

“Institutions, regulation and governance of the internet;

A European perspective on traffic, uses and business practices in the digital economy”

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Abstract

The business of the internet behaves distinctly differently in Europe from elsewhere, belying clichés about the digital economy being “global, flat and neutral”. Those differences are mainly associated with distinctive business practices and they are manifest in the architecture and dynamic features of digital traffic, the business models that are built upon that system, and the governance that applies. In this paper we describe these differences and show how the structure of competition, regulators and other governance mechanisms define an economic model for Europe distinct from that of the US and elsewhere. We base our analysis on evidence about the type, volume and routing of digital traffic. We show that in addition to the vast differential in revenue accrued through different types of traffic (e.g. SMS, voice, streaming videos, software downloads, etc.) there are great differences in the profitability that different stakeholders in the digital economy can command. These differences stem from different strategic uses of the internet architecture, different market structures, and crucially differences in the institutions and governance of the European internet.

1. Introduction -

1.1 The problem: European vs. US abilities to exploit the changing internet

Since the mid-2000s the structure of the communications network has been altered to accommodate rising traffic demand, new uses of digital technologies, and especially new business models. For companies such as Akamai, Amazon, Google, Netflix, Spotify, and Facebook, and others operating as content delivery networks (CDN), cloud services, video/audio providers and social networks, these new business models constitute their

purpose. They help to define the very character of the internet, as we currently know it. Their ability to carve out new operating realms has altered their relationships with network owners.

Over the past year, debates leading up to the 2012 ITU World Conference on International Telecommunications have cast new light on the interrelated interests of national governments, telecommunications companies and all those who do business on or simply use communication networks. While much of the discussion has centred on the idiosyncratically interpreted term “net neutrality”, beyond this is a dispute about who pays for what on the infrastructure, and how different types of traffic can be charged for. Underlying these debates are suspicions that those who control infrastructure might be setting too high prices, that those using the infrastructure are failing to pay their way and free-riding, that those who create disproportionately high demand are paying the same as those whose demands are modest.

European telecom operators providing the backbone of the infrastructure that supports this usage and expansion of the internet have been slow in modifying their revenue streams to accommodate these changes. Meanwhile, the institutions governing the internet have maintained much of the autonomy from national governance and regulators that they have enjoyed over the past four to five decades. This situation is changing as European telecoms operators feel increasing popular, political and competitive pressure to deliver high quality services.

European researchers developed many of the modern protocols of the internet such as hyperlinks and the world wide web. Europeans have also embraced earnestly the use of the internet and the attraction for many internet companies is the extent to which Europeans are intensive users of the major digital services such as Facebook, 3 and 4-G on-demand video, machine-to-machine connectivity for monitoring and surveillance, e-government services, and SMS. European users are disproportionately sophisticated, wealthy and well educated. Nevertheless, despite Europe’s tremendous capabilities (through excellent broadband, education systems, privacy and intellectual property regimes, etc.), there is a dramatic absence of European companies providing emerging digital services and products, and no major content delivery network. Aside from the BBC and its use of iPlayer, there are no major European content producers or any major European software platform controller. The major profits for all these digital economy businesses accrue to US companies and their European counterparts are both smaller and less profitable.

Table 1 shows the major players in the digital economy within Europe and demonstrates that those engaged in the highest profit sub-sectors, applications, software, retailers, social media,

devices and content delivery are dominated by U.S. firms, while the low profit transport services are dominated by European companies. Some of the dominance of European transport services within the EU can be explained by limitations in the openness of the market but some can be explained by the disincentives of U.S. companies to invest in such services within Europe.

The problem, in summary, is that while the architecture, dynamics, usage and business models of the internet are changing, value added in the European digital economy is not accruing to European companies¹. While some of this can be attributed to inefficiencies, inadequate innovation and incompetence of European businesses versus their U.S. counterparts, in this paper we describe the reasons associated with structural and governance features.

Type of digital category	Specification	Company
Services and applications	ASP	Google, Yahoo
	Software	Microsoft, Oracle, *SAP, Symantec, CA, Vmware, Adobe Systems, Intuit
	Retailers	Amazon, Ebay, Netflix, Expedia
	Social media	Facebook, Linked-In, Snapfish, Flickr
Devices Transport		Photobucket, Webshots
		Apple, RIM, Cisco, *Nokia
	CDN	Akamai, Level 3, Cogent
	Fixed/Integrated	*Telefonica, *BT, *Orange, *France Telecom
		*Deutsche Telecom, *Telecom Italia, *Verizon AT&T
	Mobile	*Vodafone, *Telefonica, *Orange, *VimpelCom [WIND], *TeleSonera, *Telenor
		*Tele2, *T-Mobile
	Cable	*Virgin Media, *Sky

Table 1: Exemplary players in the major digital categories operating in Europe. * Indicates European companies

1.2 The role of regulators in Europe and USA – Catalyst of Actions

Since 2010 stakeholders have fostered debates on how regulators, ISP, telecom operators and internet companies view the economy of the emerging internet. The list below² shows exemplary cases and we assess two to highlight the complexity of the problem.

