

# Networks in Transition

INT / MSU Summer Tour

ITU

Geneva, Switzerland

5 July 2003

Robert Shaw

<[robert.shaw@itu.int](mailto:robert.shaw@itu.int)>

ITU Internet Strategy and Policy Advisor

ITU Strategy and Policy Unit

# Understanding Network Trends



# The Impact of New 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
- Usually also corresponds to periods of rapid economic growth

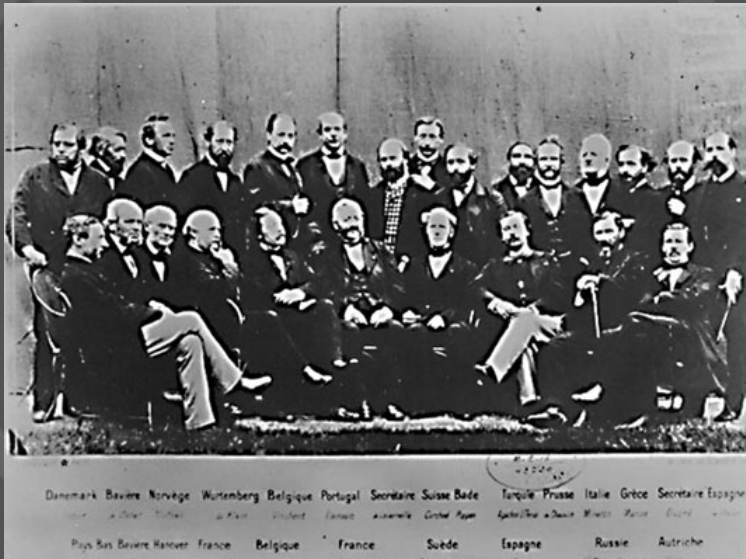
# Impact of New Communication Technologies

- This historical pattern has been repeated numerous 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 communications

1865: ITU Created

# A Thread Across the Ocean

- 1866: The Great Eastern lays the first operational transatlantic cable



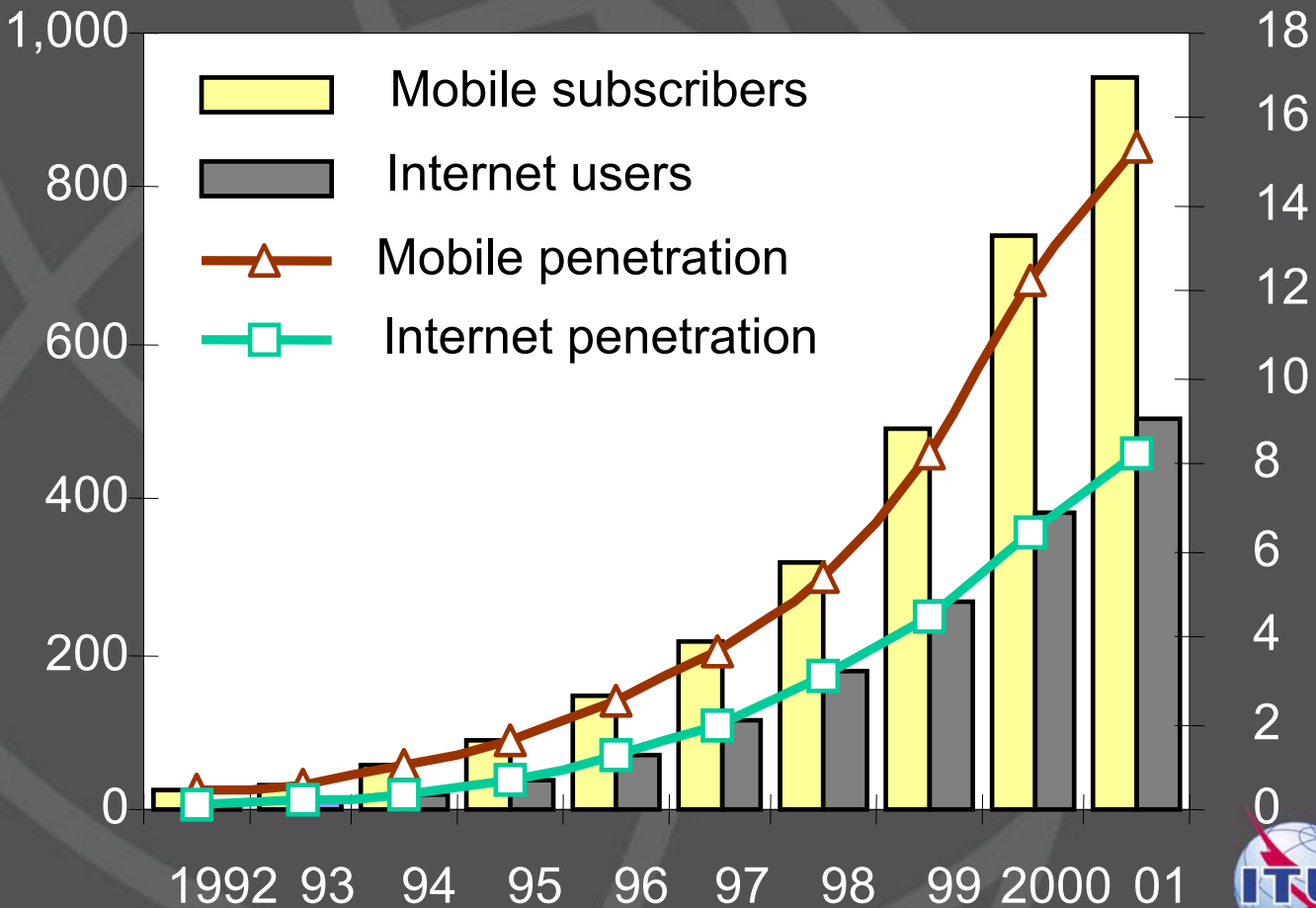
- 1865: Founders of the International Telegraph Union

