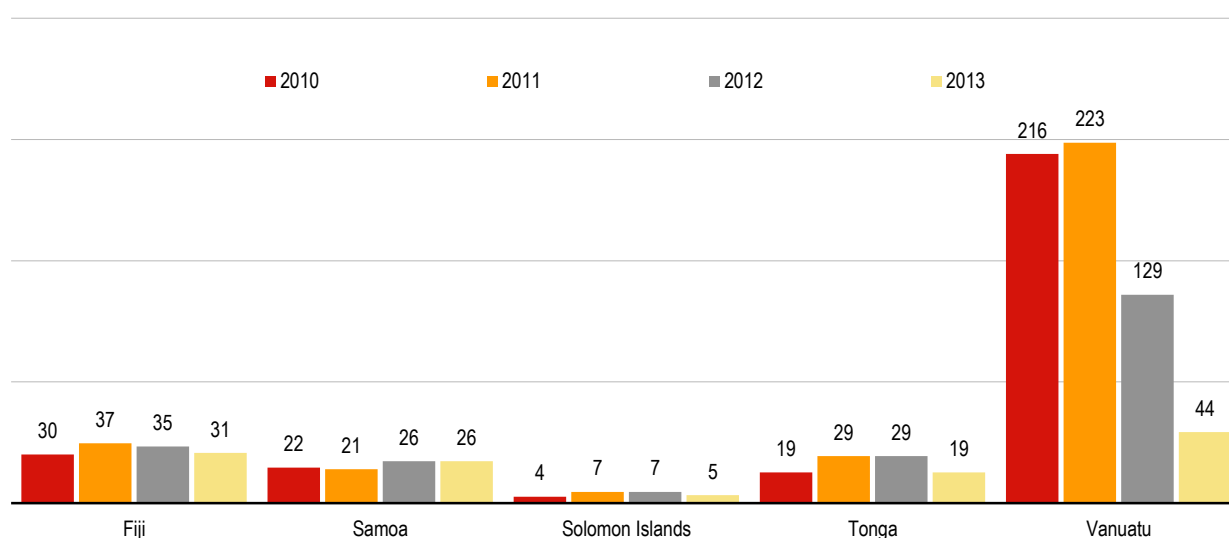
Fiji and Tonga have the highest number of Facebook users per 100 people followed by Samoa. Facebook use in Vanuatu and the Solomon Islands is very low at six per cent of the population. It is worth noting that more than 80% of Facebook users in the region use their mobiles to access the social network. The ranking of Facebook penetration is linked to mobile broadband prices with the highest prices matching the lowest user penetration.

5.2.3   Infrastructure

The Infrastructure component captures the degree of deployment of backbone and access networks and their quality. Indicators such as international bandwidth, population coverage with 2G/3G, and broadband speeds are used to measure this.

All of the countries except the Solomon Islands have deployed undersea submarine cables, leading to a significant rise in international Internet bandwidth. Fiji stands out with over 5 Gbit/s of international bandwidth, substantially more than all of the other countries combined. It has been connected to undersea fibre optic cable for over a decade and has emerged as a regional hub, landing cables from Tonga and Vanuatu. In addition, controls imposed on international bandwidth pricing have resulted in more cost-oriented tariffs spurring demand.

Table 5.4: Submarine Cable KPIs

	Fiji	Samoa	Solomon Islands	Tonga	Vanuatu
Under sea cable connectivity established	Nov 2000	2009	Planned for 2016	Aug 2013	Jan 2014
Utilised capacity on undersea cable by country	5.6 Gbit/s	1.1 Gbit/s	not yet installed	520 Mbit/s	1.2 Gbit/s
Wholesale price per Mbit/s to tier 1 ISP in US$	139	NA	NA	450	350

Source: PRIF mission.

While Fiji connected to Southern Cross in 2000 and benefited from declining international bandwidth prices, Solomon Islands is still not connected, Tonga was connected in August 2013 and Vanuatu in January 2014. Samoa uses a refurbished cable based on out-dated technology (PDH) with a limited life span that connects to American Samoa.

Figure 5.5: Regulated price cap for IP transit From Fiji to US and Australia via Southern Cross in FJD
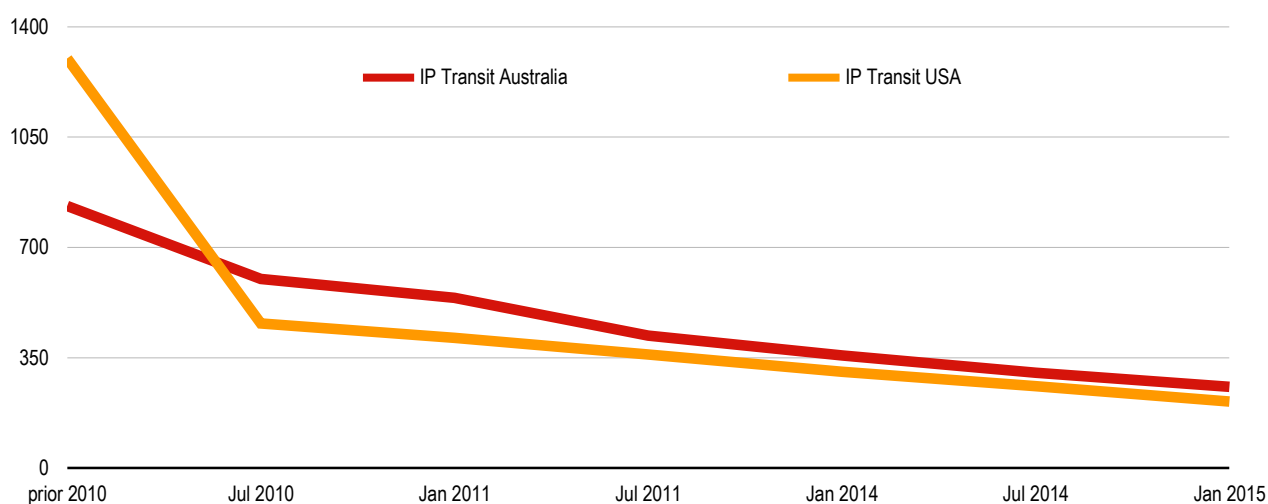
Source: Adapted from Fiji Commerce Commission

The relatively high wholesale price ($475/Mbit/s in November 2014) for access to the Tonga to Fiji undersea cable seems to be an issue of current capacity use, struggling to cover the cable's fixed cost. The wholesale price would be lower if more capacity is used. In effect, operators and in the end consumers are paying for the unused portion of the cable because the most significant cost of undersea cables is their fixed cost. The Vanuatu-Fiji cable, for example, costs about US$350 per Mbit/s at 1.1 Gbit/s utilisation yet it has similar fixed costs as Tonga Cable Limited (TCL), such as a cable maintenance ship and landing station access in Fiji.

One way that prices could be lowered without affecting TCL's financial sustainability is to offer more of the abundant unused capacity for the same price. For example, Digicel and TCC could be offered 500 Mbit/s for the same price as they are currently paying for about 200 Mbit/s (Table). Going forward, prices could be increased by 25% each year while

at the same time doubling capacity. For Digicel and TCC this means immediately lowering prices to US$208 per month per Mbit/s with a drop to US$60 within three years. The TCL price could be for Tonga-Fiji only leaving TCC and Digicel to arrange peering arrangements on Southern Cross and IP transit. TCL benefits since it gets a fixed annual increase of revenues that will allow it to raise money to build out a domestic route.

Table 5.5: Simulation to drive utilisation and reduce international bandwidth prices for Tonga

	Current	Proposed December 2014	Dec-15	Dec-16	Dec-17
Digicel (Mbit/s)	200	500	1,000	2,000	4,000
TCC	225	500	1,000	2,000	4,000
USP	100	200	200	200	200
Total Utilisation	525	1,200	2,200	4,200	8,200
Cost per Mbit/s USD	475	208	142	93	60
TCL total revenue per annum in USD	$2,992,500	$2,992,500	$3,748,800	$4,687,200	$5,859,000
Increase in revenues		0%	25%	25%	25%
Source: Authors' calculation.					

The company Ookla measures upload and download speeds by operator for most countries in the world but had data only for Fiji among the countries studied. The figure below displays average download and upload speeds for Vodafone Fiji subscribers for the period 2011 to 2014. The benefits of 3G and 4G upgrades are obvious. The average download speed in 2014 was 12 Mbit/s for Vodafone subscribers in Fiji.

Figure 5.6: Average upload and download speeds in Kbit/s for Vodafone Fiji
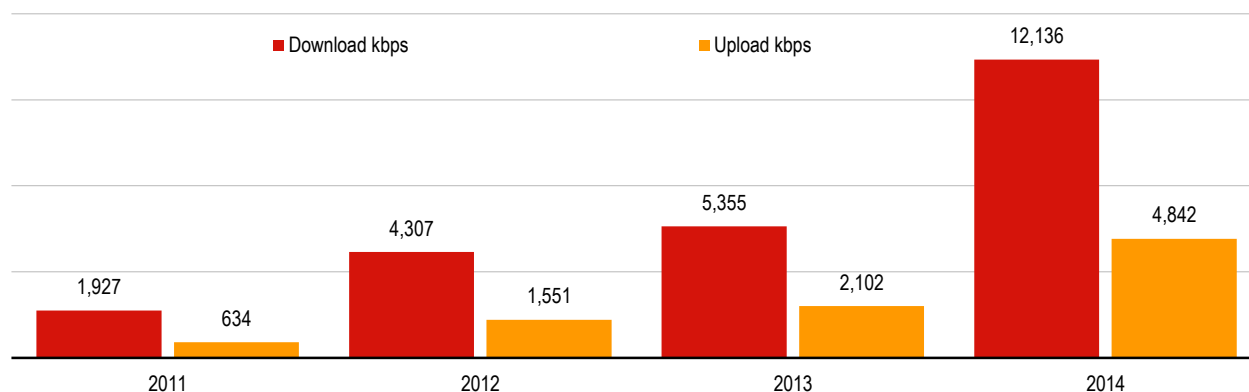
Source: Ookla

During November and December 2014, the team carried out 3G speed measurements using Ookla Speedtest[83] on an Apple iPhone 5 and 5s. Digicel's 3G network was used in Fiji, Samoa, Tonga and Vanuatu and Our Telekom for the Solomon Islands. The results (Table 5.6) are only for measurements within the capital (in the case Fiji also Nadi) and are therefore not nationally representative. Browsing and emailing speeds were between 1.2 and 3.3 Mbit/s. Apia stands out with the highest latency despite the availability of submarine cable. It is interesting that despite only relying on satellite connectivity, Honiara had the second lowest latency, reflecting the improvement in quality of the new generation of satellites.

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[83] http://www.speedtest.net/mobile/

Table 5.6: Mobile broadband performance

	Download Kbit/s	Upload Kbit/s	Latency ms	Measurements
Honiara	1,272	136	145	6
Apia	3,257	612	565	13
Nuku'alofa	1,875	869	268	11
Port Vila	2,214	593	122	14
Suva/ Nadi	3,152	866	207	16

Source: Tests carried out in November and December 2014 using the Ookla Speedtest app on an Apple iPhone 5 and 5s. Digicel's 3G network was used in Fiji, Samoa, Tonga and Vanuatu and Our Telekom for the Solomon Islands. The figures represent the averages over the number of measurements.

3G coverage lags in the region. Only Fiji has achieved a high level of population coverage with Vodafone making significant investment to convert its entire network to be 3G ready. In the Solomon Islands and Vanuatu, 3G still remains largely confined to main cities.

Figure 5.7: Coverage of 3G networks (% of population), 2014
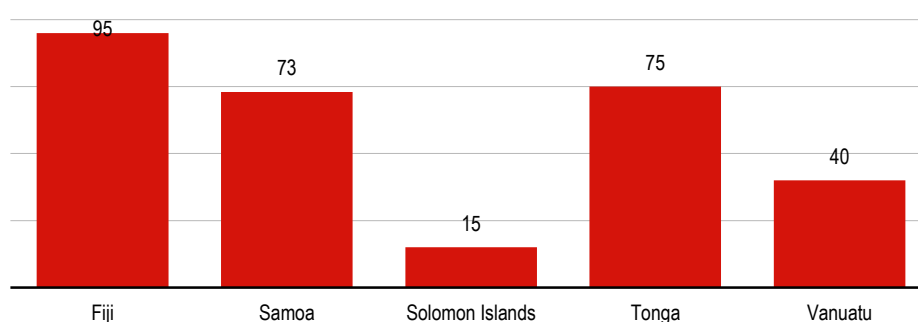
Source: Adapted from regulator and operator reports.

The lack of high-speed data infrastructure is a major concern for the Solomon Islands as well as Vanuatu. Broadband Internet is a self-reinforcing volume game. The higher the volume the lower the prices, and the lower the prices the higher the volume. In order to drive volume a country needs affordable international connectivity and wide mobile broadband coverage. This combined with low prices drive traffic. However, this requires substantial upfront investment and the break-even point may only be reached after several years. Governments in the region may want to encourage rapid allocation of the so-called "digital dividend" spectrum (700 MHz available due to conversion from analogue to digital television) since it allows wider coverage per site.

5.2.4 Competition

The competition component is at the heart of the mobile ecosystem. Effective competition in the sector leads to reasonable returns on investment for operators and affordable prices for end users. In the mobile ecosystem, competition is the framework within which the other ecosystem building blocks operate. Affordable prices are an outcome of competition between operators. Usage is related to affordable prices and, in turn, to the level of competition. Infrastructure investment is also related to competition: in the scramble to attract users, operators invest in their mobile infrastructure so that they can offer better services and better quality of service. Investment and infrastructure rollout are typically the highest in a competitive environment. The level of competition influences access to mobile services, especially when operators have exhausted growth and begin expanding coverage for both voice and data in an effort to capture more marginal subscribers.

The Herfindahl-Hirschman Index (HHI), a commonly accepted measure of market concentration, is often used to scope the competitiveness of a sector. The HHI measures industry concentration based on market share and is represented on a scale of 0 (characterised by a large number of firms with relatively equal market shares) to 10,000 (no competition).

The table below presents the results of the calculations of the HHI (based on subscription market share) for the five countries at December 2013. All five have two facilities-based mobile operators while Fiji also has a Mobile Virtual Network Operator (MVNO). The low number of operators means that market concentration will be an issue of concern in the region. Tonga is the most competitive market as measured by the HHI where the two operators are competing head to head for market share. The Solomon Islands is the second most competitive market as measured by the HHI.

Fiji, Samoa, and Vanuatu have dominant operators with over 70% market share suggesting that the other operators are struggling to keep up with the needed investment to remain competitive. The financial strength of these competitors

cannot be accessed since annual accounting statements are not publicly available and regulators do not publish relevant KPIs that would allow market analysis.

Table 5.7: Mobile market concentration, 2013

Country	Operator	Estimated mobile subscriptions	Market share %	HHI	Source
Fiji*	Vodafone	776,000	78%	6,515	Vodafone Group, prorated at 49% share [84]
	Digicel	225,000	22%		World Bank, PPI database
	Total	1,001,000	100%		
Samoa	Digicel	171,000	79%	6,701	World Bank, PPI database
	Bluesky	*45,000*	21%		Based on household market share in 2011 Census
	Total	216,000	100%		
Solomon Islands	Our	207,000	66%	5,507	Sep. 2013. Cable & Wireless Half Yearly Report.
	bmobile	*107,000*	34%		Difference between Our & reported country total
	Total	*314,000*	100%		Oct. 2013. World Bank. [85]
Vanuatu	TVL	17,000	11%	7,990	France Telecom, prorated at 50% [86]
	Digicel	133,000	89%		World Bank, PPI database
	Total	150,000	100%		
Tonga	TCC	*48,000*	50%	5,000	Per TCC web site, "over 50%" market share. [87]
	Digicel	48,000	50%		World Bank, PPI database.
	Total	*96,000*	100%		

Note: Data refer to facilities-based operators. * Fiji has licensed a Mobile Virtual Network Operator (MVNO). However, no separate statistics are available on its operations and Vodafone, from which the MVNO leases facilities, includes the MVNO wholesale subscribers in its reported figures.

Mobile Termination Rates (MTRs) are wholesale prices (per minute) that operators charge each other to terminate calls on their network. Each operator has a monopoly on terminating calls on its own network. Dominant operators may try to charge an MTR that is significantly above cost to discourage users from subscribing to other networks or to discourage calls between fixed and mobile networks. High MTRs also discourage mobile service providers from operating more efficiently. For these reasons, regulators in some jurisdictions establish a wholesale price ceiling for call termination based on a cost-based methodology. This is generally the case in the South Pacific where most of the regulators have established price ceilings for MTRs.

The average MTR in the South Pacific is US 4.7 cents per minute compared to average rates of US 1.6 cents in Europe[88] in July 2014 and US 2.1 cents in six Caribbean[89] economies where recent cost studies have been carried out. In the Solomon Islands, there are no mobile-to-mobile termination rates and instead the so-called Sender Keeps All system is used. Lower MTRs would provide new entrants more flexibility with their off-net prices in order to compete more effectively with the on-net prices of the dominant operators, result in lower retail prices for consumers and make operators more efficient.

[84] http://www.vodafone.com/content/index/investors/investor_information/financial_results.html
[85] Beschorner, Natasha. 2013. Solomon Islands - Solomon Islands Telecommunications and ICT Development Project: P113148 - Implementation Status Results Report : Sequence 05. Washington, DC: World Bank.
http://documents.worldbank.org/curated/en/2013/12/18704801/solomon-islands-solomon-islands-telecommunications-ict-development-project-p113148-implementation-status-results-report-sequence-05
[86] http://www.orange.com/en/content/download/21606/415305/version/2/file/Book+KPIs+Q4+2013+VDEF.pdf
[87] Given that the precise figure is not provided, 50% is used. http://www.tcc.to/index.php/aboutus/
[88] For the European rates see: BEREC. "Termination Rates Benchmark Snapshot (as of July 2014): Integrated Report on Mobile Termination Rates & SMS Termination Rates" at: http://berec.europa.eu/eng/document_register/subject_matter/berec/reports/4794-termination-rates-benchmark-snapshot-as-of-july-2014-integrated-report-on-mobile-termination-rates-amp-sms-termination-rates.
[89] For the Caribbean rates see: Turks and Caicos Islands Telecommunications Commission. 2014. *Review of Interconnection Rates Consultation Document.* http://www.telecommission.tc/content/root/files/20140210121640-TCI-IC-Rate-Review-ConDoc-February-7-2014-11-30.pdf.

Figure 5.8: Mobile termination rates (MTR) in US cents
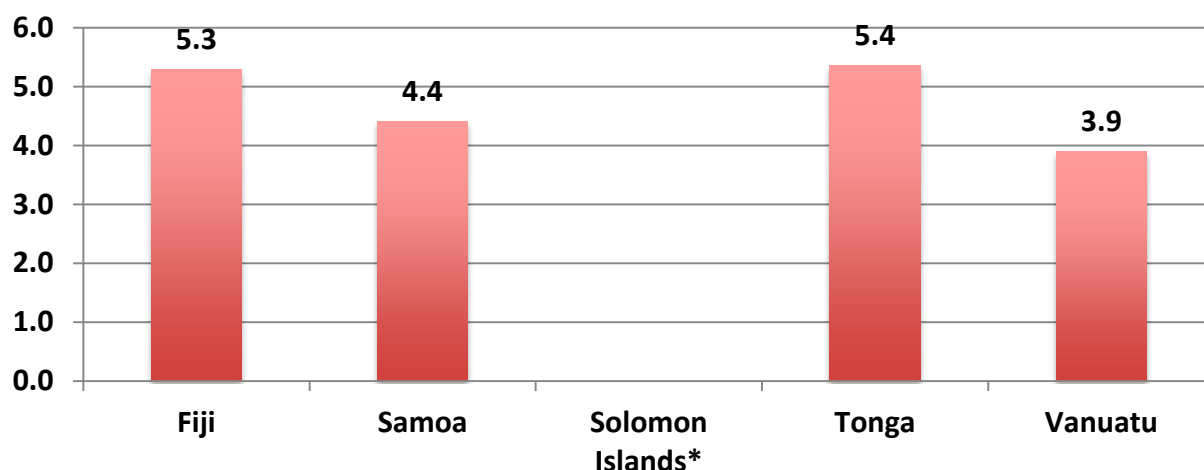
Note: * Send and Keep.
Source: Adapted from information provided by regulators.

5.2.5   Observations

Fiji performs well within the region reflected by low prices, and high access and usage. Market concentration in mobile and access to submarine cable bandwidth is offset by wholesale price controls. Fiji has the cheapest mobile broadband prices and second cheapest voice tariffs. It is amply provisioned with international bandwidth with access to undersea fibre optic cable for over a decade. Some 95% of the population lives within range of a 3G signal. A MTR reduction may stimulate further competition, though usage has moved away from voice and towards data. One reason behind the success of Fiji is an incumbent mobile operator who does not react to market entry by defensive measures but rather network upgrades and lower prices. Fiji also has the highest contribution of the communications sector to GDP. Exogenous factors such as population and income also drive its ranking. It has both the largest population generating economies of scale and the second highest per capita income enabling purchasing power for voice and broadband services.

Tonga had been held back by international bandwidth constraints now addressed via its recent connection to an undersea cable to Fiji. There is scope to reduce the cost of undersea cable access that should bring down mobile broadband prices. If wholesale data prices remain high then consideration could be given to the system in Fiji where the Commerce Commission has established caps. The falling prices would drive competition and raise the contribution of the ICT sector to GDP.

Samoa, Vanuatu and the Solomon Islands suffer from insufficient competition judging by the HHI, though Samoa is the most competitive of the three. Samoa and the Solomon Islands are in need of a modern undersea cable. Cost based termination rates and number portability may improve the situation somewhat. The entry of a financially strong operator with international economies of scale would likely change the picture in these three countries.

One challenge in analysing the mobile ecosystem is disentangling endogenous factors (e.g., competition) from exogenous ones (e.g., income, population, geography). Fiji has the region's largest population, generating significant economy of scale, which tends to lower prices as well as the longest exposure to undersea cable and mobile broadband. Tonga is the region's wealthiest nation and almost three quarters of the population lives on one island. On the other hand, the Solomon Islands and Vanuatu have the lowest incomes and populations dispersed over multiple islands. The geography results in higher costs compounded by lower purchasing power compared to the other three countries. While all markets have competition, the quality varies and there remain barriers to new entrants. These barriers should be removed to allow competition to work by expanding coverage and lowering prices as far as possible. At the same time, just because there are two competitors in the country does not mean the regulators work is limited to technical oversight. When there are clear signs the market is not functioning as expected, intervention may be required in areas such as wholesale price controls.

The other challenge in analysing the mobile ecosystem is data availability. The only mobile operator publishing publicly available annual financial reports is Vodafone Fiji. Disentangling endogenous factors from exogenous ones is very difficult in the absence of reliable performance indicators.

The mission found very limited integration of mobiles and ICTs in general in public service delivery and development projects. The next section investigates the mobile integration ecosystem to shed light on possible explanations.

5.3   Mobile Integration

Mobile and broadband facilitate public service delivery in many ways. The basis for effective use is an ecosystem that is conducive to cost effective interactions. This is an issue in the region where a lack of competition and operator complacency results in high prices for key wholesale services, inhibiting the scope for mobiles to be used to support service delivery. The key building stones for delivering information to mobiles are mobile services, mobile applications and the mobile web.

- Mobile services include bulk SMS, premium SMS, USSD and IVR[90], which can be offered to any mobile user including those with basic cellphones. These services may be integrated with mobile apps and mobile web services. Mobile services also include a SMS broadcast, a message sent to all subscribers of a network, rather than a predefined list of users as the case of bulk SMS.
- Mobile applications ("apps") are software packages that run on smartphones with an associated operating system (OS) (Symbian, Android, Apple iOS, etc.).
- Mobile web services are Internet sites accessed through the mobile phone's browser.

All three tools belong to the same ecosystem and may be combined in a suite of products or services. Farmers could, for example, request agricultural prices via premium SMS; prices can at the same time be displayed on the mobile web and within an application. These services may also be combined in a process. An IVR can be combined with a SMS request information system. A sequence of SMS or USSD interactions could identify the language and the topic and then lead to the appropriate voice content. At the end of the voice content delivery, an SMS interaction could establish whether further help is required that could then initiate a call centre call back.

Mobile integration is a sub-set of the more general mobile ecosystem and the variables that affect success include the reach and cost of the technology selected:

- Mobile outreach: Reach is dependent on the technology chosen. SMS, USSD and IVR work on almost all cell phones; mobile web services work on cell phones with Internet access and mobile applications on smartphones. Basic mobile phones are widespread and except for the Solomon Islands, 2G population coverage is in the 90% range. Interactions based on SMS and IVR are therefore ideal in terms of reach. Feature and smartphones that add the ability to communicate via data and support dedicated mobile apps that may include payment facilities are less widespread. Data interaction also requires at least 2.5G (mobile networks that have implemented technology enabling speeds faster than 2G but slower than 3G).
- Cost of interaction: Costs may be borne by the content provider or the end user. For example, the content provider could be a ministry sending agricultural price information but may also be the farmer submitting plant disease information. Relevant costs include the cost for bulk SMS, the cost for transferring mobile money, the revenue split between operators and third party aggregators for premium SMS and the revenue share kept by app stores for the sale of apps or purchases while using an app.

Generally, operating expenses for high reach services (e.g., SMS) are high compared to the low reach services (e.g., app). Sending text via an app is very inexpensive compared to bulk or premium SMS. At the same time the user's fixed expenditure is very low for the high reach technologies (e.g., basic phones are cheap compared to smartphones). Mobile services aimed at the poor are thus generally more expensive compared to catering for the rich. This is changing as feature and smartphones become cheaper.

The ideal combination of technologies and cost depend on the service to be delivered and the business model. To assess the ability of a country to deploy mobile technology for public service delivery the following information is important:

- Cost of bulk SMS
- Revenue share of premium SMS for the developer or content provider
- Cost of mobile money transactions
- Number of mobile money users
- Number of people with bank accounts
- Mobile coverage

Reach, cost and handset technology implications can be encapsulated in different stages, from simple to advanced. The figure below shows how reach and costs are linked to mobile handsets. For basic phone integration any coverage 2G or above is sufficient while feature and smartphones require at least 2.5G or 3G coverage.

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[90] SMS stands for Short Message Service, text messages up to 160 characters that can be transmitted using mobile phones. Bulk SMS are large number of text messages sent to many users. Premium SMS are text messages associated with contests such as sweepstakes or sales of services such as ringtones. USSD stands for Unstructured Supplementary Service Data, a messenger type session allowing a two-way real-time exchange of data. IVR stands for Interactive Voice Response (IVR) often used for user calling company help numbers and call centers; users interact with the system by pressing numbers on the telephone keypad (or, if voice recognition is supported, speaking) in response to prompts from a computer generated voice.

Table 5.8: Reach and costs for mobile integration

	Stage 1: Mobile voice & SMS	Stage 2: Mobile voice & data	Stage 3: Mobile apps
Reach	2G coverage Number of individuals with cell phone	2.5G-4G coverage Number of individuals with feature phone or smartphone	3G-4G coverage Number of individuals with a smartphone
Cost	Cost of SMS Revenue share for premium SMS Cost of bulk SMS Cost of mobile money	Same as Stage 1 plus cost of data	Same as Stage 2 plus cost of mobile app Revenue share for mobile app
Cell phone technology	Basic	Feature	Smartphone

Although mobile money can be used with basic phones, its full potential is only realised with more advanced phones, where it can be directly linked to other processes. There are feature phone applications with built in mobile money interactivity. However, mobile programmers are hesitant to develop applications for feature phones due to the numerous software versions and screen sizes. The falling prices for smartphones will soon mean that there will only be two types of phones on offer: basic phones and smartphones and feature phone software platforms will no longer supported.

5.3.1   Mobile outreach

Mobile penetration is close to 95% on a household level for Fiji, Samoa and Tonga and individual ownership of cell phones is estimated to be above 50% for the Solomon Islands and Vanuatu and much higher for Fiji, Samoa and Tonga. Thus the majority of the population in the region could be reached through SMS services and basic mobile money platforms.

According to operators, smartphone use is high in Tonga and Fiji and data prices low. This offers opportunities to use smartphones and tablets in business processes and interactions with customers. Agricultural extension workers could, for example, be equipped with smartphones or tablets that allow them to access relevant information in the field and collect and submit information instantaneously.

Generally, mobile apps on smartphones would only target the estimated 30% of mobile subscribers in the region (based on interviews with operators) and would thus only be a complementary channel for ministries to communicate with citizens. Once there is a high level of 3G coverage, inexpensive smartphones and low data prices, mobile apps will provide many opportunities for integration into public service delivery.

5.3.2   Interaction cost

Fiji was the only country in the region where bulk SMS is widely used. Tonga, Vanuatu, the Solomon Islands and Samoa offer SMS broadcast services. With SMS broadcast, either all users can be targeted or those users close to selected base stations. Bulk SMS sends text messages only to numbers from a specific list and organisations are able to target specific groups of subscribers. Bulk SMS could be targeted to groups as low as 50, and users could receive daily or hourly SMS updates. Operators generally were open to providing bulk SMS services. Prices in the table below are based on what an organisation would pay to send 10,000 SMS.

Table 5.9: Cost of bulk and premium SMS

		Cost for 10,000 bulk SMS in US cents per SMS	Developer revenue share for premium SMS
Fiji	Vodafone	6.5	15-30% depending on arrangement with 3rd party aggregator
	Digicel	7 off net and 3.8 on-net	NA
Samoa	Digicel	4.0	30%
	Bluesky	3.5	40%
Solomon Islands	Our Telekom	4.8	40%
	bmobile	3.4	Not available yet
Vanuatu	TVL	23	Not available yet
	Digicel	2.7	20%-40%
Tonga	TCC	Free for non-profitable causes	50%
	Digicel	Not available yet	SMS premium not developed yet, but would be 40%

Source: Based on information provided by operators.

Widespread use of mobile money in the region is limited by the cost of transactions. A domestic cash transaction via mobile money requires a cash deposit, which is free of charge, a chargeable transfer of mobile money and a chargeable withdrawal to get cash out on the other side. In Fiji, the transactions costs for the sender and recipient of a mobile money transfer exceed the amount sent for a FJD1 transaction and for a FJD6 transaction the costs as a per cent of the transfer amount are 42%; for FJD100 the transaction cost is 5% of the amount. Though the share of transaction costs drop as the transfer amount increases, this penalises lower income citizens, precisely those whom mobile money is supposed to benefit. Micro payments will not occur until prices are significantly reduced.

One factor for the high costs transaction costs are a lack of competition in the mobile money space. This is starting to change as banks also start to provide the service. The advantage of bank led mobile money is that it is mobile operator agnostic. The disadvantage is that it requires a bank account, which can be relatively expensive to maintain for the poor. The figure below compares the cost of a cash to cash transfer of US$ 1, 10 and 100 for ANZ goMoney, a bank-led mobile money implementation in the Solomon Islands to Digicel and Vodafone in Fiji. goMoney is considerably more expensive than the mobile money services from Fiji's operators. One reason that bank led mobile money is more expensive is the regulatory cost of clearing mechanisms and deposit protections.

Figure 5.9: Cost for cash to cash transfer via mobile money in % of transfer amount
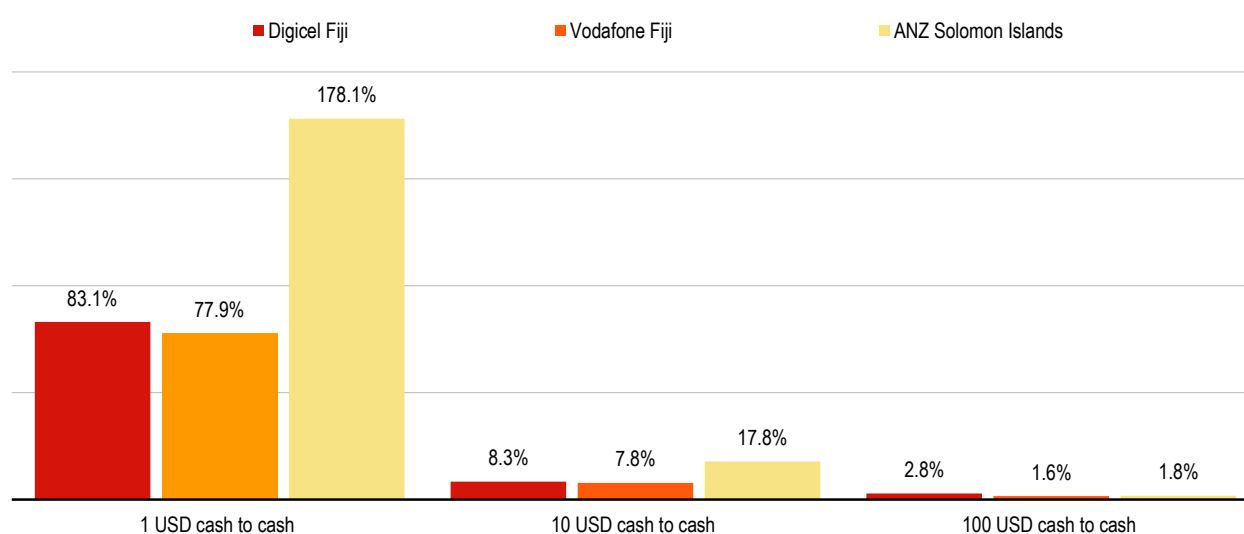
Source: Adapted from Digicel, Vodafone and ANZ.

Merchants may be reluctant to adopt mobile money due to the total cost of transactions. Mobile money needs to compete with credit cards for merchant payments. For mobile money, the customer and the merchant share the cost, the customer paying for the transfer and the merchant paying the fee for cashing out. Merchants may also pass on the cost of withdrawal onto the customer, similar to the practice with credit cards in some countries in the region. This will be another disincentive mobile money adoption. To compete with credit cards the cost of a mobile money transaction needs to be similar or lower. A successful mobile money implementation would allow merchants to directly transfer mobile money into a bank account without the need to cash out and allow customers to pay the merchant without a transaction fee or a much lower transaction fee. A customer – merchant transaction needs to be treated differently from normal money transfers.

As mentioned earlier, one area where mobile money is cost competitive is for international remittances. Digicel's service allows remittances to be sent using an online wallet, accessed through a website (www.klickexpacific.com) established with its partner, Kilickex Pacific. The cost of sending remittances using Klickex is significantly cheaper than other alternatives.

5.3.3 Observations

Mobile integration to support public service delivery in the form of bulk and premium SMS is still nascent in most of the countries. Fiji offers a full range of services and Vanuatu has several premium SMS implementations. Thus, the potential of mobiles for economic impacts is not being fully utilised.

Only Fiji has significant mobile money use for domestic transfers. In Samoa and Tonga, it is mostly used as a means for receiving funds from the diaspora in New Zealand, Australia and the UK. Even in Fiji, mobile money is too expensive to replace cash for most merchant transactions and thus likely to mostly be used for larger transactions or emergencies.

Ways to encourage wider mobile integration into the region include:

- Operators making wholesale pricing information more transparent and widely available and taking a more proactive approach to stimulating demand in the market. At the same time, regulators should monitor wholesale pricing to minimise distortions caused by significant market power.
- Development partners incorporating mobile integration products in their assistance projects.
- Specialised training courses for ministries and government agencies on how to deploy mobiles and mobile broadband to improve service delivery.
- Greater support for development of the mobile application development community through training, industry collaboration and assistance with innovation enablers such as incubation centres and venture capital.

6 Conclusions

Liberalisation of the telecommunications sector, strongly supported by development partners, has driven competition in the South Pacific leading to increased network rollout and falling prices. This in turn has dramatically *impacted ICT access*. Average mobile coverage in the countries studied jumped from less than half the population in 2005 to 93 per cent in 2014, a basket of mobile calls declined by a third between 2005 and 2014 and penetration of cell phones in households rose from 49% in 2007 to 93% in 2014.

Recent connectivity to submarine cables has resulted in an explosion of capacity. International Internet bandwidth jumped over 1,500% between 2007 and 2014 rising from less than 100 Mbit/s to over 1 Gbit/s (excluding Fiji which had already connected to submarine cable in 2000). The region is still coming to grips with the novelty of abundant bandwidth, enhanced coverage and cheaper tariffs. There is considerable scope for widening Internet take-up across the South Pacific and boosting mobile penetration in the Solomon Islands and Vanuatu.

While fixed and mobile voice had some *indirect economic impact*, the bulk of impact is likely to stem from mobile broadband. Fixed broadband is a niche product for most countries in the region and the vast majority of Internet users access the Internet via mobile phone or a laptop and desktop using dongles. The upgrade to 3G is still quite new in the South Pacific and Fiji is the only country with commercial 4G mobility services. In the Solomon Islands, a large number of rural base stations only support voice services. This means that the real impact from mobile broadband is only beginning to happen and will only be measurable several years into the future.

Direct economic impacts are noticeable with the size and contribution of the communications sector usually increasing following the introduction of competition. In general, the share of the communications sector in the countries is on par with OECD nations, influenced by the greater role that communications plays in island economies.

In terms of *impacts in different sectors*, most of the countries have devoted resources to connecting government agencies but less so to schools and health. Four of the five countries have deployed government networks with development assistance. Few citizen-oriented services are delivered electronically. Most governments are focused on internal processes and the use of ICTs for citizen and business services has not been a priority. There are some examples of mobile services such as text alerts for severe weather, ferry schedules, voting locations and status of pension fund accounts.

Important sectors such as tourism and remittances, which contribute significantly to GDP, are making use of ICTs. All of the countries have a tourist web sites marketing a range of accommodations, increasing exposure for locally run establishments. Mobile operators are also benefitting from tourists, almost a million in 2013, bringing their phones and buying local SIM cards or using roaming services. All of the countries now have mobile money or banking services. Mobile money has expanded financial inclusion and reduced overseas money transfer costs.

Apart from Fiji, there are no quantitative and methodological rigorous studies highlighting the impact of using ICTs in different sectors in the countries studied. One reason is that improvement in connectivity and widespread access to ICTs in the region is relatively recent. Another reason is that there are few relevant applications affecting citizens at a significant scale. This should be qualified by the fact that some users will quickly grasp how to use ICTs, particularly mobile phones, to reduce information disparities and generate income. Examples of impact studies from other countries suggest they could be replicated in the region if resources were devoted to this area, particularly collecting necessary data and carrying out surveys.

Limited financial and human capacity is a major impediment to the use of ICT across different sectors. Most government officials expressed interest in the use of ICTs in their sector to develop innovative and impactful applications. However, they often lacked budget--a number of ministries do not have funding for a web site--and technical expertise--most ministries had just a few IT experts if any. Many also cited the high cost of delivering mobile applications as an impediment. Another challenge is reliance on overseas developers who do not understand the local context or leave without transferring the needed skills.

Development assistance for ICT in sectors outside government is scarce and relevant impact monitoring infrequent. Apart from the construction of government networks, there have been few significant development projects incorporating ICTs in different sectors. The main exception is support for the SchoolNet program in Samoa. Most other interventions

have typically been small projects that rarely scale up beyond the pilot stage. Development agencies generally do not incorporate impact assessments that concretely measure benefits to targeted groups into the project.

The mobile ecosystem and integration analysis found that there are still a number of market barriers inhibiting development of income generating and public service delivery applications. These will need to be addressed if mobile services are to have wider social and economic impacts in the region.

The region has experienced a first wave of rapid growth in ICT access, particularly mobile communications. It now needs to leverage growing access by introducing a second wave of transformational initiatives primarily revolving around electronic applications and services as well as sustaining sector liberalisation. Based on the findings of this report, governments, operators and the development community might consider supporting the following interventions in order to grow and strengthen the ICT ecosystem in the South Pacific and better measure impacts. Several interventions have crosscutting elements that merit strengthening with assistance from development partners. These mainly revolve around capacity development and include: i) reinforcing institutions within government agencies involved with the regulatory and policymaking areas of ICT as well as those responsible for coordinating public service delivery; ii) developing basic digital literacy among the general public; and iii) elevating ICT skills for creation of relevant applications and services and to participate in the ICT-enabled employment sphere which is now possible with the arrival of submarine cables in the South Pacific.

Intervention Point 1: Improving data collection and monitoring the health of the ICT sector

The collection of data in the region needs to be improved to better monitor the ICT sector and measure impacts. Regulators should collect and publicly disseminate quarterly data on subscriber numbers, prices and other relevant key performance indicators and require all licensees to furnish audited financial statements. Confidentiality is often used as the reason for the dearth of supply side statistics on the ICT sector in the region. However many regulators around the world collect such statistics. The size of the markets in the South Pacific cannot be used as a reason for poor data availability. Poignantly, data is available for island economies in the east Caribbean even though some are smaller in population than the South Pacific countries.[91] The region's statistical agencies have an impressive amount of demand side ICT data compiled from censuses and household survey as well as economic data on value-added in the telecommunications sector. Ideally, this should be expanded to include quarterly national accounts data and detailed ICT surveys for households and businesses.[92] Development partners can help by providing needed assistance to regulators and national statistical offices.

Intervention Point 2: Strengthening competition

Operators in some of the countries appear to be struggling to keep up with the market leader. This is detrimental to the realising the full benefits of competition since dominant operators will take advantage of their competitor's weaknesses, sometimes through unfair practices. In addition, innovation is held back due to a lack of dynamism in the market. Competition can be enhanced by strengthening weaker operators or by market entry of a third operator that is financially strong and has access to international economies of scale. At the same time, much can be done on the regulatory front to enhance competition and offset significant market power. This includes regulation of wholesale prices (e.g., cost-based pricing for access to submarine cables and mobile termination rates) and ensuring equal and open access to bottleneck facilities. Assistance from development partners is needed in these areas given the recent introduction of competition and lack of experience with these issues among the region's regulators.