- November 2010: After internet backbone provider Level 3 signed a deal with Netflix to distribute video, Comcast demanded money from Level 3 for carrying traffic over the "last mile" to Comcast subscribers.

¹ Examples of this debate are the discussion on OTTs as “free riders” vs telecom operators as “rent seekers”, see <http://www.project-disco.org/competition/081513-rent-seeking-and-the-internet-economy-part-1-why-is-the-internet-so-frequently-the-target-of-rent-seekers/>

² <http://arstechnica.com/information-technology/2013/07/why-youtube-buffers-the-secret-deals-that-make-and-break-online-video/>

- January 2011: European ISPs Deutsche Telekom, Orange (formerly France Telecom), Telecom Italia, and Telefónica commissioned a report claiming that companies such as Netflix and Google (for YouTube) should pay ISPs a lot more money than they are currently charged.
- August 2011: Cogent, another internet backbone provider that handles Netflix traffic, filed a complaint in France against Orange, claiming that the ISP provided inadequate connection speeds.
- January 2013: Free, a French ISP, was accused of slowing down YouTube traffic by failing to upgrade infrastructure (but is later cleared of intentionally degrading YouTube traffic by the French regulator). Free also temporarily blocked advertisements on YouTube and other video services by sending an update to its modems.
- January 2013: Orange and Google had a similar dispute, with Orange CEO Stephane Richard claiming victory. He said that Google is paying Orange to compensate the operator for mobile traffic sent from Google servers.
- January 2013: Time Warner refused Netflix's offer of a free caching service that would provide better performance to Netflix users on Time Warner's network.
- June 2013: Cogent accused Verizon of allowing "ports" between the two providers to fill up, degrading Netflix performance for Verizon customers.
- July 2013: The European Commission opened an antitrust probe into whether ISPs abused market positions in negotiations with content providers. It searched the offices of Orange, Deutsche Telekom, and Telefónica. Separately, the French government demanded details of interconnection agreements involving AT&T and Verizon.

2. Regulatory Evidence

2.1 Case 1: Cogent Communications vs. France Telecom: Internet traffic and peering agreements under French competition law

In 2005, Cogent, a US internet services and data transport company, signed a data transit agreement with France Telecom through Orange's transit operator business, Open Transit. Six years later France Telecom refused Cogent access to the French network. According to the original "peering agreement", the exchange of data between networks, usually free, was subject to "peering fees" when traffic between transit operators becomes asymmetric. The

contract stated that France Telecom would charge a fee to open new capacity if the incoming traffic on its network was 2.5 times higher than its outgoing traffic. The purpose of such a policy was to protect France Telecom's domestic network, Orange, from congestion. At this time, Mega Upload – which has since been shut down by U.S. authorities – was a customer of Cogent. The amount of video uploaded by subscribers of Orange caused a strong asymmetry in the traffic (up to 13 times greater in one direction than in the other). France Telecom asked Cogent to pay for the opening of additional capacity of interconnection. Cogent challenged this demand, claiming that it was a violation of the antitrust laws and, among other things, that France Telecom was compromising the peering system.

This case illustrates what can happen when internet traffic and peering agreements meet French competition law (David, 2012). The core issue was the refusal by the incumbent to let the low cost ethernet service provider connect to its network in France (Fierce Telecom, 2011), with arguments that it constituted an attack on net neutrality principles (ARCEP, 2012a).

The French Competition Authority (Autorité de la concurrence) held that France Telecom's demand was not anti-competitive (ARCEP, 2012c). France Telecom did not refuse to give Cogent access to its network. Between 2005 and 2011 France Telecom opened several times, for free, new capacity to meet Cogent's demands. However, it asked Cogent to pay for the opening of new capacity in accordance to its contract regarding peering, without challenging the capacities already provided. The court explained that such a demand was not unusual in the internet industry in case of traffic asymmetry. In this case, the demand was held to be legitimate because the traffic was highly asymmetric and Cogent was aware of its contractor's peering pricing policy.

Even though France Telecom's request was held to be legal, the Competition Authority pointed out the lack of transparency and formalized relationship between the domestic network of France Telecom/Orange and its transit operator business, Open Transit. It held that this situation made it difficult to control potential margin squeeze and discriminatory practices, which therefore eased the implementation of such illegal practices.

