



ITU / BDT Regional Seminar

Fixed Mobile Convergence and Guidelines on the smooth transition of existing mobile networks to IMT-2000

Nairobi, Kenya, 9 – 12 May 2005

Network Architecture consolidation in the evolution towards NGN

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Network Architecture towards NGN Content

- **Key factors for the evolution towards NGN**
 - **Services and revenue motivations. Requirements**
- **Network architecture consolidation at transit, local and access levels**
 - **Topology and migration**
- **Network optimization based on planning methods and tools**
 - **Support to Business and Design**



Network Architecture towards NGN Key Factors: Motivation

- **New services and revenue** increase with multimedia services:
 - Compensate voice revenue reduction and increase BB related business
- **Cost reductions** by sharing network infrastructure and systems
 - Savings are a function of network scenario, equipment modernization status and customers grow speed
- **Simplification of O&M**, thus lowering OPEX
 - Integrated operation platforms, maintenance and training



Network Architecture towards NGN Key Factors: Operator Requirements(I)

- **Business continuity** required to maintain ongoing dominant services and customers that require carrier-grade service
- **Flexibility** to incorporate existing new services and react quickly to the ones that appear on real time (main advantage of IP mode)
- **Profitability** to allow feasible return on investments and in the best practices market values



Network Architecture towards NGN Key Factors: Operator Requirements (II)

- **Survivability** to allow service assurance in case of failures and external unexpected events
- **Quality of Service** to guarantee the **Service Level Agreements** for different traffic mixes, conditions and overload.
- **Interoperability across networks** to allow to carry end to end services for flows in different network domains



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Network Architecture towards NGN Architecture Consolidation: Topology

Topological changes impact on infrastructure and are slower to implement than technology substitution

- **Less network nodes and links** due to the higher capacity of systems (one order of magnitude).
- **Same capilarity** at access level due to identical customer location
- Topological **connectivity higher** for high capacity nodes and paths for security
- **High protection** level and diversity paths/sources in all high capacity systems, both at functional and physical levels

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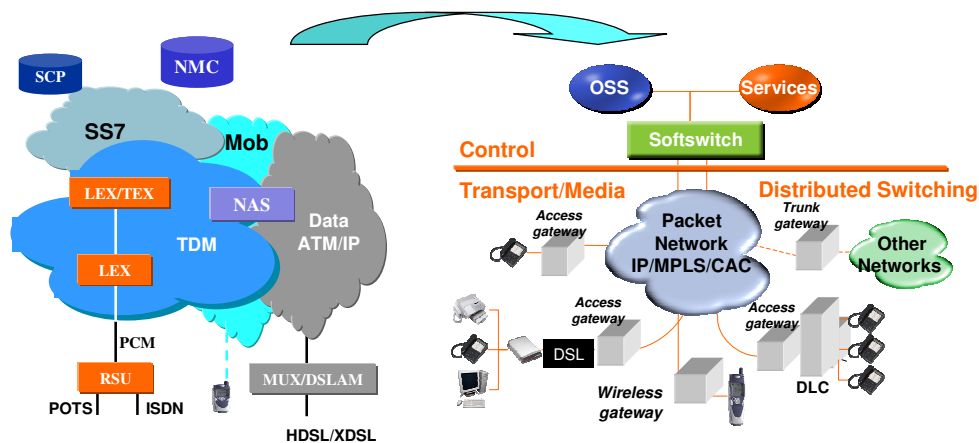
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Network Architecture towards NGN Architecture Consolidation: Topology

What changes from current scenario towards target network ?



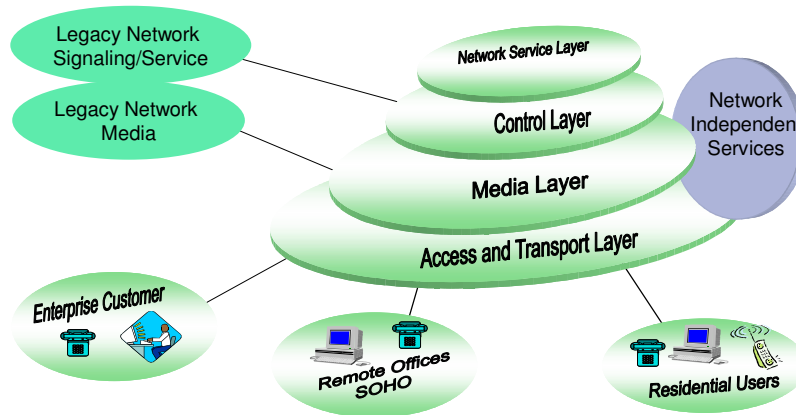
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Network Architecture towards NGN Architecture Consolidation: NGN Layers



