



Session 6

NGN Planning Tools : ITU partners VPIsystems and LStelcom

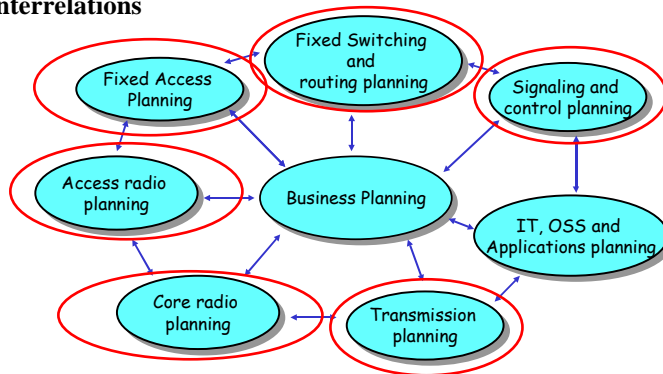
*Ignat Stanev
ITC, Bulgaria*

Presentation content

- **Requirements to the planning domains according to ITU GNPT document**
- **VPI Systems Network Planning Tools**
- **LStelcom Network Planning Tools**
- **ITU validation process for planning tools**
 - ❖ **Case study of Planning Broadband Access**
 - ❖ **Study of Planning Fixed BWA**
- **Future development**
 - ❖ **VPI's OnePlan system**
 - ❖ **LS Speed- Next Generation Planning Tools**

Planning Domains for top level Requirement Specifications

- requirements are organised by 8 planning domains derived from planner needs and networking problems
- minimise the number of tools to be applied and facilitate their interrelations



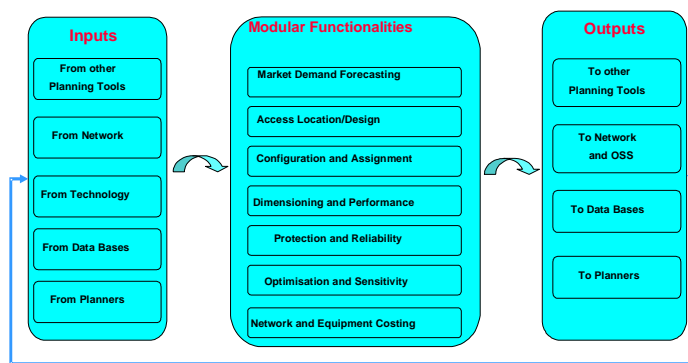
GNPT for Developing Countries and Countries with economies in transition, ITU, Geneva, 2005

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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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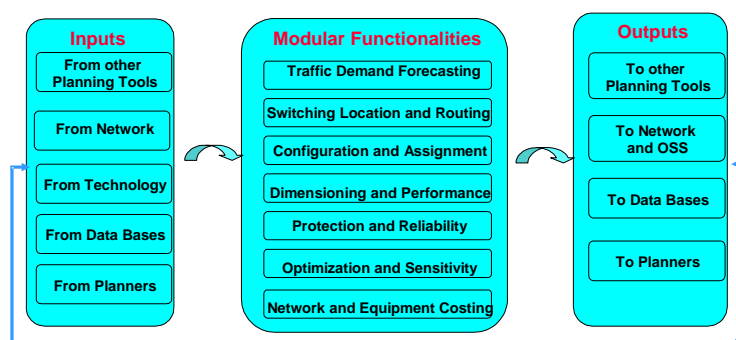
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Requirements related to NGN and corresponding new technologies

- 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

Fixed Switching And Routing Planning



Requirements for the switching and routing domain

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

Requirements related to NGN and corresponding new technologies

- **Service demands characterisation and traffics for VoIP and NGN multi-service flows**
- **Device catalogue covering most typical NGN technologies**
- **Routing and dimensioning taking into consideration protocol overheads and reservations mechanisms based on conditions at origin, destination or combined**
- **Routing flows for most typical cases including OSPF, shortest path, widest path and weighted cost functions**
- **Optimising locations and connections of network gateways**

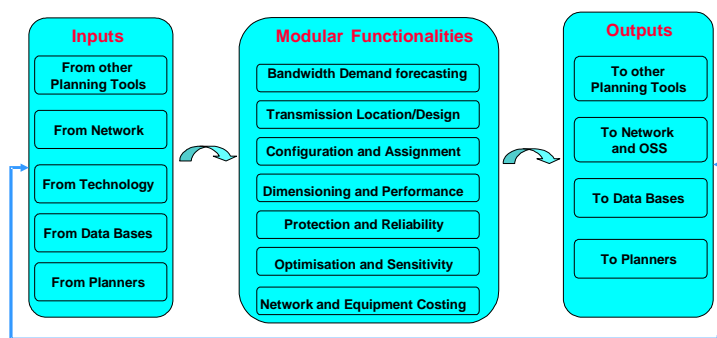
Requirements related to NGN and corresponding new technologies (continuation)

- **Formation of virtual networks**
- **Routing over ATM links or PDH/SDH systems or tunnelling via other IP links**
- **Routing methods for Labelled Switched Paths (LSP)**
- **Analysis of utilisation of network capacities and finding out the bottlenecks**
- **Handling and output IP routing tables**
- **Estimation of end-to-end delays**
- **Allocation of network cost to the bandwidth demands of carried services**

Requirements related to NGN and corresponding new technologies (continuation)

