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A critical analysis of the effects of internet traffic on business models of telecom operators

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1 Who pays for the internet economy?

We have experienced a dozen years of change since the radical restructuring of European telecommunications. While we have benefitted from increases in competition, a proliferation of diverse services, and the extensive dissemination of broadband, we have also experienced massive growth in digital traffic without any clear means to sustain the investments in network expansion and the innovation necessary to meet future demands. As network operators report dropping profits the expectations of policy makers and the public they respond to are becoming ever more ambitious. New research from the London School of Economics indicates that investment analysts who specialize in the industry are wary of the prospects of network operators to recoup their development spending. They are also perplexed by the position of regulators whose changing views on pricing and the inability of public authorities to subsidize the digital agenda directly introduce confusion into the assessment of prospects. Taken together with earlier LSE research, which shows that ICT investments are central to economic growth, we can see the critical nature of a stronger investment climate for telecoms (Liebenau et al. 2009; Bloom et al. 2007). Europe's ICT capital stock increased from 6-9% to around 20% between 1991 and 2010 compared to 30% in the US. This is a contributing factor to Europe having fallen behind the US in terms of productivity growth between 2000-2010 with the US experiencing an annual 2% growth compared to only 1% in Europe (GGDC 2011; Oxford Economics 2011). At the heart of the problem for furthering infrastructure investments in Europe is the changing character, as well as the growth, of network traffic. It is here that our analysis should start because it is here that we can best see that different forms of traffic each have their own characteristics and implications for businesses and users. Those differences stem from five key factors:

1. technical characteristics such as levels of compression, speed and latency requirements
2. types of receivers and customers, ranging from consumers of entertainment and social networking to businesses and machine-read data
3. commercial underpinnings and differing sources of revenue, ranging from paid-for services to advertising-driven businesses
4. consumer demand, fashion and expectations
5. differences in the rules of the game, usually as interpreted by regulators.

The question of "who is paying?" for rapidly increasing internet traffic is at the heart of current market and regulatory controversies in Europe. Recent massive growth rates for smartphone

and desktop video streaming have once again raised the likelihood of a scarcity in capacity for both wireless and fixed broadband networks. This growth is expected and appreciated by online service providers and the users who consume ever more digital content, in the context of European Union policies to facilitate almost ubiquitous broadband access. Whereas this is good news for policy makers who address regional development and e-government initiatives[1], it also raises the question of who foots the bill for traffic in the internet economy?

The answer to who is paying in privately owned networks, such as toll roads, cable television services or mobile telecommunications is "the user pays". Private firms have built and paid for those infrastructures in order to get financial returns. The logic they apply is that competition is the means to achieve efficient markets that have the characteristics of being allocative, productive, and dynamic. Regulation, in theory, steps in when a competitive outcome cannot be achieved by market forces alone or where deviation from economic efficiency is socially desirable. Market intervention is also used in Europe where social and private benefits deviate and to allow for coordination of technical standards or market equilibrium (Economides 2003). Hence, in regulated industries the answer to "who is paying" and "how much does it cost" also depends on the regulatory framework.

This paper introduces the expected traffic development up to 2015, presents a framework for analysing the value position of network operators, and provides a critique of the paradox of traffic neutral business models being promoted by some regulators (for telecom operators), but where only differentiated pricing models, such as managed IP traffic seemingly provide high returns.

2 Data traffic trends

The changes at the core of the network infrastructure business are most significant in scale, not in kind, because fixed networks must plan to deal with capacity restrictions as traffic grows. This makes it somewhat difficult to appreciate the importance of these changes, since from most viewpoints it looks like "more of the same". However, "more of the same" in this case cannot mean "business as usual", for two fundamental reasons. One is that the sheer scale and rate of growth demands constant increases in capacity and the current structure of pricing and revenues do not provide the means to meet that demand. The second is that growth rates vary considerably among different digital forms (e.g. video, data and voice) and among different

[1] http://ec.europa.eu/information_society/digital-agenda/index_en.htm

generators of traffic (e.g. social networking, cloud computing, location tracking, machine-to-machine traffic from sources such as near field communication payments). Overall IP traffic (Cisco 2011) is expected to increase at a compound annual growth rate (CAGR) of 32% from 2010 to 2015 with mobile internet traffic expected to grow three times faster than fixed IP traffic (from 1% of overall traffic in 2010 to 8% of total IP traffic in 2015). Video traffic surpassed peer-to peer traffic in 2010, and by 2012 internet video will account for over 50% of consumer internet traffic.

