



Net Technologies Indoor Radio Design Concept and Methodology

CCW23

Helsinki

Net Technologies

Indoor Radio Design

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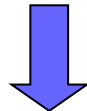


1. What are the Communication Plan Aspects
2. Life-Cycle of a Critical Communications Radio Network Deployment
3. Preparation Phase
4. Design Phase
5. Implementation Phase
6. Testing Phase
7. Optimization Phase
8. Training Phase



What are the Communication Plan Aspects

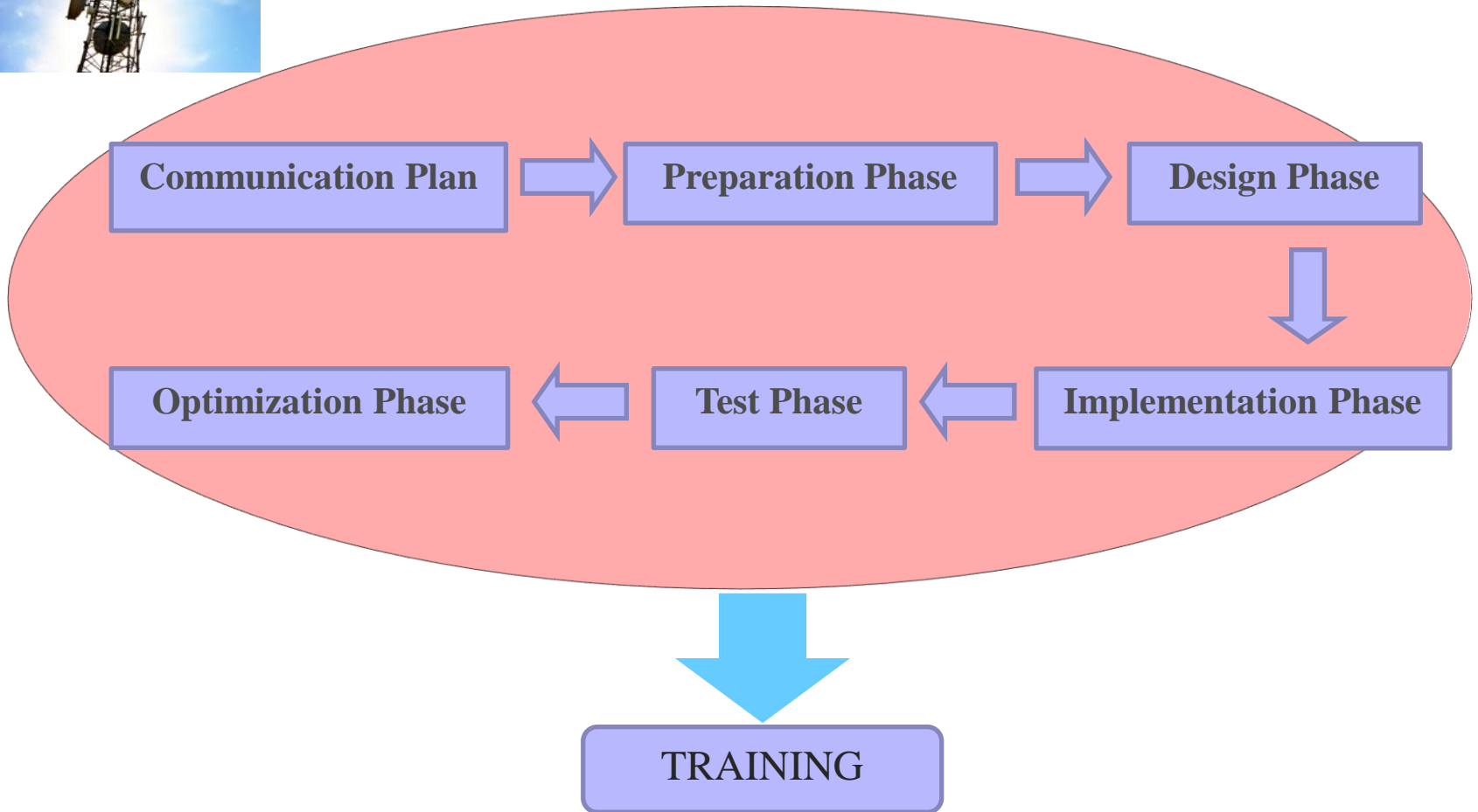
- Definition of Communication Network Characteristics
- Definition of Users' Needs
- Correlation between Technical and Users Requirements
- Specification of network characteristics by emulating different deployment scenarios leading to appropriate equipment selection and planning inputs
- Estimation of Equipment Cost, Capacity Efficiency and Frequency Allocation
- Definition of Training Practices



SUCCESSFUL NETWORK DEPLOYMENT AND OPERABILITY



Life-Cycle of a Radio Network Deployment



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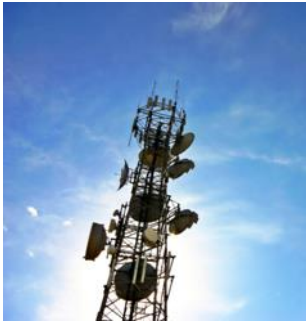
Indoor Radio Design



Preparation Phase

- Establish terms of Reference
- All tools/equipment should be in place/ordered
- Project & Quality plan definition
- Definition of communication channels with the customer
- Agreement on scheduled meetings
- Site survey schedule to be planned
- Design aspects to be planned
- Testing aspects to be planned
- Training Phase to be planned

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Design Phase

- ❑ Site Survey
- ❑ Preliminary Design
- ❑ Radio Design – Indoor

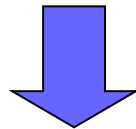


Design Phase – Site Survey

■ Site Survey

Consists of Visual Inspection for:

- ❑ Candidate site position (Lat/Lon),
- ❑ Altitude, Type of area, Obstructions, Access to site, Antenna poles etc.
- ❑ Existing Communication infrastructure
- ❑ Indoor locations and Service areas.
- ❑ Field measurements and evaluation of current coverage