Intervention Point 3: Leveraging international connectivity

Though all of the countries except the Solomon Islands now have submarine cables, several issues need addressing. The cable that links Samoa to American Samoa is based on out-dated technology and has limited capacity. Upgrading it would extend its lifetime and increase its capacity. Another alternative is to construct a second cable to provide redundancy. Three of the countries now rely on the Southern Cross cable with Fiji as a regional hub. It might be prudent to consider a second cable for redundancy and to inject greater competition into the market. Countries could also consider greater use of submarine cables for domestic backhaul. This is particularly relevant given proximity to the sea and will be essential if advanced 3G and 4G services are to be made available through the countries. Planned submarine cables could be leveraged to add national spurs such as the planned Solomon Islands cable that will connect two other islands in addition to the capital. There is also a need to review the cost of access to submarine cables. Fiji recognises that landing stations are a key infrastructure component and regulates wholesale access to the Southern Cross cable. Another possibility is to consider innovative pricing models such as suggested in this report where a larger amount of the idle capacity is provided for a fixed yearly price that still ensures financial sustainability of the cable. Development assistance can be considered for additional cables for redundancy and national backbones extending fibre

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[91] See the "Selected Telecommunications Indicators" compiled for the five island nation members of the East Caribbean Telecommunications Authority at: http://www.ectel.int/index.php/resources/publications/selected-telecommunications-indicators
[92] This could be included as a module to existing surveys carried out by statistical agencies. The Partnership on Measuring ICT for Development provides detailed specifications on measuring ICT use by individuals and households. See: http://www.itu.int/dms_pub/itu-d/opb/ind/D-IND-ITCMEAS-2014-PDF-E.pdf

to outer islands. In addition, assistance is needed for regulatory oversight of wholesale bandwidth pricing and access and innovative strategies in regards to pricing models.

Intervention Point 4: Enhancing the mobile integration ecosystem

The potential of mobiles for economic and social impacts has not been fully utilised. Integrating mobile into income earning processes and public service delivery in the form of bulk and premium SMS is still generally nascent, partly because of high costs. The same can be said for mobile money, which in some of the countries, is mostly used as a means for receiving funds from the diaspora. Mobile money transaction costs remain high for low amounts and is thus likely to mostly be used for larger transactions or emergencies. There are several ways the mobile application economy can be stimulated. This includes encouraging operators to make wholesale mobile product pricing transparent and publicly available through greater regulatory oversight. Where relevant, development agencies should include mobile integration services in their assistance projects in order to stimulate demand. Greater competition should be injected into the mobile money market, removing constraints from offering some services and allowing banks and mobile operators to compete head on. Training should be provided to government on how deploy mobile applications to improve service delivery. Finally, the mobile application development community needs to be strengthened through a partnership between operators, academia and development partners. This includes enhancing technical training opportunities for students and organising hackathons and competitions. One example is the Caribbean where the World Bank is supporting an Entrepreneurship Program for Innovation.[93]

Intervention Point 5: Fostering e-learning and digital skills

Experiences using ICTs for education have generally been limited and not always favourable. The main use of ICTs in the region is for administrative purposes. Most of the laptop programs for students never scaled up from pilots and Samoa is the only country that has implemented e-learning on a uniform basis. Development assistance for ICT in education has been limited. Three areas need strengthening to realise the potential of ICTs for the region's schools. One is increasing school connectivity. Many rural schools lack computers let alone Internet access. Ways of connecting such schools such as using universal service funds, merit exploration. Second, computer labs and training should be established in all secondary schools so that students can develop digital literacy and for advanced students, skills leading to post-secondary education in computer science or ICT-related employment. Third, ICTs should be integrated into the learning process an area that Samoa has experience in from which the other countries could learn. Locally relevant digital educational content also needs to be developed. Countries should have ICT in education roadmaps to guide them in this process. Development partners can assist in these areas as well as supporting funding for hardware and software for schools and developing strategies for ongoing sustainability. This could include advice on policies for leveraging universal service funds and obligations for connecting all schools. This is used in a number of countries in the world and Vanuatu has recently launched a similar scheme.

Intervention Point 6: Supporting ICT enabled agricultural services

Although most ministries throughout the region collect a variety of agriculture, fishing and forestry information, little of it is disseminated electronically. Despite the higher penetration of mobiles in rural areas compared to radio or television, there is scarce mobile content available for farmers, fishers and foresters. Social media platforms such as Facebook and YouTube provide a framework for distributing digital content. Relevant content includes pricing, agricultural tips and disease information. Extension workers can be utilised to collect and share information as well as teaching how to use digital applications. Market prices and disease outbreaks are examples that can be captured on GPS-enabled smart phones and then mapped and shared. Though there have been some initiatives attempting to develop these types of applications, they have suffered from low scale, limited resources and lack of cooperation with relevant ministries. While limited development assistance has been available for some e-agriculture projects, they have been pilots and not scaled up for a variety of reasons. This is unfortunate since a significant number of the population work in the agriculture sector and would benefit from the income-generating potential of ICTs.

Intervention Point 7: Stimulating e-Health

The health sector in the region has yet to leverage widespread availability of mobile phones and increased capacity offered by submarine cables to improve health outcomes. This includes the use of alerts to notify patients of when to take medication or when they have a doctor appointment. Telemedicine is another area ripe for exploitation since the required bandwidth is now available with the new submarine cables. Development partners can assist governments to develop e- and m-health roadmaps to guide enhanced deployment of ICTs for patient care and assistance for deployment of modern health information systems and applications.

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[93] http://www.infodev.org/EPIC

Intervention Point 8: Using ICTs for public service delivery

The priority for use of ICT in government has thus far been constructing backbone networks and providing employees with connectivity. Governments should begin developing citizen and business electronic public services to leverage growing connectivity among the public. Some pilot applications could be quick to develop. Such "Quick Wins" would not only provide important experience for governments but would also generate enthusiasm among the public showing that government ICT investments can directly benefit citizens. They would also increase transparency (including the provision of Open Data) and efficiency in the government. In the medium term, development partners might consider providing assistance for deployment of e-government foundational elements such as data architectures, business process reengineering, consolidated data systems, etc. in order to establish the prerequisites for a modern public service delivery system.

Intervention Point 9: Boosting tourism impacts

Tourism is a key sector for most of the countries in the region. Although ICT is widely used in the sector, more innovative use could be made to boost impacts both for local SMEs and to increase the number of tourists. Samoa provides a good example of how tourism sites can be enhanced to include e-commerce functionality for small locally owned accommodation businesses. Samoa has also experimented with digital marketing and this holds great potential for the region, particularly to broaden the base of tourism. Smartphone apps could also be more extensively used to guide tourists and which would generate revenue for local businesses as well as mobile operators. Development partners should consider partnering with governments to enhance the role of ICTs for tourism particularly for SMEs involved in the sector.

Intervention Point 10: Making ICT access universal

Access to mobile services has radically improved in the South Pacific over the last few years. Nevertheless, there is still much work to do in connecting rural populations, particularly in Vanuatu and the Solomon Islands. Even in countries such as Fiji, Samoa and Tonga, which have achieved a high level of mobile penetration, coverage has been stuck, albeit at a high level, for the last few years. This means that there is still around 2-5 per cent of the population in those countries not covered by a mobile signal. In all of the countries except for Fiji, mobile broadband coverage remains far from ubiquitous. Though some countries have initiatives such as telecentres for expanding access and increasing digital literacy it is not clear how impactful or sustainable they are in the long run. Vanuatu's Universal Access Policy calls for 98% population coverage by 2018 although the specifics of how this will be achieved are still not fully clear. Possible ways forward to universal access include on the one hand greater mobile competition so that operators are stimulated to go to unexplored markets for new customers. A second option is the use of universal service funds to provide mobile coverage in unserved areas using lowest cost auction methods. In either case, there needs to be better monitoring of universal access, specific programs for connecting the unconnected and spreading digital literacy to not only increase uptake of the Internet but also teach about is socially beneficial and income generating uses. Development partners could consider assistance in the area of policy support for designing effective and measurable universal programs including digital literacy.

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8 Appendix

8.1 Cross Section Specifications tested

Qiang et al. (2009) used a cross-sectional endogenous growth model that was initially developed by Barro (1991) and then applied by Waverman, Meschl, and Fuss (2005) to test for the impact of mobile penetration on economic growth in developing countries. The approach by Qiang et al. (2009) uses period averages and initial values and not annual data and thus does not suffer as much from data unavailability. Qiang et al. (2009) used the following model separately for various ICTs:

$$GDP_{8006} = \alpha_0 + \alpha_1 \cdot GDP_{80} + \alpha_2 \cdot (I/Y_{8006}) + \alpha_3 \cdot TELEPEN_{8006} + \alpha_4 \cdot PRIM_{80} + \alpha_6 \cdot SSA + \alpha_7 \cdot LAC + \mu,$$

where

GDP_{8006} = Average growth rate of real GDP per capita in US$ for the period 1980–2006
GDP_{80}= Real GDP per capita in 1980
I/Y_{8006}=Average share of investment in GDP for 1980–2006
$TELEPEN_{8006}$= Average telecommunications penetration per 100 people over 1980–2006 (Number of main lines or mobile subscribers or Internet users or Broadband subscribers)
$PRIM_{80}$= Primary school enrolment rate in 1980
SSA= Dummy variable for countries in the Sub-Saharan Africa Region
LAC= Dummy variable for countries in the Latin America and Caribbean Region

A subset of countries, instead of the 120 used by Qiang et al. (2009) was included. The sub group of Small Pacific Island States would have only given 10 data points and was thus expanded to include other island states and other small states. The sample was a total of 46 countries:

- Pacific: Fiji, Samoa, Solomon Islands, Tonga, Vanuatu Kiribati Marshall Islands, Federated States of Micronesia, Tuvalu and Palau.
- Caribbean: Antigua and Barbuda, Jamaica, Bahamas, St. Kitts and Nevis, Barbados, St. Lucia, St. Vincent and the Grenadines, Dominica, Grenada and Trinidad and Tobago.
- Other island states: Maldives, Cape Verde, Mauritius, Comoros, Sao Tome and Principe, Seychelles and Timor-Leste, Dominican Republic, Haiti, Papua New Guinea, Cuba, American Samoa, French Polynesia, Guam and New Caledonia.
- Other small states: Bhutan, Lesotho, Botswana, Montenegro, Djibouti, Namibia, Equatorial Guinea, Gabon, Gambia, Swaziland and Guinea-Bissau.

Table 8.1: World Bank Country Classification

Classification	Countries	Countries
Small Pacific Island States	10	Fiji, Samoa, Kiribati, Solomon Islands, Marshall Islands, Tonga, Federated States of Micronesia, Tuvalu, Palau and Vanuatu
Pacific	26	American Samoa, Myanmar, Cambodia, Palau, China, Papua New Guinea, Fiji, Philippines, Indonesia, Samoa, Kiribati, Solomon Islands, North Korea, Thailand, Laos, Timor-Leste, Malaysia, Tonga, Marshall Islands, Tuvalu, Federated States of Micronesia, Vanuatu, Mongolia, Vietnam
Caribbean small states	13	Antigua and Barbuda, Jamaica, Bahamas, The St. Kitts and Nevis, Barbados, St. Lucia, Belize, St. Vincent and the Grenadines, Dominica, Suriname, Grenada, Trinidad and Tobago, Guyana
Other small states	18	Bhutan, Lesotho, Botswana, Maldives, Cape Verde, Mauritius, Comoros, Montenegro, Djibouti, Namibia, Equatorial Guinea, Sao Tome and Principe, Gabon, Seychelles, Gambia, Swaziland, Guinea-Bissau, Timor-Leste

However, due to Gross Fixed Capital formation not being available for Federated States of Micronesia, Haiti, Kiribati, Marshall Islands, Palau, Samoa, Seychelles, Tuvalu, American Samoa, French Polynesia, Guam and New Caledonia the sample size dropped for some model specifications to 34 countries. Jamaica was omitted due to missing GDPC. Depending on the specification the number of available observation ended up as low as 15.

The base model was specified as:

$$GDPC_{200013} = \alpha_0 + \alpha_1 * GDPC_{2000} + \alpha_2 * GFCF_{200013} + \alpha_3 * CON_{200013} + \alpha_4 * EDU_{2000} + \alpha_5 * SUB + \mu,$$

where

$GDPC_{200013}$ = Average growth rate of real GDP per capita in US$ for the period 2000–2013
$GDPC_{2000}$ = GDP per capita in 2000 (constant 2005 prices in US$)
$GFCF_{200013}$ = Average Cross Fixed Capital formation as % of GDP for 2000–20123
CON_{200013} = Average connectivity of a country based on fixed lines, mobile and internet users per 100 people for the period 2000–2013
EDU_{2000} = Secondary school enrolment rate in 2000
SUB = Years, in 2012, that an island state was connected via a submarine cable.
Island = Dummy variable for countries being island states

The model was tested in various specifications without producing insignificant results for any coefficient other than Gross Fixed Capital Formation. Periods tested included 1980-2013, 1990-2013, 2000-2013, 2009-2013. The shortest period 2009-2013 was used to exclude the global financial crisis and focus on mobile 2G to 3G network upgrades. Instead of average GDPC growth, differences between the period start and end were tested as dependent variables but did not improve the model.

The sample is too small for the heterogeneity of countries included and as a consequence the Qiang et al. (2009) model could not be replicated for this subset.

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1 Country Background

The Republic of the Fiji Islands is located in the Southern Pacific Ocean, midway between the Equator and the South Pole. There are 332 islands covering a land area of 18'333 square kilometers. Its two major islands are Vanua Levu and Viti Levu. Suva, the capital, as well as Lautoka and Nadi, the other main urban centres are located on Viti Levu. Administratively, Fiji consists of four divisions and fourteen provinces.

The 2007 Census recorded a population of 837,271, spread over about one third of the islands. Just over half the population lives in rural areas (51%). According to the 2008-09 Household Income and Expenditure Survey, the average household size was 4.7. The 2014 forecasted population is 863,900.

Figure 1.1: Map of Fiji
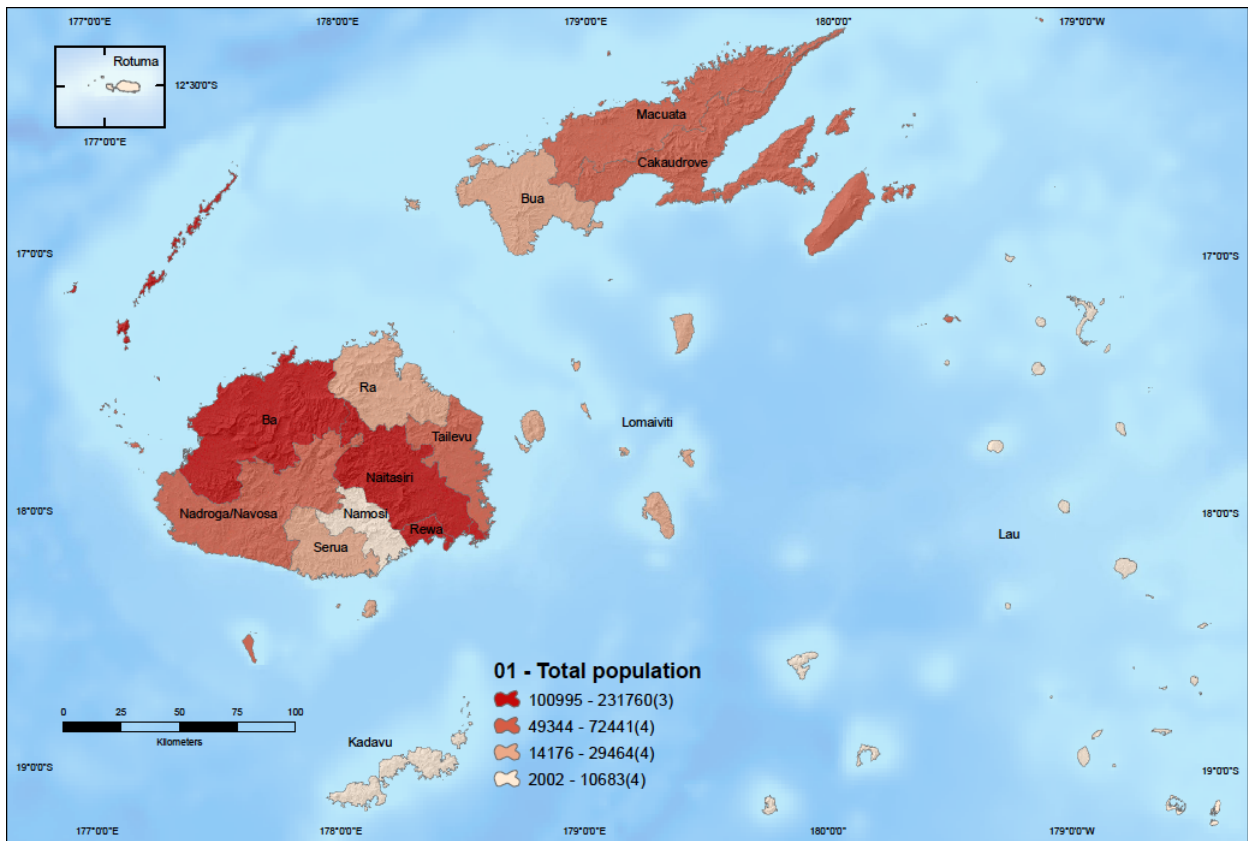
Source: Fiji Bureau of Statistics.

Fiji is one of the most industrialised Pacific Island countries. The IMF estimated Fiji's 2014 per capita Gross National Product at US$ 4,757 making it an upper-middle-income economy according to World Bank classification. Its economy is relatively diversified with agriculture estimated to account for 12 per cent of Gross Domestic Product (GDP) in 2014, a similar proportion to wholesale and retail trade and finance and insurance while manufacturing accounted for 14% (RBF 2014). Tourism is a significant source of foreign exchange with tourism earnings equivalent to a fifth of GDP in 2014.

2 ICT Market

In 1990, Fiji Post and Telecommunications (FPTL) was created to take over the government's telecommunication and postal services and granted a 25-year exclusive license for domestic telecommunications. In July 1996, FPTL split into two separate entities, *Telecom Fiji Limited* and Post Fiji Limited. *Fiji International Telecommunications (FINTEL)*, formed in December 1976, was the monopoly operator for international services. It was 51 per cent owned by the government of Fiji with the remaining shares owned by Cable and Wireless of the United Kingdom. Like Telecom Fiji, FINTEL also had a 25-year exclusivity dating from 1990. *Vodafone Fiji*, 49% owned by Vodafone of the UK with the remainder owned by the Fiji government, launched mobile services in 1994.

Amalgamated Telecommunication Holdings Limited (ATH) was created in March 1998 to consolidate government assets in the telecommunication sector before privatisation under a public sector reform program. This included 100 per cent of Telecom Fiji as well as 51 per cent of Vodafone Fiji. The partial privatisation of ATH was carried out in December 1998. The Fiji National Provident Fund (FNPF)—the country's pension system—bid F$254 (US$ 130) million for 49 per cent of ATH. FNPF paid an extra F$23 million premium for the right to acquire an additional two per cent for majority ownership that it exercised in September 1999. In March 2002, additional government shares were offered to the public and institutional investors when ATH was listed on Suva's South Pacific Stock Exchange (SPSE).

In 2007, the Government set out to remove all remaining exclusivities in the telecommunication sector. In January 2008, an agreement was signed with exclusive license holders (FINTEL for the international gateway through the Southern Cross cable, Telecom Fiji for landlines and Vodafone for mobile telephony). As a result, the mobile market was opened to competition from October 2008, international gateway in July 2009 and fixed telephone lines in February 2011. Operators are today granted 15-year unified licenses allowing them to provide any service.

The 2008 Telecommunications Promulgation is the legislation that opened the market and established an independent regulator, the Telecommunications Authority of Fiji (TAF). The TAF deals with licensing, technical regulation, spectrum, and consumer matters. The Fiji Commerce Commission is responsible for monitoring unfair trade practices and introducing price controls when necessary. Responsibility for sector policy lies with the Department of Communications reporting to the ministry designated for the ICT sector.

Irish-owned Digicel Fiji entered the mobile market in 2008 while foreign ownership in other operators has ended. ATH, who managed FINTEL on behalf of the government, consolidated its control by acquiring 49% from Cable and Wireless in 2012 and the remaining 51% from the government in 2013. Vodafone Fiji became 100% locally owned when FPNF purchased 49% from Vodafone International Holdings in 2014. The current ownership of the main operators in the telecom sector in Fiji is shown in the figure below.

Figure 2.1: Ownership of major players in Fiji's telecom sector
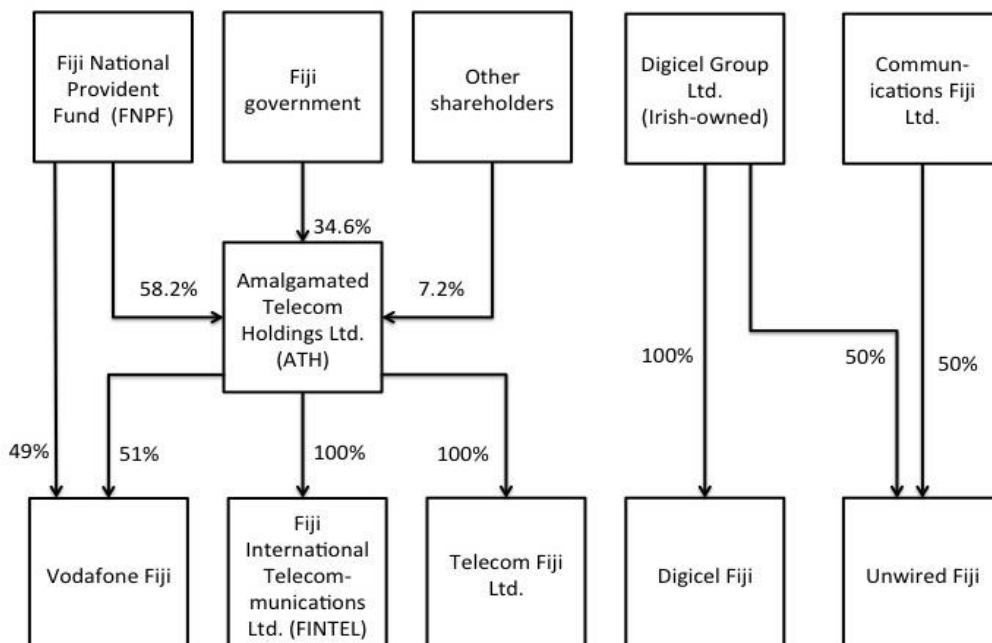
Note: ATH and Communications Fiji are listed on the South Pacific Stock Exchange. Digicel Group Ltd. is privately held, incorporated in Bermuda and domiciled in Jamaica.
Source: Adapted from ATH.

2.1 Voice telephony

Digital GSM mobile telephone service was launched in July 1994 by Vodafone Fiji. The company was until 2008 the nation's only mobile operator. With the ending of Vodafone's exclusivity, Digicel entered the market on 1 October 2008. The operator is a subsidiary of the Digicel Group, a privately held company with operations in 33 markets in 2014, primarily in the Caribbean and six in the Pacific. IFC provided a US$ 22.9 million loan for Digicel's infrastructure rollout.[94]

The mobile market has expanded tremendously due to the introduction of a second operator.[95] Penetration rose significantly before the arrival of Digicel (Figure 2.2 left) as Vodafone prepared for competition by expanding coverage and lowering prices. The year with the highest growth rate in mobile penetration was 2007, one year before Digicel's launch. The year after Digicel started, mobile penetration broke the 100 mark. It declined in 2010 due to the introduction of a decree requiring all SIM cards to be registered but then continued its growth in subsequent years reaching 113 subscriptions per 100 people in March 2014. The percentage of households with a mobile telephone increased 41% since the introduction of competition and is today almost ubiquitous with 93% of homes having a cellphone (Figure right).

Figure 2.2: Mobile penetration
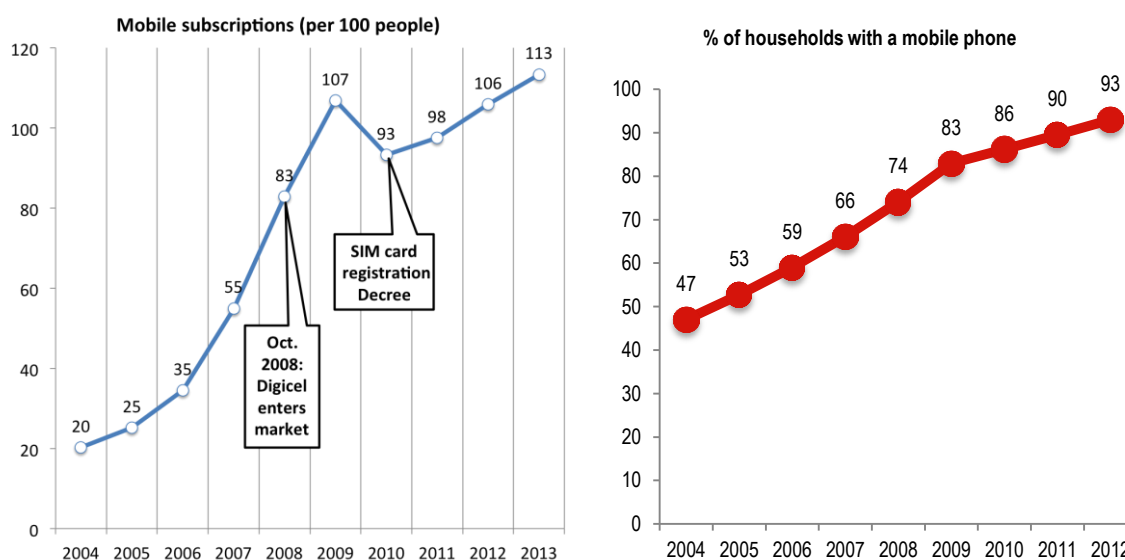
Note: Years beginning 1 April (left chart). Inter-survey years estimated (right chart).
Source: Vodafone and estimates for Digicel from the World Bank (left chart); Bureau of Statistics (HIES 2002-3 and 2008-9) and PFIP.

The introduction of competition spurred an increase in coverage and a dramatic drop in prices. The percentage of Fijians in the range of a mobile signal rose from 56% in 2004, to 78% the year Digicel launched; by March 2014, coverage was almost ubiquitous with 96% of the population able to obtain a 3G signal Figure 2.3, right). A monthly basket of mobile prices consisting of calls to different networks at different times and text messages dropped 42% in 2006 making mobile communications more affordable to the population (Figure 2.3, left). The monthly basket as a percent of per capita income dropped from 18% in 2005 to 5.8% in 2014. Even though the reduction in prices has been limited since 2006, service has become more affordable due to rising income. Handset prices have dropped dramatically over the last two decades from FJD 1,500 in 1994 to FJD 29 in 2014 for a feature phone[96] (0.4% of per capita income).

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[94] https://ieg.worldbankgroup.org/Data/reports/chapters/appf.pdf
[95] Inkk also operates in the mobile space as a virtual mobile network operator, using the Vodafone network.
[96] http://www.alcatelonetouch.com/global-en/products/featurephones/1045.html#.VFn4DL7tXfg

Figure 2.3: Mobile prices and coverage
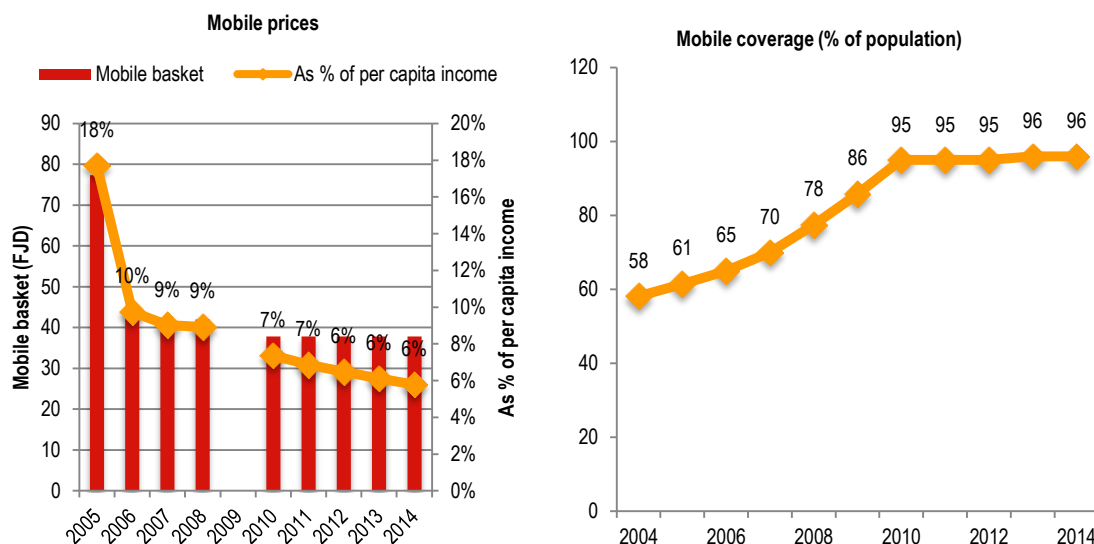
Note: The mobile basket in the left chart is based on the OECD 30 call methodology consisting of 30 calls per month distributed over different time periods to different networks (on-net, off-net and landline) and 100 text messages.[97] Data for 2009 is not available.
Source: Vodafone Fiji (left chart) and Vodafone Fiji and Digicel with estimates (right chart).

The biggest constraint to ubiquitous cellphone ownership is coverage with household penetration essentially matching the percent of the population within a mobile signal. Although cellphones far outweigh landlines as the main form of communications, over a fourth of households reported expenditures on fixed telephone service in 2009.

2.2 Internet

Commercial Internet service was introduced by Telecom Fiji in December 1995. Today there are five ISPs operating in the country using a variety of technologies including fixed wired, wireless and mobile broadband with the latter accounting for the vast majority of subscriptions.

Vodafone deployed a 3G network in November 2008 and has since converted all base stations to support high-speed mobile technology. By March 2014, its 3G coverage was 96% a feat accomplished in five years compared to 16 years to reach the same level of coverage for GSM. Vodafone launched a LTE (4G) network in December 2013. Digicel deployed its 3G network in July 2011 and its LTE network in August 2014, reportedly spending FJD 70 million.[98] The network has initially been deployed in Suva, Nadi and Lautoka and in addition to mobile 4G, will be used by its partner Unwired for fixed wireless Internet access. Similarly, Telecom Fiji has acquired LTE spectrum and plans to deploy fixed wireless broadband services.

The impact on prices from increased mobile Internet competition, particularly the launch of Digicel's 3G network in 2011 and removal of duties on mobile broadband dongles and sharp reduction in smartphone duties the same year has been astounding. Although postpaid prices remained roughly the same between 2011 and 2014, the amount of inclusive data increased 8 times, from 500 MB to 4 GB. As result, the price per GB dropped 87% (Figure 2.4 left). Savings for prepaid users are even more impressive. Prices on a pay as you go basis dropped by 40% from FJD 4.99 per MB to 2.99. However, prepaid users can now opt for data bundles, an option not available previously. A one-day 350 MB data bundle costs FJD 1.99, or just FJD 0.006 per MB, almost 900 times cheaper than in 2011 (Figure 2.4 right). A 2GB data bundle for use on the 3G network costs FJD 25 or 3.8% of per capita income.

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[97] http://www.oecd.org/sti/broadband/48242089.pdf
[98] http://www.digicelfiji.com/en/about/news/digicel-launches-fijis-biggest-4g-network

Figure 2.4: Mobile Internet prices

Postpaid mobile Internet (FJD)

Prepaid mobile Internet per 350 MB (FJD)**
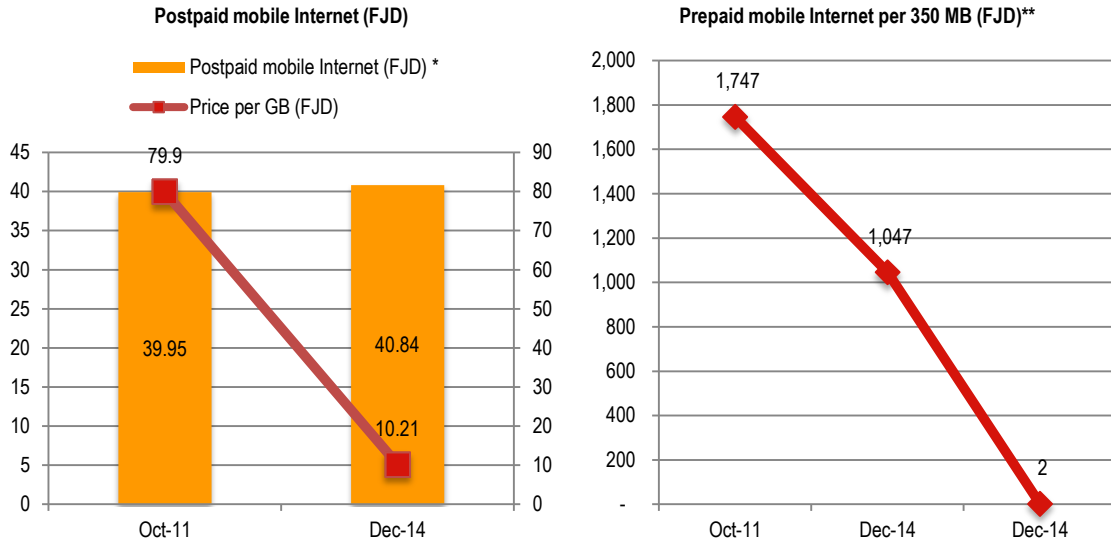
Note: * Mobile Office package. ** The first two data points show pay as you go price for 350 MB whereas the third data point shows the price for a one-day data bundle including 350 MB.
Source: Adapted from Vodafone Fiji.

Quality of mobile broadband networks has increased. Data available for Vodafone show that average upload and download speeds have improved between 2011 and 2014 despite the steady increase of mobile Internet users (**Error! eference source not found.**, left). This is the result of higher speed technologies being rolled out providing faster end-user access (2.5G to 3G and 4G). Speed tests conducted on Digicel's 3G network in November 2014 found downloads to average 6.1 Mb/s with low latency of 74 milliseconds (Figure 2.5, right).

Figure 2.5: Mobile broadband speeds on Vodafone's 3G and 4G network and Digicel's 3G network

Annual average speeds on Vodafone's network

Speeds on Digicel's 3G network, November 2014
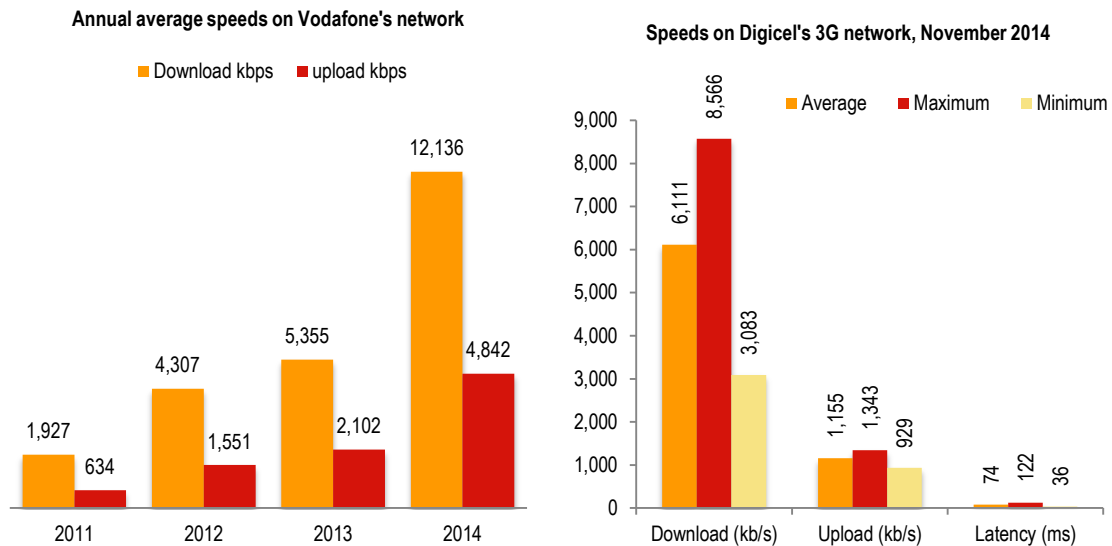
Note: Note that the figure for Vodafone is based on tests carried out by subscribers using connected to its different 3G and 4G networks across the country while the data for Digicel is based on five speed tests conducted in November 2014 using its 3G network carried out in Suva and Nadi. Therefore the data are not comparable.
Source: Adapted from Ookla (left chart) and authors (right chart).

There are no official surveys carried out to measure the number of Internet users in the country. Official supply side data on subscriptions are misleading and appear to reflect capability to access mobile data services rather than actual use. For example, TAF reported 790,000 mobile broadband subscriptions in September 2014 giving a penetration rate of 91 per 100 people.[99] In contrast, GSMA reported 330,000 3G subscriptions for 2014 or 38% of the population.[100] This would roughly correspond to Facebook data which reported it had 300,000 users in Fiji in December 2014, around a third of the

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[99] http://www.taf.org.fj/Monitoring/Country-Report.aspx
[100] https://gsmaintelligence.com/markets/1025/dashboard/ (Registration required).

total population, of which 87% accessed the social network using mobile phones. The number of Facebook users in the country grew 240% between March 2011 and December 2014. According to TAF, penetration of other broadband technologies to access the Internet—fixed broadband and other wireless technologies besides 3G/4G—is very low at 1.3 and 2.5 percent of the population respectively in September 2014.

Figure 2.6 Internet penetration and Facebook users
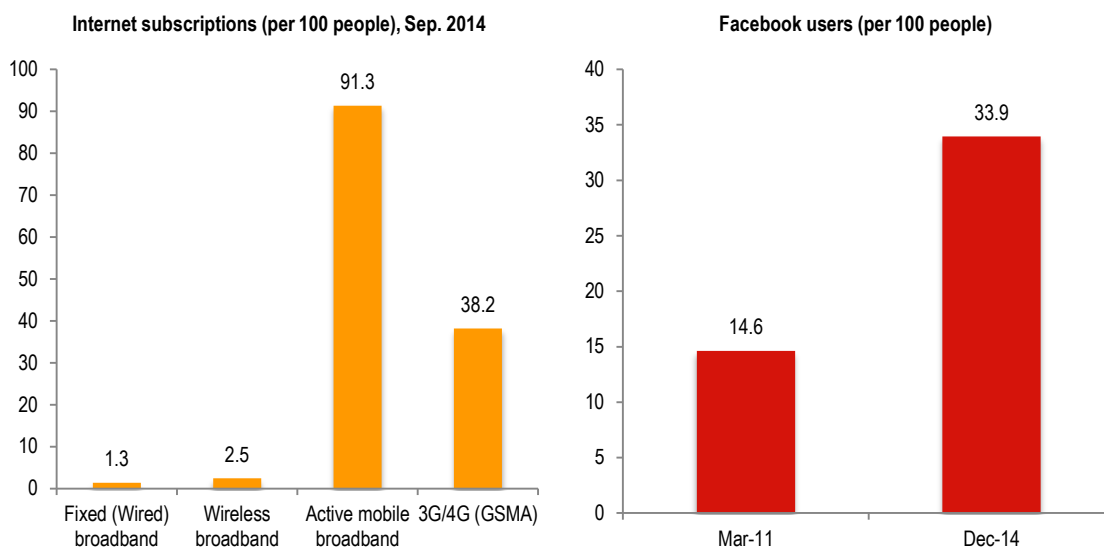
Source: Adapted from TAF, GSMA and Facebook.

Given the widespread coverage of mobile broadband (96% of the population), the main barriers to greater Internet take-up would be the cost of devices, the cost of service and digital literacy. The government has a telecentre program for promoting greater Internet access funded by a levy on international incoming calls. There are more than two dozen telecentres in schools staying open after hours to provide free Internet access to the local community. By July 2014, some 77,000 people had access to the Internet through the telecentres.[101]

2.3 Backbone networks

Fiji has international telecommunication connectivity through satellite and the Southern Cross undersea fibre optic cable.[102] Fiji connected to Southern Cross in November 2000[103] at a cost of FJD45 million. All of Fiji's international Internet traffic is via Southern Cross with satellite only used for voice. Southern Cross has been a big attraction for other countries in the region and Fiji has emerged as a regional hub for fibre connectivity. Submarine cables from Tonga and Vanuatu land in the country for onward transmission onto Southern Cross (Figure 2.7).

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[101] Sofaia Koroitanoa. "Prime Minister opens telecentre in Lami." *Fiji Television News*. 1 July 2014. http://fijione.tv/prime-minister-opens-telecentre-in-lami/
[102] For more information about Southern Cross, see http://www.southerncrosscables.com/ and
http://www.alcatel.com/submarine/refs/cibles/pacs/southerncross.htm
[103] The Southern Cross cable is named after the plane that made the first trans-Pacific Ocean crossing in 1928. The cable parallels the plane route from Oakland (near San Francisco) to Brisbane, Australia with stops in Hawaii and Fiji. See:
http://www.austehc.unimelb.edu.au/tia/505.html

Figure 2.7: Submarine cables in Fiji

Source: http://www.submarinecablemap.com

Growth in international bandwidth has been astounding. While it took nine years from connecting to Southern Cross to reach 1 Gb/s of capacity, since then, Fiji has been adding around 1 Gb/s per year (Figure 2.8 left).

Fiji is unique in the region as the only South Pacific country regulating wholesale submarine cable pricing at the end of 2014. In 2010, the Fiji Commerce Commission found that FINTEL had significant market power through its control of the Southern Cross landing station. The Commission concluded that this could be detrimental to the country in terms of high bandwidth costs. It imposed a glide path for bandwidth cost reductions and warned ISPs that if price drops were not passed on to consumers the Commission would also regulate retail prices.[104] Since 2010, the glide path has resulted in a reduction of 63% on Australian routed traffic and 83% on US destined traffic (Figure 2.8, right). In January 2015, maximum prices for the Australian route stood at US$ 139 per Mb/s and US$119 per Mb/s for the US route.

