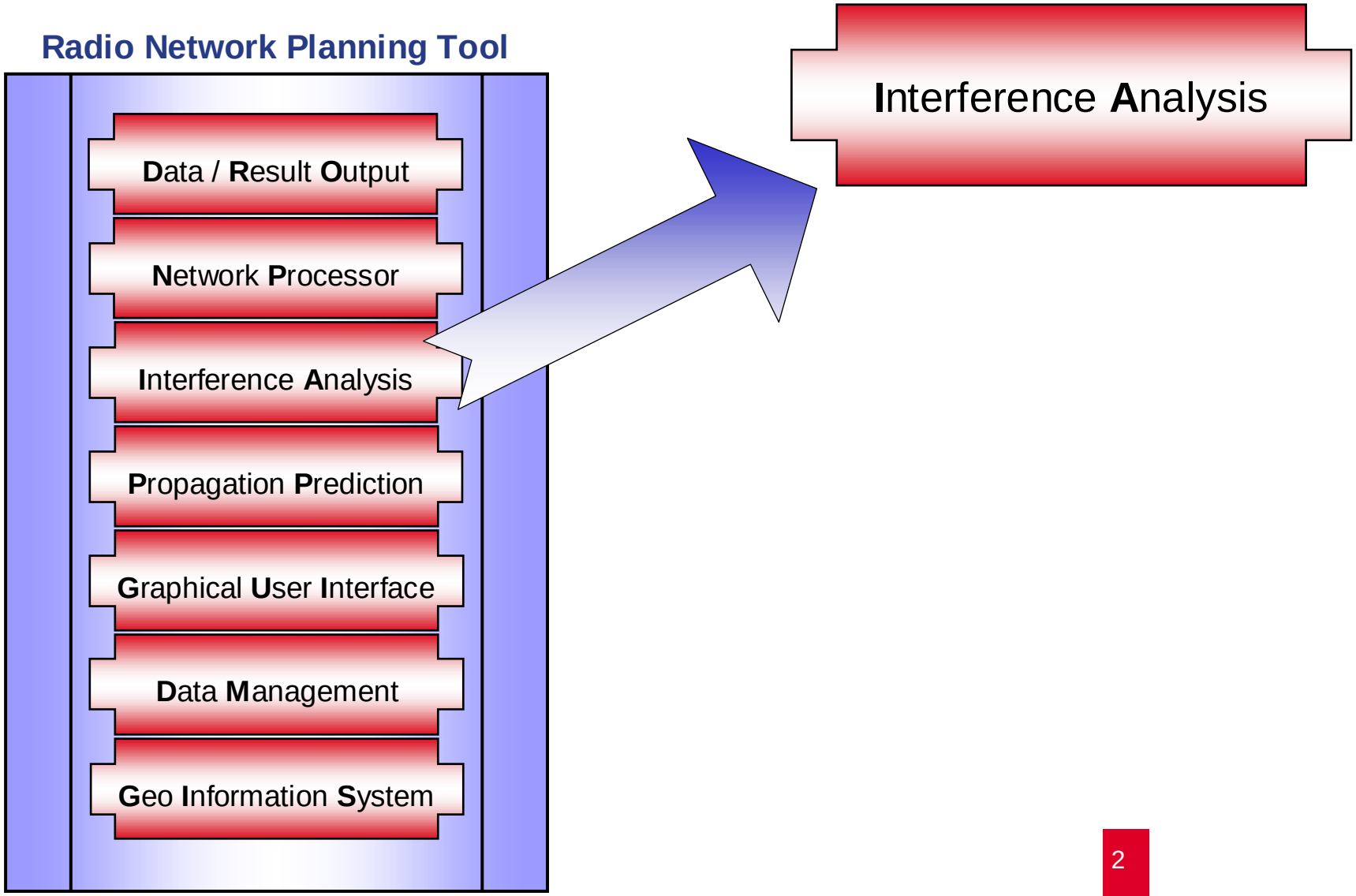
Session 5.8

Supporting Network Planning Tools III

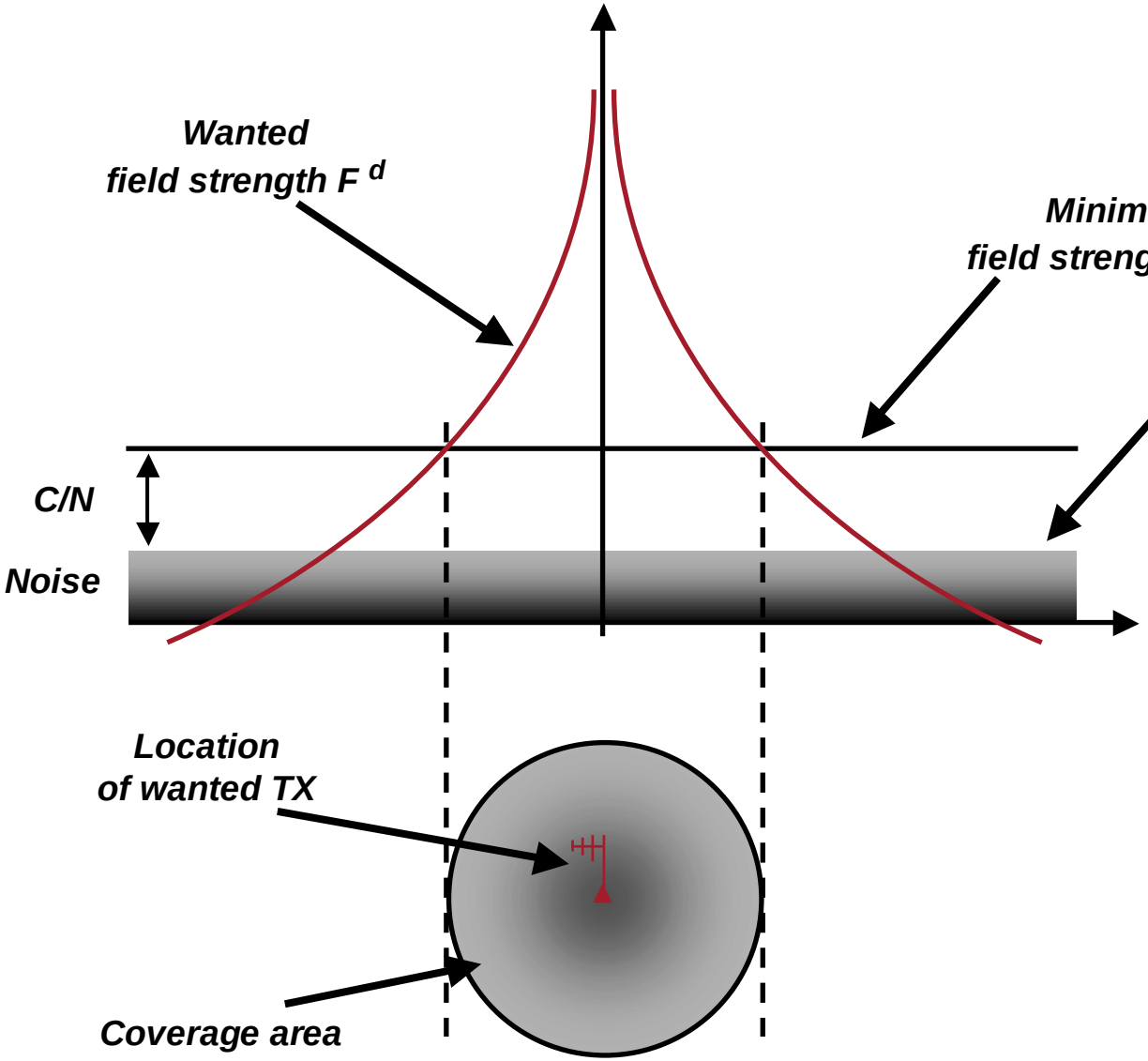
by

Roland Götz



Interference by Noise

Interference Analysis



Minimum field strength (C/N):
It is a minimum field strength level which is necessary to fulfil the signal quality for coverage.

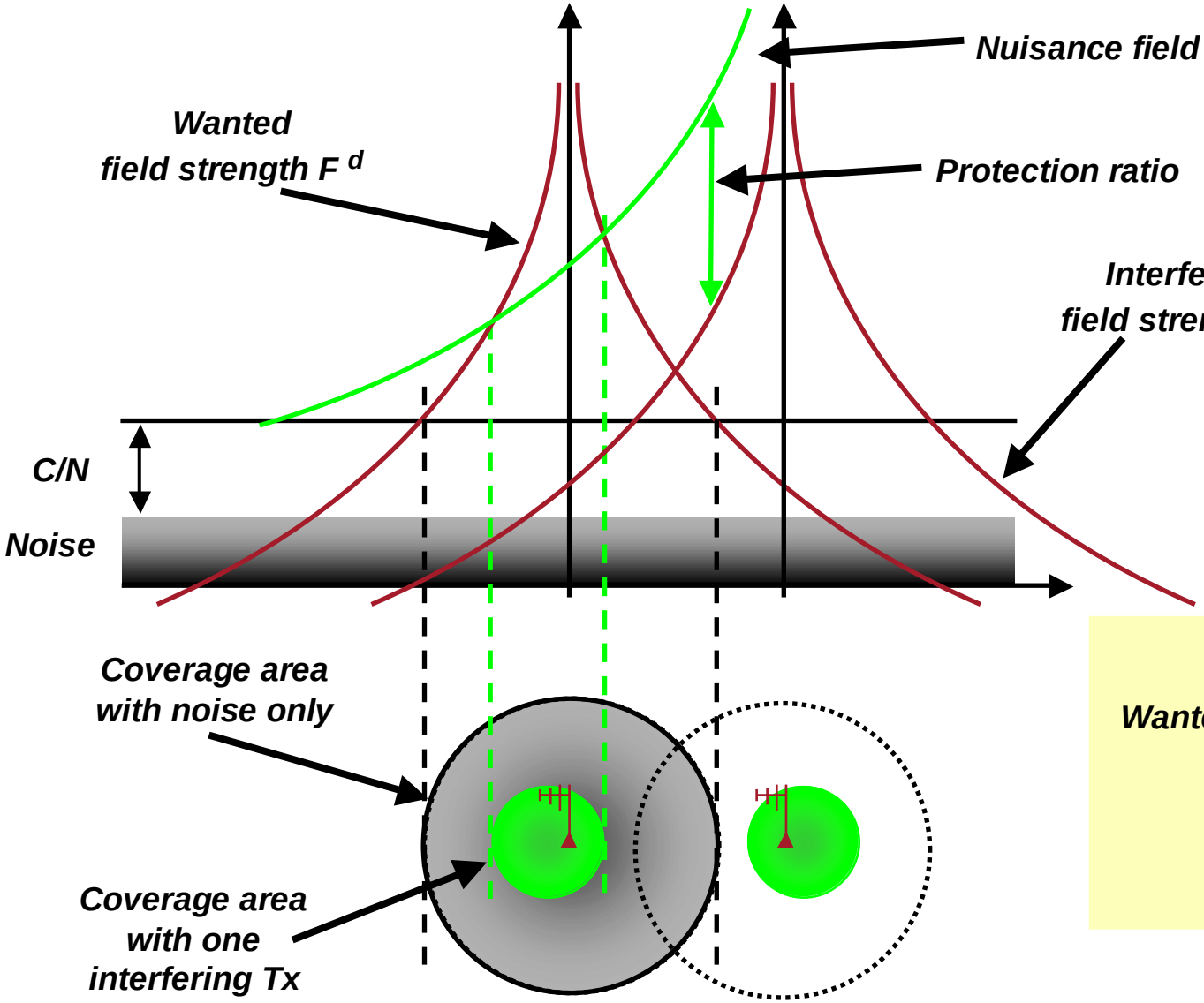
1. Criteria for coverage

Wanted Field Str. > Minimum Field Str.

$$F^{d} > \underbrace{F^{N} + C/N}_{F^{min}}$$

Interference by one Transmitter

Interference Analysis



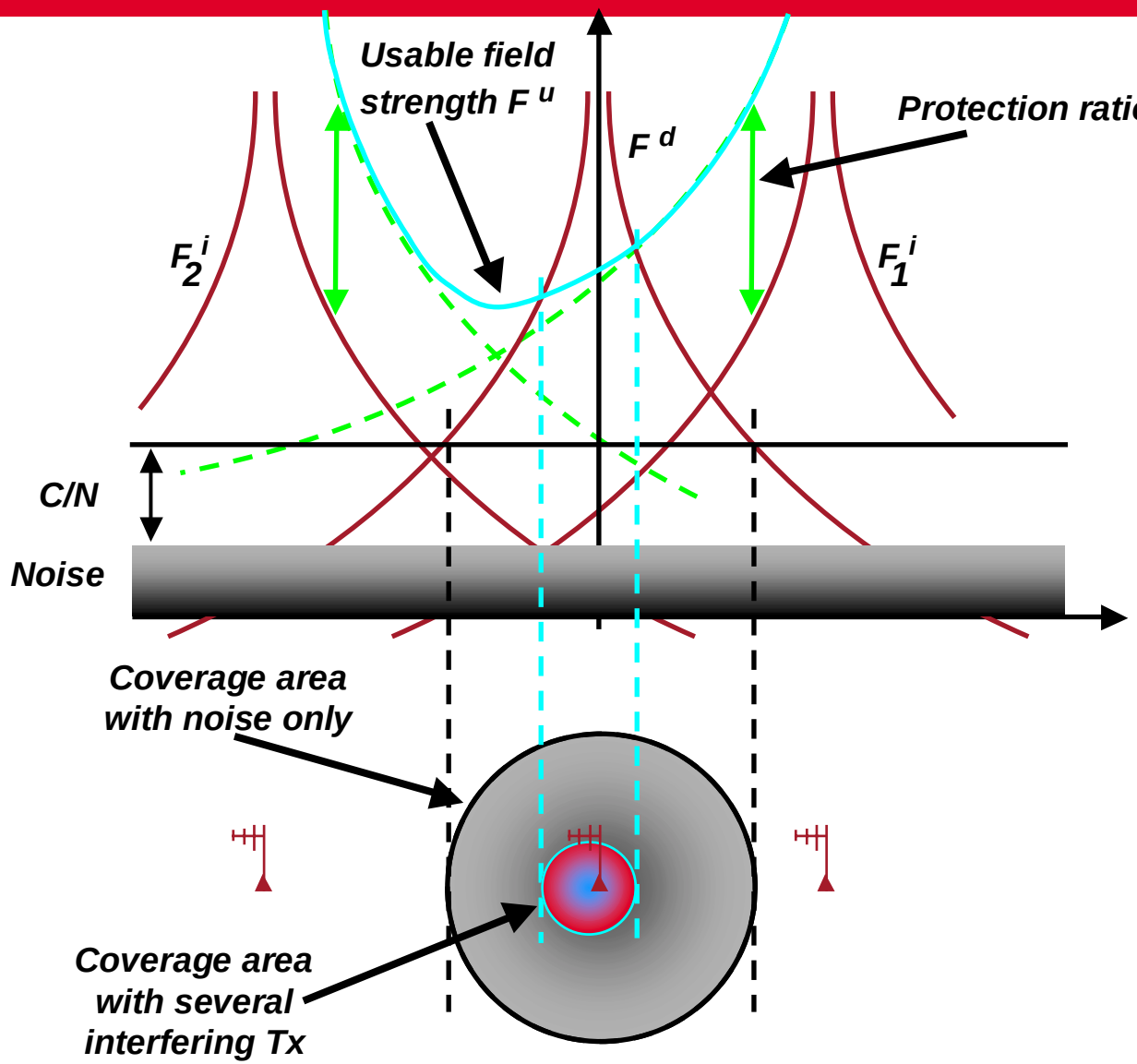
Nuisance field:
Interference field strength at the reference point plus the protection ratio (C/I) required for the considered service.

