IXPs in Asia

Philip Smith
<philip@nsrc.org>

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NSRC
Network Startup Resource Center

Background

- This is a tour of the IXPs across Asia
  - And the challenges and experiences in the IXP development activities NSRC has been involved in
- Any omissions or errors are solely mine
- Summaries are in no particular order
- Focus is on open neutral IXPs rather than commercially operated datacentre interconnects

Background

- Several organisations are involved in assisting with the set up Internet Exchange Points in the Asia & Pacific region:
  - Network Startup Resource Center (NSRC)
  - Also APNIC, PCH, & ISOC
- Plenty of help available, including:
  - Facilitating meetings of stakeholders
  - Holding hands
  - Donations of switches
  - BGP/IXP Workshops, etc
- IX development across the region has been more challenging than in Europe
  - The benefits are less well understood
  - Incumbents tended to be first with Internet access services, unlike in Europe

Thailand

- In 2013, Thailand had 8 “international internet gateways”
  - These are ISPs who are licensed international carriers in Thailand
  - License condition is that these IIGs also operate an “IXP”
  - Network Operator customers of the IIGs also have a domestic connection with the IIG operator for domestic traffic
  - If you want all of Thailand, you have to connect to all 8 IIGs (10 in 2017)
    - As they don’t all connect to each other
    - Or if they do, the connectivity is unreliable
  - Singapore is/was Thailand’s interconnect point
    - Where the content still is ☹

