

Internet Exchange Point

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IXP Tutorial

What is an Internet eXchange Point (IXP) ?

- **Internet eXchange Points (IXPs) are the most critical part of the Internet's Infrastructure. It is the meeting point where ISPs interconnect with one another. With out IXPs, there would be no Internet. Interconnecting with other networks is the essence of the Internet. ISPs must interconnect with other networks to provide Internet services.**
- **Private and Bi-Lateral Peering are considered to be a type of IXP.**

Why Connect to an IXP?

- **Save Money**
- **Save more money**
- **Save more more more money**

Background

- **The Internet is a decentralized network of autonomous commercial interests**
- **Internet Service Providers (ISPs) operate by exchanging traffic at their borders, propagating data from its source to its destination**
- **This exchange can be settlement-free (“Peering”) or paid (“Transit”)**

Why This is Important

- **If you have no domestic Internet exchange facility, your domestic ISPs must purchase transit from foreign ISPs**
- **The large foreign ISPs who sell transit are American, Japanese, and British**
- **This is an expensive and unnecessary exportation of capital to developed nations at the expense of your domestic Internet industry**

Second-Order Benefits of Domestic Exchange

- **A strong domestic Internet industry creates high-paying knowledge-worker jobs**
- **Domestic traffic exchange reduces the importation of Foreign content and cultural values, in favor of domestic content authoring and publishing**

A Brief History of Internet Exchanges

First Exchanges

- Metropolitan Area Ethernet
 - Washington, D.C.
 - 10mb shared FOIRL into assorted switches
 - No fixed topology
 - MFS fiber plant
 - Shared administration

First Exchanges

- Commercial Internet Exchange
 - Moved from Washington, D.C. to Palo Alto
 - Layer-3 MMLPA
 - Commodity DS1 (T1) lines into a Cisco 7010
 - Not-for-profit industry association

First Exchanges

- MAE-West / Federal Internet Exchange
 - San Jose / Mountain View
 - FDDI “dumbbell” ring
 - Bridged to 10mb Ethernet in many locations
 - Two locations, two administrations

First Exchanges

- Hong Kong Internet Exchange
 - Chinese University of Hong Kong
 - Single location Ethernet switch
 - Administered by the university
 - First major free exchange

Technological Progression

- Shared 10Base-T / FOIRL Ethernet
- Switched 10mb Ethernet
- Shared FDDI
- Switched FDDI
- 100Base-T / 100Base-FX
- Gigabit Ethernet
- 10Gigabit Ethernet

Other Technologies

- Layer-3 route-servers
- Frame Relay
- ATM
- Wireless Ethernet
- Crossconnect mesh
- DPT

Common Services

- Route-server
- Looking-glass
- Measurement and instrumentation
- Network Time Protocol
- Web cache parent
- News server
- Root server mirror

Common Business Models

- Hosted by a university or government
- Informal
- Industry association
- Neutral for-profit
- Anything else may not be recognized

Size Differentiation

- Municipal
- Large metro-area
- National
- “Regional” (meaning changing)