# Impact of New Technologies

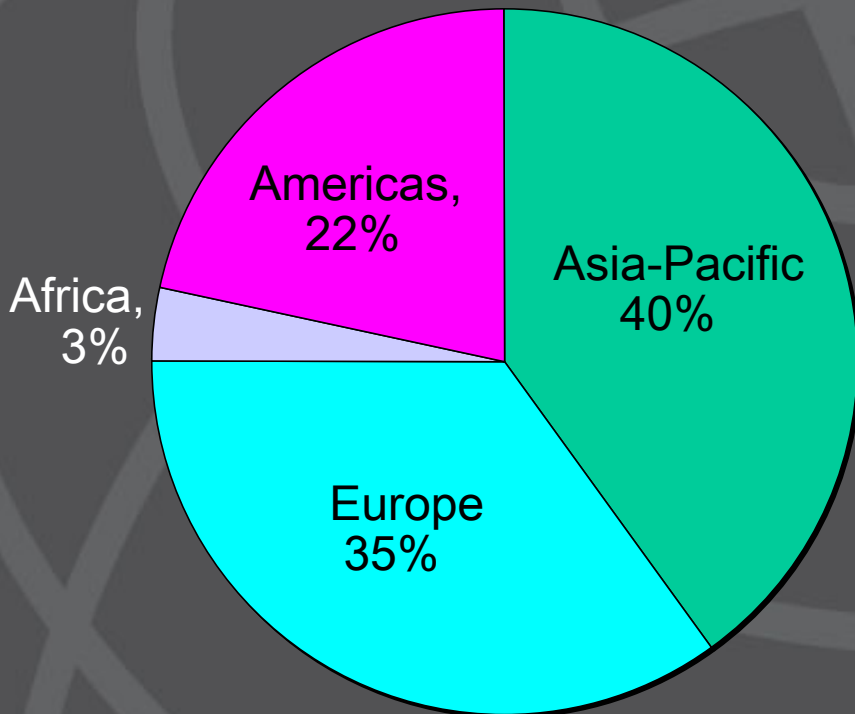
- In the last part of the twentieth century, the almost simultaneous arrival of two major innovations — mobile phones and the Internet — not only changed the face of communications, but also gave impetus to dramatic economic growth

# Mobile and Internet: identical twins born two years apart?

Users (millions) and penetration per 100 pop.

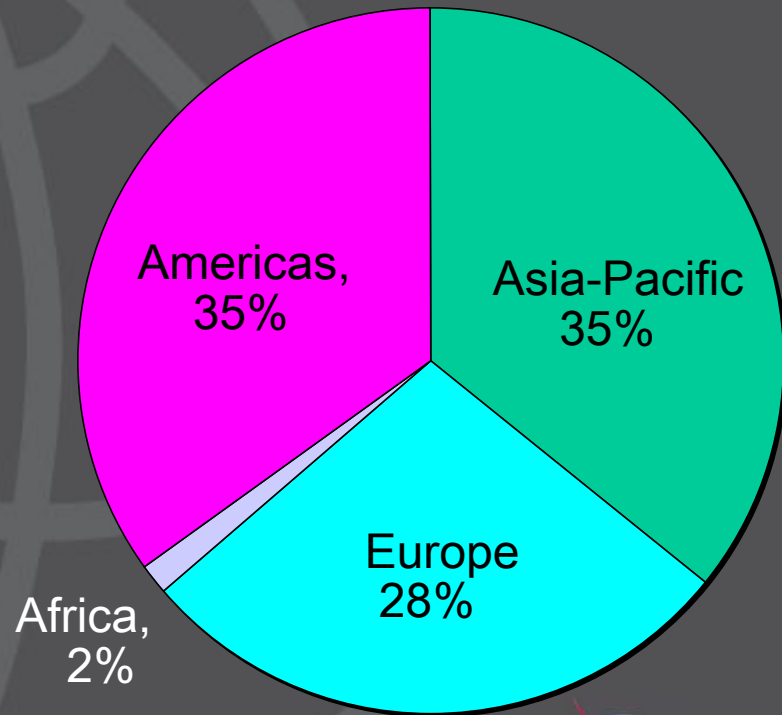


# Distribution of mobile and Internet users by region (end 2002)



Mobile phone subscribers: 1.16 billion

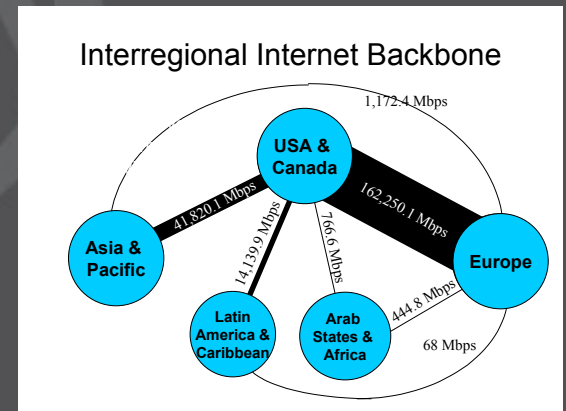
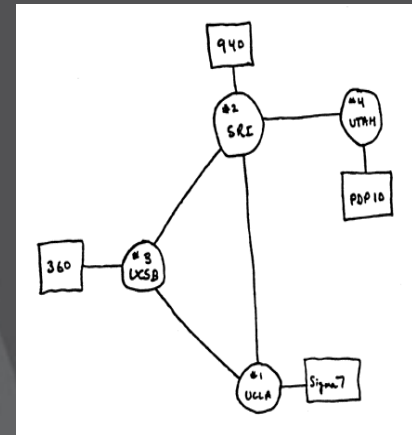
Estimated Internet users: 625 million





