Peering Costs and Benefits

Document History

Version	Date Updated	Updated By	Comments
1.0	Nov 2013	James Bensley	First draft
1.1	Jan 2014	James Bensley	Expanded glossary, corrected typos
1.2	March 2015	James Bensley	Expanded glossary, additional explanations added, corrected typos and grammatical errors
1.3	April 2015	James Bensley	Expanded glossary, expanded advantages and disadvantages, corrected typos and grammatical errors
1.4	August 2015	James Bensley	Expanded advantages and disadvantages, added references

Document Distribution

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Glossary

AS/ASN	Autonomous System – A connected group of one or more IP prefixes operated under a single routing policy
CDR	Committed Data Rate - A average usage guaranteed to a customer by an ISP on a link, that should always be available during normal operations
CGNAT	Carrier Grade Network Address Translation - An approach to IPv4 network design in which end sites are configured with private network addresses that are translated to public IPv4 addresses by middlebox network address translator devices embedded in the network operator's network, permitting the sharing of small pools of public addresses among many end sites
DFZ	Default Free Zone - In the context of Internet routing the collection of all Internet autonomous systems that do not require a default route to route a packet to any destination on the Internet
DSI	Deep Packet Inspection - A form of computer network packet filtering that examines the data part (and possibly also the header) of a packet as it passes an inspection point, searching for criteria to decide whether the packet may pass or if it needs to be routed through a bespoke network path
IX/IXP	Internet Exchange Point – Used interchangeably with the phrase "peering LAN" throughout, a network infrastructure that allows multiple ASes to exchange routing information and traffic
Multilateral	Multilateral peering is the act of using router servers to allow each peering AS to maintain only one peering session but receive all member advertised routes
NDA	Non-Disclosure Agreement - A legal contract between at least two parties that outlines confidential material, knowledge, or

	information that the parties wish to share with one another for certain purposes, but wish to restrict access to or by third parties.
Peering	The process of two or more ASes exchanging routing information over a physical connection between both parties and through that information exchange the exchange of traffic
RFI	Request for Information - A standard business process whose purpose is to collect written information about the capabilities of various suppliers
RFP	Request for Proposal - A solicitation often made through a bidding process by an agency or company interested in procurement of a commodity, service or valuable asset, to potential suppliers to submit business proposals
RFQ	Request for Quotation - A standard business process whose purpose is to invite suppliers into a bidding process to bid on specific products or services
TE	Traffic Engineering – The act of predicting, planning and steering telecommunications traffic to improve connectivity quality

1. Introduction

This document describes the advantages and disadvantages of settlement-free peering (traffic peering for which neither party pays the other for traffic exchanged, only when sharing any cost of physical connectivity infrastructure requirements e.g. cross-connects) against those of paid-for transit services. Settlement free peering considerations throughout this document are made in comparison to either a comparative property of paid-for transit or paid-for peering agreements.

This document does not provide a definitive list of the advantages and disadvantages of peering, nor a definitive list of the processes and costs involved for an ISP embarking on their first step into the world of settlement free peering. Its purpose is to be an open document that provides a view on the minimum effort required from an ISP so that they can evaluate for them selves if peering is useful and viable for them.

2. Advantages and disadvantages of peering

Network peering has various advantages and disadvantages with some existing only in specific peering scenarios. These context specific advantages and disadvantages that relate to peering agreements or transit contracts for example may only be a factor when the objectives of a peering agreement define it. Table 2.1 below attempts to lists all peering advantages and Table 2.2 below attempts to lists all peering disadvantages, neither lists are specific to every peering and transit agreement scenarios;

