# Understanding the Net Neutrality Debate

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## ABSTRACT

This paper will serve as an introduction to the concept of net neutrality and as a note to highlight the recent growing interest on this issue. We show that the standard principles organizing the functioning of the Internet, since its invention, are the main roots of neutrality that guarantee competition and innovation. Different perspectives in the net neutrality debate are discussed taking into account the changing uses and the growing traffic. Moreover, the key principles for policy decisions are identified and it is explained how regulation can preserve neutrality while allowing the commercialization of services and applications that are latency sensitive and bandwidth consuming.

## Keywords
Net neutrality; Internet; Regulation; Debate.

## 1.  INRODUCTION

Nowadays, the concept of net neutrality receives a widespread attention from different Internet stakeholders. The core problem of net neutrality is the following: the Internet is, by design, based on standardized protocols that treat all data packets equally; any attempt to prioritize a certain type of data, for non-technical motives, is considered as a violation of the neutrality principles.

Around the world, many ISPs (Internet Service Providers) and even national regulatory authorities are blocking VoIP services and some Websites content, such as Brazil, Mexico, Egypt, Kuwait, etc. Nevertheless, several countries have already put in place the regulatory framework that ensures a proper application of the net neutrality principles.

In Morocco, the three telecom operators recently blocked several VoIP services such as Whatsapp, Viber and Skype; this decision is considered illegal and against net neutrality. The Moroccan regulator did however condone these infringements, despite its legal obligation to preserve net neutrality, which stated in the General Guidance Note of the Telecommunications Sector 2018.

On January 7th, 2016, the National Telecommunications Regulatory Agency (ANRT) issued a statement justifying the blocking (observed since late December) of VoIP applications that allow free calls via 3G (Third Generation) and 4G networks. ANRT gives the following clarifications [1]:

- The establishment and operation of public telecommunications networks and the provision of public telephony services are subject to licensing, under Article 2 of the law on postal and telecommunications No. 24-96;
- The delivery of all telephone traffic to the end customer can be ensured by public telecommunications network operators, under the conditions set by the specifications of the licenses for which they are beneficiaries;
- The commercial exploitation and use of IP for the provision of telecommunications services are governed by the decision of the ANRT on the status of IP telephony No. 04-04 published in April 6th, 2004.

Net neutrality is a trending term in telecommunications that is very difficult to precisely define and cause an intense debate between two perspectives on the issue. Almost all definitions of net neutrality are based on principles that were established by Professor Tim Wu [2]:

- Net neutrality is a principle which guarantees equal treatment of all Internet data flows;
- Net neutrality also prohibits all aspects of discrimination, should it be on the grounds of the source, destination or content of the traffic transmitted on the network.

These principles, organizing the neutral functioning of the Internet since its invention, have contributed to make it a platform for innovation, economic development and freedom of speech. However, in recent years, low benefit margins and the increase of the traffic transiting on the network have prompted the operators to question these principles and defend some new practices that are against net neutrality.

The net neutrality debate takes several aspects: technical, economic and legal. Therefore, in this paper, we will discuss technologies and basic principles of the Internet while exposing the net neutrality debate and the regulatory approaches applied.

## 2. NET NEUTRALITY AND TECHNOLOGIES

Internet was originally a military network called ARPANET whose functioning was mainly based on the NCP protocol (Network Control Program is a peer-to-peer communication protocol used for data transfer via the ARPANET). Because the latter does not support communication with machines outside the ARPANET, particularly when they use a different technology, Robert Kahn and Vinton Cerf Elliot, two network engineering researcher, created a new communication protocol (TCP/IP: Transmission Control Protocol/Internet Protocol is the set of protocols used for data transfer over the Internet) which will be Internet's standard protocol afterwards.

The TCP/IP model can be described as a network architecture that consists of four layers: network access layer, Internet layer, transport layer and application layer. This communication model has gradually evolved to replace the OSI model (Open Systems Interconnection) that is still used for historical and academic purposes.
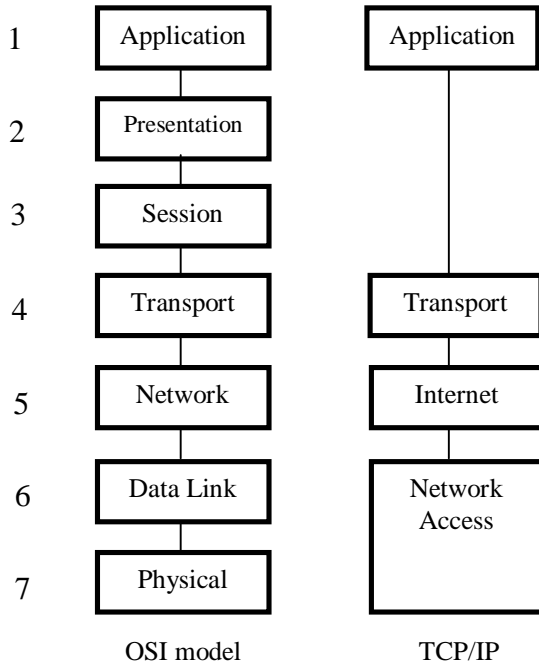
Figure 1. Comparison between OSI and TCP/IP models
(Source: Internet Engineering Task Force).

