Telecommunications in Samoa since 2010- focus: Internet Connectivity

By Richard Murphy
CEO, Lalomanu Foundation, Inc
February 19, 2026

1 Introduction

Because Internet connectivity is fundamental to education in much of the world, understanding the existing data infrastructure and any plans for change in Samoa is vital for the Lalomanu Foundation ("the Foundation"). This paper examines the changes over the last fifteen years and the feasibility of projects intended to improve upon the current baseline, including a potential project of the Foundation. It will also address some of the government policies that will affect some of the activities of the Foundation.

In Samoa, the term "Information and Computing Technology" (ICT) is used to cover both computer hardware and software, as well as computer networks. ICT is used with this same meaning in this paper.

A brief overview of the pre-2010 telecommunications history follows in order to show how the 2010 baseline came to be. It is important to note that most of the projects installing and using ICT in Samoa have had an international partner, usually providing funding, technical expertise, and sometimes equipment. Many of the government documents cited here are dated by fiscal year; where the Samoan government fiscal year runs from July 1 to June 30.

2 Historical background: reaching the 2010 baseline

Before communications satellites were launched into orbit, Samoan communications with the rest of the world were through telegraphic and radio links. The local Samoan communications infrastructure consisted of telephone exchanges and a limited number of land lines. In the early 1980s, the first communications satellites in geosynchronous orbit, such as Intelsat, changed many things on the ground.

A detailed snapshot of telecommunications in Samoa in 2005 is shown in the following list [1]:

- Six digital Exchanges. The Main Exchange in Apia provides the International Telecommunications Gateway, and a Manual Operator Assistance Centre. Five smaller Remote Subscriber Switches are located at Faleasiu, Lufilufi, Salelologa, Faleolo Airport and Asau in the Rural Sector.
- An extensive rural telecommunications network using the Digital Radio Multiple Access Subscriber System (DRMASS).
- Some areas of the country are serviced with the IRT2000 radio system.
- A Digital Microwave System interconnects all the remote exchanges to the main Gateway Exchange. Optical fiber technology has now replaced some of the microwave links that linked

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Apia Exchange to the Rural Exchanges. The main backbone infrastructure is also fiber optic and covers 70% of the rural areas of Upolu.

- All international access is provided by a standard A Satellite Earth Station operating through the 174-degree Intelsat Satellite. This station provides direct digital circuits to New Zealand, Australia, and United States mainland. A further digital microwave connection provides a direct link between Samoa and American Samoa (SAS link) with a capacity of 30 voice channels.
- Wireless Local Loop (WLL) technology was introduced in 2003 to provide telephone to the rural areas in Savaii where cables cannot be installed.
- A network of public card-payphones (132) is in place covering the two main islands.

The same Ministry of Communications and Information Technology (MCIT) document goes on to mention that there were about 3000 subscribers to "Internet services." No source for this count was provided in the MCIT document; there were several ISPs in Samoa at the time and they may have provided a tally of their customers to the MCIT. Another data point given in this list is the assertion that the main telephone infrastructure is "fibre optic" and covers "70% of the rural areas of Upolu." This may have been technically correct, but this infrastructure was built to provide backhaul for telephone exchanges rather than broadband connections to end users. No public map of this fiber infrastructure or capacity specifications exists, although a very small Vodafone Samoa map is reproduced in [2]. This paper will address the local Internet infrastructure in more detail in subsequent sections.

In 2009 the first step-up in external connection capacity occurred when the Samoa-American Samoa (SAS) cable went into service [3]. The initial capacity was 1Gb/s [4], which was a huge improvement over the old link between Samoa and American Samoa. The SAS link provided a low-latency link to Hawaii and on to the mainland of the USA, but it would take another fiber cable to modernize Samoa's connections to their two most important foreign partners, New Zealand and Australia.

3 Major infrastructure projects: external and internal (2010–present)

These projects are discussed in chronological order. No detailed technical descriptions of the infrastructure resulting from these projects are given here because no design documents are available. Most of the information in this section comes from various reports and reviews by the funding partners, as Samoan government documents tend to be very general.

3.1 Tui-Samoa submarine cable (RFS ≈ 2018) and Manatua (One Polynesia) (RFS 2020)

The Tui-Samoa cable ("Tui" means king or leader in Samoan) runs from Fiji to Samoa and went into service in 2018. There are two fiber pairs and the system theoretically can carry 16 Tb of traffic [5] [6] [7] [8]. The amount of this capacity available for use by Internet users in Samoa is unspecified. While this fiber project was definitely needed, not everyone thought that Samoans would receive any benefits from this new capacity for digital data. Current Samoan long-term economic development strategies stress the importance of the Tui-Samoa cable [9].

The Manatua cable [10] is the most recent major submarine fiber project involving Samoa. It went into service in 2020. While there is not a great demand for capacity between Samoa and Tahiti, this cable does theoretically allow for diverse routing for traffic between Samoa and the USA. The author has not discovered a case where traffic between the USA and Samoa uses this cable as part of the primary

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path. Figure 2 shows a high-level view of south Pacific data paths, including many of the smallest island nations, which now have fiber landings [11].

3.2 School Net Project

The School Net project started in 2005 and was intended to connect the secondary schools to the Internet. It was originally supported by the Asian Development Bank (ADB), along with the governments of Australia and New Zealand. The project had initial success when all 39 secondary schools were connected, some with ADSL lines and others wireless technology [12] [13]. At this time, the state of this connectivity is unknown as the Lalomanu Foundation has not found anyone in the MESC to provide this information. A related project called the Community Access project created, with the help of the ITU, about ten "telecenters" in rural Samoa, which were to provide Internet access to rural communities. This project was discontinued as community demand for this service was very low and school officials had objections to non-school activities being held at schools. The School Net project was only partially successful in that the teachers did not incorporate its availability into their curriculum. This project should not be confused with the School Connectivity Project

3.3 Samoa National Broadband Highway (SNBH)

This project was intended to expand government[1] broadband access outside of Apia and replace the reliance on Kacific satellite ground stations at rural locations. It was a partnership between the government of Samoa and the Export-Import Bank of China (EXIM) [12], which provided a loan of $20m to the government of Samoa. The network does not provide services to private entities and it is "broadband" only in the small fiber network in Apia. At this time, it has no excess capacity and is considered "end-of-life" in terms of the equipment that it uses [14]. Because of the Chinese funding, the implementing contractor was Huawei Technologies.

The project was officially completed and handed over to the local authorities on June 26, 2014. The project connected 66 ministries, corporations[2] and their centers to a Data Center next to the National Kidney Foundation in the capital city of Apia. According to the Asian Development Bank, the broadband network is underutilized and the government has not allocated an appropriate maintenance budget. [15]

3.4 Digital Connected and Resilient Samoa Project (DCRS)

This project is intended to learn from the lessons of the SNBH project and fulfill the need for a more modern, open, and resilient network infrastructure in Samoa. The World Bank is the development partner organization. For the purposes of this document, the most important sub-components of the project are:

> ***Subcomponent 1.1: National fiber network to improve service delivery (US$9.20 million).*** *This subcomponent will finance the public sector contribution to a public private partnership (PPP) to rollout and deliver a Fiber to the Premises (FTTP) network using green technologies (low-carbon technologies and climate-resilient design approach) that will bridge the digital divide and improve access to digital services particularly in underserved areas of Upolu and Savai'i. Specific activities to be undertaken include deploying new fiber, decommissioning existing obsolete systems which are highly*

[1] The SNBH was not intended to provide Internet access; it was effectively an intranet [29]
[2] It is not clear exactly how many entities are connected and what is meant by "corporation" in this context. Other documents give a different number.

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susceptible to weather-related disruptions and interruptions, and incorporating resilience and redundancy features for secure and robust communications. This PPP approach will foster market competitiveness, increase investment incentives among private sector operators and maximize benefits for end users and communities. Models for mobilizing private sector contributions could include capital injections and in-kind contributions, based on the government's assessments completed in the first year of implementation (under Subcomponent 2.1). The FTTP network will connect key government institutions, including Ministries, 166 schools, 11 rural medical centers and 51 Fono Faavae (District development Centers) (see subcomponent 1.2).