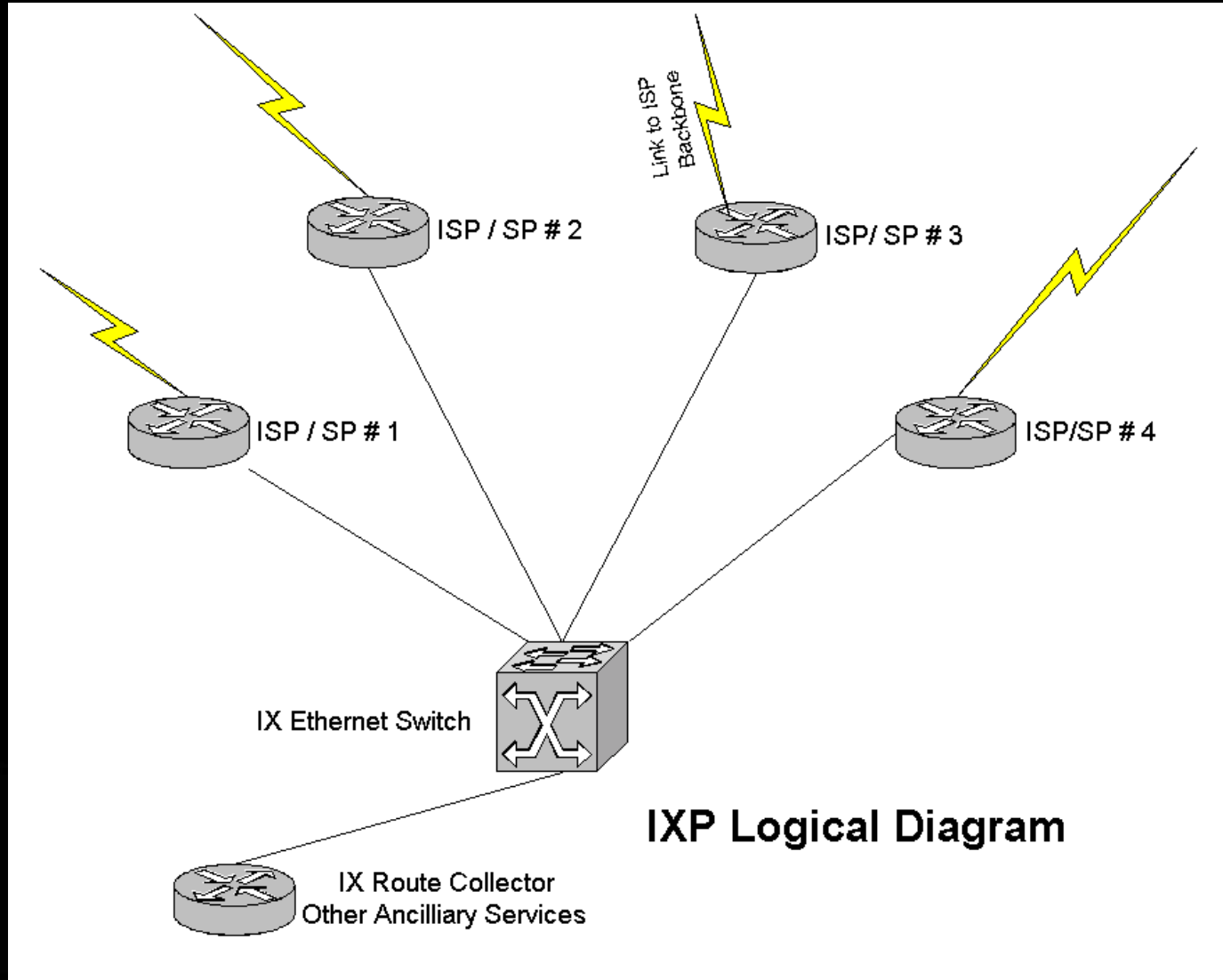
Peering / Transit Differentiation

- New concept
- Very different pricing
- Very different competitiveness

Types of IXPs

How can ISPs connect to each other ?

Typical IXP.....



Types of IXPs

- **Two Types of IXes commonly exists**
 - Layer 2
 - Layer 3
- **Other ways also practiced**
 - Ring
 - Private Internet Connect
 - GigaPoP
 - Hybrid