IP Traffic, 2010-2015							
	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**CAGR 2010-2015**
By Type (PB per month)							
Fixed Internet	14955	20650	27434	35879	46290	59364	32%
Managed IP	4989	6839	9014	11352	13189	14848	24%
Mobile data	237	545	1163	2198	3806	6254	92%
By segment (PB per month)							
Consumer	16221	23130	31592	42063	54270	70045	34%
Business	3930	4894	6011	7357	8997	10410	22%
By Geography (PB per month)							
North America	6998	9947	12978	16116	18848	22274	26%
Western Europe	4776	6496	8819	11774	15187	18858	32%
Asia Pacific	5368	7317	9847	13341	18060	24150	35%
Japan	1414	1923	2540	3283	4019	4762	27%
Latin America	665	993	1465	2158	3238	4681	48%
Central and Eastern Europe	708	1004	1413	1955	2700	3713	39%
Middle East and Africa	253	366	550	802	1235	2019	52%
Total (PB per month)							
Total IP traffic	20151	28023	37603	49420	63267	80456	32%

Table 1: Global IP Traffic, 2010-2015; Source: Cisco VNI, 2011

Managed IP traffic is also growing rapidly[2] and is estimated to reach 30% of total business traffic in 2015. A break-down of managed IP traffic shows that that it currently constitutes 18% of overall traffic and is concentrated in providing consumer applications.

[2] "Managed traffic" is defined by Cisco as corporate IP wide area network traffic and IP transport of TV and VoD (video on demand). We also note that voice over IP constitutes a minor part of the estimated data traffic (less than 1 %). Cisco defines managed IP video as "IP traffic generated by traditional commercial TV services".

	Consumer	Business	Total
Internet	66%	6%	74%
Managed IP	15%	4%	18%
Mobile data	6%	2%	6%
Total	87%	13%	100%

Table 2: Overall Traffic Share as of Year End 2015; Source: Cisco VNI, 2011

Most of the managed IP traffic in 2015, according to Cisco, is in the form of video and is expected to be delivered mainly via cable networks and to a lesser extent via telecom operators' fibre networks. It remains within the footprint of a single service provider so is not considered internet traffic. As we can see in table 3 below, IPTV video on demand on the open internet has approximately the same rate of increase as digital cable video on demand, implying that telecom operators are matching growth rates in this vital area.

IP Traffic, 2010-2015							
By Type (PB per month)	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**CAGR 2010-2015**
By Network (PB per month)							
Fixed	3692	5263	7116	9090	10499	11832	26%
By Subsegment (PB per month)							
IPTV VoD	612	878	1177	1497	1770	2041	27%
Cable Digital VoD	3042	4310	5791	7321	8309	9212	25%
Cable hybrid IP VoD	38	75	148	271	420	579	72%
By content Type (PB per Month)							
Standard-definition VoD	1965	2274	2359	2379	2556	2854	6%
High-definition VoD	1727	2967	4753	6700	7923	9140	40%
3D VoD	1	2	5	11	20	38	137%
By Geography (PB per Month)							
North America	2421	3402	4566	5665	6322	6878	23%
Western Europe	599	866	1225	1653	1954	2244	30%
Asia Pacific	281	405	539	734	938	1143	32%
Japan	320	428	540	650	719	783	20%
Latin America	18	35	64	110	175	267	71%
Central and Eastern Europe	41	92	160	249	354	470	63%
Middle East and Africa	11	17	23	30	37	47	33%
Total (PB per month)							
Managed IP video traffic	3692	5263	7116	9090	10499	11832	26%

Table 3: Global Consumer Managed IP Traffic 2010-2015; Source: Cisco VNI, 2011

Mobile network operators face capacity restrictions and consequently have introduced tiered pricing, thereby monetising increasing data traffic allowing them to raise capital spending. For example, mobile data currently constitutes 12% of Vodafone's total revenues (Sep. 2011)[3] and is expected to rise as smartphones make up 50% of handset shipments in Europe. AT&T Wireless in the United States likewise reported a combination of increasing capital expenditure and data revenues at the end of 2010[4].

