

Networks in Transition: Emerging Policy and Regulatory Challenges of Next Generation Networks

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Agenda

- Brief introduction to the ITU
- Networks in Transition
- What are NGNs?
- Emerging Policy and Regulatory Challenges of NGNs

Introduction to ITU

- International organization where governments and private sector coordinate global telecom networks and services
- Founded in 1865, it is the oldest specialized agency of the UN system
- 190 Member States, 700 Sector Members, 75 Sector Associates
- Headquarters Geneva, 11 regional offices, 790 staff / 83 nationalities

ITU Mission

- Maintain and extend international cooperation in telecommunications
- Technical and policy assistance to developing countries
- To harmonize actions of Member States and promote cooperation between Member States and Sector Members



Networks in Transition

The Impact of New Communications Technologies

- Technology-driven industries like the communications sector have historically been characterized by steady growth punctuated by “giant leaps” forward, usually when “new” technology is introduced
- “Technology is not kind. It does not wait. It does not say please. It slams into existing systems. Often destroying them, while creating new ones”
 - Joseph Alois Schumpeter (1937)



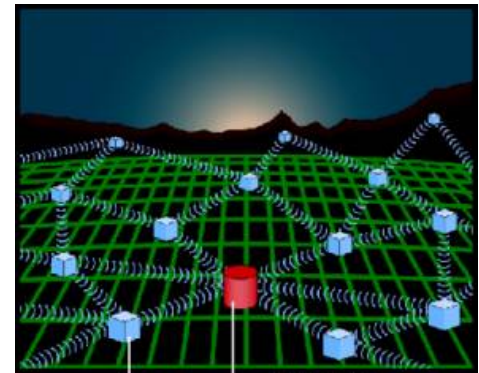
Has happened a number of times

- 1840's: telegraph
- 1870's: telephone
- 1890's: radio telegraphy or "wireless"
- 1920's: radio broadcasting
- 1950's: television broadcasting
- 1960's: geostationary satellite communications
- 1970's: computer communications
- 1980's: optical communications
- 1990's: internet and mobile
- 2000's: IP-enabled NGNs or Next Generation Internet?

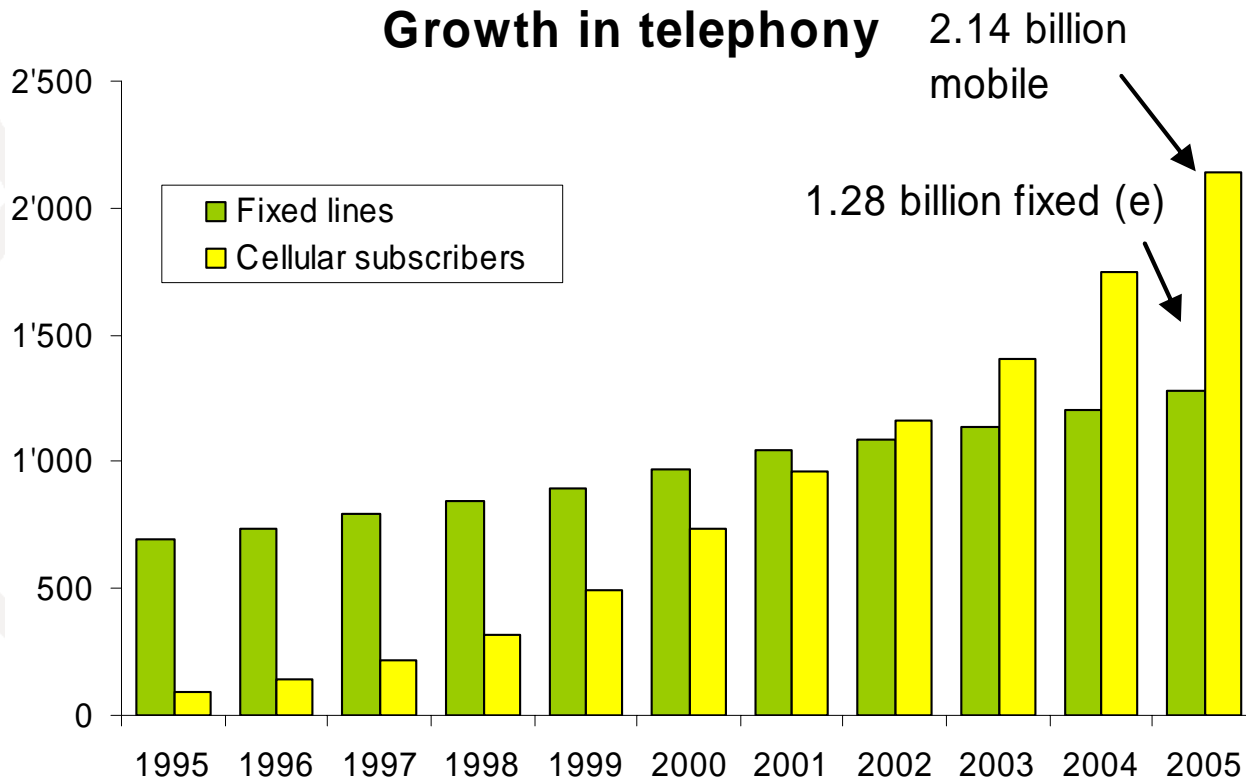
1865: ITU Created

Big Picture Trends

- Birth of Broadband
 - 250 million global broadband subscribers in about 6 years
- Growth in wireless networks & mobile data services
- Mobile overtakes fixed (2002)
- Convergence of IP-based networks with telephone, mobile and TV networks
 - “N-play” converged offerings
- End game: ubiquitous, pervasive, grid, mesh, wireless networks
 - anywhere, anytime, anything



