



IXL LIVERPOOL

The Liverpool Internet Exchange

IX Liverpool (IXL) Board Meeting Minutes 7th Dec 2017 @ 4:30pm at Baltic Creative

Present:

Prof. Matt Wilson, Chairman (MW)
Mark Fisher, Volunteer (MF)
David Parr, Independent Director (DP) (remotely)
Mr Iain Bennett, (IB)

Several members of the public as observers.

Apologies :

Liam Givens, Technical Director (LNG)
Dr. Simon Holgate, Member Nominated Director (Sea Level Research) (SH)

Start

MW welcomed everyone to the meeting and thanked Baltic Creative for the use of the board room while reminding those present that all meetings are open to members of the public should they wish to attend and later contribute to a Q&A towards the end.

Telecoms Cloud have sponsored the costs of this meeting including food and beverages.

The board reviewed minutes from the last session.

MW welcomed new members, MGISS & Baltic Broadband (BB) to the exchange.

MGISS provide geospatial solutions and services that help businesses capture, analyse and visualise spatial data with intelligent asset management software and hardware mapping solutions who is wanting to join to peer locally.

Baltic Broadband is a startup wireless internet provider based in Liverpool that is owned and ran by MW.

Liverpool Community Grid(LCG) updates - LNG had given the board an update as to the Aimes node, confirming that is has now gone live. MW thanked LNG for his time and that we would be reorganising the entire LCG project now that it is expanding at a good pace.

MW thanked local business MICT for their donation of 87 computers for the LCG project. MF confirmed that he has assembled a team of volunteers to refurbish these and put this into production use for LCG early on in the new year.

MF said it would be advantageous to obtain some donated rack servers as well as desktops, but said that the project had been well received with many people approaching him to enquire about the project.

MW gave the board an update around the LCC fibre which has been a contentious issue for some time and that the council has previously appeared to ignore IXL and our suggestions to keep the LCC ducts in public/not for profit ownership so to use as an access network. MW confirmed that LCC has now halted the sale of the fibre and that they had been in touch to meet with IXL shortly.

MW updated the board about his meetings with LINX, and that he is in talks with them about coming up to Liverpool with a team of people early 2018 and that they remain committed to helping IXL and that they intend to make a significant donation of equipment to help the DC01 project in 2018.

The board discussed the UKNOF meeting that never went ahead in Liverpool sadly, instead it was hosted in Sheffield.

MW said that DP is performing the newly appointed financial director & company secretary role well and has full access to bank accounts including handling the payments from members. It has been agreed that DP will take on the company administration and conformance from MW from the date of this meeting.

MW said that there has been no response from Wirral Council which is disappointing despite meetings with them and MW and LNG earlier in the year.

MW welcomed Mark Fisher as new volunteer who joined in October and Liam Rice and Martin Gee who both joined in November.

MW announced that LNG will be stepping down on January 28th as Technical Director, completing his 1 year term as agreed. MW proposed Mark Fisher to be appointed as Technical Director from Jan 29th 2018 and he received no objections and as such Mark Fisher was appointed as Technical Director of IX Liverpool.

MF and MW gave an update on the progress of the data centre DC01 project whilst also confirming that both members Telecoms Cloud and Baltic Broadband (BB) have reserved space in DC01 for their network equipment and encouraged more members to consider use of the new data centre once it goes live.

MW explained that it could be the first World's First Internet Exchange built within a shipping container and is hoping that he will be giving a presentation about the DC01 at Linx100 conference in London in February 2018.

MW thanked suppliers who have been very kind and donated collectively around £40,000 of equipment and services to IXL, as follows:

Baltic Creative C.I.C (donated land and power), GAP Containers Limited (Container and fit out), Envirocool Limited (Air Conditioning unit, install and maintenance), Firwood Timber & Plywood Co Limited (Timber and Insulation), Phoenix Safe Company Limited (Communications Rack), MICT Gold Limited (Computer Servers), MGISS Limited (computer servers and UPS), Crosby Systems Limited (metal Floor Plate) and Telecoms Cloud Limited (main rack, UPS and Servers)

MF also thanked the above companies and said that IXL are very grateful for what they have provided to us.

MF asked about the power supply connections to DC01 and was concerned about the cost and queried the quotations received for the installation, which was debated by the board and it was decided that DC01 was unable to go live until the funds has been raised. MF explained that the go live date for DC01 could be March 2018.

DP expressed concerns regarding the costs of DC01 and the lack of capital IXL actually has in order to commission such large projects, reminding the team that not everything can be paid for by voluntary donations.

