



# Net Technologies Outdoor Radio Planning Concept and Methodology

IT ALL STARTS WITH THE COMMUNICATION PLAN

**CCW23**

Helsinki

# Net Technologies

## Radio Planning Services

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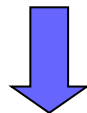


1. What are the Communication Plan Aspects
2. Life-Cycle of a Critical Communications Radio Network Deployment
3. Preparation Phase
4. Design Phase
5. Implementation Phase
6. Testing Phase
7. Optimization Phase
8. Training Phase

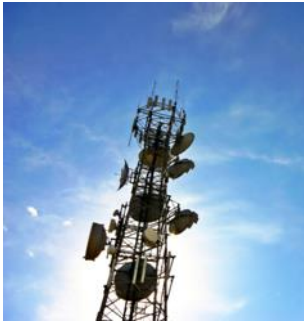


## What are the Communication Plan Aspects

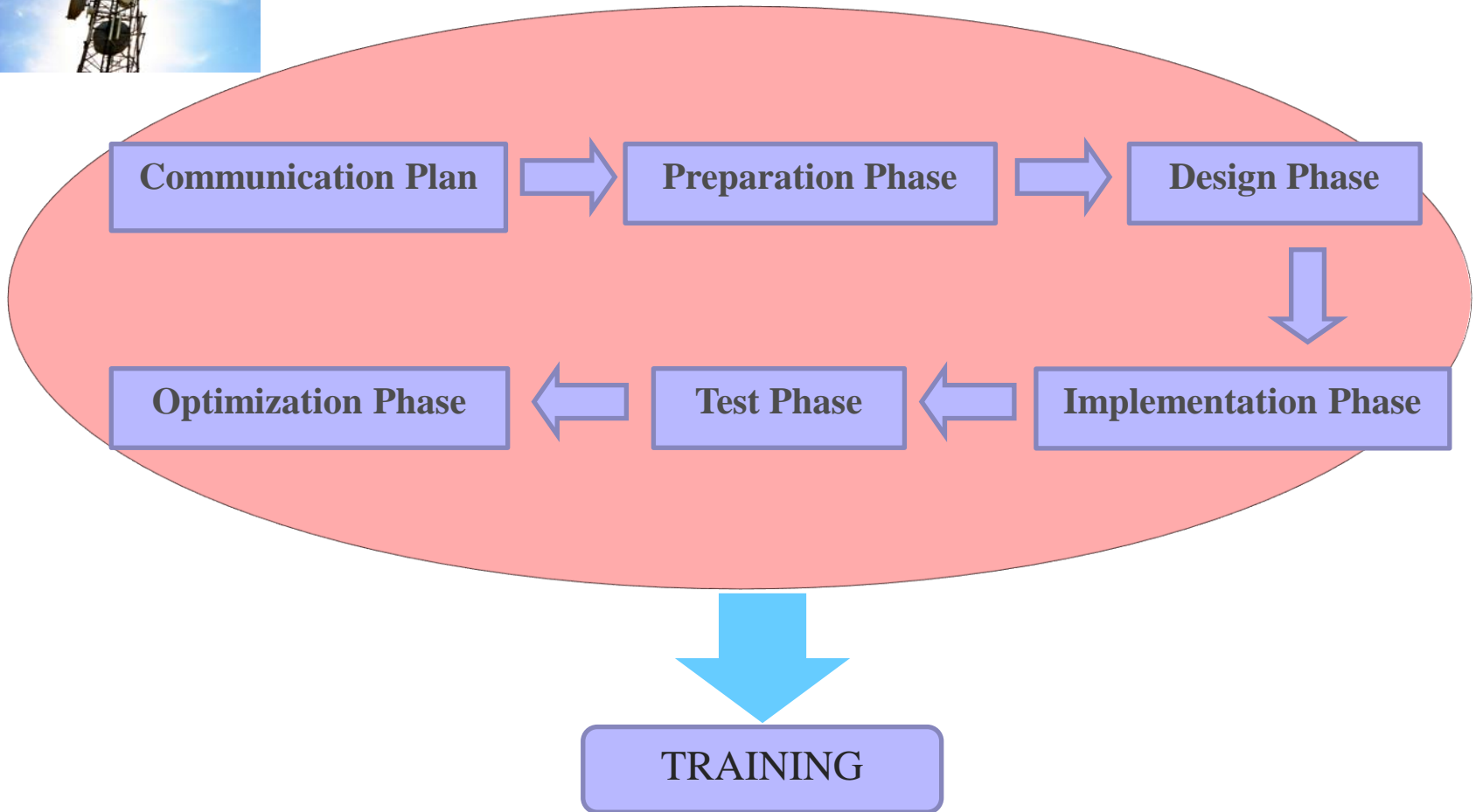
- Definition of Communication Network Characteristics
- Definition of Users' Needs
- Correlation between Technical and Users Requirements
- Specification of network characteristics by emulating different deployment scenarios leading to appropriate equipment selection and planning inputs
- Estimation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



