Net Technologies Indoor Radio Design Concept and Methodology

CCW23

Helsinki

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Indoor Radio Design

Contents

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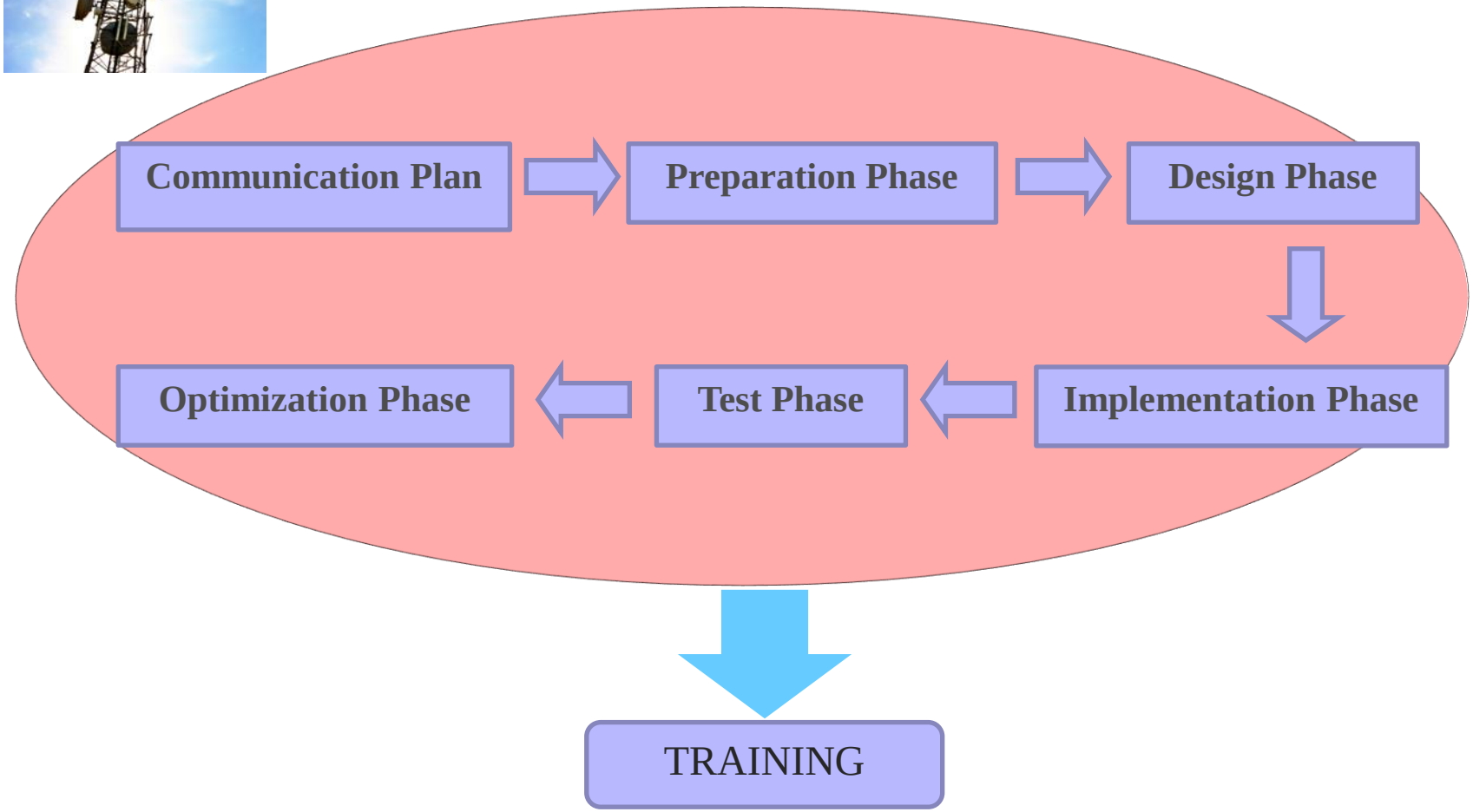
What are the Communication Plan Aspects

- 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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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

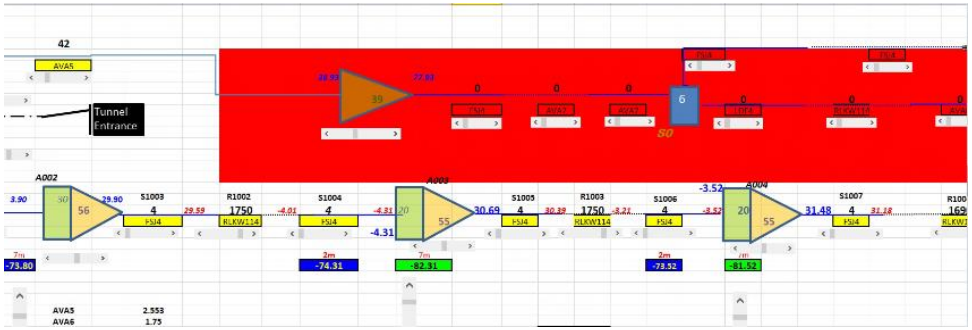
  Provides valuable input for the Radio Planning process

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)

