LAYER10
TELECOMMUNICATIONS STRATEGY AND DESIGN

Pacific IXP: Operating Guideline

August 2021

This report is formatted for double-sided printing.
If printing a hard-copy, please reduce paper use by
printing on both sides of the paper.

Declaration and Disclaimer

Declaration and Disclaimer

This Report has been prepared by Dr Paul Brooks of Layer 10 for the United Nations Economic and Social Commission for Asia and the Pacific, in support of the Asia-Pacific Information Superhighway initiative.

In preparing this report, Layer 10 has relied primarily on information from publicly available sources, best practices documents and our domain expertise. While reasonable measures were taken to confirm, verify and validate these sources, we offer no warranty, express or implied, regarding any information referenced within.

The findings and recommendations of the study should not be reported as representing the views of the United Nations. The views expressed herein are those of the author(s). The study has been issued without formal editing, and the designations employed and material presented do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area, or of its authorities, or concerning the delimitation of its frontiers or boundaries.

To follow up aspects of this report, please contact:

Dr Paul Brooks
Director
Layer 10 Pty Ltd
29 Willis Avenue
St Ives NSW 2075

pbrooks@layer10.com.au
Telephone: +61-2-8004-7961

Table of Contents

Declaration and Disclaimer 3

Table of Contents 4

Table of Figures 6

Glossary of Terms 7

1. Introduction 7

1.1 Current status 7

1.2 Sources and Resources 8

2. The Pacific-IXP Proposal 9

2.1 Topology 10

2.2 Inter-Node Links 12

2.3 Suggested Physical Infrastructure at each node site 13

3. Organisation Structure 14

3.1 Governance 15

3.2 Leadership and Management 15

3.3 Operational staffing 16

3.4 Ownership of Equipment and Services 16

3.5 Policy Development Process 16

4. Peering & Interconnection Policies 17

5. Questions to be resolved 19

5.1 Organisational 19

1. In which country (or countries) should the 'IXP Association' be registered as an entity? 19

2. Can this entity operate in each node-hosting country (execute contracts, engage staff or contractors, comply with local telecommunications laws operating the IXP equipment) without requiring a local subsidiary to be formed? Or will a local subsidiary entity be required? 19

5.2 Regulatory - telecommunications 19

3. In New Zealand, Fiji and Samoa, what telecommunications-specific licenses and permits are required to operate the IXP infrastructure? 19

4. In New Zealand, Fiji and Samoa, what telecommunications-specific licenses and permits are required by an Internet provider in a different country to connect to the IXP infrastructure using a subsea cable into that country? 20

5.3 Regulatory – national security 20

5. In New Zealand, Fiji and Samoa, are there national security obligations or 'critical-infrastructure' requirements that the IXP will need to comply with? 20

5.4 Fairness – node-hosting vs long-line countries 20

6. How can costs and fees charged to service providers of New Zealand, Fiji and Samoa be

adjusted in a fair way to counteract their cost advantage from avoiding requirement to acquire subsea cable capacity compared to providers in non-node-hosting countries which are required to pay for the international cable capacity to connect? 20

6. Next Steps 21

6.1 Constitution 21

7. Service Providers, IXPs, Regulators - please nominate up to 3 representatives to be involved and work within the working-groups to actively draft the constitution, and discuss the registration and formation of the entity to own and operate the Pacific IXP. 21

6.2 Multilateral Peering Agreement 21

6.3 Business Plan 22

6.4 Infrastructure 22

Table of Figures

Figure 1. AP-IS Initiative Objectives 7
Figure 2. North-Pacific and South-Pacific Island Nations and Subsea cables 9
Figure 3. South Pacific Islands cable latency graph and Pacific-IXP nodes 11
Figure 4.Table of 'closest node' and cable latencies from each proposed member to the closest Pacific-IXP node 11
Figure 5. Core Pacific-IXP Ring, and likely connection points 12
Figure 6. A simple IXP can consist only of a small number of Ethernet switches 14

Glossary of Terms

TERM	DEFINITION
AMS	Amsterdam
AP-IS	Asia-Pacific Information Superhighway
APNIC	Asia Pacific Network Information Centre
ARP	Address Resolution Protocol
ASN	Autonomous System Number
AUIX	Internet Association of Australia
BGP	Border Gateway Protocol
BLP	Bilateral Peering
DNS	Domain Name Server
ESCAP	Economic and Social Commission for Asia and the Pacific
GPS	Global Positioning System
ICN	Information-Centric Networking
IGF	Internet Governance Forum
IP	Internet Protocol
IRR	Internet Routing Registry
ISOC	Internet Society
ISP	Internet Service Provider
IX	Internet Exchange
IXP	Internet Exchange Point
LINX	London Internet Exchange
MAC	Media Across Control
MANRS	Mutually Agreed Norms for Routing Security
MLP	Multilateral Peering
MLPA	Multilateral Peering Agreement
NTP	Network Time Protocol
PITA	Pacific Island Telecommunications Association
ROA	Route Origin Authorization
RPKI	Resource Public Key Infrastructure
RU	Rack Unit
SFP	Small form-factor pluggable
UN	United Nations
USA	United States of America

1. Introduction

The Pacific IXP proposal is a development of United Nations ESCAP stemming from a series of subregional workshops aimed at progressing the Asia-Pacific Information Superhighway (AP-IS) initiative, and requests from Pacific island nations to examine the feasibility of a Internet Exchange Point for the whole Pacific islands community.