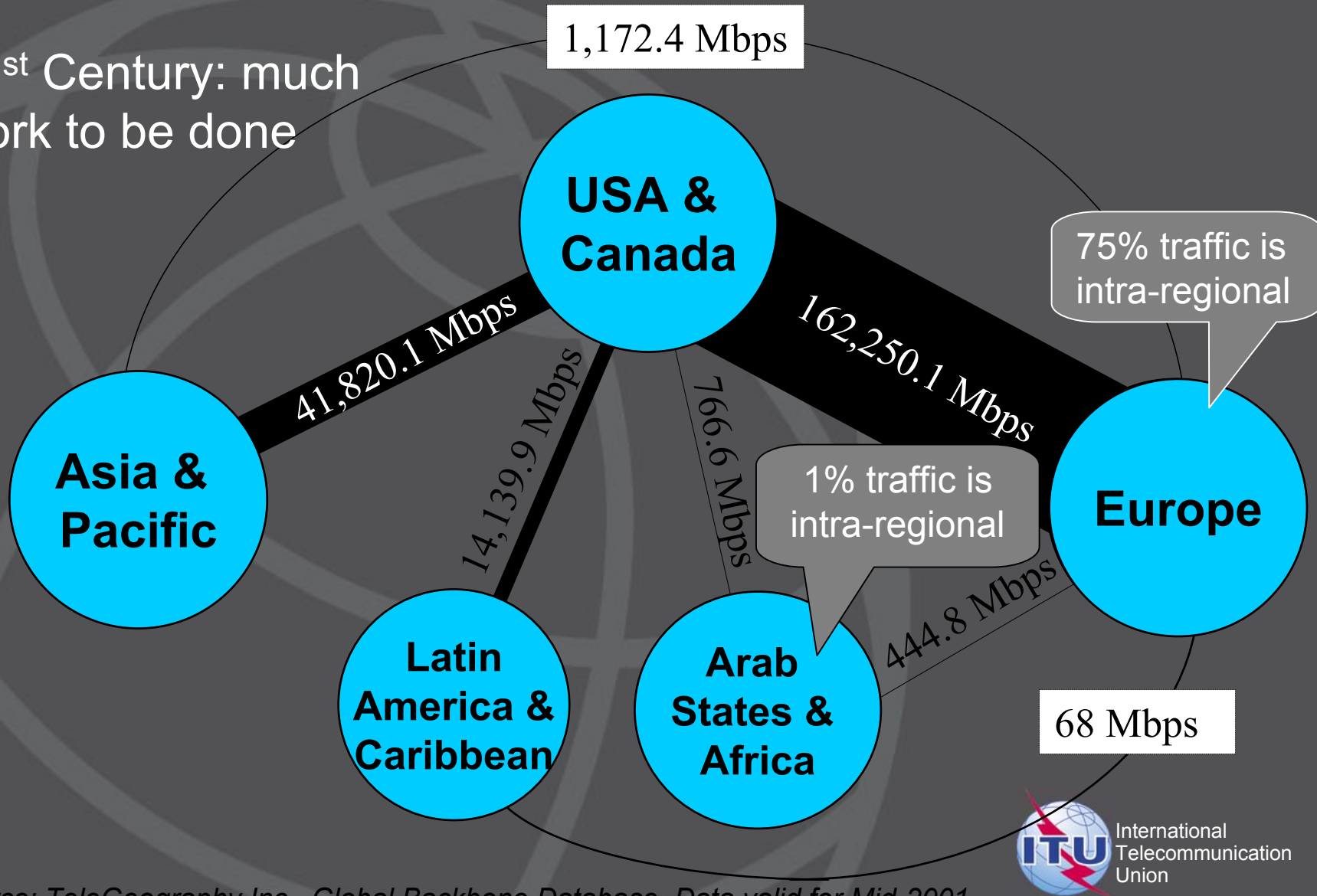
# Understanding telecommunication trends: growth of the Internet

- 10-15 years ago
  - Focused around academia and research
  - Primarily North American
  - Not-for-profit
  - Used primarily for email and file transfer
- 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



