ITU / BDT regional seminar

Network Planning for the CEE, CIS and Baltic

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Network Layers, Architectures and Technologies

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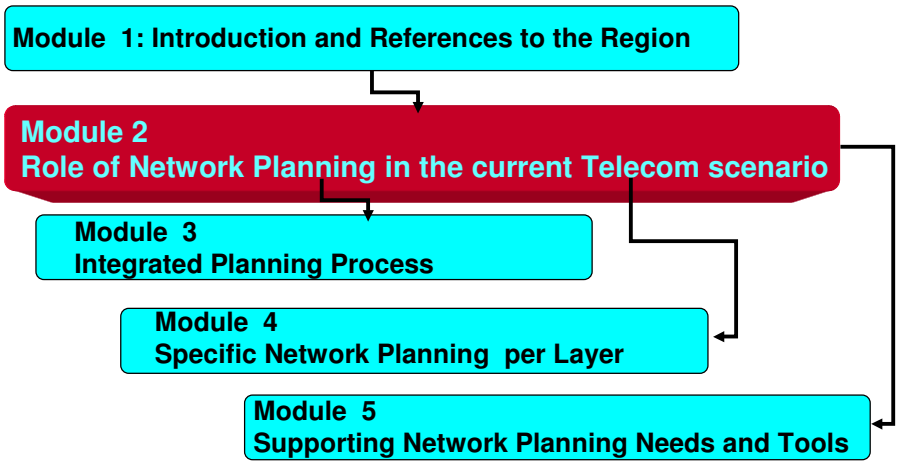
BDT workshop on Network Planning



Content Chapter 2.4

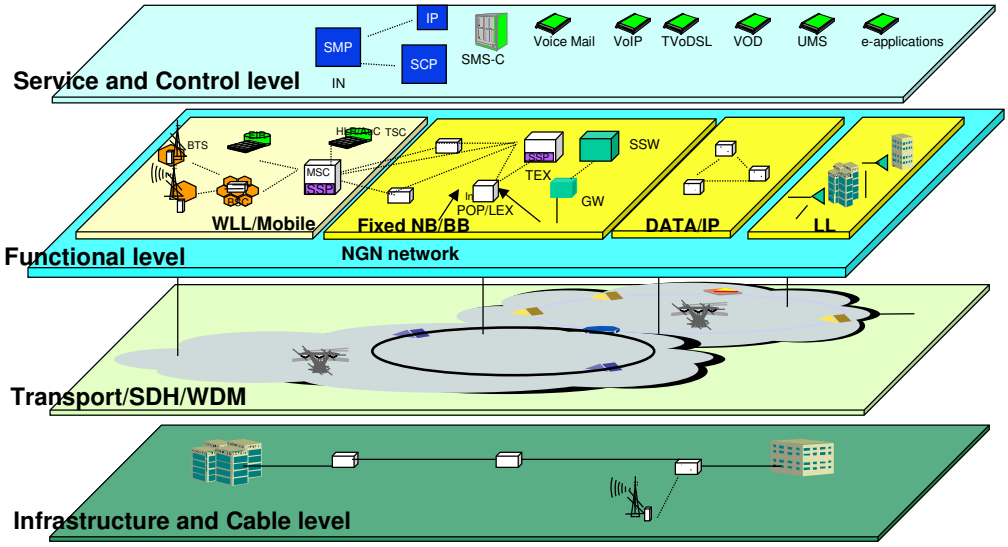
Network Architectures and Technologies

- **Modeling of the network by layers and segments for planning purposes**
- **Technology alternatives for today´s telecom networks**
- **Access and Core architectures and solutions**
- **NGN: What and how**