Partner Bodies
UN ESCAP has worked with the Internet Society to conduct subregional training workshops and raising awareness of national strategies for improving Internet traffic management in Pacific island countries.

In particular, under AP-IS Pillar 2 'Internet Traffic & Network Management', ESCAP and the Internet Society (ISOC) collaborated on a series of studies that showed a model for such an IXP traffic exchange was technically feasible, and examined several possible operating models.

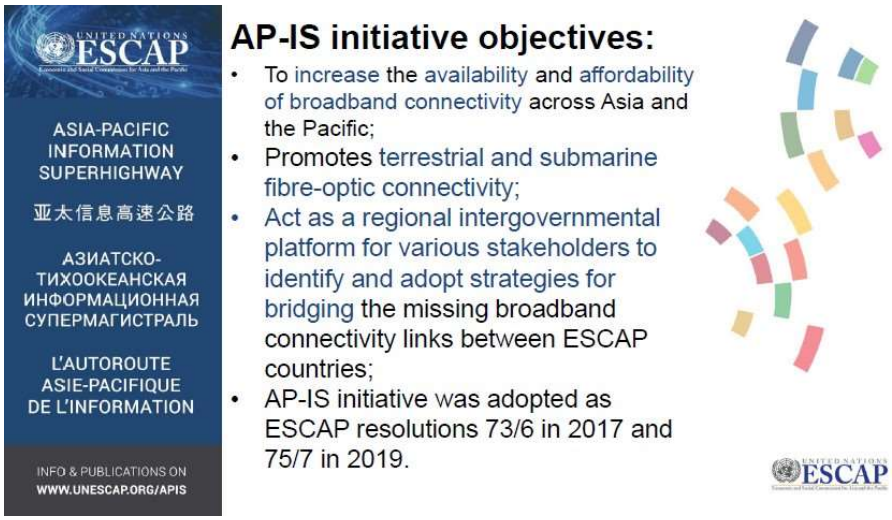


Figure 1. AP-IS Initiative Objectives

UN ESCAP Asia-Pacific Information Superhighway initiative

The Pacific-IXP proposal arose from requests by member states for UN ESCAP to facilitate investigations on the feasibility of establishing a Pacific-islands wide Internet exchange point.

These high-level designs have been the subject of consultations with relevant key stakeholders in Fiji, Samoa and New Zealand, including government departments, regulators, service provider association groups such as PITA (Pacific Island Telecommunications Association) and existing domestic IXP managers. All consulted stakeholders expressed support for developing the concept further.

1.1 Current status

Within the southern Pacific island nations, the largest nations have increasingly been connected to the world using subsea optical fibre cables, providing significant benefits of reduced latency and increased throughout compared to the satellite-based connectivity traditionally used.

Many smaller Pacific island nations still use satellite connections, which form a radio- based link directly from the island's satellite earth station to a far-end earth station which is typically located in the United States. All traffic flows through this far-end link, typically located outside the Asia-Pacific region, and then must find its way back if it is destined for another Pacific island recipient.



Satellite dishes in PNG
Many Pacific island nations rely on satellite for their international communications.

Even service providers with optical fibre cable available to them tend to use the cable to establish upstream connections with foreign Internet backbone providers, with the consequence that often traffic from one pacific island to another pacific island must literally travel around the globe, introducing large delays (latency) and needlessly occupying capacity on expensive long-distance cable and satellite capacity.

In one extreme example, traffic from Singapore to Tonga followed a path around the world from Singapore first to London, then Boston in the USA, through five distinct cities traversing the USA to San Jose, then to Fiji, then to Tonga, instead of the shorter, direct path.

An Internet traffic exchange located within the Asia-Pacific area, where all service providers from all Pacific nations can interconnect, will help keep inter-island traffic local, greatly reduce latency of inter-island traffic, and free up expensive capacity on the international long-haul connections, reducing costs and improving reliability.

Primary role of an IXP is to keep local traffic within local infrastructure, reduce costs, reducing latency, improving performance.
This, in turn, will encourage content providers to establish local connections and develop in-region digital skills.

By extending these benefits beyond purely national exchange points to an international exchange infrastructure, island nations and service providers without the inherent scale required to set up a national exchange can collectively contribute to and connect to this Pacific-IXP and gain the benefits of a local interconnection and peering, and in the process bring the various island nations and networks closer together.

1.2 Sources and Resources

These guidelines are the distillation of Internet Best Practices guidelines and case studies published by:

- Internet Governance Forum (IGF) **Best Practices Fortum on IXPs** (2015)
- Internet Society./Google **'IXP Toolkit'**
- EURO-IX **Best Practices and Best Operational Practices**
- LINX (London Internet Exchange) **Best Current Practices**
- And technical standards from Internet Association of Australia (AUIX), Amsterdam AMS-IX, and Ireland's INEX.