Figure 2.8: International bandwidth and IP transit costs
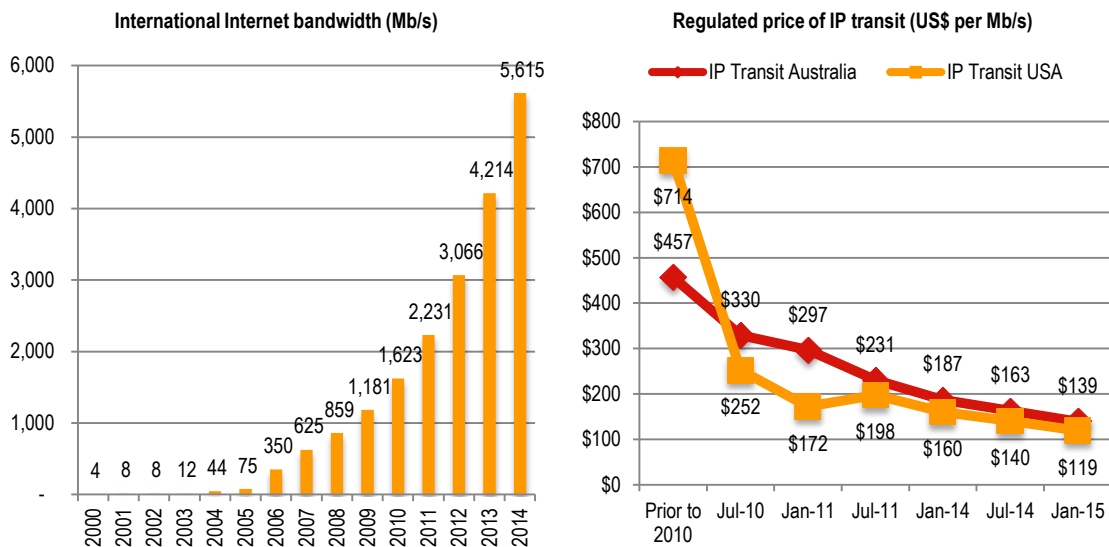
Note: In the left chart, 2014 refers to June and 2004, 2006, and 2008-2012 are estimated.
Source: ITU, World Bank, TAF (left chart), Commerce Commission (right chart).

Telecom Fiji uses fibre and microwave for its backbone network. Fibre is mainly utilised in urban areas with plans to extend the fibre network in order to backhaul data from LTE base stations. Digicel primarily uses microwave for its backbone network.

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[104] Fiji Commerce Commission. 14 November 2013. *Final Determination on Prices and Access for Southern Cross Capacity and Network.* http://www.commcomm.gov.fj/wp-content/uploads/2012/07/Final-determination_Access-to-Capacity-and-Network_Nov-2013.pdf

3 ICT Socio-Economic Impacts

3.1 Macro-economic

The contribution of the information and communication sector[105] to Fiji's Gross Domestic Product (GDP) has risen from 5.8 per cent in 2008 to 7.5 by 2013 although it has declined from a high of 7.8 per cent in 2009 (Figure 3.1). It is noteworthy that the significant rise in 2009 coincided with the introduction of mobile competition in late 2008 and consequent large increase in the market.

Figure 3.1: Contribution of ICT sector to GDP
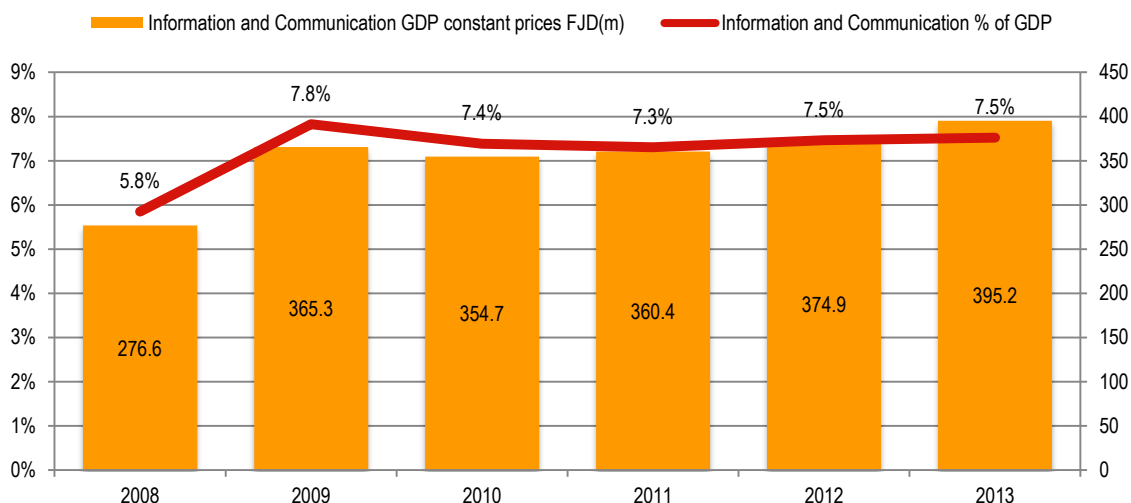
Source: Adapted from Fiji Bureau of Statistics.

Fiji's information and communication sector contribution to GDP is high compared to Japan, Korea, and the United States, where the GDP contribution ranges from 3 to 6 per cent (Figure 3.2). The share of the information and communication sector in the Fijian economy is also around two times more than in the developed Pacific economies of Australia and New Zealand.

Figure 3.2: Information and communication (ISIC rev4) as % of GDP
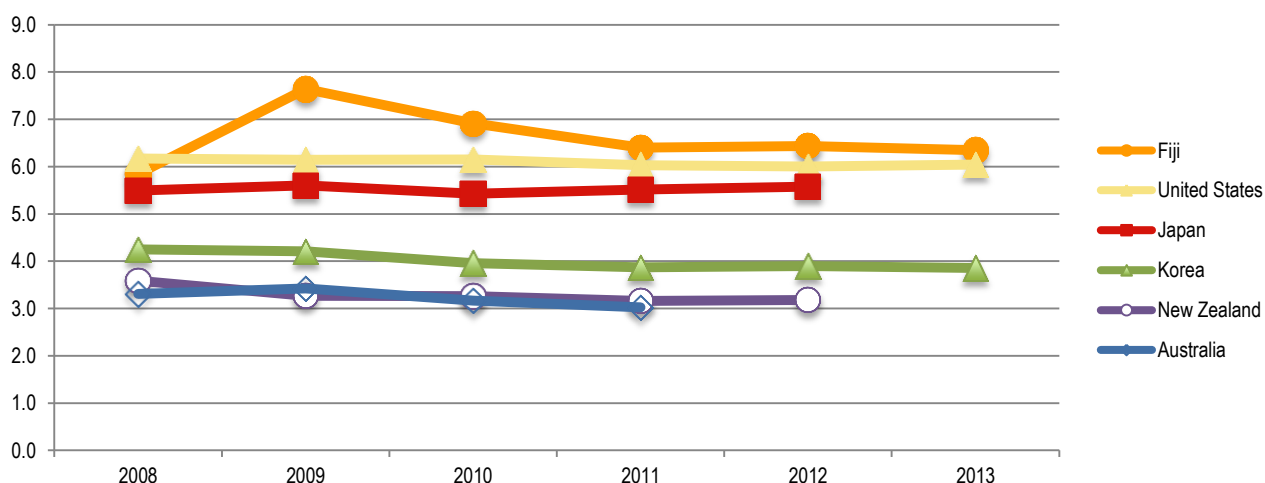
Note: ISIC Revision 4.0. Current prices.
Source: Adapted from Fiji Bureau of Statistics, Statistics New Zealand and OECD.

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[105] Based on the International Standard Industrial Classification (ISIC) Revision 4. See: http://unstats.un.org/unsd/cr/registry/regcst.asp?Cl=27.

Telecommunications capital expenditure jumped with the imminent entry of Digicel, peaking at 15% of total investment in the country in 2008, the year Digicel launched service (Figure 3.3). There was also a spike in 2012 with Vodafone investing heavily to fully convert its network to be 3G-ready.

Figure 3.3: Telecommunications capital expenditure as a % of total investment
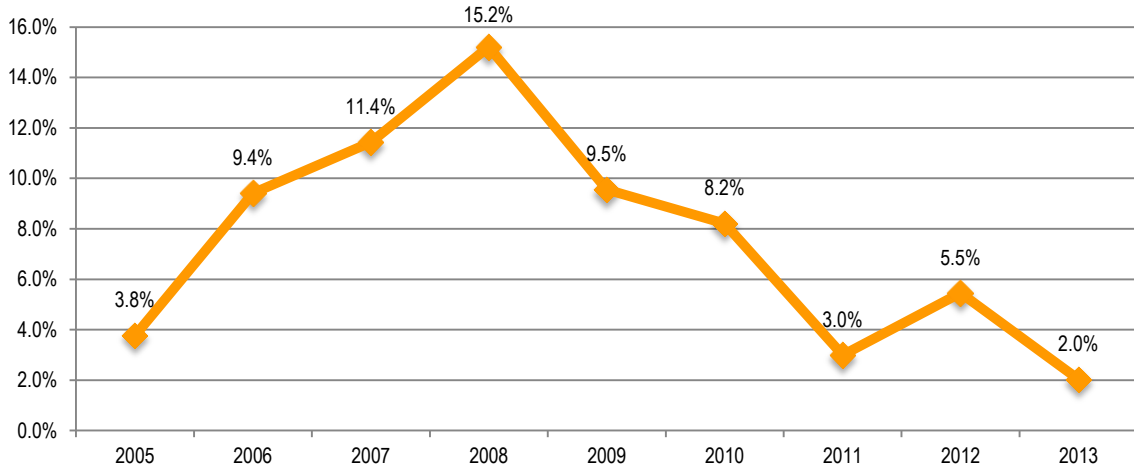
Note: Figures for ATH are from its consolidated results. Capex data refer to years beginning 1 April. Investment or gross capital formation is measured by the total value of the gross fixed capital formation and changes in inventories and acquisitions less disposals of valuables.
Source: Adapted from ATH, Digicel and IMF.

Regarding the structure of the information and communication sector, telecommunications dominates with 85% of value added in 2011 (Figure 3.4, left). Turnover from telecommunication services were FJD 375 million in 2011, with mobile services contributing 61%. Despite efforts to promote its computer software sector, programming and information service activities accounts for just 4.4% of Information and Communication value added. Further, Fiji runs a deficit in computer and information service trade that has gotten worse over time (Figure 3.4, right).

Figure 3.4: Structure of Information and Communication sector and trade in computer and information services
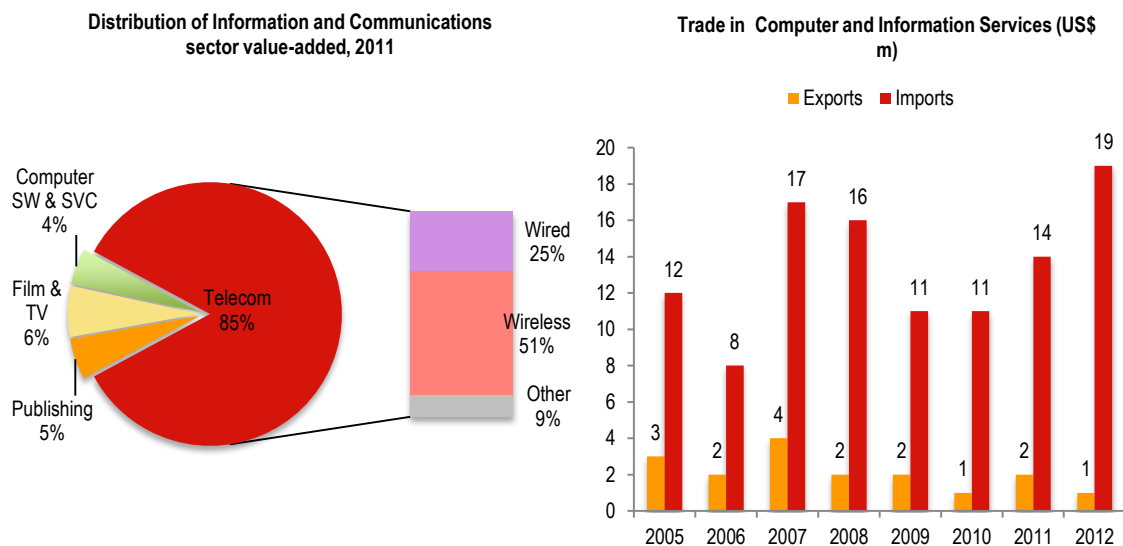
Source: Adapted from Fiji Bureau of Statistics and World Trade Organisation.

Employment in the telecommunication sector was 2,358 in 2011. This was 0.68% of total employment. Computer programming, information services and related activities employment was 411.

The presence of Fiji's telecommunication sector is highly noticeable through billboards, newspaper ads and radio commercials. After wages and salaries, advertising is the next biggest expenditure item for the telecommunications sector. In 2011, advertising expenses were FJD 21 million or 8.9% of expenditure and a significant contributor to the country's advertising industry.

3.2 Impacts across different sectors

3.2.1 Government

Fiji's e-government Master Plan was released in 2007.[106] The Peoples Republic of China, through its EXIM bank granted a loan of RMB 145 (US$18) million for the project. The Department of Information Technology and Computing Services (ITCS) under the Ministry of Finance is responsible for implementing the plan. The two main components are:

- development of the Government Information Infrastructure (GOVNET)
- deployment of Government services online via an e-Government portal

To date, the main accomplishment has been the development of GOVNET, linking most government agencies in Suva as well as some in other locations. The network backbone is fibre in Suva and wireless technology to other parts of the country. It allows the government's some 36,000 civil servants to exchange information electronically. In addition, the government also has a state-of-the-art data centre.

The development of online services for business and citizens has progressed at a slower pace. One challenge has been the lack of a central citizen and business registrar with each agency maintaining their own. In addition, ministries have developed their own applications with little sharing across government and different software systems. If government IT experts move ministries they often have to learn a new system. This environment means that businesses and citizens must go to each ministry for each type of service.

In an effort to streamline the system, ITCS has been working on a flagship application for Investment Fiji. The aim is to create a single window for foreign investors covering registration and all other process to operate a business in Fiji. This is badly needed with the World Bank estimating that it takes 11 procedures, two months and costs a fifth of per capita income to register a business in the country. Fiji has one of the lowest ranks in the world for starting a business in the Doing Business survey and getting worse dropping 8 ranks between 2014-2015. In Samoa, there are just 4 procedures taking on average 9 days to register a company.

A second application in the pipeline is automation of land registration process for indigenous Fijians. Another is streamlining applications for birth/marriage/death certificates.

Government Service Centres (GSC) located in Lautoka, Labasa, Nausori and Suva have been established to fulfill citizen requests for government services.[107] They are connected to GOVNET providing notary services, information about government services including birth, death and marriage certificates and can assist with online applications for scholarships and exam results. There are hopes to also include the network of post offices as government service centres. In addition, telecentres could provide access to government services and eventually this will be extended to individual access. There is also a government call centre.

3.2.2 Financial inclusion

Mobile telephony has enhanced financial inclusion in Fiji through the provision of mobile money services. It is notable that the launching of mobile money services in the country was supported by a variety of donors. Introduction of mobile money services was also facilitated by favorable government policy.

With assistance from the Pacific Financial Inclusion Program (PFIP), Vodafone became the first company in the South Pacific to launch mobile money services (M-PAiSA) on 18 June 2010. Digicel followed suit on 15 July 2010 with the help of the GSMA through the Mobile Money for the Unbanked Fund. M-PAiSA is modeled on Safaricom Kenya's M-Pesa service, but developed by Vodafone Fiji. Since launch, M-PAiSA has enrolled over 300,000 customers, of which 40,000 are active customers. Digicel does not publicly disclose the number of active subscribers it has.

In addition to transfers, customers can pay bills and receive international remittances. Recently M-PAiSA partnered with SPBD Fiji and LICI Fiji to enable customers to pay their microloans and insurance premiums.

According to the Reserve Bank of Fiji, there has been a noticeable increase in cash-in-/out points and banking agents in the country because of mobile money initiatives. The number of cash-in-/out access points per 10,000 adults jumped from 1.8 in 2011 to 11.3 in 2013 (Figure 3.5, left) and the number of agents per 10,000 adults rose from 0.7 to 10.2 over the same period (Figure 3.5, right).[108]

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[106] http://unpan1.un.org/intradoc/groups/public/documents/un-dpadm/unpan040829.pdf
[107] http://www.fiji.gov.fj/Media-Center/Press-Releases/GOVERNMENT-SERVICE-CENTRES-PRAISED.aspx
[108] Reserve Bank of Fiji. October 2014. The Fiji Economy. http://www.rbf.gov.fj/getattachment/Home/Chartbook-tables-Oct14.pdf.aspx

Figure 3.5: Number of cash-in/cash-out access points and agents per 10,000 adults
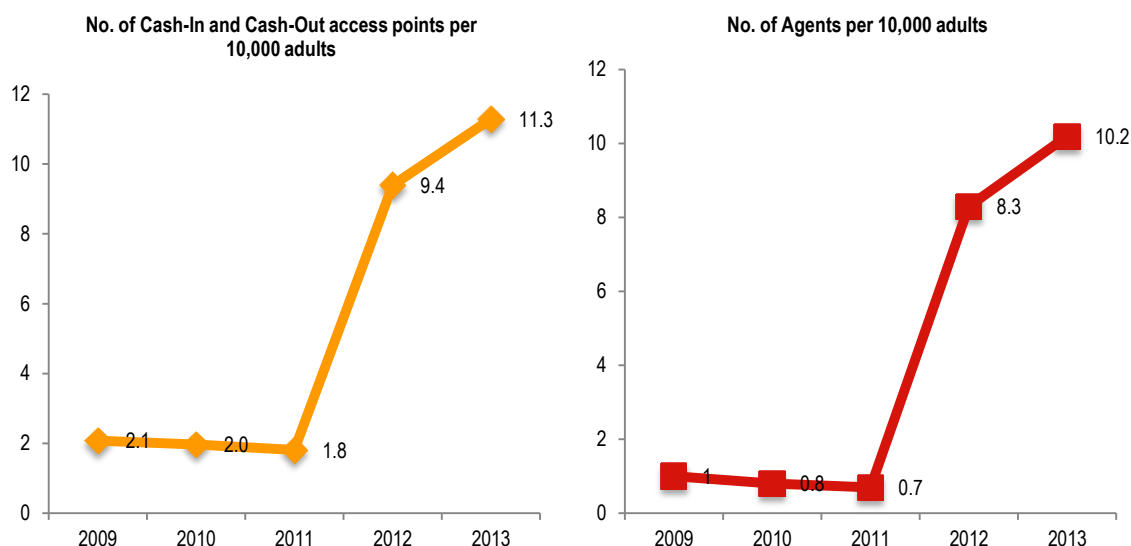
Source: Reserve Bank of Fiji.

According to a survey carried out by PFIP in 2012, seven percent of those with a cellphone were using mobile money services (Subramanian 2012). Take-up of mobile money faces significant barriers with 80% of those surveyed saying they preferred cash to mobile money, less than 50% trusted mobile money and around 60% found mobile money to be expensive. Over 40% replied that the main benefit of mobile money is convenience with 37% stating that it saves time.

The success of mobile money in Fiji is limited by the cost of transactions, particularly for low volumes. A cash to cash transaction via mobile money requires a deposit, which is free of charge, a chargeable transfer of mobile money and a chargeable withdrawal. The cost also varies by whether the recipient is a registered member of the mobile money service or not. For example, the total cost for a cash to cash transaction of between FJD 1-5 is FJD 1.25 to registered recipients (0.75 to send and 0.50 to withdraw) and FJD 1.75 to non-registered recipients (1.00 to send and 0.75 to withdraw) for Vodafone's M-PAiSA service (Figure 3.6, left).

The purchase of products and services from merchants also impacts the adoption of mobile money due to the total cost of transactions. Mobile money competes with debit and credit cards for merchant payments. Users pay an annual fee to have a credit card, which might make mobile money more attractive. However, bank charges to the user for credit card transactions are free and low for debit cards at only FJD 0.30 per transaction.[109] On the other hand, a surcharge is sometimes added to the customer's bill in Fiji.[110] This is usually for low value denominations and is either a flat fee or a percentage of the purchase price.[111] For mobile money, the customer and the merchant share the cost, the customer paying for the transfer and the merchant for cashing out. Merchants may also pass on the withdrawal cost on to the customer, similar to the practice with credit cards. For the user, if the merchant's credit card transaction cost is passed on to customers, then it makes sense to use mobile money, particularly for low value transactions (Figure 3.6, right).

However, if there is no surcharge for the user, then a debit/credit card is cheaper. For the merchant, if the card transaction is passed on to the user, then it benefits them to prefer cards; this is generally only the case for low value transactions. Otherwise, mobile money only is advantageous after a certain value (around US$46).

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[109] See BSP's Banking Services Fees and Charges at: http://www.bsp.com.fj/Personal/Fees--Charges.aspx
[110] Consumer Council of Fiji. "Beware of high credit card surcharges, Council warns." *Press Release*. 6 November 2013.
http://www.consumersfiji.org/media-center/press-releases/3838
[111] The Consumer Council of Fiji found the going rate to be 3.5% of the transaction value. See:
http://www.consumersfiji.org/upload/Submissions/Submission%20-%20RBF%20on%20Credit%20Card%20Surcharges%20FINAL%20-%20%20310510.pdf

Figure 3.6: Cost of a mobile money cash transfer as % of the transfer amount, November 2014
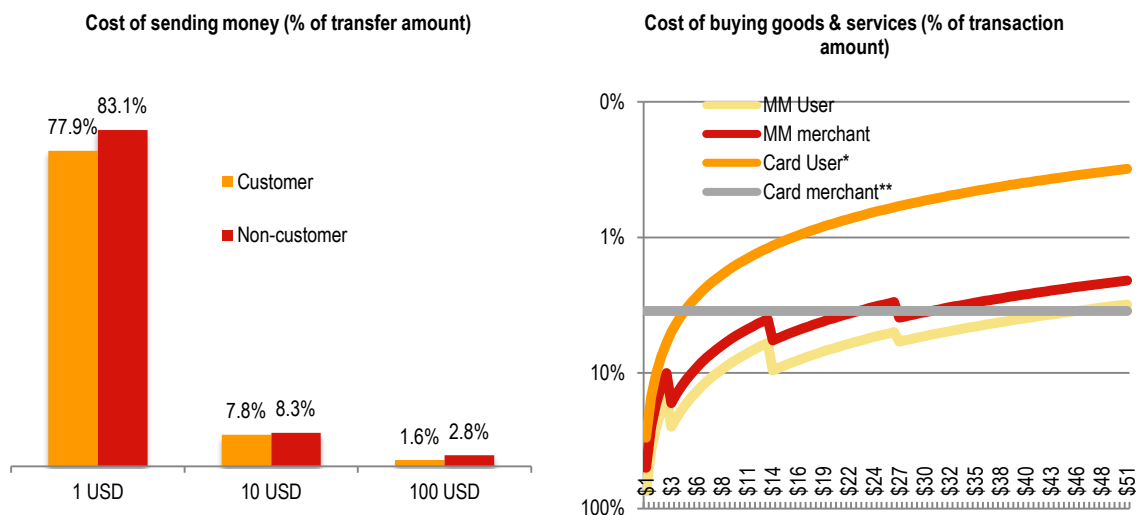
Note: In the right chart, MM = mobile money and Card = Debit/Credit card. * = flat transaction fee for debit cards only. ** Per Consumer Council of Fiji, transaction percentage observed in a survey.
Source: Adapted from Vodafone and Consumer Council of Fiji.

A successful mobile money implementation would allow merchants to directly transfer mobile money into a bank account without the need to cash out and allow customers to pay the merchant without a transaction fee or a much lower transaction fee. A customer – merchant transaction needs to be treated differently from normal money transfers.

3.2.3 Education

In primary and secondary schools, efforts are made to increase connectivity and computers. At the tertiary level, Fiji is home to the University of the South Pacific (USP), the region's flagship institution with a range of ICT initiatives both within Fiji and throughout the region.

Recognising the importance of computer science, a curriculum for secondary schools was developed as far back as 1996.[112] However, by 2003, it had only been implemented in a little over half the secondary schools in the country. Allocation of ICTs in schools has mostly progressed on an ad-hoc basis. Recent data is not available on school connectivity. In 2002, 86 (55%) of the 156 secondary schools in Fiji offered Computer Science/Information Technology (CS/IT) education. Among secondary schools that offered computer science or IT courses (55%), 41% had Internet access. Most of these schools were in urban areas.

The Ministry of Education has recently launched a One Laptop per Child (OLPC) project.[113] This is somewhat surprising given that the program has been around for years. OLPC has issues about the contextual relevance of the applications it comes bundled with and today, cheaper and possibly more relevant alternatives are available in the form of tablet computers.

Apart from the Ministry of Education, there are other initiatives by others to put computers and Internet in schools such as the Department of Communications telecentre program where some schools stay open after hours to serve the community as well as ad-hoc initiatives from groups such as overseas universities.[114] In terms of educational outcomes, there are few studies available for Fiji. Most are anecdotal and none employ rigorous ex ante and ex post or control group methodology.

The University of the South Pacific (USP), headquartered in Suva, serves 12 countries in the region via distance learning.[115] Its satellite-based USPNet was established in 1973 and today around half the students are using distance education via applications such as audio and video conferencing and Internet access.[116] The network has been progressively upgraded to increase capacity. This is important given that the highest attrition rates are in countries with

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[112] http://www.usp.ac.fj/jica/ict_research/documents/pdf_files/ICT%20in%20Secondary%20Education%20in%20the%20Pacific%20Region.pdf
[113] Press Release. 2013. "Minister launches OLPC for Nadarivatu Primary School," October 9. http://www.fiji.gov.fj/Media-Center/Press-Releases/MINISTER-LAUNCHES-OLPC-FOR-NADARIVATU-PRIMARY-SCHO.aspx.
[114] http://theseeproject.org/2014/04/10/the-2013-see-project-report/
[115] Cook Islands, Fiji, Kiribati, the Marshall Islands, Nauru, Niue, Samoa, the Solomon Islands, Tonga, Tokelau, Tuvalu, and Vanuatu.
[116] For more on USPNet see Duncan, Ron, and James McMaster. 2008. "Impact of ICT on University Education in Small Island States: The Case of the University of the South Pacific." In Small States, Smart Solutions: Improving Connectivity and Increasing the Effectiveness of Public Services. Directions in Development - Public Sector Governance. The World Bank. http://elibrary.worldbank.org/doi/book/10.1596/978-0-8213-7460-3.

poor bandwidth. Recently, USP has purchased dark fibre on submarine cable networks in the Marshall Islands, Tonga and Vanuatu. Improved connectivity will support sophisticated distance learning applications and link students and professors in these countries to international educational research networks.

The Japan International Cooperation Agency (JICA) has supported USP with development assistance funding over the years. It carried out a 2009 evaluation of its technical cooperation program.[117] The evaluation noted an increase of 120% in computer science graduates and availability of 350 Distance and Flexible Learning courses (DFL). Three indicators were tracked to measure overall project goals noting: 1) There was an increase in the number of applicants for higher education and continuing education though specific figures were not mentioned; 2) In terms of an increase in qualified jobs for computer science graduates, it was noted that many are employed by IT-related firms, banks and educational institutions without specifying a specific number; and 3) five papers were published by international academic journals. The Japanese evaluation considered the overall impact of the project to be low.

3.2.4 Health

The Ministry of Health is keen about the potential of ICTs for promoting wellness in the country. Many of its agencies throughout the country are connected to the government backbone network including all hospitals with more than 30 beds. The Ministry faces challenges connecting all establishments due to high costs; it is trying to negotiate with operators to bring down the charges. Some existing connections suffer from quality issues as they are using bandwidth of between 256 kb/s to 2 Mb/s, deemed insufficient for growing traffic. The network is mainly used for administrative applications such as email and sharing information and also supports videoconferencing to exchange information among medical staff and which could be a precursor for eventual diagnostic applications. The ministry currently has one telemedicine application that holds great promise for scaling up throughout the country. Scans from an MRI are transmitted to Sahyadri hospital in India where diagnosis is turned around within 24 hours. This is carried out on average for four patients a day.

The ministry is keen to develop a pilot paperless hospital. This would create significant savings and result in better treatment for patients. The amount of existing paperwork in hospitals is huge and sometimes misfiled. Although some information is currently digitised, much is not, especially doctors' notes and discharge summaries. A paperless office would enhance patient care by ensuring that all pertinent records are computerised and linked. There would also be synergies throughout the process of drug administration, inventory management and warehousing, resulting in greater efficiency. The ministry estimates that the cost of developing a paperless hospital would be around US$ 1 million.

Wireless is another area ripe for exploitation. This includes making ministry offices and hospitals Wi-Fi zones where devices such as smartphones and tablets could be extensively deployed. It would also reduce costs since not as many wired connections would be needed. Push and pull services for patients are another area of interest where applications can be developed to remind patients to take medicines or of upcoming appointments. The ministry's IT staff is very cognizant of the potential of such applications for the sector but lacks funding to pursue all the possibilities.

The ministry tracks almost 90 indicators relating to health assisting the monitoring of MDGs and the country's National Strategic Plan. There is currently no research carried out on how ICTs impact health outcomes within the ministry but it has expressed interest in this area. Of note is a study carried out by Fijian researchers looking at the relationship between output per worker, health expenditure and ICTs (Kumar and Singh 2014). The premise is that better health outcomes result in higher productivity. The study found spending on health has a positive and significant short-run effect in the short-run only while each percentage point increase in telephone penetration results in a 0.9% increase in worker output in the short-run and 0.62% in the long run.

The Vodafone ATH Fiji Foundation has developed a health-related mobile phone application. Its mHealth service uses SMS to provide information about kidney diseases, cancer, sex education, overall well-being, physical fitness, diabetes and high blood pressure. The Foundation works with a group of doctors to provide information. mHealth has some 50,000 subscribers.

3.2.5 Agriculture and fishery

ICT could have significant potential in Fiji's agricultural and fishery sectors considering their relevance for the economy and number of people they engage. The Ministry of Agriculture collects and compiles information relevant for farmers. Its agents record pricing information for over 30 products from various markets around the country that is disseminated via radio and the ministry's web site. Tablet computers are used to collect the information.[118] The ministry also compiles information about growing techniques, dealing with plant diseases and similar information that is printed and distributed to farmers through agricultural extension offices and via its web site. The Ministry would like to spread pricing information via mobile text messages in order to leverage the high cellphone penetration among farmers and get information to them more quickly. This has been delayed due to high costs. For example, the cost charged by a mobile operator to send 200,000 text messages a month would cost FJD 0.6 per message (US$ 6,243 per month).

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[117] http://www2.jica.go.jp/en/evaluation/pdf/2008_0603429_4.pdf
[118] ITC News. 2014. "ICTs and e-solutions can reap benefits for Fijian farmers: Harvesting mobile technology for agri-business," March 28. http://www.intracen.org/news/ICTs-and-e-solutions-can-reap-benefits-for-farmers-Harvesting-mobile-technology-for-agri-business/.

One potentially impactful application would be to use smartphone and tablets to share detailed agricultural advice that go beyond the limitations of a text message by using audio and video clips. However, extension staff themselves lack these devices and a first step would be to provision them so they could then demonstrate the potential to farmers. This is held back due to a lack of funding.

The ministry also has a help desk that receives queries by phone, email, fax and post. According to data from the first quarter of 2011, the vast majority of contact was via email. Farmers contacted the help desk the most, but there were also inquires from a range of other parties.

Several mobile-based initiatives aimed at enhancing agricultural livelihoods for farmers are in various stages of piloting or recently launched. None has reached significant scale and impacts are yet to be measured:

- Fiji Makete is a service for farmers to sell products to potential buyers.[119] Digicel Fiji, in partnership with F1 Mobile Solutions was originally involved in developing the platform.[120] The application allows farmers to use simple menus on their mobile phones to access information about market pricing for their crops and sell their produce.
- The Fiji Crop and Livestock Council (FCLC) is piloting a system that sends alerts to different groups. This allows FCLC to send text messages targeted to audiences in defined locations. Messages also include tips providing information on growing crops.
- The Vodafone ATH Fiji Foundation developed a mobile application aimed at farmers called mFarmacy. It provides information about improving growing techniques including advice in innovative areas such as organic farming, aquaculture, and herbal and medicinal plants.

3.2.6 Tourism

The tourist sector is an important part of Fiji's economy, with gross tourism earnings of FJD 1.4 (US$ 0.743) billion accounting for around a fifth of GDP in 2014. The country received 692,630 overseas visitors in 2014.[121] Tourism Fiji has a web site (http://www.fiji.travel) available in both English and Chinese. The latter language is a reflection of the rapid jump in Chinese tourism with arrivals from China up seven times since 2009 and accounting for the fourth largest number of visitors to Fiji. Tourism Fiji's website has links to hundreds of accommodations with a description and contact phone numbers, email and website if available. Many hotels also have a web presence either directly with their own site and/or indirectly through popular online brokers.

Tourism benefits the mobile sector with many overseas visitors bringing their cellphone with them. According to Vodafone, in 2004 some 80% of tourists from Australia and New Zealand brought their mobile phone of which 90% roamed onto the Vodafone Fiji network. It is likely that today, given the launch of 3G/4G networks and demand for accessing social media sites, more tourists than ever are using smartphones and opting to purchase local SIM cards given the price savings compared to roaming.

Telecom Fiji has a Flight Information Display service that it offers to hotels. The service provides airline real time departure information linked to the main system at Nadi International Airport. The information is displayed on video monitors in hotel lobbies so that guests have up-to-date status of their flights before departing for the airport.

An econometric study looking at the impact of both tourism and ICT on the Fijian economy found that each percentage point increase in telecommunication penetration contributes 1.1% to GDP growth and each percentage point increase in tourism receipts as a percent of GDP contributes 0.23% (Kumar and Kumar 2012). The study, using annual data for 1980-2008, also found causalities from capital stock to ICT and ICT to tourism, concluding that ICT investment and tourism are "crucial for Fiji's growth".

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[119] http://fijimakete.com.fj/about.php
[120] "Digicel teams up with F1 to make 'Fiji Makete' a reality." *Press Release*. December 11 2012 http://www.digicelfiji.com/en/about/news/digicel-teams-up-with-f1-to-make-fiji-makete-a-reality
[121] See "Visitor Arrivals Statistics" at: http://www.statsfiji.gov.fj/index.php/migration-a-tourism/10-migration-statistics/migration-a-tourism/115-visitor-arrivals-statistics

4 Business Case for Public Investment

Fiji is today relatively well endowed with ICT infrastructure and has a competitive telecommunications market. Coverage of and access to mobile networks is high with 96% of the population within reach of mobile broadband. The government has several initiatives for expanding access. This includes operator contributions to a universal fund (0.5% of revenue) to subsidise deployment of infrastructure in underserved areas.

Over the last decade, development assistance for ICTs has been relatively limited due to military rule (Table 4.1).[122] The only major infrastructure assistance was by the World Bank private sector arm International Finance Corporation (IFC) for a loan to Digicel to build out its mobile network. Otherwise, assistance has primarily focused on strengthening networks in government and higher education. Given the relatively high level of connectivity in the country and universal service fund, it is unlikely that significant development assistance would be needed to finance infrastructure rollout. One exception might be assistance for an additional submarine cable, relevant for capacity and redundancy purposes given Fiji's emergence as a regional bandwidth hub.

Table 4.1: Multi-lateral and bi-lateral development assistance for ICT projects in Fiji

Donor	Project	Amount (US$ m)	Year
China	e-government project	19.9	2004
IFC	Digicel	22.9	2009
JICA	Construction of the Japan-Pacific Information and Communication Technology Centre at University of the South Pacific	23.0	2009
JICA	Construction of the Japan-Pacific Information and Communication Technology Centre at University of the South Pacific (Phase II)	9.4	2010
World Bank	Grant to Telecommunications Authority of Fiji on strengthen the monitoring & evaluation of ICT development	0.5	Completed 2014

Note: IFC = International Finance Corporation. JICA = Japan International Cooperation Agency.
Source: Adapted from Government of Fiji, IFC, JICA and World Bank.

One area that could benefit from public support is the development of applications across sectors such as agriculture, fisheries, health, education and government. Available applications are limited and development and transaction costs are high. Application development could be stimulated through assistance in areas such as mobile hubs that bring together developers, universities, ICT industry and investors (Box 4.1).

Box 4.1: Mobile hubs

A way to stimulate local app development is through the establishment of an m-hub or mobile applications incubator. Incubators may provide dedicated space for app developers to work and meet fellow developers and learning opportunities for app developers through workshops and lectures covering technical and commercial skills.

The structure provided by hubs may vary along a continuum, with the most basic offering only shared office space with guaranteed Internet bandwidth, all the way to structured daily classes for a year with developers expected to be on campus daily. The further along the continuum, the greater the participation in the hub's activities and the greater the level of collaboration between developers. An important hub attribute supporting success is the combination of technical and commercial expertise. This can take the form of interactions between developers, industry players and investors facilitated through the hub.

Hubs have an important role to play as part of the app ecosystem in terms of imparting technical and commercial skills and as advocates for app developers. For example, hubs could play an important advocacy role in encouraging operators to adopt Direct Carrier Billing as a payment facility. Incubators may also aggregate negation power when it comes to bulk SMS prices and revenue share for premium SMS.

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[122] Stephen Howes. "Australia's ban on the World Bank and the ADB lending to Fiji." *Development Policy Blog*. 27 May 2013. http://devpolicy.org/australias-ban-on-the-world-bank-and-the-adb-lending-to-fiji-20130506/

5 Conclusions

Fiji has witnessed a remarkable transformation of its ICT sector over the last decade. Connection to the South Cross fibre optic cable has provided progressively cheaper and high speed international backbone capacity for development of the Internet. Introduction of competition in the mobile market has boosted penetration, dropped prices, expanded coverage and driven wireless broadband services.

There is a consensus that the country is fairly well provisioned with infrastructure, although there is a view that additional submarine cable connectivity options would strengthen redundancy, enhance the country's position as a hub and ensure that there is sufficient capacity for growing data usage. The recent linking of Tonga and Vanuatu to Fiji via fibre optic cable for forward transmission onto Southern Cross now makes three countries vulnerable in case of any disruption of Southern Cross.

There are examples emerging showing how the increase in connectivity and access to ICTs is being leveraged to deliver various services. For example, both Vodafone and Digicel have launched mobile money and cellphones are used as a virtual ticket to pay for bus fares. One hospital is using telemedicine to transmit radiology images to India for diagnosis. Tablet computers are used to collect prices of vegetables. The University of the South Pacific is at the forefront of delivering online educational services in the region. However, these are isolated examples and evidence of objective impacts is scarce. Innovative, localised applications and services to fully exploit the increased bandwidth availability in the country are still lacking. Though there is nascent computer software and services industry, there is still heavy reliance on overseas software and IT services. Assistance to support a more dynamic applications development market through initiatives such as mobile laboratories, incubators, venture capital funds and other innovation ecosystem activities should be contemplated in order to enhance ICT impact in the country.

Appendix

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List of meetings

Amalgamated Telecom Holdings (ATH): Ivan Fong, General Manager

Asian Development Bank: Caroline Currie, Unit Head, Economics and Programming Unit, Pacific Subregional Office

Department of Communications & Telecommunications Authority of Fiji (TAF): Shivnesh Prasad, Director & TAF Chairperson

Digicel (Fiji) Limited: Craig Smith, Head of Business Solutions

Fiji Bureau of Statistics: Serevi Baledrokadroka, Deputy Government Statistician

Information Technology and Computing Services (ITCS): Nisar Ahmed Ali, Managing Director, Pacific Technologies Limited; R. 'Ramki' Yalamanchili, Founder & CEO, Yalamanchili

Ministry of Agriculture: Mere Nakota, Senior Information Officer, Information & Communication Section

Ministry of Health: Shivnay Naidu, Director, Health Information, Research & Analysis

Pacific ICT Regulatory Resource Centre (PiRRC): Xandra Fong, Executive Assistant

University of South Pacific (USP): Ian Thomson, Fellow, School of Education; Ronald Kumar, Assistant Lecturer, School of Accounting & Finance

Vodafone Fiji Limited: Shailendra Prasad, Head of Corporate Affairs & VAS

SAMOA
COUNTRY
REPORT

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1 Country Background

The Independent State of Samoa is a South Pacific nation consisting of ten islands of which four are inhabited. The largest is Savaii and the second largest is Uplou, where the capital, Apia, is located. American Samoa is its closest neighbour, some 80 miles away.

The 2011 Samoan census found the population to be 187,820. The latest population estimate for 2014 is 192,067. The Apia Urban Area is considered the only non-rural part of the country with 19 percent of the population in 2011. There were 7.2 persons per households in 2011.

Figure 1.1: Map of Samoa
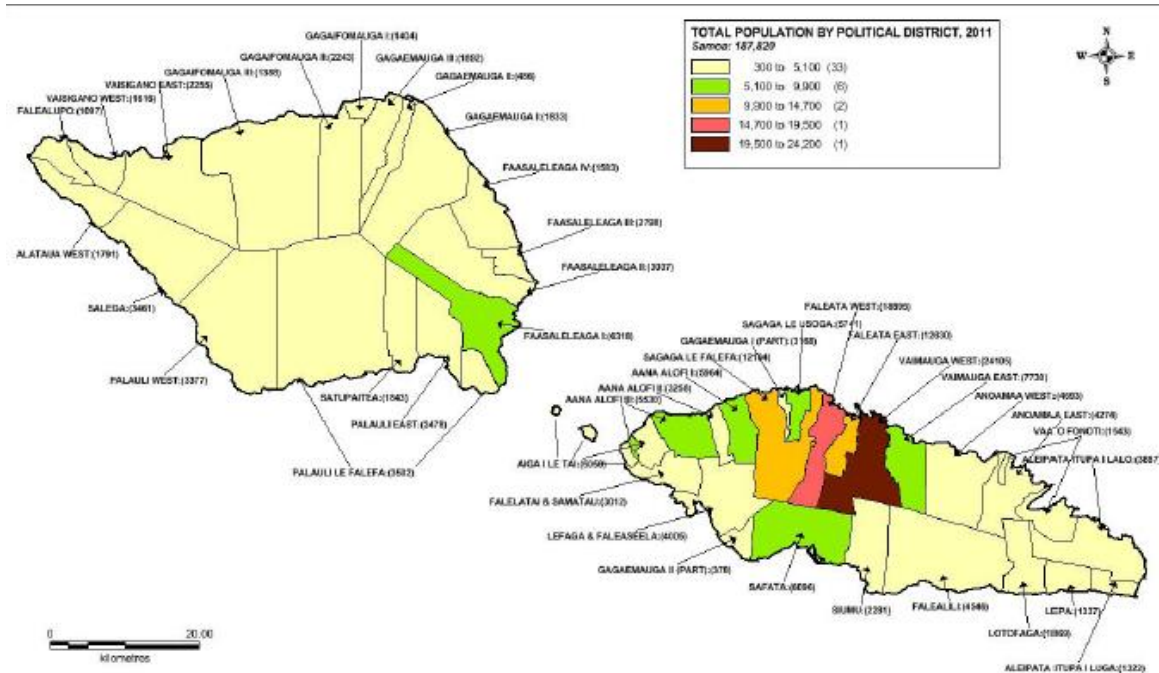
Source: Samoa Bureau of Statistics.