# Internet Interregional Backbone

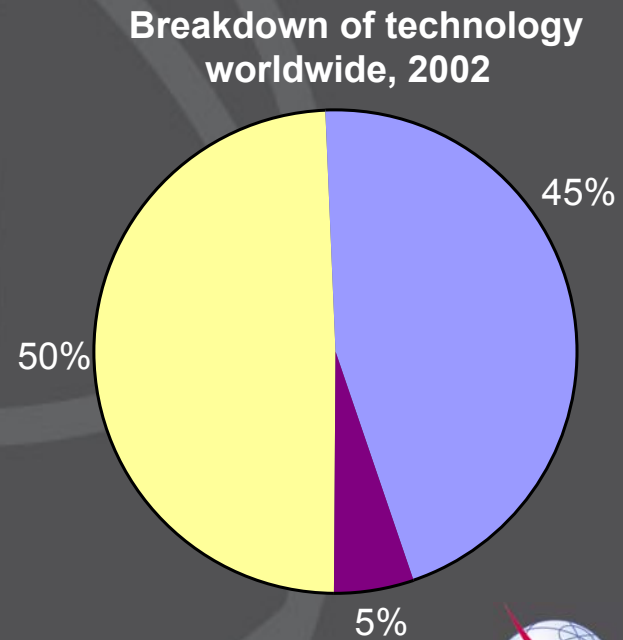
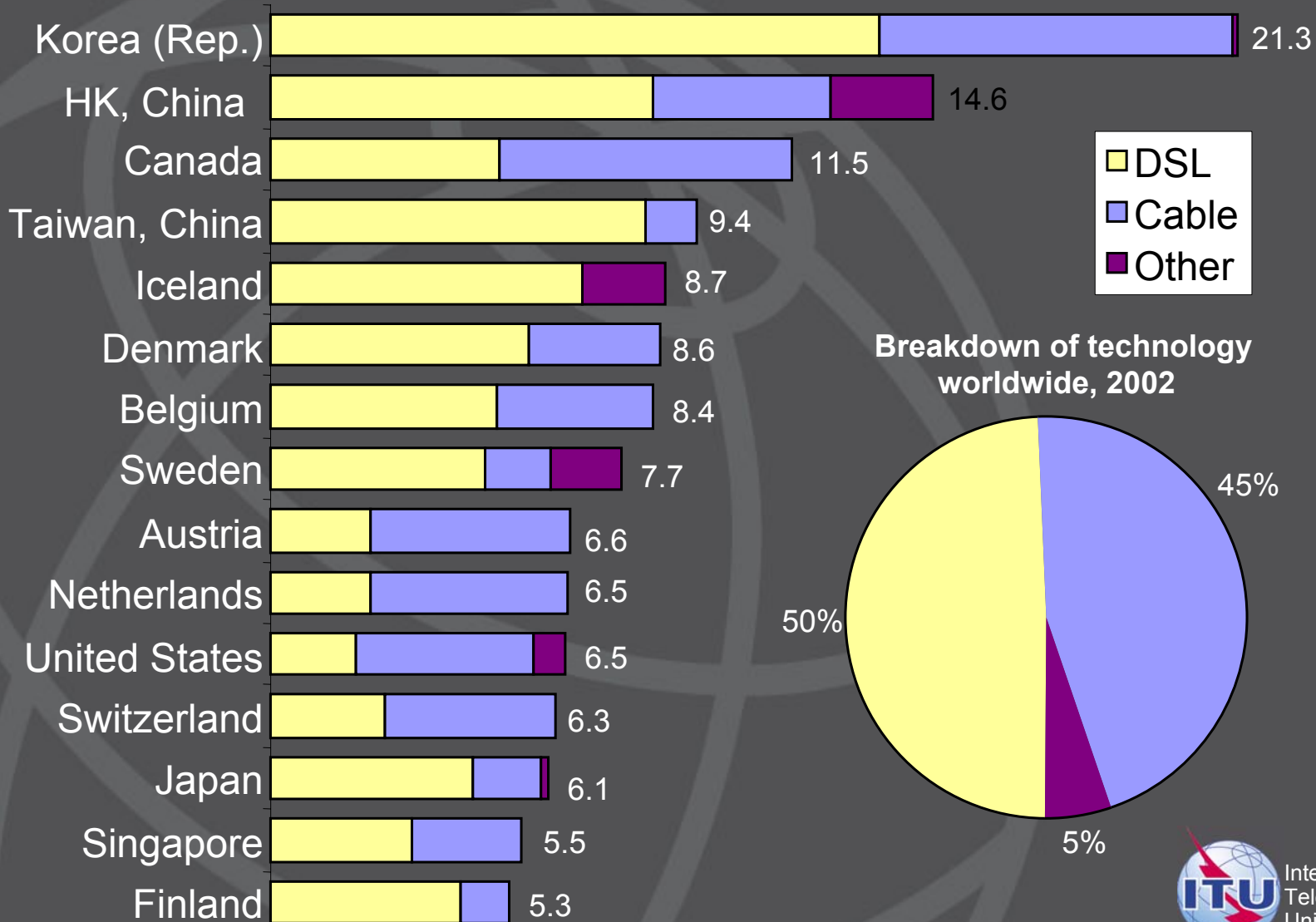
21<sup>st</sup> Century: much work to be done



