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Decision making requirements in planning and solution mapping

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Network Planning Requirements Content

- **Requirements to the Network Planner**
- **Modeling issues for NGN and 3G**
- **Solution mapping per scenario**

Network Planning Requirements
Mission of network Planning

"Decision making on the network deployment to Optimize Business and Quality based on quantitative evaluation"

- Considering geo-marketing scenarios and traffic demand
- Overall vision on the network layers
- Deciding network topology, interconnection and routing
- Optimizing balance between performance/SLA and cost (CAPEX + OPEX)
- Considering regulatory constraints
- Anticipating business evaluation and feasibility

Network Planning Requirements
Key requirements in competition (I)

- **Strategy Oriented Needs**
  - **What selection of customer classes and associated services?**
  - **When to decide migration to new technologies and what speed?**
  - **Which level of convergence versus specialization?**
  - **What resources to built and what to lease ?**
  - **Which are the most convenient partnerships with other operators and suppliers?**

Network Planning Requirements
Key requirements in competition (II)

- **Business Oriented Needs**
  - Which services have to be introduced through time ?
  - What is the best service bundling per customer type ?
  - How to maximize revenues ?
  - How to reduce capital expenditure ?
  - How to reduce operational expenditure ?
  - How to price services and bundles?
  - How to optimize network profitability?

Network Planning Requirements
Key requirements in competition (III)

- **Network Oriented Needs**
  - How to forecast new services and traffic demands?
  - How many nodes to install ?
  - What is best location for systems and related communication media ?
  - What is the best network architecture and routing ?
  - How to plan capacity evolution and solutions migration at access, local and transit segments?
  - How to ensure QoS across multiple domains?
  - How to ensure protection level and survivability?
  - How to ensure and manage SLA ?

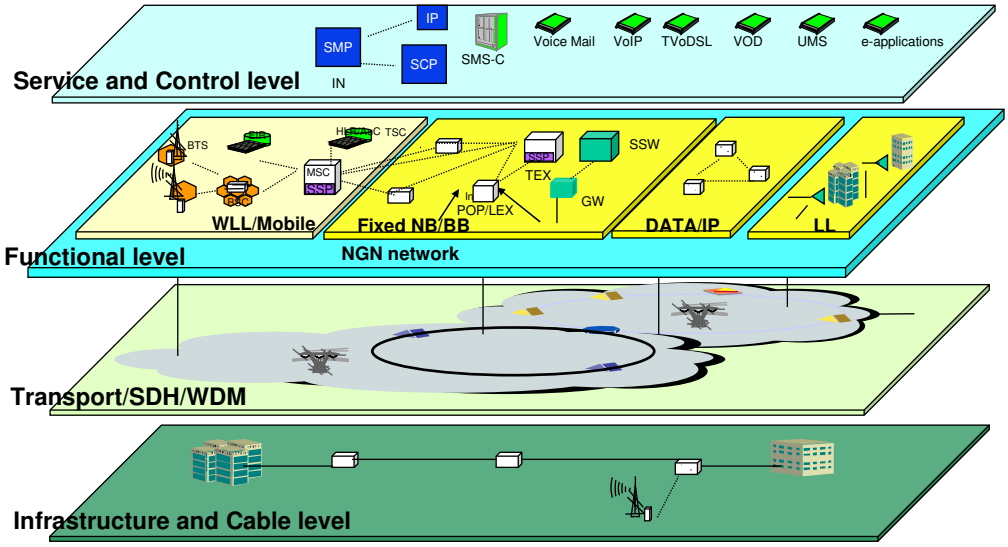
Network Planning Requirements
Key requirements in competition (IV)

- **Operation Support Needs**
  - **How to evaluate alternatives for direct vs outsourced operation ?**
  - **How to organize the operation processes ?**
  - **Which level of integration is needed to operate multimedia services?**
  - **Which IT applications ensure an efficient support to operation ?**
  - **How to plan labor force training on the new operational activities ?**

