Network neutrality

Internet freedom is really at risk?

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Abstract

The last century has faced the explosion of telecommunications systems. Telephone, radio, television and Internet are now so rooted in the daily life of millions of people that is difficult to imagine a world without them. In particular, Internet is so attractive because of its freedom. Recently network providers have started to use traffic filtering policies aiming to optimize the network performance but this has hurt the freedom of both users and content providers.

In this work is described the current scenario of the network neutrality issue looking at the forces that hold the discussion and identifying a possible route to follow in the next years based on recent developments in matter.

1. Introduction

The last century has faced the explosion of telecommunications systems. Telephone, radio and television are now so rooted in the daily life of millions of people that is difficult to imagine a world without them. This is particularly truth for Internet. Started as the Advanced Research Project Agency - ARPA research project at the Department Of Defence - DOD of the USA in the early 70's, in the last decades has been transformed in a commercial network of network in constant growth connecting millions of pc allover the world. What makes Internet so attractive resides in its architecture which is very similar to the postal delivery system: when one node of the network wants to talk to another one it simply needs to prepare a message, called *packet*, stating what is the destination. Then the packet is injected in the network which in turns deliver it to the correct destination using *routing informations* which describe the location of the nodes in the network. As the postal delivery system, the network is general purpose because can delivers different types of data: images, text document, audio/video, ecc. . . .

Each type of data can be coded in different ways so a packet can be formatted with different *syntax*. Each message also contains other informations related to its *semantic* so that is possible to give to it the proper meaning inside a communication. Furthermore the *timing* of a communication can differs, for example real time audio/video communications have stronger timing constrains than the delivery of text documents. Syntax, semantic and timing rules are collected in particular documents called *protocols* and most of the them, including all those describing the internal functioning of the network, are free and published as Request For Comment - RFC.

From the protocols point of view, we can think at Internet as a self-described system because describes it self through protocols and needs other protocols to be used. This is similar to what happen in computer programming where a compiler is a program that has been compiled in some ways. Anyway the important fact is that Internet is a general purpose system or, stated more correctly, it adopts the end-to-end principle [1]: whenever possible, protocol's operations should be defined to occur at the end-points of communication systems, or as close as possible to the resource being controlled. In other way, the core network should remain simple as possible so it can be seen as a generic purpose transport system upon which to create other services using ad-hoc protocols.

This approach is the most important explanation of the great success of Internet. The last decades have seen the rising of plenty of protocols and applications that use the network. We are arrived to the point that some works, as financial/banks world, would be very difficult to do without the network. Moreover Internet has created new way to make money easier than before. For example a little farm now can reach more consumers allover the world simply selling its product directly on the net. Furthermore, Internet has created new kinds of markets, for example the *webservices*.

The article is organized as follow: in Sec. 2 is described the network neutrality issue while in Sec. 3 are detailed the stakeholders that play important roles in the discussion and the forces through which they interact. In Sec. 4 are stated

the precise ethical issues related to the network neutrality while in Sec. 5 are described actions that has been adopted in the recent past and that define a possible route for the future.

2. Current scenario

Today exists a lot of classes of network applications: web, filing/office, peer-to-peer, voip, gaming ecc.... Each of them can be splitted in subclasses: web vary browsers to feed readers; filing/office vary from e-mails to ssh/telnet; peer-to-peer vary from file sharing to the more recent tv streaming.

This variety is strictly related to the end-to-end principle and, more precisely, to the *network neutrality* approach. As stated before, the network can be seen as a blind delivery system. When a node generates some traffic, the network delivers it to destination without apply any modification to the data contained in the packets so it can be said that the network it's blind to the application that has generated the traffic. This freedom has allowed the creation of a lot different ways to use Internet and this explain the big numbers of applications that use it.

