INTRODUCTION TO CONVERGENCE

Rolland Vida

Department of Telecommunications and Media Informatics

vida@tmit.bme.hu

Convergent Networks and Services (VITMM156)

What do we mean by „convergence"?

- In the traditional "vertical silos" architecture different services are provided on different dedicated networks (mobile, wired, CATV, IP), sometimes by the same providers
    - Wired voice communication over the PSTN network
    - Mobile voice communication over the mobile networks
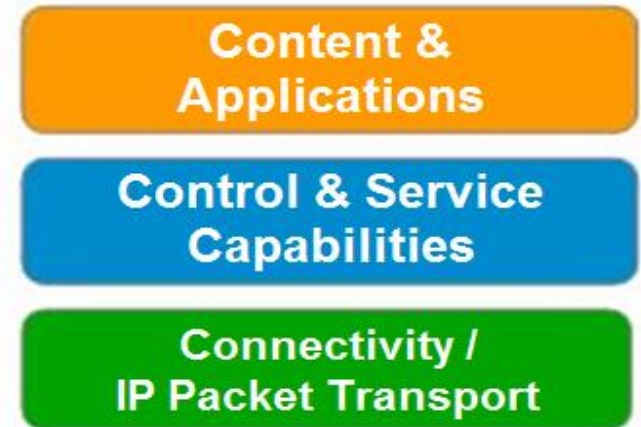   - TV programs over the Cable TV networks

Convergence

- In case of **convergence** the users can access different communication services in a transparent manner, over different networks and using different communication devices
  - Unified IP-based packet transport
  - Unified control and service management
  - The same content and services available to all the users

Spagetti vs. Lasagna

Spaghetti vertical silo integration

Fixed Line Network / Fixed Applications
Broadband Network / Broadband Application
Mobile Network / Mobile Applications

Lasagne horizontal service layer

Content & Applications
Control & Service Capabilities
Connectivity / IP Packet Transport

DSL, Cable, 3G, WLAN, Fibre, WiMAX

Types of convergence

- **Fix-mobile convergence (FMC)**
  - The integration of fixed and mobile technologies, to provide different broadband services , independently of the available access infrastructure

Mobility

- **Terminal mobility**
  - The ability of a telecommunication device to continue the communication after a handover
  - The same device (notebook, phone) is used at home, in the office, abroad, during travel
  - The network is capable to identify the device and detect its capabilities
- **User/Personal mobility**
  - The user identification is ensured independently of the access point and the terminal
  - E.g. WebMail
  - Based on identification of individuals
- **Service mobility**
  - The service can be interrupted and resumed on a different device
    - E.g. redirecting a call from a mobile to a landline phone
- The definitions of mobility are orthogonal to each other
  - Full mobility is achieved if all the three are available

Definitions related to mobility

- Handover
  - The change of access point of a mobile terminal
- Horizontal handover
  - Handover between two access points using the same technology (and provider)
  - E.g. between two WLAN APs (access points)
- Vertical handover
  - Handover between two access points using different technologies
  - E.g. WLAN –UMTS
- Seamless mobility
  - Handover without discontinuity of connection and service
- Nomadicity
  - Handover keeping the full service environment
  - E.g. Virtual Home Environment
- Roaming
  - Connection is provided through a third party provider based on agreements between the providers