- Exact allocation of the IP or MPLS links
- Sub networking and addressing
- Configuring the network elements (IP router)
- Mapping tables with overheads, multiplex factors, net(to) and brut (gross) bit rates
- Standard import and export formats for the complex data structures required for the management of routes in IP/MPLS networks
- Estimation of investment costs for the rollout and the extension of the investigated multi-service network

Transmission Planning



Requirements for the radio transmission domain

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

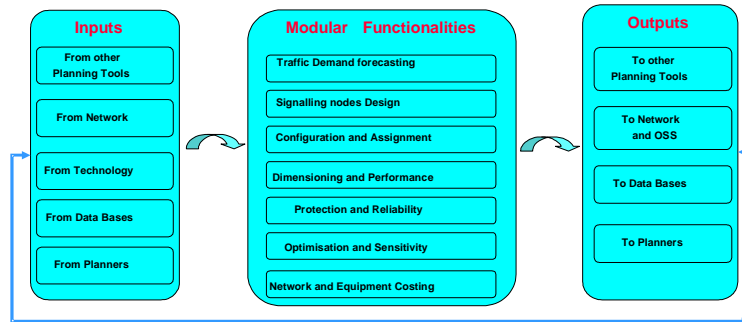
Requirements related to NGN and corresponding new technologies

- **Device catalogue covering Next Generation SDH technologies**
- **Formation of optical networks**
- **Capability to model IP over SDH and IP over WDM**
- **Modelling architecture and capabilities of Ethernet mesh topology with Spanning Tree Protocol (STP) and Ethernet ring topology with Resilient Packet Ring protocol (RPR)**

Requirements related to NGN and corresponding new technologies (continuation)

- **Modelling traffic adaptation procedures like the Generic Framing Procedure (GFP), Virtual Concatenation (VC) procedures and Link Capacity Adjustment Scheme (LCAS)**
- **Allocation of network cost to the bandwidth, circuit or fiber demands of carried services**
- **Estimation of investment costs for the rollout and the extension of the investigated multi-service network through the intermediate migration steps**

Signalling, Control And Nm Planning



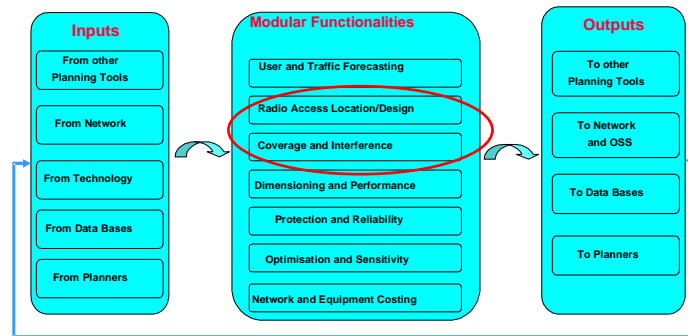
Requirements for the signalling domain

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

Requirements related to NGN and corresponding new technologies

- **SS7 network planning tool should be easily upgraded for the requirements related to NGN and corresponding new technologies in respect to the demand flows and protection level. Also capabilities should be provided to analyze and optimize signalling gateway locations and dimensioning**

Radio Access Planning



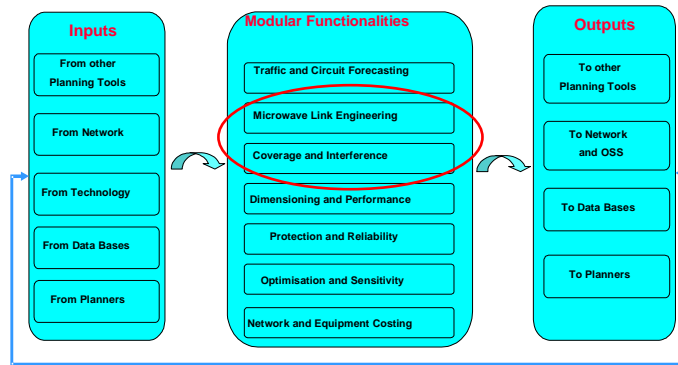
Requirements for the radio access domain

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

Core Radio Planning



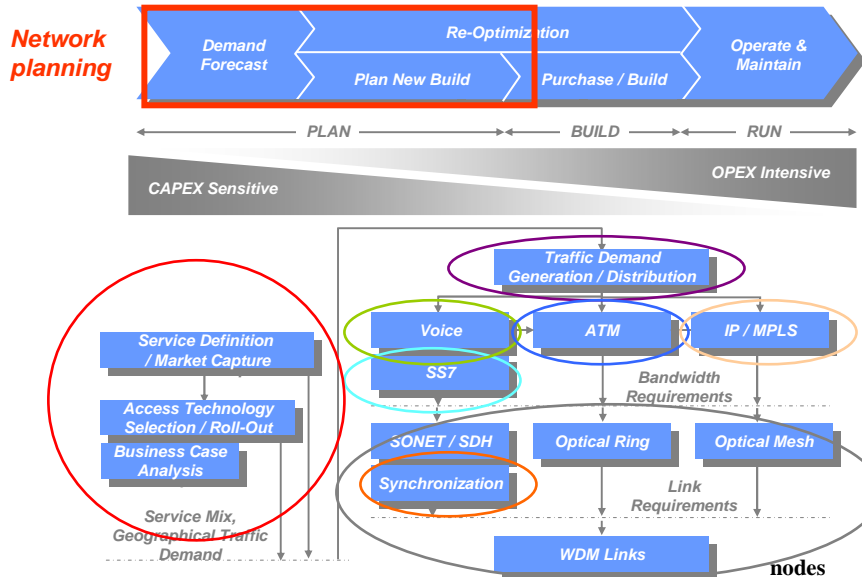
Requirements for the radio access domain

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

Requirements related to NGN and corresponding new technologies

- Service demands characterisation and traffics for VoIP and NGN multi-service flows
- Device catalogue covering most typical NGN technologies
- Optimising locations and connections of network gateways
- Estimation of investment costs for the rollout and the extension of the investigated multi-service network
- ...