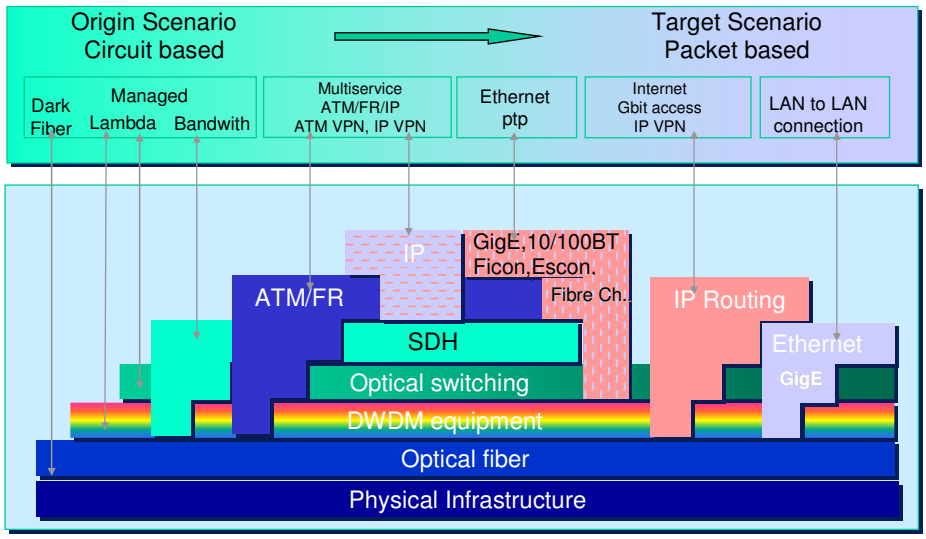
Network Planning Requirements :
Network Modeling for planning

- **High complexity of the whole Network requires a modeling and splitting in subnetworks to facilitate analysis , design and planning.**
  - 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 SDH, WDM, ATM, IP, GSM, 3G, WiMax, etc.....

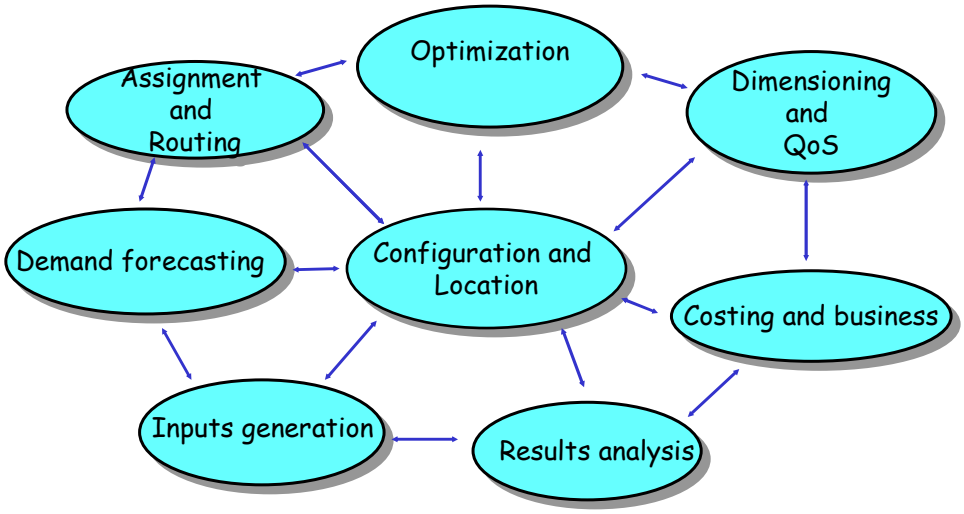
Network Planning Requirements
Network Layer Modeling for planning



