United Nations
ESCAP

UN-OHRLLS

UNDP

ENHANCING PACIFIC CONNECTIVITY

The current situation

Opportunities for progress

Economic and Social Commission for Asia and the Pacific

ENHANCING PACIFIC CONNECTIVITY

The current situation **Opportunities for progress**

United Nations ESCAP

UN-OHRLLS

UNDP

Acknowledgments

This report was prepared with the support of the United Nations Office of the High Representative for Least Developed Countries, Landlocked Developing Countries, and Small Island Developing States; the Special Unit for South-South Cooperation; and the Government of Turkey. Peer review was provided by several staff members in ESCAP, and through official submissions of manuscripts to governments in the Pacific, and to developmental partners, including the Pacific Island Forum Secretariat, the Secretariat of the South Pacific, The Pacific Islands Telecommunications Association, the International Telecommunication Union, and the World Bank.

United Nations Publication
Sales No. E.08.II.F.14

Manufactured in Thailand
ISBN: 978-92-1-120546-6
ST/ESCAP/2472

FOREWORD

A global downturn in international telecommunications infrastructure development in the first half of this decade has recently been replaced with renewed enthusiasm for new investments, partnerships and telecoms capacity. This is partly fuelled by the anticipation that current returned growth in users and traffic may soon saturate international and domestic telecoms capacities in many parts of the world. Telecoms usage is growing rapidly in many economies. Yet, there is the perception that many economies in the Pacific lag in the development of competitively priced telecoms infrastructure, products, services and benefits therefrom – and that this has negative implications for employment, business, and other opportunities in such economies.

In response to interest expressed in improved information and communication services by Pacific leaders at the Pacific Leaders UNESCAP Special Session (PLUS) at the sixty-second session of the Commission, in 2006, the secretariat of ESCAP conducted a study of the Pacific Connectivity situation in the Pacific, and on opportunities for improved benefits to Pacific States from improved connectivity infrastructure, products and services. The study was supported by the United Nations Office of the High Representative for Least Developed Countries, Landlocked Developing Countries, and Small Island Developing States; the UNDP Special Unit for South-South Cooperation; and the Government of Turkey. It also benefited from a large number of recent studies on various aspects of connectivity in the Pacific and other potentially comparable developmental situations, such as by recent growth in infrastructure, usage, and benefits in some African, Indian Ocean and Caribbean island countries that previously had been poorly connected. Apart from Turkey, other countries from the South are interested in the study, and on Pacific connectivity reflecting the spirit, and the value, of South-South Cooperation.

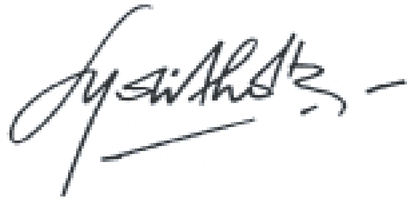
There are many internal and external factors that either facilitate or *constrain* the development of information and communication infrastructure and services in Pacific developing countries. The report analyses such factors and opportunities, and proposes some technical, institutional and financial options. The World Bank and others are interested in providing various kinds of support to help Pacific States develop strategies and actions to move forward with connectivity. Other organizations have officially or unofficially expressed interest in collaborating with the Pacific to facilitate the progress.

One challenge for Pacific developing countries that are urgently requesting improved connectivity is to show to potential partners their willingness to cooperate in the pursuit of improved information and communication infrastructure connectivity and the benefits that this will ultimately bring.

Small Island Developing States are a priority focus of the United Nations. We are dedicated to helping Pacific States to understand, strategize and benefit from advances in connectivity. We believe that this study, along with several other recent studies, can help countries and their partners to move forward in this exciting arena. With the good examples, noted in this study as occurring in several parts of the world, now is an excellent time for countries to learn from each other, adapt and extend best practices to their own circumstances, and to cooperate in a manner that brings each country understandings and resources to better move forward.

Noeleen Heyzer

Executive Secretary
United Nations
Economic and Social
Commission for Asia
and the Pacific



Cheick Sidi Diarra

High Representative for
Least-Developed Countries,
Landlocked Developing Countries
and Small Island Developing States
United Nations

Kemal Derviş

Administrator
United Nations
Development
Programme

PREFACE

Working on this study was an interesting exercise. Fortunately, it occurred shortly after several other experts assessed different aspects of the Pacific connectivity situation. Those of us involved in this project greatly appreciate those efforts, and their generous sponsors. This study also provided an opportunity to combine several areas of the authors' own researches and development activities into the study. Thus the report contains:

1. Human development index estimates, as well as Connectivity Index values for all Pacific economies covered by the study. Such data, which are often lacking for small economies like the Pacific, enable one to conclude that now may be an excellent time to pursue job, economic and social benefits that come with modern connectivity infrastructure and services.

2. Conceptual descriptions for re-deploying first-generation submarine cables, and for designing cost-effective satellite capabilities to serve the Pacific. We have met leaders of communications satellite companies, of various sizes, that are interested in working with Pacific leaders and service providers to improve quality and economy of services to the Pacific.

3. Rule of thumb estimates that funds should be available to incubate individual and/or shared access to telephone and Internet connectivity in the Pacific, if useful services are offered under reasonable conditions and prices.

4. General descriptions of institutional arrangements that can help the Pacific to achieve goals of world-class communications infrastructure and services, and benefits therefrom.

We have heard from several people that have doubts about the preparedness of Pacific decision-makers to facilitate an enabling climate for connectivity enhancements, and their benefits. However, we have also been assured that this is not the case in many Pacific economies – witness several recent movements in that direction – with results already visible in some areas.

Another challenge is how to develop a critical mass of expertise, to help decision-makers deal with opportunities, uncertainties, and opportunists in this arena. Fortunately for those in the Pacific, others have faced this challenge, and found that various forms of cooperation, through real and virtual community approaches, help to overcome feelings of isolation, and uncertainties about what to do to achieve success in this arena.

The Pacific has a large diversity of agreements and regional cooperation forums, between governments, telecommunications providers, Internet developers and users, educational and other capacity-building institutions. Some stakeholders in connectivity development for the Pacific point to other parts of the world, such as to the Eastern Caribbean Telecommunications Authority, asserting that cooperation via some appropriate form of new institution can be vital to progress. Others assert that no case has yet been made for a new institution to help support and coordinate such development. Some experts assert that regulatory frameworks, or improved expertise and decision-making capability/support, or technical skills and capabilities, or enlarged markets are first needed before major progress is assured. From my studies of this project, and our several decades of working, and travelling, in numerous countries, we have seen almost every circumstance leading to success if people are "considerately and inclusively proactive", and almost every circumstance leading to failure without the right combination of those four words.

Can a single existing agreement or cooperation body provide the catalytic environment to help guide the Pacific to its dreams of being an information society? If so, will it be a governmental-, industry-, developer- or user-centric body? Might good results in enhancing Pacific connectivity be strengthened if all these sectors shared inputs to, and learned from, the considerate and inclusively proactive among the other sectors?

Fortunately, the twenty-first century has given us virtual discussion forums, wikis, blogs, video conferencing, streaming audio and video, and other forms of communication. We can thus move beyond the limitations of letters, emails, telephone calls, faxes, in-person meetings – and use such tools to achieve our common goals, as stated in the Declaration of Principles and the Plan of Action of the World Summit on the Information Society, for a people-centred, inclusive and development-oriented Information Society.

CONTENTS

CONTENTS *(continued)*

Page

CONTENTS *(continued)*

CONTENTS *(continued)*

Page

Chapter 4:
Institutional and Associated Financial Considerations

Appendices, available on the United Nations ESCAP Website have supporting data and information. (http://www.unescap.org/icstd/research/ap-connectivity.asp). The entire report is also located there.

ABSTRACT

Many parts of the world, including parts of Asia and the Pacific, have begun to benefit significantly from improved telecommunications infrastructure and services. Emerging benefits include job and business opportunities; improved delivery of educational, health and other public services; and from an overall feeling of being connected, regardless of location where such capabilities are available.

Small island developing States in the Pacific sometimes feel left out of such developments. Only half the populated Pacific islands have any form of telecommunications, with many of limited capacity and expensive. Increasing numbers of cables cross the Pacific – but most of these bypass small Pacific islands.

Nevertheless, fundamental conditions within the Pacific greatly favour increased benefits from connectivity and related services. Literacy rates and health care delivery are at relatively high rates in most Pacific States, with others standing to benefit in such arenas from beneficial connectivity improvements. Jobs and business opportunities would be extremely timely benefits to communities and peoples in the Pacific. Peoples in the Pacific appear ready to benefit from the types of job opportunities that accompany new connectivity services, such as data entry, call centre operations, back office support, and e-commerce such as tourism and SME product marketing.

External infrastructure conditions are also favourable. C-band satellite infrastructure is reaching capacity in Asia-Pacific. Some operators with existing capacity are interested in exploring opportunities with Pacific stakeholders for leasing additional capacity at rates lower than some Pacific States may be paying now. Some providers are willing to co-design, cooperatively with stakeholders in the Pacific, new satellites or services. Satellite telephony soon to reach the western Pacific offers costs that are generally much lower than existing international calling rates – with the possibility of "universal service" in covered areas. Such systems are often pursued with local partnerships, offering opportunities for incumbents or new entrants to offer exciting and cost-effective services.

Populations in most small Pacific economies compare reasonably favourably in literacy and densities with rural areas, or even small islands, that are gaining services in other parts of the world, including rural North America, parts of Africa, the Caribbean, and Indian Ocean small island States. Models for harmonized regulatory environments, business and service environments, should offer good ideas for the Pacific. Other developmental partners have also expressed interest and willingness to help.

This report assesses the current state of connectivity in the Pacific, and the socio-economic, economic, technical and institutional bases for making progress for improved connectivity for Pacific states – not merely through or over them.

The report recommends improved usage of existing regional governmental, industry and user cooperation institutions, and/or the enhancement of these into a capability to strengthen decision-makers' abilities to move forward, to help increase Pacific synergies for acquiring, sustaining, and benefiting from current connectivity trends and opportunities.

HOW TO SKIM THIS REPORT

(capsule abstracts of the chapters/sections of the report)

The Overview section is an extended, non-technical, executive summary of the report.

Chapter 1 gives a stocktaking background of the current situation, including a socio-economic analysis that suggests that improved connectivity could be of great benefit to Pacific States, and potential developmental or commercial partners.

Chapter 2 assesses the potential for cable, satellite, and terrestrial wireless to connect and serve small Pacific economies. It proposes optiions in cost-effective cable and satellite, with terrestrial wireless providing "last-mile" connectivity in appropriate areas.

Chapter 3 assesses the economic viability of service for the Pacific, and finds that capitalization of contemporary telecoms business/service models should be feasible, on a family basis, in the Pacific.

Chapter 4 describes institutional arrangements that could help Pacific States enhance their telecoms. Whether a new institution is needed, or whether some combination of existing institutions can fulfill such task is up to stakeholders in Pacific connectivity. However, most stakeholders who have spoken have expressed hopes that decision-makers can be supported with impartial advice/expertise, and that the Pacific can be strengthened to strategize and arrange for the provision of improved connectivity and services – by facilitating an environment that enables investors to develop and sustain infrastructure and services without the necessity for subsides.

Appendices, available on the United Nations ESCAP Website have supporting data and information. (http://www.unescap.org/icstd/research/ap-connectivity.asp). The entire report is also located there.

Overview

Enhancing Pacific Connectivity

The Pacific Leaders' United Nations ESCAP Special Session (PLUS) held in Jakarta on 10 April 2006 in conjunction with the sixty-second session of the Commission and the Asia-Pacific Business Forum, identified among the major priority areas for assistance a request for ESCAP to undertake a study on the situation of telecommunications connectivity infrastructure and services supporting development in the Pacific region.

This study summarizes the connectivity situation in the Pacific, examines technical options, economical and commercial aspects, and discusses institutional and financial considerations and opportunities for enhancing connectivity in the Pacific region.

I. Introduction: Taking Stock

Pacific island economies have had basic international telecommunication connectivity since the 1970s. Of about 500 populated Pacific islands, telecommunications reach about 265 of them, serving a majority of the people. However, connectivity and benefits thereof have been hindered by high costs of existing limited international and domestic bandwidth, perceptions and institutional structures that discourage telecommunications investment.

Pacific island economies have expressed their desire to change institutional structures and to cooperate to move forward on a comprehensive range of issues. Conditions now support the pursuit of significant progress in Pacific connectivity, and the benefits thereof to all stakeholders, primarily because of global developments and the interest of potential partners.

Recent advances such as voice-over IP (VoIP), streaming audio (radio) and video (television), improved performance and pricing of satellite communications bandwidth, lower-cost very small aperture terminals (VSAT), wireless networking, and the existing, upgradeable fibre-optic undersea cables have broken price and performance barriers.

In addition, research indicates the overall growth of worldwide utilization of satellite capacity for the different major segments of the satellite telecommunication market. Total demand is forecast to increase from 5,200 transponders in 2004 to 7,500 transponders by 2013. Broadcasting, including direct-to-home broadcasting and distribution of television content via satellite, consumes around 52 per cent of total demand; while telephony, data and Internet trunking are expected to require around 40 per cent of total demand. One of the most significant trends identified by this forecast is the emergence of Internet direct broadband access, which is beginning to trigger great demand. As a result, commercial satellite services will be revitalized in delivering worldwide information and communication technology services.

Socio-economic Situation

One sees a wide diversity of development performance among Pacific island economies. Most independent Pacific island economies have Human Development Indices in the middle-development range of .59 – .79. This is a stage at which ICT use begins to take off, but many developing countries defer such issues as ICT infrastructural prioritization until education and health-care investments are delivering results. Most Pacific island economies have reached such a stage, so they might logically prioritize ICT when such investments appear timely.

Four economies have literacy rates of 57-77 per cent (noting that they include some of the larger populations in the region), and the rest have literacy ranging between 89-100 per cent. That the lowest literacy rates correlate with several of the larger population centres suggests that there is considerable potential for ICT-strengthened literacy campaigns in such States, if supportive infrastructure can be provided.

A. Connectivity Situation

Formerly, cable was considered unaffordable for small economies, and would unlikely be built out to all islands of a dispersed multi-island State, but economies such as Hawaii, Guam, Johnston Atoll, Fiji, the Northern Mariana Islands and Papua New Guinea are connected to international cable. Now, more Pacific economies are aspiring for cable service, thanks to new approaches to economically re-deploying underused cable, new cable clubs that include small developing countries, and new initiatives/promotions by prospective providers.

The original wireless telecoms in the Pacific were two-way radio and broadcasting. Now they also include mobile telephones, microwave signal trunking, and wireless networking such as WiMax to provide last-mile connectivity in towns, and even in the countryside. This is the fastest growing field of telecoms at the end-user side of developing countries, though the Internet accounts for most actual traffic bandwidth growth.

Dozens of Pacific islands are served by satellite communications, which could serve all islands "today," with satellite phones or VSAT. Most Pacific island economies rely on satcom for external telecommunications. With new technologies and business models, it may be timely to pursue cost-effective universal satcom service in the Pacific by exploring the possibility of designing and operating a dedicated communications satellite to provide broadband services to the Pacific, or the possibility of contracting for more efficient use of bandwidth towards universal service at more favourable pricing.

B. Policy/Regulatory Issues

Many laws and policies pre-date the explosive impact of the Internet, mobile telephony, and broadband on telecommunications benefits to society, and/or the tremendous involvement of such telecommunications in the new 21st century globalization. The data indicate that the regulatory and ownership status in many Pacific island economies remains uncompetitive, though a number of discussions and actions have moved toward increased competition in some Pacific economies.

Such an environment may come at a cost. Costs for Internet and mobile telephone access tend to be higher in Pacific island nations than in peer small island economies elsewhere, even when adjusted for income status. Re-designing Pacific telecommunication markets for innovative competition may benefit consumers in Pacific island economies by about US$80 million annually, according to this report, which means that perhaps US$400 million might be saved over five years. Much of these savings could be attracted to modernizing telecommunications products and services – and thus underwrite costs of new infrastructure such as cable, wireless, and satellite-based products and services.

Removing constraints on telecommunications innovation should put millions of dollars into the pockets of telecom customers in the Pacific. In addition, new products and services should bring business and income to the region. This should be more than enough money to pay for investment in telecoms infrastructure like cable, satellite, and wireless – and for additional products and services. The cost savings, and additional incomes, should also bring some prosperity to other segments of Pacific society.

Deregulation and services of the Eastern Caribbean Telecommunications Authority (ECTEL), gratis wireless Internet in Niue, domain name revenue for Tuvalu and Tokelau, economical reuse of first-generation undersea cables by Telikom Papua New Guinea, new-style "club" partnerships building undersea cable systems, and other modalities offer potentially valuable examples for the Pacific to build upon for its own benefit. In some cases, governments and/or operators continue to pursue policies or practices that hinder progress in connectivity infrastructure, services, and pricing – to considerable social cost. Others, such as Samoa, are making considerable progress in these arenas, to considerable social benefit.

II. Technical Viability

A. Technical Options for the Pacific

Connectivity infrastructure may be broadly categorized as wired, terrestrial wireless, and satellite. Each of these different types of "pipe" has traditional analogue, narrowband digital, and broadband digital capabilities, and can provide broadcasting, telephony, Internet and conferencing services. Technical options include those shown in Table 1.

Table 1. Technical options for Pacific connectivity "pipes": a summary

Pipe Media	Media Details	Generalized Description
Wired	**Fibre-optic cable**	This is the most desired and cost-beneficial connectivity for sufficiently large markets. The market size necessary for cable appears to be dropping, making cable possible for increasingly small communities. First-generation cable is being retired due to excess capacity in the marketplace. Redeployment of such cable may be an affordable opportunity for small markets.
Wired	**Copper cable**	This might be largely obsolete for international connectivity. Where already installed, this might be maintained, awaiting replacement by fibre, wireless or broadband satellite. In some communities, digital subscriber line (DSL) over copper may justify installing or upgrading the copper infrastructure for such a purpose.
Terrestrial wireless	**Microwave wireless phone, WiFi, WiMax, Wireless LAN,etc.**	The revolutionary connectivity brought by WiFi/WiMax has been extended to several kilometres from each transmitting node. Such approaches enable a single transmission node (satellite terminal or broadband cable) to cover larger dispersions of people – thus making them more cost-effective. Microwave, limited by its relay requirement for every 50 km, could be used as backbone connecting neighbouring areas.
Wired	**Terrestrial two-way radio**	This "pipe" may be the least capable and reliable option today, but has long served distant, dispersed populations with basic telecommunications. Where other means become cost-effective, this might be replaced. However, modernized two-way radio, including amateur radio, may continue to serve communities for years to come.
Satellite	**Communication satellites**	For an appropriately located satellite, this can bring "universal service" more practically than cable where populations are widespread. Existing C-band services are reliable, and may be worth continuing for high-reliability needs, though a satellite phone might also provide basic backup at lower cost in some locations. Ku band may be lower cost for higher bandwidth yet adequately reliable for Pacific island environments – for all but the most essential basics. New approaches suggest that a dedicated satellite for the Pacific can now improve performance, yet be cost-effective. New approaches to jointly negotiating for one or more existing satellite transponders and shared ground supporting facilities (by collectives of Pacific economies) may bring economies of scale to several countries.

The Pacific can benefit by blending the three (cabling, satellite, and wireless) classes of connectivity. All have valuable roles to play in the region. Infrastructure projects may be pursued on their appropriateness for the existing situations in areas targeted for each project.

B. Undersea Cables

Wired connectivity has evolved from copper to fibre-optic cable. New technologies have prolonged the life of copper in the "last mile" through the use of digital subscriber line (DSL) technology. Previously considered unaffordable for small Pacific island economies, undersea fibre-optic cable is nevertheless considered desirable for its cost-effective and relatively reliable bandwidth. Although relatively few small Pacific island economies formerly benefited from broadband cable connectivity, this situation is improving as several cable projects are underway. Anticipated service areas include the Marshall Islands, the Federated States of Micronesia, and New Caledonia.

Papua New Guinea is using retired cables, especially first-generation fibre-optic cables to redeploy part of the PacRimWest cable to Port Moresby. This pioneering effort might give other countries ideas about doing similarly. Such an approach could connect many Pacific islands to existing cables for perhaps about US$3 – US$5 million per country on average.

C. Terrestrial Wireless

Terrestrial wireless connectivity used to mean two-way radio, shortwave and AM/FM radio, and television. It now includes mobile phones, and in some countries, between-island microwave backbone and/or WiFi/WiMax end-user connectivity.

Mobile phone is gaining popularity among users faster than all other forms of telecommunications. In countries where mobile phones are advanced, many products and services available on the Internet are also available via phone. These include short messaging, Internet banking and other e-business, e-government, radio, television and film broadcasting, as well as simple voice. Phones also have the advantage that they are easier and cheaper to purchase and maintain than computers, in many island economies. Facilitating their creative growth should be at the centre of telecom development in the Pacific.

In many cases, small islands may be amenable to new forms of wireless networking such as WiFi, Wireless LAN, WiMax, or WiBro. WiMax can reportedly serve an area of up to about 10,000 square kilometres from one fibre-optic or VSAT node. Though it should be noted that there are some trade-offs between coverage area, reliability and bandwidth in wireless networking, it can greatly increase the coverage around a cable node or VSAT installation.

D. Communication Satellites

Satellite communications provided a leap forward in Pacific connectivity about three decades ago. Since then, costs have dropped somewhat, and C-band connectivity has been adapted for digital as well as broadcast capabilities. However, the recent revolution in cost-effective satellite broadband, coupled with great improvements in terminal performance/cost, has not yet substantially benefited the Pacific. A satellite communications service model, designed to maximize service/cost for the Pacific, now appears possible and may be able to significantly improve the financial sustainability of such a service. In the short term, Pacific States may wish to form user consortia to negotiate grouped bandwidth (at lower rates for the consortium than may be achievable individually by the States).

For "immediate" benefit, several countries which currently lease less-than-full-transponder bandwidth may wish to consider joining forces for longer-term leases of multiples of full-transponder bandwidth at the reduced rates given to such leases. The Pacific Islands Telecommunications Association (PITA) is working on this concept. Longer-term benefits may stem from adapting to the Pacific recent developments in North America and Asia, whereby satcom broadband has been designed to serve dispersed populations at economical rates using inexpensive terminals. This study describes several options for higher performance satellite communications for the Pacific (summarized in Table 2). These can be sufficiently economical for the region to include new satellite capabilities in its telecoms strategy.

Estimating the Cost of a Satellite System, Including Major Application Supporting Systems

A refined cost estimate of a desired satellite system would depend on a number of factors, such as the applications and equipment to be supported, services to be provided, the coverage area, data rate, satellite power, the construction of the satellite, launching costs, insurance, and operation and maintenance.

Costs would also depend on other factors: whether a single bigger satellite, or a number of medium-sized satellites, would be required; redundancy option (e.g., potential for backup by another satellite or other means); and time duration for building and launching a satellite.

Unlike commercial telecom traffic in highly populated areas of the world, in this case it is to be expected that the break-even point in terms of revenue earned may not be reached for quite a long time, or in some cases may not happen at all. It is expected that an element of capital subsidy will be sought, plus some capacity to subsidize remote connections. Alternatively, service sharing, with beams added to serve partner areas, such as eastern Australia, New Zealand, Hawaii and eastern Asia. The overall costing in such cases may thus take into account intangible benefits such as improving the standard of living of the people, establishing a robust communication infrastructure, and other external or non-commercial benefits. The desired satellite systems would need to be built to achieve such objectives.

Table 2. Summary and comparison of four satellite options

Option [1]	Estimated cost in US$ [2]	Advantages [3, 4]	Disadvantages
1. Build and own a Ku-band satellite with 11 spot beams	**110-120 m., satellite only**	High power and reused frequency may provide affordable bandwidth. May meet the bandwidth need in normal ICT development by 2015. May be able to provide additional economically useful services to Pacific Rim countries.	If applications develop quickly, a second satellite may be needed before its retirement.
2. Build and own a Ku-band satellite with 26 spot beams	**130-150 m., satellite only**	High power and reused frequency may provide affordable bandwidth. More bandwidth than option 1. May be able to provide additional economically useful services to Pacific Rim countries.	Capacity might not be fully used.
3. Build and own a C-band satellite, with part of resources for commercial services	**200 m., including satellite and main Earth station**	High power and reused frequency may provide affordable bandwidth. Commercial services may reduce subsidiary. Connection to outside world through the same satellite.	Covering only 13 Pacific economies, not all Pacific island countries and territories.
4. Own or lease partial capacity of a possible commercial satellite	**75-85 m., part of satellite for 12 years**	The partner provides all technical support. Connection to outside may be through the partner.	Lower power requires more expensive user terminals. Fixed satellite operator.

Notes: [1] All satellites have a lifetime of 12-15 years; construction requires 2-3 years.

[2] The estimated cost includes satellite manufacture, launch and insurance.

[3] Options 1-3: May provide broadband services, accessible with similar low-cost user terminals.

[4] Options 1-3: Operation of satellite may be contracted to any satellite operator under satellite footprint; it is not necessary to be in a Pacific island economy.

Estimating the Cost of the Control Facilities and User Terminals and Facilities

The cost of telemetry, tracking and control and satellite control facilities for options 1 and 2 (Table 2) will be US$9 million. For user terminals under options 1 and 2, the cost estimation takes into account the following factors: population to be served; service establishments that need connectivity (hospitals, schools, civil service offices, Internet cafés, security agencies and private establishments); type of service (always-on broadband, dial-up etc.); emergency services; fixed or mobile or television broadcast; communication terminals at personal level or at community level.

Consideration of these factors will lead to an estimate of how many ground terminals would be required in each service category, and cost estimates need to be arrived at appropriately. For the suggested application and services, recurring monthly subscription of the poorer communities should be kept to the minimum, financed by direct subsidies where possible and needed, in order to deliver affordable benefits of ICT to the rural poor people of the region. General access and user charges should, however, be set at commercially viable levels, which will depend on fund sources and costs. While estimating the cost, this point is to be kept in mind and all possible techniques should be adopted to reduce the cost, consistent with sustainable finance.

III. Economic and Commercial Viability

Economically, a competitive, less constrained marketplace has been estimated to save customers[1] US$66 – US$80 million annually. The present study estimates total savings for the economies noted here to be perhaps US$80 million. Over the 10-20-year time frame of a communications satellite or undersea cable, we see as much as US$1.5 billion potentially available (conservatively estimated at constant revenue levels and populations) for telecommunications infrastructure, products, and services. An investment of about US$300 million could deliver significant satellite, cable and wireless infrastructure, as well as the services available from them. With estimated savings from telecoms restructuring – and with or without supplementation from potential developmental and commercial partners – the Pacific should be in good shape to pay for enhancements from anticipated savings.

The Pacific lacks most-connected economies, and is characterized by middle-connected and least-connected categories. The levels of human development generally range in the lower- to upper-middle range. The approach taken in this study suggests that, for an "average" Pacific community, per capita funds available for telecommunications might be US$12 – US$20 per month. When combined in family or clan groupings, this could become US$25 – US$100 per month. At prices elsewhere in Asia and the Pacific, this is enough for one or more phones, Internet, and some services. In poorer communities some of those services might be shared through Internet cafés, e-centres, or shared use of phones among neighbours, or by the use of a Grameen Phone type of modality. In more wealthy communities, more individual options, products, and services might be consumed.

A. Affordability Assessment

Two approaches are presented below:

Percentage of GDP Approach

The Percentage of GDP approach considers information and communication service revenues as a percentage of GDP globally and applies them to Pacific economies in order to determine the

1 "Consumer" includes governmental agencies, developmental partners, and industry, not just individuals.

purchasing power of residents in Pacific economies. The sample group of economies for this analysis includes a total of 16 sample countries (the four highest and three lowest GDP per-capita economies were excluded). The estimated "average" GDP per capita of the economies then is US$4,867. As a result, their purchasing power for information and communication services varies from US$12 to US$20.8 per month. If we consider extremes, the Northern Mariana Islands figure could be US$36 – US$52/month, whereas Tokelau might be US$2.50 – US$4.15/month per capita. Even the latter can be appropriate for shared capacities through e-centres.

Average Revenue per User Approach

The Average Revenue per User approach takes into account the average revenue per user (ARPU) of the telecommunication services in the Pacific. The average monthly ARPU of the 12 sample countries is US$8.74. This figure is indicative only of the monthly amount Pacific residents are currently willing to pay for the telecommunication services with existing configurations.

B. Commercial Viability

A case study was conducted in order to indicate the generic end-user prices for consumer broadband in different scenarios via different solutions. The study compared the generic end-user prices for consumer broadband in different scenarios via different solutions such as urban DSL, fixed wireless, WiFi, and broadband satellite. In urban areas, where consumer broadband user density is high, the most appropriate solution for providing the telecommunication services may be urban DSL. Broadband satellite is often essential in rural and remote areas, because consumer broadband via satellite can also be used to complement service in blind spots anywhere under the satellite's service area, regardless of terrain. Concentrations of people in rural areas, such as in villages, and in some urban areas where costs of installing cable are high, might benefit from a central satellite terminal or cable point – whose reach is extended by cellular mobile, WiMax or other wireless networking – to extend the number of people served by the satellite terminal.

The affordability and unit cost studies of consumer broadband services suggest that there may be a gap between the cost and purchasing power of some Pacific residents, especially when considering the ARPU approach. The monthly unit cost of consumer broadband via DSL and via satellite is US$16 and US$32 (varying depending on the user's terminal) respectively. However, this discusses individual GDP per capita. In the Pacific, as in many other societies, at least some telecoms services are shared among family or neighbourhood groups. For example, wired phones and household Internet is usually shared among families, and sometimes among neighbours. If one looks at Average Revenue per Family Grouping (or other grouping), the revenues available for telecoms are considerably higher.

It is worth noting that satellite telephony has dropped in price, both for handsets and for call charges. In addition, reductions in costs for satellite mobile phone, and operators business models of partnering with local service providers can help Pacific States pursue universal service while generating revenues.

As demonstrated in a number of countries, if mobile and land line telecommunications can be opened up to competition and micro-finance techniques – or through shared services like Internet cafés or community Internet/call centres, this both expands the market base for telecommunications and stimulates a range of economic activity. In higher-income economies, much flexibility of individual options is possible. In lower income economies, family/clan/communal sharing or e-centres, Internet cafés and call centres should serve to facilitate access for people of more modest means. A pro-active service model could support individual accounts which could be shared.

In the short term, reductions in cost of existing communications satellite capacity may be achieved if Pacific States join together to jointly lease one or more full transponders, as opposed to small States leasing parts of transponders at higher rates. Leasing in units of one or more *full transponders*, for relatively longer terms (e.g., more than 2-3 years where possible), should markedly reduce per-byte rates. An extension of the OPT French Polynesia/Telecom Cook Islands shared leasing example might serve several Pacific island States well.