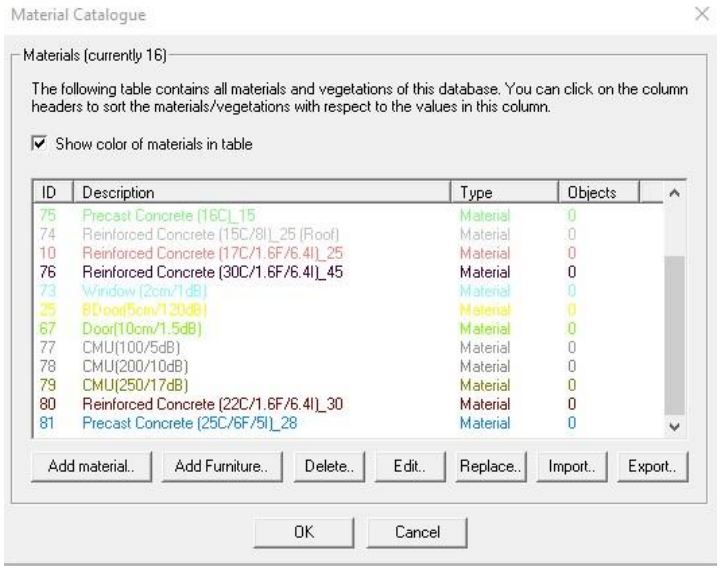
Based on the Site Survey feedback, 3D Model Design begins. Site Survey provide us with significant information about:

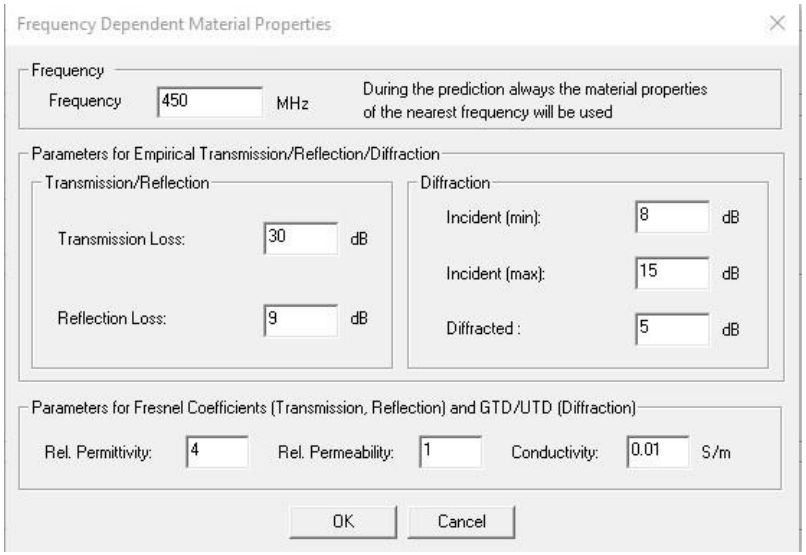
- Walls/Structures penetration losses and building materials
- Buildings/ceilings/objects heights
- Reference distances

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)

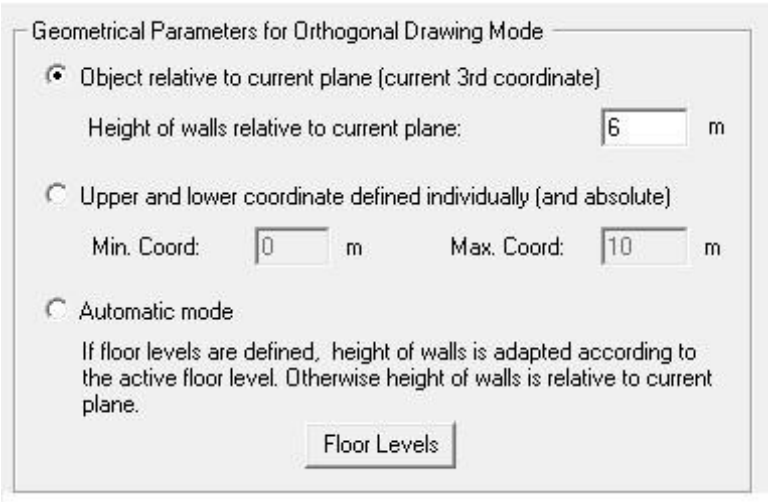
- Walls/Structures penetration losses and building materials information, is used for the creation of the materials at the 3D model creation software tool.

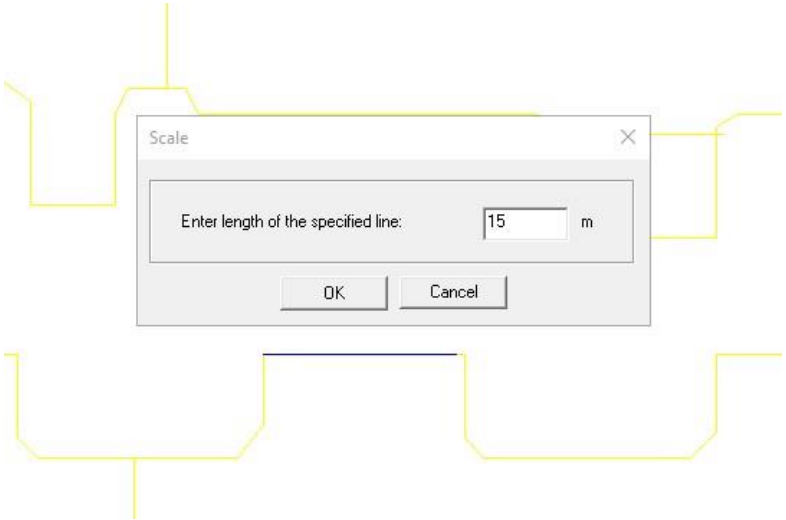




Indoor Area 3D Model Design, based on Site Survey Feedback (3)

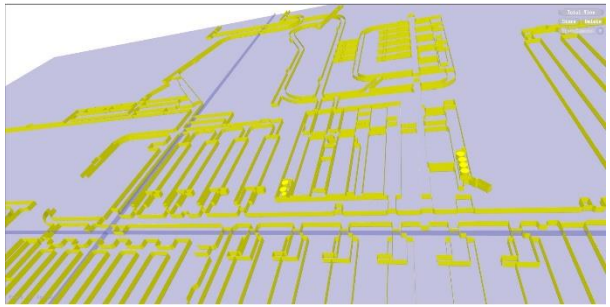
- Buildings/ceilings/objects heights information is used for the definition of structures heights at the 3D model creation software
- Reference distances information is used to scale the distances of our 3D model in order to match with the real area of interest scaling

