IX Liverpool (IXL) Board Meeting Minutes 24th August 2016 @ 7:00pm at Baltic Creative

Present:

Prof. Matt Wilson, Chairman (MW)
Dr. Simon Holgate, Non Executive Director (SH)
John McKenna, Independent Director (JMK)
David Parr, Independent Director (DP)

Apologies : Paul Freeman-Powell, Technical Director (PFP)

Public Observers : Mr Jamie Roberts (JR), (Solve HQ), Liam Givens (LG) (Stack Data Solutions LTD), Mark Russell (MR) (bmicro)

Start

MW thanked everybody for their attendance while also thanking SH for arranging the use of the POD meeting room at Baltic Creative and Baltic Creative, whom have been very supportive of IX Liverpool to date.

MW reminded the board that all board meetings are open and fully transparent, and that members of the public are invited to attend to observe and also contribute to a 15 min. Q&A session at the end.

MW also stated that as with the current meeting in Baltic Creative, one of the reasons of having the board meeting at different locations around the city, was to aid accessibility while engaging people from those areas, for example interested members of the public or businesses (residents of the Baltic Creative), who can attend and contribute to our meetings, and, he stated that he would like to see more engagement from these communities in the future.

MW announced that PFP (serving currently as Technical Director) is to step down in Sept as originally intended (when he co-founded IXL in February), and due to family reasons, he is unable to continue his stay. The board thanked PFP for his contribution and help towards founding an IX in Liverpool and hoped he could return at some point in the future.

MW announced that after several talks, Mr. Jamie Roberts from Solve HQ is to be the new Technical Director of IX Liverpool from 28th Sept 2016, the day after PFP is to step down.

MW confirmed that from the 1st of May 2016, Mr. David Parr was elected to the board as an Independent Director, making two Independent Directors on the board of IXL (in addition to JMK)

The board read and discussed the minutes from the last board meeting and reviewed the action points and updates since April 2016.

The board debated the ambition of connecting local data Centres (DC) to the IX (now that the Aimes DC are a member) and how that could be achieved, LG gave the board an update about Stack Computers and their DC in North Liverpool and the possible intentions of Stack who may be an interested party in the future as a member of IXL.

The board discussed the HSBC DC in Bridle road, Bootle, that appeared to still be live but with a new owner. LG offered to take up contact with the new owner and invite them to the next IXL board session should they still have the operation running as a DC and would feel it worthwhile to be on an IX.

SH discussed with the board the merits of connecting LJMU's Sensor City project for the Internet of Things into IXL. JR suggested that he has contacts there and would arrange a meeting with decision makers and work on a proposal to LJMU that would be of mutual benefit.

SH discussed that any such link from IXL into one of the big Universities could be connected into the JANET network which could be of use to IXL members at a later point.

DP opened a discussion surrounding the Transatlantic Cable owned by Hibernia Networks that comes into Southport and encouraged debate on the merits of extending this into Liverpool, with the board confirming that the installation of a cable from the Southport landing stage, into the Port of Liverpool should be a serious consideration and that IXL should now include it in its overall strategic plan.

SH informed the board regarding the new Liverpool SuperPort that has been recently developed, and that IXL should begin talks with them, concerning both IXL and the installation of the submarine cable within the Mersey Estuary in which they operate, confirming he would take up these discussions.

LG asked the board if such installation of the submarine cable would result in a single point of failure for transatlantic connectivity (for IXL), and asked that the board consider an additional resilience route, via the River Mersey or land based.

MW stated that he had recently met with CityFibre about establishing a presence within the Liverpool Region, and suggested that such resilience for the submarine cable may be possible using their network and would discuss this with Cityfibre at the next meeting.

MW gave the board an update regarding his meeting with Liverpool LEP, explaining that it was a positive meeting and that additional meetings were scheduled for Sept to discuss several opportunities within the region that would be advantageous to IXL.

MW gave an update to IXL's application for Internet Address space, as allocated by RIPE, and was pleased to confirm that RIPE had now allocated IXL it's AS number (AS 202944) and that on the 24th of May 2016, IXL was also allocated specific IPV4 and IPV6 (185.1.71.0/24 & 2001:7f8:a2::/48) IP

address space and that the sponsoring LIR was his business Telecoms Cloud Networks, and also confirmed that Telecoms Cloud Networks would pay the costs to RIPE by way of donation to IXL. MW also confirmed that as the IP addresses allocated by RIPE were only for Internet Exchange Points and were not allowed to be internet routable (a restriction placed by RIPE), and that IXL would likely need routable address space soon, his company Telecoms Cloud Networks would donate some IPV4 and IPV6 address space from his company's existing block allocations and would also be asking other members, including Aimes Grid Services if they would consider doing the same.