IV. Institutional and Associated Financial Considerations

A. Institutional

Since telecommunications and connectivity are keys to 21st century economic and social development, there seems little doubt of the social and international case for expanding telecommunications. A corollary question is how to ensure that existing and future stakeholders can benefit from this process. If there is to be a major step forward in terms of Pacific connectivity – and benefits for all stakeholders – the key is to determine and implement what is required of member governments collectively in the Pacific.

An example of good practice may be found in the Caribbean, where similar challenges have drawn successful regulatory, financing and investment responses, within a new competitive framework led by the Eastern Caribbean Telecommunications Authority (ECTEL). ECTEL provides regional expertise, as well as a mechanism for the Eastern Caribbean to partner with enablers toward lower costs and greater effectiveness of telecoms infrastructure, products and services. It is noted that at the Pacific Islands Forum Economic Ministers' Meeting in 2006, Ministers expressed major interest in the ECTEL experience.

The issue of coordination and planning led this study to recommend the formation of a similar type of organization, which, for purposes of discussion, may be called "Pacific Islands Telecommunications Authority" (PACITEL).[2] It could operate as a regional cooperative mechanism to coordinate the process of expanding telecommunications (and digital data) capacities and their governance and financing in the region. The suggestion is that this cooperative mechanism may put in place the regulatory and other arrangements necessary so that countries can elect to join, which in turn can commission and oversee expansions of fibre-optic cable, satellite, and terrestrial wireless telecommunications capacities.

The study suggests, following discussions by decision makers in Pacific telecommunications, that a feasibility study drawing on this and related reports, that the authority would in turn commission one or more platform service providers and operators (tentatively called PACSAT for purposes of discussion). This platform entity (or entities) could be a consortium of commercial investors with the relevant technical, financial and legal expertise. While the service providers could in turn acquire a satellite, lay or re-lay cable, and perhaps be involved in wireless trunking and networking, it would be expected to develop the best expansionary path, including contracting from existing satellite and other service providers. Many telecommunications entities world wide contract with satellite entities and cable operators for bandwidth for periods of time, rather than physically acquiring satellites or cable.

[2] This name is merely an example. Several existing institutions, such as the Pacific Islands Forum Secretariat, could conceivably perform such a function, without the necessity of forming a new entity.

B. Financial

The regional authority could work with private investors and other possible partners (development banks and donor nations), rather than risk tax funds on infrastructure and services that are better managed by the private sector (under a regulatory environment that promotes good governance of such infrastructure and services).

It is envisaged that the international development bank and donor community would arrange financing and/or other assistance for the regional cooperative mechanism – to develop its regulatory and governance framework that would apply to the operators, service providers and other participants. The preparation of tender documents for the platform service providers would also be one of the early tasks of the suggested technical assistance.

There is no doubt that cost-effective enhancements to telecoms infrastructure and services should lead to increased prosperity and stability – but co-investors would want assurances that their investments will not be subject to undue risk. The role that a government takes will have far-reaching effects not only on the public's use of ICT, but, perhaps even more importantly, on investors' perceptions of the risks they will face and the type of cooperation they will receive in the short and long term. To ensure that lenders and investors feel comfortable putting their money in Pacific economies, governments need to ensure that private and public sector participants in telecommunications are treated equally and consistently.

C. Financing Mechanisms

Contributory Organizations

A crucial commitment from the development banks and ODA will be to support the formation of a regional cooperative mechanism and preparation of the charter for such cooperation. If total capital costs are roughly US$200 million for the platform service providers and operators, then seed capital of 20 per cent of this sum, plus funds adequate to sustain the formation of the regional authority, may be required, possibly US$25 – US$40 million in total. There may be scope to attract financial and technical support from countries that have a strategic interest in the Pacific plus space expertise. There should also be meetings arranged with development banks and agencies.

Private Sector

What is critical in obtaining private sector funds for reasonable maturities is clarity of the commercial opportunities and the likely income stream from selling capacity. Tenderers for services should have a clear perspective on the issues involved. This creates a major responsibility for the regional authority and the member States, to create a market environment of relative certainty in terms of access and other charges and conditions. Hence the capacity to supplement any seed capital available will depend on the new regulatory environment established jointly by regional cooperative organization and the respective telecommunications authorities and policies in the Pacific.

Service Providers

There is a need to consult on technical and commercial issues and alternatives with a range of companies. Companies with experience providing mobile phones, broadband, satellite phones and other services and technologies may be interested in the opportunities arising from satellite and expanded telecommunications systems in the Pacific.

V. Conclusion

A final issue is how to ensure that all relevant stakeholders may benefit from enhanced telecommunications connectivity/services in the Pacific. Willingness of Pacific economies in jointly pursuing information and communication infrastructure connectivity, transparency of policies and regulations, and a successful all-win situation for governments, incumbent and potential providers, communities and peoples of the Pacific, and development partners, will help move forward the process of improving information and communication services in the Pacific.

Chapter 1

Taking Stock of Telecommunication Connectivity and Associated Supportive Infrastructure in the Pacific[1]

I. Introduction to the Situation

The Pacific has a population of about ten million people, if one includes Timor Leste and Papua New Guinea. A lack of employment opportunities, despite major investments in education and health care, has led many to migrate in search of better opportunity. In larger countries, such migrations are often from rural to urban areas. In the Pacific, a similar move is often international. Emigration has reduced populations in some communities to levels that create fears for their sustainability. Can improved connectivity help stem such emigration, and perhaps attract sustainable opportunities?

The Pacific can be a good base for some to live and work in a globalized economy. We are in an age in which information and communications technology (ICT) allows executives, consultants and other knowledge workers to telecommute from their dream location. Such location might be a rural farm or ranch, mountain top or valley, lake shore, seashore, or island paradise. Indeed, parts of rural North America and Europe, Caribbean islands and other formerly remote areas have found opportunities arrive at their doorsteps, with such entrepreneurs setting up their 21st-century “homesteads”.

With improved communications and opportunities, many Pacific islands would be able not only to attract back some of their “diaspora”, but also to benefit from globalization and the dreams of others to start a new life on a Pacific island. This trend could lead to investments by native-born or immigrant entrepreneurs desiring to live and work on a particular Pacific island. Some economies are looking to attract Japanese or other retirees. ICT-strengthened small businesses can be a great ally in appropriately capitalizing the Pacific.

For many years, representatives from Pacific island economies have met in forums facilitated by United Nations bodies, the Pacific Island Forum and others, to discuss possible solutions to this challenge. Plans and declarations abound. Recent efforts include the Pacific Islands Information and Communication Technologies Policy and Strategic Plan of 2002, and the Pacific Plan of 2005. The latter is a far-reaching framework for regional cooperation, and includes a Pacific Regional Digital Strategy,[2] reviewed and elaborated into a road map in 2006, for review by ICT/Communications Ministers in the first half of 2007. In addition, the Terms of Reference for the Task Force on Regional Approaches to ICTs in the Pacific were also set in March 2006. A stepladder for implementing the Digital Strategy is shown in Figure 1-1.

---

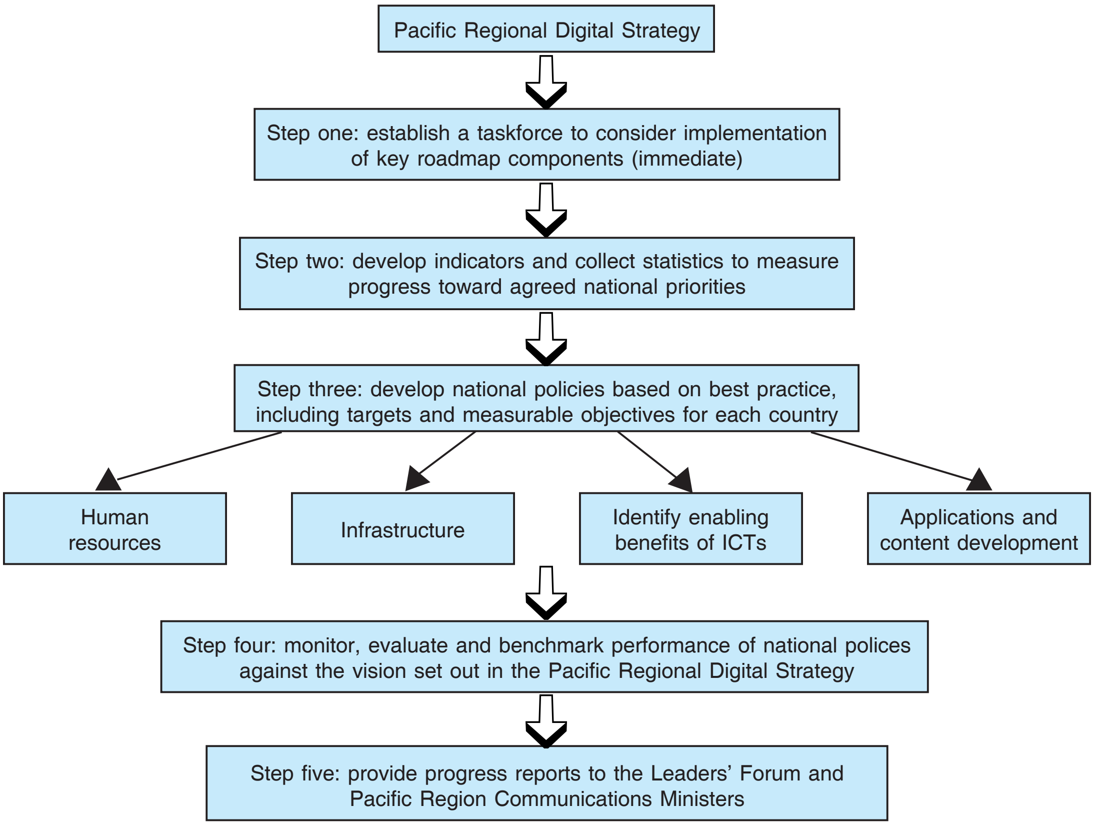
[1] This chapter was written by David A. Hastings.

[2] http://www.pacificplan.org/tiki-page.php?pageName=Digital+strategy.

With many unfulfilled plans, Pacific island economies may appear to be in a quandary. However, worldwide developments in recent years bring hope that positive developments elsewhere can lead to equally positive developments for Pacific island economies.

Several recent studies by various organizations provide important information for developers of Pacific telecommunications. This report adds and assesses connectivity and Human Development Index values for several Pacific island economies. The report notes several recent developments in telecommunications, institution-building and partnerships supporting small developing economies that provide valuable new context. This information shows interesting patterns, which can help planners and decision makers to visualize the path toward a better-connected Pacific. Findings of several such studies are summarized in this report, including its appendixes.

Figure 1-1. Pacific Plan Digital Strategy: Stepladder for development[3]



II. Historical Development of Connectivity in the Pacific

Undersea cables have traversed the Pacific for over a century. Cable and Wireless reached Singapore, Hong Kong and Australia from the United Kingdom with telegraph cabling by 1871. That company eventually gained recognition for connecting Fiji, Vanuatu, Tonga and the Solomon Islands,[4] and for providing similar services (and eventually perceived monopoly status) to the Caribbean. In 1902, when Cable and Wireless received permission to build the telegraphic Pacific Cable between Canada,

---

[3] http://www.pacificplan.org.

[4] http://en.wikipedia.org/wiki/Cable_&_Wireless.

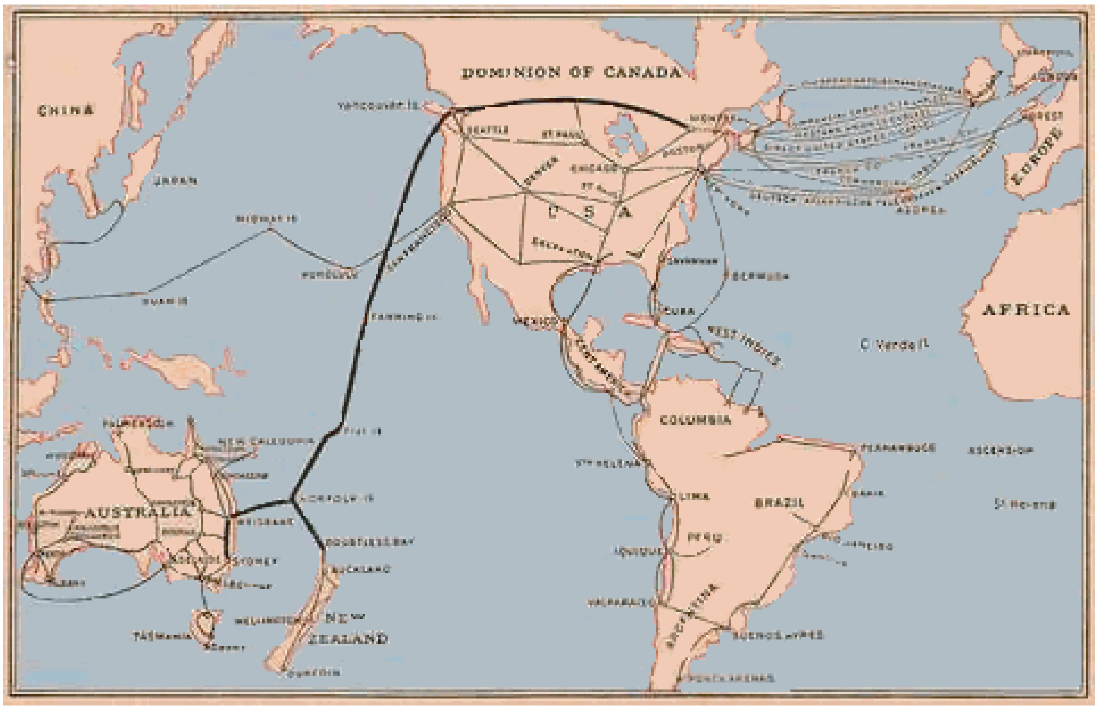
Australia and New Zealand, connectivity was as appears in Figure 1-2. That cable included Fiji, Norfolk Islands and Fanning Islands. By 1940, the situation had evolved, with Hawaii, Midway, Guam, Saipan and Yap also connected by cable, and most other island groups connected by wireless (e.g., radio) communication (Figure 1-3).

Since then, cabling advanced to support telephone services. The first Pacific cable was installed in 1957 between the United States mainland and Hawaii (not yet an American state). Copper coaxial telephone cables followed to Australia and many other economies in the Pacific.

First-generation fibre-optic digital cabling (with ~500 Megabit bandwidth) was introduced in the late 1980s, with current-generation cabling (~500 Gigabit or more bandwidth) arriving in the mid-1990s. Island economies situated near primary routes between North America, Japan, Australia and New Zealand were most likely to be linked. Currently, Fiji, Guam, the Northern Mariana Islands and Papua New Guinea have some form of modern international cable connectivity. Cabling projects in various stages of development should benefit the Federated States of Micronesia, the Marshall Islands and New Caledonia within the foreseeable future.

Radio has linked many "remote" Pacific islands for decades. Mobile telephony, wireless networking, two-way[5] and government trunked radio services[6] are modern evolutions of such technology, and are likely to provide important connectivity for public and governmental users.

Figure 1-2. Trans-Pacific connectivity was strengthened by the Pacific Cable from 1902[7]

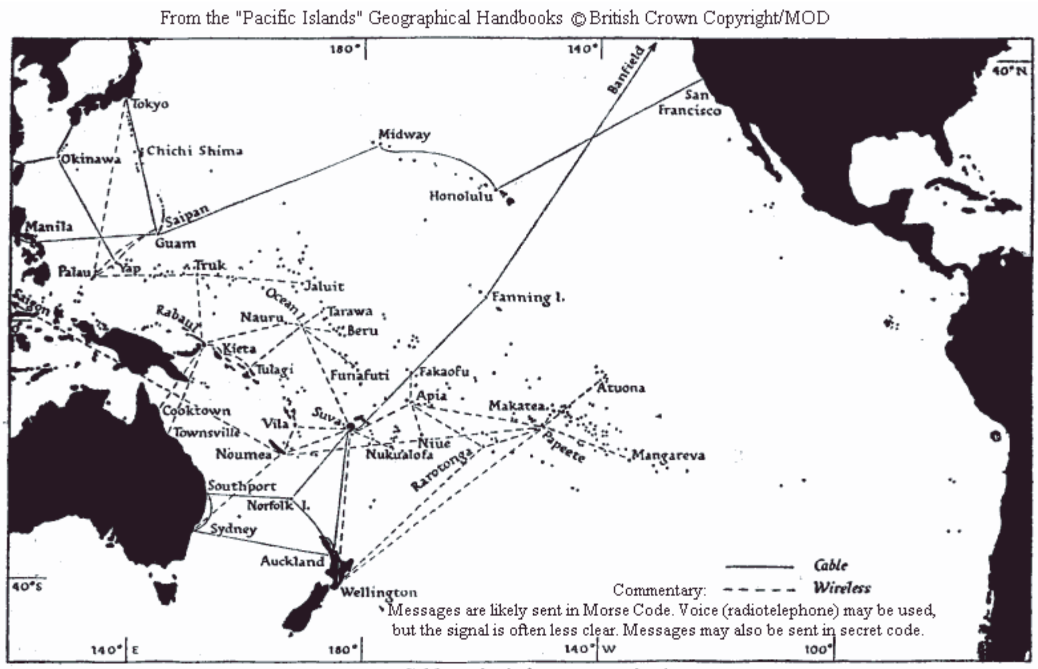


5 http://en.wikipedia.org/wiki/Two-way_radio.

6 http://en.wikipedia.org/wiki/Trunked_radio_system. Note, specifically, systems such as TETRA and P25 for coordinated communication among government agencies for routine, urgent and disaster situations.

7 http://www.cwhistory.com/history/html/Pacific1.html.

Figure 1-3. Cable and wireless communications in 1939[8]



Volume 1 Fig. 119. Cable and wireless communications
This map shows cables and the main outline of the system of wireless communication existing in the Pacific area in 1939. Based on various sources.
Commentary: On this map "Wireless" (radio) is diagrammed to show how the networks work: An operator on Tarawa with a low-power transmitter is supposed to contact the higher-powered Ocean Island radio station, that will then relay a message to Rabul or Suva. A radio usually send signals in every direction, range depending on the power of the transmitter. This is simplified: the earth's magnetosphere can influence how far a signal can be heard.

Satellite communications began serving the Pacific in the 1970s. C-band connectivity still dominates the Pacific with relatively reliable but expensive services. Satcom brought greatly increased telephone and broadcasting support, including global programme content feeds. Television broadcasting services spread rapidly from the mid-1970s, now covering population centres in most Pacific island economies. Internet services began in 1995 in Fiji, 2000 in Tuvalu, with gratis non-commercial wireless Internet beginning in Niue in 2003. However, it is reportedly still difficult to send a multi-page fax in several countries.

III. The Socio-Economic Situation

The United Nations Development Programme has produced Human Development Reports since 1990, to considerable critical engagement. Recent editions of the report include 177 economies. The author has extended the coverage of the Human Development Index to include more countries, and currently has 232 countries with a computed HDI. Table 1 thus includes several economies in the Pacific not yet covered by UNDP.

One sees a wide diversity of life expectancies in the Pacific island economies, from 56 to 80 years of age. The average life expectancy is neither short nor long at about 70-71 years. With 17 economies having average life expectancy rates of 70 years or more despite concerns over the logistics of providing the best medical care, this is a testament to the already significant investments in health care in many Pacific island economies.

8 http://www.lib.utexas.edu/maps/historical/pacific_islands_1943_1945/communications_cable_wireless.jpg, http://spontoon.rootoon.com/SPwMap/GePaM011.gif.

Four economies have literacy rates of 57 to 77 per cent, but the rest have literacy ranging between 89 and 100 per cent (Table 1-1). Omitting the four economies with low literacy rates (noting that they include some of the larger populations[9] in the region), one finds a basic literacy rate of about 95-96 per cent in the other economies. This testifies to the long-standing investments in education of many economies and their developmental partners, and bodes well for utilization of any future improved telecommunications infrastructure in such economies.

Incomes vary widely; but Pacific economies tend to have moderate incomes in comparison with their Human Development Index. This report introduces the GDP Ratio,[10] an indicator of an economy's economic performance vs. overall human development. Because they have generally high basic literacy rates and life expectancies that are not low, many Pacific island economies may be considered potential knowledge economies if so supported – including with telecommunications. Pacific island economies might be cost-effective partners in knowledge-economy industries such as data entry, help desk and customer support services for the 24-hour globalized economy – if the telecommunications infrastructure were effective and affordable enough to support such industries.[11] Wireless "m-banking" and other ICT-enabled services could be implemented.

Table 1-1 indicates that the three economies with Human Development Indices below .600 are among the most populous economies in the region. This suggests that creative policies and programmes in those countries may be useful to raise overall telecommunications penetration rates for the Pacific. Such policies could include the fostering of Internet cafés, shared telephony (perhaps like Grameen Phone in Bangladesh), or mechanisms that leverage the family/clan social systems of many Pacific countries, combined with help for people in lesser developed communities to learn how to benefit from ICTs. The opportunity for developmental organizations (such as non-governmental organizations) is thus significant.

Most independent Pacific island economies have Human Development Indices in the middle-range of .59 – .79. This is a stage at which ICT use (as indicated by the Connection Index of Table 1-2) begins to take off. Many developing countries defer such issues as ICT infrastructural prioritization until education and health-care investments are delivering results. However, the Pacific island economies that have reached such a stage might logically prioritize ICT when such investments appear timely for delivering results. That time appears to be now.

---

9 That the lowest literacy rates correlate with several of the larger population centres suggests that there is considerable potential for ICT-strengthened literacy campaigns in such economies, if supportive infrastructure can be provided – perhaps by developmental partners. Aggressive literacy campaigns, as was pursued in the Seychelles, may be able to raise literacy rates as effectively as was done in that country in recent history.

10 See the column on GDP Ratio in Table 1-1, and the footnote explaining that parameter. A large number of Pacific island economies have GDP ratios well below 1.0, indicating that income is lower than proportionate for those economies' Human Development Index. The many Pacific island economies with literacy rates over 88 per cent, and GDP ratios below 1.0 could be considered potentially attractive locations for investment in knowledge "industries" or SMEs.

11 A leap into ICT mega-prosperity should not be considered an overnight process. Investments in supportive policy environments, and in developing marketable and proactive populations are part of this process. However, various factors, such as the appearance of effective catalysts can appear at any time where appropriate groundwork is laid.

Table 1-1. Population, gross domestic product per capita, life expectancy at birth, literacy, and Human Development Index for Pacific island economies

Economy	Population **		GDP *** PC PPP	Life **** Expectancy	Literacy	HDI *****	GDP ****** Ratio
	2005	2015					
American Samoa *	57,084	55,696	5800	76	97	*0.81*	0.5
Cook Islands *	21,388	22,984	5000	72	95	*0.72*	0.7
Fiji	905,949	1,023,479	6066	68	99	0.758	0.7
French Polynesia *	274,578	309,714	17,500	76	98	*0.78*	1.6
Guam *	171,019	192,302	15,000	79	99	*0.90*	0.7
Hawaii *	1,263,000	1,385,952	53,123	80	99	*0.97*	1.6
Kiribati *	105,432	128,643	2397	62	100	*0.61*	0.6
Marshall Islands *	60,422	72,139	2300	71	94	*0.62*	0.6
Micronesia *	108,004	105,183	3900	70	89	*0.61*	1.0
Nauru *	13,287	15,494	5000	63	95	*0.71*	0.7
New Caledonia *	239,067	241,731	15,000	74	91	*0.79*	1.3
New Zealand	4,195,729	4,395,567	23,413	79	99	0.936	1.0
Niue *	1,733	n.a.	3600	70	95	*0.78*	0.3
Norfolk Island *	1,828	n.a.	27,000	78	99	*0.93*	1.0
Northern Mariana Is *	82,459	100,286	12,500	76	97	*0.84*	0.8
Palau *	21,492	22,577	5800	70	92	*0.76*	0.6
Papua New Guinea	6,002,079	6,789,589	2543	56	57	0.523	1.1
Samoa	183,308	177,195	5613	71	99	0.778	0.6
Solomon Islands	552,438	679,635	1814	63	77	0.592	0.6
Timor Leste	1,062,777	1,269,603	1033	56	59	0.512	0.5
Tokelau *	1,403	n.a.	1000	67	94	*0.63*	0.2
Tonga *	114,689	131,199	8694	70	99	*0.81*	0.7
Tuvalu *	11,810	13,676	1100	68	98	*0.67*	0.2
Vanuatu	217,955	235,949	3051	69	70	0.670	0.7
Wallis and Futuna *	16,025	17,367	3800	69	95	*0.71*	0.5

* Economies so marked lack a UNDP computation for Human Development Index. Presented values of HDI, using data from a variety of sources, are modelled by the author after the UNDP approach. Other parameters in this table also use data from a variety of sources.

** Data from censuses, and estimates for 2005-2006 and 2015 populations.

*** Gross Domestic Product, Per Capita, corrected for Purchasing Power Parity.

**** Life expectancy at birth.

***** Human Development Index. Where given in three decimals, the figure is from UNDP (2006). Where in two decimals, the figure is modelled by the author (Hastings, David A., 2007. Enhancing the Human Development Index. In preparation.).

******* GDP Ratio is the ratio of measured GDP per capita to the GDP per capita proportional to an economy's Human Development Index. For example, Samoa's GDP per capita is reported at US$6,823 in the 2006 Human Development Report, but the GDP corresponding to a GDP Index of .776 is about US$10,600. Thus Samoa's GDP ratio is 6823/10600 = .64. With Samoa's high literacy rates and low GDP/capita, Samoa might be a good location for a knowledge-industry SME, given adequate connectivity.

IV. The Connectivity Situation

Many indicators of connectivity are hybrids attempting to describe: (a) conditions conducive to connectivity (such as literacy), and (b) actual connectivity performance (e.g., users). Besides being difficult to assess, such indicators often are forced to omit many economies, for which data is lacking. This study offers a relatively straightforward Connection Index, which: (a) focuses solely on user connectivity, and (b) includes most Pacific island economies by sometimes using diverse data sources where data from The International Telecommunication Union may be lacking. In addition, another indicator of Internet development is presented for most Pacific island economies. Assessment of that index illustrates potentially useful patterns of Internet development and use among Pacific island economies.

Table 1-2 introduces the Connection Index,[12] a simplified indicator of basic connectivity. It sums telephone and Internet use, where telephone use is averaged between fixed and mobile use. Like other indicators, this is imperfect, as it may not be fully consistent between economies. Some economies may be characterized by many users sharing access through Internet caf□s, or at their workplaces, whereas in other economies people may have multiple accounts (e.g., one at work, one at home and one on a mobile phone). Nevertheless, it may be a useful framework for tentative use, and improvement – and as reliable as other indicators may be in the evolving effort to describe the developmental situation of ICT.

Table 1-2. Internet and phone use, and Connection Index for Pacific island economies[13]

Economy	Connection Index[14]	Internet Use	Mobile Use	Wired Use
American Samoa	**25**	10.0	4.0	26.0
Cook Islands	**41**	20.0	8.0	34.0
Fiji	**22**	7.2	16.8	12.4
French Polynesia	**49**	21.5	34.0	20.9
Guam	**103**	47.9	59.4	50.9
Hawaii	**126**	69.3	65.0	48.0
Kiribati	5.3	2.4	0.7	5.1
Marshall Islands	8.2	3.5	1.1	8.3
Micronesia	**25**	12.6	12.7	11.2
Nauru	17	2.3	13.0	16.0
New Caledonia	**72**	32.1	56.7	23.0
New Zealand	**125**	58.9	87.6	45.1
Niue	**95**	52.9	22.0	62.0
Norfolk Island	**112**	42.2	0.0	139.0
Northern Mariana Islands	**46**	12.7	26.6	40.0
Palau	**28**	8.9	5.0	33.0
Papua New Guinea	3.7	2.9	0.4	1.1
Samoa	13	3.3	13.0	7.3
Solomon Islands	1.6	0.8	0.2	1.3
Timor Leste	1.6	0.2	2.5	0.2
Tokelau	10.8	n/a	0.0	21.6
Tonga	17	3.0	16.4	11.3
Tuvalu	16	12.5	0.0	7.0
Vanuatu	7.9	3.5	5.8	3.1
Wallis and Futuna	12.1	5.9	0	12.4

The most-connected economies in the Pacific include Guam, Hawaii, New Caledonia, New Zealand, Niue and Norfolk Island, while American Samoa, the Cook Islands, Fiji, French Polynesia, the Federated States of Micronesia, the Northern Mariana Islands and Palau are "middle-connected".

[12] Introduced by Hastings, David A., 2006. Asia-Pacific connectivity: current situation and prognosis. Bangkok, Thailand, United Nations Economic and Social Commission for Asia and the Pacific; Asia-Pacific Journal on Information, Communication and Space Technology: Reviews and Updates, Vol. 1, pp. 13-60.

[13] Internet, mobile and wired telephone use is in percentage of inhabitants. The number of accounts may exceed the number of inhabitants (e.g., if a person has more than one SIM card or phone, perhaps at home and in the office). Figures from International Telecommunication, or other sources when ITU data were not found – for recent years.

[14] Connection Index = Internet Use + (Mobile + Fixed Phone Use)/2.

A. Communication Satellites

Information on satellite connectivity is presented in Appendixes A and C. Most Pacific island economies have external satellite communications links. Many Pacific economies utilize satellites for domestic connectivity, which might be supplemented by cable, wire, wireless or radio communications. However, the bandwidth available, and associated costs, have tended to dampen telecommunications growth.

Several satellites offer communications and Internet connectivity to the Pacific. None of those satellites currently in use was designed specially for Pacific island States, but rather are more suitable for international communications over broad areas. The low power densities of such satellites require large Earth stations offering limited bandwidth, but requiring high cost of installation and maintenance in storm-susceptible areas. Such expensive bandwidth has discouraged stakeholders from more widely utilizing satellite communications for smaller markets.

More recent satellites, on the other hand, may have shaped or spot beams covering target areas with higher power density, so that inexpensive user terminals may be installed at community, business, or even household levels, providing affordable bandwidth where appropriate policies and services are in place. However, current usage and slow growth rates may discourage satellite service providers from designing and deploying greater capacities at lower costs for the Pacific. Similarly, the belief that the cost of developing and operating their own satellite would be prohibitive may have discouraged the Pacific islands from considering such an option.