FMC types

- **Commercial Convergence**
  - Using the same marketing and administrative staff of a company for both its fixed and mobile network and services
  - Organizational restructuring
- **Service Convergence**
  - Providing fixed and mobile services in one package independently of the technical solution of service provisioning
  - Subscription, authentication and billing are provided in a unified way
- **Network Convergence**
  - The same physical infrastructure is used to provide fixed and mobile services (in the access part of the network)
- **Terminal Convergence**
  - The same terminal could be used to access the services provided through different access technologies (Fixed/Wireless/Mobile)
- **Legal and Regulatory Convergence**
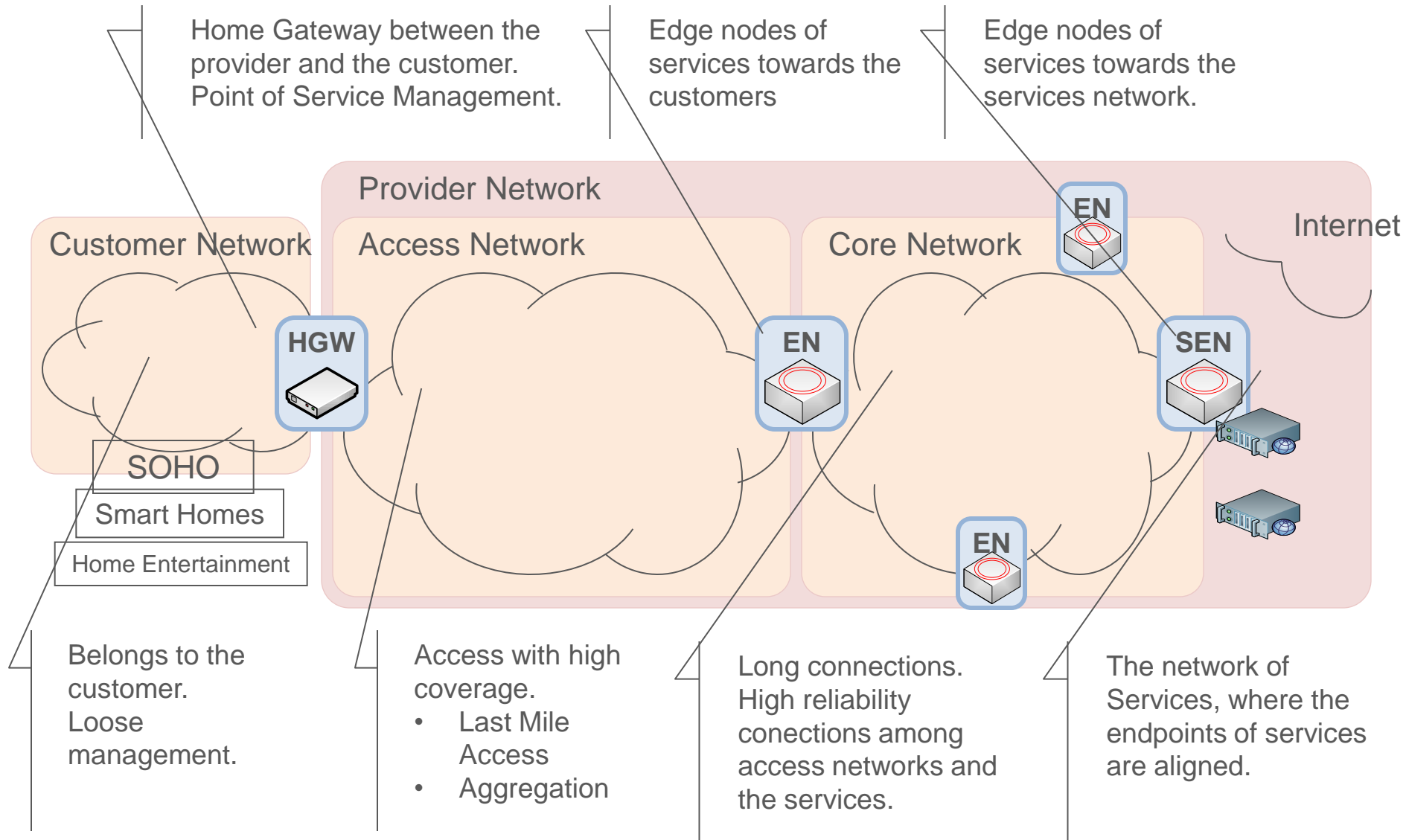 - Unified, technology independent regulation

Types of convergence

- **Three Screen Convergence**
  - TV, PC/laptop, smartphone
- Providing the same service on different devices (screens)
  - Different resolution, different transfer speeds, over different access networks

Convergent **Networks** and Services

- Networks
  - Internet
    - „Networks of networks", connection among networks
    - Free world
    - Distributed operation
    - Low network „intelligence"
    - No unified management
    - No guarantees (Best Effort)
  - Provider networks
    - Controlled world
    - Centralized
    - Unified management solution
    - Guaranteed services

Architecture of Provider Networks

Home Gateway between the provider and the customer. Point of Service Management.

