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A Study on National Costings of a Pacific Internet Exchange Point

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Abstract

While access to the Internet in Pacific island countries has improved in the last decade as a result of several submarine fibre-optic cables connecting many island countries, efficient management of Internet traffic at the national and subregional levels continues to lag behind. The weighted average latency in Pacific island countries without a subregional Internet exchange point (IXP) to New Zealand is estimated at 44.21 milliseconds. However, if IXPs in Fiji, Samoa and New Zealand are connected to coordinate Internet traffic using the shortest route, it could drastically reduce average latency by up to 64 per cent, from 44.42 milliseconds to 15.99 milliseconds. For some Pacific island countries, this reduction could be a major Internet quality improvement considering their national latencies are more than 100 milliseconds.

In recent years, the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) and partners have facilitated multi-stakeholder consultations and training workshops, and conducted technical studies to inform Pacific island countries' discussions on establishing a Pacific IXP. In 2021, these discussions have focused on the three target countries of Fiji, Samoa and New Zealand with different stakeholders including governments, national Internet exchange authorities, regulators and Internet service providers.

This working paper contributes three key findings to the current dialogue on establishing a Pacific IXP. First, Fiji and New Zealand can facilitate the Pacific IXP segment with its current infrastructure and personnel, while Samoa is still working on the deployment of its domestic IXP. However, once deployed, the operation will assist in the establishment of the Samoa segment of the Pacific IXP. Second, establishing the Pacific IXP as a not-for-profit entity aligns well with the established IXPs in Fiji and New Zealand, and with the planned IXP in Samoa. Lastly, the working paper has estimated the cost of establishing the Pacific IXP for each of the three target countries, based on consultations with national stakeholders.

Keywords: Internet latency, Internet connectivity, costs, cooperation, agreements.

1. Introduction

The Pacific Internet Exchange Point (IXP) is an Internet exchange proposal to address the limited means of interconnection for Internet networks among the South Pacific island community, located within the Pacific Ocean between Australia and New Zealand to the south-west and Hawaii to the north and east. As part of the development of the Pacific IXP, "A Study on the Costing, Operational Principles and Modalities of a Proposed South Pacific Internet Exchange"[1] in August 2020 recommended that a Pacific IXP be established in Fiji, Samoa and New Zealand utilizing a "hybrid IXP" model.

Based on the outcomes of two workshops on "Strengthening Efficient Internet Traffic Management through a Subregional IXP in Pacific Island Countries" on 3-5 December 2019,[2] and the "Second Working Group on Pacific IXP and Capacity Training Workshop on IXP's operational modalities" on 5 August 2020,[3] the recommendations for operationalizing a Pacific IXP from the above-mentioned August 2020 study was endorsed, and it was agreed that a not-for-profit entity would be the likely structure for the Pacific IXP.

In support of the implementation of the Pacific IXP, this working paper aims to assess the national operational costings for establishing the Pacific IXP in Fiji, Samoa and New Zealand. The costing estimates are based on consultations with key stakeholders in the three countries.

1.1 Role of IXPs and Internet Traffic Quality

The key role of IXPs is to coordinate and link all Internet traffic locally within a country or a group of countries, thereby reducing the transit cost of Internet traffic exchanged internationally, reducing the Internet traffic tromboning effect and improving the quality of domestic users' access through more direct connections to local and cached content. IXPs therefore drastically improve the efficiency of Internet traffic flows by eliminating the need for Internet traffic to flow through expensive long-distance traffic routes lying outside the country of origin.[4] IXPs not only increase Internet speed, but countries with higher number of IXPs tend to have higher access and more affordable broadband Internet.[5]

However, establishing an IXP is complex, especially when multiple countries are involved. Many IXPs are established as a non-commercial public service, which requires the collaboration of all Internet service providers (ISPs) in the country. The success of an IXP relies on the willingness of competing ISPs to cooperate