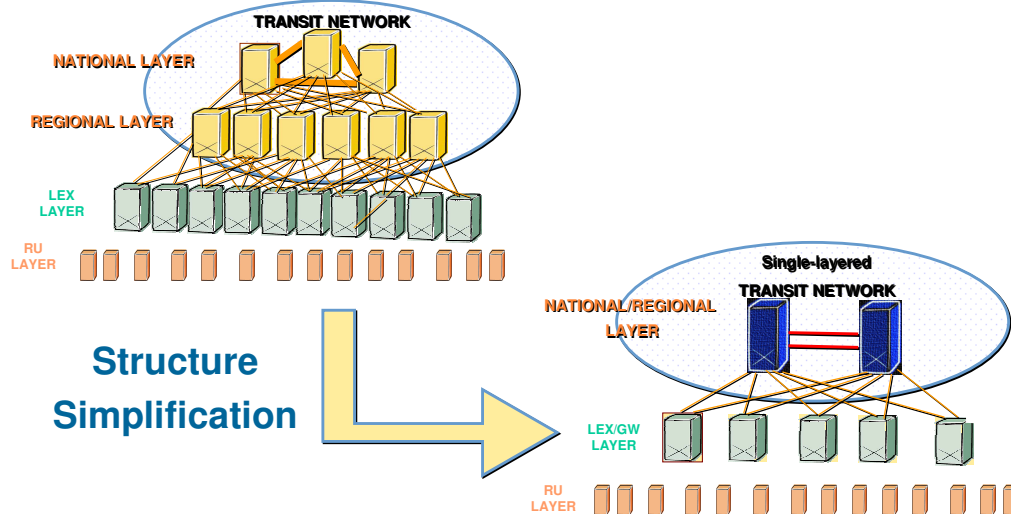
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Network Architecture towards NGN Architecture Consolidation: Topology



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Network Architecture towards NGN Architecture Consolidation: Access

Access dominated by physical infrastructure cost and deployment time

- Quick deployment of DSL and Multimedia Services
- FO closer to customer when implementing new outside plant or renovating existing one
- New Wireless technologies for low density customer scenarios
- Shorter LL length than classical network to be prepared for high bandwidth Multimedia services

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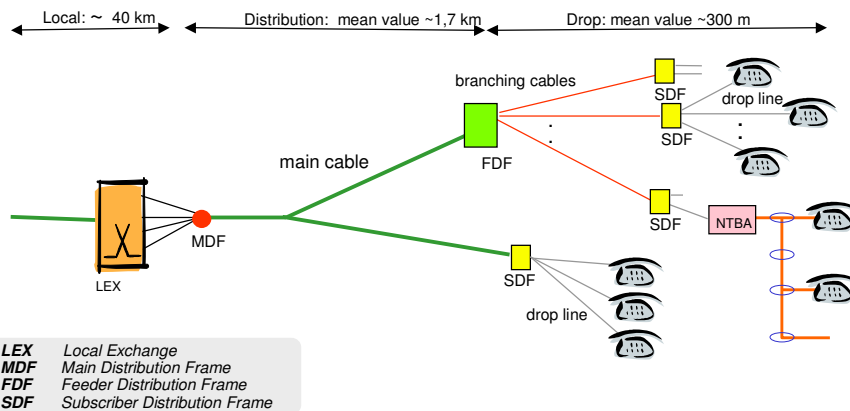
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Network Architecture towards NGN Architecture Consolidation: Wireline Access