Edge nodes of services towards the customers

Edge nodes of services towards the services network.

Provider Network

Customer Network

Access Network

Core Network

EN

Internet

HGW

EN

SEN

SOHO

Smart Homes

Home Entertainment

EN

Belongs to the customer. Loose management.

Access with high coverage.
- Last Mile Access
- Aggregation

.

Long connections. High reliability conections among access networks and the services.

The network of Services, where the endpoints of services are aligned.

Convergent Networks and **Services**

- Services
  - Any solution, function, available to the networking entities
    - Application Services
    - Network Services

- Application Services
  - User Services
    - Voice, video, data services
  - Business services
    - VPN (Virtual Private Networks)

- Network services
  - Services provided by the network itself

Network services

- **Traffic separation**
  - Different subscriber / application flows are separated from each other
- **Quality of Service**
  - Providing special treatment, quality of service to certain flows
- **Operation, Administration, Maintenance (OAM)**
  - Operating, administrating and managing the different networking entities (routers, switches, servers, etc.)
- **Scalability**
  - How can a given network and its services cope with the increasing requirements (number of users, number of flows, etc.)
- **Availability & Reliability**
  - Reliability at different levels (network connections, service quality, service availability) influencing the QoE (Quality of Experience)

Multi-play Services

Muli-play Services

BME/TMIT
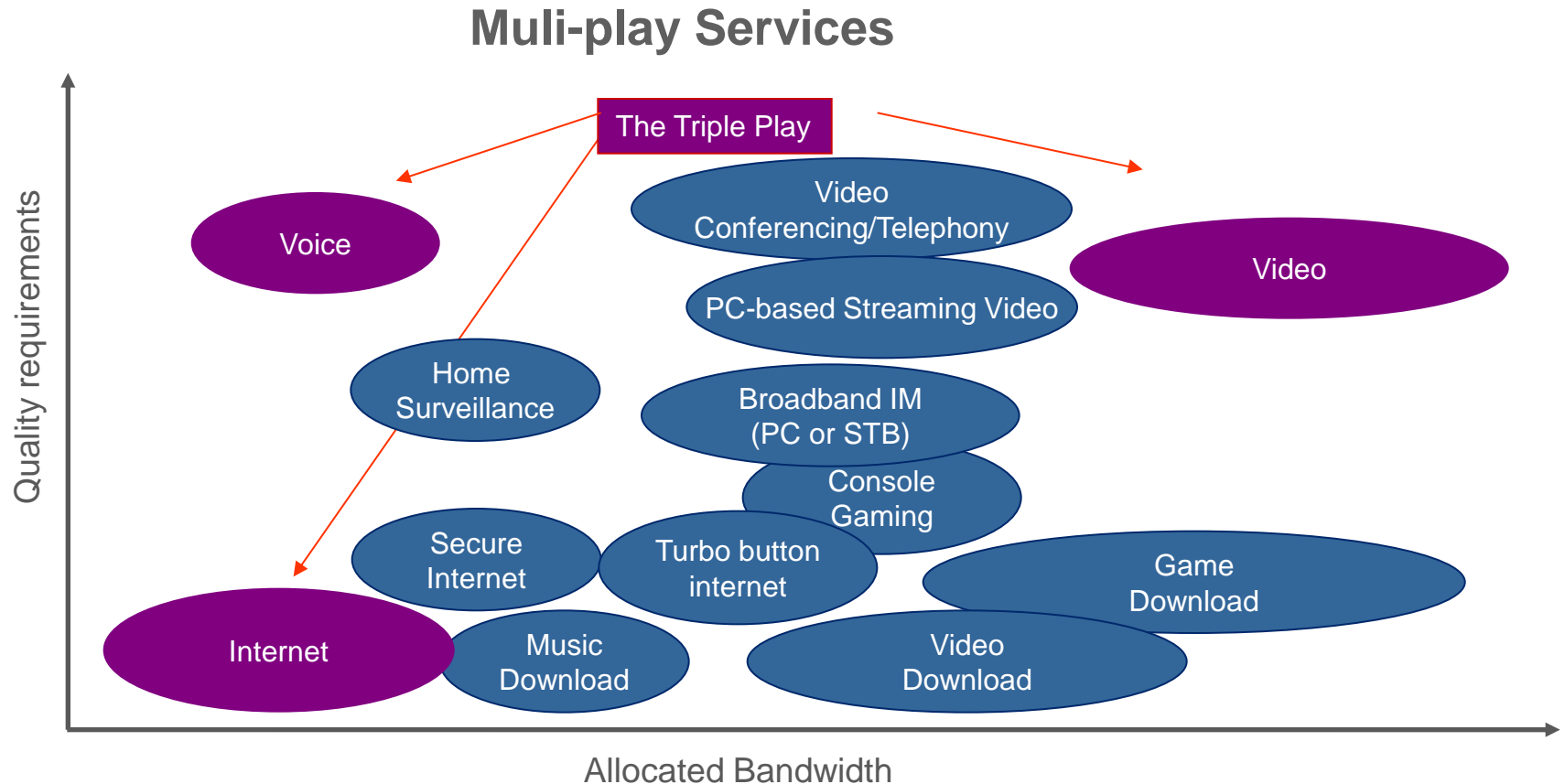
NGN

- **NGN – Next Generation Networks**
- Two explanations
  - A marketing term, that always changes its meaning
    - Everyone understands something else, „next generation" is relative to what was before…. (similarly to the term „broadband")
      - The 20th NGN Conference

      - 20 years ago „next generation" meant something else than today
