Peering Best Practices

Philip Smith
<philip@nsrc.org>

MyIX Peering Forum 2016

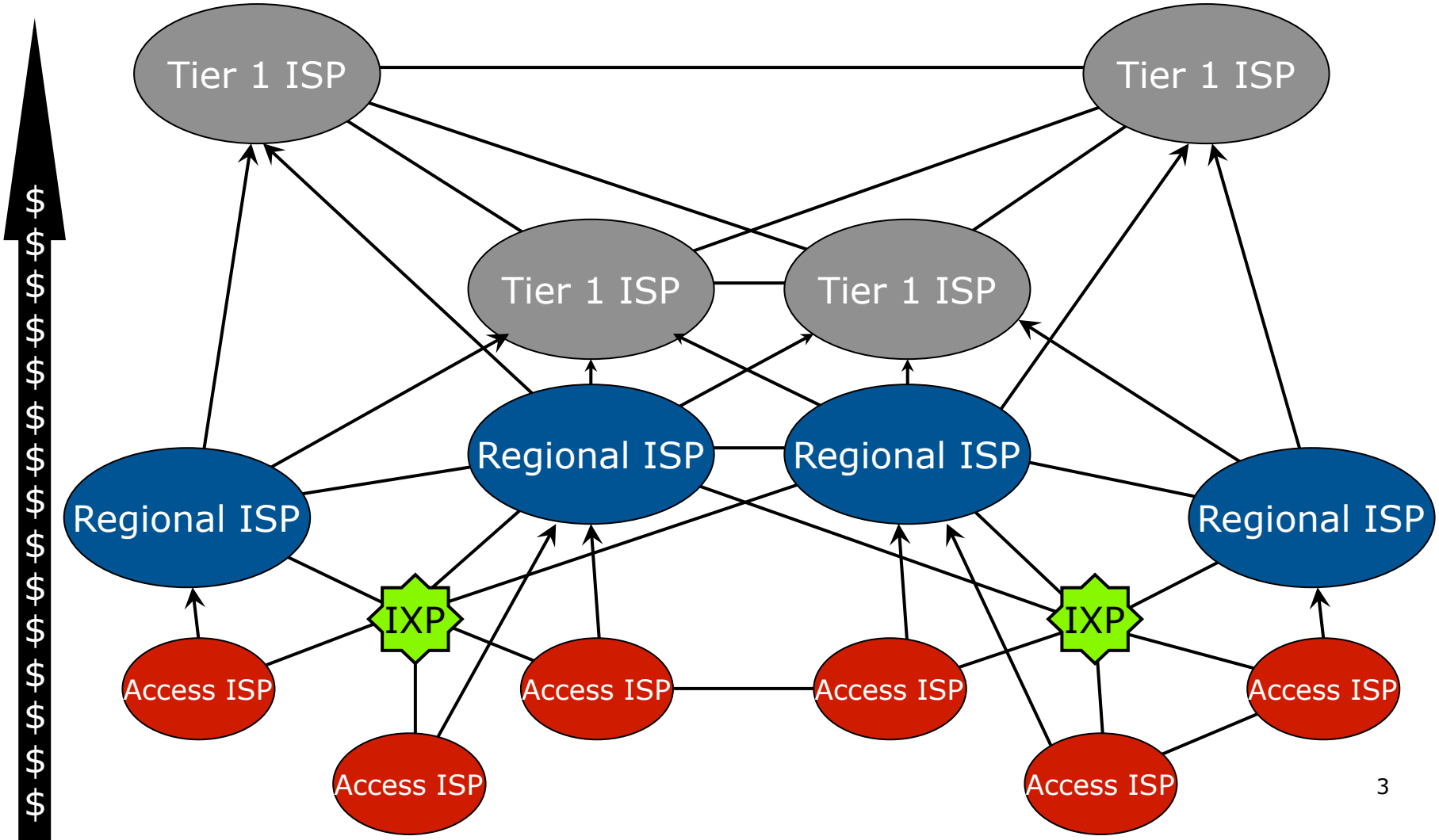
Kuala Lumpur

10th October 2016

The Internet

- Internet is made up of ISPs of all shapes and sizes
  - Some have local coverage (access providers)
  - Others can provide regional or per country coverage
  - And others are global in scale
- These ISPs interconnect their businesses
  - They don't interconnect with every other ISP (over 54900 distinct autonomous networks) – won't scale
  - They interconnect according to practical and business needs
- Some ISPs provide transit to others
  - They interconnect other ISP networks
  - Just over 6500 autonomous networks provide transit

Categorising ISPs