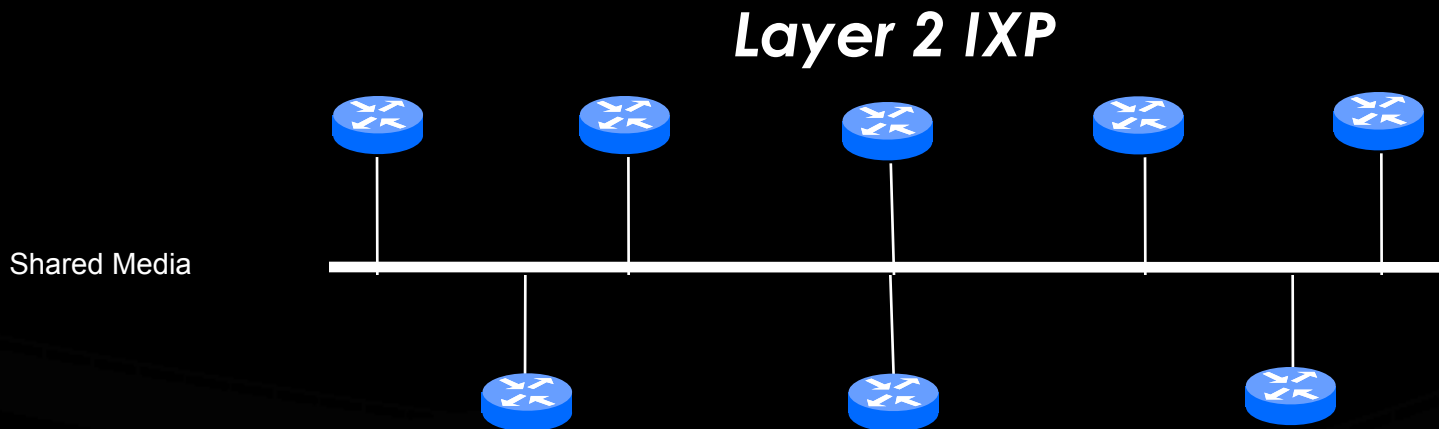
Layer 2 IXPs

- **Layer 2**

- Uses a common network medium like Ethernet and ATM (Point to Point VCs) . Most popular is Ethernet (10/100/1000Base TX technologies)
- Members bring their own routers and circuits from their backbone.
- No Transit or customer connections
- Members of the IXP determine who they peer with. You do not have to peer with everyone.
- MAE-E, MAE-W, PAC-Bell, Sprint, D-GIX, LINX, NSPIXP, HKIX

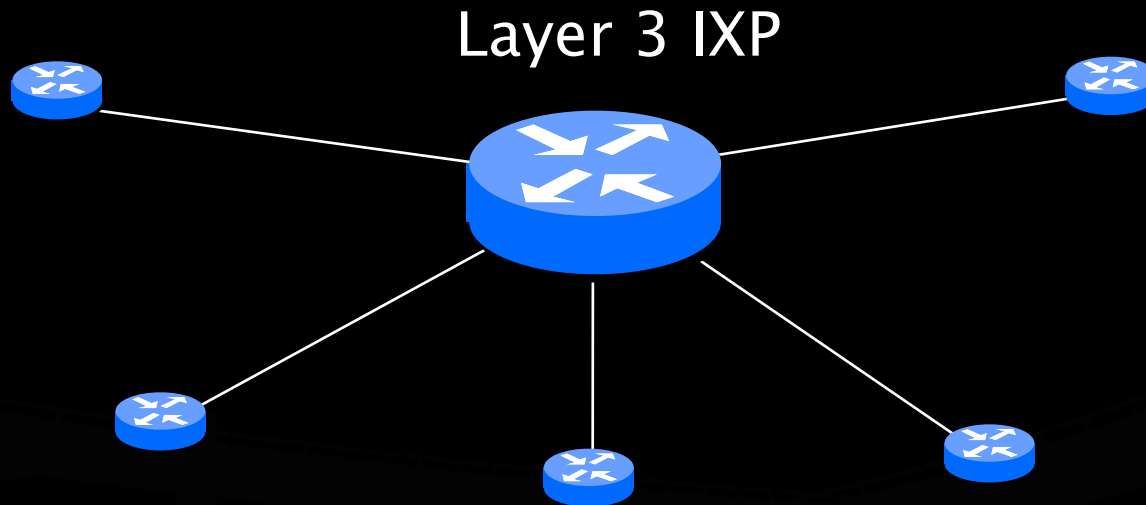
Layer 2 IXPs

- **Layer 2 Exchange** - All traffic is exchanged *outside* routers that are connected to a shared media (i.e. Ethernet 10/100/1000BaseTX)



Layer 3 IXPs

- **Layer 3 Internet eXchange Point** - All traffic is exchanged *inside* a router.