  - A concept of a future network, whose details are constantly changing
    - An evolving set of standard for the networks of the future
    - Providing voice, data and multimedia services over packet switched networks

The initial NGN

- The NGN conference was started 25 years ago by BCR
  - http://www.bcr.com/

- „Netheads" vs. „Bellheads"
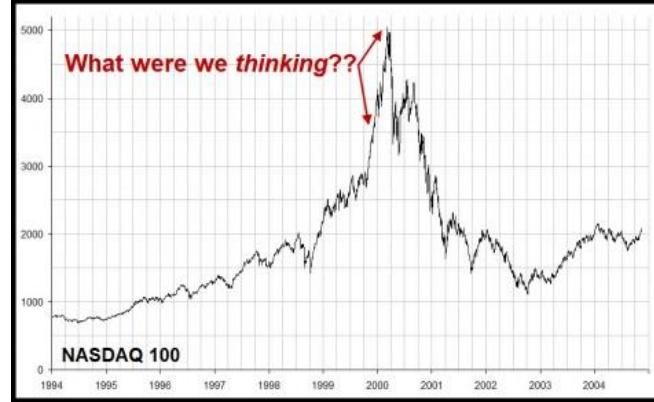 - Nethead – People believing in the power of the Internet and packet switched networks

  - Bellhead – Telco people, believing in circuit sw networks

- The NGN conference was the meeting place of „netheads"
  - They could make joke about the PSTN (Public Switched Telephone Network) providers, who do not recognize the significance of IP and packet switched networks

BME/TMIT

The initial NGN

- Changes in 2000
  - After the explosion of the dot-com bubble, only the incumbent carriers got enough money to survive on the market
  - NGN-believer manufacturers, who up until now calculated with the exponential growth of the Internet and the related profits, had now to pay attention to the needs of the telecom providers
- New faces appeared in the NGN world
  - Incumbent PSTN service providers, mobile operators, Cable MSOs – Multi Service Operators
  - They have also recognized, at their turn, that future networks will be IP-based
    - The Internet has won the race against the PSTN

The „new" NGN

- For the traditional PSTN and mobile operators, the Internet was a significant „threat"
  - Fewer and fewer PSTN subscribers
  - The number of mobile subscribers increased significantly, but the penetration was near to its limits
  - IP networks gained space, the competition became tougher
    - Voice transfer is just one of the many services on the Internet
- How to migrate the circuit switched voice service to the IP-based core network?
  - In a transparent manner
  - Keeping all the important characteristics, services
- The infrastructure had to be changed
  - More efficient support of the multimedia and content distribution services

