



ITU-D Regional Development Forums 2010 on
NGN and Broadband for the Arab Region



“NGN and Broadband, Opportunities and Challenges”

Session 4

NGN and Broadband Planning Tools

*Ignat Stanev
HCTP/ITC, Bulgaria*

ITU-D Forum

Cairo, Egypt, 13 to 15 December 2010

Session 4_IS - 1

Content of presentation

- **Broadband and NGN**
- **Top level planning domains for broadband access**
- **Modeling of broadband access networks**
- **Broadband planning tools of ITU partners**
- **ITU validation process for planning tools**
- **Benefit of using planning tools**

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Session 4_IS - 2

Broadband as Definition for Next Generation Networks

Definition of NGN

ITU-T Rec. Y.2001	<p>Next Generation Network (NGN): a packet-based network able to provide telecommunication services and able to make use of multiple broadband, QoS-enabled transport technologies and in which service-related functions are independent from underlying transport-related technologies.</p> <p>It enables unfettered access for users to networks and to competing service providers and/or services of their choice. It supports generalized mobility which will allow consistent and ubiquitous provision of services to users.</p>
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Broadband definitions of ITU

Recommendation I.113 of the ITU Standardization Sector defines broadband as :

Transmission capacity that is faster than primary rate Integrated Services Digital Network (ISDN) at 1.5 or 2.0 Megabits per second (Mbits)

Mobile <div style="border: 1px solid black; border-radius: 50%; width: 40px; height: 40px; margin: 0 auto; display: flex; align-items: center; justify-content: center;"> Mobile broadband </div>	i271L: Number of mobile cellular subscribers with access to data communications at low speeds (below 256kbit/s). Typically referred to as 2.5G. i271mb: Number of mobile cellular subscribers with access to data communications at broadband speeds (defined as greater than or equal to 256 kbit/s in one or both directions). Typically referred to as 3G.
Fixed broadband	Total fixed broadband Internet subscribers: high speed access to the public Internet at speeds equal to, or greater than 256kbit/s in one or both directions.

DEFINITIONS OF WORLD TELECOMMUNICATION/ICT INDICATORS - March 2010



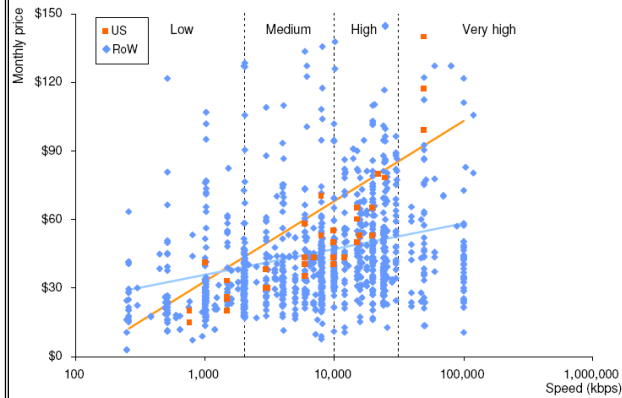
Related to transmission speed

Offered broadband connections by speed

By speed of connection:

- Low speed (256kbps – 2Mbps)
- Medium speed (2.5Mbps-10Mbps)
- High speed (10Mbps-32Mbps)
- Very-high speed (above 35Mbps)

Offered broadband connection – by price and speed



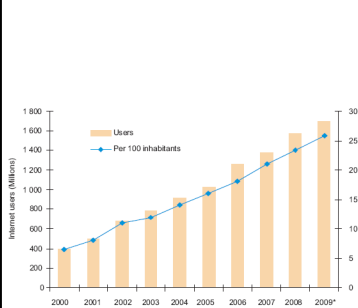
Source : OECD, TeleGeography, Point Topic

