DISCRIMINATION IN NGN SERVICE MARKETS: OPPORTUNITY OR BARRIER TO DIGITAL INCLUSION?

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ABSTRACT

The promise of digital inclusion may be deterred by different sorts of discrimination brought about by Next-Generation Network (NGN) operators. As the growth of fixed and mobile networks relies on private investment and sufficient regulatory and economic incentives, competition in different telecommunications markets will increasingly depend on providers' ability to differentiate their product and discriminate among consumers. Unless the industry – operators, content providers, regulatory and competition authorities – fully understands and exploits the welfare enhancing role of discrimination in the new environment, NGN's promises of universal and ubiquitous access, sustainability and affordability might be only incipiently achieved.

Keywords— Next-Generation networks; network neutrality; two-sided platforms; discrimination; digital inclusion.

1. INTRODUCTION

The deployment of and evolution towards Next-Generation Networks (NGNs) promise many benefits to network operators and consumers. Nevertheless, instances in which network operators have threatened basic principles of IP-based networks indicate that traditional policy, economic and regulatory views of telecommunication network service markets may no longer apply or may need to be reassessed. With a dualistic view that uses the concepts of discrimination and network neutrality, the paper advocates for a better understanding of the incentives network operators require in order to identify manifestations of discrimination which may improve access and affordability for consumers. It also conjectures that discrimination may have a role in the process of including individuals or firms that otherwise may be excluded from access to and use of the network.

Section 2 discusses what is currently understood as NGN and briefly presents examples of NGN deployments in some countries; it also summarizes basic distinctions between legacy networks and NGN. Section 3 brings together contrasting views of the network neutrality debate, a crucial issue to policy and regulatory authorities that originated in the U.S. Section 4 discusses the role of discrimination and its potential to influence consumer's service valuation in an NGN service market, whereas section 5 discusses economic concepts instrumental in understanding the evolution of pricing from its application to conventional networks to its use in NGN platforms. In concluding, section 6 identifies some opportunities and barriers to the deployment of broadband network access and the promotion of innovation on the edges of the network.

2. WHAT IS NGN?

The ITU defines an NGN as "*a packet-based network able to provide services including telecommunications services and able to make use of multiple broadband, QoS-enabled transport technologies and in which service-related functions are independent from underlying transport-related technologies. It offers unfettered access by users to different service providers. It supports generalized mobility which allows consistent and ubiquitous provision of services to users*". In general, NGN can be regarded as a multi-service, packet-based, QoS-enabled technology.

Increased demand for ubiquitous, integrated and innovative telecommunications services is driving the deployment of NGNs. The move is reflected on the rollout of new, all-IP networks by new entrants and in the addition of complementary IP networks to existing legacy networks. The search for increased revenue, higher productivity and a wider set of services is driving telecommunication companies to invest in NGNs. Market trends and consumers' needs may provide strong bases to the operators' business cases.

A view of the general NGN architecture is shown in Figure 1. Conceptually, the NGN architecture comprises an access plane in addition to transport, control and service layers.

What distinguishes NGNs from legacy networks can be summarized in the following key characteristics [1]:

(i) Packet-based transfer

NGNs are packet-based networks using the Internet Protocol (IP). Packet transfer is possible due to the addressing system and routing capabilities provided by IP.

(ii) Decoupling of service provisioning from the network infrastructure

The layer model shown above depicts how the network layer, comprised of transport and access, is clearly decoupled from the application or service plane.