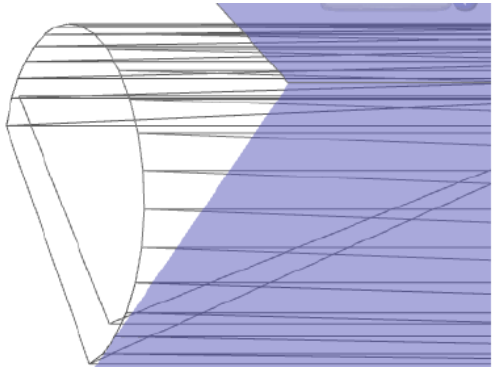




Indoor Area 3D Model Design, based on Site Survey Feedback (3)

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



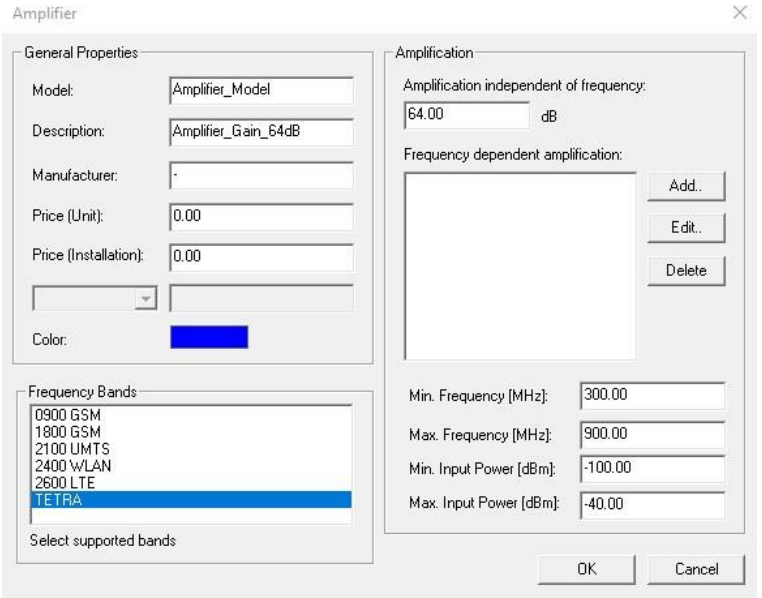


Creation of Network's Components

- 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

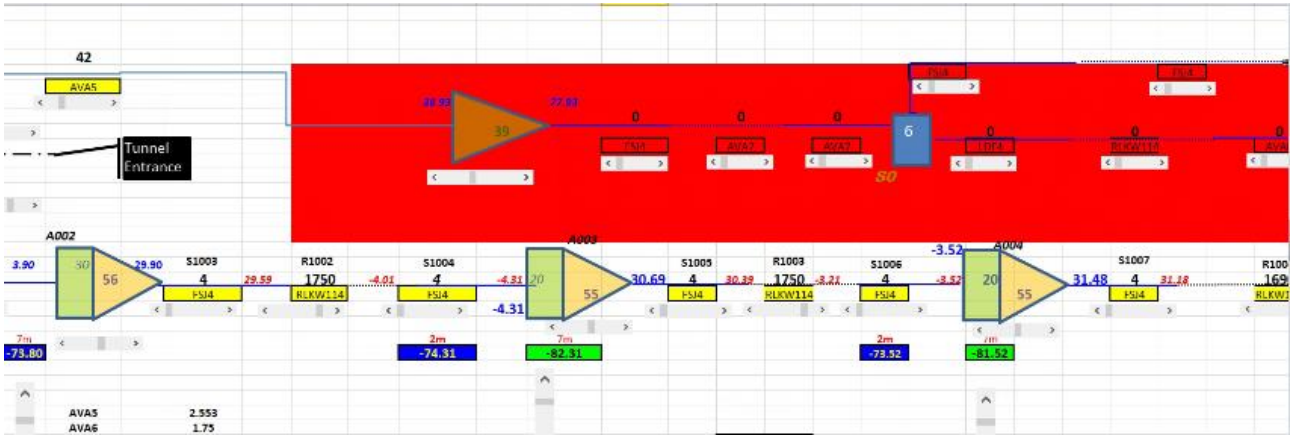
Model
50OHM
716-ATT-03-05
716-ATT-06-05
716-ATT-10-05
716-ATT-20-05
756430-DS
80010339
APG-BNFNF-350
AVA5-50
AVA6-50
AVA7-50
BSF3604
C-0-PSU-NAi
C-10
C-10a
C-15
C-15a
C-20
C-20a
C-30
C-30a
C-6
C-6a
D-CSR

Type	Description
Terminator	5W N Male Dummy Load
Attenuator	Fixed Attenuator 3dB
Attenuator	Fixed Attenuator 6dB
Attenuator	Fixed Attenuator 10dB
Attenuator	Fixed Attenuator 20dB
User defined component	DC Block
Antenna	2 dBi Omni Indoor
User defined component	Surge Arrestor
Cable	7/8" Coaxial Cable
Cable	1=1/4" CoaxialCable
Cable	1-5/8" Coaxial Cable
Amplifier	FOREP
Splitter	0 dB Directional Coupler
Splitter	10 db Directional Coupler
Splitter	10 dB Directional Coupler
Splitter	15dB Directional Coupler
Splitter	15 dB Directional Coupler
Splitter	20_dB Directional Coupler
Splitter	20dB Directional Coupler
Splitter	30dB Directional Coupler
Splitter	30db Directional Coupler
Splitter	6 dB Directional Coupler
Splitter	6dB Directional Coupler
Amplifier	D-CSR3604