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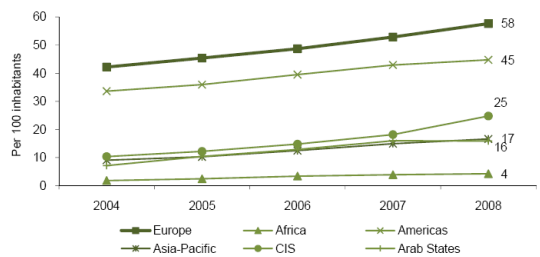
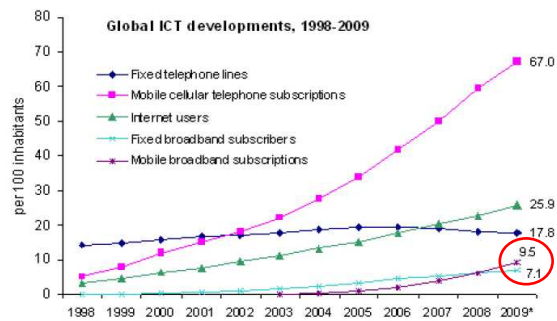
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Session 4_IS - 5

Broadband customers (ICT market trends)



Internet users



Source :

ITU Database
2010

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Session 4_IS - 6

Broadband customers

Growth of broadband customers by region

Territories	2008Q2	2009Q1	2009Q2		growth in quarter	growth in 12 months
		Total	Total	Net Qtr Add		
Asia-Pacific	60,875,668	64,598,397	65,959,917	1,361,520	2.11%	8.35%
Eastern Europe	19,408,909	23,713,655	25,107,902	1,394,247	5.88%	29.36%
Latin America	22,294,590	27,947,382	29,292,408	1,345,026	4.81%	31.39%
Middle East and Africa	10,934,739	12,819,703	13,054,260	234,557	1.83%	19.38%
North America	83,445,376	93,502,047	95,845,689	2,343,642	2.51%	14.86%
South and East Asia	84,002,699	100,884,917	105,389,289	4,504,372	4.46%	25.46%
Western Europe	99,721,070	107,878,672	109,650,503	1,771,831	1.64%	9.96%
Global Total	380,683,051	431,344,773	444,299,968		3%	14%

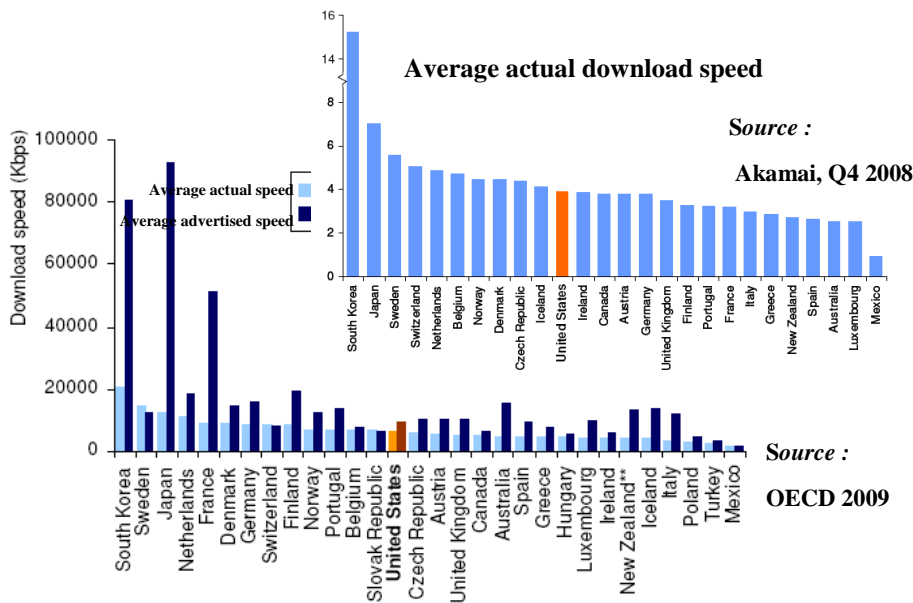
Source: Data provided for the Broadband Forum by Point Topic (www.point-topic.com)

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Session 4_IS - 7

Broadband customers – download speed

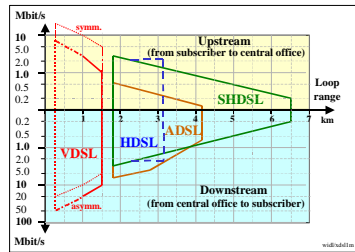


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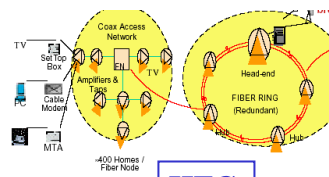
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Session 4_IS - 8