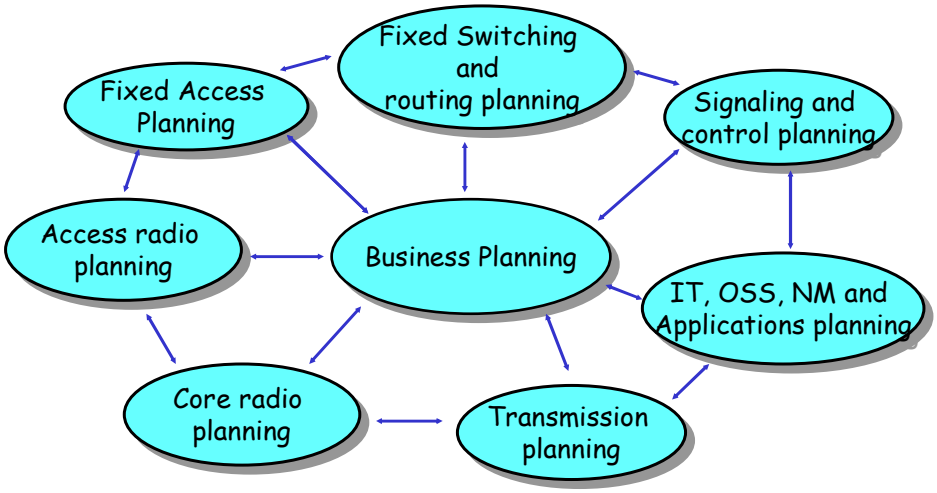
Network Planning Requirements
Technological alternatives at core



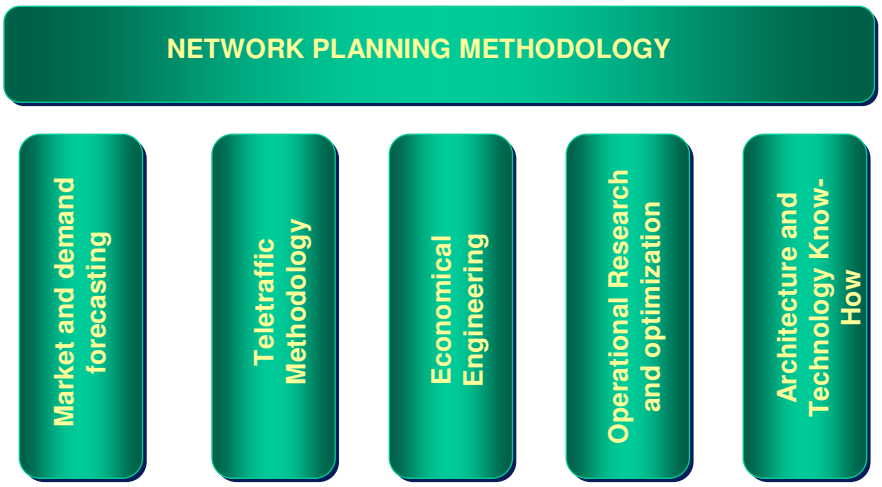
Network Planning Requirements
Planning activities



Network Planning Requirements
Network Planning Domains



Network Planning Requirements
Planning: Main supporting pillars



Network Planning Requirements
Scope: Main supporting pillars

- Statistical flow modeling for arrival rates and holding times
- Capacity models based on stochastic processes: Analytical and Simulation
- Dimensioning based on efficiency, performance and QoS
- Good foundation on the multiple contributions from the International Teletraffic community (ITC)

Network Planning Requirements Content

- Requirements to the Network Planner
- Modeling issues for NGN and 3G
- Solution mapping per scenario

Network Planning Requirements
Modeling issues for NGN and 3G

- New models to represent multiservice flows
- New dimensioning methods for resources handling multimedia services with QoS
- New measurement procedures for aggregated multiservice traffics
- New multicriteria dimensioning for 3G and xG combining coverage by frequency, service speed and data traffic capacity
- Which procedures to ensure interoperability and end-to-end performance across multiple domains?
- Which units to define dimensioning and costing units for interconnection?