In addition to C-band systems, recent developments have led some other parts of the world into Ku- and Ka-band satellite communications, offering higher bandwidth (e.g., throughput) through smaller and less expensive ground stations. Most recently, Internet Protocol (IP) Ku/Ka-band satellite communications have begun serving North America and Asia with ANIK-F2 and WildBlue-1 (Ka band) and IPStar (Ku band for user terminals, Ka band for hubs), respectively. WildBlue Communications markets ANIK-F2 and WildBlue-1 as an economic means of connectivity for rural residents, SMEs and telecommuters in the United States. IPStar provides Internet Protocol satellite connectivity marketed in Asia, and will be used by Thailand in implementing its universal service obligation. It has noted that retail services (which it leaves to business partners to provide) may cost as low as US$50/month – making it competitive with completely unregulated DSL (digital subscriber line) markets elsewhere. However, such services are new, and do not yet serve most of the Pacific.

Meanwhile, very small aperture terminals (VSATs) are available to parts of the Pacific Ocean area, at retail costs below US$130/month as shown (plans with an "R" code) in Table 1-3. A full transponder can cost about US$100,000 – US$150,000/month (or sometimes substantially less for longer-term and larger-volume lease).

Note the lower costs for retail offers (which may be for a maximum bandwidth that may not be sustained if a customer actually tries to use the maximum for sustained periods), and the higher amounts paid by telecoms operators (which are normally for a contracted-for higher level of performance). Note the increasing costs per Megabits/second for larger retail plans (perhaps because larger users may be more likely to use a higher proportion of their planned bandwidth), but there is a tendency toward lower costs per Mbps for operators, as they are more likely to enter into longer-term contracts, for one or more full transponders, at higher usages. This indicates the potential for South Pacific neighbours, near Tonga, Samoa, and Vanuatu, to form a user consortium to lease one or more full transponders, for considerable potential savings for each operator in such a consortium. States in the North Pacific may be able to do similarly.

For telecoms access "now" for 230 populated islands lacking telecoms,[15] mobile satellite telephony might be useful. The Iridium satellite phone system has global coverage, including Pacific islands, supporting voice, SMS and data transmissions. Solar chargers are available. One may purchase a new Iridium phone handset for about US$1375, and a used handset for a lower price, with prepaid rates of about US$1/minute anywhere in the world to a fixed-line or mobile phone, or about US 50¢ (50 cents) to another Iridium phone. These rates are available if one prepays[16] for the air time, and are retail rates. Negotiated bulk agreements for one or more States might reduce such costs. A Grameen Phone arrangement, in which one person/office contracted for the phone and air time, then retailed the access to other island residents, might share call volumes to reduce rates. Thuraya's ECO service[17] notes calling rates of 20 cents/minute to another Thuraya phone, 39 cents/minute to other systems' phones. It plans to begin service to the Western Pacific in 2008, and normally provides service to national markets in partnership with local service providers – thus offering the potential for reduced international calling and universal service, while offering revenue potential to local service providers.

Table 1-3. Retail offers (upper half – with "R" code), and costs to telecom operators (lower half) for more reliable satellite bandwidth

Plan		Kbps Down	Kbps Up	US$/Month	US$/Month/ Mbps
Home[18]	R	128	42	127	508
Business[17]	R	256	64	165	660
SAT Pro[17]	R	512	128	173	346
Corporate[17]	R	1,024	512	605	1,210
SAT Biz+[17]	R	1,024	1,024	1,512	1,512
SAT Biz++[17]	R	1,024	1,024	2,149	2,149
SAT ISP[17]	R	2,048	2,048	5,821	2,910
Telecom Niue[19]		2,048		16,000	8,000
SES New Skies NSS-7 Ku-band transponder[20]		54,000		150,000	2,778
OPT[20] and TCI[21]7Direct-to-Home/Office		84,000		250,000	2,976
OPT[20] and TCI[20] Phone		108,000		208,333	1,929
New Caledonia[20]		300,000		250,000	833
OPT[17] and TCI[20] Internet		300,000		250,000	833

---

15 According to the Pacific Islands Telecommunications Association (PITA).

16 See http://www.outfittersatellite.com, http://www.globalcomsatphone.com, http://www.blueskynetwork.com, and several other vendors for various rate plans and promotions.

17 http://www.thuraya.com/content/prepaid.html.

18 The website http://www.satsig.net/ivsat-asia.htm is a compendium of offerings of Asiasat and SES New Skies C- and Ku-band capacity.

19 Data for Telecom Niue, New Caledonia, OPT and Telecom Cook Islands reported informally at the 2007 Annual General Meeting of the Pacific Islands Telecommunications Association (PITA), Papeete, French Polynesia.

20 http://www.foundation-partnership.org/pubs/bandwidth/index.php. These rates for leasing a full 54 mHz transponder on SES New Skies NSS7 satellite can be reduced "considerably" with longer-term contracts – e.g., three-years' duration. NSS-5 provides service to the Pacific, but available NSS-7 prices may be roughly comparable.

21 The Office of Post and Telecommunications (French Polynesia) and Telecom Cook Islands have joined in a consortium to lease and share transponders together. This might slightly reduce net costs for French Polynesia, and significantly reduce costs for the Cook Islands, through economies of scale.

B. Undersea Cables

Cable infrastructure is itemized in Appendix A. Table A-2 records historical, current and announced (with some public documentation) cables serving Pacific island economies. It omits cables running solely between the Americas and Hawaii, between the Asian mainland and Japan, the Philippines, Indonesia, and between Australia and Asia via the Indian Ocean. Due to inadequate information, it also omits the proposed Pacific Island Cable System by Cable and Wireless, announced as intending to connect almost all island economies[22] with Australia. Table A-3 depicts the cable and satcom international traffic for 2004, 2000, and 1996 to, from, or transiting the United States, as reported by the United States Federal Communications Commission. Table A-4 and Figure A-5 depict growth in submarine digital cable bandwidth. Table A-5 and Figure A-6 depict growth in cable and satellite connectivity in the Pacific, and the Eastern Caribbean area of small island economies. Though this does not describe all traffic for the Pacific island economies, it is a reliably documented indicator of relative traffic and growth thereof. In Appendix A, Figure A-4 maps currently active undersea cables,[23] plus discontinued cables that could be deployed (see Table A-2), as well as planned cables included in Table A-2. Figure A-4 also shows a bathymetric map of the Pacific, to enable planners to envision where cables might be most accessible – for possible splicing of additional loops linking additional island economies.

External cable connectivity includes Fiji, Guam, the Northern Mariana Islands, and Papua New Guinea. The Federated States of Micronesia and the Marshall Islands are building a cable to Guam. Though several economies are near the Southern Cross Cable Network, and close to Fiji's Southern Cross landfall, no nearby country has built a local loop to those communications media to date. The example of the SAT3/WASC/SAFE cable around Africa, described in Appendix B2, is an intriguing business, connectivity and service model for the Pacific to consider.

The scientific community has developed a strategy for reusing retired cables, especially first-generation fibre-optic cables. Papua New Guinea used such an approach to redeploy part of the PacRimWest cable to Port Moresby in 2006. This pioneering effort might give other countries ideas about doing similarly. These developments are described Chapter 3.

Internal connectivity is improving in several Pacific island economies. Several of these have begun installing buried fibre-optic cables to replace or supplement copper wire. Others are installing VSAT or other satellite connectivity to remote locations, as partly summarized in Table B-1, Appendix B. Digital switching has also been installed in several urban areas in the Pacific. However, analogue switching, old copper cable, and analogue mobile telephones (or no mobile service) characterize several parts of the Pacific.

C. Terrestrial Wireless

Terrestrial wireless only meant two-way radio, broadcast radio and television until recently. Mobile telephony is becoming popular in some Pacific states, increasingly so with the conversion of first-generation analogue systems to digital technology earlier this decade in many economies. However, the future is likely to see considerable growth in terrestrial wireless, for trunking in some amenable locations, and for end-user connectivity in many locales, partly owing to upgraded 21st-century approaches to radio.

---

22 American Samoa, Cook Islands, Federated States of Micronesia, Fiji, French Polynesia, Guam, Kiribati, Marshall Islands, Nauru, New Caledonia, Niue, Northern Mariana Islands, Palau, Papua New Guinea, Pitcairn Island, Samoa, Solomon Islands, Tokelau, Tonga, Tuvalu, Vanuatu, Wallis and Futuna.

23 Figure 2-3 maps most of the active cables in Table A1.

In many cases, small islands may be amenable to new forms of wireless networking such as WiFi, WirelessLAN, WiMax, or WiBro. WiMax can reportedly serve an area of up to about 10,000 square kilometres from one fibre-optic or VSAT node. These can thus greatly increase the coverage around a cable landfall or VSAT installation.

Niue is using wireless LAN to provide gratis non-commercial Internet to its residents and visitors. Presumably, this could offer Voice-over IP connectivity as an alternative to Niue's analogue cellular phone system and old copper wiring. Such networking may in the future provide entertainment, public safety, distance learning and medicine, and other forms of direct-to-home communication via solar-charged notebook computers even in homes lacking electrical wiring (or after a failure of the electrical system, say, in a storm).

Tonga is using GSM-VSAT-IP-based system, with wireless and VSAT between islands. Palau has fibre-optic domestic networking for telecommunications, including cable television, while international connectivity is via satellite.

V. The Policy/Regulatory Situation

Appendix C summarizes several aspects of the policy/regulatory environment of Pacific island economies. Most, but not all, economies have laws and policies related to telecommunications. However, many of these pre-date the explosive impact of the Internet, mobile telephony, and broadband on telecommunications benefits to society. The regulatory and ownership status in many Pacific island economies remains uncompetitive, though a number of discussions and actions have moved toward increased competition in some Pacific economies.

One of the most challenging concerns regarding enhancing Pacific connectivity is the monopoly situation in telecommunication services in several Pacific developing countries. Governments have had long-term grants of monopoly status with some service providers to protect profits from their investment and services. Prior to the current explosive penetration and development of information and communication applications and services, such agreements were considered reasonable for attracting investment in telecommunication infrastructure and relevant services provision. However, recently, the rapid transformation of information and communication services has been considered a major driving force in socio-economic development, and the "digital divide" has been considered a major gap to be filled through joint efforts of government, the international community, development agencies and civil society. As indicated by many studies, lack of enabling competitive environments has hindered the growth of information and telecommunication services and applications in parts of the world where such competition is lacking – including the Pacific. Such monopoly arrangements may further obstruct development in Pacific island States, which need broader-based cooperation and investment for success. The experiences of the Eastern Caribbean Telecommunications Authority (ECTEL, see Appendix B3) in dealing with their inherited monopoly situations may provide a useful example for the Pacific to consider.

It is noted that regulators and service providers have often for several years been separate entities,[24] though both may be government-influenced. The Internet Root-Zone Whois Information of Appendix C indicates that many Pacific States refer to offshore technical expertise, while others (even ones with relatively small populations) cite domestic points of contact for both administrative and technical matters – thus keeping the knowledge generated from at least initial contacts within the country.

[24] http://www.bizconnections.com/pacific_telecom_regulators.htm.

Such an environment may come at a cost. Costs for Internet and mobile telephone access tend to be higher in Pacific island nations than in peer small island economies elsewhere, even when adjusted for income status.[25] Professor James McMaster describes advantages for deregulating telecommunications markets in the Pacific,[26] as does Naruse.[27] McMaster estimates benefits to consumers in 13 Pacific island economies to be about US$66 million annually. If one extended this to the other economies included in this report, by rough extrapolation by population, perhaps US$400 million might be saved over five years. Costs/challenges might include slower roll-out of some services to rural customers distant from population centres, reduced market power by incumbent single [monopoly] providers, and the need for such providers to reform for improved efficiency and customer focus, and the need for improved regulatory structures to protect otherwise marginalized customers. Benefits might include reduced tariffs, increased efficiency and customer focus of providers even in some rural areas, introduction of new services, including mobile telephony and Internet, better and more affordable Internet access for e-learning and other benefits, better and more affordable governmental services to the public, local businesses becoming more competitive in the global marketplace, new opportunities for local business in the global marketplace, increased governmental revenue from a more rapid growth of total ICT revenue, and capital savings that can be reinvested in improved capabilities.

Zwimpfer Communications (2002, for UNESCO) addresses additional aspects of governance, specifically related to the Internet. ECTEL[28] provides a case example of the benefits of such deregulation, which Pacific island economies may wish to adapt for their own benefit.

John Ure (2004, p. 3, see references at the end of this report) notes that "not all telecom markets are elastic, yet evidence . . . suggests that the growth potential is enormous". Ure notes that the public sector has several roles to play:

(1) In the area of institutional and policy reform;

(2) Planning and capacity-building, including coordination between stakeholders;

(3) Regulatory reforms to ensure consistency of regulations;

(4) Provision for universal access, and tackling the digital divide through the encouragement of the adoption and diffusion of ICTs;

(5) Large-scale infrastructure projects, such as backbone and technology park initiatives;

(6) Noting that telecom markets in many areas are elastic, to have policies and regulations that avoid becoming locked into traditional yet unsustainable business models of incumbents – rather becoming flexible enough to take advantage of market elasticity.

---

25 Exception: The low-income Pacific island States of Papua New Guinea and the Solomon Islands have relatively low Internet access costs for their income group.

26 McMaster, James, 2005. Costs and Benefits of Deregulating Telecommunication Markets in the Pacific. Pacific Studies Series, Volume 3, Working Papers: Working Paper No. 15. Suva, Fiji, University of the South Pacific (for the Asian Development Bank, Commonwealth Secretariat, and Pacific Islands Forum Secretariat). 60 pp. http://www.pacificplan.org/tiki-download_file.php?fileId=142.

27 Naruse, Yuki, 1999. Competitive Undersea Cable Policy. M.S. Thesis, Massachusetts Institute of Technology. 82 pp. http://itc.mit.edu/rpcp/Pubs/Theses/yuki.doc.

28 Eastern Caribbean Telecommunications Authority, 2006. ECTEL Fifth Anniversary Magazine. Castries, St. Lucia, ECTEL. 42 pp. http://ectel.int/ectelnew/latesnewsdoc/ECTEL%20Mag%20HIGHRES.pdf. Eastern Caribbean Telecommunications Authority, 2006. Socio-economic Impact of Liberalization of Telecoms Sector in the ECTEL Member States. Castries, St. Lucia, ECTEL. 93 pp. http://ectel.int/ectelnew/latesnewsdoc/Socioeconomic%20Impact%20of%20 Liberalization%20of%20Telecom%20Sector%202005.doc.

Ure also notes that wise implementation of ICTs in developing countries often results in net increases in exports over imports for those countries, e.g., through increased access to previously unknown SME products and services to a new overseas market. This counters some fears, and offers hope for additional net benefits from carefully considered ICT developments.

VI. The Institutional Situation

Pacific island economies tend to be improving their telecommunications competitiveness. They fall between leaders and less developed economies. Privatization is ongoing, but relatively slowly. ICT infrastructure is developing, but still lagging behind many countries with similar levels of Human Development Index. Some of this is due to relatively high costs compared with incomes for telephone installation, monthly charges, calls, Internet, and other services. Much old infrastructure remains, though buried fibre and copper are becoming somewhat more common within economies. Radio communications are still vital for reaching almost half the islands of Pacific economies – those that are generally more rural than their better-connected siblings. However, an impressive trend appears to be underway to connect several countries with undersea cables – notably Micronesia, the Marshall Islands, Papua New Guinea (with its pioneering redeployment of cable from PacRimWest to its new APNG-2) and New Caledonia.

Fixed-line telephone growth is generally low in the region, with little growth in the last several years. Where service is largely acceptable in urban areas, many rural areas remain disconnected, and others are marginally served. According to Guild,[29] taking demographics into account, most urban residents have telephone access. Urban fixed-line penetration has been estimated at 2-10 times that of rural areas.[29] Fixed-line density is about 50 per cent in Guam and Niue, but ranges to less than 2 per cent in Papua New Guinea, the Solomon Islands and Timor Leste (with a combined population of about 7.5 million people).

Modest numbers of radio and television stations exist in the Pacific, with few countries lacking local radio or television. Broadcasting infrastructure tends to be basic and analogue, however.

The Pacific recently saw a major shift from analogue to GSM mobile telephony, and to lower-cost prepaid systems, which have been received favourably by the public. Mobile telephone growth has been strong in several areas, with penetration rates of over 50 per cent in Guam, New Caledonia, and (very recently) Samoa. However, mobile penetration remains below 10 per cent in 13 economies. Mobile phone penetration exceeds that of fixed lines in Fiji, French Polynesia, Guam, Micronesia, New Caledonia, Samoa, the Solomon Islands, Timor Leste, Tonga and Vanuatu. Some of this success is due to competition, or increased competitiveness in the approaches of service providers. Internet penetration is over 50 per cent of the population in Niue (where it is free) but less than 1 per cent in the Solomon Islands and Timor Leste.

The Internet is one arena with growing competition, with six countries having a choice of ISPs in 2004. Increasing numbers of governmental organizations are building websites and delivering information to citizens and other stakeholders. In many countries, at least a few local companies are also serving local users on the web, with information portals, news (web-based versions of publications for residents and expatriates), banking services, and the like. Some countries with popular domain names have thousands of websites under their top-level domains – many of these highly commercial – a few of them genuinely popular. Some economies with potential, such as Micronesia (.fm) and Tonga (.to) have fewer popular websites than might be expected, whereas at least one country with an apparently routine domain name (Samoa, .ws) has many popular websites.

---

[29] Robert Guild at http://www.digital-review.org/03_Pacific_Island_States.htm.

Although some of Papua New Guinea's telecommunications deregulation has fallen behind schedule, Telikom PNG has been reported to be taking anticipated competition seriously. It has reportedly invested in training on new management approaches, and has taken several initiatives, including building a pioneering new undersea cable, and upgraded and extended satellite communications infrastructure. Telikom PNG's pioneering example of the APNG-1 cable, and its aggressive rolling out of promotions to use the increased bandwidth coming from this cable, may help schools, hospitals and NGOs to use such services.

In addition to the high prices of entry and access to telecommunications bandwidth and other services, economies and residents of the Pacific are considered to face challenges in limited international bandwidth in countries lacking international cables, legacy regulatory frameworks, sometimes unreliable power supplies, limited support personnel, and limited technical savvy among the populace for developing and supporting applications and services.[29] Despite such a tone, conditions are improving. Several formerly novel technologies are considered current necessities, at least among the urban middle class.

The Pacific has had various cooperative forums, organizations and other initiatives that have addressed Pacific-wide cooperation, in subjects such as telecommunications. Many such institutions have produced declarations of commitment, policy frameworks, or other agreements. Challenges have been realized in taking such outputs to the next stages of positive outcomes, where others had only the agreement, and the understandings leading to the agreement, as the outcome. In other cases, such as USPNet, discussions and agreements led to the development of institutions which have served the Pacific well, in their designated areas of activity – and in some cases serve as stepping stones for the next steps (in this case, for possible Pacific-wide videoconferencing, for any number of purposes).

The most recent wide-ranging agreement on Pacific-wide cooperation in development is the Pacific Plan. Under this umbrella, Pacific leaders have called for the serious challenges facing the countries of the Pacific to be met through sharing scarce resources and aligning policies to strengthen national capacities to support their people. The Pacific Plan was developed through broad-based national and regional consultations, and was endorsed by leaders at the Pacific Islands Forum meeting in October 2005. The Pacific Plan includes regional organizations, non-State actors and development partners.[30]

One element of the Pacific Plan is its Digital Strategy.[31] At the Pacific Islands Forum Information and Communications Technologies Policy Meeting in Wellington, New Zealand, on 28-30 March 2006, participants agreed to establish a Task Force to investigate the potential for developing regional approaches to ICTs to further implement the Digital Strategy. The Task Force is to analyse the benefits to be gained from regional cooperation, investigate the full range of issues and modalities related to developing such regional cooperation, and investigate the potential of regional approaches in using ICTs for improved health and educational outcomes. The Task Force will consider priority areas, whether regional approaches will be effective in each area to be considered, and the shared concerns where the region might make the most useful gains from a shared approach.

In the realm of telecommunications, the Pacific has numerous governmental and private sector entities, including non-governmental actors, and also development partners among nations and international organizations. Many of these are summarized in Appendix B of this report.

---

[30] http://www.pacificplan.org.

[31] http://www.pacificplan.org/tiki-page.php?pageName=Digital+Strategy.

One parallel, and potential developmental partner, is the Eastern Caribbean Telecommunications Authority, mentioned several times in this report. It is interesting that discussions were initially widespread, but that some economies decided to forego their participation, at least for the meantime, in ECTEL. This did not cause ECTEL to be stillborn. The organization forged ahead with the economies committed to acting then, while continuing to dialogue with those economies that (for whatever reason) had not participated from the outset. There are reports that at least one of those initially non-participatory States is considering if it should now join ECTEL, when, and under what conditions. Thus, in the spirit of the Pacific Plan being a living entity, with living documents, participation in ECTEL began with the then-interested parties, without waiting for the then-reluctant parties, while continuing to dialogue and show an open door to those economies that were not participating at any one time. Several years later, parties appear to be satisfied by this approach.

VII. A Vision

Communities in the Pacific will be, at long last, well-served by access to information and communication products and services in a competitive environment that gives them a choice of mobile, Internet and other services. Major population centres, and outlying areas alike, are connected through a variety of means. These means include submarine fibre-optic cables, communication satellite terminals and phones, and wired, microwave and WiMax wireless networking. Peoples can prioritize between individual/household accounts, or shared access through Internet caf□s, special mobile service packages such as Grameen Phone's Village Phone,[32] or community e-centres. Community e-centres can provide mini- "stadium-like" atmospheres for global sporting events, mini- "cinema-like" atmospheres for films, as well as individual and small-group access for education, small business (including medical consultancy), and entertainment. Through various means, many people have become e-entrepreneurs, making money by providing e-business services of various types.

For various reasons – often summarized as "little business potential" – the Pacific has fallen behind its developmental peers in benefits from the current revolutions in information and communications. The Introduction to the Pacific Regional Digital Strategy states, "Numerous studies have highlighted both the potential of, and impediments to, 'ICTs for every Pacific Islander'. The Communication Action Plan (CAP) and Pacific Islands Information and Communications Technologies Policy and Strategic Plan (PIIPP) have recently made clear recommendations on actions required for ICTs to reach potential in the region. However, countries have been less than successful in following these recommendations due to challenges such as scale, institutional capacity and isolation".

This statement no longer need be true. Parallels exist in Eastern Caribbean and African States. Some small island States are taking a variety of initiatives, which are delivering results. There appears to be a window of opportunity, and potential "best practices" and advisers/coaches in virtually every part of the connectivity process.

Several recent developments, summarized in this report – including the appendixes – may be synthesized toward the following vision:

1. Pacific island economies are diverse and widely separated. Many are near pathways for undersea telecommunications cables between Australia, New Zealand, the Americas and East Asia. In the past, commercial "clubs" co-financed the costs of laying and managing cable services. Now de-regulated, pro-active telecommunications providers in developing countries have joined to finance the laying of new cable systems connecting previously underserved economies in West

[32] http://en.wikipedia.org/wiki/Grameen_Phone.

Africa and the Indian Ocean. At least one developing country (Papua New Guinea) has built upon academic community proposals for redeploying decommissioned first-generation fibre-optic cabling. Other economies (Palau, Micronesia, Marshall Islands and New Caledonia) previously considered small or distant have committed to domestic or international cable backbones. Yet others are close enough to link up with current or possible near-future fibre-optic infrastructure for international or domestic fibre-optic backbone development. A possible system is sketched and "mapped" in Section 2A.

2. Satellite communications have been dominated by relatively low-bandwidth C-band systems; although they are fairly reliable (e.g., in rain storms), commercial systems currently used by Pacific states are not optimized to serve this market, so available bandwidth is expensive. Elsewhere in the world, Ku- and Ka-band systems are serving small, scattered communities with broadband direct-to-home/business models. WildBlue has been providing price-competitive rural connectivity in rural North America, using the Anik F2 and WildBlue-1 satellites. Shin Satellite, through nationally based retailers, has been pursuing a similar model for Asia but not yet for most of the Pacific. Very small aperture terminals have been cornerstones of domestic satellite communications in recent years, and have considerable potential in the Pacific. In the 21st century, video conferencing has great potential Pacific-wide for cost-effective meeting management in the public and private sectors. Strategically placed communications satellite connectivity can now be designed at lower costs, and/or greater capacity, to provide Pacific-wide service with satellite broadcasting, network feeds, video conferencing, telephone and IP services (including content such as weather forecasts and the support of tourism cooperatives). It could also support knowledge work in the Pacific, such as the staffing of call centres and help desks. Such a system is also sketched in Section 2C and figures 2-5 to 2-7.

   While working with potential partners to design and implement a Pacific-optimized communication satellite, Pacific economies might "immediately" reap economies of scale by leasing full transponders as consortia, rather than smaller amounts of bandwidth per State. For example, retail costs for VSAT bandwidth include US$605/month for 1024 Kbps downloads and 256k Kbps uploads in the Pacific (compared to US$19 for similar connectivity for a cable-backed ADSL (asymmetric digital subscriber line) retail residential customer in Thailand). A recent rule-of-thumb is US$2000 per megabit, uploading or downloading. However, a full 50-84 Mbps transponder might cost US$120,000+/month, with partial transponder leases costing 20-40 per cent higher.[33] As French Polynesia and the Cook Islands joined forces to share several transponders among their combined population of ~300,000, several countries[34] could form consortia to share one or more transponders at similar rates. Several Pacific economies might be able to significantly cut their wholesale costs and/or increase the amount of bandwidth that they could afford – and thereby increase their markets and beneficiaries.

[33] http://www.viasat.com.

[34] Conceivably, American Samoa, Fiji, New Caledonia, Niue, Samoa, the Solomon Islands, Tokelau, Tonga and Vanuatu (total population over two million – seven times that of the French Polynesia and Cook Islands consortium) might be able to share a transponder, say, on SES New Skies NSS-5 or an Intelsat satellite. Similarly, the Federated States of Micronesia, Guam, at least parts of Kiribati, the Marshall Islands, Nauru, the Northern Mariana Islands, and Palau (total population 561 thousand – twice that of the French Polynesia and Cook Islands consortium) might be able to join forces.

3. Whatever the case, Pacific decision-makers faced with a bewildering diversity of potentials, opportunities, and possibly opportunists not always with public interests at heart, may benefit from having expertise that they could rely on to assist their decision-making. Small economies can federate, somewhat along the lines of the Eastern Caribbean Telecommunications Authority, in order to provide a more level playing field for all stakeholders in a modern telecommunications infrastructure for the Pacific. They may also be able to free themselves from untimely (and even potentially unconstitutional) monopolistic concessions previously agreed to under non-ideal circumstances. Potential elements for such federation already exist at governmental, service provider, and user levels in several sectors. Whether these may be nuclei for stronger, broader, cooperation, or whether new institutions may be useful in such process, remains to be seen.

Chapter 2

Technical Viability[1]

I. Introduction

The telecommunications landscape is changing rapidly, in technical, economic, and institutional arenas. This section concentrates on technical options that could strengthen the Pacific.

Many considerations should be addressed when designing new, comprehensive, systems. This is certainly true in the Pacific, where investments have already been made in such technologies as: (a) over-the-air and/or cable broadcasting, (b) two-way radio communications for outlying areas, (c) C-band satellite communications infrastructure between metropolitan areas and internationally, (d) analogue or digital microwave mobile telephone services, and (e) copper and limited fibre-optic cabling. How much of such infrastructure should be expanded or at least maintained – long-term or for transitional periods? How much of such infrastructure should be replaced – quickly or in the longer term?

To dispel such apprehensions, the (admittedly early) experiences reported by the Eastern Caribbean Telecommunications Authority, and by other small States such as Mauritius, is that new technical opportunities, coupled with new business/service models, offer unprecedented opportunities for small island economies to benefit from improved telecommunications.

II. Technical Options for the Pacific

Findings from this study result from a synthesis of previous studies on different aspects of telecommunications infrastructure development, strengthened by additional context from socio-economic analysis of all Pacific island economies; compilation of information from sources on connectivity in the Pacific; relatively new perspectives on redeploying surplus cable capacity; and new developments in satellite communications and wireless networking.

Connectivity infrastructure may be broadly categorized as wired, terrestrial wireless, and satellite. Each of these different types of "pipe" has traditional analogue, narrowband digital, and broadband digital capabilities, and can provide broadcasting, telephony, Internet and conferencing services. Technical options include those shown in Table 2-1.

Wired connectivity has evolved from copper to fibre-optic cable, though new technologies have prolonged the life of copper in the "last mile" through the use of digital subscriber line (DSL) technology. Although previously considered unaffordable for small Pacific island economies, undersea fibre-optic cable is nevertheless considered highly desirable for its cost-effective and relatively reliable bandwidth. Although relatively few small Pacific island economies formerly benefited from broadband cable connectivity, this situation is improving as several cable projects are underway. Several more countries are near to existing or planned cable nodes – offering the potential to build short, potentially affordable, extensions to serve their people.

[1] This chapter was written by David A. Hastings and A. Bhaskaranarayana.

Terrestrial wireless connectivity used to mean two-way radio, shortwave and AM/FM radio and television. It now adds mobile phones, and in some countries, between-island microwave backbone and/or WiFi/WiMax end-user connectivity. Mobile devices are growing in popularity at the fastest rate among ICT tools in much of the world, and should be seriously considered for their lower cost and greater reliability, in comparison with personal computers, and rapid enrichment as end-user ICT devices.

Satellite communications provided a leap forward in Pacific connectivity about three decades ago. Since then, costs have dropped somewhat, and C-band connectivity has been adapted for digital as well as broadcast capabilities. However, the recent revolution in cost-beneficial satellite broadband, coupled with great improvements in terminal performance/cost, has not yet substantially benefited the Pacific. A no-frills satellite communications service model, designed to maximize service/cost for the Pacific, now appears possible and may be able to significantly improve the financial sustainability of such a service. In the short term, Pacific States may wish to form user consortia to negotiate grouped bandwidth (at lower rates for the consortium than may be achievable individually by the States).

Table 2-1. Technical options for Pacific connectivity "pipes": a summary

Pipe Media	Media Details	Generalized Description
Wired	**Fibre-optic cable**	This is the most desired and cost-beneficial connectivity for sufficiently large markets. The market size necessary for cable appears to be dropping, making cable possible for increasingly small communities. First-generation cable is being retired due to excess capacity in the marketplace. Redeployment of such cable may be an affordable opportunity for small markets.
Wired	**Copper cable**	This might be largely obsolete for international connectivity. Where already installed, this might be maintained, awaiting replacement by fibre, wireless or broadband satellite. In some communities, DSL over copper may justify installing or upgrading the copper infrastructure for such a purpose.
Terrestrial wireless	**Microwave wireless phone, WiFi, WiMax, Wireless LAN,etc.**	The revolutionary connectivity brought by WiFi/WiMax has been extended to several kilometres from each transmitting node. Such approaches enable a single transmission node (satellite terminal or broadband cable) to cover larger dispersions of people – thus making them more cost-effective. Microwave, limited by its relay requirement for every 50 km, could be used as backbone connecting neighbouring areas.
Wired	**Terrestrial two-way radio**	This "pipe" may be the least capable and reliable option today, but has long served distant, dispersed populations with basic telecommunications. Where other means become cost-effective, this might be replaced. However, modernized two-way radio, including amateur radio, may continue to serve communities for years to come.
Satellite	**Communication satellites**	For an appropriately located satellite, this can bring "universal service" more practically than cable where populations are widespread. Existing C-band services are reliable, and may be worth continuing for high-reliability needs, though a satellite phone might also provide basic backup at lower cost in some locations. Newer Ku-band may be lower-cost for higher bandwidth yet adequately reliable for Pacific island environments – for all but the most essential basics. New approaches suggest that a dedicated satellite for the Pacific can now improve performance, yet be cost-effective. New approaches to jointly negotiating for one or more existing satellite transponders (by collectives of Pacific economies) may bring economies of scale to several countries.