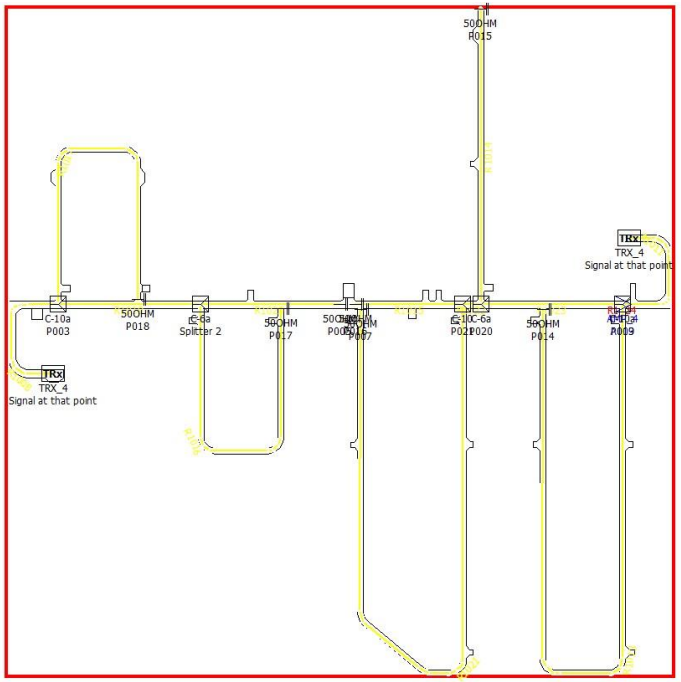
Link Budget Calculations

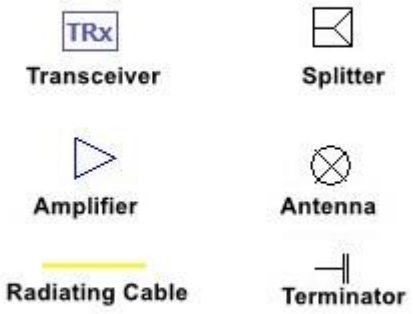
- Link budget calculations have a vital role in our Indoor Radio Design procedure
- Parameters such as network topology, equipment characteristics(Gain of the amplifier, cables losses etc..) are taken in account
- Noise calculations also performed at this stage



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





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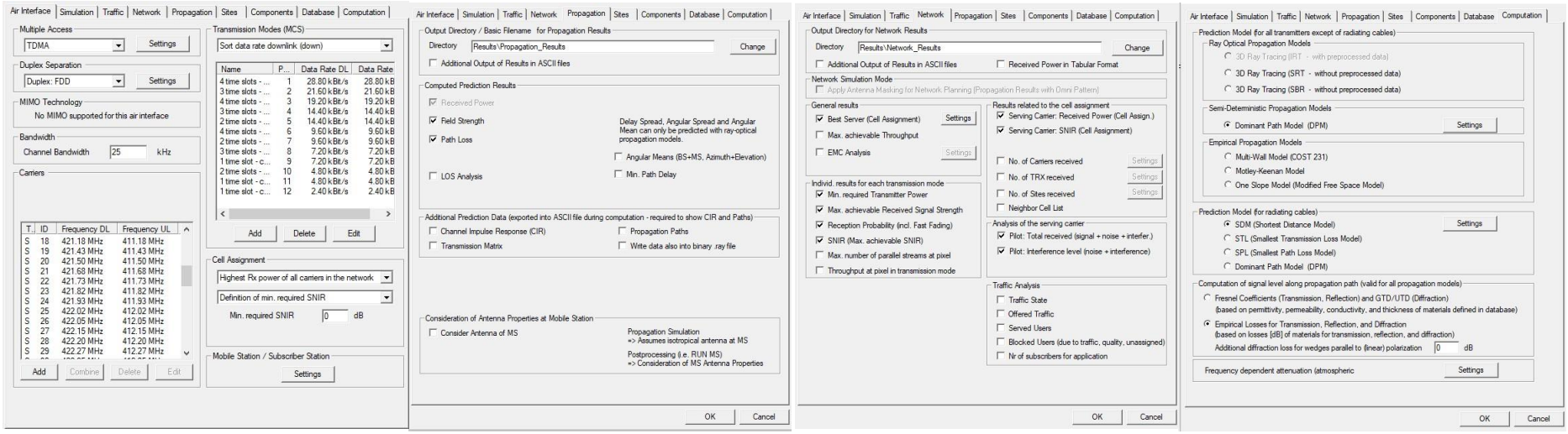
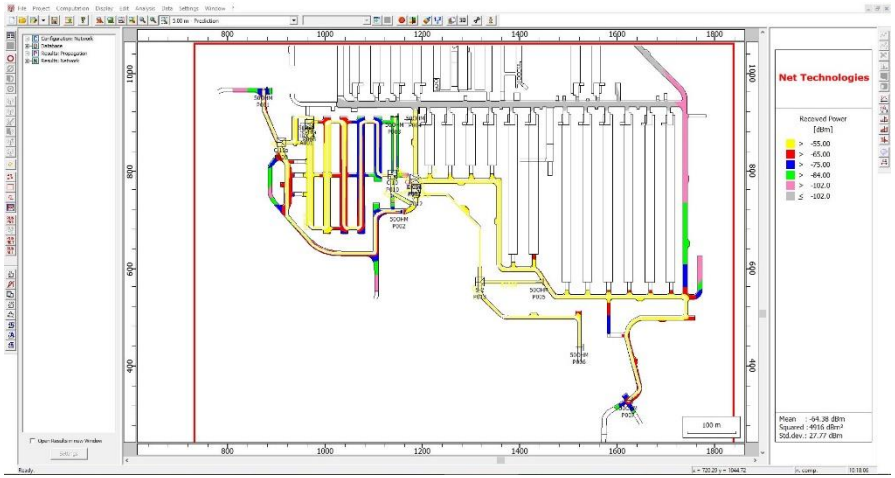
Simulation Tool Setup

- 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.



