Setting the scene:

- Major trends in ICT trends and their impacts on today′s regulatory framework

ITU-*info*Dev Executive Level Training for Regulators and Policy Makers, Hong Kong, China

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Overview

- Traditional regulatory framework
- Changes and disruptions
- Parameters driving Changes, innovations and disruptive technologies
- What are disruptive technologies? (interpretation of Clayton M. Christensen)
- Examples of innovations/disruptive technologies
- Technological trends: 3 waves of changes
- The Internet
- Mobile Communications
- Next Generation Networks
- Convergence and Converged services
- Conclusion

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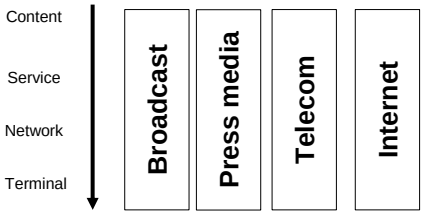
Traditional/current framework -Silo based

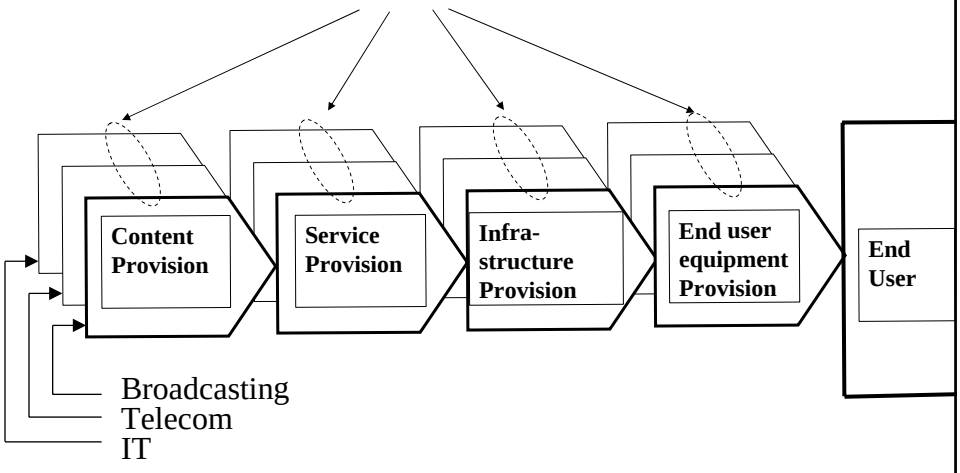
- Different technologies,
- Different sectors,
- Different industries
- Different markets
- Different regulations