Typical historical Access Network structure



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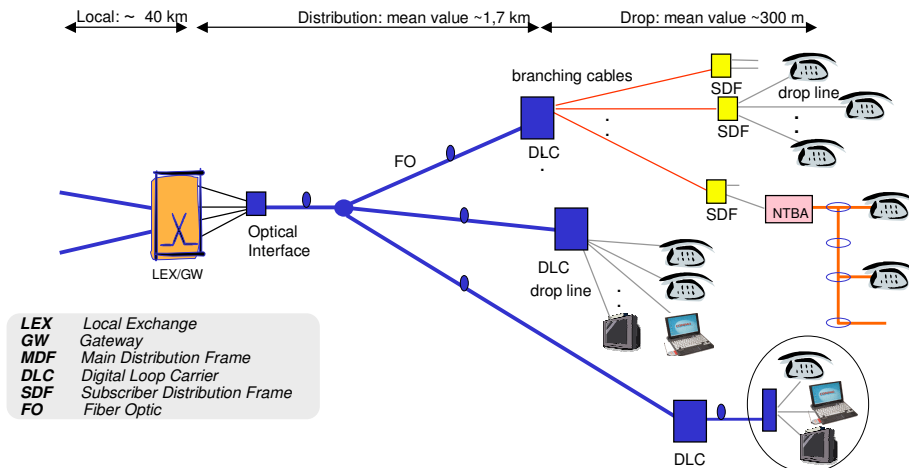
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Network Architecture towards NGN Architecture Consolidation: Access

Typical Access Network evolution



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Network Architecture towards NGN Architecture Consolidation: Local

Dominated by functions migration investment and interoperability

- Move from joint switching and control to separated control and media GW
- Introduce Multimedia Services at all areas
- Optimize number, location of nodes and interfaces among existing and new network
- Requires longer time and higher investments due to variety of geo-scenarios and geographical distribution

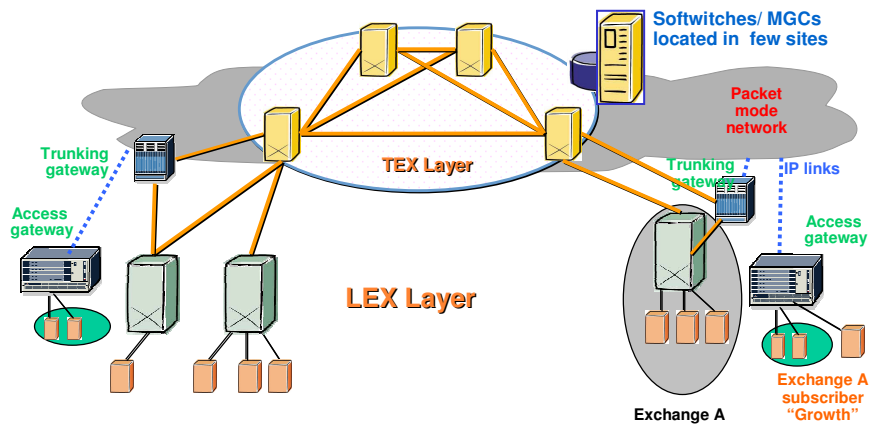
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Network Architecture towards NGN Architecture Consolidation: Local



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Network Architecture towards NGN Architecture Consolidation: Core

Dominated by high capacity and protection level

- Overlay deployment for full coverage in all regions
- Quick deployment needed for homogeneous end to end connections
- Strong requirements for high quality, protection and survivability
- Importance of the optimization for location and interconnection

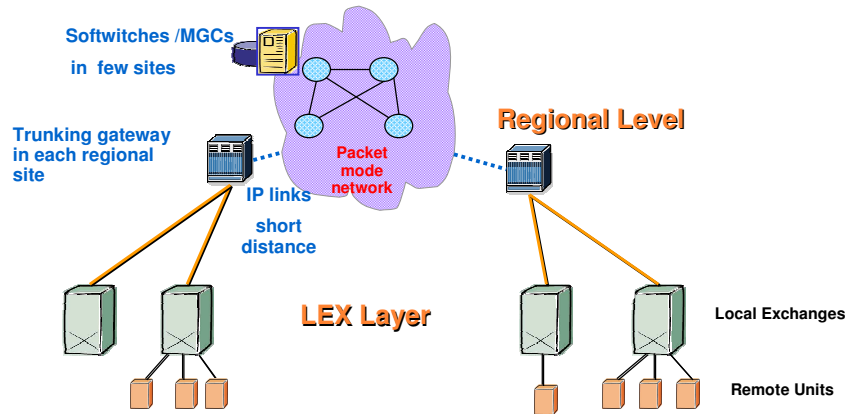
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Network Architecture towards NGN Architecture Consolidation: Core