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



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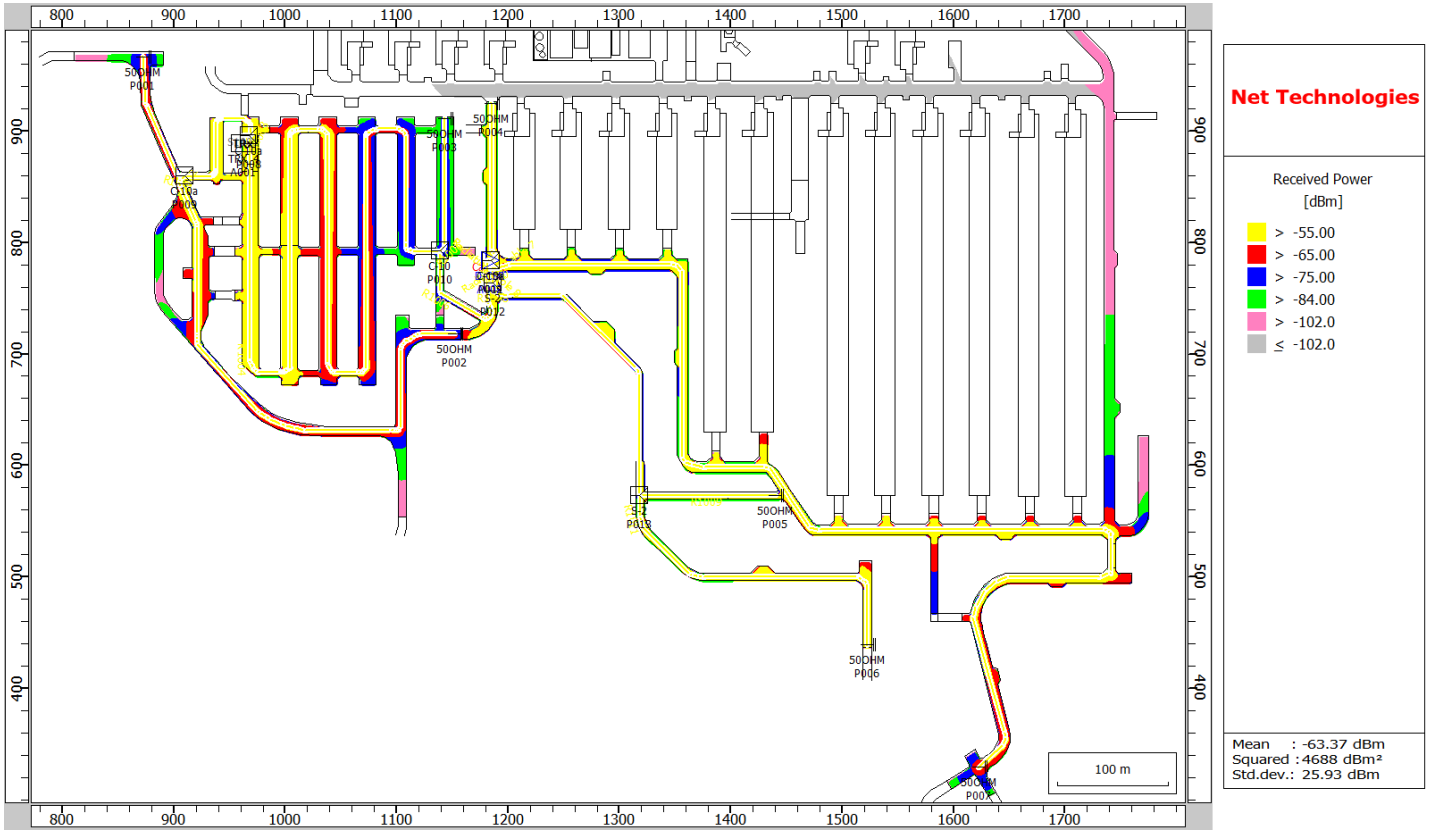
Coverage Analysis – Received Power