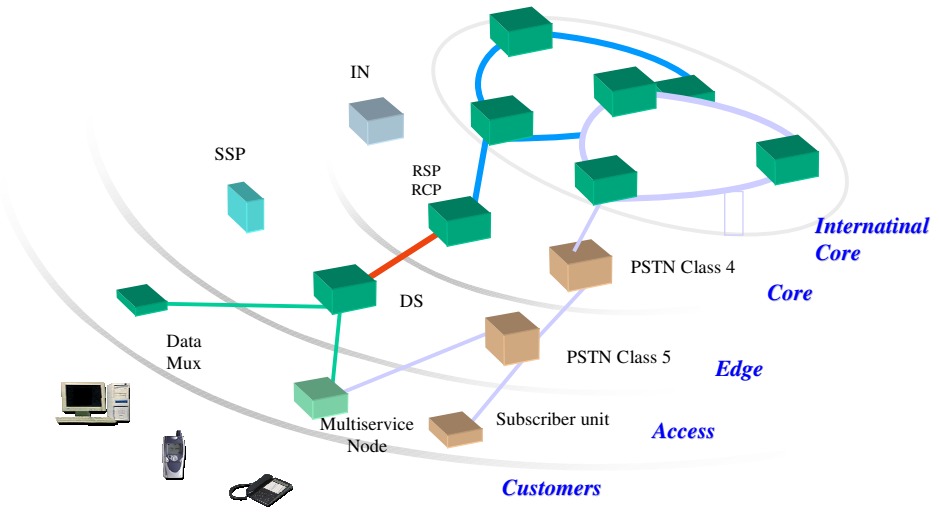
Network Architectures and Technologies: Network Modeling

- **High complexity of the whole Network requires a modeling and splitting in subnetworks to facilitate analysis and design.**
  - By Layers in a vertical dimension following the client-server relation (one layer is suppoorted in the layer below and provides resources for the layer up). Physical, Transmission, Switching, etc.
  - By Segments or splitting of the end to end communication into subareas as customer premises, access, core national, core international
  - By Technologies or underlying technique as PDH, SDH, PSTN, ATM, IP, GSM, etc.....
- **Network Planning follows the same splitting or partitioning to allow treatment of the problems and adaptation to associated**

Network Architectures and Technologies: Network Layer Modeling

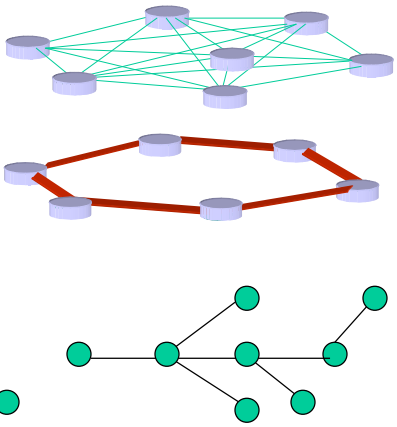


Network Architectures and Technologies: Network Segment Modeling



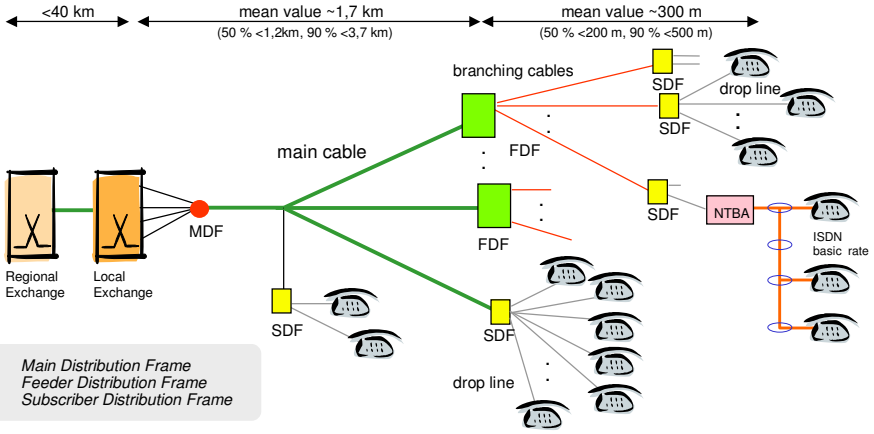
Network Architectures and Technologies: Topologies

- **Meshed (direct connection among nodes)**
  - Fully (for all network nodes)
  - Partial (with limited connectivity)
- **Ring**
  - Single, Multiple, Folded
- **Star**
- **Tree**
- **Linear**
- **Combined**



