Prof. Ing. Vittorio Trecordi

Comitato Scientifico FUB
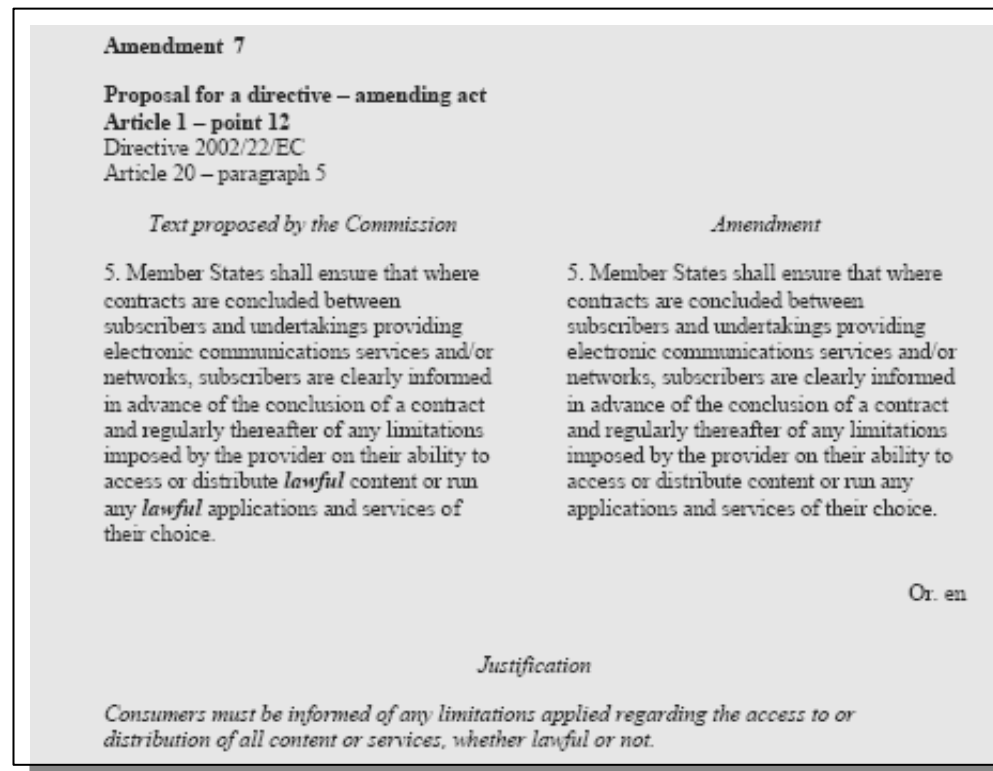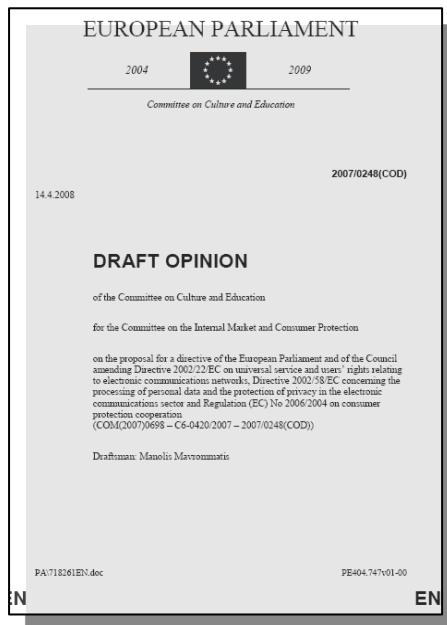*Politecnico di Milano – ICT Consulting SpA*

"Neutralità della rete e aspetti socio-economici"

Roma – May 14, 2009

Network Neutrality: a matter suitable for public policy

▶ Network Neutrality is about establishing <u>policy rules</u> on the <u>behaviour of network providers</u>

- The focus is on <u>broadband Internet</u>

▶ The term is being used in a lot of different contexts, covers a number of topics and creates matters suitable for <u>public policy</u> in <u>many regions</u> of the World:

- Protection against <u>anti-economic behaviours</u>:
  - Traffic discrimination (e.g. prioritization) to favour the business of the network provider

- Protection of <u>individual rights</u>:
  - Inspecting traffic to apply traffic management policies or to derive information suitable for targeted advertisement (Privacy concern)
  - Discriminating the access to network resources (Digital Divide, Free Speech, limitation of end-users' property rights and barriers to innovation)

- Protection of <u>commercial rights</u> :
  - Inspecting traffic and blocking protocols used to share contents (Digital rights protection)

- Protection against <u>terrorism and crime</u>:
  - Inspecting and blocking traffic that compromise the capability to identify users and to apply content interception (Non-repudiation and lawful interception)

Network Neutrality: a matter suitable for public policy

► Distinguish between welfare-enhancing discrimination (such as advertising-supported content) versus anticompetitive discrimination
  - Risk that network operator or service provider might leverage market power into an otherwise competitive upstream or downstream segment
► One area where preventive regulatory measures should be considered is in ensuring that consumers have the information they need to make informed choices
► **<u>Just to give the feeling of the type of ongoing discussion</u>**, below an excerpt of a "Draft Opinion Document"

EUROPEAN PARLIAMENT

2004   2009

Committee on Culture and Education

2007/0248(COD)

14.4.2008

DRAFT OPINION

of the Committee on Culture and Education

for the Committee on the Internal Market and Consumer Protection

on the proposal for a directive of the European Parliament and of the Council amending Directive 2002/22/EC on universal service and users' rights relating to electronic communications networks, Directive 2002/58/EC concerning the processing of personal data and the protection of privacy in the electronic communications sector and Regulation (EC) No 2006/2004 on consumer protection cooperation
(COM(2007)0698 – C6-0420/2007 – 2007/0248(COD))

Draftsman: Manolis Mavrommatis

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EN   EN

Amendment 7

Proposal for a directive – amending act
Article 1 – point 12
Directive 2002/22/EC
Article 20 – paragraph 5

Text proposed by the Commission	Amendment
5. Member States shall ensure that where contracts are concluded between subscribers and undertakings providing electronic communications services and/or networks, subscribers are clearly informed in advance of the conclusion of a contract and regularly thereafter of any limitations imposed by the provider on their ability to access or distribute *lawful* content or run any *lawful* applications and services of their choice.	5. Member States shall ensure that where contracts are concluded between subscribers and undertakings providing electronic communications services and/or networks, subscribers are clearly informed in advance of the conclusion of a contract and regularly thereafter of any limitations imposed by the provider on their ability to access or distribute content or run any applications and services of their choice.

