Final report

Satellite services in the Pacific

Perspectives from the region

Network Strategies Report Number 27013. 5 June 2007

NETWORK STRATEGIES
• Telecommunications Strategy •

ISBN 978 0 9805180 2 3

© Commonwealth of Australia 2007

This work is copyright. Apart from any use as permitted under the Copyright Act 1968, no part may be reproduced by any process without prior written permission from the Commonwealth. Requests and inquiries concerning reproduction and rights should be addressed to:

The Commonwealth Copyright Administration
Attorney-General's Department
Robert Garran Offices
National Circuit
BARTON ACT 2600

Or posted at www.ag.gov.au/cca

Satellite services in the Pacific

Final report for DCITA

Contents

NETWORK STRATEGIES

Glossary of terms and abbreviations

ADSL: Asymmetric Digital Subscriber Line

Broadband: A communications channel which carries traffic at a rate higher than dial-up communications

BWA: Broadband Wireless Access

Cache (cached): data management technique whereby frequently accessed data is temporarily stored locally, reducing both the time to access the data and usage of network resources

C-band: radio frequency band used by satellites. 3700–4200MHz is used for the downlink and 5925–6425MHz is used for the uplink

DCITA: Department of Communications, Information Technology and the Arts

Dial-up: A communications channel which is established between two modems to allow for the transmission of digital data across the PSTN at a rate of up to 56kbit/s

DSL: Digital Subscriber Line

DTH: Direct to Home

Extended C-band: radio frequency band used by satellites. 3625–4200MHz is used for the downlink and 5850–6425Mhz is used for the uplink. The reference to 'extended' is often omitted

FSM: Federated States of Micronesia

Full Duplex: transmits in both directions at the same time

Gbit/s: Gigabits per second

GNI: Gross National Income

GNP: Gross National Product

GSM: Global System for Mobile communication

ICT: Information and communications technologies

IP: Internet Protocol

ISP: Internet Service Provider

ITSO: International Telecommunications Satellite Organisation

ITU: International Telecommunication Union

Ka-band: radio frequency band used by satellites. 18 300–18 800MHz is used for the downlink and 27 500–31 000MHz is used for the uplink

kbit/s: Kilobits per second

Ku-band: radio frequency band used by satellites. 11 700–12 200MHz is used for the downlink of fixed satellite services, 12 200–12 700MHz is used for the downlink of broadcast satellite services and 14 000–14 500MHz is used for the uplink

Latency: time delay. Can refer to transmission – the time it takes the signal to reach a satellite and return to earth; or processing – the time taken to digitalise an analogue signal for transmission, and then to reconstitute it at the destination

LCO: Lifeline Connectivity Obligation

LEO: Low Earth Orbit

Mbit/s: Megabits per second

MEO: Medium Earth Orbit

PC: Personal Computer

PIF: Pacific Islands Forum

PNG: Papua New Guinea

Polarisation: Polarisation is a characteristic of the satellite beam and is either circular or linear. The satellite transponder polarisation must match the polarisation of the earth station antenna

PPP: Purchasing power parity

PSA: Public Services Agreement

PSO: Public Service Obligation

PSTN: Public Switched Telephone Network

RMI: Republic of the Marshall Islands

Tbit/s: Terabits per second

TDM: Time Division Multiplexing. A method of transmitting traditional voice calls.

VoIP: Voice over Internet Protocol

VSAT: Very Small Aperture Terminal

WAN: Wide Area Network

0 Executive summary

Satellite services are a key element of any telecommunications strategy for the less developed countries of the Pacific Islands Forum, and will remain essential for the foreseeable future. No other telecommunications technology is able to span the vast distances of the Pacific region and cost effectively provide service to the very sparsely distributed, relatively small, regional populations.

Currently, radiotelephones are used to provide domestic voice services to the many small remote population centres. These are unable to provide broadband data connectivity, and if broadband is deemed necessary, will have to be replaced, with satellite being a likely option.

However, commercial satellite operations are high-cost and high-risk, which is reflected in the usage prices. Even in developed countries satellite services are rarely the first choice considered. The less developed countries of the PIF are dependent on satellite services, but are less able than developed nations to afford them. Every industry representative from PIF countries that we spoke to for this report stated that satellite prices were too high, and were a significant barrier to their capacity building efforts. These costs are passed on to consumers, resulting in high prices for international telephony and Internet services.

Operators anticipate that international bandwidth capacity will need to increase substantially over the next few years, driven mainly by greater Internet use. Our projections indicate that in most Pacific Island countries potential demand for international bandwidth will increase by between 50% and 200% over the next five years, which will represent a huge cost burden on operators.

However, compared to global benchmark prices the prices being paid by several of the telecommunications operators in PIF countries are reasonable, and in one case was at the minimum benchmark price. Given that prices over the Pacific were expected to be at the high end of the global benchmarks, and that the benchmarks applied to a volume usage level that the PIF operators did not reach, this finding is somewhat surprising. Nonetheless there are some PIF operators paying satellite service prices well above the global benchmarks.

In addition, there are newer earth station technologies that will enable the bandwidth extracted from the satellite services to be increased with no change in satellite fees.

These findings suggest there is an opportunity for almost all PIF operators to reduce their satellite charges and/or increase their bandwidth, some quite substantially, but probably not to a level that would be considered reasonable – in the context of small low-income markets – to support their capacity building efforts.

Access to submarine cable networks provides some relief from high satellite charges to Fiji and Papua New Guinea, and there are prospects for cables to connect to two or three other countries, but the majority of Pacific Island countries remain absolutely dependent on satellite.

In other contractual aspects, operators in PIF countries have standard contracts with the satellite operators. While this may seem reasonable, ‘standard’ conditions do not include a guarantee of service or maximum time to reconnection when a satellite fails. The risk incurred by this absolute reliance on satellite and lack of guarantee of service was dramatically demonstrated in January 2005 when Intelsat lost its IS-804 satellite and several PIF countries lost all international connectivity. Restoration of service to all customers took over a month. Several, but not all, countries now acquire service from two different satellite operators, and/or have backup earth station facilities.

Access to additional satellite capacity is also difficult for some PIF countries, despite our earlier finding that there was a reasonable amount of spare capacity available over the Pacific. On further investigation, we found that some earth stations were not compatible with the satellites on which there was spare capacity, or had other limitations that

prevented them from accessing that capacity while simultaneously accessing their existing capacity:

- additional capacity was on a different satellite and a single dish cannot access two satellites simultaneously
- additional capacity was available via a transponder that utilised a different frequency
- additional capacity was available via a transponder that utilised a different antenna polarisation
- earth station was not capable of accessing satellites in inclined orbits.

The business models utilised by local ISPs can also have a marked effect on demand for international bandwidth. A number of business strategies, in most cases already in use around the world, can be adapted to PIF countries to minimise the use of international bandwidth and further reduce satellite costs:

- apply download limits with higher charges for higher limits
- mirror popular Internet sites locally and direct traffic to those sites by including them in a 'freezone'
- implement local branches of online commercial content sites, with content updated during off-peak times
- 'almost real-time' news sites such as sports results may also be able to be mirrored.

The key aims of all of these strategies are to improve the accessibility and affordability of ICT. Even if all of the above strategies are implemented, greater potential gains could come from regional cooperation. This would require a great deal of national autonomy to be ceded to the cooperative, but the benefits could be very high. The Eastern Caribbean Telecommunications Authority (ECTEL) provides a good example of what could be achieved with just regulatory harmonisation. The PIF countries collectively have the potential market size to leverage not just regulatory harmonisation, but also cooperation on a range of technical choices and the development of social programmes.

1 Introduction

Network Strategies has been commissioned by the Department of Communications, Information Technology and the Arts (DCITA) to examine the use and application of satellite networks in the Pacific region.

The focus of our study is the countries within the Pacific Islands Forum (PIF), namely: Australia, Cook Islands, Federated States of Micronesia (FSM), Fiji, Kiribati, Nauru, New Zealand, Niue, Palau, Papua New Guinea (PNG), Republic of the Marshall Islands (RMI), Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu. However, our study concentrates on the developing countries within PIF rather than the developed markets of Australia and New Zealand.

The study objective is to establish facts to support Australian policy development on the use and application of satellite networks in the Pacific Region. This report details our findings from the second stage of the project and examines the issues, challenges, problems and concerns experienced by Pacific Island countries regarding the provision of satellite services. We substantially develop the issues discussed in our previous report, *Satellite services in the Pacific: a perspective on operators and service offerings*[1] ('interim report'), which reviewed the structure and operation of the current satellite market within the region, largely from the perspective of the satellite operators.

Although this study was commissioned by DCITA, the views expressed within this report are entirely those of Network Strategies.

---

1 Network Strategies (2007) *Satellite services in the Pacific: a perspective on operators and service offerings*, report for DCITA, 16 April 2007.

Following this introduction, this report includes:

- a discussion of key issues raised by a variety of representatives from the telecommunications industry in the PIF countries. These are contrasted with the issues and analyses presented in our previous report, and key demand inhibitors are identified (Section 2)
- an assessment of potential levels of demand should those inhibitors be eased (Section 3)
- an overview of industry outcomes, including scenario analysis on key issues (Section 4)
- final conclusions (Section 5).

In the Annexes to this report we provide summary profiles for each of the Pacific Island countries, examine the prices for Internet and international telephony services and list persons and organisations that provided us with assistance in our research.

2 Issues and challenges for Pacific Island countries

Our previous report approached the issue of satellite networks in the Pacific region from a largely external perspective, identifying and interviewing the satellite operators and undertaking general industry research. This report substantially extends and validates those results by investigating the issue from the perspective of the inhabitants of the Pacific Island countries. We conducted a series of guided interviews with participants from the telecommunications industry located on a sample of Pacific Island countries, comprising the Cook Islands, Fiji, Niue, Samoa, Solomon Islands and Tonga. Additional information was obtained in discussions with service providers within the region, including REACH, SES New Skies and Telecom New Zealand.

The interviewees were drawn from a range of industry participants, from domestic and international operators to Government departments and regulators. Most interviews were conducted by telephone.

Based on the evidence of our interview participants, the region is very aware of its situation in regard to international satellite communications and is actively exploring means to manage and alleviate barriers to growth. Nonetheless there were a small number of examples where a local operator or country may have been able to gain better contract conditions from the satellite operators with better negotiation power and skill. However, our findings must take into account a potential bias in our interview sample – those who were keen to participate are likely to be more pro-active in seeking solutions. A comprehensive in-country survey would be required to ensure that the less engaged countries are accurately represented.

2.1 Geography

While all of the PIF countries are islands situated in the Pacific Ocean, their differing geographies have a marked effect on the 'ideal' telecommunications infrastructure. Some countries, such as Nauru, consist of a single island. At the other extreme are countries such as Kiribati, which comprises three island groups spanning 2400km west to east. Many countries are coral atolls with maximum elevation of only a few metres, while others, such as Papua New Guinea, have very rugged interiors that are a challenge for the deployment of domestic telecommunications infrastructure.

Satellite versus submarine cable for international telecommunications

Access to submarine cable for smaller countries is largely determined by a combination of location and traffic demand. In simple terms, the closer the cable path to the country, the lower the level of traffic needed to justify the inclusion of a termination point. While several cables traverse the Pacific, only two PIF countries currently have access to submarine cable – Fiji and Papua New Guinea.

There are commercially-based proposals to provide cable access to the FSM and on to the Marshall Islands via existing cable access to Guam, and Samoa may gain cable access via a proposal to provide cable access to nearby American Samoa. Within PITA other proposals are under discussion but these would require as yet unknown levels of capital subsidisation. It must also be noted that operational and maintenance costs associated with the cable termination would be significant and may require ongoing subsidisation.

The advantages of cable over satellite for telecommunications were discussed in the previous report. However, access to submarine cable does not remove the need for satellite access – Fiji, which uses both submarine cable and satellite services, intends to not only retain its satellite access, but is planning to construct a second satellite earth station on the opposite side of the main island. The satellite provides backup for the cable, and the new earth station will provide additional security for that satellite service. Papua New Guinea also uses both submarine cable and satellite, with the latter being used extensively for domestic telecommunications.

Satellite for domestic telecommunications

Satellites also benefit domestic telecommunications, for situations where terrestrially-based wired or wireless infrastructure is impractical, too expensive, or cannot provide broadband services. For example, two common terrestrial wireless technologies that can be deployed over large distances are microwave links and radiotelephones. Microwave links are able to provide broadband services over very large distances, but require microwave towers to be placed regularly every 30-80km or so, depending on the technology, the radiofrequencies being used, and the height of the towers. This is not possible or practical for the thousands of kilometres that separate the individual islands of some of the PIF countries. Radiotelephones are able to span these distances easily and relatively cheaply, but are restricted to voice services or very low rate data.

FSM consists of four island states – Kosrae, Pohnpei, Chuuk and Yap – of more than 600 tiny islands and atolls that stretch almost 2800 kilometres across the Pacific. The main islands of each state appear to have adequate infrastructure, with some deployments of coaxial and optic fibre cable. Cellular mobile is also available on the four main islands and international and domestic inter-island communications is facilitated by five satellite earth stations.

Similarly, Kiribati consists of three island groups – Kiribati, Line Islands and Phoenix Group – of 32 islands spread over almost 2400 kilometres across the Pacific. The main population centres appear to have adequate domestic infrastructure, with cellular mobile available in the capital Tarawa.

