

BROADBAND IN SMALL ISLAND DEVELOPING STATES

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ABSTRACT

Like larger states, the Small Island Developing States (SIDS) have been deploying broadband for several years, with some successes. However, performances vary greatly and availability is often geographically and socially limited. SIDS have special characteristics which need to be taken into account, in particular their small economies which are subject to economic shocks and geo-physical risks from hurricanes, volcanoes, tsunami and climate change. Their telecommunications markets are small, oligopolistic and often reliant satellites for international and some national connections. Global best practice cannot simply be scaled down from the US National Broadband Plan or the EU Digital Agenda. Instead, it is necessary to identify those policies and instruments that have worked on a small scale and determine why succeeded and identify if they can be replicated. From that it is possible to build, bottom-up, national plans for broadband in SIDS which can be subjected to impact assessment, public consultation and regular reviews.

Keywords: broadband, wireless, developing countries, SIDS, economics.

1. INTRODUCTION

Small Island Developing States (SIDS) and the island territories of Australia, France, Netherlands, United Kingdom (UK) and the United States of America (USA) have specific economic and physical characteristics.¹ They are very small markets, ranging from a few thousands of potential customers to a few millions, lacking in economies of scale and generally on the edge of supporting the two or three operators needed to sustain competition in their telecommunications markets. They have very small pools of the skilled and, especially, the independent individuals necessary for the complex governance systems considered to be global best practice. The islands are geographically marginal, being isolated and often remote, sometimes with their own outlying and yet more remote islands. Most are exposed to significant risks of natural disasters from volcanic eruptions, earthquakes, *tsunami* and hurricanes, which in addition to their human and social costs are heavy burdens for their small economies.

Over recent years, mobile telephony has grown rapidly on the islands, becoming widely and in some cases universally available. However, it is often not affordable for many individuals, with significant policy challenges to be faced to ensure regular and unconstrained access for the poor and the disabled.² Operators on a number of islands have launched 3G services, often aimed initially at exploiting the market for international mobile roaming services for tourists and business travellers. In the less developed

islands the provision of fixed broadband has been exploratory and tentative, as providers try to build up a subscription service in markets where pre-paid has been the dominant form of consumption. Moreover, computers are often relatively unavailable, sometimes compounded by a lack of mains electricity, by significant levels of illiteracy and by a lack of content in indigenous languages. At the other extreme, those islands that host offshore financial services have been obliged to ensure provision of enterprise grade telecommunication services, though this need not benefit the general population.

One of the key arguments for the availability and use of telecommunications in islands, especially those at remote locations, is the “death of distance”.³ Broadband Internet provides access to a wide range of content and services, such as education and health, but is also important for social networking, connecting islanders to those who have migrated or who are temporarily working elsewhere and to the associated flows of remittances. It plays important roles in key economic sectors – enabling financial services and supporting tourist services. However, even at modest speeds broadband can be used for Voice over IP (VoIP), potentially suppressing the primary revenue flow for operators from voice telephony, before alternative revenue streams have been developed.

Some commentators argue in favour of infrastructure-based and against service-based competition, some claiming the latter actively discourages investment in infrastructure.⁴ Very small markets may not readily sustain a single fixed network infrastructure operator, let alone many, suggesting that service-based competition may be the only option. However, it is unclear at which point infrastructure-based or inter-modal competition ceases to be viable.

Each type of network has its own minimum efficient scale and economies of scale, whether cellular voice, ADSL or Fibre To The Home (FTTH), meaning that the different sizes of the various national markets affect how many operators might be expected to survive on any island state or territory. Mobile telephony markets have usually been able to support two and sometimes three GSM operators, though fixed telecommunication markets are more commonly limited to the incumbent operator. With rare exceptions, notably Singapore, very few of the other islands has sufficient demand to justify the presence of Content Delivery Networks (CDNs), so that content, other than locally hosted material, must be carried over international connections.^{5,6} This problem is compounded by the weak state of local content creation industries, with their small markets and limited access to skills and finance.

This paper considers first the broadband technologies and markets in the SIDS, then examines issues related to undersea cables. National plans for information societies, knowledge economies and for broadband are then reviewed. A set of geographical analyses then consider issues in the Caribbean Islands, Pacific Islands and the Atlantic and Indian Oceans. Finally conclusions are drawn and issues for future research identified.

2. TECHNOLOGIES AND MARKETS

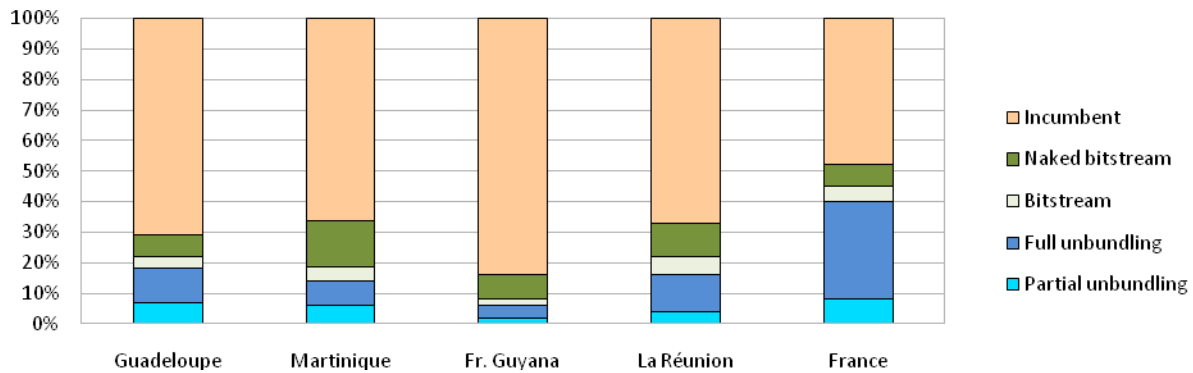
Offers of broadband Internet access in the islands have increased substantially over recent years. Initially these were pitched at businesses, especially hotels and Internet cafés wishing to resell a service to their retail customers. Offers were extended to Small and Medium-sized Enterprises (SMEs) and to wealthier households, including holiday homes, they were also expanded beyond core areas, though often they have not yet reached remote areas or outlying islands. Internet cafés and community access centres continue to play significant and enduring roles in widening access on most islands. Adoption of fixed broadband is generally limited, not least because of the relatively high prices, low income levels and a reluctance to commit to monthly spending.

Fixed broadband is delivered primarily with DSL, where copper loops are available in sufficient numbers, and by fixed wireless using WiMAX, with only very limited use of CDMA-WLL. Additionally, in a handful of US territories there is a cable modem service. Residential FTTH is very limited, being found only in Iceland and Singapore, though with business FTTP in some islands with financial services.