Subcomponent 1.2: Enhancement of the capacity, coverage, security and resilience of the Government's Intranet (US$2.64 million). *The FTTP network deployed under Subcomponent 1.1 will provide the infrastructure layer that will be used under this subcomponent 1.2 to connect government agencies and establish secure cross-government data and information exchange at the national level. Approximately 90 percent of government agencies outside Apia will migrate from an outdated, end-of-life copper network to the new climate resilient, secure FTTP network. Specifically, this Subcomponent will support the deployment of a robust communication platform equipped with backup functions and recovery plans to ensure continuous operation of government services, facilitate secure and efficient data exchange across government agencies, and allow for better coordination and data sharing at the national level including during emergencies. The investments in climate-resilient technology will help minimize network downtime (currently at a high 10 percent outside Apia), particularly downtime due to weather-related disruptions, eliminate Single Points of Failure (SPOF), and mitigate the impact of power cuts on government agencies, schools, and hospitals. This subcomponent will also finance activities to strengthen cyber resilience through support of SamCERT, protecting the Government network against cyber threats, minimizing the impact of cyber breaches and putting in place business continuity strategies for critical infrastructure, such as utilities and telecommunications, to maintain government services in the event of cyber breaches. Finally, this subcomponent will also support expanded public access by financing the installation of public Wi-Fi hotspots in rural areas.*

Subcomponent 1.3: Upgrade and establishment of secure and resilient government data center and support for the rollout of broadband pilot(s) (US$3.55 million). *Subcomponent 1.3 will finance a secure and resilient government data center, and the rollout of broadband pilots to enhance Samoa's digital infrastructure and services. Specifically, this Subcomponent will:*

a) Establish a Government Integrated Data Center: *Financing for a Government integrated data center for storing critical data which utilizes renewable, redundant energy sources to minimize network downtime, eliminate SPOF and reduce the carbon footprint. The specifications for the data center will meet good practices for access management, resource efficiency, and security and cyber resilience. Government will seek EDGE certification for any data center infrastructure located domestically.34 This subcomponent will also finance technical assistance to examine options for incorporating cloud computing to enhance the resilience and security of Government data systems, particularly during national emergencies and climate-related disasters, while also reducing maintenance costs. This analysis will also evaluate the potential use of a private government cloud for securely storing sensitive information.*

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> ***b) Create an Internet Exchange Point (IXP):*** *Financing for the establishment of an IXP within the government integrated data center to localize internet traffic. This initiative will result in faster network connections, decreased demand for international bandwidth, reduced latency and improved fault tolerance, enhancing the overall efficiency and reliability of the Government's digital infrastructure.*
>
> ***c) Pilot Broadband Use Cases:*** *Several broadband use cases to explore their viability and impact, including: (i) modernizing National Radio 2AP through upgrades and expansions of its transmission capabilities for emergency communications, with a particular focus on early warnings for climate-related events; and (ii) enhancing access to Government services by providing access to the National Government Portal at 12 Fono Faavae (District Development Centers), allowing residents without personal devices to receive alerts, access government services, submit disaster-related information (such as online damage assessments for timely relief fund distribution), and connect with support groups for gender-based violence35. [16]*

Additionally, the project seeks to create public-private partnerships (PPP) to enhance the use of the infrastructure and to support economic activity in Samoa. This project has a much wider scope than the SNBH and, if successful, will transform the abilities of all users to be more aligned with those in highly connected countries. Subcomponent 1.2 defines the replacement for the SNBH. Subcomponent 1.3b is a key part of a modern Internet infrastructure, presumably restarting the project described in Section 3.6 of this document.

While no detailed engineering plans are available, one can reasonably assume that several fiber rings will be constructed on Upolu, most likely following the right-of-way on the main coastal highway. The project target is for 700 km of fiber to be installed [17]. As the ring road of Upolu is about 185 km in length and [17] says that 20 villages will be passed by resilient fiber infrastructure, one can infer that the 700 km of fiber includes redundancy and sub-loops to 20 villages. At this time, progress reports made available by the World Bank indicate that there is little progress on many of the key components to this project. The World Bank ranks the risk factor for some components as substantial, meaning they may not be completed on time, within budget, or at all. Subcomponents 1.3b and 1.3c are not mentioned at all in the progress reports. Project expenditures are very low and essentially the project is one year behind schedule.

3.5 Last Mile Project

This project was for the island of Savai'I, the largest and completely rural island in the country and was funded by the Asia Pacific Telecommunity (APT) organization. As stated in [18]:

> *This is a pilot project to bridge the digital divide by improving rural connectivity and community access with advanced ICT infrastructure in Savaii. The project is delivered in two categories where Category 1 completed in March 2023 and report was submitted [to] Japan Telecommunication Engineering and Consult Services. The Category 2, kick starts in April 2023 and it is planned to be completed in FY23-24.*
>
> *The objectives for this project are:*
> *i) to provide access by connecting to the SNBH to localized digital resources;*
> *ii) to establish broadband access to connect hospitals and clinics to improve healthcare services at Tuasivi Hospital;*
> *iii) to introduce broadband to colleges and schools in Tuasivi and proximate area to enhance ICT education with improved remote learning and distant education media;*

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iv) To enhance communications at Tuasivi Police Station using broadband for improved security and disaster management with advanced information collection systems during normal and emergencies;
v) to connect Savaii Post Office stations to the optical Fibre system to improve postal services, logistics and Post Office financial network;
vi) to access national digital platforms such as the National digital library, the lifelong learning platform as well as various open access repositories in Samoa and elsewhere, thereby empowering people to take part in participating in the 21st century digital economy;
vii) to provide network access to the local community for better information collection at normal and emergency situations such as cyclone, tsunami, earthquake and others;
viii) to ensure continuity of access to educational programmes for rural students through technology enabled learning at times of disaster and pandemic lockdown situation.

The APT organization does not allow public access to its publications, so a detailed evaluation is not possible with access to MCIT documentation.

3.6 The Samoa Internet Exchange Point (IXP)

The seed of this project was planted in 2014 by the Samoan Office of the Regulator [19]. An Internet Exchange Point allows ISPs and other large networks to exchange traffic without having explicit peering arrangements with every entity connected to the exchange point. For a location like Samoa, an IXP essentially keeps traffic local when both end-points are in Samoa. This has some important benefits:

- Lower latency due to much shorter network paths
- Reduced transit costs due to not passing traffic over marine fiber networks. Most of the time, there is no cost per byte of traffic passed through an IXP
- Ability to cache data for all users in Samoa. An IXP is a natural location for CDNs to place equipment.

In the case of Samoa, the lack of clients and buy-in by the ISPs essentially left a small amount of infrastructure in place but it carries no traffic. This project was supported by APNIC and could be part of a larger, Pacific region, distributed IXP [20]. The facility is located at the National University of Samoa, although the author could not identify anyone there who had responsibility for it. The company CSL Samoa is mentioned in verbal communications as having some role in maintaining the IXP. The MCIT reports that the IXP is ready for ISPs to connect [18]. More details appear in Section 5.4 of this document.

3.7 School Connectivity Project

Again, the MCIT states in [18] this status for the project:

The Ministry in partnership with Bluewave Company have completed the third phase of the School Connectivity Project during the FY22-23. The three phases of the School Connectivity Project were:

Phase 1: Mobilisation and Transfer of 40 VSATS;
Phase 2: Installation of Relocated VSATS; and
Phase 3: Installation of 80 VSATS.

By the end of Phase 3, 120 schools (government and some are mission) in both Upolu and Savaii wer[e] covered under the School Connectivity Project. Yet, there are still about

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53 schools that have yet to connect. The Ministry is looking at an extension of this project to ensure school connectivity for all the government schools.