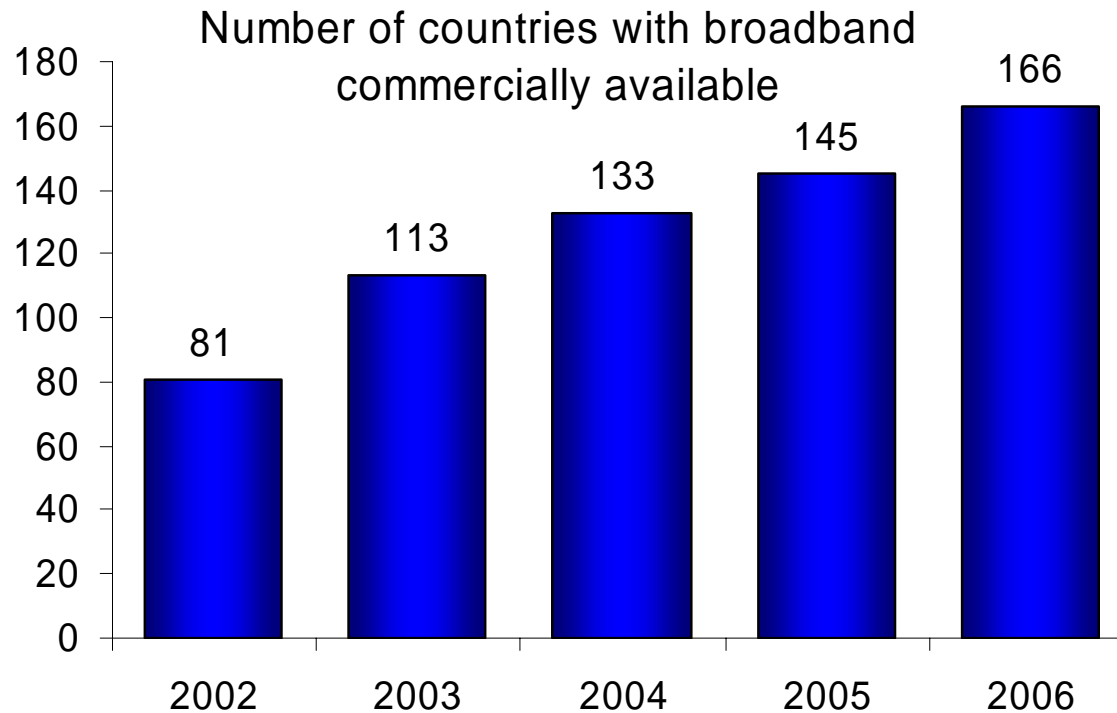
Growth in telephony: mobile overtakes fixed



Growth of Mobile



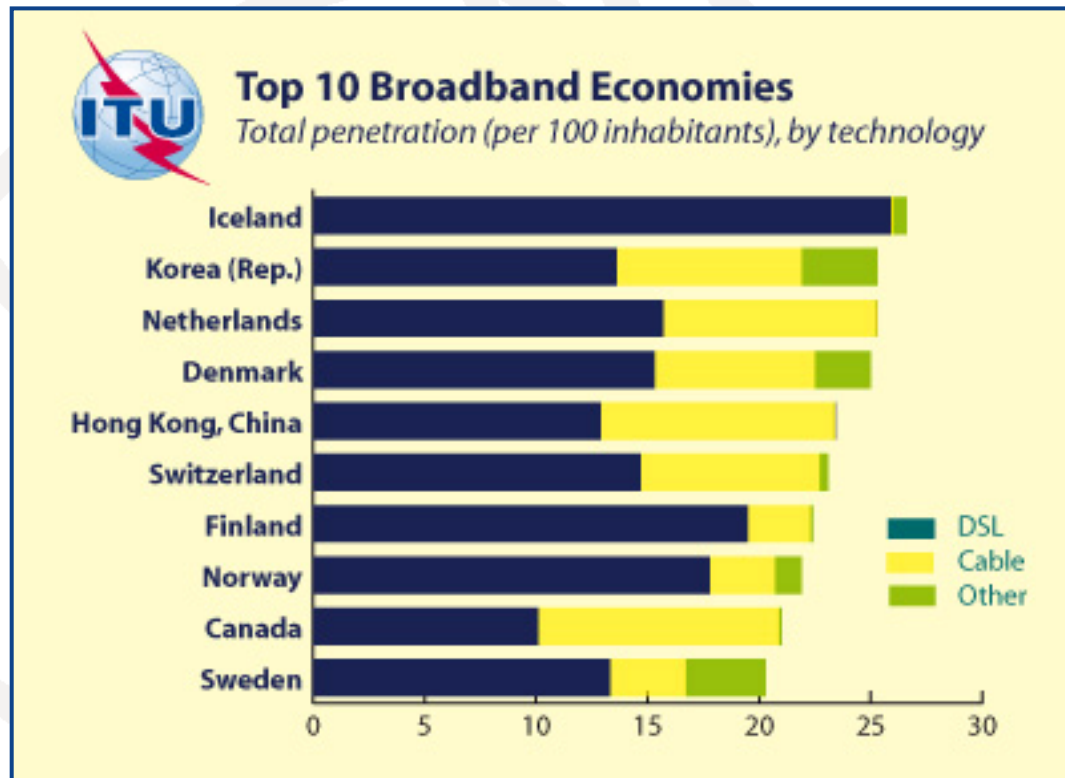
Broadband Build-Out



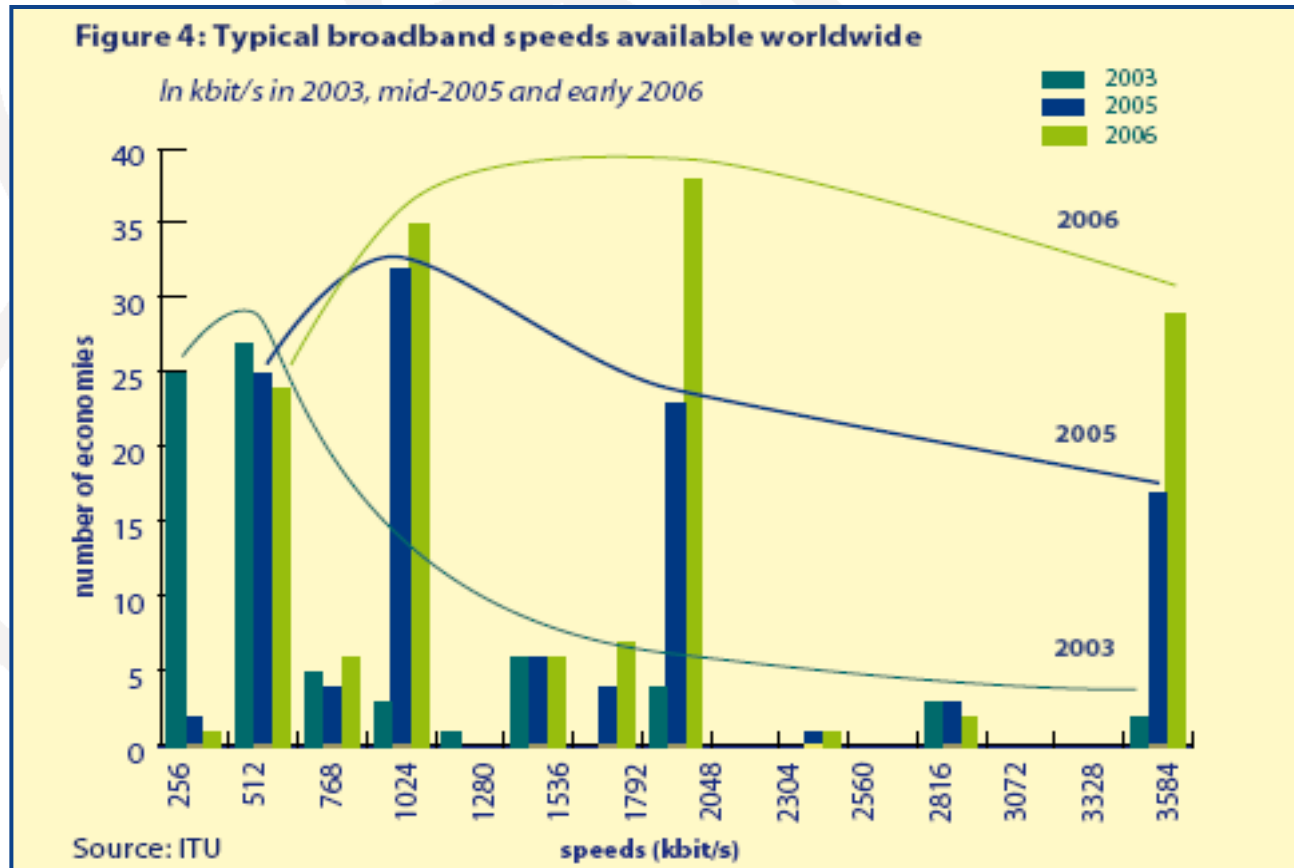
Source: ITU World Information Society Report.