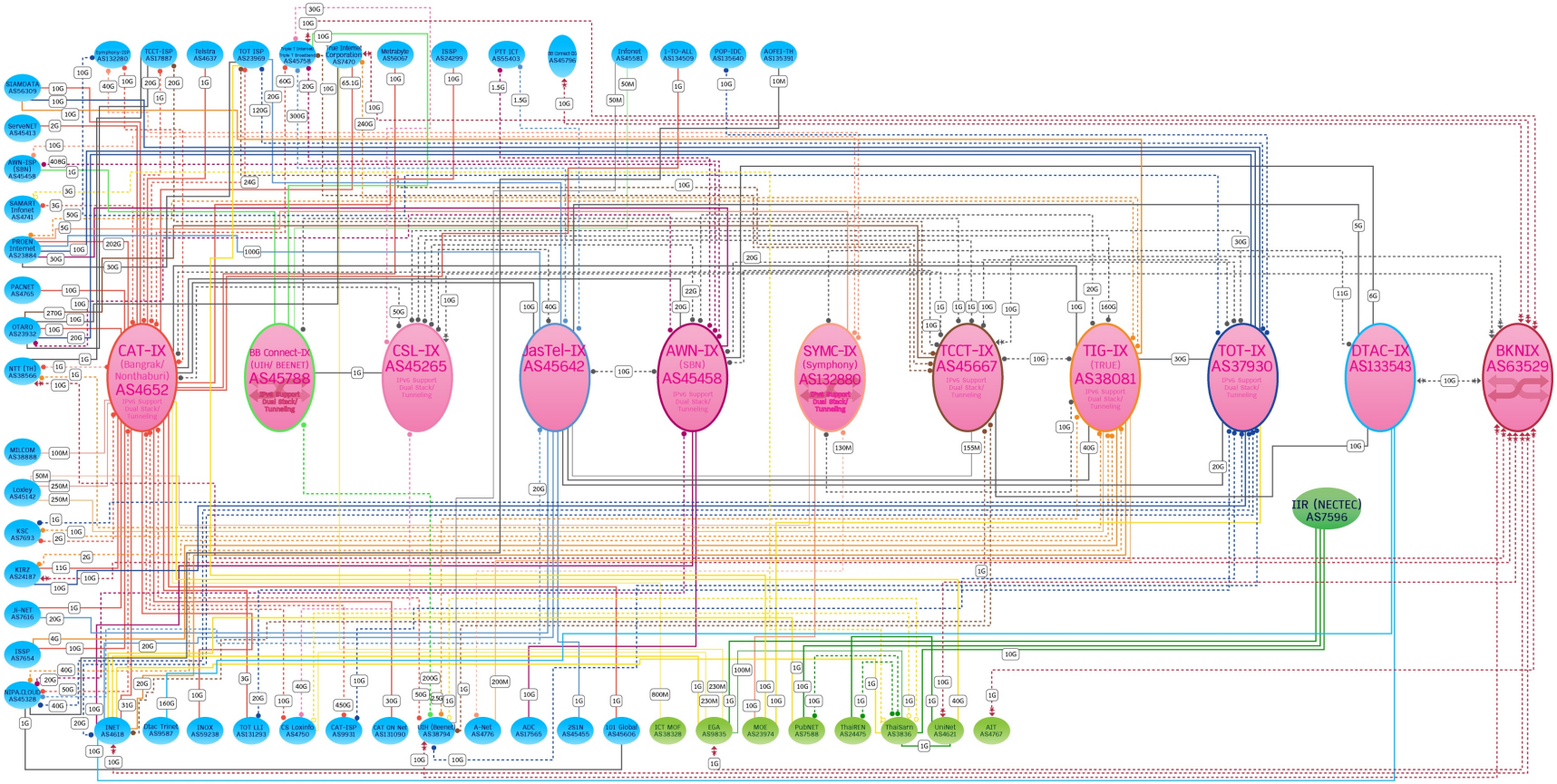
Thailand Internet Map
July 2017

กสทช.

THAILAND DOMESTIC INTERNET EXCHANGE
แผนภาพการเชื่อมต่อเครือข่ายอินเทอร์เน็ตภายในประเทศ

NECTEC

Total Domestic Bandwidth
4,311.585 Gbps.
Last update: 07/08/2017



Legend

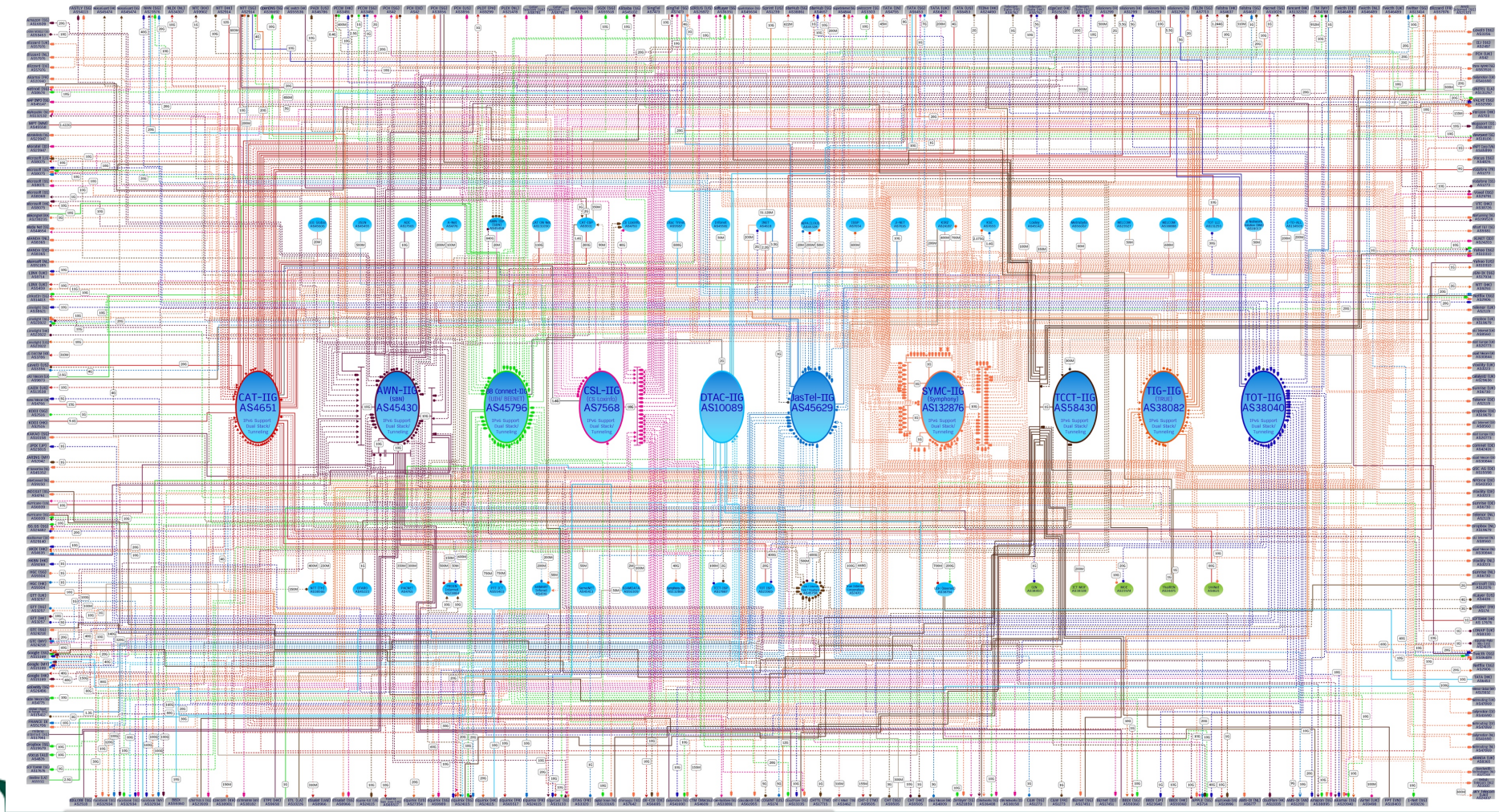
- Thailand Internet Exchange : IX
- Commercial Internet Provider
- Government/Research/Academic
- Layer2 Exchange Point
- CAT Internet Exchange
- BB Connect Internet Exchange
- CS Loxinfo Internet Exchange
- DTAC Internet Exchange
- JasTel Internet Exchange
- SBN Internet Exchange
- Symphony Internet Exchange
- TCCT Internet Exchange
- TIG Internet Exchange
- TOT Internet Exchange
- BKNIX
- IIR (NECTEC) Internet Exchange
- ISP to ISP/Internet Exchange to Internet Exchange
- Government/Research/Academic
- Government to ISP or Internet Exchange
- Internet Protocol Version 6 Native
- Internet Protocol Version 6 Tunneling
- Internet ProtocolVersion 6 Dual Stack
- Peering/ IPv6 Native