In both cases the majority of islands, although not the majority of the population, are connected via radiotelephone facilities. While adequate for voice telephony, radiotelephones are not able to provide broadband data speeds and will need to be replaced or augmented if broadband services are to be provided. Additional satellite facilities would easily provide the technical broadband capability, although cost may be an issue.

However, it is not only widely spread island countries that can benefit from domestic satellite telecommunications. Compared to FSM and Kiribati, Papua New Guinea, for example, is a relatively compact country which covers the eastern half of the island of New Guinea plus only a few populated islands. It has access to a submarine cable for

international connectivity, yet makes extensive use of satellite facilities for domestic communications as its rugged interior terrain coupled with sparse population density are difficult and expensive for terrestrially-based alternatives.

2.2 Satellite service providers

In most countries we interviewed both Intelsat and SES New Skies are used, with the exception of Niue (Intelsat only) and Fiji (SES New Skies only). Solomon Islands largely uses SES New Skies with only minimal usage of Intelsat. Almost all satellite services in the region use C-band frequency, however Ku-band is also available to many of the countries.

Fiji reported that it used Intelsat until the loss of IS-804 and then changed to SES New Skies, even though the original Intelsat contract is still active.

Some countries are currently in discussions with other satellite providers about provision of services which is natural in a competitive marketplace, as customers seek improved prices, capacities or other contract terms. Discussions with alternative providers are also influenced by a need for additional satellite capacity, or contingency planning in the event of satellite outage. One interviewee queried whether the Australian satellite fleet could be used to provide more coverage in the region, particularly in the Western Pacific.

Satellite services are largely used for international telephony and Internet trunking. Some domestic telephony usage was reported for countries with a large geographic spread such as Tonga, Cook Islands and Solomon Islands. Some TV or direct to home services are also provided via satellite, such as the Sky Pacific television service which has a footprint across the region. Cook Islands also reported using satellite for cellular backhaul. There is an increasing demand for leased circuits, largely from banking institutions (such as ANZ and Westpac) with strong commercial links across the region.

2.3 Technical issues affecting access to satellite capacity

As identified in the interim report, there is currently a reasonable amount of spare satellite capacity in orbit over the Pacific, and new satellites already under construction or in the late stages of planning should be sufficient to satisfy projected demand based on conservative assumptions. However, a number of technical issues combine to restrict greatly the access of the PIF countries to this current and future capacity. Indeed, some countries reported great difficulty in obtaining additional capacity, at any price, as their ground equipment was not capable of accessing the available spare capacity.

Transmission characteristics – impact on terrestrial infrastructure requirements

The radiofrequency characteristics most commonly used by satellites serving the Pacific region are:

- radiofrequency is either C-band, Ku-band or Ka-band[2]
- polarisation[3] is either linear or circular.

A satellite dish must be tuned to one of the radiofrequency bands, and it must utilise one of the polarisations. Having been constructed for one of these combinations of characteristics, it is not able to utilise transponders operating using one of the other combinations.

All of the older Intelsat satellites (IS-602, IS-605 and IS-701) utilise circular polarisation for their C-band transponders. While there are several other satellite operators providing capacity to the region (including APT Satellite Holdings, AsiaSat and JSAT), only SES New Skies provides any C-band transponders that utilise circular polarisation, and only on its NSS-5 satellite. NSS-5 is expected to remain operational until 2015, but will be moved

2 Ka-band is used for a small but increasing number of transponders. It is a higher frequency than Ku-band, and is thus even more susceptible to rain-induced interruptions and must utilise very high powered transmitters and receivers.

3 Polarisation is a radio transmission characteristic that minimises interference between adjacent transmission bands and allows for smaller guard bands, thus making more use of the available spectrum.

to a new orbit in 2009. The replacement, NSS-9[4], will contain C-band transponders, and SES New Skies has confirmed that C-band on NSS-9 will use circular polarisation.

Modulation techniques—effect on available bandwidth

The capacity of communications satellites is often referred to by the radiofrequency spectrum bandwidth that it uses. The standard unit of capacity is the 36MHz transponder[5], and it is possible to lease whole, multiple, and fractional transponders. However, radiofrequency bandwidth does not translate directly into achieved data transmission bandwidth, and this re-use of the term 'bandwidth' may cause some confusion.

The actual transmission bandwidth able to be supported by a full 36MHz transponder varies from 45Mbit/s to 155Mbit/s depending on a number of factors, including the prevailing environmental conditions and the modulation techniques being used by the earth station equipment at both ends of the satellite transmission. PIF countries, being located in areas subject to tropical rainstorms and generally using older earth station equipment, will generally be capable of achieving transmission bandwidths at the lower end of the range. However, we were informed that at least one PIF country, Vanuatu, has implemented equipment that uses advanced modulation techniques which will boost the achieved transmission bandwidth.

In all other sections of this report, the term 'bandwidth' refers to transmission bandwidth and is measured in Mbit/s.

Impact of reliance on single dish antenna

Access to spare capacity is further restricted for PIF countries that have only one earth station with only one antenna. A dish antenna is only capable of accessing one satellite at any one time, so if there is only one antenna and spare capacity is required, it can only be

4 SES New Skies press release 20 November 2006. http://www.newskies.com/pressreleases_424.htm

5 Not all transponders are 36MHz, but this is the standard generally quoted. For example, a 54MHz transponder would be referred to as 1.5 36MHz equivalent transponders.

accessed if it is available on the same satellite from which service is already obtained. Alternatively, the total service can be shifted to another satellite that has spare capacity equal to or greater than the total requirement.

The addition of even one additional antenna will greatly increase the available system flexibility and make more bandwidth accessible, as well as increasing diversity and lowering overall risk. The configuration of the additional antenna(e) would be a key aspect of any strategy that attempted to aggregate demand across the PIF countries. The strategy involving the aggregation of demand is discussed in more detail in Section 2.8.

Inclined orbit satellites

All PIF interviewees who were aware of inclined orbits[6] reported that their earth stations were capable of accessing these satellites, but in general preferred to use satellites in normal geostationary orbits. Reasons for the preference were not provided. The cost of capacity from an inclined orbit satellite is generally substantially discounted as the satellite is likely to be already beyond its planned economic life. The ability to access inclined orbit satellites may be a valuable part of any regional cooperation negotiation strategy.

Capability of domestic telecommunications networks

The technologies providing the local domestic telecommunications networks deployed by PIF countries vary widely, from modern optic fibre loops deployed around some capital cities to legacy equipment such as radiotelephones that can provide only voice and very low rate data, often coexisting in the same network. The use of such limiting technology, especially where it provides the only connectivity to peripheral, yet still significant populations, is a barrier to their accessing the benefits of better communications. Depending on the distances that need to be traversed, satellite communications, point-to-point microwave links, or domestic submarine cable may be viable alternatives that are capable of providing sufficient bandwidth capability for the domestic backbone network.

6 Inclined orbit satellites were described in Appendix A.1 of our interim report.

However even in many main population centres the domestic network may still be the limiting factor in preventing access to network services that are commonplace in developed countries. For example, local branches of international businesses such as banks and travel agencies may be unable to connect to their parent company's international Wide Area Networks (WANs), even where there is sufficient raw bandwidth available, and so cannot access a large range of services that are the norm in countries with a more developed domestic network.

2.4 Government policy and regulation

All PIF countries seem to have active policies to advance their telecommunications infrastructure and usage. Telecommunications regulatory policy is starting to move down the path of market liberalisation (Table 2.1), with variance between countries only in the timing and staging of the granting of additional licences, and the final form of those licences. Interviews with local operators and government representatives presented a general feeling of satisfaction with progress to date and with the policy objectives.

Monopolies	*Market liberalisation status*
Cook Islands	Fiji – exclusive licences terminated
Federated States of Micronesia	Samoa – second mobile operator
Kiribati	Tonga – second carrier
Nauru	
Niue	
Palau	
Papua New Guinea	
Republic of the Marshall Islands	
Solomon Islands	
Tuvalu	
Vanuatu	

Table 2.1: *Telecoms market liberalisation status in Pacific Island countries, 2007 [Source: ITU, regulators]*

Views of satellite operators and service providers, however, varied from almost resigned acceptance to a strong desire for market liberalisation to be accelerated. Companies urging acceleration were more likely to be those actively engaged in the PIF markets with, for example, international corporate clients wishing to connect local branches to WAN

services. These companies did not necessarily have aspirations to acquire local telecommunications licences and enter the markets themselves, but were anticipating that more competition would lead to greater functionality and quality of service from the domestic networks, and more flexibility in the connection with their satellite facilities.

While the scope of this project did not include an in-depth analysis of each PIF country's regulatory regime[7], our broad analysis suggests that current directions are reasonable, though progress throughout the region is varied. Some countries are well advanced, with competition in both network infrastructure and service provision. Others still have monopoly licensees, with plans for the introduction of competition in the next few years. Universal service concepts and policies were mentioned by only some interviewees, but it is clear that access beyond main population centres is a key concern in many countries.

If regional cooperation is pursued, it will be necessary to ensure that the regimes are all compatible, and progress with regime change in some countries will need to be accelerated. Areas that may require harmonisation include:

- competition policy, especially with respect to allowing cooperation between competitors in their dealings with providers of international bandwidth
- technical standards
- spectrum allocations.

These aspects are discussed in more detail in Section 2.8.

One example of regional cooperation that appears to be functioning well is ECTEL, the Eastern Caribbean Telecommunications Authority, with member states Dominica, Grenada, St Christopher (formerly St Kitts) & Nevis, St Lucia, and St Vincent and the Grenadines. ECTEL's focus is telecommunications regulatory matters, on which it provides advice and makes recommendations, and helps to manage the sector in its member states. Each member state has its own National Telecommunications Regulatory Commission (NTRC) which interacts directly with users and service providers.

7 A summary of the regulatory regimes of the PIF countries is provided in Annex A.

ECTEL member countries are similar to PIF countries in that they are all island states with less developed economies that are actively developing their telecommunications industries. The ECTEL model could well be applicable to the Pacific situation.

However, the Pacific region covers distances of many thousands of kilometres, mostly over unpopulated ocean, whereas the ECTEL members are located within a relatively tightly packed archipelago amongst several other populated island countries, and within relatively easy reach of the South American mainland. The technical challenges of providing telecommunications services to the PIF countries are very different to those of the ECTEL members, and Pacific regional cooperation could gain substantial value by extending ECTEL's regulatory cooperation model to include technical and commercial aspects.

2.5 Human capacity building issues

Engineers and technicians

The general view from the PIF countries that we have interviewed is that their current level of local technical and engineering expertise is sufficient for their needs, although some stated that it was difficult to retain skilled staff. The view from external stakeholders such as service providers servicing multinational clients with presence in some PIF countries, varies from satisfaction to frustration. The frustration stems from a dual perception of poor quality maintenance coupled with inadequate hardware. External stakeholders that expressed satisfaction acknowledged that they could not justify their own local representation, and were appreciative of the tasks performed by the local operators in challenging environments.

All PIF country interviewees reported that local expertise was sufficient for their technical activities, such as re-aiming satellite dishes and building and maintaining terrestrial networks. Generally, when Pacific Island countries buy new equipment, it is installed by the vendor who then trains local staff to maintain it.

However, the lack of capacity constraints for technical activities should not necessarily be extrapolated across all countries in the region and may reflect the particular circumstances

of those countries interviewed. Those countries where we were unable to conduct interviews (such as Kiribati and Tuvalu) may well have different capacity issues.

Irrespective of the current level of satisfaction, if domestic and international telecommunications networks are to be upgraded, local engineering and technical expertise will need to be similarly enhanced, and locally available qualified staff will be essential for day-to-day management, maintenance and immediate emergency response.

It may be that a regional cooperative effort could see the creation of a pool of expertise that is shared between the countries. Local expertise could have access to a user community for assistance, especially for problems that are more common in tropical and island environments. This approach could provide some economies of scale whilst achieving the required level of local technical and engineering competence, as well as providing enhanced career prospects that will assist the retention of skilled staff in the islands.

Regulatory expertise

Upgrading the technical infrastructure and liberalising markets will require a similar extension of the regulatory expertise available to each PIF country. Competitive markets necessitate regulatory management in many different areas, including:

- access to shared resources such as radio spectrum, numbering resources, antenna towers, local exchanges and underground ducting
- ensuring interconnection standards are met and any-to-any connectivity is maintained
- monitoring retail and interconnect pricing and preventing collusion between competitors
- establishing and monitoring standards for products, services and customer services, that utilise the infrastructure of more than one licensee.

If regional cooperation proceeds, it will also be necessary to establish regulatory regimes in each PIF country that facilitate cooperation for international capacity.

User expertise

The ability and propensity of users to access the Internet is expected to have a large influence on the demand for bandwidth capacity, as well as being integral to a significant proportion of the benefits that are expected to accrue from effective ICT. Experience in countries with well-developed Internet economies shows that both business and non-business Internet users progress through a familiarisation and education process. This process builds confidence in businesses and applications providers that doing business over the Internet is safe, and it facilitates consumers and other non-commercial Internet users to become computer literate, and also skilled in the use of the Internet. As the improving levels of proficiency spread throughout the community, usage grows rapidly and potential benefits are realised.

In general, this process has only barely begun in most of the PIF countries, and even in those that have advanced some way down this path, many of the more remote communities have little or no experience with the Internet. We have been able to locate a number of different initiatives in local communities around the PIF countries, mostly involved in education, from primary to tertiary levels. All of these programmes provide training and ongoing support for local staff and students, as well as local technical expertise.