Top Broadband Economies

(January 2006)



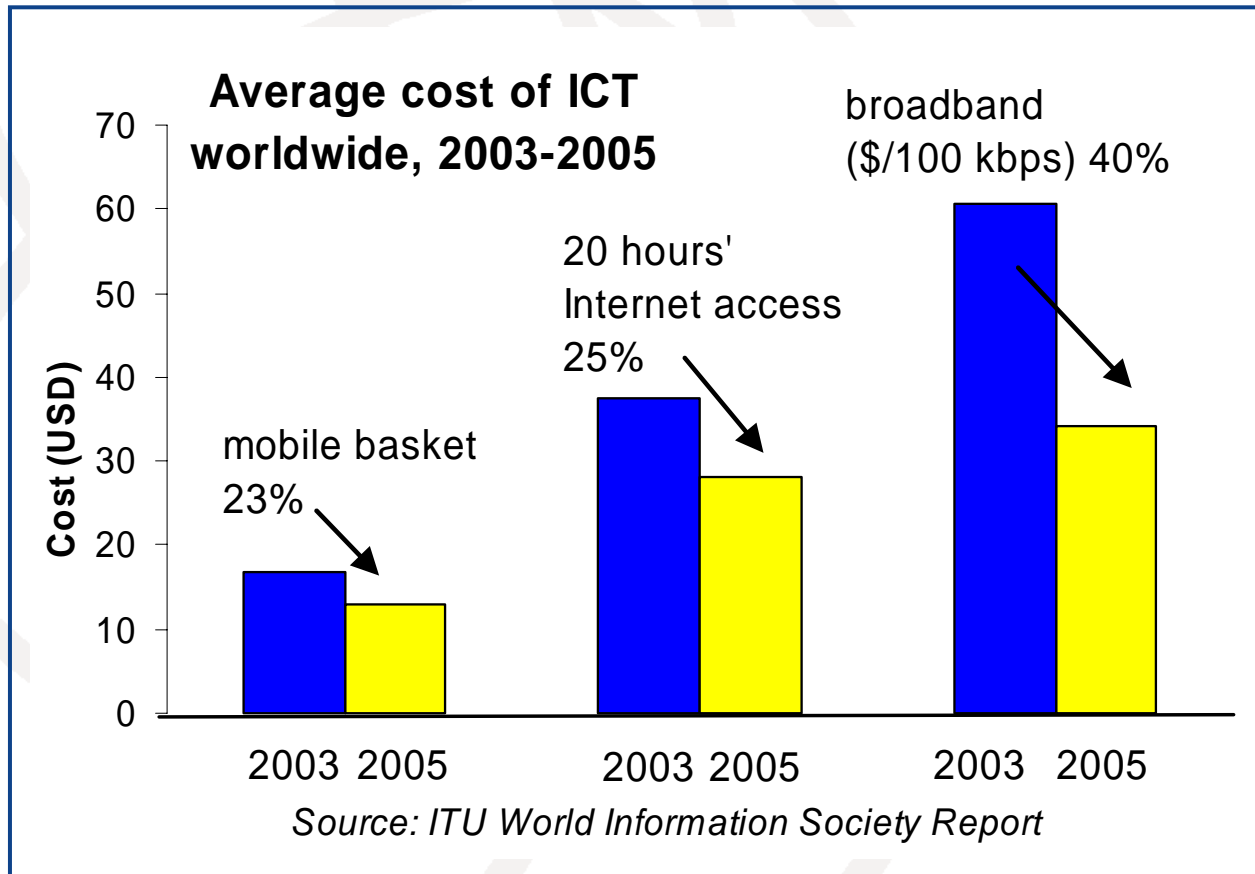
Broadband is getting faster



And cheaper

<i>Economy</i>	<i>Company</i>	<i>Speed kbit/s</i>	<i>Price per month US\$</i>	<i>US\$ per 100 kbit/s</i>	<i>Change 2005-06</i>
Japan	Yahoo BB	51'200	36.00	0.07	-12.5%
Korea (Rep.)	Hanaro	51'200	40.59	0.08	--
Netherlands	Internet Access Ned.	20'480	27.97	0.14	-81.3%
Taiwan, China	Chunghwa	12'288	22.67	0.18	--
Sweden	Bredbandsbolaget	24'576	56.08	0.23	-6.5%
Singapore	StarHub	30'720	73.17	0.24	-85.0%
Italy	Libero	12'288	37.23	0.30	-73.8%
Finland	Elisa	24'576	85.64	0.36	-51.4%
France	Free	10'240	37.29	0.36	-90.1%
United States	Comcast	4'096	20.00	0.49	--
Germany	Freenet.de	6'016	30.95	0.52	--
United Kingdom	Pipex	8'128	50.89	0.63	-53.6%
Hong Kong, China	Netvigator	6'144	51.17	0.83	-0.1%
Portugal	Sapo	8'128	75.82	0.93	-0.8%
Canada	Bell	4'096	41.26	1.01	-3.93%
Average		18'278	44.33	0.43	-45.5%
Best practice (top 20%)		40'960	27.59	0.10	-46.9%