Network Planning Requirements
QoS and Performance Issues

• Quality of Service (QoS) domains to be modeled, defined and/or extended for NGN and 3G. Measured in waiting time and/or loss probabilities

• Domains for QoS evaluation:

- Service accessibility: capability to access a service
- Connection establishment: Capability to get connection
- Information transfer: Quality of information delivery
- Reliability: Failure probability
- Availability: Probability of system being active
- Survivability: Capability to provide service in abnormal conditions
- Security: Information and systems protection level
- Qualitative: Intelligibility, audibility, visualization ... of information content as derived from user perception (MOS)

Network Planning Requirements
Traffic flow types for QoS based dimensioning

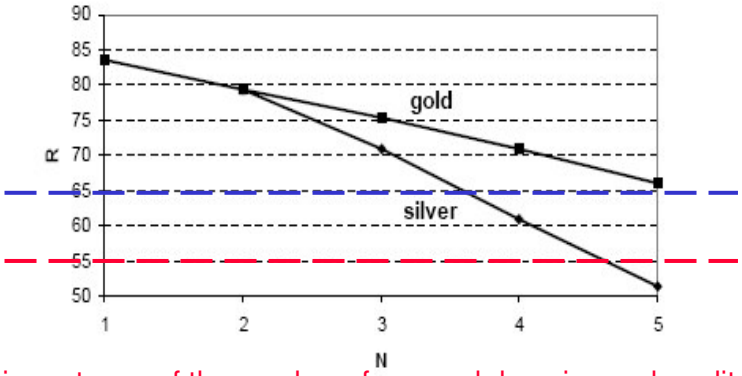
– **T1) QoS constant stream**: bandwidth transmission at a constant speed with a specified delivery and jitter (ie: video distribution)

– **T2) QoS variable stream** : bandwidth transmission at a variable speed derived from a user information and coding algorithm which requires guaranteed quality and specified jitter (ie: VoIP, Video streaming, audio streaming, etc.)

– **T3) QoS elastic:** bandwidth transmission at a variable speed without jitter restrictions and asynchronous delivery (ie: browsing, file transfer, mail, UMS, etc.)

Network Planning Requirements
Performance Issues: case of VoIP

Perceived Quality of Service as a function of the number of crossed domains for the G.711+PLC coding with ppp = .01 and gold /silver SLA (19th International Teletraffic Congress September 2005, Beijing)



High importance of the number of crossed domains and quality per domain on the end-to-end performance

Network Planning Requirements
How to define dimensioning and costing units for interconnection ?

– Requirements for service flow units to be used:

- Should be quantifiable with defined engineering rules
- Useful for interrelation between demand/dimensioning/costing for a given QoS and SLA
- Reflecting service provisioning and market value across multiple networks
- Applicable to multiservice/multimedia flows

Network Planning Requirements
Traffic units for aggregated flows

Proposal of NGN units in multiservice networks/interfaces for demand/dimensioning/costing :

- Equivalent Sustained Bit Rate (ESBR) or aggregated equivalent rates for same QoS category flows efficiently carried in a common reference busy period (ie. 5 minutes)

- Computed as weighted average for the services at QoS category (i) and customer classes (j) at each network element: $\sum_i \sum_j ESBR_{ij}$

Network Planning Requirements
Dimensioning criteria in 3G

Multicriteria Dimensioning principles for multimedia services

C1) - Radio Coverage per frequency type: 450, 600, 900, 1800, 2500: dominant for low voice traffic without data.

C2) - Traffic in erlangs for voice: dominant in urban scenarios and hot-spots

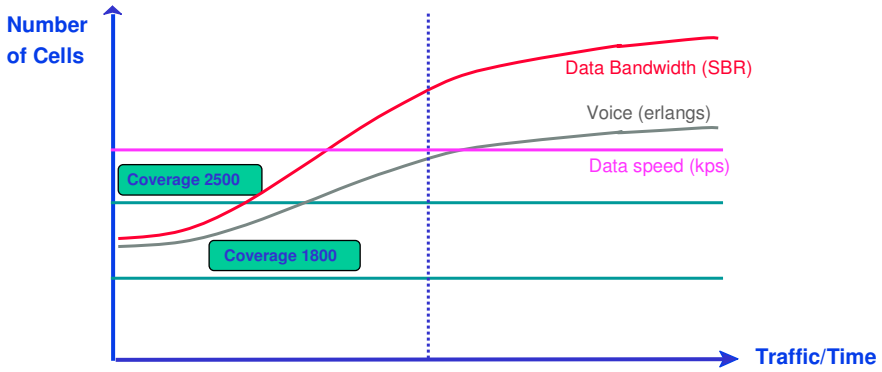
C3) - Data services quality as a function of speeds: dominant in suburban and rural scenarios

