Internet Interconnection in Developing Countries

(Item on the Agenda: 4.1.1 Asuntos Relativos a Internet)

(Document submitted by Internet Society)

This document describes the evolution of interconnection in developing markets. It also provides a review of the ways in which a company's IT manager or a local ICT policy maker might undertake planning in order to build a successful interconnection strategy for an organization, a country or a region. Most of the document takes Internet Service Provider (ISP) networks as examples, but the concepts introduced could be applied to any other network. This document is organized as follows: first, a brief evolution of interconnection in developed and developing countries is given; second, the major actors in interconnection are introduced; third, a list of interconnection steps and the localization of interconnection is described.

Introduction:

Today, we take for granted that when connecting to the Internet we can access any content just with the click of a mouse. Access to news, social networks, instant messaging - doing it from home, from work or on the move - all of this is possible on the global Internet.

But, how does this connection happen? The answer is in the architecture of the network, how it was originally designed and how it has evolved.

The Internet is not simply one network, but thousands of networks for which there are some basic routing and interconnection principles - this is the origin of the expression network of networks. The ability to interconnect networks in different parts of the globe has been central to the evolution of the web. Ensuring Interconnecting networks not only has technical benefits, but it also encourages services innovation and customer demand, attracts investment and helps foster local ICT (Information and
Communications Technologies) market development by fostering the efficient, reliable, and cost-effective exchange of traffic. acting as a logistics center of sorts for the Internet where economic activity is fostered in part by the availability of capacity at lower costs.

Since the moment when engineers started connecting networks to form the Internet, commercial relationships and agreements related to the exchange of Internet traffic were, and still are, different when compared to existing legacy networks.

Prior to the Internet, interconnection was largely based on the traditional telephony system. A traditional phone call takes very little bandwidth and is typically symmetrical (the same amount of bandwidth on both directions), as opposed to asymmetrical bandwidth, which is typical of Internet usage (usually, more download bandwidth than upload). The economics of traditional telephony agreements were based in call termination minutes. The parties involved negotiated the value of terminated minutes (not bandwidth) so there was a genuine commercial interest from both parties to interconnect, even if this meant paying for or sharing the costs of international capacity. For international phone calls, the prices related to the exchange of traffic minutes between networks had been traditionally specified through the International Telecommunication Unions (ITU)Accounting Rate System. For several decades this system generated revenues to companies in developing countries, independently of the local development of telecommunications infrastructure. However, the emergence of competition in the local and international telephony services placed pressure on the traditional Accounting Rate System in favor of encouraging by bilateral negotiation between carriers for call termination.1

Conversely, for the Internet, bandwidth usage (and not minutes) is an important part of the economics of the Internet, along with the associated application and/or content. In addition, the terminology and methods in which networks on the Internet connect differs significantly from that of the traditional telephony world. Understanding the basics of the unique way networks on the Internet exchange traffic between one another is important for policymakers, regulators, and network operators to understand in order to make decision that will improve the economic and technical efficiency of their infrastructures.

Interconnection - past and present for developing countries.

As recently as the mid 1990s, many countries around the world, not just developing countries, had limited local, regional, and international interconnections between networks. This was due in large part to the fact that, at that time, most content that users wanted to reach was located in the United States. Even in Europe for example, many ISPs had their own independent international connection to the United States with very little interconnectivity between European countries.

In the last decade, however, Europe's interconnection landscape has matured considerably. Regulatory changes in the European telecommunication market allowed multiple operators to establish infrastructure and services across Europe. Introducing these pan-European fibre links and services meant that traffic stayed and could be
aggregated in the region, which also provided an incentive for the development and local hosting of content on the continent. Currently in Europe, a number of Internet Exchange Points (IXPs) are now in operation in different European cities (i.e. Amsterdam, London, Frankfurt, and others). A significant amount of traffic is exchanged within the European region and ISPs can offer to their customer bandwidth at very low cost. In fact, many European IXPs and network operators have come to rival their US counterparts as hubs for international network interconnection.