2. Criteria for coverage

Wanted Field Str. > Nuisance Field Str.

$$F^d > \underbrace{F^i + A}_{F^n}$$

Interference by several Transmitter



Usable field:
Summation of the nusiance fields of the interfering tansmitters according to a certain summations algorithm (maximum, simplified multiplication, ...)
It is the fieldstrength value which is *usable* by a possible new site just to fulfill the condition of coverage (C/I>0) by the existing interferer situation.

3. Criteria for coverage

Wanted Field Str. > Usable Field Str.

$$F^d > \underbrace{\sum_{j=1}^{M} F_j^n}_{F^u}$$

In modern Planning Tools, the cumulation of the single interfering fields can be done in several different ways.

The various procedures differ in the way how simplifications are used to minimize the calculation effort.

In the following a short overview is given for the procedures which are most often used in interference calculations.

Non-statistical methods:

- Maximum procedure
- Power-sum method

Statistical methods:

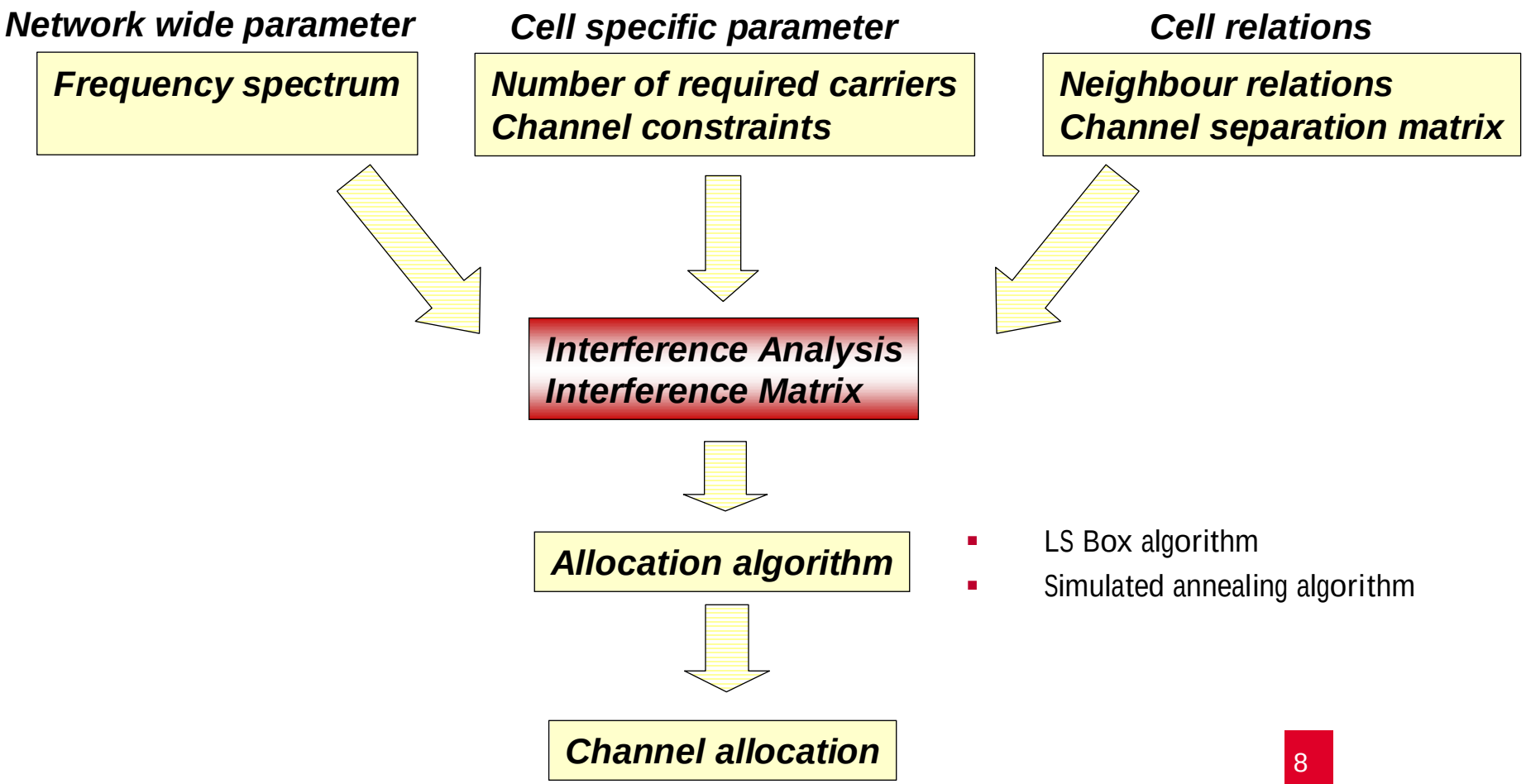
- Integration method
- Log-normal method
- Multiplication method
- Simplified multiplication method
- Simplified Log-normal method
- Trilinear Log-normal method

Most use is made of the power-sum method and the simplified multiplication method

Reference CCIR Report 945-2: Methods for the Assessment of Multiple Interference

Automissed Frequency / Channel Assignment

Interference Analysis



- LS Box algorithm
- Simulated annealing algorithm

Frequency Scan

- ***This function is used to find out gaps in the frequency spectrum where new TV or FM transmitters could be planned. At a desired transmitter site (transmitter coordinate) a wanted transmitter calculation based on a frequency range given by the user is done and the usable field strength calculated for each frequency point.***

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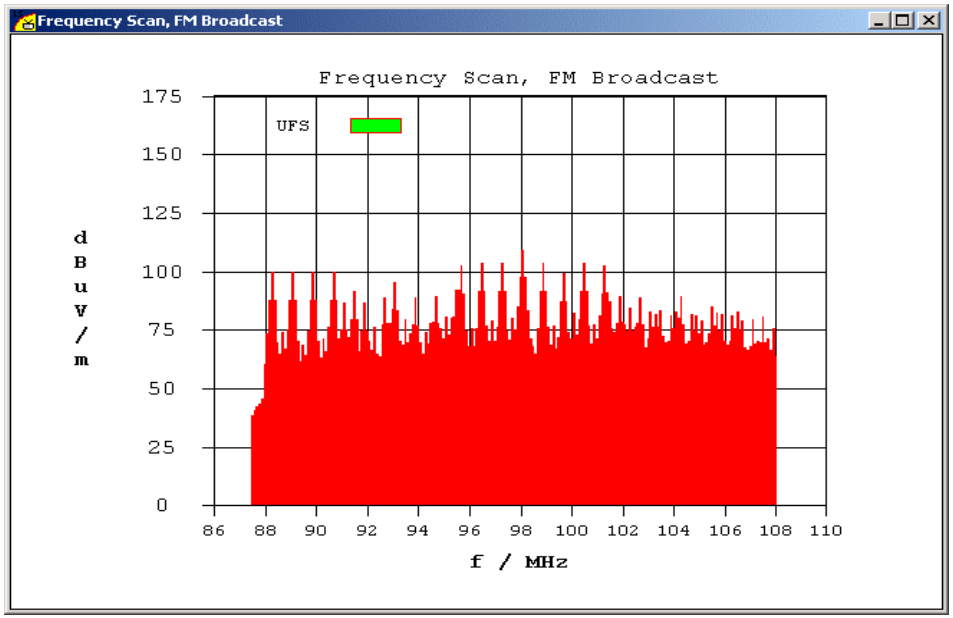
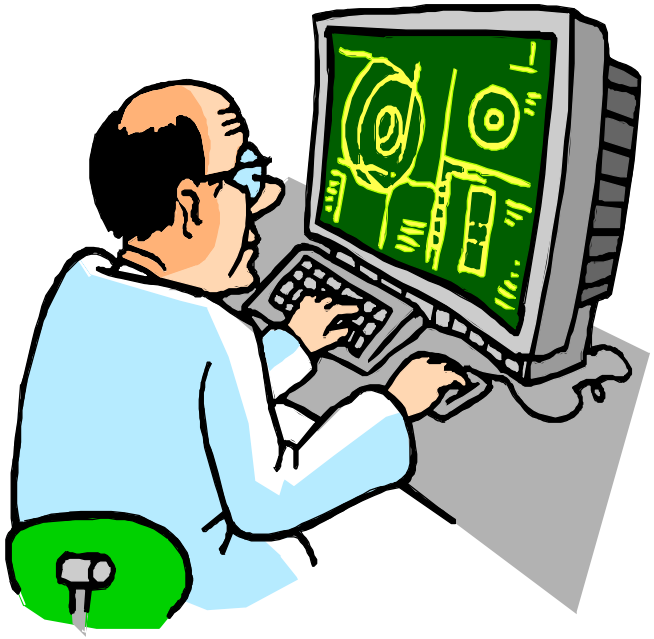
38.67 Useable Fieldst - Analysis Method: Simplified Multiplication

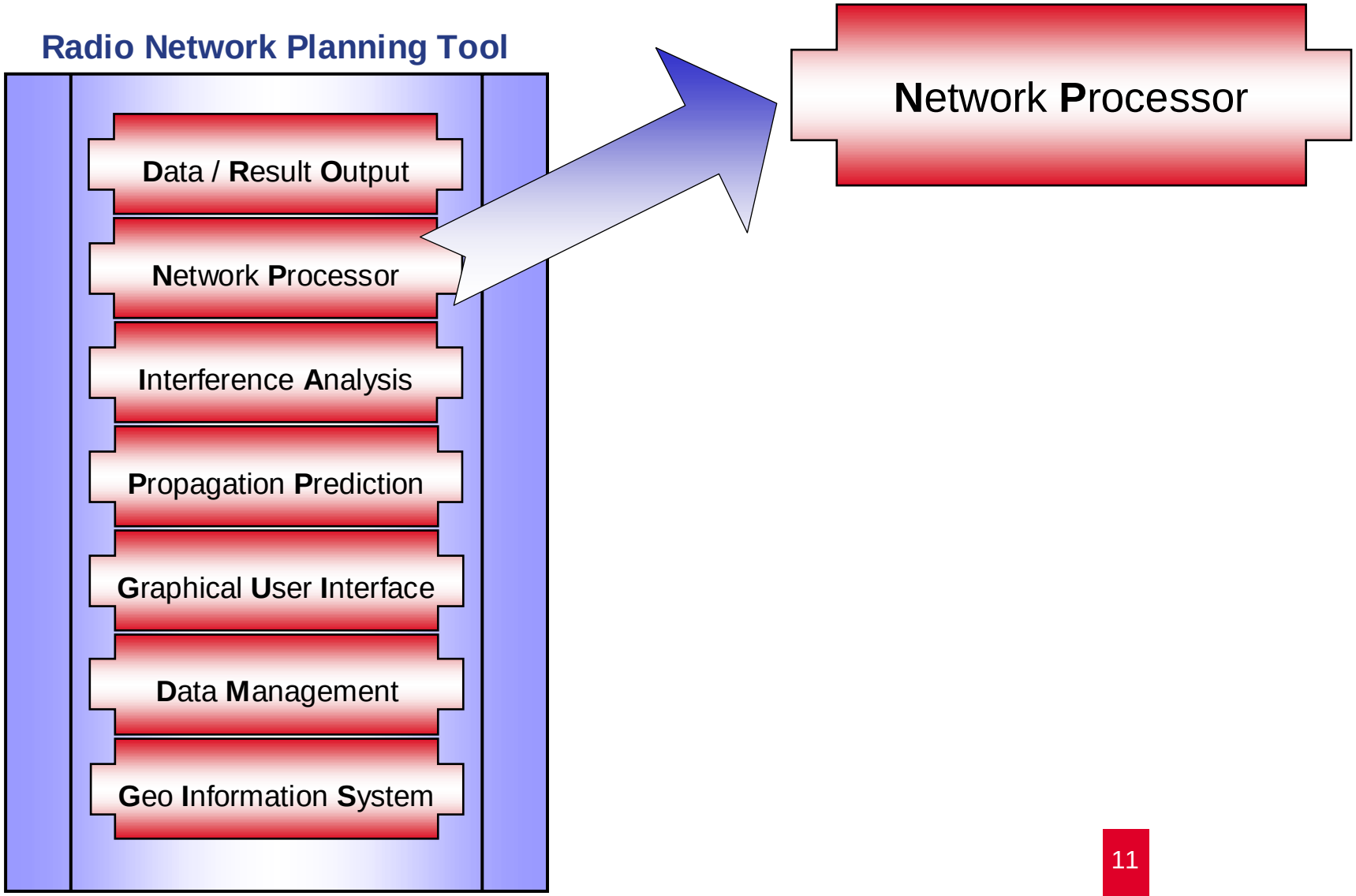
No	Frequency	Channel	UFS	A/sqkm	Max.Interferer		
1	87.50000	-2	38.7	0.00	SW Slopes/E Riverina	88.30	AUS
2	87.60000	2	40.7	0.00	SW Slopes/E Riverina	88.30	AUS
3	87.70000	+2	42.7	0.00	SW Slopes/E Riverina	88.30	AUS
4	87.80000	-3	43.7	0.00	SW Slopes/E Riverina	88.30	AUS
5	87.90000	3	45.5	0.00	SW Slopes/E Riverina	88.30	AUS
6	88.00000	+3	60.4	0.00	SW Slopes/E Riverina	88.30	AUS
7	88.10000	-4	73.6	0.00	SW Slopes/E Riverina	88.30	AUS
8	88.20000	4	87.7	0.00	SW Slopes/E Riverina	88.30	AUS
9	88.30000	+4	99.7	0.00	SW Slopes/E Riverina	88.30	AUS
10	88.40000	-5	87.7	0.00	SW Slopes/E Riverina	88.30	AUS
11	88.50000	5	70.0	0.00	SW Slopes/E Riverina	88.30	AUS
12	88.60000	+5	65.0	0.00	SW Slopes/E Riverina	88.30	AUS
13	88.70000	-6	74.4	0.00	Walwa/Jingellic	88.70	AUS
14	88.80000	6	66.8	0.00	SW Slopes/E Riverina	89.10	AUS
15	88.90000	+6	75.3	0.00	SW Slopes/E Riverina	89.10	AUS
16	89.00000	-7	87.7	0.00	SW Slopes/E Riverina	89.10	AUS
17	89.10000	7	99.7	0.00	SW Slopes/E Riverina	89.10	AUS
18	89.20000	+7	87.7	0.00	SW Slopes/E Riverina	89.10	AUS
19	89.30000	-8	70.3	0.00	SW Slopes/E Riverina	89.10	AUS
20	89.40000	8	61.8	0.00	SW Slopes/E Riverina	89.10	AUS
21	89.50000	+8	68.9	0.00	Orange	89.50	AUS
22	89.60000	-9	64.5	0.00	SW Slopes/E Riverina	89.90	AUS
23	89.70000	9	74.9	0.00	SW Slopes/E Riverina	89.90	AUS
24	89.80000	+9	87.7	0.00	SW Slopes/E Riverina	89.90	AUS
25	89.90000	-10	99.7	0.00	SW Slopes/E Riverina	89.90	AUS
26	90.00000	10	87.7	0.00	SW Slopes/E Riverina	89.90	AUS
27	90.10000	+10	70.2	0.00	SW Slopes/E Riverina	89.90	AUS
28	90.20000	-11	63.0	0.00	SW Slopes/E Riverina	89.90	AUS
29	90.30000	11	71.1	0.00	Bendigo	90.30	AUS
30	90.40000	+11	66.1	0.00	SW Slopes/E Riverina	90.70	AUS
31	90.50000	-12	76.3	0.00	SW Slopes/E Riverina	90.70	AUS