During the project, the Ministry has been performing its regular monitoring to ensure that there is internet connectivity within the vicinity of the schools. The Ministry ensured that any technical issue is documented and referred to the contractor whereas any resource issues such as (computers, tablets, printers, etc) are to be referred to the Ministry of Education, Sports and Culture (MESC).

The completion report for the School Connectivity Project in its Phase 3 is ready for Cabinet submission.

Unfortunately, at the Lalomanu Primary School, VSAT connectivity is not working. It is reported that the VSAT equipment was not under a maintenance contract, so equipment failures and upgrades could not be accommodated. It is unclear how many schools have working VSAT connections.

Recently, a request for tenders to complete the School Connectivity Project was released by the Ministry of Finance on behalf of the MESC [21]. It is interesting in that the MCIT is seeking private companies to provide one year of broadband service to 80[3] schools, leaving it to the bidder to decide which network technologies to deploy. Implied by the release of this tender is that the MESC does not intend to wait for the DCRS project to provide fiber connectivity to the schools. The tender defines the

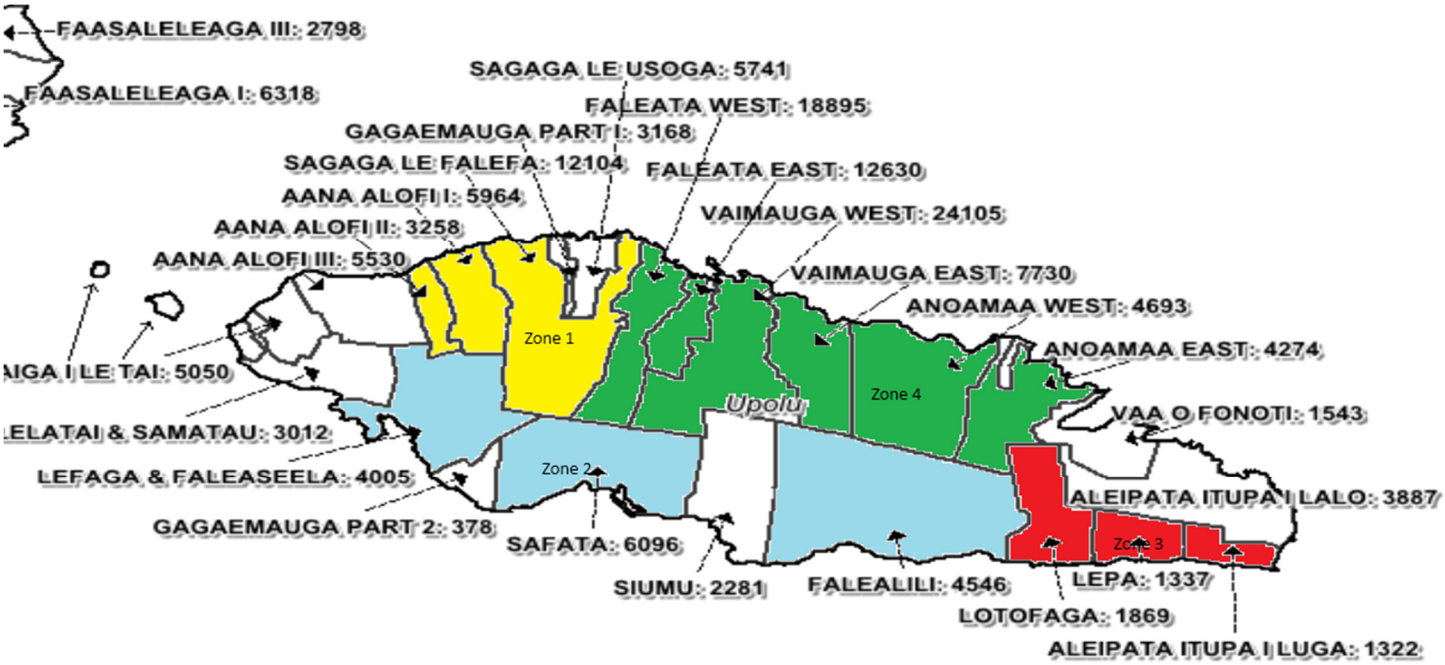

Figure 1 Service zones from the SCP tender (zone 1= yellow, zone 2 = light blue, zone 3 = red, zone 4 = green)

acceptable minimum bandwidth as 30/20 Mb/s, which is low enough to allow LTE/5G cellular providers to compete. Minimum latencies are also required, but it is not clear whether this is an average latency or the latency to the first hop outside of Samoa. The MESC will provide a firewall for each school. The planned service area for Upolu, with the zones labeled, is shown in Figure 1.

[3] 47 are on Upolu, 33 are on Savai'I; 80 is the number of VSATs that were originally planned for Phase 3.

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4 Market structure, ownership & policy changes

While a whole paper could be written on the changes in both the regulatory structure, ownership, and market penetration since 2010, this section will simply summarize the key aspects for reference purposes. Regulatory reforms created more competition, at least in the mobile communications area, which has led to lower costs for consumers. The two key companies, Digicel Samoa and Vodafone Samoa roughly split the market 50-50.

Perhaps the most important part of the telecommunications infrastructure is the Tui-Samoa cable, which, since the buy-out in 2022, is wholly owned by the government of Samoa. The government sets the charges for services, which include metered data transport and leased capacity [22]. Needless to say, actions of the government in privatizing some government telecom entities and removing private ownership from others has drawn criticism from some parties [23]. The Samoa American Samoa cable plays a smaller role in moving data between Samoa and the rest of the World. This may change as more submarine fiber is installed in the region, such as the just announced Le Vasa[4] cable [24]. The current capacity between Samoa and American Samoa via the SAS cable could provide the trans-Pacific and inter-Pacific connections that would make both Samoas a key location for CDNs serving Oceania.

The next level of connectivity is provided by Digicel Samoa and Vodafone Samoa. Presently, Digicel Samoa is owned by Telstra of Australia, with the majority of funding for the acquisition coming from the Australian government. Vodafone Samoa is primarily owned by Amalgamated Telecom Holdings Ltd of Fiji; a minority 25% share is held by the Unit Trust of Samoa (UTOS). Section 5.6 contains a comparison of the services they offer. Most of the public Internet users in Samoa use one of these companies.

Computer Services Ltd (CSL) has a unique role in Samoan telecommunications. Besides being an ISP, CSL has the operations contract for the SNBH and was involved in the Tui-Samoa cable project. The size of their customer base is not easily derived. They are the ISP for two Samoan government entities: the Office of the Regulator and the Electoral Commission.

[4] This cable is a spur off of the Bulikula cable. The available bandwidth and directly connected end-points are not known at this time. This cable is operated by the Google subsidiary Starfish Infrastructure,Inc.

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5 Current infrastructure

5.1 High-level technical view of Samoan Connectivity

This section first covers external infrastructure that benefits Samoa, and then the internal infrastructure, especially that which supports network connectivity. Because the internal structure of the Internet on Samoa is not documented publicly, much of the physical network is inferred. We do explore the network layer as that is something that can be probed remotely.