In the fixed broadband environment the main revenue streams stem from distributing traffic and content, aggregating content, providing access devices to content, search, and equipment manufacturers enabling the infrastructure. Fixed-line broadband operators have not been able to compensate for increasing traffic with tiered pricing due to their position in the market place affected by regulatory and competitive factors that we will describe in the next section. In spite of growing traffic, the overall revenue trend was negative for telecom operators since 2004 (see the distribution in figure 1 below; BCG 2011).

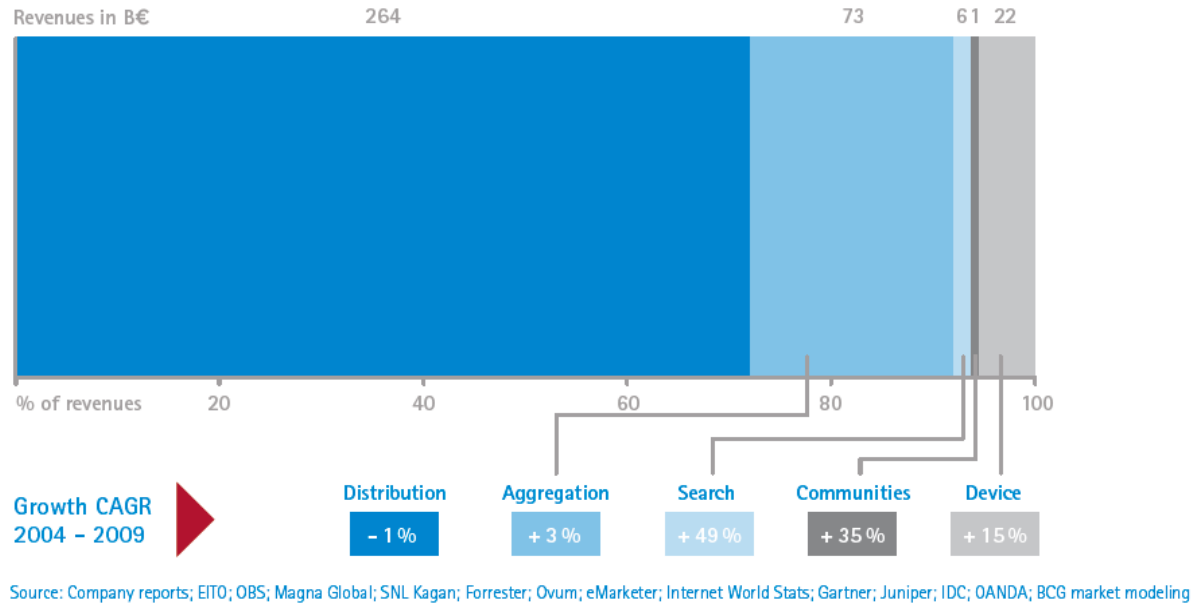

Figure 1: European (EU25) revenues 2009; Source BCG (2011)

[3] http://www.vodafone.com/content/dam/vodafone/investors/conference_presentations/mc_tmt_conference_2011.pdf

[4] http://www.att.com/Investor/Financial/Earning_Info/docs/3Q_10_IB_FINAL.pdf

3 The internet value network and the position of telecom operators

Telecom operators face a fundamental set of challenges to address profitability in the market for internet services. This section introduces an analysis of the internet value network and the position of telecom operators within it.

The market structure of the telecommunications and internet industry can be characterized by five key categories of actors (Pigliapoco and Bogliolo, 2010):

- Content aggregators: those entities who own the rights over the content that is distributed over the internet. This may either be user-generated or produced by commercial organisations.
- Online services providers: those entities who provide services that are accessed by users of the internet. These are diverse for both consumer and corporate markets, including content aggregators, search, and community providers.
- Equipment and enabling technology providers: those entities that facilitate the technical delivery of web content and the generation of revenues. These typically fall under the banners of support technology, billing and payments, and advertising services.
- Distribution and connectivity providers: internet service providers or those entities that enable access to the internet. These consist of organisations that provide core network connectivity, those that provide IP interchange and those who sell retail internet access to end users.
- User interface and devices: those entities that facilitate hardware, operating systems and software that enable end users to interact with the internet.