VPI Systems Network Planning Tools

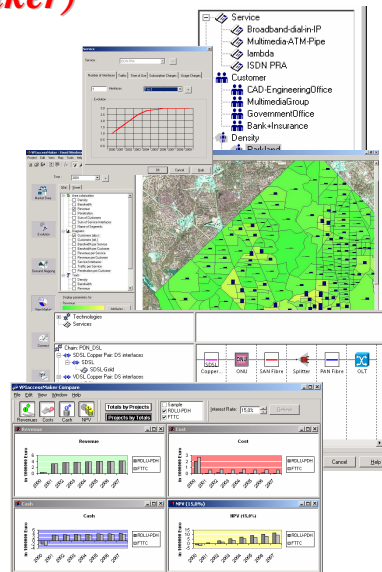


Planning tools - OnePlan Access™ (VPIaccessMaker)

Provides geo-market forecasting, access network design and dimensioning, and economic analysis functionality

OnePlan Access plans access networks of any technology and produces business cases for new services by:

- Capturing sophisticated market forecasts
- Selecting the best access technology for a geographic region
- Designing and dimensioning optimized access networks with wireline and wireless technologies
- Providing detailed economic analysis based on forecasts and infrastructure investments
- Visualizing geographic data such as area maps, customer locations and network layout



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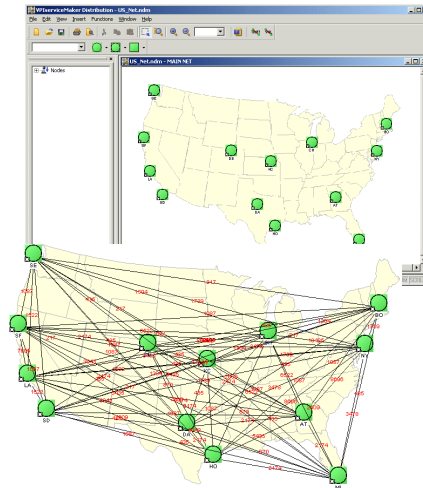
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Planning tools - OnePlan Distribution™ (VPIserviceMaker Distribution)

OnePlan Distribution supports users with the following major planning steps:

- *Calculating a traffic matrix based on input data*
- *Equalizing unbalanced traffic demands based on traffic measurement data*
- *Manipulating a traffic matrix (single, hybrid or interconnect) through changing values or interest factors*



Planning tools - OnePlan Switch™ (VPIserviceMaker Switch)

Key Features

- *Support for hierarchical and non-hierarchical circuit-switched TDM networks*
- *Support of fixed alternate routing and dynamic network routing schemes*
- *Cost-optimized circuit-switched network design capabilities:*
 - *Generate cost-optimized trunk link topology, considering traffic and service requirements, topology, diversity constraints and cost parameters*
 - *Calculate bandwidth requirements and expected switch and trunk group loads*
 - *Route end-to-end traffic while taking into account grade of service and call blocking probability constraints*
- *Comprehensive network performance analysis*

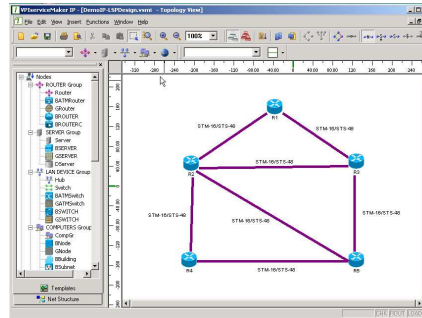
To further support next generation VoIP network planning and design:

- *VoIP traffic modeling and profiling, with consideration of various voice coding schemes*
- *Support of equipment models/libraries for media gateways, signaling gateways, media control gateways and session border controllers*
- *Optimized VoIP network design*
- *Comprehensive VoIP network performance analysis*
- *TDM to VoIP network migration*

Planning tools - *OnePlan IP™* (*VPIserviceMaker IP*)

Key Features

- Plans IP network capacity for best-effort services (such as HTTP, FTP, e-mail, news services, etc.) and other services in an access IP network
- Provides Open Shortest Path First (OSPF) topology checks, effective bandwidth calculation, bottleneck identification, export and import of user-definable access profiles and device libraries, detailed reports of all planning data and more
- Optimally computes the Label Switched Paths (LSPs) and allocates bandwidth for the MPLS core transport to meet the QoS requirements of different types of services