2. The Pacific-IXP Proposal

The Pacific-IXP is an internet exchange proposal to address the limited means of interconnection for Internet networks amongst 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.

Pacific-IXP
An Internet Exchange Point (IXP) to benefit all nations of the South Pacific area.
A single integrated Internet fabric spanning multiple anchor 'node sites', providing every Internet provider in every Pacific nation a low-latency connection point to interconnect with all other member networks, while minimizing the number of 'cable hops' required to connect.



Figure 2. North-Pacific and South-Pacific Island Nations and Subsea cables

Pacific Island nations form naturally into two distinct groupings for telecommunications cable purposes

Nations in the North Pacific group tend to be interconnected by subsea cables converging on the island of Guam, which has traditionally (along with Hawaii) been used as a regeneration point and hub location, and increasingly as a point of interconnection for cables in this region. Several existing IXPs operate in Guam, enabling Internet providers in the islands around Guam to interconnect and exchange traffic.

Nations in the South Pacific group, by contrast, have traditionally been poorly served by subsea telecommunications cables until recently. In many cases trans-Pacific cables between Australia, New Zealand and Hawaii have

been laid that bypass smaller island nations without landing, so they cannot be used. International Internet service in most of these countries has traditionally been achieved using satellite technology, which has struggled to keep pace with increased demand for reliable, low-cost and high capacity connections.

South Pacific island communications traditionally uses satellite links, which is a high-latency solution that doesn't provide local interconnection.

In recent years, several subsea optical fibre cables have been built amongst the southern Pacific islands, and also trans-Pacific cables increasingly link the islands to global Internet hubs in Australia, New Zealand and the United States. The Pacific-IXP proposal is to utilise these cables to enable every Internet provider in every Pacific island nation a low- latency connection point to interconnect with all other member networks, while minimising the number of subsea 'cable hops' required to connect.

2.1 Topology

The Pacific-IXP is envisaged as a single distributed Internet traffic exchange, with nodes located in three locations - Fiji, Samoa and New Zealand, as shown below:

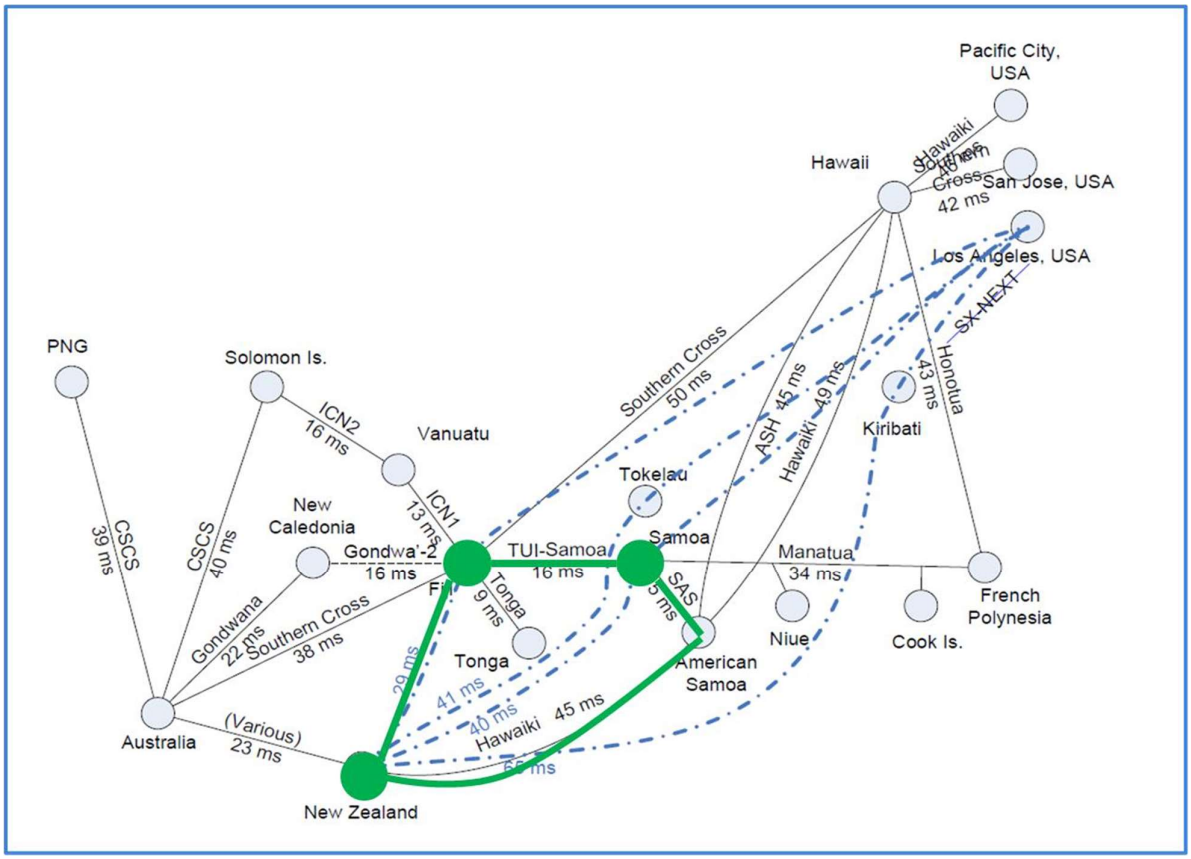


Figure 3. South Pacific Islands cable latency graph and Pacific-IXP nodes

Map of South Pacific Island subsea telecommunications cables by latency (one-way speed-of-light transit time in milliseconds)

Internet service providers in almost every Pacific nation can connect to one of these three node locations with a single cable-hop (the exception being Solomon Islands, which needs two short cable-hops via Vanuatu on ICN2 and ICN1 to connect in Fiji).