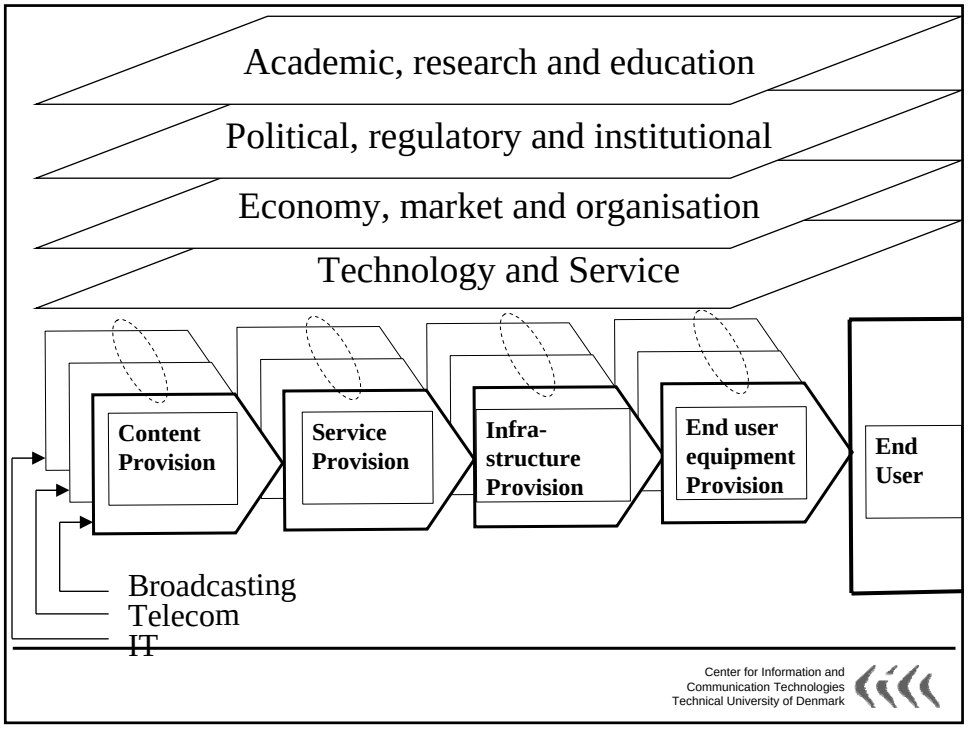


The Silo based framework is due to:

- Technology specific parameters
- Regulatory parameters

New/Future framework -Convergence




Academic, research and education
Political, regulatory and institutional
Economy, market and organisation
Technology and Service
Content Provision
Service Provision
Infra-structure Provision
End user equipment Provision
End User
Broadcasting
Telecom
IT
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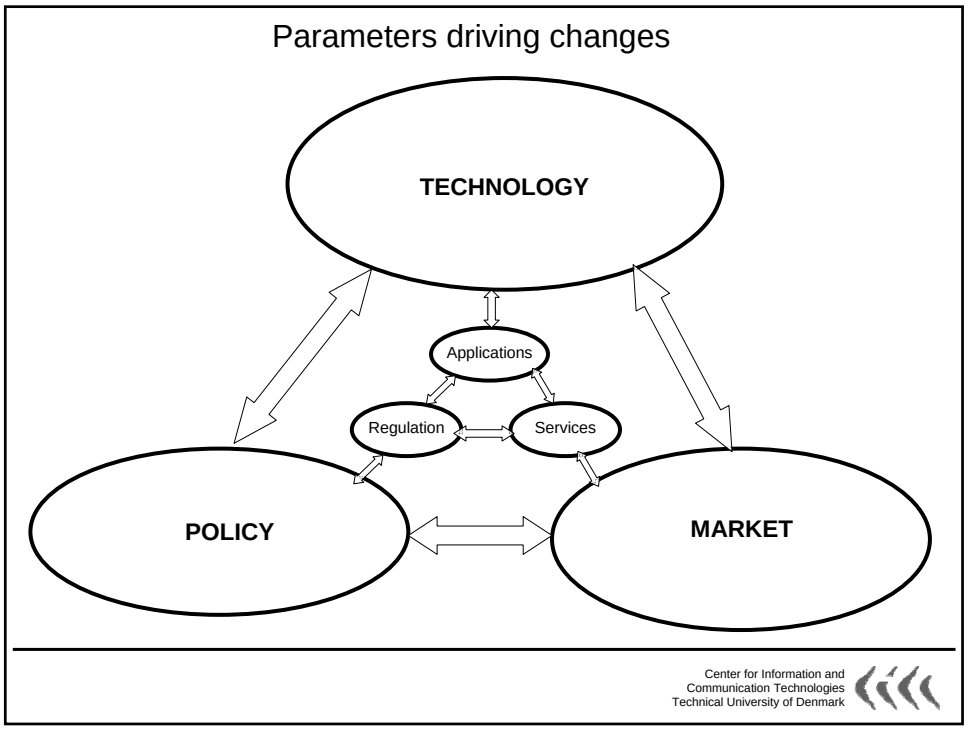
Parameters driving changes
TECHNOLOGY
Applications
Regulation
Services
POLICY
MARKET
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Disrubtive technologies (I)

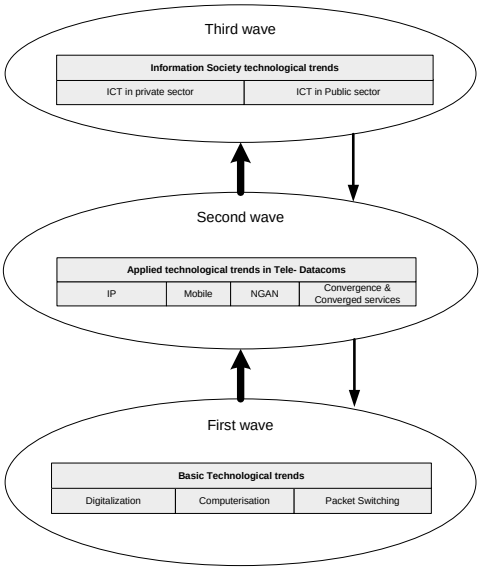
- (Christensen)