Provides valuable input for the Radio Planning process

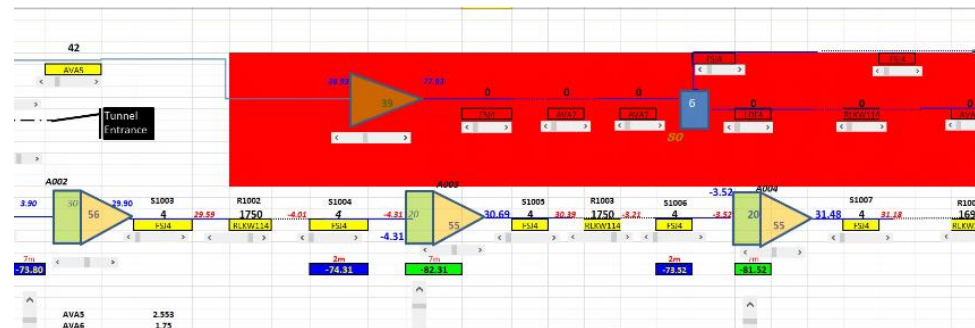


Design Phase – Preliminary Design

Why preliminary design is needed?

- For Assisting Engineering efforts towards detailed design
- Providing reliable input to decision makers for initial cost control handling
- Providing in a time-efficient manner, network dimensioning estimations for initiating the detailed design

Net Technologies has developed a Link Budget Calculation Tool for providing all relevant information to Radio Planners and Decision Makers





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Design Phase – Radio Design Indoor

Indoor Radio Design Workflow

- Indoor Area 3D Model Design, based on Site Survey Findings and Architectural drawings
- Creation of Network's Components (Antennas, Radiating Cables, Splitters, Amplifiers etc.)
- Link Budget Calculations
- Incorporating of Network's Components on the 3D Model
- Simulation Tool Setup
- Simulation's Results Evaluation and Network Optimization

Simulations / Results

- Received Power
- Best Server
- Cell Area
- SNIR



Indoor Area 3D Model Design, based on Site Survey Feedback (1)

Based on the Site Survey feedback, 3D Model Design begins. Site Survey provide us with significant information about:

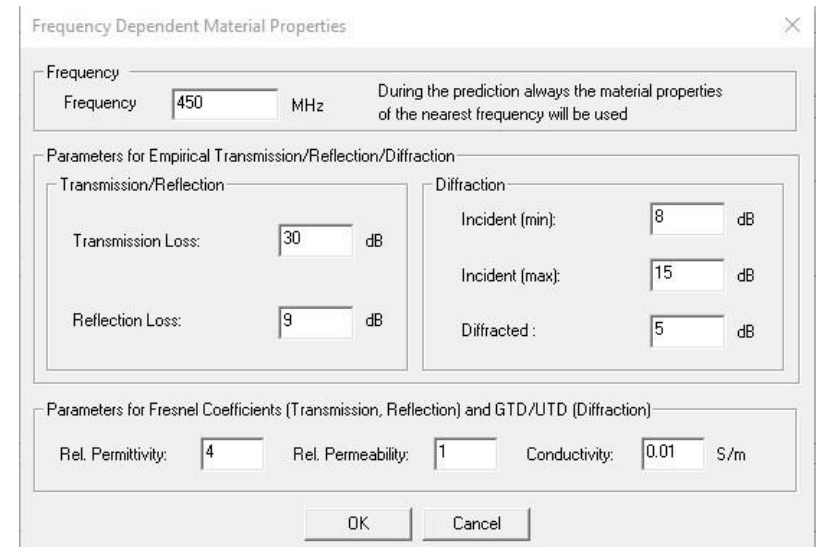
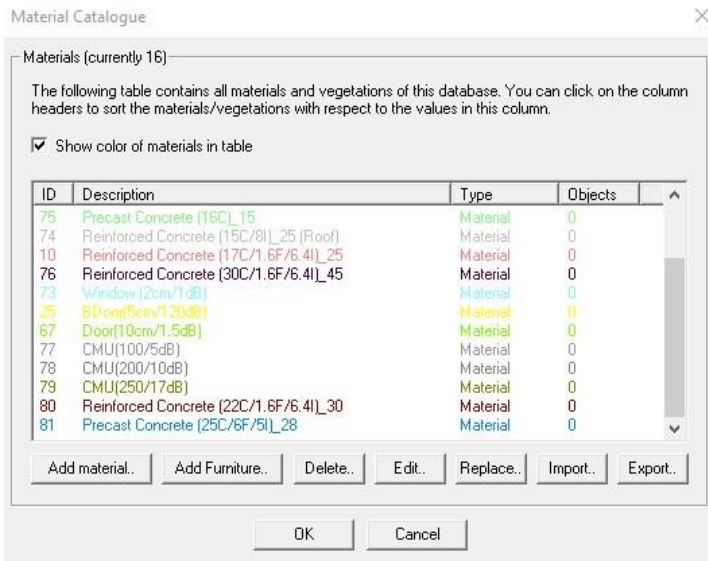
- Walls/Structures penetration losses and building materials
- Buildings/ceilings/objects heights
- Reference distances

All the previous information should be taken in account for the effective and correct design of the 3D Model, in order to resemble as much as possible with the real area of interest.



Indoor Area 3D Model Design, based on Site Survey Feedback (2)

- Walls/Structures penetration losses and building materials information, is used for the creation of the materials at the 3D model creation software tool.