The consequences of the discrepancies on how to address the issues of internet neutrality have been for the French telecommunications regulator, ARCEP, to raise a First Commitment Decision in September 2012 (ARCEP, 2012b and David, 2012):

“Three types of stakeholders operate in the internet connectivity market: a) internet service providers (ISPs) such as Orange (part of France Telecom), which provide

internet access services to end-users; b) content providers; and c) transit operators, such as Cogent or France Telecom.

The internet connectivity market comprises exchanges of internet traffic between ISPs (including France Telecom/Orange) and among ISPs and content providers and transit operators (such as Cogent). In general, ISPs and content providers purchase transit services from one or more transit operators in order to connect to the internet and deliver traffic to the internet users. However, ISPs are also able to connect with each other directly, without a transit operator, via “peering” agreements that consist in traffic exchanges without payments. These peering agreements are commonly free of charge, but some peering agreements may involve remuneration if the traffic exchanged between the operators is not balanced.

In the case at stake, Cogent claimed, inter alia, that France Telecom compromised the sustainability of the peering system by requesting payment for opening up additional technical capacity for access to the subscribers of its ISP subsidiary, Orange.

Pursuant to France Telecom’s peering policy, which is also adopted by most other transit operators in France, and was specified in its contract with Cogent, a fee may be charged where the requested traffic capacity exceeds a determined traffic ratio.

In consideration of the high asymmetry of traffic exchanges between France Telecom and Cogent, the Autorite, in its decision, did not express concerns on the payment required by France Telecom, based on the elements known in the case at hand. However, the Autorite was concerned by the lack of transparency in the relationship between Orange as an ISP and France Telecom (“Open Transit”) as a transit operator, due to the absence of formalization of their internal exchanges. More transparency in their business relations could help to detect possible abusive margin squeeze or anticompetitive discriminatory practices in the future.

In view of the mentioned concern the Autorite obtained from France Telecom the following commitments, to:

- i) Define a formal internal protocol between Orange and its transit division Open Transit specifying the conditions for the provision of internet connectivity services France, and
- ii) To implement a monitoring system of the internal protocol.

Following the market test, which proved positive, these commitments were made binding by the Autorite for a period of two years. The Autorite will remain vigilant during this period.”

France Telecom proposed to formalize and monitor the application of an internal protocol between Orange and Open Transit describing the technical, operational and financial rules applicable to the supply of interconnection services. Following some consultations and adjustments, the Competition Authority decided that these commitments were relevant, credible, and verifiable and made them mandatory. In the event of future litigation, they should enable the Authority to verify that France Telecom has not implemented discriminatory or margin squeeze practices against competitors.

2.2 Case 2: Studying the raising importance of internet exchanges

Most of the methods used to understand the growth and direction of the internet focus on compiling data that measure autonomous system numbers (ASNs), traffic, transit and peering agreements (Claffy 2011a & b), or connection speeds (Clark et al. 2011). However, each of these counts is only partially accurate and none are complete with regard to the totality of digital traffic, with much of it focusing on the U.S. market. Much traffic is carried over private networks and is very hard to investigate and measure (Claffy 2009). Traffic data sources also include ASNs, peering traffic, classified traffic by type (as with the Cisco VNI data, 2012), reports on traffic volume by Renesys (2012), Akamai (Belson et al. 2011 & 2012) and Sandvine (2011 & 2012) and data compiled by the International Telecommunications Union (ITU 2011). Other reports, such as the description of ASNs consolidation by Telenor (Hallingby and Erdal 2011), and industry reports on pricing and related topics (e.g. Howard et al. 2011) provide further evidence.

Data access problems and information asymmetry have long prevailed in the internet economy. Numerous not-for-profit and educational organizations monitoring the internet, such as CAIDA (Claffy 2008c; CAIDA “WIE 2012”) have worked to overcome this handicap. Contrary to a widespread commercial belief that reports from Cisco, Google, Akamai, Netindex, Sandvine and others present an adequate commercial view of the internet, the sheer volume of assumptions and different metrics used to provide the analysis and forecasts of such industry reports makes it difficult to get a comprehensive view of multiple areas of the internet.

Although the Internet Engineering Task Force paper on terminology for describing interconnection [RFC 4084] (Klensi, 2005) is very clear on the definition of internet connectivity, current and evolving business models, particularly those used by Google, Akamai, Facebook and others go beyond the five categories used to describe interconnectivity: web connectivity, client connectivity only-without a public address, client only-public address, firewalled internet connectivity, and full internet connectivity. These companies and others are able to provide business models that mix some of these categories not only at the service layer but also at the network and transport layers.