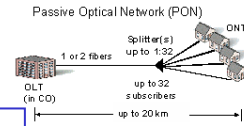
Broadband access technologies - wireline



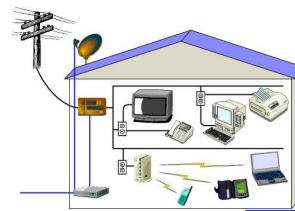
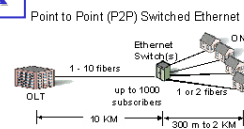
xDSL



HFC



FTTx



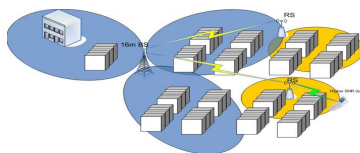
Power line

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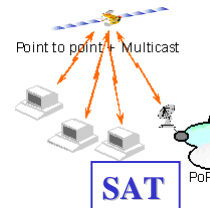
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Session 4_IS - 9

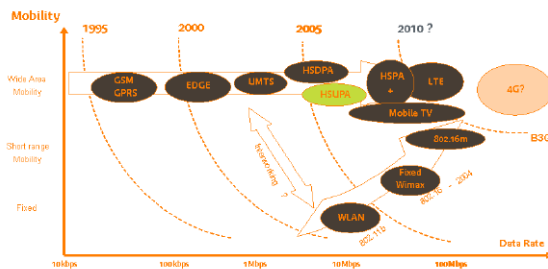
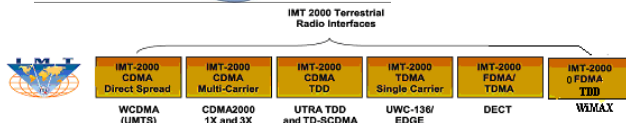
Broadband access technologies - wireless



Terrestrial Wireless



SAT



WCDMA (UMTS)	HSDPA	HSUPA	Evolved 3G
3GPP Release 99	Release 5	Release 6	Proposed Release 7 + Release 8 +
<ul style="list-style-type: none"> • FL: 64 kbps CS • 384 kbps to 2 Mbps • RL: 64 kbps CS • 384 kbps RL • MMS / LCS • ATM Transport 	<ul style="list-style-type: none"> • FL: 1.8 - 14.4 Mbps • IMS • IP Transport • WB-AMR 	<ul style="list-style-type: none"> • RL: 1.4 - 5.6 Mbps • MBMS • HSPA-UMTS Interworking 	<ul style="list-style-type: none"> • Proposed • Continued evolution of WCDMA in 5 MHz • All IP network • UMTS support new frequencies • OFDMA • MIMO • Flexible Bandwidth

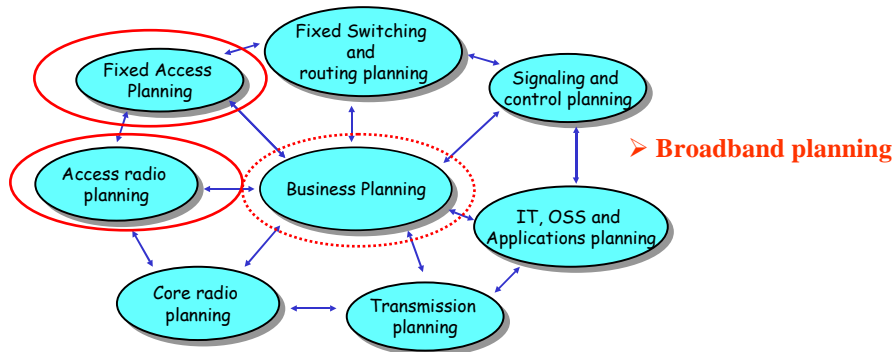
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Top Level Broadband Planning Domains

- NGN requirements to the planning tools are organised by eight planning domains derived from planner needs and networking problems