Decline in prices, 2003-2005



Birth of Triple Play

Table 1. Triple-play pricing with unlimited PSTN calling plans, September 2005

Company	Type	Country	Price USD (PPP)	Price USD	Down (kbit/s)	Bit Cap (MB)	TV Chan
Free Telecom	ADSL	France	32.50	36.72	20 000		93
Casema	Cable	Netherlands	48.43	53.75	10 000		42
Versatel	ADSL	Netherlands	60.62	67.28	20 000		1
Kabel Deutschland	Cable	Germany	68.77	78.40	6 200		38
Cablecom	Cable	Switzerland	71.83	102.72	2 000		87
TeliaSonera	ADSL	Sweden	75.00	92.25	24 000		23
Dansk Bredbånd	FTTB	Denmark	78.87	112.78	10 000		30
France Telecom	ADSL	France	78.98	89.25	8 000		34
Lyse	Fibre	Norway	80.86	120.48	4 000		23
Mstar	Fibre	USA	90.26	90.26	15 000		24
Smart Telecom	Fibre	Ireland	91.38	122.44	2 000		70
Noos	Cable	France	91.89	103.83	10 000		100
Telenor	ADSL	Norway	98.54	146.83	4 000		25
TDC	ADSL	Denmark	100.68	143.97	4 096		18
Telewest	Cable	UK	106.50	119.28	1 000		100
Belgacom	ADSL	Belgium	113.54	124.89	4 000	30 000	42
SBC	ADSL	USA	124.97	124.97	3 000		60
Homechoice	ADSL	UK	129.89	145.47	8 000		55
Cogeco	Cable	Canada	144.05	151.25	10 000	30 000	88
Comcast	Cable	USA	149.79	149.79	6 000		70

Source: <http://www.oecd.org/dataoecd/47/32/36546318.pdf>

History of the Internet

1990's

- Growth throughout OECD countries
- Begun "privatisation" of backbone
- Primarily a channel for the Web and email
- Wide disparity in connectivity
- "Dot.com" mania rules
- Some thought internet was suitable platform to subsume all existing networks & services
- Cocktail of over-investment, hyper-competition and technological change lead to telecoms & internet recession



Internet today (2006)

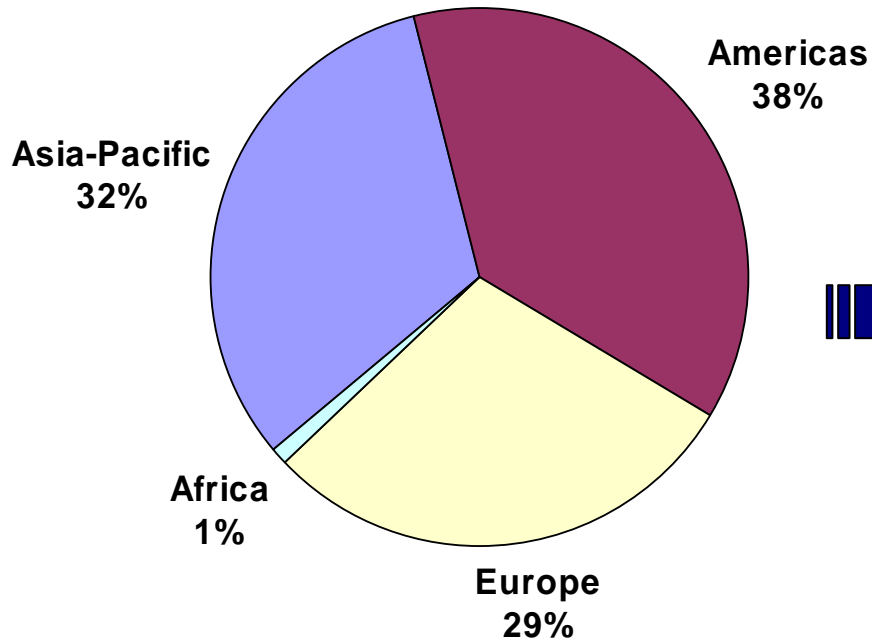
- Communications epicentre shifting from North America and Western Europe to Asia-Pacific
- Majority of internet and mobile users in Asia-Pacific and nowhere to grow but up
- China has overtaken the United States as the world's largest market for fixed-lines, mobile and soon broadband
- Continued innovation:
 - Blogs, Wikis, XML, Ajax, Grids, Mesh, SOAP, Web services, Skype, RSS, Torrents, Podcasts, Web 2.0, mashups, geo-location services
 - voice just another application
 - massive growth of video to come