**SUCCESSFUL NETWORK DEPLOYMENT AND OPERABILITY**



# Life-Cycle of a Radio Network Deployment





## 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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## Radio Planning Services



### Design Phase

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

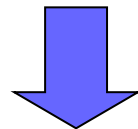


## Design Phase – Site Survey

### ■ 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
- ❑ Outdoor locations and Service areas.
- ❑ Field measurements and evaluation of current coverage



Provides valuable input for the Radio Planning process

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### 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 **Infrastructure Dimensioning Tool (IDT)** for providing all relevant information to Radio Planners and Decision Makers

Call Type	Holding Time (sec)	Setup time call (sec)	CS1 Bear. Rate	Traffic
RFMT call	[0]	[0]	[0]	[0]
USDPST call	[0]	[0]	[0]	[0]
PTMS	[0]	[0]	[0]	[0]
T.C	[0]	[0]	[0]	[0]
USER	[0]	[0]	[0]	[0]
CS1 BULL	[0]	[0]	[0]	[0]
				CS1 Total Average: [0]





## Design Phase – Radio Design Outdoor

### Coverage Analysis

- Maps (elevation, clutter, vectors)
- Propagation Model
- Model tuning (field measurements vs propagation model)
- Antenna types and configurations / radiation patterns of antennas
- Feeder types and length
- Parameter setting (network parameters, hardware parameters, location parameters)

### Simulations / Results

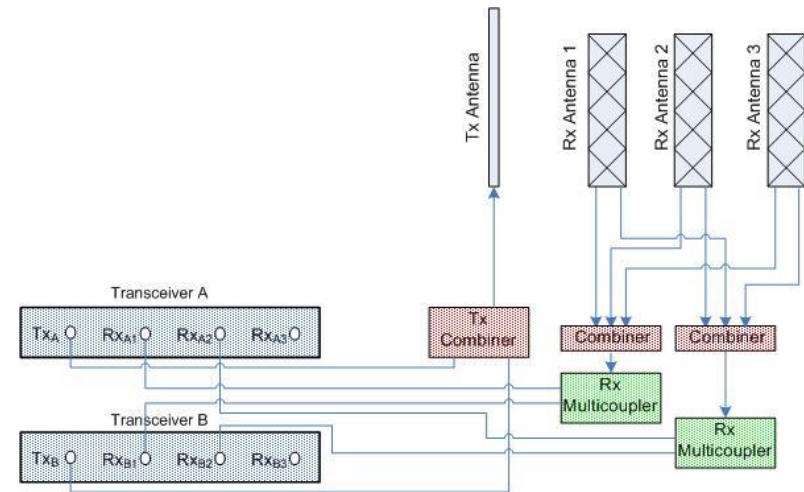
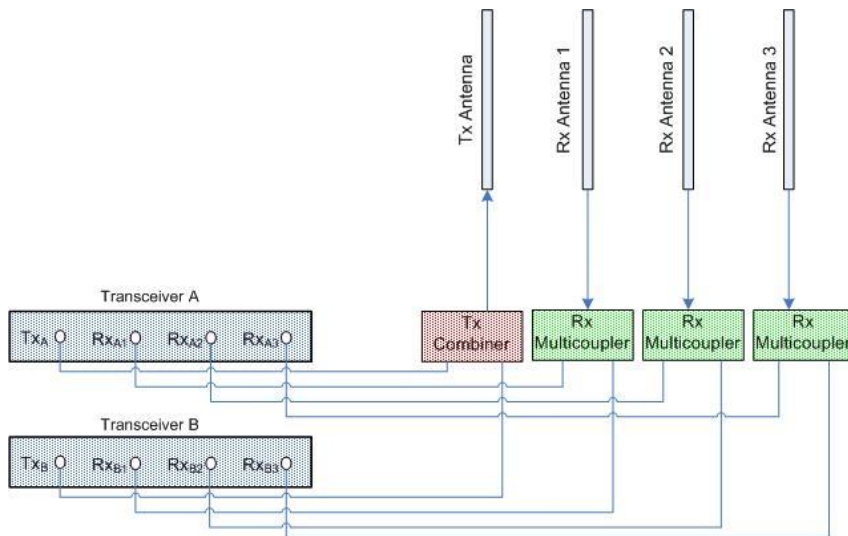
- Best serving sector plot
- Best Server Signal strength
- Best Server Classes
- Coverage probability
- Link Budget and Link unbalance
- Coverage Threshold Definition
- Backhaul Connection and Line of Sight (LoS)