MW explained that he has a meeting scheduled with the Liverpool LEP later on in the month concerning help with raising of funds for DC01, however small, and would update the board as to the outcome of this.

The board debated the value of partnering with new member BB for the provision of a 10GB fibre to Telehouse North and Williams House Manchester data centres in order to access both LINX and Manchester Internet Exchanges. It was agreed that IXL and BB would enter into a partnership to share the 10GB circuit, with BB paying all of the costs to do so in the first instance with IXL paying a share of the install cost and monthly fee's at a later date once members join and begin using it. It was acknowledged that BB's contribution in financing the circuit would help IXL greatly for the future.

It was also noted that as part of the partnership between IXL and BB, that BB would allow use of its radio network across the city so that IXL could connect up the various nodes that it has planned in the future, such as the Wirral, Sefton and the planned DC02 project that is scheduled for later on in 2018 in the Fabric District, allowing members to connect and peer at one or more locations for better resilience and redundancy as well as lowering the cost for future members who cannot afford or justify the costs to bring fibre directly into the DC01 facility.

MW updated the board regarding conversations with LINX regarding the various reseller programs and partner services that they offer, and that there would not be any charge for IXL to offer remote peering for IXL's members. MW said that from March 2018, IXL will begin to offer members the ability to remotely peer at LINX and IXL using the 10GB fibre that will be installed.

MW explained that he held meetings with Megaport last month and are in talks about a partnership to offer various layer 2 services such as direct connections to Amazon Web Services, Salesforce.com, SAP, Oracle and IBM BlueMix at IXL.

MF stated that he is looking forward to edge cache providers such as Netflix and Limelight networks to take a leap of faith and consider IXL as a possible location for co-location, especially once DC01 goes live in early 2018.

MW confirmed that BB is happy to offer all new members to the exchange for the next 12 months free IP addresses and IP transit free of charge in order to help encourage more networks to peer at the exchange.

MW also explained that BB is also offering members of IXL free space at Telehouse North for the same period and are happy for IXL to offer this space out generally for interested members should they need it and can offer it as one of their services in order to make things easier.

MF said he was disappointed to hear that Sensor City did not appear interested to connect at the Exchange, especially give that IXL have a dedicated Internet of Things LAN which is performing very well with the city wide LorAWAN project that went live last year and is powering many sensors and applications around the city that is used in Healthcare, Environmental monitoring and Maritime research.

MW confirmed that he had met with Sensor City several times about this and was equally disappointed that they are not going to be a member given how much synergy there is between both parties.

MF also explained that once DC01 goes live, that he wants IXL to offer a set amount of space within it for members to host single board computers to run applications, for example Raspberry PI's and Arduino computers and intends to set a fixed price of £10 per month in order to encourage participation in web, enthusiasts projects and scientific projects.

MW confirmed that talks with Metro Mayor Steve Rotherham are progressing, however is concerned that LCR appear fixated on the Transatlantic submarine cable that lands in Southport as the answer to the connectivity problems within the region. MW stated that while it will be an asset to the region, he feels that it is only part of the mix of eventual assets that the region needs but an internet exchange has to be at its core.

MW said that he has met with JISC (Janet) in regards to them joining the exchange to peer in Liverpool at some point in the future, talks of which sounded positive.

MW updated the aboard on discussions with Jon Wetherall from Onteca who has made contact with IXL regarding 5G trials within Liverpool. MW said that IXL intends to offer in the future a Peering Exchange for the interconnection of mobile networks for (3G/4G/5G) and that working with companies such as Onteca could be advantageous for encouraging 5G trials within the region.

Events Updates

MW confirmed that all of the planned talks at Sensor City have now been completed as planned, he confirmed that 218 people attended over the 4 events.

MW updated the board in regards to a joint event with IXL and the Department of Education for its T panel event and was kindly sponsored by Shop Direct.

DP said that he will be removing members from the website and from membership who have not paid by the end of the month, as there is a small amount of members who continue to not pay despite many reminders and that a small amount of members have failed to respond to him altogether.

AOB

IB introduced himself and his role as recently appointed by the city. IB explained that his role it to research and investigate connectivity within the region as part of the comprehensive digital infrastructure action plan for the primary purpose of driving transformational economic growth.

End

Next Meeting 17th May 2018 @6:30pm at The Tapestry, 68-76 Kempston St, Liverpool L3 8ET

Glossary of Terms Used

24x7

A service that has permanent availability – ‘always on’ (i.e., 24 hours a day, every day of the week); such as for a technical support service at an IXP or network operator.