C4) - Data bandwidth as a function of mix of data services Sustained Bit Rates and QoS along the cell due to the cell-breathing effect: dominant for high proportion of data and video consumption in all scenarios

Actual dimensioning for cells and equipment as a result of the convolution of all of them per geo-scenario

Network Planning Requirements
Dimensioning criteria in 3G Convergence

Multicriteria Dimensioning for QoS (urban case)



!! Avoid dimensioning based only on coverage !!
Data Bandwidth dominant in 3G

Network Planning Requirements
Content

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- **Solution mapping per scenario**

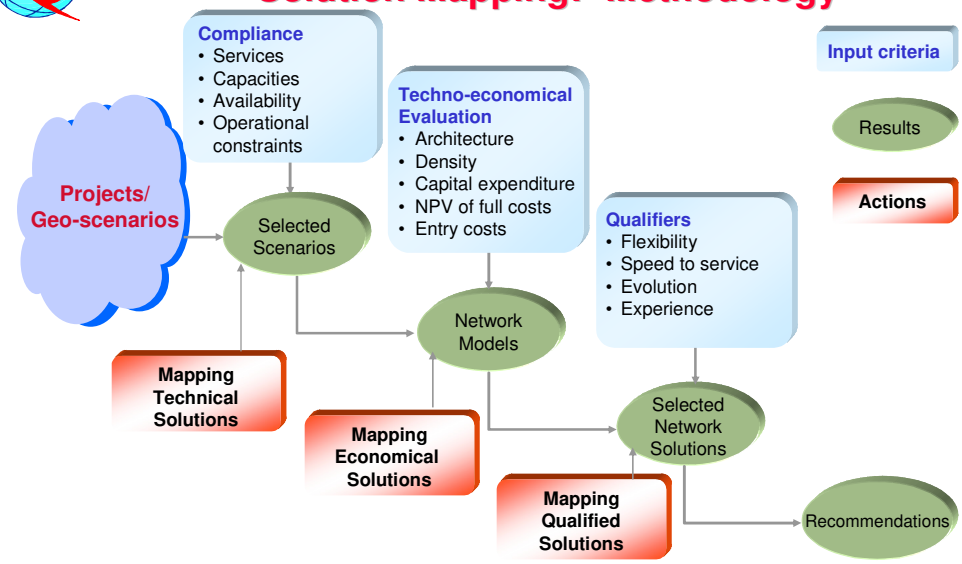
Network Planning Requirements
Solution Mapping

Solution mapping is more important as number of technologies and network options increase

- Large variety of geo-scenarios within the country
  - Geography
  - User profiles
  - Density
  - Economy

- Alternatives modeled with all key parameters that characterize scenario, services, demands and solutions
- Best solutions selected based on techno-economical evaluation and resulting best Cost of Ownership

Network Planning Requirements
Solution Mapping: Methodology



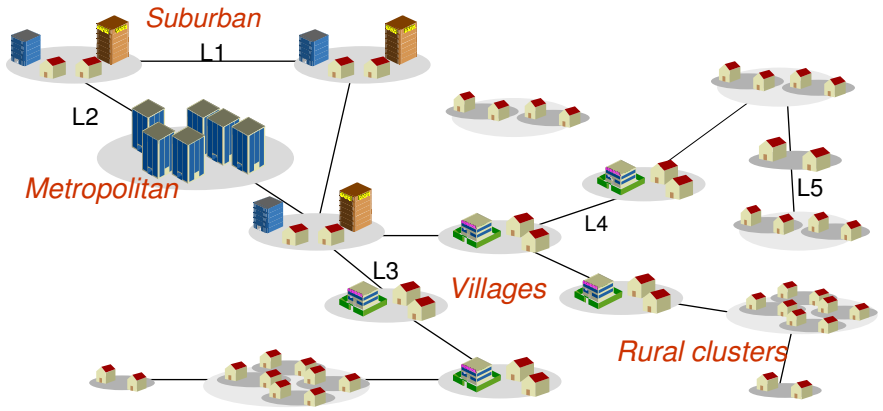
Network Planning Requirements
Solution Mapping: Cost Modeling