## Antenna types and Configurations

According to the requirements a selection among different antenna types has to be performed. Mainly 2 different types are commonly employed:

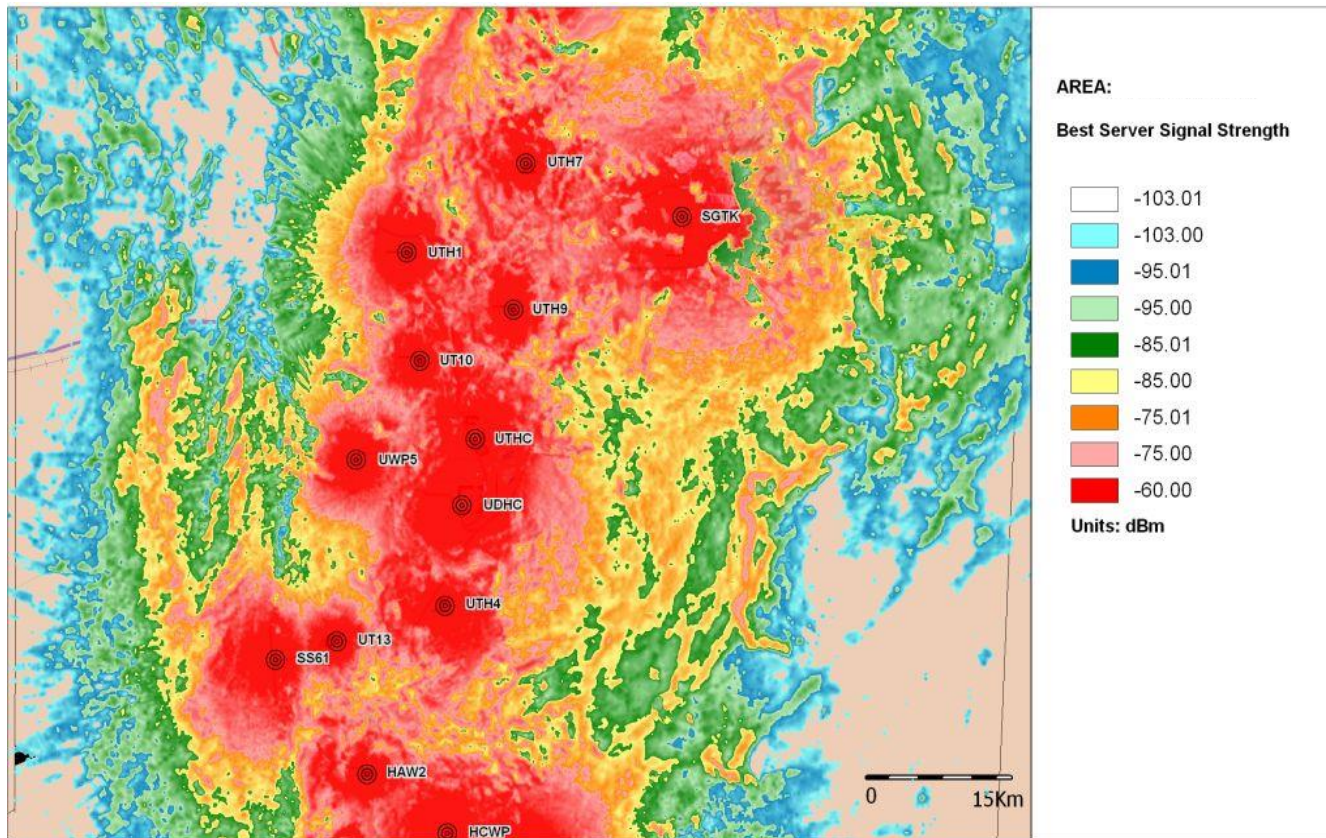
- Omni-Directional Antennas
- Panel Antennas (Single or Dual Polarization)