III. Communication Services

A. Basic Internal and International Connectivity

Communications for Pacific island economies can be broadly divided into local communications within a community, nearby communications within an island, national trunking communications farther away in a single country, and international communications.

Local communication within a community may be accomplished by wired or wireless telephony and/or Internet. In many cases, wireless networking may be ideal for communities with little legacy wiring to support – or even when such wiring is in place. WiMax may serve cities and their surroundings, supporting flexible connectivity/networking with more types of device than traditional cellular wireless.

Nearby communications within an island may be similar if the island is sufficiently compact and flat (e.g., an atoll), but might involve trunking similar to inter-island communications if line-of-sight communication is made more challenging by distance or terrain.

National long-distance trunking is likely to involve local networks at each end similar to local communication within communities. Wired, wireless or satellite trunking can serve between communities. The choice of trunking may be influenced by pre-existing infrastructure. For example, legacy satellite communications may be expensive, low-bandwidth (adequate for current use, but perhaps inhibiting growth), and beset by latency that is inconvenient but can easily be adjusted to. Legacy copper cable with analogue switching, or two-way radio, may be of limited use for modern applications. New approaches may be worth encouraging.

International trunking may be similar to national trunking, with national networks at both ends linked by wired, wireless or satellite trunking between communities and nations. Established Pacific pipe is likely to be C-band satellite communications, other than in the few countries with undersea cable. C-band trunking may be worth replacing or supplementing with greater capacity and cost-efficient Internet Protocol trunking by cable or satellite – at least in the long term.

B. Applications

Applications include radio and television broadcasting, audio and video conferencing, including business, government and education (such as international lecturing); voice (including local and trunking services); Internet (including distributed data management and file sharing); direct-to-home/office services; e-learning including distance education; e-health including tele-medicine; e-governance/ government and public services; e-commerce and business services (including locally or globally collaborative open-source software development and support); and community services such as Internet caf□ s and e-centres carrying social/enabling services, including disaster management and entertainment.

Such applications may be grouped into the broad categories shown in Table 2-2, and may often be suitably delivered by whatever international connectivity pipe (Table 2-1) is available.

Note that services formerly associated with specific media (such as over-the-air for radio and television, copper cable for telephony and Internet) now may be delivered by a diversity of "pipes" from satellite, cable and terrestrial wireless – or combinations of these. In the end, revenues, and the delivery of compelling telecommunications products and services, will depend on creativity resulting from competitiveness and focus on customers.

Table 2-2. Generalized types of telecommunications services (ordered by current popularity)

Broadcasting (radio, television) is traditionally received via over-the-air broadcasting, but may also be accessed over the Internet (as streaming audio and video), via new mobile wireless, and via satellite. This may be via direct-to-home or cable subscriber systems. Much broadcast content is fed from content developers to service providers via satellite.
Telephony was traditionally circuit-switched over fixed telephone lines, though new wireless mobile services have surpassed fixed lines in many markets. Rapidly increasing in popularity, Voice-over Internet Protocol (VoIP) services are often economical, and may be delivered to users through fixed and mobile services, or through users' computers. Satellites have been supporting the expansion of both circuit-switched and VoIP telephony services to less-developed and remote areas. Satellite phone services cover many areas that lack alternatives. Though costs of the latter have been dropping, they are considered expensive for some users. Many parts of the Pacific are still served by two-way radio telephone, which has little opportunity to go beyond traditional voice calling or conferencing.
The **Internet** is normally delivered by copper or fibre cable to service nodes, and then to users by many approaches, such as cable, DSL, terrestrial wireless and satellite.[2]
Audio and video conferencing have been implemented in various forms, from simple conference telephone calls, to ISDN and Internet-based video conferencing. Satellite-based systems have also been used, as have two-way radio-based audio conferences.

IV. Findings

A. Wired "Pipe"

Though many submarine cables cross the Pacific, most are clustered across the North Pacific between Asia and North America, or run between south-eastern and north-eastern Asia, or between Asia or Hawaii and Australia/New Zealand. To date, such cabling has bypassed most Pacific island economies, and it recently demonstrated its vulnerability when the earthquake of 26 December 2006 damaged several cables at once, severely constraining connectivity in many countries. For this reason, the cabling industry might consider diversifying its routings: (a) to better protect itself against such catastrophic breakage, and (b) to better diversify the markets it serves. Such diversity of routing might pass through the northern, central, or southern Pacific. Such strengthening of routes can also be routed to facilitate connections to Pacific island economies. Figure 2-1(a-c) illustrates such a view of current and possible next-step cabling.[3]

It is notable that several storms, as well as the recent unexpected complete failure in November 2004 and January 2005 of Intelsat communications satellites IA-7 and IS-804, have also cut off peoples, including Pacific island users/economies, from the telecoms world. Therefore, a single satellite or cable is not yet the "unique" solution. Rather, affordable, integrated alternatives of different characteristics may today provide the best "fail-safe" system against complete isolation in the case of single-system failure. An ITU-PITA project has addressed this issue, emphasizing the necessity to establish and implement regional strategies for contingency planning, including the development of systems to rapidly switch between satellites in case of a difficulty or failure in one option.

Increased partnering is resulting in some cabling projects, such as those announced or underway to link the Federated States of Micronesia and the Marshall Islands to Guam, and New Caledonia to Australia. In addition, the redeployment of a portion of the PacRimWest cable to Papua New Guinea (discussed later in this chapter) offers an exciting first example of such an approach – which could potentially benefit several other countries. The cost savings of such redeployments, and the attention that it might gain, can be significant strategic assets to countries that may be prepared to truly benefit from connectivity.

[2] The Internet may also be directly received by satellite or via VSAT or satellite phone user interfaces.

[3] It might be worth noting that, though decisionmakers in Saipan are happy with their bandwidth, they have stated a preference for a more competitive environment, where the cable access costs would be more modest.

Figure 2-1a. Illustration of the "Japan-USA bottleneck" attributed to imbalanced trans-Pacific capacities

Figure 2-1b. Proposed cable routing bypassing the Luzon-Taiwan Strait

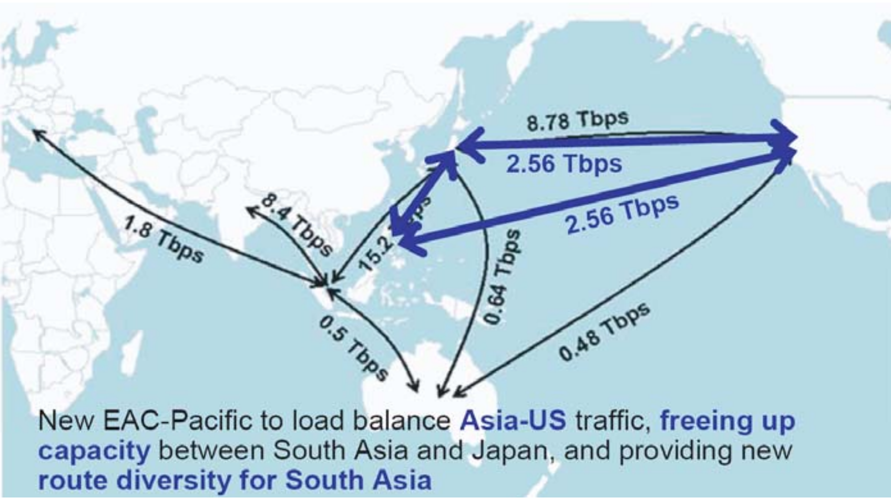


Figure 2-1c. A multi-ring architecture, reducing dependency on any one potential failure route[3]

Source: Barney, Bill 2007. Crisis, Opportunity and the Submarine Cable Industry. Proceedings PTC'07, Honolulu, USA. Mr. Barney is president and CEO of Asia Netcom.

In the 1990s, great enthusiasm developed for cabling "solutions", mostly across the North Atlantic and Pacific oceans. Around the turn of the millennium, however, this enthusiasm turned into a potential crisis, as the "bubble" burst and many pioneers wound up in bankruptcy, and their systems wound up in the hands of new operators, who acquired them for pennies on the dollar. These operators can provide services for a much lower cost point, yet still make a profit. Enthusiasm returned to the cable industry by 2007, with several recent announcements on new trans-Pacific cable initiatives. The earthquake of 26 December 2006, which severed several cable links, resulted in a call for a more fail-safe cabling infrastructure (as partly illustrated in Figure 2-1), and the realism that grew out of the 1990s boom and bust may help the industry develop improved sustainability and improved marketing (including the serving of additional markets) in its next build-out.

1. Local Cabling Initiatives in the Pacific

Guam and Fiji have undersea cables. Several additional countries have cabling projects underway or under discussion – and the approaches taken by those countries may set an example for other Pacific States, for both international and internal connectivity.

The Marshall Inter-Island Cable was installed in 1992, and the Palau Inter-Island Cable was installed in 1996, dispelling the view that small economies cannot develop a domestic fibre-optical backbone. The MTC Marianas Cable connects Saipan,[1] Guam and intermediate islands, dispelling the notion that small economies cannot lay domestic and international backbones. Though the MTC is only 240 km long, spurs or loops of slightly greater length could link several Pacific island economies to current or envisaged trans-oceanic cables (Figure 2-3, Tables A-2 and 2-3). The governments of the Federated States of Micronesia and of the Marshall Islands have begun construction of a cable between Guam, Majuro and some islands between these end points. On the drawing board are plans to extend this system. Papua New Guinea's new APNG-2 cable connection is described just below.

These changes bode well for other Pacific economies. Several economies are relatively near to the Southern Cross Cable Network landfall in Fiji, and could build local or subregional loops from Fiji to serve themselves. Early discussions about another major cable between Australia-New Zealand, the United States of America, Guam and Asia might be an opportunity to pursue additional local loops. Redeployment of first-generation fibre-optic cables (labelled "Reuse?" in Table A1, Appendix A), along the lines of APNG-2 to Port Moresby, is another opportunity, sketched later in this chapter. Other plans, involving French Polynesia and several other states are in development. Such activities merit attention by Pacific states (who should probably not "sign the first contract offered" but negotiate aggressively, perhaps with knowledgeable and unbiased help, to ensure that they do not jump irrationally at the first offer by overpaying, or over-committing of state resources, for such connectivity).

The cost for deployment and maintenance of current-generation fibre-optical cable is quite high, so it is suitable for high-traffic situations, including connecting Pacific Rim economies to one another. Two options appear viable for the Pacific:

(a) Partner with trans-Pacific cable projects, to include spurs to one or more Pacific islands, as Fiji was connected to the Southern Cross cable. This may be good for the public relations of cable operators, and such operators may seek additional diversity of routings as they respond to the cable cuts of 26 December 2006. Indeed, Palau, Guam, the Marshall Islands and perhaps others are situated along the path of the Proposed AsiaNetcom cable illustrated in Figure 2-1;

(b) Consider redeployment of first-generation undersea cabling as noted immediately below. This may be much more economical to deploy and reasonable to maintain.

2. Redeployment and Reuse of Undersea Cables

First-generation electro-optical fibre-optic submarine cables, installed between about 1988 and 1995, pioneered a revolution in connectivity. Such cable was replaced in the mid 1990s with second-generation purely optical cable technology with much greater capacity. Because of in-place upgradeability, innately greater capacity, and a surplus of overall capacity installed in the past decade, operators of first-generation cables have retired them prematurely, or are considering doing so.

Such retirements, however, are occurring long before such cables become technically unserviceable. These cables may be redeployable for Pacific island economies with suitable requirements.

Cable Case History #1: The academic community reuses undersea cables

There are plans to reuse first-generation submarine fibre-optic cables for two purposes. One is for research, and the other for operations supporting research. Butler (2003)[4] discussed a study by the Incorporated Research Institutions for Seismology (IRIS) on the potential of economically repositioning first-generation cables for new uses. Used cabling can be redeployed for about 10 per cent of the raw materials costs, and about 20 per cent of former peak-demand ship time. The report notes that Pacific cabling laid in the late 1980s and early 1990s might be decommissioned as surplus,[5] and might be negotiable for redeployment and reuse. Such cabling has nominal bandwidth between 280 and 560 Megabits/second (as opposed to 1,000 times that bandwidth or more for recent-generation cabling). IRIS has formed IRIS Ocean Cable Inc. to negotiate the assumption of management of several such cables upon their decommissioning. It has taken over some of these systems and is using them for scientific purposes.

Clearly, if the scientific community can negotiate to take over such systems, such developments indicate a potential for redeployment for Pacific islands, as well. Additional possible cables that could be redeployed to connect Pacific island economies include GPT, PacRimEast, the remainder of PacRimWest after part was taken to make APNG-2 (see below), TPC-3 and TPC-4 (see Appendix A). Pacific Island economies that could be connected in such ways could include American Samoa, the Cook Islands, the Federated States of Micronesia, French Polynesia, Kiribati, the Marshall Islands, Niue, the Northern Mariana Islands, Palau, Samoa, the Solomon Islands, Tonga, Tuvalu, and Wallis and Futuna. An article aimed at scientific[6] use could be adapted as an overview of how Pacific island economies could be connected using such cables. Indeed, a pioneering initiative of that type has taken place (see below).

Cable Case History #2: Papua New Guinea – A new pro-activity

Until recently, connectivity in Papua New Guinea was via the 897-km long Australia-PNG (APNG) cable, a copper coaxial analogue telephone cable laid between Cairns and Port Moresby in 1967, and by Intelsat Earth stations at Port Moresby and Lae. However, not long ago APNG was retired from service, leaving the country and Telikom PNG with only satellite connectivity. Recently, Telikom PNG announced a partnership effort to acquire 1,800 km of the recently retired PacRimWest cable, previously linking Sydney and Guam, and redeploying it between Sydney and Port Moresby, naming it APNG-2 (see redeployment map in Figure 2-2), anticipated to be serviceable for at least 15 years. Its cost has been estimated at US$11 million, compared with an estimate of US$60 million

[4] http://www.iris.iris.edu/cable/SSC03_RB_Paper.doc.

[5] Indeed, some cabling has now been decommissioned. Papua New Guinea is taking advantage of this approach, sketched by the academic community, to greatly upgrade connectivity to that country.

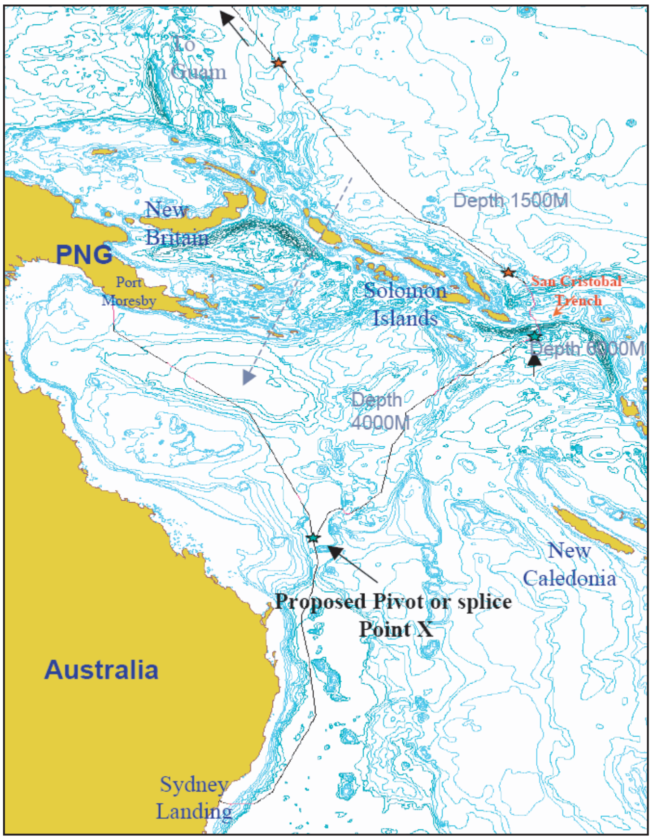
[6] http://www.soest.hawaii.edu/soest/facilities/esf/Projects/DEOSCableRe-UseReport.pdf.

to acquire and lay new cable. Its anticipated capacity of 560 Megabits/second is considered roughly 70 times that of the old copper analogue cable. A trial recovery of 300 km of PacRimWest cable, conducted by contractor Alcatel, found that the retired cable and its repeaters were in good condition. Completion of the laying of APNG-2 was announced in October 2006, with initial services commencing soon thereafter. Telikom PNG also has plans for an additional 18 Mb/s of satcom capacity in the near future,[7] of which 8 Mb/s has already been installed.[8] In addition, broadband VSAT terminals are being eyed for connecting about 25 additional communities, with new VSATs already installed at Tufi, Bogia and Pangia.

In this estimate, a cable landing could be established in most Pacific island economies for a total of roughly US$50 million, considerably less than previously estimated – by redeploying first-generation cable that has been or is soon to be retired.

Telikom PNG is coming to the end of its current regulatory environment, during which it enjoyed a virtually monopoly situation. It is thus positioning itself to act more pro-actively, in preparation for an envisaged climate of freer competition. One move has been to invest in management training for its staff. Another has been to aggressively expand mobile phone service coverage. Another move in late 2006 was to make unlimited Internet use available to universities, colleges and schools for US$275/month – a service it plans to extend to other non-profit organizations such as hospitals. Telikom states that such access is being provided as part of its community service obligation programme, and is being timed to coincide with increased capacities anticipated from APNG-2.

Figure 2-2. Redeployment map



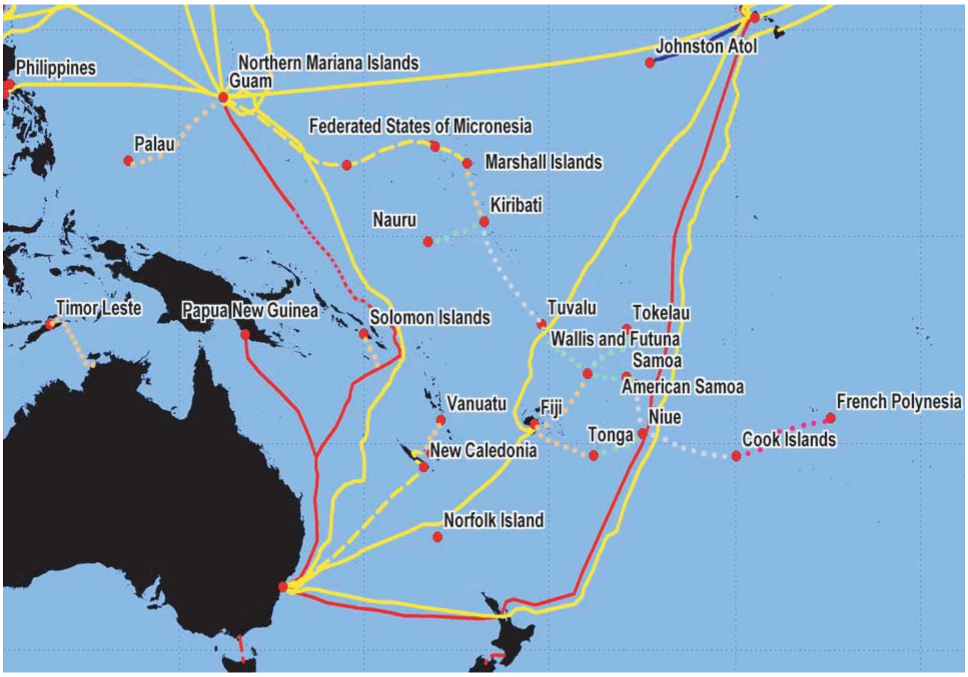
7 http://www.postcourier.com.pg/20051228/news02.htm (viewed on 17 October 2006). Also, http://www.thenational.com.pg (viewed 3 August 2006).

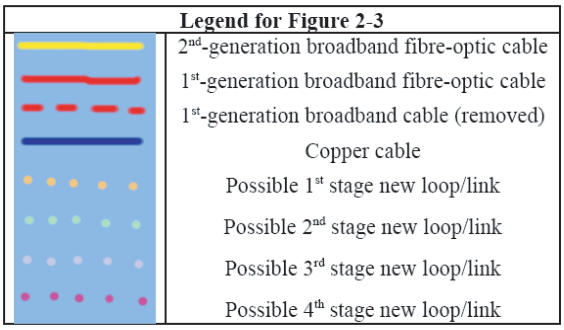
8 http://www.pnginusa.org/forums/index.php?showtopic=184 (viewed on 17 October 2006).

3. Recommendations on Cable

Given the opportunities, and in spite of uncertainties inherent in the task of laying cable, the Pacific should look seriously at potential partners toward acquiring their own international cable landings – especially in light of the cost savings from the redeployment of first-generation cable, and the potential interest of developmental partners in seeing improved connectivity for Pacific islands. Figure 2-3 illustrates, and Table 2-3 lists, Pacific island economies, ordered by population but also showing the Human Development Index.[9]

Figure 2-3. Sketch of possible caling spurs (dotted red lines) to reach Pacific island economies





The following example may illustrate the possible use of Table 2-3 for strategizing cable deployments: Tonga might be connected to Fiji, which is on Southern Cross, with about 700 km of cable – costing perhaps US$3 million if first-generation cable is redeployed as exemplified by APNG-2. Niue, Samoa or American Samoa could be next, connected to Tonga (after Tonga was connected), with a few hundred kilometres of cable costing perhaps US$2 million per State.

[9] Note that 3-digit HDI figures are from the UNDP Human Development Report, 2006. 2-digit figures are estimates of David Hastings, ESCAP Secretariat, using available data to recreate the HDI for States left off the UNDP list.

Table 2-3. Present and possible future international cable connectivity in the Pacific[10]

State	Population 1,000s	HDI	Cable Date	Length (km)	Sequence?	Cost Estimate US$M	Notes
Papua New Guinea	6,002	0.523	2006	3000	**Operating**	11	Pioneering redeployment of PacRimWest
Timor Leste	1,063	0.513		~800	Next?	3??	From Darwin?
Fiji	906	0.752	2000	hub	**Operating**	20?	Short loop, on Southern Cross
Solomon Islands	552	0.594		100	Next?	2??	Redeploy PacRimWest – as spur to APNG-2?
French Polynesia	275	0.78		1000	4?	4??	Redeploy PacRimEast?, extension beyond Cook Island, or direct from Hawaii?
New Caledonia	239	0.79	2008?	2000	**Announced**	53	Gondwana-1 cable announced from Sydney
Vanuatu	218	0.659		300	Next?	2??	Extension from New Caledonia using redeployed 1st generation cable?
Samoa	183	0.776		500	2?	2??	From Wallis and Futuna or Tonga, from Fiji?
Guam	171	0.9	1989		**Operating**	10?	Hub with many cables
Tonga	115	0.81		700	Next?	3??	From Fiji, redeployed 1st generation cable?
Micronesia	108	0.61	2007?	2175	**Being laid**	67.4 (shared)	From Guam, combined with Marshall Island
Kiribati	105	0.61		600	Next?	3??	From Majuro, redeployed 1st generation cable?
Northern Mariana Islands	83	0.84	1997		**Operating**		From Guam
American Samoa	63	0.81		500	2?	1??	Extension (with Samoa?) from Wallis and Futuna?
Marshall Island	60	0.62	2007?	2175	**Being laid**	67.4 (shared)	From Guam, combined with Micronesia
Palau	22	0.76		800	Next?	4??	From Guam
Cook Islands	21	0.72		1000	3?	5??	Extension from Niue, redeployed 1st generation cable?
Wallis and Futuna	16	0.71		700	Next?	3??	Side loop from Fiji, extensions to Samoa, Tuvalu, etc.; redeployed 1st generation cable?
Nauru	13	0.71		700	2?	3??	Extension beyond Kiribati from Majuro, redeployed 1st generation cable?
Tuvalu	12	0.67		700	2?	3??	Extension beyond Wallis and Futuna from Fiji, redeployed 1st generation cable?
Norfolk Island	2	0.93		?			
Niue	2	0.78		300	2?	2??	Extension beyond Tonga from Fiji, redeployed 1st generation cable?

Note: Completed, underway or announced projects cost ~US$160 million (not including Northern Mariana Islands).

[10] The column "Cable date" shows the date of cable competition (estimated for cables that have been announced or are under construction). The column "Cable Length" shows estimated cable length described in "Notes". "Sequence" notes if the cable is operating, being laid, or possible future sequence. "Next" indicates economies that can be connected to an already-connected nearby State, for (in rough estimate) costs in millions of US Dollars given in the column on "Cost Estimate". Described in another way, "Next" in Table 2-3 (corresponding to "Possible 1st stage new loop/ link" in Figure 2-3) might be the easiest islands to add to the current and announced Pacific cable system. "2??" in the "Sequence" column (corresponding to "Possible 2nd-stage new loop/link" in Figure 2-3) indicates that a cable to the indicated State might be most economically built to a State noted in "Notes", after that State is connected to the global cable system.

B. Terrestrial Wireless "Pipe"

Terrestrial wireless is invaluable for last-mile user connectivity in various parts of the world. In some Pacific island economies it may be used for some domestic trunking.

Mobile phones and related services (short messaging service, Internet and broadcasting via mobile phone, etc.) is the fastest growing telecommunications product/service in most developing countries. In the Pacific, it has an advantage over the Internet (which may get more publicity despite its lower growth and penetration in many markets), due to the relatively lower cost and greater ease in purchasing and servicing a phone, compared with computer equipment – in most Pacific markets at present.

In addition to the desirability of delivering popular and enabling mobile phone services to people of the Pacific, terrestrial wireless may be useful (in the form of WiMax or other wireless networking) in delivering the Internet and IP-based services, such as low-cost Voice-over IP telephone services. In this mode, connectivity brought by VSAT or cable to a community could serve an area up to several kilometres from the connectivity point – by means of wireless networking.

Terrestrial microwave wireless has been used to provide a "backbone" between islands, where they are sufficiently close together for line-of-sight transmission between microwave towers.

All of these approaches to terrestrial wireless have been implemented in the Pacific, as noted in Appendix B, and offer the potential to serve additional Pacific communities.

1. Wireless Case History #1: Niue – Gratis non-commercial WiFi, Internet etc.

With fewer than about 2,000 residents on a single low-lying coral atoll of 259 square kilometres, vulnerable to tsunamis and other disasters, Niue is located 400 km from its nearest neighbours, which are also small island economies. Most of the country's citizens are living overseas because opportunities are scarce in the country. Providing telecoms infrastructure to such a small nation has been a challenge. The country outsourced the licensing of its .nu domain name to an overseas company. The .nu domain name is considered "trendy" in several other countries (primarily in Scandinavia, where it is associated with "new").

Niue has been offering free local email to residents since 1997, free non-commercial dial-up Internet supplemented by international satellite communications link from 1999, and free non-commercial Wi-Fi wireless broadband Internet to all residents and visitors (including owners of yachts in the harbour) from 2003. The country was severely damaged by 300-km/hr winds from Cyclone Heta; but quickly restored the Internet service, thanks in part to help from its neighbours in the Pacific. This is arguably the first nation with full Internet connectivity, free (and license/contract-free) for all residents and visitors with Wi-Fi capability. A gratis Internet café is operated in Alofi, for the use of those lacking their own computers.

People involved in the process may describe[11] Niue's situation as unique, but some aspects appear adaptable to other communities, and it demonstrates that high technology can be appropriate for small, isolated communities, if they can combine local conditions with capabilities developed in the global ICT community – and develop a supportive policy environment. The business model – revenues from domain name licensing helping to underwrite connectivity improvements – might be applied to a few other countries in the Pacific. The service model of "universal" access to wireless Internet, is being taken up elsewhere, with New Orleans installing free wireless city-wide after hurricane Katrina,

11 http://www.niue.nu/history/history.htm (Note the "White Papers" linked from this page.).

Rhode Island and Vermont both aiming to become the first American state to have complete statewide wireless networking, the Former Yugoslav Republic of Macedonia reportedly covering 95+ per cent of its population with wireless broadband networking, and Tonga Communications Corporation pursuing national WiMax coverage.

2. Wireless Case History #2: Microwave LAN – Connecting Tongan islands with broadband

Comprising 36 inhabited rugged volcanic and low coral islands, plus about 140 additional islands, Tonga faces a challenge in building communications infrastructure. However, recently a public-private partnership brought GSM wireless networking to several islands, giving them mobile telephony and broadband Internet. Using existing commercial capabilities, several islands have been connected with scalable bandwidth. Each connected island has a satellite link with about 1 megabit per second bandwidth. The project recently received the GSM Association Award for best infrastructure or network solution product for its delivery of Internet, GSM telephony, and entertainment services around the country. Schools have been connected, to bring educational opportunities to the country's people. Shoreline, a Tongan ISP, has been rolling out such wireless network assess[12] across the islands, with satellite or wireless linkages between islands. Tonga is also getting a WiMAX network to coordinate with the GSM network of Tonga Communications Corporation, currently serving part of the country.[13]

C. Satellite Communications "Pipe"

1. Satellite for the Pacific

Because of the traditional views of satellite communication, people may overlook the improved cost-effectiveness of the technology in addressing the ICT requirements of rural and remote areas and islands, so alleviating problems associated with inadequate connectivity. In the long run, the combined commercial and non-commercial benefits of expanded telecommunications with a satellite platform should far exceed the direct cost involved. The resulting connectivity could result in significant national developments, thus reducing the perceived obstacles of isolation, rural poverty, general social inequity and increased urban/overseas migration.

Satellite communication by its very nature can provide "universal" connectivity for urban and rural areas. The biggest advantage of satellite is that it can provide instantaneously deployable (and redeployable) infrastructure, assuming a suitable satellite is available, so that it can be used for point-to-point, point-to-multipoint and for broadcast applications. Solutions exist for sparsely distributed areas such as the Pacific, and suitable purely satellite, or satellite/cable/wireless approaches may be implemented in several combinations. Depending on the amount of traffic, one or two satellites can be designed to meet the requirements of Pacific islands. This might include deploying a small or medium-sized satellite to meet first-phase projected requirements and adding a co-located satellite later for enhanced capacity. Such an approach, though slightly more expensive at the outset, in comparison with a single larger satellite, in the long run will be more commercially viable due to greater flexibility and the increased security of redundancy. Other solutions may involve a range of contracts with satellite service providers, with a number of satellites being used over time according to capacity, pricing and demand considerations – and of hybrids with cable perhaps being built to high-traffic areas as a satellite approaches full utilization.