Shift in Internet Demographics: Internet Users by Region 2001-2004

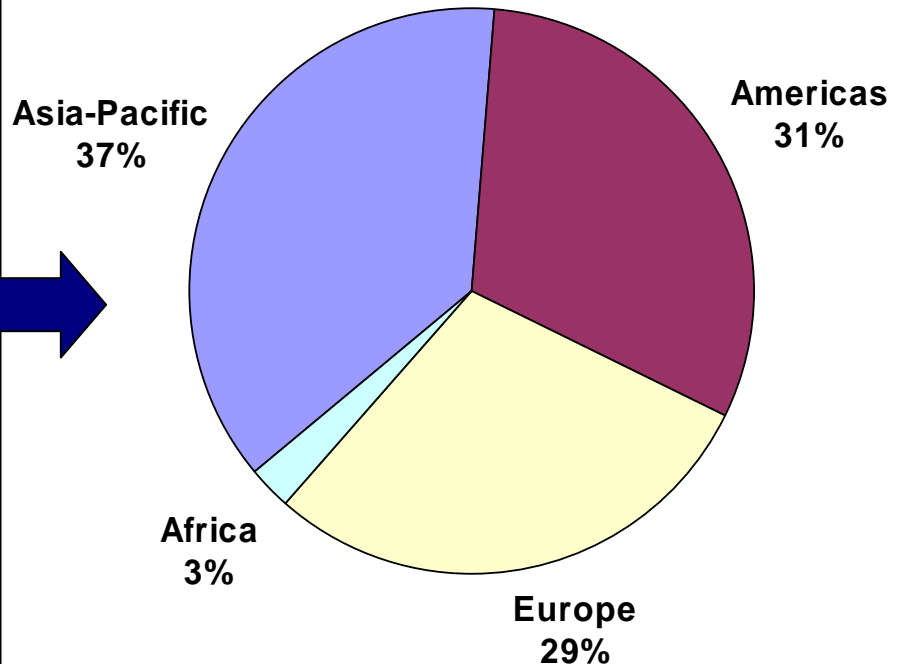


**International
Telecommunication
Union**

**2001: Number of Internet Users by Region
Estimated 500 Million Users**

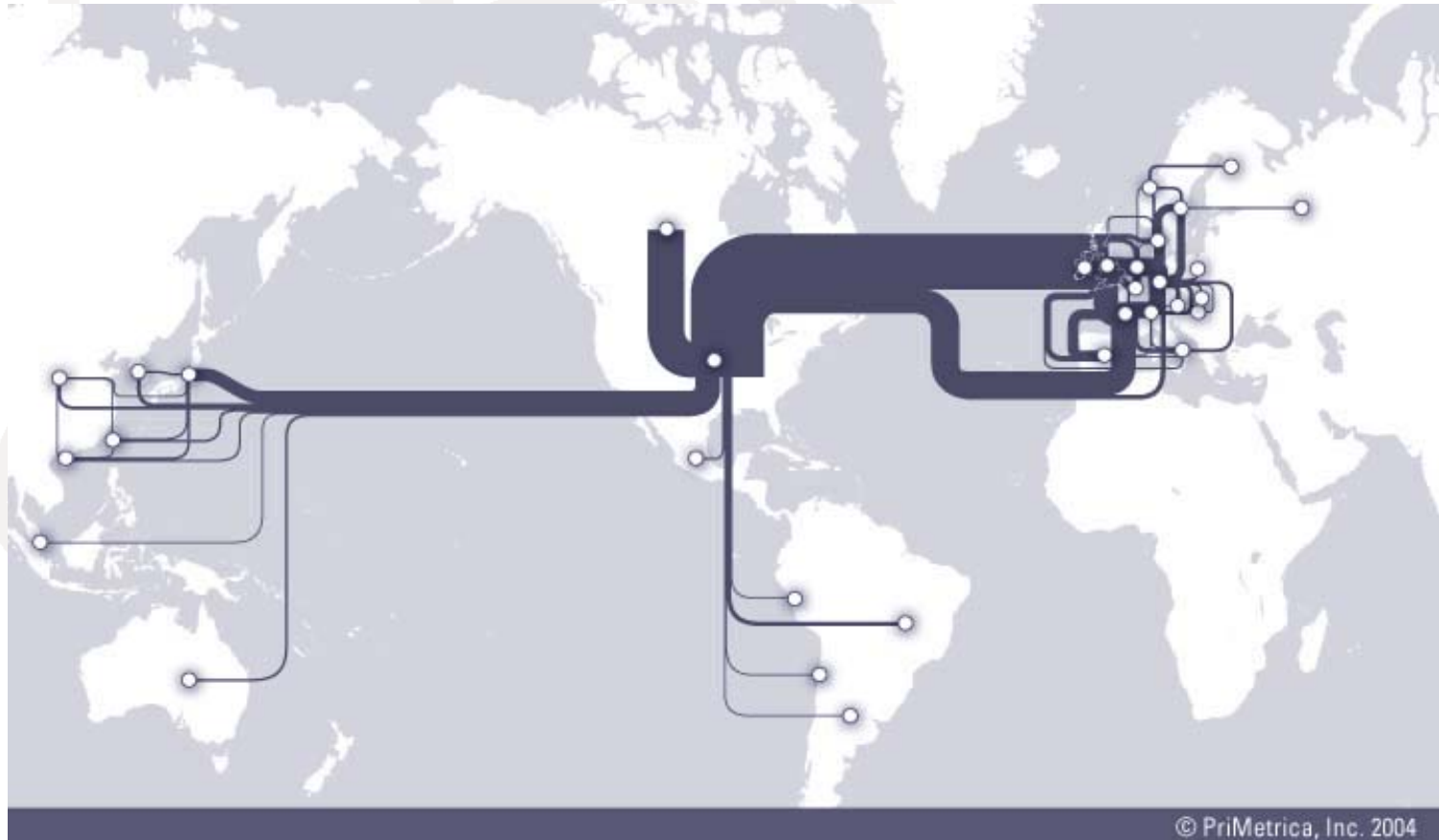


**2004: Distribution of Internet Users by Region
Estimated 875 Million Users**



Asia-Pacific has overtaken Americas as largest percentage of regional Internet users with much more potential for growth...

But still much work needed to improve international and regional bandwidth



Many problems preventing internet to scale to robust public infrastructure

- authentication
- security
- spam
- scalable configuration management
- robust scalability of routing system
- compromise of e2e principle
- dumb network
- measurement
- patch management
- "normal accidents"
- growth trends in traffic and user expectations
- time management and prioritization of tasks
- governance
- intellectual property and digital rights
- interdomain qos/emergency services
- inter-provider vendor/business coordination

why so persistently unsolvable?
rooted in non-technical issues:
economics, ownership, and trust

Clean Slate Approach?

- “It's time for a clean-slate approach”
 - MIT's David D. Clark
- “If fails to fail often enough so it looks like it works.”
 - Mike O'Dell
- “The Internet is Broken”, David Talbot, Technology Review, Dec 2005/Jan 2006 in three parts: [Part 1](#), [Part 2](#), [Part 3](#)
- E2E architecture means intelligence at edges so security is every user's problem
 - well, that scales...
 - Internet evangelists: “the internet empowers users to do anything you want!”
 - “O.K. I chose not to get spam”
- Is this the critical public communications infrastructure?

Approaching inflection point?

