Net Neutrality and Quality of Service

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Abstract

The original meaning of the word *internet* has drifted from packet switching infrastructure to anything using it. Net neutrality has no technical definition. We summarize the positions of operators, content providers and users. The lack of well defined operator service and non committing contracts generate suspicion and frustration among users. Content providers and operators are reluctant to invest in network upgrades. Managing services by QoS lets users choose their own end to end quality across nets. Finally, ICANN keeps a lock on domain names for protecting its monopoly.

1. Foreword

The terminology "Net Neutrality" associates two words for which there is no precise definition. Thus we must define here the meanings we use in the body of the present document.

"Net" is an abbreviation for Internet. But what is Internet ? Initially, in 1973, the term became used as a short for internetwork, that is a set of interconnected packet switching networks. The term "catenet" was proposed [1,2] for this level of communication infrastructure. Actually over the years people kept using the word internet to mean anything and everything (hardware, software, applications, services) including catenet itself. Thus the meaning of the word "internet" became a hodgepodge of fuzzy interpretations and misconceptions making unlikely any public rational consensus on desirable policies and improvements.

In this document, "net" means "catenet".

Neutrality is often understood as non partisan, when bringing up several viewpoints or proposing various alternatives to a disputed resolution. This is a human or institutional posture. When associated with (computer) network it is literally meaningless. Nevertheless people somehow invent their own interpretation of network neutrality fitting their concerns. Usually their perception derives from a feeling of being unfairly discriminated in ways they get network service. At the same time they cannot advance technical specifications intended to make the network neutral.

2. Implementation of the net neutrality principle

The immediate question is: what is the principle ?

Many people think that all packets should be handled equally. E.g. packets sent to a high bandwidth destination would be delayed so that they would not exceed the number of packets sent to a low bandwidth destination. Or packets carrying voice conversation would have to wait for an available slot in a common output queue. Etc.

A quick scan for "network neutrality" in a search engine turns up scores of references, e.g. [3], based on various usage assumptions and network characteristics.

It is clear that interpretations vary with net operators, content providers, and end users.

An example is a set of principles worked out in Norway [9] in 2009. For a time this was hailed as a model of a broadly agreed consensus. However, in 2012 this agreement fell apart [10], due to a major increase in bandwidth requirements for video traffic.

3. Net operators

Net operators endeavor to handle data within the technical constraints of the service expected by end users, e.g. interactive session, transaction, file transfer, voice conversation, web page, voice or video streaming, real time. Each type of service usually expects a minimum transit delay, or a minimum bandwidth, or a stable delivery rate. Fulfilling all these constraints at any time cannot be achieved without monitoring data flows and moving packets within specific time frames. In case of bandwidth shortage some arbitration is needed among flows so that the service degradation perceived by users remain tolerable. Obviously there is no magic recipe to guarantee that all users perceive an equal degree of degradation.

When bandwidth shortage is severe it may be necessary to delay some high bandwidth flows which reduce low bandwidth ones to a trickle. That is, some types of less demanding users get priority. This is service management.

Typically from their source to end users data flows are carried through more than one operator. Nets are usually independent systems applying their own service management policy. Thefore one should not expect a natural built-in consistency among all operators. Mutual adjustments result from experience, proper selection of net partners, and administrators preferences.

4. Content providers

A content provider could be, for example, a heat sensor, a camera, a PC or a data center, that is, any computing system collecting or serving data, but not a packet carrier. They are connected to one or more nets and are used remotely in interactive, transaction or streaming mode or file transfer. As long as their traffic flow is substantially lower than the net capacity there is no specific issue to be raised. On the other hand providers may not receive data in time, or they may exhaust the net capacity.

Net overload or insufficient data collection frequency may cause provider's data loss, which might be mitigated with buffering (storage) and compression, if applicable by providers. Statistics collection is presumably more tolerant to some minimal data loss. Alarms are not.

Massive provider data transfer is more likely to trigger congestion in a part of the net. This is unwelcome by net operators, and a major bone of contention with content providers. This is not a matter of technical arguments. The crux of the matter is money: who should pay for increasing net capacity. Is more capacity really justified, when more than half a web page is preempted by unwanted publicity and visual gadgets ? Why is the provider not applying better data compression ?