---

[12] http://www.smartbridges.com/css/articles.asp?id=201.

[13] http://www.wimaxxed.com/wimaxxed_news/20060919/alvarions_bree.html.

Given the nature of the Pacific climate, it is noteworthy that satellite connectivity is increasingly independent of weather and local conditions.[14] In recent times, satellites have been used for societal development applications like telemedicine and tele-education, all complemented by dramatic reductions in mobile phone and computing costs. A single satellite platform can be designed to have communication, entertainment and societal applications such as telemedicine and distance learning, since all applications use digital data and thus can share storage capacities. Recent trends in satellite communications, which involve higher modulation and coding techniques and use of multiple spot beams supported by a shaped beam, make satellite communication increasingly competitive with terrestrial systems.

Satellite Case History #1: Internet Protocol Communication Satellites

Anik F2 was launched on 17 July 2004, marking a new generation of broadband Internet Protocol communications satellites. It has 45 downlink Ka spot beams covering Canada (except the Arctic islands) and the 48 lower states of the United States (not including Alaska or Hawaii). It has six uplink beams. Total Ka bandwidth is 9 Gbps, while C and Ku bandwidths are each about 1 Gbps. The satellite weighs about 5,950 kg, sits over 111.1^{o}W longitude, and has an anticipated service life of 15 years. One estimate is that about 750,000 individual users can be served by the system. In the United States, Anik F2 bandwidth is being marketed by wildblue.com, and in Canada by telesat.ca. Wildblue packages reportedly start at US$50/month for 512 kbps download and 128 kbps upload maximum. A 30-cm (nominal) dish and hardware normally cost about US$300; a 60-cm dish for fringe areas will cost somewhat more, not counting the cost of required professional installation. In late 2006 there was a promotion offering gratis installation, and a reduced price of US$200 for the terminal. Wildblue 1, the first exclusively Ka-band broadband satellite, weighing about 4,735 kg, was launched on 5 December 2006. It is also designed to serve dispersed populations in rural North America.[15]

IPStar was launched a year after Anik F2. Estimated prices are reported by Shin Satellite to be similar to those for Anik F2, with 90 Ku-band spot beams over the most populated portions of southern and eastern Asia and Australia. Unfortunately, there is only a broad beam covering some Pacific island economies.

Satellite Case History #2: Edusat

The Indian Space Research Organization (ISRO) launched Edusat in September 2004, the world's first communication satellite dedicated to educational applications. With five Ku-band spot beams, one Ku-band and five C-band shaped beams with national coverage, Edusat weighs 1,950 kg and cost US$20 million to build. The Indian launch vehicle cost US$33 million to build, with the total launch priced at US$45 million.[16] This is an example of how costs can be contained when affordable service delivery is a main objective.

---

[14] Note that this includes "space weather," the environment of cosmic radiation, small and occasionally large particulate collisions, and electromagnetic radiation, often considered cyclic with the 11-year sunspot cycle but which recently has been attributed to satellite degradation and perhaps failure in space – although the 11-year sunspot/solar activity cycle is now near a minimum.

[15] http://en.wikipedia.org/wiki/WildBlue.

[16] http://www.astronautix.com/lvs/gslv.htm.

Satellite Case History #3: French Polynesia and Cook Islands "licensing consortium"

OPT, the French Polynesia telecoms operator, and Telecom Cook Islands have joined in a form of licensing consortium, to jointly lease satellite communications transponder capacity. OPT had some spare capacity, in its arrangements for transponders for Internet, direct-to-home/office, and telephone traffic for its 275,000 people. Telecom Cook Islands arranged to lease some of that capacity for its 21,000 residents, at rates reported as a 50 per cent savings to customers, yet affording OPT a modest mark-up to its cost price. "The result was a huge saving for Telecom Cook Islands. And OPT also got revenue that they otherwise would not have had. It was a real life win-win situation," according to Stuart Davies, chief executive of Telecom Cook Islands.[17]

2. VSAT Technology for Communication

Satellite communications can be facilitated on the terrestrial end by satellite Earth stations, very small aperture terminals (VSATs) or satellite phones.

Satellite Earth stations exist in most Pacific States, as noted in Appendix A. Satellite phones could serve all Pacific island economies, depending on the phone system – with no other infrastructure than a means of charging batteries in the phones, and the battery charger may be solar. With a retail cost of about US$1,000 for the phone, this may be the lowest-cost current modern telecommunications infrastructure option available to the Pacific – probably beating the lowest-cost VSAT by a small amount. Air/bandwidth is still relatively expensive, but a "bulk" agreement for airtime might reduce costs somewhat, and make possible universal coverage at least for urgent communications.

Very small aperture terminals have been made possible by improved technology. Unlike the several-metre-wide Earth stations that currently exist to provide the most reliable (but expensive and relatively low bandwidth) "fail-safe" gateway for many Pacific communities, sub-metre VSAT terminals are almost as reliable, and, when used for Ku- or Ka-band broadband satcom, they can deliver true broadband capabilities. The terminals themselves are much more economical than previously – on the order of US$1,000 per installation (antenna, electronics, installation, and short communication line). VSAT offers improved cost-effectiveness implementing high-quality, reliable communications to regions that are not well served by terrestrial networks.

VSAT-based solutions can service a wide range of population densities and be flexible enough to grow as user requirement change. Various solutions include: (a) connectivity to subscriber lines to serve a scattered population (1 to 20 lines), (b) connectivity to wired or wireless/cordless local loop for clustered populations (20 to 300 lines), and (c) connectivity to macro-cellular networks for medium-density populations uniformly distributed (> 300 lines).

Advantages of VSAT networks include costs that are independent of distance and terrain,[18] expansion costs that are predictable; a high degree of customizability; a high level of security; control and network management; rapid installation and relocation; and unattended and maintenance-free operation. As a result of such features, VSATs provide customers with significant gains in productivity efficiency, cost control and profitability. Satellites have advantages in networking broad, sparsely populated areas, as infrastructure is less a function of distance than when one must lay cable or build wireless towers.

---

[17] http://www.islandsbusiness.com/archives/islands_business/index_dynamic/containerNameToReplace=MiddleMiddle/focusModuleID=15807/overideSkinName=issueArticle-full.tpl.

[18] This is a major limitation of terrestrial-based wired and wireless connectivity.

VSAT services are available to parts of the Pacific Ocean area "from US$160 for 512 Kbps/128 Kbps download/upload"[19] using New Skies and Asiasat C- and Ku-band satellites. By using dedicated satellites and adopting new commercial modes, the cost may be greatly reduced.

To illustrate the importance of VSAT in 21st century operations, every Wal-Mart (considered a global leader in efficiency in inventory management and resupply distribution) has a satellite terminal, which it uses to minimize overhead costs, while maximizing information and communications management, delivery and efficiency.

3. Satellite Capacity Estimation

Table 2-4 computes the estimated bit rate needed for rural satellite services. In addition to rural connectivity, capacity can utilize direct-to-home (DTH) broadcast and community-development-oriented applications such as telemedicine, tele-education, and disaster management. A total bandwidth allocation of 100 MHz is earmarked for such applications between all service areas. This will be apportioned among the various nations being covered.

The total bandwidth estimate is as follows:

(a) Bandwidth for rural connectivity (assuming 2 bits/Hz) is 463,230 MHz;

(b) Bandwidth requirement for services like DTH, etc., is 100 MHz.

The above indicates an approximate total bandwidth requirement of 540 MHz.

Note that, though this computation is in terms of a satellite option, additional considerations should be made here. If satellite communications were to play a stronger role in urban areas – and as new, bandwidth-hungry products and services develop[20] – total bandwidth used by the Pacific would potentially grow to greater volumes, thus justifying longer-term plans for greater total bandwidth (satellite and cable combined).

Table 2-4. Estimated capacity requirements for rural connectivity

	A	B	C	D	E	F	G
Type of Connectivity	Population to be Connected	Connection Ratio	No. of Connections (Col. A x Col. B)	Activity Ratio	Actual Connectivity (Col. C x Col. D)	Data Size (Kbps)	Total Data Size (Kbps)
Wired (voice)	348,602	0.20	69,720	0.050	3,486	8	27,888
Mobile	2,371,874	0.20	474,375	0.020	9,487	16	151,800
Internet	1,555,774	1.00	1,555,774	0.020	31,115	4	124,462
Internet (download)	1,555,774	1.00	1,555,774	0.020	31,115	20	622,310

[19] http://www.satsig.net/ivsat-asia.htm.

[20] For example, few would have predicted the bandwidth consumed by Myspace or Youtube, even two years ago.

4. Satellite System Design Considerations

Frequency Band of Operation

For different applications using satellites, various frequency bands such as L, S, C, Ku or Ka are used. Sometimes the types of applications envisaged require a hybrid satellite using more than one frequency band. For the applications envisaged for Pacific islands, S- and L-band frequencies are not suitable from the viewpoints of coverage, equivalent isotropically radiated power (EIRP) or orbit-frequency coordination. C band is already well-deployed in the Pacific. However, most such systems covering the Pacific are low-powered, which require more expensive and difficult-to-operate user terminals than newer models might require. New broadband services built on Ku and Ka band are a major consideration. Ku band is considered more appropriate to conditions in the Pacific than Ka band, because of the latter's susceptibility to signal attenuation or drop-out in heavy rains experienced in many tropical areas. Cost considerations for ground equipment also suggest that Ku band be considered the preferred frequency band option for the Pacific. A dedicated C-band satellite with shaped beam may also meet requirements for Pacific connectivity, and so should also be considered.

The selection of frequency bands can be from planned or unplanned bands. In the case of planned bands, the cost of ground equipment will be costly, whereas for unplanned bands, ground equipment is cheaper and technologically more advanced. In the case of unplanned bands, the frequency of operation should be decided by consideration of coordination constraints, in addition to satellite complexity, data rate requirements, user terminal size and cost of acquisition of ground equipment.

Satellite Orbit Location

The ideal orbital slots for satellites to provide coverage over Pacific islands are between 120° W and 170° E longitude. However, there are already around 10 satellites parked between 120° W and 150° W providing services over the Pacific and other regions, as shown in Figure 2-4.

Much of the remaining 20° of arc of geo-stationary orbit is vacant. Use of such slots can avoid coordination issues and can provide coverage over Pacific islands within a 10° elevation angle of the horizontal. If the slot between 120° W and 150° W were to be used for Pacific Island coverage, coordination issues would need to be resolved before finalizing any candidate orbit. A few orbital slots earmarked for the Pacific island countries are in the planned bands. But the ground equipment for planned bands would be costlier than equipment for unplanned bands. With such considerations, choice of orbital slot may be made judiciously considering all traditional selection factors.

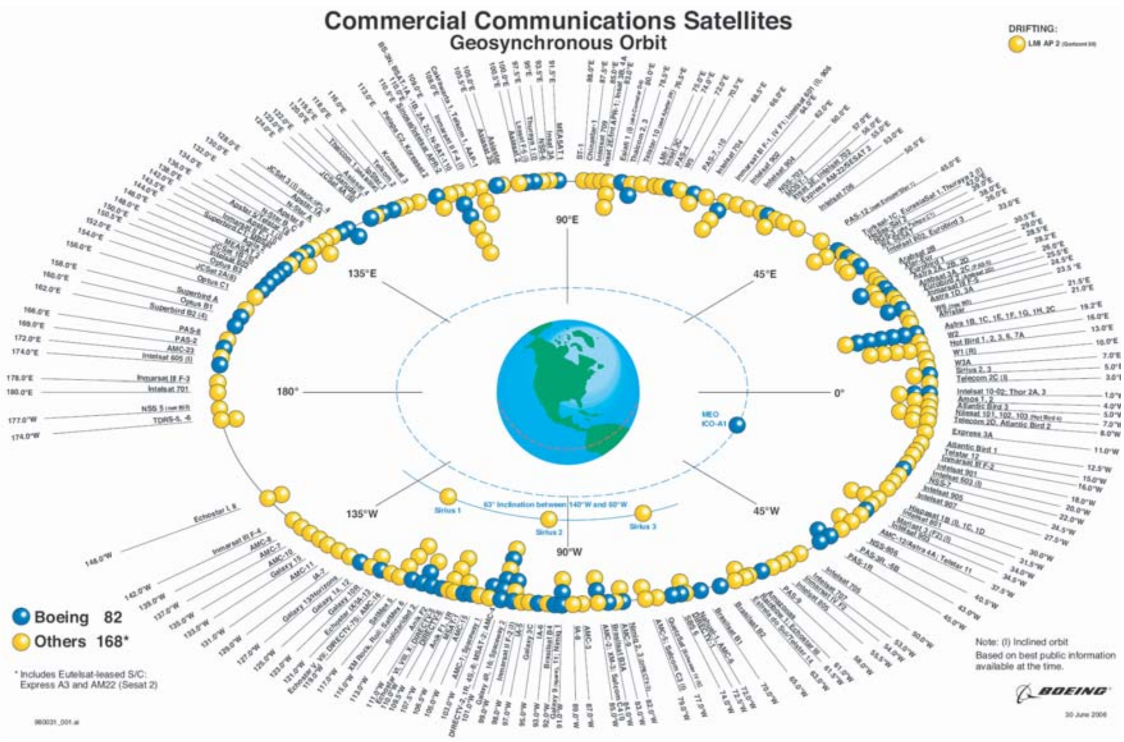
Satellite Technology: Bent Pipe vs On-Board Processing

Satellites with on-board processing reduce the complexity and size of the hub but increase the complexity of the satellite system. Moreover, satellites with on-board processing cannot utilize advancements in modulation and coding techniques that occur after launch. Over the 15-year life span of a communications satellite, bent pipe transponders are a better choice for lower satellite costs, and for benefiting from possible technological advancements during the lifetime of the satellite.

Modulation and Access Schemes

Modulation and accessing schemes can be based on traditional or IP-based platforms. Selection should be made in the detailed network design phase. Use of advanced modulations like 8PSK turbo coding and of adaptive modulation and access technologies are assumed here in estimating the bandwidth, i.e., 2 bits/Hz. System cost and flexibility will depend on the technology selected.

Figure 2-4. Commercial communications satellites in geosynchronous orbit



Source: (http://www.boeing.com/defense-space/space/bss/launch/980031_001.pdf) 30 June 2006.

5. Recommendations on Satellite

Four candidate configurations are presented here:

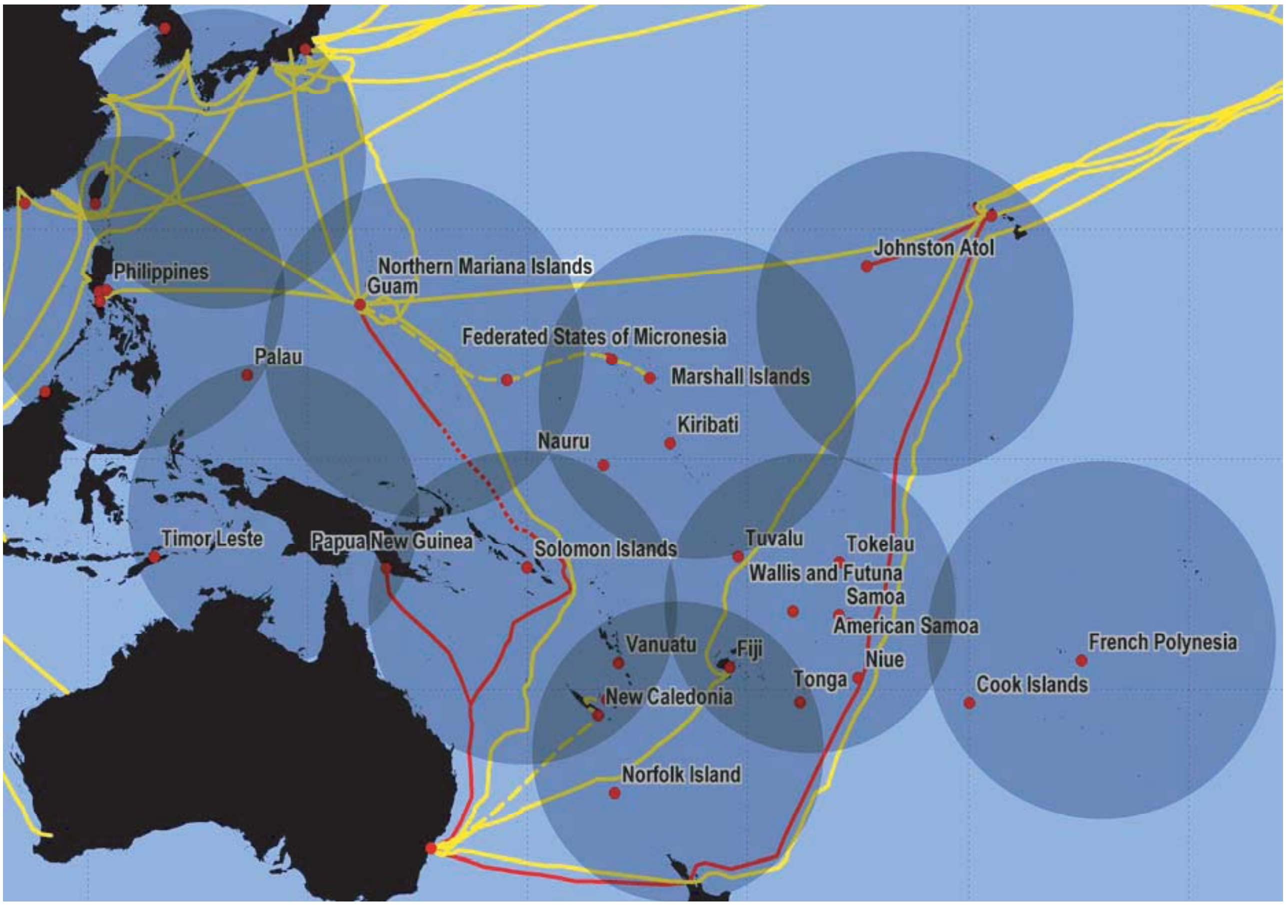
Option 1

A first option would be a satellite with 10 spot beams covering each Pacific Island nation and two transponders with a global beam encompassing all the nations. The details of the payload are as follows:

Satellite type:	Three axes stabilized.
Payload:	10 spot beams with 54 MHz transponders @ 51 dBW EIRP operating in Ku band Two transponders of 54 MHz for two wide beams with 39 dBW EIRP in Ku band.
Power amplifier:	Linear TWTA.
Power source:	Sun tracking solar panels with advanced multi-junction cells, 100 per cent eclipse support using lithium iron batteries.
Life:	Orbit manoeuvre 12 years, design life 15 years.

This proposed satellite would provide a total capacity of 540 MHz in spot beams and 108 MHz in wide beams, to satisfy the projected requirement derived above. It would have a total power of 2.5 KW and weigh 2-2.5 tonnes. The total estimated cost for the spacecraft, including launch and spacecraft insurance, would be US$110 – US$120 million. Coverage is shown in Figure 2-5.

Figure 2-5. Sample 10-spot beam system covering the Pacific



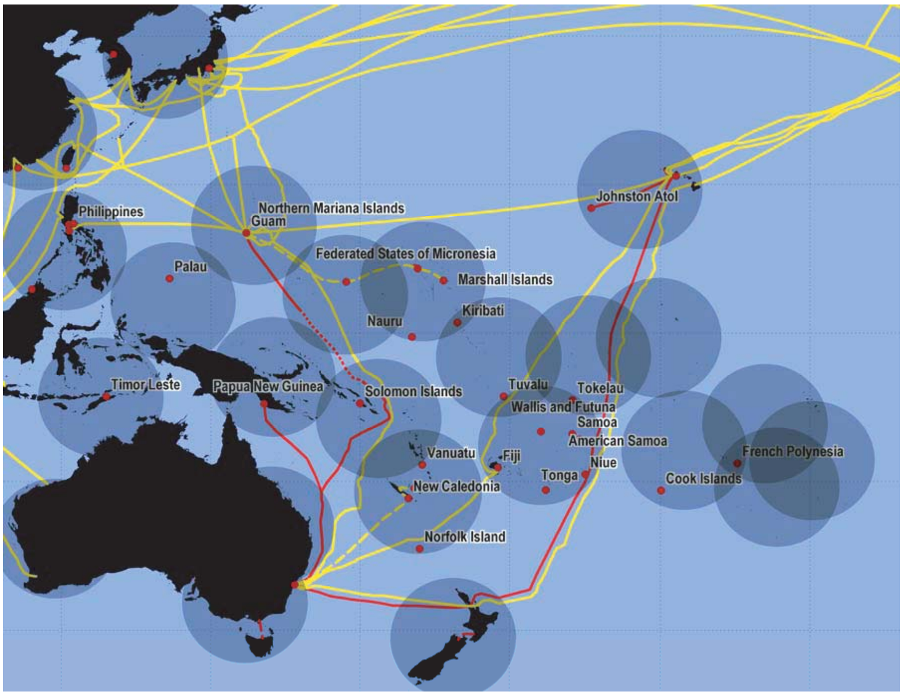
A first satellite could be launched for the first phase of a satellite project, with a similar unit co-located later – or a larger satellite designed to replace the first satellite if its capacity is fully used or it becomes old enough for retirement.

Option 2

As a second option, a satellite named PIS-2 with 24 spot beams, with each beam dedicated for each Pacific nation, and two global beams encompassing all the nations is proposed. The details of the payload are as follows:

Satellite type:	Three axes stabilized.
Payload:	24 spot beams with 54 MHz Ku-band transponders with 54 dBW EIRP.
	Two transponders of 54 MHz for two wide beams with 39 dBW EIRP in Ku-band.
Power amplifier:	Linear TWTA.
Power source:	Sun tracking solar panels with advanced multi-junction cells, 100 per cent eclipse support using lithium iron batteries.
Life:	Orbit manoeuvre 12 years, design life 15 years.

Figure 2-6. Sample 24-spot beam system covering the Pacific, the "diaspora" and other neighbours, while also providing redundancy in case of failure of cables or other satellites



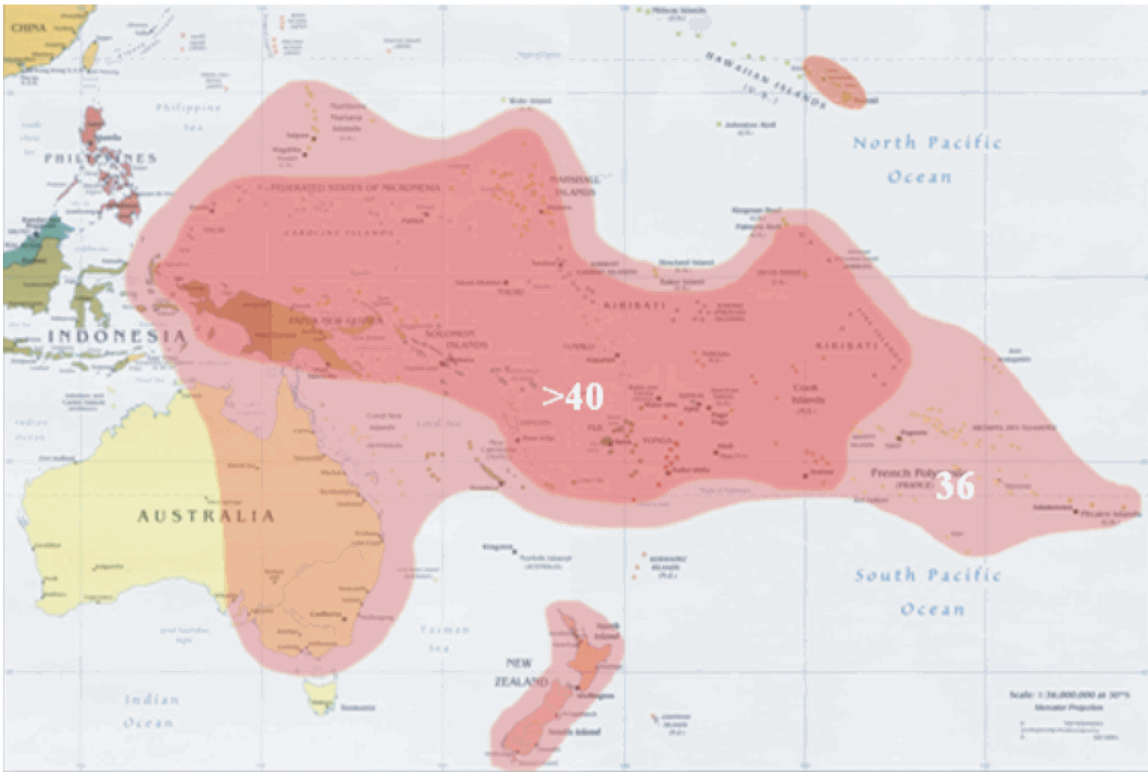
The system as configured also provides coverage to islanders who have emigrated to Australia, New Zealand and Hawaii, and provides services (including partial back-up in case of another 26 December 2006-type cable outage) for countries around the Pacific Rim.

Option 3

The third option is to launch a more traditional C-band system, with coverage for all Pacific island economies, plus perhaps neighbouring areas of Australia, New Zealand and mainland Asia. The cost of such a package might be about US$205 million, including satellite, ground station for control and management, launch, and insurance. A sample coverage map is given in Figure 2-7.

Satellite type:	Three axes stabilized.
Payload:	One shaped beam (2-4 transponders) covering 13 Pacific developing countries with EIRP > 40 dBW, for television and audio coverage; 3 spot beams (9-12 transponders, frequency–reused) covering 13 Pacific developing countries in three groups, with EIRP > 44 dBW for connectivity within and among these countries, and broadband based services; 1 shaped beam (5-12 transponders) to cover 13 Pacific developing countries, some South-East Asian countries, east Australia, New Zealand and part of south-east China, with EIRP > 40 dBW, for connection of the 13 Pacific developing countries with the outside world and for commercial services of these non-Pacific developing countries, so that the income may used for the operation of the satellite system.
Power amplifier:	Linear TWTA or solid amplifiers.
Power source:	Sun tracking solar panels with advanced multi-junction cells, 100 per cent eclipse support using lithium iron batteries.
Life:	Orbit manoeuvre 12 years, design life 15 years.

Figure 2-7. Sample C-band shaped wide beam system covering developing countries of the Pacific, and part of Australia, New Zealand and South-East Asia



Source: Sino Satellite Communications Ltd. Presentation to Asia-Pacific Business Forum, 2006.

Option 4

Another option would be to partner with one or more operators to lease partial capacity of a commercial satellite. This might be an existing satellite with spare capacity, or a future satellite whose design could be modified for maximum cost and performance efficiency for the situation of the Pacific.

This fourth option complements other options and might yield relatively quick benefits if pursued quickly. The Pacific Islands Telecommunications Association is currently studying such a course of action. Its understandings to date, and partnering potential, should be assets in the pursuit of this option.

6. Realization of the Selected Satellite

Options discussed here are summarized in Table 2-5.

Considering the population and traffic required for providing connectivity to all the countries in Pacific developing countries – plus providing financially rewarding services to neighbouring areas (including the nearby diaspora), a small or medium-sized satellite will suffice. It takes about 24-30 months to fabricate and operationalize such a satellite.

Because of the steady advances in technology and cost savings, it is suggested that establishment of infrastructure for ground systems begin one year before launch of the satellite.

Cost Estimation of the Satellite System, Including Major Application Supporting Systems

A refined cost estimate of a desired satellite would depend on the following factors:

- Application
- Coverage
- Data rate
- Satellite power
- Satellite construction
- Launch
- Insurance
- Operation and maintenance

Costs would also depend on other factors:

- Whether a single bigger satellite, or a number of medium-sized satellites, would be required;
- Redundancy option (e.g., potential for backup by another satellite or other means);
- Time duration for building and launching a satellite.

These points require detailed analysis regarding services to be provided, coverage area, and other factors.

However, unlike commercial telecom traffic in highly populated areas of the world, in this case it is to be expected that the break-even point in terms of revenue earned may not be reached for quite a long time, or in some cases may not happen at all. It is expected that an element of capital subsidy will be sought, plus some capacity to subsidize remote connections. Alternatively, service sharing, with beams added to serve partner areas, such as eastern Australia, New Zealand, Hawaii and eastern Asia. The overall costing in such cases may thus take into account intangible benefits such as improving the standard of living of the people, establishing a robust communication infrastructure, and other external or non-commercial benefits. The desired satellite systems would need to be built to achieve such objectives.

Cost Estimation of the Control Facilities and User Terminals and Facilities Individually, as well as Community-Based Facilities, for the Suggested Applications and Services

The cost of telemetry, tracking and control (TT&C) and satellite control facilities for options 1 and 2 will be US$9 million. For user terminals under options 1 and 2, the cost estimation takes into account the following factors:

- Population to be served;
- Service establishments that need connectivity (hospitals, schools, civil service offices, Internet cafés, security agencies and private establishments);
- Type of service (always-on broadband, dial-up etc.);
- Emergency services;
- Fixed or mobile or television broadcast;
- Communication terminals at personal level or at community level.

Table 2-5. Summary and comparison of the four satellite options

Option[1]	Estimated Cost in USD[2]	Orbital Slot	Service Supported	Advantages[3, 4]	Disadvantages
1. To build and own a Ku-band satellite with 11 spot beams.	110-120 m satellite only.	170ºE – 150ºW. Easy to find a slot.	10 spot beams for broadband-based services; 2 wide beams for television.	High power and reused frequency may provide affordable bandwidth. May meet the bandwidth need in normal ICT development by 2015. May be able to provide additional economically useful services to Pacific Rim countries.	If applications develop quickly, second satellite may be needed before its retirement. Connection to outside relies on other means.
2. To build and own a Ku-band satellite with 26 spot beams.	130-150 m satellite only.	170ºE – 150ºW. Easy to find a slot.	24 spot beams for broadband-based services; 2 wide beams for television.	High power and reused frequency may provide affordable bandwidth. More bandwidth than option 1. May be able to provide additional economically useful services to Pacific Rim countries.	Capacity might not be fully used. Connection to outside relies on other means.
3. To build and own a C-band satellite, with part of resources for commercial services.	200 m., including satellite and main Earth station.	145-180ºE.Not easy to find a slot, but easy to find partner and commercial opportunity.	2-4 wide beam for television; 9-12 spot beams for broadband-based services; 5-12 mid-wide-shaped beams for commercial service and interlink to outside.	High power and reused frequency may provide affordable bandwidth. Commercial services may reduce subsidiary. Connection to outside world through the same satellite.	Covering only 13 Pacific economies, not all Pacific island countries and territories.
4. To own or lease partial capacity of a possible commercial satellite.	75-85 m., part of satellite for 12 years.	~ 180ºW. Easy to find a slot, but not easy to find a partner.	1 wide beam.	The partner provides all technical support. Connection to outside may be through the partner.	Lower power requires more expensive user terminals. Fixed satellite operator.