A

AF-IX

African Internet Exchange Point Operators’ Association - A community of practice set up in 2013 to “provide a collaborative environment for Internet Exchange Point Operators in the African region to be able to share knowledge, experiences, and to provide support for each other.

AFRINIC

Africa Network Information Centre - One of the 5 regional Internet registries (RIRs) that provides IPv4 and IPv6 address allocation services for the African. AFRINIC, like most of the other RIRs, it has an active IXP support programme.

Anycast

Anycast is a networking strategy where the same IP address prefix is advertised from multiple locations. Users of an anycast service (such as DNS) will always connect to the closest server available.

AP-IX

Asia-Pacific Internet Exchange Point Association - Serves as a forum for Internet Exchange Points to exchange experiences. APIX members meet twice a year at the APNIC Conference and Members meeting.

APNIC

Asia Pacific Network Information Centre - One of the 5 regional Internet registries (RIRs) that provides IPv4 and IPv6 address allocation services; APNIC serves the Asia-Pacific region except for China, India, Japan, Korea, and Taiwan, Vietnam, which each have their own National Internet Registry (NIR) to handle address allocation and assignment.

ARIN

American Registry for Internet Numbers - One of the 5 regional Internet registries (RIRs) that provides IPv4 and IPv6 address allocation services. The ARIN service region includes Canada, many Caribbean and North Atlantic islands, and the United States.

ASN

Autonomous System Number - An identifying number allocated to an Autonomous System on the Internet. ASNs are a basic requirement to run a network with more than one link to the Internet and are almost always required when joining an IXP. ASNs are used in conjunction with the Border Gateway Protocol (BGP) to determine the path along which to route traffic. RIRs assign ASNs.

AUP

Acceptable Use Policy - A policy adopted up by a network operator describing the rules for using the service – most often limiting the volume of data that may be transferred over certain time period or in defining types of network abuse, such as accessing undesirable types of websites, downloading pirated media, or using the network for sending unsolicited bulk email (spam). Some IXPs provide services to support the enforcement of their member's AUPs, such as anti-spam measures.

B

Backbone

The main route of a network used as the path for transporting traffic. Also used to refer to long-distance fibre optic links, such as in 'national backbone'.

Bandwidth

A measure of the capacity of a communications channel to transfer a certain amount of data in a specific time, usually defined in bits per second (bps), as in Kbps, Mbps, Gbps.

BGP

Border Gateway Protocol - An IETF routing protocol defining the way in which Autonomous Systems exchange information to determine the path to use in order to send data. Participants at an IXP normally must be able to configure and maintain routers that run BGP. See below for information about the IETF.

Bilateral Peering

This is peering negotiated between any two providers, through an IXP switch or privately. Also, see Peer/peering

Bit

Binary digit, i.e., 0 or 1; it is the basic unit used in computing and data transmission. 8 bits usually define a single character that is called a 'Byte' (see below).

Blackholing

A configuration technique used to deal with DDoS attacks or routing configuration errors on other networks in which packets to or from selected destinations are 'blackholed' or dropped.

Bps

Bits Per Second - The number of bits passing a given point every second. This is the transmission rate for digital information, i.e., a measure of how fast data can be sent or received. Often expressed as Mbps, for Megabits per second for broadband links. See Bandwidth.

Broadband

A high-speed (multi-megabit) data-connection, normally provided to the end-user. The International Telecommunication Union (ITU) currently defines broadband as greater than 256Kbps; however in practice, a broadband connection is usually expected to be at least 1Mbps. In many countries, 10Mbps is now a commonly seen domestic broadband connection (on the download link), 50+Mbps is also becoming increasingly available, and some residential service providers are even providing 1Gbps broadband connections, where fibre to the premises is available.

Byte

8 bits of data, sometimes called a "word" or an "octet". While data streams are usually measured in bits, file sizes and units of data storage are normally measured in Bytes; e.g., a one terabyte hard drive.

C

Cache

A copy of a set of data that is stored closer to the end-user than the original source of the data in order to improve performance, reduce bandwidth requirements, or limit real-time access to the original content. Caches are filled when a piece of content is downloaded the first time, and usually refreshed at regular intervals or when a later version of the content becomes available. Web browsers often include a cache and so do IXPs – see Content Distribution Networks.