In a few developed islands and in the dependencies of France and the USA, there are relatively affordable, high-speed and uncapped broadband tariffs, notably in Guam and Iceland.⁷ In September 2010, Singapore launched its FTTH network, with ISPs offering speeds of up to 100 Mbps at relatively modest prices (n.b. 1 Gbps is available, but is relatively expensive). While the offers in Singapore and Iceland appear to reflect underlying costs, with only modest levels of subsidies, the offers in the French and US territories appear surprisingly low.

There has been little unbundling of local loops, since many islands have few loops to unbundle and there are very limited prospects of operators or ISPs leasing the loops. Even though it has own copper loops in several Caribbean islands, Cable & Wireless (LIME) has preferred to use WiMAX for broadband services. The obvious exceptions are the French territories where the example of the colonial power has been replicated to the extent of a handful of ISPs offering ADSL and ADSL2+ services over unbundled loops (see Figure 1). These are combined with offers of television channels and unlimited telephony (both local calls and to France). Iceland, using the European Union legislative framework, has unbundled local loops, which are resold by two mobile operators: TAL and Vodafone. However, there is also infrastructure competition with rival providers of FTTH, resold by TAL, Vodafone and others. In US territories cable modem competes with DSL services.

FIGURE 1 UNBUNDLED ACCESS IN FRENCH TERRITORIES AND FRANCE



In recent years a number of Caribbean islands have addressed the possibility of unbundling local loops, while reviewing their interconnection policies:

- Bahamas;⁸
- Barbados;⁹
- Bermuda;¹⁰
- Jamaica;¹¹ and
- Trinidad & Tobago.¹²

In some respects this was copying European examples, and some documents closely follow others. They address the challenge of how to achieve service-based competition where competing infrastructures are seen as unlikely or impracticable. However, as the Jamaican authorities noted, the response was “lukewarm”, with alternative service providers unenthusiastic about such a complex regulatory measure with uncertain financial returns. The Eastern Caribbean Telecommunications Authority (ECTEL) did not follow these examples, seemingly accepting the need to pursue other policies.

Fixed broadband is supplemented by Internet access on cellular networks, the so-called mobile broadband service, using GSM, UMTS and cdma2000 technologies, which operators are committed to upgrading to Long Term Evolution (LTE). The early introduction of 3G services was driven by the search for roaming revenues (e.g., Guam and Mauritius).¹³ In some islands and in some market segments mobile broadband competes directly with fixed broadband, in others it as a supplementary service. Thus some customers use only mobile broadband while others use it in addition to Wi-Fi and fixed broadband.

A report on the outermost regions of the EU in 2005, noted the low levels of fixed lines and broadband, with a significant gap to continental Europe.¹⁴ In 2010, the French parliament received a report from the telecommunications regulator, noting the higher prices and lower quality of service in its island territories, compared to European France.¹⁵ The causes were the absence of economies of scale and the high costs of undersea cables, which sometimes required public subsidies. It noted the potential benefits of publishing comparative data on quality of service in each market and the benefits of installing local content servers. The proportion of people eligible for support

on grounds of low income was three times higher in the islands.

Operators and regulators are continuing to search for appropriate, affordable and viable solutions on the small scales of the islands. The importation of models from Europe appears, at best, to require careful assessment and tuning to local circumstances.

3. UNDERSEA CABLES

Other than for VSAT and other end-user satellite services there is a requirement for a domestic backhaul network and an international undersea cable. In some cases the domestic network will require inter-island links, either cables (e.g., Cape Verde Islands and French Polynesia) or microwave (e.g., Comoros and São Tomé). The wider adoption of broadband greatly increases the demand for such capacity, which represents a significant bottleneck.

A few islands have multiple undersea cables – such as the Faroes, Iceland and Guam – which provide competition in the provision of international capacity and back-up in the event of the inevitable breakages.¹⁶ Many islands have only one cable while some, notably in the Pacific and South Atlantic Oceans, rely exclusively on satellite connections. There have been important recent additions, with a second cable to Réunion and cables serving, for the first time, Greenland, Samoa, American Samoa and Tahiti. First cables are also promised for the Seychelles and São Tomé, plus a second cable for Cape Verde Islands.¹⁷ There are projects in the Pacific for additional cables to serve those islands still relying on satellite links.

A single cable exposes users to risks of outages of up to two weeks, especially in areas prone to earthquakes. This can be reduced by redundancy, for example, the Australia-Japan Cable has two separate spurs landing at two separate landing stations on Guam. While satellite links can be used for back-up, these are expensive and are likely to be limited to business critical applications, such as banking.

Where there is only one cable it is an essential facility, this justifies regulation of access and, if necessary, of the prices charged for access. A significant risk is of a vertically integrated operator using its access to the undersea cable to offer cheaper broadband or bundling international telephone calls with broadband in ways that rivals cannot. A useful precedent was set by the French authorities, which determined the prices for capacity on the undersea cable from Réunion to France.¹⁸

There are considerable variations in the download speeds achieved by customers on islands, as a result of the constraints of domestic backhaul and connections through undersea cables and satellite systems (see Annex 1). The best performances, especially in terms of upload speeds, are the Åland Islands, Iceland and Greenland, with Trinidad and Jamaica performing at the same level as Chinese Taipei, benefitting from the competition between cable providers in the Caribbean, partly to meet the needs of financial institutions.

While the extent to which international capacity determines the price of Internet access is not settled, it is clear that it constrains many of the broadband offers, especially in those islands which do not yet have access to an undersea cable. Thus efforts to improve the provision of and access to undersea cables will continue to be important.

4 INFORMATION SOCIETY PLANS

The government of Niue, aspiring to a more prosperous future for its citizens, has committed to developing a national ICT plan.¹⁹ The government of Jamaica in its *Vision 2030 National Development Plan*²⁰ has already designated ICTs as a priority area and is now working to ensure a national backbone network is available to provide backhaul for broadband access networks.²¹ Singapore is completing installation of an optical fibre to every residence and business, as part of its iN2015 master plan for ICTs.²² Other island governments and agencies are expected to develop similar plans.

Providing wider access to faster broadband is usually a prominent part of a national ICT plan and information society strategy. This is based on claims that it will:

- Boost economic growth;
- Save money through easier access to and improve the quality of government services; and
- Provide a range of environmental, health and social benefits.