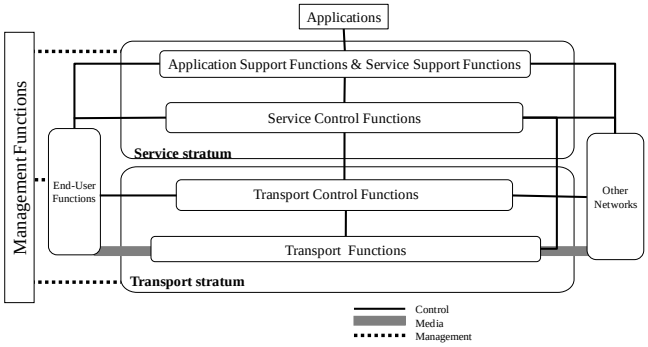

Figure 1. A view of a general NGN architecture. Adapted from ITU [Rec Y.2012]

(iii) Internetworking with legacy networks

Interconnection is possible due to the open interfaces. Currently legacy operators are not only deploying IP networks but also using open interfaces to interconnect with all-IP networks, mainly voice-over-IP (VoIP) providers.

(iv) Provision of end-to-end quality of service (QoS)

Although QoS remains an object of debate, particularly because of the need for standardisation, important progress is being made with the growing use of Multi-Protocol Label Switching (MPLS), a protocol that implements limited traffic engineering and service provider virtual private networks over existing IP networks. MPLS was designed to provide a unified data-carrying service for both circuit-based traffic and packet-switched traffic, and is primarily intended to support multiple service models – implying a QoS orientation - and perform traffic management.

(v) Unrestricted access to different service providers

Besides the technical differences between circuit-switching and packet switching networks, unrestricted access is the foundation for the change in business models that legacy operators turning into all-IP will have to face.

Since the ITU NGN architecture is built upon technological blocks from the Internet with the goal of replacing fixed and mobile networks, it is assumed to blend the openness and flexibility of the Internet with the quality guarantees of the Public Switched Telephone Network. Transport functions – on the transport layer - are separated from service control functions – on the service layer. Management functions are located in a separate plane that relates to both the transport and service control layers. Communication with end-users proceeds through a User-to-Network Interface; other networks are interconnected through a Network-to-Network Interface with physical connection at the transport layer and in relation to service control and application and service support functions. Third party applications run "on top" of the service control and transport planes.

One vision of NGN is that of many different networks - traditional copper-based networks as in the PSTN, HFC for television services, wireless access networks and cellular networks – that become a single architecture, enabling the integration of the different existing networks and improving access (Figure 2).

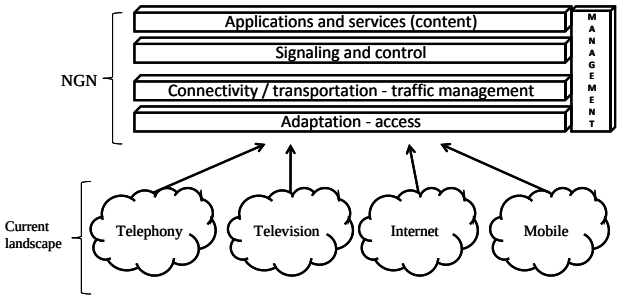

Figure 2. A vision of the transition towards NGN

Major operators are planning to deploy – or in fact are deploying – new access networks that allow for the provision of new services. In 2007, AT&T announced a new contract with the state of Missouri to implement an NGN solution. The five-year contract will allow AT&T to provide Virtual Private Network (VPN) services, call centre support, managed data storage, private fibre-network management and video communications. In the U.K. BT's 21st Century Network (21CN) is a network transformation project which will see the UK's telephone network move from the present Public Switched Telephone Network (PSTN) to an IP/MPLS system. However, BT has decided to step back from its original vision of a complete replacement of its PSTN to a "replace-when-needed" approach. In March 2009, New Zealand's incumbent Telecom made its first official IP call. Telecom claims NGN will replace its PSTN at some point before 2020. In the Netherlands, KPN is developing an "all-IP" transformation program, which is intended to migrate KPN's existing services and customers to a new all-IP network. In Bulgaria, BTC (Bulgarian Telecommunications Company) has implemented a NGN as the underlying network of its services on a large scale project in 2004. The examples above indicate that incumbent operators need new sources of revenue to make up for losses in the voice business, or compete with new players, and they can do it by responding to network obsolescence or enabling the utilization of new standards.

