Telematics and Informatics 33 (2016) 631–640

Contents lists available at ScienceDirect

Telematics and Informatics

journal homepage: www.elsevier.com/locate/tele

Localizing Internet infrastructure: Cooperative peering in Latin America

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ARTICLE INFO

Article history:
Received 7 March 2014
Received in revised form 26 May 2015
Accepted 19 August 2015
Available online 28 August 2015

Keywords:
Internet interconnection
Development
Latin America
Cooperative models

ABSTRACT

This paper offers an overview of the changes in the Internet interconnection regime in the past decade and their key implications for the development of Internet infrastructure in developing regions based on the Latin American experience. The main argument presented is that changes in market conditions and Internet traffic patterns over the past decade have favored the search for new interconnection arrangements between actors located at the outer edges of the traditional Internet topology. Driven by the need to control operating costs and optimize content delivery to end-users, network operators in Latin America (and elsewhere in developing regions) are increasingly experimenting with cooperative peering arrangements to meet interconnection needs. The evidence suggests that these new arrangements are resulting in multiple benefits to local Internet ecosystems, among them reduced transit costs, greater network redundancy, improved service quality, new infrastructure investments and better technical coordination among operators.

1. Introduction

As a network of networks, the Internet critically depends on adequate arrangements for traffic exchange between the different participants in the Internet ecosystem. These interconnection contracts have changed significantly over the past decades, driven by changes in policy frameworks, in the scale of Internet traffic and its patterns, and in the goals and incentives of participating actors. The hierarchical, U.S.-centric Internet architecture that characterized the 1990s has given way to a flatter and more globally dispersed network populated by a less homogeneous set of market actors. While these changes have disrupted the existing interconnection regime, at the same time they have allowed the emergence of new cooperative arrangements by actors located at the outer edges of the Internet topology.

This paper offers an overview of these changes and their key implications for the development of Internet infrastructure in emerging countries based on the recent Latin American experience. To a large extent, this analysis can be extended to other developing regions, though variations in infrastructure deployment, policy frameworks, geographical location and other factors must be considered in each particular case. The main argument presented is that changes in market conditions and Internet traffic patterns over the past decade have favored the search for new interconnection arrangements between network operators in emerging countries. Driven by the need to control costs and optimize content delivery to end-users, network operators in Latin America (and elsewhere in developing regions) are increasingly experimenting with cooperative peering arrangements to meet interconnection needs. The evidence suggests that these new arrangements are resulting in

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http://dx.doi.org/10.1016/j.tele.2015.08.010
0736-5853/

multiple benefits to local Internet ecosystems, among them reduced transit costs, greater network redundancy, improved service quality, new infrastructure investments and better technical coordination among operators.

This paper draws from two types of primary data. First, personal interviews were conducted with representatives of key stakeholders, including Internet Service Providers (henceforth ISPs), content providers, Internet Exchange Point (henceforth IXP) operators, and relevant regional organizations such as LACNIC and LAC-IX.[1] Second, active network probes were deployed in Bolivia in order to obtain end-user measurements for different QoS parameters following the implementation of a new interconnection regime in November 2013. In addition, secondary data about interconnections arrangements in Latin America was obtained from various sources, including the Packet Clearing House (PCH)'s peering database and LAC-IX.

The paper is organized as follows: Section 2 provides a brief overview of the changes in the Internet interconnection regime over the past decade, with emphasis on the emergence of cooperative peering arrangements among ISPs in developing regions. This is followed in Section 3 by a more detailed discussion of the evolution of such arrangements in Latin America. Section 4 documents the impact of IXPs in Latin America, drawing evidence from case studies in Argentina, Brazil, Bolivia, Colombia and Ecuador. Section 5 offers policy recommendations for stimulating cooperative arrangements for local traffic exchange while preserving the light-touch regulatory approach that has allowed the Internet to flourish.

2. The evolution of Internet interconnection

At its core, the Internet is a sparse mesh of independent networks that exchange data packets using a common set of communication protocols. These independent networks are administered autonomously, serving different goals and occupying different spaces in the Internet architecture. In the early days (until the mid-1990s) the Internet presented a clear hierarchy between a few large networks interconnected at the core (the so-called Tier-1 operators, by and large located in the U.S. and Europe), and a vast number of national/regional (so-called Tier-2) and local (Tier-3) networks. As Faratin et al. (2007) argue, the key distinction between these networks was their size, measured by geographical reach, traffic volume and number of customers. Yet they were remarkably similar with respect to the services offered and their traffic patterns.

The result was an interconnection regime characterized by two basic types of contracts:

1. *Peering.* In a peering agreement two or more network operators (e.g., two Tier-1 operators) agree to exchange IP traffic at no cost by providing each other access to their customer base. The decision to peer is a matter of negotiation between the parties, and generally requires that networks share similar characteristics in terms of network capacity, geographical coverage and QoS. Since peering is settlement-free, these requirements seek to ensure that costs are approximately symmetrical between peering parties. Peering can be further divided into *private peering*, in which two parties establish point-to-point transport between them over a dedicated link, and *public peering*, which refers to the exchange of traffic at third-party locations to which other operators are also connected.
2. *Transit.* In a transit arrangement, a network operator (e.g., a local ISP) pays another operator (e.g., a backbone provider) to deliver packets to any Internet destination, and to receive packets from any destination. Typically, transit is sold at a single rate (expressed in price per Mbps per month) regardless of the origin/destination of the packets. While volume discounts are typical, the key fact is that rates do not vary according to actual delivery costs (e.g., whether traffic is offloaded on-net or off-net, whether it is delivered to a neighboring network or to a network in a different continent, and so forth). As Valancius et al. (2011) show, this crude form of pricing is one of the factors that has led ISPs in developing countries to search for alternatives to transit.[2]

It is important to note that, while in a peering arrangement the parties will only have access to each other's downstream customers (in other words it is not transitive to other agreements the parties may have), in a transit agreement the paying party buys access to all Internet destinations from the selling party. Peering therefore requires agreements with multiple other parties in order to reach all possible Internet destinations, while a single transit connection allows a network operator to access the entire Internet.

Until the early 2000s, peering arrangements were by and large limited to the large backbone operators located in developed countries, while in the outer edges operators typically bought transit in order to reach these core networks (where much of the content was hosted) as well as to exchange traffic with other network operators, even geographically adjacent ones. This often resulted in international tromboning, a practice whereby adjacent ISPs in emerging countries exchanged traffic not bilaterally but rather over international transit routes provisioned by backbone operators. This practice increased costs and decreased service quality for customers of networks at the bottom of the Internet hierarchy (Lie, 2007).

[1] LACNIC is the Latin American and Caribbean Internet Addresses Registry, responsible for assigning and administrating Internet numbering resources, Autonomous System Numbers (ASNs), and other resources for the region of Latin America and the Caribbean. LAC-IX is an association of IXP operators in Latin America and the Caribbean.

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