BME/TMIT

The „new" NGN

- A Voice over IP (VoIP) infrastructure, to support as many PSTN services as possible
  - Emergency calls (911)
  - Helping the deafs and those with speech disabilities
    - TDD (Telephone Device for the Deaf), TTY (TeleTYpewriter)
  - Ensuring legal interception of the conversations
  - Privacy and data security
  - Ensuring precedence/pre-emption in case of emergency
  - Protection against fraud
- Calls between operators
  - Charging issues still to be discussed

NGN standardization

- International standards to facilitate the migration

  - International Telecommunications Union (ITU) Study Group

  - Alliance for Telecommunications Industry Solutions (ATIS)

  - 3rd Generation Partnership Program (3GPP)

  - 3rd Generation Partnership Program 2 (3GPP2)

  - European Telecommunications Standards Institute Telecoms & Internet converged Services & Protocols for Advanced Network (ETSI TISPAN)

  - Internet Engineering Task Force (IETF)

  - Fixed Mobile Convergence Alliance (FMCA)

  - Open Mobile Alliance (OMA)

  - American National Standards Institute (ANSI)

  - CableLabs

  - Multi Service Forum

ITU-T definition

- ITU-T (International Telecommunications Union –for Telecommunication Standardization Sector)
  - NGN Focus Group
  - NGN-GSI (NGN Global Standard Initiative)

- A Next Generation Network (NGN) is a packet-based network able to provide services including telecommunication services and able to make use of multiple broadband, Quality of Service-enabled transport technologies and in which service-related functions are independent from underlying transport-related technologies. It offers unrestricted access by users to different service providers. It supports generalized mobility which will allow consistent and ubiquitous provision of services to users.