[1] ESCAP, "A Study on the Costing, Operational Principles and Modalities of a Proposed South Pacific Internet Exchange", August 2020. Available at https://www.unescap.org/resources/study-costing-operational-principles-and-modalities-proposed-south-pacific-internet.
[2] ESCAP, "Strengthening Efficient Internet Traffic Management through a Subregional Internet Exchange Point (IXP) in Pacific Island Countries", December 2019. Available at https://www.unescap.org/events/strengthening-efficient-internet-traffic-management-through-subregional-internet-exchange.
[3] ESCAP, "Second Working Group on Pacific Internet Exchange Point (IXP) and Capacity Training Workshop on IXP's Operational Modalities (Virtual Meeting)", August 2020. Available at https://www.unescap.org/events/second-working-group-pacific-internet-exchange-point-ixp-and-capacity-training-workshop-ixp-s.
[4] For a discussion on the benefits of IXPs, see: Internet Society, "The Internet Exchange Point Toolkit and Best Practices Guide: How to Maximize the Effectiveness of Independent Network Interconnection in Developing Regions and Emerging Markets (Collaborative Draft)", February 2014. Available at https://www.ixptoolkit.org/ixp-toolkit-report/.
[5] ESCAP, "Estimating the Effects of Internet Exchange Points on Fixed-broadband Speed and Latency", Asia-Pacific Information Superhighway (AP-IS) Working Paper Series, December 2019. Available at https://www.unescap.org/resources/estimating-effects-internet-exchange-points-fixed-broadband-speed-and-latency.

and connect their traffic. Considerable time and resources are required to build trust and convince ISPs of the expected mutual benefits.

Internet latency in the Pacific varies significantly and is generally affected by factors such as inefficient Internet network and traffic management and the long distances that fibre-optic cables have to cover. Higher Internet latency in several Pacific island countries has been linked to the lack of national or international IXPs. In the Pacific, Australia and New Zealand have established neutral IXPs. Fiji, Tonga and Vanuatu have also established national IXPs and latency between local operators has improved significantly in these countries. Samoa is in the process of establishing a national IXP, but most of the other Pacific island countries do not have IXPs.

A Pacific IXP feasibility study[6] on establishing a subregional IXP estimates significant improvement in Internet latency between selected Pacific island countries and New Zealand. The weighted average latency of Pacific island countries without a subregional IXP to New Zealand is estimated at 44.21 milliseconds. However, if IXPs in Fiji, Samoa and New Zealand are connected to coordinate Internet traffic using the shortest route, it could drastically reduce average latency by up to 64 per cent, from 44.42 milliseconds to 15.99 milliseconds. For some Pacific island countries, this reduction could be a major Internet quality improvement consider their national latencies are more than 100 milliseconds.

1.2 Operating Principles and Organizational Structure

In the August 2020 study,[7] it is recommended that the Pacific IXP adopts either a corporate or not-for-profit structure. Since the IXPs in Fiji and New Zealand – Fiji-IX and NZIX, respectively – are set up as not-for-profit entities, and the planned IXP in Samoa is proposed to be a not-for-profit as well, establishing the Pacific IXP as a not-for-profit entity would align well with the national IXPs. Moreover, peering with NZIX would enable the Pacific IXP to become a member of NZIX. However, the complex political situation of some Pacific island countries may hinder the establishment of the Pacific IXP.

In response to this challenge, a study has been carried out to draft the Pacific IXP operating guidelines.[8] This study recommends that the Pacific IXP is operated by an incorporated entity constructed as a cooperative or association of IXP members. With the aim to achieve strong financial governance, an independent accountant (who is not a board member) is recommended to prepare the accounts for approval by members. Meanwhile, the IXP association owns and manages the property of the IXP hardware, processes, procedures and intellectual property, as well as holds the contracts for services.

The study also recommends that all organizations that connect to the Pacific IXP become members of the IXP association, with voting rights on matters involving the operations of the Pacific IXP and the IXP association. Hence, all members nominate and vote on electing a board of directors with a chairperson. It is proposed that the board comprises of five persons - one from each of the three country nodes – Fiji, Samoa and New Zealand, and two from providers of other countries. The board would report to the members of the IXP association and would be supported by a leader/general manager/head engineer, which should possess extensive knowledge of the design and engineering norms of the Internet and IXPs, and would lead the development of the IXP, the development of detailed workflows and standards, as well as direct any staff. In

[6] ESCAP and Internet Society, "Pacific-IX Desktop Feasibility Study", December 2019. Available at https://www.unescap.org/resources/pacific-internet-exchange-point-feasibility-study.

[7] ESCAP, "A Study on the Costing, Operational Principles and Modalities of a Proposed South Pacific Internet Exchange", August 2020. Available at https://www.unescap.org/resources/study-costing-operational-principles-and-modalities-proposed-south-pacific-internet.

[8] ESCAP, “Pacific IXP: Draft Operating Guidelines”, forthcoming.

addition, it is proposed that at least one site engineer is recruited for each of the three country node sites who would report to the head engineer.

