Local Internet Exchange for Keeping Local Traffic Local

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Asia Pacific Network Information Centre – APNIC

• APNIC is the Regional Internet Registry administering IP addresses for the Asia Pacific

• APNIC’s Vision: “A global, open, stable, and secure Internet that serves the entire Asia Pacific community”

• We achieve this by:
  – Serving APNIC Members
  – Supporting Regional Internet Development
  – Collaborating with the Global Internet Community
How Does Internet Operates?

• Internet is a network of networks, composed of networks of ISPs and users
• User networks connect to ISPs
• Small ISPs connect to large ISPs
• Various networks (large or small) are interconnected with one another to form Internet
Autonomous Systems

- A network on Internet is called Autonomous System (AS) which is represented by AS Number (ASN)
  - ASN is unique around the world
    - APNIC is in charge of ASN assignment for AP region
  - Used together with BGP (Border Gateway Protocol) for interconnections with multiple networks (or multi-homing)
  - Networks having ASNs can be more independent, or portable
    - Together with portable IP addresses
    - Like what APNIC members are enjoying…
Ordinary Transit Model

Global Internet

Transit Provider
(Upstream)

Downstream Customer

All customer routes

Routes of the whole world
Customer routes only
Transit in General

• Networks pay transit providers to get to the whole Internet
  – Can connect to multiple transit providers for resilience and portability

• A few very large ISPs act as transit providers for the whole world (the so-called tier-1 networks) which do not need to pay others to get full Internet connectivity
  – Other ISPs must be transit customers of those tier-1 networks directly or indirectly in order to gain full connectivity

• Networks on Internet are trying to bypass transit providers as much as possible
  – for lower cost and higher performance
Ordinary Peering Model

Transit Provider A (Upstream)  Routes of A and its customers

Downstream Customer  Downstream Customer

Transit Provider B (Upstream)  Routes of B and its customers

Downstream Customer  Downstream Customer  Downstream Customer  Downstream Customer
Peering in General

- ASes are interconnected/peered at Internet exchanges points (IXPs) or privately.
- Interconnection/peering is among ISPs / data centres / content providers / cloud services providers which have different ASNs using BGP protocol.
- For mutual benefits
  - For higher performance, lower latency and lower cost
  - Usually no settlement between peers and cost is shared.
- Local Peering
  - Local-to-local traffic do NOT need to route through overseas.
  - Important to local Internet development.
- Between 2 ASes
  - BLPA (Bi-Lateral Peering Agreement).
- Among > 2 ASes
  - MLPA (Multi-Lateral Peering Agreement).
Private Peering

• A form of BLPA having dedicated point-to-point connection between 2 ASes

• Using cross-connect or local loop or IPL to interconnect
  – Cost is usually shared between 2 peers

• May have multiple connections between 2 ASes for resiliency

• Not quite cost-effective
  – Spare bandwidth cannot be used for other traffic

• Not very scalable
  – $nC_2$ physical connections for n ASes to peer fully with one another
What is an Internet eXchange Point (IXP)?

- An IXP is a shared physical network infrastructure over which various Autonomous Systems can do easy peering with one another
  - One physical connection to IXP can be used for interconnections with multiple networks
  - More cost-effective and scalable
- ASes to be served by IXP include Internet Gateways, Internet Service Providers (ISPs), Research & Education (R&E) Networks, Cloud Service Providers, Content Providers and Content Delivery Network (CDN) Service Providers
Benefits of IXP

• One main objective of an IXP is to keep local traffic local
  – Important to local Internet development

• Helps bypass 3rd-party network infrastructure for easy interconnection and direct traffic exchange among participating networks
  – Reduced cost – cheaper connectivity
  – Enhanced network performance – faster speed
  – Reduced latency – lower delay

• Helps encourage development of more local content and local applications
  – Helps local data centre business and other businesses

• Everybody is benefited
  – The gain for each may be different but all will gain
  – At the end, it is the most important that end users or consumers are benefited

• Often considered as Critical Internet Infrastructure locally, regionally or globally
IXPs are Layer-2 Networks

- Switched Ethernet
  - One physical connection for interconnections with multiple networks
  - Only routers are allowed to connect to the switching fabric directly
- IXP participants can do direct Bilateral Peering (BLPA) over the layer 2 infrastructure anytime
- With Route Server added to the layer 2 infrastructure, IXP participants can also do Multilateral Peering (MLPA) for easier interconnections among everybody
  - Traffic exchange is not going through the route server but direct
- Those called themselves “IXes” but serving layer-3 services are mostly transit providers
Value and Attractiveness of an IXP

• Proportional to the number of different networks (ASNs) connected and also the traffic volume

• Snowball effect after reaching critical mass
  – The initial period usually is the hardest
    • Most will take wait-and-see approach
  – Gradually will have good mix of networks of different types
    • E.g. Eyeballs vs Content
Evolution

• IXP development is an evolutionary process done step by step
• It can be improved over time, but picking the right initial neutral organisation / governance model and a neutral site at the start is important for future success
Possible Steps for IXP Development

• Can be gradual, step by step

• Layer-2 network is the bare minimal
  – Can use private IP addresses if small amount of participants

• Public IP addresses next
  – Legal entity issue

• Site resilience is IMPORTANT while equipment resilience is already included
  – Has to have site resilience sooner or later

• Route server(s) with ASN follows
  – RPKI consideration

• Other value added services
  – DNS: Root / TLDs / Recursive
  – Shared Content Caches?
Neutral Location is Good Starting Point

• May choose one of the followings as starting point:
  – University
  – Technology Park
  – Carrier Neutral Data Center
  – Government Data Center

• Having multiple carrier options with easy access is important

• Should maintain neutrality continuously

• Expansion to multiple sites within the same metro area can be done gradually, coupled with growth
Governance

• Multi-stakeholder bottom-up approach is the preferred approach for maximum acceptance of the community

• Government support is also important

• Be as inclusive as possible in order to provide maximum benefits to the whole community which it serves

• Should be fair and consistent to every participant

• Should be open and transparent as much as possible
Which Models Can Sustain?

