Annex 4. Glossary

This section provides details on the main terms and concepts that relate to the deployment of IXPs.

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.

Acceptable Use Policy (AUP)
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 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, such as anti-spam measures, to support the enforcement of their member’s AUPs.

African Internet Exchange Point Operators’ Association (AF-IX)
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.” http://af-ix.net

Africa Network Information Centre (AFRINIC)
One of the five 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.

American Registry for Internet Numbers (ARIN)
One of the five 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.
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.

Asia-Pacific Internet Exchange Point Association (AP-IX)
Serves as a forum for Internet Exchange Points to exchange experiences. APIIX members meet twice a year at the APNIC Conference and Members meeting. http://apiix.asia

Asia Pacific Network Information Centre (APNIC)
One of the five 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.

Autonomous System Number (ASN)
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.

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.

Bilateral Peering
This is peering negotiated between any two providers, through an IXP switch or privately. See Peer/peering.

Bit
Binary digit, i.e., 0 or 1; it is the basic unit used in computing and data transmission. Eight bits usually define a single character that is called a Byte. See Byte.

Bits per Second (Bps)
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.

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.

Border Gateway Protocol (BGP)
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 IETF.

Broadband
A high-speed (multimegabit) data connection, normally provided to the end-user. The International Telecommunication Union (ITU) currently defines broadband as greater than 256Kbps. In practice, however, 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
Eight 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.

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.

Category 5 Cable (Cat5)
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.

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.
Co-location (colo)
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. 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’s perspective, it is the material that the user is accessing and interacting with over the network. Because IXPs help to reduce local bandwidth costs and improve network performance, they help to encourage hosting of content, including local content. See Content Distribution Network.

Content Distribution Network (CDN)
A network whose primary aim is to deliver content to end users and that 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.

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

Country code Top Level Domain (ccTLD)
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 termed name servers and are often hosted at IXPs to improve performance and reliability for end users.

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 that 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.

Dense Wave Division Multiplexing (DWDM)
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.

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

Domain Name System (DNS)
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.

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.

Ethernet
The communications protocol used within a switch to route data packets inside the local network. It 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.

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.

European Internet Exchange Association (Euro-IX)
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 assisting the formation of a global federation of IXP associations.

Fibre Optic Cable; also Optical Fibre 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.

Gbps
Gigabits per second.

generic Top Level Domain (gTLD)
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, seven gTLDs are commonly used: .com, .org, .net, .edu, .gov, .mil, .int. 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.

Gigabit (Gb)
One billion bits.

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

Global Routing Table; also Global BGP Table
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. Large IXPs, which usually have routes seen by multiple large networks are among the best places to assess global Internet routing.

Information and Communication Technologies (ICT)
The most common means of referring collectively to both computing and communications technologies, which include the Internet.
Internet Exchange Point (IXP)
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 other 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.

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

Internet Service Provider (ISP)
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.

Internet Service Providers Association (ISPA)
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.

Internet Society (ISOC)
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. Its programmes 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. http://www.internetsociety.org

IP Address
A unique numeric identifier for a device connected to the Internet. Until recently, this was usually expressed as four 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 because it is inherently limited to 4,294,967,296 addresses. Consequently, 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 (e.g., 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. Different packets may take different routes before being reassembled as the data stream on the recipient device.

Kilobits per Second (Kbps)
A data transfer rate of one thousand bits per second.

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

Latin America and Caribbean Internet Exchange Point Association (LAC-IX)
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

Latin America and Caribbean Network Information Centre (LACNIC)
One of the five 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.

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.

Link Aggregation Control Protocol (LACP)
Link aggregation is used by some IXPs to provide higher-capacity links to members.
Local Area Network (LAN)
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.

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

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

Metropolitan Area Network (MAN)
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.

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

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.

Network Access Point (NAP)
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.

National Regulator Authority (NRA)
See Regulator.

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.

Nongovernmental Organisation (NGO)
A nonprofit 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 nonprofit companies.

Optical Fibre Cable (OFC)
See Fibre Optic Cable.

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 where some routes may be settlement free while other routes carry a fee (‘paid peering’) or where there is some other form of compensation between the two networks. In all these cases, 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.’ See Multilateral Peering.

Petabit
One thousand Terabits.

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

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

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).

Public Switched Telephone Network (PSTN)
The traditional circuit switched voice telephone system; however, may also refer to mobile networks.
Public Telecom Operator (PTO)
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.

Public-Private Partnership (PPP)
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).

Quality of Service (QoS)
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.

Regional Internet Registry (RIR)
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.

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 provides 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 play an important role in helping to ensure that dominant operators participate fully in the IXP and in ensuring that 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.

Réseaux IP Européens Network Coordination Centre (RIPE NCC)
One of the five regional Internet registries (RIRs) around the globe that provide IPv4 and IPv6 address allocation services (for Europe and the Middle East).

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

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,’ up 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.’ For a map of these entities, see 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 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 that a network applies when carrying traffic from other networks.

Spam
Unsolicited email, usually used in questionable marketing practices. Some IXPs provide an anti-spam service.

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

Terrabit
One thousand gigabits.

Tiered ISP Model
Internet Service Providers have traditionally been classified by size into 3 tiers: Tier 1 ISPs are the largest (usually global ISPs that peer directly with each other), 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.

Top Level Domain (TLD)

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

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.

Unshielded Twisted Pair (UTP)
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.

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.

Wide Area Network (WAN)
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.