- Theses I
  - Sustaining and disruptive innovations
  - Sustaining as well as disruptive innovations can be both incremental and radical – it's a marketing challenge not a technology issue
  - A sustaining technology increases the quality, etc.
  - The products may become too sophisticated
- Theses II
  - Low-end disruptions and new-market disruptions: In both cases lower quality
  - No incentive for incumbents to enter these market segments – small markets and low margins
  - Also impossible to enter the market segment because of internal priorities
  - It's not a lack of technology capability but a market issue

Examples of 'disruptive' technologies

- IP
- Cellular telephony
- VoIP
- ADSL
- IPTV
- In other areas:
  - Digital cameras
  - Minicomputers
  - Linux

Technological trends



Key Technologies

The study has identified and examined specific key technologies. The following criteria were applied in selecting them:

- they must be important parts of the ICT technological change;
- they must significantly affect market conditions and, consequently, the conditions for regulation;
- they require changes from the current regulatory paradigm, either now or in the foreseeable future;
- they are affecting, or will affect, the fundamental cost structures and investment patterns in the ICT/ telecom sector;
- they must include infrastructure as well as applications, services and content oriented technology developments;.
- they must have direct implications for developing countries.

Selection of Technologies

six techno-economic ex-ante selectors:

- **Bandwidth**
- **Cost**
- **Scalability**
- **Flexibility**
- **Mobility**
- **Innovativeness**

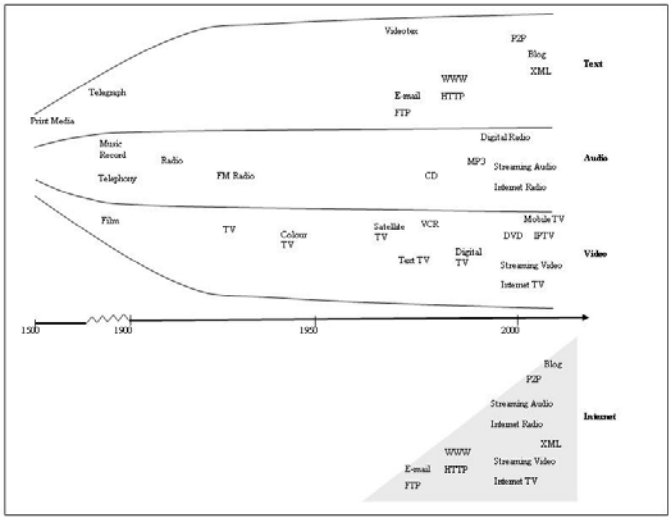
	Band width	Cost	Scala bility	Flexi bility	Mobi lity	Innova tiveness
The Internet		X	X	X		
Mobile		X		X	X	
NGN	X	X		X		
Convergence		X		X		X

The Internet

- In the beginning primarily used for
  - data services, E-mail and World Wide Web (WWW)
- Today:
  - a variety of audio/video services like Internet radio and TV, B-logs, computer games, etc
- Future:
  - 'Internet of things': RFID and 'sensor networks'
- Internet Protocol (IP) design principles
  - Separation between network technology and services
  - End-to-End architecture, and extension of intelligence from the core to the edge of a network
  - Scalability
  - Distributed design and decentralized control