The correct means to deploy a National Broadband Network (NBN) was a major issue in the 2010 Federal election in Australia, one that tipped the balance in the subsequent negotiations to form a government. Two Australian territories in the Indian Ocean, Christmas Island and the Cocos (Keeling) Islands, plus Norfolk Island in the Pacific, are not to be reached by the NBN, due to the expense of installing undersea cables. However, they were already covered by the Australian Broadband Guarantee.²³ Norfolk Island, recently upgraded its international satellite connection to 155 Mbps to allow all businesses and residences access to broadband services.²⁴

To increase the chances of emerging quickly from the global financial crisis, the USA adopted a wide range of stimulus measures, including investments in the provision of broadband to homes, small businesses and farms. It has provided funds for its island territories as follows:

- American Samoa:
 - USD 1M for broadband data collection and mapping,
 - USD 81M to replace inter-island links with fibre optic cables;
- Commonwealth of the Northern Mariana Islands (CNMI) and Guam:
 - USD 8M to upgrade backbone infrastructure and inter-island links,
 - USD 8M to stimulate demand, widen access and upgrade “middle mile” infrastructure,
 - USD 1.55 million for a broadband mapping programme;
- Puerto Rico:
 - USD 12M for a microwave ring, links to anchor institutions and local access,

- USD 25M for a core and peering network.

The reasons for ensuring the provision of broadband are in part economic, to stimulate growth and create jobs, though the evidence on this is still far from certain, there being only limited data. Another factor is competitiveness – Singapore wishing to keep up with Hong Kong, Jamaica with Trinidad and so on. Social inclusion is a further driver, for example, New Caledonia keeping pace with “metropolitan” France and Guam with continental USA.

5. CARIBBEAN ISLANDS

Several islands in the Caribbean Sea are important centres for international financial services, largely based on financial regulatory arbitrage.²⁵ This requires the provision of resilient, enterprise grade telecommunication services, primarily Virtual Private Networks (VPNs), from a small number of global network service providers (e.g., AT&T, NTT and Orange).²⁶ These operators lease capacity on undersea cables, which they combine with local leased lines, Ethernet or dark fibre to reach the individual premises of banks and financial services firms.

Many Caribbean hotels are at the top end of the market, charging significant sums for a single night. They are expected to provide broadband Internet in bedrooms and Wi-Fi in public areas, in addition to any access to international mobile roaming services. While some tourists have traditionally maintained communications for business purposes, an increasing number are now doing so for social reasons. A survey of US tourists found that of those who would remain connected, only 14 per cent did so for work, while 89 per cent wanted to communicate with family and friends, a significant change from only a few years ago.²⁷

While the Caribbean enjoys pervasive access to and widespread adoption of mobile telephony, broadband penetration levels are in single digits.²⁸ The factors which explain this include price and capacity limitations. To provide citizens, especially vulnerable groups, with access to broadband and other ICTs, a common approach has been the development of community access points. However, reliable data on the number of citizens being served and the effectiveness of these centres is not readily available.

The national markets for broadband are generally very small, with only four having any significant scale: Dominican Republic, Jamaica, Puerto Rico and Trinidad (see Table 1). Nonetheless, some islands have achieved substantial levels of broadband penetration, notably Anguilla, Aruba, Bermuda, Cayman Islands, Dominica and St Kitts. Despite having a large Internet access market, Cuba has almost no broadband.

TABLE 1 *INTERNET & BROADBAND IN SELECTED CARIBBEAN ISLANDS IN 2009*²⁹

	<i>Internet subscriptions</i>		<i>Internet users</i>		<i>Broadband subscriptions</i>	
	<i>000s</i>	<i>per 100</i>	<i>000s</i>	<i>per 100</i>	<i>000s</i>	<i>per 100</i>
Anguilla	3.7	24.6	3.7	24.4	3.7	24.6
Antigua & Barbuda	15.6	17.8	65.0	74.2	14.9	17.0
Aruba	18.4	17.4	24.0	22.5	22.0	20.7
Bahamas	38.6	11.3	115.8	33.9	31.6	9.2
Bermuda	37.9	58.8	54.0	83.3	40.0	61.7
Cayman Is.	36.2	63.0	24.0	42.8	18.3	32.0
Cuba	33.6	0.3	1,605.0	14.3	2.0	0.0
Dominica	0.0	0.0	28.0	42.0	16.0	24.0
Dominican Republic	429.0	4.3	2,701.3	26.8	396.3	3.9
Grenada	10.9	10.5	25.0	24.1	14.0	13.5
Guadeloupe	0.0	0.0	109.0	23.4	0.0	0.0
Haiti	100.0	1.0	1,000.0	10.0	0.0	0.0
Jamaica	112.4	4.1	1,581.1	58.2	112.2	4.1
Martinique	0.0	0.0	170.0	42.0	6.0	1.5
Montserrat	1.0	16.2	1.2	20.3	0.6	9.7
Puerto Rico	513.4	13.0	1,000.0	25.1	426.3	10.8
St Kitts & Nevis	0.0	0.0	17.0	32.9	13.0	25.1
St Lucia	15.5	9.1	142.9	83.0	15.5	9.1
St Vincent & the Grenadines	11.8	10.8	76.0	69.6	11.5	10.5
Trinidad & Tobago	114.1	8.6	485.0	36.2	105.0	7.8
U.S. Virgin Islands	-	-	30.0	27.4	9.0	8.2

See also Annex 2.

The Trinidad & Tobago household survey shows higher income being closely associated with possession of telephones, personal computers, televisions and cable television service (see Table 2). With the bulk of households lying in the income range TTD 1,000 to 4,000 (USD 154 to 620) per month, a monthly subscription to broadband is practicable only at the slowest speeds, if at all.

TABLE 2 *TRINIDADIAN HOUSEHOLDS WITH SELECTED FACILITIES BY INCOME*³⁰

Monthly income	0-499	500-999	1,000-1,999	2,000-2,999	3,000-3,999	4,000-4,999	5,000-5,999	6,000-6,999	7,000-7,999	8,000-8,999	9,000-9,999	10,000-10,999	11,000-11,999	12,000-12,999	>12,999
% of total	2.98	7.53	19.01	18.29	13.53	9.74	6.68	5.57	3.57	2.98	1.96	1.45	1.36	0.94	4.42
Telephone	11.40	25.40	34.00	48.10	55.00	62.90	69.40	77.90	82.10	85.70	87.00	88.20	90.60	95.50	93.30
PC	2.90	0.60	0.00	1.20	2.20	3.50	2.50	7.60	9.50	14.30	8.70	23.50	15.60	27.30	45.20
TV	54.30	59.30	77.60	89.10	92.10	95.20	95.50	96.20	97.60	100.00	100.00	100.00	93.80	95.50	98.10
Cable	2.90	2.30	5.10	9.30	14.50	18.80	24.20	27.50	21.40	35.70	41.30	41.20	31.30	45.50	56.70

At mid-2009, UMTS/HSPA networks were found still to have only a limited effect in driving down WiMAX prices.³¹ There was also a significant gap between cable prices and other broadband technologies, which had widened from being 5 per cent less than DSL and fixed wireless in 2008 to being 44-65 per cent cheaper in 2009. Prices for the

cable modem service vary considerably between Caribbean islands (see Table 3). Competition appears to be patchy and in many markets to be quite limited.