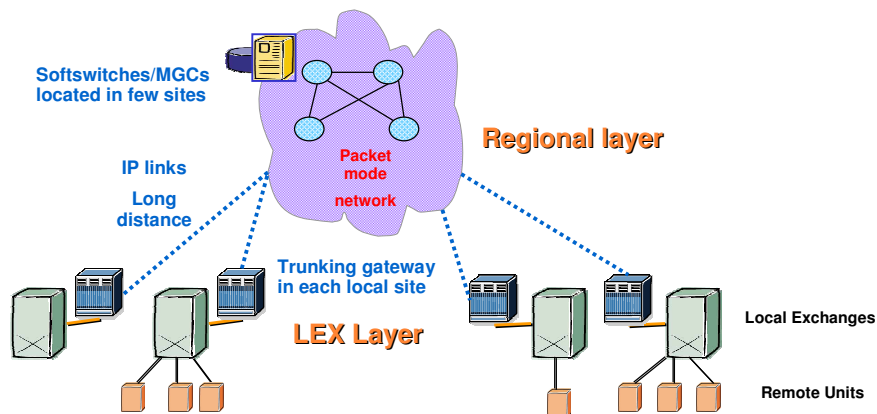
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Network Architecture towards NGN Architecture Consolidation: Core



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Network Architecture towards NGN Architecture Consolidation: Combined Segments

Where to start and how to co-ordinate migration?

Network “consolidation”

Cost Optimisation of the network

- Reducing nodes and increase their capacity
- Deployment of ADSL and multiservice access

Network expansion

NGN solution :

- **Cap and Grow**; this means keeping the existing PSTN network as it is, and grow demand with NGN equipment

Network replacement

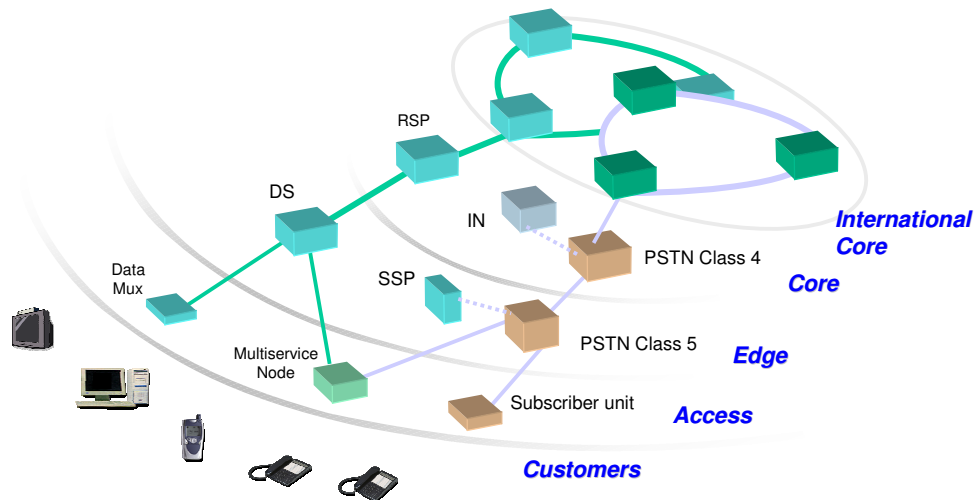
Replacement of out-phased (end of life) TDM equipment

- gradual replacement : this means **coexistence** of the two technologies
- **full accelerated replacement** with a short transition period

Need to optimize overall network evolution: technically and economically

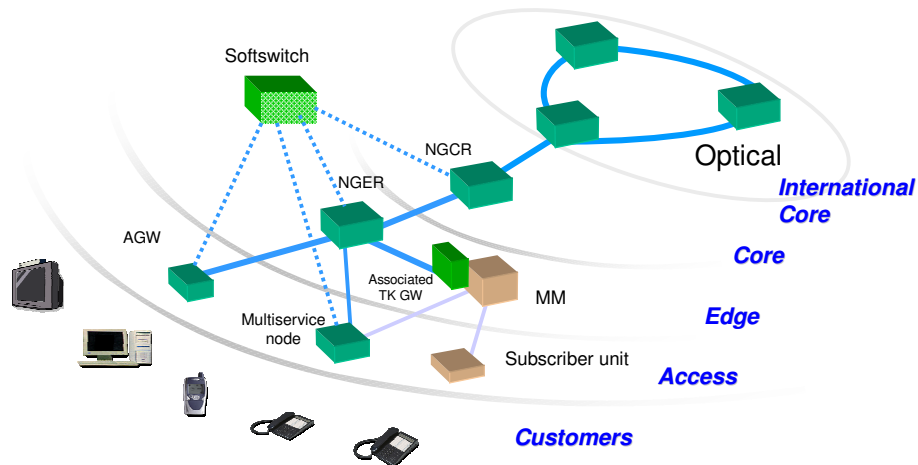


Network Architecture towards NGN Architecture Consolidation: Combined Segments (I)