Internet services

- Examples of Internet's impacts on media servcies



Mobile Technologies

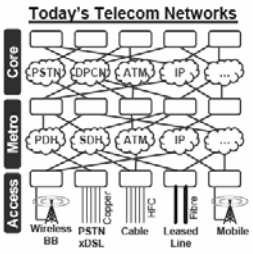
- First Generation: 1G
  - Fragmented analogue technology: The Nordic Mobile Telephone (NMT) Total Access Communication Systems (TACS) in the UK and Ireland, NMT-F and RC 2000 in France, NTT in Japan, Advanced Mobile Phone System (AMPS) in the US, C-450 in South Africa and C-Nets in Germany and Austria
- Second generation: 2G
  - Digital technology: less fragmented, dominated by GSM; co-existence with *TDMA IS-136* (North America); *CDMA IS-95(* South Korea); *Personal Digital Cellular* (PDC) (Japan)
- Evolution of 2G towards 2.5G
  - Two approaches: several time slots, HSCSD (High Speed Circuit Switched Data) & packet oriented IP based technologies like GPRS and EDGE
- Third generation: 3G
  - Driven by the lack of frequency resources in 2G. W-CDMA (Wideband Code Division Multiple Access) is the access scheme defined by the ITU as the main technical platform; NTT DoCoMo's FOMA network uses a special version of the W-CDMA standard. CDMA2000 is a direct evolution of the 2G CDMA systems and has provided a fast and easy path to 3G services

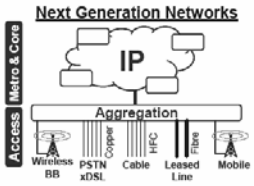
Future Mobile Technologies

- Beyond 3 G
- Software Defined Radio
  - a flexible radio architecture programmed through software, reconfigured depending on the usage scenario.
  - Consists of a programmable hardware base that is controlled through software, where different parameters, like power level, frequency band, modulation, etc. are changed/configured depending upon the environments in which users move
- Cognitive Radio
  - a technology making efficient use of unused spectrum, potentially allowing large amounts of spectrum to become available for future high bandwidth applications.
  - Most of today's radio systems are designed to operate in a specific frequency band.
  - A Cognitive Radio system senses and understands its local radio environment to identify temporarily vacant spectrum to operate in
  - Unlikely before 2010

Next Generation Networks (NGN):

- A specific network architecture and related equipments, with one common IP core network deployed for the entire legacy. Relates to the transition of current dedicated voice (and radio/TV) networks to the IP based networks:
  - Next Generation Core Network (NGCN)
    - the new switching, gateways and transmission equipments in the core network, enabling several access networks to use the same core network
  - Next Generation Access Network (NGAN)
    - new *access* networks, as deployment of optical fibers, and the associated challenges





NGAN: Fixed networks
- xDSL

- Main access technologies are **DSL** and **cable modem**. The broadband statistics in the last slide refer to these technologies.
- Main development tendencies for these technologies:
  - Extension of coverage
  - Increase in capacity per connection.
  - Unbundling
  - Bitstream access
- Competitive advantage to Cable TV
  - No service bundling with traditional TV services
  - High coverage

Technology	Maximum Downstream	Maximum Upstream
ADSL	8 to 10 Mbps	640 Kbps
ADSL2	12 Mbps	1.2 Mbps
ADSL2+	24 Mbps	1.2 Mbps
VDSL	52 Mbps	2 to 11 Mbps
VDSL2	*100 Mbps Plus*	*Undecided*

Mbps	ADSL	ADSL2+	VDSL
1.0	5,0 km	5,0 km	1,5 km
3.5	3,8 km	3,8 km	1,5 km
5.5	2,9 km	3,2 km	1,5 km
7.5	0,9 km	2,5 km	1,5 km
10	--	2,0 km	1,3 km
15	--	0,4 km	1,0 km

Source: TDC

NGAN: Fixed networks
- Cable modem & PLC

- Cable Modem
  - Bandwidth of 3.5 Gbps for a cable TV system (40 Analogue channels and 30 channels for DTV services)
  - Possibility for going up to 10 Gbps when new frequency spectrum is utilised
- PLC
  - Initial application: simple telemetering and control of electrical equipment
  - PLC advantage:
    - Availability of infrastructure in the households, No need for wireing
    - High bandwidth: started around 1 Mbitps but know 45 Mbps modems are available
  - PLC disadvantage:
    - Interference: The main problem of first generation technologies
    - Shared medium, so the capacity per user is not necessarily competitive with other broadband infrastructures
  - Many successful trails are carried out, and there are commercial provisions available, e.g., in Finland