Table 2.1: Peering advantages

Area of Improvement	**Peering Advantage**	**Comments**
Transit		
	Can be cheaper than transit (£-Mbps)	When (multi-lateral) peering traffic levels are high enough to outweigh transit cost per-Mbps + peering fees (such as IXP membership cost).
	Can reduce ongoing transit costs	Fewer transit providers are required as IXP (multi-lateral peering) connectivity is increased and lower transit CDRs are required. Future growth is cheaper if major source/destination ASes are present at IXP (IXP ports are typically cheaper than transit ports and IXP CDRs are also typically cheaper than transit CDRs £-Mbps, private peering is often even cheaper than public IXP peering).
	New peer set up cost is often lower than new transit set up	When peering over a peering LAN (IXP) new peering relationships have minimal infrastructure cost and increase the ROI on existing IXP connections and hardware (router memory used for BGP, engineering overhead of configuration, NMS reporting etc).
	Lower transit provider significance	More peering and less transit moves negotiation power towards the ISP and away from the transit provider, as the ISP becomes less reliant on the transit provider(s).

Engineering and Operations		
	Improved troubleshooting	Direct NOC to NOC relationship for inter-AS connectivity issues. Typically direct a point of contact and direct escalation paths can be agreed upon. Issues between directly connected ASes are faster and easier to diagnose than through an intermediary transit providers. The IXPs them selves often offer traffic stats such as sFlow and port-to-port matrix traffic graphs.
	Peering can improve routing control (Traffic Engineering)	Traffic is exchanged directly between ASes, transit is usually "all or nothing" to meet a commit rate. IXP peering allows AS egress/ingress traffic monitoring and (re)routing accordingly.
	Peering can lower latency and congestion	Lower latency can be achieved by adding additional direct peering connectivity. Shorter paths mean congestion becomes easier to identify and more important to mitigate, especially at IXPs. Access providers and content providers are closer together.
	Traffic can be managed regionally	The use of regional IXPs allows latency and congestion to be managed locally (where regional IXP connectivity is available separate to IXPs operating at a national level) which can also prevent traffic "trombone" routing often encountered through transit providers.
	Peering can improve security	Improved ingress/egress DDoS mitigation granularity. Trusted routing initiatives between ASes (for example: http://goo.gl/cixDcL and https://goo.gl/GhTahw). Removes 1 port == 1 SPoF model with transit. Traffic bypasses transit filters, CGNAT, DPI et al. of larger transit providers.
	Additional logical paths between AS	Peering provides additional paths between each AS peered, in addition to those already provided between them through a transit provider, usually into separate parts of the peers network.

	Additional physical paths between AS	Some peering LANs offer the ability to set up VLANs between peers doubling-up the IXP LAN as a private LAN between those peers. This allows for direct service interconnects and NNIs between peers.
	Remove political issues from the data path	Disputes occur between major tier 1 carriers and between governments that have resulted major in traffic issues going unresolved for long periods of time (such as neither party agreeing to pay to upgraded a congested interconnect). Peering in multiple regions or countries can resolve this or by using remote IX services. IXPs often have processes in place to protect their members from unresolved political or technical issues that arise between two or more participating members at the LAN.
	Gain visibility of exchange outages	ISPs not currently peering are likely having their traffic carried to an exchange by their transit provider. During exchange issues the ISP has no visibility of this.
Sales, Marketing and Relations		
	Marketable resource	Peering is a popular requirement on RFP/RFI/RFQs and a marketable resource.
	Upgrade from Tier III to Tier II transit offering	ISPs can sell transit as a Tier II service rather than Tier III (assuming the ISP uses Tier 1 carriers + peering).
	Industry community presence	Peering increases the company presence within the industry community.
	Value added services	IXP memberships often comes with additional benefits such as conferences and meet-ups (both social and professional), meeting rooms for hire, wholesale services like colocation which are free or heavily discounted to members, technical resources such as stratum 0 NTP servers and DNS root servers, AS112 access, and many more.
	IXP members services	Some IXPs compile and provide a list of

	catalog	the services their members offer. When discussions arise from their members, customers, suppliers or partners about where to buy a specific service the IXP will refer a member first and foremost generate sales opportunities for the members.