Notes: [1] All satellites have a lifetime of 12-15 years; construction requires 2-3 years.

[2] The estimated cost includes satellite manufacture, launch and insurance.

[3] Options 1-3: May provide broadband services, accessible with similar low-cost user terminals.

[4] Options 1-3: Operation of satellite may be contracted to any satellite operator under satellite footprint; it is not necessary to be in a Pacific island economy.

Consideration of these factors will lead to an estimate of how many ground terminals would be required in each service category, and cost estimates need to be arrived at appropriately. For the suggested application and services, recurring monthly subscription of the poorer communities should be kept to the minimum, financed by direct subsidies where possible and needed, in order to deliver affordable benefits of ICT to the rural poor people of the region. General access and user charges should, however, be set at commercially viable levels, which will depend on fund sources and costs. While estimating the cost, this point is to be kept in mind and all possible techniques should be adopted to reduce the cost, consistent with sustainable finance.

Pricing of service access is discussed in Section 4.III.B.

Chapter 3

Economic and Commercial Viability[1]

I. Introduction

Enhancing connectivity within a region and between the region and the rest of the world conveys benefits not only commercially but also economically and socially to the region. There are always commercial and non-commercial costs and benefits involved.

This section assesses situations, costs and benefits pertinent to possible enhancements to the telecommunication infrastructure for the Pacific, and describes government and regulatory impact issues. Business models for information and communication technology (ICT) services are suggested, along with examples of factors influencing the commercial viability of the services.

As de/re-regulation of telecommunications from monopolistic to competitive business environments proceeds, in much of the world one regularly sees drops in prices and increases in traffic. An inclination is to wonder if lowered prices, combined with increased demand for services, would lead to financial difficulties for suppliers.[2] Figure 3-1 demonstrates that the recent tendency is for

Figure 3-1. Internet traffic increases exceed price drops, leading to revenue gains

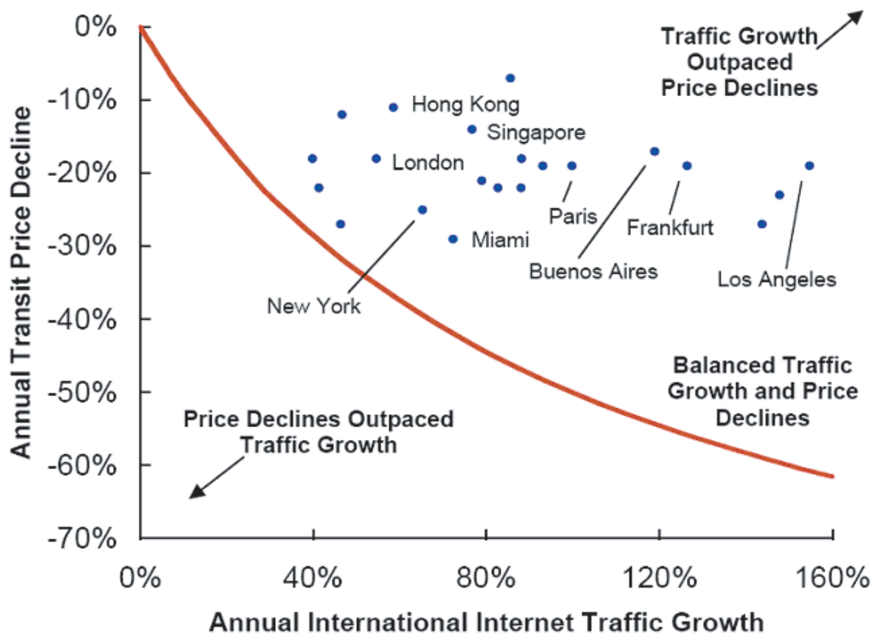


Figure from Stephan Beckert and Eric Schoonover. Global traffic, bandwidth and pricing trends and wholesale market outlook. Presented at PTC'07.

---

[1] This chapter was written by David A. Hastings, Yongsit Rojsrivichaikul, Komson Seripapong, Teeratat Kerdchouay and A. Bhaskaranarayana.

[2] A related concern is whether services will be reduced for some (e.g., rural) people if suppliers have financial difficulties.

traffic growth to exceed price drops – making for significant revenue opportunities for carriers, even before considering value-added products and services that can be added for larger markets because of such revenue growth. Globally, average volume declines have exceeded price dips (signalling revenue growth) in all years since 1991, except during 2000-2002.[3] This pattern is anticipated to continue through the decade, after which forecasts are difficult.

II. The Pacific Service Area/Marketplace

In an attempt to move beyond generalizations about Pacific island economies' socio-economic abilities to support potential telecommunications enhancements, this section provides itemized estimates for urban and rural populations (important for designing "last-mile" connectivity and services) in Table 3-1, current international cable and satellite communications traffic in Table 3-2, and current and forecast teleconnectivity in Table 3-3. The figures "push the envelope" geographically, thematically and temporally – making them thus imperfect measures. Nevertheless, they should serve as an initial basis for developing ideas, which may be tested with better data that may be developed.

Table 3-1. Urban and rural population distribution

Country	Population	Est. % 2015/2005 Change	Urban (%) Population	Urban Population	Rural (%) Population	Rural Population
American Samoa	57,084	(decrease) – 4%	33	19,009	67.0	38,075
Cook Islands	21,388	7%	50	10,694	50.0	10,694
Fiji	905,949	15%	51.7	468,376	48.3	437,573
French Polynesia	274,578	15%	40	109,831	60.0	164,747
Guam	171,019	14%	85	145,366	15.0	25,653
Kiribati	105,432	25%	47.3	49,869	52.7	55,563
Marshall Islands	60,422	22%	66.3	40,060	33.7	20,362
Micronesia	108,004	(decrease) – 3%	11.2	12,096	88.8	95,908
Nauru	13,287	19%	16	2,126	84.0	11,161
New Caledonia	239,067	12%	61.6	147,265	38.4	91,802
Niue	1,733	?	60	1,040	40.0	693
Northern Mariana Islands	82,459	25%	85	70,090	15.0	12,369
Palau	21,492	11%	68.6	14,744	31.4	6,748
Papua New Guinea	6,002,079	22%	13.2	792,274	86.8	5,209,805
Samoa	183,308	0%	22.3	40,878	77.7	142,430
Solomon Islands	552,438	26%	16.5	91,152	83.5	461,286
Timor Leste	1,062,777	22%	8	85,022	92	977,755
Tonga	114,689	17%	33.4	38,306	66.6	76,383
Tuvalu	11,810	15%	55.2	6,519	44.8	5,291
Vanuatu	217,955	12%	22.8	49,694	77.2	168,261

[3] Stephan Beckert and Eric Schoonover. Global traffic, bandwidth and pricing trends and wholesale market outlook. Presented at PTC'07.

Table 3-2. Pacific cable and satellite circuit activity reported to the FCC (units are 64 kbps equivalents)

Country	Population	Cable			Satellite Communications			Combined		
	(000s)	2004	2000	1996	2004	2000	1996	2004	2000	1996
American Samoa	57	0	0	0	418	187	82	418	187	82
Cook Islands	21	0	0	0	0	0	0	0	0	0
Fiji	906	297	46	20	14	85	26	311	131	46
French Polynesia	276	0	0	0	42	57	35	4	57	35
Guam [a]	171	1873	1964	533	655	6	94	2528	1970	627
Kiribati	105	0	0	0	0	0	0	0	0	0
Marshall Islands	60	0	0	0	883	156	68	883	163	7
Micronesia	108	0	0	0	89	70	65	89	70	65
Nauru	13	0	0	0	0	8	8	0	0	0
New Caledonia	239	0	0	0	8	8	4	8	8	4
Niue	2	0	0	0	0	0	0	0	0	0
Northern Mariana Islands	83	320	363	0	227	138	337	547	501	337
Palau	22	0	0	0	109	37	28	109	37	28
Papua New Guinea [a]	6,002	30	15	8	8	8	10	38	23	18
Samoa	183	0	0	0	8	16	13	8	16	13
Solomon Islands	552	0	0	0	0	30	0	0	30	0
Timor Leste	1,062	0	0	0	0	0	0	0	0	0
Tonga	115	0	0	0	31	30	30	31	30	30
Tuvalu	120	0	0	0	0	0	0	0	0	0

[a] Some 2004 figures not reported to the United States FCC; figures for 2002-2003 used.

Table 3-3a. Current and forecast teleconnectivity

Country	Population (000s)	Urban Population (%)	Wired Phone (%) 2005	Wired Phone (%) 2015	Mobile Phone (%) 2005	Mobile Phone (%) 2015	Internet (%) 2005	Internet (%) 2015
American Samoa	57	33.0	26.0	40	8.0	70	10.0	60
Cook Islands	21	50.0	34.0	40	8.0	80	20.0	60
Fiji	906	51.7	12.4	25	17.0	80	7.0	60
French Polynesia	276	40.0	21.0	25	34.0	90	22.0	70
Guam	171	85.0	51.0	51	59.0	80	48.0	80
Kiribati	105	47.3	5.1	20	0.7	60	2.4	50
Marshall Islands	60	66.3	8.3	20	1.1	75	3.5	60
Micronesia	108	11.2	11.2	20	12.7	50	13.0	50
Nauru	13	16.0	16.0	25	13.0	80	2.3	60
New Caledonia	239	61.6	23.0	30	57.0	70	32.0	65
Niue	2	60.0	62.0	65	22.0	80	53.0	80
Northern Mariana Islands	83	85.0	40.0	40	27.0	80	13.0	60
Palau	22	68.6	33.0	45	5.0	75	9.0	60
Papua New Guinea	6,002	13.2	1.1	5	0.4	30	3.0	20
Samoa	183	22.3	7.3	20	13.0	60	3.0	40
Solomon Islands	552	16.5	1.3	5	0.2	30	0.8	15
Timor Leste	1,062	8.0	0.2		2.5		0.2	
Tonga	115	33.4	11.3	15	16.0	50	3.0	40
Tuvalu	12	55.2	7.0	10	0.0	60	13.0	50
Vanuatu	218	22.8	3.1	10	6.0	50	5.9	40

Table 3-3b. Estimation of future wired connectivity

Country	Popu-lation	Urban Popu-lation (%)	Urban Popu-lation	Wired Phones (%) 2005	Wired Phones 2005	Wired Phones (%) 2015	Wired Phones 2015	Total Increase (2005-2015)	Rural only Increase
American Samoa	57,084	33	19,009	26.0	14,842	40	22,834	7,992	5,355
Cook Islands	21,388	50	10,694	34.0	7,272	40	8,555	1,283	642
Fiji	905,949	52	468,376	12.0	112,338	25	226,487	114,150	55,134
French Polynesia	274,598	40	109,831	21.0	57,661	25	68,645	10,983	6,590
Guam	171,019	85	145,366	51.0	87,220	51	87,220	0	0
Kiribati	105,432	47	49,869	5.0	5,377	20	21,086	15,709	8,279
Marshall Islands	60,422	66	40,060	8.0	5,015	20	12,084	7,069	2,382
Micronesia	108,004	11	12,096	11.0	12,096	20	21,601	9,504	8,440
Nauru	13,287	16	2,126	16.0	2,126	25	3,322	1,196	1,004
New Caledonia	239,067	62	147,265	23.0	54,985	30	71,720	16,735	6,426
Niue	1,733	60	1,040	62.0	1,074	65	1,126	52	21
Northern Mariana Islands	82,459	85	70,090	40.0	32,984	40	32,984	0	0
Palau	21,492	69	14,744	33.0	7,092	45	9,671	2,579	810
Papua New Guinea	6,002,079	13	792,274	1.0	66,0923	5	300,104	234,081	203,182
Samoa	183,308	22	40,878	7.0	13,381	20	36,662	23,280	18,089
Solomon Islands	552,438	17	91,152	1.0	7,182	5	27,622	20,440	17,068
Timor Leste	1,062,777	8	85,022	0.2	2,125				
Tonga	114,689	33	38,306	11.0	12,960	15	17,203	4,243	2,826
Tuvalu	11,810	55	6,519	7.0	827	10	1,181	354	159
Vanuatu	217,955	23	49,964	3.0	6,757	10	21,796	15,039	11,610
Total	**9,144,193**	**23.1**	**2,115,635**	**5.6**	**507,212**	**10.9**	**991,903**	**484,691**	**348,017**

Table 3-3c. Estimation of future mobile connectivity

Country	Popu-lation	Urban Popu-lation (%)	Urban Popu-lation	Mobile Phones (%) 2005	Mobile Phone 2005	Mobile Phone (%) 2015	Mobile Phones 2015	Total Increase (2005-2015)	Increase for Rural only
American Samoa	57,084	33	19,009	8.0	4,567	70	39,958	35,391	23,606
Cook Islands	21,388	50	10,694	8.0	1,711	80	17,110	15,399	7,700
Fiji	905,949	52	468,376	17.0	154,011	80	724,759	570,748	275,671
French Polynesia	274,578	40	109,831	34.0	93,357	90	247,120	153,764	92,258
Guam	171,019	85	145,366	59.0	100,901	80	136,815	35,914	5,387
Kiribati	105,432	47	49,869	1.0	738	60	63,259	62,521	32,949
Marshall Islands	60,422	66	40,060	1.0	665	75	45,317	44,652	15,048
Micronesia	108,004	11	12,096	13.0	13,717	50	54,002	40,285	35,774
Nauru	13,287	16	2,126	13.0	1,727	80	10,630	8,902	7,478
New Caledonia	239,067	62	147,265	57.0	136,268	70	167,347	31,079	11,934
Niue	1,733	60	1,040	22.0	381	80	1,386	1,005	402
Northern Mariana Islands	82,459	85	70,090	27.0	22,264	80	65,967	43,703	6,555
Palau	21,492	69	14,744	5.0	1,075	75	16,119	15,044	4,724
Papua New Guinea	6,002,079	13	792,274	0.0	24,008	30	1,800,624	1,776,615	1,542,102
Samoa	183,308	22	40,878	13.0	23,830	60	109,985	86,155	66,942
Solomon Islands	552,438	17	91,152	0.0	1,105	30	165,731	164,627	137,463
Timor Leste	1,062,777	8	85,022	2.5	26,570				
Tonga	114,689	33	38,306	16.0	18,350	50	57,345	38,994	25,970
Tuvalu	11,810	55	6,519	0.0	0	60	7,086	7,086	3,175
Vanuatu	217,955	23	49,694	6.0	13,077	50	108,978	95,900	74,035
Total	**9,144,193**	**23.1**	**2,115,635**	**6.7**	**611,753**	**42**	**3,839,518**	**3,227,785**	**2,369,173**

Table 3-3d. Estimation of future Internet connectivity

Country	Popu-lation	Urban Popu-lation (%)	Urban Popu-lation	Internet (%) 2005	Internet 2005	Internet (%) 2015	Internet 2015	Increase (2005-2015)	Increase for Rural
American Samoa	57,084	33	19,009	10.0	5,708	60	34,250	28,542	19,038
Cook Islands	21,388	50	10,694	20.0	4,278	60	12,833	8,555	4,278
Fiji	905,949	52	468,376	7.0	63,416	60	543,569	480,153	231,914
French Polynesia	274,578	40	109,831	22.0	60,407	70	192,205	131,797	79,078
Guam	171,019	85	145,366	48.0	82,089	80	136,815	54,726	8,209
Kiribati	105,432	47	49,869	2.0	2,350	50	52,716	50,186	26,448
Marshall Islands	60,422	66	40,060	4.0	2,115	60	36,253	34,138	11,505
Micronesia	108,004	11	12,096	13.0	14,041	50	54,002	39,961	35,486
Nauru	13,287	16	2,126	2.0	306	60	7,972	7,667	6,440
New Caledonia	239,067	62	147,265	32.0	76,501	65	155,394	78,892	30,295
Niue	1,733	60	1,040	53.0	918	80	1,386	468	187
Northern Mariana Islands	82,459	85	70,090	13.0	10,720	60	49,475	38,756	5,813
Palau	21,492	69	14,744	9.0	1,934	60	12,895	10,961	3,442
Papua New Guinea	6,002,079	13	792,274	3.0	180,062	20	1,200,416	1,020,353	885,667
Samoa	183,308	22	40,878	3.0	5,499	40	73,323	67,824	52,699
Solomon Islands	552,438	17	91,152	1.0	4,420	15	82,866	78,446	65,503
Timor Leste	1,062,777	8	85,022	0.2	2,125				
Tonga	114,689	33	38,306	3.0	3,441	40	45,876	42,435	28,262
Tuvalu	11,810	55	6,519	13.0	1,535	50	5,905	4,370	1,958
Vanuatu	217,955	23	49,694	6.0	12,859	40	87,182	74,323	57,377
Total	**9,144,193**	**23.1**	**2,115,635**	**5.8**	**532,783**	**30.4**	**2,785,333**	**2,252,553**	**1,553,596**

Table 3-1 populations are harmonized from several sources, as are figures for urbanization. Pacific island economies may have better figures for their own territories. In addition to these figures, the population density distribution maps produced by the "Gridded Population of the World Project"[4] may be very useful to planners, particularly in estimating potential cable lengths or deciding between terrestrial microwave, cable, satellite, wireless (e.g., WiMax) networking, and possible maintenance-redeployment-upgrade of over-the-airwaves infrastructure, including broadcasting and communications radio. Note that the estimated population for the Pacific is over 11.5 million by 2015, a 20 per cent increase, according to forecasts by the United States Bureau of the Census.[5]

Table 3-2 data are reported by the United States Federal Communications Communication, based on reports from carriers of traffic to or through the United States. Data on States sending international traffic directly to another country (and not through the United States) are not reported here. This is an imperfection in Table 3-2 for our purpose of understanding international traffic to and from Pacific island economies. Indeed, an organization such as the Pacific Islands Telecommunications Association may wish to maintain a more complete version of such data on its Website, for use by potential development partners.

Table 3-3 makes growth forecasts for fixed line and mobile telephony and for the Internet. It assumes that broadcast radio and television will remain stable, unless mobile telephony or the Internet become supplemental means of delivering radio or television programming to potentially wider audiences (which could be global, including serving overseas nationals or friends of Pacific

4 http://cedac.ciesin.columbia.edu/gpw/.

5 http://www.census.gov/ipc/www/idbprint.html.

island economies). The estimates should be considered educated guesses, based partly on socio-economic development (Human Development Index), current telecom penetration rates, and the anticipated onset of competition that may bring new products and services to the market and lower prices. Looking at growth patterns elsewhere, when countries have gained competitive connectivity, usage has increased in line with estimates made here for the Pacific.

The main message here is that new, competitive products and services should be able to find customers if Pacific island economies follow best practices elsewhere – particularly for small, disparately located concentrations of people.

The estimates do not incorporate gains from estimated population changes noted in the second column of Table 3-1, many very significant. Planners would do well to include such population growth estimates in their telecommunication policies and activities aimed at services for their populations.

Table 3-4 shows the increase in demand for telecommunications "pipe" in Asia and trans-Pacific,[6] and it presents normalized low (generally trans-Pacific) and high growth (generally intra-Asia) patterns from such data. Asia Netcom, reported by Barney in the presentation just cited, forecasts that Asian traffic will continue to grow, as reflected in Table 3-5 (which uses Telegeography figures reported by Barney, and other figures reported directly by Telegeography). Such forecasts (and broadly similar statements by others) appear to indicate a return to heady optimism, as in the late 1990s. However, even at half such forecast growth rates, the next decade appears to be one of very significant growth, fuelled by more affordable bandwidth, plus bandwidth-consuming products and services.

For the Pacific, possible implications are that, with a diversity of national policies, socio-economic situations and resultant demands for bandwidth, growth has been significant elsewhere – with the need for bandwidth growth greatest for Internet and other (e.g., private) networking. Such high relative (not absolute) bandwidth growth is possible in the Pacific, as multimedia content is downloaded to – and perhaps also created and served from – the Pacific. Such growth can occur with users and developers working from Internet cafés and community e-centres, offices, businesses, homes, and wireless networking coverage areas (including via mobile phones).

If the region sits on the sides during this period of growth, it risks being bypassed – yet proactive approaches may help get the Pacific connected as cables are laid and satellite systems put into service.

Because international fibre-optic cabling is scalable, there is opportunity for it to serve population centres, and readily deployable and locally scalable communications satellites may provide universal coverage – if accessibility is made affordable. Potential users have funds to pay for new and affordable telecommunication products and services. With the US$300 – US$400+ million estimated to be saved by customers over five years from competitive telecommunications in the Pacific,[7] and the trends described in Figure 3-1, revenues should be available for investments in complementary satellite and cable infrastructure that can be designed for optimal cost-efficiency.

[6] Source: Telegeography, reported by Bill Barney, 2007. Crisis, Opportunity and the Submarine Cable Industry. Presented at PTC'07, January 2007.

[7] See the discussion in Chapter 1 of Professor James McMaster's work.

Table 3-4. Demand levels (GBps), 1997-2007

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Intra-Asia										
Total used capacity	2.3	8	16.1	29.8	57.6	105.7	181.4	318.7	545.2	902.8
Voice	1.3	1.7	1.9	2.3	2.9	3.5	4.2	5	5.9	6.9
Internet	0.3	2.8	8.3	18.8	41.7	84.8	157.3	290.8	512.9	865.8
Other networks	0.7	3.5	5.9	8.6	1.3	17.3	19.9	22.9	26.3	30.3
Trans-Pacific										
Total used capacity	6.3	13.3	28.2	60.2	82.1	135.1	212.8	33.5	517.2	774.4
Voice	1.7	1.8	1.9	2.2	2.8	3.7	4.7	5.9	7.2	9
Internet	1.6	5.6	1.7	40.1	61.2	108.2	181.4	299.4	474.7	724.7
Other networks	3	5.9	9.3	17.8	18.2	23.2	26.7	30.7	35.3	40.6
Normalized Low Bandwidth Growth										
Total used capacity	1	2.11	4.48	9.56	13.03	21.44	33.78	53.17	82.1	122.92
Voice	1	1.06	1.12	1.29	1.65	2.18	2.76	3.47	4.24	5.29
Internet	1	3.5	10.63	25.06	38.25	67.63	113.38	187.13	296.69	452.94
Other networks	1	1.97	3.1	5.93	6.07	7.73	8.9	10.23	11.77	13.53
Normalized High Bandwidth Growth										
Total used capacity	1	3.48	7	12.96	25.04	45.96	78.87	138.57	237.04	392.52
Voice	1	1.31	1.46	1.77	2.23	2.69	3.23	3.85	4.54	5.31
Internet	1	9.33	27.67	62.67	1.39	282.67	524.33	969.33	1709.67	2886
Other networks	1	5	8.43	12.29	18.57	24.71	28.43	32.71	37.57	43.29

Table 3-5. Bandwidth usage growth and pricing: Asia and global

	2006	2007	2008	2009	2010	2011	2012	2013
Intra-Asia Used Capacity (GBps)	545	902	1300	2600	5000	9500	16000	30500
Intra-Asia Demand Growth	+60%	+50%	+40%	+35%	+20%	+19%	+18%	n.a.
Intra-Asia Pricing	0%	–2%	–4%	–5%	–18%	–20%	–18%	n.a.

Source: Various Telegeography media releases, AsiaNetcom as reported at PTC'07.

III. The Pacific, a Telecommunications Crossroads

The Pacific has long been a crossroads for commerce between Asia, the Americas, Australia, New Zealand, plus between and within individual groupings of islands. It is certainly such a crossroads now, as cables are deployed within or near the territorial waters of Pacific island economies, and as communication satellites orbit overhead. Unfortunately, much of the best connectivity has passed directly through or over the Pacific. A challenge is to tap into such connectivity to benefit Pacific economies.

However, the earthquake of 26 December 2006 brought to Asia the reality experienced by the Pacific when Intelsat satellite 804, at 174^{o} East longitude, failed in January 2005, causing widespread outages of connectivity throughout the Pacific. Those failures, and recent troubles with the GlobalStar constellation, initially attributed to unexpectedly high degradation in the space environment, remind us of the vulnerability of both submarine and space-based telecommunications. Indeed, with the

Earth near a low in the 11-year sunspot cycle,[8] the fact that satellites are having such difficulties does not bode well for 5-6 years from now.

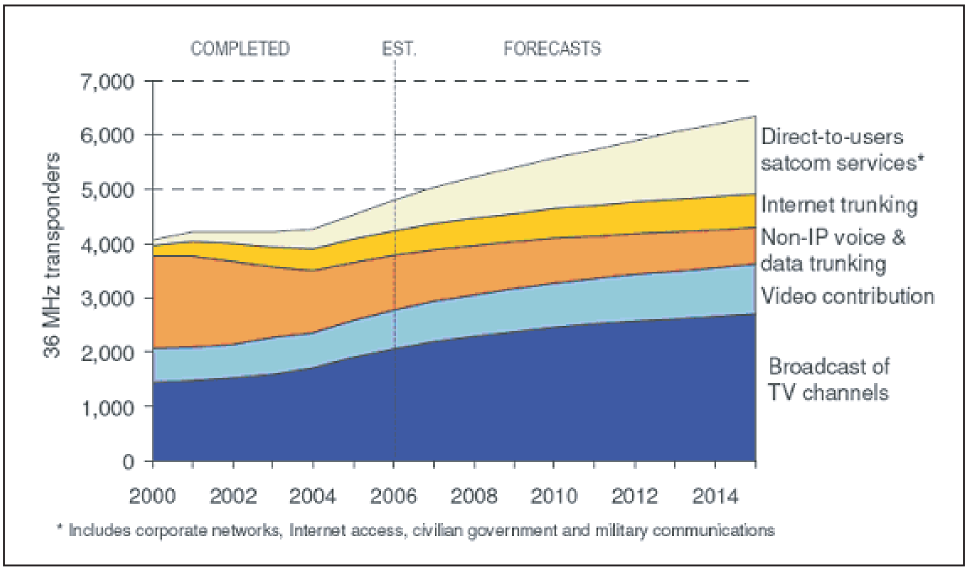
All this argues for a cautious paradigm for new telecommunications infrastructure for the Pacific. Cabling systems should not all traverse the same seismically active zone or other areas at risk of causing service interruptions. Satellites should be well-built to withstand space weather. The former paradigm should serve the Pacific well, as a diversity of cabling routes can reach new markets. The latter paradigm indicates that satellite infrastructural designers may need to refresh their understanding of space weather.

IV. Global Trend of Commercial Satellite Services

In 2001-2003, commercial satellite services experienced an unprecedented crisis resulting from a global economic downturn, which broadly affected the telecommunications business. According to a report by Euroconsult, global transponder capacity demand stabilized at around 4,200, 36 MHz equivalent transponders. In 2004, capacity grew, totalling more than 4,500, 36 MHz equivalent transponders in the combined C band, Ku band and Ka band (around 70 per cent fill-in rate).

As shown in Figure 3-2, such research further indicates the overall growth of worldwide utilization of satellite capacity for the different major segments of the satellite telecommunication market. Total demand is forecast to increase from 4,200 transponders in 2004 to 6,500 transponders by 2015.

Figure 3-2. Transponder demand by application: from 2000 to forecast 2015



Source: http://www.euroconsult-ec.com/pdf_news/synthese-ws2-financial-community-final-4a.pdf.

[8] At peaks of the 11-year sunspot cycle, associated electromagnetic activity has been known to interfere with, or even destroy, satellite systems, thus interfering with predictable radio propagation and contributing to increased transmission losses in terrestrial power systems.

Broadcasting, including direct-to-home (DTH) broadcasting and distribution of television content via satellite, consumes more than half of this projection, accounting for around 52 per cent of total demand; while telephony, data and Internet trunking are expected to require around 3,000 transponders, or 40 per cent of total demand. One of the most significant trends identified by this forecast is the emergence of Internet direct broadband access, which is expected to trigger demand approaching 1,000 transponders. As a result, commercial satellite services will be revitalized in delivering worldwide information and communication technology services.

V. Benefits and Risks of Enhancing Pacific Connectivity

A. Economic and Social Benefits

Enhancing Pacific connectivity can play an important role in the economic and social development of Pacific island economies. Establishing community communication centres, for example, in communities where shared resources may be economically and socially effective, can both enhance communication and community spirit among residents and connect them globally. Such centres, as well as other ICT services, also generate employment opportunities for people in the community. However, the level of employment growth may vary, depending on the scope of services and the nature of transactions handled by each centre. In the long run, such ICT enhancement should help operators reduce their unit costs of services, and will help enablers to reach more people quickly, resulting in a decrease of service fees to end-users, and the expansion of impact and demand.

Other indicators of economic benefit are also of interest. For example, people trained to operate communication centres acquire new skills that can stimulate the community economy. Trained staff could offer new services such as customer relations, computer hardware/software technology and the operation of communication technology. To parts of the private sector, such as small or medium-sized business operators (SMEs), the expansion of ICT facilities among and between the Pacific islands will offer new business/service opportunities, new tools and new knowledge. This will stimulate the local business sector, attract more foreign investors and finally lead to an increase in the national GDPs of Pacific economies. It has been shown in the past that attracting highly skilled personnel to relatively quiet, dispersed communities has been a challenge. However, the very connectivity supported by such ICT specialists will bring these communities into the global mainstream, and may be particularly attractive to enough people to sustain SMEs, particularly if such personnel can be shared around the Pacific under the umbrella of a regional cooperative mechanism (see the Overview and Chapter 4).

B. Economic and Social Risks

One of the consequences of enhancing Pacific connectivity concerns the distribution of benefits: who gains and who does not. Of course, the goal is to bring appropriate marketplace products and services to everyone. Although governments in the Pacific will seek to distribute benefits broadly, in reality the expanded telecommunication apparatus may initially favour the sections of the community who are capable of using the new opportunities. For example, rich and poor residents experience information and communication technology differently. On one hand, moneyed and educated segments may enjoy using direct international telephone access, Internet and emailing facilities, multimedia downloads and the like. Moreover, owing to cost structures, only corporate bodies and educated urbanites with substantial incomes are initially likely to use these services on a large scale. On the other hand, people of more modest means – such as labourers, farmers and fishermen –

who have limited budgets, skills and training, will experience limited access to the information and communication facilities. Nevertheless, it has been shown that, if economical means of access are available – such as entry-level mobile phones and Internet caf s and e-centres – that people on low budgets will still acquire a used or entry-level mobile phone and incorporate affordable ICTs into their lives when possible.

