API
Approaches
to Paradigms
of a future Internet

Impact of Dot-Socialism on the Internet End-to-End Principle

API 2010 White Paper, First Think Tank Meeting

Authors/Editors

Author	Affiliation
Paulo Mendes	SITI/ULHT/COFAC
Rute C Sofia (editor)	SITI/ULHT/COFAC
José Legatheaux Martins	DI, Universidade Nova de Lisboa
Susana Sargento	DETI, Universidade de Aveiro

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Executive Summary

This report represents the outcome of the brainstorming session that took place on the 2010 “First Think-Tank meeting” of the Approaches to Paradigms of a future Internet (API). The event which took place in April 30th 2009, in INESC Porto (Porto, Portugal), was dedicated to the discussion of the global theme of the Impact of dot-socialism on the Internet.

This document has a pure informational intention and reflects opinions from different experts that have background on Internet services and technologies.

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Acronyms

Acronym	Meaning
API	Approaches to Paradigms of a future Internet
FCC	Federal Communications Commission
FTTC	Fiber to the Curbe
FTTH	Fiber To The Home
NAT	Network Address Translation
SIP	Session Initiation Protocol
STUN	Simple Translation of UDP over NATs
Wi-Fi	Wireless Fidelity

Acknowledgements

We would like to deeply thank all the invited experts that took part on the brainstorming session that lead to this report:

- Prof. Dr. José Legatheaux Martins, from Universidade Nova de Lisboa.
- Prof. Dr. Alexandre Santos, from Universidade do Minho.
- Prof. Dr. Artur Arsénio, from Instituto Superior Técnico/Nokia Siemens Networks Portugal.

Our deep gratitude also goes for the invited guests that took part in this Think-Tank:

- Dr. Dirk Trossen, Cambridge University.

In addition, we would like to thank all the API Steering Committee members that participated in this brainstorming.

Extra information at: http://siti.ulusofona.pt/ianlab/index.php/api-events/55

1. Introduction

Dot-socialism [10] as coined by K. Kelly (Wired Magazine [8]) and when applied to the Internet relates to the trend where masses of individuals cooperate by means of social tools and collaborative technology, e.g. Facebook, GoogleApps. This is a trend where the Internet end-user is a provider of content, and in particular a trend which is **impacting the basic principles of Internet access**.

The Internet end-to-end principle [11] is already being affected by the impact of the rise of "middle boxes" [9] such as *Network Address Translators* (NAT) and firewalls, most of which raise problems which are overcome through the application of technical workarounds. For instance, this is the case that SIP-based applications had with NAT, and the solution was the development and application of the *Simple Traversal of UDP over NAT (STUN)*.

More recently, the wave of collaborative tools gave rise to a “dot-socialism” trend that brought in several new challenges to the day-to-day Internet operation. The most relevant aspect that is being introduced by this trend is the fact that the older Internet paradigm of client/server, where end-user devices were mostly “dumb terminals” simply serving the purpose of accessing remote services and applications seems to be back. Today we have several of such applications and tools (e.g. GoogleApps) which are backed up and supported by adequate cloud computing tools. So, it is now often common for the Internet end-user to rely on tools that are “somewhere” on the network and that store the user’s data “elsewhere”. The user is unaware of the location of its data and also of the tools he/she uses. This is quite similar to what occurred in the Internet of the early 90’s, from a service perspective.

There are, however, some significant differences between the current Internet and the “old” Internet design, having been this Think-Tank devoted to such a debate and which are presented in section 2.

Main aspects to discuss in this Think-Tank meeting were:

- Impact of dot-socialism on: networking architectures design; Telecom/Internet legislation, Internet design and security; Mobility and nomadism.
- Can collaborativism be safe in terms of traceability, non-repudiation and confidentiality?

- Which incentives (from a technical perspective) can benefit users and access e.g. from a security perspective? How can the access management cope with these new paradigms?