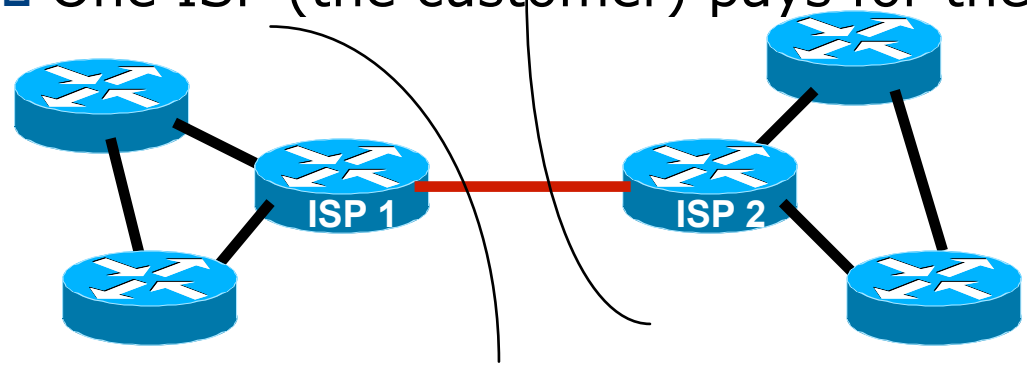


Peering and Transit

- Transit
  - Carrying traffic across a network
  - Usually for a fee
  - Example: Access provider connects to a regional provider
- Peering
  - Exchanging routing information and traffic
  - Usually for no fee
  - Sometimes called settlement free peering
  - Example: Regional provider connects to another regional provider

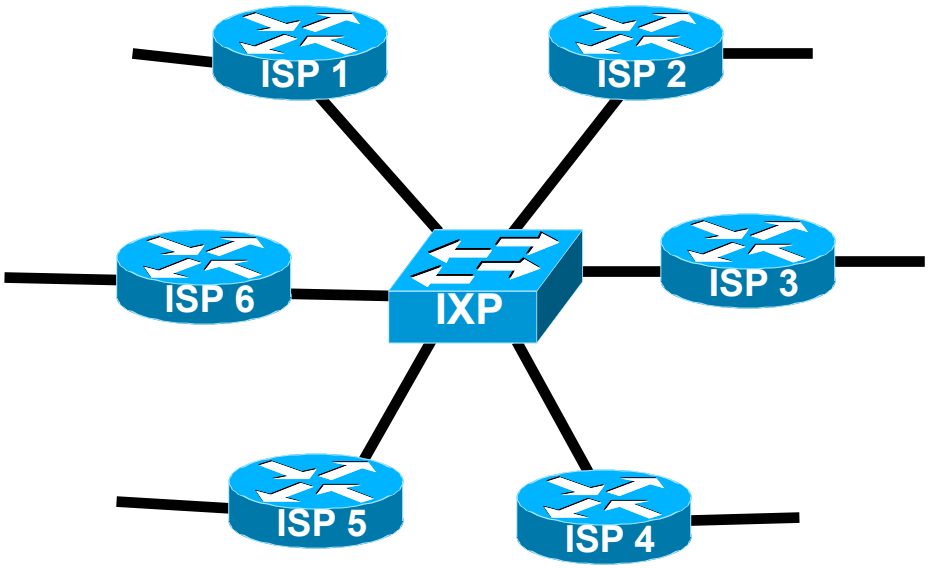
Private Interconnect

- Two ISPs connect their networks over a private link
  - Can be peering arrangement
    - No charge for traffic
    - Share cost of the link
  - Can be transit arrangement
    - One ISP charges the other for traffic
    - One ISP (the customer) pays for the link