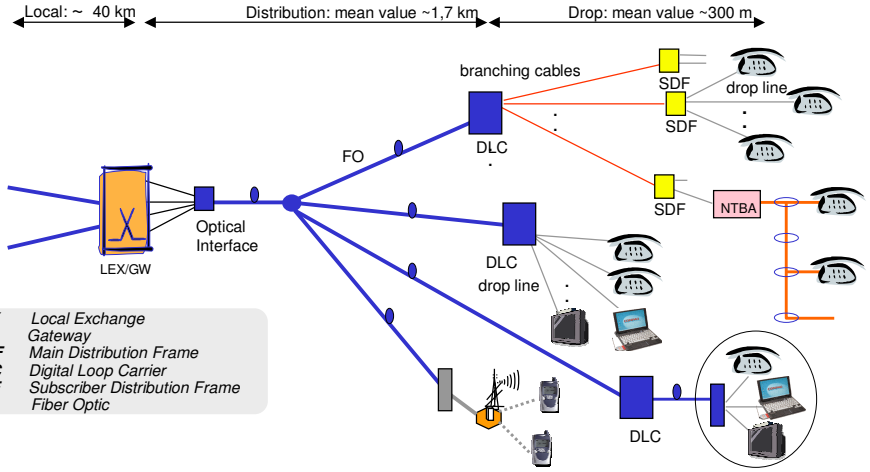
Access Network Architecture: Wireline

Typical Access Network structure: (clasical)

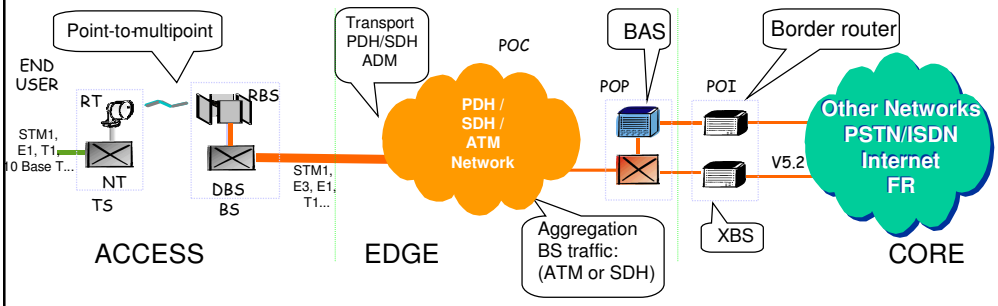


Access Network Architecture: Wireline Evolution: FTTx

Typical Access Network evolution towards BB and Convergence



Access Network Architecture: LMDS

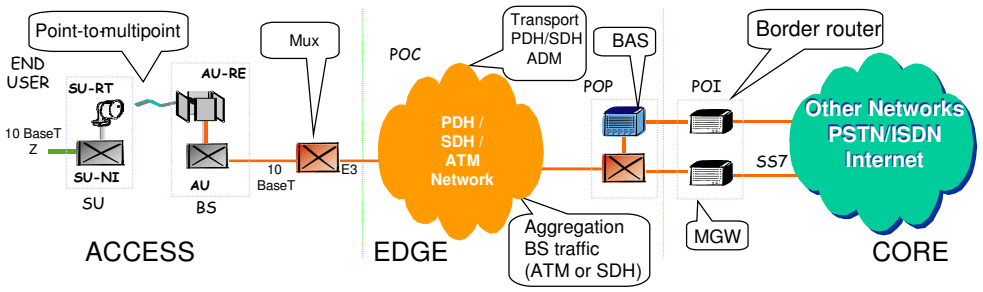


RT: Radio Termination
NT: Network Termination
TS: Terminal Station

BS: Base Station
DBS: Digital Base Station
RBS: Radio Base Station
XBS: Exchange Base Station

POC: Point of Concentration
POP: Point of presence
POI: Point of Interconnection
BAS: Broadband Access Server

Access Network Architecture: WIP



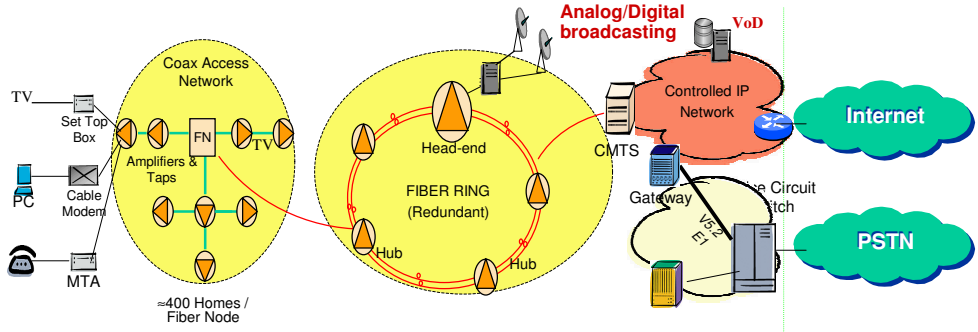
SU: Subscriber Unit
SU-RT: Subscriber Unit Outdoor Unit
SU-NI: Subscriber Unit Indoor Unit