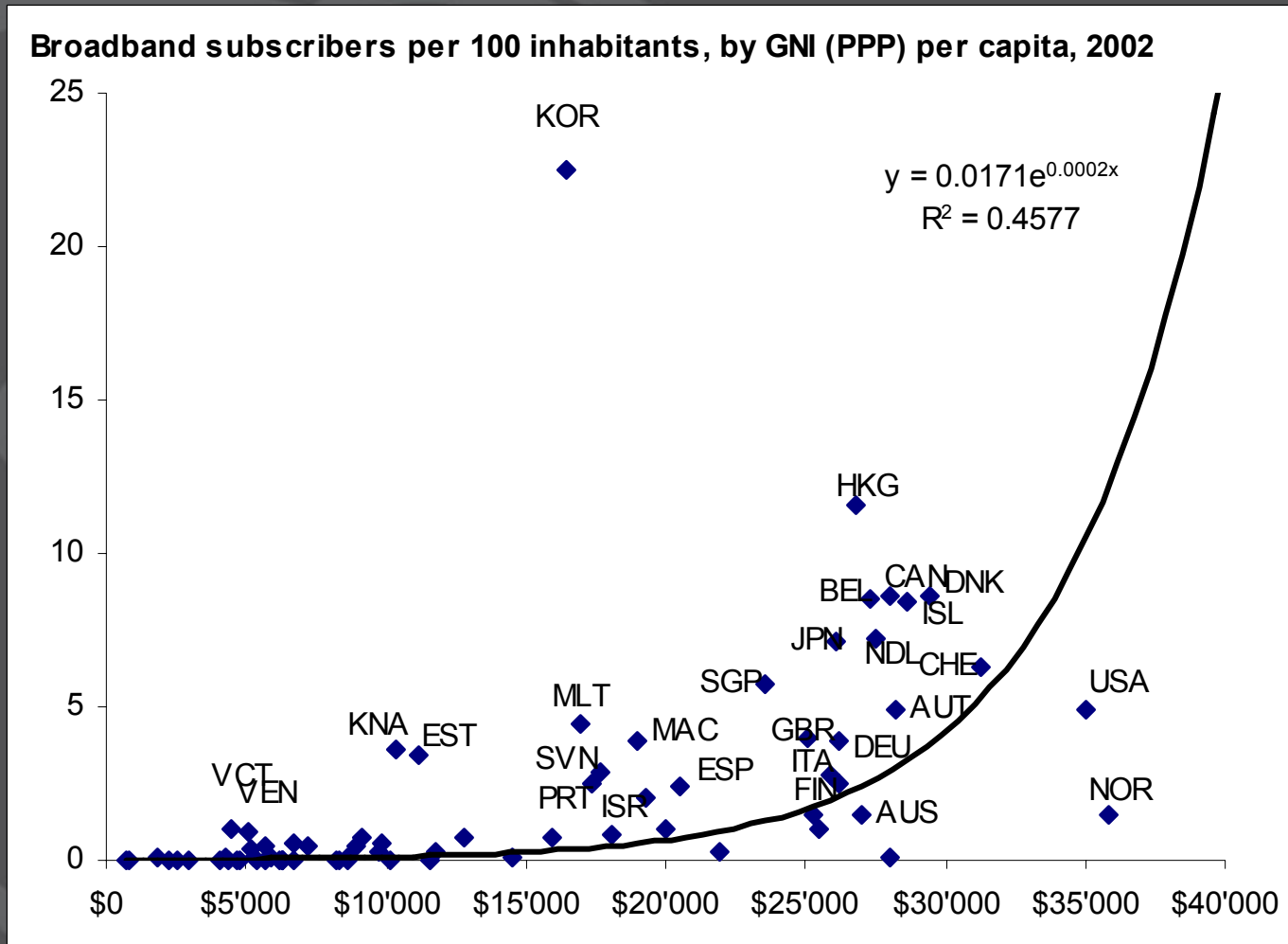
# More recent trends

- Birth of Broadband
- Growth in wireless networks and mobile data services
- Mobile overtakes fixed
  - LDCs have fastest growth in mobile (e.g. Africa)
  - Mobile Internet and multimedia applications
- Advent of “ubiquitous networks” & “portable internet”
- Future of millions of IP-enabled “appliances”

# Broadband penetration, per 100 inhabitants, 2002, by technology



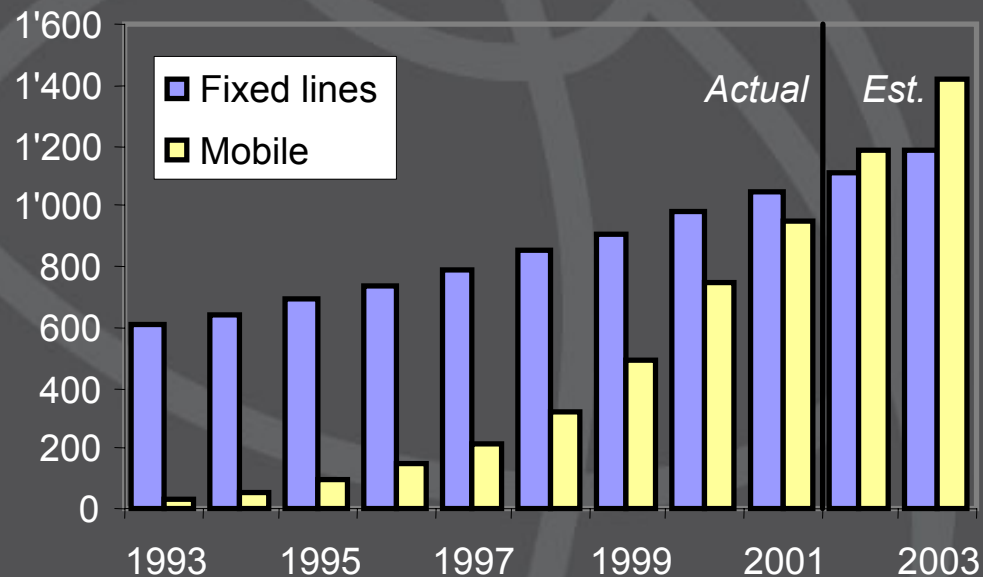
# Which economies are doing well



# Mobile Overtakes Fixed

The year 2002 marked an historic turning point in the history of telephony: the year when mobile subscribers overtook fixed-line subscribers worldwide

**Global fixed lines and mobile subscribers, millions**



Source: ITU World Telecommunication Development Report, 2002: Reinventing Telecoms.

# 20 years of sector reform

- ~20 years ago, AT&T formally agreed to the break-up of the Bell system
- 10 years ago, around 10 countries had some measure of fixed-line competition
- 5 years ago, in concluding the WTO basic telecoms agreement, some 70 countries committed to telecoms market liberalization
- Countries with privatized operators and some degree of competition are in majority among ITU Member States
- World now numbers 124 separate regulatory bodies, up from 30 in 1994



# But many challenges to the policy & regulatory environment

- All policy makers and regulators - both new and old - struggling to address changes resulting from convergence of information and communication (ICT) sectors
- Build-out of networked economies and national information societies have raised public policy stakes
- National telecommunication infrastructures are now platform for deployment of advanced national information communications networks
- Result: broader ICT perspectives from policy makers and regulators



# Predicting the Future

# The Historical Perspective

- Napoleon: “History is the version of past events that people have decided to agree upon.”
- When we look back over history at any advancement in electronic communication networks, we tend to forget about the highs and the lows, the boom-bust cycles and the failed predictions about likely usage
- Some examples...

# We often get it wrong: telephone

- “For the first 30 years of the telephone, promoters struggled to identify the killer application that would promote its wide adoption by home owners and businesses. At first the telephone was promoted as a replacement for the telegraph, allowing businesses to send messages more easily and without an operator. Telephone promoters in the early years touted the telephone as new service to broadcast news, concerts, church services, weather reports, etc. Industry journals publicized inventive uses of the telephone such as sales by telephone, consulting with doctors, ordering groceries over the telephone, listening to school lectures and even long distance Christian Science healing! The concept that someone would buy the telephone to chat was simply inconceivable at that time.”

- C. Fischer, *America Calling*

# Communication technologies takes time to mature



- You probably don't remember when people use to have multiple phones on their desk?

# We often get it wrong: email

- “The popularity of email was not foreseen by the ARPANET's planners. Roberts had not included electronic mail in the original blueprint for the network. In fact, in 1967 he had called the ability to send messages between users “not an important motivation for a network of scientific computers” . . . . Why then was the popularity of email such a surprise? One answer is that it represented a radical shift in the ARPANET's identity and purpose. The rationale for building the network had focused on providing access to computers rather than to people.”