Similar targeted programmes could also address community and Government issues such as health, local community activities, and access to Government services. Business products and services that can benefit from or are reliant on an online presence could also be the target of development programmes – for both the businesses and the potential users, as there will be a natural initial reluctance to use unfamiliar methods of transacting business.

It must be recognised that while most of the PIF countries have a reasonable level of literacy, PNG, the Solomon Islands and Vanuatu all have literacy levels below 77%, and special programmes may be required to address this issue.

2.6 Existing satellite contracts

Global benchmark prices

We have had confirmation from satellite providers that the current global benchmark price for a 36MHz transponder is in the order of USD800 000 to 'about' USD1.2 million per year, with Pacific region customers paying at or above the higher end due to capacity issues, as outlined in Section 2.2. As discussed earlier, a 36MHz transponder is capable of transmitting from 45Mbit/s to 155Mbit/s, depending on the modulation technique utilised by the earth station technology. Table 2.2 below shows the range in prices per Mbit/s that result from these benchmark figures.

	Achieved data bandwidth per transponder	
Per transponder price	*45Mbit/s*	*155Mbit/s*
USD800 000	USD18 000	USD5 000
USD1 200 000	USD27 000	USD8 000

***Table 2.2:** Price per Mbit/s for different transponder prices [Source: Network Strategies]*

Note that these per-Mbit/s price calculations assume that a whole transponder is being leased. Leasing of a part transponder incurs a price premium.

PIF country pricing

The prices being paid for satellite capacity reported by network operators in the PIF countries are mostly consistent with the global benchmark price calculations shown in Table 2.2. This is quite remarkable as all operators are purchasing capacities that utilise much less than a whole transponder, a situation which would normally attract a price premium, and the equipment in PIF earth stations is probably not capable of achieving the top speed of 155Mbit/s.

Therefore, although prices are high – especially for low income countries – in general they are broadly comparable with benchmark prices. Nonetheless, there are some exceptions

where the prices are markedly above benchmarks. Only one operator stated for the record that they felt that they had obtained a good price – claimed to be 30% below the current benchmark, because it was a long-term contract negotiated when prices were lower..

Contract duration

There is a large variation in the length of satellite supply contracts across the region. SES New Skies contracts generally are short term with countries surveyed citing durations of one to two years. The duration of Intelsat contracts varies widely from three years up to 15 years, which is consistent with our interview of Intelsat for our previous report when it was stated that legacy contracts were mostly 15 years duration, but most new contracts are three to five years duration, and sometimes shorter. These contracts with PIF countries expire between 2012 and around 2017.

Many PIF country operators reported a preference for shorter term contracts which could accommodate more modern services. A shorter contract term also provided the option to take advantage of the decrease in satellite rates over time. However, one operator reported a preference for its long-term contract with Intelsat which had locked in a cheaper rate, negotiated when prices were low.

Other contract terms

Other contract terms were reported to be standard for the industry, using terms such as ‘best efforts’ clauses for quality and continuity of service. Several PIF country operators felt that these were vague and difficult to interpret and enforce.

The SES New Skies contract terms seem to vary depending on the reseller. One operator reported having a range of quality of service terms from ‘best efforts’ to a ‘24/7’ service standard, with associated prices varying according to the service standard. Another operator reported that as a small customer, it expected to always be one of the last to be restored after satellite failure, since co-owners have priority.

Some PIF country operators reported that their contracts met both their current and future needs. However, there was a strong theme across the operators that the prices are too high and the contracts need to be more flexible and affordable..

Other PIF countries indicated that the increase in data demand will greatly affect their future satellite needs. Some countries, such as Samoa, Solomon Islands and Vanuatu, are investigating various modulation and other traffic engineering techniques that have the potential to increase their effective bandwidth without increasing their satellite costs.

Overall negotiating power of PIF country operators

Many PIF country operators remarked that their satellite supply contracts were not negotiated, but were standard contracts over which they had little influence. This suggests that they have little negotiating power with the satellite operators, nevertheless the prices that several have obtained, which while very high for their country's economic situation, are reasonable compared to global benchmarks.

Commercial VSAT services

Full duplex Internet services using VSAT technology are very widely available and often offered as package deals which include the supply and installation of all equipment. Supply and installation of local area network equipment is also available. Sample prices[8] available off the AsiaSat 4 satellite's C-band global beam for unlimited uploads and downloads are shown in Table 2.3.

8 http://www.tonywaters.co.uk/Apex%20iDirect%20Sat%20Pricelist_Asia%20Pacific.pdf. Note that these prices are provided for information only, and should not be interpreted as an endorsement of this particular service provider.

Maximum duplex speed	*1Mbit/s*	*1Mbit/s*	*2Mbit/s*
Hardware (3m antenna)	USD12 800	USD12 800	USD14 500
Monthly fee	USD1 500	USD2 150	USD5 800
Connection fee (once off)	USD350	USD350	USD350
Contention ratio (down/up)	10:1	4:1	4:1
Recommended maximum users	20	100	200

Note: Installation and shipping are additional, as are any licensing and other regulatory fees.

Table 2.3: *Sample VSAT pricing [Source: Apex Broadband]*

Apex Broadband – a Melbourne-based VSAT service provider – stated that it is providing VSAT services to Telsat in Vanuatu, as well as customers in Papua New Guinea, Fiji and Wallis and Futuna.

Note that these particular VSAT services incur a contention ratio[9] between the downlink and uplink speeds, and that this ratio has a significant effect on the monthly fee. The carrier-grade transponder services discussed above do not incur contention between the downlink and uplink and will provide a significantly higher grade of service, so the prices are not directly comparable. However, these VSAT monthly fees are significantly lower than the global benchmark price range, and this illustrates that substantial cost savings may be made if the lower grade of service is acceptable to the end-user.

2.7 Strategies to maximise value from satellite access

Business models

The use of the Internet has been identified as one of the key drivers of the use of international bandwidth in the PIF countries. It can be expected that if or when affordable broadband services become available, then the use of the Internet will increase

9 Not all VSAT services incur a contention ratio. The services presented here are to illustrate that a variety of services are available, plus the pricing comparisons.

substantially, highlighting the importance of negotiating reasonable prices for supply, but also for the need to manage carefully the use of that capacity.

Even in the most developed countries with comparatively massive international Internet pipes, business and operational models have been created that seek to limit and optimise usage of international capacity:

- ISPs apply limits to the amount of data that can each user can download each month. Higher limits attract higher monthly fees

- ISPs will designate sites with which they have a commercial agreement as being within the 'Freezone'. Downloads from these sites are not counted towards the users' monthly download limits, or only a fraction of the download is counted If Freezone sites are located overseas a mirror[10] site will normally be hosted locally by the ISP.

- Popular download sites for products such as freeware, and free or paid audio and video content, where the content is relatively stable, will often be mirrored in several different locations around the world.

ISPs with facilities in the PIF countries need to utilise and further develop business models and strategies such as these in order that demand for international bandwidth be minimised whilst maintaining a reasonable quality of service. For example:

- Develop mirror sites for many popular Internet sites and provide local users with an incentive to use these sites by making them part of the 'Freezone'. Updates would occur at off-peak times.

- Implement local branches of popular online movie sites that may contain only a subset of the full database. This subset could be updated every month with a number of newer releases. Monthly updates would occur during off-peak times, but local access to movies would not require international access. This approach would have the additional benefit of allowing the local authorities to apply content classifications that

10 A mirror site is a copy of the original site. Users are asked to access the physically closest mirror site so that transmission charges for their downloads are minimised.

are more closely aligned with local cultural values (although not permit the editing of content).

- Very popular real-time information such as sports updates could be downloaded once to a local site, and then local users could access the local site, rather than multiple accesses of the same information over the international link. These could also be in the 'Freezone'.

- Sensible use of local caching will automatically identify and manage access to the content of many other sites, even if of only temporary interest.

All of these strategies and business models are already in use in developed countries, and it is likely that any supporting software is readily available. Commercial contracts with content providers will also be required in many cases.

However, some Internet usage is not amenable to these techniques. Applications characterised by real-time interaction cannot be cached and need to use bandwidth on demand. Examples are VoIP (which we expect to be very popular), videoconferencing, and online interactive gaming. It should be noted that even with plentiful bandwidth, online interactive games that are time sensitive will not offer a robust user experience due to the time delay caused by the unavoidable latency of satellite transmissions.

Community models

Provision of public access Internet terminals and defined-use Internet terminals that can become community resources when not required for the defined use is a common strategy around the world. Programmes to equip local schools and libraries with Internet terminals are already in place and working well in some PIF countries, along with training programmes for staff to facilitate and encourage usage by the general community.

An alternative type of programme involves Government facilitation of widespread broadband accessibility by ensuring that the access provider's business plan is supported by an anchor customer. This customer is usually one providing basic community services such as:

- medical facilities with broadband access to a major hospital for assistance with diagnosis and treatment of patients
- banking and other financial services
- access to government services.

2.8 Regional cooperation strategies

The basic concepts underlying traditional telecommunications network structures comprise a customer access network providing connectivity to a central backbone network, which in turn provides connectivity to a full international network. This is seen clearly in the traditional copper access network where each service utilises it own copper cable to connect to the local exchange, which is in turn connected to the backbone network and then to the international network. The extent to which resources are shared increases markedly with each level of network hierarchy.

Wireless technologies support infrastructure sharing at the level of the end-user to a much greater extent than wireline technologies. There are many examples: cellular mobile, wireless local loop, and trunked mobile radio services. Satellite communications is a wireless technology, but most PIF countries have only one satellite earth station and opportunities to gain benefits from infrastructure sharing are limited.

From a technical viewpoint, it is reasonably straightforward for PIF countries to aggregate their demand and lease the appropriate amount of transponder capacity as a single entity, with a regional agreement managing the amount of capacity that each country accesses and the price that each pays. There would need to be some modification of engineering practices to better monitor and manage transmission power levels, as well as to provide commercial and management information. Commercially, a regional agreement would be operationally complex and require substantial management resources. However, the benefits could greatly outweigh the costs.

The formation of some model of regional cooperation with respect to satellite communications may result in a number of benefits:

- The PIF countries collectively cover a number of different time zones and their combined peak busy hour traffic demand will likely be less than the sum of their individual peak demand levels. This may reduce the aggregate amount of satellite capacity that needs to be purchased while still maintaining the quality of service, or alternatively will allow the quality of service to be improved without increasing the capacity purchased.

- Capacity for special events can more readily be included in the standard contract and shared between the countries rather than requiring very short-term contracts to be purchased. Short-term contracts are generally relatively expensive.

- The PIF countries can ensure that they are represented by an experienced negotiator.

- The negotiator will have much more bargaining power than if representing only one country[11]. Given that a number of the PIF countries are already achieving close to global benchmark prices from their satellite providers, additional advantages in basic pricing for those countries may be small, but a significant advantage could be gained for other countries. It may also be possible to negotiate an early termination to any legacy contracts that are providing little or no value.

- If compatible equipment and technical procedures are adopted, there may be opportunities for savings in the sourcing of maintenance services and spare parts, the local storage of spare parts, and training of local staff.

- Local technical and management staff will have the opportunity to create a self-supporting community that shares expertise and problem-solving. There will also be an enhanced career path that will improve the retention of skilled staff in the region.

- There may be situations suitable for VSAT solutions (perhaps at lower than carrier-grade service) that can be leveraged with regional buying power.

---

11 The possibility of additional bargaining power must be viewed in context. Satellite traffic for the entire Pacific Island region probably constitutes less than 1% of total global satellite traffic. Intelsat's 2006 Annual report (Notes to Consolidated Financial Statements: Note 20 Business and Geographic Segment Information http://www.sec.gov/Archives/edgar/data/1156871/000119312507072253/d10k.htm) states that its largest customer was responsible for 5% of its worldwide revenues, and its top ten customers responsible for 22% of revenues.

Such cooperation need not be restricted to satellite services, but could be extended to include terrestrial network infrastructure, where many of the above potential advantages would also apply. Companies with branches in multiple PIF countries will appreciate such a level of consistency as it will simplify the process of connecting branch offices to corporate WANs, lowering internal costs.

2.9 Intelsat Lifeline Connectivity Obligations (LCO) and ITSO

Our interim report discussed the various obligations placed on Intelsat through its Public Services Obligations (PSO) and Lifeline Connectivity Obligations (LCO), and the supervisory role undertaken by the International Telecommunications Satellite Organisation (ITSO). This report is further informed by the results of interviews with various PIF country representatives.

There is only a low level of awareness of the Intelsat LCOs amongst the PIF interviewees, and attitudes towards them are largely negative. Furthermore there appears to be some confusion between LCOs and PSOs.

In the few instances where we were able to obtain sufficient detail, the services covered by LCO contracts emphasised carrier-based services such as traditional voice, rather than transmission services such as data links

Membership of ITSO is similarly low, although attitudes are neutral rather than negative, and one respondent who was not previously aware of the organisation thought that it might be worthwhile joining. So the current awareness of ITSO and LCOs in the Pacific region is low.

However the principles underlying ITSO and LCO are still sound, and may become highly relevant should a supply shortage occur. While such a shortage is not predicted, unexpected satellite in-orbit failures and failed launches are not uncommon, and a combination of such incidents could easily see a short- or medium-term supply shortage over the Pacific.