• Usual business model
  – IXP alone cannot make big money
  – Or IXP may just be a value added service

• Subsidized Model
  – Government funding may be more reliable?

• Model relying on sponsorship and/or volunteers
  – Most risky as sponsorship or support of volunteers is not guaranteed

• Membership-based Model
  – Open Membership vs Closed Membership
  – Proper governance is important
  – Most neutral but still need to have good financial model for long-term sustainability
Advanced / Developed Economies

• IXPs are business
  – Even for not-for-profit set-up
  – Less government involvement

• Multiple IXPs
  – Keen competition

• But if they cannot keep intra-economy traffic local, someone needs to step up
Developing Economies

• Some do not have any IXPs yet
• Local traffic does not stay local
  – A lose-lose situation for everybody
• IXPs can help Internet development a lot
  – Better to be non-for-profit set-up
  – May need to start with subsidized model
  – May not be a business at all
  – Help from government is mostly needed
  – Active participation of the biggest players is also very important
Examples of Pacific Islands

• Far from any other places
• External connectivity is very expensive
  – Even though more submarine cables are being built for them
• Small markets because of small population
• Usually just a few ISPs but they may not be interconnected locally
• Local traffic across ISPs usually routed through US or Australia
• Local IXP is very much needed
• Witnessed immediate benefits on Day 1 of set-up of Fiji-IXP
  – Much improved latency and high volume of traffic
Politics Involved in Early IXP Development

• If major ISPs refuse to connect to IXP, the IXP is of little value
• There are multiple possible options but in any case, major ISPs need to collaborate
  – E.g. separating access networks from Internet gateway or transit network
• If hurting the goal of “Keeping Local Traffic Local”, then it is lose-lose to everybody
• Government involvement may help the case
• Having an IXP is NOT a magic wand to solve all the issues
  – But collaborative spirit is
Government Funding for IXPs?

• Is it good or bad?

• More needed during infancy stage of IXP development

• But for long-term, it is probably better to have bottom-up industry-led governance for IXP
  – Align with bottom-up multi-stakeholder approach
Geography

• IXP usually is not expanded beyond a metro area so as to avoid competing with IXP participants and to maintain neutrality

• Should start with the biggest city first and gradually set up separate infrastructure in other bigger cities one by one
To Leverage the Position of &

to Add Value to an IXP

• **Domain Name Infrastructure:** DNS infrastructure is very important to Internet operations so Root/TLD DNS server instance(s) should be connected directly to IXP for direct peering in order to benefit all participants for better DNS performance and resilience.

• **Shared Cache:** Connecting cache servers of popular content to the IXP will help everyone save bandwidth, but the cost of the bandwidth for cache-fill has to be properly shared by the ISPs benefited.
  – Different cache service providers have different supported models.
  – Need to think about long-term sustainability.

• **NOTE:** Transit for the above should NOT be used for providing usual transit service to IXP participants so as to maintain neutrality.
IXP Participants

• Unfortunately, a lot of IXP participants do not make the best use of the IXP(s) they have connected

• IXP Participants without enough knowledge and skills may disrupt the operations of IXP from time to time

• IXP operators need to do a lot of education or push to their participants

• So, IXP engineers would be busy and dedicated resources would be needed
  –Volunteering type of operations mode cannot sustain for too long
IXP Development Work of APNIC

• APNIC strongly believes IXPs help Internet development
  – That is why we support APIX and related activities
  – After all, IXPs serve and benefit APNIC members
  – In fact, IXPs need IP addresses and ASNs and so are APNIC members themselves

• Do more on helping those developing economies
  – Especially those which do not have any IXP yet
  – Or those which their only IXP is not functioning

• Training and Technical Assistance work primarily
  – Not just for IXP operators but also for IXP participants
  – Also help talk to major stakeholders to convince them of the benefits of having a local IXP while maintaining neutrality
  – May need help of Community Trainers and Consultants from time to time

• Having been supporting IXP development in Fiji, PNG, Vanuatu, Mongolia, Bhutan, Myanmar, some cities in India and others
IXP Development Package of APNIC

• Providing Training & Technical Assistance is the minimum
• Will tailor-make support according to individual needs
• Other possible support items (on a case-by-case basis):
  – Ethernet switch
  – Root Server anycast instance
  – Route Server
  – ROV & IPv6 deployment support
  – IXP Manager
  – RIPE Atlas Anchors
  – BGP Route Collection for Analysis
  – CSIRT Development
  – Honeypot of Honeynet Project for Analysis
• APIX Membership is recommended to all IXPs
ROV at IXP – RS and/or Shared Validator

- RS
- Validated cache
- RPKI-to-Router (RTR)
- Routes
- Tagged/filtered routes
Other Help & Support by APNIC

• APNIC also provides help & support to:
  – Peering Asia
  – Peering Forums hosted by not-for-profit IXPs
  – NOGs (which IXPs usually support)

• APNIC also sponsors:
  – PeeringDB
  – IXP-DB
  – IXP Manager
Final Remarks

• IXPs will continue to play a key role for easier interconnections among networks
  – Especially for developing economies
  – But IXP is NOT a magic wand to solve all the issues
    • Collaborative spirit is

• Need to find a suitable model for long-term sustainability

• Relative neutrality is important
  – So better to maintain it as much as possible

• After all, “Keeping Local Traffic Local” is the most important thing