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## Radio Planning Services

### Coverage Analysis – Best Server Signal Strength



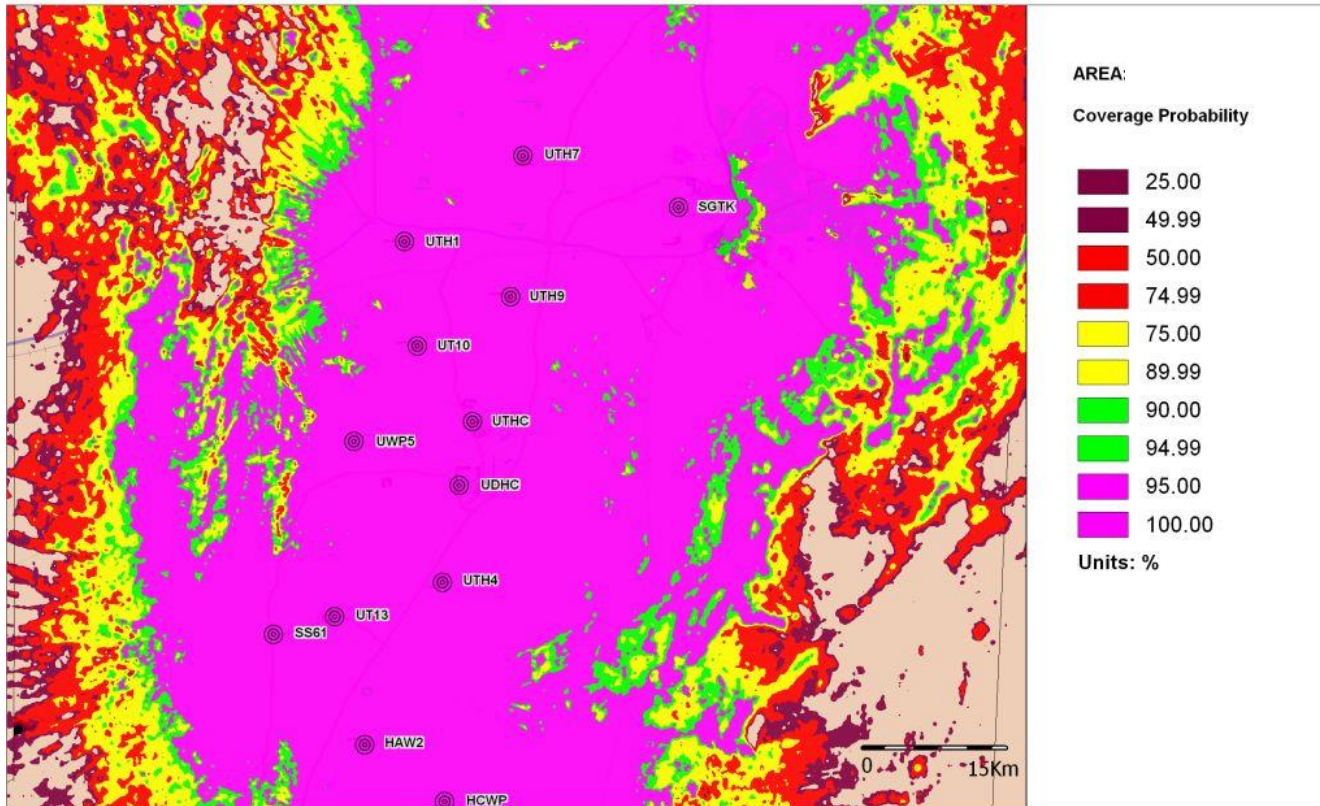
### Best Server Signal Strength Study:

Illustrates the signal strength of the best serving sector in a given location.

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## Radio Planning Services

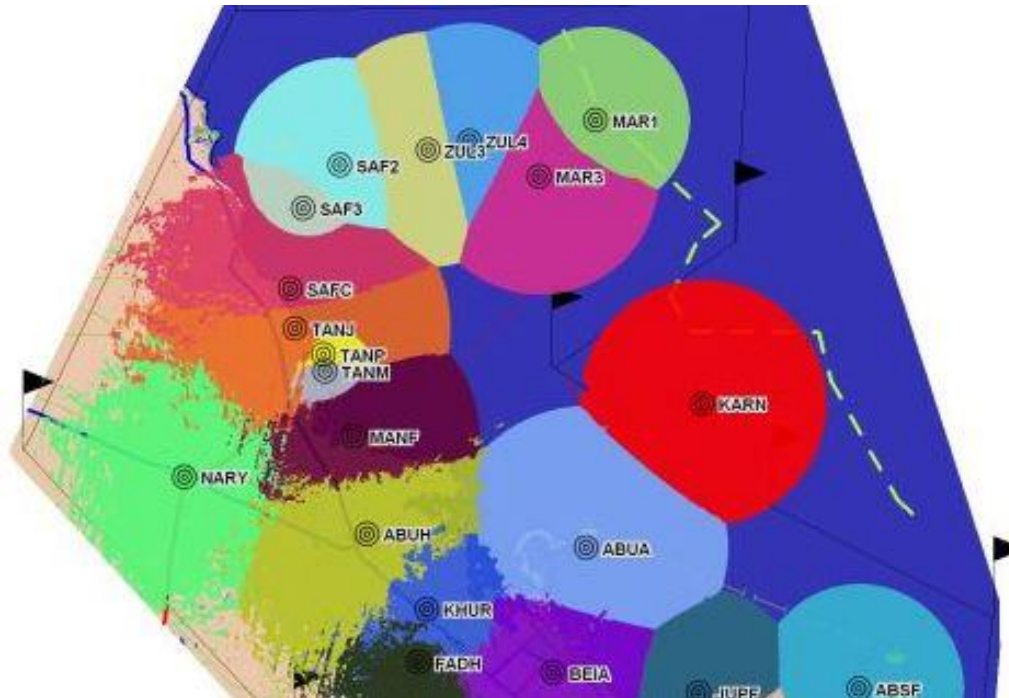
### Coverage Analysis – Coverage Probability



#### Coverage Probability study:

Illustrates the reception probability of a user in a given location.