None of the countries interviewed were aware of ITSO and the LCOs imposed on Intelsat, with the exception of the Cook Islands. This is despite the fact that four of the six countries

interviewed are eligible for LCO status or have links accorded LCO status. One interviewee commented that Intelsat does not promote the LCOs.

A number of countries have alternative supply options to Intelsat for international connectivity in the event of satellite failure. This is largely achieved through supply contracts with SES New Skies. Some countries have cable access (eg Fiji) or are currently investigating cable access (Samoa, Solomon Islands and Tonga). Samoa also has a microwave link to American Samoa. These technologies ensure connectivity during emergency situations such as natural disasters. Intelsat also provided Niue with three months of free satellite use after Cyclone Heta in 2004.

Mobile satellite services such as Iridium and Inmarsat are also available across the region and may be used in the event of emergencies. While Iridium is largely used for emergencies only, in Solomon Islands it is retailed to international organisations and foreign logging companies that have a need for uninterrupted access or use in remote areas.

3 Demand for international capacity

A common theme from our interviews with Pacific Island operators was that demand for international capacity was growing faster than supply, but that the cost for international capacity was a huge barrier for operators to satisfy the potential traffic levels.

The key driver for international bandwidth capacity is seen to be demand for Internet services, in particular for broadband Internet. Views were mixed on traditional voice telephony as a factor driving growth – monopoly operators tended to regard voice traffic as either static or declining, however in some more liberalised markets, price promotions for international calls appear to have stimulated demand.

Several commentators also believed that market liberalisation is a key factor in growth for international capacity.

In this section we outline the potential bandwidth requirements in the Pacific Island countries and discuss the various demand drivers.

3.1 Projections for international bandwidth

How much international bandwidth will Pacific Island countries require over the next five years? This is a complex question as it will depend on many factors, including:

- growth in broadband Internet services, the speeds offered and the types of applications being used
- growth in dial-up Internet services
- growth in incoming and outgoing voice traffic.

In turn, each of these will be influenced by price (and thus affordability), the ability of the domestic infrastructure to support the services and whether or not services are widely available throughout each country. These issues are discussed further below.

We have made an assessment of the potential increase in bandwidth requirements for each country over the next five years (Table 3.1). In most countries, we expect that the demand for international capacity will increase by between 50% to 200% over the next five years.

	2008	*2012*
Cook Islands	25%	150%
Federated States of Micronesia	5%	50%
Fiji	15%	138%
Kiribati	8%	83%
Nauru	0%	50%
Niue	0%	50%
Palau	0%	31%
Papua New Guinea	13%	90%
Republic of the Marshall Islands	14%	57%
Samoa	9%	77%
Solomon Islands	31%	192%
Tonga	7%	56%
Tuvalu	0%	100%
Vanuatu	8%	77%

Table 3.1: *Growth in potential demand for international bandwidth from 2007 [Source: Network Strategies]*

These projections represent the growth in *potential* international bandwidth requirements for each country. They have been based on a market assessment of the potential future take-up and usage of key services, including voice telephony, dialup Internet and broadband Internet. In addition, we have made a number of global assumptions regarding the busy hour traffic, projections for the effective bandwidth of Internet services, contention ratios for broadband services and the modem ratios for dial-up Internet traffic.

The *actual* bandwidth supplied may differ from our projections, which are based on publicly available data on subscriber numbers and traffic (where available).

Our analysis suggests that there will be continued pressure on international bandwidth capacity over the next few years. The growth is driven mostly by Internet services.

Any projections of this nature have a degree of uncertainty, especially in dynamic environments such as those typified by the telecoms sector. Several of the countries have not yet introduced broadband Internet services, and so we have made assumptions regarding the timeframe for commercial availability. In other countries there is no data yet available on broadband take-up as services have only been recently introduced.

It is particularly difficult to develop projections for Pacific Island countries as any statistical data is limited and, even if available, is often several years old.

Our projections may be overstated if:

- ISPs employ strategies – such as those discussed in Section 2.7 – to reduce international bandwidth requirements
- the effective bandwidth for Internet services is lower than our assumptions
- access to Internet services continues to be restricted
- declines in retail prices such as those that occurred in other developing markets do not eventuate.

Conversely, our projections may be too low if:

- there are dramatic increases in affordability of all services and especially high-bandwidth Internet services
- broadband services with greater effective bandwidth are taken up – with higher than expected usage of real-time applications
- content stored on local servers becomes very popular with overseas users.

3.2 Internet

As discussed in our interim report, we believe there to be significant pent-up demand for Internet services in Pacific Island countries. As is common in many markets, the number of users greatly exceeds the number of subscriptions, as more than one person may use a

single subscription. Anecdotal evidence from our interviewees suggests that many users access the Internet at work rather than at home. In addition, there are public Internet facilities at libraries and other locations. The high price of Internet services is a major barrier for take-up of Internet subscriptions.

In addition, there are geographic limitations on the availability of Internet – in particular broadband – services, which further constrains demand. For example, at the current time:

- dial-up Internet in Tuvalu is available only on the island of Funafuti
- broadband in Samoa is commercially available only in the capital Apia.

DSL services are not yet available in several of the Pacific Island countries, such as Niue[12] and Tuvalu. Where DSL is available, speeds are relatively low in comparison with those available in developed countries – Fiji is currently the only country with services of bandwidth higher than 512Mbit/s. Operators in some countries offer services at speeds not normally associated with broadband, for example Tonfon in Tonga offers an 'always on' service of 32kbit/s, and 64kbit/s 'broadband' services are available in Palau and Tonga[13].

Users restricted to dial-up services have a very different experience to that of broadband users. With dial-up, users can send and receive emails, browse Web pages and use instant messaging ('chat') services. These are all applications that are suitable for low-bandwidth services, and for which some brief delays are tolerated.

Broadband users, however, will be seeking a far richer interactive experience – with broadband, downloading large amounts of content, such as video and music becomes feasible. Moreover fast broadband enables access to real-time applications such as voice and video telephony, streaming media and online games, for which any delays due to congestion are less acceptable.

---

12 Niue Post and Telecommunication commenced rollout of broadband DSL services for Government Departments in early 2007, and will be offering commercial DSL services.

13 Note that dial-up Internet is up to 56kbit/s (depending upon the modem used). Broadband is frequently defined as having download speeds of at least 256kbit/s.

A significant proportion of this Internet content will be sourced from servers located overseas. Certainly there are strategies that local ISPs can adopt in order to manage their international bandwidth requirements (discussed further in Section 2.7), nonetheless download volumes will continue to put pressure on international capacity as broadband take-up, and speed, increases.

It should also be noted that another component of Internet traffic will be generated by users from other countries accessing content located on local servers – local news or streaming audio would be keenly sought by expatriates, and anyone conducting business with the Pacific Islands would be accessing local content.

3.3 Voice telephony

The traditional driver for international bandwidth has been voice telephony, however this has become less significant with the explosive growth in Internet traffic.

International voice traffic is typically subject to major fluctuations (Figure 3.1), in response to factors such as price changes, economic conditions and unusual occurrences, such as sporting events and disasters. In recent times, international traffic has also been affected by the substitution of Internet applications, such as email, instant messaging and online VoIP services such as Skype.

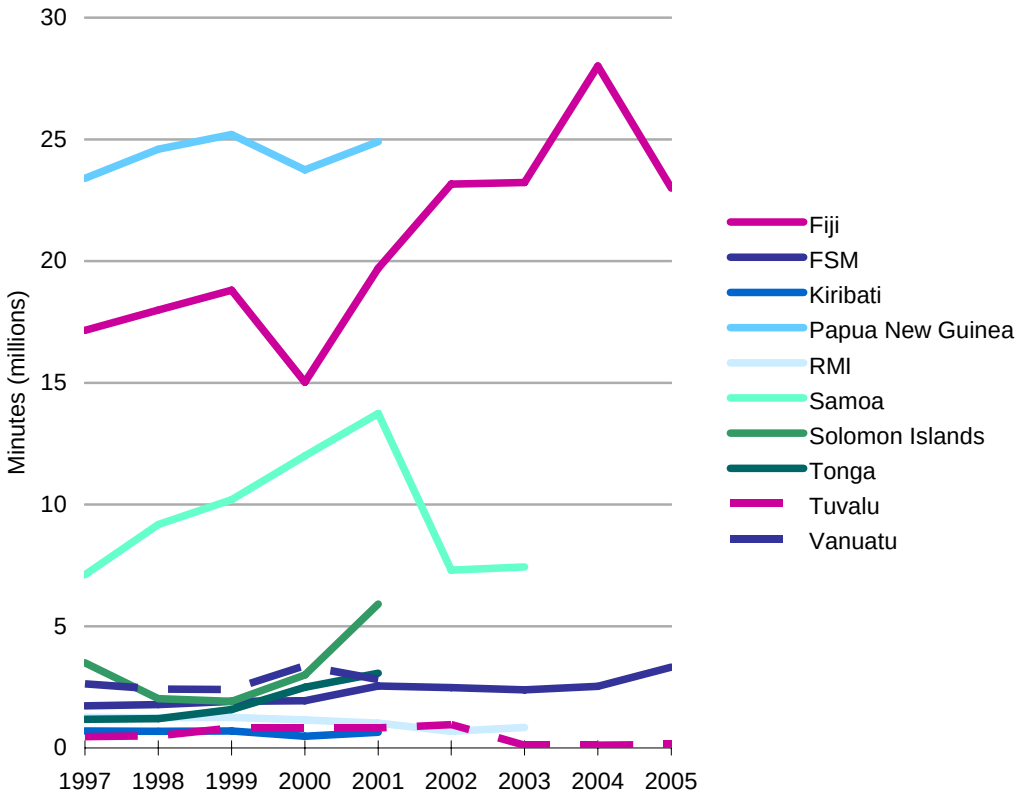


Figure 3.1: *International outgoing minutes for selected Pacific Island countries, 1997 to 2005 [Source: ITU]*

In dimensioning the international capacity, it is essential to assess not only the volume of outgoing traffic, but also incoming traffic. There is only limited data available on incoming international traffic to the Pacific Island countries, however evidence suggests that many countries may have a large traffic imbalance, with the volume of incoming international traffic in some countries being up to three times that of the outgoing traffic (Figure 3.2).

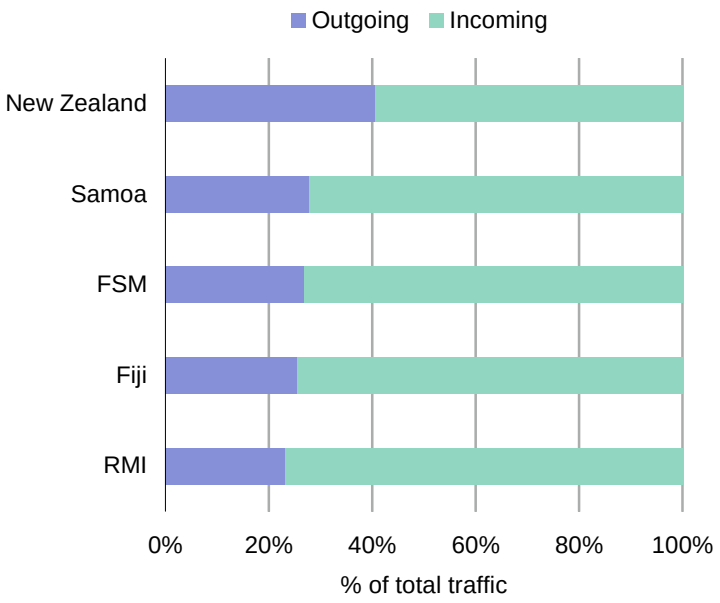


Figure 3.2: *International traffic, proportion by direction of traffic 2002 [Source: Network Strategies]*

3.4 Market liberalisation

In a number of the Pacific Island countries, the telecoms and ISP markets are being opened to competition. Satellite operators and service providers see this as an opportunity to expand their sales within the region, as the new entrants will be seeking international bandwidth. Moreover, liberalisation leads to expansion of the total telecoms market, as competition stimulates demand for services with new offerings and cheaper prices.

3.5 Barriers to growth

Cost and affordability – the main barrier

The main barrier to growth of international satellite capacity is the cost and affordability of satellite services. While prices paid across the region may be commensurate with international benchmarks, they are not affordable in terms of Pacific Island economies. The

high prices paid by telecommunications service providers flow onto high costs for consumers seeking voice and data communications. Indirectly, the high cost of computers in Pacific Island countries contributes to low computer penetration in each country, which in turn constrains the demand for data services. Even when call costs come down after competition is introduced and tariff rebalancing occurs, many consumers still cannot afford international calls. Telecommunications providers are developing strategies for families overseas to be able to pay Pacific Island family members' bills, such as Internet-based payments, offices located in New Zealand and 'top up' schemes for mobiles.

Pacific Island countries widely acknowledge that it is difficult to negotiate good prices for satellite services because of low population densities in the Pacific, which results in low yields for satellite operators. The lack of flexibility in satellite supply contracts and capacity limits are also creating barriers to growth. Some countries are investigating ways to better use their existing bandwidth to meet increasing Internet demands through compression and modulation techniques. Some countries are using an iGate gateway which offers an affordable (USD20 000 – 30 000) 7:1 compression mechanism.

Other countries have replaced their Intelsat modem boxes with a 'Turbo' coded modem box to increase bandwidth. It was reported that one country recently installed a turbo box, which required renegotiation of its contract conditions. In contrast, the iGate mechanism would not necessarily require contract renegotiation.