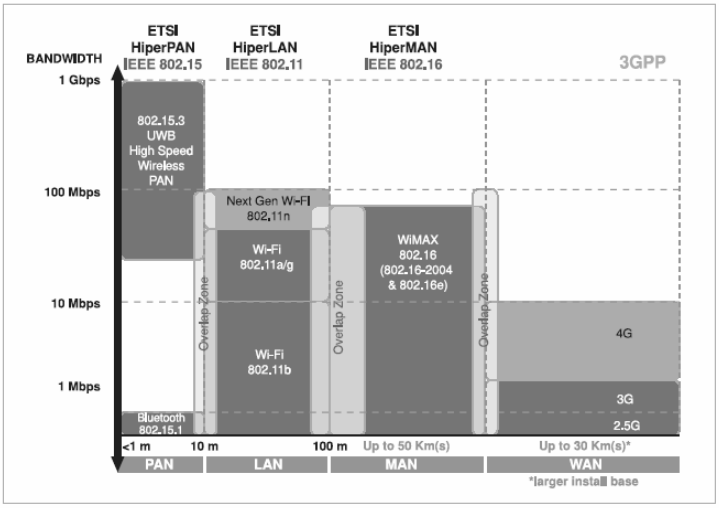
NGAN: Fixed networks
- FTTx

- Fibre has generally been used in the backbone of telecom networks
- Fibre comes closer and closer to the end-users.
- The technology has been there for long time. The precondition for the diffusion of the technology to residential market has been **services** and a **viable business model**
- Capacity is almost a 'non-issue' but of course high capacity has high cost
- In the current provisions of FTTH from energy firms, figures of 2 – 10 Mbps and up to 100 Mbps can be identified
- The main deployment of fibre is in the backbone network of the **new/alternative broadband operators**

NGAN Technologies
- Wireless

- WiFi
  - The IEEE 802.11b standard uses the unlicensed Industrial, Science and Medical (ISM) band. Absence of licensing barriers, the simplicity of the technology and cost effectiveness have resulted in rapid growth in both industrialized and developing countries. Indoor coverage is 50 to 100 meter and depending on the standard, bit rates are 11 to 54 Mbps
- WiMAX
  - the popular name of IEEE802.16 standard for fixed wireless access; it is expected to go mobile in 2008. Coverage of 50 Km and max capacity of around 70 Mbps; however, the capacity offered over long distances is only a fraction of the maximum capacity.
- Digital broadcast infrastructures
  - Digital broadcast standards are not worldwide standards and different markets apply to different standards: European DAB &DVB, US ATSC or Japanese ISDB standards. The main block of the Digital TV standards, namely video compression standard MPEG-2, is deployed in a majority of standards. Digital broadcast platforms will integrate elements from several different media, computers, telecommunications and broadcasting.

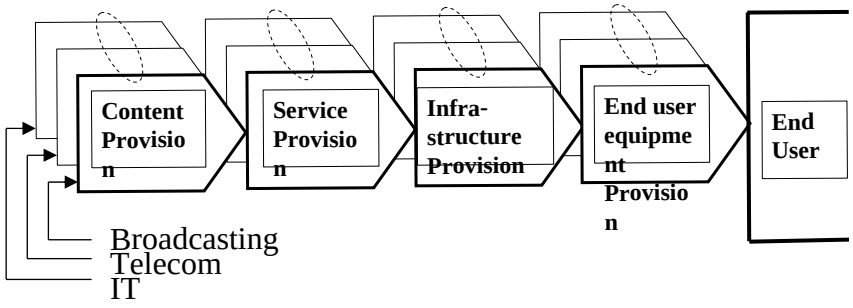
NGAN Technologies - Wireless



Source: Understanding Wi-Fi and WiMAX as Metro-Access Solutions, Intel, white paper

Convergence (I)