Papua New Guinea Note
Papua New Guinea is connected to Australia in Sydney via the PIPE cable and the newer Coral Sea Cable System. All paths to the other South Pacific islands pass through Sydney, so PNG Internet providers will achieve better performance connecting to a Sydney-based IXP than to Pacific-IXP.

The locations of the three node sites were selected by analysing the one-way speed-of- light latency (expressed in milliseconds) along all known and under-construction submarine cables amongst the nations in the region. These three node sites minimises the average latency to a node site from all Pacific Island nations, on a weighted-average basis (weighted by Internet-using population), and forms the mathematically optimum topology for a Pacific islands IXP.

Each node site is also well-connected by multiple subsea cable systems, providing enhanced availability when a subsea cable breaks or is taken down for maintenance.

Pacific-IXP node sites were determined based on: Optimum minimal average Latency for all Pacific members
Two or more cable paths for diversity and resilience
Low-cost backhaul from Cable Stations to IXP datacenters

The table below sets out the closest node and measured (or inferred) latency from all South Pacific nations expected to benefit from connecting to Pacific-IXP, to their nearest Pacific-IXP node.

Country	Population	Internet Users	Nearest Node	Cable Path	Latency	Weighted Latency
Fiji	926276	425680	Fiji		0	0.00
New Caledonia	282754	201000	Fiji	Gondwana-2	16	2.93
French Polynesia	290373	195275	Samoa	Manatua	34	6.05
Solomon Is	660121	69859	Fiji	ICN2+ICN1	29	1.84
Vanuatu	288037	66613	Fiji	ICN1	13	0.79
Samoa	201316	58508	Samoa		0	0.00
Tonga	106398	42552	Fiji	Tonga	9	0.35
American Samoa	50826	17000	Samoa	SAS	5	0.08
Kiribati	109367	14649	New Zealand	SX-NEXT	65	0.87
Cook Is	11700	5160	Samoa	Manatua	26	0.12
Niue	1618	1090	Samoa	Manatua	4	0.00
Tokelau	1285	805	New Zealand	SX_NEXT	41	0.03
TOTAL	2930071	1098191			**26.58**	**13.06**
					Latency Average	**Weighted Average**

Figure 4. Table of 'closest node' and cable latencies from each proposed member to the closest Pacific-IXP node

Average latency (one-way speed-of-light time expressed in milliseconds) across all nations (weighted by Internet-using population) is just 13 milliseconds.

2.2 Inter-Node Links

The subsea cable capacity linking the nodes together will carry the shared traffic amongst all participants in the exchange, destined for other members that are connected to a different node.

The subsea cable capacity forms a triangular "ring" which provided inherent protection against a cable outage, whether caused by a fault, by accident (anchor drag) or for scheduled cable maintenance. If any leg of the triangle fails, traffic amongst all three nodes will re-route around the remaining two links to maintain connectivity.

Capacity of the core links may start at 10 Gbps, which is usually the smallest unit of capacity that can be procured on a modern subsea cable. This should provide ample room for anticipated peering traffic across the IXP system.

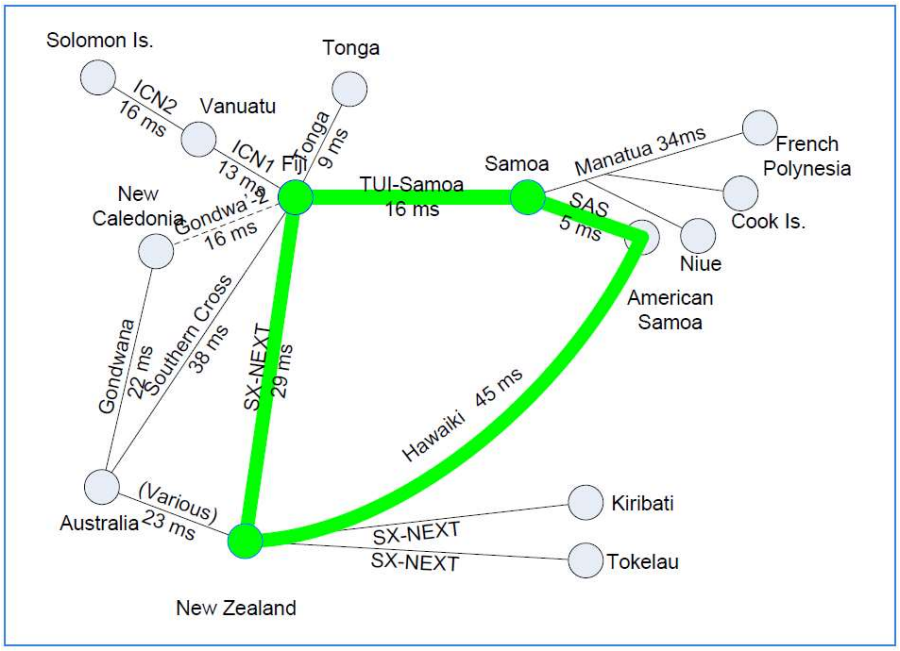


Figure 5. Core Pacific-IXP Ring, and likely connection points

Capacity of each leg should be between 1 Gbps up to 10 Gbps.