Or. en

Justification

Consumers must be informed of any limitations applied regarding the access to or distribution of all content or services, whether lawful or not.
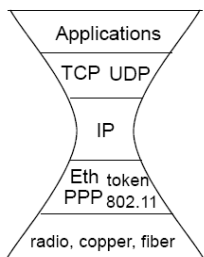
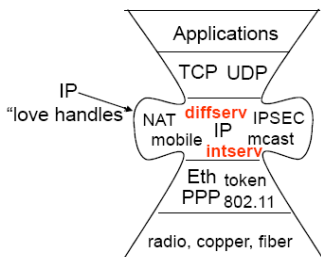# The sunset avenue of vanilla best-effort packet switching

▶ One of the main reasons for the success of the hourglass model of Internet is the capability to decouple communications services and network infrastructure: the key to service convergence and to open evolution of the layers of the horizontal stack

- The end-to-end network paradigm enabled by the Internet "cloud" (end-to-end protocols starting from the layers above the hourglass bottleneck are an end-system affair only) paves the way to Over The Top players ("Internet giants" such as Google, Yahoo, Ebay, Amazon, ...)

▶ Quality Of Service (QoS) requirements for real-time services, such as VoIP/ToIP, IPTV, on a wide scale put the vanilla IP packet switching under stress; network overprovisioning is not the solution, especially in key bottlenecks, such as network interconnection points

- Multicasting and security foster other emerging requirements

▶ Professor Jim Kurose (University of Massachusetts at Amherst) called it "*the Internet middle-age*"

Middle-aged Internet: losing the hourglass?   Middle-aged Internet: *keeping* the hourglass!
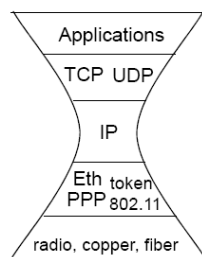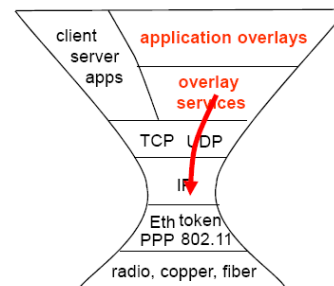
IPTV services call for guarantees in broadband and delay

Network Neutrality

Risks: network balkanization (walled gardens) vs barrier to investments (need for policy)

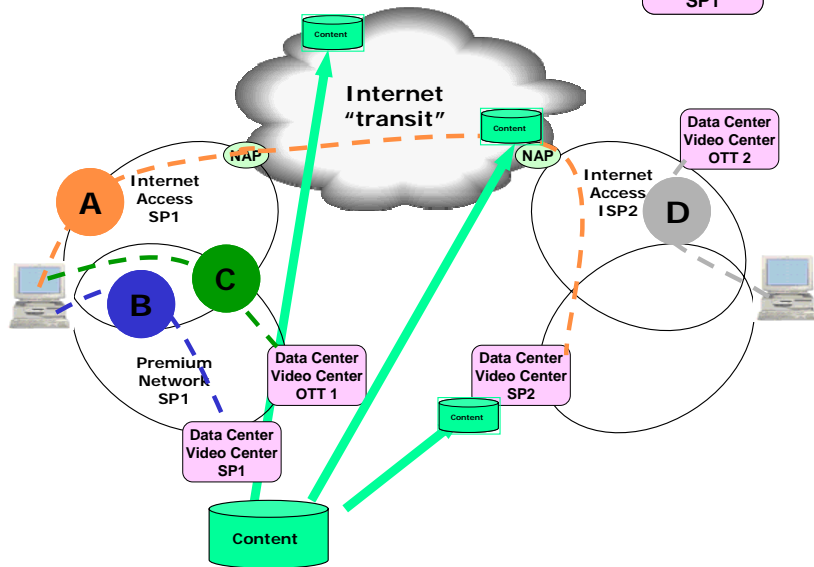Access and interconnection network resources call for heavy investments and widely accepted agreements

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End-to-end view matters
Internet and Walled Gardens

Internet and Premium Walled Garden
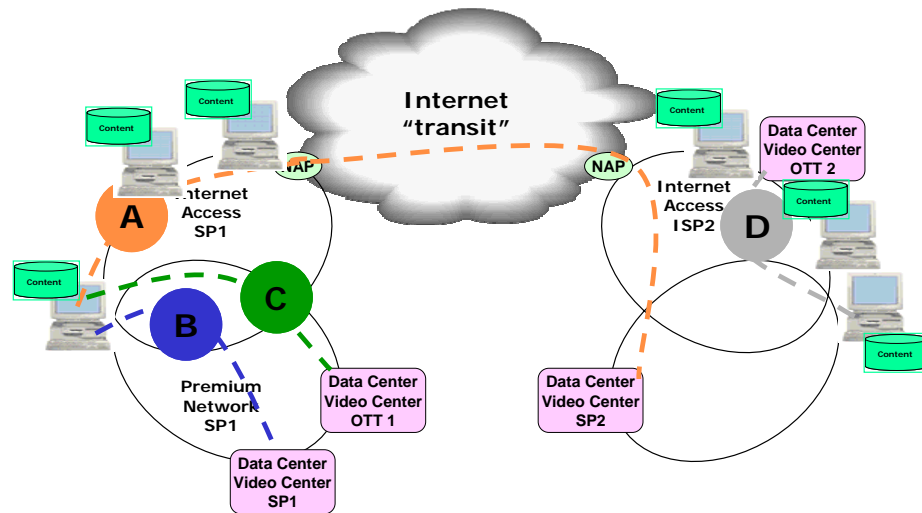
Internet "transit"
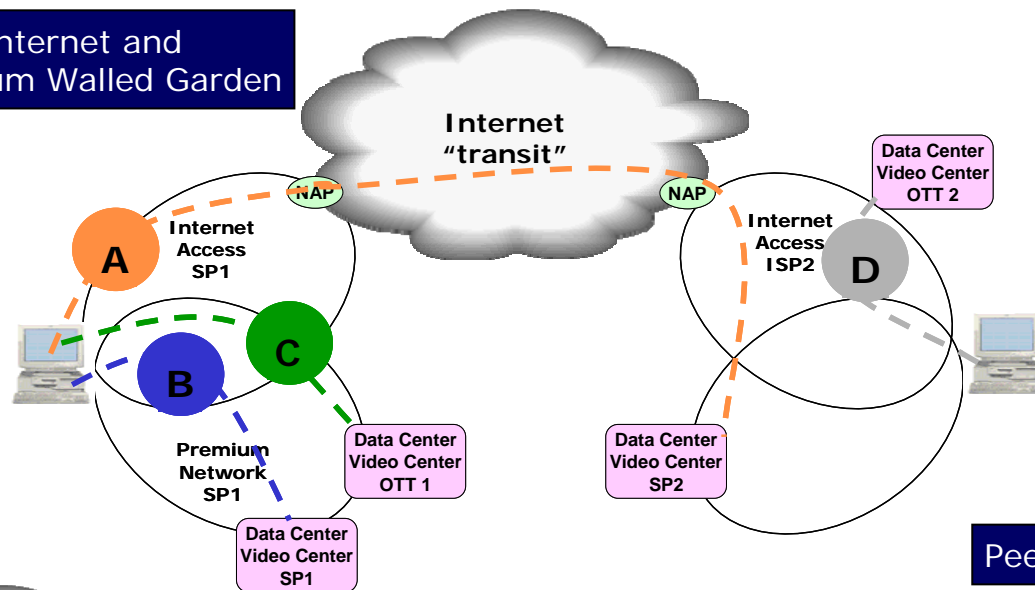
So far Internet key feature is reachability for communications and information sharing and not quality of service