The same service on different networks & different services on the same network

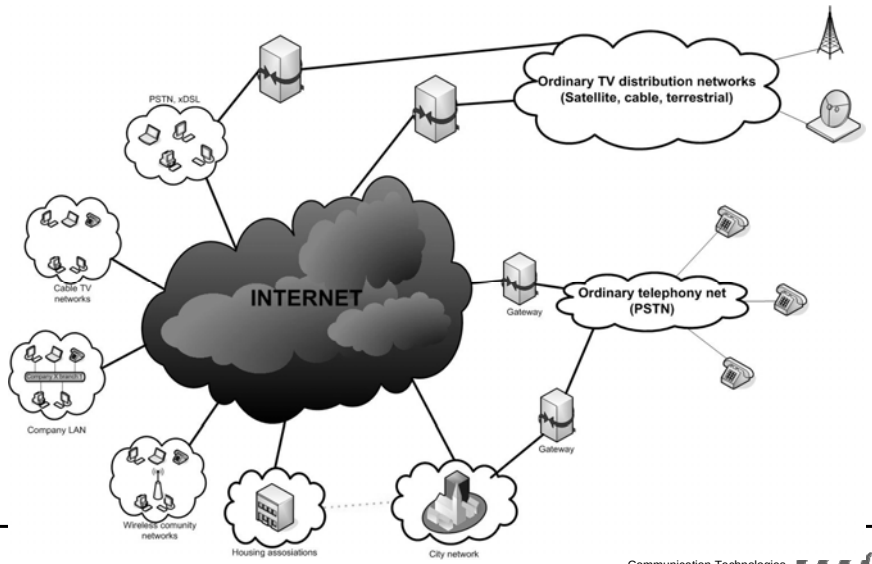


Convergence (II)

	Single Play -2000	Dual Play 2000-2004	Triple Play 2005-
FTTH			TV, Internet, Telephone
DSL	Internet	Telephone	TV
Cable	TV	Internet	Telephone
Wireless		Internet	TV, Telephone

Based on Henrik Clausen, IDC Telecom Conference 2006

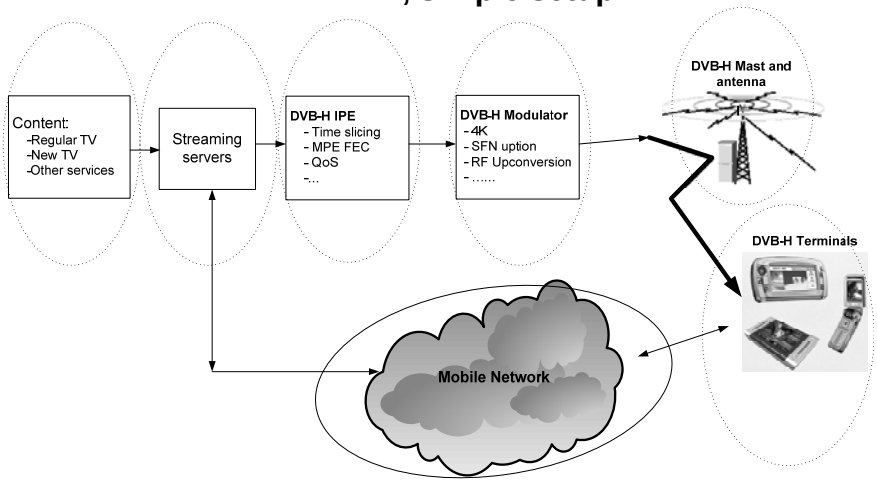
Convergence (III)



Converged mobile broadcast platforms (III)

- The mobile terminal has Interface to both broadcast and mobile networks
- The broadcast (TV) content is mainly delivered through Digital terrestrial broadcast networks
- Mobile networks are used to enable Interactivity, DRM, payment, etc
- Main Standards
  - DVB-H
    - European, Based on DVB-T
    - Huge interest beyond Europe
  - T-DMB
    - Promoted by Koreans but based on European DAB,
    - Interest in Europe to supplement traditional DAB
  - MediaFLO
    - Qualcomm's proprietary standard
    - Mainly In the US
  - ISDB-T
    - Mobile version of Japanese DTT standard

Converged Platforms (III)
- DVB-H, simple setup



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Convergence: Fixed Mobile

- A broad concept that covers various ways of integration of mobile and fixed - wired/wireless-technologies
- Drivers:
  - A high portion of mobile calls are done from home and office environment
  - The fixed operators are loosing voice minute - want to reallocate traffic from mobile to their fixed network.
  - Mobile networks have less data capacity - more efficient to connect to the fixed network when it is possible.
  - VoIP is getting momentum - integration of mobile telephony and VoIP over broadband increases competition on the Voice market.