It is also clear that the data dearth is not a new problem in the field; many public and private sector organizations have tried and failed to solve it because, as with the Cogent case in France, the meaning of traffic and its form of monetization are disputed. In 2001 CAIDA, with the support of the US National Science Foundation, tried to create an internet measurement data catalogue to support sharing of internet measurements, but the presumption of data sharing among multiple stakeholders was necessarily limited because the real obstacles for data sharing are economic (time and money), ownership (legal) and trust (privacy) constraints.

Thus the research community continues to be handicapped by inadequate data for network research. The traditional model of getting data from public infrastructures to inform policy making has led to mixed results. Regulators have tended to be reluctant to force disclosures of how the internet is structured, used and financed (Houle et al., 2007). However, the opaqueness of the infrastructure to empirical analysis has generated many problematic responses.

Internet exchanges (IX) in Europe, where public peering arrangements and sometimes traffic volumes are well documented, provide ample opportunity to perform necessary analyses.ⁱ The same cannot be said of transit (Telecom Paper, 2012) where we are limited to a range of consultancy data and telecommunication firm internal reports linking data from disparate sources to pricing and quantity of traffic (Valancius 2011). To understand the forces driving the internet, and crucially the innovation processes that take place within it, we need a much more detailed and coherent view of the scale and character of traffic. We also need new kinds of qualitative evidence relating to the role of regulators and of interactions among developers, network managers, telecommunication systems operators, fixed and mobile platform owners and other stakeholders such as big users and consumers groups.

For business models analysis, we turned to consultancy reports such as those by the Boston Consulting Group (BGC 2011), Analysis Mason (Kende 2012), Plum (2011), and AT Kearney (2010a & b), company annual reports, specialized reports on particular technologies, industry intelligence bulletins and published materials of all kinds from organizations representing the industry. There are similarities and differences in the regulatory approaches from both sides of the Atlantic. We must consider declarations by regulators about their own initiatives based on government or international policy guidelines, reports commissioned by industry players such as the Cullen Reports (2012), those released by the Body of European Regulators for Electronic Communications and consumer group reports. Furthermore, the debate on regulation is often presented as a binary choice between self-regulatory regimes versus stringent and structured frameworks, when in reality the picture is more multidimensional than that and varies among geographic regions (BEREC 2012).

3. Internet exchanges: a starting point for analysis

We start with aggregate estimates of national traffic for Europe generally and then for Europe's three dominant internet exchanges, those in London, Frankfurt, and Amsterdam. We can then analyse these aggregates in conjunction with our own qualitative assessment of the categories provided by Cisco or those used by specialist industry analysts (such as Quantum-Web, 2012). We have chosen to use either one or the other according to careful definitions of categories, and in some cases we have felt it necessary to devise our own categories based on relevance or on what we believe European IX are able to provide, and to account for likely multiple counting. Additionally we have compared whether the ASNs can be categorized as is done by Hurricane Electrics, ALEXA or similar categorization techniques (Alexa 2012). We have reflected these data back to Euro-IX data to minimise multiple counting.

This sheds light on the extent that competition, control and convergence are at the core of the changes for the emerging internet. Just as there is not one internet, there is not one single measure that captures the key features, even for as straightforward a question as, "*how much internet traffic is there?*" One internet is the direct successor of the ARPANET, an internet of commons where largely undifferentiated net neutrality principles and universal access principles apply. Most of the current debate on net neutrality focuses on this internet. However, a second internet has emerged, and it can be portrayed as driven by commercial interests and is composed of multiple networks providing specialized content with varying quality and services requirements.

3.1 Private and public peering: relevance and change

European internet traffic has traditionally been routed through transit contracts where smaller ISPs buy access to the whole internet through a layered model of access by using a Tier-1 provider that might be telecommunication network operators or global ISPs. The ISP often physically connects in a facility operated by the Tier-1 provider. Increasingly this is changing whereby multiple ISPs connect instead in about 250 internet exchanges around the world, more than half of them located in Europe. Euro-IX, the regional association of exchanges, has 139 members (Euro-IX, 2012).