3. THE NETWORK NEUTRALITY DEBATE

The Internet was designed as an open network with "*no gatekeepers over new content or services*" [2]; its layered, end-to-end architecture places network intelligence at the edges rather than at the core. Internet advocates point at such technical features as the sources of the wide range of services and innovative offers only possible by avoiding central control and by incentivizing innovation at the edges.

The network neutrality principle proposes that no operator can discriminate against content or traffic that travels on its network or against particular websites and devices used to the access the Internet. Discrimination can be defined as the unequal treatment of applications and content from whoever manages or handles the network, seeking individual benefit, without the consent or all market participants. Marsden and Cave assert that "*… discrimination is typically characterised as behaviour by 'last mile' ISPs against*

content providers (CPs); it can equally be undertaken at peering points by third parties" [3]. They also stress that while "*discrimination may be more easily detected by the end-user when it is conducted by its ISP*", discrimination at peering points, far from end-users' perceptions, may be more undetectable and potentially disrupting.

NGN platforms may basically exert four different types of discriminatory activities: price discrimination, access tiering, blocking and service quality discrimination [3]. As the cases listed below demonstrate, blocking is the most usual form of discrimination. Nevertheless, blocking of access to specific applications or sites by network operators seems to be giving way to the more subtle, yet potentially more dangerous practice of giving higher priority to traffic received or sent to specific content providers. An equally damaging practice is to create artificial latency on application traffic from non-preferred content providers. The two practices constitute service quality discrimination or degradation.

In recent years several cases have been in the spotlight as they have either been deemed anticompetitive or attracted attention due to their controversial nature. They have also been helpful in profiling the network neutrality debate as the following list illustrates:

- Comcast was accused of blocking P2P traffic on its networks. According to the company, this practice was part of its network administrative decisions to relieve congestion [4].
- In 2004, Madison River Communications obstructed the use of the VoIP service from Vonage to Madison's DSL customers.
- Telefónica CTC Chile acknowledged it blocked access to the ISPs' operating VoIP on its platform "MegaVía". RedVoiss, one of the affected ISPs, filed a complaint against Telefónica for anticompetitive behavior.
- In 2005, Telus, one of the largest telephone operators in Canada, locked their customers' access to the site of the communications workers union in the midst of a union dispute.
- Canadian telephone operator, Shaw, intentionally worked to "reduce the quality" of VoIP services to its competitors forcing their customers to buy an additional service provided by Shaw as a strategy to make its rivals look as though they were providing a lower quality of service.
- AOL Time Warner has blocked all mail mentioning 'www.dearaol.com', a group which opposes the AOL's scheme to demand payment from its customers when sending e-mail to the company.

Some network neutrality opponents may argue that allowing discrimination through tiered connections may lead to higher efficiency. On the other hand, price discrimination is claimed to also have potential positive effects. Such unilateral actions by network operators might be justified by two reasons: they may show a path to efficiently internalizing the congestion costs raised by high-volume users; and they can benefit low-volume users by lowering the access prices they must pay [5].

4. A PATH TOWARDS DISCRIMINATION

As the growth of fixed and mobile networks depend on private investment and sufficient regulatory and economic incentives, competition in different telecommunications markets will increasingly depend on providers' ability to differentiate their products and exert varying degrees and types of discrimination.

Producers respond to different consumers' tastes by offering different sets of product attributes or projecting different product images and personalities. Consumers may benefit from having a wide variety of products and/or services that closely match their preferences. For instance, since ISPs' offers include different speeds for Internet access, users must choose one from a speed menu when subscribing to the network; performance-sensitive users may benefit from purchasing higher-speed access, while other users would not mind to have access at lower speeds.