The USA is no longer the center of the Internet for Europe Henk Steenman (Amsterdam Internet Exchange; AMS-IX).

Many developing regions have yet to experience the growth in infrastructure and services as their European counterparts, but have the ability to experience a similar transformation. In fact, many developing regions are currently on a similar path to positive change.

Today, local networks in developing countries have matured not only in terms of their infrastructure, but also in terms of their role in the global Internet. Increasing broadband penetration has provoked an explosion of bandwidth consumption around the globe and particularly in developing countries which are experiencing very strong growth in Internet usage. With more bandwidth available, users traffic patterns have changed from downloading email and web services in the early days of the Internet to the predominance of peer-to-peer applications, web 2.0, direct downloading, social networks and multimedia services. Thanks to the growth in global traffic share from developing countries, additional infrastructure is now built connecting these countries at lower costs.

Like in Europe, local traffic growth also requires additional efficiency in local, regional, and international traffic exchange in developing regions. This efficiency is achieved through the promotion and development of additional interconnections between networks locally and regionally. In order to scale, local networks need to exchange local traffic locally instead of using their upstream links to reach other local networks.

Diverse and reliable local, regional and international interconnections will contribute to the reduction of costs by avoiding the use of expensive international links for purely local communications; the improvement of the users Internet experience by reducing the time needed to obtain content (improving the responsiveness of the network); and, help attract new investments in the ICT sector. Achieving a successful interconnection plan for any organization requires skills in network engineering, telecommunications, regulation, negotiation and entrepreneurship.

What organizations play a role in Internet interconnection?

An Autonomous System is an IP based network, that identifies itself on the Internet as a unique entity that exchanges its traffic with other networks under a consistent traffic
routing policy. Based on an evaluation of Autonomous System Numbers assigned, there are more than 30,000 entities that interconnect and exchange data to make the Internet what it is today. Autonomous Systems do not just include local ISPs. They are a diverse group of players that includes a broad spectrum of network service providers, Internet content providers, backbone networks, and other entities that pass traffic between one another. Before discussing the opportunities and challenges of interconnection, it is important to identify the different actors involved in this process:

Internet Service Providers (ISPs): These companies own or lease last-mile networks that bring Internet access to the end-users. They use a great variety of technologies such as wireless, digital subscriber line (DSL) or cable-modem. ISP residential customers both consume and generate Internet content.

Content Providers (CPs): CPs act as content factories. A CP may have presence in a reduced number of data centers around the globe; however, in the last 5 years, many CPs have increased the distribution of traffic by installing new nodes in different countries or using Content Delivery Networks (below). Examples of CPs include media companies (distributing films, music or videos), streaming services, e-Government, e-learning, e-commerce, social networks or software companies that use the Internet to distribute their products.

Regional/Global Transit providers: These networks are usually global providers of connectivity. They normally provide access to the global Internet for ISPs, allowing them to access distant networks.

Content Delivery Networks (CDNs): CDNs act as local warehouses and transport providers for content. CDNs have servers in many data centers distributed around the globe and their main customers are CPs. An example of how CDNs are used is when a software company is about to release a new version of its software. By hiring a CDN to distribute its content, CPs can cope with very high short-term demand from end-users without needing to own infrastructure around the globe.

Internet Exchange Points (IXPs): IXPs are meeting points for all entities to facilitate interconnection. At the IXPs everybody shares a common infrastructure. Thus it is simple and, in most cases, inexpensive to access high bandwidth at an IXP. The availability of IXPs is central to allowing local, regional or international interconnection, particularly for the smaller networks.

Infrastructure Operators: Interconnections need availability of infrastructure such as data centers and data transport (local, regional or intercontinental). Particularly important are the submarine cable operators as most of the Internet regional and international traffic use these infrastructures.

Private Companies and/or Universities: These organizations often interconnect in order to improve their Internet access by adding multiple providers and reducing their access costs.