5.2 South Pacific Marine Cable/Fiber Infrastructure

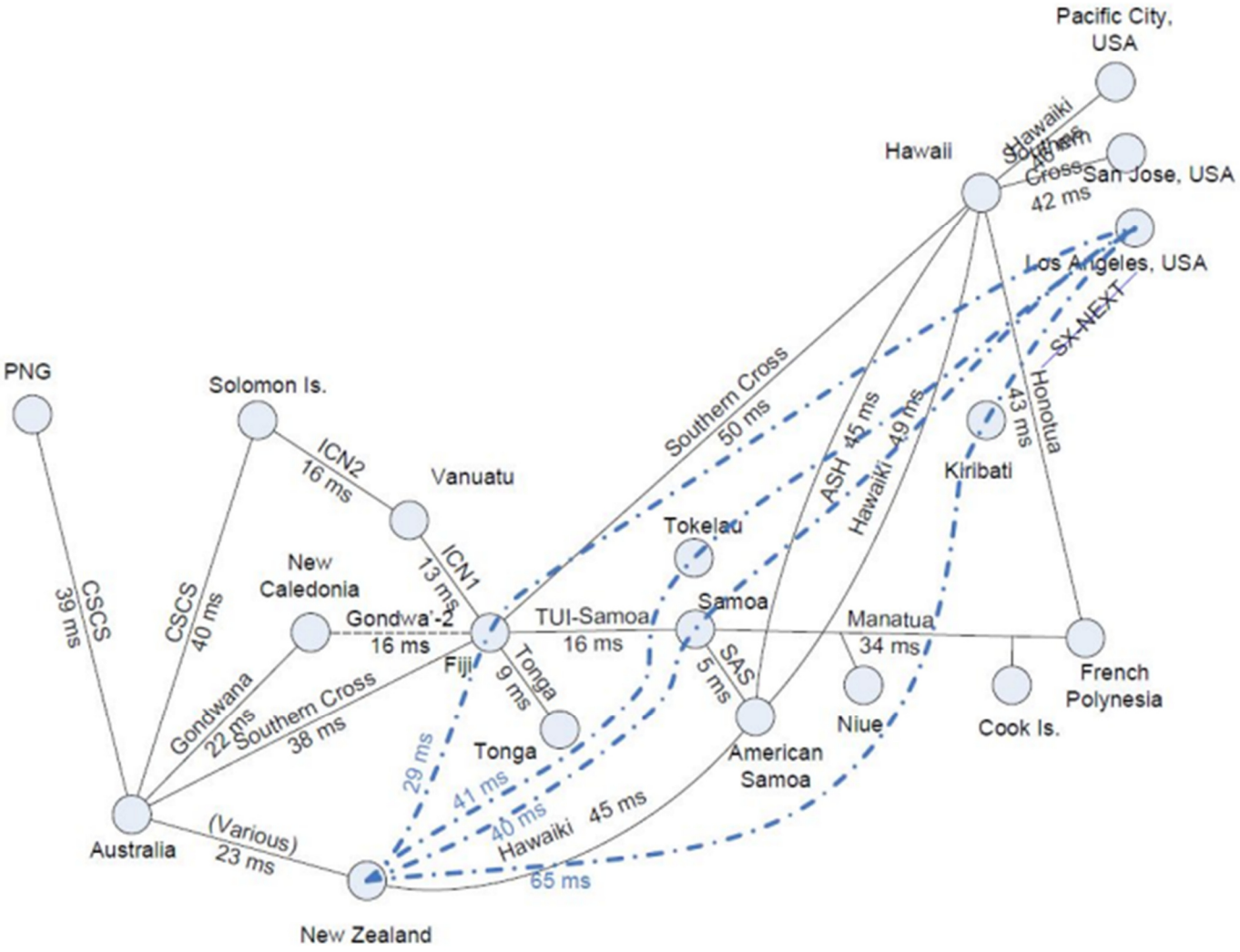

Figure 2Pacific physical and logical Internet links with latencies [10]

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5.3 Pacific Region IXPs

With the exception of IXPs in Australia, New Zealand, and Papua-New Guinea, there are only three [21]:

Table 1 Pacific IXP Comparison (excluding New Zealand)

Country	Capacity Gb/s	Website	Downstream count	Customers
Fiji	30	www.taf.org.fi	3	Digicel Fiji, Telecom Fiji, Vodafone Fiji
Samoa	unknown		0	
Vanuatu	4	vix.vu	3	Netnod, PCH AS42, PCH AS3856

The two working IXPs are very small in the number of Autonomous Systems (AS) that use them. Fiji, being a major telecommunications hub for Oceania, has the largest capacity. Figure 2 shows that Fiji benefits from no less than five submarine cables that connect the country to other countries.

There is an initiative supported by UN ESCAP to create a Pacific regional IXP [11] [25] [26], which would be a distributed IXP based on those in Samoa, Fiji, and Vanuatu. These IXPs would be connected via a layer-2 switching fabric and controlled by a distributed router server. This project depends on the Samoa IXP becoming operational.

5.4 Samoa Internet Exchange Point (IXP) Development

Within Samoa's broader telecommunications modernization, the establishment of a national Internet Exchange Point (IXP) has emerged as a crucial step toward improving local Internet efficiency and reducing costs. According to the MCIT Annual Report 2020–2021, the creation of the *Samoa National Internet Exchange Point (SamIXP-SIXP)* is designed to "keep local traffic local and avoid international links," thereby reducing bandwidth costs for domestic ISPs and improving latency for end-users [1].

Efforts to establish an IXP began in earnest in 2015 with an APNIC-supported national workshop that brought together operators, government agencies, and international partners [2]. The working group developed initial technical and policy frameworks to support neutral interconnection, peering policies, and local content hosting.

The anticipated benefits of the Samoa IXP include:

- Lower latency for intra-Samoa traffic,
- Decreased reliance on expensive international transit,
- Improved resilience during regional cable outages, and
- The foundation for future local content delivery networks (CDNs).

However, challenges persist, such as low local traffic volumes, the need for sustained coordination among ISPs, and governance clarity for neutral exchange operations.

In the *ICT Sector Plan 2022–2027* [27], the Samoan government explicitly identifies the IXP under its "Infrastructure and Access" pillar as a national priority to enhance domestic connectivity. Evaluating the

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IXP's eventual impact on latency, transit costs, and domestic routing metrics will be key to assessing its success within Samoa's evolving broadband ecosystem. Unfortunately, compared to the other IXPs in the Pacific region, the Samoa IXP is not technically operational as of November 2025. Some additional details are covered in Section 3.6. Given the low number of potential clients of the IXP, initially a route-server may not be needed and an over-provisioned layer-2 switching fabric will suffice. The following section shows the potential clients of the IXP.

In Figure 3, the box in green is the Samoa IXP, which has no customers and peers with Computer Services Ltd (CSL) (AS 38227) in Apia. CSL has two customers, the IXP and the Office of the Electoral Commission. CSL peers with Digicel Samoa, which is the de facto ISP. Besides operating the only terrestrial Internet trunk connection to Samoa, Digicel has two customers: CSL and No. 1 Commercial Center in Niue (AS 55885)[22].