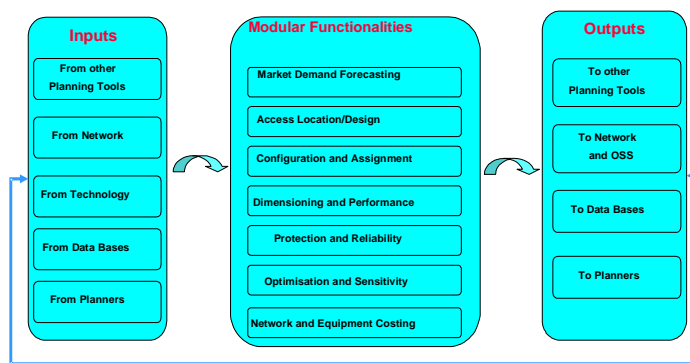
Guidelines for Network Planning Tools for Developing Countries and Countries with economies in transition, ITU, Geneva, 2005

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Session 4_IS - 11

Fixed Access Planning



Requirements for the fixed access planning domain

GNPT for Developing Countries and Countries with economies in transition, ITU, Geneva, 2005

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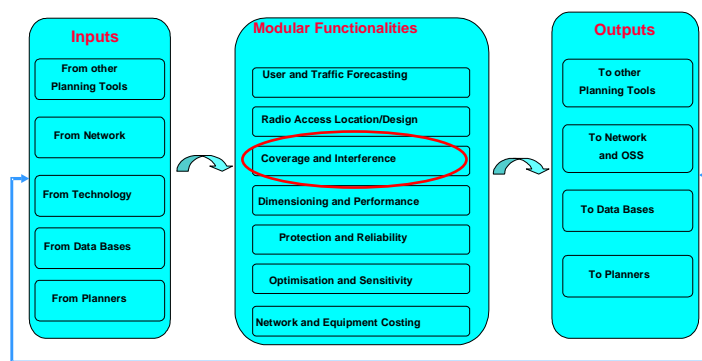
Session 4_IS - 12

Requirements related to NGN and corresponding new technologies

- Modeling of future NGN access network equipment, including equipment parameters, technological constraints, costs structures
- Extending of the forecasting models and methods due to NGN service/customer requirements
- Adapting of the calculation modules to the NGN access network requirements

Modeling of new services and new NGN access technologies

Radio Access Planning



Requirements for the radio access domain

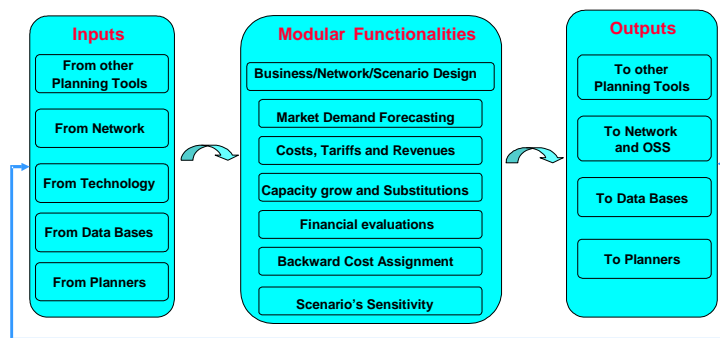
GNPT for Developing Countries and Countries with economies in transition, ITU, Geneva, 2005

Requirements related to NGN and corresponding new technologies

- **Modeling of new NGN services which do not fall in the present service models and specially multimedia service types**
- **Modeling of future NGN access network equipment, including equipment parameters, technological constraints, costs structures**
- **Extending of the forecasting models and methods due to NGN service/customer requirements**
- **Adapting of the calculation modules to the NGN access network requirements**

Coverage calculation methods related to the new NGN access technologies

Business Planning



Requirements for the business planning domain

GNPT for Developing Countries and Countries with economies in transition, ITU, Geneva, 2005

Requirements related to NGN and corresponding new technologies

- Modeling of service demands characterisation and traffics for VoIP and NGN multi-service flows
- Network and systems dimensioning with the multi-service NGN criteria
- Modeling of NGN systems with their corresponding capacities, capital costs, operational costs, lifetimes, etc.
- Representation of interrelations among NGN network subsystems, nodes and links