The Pacific IXP should be governed by the members for the members and the Internet community, with the leadership team guiding and advising but not controlling the policy development process. The Pacific IXP would have policies that govern membership criteria and joining processes, policies for peering and interconnection, as well as policies on the services and systems that the Pacific IXP would provide, including the pricing of services. Most IXPs have a formal policy development process, whereby any member could:

- Propose a new policy or amendment to an existing policy;
- Deliberate on the addition of a new policy or amendment of an existing policy among the members;
- Vote on the proposal; and
- Formally implement the proposal if it is endorsed through the voting process.

2. Existing Infrastructure

2.1 Fiji

Fiji established an IXP in November 2017, known as Fiji-IX. It is located in one of the premises of Fiji International Telecommunications (FINTEL) in Vatuwaqa, Suva. The decision to locate the IXP at a FINTEL premise instead of a more neutral government facility was due to the lack of continuous access at the latter.

There are presently seven members on the Fiji-IX switch (as of August 2020), which include:[9]

- All four major ISPs in Fiji – Digicel, Fintel, Telecom Fiji and Vodafone
- University of the South Pacific
- Fiji National University
- Walesi - an over-the-top video provider

The Fiji-IX is run as a not-for-profit organization, with the operational costs equally divided among all members. An expansion of Fiji-IX (referred to as Fiji-IX Phase 2) was planned for April 2020, but it has been delayed due to the COVID-19 pandemic. The expansion is expected to be completed by the end of 2021 or beginning of 2022.

As part of Fiji-IX Phase 2, the Asia Pacific Network Information Centre (APNIC) has allocated an autonomous system number and public address range for Fiji-IX's use. APNIC has also provided two Cisco Nexus 9000 series switches and a domain name system root server to be established at the University of the South Pacific.

2.2 Samoa

Samoa is currently setting up its first IXP. Its establishment has been delayed due to COVID-19 restrictions and the 2021 election crisis. However, there is a newly elected government in Samoa and as of October 2021, the IXP is currently awaiting the approval of the Cabinet before moving into the implementation phase. A national working group to set up the Samoa IXP is being formed and the not-for-profit structure is being considered together with the policy that is currently awaiting the Cabinet's approval.

2.3 New Zealand

New Zealand has two major national IXPs and a few smaller city-based ones. The two primary IXPs are the NZIX and NZIX ExchangeNET.

2.3.1 New Zealand Internet Exchange (NZIX)

The NZIX is established as a not-for-profit entity with its administration outsourced to the Internet Association of Australia (IAA).[10] Participants intending to connect to the IXP must join as members. The

[9] Telecommunications Authority of Fiji, "Fiji - Internet Exchange Point". Available at http://www.taf.org.fj/Publications/Fiji-IX.aspx.
[10] IAA, "Our Partners". Available at https://www.internet.asn.au/about/partners/.

Pacific IXP would need to apply to the NZIX to become an affiliate member. The NZIX has three exchange points – one in the North Island in Auckland, known as AKL-IX; and two in the South Island in Christchurch, known as CHC-IX. The AKL-IX has 80 active peers on its peering fabric, and CHC-IX has 7 active peers on its peering fabric. Both locations offer port speeds of 1Gbps, 10Gbps, 40Gbps and 100Gbps.

2.3.2 NZIX ExchangeNET

The NZIX ExchangeNET is a commercial IXP operated by Citilink Limited with locations in Auckland and Wellington in the North Island, and Christchurch in the South Island. The Auckland peering fabric, known as APE, is present at 13 locations across Auckland, while the Christchurch peering fabric, known as CHIX-NZ, is accessible at 2 locations with 5 active peers. The Wellington peering fabric, known as WIX, is accessible at 11 data centres and over 500 buildings. There are currently plans for peering fabrics in Hamilton and Dunedin.

3. Budgetary Estimations

3.1 Establishment Costs

APNIC makes available to entities in its coverage area an IXP Development Package. This package consists of various items that can be provided to assist in the establishment of new IXPs. The establishment costs for the initial construction of the Pacific IXP can be minimized if APNIC's IXP Development Package is leveraged. At the Second Working Group on Pacific IXP and Capacity Training Workshop on IXP's Operational Modalities,[11] APNIC confirmed that each Pacific IXP node would be able to leverage the IXP Development Package that includes support for purchasing equipment and software, as well as technical assistance and training to establish and manage the IXP. The Internet Society also affirmed its support in establishing the Pacific IXP, in partnership with APNIC.