5. End users

A dominant majority of end users are not (interested in becoming) net experts. They pay their ISP, and other providers, for various services, net access, search engines, email, social nets, banking, travel services, phone, music, TV, etc. They feel ripped off when the service is slow, broken, or error 404 *(typical diagnostic for a missing page)*. There could be a number of reasons for the degradation, ISP or net adapter, some operator trouble, a slow application server, a bugged DNS, a clumsy routing through

the net, a virus, or other. For the user it's the "internet". After several calls to support, and much wasted time, he blames the net operator, which has a reputation of favoring some profitable clients, to the detriment of his kind of user. Adding to the picture a one-sided contract whereby the user is under threat of being cut off the net while the operator or ISP is immune from complaints. In conclusion the net is not neutral, not to say crooked.

6.   Conflict generators

Users reactions may be partially subjective, but quite predictable. As ISP/operator contracts are one-sided, and exclude any quality of service evaluation, users may think they pay for other users enjoying better service, and it's certainly true in some areas of the net. Without factual observation of the service characteristics there cannot be any credible assertion of neutrality. The result is an endemic user suspicion and frustration. Nevertheless the net neutrality they call for may be just a mirage.

7.   Quality of service (QoS)

Initial QoS definition for telecommunications was produced by ITU in 1994. Its definition for computer networks was more arduous due to environment complexity, which keeps growing. An overview is in Wikipedia [4]. Selected research articles have elaborated solutions applicable to the net [5,6,7]. Hence best effort, meaning no QoS, is no longer the essence of the net. End-to-end flow characteristics are now predictable.

A significant result is a new business model for the net. An operator or ISP is in a position to offer users differentiated classes of guaranteed service. In return a user is in a position of checking that he gets what he pays for, or claiming a compensation. What other users are getting becomes immaterial. Each user pays for his own QoS. Net neutrality no longer makes sense in the net context. Users may resent the same QoS being charged at lower fees to some clients, and complain about unfair competition, but this would be a strictly commercial dispute unrelated to the net operation.

As it occurs, QoS may not be implemented properly. Some net or ISP may enforce filtering based on content technical characteristics. E.g. it is reasonable to defer the delivery of huge attachments to a low bandwidth device. Thus users need well documented information on conditions which could interfere with QoS. Options should be available to let users arbitrate between options, e.g. cutting video or images to speed up delivery.

Who is charged for QoS ? Even though the subject appears more commercial than technical, it may have a strong influence on traffic. Some content providers can flood the net, in clogging all service classes. Unless a minimum QoS is maintained in each class some users could be denied service. That is, traffic thresholds may be needed to limit production or consumption during peak times (similar to electricity distribution). Content providers and users contribute to net load, and should be charged to facilitate traffic smoothing.

8.   Closed internet

There are more factors that may distort service. E.g. a file transfer class may be limited to very short files, a video channel may reduce image resolution, etc. Such constraints may not be attractive for users, but on a competitive market they could hopefully find better providers.

Presently accessing internet services requires either an IP address or a domain name. Web applications are often designed only for domain names. These names are registered in the DNS, a

directory fed by a private company (Verisign) under contract with ICANN, a private monopoly imposed by the US gov without any international legitimacy. Domain name rental fees paid by users crawl up the food chain to ICANN through retailers (registrars) and Verisign.

Apart from this cash cow scheme there is a neutrality issue. Like any monopoly ICANN protects its turf against competition: its DNS contains only names paying a rental fee. There are non-ICANN DNS [8] containing more domain names that are not in the ICANN DNS. However, ISPs, browsers and mailers on the market know only the ICANN DNS. This may be fixed, but needs a user's initiative, a common deterrent.

Another case observed in some hotels and institutions is denial of net access when the user device has been equipped with non ICANN DNS addresses. This is rather surprising since other institutions have no need to protect the ICANN monopoly nor the NSA tracking.

Being under US gov proclaimed jurisdiction, the ICANN DNS content is monitored, if not altered, out of users knowledge. Personal and confidential information can be collected when the root servers are used. Hence some users have solid reasons for not using the ICANN DNS.

Anyhow, denying users their choice of DNS is an attempt to privacy, and an abuse of dominant position.

9.   Conclusions

The best effort internet service shows its age (1983). QoS is sorely needed for critical applications. However upgrading the present infrastructure appears doomed to a fate similar to IPv4 - IPv6 upgrading. Actually class 0 of QoS is what we have, and what many people are satisfied with. Why not start building a new infrastructure ?

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