Pricing of new services and costing of new NGN access technologies

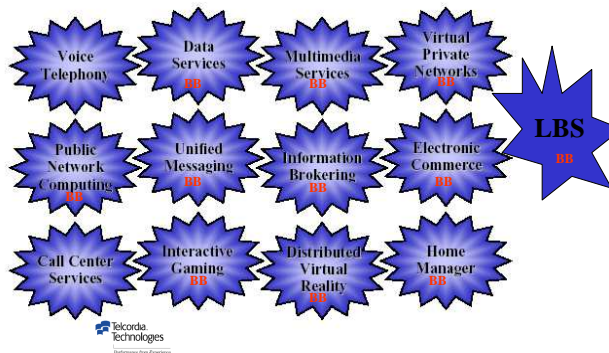
Modeling of broadband services

Combination of Services, e.g. triple play

Customer classes - customers using same services – e.g. residential with triple play

Service models :

- *Permanent (contention ratio)*
- *Elastic*
- *Real -Time CBR / VBR*



Modeling of broadband customers

Model of geographical location of customers
divided in customer classes

Digital maps – Geo
referenced and scaled

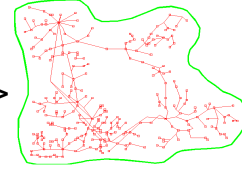


=>



zones / areas

=>



nodes / sites

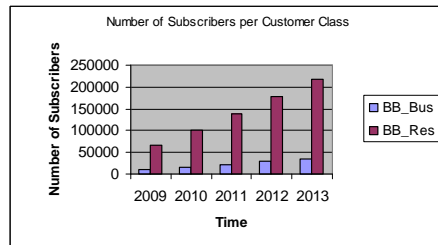
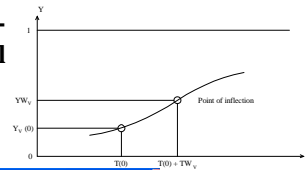
Possibility for interaction
with GIS systems

Forecasting of broadband customers

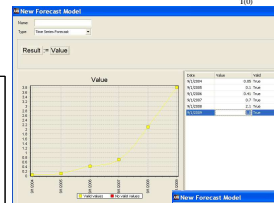
Forecasting of :

- Customers and penetration,
- Service utilization,
- Service tariffs

Trend methods -
Logistic model

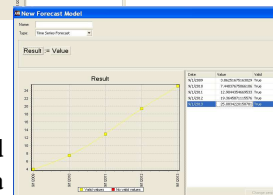


Evolution of BB customers

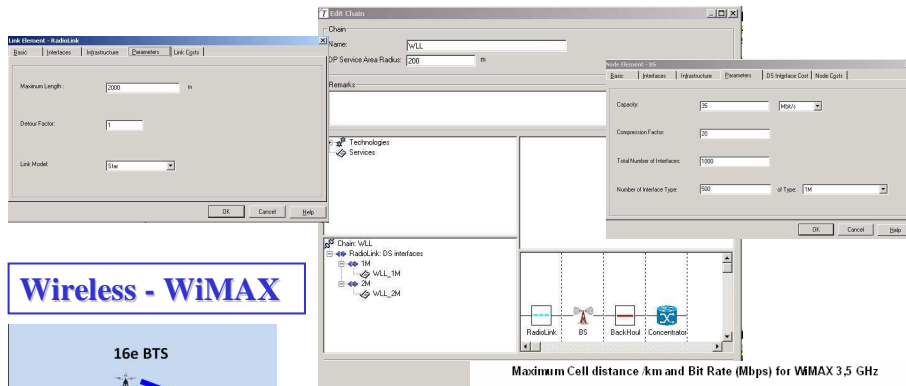


Historical
data

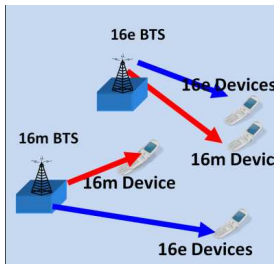
Forecasted
data



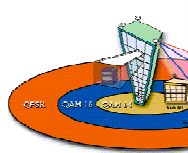
Modeling of broadband access technologies



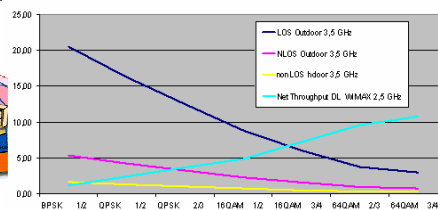
Wireless - WiMAX



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Maximum Cell distance km and Bit Rate (Mbps) for WiMAX 3.5 GHz