Cat5

Category 5 Cable - A specification of twisted-pair copper cable able to provide a performance of up to 100Mhz that is suitable for up to 1000Mbps (1Gbps). It has been superseded by the CAT5e (enhanced) specification.

cc

Country code - A two-letter code uniquely identifying a country, used in top-level national domains, such as .ca (Canada) or .fr (France). Standardised by ISO3166-1. See ccTLD .

ccTLD

Country code Top Level Domain - The last part of a domain name using a country code allocated to a specific nation. This normally signifies the country in which the domain is registered and usually, but not always, indicates where the holder of the domain name is based. Some ccTLDs have also been used for denoting certain types of content services or websites, such as .tv (Tuvalu). The database of sub-domains registered under a specific ccTLD are called name servers and are often hosted at IXPs to improve performance and reliability for end-users.

CDN

Content Distribution Network - A network whose primary aim is to deliver content to end-users and is often hosted at an IXP to improve performance by bringing the content closer to the end user. These can be content redistribution networks that act as intermediaries, such as Akamai, or content generators themselves, such as Google and Netflix.

Cloud Service

A service provided via the Internet that gives its users access to applications and data-storage facilities that are hosted remotely on a 'cloud' service provider's network consisting of distributed storage and application servers, which may be spread around the world. Cloud services provide a business model that allows entrepreneurs the ability to more easily scale up and offer service(s) without provisioning their own infrastructure. Typical examples of cloud-based applications are DropBox, Gmail, and Hotmail. Increasing use of cloud services means end-users are ever more dependent on fast and reliable Internet connectivity, adding to the incentive for networks to peer at an IXP.

colo

Co-location - The renting of space for housing computer equipment, usually in buildings specially designed to support a high density of computers and network connections, often called data centres, but also called telehouses or carrier hotels. Co-location is not normally an IXP service as it usually competes with exchange participants, however many IXPs are hosted at colo/data centres.

Connection Redundancy

Two or more connections, ideally via physically different paths to different networks, linked to the Internet. Redundancy ensures continued availability of the Internet in the event of a service interruption on one of the connections. IXPs can help to improve a network's reliability by making it easy to access more than one connection to the rest of the Internet. Of course, this may also require two physically independent connections to the IXP unless the network is also using a direct connection to a peer or transit provider.

Content

The data that travels over a network, which can also be termed traffic, but from the user perspective, it is the material that the user is accessing and interacting with over the network. See Content Distribution Network. Because IXPs help to reduce local bandwidth costs and improve network performance, they help to encourage hosting of content, including local content.

D

Data Centre

Data centres primarily focus on hosting content although they often host IXPs, especially carrier-neutral ones (i.e., not those built by a specific telecom operator, but those which have multiple carriers terminating links into the data centre). Some

commercial data centres operate as IXPs and may provide good value for purchasing transit capacity, but are often less cost-effective for peering. See co-location.

DNS

Domain Name System - A distributed database that allows names to be associated with IP addresses. A query of a DNS server will match a domain name to the IP address required by the computer in order to route the traffic to its destination; e.g., www.lemonde.fr will match to the IP number 62.116.143.15 - the IP address of the web server hosting Le Monde's online service.

Domain Name

A sequence of characters (a name) for use by Internet applications; e.g., someone wishing to access the Le Monde newspaper via a web browser would type www.lemonde.fr (to be clear the registered domain name is lemonde.fr).

Downstream

A network's paid traffic, in contrast to upstream traffic for which a network must usually pay transit fees, and peered traffic which is usually settlement free. See Peers/peering.

DWDM

Dense Wave Division Multiplexing - A technology that enables multiple data streams to be transmitted simultaneously on a single optical fibre by using different optical wavelengths (colour) for each data stream. Up to 160 (and theoretically more) wavelengths can now be transmitted on a single optical fibre. Availability of DWDM fibre is helping to meet exploding bandwidth requirements.

E

Ethernet

The communications protocol used within a switch to route data packets inside the local network. Ethernet is normally only used within a local network because the packets are broadcast to every device attached to the switch. This is computationally inexpensive but makes this protocol less suitable for long-distance, usually more expensive, lower-capacity links. Ethernet switches are normally used to interconnect the routers of participants at an IXP. Maximum Ethernet speeds have steadily increased and some IXPs are now able to support 100Gbps Ethernet connections. GE is a common notation for one-gigabit Ethernet links, 10GE for 10Gbps links.

Euro-IX

European Internet Exchange Association - An Association of European exchange points and other members formed to exchange ideas and information on IXP and related issues. Most IXPs in Europe have joined Euro-IX to share information about best practices. The association is not restricted to European members and welcomes members from other regions. It is also helping to assist in the formation of a global federation of IXP associations.