- ITU-T Recommendation Y.2001

NGN layered architecture

Service layer
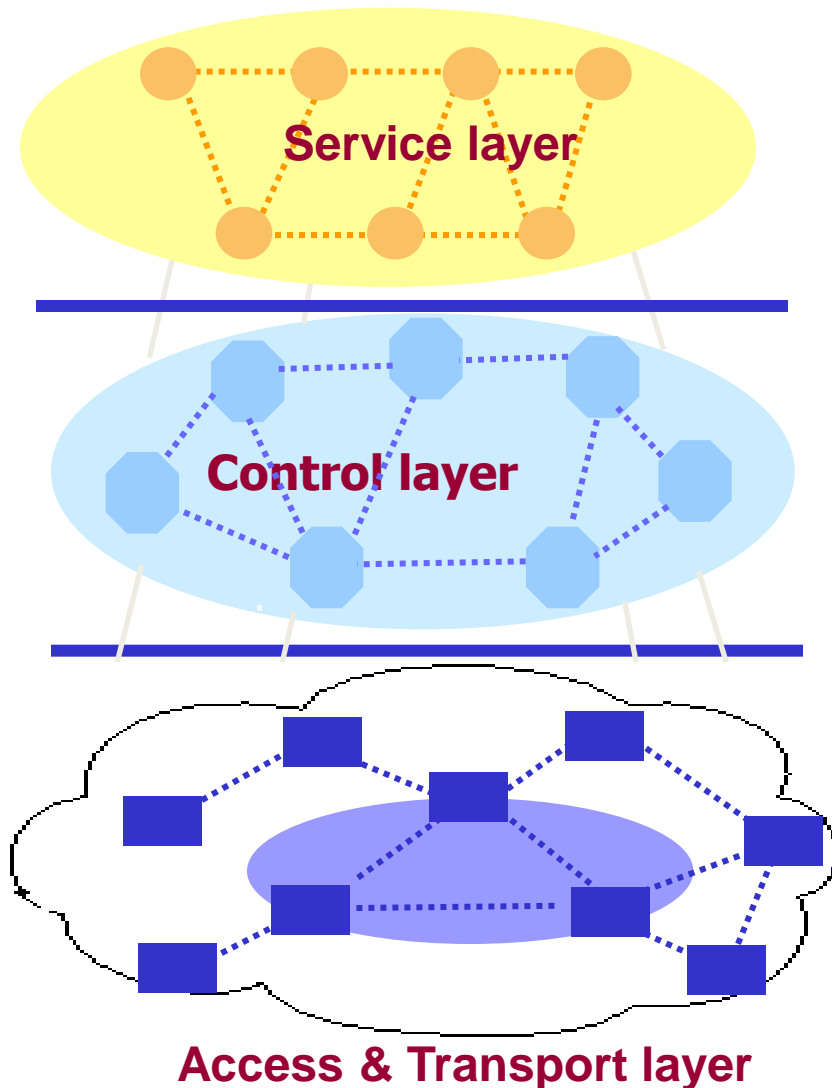
- Voice/video conferencing
- Directory/policy services
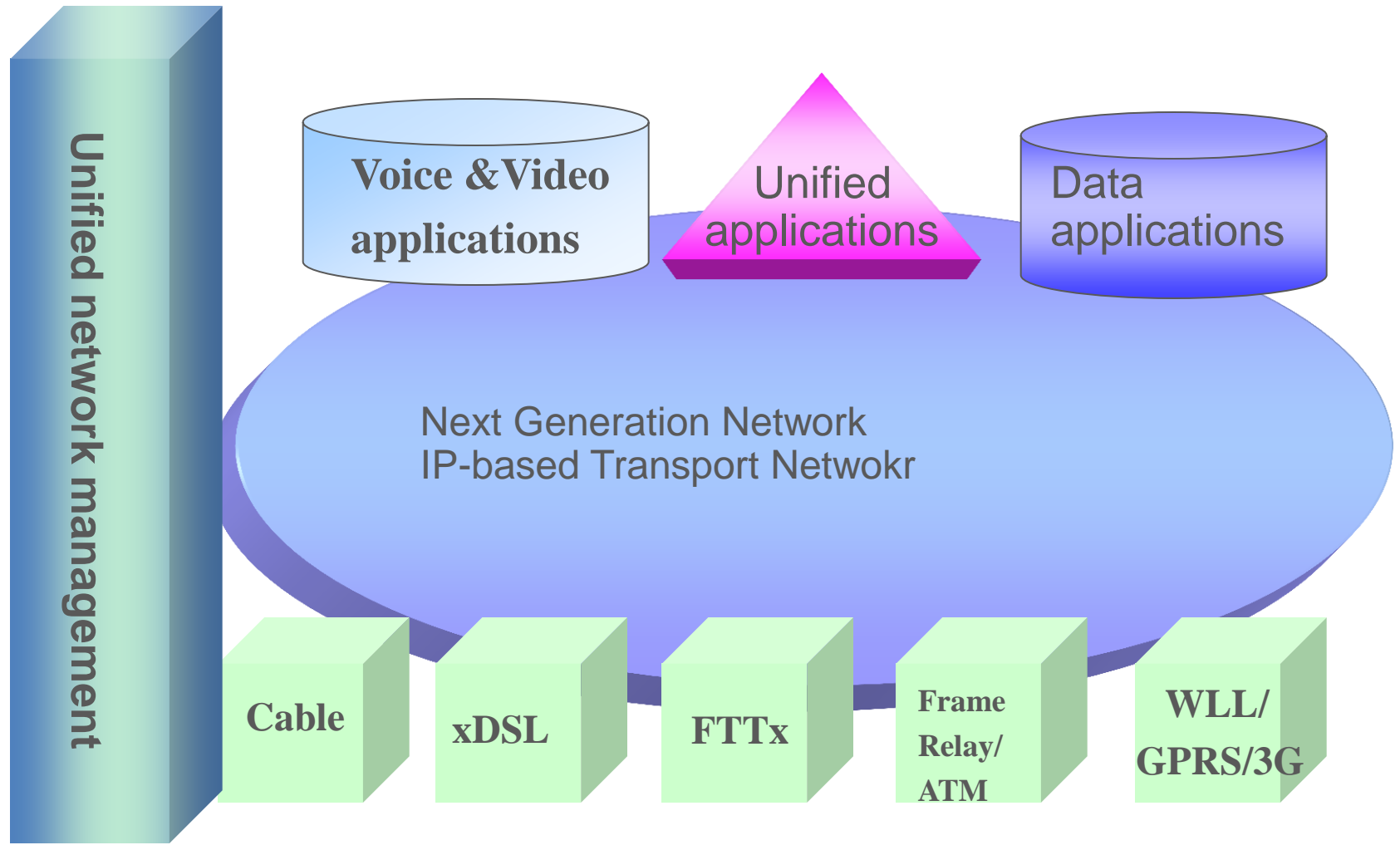- VPN (Virtual Private Network)
- Personalized services