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

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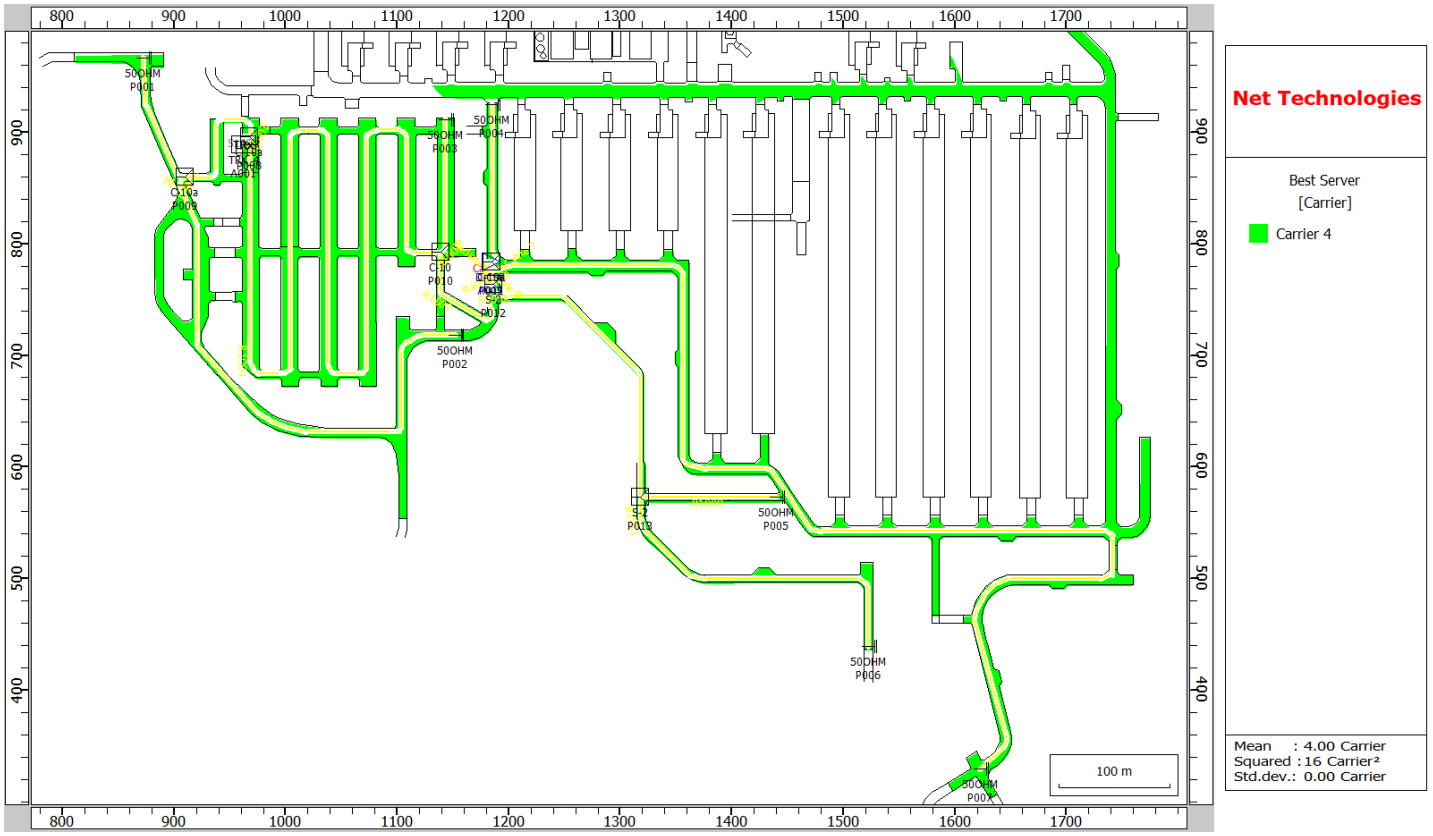
Coverage Analysis – Best Server



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

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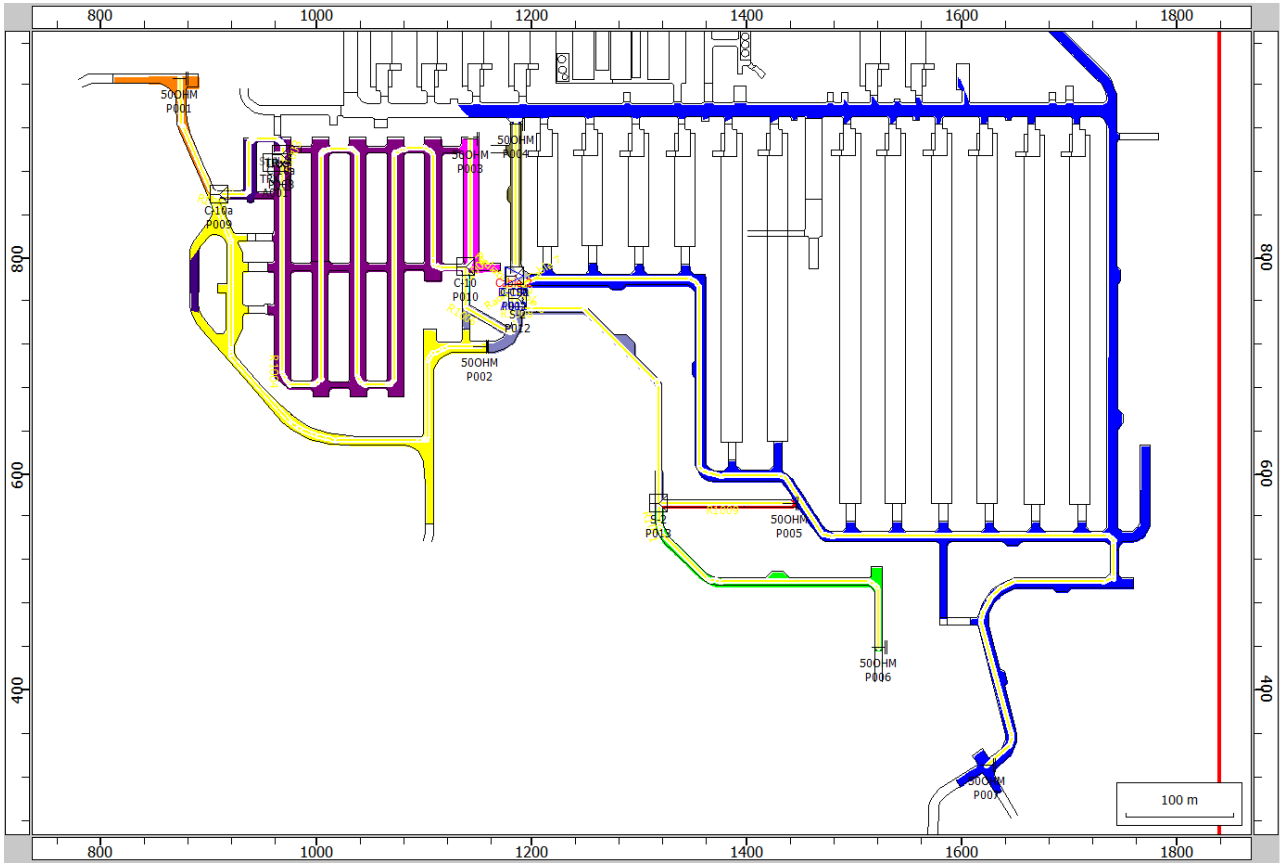
Coverage Analysis – Cell Area