Node 1	Node 2	Effective utilization (Mbit/s) 1-2	Effective utilization % 1-2	OSPF utilization 1-2	LSP utilization 1-2	Effective utilization (Mbit/s) 2-1	Effective utilization % 2-1	OSPF utilization 2-1	LSP utilization 2-1	Free capacity 1-2	Free capacity 2-1
R2	R3	3400.000	141.350	0.000	3400.000	0.000	0.000	0.000	0.000	894.624	2426.376
R2	R5	5800.000	120.563	0.000	5800.000	1200.000	24.944	0.000	1200.000	888.248	5616.752
R1	R2	4800.000	99.777	0.000	4800.000	2400.000	49.999	0.000	2400.000	10.752	2410.752
R1	R3	2400.000	99.777	0.000	2400.000	0.000	0.000	0.000	0.000	5.376	2426.376
R6	R4	4400.000	91.462	0.000	4400.000	0.000	0.000	0.000	0.000	410.752	4810.752
R2	R4	3400.000	70.675	0.000	3400.000	1800.000	37.416	0.000	1800.000	1410.752	3010.752
R3	R5	1400.000	59.203	0.000	1400.000	0.000	0.000	0.000	0.000	1006.376	2426.376

Planning tools - *OnePlan Ethernet™*

Key Features

- Ethernet service and traffic models supporting Ethernet Private Lines and switched Ethernet services (point-to-point and multi-point) with Class of Service (CoS) requirements
- Ethernet network design and planning functionality including equipment models, L2 Ethernet link/services (i.e., VLANs) design and dimensioning, graphical views of multi-layer designs and much more
- A comprehensive data import and export interface

Planning tools - OnePlan ATM/FR TM (VPIServiceMaker ATM/FR)

Key Features

- **Comprehensive multi-service modeling capabilities:**
 - Describe service volumes with specific parameters and service categories
 - Profile ATM classes with real-time, non-real-time, bandwidth and QoS requirements
- **Traffic characterization, service identification and traffic modeling by mapping and clustering services to appropriate ATM traffic and Virtual Path (VP) classes**
- **Advanced ATM/Frame Relay network sizing functions:**
 - Aggregate ATM traffic classes to VP classes
 - Calculate VP bandwidth requirements based on traffic load
- **Multi-service ATM/FR network design capabilities:**
 - Generate cost-optimized ATM link topology
 - Optimize routing connections according to various matrices
- **Powerful network analysis capabilities:**
 - Analyze network design and generate detailed reports
 - Identify potential bottlenecks and plan relief categories

Planning tools - OnePlan SS7 TM (VPIServiceMaker SS7)

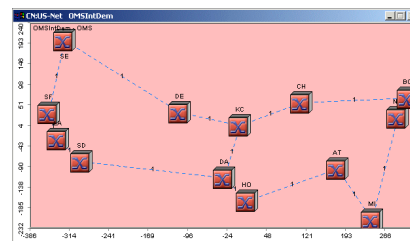
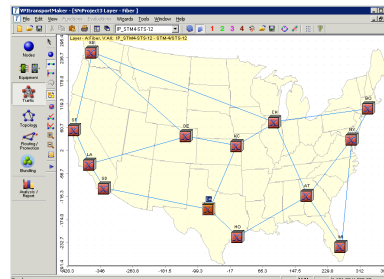
Key Features

- **Support of a wide variety of signaling protocols (e.g. SIP, H.323, MGCP, SiGTran)**
- **Automatic generation of signaling routing tables for signaling nodes to determine route sets without possibility of circular routing**
- **Calculation of bandwidth requirements and expected signaling node and link loads**
- **Optimal routing of end-to-end signaling relations while accounting for reliability constraints**
- **Signaling network performance metrics to aid in bottleneck reductions, traffic load redistributions and network reliability**
- **Comprehensive modeling supporting hybrid SS7 and VoIP signaling networks**

Planning tools - OnePlan Transport™ (VPITransportMaker™)

Key Features

- *Link/node failure analysis*
- *Network survivability studies*
- *What-if analysis and detailed reporting*
- *Hot-spot identification*
- *SDH/SONET/Ethernet/WDM modeling*
- *Equipment and Central Office (CO) modeling capabilities*
- *Scripting interface*
- *Multi-Period modeling*
- *Greenfield and brownfield modeling*
- *Top-down and bottom-up routing plans*



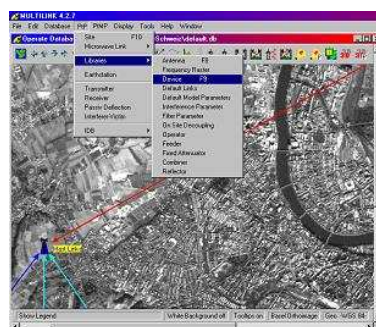
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Radio planning tool - MULTILINK

MULTILINK is a network planning tool for



- **Interactive microwave link engineering**
- **Planning of core radio network**
- **Design of radio access networks**
- **Planning wireless broadband networks**
- **Frequency allocation and coordination (ITU-R recommendations are implemented)**

MULTILink could be used for case studies, as well as for the planning, operation and optimization of real wireless networks

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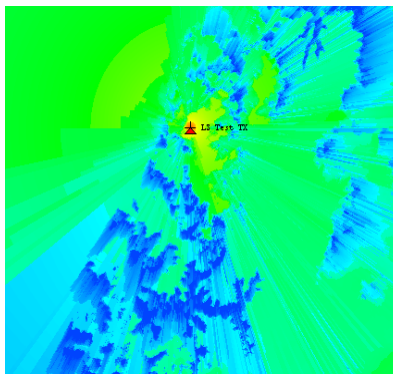
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LStelcom MULTIlink - Propagation Models