TABLE 3 CABLE MODEM SERVICE IN SELECTED CARIBBEAN ISLANDS

<i>Island</i>	<i>Operator</i>	<i>Download (Mbps)</i>		<i>Monthly fee</i>	<i>Monthly fee (USD)</i>
Anguilla	Carib Cable	2	XCD	107	39.85
Anguilla	Carib Cable	3	XCD	144	53.63
Anguilla	Carib Cable	6	XCD	239	89.01
Bermuda	CableVision	4	BMD	35	35.00
Bermuda	CableVision	6	BMD	45	45.00
Bermuda	CableVision	8	BMD	55	55.00
Grenada	Flow	8	XCD	136	50.65
Grenada	Flow	12	XCD	230	85.66
Jamaica	Flow	8	JMD	2450	28.70
Jamaica	Flow	15	JMD	3200	37.48
Nevis	Carib Cable	0.2	XCD	85	31.66
Nevis	Carib Cable	2	XCD	98	36.50
Nevis	Carib Cable	3	XCD	144	53.63
Nevis	Carib Cable	6	XCD	239	89.01
St Lucia	KaribCable	1	XCD	79	29.42
St Lucia	KaribCable	4	XCD	499	185.84
St Vincent	KaribCable	1	XCD	91	33.89
St Vincent	KaribCable	4	XCD	574	213.77

Digicel, otherwise a GSM and UMTS operator, offers a pre-paid WiMAX service, branded as “4G”, effectively competing with its own mobile broadband service (see Table 4). It is available only as a prepaid service by the week or month and much cheaper in Jamaica.

TABLE 4 PRICES FOR DIGICEL PRE-PAID WIMAX

<i>Country</i>	<i>7 days</i>		<i>Per day</i>	<i>30 days</i>		<i>Per day</i>
Cayman Islands	KYD 15	USD 18	USD 2.57	KYD 49	USD 60	USD 2.00
Jamaica	JMD 1,200	USD 14	USD 2.00	JMD 3,000	USD 35	USD 1.17

There are continuing wide variations in the adoption of broadband across the Caribbean, due to market sizes, levels of economic development and infrastructure competition. Prices and speeds also vary greatly, reflecting the levels of competition. As mobile broadband on 3G and LTE become more widely available, fixed broadband prices are expected to be forced down as and when competition heats up.

6. PACIFIC ISLANDS

In the overseas territories of France and the USA the broadband offers look much more like those of the colonial power than of neighbouring independent islands, in terms of prices, speeds and download caps (see

THE high cost of international connections is reflected in complex retail pricing schemes, which very finely segregate customers based on the volume of traffic they consume and their upload speeds. While some ISPs offer relatively high speeds on the local access circuit, most constrain the international bandwidth. For example, in the Cook Islands residential plans are reduced to dial-up speed for international traffic between 7am and 5pm on weekdays, only reaching 256 kbps download at evenings and weekends, because of the limited international satellite capacity. Even then NZD 59 (USD 44) buys only 1.5 Gbytes of data, while NZD 129 (USD 97) buys 4.5 Gbytes per month, with any excess being charged at NZD 0.11 and 0.08 (USD 0.06 and 0.06) per Mbyte respectively. By comparison, tariffs in New Caledonia (France) are uncapped with speeds of up to 2 Mbps.

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TABLE 5 BROADBAND PRICES IN FRENCH AND U.S. PACIFIC TERRITORIES

<i>Islands</i>	<i>Provider</i>	<i>Download (kbps)</i>	<i>Upload (kbps)</i>	<i>Monthly fee (USD)</i>
Am. Samoa	ASTCA	256	128	59.95
Am. Samoa	ASTCA	384	384	185.00
Am. Samoa	ASTCA	512	128	150.00
Am. Samoa	ASTCA	768	256	175.00
Am. Samoa	ASTCA	1,024	256	200.00
Guam	MCV	1,024	n/a	90.99
Guam	MCV	2,560	n/a	107.00
Guam	MCV	7,168	n/a	147.99
Guam	MCV	10,240	n/a	197.99
Guam	GTA TeleGuam	1,230	n/a	37.95
Guam	GTA TeleGuam	2,560	n/a	56.25
Guam	GTA TeleGuam	7,168	n/a	84.35
French Polynesia	Mana	256	64	40.96
French Polynesia	Mana	512	256	52.67
French Polynesia	Mana	1,024	256	93.63
French Polynesia	Mana	2,048	512	152.15
New Caledonia	Nautile	256	256	38.81
New Caledonia	Nautile	512	512	89.91
New Caledonia	Nautile	1,024	512	159.49
New Caledonia	Lagoon	512	512	56.07
New Caledonia	Lagoon	1,024	512	85.01
New Caledonia	Lagoon	2,048	512	93.53
Saipan (CNMI)	IT&E	384	128	39.95
Saipan (CNMI)	IT&E	768	256	50.00
Saipan (CNMI)	IT&E	1,024	512	85.00
Saipan (CNMI)	IT&E	1,536	768	135.00
Saipan (CNMI)	IT&E	2,560	1024	180.00

ADSL except for MCV in Guam which offers a cable modem service.

The only broadband markets of any size are Australia and New Zealand, neither of which could be considered small or developing and both of which are seeing significant levels of government intervention to ensure access in rural and remote areas (see Table 6). Most of the broadband penetration levels in the Pacific are extremely low, with the exception of the two French colonies and, to a lesser extent, the Cook Islands. Even the dial-up Internet markets are far from large, suggesting that problems in developing broadband Internet access will endure.