MW also presented to the board, the recently published Liverpool City Region Growth Strategy (https://www.liverpoollep.org/wp-content/uploads/2016/06/SGS-Final-main-lowres.compressed.pdf))(produced by the Liverpool City Region LEP on behalf of Liverpool City Region Combined Authority), showing how IXL was now included as part of this strategy and thanked the LEP for their support so far.

PFP (via a pre-arranged question) ask the board for an update regarding the progress of connecting the Aimes DC to the network now that IP addresses had been allocated and that it would be prudent to be connected to both LAN's that IXL operate, given that they have IP allocations on both LAN's.

PFP also left details about the recent updates on the website and that it had been reorganised to make things clearer and easier to find.

The board confirmed that they had not heard much from Aimes for a while and that MW would contact them again to obtain and update on their intentions and stated that he hoped Aimes would be present at a next board meeting to provide the board an update themselves.

MW gave the board an update regarding LINX and the presentation he had given at Linx94 and the importance of the UK decentralising the internet (away from London), which was well received and hoped to gain a wider awareness of IXL outside of the region.

MW thanked LINX for their support for the creation of an IX in Liverpool so far, and was looking forward to future meetings with them in order to access resources, advice and experience.

MR confirmed that he has taken charge of the social media (Twitter, Linkedin, Facebook & website/blogs) and with input from JMK and LG and the rest of the board, he would continue with the current marketing campaign and work on additional communications to the IXL community to encourage additional engagement.

MW discussed with the board that he had approached Tim Heatle from the company Capital & Centric with the opportunity of installing IXL nodes at both the Tempest and Bunker Buildings (for connecting future members at the likes of Launch 22 and content members at the new proposed Film studios at Edge Lane) and that he was still waiting for a reply after several months from Louise Kilbride who he will continue to chase for an answer as to their intentions.

MW gave details on conversations with Cllr Jim Noakes from Liverpool City Council, who has been really helpful in giving IXL advice and pointing IXL in the right direction for support within the council, and knows that IXL wants to gain the use of dark fibre/ducts around the city to connect its nodes together.

Jim Noakes said he will help IXL by speaking to the right people about this and in addition see how IXL can help enable the Smart Cities agenda via the exchange and use of the city fibre.

MW gave an update on the community meetups that he had organised since the start of IXL, and that they had been a big success, with growing numbers of interested parties and record numbers attending each time. MW stated that a total of 3 events had been completed as a trial, in order to gauge community interest. The board debated the future of such events and it was collectively decided that:

● Meetups should be restarted, and made a permanent arrangement in the IXL calendar and that these meetups should happen once per quarter and at different locations around the city, similar to IXL's board meetings, and that some even could be scheduled after board meetings.
● There will be 12 months forward planning of events, booked so to give the community advance notice, for maximum inclusion
● The Meetup's would be controlled and scheduled using the meetup website
● DP and LG will jointly organise and run such events

MR suggested that Launch22 would be an ideal space to use for the first of the new series of meetups, and that he would arrange this with the owners.

JMK discussed the recent news that I.T Answers had recently advertised on Facebook that they could be using the cityfibre to deliver ISP services to local businesses and that IXL should make an approach.

MW confirmed that he had already met with Andrew Hilton from I.T Answers, who seemed keen to join IXL as a member and were awaiting their AS number from RIPE before joining, however that was at the start of the year and the board confirmed that it had not heard anything since. MW confirmed that he would contact I.T Answers and obtain and update as to their intentions.

MW explained that Cogent are very keen to connect to IXL to offer wholesale bandwidth and peer with members at the exchange, and have started investigations on how they could physically connect their network. MW explained that he had introduced them to Aimes as Cogent may consider connecting at the Aimes Node, into IXL given the lower costs of connectivity for larger providers at that end of the city.

MW explained that he had met with Raj Mack from Digital Birmingham (part of Birmingham city council) whose organisation is wanting to setup an IX in Birmingham. MW explained that he suggested a possible partnership and sharing of knowledge and information, and that Raj should meet the board when possible for this to happen. MW explained he will meet Raj again shortly to discuss this further.

MW explained that Tech North have been in contact, offering to help IXL and await proposals.

MW explained that IX Leeds have invited the board of IXL to it's next board meeting, and asked for members to attend if available on the date once confirmed. MW explained that IX Leeds are keen to help and share their experiences so IXL and IX Leeds and help contribute together to the "Northern Powerhouse" agenda.

LG discussed the local ISP "Mersinet" and wondered of thier involvement locally, and the board discussed that it was currently being operated by Paul Furley as part of an open wireless.org movement, and that his involvement could be useful towards the vision to create the free city wifi project that IXL would like to acheive, that involves installing Wifi access points on lamp posts, designed for visitors to the city and local citizens.