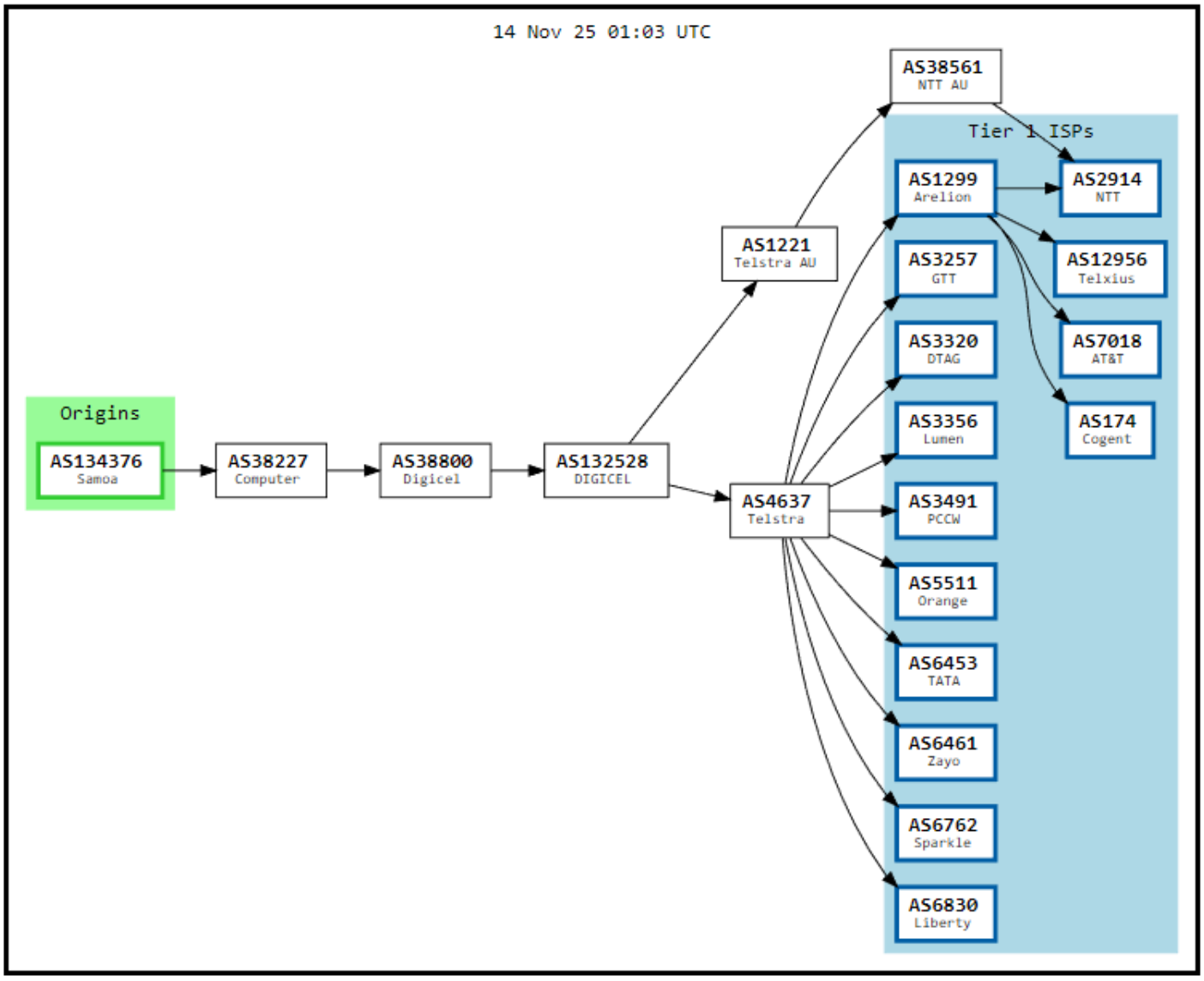

Figure 3 AS and Peer Relationships for Samoa [17]

Tables 6 and 7 provide data that illustrates why the Samoa IXP is vital for Internet usage growth in Samoa.

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5.5 ASNs in Samoa

Table 2 ASNs assigned to entities in Samoa [28]

ASN	Name	Type	Number of IPv4s	Active IPv4s
AS9218	WISEVAN GUARD Limited	inactive	0	
AS17993	Vodafone Samoa Limited [note B]	isp	9,472	
AS38227	Computer Services Limited (CSL) [note A]	isp	3,072	80
AS38800	Digicel Samoa Ltd [note C]	isp	4,096	
AS55579	Computer Services Ltd	inactive	0	
AS134376	Samoa IXP	inactive	0	
AS138356	National University of Samoa	inactive	See note C	
AS139679	Office of the Electoral Commission	government	256	5
AS150321	Secretariat of the Pacific Regional Environment Programme	business	256	9
AS153053	Lesamoa.net	isp	512	21

[Note A] CSL has two address blocks: 123.176.72.0/21 and 182.50.72.0/22, so the 3073 value comes from two different address blocks. Ten government servers or services are in CSL address space, which usually indicates physical or virtual hosting. These are the ministries or offices that are clients of CSL: Ministry of Finance; Ministry of Agriculture and Fisheries; Ministry of Health; Ministry of Works, Transport, and Infrastructure; Public Service Commission; and the Samoa Law Reform Commission. The Office of the Electoral Commission has its own address space (103.143.149.0/24), presumably routed through CSL.

[Note B] Vodafone Samoa has the largest amount of IPv4 address space, where the total number of IP addresses is the sum of these blocks: 202.4.32.0/19, 110.5.112.0/22, and 203.99.255.0/24

[Note C] Digicel Samoa is announcing these prefixes: 103.154.194.0/23, 182.50.168.0/22, 202.87.208.0/22, 203.99.156.0/22, 103.131.62.0/24 and 103.131.63.0/24. The last two blocks are assigned to the National University of Samoa. The number of IPv4 addresses is as given in Table 2, but a *nmap* scan for active devices was not done to avoid the appearance of hacking.

5.6 Important routers in Samoa

Table 3 IP addresses associated with routers in Samoa [28]

IP address	City	ASN
202.4.32.249	Apia	AS17993
202.4.32.250	Apia	AS17993
202.4.32.232	Apia	AS17993
202.4.32.195	Apia	AS17993
202.4.32.238	Apia	AS17993
202.4.32.242	Apia	AS17993
202.4.32.252	Apia	AS17993
202.4.32.229	Apia	AS17993
202.4.35.254	Apia	AS17993
202.4.37.73	Apia	AS17993
202.4.37.1	Apia	AS17993
202.4.37.5	Apia	AS17993
202.4.37.9	Apia	AS17993

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IP address	City	ASN
202.4.37.10	Apia	AS17993
123.176.72.250	Apia	AS38227
123.176.72.251	Apia	AS38227
123.176.72.249	Apia	AS38227
202.87.208.245	Apia	AS38800
202.87.208.198	Apia	AS38800
202.87.208.244	Apia	AS38800
202.87.209.204	Apia	AS38800
182.50.168.124	Apia	AS38800
203.99.157.59	Apia	AS38800
182.50.169.217	Apia	AS38800
103.154.195.6	Apia	AS38800

Note that these addresses are associate with router interfaces, so multiple addresses may be assigned to the same router. Clearly, there is at least one router in each AS and Vodafone Samoa has at least two routers.

5.7 Starlink: LEO displaces GEO

With the approval of Starlink use in Samoa, those seeking high performance network access have a simple alternative. One source reports that even before approval, over 100 ground stations were in use in Samoa [29]. Starlink is provided by a constellation of Low-Earth-orbit satellites, which has the advantage of low-latency when compared to MEO and GEO satellites. Starlink provides redundancy through numbers; a single satellite failure is transparent to a user. The key performance drawbacks to Starlink are the delays introduced by connection hand-offs when a satellite goes out-of-view from the ground station, and the fact that common default TCP congestion control mechanisms (Reno, Tahoe, Cubic, etc) do not deliver optimal throughput; the best TCP variant to use over Starlink is BBR [30].

Another drawback to Starlink is the lack of resilience in severe weather events. While the ground station antenna is small, casual mounting will not suffice in the face of high winds and rain. There is also the issue of Starlink using what is commonly called Carrier Grade NAT[5] (CGNAT). In this form of network address translation, multiple users share the same network address and there are two levels of NAT. Practically, this prevents direct[6] communications between two Starlink stations, even if techniques like port forwarding are used.

The users of Starlink in Samoa are motivated by the same factors that drive adoption in many rural areas: no wired broadband available, poor reputation of existing ISPs, and cost. Starlink still has some plans without data caps, which is a big incentive for users with unpredictable usage.

[5] Business accounts may upgrade to a routable IP address and all accounts may use IPv6.
[6] Indirect links are possible through tunnels and proxy servers, which introduce additional points of potential failure.

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5.8 Samoan ISPs

The three largest companies in terms of retail customers are Vodafone, Digicel, and Lesamoa Net[7].