Indoor Area 3D Model Design, based on Site Survey Feedback (3)

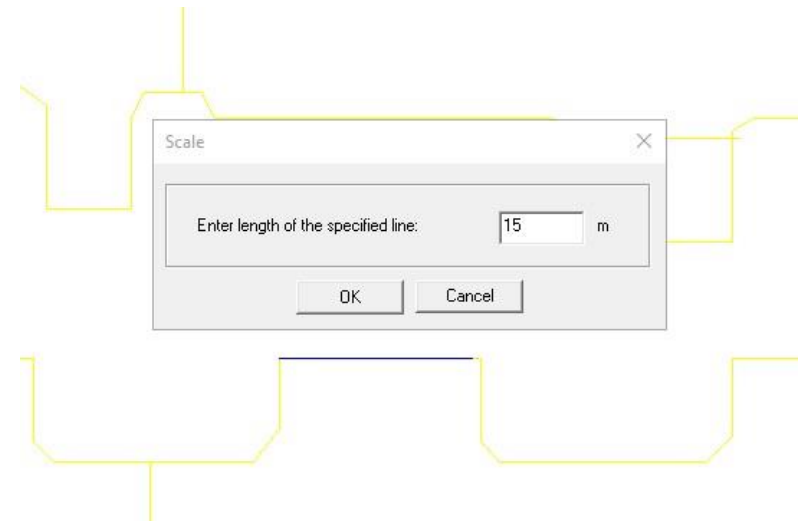
- Buildings/ceilings/objects heights information is used for the definition of structures heights at the 3D model creation software
- Reference distances information is used to scale the distances of our 3D model in order to match with the real area of interest scaling

Geometrical Parameters for Orthogonal Drawing Mode

Object relative to current plane (current 3rd coordinate)
Height of walls relative to current plane: m

Upper and lower coordinate defined individually (and absolute)
Min. Coord: m Max. Coord: m

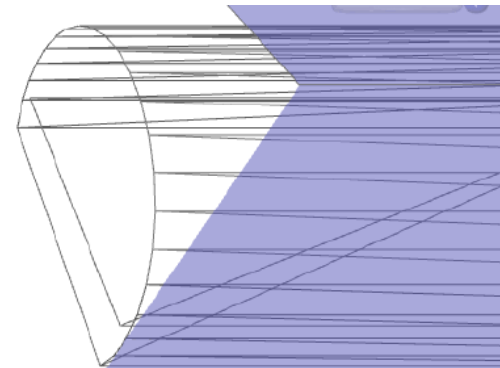
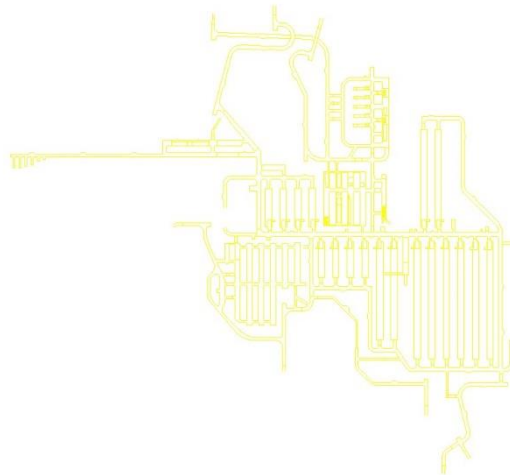
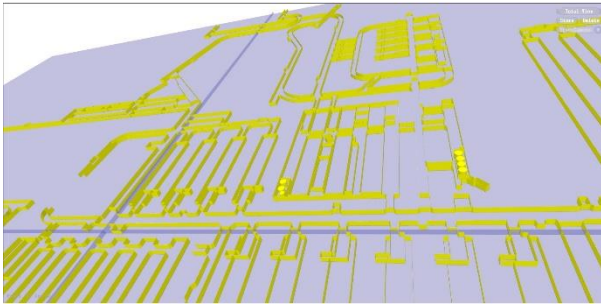
Automatic mode
If floor levels are defined, height of walls is adapted according to the active floor level. Otherwise height of walls is relative to current plane.





Indoor Area 3D Model Design, based on Site Survey Feedback (3)

- Combine all the previous elements that we created, for the finalization of our 3D model design at the software tool





Creation of Network's Components

- Network's Components creation is mandatory in order to model in our software all the required equipment (Antennas, Radiating Cables, Splitters, Amplifiers etc..) that we are planning to use for our Indoor Radio Design

Model	Type	Description
500HM	Terminator	5W N Male Dummy Load
716-ATT-03-05	Attenuator	Fixed Attenuator 3dB
716-ATT-06-05	Attenuator	Fixed Attenuator 6dB
716-ATT-10-05	Attenuator	Fixed Attenuator 10dB
716-ATT-20-05	Attenuator	Fixed Attenuator 20dB
756430-DS	User defined component	DC Block
80010339	Antenna	2 dBi Omni Indoor
APG-BNFN-350	User defined component	Surge Arrestor
AVA5-50	Cable	7/8" Coaxial Cable
AVA6-50	Cable	1-1/4" Coaxial Cable
AVA7-50	Cable	1-5/8" Coaxial Cable
BSF3604	Amplifier	FOREP
C-0-PSU-NAI	Splitter	0 dB Directional Coupler
C-10	Splitter	10 dB Directional Coupler
C-10a	Splitter	10 dB Directional Coupler
C-15	Splitter	15dB Directional Coupler
C-15a	Splitter	15 dB Directional Coupler
C-20	Splitter	20_dB Directional Coupler
C-20a	Splitter	20dB Directional Coupler
C-30	Splitter	30dB Directional Coupler
C-30a	Splitter	30db Directional Coupler
C-6	Splitter	6 dB Directional Coupler
C-6a	Splitter	6dB Directional Coupler
D-CSR	Amplifier	D-CSR3604

✕

Amplifier

General Properties

Model:

Description:

Manufacturer:

Price (Unit):

Price (Installation):

Color:

Amplification

Amplification independent of frequency: dB

Frequency dependent amplification:

Min. Frequency [MHz]:

Max. Frequency [MHz]:

Min. Input Power [dBm]:

Max. Input Power [dBm]:

Frequency Bands

0900 GSM

1800 GSM

2100 UMTS

2400 WLAN

2600 LTE

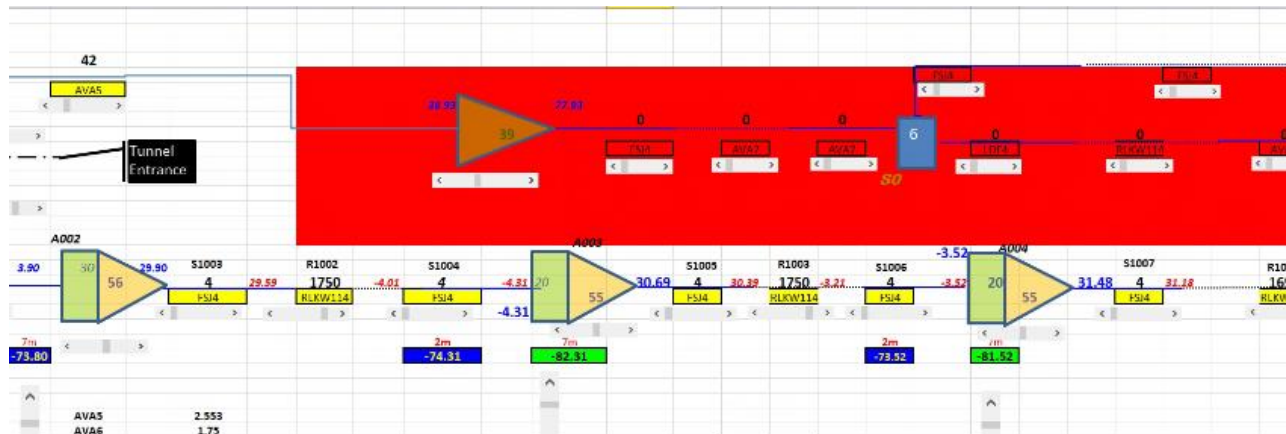
TETRA

Select supported bands



Link Budget Calculations

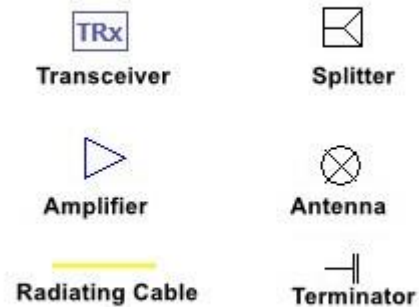
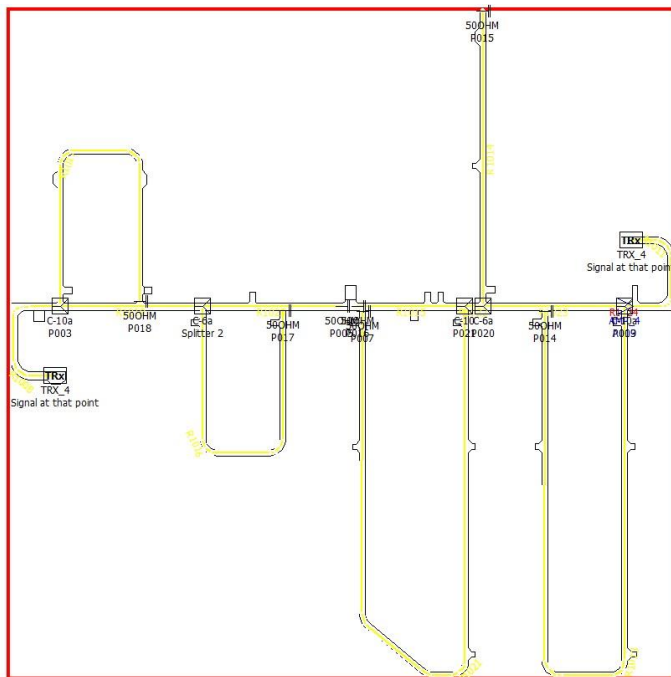
- Link budget calculations have a vital role in our Indoor Radio Design procedure
- Parameters such as network topology, equipment characteristics (Gain of the amplifier, cables losses etc..) are taken in account
- Noise calculations also performed at this stage





Placement of Network's Components on the 3D Model

- Network initial configuration should be implemented/placed on the simulation software tool
- This stage constitutes the groundwork of our Indoor Radio Design





Simulation Tool Setup

- Simulation Tool Setup contains important settings which are related with the indoor area simulations such as: Air interface/Standard selection, simulation parameters, propagation/prediction model etc.

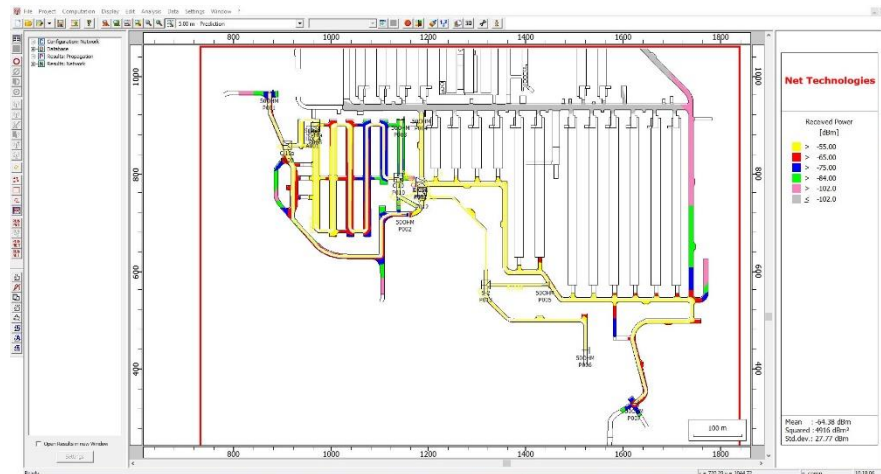
The screenshots show the following configuration panels:

- Multiple Access:** TDMA, Duplex Separation (FDX), MIMO Technology (No MIMO supported), Bandwidth (25 kHz), Carriers table.
- Transmission Modes (MCS):** Table with columns for Name, P, Data Rate DL, and Data Rate. Includes options for Computed Prediction Results (Received Power, Field Strength, Path Loss, LOS Analysis) and Additional Prediction Data.
- Network Simulation Mode:** General results (Best Server, Max. achievable Throughput, EMC Analysis), Results related to cell assignment (Serving Carrier, Neighbor Call List), and Traffic Analysis (Offered Traffic, Served Users, Blocked Users, Nr of subscribers).
- Prediction Model:** Ray Optical Propagation Models (3D Ray Tracing), Semi-Deterministic Propagation Models (Dominant Path Model), Empirical Propagation Models (Multi-Wall Model, Mitsky-Keehan Model, One Slope Model), and Prediction Model for radiating cables (SOM, STL, SPL, Dominant Path Model).