Public Interconnect

- Several ISPs meeting in a common neutral location and interconnect their networks
  - Usually is a peering arrangement between their networks



Types of Peering (1)

- Private Peering
  - Where two network operators agree to interconnect their networks, and exchange their respective routes, for the purpose of ensuring their customers can reach each other directly over the peering link
- Settlement Free Peering
  - No traffic charges
  - **The most common form of peering**
- Paid Peering
  - Where two operators agree to exchange traffic charges for a peering relationship

Types of Peering (2)

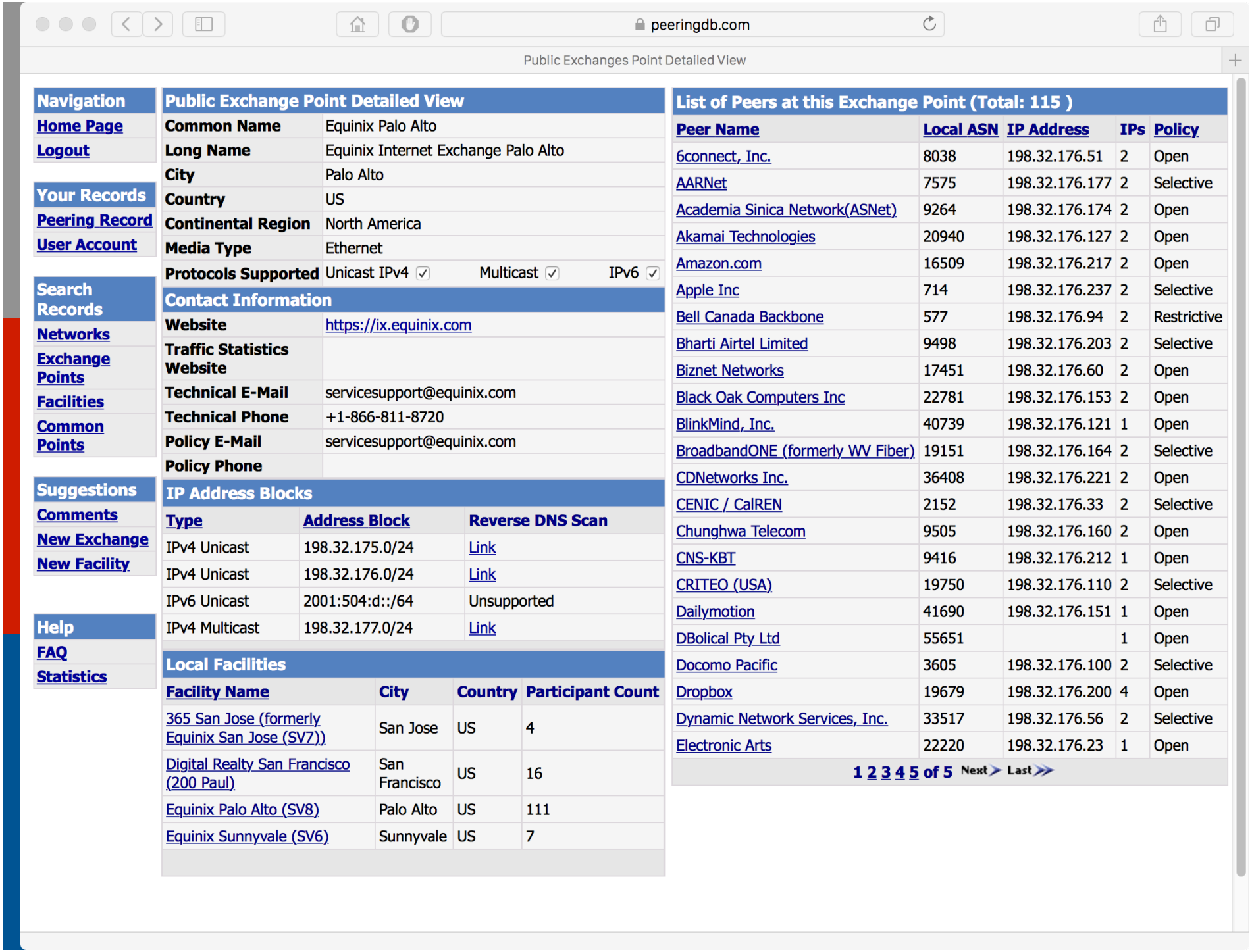
- Bi-lateral Peering
  - Very similar to Private Peering, but may take place at a public peering point (IXP)
- Multilateral Peering
  - Takes place at Internet Exchange Points, where operators all peer with each other via a Route Server
- Mandatory Multilateral Peering
  - Where operators are forced to peer with each other as condition of IXP membership
  - **Strongly discouraged: Has no record of success**