Table 4 Overview of Internet services in Samoa[8]

Company	Retail ISP	Wholesale ISP	Fixed wireless	Mobile broadband	IGW-SSCC	IGW-mPower (MEO sat)	Starlink retailer
Vodafone Samoa	✓		✓	✓	✓		
Digicel Samoa	✓			✓	✓	✓	
Computer Services Limited	✓						✓
Bluewave Samoa Ltd	✓						
South Pacific Broadband Company	✓						
Samoa Submarine Cable Company (SSCC)		✓			✓		
Lesa's Telephone Services Ltd	✓						
Samoa Digital Communications Ltd							✓

None of the ISPs here publish a coverage map, so it is not clear how many cellular service towers have fiber back haul. Several questions naturally arise from a careful reading of Table 2. For example, Samoa – American Samoa Cable Ltd holds a cable landing license but neither a wholesale license nor an IGW license. This implies that the cable to American Samoa does not carry Internet traffic or provide redundancy with the TuiSamoa cable. This inference is supported by traceroute data that always reaches Samoa via Australia instead of Hawai'i. Another observation is the Digicel provision of ground stations for MEO satellite connections. Starlink, using LEO satellites, has lower latency, but more instability in throughput, whereas MEO satellites have larger latencies but fewer hand-offs between satellites. The latter factor is what causes throughput instability. This service is intended for large enterprises and government as it is much more expensive than Starlink.

Table 5 shows that the government of Samoa does not have a unified ICT strategy. Some ISPs benefit from selling Internet access to the government, but in many cases government content is kept with various cloud services. While this is good from the point of view of resilience, it can be a problem if there are chokepoints on bandwidth or high network latencies.

[7] Lesa's Telephone Services Co Ltd t/a Lesamoa.net

[8] Source: Licensed Telecommunication providers from the Office of the Regulator and Starlink's list of Samoan retailers. Retailers that are not telecommunications companies are omitted.

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5.9 Several big issues face Samoan Internet users

These can be summarized as

1. the lack of terrestrial fiber infrastructure and providers of FTTH/FTTP outside of Apia.
2. the lack of a functional Samoan IXP (wastes bandwidth and increases latency)
3. a price structure tied closely to the costs the ISPs incur from their use of marine fiber bandwidth. Capped data usage is a feature of many home service offerings.

Table 5 Computing and Storage Providers for the Samoan Government

Ministry/agency	IPv4	Provider	Services
MCIT.GOV.WS	192.185.39.31	Host Gator	VMs
MESC.GOV.WS	110.5.213.67	Vodafone Samoa	Server (VM?)
MYGOV.GOV.WS	35.213.213.170	Google Cloud	Cloud services
REGULATOR.GOV.WS	123.176.73.3	CSL Samoa	Server (VM?)
MOF.GOV.WS	198.202.211.1	Webflow	VMs

Table 6 Routing Path Comparison

Target: Vodafone (202.4.37.1)	Target: National University of Samoa via Digicel(103.131.62.10)
1 _gateway (192.168.1.1) [*] 0.700 ms 0.633 ms 0.805 ms 2 * * * 3 * * * 4 * * * 5 23-255-225-45.googlefiber.net (23.255.225.45) [AS16591] 5.012 ms 5.140 ms 6.211 ms 6 e0-26.core1.aus1.he.net (184.105.60.137) [AS6939] 5.722 ms 5.298 ms 5.249 ms 7 * * * 8 * * * 9 port-channel6.core3.sjc1.he.net (184.104.195.113) [AS6939] 44.497 ms 44.472 ms 44.560 ms 10 100ge0-58.core1.syd1.he.net (184.104.194.234) [AS6939] 184.255 ms * * 11 17993-sy4-ix.equinix.com (45.127.173.64) [*] 184.012 ms 183.985 ms 184.026 ms 12 202.4.32.9 (202.4.32.9) [AS17993] 187.260 ms 186.590 ms 186.342 ms 13 202.4.37.10 (202.4.37.10) [AS17993] 234.720 ms 234.231 ms 234.446 ms 14 202.4.37.9 (202.4.37.9) [AS17993] 232.730 ms 232.833 ms 232.826 ms 15 202.4.37.5 (202.4.37.5) [AS17993] 236.797 ms 236.714 ms 236.321 ms 16 202.4.37.1 (202.4.37.1) [AS17993] 236.012 ms * *	1 _gateway (192.168.1.1) [*] 0.467 ms 0.598 ms 0.578 ms 2 * * * 3 * * * 4 * * * 5 23-255-225-45.googlefiber.net (23.255.225.45) [AS16591] 6.047 ms 6.034 ms 6.186 ms 6 e0-26.core1.aus1.he.net (184.105.60.137) [AS6939] 5.847 ms 4.982 ms 4.043 ms 7 * * * 8 port-channel13.core1.fmt2.he.net (184.104.188.144) [AS6939] 43.328 ms * * 9 port-channel6.core3.sjc1.he.net (184.104.195.113) [AS6939] 44.502 ms 44.477 ms * 10 100ge0-58.core1.syd1.he.net (184.104.194.234) [AS6939] 183.558 ms * * 11 132528.syd.equinix.com (45.127.173.29) [*] 181.773 ms 182.080 ms 182.205 ms 12 103.73.110.38 (103.73.110.38) [AS132528] 230.189 ms 230.187 ms 229.150 ms 13 * * * 14 * * * 15 gi0-0-0.rgwict02.digicelsamoa.ws (202.87.208.245) [AS38800] 229.522 ms 229.452 ms 229.392 ms 16 182.50.169.217 (182.50.169.217) [AS38800] 230.264 ms 230.228 ms 230.377 ms

Target: A Digicel customer Source: A Vodafone customer	Observation
Partial traceroute to cslsamoa.ws (123.176.73.91), 64 hops max, 40 byte packets 1 unifi.localdomain (192.168.0.1) 3.802 ms 2.823 ms 3.432 ms 2 202.4.38.1 (202.4.38.1) 5.515 ms 4.812 ms 4.716 ms 3 tw.mfu.samoatel.ws (202.4.32.252) 19.164 ms 8.320 ms 5.795 ms 4 202.4.37.2 (202.4.37.2) 8.529 ms 6.011 ms 5.666 ms 5 202.4.37.6 (202.4.37.6) 5.037 ms 4.846 ms 4.948 ms 7 202.4.32.9 (202.4.32.9) 56.152 ms 54.796 ms 55.262 ms 8 202.4.32.10 (202.4.32.10) 54.832 ms 54.675 ms 54.856 ms 9 132528.syd.equinix.com (45.127.173.29) 55.934 ms 56.525 ms 55.280 ms 10 103.73.110.38 (103.73.110.38) 55.650 ms 55.651 ms 55.709 ms 11 10.173.0.33 (10.173.0.33) 55.495 ms 55.819 ms 55.450 ms 12 202.87.208.198 (202.87.208.198) 55.410 ms 54.619 ms 54.711 ms (remaining hops timeout)	here you hit Vodafone Samoa Six hops to Equinix in Sydney! Digicel address space here Digicel Samoa IP space here

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Table 7 Local network traffic does not stay local

It is not clear whether Samoa has the "critical mass" of business, government, and educational users to support a functional broadband network in terms of user fees alone. There are better ways to approach how networks are done and this is touched upon in Section 8.

5.10Physical infrastructure

Understanding what is already in place is difficult due to the lack of any general "on-the-ground" survey for Upolu and Savai'i. We have statements like this one made by Vodafone:

> *Voda thinks this may be a duplication work, and mentioned that they have a fiber connecting the majority of Upolu Island, but they believe Savaii may need more connectivity. The topic of who will manage and maintain the network was brought up, including the potential involvement of the private sector.* [31]

This statement is a stakeholder comment given to the MCIT for the Digitally Connected and Resilient Samoa project, which calls for a major installation of fiber on Upolu. The statement is lacking in important details, such as the topology of the fiber network, the available capacity, where it is installed, and the type of optical add-drop multiplexors in use. There were no comments of a similar nature made by Digicel Samoa.