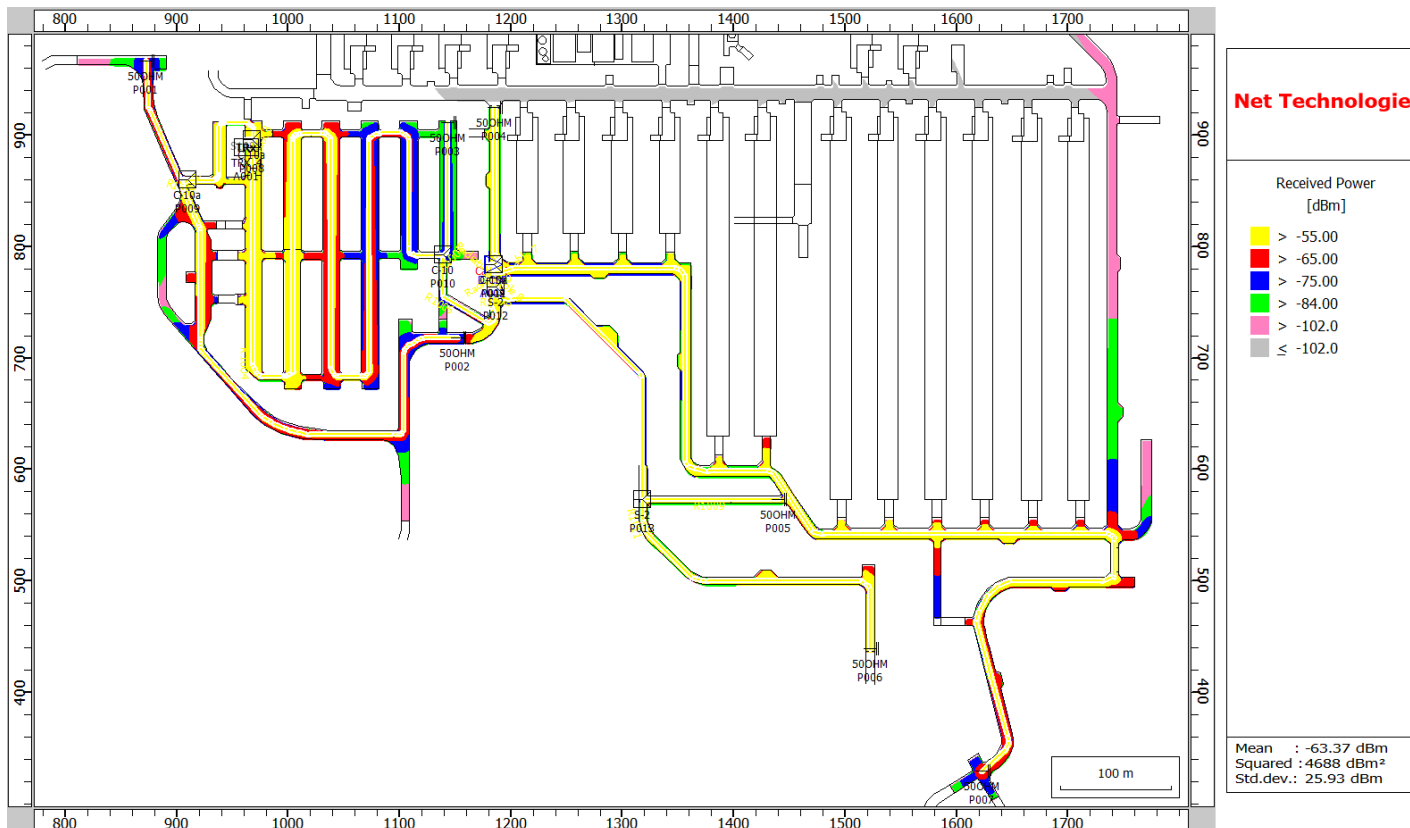


Simulation's Results Evaluation and Network Optimization

- Simulation's results assist us in order to locate the vulnerable parts of our Network
- Network Optimization phase begins
- Additional link budget calculations and simulations are performed so to finalize and optimize our Network Configuration