Content Delivery Networks

Peer-to-Peer content sharing

Putting together NGN and Internet evolution

▶ The effort of telco players to transform legacy networks (vertically integrated and separated) into the so called Next Generation Network touches several key and disruptive items:

- Next generation access (high investment initiatives)
- Next generation control architecture (Internet style or IMS telco style)
- Next generation interconnection agreements (technical and economical question)
- Revenue model, operational model and business model under "heavy stress"

Fonte: Koichi Asatani (2008)
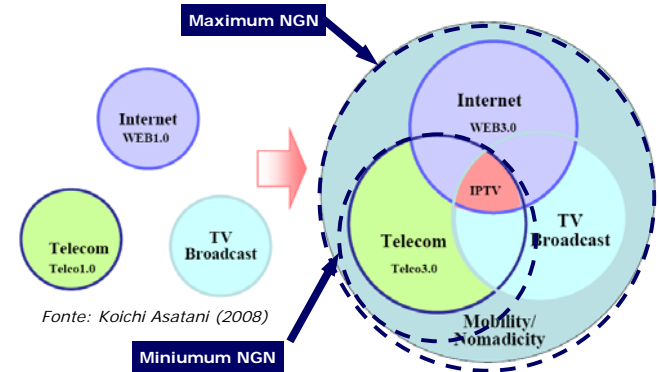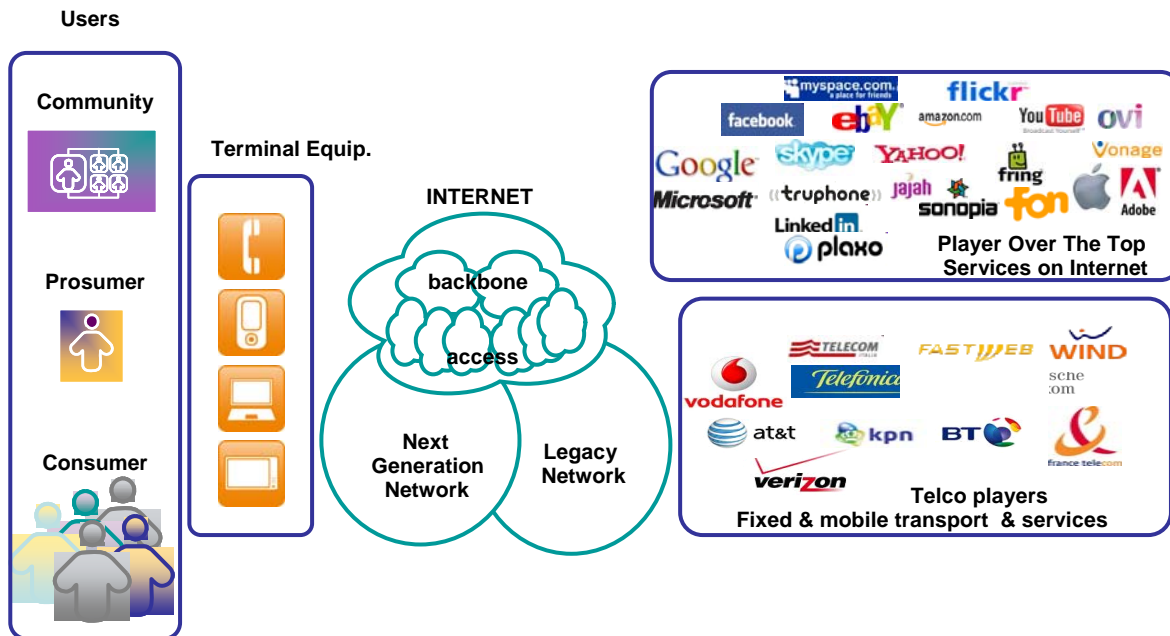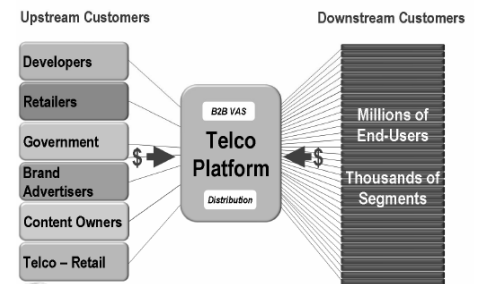
Next Generation Network

▶ The move to NGN raises issues related to market failure and call for regulation of electronic communications
- Address distortions of competition, especially those caused by market power
- Address social needs that the free market might not, typically because the social value exceeds the private value to parties that might otherwise invest
- Allocate scarce resources that are unique to each country