The TCP/IP layers, above, give a technical representation of the Internet. In order to provide a conceptual overview -rather than technical one- that could enable us to examine the various issues related to Internet governance, a redefinition of the layers is necessary, to take into account the specificities of Internet regulation. The representation of technical layers were slightly modified in order to facilitate the analysis of regulation and its influence over the Internet.

Werbach has opted for a network architecture with four layers: content, applications or services, logic and physical infrastructure [3]. Benkler suggested only three layers: the physical layer; the logical layer that controls access and network operation; and the content layer [4].

The physical layer includes objects in the Internet infrastructure such as cables, wireless communication devices or satellite, etc. In general, the deployment of this layer requires heavy investments, a characteristic of network industries that needs a constant regulatory effort. The focus of regulation in the physical layer may also be the architecture adopted, the communications' interception capabilities by the government and in the control of encryption technologies, etc.

The logic layer deals with standards and protocols that manage the data flows through the network. The main question addressed in this layer is the functioning efficiency of the domain name system (DNS).

The application layer, as its name suggests, contains all of the applications available to the end use such as VoIP (Voice over IP), IPTV (IP Television), web browser, etc. Several applications have been considered as special services provided by proprietary infrastructure, such as television and telephony. Today, however, with the convergence of services and networks, the distinction between services is irrelevant since they use the same IP based infrastructure. Therefore, the adoption of a unified regulatory

approach is a necessity for the proper functioning of the new network.

The content layer consists of all data made accessible by applications. Currently, the content regulation depends on the type of the offered service. For example, the content of telephony conversations and broadcast television are subject to different rules. However, the Internet does not differentiate between packets of a VoIP communication and those of a video stream, which causes regulatory confusion.

Regulation in the content layer focuses on the intellectual property protection and the transposition of the physical world laws to the digital medium.

The redefinition of these layers allows to highlight the complexity of Internet regulation, which should take into consideration the legal, economic, social and technical aspects.

From a technical standpoint, the Internet regulation depends largely on the basic principles that have been the source of its invention: "thesis Code" and the end-to-end principle. According to the basic principle of "thesis Code", the Internet is an artificial environment created, designed and deployed by humans to the extent that current technologies offer. It does not have natural properties because its nature is totally defined by its design, its protocols and applications. Thus, protocols and applications of the logical layer (code) define the properties of the law governing the Internet (Code = Law) [5]. Solum and Chung make use of an analogy with the building sector [6]: "In this sense, Internet architecture is like the architecture of buildings and cities. Just as the architecture of a building enables and encourages humans to move and congregate in certain ways, so the architecture of the Internet enables some activities by users and regulators while discouraging others".

The end-to-end principle -one of the Internet key attributes- describes the Internet as a stupid network with intelligent applications. In fact, in the Internet network, intelligence is located at the ends and the intermediate elements are only responsible for data delivery. Rather than installing intelligence at the core of the network, we locate it at the ends: the computers in the network perform the very basic functions required for various applications, while functions that are required by some specific applications are executed on the network edges. This way, the network complexity and intelligence are pushed towards its edges: simple networks to intelligent applications [7].

Isenberg believes that the stupid character of the Internet, when compared to the telephone network, results from a neutral data transport with intelligent terminals, controlled by users, at the ends [8].

The contribution of the end-to-end principle in the growth and the success of the Internet has been very clear. By allowing a variety of applications to use the Internet, this principle has contributed to increase competition and innovation in content and services.

The preservation of the end-to-end principle is the major issue in the debate on net neutrality. The stakeholders discuss whether the Internet should maintain its original design or adopt the prioritization through operators, who own and control the various aspects of the physical layer, thus allowing source, destination or content based data discrimination.

The idea that the Internet today is entirely neutral remains false. As a matter of fact, without considering the hierarchy of access, there are strategies that prioritize certain types of data over the remaining network traffic. For example, the operator and the service provider can sign a transit agreement including guarantees on the level of service. Similarly, the supplier can host his content

in the operator's facilities, which will guarantee a good level of reliability and quality of service.