The need for a collective regional approach to satellite services to 'get a better deal' was a strong theme of our interviews. Some countries, such as Samoa, Solomon Islands and Tonga, are investigating the possibility of accessing cable. While this might not necessarily be more cost-effective, it would resolve the issue of bandwidth constraints. New cable connections would also necessarily rely on donor assistance or borrowing to cover the prohibitive costs.

Geographic barriers

Some islands face geographic constraints. For example, the Cook Islands can access only the global beam (the most expensive) due to its geographical location. Solomon Islands is on the fringes of the Ku-band footprint. If this were to be improved, then service delivery

to remote areas in the Solomons would become cheaper due to factors such as smaller units and lower power needs.

Regulatory barriers

Regulatory barriers were not perceived as limiting growth in international capacity with the exception of Fiji. The Fiji regulator has banned the use of VoIP by consumers, however, bypass using VoIP continues to occur via ISPs in Fiji. Fiji also highlighted the need for more competition to fuel growth.

4 Scenario analysis

The Thirty-Seventh Pacific Islands Forum[14], held in Fiji in October 2006 and attended by Australia, issued a communiqué which noted that:

> …effective regional ICT would have significant beneficial impacts on private sector development and education in the region.[15]

The communiqué also welcomed the outcomes of the Meeting of Communications Ministers in New Zealand in March 2006, which had recognised that:

> …information and communications technologies (ICTs), while not an end in themselves, have a key role as a basis for economic development, while also promoting and enhancing social cohesion, cultural enrichment and environmental conservation.[16]

It is clear that the provision of modern and affordable satellite telecommunications services to Pacific Island countries is a very important element of any strategy towards the goal of capacity building in those countries. It has also been noted that for these telecommunications services to be effective, they must reach the end-user, and the end-user must be comfortable using them. Thus this report has gone beyond the strict bounds of the

---

14 The Thirty-Seventh Pacific Islands Forum was attended by Australia, Cook Islands, Federated States of Micronesia, Fiji, Kiribati, Nauru, New Zealand, Niue, Palau, Papua New Guinea, the Republic of the Marshall Islands, Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu.

15 Thirty-Seventh Pacific Islands Forum. Fiji, 24-25 October 2006. Forum Communiqué: Paragraph 8.

16 Forum Information and Communications Technologies Ministerial Meeting. Wellington, New Zealand, 30 March 2006: Wellington Declaration.

technical provision of satellite services, to investigate all of the issues that directly affect the ability of the end-user to access and make use of them.

This section identifies the critical elements of any telecommunications strategy that is aimed at capacity building in the Pacific region. Borrowing from the discipline of scenario planning, it then identifies where actions designed to address specific single issues may be in conflict when implemented as part of an holistic strategy.

4.1 Critical issues

The two most basic, critical issues for the PIF countries are affordability and accessibility. All of the other issues discussed previously are secondary, addressing the means by which services can be made more affordable, and/or more accessible. Table 4.1 below summarises the relationships between the critical and secondary issues.

	Critical issue	
Secondary issue	*Affordability*	*Accessibility*
Geography		
Satellite versus submarine cable	Direct effect on wholesale prices	
Satellite for domestic communications		Access outside main cities
Technical issues affecting access to satellite capacity		
Transmission characteristics	Indirect influence on wholesale price by restricting access to additional bandwidth and alternative suppliers	
Modulation techniques	Direct effect on wholesale price for bandwidth	
Reliance on single dish antenna	Indirect influence on wholesale price by restricting access to additional bandwidth and alternative suppliers	
Inclined orbit satellites	Direct effect on wholesale price	
Capability of domestic network		Accessibility to advanced network services in both main centres and outlying areas
C-band spectrum	Indirect effect on wholesale price	
Government policy and regulation		
	Indirect effect on retail prices through competition policy, spectrum policy, and licensing policy	Direct effect through Universal service policies. Indirect effect through spectrum and licensing policy
Human capacity building		
Engineers and technicians	Indirect effect on retail price through cost of training and retaining staff	Indirect effect through ability to build and maintain remote connections
Regulatory expertise	Indirect effect on retail price through cost of training and retaining staff	Indirect effect through ability to create and monitor good policy
User expertise		Direct effect through end-user education, training and encouragement

Table 4.1: *Critical and secondary issues for PIF countries [Source: Network Strategies]*

	Critical issue	
Secondary issue	*Affordability*	*Accessibility*
Existing satellite contracts		
Global benchmark pricing and PIF country pricing	Indicates the magnitude of potential price reductions.	
Commercial VSAT service	Potential alternative supply at a lower price	Alternative for provision of access to remote populations
Strategies to maximise value from satellite access		
Business models	Cost minimisation for businesses whilst still providing access to online commercial world	
Community models		Provision of access to remote populations
Regional cooperation strategies	Cost reduction, wholesale price reduction	Access to improved distribution technologies
LCO		
	Cost reduction/protection against price increases	
Regional cooperation		
	Potential for lower prices from suppliers of equipment and bandwidth	Potential to lower the cost of providing access

***Table 4.1** (cont.): Critical and secondary issues for PIF countries [Source: Network Strategies]*

Affordability

Improving affordability can be approached from two directions – increasing user incomes or lowering retail prices. Strategies to increase income levels are beyond the scope of this report, but as shown in Table 4.1, there are several secondary strategies[17] that can be pursued that are likely to result in lower prices, either directly through lower prices from suppliers or indirectly through increased efficiencies and/or lower costs of operation.

17 The consideration of different types of subsidisation programmes was explicitly excluded from the terms of reference for this project.

Accessibility

Accessibility addresses the mainly technical issues of getting the services to locations that end-users are able to access without difficulty, and also the issue of user education – ensuring users' practical ability to use the services. Table 4.1 summarises a number of strategies that will improve accessibility.

4.2 Conflicts between strategies

All of the above strategies, with the exception of regional cooperation, are able to be pursued independently with the main potential for conflict being access to key resources. All of the strategies require trained and knowledgeable people; some of them require physical access to existing or new earth stations; most require funding for both supplies and on-going operations. A more detailed investigation is required to prioritise the strategies and plan activities. Estimated costs, achievable benefits, and likely timeframes must be quantified, together with identifying potential sources of funding and other resources.

Regional cooperation

A regional cooperation strategy need not conflict with any of the abovementioned secondary strategies. However, if the value from such regional cooperation is to be maximised, there are a number of areas which should be harmonised throughout the region. Harmonisation would require the cooperative to agree on a number of factors that would be applied consistently to all PIF countries:

- Competition policy normally prevents price cooperation between competitors in any market. Regulatory policy will have to be modified to allow competitors in the telecommunications industry to collaborate for the purposes of the regional cooperation.

- Technical standards (including transmission characteristics, modulation techniques, earth station equipment and operational procedures) will need to be harmonised across

all countries within the cooperative to ensure full compatibility with whatever satellite services are purchased. These standards will also be strongly influenced by the technical offerings and operational processes of the chosen satellite supplier(s). Countries that do not comply with such standards may not be able to access all of the benefits of the cooperation.

- Spectrum allocations are a subset of the technical standards, and harmonisation across all of the countries in the cooperation will ensure that all services (satellite and terrestrial wireless) are able to operate at full efficiency.

- Business models designed to minimise operational costs may need some harmonisation. For example, an agreement for all ISPs to resell the same online movie content may achieve a better wholesale price. If the monthly supply of new movie titles can be broadcast to all of the ISPs simultaneously rather than downloaded to each one individually it will provide a significant reduction in the international bandwidth needed to operate the service. Similarly, if all ISPs use the same equipment and software to provide mirroring facilities, they will gain economies of scale for the equipment purchases.

5 Concluding remarks

Using a combination of industry research and structured interviews of key stakeholders, we have conducted a first level analysis of the issues, challenges, problems and concerns experienced by member countries of the Pacific Islands Forum regarding the provision of satellite services. We have also identified potential strategies that could address those issues, in relation to capacity building, accelerating the usage of ICT in the Pacific region and enabling the PIF countries to better access the benefits of that ICT.

It is clear that Pacific Island countries face significant barriers to capacity building. These barriers come from a wide range of aspects affecting the region:

- The geography of the region is such that huge distances must be crossed, and the technology used to communicate over those distances must be able to tolerate the tropical environment, including heavy rainstorms that can disrupt almost any wireless transmission.

- Transmission technology options are restricted. Long-distance microwave simply cannot go far enough. Submarine cable is the most cost effective option but is currently available to only two countries – Fiji and PNG. While there are prospects for cable access to be provided to several of the other countries, these projects are only in the early stages of development and are not certain to proceed. Satellite remains the only realistic option but it is expensive.

- All of the PIF countries have less developed economies serving relatively small populations. Per-capita incomes are low. Consequently the purchasing power of local telecommunications operators is low when dealing with global suppliers, including satellite operators.

- Competition between satellite operators in the Pacific region is limited, further restricting the negotiating ability of local telecommunications operators. There are two main competitors – Intelsat and SES New Skies. Several other operators have coverage to various extents but maintain only a low level of marketing activity within the Pacific region as their main markets are over the densely populated and much more economically attractive South East Asian region.

- Engineering and technical skills are a limited resource. Local telecommunications operators seemed comfortable with their current availability and level of skills, but external stakeholders saw significant opportunities for improvement.

- Local user populations have limited exposure to the Internet, so their take up of Internet-related opportunities may be slow.

Two fundamental issues underlie all of these barriers: the need for ICT to be accessible, and for that access to be affordable[18]. A number of strategies to address these two issues have been identified:

- A variety of technology strategies and business models, already in use in developed markets, can be used reduce the amount of bandwidth required to provide commercial content services.

- Community access programmes can be developed and offered. Programmes of this type are already being deployed in some PIF countries, as well as in more developed countries.

- PIF countries (and possibly their neighbours) could combine their buying power. ECTEL demonstrates the benefits of the harmonisation of regulatory functions. The ECTEL model could be used as the seed of a PIF model that adds several technology and human capacity building aspects to the regulatory core.

18 Affordability can be approached from two directions – increases in income and decreases in costs. This report addresses only cost issues. Income issues are beyond the scope of this report.

However, the key barrier that constrains domestic operators from acquiring sufficient capacity to meet potential demand is price. While satellite services clearly represent a huge cost component for operators in small low-income markets, several operators in PIF countries have negotiated prices that seem reasonable when compared to global benchmarks. So these countries may have less scope for price reductions than may have been anticipated.

Many of the PIF country regulators and telecommunications operators are actively investigating and implementing strategies to address these barriers, but progress throughout the region, and levels of success, are mixed. A well coordinated and resourced regional cooperation could go some way to improving the overall outcome and accelerating progress.

Annex A: Country profiles

This Annex contains brief overviews of each of the Pacific Island countries within the scope of our analysis. All statistical data is for 2005 unless otherwise specified.

Most of the Pacific Island countries – with the exception of the Cook Islands, Niue and Palau – have low teledensity (Figure A.1). All countries have low levels of income, represented here by GDP per capita.

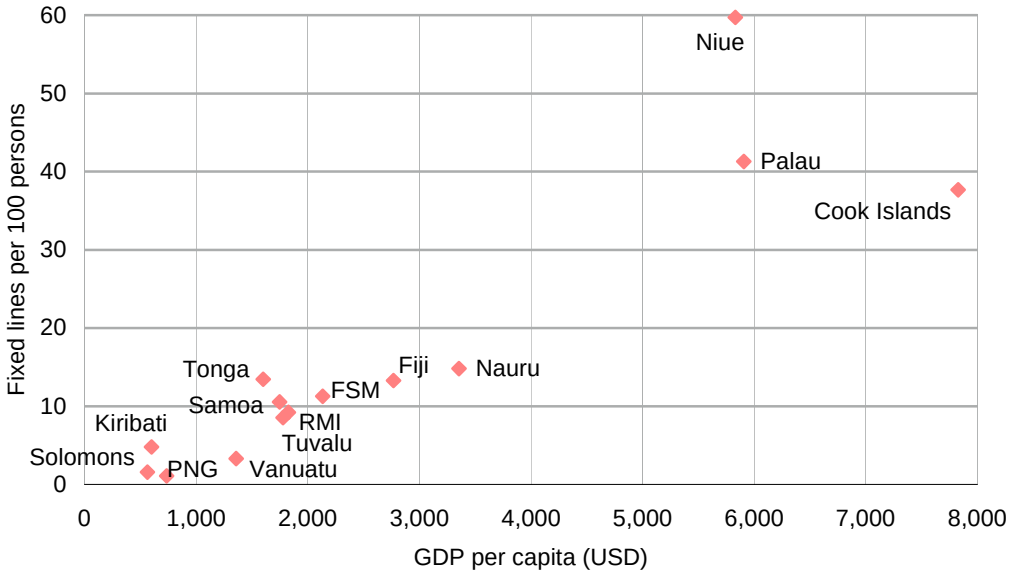


Figure A.1: *The relationship between GDP per capita and fixed line teledensity for Pacific Island countries [Source: ITU, UN]*

A.1 Cook Islands

	2005
Population	17 954
Land area (square kilometres)	236.7
GDP per capita (2003)	USD7 828
Fixed lines (2007)	6 700
Fixed lines per 100 persons (2007)	37.6
Mobile subscribers (2007)	5 400
Mobile subscribers per 100 persons (2002)	30.3
Estimated Internet users	n.a.
Internet users per 100 persons	n.a.
Broadband subscriptions	507
Broadband subscriptions per 100 persons	2.8

Table A.1: *Cook Islands – key statistics [Source: ITU, UN, Telecom Cook Islands]*

Geography

The Cook Islands is located in the central Pacific and consists of 15 islands scattered over approximately two million square kilometres of ocean. The southern group consists of volcanic islands constituting approximately 90% of the total land area. Coral atolls predominate in the northern group. The main island of Rarotonga is a volcanic, mountainous island located in the southern group.