While public peering allows many networks to interconnect via a more cost-effective shared connection, private peering is the direct interconnection between only two networks, across a Tier-1 or Tier-2 physical medium (e.g. direct cable or fiber connection) that offers exclusive, dedicated capacity. Early in the history of the internet, many private peering arrangements occurred across circuits provisioned by telecommunications operators at individual carrier-owned facilities. Today, most private interconnections are made at exchanges or telco-neutral co-location facilities, where a direct cross-connect can be provisioned between participants within the same building. IP transit is a simpler form of interconnection. Most Tier-1 and some large Tier-2 ISPs are willing to sell dedicated access to their networks via private leased-line circuits. However, because of the resources required to provision each private peer, many networks are unwilling to provide private peering to small networks, or to new networks that have not yet proven that they can provide mutual benefit. Some companies, such as Facebook, actively engage in searching for many peering partners to increase the perceived quality of access to their pages (see their company policy described at <http://www.facebook.com/peering/>)

Very large content providers are also contracting with content delivery networks, or building their own private networks - as Google does - where they use private peering. Very large backbone providers (such as Level 3 or Cogent) engage in private peering arrangements as they challenge even large incumbents in Europe with global ASN accessibility. There have been several published cases of disagreement (such as between the French regulator and France Telecom vs. Cogent) leading to temporary service interruptions for users in Europe.

3.2 New roles of internet exchanges

An internet exchange can in some ways be compared to a switching station, where different internet service providers or system stakeholders connect to each other. Smaller ISPs who

serve a region or parts of a country will be able to exchange traffic with each other rather than buying transit from a large backbone/core/global ISP/upstream provider. A large internet exchange point, such as AMS-IX in Amsterdam or LINX in London, may bring together hundreds of Tier-1, Tier-2, and Tier-3 ISPs, CDNs, hosting service providers, mobile companies and others. In the case of AMS-IX this amounts to more than 500 ASNs.

In contrast to those in the US, European internet exchanges are mainly operated by academic or non-profit membership organizations. In the US data centre providers such as Equinix and Telehouse typically offer internet exchange as a commercial service. Most countries in Europe have at least one exchange that keeps domestic traffic within the country. In this sense, IX are contrived monopolies and due to risk of traffic capture, conflicts of interest, and mistrust among competitors, an independent company is most often in charge of the premises. This does not mean, however, that exchanges do not differentiate among customers (BEREC, 2012).

Public peering points could become overloaded and create sources of packet loss, which results in the current standard of "best-effort" level of service. However, IX in both Europe and the US strive to equal the performance of private peering connectivity and most European exchanges move large traffic volumes without significant packet loss. Unlike the bidirectional private arrangements, public peering enables multiple streams of traffic. The business arrangements for the cost of traffic are estimated using economic assumptions based on balanced and best effort levels of service (Clark et al., 2011)

The vast majority of internet exchanges worldwide apparently consist of not-for-profit associations of participating internet service providers (Mitchel, 2011). Much of the data on public peering traffic is available through the IX, but very little detail is openly available on private peering arrangements. Exchanges themselves in many cases do not monitor this traffic because by bringing together enough peering partners, running costs and new equipment are paid for.

3.3 European exchanges offer different business models from US counterparts

Let us consider the core commercial characteristics of internet exchanges. Business models for peering affect how internet traffic is routed and look different in Europe from the US. The US internet exchanges are mostly large-scale commercial operations that combine co-location services with public peering, while European IX separate out co-location services from the operation of the switch fabric. The operation of the internet exchange fabric is generally

offered by a not-for-profit association of the peering participants.

These associations have a budget and staff to operate the infrastructure on behalf of the associated members and seek to provide the best service possible for the lowest possible price. While they need to maintain enough cash for working capital and anticipated upgrades they are also required not to make a profit from their activities. This is why European IX tends to lead worldwide in dropping prices. An overview of the differences between European and US internet exchanges is provided in Table 2.

The difference between the structure and governance of European and US IX is further evidence that we can no longer describe a singular, worldwide model of the internet. Rather, we need to regard the internet as a patchwork of interconnected networks that differ significantly between regions. Business models for connecting networks through public and private peering consequently differ in Europe and the US.

European IXs are spread across multiple co-location providers whereas US-based IX are generally contained within the same co-location provider building or specially designed locations. One implication of this is that an ISP can choose a co-location provider with a different mix of price/product/service and there is an open market for co-location space. There is comparably little negotiation room with the co-location provider if one needs to be at a particular internet exchange in the US.

The aggregate volume of traffic over the public peering fabrics tends to be historically larger in Europe than in the U.S. The technical experiences of large European IX in public peering could in the future benefit US IX because of their experience in handling large-scale traffic (Mitchel 2011). As the US based IX are often for-profit operations it is part of their business model to provide commercial value such that the more interlinked the customer base, the more difficult it is for customers to leave; IX have the ability to lock-in their customers (SeekingAlpha, 2011).