Thailand Internet Map
July 2017

THAILAND INTERNATIONAL INTERNET GATEWAY

แผนภาพการเชื่อมต่อเครือข่ายอินเทอร์เน็ตระหว่างประเทศ

Total International Bandwidth
4,724.401 Gbps.
Last update: 07/08/2017



Legend

- International Internet Gateway: IIG
- International Internet Provider
- Commercial Internet Provider
- Government/Research/Academic
- CAT International Link
- BB Connect International Link
- CS Loxinfo International Link
- DTAC International Link
- JasTel International Link
- SBN International Link
- Symphony International Link
- TCCT International Link
- TIG International Link
- TOT International Link
- IIG to IIG
- ISP to International Internet Provider
- Share Bandwidth
- IPv6 Dual Stack
- IPv6 Tunneling
- IPv6 Native
- Peering
- Peering/ IPv6 Dual Stack
- Peering/ IPv6 Tunneling
- Peering/ IPv6 Native

Thailand

- To solve the interconnect problem, Bangkok Neutral Internet Exchange (BKNIX) was established
  - Has been operational since early 2015
  - Operated by the THNIC Foundation, located in a datacentre near Bang Na
  - https://bknix.co.th/en
  - First and **only** IXP in Thailand
- Establishing BKNIX
  - ISOC led a concept workshop in December 2012
  - Randy Bush and I visited in May 2013 at invitation of THNIC Foundation to move things along – 2 day workshop
  - April 2015, after launch, the first technical BGP/IXP Workshop for new members

Thailand

- Equipment:
  - Dual Alcatel Lucent 7750SR operating L2
  - Dual servers (using Ganetti) to host the IX VMs
  - Dual BIRD Route Servers
  - Cisco 2511RJ out of band & ASR1001X services router
- Build completed November 2014, officially launched in February 2015
  - Has IXP Manager, SpeedTest and Looking Glass
- BKNIX has hosted two very popular Peering Fora, in May 2016 and May 2017
  - Membership uptake is slow, even though the IX benefits are well understood
  - Most Thai content is still outside Thailand ☹