Coverage Analysis – Received Power

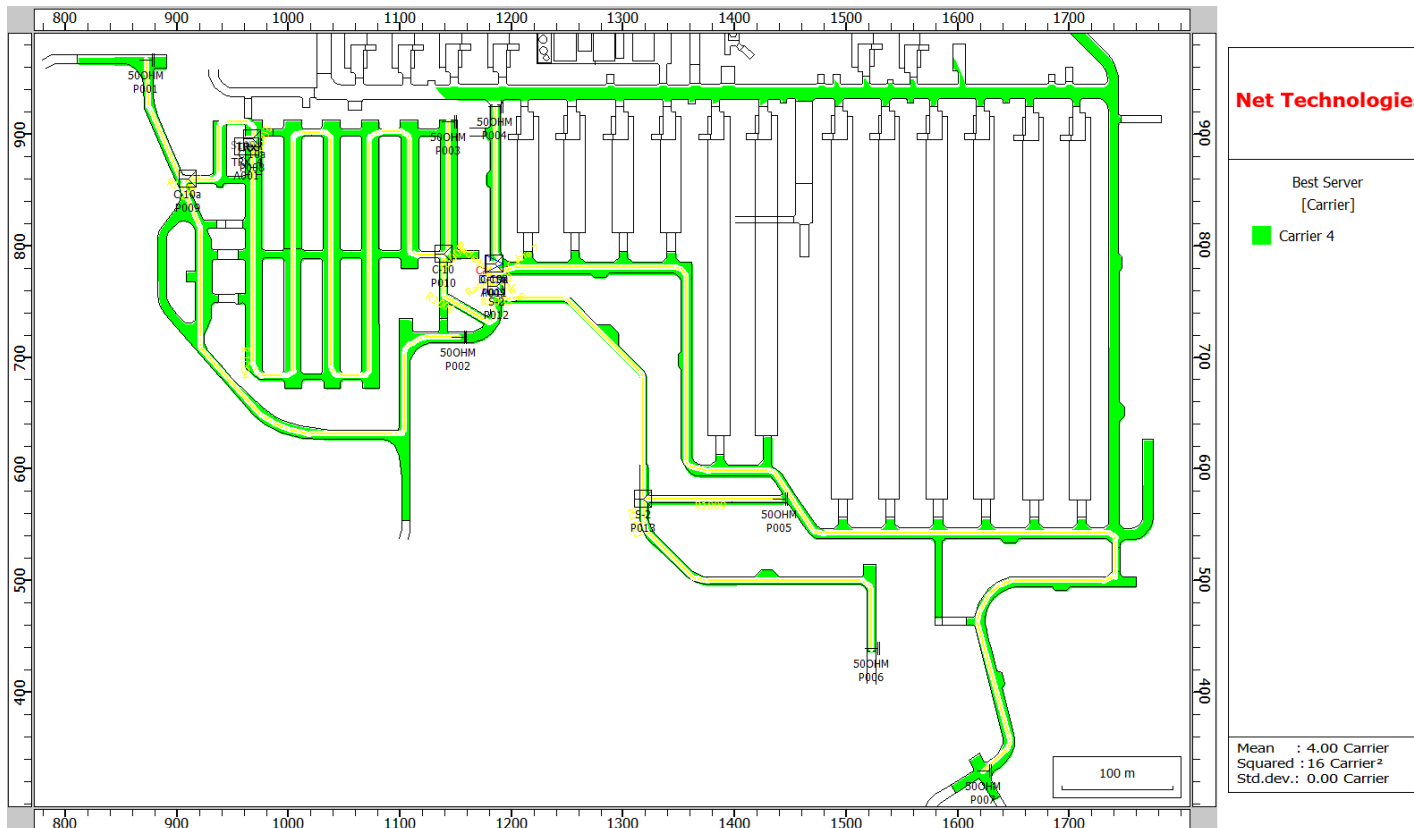


Received Power Study :
Illustrates the received power in a given location .

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Indoor Radio Design

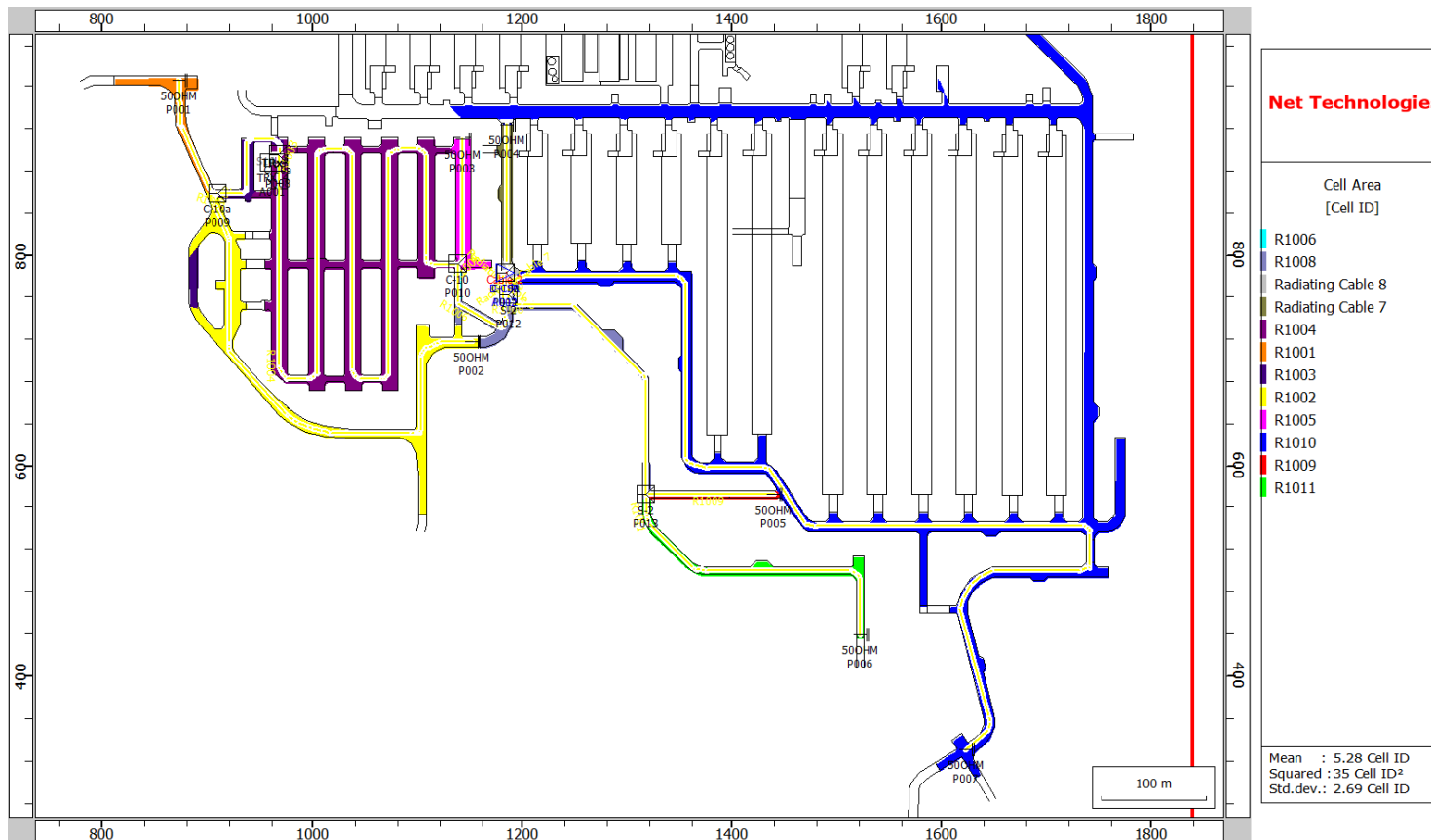
Coverage Analysis – Best Server



Best Server Study:
Illustrates the carrier with the highest power in a given location.