Network Architecture towards NGN Architecture Consolidation: Combined Segments (II)



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Network Architecture towards NGN Architecture Consolidation: Combined Segments

Overall impact of evolution on network CAPEX and OPEX

CAPEX

- TDM and NGN CAPEX are **close**
- NGN CAPEX in the first years driven by **geographic coverage**
- Access systems represent a large part of CAPEX
 - **similar values** in TDM and NGN

OPEX

- OPEX in NGN trends to be **lower**
- Migration scenarios will have a **mix** of TDM OPEX (installed base) and NGN OPEX (substitution and growth)
- Significant impact of manpower cost due to **convergence** in operations

Key factors for the evaluation: Geo-scenarios, Network grow rates, Aging of equipment, New services

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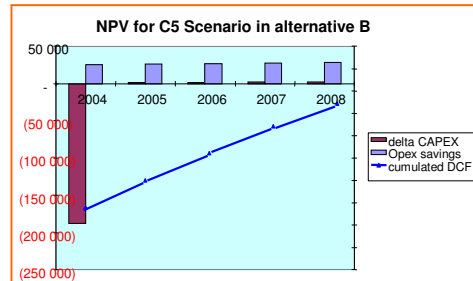
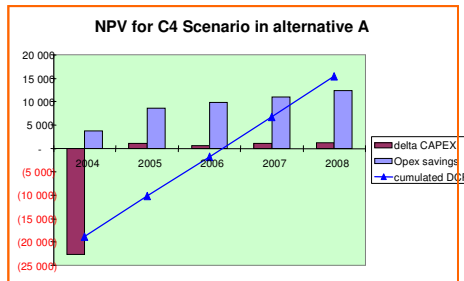
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Network Architecture towards NGN Architecture Consolidation: Scenario evaluation

- **Net Present Value (NPV)** for the overall migration project is the best global evaluator



A large variety of country scenarios and transition strategies generate major differences in the economical results → **Planning to be performed per country and operator**



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Network Architecture towards NGN Support tools: Business

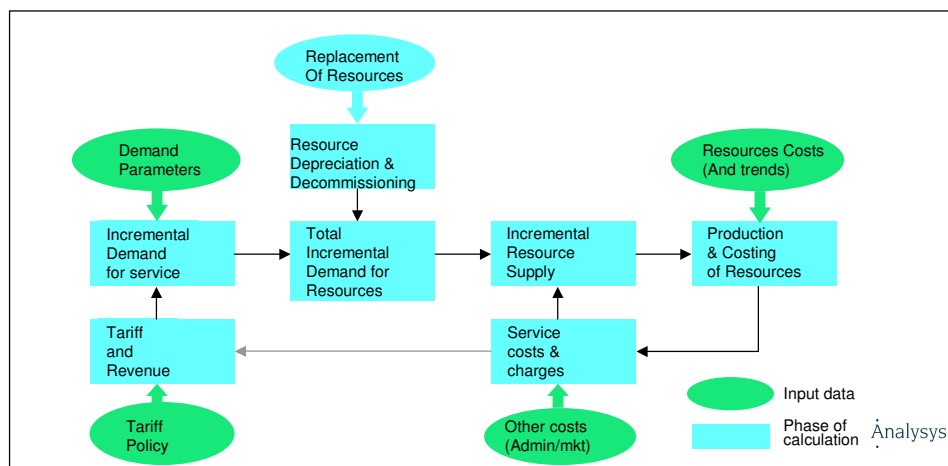
• Required functionality for Business tools

- Service Demand Projection
- Dynamic modeling for technology **substitution and migration rates**
- Dimensioning **multiple flows** (circuit and packet modes)
- Evaluation of network resources and associated investment (CAPEX)
- Evaluation of revenues for given tariffs and installation rate
- Modeling **multiple resource lifetimes**
- Modeling of demand elasticity to tariffs
- Interrelation between network growth and operational cost (OPEX)
- **Cost assignment** as a function of utilization rates
- Generation of standard financial results like Cash Flow, Profit & Loss, Balance Sheet, NPV, IRR, etc.