- Deployment of new communications technologies is typically a series of relatively short cycles of one or two decades' duration:
 - beginning with invention
 - early stages of rapid innovation and application
 - typically over-hyped and not used for original purpose intended
 - took 30 years for telephone killer app to emerge!
 - finally deployed in way to scale to broader market acceptance and commoditization
 - not necessarily platform for techies or innovation

First phase

- Growth of Internet and other IP-based networks and their requirements for bandwidth and capacity has driven rapid innovation in telecommunication access and transport networks:
 - leveraging copper wire “last-mile” networks through digital subscriber line (“DSL”) technologies
 - re-architecting of cable networks to support IP services
 - advances in optical networking technologies (e.g. PON)
 - advances in wireless technologies (Wi-Fi, WiMax)

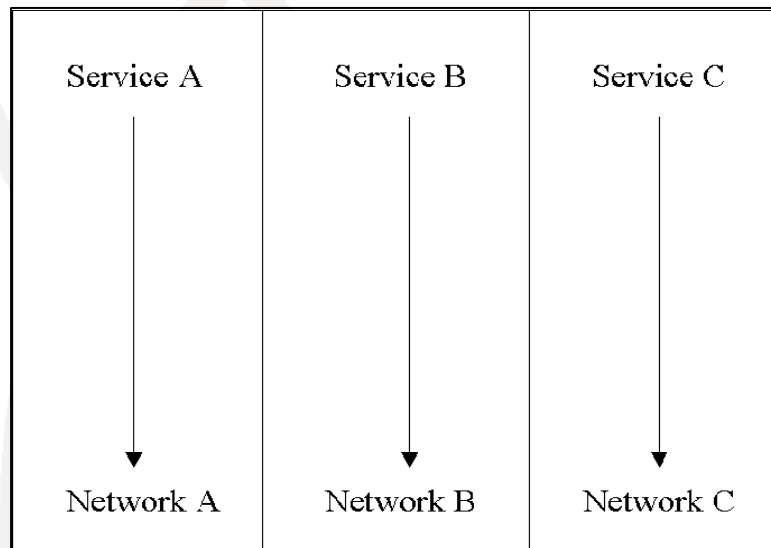
Second phase

- Trend towards integration & interoperability of IP-based and PSTN network services and applications
- Major impact on direction of build-out of national communications infrastructures
 - Shift from PSTN build-out to broadband-based “converged” platform
 - New ITU standards (DSL, cable) have brought broadband access to over 250 million new users since 2000

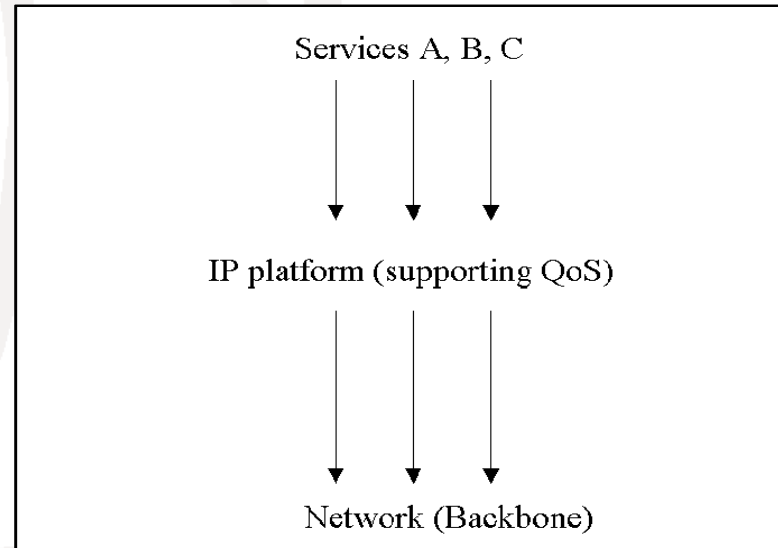
The paradigm shift

- In converged networks, services are no longer tied to specific networks. A converged **Next Generation Network** can deliver all services

Current



Future



What are NGNs?

- Faced with separate infrastructures for voice and data businesses, convergence and growing competition, almost all telecommunication operators and equipment manufacturers are making substantial investments in what can be referred to as IP-Enabled Next Generation Networks (NGNs).
- IP-based NGNs represent the “marriage” of the Public Switched Telephone Network (PSTN) with the world of the Internet
 - an extensive area of standardization within ITU
- In the coming years, IP-enabled NGNs will be deployed by numerous service providers around the globe



Migration to NGNs

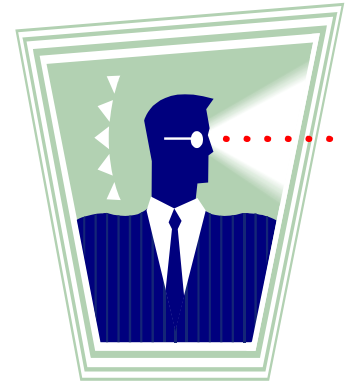
- **2009 / British Telecom:** BT aims to move majority of its subscriber base to “broadband dial tone” by 2009. Aims for annualized cost savings of £1bn pa from 21st century network Capex in medium term likely to be below current £3bn pa level once network migration completed.
- **2012 / Deutsche Telekom:** Company has completed an NGN overlay backbone network, voice/data integration to be driven by customer demand, company has suggested by 2012. Core network already IP-MPLS, carriers traffic for both fixed and mobile business.
- **2009 / KPN:** Company is in “first phase” of move to an IP everywhere environment for corporate customers. KPN aims to move to an all IP core backbone by 2007, with Ethernet in the access network by 2009. ATM and SDH to be phased out of network by 2010, completing move to IP. Cost savings targeted at 150 M Euro pa from 2005, rising to 2000 m EURO pa from 2008. Headcount to fall by equivalent of 8000 by 2009. Network transformation programme means capex at 1-2 bn Euro pa from 2006 onwards.

ITU-T Definition of NGN (Y.2001)

- Next Generation Network (NGN): a packet-based network able to provide telecommunication services and able to make use of multiple broadband, QoS-enabled transport technologies and in which service-related functions are independent from underlying transport-related technologies.
- It enables unfettered access for users to networks and to competing service providers and/or services of their choice.
- It supports generalized mobility which will allow consistent and ubiquitous provision of services to users.

But NGN visions differ

- PSTN on steroids? Internet on steroids?
- To fix the internet security mess?
- Monetize the internet? Emulate mobile players?
- Revenge of the telcos? Walled gardens?
- Attempt to move “up the value chain” into audiovisual content services
 - from “dumb pipe” provider into “content”
 - e.g., much of current US telecom legislation revision activity is about carriers getting video franchises
- Is this a wise strategy?



Running the Numbers

■ Content:

- Hollywood box office revenues (2003): ~ 11 billion
 - with home rentals perhaps 3 x that (~ 35 billion?)
- Global music industry revenues ~ 35 billion

■ Telecoms:

- US only telecom revenues (2003): 348.0 billion!
- Global text messaging revenues for 2005: ~ 75 billion



NGN Core & Access Networks

- **NGN access:** "the deployment of fibre into the local loop, either to the incumbent's street cabinet ... or the deployment of fibre all the way to customer premises (typically apartment blocks rather than individual houses).
- **NGN core:** "the replacement of legacy transmission and switching equipment by IP technology in the core, or backbone, network. This involves changing telephony switches and installing routers and Voice over IP equipment."

