

Internet Exchange Points (IXPs)

The benefits of establishing an IXP depend on amount of traffic and costs of intra-IXP network connections.

THE INTERNET is a 'network of networks', currently comprising some 42,000 discrete networks. The way in which these networks interconnect and exchange traffic is fundamental in shaping the Internet as we know it. The network architecture and web of commercial peering and transit agreements for traffic ultimately determine our ability as end-users to access, exchange and receive content, email and other Internet traffic, including social media and video on-demand.¹ Indeed, today, the way in which an IXP is managed can impact an entire region's Internet economy.²

IXPs are a key locale for interconnection and exchange of traffic – technical facilities where all Internet players interconnect directly with each other. Such exchange points enable the local peering of domestic traffic, reduce the number of network hops to exchange traffic, increase the number of route options available, optimize use of international Internet connectivity, improve network resilience (and potentially quality of service), reduce transmission costs and may increase Internet penetration and usage over the long-term. Operators and ISPs can benefit from reduced international capacity costs (in millions of dollars per year).

Most policy-makers agree that an IXP is a national asset conferring many benefits.³ According to Packet Clearing House, to date, 95 countries have established IXPs, while 104 countries did not yet have IXPs by January 2013⁴ (mostly developing countries and LDCs – see [»](#))

1 Traffic shaping practices or the way in which operators manage their network traffic influence our ability to access applications and content.

2 "A primer on IXPs for policy-makers and Non-Engineers", Google, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2128103

3 See, for example, "Study on international Internet connectivity in sub-Saharan Africa", ITU (forthcoming), and "Study on international Internet connectivity in Latin America and the Caribbean" (ITU, forthcoming).

4 <https://prefix.pch.net/applications/ixpdir/summary/>



Figure 1). The benefits of establishing an IXP depend on amount of traffic and costs of intra-IXP network connections (versus the cost of upstream Internet cloud connectivity), while the absence of an IXP depends on awareness of their mutual benefits, and potentially the lack of open, competitive telecom and Internet markets.⁵

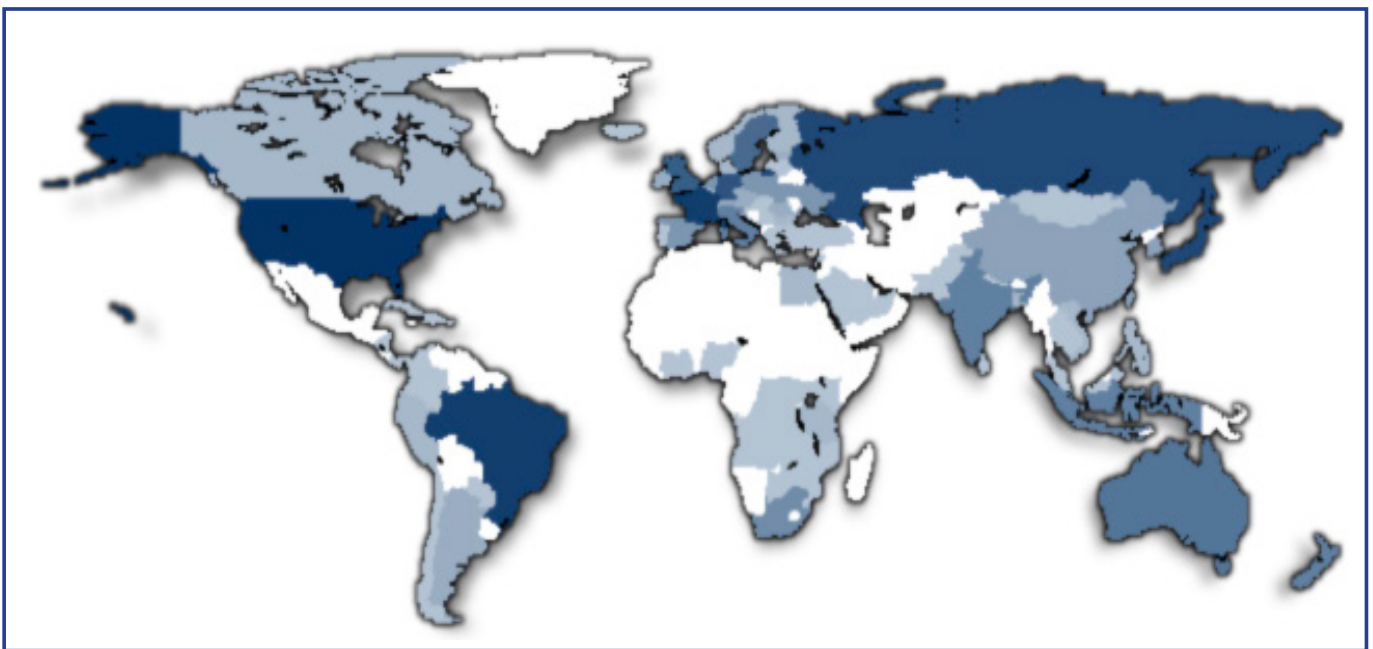


Figure 1:
Density distribution
of Internet
Exchange Points
(darker blue denotes
higher density)

Source: Packet Clearing House
Report on IXP Locations, at:
[https://prefix.pch.net/applications/
ixpdir/summary/](https://prefix.pch.net/applications/ixpdir/summary/)

There were 376 IXPs globally by January 2013, up by 3% from 266 in January 2012.⁶ Nine countries have more than ten national IXPs, including: U.S. (84), Brazil and France (19), Japan and Russian Federation (16), Germany (14), UK (13), Sweden (12), and Australia (11).⁷ Approximately a quarter (93 IXPs or 26%) of all IXPs have IPv6 subnets.⁸ The number of African countries with IXPs has increased from 15 in 2008⁹ to 18¹⁰ by 2013, despite their early growth and the recent explosion in submarine cable connections.