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

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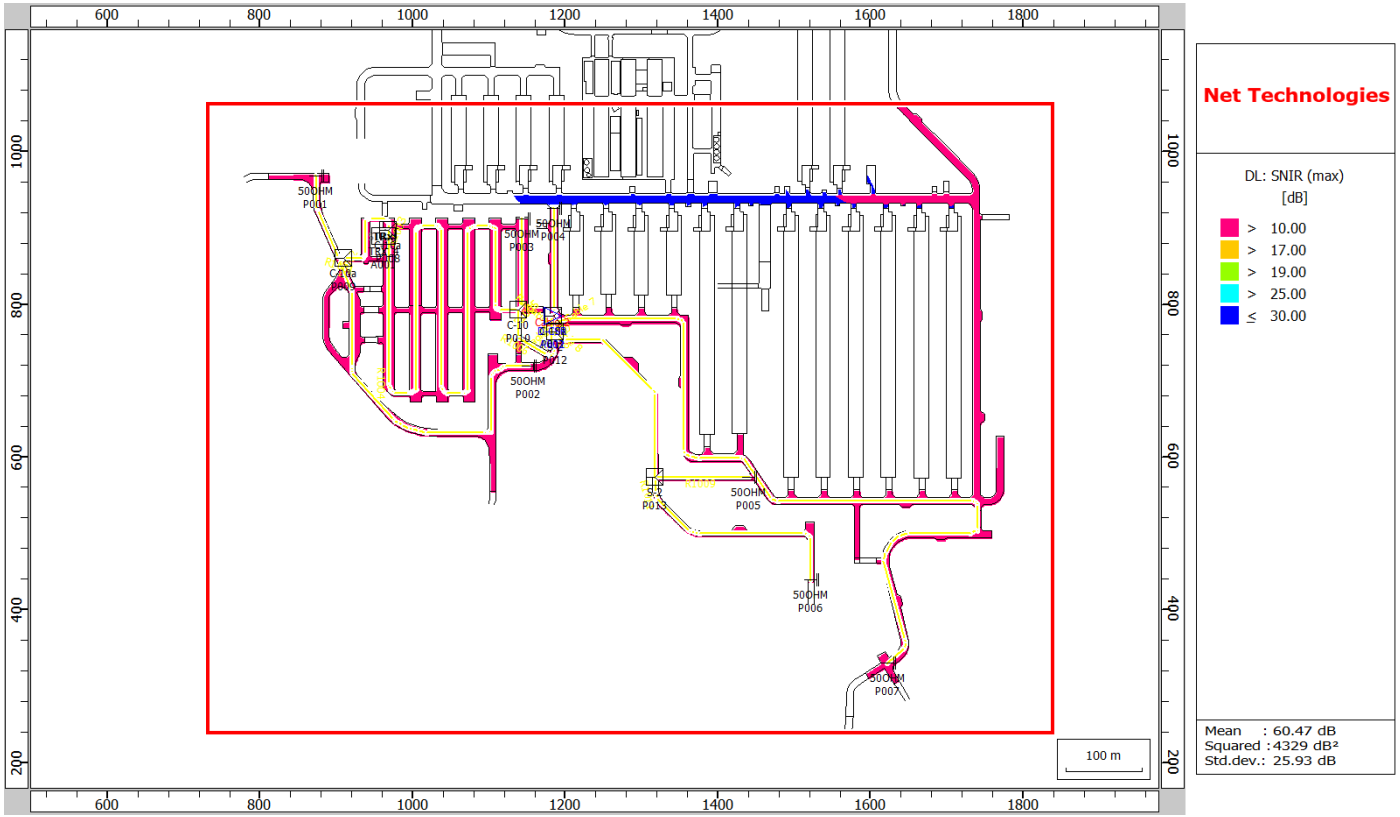
Frequency Analysis – SNIR Plot



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.

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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

Different scenarios
Different organizations
Different areas
Different functionalities