A side effect of this variety is that each application has its own characteristics i.e. generates traffic with different features and has different network performance requirements. For example, is easy to understand that e-mail/web applications compared to streaming applications as voip/p2ptv generate traffic with opposite *shaping*: in the first case are used small packets without strong timing constraints but in the second case are used burst of big packets. To increase the performance of the network it can be used *Quality Of Service - QoS* policies i.e. handle the traffic according to the class that best fits the features of the specific traffic. For example, to satisfy timing constraints, streaming traffic could be handled before web traffic applying specific routing policies. However this approach violates the network neutrality principle for two reasons. As first thing, the classification process is based on the inspection of the traffic i.e. network providers in some way investigate the behaviour of the users of their network. This means that users not interested in QoS see their traffic handled not fairly and they have also to bear the snooping of the providers. Furthermore through the violation of the network neutrality it could be inevitably lost the freedom to use and experiment new ways to use the network. Instead to have "data that tells to the network were to go" there would be the opposite situation in which "data goes where the network tells".

Even if at a first glance the violation of the network neutrality seems a real attack the freedom of Internet there is no doubt that anyway there would be some gains. For example the traffic inspection could increase the protection against anomaly like the proliferation of viruses/malware and spam. Furthermore a certain level of knowing about the behaviours of the users is really useful for the *network engineering* i.e. the managing operations performed by the network providers for example to value the amount of traffic that is flowing in their network so to identify possible bottleneck.

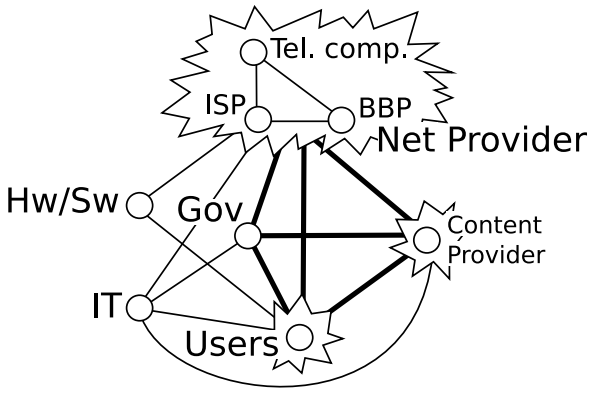

Figure 1. Stakeholders network. The stronger is the line the harder is the connection between the subjects

A more detailed discussion about pros and cons in the violations of the network neutrality and which are the subject that are directly interested in the discussion is provided below. Anyway one may ask why and if this discussion is really so important. The answer is yes simply because the broadband network access has not reached its maximum point of expansion. This means that the access to Internet is still in the first part of its life and decision taken today can affect heavily the future.

3. Stakeholders network

The Network neutrality discussion is not new in the telecommunications world. On June 16, 1860 a US federal law stated that

> *"messages received from any individual, company, or corporation, or from any telegraph lines connecting with this line at either of its termini, shall be impartially transmitted in the order of their reception, excepting that the dispatches of the government shall have priority"* [2].

The discussion today is held mainly among three subjects. From one side there are the Internet users which aim to use the network without any restriction on which application use or which information retrieve. On the other side there are network providers which violating the neutrality want to improve the performance of the network. In the middle there are content providers which don't what to lose the freedom to experiment new application but can have some gains in the violation of the neutrality.

Most of the users look at ISP's *layered Internet* very skeptically. They are afraid that giving to much freedom to the network providers to choose which classes/performance and how to implement them it would turns out in more money for theirs bills. An evidence of this is a mail reply

of a Comcast's user in 2001 who had complained about the ban on VPN usage of the provider network:

> "[...] *To accommodate the needs of our customers who do choose to operate VPN, Comcast offers the Comcast @Home Professional product.* [...] *This product will cost $95 per month"*