Types of Peering (3)

- Open Peering
  - Where an ISP publicly states that they will peer with all parties who approach them for peering
  - Commonly found at IXPs where ISP participates via the Route Server
- Selective Peering
  - Where an ISP's peering policy depends on the nature of the operator who requests peering with them
  - At IXPs, operator will not peer with RS but will only peer bilaterally
- Closed Peering
  - Where an ISP decides who its peering partners are, and is generally not approachable to creating peering opportunities

Types of Peering (4)

- The Peering Database documents ISPs peering policies
  - http://peeringdb.com
- All operators of ASNs should register in the peeringdb
  - All operators who are considering peering or are peering must be in the peeringdb to enhance their peering opportunities
- Participation in peering fora is encouraged too
  - Global Peering Forum (GPF)
  - Regional Peering Fora (European, Middle Eastern, Asian, Caribbean, Latin American)
  - Many countries now have their own Peering Fora



Navigation
- Home Page
- Logout

Your Records
- Peering Record
- User Account

Search Records
- Networks
- Exchange Points
- Facilities
- Common Points

Suggestions
- Comments
- New Exchange
- New Facility

Help
- FAQ
- Statistics

Public Exchange Point Detailed View

Common Name	Equinix Palo Alto
Long Name	Equinix Internet Exchange Palo Alto
City	Palo Alto
Country	US
Continental Region	North America
Media Type	Ethernet
Protocols Supported	Unicast IPv4 ☑ Multicast ☑ IPv6 ☑

Contact Information

Website	https://ix.equinix.com
Traffic Statistics Website	
Technical E-Mail	servicesupport@equinix.com
Technical Phone	+1-866-811-8720
Policy E-Mail	servicesupport@equinix.com
Policy Phone	

IP Address Blocks

Type	Address Block	Reverse DNS Scan
IPv4 Unicast	198.32.175.0/24	Link
IPv4 Unicast	198.32.176.0/24	Link
IPv6 Unicast	2001:504:d::/64	Unsupported
IPv4 Multicast	198.32.177.0/24	Link