Network Architecture towards NGN Support tools: Business

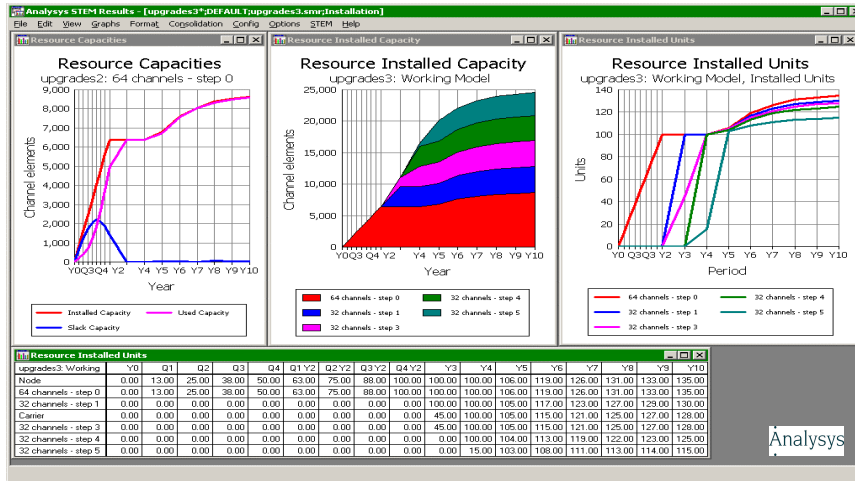
Activity Flow in STEM to evaluate migration alternatives:





Network Architecture towards NGN Support tools: Business

Type of STEM tool results



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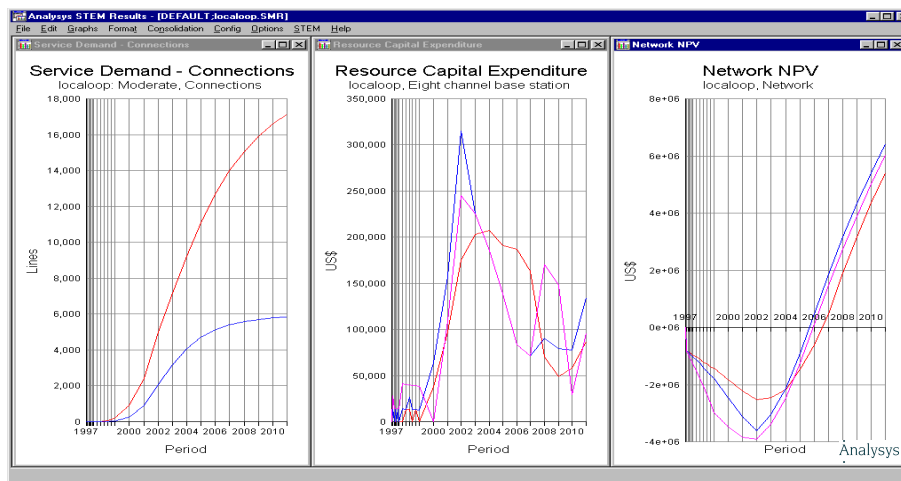
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Network Architecture towards NGN Support tools: Business

Type of STEM tool results



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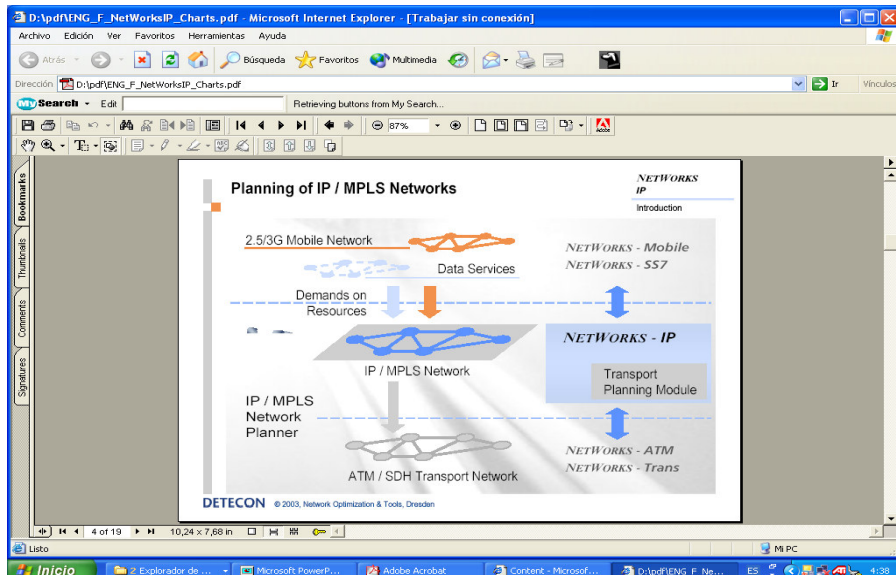
Network Architecture towards NGN Support tools: Design and Optimization