1. Question for Internet Service Providers (confidentially collected and aggregated) what is current level of actual peak IP Transit across all upstream connections?

Initial estimates of IXP trunk capacity will use 5% of all IP Transit traffic levels. Anticipated to exclude major content provider traffic.

2. Question for Internet Service Providers (confidentially collected and aggregated)

    a. Please provide an estimate for how much of your current global Internet Transit traffic (in Mbps or Gbps peak) might be exchanged

with other Pacific Island region networks andtraverse the Pacific IXP network (for initial capacity planning)?

b. Please provide an estimate for how much of your current global Internet Transit traffic (in Mbps or Gbps peak) might be sourced from global Content networks such as Facebook, Google, Amazon, Microsoft, etc.?

Characteristics of Node Locations

Each Pacific-IXP node should be located in a secure datacentre with the following characteristics:

- Neutral location for all likely participants (including commercial non-telcos)
- Secure Power, Cooling/Humidity control, Secure access
- No or little onerous restrictions or costs for potential members to access, install equipment, and establish connectivity into the location
- Low cost terrestrial connections ("backhaul") from the IXP building to other domestic locations, including the Cable Landing Station where international connections will terminate.

1. Questions for National IXP Operators – what restrictions or costs are involved for a potential member accessing the location where the National IXP is located? E.g. another ISP, a commercial organization such as a bank, a government agency, an international ISP not licensed in this country?

2.3 Suggested Physical Infrastructure at each node site

The physical infrastructure at each node site may only require one or two equipment cabinets.

Each of the three physical nodes should have the following key principles:

No single point of failure:

- Duplicated Ethernet switches – a member ISP will connect their router to two switches, providing redundancy in case of a switch or cable failure.
- A single Route Server - each of the three nodes will have a route-server, and each member will connect to all three Route Servers, including the Route Servers at the other two nodes. The three Route Servers (one at each site) will be synchronised replicas of each other, so there is no need for multiple Route Server servers at each site.



IXP-in-a-rack
An IXP need not be a large or complex project – in small cases the entire EIXP infrastructure can be installed in a single cabinet.

Space for each Member to install a small router (suggest 2 RU per Member should be sufficient) and tidy structured cabling system to the Ethernet switches.

Ethernet switches to accommodate both copper RJ45 Ethernet ports (up to 1 Gbps), and pluggable optical fibre ports (1 Gbps and 10 Gbps Ethernet SFP/SFP+).

1. Questions for Service Providers – what speed and technology port would you wish to use to connect to the IXP?

   *100/1000 GigE? Copper RJ45, or optical fibre?

   *10 GigE?

Each node will have a Route Collector function which every participant must peer with, which will be used to generate a LookingGlass webserver function for diagnostics and troubleshooting.

Customer/Member connections should be 100 Mbps, 1 GigE, 10 GigE ports. Optional services that could be served through the IXP:

- GPS-backed NTP (Network Time Protocol) Server at each node
- DNS Root Server (requires a small Internet Transit connection for the IXP)

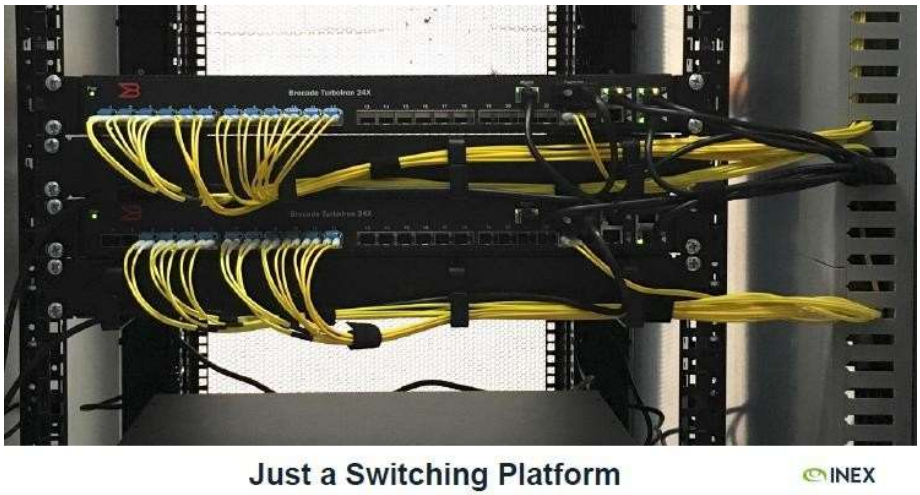


*Figure 6. **A simple IXP can consist only of a small number of Ethernet switches***

(courtesy INEX – the IXP for Ireland)

3. Organisation Structure

The Pacific IXP should be operated by an incorporated entity constructed as a cooperative or association of the members of the exchange. In some jurisdictions this structure is known as a "Company limited by Guarantee".