To ignite discussion around these topics, the 1st API think-Tank meeting included a brainstorming session where invited experts brought in expertise from different fields on Internet design and architectures, ranging from routing to security; from an application level to the network layer level. This report corresponds to the outcome of such discussion.

This is therefore an informational deliverable which has the sole purpose of assisting in igniting a debate on novel ideas concerning Internet services and architectures. It is not a report intended to exhaustively debate on the different aspects of the impact of dot-socialism on the Internet.

The report is organized as follows. The next sections are dedicated to a few aspects that were brainstormed. Therefore, section 2 provides an overview on the discussion that took place related to the impact of collaborativism (dot-socialism) on Internet design. Section 3 discusses the Internet end-user perspective, while section 4 provides an overview on the discussion related to security impact. We conclude in section 5 by presenting the main findings that the brainstorming session lead to.

2. Today's Internet – the New Early 90's?

The current cooperative tools and Internet "dot-socialist" services being provided exhibit some characteristics that resemble the Internet offer available in the early 90's. **Erro! A origem da referência não foi encontrada.** provides a summary on the main differences, which we shall explain in the next sub-sections.

Table 1: Main differences between today's collaborative Internet and the 90's Internet.

Internet in the early 90's	Internet Today
End-user was a consumer of information	End-user produces content AND provides networking services
Simpler tools (mostly for search; less security implications)	Tools used are of a varied nature, imply sharing of confidential and quite personal information
Individual end-user	Cooperative end-user
Fixed Networks	Wireless, cellular as last-hop of the local mile;

Internet in the early 90's	Internet Today
Static, Point-to-Point Access Architectures; downloading mostly (network to client)	access more flexible (e.g. Ethernet IPoWDM), but still restrictive in terms of uploading (client to network)
Mostly x86 architectures for end-devices	X86, x64; mips; … for end-devices
End-user more tolerant to network disruption; affected a few users (mostly enterprise)	End-user always on; affects enterprise and residencial markets
Client/server paradigm	Client/server, Peer to Peer paradigms
Normally, 1 device per access port (no NAT)	Today, N devices per access port AND connection may be shared between different subscribers
1 networked device per user	In average, 3 networked devices per user: 2G/3G phone; laptop; PDA
1 device = 1 network interface	1 device = N network interfaces
End-user can use any device and application (few options)	End-user may have restricted use of devices and applications (a lot of options)

2.1 End-User Aspects

Starting by the end-user role, while in the early 90's the end-user merely assessed the Internet to search for (obtain) information, today we have a proactive end-user who relies on the Internet for the most varied reasons. Moreover, he/she is actively contributing with data and by building collaborative tools to the Internet. It should also be highlighted that this is not just happening from a content perspective. Instead, the end-user has tools at its reach that allow him/her to be a "micro-provider" of networking services e.g. by sharing with its social network Internet access. Therefore, instead of an individual Internet end-user today we have on the Internet a **cooperative end-user.**

Another major difference is the fact that while in the early 90's the Internet end-user had at this reach fewer devices, technologies, and services, than what happens today.

2.2 Applications & Services Aspects

Services in the early 90's were much simpler than the ones that the Internet today supports. Most tools related to data searching and the security implications were minor. This is a crucial aspect that changed, as today most of the collaborative tools around us imply exchange of information often quite personal and therefore confidentiality is today a main aspect to address in the Internet, often disregarded.

When we think about using the Internet as a host for (collaborative) applications and services and not just information, cloud computing is the term that is normally. The concept of cloud computing may soon apply on a mass scale to other aspects such as word processing, and Service oriented Architectures. Google Apps and Apple's MobileMe [12] are two recent examples of initiatives that are focused on such a concept.

Another major difference relates to the wide variety of portable multimedia devices that today the end-user relies on for Internet access. Not only do these devices normally integrate more than one networking interface, but they also rely on different types of node architectures, e.g. mips, x86, x64.