Required functionality for Technical design tools

- Service demands characterisation and traffics for **VoIP and NGN multiservice flows**
- Conceptual Network Design and Capacity Planning
- Comparison of different network structures
- Routing flows for most typical cases including **OSPF, shortest path, widest path and weighted cost** functions.
- Optimizing locations and connections of network gateways
- Cost, **Performance and Reliability** Analysis
- Estimation of investment costs for the rollout and the extension of the investigated multi-service network
- Estimation of end-to-end delays
- Technical Site and System Planning
- Allocation of the IP or MPLS links
- Formation of **virtual networks**
- Routing over ATM links or PDH/SDH systems or tunneling via other IP links
- **Sub-networking and addressing**
- Configuring the network elements (IP router)

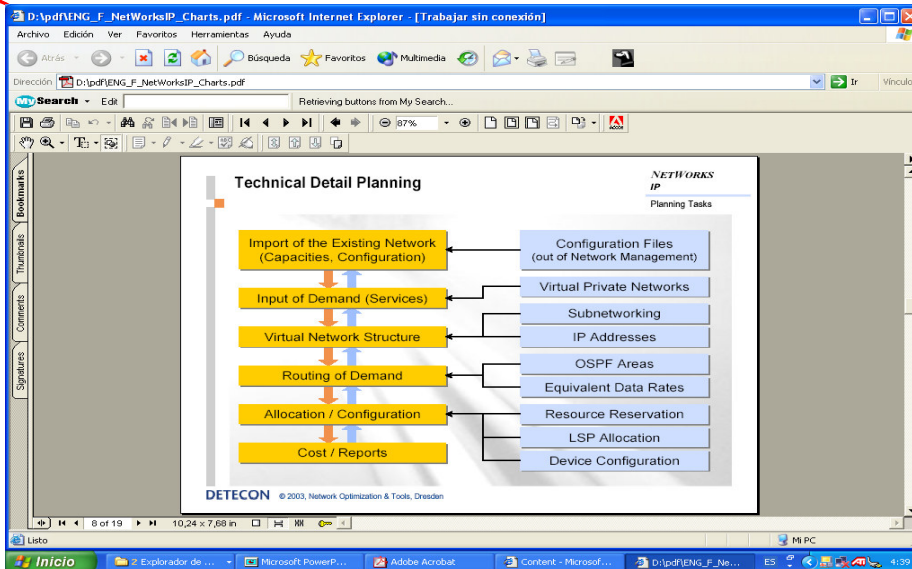


Network Architecture towards NGN Support tools: Design and Optimization





Network Architecture towards NGN Support tools: Design and Optimization



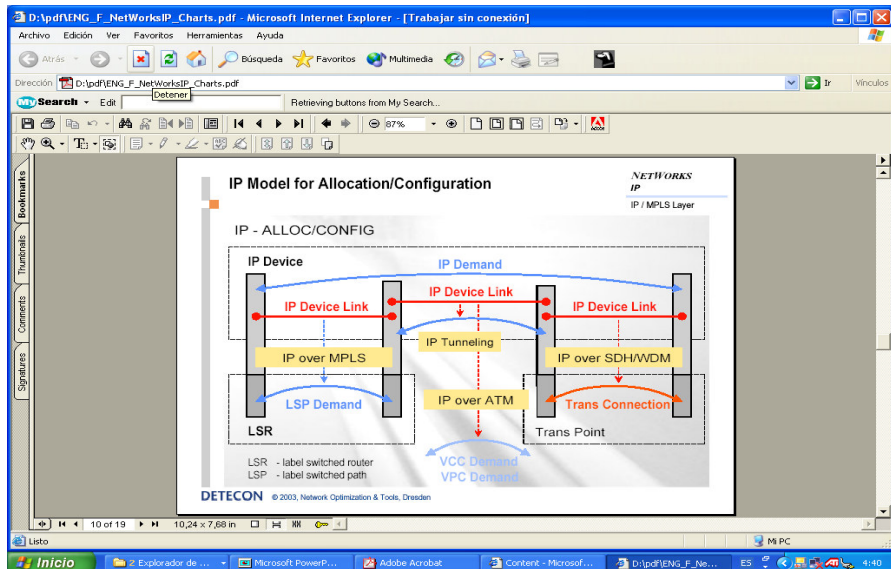
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Network Architecture towards NGN Support tools: Design and Optimization