Based on APNIC's documentation, training and technical assistance can be provided for the establishment of the peering switch fabric, the settlement of route servers, and the configuration of software components such as root server anycast instance, IXP manager and route origin validation/Internet Protocol version 6 deployment support, among others. APNIC has continuously provided training for technicians in the Pacific, such as the Border Gateway Protocol and Domain Name System workshops at the 24th Meeting of the Pacific Network Operators Group in June 2019.[12] APNIC also conducts online trainings and webinars throughout the year. For example, an online technical workshop held on 12 August 2021 consisted of lectures and hands-on lab work to teach the fundamentals and the skills required for the configuration and operation of an IXP.[13]

3.2 Operating Budget

The proposed operating budget for the Pacific IXP has three primary components – infrastructure, capacity and location. These are described in the subsections below.

3.2.1 Infrastructure

a) Fiji

The ongoing monthly costs for the Pacific IXP in Fiji are estimated as follows:

- Power - FJD1,300 for 1 kilowatt consumption per month (USD624)
- Half rack rental per month - FJD500 (USD240)
- Staff – average FJD16 per hour - FJD2,560 per month (USD1,230)

b) Samoa

[11] ESCAP and Internet Society, "Summary Report on Second Working Group on Pacific Internet Exchange Point (IXP) and Capacity Training Workshop on IXP's Operational Modalities (Virtual Meeting)", 5 August 2020. Available at https://www.unescap.org/sites/default/files/Summary%20report%2C%20final.pdf.
[12] Marilyn Zhang, "BGP and DNS Workshops at PacNOG 24", APNIC, 14 May 2019. Available at https://blog.apnic.net/2019/05/14/bgp-and-dns-workshops-at-pacnog-24/.
[13] APNIC Training Wiki, "IXP SetupWorkshop", 12 August 2021. Available at https://wiki.apnictraining.net/ixp-20210809-online.

The ongoing monthly costs for the Pacific IXP in Samoa are estimated as follows:

- Power - WST576 for 1 kilowatt consumption per month (USD224)
- Half rack rental per month - WST1,000 (USD395)
- Staff – average WST5,416 per month (USD2,107)

c) New Zealand

The ongoing monthly costs for the Pacific IXP in New Zealand are estimated as follows:

- Power - NZD292 for 1 kilowatt consumption (USD192). An estimated monthly cost of NZD767 (USD502) should be budgeted for 1.5 kilowatt consumption, with a variance of up to NZD914 (USD600)
- Half rack rental per month - NZD475 (USD312) for DataCentre220 (220 Queen Street, Auckland)
- Staff – average NZD8,750 per month (USD6,282)

These national estimates are summarized in Table 1.

Table 1: Estimated cost of operating a Pacific IXP in Fiji, Samoa and New Zealand

Country	Power	Half Rack Rental	Staff	TOTAL
Fiji	FJD1,300 (USD624)	FJD500 (USD240)	FJD2,560 (USD1,230)	FJD4,360 (USD2,094)
Samoa	WST576 (USD224)	WST1,000 (USD395)	WST5,416 (USD2,107)	WST6,992 (USD2,726)
New Zealand	NZD292 (USD192)	NZD475 (USD312)	NZD8,750 (USD6,282)	NZD9,517 (USD6,786)
TOTAL	USD1,040	USD947	USD9,619	USD11,606

Source: Author's estimates based on consultations with stakeholders in Fiji, Samoa and New Zealand.

3.2.2 Capacity Costs

The capacity costs associated with the Pacific IXP can be broken down as follows:

- Fiji-to-Samoa and Samoa-to-Fiji inter-IXP costs – The costs will generally be constrained as there is little content hosted in both economies that is accessed by the other (as in August 2020). Bandwidth cost on the Fiji side is FJD500 (USD240) per 1 megabit per second. Samoa is estimated at WST763 (USD300).[14]

- Fiji-to-New Zealand and Samoa-to-New Zealand inter-IXP costs – The capacity required will be associated with various cache-fill and content retrieval costs that will come from content caches and related situation at the New Zealand leg of the Pacific IXP.

It is important to note that there may be limited commercial benefits for New Zealand to connect to the

[14] Asian Development Bank, "Samoa Submarine Cable Project: Sector Assessment Summary: Information and Communication Technology". Available at https://www.adb.org/sites/default/files/linked-documents/47320-001-ssa.pdf.