Regulatory and competitive environment

Telecommunications in the Cook Islands are governed under the Telecommunications Act of 1989, which was amended in 1992. This act is tailored for Telecom Cook Islands Limited as the sole provider of telecommunications services. The Act protects the company by prohibiting any other person from operating a telecommunications network in the Cook Islands.

A.2 Federated States of Micronesia

	2005
Population	110 487
Land area (square kilometres)	702
GDP per capita (2003)	USD2 134
Fixed lines	12 449
Fixed lines per 100 persons	11.3
Mobile subscribers	14 094
Mobile subscribers per 100 persons	12.8
Estimated Internet users	14 000
Internet users per 100 persons	12.7
Broadband subscriptions	n.a.
Broadband subscriptions per 100 persons	n.a.

Table A.2: *Federated States of Micronesia – key statistics [Source: ITU, UN]*

Geography

FSM is located to the north of the Equator in the Western Pacific. It consists of four states: Kosrae, Pohnpei, Chuuk and Yap, which contain a large number of islands spread over a vast sea area. Pohnpei, the largest island, is volcanic and mountainous with almost half of the FSM's landmass. Other outerlying atolls make up the remainder of Pohnpei State. Chuuk has many outer islands (192) and islands and islets in the Chuuk Lagoon. Yap Proper has rolling hills while the eastern Yap State contains a number of atolls. Kosrae is the only state with no outer islands.

Regulatory and competitive environment

The FSM Telecommunications Corporations Act of 1981 governs telecommunications in the Federated States of Micronesia. All telecommunications services are provided by the public corporation FSM Telecommunications Corporation (FSMTC). Regulation of telecommunications is the responsibility of the Department of Transportation, Communication and Infrastructure.

A.3 Fiji

	2005
Population	847 706
Land area (square kilometres)	18 270
GDP per capita (2003)	USD2 770
Fixed lines	112 493
Fixed lines per 100 persons	13.3
Mobile subscribers	205 000
Mobile subscribers per 100 persons	24.2
Estimated Internet users	70 000
Internet users per 100 persons	8.3
Broadband subscriptions	7 000
Broadband subscriptions per 100 persons	0.8

Table A.3: *Fiji – key statistics [Source: ITU, UN]*

Geography

Fiji is located in the central Pacific at the crossroads of Melanesia and Polynesia. It is an archipelago of some 300 islands varying from large volcanic masses to tiny coral atolls. Only about one-third of the islands are inhabited, with most Fijians living on the largest island, Viti Levu, which is 10 390 square kilometres in area. The capital, Suva, is located on the southern side of the island. Most of the tourist resorts, which are a large contributor to the Fijian economy, are on the west of Viti Levu or on island groups off the adjacent coast.

Regulatory and competitive environment

The telecommunications system in Fiji is governed by the Post and Telecommunications Decree of 1989. The Act has no monopoly provisions and regulation is provided by the Department of Communications. Telecommunications services are operated by nine companies, three of which have monopolies in their specific area:

- Telecom Fiji is the sole provider of local and long-distance fixed telephone services

- Vodafone Fiji, which operates under a licence awarded to Telecom is the sole mobile phone provider
- Connect and Unwired are commercial Internet service providers (ISPs)
- FINTEL is the sole provider of international fixed telephone services
- Coms provides rural wireless services
- Fiji Directories is the non-exclusive provider of directory services
- Transtel provides calling card services
- Xceed Pasifika provide business communication and IT solutions.

Fiji is moving towards market liberalisation with the exclusive rights for Vodafone, FINTEL and some Telecom Fiji services having been recently terminated. Eight ISP licences have also been issued.

A.4 Kiribati

	2005
Population	99 350
Land area (square kilometres)	811
GDP per capita (2003)	USD601
Fixed lines (2002)	4 474
Fixed lines per 100 persons (2002)	4.8
Mobile subscribers (2004)	615
Mobile subscribers per 100 persons (2004)	0.6
Estimated Internet users	2 000
Internet users per 100 persons	2.0
Broadband subscriptions	n.a.
Broadband subscriptions per 100 persons	n.a.

Table A.4: *Kiribati – key statistics [Source: ITU, UN]*

Geography

Kiribati is located in the mid Pacific, straddling the equator. It consists of 33 atolls totalling 811 square kilometres, scattered over 3.5 million square kilometres of ocean. Of the three

main island groups (Gilbert, Phoenix and Line Islands), most inhabitants are located in the Gilbert islands, particularly the atoll of Tarawa which contains the capital.

Regulatory and competitive environment

Telecommunications in Kiribati are governed under the Telecommunications Act of 2004. Telecom Services Kiribati Limited (TSKL) is the sole provider of telephone services. There are two ISPs – TKSL (Coconut Wireless) and Maurinet – offering wireless Internet services.

A.5 Nauru

	2005
Population	13 635
Land area (square kilometres)	21
GDP per capita (2003)	USD3 357
Fixed lines (2001)	1 850
Fixed lines per 100 persons (2001)	14.8
Mobile subscribers (2001)	1 500
Mobile subscribers per 100 persons (2001)	12.0
Estimated Internet users (2001)	300
Internet users per 100 persons (2001)	2.4
Broadband subscriptions	n.a.
Broadband subscriptions per 100 persons	n.a.

Table A.5: *Nauru – key statistics [Source: ITU]*

Geography

Nauru is located 42 kilometres south of the equator. It is a small, single island of 21 square kilometres. The interior has been deforested and mined for phosphate, leaving a pinnacled landscape.

Regulatory and competitive environment

The Telecommunications Act of 2002 transferred telecommunications regulatory responsibility from the government to the Republic of Nauru Telecommunication Corporation (Rontel). This state-controlled corporation has a monopoly in telecommunications services and systems. Rontel may, however, also license other providers.

A.6 Niue

	2005
Population	1 445
Land area (square kilometres)	260
GDP per capita (2003)	NZD10 048
Fixed lines (2007)	820–920
Fixed lines per 100 persons	56.3–63.1
Mobile subscribers	n.a.
Mobile subscribers per 100 persons	n.a.
Estimated Internet users (2007)	350–420
Internet users per 100 persons	24.0–28.8
Broadband subscriptions	n.a.
Broadband subscriptions per 100 persons	n.a.

Table A.6: *Niue – key statistics [Source: ITU, UN, Statistics Niue, Niue Post and Telecommunication]*

Geography

Niue is located in the central Pacific and is a raised atoll island, with dramatic cliffs falling to the sea. It is relatively flat with a slightly hilly interior. Niue has no outlying islands.

Regulatory and competitive environment

The Communications Act of 1989 (amended in 2000) granted Cabinet the power to issue public communications service licences. The government Department of Post and Telecommunications has a monopoly in the field of telecommunications.

Note that after Cyclone Heta in 2004, the mobile network is largely non-operational – there is only a single remaining base station operating at less than 50% performance.

A.7 Palau

	2005
Population	19 949
Land area (square kilometres)	458
GDP per capita (2003)	USD5 909
Fixed lines (2001)	6 527
Fixed lines per 100 persons (2001)	33.5
Mobile subscribers (2001)	2 407
Mobile subscribers per 100 persons (2001)	12.3
Estimated Internet users (2004)	5 400
Internet users per 100 persons	27.2
Broadband subscriptions	n.a.
Broadband subscriptions per 100 persons	n.a.

Table A.7: *Palau – key statistics [Source: ITU, UN]*

Geography

Palau is located in the westernmost part of the Caroline Islands, to the north of the equator. It is an archipelago of high limestone islands and low coral atolls. Babeldaob Island, which contains most of Palau's land area and is thickly jungled, lies just to the north of the capital Kosrae.

Regulatory and competitive environment

The government-owned Palau National Communications Corporation (PNCC) was established in 1982, and has regulatory oversight of the telecommunications industry. The PNCC is the sole provider of telecommunications services in Palau.

A.8 Papua New Guinea

	2005
Population	5 887 138
Land area (square kilometres)	452 860
GDP per capita (2003)	USD737
Fixed lines	63 720
Fixed lines per 100 persons	1.1
Mobile subscribers	75 000
Mobile subscribers per 100 persons	1.3
Estimated Internet users	135 000
Internet users per 100 persons	2.3
Broadband subscriptions	n.a.
Broadband subscriptions per 100 persons	n.a.

Table A.8: *Papua New Guinea – key statistics [Source: ITU, UN]*

Geography

Papua New Guinea is the largest of the Pacific islands. It consists of the rugged and mountainous eastern half of the island of New Guinea plus a few populated outer islands.

Regulatory and competitive environment

The Telecommunications Act of 1996 established PANGTEL (the Papua New Guinea Radiocommunication and Telecommunication Technical Authority) as the regulator and licensing authority for telecommunications and broadcasting in Papua New Guinea. Subsequently, the enactment of the Independent Consumer and Competition Corporation

(ICCC) Act of 2002 and the Telecommunications Industry Act of 2002 transferred licensing of telecommunications services to the ICCC.

PANGTEL remains responsible for the following:

- developing policies for technical standards
- developing policies for performance standards
- in consultation with ICCC, inter-acting with accredited international telecommunications bodies on behalf of the Independent State of Papua New Guinea
- approving and certifying telecommunications equipment
- managing telecommunications numbering resources
- spectrum management and licensing for radiocommunications operators.

There are three classes of telecommunications licence: general telecommunications licence; mobile telecommunications licence and value-added services licence which is the relevant licence type for ISPs. Telikom PNG has three telecommunications licences, and together with its wholly-owned subsidiary Pacific Mobile Communications has a monopoly for both fixed and mobile telephone services in Papua New Guinea. There is however some competition with other ISPs for Internet services.

A.9 Republic of the Marshall Islands

	2005
Population	61 963
Land area (square kilometres)	181.3
GDP per capita (2003)	USD1 826
Fixed lines (2003)	4 461
Fixed lines per 100 persons (2003)	7.8
Mobile subscribers (2004)	644
Mobile subscribers per 100 persons (2004)	1.1
Estimated Internet users (2000)	2 200
Internet users per 100 persons (2000)	4.2
Broadband subscriptions	n.a.
Broadband subscriptions per 100 persons	n.a.

Table A.9: *Republic of the Marshall Islands – key statistics [Source: ITU, UN]*

Geography

The Marshall Islands consist of more than 1000 flat coral islands, grouped into 29 coral atolls. They are located north of the equator in the central Pacific and are grouped into two nearly parallel chains that run roughly north-south.

Regulatory and competitive environment

The National Telecommunications Authority Act of 1990 establishes the National Telecommunications Authority (NTA) as the sole provider of telecommunications services in the Marshall Islands. The Act grants exclusivity rights for NTA and provides for privatisation of NTA. NTA has 90% government and 10% private investor ownership.

A.10 Samoa

	2005
Population	184 984
Land area (square kilometres)	2 934
GDP per capita (2003)	USD1 748
Fixed lines	19 500
Fixed lines per 100 persons	10.5
Mobile subscribers	24 000
Mobile subscribers per 100 persons	13.0
Estimated Internet users	6 000
Internet users per 100 persons	3.2
Broadband subscriptions	65
Broadband subscriptions per 100 persons	0.0

Table A.10: *Samoa – key statistics [Source: ITU, UN]*

Geography

Samoa consists of two main islands (’Upolu and Savai’i), two other inhabited islands (Manono and Apolima) which are located in the strait between the two main islands, and several uninhabited islets. The islands are volcanic in origin and mountainous.

Regulatory and competitive environment

Prior to 2005 the Samoan telecoms market consisted of two separate companies, one with an exclusive licence for the provision of fixed services and the other with an exclusive licence for the provision of analogue mobile services. Fixed telecommunications services were provided solely by SamoaTel which is still wholly owned by the Samoan Government. Note however that the Government is considering stepping back from its ownership role in the near future. Mobile communications services were provided exclusively by Telecom Samoa Cellular (TSC) which was 90% owned by Telecom New Zealand and 10% by the Samoan Government.

The following changes were included in the reforms:

- SamoaTel and TSC to be given GSM mobile licences
- a third mobile operator to be licensed
- SamoaTel would lose its exclusive international gateway licence.

A new mobile licence was issued in 2006 to Digicel to provide a GSM service. Subsequently Digicel successfully purchased TSC and launched its GSM service in October 2006. In the wake of Digicel’s entry to the market SamoaTel has undertaken tariff rebalancing and there has been considerable pressure on mobile prices. This has intensified when SamoaTel entered the market with its new GSM service in January 2007.

A.11 Solomon Islands

	2005
Population	477 742
Land area (square kilometres)	27 540
GDP per capita (2003)	USD564
Fixed lines	7 407
Fixed lines per 100 persons	1.6
Mobile subscribers	6 000
Mobile subscribers per 100 persons	1.3
Estimated Internet users	4 000
Internet users per 100 persons	0.8
Broadband subscriptions	450
Broadband subscriptions per 100 persons	0.1

Table A.11: *Solomon Islands – key statistics [Source: ITU, UN]*

Geography

The Solomon Islands archipelago is the third largest in the Pacific. It contains a variety of landforms, from large, mountainous, volcanic islands to tiny, low-lying coral atolls. The islands are a scattered double chain that extends some 1660 kilometres south-east from Bougainville in PNG. The islands are spread over some 1.35 million square kilometres of ocean.