- J. Abbate, *Inventing the Internet*

# We often get it wrong: dot.bomb

- Billions of dollars evaporated in stock market valuations
- Once high-flying telecom companies like Worldcom & Global Crossing have dramatically gone bankrupt, leaving behind massive debts; others teeter on edge
- US telecom operators and equipment manufactures have probably laid off close to a million people since the beginning of last year
- Massive overbuilding of capacity compared to need
  - about 4% of US fibre capacity is currently lit

# We often get it wrong: dot.bomb

- Hyperdebt and falling investment
- No demand for privatization share issues
- Drop in research, experimentation, innovation
- However, recession mostly in North America & Europe - not in Asia & developing country markets
  - Asia-Pac is now biggest telecom, mobile and Internet market with much growth potential

# Some Specific ITU Activities



# New Report: ITU and its Activities Related to Internet-Protocol (IP) Networks

- Report on how Internet Protocol (IP) networks and the Internet, as well as their convergence with other kinds of networks, have impacted ITU's activities
  - <http://www.itu.int/osg/spu/ip/>
- Provides overview (April 2004) of wide scope of the ITU's activities related to IP networks and the Internet—ranging from technical standards to regulatory and policy matters to development initiatives

# New Report: ITU and its Activities Related to Internet-Protocol (IP) Networks cont'd

- Description of ITU-T, ITU-D and Strategy and Policy Unit activities
- Case study on how ITU's Broadband Standards Improve Access to the Internet
- Case study on how ITU's Internet Training Centre Initiatives Provide Capacity Building in Developing Countries
- Maps overlaps of WSIS Declaration of Principles and Plan of Action with ongoing or planned ITU activities

# IP Policy Manual

- ITU Council 2003 requested ITU to prepare IP Policy Handbook
- To advise Member States, especially developing countries, on issues related to IP-based networks, including management of Internet domain names & related issues
- Intended audience is policy makers at national level who are or may be called upon to influence or decide national policies with respect to IP-based networks and/or services

# How has the Internet impacted ITU?

- Support for IP-related technologies is now strategic element in design, development and use of most telecommunication networks;
- Has had major impact on ITU's core activities in radiocommunication, telecom standardization and development programmes
- Increased focus by ITU members on issues related to convergence and international coordination issues arising out of it:
  - includes IP-based networks such as the Internet

# Changing Profile of ITU

## Members: Most Active in ITU-T

- Scientific or Industrial Organizations (SIOs)
  - NTT ♦ Cisco ♦ Nortel ♦ ETRI ♦ Huawei ♦ Siemens ♦ L. M. Ericsson ♦ ZTE ♦ Alcatel ♦ Infineon ♦ Lucent ♦ NEC ♦ Fujitsu
- Recognized Operating Agencies (ROAs)
  - France Telecom ♦ Telekom. Polska ♦ China Telecommunication Corporation ♦ BT ♦ Deutsche Telekom ♦ KDDI ♦ Bharat Sanchar Nigam ♦ Telenor ASA ♦ AT&T ♦ NTT DoCoMo ♦ Telecom Italia ♦ TeliaSonera ♦ Belgacom

# Networks in Action: Convergence

- Growth of the Internet and other IP-based networks and their requirements for bandwidth and capacity drive innovation in access and transport networks, examples:
  - 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

# Convergence cont'd

- Trend towards integration and interoperability of IP-based and PSTN network services and applications
- Emergence of differentiated Quality of Service (“QoS”) IP-based services
- Managed end-to-end performance needed for new applications requiring real-time traffic (e.g., video, voice)
- New network management, QoS, traffic engineering, pricing & accounting models emerging

# In the future

- Telephone network (fixed and mobile) and Internet will converge into Next Generation Networks (NGN)
- Probably packet based (IP & ATM) with necessary extensions to give a level of service equal to or better than current PSTN carrier networks
- Telephony and multimedia may be just another application over the Internet but to make this happen, there needs to be:
  - Substantial standards work
  - Substantial resource investment



# What is needed for “Carrier Grade IP”?

- What is the underlying demand, business case and likely timing (and eventual policy & regulatory framework)?
- International and national work based on open standards is needed to introduce interoperable NGN:
  - architecture and protocols
  - end to end QoS
  - service platforms
  - network management
  - lawful interception
  - Security
- Much current ITU standards work relates to NGN

# ITU Telecom Standardization Sector (ITU-T)

- See [www.itu.int/itu-t/](http://www.itu.int/itu-t/)
- Director: Houlin Zhao (China)
- Standardization activities are segmented into “Study Groups” that focus on different topic areas (e.g., security, access & transport networks, multimedia, signalling, numbering, naming and addressing, tariffing, IP and NGN)
- Unique forum for public-private partnership
- Cooperative activities with many organizations and forums including regional telecom forums, IETF, ISO, IEC, ETSI, etc.

# ITU Telecom Standardization Sector (ITU-T) cont'd

- During last 4 years, large reorientation towards IP-related standardization and accelerated procedures
- Majority of ITU-T activities are now related to Internet Protocol (IP) and NGN activities
  - [www.itu.int/ITU-T/studygroups/com13/ip/ietf](http://www.itu.int/ITU-T/studygroups/com13/ip/ietf)
- Common interest areas between ITU-T and IETF at:
  - [www.itu.int/ITU-T/studygroups/com13/ip/documents/IPprojV7.pdf](http://www.itu.int/ITU-T/studygroups/com13/ip/documents/IPprojV7.pdf)

# ITU-T Study Group 2

- Lead study group on naming, numbering, addressing, and routing issues, examples:
  - E.164 international numbering plan
  - E.212 mobile (“IMSI”) codes
  - ENUM: mapping between the Internet Domain Name System (DNS) and the E.164 numbering plan
  - E.164 numbering resources for IP telephony (e.g. UPT 878 code allocated for testing)
  - ITU-T SG for ongoing activities related to management of Internet names and addresses (MINA) issues