Pakistan

- Work on an IXP started in 2015, led by Pakistan Telecom Authority
  - Benefits & requirements understood
  - Work to build consensus amongst operators
- BGP/IXP Workshop in April 2016
  - One day of high level for decision makers, led by Jane Coffin/ISOC
  - I ran 3½ days of technical hands-on for staff of prospective members
  - Concepts and technology understood
    - But no one taking first step
    - Involvement of PTA very helpful as neutral outside party

Pakistan

- PKIX launched in January 2017 during SANOG 29
  - First site in Islamabad (located at PERN NOC, the Pakistan Education and Research Network)
  - New sites in Karachi and then Lahore being set up this year
  - PKIX is collaboration between network operators and Pakistan Telecom Authority
    - Very nice example of cross industry collaboration
- This is third attempt at an IXP in Pakistan
  - First “IX” operated by Pakistan Telecom (L3 transit service)
  - Second IX (first L2 IX) operated by CyberNet (an ISP) in Karachi

Mongolia

- Started with the Mongolia Internet Exchange (MIX)
  - Built by Infocon in 2001, L3 & static routes
- First BGP Workshop in 2005 in Ulaanbaatar by Gaurab Raj Upadhaya and myself
  - Hosted by Mobicom, one of the international carriers
  - Also explored the creation of a proper IXP to replace the MIX – only 6 ISPs in Mongolia then
- OpenMIX created as a true neutral interconnect by a few ISPs
  - Migrating ISPs off MIX onto a Catalyst 6509 based IX in 2009
- Govt and Regulator required relocation to the National DataCentre in 2011
  - And became very closed MIX by 2012 with few participants
  - Cisco Nexus 7010 but operating at L3

Mongolia

- In 2014 saw another BGP Workshop
  - Led by Kurtis Lindqvist and me
  - ISP market place was large, more than 20 ISPs across the country
  - Keen interest in a neutral IXP, as the GDC was off-limits
- The Regulator facilitated meeting of the major ISPs to discuss fixing the IXP
  - Broad agreement that IXP was needed
  - Offers to host from Gemnet and from Mobicom – no carrier neutral DC in Ulaanbaatar ☹
  - Despite this, nothing happened
- Today (2017) the two main transit providers (Gemnet and Mobicom) both operate interconnects for their customers and whoever else wants to join
- Sadly still no open neutral interconnect, but we keep trying!

Vanuatu

- Vanuatu was first Pacific Island nation to deploy an IXP
- The VIX was established in 2012
  - Operational in March 2013
  - BGP/IXP Workshop for participating ISPs
- An initiative of the Office of the Government Chief Information Officer (OGCIO)
  - Jethro Tambeana (right) was main motivator and now runs the VIX
  - (graduate of APRICOT and PacNOG BGP Workshops, formerly of Telecom Vanuatu)

Vanuatu

- Vanuatu Internet Exchange
  - Housed in a Govt Datacentre (the only neutral location in Port Vila)
  - Donated Cisco switch (Catalyst 2960G) and router (7204VXR) for route server (15.2S IOS)
  - 5 ISPs participate (Telecom Vanuatu last to join, in May 2014)
  - Also Govt network
  - GoogleCache (still waiting for Akamai)
  - I-root and Netnod TLD servers
- Initially only satellite Internet for Vanuatu
  - IXP saw very little traffic (no local content, Google/YouTube unusable)
- Submarine fibre arrived in 2013
  - Made the IXP and the on-island shared GoogleCache functional
  - And big boost for the local Internet industry

Bhutan

- No Internet Exchange Point
  - This is a current “work in progress”
- There are 5 network operators:
  - DrukNet (operated by Bhutan Telecom – LINX member)
  - TashiCell
  - Drukcom
  - NANO
  - DrukREN (the soon to go live Research & Education Network)
- Also:
  - DCS – Government Data Centre operator
  - Ministry of Information & Communication – operates the Government WAN