Eyeball Networks

Networks that focus on provision of Internet access to the end-user – these networks provide the demand for content networks that operate applications or services desired by end-users.

F

Fibre optic cable

The use of specially manufactured glass fibre for the transmission of data. The signal is transmitted along the fibre using pulses of light from a laser or a light-emitting diode (LED). Current modulation technology allows fibre cables thousands of kilometres long to carry many terabits of data per second (see DWDM above). Optical fibre patch cables are used in IXPs to connect with high speed ports, such as 10 or 100Gbps.

G

Gb

Gigabit - One billion bits.

Gbps

Gigabits per second.

GE

Gigabit Ethernet - Ethernet that supports data transfer rates of 1 Gbps. See Ethernet. Most IXPs now support 1Gbps and 10Gbps ports.

Global Routing Table

Also called the global BGP table, this is a database of the different paths in the public Internet over which traffic can be routed. In mid-2013, there were about 480,000 IPv4 and 14,000 IPv6 routes visible on the Internet. This information is used by routers that run the BGP protocol to decide on the most efficient path over which to direct traffic. In practice, with the common use of route filters and rapid changes in Internet routing, no router has the complete view of all routes available. Big IXPs, which usually have routes seen by multiple large networks are among the best places to assess global Internet routing.

gTLD

generic Top Level Domain - A top-level domain of the Internet that does not carry a ccTLD identifier. In contrast to ccTLDs (see above), gTLDs are normally used to register names that are not associated with a particular country. However, due to the history of the emergence of the Internet, most US-based organisations have, in practice, also used gTLDs in place of the .us ccTLD. Currently, 7 gTLDs are commonly used -.com, .org, .net, .edu, .gov, .mil, .int, and another six have more recently come into use -.aero, .biz, .coop, .info, .museum, and .name. The management of TLDs is the responsibility of ICANN. ICANN is now in the process of greatly expanding the number of gTLDs in use. IXPs often host copies of gTLD and ccTLD databases to improve local performance in name lookups.

I

ICANN

Internet Corporation for Assigned Names and Numbers - The highest level coordinating body for the technical resources of the Internet, responsible for global policy and management of Internet domain names and IP numbers.

ICT

Information and Communication Technologies - The most common means of referring collectively to both computing and communications technologies, which include the Internet.

IETF

Internet Engineering Task Force - The body responsible for developing standards for the technical operation of the Internet. The IETF is an open community of network

designers, operators, vendors, and researchers concerned with the technical aspects of the operation and evolution of the Internet. It is open to any interested individual.

Interface

The hardware and software that connects a computer or communications devices to each other or to the end-user.

International gateway

A telecommunications link that crosses a national boundary. It is usually a service that aggregates international traffic from many networks and end-users. It is also a construct used by some developing country governments to restrict access to international capacity to particular license holders, often the incumbent state operator, and to mobile network operators. Where there is a single entry point where Internet traffic must pass through the same point, creating a de-facto IXP, but without the benefits of building a community. This arrangement often constrains local growth of the Internet through inefficient routing or by imposing non-cost based pricing for local traffic exchange. The resulting incumbent can also often be a significant barrier to creating an IXP for the other ISPs in the country.

Internet

Interconnected networks that use the TCP/IP protocol (see below) to communicate with each other. Emerging from military and academic research in the 1960s, the Internet is continuing to double in size every year. Currently, the Internet is made up of about 44,000 independent networks that connect about 2.5bn end-users to each other and to millions of content and application providers. The Internet is also now emerging as the platform for machine-to-machine communications, known as the 'Internet of things', which will result in the Internet growing even faster and becoming even larger.

IP

Internet Protocol - The basic packet communications protocol used on Internet networks. See IP Packet.

IP Address

A unique numeric identifier for a device connected to the Internet. Until recently, this was usually expressed as 4 sets of numbers in the range 0-255 separated by dots, e.g., 196.6.208.1, which is known as an IPv4 IP address. Due to the unexpected growth of the Internet from the time it was first developed, this addressing model cannot provide

enough addresses to uniquely identify every device that needs to be connected to the Internet – it is inherently limited to 4,294,967,296 addresses. So a new, larger standard of IP Address was developed – IPv6 which can provide 3.4×10^{38} addresses in the form of eight groups of four hexadecimal digits separated by colons (for example, 2001:0cb7:64g2:0342:1000:8a2e:0370:7334) however, methods of abbreviation of this full notation can be used. IPv6 has enough addresses to connect every device for the foreseeable future.