4. Internet modularity, new topologies and business model impact

The ways internet exchanges works are keys to understanding how business models are shaped by changes in the structure of the internet towards a modular architecture. The growth of IP traffic volumes fuels cost increases both with regard to capital expenditures and

operating expenditures but the average revenue per end user for internet access is flat or decreasing in Europe (ITU 2012; ATKearney 2011). The International Telecommunications Union (a UN body) now claims that world fixed broadband prices fell 75% between 2008 and 2011 (ITU 2012). Increasingly, traditional telecommunication services are provided by IP networks and the prospect is that legacy networks will be fully substituted for by IP networks. Already, new services such as video streaming require high quality of service [QoS] standards for delivery over domestic networks. This need gives an opportunity to network operators to provide QoS delivery for certain services in order to get incremental revenues able to finance network upgrades and the introduction of new technologies such as fiber to the home. Moreover, it could allow other internet companies to increase their customer base and extend the services they can provide.

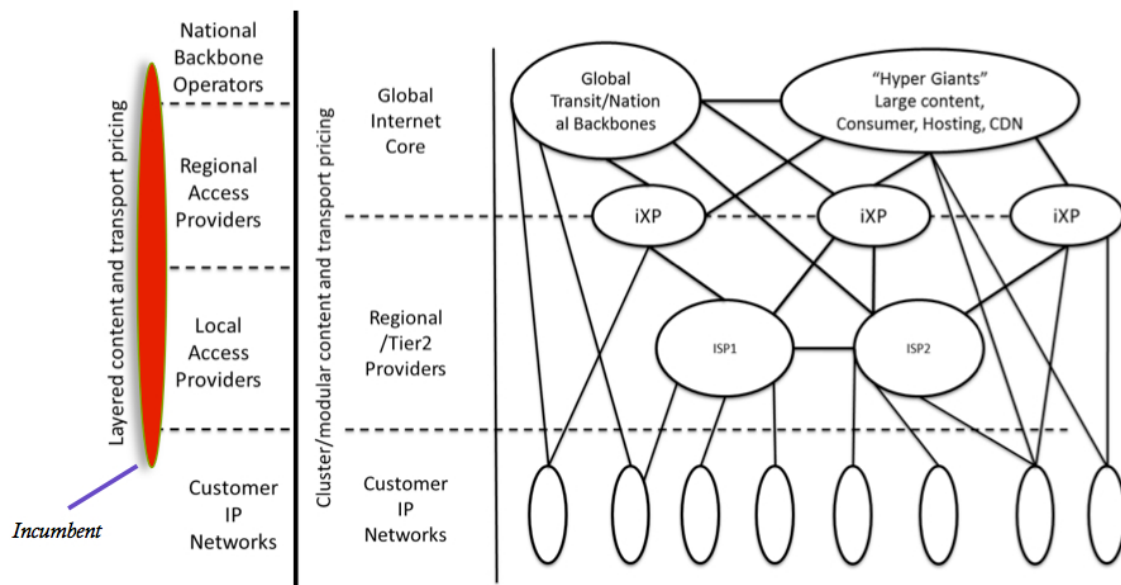
	Legal neutrality modes of operation	Governance mode	Type of peering agreements available	Pricing goals	Pricing flexibility
European IX model	Carrier-neutral ISP-neutral co-location-neutral	Not-for-profit formal member association	In any co-location company that has the peering fabric installed	Recover costs	Fixed – every member pays the same
US IX model	Carrier neutral ISP-neutral	For-profit corporation	Only within the co-location operator's space using only the co-location operator's peering fabric	What the market will bear	Negotiable – important players may be lured in with preferential terms and pricing

	Contracts	Peering fabric distribution	Peering is predominantly	Information shared	Cross connects
European IX model	Co-location contract and IX member contract are required	Spread across potentially many competing co-location operators	Public	Openly	Run your own, inexpensive one-time fee, or low recurring fee to co-lo operators
US IX model	One contract for all co-lo locations and peering services	Spread only across the co-lo provider's data centers	Private	Selectively	Only co-lo operators can run core connects priced around \$300/month

Table 2: Comparison of internet exchanges in the US and Europe (based on Norton, 2012a)

A major reason for this change stems from infrastructure innovation fueled by users accessing more dynamic content on more devices. As the importance of online channels for the distribution of content grows, firms assume growing importance also of dynamically constructed and targeted content. Mobile and connected internet devices further affect new user behaviour.

In figure 1 below, we show how the standard internet model of four tiers has been replaced by a modular model of three levels (Liebenau et al., 2011), the worldwide internet core, regional providers, and customer IP networks. Assessing traffic at internet exchanges reveals how traffic is exchanged among these three levels, who the players are, and which practices are efficient for different types of traffic, either public or private.