- **Information models**
 - Sight Check
 - Sight Check (Fresnel)
- **Physical models**
 - Free space
 - Epstein-Peterson
- **Empirical models**
 - Okumura-Hata
- **Mixed models**
 - Longley-Rice
 - ITU-R P.370
 - ITU-R P.1546
 - GEG
 - L&S VHF/UHF

Propagation Prediction



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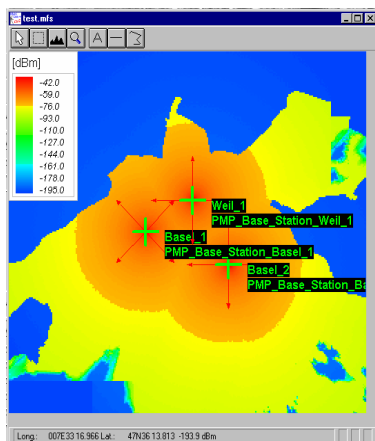
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LStelcom MULTIlink – Network Processor

Maximum Field Strength

Network Processor



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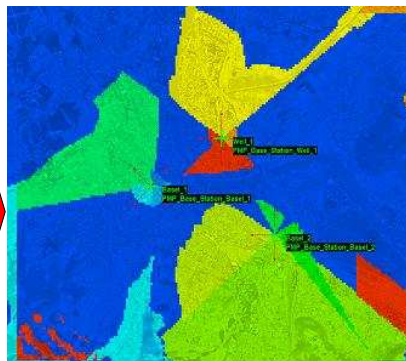
LStelcom MULTIlink – Network Processor

Network Processor

Maximum Server



Best Server

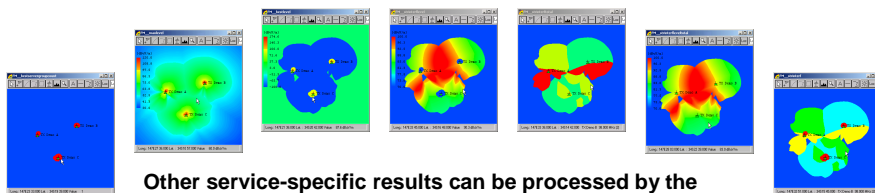


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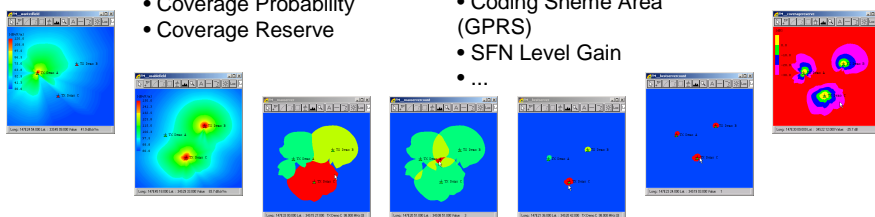
LStelcom MULTIlink – Network Processor



Other service-specific results can be processed by the Network Processor, like:

- Number of Max Sever
- Number Best Server
- Strongest Interferer
- Level of Strongest Interferer
- Coverage Probability
- Coverage Reserve
- Power Difference
- Assignment Probability
- Handover Zone
- Requeired Channels
- Coding Sheme Area (GPRS)
- SFN Level Gain
- ...

Network Processor

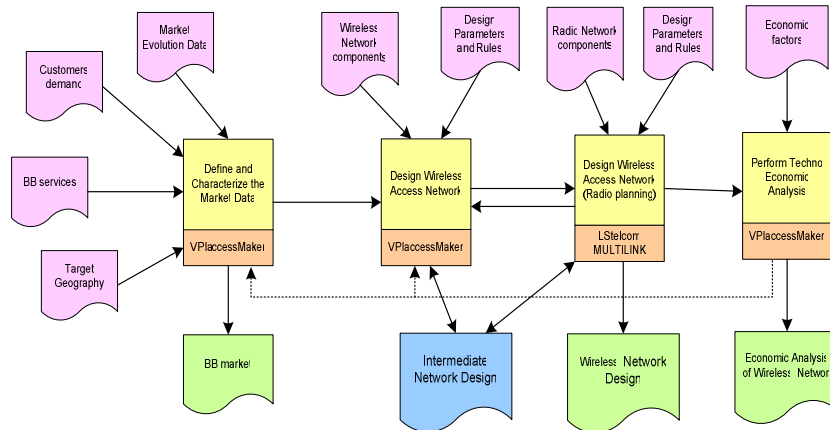


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Case study - Planning process

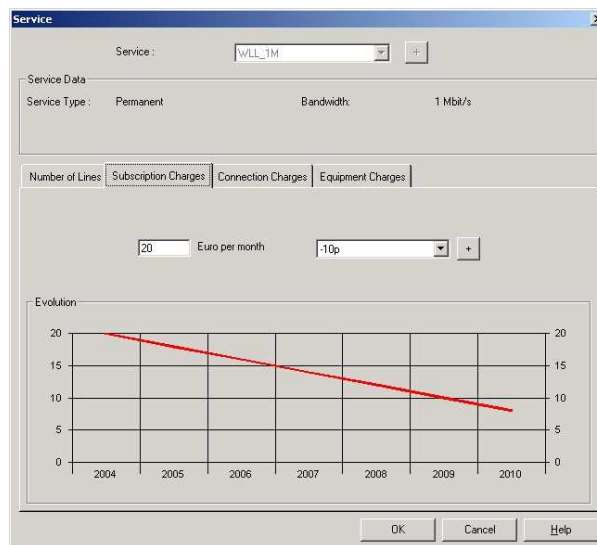


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Case study – services and customers definition



➤ Permanent BB service – BB connection at 1 Mbit/s

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Case study - Service Area definition

Service area

Name: Stuttgart

Density: Stt

Area Size: 35,1717 kml

Remarks: With BB penetration between 10% (2004) and 70% (2010) from all customers and strategy for 20% of the market, it makes penetration from 2% to 14%.