Another inequality can stem from the different service tariffs in different areas. For example, residents in small towns may have to pay more to use information and communication services similar to those for urbanites because of the higher unit cost to rural telecommunication service operators. This differential cost thus has an impact on the ability of non-urbanites to afford or benefit from the information and communication services. Again, there will be a need to explore the scope for creative accounting or other means to serve outlying communities, without compromising the viability of the new systems in more highly capitalized areas.

C. Opportunity

While enhancing Pacific connectivity may have uneven initial benefits and costs, residents of Pacific island economies would, through expanded connectivity, now have the opportunity to benefit from access to information and communication technologies. Just as in Africa and China we are seeing economic expansion assisted by rapid penetration of mobile phones and other ICT, it is likely to be so, as well, for the Pacific after the expansion of satellite and associated capacity.

VI. Commercial Viability Analysis

This section of the report studies the affordability of telecommunication services in Pacific island economies and compares the estimated costs of providing the services in order to assess the commercial viability of providing telecommunication services in the region.

A. Affordability Assessment

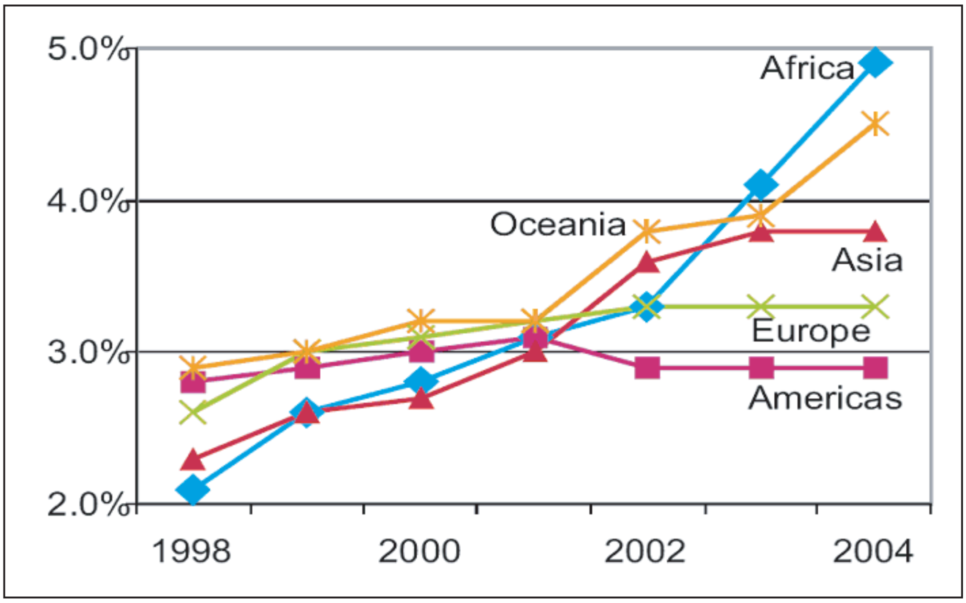
Two approaches are presented below: (a) Percentage of GDP, and (b) Average Revenue per User.

1. Percentage of GDP Approach

The Percentage of GDP approach considers information and communication service revenues as a percentage of GDP globally and applies them to the Pacific island economies in order to determine the purchasing power of residents. Figure 3-3 presents percentages of telecommunication service revenues per GDP for each continent from 1998 to 2004.

Figure 3-3 indicates that the global percentages of telecommunication revenue per GDP in 2004 vary from 2.9 per cent in the Americas to almost 5 per cent in Africa. These figures can be used as an indicator to estimate the purchasing power in Pacific island economies for information and communication services.

Figure 3-3. Telecommunication service revenues as a percentage of GDP, 1998-2004



Source: International Telecommunication Union, World Telecommunication Development Report 2006. http://www.itu.int/dms_pub/itu-d/opb/ind/D-IND-WTDR-2006-SUM-PDF-E.pdf.

As in the "Socio-Economic Situation" section in Chapter 1, the sample group of Pacific island economies includes America Samoa, the Cook Islands, Fiji, French Polynesia, Guam, Kiribati, the Marshall Islands, Micronesia, Nauru, New Caledonia, Niue, Norfolk Island, the Northern Mariana Islands, Palau, Papua New Guinea, Samoa, the Solomon Islands, Timor Leste, Tokelau, Tonga, Tuvalu, Vanuatu, and Wallis and Futuna. In order to characterize the average GDP per capita, the four highest GDP per capita (Norfolk Island, French Polynesia, Guam and New Caledonia) and the three lowest GDP per capita (Tokelau, Tuvalu and Timor Leste) economies were removed (somewhat akin to the "Olympic Scoring Method"), leaving a total of 16 sample countries. The estimated "average" GDP per capita of the PIEs then is US$4,867. As a result, their purchasing power for information and communication services varies from US$12 to US$20.8 per month.[9] (By comparison, in Thailand, which does not have full competition in telecommunications, unlimited dial-up Internet costs US$8/month, and a basic prepaid mobile phone account can cost the same. Therefore, such revenues can support significant telecommunications usage – even before considering the sharing of resources between families or in e-centres.)

2. Average Revenue per User Approach

The Average Revenue per User approach takes into account the average revenue per user (ARPU) of the telecommunication services in the PIEs. The table below presents samples of population, total telecommunication revenue for each country in 2004, and the calculated ARPU for each country.

From Table 3-6, we find that the average monthly ARPU of the 12 sample countries is US$8.74. This figure is indicative only of the monthly amount PIE residents are currently willing to pay for the telecommunication services with existing configurations.

[9] If we consider extremes, the Northern Mariana Islands figure could be US$36 – US$52/month, whereas Tokelau might be US$2.50 – US$4.15/month. Even the latter can be appropriate for shared capacities through e-centres.

B. Case Study: Consumer Broadband Service

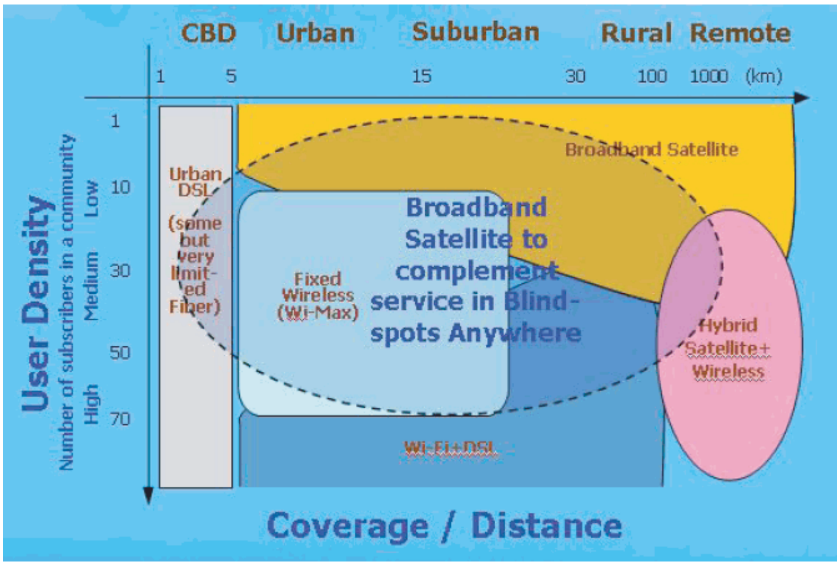
This case study was conducted by Shin Satellite PLC, Thailand in order to indicate the generic end-user prices for consumer broadband in different scenarios via different solutions, such as urban DSL, fixed wireless, WiFi, broadband satellite, and others. Moreover, it also estimates the monthly cost of consumer broadband and compares it to DSL and broadband satellite (IPStar) costs.

Table 3-6. Average telecommunications revenue per user, Pacific island economies

Country	Population	Total Telecommunication Service Revenue in 2004 (US$ Millions)	Telecommunication Monthly ARPU (US$)
Fiji Islands	905,949	120.70	11.10
Kiribati	105,432	4.40	3.48
Marshall Islands	60,422	6.60	9.10
Micronesia (Federated States of)	108,004	12.00	9.26
Nauru	13,287	1.50	9.41
Palau	21,492	8.01	31.06
Papua New Guinea	6,002,079	115.88	1.61
Samoa	183,308	16.00	7.27
Solomon Islands	552,438	11.57	1.75
Tonga	114,689	6.92	5.03
Tuvalu	11,810	1.50	10.58
Vanuatu	217,955	13.74	5.25

Source: International Telecommunication Union (ITU) Database (http://www.itu.int) and the Stocktaking of UNESCAP's Pacific Island Connectivity project.

Figure 3-4. Broadband services appropriate for given urban and rural settings



1. Consumer Broadband: End User Prices

Figure 3-5 is a schematic representation of connectivity market share in a typical country that has such options available. In central business district (CBD) areas, connectivity is dominated by fibre-optic and DSL services. Currently in the Pacific, rural connectivity may be dominated by two-way radio, but might benefit from a build-out of satellite and terrestrial wireless infrastructure. Figure 3-5 also demonstrates the diversity of services available in an early 21st-century diversified market.

Figure 3-5. Broadband market share in economic centres to remote rural areas (typical worldwide scenario)

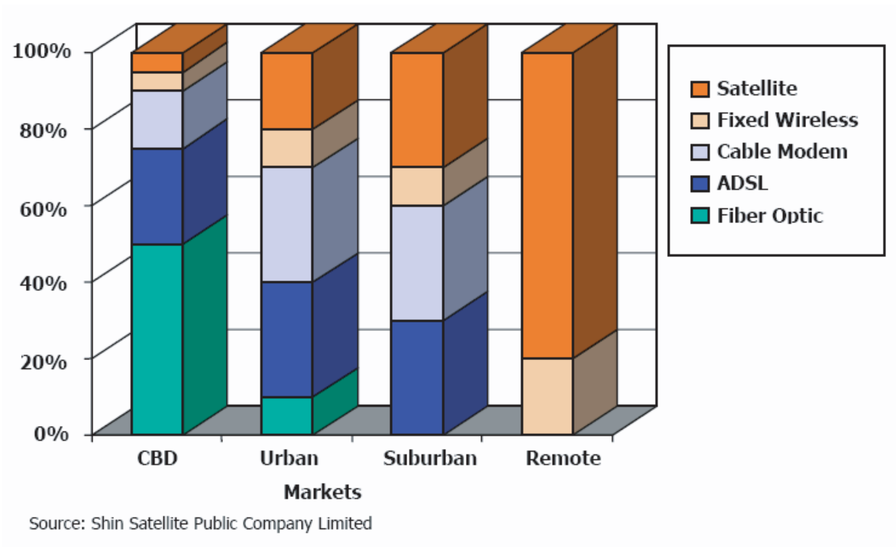


Figure 3-6 shows that in CBD and urban areas, where consumer broadband user density is high, the most appropriate solution for providing the telecommunication services may be urban DSL. Monthly prices of urban DSL service in an area where DSL infrastructure exists may vary from the US$15 price in suburban areas, where there is medium density of broadband consumer users. WiFi + DSL and fixed wireless are often attractive options with monthly end-user prices between US$20 – US$35. Broadband satellite is often essential in rural and remote areas. One of the most important benefits of a satellite solution is that consumer broadband via satellite can also be used to complement service in blind spots anywhere under the satellite's service area, regardless of terrain. The monthly end-user prices of broadband consumer service via broadband satellite vary from US$30 to US$40. It is noted that concentrations of people in rural areas, such as in villages, might benefit from a central satellite terminal or cable point – whose reach is extended by WiMax or other wireless networking. Similarly, even in some urban areas, if costs of installing cable are high, or administrative restrictions inconvenient, satellite might be cheaper or quicker to install – again linked to wireless networking to extend the number of people served by the satellite terminal.

Figure 3-6. Satellite broadband and wired end-user service scenarios (Service flow is from right to left)

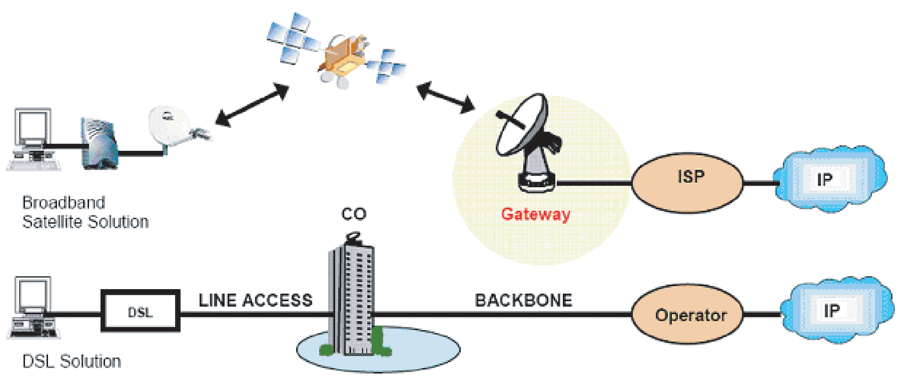


Table 3-7 presents the estimated broadband market share, average for most countries. In CBD areas, the broadband market is dominated by fibre-optic and ADSL services. However, broadband service via satellite plays a much bigger role in remote areas.

Table 3-7. Cost schematic for wired (DSL) vs. wireless (broadband satellite) end-user connectivity

Platform Infrastructure	Total Cost per User (USD/Sub/Month)	CPE (5 years)	Last Mile Line Access	DSLAM Equipment (5 years)	Domestic Backbone	ISP Services			IP Network
						Billing	Call Centre	Network Operation	
DSL	16	1.9	2.5	3.1	1.7	1	1.3	2.5	2.5
Broadband Satellite	32	17	8 (BW + GW Cost)			1	1.3	2.1	2.5

Source: Shin Satellite Public Company Limited.

2. *Consumer Broadband: Monthly Cost Comparison*

In general, in the areas where DSL infrastructure exists, it seems that DSL's monthly cost per user is only half of broadband satellite's cost. This difference results mainly from the high cost of a broadband satellite's user terminal or consumer peripheral equipment (CPE). As specified in Table 3-7, the estimated monthly cost per user for DSL and broadband satellite consumer broadband services is US$16 and US$32 respectively.

C. Commercial Viability

The affordability and unit cost studies of consumer broadband services suggest that there may be a gap between the cost and purchasing power of some residents of the Pacific, especially when considering the ARPU approach. Using the Percentage of GDP approach, average monthly purchasing power for telecommunication services varies from US$12 to US$20.8, while the average purchasing power becomes US$8.74 per month per person with the ARPU approach. Nonetheless, the unit cost of consumer broadband via DSL and via satellite is US$16 and US$32 respectively.

However, this discusses individual GDP per capita – which may be more appropriate for developed than developing economies. There are often several individuals in a household. Sharing resources would thus often be sufficient for Internet and at least one (mobile or fixed-line) phone per household. Where communities are comfortable sharing phone or Internet access, a pro-active service model could support individual accounts (which could be shared among households or neighbourhoods). Of course, shared resources such as e-centres and call centres facilitate access for people of more modest means, and may add a social ambiance to the process.

Some relatively simple mechanisms have reduced real costs to users of connectivity. These include efforts to make available low-cost (simplified but high-quality) mobile phone handsets and (recently, with the commercial success of the ASUS eee 701 low cost notebook computer) and portable computers, availability of low-cost prepaid Internet and mobile phone recharges, reduced import duties/taxes on basic ICT equipment, etc.

As demonstrated in a number of countries, if mobile and land line telecommunications can be opened up to competition and micro-finance techniques, this both expands the market base for telecommunications and stimulates a range of economic activity. Therefore, we should be encouraged by these calculations. In higher-income economies, much flexibility of individual options is possible. In lower income economies, family/clan/communal sharing or e-centres and Internet cafés should serve to bring such facilities to everyone, as happens elsewhere.

It is noted here that, in the short term, reductions in cost of existing communications satellite capacity may be achieved if Pacific island economies join together to jointly lease one or more full transponders, as opposed to small States leasing parts of transponders at higher rates. Leasing in units of one or more *full transponders*, for relatively longer terms (e.g., more than 2-3 years where possible), should markedly reduce per-byte rates. An extension of the example of the shared leasing partnership between OPT French Polynesia and Telecom Cook Islands, as noted in section 2C of this report, might serve several Pacific island States well.

Chapter 4

Institutional and Associated Financial Considerations[1]

I. Introduction

Dramatic cost declines of ICT products and services in comparator small and developing economies indicate that such costs could also drop in the Pacific. New infrastructure is achievable. New entrants are interested in providing service.[2] New benefits in jobs, services, and quality of life for residents of other countries can be brought to the Pacific, if supportive conditions can be put into place.

Now is an excellent time to pursue progress. However, the need is not for a once-and-for-all technical solution – since telecommunications is far too dynamic an industry for that. Rather the need is for an institutional and management arrangement (or support system) capable of fostering good decision-making, and strong Pacific telecommunications infrastructure, services and opportunities.

A defence of the current telecommunications situation could be that it is not possible, given the economies of scale in telecommunications, for scattered and sparsely populated Pacific islands to finance state-of-the-art participation in the new information economy. This study indicates that the situation is much better than many people may realize.

There remain the questions: "Which Pacific States are truly motivated to solve this problem?" and "What improvements in progress can be achieved through joining forces and sharing resources/ expertise, and which ones might best be done with opportunities available at local levels?" Some States (in the Pacific, and in somewhat parallel situations) are making changes, and beginning to see good results.

With new regulatory and corporate structures, possible catalytic assistance from development banks or others, and importantly through declining costs, stakeholders in the Pacific should be able to support operations of a Pacific telecommunication authority, or mechanism, (e.g., "PACITEL")[3] and a contracted platform operator (e.g., "PACSAT"),[4] or other means of cooperating on decision-maker support, policy and systems toward beneficial connectivity improvements.

---

1 This chapter was written by Michael Porter, with modest edits by the ESCAP secretariat, in response to reviews.

2 We now have new entry into airline services through the Virgin group, who are also active in mobile phones. Digicel are seeking to enter Pacific telecoms following expansion in the similar geographic region in the Caribbean.

3 This name is merely an example. Several existing institutions, such as the Pacific Islands Forum Secretariat, could conceivably perform such a function without the necessity of forming a new entity.

4 This name is also simply an example. "PACSAT" may be one or (preferably) more platform entities, each partnering with the regional cooperative authority and its member States to provide cable, satellite and/or terrestrial wireless platforms. The service providers should operate for the benefit of all Pacific economies, and should be barred from having any restrictive political, diplomatic, social, economic or other agenda. Ability to abide by transparent and agreed-to financial and governance criteria should be the only prerequisites for States to participate as partners in the co-management of the telecom mechanism, to benefit member States with sustainable and enabling platforms, products and services. The organization or consortium of service providers could be composed of existing entities (such as a corporatized Pacific Islands Telecommunications Association, or individual or consortium of PITA members).

Catalytic efforts by development banks, donors and (most importantly) Pacific governments can be invaluable in fostering an expanding array of telecommunications entities and ICT service providers. These can drive expansion of services and eventually enable a self-sustaining telecommunications sector. Financing an enhanced satellite and cable "backbone" should deliver capacities for existing and new services. Though initial costs might be slightly higher than in larger markets, current cost gaps can be narrowed, allowing the Pacific's economical but educated workforce to create jobs and other opportunities.

A multi-State Pacific telecommunication authority could serve to expand capacity to be used by private and public sector firms that critically need better telecommunications. Such an authority could derive from existing institutions, or from logical extensions of them. By working with governments and public and private parties to implement an institutional and financial framework for progress, such an authority would greatly benefit the business/service plans for telecommunications in all the participating Pacific States.

While there is no need to mimic others, Pacific connectivity enhancements might benefit from leveraging recent experiences in the Caribbean, circum-Africa, Scandinavia, China and southern Asia. Mobile phones in the Bangladeshi Grameen example have been in part self-financed, at affordable rates, helping to transform local economies and social connectivity. Grameen is an example of a new financing methodology showing the way for the spreading of new technology to the poor. Indeed, with mobile telephones now reaching 33 million (22 per cent market penetration) in Bangladesh, the Grameen business model is being utilized less than previously – but may be an invaluable transitional model for Pacific States that have yet to realize widespread access to telephones. Low-cost computer initiatives are growing. Bandwidth demands from less-educated or low income people are potentially larger, not smaller than in better-educated or richer economies, as more multimedia-intensive content may be needed for development-oriented services and applications, as well as for entertainment – as "the message may be in the medium" more than "in the content" than for some technical or business applications. A challenge may be to leverage such experiences to create content relevant to all in the Pacific.[5] Appropriately placed e-centres could be designed on a community or clan/family service model, to provide connectivity, entertainment, and beneficial services.

While estimated benefits from expanding multi-sectoral connectivity are huge – of the order of US$60+ million per year as summarized in Chapter 1 – we do not really need detailed cost-benefit analyses when the costs of *not* having sound institutions and technologies in the telecommunications sector are most likely to be far in excess of the annualized direct costs of appropriate technologies. The benefits to markets and society of a sound and dynamic communications and information system have tended to be much greater than anticipated over the past 15 years. They also add dignity and vitality to living in often remote communities. The new technologies also have the real prospect of attracting people both from the "Pacific diasporas" and natives of more developed countries, i.e., people who would like the mix of a Pacific life and reliable communications.

The main objective of this study is not to further debate or document the new ICT revolutions – beyond what appears elsewhere in this report and appendices, that task is for others, and indeed it is well-understood in general terms across the media.

---

[5] See for example, the One Laptop per Child initiative of MIT Media Lab, http://laptop.org/, and for comment see http://wiki.laptop.org/go/One_Laptop_per_Child.

What is sought is to facilitate sustainable and ultimately self-financing access across the Pacific to improved and cheaper telecommunications services, including mobile phones and broadband Internet. As manifest in the Pacific Regional Digital Strategy,[6] there is a desire to use and possibly piggy-back on new technology being developed and applied elsewhere – satellites, cables and wireless systems – so that living, working, investing and holidaying in the Pacific can be an attractive option for all people. New technologies can make residence in such Pacific island locations compatible with being fully in communication with the rest of the world, but the costs and convenience to date are a problem – and this is the challenge.

While there is a bewildering range of new technical possibilities, there is a risk of wasting considerable public sector resources on unsustainable approaches to infrastructure and services. If a proposal calls for large direct governmental investments, or of governmental commitments to build and main infrastructure, that proposal should be looked at with caution, even suspicion. A truly sustainable process should be commercially viable, and should have the backing of reputable commercial providers. However, governments have a critical role: they need individually to support the creation of a predictable policy environment if new investments within their countries are to be feasible and less risky than investments of the past. A predictable policy environment will lower capital costs by lowering risk, making such risk easier to predict, with the result that lower-cost funds will be available for such projects – enabling services to be more affordable to final customers. A harmonization/ coherence of approaches by Pacific States, to enable providers to work similarly and predictably in several Pacific States, is likely to attract more successful partnerships – than if each Pacific State separately creates regulatory and business regimes that lack such regional harmony/coherence.

Finally, on the need for aid finance, there are many external benefits from what is proposed, in terms of educational, health, weather and disaster-management facilities based on new telecommunications. Poverty, isolation, and a shortage of opportunity in the Pacific is also a breeding ground for disaffected groups. All of this makes a case for development bank and official governmental development assistance (ODA) seed capital. The development banks have been active in such reform space, despite long setbacks. It would seem essential that they continue their support of the process, particularly of regulatory and institutional reform, and support for good decision-making, seeking to bring the benefits of competitive telecommunications. It was such support (from the World Bank) that helped trigger the beneficial ECTEL reform on telecommunications in the Caribbean. One way of summarizing the emerging opportunities is that a case can be made for a trans-Pacific telecommunications authority reporting to and supporting Pacific island economies, which would have a structure and legal capacity to negotiate contracts for a platform entity. The platform service entity would structure and finance the backbone system, which probably would be a mix of existing satellite, relocated cable and new dedicated/shared satellite and terrestrial wireless capacity, which could be serviced competitively to expanding and competitive telecommunications entities in Pacific island economies. Illustrative sample options are sketched out elsewhere in this document – as discussion points for the Pacific to consider as it crafts its strategy and implementation agenda. We note that it is by no means essential that the authority facilitate Pacific ownership of satellite capacity, as even one of the largest telecommunications entities in the Pacific, Telstra in Australia, owns no satellites and contracts for all capacity on a purely commercial basis.[7]

---

6 As part of the Pacific Plan for Strengthening Regional Cooperation and Integration, 2005.

7 Note that this could imply an opportunity for an appropriately designed Pacific satellite. It might be able to provide services for Pacific states, but also provide some competitive services for nearby companies, such as Telstra, if it can offer cost-effective services for such firms – and thus use such revenues to improve economies of scale for the owners of such services.

II. Institutional Support: Considerations

With the right organizational and investment structures the framework for delivering new low-cost services can become clearer and stronger. The established authority could have a charter for facilitating service delivery by private entities now active, or potentially active, in the satellite, cable and terrestrial wireless arena. There will, however, be a need for expertise, training and incentives in any new Pacific regulatory structure and in the member governments and agencies, so that officials and their advisers are capable of matching the dynamic and well-financed private sector participants and competitors. The need for a new telecommunications authority is highlighted by the following considerations:

(a) When the identity and legal status of the consortium managing the investment is uncertain;

(b) Where the technology to be used is rapidly evolving, so that competitive modes of provision of service make demand and thus revenue projections difficult.

Put in other words, there is a need to choose the best charter, form and financial structure for a Pacific telecommunications authority, which may in turn attract, negotiate and arrange partnerships, provisions and finance for an expanded capacity to provide telecommunications services. Existing stakeholders in Pacific telecommunications will have a diversity of suggestions for such an authority – which could be harmonized to guide the formation of the actual body.

In summary, the suggestion is that a there be formed a cooperative Pacific regional authority with all[8] Pacific governments as members, a clear charter, and a management charged with implementation of the charter free of day-to-day political interference. The ECTEL documentation provides a guide to what would no doubt be adapted to the situation in the Pacific.

A significant aspect of institutional design will be enabling sound contracts to be written and enforced by the new regional mechanism, so that funding can be obtained by platform/service entities. If risks are mitigated through sound allocations and incentives, this will also enable the costs of capital to be minimized for the class of activity.

Platform operators should operate for the benefit of all Pacific island economies, and should be barred from having any restrictive political, diplomatic, social, economic or other agenda. The ability to abide by transparent and agreed-to financial and governance criteria should be the only prerequisites for States to participate as partners in co-management of the regional cooperative mechanism, to benefit member States with sustainable and enabling platforms, products and services.

A. Convergence of Telecommunications Services

The fact that there is convergence of information and communication technologies, applications and services indicates that it no longer makes sense to think of excluding service providers from some of the wired, wireless, television, radio, Internet and mobile services – as increasingly the technologies overlap and converge. The latest mobile phones embody all of these technologies and more, and they will be relevant devices and become relatively cheap over the time frame of the satellite investments.

While it can be meaningful to define and auction spectrum ranges, many questions can be raised about the virtue of defining technical boundaries for regulatory purposes. There may be merit in having limited geographical franchises and so facilitate benchmark competition, yet it may be useful to reconsider the restrictions that prevent Internet service providers, mobile phone companies and land line companies from competing with each other. Companies such as Alcatel and Motorola will

[8] Or as many states as can be prepared to move forward, together, in such manner.

argue for removing cross-technology boundaries, within regional franchise models. Because of small numbers across some parts of the Pacific, it is an interesting question as to how many full-range service providers would prove economic and viable, and how many of these might come from the incumbents (or perhaps alliances/consortia of such incumbents – perhaps in the future acting regionally rather than merely in one State). However, that number should be adequate, if providers are rewarded for being efficient.

B. Tender Processes

One priority for development is the process by which the regional authority would call for tenders to meet desired investment and service goals. Preparation of such process will require substantial inputs of a complex nature – technical, legal and financial. The need for, and definition of, such a tender process, and the goals to be delivered, might be part of the charter of any cooperative mechanism.

The development of financing options for Pacific telecommunications will be made easier if the required goals are clear and private parties/consortia can make conforming tenders, albeit with the right to suggest modifications. What we know from extensive experience with private sector financing of infrastructure across the globe, is that governments and their agencies (including international bodies) can (and should) create a climate of trustworthiness and income predictability for investors that makes such investments attractive to those ultimate lenders with long-term funds available at acceptable rates – e.g., pension funds.[9]

The term "income predictability" includes factors such as agreement on access charges, user charges, lease fees and processes for setting user charges, for example. In general there should be only direct national or supra-national regulation of such charges where it is not possible to achieve genuine competition. In such cases the tender process for a monopolistic[10] element (competition *for* the market) is a preferred direction to go, with clear processes for tariff adjustment over time.

C. Institutional Influence on Financing Issues

The reason debt finance for regulated monopoly infrastructure services (e.g., pipelines, transmission lines, ports) in Australia and the United Kingdom is available from pension funds at rates well below 10 per cent (often ~ 6 per cent) but that low-income countries such as Indonesia, say, face costs of debt finance for essential infrastructure at over 20 per cent, is that there is little confidence to date that tariffs and other determinants of income flows over the duration of contracts (say 15-30 years) will be free of political constraints and intervention. It is the government that is the source of this risk, and the need is for regulatory certainty, believable assurances and enforced laws that make sure that tariffs and income-affecting policies are within the boundaries defined by contracts, which need also to be competitively tendered. While often "comfort letters" are sought from, and offered by such high-risk governments to investors, what is really sought by lenders is confidence that contract terms will be respected and enforced. That confidence can lower capital costs by around 10 per cent, as it brings in the class of long-term investors such as pension funds that are happy with a real (post-inflation) rate of around 5 per cent on secure, asset-delivering essential

---

9 In the Pacific it would appear that pension funds are available for infrastructure investment such as in a proposed group of service providers, although the fund managers have been wary of Pacific investments. There are also concerns that pension funds can be used for political purposes, rather than delivering sound returns to policy holders/beneficiaries.

10 In this vein, it is desirable not to grant explicit monopolistic concessions, nor to permit policy or administrative procedures that result in de-facto monopolies. Such barriers to additional potential entries will almost always ultimately ill-serve Pacific States and their residents.

services. When income streams are "political", through intervention re tariffs and contracts, this creates risk and drives the weighted average cost of capital for infrastructure to very high levels – e.g., 25 per cent. It may even make it impossible to obtain funds at all. In turn, this political risk element can push costs to consumers or government upwards, despite the fact that the infrastructure services are essential and often (at least temporarily) monopoly[11] based, thus making them a secure use of funds. Although in the current era telecommunications are far from being monopoly services – indeed the competitive and technology change element is extreme in many cases – the point still applies: it requires sound governance over contracts and their enforcement in order to obtain the lowest cost of capital and thus the most affordable service charges.

What needs also to be stressed, given the private sector nature of satellites and most telecommunications services in the 21st century, is that the whole governmental mechanism for handling public-private partnerships and private sector involvement in infrastructure needs to be upgraded, as is in process in some Pacific countries.