### Coverage Analysis – Best Serving Sector



#### AREA: OVERALL

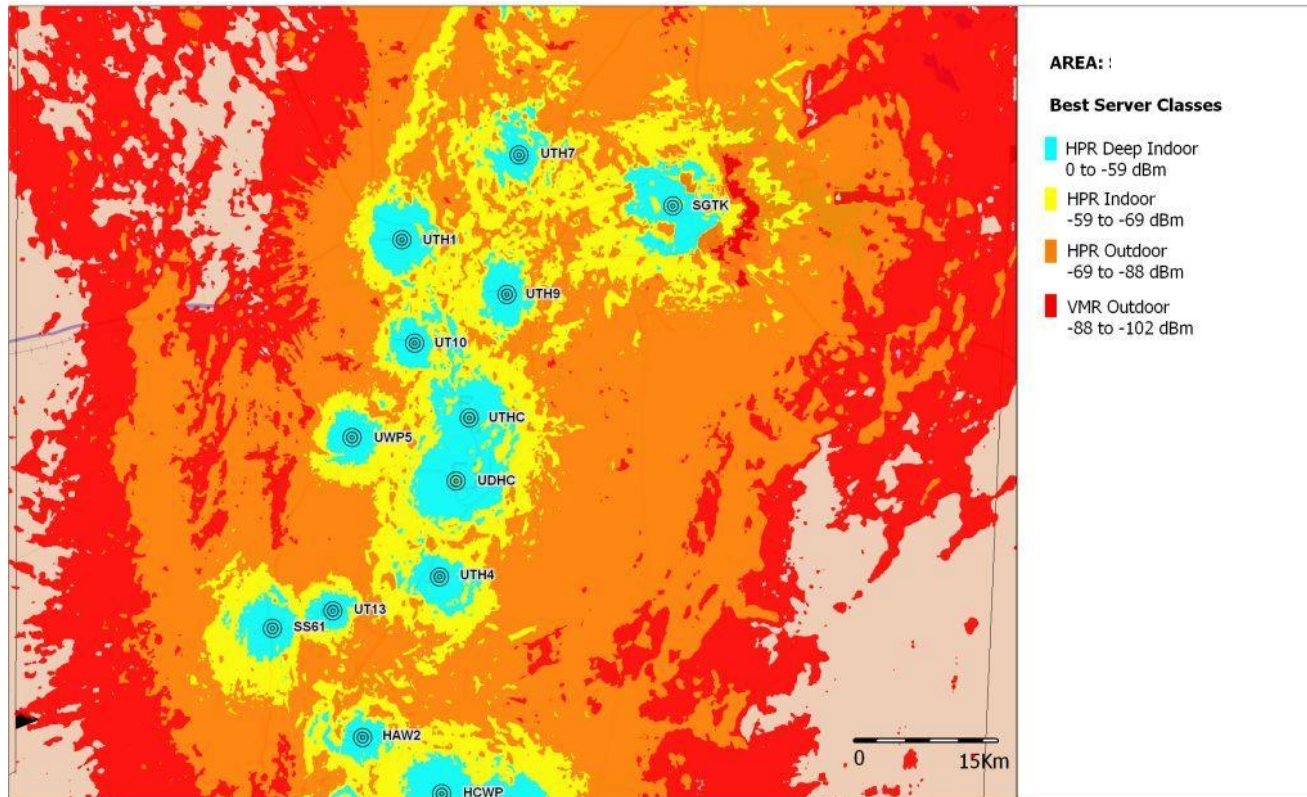
#### Best Serving Sector

- ABQ2
- ABQ3
- ABQ5
- ABQA
- ABSF
- ABUA
- ABUH
- AIN2
- AIN3
- BEIA
- CHAC
- DMCB
- FADH
- FAZ1
- GHZL
- HAM1
- HAW2
- HAW3
- HAW4

**Best Serving Sector Study:** Illustrates the sector that provides the highest signal strength in a given location.



## Coverage Analysis – Best Server Classes



**Best Server Classes Study:**  
Illustrates the reception service level achieved in terms of Hand Portable (HPR) deep indoor, HPR indoor, HPR outdoor and Vehicle Mounted Radios (VMR) outdoor coverage.