▶ The large capital investment needed to build NGN (in particular in the access and metro levels) calls for a clear regulatory landscape:
- Risks of market failure have to be mitigated
- Investors want clear conditions for return
- Policymakers must create conditions to avoid deadlocks and to keep own country on the leading edge of an enabling technology which is key for social and economic development in a global landscape

▶ Infrastructure and service level competition should preserve development and avoid market failure
- one-network, structural&operational separations, public&private co-operation are among the measures under scrutiny in many countries

▶ Carrier Interconnection should be upgraded with respect to plain Internet peering&transit agreements in order to include QoS and novel payment schemes
- technolgy is almost available, though it's far from happening: walled gardens rule
- Internet champions reachability, while end-to-end QoS is achievable in walled gardens
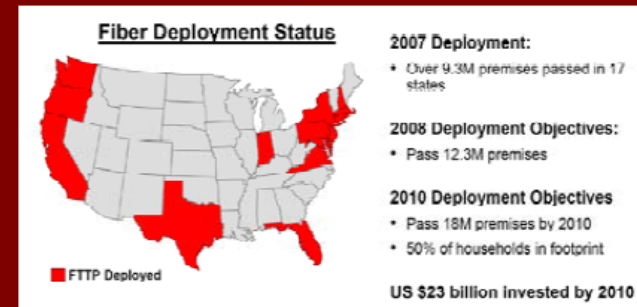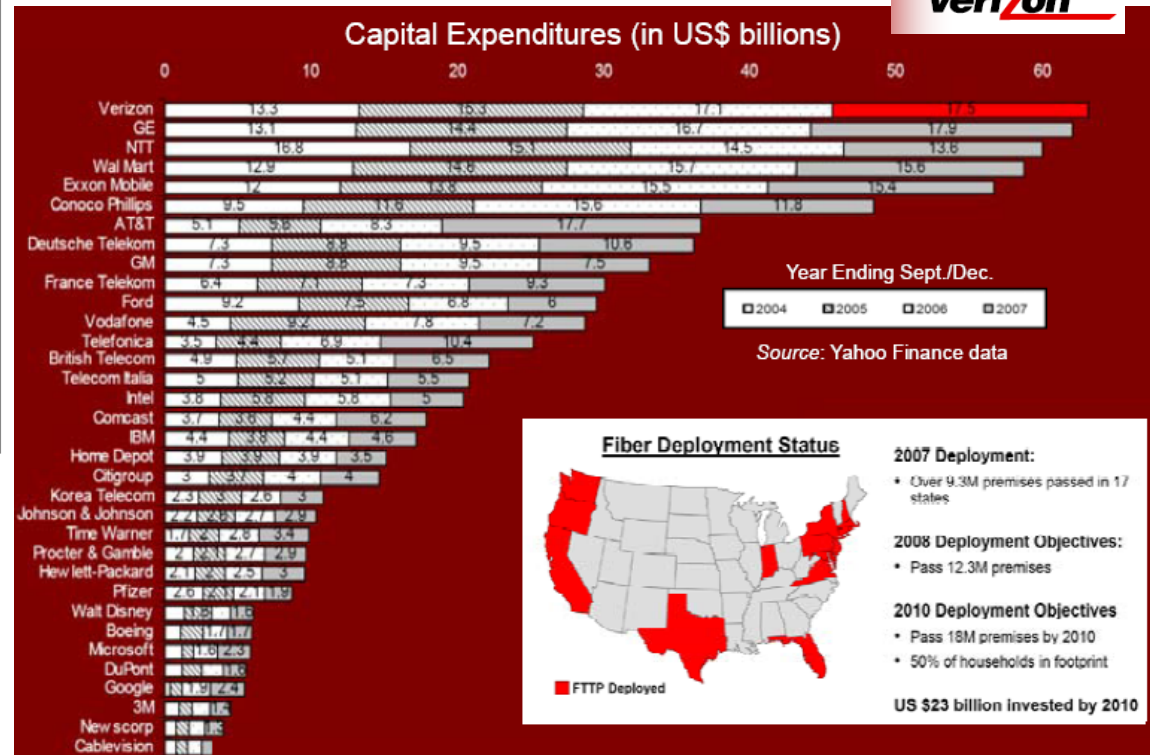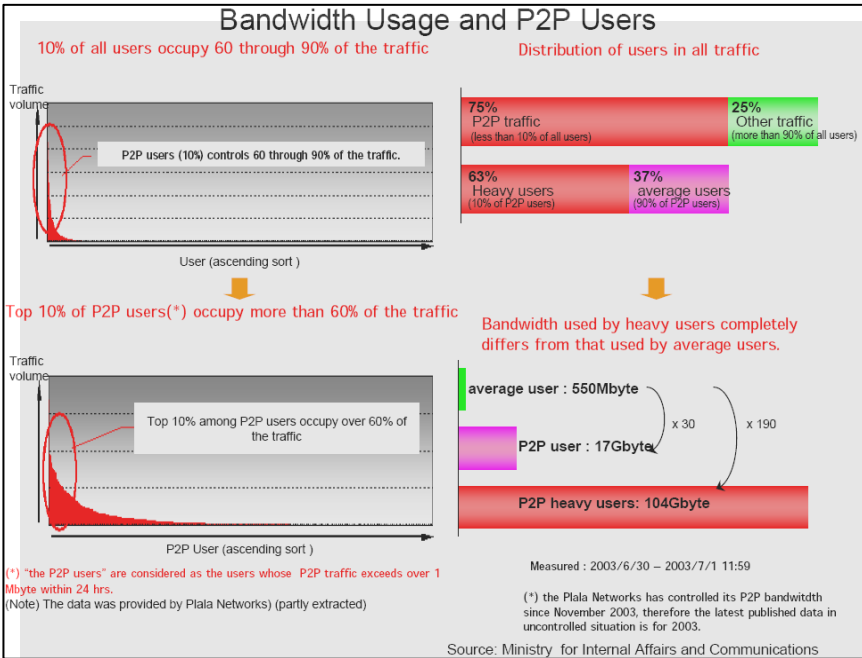
Investments in network resources, usage and returns

▶ The policy debate encounters the business issue:

- return on investment drive infrastructured players towards non neutral behaviour

Bandwidth Usage and P2P Users

Source: Ministry for Internal Affairs and Communications

▶ Internet providers test the limits of access with new pricing systems, Thursday, May 7, 2009, http://www.pantagraph.com/articles/2009/05/07/news/doc4a02f1768decd813696873.txt