With a FY2014 Gross Domestic Product (GDP) per capita of US$4,298, the World Bank classifies Samoa as a lower-middle-income economy. Commerce made up 32% of GDP in the fourth quarter of 2013, followed by construction (12%) and agriculture and fishing (9%). Remittances are critical to the economy amounting to an estimated US$176 million in FY2014 or 21% of GDP. Tourism is also an important part of the economy with 124,196 visitors in FY2014 and the contribution to GDP from tourism earnings averaging 21% between 2010 and 2013. Tourism earnings declined to 17% of GDP in FY2014.

2 ICT Market

2.1 Industry structure, regulation and liberalisation

Sector reform began in 1999 when the Posts and Telecommunications Department was corporatised and renamed Samoa Communications Ltd (SCL). It changed its name to SamoaTel in 2002. In 2007, posts were spun off from SamoaTel. Three years later the government invited tenders for 75% of SamoaTel. It was privatised in March 2011 through its sale for US$11 million to Bluesky, a telecommunications company based in American Samoa and 75% owned by eLandia (a subsidiary of Spanish holding company Amper).[1] The Unit Trust of Samoa (UTOS), a government-owned investment fund, holds the remaining 25% of Bluesky.

The Ministry of Communications and Information Technology (MCIT) is responsible for policy while the Office of the Regulator (OOTR), established in 2006, is responsible for oversight of telecommunications, broadcasting, postal services and electricity. The Telecommunications Act of 2005 is the key legislation for the sector. A World Bank sector reform project has been instrumental in triggering market liberalisation in Samoa. In 2006, two GSM licenses were awarded, introducing competition into the mobile sector.

2.2 Landlines

Bluesky provides landline telephony services. Samoa had a relatively high penetration of fixed telephone lines for a developing economy peaking at 43% of households in 2006. This is partly the legacy of the delay of introducing mobile competition. Following the entry of a second mobile operator and launch of GSM networks, landlines declined rapidly and by 2011, only one fifth of households had a landline, less than the level ten years earlier (Figure 2.1).

Figure 2.1: Percentage of households with a landline
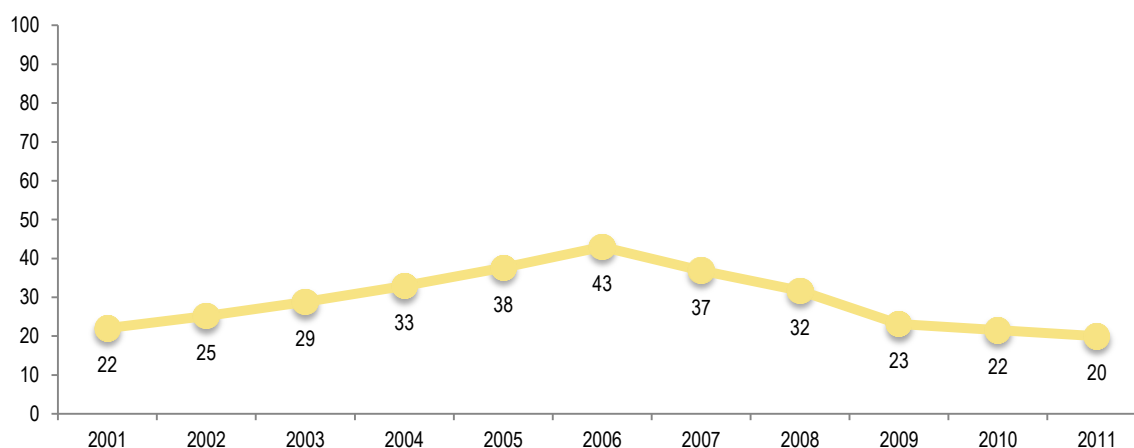
Note: Data is from Census (1997, 2001, 2006 and 2011) and household survey (2009). Data for intervening years are estimated based on annual average growth rates between surveys.
Source: Adapted from Samoa Bureau of Statistics.

2.3 Mobile

Telecom Samoa Cellular Limited (TSCL) began operation in July 1997 with an analog AMPS network as a joint venture between the Government of Samoa and Telecom Pacific Investments (a subsidiary of Telecom New Zealand). In 2001, TSCL launched a digital AMPS network, rather than the popular GSM technology. Since TSCL had an exclusive ten-year license, the government had to negotiate a "Deed of Settlement" in 2005 where TSCL surrendered its exclusivity in exchange for the right to deploy a GSM network and to have its own international gateway.[2] Two GSM licenses were awarded in the first half of 2006 to TSCL and Digicel, an Irish owned pan-Caribbean operator making its first foray into the Pacific. However, Digicel ended up purchasing Telecom New Zealand's stake in TSCL. Digicel started its GSM network in November 2006 with 80% population coverage at launch. The second GSM license was awarded to then state-owned fixed line operator SamoaTel who launched its network in 2007.

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[1] "BlueSky & Government Close SamoaTel Sale." *PRNewswire*. April 1, 2011 http://www.prnewswire.com/news-releases/bluesky--government-close-samoatel-sale-119051024.html
[2] See: Ministry of Communications and Information Technology. *Annual Report 2005/2006*.

Penetration of mobile phones in Samoan households rose dramatically following the launch of competition, rising from less than half of households in 2006 to 96% in 2011 (Figure 2.2). In fact, mobile phones are the most prevalent consumer item in a Samoan home, with a greater penetration than even radios and TVs. There is scarce difference in penetration between urban (97.1%) and rural (95.3%) households and the top seven ranked districts in terms of mobile penetration are all considered rural. According to OOTR, mobile subscription penetration had reached 89 percent of the population (though data for end-2014 indicates 237,411 active SIM cards, representing a mobile penetration level of 124 percent).

Figure 2.2: Percentage of households with a mobile telephone

Note: Data is from Census (1997, 2001, 2006 and 2011) and household survey (2009). Data for intervening years are estimated based on annual average growth rates between surveys.
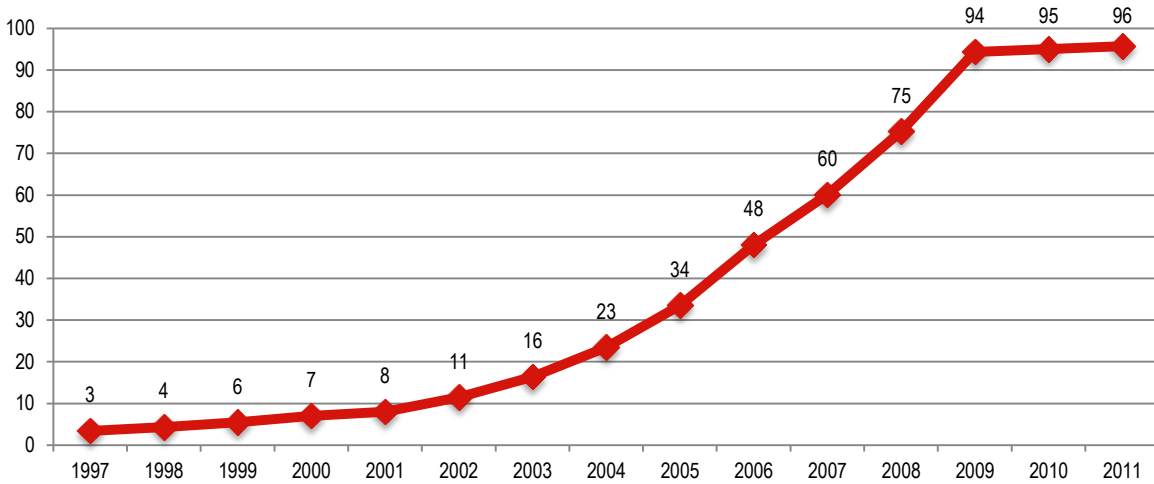Source: Adapted from Samoa Bureau of Statistics.

The percentage of the population that can receive a GSM mobile signal has risen in tandem with household penetration from 80% at Digicel's launch to 95% by 2014 (Figure 2.3). It would appear that coverage rather than affordability is currently the biggest barrier to higher levels of penetration. Although mobile tariffs have not changed significantly over the last few years, household penetration continues to rise, albeit slowly. Note that household penetration is higher than the coverage rate suggesting that although some households do not have coverage, they nonetheless possess a mobile phone and use it when they are within signal range. It is notable that there has been no increase in coverage since 2010 suggesting that the remaining uncovered areas must be uneconomic from the perspective of the mobile operators.

Figure 2.3: Mobile coverage (% of population that can receive 2G mobile signal)
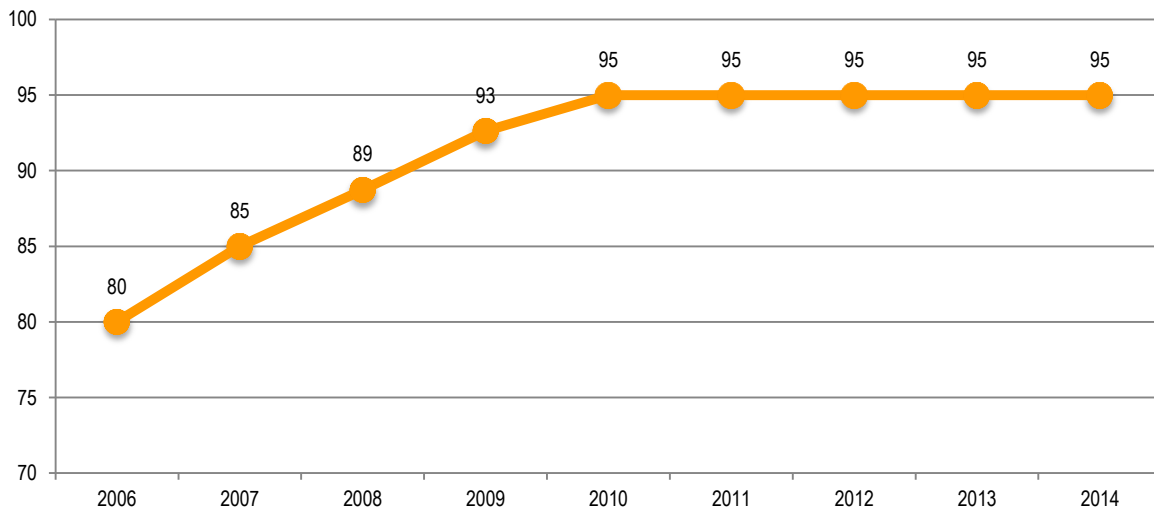
Source: Adapted from Digicel, Bluesky and OOR.

Despite competition, published mobile tariffs have actually increased slightly since 2003 (Figure 2.4 left). A monthly basket of prepaid calls and text amounted to 5.5% of income in 2014, down from 2003 but the same level as 2008. The affordability of mobile services has only increased due to rising incomes rather than drops in published prices with per

capita income increasing by over 100% between 2003 and 2013 (Figure 2.4, right). The rigidity of published mobile prices is somewhat surprising given that mobile termination rates for voice calls declined by 27% and for text messages by 30% in 2013. It is not clear whether there is a link between affordability, which has not improved since 2008 and household penetration, which has barely budged since 2009. It could be that actual prices are better reflected by ongoing promotions but not passing price drops on to published prices makes it difficult to compare trends over time. Since traffic data is not available, it is not possible to gauge how tariffs are affecting usage.

Figure 2.4: Mobile prices and GDP per capita
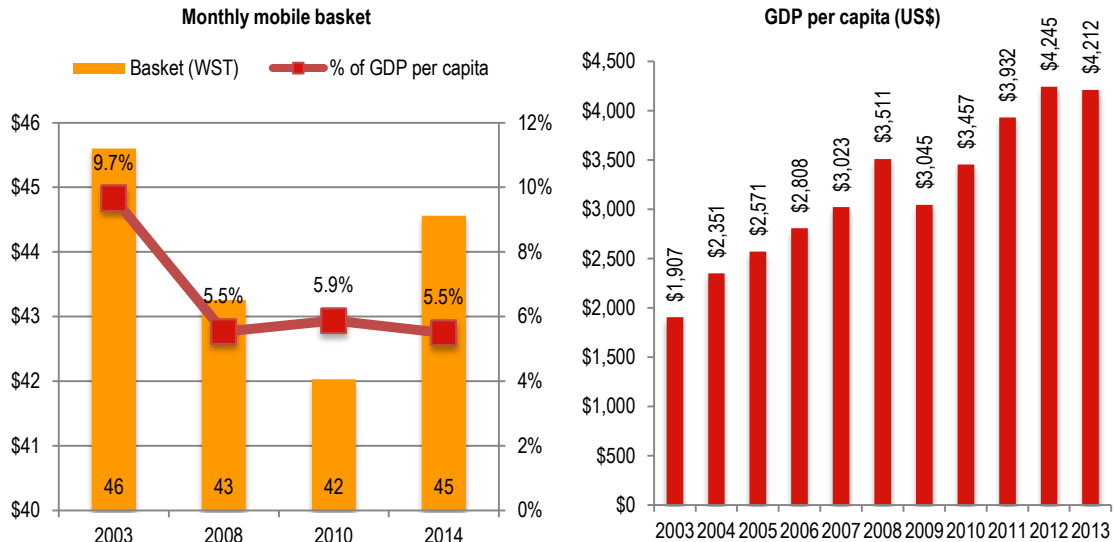
Note: Affordability calculation for 2014 in the left chart is based on 2013 GDP per capita, the latest available at the time of this report.
Source: Adapted from operator web sites (left chart) and World Bank (right chart).
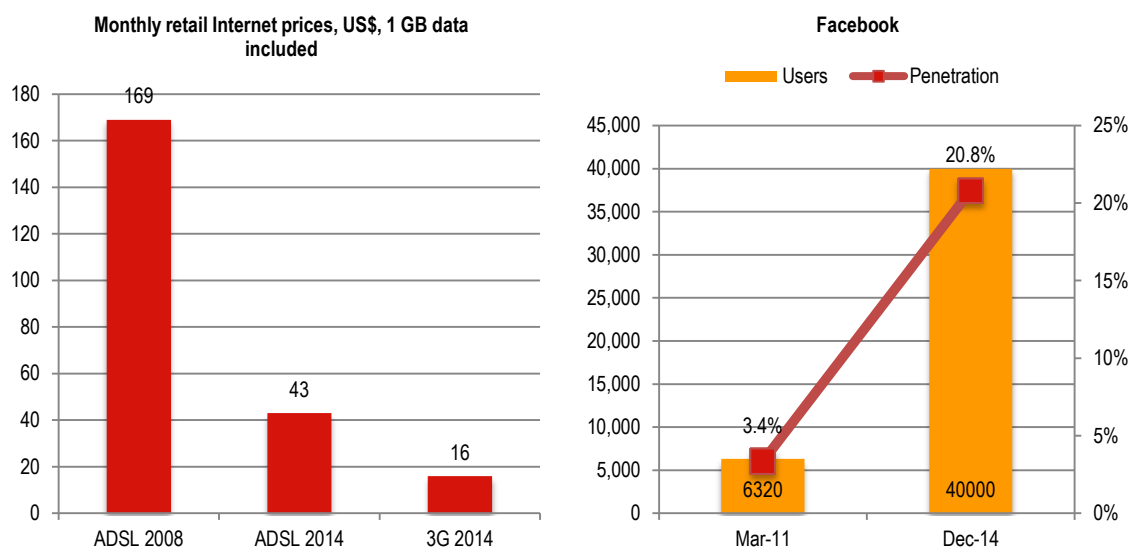
2.4 Internet

In 1998 Computer Service Ltd (CSL), established to provide computing services to the government, launched Samoa's first dial-up Internet service, later followed by Lesa Telecommunication Services. A third Internet provider, iPasifika was launched in 2000. Since then Bluesky has launched fixed broadband using ADSL technology. Both mobile operators launched mobile broadband in 2011 using HSPA+ technology with theoretical download speeds of 21 Mbit/s.[3] According to operators, population coverage of 3G is 73%. Today there are four Internet Service Providers (ISPs): the two mobile operators, CSL and Lesa with access available over the mobile networks, dial-up and ADSL using the telephone network and fixed wireless using Wimax. However, Internet access is lagging significantly, which impacts the potential for connectivity to external markets. Broadband penetration was estimated at about 1 percent (fixed) and 27 percent (mobile).

Pricing generally varies by data usage rather than speed or technology. Internet tariffs have dropped significantly since 2008 when an entry-level ADSL subscription was US$169. In 2014, a monthly ADSL subscription was US$ 43 whereas 1 GB per month using mobile Internet was US$16 (Figure 2.5, left).

The 2011 Census reported that 7% of households had Internet access, a figure believed not to include access via mobile networks and definitely not including access at work places and schools. According to Facebook, 40,000 Samoans were using the social network in December 2014 or 21% of the population, up over 500% from March 2011 (Figure 2.5, right).

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[3] Bluesky's announcement of the network launch is here: eLandia. "Bluesky launches first 4G networks in Samoa and American Samoa." *Press Release*. 19 December 2011. http://files.shareholder.com/downloads/ELAN/0x0x529861/88ba72e0-546d-42a5-b7c6-28da7f122b17/ELAN_News_2011_12_21_eLandia.pdf. Note that it was referred to as a "4G" launch but according to the regulator, the HSPA+ network did not meet the International Telecommunication Union criteria for that technology. Bluesky and Digicel were ordered to refrain from advertising the HSPA+ network as 4G. See: "Bluesky accepts 4G ruling." *Samoa Observer*. 8 December 2012. http://www.samoaobserver.ws/local-news/35-business-trading/2391-bluesky-accepts-4g-ruling-

Figure 2.5: Internet prices and Facebook users

Source: Adapted from Bluesky, Digicel and Facebook.

In an effort to boost Internet penetration in rural areas, the government started a telecentre project in 2006 with the support of the International Telecommunication Union (ITU). Around ten telecentres ("Fesootai centres") were established in rural parts of Upolu and Savai'i and mainly operated by women. Given the rapid growth in mobile penetration over the last few years and availability of mobile broadband it is uncertain how utilised these centres are.

The MCIT issued the National Broadband Policy in 2012 calling for higher penetration of high-speed services. Possible government support for expanding access include PPPs, subsidies and tax relief as well as increasing international connectivity through a second submarine cable. The MCIT proposed broadband adoption targets for 2015 and 2020 (Table 2.1).

Table 2.1: Broadband Adoption Targets

2015				2020	
	Households	Businesses		Households	Businesses
Urban	11-20%	~30%	Urban	31-40%	~60%
Rural	0-10%	11-20%	Rural	21-30%	~40%

Source: MCIT 2012.

2.5 Backbone networks

In 2009, the Samoa-American-Samoa (SAS) fibre optic submarine cable was completed. This provides Samoa with international Internet bandwidth connectivity to Hawaii via American Samoa, increasing capacity by more than 40 times. The project was different than other cable deployments. In the case of SAS, the unused PACRIM East cable between Hawaii and New Zealand was moved and refurbished, reducing costs. Because PACRIM East was the first fibre optic cable across the Pacific, the technology is somewhat antiquated and capacity is limited to 1.1 Gbit/s.

The owners of the SAS cable are the American Samoa Government and eLandia, Bluesky's parent company. Despite the launch of the cable, Digicel continues to use satellite for a significant portion of its international Internet bandwidth and has contracted capacity with O3b.[4] The major reason is the wholesale cost of submarine cable access of approximately US$1,500 Mbps/month. According to MCIT, Samoa had 135 Mbit/s of international Internet capacity in 2011. The government has requested assistance from the Asian Development Bank and World Bank for a second submarine cable linking Samoa to Fiji, given the need for a longer-term fibre optical solution and the benefit of redundancy.[5] Demand for Internet services is expected to grow to 4 Gbps by 2021 and 29 Gbps by 2028. This demand will be driven both by increased household/individual use for high-bandwidth applications such as streaming video and multimedia, and institutional use, including from government institutions.

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[4] http://www.o3bnetworks.com/content/digicel-group/
[5] Ministry of Information and Communication Technology. 2015. *Samoa Submarine Cable Project*.
http://www.fintel.com.fj/userfiles/file/150414%20Final%20Draft%20IEE%20Report%20-%20Fintel.pdf

Bluesky's domestic backbone network is primarily underground fibre optic cable, which is generally resilient to cyclone-related hazards. Some domestic transmission is conducted over microwave, generally in less densely populated areas. Digicel has a metropolitan fibre loop in Apia and uses microwave for backhaul in other areas as well as leasing fibre from the Electric Power Corporation. The government has a backbone network discussed in Section 4.1.

There are plans to create an Internet Exchange Point that would reduce the need for international bandwidth by keeping locally destined data traffic within the country. This would also improve quality by reducing latency. OOTR organised a workshop on this subject in November 2014.[6]

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[6] http://www.regulator.gov.ws/ixp

3 Economic Impact

Valued added of the communications sector (comprising telecommunications and postal services) was WST 73 (US$31) million in 2014 (current prices) (Figure 3.1, left). The sector's contribution to GDP was 5.0% in 2009 but had dropped to below 4% in 2014 (Figure 3.1, right). The contribution of the communications sector has dropped due to greater competition stimulating a faster reduction in prices than growth in demand and usage. Nevertheless, according to the Bureau of Statistics the communications sector directly contributed 0.4% to Samoa's GDP growth rate in the fourth quarter of 2014.[7]

Figure 3.1: Communications sector value added
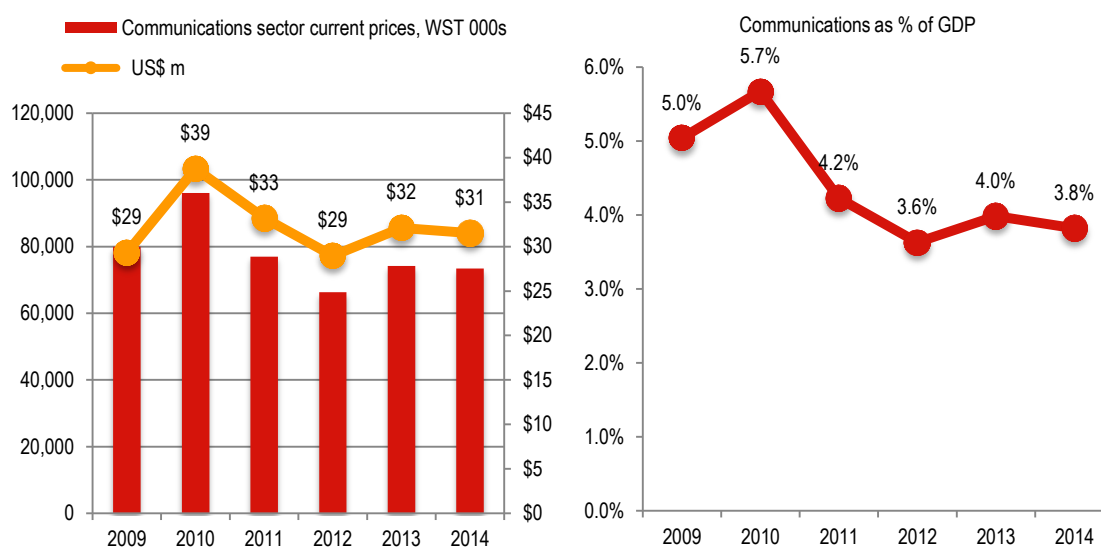
Note: Fiscal years ending in the year shown.
Source: Adapted from Samoa Bureau of Statistics.

National data on investments in the telecommunication sector is not available. There was significant capital expenditure for the submarine cable and landing station and rollout of GSM and 3G+ by the two mobile operators. The total cost for the deployment of Digicel's GSM network was US$42 million.[8]

The World Bank has calculated the impact on consumer welfare from the introduction of the second mobile operator. Results are shown in the table below. The analysis suggests that the introduction of the second mobile operator created between $20 million and $51 million in consumer welfare. The World Bank also estimates that its support project generated a profit of US$2.4 million from the sale of SamoaTel (World Bank 2011).

Table 3.1: Estimation of consumer welfare gains from introduction of mobile competition

	Conservative	Optimistic
Price elasticity	0.28	0.1109
Subscribers in 2005	24,000	24,000
Subscribers in 2009	151,000	151,000
Price/month 2009 ($)	8.75	8.75
Increase in welfare (2005-2009)	**$20.03 million**	**$50.56 million**

Source: World Bank.

It is not possible to calculate the indirect impact of ICT on the Samoan economy. Although the Samoa Bureau of Statistics is one of the few in the region to compile quarterly national accounts data, it does not produce data on Gross Fixed Capital Formation, a key input to models for estimating the economic impact of ICTs.

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[7] Samoa Bureau of Statistics. Gross Domestic Product. December 2014 Quarter.
[8] See IFC. Digicel Samoa: Summary of Proposed Investment at
http://ifcextapps.ifc.org/ifcext/spiwebsite1.nsf/78e3b305216fcdba85257a8b0075079d/118193a124f50a6b852576c10080cd0e?opendocument

4 Sector Impacts

4.1 Government

The primary focus of government use of ICTs has been to enhance connectivity in order to carry out administrative processes more efficiently. The Samoan National Broadband Highway (SNBH) is the government communications network linking offices throughout Apia as well as other locations. Launched in June 2014, the network was financed through a US$20 million loan from China's Export Import Bank.[9] SNBH uses fibre optic cable and microwave for backhaul and fibre, Wi-Fi and the country's first implementation of 4G LTE for local access.

A government portal provides a link to ministry web sites.[10] Some services aimed at business have been brought online such as customs declarations. The land registry is computerised reducing the time required to register property by four months. However, in general most business interactions with government remain manual resulting in extra time and money to carry out. Citizen services such as requests for civil registry documents (e.g., birth, marriage or death certificates) must be made in person at government offices in Apia entailing travel costs and time for citizens.

One important mobile-based application is the disaster warning system. Text messages are sent to key leaders such as village mayors, church ministers, teachers and others to inform the public. Mobile text advertisements are used for local elections and National Provident Fund members can check contributions and loan balances via SMS.[11]

4.2 Education

Several ICT initiatives have been deployed in the educational sector including distribution of laptops, computer labs and e-learning.

In 2009, a One Laptop per Child (OLPC) pilot was launched involving the provision of laptops to two primary schools in Savaii. In May 2010 48 XO laptops were deployed to children at Laumoli Primary School and 27 XO laptops to Paia Primary School plus additional laptops for teachers.[12] Despite initial enthusiasm for the project, it was not completely successful and the laptops are rarely used today. The laptops were mainly used for students to learn how to use computers rather than being incorporated into learning. Challenges included technical issues and isolation of the schools.

The SchoolNet project was supported by the ADB with the aim of incorporating e-learning in secondary schools. It started as a pilot in 2005 and today all 39 secondary schools are connected using a mix of ADSL and wireless solutions. SchoolNet incorporates digital resources for teaching Math, Science and English using content from Learnetic.[13]

Although schools have Internet access, the use of local servers ensures centralised control over all equipment, remotely monitored over a wide area Intranet. This reduces technical support issues and Internet access costs. One of the indicators for project monitoring was that students' learning outcomes were to be improved by 2%. Neither the selection of indicators to measure this nor the necessary analysis has been carried out due to project delays. Further, education staff indicate that several years are required after the intervention before the impacts become observable. The Community Access component of the project has not been satisfactorily implemented. This was to allow the local community to use the school's computers after school hours.

Parallel to the SchoolNet, Samoa has been continually increasing the number of computers in schools. Unlike the SchoolNet equipment consisting of thin clients connected to servers in learning centres in secondary schools, the computer labs use Windows-based computers and are installed in both primary and secondary schools. By 2014, there were 607 computers in primary schools and 1,153 in secondary schools. There were 14 secondary schools with a computer studies curriculum in the 2014 school year. Computer Studies is one of the Year 12 exam subjects and in 2014, 1,083 students took the exam. One would assume a relationship between rising school computer penetration and test scores and that is somewhat the case. However, in 2013, test scores plummeted[14] raising questions about the impact of the school computers on computer science proficiency.

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[9] Lance Polu. "Samoa's National Broadband Highway Launched." *Talamua*. 26 June 2014. http://www.talamua.com/samoas-national-broadband-highway-launched/

[10] www.samoagovt.ws/directories/government-ministries

[11] See "Digicel SMS Service for NPF Members" at http://npf.ws/digicelservice

[12] http://wiki.laptop.org/images/0/0a/Volunteers_report_August_2010_-_olpc_Samoa_deployments.pdf

[13] http://www.learnetic.com

[14] Ministry of Education, Sports & Culture. 2014. *Education Statistical Digest*. http://www.mesc.gov.ws/pdf/Stats%20Digest%20Draft%202014_FINAL_Core.pdf

Figure 4.1: Computers in secondary schools and Computer Studies test scores
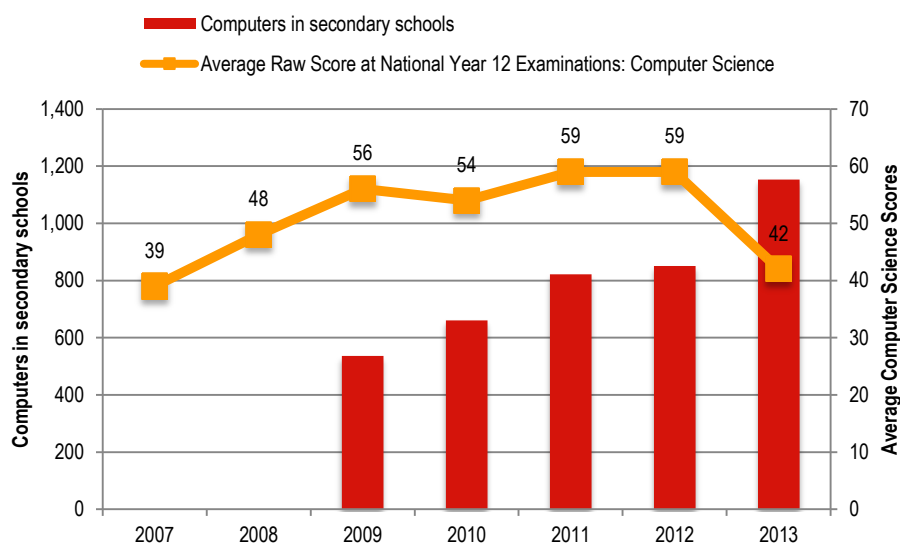
Source: Adapted from MESC, Education Statistical Digest.

4.3 Health

The Ministry of Health is in the process of developing an e-health strategy. Meanwhile the main hospital in Apia and eight district hospitals have been connected to the SBNH facilitating exchange of information. Previously nurses had to bring written files to Apia to be incorporated into the ministry's databases. There are few applications aimed at citizens such as telemedicine or use of mobile phone text alerts for reminders and appointments. One challenge with existing systems is the shortage of programmers both in house as well as freelance in the country. As a result, some information systems have had to be abandoned since the original software developers left the country.

The University of Auckland is planning a tobacco cessation program based on the mobile phone mCessation application used in New Zealand and the United Kingdom.[15] They aim to deliver the program to 100 participants and carry out an evaluation assessing its impact on encouraging participants to stop smoking.

4.4 Agriculture and fishery

The Ministry of Agriculture and Fisheries (MAF) ICT initiatives have mainly focused on connecting its own departments and enhancing administrative processes. The main outreach program for farmers is disseminating information about crops primarily via radio. There are plans to develop a call centre for farmers and fishermen. The ministry's web site was receiving 370 visits a month in November 2014 and its Facebook page has almost an equal number of "Likes" (377).

The Bureau of Statistics publishes a monthly survey on its web site with prices and volumes of around a dozen agricultural products available at local markets around Apia.[16] This information is disseminated by MAF in its radio broadcasts. Following the 2009 tsunami, which caused widespread destruction, a program was implemented so that farmers could receive credit on their mobile phones for purchasing equipment from selected retailers.[17]

Women in Business Development Inc, a Samoan NGO, is developing a smartphone app aimed at the some 600 organic farms in the country.[18] Initially aimed at field staff, the idea is then to disseminate the app to the farmers themselves. Developed specifically for the Samoan language, the app is linked to a database with information on farmers, fair trade rules, etc. The app provides advice to farmers such as when to harvest and information about organic fertilizers and pesticides. Finding programmers to develop the app has been a challenge so overseas developers are used. Coordination is difficult and software developers abroad are unfamiliar with local contexts. The ultimate aim is to encourage innovation and raise awareness of the farm to table movement and growing popularity of organic food in order to change perceptions about agricultural work.

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[15] University of New Zealand. "Pacific mCessation."
[16] Samoa Bureau of Statistics. 2014. *Local Market Survey*.
1/10/14http://www.sbs.gov.ws/index.php?option=com_advlisting&view=download&fileId=1391&Itemid=164
[17] World Bank. "Mobile Technology Helping Cyclone Evan Recovery in Samoa." *Feature Story*. December 11, 2014.
http://www.worldbank.org/en/news/feature/2014/12/11/mobile-technology-helping-cyclone-evan-recovery-in-samoa
[18] "Samoa develops smartphone app to help organic farmers." 2014. Accessed November 9.
http://www.radioaustralia.net.au/international/radio/program/pacific-beat/samoa-develops-smartphone-app-to-help-organic-farmers/1206602.
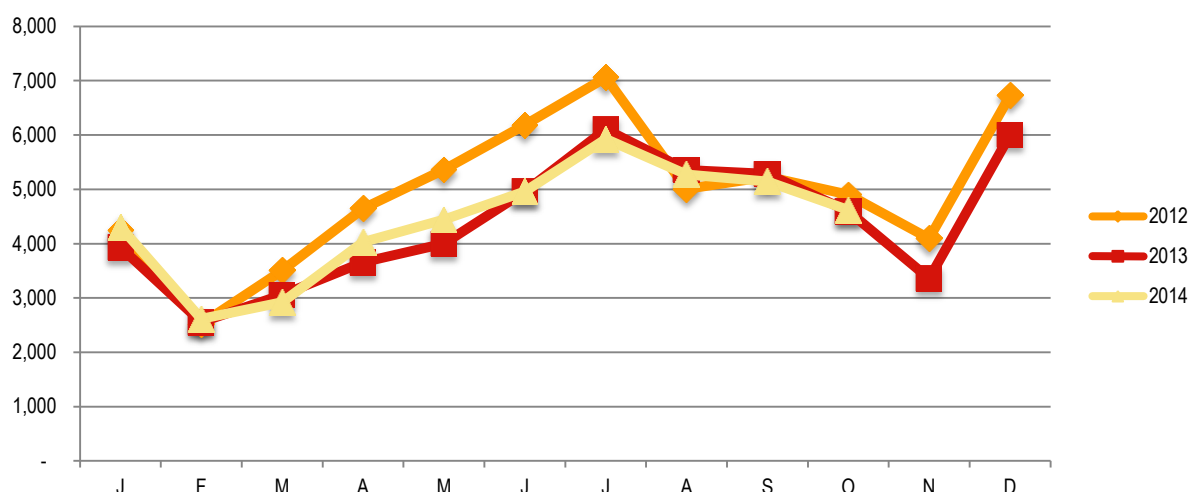
4.5 Tourism

Like other Pacific economies, tourism is significant in Samoa. There were 130,955 tourist arrivals in 2014 compared to the population of just under 200,000. Tourism expenditures accounted for 20.5% of the economy between 2010-2013 and a growing portion of employment (2,471 in 2011 or 5.5% of total employment).[19]

The Samoa Tourism Authority (STA) has several initiatives aimed at incorporating ICTs into its operations. Its web site (www.samoa.travel) includes an accommodation portal. This allows STA to market smaller properties that would find it difficult to be listed on large travel directories due to fees and other requirements. These smaller properties are often beach "fales" run by Samoan households aimed at budget conscious tourists. The portal not only has a description of the accommodation but also provides an online payment facility, something that smaller tourist businesses run by Samoans lack. When these properties are contacted via email, they send clients to the STA site to pay. Some 70 places to stay are listed on the site with around 190 orders a year. The STA provides training for accommodation owners on how to upload information to the system. According to the STA, their site generates the most traffic in the Samoan tourism industry. STA also has an online shopping site for Samoan products.

The STA has been using a New Zealand company, Electric Art, for its software development needs due to a lack of in-country capacity. One relevant initiative is an online video campaign Electric Art ran for STA in the first quarter of 2013. They aired the STA video on five sites (YouTube, Facebook, Stuff.co.nz, TVNZ On Demand and Mediaworks On Demand). According to Electric Art, the video was played over 350,000 times generating more than 10,000 clicks, and reportedly selling a significant number of travel packages.[20] However there does not appear to be any perceptible increase in tourists from New Zealand in the more than one-year period after the online ad.

Figure 4.2: Tourist arrivals from New Zealand

Source: Adapted from Bureau of Statistics.

There are several mobile apps for Samoan tourism. Triposo, developed by a former Google employee, has a guide for Samoa available for Android and iOS smartphones.[21] STA worked with the company Polynesian Xplorer to develop Samoa Smart Guide an app for Android smartphones.[22] The guide works offline so there is no need for the user to have Internet access but it can still make use of the smartphone's GPS to locate attractions on a map.

Mobile operators leverage tourist revenues for their services by placing kiosks at the international airport so that SIM cards can be purchased on arrival. Due to high roaming charges, a growing number of tourists are buying local SIM airtime, particularly attractive since the SIM cards are free. For example, roaming charges for tourists with a United States mobile subscription are high compared to local rates, particularly for text messages and data (Table 4.4).

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[19] Central Bank of Samoa. Tourism and remittance economies: Prospects for inclusive growth. Case of Samoa.
[20] http://www.electricart.co.nz/p1080/samoa-tourism-online-video-campaign
[21] http://www.triposo.com/loc/Samoa
[22] https://play.google.com/store/apps/details?id=com.samoa_polynesian_xplorer.guide&hl=en

Table 4.1: Roaming versus local rates, US$, November 2014

	Roamer with a United States mobile subscription	Samoa local rates
Local call (per minute)	0.20	0.19 (Peak)
Text message	0.50	0.09
Data (per MB)	15.00	0.02

Source: Adapted from Digicel (1 day bundle for data) and T-Mobile USA.

4.6 Financial inclusion

Digicel launched its mobile money product in 2011. By September 2011, there were 656 active users.[23] Take-up has been slow and it is estimated that only around 1-2% of subscribers are currently using the service. According to the Central Bank of Samoa, during the 2011-2012 financial year, SAT$0.8 million was created in mobile money accounts served by 57 cash-in/out agents.[24] The main barrier appears to be a lack of confidence in mobile wallets compared to cash. Mobile banking services from ANZ, NBS and Westpac can also be accessed using cell phones, further reducing the need to use mobile money services. Mobile money has also been used for development initiatives as demonstrated by the conditional cash transfer program for farmers mentioned above.

One of the main attractions of the mobile money service is the low remittance fee for Samoans in Australia, New Zealand or the UK who want to transfer money back home. According to the 2008 HIES, 11% of households reported receiving remittances as a source of income. Money transfers from abroad are critically important for Samoa with World Bank data showing remittances amounting to US$138 in 2014 accounting for 24% of GDP. Digicel collaborates with KlickEx Pacific for overseas remittances, which allows users in Australia or New Zealand to send funds to mobile phones in Samoa in less than one hour. Compared to banks and traditional money transfer operators, KlickEx Pacific is the least expensive method to transfer money from New Zealand to Samoa (Figure 4.3).

Figure 4.3: Cost of sending NZ$200 to Samoa, December 2014

	Fee (NZ$)	Total cost (NZ$)*	Total cost (%)
Bank average	20.50	38.73	19.37
Money Transfer Operator average	7.53	17.46	8.73
Digicel/Klickex	3.00	8.95	4.47

Note: * Transaction fee plus margin on foreign exchange transaction.
Source: www.sendmoneypacific.com [Accessed 5 January 2015].

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[23] Pacific Financial Inclusion Programme (PFIP). 2011. "Brief Project Update for Investment Committee."
[24] Central Bank of Samoa. *2011-12 Annual Report*. http://www.cbs.gov.ws/index.php/media/publications/annual-reports/

5 Business Case for Public Investment

The main public sector investment will be to support improved access to regional connectivity through the planned investment by WB, ADB, DFAT and the Samoan private sector in a new Samoa-Fiji cable to be ready for service late 2016/early 2017. This is a US$42 million investment that will connect Upolu and Sava'i to the SCCN at Suva, Fiji .The project will be implemented by the Samoa Submarine Cable Co which is currently being established. Financing for the project is expected to be approved by the WB's board in June 2015 and by the ADB's board in Sept 2015. The project will also support capacity development for the OOTR particularly in areas related to wholesale pricing, open access etc.

There is a case to be made for public support in non-infrastructure areas. This includes technical assistance in the areas of regulation, particularly models for cost-based access to key facilities such as submarine cables. There is also a need for the development of back office systems using common data architectures and protocols with solid security to mitigate risks in government in order to create the foundation for the delivery of online public services.

Software development is another area where there appears to be a major gap. There is little push by the government or private sector to foster this area with the result that applications leveraging the take up in ICTs, particularly mobile telephony, are lacking. This is particularly true in areas that could have a significant impact on people's lives such as health, public service delivery, agriculture and fishery. One factor for the low level of impactful applications is a lack of domestic expertise and hence reliance on overseas software developers. SMEs and NGOs often cannot find local software developers and lack the budget to employ programmers overseas. Support could be envisioned for promoting a software sector through innovation hubs, incubators, labs, etc. and enhancing ICT skills development in post-secondary institutions.