In general, we can distinguish between three data processing models in the Internet:

- **The best efforts rule**: the default model that processes data packets without discrimination regardless of their sources and their destinations by applying the principle of first in, first out (FIFO).
- **Needs-based discrimination**: this model applies the rule of best efforts as long as the network is not congested; otherwise, the latency-sensitive packets are prioritized and placed toward the front of the waiting line.
- **Active discrimination**: operators use predefined rules to inspect and prioritize all data packets regardless of the network status.

The latter model, also called hierarchy of access, is the subject of the debate on net neutrality. It allows operators to control the network and set the access charge that suits them. It also allows them to discriminate between service providers or between applications.

## 3. THE ANTAGONIST PERSPECTIVES OF THE DEBATE

In the recent years, the net neutrality debate has assumed great importance in the telecommunications sector. It examines the question of defining the roles of different Internet actors, but also specifies the level of freedom that must be preserved to ensure the continuity of Internet development.

Given the rapid growth of traffic and the changing uses, finding a balance to the ecosystem of the Internet becomes a priority. ISPs noted the investment requirements for the modernization of the existing infrastructure to support the increasing traffic.

The net neutrality debate has been opened for two main reasons:

1) Internet service providers witness the growth of the load on their equipment because of the increasing traffic exchanged, which requires the upgrade of the existing infrastructure, and ISPs have to consider the profitability of their investments;

2) the public authorities seek to impose some Internet laws such as those protecting intellectual property or those relating to the fight against cybercrimes.

Internet actors were divided between supporters and opponents in the net neutrality debate. On the first side, there are operators and Internet access providers; while users and producers of content and applications make the other.

J. Gregory Sidak, a professor and an expert on regulation, testified in opposition to the net neutrality principles at a hearing before a Senate Committee on Commerce, Science and Transportation [9]:
" ''Net neutrality'' obligations would require a telecommunications carrier to operate its broadband network so that no packet of information is treated as inferior to others in terms of its urgency of delivery. Under ''net neutrality'' I can take comfort in knowing that my son's Internet chatting about what agent Jack Bauer did on last night's episode of 24 will receive the same priority of delivery as my file transfer of this testimony to the Committee's staff".

The net neutrality debate was nurtured later by economic studies exploring the impact of neutrality on innovation and on investment in network infrastructure and in content.

Operators and Internet service providers, the main opponents of the net neutrality, suggest that the rules of neutrality are likely to reduce investment in infrastructure. They also support the idea of a multi-speed Internet for its eventual effect in improving the efficiency of the existing infrastructure. Opponents build their argument on the investment requirements in the network infrastructure that are necessary to deal with the increase of Internet users and the changing uses.

Furthermore, the use of certain latency sensitive and bandwidth-consuming applications requires a high level of service quality, which strains the existing infrastructure. Upgrading the latter requires heavy capital expenditure. The ISPs are hoping to recover some of these costs from content and applications providers; they advocate for putting forth their property rights and the positive impact that such decision could have on the customer experience and on the acceleration of the next generation networks' deployment.

However, proponents of neutrality believe that the fees paid by users are already sufficient for the infrastructure modernization. They describe the hierarchy of access practices as undemocratic [10].

According to the net neutrality supporters, the end-to-end principle is the main catalyst for innovation on the Internet and that any deviation from this rule would greatly harm the incentives to invest in content. Prioritization of access also would harm innovation by reducing the usefulness of certain applications that require prioritization of their traffic to guarantee a proper functionning.

Neutral Internet has enabled startups and small suppliers, the most innovative, to compete with the giants of the market. However, with the prioritization of access, a small innovator will not be able to offer a new solution where the priority access payment is required; creative destruction will be compromised and innovators will face new barriers to entry. Lessig says in his testimony on net neutrality that [11]: "If the principle of end-to-end is abandoned, however, then innovators must now include in their calculation of risk the threat that the network owner might either block or tax a particular application. That increased risk will reduce application investment".

The most dominant economic approach analyzes the issues of net neutrality as a part of a two-sided market [12]. Participants in the market are: Internet service providers (ISPs), Internet users and content and applications suppliers. ISPs, which are placed at the heart of the two-sided markets, determine the pricing policy. It is commonly accepted that in the absence of constraints, ISPs apply positive rates to content and applications suppliers. The net neutrality is regarded as a form of pricing regulation equivalent to a zero price for content and applications providers.

To reach the Internet users, the content and applications producers are forced to go through the ISP infrastructure (bottleneck). An unfair pricing policy will reduce the return on investments in content and even prevent their production. That being said, any deviation from the neutral and the free nature of the Internet would slow down the creation of content and innovation in applications.