# ITU-T Study Group 3

- In 2000, SG 3 adopted draft recommendation “D.50” on the cost sharing of international Internet connection between administrations, and continues the study on applicability of principles contained in that Recommendation;
- Result of tensions over costs of full leased circuits to Internet “backbone” and argued lack of transparency over peering and interconnection rules
- Very short Recommendation that says “thou shall negotiate and agree in good faith”

# Diverse views on Internet interconnection and peering rules

- One view from unnamed government policy maker:
  - “ITU is trying to apply legacy telephony interconnection rules to the Internet!”
- Another view from an Internet expert:
  - “when this situation has existed in other industries, gov't intervention has always resulted. even when the scope is international. i've not been able to puzzle out the reason why the world's gov'ts have not stepped in with some basic interconnection requirements for IP carriers.”
  - Paul Vixie, Author of DNS BIND, runs F root server
  - [www.merit.edu/mail.archives/nanog/2002-06/msg00937.html](http://www.merit.edu/mail.archives/nanog/2002-06/msg00937.html)

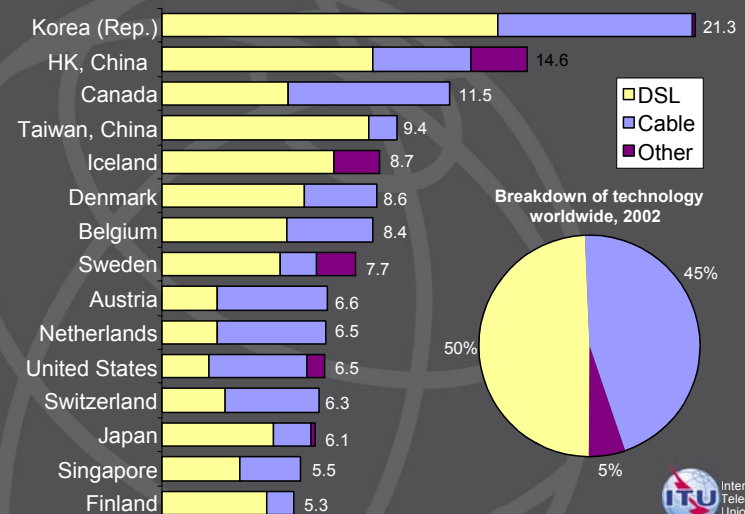
# ITU-T Study Group 4

- Lead Study Group on telecommunication management network (“TMN”) issues
- Framework for unified management of integrated circuit-switched and packet-based networks (with initial emphasis on IP-based networks)
- Also active in IMT-2000 3<sup>rd</sup> generation mobile and beyond network management for service provisioning and security

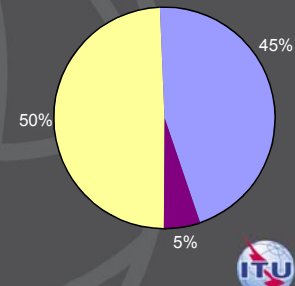
# ITU-T Study Group 9

- “IPCablecom” project specifies architecture and protocols for delivery of time-critical IP-based interactive services over cable television networks
- J.122, J.112, and J.83 Recommendations define provisioning of IP-based services over cable networks using cable modems
- J.120, defining a transmission protocol and configuration for distribution of sound and television programs (webcasting) over IP networks

Broadband penetration, per 100 inhabitants, 2002, by technology



Breakdown of technology worldwide, 2002





# ITU-T Study Group 11

- Standardized signalling for IP and advanced network applications, Intelligent Networks (“IN”)
- Key role in:
  - Signalling support of mobility services (e.g., IMT-2000)
  - IP related signalling (e.g., bearer independent call control (BICC), see Q.1901)
  - Signalling transport over IP and Interactions between IN and IP-based networks
  - Use of SIP for user access and network-to-network interfacing

# ITU-T Study Group 12

- Lead Study Group coordinating Quality of Service (QoS)
- End-to-end transmission performance of networks
- Transmission requirements for IP gateways and terminals
- Voiceband services via IP networks
- Perceptual appreciation of quality of speech
- QoS issues related to IP networks....(e.g. G.1010)
- Multimedia QoS/performance
- In-service non-intrusive assessment of VoIP

# ITU-T Study Group 13

- ITU-T lead Study Group for Internet Protocol (IP), B-ISDN, GII and satellite matters, for example:
  - Y.1310: Transport of IP over ATM in Public Networks
  - Y.1221: Traffic control and congestion control in IP networks
  - Y.1310.2: IP-MPLS transfer and control protocols
  - Y.1541: Network performance objectives for IP-based services allocations (relates to QoS classes)
- See ITU IP Project at
  - [www.itu.int/ITU-T/studygroups/com13/ip/documents/IPprojV7.pdf](http://www.itu.int/ITU-T/studygroups/com13/ip/documents/IPprojV7.pdf)
- Next Generation Networks 2004 Project
  - [www.itu.int/ITU-T/studygroups/com13/ngn2004](http://www.itu.int/ITU-T/studygroups/com13/ngn2004)

# ITU-T Study Group 15

- Lead Study Group on Access Network Transport and related to the Optical Networking technologies
- Standardizes high-speed access over copper wire loops using Digital Subscriber Line (“DSL”)
- Standardizes optical access networks for delivery of broadband services
- Working on optical transport of Internet packets: IP over Wavelength Division Multiplexing (WDM), DWDM, CWDM
- Important work related to Fibre to the Home, SMEs

# ITU-T Study Group 16

- Lead Study Group on multimedia services and systems
- Produced Recommendations that are widely used in IP-based and other (including mixed) network architectures.
- Examples include:
  - standards for IP telephony (e.g., H.323 series)
  - modems (e.g., V.90, V.92)
  - audio and video codecs (e.g., G.723.1 and G.729 series, H.260 series)
  - H.248 “media-gateway” series for interworking between IP networks & PSTN