Within the value network, telecom operators are regarded for the purpose of this analysis narrowly as connectivity providers. We take the key assets of operators to be their network and supporting systems as a digital infrastructure. As their core competency lies within enabling and executing the logistics of information delivery to end-users, this part of our analysis does not cover their role in the remainder of the value network.

One useful way of thinking about regulation is as categorized into four modalities (see Lessig, 2006). From this we can analyse those factors that constrain an internet connectivity provider's bounds of potential action. Further, we can use this approach to assess business models. Each of these four modalities is considered in turn:

3.1 Architecture: technological change on the internet

The advent of two technologies, multiprotocol label switching (MPLS) and internet exchange points (IXPs), have flattened the three tiered model of the internet. That model was previously conceptualized as a hierarchy of multiple networks interconnected by routers and providing delivery of data through best effort. The adoption of MPLS means that virtual paths and virtual channels are set up across networks, so that packets of IP data are no longer frequently analysed and are often sent directly to their destinations embedded within MPLS data packets. The advantage of this is that there is less processing overhead on routers, meaning that data transfer is faster and that routers can be simplified and manufactured more cheaply. Furthermore, MPLS is agnostic regarding the type of traffic that it carries, enabling a range of service types to be carried over its networks ranging from IP VPNs, virtual private LANs and even traditional voice traffic (Spatscheck and Van der Merwe, 2011). The overall quality of service is improved, and the fact that IP packets are less frequently laid bare to be inspected within routers has improved data security.

Internet exchange points are data centres that enable any party wishing to exchange traffic to connect with interconnect equipment. It also allows peering with another party using a border gateway protocol. This enables connecting online service providers directly with internet service providers at IXPs. In this way, the combination of using MPLS and IXPs enables many content and consumer networks to be directly connected, such that many Tier 1 networks are effectively bypassed (Labovitz et al., 2009).

3.2 Markets: migration of value from connectivity to content

Market factors affect the role of network operators as internet connectivity providers. A key example of how technological change has led to changes in business relationships is typified by the development of MPLS and IXP enabling online service providers and Tier 2/3 ISPs to dis-intermediate Tier 1 interconnect and Tier 2 ISPs (Friederiszick et al., 2011). This trend has been facilitated by content delivery networks (CDNs) commonly owned by newcomers (such as Akamai and Limelight) or by online service providers themselves (Google, Amazon, Microsoft) who build and operate MPLS networks that bypass the internet core. CDNs enable superior delivery of IP data in two ways. First, they bypass IP core (Tier 1) networks to peer content providers directly with local internet service providers (ISP) around the world. Second, CDNs cache content provider data that is most accessed by customers of a local ISP, either at the peering connection between CDN and ISP (typically an IXP) or in servers embedded at the core of an ISP's network. The principle behind this is that by placing copies of popular data closer to end users then quality of experience is improved, as local connections perform better than remote connections; transit costs are reduced over core networks, as data are stored locally and

not repeatedly transported over long distances; and that content provider resilience is improved as data are replicated and stored in different global and regional locations (Hall et al., 2011).

Network economy effects tend to favour a few, very large CDNs (Hall et al., 2011), such that their growth in the past five years has been dramatic and they now carry a large proportion of internet traffic (Labovitz et al., 2009). The delivery of bandwidth-hungry services, such as video, which require a high quality of connectivity without jitter or latency, are no longer hindered by the performance limitations of the internet core. Consequently, CDN operators, such as Google and Comcast, are displacing some Tier 1 providers as the largest IP traffic carriers (Labovitz et al., 2009).