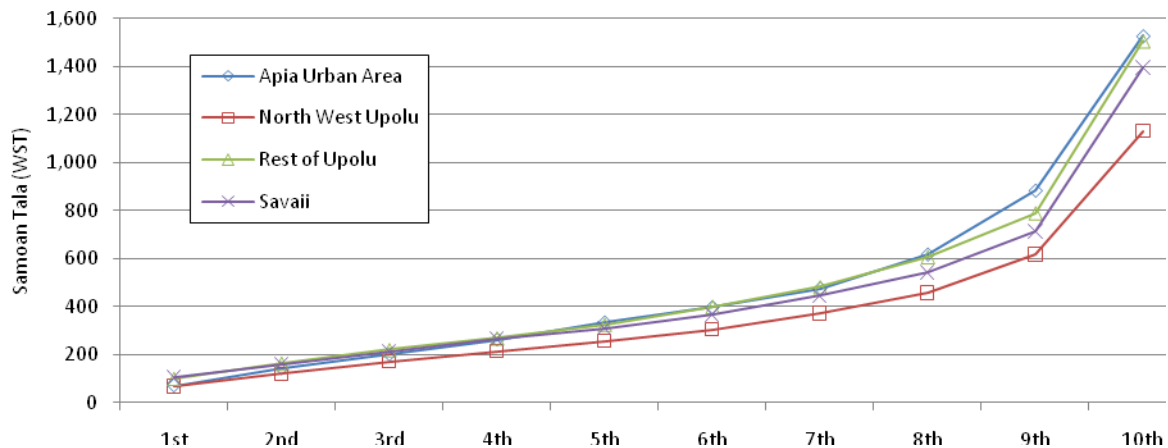
TABLE 6 INTERNET AND BROADBAND IN PACIFIC ISLANDS IN 2009³³

	<i>Internet subscriptions</i>		<i>Internet users</i>		<i>Broadband subscriptions</i>	
	<i>000s</i>	<i>per 100 inhabitants</i>	<i>000s</i>	<i>per 100 inhabitants</i>	<i>000s</i>	<i>per 100 inhabitants</i>
Australia	6,300.0	29.59	15,756.7	74.00	5400.0	25.36
Cook Is.	1.9	9.64	6.0	30.29	1.5	7.40
French Polynesia	30.5	11.33	120.0	44.60	30.0	11.16
Guam	0.0	0.00	90.0	50.64	3.0	1.69
Kiribati	0.0	0.00	2.0	2.04	0.0	0.00
Marshall Islands	0.0	0.00	2.2	3.55	0.0	0.00
Micronesia	1.3	1.17	17.0	15.35	0.1	0.10
New Caledonia (Fr.)	26.6	10.80	85.0	33.99	32.0	12.80
New Zealand	1,415.0	33.17	3,600.0	84.38	981.0	22.99
Niue	0.0	0.00	1.1	74.48	0.0	0.00
Palau	1.0	5.05	0.0	0.00	0.2	0.81
Papua New Guinea	0.0	0.00	125.0	1.86	0.0	0.00
Solomon Islands	1.9	0.40	10.0	1.91	2.0	0.38
Timor Leste	0.7	0.07	2.1	0.19	0.2	0.01
Tokelau	0.2	12.37	.0	0.00	0.0	0.00
Tonga	4.5	4.30	8.4	8.08	1.0	0.96
Tonga	4.5	4.30	8.4	8.08	1.0	0.96
Vanuatu	2.6	1.08	17.0	7.09	0.5	0.21
Wallis & Futuna (Fr.)	0.6	3.68	1.3	8.48	0.3	1.96

See also Annex 3.

One explanation for the modest levels of adoption is the low levels of income and the pattern of its distribution within each society. Figure 2 shows the weekly incomes for the four regions of Samoa. With wireless broadband costing between WST 25 and 250 (USD 10 and 100) per week and spending on communications typically 3-5 per cent of income, the higher speeds are out of the reach of most households and even the slower speeds are comparatively expensive.

The Pacific Islands are significantly worse off than the Caribbean Islands in terms of Internet access and especially broadband. There is little to suggest that this position will change, unless mobile broadband proves to be economic on these rather small scales. The relative success of the French colonies requires further work.

FIGURE 2 AVERAGE WEEKLY INCOME BY DECILE IN SAMOA³⁴

7. ATLANTIC AND INDIAN OCEAN ISLANDS

As noted above, Singapore is a world leader in the provision of high speed broadband, seen as essential to sustaining the economic growth of the city-state. Adoption is supported through programmes for children of school age and for senior citizens. Réunion and Mayotte look like the French colonies in the Pacific, with offers closely resembling the French national market than the island states of the region.

The SIDS around Africa show considerable variations.³⁵ Mauritius aspires to add ICTs as a “fifth” economic pillar, partly based on tax arbitrage to benefit from its growth in India. However, the more impressive performance is from the Cape Verde Islands, which have developed a carefully tailored national ICT plan and have delivered relatively affordable broadband and triple play services. At the other extreme are the Comoros Islands where broadband is very limited, despite support from Chinese manufacturers.

The British possessions in the South Atlantic are small with smaller populations (see Annex 5). Nonetheless, Cable & Wireless offers broadband services, based on international satellite connections, though at relatively high prices.

In the North Atlantic and European coastal waters lie a number of small island territories and one state that, while economically developed, provide useful points of comparison: Greenland, Iceland, Faroe Islands, Isle of Man, Jersey and Guernsey.³⁶ While Iceland is independent, the others have complex historical and constitutional links to the British and Danish crowns. Greenland was the last to obtain an undersea cable, operational since March 2009, with the others having substantial and redundant international links. The markets are small or tiny, struggling to maintain the sufficiency of operators necessary to ensure competition in mobile and in fixed telecommunications – except for Greenland which has a state-owned monopoly.

Broadband services are well established and widely available, predominantly using DSL including some unbundled local loops, with infrastructure competition limited to WiMAX on the Isle of Man and FTTH on Iceland. The FTTH offers on Iceland are from ISPs and mobile telephone companies over infrastructure provided by an electricity utility, costing USD 20 to 95 per month for speeds of up to 100 Mbps, slightly more expensive than comparable services in Singapore. Whereas in Greenland only capped DSL offers are available, charging DKK 0.42 (USD 0.07) per Megabyte for data.

Given the diversity of these islands, from the highly developed Singapore to the deeply troubled Comoros, there is little commonality in broadband. The French colonies, as elsewhere, have more competition and better offers than their remoteness and levels of economic development would suggest.

8. CONCLUSION

Broadband Internet access is now available on almost all the SIDS and island territories, though not on all islands, often being limited to the capitals, urbanised and tourist areas. Yet, the speeds are generally slow and the data volumes are frequently capped, constraining the use of applications and services. Broadband is far from being universally unaffordable, with little prospect that this will change quickly. Wider availability and the development of faster and cheaper services are constrained by the lack of economies of scale and by the shortage of potential subscribers.

While pre-paid broadband is emerging as an option, it is still in the very early stages of development as a business model, constrained by the lack of current and of market entrants. It seems likely that progress will come with offers of pre-paid mobile broadband using cellular networks, even if the services are not the same. However, the development of 3G and LTE as an alternative to fixed broadband remains far from certain, as is its combination with WiMAX and DSL.