# ITU-T Study Group 16 cont'd

- H.264: advanced new video coding
  - MPEG-4 Part 10
  - half bandwidth requirement for same quality as MPEG-2 (e.g., used on DVD players)
  - Important for future streaming applications over IP-based networks and the Internet
- Emergency services
- Wideband voice codecs

# ITU-T Study Group 17

- Lead Study Group on frame relay (fast packet), communication systems security and language description techniques (e.g., ASN.1)
- Responsible for X.509; reference standard for authentication services using asymmetric cryptography and Public Key Infrastructure (“PKI”) services
- X.509 is widely used in digital signature technologies and for E-commerce on IP-based networks

# ITU-T Study Group 17 cont'd

- Some recent work:
  - X.85/Y.1321: IP over Synchronous Digital Hierarchy (SDH) Networks
  - New versions of frame relay standards offering improved support for IP networks
  - X.842: Information technology - Security techniques - Guidelines on the use and management of trusted third party services
  - X.843: Information technology - Security techniques - Specification of TTP services to support the application of digital signatures



# ITU-T Study Group 17 cont'd

- Security related activities, new work started in
  - Security management
  - Telebiometrics
  - Mobile security
  - [www.itu.int/itu-t/studygroups/com17/cssecurity.html](http://www.itu.int/itu-t/studygroups/com17/cssecurity.html)

# Special Study Group IMT

- ITU's IMT-2000 initiative is a cross-sector project with technology defined in interdependent set of ITU-R and ITU-T Recommendations
  - ITU-R standardized 3G radio transmission technology family:  
e.g. CDMA 2000, W-CDMA, TD-SCDMA
- Interworking with IP networks
- Interworking with other fixed networks
- Multimedia terminals and services
- Emergency and priority calls
- Geographic position/location services

# Telecommunication Development Sector (ITU-D)

- See [www.itu.int/itu-d/](http://www.itu.int/itu-d/)
- Director: Hammadoun Touré (Mali)
- Regulatory assistance and technical cooperation
- Many IP and Internet related initiatives
- Internet Training Centres Initiative for Developing Countries (partnerships with Cisco, Alcatel)
- Source of well-known telecommunication indicators reports and databases (used by World Economic Forum, World Bank, others)
- Regional and area offices (11)

# Telecommunication Development

## Sector cont'd

- Study Groups: a few “Questions” related to Internet Protocol networks:
  - 19/1: Implementation of IP telephony in developing countries
  - 12-1/2: Examination of broadband communications over traditional copper wires, taking into account certain aspects of technologies, systems and applications
  - 19/2: Strategy for migration from circuit-switched networks to packet-switched networks
  - 20/2: Examination of access technologies for broadband communications

# Examples of numerous ITU-D activities related to ICT networks

- Technical assistance, advice, case studies, national IP-based networks design consulting, symposia; a few examples:
  - South-South Cooperation and Cost-effective Access to the Internet in Africa (Cameroon, 15-17 July 2003)
  - IP Symposium for Africa (Rwanda, 7-9 July 2003)
  - ITU Symposium: African ICT Roadmap to Achieve NEPAD Objectives (Arusha, 1-3 April 2003)
  - IP Networking and IPv6 for Engineers working in PTOs in the framework of the Centre of Excellence (Mauritania, 19-23 May 2002);
  - IP Technologies and Applications for Arab region (Tunisia, 17-19 June 2002);

# ITU-D Regulatory Reform Unit (RRU)

- See [www.itu.int/ITU-D/treg/](http://www.itu.int/ITU-D/treg/)
- RRU organizes annual “Symposium for Regulators” allowing world’s policy makers and regulators to share country experiences
- Prepares annual reports on latest “Trends in Telecommunication Reform”

# Effective regulation and Internet case studies

- Country Case Studies on Effective Regulation
  - ITU Member States request information and models with regard to independence and operation of regulatory agencies
  - With assistance of Member States, ITU prepares and publishes case studies on how administrations established regulatory bodies and the results
  - Morocco, Peru, Botswana, Brazil, Singapore
  - See [www.itu.int/ITU-D/treg/Case\\_Studies/](http://www.itu.int/ITU-D/treg/Case_Studies/)
- Internet case studies show how countries have fostered deployment of IP-based networks
  - See numerous country case studies at [www.itu.int/spu/](http://www.itu.int/spu/)

# Strategy and Policy Unit (SPU)

Strategic research/workshops/reports (see [www.itu.int/spu/](http://www.itu.int/spu/))

- SPAM
- Internet Governance
- Shaping the Mobile Information Society
- Radio Spectrum Management for a Converging World
- Promoting Broadband
- Competition Policy in Telecommunications
- Improving IP Connectivity in the Least Developed Countries
- Trust in Critical Network Infrastructures
- Multilingual Domain Names
- 3G Licensing
- Broadband
- Fixed Mobile Interconnect
- IP Telephony
- Electronic Signatures and Certification Authorities



# Some ITU Internet Research Reports 1997-2004

- See <http://www.itu.int/osg/spu/publications/>
  - 2004: "Portable Internet" (Sept 2004)
  - 2003: "Birth of Broadband"
  - 2002: "Internet for a Mobile Generation"
  - 2001: Multilingual Domain Names
  - 2001: Internet Diffusion in South-East Asia
  - 2001: IP Telephony
  - 1999: Challenges to the Network: Internet for Development
  - 1997: Challenges to the Network: Telecommunications and the Internet

# Summary

- For the last 139 years, ITU has adapted to and embraced all new innovations in communications technologies
- Internet Protocol (IP) networks and the Internet, as well as their convergence with other kinds of networks, have major impact on ITU's activities
- The transition to the “Information Society” is fundamentally reshaping the ITU and how countries view telecommunications

Thank you

International  
Telecommunication  
Union

Helping the world communicate