Table 2.2: Peering disadvantages

Area of Deterioration	**Disadvantage**	**Comments**
Transit		
	Non-transitive connectivity	Transit providers aim to provide full global routing table visibility, peering is (usually) single AS connectivity (a peer may advertise downstream ASes over an IXP).
	Higher capex cost	Peering can incur a higher capex cost than transit (10G ports aren't dirt cheap, yet, it's easier to gaurentee and achieve high utilisation over a port used for transit the peering (percentage of all Internet routes available via the router port is lower with public peering, further with private peering).
	Can be harder to achieve ROI	Large volumes of traffic exchange are required for cost effectiveness (private peering typically requires a larger volume of traffic exchange than public peering unless it is subsidised).
	Can be cheaper than peering (£-Mbps)	If the ISP can take a large transit connection with a high commit rate transit can be very cheap per Mbps which can be hard to mach via peering (unless the ISP can peer with it's top destination AS's by volume).
Engineering and Operations		
	Administration overhead	Initial overhead of administrative work is high, there is often an initial influx of peering arrangements to set up. Ongoing administration becomes an additional responsibility that needs delegating.
	Agreement compliance	Agreements with traffic ratio requirements or multiple peering point requirements will need ongoing compliance monitoring.
Sales, Marketing and Relations		
	None are currently known	N/A

3. Peering objective and aims

The following business objective defines the peering requirement for a typical ISP:

> Provide year on year improvements to the ingress and egress connectivity quality and capacity of the network, to benefit the network customers and investors.

This objective is comprised from the below list of aims expected to be achieved in a typical public peering environment using bi- and/or multi-lateral peering as found at a typically Internet Exchange Point. Together they form a detailed description of the overall objective above and a list of tangible benefits an ISP can create commercial milestones against to measure the positive business impact from peering:

- **Increase marketable assets**: Peering can be a highly desirable and marketable credential for an ISP.

- **Improve industry social image**: Increase the presence of the local AS and company image within the industry community.

- **Improve path quality**: Shorter network paths with lower latency, packet loss and congestion to improve the flow of traffic in and out of the local AS.

- **Reduce transit commitments**: As the local AS sends and receives more traffic via settlement free peering agreements (or cost neutral private peering agreements), a lower commit rate can be negotiated with transit providers.

- **Reduce troubleshooting overhead**: Troubleshooting ingress and egress connectivity to remote ASes becomes faster and easier when directly connected to an AS.

4. Peering costs

Below is a list of expenditure required to engage in public peering. Some of the items listed are not required and may be already fulfilled by typical ISP, they are all listed for clarity;

- **Network transport**: Connectivity to a peering LAN may be reachable via internal transit (the local AS is physically connected to an IXP in PoP-A but a dedicated PE which terminates peering services in located in PoP-B) or with a mix of internal transit and 3rd party connectivity transit using remote IX services, 3rd party interconnects or reseller ports.

- **Hardware**: New hardware maybe required to join a peering LAN. Further peering LAN connections will require additional hardware for resilience depending on the business driver.

- **Software**: Software for traffic analysis could be deployed to better understand traffic distribution. This is provided by some IXPs as value add to members. This is not required to join a peering LAN although many IXPs may require the ISP to run some sort of NMS for reactive incident response.

- **Colocation**: Additional co-location maybe required for a typical ISP to join a peering LAN or additional LANs. There are often other benefits to having a PoP in a major IXP location, ISPs can often establish NNIs with access circuit providers or back-haul providers and carriers at the same locations.

- **Staffing costs**: A typical ISP will have staff with the required skill set to establish and maintain peering sessions at a peering LAN. It would be advantageous to implement an official on call rota amongst engineers if additional peering LANs are to be joint, 24x7x365 support is a requirement of many IXPs.

- **Admin/engineering overhead**: There is an induction operational overhead of configuring devices for bi and multilateral peering for the first time and configuring peering sessions with peers not using a router server. Also there is an ongoing overhead of peering session maintenance. The initial joining to an IXP would be expected to only take a moderate but not excessive amount of engineering time which will be acceptable within the current engineering time resources of a typical ISP. The ongoing overhead is expected to be low and create only a minor impact on engineering time (within the scope of normal operations).