Infrastructure or inter-modal competition for fixed broadband is limited, there are very few cable television and WiMAX networks, often it is entirely absent from an island, with little prospect that this will change. Service-based competition is present on French island territories, Iceland and Singapore, but on very few other islands and does not seem likely to become more popular. The lack of scale is the major factor in holding back these market and regulatory developments. The model conventionally used in developed countries, the “ladder of investment”, does not operate in a recognisable way at this scale.

While most island states and territories now have their own undersea cable and landing station, the cost of international connectivity remains a problem. Those islands without a cable are faced with the choice of paying for one or continuing to pay for a satellite connection. Content delivery networks (CDNs) are extremely rare, requiring content to be brought from overseas – a problem made worse by the weak local content and web hosting industries.

There is considerable scope for further research, for example, in surveys of the use of fixed and mobile broadband services and applications. Analysis of the changes to the speeds and prices of broadband, with the publication of key information, would help to show how markets are evolving. Where traffic data are available, it would be helpful to compare the islands with each other and with appropriate continental states and regions. Given the problems in achieving infrastructure-based competition, the limited experiences with local loop unbundling and models of commercial and regulated access on fibre access networks will also be worth further study. Development of the content industry and the related skills needs to be documented, along with the availability of web hosting and its use by local firms. The adoption of VoIP is likely to have profound adverse effects on voice revenues, though this may be offset by a further increase in remittances, both of which need to be monitored. The economic benefits of the adoption of broadband in very small markets need to be differentiated from larger markets, requiring econometric analyses.

The wide range of problems and experiences suggests that there would be benefit in the governments and regulators sharing their knowledge. This could be through meetings or a virtual community making expertise and documents available to each other.

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ANNEX 1 INTERNET SPEED TESTS FOR SELECTED ISLANDS IN AUGUST 2010³⁷

	<i>Download (Mbps)</i>	<i>Upload (Mbps)</i>	<i>Tests taken</i>	<i>Unique IP addresses</i>
Åland Is.	20.70	13.00	10,817	1,952
Iceland	14.39	7.65	178,894	38,837
St Pierre & Miquelon (Fr.)	8.85	0.76	7,566	1,031
Greenland	8.53	7.31	5,519	1,626
Trinidad & Tobago	8.15	0.79	657,406	115,385
Chinese Taipei	7.94	1.78	2,049,028	612,816
Malta	6.41	1.00	244,073	50,990
Singapore	6.25	1.43	4,483,925	742,290
Isle of Man	6.16	0.70	63,164	10,436
Jamaica	5.18	1.34	288,171	55,680

Faroe Islands	4.92	1.32	46,530	5,892
Maldives	4.80	0.88	79,510	12,810
Mozambique	4.45	1.26	36,668	6,940
Aruba (NL)	4.00	0.61	58,941	13,480
St Vincent	3.60	2.22	20,068	4,322
Guernsey	3.55	0.38	27,548	7,433
Jersey	3.36	0.56	29,258	8,155
Papua New Guinea	3.32	0.73	27,139	2,146
Guam (U.S.)	3.09	0.84	57,155	12,842
Cyprus	3.03	0.60	679,787	97,133
Puerto Rico (U.S.)	3.03	0.55	2,792,624	362,437
Grenada	3.01	0.56	29,423	5,787
Bermuda	2.72	1.35	87,911	16,111
Netherlands Antilles	2.62	0.75	243,543	35,862
Cayman Is.	2.60	0.51	55,002	9,671
Bahamas	2.47	0.67	41,462	9,555
New Caledonia (Fr.)	2.46	0.64	64,160	14,541
Martinique (Fr.)	2.35	0.40	86,631	16,155
Guadeloupe (Fr.)	2.34	0.41	58,018	11,408
Dominica	2.28	0.37	15,374	2,356
Cape Verde	2.27	0.24	11,451	2,432
St Lucia	2.23	0.83	38,171	4,069
Anguilla	2.34	0.74	4,844	1,291
St Kitts	1.97	0.74	15,132	3,535
US Virgin Is.	1.88	0.75	54,203	3,898
Réunion (Fr.)	1.79	0.30	73,354	18,306
British Virgin Is.	1.63	0.43	13,288	3,117
Barbados	1.48	0.42	138,530	32,218
Antigua	1.38	0.53	49,862	5,021
Fiji	1.05	0.32	65,233	11,554
Haiti	1.01	0.63	32,867	4,086
Dominican Rep.	0.98	0.38	834,002	177,515
Turks & Caicos	0.90	0.43	13,914	3,293
CNMI	0.90	0.27	13,606	2,040
French Polynesia	0.59	0.08	3,899	2,132
Mauritius	0.55	0.15	72,371	26,384

ANNEX 2 INTERNET USERS IN THE CARIBBEAN AS AT 30 JUNE 2010³⁸

	<i>Population (2010 Est.)</i>	<i>% Pop. Caribbean</i>	<i>Internet usage, latest data</i>	<i>% Population (Penetration)</i>	<i>User Growth (2000-2010)</i>	<i>% Users Caribbean</i>
Anguilla	14,766	0.0%	4,500	30.5%	389.7%	0.0%
Antigua & Barbuda	86,754	0.2%	65,000	74.9%	1200.0%	0.7%
Aruba (Neth.)	104,589	0.3%	24,000	22.9%	500.0%	0.2%
Bahamas	310,428	0.7%	115,800	37.3%	784.0%	1.2%
Barbados	285,653	0.7%	142,000	49.7%	2266.7%	1.5%
British Virgin Islands	24,939	0.1%	4,000	16.0%	0.0%	0.0%
Cayman Islands	50,209	0.1%	24,000	47.8%	207.7%	0.2%
Cuba	11,477,459	27.6%	1,605,000	14.0%	2575.0%	14.0%
Dominica	72,813	0.2%	27,500	37.8%	1275.0%	0.3%
Dominican Republic	9,823,821	23.6%	3,000,000	30.5%	5354.5%	31.1%
Grenada	107,818	0.3%	27,000	25.0%	558.5%	0.3%
Guadeloupe (Fr.)	444,100	1.1%	103,000	23.2%	1187.5%	1.1%
Haiti	9,648,924	23.2%	1,000,000	10.4%	16566.7%	10.4%
Jamaica	2,847,232	6.8%	1,581,100	55.5%	2535.2%	16.4%
Martinique (Fr.)	406,057	1.0%	170,000	41.9%	3300.0%	1.8%
Montserrat	5,118	0.0%	1,200	23.4%	0.0%	0.0%
Netherlands Antilles	228,693	0.5%	2,000	0.9%	0.0%	0.0%
Puerto Rico	3,978,702	9.6%	1,000,000	25.1%	400.0%	10.4%
St. Barthélemy (Fr.)	7,406	0.0%	0	0.0%	0.0%	0.0%
St. Kitts & Nevis	49,898	0.1%	17,000	34.1%	750.0%	0.2%
Saint Lucia	160,922	0.4%	142,900	88.8%	4663.3%	1.5%
St. Martin (FR)	30,235	0.1%	0	0.0%	0.0%	0.0%
St. Vincent & Grenadines	104,217	0.3%	76,000	72.9%	2071.4%	0.8%
Trinidad & Tobago	1,228,691	3.0%	485,000	39.5%	385.0%	5.0%
Turks & Caicos	23,528	0.1%	0	0.0%	0.0%	0.0%
US Virgin Islands	109,750	0.3%	30,000	27.3%	150.0%	0.3%
Total Caribbean	41,632,722	100.0%	9,647,000	23.2%	1624.5%	100.0%