Regarding the infrastructure investment, ISPs put forward the argument of lower margins due to the increased competition. For them, the content creators pricing is a good source of income. Net neutrality deprives ISPs of pension appreciated fully by content and applications providers, which discourages investment in infrastructure. Proponents of neutrality recall that despite the low

revenue per transaction (subscriber), ISPs benefit from the volume (number of subscribers) driven by free Internet.

# 4. THE NET NEUTRALITY REGULATION

Nowadays, the net neutrality regulation is a passionately debated subject by both partisans and oppositionists alike. The debate is rich in emotional argument but short on rational economic analysis. Policymakers continue to seek answers to strike a balance between the two opposing perspectives in the net neutrality debate. On one side, supporters of net neutrality seek the establishment of a regulatory framework ensuring transparency, openness and protection of users against certain abusive conduct on the Internet. On the other side, opponents fear that the regulation changes the current model of the Internet, which could reduce innovation and cause considerable commercial losses. In this context, policymakers investigate the issue with care and seek to make informed decision based on rational judgment in order to provide a market environment in which the right signals are given.

ISPs develop and implement large IP-based networks and can prioritize certain types of traffic, assuming it is done in a balanced and fair manner. Nobody can complain if they prioritize voice over data in congested networks. Nevertheless, if the ISP do so to receive an additional revenue then they wouldn't be abiding by the law and the regulators may have to intervene.

Given their core missions of maximizing the total surplus and promoting optimum use of the existing infrastructure, regulators must be guided by some general principles to be effective. Since 2005, the FCC (Federal Communications Commission) identified four key principles [13]: "(1) consumers are entitled to access the lawful Internet content of their choice; (2) consumers are entitled to run applications and services of their choice, subject to the needs of law enforcement; (3) consumers are entitled to connect their choice of legal devices that do not harm the network; and (4) consumers are entitled to competition among network providers, application and service providers, and content providers".

In Europe, it was during the preparation of the third telecom package that the European Commission was interested in the issue of net neutrality. This package contained the following provisions [14]: 1) setting a target for national regulatory authorities to promote net neutrality; 2) forcing operators to inform consumers about the quality of service levels provided, and traffic management measures implemented; and 3) providing the ability of national regulatory authorities to set a minimum level of service quality.

Regulators want, unanimously, to preserve the neutral model of the Internet, which is based on the market game rules to discern between winners and losers. They prefer a regulation that is based on principles rather than on an abstract definition of net neutrality. In December 2010, the FCC released the Open Internet Order, a document which takes from the Internet standards, that are commonly accepted in earlier decisions of the FCC; and which suggests three key principles [15]:

- **Transparency**. Fixed and mobile broadband providers must disclose the network management practices, performance characteristics, and terms and conditions of their broadband services;

- **No blocking**. Fixed broadband providers may not block lawful content, applications, services, or non-harmful devices; mobile broadband providers may not block lawful

websites, or block applications that compete with their voice or video telephony services; and

- **No unreasonable discrimination**. Fixed broadband providers may not unreasonably discriminate in transmitting lawful network traffic".

The FCC requires that the application of these principles combined with a reasonable network management (4th principle) will protect consumers and innovators. It will also ensure the continued prosperity of the Internet by attracting private investments that will fund innovation in the core and in the extremities of the network [16].

Traffic management is a major issue in the development of each policy on net neutrality. This management must not generate negative effects on the ecosystem of the Internet, particularly on competition. The information that is available today, for commercial reasons, on traffic management practices show that competition alone is not sufficient to ensure neutrality. Hence, the regulatory intervention is necessary to correct the market deficiencies. For a successful prioritization of access, regulators should adopt the following measures:

- Prohibit operators from discriminating between the suppliers of a particular application while allowing them to offer different connection offerings with differentiated levels of service quality;

- Require operators to make their offers more readable and to clarify some technical parameters such as upload, download, and the minimum quality of service; In addition, they must report cases where the connection is shared with other services and the terms of this division;

- Prohibiting operators from censorship based on content or source. Some censures are not based on commercial or political interests may be authorized, as the case of child pornography.

On pricing, regulators must ban all payments that give priority to content, application or services. Operators should continue to apply capacities based pricing; which means that they can receive higher payments for large capacities selected by consumers or content, applications and services providers.

# 5. CONCLUSION

Recently, the net neutrality has received great attention by Internet users, regulators, policy makers and academics alike. This paper provides an overview of the major principles that were adopted, since the creation of the Internet and which allow its neutral functioning. These principles have played an important role in fostering competition and in encouraging content, applications and services innovation. This paper is an attempt to explain the net neutrality debate between Internet service providers and producers of content, applications and services. A balancing approach between the two antagonistic perspectives must be found by policy-makers and all stakeholders in order to maintain the development of the Internet. Regulators have identified the key principles to apply such as transparency, no fortuitous blocking and no unreasonable discrimination.

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