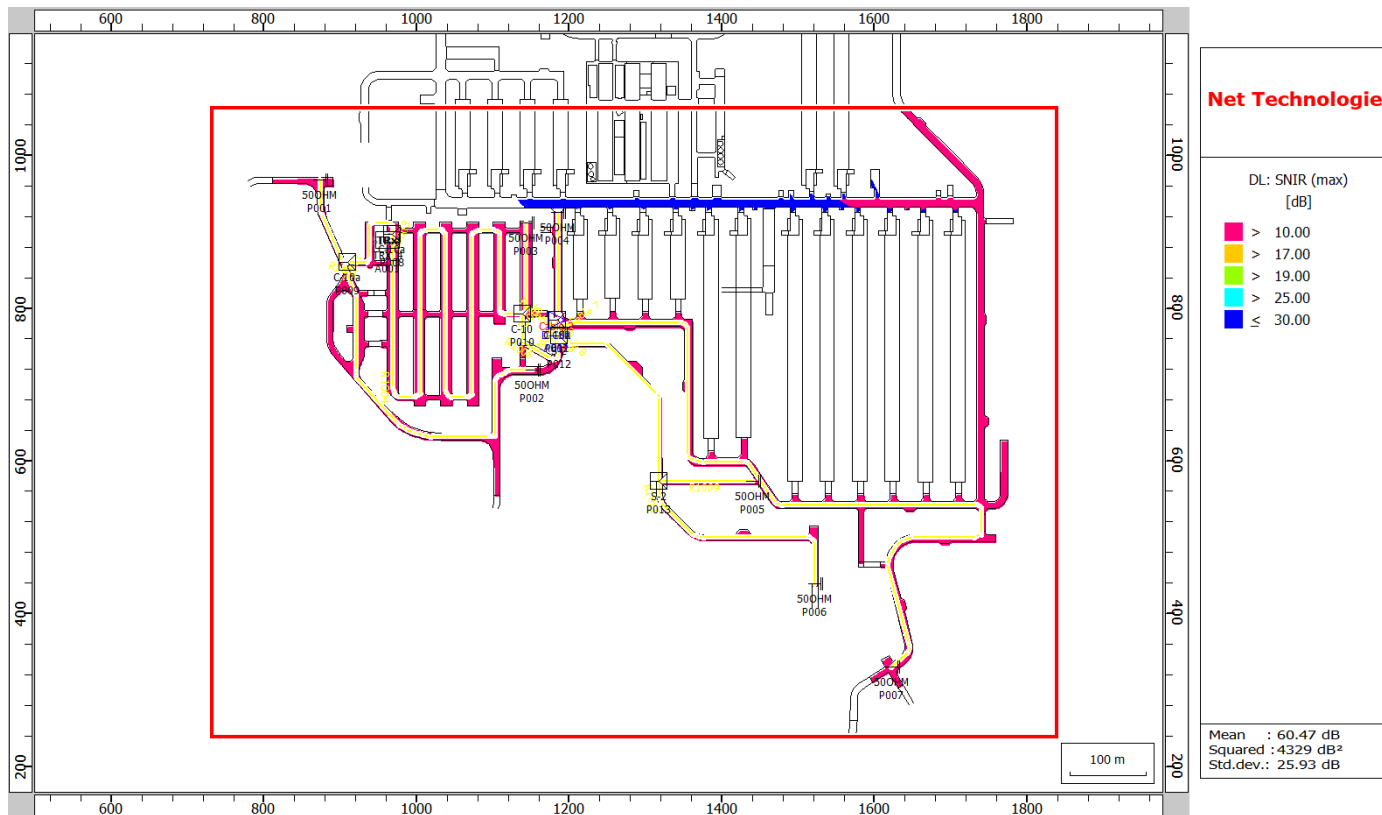
Coverage Analysis – Cell Area



Cell Area Study:
Illustrates the radiating component that provides coverage in a given location



Frequency Analysis – SNIR Plot



SNIR is the ratio between the received modulated carrier power and the sum of noise plus interference power from all transmitters using the same or a directly adjacent channel.



Design Phase – Radio Design Indoor

Traffic Analysis

- Define number and type of users and user equipment
- Define the traffic analysis parameters (like queuing time, holding time, grade of service etc.)
- Define user distribution
- Define traffic resources
- Define user Traffic profile

Results

- Offered Traffic
- Carried Traffic
- Grade of Service (GoS)
- Potential Carried Traffic
- Potential Number of Users
- Potential Traffic growth



Implementation Phase

During Network implementation, Radio Planning team assists as follows:

- Providing consultancy in resolving installation problems
- Proposing alternative solutions to initial design if needed
- Verifying that initial design is applied properly
- Provide assistance in RF equipment set-up



Testing Phase – Coverage and Performance verification

The major steps are:

- Determination of survey areas and routes
- Execution of the required tests and acquisition of measurements
- Post-processing and analysis of the collected measurement data

Testing types:

- Drive tests mainly applicable for indoor measurements and large underground areas such as tunnels.
- Walk tests for smaller scale areas such as buildings or subterranean areas.



Optimization Phase

The optimization phase involves tasks that improve the network performance based on test results of performance measurement campaign and updated / new end-user requirements

The optimization procedure may include modifications and/or fine tuning in the following areas

- Radio Coverage (e.g. insufficient or weak coverage areas)
- Capacity (e.g. blocking due to insufficient network resources)
- Interference (e.g. related to other radio systems)
- Network parameters
- Additional services



TRAINING PHASE

TRAINING PHASE

- Understanding of users' needs
- Definition of Training Plans
- Which are the operational procedures – daily and emergency events?
- Definition of training schedule
- What are the network functionalities?
- What are the operational functionalities?
- Which are the target user groups?