In an economic system with a fair competition, this threat should not exists because users are free to choose the network provider closer to their needs. Unfortunately the reality is different. Internet access is provided by the interaction of two subjects: *Broad Band Providers - BBPs* control the physical wires upon which communications flow while *Internet Service Providers - ISPs* manage the network and act as a bridge between users and the broadband network. The BBPs are mainly telephone companies (in USA also tv cable providers) and in the *narrow band* age i.e. before the rise of the DSL technology, they also act as ISP, so the market was very closed. After the *unbundling* i.e. the regulatory process of allowing multiple telecommunications operators to use connections from the telephone exchange's central office to the customer's premises, has started to appear new ISPs but anyway the market hasn't opened so much till now. For example, in Italy the 95% of the contracts is held by only 5 companies (Telecom Italia, Fastweb, Wind, Tiscali and Tele2) which provide also telephone service and the 65.8% of the total is controlled only by one company (Telecom Italia)[4]. In this context, the competition is price based and new operators cannot enter because the start up costs are very high. ISPs also state that the revenues earned applying the layered access would be used as internal investment for both research and speed up wired connections.

If telecom corporations act as both single voices and groups like the *National Cable and Telecommunications Association - NCTA*, network users maily organize themself in association as *Network Neutrality Squad - NNSquad* or *Elettronic Frontier Foundation - EFF* but are also represented by many important personalities of the IT/research world as Tim Berners-Lee [5] or Lawrence Lessig [6]. Both side push the governments to find a proper regulation on the subject. The same 44th president of the USA Barack Obama state clearly his position in favour of the net neutrality [7].

The violation of the network neutrality is not a remote hypothesis but the nowaday reality. ISPs has started to use filtering/inspection techniques some years ago and the question, beside if this policies are correct or not, is how much they should push further in that directions. The *Federal Communication Commission - FCC*, i.e. an independent United States government agency in charge to regulate radio, television, wire, satellite and cable communications, levied $15,000 on Madison River Telephone Company for blocking ports used by VoIP applications [8]. Many other enforcement actions has been risen against Comcast, the biggest cable provider and the second ISP of the USA, which use *Sandvine* hardware control peer-to-peer communications [9].

In Italy, Wind provides contracts stating precisely which protocol are allowed: HTTP, SMTP, POP3, IMAP4 and FTP, so, roughly speaking, this means that only "simple" web an e-mail applications seems allowed. Tele2 instead explicitly say to apply shaping policies to reduce the p2p traffic during peak time [4].

Anyway the ISP contracts have the tendency to be vague in terms of performance even if should be an user right to now the precise terms of the service they subscribe. Because of the lack of trasparency, when an application doesn't work as expected it can be very difficult to find the solution for the problem even for a technical expert. Recently the research community started to develop some tools that help to investigate the possible threats. The NeuBot project [10] proposes an open source application that measures both classical network statistics like jitter, packet lost rate, port filtering ecc. . . and specific tests to check if the bittorrent protocol is blocked by ISP's policies. A more interesting example is M-Lab [11], a measuring framework founded by New America Foundation's Open Technology Institute, the PlanetLab Consortium, Google Inc. and academic researchers. The project aims three target: provide a set of measuring tools to the users, a set of server allover the world to be used as reference point for the measurements and public database to collect the results obtained.

Content providers i.e. societies as YouTube.org but also media corporation like Fox, as the Internet users, are afraid to lose the freedom to use the network by the violation of the neutrality because some content could be suppressed or handled not fairly. The fact is that already today the traffic cannot be handled fairly because of the volumes of peer-to-peer traffic that congest the network. Anyway is not a simple problem of network capacity because the more bandwidth is available the more will be used. In Japan exists contracts for 100 Mbps connection but there are the same saturation problems like any other country. Furthermore, supposing that in the next future Internet will be available everywhere thanks to the spreading of wireless technologies, without appropriate traffic policies the network could collapse easily.

Related to the content providing, it cannot be hided the fact that the major part of the peer-to-peer traffic is pirate. For this reason content providers, specially music and cinema, push toward to the formulation of precise laws. From this point of view violations of the network neutrality could act as education tools to teach how to use the network more correctly.