- Most mobile ISPs propose semi-flat tariffs

Capital Expenditures (in US$ billions)

Source: Yahoo Finance data

Fiber Deployment Status

2007 Deployment:
- Over 9.3M premises passed in 17 states

2008 Deployment Objectives:
- Pass 12.3M premises

2010 Deployment Objectives:
- Pass 18M premises by 2010
- 50% of households in footprint

US $23 billion invested by 2010

▶ A small amout of heavy users starve most of the bandwidth in the "all you can eat" pricing policy adopted by fixed ISPs
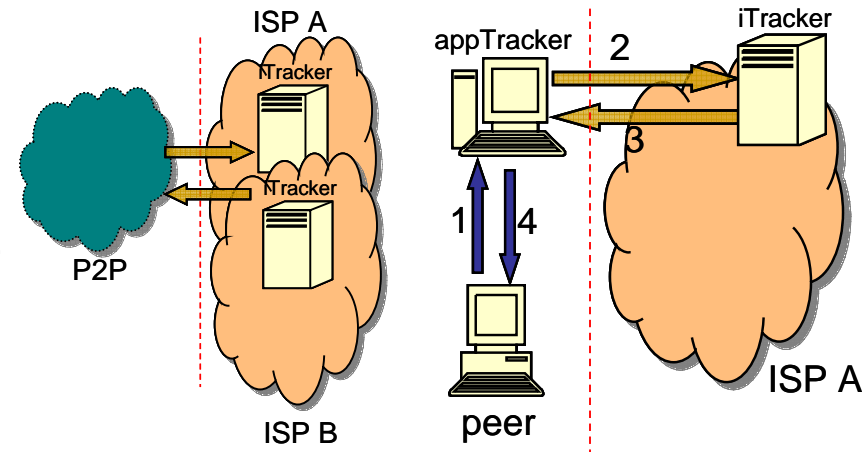
Which functionalities? Where in the network?

▶ The dilemma faced by service providers and vendors is being answered under a set of concurrent drivers:

- Primary driver is the understanding of return on investments in the emerging landscape

- De jure and de facto standards and working groups try to create consensus around viable architectural models (components, interfaces, protocols, ...)

- Over the top players and emerging user communities drive new network requirements and influence dramatically the marketplace
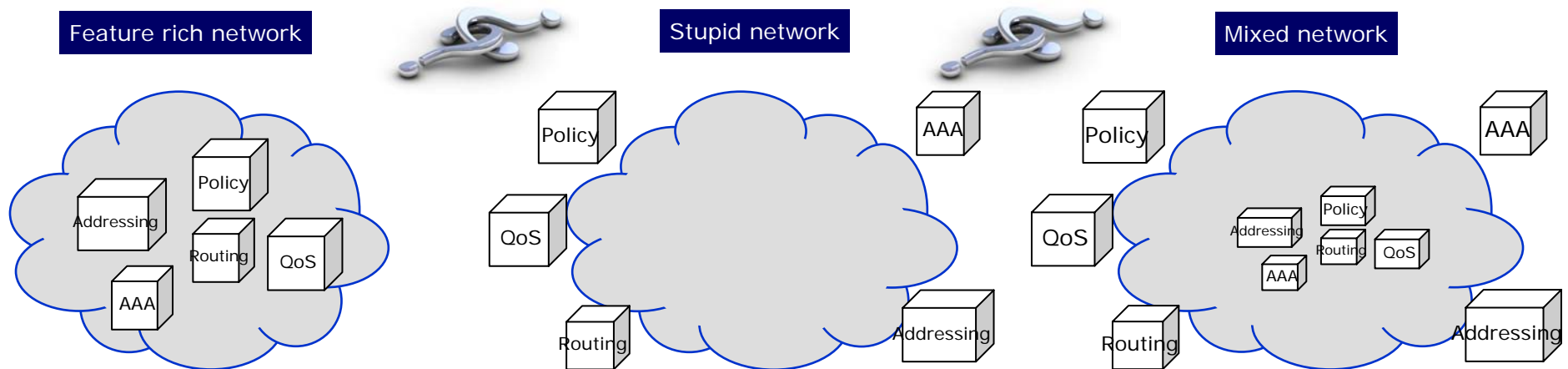
P4P: Proactive network Provider Participation for P2P

▶ Objective: design an open framework to enable better cooperation between network providers and network applications

▶ Data plane:
- applications mark importance of traffic
- routers mark packets to provide faster, fine-grained feedbacks
- transparent storage in the network (data locker) for last mile

▶ Management plane
- monitoring compliance

▶ Control plane
- Providers: publish information (API) via iTrackers
- Applications: query providers' information adjust traffic communication patterns accordingly

▶ Extensibility and neutrality
- ISP: application-agnostic (no need to know application specific details)
- application: network-agnostic (no need to know network specific details/objectives)

Current P4P-WG

Core Group	AT&T Bell Canada Bezeq Intl BitTorrent Cisco Systems Comcast Grid Networks Joost	Kontiki LimeWire Manatt Oversi Pando Networks PeerApp PPLive Solid State	Telefonica Group Velocix VeriSign Verizon Vuze U. of Toronto U. of Washington Yale U.
Observers	Abacast AHT Intl AjauntySlant Akamai Alcatel Lucent CableLabs Cablevision Cox Comm Exa Networks IBM	Juniper Networks Lariat Network Level 3 Communications Limelight Networks Microsoft MPAA NBC Universal Nokia Orange Princeton University	RawFlow RSUC/GweepNet SaskTel Solana Networks Speakeasy Network Stanford University Thomson Time Warner Cable Turner Broadcasting UCLA

http://www.cs.yale.edu/~yry/projects/p4p/p4p-long.ppt

P4P: Proactive network Provider Participation for P2P

▶ "Results of Second Round of P4P Field Trials with Pando Networks Yield Greater Improvement in Performance of Broadband Networks", New York, NY & Washington, DC (PRWEB) November 11, 2008, http://www.prweb.com/releases/2008/11/prweb1598974.htm

- As part of this second round of P4P field trials, more than one million consumers worldwide downloaded a video program delivered by Pando Networks using different P2P algorithms including standard P2P delivery and P4P, a mechanism that allows ISPs to provide guidance to P2P applications