Table 5.1: ICT-related development assistance, 2003-2013

Donor	Project	Amount (US$ million)	Year	Comment
ADB	Samoa Schoolnet and Community Access Pilot Project[25]	0.655	2003	Grant supporting ICT in schools.
ADB AusAID NZaid	Schoolnet and Community Access Project[26]	5.9	2007	Grant supporting ICT in schools.
World Bank	Telecommunications and Postal Sector Reform Project	4.5	2002	Grant supporting sector liberalisation.
UNDP	ICT for Development	0.2	2006	Several ICT related projects
China	Samoa National Broadband Highway (SNBH)	20	2011	Loan from Export Import Bank for constructing government backbone network.[27]
ITU	ICT for Development	0.02	2006	Assistance for community telecentres
IFC	Digicel Samoa	8.2	2007	Loan for financing GSM network deployment
IFC	Digicel Samoa 2	10.5	2009	Loan for financing GSM network deployment

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[25] http://adb.org/projects/details?proj_id=36513-022&page=overview
[26] 36513-032: Schoolnet and Community Access Project at http://www.adb.org/sites/default/files/project-document/65299/36513-sam-grj.pdf
[27] "Government launches the National Broadband Highway." 2014. Talamua On-line. Accessed November 12. http://www.talamua.com/government-launches-the-national-broadband-highway/.

6 Conclusions

Samoa has made a tremendous leap in connectivity over the last decade. The introduction of two mobile operators has radically boosted access to cellphones, connection to submarine cable has alleviated international bandwidth concerns to some extent and many government institutions are now connected to a dedicated network. There is a universal consensus that a key impact has been the ability of citizens to access information easily, be more informed and stay in touch with families and friends more readily. Applications in education and tourism have demonstrated the use of ICTs in those sectors although impacts remain uncertain.

Many of these developments are the result of development support. The World Bank was critical in assistance for sector reform, Digicel's network was partially funded with IFC support, and the ADB has been instrumental in the SchoolNet project. Bi-lateral assistance has also been noteworthy particularly Chinese support for development of the government backbone.

There remain a number of areas hindering better usage of ICTs in the country. While improved connectivity has enhanced government administrative processes, there is scarce concrete evidence of ICT interventions directly affecting citizens in areas such as agriculture, government services and health. Undersea fibre optic connectivity has increased bandwidth for the country but the potential is limited due to market and technical constraints. Digital literacy across the public and skilled software developers is lacking.

There is a need to operationalise practical solutions outlining how all communities can access broadband services at affordable prices as called for in the Universal Access and National Broadband policies. There is also a need for effective regulatory oversight that encourages open access and cost-based wholesale bandwidth pricing. Widespread availability of e-services across different sectors needs to be encouraged through support of the software developer ecosystem including deeper capacity building initiatives to develop an ICT skilled workforce. These steps will ensure the country generates the impacts available from the growth in its mobile and broadband infrastructure.

Appendix

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List of Meetings

Apia, 10-13 November 2014

Government
Office of the Regulator, Donnie De Freitas, Regulator

Bureau of Statistics, Muagututia Sefuiva Reupena, Government Statistician

Ministry of Communications & Information Technology, Tua'imalo Asamu Ah Sam, CEO

Ministry of Agriculture and Fisheries, Policy, Planning and Communications Division

Ministry of Health, Sarah A Faletoese Su'a, Policy & Research Division

Samoa Tourism Authority, Pativaine Petaia-Tevita, Manager, Finance & Corporate Services

Ministry of Education, Sports and Culture, Rosemarie Esera, ICT Coordinator

Private sector
Bluesky American Samoa, Adolfo Montenegro, Chief Executive Officer

Bluesky Samoa, Alex Abraham, Chief Technology Officer

Digicel Samoa, Pepe Fia'ailetoa Christian Fruean, Chief Executive Officer

Development partners & others
Asian Development Bank, Antonia Wang, Administrative Assistant

National University of Samoa, Ioana Tuugalei Chan Mow, Faculty of Science

Women in Business Development, Faumuina Tafuna'i, Media Officer

SOLOMON ISLANDS
COUNTRY
REPORT

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1 Country Background

The Solomon Islands is made up of 992 islands (of which around 90 are inhabited) divided into nine provinces (Figure 1.1). According to the 2009 Census, the population was 515,870. The capital Honiara is located in the province of Guadalcanal with a population of 64,609. Some four fifths of the country's inhabitants reside in rural areas. The population was 547,787 in 2012, an increase of 6% since the census.

GDP per capita was US$1,954 in 2013, classifying the Solomon Islands as a lower-middle income economy. Subsistence agriculture is the main livelihood with less than a quarter of the population engaged in paid work.[1] The primary sector is an important part of the economy with logging a major source of exports. Tourism has considerable potential but currently is not yet as developed as in other South Pacific countries. There were some 24,000-tourist arrivals by plane in 2013. Personal travel receipts were SI$ 252 million in 2013 or 3.5% of GDP. Similarly, remittances play a smaller role in the Solomon Islands than other Pacific countries. Though increasing sharply since 2011, remittances totalled US$16 million in 2014 or 1.5% of GDP.

Following several years of ethnic tensions and a coup, in 2003, the government requested the Regional Assistance Mission to Solomon Islands (RAMSI) to help restore order. Members of the Pacific Island Forum support RAMSI with Australia taking the lead and providing most of the funding. Since 2013, RAMSI's main activity has been supporting the Royal Solomon Islands Police Force.

Figure 1.1: Map of Solomon Islands
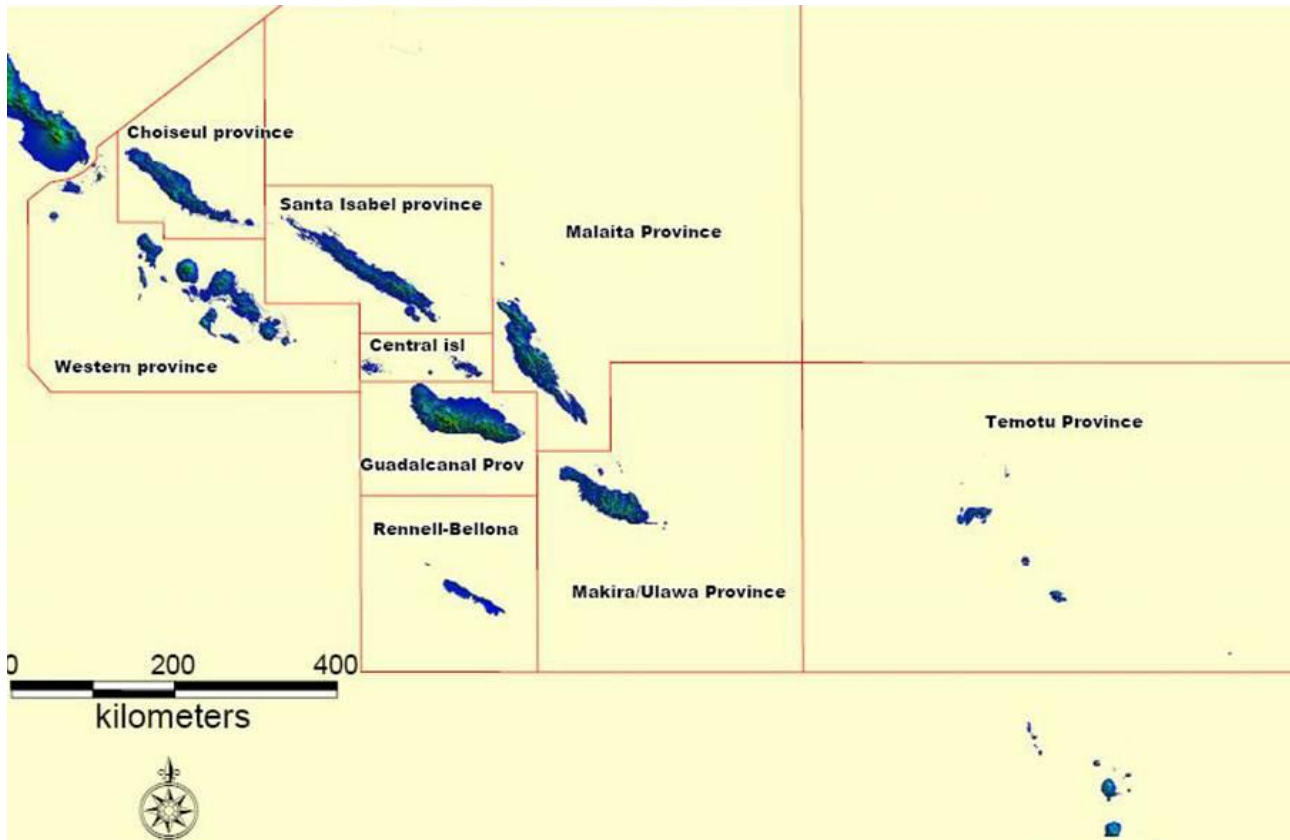
Source: National Statistical Office.

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[1] Department of Foreign Affairs and Trade. "Solomon Islands country brief."
http://www.dfat.gov.au/geo/solomon_islands/solomon_islands_brief.html

2 ICT Market

2.1 Industry structure, regulation and liberalisation

The Telecommunications Act of 2009 laid the path for sector liberalisation by introducing competition. The Act also established an independent regulatory agency, the Telecommunications Commission of the Solomon Islands (TCSI). Australia and the World Bank have provided significant assistance for sector reform.

A 2009 Settlement Arrangement ended the exclusivities of Solomon Telekom, the incumbent telecommunications operator. Solomon Telekom was a joint venture between the government and Cable and Wireless of the United Kingdom. Most of the government's shares held by the Investment Corporation of the Solomon Islands (ICSI) were transferred to the National Provident Fund (NPF) so that at the end of 2013 NPF owned 64.7%, Cable and Wireless Communications (CWC) 32.6% and ICSI 2.7%. In 2014, CWC sold its shareholding to NPF.[2] Solomon Telekom provides a suite of services including landlines, mobile cellular and Internet access under the Our Telekom brand.

Bmobile Limited, a mobile operator from Papua New Guinea, entered the market in 2010. Bmobile has a partnership agreement with the Vodafone Group of the UK.[3] The company received funding from the Asian Development Bank (ADB), making Bmobile the first private sector investment by the regional development agency in the Solomon Islands. According to project documents, the ADB took a six percent equity stake in Bmobile for up to US$9 million and made a loan of up to US$40 million available (ADB 2011). The funds were distributed to the parent company located in Papua New Guinea and there is no detail about how much was invested in the Solomon Islands operation.

Note that TCSI now operates a class services licensing regime so the sector is open to multiple operators deploying different technologies. An earlier proposal for a third individual GSM mobile license was abandoned in the face of objections. (TCSI 2012).

2.2 Voice

Solomon Telekom launched its GSM network in September 2003. Bmobile started operation some seven years later, in August 2010. Until the arrival of Bmobile, mobile coverage was essentially limited to urban areas with only ten percent of the population within reach of a mobile signal. According to TCSI, subscription penetration rose five times between 2009 and 2011 from less than 10% of the population to just over half (Figure 2.1, left). By 2013, it is estimated that almost 60% of the population owned a mobile phone (Figure 2.1, right).

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[2] On 15 October 2014, CWC announced that it had agreed to divest its 32.577% shareholding in Solomon Telekom to the Solomon Islands National Provident Fund Board for approximately US$16.5 million. The transaction completed on 24 October 2014. See: CWC. *Announcement*. 6 November 2014.
http://www.cwc.com/assets/uploads/files/IR/Results%20Announcements/CWC%20Interim%20Results%20Announcement%20November%202014.pdf
[3] "Vodafone and Bemobile announce partner market agreement in Papua New Guinea and the Solomon Islands." *News Release*. 10 July 2014.
http://www.vodafone.com/content/index/media/vodafone-group-releases/2014/bemobile.html

Figure 2.1: Mobile access
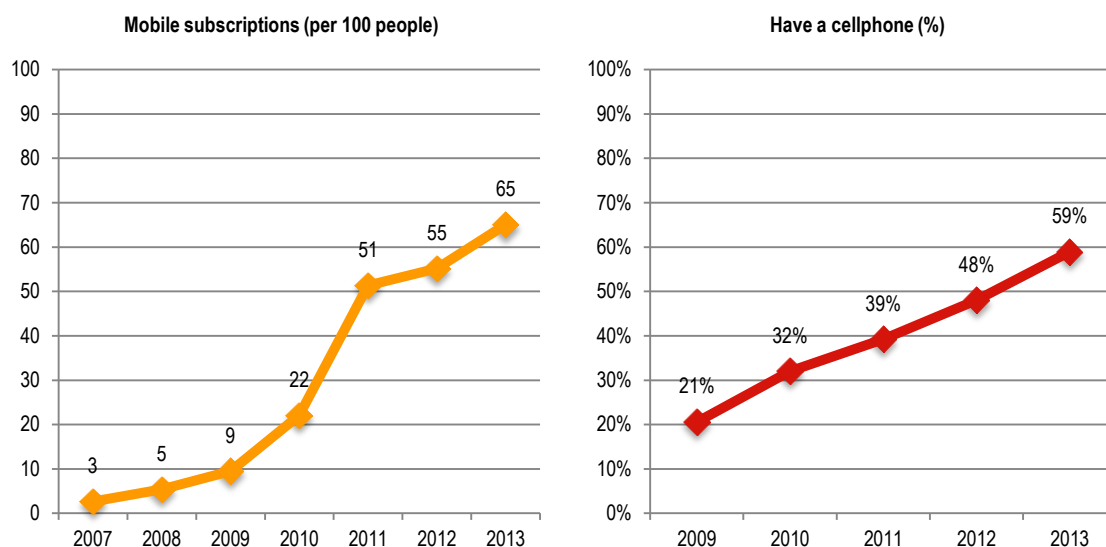
Note: The left chart is based on data from Cable & Wireless, TCSI and World Bank. Data for the right chart has been compiled from several sources. The 2009 figure is from the census and refers to the percentage of households with a mobile phone; we estimate that at that time, there was only one individual in the household with a mobile. The 2010 data is based on 1,229 respondents who replied they personally owned a mobile phone; the survey was national representative of those 14 years, older, and carried out in the capital and five provinces in March and April. 2013 is from the People's Survey asking respondents if they owned a mobile phone; it is based on interviewing 3,403 people. Intervening years have been estimated using growth rates.
Source: Adapted from Cable & Wireless, TCSI, Tebbutt Research, People's Survey. World Bank and National Statistics Office.

According to the People's Survey, only two percent of the population had a landline in 2013 (Table 2.1). There are large differences in phone ownership between provinces, across islands and between urban and rural areas. Some four fifths of people in Honiara had a mobile compared to less than a third on the rest of Guadalcanal. On the other hand, there appear to be small differences in access to mobile phones between men and women.

Table 2.1: Phone ownership, 2013

Province	Landline	Mobile	None
Guadalcanal	0.3	31.5	68.4
Honiara	3.8	82.8	16.9
Honiara Settlements	5.3	78.4	21.2
Malaita	1.4	55.0	44.9
Western	1.5	62.7	37.2
Age/gender group			
Man	3.6	57.0	42.8
Woman	1.2	57.0	42.7
Young Man	1.9	60.0	39.9
Young Woman	1.2	61.7	38.2
All	2.0	58.9	40.9

Note: Based on a survey of 3,403 people.
Source: People's Survey.

Coverage of mobile networks has grown sharply reaching just over 80% of the population by 2014 (Figure 2.2, right). The gap between mobile use (59% in 2013) and coverage suggests there is considerable scope for increasing access particularly on outer islands. Affordability is a constraining factor with a monthly basket of services equivalent to over 10 percent of per capita income. Prices are less than half of what they were in 2008. However there has been no change in published prices in the last three years so affordability is only rising slowly in line with increases in per capita income. However, it should be noted that there are ongoing promotions with prices lower than the published tariffs including as of April 2015, unlimited mobile data packages. The regulator's view of the pricing evidence is that affordability is continuing to rise because of the competitive process, regardless of whether incomes are rising.

It is not clear whether current market and regulatory conditions are sufficient for the mobile operators to deploy network coverage to certain parts of the country that are economically unviable.

Figure 2.2: Mobile coverage and prices
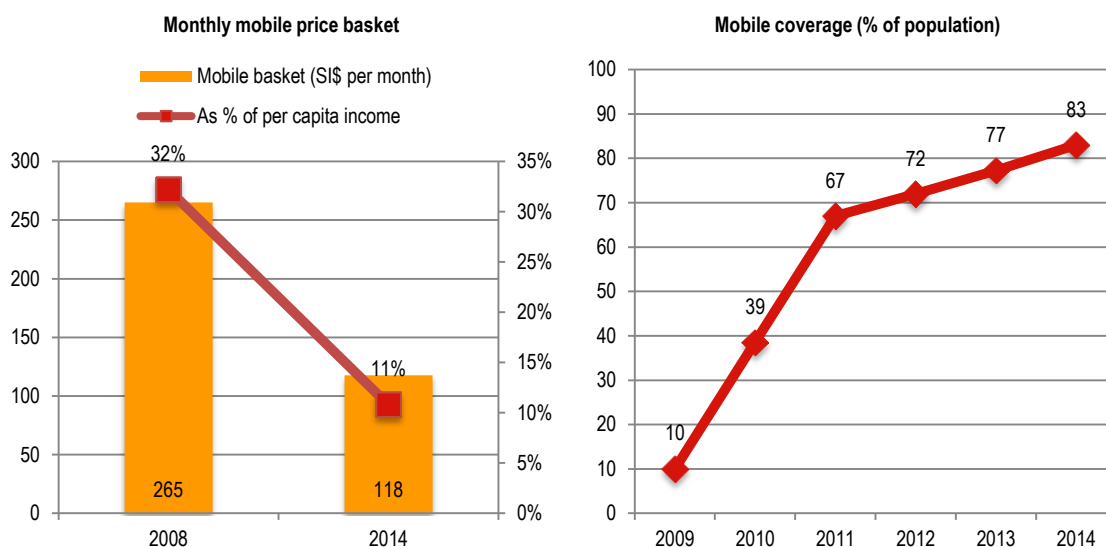
Note: Mobile prices are for Solomon Telekom and refer to a basket of calls (on and off net) and text messages using the OECD low user methodology. Per capita income of 2012 is used to derive 2014 affordability. Coverage data for 2009, 2011 and 2014 is from TCSI; other years have been estimated based on growth rates. Source: Solomon Telekom, TCSI.

2.3 Internet

There are three Internet Service Providers (ISPs). Solomon Telekom offers ADSL broadband service in Honiara, Auki and Gizo. In addition, dial-up service is available from any landline. In the third quarter of 2011, both Solomon Telekom and Bmobile launched 3G (HSDPA) wireless broadband services in Honiara. As of 2014, 3G was available in Honiara, Auki and Gizo, where 15% of the population resides according to the 2009 Census. Most of the other islands have 2G Internet access (i.e., GPRS and EDGE) except locations where solar-powered base stations are utilised. Satsol, a satellite TV provider, also offers Internet services. It uses WiMAX technology and offers three uncapped packages at different speeds (128 kb/s, 256 kb/s and 512 kb/s).

Solomon Telekom had around 1,000 fixed broadband subscriptions in September 2013. According to the GSMA, there were 58,000 mobile broadband subscriptions in the country at the end of 2013.

Options for accessing the Internet and coverage have increased over the last few years. Mobile Internet is generally available wherever there is coverage, albeit at low speeds outside urban areas. Internet access prices have dropped to some extent since 2008. Solomon Telekom charged SI$827 (US$107) for one GB of data in 2008 (using ADSL) compared to SI$ 500 (US$68) today.

However, Internet prices remain high relative to per capita incomes. This is alleviated somewhat by mobile data plans, which vary in price according to data consumption and validity. Speeds have increased since 2008 when an entry-level ADSL plan offered 128 kbps. In early December 2014 Telekom's 3G network in Honiara was averaging download speeds of 1.3 Mbit/s.[4] It should be noted that broadband speeds are only available in urban areas and users in the rest of the country must make do with significantly slower access.

Internet use has jumped over the last few years. The number of Facebook users more than doubled between March 2011 and December 2014 from 14,000 to 32,000 (Figure 2.3). According to the People's Survey, 13% of those with a cellphone were using it to access Facebook or the Internet in 2013.

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[4] Average of six speed tests carried using an iPhone 5S.

Figure 2.3: Internet prices and Facebook users
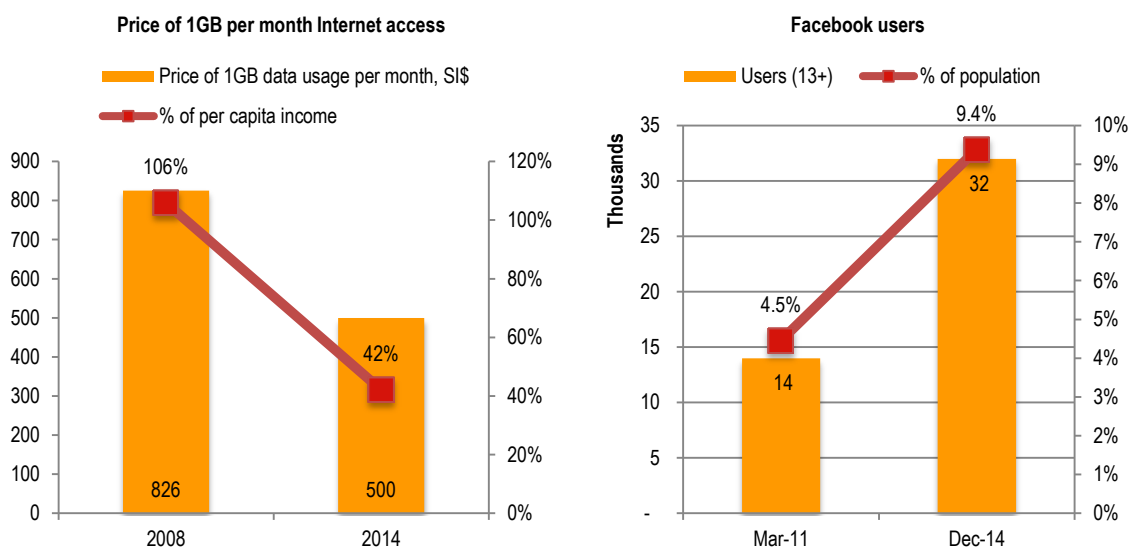
Note: Data in left chart refer to Solomon Telekom. Prices for 2008 are for a 128 kbit/s download package over ADSL. Prices for 2014 are for mobile data.
Source: Adapted from Solomon Telekom and Facebook.

2.4 Backbone networks

International connectivity is via satellite using several providers. Solomon Telekom recently signed a deal with O3b to use their satellite service, which reportedly rivals "the throughput and latency of fibre".[5] International bandwidth was 230 Mb/s in 2014 (TCSI 2014). Microwave is used for some domestic backhaul routes but is not a feasible nationwide solution since many islands are too far away. Domestic satellite is utilised for these locations.

Plans are underway to deploy an undersea fibre optic cable. The Solomons Oceanic Cable Company (SOCC) has been formed to manage and operate the cable. The proposed route is a cable from Honiara to Sydney; a spur to Vanuatu (Interchange network) is also being considered. In addition to Honiara, there will be two other domestic landing points (Auki and Noro) and branching units could be made available for Papua New Guinea, Vanuatu and New Caledonia. The Asian Development Bank (ADB) will provide US$18 million through a mix of loan and grant to the project. The shareholders in SOCC (51% National Provident Fund and 49% Solomon Telekom) will contribute to the cost of the cable including borrowing from commercial banks. Construction is scheduled for 2015 with anticipated deployment in mid-2016. The ADB expects the impact of the cable will result in wholesale bandwidth prices halving, "leading to a conservatively estimated retail price reduction of 20%."[6]

2.5 Observation

Liberalisation of the telecom sector leading to mobile competition had a dramatic impact on cellphone coverage and access. The improvement is highlighted in an assessment carried out for Australian development assistance projects noting "there could be significant development benefits from further access to digitalised technology across Solomon Islands."[7] Respondents in the 2011 People's Survey reported that after no change, communications had the most significant impact on their life (Figure 2.4, left). Interestingly, over 40% of respondents reported that the change made things worse (Figure 2.4, right) with negative impacts such as already limited household income diverted to paying for mobile services and access to offensive content (Box 2.1).

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[5] O3b Networks. 2014. "O3b announces agreement with Our Telekom for Solomon Islands." *Press Release*. http://www.o3bnetworks.com/media-centre/press-releases/2014/o3b-announces-agreement-with-our-telekom-for-solomon-islands.
[6] ADB. 2012. *Proposed Loan and Grant Solomon Islands: Broadband for Development Project.* http://www.adb.org/sites/default/files/project-document/74026/44382-022-sol-rrp.pdf
[7] Solomon Islands – Australia Partnership for Development. Independent Performance Assessment Panel Assessment for 2012

Figure 2.4: Most significant change in Solomon Islanders lives and effect of change in communications, 2011

Most significant changes in peoples' lives, 2011

Effect of change in communications, 2011
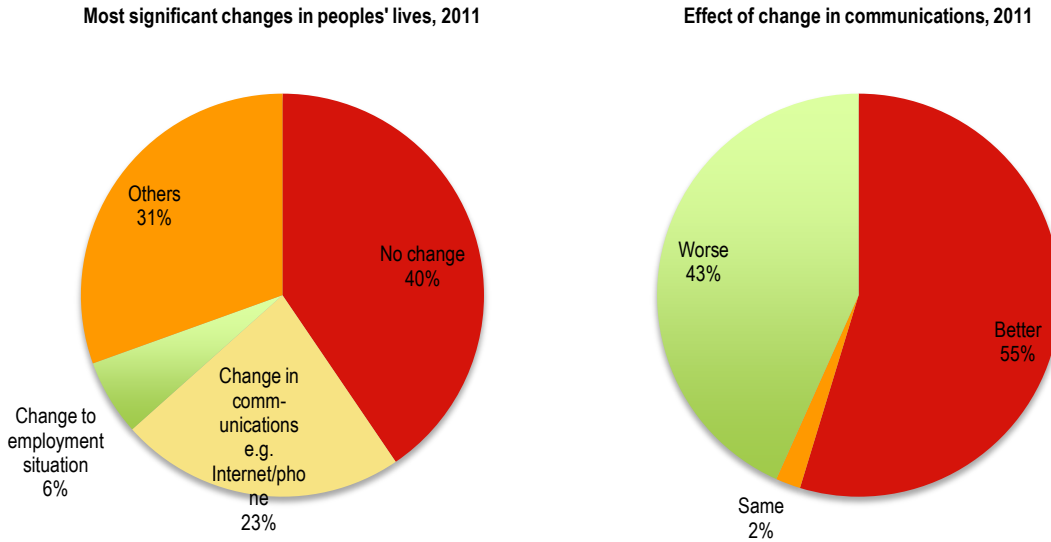
Source: People's Survey

Box 2.1: Positive and negative impacts of increased mobile communications

The establishment of Telekom's 3G network and entry of Bmobile into the market in competition with Telekom in the last year has clearly had a major impact on many Solomon Island communities. Observations in Honiara and provinces reflect an enormous uptake of mobile phones in the past year. Coverage has improved markedly and costs have come down significantly for mobile phone services, although not for internet, which is still a Telekom monopoly, and expensive and unreliable. Phone 'top up' locations are widespread and provide a new source of livelihoods for small stores and canteens.

Reported negative aspects of this improvement in communications include the expense of maintaining a phone, unreliable connections, 'sex texts', opportunities for mobile dating, facilitation of illicit affairs (O2s) and pornography. World Bank FGD7 comments from Malaita that mobile phones increase 'O2 business' and family break up were confirmed by People's Survey FGDs.

Another concern raised was that people may be unaware that they are spending substantial amounts of household income on mobile phone services, and this may impact on their capacity to purchase food and other essentials. They also mentioned that wantoks may pressure them to pay for 'top ups'. There were fewer mentions of problems than advantages, however. Being able to communicate with family members elsewhere and receive immediate information about important life events, such as births, deaths and illness, was especially valued by respondents.

Source: People's Survey 2011.

3 Economic Impacts

The value added of the communications sector in the Solomon Islands was SI$ 67 (US$ 9) million in 2012 in current prices or 0.9% of GDP (Figure 3.1, left). The sector's contribution has declined from 2.5% in current prices in 2007. The drop is noticeable after 2010 when mobile competition was introduced. The drop would be explained by prices falling due to competition. While access grew, particularly for mobile communications, newer subscribers tend to be less affluent without sufficient usage to maintain operator revenue.

On the other hand, in constant prices, the contribution of the communications sector has remained the same since 2007 at 2.6% of GDP. This is explained by the fact that price increases have been non-existent in communications compared to other sectors allowing it to maintain its share of the economy in inflation-adjusted terms. The communications sector directly contributed between 2.3%-3.3% to real GDP growth between 2008 and 2012 (Figure 3.1, right). Due to the relatively recent introduction of mobile telephony and broadband Internet access and the lack of quarterly GDP data, there are not sufficient data points to measure the indirect economic impact of ICT.

Figure 3.1: Communications sector and GDP
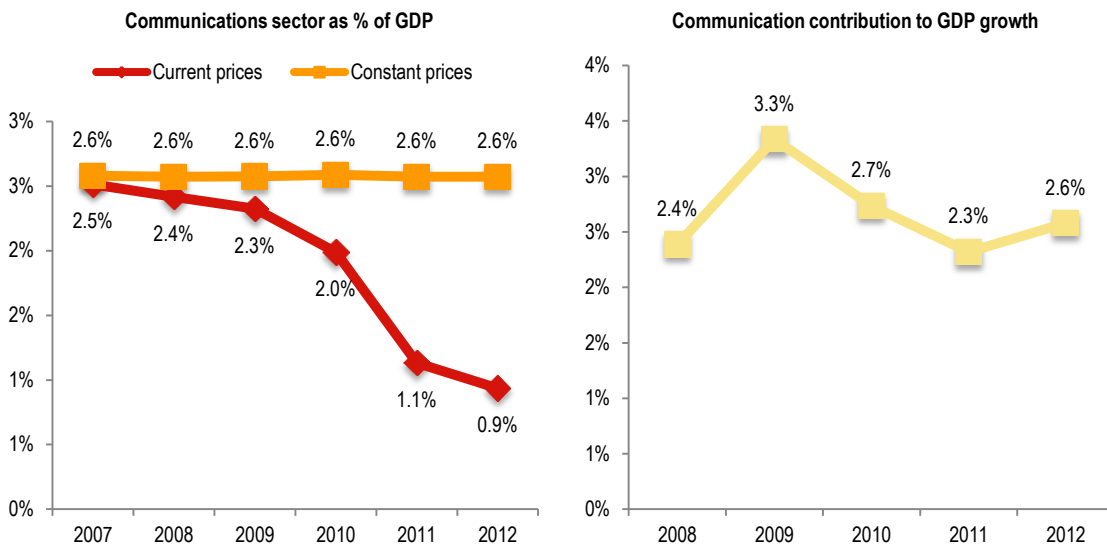
Source: National Statistics Office.

The two main telecommunication operators had around 460 staff between them in 2014. This figure is equivalent to 0.8% of the salaried work force in the country (based on 2009 Census, the latest year available). In addition, the operators supplement the income of hundreds of small shop owners who sell airtime.

4 Impact Across Different Sectors

4.1 Government

A wireless (WiMAX) metropolitan area network (MAN) has been implemented for government offices in Honiara. The AUD 3.25 million project was financed by the Australian government[8] and is managed by the Ministry of Finance ICT Support Unit (ICTSU). The Solomon Islands Government (SIG) Connect Network links around 85 government offices and was completed in May 2014. It provides staff with official email addresses, access to the Internet, virus protection in addition to Internet access. SIG Connect has saved money by reducing the cost of communications and improving efficiency although there are no specific figures available. At the same time, there have been some negative repercussions and computerisation has not been accompanied by significant process reorganisation or online service delivery (Box 4.1).

There are few examples of public e- or m-services in the Solomon Islands. One exception is biometric voter registration (BVR) used for the 2014 election. Citizens were photographed and fingerprinted with information stored in a database. Both a web site and text messages were used to provide information to voters. The web site allowed users to check their registration, watch videos to see how to vote and review candidate lists. A text message campaign was used to inform the public about candidates, voting procedures and locations of polling stations. The Electoral Commission cited the importance of the BVR system for registering over 80% of the eligible voting population.[9]

Box 4.1: ICTs and public service

Public servants mentioned the impact of computer technology, mobile phones and the internet on the work of the Public Service. All had access to computers in their workplace. They said computer technology, mobile phones and the internet have all made work faster, easier and more effective. Even so, many considered that technology has reduced face-to-face communication and many officers use the internet inappropriately. Use of the internet and mobile phones during working hours for private purposes was criticised by most participants. Despite extensive computerisation within the Public Service, most participants said procedures are still slow and complex, especially recruitment, payroll, allowances, transfers and housing. Procedures were also considered to be ineffective and confusing and participants were very critical of the time it takes to process applications.

Source: People's Survey 2011

4.2 Education

The Ministry of Education and Human Resources Development (MEHRD) uses the Solomon Islands Education Management Information System (SIEMIS) to capture key information about schools, teachers and students. Surveys are sent out to schools once a year. Very few are returned in electronic format and most are sent by mail or personally delivered to the ministry. The ministry is one of the few that has its own web site (www.mehrd.com) and is supported by two IT staff.

A One Laptop per Child (OLPC) trial began in July 2008 at three primary schools in Marovo Lagoon, Western Province with students and teachers receiving 375 XO laptops. The Australian Council for Educational Research (ACER) was commissioned by the (MEHRD) to undertake an evaluation of the trial. The assessment consisted mainly of qualitative interviews with teachers, students, parents and community members. An MEHRD monitoring and evaluation framework was used to evaluate the program (Table 4.1). Despite the relatively positive findings, the program was not scaled up.

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[8] "CBO Completes Solomon Islands Government Rollout." July 2013. http://www.cbo.net.au/2013/07/cbo-completes-solomon-islands-government-rollout/
[9] See: "SIEC Releases Provisional Voters List" at http://www.siec.gov.sb/index.php/journalist/18-siec-releases-provisional-voters-list

Table 4.1: OPLC evaluation

Objective	MEHRD Objective	ACER
1	Raise awareness about OLPC and the objectives of the trial	In general, awareness has been raised about the OLPC program, its vision and its functions.
2	Assess the impact of OLPC in the area of teaching and learning	Evidence to date indicates that there has been a positive impact in the pilot schools and that this should continue to strengthen.
3	Assess the impact of OLPC on enrolment or attendance (Objective 3)	Teachers and parents believe that the program is positively influencing student attendance.
4	Assess the impact of OLPC in delivering/producing new curriculum materials/learning content (Objective 4)	The OLPC program is leading to an increasing demand for the development of new and appropriate curriculum materials.
5	Assess if OLPC/XO technology is technically feasible and sustainable (Objective 5)	While there are some 'teething' and other difficulties with the technology, and a need for further technical support, the program is proving to be both feasible and sustainable.
6	Assess the impact of capacity building for teachers (and learners) in the OLPC project	While teachers have indicated a need for further and ongoing training and professional learning opportunities, the program has increased their professional capacity.
7	Assess the impact of OLPC on student learning, and school environment	The program is regarded in a positive light by schools and their communities.
8	Assess the impact of OLPC/XO technology on the community	There is considerable interest and involvement in the program by the school communities.

Source: ACER 2010.

ADB, with funding from Republic of Korea e-Asia and Knowledge Partnership Fund, is supporting an ICT program for schools with a grant of US$500,000 (ADB 2013). The "Information and Communication Technology for Better Education Services" project aims to develop applications and administrative systems and assist with the acquisition of mobile phone and related devices and service usage charges. A mix of technologies—including cell phones, tablets, and radio—will be investigated to test implementation of the applications and find the best options for the local school context. The project is targeting 100 pilot schools in three provinces.

4.3 Health

The Ministry of Health and Medical Services is connected to the SIG-Connect network. This has improved reporting for the District Health Information System (DHIS). A database is used to manage information such as discharge information from hospitals with plans to widen the scope such as including diagnosis. The ministry uses "mSupply" [10] for pharmaceutical inventories and a Picture Archiving and Communication System (PACS) for xrays and radiology (creates digital images which can be sent to ward doctor).

4.4 Agriculture and fishery

Though the Ministry of Agriculture recognises the potential of ICT in the sector, little has been achieved due to a lack of capacity and funding. The ministry does not have a web site although it has an internal server and information can be accessed from the ministry's intranet. It produces a once a week 15-minute radio show on different agricultural topics. Exposure to such programs is extremely limited with less than 1% of those with a radio listening to agricultural programs in 2013 (2013 People's Survey).

Extension offices in provincial capitals are connected to the Internet and email is used to exchange information. Connectivity is weak at lower levels and most extension workers lack electricity let alone computers. The ministry would like to equip extension workers with smartphones and tablets to share information with farmers. This is particularly relevant since graphical and video information could be provided, deemed to have greater impact given the number of languages and low literacy in rural areas.

The Ministry of Fisheries and Marine Resources is comparatively advanced in its use of ICT. Tablets are used to input fish prices from markets in Honiara and Gizo and transferred to the ministry's Integrated Fisheries Information Management System (IFIMS) for analysis. There is a MoU with Solomon Telekom to receive a discount on Internet access. Tablets are also used to monitor fishing. Staff go out on boats to observe and input data such as catches, take digital photos and record locations using GPS as well as monitor illegal, unreported and unregulated (IUU) fishing. Locations of all fishing boats in the region can be monitored from computer displays in the central command post in the ministry's headquarters.

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[10] http://msupply.org.nz

4.5 Tourism

The Solomon Islands Visitors Bureau has a web site (www.visitsolomons.com.sb) with considerable content for tourists. It includes listings for a range of accommodations from five star resorts to eco lodges, providing information about the property including contact details. The site is designed by a New Zealand company.

4.6 Financial inclusion

According to the 2011 People's Survey, only a quarter of the population had a bank account. Financial inclusion is therefore a key development priority for the Solomon Islands. The rapid growth in cellphones ownership has tremendous potential for reducing the unbanked. Banking using mobile phones was launched in 2013 by three financial institutions providing services over the network of Solomon Telekom (Westpac "banking on the go", ANZ "goMoney" and BSP "Branchless Banking"). The services use Unstructured Supplementary Services Data (USSD), which works on 99% of handsets and does not require Internet access. Clients can use their handsets to transfer money to bank accounts, check balances, pay bills and top up phone credit.

The impact of mobile money has been immediate since launch in 2013. According to the Central Bank of the Solomon Islands, 15,127 branchless banking accounts were opened in the country in 2013 (Table 4.2). This accounted for almost half of all new bank accounts that year helping towards the financial inclusion goal of 70,000 new bank accounts between 2011 and 2015.

Table 4.2: Number of new accounts opened by commercial banks, 2011-2013

	2011	2012	2013
Total new deposit accounts opened at bank branches	8,235	21,896	16,788
Total new accounts opened using branchless banking channels	0	0	15,127
Total new accounts opened each year	8,235	21,896	31,915
Total year to date	8,235	30,131	62,046

Source: Central Bank of Solomon Islands.

5 Business Case for Public Investment

There has been extensive assistance by donors over the last few years to support ICT in the Solomon Islands (Table 5.1). Australia and the World Bank provided grants of totaling US$6 million to develop laws introducing competition in the sector and support a new regulator. On the infrastructure side, RAMSI granted US$3.2 for the development of the government network[11] and the ADB provided US$18 million in grants and loans for the planned submarine cable system. ADB also provided financing to Bmobile in the form of equity and loan for the expansion of its mobile network.[12] In the education sector, ADB provided a grant of US$0.5 million for developing software and providing ICT hardware to schools. In total, this assistance amounted to US$ 28 million.

It is extremely unlikely that the necessary reforms for liberalising the telecom sector in the country would have taken place without donor assistance, particularly funding aimed at institutional development. The reforms enabled competition, ushering in a rapid increase in access to ICTs, particularly mobile communications. Assistance for building a government network in Honiara has enhanced communications in the public sector with likely positive impacts in reducing costs and improving efficiency. Similar to sector reform, SIG lacked the funding to have built a backbone network on its own. It is also extremely unlikely that the private sector by itself would have the full financial resources to deploy a submarine cable.

In the future, it is *unlikely* that significant development assistance will be needed for ICT *infrastructure*. Access has risen and there remains scope in the short run to boost penetration by increasing competition. Eventually the point will be reached where the operators deem further network expansion not profitable. In that case, regulatory tools such as specifying rollout requirements in license conditions and a universal service fund to expand mobile coverage could be employed.[13]

There is scope for shifting development assistance from "hardware" to "software". The majority of the population now has a cellphone and Internet access has grown. However, applications in health, education and government to leverage this increase in connectivity are limited. There is a general lack of human capacity and financial resources to develop e-services. There is a need for more institutional support, including a National Chief Information Office, to implement the National ICT Policy.

Table 5.1: Key ICT development assistance, Solomon Islands, 2010-2013

Donor	Project	Amount (US$ m)	Year	Comment
RAMSI	SIG Connect14	3.2 (grant)	2013	Government backbone network
AusAid	Telecommunications and ICT Development Project	2.7 (grant)	2010	Support for TCSI
ADB	Information and Communication Technology for Better Education Services	0.5 (grant)	2013	Support for diffusion of ICT in schools
ADB	Broadband for Development Project15	10.5 (loan) 7.5 (grant)	2012	Financing of submarine cable
ADB	Bmobile expansion	...	2011	Support for Bmobile network
World Bank	Telecommunications and ICT Development Project16	3.3 (Grant)	2010	Support for TCSI
TOTAL		27.7		

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[11] "CBO Completes Solomon Islands Government Rollout." July 2013. http://www.cbo.net.au/2013/07/cbo-completes-solomon-islands-government-rollout/

[12] An equity investment (up to US$9 million and loan (up to US$40 million) was proposed for Bemobile which is headquartered in Papua New Guinea. No breakdown is available about the proportion invested in the Solomon Islands. See: ADB. 2011. *Proposed Equity Investment and Loan Bemobile Expansion Project (Papua New Guinea and Solomon Islands).*

[13] Indeed this is called for in the country's Telecommunications Act which states that areas eligible for universal access support include those where "the cost of providing telecommunications services in such areas apparently prevents their provision on a reasonable commercial basis." See "Telecommunications Act 2009" available at: http://www.tcsi.org.sb/downloads

[14] *Report to the Pacific Islands Forum on RAMSI activities 2013.* http://www.ramsi.org/wp-content/uploads/2014/07/RAMSI-2013-Activities-Report-to-PIF.pdf

[15] Asian Development Bank. 2012. *Project Agreement (Broadband for Development Project).* http://www.adb.org/sites/default/files/project-document/74989/44382-022-sol-pa1.pdf

[16] World Bank. "Solomon Islands: Telecommunications and ICT Development Project." *News.* April 6, 2010.
http://www.worldbank.org/en/news/loans-credits/2010/04/06/solomon-islands-telecommunications-and-ict-development-project

6 Conclusions

ICT access has improved significantly since liberalisation of the sector, largely supported by development partners. The percentage of population with a cellphone has increased from around 20% in 2009 to almost 60% in 2013 and Facebook users more than doubled between March 2011 and November 2014. Financial inclusion has expanded through the recent deployment of mobile banking.