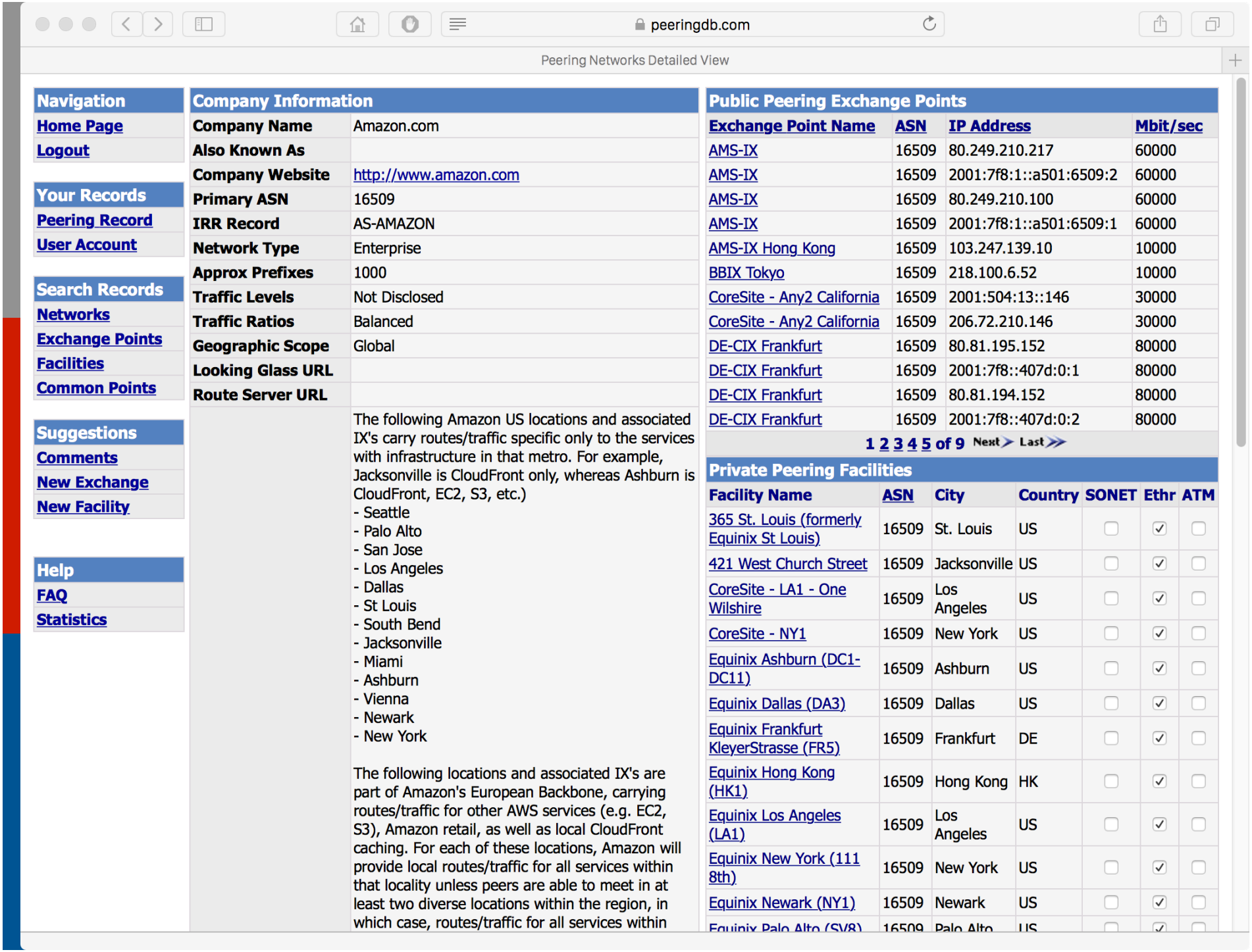
Local Facilities

Facility Name	City	Country	Participant Count
365 San Jose (formerly Equinix San Jose (SV7))	San Jose	US	4
Digital Realty San Francisco (200 Paul)	San Francisco	US	16
Equinix Palo Alto (SV8)	Palo Alto	US	111
Equinix Sunnyvale (SV6)	Sunnyvale	US	7

List of Peers at this Exchange Point (Total: 115)