IP Packet

A discrete unit of data that contains the source and destination of a transmission for routing purposes, along with other management information, as well as the user's data. Because each packet contains the source and destination, each packet can be treated independently by the networks it travels through to reach its destination and different packets may take different routes before being reassembled as the data stream on the recipient device.

ISOC

Internet Society - The Internet Society is a cause-based organization that works with governments, industries, businesses, policymakers, regulators and others to ensure the technologies and policies that helped develop and evolve today's Internet will continue into the future. Our programs support and advocate for an Internet that is open and accessible to everyone, everywhere, and ensures that it will continue to be a tool for creativity, innovation, and economic growth. Working with its members and Chapters around the world, the Internet Society enables the continued evolution and growth of the Internet for everyone. www.internet-society.org

ISP

Internet Service Provider - A company or organisation that provides individuals, organisations, and enterprises with access to the Internet. Aside from connecting users, ISPs often provide other services such as email and hosting of websites for their customers. ISPs are also known as 'eyeball networks' that essentially aggregate bandwidth in bulk and resell it to consumers and businesses in smaller chunks. This is in contrast to content networks that focus on providing content and applications for end-users. These two types of networks most often meet at IXPs.

ISPA

Internet Service Providers Association - An association of ISPs often run on a membership basis in a defined geographic region, usually in a country or a capital city of a country. Many IXPs are operated by national ISP associations.

ITU

International Telecommunication Union - The UN agency responsible for the development of infrastructure, orbital slot and coordinated spectrum allocation, and development of technical standards used in telecommunication networks, particularly traditional voice networks. The ITU has also recently become more involved in Internet public policy and other related matters.

IXP

Internet Exchange Point - A physical location that allows many Internet-based networks to exchange traffic with each other at a common meeting point, thus eliminating the need to build separate bilateral links with each local network. Most IXPs are non-commercial organisations funded by membership and/or port fees paid by the participating networks. Commercial exchanges are also common, particularly in North America, where IXPs are often called Network Access Points (NAPs). INX and IX are also common abbreviations. In Latin America, additional abbreviations are: NAP, PIC, PIT, and PTT.

K

Kbps

Kilobits per second - A data transfer rate of one thousand bits per second.

L

LAC-IX

Latin America and Caribbean Internet Exchange Point Association - The association's objectives are to increase Internet traffic in the region, represent the member IXPs worldwide, support governments on policies, provide statistics and advice related to Internet Exchange Traffic, simplify cooperation between the IXPs, and promote and support the establishment of new IXPs. <http://lac-ix.org>

LACNIC

Latin America and Caribbean Network Information Centre - One of the 5 regional Internet registries (RIRs) around the globe that provide IPv4 and IPv6 address allocation services (for the Latin American and Caribbean region except for Brazil, Chile and Mexico, which each have a National Internet Registry (NIR) to handle address

allocation). LACNIC has recently helped to launch an association of IXPs in the region called LAC-IX.

LACP

Link Aggregation Control Protocol - Link aggregation is used by some IXPs to provide higher capacity links to members.

LAN

Local Area Network - A local network of devices interconnected physically through one or more Ethernet switches or wireless links. An IXP is essentially a set of participant routers connected to a LAN. An IXP may have additional LANs for administrative purposes or for providing other shared services.

Latency

Typically measured in milliseconds (ms), latency is a measure of the delay in the round trip time (RTT) it takes for a packet of data to reach and return from its destination.

Leased Line

A telecommunications circuit leased between two or more locations from a telecom provider. Networks will normally need to lease a line or deploy their own infrastructure to connect with the IXP.

Looking Glass Server

A server hosted on a network or IXP that makes it easy to identify the routes available at that location.

M

MAN

Metropolitan Area Network - A network spread over a metropolitan area. This may refer to a physical fibre or microwave network, such as may be operated by a telecom provider to carry voice and data traffic within a large city, or it may refer to an IP network linking different locations in one city, including an IXP with several locations in the same city.

Mbps

Megabits per second - A data transfer rate of Mega (million) bits per second.

MLPA

Multilateral Peering - A type of peering policy available at many IXPs where members agree to exchange traffic with every other member present at the exchange, usually through a route-server. This contrasts with bilateral peering or 'private peering' where two networks agree to exchange traffic with each other in a private arrangement. A choice of multilateral and bilateral peering is usually available at most IXPs.

Multi-homing

An IP network with two or more physical links to other networks, to provide resilience and/or diversity. An AS number and appropriate routers are required to operate multi-homing networks connected to the Internet. Knowledge of multi-homing router configuration is a basic prerequisite for joining an IXP.