Source: ECTA

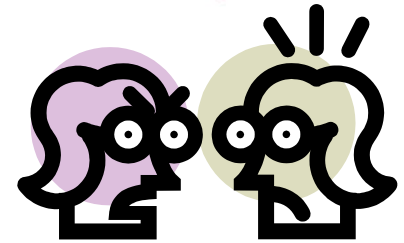
Intelligent Infrastructures

- NGN core and access network infrastructures will be supplemented with an “**intelligent infrastructure**” or a “business layer” for IP networks capable of providing QoS, reliability and security assurances for multiple service scenarios across service providers
- With growing security problems, imagine this must be “out-of-band” (like for mobile)
- Basis for identity, authentication, DRM, access to resources and intercarrier/service compensation mechanisms...
- Watch trusted federation initiatives
 - e.g., IPSphere Forum (www.ipsphereforum.org)



What rules will apply to Next Generation Networks?

Déjà vu all over again



- Telecommunications sector has always had a variety of interest groups who have clashed over its rules
- For those who know history, little surprise there are strongly held views on how to address numerous policy and regulatory issues that emerge with new technologies
- That's why establishment of independent regulators was seen as a necessity to liberalizing the sector!

25 years of policy & regulatory reform



- ~25 years ago, AT&T formally agreed to the break-up of the Bell system
- 15 years ago, around 10 countries had some measure of fixed-line competition
- about 7 years ago, in concluding the WTO basic telecoms agreement, some 70 countries committed to telecoms market liberalization
- At the end of 2005, 137 independent regulators
- Countries with privatized operators and some degree of competition are now in majority among ITU's 190 Member States

Convergence changes the game

- Converged networks like NGNs will make services available across a range of devices
- Regulators currently regulate many services based on networks that deliver them
- Days when legislation and regulation could assume distinct services running over distinct technologies and networks are disappearing fast
- Policy and regulatory frameworks must adapt



Example: “Battle Brews Over Rules for Phones on Internet”

- USA: “Fierce battle is emerging among rival companies and between federal and state regulators over the shape of the new government regulations and control of the service, which has the potential to be the most significant development in telecommunications since the breakup of the AT&T monopoly 20 years ago.”
 - New York Times, 28 July 2004

IP-enabled NGNs means wave of major challenges for national policy makers and regulators

- Technologies and architecture of IP-enabled NGNs are fundamentally different from PSTN
- This means new services, network topologies, associated costs and commercial models
- It is also likely to lead to development of new and different kinds of IP-based interconnection arrangements that are service-based, time-based, capacity-based or even IPR rights-based (e.g., for audiovisual content crossing IPR border regimes)

Regulatory forbearance?



- Incumbent carriers state commercial models for IP-enabled NGNs are at an early and evolutionary phase and it is too early to discuss open access or wholesale mandated interconnection regimes
- Also argued that IP-enabled NGNs, particularly the deployment of high-speed access networks (e.g. FTTx, VDSL), require massive investments and that national regulatory moratoria for incumbents are appropriate
- Capital markets appear to agree...

Value Redistribution in Industry

INNOVATOR	EPS (\$)	MKT CAP (\$B)
MCIW	-11.22	6.5
SPRNT/NXTL	-0.31	34
VERIO/NTT	1.98	71.6
LEVEL3	-0.74	1.9
SBC/T	1.41	78
QWEST	-0.45	7.7
COGENT	-7.42	0.2
GLBC	-13.84	0.3
SAVVIS	-0.90	0.12
ABOVENET	n/a	n/a
WILTEL	n/a	n/a
TELEGLOBE	-0.74	0.2
C&W	0.70	4.7B
TWTELCOM	-1.12	1.0
(TWARNER)	0.48	82
XO	-2.18	0.4

INNOVATOR	EPS (\$)	MKT CAP (\$B)
CISCO	0.87	108
GOOGLE	3.41	97
AMAZON	1.25	19
YAHOO	1.07	49
EBAY	0.73	51
JUNIPER	0.53	13
APPLE	1.56	47.
INTEL	1.33	141
VERISIGN	0.93	6.15
DELL	1.27	76.3
MICROSOFT	1.12	269B

source: finance.yahoo.com, 25 oct 2005

Kim Claffey – CAIDA – ARIN XVI IPv4 Roundtable – 26 October 2005

Source: Geoff Huston, Convergence at http://www.ptc06.org/program/public/proceedings/Geoff_Huston_slides_M21.pdf

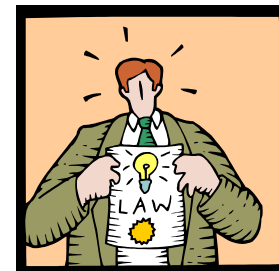
Negative sentiment towards NGN access investment in Europe

- “[A]lthough we expect some fibre build, particularly...for VDSL in European countries with cable competition, we still see the regulatory backdrop as unsupportive of a sustained increase in capital intensity.”
Merrill Lynch, June 2006 (cited in Telecom Markets, 13 June 2006)
- “The dominance of free cash flow yield (FCFY) valuation measures in Europe is testament to the fear and suspicion with which the market regards investment in capex. The focus on FCFY has sent company management teams a clear message – spend as little as possible on network...”
HSBC Global Research, Telecoms and Media. April 2006. “Net Neutrality”
- “We...see little incentive from a regulatory perspective for incumbents in Europe to pursue FTTP [Fibre to the Premises].”
Credit Suisse First Boston. July 2005.

Source: Brian Williamson, Director, Indepen

Others say not so fast...

- Competitive providers argue the opposite, saying that regulators need to ask whether, in the absence of wholesale economic regulation, will market dynamics be sufficient to ensure a competitive environment?
- They are worried that without immediate attention by regulators to NGNs, carriers will rapidly vertically integrate services and that bottlenecks will emerge, particularly for delivery of audiovisual content...
- But is it just the traditional carriers that we need to be worried about?



What about these players?

- Mega-internet service providers like Google, MSN, eBay and Yahoo
 - strong brands, deep pockets
 - entering audiovisual content business
 - Most internet traffic will be video in a few years
 - entering voice markets and some infrastructure provisioning



But who pays for the infrastructure?



- “The Internet can't be free in that sense, because we and the cable companies have made an investment and for a Google or Yahoo! or Vonage or anybody to expect to use these pipes [for] free is nuts!”

– Ed Whitacre, CEO of AT&T

Double standards?



- "Let's see if I can summarize [network neutrality debates]"
 - **BAD:** Verizon and SBC want to charge for "premium" access to their network.
 - **GOOD:** Yahoo and AOL want to charge for "premium" access to their network/servers

What am I missing here?"