Live
Planning Tool Demonstration

Modern Radio Network Planning Tools



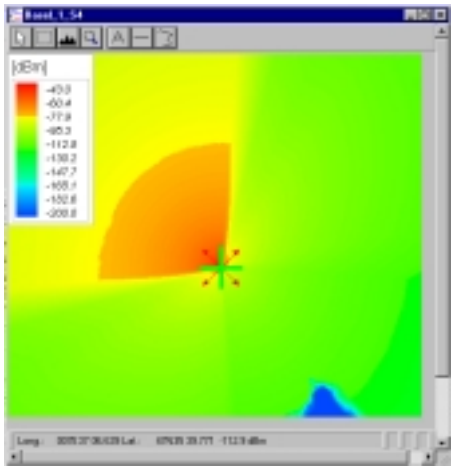
The Network Processor

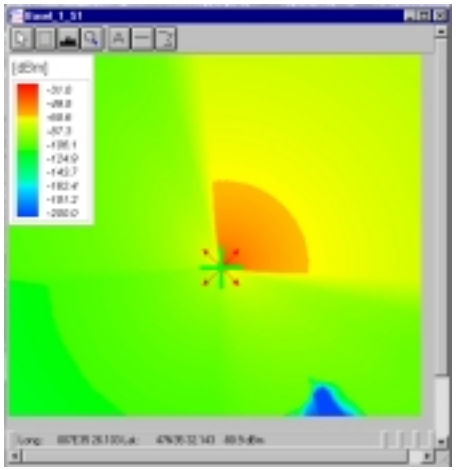
- produces network-wide results out of the single-cell-based results
- allows to analyse the radio network
- allows to simulate changes of the network parameter
- allows to simulate changes of the network design
- allows to optimise the radio network
- allows to plan the future roll-out phases
- produces statistics on the selected results

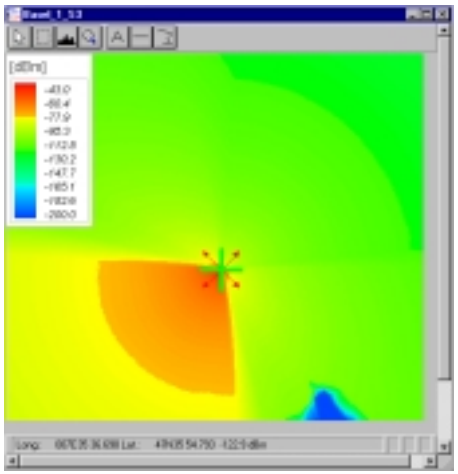
Each Service needs an own service-specific Network Processor

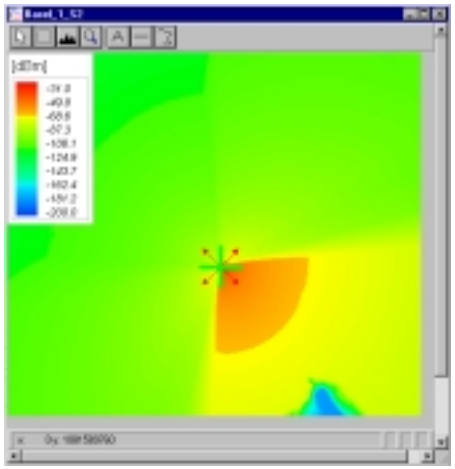
Coverage of Single Sectors

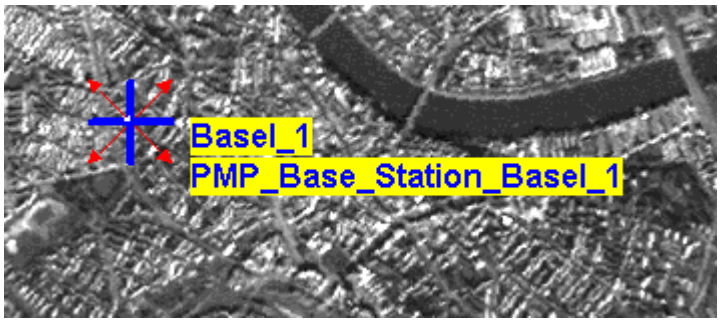
Network Processor



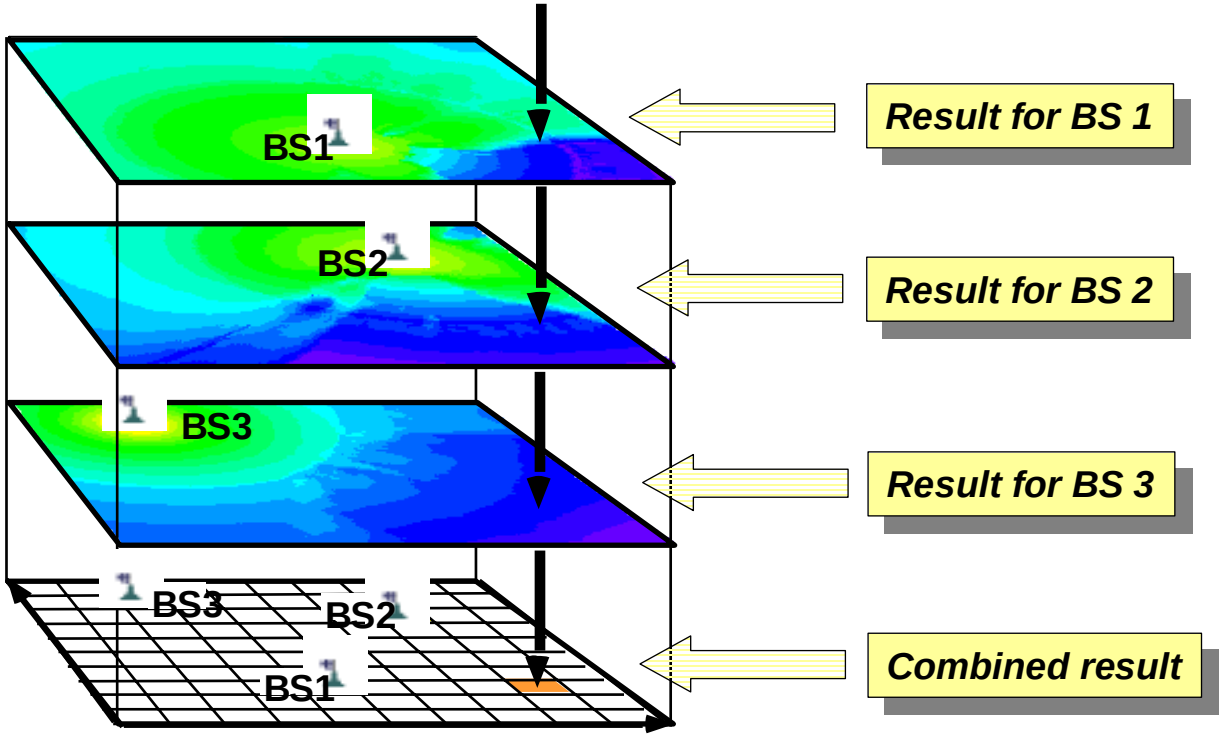








Principle of calculation: Combination of different results



Maximum Field Strength:

For every pixel, this plot shows the signal level of the cell/transmitter producing the maximum single field strength.

Sector 1

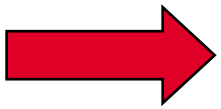
-120	-128	-130
-120	-127	-129
-115	-118	-121

Sector 2

-95	-80	-75
-90	-75	-70
-85	-70	-65

Sector 3

-65	-80	-95
-65	-80	-95
-65	-75	-95

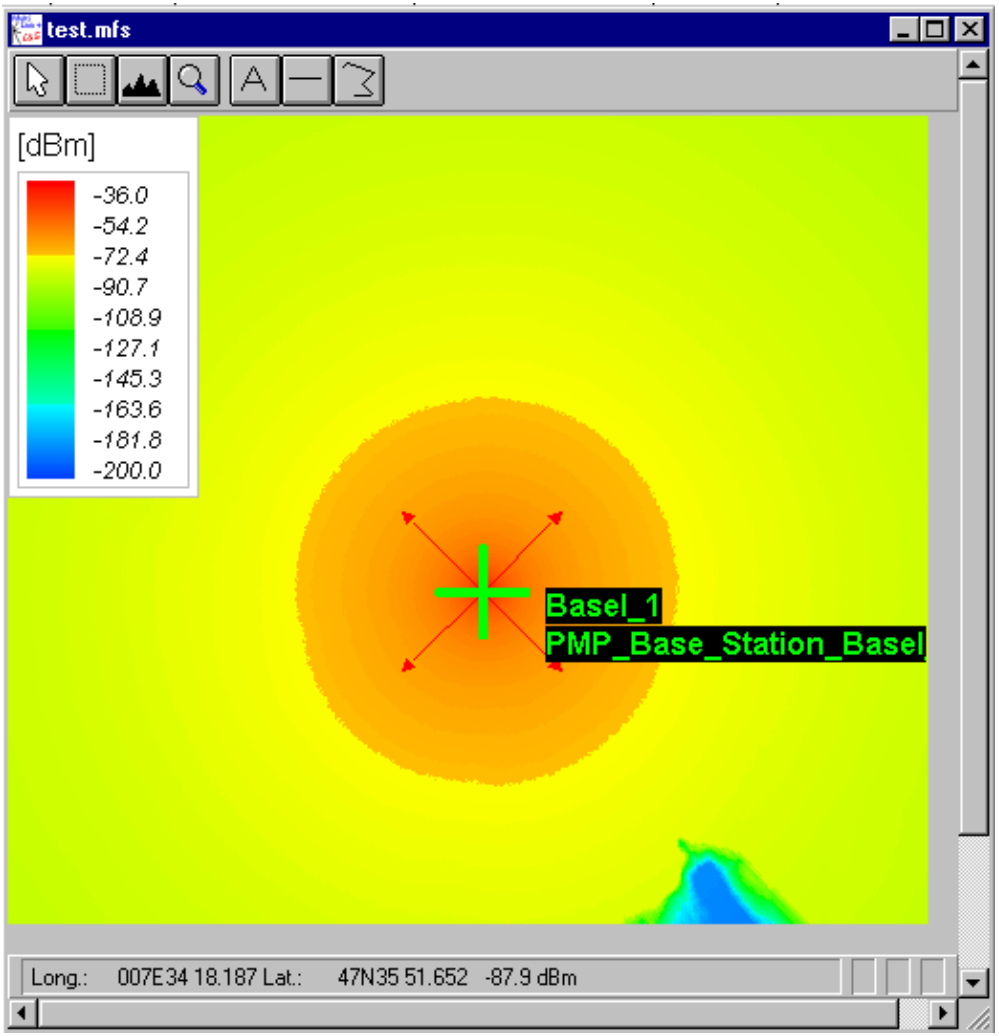


Max. Field.