- The results demonstrated improved performance for all classes of users for all participating ISPs, using cable, digital-subscriber-line (DSL), and fiber-to-the-home (FTTH)
    - Download delivery speed increased on average fifty-nine percent (59%) - and up to one-hundred-fifty percent (150%) for the fastest class of users

- The second round of P4P field trials also showed improvements in how the P4P protocol can increase P2P efficiency for broadband network operators by delivering data to end-users from within their networks as opposed to pulling data from external sources

- The percentage of data delivered within each ISP increased from fourteen percent (14%) for normal P2P delivery to as much as eighty-nine percent (89%) for P4P delivery

- In addition, a majority (up to 60%) of the internal data delivered using P4P was delivered within the same metro area

▶ More advanced "peer-assisted" systems such as those used by Kontiki (which powers most of the major P2P UK online video systems such as the BBC iplayer, Sky Anytime and 4oD) have network analysis tools and centralized coordination

Deep Packet Inspection

- ▶ Deep Packet Inspection (DPI), allows network providers to peek into the digital packets that compose a message or transmission over a network
- ▶ DPI has been used for several years to maintain the integrity and security of networks, searching for signs of protocol non-compliance, viruses, malicious code, SPAM and other threats
- ▶ DPI technology raises privacy concerns because it can involve the inspection of information sent from one end user to another – enabling third parties to draw inferences about users' personal lives, interests, purchasing habits and other activities (targeted advertising)
- ▶ A diverse set of actors have their distinct ideas of how to use DPI:
  - government agencies and content providers, who are interested in the monitoring and filtering of information flows (political control)
  - network operating staff, who have to deal with more malware and bandwidth-hungry applications than ever before and who often have limitations for expanding bandwidth on the last mile (technological efficiency),
  - vertically integrated ISPs that want to create additional revenues or protect them, e.g. through preventing the Internet from cannibalizing their telephone- or video-on-demand revenues (economic interests).
- ▶ DPI thus has the potential to change the nature of the Internet, by making it less open, by introducing means for political control, and by stifling economic openness

- ▶ NebuAd is well known in the US as the vendor of behavioral targeting advertising systems: the largest of its customers (at the top of success 30 ISPs covering 10% of US broadband users) pulled out following public and Congressional concern on Network Neutrality
- ▶ Phorm is the vendor of behavioral targeting advertising systems used by BT, TalkTalk and Virgin Media the UK:
  - The European Commission launched in April 2009 infringement proceedings against the UK Government, claiming the country is not sufficiently complying with European data-protection laws: the action was initiated, following complaints over BT's trials — carried out in 2006 and 2007 without user consent — of technology from the behavioural advertising company Phorm.
  - BT Webwise claims to increase protection against online fraud and makes ads that appear on participating websites more relevant to one's interests

The Pirate Bay Guilty: Jail for File-Sharing

► Administrators of The Pirate Bay, the world's most popular file sharing site, were convicted by a Swedish court in mid April 2009 for contributory copyright infringement, and each sentenced to a year in prison

► The attention brought by the highly-publicized trial made The Pirate Bay more popular: the site claims 22 million users

► A large number of Pirate Bay fans have signed up for its new 5 Euro anonymization VPN service (IPREDATOR) which allows torrent feeders and seeders to conduct their business in private without leaving a trace of their internet IP addresses (113.000 at April 9)

► Even if The Pirate Bay is under scrutiny, other illicit BiTtorrent tracking services remain accessible

► The defendants are expected to appeal, and they remain free pending further proceedings

► The defense largely hinged on an architectural point

- Because of the way BitTorrent works, pirated material was neither stored on, nor passed through, The Pirate Bay's servers

- The Pirate Bay site merely provided an index of torrent files — some on its servers, some elsewhere — that direct a user's client software to the content.

Internet traffic in Sweden fell by 33% as the country's new anti-piracy law came into effect

· Sweden's new policy - the Local IPRED (Intellectual Property Rights Enforcement Directive (IPRED) law – allows copyright holders to force internet service providers (ISP) to reveal details of users sharing files.

http://royal.pingdom.com/2009/04/15/swedish-anti-piracy-law-two-weeks-on-traffic-down-and-sales-up/
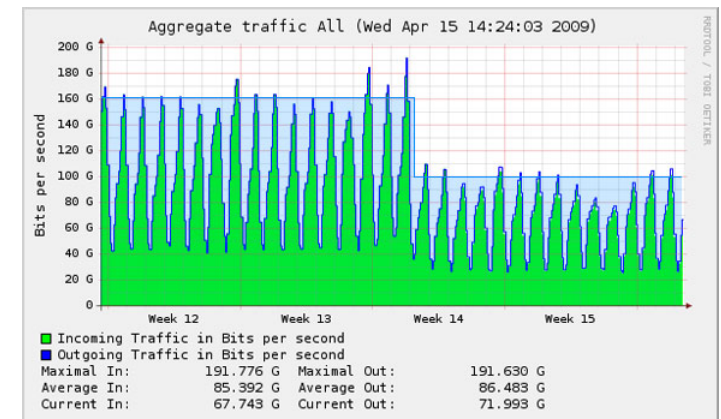
Phone locking and restrictions for Skype on smartphones

▶ *'Furious' UK Operators Want Nokia To Strip Skype From N97 (27 Feb 2009)*
  - *"UK operators O2 and Orange are reportedly "furious" with Nokia over the Finnish handset makers plans to pre-load Skype, the VoIP provider that lets consumers make free calls, on to its upcoming flagship device, the N97. According to Mobiletoday.co.uk, citing "operator sources," the networks may end up refusing to stock the devices if Nokia doesn't strip out the application"*

▶ *German Carrier T-Mobile Blocking Skype (01 Apr 2009)*
  - *"German carrier T-Mobile, and exclusive carrier of the iPhone in Germany, will not allow customers to use the application, and is blocking it both physically and contractually"*

▶ *Microsoft to Forbid VoIP, Rival Stores at Mobile Market (05 May 2009)*
  - *"Microsoft has banned VoIP applications from its upcoming Windows Mobile Marketplace. The blocking move is part of a 12-point restriction on applications sold in the Redmond giant's online marketplace, the opening timed to coincide with the introduction of Windows Mobile 6.5. But is the software giant fighting a rear-guard action against an inevitable future?*
  - *Microsoft's decision means VoIP applications, such as Skype, will sell to Windows Mobile users with only Wi-Fi calling available; the action may also head off a confrontation carriers faced when the VoIP application began selling to iPhone users through Apple's App Store. In that case, hackers found a way around AT&T, the iPhone carrier that blocked Skype from its 3G network."*