TRAINING PHASE

New features
New procedures
Responsibilities
Cooperation

Daily operations

Different scenarios
Different organizations
Different areas
Different functionalities

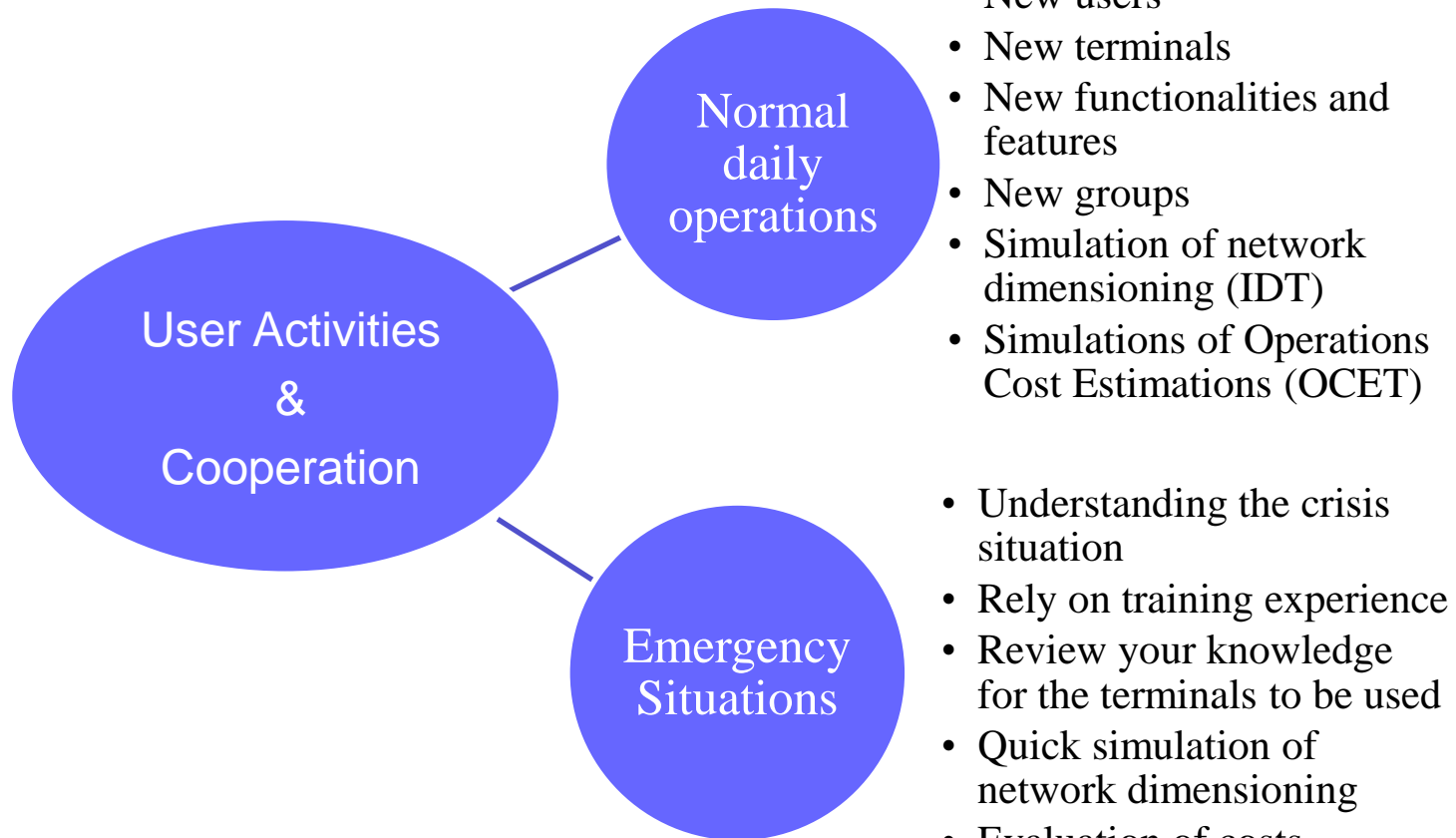
Regular updates

Simulations of emergency events

Fully prepared for crisis situations



TRAINING PHASE



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TRAINING PHASE - TOOLS

Indoor Radio Design

Operations Cost Estimation Tool (OCET)



Infrastructure Dimensioning Tool (IDT)

Infrastructure Dimensioning Tool

Tetra/TetraPOL calculator

Traffic Calculation

Cost Calculation

User Profile

Number of users: Light User (15 mEr) | 0 - 50

Number of TRXs

Number of Base Stations

Area Type: Dense Urban area

Use TetraPOL Base Station?

Select Tetra base station: Motorola M | Select TetraPOL base station: TetraPOL E

TBS Name: TBS12

Latitude: 43.4120621208645

Longitude: -0.634765625

Effective Antenna Height (m): 0

TxRx Number: 1

Operations Cost Estimation

Navigation: Logout, Profile, Add Content, Manage Content, New Estimation, My Estimations, New Cost Template, My Cost Templates, New Roaming Model

Cost per Control Room

Upgrade infrastructure (HW components, deployment and installation):

Upgrade Software platforms:

Cost per User Implementation

Legal framework:

Special ISI subscription:

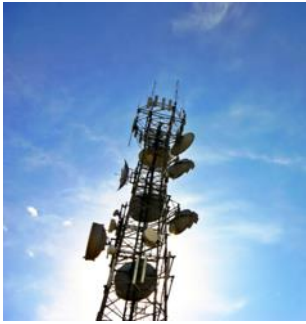
Training Costs:

Licenses, fees:

Transmission (Please add cost to only one of the following 2 fields)

Total cost for the Transmission Line:

- Maintenance of equipment and components
- Equipment and component licenses, maintenance outsourcing
- Customer Provisioning
- Customer Care, Charging and billing Costs
- Service Management Costs
- Network Management Costs
- Network Optimization
- Rental of physical network resources (Including licenses)
- Regulation Costs
- Detailed Equipment Costs
- Other Costs



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building quality in telecom networks

Thank you for your attention!

We are looking forward to meeting you at booth

H60

If you have any question, you can always contact us

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Or

info@nettechn.com