-65	-80	-75
-65	-75	-70
-65	-70	-65

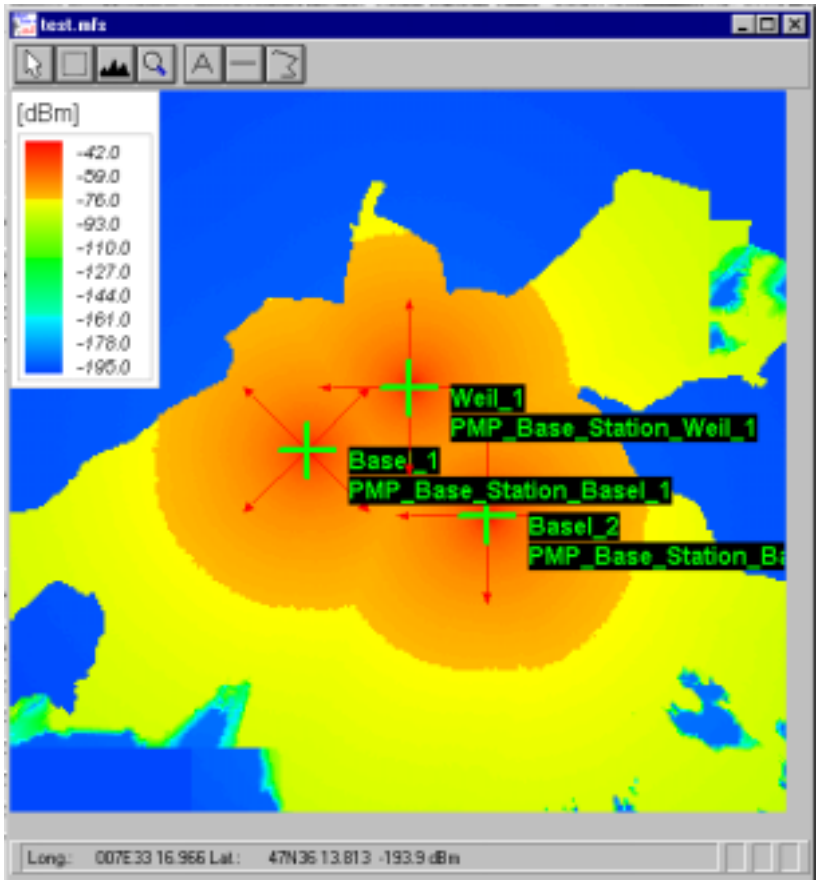
Maximum Field Strength

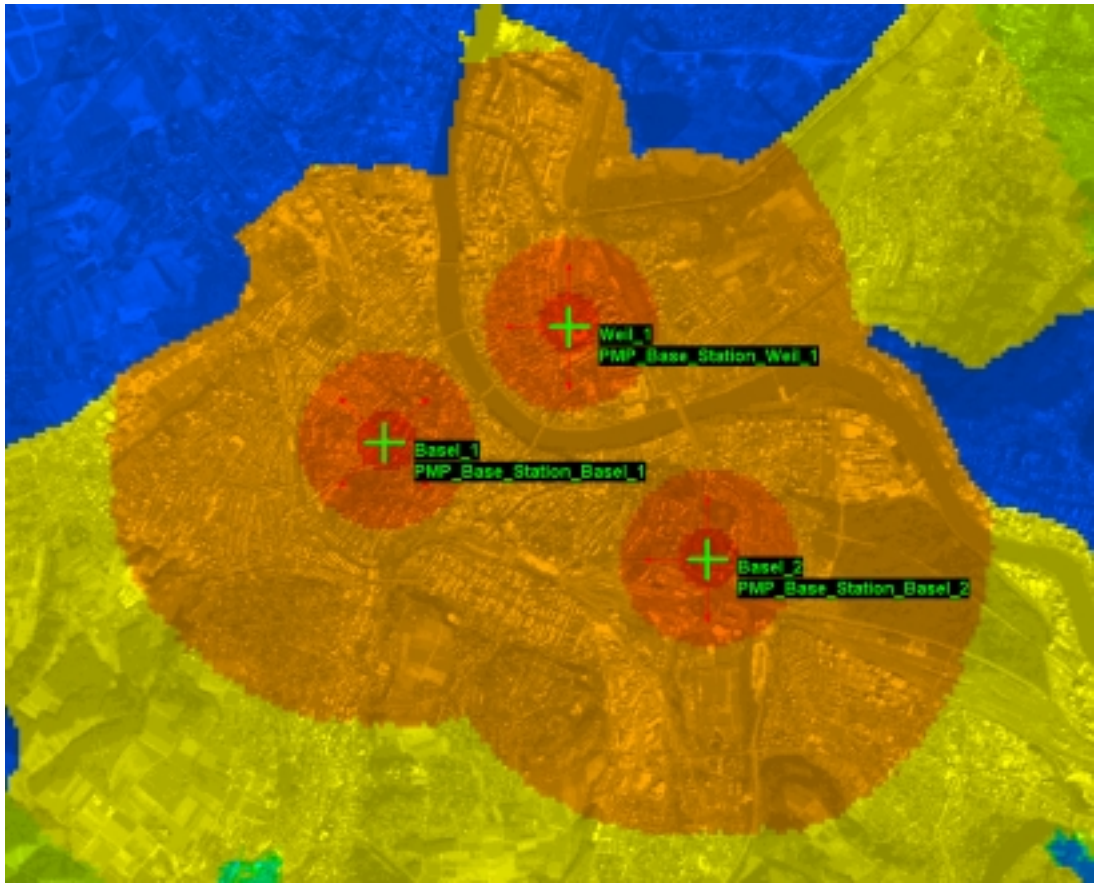
Network Processor



Maximum Field Strength (Network)

Network **P**rocessor





Maximum Server:

The maximum server plot shows, for a certain pixel, the name of the transmitter featuring the maximum signal; its field strength must exceed the minimum field strength required for coverage, $E_{min\ equiv}$.

Sector 1

-120	-128	-130
-120	-127	-129
-115	-118	-121

Sector 2

-95	-80	-75
-90	-75	-70
-85	-70	-65

Sector 3

-65	-80	-95
-65	-80	-95
-65	-75	-95

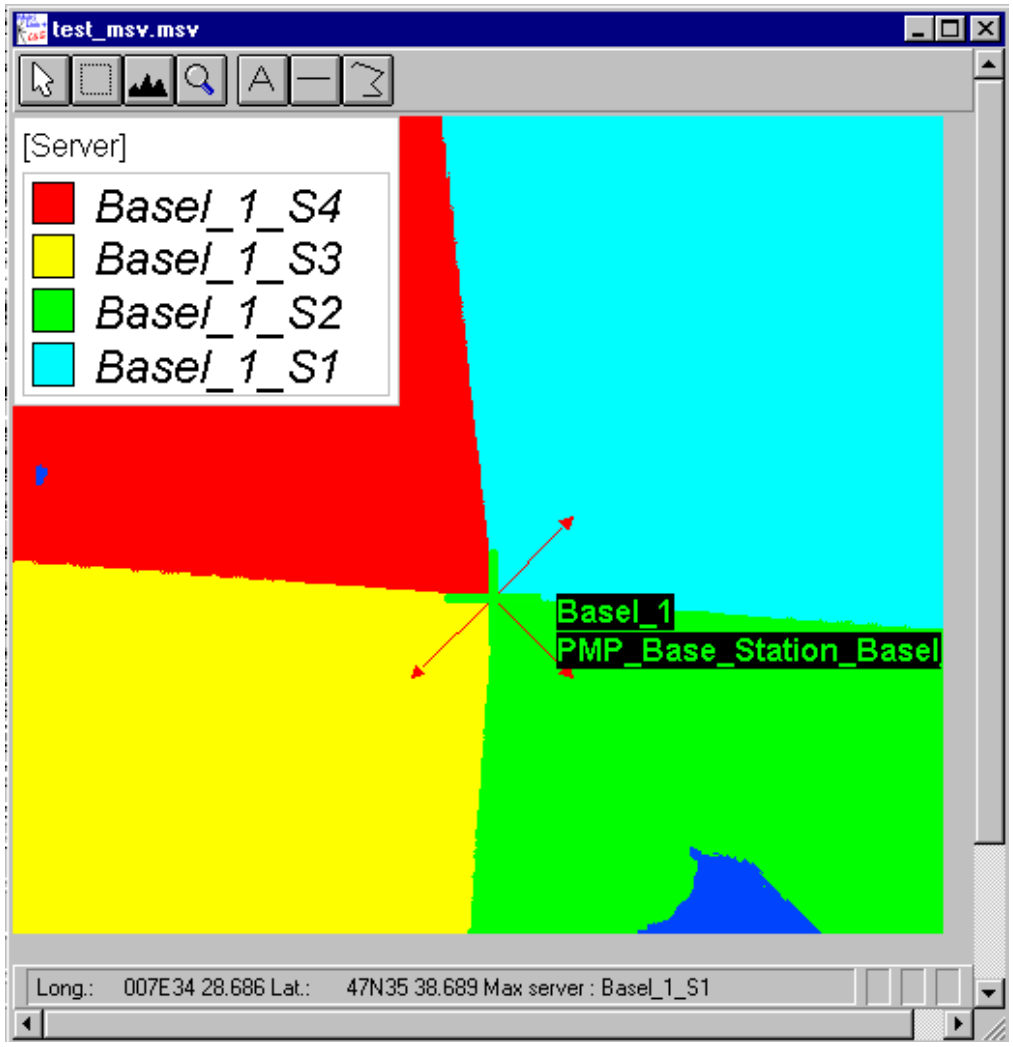
P_{min}= -75dBm

Max. Server

S3	x	S2
S3	S2	S2
S3	S2	S2

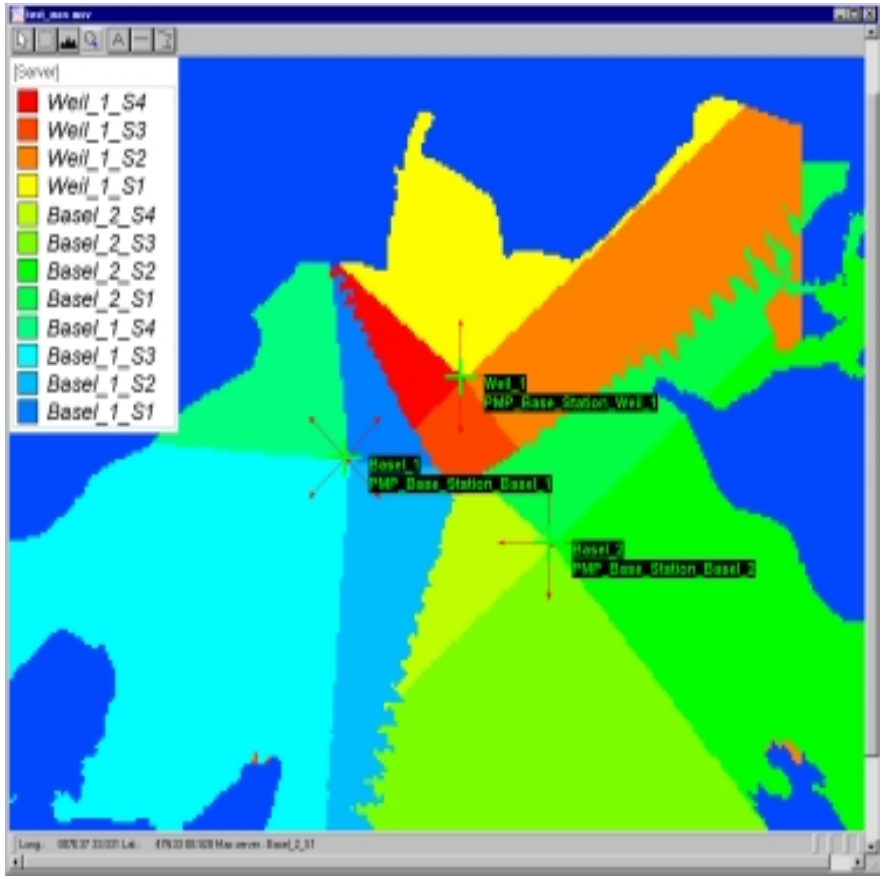
Maximum Server

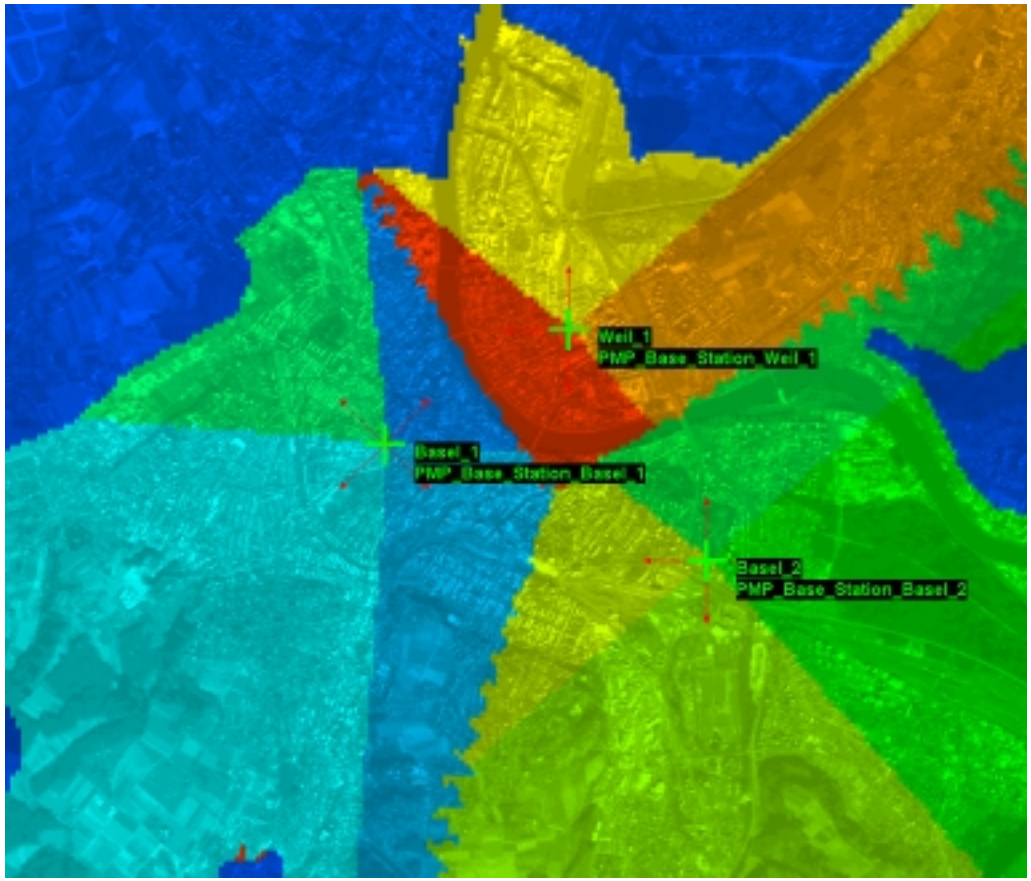
Network Processor



Maximum Server (Network)