Customer Class	Evolution	Penetration...	Total Number of Subscribers 2004
Res	2_14	2%	4811,49
SOHO	2_14	2%	534,61

Customer of Service Area - Stuttgart

Customer: Res

Evolution: 2_14

Penetration graph showing % from 2004 to 2010. The graph shows a linear increase from 2% in 2004 to 14% in 2010.

➤ Average BB penetration from 10% to 70% and strategy for 20% of the market

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Case study - Technology Definition

Edit Chain

Chain Name: WLL

DP Service Area Radius: 200 m

Remarks:

Technologies

- Services
- Chain: WLL
 - RadioLink: DS interfaces
 - 1M
 - WLL_1M
 - 2M
 - WLL_2M

RadioLink: DS interfaces

Capacity: 35 Mbit/s

Compression Factor: 33

Total Number of Interfaces: 1000

Number of Interface Type: 500 of Type 1M

Link Element - Blank

Maximum Length: 5000 m

Detour Factor: 1

Link Model: Star

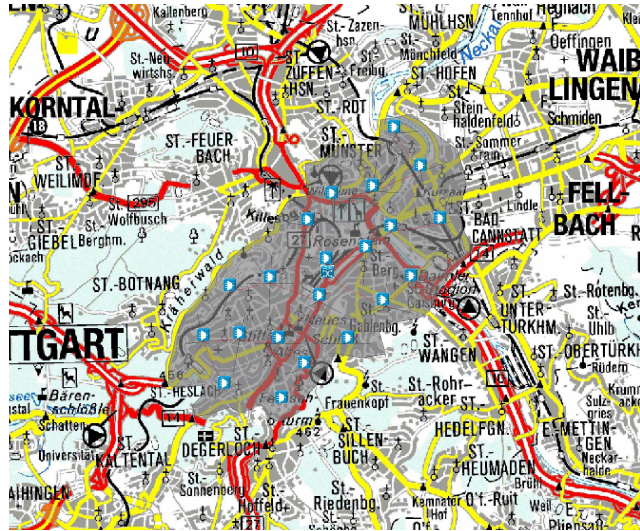
RadioLink BS BackHaul Concentrator

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Case study – planning of DSL access network



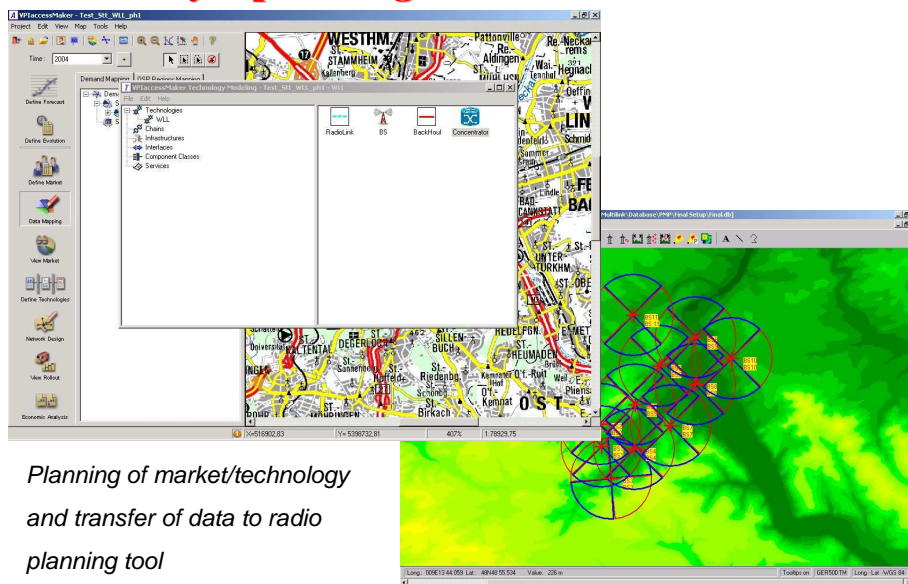
Optimization of access node number/locations and service areas

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Case study – planning of wireless access network