## Frequency Analysis – C/(I+A) Plot



C/(I+A)



Units: dB

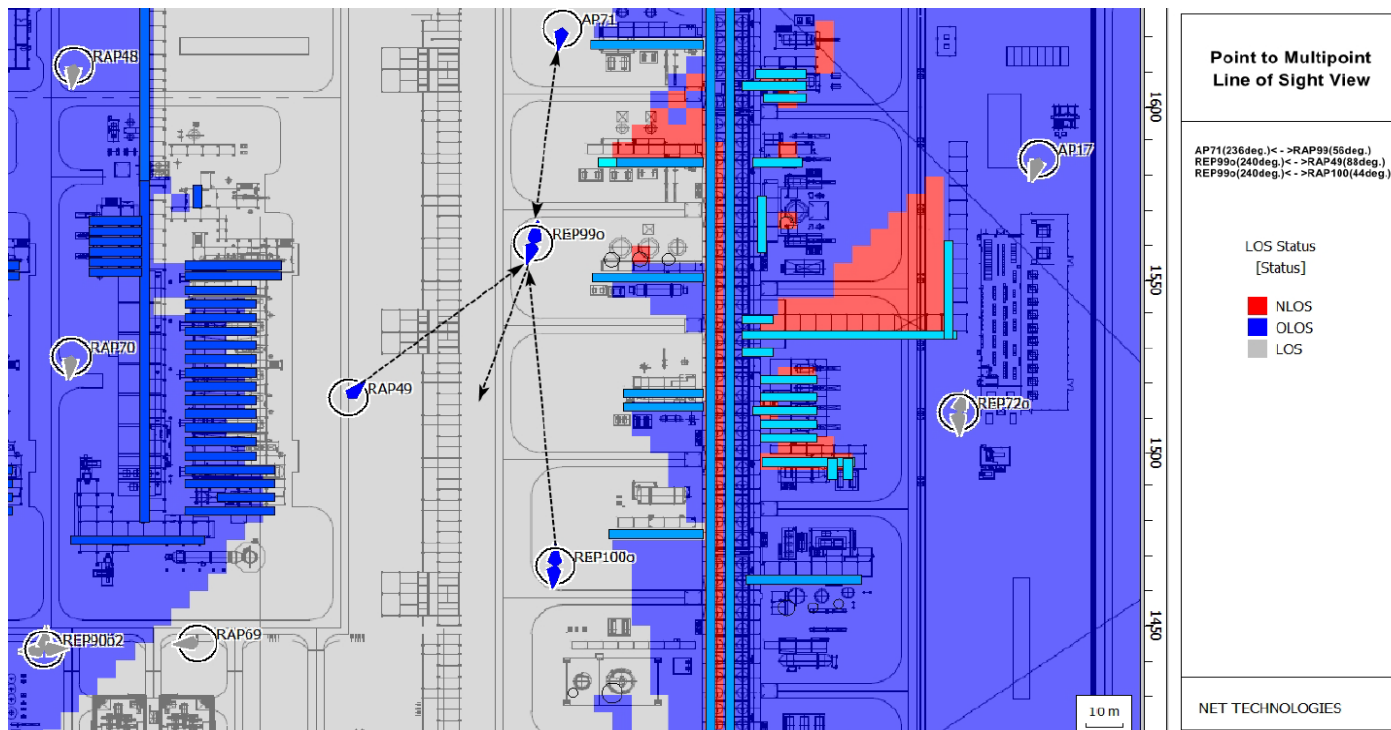
**C/(I+A)**

is the ratio between the received modulated carrier power C and the sum of received interference power I+A from all transmitters using the same or a directly adjacent channel.