Network **P**rocessor





Best Server:

The maximum server plot shows, for a certain pixel, the name of the transmitter featuring the maximum signal; its field strength must exceed the minimum field strength required for coverage, $E_{min\ equiv}$ and the Minimum C/I

Sector 1

-120	-128	-130
-120	-127	-129
-115	-118	-121

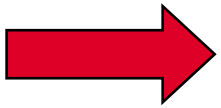
Sector 2

-95	-80	-75
-90	-75	-70
-85	-70	-65

Sector 3

-65	-80	-95
-65	-80	-95
-65	-75	-95

P_{min}= -75dBm
C/I_{min}= 7 dB



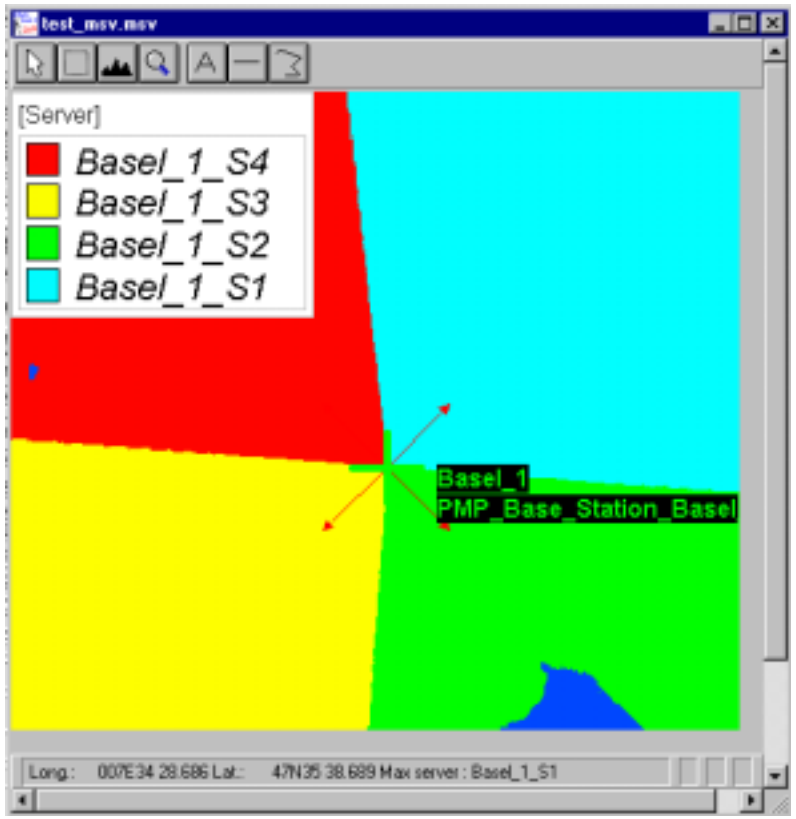
Best Server

S3	x	S2
S3	x	S2
S3	x	S2

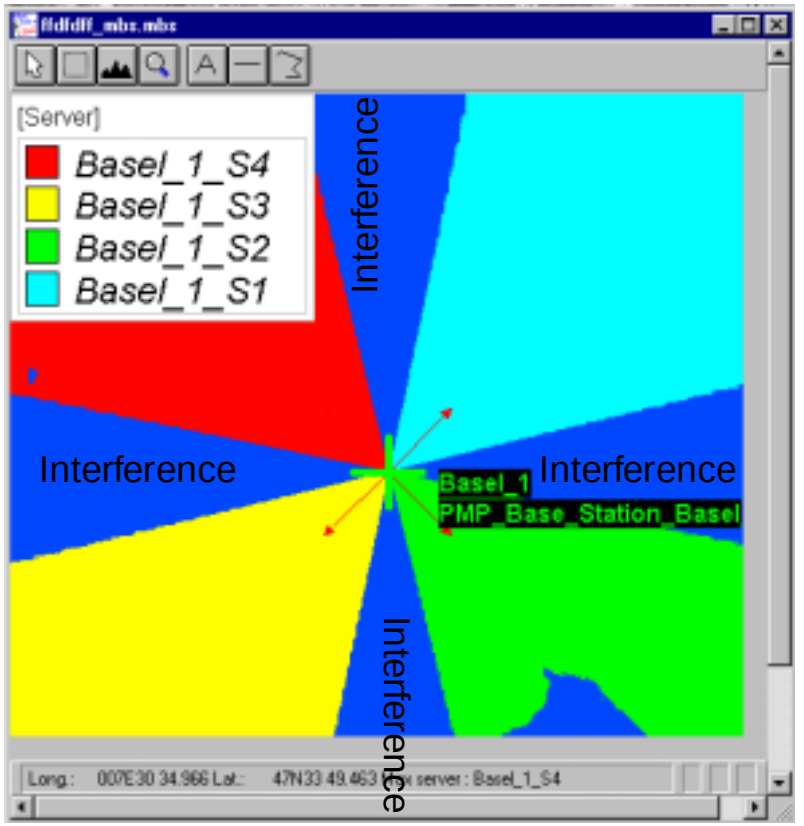
Best Server

Network Processor

Maximum Server



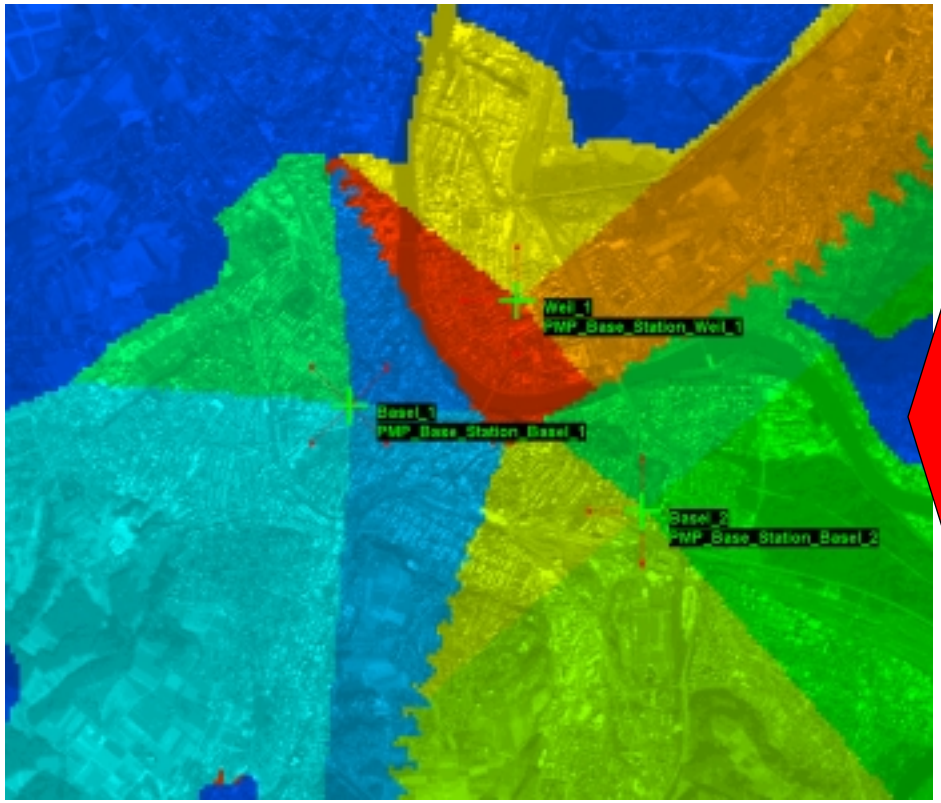
Best Server



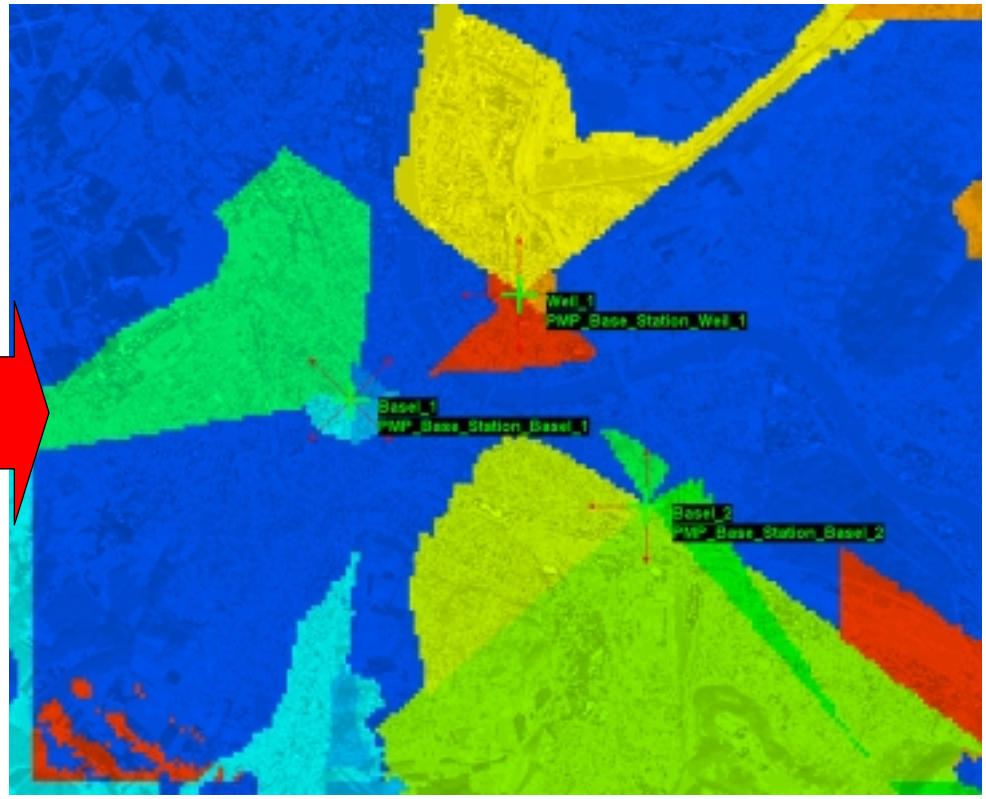
Best Server (Network)

Network Processor

Maximum Server



Best Server



C/I at Max. Server:

C/I at sector with highest power at a certain position

Parameters: Minimum Level (P_{min})