ANNEX 3 INTERNET USERS IN OCEANIA AS AT 30 JUNE 2010³⁹

	<i>Population (2009 Est.)</i>	<i>% Pop. Oceania</i>	<i>Internet usage, latest data</i>	<i>% Population (Penetration)</i>	<i>User growth (2000-2009)</i>	<i>% Users Region</i>
American Samoa	65,628	0.2%	0	0.0%	0.0%	0.0%
Antarctica	1,169	0.0%	0	0.0%	0.0%	0.0%
Australia	21,262,641	61.0%	17,033,826	80.1%	158.1%	81.2%
Australia, Ext. Ter.	1,648	0.0%	0	0.0%	0.0%	0.0%
Christmas Island	1,402	0.0%	464	33.1%	0.0%	0.0%
Cocos (Keeling) Is.	596	0.0%	0	0.0%	0.0%	0.0%
Cook Islands	11,870	0.0%	5,000	42.1%	0.0%	0.0%
Fiji	944,720	2.7%	103,000	10.9%	1273.3%	0.5%
French Polynesia	287,032	0.8%	90,000	31.4%	1025.0%	0.4%
Guam	178,430	0.5%	85,000	47.6%	1600.0%	0.4%
Kiribati	112,850	0.3%	2,000	1.8%	100.0%	0.0%
Marshall Islands	64,522	0.2%	2,200	3.4%	340.0%	0.0%
Micronesia	107,434	0.3%	16,000	14.9%	700.0%	0.1%
Nauru	14,019	0.0%	300	2.1%	0.0%	0.0%
New Caledonia	227,436	0.7%	85,000	37.4%	254.2%	0.4%
New Zealand	4,213,418	12.1%	3,360,000	79.7%	304.8%	16.0%
Niue	1,598	0.0%	1,000	62.6%	122.2%	0.0%
Norfolk Island	2,554	0.0%	700	27.4%	0.0%	0.0%
Northern Marianas	51,484	0.1%	10,000	19.4%	0.0%	0.0%
Palau	20,796	0.1%	5,400	26.0%	0.0%	0.0%
Papau New Guinea	5,940,775	17.1%	120,000	2.0%	11.1%	0.6%
Pitcairn Islands	48	0.0%	0	0.0%	0.0%	0.0%
Samoa	219,998	0.6%	9,000	4.1%	1700.0%	0.0%
Smaller Territories*	3,902	0.0%	0	0.0%	0.0%	0.0%
Solomon Islands	595,613	1.7%	10,000	1.7%	400.0%	0.0%
Tokelau	1,371	0.0%	800	58.4%	1112.1%	0.0%
Tonga	120,898	0.3%	8,400	6.9%	740.0%	0.0%
Tuvalu	12,373	0.0%	4,200	33.9%	0.0%	0.0%
Vanuatu	218,519	0.6%	17,000	7.8%	466.7%	0.1%
Wallis & Futuna	15,289	0.0%	1,200	7.8%	0.0%	0.0%
Total Oceania	34,700,201	100.0%	20,970,490	60.4%	175.2%	100.0%

* The Smaller Territories include those of Chile, Norway, the UK and the USA.

ANNEX 4 INTERNET AND BROADBAND IN SELECTED ISLANDS⁴⁰

	<i>Internet users per 100 inhabitants</i>			<i>Fixed broadband Internet subscribers per 100 inhabitants</i>		
	<i>2007</i>	<i>2008</i>	<i>2009</i>	<i>2007</i>	<i>2008</i>	<i>2009</i>
Cape Verde	8.3	20.6	29.7	0.8	1.5	1.4
Comoros	3.4	3.5	3.6	0	0	0.0
Cuba	11.7	12.9	14.3	0	0	0.0
Dominican Rep.	17.1	21.6	26.8	1.6	2.3	3.9
Fiji	10.9	12.2	13.5	1.4	1.8	2.5
Iceland	89.9	90.6	93.5	31.8	32.9	33.2
Jamaica	55.6	56.9	58.2	3.4	3.6	4.1
Maldives	16.5	23.5	28.4	3.5	5.2	5.8
Malta	45.3	48.8	58.9	20.2	24.8	24.4
Papua New Guinea	1.8	1.8	1.9	0	0	0.0
Singapore	69.2	73	77.2	20	21.7	23.7
St. Vincent and the Grenadines	52.3	60.5	69.6	7.3	8.6	10.5
Trinidad & Tobago	16	17	36.2	2.7	4.6	7.8

ANNEX 5 INTERNET AND BROADBAND IN ISLANDS NOT INCLUDED ELSEWHERE

	<i>Internet subscriptions</i>		<i>Internet Users</i>		<i>Broadband subscriptions</i>	
	<i>000s</i>	<i>per 100 inhabitants</i>	<i>000s</i>	<i>per 100 inhabitants</i>	<i>000s</i>	<i>per 100 inhabitants</i>
Ascension	0.3	0.0	0.3	0.0	0.3	0.0
Cape Verde	9.2	1.9	150.0	29.7	7.0	1.4
Falkland Is.	1.1	37.7	2.9	95.8	1.1	37.7
Faroe Is.	16.0	32.2	37.5	75.2	17.0	34.1
Mauritius	223.9	17.4	290.0	22.5	92.5	7.2
Réunion	0.0	0.0	300.0	36.3	185.0	22.4
São Tomé	2.5	1.6	26.7	16.4	2.0	1.2
Seychelles	6.0	7.1	34.0	40.4	3.8	4.5
St Helena	0.7	14.6	0.8	19.1	0.4	9.3

Source: ITU.