Source: Labovitz (2010) and Liebenau et al (2012)

Figure 1: The change from a four-tiered vertical model to a modular internet model

Activity	Google	Microsoft	Apple	Amazon	Telecom companies
ASP	Search			Cloud	Cloud
Ecommerce	AdSense		iTunes Appstore	Amazon Store	
App Software	Docs	Office			
Operative System	Android	Windows	OsX		
Devices		Xbox	iPhone, iPad	Kindle	
Voice	Google voice	Skype			PSTN, GSM, RCS
Messaging Networks	Gmail Kansas Project	Messenger			Data serv Mobile, fixed, transit

Table 3: Internet companies' competition and modularity in bundles. Sourced Telefonica (2012)

This is also clear when considering the services these companies provide and how they overlap in the provision of digital services. In table 3 we illustrate this increasingly compact modularity of the internet. Internet companies seem to be able to provide with great success modular services and products to consumers, while telecom operators have been slow in innovating with products and services that can be offered in the same market. It can be easy to infer that the reasons for this situation are beyond the technical issues, there are other factors such as regulation and business models influencing the changes.

5. Changing architectures changing transit and peering business

Transit arrangements, along with peering prices have declined despite increasing traffic and this has occurred most significantly for those who have a strong bargaining position such as large media and entertainment firms. Anecdotal evidence indicates that prices for CDN services have declined with growing traffic for the last four years, and generally ranges between 1 and 12 cents per gigabyte in the U.S. Very large media and entertainment firms (those distributing more than 3 petabytes per month such as Netflix) only pay between 1 and 3 cents per gigabyte delivered (BlogStreamingMedia, 2012). The underlying reasons for lower transit prices might include decreasing peering costs in internet exchanges, and this practice is fueled by European exchanges continuously lowering their prices to protect their not-for-profit status. It is also the case that backbone costs fall as new multiplexing technologies allow ISPs to deliver traffic more efficiently (Norton, 2012a). While total peering costs for ISPs consist of IX peering cost and the international transit price to connect, transit costs include the circuit required for the ISP and the variable cost associated with the traffic carried upstream to the internet and depend upon co-location costs. Transit costs are sometimes called wavelength or capacity, and it is defined as transit cost equal to co-location cost + backbone cost + upstream port cost. In this case we refer only specifically to IP traffic or data traffic.

This form of interconnection is attractive for smaller Tier-2 and Tier-3 ISPs that may not be located near a public internet exchange point or other internet exchange. It can be inferred, based on current business models, that many lower-tier ISPs have neither the technical resources nor the traffic volume to justify a private peering relationship with a higher-tier ISP. In a competitive market for international transit, large internet exchanges enjoy economies of scale and offer lower prices for ISPs than in markets where peering prices are higher, as with

regional internet exchange points, where costs are affected by the number of members connecting to the exchange.

Incumbents could therefore be drawn into a race to the bottom for transit as the price they offer ISPs will depend on the sum of the remote transit price offered by competing backbone providers and the cost of remote peering in large European internet exchange points. They will instead concentrate on the downstream network activities that they have greater control over, especially those that are expensive and customer-facing. In this way the large IX in Frankfurt, Amsterdam, and London will drive down transit prices offered by incumbents in markets as far away as Eastern and Southern Europe.

Norton (2012b) believes that transit prices decrease on average by 30% per year in the US, but such claims are contested. For maintained profitability, sufficient economies of scale are needed in order to keep networks cost-effective while expanding capacity. In response to this, Deutsche Telekom, for example, prefers to be discriminatory in their choice of peering partners and to keep a policy of engaging in transit deals where they have tighter control over pricing. Another example is apparent from the conflicts between Cogent and France Telecom. As telecommunications companies are squeezed between increasing customer demand and content provider push, distorted market pricing is aggravating a misunderstanding of quasi-markets for traffic provision. Some telecommunications operators are actively accusing content providers and other internet businesses of being “free riders” on their networks.

6. Control over traffic; a major issue in the internet

Traffic can be described as fitting into three categories:

- Convergence enabling business integration e.g. cable providers as ISPs and media transport and content creators
- Digital services enabling “live” experiences, e.g. multimodal digital integration in real time
- Software platforms exclusively for digital services e.g. Apple, Google, advertisement, and some European mobile manufacturers.

So, changes to the internet architecture imply digital services and products provided through utilizing technologies and business relations in more than one layer. The consequence of these practices is that new business models have emerged. However, while most of these have fuelled increased traffic throughout the internet worldwide, their effect on regional markets has been distinct. Within the United States, partly because of the size of the market and of the

size of internet firms, and partly because of the small number of network operators, this shift in traffic demand has changed the bargaining power of actors. This is critical in the context of new, modularized internet.