- Rick Adams, founder of UUNet, first US ISP
- Ironic that large internet players now argue for economic regulation....

Doubtful that policy makers and regulators understand what interconnection means in a multi-service NGN environment

- Extensive economics literature exists about interconnection in the traditional PSTN world
- An emerging literature deals with interconnection in the world of IP-based networks like the internet
 - e.g., economics of peering, transit, private IXPs
- Very different interconnection arrangements prevail in these two worlds.
 - Different technology
 - Different regulatory history
 - Different industry structure

Interconnection economic models

- Is it tenable to continue to distinguish voice (including VoIP) as a service needing to be treated with a distinct set of policy, legislative and regulatory provisions?
- What should happen “**when worlds collide?**”
- We are in very early stages of understanding the relationships between these two worlds

So it's arguably back to basics...

- Why do we regulate?
 - Manage limited resources (spectrum, numbers)
 - Market failures: Market power
 - Market failures: Desirable capabilities that would not be deployed without intervention
- But policy makers and regulators have a changing role in building “information economies”
- National telecommunication infrastructure is now much more important than platform for voice
- Fundamental underpinning layer of networked economies and information societies
 - so is it promoting competition “über alles”, or
 - is it promoting the development of national infrastructure industries (e.g., like power, water, sewage, transport)?

Distinguishing types of regulation

Subject of many national policy and regulatory proceedings for IP-based networks

- **Symmetric**, examples:
 - Universal service and access
 - Consumer emergency calls (E112/E911)
 - Consumer protection and privacy (e.g. SPAM, SPIM)
 - Quality of services
 - Legal intercept
 - Authenticated caller or sender identification
 - Data protection and privacy issues
- **Asymmetric**
 - e.g., open access, wholesale economic regulation
 - clear that one size does not fit all across different economies because of different starting conditions
 - is there facilities-based infrastructure competition?

Market power and interconnection

- Migrations to NGN will not eliminate Significant Market Power (SMP)
- Where service providers possess SMP, they tend to have ability and incentive to exploit it to detriment of consumers
- In the absence of regulation, interconnection often serves as locus for exploitation of SMP
- Market power associated with last mile bottlenecks will continue to be a significant regulatory concern for foreseeable future

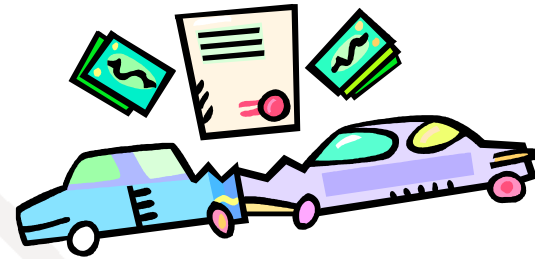
Network Neutrality

- Current U.S. “network neutrality” debate reflects concerns about SMP of internet providers
 - Reflects lack of competition for broadband internet access
 - US currently ranked 15th in world economies
 - no open access mandate, limited choice of providers, higher prices
- Can be argued that network neutrality debate is just shifting the open access debate to a higher network layer
 - the internet was never neutral to all applications
 - see first paper on Network Neutrality by Tim Wu

Line of Defense

- Trying to address market inefficiencies in NGN interconnection arrangements through *ex ante* regulation is likely to be extremely difficult
 - particularly as must be service-specific and NGN services are still not clearly defined!
 - not enough understanding of new services, network topologies, associated costs or commercial models
 - costs aren't sunk as in case of PSTN unbundling
- First line of defense for policy makers and regulatory authorities might be to focus on competitiveness in underlying access and transport markets for consumer broadband internet access and high capacity internet transit
- In Europe, where there is lack of facilities-based competition (e.g., cable), unbundling and service-based competition has demonstrated success (e.g., France)

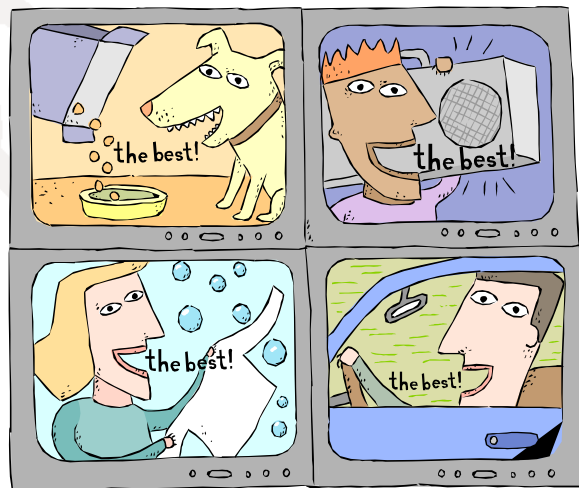
And what about content?



- Convergence is setting two very different regulatory cultures on a **rapid collision course**: the highly-interventionist regulatory culture of broadcasting and less interventionist culture of telecommunications (at least with regard to content)
- Particularly sensitive topic as the regulation of audiovisual content industries is culturally embedded and tied to national regulatory regimes consistent with societal, cultural and religious values

Content Regulatory Issues

- What about:
 - advertising
 - public broadcasting
 - licensing
 - quality
 - child and youth protection
 - content diversity
 - support for national content quotas
 - decency and protection from abusive uses and community standards?
- In Europe being tackled in the **Audiovisual Media Services Directive** (ex-Television without Frontiers Directive)



Summary

- Early days: different visions of what NGNs will be...
- Symmetric regulation of IP-based networks and NGNs now subject of regulatory proceedings around the world
- For asymmetric regulation (e.g., open access), one size does not fit all across different economies because of different national starting conditions with regard to infrastructure competition
- We don't understand NGN architectures enough to understand what will represent bottlenecks

Summary Cont'd

- We don't understand the collision of the PSTN and IP interconnection regimes enough to address asymmetric economic regulation in NGNs
- However, capital markets want regulatory certainty for access network infrastructure build-out
- Delicate balancing act for policy makers and regulators



Thank you

International Telecommunication Union

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Some Background Materials



▪ **ITU Strategy and Policy Unit NGN site:**

www.itu.int/spu/ngn/

- What Rules for IP-enabled NGNs? workshop (March 2006)
 - Background papers (e.g., interconnection, universal service)
 - Presentations and contributions, video archives
- Survey of ongoing NGN policy and regulatory proceedings
- Some of my talk derived from material contributed to that meeting (particularly Scott Marcus' excellent background paper reviewing possible NGN interconnection models)