## Backhaul Links – Line of Sight (LoS)

Simulation Results for LoS Point to  
Multipoint Links

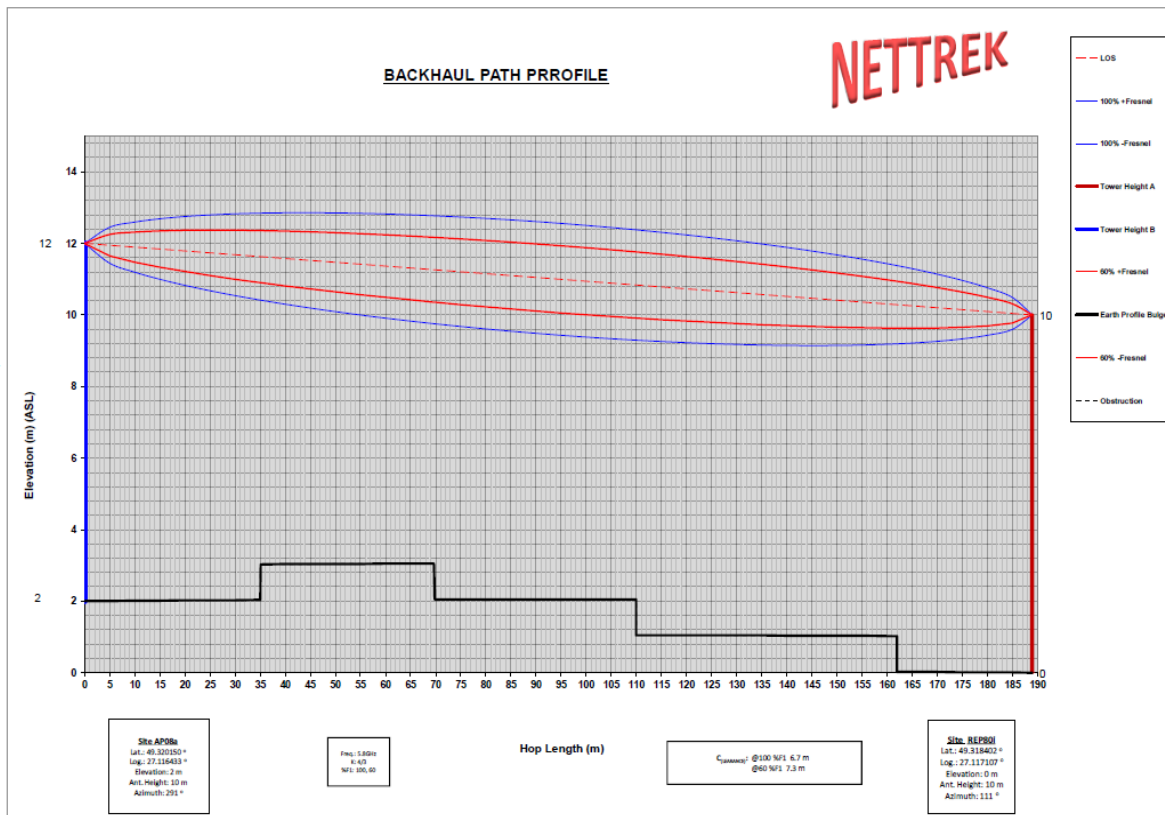






## Backhaul Links – Line of Sight (LoS)

Net Technologies developed a dedicated professional tool (NETTREK) for Fresnel Zones calculations and visualization of parameters and results



	AP08a	REP80I
Latitude	49.32014974	49.31840184
Longitude	27.11643253	27.11710733
Azimuth (°)	291.00	111.00
Gradient (°)		0.606281916
Elevation (m)	2	0
Antenna model	V22 H22 G14	V22 H22 G14
Antenna gain (dBi)	14.0	14.0
Antenna height (m)	10	10
Frequency (GHz)		5.8
Polarization		X-POL
Path length (km)		0.189
Free space loss (dB)		95.30
Atmospheric absorption loss (dB)		0.05
Net path loss (dB)	75.35	75.35
Radio model	AP8150DN	AP8150DN
EIRP (in RAP's direction)(dBm)	30.0	30.0
TX channel assignments		108
RX threshold level (dBm)	-69.0	-69.0
Receive signal (dBm)	-48.80	-48.80
Thermal fade margin (dB)	20.20	20.20
Dispersive fade margin (dB)	64	64
Dispersive fade occurrence factor		4
Effective fade margin (dB)	41.59	41.59
Climatic zone		C
0.01% rain rate (mm/hr)		15
Rain Fade Depth (dB)		-36.28
Total Link Budget Vert. Pol. (dB)		95.3008
Total Link Budget Hor. Pol. (dB)		95.3023
AVAILABILITY (Vert.) (%)		99.99999997
OUTAGE (Vert.) (Min/Y)		0.01431241
OUTAGE (Vert.) (Sec/Y)		0.858745



## Design Phase – Radio Design Outdoor

### 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 large area outdoor measurements or 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

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## Radio Planning 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?

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## Radio Planning Services



### TRAINING PHASE

New features  
New procedures  
Responsibilities  
Cooperation

Daily operations

Different scenarios  
Different organizations  
Different areas  
Different functionalities