Such portable devices may evolve into thin clients of powerful clients. Examples of the latter are smartphones, which have more and more processing power, storage and memory. Such devices may end up being able to act not only as clients but also as servers, aggregators of information, thus leading the concept of cloud computing to a new edge: crowd computing. Evidence is the increasing decentralization of the big computer center of the cloud computing work (e.g. Google data centers) to smaller facilities that have a higher geographic distribution, leading to a higher robustness.

Besides the smart powerful portable devices, such as smartphone, thin clients may be another type of portable devices that may help to implement dot-socialism approaches. The term thin client is commonly used for a terminal (device without storage) that allows most of the data processing to occur on a server, be it geographically nearby or not. Thin clients are dependant on cloud computing, or pulling services from a network.

2.3 Infrastructure Aspects

A key aspect that significantly changed relates to the Internet infrastructure in terms of technologies available, of architecture, as well as of user interaction to the infrastructure. For instance, in the early

90's the infrastructure was based on fixed networks only, and today we have an Internet based on wireless, cellular, and fixed technologies. Wireless, in particular Wireless Fidelity (Wi-Fi) forms the last hop to the Internet end-user and complements broadband backbone technologies. Fixed network technologies such as carrier-grade Ethernet allowed the access and core of the Internet to evolve towards multipoint architectures with support for larger debit rates. Fiber based infrastructures and delivery models such as *Fiber-to-the-Home (FTTH)* or *Fiber-to-the-Curve (FTTC)* introduced high debit rates beyond the access core.

The user relation towards the infrastructure has also experienced a significant evolution. For instance, from a residential perspective, a user in average holds at least three different devices to access the Internet (laptop, smartphone, cellular phone). For each device, more than one interface (e.g. 3G and Wi-Fi) can be used.

This lead to having the Internet end-user always-on, i.e., connected at the Internet at anytime. In terms of network infrastructure this implies that the difference between empty and full hours became less noticeable and therefore, there is a strong impact in terms of aggregate traffic and as consequence on the computation of flat rates associated to the individual Internet access subscription.

3. Impact on Internet Design

One of the aspects discussed was what exactly was meant by the notion "Internet". During the discussion such term related to:

- A set of IP infrastructures and services (public/private).
- A mirror of globalization and of societal evolution.

Today the Internet as a media includes both a public and private part and is also a mirror of globalization and of societal evolution. Cooperative tools and network sharing tools are speeding up such medling. Today it is hard to make a clear distinction between private and public infrastructures. However, a main aspect that did not change and is making it difficult to support such evolution is the fact that telecommunications' legislation should ensure that there is a framework that includes decentralization for infrastructures.

3.1 Network Neutrality Aspects

In the discussion and debate around **network neutrality** there is a side of the discussion that defends that the Internet should be seen as a regular telecommunications service, and where the other faction expects diversity (of services) to be ensured [13].

In 2005, the Federal Communications Commission (FCC) issued its Broadband Policy Statement including four principles of open Internet, aiming to encourage broadband deployment and preserve and promote the open and interconnected nature of the public Internet. In Europe, the European Union is planning to regulate network neutrality in face of the potential damage caused by non-neutral broadband. Currently, European regulation allows operators to offer different services to different customers groups, but does not allow dominant players to discriminate in an anti-competitive manner. Today we have several examples of network neutrality infringement, for instance, the FCC regulation that prevents unlicensed TV frequencies from being freely used. This relates to the Internet infrastructure design, which today is not considered to be a regulatory problem.

Independently of the regulatory issues, during the lifetime of the Internet we saw the duel between decentralization and user empowerment on the one hand, and the surveillance of society and centralized information on the other. Hence, what should be the tussle balance over an open Internet platform is a critical question to scope the future of the Internet. Therefore, the debate around network neutrality can take different roles all valid in their own sectors — the open nature of the Internet, and the tied content-conduit model of the entertainment industry.

Asides political aspects, a relevant remark during this brainstorming session relates to the fact that in order to have an adequate Internet (service) regulatory framework such legislation should consider that the Internet service development cycle is too short in comparison to other telecommunications services. Currently, telecommunications legislation do not adjust well to the Internet service development cycle, it just follows such evolution.