Any differentiation must be valued by consumers, so the question of value becomes central to our view of differentiation and discrimination. Differentiation of access services becomes less relevant to the market as access tends to be commoditized. Therefore, access providers - the owners of the pipelines - can hardly rely on differentiation marketing tools any longer as a means to increase their revenues. The desperate claim in 2005 by AT&T's CEO that "*I ain't going to let them (Google, MSN, Vonage {and others}) use my pipes for free*" along with his assertion that "*… So there's going to have to be some mechanism for these people who use my pipes to pay for the portion they're using*" can be understood as an announcement that large access providers would attempt to exploit their monopolistic power even though they cannot really be generators of contents or services that accrue to what consumers regard as the largest portion of the value created.

Discrimination against particular sites, or services, or contents by NGN platforms may be seen not only as a network management tool (i.e., a means to alleviate network congestion), but also as a strategic marketing tool that providers might use to bundle their access services with preferred content generators offers. An exploratory study on the interconnection of all-IP networks [6], presents a simple model of interconnection settlements with fixed fees and session-based charges. The paper argues that the traditional regulatory goal of promoting competition may be less important than other regulatory concerns. For example, as QoS-enabled networks may find it attractive to degrade the quality or capacity of interconnection between QoS-enabled and best-effort networks, regulatory concerns emerge that must address this issue.

Because of its potential to widen current manifestations of exclusion, we find it useful to classify discrimination according to the network level it affects. For instance, as long as consumers are affected by the decisions of network operators regarding the deployment of access facilities and

the operation of their network through traffic management, initially we can distinguish two types of discrimination: network access discrimination and QoS discrimination. Some groups in society are left behind when the deployment of access facilities do not reach them; high investment costs or the search for more profitable market segments, such as densely populated areas, drive such network deployment decisions. Lack of network interoperability or the inadequacy of network standards may also be contributors to this type of discrimination. Degradation of QoS, even reaching outright traffic blocking, can be regarded as a manifestation of service discrimination, but it really depends on the actual drivers that motivate the operators to take such actions; one such driver is congestion.

Additionally, as network operators may find it profitable to bundle their commoditized access service with certain content generators, content discrimination rises as a third kind of discrimination. Discriminating against content providers affects not only those generating contents over NGN platforms but also the consumers of such services. Thus, content discrimination practices go further than access or service discrimination in that the platform affects both sides of its two-sided market, potentially increasing its market power by forming alliances, associations or even mergers with preferred content providers.

5. WHO GETS CHARGED?

There are positive uses of discrimination. Dropping dangerous traffic or redirection to a website with anti-virus tools, denying service from unauthorized devices, QoS-based discrimination that give "TCP-unfriendly applications lower scheduling; also, discriminatory pricing, for instance congestion-based dynamic pricing is a form of congestion control.

There are also potential negative effects. An NG platform that dominates the broadband market can use perfect price discrimination; as platforms are able to collect more, accurate information about individual customers, the platform can elaborate ever more customer categories to estimate customers' willingness to pay for services. Such power does not extend only to the retail segment but the upstream market as well. As the platform's ability to identify the upstream traffic value is only limited by technology advances on effectively "reading" network traffic, a platform may develop different forms of charging content and service providers as they deliver their products over the network. This would also allow network operators to separately charge oligopoly prices to both sides

Among other aspects, network neutrality demands that network operators do not distinguish in terms of price between packets belonging to different services; neither should they price-discriminate between the up-loader and the down-loader of information. As some of the cases above attest, large telecommunication operators with considerable market power tend to advocate price discrimination according to the type of application and the provider used to transmit the content. Such operators would like to have in place a more complex pricing scheme that would allow broadband Internet access providers to impose price discrimination on the provider's side of the market. Such scheme allows operators to charge fees to a traffic originator even when the originating party does not connect to the Internet using the operators' networks and, therefore, does not have any contractual relationship with them [7]. In other words, the operator may impose price discrimination on the provider's side of the market and not on the subscriber's.