Peer Name	Local ASN	IP Address	IPs	Policy
6connect, Inc.	8038	198.32.176.51	2	Open
AARNet	7575	198.32.176.177	2	Selective
Academia Sinica Network(ASNet)	9264	198.32.176.174	2	Open
Akamai Technologies	20940	198.32.176.127	2	Open
Amazon.com	16509	198.32.176.217	2	Open
Apple Inc	714	198.32.176.237	2	Selective
Bell Canada Backbone	577	198.32.176.94	2	Restrictive
Bharti Airtel Limited	9498	198.32.176.203	2	Selective
Biznet Networks	17451	198.32.176.60	2	Open
Black Oak Computers Inc	22781	198.32.176.153	2	Open
BlinkMind, Inc.	40739	198.32.176.121	1	Open
BroadbandONE (formerly WV Fiber)	19151	198.32.176.164	2	Selective
CDNetworks Inc.	36408	198.32.176.221	2	Open
CENIC / CalREN	2152	198.32.176.33	2	Selective
Chunghwa Telecom	9505	198.32.176.160	2	Open
CNS-KBT	9416	198.32.176.212	1	Open
CRITEO (USA)	19750	198.32.176.110	2	Selective
Dailymotion	41690	198.32.176.151	1	Open
DBolical Pty Ltd	55651		1	Open
Docomo Pacific	3605	198.32.176.100	2	Selective
Dropbox	19679	198.32.176.200	4	Open
Dynamic Network Services, Inc.	33517	198.32.176.56	2	Selective
Electronic Arts	22220	198.32.176.23	1	Open

1 2 3 4 5 of 5 Next > Last >>


peeringdb.com
Peering Networks Detailed View
Navigation
Home Page
Logout
Your Records
Peering Record
User Account
Search Records
Networks
Exchange Points
Facilities
Common Points
Suggestions
Comments
New Exchange
New Facility
Help
FAQ
Statistics
Company Information
Company Name Amazon.com
Also Known As
Company Website http://www.amazon.com
Primary ASN 16509
IRR Record AS-AMAZON
Network Type Enterprise
Approx Prefixes 1000
Traffic Levels Not Disclosed
Traffic Ratios Balanced
Geographic Scope Global
Looking Glass URL
Route Server URL
The following Amazon US locations and associated IX's carry routes/traffic specific only to the services with infrastructure in that metro. For example, Jacksonville is CloudFront only, whereas Ashburn is CloudFront, EC2, S3, etc.)
- Seattle
- Palo Alto
- San Jose
- Los Angeles
- Dallas
- St Louis
- South Bend
- Jacksonville
- Miami
- Ashburn
- Vienna
- Newark
- New York
The following locations and associated IX's are part of Amazon's European Backbone, carrying routes/traffic for other AWS services (e.g. EC2, S3), Amazon retail, as well as local CloudFront caching. For each of these locations, Amazon will provide local routes/traffic for all services within that locality unless peers are able to meet in at least two diverse locations within the region, in which case, routes/traffic for all services within
Public Peering Exchange Points
Exchange Point Name | ASN | IP Address | Mbit/sec
AMS-IX | 16509 | 80.249.210.217 | 60000
AMS-IX | 16509 | 2001:7f8:1::a501:6509:2 | 60000
AMS-IX | 16509 | 80.249.210.100 | 60000
AMS-IX | 16509 | 2001:7f8:1::a501:6509:1 | 60000
AMS-IX Hong Kong | 16509 | 103.247.139.10 | 10000
BBIX Tokyo | 16509 | 218.100.6.52 | 10000
CoreSite - Any2 California | 16509 | 2001:504:13::146 | 30000
CoreSite - Any2 California | 16509 | 206.72.210.146 | 30000
DE-CIX Frankfurt | 16509 | 80.81.195.152 | 80000
DE-CIX Frankfurt | 16509 | 2001:7f8::407d:0:1 | 80000
DE-CIX Frankfurt | 16509 | 80.81.194.152 | 80000
DE-CIX Frankfurt | 16509 | 2001:7f8::407d:0:2 | 80000
1 2 3 4 5 of 9 Next > Last >>
Private Peering Facilities
Facility Name | ASN | City | Country | SONET | Ethr | ATM
365 St. Louis (formerly Equinix St Louis) | 16509 | St. Louis | US | ☐ | ☑ | ☐
421 West Church Street | 16509 | Jacksonville | US | ☐ | ☑ | ☐
CoreSite - LA1 - One Wilshire | 16509 | Los Angeles | US | ☐ | ☑ | ☐
CoreSite - NY1 | 16509 | New York | US | ☐ | ☑ | ☐
Equinix Ashburn (DC1-DC11) | 16509 | Ashburn | US | ☐ | ☑ | ☐
Equinix Dallas (DA3) | 16509 | Dallas | US | ☐ | ☑ | ☐
Equinix Frankfurt KleyerStrasse (FR5) | 16509 | Frankfurt | DE | ☐ | ☑ | ☐
Equinix Hong Kong (HK1) | 16509 | Hong Kong | HK | ☐ | ☑ | ☐
Equinix Los Angeles (LA1) | 16509 | Los Angeles | US | ☐ | ☑ | ☐
Equinix New York (111 8th) | 16509 | New York | US | ☐ | ☑ | ☐
Equinix Newark (NY1) | 16509 | Newark | US | ☐ | ☑ | ☐
Equinix Palo Alto (SV8) | 16509 | Palo Alto | US | ☐ | ☑ | ☐