N**NAP**

Network Access Point - Another name for an IXP. NAP was the name given to the first exchange points established in the United States when parts of NSFNet, the first TCP/IP-based network, were spun off from its academic roots into commercial operations. NAP is also more commonly used in Latin America

Network

Two or more interconnected computers or data communications devices. "IP network" or just "network" is now the commonly used term for a distinct group of interconnected devices linked to the Internet and operated by a specific entity.

NGO

Non-Governmental Organisation - A non-profit organisation whose shareholders or other governing body do not financially benefit from the organisation's primary activity. Noncommercial IXPs may be registered as NGOs or as non-profit companies.

NRA

National Regulatory Authority See "Regulator,"

O

OFC

Optic Fibre Cable - See Fibre Optic Cable.

P

Packet

A discrete unit of data traffic. Packet switched networks are the basis of Internet in contrast to the older circuit switched networks that were developed in the previous century for voice networks.

Peer/Peering

Peers are networks that agree to exchange routes (and therefore traffic) with each other, normally on a settlement free basis. The distinction between settlement-free peering and 'transit,' where one network pays another to exchange traffic (usually to reach most of the other remote networks on the Internet), is blurred by options such as 'paid peering,' where some routes may be settlement free while other routes carry a fee, or where there is some other form of compensation between the two networks. In all these cases, these specific business arrangements between two networks are called 'bilateral peering' or 'private peering.' Bilateral peering can either take place at an IXP or through direct physical interconnection between the two networks. The latter is normally called 'private peering.' The other common form of peering at an IXP is called 'multilateral peering'

Petabit

One thousand Terabits.

PoP

Point of Presence - A physical infrastructure location where a network or end-user can access the services of a provider.

POTS

Plain Old Telephone Service - A traditional fixed-line copper cable phone service. See PSTN and PTO.

PPP

Public-Private Partnership A partnership between the private sector and government in a common project. In some cases, IXPs are established as a partnership between privately operated commercial networks and government bodies. Not to be confused with the PointtoPoint Protocol as used in computer networking or with Purchasing Power Parity (a mechanism to compare the relative values of currencies).

Private Peering

See Peer/peering.

Protocol

At a technical level in the ICT world, a protocol is usually a set of rules that determine the way in which two networked devices communicate with each other, e.g., routers exchange routing information using the border gateway protocol (BGP), just as all devices connected to the Internet must exchange traffic using the Internet Protocol (IP).

PSTN

Public Switched Telephone Network The traditional circuit switched voice telephone system; however, may also refer to mobile networks.

PTO

Public Telecom Operator - Usually the circuit switched fixed line telecom operator although technically, as communication technologies converge toward the Internet, the distinction between fixedline operators, cellular operators and ISPs is becoming increasingly blurred. PTOs usually have a different business culture to the new Internet network operators and are often the dominant network operator, a status that may limit their interest in peering locally as opposed to selling transit.

Q

QOS

Quality of Service A measure of the level of service provided by a network. There are many different QOS measures. Common examples include uptime (e.g., five 9's –

operational for 99.999% of the time), packet loss, roundtrip time, etc. QOS may be defined in a business relationship called a Service Level Agreement (SLA). QOS rules can also be applied to different types of traffic passing through a router; for example, voice traffic might be given a higher priority than email. IXPs may provide certain QOS and SLA commitments to their members.

R

Regulator

A government entity with legally mandated responsibility for executing national ICT policy by establishing a set of regulations that govern the sector. Ideally, the regulator is semiautonomous with an income derived from license fees that provide substantial independence although the state usually appoints the executive body. Ideally the regulator helps ensure that there is a level playing field in telecom and Internet markets. In this respect, it often has a major responsibility to curb the impact of market dominance of the incumbent operator, especially in developing countries. (In some economic regions with a high level of integration, such as the EU and ECOWAS (West Africa), a significant level of policy and regulatory development takes place at the regional level that the member states are obliged to adopt.) The regulator does not normally have a direct role in IXP development although in some countries, the IXP may be hosted by the regulator or facilitated by regulatory proceedings allowing the IXP to exist. The regulator can also play an important role in helping to ensure dominant operators participate fully in the IXP and in ensuring there is a competitive market for national and international Internet capacity.

Remote Hands

A facility provided by IXPs and data centres where participants can make use of a local onsite engineer to perform physical activity at the exchange, such as rebooting a router, installing patch cables etc.