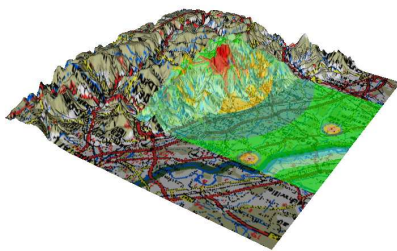
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Session 4_IS - 21

Design and Optimization of Broadband Access Networks

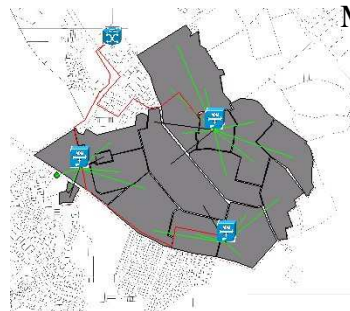
Optimization of node Locations :

E.g. optimal placement of BS



Optimization of Service areas :

E.g. optimal service areas of MSAN



Combinatorial problem, not possible to check all possible solutions :

- Heuristic algorithms
- Genetic algorithms, Simulated annealing algorithms

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Session 4_IS - 22

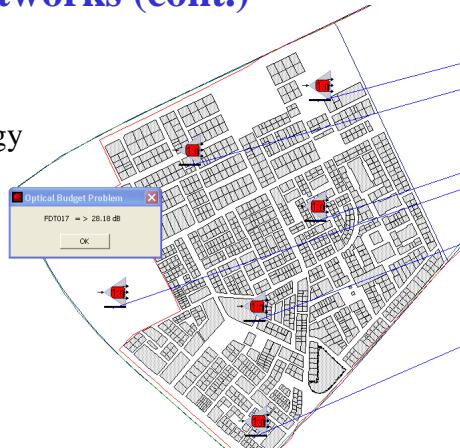
Design and Optimization of Broadband Access Networks (cont.)

Optical Budget impact:

FTTH – PON technology

Calculate Optical Budget :

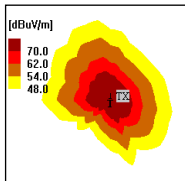
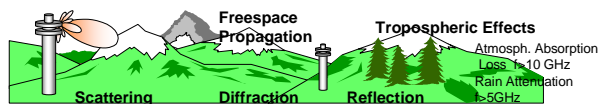
- verify design and adjust accordingly
- integrate in the optimization methods



Node	OLT CO	OF Primary	FDT 576 Site	OF Secondary	MaxDistance[m]	Budget[dB]	TotLoss[dB]	SpareBudget[dB]
FDT015	6.4	3.6	17.8	0.2	10912.6	28	28.02	-0.02
FDT013	6.4	3.5	17.8	0.2	10507.4	28	27.88	0.12
FDT016	6.4	3.7	17.8	0.2	11354.8	28	28.17	-0.17
FDT017	6.4	3.8	17.8	0.2	11384.8	28	28.18	-0.18
FDT014	6.4	3.8	17.8	0.2	11240.5	28	28.13	-0.13
FDT018	6.4	4	17.8	0.2	11833.4	28	28.34	-0.34

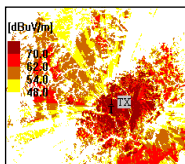
Modelling of Radio access - coverage

Prediction Models :



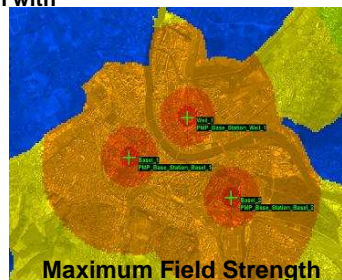
Non-Terrain Based

- Use of "effective antenna height"
 - Monotonous decline of field strength with increasing distance to transmitter
- Example: ITU-R P. 370

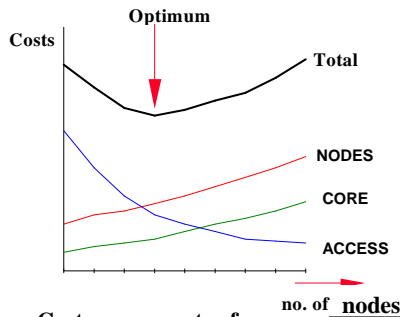


DTM Based

- Diffraction, shading, reflection
 - Terrain elevation and land use (morphology)
 - 2D and 3D models
- Examples: "Epstein-Peterson", "Longley&Rice", "Okumura-Hata"