The aggregate result of these developments is that the performance bottleneck now lies within the network operator's backhaul, putting pressure on them. This can in part be overcome by allowing CDNs to deploy their servers yet further into the infrastructure of network operators. However, the concern for network operators is that as CDNs become more powerful, operators risk losing control of the distribution of data within their own networks (van der Ziel, 2010). This is already occurring in some regional networks as some CDNs communicate poorly with regional ISPs regarding traffic volumes and at times can unexpectedly overwhelm local networks with internet data at IXPs (van der Ziel, 2010).

In addition to these market trends affecting the business of interconnect, there has occurred a shift in power within the value network as profitable revenues move from connectivity to content. This is indicated in analyst and consultancy reports (Page et al., 2010b) concerning market sizes, growth rates and attractiveness, see table 4 below.

	Online Services	Enabling Technologies	Connectivity
Global Value ($bn 2008 Revenues)	242	61	262
Growth (CAGR 2008-2013)	16%	13%	6%
Profitability (ROCE 2008)	21%	13%	11%

Table 4. Value in various internet segments. Source: AT Kearney (A).

The table above (Page et al., 2010b) addresses the value network of the consumer market for internet services. Whilst the revenue figures for the business market will be different, it is assumed that the growth rates and figures for return on capital employed will be similar.[5] In the consumer market, it can be seen that whilst the market for connectivity is the largest, it is

[5] The revenue figures are for 2008, the growth rates are estimates for five year compound annual growth rates starting in 2008, and the figures for return on capital employed (ROCE) are also for 2008.

growing at the slowest rate and offers the least opportunity for returns. However, the market for online services is growing most rapidly and offers the highest returns; and the market for enabling the distribution and commercialisation of online services is in between.

A number of factors have caused this shift in value from connectivity to content. In terms of the core network, competition and excess capacity lead to a collapse in the price of wholesale transit (Labovitz et al., 2009). Competition in the internet access market sees margins in broadband reduced to a minimum as flat rate "all you can eat" tariffs become the norm both in fixed and mobile markets (Page et al., 2010a). Innovations in cloud computing facilitate new markets in applications (web-apps) and content (video streaming) (Hall et al., 2011). The fact that these online services are often not paid for by the consumer, but rather by advertising, has led to demand unconstrained by pricing and has contributed to the explosion in volume of data traffic. This in turn has put pressure both on network operators' backhaul capacity and on data centre capacity (Labovitz et al., 2009). There is evidence that the growth of video streaming has reduced demand for peer-to-peer in some markets (Labovitz et al., 2009). Demand for bandwidth rich constant bit rate services (such as IP based video streaming and internet gaming) is forecast to continue growing (Page et al., 2010b). We are also beginning to see the effects of increasing machine-to-machine data traffic, especially as near field communications services for public transport, payment systems and other functionalities begin to take off.

3.3 Social norms: consumers driving demand for new services

There are at least three kinds of trends in consumer preferences, prejudices and predispositions that may exacerbate the trends that have been highlighted above. For certain leading applications, such as cloud computing, the home environment of consumers is often leading the way for corporates. The shift in business models is such that internet services are increasingly being funded by advertising revenue. This means that consumers are increasingly accustomed to "the economy of free". The effects of this may be two-fold. Consumers may be increasingly demanding of the internet services that they do pay for, for example high quality online access. Furthermore, their expectations are now set in such a way that it may be increasingly challenging for online service providers to charge them for content and applications.

It would appear that consumers do not like walled gardens due to limited choice. However, Apple's i-tunes and DoCoMo's i-mode have shown that closed platforms can provide a high quality of service and level of innovation When offered the choice of freedom consumers will migrate to freer platforms (van der Ziel, 2010). In 2009, for example, 600,000 US households migrated away from cable TV subscriptions and moved to internet TV solutions. This trend is continuing with two US cable TV operators alone reporting a drop of nearly 200,000 subscribers

in the second quarter of 2011 (Lawler, 2011). The expectation is that this trend will increase as individuals spend more time online and possibly begin to demand interactive TV services using two or more screens simultaneously (van der Ziel, 2010). While the European market is distinct from the US in that there is a fragmentation of national audiences, local language content and intellectual property rights, nevertheless American market trends are indicative of consumer behaviour that may be manifest in Europe in somewhat similar ways. Increasingly it may be seen to be more cost effective to source free or cheap internet based video content with a broadband subscription, rather than to pay an additional charge for cable TV. In 2010 70% of internet users watched online video. These habits are also being applied to the TV screen. At the end of 2010 around 22% of global online consumers already owned, or planned to buy an internet-connected television set within the year. Almost one third of Netflix subscribers in the US aged 18–24 used their online subscription instead of cable or satellite (BCG, 2011). The impact of this may be felt twice over for network operators, such as those who depend on the contributions of cable TV for profits. These network operators face the loss of cable TV subscription revenues as well as the additional infrastructural costs in order to meet increasing demands for internet TV.