There is no “ideal” model for an IXP since market, cultural, and legal conditions vary widely and the “business” of IXPs varies widely across geographies and cultures.¹¹ Many IXPs begin by collaborative agreement between ISPs, but their subsequent success depends on



⁵ Jensen, Mike (2009). Promoting the Use of Internet Exchange Points: A Guide to Policy, Management, and Technical Issues. ISOC

⁶ <https://prefix.pch.net/applications/ixpdir/summary/growth/>

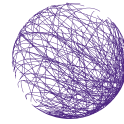
⁷ <https://prefix.pch.net/applications/ixpdir/summary/growth/>

⁸ <https://prefix.pch.net/applications/ixpdir/summary/ipv6/>

⁹ “Overview of African IXPs”, ISOC, 2008, at: http://www.isoc.org/isoc/conferences/inet/08/docs/inet2008_mwangi.pdf

¹⁰ <https://prefix.pch.net/applications/ixpdir/summary/>

¹¹ “A primer on IXPs for policy-makers and Non-Engineers”, Google, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2128103



Tromboning the Web

In many developing countries (or early on in the evolution of the Internet in a country), many ISPs find it (or found it) cost-effective to use international Internet connections to exchange domestic traffic (what is variously referred to as ‘the hotmail problem’ or the process of ‘tromboning’), rather than negotiate separate exchange and peering agreements with other ISPs. However, the use of international capacity for domestic traffic is very expensive (especially where traffic imbalances or asymmetric traffic exchanges exist). The exchange of domestic traffic locally (via peering agreements) means that cost savings can be achieved through more economical use of international Internet transit mainly for international traffic.



the goodwill and ability of ISPs (which may be in competition) to cooperate in their use of shared infrastructure¹². IXPs differ in:

- Their membership policies (open, closed, semi-open in terms of who can become a member – licensed ISPs only, or other players)
- Connectivity arrangements (amount of bandwidth, network technologies employed)
- Peering arrangements (bilateral peering, mandatory multilateral peering or both)
- Character (e.g. commercial, not-for-profit, academic etc.), fee structure and sustainability
- Degree of government involvement and/or peering
- Services (basic peering, MRTG services, looking glass, root servers, FTP mirrors, IPv6-enabled)

Local institutions and economic sectors may need to incorporate the IXPs into their delivery of services (eg. the revenue authority in Kenya, or the educational and banking sectors in Nigeria¹³). Considering this wide variety of differentiating parameters, experts advise that governments should not prescribe IXP governance models, as it is difficult to pick *a priori* the best model for a country.

Regional interconnection has generally proven more complex than national IXP interconnection. Depending on market conditions, the costs of regional IXPs may exceed their benefits for ISPs, especially where a new regional IXP is brought into in competition with ISPs (ISOC, 2010¹⁴). Policy-makers may not always grasp the issues involved, while regulatory involvement has caused problems in some cases. A move for mandatory disclosure in Chile for the routes of all ISPs connected to one IXP to other ISPs connecting at other exchanges proved problematic, as it removed the incentives for ISPs to expand their connections beyond a single exchange, and ultimately for the market to grow (Southwood, 2005). In contrast, Southwood suggests mandatory interconnection of IXPs in India might have inhibited Internet growth¹⁵.

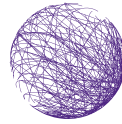


¹² Sam Paltridge et al., “Internet Governance Forum 2007 Best Practices Report”, ISOC, March 2009, <http://goo.gl/707ag>

¹³ “Assessment of the Impact of IXPs”, Michael Kende, Charles Hurpy, ISOC, April 2012, available from: <http://www.internetsociety.org/sites/default/files/Assessment%20of%20the%20impact%20of%20Internet%20Exchange%20Points%20%E2%80%93%20empirical%20study%20of%20Kenya%20and%20Nigeria.pdf>.

¹⁴ “African Peering and Interconnection Forum: Summary of Proceedings,” Internet Society, 2010, <http://goo.gl/UKXLK>

¹⁵ Ibid.



Given the growth in demand and Internet traffic for bandwidth-hungry services and latency-sensitive traffic, the benefits of IXPs and local exchange of traffic are growing.



Given the growth in demand and Internet traffic for bandwidth-hungry services (eg. video) and latency-sensitive traffic (eg. VoIP – see Cisco, 2013¹⁶), the benefits of IXPs and local exchange of traffic are growing. It is in this spirit, and in view of this evidence, that the World Telecommunication/ICT Policy Forum (WTPF) 2013 presents its draft opinion on [Promoting IXPs as a long term solution to advance connectivity](#).

¹⁶ Cisco Virtual Networking Index, March 2013.

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