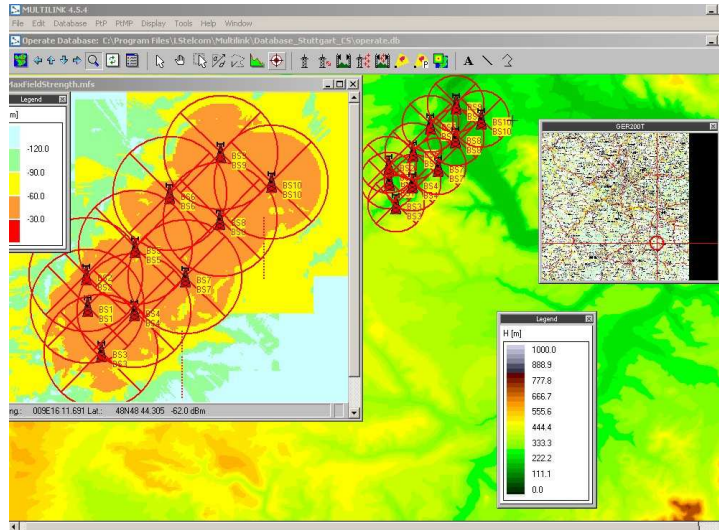
Planning of market/technology and transfer of data to radio planning tool

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Case study – planning of wireless access network



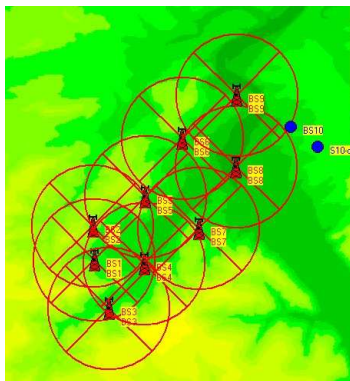
Max server
coverage :
calculation and
improvement

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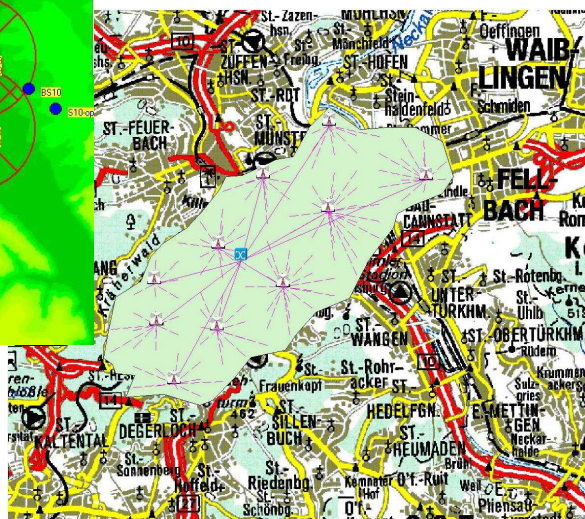
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Case study – planning of wireless access network



Transfer of results from
radio planning tool for
costing of the network

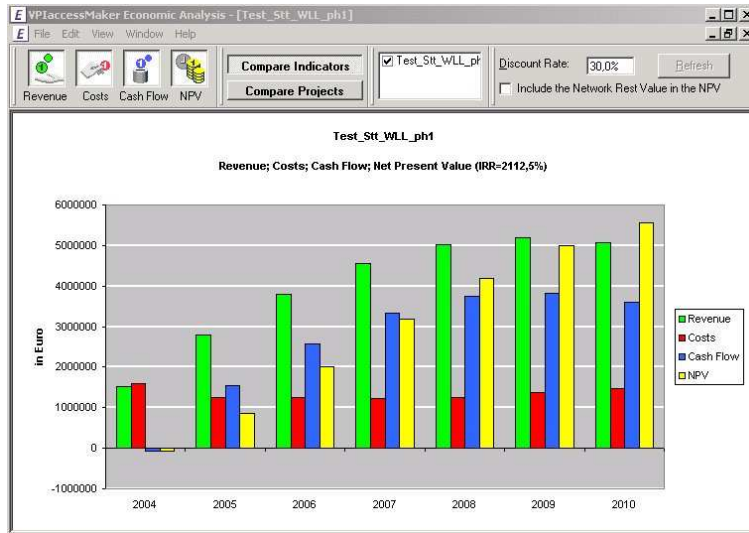


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Case study - Economic Analysis



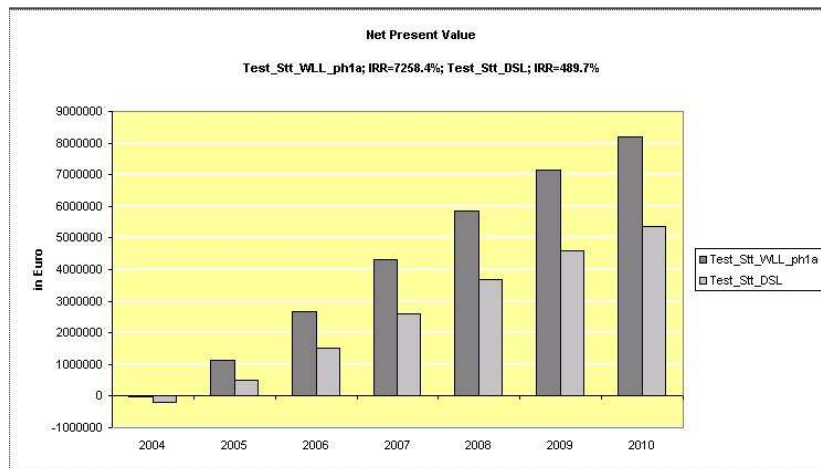
Wireless access network

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Case study - Economic Analysis



Comparison of DSL and Wireless access network

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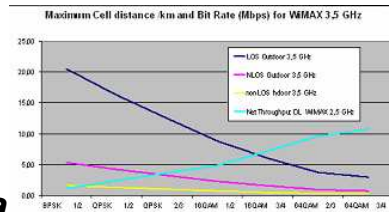
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Study of Planning Fixed BWA