BS: Base Station
AU: Access Unit
AU-RE: Radio Front-end
MGW: Media Gateway

POC: Point of Concentration
POP: Point of presence
POI: Point of Interconnection
BAS: Broadband Access Server

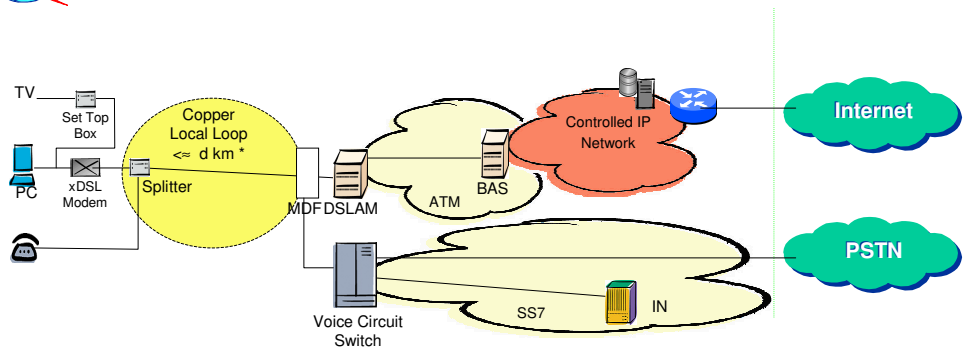
Note: The current Network description shows the ATM approach (BAS is needed). A fully IP scenario is also feasible (BAS is not needed)

Access Network Architecture: HFC



MTA: Multimedia Terminal Adapter
FN: Fiber Node
CMTS: Cable Modem Termination System
VoD: Video on Demand
IN: Intelligent Network

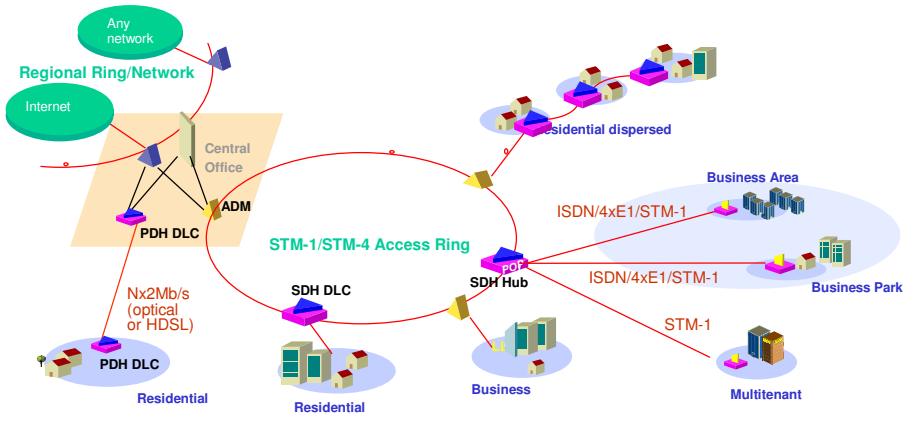
Access Network Architecture: xDSL



* Bandwidth/distances per solution
ADSL: up to 8 Mbps/800 kbps d <= 3 km
ADSL plus: up to 8 Mbps/800 kbps d <= 4.5 km
SHDSL: up to 2.3 Mbps symmetric d <= 1.8 km
VDSL: up to 52 Mbps Assym/ 26 Mbps Sym d <= 300m
(In all cases, higher distances imply less bitrate following bandwidth shape curve)

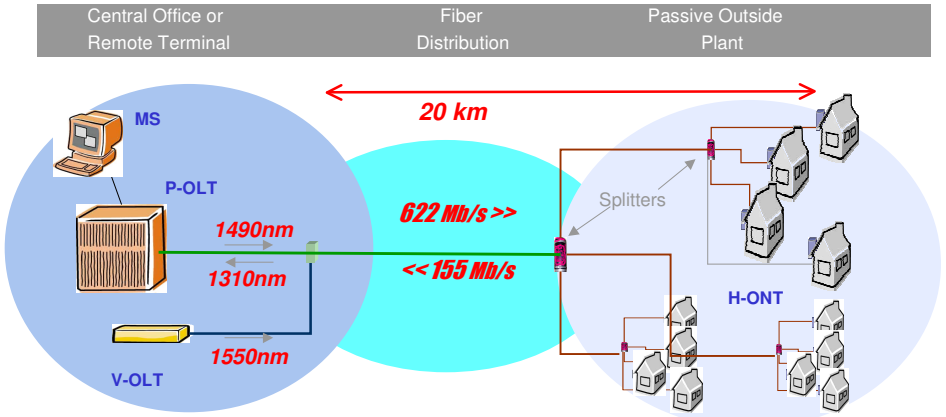
MDF: Main Distribution Frame
DSLAM: Digital Subscriber Line Access Multiplexer
IN: Intelligent Network
BAS: Broadband Access Server