MW suggested that SH could take up discussions with Paul Furley and gauge interest, with IXL possibly being part of the open wireless.org movement at a local level and how the city fibre could provide connectivlty to power the network.

DP raised a point regarding the rapid progress that IXL had made in the little time it has been in operation and that the board should reflect on how far it has come and it should celebrate it's progress to date and looked forward to seeing comparable progress in the future.

The board discussed & debated the topic surrounding member fees and port charges, and the benefits of offering a fee-free period to encourage joining. After a debate, it was decided that IXL will give a percentage of total available ports as free ports for a set time, yet to be determined.

MW explained that IXL should now set up a bank account and that IXL would be needing a Treasurer to maintain the company's finances and perform minor administration from time to time, and asked for nominations for such a position, including the placing of an advert on our website asking for volunteers for the role.

JR nominated Sean Gleeson from Does Liverpool who may be interested and confirmed that he would begin talks to gauge interest.

SH nominated Jonathan Ford from Jonathan Ford & Co and confirmed he would begin talks.

MW asked the board to promote the recruitment of the Treasurer role within their networks and confirmed it would be added to the website to encourage applications from members of the public.

The board debated proposals and ideas for the official launch event of the exchange, now that IXL has it's IP space allocations, three members present and is a recognised Internet Exchange Point, even at this early stage, and discussed dates for such an event so it can be planned well in advance.

JMK suggested that representatives from the IX Manchester committee could give a presentation at the launch event and/or future meetup events

SH suggested that there should be multiple stakeholders at the event, possibly giving presentations, such as Google, MicroSoft, Akiami and other potential future members including supporting organisations such as RIPE and LINX. MR suggested that the LEP could give a talk also.

It was decided that arrangements for an official event would proceed by the group off-line and be completed before the next board session and that members would use their networks to invite interested parties.

JMK gave the board an update to his efforts on obtaining letters of support, and has confirmed one letter from Anchor Tutoring Services which will be placed on the website shortly. MW thanked JMK for his work so far and encouraged the board to gain as many letters as possible.

MW also gave an update with his letters of support, explaining that he had obtained three additional letters since the last board, and would seek more, explaining that he is waiting on letters from DoES Liverpool, Starship and around 18 other companies.

JMK suggested that we should consider the Cotton Exchange on Old Hall Street as a peering node, in order to pick up several providers who are already present there as a node would help bring down the cost for providers to peer.

LG explained that he was in the process of organising a letter from Stack Computers

The board thanked Liam Givens for the donation of a Cisco 2951 at some point in the future.

SH suggested the board set up a Slack Channel to aid better communication. SH agreed to do this as soon as possible.

MW confirmed that IXL are now on http://www.ixptoolkit.org/ixps and Internet Exchange Map (http://www.internetexchangemap.com/#/internet-exchange/ix-liverpool-liverpool-united-kingdom)

AOB

None.

End

Next Meeting 7th Dec 2016 – 7pm

Action Points from meeting

- LG to contact HSBC DC New owner
- JR to contact Sensor City
- SH to contact SuperPort
- MW to contact Aimes to ask for donations of Internet Routable Addresses
- MW to contact Aimes about their intentions
- MW to meet with LEP in Sept
- DP and LG (events team) to organise meetup's
- MR to contact Launch22 to ask to use meeting space
- MW to contact I.T Answers
- MW to meet with Raj Mack from Digital Birmingham
- MW (and others) to meet with IX Leeds
- SH to contact Mersinet
- JR to speak with Shawn ? from Does Liverpool regarding open Treasurer position
- SH to approach Jonathan Ford and & Co with a view to offering him the Treasurer Role and potentially being IXL's accountant.
- SH to set up Slack Channel for better collaboration between board and community
- SH to contact J Ford & Co
- LG to obtain letter of support from Stack Computers

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 bounder. 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 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 X 1038 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 discreet 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.internetsociety.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 capitol city of a country. Many IXPs are operated by national ISP associations.

ITU

International Telecommuni-cation 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. Non-commercial 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 discreet 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 Point-to-Point 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 fixed-line 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 up-time (e.g., five 9's – operational for 99.999% of the time), packet loss, round-trip 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 semi-autonomous 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 on-site 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 name-servers are used to determine the location of other DNS servers. DNS servers are the authoritative source of information about top-level domains (e.g., .com, .org, .int, and, .arpa). There are currently 13 root servers around the world, with the domain names 'a.root-servers.net', 'b.root-servers.net' etc., to 'm.root-servers.net'. Copies of these root server databases are often hosted at IXPs or other well-connected locations in order to increase the resiliency of the Internet locally in the event of international connectivity interruptions. Copies of these root-servers are often called 'instances' or 'mirrors.' Click here for a map of these entities: http://root-servers.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 pre-configured 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 anti-spam 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/Top-level_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 rack-mounted 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.