The impact of sector reform on ICT access is evident. However, indirect ICT impacts in enhancing social and economic welfare and improving service delivery are often not quantifiable. This is partly due to limited monitoring and evaluation. For example, the SIG Connect network has enhanced communications and document exchange for the government, lowering costs and increasing efficiency, but these changes have not been quantified. Similarly, mobile phones have contributed to enhancement of safety through emergency calls, created opportunities for raising incomes from easier access to pricing information and lowered costs from ability to check transport schedules. However, the number of people this has affected, the cost, timesaving and income increases have not been captured in a systematic way.

There are few examples of enhanced service delivery through the Internet and mobile phone applications. This is in part due to the novelty of increased access to ICTs, which has only emerged in the last few years. Availability has improved but the applications have lagged. There is evidence of social networking with the rise in Facebook users but scarce evidence of agricultural, health, education or government electronically delivered services. Human and financial capacity to create and build socially beneficial applications is limited.

Although ICT usage has increased, it is far from ubiquitous. Around 15% of the population does not have access to 2G mobile services and some 85% are not covered by a mobile broadband signal. Service charges remain high compared to incomes. It is not clear that under current market conditions access to high-speed Internet access will be significantly increased. There is a need to intensify competition and operationalise universal access policy called for in the Telecommunications Act so that a greater number of Solomon Islanders can access and afford communications services and impacts can become more widespread. The submarine cable implementation is critical for reducing bandwidth pricing.

Appendix

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List of Meetings

Bmobile: Cliven Wale, Senior Financial Officer

Information Communication Technology Support Unit (ICTSU): Smith Iniakwala, Director; Paul Asitewa, Deputy Director-Technical; Beau Tydd, ICT Advisor

Ministry of Agriculture and Live Stock (MAL): Permanent Secretary, Mr Jimmy Saelea

Ministry of Culture & Tourism (MCT): John Walton Wasi, Permanent Secretary

Ministry of Education and Human Resource Development (MEHRD): James Bosamata, Deputy Secretary

Ministry of Finance & Treasury (FEDU): Dalcy Tozaka, Director,Financial Economic Development Unit

Ministry of Fisheries and Marine Resources (MFNR): Permanent Secretary, Dr. Christian Ramofafia

Ministry of Health and Medical Services (MHMS): Wayne Murray, Senior Health Planner

National Statistics Office: Douglas Kimie, Government Statistician

Solomon Telekom Company Limited: Keir Preedy, Chief Operating Officer

Solomons Oceanic Cable Company (SOCC): Robin Russell, Chief Executive Officer

Telecommunications Commission of Solomon Islands (TCSI): Bernard Hill, Commissioner

TONGA
COUNTRY
REPORT

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1 Country Background

The Kingdom of Tonga, the only constitutional monarchy among the Pacific Island countries and the only one to have never been colonised, is spread across 171 islands of which 48 are inhabited. According to the 2011 census, the kingdom's population was 103,252, an increase of 1.2% from the last census in 2006. The island of Tongatapu is home to 73% of the total population. Some 24,229 people or 23% make up the urban population, consisting of the capital of Nuku'alofa and surrounding areas. The population on 30 June 2012 was estimated at 103,219. Tonga is divided into five administrative island groups: Tongatapu, Vava'u, Ha'apai, 'Eua and the Niuas (Figure 1.1).

Tonga's Gross Domestic Product (GDP) per capita of US$4,427 in 2013 qualifies it as an upper middle-income economy.[1] A significant number of Tongans live abroad. Overseas remittances were US$61 million in 2013, accounting for 13% of GDP.[2] Tourism is the largest foreign exchange earner with 47,967 visitors in 2011/12 and tourism receipts of T$75 million in 2013 (around 10% of GDP).[3] Agricultural exports, including fish, make up two-thirds of total exports and the agricultural sector contributes almost 20% of GDP.

Figure 1.1: Map of Tonga

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[1] http://data.worldbank.org/about/country-and-lending-groups
[2] http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTDECPROSPECTS/0,,contentMDK:22759429~pagePK:64165401~piPK:64165026~theSitePK:476883,00.html#Remittances
[3] National Reserve Bank of Tonga, Quarterly Bulletin, June 2014

2 ICT Market

This chapter provides an overview of Tonga's telecommunication market environment as well as recent trends in voice and Internet access, pricing and coverage and status of backbone networks.

2.1 Industry structure, regulation and liberalisation

Tonga Communications Corporation (TCC), the country's incumbent carrier, was formed in 1978 to operate domestic telecommunications services with Cable and Wireless of the United Kingdom operating international services. In 2001, the assets of Cable and Wireless were purchased and merged with TCC. TCC is a state owned enterprise with around 300 employees in 2014. It reports 100% market share for landlines, 70% for fixed Internet access and over 50% for mobile services.[4]

The 2000 Communications Act established the basis for the introduction of competition in the telecommunications market. A second provider, Shoreline Communications Ltd., entered the market in 2002 offering various services including mobile (branded TonFon). In 2007, Irish-owned Digicel entered the market through its purchase of TonFon. Digicel had 100 full time employees in 2014.

The Ministry of Environment, Energy, Climate Change, Disaster Management, Meteorology, Information and Communication (MEECCDMMIC) is responsible for sector policy and for now, regulation. There are plans to create a separate regulatory unit. In conjunction with that, new legislation is being prepared including amendments to the Communications Act, a Communications Commission Act and a new Cybercrime Act as well as amendments to the copyright act and a new electronic transactions act.

2.2 Voice

TCC launched its GSM network in October 2001 branded as U-Call. Tonga became the first Pacific Island nation to introduce mobile competition when TonFon was awarded a license in 2002. Digicel acquired TonFon in December 2007 and re-launched service under its own name in May 2008 with an investment of US$20 million.[5]

Given that mobile competition had existed since 2002, penetration was already relatively high before Digicel's entry with cellphones available in 73% of households according to the 2006 Census. A year after Digicel entered the market the figure stood at 90% and by 2012 reached 95% (Figure 2.1).

Figure 2.1: Percentage of households with a mobile telephone
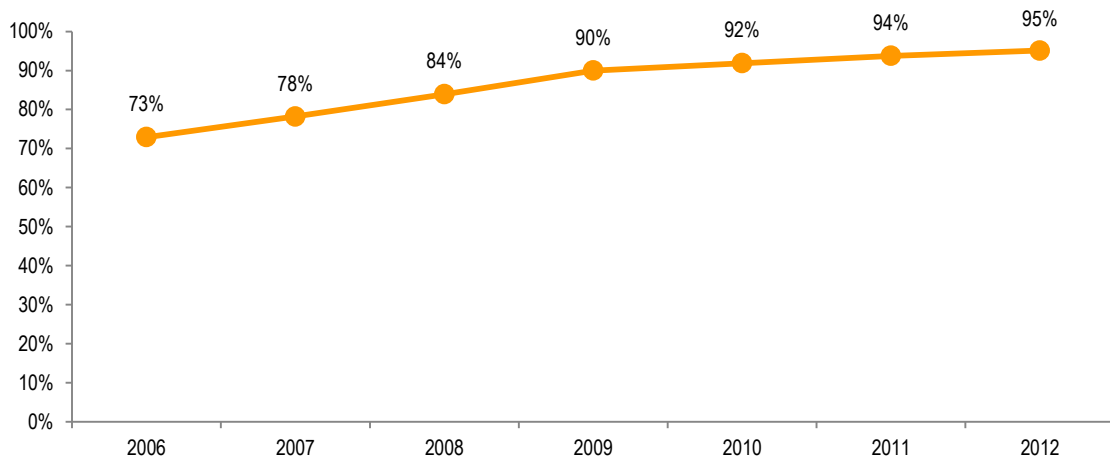
Note: 2006, 2009, 2011 and 2012 are from household surveys and the Census. Other years estimated from inter-survey growth rate.
Source: Adapted Tonga Department of Statistics.

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[4] See "About Us" at: http://www.tcc.to/index.php/aboutus/ [Accessed 1 May 2015]
[5] "Digicel Launches Its Bigger, Better Network in Tonga." *Market Wired*. May 7, 2008. http://www.marketwired.com/press-release/digicel-launches-its-bigger-better-network-in-tonga-853383.htm

Mobile population coverage is not regularly tracked in Tonga. Digicel's coverage map suggests that all of the island groups except for the Niuas are covered by at least a 2G mobile signal (Figure 2.2). This would imply that 98.2% of the population is covered by a Digicel mobile signal. TCC does not have a coverage map on its web site but states that it provides nationwide coverage.[6] This seems to be borne out by the fact that 61% of households in Niua reported having a mobile phone in 2011, implying that there was at least partial coverage in that island group.

Figure 2.2: Digicel 2G mobile coverage area, November 2014

Source: http://www.digiceltonga.com/en/coverage_roaming/coverage_map

Although a basket[7] of mobile prices decreased sharply following the introduction of competition in 2002, they subsequently increased and have not changed since 2006 despite the entry of Digicel in 2008 (Figure 2.3).

The increase is due to two factors: the introduction of the 15% Consumption Tax since 1 April 2005 and charging for text messages which prior to 2006 had been free. On the other hand, there is no longer a distinction between local and national long distance with a single nationwide calling rate implemented since 2010. A low user basket featuring a mix of on and off net calls at different times as well as 100 text messages works out to T$20 per month.

Despite the freeze in the basket price since 2006, affordability has slowly improved due to rising incomes and the basket as a percent of per capita income stood at three percent in 2014, but still above the period between 2003-2005. According to the household income expenditure survey carried out in 2009, average spending on mobile telephone service was T$60 per month or three times more than the basket. Therefore, tariffs per se do not appear to be a barrier to access. Given that 95% of households have a mobile phone, the main constraint to ubiquitous household penetration is covering the estimated remaining two percent of the population not within reach of a mobile signal.

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[6] "Rizvi Jurangpathy, acting Chief Executive Officer of the Tonga Communication Corporation (TCC) said that the mobile service now covered all of Tonga's small remote islands." See: "Tonga Launches New Mobile Network Covering Remote Islands." *Pacific Islands Report*. 8 August 2014. http://pidp.eastwestcenter.org/pireport/2014/August/08-08-16.htm

[7] This is based on the Organization for Economic Cooperation and Development (OECD) "30 calls" basket. The OECD methodology does not explain how to treat the situation where long distance mobile call prices differ from local mobile calls. It is assumed that the majority mobile calls in Tonga are inter-island and therefore the price of local mobile calls is used for the basket calculation. The OECD basket also includes calls to voicemail, which is excluded from the Tonga calculation. See: http://www.oecd.org/sti/broadband/48242089.pdf

Figure 2.3: Mobile prices (monthly prepaid basket)
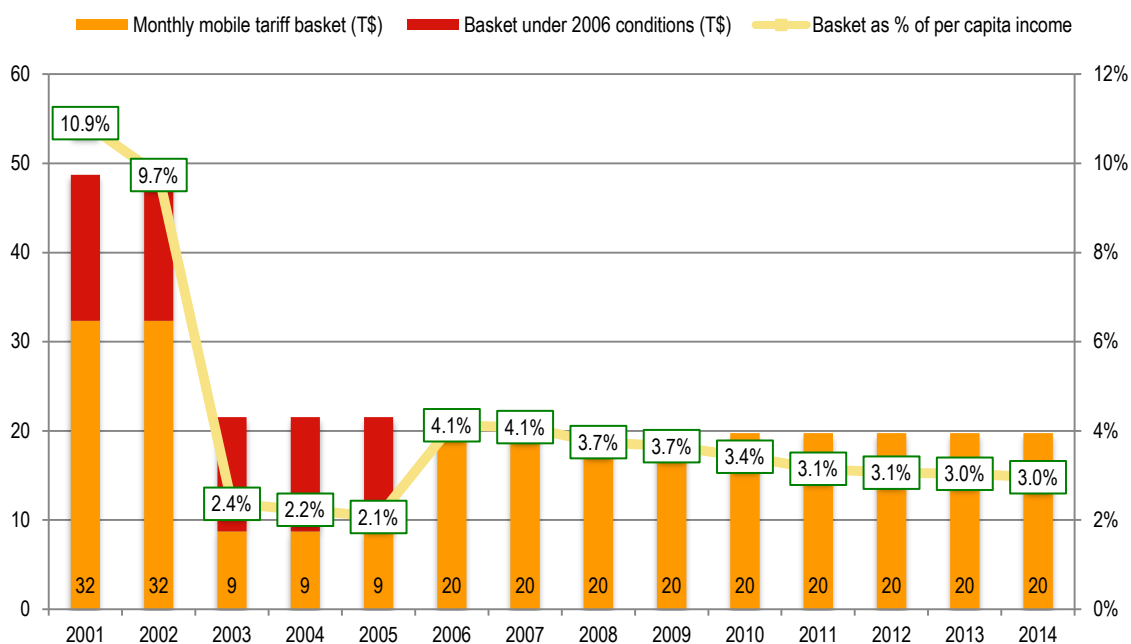
Note: Basket based on OECD methodology. Before 2010, national long distance mobile calls were higher priced than local mobile calls; the basket only includes local mobile calls. The basket prices after 2006 include the new consumption tax and SMS (which had been free).
Source: Adapted from TCC price information.

Mobile handsets have declined in price and at T$29 (US$16) a basic entry-level feature phone would be affordable for most Tongans.[8] Smartphones are available for less than US$50 (the Alcatel Pop C1 retails for T$85 (US$48)) and a laptop dongle costs T$99 (US$56).[9]

According to the 2006 Population Census 51.2% of households had a landline telephone, while the 2012 Demographic and Health Survey (DHS) found the figure to be 53.9% of households.

2.3 Internet

There are two main Internet Service Providers: TCC, providing both wireless and fixed broadband access and Digicel, providing wireless access. The Danden Group provides Internet access over VSAT. Several wireless technologies are offered (WiMAX and 3G) and TCC provides fixed broadband using ADSL 2+ in some areas.[10] Tonga launched mobile broadband relatively late compared other South Pacific nations. TCC deployed its 3G+ network in December 2013 and Digicel in July 2014. According to MEECCDMMIC, there has been rapid take up to 3G services with over 50,000 users by the end of 2014 (Table 2.1). Both operators provide Wi-Fi access throughout the Nuku'alofa Central Business District (CBD) and TCC also offers narrowband dial-up services.

Table 2.1: Tonga ICT Market Summary, end-2014

MOBILE (2G) Active SIM cards Nov 2014	MOBILE (2G) Active SIM cards per 100 Inhabitants (%)	BROADBAND (FIXED) ADSL subscriptions	BROADBAND (Fixed) % of population%	BROADBAND (MOBILE) Subscriptions	BROADBAND (Mobile) % of population
71,000	67.4	1,400	1.5	>50,000	50
Digicel, TCC	Digicel, TCC	TCC	Digicel, TCC	Digicel, TCC	Digicel, TCC

Sources: ITU/World Development Indicators 2014, MEECCDMMIC

Retail Internet prices have dropped and shifted from speed to data caps. In 2008, TCC offered a 256 kbps download package for T$1,840 per month. In 2014, a 3GB data plan using WiMAX was T$49 and fixed broadband was T$99. A

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[8] Handset prices based on offerings at Digicel's store in November 2014.
[9] Prices in November 2014 for models available at Digicel's store in the capital.
[10] ADSL2+ provides a minimum download speed of 16 Mbit/s. See "ITU-T G.992.5 (01/2009)" at: http://www.itu.int/ITU-T/recommendations/rec.aspx?id=9653&lang=en

1GB 3G mobile broadband package was T$24 with 60 day validity. Mobile broadband download speeds averaged 1.6 Mbit/s in November 2014.[11]

According to the 2011 Census, 45% of Tongan households had access to the Internet via some location compared to 9.3% with Internet at home. The figure refers to the total number of households, rather than respondents or all household members. Fueled by sharply dropping Internet access prices, the number of Facebook users skyrocketed in the 45 months between March 2011and December 2014 from 7,000 to 30,000 with penetration among the population aged 13 and older rising from 10% to 43% (Figure 2.4). This can be interpreted as a minimum estimate for the number of Internet users in the country since not all Internet users may be using Facebook.

Figure 2.4: Facebook users
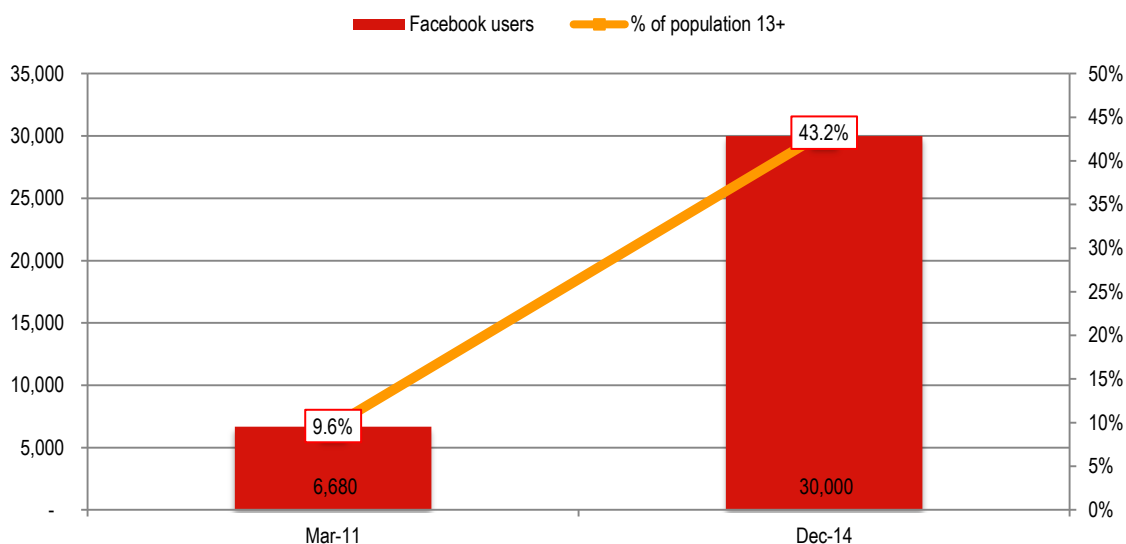
Source: Adapted from Facebook.

Tonga is close to reaching most of the year 2015 targets established by the Broadband Commission.[12] Although, it does not have a specific broadband plan, individual Internet penetration is just below the target. If mobile broadband pricing and households having access to the Internet anywhere are used as the tracking indicators then the affordability and connectivity targets have been reached.

Table 2.2: Tonga and the Broadband Commission targets

Goal	Target	Tonga status
Making broadband policy universal	By 2015, all countries should have a national broadband plan or strategy or include broadband in their universal access/service definitions.	None
Making broadband affordable	By 2015, entry-level broadband services should be made affordable in developing countries through adequate regulation and market forces (for example, such services should cost less than 5 per cent of average monthly income).	An entry level fixed broadband plan is 15% of per capita income. An entry level 3G mobile broadband package is 3.6% of monthly income.
Connecting homes to broadband	By 2015, 40 per cent of households in developing countries should have Internet access.	In 2011, 9.3% of households had an Internet connection while 45% could access the Internet outside the home.
Getting people online	By 2015, Internet user penetration should reach 60 per cent worldwide, 50 per cent in developing countries and 15 per cent in least developed countries	43% of the population aged 13 years and older used Facebook in 2014.

2.4 Backbone networks

An undersea fibre optic cable linking Tonga to Fiji—a distance of 827 kilometers—was commissioned in August 2013. From Fiji, onward connectivity is provided via the Southern Cross cable to Australia and the United States. The new cable provides an initial capacity of 10 Gb/s. TCC, Digicel and the University of the South Pacific (USP) are connected to

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[11] Based on six speed tests conducted by the authors.
[12] See "Broadband Targets for 2015" at http://www.broadbandcommission.org/publications/Pages/bb-targets.aspx

the cable. International bandwidth has grown almost seventeen-fold from 37 Mb/s in July 2011 to 620 Mb/s by February 2015 (Figure 2.5).[13]

Figure 2.5: International Internet bandwidth, Mb/s
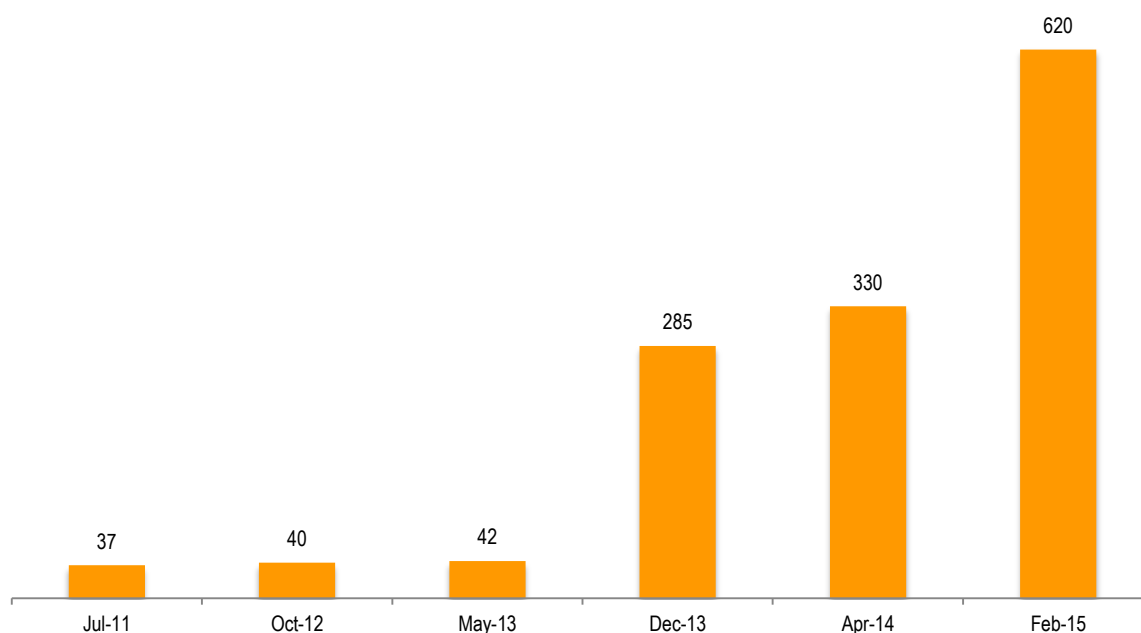
Source: Adapted from World Bank, Tonga - Pacific Regional Connectivity Program: P113184 - Implementation Status Results Reports.

The cable is owned and operated by Tonga Cable Limited (TCL) whose shareholders are the Kingdom of Tonga (83%) and TCC (17%). Previously satellite connectivity was US$ 3,600 per Mbit/s per month whereas the cost with the new cable is US$475 per Mbit/s per month (can be lower depending on volume purchased). This is still almost twice the price of international bandwidth in Fiji and results in higher retail Internet prices in Tonga. The wholesale price of the Tonga to Fiji undersea cable is linked to matching current capacity use to cover the cable's fixed cost. Interpreting the fixed cost is muddled. The final cost of the cable was US$25 million compared to an initial project estimate of US$ 34 million of which 81% was provided in the form of grants by development agencies with the Kingdom of Tonga funding the remaining 19%. It is planned to use the savings to part-finance the extension of the cable to Vava'u and Ha'apai if the Government can mobilise additional funds from private or public sources.

Given the size of the market, it is unlikely there will be many more parties contracting bandwidth on the cable. On the other hand, the demand for bandwidth is likely to grow particularly with the expansion of multimedia services delivered online.

Based on calculations carried out by the authors of this report, the cost of the cable could be recouped in a shorter period by moving to flat rate pricing. At current prices, the original costs of the cable would recouped in fourteen years[14] with consumers paying for the some 90% of unused but activated capacity. One way to lower retail Internet prices is to increase the amount of bandwidth available at a fixed price that still recovers the cost of the cable. In other words, instead of pricing per Mbit/s, the price would be a fixed amount rising a certain percentage per year while bandwidth supplied would be increased. For example, the amount of capacity provided could be doubled each year with an annual increase in price of 25%. Under this scenario, prices would initially be lowered to US$208 per Mbit/s per month and then dropping to US$24 within five years (Table 2.3). For TCL, it provides a more stable revenue stream and it would recover the costs of the cable faster than under its current tariff structure. It is the authors' opinion that this scenario would reduce international bandwidth costs, drive Internet utilisation and trigger exciting applications made possible by abundant capacity such as high quality video streaming, ICT enabled outsourcing and undoubtedly new innovative services.

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[13] http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/SDN/2014/09/28/090224b08278ba57/1_0/Rendered/PDF/Tonga000Pacifi0Report000Sequence005.pdf
[14] Based on the final cost of the cable (US$25 million) and estimated operating costs of US$1.2 million per year (see "Tonga-Fiji Submarine Cable Project (RRP TON 44172), Financial and Economic Analyses" available at: http://www.adb.org/sites/default/files/linked-documents/44172-022-ton-efa.pdf)

Table 2.3: Alternative scenario for wholesale international Internet bandwidth pricing

	Current (Mbit/s)	Proposed December 2014	Dec-15	Dec-16	Dec-17	Dec-18	Dec-19
		(Mbit/s)	(Mbit/s)	(Mbit/s)	(Mbit/s)	(Mbit/s)	(Mbit/s)
Current allocation Digicel	200	500	1,000	2,000	4,000	8,000	16,000
Current allocation TCC	225	500	1,000	2,000	4,000	8,000	16,000
Current allocation USP	100	200	200	200	200	200	200
Total Utilisation	525	1,200	2,200	4,200	8,200	16,200	32,200
Cost per Mbit/s USD	475	208	142	93	60	38	24
TCL total revenue per annum in USD	$2,992,500	$2,992,500	$3,748,800	$4,687,200	$5,859,000	$7,323,750	$9,154,688
Increase in revenues		0%	25%	25%	25%		
Operational costs	1,229,000	1,229,000	1,229,000	1,229,000	1,229,000	1,229,000	1,229,000
Annual net revenue	$1,763,500	$1,763,500	$2,519,800	$3,458,200	$4,630,000	$6,094,750	$7,925,688
Total net revenue		$1,763,500	$4,283,300	$7,741,500	$12,371,500	$18,466,250	$26,391,938

Note: Constant prices of 2014. Current activated capacity is 10 Gbps out of total design capacity of 320 Gbps. This scenario assumes that additional capacity would be activated from 2017.
Source: Authors' calculation based on information from TCL and ADB.

TCC has a fibre backbone on the island of Tongatapu. It uses microwave to link the island of 'Eua. Satellite is used to connect the Ha'apai, Vava'u and Niuas island groups. Digicel uses microwave on Tongatapu and to connect 'Eua and satellite for connectivity to the other islands. TCL plans to use the savings from the international cable costs to construct a domestic fibre backbone linking 'Eua, Ha'apai and Vavu'u. This would lower costs compared to current alternatives and provide the necessary backhaul capacity to better handle broadband traffic.

3 ICT Economic Impacts

Value-added of Tonga's communications sector[15] was T$ 22.8 (US$12.9) million in the 2012-13 financial year, doubling in the last decade (in current prices). The contribution of the sector to GDP in constant prices dropped in 2001-02 (Figure 3.1) following the introduction of competition and significant price reductions for mobile telephony. The ICT's sector contribution started to grow from 2004-05 with a notable increase in 2008-09, the period Digicel entered the market. The contribution has been steady at around 3% since 2009-2010.

Figure 3.1: Communication sector as a percent of GDP (constant prices)
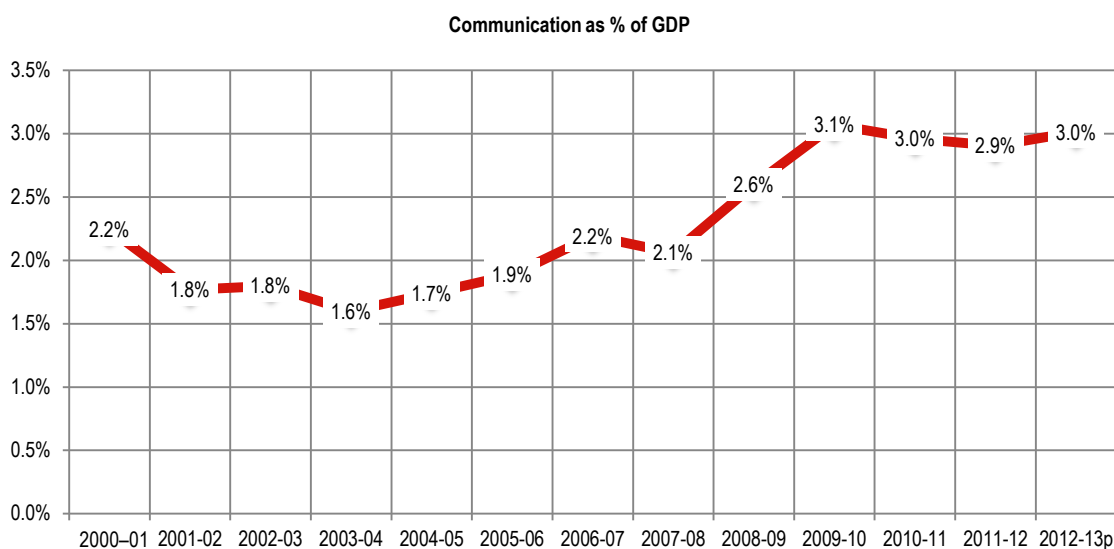
Note: Based on ISIC 3.1. Figures for the 2012-13 financial year are preliminary.
Source: Tonga Bureau of Statistics.

Digicel's entry into the market, construction of the undersea cable landing station and launch of 3G networks have contributed to an upswing in telecommunications investment in the country. Consolidated industry figures are however not available. Data on Digicel's capital expenditure suggest significant investment in 2008 to upgrade and expand the network, accounting for about a quarter of Tonga's Gross Fixed Capital Formation (GFCF) that year (Figure 3.2). Since then, Digicel's investment has tapered off.

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[15] Including posts and telecommunications. Published national accounts data combine communications with transport. The Tonga Department of Statistics kindly provided a breakdown.

Figure 3.2: Digicel capital expenditure as percentage of Gross Fixed Capital Formation (GFCF)
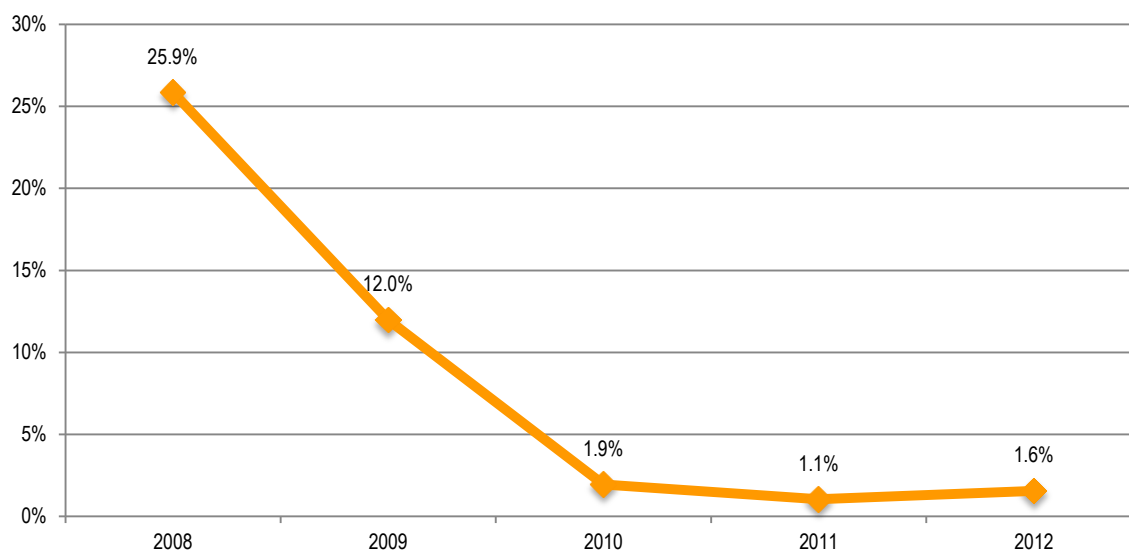
Note: Capital expenditure relates to fiscal years beginning 1 April.
Source: Adapted from Digicel and World Bank data.

Digicel and TCC have around 400 employees and generate other employment for equipment vendors and airtime resellers. Launch of the submarine cable creates the potential for ICT-enabled work in Tonga. According to a study on the prospects for a Business Process Outsourcing (BPO) there were 179 people working as "information and communication technicians" and over 100 post-secondary graduates in fields related to BPO in 2012 (Commonwealth Secretariat 2013). A call centre was established in 2013 and handles TCC's help line.[16] Current potential for BPO services in the country is constrained by inadequate computer-related legislation, insufficient IT industry accreditation and limited BPO experience. There are moves underway to remedy this and according to a World Bank study, Tonga is well positioned to take advantages of global outsourcing services leading to direct job growth.[17]

In order to calculate the indirect economic impact of ICTs at least data 30 observations are required. Since quarterly GDP data is not available for Tonga, it would be necessary to use annual ICT figures from 1984. Digital mobile was only launched in 2001, fixed broadband in October 2005 and mobile broadband in December 2013 so there are insufficient annual observations to measure the economic impact of ICTs. In any case, results from other developing countries suggest there is little significant statistical impact until penetration has reached a certain threshold.[18] Given Tonga's low fixed broadband penetration and the recent launch of mobile broadband, it could be some years before economic impacts are noticeable.

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[16] Matangi Tonga. "Princess launches call centre for telecommunications in Tonga." *Islands Business.* 1 March 2013.
http://www.islandsbusiness.com/news/tonga/479/princess-launches-call-centre-for-telecommunicatio/
[17] World Bank. 2015. *ICT for Jobs in the Pacific Island Countries.*
[18] One study found no significant impact from broadband in countries where average penetration over a ten-year period was less than 12%. See: Michael Minges. 2013. "Moving to the next step: Standardizing broadband economic impact measurements." Presented at *Measuring the Economic, Social, and Political Impact of the Web*, Washington D.C., 14 November.

4 ICT Sector Impacts

This chapter outlines the availability and usage of ICTs across government, education, health, agriculture and tourism and the use of mobile money.

4.1 Government

Government connectivity varies. Most ministries in Nuku'alofa are connected to the Internet. Each ministry makes its own arrangement with an ISP. Some are using wireless, some ADSL and some are connected by fibre optic cable. Most ministries have a web site. The Freedom of Information policy website provides links to relevant ministries describing their work and contact details.[19]

The idea of creating a government network with a data centre has been around since 2002 but remains stalled due to a lack of funding. Because there is no managed virtual government network inter-linking ministries nor standard software and data protocols, e-government applications aimed at citizens and businesses lag. Some effort has been devoted to digitising documents to speed up workflows. But the ability to pay taxes on line and carry out web requests for civil records does not exist. Obtaining documents such as birth, marriage and death certificates entails a visit to government offices to file a request and a wait of at least several days before receiving them. Given that there are so few electronic public services, any formal impact study would likely show limited results.

Most e-services aimed at business and the public are developed by the private sector. Mobile alerts from the Tonga Power Limited and Air New Zealand advise customers of power outages, overdue bills and flight information. Some utility payments can be made using mobile money or mobile banking applications. Westpac's EFTPOS uses the mobile network to provide information for merchants (sales, tax calculation, etc.).

There was recently a significant improvement in the business environment. All processes for registering a business including name, certificate of incorporation, business license and registration with tax authority have been integrated into a single online window available 24 hours a day.[20] Payment for all related fees can be made online using a credit card. The Registrar of Companies has installed two kiosks at its offices for people who do not have access to a computer to carry out the process. The new integrated process reduces the time to register a firm from 16 days to less than one, placing Tonga among the countries with the fastest business registration process in the world (Figure 4.1).

Figure 4.1: Number of days to register a business, Tonga
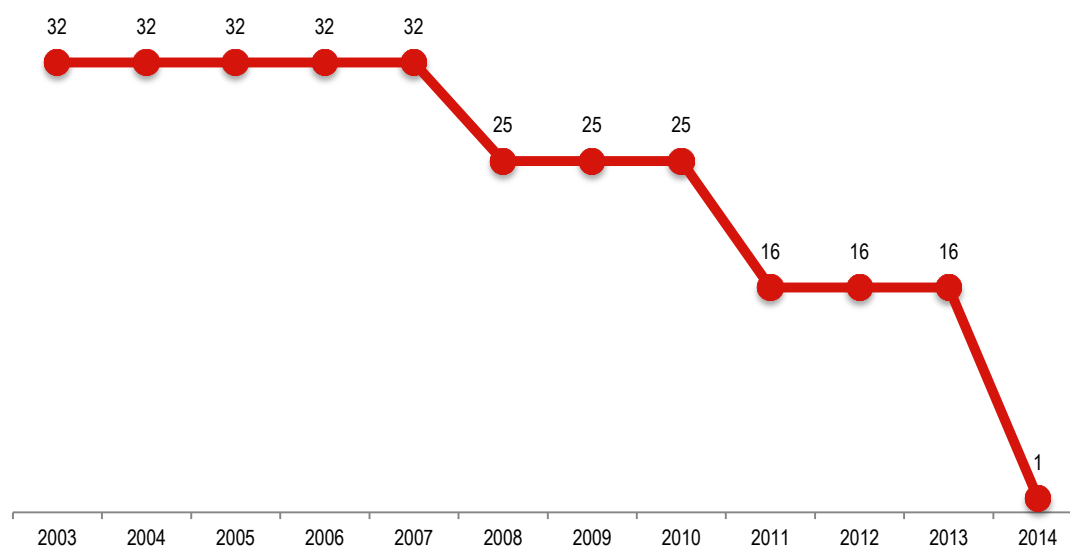
Source: Adapted from World Bank Doing Business and Tonga Registrar of Companies.

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[19] http://www.foi.gov.to/index.php/other-agencies
[20] "Tonga's Innovative Online Business Registry Goes Live – ADB." *News from Country Offices.* 2 December 2014.
http://www.adb.org/news/tonga-s-innovative-online-business-registry-goes-live-adb. Instructions for registering a company online are here:
http://www.businessregistries.gov.to/how-to-use-online-services/

4.2 Education

ICT in education has been mainly focused on strengthening school administration through better collection and exchange of electronic records as called for in the Education Act.[21] The Ministry of Education and Training experience developing an Educational Management Information System (EMIS) has been trying. It has been working with a system originally provided by UNESCO but it is hard to adapt to local context and the ministry suffers from a lack of technological resources and capability. The ministry is currently looking to replace the system with a cloud-based system.[22]

All secondary schools are connected to the Internet using TCC and receive an educational discount. Most secondary and primary schools have computers primarily from donations. For example, a local bakery recently donated 100. This presents maintenance challenges given the variety of models and software versions. Nevertheless, the ministry tries to staff schools with at least one person who has computer experience.

There was a One Laptop Per Child (OLPC) pilot for primary schools introduced several years ago. It was not successful due to several issues: teachers were not provided adequate training, content was not localised (children are not normally exposed to classes in English until Class 3) and after the trial, it was expected that the beneficiaries would pay $100 per laptop.

There is no formal e-learning program due to a lack of budget, equipment and expertise. This would be very relevant for the country due to the shortage of teachers, particularly for some subjects such as physics. There is one example of using mobile phones for homework. Students were to text their teacher the daily answer to a quiz. The teacher received too many texts so the experiment was ended.

Computer science is included in the curriculum in secondary schools. Post-secondary educational institutions in Tonga offer computer science courses including the University of the South Pacific (USP) and the Tonga Institute of Higher Education (TIHE). Some church schools have diploma programs, as do private companies. The Tonga Chamber of Commerce offers two-week training programs in office applications such as Excel, Word, etc. This is coordinated through the Tonga Business Enterprise Centre with assistance from the New Zealand government and aims to build up business skills in the country.

There are no impact studies available that would show for example how the EMIS has increased efficiency and lowered the cost of school administration nor how access to the Internet in schools has impacted learning outcomes.
USP, headquartered in Fiji, has contracted 100 Mbit/s of bandwidth on the Tonga-Fiji submarine cable. This will enable USP to offer higher quality and enhanced functionality for its e-learning offerings to the campus in Tonga, which had around 1,300 students in 2013.[23]

4.3 Health

Like the education sector, the main ICT intervention in health is computerising internal processes. The introduction of ICT goes back to 1999 as part of a health system reform undertaken with Australian assistance. At that time, the Ministry of Health had three computers and two dial-up connections.

The country's Health Information System (HIS) is robust and advanced. It was developed with World Bank support. The vendor carries out system maintenance[24] reducing the need for skilled staff. Out of 944 staff in the ministry, only four are in IT. The HIS has undergone continual improvements with the focus currently on integrating databases to reduce duplication. The HIS has improved health outcomes through more efficient management of patient information but there is a lack of long time series and models to prove the correlation. Indirect impacts include reduced waiting times for doctors through improved scheduling.

The ministry has a data centre located at the main hospital. All four hospitals are connected to the Internet and networked to the HIS. In addition the seven health centres in Tongatapu are connected. It has been a challenge to provide reliable connectivity to the seven health centres in the outer islands due to the expense. The ministry has been making efficient use of bandwidth such as not emailing radiology images back and forth but instead accessing them from a central server.