Mobile calls will be 50% VoIP in 10 years (08 May 2009)

Within ten years, half of all voice calls on mobile handsets will be made using VoIP software, Gartner said this week.
Mobile VoIP is set to challenge the revenue models of traditional mobile operators, as high-speed 4G connections make the technology increasingly attractive to handset users. Gartner predicts that within ten years, VoIP calls made on portals such as Google, Facebook, MySpace, and Yahoo will take a 30% share of all voice traffic, whilst half of mobile voice calls will be made on VoIP software.
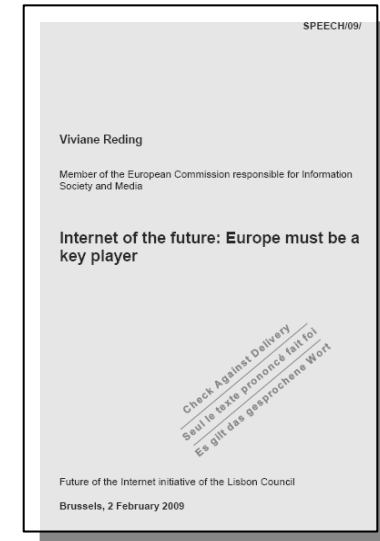

25000 Applications end of Feb 2009

iPhone applications
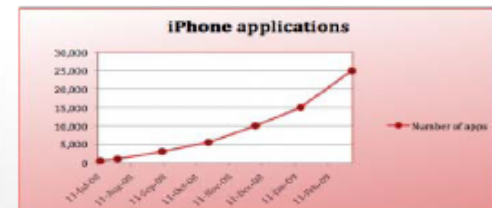
Japan's Network Neutrality Principles (November 2007)

▶ Introduced as an amendment to the "New Competition Policy Program 2010", November 2007:

- IP networks should be accessible to users and easy to use, allowing ready access to content and application layers

- IP based networks should be accessible and available to any terminal that meets relevant technical standards and should support terminal-to-terminal (or "end-to-end") communication

- Users should be provided with equality of access to telecommunications and platform layers at a reasonable price ("users" refers to end users and content providers and other companies conducting business using IP networks)

- Network neutrality also includes the concept of utilizing IP networks with the proper allocation of costs, and without discrimination

▶ Report on Network Neutrality, Working Group on Network Neutrality, Ministry of Internal Affairs and Communications,

http://www.soumu.go.jp/joho_tsusin/eng/pdf/070900_1.pdf

► *1. Openness of the Internet*

- *"First we will only be able to reap the full social and economic benefits of a fast moving technological landscape if we manage to safeguard the openness of the Internet. Openness is one of the key ingredients that made the Internet so successful as an innovation place, and we have to make sure that it is not compromised. In its Communication on future networks and the Internet adopted at the end of last year, the European Commission outlined three key areas where we have to ensure that openness remains preserved."*

  • *Net Neutrality*

    – *"In the first place, "Net Neutrality" has to be guaranteed. New network management techniques allow traffic prioritisation. These tools may be used to guarantee good quality of service but could also be used for anti-competitive practices. The Commission has taken additional steps, through measures proposed to reform our telecom package, to better prevent such unfair abuse to the detriment of consumers"*

  • *Open Standards*

  • *The "Internet Of Things"*

SPEECH/09/

Viviane Reding

Member of the European Commission responsible for Information Society and Media

Internet of the future: Europe must be a key player

Check Against Delivery
Seul le texte prononcé fait foi
Es gilt das gesprochene Wort

Future of the Internet initiative of the Lisbon Council

Brussels, 2 February 2009

Bruxelles, 6 May 2009 - No agreement on reform of telecom legislation - A user's Internet access cannot be restricted without prior ruling by the judicial authorities, insists the European Parliament reinstating one of its first-reading amendments. By amending an informal agreement reached with Council, MEPs send the whole "telecom package" to conciliation.

Paris, 12 May 2009 - French "HADOPI" law implementing "three strikes" policy adopted by a short majority in National Assembly, after a previous rejection on April 9th

"Haute Autorité pour la Diffusion des Œuvres et la Protection des Droits sur Internet"

An attempt to put numbers on resource usage

▶ *"The objective of this first-ever research study of U.S. consumer Internet bandwidth usage and costs was estimating how much bandwidth Google uses and pays for*

▶ *The study estimated Google used 16.5% of all U.S. consumer Internet traffic in 2008 (estimate 25% in 2009 and 37% in 2010)*

  - *Google's search bots regularly copy every page on the Internet, some as frequently as every few seconds, and Google's YouTube streams almost half of all video streamed on the Internet*

▶ *Google's payment to fund just the U.S. consumer broadband Internet segment to be approximately $344 million in 2008 or 0.8% of U.S. consumer's flat-rate monthly Internet access costs of $44.0 billion.*

  - *Thus Google's 16.5% share of all 2008 U.S. consumer bandwidth usage, is ~21 times greater than Google's 0.8% share of U.S. consumer bandwidth costs – or an implicit ~$6.9 billion subsidy of Google by U.S. consumers"*

A First-Ever Research Study:
Estimating Google's U.S. Consumer Internet Usage & Cost -- 2007-2010

By Scott Cleland

President, Precursor LLC* -- Chairman, NetCompetition.org**

December 4, 2008

Table I
US Consumer: Total Internet Traffic

US Consumer (PB per month)	2007	2008	2009	2010
Web, email, transfer	186	249	325	425
P2P	370	439	507	562
Gaming	15	19	23	28
Video Communications	4	4	5	7
VoIP	5	7	9	11
Internet Video to PC	139	240	346	449
Internet Video to TV	48	155	301	492
Total	767	1113	1516	1974

Table II
US Consumer: Legal Internet Traffic

US Consumer (PB per month)	2007	2008	2009	2010
Web, email, transfer	186	249	325	425
P2P (legal)	37	44	51	56
Gaming	15	19	23	28
Video Communications	4	4	5	7
VoIP	5	7	9	11
Internet Video to PC	139	240	346	449
Internet Video to TV	48	155	301	492
	434	718	1060	1470