Organisation Structure
It is important the IXP operating body is an organisational entity that can execute contracts, own assets, and operate the infrastructure under the laws and regulations of each country hosting a IXP node. The IXP operating body should persist even as members and individuals come and go.

The IXP hardware, processes, procedures and intellectual property are the property of the IXP association.

The IXP association holds the contracts for services, such as renting datacentre space, buying and leasing of transmission capacity, engaging employees and contractors.

The IXP association will be registered and run as a not-for-profit cooperative. Financial governance will need to be strong, and there should be an independent accountant (who is not also a board member) involved in preparing accounts for approval by the members.

All organisations that connect to the IXP should become members of the IXP association. Membership allows for voting rights on matters involving the operations of the IXP and the IXP Association.

The IXP association will need to be formed and registered in a suitable jurisdiction such that the body is recognised and able to operate in each of the three countries hosting the initial nodes.

3.1 Governance

All members nominate and vote on electing a small Board of Directors with a Chairperson. Initial Board to comprise of 5 persons – one from each of the three node- hosting countries, and two from providers of other countries.

Board members act in a personal capacity, not as representatives or advocates for a particular country or member.

Propose the Chair role should be rotated no less frequently than every 3 years.

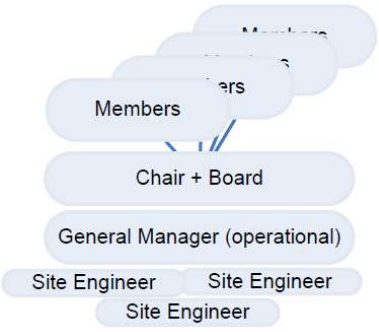
The Chair and the Board report to the Members of the IXP Association.

3.2 Leadership and Management

One person to be elected or engaged as the leader/General Manager/Head Engineer. This person will possess extensive knowledge of the design and engineering norms of the Internet and IXPs in general, and will lead the development of the IXP, the development of detailed workflows and standards as well as direct any staff.

The General Manager will report to the Board.

There will be at least one Site Engineer for each of the three node sites providing ‘hands and feet’– these will report to the Head Engineer. Site Engineers may not be a full-time role, and might be a shared resource already working on the national IXP infrastructure. Ideally there will be sufficient budget to pay the Site Engineers a small sum for the time they spend working on the node infrastructure.



Simplified Organisation Chart
An IXP leadership team should be small to minimise costs, but should be responsible to the general membership for policy development and structure.

We don't expect the Pacific IXP to require a large staff to run. One Head Engineer initially full-time, and three part-time Site Engineers should be sufficient.

3.3 Operational staffing

To an ISP, an IXP connection is not mission-critical. An IXP connection does not replace an upstream Internet Transit connection – an ISP still needs one or more Internet Transit connections with upstream network providers to provide global connectivity. If an IXP connection is down, then all networks should still have connectivity through their respective transit connections, but with higher latency. If a member's connection drops for some reason, the Member should be able to wait until the following day for the Site Engineer to get to the site and rectify the issue.

For this reason, 24x7 staffed coverage is likely not required, at least in early days. 8 x 5 business hours of attendance by a local Site Engineer, or even a part-time say, Tuesdays and Thursdays scheduled attendance may be sufficient.

3.4 Ownership of Equipment and Services

Ownership of equipment and services should vest with the IXP Association. Any equipment or services donated by a member or other organisation should be formally handed over in a written agreement and relinquished to the IXP Association as an asset under the Association's sole control. This avoids any suggestion the infrastructure won't be operated in a neutral manner, and removes risk of essential infrastructure being withdrawn by another owner.

3.5 Policy Development Process

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 IXP will have policies that govern membership criteria and joining processes, peering and interconnection policies, through to what services and systems the IXP should provide, and potentially to pricing of services.

Most IXPs have a formal Policy Development Process, whereby any member can:

- Propose a new policy or amendment to an existing policy,
- Debate the change or new policy amongst the members
- If there is a rough consensus formed, to vote on the proposal
- If the vote shows the proposal is endorsed, then to formally implement the proposal

4. Peering & Interconnection Policies

The following suggested elements of a peering and interconnection policy represent best-practice for open, not-for-profit association-based IXPs, documented further by The Internet Society and Google in the IXP Toolkit (www.ixptoolkit.org). To be discussed and agreed or modified by the IXP members.

Membership
Every member of an IXP benefits when the participation is as wide and as many different participants as possible.

Membership and peering connection to be open to any organisation that agrees to abide by the membership rules (policy and technical), including:

- **Has been allocated a public ASN (Autonomous System Number)**
- **Has portable IPv4 and IPv6 address space that can be advertised to the IXP**

An open IXP should be available to service providers, content providers, commercial organisations (e.g. banks), academic institutions, government departments – any entity that can justify being multihomed and an allocation of portable address space and an ASN from one of the Regional Internet Registries.