Mobile based health applications can supplement support from health centres to the household. For example, alerts sent to mobile phones can remind people to take medications. These types of applications are expected to have the following impacts: reduce defaulters, increase compliance, decrease hospital stays, and have more patients managed at the

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[21] The Act states "The Ministry shall establish and maintain an Information and Management System to capture all relevant data in relation to the work of the Ministry."
[22] http://triesten.com/products/iskool/
[23] http://www.usp.ac.fj/index.php?id=usp_tonga_campus
[24] http://www.cse-global.com/Solutions/Healthcare.html

community level, lowering costs. Charges for patients treated at health centres at three times less compared to hospitals and nine times less for outpatients compared to inpatients.

There is high interest in remote consultation particularly with the higher bandwidth now available via the submarine cable. Consultations are currently done over the telephone with specialists in New Zealand. The ministry is negotiating with the government to get a leased line with direct connection to the cable in order to support telemedicine. A local eye surgeon notes:

> "This fibre optic cable will allow our doctors to communicate more easily with health workers on other islands also with doctors overseas. We are planning live surgery with overseas partners, getting a live feed to what is happening here in Tonga, and directing the doctors in complicated surgery..."[25]

A prerequisite for developing health-based online services is a unique identification code for each person. Here Tonga has an advantage since every person is assigned a unique National Health Number at birth as well as for any visits to the health system. The need for dissemination of health information via the Internet can be inferred from the 2012 Demographic Health Survey asking respondents how they obtained contraception information. There was only a choice of three media—TV, newspapers and radio—and Internet was not included. Over a quarter of female respondents did not use any of these three sources, rising to almost half for those aged 15-19 (Figure 4.2, left). The 15-24 age group is most at risk for unwanted pregnancy and is the age group with the most intensive use of online social media (Figure 4.2, right). This suggests that the most relevant channel for disseminating health information to this age group would be online social media.

Figure 4.2: Source of contraception information, 2012 and Facebook users, 2014, Tongan women
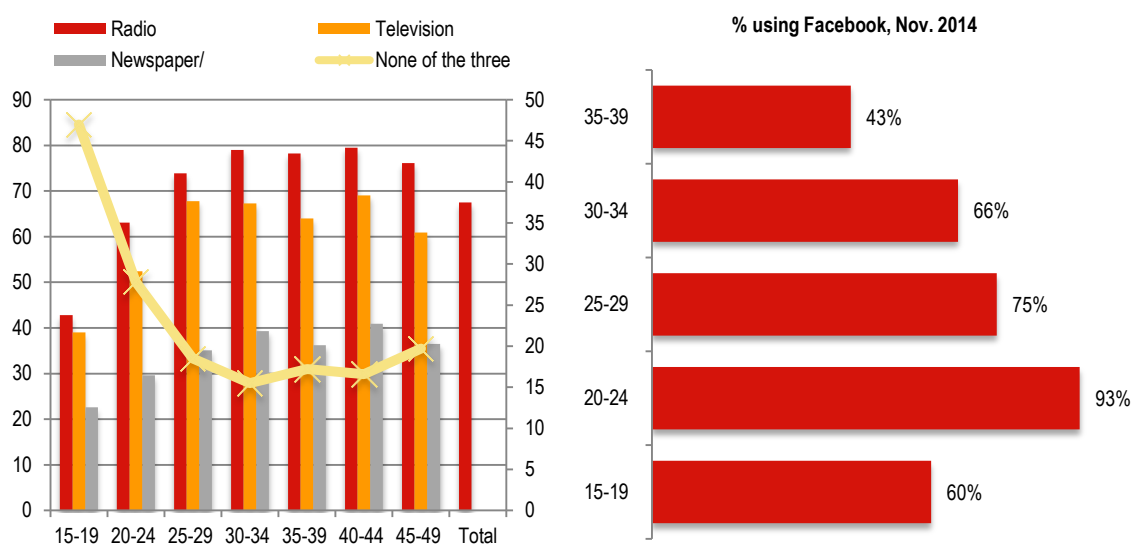
Source: Adapted from DHS 2012 and Facebook.

4.4 Agriculture and fishery

The Ministry of Agriculture and Food, Forests and Fisheries (MAFFF) has a web site and the fisheries division has their own web site where a variety of information is disseminated. Local firm Pasifika Solutions supports the web sites. The ministry currently receives many calls about import regulations and would like to upload relevant information to the website.

MAFFF's main method for disseminating information to farmers and fishermen is via three radio programs a week. It uses the Tonga Broadcasting Service, which has the country's largest broadcast coverage. MAFFF makes limited use of television due to lower coverage and higher costs although audio-visual dissemination is more effective than just audio. Experts are tapped to share knowledge in areas such as diseases, pests, growing techniques, etc. on the broadcast programs. MAFFF would like to send staff into the field and record best practice but budget is restricted and they lack the equipment to do so. They also lack qualified journalists. Price information is collected by ministry staff on a weekly basis and disseminated via radio but are not available on the web site. There is no information about use of the pricing information, whether it has reduced price asymmetry and how that might have affected the welfare of those working in the agricultural sector.

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[25] Faster Internet in Tonga = Better Healthcare. 2013. https://www.youtube.com/watch?v=GWclQJh2HKQ&feature=youtube_gdata_player.

There was a project to build up a database of agricultural information to respond to queries from farmers and fishermen. The idea was for farmers and fishermen to call or text a call centre, including sending photos if their cellphones have that capability. The database would be consulted for appropriate remedies. Ten mobile phones were provided to extension workers to kick-start the project, which was supported by the Secretariat of the Pacific Community Land Resources Division.[26] Despite the high prevalence of mobile phones in rural areas, the initiative did not advance beyond the pilot stage.

In fisheries, mobile phones have been mainly used for safety. Fisherman can be warned more easily if there is bad weather approaching or if they have a problem while out at sea. Fishers also use mobile phones to alert each other when they are fishing out of season and law enforcement officials are nearby. At the same time, digital cameras and GPS are used by Fisheries Rangers to police illegal fishing.[27]

Australia's Queens Foods is collaborating with Digicel to deliver mobile services to vanilla farmers on the island of Vava'u.[28] The Queen Vanilla Growers Association has been set up grouping some 280 organic vanilla farmers in an attempt to revive Tonga's vanilla industry. All growers will purchase mobile phones to improve communications by sending group messages and have access to mobile money to pay growers monthly maintenance payments. Queen Fine Foods is completing certification for "Fair Trade" and "Organics" and is funding this for the farmers.[29]

4.5 Tourism

Tonga Tourism Authority has a web site (www.thekingdomoftonga.com) designed by a New Zealand company.[30] It also has a Facebook page (https://www.facebook.com/tonga) that had 34,025 "likes" on 17 November 2014. The web site lists a variety of accommodations providing a brief description and contact information. Mobile operators also leverage the significant number of visitors by offering special tourist SIMs through kiosks at the international airport.

4.6 Mobile money

Tonga could benefit from greater financial inclusion with around 60% of the population not having bank accounts in 2011.[31] Digicel launched its Mobile Money service in Tonga in January 2011; by September 2011, it had 2,157 active users.[32] The service supports transfer of money as well as bill payment. Digicel works with domestic and overseas partners to enhance its mobile money offerings. The Development Bank of Tonga processes cash deposits and retrievals for mobile money users and KlickEx Pacific handles overseas remittances. In May 2012 Digicel launched its "Beep and Go" service based on NFC technology. This allows users to simply swipe their phone across a Point of Sale (POS) terminal to pay. It was available at some 50 merchants in Nuku'alofa at launch with plans to extend the service. Around ten percent of Digicel's customer base was using the mobile money platform in November 2014. Given Tonga's large overseas population, remittances are important. The 2011 Census found that over half of households in the country received overseas remittances and according to World Bank estimates, US$61 million in remittances was received by Tonga in 2014 equivalent to 13% of GDP. The KlickEx Pacific service allows users in Australia or New Zealand to send funds to mobile phones in Tonga in less than one hour.[33] Compared to banks and traditional money transfer operators, KlickEx Pacific is the least expensive method to transfer money from New Zealand to Tonga (Table 4.1).

Table 4.1: Cost of sending NZ$200 to Tonga, December 2014

	Fee (NZ$)	Total cost (NZ$)*	Total cost (%)
Bank average	20.00	40.27	20.13
Money Transfer Operator average	7.50	21.64	10.82
Digicel/Klickex	3.00	10.96	5.48

Note: * Transaction fee plus margin on foreign exchange transaction.
Source: www.sendmoneypacific.com [Accessed 5 January 2015].

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[26] See: SPC. 2014. "Pacific agriculture and forestry leaders encouraged to embrace 'e-agriculture.'" Accessed November 22. https://www.spc.int/fr/liste-de-diffusion/571-pacific-agriculture-and-forestry-leaders-encouraged-to-embrace-e-agriculture.html.
[27] http://www.tongafish.org/index.php?option=com_content&view=article&id=136:fafanewequipment&catid=113&lang=en&Itemid=484
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[32] Pacific Financial Inclusion Programme. "Quarter 3, 2011 Brief Project Update for Investment Committee." http://aid.dfat.gov.au/countries/pacific/fiji/Documents/financial-inclusion-monitoring-report-investment-committee.pdf
[33] https://www.klickexpacific.com

4.7 Conclusions

Impacts in specific sectors are generally not quantifiable due to a lack of survey data and the lack of relevant applications using ICTs across government, health, education and agricultural sectors. There are measurable results in the case of business registration where the implementation of an online system reduced the number of days from 16 to less than one. Another potential impact is the cost of remitting funds, which is significantly cheaper when sent to Tongan users with a mobile money account.

5 Business Case For Public Investment

Major infrastructure projects have been implemented over the last few years including the deployment of the submarine cable and launch of mobile broadband networks. These projects have depended on funding from development partners to a significant extent due to their large scope, need for concessional financing and limited availability of private sector funding.

Table 5.1: Key ICT project assistance from development partners, Tonga, 2003-2013

Donor	Project	Amount (US$ m)	Year	Comment
IFC	Digicel Tonga	6.8	2009	Funding for Digicel's mobile network34[this is a commercial investment]
World Bank	Pacific Regional Connectivity Program	17.2 (grant)	2011	Funding for roll-out of Tonga-Fiji cable35
ADB	Tonga–Fiji Submarine Cable Project	9.7 (grant)	2011	Funding for roll-out of Tonga-Fiji cable36
PRIF	Tonga–Fiji Submarine Cable Project	0.5 (grant)	2011	Funding for regulatory support in relation to roll-out of Tonga-Fiji cable

Given widespread mobile coverage, possibly the highest in the South Pacific, there is no need for public sector involvement in basic connectivity. There are other areas where support could be important. This includes mechanisms to enhance broadband connectivity in areas lacking suitable and affordable access. The most feasible approach would be to incentivise operators to cover remaining areas that are not under a mobile broadband footprint. The planned construction of a domestic fibre backbone will likely require public assistance since it will be partly funded by savings from construction of the cable to Fiji. However, this will be dependent on government obtaining the remaining funding (e.g., from sale of TCL shares or mobilisation of concessional funds from other partners).

Areas the public sector could support includes development of online government services (back office and citizen facing applications) as well as funding and expertise for developing applications in health, education and agriculture. The educational sector could benefit from a structured approach to deployment of computers in schools, training in digital literacy for both teachers and students, application of e-learning and provision of higher level computer and network skills for those who have completed secondary school. The latter is particularly important for enhancing the country's software sector, which is nascent at best but critical for developing applications that could generate meaningful socio-economic impacts.

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34 See: "IFC ICT Sector Investments, FY03- FY10" at: https://ieg.worldbankgroup.org/Data/reports/chapters/appf.pdf
35 http://web.worldbank.org/external/projects/main?Projectid=P113184&theSitePK=40941&piPK=64302772&pagePK=64330670&menuPK=64282135&Type=Financial
36 http://adb.org/projects/details?page=financing&proj_id=44172-022

6 Conclusions

The arrival of the Tonga-Fiji submarine cable in 2013 has radically altered the ICT landscape. The supply of bandwidth has increased and there has been a dramatic rise in Internet use measured by both subscriptions and usage. The cable has also enabled the launch of 3G+ broadband. Mobile access is high, driven by the Kingdom's early introduction of competition.

Sector wide applications that could leverage the increased bandwidth and mobile penetration are limited. With the exception of the new online business registration system, there are few government e-services aimed at businesses and citizens. Apart from ongoing computerisation of administrative process, there is minimal use of ICTs in the pre-tertiary education and health sectors. Much software is developed abroad due to scarce domestic capacity.

There are several areas development partners might contemplate assisting. There is a need for support of government networking and applications. If this were to be supported, it should be as an integrated project that not only connects government agencies but also streamlines sharing of data through common protocols and standards and develops key online services for businesses and citizens.

Another area unlikely to develop without some assistance is a local software industry. There are scarce IT companies and Tongan organisations have limited in-house ICT capability with many outsourcing software needs from abroad. The country runs an ongoing deficit in trade of computer software and services. A study by the Commonwealth Secretariat reiterates the Tongan government's position that "...a critical mass of ICT and knowledge based specialists ... will be required to sustain the growth of the information society and the information economy..." (Commonwealth Secretariat 2013). The domestic software and services industry needs nurturing through a partnership of telecoms firms, tertiary institutions, government, the private sector and development partners. Until this happens, the full potential of the country's ICT fibre optic connectivity and high mobile penetration is unlikely to be fulfilled.

Appendix

This report was prepared based on background documents listed in the references as well as meetings with stakeholders from 17-19 November 2014.

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List of Meetings

Asian Development Bank, Saia Faletau, Focal Officer

**Ministry of Environment, Energy, Climate Change,
Meteorology, Information & Communications**, Paula Ma'u, CEO

Tonga Communications Corporation, Sione Veikoso, Manager Engineering

Tonga Communications Corporation, Rizvi Jurangpathy, CEO

Department of Statistics, 'Ata'ata Finau, Government Statistician

Digicel Tonga, Ronan McGrane, CEO

ProComm, Sionne Tupou, Acting Team Leader

Tonga Cable Ltd., Robert Bolouri, CEO

Ministry of Education & Training, Emeli Pouvalu, CEO

Ministry of Health, Sione Hufanga, Chief Information Officer

Ministry of Agriculture, Food, Forests and Fisheries, Taniela Hoponoa, Head of Corporate Services Division

Ministry of Commerce, Tourism and Labour, Vaimoana Taukolo, CEO; Distaquaine Tu'halamaka, Head of Registry & Intellectual Property Office

VANUATU
COUNTRY
REPORT

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1 Country Background

The Republic of Vanuatu consists of 83 islands in the South Pacific Ocean. According to the 2010 Household Income and Expenditure Survey (HIES), the population was 249,850. The country consists of six provinces. The most populated island is Efate home to the capital Port Vila (Table 1.1). The urban area consists of Port Vila and Luganville, accounting for 27% of the population. The 2013 estimated population reported by the Vanuatu National Statistical Office was 256,656.

Table 1.1: Vanuatu, population by province, 2010

Province	Capital	Main islands	Population	%
Torba	Sola	Torres and Banks Islands	9,710	4%
Sanma	Luganville	Santo, Malo	45,855	20%
Penama	Longana	Pentecost Island, Ambae, Maéwo	30,819	13%
Malampa	Lakatoro	Ambrym, Malakula, Paama	36,727	16%
Shefa	Port Vila	Efate, Shepherd Islands	78,723	34%
Tafea	Isangel	Tanna, Aniwa, Futuna, Erromango, Anatom	32,540	14%
TOTAL			234,374	100%

Source: VNSO, 2010 HIES.

With a 2013 per capita of income of US$ 3,303,[1] Vanuatu is classified as a lower middle-income economy[2] by the World Bank. Like many Pacific Island countries, tourism is the bedrock of the economy with tourism receipts accounting for a third of GDP.[3] Unlike other neighbors in the region, remittances are relatively low, accounting for US$22 million in 2013 or 2.6% of GDP.[4] Agriculture, fishing and forestry accounted for 6.5% of GDP in 2013.[5]

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[1] http://data.worldbank.org/indicator/NY.GDP.PCAP.CD
[2] http://data.worldbank.org/about/country-and-lending-groups
[3] International Monetary Fund. 2013. Vanuatu 2013 Article IV Consultation. Country Report 13/169.
[4] http://go.worldbank.org/092X1CHHD0
[5] Vanuatu National Statistics Office. Statistics Release: Gross Domestic Product 2013.

Figure 1.1: Map of Vanuatu
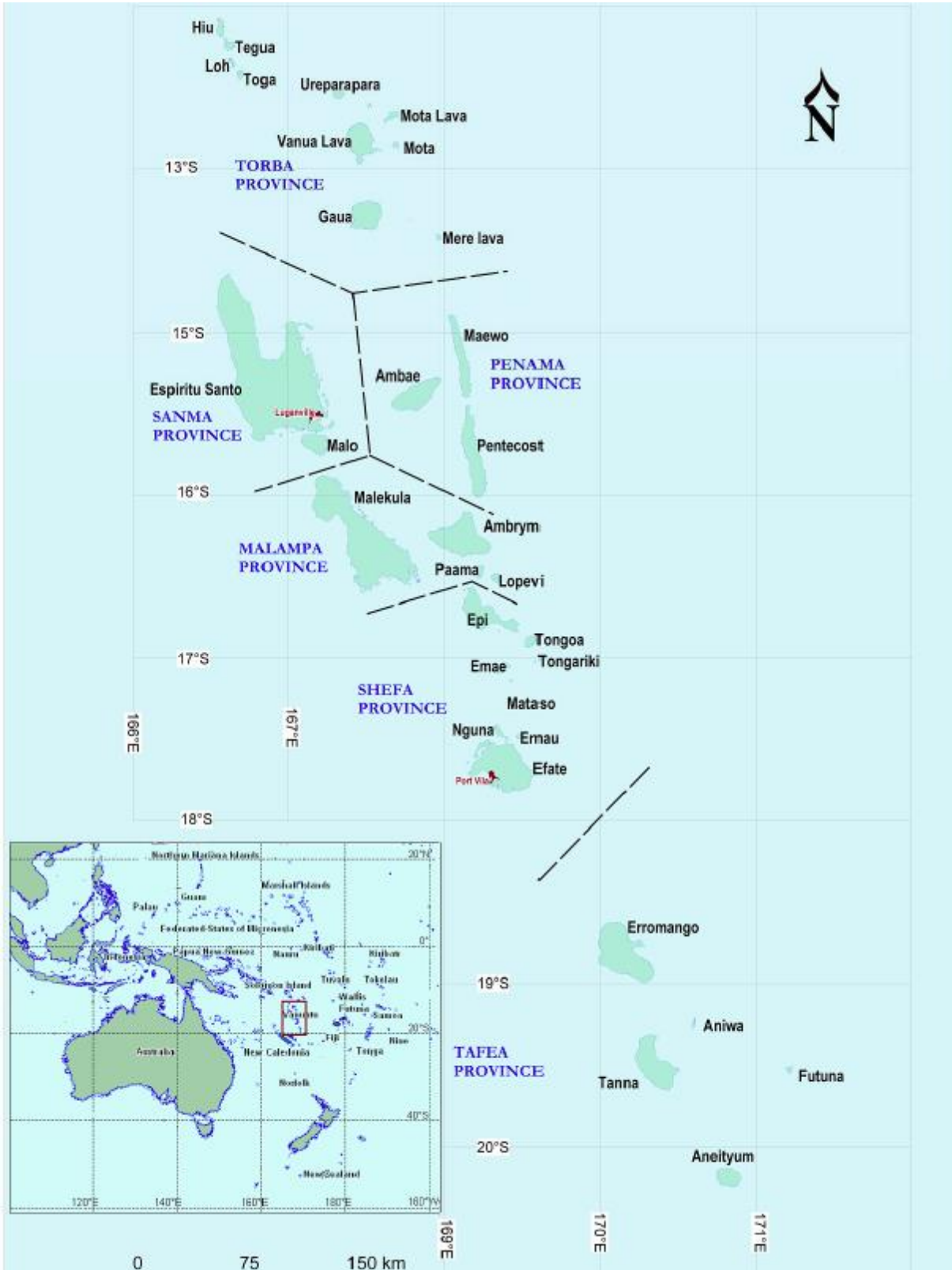
Source: VNSO, 2009 Census, Volume 1.

2 ICT Market

2.1 Industry structure, regulation and liberalisation

Before liberalisation of the telecommunication sector in 2008, Telecom Vanuatu Limited (TVL) had a monopoly over the telecommunications sector in the country. TVL was owned in equal shares by the government, Cable and Wireless of the United Kingdom and France Telecom with an exclusive license until 2012. In an effort to bring forward competition in the market, the Telecommunications Act was amended in 2007. As part of the liberalisation process, the government sold its shares in TVL to the two remaining shareholders. In 2011, Cable and Wireless sold its 50% stake to Mauritius Telecom (itself owned 40% by Orange (formerly known as France Telecom) and 59% by the government of Mauritius). In 2013, Mauritius Telecom increased its ownership of TVL to 90% with 10% held by Orange.

In March 2008, Digicel was granted a mobile telecommunications license and became the country's second mobile operator. In addition, there are five other service providers operating in the broadband Internet space and one licensed to operate a submarine cable (Figure 2.1).

The Office of the Government Chief Information Officer (OGCIO) is responsible for ICT sector policy, guided by the 2013 *National Information and Communication Technology Policy*.[6] The Telecommunications and Radiocommunications Regulator (TRR) was established under the Telecommunications and Radiocommunications Regulation Act of 2009.[7]

Figure 2.1: Telecommunications market licenses in Vanuatu, April 2015
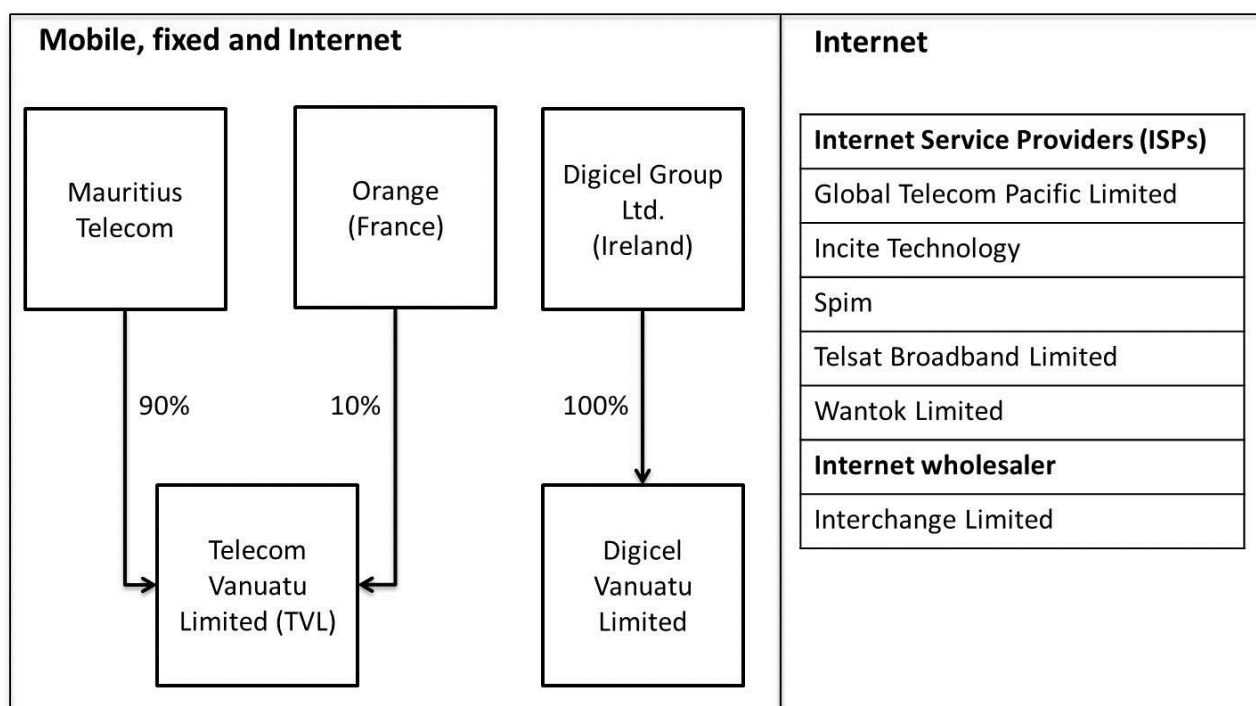
Source: Adapted from Mauritius Telecom and TRR.

2.2 Voice

Mobile is by far the most prevalent method for voice communications. According to the 2010 Household Income and Expenditure Survey (HIES), 82 percent of rural and 94 percent of urban households used mobile phones as their main source of communications compared to less than 5% for landlines. TVL began offering GSM mobile services in April 2002 and Digicel launched its GSM network in June 2008 reportedly costing US$ 35 million.[8] The introduction of cellular competition in 2008 initially rapidly increased coverage and uptake. The percentage of households with a mobile phone

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[6] http://ogcio.gov.vu/ICT%20Policy/Vanuatu-National-ICT-Policy-EN.pdf
[7] http://parliament.gov.vu/Acts/Official%20Gazettes/Extra%20Ordinary%20Gazettes/2009%20-%20Extraordinary%20Gazettes/Extraordinary%20Gazette%20Numero%20Special%20No.%2018%20of%202009%20(dated%2027%20November%202009).pdf
[8] http://lists.spc.int/pipermail/vignet/2009-December/012467.html

more than doubled between 2007 and 2009 from 35% to 76% (Figure 2.2, left). The percentage of the population within reach of a mobile signal grew more than three times from less than 30% in 2007 to 85% in 2009 (Figure 2.2, right). However, coverage stagnated from 2010-2012 and mobile subscriptions declined with TRR attributing this to "competition being stabilised".[9]

There was little expansion of the network in that period with coverage remaining roughly the same. Household penetration continued to grow, but slowly. Coverage has ticked up over the last two years and was estimated at 92% in 2014. Under the Universal Access Policy (UAP), coverage is expected to be 98% by 2018. The UAP uses a 'Pay or Play' approach whereby licensed operators either contribute to a fund (contribution not to exceed 4% of net income) used to finance objectives (pay) or a universal service obligation agreement is reached with operators for meeting objectives (play).[10]

Figure 2.2: Percentage of households with a mobile telephone and percentage of population covered by a mobile signal
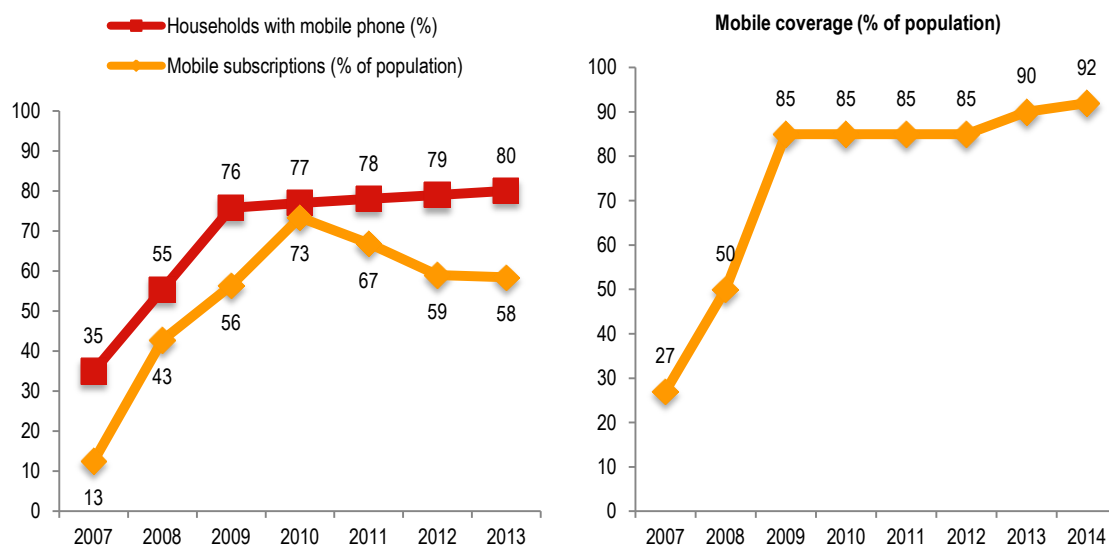
Note: The household penetration figures in the left chart is based on surveys and census data from 1997, 2009 and 2013 with intervening years estimated. Mobile subscription data is based on figures reported by TRR. The right chart is based on data from Digicel, DFAT and TRR for 2007, 2009, 2013 and 2014 with intervening years estimated.

Although household possession of mobile phones was 80% in 2013, access is believed to be higher through sharing. The 2010 HIES reported that 82% of rural households used a mobile phone as their "usual means of communication".

Previous assessment of the mobile market has shown that with Digicel just entering the market there was increased competition between the mobile operators leading to mobile subscriptions reaching a peak of 160,000 registered subscribers in the period 2007-2010. This figure fell in 2011 to around 130,000 subscribers, as the market normalised with consumers picking their network of preference. In 2014, mobile subscriptions increased by 18% compared to 2013, rising to over 150,000 subscriptions. This is due to more roll out of mobile services in rural areas in 2014 and more consumer awareness due to aggressive marketing. In addition, more promotions are introduced into the market and consumers have also significantly impacted the trend as they switch between the two major mobile operators (TVL and Digicel) continuously driving communication prices lower.

Nonetheless, there remains a significant gap between urban and rural mobile possession. According to the 2013 Demographic Health Survey (DHS), 97% of urban households had a mobile phone compared to 73% in rural homes.

The growing availability of mobile communications has had significant impact for users ranging from enhanced contact with family members, avoidance of travel costs, increased security, etc. Several surveys have been carried out by the Pacific Institute of Public Policy (PiPP) regarding communication use in Vanuatu, attempting to quantify some of these impacts (O'Connor et al. 2012). The latest from 2011, surveyed some 1,200 households across the country. Respondents were asked how mobile telephones have benefitted them across four areas (Figure 2.3, left). One third reported that telephones had helped with social networks through more frequent contact with family and friends, improved group coordination and increased support. The area with the lowest impact was access to specialised information and services likely due to the lack of mobile applications in these areas. The effect of telephones on saving travel time and reducing travel costs is notable with both ranking in the top ten impacts (Figure 2.3, right). It also

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[9] TRR. 2014. Annual Report 2013.
[10] For more on the UAP see: Ron Box. Universal Access Policy (UAP) Stakeholders Update No. 2: Implementation of the UAP. http://www.trr.vu/attachments/article/458/uap_public_stakeholder_report_no2_17dec_2014_final.pdf

noteworthy that the third highest impact area is obtaining public information, illustrating the potential for government to citizen online services.

Figure 2.3: Impact of mobile telephones, 2011
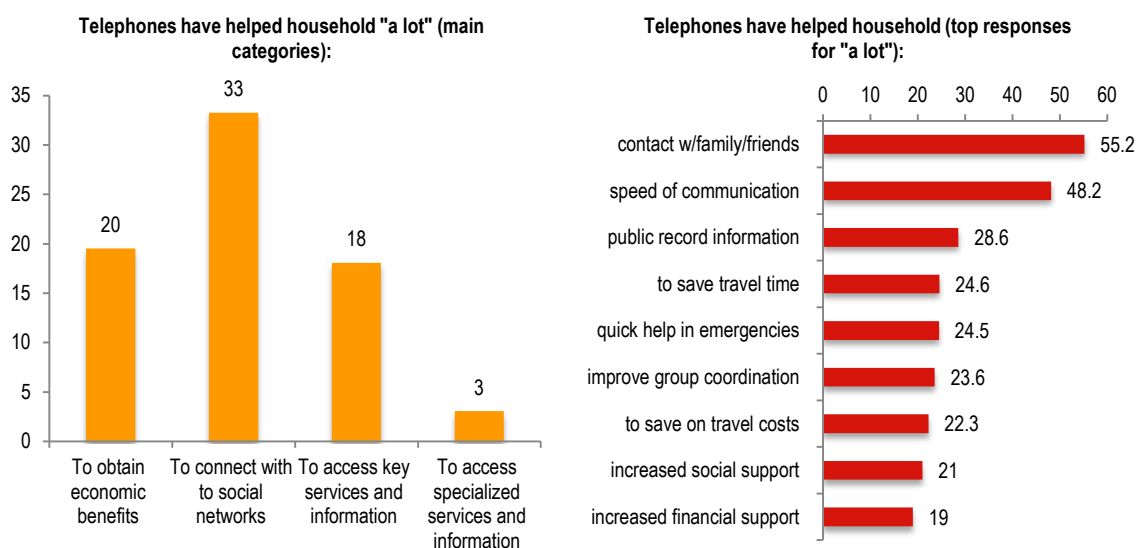
Source: Adapted from O'Connor et al. 2012.

According to TRR, since the introduction of mobile competition in 2008, affordability barriers to *joining* networks have eased significantly.[11] The price of a SIM card has dropped 90% (from VT 5,000 to VT 500) and in some cases comes free as part of a package. Top-up cards can be purchased for VT 100 whereas the cheapest before was VT 500. In terms of mobile phones, prices for entry level handsets decreased by more than 80%.

Mobile prices had been unchanged in the years leading up to competition (Figure 2.4, left). After Digicel entered the market, a basket of calls and text messages declined 34%.[12] As a percentage of per capita income, the basket dropped 7 percentage points between 2007-2008. Since then, there was a further drop of 11% in the basket. However, published prices have remained the same since 2011 with affordability improvements due to marginally rising incomes. In 2014, the mobile price basket was 9.2% of per capita income, high by global standards. The International Telecommunication Union (ITU) ranked Vanuatu 138 out of 165 countries in 2014 in respect to its mobile pricing.[13] One factor contributing to high mobile tariffs is the mobile termination charges between operators. The mobile termination rate in Vanuatu was Vatu 3.78 (US$ 0.039) per minute in 2014, the 9th highest among mobile operators in 20 countries Orange has ownership interests in outside of the European Union.[14] The rate is being reduced through a glide path agreement between operators and will drop to Vatu 3.54 by June 2016.[15] There is no interconnection charge for SMS and instead the "bill and keep" method is used.

Given that the mobile price basket as a percentage of per capita income is an overall country average, affordability is much more of a challenge among lower income citizens and those living in rural areas. Data from the 2010 HIES shows that mobile communications already accounted for the second largest operation expenditure in both rural and urban households (Figure 2.4, right).

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[11] http://www.trr.vu/attachments/article/249/market_competition_article.pdf
[12] Based on the Organization for Economic Cooperation and Development (OECD) methodology. See: OECD. 2010. *Revision of the Methodology for Constructing Telecommunication Price Baskets*. http://www.oecd.org/sti/broadband/48242089.pdf
[13] ITU. 2014. Measuring the Information Society Report. http://www.itu.int/en/ITU-D/Statistics/Documents/publications/mis2014/MIS2014_without_Annex_4.pdf
[14] Orange. 2014. *Registration Document 2013.* p. 33. http://www.orange.com/en/content/download/22778/472246/version/2/file/Orange_DDR+2013_EN.pdfOriginal figure in Euros and converted to United States dollars using annual average exchange rate.
[15] http://www.trr.vu/attachments/article/407/interconnection_agreement_between_tvl_and_digicel_amendment.pdf

Figure 2.4: Mobile prices 2005-2014 and household operation expenditure 2010
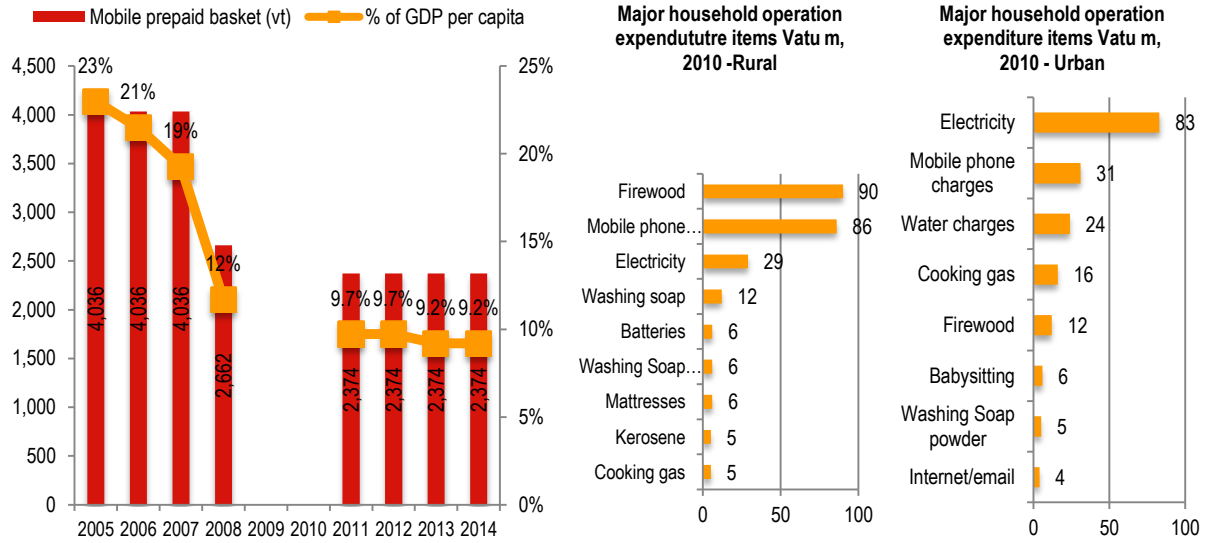
Note: Basket in the left chart is based on the 2009 OECD methodology and consists of a mix of 30 on-net and off-net calls and 100 SMS for prepaid users. Data for 2009 and 2010 are not available.
Source: Adapted from TVL and VNSO.

The reduction in mobile subscriptions since 2010 is partly the result of previously having SIM cards from both operators and instead settling for one operator. Another reason for the decline in active SIM cards is arguably insufficient competition due to ownership transitions at TVL and lack of financial resources to keep abreast with market changes. TVL's market value shrank by 89% between 2011 and 2013.[16] It is estimated that Digicel controlled over 70% of the mobile market in 2013.[17] The hypothesis of insufficient competition is supported by relatively high prices for prepaid mobile voice with a close match between stagnant subscriptions and pricing (Figure 2.5).

Figure 2.5: Relation between mobile subscriptions and mobile pricing

Source: Adapted from TRR and TVL.
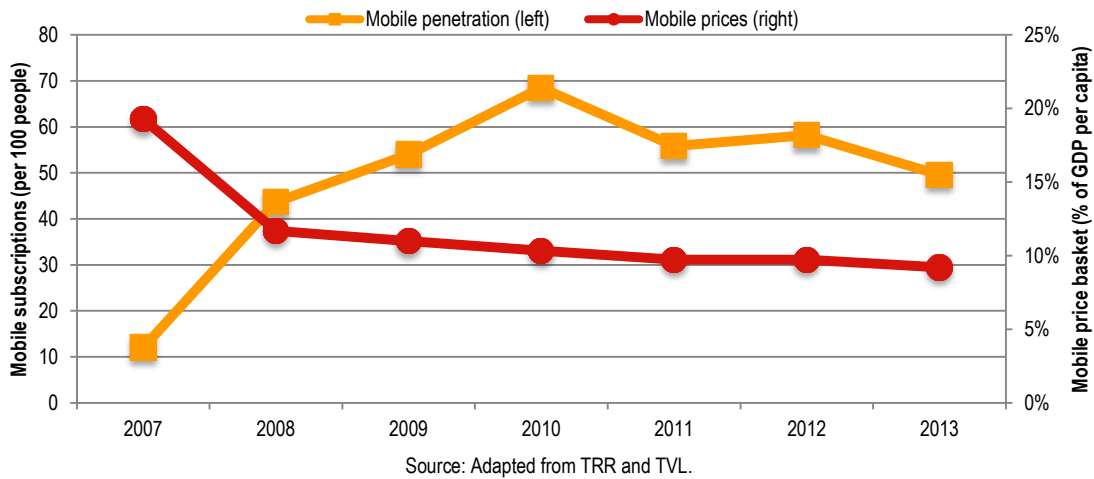
2.3 Internet

According to the 2009 Census, 9,290 persons in Vanuatu, aged 15 and older had used the Internet the week before the census or 6.7% of the population in that age group. In March 2011, Facebook reported 5,220 users in Vanuatu aged 13

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[16] Cable and Wireless sold 50% of its ownership in TVL in October 2011 for US$5 million, for a total TVL market value of US$10 million. In July 2013, Mauritius Telecom purchased 40% of TVL for Rs 12.9 (US$ 0.42) million valuing TVL at US$1.05 million. See: Cable & Wireless Communications. 2013. *Annual report 2012/13* (Note 7a) and Mauritius Telecom. 2014. *Annual Report 2013*. (Note 33).
[17] Based on operator subscription data for TVL sourced from Orange (www.orange.com) and for Digicel from the World Bank's Public Private Participation in Infrastructure (PPI) Project Database (http://ppi.worldbank.org).

and over. By December 2014, there were 15,400 persons aged 13 and older using Facebook, an increase of almost three times from March 2011. Facebook users accounted for around 9.6% of the population in December 2014.[18]

There were seven active companies providing broadband Internet services in 2014. The lion's share of subscriptions would be with the two main operators, TVL and Digicel. TVL offers both fixed line (ADSL) and mobile broadband Internet access while Digicel offers wireless Internet access using both WiMAX and its mobile network. Digicel launched its 3G network in December 2011[19] with TVL following in January 2013[20] giving the former a one-year head start. A notable milestone was the launch of 4G/LTE by WanTok in April 2014 when it commenced providing fixed wireless services in Port Vila. Like WanTok, other Internet Service Providers (ISPs) are offering wireless Internet access but using point-to-point connections or VSAT.