- **Peering port**: The ISP would need to purchase a peering port at an IXP. The cost benefit for this needs to be reviewed in line with the advantages and disadvantages in Tables 1.1 and 1.2. Sometimes an IXP required the purchase of dual ports or 1 port to separate physical LANs and also sometimes dual cross-connects within the PoP are required to be purchased by the joining ISP.

- **Reseller ports**: The ISP might need purchase a reseller port to join other IXPs for example where the ISP has no existing connectivity or PoPs within those geographical areas in order to participate in regional peering at remotely locations. Reseller ports enable the ISP to remotely peer at multiple IXPs around the globe and also for the reseller to deliver transit to the ISP, all over a single port or NNI.

5. Peering procedures and requirements

The ISP should complete as much of the following list of typical procedures as is relevant before joining a peering LAN, some are optional but listed for completeness;

- Define the peering requirements for other ISPs to be able to peer with the local ISP such as a minimum traffic levels, minimum traffic ratio between peering ASes, multiple location requirements, locations of peering interconnects, types of traffic interconnect, signed agreement requirements, BGP communities available to peers, and so on.

- Define peering contact details, create a peering@ email and noc@ email account, these are industry standard mailboxes that will be expected to be in operation by many IXPs.

- 24x7x365 NOC support and call rotas must be established to support peering issues at any time (especially issues where the local AS is causing disruption to the peering LAN and its members). This is usually required for joining an IXP.

- Create a private peering agreement document that requires a signature should any peer require it for private peering interconnects or direct BGP peering sessions established separate from any IXP provided route servers (this is usually optional but it’s helpful to have prewritten).

- Create a peeringdb.com page listing an overview of the ISPs peering options and requirements, to promote peering with the ISP (this is optional but some IXPs require members to have a peeringdb.com page).

- BGP and prefix filters must be designed and configured on peering devices and on transit devices to ensure the ISP routes traffic as required and does not mix the two forms of connectivity in a manner that causes any ill effects or easily be effected by the misconfiguration of other networks (within reason, such as not advertising the IXP LAN range to upstream or downstream networks is a common practice).

- An NDA should be available to exchange should and sign should a private peering be established that uses unusual circumstances such as extending MPLS LSPs across an AS boarder that causes either peering party to become aware of private operational information regarding the other party.

- WHOIS records must be updated with AS import and export details relating to transit providers/customers and peering arrangements of the local ISP every time a new peering sessions is established. Also contact details like admin-c and tech-c, mnt records and abuse records etc should be kept up to date irrelevant of IXP requirement status.

- Optionally use an Internet Routing Registry to at least help others automate their peering and filtering updates (this maybe required to peer with some ISPs).

- Optionally deploy Resource Public Key Infrastructure to valid and secure the routing announcements you make and receive (this maybe required to peer with some ISPs in private peering sessions).

- Optionally deploy a looking glass to help other peers troubleshoot connectivity to/from their network from the local ISP network.

- Create a peering web page the provides detailed information with regards to all peering requirements and options listed above (some examples: http://www.gtt.net/peering/, http://www.level3.com/en/legal/ip-traffic-exchange-policy/, http://www.us.ntt.net/support/policy/routing.cfm, http://he.net/peering.html)

References

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MidWest Internet Exchange. Benefits of joining MidWest Internet Exchange. Available: http://www.midwest-ix.com/benefits.html. Last accessed May 2015.

William B. Norton (2014). The Internet Peering Playbook : Connecting to the Core of the Internet. USA: DrPeering Press. p*NO PAGE NUMBER* (I'm referencing the whole book because its great and the kindle version costs a couple of beers, everyone should buy it).