Costing of Access Networks

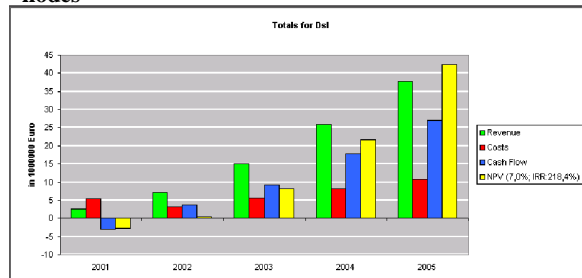


CAPEX
 ➤ Acquisition
 ➤ Installation

OPEX
 ➤ Maintenance

Cost components of telecom network

Overall economic results – Revenues, Cost, Cash-flow and Net Present Value



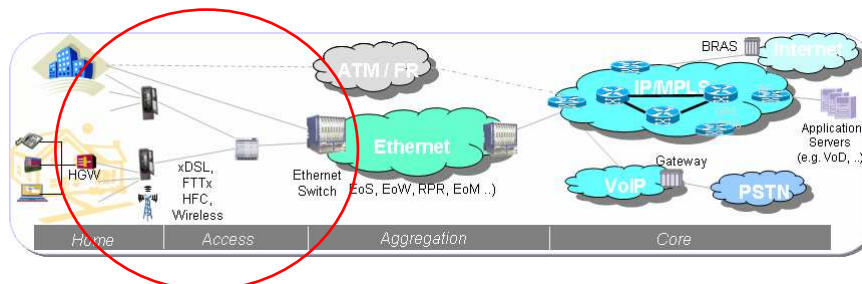
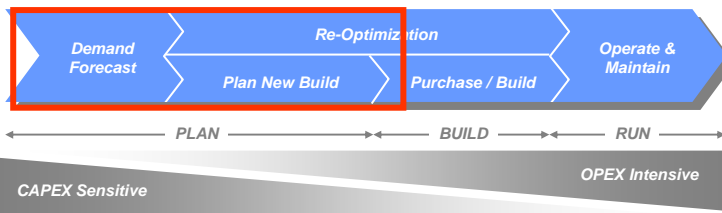
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Session 4_IS - 25

Planning of broadband access networks

Network planning



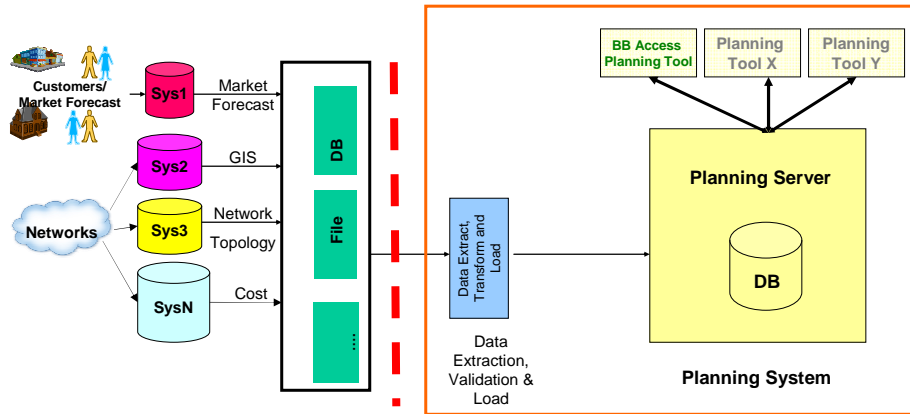
nodes

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Session 4_IS - 26

Planning of broadband access networks (cont.)