Finally, of all the players in the value network, network operators (including mobile and cable operators) and ISPs providing internet access have the greatest exposure to the prejudices and predispositions of their consumers. This translates into a risk of poor brand image on the side of network operators and a lack of trust on the side of their consumers (van der Ziel, 2010). Unfortunately, and despite their technological prowess, network operators lack the "wow factor" that many device manufacturers (e.g. Apple), online service providers (e.g. Google) and content providers (e.g. BBC iPlayer) have cultivated. It is the network operator/ISP that the consumer blames when the experience of using the internet is poor, whether it is due to network contention or poor network coverage. Trust in network operators suffers, especially when broadband access packages are marketed with undeliverable promises of unlimited broadband at high speeds and with ubiquitous coverage. Of all the members of the value network, it is the network operator that the end user is most likely to have direct contact with, and that is most likely to suffer from any problems occurring.

3.4 Regulation: uncertainty about traffic management

The internet value network, aside from policy controls on broadband access, is largely self-governing. However there is increasing concern with regards to the technical architecture, the commercial architecture and the way that internet content is processed (Page et al., 2010a).

Whilst many concerns regarding content focus on decency, privacy and piracy, the remaining worries regarding internet content, technology and commercial arrangements concern "network neutrality". Network neutrality is interpreted in many different ways and most European jurisdictions focus on society's rights to freedom of expression and to equal access to information over the internet. The parallel debate in the United States focuses on the extent to which traffic controls can be applied in a discriminatory manner.[6]

As yet there are no European governmental policies regarding the regulation of the internet in order to impose or maintain network neutrality, with the exception of recent revisions to the law in the Netherlands which, although being contested, would restrict most any discriminatory traffic management practices. Existing EU policies impose transparency over network management and promote consumers' access to content, extending users' choice and allowing differing quality of service agreements. Policies under general discussion cover one or more of the following five areas (Page et al., 2010a) and the EU framework addresses all of these to one degree or another:

1. Accessibility: the extent to which consumers are able to access all legal content on the internet
2. Transparency: the extent to which connectivity providers give consumers clear, understandable information about the services they offer and their capabilities
3. Non-discrimination: the extent to which connectivity providers discriminate against or prioritise lawful internet content, applications or services in a way that causes harm to users or competition
4. Traffic management: the extent to which connectivity providers intervene with the flow of traffic in the open internet, for example not at all, or to remove malicious traffic only (e.g. spam, viruses etc)
5. Differentiation: the extent to which consumers are offered grades (speed, QoS) of internet access based on price.

Most stakeholders are committed to the protection of consumer rights, including safeguards against extreme price distortions in the market (Page et al., 2010a, Zittrain, 2009). What the general community will need to understand, however, is what effect market intervention would have on key parts of the internet value network. The main organisations affected would likely be those providing online services and those providing internet connectivity. Network neutrality must be considered in any analysis, as future policy may lead to the reallocation of resources in the value network, which in turn would affect pricing strategies, and hence incentives to invest and innovate.

[6] That is, by differentiating among web sites or portals or sources of traffic, as opposed to traffic controls that might be necessary to adjust for congestion or to provide preferential access to special users in times of crisis.

4 The opportunities and challenges generated from traffic growth

Increasingly internet traffic growth is creating an unbalanced situation where all stakeholders are not direct beneficiaries. Innovations in traffic routing mean for example that much of video traffic emerges at the edge of operator networks. Regaining that balance in the market is partly the responsibility of regulators and partly that of corporations, whose strategy must better take into account the new architecture and the business models it supports.