Info on remote peering services:

http://www.allegro.net/snappeering

http://www.ixreach.com/services/ix-remote-peering/

Appendix A: Weighing the cheese

The following metrics can be used to calculate the cost of peering to meet the individual business requirements of a typical ISP:

- **Required Bandwidth** - How much traffic the ISP intents to route via public peering
- **Peering Port Speed** - The speed at which the ISP will connect to an IX
- **Peering Port Monthly Cost** - The charge from the IX per port per month (an ISP may have to include a cross connect monthly rental in here too, or monthly payment to remote IX provider)
- **Peering Port Install Cost** - The charge from the IX to set up each port (this will vary between IXPs, include any cost of a cross connects and SFPs in here)
- **Required Port Count** - The number of ports the ISP must purchase to physically meet their bandwidth requirements
- **Desired Port Count** - The number of port the ISP desires to support a link or node failure and still maintain IX connectivity (if at all)
- **IX Monthly Membership Fee** - The charge from the IX per month
- **Total Monthly Peering Cost** - Total the ISP will pay peer month to the IX
- **Peering Cost per Mbps** - How much the ISP would pay per Mbps for peering routed traffic (only up to the Required Peering Bandwidth)
- **Transit Cost per Mbps** - How much the ISP would pay per Mbps for transit routed traffic
- **Transit Port Install Cost** - How much the ISP would pay for the cost of setting up a new transit port (this will vary by transit provider, include any cost of a cross connects and SFPs in here)
- **Transit Port Monthly Cost** - How much the ISP would pay for the transit port per month (this might include a cross connect rental or remote transit port provider fee)
- **Minimum Peering Bandwidth** - The minimum amount of bandwidth the ISP needs to route via public peering to match the cost of Transit
- **Maximum Peering Bandwidth** - The maximum amount of traffic the ISP can route via peering (some IXPs don't allow customers to have sustained high port utilisation to prevent congestion and packet loss at the exchange, 80% is used as the example below)

There are some additional fees that exist at some IXPs and not at others, and some additional considerations that some ISPs have that others don't. Below are a few examples using the above metrics however prices used are only examples, any likeness to any real IXP pricing is merely coincidence and are only meant to reasonably reflect actual market rates at the time of writing (last updated Q3 2015).

Also the examples aren't clear with regards to which option is "better", public peering or transit to highlight how dependant this is on the individual ISP.

Example 1: Mid-Sized ISP peering off 3Gbps of traffic from transit to public peering

In this example a medium sized ISP peers off 3Gbps of traffic so 10Gbps bearer ports are required and the ISP wants resiliency so the cost comparison is between dual 10Gbps peering ports to the same peering LAN and dual 10Gbps ports from the same transit provider (various transit providers these days allow an ISP so share a commit rate over multiple ports rather than having to buy a 3Gbps CDR on 2 separate ports, effectively a 6Gbps CDR).

The peering costs in this example are slightly lower than those of transit (per month) and the ISP can push 4Gbps over each peering port simultaneously because they are paying for the entire port usage rather than a specific CDR, typical of transit providers.

The ISP needs to push 2.6Gbps of traffic (total aggregate) via peering to break even with the cost of transit but 4Gbps is the maximum they can push via each link, due to the IXP restriction on consistent high port utilisation. With the transit provider the ISP can max out both ports over the agreed CDR if required and pay a "charge" for this "offence" (or overage or burst rate is usually agreed at the start of a transit contract).

The transit provider gives a full view of the global routing table however technically the ISP can push 8Gbps via each port simultaneously for a total of 16Gbps of traffic at no extra cost but as soon as one link fails the ISP would have 16Gbps of traffic flow trying to squeeze through the remaining 10Gbps link.

Required Bandwidth (Mbps) = 3,000

Required Port Speed (Mbps) = 10,000

Required Port Count = ⌈(Required Bandwidth / Required Port Speed)⌉ = 1

Desired Port Count = 2

Transit Port Install Cost = £500 + £1000 cross connect setup fee

Total Transit Install Cost = (Desired Port Count x Transit Port Install Cost) = £3000

Transit Cost per Mbps per Month (using Required Bandwidth as CDR) = £0.50

Transit Port Monthly Cost = £100 cross connect recurring fee

Total Transit Monthly Cost = (Transit Cost per Mbps x Required Bandwidth) + (Desired Port Count x Transit Port Monthly Cost) = (£0.50 x 3000) + (2 x 200) = £2,450

Peering Port Install Cost = £500 + £1000 cross connect setup fee

Total Peering Install Cost = (Desired Port Count x Peering Port Install Cost) = £3000