Access Network Architecture: Multiservice DLC



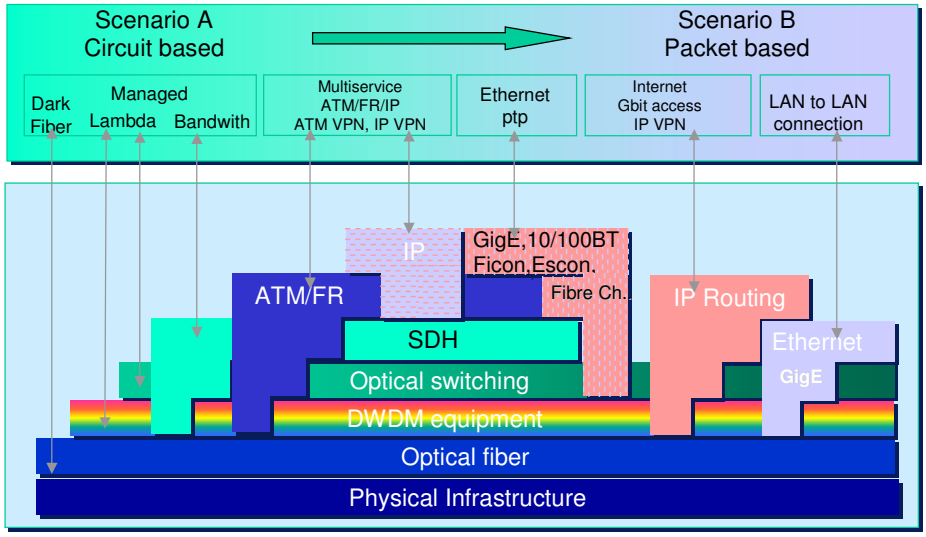
DLC:Digital Loop Carrier

Access Network Architecture: FTTU

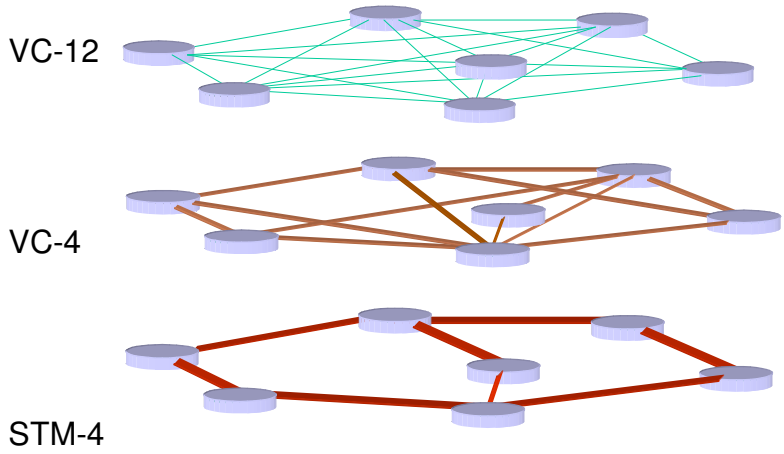


FTTU:Fiber to the User
ONT: Optical Network Termination
OLT: Optical Line Termination

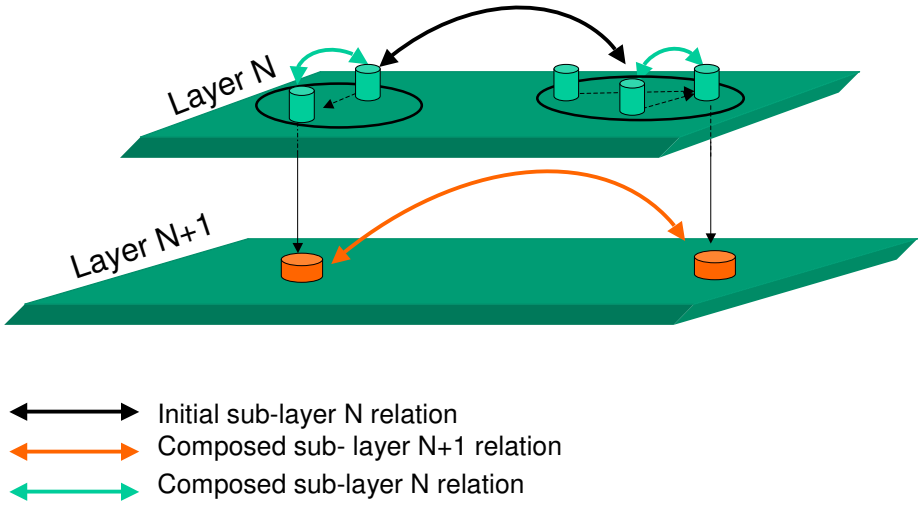
Network Architectures and Technologies: Technological alternatives at core