Regulatory and competitive environment

Telecommunications in the Solomon Islands is governed under the Telecommunications Act of 1972, which gives telecommunications regulation authority to the Ministry of Post and Communications. Solomon Telekom Company Limited ('Solomon Telekom') is the sole provider of telecommunication services, and had an exclusive licence up to 2003.

In 2003, the Government granted Solomon Telekom a 15 year exclusive licence. With the change of government in 2006, there were moves to open the telecoms market to competition by granting an 'experimental' licence to the mobile operator Digicel, however

Solomon Telekom is taking legal action against the government to uphold its exclusive licence. Digicel has been restrained from offering telecoms services in the Solomons until after the decision of the High Court.

A.12 Tonga

	2005
Population	102 311
Land area (square kilometres)	718
GDP per capita (2003)	USD1 603
Fixed lines	13 746
Fixed lines per 100 persons	13.4
Mobile subscribers	29 872
Mobile subscribers per 100 persons	29.2
Estimated Internet users	3 000
Internet users per 100 persons	2.9
Broadband subscriptions	645
Broadband subscriptions per 100 persons	0.6

Table A.12: *Tonga – key statistics [Source: ITU, UN]*

Geography

Tonga is located to the east of Fiji, in the central south Pacific. It has four main island groups stretching from north to south. Much of the land area in the main island of Tongatapu has been cleared for agriculture.

Regulatory and competitive environment

The Tonga Communications Act of 2000 established the Department of Communications as the body responsible for communications, with the power to issue licences. There is currently competition between two companies for providing telecommunication services: the Tonga Communication Corporation (TCC) and Shoreline Communications (Tonfon).

A.13 Tuvalu

	2005
Population	10 441
Land area (square kilometres)	26
GDP per capita (2003)	USD1 780
Fixed lines	890
Fixed lines per 100 persons	8.5
Mobile subscribers	1 300
Mobile subscribers per 100 persons	12.5
Estimated Internet users (2004)	1 600
Internet users per 100 persons (2004)	15.4
Broadband subscriptions	30
Broadband subscriptions per 100 persons	0.3

Table A.13: *Tuvalu – key statistics [Source: ITU, UN]*

Geography

Tuvalu consists of seven coral atolls and two low-lying coral islands totalling 26 square kilometres in land area, spread over 800 kilometres of ocean. It is located in the central Pacific, just south of Kiribati.

Regulatory and competitive environment

Telecommunications in Tuvalu is governed under the Telecommunications Ordinance of 1979 and the Telecommunications Corporation Act of 1993. The Tuvalu Telecom Corporation has a monopoly for providing telecommunications services in Tuvalu.

A.14 Vanuatu

	2005
Population	211 367
Land area (square kilometres)	12 200
GDP per capita (2003)	USD1 359
Fixed lines	6 964
Fixed lines per 100 persons	3.3
Mobile subscribers	12 692
Mobile subscribers per 100 persons	6.0
Estimated Internet users	7 500
Internet users per 100 persons	3.5
Broadband subscriptions	59
Broadband subscriptions per 100 persons	0.0

Table A.14: *Vanuatu – key statistics [Source: ITU, UN]*

Geography

Vanuatu consists of some 80 islands, spread in a Y-shaped chain in a north-south direction, just south of Solomon Islands. The islands are volcanic in origin and are mountainous. Its 12 200 square kilometres of land area is spread over some 860 000 square kilometres of ocean.

Regulatory and competitive environment

In 1992 Telecom Vanuatu Limited (TVL) was given a twenty-year exclusive franchise to operate a public telecommunications service in Vanuatu. A shareholders' agreement of 1993 among the Government, Société France Cables et Radio and Cable & Wireless established TVL with the transfer of the assets and liabilities of its predecessors (Vanitel and National Vanuatu). The parties to the agreement acquired equal shares in the new company.

Regulatory powers for the industry are currently vested in the Minister for Telecommunications. The original Telecommunications Act of 1989 introduced a

regulatory authority but with the subsequent repeal of that Act the Minister assumed the role of oversight of the industry[19]. Thus the Government has two quite separate interests in TVL: firstly as a shareholder the Government is represented on the Board of TVL; and, secondly, there is an industry oversight role with regulatory responsibilities. Currently the Government, in conjunction with the World Bank, is establishing a multi-utility regulatory body to take over industry oversight responsibilities.

Restricted licences have recently been granted to Pacific Data Solutions (PDS) and Global Data Transfer (GDT). Under these restricted licences operators cannot provide telephony services to the general public.

19 The Authority is defined for the purposes of the licence to include any successor body, entity or person established pursuant to the Telecommunications Act.

Annex B: Comparative prices in the Pacific Islands

In this Annex, we examine prices charged for Internet services and international calls within various Pacific Island countries. From our analysis, it is clear that these services are relatively expensive, especially when compared with prices in Australia and New Zealand.

B.1 Overview of dial-up Internet plans

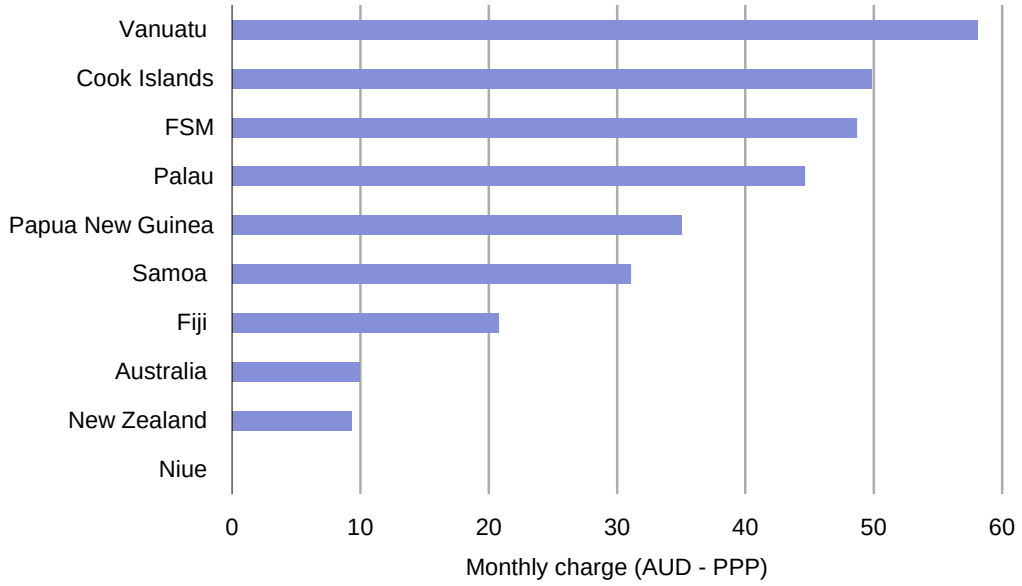
Dial-up Internet services in Pacific Island countries typically incur usage-based charges, normally the number of hours used per month, with the different plans including various levels of monthly hours, ranging from five to 120 hours. Usage in excess of these monthly allowances incurs an additional per-hour fee. There are some exceptions to this rule:

- in Papua New Guinea, the ISP Datec's charges are determined by the data volume downloaded
- ISPs in Fiji, Palau and Samoa offer unlimited usage plans
- the ISP in Niue allows free non-commercial dial-up Internet access (for up to 60 hours per month), after which usage is charged per hour at the business rate
- in the Solomon Islands, the not-for-profit People's First network provides an Internet café in Honiara and a number of rural community email stations on remote islands.

In the Cook Islands, Palau and Papua New Guinea it is also possible to purchase prepaid Internet dial-up access.

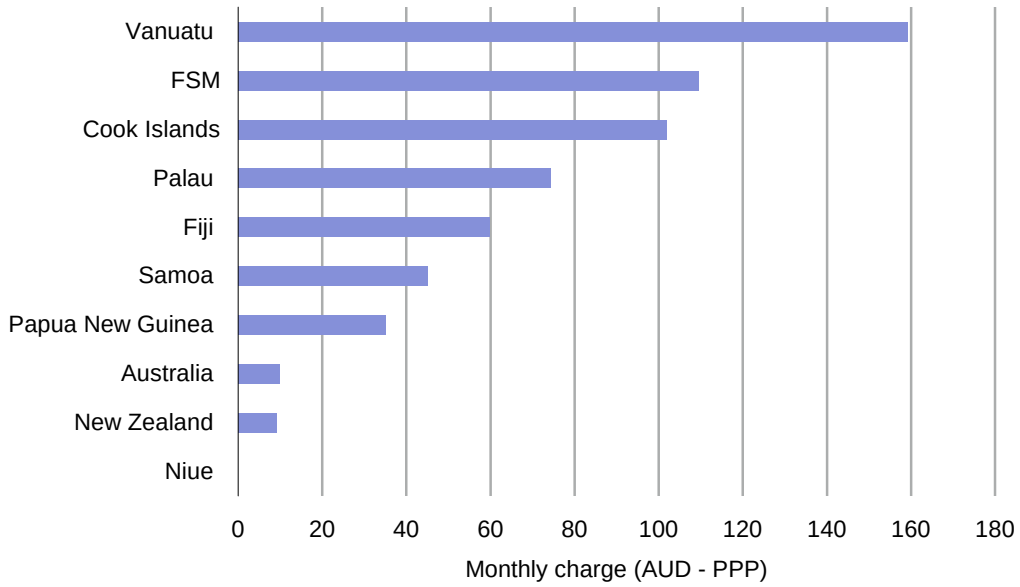
If we consider three different usage levels – ten, 25 and 100 hours per month – users in Pacific Island countries pay far more than Australians and New Zealanders for dial-up Internet use (see Figure B.1 to Figure B.3 below). The exception to this is Niue, where

services are free for up to 60 hours per month, however for our high usage level Niue becomes by far the most expensive country at nearly AUD2500 per month (not shown on the graph below due to scale).



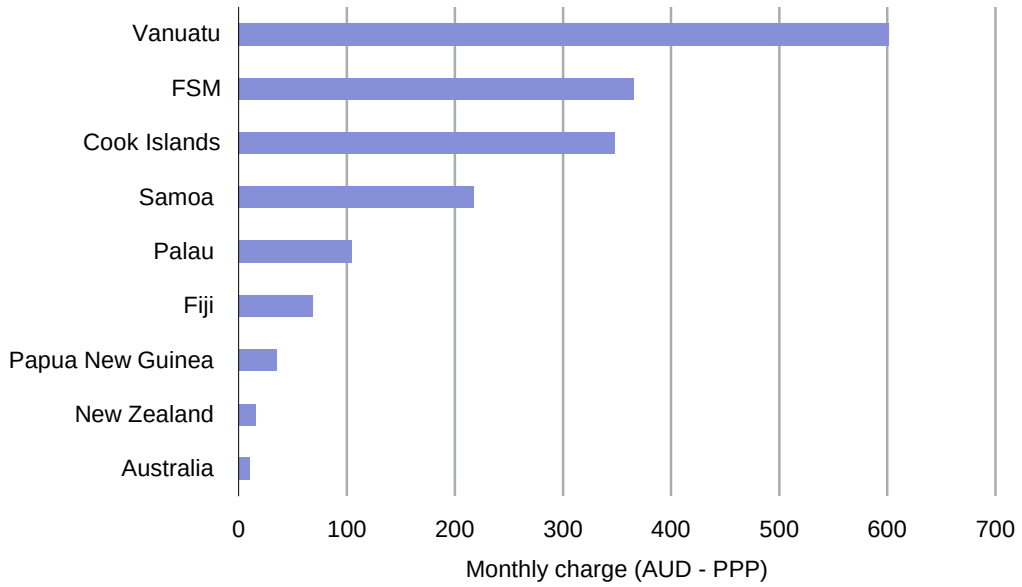
Note: In Niue, dial-up Internet is free for non-commercial use for up to 60 hours per month.

Figure B.1: *Monthly cost of dial-up Internet services for a low level of use (ten hours per month) [Source: Network Strategies]*



Note: In Niue, dial-up Internet is free for non-commercial use for up to 60 hours per month.

Figure B.2: *Monthly cost of dial-up Internet services for a medium level of use (25 hours per month) [Source: Network Strategies]*



Note: Niue (AUD2480 per month) not shown for reasons of scale.

Figure B.3: *Monthly cost of dial-up Internet services for a high level of use (100 hours per month) [Source: Network Strategies]*

The price of dial-up Internet represents a significant proportion of monthly income in many Pacific Island countries, suggesting that affordability is a major barrier (Table B.1).

Country	*Low-level use 25 hours per month*	*Medium-level use 25 hours per month*	*High-level use 100 hours per month*
Australia	0.3%	0.3%	0.3%
Cook Islands	2.8%	5.8%	19.9%
Fiji	2.7%	7.7%	8.8%
Federated States of Micronesia	11.0%	24.9%	83.0%
New Zealand	0.3%	0.3%	0.5%
Niue	0.0%	0.0%	57.3%
Palau	5.8%	9.7%	13.6%
Papua New Guinea	8.5%	8.5%	8.5%
Samoa	4.0%	5.9%	28.2%
Vanuatu	16.2%	44.5%	168.1%

Note: Analysis uses GDP per capita divided by 12 as a proxy for monthly income.