While the Vodafone fiber network is used for cellular backhaul, the rate schedule approved by the Office of the Regulator mentions the "Matagi Fibre Plans." This is a service tiered by bandwidth (symmetrical) from 10 to 200Mbps and no volume caps. The 30/30Mbps service, for example, costs $US 2000/month, so this not intended for households or schools. It is not clear which areas of Upolu have Matagi plans available, outside of Apia. Digicel mentions no fiber service in their approved rate sheet. [32]

The best assessments of the telecommunications infrastructure in Samoa come from the World Bank as part of their Digitally Connected and Resilient Samoa project [33] and from the UN ESCAP office in their report on promoting rural ICT in Samoa [2]. The following description is taken from the World Bank Project Appraisal Document just cited:

> ***Expanding fixed fiber infrastructure beyond Apia— in Upolu and in Savai'i — is crucial for delivering consistent, high-quality digital services across Samoa, particularly in rural areas.*** *Currently, only 30 percent [as per the MCIT] of the cell towers in Samoa are connected by fiber, primarily around the central Apia area, while the rest rely on microwave links. This results in variable service quality, especially in rural areas in Upolu and in Savai'i. Out of 51 Districts in Samoa, OoTR identifies 47 as unserved or underserved, where more than 60 percent of the population resides.*

Other sources [34] describe this fiber infrastructure as part of Vodafone Samoa's network and Digicel Samoa's backhaul as being all fixed wireless. The two physical-layer technologies used to deliver broadband are ADSL and WiMAX. Data over a 4G cellular connection is not considered broadband for the purposes of this white paper. ADSL sometimes does achieve a 10Mb/s download rate, but this requires bonding two physical lines at the link layer and very noise-free circuits without repeaters.

The distribution of cell towers is shown in Figures 4 and 5 that follow. Backhaul bandwidth and media are not usually publicly available as this information is considered proprietary.

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Projects to expand the number of kilometers of installed fiber have important goals, but because such projects do not clearly spell out whether this fiber will be government owned or be owned by a consortium of entities, the rates for customers to acquire broadband capacity may be formidable. Additionally, the rates to use marine fiber bandwidth will be reflected in any end-user charges.

The planned fiber expansion under the Digitally Connected and Resilient Samoa project is for 700km, with 400km being on Upolu and 300km being on Savai'i. This amounts to an order of magnitude expansion of the amount of fiber. Since the design is not finalized, the number of fiber pairs and the type of optical multiplexing is not yet specified, so the total new capacity is unknown. Because the term "resilient" is prominently in the name of the project, it is safe to assume that the topology will consist of several rings that provide redundant paths to most stubs off the rings. Given that the main road circumscribing Upolu is about 180km in length and that the three main cross-island roads are another 40km, 400km of fiber would include redundancy and many stubs.

Cabinets holding active equipment will need to be placed well away from areas that may see storm surge during cyclones. The obvious customer for using some of the bandwidth is Digicel, who could use fiber for all backhaul all cell tower connections instead of point-to-point microwave.

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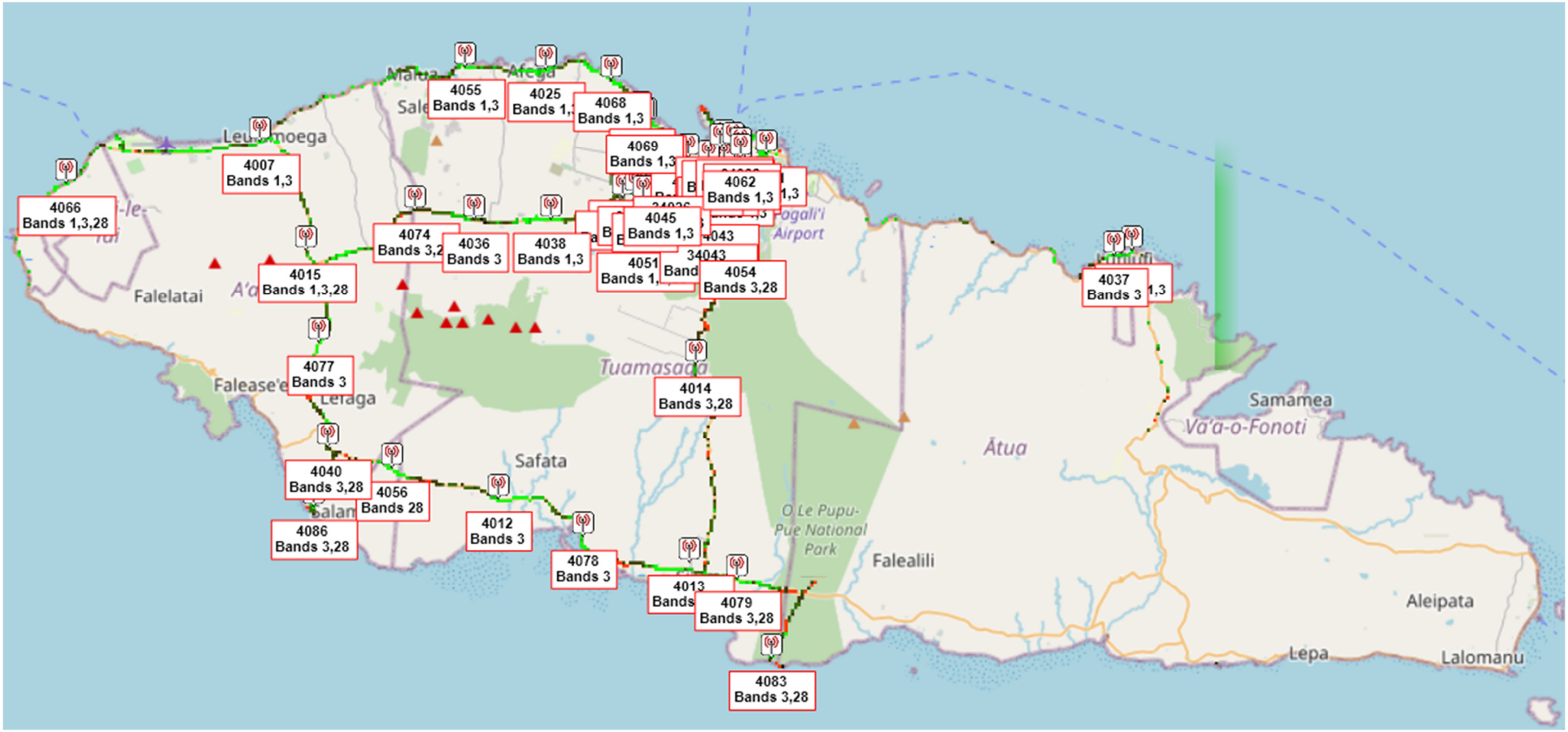

Figure 4 Digicel wireless network [from cellmapper.net]