Open interface

Control layer

- Call/connection control
- Authentication, Authorization, Accounting
- Resource management

Open interface

Access & Transport layer

- Universal access
- Switching and routing
- Quality of Service (QoS) support
- Large bandwidth, reliability

IP-centric convergent network

Unified network management

Voice & Video applications

Unified applications

Data applications

Next Generation Network
IP-based Transport Netwokr

Cable

xDSL

FTTx

Frame Relay/ ATM

WLL/ GPRS/3G

IP vision: IP over all, all over IP

BME/TMIT

NGN motivation

- Some say that the NGN is pushed by ITU-U just to gain attention again
  - For years it was the most important standardization body
  - With the emergence of the Internet it has lost that position to IETF
    - TCP/IP (IETF) vs. OSI (ITU-T & ISO)
    - SIP (IETF) vs. H.323 (ITU-T)
- Others argue that the Internet need significant improvements
  - Proliferation of cybercrime, spam, phishing, the Internet is vulnerable due to many of its architectural characteristics
    - Providers want to have a stricter control of the subscribers
- The NGN fits well the business model of the providers
  - If they provide content and applications directly to the users, they can control the competition
  - Best-effort transport and third party services (e.g., P2P) will still exist
    - The service providers will be able to provide their own multimedia services with QoS guarantees, gaining thus an advantage over third-party services

NGN/IMS vs. P2P/Skype

- The NGN/IMS architecture reflects the opinion of service providers and manufacturers
  - Their own multimedia services, unified control layer, over different access technologies
  - Intelligent network, content at the provider
- **P2P philosophy** – intelligence and content at the end userl
  - The network is just a bitpipe
  - Skype – P2P VoIP service, without SIP
    - Hundreds of million of users
    - Handling more than 8% of long diatnce calls in the world
    - P2P-based NAT traversal, P2P-based signaling
  - File sharing – Kazaa, BitTorrent
    - Serious competitors of the content providers
    - Mostly for video on demand (VOD) services
      - Why should I pay to download from a VOD server, if I can have it for free?
      - DRM – Digital Rights (Restriction ?) Management
  - The NGN/IMS (yet) in advantage in case of interactive, real time content
    - A football game has to be watched live, even if you pay for it
    - P2P Streaming Internet TV – based on BitTorrent