Sector 1

-120	-128	-130
-120	-127	-129
-115	-118	-121

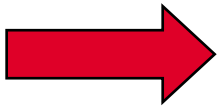
Sector 2

-95	-80	-75
-90	-75	-70
-85	-70	-65

Sector 3

-65	-80	-95
-65	-80	-95
-65	-75	-95

P_{min}= -75dBm

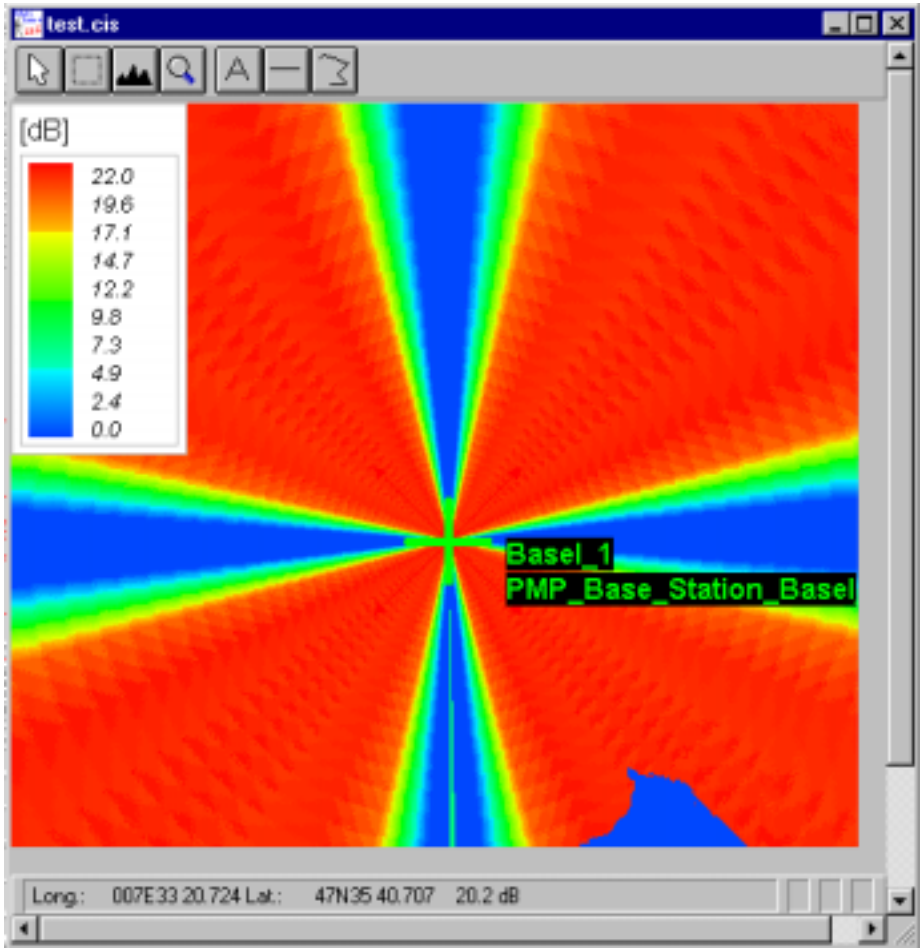


C/I at Max. Server

30	x	20
25	5	25
20	5	30

C/I at MaxServer

Network Processor

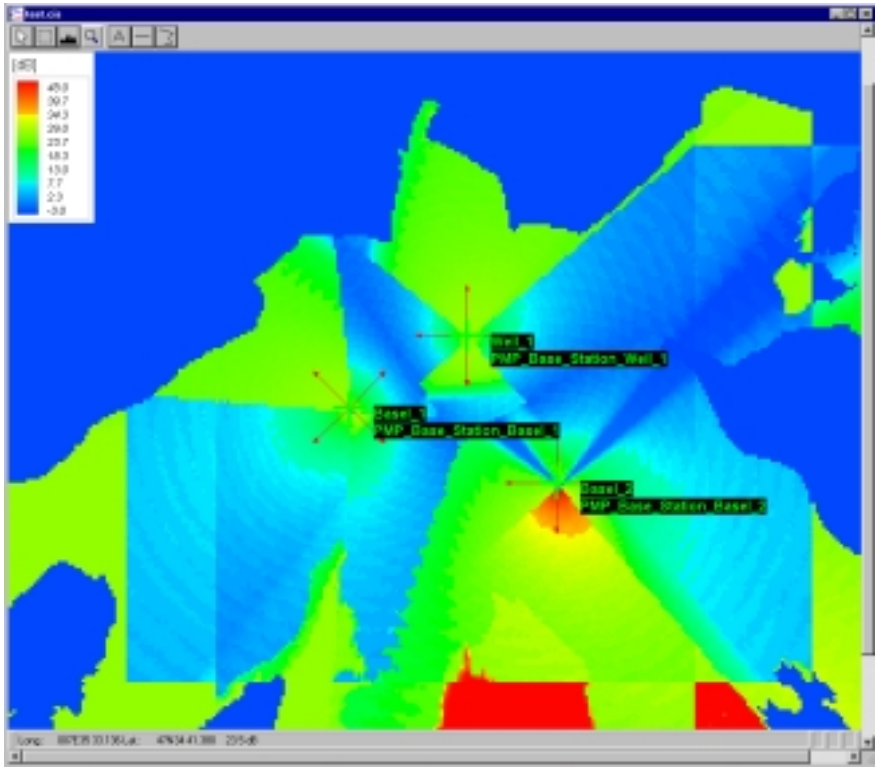


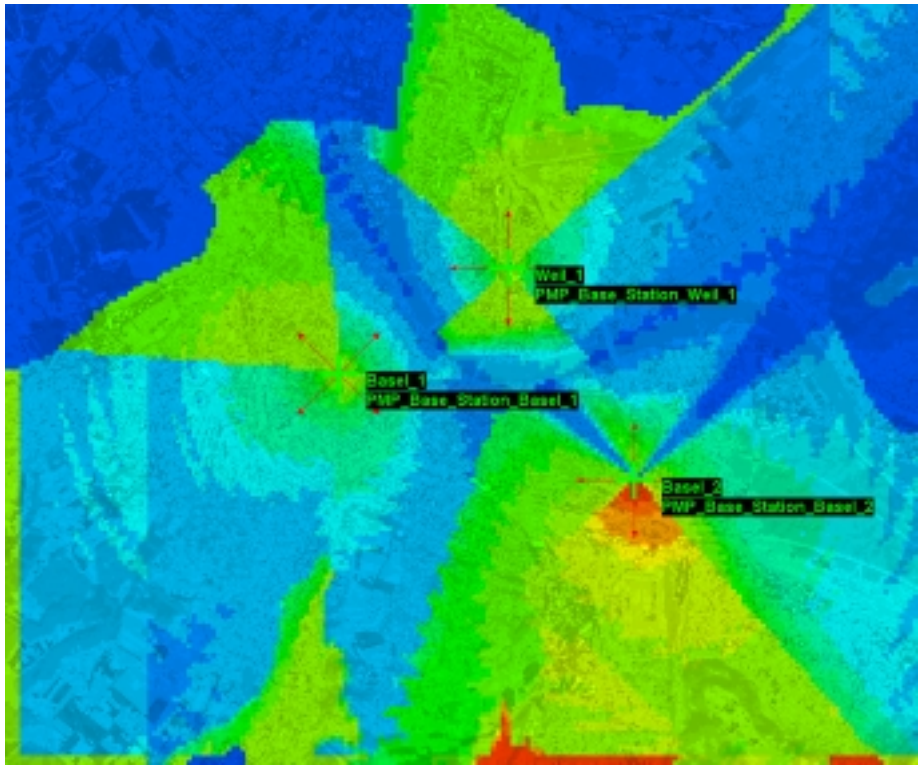
Spectrocan

C/I at MaxServer (Network)

LS telcom

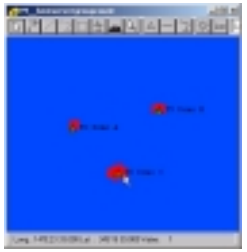
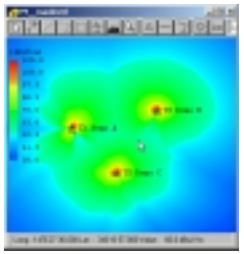
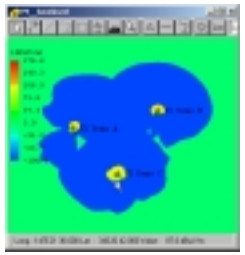
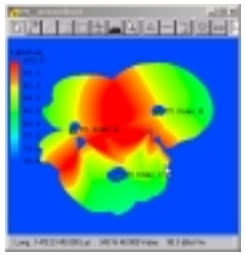
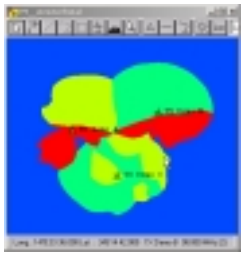
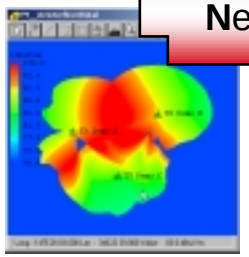
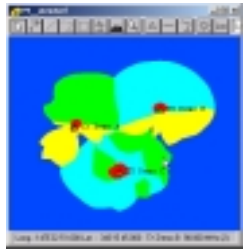
Network **P**rocessor





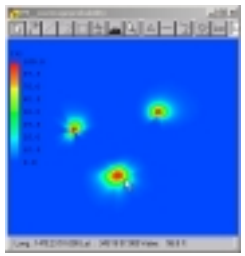
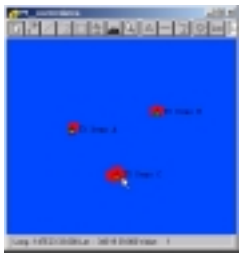
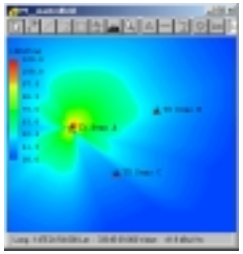
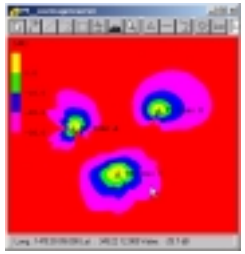
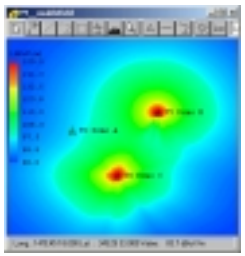
Network Processor Results

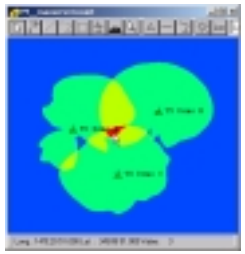
Network Processor

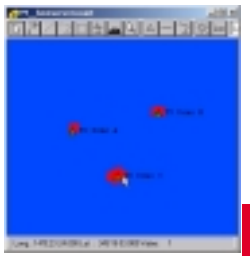








Many other service-specific results can be processed by a powerful Network Processor, like:

- 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
- ...

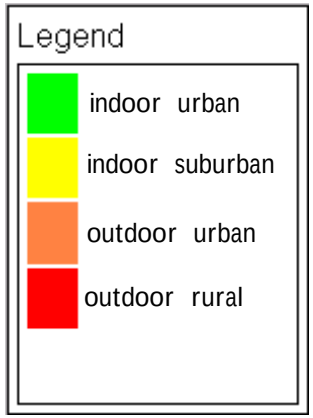


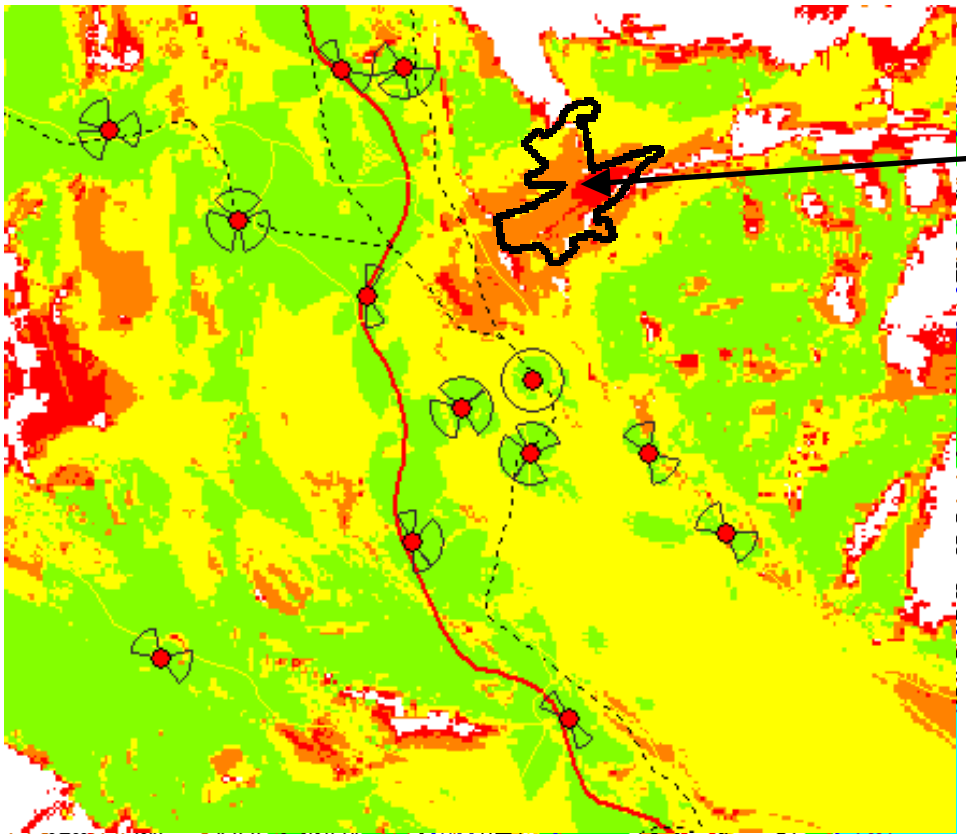


Example: Coverage Optimisation GSM Network

Network Processor

Current network coverage



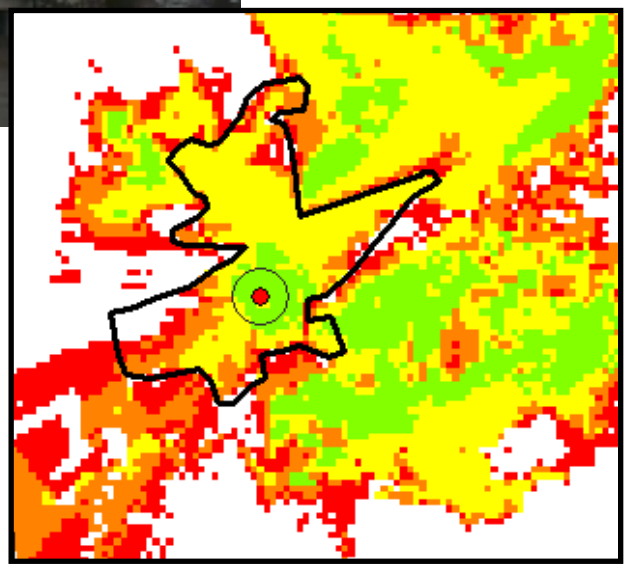


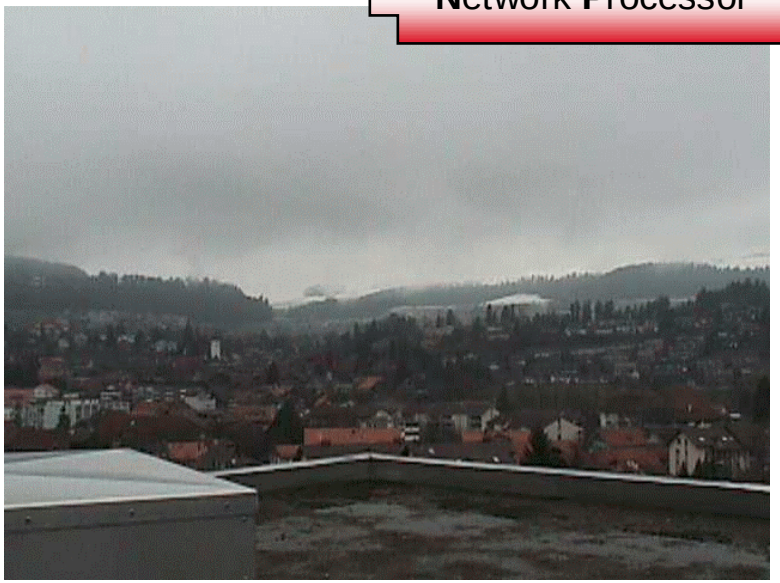
Now, we want to improve the coverage in this region.