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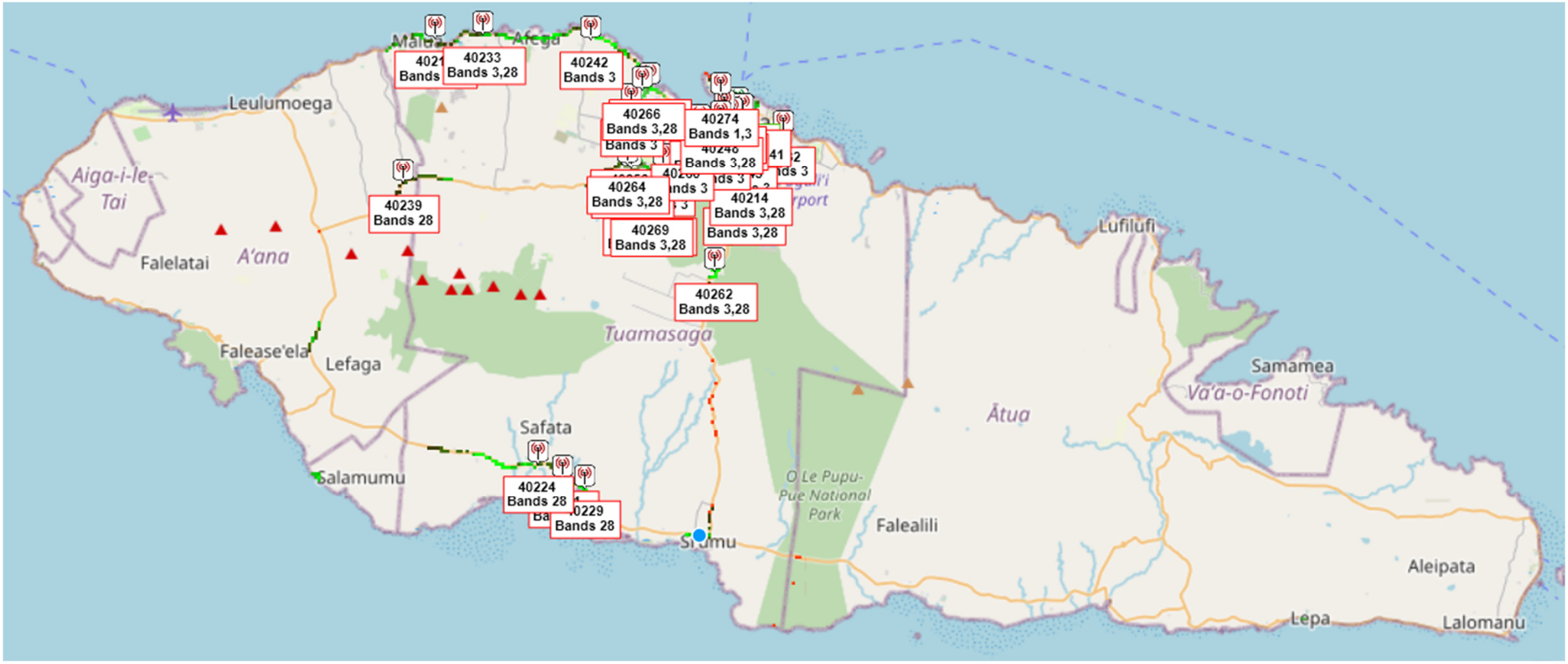

Figure 5 Vodafone wireless network [from cellmapper.net]

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6 Socio-economic impacts & sectoral uses

The main sectoral uses of broadband connectivity are education, health care, and government access. Banking services and a small number of commercial enterprises also play a role in the overall connectivity landscape.

6.1 Education, Health, and Government Use

Broadband connectivity in Samoa is heavily oriented toward social and public-service outcomes. In education, initiatives such as SchoolNet and the Samoa National Broadband Highway (SNBH) provide connectivity to schools, enabling digital learning and administrative coordination. In the health sector, e-health projects support improved service delivery, data sharing, and remote consultation. Public administration benefits through a government intranet that connects ministries and agencies, improving efficiency and coordination. Beyond the public sector, broadband has measurable impacts on business activity and tourism, supporting online services, communications, and international engagement, as noted by the Asian Development Bank.

6.2 Digital Inclusion Challenges

Despite these advances, significant digital inclusion challenges persist. Connectivity in rural areas, particularly on Savai'i, remains uneven compared to urban centers. Affordability of broadband services continues to limit access for many households, and device ownership is not universal, constraining the ability of individuals and communities to fully benefit from available connectivity.

6.3 Complementary Demand-Side Interventions

Alongside infrastructure investments, demand-side initiatives are increasingly important to ensure effective use of broadband. The PacifiCODE Digital Fluency Project, supported by the APNIC Foundation, provides an example of how digital skills development can complement network expansion. Such programs focus on building digital competencies, training educators, and piloting technology use in schools and communities, helping to translate improved connectivity into meaningful social and economic outcomes. By strengthening digital skills, these initiatives enhance the benefits of improved bandwidth and local infrastructure such as internet exchange points, enabling more effective use of online resources and encouraging local content creation.

6.3.1 The PacifiCODE (APNIC Foundation) Digital Fluency Project

Complementing infrastructure investments, the PacifiCODE Digital Fluency Project, funded by the APNIC Foundation through its Impact Grant program, represents a significant demand-side intervention focused on digital skills and educational access in Samoa. The project equipped ten pilot schools with 111 laptops and provided three years of internet connectivity, while also delivering teacher training through a Professional Learning Development (PLD) certification in ICT and Digital Technologies.

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By mid-2023, forty of the sixty-two participating teachers had completed the PLD certification and established after-school ICT programs that engaged 953 students, including 411 female students. These activities were designed to improve digital literacy, coding skills, and overall confidence in the use of technology among both teachers and learners.

From a telecommunications policy perspective, PacifiCODE illustrates the strong link between supply-side improvements—such as broadband networks, submarine cables, and internet exchange points—and demand-side readiness in the form of digital skills and access to devices. When a larger share of the population is able to use digital tools effectively, the national return on infrastructure investment increases. Enhanced local skills also create opportunities for Samoan content creation and local hosting, further increasing the value of a national IXP.

Challenges remain, particularly in sustaining training programs, maintaining hardware, and ensuring continuity beyond donor funding cycles. Even so, the project demonstrates how investments in infrastructure and human capacity can reinforce one another, offering a useful model for digital development across the Pacific region.

7 Discussion — evaluation & remaining challenges

Looking at the set of projects given here, one sees a number of weaknesses in these attempts to improve Samoan telecommunications:

- The implementing Ministries do not have a large enough stable pool of technical people to property administer long-term projects. They are also negatively affected by unfilled positions and changes at the top level of administration.
- Building something is easier than sustaining its operations over many years, especially in an environment subject to power outages, severe weather, and an underfunded operations budget.
- The public-private partnership (PPP) mechanism to obtain a return on investment (ROI) from the FTTP infrastructure does not have a clear economic justification. Naturally, questions arise, such as (1) what are the incentives for private companies to participate and (2) what does the government give up to draw private companies into the partnership. Samoa should see this as a long-term investment that will eventually stimulate economic activity and local entrepreneurship. Most of the benefits of this infrastructure will come over the long-term and not within a particular government budget cycle.

To summarize, the biggest challenge faced by Samoa in this area is sustainability. Sustainability touches on several areas, but the key factor behind all of them is economic[9]. There is something of the chicken-or-the-egg problem: demand for services is limited due to Samoa's low population and the basis of the economy, but higher demand is needed to fund better connectivity. However, without better connectivity, economic and education improvements and diversity are much slower to achieve. Some non-government plans [2] recognize that connected communities offer an answer to the sustainability problem on both the financial and technical sides.

[9] The main secondary factor is operational support: hardware and software maintenance and user training.

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8 Conclusion and recommendations

Samoa is at a crossroads in terms of becoming a highly connected, broadband enhanced nation. The current infrastructure frustrates commercial users and limits their abilities to attract and sustain more business. The inconsistent results from prior educational connectivity projects have left this sector somewhat skeptical of whether any new projects will succeed in a sustainable manner.

The Lalomanu Foundation believes that the educational sector would be best served by its own network for all of the schools rather than just connecting each school to the Internet. This allows schools to share resources securely and allows a single firewall cluster to enforce a common policy across the whole network. This reduces the cost by not buying a firewall for each school and having to manage all of the firewalls. It is also evident that there are schools where FTTP does not make economic sense, so some type of fixed wireless link to the nearest fiber connected router would be a good solution. This topic is discussed under a proposed school unified network pilot project described in a separate document. This project will also address the long-term sustainability issue.

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10Glossary

ADSL	Asymmetric Digital Subscriber line
ASN	Autonomous System Number
CSL	Computer Services Ltd
GEO	Geosynchronous Earth Orbit
ITU	International Telecommunications Union
IXP	Internet Exchange Point
LEO	Low Earth Orbit
LTE	Long-term Evolution
MCIT	Ministry of Communications and Information Technology
MEO	Middle Earth Orbit
MESC	Ministry of Education, Sports, and Culture
NUS	National University of Samoa
SITA	Samoa Information Technology Association
SNBH	Samoa National Broadband Highway
UN ESCAP	United Nations Economic and Social Commission for Asia and the Pacific
WST	Samoan tala (currency)

2G, 3G, 4G Second, third and fourth generation mobile network

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