All participants must peer with the Route Collector for diagnostic purposes

A Route Collector is like a Route Server, except it doesn't advertise any routes. A Route Collector collects all participants routes and drives a LookingGlass server for the whole IXP for diagnostic purposes.

Multilateral Peering (MLP) is strongly encouraged - participants may peer with the Route Servers and instantly gain access to all other networks participating in Multilateral Peering, with a single group of BGP sessions.

Bilateral Peering (BLP) is permitted – participants may establish individual private peering relationships directly with other participants.

Participating in Multilateral Peering is a great improvement with regard to scalability. The number of necessary BGP sessions in a full-mesh of bi-lateral peering relationships increases with the square of members, and every new member joining requires other existing members to set up a new dedicated peering agreement and relationship. In contrast, by connecting to the Route Server, all participants automatically receive the benefit of a new member joining without any changes to the existing configuration being required.

Multilateral Peering with the IXP's Route Servers will require execution of a MLPA (Multilateral Peering Agreement) with the IXP Association. Bilateral Peering will be governed by whatever form of agreement is determined between the parties, the IXP is not involved in bilateral peering negotiations.

Provision of Internet Transit across the peering fabric is forbidden, advertisements of a 'default route' will be filtered out.

The IXP infrastructure is intended solely to facilitate traffic exchange

between member networks, not for the entire global routing table. Internet transit traffic across the international backbone trunks is likely to overwhelm the backbone trunks, which will have limited capacity. Transit providers who wish to offer Internet Transit services should do so using a private interconnect link directly between provider and customer routers.

Participation in the international Pacific-IXP is independent of participation in a domestic IXP. A service provider is encouraged to connect to both infrastructures

The Pacific-IXP will operate under its own ASN, different from a domestic IXP, and (where they are co-located) a Member will need to establish dedicated BGP peering sessions with the Pacific IXP infrastructure, using a dedicated physical port on its router to prevent congestion or issues with one IXP affecting traffic exchanged in the other IXP.

A participant in a node-hosting country with a domestic IXP is likely to experience peering sessions with the same other local provider(s) across both domestic and Pacific-IXP infrastructures. Participants should use route filters and preferences to prefer such traffic to pass through the domestic IXP.

Participants will agree to comply with MANRS requirements for IXPs. Participants will register all owned and customer routes with IRR and implement RPKI ROA records

Common Technical Criteria
Most IXPs have similar acceptable traffic policies, which are also codified in requirements for MANRS compliance for the IXP.
See AMS-IX for examples (https://www.ams-ix.net/ams/documentation/allowed-traffic).

MANRS – Mutually Agreed Norms for Routing Security – are an important initiative to help protect the Internet from malfunctioning through deliberate or accidental actions.

The IXP fabric will filter route advertisements from participants based on registered Route Registry data and validated RPKI objects.

Participants will correctly register their route announcement intentions in public Internet Routing Registry (IRR) through APNIC (https://www.apnic.net/manage-ip/apnic-services/routing-registry/), and will establish correct RPKI ROA objects for each of its own and customer route objects prior to connection.

Participants must comply with technical rules around traffic sent to the Peering Switch:

- **Ethernet frames with Ethertype 0x0800 (IPv4), 0x86dd (IPv6), 0x0806 (ARP) only**
- **Only one MAC address per individual port**
- **No Proxy ARP or 'link-local' protocols**
- **No broadcast (except ARP), no multicast frames (except IPv6 Neighbour Discovery)**
- **Others to be determined**

These are common best-practice criteria for traffic that is and is not acceptable for members to push into the exchange. Such traffic can severely disrupt the operation of the whole exchange. Participants that can't comply will risk being forcibly disconnected.

The IXP will implement controls using BGP community strings so that participants can influence how routes are advertised through the TXP, and who the routes are advertised to or blocked to.

There are common best-practice formats for introducing BGP community strings, so that a participant can, for example, ensure peering routes aren't sent to a downstream customer, or to a peer that they are already connected with on another IXP (such as a domestic IXP).

5. Questions to be resolved

5.1 Organisational

1. In which country (or countries) should the 'IXP Association' be registered as an entity?

A corporate structure of 'Company Limited by Guarantee' where all participants can be Members of the company is supported in New Zealand, Australia, Fiji. In Samoa a structure of 'Incorporated Society' might also be suitable.

2. Can this entity operate in each node-hosting country (execute contracts, engage staff or contractors, comply with local telecommunications laws operating the IXP equipment) without requiring a local subsidiary to be formed? Or will a local subsidiary entity be required?

Formation of a local subsidiary will add costs, compliance and reporting overheads, and administrative overheads dealing with local ownership aspects, voting rights, ownership of assets, and other matters. Ideally, the IXP Association should be able to operate in practice in each of the three node-hosting countries without requiring a separate local subsidiary to be formed.