Chart III
Google's Share of Total US Consumer Internet Traffic

Chart IV
Google's Share of Legal US Consumer Internet Traffic

Table VI
Google's Share of US Consumer Internet Market

Google Share %	2007	2008	2009	2010
Web, email, transfer	22.1%	24.1%	25.6%	27.1%
P2P	0.0%	0.0%	0.0%	0.0%
Gaming	0.0%	0.0%	0.0%	0.0%
Video Communications	0.0%	0.0%	0.0%	0.0%
VoIP	0.0%	0.0%	0.0%	0.0%
Internet Video to PC	32.6%	51.6%	69.6%	87.6%
Internet Video to TV	0.0%	0.0%	17.4%	43.8%
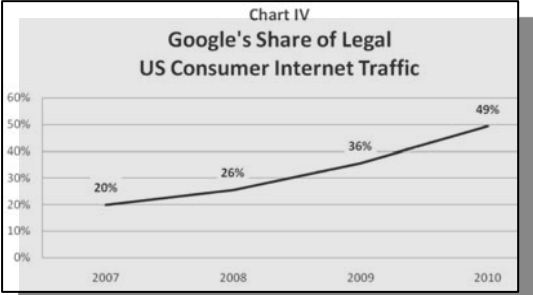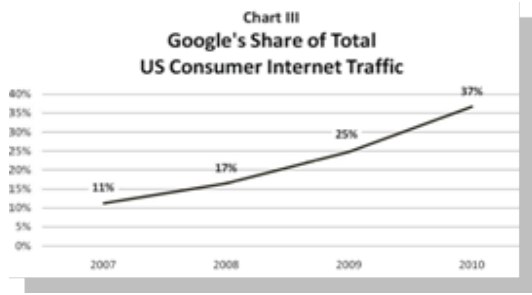
http://www.netcompetition.org/study_of_google_internet_usage_costs2.pdf

"Skype's Anti-competitive Uneconomics"

- ▶ Submitted by Scott Cleland on Thu, 2009-04-02, http://www.precursorblog.com/content/skypes-anti-competitive-uneconomics

- ▶ *"At the end of 2008, Skype had 405 million users that generated $550m in revenues -- generating $1.36 per user per year, or 11.3 cents per user per month in revenues (RPU).*
  - *$550m/405m = $1.36... $1.36/12 = $.113*

- ▶ *At the end of 2008, according to CTIA, the U.S. wireless industry had ~270 million subscribers that generated ~$151 billion, and had average revenue per user of $50.07 per month (RPU).*
  (Since 2000, wireless subscribers monthly bills have remained roughly flat while minutes of use have increased over 700%.)

- ▶ *On that revenue base, the industry:*
  - *Invested $21.1b in infrastructure/spectrum in 2008, for a total cumulative capital investment since inception of $265b;*
  - *Provided 268,528 direct jobs that pay significantly above the national average comparables (this is an increase of 46% or 84,079 jobs since 2000); and*
  - *Constructed and operated 242,130 cell sites (this is an increase of 132% or 137,842 since 2000).*

- ▶ *Now let's compare the business/economic models of Skype vs. wireless providers.*

- ▶ *Skype generates $.113 in RPU to competitive wireless carriers $50.07.*
  - *That means competitive wireless carriers produce 443 times more RPU than Skype.*
  - *That also means Skype's RPU is .2% of wireless providers' RPU.*

- ▶ *For illustrative purposes only, lets now assume Skype's .2% uneconomics were somehow forced on the U.S. wireless industry (which already is arguably the most competitive in the world) and Skype's business/pricing model became the new business model and pricing point at which U.S. wireless providers had to offer services. Looking at it another way, if Skype's business model became the Government's new economic benchmark to beat, and we take Skype's .2% uneconomics to its logical extreme, that would mean a 99.8% reduction in wireless:*
  - *Revenues from $151b to $300m, a reduction of $150b from the economy, much more with a normal macroeconomic multiplier; and*
  - *Employees from 268,528 to 537, a reduction of 267,990, much more with a normal macroeconomic multiplier."*

Measurement LAB initiative by BigG (GOOGLE)

► Measurement Lab (M-Lab) is an open platform for researchers to deploy Internet measurement tools
  - It is based on an open, distributed server platform (total of 36 servers will be deployed early in 2009 at 12 sites in the United States and Europe)
  - Provides passive server-side resources for client-initiated active network measurement of users' Internet connections and resource allocation on each server that will ensure sufficient bandwidth and machine resources (each site will host three servers with 8 cores on each machine)

► M-Lab is at the beginning of its development and is only a "proof of concept."

► "*By enhancing Internet transparency, we aim to help sustain a healthy, innovative Internet*"

► User tools running on M-Lab to test your Internet connection:
  - Network Diagnostic Tool
    • Test your connection speed and receive sophisticated diagnosis of problems limiting speed.
  - Glasnost
    • Test whether BitTorrent is being blocked or throttled.
  - Network Path and Application Diagnosis
    • Diagnose common problems that impact last-mile broadband networks.
  - Pathload2
    • Test your available bandwidth.
  - DiffProbe (coming soon)
    • Determine whether an ISP is giving some traffic a lower priority than other traffic.
  - NANO (Coming soon. In the meantime, try the non-M-Lab Alpha release.)
    • Determine whether an ISP is degrading the performance of a certain subset of users, applications, or destinations.

Transparency first

- ► US cable news network C-SPAN (may 9, 2009) - The new chair of the US Federal Trade Commission, Jon Leibowitz, said the organization may start to enforce a kind of net neutrality alongside the Federal Communications Commission, the FCC
  - "Leibowitz said that it's "very, very important" ***that internet service providers tell consumers what speeds they're getting and "whether they're making any types of management decisions in terms of the network that affect consumers***." He acknowledged that ***ISPs should be allowed to charge more for more bandwidth, but he also insisted that consumers should be properly notified beforehand***. "You can't just surprise someone with a bill."

- ► Welcome the AGCOM initiative to work for quality of Internet access services (at least for fixed access)
  - "Delibera n. 244/08/CSP "Ulteriori disposizioni in materia di qualità e carte dei servizi di accesso a internet da postazione fissa ad integrazione della delibera n. 131/06/CSP" - 21/01/09 - Gazzetta Ufficiale della Repubblica Italiana n. 21 del 27 gennaio 2009"