RFC

Request For Comment. The IETF procedure used for the development of Internet standards. For example, RFC 5963 describes how IPv6 may be deployed at IXPs.

RIPE NCC

Réseaux IP Européens Network Coordination Centre One of the 5 regional Internet registries (RIRs) around the globe that provide Ipv4 and Ipv6 address allocation services (for Europe and the Middle East).

RIR

Regional Internet Registry One of the regional organisations that are allocated blocks of IP addresses and ASNs by ICANN/IANA for onward allocation to individual local networks (except for 10 countries in Asia and Latin America which operate their own national registries). Currently, there are five RIRs – one for each major geographic region: ARIN, APNIC, AFRINIC, LACNIC and RIPE NCC.

Root name server

Root nameservers are used to determine the location of other DNS servers. DNS servers are the authoritative source of information about toplevel domains (e.g., .com, .org, .int, and .arpa). There are currently 13 root servers around the world, with the domain names 'a.rootservers.net', 'b.rootservers.net' etc., to 'm.rootservers.net'. Copies of these root server databases are often hosted at IXPs or other wellconnected locations in order to increase the resiliency of the Internet locally in the event of international connectivity interruptions. Copies of these rootservers are often called 'instances' or 'mirrors.' Click here for a map of these entities:

<http://rootservers.org/map/>.

Route

The path through one or more networks that is taken by IP packets. Due to the dynamic nature of routing on the Internet, packets from the same data stream may travel to their destination by different routes.

Router

A device that receives IP packets and decides where to send them based on which device is 'closest' or 'least expensive' on the way to the packets' final destination. Routers usually make these decisions based on a set of preconfigured rules combined with dynamic routing information exchanged with other routers on the Internet, usually based on the BGP routing protocol. Routers with only one physical connection to

another network are usually configured with a 'default route' that is the upstream connection to the rest of the Internet. Normally, a network participating in an IXP will have a router at the IXP premises that will be connected to the other participants' routers via an Ethernet switch.

Routing Policy

The routing rules a network applies when carrying traffic from other networks.

S

Spam

Unsolicited email, used in questionable marketing practices. Some IXPs provide an antispam service.

T

TCP/IP

Transmission Control Protocol/Internet Protocol – the key protocols for transmitting packet based data, on which the Internet is built.

Terabit

One thousand gigabits.

Tiered ISP model

Internet Service Providers have traditionally been classified by size into 3 tiers – Tier 1 being the largest, usually global ISPs that peer directly with each other, while Tier 3 ISPs are the smallest local ISPs and Tier 2 ISPs fall somewhere in the middle. These distinctions are blurring as the ISP sector evolves, but normally it is assumed that ISPs from lower tiers usually have to purchase transit from higher tier ISPs.

TLD

Top Level Domain See gTLD and ccTLD. http://en.wikipedia.org/wiki/Toplevel_domain;
<http://archive.icann.org/en/tlds/>;<http://www.icann.org/en/resources/cctlds>.

Transit

The capacity or routes purchased from a larger network, usually to reach remote networks on the Internet. See Peer/peering.

U

U

A unit of measurement mainly used to describe the height of rackmounted computer equipment (especially servers and routers) and the racks into which they are fitted. One "u" is 1.75 inches or 4.445 centimetres. IXPs may have policies on the amount of rack space that can be occupied by each participant at the exchange.

Upstream Traffic

Traffic that a network must usually purchase as transit in order to make connections with other networks, in contrast to downstream traffic which is usually the revenue generator for a commercial access provider ('eyeball') network or for a lower level wholesale capacity provider. See Peer/Peering.

UTP

Unshielded Twisted Pair A type of data cable containing four pairs of conductors, each pair being twisted together. UTP is used extensively in connecting local Ethernet network devices together.

V

VoIP

Voice over Internet Protocol - There are many Internet based VoIP services, such as Skype and Google Talk. Traditional circuit switched voice networks are also increasingly migrating to the Internet. The 'best effort' model of Internet service provision requires that specialised traffic management techniques may need to be applied to deliver the same level of QOS that is expected by customers of traditional voice networks. In addition, gateways between IP and circuit switched voice networks may require specialised signalling to support features such as caller ID. Some IXPs are now implementing these techniques so that voice networks can continue to migrate smoothly to an all IP environment.

W

WAN Wide Area Network A network normally spanning a larger physical area than a LAN, in particular denoting the use of different physical transmission media. The most common use of WAN terminology is in the WAN port(s) on a router which collects traffic from the LAN and passes upstream traffic to the WAN links, usually to the rest of the Internet, and vice versa.