Bhutan

- IXP has been mooted for several years
  - Lots of talk, but left to be done “later”
  - DrukNet, TashiCell and NANO have their own international connectivity
  - DrukNet and TashiCell peer
  - Drukcom, MOIC and DCS buy transit from DrukNet/TashiCell
- Current situation
  - DrukREN has procured a switch
  - APRICOT has donated servers to host services VMs
  - The operators agree an IXP is required
  - BhutanNOG Workshops have covered BGP and IXP peering

Bhutan

- Need to agree on a neutral location
  - Donated equipment currently in the old Bhutan Telecom Microwave room
    - Not neutral
  - MOIC proposed the Government DataCentre
    - Unease about IXP at Govt premises
  - Thimphu Technology Park proposed
    - But on outskirts of the city
    - Concerns about power and fibre access
  - No other operator neutral location in Bhutan ☹
- Everyone is waiting for someone else
  - Needs someone to be there to lead/chase ☺

IXPs in Asia & Pacific

A tour around the region

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Network Startup Resource Center

Thailand

- Bangkok Neutral Internet Exchange (BKNIX) was established in early 2015
  - Operated by the THNIC Foundation, located in a datacentre near Bang Na
  - https://bknix.co.th/en
  - First and only IXP in Thailand
- Equipment:
  - Dual Alcatel Lucent 7750SR operating L2
  - Dual servers (using Ganetti) to host the IX VMs
  - Dual BIRD Route Servers, Cisco 2511RJ console server, ASR1001X services router
- Build completed November 2014, formally launched early 2015
  - Offers IXP Manager, SpeedTest and Looking Glass
- BKNIX has hosted two very popular Peering Fora, in May 2016 and 2017
  - Membership uptake is slow, even though the IX benefits are well known
  - Most Thai content is still outside Thailand ☹

Cambodia

- Cambodia Network Exchange in Phnom Penh
  - http://cnx.net.kh/
  - Established in 2008
  - Major sponsor is Sabay Digital
  - Based on a Cisco Nexus switch (1Gbps and 10Gbps access speeds)
  - 27 peers

Lao PDR

- No Internet Exchange Point
- Network Operators are required to connect to LANIC, the Lao National Internet Center
  - This transition is still in progress – ISPs right now transit via Thailand and Vietnam
  - Alcatel Lucent router running L3
  - All licensed operators are required to peer with LANIC who are to be the sole international transit operator (Internet Gateway)

Vietnam

- VNNIC, the operator of .vn and National Internet Registry for Vietnam, operate VNIX
  - https://www.vnnic.vn/en/dns-vnix/vnix-member-isp?lang=en
  - Has 17 members across three locations, Ha Noi, Da Nang and Ho Chi Minh City
  - Access speeds of 1Gbps and 10Gbps

Myanmar

- No Internet Exchange Point
  - But it is being explored
  - The three biggest operators (MPT, Telenor and Oredo) do not interconnect
    - Internet is slow and expensive, unless on the mobile 4G network
- National REN (MMREN) being explored

Bangladesh

- Bangladesh Internet Exchange (BDIX)
  - Established in 2004
  - http://www.bdix.net/home.html
  - Created as a collaborative effort of the major ISPs in Dhaka
  - Started off with a Cisco 2924XL switch, then a Catalyst 4506, and now migrating to a Cisco Nexus 3548
  - 100Mbps, 1Gbps and 10Gbps access speeds
    - 100Mbps all via fibre media convertors (sigh!) being upgraded to 1Gbps on Nexus
  - 78 members
  - Not sharing pictures! Tidy up under way with migration to the 3548.

Bhutan

- No Internet Exchange Point
  - But work under way
  - DrukREN (National R&E network) has procured a switch
  - APRICOT has donated servers to host services VMs
  - The operators agree an IXP is required
  - Need to agree on neutral location
    - Thimphu Technology Park proposed
  - Need to get a move on!