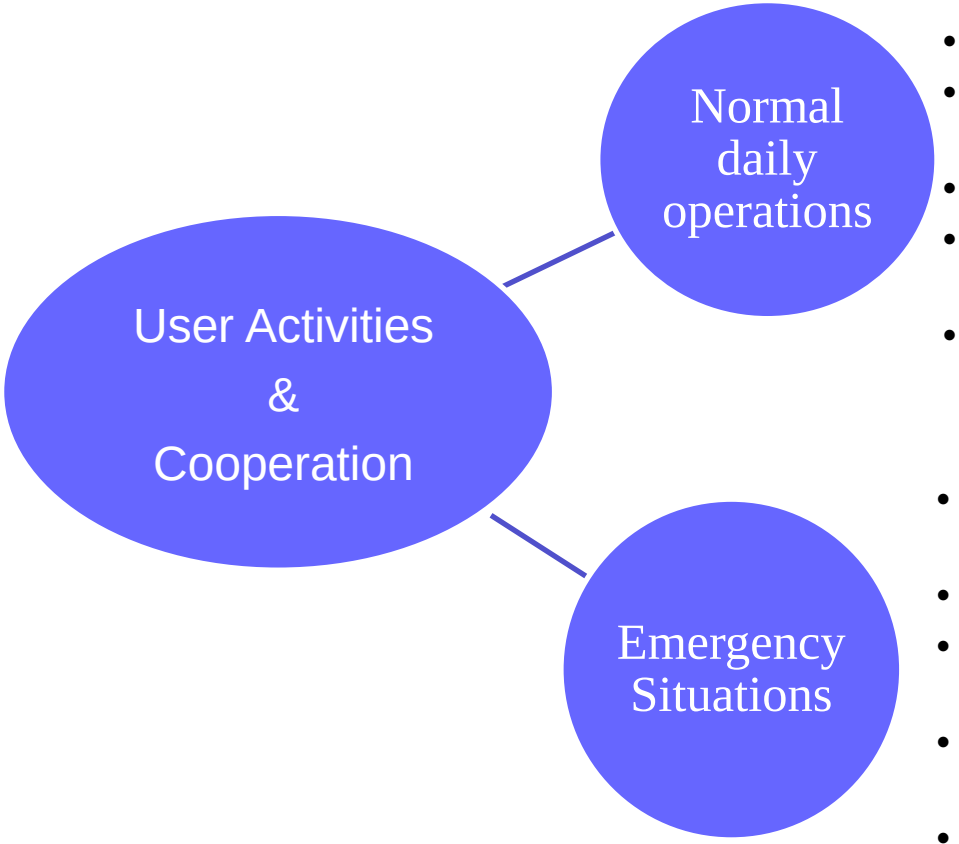
Daily operations

Regular updates

Simulations of emergency events

Fully prepared for crisis situations

TRAINING PHASE



- Updates
- New users
- New terminals
- New functionalities and features
- New groups
- Simulation of network dimensioning (IDT)
- Simulations of Operations Cost Estimations (OCET)

- Understanding the crisis situation
- Rely on training experience
- Review your knowledge for the terminals to be used
- Quick simulation of network dimensioning
- Evaluation of costs

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TRAINING PHASE - TOOLs

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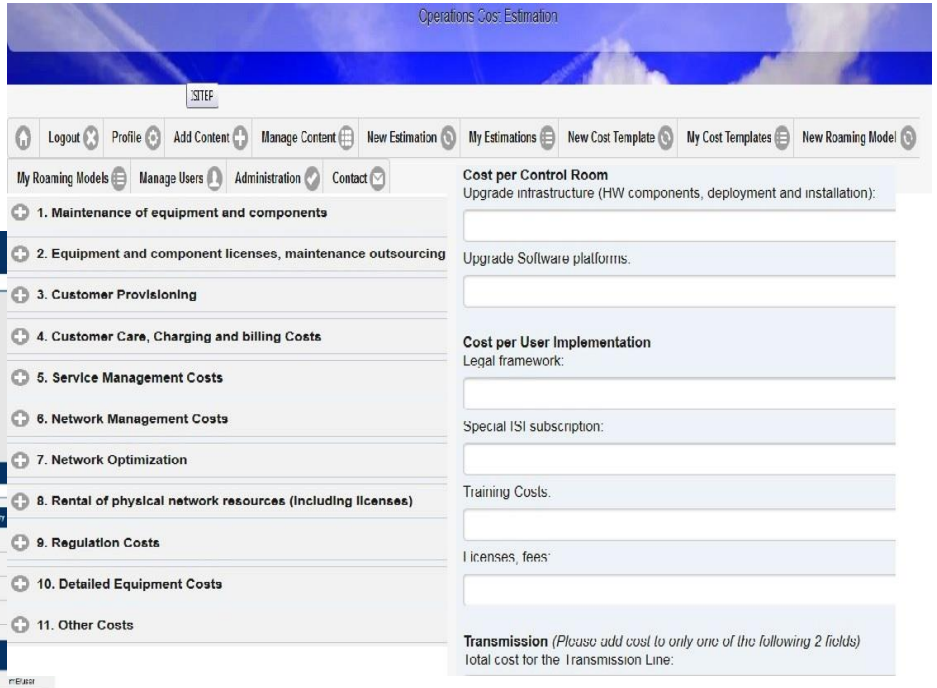
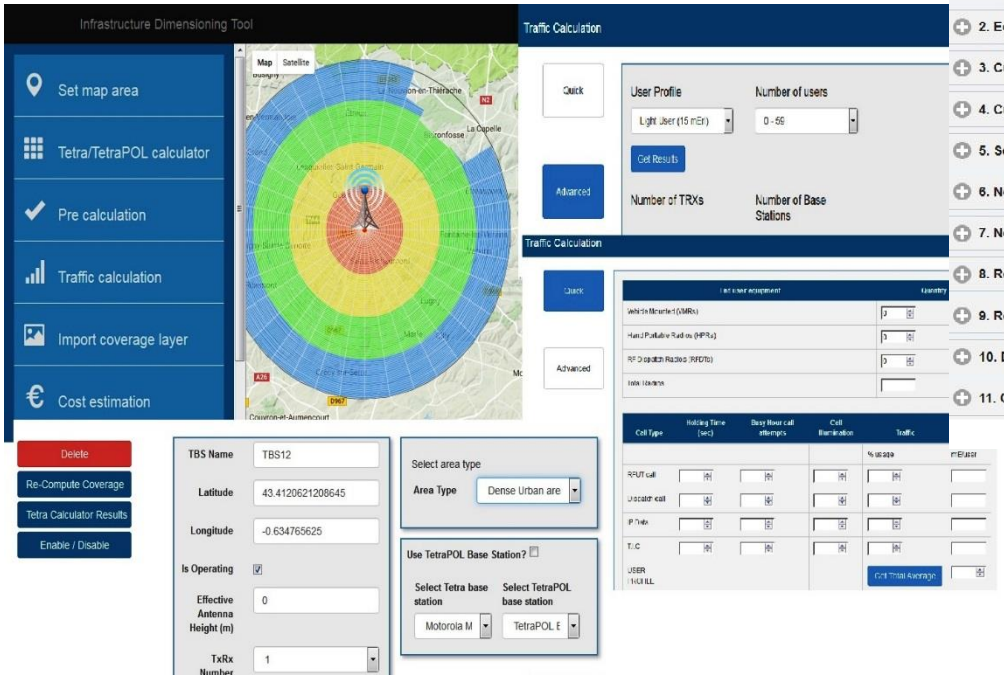
Operations Cost Estimation Tool (OCET)



Infrastructure Dimensioning Tool (IDT)



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We are looking forward to meeting you at booth

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