Multi-Layering in Transport Networks: Sub-layer relations

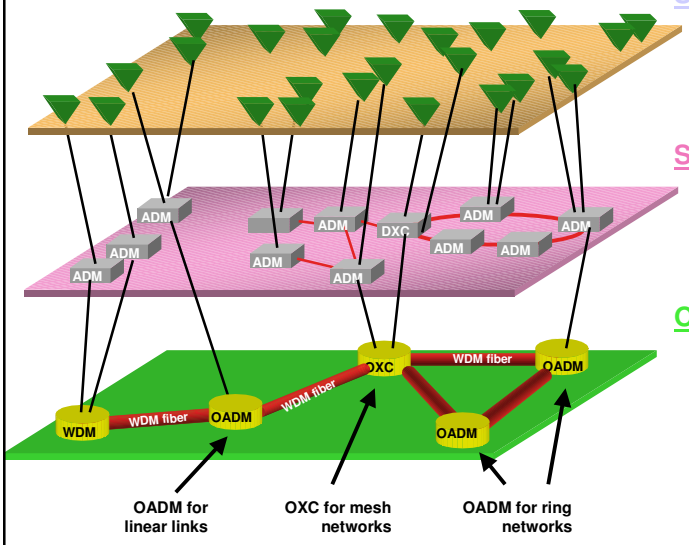


Multi-Layering in Transport Networks: Sub-layers composition



Initial sub-layer N relation
Composed sub- layer N+1 relation
Composed sub-layer N relation

Multi-Layering in Transport Networks: Introduction of WDM



Services Layer

Delivery of services to end users

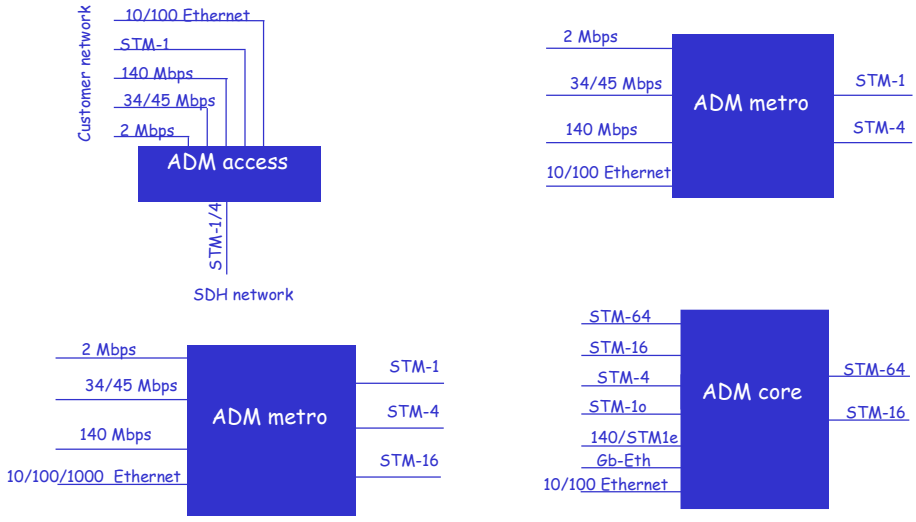
SDH/SONET Layer

High-speed protection and restoration
Time division multiplexing
Time slot grooming

Optical Layer

Wavelength division multiplexing
High-level protection and restoration
Dynamic transport reconfiguration

Transmission Network Architecture: ADM Network Elements



Network Architectures and Technologies: Trends in Transport Technology

TODAY		TOMORROW
Point-to-Point DWDM for backbone capacity	→	Intelligent Optical Networks for end-to-end service
Predetermined Bandwidth Re-allocation	→	Fast and efficient On-demand bandwidth
Network Design Specific to Type of Service Provided	→	Multi-Service Optimized Network (IP/ATM/TDM)
Protection Provided Mainly by Sonet/SDH Layer	→	Optical Layer Protection • independent of service type • adaptable to class of service