Layer 3 IXPs

- **Layer 3 IXPs limit the autonomy of the members.**
- **Someone has to manage the router in the middle.**
- **Create business issues, as ISPs don't have control with whom they can peer with**

Layer 2 versus Layer 3

- **Layer 3**

- IXP team requires good BGP knowledge
- Rely on 3rd party for BGP configuration
- Less freedom on who peers with whom
- Could potentially compete with IXP membership
- Easier to distribute over wide area

- **Layer 2**

- IXP team does not need routing knowledge
- Easy to get started
- More complicated to distribute over wide area
- ISPs free to set up peering agreements with each other as they wish

Design and Construction of Local and Regional Exchange Facilities

Determining Need

- Sufficient end-user base?
- No existing facility to build upon?
- Sufficient degree of locally-destined traffic?

Geographic Location

- User population
- Fiber facilities or rights-of-way
- Founding participants

Density

- Centralized in one room
- Campus of adjacent buildings
- MAN
- Frame or ATM cloud

Building Management

- Telco hotel
- University computing or telecommunications facility
- City emergency services facility

In-Building Facilities

- Pathways
- Power
- Cooling
- Access and security

Services

- Switch fabric
- Crossconnects
- Route-server
- Remote hands
- NTP
- Web caching

Business Structure

- Incorporated or unincorporated?
- Staffed or volunteer?
- Non-profit or for-profit?
- Cooperative or external ownership?
- Cost-recovery (predictive or actuals), ad-hoc, or market pricing?

Policies

- BLP, MLPA or MMPLA?
- Mandatory looking-glass?
- Routing and switch-port information public or members-only?
- Secrecy in the event of security problems, failures, or mistakes
- Extensible switch fabric?

Technical Requirements for Peers

- **ASN is required for BGP**
 - **APNIC members can get one for free**
 - **Non-APNIC member can make a request through their upstream provider and get one for free**
 - **Yet, others can pay a one time US\$500 to get one.**
- **Members provide their own connectivity equipment at both ends and can have redundant links in place**

Router Configuration ?

- **See excellent tutorials by Philip Smith at SANOG, APRICOT etc.**
- **But some specifics**
 - **Any router which speak BGP works.**
 - **But routers at an IXP are a special category in sense that they don't 'connect to upstream' or 'connect to customers'**

Some IXP specific on routers

- Do not introduce the IXP LAN address block into your IGP or BGP.
- Use 'next hop self' on the IXP router towards iBGP peers.
- Set up peering sessions with the Exchange point IP (not loopbacks)
- Do not put a default route on the IXP router
- Do not originate routes from the IXP router
- Use prefix-list or as-path filters

IXP specific routes

- **You only announce the following to your peers**
 - **Your 'own' addresses/routes**
 - **Your customer routes**
- **You do not announce**
 - **Your upstream routes, or full routing tables**
 - **Default Routes**
 - **Your other peers route**
 - **Things that do not belong to you**

Any Question?

- **It's all about experience !!**
- **Maurice Dean from Google will talk about 'peering' and there is a peering panel tomorrow.**

Where to go for more information?

- **South Asian Network Operators Group (SANOG).. www.sanog.org**
 - **We are in SANOG VII !!**
 - **SANOG VIII in Karachi in Late July / Mid-August**
 - **mailing list sanog@sanog.org. Send e-mail to sanog-request@sanog.org to subscribe**
 - **Schedules and materials on the website**

More Forums

- **APRICOT (Asia Pacific Regional Internet Conference on Operational Technology)**
 - AP Wide, fourth week of February, Perth Australia
- **APNIC Meetings**
 - Twice a year. Once during APRICOT
- **EOF / Nanog / AfNOG**
 - European , North African, African NOGs

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