Example: Coverage Optimisation GSM Network

Network Processor

Candidate Steffisburg A

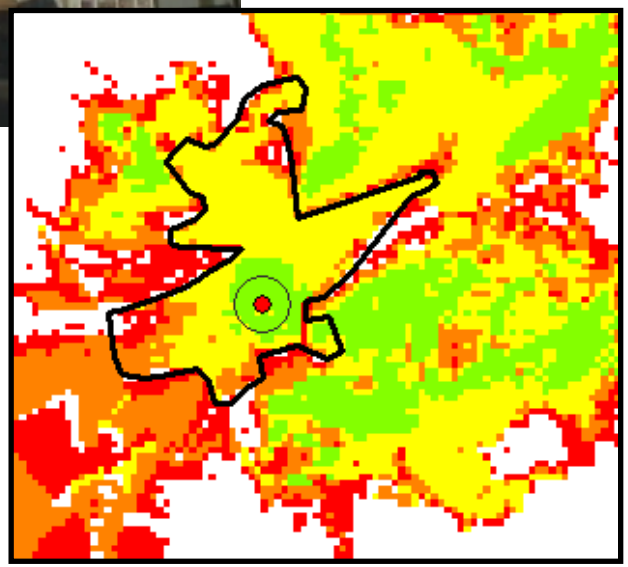




00°

Example: Coverage Optimisation GSM Network

Candidate Steffisburg B

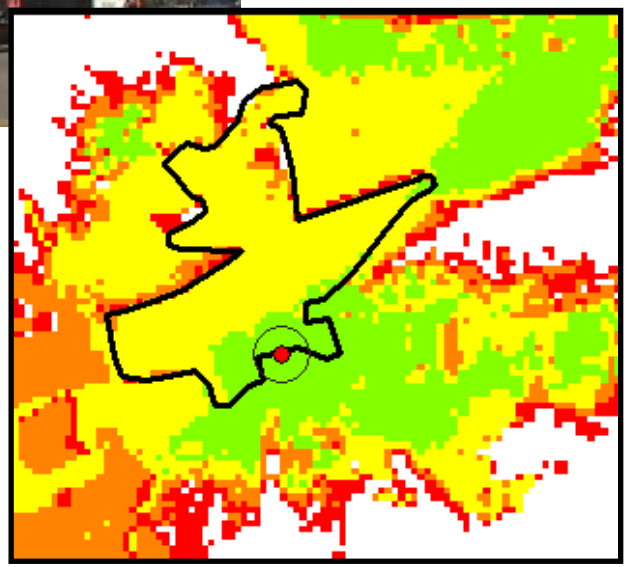


Network Processor

00°

Example: Coverage Optimisation GSM Network

Candidate Steffisburg C



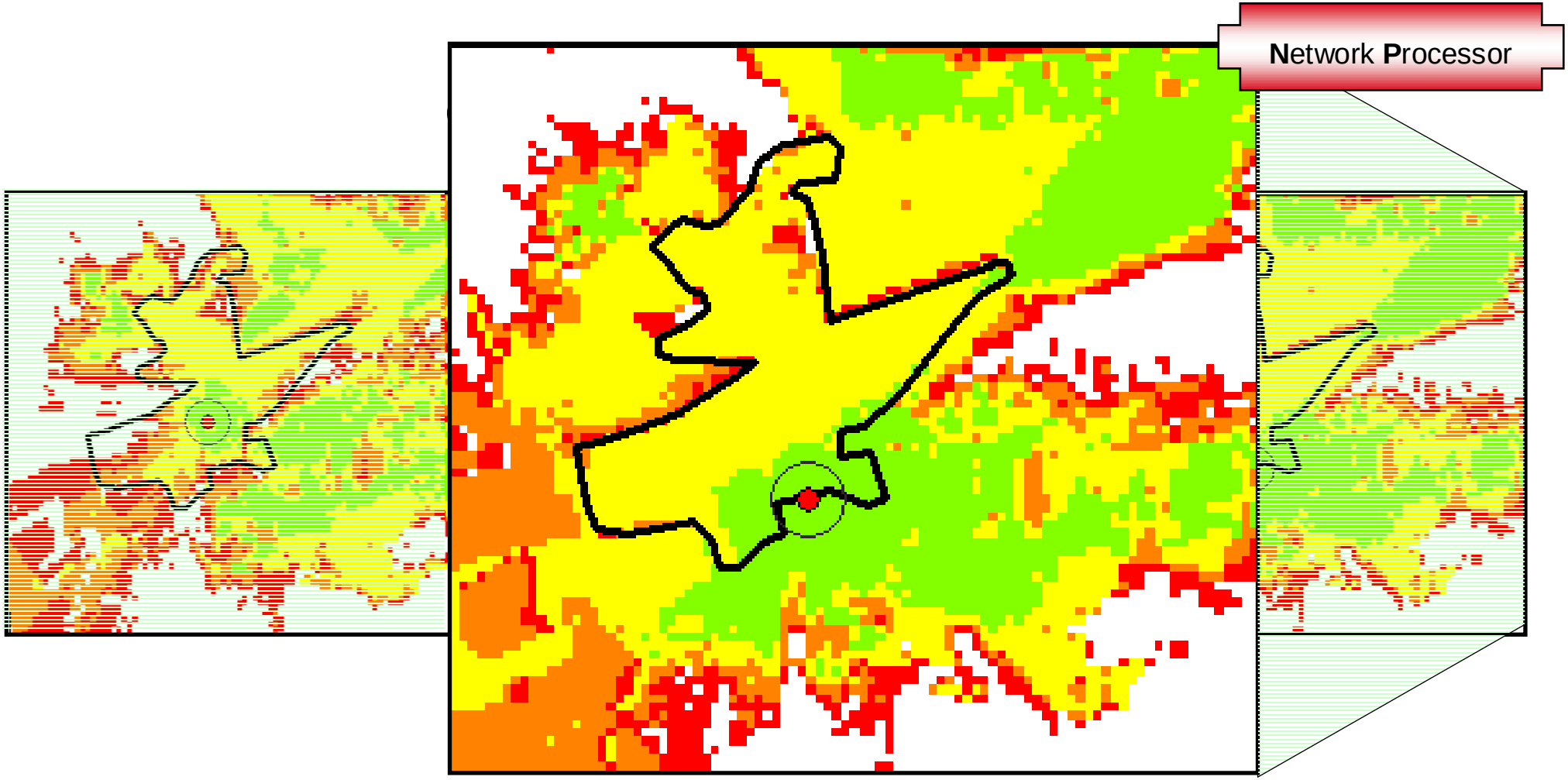
Network Processor

00°

Spectrocan

Example: Coverage Optimisation GSM Network

LS telcom



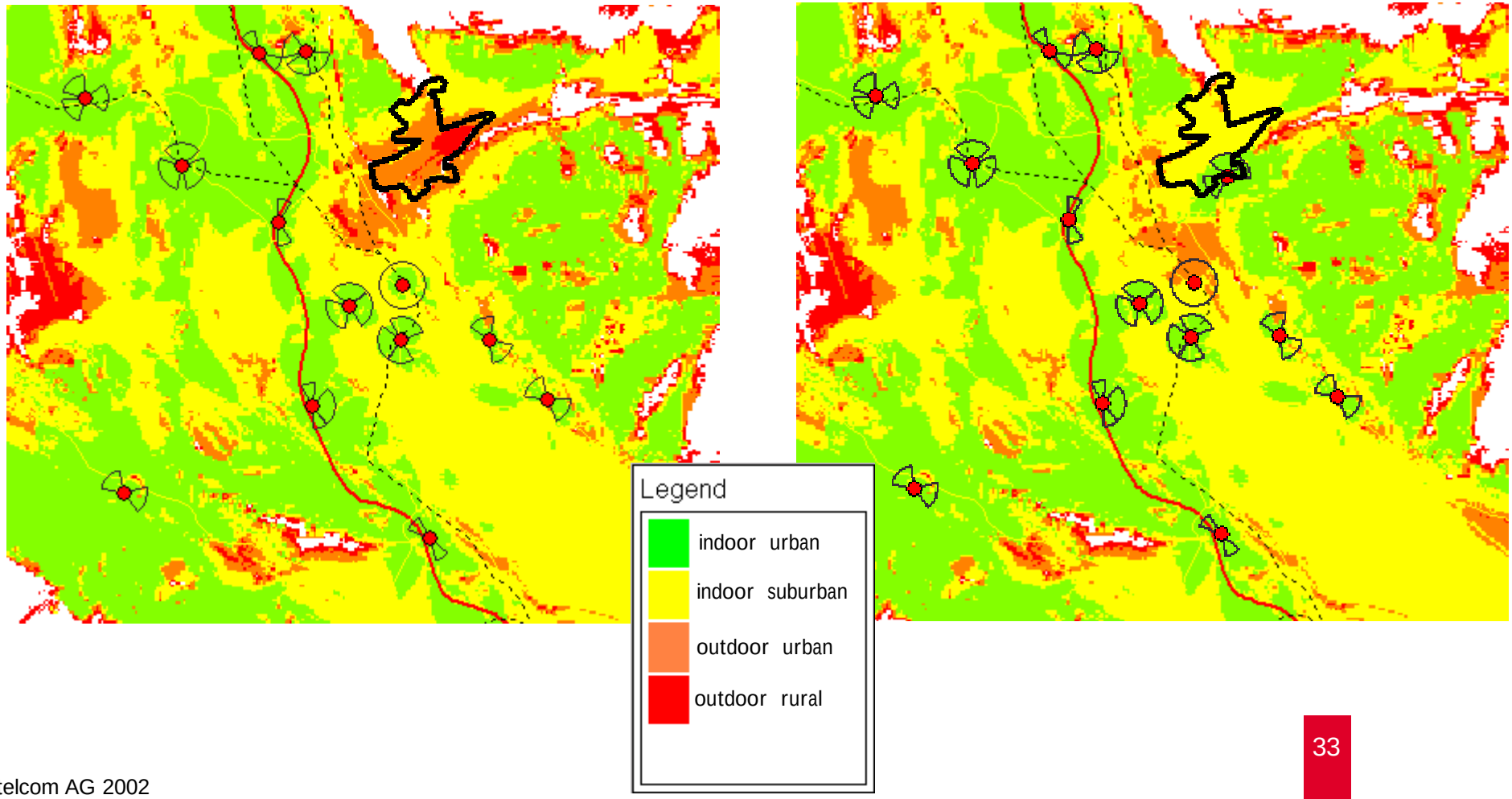
Selection of Candidate Steffisburg C

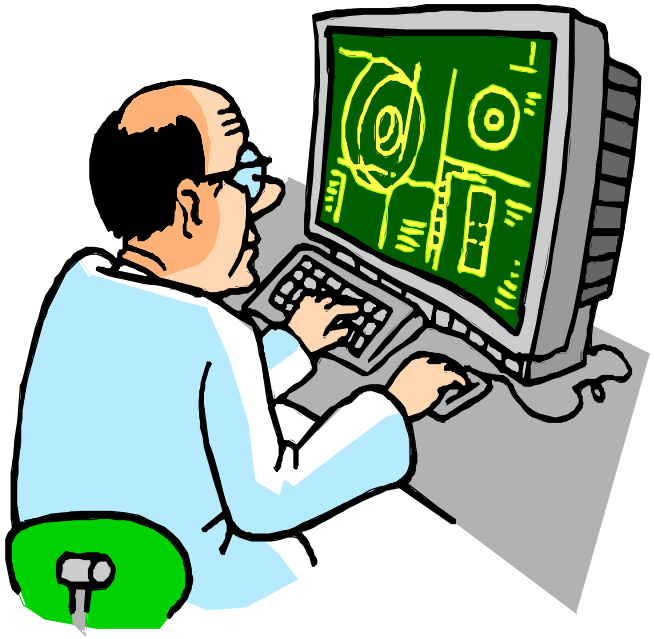
Example: Coverage Optimisation GSM Network