ISP Goals

- Minimise the cost of operating the business
- Transit
  - ISP has to pay for circuit (international or domestic)
  - ISP has to pay for data (usually per Mbps)
  - Repeat for each transit provider
  - Significant cost of being a service provider
- Peering
  - ISP shares circuit cost with peer (private) or runs circuit to public peering point (one off cost)
  - No need to pay for data
  - Reduces transit data volume, therefore reducing cost

Transit – How it works

- Access provider provides Internet access for the region they serve
  - How do their customers get access to the rest of the Internet?
- Provider buys access from one, two or more larger ISPs who already have visibility of the rest of the Internet
  - This is transit – they pay for the physical connection to the upstreams and for the traffic volume on the link

Peering – How it works

- If two ISPs are of equivalent sizes, they have:
  - Equivalent network infrastructure coverage
  - Equivalent customer size
  - Similar content volumes to be shared with the Internet
  - Potentially similar traffic flows to each other's networks
- This makes them good peering partners
- If they don't peer
  - They both have to pay an upstream provider for access to each other's network/customers/content
  - Upstream benefits from this arrangement, the two ISPs both have to fund the transit costs

The IXP's role

- Private peering makes sense when there are very few equivalent players
  - Connecting to one other ISP costs X
  - Connecting to two other ISPs costs 2 times X
  - Connecting to three other ISPs costs 3 times X
  - Etc… (where X is half the circuit cost plus a port cost)
- The more private peers, the greater the cost
- IXP is a more scalable solution to this problem

The IXP's role

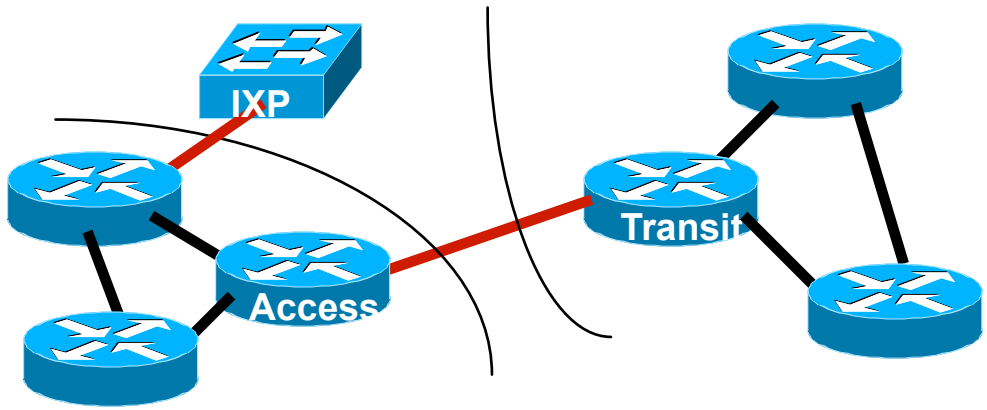
- Connecting to an IXP
  - ISP costs: one router port, one circuit, and one router to locate at the IXP
- Some IXPs charge annual "maintenance fees"
  - The maintenance fee has potential to significantly influence the cost balance for an ISP
- Generally connecting to an IXP and peering there becomes cost effective when there are at least three other peers
  - The real $ amount varies from region to region, IXP to IXP