Data provided by TRR suggest there are about 4,000 fixed broadband and nearly 70,000 mobile broadband subscribers as of December 2014. Total fixed and mobile broadband penetration is around 27% with most users in urban areas. TRR through its consumer awareness programs and the implementation of the government Universal Access Policy (UAP) initiatives aims to expand penetration of broadband services into rural areas, with the UAP objectives of targeting 98% population coverage with a minimum download speed of 2 Mb/s by 2018.[21] Tests carried out in Port Vila in November 2014 found average mobile broadband download speeds to be 2.8 Mb/s with peak speeds of 7 Mb/s (Table 2.1).
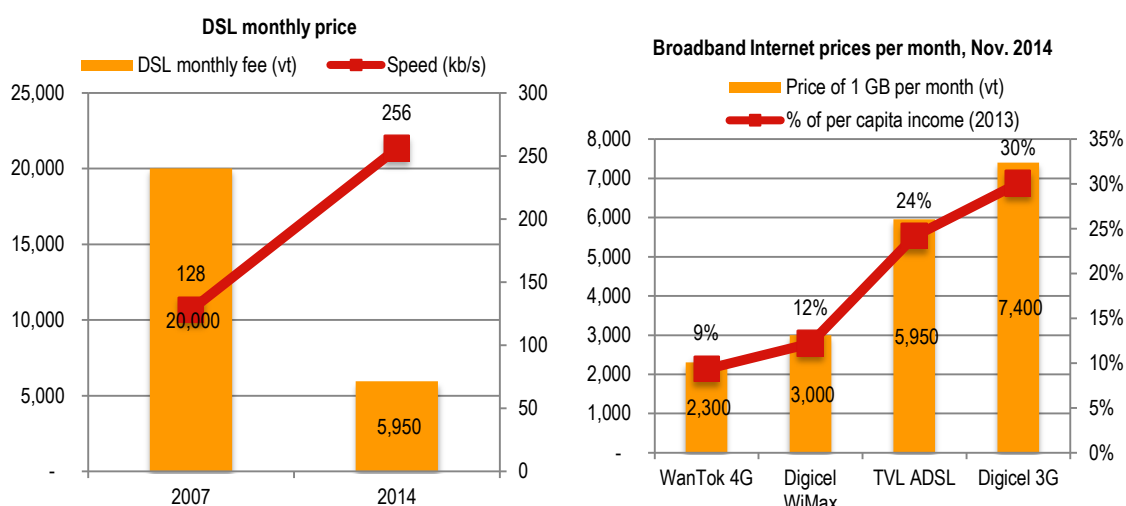
Table 2.1: Mobile broadband speeds and latency, November 2014

	Download (kb/s)	Upload (kb/s)	Latency (milliseconds)
Average	2,844	593	166
Maximum	6,950	1,250	536
Minimum	1,066	253	78

Note: Based on seven tests carried out between 21-30 November 2014 using Digicel's network.
Source: Authors.

Retail Internet prices have declined sharply since 2007. An entry level ADSL subscription dropped 70% between 2007 and 2014 while speeds doubled (Figure 2.6, left). Prices for an entry-level broadband package with at least 1 GB of data vary depending on the operator and technology ranging from VT 2,300 to VT 7,400 per month (Figure 2.6, right). Broadband Internet access is costly in terms of average incomes. An entry-level broadband subscription ranges from 9-30% of per capita income depending on wireless or fixed and the operator. One reason for the high prices includes the difficult geography of Vanuatu resulting in a high cost structure. Another factor is that although wholesale bandwidth prices have come down significantly since the introduction of the submarine cable, there is scope for further reductions. Given that there is just one cable, there might be a need for wholesale price controls for bandwidth such as exist in Fiji.[22]

Figure 2.6: Internet prices

Source: Adapted from TVL, WanTok and Digicel.

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[18] Based on 2014 population aged 15 and older.
[19] http://www.digicelvanuatu.com/en/about/news/digicel-launches-3g-mobile-broadband-in-vanuatu
[20] http://www.tvl.vu/sites/default/files/events/2013-01-14_TVL%203G%2B%20launch.pdf
[21] The was modified from the original 21 Mb/s specified in the Universal Access Policy. See:
http://www.trr.vu/attachments/article/431/uap_implementation_update_report_20_november_2014.pdf
[22] Fiji Commerce Commission. 14 November 2013. Final Determination on Prices and Access for Southern Cross Capacity and Network.
http://www.commcomm.gov.fj/wp-content/uploads/2012/07/Final-determination_Access-to-Capacity-and-Network_Nov-2013.pdf

Box 2.1: Rensarie Pilot Telecentre Project

Access to ICTs in rural areas of Vanuatu is extremely low. In an effort to test the sustainability of computer and Internet access in rural areas, TRR and other partners (with funding from the Australian government) launched a telecentre pilot project. The location selected was the village of Rensarie on the island of Malekula, the second largest island in Vanuatu. The pilot started in October 2010 with Incite, one of the country's ISPs, awarded the tender to build the centre. A prefabricated building was transported to Rensarie to house the telecentre. It is powered by solar energy and once fully charged, the centre can run for three days without sun and has a backup generator. VSAT was initially used for Internet access but has since been changed to mobile broadband and Wi-Fi is available in the area surrounding the telecentre. Two members of the local community were trained to manage the facility. In November 2011, the centre was officially launched.

The telecentre aims to provide a number of benefits to the surrounding community, many of whom had never used computers let alone the Internet. Education could be enhanced by making available a wealth of information compared to the limited resources of the school library. Upper level students can access Distance and Flexible Learning (DFL) packages offered by the University of the South Pacific instead of having to travel to Port Vila. The village's health centre is able to file monthly statistics reports and order medical supplies instead of having to pay VT 1,000 in travel costs to acquire the same service at the provincial centre..

Sustainability had been a prime concern. Villagers are charged VT 300 per hour to access the internet at the telecentre. Following extensive follow-up by TRR to ensure the centre would be properly operated, management was turned over to Rensarie College in 2013 as a self-sustainable entity and that remains today.

Interviews with the local community suggest the telecentre has had a positive impact. TRR has provided monitoring and evaluation during the 2 years piloting period (2012 and 2013) and submitted 3 reports to the Prime Minister, OGCIO, GfG and other interested stakeholders. At Pilot closure in November 2013, the Rensarie Pilot Telecentre was fully sustainable and Rensarie College now had the knowledge, resources and energy to continue to make the telecentre sustainable. In its closure report of April 2014, TRR did not recommend that such a pilot program as designed this way be replicated. In this respect, designing, shipping and building a telecentre on-site is considered to be a far too costly exercise. TRR, stakeholders, donors, and the government have gained experience and learnt invaluable lessons from this pilot. This has assisted, and will continue to assist, universal access implementation strategies and considerations in the future.

Source: TRR. 2014. "Rensarie: Reaching The Rural Community Through Broadband Internet."
https://www.youtube.com/watch?v=LxmU1Uc9azs&feature=youtube_gdata_player.

2.4 Backbone networks

The 1,259 kilometer Interchange Cable Network 1 (ICN1) linking Vanuatu to Fiji via fibre optic cable was completed in January 2014. The cable has been configured with an initial capacity of 20 Gb/s. The official launch was delayed by several months of negotiations with the country's leading telecommunications operators. With ICN1, traffic is sent to Fiji where it is transferred to the Southern Cross cable and routed to either Australia or the United States.

The cable is managed by Interchange Limited and cost US $32 million. The strategy of Interchange is to be a wholesale provider of bandwidth capacity to operators in the region. Interchange is planning ICN2, a 3,000-kilometer cable linking Vanuatu to Solomon Islands and Papua New Guinea at an estimated cost of US$72m. It is planned to be ready early in 2016 if funding is mobilised.

There are several options for procuring bandwidth on ICN1 with prices varying by the method and the volume. Discussions with different stakeholders suggest the average price is around US$350 per Mb/s per month compared to around US$1,000 per Mb/s on satellite. Roughly, 155 Mb/s of international capacity was being used when ICN1 launched and it is estimated this has grown to 1 Tb/s by the end of 2014. Of the retail operators, only WanTok is connected to the cable on the basis of an Indefeasible Right of Use (IRU), the other operators making use of intermediate wholesale operators (Fidelity Communications Corp and SpeedCast). The government has also purchased an IRU on the cable. As noted, the launch of the cable has resulted in decreases in retail Internet prices, increase in speeds for users and a variety of plans.

Each of the operators has their own domestic backbone network, mainly consisting of microwave links with satellite to a few areas. TVL has some fibre in Port Vila and Digicel is in the process of installing its own fibre links in the capital. The government also has its own backbone network with fibre in provincial capitals and microwave and satellite to other areas. It is somewhat unfortunate that there is not better coordination since the cost of three microwave networks is likely more than the cost of a fibre backbone. There could be an opportunity to leverage ICN2 for domestic fibre backbone connectivity provided it gets deployed.

Figure 2.7: Interchange Limited existing and planned undersea fibre optic cable network
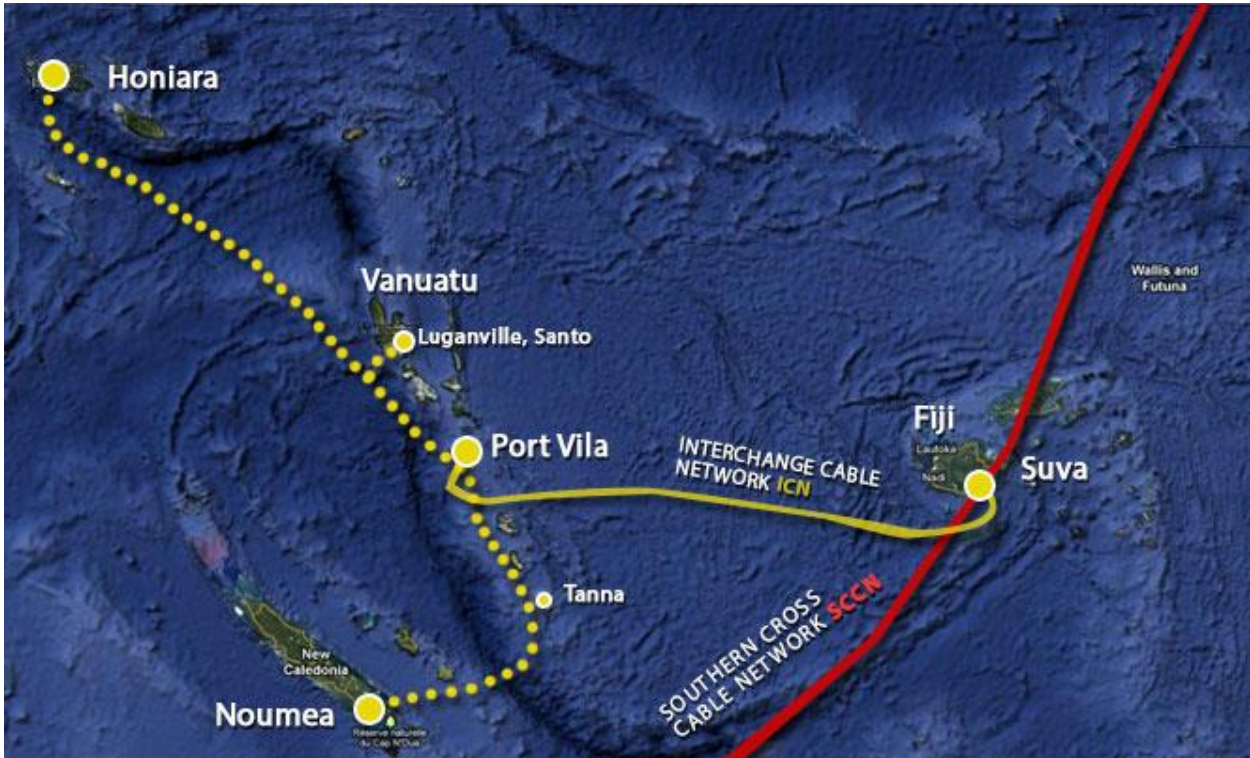
Source: Interchange Limited.

Vanuatu signed a MoU in December 2012 between relevant stakeholders to implement an Internet Exchange Point (IXP). After months of preparation, Vanuatu launched the region's first IXP in August 2013. The Vanuatu Internet Exchange (VIX) had seven members by December 2013. Use of VIX keeps locally generated and destined traffic within the country to avoid international transit expenses and improve quality. Three Google cache servers and i-root servers have been installed at VIX. The VIX is IPV6 enabled and two members now have IPV6 peering at the VIX

3 ICT Socio-Economic Impacts

3.1 Macro-economic

The contribution of telecommunications value added to Vanuatu's Gross Domestic Product (GDP) rose modestly between 2004 and 2007, which continued in 2008, the year competition was introduced, and a sharp rise a year later (Figure 3.1, left). In 2010, the sector contracted likely due to subscription growth not keeping pace with the fall in prices but then rose sharply in 2011, possibly due to large investments by Digicel for its 3G network. By 2013, the telecommunication sector contribution was 4.4% of GDP in constant prices, some 1.3 percentage points higher than the year before the introduction of competition.

The annual change in constant price telecommunications value added fluctuated sharply between 2005 and 2013 (Figure 3.1, right). Its sharpest increase was 2009 when value added rose 32% and the year when household mobile phone penetration is estimated to have grown by 20%. The direct contribution of telecommunications growth to annual GDP growth has ranged between 7% to an astounding 91%; in 2011, almost all the growth in Vanuatu GDP was due to the telecommunications sector.

Figure 3.1: Telecommunications as percentage of GDP & contribution to GDP change, constant prices
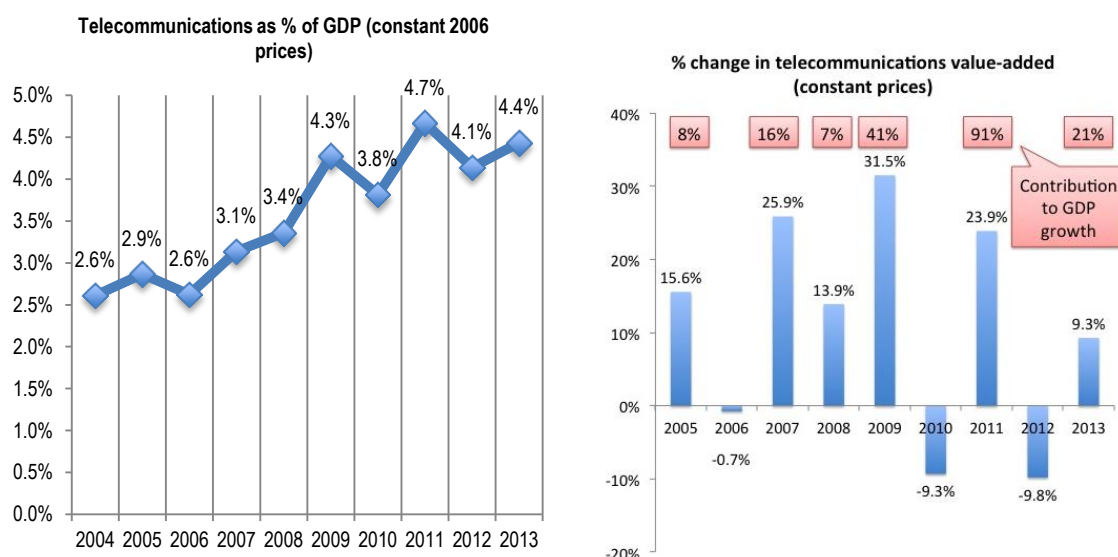
Note: The right chart shows the annual change in telecommunications value added (blue bars, in constant prices). The contribution to GDP growth is calculated by multiplying the annual telecommunications change by its contribution to overall GDP (4.4% in 2013) and dividing that amount by the percentage change in GDP. Source: Adapted from VNSO.

One driver of the telecommunication sector contribution in 2007 and 2008 was the market entry of Digicel. Its telecommunication investment in those years accounted for a significant share of overall Gross Fixed Capital Formation (GFCF) in the country (Figure 3.2).[23]

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[23] CAPEX figures for TVL were not available.

Figure 3.2: Digicel's capital expenditure as a percentage of GFCF
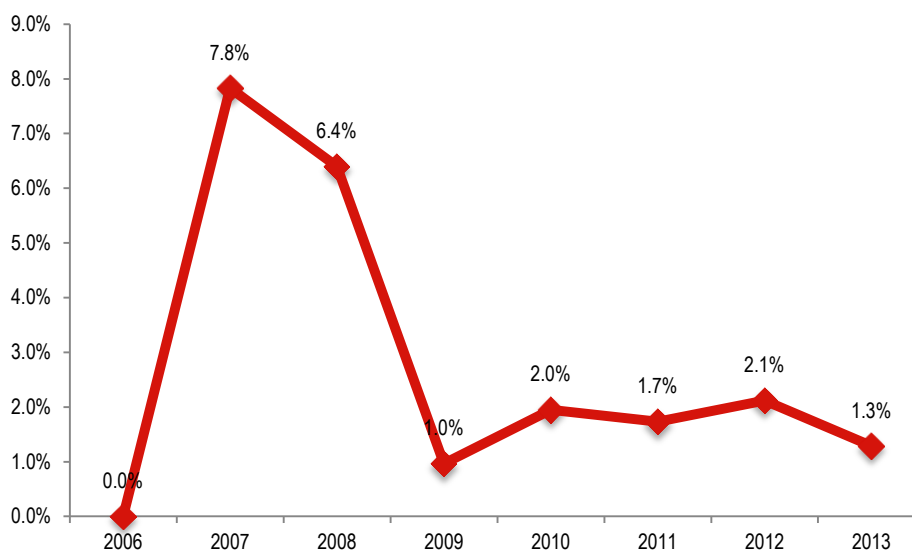
Source: Adapted from Digicel and VNSO.

VNSO's data on telecommunications value-added forms part of the wider Information and Communication Sector including publishing and printing and other information and communication. Publishing and printing is not so relevant in terms of ICT sector analysis. However, other information and communication relates to the computer software sector and consists of computer programming, consultancy, information services and related activities. Its value added was VT 411 million (US$4.4 million) in 2013. Here it is interesting to note how over time the share of telecommunications has risen while other information and communication has shrunk. For example, other information and communications stood at 23% in 2009 but had declined to 14% by 2013 (Figure 3.3). This is likely due to telecommunication firms internalising more of their own software development and services. It has negative consequences for the country's software sector, which has not been successful in outsourcing services to telecommunication operators nor been able to grow the domestic computer programming and information services market despite the recent large increase in connectivity.

Figure 3.3: Share of Information and Communication sector
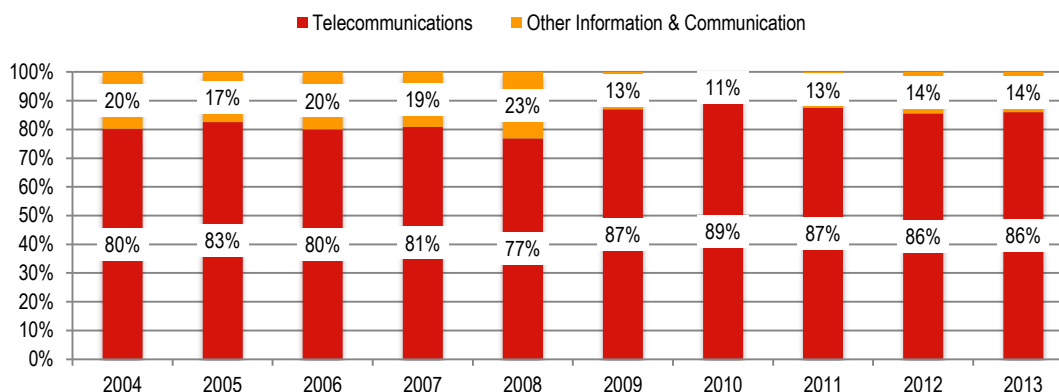
Note: Other Information & Communication consists of computer programming, consultancy, information services and related activities.
Source: Adapted from VNSO.

The relatively recent introduction of mobile and broadband services makes it difficult to carry out a meaningful statistical analysis of the indirect impact on the economy. This is compounded by the fact that quarterly GDP data is not available. Statistical models would require data beginning in 1985 whereas GSM was only introduced in 1992, fixed broadband in 2006 and mobile broadband in 2011. Telephone subscriptions (fixed plus mobile) were regressed against constant GDP per capita for the years 1983-2013 and found to have no statistical significance.[24] This is line with results indicating that

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[24] The regression was carried out based on World Bank methodology described in Qiang et al. 2009. "Economic Impacts of Broadband" in *Information and Communications for Development*. Washington DC: World Bank. GDP per capita in constant United States dollars was regressed against Gross Fixed Capital Formation (as a percent of GDP), secondary school enrollment (% of gross) and telephone subscriptions (fixed and mobile, per 100 people). Telephone subscription penetration was not statistically significant at the 10% level.

telephone penetration has a lower impact on the economy than broadband and that broadband impacts are only noticeable after a certain threshold of penetration has been reached.[25]

TRR, citing data from the National Provident Fund (NPF), reported that the telecommunications sector in 2013 provides direct employment for some 370 people.[26] This is 1.4 % of the total NPF registered employment for Vanuatu. In 2014, direct employment reached 430 active jobs registered with the NPF, making up 1.7 % of the total VNPF registered employees in Vanuatu. This is an increase by 0.3% as compared to 2013 telecommunications employment data. Apart from the registered employment, the sector also provides additional jobs to Ni-Vanuatu citizens across the nation in the form of subcontractors, street vendors, resellers, infrastructure caretakers and other employment as well that at large contribute to the welfare of the people of Vanuatu.

3.2 ICT impact across different sectors

3.2.1 Government

The OGCIO is the entity responsible for government ICT. In 2008, it launched an e-Government project. This included construction of a government backbone network financed through a US$29.5 million loan from China's Export-Import Bank[27] with Huawei as the lead contractor.[28] The network connects the six provincial capitals via microwave and satellite with local access through fibre optic cable. There are also two data centres and disaster recovery capability. The backbone is the country's third largest after the two main telecom operators. An agreement is in place for each to utilise one of the three networks in case of outages and there are plans for the government to provide wholesale services over its backbone. Around half of the some 7,000 government employees use the network. It offers VoIP and video-conferencing services, substantially reducing communications costs although no precise figures are available. There are several applications, mainly involving financial management. A smartphone version is to be launched providing staff with access to services from anywhere with mobile broadband coverage.

There are presently no e-services available over the central government network for business or citizens but this is planned over the next several years. OGCIO is working on the preparation of a medium-term e-government program focusing on high-priority applications and citizen services. This will, inter alia, require significant development/strengthening of back office government systems, including enterprise architecture, government data centre and disaster recovery, cyber security, and government cloud, and development of an interactive government portal. At a smaller scale there are several mobile applications aimed at citizens developed by different organisations. For example, the Vanuatu Ferry sends text messages advising of its schedules. The National Provident Fund allows its some 21,000 contributing members to use mobile phones to check balances and receive text alerts whenever there is a contribution to their account.

3.2.2 Education

ICT integration in the educational sector has been limited. Until recently, there has been no *formal* government support for ICTs in schools. Internet access and computers need to be purchased from limited school budgets. As a result, connectivity varies tremendously across schools, particularly between urban and rural and primary and secondary.

A survey carried out among school officials attending a workshop in Port Vila in January 2013, identified three types of schools according to computer availability: those with computer labs (37%), those with a few computers used by teachers or administrators (37%), and those with no computers (26%).[29] Given that the survey was not nationally representative and slanted towards urban areas, it can be inferred that the majority of schools in the country do not have computers. Only around five percent of students in the surveyed schools have access to ICTs and could be considered computer literate with the shortage of computers, around 1 per 200 students, a major obstacle. There are no schools with computers well integrated into the learning process. Most of the respondents indicated that ICTs in education are given low or very low priority and the two main obstacles are lack of electricity and lack of trained staff. According to Ministry of Education and Training statistics, only 44% of schools had access to power electricity and 15% had Internet access in 2013.[30]

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[25] Minges, Michael. 2013. "Moving to the next Step: Standardizing Broadband Economic Impact Measurements." presented at the Measuring the Economic, Social, and Political Impact of the Web, George Washington University, November 14. http://www.gwu.edu/~iiep/knownknowns/Presentations/MingesBBPresentation.pdf.

[26] See "Market Indicators for Telecommunications" at: http://www.trr.vu/index.php/en/telecom-industry/market-and-competition/market-indicators-for-telecommunications

[27] Maya Schmaljohann and Annalisa Prizzon. 2014. *The age of choice: Fiji and Vanuatu in the new aid landscape.* London: Overseas Development Institute. http://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/9172.pdf

[28] See "Huawei e-Government Cases" at: http://www.alphacomputer-dz.com/alphadays/galerie/presentation2/Huawei/01%20Datacom%20Solution/Solutions/Huawei_e-Government_Cases.pdf

[29] OGCIO, Ministry of Education, and TRR. 2013. The First Survey of ICT Usage in the Vanuatu Schools. http://ogcio.gov.vu/images/pdf/First%20Survey%20of%20ICT%20Usage%20in%20Schools%20Final%20Final.pdf.

[30] Ministry of Education and Training. 2014. *Annual Statistical Digest.*

As in other Pacific countries, there was a One Laptop Per Child (OLPC) pilot in Vanuatu. In July 2008, 25 laptops were provided to the Wan Smol Bag theatre in Port Vila.[31] They were used to provide literacy classes at the theatre. At one point, it was anticipated that this would be scaled-up to a nationwide project but that never materialised.[32]

The government is planning to deploy Internet access, computer labs and tablet computers to select schools during a first phase of the Universal Access Program. The program is supported by the Australian government's Governance for Growth (GfG) program and is implemented in coordination with the Ministry of Education, TRR and OGCIO.[33]

The University of the South Pacific (USP) has contracted bandwidth on the ICN cable. This will enable it to offer higher bandwidth services including access to regional higher education networks.

3.2.3 Health

Health is the second targeted sector after education for government ICT support. The focus has been on improving communications links among the various health institutions across the country. There are six hospitals, one in each province. Five are linked to the government network with a minimum bandwidth of 2 Mb/s. The other uses a private ISP. An audit is being undertaken to gauge the status of connectivity in health centres and dispensaries with a view to determining needs. Improved connectivity among the different health institutions will improve the timeliness and quality of data supplied to the Health Information System (HIS). In some instances, health staff have to travel to provincial capitals to deliver reports. This results in a low level of compliance for providing needed information.

The HIS is being enhanced with a dashboard that shows key health indicators at a glance. Data should become more timely and reliable following improvements to national connectivity and distribution of devices for regional staff to input and request information.

An application is under development for managing inventory. "mSupply"[34] will link inventories of medical goods including pharmaceuticals in a database. This will support better monitoring and distribution in the provinces and reduce storage of drugs that have expired.

There is a desire to use social media and mobile phones to disseminate information to the public. One example would be to text people more detailed information about health advertisements in local newspapers. Some NGOs have piloted text alerts in the health sphere but these have had limited success due to SMS prices and the reluctance of operators to provide discounts for bulk SMS services for the health sector.

3.2.4 Agriculture and fisheries

Although there is much enthusiasm ICTs, the Ministry of Agriculture, Livestock Forestry, Fisheries and Biosecurity presently lacks the capacity and budget to develop e-services. For example, the ministry does not have any IT staff and lacks a web site.[35] The headquarters in Port Vila and offices in provincial headquarters are however connected to the government network.

The ministry sponsors a weekly "talk back show" on Radio Vanuatu where experts field questions from users calling in. It also distributes a monthly newspaper to interested farmers through agricultural extension workers.

Given that the 2009 Census shows mobile phones far outnumbering radios in rural households, cellphones have a wider reach for spreading and receiving agricultural information. The ministry would like to leverage this more widely to send text messages with pricing and marketing information to empower farmers, foresters and fishers with timely information. Cell broadcasting has been used to alert relevant populations about livestock fairs.

In the area of biosecurity, high quality images of plant diseases are being transmitted over the Internet to New Zealand for remote diagnosis.[36]

There have been some development initiatives to boost the use of ICTs in agriculture. Lionfish, a Vanuatu company, is looking to develop agricultural information systems for local farmers.[37] This includes making pricing data available through mobile telephones. The Secretariat of the Pacific Community (SPC), in collaboration with the Technical Centre for Agricultural and Rural Cooperation (CTA), held a workshop in Vanuatu in October 2014 on use of Web 2.0 and social media to promote networking and information exchange in the agriculture sector.[38]

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[31] http://wiki.laptop.org/go/OLPC_Vanuatu
[32] See TRR. "OLPC is an education project, not a laptop project." at: http://www.trr.vu/attachments/article/91/OLPC_PRESS_RELEASE.pdf
[33] TRR. 2014. "A new dawn in education - ICT enabler," October.
http://www.trr.vu/attachments/article/410/a_new_dawn_in_education_ict_enabler_final.pdf.
[34] See: http://msupply.org.nz/News/welcome-vanuatu
[35] The Department of Forests does have a web site at: http://forestry.gov.vu
[36] https://www.spc.int/en/about-spc/structure/956-spc-fiji-and-new-zealand-collaborate-to-train-fiji-and-tuvalu-biosecurity-officers.html
[37] http://www.certlink.org/a/lionfish-ltd
[38] http://www.cta.int/en/article/2014-10-17/web-20-and-social-media-spread-like-wildfire-in-vanuatu.html

3.2.5 Tourism

Tourism is a major part of the economy. In 2013, there were 110,000 tourist arrivals by air and 240,483 cruise ship visitors. The Vanuatu Tourism Office has a web site, a twitter account and a Facebook page.[39] It provides a listing service[40] for bungalows mainly operated by local communities who often lack the ICT expertise to market their services on the web. Another initiative to encourage Ni-Vanuatu tourist business are provincial web sites such as the one for Malampa where there is an online form to enquire about packages and bungalow stays.[41]

Like in other Pacific countries, mobile operators are leveraging the high purchasing power of travelers and the strong likelihood of their bringing a mobile phone. Both have kiosks at the airport and provide "tourist" SIM cards for VT 1,000 (including the same amount in free credit). This is encouraged by a limited number of roaming partners and high roaming fees.

3.2.6 Financial inclusion

Digicel has launched mobile banking services in partnership with the National Bank of Vanuatu (NBV).The "Isi Mani" service is linked to the user's NBV account from which online banking services are available. The service has had modest uptake mainly because it has not been successful in obtaining permission to offer international remittance transfers. In 2014, Digicel further partnered with ANZ Vanuatu for the utilisation of Digicel network to enable the banking service, known as the "*goMoney*". This service enables users to view their ANZ account balance, transfer of money and do purchases through the mobile phone. In addition to branchless banking/mobile money deployments, Vanuatu has taken other steps to deepen financial inclusion with the support of the Pacific Financial Inclusion Programme.[42]

3.3 Conclusions

Direct benefits to the economy from ICT stem from wider coverage and adoption. Competition has continued to reduce prices and increase access and use throughout Vanuatu. The contribution of the telecommunications sector to GDP in constant prices is about one percentage point higher since liberalisation of the ICT sector. However, the opportunities that may arise from mobile voice and broadband services to generate jobs and increase economic efficiency are below the actual potential due to high prices. The relative novelty of mobile and broadband services results in insufficient data points to carry out an analysis on the economic impact of such services.

Mobile integration in the form of machine to machine communication, demand driven information systems based on premium SMS or bulk SMS and mobile applications is still expensive and under developed, inhibiting provision of social and economic applications aimed at mobile phones. Economic productivity gains may be derived from various forms of mobile and broadband integration. Despite price reductions mobile tariffs still remain high by global comparisons and Vanuatu is currently only benefiting from limited productivity gains due to high prices for mobile voice and data. Premium SMS and short codes as well as bulk SMS are currently not offered or offered as an individually negotiated service and not as a standard service with fixed prices and volume discounts. Mobile application development is also nascent at best. Evidence from other South Pacific countries suggests that two operators could be enough to create a competitive environment that leads to lower prices and wider access and use. Competition in Vanuatu has thus far been insufficient to lower prices below global standards and either further market entry or strengthening the commercial capacity of TVL would be required to stimulate competition.

The government network has provided connectivity to offices in Port Vila and the provincial capitals. No doubt, efficiency has been improved and government expenses reduced through free internal communications and less need for travel. These stated impacts are not monitored so it is not possible to draw evidence-based conclusions.

The government is operating at two "digital speeds" in terms of application development. Critical agencies such as Customs and Inland Revenue or those with some IT expertise or development assistance such as the Ministry of Health are able to move ahead with creating ICT applications and services. Others without IT capacity and funding such as agriculture and education are less fortunate, even lacking web sites. Current focus is on using ICT to strengthen internal systems rather than rolling out e-services to business and citizens. One challenge in this area is coordination of various databases and systems maintained by different agencies that would need to be integrated and user oriented to present cohesive portals to business and citizens. A crucial building block for providing mobile-based services to citizens is a civil registry. Currently there is no integrated registry and several ministries maintain their own incomplete and partially overlapping systems.

There are some examples of m-services for citizens. These include using mobiles to check National Provident Fund contributions, online mobile banking from Digicel and NBV and schedules from Vanuatu Ferries. Impact measurement is not possible due to a lack of or reluctance to provide data on number of users, costs and volume of transactions. There are also no quantifiable demand side surveys about impacts. Such surveys would interview populations before and after

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[39] The Facebook page had 11,976 "likes" on 28 November 2014. See: https://www.facebook.com/vanuatuislands
[40] http://vanuatu.travel/index.php/en/places-to-stay/bungalows-and-backpackers
[41] http://www.malekula.travel/
[42] See "Highlights of financial inclusion achievements in Vanuatu" at: http://www.pfip.org/about/where-we-work-1/vanuatu/

interventions to assess impacts and ideally include surveys of population not receiving the intervention as a control group. Applying this to the Vanuatu Ferries example would involve asking how people got information about schedules before and after the text message intervention with questions such as how much time and money was involved. This could be supplemented with macro level assessment from the ferry company such as whether ship occupancy is higher, revenues have increased, etc.

4 Business Case for Public Investment

Vanuatu's telecommunications sector is financed primarily by the private sector. The government received assistance from several development partners to support reform and liberalisation of its telecommunication sector for key policy and regulatory institutions (Table 4.1). This included a two-phase grant from Australia's Governance for Growth Program through the PRIF, administered by the World Bank to support capacity building and technical assistance for TRR and OGCIO. Australia also provided direct bilateral support to OGCIO for ICT policy development, OGCIO operational costs and for the UAP program. IFC provided commercial financing for Digicel to expand its network as part of a regional investment in the company. The submarine cable implementation was led by the private sector; the sources of funding were primarily from the Vanuatu National Provident Fund.

Going forward, the direction of such assistance is likely to change. Mobile penetration has risen dramatically and now reaches 80% of households. Many of the remaining households are likely to be connected because of the government's universal access program, which aims to achieve 98% population coverage of mobile networks by 2018. This is to be accomplished through contributions to the universal service fund and incentives for operators to expand their networks. However there will remain a gap of 2% of the population without coverage as well as likely affordability constraints for those with coverage. Enhanced competition and adjustments to the universal access program might suffice to deal with this.

The main area where public funding is likely to be needed going forward is to support the development of e-government including back office components, and applications/information systems supporting the delivery of services. OGCIO is working to develop such a program and conducted a report with the United Nations University identifying a number of mobile government applications.[43] Support will be needed to develop relevant applications particularly capacity building in areas such as coding, business process reorganisation and government data architecture.

Another area where Vanuatu could benefit from development assistance is applications to leverage the increased connectivity and generate greater impacts. There are very few applications aimed at important sectors such as agriculture, education and health that benefit citizens. Consideration should also be given to the possibility of establishing incubators, laboratories and similar support mechanisms for the application development community. It is unlikely that without some support, mobile application and software development will realise its potential given the absence of venture capital and angel investors in the country.

Table 4.1: Key ICT project assistance from development partners, Vanuatu, 2008-2013

Donor	Project	Amount (US$ m)	Year	Comment
DFAT a)	Governance for Growth	2.6	2008	Grant to support liberalisation of the telecommunications sector and seed funding for universal access program
IFC b)	Digicel Vanuatu	9.0	2009	Loan to fund Digicel's mobile network
PRIF c)	Telecom & ICT Technical Assistance Program	2.8	2009	Australia grant under PRIF with World Bank partnership to support TRR
China Export-Import Bank d)	e-Government	29.5	2009	Loan for building government backbone
DFAT	Governance for Growth	5	2010	Direct support to OGCIO
DFAT / World Bank		2.73	2013	Grant to support liberalisation plus capacity-building for TRR and OGCIO

Note: IFC = International Finance Corporation. DFAT = Australian Department of Foreign Affairs and Trade. PRIF=Pacific Regional Infrastructure Facility.

Source: Adapted from a) TRR. "Universal Access Program Initiative: Undertaking Agreement Signing" at: http://www.trr.vu/attachments/article/246/signing_of_undertaking_agreement.pdf; b) "IFC ICT Sector Investments, FY03- FY10" at: https://ieg.worldbankgroup.org/Data/reports/chapters/appf.pdf; c) World Bank. "Vanuatu Telecommunications & ICT Technical Assistance Program" at: http://siteresources.worldbank.org/INTPACIFICISLANDS/Resources/VanuatuProjectBrief090610.pdf; d) Maya Schmaljohann and Annalisa Prizzon. 2014. *The age of choice: Fiji and Vanuatu in the new aid landscape*. London: Overseas Development Institute. http://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/9172.pdf.

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[43] United Nations University IIST. 2014. Mobile Governance for Vanuatu – Strategy and Implementation Plan.

5 Conclusions

There has been a major expansion in ICT access in Vanuatu since 2008. The introduction of mobile competition, launch of high-speed wireless Internet access and connection to undersea fibre optic cable have transformed the ICT landscape. Deployment of the government backbone network has established a prerequisite for delivery of public e-services. Enabling laws and policies are in place covering ICT and cyber security and the universal access policy would see 98% of the population covered by the Internet in 2018.

While the increase in ICT access has undoubtedly had significant impact, there is limited quantifiable evidence of this. Feedback about the impacts is mostly based on opinion surveys such as the research carried out by the Pacific Institute of Public Policy. Studies objectively quantifying benefits to citizens in terms of increased incomes, travelling costs avoided, educational outcomes, etc. are mainly non-existent. One reason is the number of applications available and used on a wide scale that would have social-economic benefits is limited. Also, the increase in access to ICTs is recent and it is too early to assess many impacts, particularly economic ones that require a large number of observations to be statistically significant. Broadband economic impact literature also suggests that impacts are often not visible until a critical mass of penetration is reached.

Vanuatu faces two challenges leveraging ICT to generate impactful outcomes. The first is deepening access. There is a sharp contrast between urban and rural access to ICTs particularly broadband Internet. The country's universal access program calls for connecting all schools, hospitals and public hospitals as well as 98% of the population with broadband access featuring download speeds of at least 2 Mb/s by 2018. This target will be difficult to achieve unless there are parallel actions to deal with barriers such as affordability, electricity and digital literacy. The second challenge is building up a computer software and services community. Vanuatu's absorptive capacity for the new connectivity is constrained as evidenced by the dearth of applications in the country to extend impact. Expertise is needed for developing applications and matching them to the country's needs and development objectives. This could be achieved through a two-pronged strategy of attracting overseas talent and investment while at the same time creating a nurturing tech ecosystem with enablers such as incubators and training. Higher access to broadband with better geographic balance and a local tech ecosystem able to create innovative applications meeting development needs will ensure sustainability and inclusiveness for Vanuatu's emerging information society.

Appendix

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List of Meetings

The following organisations were consulted during a mission to Port Vila 24-28 November 2014:

Department of Customs & Inland Revenue: Collins Gesa, Acting Deputy Director Inland Revenue

Digicel: Simon Fraser, Chief Executive Officer

Interchange: Simon Fletcher, Chief Executive Officer

Joint ADB/World Bank Group Vanuatu Liaison Office: Nancy Wells, Development Coordinator

Ministry of Agriculture, Livestock, Forestry, Fisheries & Biosecurity: Abel Tapisuwe, Private Secretary

Ministry of Education

Ministry of Health: Scott Monteiro, Consultant

Ministry of Tourism, Trade, Commerce and Ni-Vanuatu Business: Mary Navaika, Executive Officer

Office of the Government Chief Information Officer: Fred Samuels, Chief Information Officer

Pacific Institute of Public Policy (PiPP): Dan McGarry, Chief Technologist

Telecom Vanuatu Limited (TVL): Prakash Bheekhoo, Chief Executive Officer

Telecommunications & Radiocommunications Regulator (TRR): Dalsie Baniala, Manager - Consumer and Corporate Affairs; Lloyd Fikiasi, Manager - Legal and Market Competition/CLO; Louise Nasak, Technical & Internet General Manager; Alma Wensi, UAP Project Manager

Vanuatu National Statistics Office (VNSO): Benuel Lenge, Senior Statistician

Abbreviations

3G	Third Generation
4G	Fourth Generation
ADSL	Asymmetric Digital Subscriber Line
CTA	Centre technique de coopération agricole et rurale (Technical Centre for Agricultural & Rural Cooperation)
DFAT	Department of Foreign Affairs and Trade (Australia)
DHS	Demographic Health Survey
GB	Gigabyte
Gb/s	Gigabit per second
GDP	Gross Domestic Product
GFCF	Gross Fixed Capital Formation
GfG	Governance for Growth
GSM	Global System for Mobile Communications
HIES	Household Income and Expenditure Survey
HIS	Health Information Service
ICN	Interchange Cable Network
ICT	Information and Communication Technology
IFC	International Finance Corporation
IRU	Indefeasible rights of use
ISP	Internet Service Provider
IT	Information Technology
kb/s	Kilobits per second
LTE	Long Term Evolution (4G mobile technology)
Mb/s	Megabits per second
NBV	National Bank of Vanuatu
NGO	Non Governmental Organisation
NPF	National Provident Fund
OGCIO	Office of the Government Chief Information Officer
OLPC	One Laptop per Child
PiPP	Pacific Institute of Public Policy
PRIF	Pacific Regional Infrastructure Facility
SIM	Subscriber Identity Module
SMS	Short Message Service
SPC	Secretariat of the Pacific Community
TRR	Telecommunications and Radiocommunications Regulator
TVL	Telecom Vanuatu Limited
UAP	Universal Access Policy
US$	United States dollar (all conversions using annual average exchange rates)
USP	University of South Pacific
VIX	Vanuatu Internet Exchange
VNSO	Vanuatu National Statistics Office (VNSO)
VSAT	Very Small Aperture Terminal (satellite dish)
VT	Vanuatu Vatu (national currency)