The theory of two-sided markets provides elements to understand the potential benefits, or the threats, to consumer welfare in an NGN service market. In a two-sided market one platform (or network, in the present case) enables interactions between end-users such as consumers and content providers. The two groups engage in transactions that utilize their access to and use of the platform; thus, such a market is characterized by membership and usage externalities and by usage and membership charges. As gains from trade usually arise from usage, [8] presents a model of pure usage, two-sided market in which the platform sets usage prices to both sides. A two-sided market is characterized as one in which the volume of transactions on the platform varies as any of the two prices changes, i.e., prices charged to consumers or content providers, while the aggregate price is kept constant. On the other hand, if the market is insensitive to reallocations of the total price between buyer and seller the market is called one-sided.

The two-sided market concept is used in [9] to understand how competition develops between two NGN platforms. Each platform, assumed to be a two-sided market, signs up two main subscriber types: end-users and content providers, and sells two service types: voice and data. Their model uses prices and market shares as variables to determine platforms' profit levels, and consumers' and content providers' benefits on a multi-period horizon. The pricing structure used by the platforms is a two-part tariff: subscription charge and usage charge. This allows observing the evolution of the model variables in response to changes in model inputs such as regulated access charges, among others. The model succeeds in proving the existence of market equilibria under different market assumptions but leaves it open to determine the general conditions under which equilibrium is guaranteed to exist or whether it exists at all.

The main contribution of [9] to the current debate is that the model allows us to understand the effects of two discriminatory activities such as traffic blocking and price discrimination on the model's main performance measurements: total welfare, consumer surplus, content provider profit and platform profits. As expected traffic blocking reduces consumer welfare because consumers cannot derive any utility from the other platform; the platform's profit is also affected because it does not receive any revenues for incoming or outgoing traffic. On the other hand, a less intuitive result is the observed potential of price discrimination to raise content providers' surplus and the incentives it gives to increase the innovation in service offer, with only minor effects in total welfare. The model seems to predict a key concern of net neutrality advocates

that charging content providers to send data to end-users would inefficiently reduce content provision. However by making content provider usage charges exogenous, the model is unable to address a core issue in the debate over network neutrality: that content provision should not be charged for at all.

The model reflects that depending on the type, discrimination can be harmful or beneficial and it is necessary to identify the incentives that lead the platforms to discriminate and assess their impact on the society's welfare. It also captures the assertion found in the literature that in a two-sided market, retail prices charged to consumers and websites, need not reflect the benefits or costs of either side by itself [7]. Other results seem also to agree that changes in fee structure proposed by access providers have can disrupt the current distribution of wealth between content providers and network access providers [4].

6. BARRIERS AND OPPORTUNITIES

Digital inclusion is about ensuring that individuals have access to Information and Communication Technologies (ICT), thus being able to participate and benefit from a growing knowledge society. Regulation on network neutrality, in particular, and NGN, in general, will have to deal with two important aspects that may erect themselves as opportunities or barriers to inclusion in the knowledge economy. On the one hand is the question of whom and how will guarantee the deployment of NGN; on the other hand is the question of promoting innovation at the edges of the network.

As the worldwide trend is for governments to participate in the construction of national broadband access networks, it would seem plausible to entertain a vision of accelerated opportunities for individuals and society at large to be provided with high-capacity access to the network. The latter is more likely to occur, of course, in more developed nations. The less developed nation's universal broadband access conundrum will most likely follow the path that has characterized its provision of telecommunications services, i.e., an uneven and disproportionate offer of telecommunications services across layers of society, with a relatively large sector unable to grasp the benefits of new technologies.

Innovation at the edge of the network has been one obvious result of the way in which Internet was originally conceived. Some technical functions at the network or transport layers may seem dated now or in need of major updates, but as it stands, Internet has allowed many individuals to try, test and commercially launch their ideas, which have become tangible demonstrations of what is possible to achieve on a 'neutral' network. In a network environment where QoS is part of the operator's offering it is not yet clear how the pace of innovation can be sustained or even increased.