Peering Port Monthly Cost = £500 + £100 cross connect recurring fee

IX Monthly Membership Fee = £100

Total Monthly Peering Cost = (Desired Port Count x Peering Port Monthly Cost) + IX Monthly Membership Fee = (2 x £600) + £100 = £1300

Peering Cost per Mbps per Month = Total Monthly Peering Cost / Required Bandwidth

= £1300 / 3000 = £0.43 p/Mbps/pcm

Effective Peering Bandwidth = ⌈(Total Monthly Peering Cost / Transit Cost per Mpbs per Month)⌉ = ⌈(£1300/£0.50)⌉ = 2600 Mbps

Maximum Peering Bandwidth = Required Port Speed - (Required Port Speed / Desire Port Count) * Max Peering Port Utilisation = 10,000 - (10,000/2) * 0.8 = 4,000 Mbps

Lowest Cost per Mbps per Month = Total Monthly Peering Cost / Maximum Peering Bandwidth = £1300 / 4000 = £0.36

Example 2: Small ISP peering off up to 1Gbps of traffic from transit to public peering

In this example a small voice provider is wanting to move a steady 500Mbps of traffic to a peering LAN away from existing transit, and allow for future growth, so a 1Gbps port is required. No resiliency is required here as the ISP is happy to fall back to existing transit links in the event of a peering LAN or link failure.

The transit price per month is a lot more than the peering price in this example and for a small provider to get the most from public peering they need to peer with as many peers as possible at the IXP LAN, which isn't likely because they larger ISPs, carriers, CDNs and content providers have minimum peering requirements the small provider likely won't meet (such as minimum traffic exchange ratios).

Despite the cost difference the transit link is "easy" to make an efficient return on investment with, however the ROI for peering can be increased too. Since this small provider specialises in voice 500Mbps of voice traffic accounts for a significantly larger revenue stream than 500Mbps of customer Internet connectivity.

Some peering LANs offer private VLANs across their fabric for free or a minimal fee, some offer low-cost private interconnects between peers too. The provider could establish private peerings with upstream VOIP carriers (or downstream customers) directly over the peering LAN for an additional fee (which could be lower than the cost a new private connection or NNI with that upstream) whilst also receiving the partial view of Internet routes the IXP offers and all potentially for less than the cost of transit.

Required Bandwidth (Mbps) = 500

Required Port Speed (Mbps) = 1,000

Required Port Count = ⌈(Required Bandwidth / Required Port Speed)⌉ = 1

Desired Port Count = 1

Transit Port Install Cost = £0 + £1000 cross connect setup fee

Total Transit Install Cost = (Desired Port Count x Transit Port Install Cost) = £1000

Transit Cost per Mbps per Month (using Required Bandwidth as CDR) = £1.50

Transit Port Monthly Cost = £100 cross connect recurring fee

Total Transit Monthly Cost = (Transit Cost per Mbps x Required Bandwidth) + (Desired Port Count x Transit Port Monthly Cost) = (£1.50 x 500) + (1 x £100) = £850

Peering Port Install Cost = £0 + £1000 cross connect setup fee

Total Peering Install Cost = (Desired Port Count x Peering Port Install Cost) = £1000

Peering Port Monthly Cost = £100 + £100 cross connect recurring fee

IX Monthly Membership Fee = £100

Total Monthly Peering Cost = (Desired Port Count x Peering Port Monthly Cost) + Monthly Membership Fee = (1 x £100) + £100 = £200

Peering Cost per Mbps per Month = Total Monthly Peering Cost / Required Bandwidth = £200 / 500 = £0.4 p/Mbps/pcm

Effective Peering Bandwidth = ⌈(Total Monthly Peering Cost / Transit Cost per Mpbs per Month)⌉ = ⌈(£200/£1.50)⌉ = 134 Mbps

Maximum Peering Bandwidth = Required Port Speed * Max Peering Port Utilisation = 1,000 * 0.8 = 800 Mbps

Lowest Cost per Mbps per Month = Total Monthly Peering Cost / Maximum Peering Bandwidth = £200 / 800 = £0.25