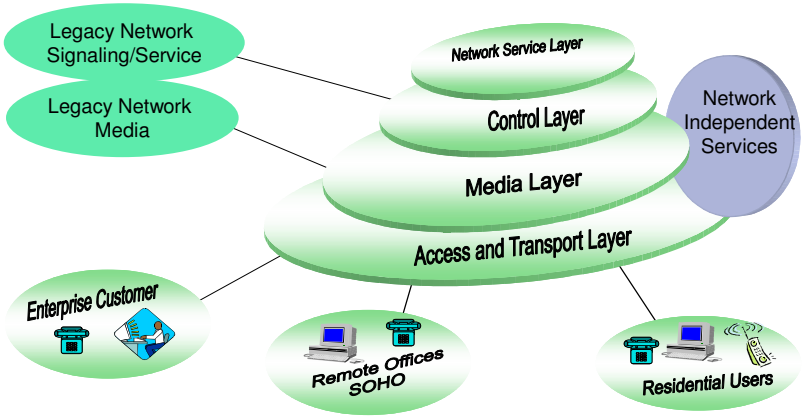
Network Architectures and Technologies: Evolution towards NGN

NGN concept

- A **multi-service network** able to support voice, data and video
- A network with a control plane (signaling, control) **separated** from the transport/switching plane
- A network with **open interfaces** between transport, control and applications
- A network using **packet technology** (IP) to transport of all kind of information
- A network with **guaranteed QoS** for different traffic types and SLAs

Network Architectures and Technologies: Evolution towards NGN

NGN layers



Network Architectures and Technologies: Evolution towards NGN

NGN : Why

- **Flexibility** for service building and offering
- Expectation of **cost reductions** by sharing infrastructure and systems
- **Simplification of O&M**, thus lowering OPEX.
- Use of **open interfaces** leads for:
  - quick deployment of services and applications
  - new services (third parties)

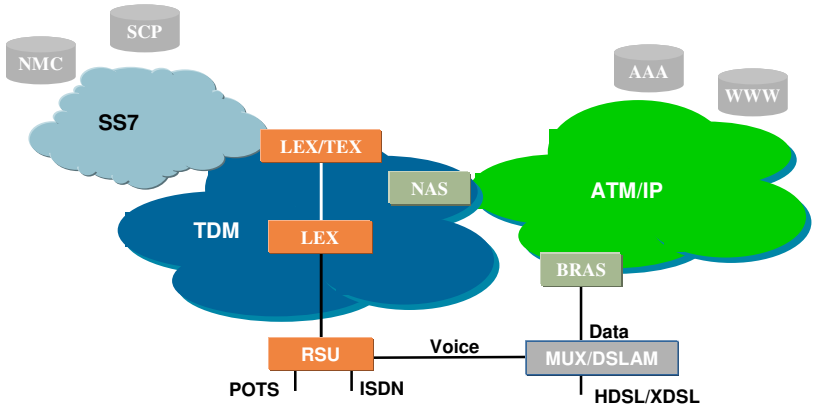
Network Architectures and Technologies: Evolution towards NGN

NGN : Issues today

- Availability for all the functionalities within a public environment and carrier-grade service still needing “some time”
- QoS guarantee for high priority flows currently in evolution and standardization
- Security and Survivability being studied and needing explicit solutions and more emphasis
- Implementation of CAC mechanisms and inter-domain negotiations for end to end quality with some design differences and in evolution

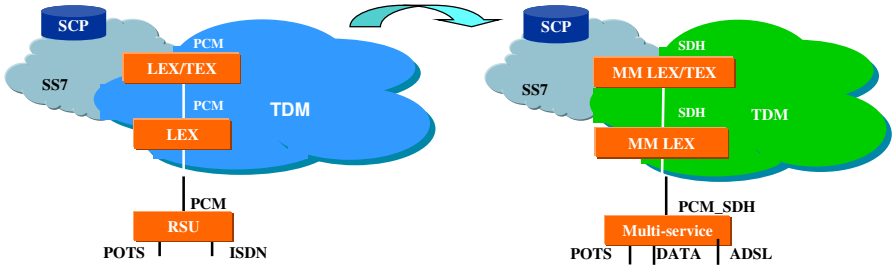
Network Architectures and Technologies: Evolution towards NGN