END NOTES

- ¹ The United Nations maintains a list of 38 SIDS and 14 similar territories, available at: <http://www.un.org/special-rep/ohrlls/sid/list.htm>
- ² Ewan Sutherland (2010) "Ubiquity and broadband in small island developing states" presented at *ITS Asia-Pacific Regional Conference*, Wellington, 26-28 August. Available at: <http://papers.ssrn.com/abstract=1588626>
- ³ Frances Cairncross (1997) *The death of distance: how the communications revolution will change our lives*. London: Orion Business.
- ⁴ Thomas W. Hazlett and Anil Caliskan (2008) "Natural experiments in U.S. broadband regulation" *Review of Network Economics* 7 (4) 460-80.
- ⁵ Akamai Technologies, Edgecast and Limelight all have offices in Singapore. Akamai has 50,000 servers at 2,000 locations in 70 countries.
- ⁶ Erik Nygren, Ramesh K. Sitaraman & Jennifer Sun (2010) *The Akamai Network: A platform for high-performance Internet applications*. Available at: http://www.akamai.cn/enzs/dl/technical_publications/network_overview_osr.pdf
- ⁷ An exception amongst the French territories is the island of Mayotte.
- ⁸ Committee for the Privatisation of the Bahamas Telecommunications Company (2009) *A consultation paper on the issues and options for the access and interconnection framework for electronic communications in the Commonwealth of the Bahamas*. Nasau: Government of the Bahamas.
- ⁹ Telecommunications Unit (2007) *Local Loop Unbundling for Cable & Wireless (Barbados) Limited: Consultative Document*. Bridgetown: Ministry of Economics Affairs and Development.
- ¹⁰ Ministry of Energy, Telecommunications & E-Commerce (2009) *Access and interconnection in Bermuda: Consultation Paper*. Hamilton: Government of Bermuda.
- ¹¹ Office of Utilities Regulation (2006) *Local loop unbundling for Cable & Wireless Jamaica: Consultative Document*. Kingston: Office of Utilities Regulation.
- ¹² Telecommunications Authority of Trinidad and Tobago (2009) *A consultative document: proposed framework for local loop unbundling in Trinidad and Tobago*. Port of Spain: Telecommunications Authority of Trinidad and Tobago.
- ¹³ Ewan Sutherland (2010) "International mobile roaming in Asia and the Pacific Islands" presented to the *PITA Conference on international mobile roaming*, August, Sydney. Available at: <http://papers.ssrn.com/abstract=1639378>
- ¹⁴ IDATE (2005) *Regulatory, infrastructure and tariff aspects of electronic communications and broadband connectivity in the Outermost Regions (OR): A comparison of the current situation with that in the rest of the Community and neighbouring countries*. Brussels: European Commission.
- ¹⁵ ARCEP (2010) *Rapport au Parlement et au Gouvernement relatif au secteur des communications électroniques outre-mer*. Paris: Autorité de régulation des communications électroniques et des postes.
- ¹⁶ A list of existing and planned cables serving islands is provided in Annex 6.
- ¹⁷ "Broadband cable link-up set for end of next year" *Seychelles Weekly*, 1 February 2010.
- ¹⁸ Décision n° 04-376 de l'Autorité de régulation des télécommunications en date du 4 mai 2004 se prononçant sur un différend opposant Outremer Télécom à France Télécom.
Décision n° 04-374 de l'Autorité de régulation des télécommunications en date du 27 avril 2004 se prononçant sur un différend opposant le Conseil régional de la Réunion à France Télécom.
- ¹⁹ <http://www.sprep.org/att/IRC/eCOPIES/Countries/Niue/40.pdf>
- ²⁰ <http://www.vision2030.gov.jm/>
- ²¹ "Jamaica: Gov't focused on ICT broadband backbone". Press release 20 July 2010. <http://www.caribbeanpressreleases.com/articles/7183/1/Jamaica-Govt-Focused-on-ICT-Broadband-Backbone/Page1.html>
- ²² [http://www.ida.gov.sg/About Us/20060406102431.aspx](http://www.ida.gov.sg/About%20Us/20060406102431.aspx)
- ²³ http://www.apf.gov.au/senate/Committee/broadband_ctte/submissions/sub035.pdf
- ²⁴ "Norfolk Island to lead the way on high-speed broadband" *Voice and Data* online. 24 April 2009.
- ²⁵ This is also true of the British Crown Dependencies: Guernsey, Isle of Man and Jersey.
- ²⁶ Neil Rickard, Robert F. Mason (2010) *Magic quadrant for global network service providers*. Gartner RAS Core Research Note G00174070.
- ²⁷ "When getting away means staying in touch" Reuters, 27 August 2010.

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- ²⁸ Opal Lawton (2010) *Monitoring Caribbean information societies*. Santiago: ECLAC.
- ²⁹ <http://www.itu.int/ITU-D/icteye/Indicators/Indicators.aspx>
Data for subscriptions for Cayman Islands are from the Cayman ICTA, as the ITU reports are blank.
http://www.icta.ky/docs/Stats/Cayman_Islands_ICT_statistics.pdf
- ³⁰ Tables 2 and 18 from http://cso.gov.tt/statistics/pdf/Tables1-10,76-81_HBS.pdf &
http://cso.gov.tt/statistics/pdf/Table18_HBS.pdf
- ³¹ "Jamaica leads Caribbean region in residential broadband offer; Delays of UMTS/HSPA deployments encourages deployment of WiMAX services" Press release. 10.09.2009. Signals Telecom Consulting.
- ³² "Telecom Cook Islands signs broadband contract with O3b" *Telegeography*. 16 June 2010.
- ³³ <http://www.itu.int/ITU-D/icteye/Indicators/Indicators.aspx>
- ³⁴ Samoa Household and Income Expenditure Survey,
http://www.spc.int/prism/wstest/census_survey/Hies-02/hies_02.htm
Specifically Table 2.15 available at:
http://www.spc.int/prism/wstest/Products&Services/Reports/PDF/Hies/hies02_tables2.PDF
- ³⁵ Ewan Sutherland (2010) "Telecommunications in the African Small Island Developing States" presented at CPR Africa Conference, Cape Town. Available at: <http://papers.ssrn.com/abstract=1583441>
- ³⁶ Ewan Sutherland (2010) "Telecommunications in the small island states and territories of Europe" presented at ITS Europe Conference, Copenhagen. Available at:
<http://papers.ssrn.com/abstract=1583970>
- ³⁷ Speed test results as at 31 August 2010 from <http://www.speedtest.net/global.php>
- ³⁸ <http://www.internetworldstats.com/stats11.htm#caribbean>
- ³⁹ <http://www.internetworldstats.com/stats6.htm#oceania>
- ⁴⁰ Annex 3 of
http://www.itu.int/ITU-D/ict/publications/idi/2010/Material/MIS_2010_without%20annex%204-e.pdf
2009 data from ITU ICT indicators database.