For software and hardware manufactures it can be difficult to take a position. It's clear that enforcing the neutrality means the complete freedom to experiment new "toys" but even with strong violations there is always space to identify optimizations. In other way, instead to have a heterogeneous market it would be a very specialized market for them.

4. Ethical issues

Around the network neutrality discussion there are many ethical issues. First of all the *open access*, i.e. the need to have a more competitive market between the ISP which should not based only on prizing but on real performance.

Beside this there is a problem on which content provide. Most of the peer-to-peer traffic is pirate so there are *copy rights* issues but also the exponential increasing of network *viruses/malware* is a big threat.

Through the application of the layered Internet it comes a *privacy* issue because an ISP has to "spy" the users behaviour to apply a classification of the traffic.

5. Alternatives scenarios

To unravel the network neutrality issue there are three possible solutions: enforce some government laws, reach self regulated scenarios or a mix of the two. Applying hard laws seems too extreme also because, as FCC's commissioner Robert McDowell said

> *Internet has flourished by operating under the principle that: engineers should solve engineering problems, not politicians and bureaucrats.* [12]

On the other side the formulation of some code of conduct seems reasonable. A good example of this regulation are the *Four Internet Freedom* formulated by the FCC chairman Michael Powell in February, 2004 [6]:

- *Freedom to access content* [...] *I recognize that network operators have a legitimate need to manage their networks and ensure a quality experience* [...] *Such restraints, however should be clearly spelled out and be as minimal as necessary;*
- *Freedom to use application* [...] *no one can know for sure which "killer" application will emerge to drive deployment of the next generation high-speed technologies.*
- *Freedom to attach personal devices*
- *Freedom to obtain service plan information*

Lawrence Lessig proposed an extension [6] to this code to clarify the concept of *consumer tiering* i.e. instead of have a fine grained tiering system able to identify specific applications (e.g. eMule, μTorrent rather than Skype) or specific content (e.g. Youtube rather than a CNN video streaming) the diversification should be limited to either bandwidth (e.g. at least 10 Mbps) or service guarantees (e.g. fast video streaming without specifying a particular provider).

Another example is the Tim Wu proposal [13] which states that broadband users are free to use Internet connection excepts if they comply with any laws, harm or interfere with a BBN but at the same time the network providers are free to manage the network so as to remove delays and identify security violations.

This examples seem a perfect mixture of "carrot and stick" even if they haven't been formulated to be hard laws. Beside them the most important self regulated action is the P4P framework [14] a workgroup founded by big software producers (e.g. Bittorrent and Vuze), broadband companies (e.g. AT&T and Verizon) and hardware manufacturers (e.g. Cisto System) that aims to reduce the volumes of data flowing in the network using optimized protocols and applications. Even if it's a very young project (has been created only last year, 2008) preliminary results shows that is possible to have high performance networks without strong tiering even with *protocol agnostic* manage policies. In other words something very similar to the Lessig proposal.

Also Comcast, after all the enforcement actions of the FCC, has taken an active position. On March 27, 2008 started a collaboration with Bittorrent Inc. to more effectively address issues associated with rich media content and network capacity management [15]. Then, nearly one month later, on April 15, they announced a collaboration with Pando Networks for the creation of a *"P2P Bill of Rights and Responsibilities"* for peer-to-peer users and ISPs.[16]. The purpose would be to clarify what choices and controls consumers should have when using P2P applications as well as what processes and practices ISPs should use to manage P2P applications running on their networks. Furthermore they plan to public the results of the various tests so other ISPs can benefit from understanding how peer-to-peer applications might be optimized.

6. Conclusion

Internet is the most important telecommunication system of the nowaday economy. Its versatility is deeply related to its freedom so is good to be concerned about network neutrality violation but in the end no one would have a real gain limiting it. The codes of conduct proposed and the promising result obtained by some workgroups founded by many ISP, software producers and content providers seem trace a precise way to follow for the next years. It's interesting to notice that this approach perfectly fits the system upon which the Internet has been developed i.e. self agreements without a strong intervention of governments.

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