Project Description

- BWA Network to provide fast Internet
- 3,5 GHz band (WiMAX)
- Two different Scenarios
 - Scenario 1: *Rural Area*
 - Scenario 2: *Urban Area*



Presented on ITU-BDT Regional Network Planning Workshop with Tool Case Studies for the Arab Region Cairo, Egypt, 16 – 27 July 2006

Planning Fixed BWA - “Rural Area”

- Valley, villages
- Lower average income
- Lower penetration of home computers
- Fewer business
- No DSL via cable available, “no competition”



Rural Area

- Residential-dominated market
- Outdoor coverage (using outdoor antenna)
- Large cell sizes
- Existing core network / microwave link for backhaul
- Data Rate: >1.0 Mbit/s



Suburban Area

Planning Fixed BWA - "Urban Area"

Urban Area



- Major city, high-rise buildings
- Many potential broadband customers
- High penetration of home computers
- Many business users
- Cable and/or DSL available, strong competition
- Residential & business market
- Indoor coverage dominant
- Small cell sizes
- Extension (more capacity) of existing or new core network necessary
- Data Rate: >2.5 Mbit/s, 1Mbit/s

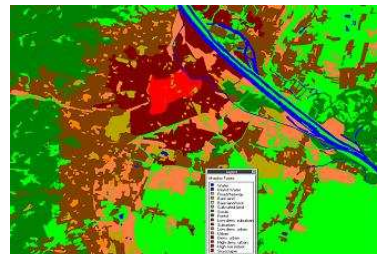
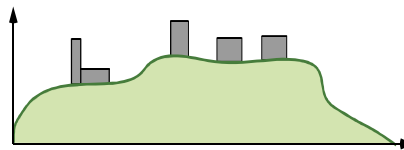
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Planning Guideline Parameters - "Rural Area"

- Based on existing sites
- Tx antenna height: 20m above ground
- Receiver height: 2.5 / 5.0 / 9.0 m
- **Medium Resolution Data** (25m / 50m)
- based on 2 different files:
 - Digital Terrain Model, elevation of earth-surface
 - Digital Clutter Model, describing land use above terrain
- Provide no building heights



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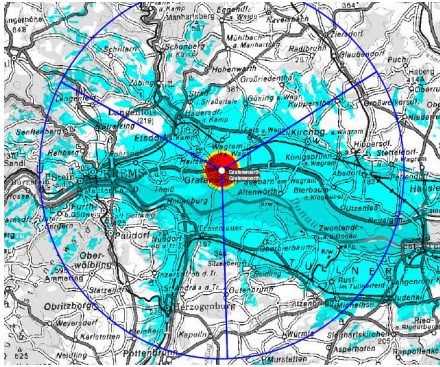
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Planning Fixed BWA - “Rural Area”

Rural Scenario

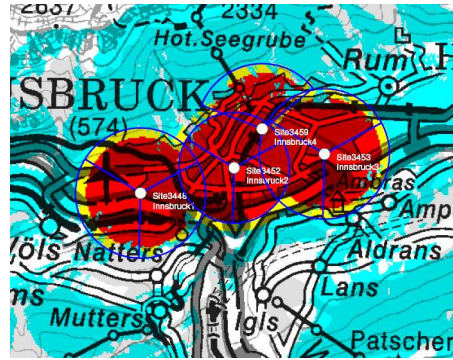
Coverage Plot



blue: outdoor 1Mbit/s
yellow: indoor 1Mbit/s
red: indoor 2,5 Mbit/s

Suburban Scenario

Coverage Plot



blue: outdoor 1Mbit/s
yellow: indoor 1Mbit/s
red: indoor 2,5 Mbit/s

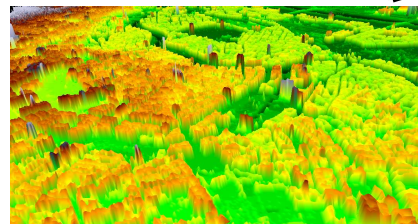
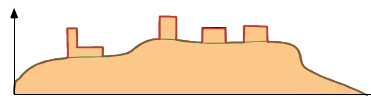
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Planning Guideline Parameters - ” Urban Area”

- “Greenfield” planning, fictive sites
- Tx antenna height: 3m above rooftop
- Receiver height: 2.5 / 5.0 / 9.0 m
- **High Resolution Data** (1m / 5m)
- Digital Elevation Model, elevation of earth surface + building heights
- Sat-Image, 1m resolution
- Provide details of buildings



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Planning Fixed BWA - "Urban Area"



Urban Scenario

*Sub-Scenario 1:
Basic coverage*

*Sub-Scenario 2:
Extended indoor
coverage*

	Base- Stations	Covered Households		
		Indoor	Outdoor	Total
Scenario 1	16	34 %	36 %	70 %
Scenario 2	60	65 %	30 %	95 %

Partnership between ITU and VPIsystems/LStelcom

- Participation in ITU Conferences, Exhibitions, Regional Seminars and Workshops
- Partnership agreement for utilization of the VPIsystems/Lstelcom planning tools
- Assisting of ITU experts in creating case studies for developing countries
- Contribution to the ITU Reference Manual for „Telecom Network Planning for evolving Network Architectures“