Benefits of a Not-For-Profit entity

A not-for-profit entity may make it easier to attract involvement of non-commercial entities such as educational and research networks, Internet governance organisations, government institutions.

An independent (independent from any member) corporate entity may instil confidence the IXP will continually maintain neutrality regarding open participation and equal rights of participation.

5.2 Regulatory - telecommunications

3. In New Zealand, Fiji and Samoa, what telecommunications-specific licenses and permits are required to operate the IXP infrastructure?

Relevant considerations include:

a) The IXP will not be constructing or owning communications link infrastructure such as cables. If the IXP requires a communications link for its own purposes (such as equipment monitoring) it will acquire it from a local provider in the same way as any other

Considerations unique to international IXPs

Ideally no licenses or other regulatory costs should be required by an international network that doesn't have any other local legal presence or local services in order to simply connect to an IXP to exchange purely international traffic – similar to the freedoms of passengers in the international side of airports, 'outside' the customs checks, when transiting between countries without entering through 'customs'.

business.

b) All local participants will be bringing their own communications links to the IXP location to carry Internet traffic.

c) The IXP may be buying or leasing international communications links directly from the subsea cables landing in each country, or indirectly buying or leasing the links through a local telecommunications provider.

d) The IXP will not be providing services to the public (depending on how this is defined in each country's telecommunications regulations).

4. In New Zealand, Fiji and Samoa, what telecommunications-specific licenses and permits are required by an Internet provider in a different country to connect to the IXP infrastructure using a subsea cable into that country?

For example, if an Internet provider in Vanuatu wished to connect to the IXP infrastructure in Fiji in order to peer with providers in New Zealand, or an Internet provider in the Cook Islands wished to connect to the IXP infrastructure in Samoa, what licenses or permits would the provider need to acquire in Fiji or Samoa respectively?

Relevant considerations may include:

a) The international provider would not be providing services in the node-country.

b) Include any restrictions or licenses required to install equipment in the IXP node location

5.3 Regulatory – national security

5. In New Zealand, Fiji and Samoa, are there national security obligations or 'critical-infrastructure' requirements that the IXP will need to comply with?

Examples include:

a) Lawful interception of communications data for the local law-enforcement authorities

b) Retention of meta-data about communications, but not the content

5.4 Fairness – node-hosting vs long-line countries

6. How can costs and fees charged to service providers of New Zealand, Fiji and Samoa be adjusted in a fair way to counteract their cost advantage from avoiding requirement to acquire subsea cable capacity

compared to providers in non-node-hosting countries which are required to pay for the international cable capacity to connect?

In other jurisdiction examples the hosting organisation pays a 'hosting charge' to even up the costs compared to other participants that have transmission costs.

6. Next Steps

6.1 Constitution

A draft constitution for the IXP Association Entity will be required. This will need to be somewhat customised to the jurisdiction in which the entity is formed, so potential members should agree on the jurisdiction first.

Stakeholders to nominate no more than 3 representatives to assist in driving this process.

Stakeholders to agree on how costs for the process will be met, prior to the IXP organisation being formed.

Timeframes will need to be agreed to:

- Draft the constitution
- Present the draft constitution for review and approval
- Following approval, to register and form the operating entity

7. Service Providers, IXPs, Regulators - please nominate up to 3 representatives to be involved and work within the working-groups to actively draft the constitution, and discuss the registration and formation of the entity to own and operate the Pacific IXP.

    a) Name 1, position, email address, telephone number
    b) Name 2, position, email address, telephone number
    c) Name 3, position, email address, telephone number

6.2 Multilateral Peering Agreement

Best Practice Forum on IXPs, IGF 2016, Internet Governance Forum

One of the legal contracts that will be required is the Multilateral Peering Agreement that members will need to agree and sign with the IXP Association before they can connect to the Route Servers and commence setting up peering relationships.

There are many public examples that can be used as templates to start from.

6.3 Business Plan

A plan for operating the Pacific-IXP, including budgets, responsibilities or members and IXP staff I required to ensure all agree on a realistic timeline of activities and costs.

Why does an IXP need a business plan?
Whether the IXP is for-profit, not-for-profit or subsidized and regardless of the chosen organization form, business planning can contribute to the stability, growth, sustainability and long-term development of the IXP.
Some of the large European exchanges have shown that with the right business plan and strategy, a not-for-profit membership-based IXP can become a business employing 50+ people with a turnover of $15m per annum or more.

After the preparation and set-up phase of the IXP project (bringing participants together, getting support and initial funding, installing the technology and successfully launching the IXP) the attention needs to shift to the long-term growth and sustainability of the IXP. It is important to understand however that developing a business plan and mindset is not a synonym for commercializing the IXP.

6.4 Infrastructure

- Register for an initial IPv4 and IPv6 address block allocation, and ASN allocation, for the use of the IXP from APNIC.
- Obtain suitable Ethernet switches, (initially two per node site), servers, cabling and other hardware (note – may be donated, or funded by grants. Should not be loaned in, to avoid risk of having to return it).
- Set up IXP management software and systems such as the freely available IXP Manager system developed by INEX and in use across 173 IXPs world-wide (https://www.ixpmanager.org/).
- Connect ISPs!