FULL COSTS = **CAPITAL COSTS** + **OPERATING COSTS**

CAPITAL COSTS
- Electronic equipment
- Cables/towers
- Civil works
- Licenses, permits
- Installation
- Replacement
- Customer premises equipment

OPERATING COSTS
- Rights of way
- Space rental
- Operations and maintenance
- Power
- Management and salaries
- Cost of inventory
- Marketing campaigns
- Overheads

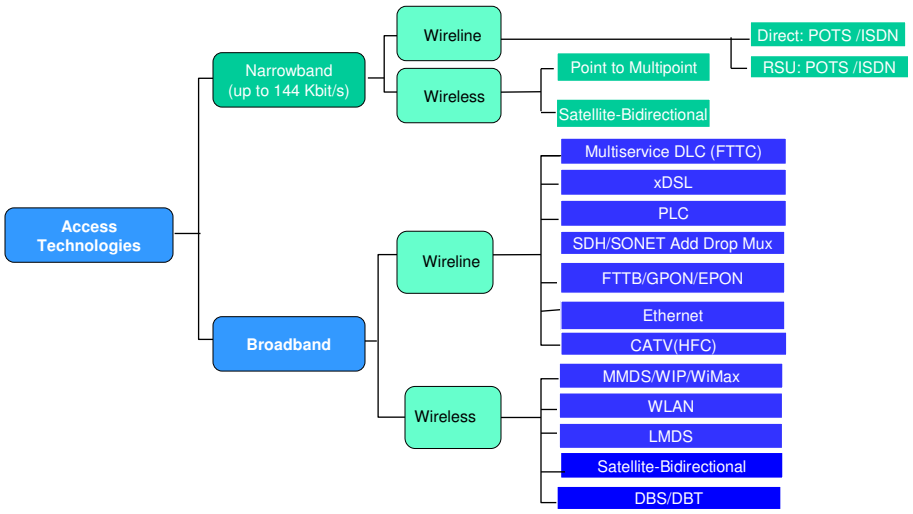
Network Planning Requirements Solution Mapping: Example of Geo Scenarios



L1: Distance between suburban
L2: Suburban - metropolitan distance
L3: Suburban - village distance

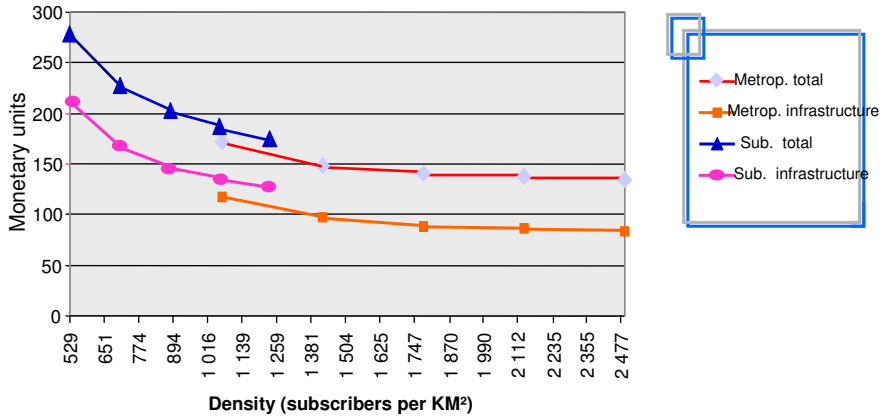
L4: Distance between villages
L5: Distance between rural