3.2 Emerging Business Models

An aspect often disregarded is the fact that new business models on the Internet have emerged due to the collaborative trend. Content retailers and Web2.0 advertisement are today the main Internet stakeholders, in contrast to the early 90's where the incumbent was the main stakeholder. While incumbent operators assimilated the need to reinvent themselves there seems to be a return to the wholesale bundled model but with a twist: verticalization of services.

Rising markets also introduce new challenges: they normally rely on wireless technologies and require support for millions of users. Moreover, they introduce challenges and critical aspects that are often quite different than the ones on the already established Internet markets.

3.3 Infrastructure and Design

The main impact of the collaborative trend in terms of Internet design may be the fact that while today the fringes of the Internet are the bottleneck, the network core is now also affected. Video (in particular ambient video) is today one of the main contributors to the core load and requires asymmetry support; the core of the network today has to adjust to multiple services and service providers simultaneously.

In terms of infrastructure, FTTH seems to be gaining pace and also require asymmetry; yet, the last hop to the user is based on wireless or cellular technology. Moreover, there is a recent trend which indicates that the Internet is becoming information-centric and despite the fact that collaborativism empowers the end-user as provider of services, the fact is that the Internet infrastructure is not yet ready to allow the user to be always-on: Internet access may be intermittent.

4. The Internet End-User Perspective

A second aspects discussed relates to the end-user empowerment and perspective on the Internet due to dot-socialism. Today we have an end-user (and citizen) fully dependent on the Internet. Not only did the Internet become a fundamental media but in fact there are several tools that the end-user relies on daily which only work online (e.g. GoogleApps, FlickR). Therefore, traditional communication services are today heavily dependent on the Internet.

Such dependency raises several questions. For instance, if today the Internet would stop for one day, what would happen to society? The impact would be severe and go beyond the impact that e.g. TV would have, were it to stop for a day. Therefore, some fields that are crucial to address are:

- Robustness and tolerance to faults becomes more urgent.
- Possibility to transfer information between Service Providers.
    - Invest on making SOAs uniform.
- How to cope with these aspects, namely, the fringes of the Internet are changing and require robustness?

5. Security Implications

A final aspect debated related to security and privacy implications of dot-socialism. Today we have economical, personal, as well as public information mixed and available. The Internet end-user in fact is the major culprit as today and due to this trend the border between private and public often disappears mostly due to the fact that the end-user does not fully understand that his/her information

by being shared becomes in fact public. In other words, the user is often unaware that information can be obtained with or without consent from social applications.

Therefore, security in the Internet has also become more than a critical aspect to deal with, in particular in regards to confidentiality, privacy, as well as non-repudiation. More than being critical, **privacy is in fact an aspect that can be considered as a premium service that a provider could offer to differentiate itself from competitors**. Today, the technology to sustain such service is already available. Another aspect that is critical in terms of security is non-repudiation and this can also easily be offered by the operator.

6. Conclusions

Out of the brainstorming we summarize here the most relevant aspects discussed:

- **Dot-socialism gave rise to an Internet end-user that is heavily dependent on the Internet**. Such dependency impacts every aspect of life and becomes critical from a societal perspective. Such dependency is also worrying and a question that arises in terms of Internet design is whether one is demanding too much of the Internet.
- **Network neutrality and impact on telecommunications legislation**. As it stands, telecommunication keeps the Internet aside mostly due to difficulty in identifying adjusting to new markets. Moreover, the Internet has always been a highly autonomic environment that never was completely legislated. Today, most of the creative and collaborative services available are not legislated; yet they are also the main sources of profit on the Internet. There is a clear concern regarding legislation and the Internet, but there is also a clear limitation related to the fact that the telco and the Internet worlds have different technical perspectives in terms of infrastructure design.
- **Privacy is an aspect essential to consider.** This is more than a technical or research aspect only And can be a new business source for access operators.
- **Legislation is also an essencial aspect to deal with**. Has to keep up the pace with the short lifecycles.

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