Table B.1: *Monthly spend on dial-up Internet services as a proportion of average monthly income for low, medium and high levels of use [Source: Network Strategies]*

B.2 Overview of broadband Internet plans

Broadband Internet services in the Pacific Islands typically incur a monthly access fee which includes a specified allowance for monthly data download (the 'data cap'). Usage in excess of the data cap incurs a per-Mbyte fee. Plans vary according to the bandwidth and the size of the data cap. There are plans that allow unlimited downloads in Palau, Tonga and Vanuatu, although there is generally a 'reasonable use' clause.

The price of the cheapest available broadband plans is much higher than those on offer in Australia and New Zealand (Figure B.4). Fiji has the lowest price for broadband Internet, at AUD65 per month, but this is still over 60% more expensive than the cheapest plans offered in Australia and New Zealand. Papua New Guinea, not shown on the graph, has by far the most expensive broadband Internet services, costing over AUD2 000 per month.

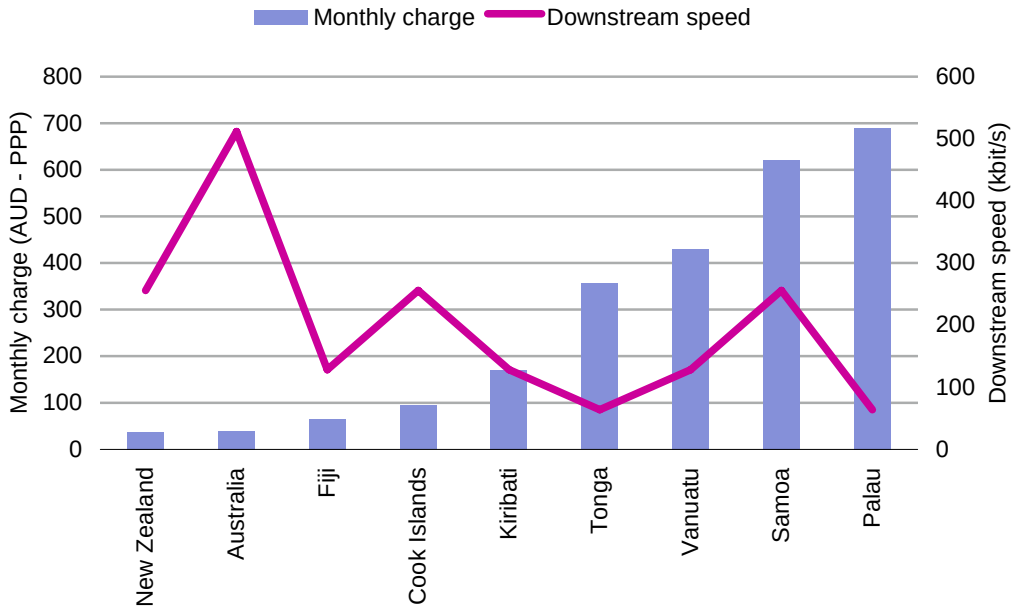


Figure B.4: *Monthly cost of broadband Internet services, including 500Mbytes download [Source: Network Strategies]*

The high price of broadband services puts them beyond reach of many potential users (Figure B.5). Whereas in Australia and New Zealand the monthly cost of broadband plans is around 1-2% of monthly income, the only Pacific Island countries where the price of broadband is less than 10% of monthly income were the Cook Islands and Fiji. At the other end of the scale, the cheapest broadband plan in Vanuatu costs more than 100% of monthly income and in Papua New Guinea more than 500% of monthly income.

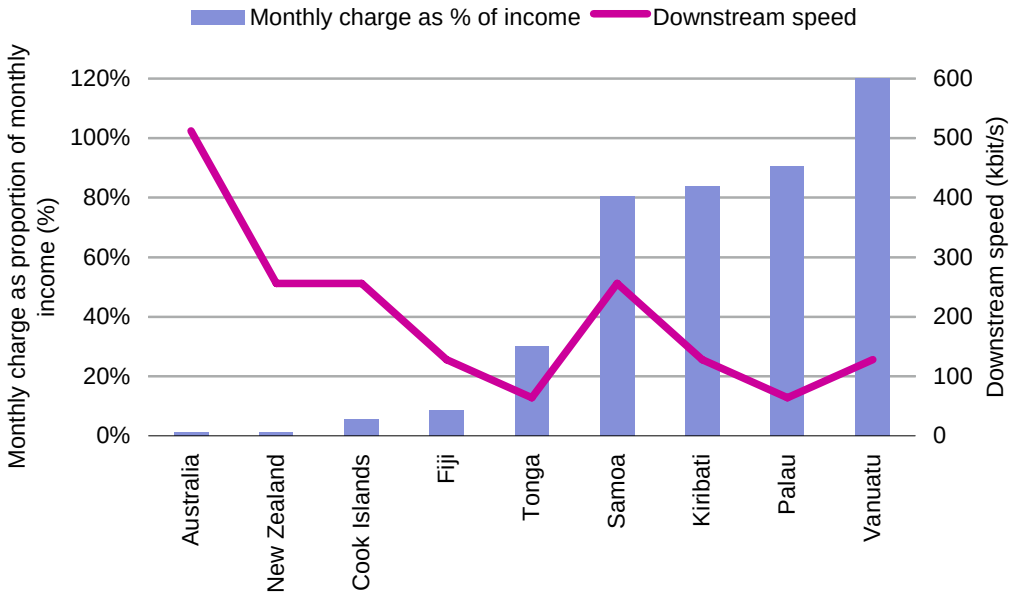


Figure B.5: *Proportion of monthly income spent on broadband Internet services, for up to 500Mbytes downloaded per month [Source: Network Strategies]*

B.3 International telephony prices

The high prices for international telephony (as illustrated in Figure B.6 and Figure B.7) would be a substantial factor in constraining demand and encouraging a shift to alternative Internet-based services. Note that these comparisons use purchasing power parity[20] (PPP) rates to adjust for relative affordability.

20 The use of PPP rates adjusts for the relative differences in the prices for goods and services between countries. PPP rates used in our analysis were sourced from the World Health Organisation, available at http://www.who.int/choice/costs/ppp/en/index.html.

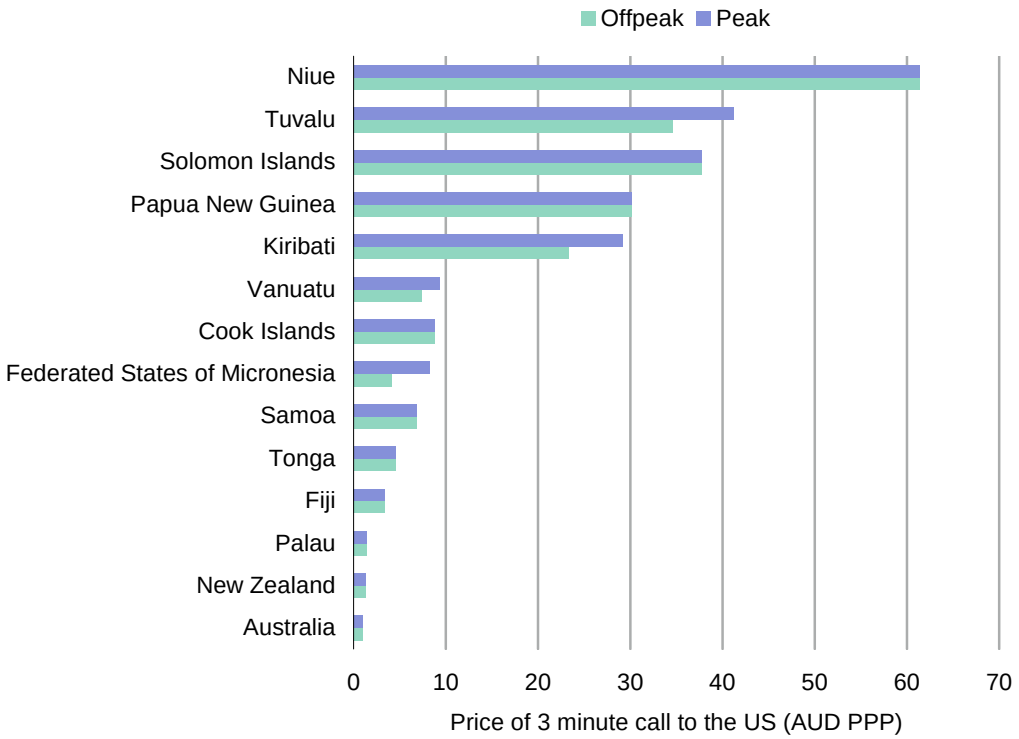


Figure B.6: *Comparison of the price for a three minute call to the United States from selected Pacific Island countries (AUD PPP) [Source: Network Strategies]*

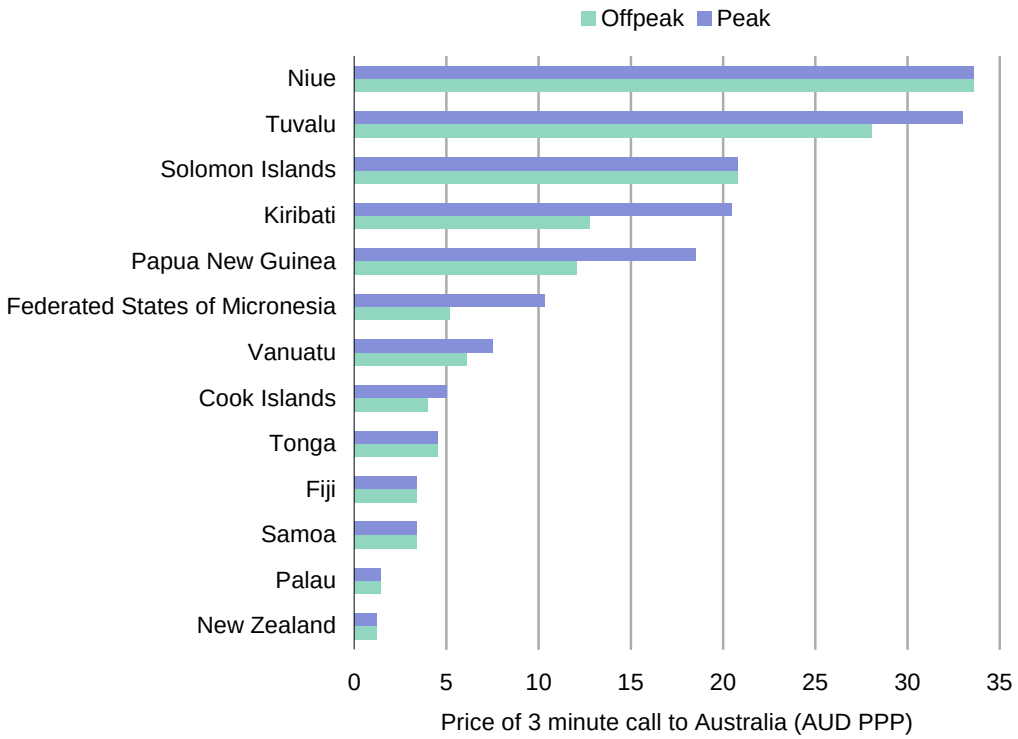


Figure B.7: *Comparison of the price for a three minute call to Australia from selected Pacific Island countries (AUD PPP) [Source: Network Strategies]*

Annex C: Acknowledgements

Network Strategies thanks the following organisations and people who provided assistance to us during the second stage of this project.

Person	*Organisation*	*Location*
Tony Waters	Apex Broadband	Australia
Alfred Soakai	Department of Communications	Tonga
George Samisoni	FINTEL	Fiji
Tua'imalo Ah Sam	Ministry of Communications and Information Technology	Samoa
Alex Orange	Ministry of Economic Development	New Zealand
Richard Hipa	Niue Post and Telecommunication	Niue
John Budden	Pacific Islands Forum Secretariat	Fiji
Anita Currie	REACH	Hong Kong
Dermot Keilthy	REACH	Hong Kong
Desmond Young	REACH	Hong Kong
Mike Johnstone	Samoatel	Samoa
Glen Tindall	SES New Skies	Sydney
Mark Schmid	Shoreline Communications	Tonga
Harry Zoleveke	Solomon Telekom	Solomon Islands
Stuart Davies	Telecom Cook Islands	Cook Islands
Peter Dowers	Telecom New Zealand	New Zealand
John Morgan	Telecoms Regulator	Samoa

Annex D: Bibliography

Apex Broadband (2007) *Australia, NZ and South Pacific Price List 2007*. Available at http://www.tonywaters.co.uk/Apex%20iDirect%20Sat%20Pricelist_Asia%20Pacific.pdf.

Intelsat (2006) 2006 Annual report.

Network Strategies (2007) *Satellite services in the Pacific: a perspective on operators and service offerings*, report for DCITA, 16 April 2007.

Pacific Islands Forum (2006) *Forum Information and Communications Technologies Ministerial Meeting*. Wellington, New Zealand, 30 March 2006: Wellington Declaration.

Pacific Islands Forum (2006) *Forum Communiqué*, Thirty-Seventh Pacific Islands Forum. Fiji, 24-25 October 2006.

SES New Skies (2006) SES New Skies press release 20 November 2006. Available at http://www.newskies.com/pressreleases_424.htm