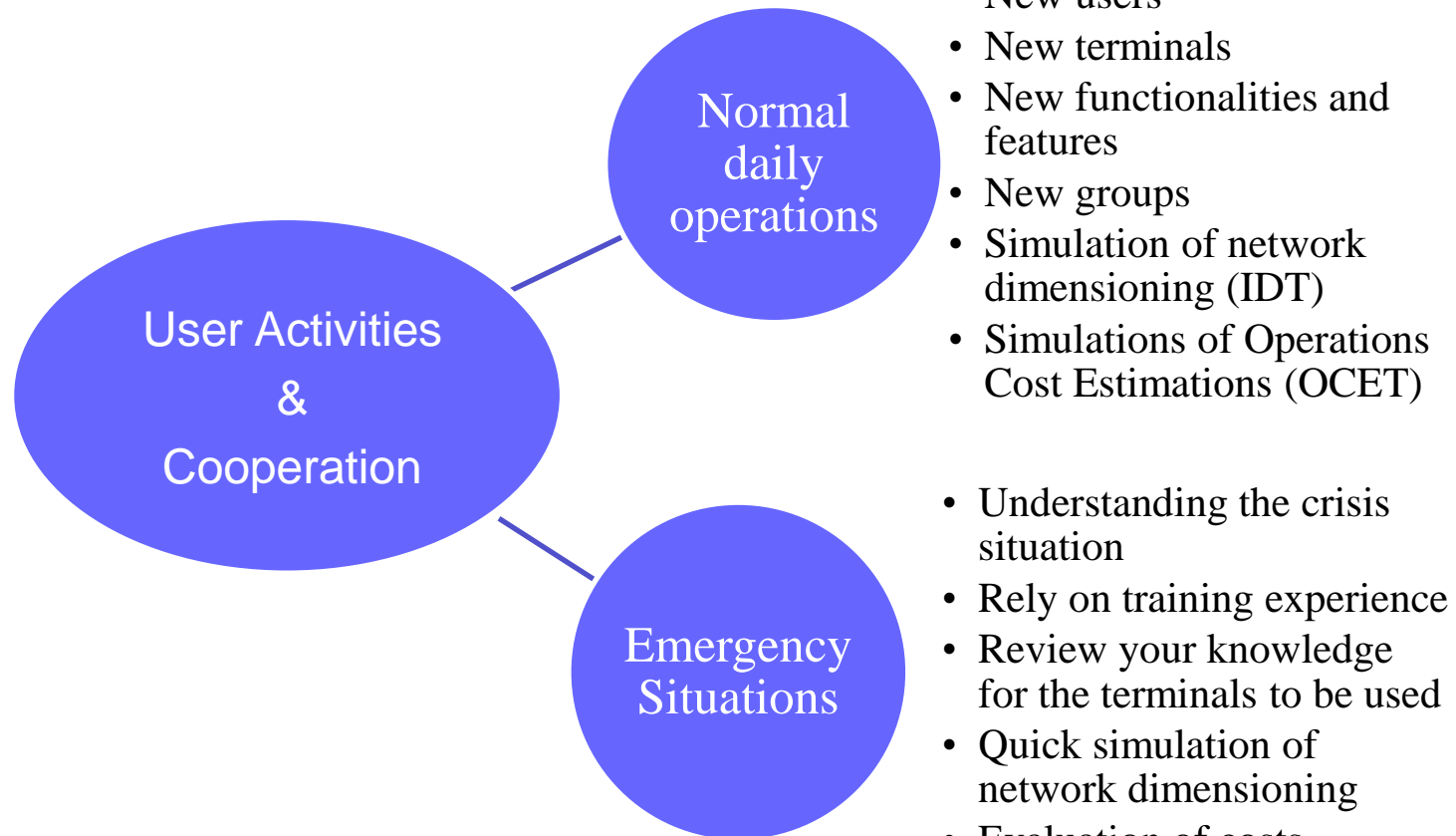
Regular updates

Simulations of emergency events

Fully prepared for crisis situations



### TRAINING PHASE





# Radio Planning Services

## Operations Cost Estimation Tool (OCET)



## Infrastructure Dimensioning Tool (IDT)

**Infrastructure Dimensioning Tool**

**Traffic Calculation**

Quick: User Profile: Light User (15 mEr), Number of users: 0-50, Cost Results

Advanced: Number of TRX's, Number of Base Stations

**TBS Calculation**

Cell Type	Holding Time (sec)	Busy Hour call attempts	Cell Transmission	Traffic
RRUT call				
URUT call				
P. Trk				
T.C				
USER				
TRX BL				

**TBS Calculation**

TBS Name: TBS12, Latitude: 43.4120621208645, Longitude: -0.634765625, Effective Antenna Height (m): 0, TxRx Number: 1

Area Type: Dense Urban are

Use TetraPOL Base Station?

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

**Operations Cost Estimation**

ISTEF

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

My Roaming Models Manage Users Administration Contact

**1. Maintenance of equipment and components**

**2. Equipment and component licenses, maintenance outsourcing**

**3. Customer Provisioning**

**4. Customer Care, Charging and billing Costs**

**5. Service Management Costs**

**6. Network Management Costs**

**7. Network Optimization**

**8. Rental of physical network resources (including licenses)**

**9. Regulation Costs**

**10. Detailed Equipment Costs**

**11. Other Costs**

**Cost per Control Room**  
Upgrade infrastructure (HW components, deployment and installation):

**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:



**Net Technologies**  
building quality in telecom networks

**Thank you for your attention!**

**We are looking forward to meeting you at booth**

**H20**

If you have any question, you can always contact us

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