The increased efficiency of European internet exchanges along with their not-for-profit status has driven prices down.ⁱⁱ However, there is no simple correlation between advances in technology, increasing carrying capacity, and cost. It is widely accepted that technology providing 4-10 times more capacity is only about twice as expensive. It is also the case that with the invention of peering, transit providers have made changes in their business models. The best example of this is the entrance of the likes of Level3 and Telefonica into the CDN market. One effect of this has been to squeeze prices for transit throughout Europe. Here again we see the effect of changes in traffic characteristics shaping the structure of the industry. Given that incumbent network operators are dominant players providing transit services in Europe, the prospect of decreasing prices and the shift to peering challenges their current business model.

In the short-to-medium term the strategic options for network operators appear very limited indeed. It should be no surprise that different pictures are used to describe the internet economy and that the strategic implications and public policy responses diverge. Some of these differences can be explained by differing conceptualizations of what the industry consists of and how those components interact. Some of them can be ascribed to outmoded, layered models of the technology and the roles of businesses within those layers. Much of it, however, can be regarded as a consequence of the extreme information asymmetries that analysts encounter whenever they attempt to understand the interrelationships that dynamically emerge and disappear. This analytical problem is a serious inhibitor of better relations with regulators and investors. While many incumbents are fully engaged in providing “status-quo plus” solutions as their primary business focus, the current internet trends weaken the European telecom industry’s bargaining power, revenue sources, investment credibility and present and future competitive edge on innovation (ETNO, 2012b). Given the combined pressures on network operators from customers and public policy initiatives to upgrade the infrastructure and their declining share values, the situation we describe demands reconsideration of how pricing, revenues, and the sources of funding for public initiatives are derived.

7. Conclusions

Clear choices appear as a response to the new structures and ways of doing business on the

internet. Either regulators and others engaged in governance can come to regard the internet as an essential infrastructure and govern it accordingly at EU-level or they can limit regulation to clear instances of market failure. The key is no longer a focus on either retail or wholesale pricing regulation, network access (through local loop unbundling) or interconnection rules, but rather a better monitoring of traffic and an understanding of how bargaining works for payments. Only then can we expect a properly governed market for digital goods and services that also maintains the infrastructure.

Two general irritants concern the industry and define governance disputes. One is that the changing digital economy has not been taken into account by regulators who maintain a strict distinction between incumbent network operators who are regulated, in differing ways internationally; by both price and product offerings while other participants in the network are largely unregulated. The other is that many management practices, strategic choices and relations with financial services differentiate strongly between network operators, who see their businesses literally as legacies of state-owned enterprises, and internet businesses. Practices that are common among leading internet companies are uncommon among network operators, such as detailed data mining, capacity monitoring, rapid shifting of routing, and the use of outsourced services. This affects their attitude towards competition, placing them too frequently in a responsive mode, unable to take the initiative to innovate and uncertain as to what the market response may be. This has had the effect of entrenching the business of infrastructure into a paradoxically vulnerable position with low barriers to entry into those more profitable services, especially now in the area of mobile internet services.

Our analysis holds implications for how more stakeholders, including telecommunication companies, can monetize the changes in the newly modularized internet. The trend seems to be to open up peering as an alternative to interconnectivity, along with changes in traffic patterns that pose major challenges to telecom companies. The current multi-stakeholder approach to pricing and business models – with norms of membership and handshake practices - especially with regard to public peering through internet exchanges, is challenged by both a shift from contracted transit to peering agreements and also from public to private peering arrangements. Furthermore, anomalies in peering such as the conflicts between Cogent and France Telecom invite just the sort of regulatory intervention that the peering community had sought to avoid at the outset (ARCEP, 2011d). Given the extremely high proportion of internet traffic that passes through European IX, it is not surprising that public interest would be expressed in the form of interventions to resolve disputes. Beyond dispute resolution, however, if systemic problems emerge with the structure of the IX then we can expect further, perhaps unwelcome, extensions of regulatory powers.

So far, European internet analyses have not taken into account the changing trends of traffic demand and the differences between the layered vs. the modular layer of the internet. Until that happens we cannot expect any form of governance to account for who pays for what goods and services, and consequently we cannot expect a smoothly working market.

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ⁱ AMS-IX for example provides a comprehensive data set, with historical data at <https://www.ams-ix.net/statistics>. Another source is EURO-IX with publishes reports from several of the IX in Europe at <https://www.euro-ix.net/europe>.

ⁱⁱ Our interviews among European incumbents support the view that a main reason for the fall in transit prices relates to falling peering prices in the internet exchanges.