Pacific IXP, given the little traffic from Fiji and Samoa that will flow towards New Zealand. However, the opportunity is in the movement of content from New Zealand to the Pacific. New Zealand content providers will need to be made aware of the additional consumers based in the Pacific for their services. Discounted service fees may alleviate costs.

3.2.3 Locations

a) Fiji – Suva

The location for the Fijian node of the Pacific IXP should be co-located with the existing Fiji-IX. This is physically located at FINTEL in Suva, Fiji and it is the landing station for one of their submarine cables as well.

b) Samoa – Apia

The location for the Samoan node of the Pacific IXP should be co-located with the planned IXP in Samoa. During the discussions related to this study, it is yet to be confirmed if the Samoa IXP will be physically located at the National University of Samoa, the National Broadband Highway Data Centre or the Samoa Submarine Cable Company's TUI-Samoa landing station at Vaivase, Apia. They are all centrally located in Apia, Samoa with the National University of Samoa located 300-400 metres from the cable landing station and the National Broadband Highway Data Centre located 2 kilometres from the cable landing station.

c) New Zealand – Auckland

It has been indicated in the August 2020 study[15] that the New Zealand node of the Pacific IXP would be located in Auckland at the DataCentre220 – a facility at 220 Queen Street, Auckland operated commercially by Data Centre Limited. This location has access to both AKL-IX of NZIX and APE of NZIX ExchangeNET, as well as Megaport's MegaIX service. Additionally, infrastructure for caches and content associated with Akamai, Amazon, Cloudflare, Fastly, Microsoft and Netflix, among others, is present there.

[15] ESCAP, "A Study on the Costing, Operational Principles and Modalities of a Proposed South Pacific Internet Exchange", August 2020. Available at https://www.unescap.org/resources/study-costing-operational-principles-and-modalities-proposed-south-pacific-internet.

4. Key Findings

4.1 Infrastructure

In Fiji, although the second phase of the Fiji-IX is incomplete, Fiji can facilitate the Pacific IXP segment with its current infrastructure and personnel.

In Samoa, the delayed domestic IXP is expected to move into implementation phase once approved by the Cabinet. The not-for-profit organization and national working group are also awaiting the Cabinet's approval. These expected outcomes will assist in establishing the Pacific IXP segment in Samoa.

In New Zealand, the NZIX remains committed to supporting the Pacific IXP. To enable the Pacific IXP to become a member of NZIX, it is recommended that a request is made to NZIX to support the application of Pacific IXP in joining as an affiliate member as stated in the NZIX by-laws:[16]

> *5.4. Affiliate Members: Affiliate Members shall:*
> *(a) not have voting rights; and*
> *(b) may, with the approval of the Committee and subject to compliance with any applicable terms and conditions, connect to any Internet exchange operated by the Society.*

As an affiliate member, Pacific IXP will not have voting rights and may not be nominated to represent their organization on the NZIX Committee, but will receive services at no charge.[17]

4.2 Operating Structure

Establishing the Pacific IXP as a not-for-profit entity aligns well with the established IXPs in Fiji and New Zealand, and with the planned IXP in Samoa.

One point raised in the discussions with NZIX and IAA is the model that was adopted, whereby the IAA provided operational support to NZIX in its establishment phase. The financial, operational and management assistance that was provided allowed NZIX to grow and become fully operational and self-sufficient. The IAA is open to consider such an arrangement with the Pacific IXP if there is an opportunity. Further discussions on the matter would be needed with IAA and NZIX.

4.3 Costs

The costs vary for each country. Establishment of the Pacific IXP would benefit if costs could be covered by each country node in Fiji, Samoa and New Zealand with support from partners such as APNIC and the Internet Society. Equipment and training could be supported by APNIC through its IXP Development Package. Human resources could be shared with the existing IXPs and, in the case of Samoa, the implementation of its national IXP would also benefit the Pacific IXP. In terms of budgeting, an initial 12-month period could be considered for the costs to be covered with a tiered approach to step payments at certain intervals after the 12 months. Perhaps at every 6 months after a review and growth milestones are

[16] NZIX, "Society Rules", 17 June 2021. Available at https://ix.nz/wp-content/uploads/2021/07/NZIX-Society-Rules-V2.0-20210617-Public.pdf.
[17] NZIX, "NZIX By-Laws", 20 May 2020. Available at https://ix.nz/wp-content/uploads/2020/05/NZIX-By-Laws-V2.0-20052020.pdf.

reached, the Pacific IXP may be able to begin covering costs incrementally.

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