Today: Overlay Networks for Basic PSTN & Internet access



Network Architectures and Technologies: Evolution towards NGN

First Step: Network consolidation & access optimization

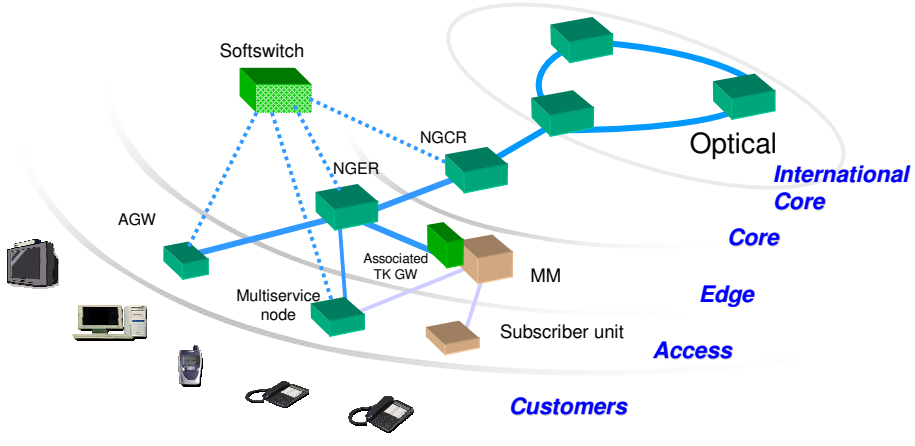


- Low capacity (2000 PCM)
- TDM switching matrix
- Overwhelming data traffic

- Higher capacity (16.000 PCM)
- ATM switching matrix (80 Gbit/s)
- SDH-STM1 interfaces
- Data and ADSL integrated in the Multi-service access
- OPEX & CAPEX optimization

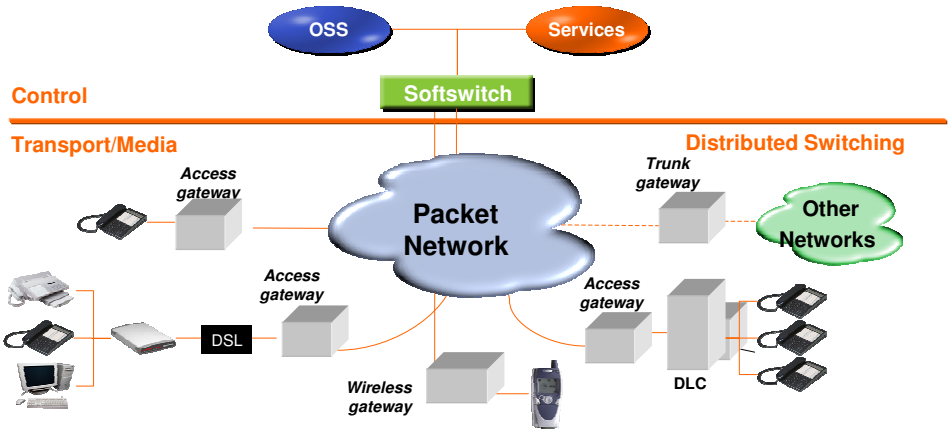
Network Architectures and Technologies: Evolution towards NGN

Second Step: Smooth migration to NGN



Network Architectures and Technologies: Evolution towards NGN

Target : Converged networks



Network Architectures and Technologies NGN: Cost drivers and trends

- Network physical infrastructure as a function of location and density (costs proportion around 70% in the access segment)
- Volume of customers per category
- Bandwidth demand per origin/destination
- Packet processing rates for control related functions
- Variety of applications/services and related platforms
- Content storage and location within the network
- Leasing of physical or communication resources

Fundamental importance of economies of scale by volume and convergence at network resources, service platforms and OSS

Network Architectures and Technologies
NGN: Cost drivers and trends

Cost trends for NGN

- Cost reduction in CAPEX due to technological economy of scale by larger capacities
- Similar values for costs in the physical civil infrastructure
- OPEX in NGN trends to be lower due to the integrated operation and maintenance
- Plan higher investments in security/survivability with diversity paths and protection for large capacity systems

Check and validate correct cost modelling with fixed and variable components as a function of economy of scale

Network Architectures and Technologies:
Evolution towards NGN

NGN : Recommendations today

- Ready to be applied in private multiservice data networks
- Ready for public data networks to integrate different "data applications"
- Optional for "small" alternative operators and multi-service environment
- Very careful planning (technical and economical) for operators with significant existing infrastructure and operations