Nepal

- Nepal IX (NPIX) was the first open neutral IXP in South Asia
  - Established in 2002
  - http://www.npix.net.np/
  - Now 28 members in two locations in Kathmandu
  - Most local traffic now passes through NPIX
- Aside: NPIX is hosting APRICOT 2018 in February in Kathmandu
  - See you there! ☺

Pakistan

- PKIX launched in January 2017 during SANOG 29
  - Work started in 2015, technical IXP Workshop in April 2016
  - First site in Islamabad (located at PERN NOC, the Pakistan Education and Research Network)
  - New sites in Karachi and then Lahore being set up this year
  - PKIX is collaboration between network operators and Pakistan Telecom Authority
    - Superb example of cross industry collaboration
- Third attempt at an IXP in Pakistan
  - First “IX” operated by Pakistan Telecom (L3 transit service)
  - Second IX (first L2 IX) operated by CyberNet in Karachi

Afghanistan

- Initial discussion about an IXP in 2004
  - Under the umbrella of ISP Association
  - Popped up again in 2009 as a discussion point
- An IXP was set up in Kabul in 2011
  - But operators recently reported that it has ceased to operate
  - Although there are several ISPs in Kabul, all with satellite links out
- AFAIK there isn't currently an operational IX ☹

India

- National Internet Exchange of India (NIXI) established soon after the privatisation of VSNL (ie sale to TATA)
  - Major project studying other IXPs world wide and seeking expert consultation
  - Initiated and operated by the Department of Telecom
  - Biggest site in Mumbai, with other locations including New Delhi and Chennai
  - Many basic errors made during its founding and operation meant lack of success
- Today:
  - Mumbai Convergence Hub – IXP in Mumbai, now DE-CIX partner
  - AMS-IX partnering with SIFY to set up IXPs in Mumbai and New Delhi
  - IIFON (India Internet Foundation) established IXP in Chennai, and planning other locations in the smaller cities across India
  - Peering & Internet landscape is much better than it was 2 years ago

Sri Lanka

- No open neutral IXP
- SLIX is operated by Lankacom, one of the major operators
  - Subsidiary of Singapore Telecom
  - While it is listed as an IX, it looks and feels like a domestic commercial transit service (like Singapore Telecom's "IX")

Maldives

- No Internet Exchange Point
  - Only two operators

Malaysia

- MYIX is the Internet Exchange Point for Malaysia
  - Established by the Malaysian Government in 2006
  - Neutral and Non-profit
  - http://myix.my/
  - 6 locations in Malaysia
    - Kuala Lumpur, Cyberjaya, Penang, Johor, Kuching, Kota Kinabalu
  - Most ISPs and Content Providers in Malaysia are members
  - MYIX ran a successful peering forum in 2016
  - Joint MYNOG and MYIX Conference in October 2017

Singapore

- Apart from Equinix Singapore...
- SGIX (Singapore Internet Exchange)
  - Launched in 2010
  - http://www.sgix.sg/
  - Over 140 members
- SOX (Singapore Open Exchange)
  - Launched in 2001 (because SingTel IX (STIX) is not an IX)
  - http://www.sox.net.sg/
  - At the National University of Singapore & GlobalSwitch

Indonesia

- NiCE (National Interconnect Exchange)
  - http://www.openixp.net/
  - Formed in 2010
  - Biggest IXP in Indonesia (>700 members)
    - http://www.openixp.net/routedasn.html
- Indonesia Internet Exchange (IIX)
  - Operated by APJII, the Association of Internet Service Providers Indonesia
    - APJII also operates IDNIC and is the National Internet Registry for Indonesia
  - Formed in 1997
  - http://www.iix.net.id/

Timor Leste

- No Internet Exchange Point
- Two major operators
  - IXP being discussed by Government and operators, as well as interested parties and supporters

Brunei Darussalam

- No Internet Exchange Point
- TelBru is the main operator in Brunei
  - BRUIX is their “exchange”, but is part of TelBru’s transit business

Philippines

- PHIX proposed in 2006 and to be hosted by Innove
  - PHNOG launched at the same time
    - The NOG met a few times, the IX stalled
- Philippine Open IX (PHOpenIX)
  - Operational by 2011 and operated by DOST-ASTI (Department of Science and Technology, Advanced Science and Technology Institute)
  - http://phopenix.net/
  - 59 members
  - Nodes in Metro Manila (Makati, Quezon, Pasig) and Cebu
  - Based around Cisco Catalyst 3000 series switches, migrating to Cisco Nexus 3064
- PHOpenIX forms the basis and supporting organisation for PHNOG