The evolution of networks and services

The obvious limitation is the speed of the access networks

Network capacity

Mbps

1,200,000 Mbps
2,400 Mbps
155 Mbps
2 Mbps
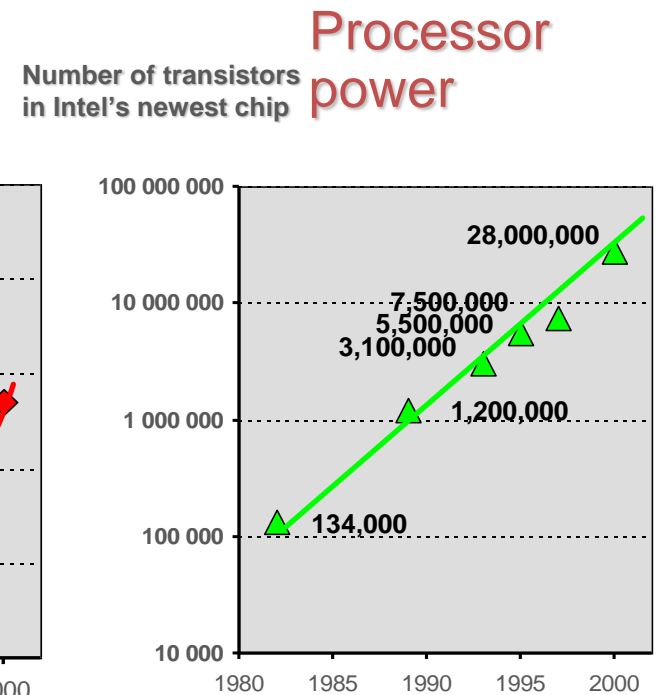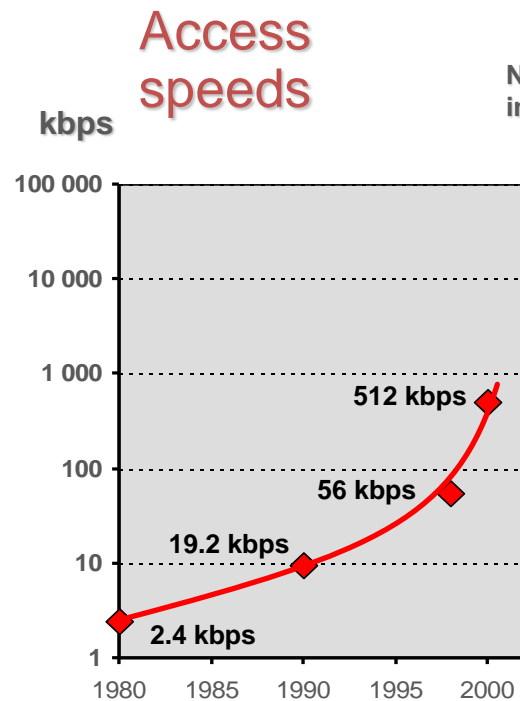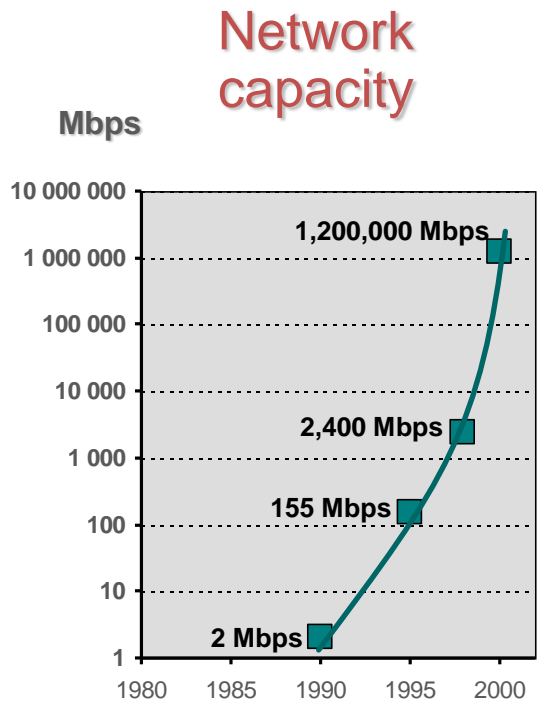
Optical backbone Doubles each 9 months

Huge increase in the transfer capacities

Access speeds

kbps

512 kbps
56 kbps
19.2 kbps
2.4 kbps

The "First mile" Is the bottleneck

Processor power

Number of transistors in Intel's newest chip

28,000,000
7,500,000
5,500,000
3,100,000
1,200,000
134,000

"Moore's law" Doubles each 18 months

Huge increase in the generation and processing of information

NGN requirements

- The NGN multimedia services require a large bandwidth
    - Over all types of access networks
        - Wired, fixed wireless and mobile
        - Otherwise FMC and vertical handovers cannot be ensured
    - At least 100 Mbit/s downlink and/or uplink speeds
        - HDTV, videoconferencing, games, etc.
- The evolution of the access networks today can already (at least partly) ensure this