Who peers at an IXP?

- Everyone!
  - As long as the network operator has their own address space, own AS number, and own transit arrangements
- This includes:
  - Access Providers
  - Regional Providers
  - Content Providers
  - Root, ccTLD and gTLD operators
  - …

The IXP's role

- Global Providers can be located close to IXPs
  - Attracted by the potential transit business available
- Advantageous for access & regional providers
  - They can peer with other similar providers at the IXP
  - And in the same facility pay for transit to their regional or global provider
  - (Not across the IXP fabric, but a separate connection)



Connectivity Decisions

- Transit
  - Almost every ISP needs transit to reach rest of Internet
  - One provider = no redundancy
  - Two providers: ideal for traffic engineering as well as redundancy
  - Three providers = better redundancy, traffic engineering gets harder
  - More then three = diminishing returns, rapidly escalating costs and complexity
- Peering
  - Means low (or zero) cost access to another network
  - Private or Public Peering (or both)

Transit Goals

1. Minimise number of transit providers
   - But maintain redundancy
   - 2 is ideal, 4 or more is hard
2. Aggregate capacity to transit providers
   - More aggregated capacity means better value
     - Lower cost per Mbps
   - 4x 155Mbps circuits to 4 different ISPs will almost always cost more than 2x 622Mbps circuits to 2 different ISPs
     - Yet bandwidth of latter (1240Mbps) is greater than that of former (620Mbps) and is much easier to operate

Peering or Transit?

- How to choose?
- Or do both?
- It comes down to cost of going to an IXP
  - Free peering
  - Paying for transit from an ISP co-located in same facility, or perhaps close by
- Or not going to an IXP and paying for the cost of transit directly to an upstream provider
  - There is no right or wrong answer, someone has to do the arithmetic

Private or Public Peering

- Private peering
  - Scaling issue, with costs, number of providers, and infrastructure provisioning
- Public peering
  - Makes sense the more potential peers there are (more is usually greater than "two")
- Which public peering point?
  - Local Internet Exchange Point: great for local traffic and local peers
  - Regional Internet Exchange Point: great for meeting peers outside the locality, might be cheaper than paying transit to reach the same consumer base

Local Internet Exchange Point

- An open neutral interconnect point serving the local Internet industry
- "Local" means where it becomes cheaper to interconnect with other ISPs at a common location than it is to pay transit to another ISP to reach the same consumer base
  - Local can mean different things in different regions!

Regional Internet Exchange Point

- These are also “local” Internet Exchange Points
- But also attract regional ISPs and ISPs from outside the locality
  - Regional ISPs peer with each other
  - And show up at several of these Regional IXPs
- Local ISPs peer with ISPs from outside the locality
  - They don’t compete in each other’s markets
  - Local ISPs don’t have to pay transit costs
  - ISPs from outside the locality don’t have to pay transit costs
  - Quite often ISPs of disparate sizes and influences will happily peer – to defray transit costs

Value propositions

- Peering at a local IXP
  - Reduces latency & transit costs for local traffic
  - Improves Internet quality perception
- Participating at a Regional IXP
  - A means of offsetting transit costs
- Managing connection back to home network
- Improving Internet Quality perception for customers

Summary

- Benefits of peering
  - Private
  - Internet Exchange Points
- Local versus Regional IXPs
  - Local services local traffic
  - Regional helps defray transit costs