It may be argued that not letting operators experiment with new pricing schemes could impair their plans to deploy and upgrade their networks. Thus, if the promise of all-IP, QoS-based networks is not achieved then innovators will not even be able to rely on network infrastructure where to offer their new contents, services and products. On the opposite side, it could also be argued that granting platforms the ability to discriminate among traffic flows or information packets opens the path to differential charges, depending on the origin of the packet or other related characteristics; such practice may exclude content providers whose potential innovations may not reach consumers or only partially be offered on new, artificially restricted markets.

Those in favor of network neutrality argue that the success of Internet lies on its open network architecture that does not allow discrimination and the fact that users are able to access the applications and contents they want without any restriction or blockage. Those against it, mainly network operators, explain that the high costs of infrastructure maintenance and their need for investment recovering demand that they are allowed to explore new charging schemes and pricing models.

As operators worldwide engage in major updates to their core networks, they expect favorable regulatory mandates that give them incentives to continue their network expansion and to recover their investments. They claim that new applications will demand ever more resources in addition to quality assurance. In summary, while network neutrality opponents expect regulators not to oppose to various forms of discrimination, all of which threaten network neutrality principles to some extent, defenders invoke those principles to justify the need for an explicit neutrality mandate that preserves the incentives for innovative service and application development.

New services and applications will be provided if next generation network access is available. Regulators seem to agree that the key policy challenge for NGN access is to achieve a balance between market incentives and the level of competition in access network markets. How to strike such balance and implement a policy that ensures available networks with maximum coverage and affordable prices is a matter of disagreement. It is possible then that allowing discrimination becomes a tool to achieve policy objectives, as long as its implementation proves that more individuals benefit by being included into the knowledge society.

In conclusion, regulatory principles and practices developed in a world of legacy infrastructures and monopolistic provision of services may no longer apply. As stated by Waverman, "*the* (regulatory) *principles …, which basically revolved around non-discrimination by the incumbent telco, need rethinking. Discrimination, innovation and investment are the ways in which markets function and firms add value*" [10]. Given the overwhelming presence of private capital and private participation in the telecommunications industry, it is necessary to reflect on what and how incentives will attract investment in NGN. If competition is a driver to the deployment of innovating services, then surely there must be a role for discrimination to promote it. Discrimination can and will be made a tool for pursuing policy objectives, and its use must guarantee that more

individuals benefit by being included into the knowledge society.

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BIOGRAPHIES

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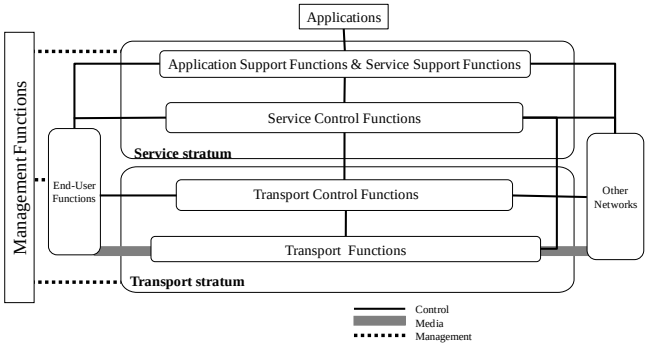
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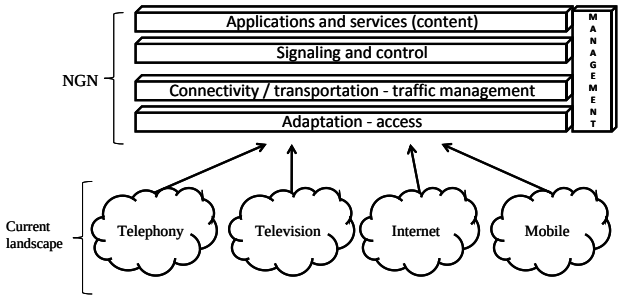
Service Control Functions
Service stratum
Transport Control Functions
Transport Functions
Transport stratum
Management Functions
End-User Functions
Other Networks
Control
Media
Management


NGN
Applications and services (content)
Signaling and control
Connectivity / transportation - traffic management
Adaptation - access
MANAGEMENT
Current landscape
Telephony
Television
Internet
Mobile