Overview of Regulatory Implications

- Need for Unified Licensing
- Less demand for price regulation
- Facilitation of National Internet Access Points
- Internet Settlements: Developing countries become net contributors as services move to IP-networks
- Universal access challenged by VoIP
- Flexible and adaptive spectrum management a key for infrastructure development in rural areas.

Six Issues

- Technology developments affect the relevant handling of cross-cutting areas

1. **Sector specific and/or general competition regulation**
2. **Technology neutrality**
3. **Infrastructure vs. service competition**
4. **Cost based regulation**
5. **Regulatory set-up and business models**
6. **Quality of service**

Sector specific and/or general competition regulation

- The general aim is to create fair competition lift sector specific regulation
  - Three market oriented reasons for intervention in markets: Market failures, Social concerns, and Industrial policy
  - The present concern is centered on the level of competition
  - If a sufficient degree of competition has been attained specific regulations need not be applied

Technology neutrality

- The aim is to leave the choice of technology solutions to the companies in the markets
  - Technology neutrality implies that different technologies offering similar services has identical regulation
    - Exactly identical regulations may favor one technology over another
  - The discussion of technology neutrality is based on technology convergence
    - the concept has the policy aspect of limiting public intervention in technology development
  - The concept has implications on most regulatory issues in telecoms
    - Change enabling aspects of regulation has to be considered

Infrastructure vs. service competition

- Infrastructure competition is more sustainable than service competition
  - Speed in competitive development vs costs and duplication
    - The ladder 'theory'
      - a 'ladder' in the markets from service to infrastructure based competition?
  - Solution: support all kinds of competitive strategies and network expansion strategies
  - Consider the two forms of competition as complements
    - infrastructure and service markets are different market segments with different market players

Cost based regulation

- Two issues
  1. The development towards interconnection prices and end user prices based on costs
     - Facilitates the development of fair competition
       - Forward looking costs models: complicated
       - Simpler methods as cost and price comparisons with similar countries
  2. Using cost calculations as a basis for technology choices
     - Cost is an important parameter in technology choice and substitution
       - Cost information on different solutions can shape regulations as incentives to take up new technology solutions
         - Change enabling

Regulatory set-up and business models

- Increasing emphasis on promoting alternative, demand-led and cooperative telecom networks
  - Limits to the success of expanding telecom infrastructures by the activities of alternative, telecom operators
  - Open as many paths to network development as possible and refrain from controlling and restraining these developments
  - Telecoms have been dominated by large companies benefiting from economies of scale and scope and they will continue to play important roles
  - Regulations can promote alternative operators and more demand lead initiatives such as end user organized networks

Structuring Regulatory Organizations

- Convergence of telecommunication, IT, broadcasting and other media lead to ICT convergent regulators
  - Multi-utility regulators covering a larger range of infrastructure provision, e.g., telecom, energy, transport, water
  - Working relations between sector specific regulation and general competition regulation
  - Optimal organizational design of regulatory institutions depends on the specific national circumstances
- The regulatory organizations in developing countries are typically at an early formative stage
  - Weak organizations easily shaped to the new convergence developments with political will
  - Possibility for leapfrogging the institutional evolution

Conclusions (1)

- Regulatory activities and organisations must reflect the changing technology and market developments.
  - Good regulation can support growth and new technologies
  - Failing regulation can be a major barrier
  - Regulation has to adapt to the changing environments
- New Paradigm
  - Establish of an open and level playing field for
    - commercial companies
    - non-commercial,
    - community-based or end-user-organized network initiatives
  - Reflect
    - existing best practice
    - emerging technology and market developments

Conclusions (2)

- National developments in ICTs take place in a wider international context
- Different influence on the Three Wave technologies
  - Local and national policy initiatives play a significant, but different role in Second/ Third Wave
- The organisational aspects of regulation must be adapted to the changing technology and market developments in terms of scope and regulatory practices
  - Convergence lead to new technology solutions and the development of new market opportunities
  - Developing countries
    - Leapfrogging
    - Windows of opportunity
    - Lack of regulatory resources