Hong Kong

- HKIX
  - The oldest IXP in Asia, formed in April 1995
  - Hosted and operated by the Chinese University of Hong Kong
  - http://www.hkix.net/
  - Cisco Nexus 7710 switches and Route Server
  - 269 participants, 1GE/10GE/100GE connections
- AMS-IX have also set up a presence Hong Kong, but v few participants

China (Mainland)

- CHN-IX
  - The first carrier neutral IXP in mainland China
  - Launched in December 2015 in Beijing
    - Shanghai and Guangzhou sites following
  - Initiative of ChinaCache, partnering with AMS-IX
- Government had launched official NAPs in the early 2000s
  - In Beijing, Shanghai and Guangzhou
  - But only for the major carriers to interconnect
    - Everyone else had to connect to the carriers

Taiwan

- Taiwan Internet Exchange (TWIX)
  - Established in 1997
  - http://www.twix.net/index_e.html
  - 26 members
  - Operated by Chunghwa Telecom
- Taipei Internet Exchange (TPIX)
  - Established in 2002
  - http://www.tpix.net.tw/
  - Located in Chief Telecom building in Taipei (carrier neutral IDC)
  - 38 members
  - Cisco Nexus 9508 switches (1GE/10GE/100GE)
- Just completed the 2017 Taiwan Peering Forum

Mongolia

- Started with the Mongolia Internet Exchange (MIX)
  - Built by Infocon in 2001, L3 & static routes
- OpenMIX created as a true neutral interconnect by a few ISPs
  - Migrating ISPs off MIX onto a Catalyst 6509 based IX in 2009
- Govt and Regulator required relocation to the National DataCentre in 2011
  - And became very closed MIX by 2012 with few participants
  - Cisco Nexus 7010 but operating at L3
- The Regulator facilitated meeting of the major ISPs about fixing the IXP
  - Broad agreement that IXP was needed
  - Offers to host from Gemnet and from Mobicom – no carrier neutral DC in Ulaanbaatar ☹
  - Despite this, nothing happened
- Today (2017) the two main transit providers (Gemnet and Mobicom) both operate L2 interconnects for their customers and whoever else wants to join
- Sadly still no open neutral interconnect, but we keep trying!

Korea

- Carrier operated “IXP”s by LG Telecom and Korea Telecom
- Korea Internet Neutral Exchange (KINX)
  - The only carrier neutral IXP
  - Established in 1999
  - https://www.kinx.net/?lang=en
  - 42 members

Japan

- WIDE operated NSPIXP-2
  - Established in 1996
  - http://nspixp.wide.ad.jp/2/ (not updated)
  - Now known as DIX-IE (Distributed IX in Edo)
- Then there are three commercial IXPs:
  - JPNAP http://www.jpnap.net/english/ (2001)
  - JPIX https://www.jpix.ad.jp/en/ (1997)
  - BBIX http://www.bbix.net/en/ (2003)
- Very well established IXP environment across major cities

Vanuatu

- Vanuatu was first Pacific Island nation to deploy an IXP
- The VIX was established in 2012
- An initiative of the Office of the Government Chief Information Officer (OGCIO)
  - Jethro Tambeana was main motivator (graduate of APRICOT and PacNOG BGP Workshops, formerly of Telecom Vanuatu)
  - Housed in a Govt Datacentre (the only neutral location in Port Vila)
  - Donated Cisco switch and router for route server (15.2S IOS)
  - 5 ISPs participate (TVL last to join), plus Govt network, and GoogleCache
- Initially only satellite Internet for Vanuatu – fibre arrived in 2013, making the IXP and the on-island shared GoogleCache a massive boon for the Internet industry

As for the rest of the Pacific...

- Australia and New Zealand have well functioning IXPs in the major population centres
- Vanuatu was first Pacific Island nation to have an IXP, the VIX, established in 2012
- Papua New Guinea finally has an IXP this year in Port Moresby after 15 years of trying
- As for the rest, only:
  - Guam: enthusiasm for several years, nothing more
  - Samoa: enthusiasm, commitments made, workshops done, switch installed, then nothing more
  - Fiji: enthusiasm for a few years, envy about Vanuatu, something might happen this year or next

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