Financing telecommunications may be difficult, given government budget constraints, and a lack of private sector appetite for funding Pacific telecommunications investments. But the situation gets even more complex owing to new yet uncertain technologies – e.g., WiMax. There is much debate about which standards and models will prove viable in terms of wireless systems, and just how far they can go in replacing the need for land lines. From telecommunications systems once being deemed natural monopolies, owing to the monopoly status of the copper connections to the home and business, new wireless technologies are now making virtually all elements of telecommunications open to competition at great potential benefit to consumers. For the service providers, however, the commercial risks are expanding, not contracting, with these new and disruptive technologies.

A key priority is the reduction in policy and in other government-sourced risks, a major challenge going well beyond telecommunications policies. Creating a regional telecommunications authority, with a sound corporate structure, and free of day-to-day political interference as per its charter, with management by an expert team, is one way of stepping into a new financing arrangement. In sum, there may be development bank seed capital and co-finance, supplier finance, and most critically, market demand-based finance from those who will be on-selling the capacity and thus will be able to enter into contracts for use of satellite and cable capacity.

D. Regulatory Issues

Pacific land lines and charges, Internet access and costs, and penetration and roaming options for mobile phone services are all documented as lagging well behind normal requirements of market economies. The good news is that new technologies – wireless, satellite and Internet – are increasingly likely to be cost-effective at low scale, as suits the Pacific. But for investors to sustain interest in provision of a range of telecommunication services across a range of jurisdictions, the cooperation agreements, a relevant regulatory framework, and sound governance arrangements need to be in place and to be contractually supportive of those investments while delivering fair and ideally competitive outcomes.

This pattern of technical and social change also means that the regional communications authority will need high levels of technical, financial and commercial expertise. Given that the expanding and overlapping services from wireless and land line technologies, causing Internet, television and voice communications to reach out in new ways and on small platforms such as mobile phones, there will be pressure on the regulatory process for allowing systems of provision that enable one provider

[11] Or market leader in a nevertheless competitive environment.

to cover all systems of delivery – and to argue that this may be the most efficient system. Thus while we do not believe there is a case for tolerating barriers to entry, we should also not create, through regulation, barriers to realizing the economies of scale and scope that exist.

E. New Entrants

The recent activity of Digicel in Samoa, Papua New Guinea, the Cook Islands and other Pacific countries, and the expansion of the Virgin group in Pacific aviation, all suggest that this connectivity project is timely. Financing groups of island telecommunications investments, possibly in tandem or as adjuncts to larger external investments, would seem now to be deemed feasible and profitable.

An issue that has been a problem in attracting investment in infrastructure generally in the Pacific is that governance arrangements in most Pacific countries make foreign and private sector investors wary of such investment. Globalization often means that the poorer performing economies, and economies deemed to have poor economic governance, attract less interest from the investment community. This suggests that for telecommunications, as for all other investment, the most basic financing challenge is to respond to the fact that political risks in the Pacific (and other country and group risks) are judged substantial, such that if capital is obtained it may be at premium rates of interest.

The world has recently seen a new breed of international technology service provider and investor, such as Orascom Telecom. Often based in developing countries and working primarily in other developing countries, a regional telecommunications authority might consider engaging their interest. For example, when some companies such as Malaysia Telekom,[12] AsiaNetcom[13] or VSNL[14] consider new systems that may contribute to enhanced Pacific connectivity, the regional authority would serve the Pacific well if it would engage them on partnering.

F. Some Key Risks Related to Institutional Setup and Operations

1. Setup and Initiation Risks

- Will the technology be appropriate to the likely time span of operations, and to the hopefully competitive environment?
- Will it work in the jurisdiction, given other possible changes?
- Is the regulatory structure on related activities consistent with the development?
- Will the contractor have the ability to install, maintain and update the technology in this rapidly changing field?
- Will legal clearances be delivered?
- Will land rights facilitate the necessary physical access?
- Will there be delays due to unforeseen or expected new uses of spectrum?

---

12 In 2006 Malaysia Telekom announced plans for the ambitious Asia-America Gateway trans-Pacific cable system, which might be an opportunity for engagement by the Pacific, to serve some Pacific economiess while also reducing redundant routings in trans-Pacific cables.

13 In early 2007 Asia Netcom announced plans for an ambitious trans-Pacific cable loop, which in its sketch map traversed near Palau, the Northern Mariana Islands, Guam, the Marshall Islands and the Federated States of Micronesia. Partnership opportunities appear to exist, if pro-active approaches can be made.

14 VSNL has discussed cabling plans, and as a relatively new but major owner of trans-Pacific fibre, might be an excellent partner with a regional telecom cooperation mechanism in win-win developments.

2. On-going Risks

- Technology risks: Will, for instance, GSM or wireless standards change and render the standard uneconomic? Is the technology speculative and "bleeding-edge" or at the opposite extreme, obsolete?
- Will the operator be able to sustain the network and service effectively?
- Will conflicts of interest emerge?
- Will market risk prove a problem, e.g., VoIP (Skype) driving out other investment?
- Will project revenue be at risk from other challenges, related to subscriber numbers, airtime per consumer call, tariff pressures and interference, other competition?
- Regulatory risks: These include the extension of the licence period and access charges and interconnect policies.
- Availability of other radio spectrum may change and alter competitive conditions.

3. Interconnection Risks

- Access risks relating to cross-network system connections and transit risks arise where efficient arrangements involve using other networks. In both cases, a sound regulatory and legal system is necessary for these risks to be effectively managed.

G. Risk Mitigation

There is sufficient evidence of market-based risk that the presumption should generally be that most ongoing and new investments in satellite and cable telecommunications are best managed through private sector investment. While such investments will need to be facilitated by improved governance and regulatory reforms in the Pacific countries, there should be a major caution against creating a new public sector body, other than a regional cooperative authority (which, as noted at the top of the chapter, may be formed from an existing body). Almost all the activities should be contracted for, with management and financing a largely private-sector matter, under rules set by the authority as per its charter. While shareholders in the service providers or operators could include signatory economies, it would be advisable not to have the investments directly owned by governments. Further, the boards of the regional authority and the consortium of operators would respectively be appointed for their expertise (the board of the former through Pacific island economies and Pacific Island Forum Secretariat; the board of the operators, in this latter case by and partially from the shareholders, and perhaps partially from stakeholders in Pacific island economies).[15] The management team would report to the board as per the chart in Figure 4-2.

Most of the risks that will arise in provision of a new generation of services will best be mitigated by private parties, with the exception of the regulatory and political risks and land allocation and legal clearance risks, which the Pacific island economies can best deal with.

H. Recommendations on Institutional Options

1. The key to securing finance and the resulting investment is that potential investors have confidence in the organization and structure, as well as in the resulting income stream. An initial suggestion is that Pacific island economies be invited to endorse a Commission, made up of persons

[15] Balancing a need and desire to ensure fair operation for residents with the need to avoid official meddling in good operations will be an issue that needs addressing when board constitution of the operator organization is designed.

of relevant expertise and eminence, under a charter to expand sustainable telecommunications services in the Pacific. The endorsement process and subsequent appointment of the initial commissioners is a matter that could be overseen by ESCAP and the Pacific Islands Forum, for example. The suggestion is also that (say, seven) commissioners be appointed for terms of four years, renewable once, and that they be independent of individual governments and responsible for performance as set down in the charter of the regional authority and associated contracts.

2. Implicit in the formation of cooperative mechanism is that the Commission would develop expansion plans for telecommunications, including satellite capacity, both leased and ideally a special-purpose satellite with beams targeted on the Pacific island economies, reflective of the market and expansion plans. The authority would need members and staff with technical, financial, legal and regulatory expertise.

3. As cabling serving the Pacific has recently become an inventive set of modest one- or two-country initiatives, the regional cooperative mechanism could perhaps help by developing for and with Pacific island economies a strategic framework and tactics for promoting affordable cable projects, perhaps along the lines outlined in Chapter 3. Whether it should oversee all such projects, or merely help promote them, would be left to a decision by its members.

4. The respective service providers (such as fixed and mobile phones, Internet and television) and key user groups (education, weather, health and so forth) would, along with the new private satellite group of service providers to be commissioned, have inputs to the commission through a Service Provider Advisory Group, but policy and decisions would be made by the Commission as executed by the management team.

5. It is envisaged that the authority would call for tenders for a company to be charged with providing expanded backbone communications capacities, including satellite services and potential fibre-optic cable connections. To the extent that there is equity and loan capital available from development banks, ODA and other sources that will assist more rapid development of capacity; to the extent it is intended to subsidize some initial use of expanded communications; and to the extent that there is scope for attracting philanthropic support, there will be scope for those funds to be provided and managed via rules administered through the regional cooperative mechanism.

6. Figure 4-1 sketches a conceptual example of possible relationships proposed once the authority is established by the Pacific community. As noted, it is envisaged that, as with ECTEL in the Caribbean, there should be a technical assistance grant along the lines the World Bank successfully made available to the Caribbean countries to start the process.

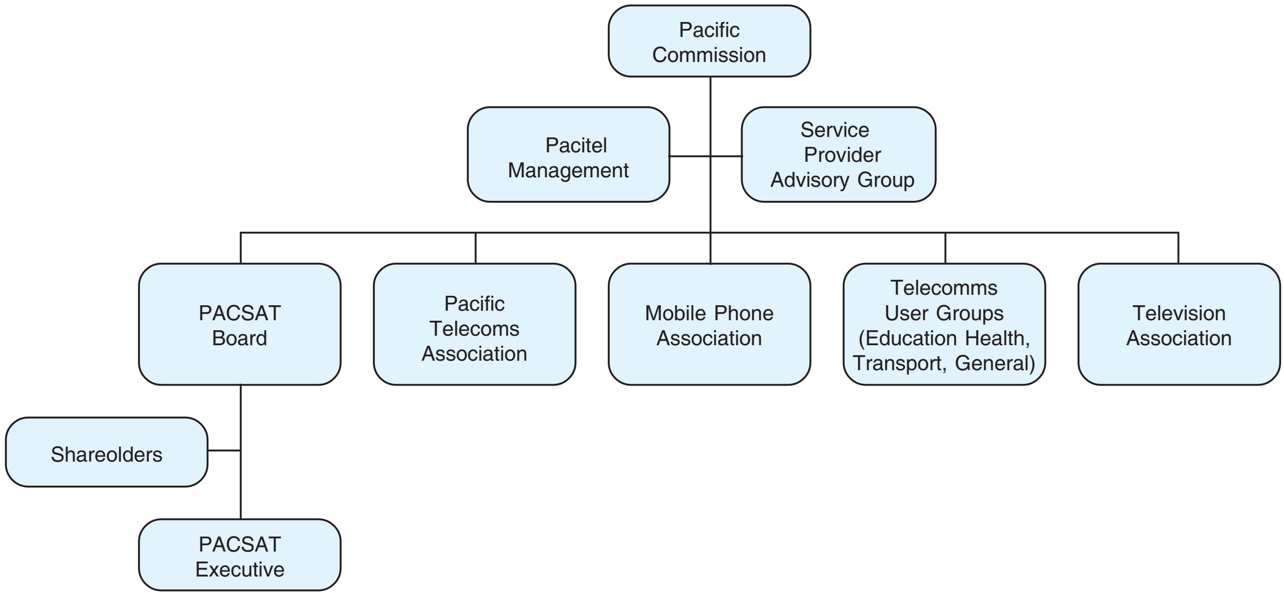
7. Alternative design proposals and suggestions could, in the meantime, be sought from interested parties with the relevant expertise.

8. The regional cooperative mechanism will need to have a sound corporate structure that enables it to prepare and sign contracts, and must have a top-quality professional staff.

9. The incomes earned by any such body from satellite and cable services, for instance, will need to be backed by enforceable contracts, so that any debt commitments that may be obtainable can have reasonable levels of risk and thus attract funds at a reasonable weighted average cost of capital.

10. The charter could be prepared based on best practices from comparator bodies, and in consultation with key players – e.g., Intelsat, ECTEL, cable entities, and mobile phone operators. This could be part of a technical assistance process for the Pacific, as was done for the Eastern Caribbean states that formed ECTEL.

Figure 4-1. Possible organizational chart for a regional cooperative mechanism or authority



III. Financial Issues

A. Stakeholder Issues: The Development of Pacific Connectivity

1. Governments

Concurrent with the globalization of the world economy, which has been partly enabled and stimulated by rapid ICT penetration and applications, there has been concern among other countries that Pacific island economies also benefit from this process. Those countries have expressed interest in enhancing the effectiveness of their cooperation with Pacific island economies, to help ensure improved sustainability of the latter. In addition to the geographically neighbouring countries of Australia and New Zealand, the United States of America, Japan, European Union, and France have been major donors to Pacific island economies. Other countries, including China and India, have begun engaging with the Pacific on possible cooperation in development. Figure 4-2 shows the relative contributions to Pacific island economies studied by the World Bank[16] between 1998 and 2002.

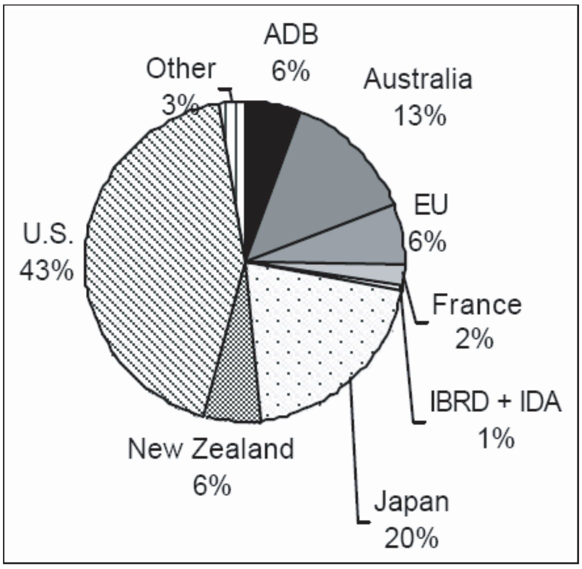
Although telecommunication infrastructure has been a major topic in such assistance and cooperation, the connectivity issue is difficult to solve with bilateral frameworks, or within a small group of some Pacific island economies and donors, owing to the economic scale and the dispersed population. With the stated intentions of Pacific island economies to build such infrastructure collectively under the Pacific Plan, partner governments' ODA may be leveraged collectively with resources from development banks, other donors, and investors, through the regional authority and the service providers and operators.

Member governments of the Pacific island economies all have an interest in expanding the quality of, and access to, communications. Tourism and business locations in any country become more attractive with better communications, since more people wish to have ready access to wireless communications – whether at work or leisure. Therefore, we take it that all potential countries within the footprint of expanded satellite and terrestrial expansion will be keen to see the cooperative mechanism develop and will commission expanded services. In terms of their ODA budgets, it is hard to think of an area for aid where there would be larger external and flow-on benefits.

[16] http://siteresources.worldbank.org/INTPACIFICISLANDS/Resources/1-Defining-Features-of-PI.pdf.

The major challenge for some governments will come from the deregulatory thrust of a new wave of telecommunications competition that should now arise. Since the existing telecommunications entities in the Pacific are primarily monopolies, one challenge for Pacific island economies will be to take steps to allow competition. It is interesting to note how this was accomplished by Caribbean members of ECTEL (see Appendix B). It is also worth noting that the incumbents should likewise benefit from expanded access to capacity and the disciplines of competition.

Figure 4-2. Aid donors to Pacific island economies covered in a World Bank study



Source: http://siteresources.worldbank.org/INTPACIFICISLANDS/Resources/1-Defining-Features-of-PI.pdf.

With the current renewed interest in building infrastructure and services, this is an opportune time for potential donors to be proactive, and to partner with the Pacific.

2. International Agencies

The international development banks (World Bank and Asian Development Bank) and the various ODA entities (including AusAID, NZAid and the European Union for example) all understand the pivotal role communications can play in facilitating improved governance and economic and social performance in the Pacific. USAID assisted the ECTEL effort in the Caribbean, and it might also find benefits in leveraging that investment for the Pacific. In terms of money spent to date, arguably the highest per capita aid in the world, the sums needed to kick start a telecommunications expansion are modest. But we believe that those funds will come only if there are signs of improved governance in relation to telecommunications and communications entities. The agencies have considerable experience in funding both telecommunications and regulatory bodies.

International organizations such as the United Nations (and its regional commission ESCAP), the International Telecommunication Union, the United Nations Development Programme, and specialized agencies such as UNESCO, WHO, UNICEF, WMO and ICAO all could pursue their visions more effectively with better Pacific telecommunications in place, and may be able to provide policy-making forums, advice and technical support for such work. Similarly, Pacific island regional organizations, such as the Pacific Island Forum (PIF), South Pacific Applied Geoscience Consortium (SOPAC), Asia-Pacific Telecommunity (APT), Asia-Pacific Economic Cooperation (APEC), including those in the fields of telecommunications such as the Asia-Pacific Satellite Communications Council (APSCC), Asia-Pacific Broadcasting Union (ABU), Pacific Islands Telecommunication Association (PITA), and the Pacific Islands Chapter of the Internet Society (ISOC) should be valuable stakeholders in a successful effort. The Pacific Disaster Centre might be a motivated partner in Pacific telecoms improvements, and the East-West Centre might be a valuable venue and partner for forum discussions on this topic.

3. Private-Sector Funding Sources (Pension Funds, Private Equity, Communications Entities)

The larger Pacific States, such as Papua New Guinea and Fiji, have superannuation and other funds that should create investor interest in quality telecommunications and satellite investments, if properly structured so that the income stream is made predictable. This means the funds will be concerned with the nature of both the contracts and the regulatory environment that is put in place in regard to contracts with the service provider parties as governed by the regional authority. While the gap between likely broadband and mobile phone costs and capacity to pay suggests that incentives may be required for operators and service providers in the early days, so long as such incentives are securely funded, this should enable the balance of funding to be provided by private funds, which can then make competitive returns for the superannuation contributors and beneficiaries.

Pacific banks, such as ANZ and Westpac, have strong interests in improved telecommunications, not least for ATMs and other service provision. Hence it is reasonable to project that loan funds will be available both for investment in the backbone and satellite assets, and crucially, in the terrestrial service investments – VSATs, mobile phone infrastructure and broadband.

Companies in the broadband and mobile phone businesses (e.g., Digicel, Voda, and Telkom PNG) have already flagged their willingness to invest in terrestrial infrastructure – and this interest can be enhanced only by sound investment in satellite and related technology.

4. Customers: Residential, Educational and Business (Current and Potential)

A new and positive factor in financing any new communications technology in the Pacific is that it is possible to monitor usage (of phones or services) and extract contributions from customers in small amounts, with new mobile phone, prepayment cards and computer technology enabling service providers to accumulate revenue from large numbers of small transactions. In this sense, telecommunications is one of the more readily financed items of infrastructure.

The above means there are significant emerging external benefits from the introduction of low-cost mobile phone systems. Recent advances in pre-payment techniques and associated developments in relation to the functionality and cost of "smart cards" also indicate that new financing possibilities via mobile phones, but for other services, will continue to emerge with great relevance to the Pacific. This capacity to extract large numbers of small payments at low or zero transaction costs helps account for the explosion of investment in telecoms and mobile phone usage in most countries over recent years – it has become a technology for all. But in terms of payment processes and location-based charging, the revolution is just starting.

An underpinning source of telecommunications and other infrastructure finance has connections to the micro-finance innovation (recently rewarded with a Nobel Peace Prize to its founder, Muhammad Yunus). One indicative new opportunity could be the capacity for mobile phones to be used to debit users of infrastructure services to pay for use by debits (say against pre-paid cards), which could be smart cards, that could be replenished or even implemented through mobile phones. The GPS and cellular locational capacity of mobile phones also enables the possibility of location-specific charges (like transponder-based charges for using roads, bridges, ports or even parking spaces, as well as for low-cost transactions charges for other services such as training courses, medical and finance), and these could be for road, port, bus and even water and electricity charges. The point is that mobile phone services introduce a new payments mechanism possibilities and this creates new user-pays systems for financing infrastructure. It also is an example of how expanding telecommunications and mobile phone usage raises new infrastructure funding capacity in member governments. This also adds to the arguments for ODA subsidizing of access to communications and the backbone such as satellites and cable spurs, as the economic and social spin-offs are likely to be substantial.

It has also been demonstrated that small-scale loan programmes to sequences of borrowers can play a major role in spreading telecommunications in poor village economies, setting the stage for the broader range of services that can in turn be enabled by mobile phones. Thus we see scope for an associated telephony project financed by one of the international aid and development agencies, so as to promote the extension of mobile phones, Internet and broadband communications across the Pacific.

Educational and health institutions in the Pacific have more than the usual reasons for wishing to co-invest in telecommunications, since island locations create special needs and opportunities. Therefore, the health and education budgets of Pacific island economies should be cast with one eye on allocations for enhanced communications.

Tourism across the Pacific can be enhanced by availability of improved mobile phones and Internet service, including broadband and television. The prospect of persons increasingly choosing to live and run businesses from Pacific islands is also a real prospect, should telecommunications be improved as planned. The customer base for mobile phones, broadband and tourism generally should be seen as one of the financing underpinnings of the telecommunications financing strategy.

B. Pricing of Service Access

As already noted above, the principles governing the pricing, and any subsidy element, of access charges and user costs for telecommunications, satellites and mobile phones are not unlike those that should apply for other utilities such as water and electricity. We note that the general principle for sound and fair finance is that there should be cost recovery on a commercially sustainable basis, with access and usage tariffs that recoup competitive levels of costs, including capital, in an efficient manner. Subsidizing all users is generally inappropriate if the goal is to assist only the poor. Across-the-board subsidies mean that affluent persons and those able to pay reasonable charges will also be subsidized, and then the overall revenue situation and indeed the viability of service will be undermined. And subsidizing users of telecommunications and satellite services is considered a grossly unfair use of scarce government revenues – given that usage will (at least initially) be heavily biased towards more affluent members of the communities. Rather, there should be processes by which persons and sectors in need, or whom the government seeks to target (education and health, for instance), may apply for rebates or preferential rates, which should be separately funded through the Ministry of Finance. The Ministry can then consider the least distorting means of finance of the subsidy element, considerations which should include licence fees and charges for service providers.

In place of subsidies, authorities may wish to consider modalities that reduce individual costs, such as through shared access in Internet cafés, e-centres, Grameen Phone-like services, and sharing individual accounts among households or neighbourhoods.

C. Financing Risks

- Will the government act in a predictable manner so that lenders and investors feel comfortable?
- Will contract commitments be honoured and enforced, notably in relation to setting tariffs?
- Will the regulatory and judicial processes allow tariffs and other income-affecting matters to proceed as planned and contracted?
- Will international (FCC-type) pressures on international rates create revenue risk?

- Will private and public sector participants in telecommunications be treated equally and consistently?
- Competition between different elements of telecommunications systems brings risks – will policy makers allow all participants to enter all sectors of the telecommunications business, on the grounds that there are no longer valid natural monopoly arguments for protecting the backbone service?

D. Commitments from Pacific Island Economies

1. Commitments from Pacific States to the formation and the charter of the regional cooperative mechanism may be incremental – i.e., not all will need to commit immediately,[17] but there will be a need for critical mass to achieve credibility. One issue that may be perceived as difficult relates to existing franchisees, typically monopoly telecommunications companies. Indeed, all telecommunications licences may need to be reviewed (see draft lists in Appendix C). However, since existing companies should benefit from expanded capacity via the cooperative mechanism, it should prove possible to negotiate improved and competitive outcomes.

2. There should be an agreement from signatory Pacific island economies that they will open their borders to telecommunications competition across all modes, to enable critical mass to telecommunications entities needing to operate across countries.

3. There will be a need to harmonize legislation, regulatory and enforcement policies across the Pacific. A list of relevant laws and regulations is presented in Appendix C.

E. Financing Mechanisms

1. Contributory Organizations

A crucial commitment from the development banks and ODA will be to support the formation of a regional telecommunications authority and preparation of the charter for such cooperation. If total capital costs are roughly US$200 million for the organization of operators and service providers, then seed capital of 20 per cent of this sum, plus funds adequate to sustain the formation of the regional mechanism, may be required, possibly US$25 – US$40 million in total. There may be scope to attract financial and technical support from countries noted in Figure 4-1, as well as China, India and others that have a strategic interest in the Pacific plus space expertise. There should also be meetings arranged with development banks and agencies.

2. Private-Sector

What is critical in obtaining private sector funds for reasonable maturities is clarity of the commercial opportunities and the likely income stream from selling capacity. Tenderers for operators and service providers should have a clear perspective on the issues involved. This creates a major responsibility for the regional authority and the member States, to create a market environment of relative certainty in terms of access and other charges and conditions. Hence the capacity to supplement any seed capital available will depend on the new regulatory environment established jointly by the regional cooperative authority and the respective telecommunications authorities and policies in the Pacific.

3. Service Providers

There is a need to consult on technical and commercial issues and alternatives with a range of companies. Companies with experience providing mobile phones, broadband, satellite phones and other services and technologies may be interested in the opportunities arising from satellite and expanded telecommunications systems in the Pacific.

[17] In the Caribbean, several countries, including some major ones, have yet to sign up to ECTEL.

Selected Key Readings

Asian Development Bank, 2005. Toward a New Pacific Regionalism, vols. 1 and 2 <http://www. adb.org/Documents/Reports/Pacific-Regionalism/vol3/default.asp>.

Butler, Rhett, 2003. Scientific use of optical-fibre submarine cable systems. IRIS Ocean Cable, Washington, DC. 14 pp. <http://www.iris.iris.edu/cable/SSC03_RB_Paper.doc>.

Cayla, Guy, Stephane Cohen and Didier Guigon, 2005. WIMAX, an efficient tool to bridge the digital divide. WIMAX Forum <http://www.wimaxforum.org>.

Eastern Caribbean Telecommunications Authority, 2006. ECTEL Fifth Anniversary Magazine. Castries, St. Lucia, ECTEL. 42 pp. <http://ectel.int/ectelnew/latesnewsdoc/ECTEL%20Mag%20 HIGHRES.pdf>.

Eastern Caribbean Telecommunications Authority, 2006. Socio-economic Impact of Liberalization of Telecoms Sector in the ECTEL Member States. Castries, St. Lucia, ECTEL. 93 pp <http://ectel.int/ectelnew/latesnewsdoc/Socioeconomic%20Impact%20of%20Liberalization%20of%20Telecom%20Sector%202005.doc>.

Johnson, Lennart, 2005. Lecture 3: High Performance Networks. University of Houston Department of Computer Science. 72 pp. <http://?www2.cs.uh.edu/~johnsson/COSC6365_2005/Lecture_HPC_Networks_Fall_2005_S.pdf>.

McMaster, James, 2005. Costs and Benefits of Deregulating Telecommunication Markets in the Pacific. Pacific Studies Series, Volume 3, Working Papers: Working Paper No. 15. Suva, Fiji, University of the South Pacific (for the Asian Development Bank, Commonwealth Secretariat, and Pacific Islands Forum Secretariat). 60 pp. <http://www.pacificplan.org/tiki-download_file.php? fileId=142>.

Naruse, Yuki, 1999. Competitive Undersea Cable Policy. M.S. thesis, Massachusetts Institute of Technology. 82 pp. <http://itc.mit.edu/rpcp/Pubs/Theses/yuki.doc>.

Pacific Island Forum Secretariat, 2003. Pacific Islands Regional Input Paper. Asian Regional Conference for the World Summit on the Information Society, Tokyo, Japan, 13-15 January 2003. 40 pp.

Poppe, Yves, 2006. Early 21st Century Bandwidth Glut? Proceedings of Asia-Pacific Advanced Network Conference, APAN 2006, Tokyo <http://www.apan.net/meetings/tokyo2006/proposals/ppts/GAN.pdf>.

St. Clair, Richard, 2002-2005. White Papers on Internet in Niue, Nos. 1-4. Internet Users Society – Niue <www.niue.nu>.

Samarajiva, Rohan, 2006. Bridging the Divide: Building Asia-Pacific Capacity for Effective Reforms. LIRNEasia <www.lirneasia.net>.

UNCTAD, 2006. Information Economy Report 2006: The Development Perspective. New York, United Nations Conference on Trade and Development. 314 pp. <http://r0.unctad.org/ecommerce/ecommerce_en/ier06_en.htm>.

Ure, John, 2004. Infrastructure in East Asia and the Pacific – The Way Forward: Telecom Note. Hong Kong, China; University of Hong Kong (for the World Bank). 158 pp. <http://www.trp.hku.hk/publications/telecom_note040721.pdf>.

Zwimpfer Communications, Ltd., 2002. Internet Infrastructure and e-Governance in Pacific Island Countries: A survey on the development and use of the Internet. United Nations Educational, Scientific and Cultural Organization, Paris <http://?www.unesco.org/webworld/publications/2002_internet_survey_report.rtf>.

كيفية الحصول على منشورات الامم المتحدة

يمكن الحصول على منشورات الامم المتحدة من المكتبات ودور التوزيع في جميع انحاء العالم ٠ استعلم عنها من المكتبة التي تتعامل معها أو اكتب الى : الامم المتحدة ،قسم البيع في نيويورك او في جنيف ٠

如何购取联合国出版物

联合国出版物在全世界各地的书店和经售处均有发售。请向书店询问或写信到纽约或日内瓦的联合国销售组。

HOW TO OBTAIN UNITED NATIONS PUBLICATIONS

United Nations publications may be obtained from bookstores and distributors throughout the world. Consult your bookstore or write to: United Nations, Sales Section, New York or Geneva.

COMMENT SE PROCURER LES PUBLICATIONS DES NATIONS UNIES

Les publications des Nations Unies sont en vente dans les librairies et les agences dépositaires du monde entier. Informez-vous auprès de votre libraire ou adressez-vous à : Nations Unies, Section des ventes, New York ou Genève.

КАК ПОЛУЧИТЬ ИЗДАНИЯ ОРГАНИЗАЦИИ ОБЪЕДИНЕННЫХ НАЦИЙ

Издания Организации Объединенных Наций можно купить в книжных магазинах и агентствах во всех районах мира. Наводите справки об изданиях в вашем книжном магазине или пишите по адресу: Организация Объединенных Наций, Секция по продаже изданий, Нью-Йорк или Женева.

CÓMO CONSEGUIR PUBLICACIONES DE LAS NACIONES UNIDAS

Las publicaciones de las Naciones Unidas están en venta en librerías y casas distribuidoras en todas partes del mundo. Consulte a su librero o diríjase a: Naciones Unidas, Sección de Ventas, Nueva York o Ginebra.

United Nations Publication
Sales No. E.08.II.F.14

ISBN: 978-92-1-120546-6
ST/ESCAP/2472

Printed in Bangkok
February 2008 – 640

9 789211 205466