Network providers are mostly operating on a pricing model that provides customers with flat rate access to unlimited internet data while internet service providers are not charged for the data that their content produces. The current business model in the internet value network is therefore imbalanced, seen from the perspective of network operators. There is a disconnect between revenue generation and cost centres implying the internet value network is becoming polarised. Revenue growth is generated at one end of the value network, namely within online content and services, and the growth in costs is incurred with network operators with current technical architectures.

There is no incentive for internet service providers or consumers to restrict their data production and consumption, and the current market structure makes it difficult for network providers to compensate for the dramatic increases in volumes of IP traffic through increasing video usage. Broadband build-out policy creates additional pressure for network investments. However, investors question the profitability of network investments under the current framework conditions, and in particular doubt whether network operators will become direct beneficiaries of traffic growth. This threatens the whole of the digital agenda. Just as European policy expresses the need for network operators to invest in broadband build-out and innovation, financial analysts have penalized the telecommunications industry for their loss of revenues and the lack of clarity about the near future. LSE research (Liebenau & Karrberg, 2010) shows that one inhibitor is the confusion about risk premiums associated with new network investments. Risk premiums apply to the price levels that will be allowed for regulated wholesale products on fibre access networks. They express concern about what national differences would be allowed and how competition would be defined in national markets. As most investors anticipate that incumbents will roll out next generation access broadband, they further express concern that insufficient overall incentives are available to them in the short term.

In Japan the mobile telecom industry demonstrated before the advent of 3G that service providers can devise incentives for efficient bandwidth utilisation when users foot the bill for

data. Online service providers responded with efficient traffic management, such as local storage on devices and new encoding (Karrberg 2011). With few incentives for effective traffic management the result could be inefficient utilisation of existing infrastructure. Future demand for non-discriminatory traffic management practices, such as tele-health services, hold great potential for European businesses.

Public cloud computing services are in the process of rapid growth and the associated traffic is migrating from corporate intranets to the public network. By current trends, the US will dominate global public cloud IT services, shifting some of the European generated traffic growth abroad (IDC 2011). This is one of the high-growth segments that European stakeholders ought to take into account.

Managed IP traffic enables operators to guarantee and directly control quality of service for critical applications. BT has been doing this, for example, by focusing on corporate services, where non-discrimination is rarely an issue. In other words, if managed IP traffic continues to be unregulated it should become both the source of revenues in the industry generally and the strategic direction that network operators need to consider. The balance of profitable revenue streams will of course affect the willingness among operators to invest, especially considering the higher proportion of managed IP traffic within the business segment (as can be seen in table 2).

From traffic growth estimations[7] we see that cable operators generate most of the managed IP traffic in the consumer segment. However, telecom operators are keeping up the pace[8] as IP TV their main traffic generator is growing at the same rate as managed IP traffic over cable. It is clearly an advantage for cable operators not to be faced with competition on their networks, enabling pricing freedom unchallenged by cost-based regulation and the ability to innovate freely with services. For most operators focusing on fibre, however, there is regulatory uncertainty about future unbundling of fibre holding back investment.

We should not be surprised then, that telecom operators will assume that it is easier to generate revenues from managed IP traffic where quality of service could be charged for. The corollary is that prioritised traffic will not occur soon on the open internet and therefore data can only be priced as a commodity. The immediate dangers of this are likely to be a shortfall in funding for the EU 2020 goals. It may further threaten the ability or incentive of operators to improve the quality of the existing infrastructure. The effect may endanger the future of the network by

[7] As defined by Cisco (2011)

[8] See table 3

shifting responsibilities for innovating away from operators to those who can more directly see the relationship between revenue growth and innovation.

In conclusion, our analysis of traffic has shown that there are severe imbalances in the rate of growth with greater revenues being generated by traffic that is not being monetized by network operators. Different business models apply to those different segments that generate traffic and network operators are not participating in the most profitable business activities. The resulting imbalances are partly the responsibility of regulators and partly that of business strategists within network operators. Given the political context and the European goals to enhance broadband build-out, the current instability, especially as expressed by investors, threatens the ability of network operators to respond. That situation is unlikely to change until investors have confidence that network operators will over time become the beneficiaries of traffic growth.

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