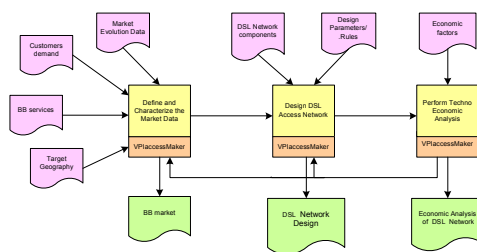
Planning Data Integration Architecture

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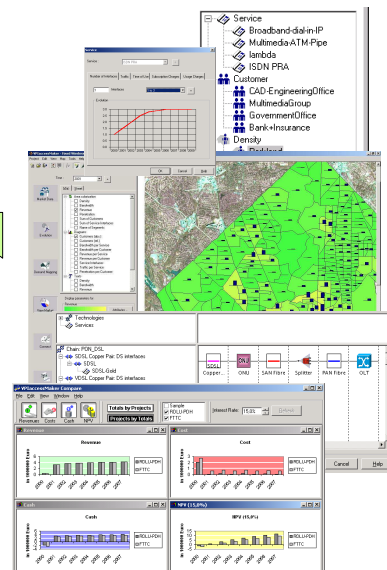
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Session 4_IS - 27

Broadband Planning Tools of ITU partners : Planning of wireline BB access network



- Capturing sophisticated market forecasts
- Selecting the best access technology for a geographic region
- Designing and dimensioning optimized access networks
- Providing detailed economic analysis based on forecasts and infrastructure investments

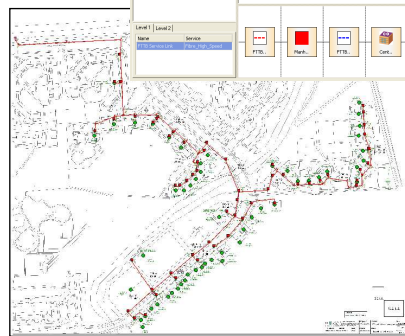
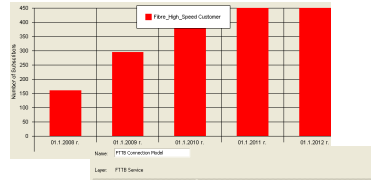
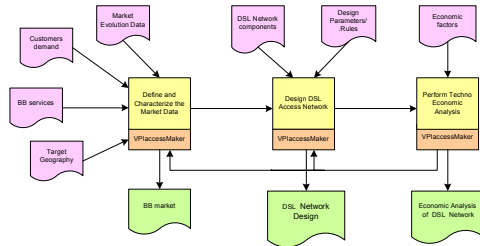


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Session 4_IS - 28

Broadband Planning Tools of ITU partners : Planning of wireline BB access network



FTTx access network design for outside plant :

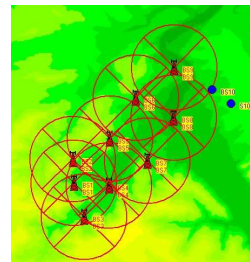
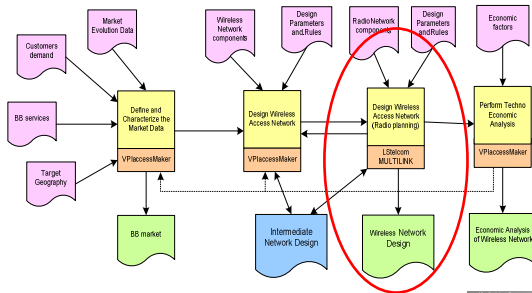
- Capturing sophisticated market forecasts
- Determining the best locations for fiber splitters, MSANs or DSLAMS
- Dimensioning duct and conduit capacities
- Providing detailed economic analysis based on forecasts and infrastructure investments

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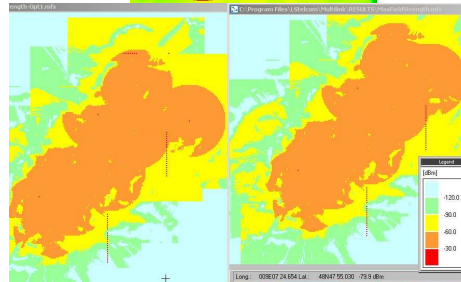
Session 4_IS - 29

Planning of wireless BB access network



Radio access coverage :

- Interactive microwave link engineering
- Design of radio access networks
- Planning wireless broadband networks
- Frequency allocation and coordination



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Session 4_IS - 30

ITU validation process for planning tools

Purpose: Validation of Network Planning Tools for Developing Countries and Countries with economies in transition

- **Compliance with the technical requirements specified in the ITU Guidelines for Network Planning Tools**
- **Performance of the planning tool in terms of size of the network and time to execute typical planning cases**
- **Creating of Set of real data reference networks**

Benefit of using planning tools