Network Planning Requirements
Solution Mapping:
Technological alternatives at access (Fixed)

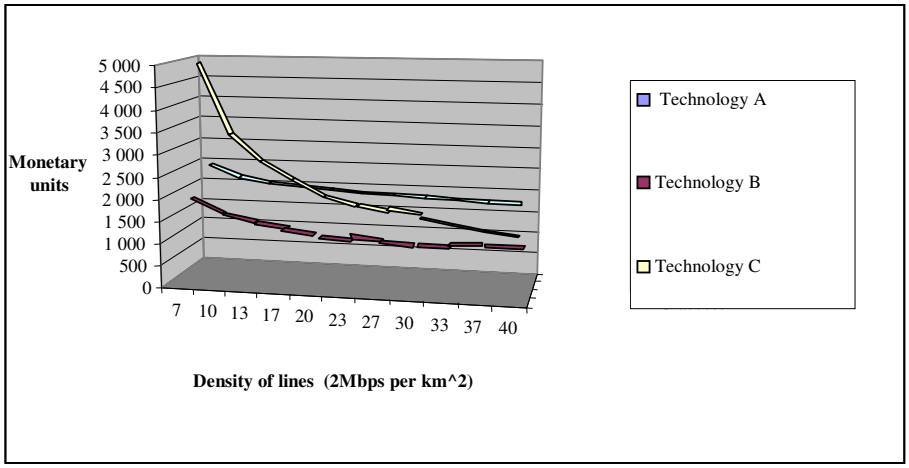


Network Planning Requirements
Solution Mapping:
Investment sensitivity to density in WL Access

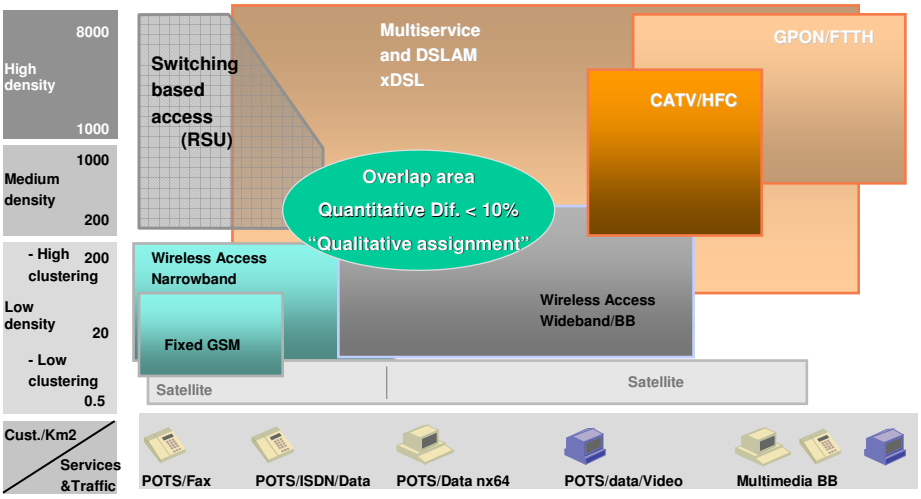
High density areas



Network Planning Requirements
Solution Mapping:
Solution selection per customer density



Network Planning Requirements
Example of mapping recommendation



Network Planning Requirements
Benefits of mapping and planning activities

- **Saving factors of 20 to 200 % by adequate solution/technology mapping in the access segment**
- **Additional gains between 20 to 40 % by topology/routing optimization**
- **Anticipation of 2 to 3 years in the positive IRR**
- **Assure fulfillment of SLA and QoS**
- **Positioning of the operator in the top competition levels**

Network Planning Requirements
Summary of Key Requirements

- **Multiservice flows** impose a set of requirements on models and tools for NGN and 3G.
- **Interoperability and interconnection** require special effort to players and planners to ensure end-to-end performance
- High number of new technologies and capabilities reinforce the need of **solution mapping** for each country scenario
- Complexity of converged networks require the use of **high quality support tools**