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Network Architecture towards NGN Support tools: Design and Optimization

Interaction between IP / MPLS and Transport Layer

NETWORKS IP
Layer Interaction

The diagram illustrates the interaction between the IP Layer and the TRANS Layer. In the IP Layer, there are 'Locations' containing 'IP Devices (LSRs)'. These are connected to 'IP Device Links (LSP Links)'. In the TRANS Layer, there are 'Trans Points' and 'System Links'. The diagram shows how IP Device Links connect to Trans Points and how Trans Points connect to System Links. Arrows indicate the flow of traffic and the assignment of IP Device Links to Trans Points and System Routes.

- Rule 1: IP Devices (LSRs) of one Location on one Trans Point
- Rule 2: IP Devices (LSRs) on a Physical Device at the Trans Point
- Rule 3: IP Device Links (LSP Links) on Trans Connection + System Route

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Network Architecture towards NGN Support tools: Design and Optimization

Table - IP-DEVICE (25) - demio.demio

Index	Company	Country	ID	Label	Type	Level	RoutingTable	Enter nodes
1	0.947593	03.950355	K_3745_03	Cologne-VIPBank	Cisco 3745	Customer Edge	Table (1)	3 IP's
2	0.956772	00.12194	P_3745_03	Frankfurt-VIPBank	Cisco 3745	Customer Edge	Table (1)	3 IP's
3	0.916222	48.776208	G_3745_03	Saargem-VIPBank	Cisco 3745	Customer Edge	Table (1)	3 IP's
4	0.916111	62.650008	H81_3745_02	Hamburg-VIPBank	Cisco 3745	Customer Edge	Table (1)	4 IP's
5	11.576981	48.146539	M_3745_03	Munich-VIPBank	Cisco 3745	Customer Edge	Table (1)	3 IP's
6	12.355111	51.355208	L_3745_03	Leipzig-VIPBank	Cisco 3745	Customer Edge	Table (1)	3 IP's
7	13.335683	02.49875	B_3745_03	Berlin-VIPBank	Cisco 3745	Customer Edge	Table (1)	3 IP's

Object: TransPoint P_3745_03

Name	IP Address	Priv.	Type	Description
Loopback0	10.1.1.2/24	X	Loopback	
FastEthernet0/0/0	10.1.1.2/24	X	FastEthernet	
Serial2/2/0/0	213.143.195.45/30		Serial	Circuit emulation connection to F_4M401_2/2/0
Serial2/1/0/0	213.143.195.41/30		Serial	Circuit emulation connection to F_Phys01_2/1/0
Serial2/0/1/0	213.143.192.70/30		Serial	Circuit emulation connection to K_13n18_03_2/0/1
Serial2/0/0/0	213.143.192.30/30		Serial	
Serial2/0/0/1	213.143.192.61/30		Serial	
Serial2/2/1/0	213.143.192.185/30		Serial	Loop
Serial1/1/0/0	213.143.192.136/30		Serial	Circuit
Serial1/0/0/0	213.143.192.69/30		Serial	Circuit
Serial2/2/0/0	213.143.192.89/30		Serial	Circuit

Schematic Display - demio_ipodm2

The schematic display shows a network topology with nodes representing IP devices and links representing connections. The nodes are color-coded by level: Customer Edge (blue), Provider Edge (red), and Server (green). Links are color-coded by utilization: Utilization (<= 0.0) (green), Utilization (0.0 < u <= 1) (red), and Overload (> 1) (orange). A legend in the bottom right corner provides the key for these colors.

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Network Architecture towards NGN Summary of Key Factors

- Plan **business and services first**, later the network with proven solutions.
 - Implement **pilot cases** before network migration
- **Differentiation** to competitors on new services and quality
 - Design financial performance with **best business practices**: compare and optimise NPV.