Network Processor

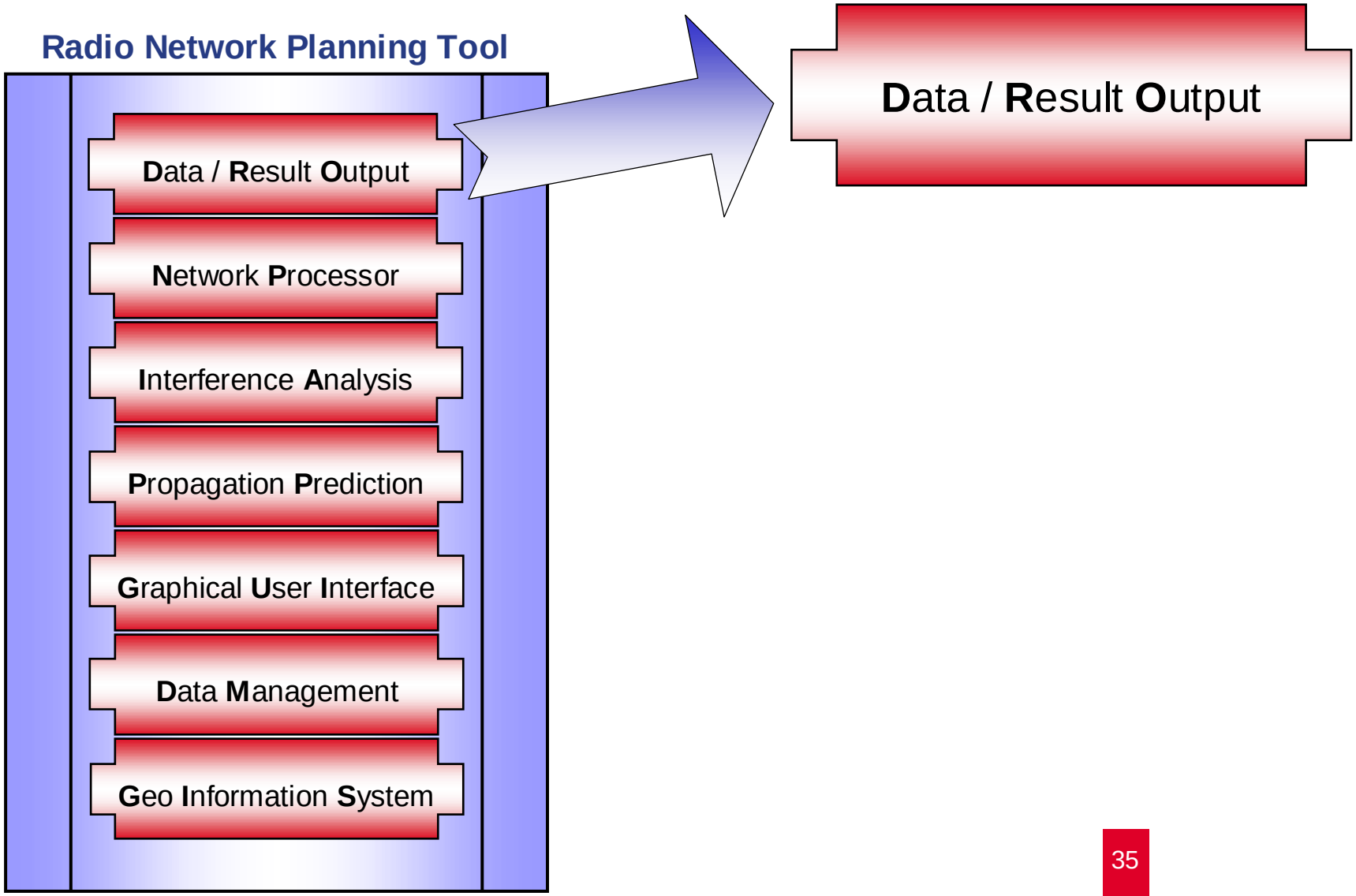
Previous coverage

Improved coverage





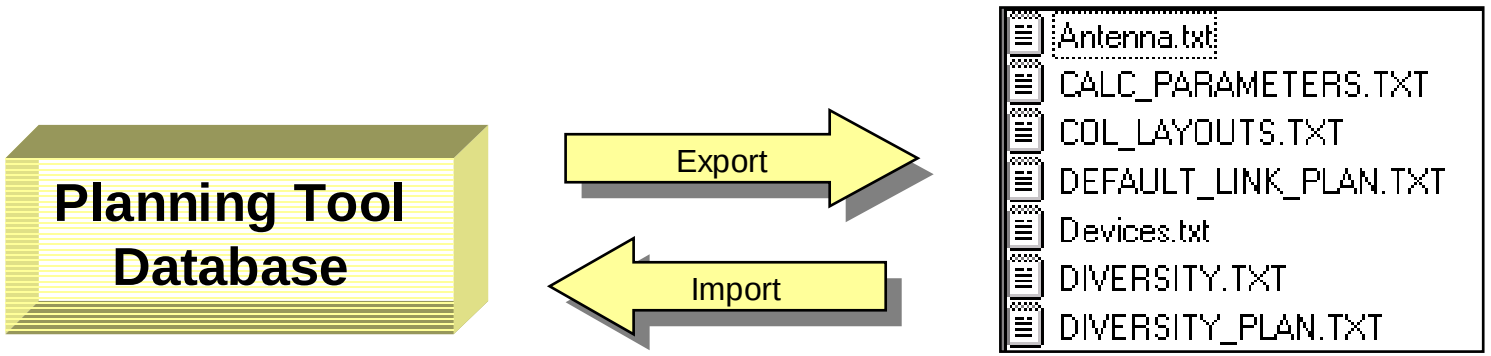
Live
Planning Tool Demonstration



- **Import and Export of**

Databases and Tables (Sites, Antennas,…)
Result Files
Measurement Data

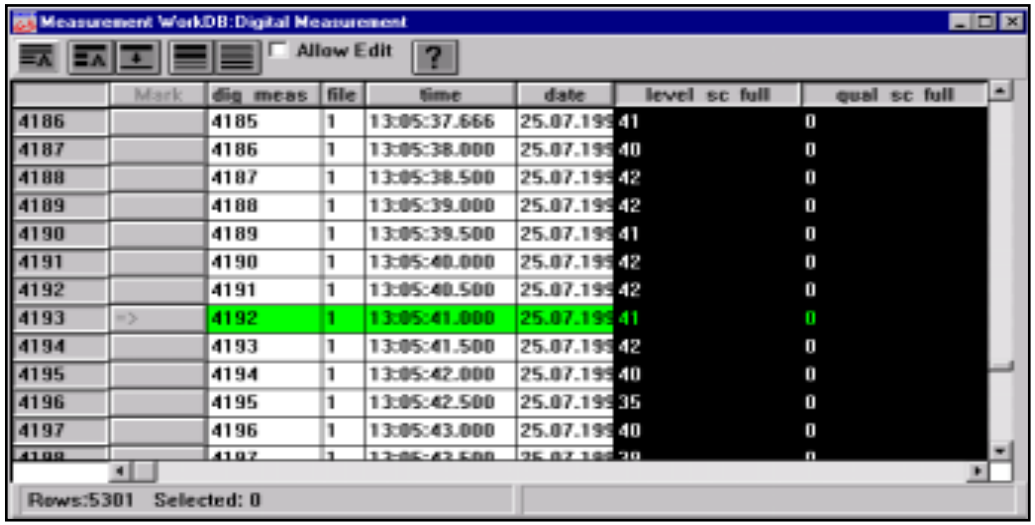
Should be possible in several formats (.txt, .xls, ASCII, .jpg, …)

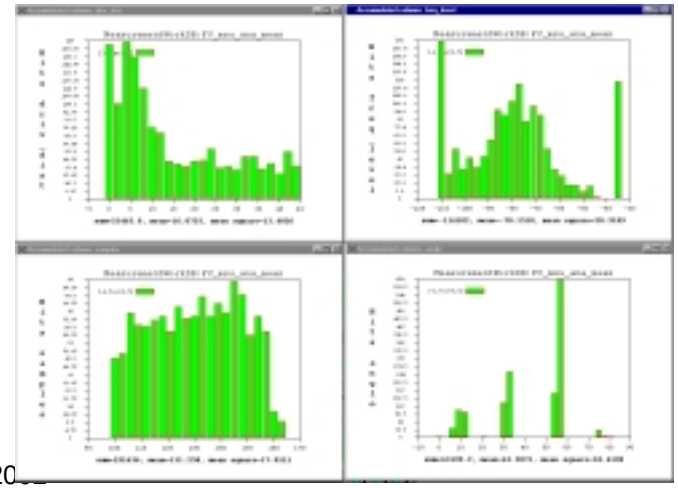


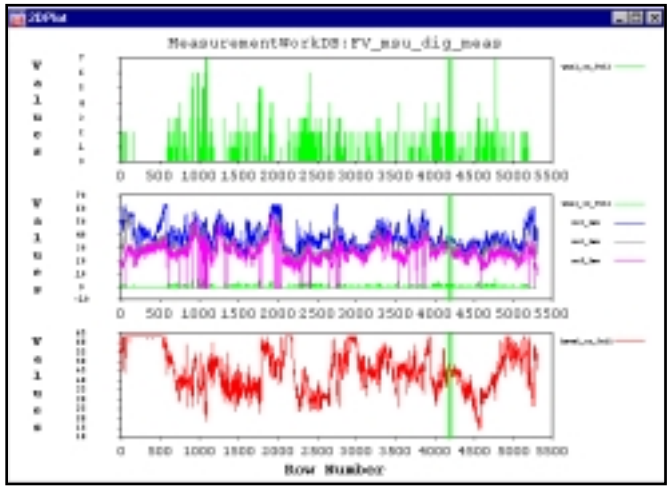
Example: Measurement Data

Data / **R**esult **O**utput

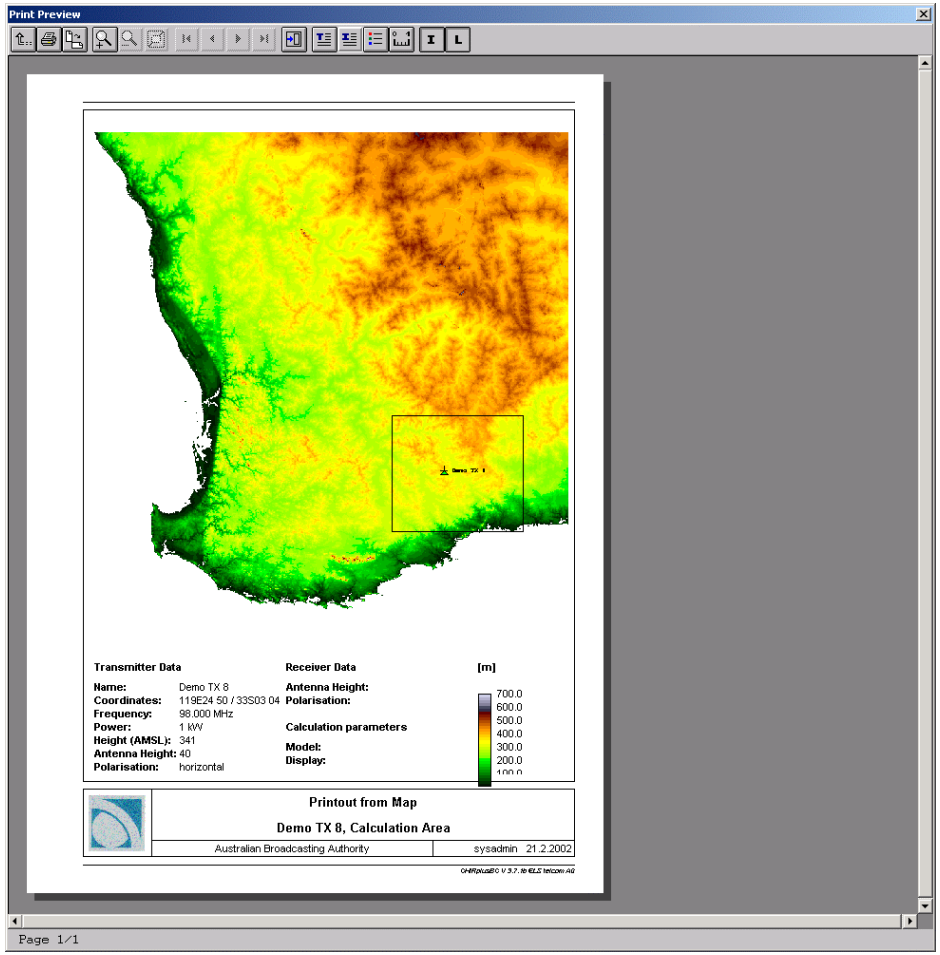
- Import measurement data
  - Analogue
  - Digital
  - BER
- Evaluation of measurement data
  - Rohde&Schwarz,
  - Alcatel, Ericsson TEMS, generic ASCII
- Plotting of measurement data
- Calibration
  - Path loss fit
  - Calibration of extended OH model





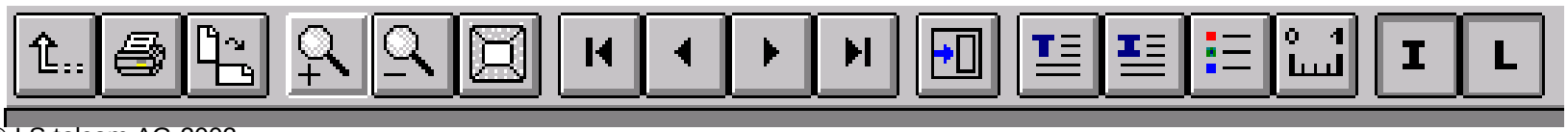


Printing of Maps and Result Plots



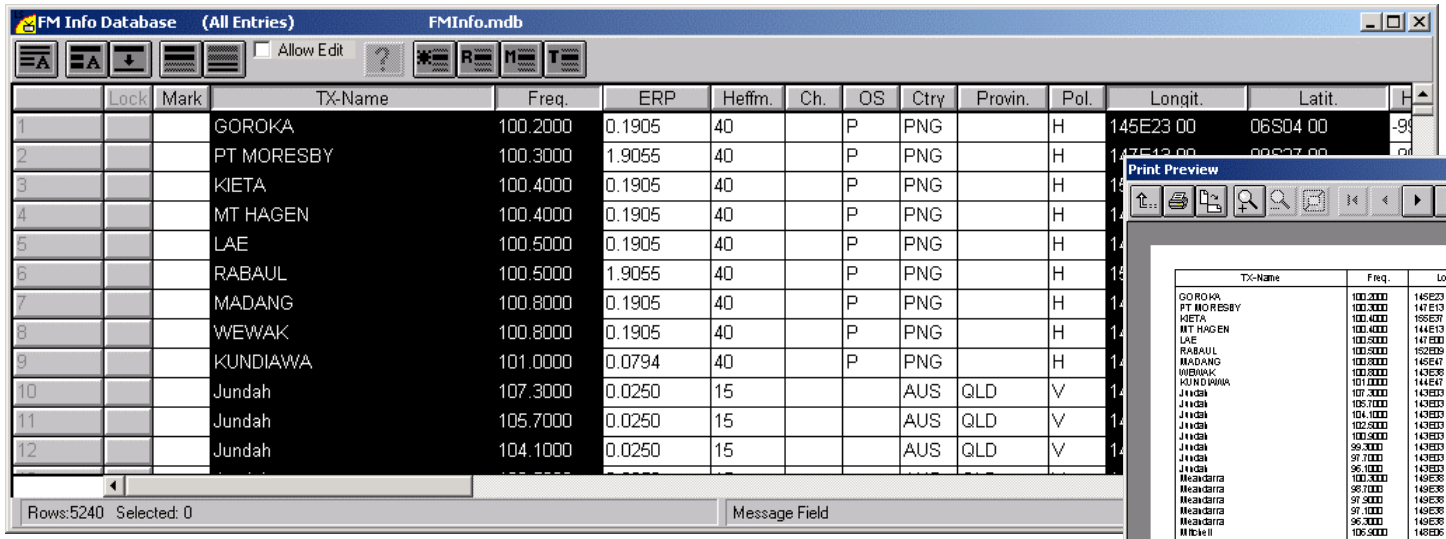
Print Process Preview

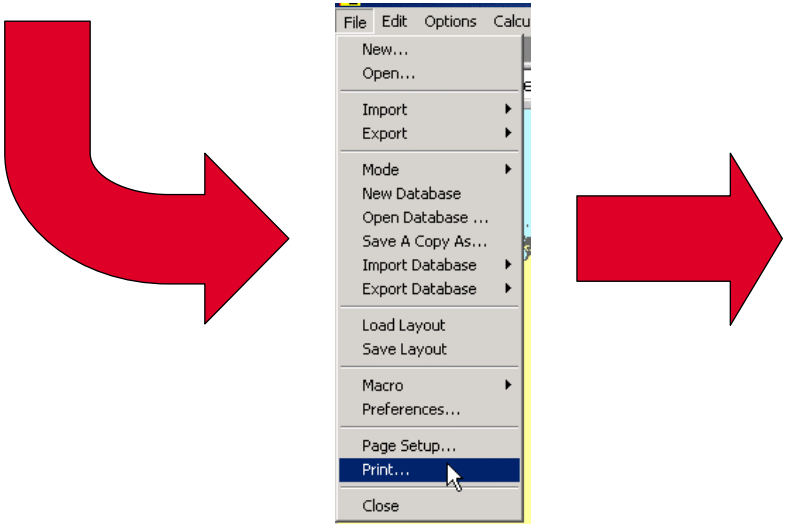
- Application specific frame
- Legend
- Print in specific map scale
- Specify margins and borders
- Multiple printing
- Support various paper sizes
- Add site specific information

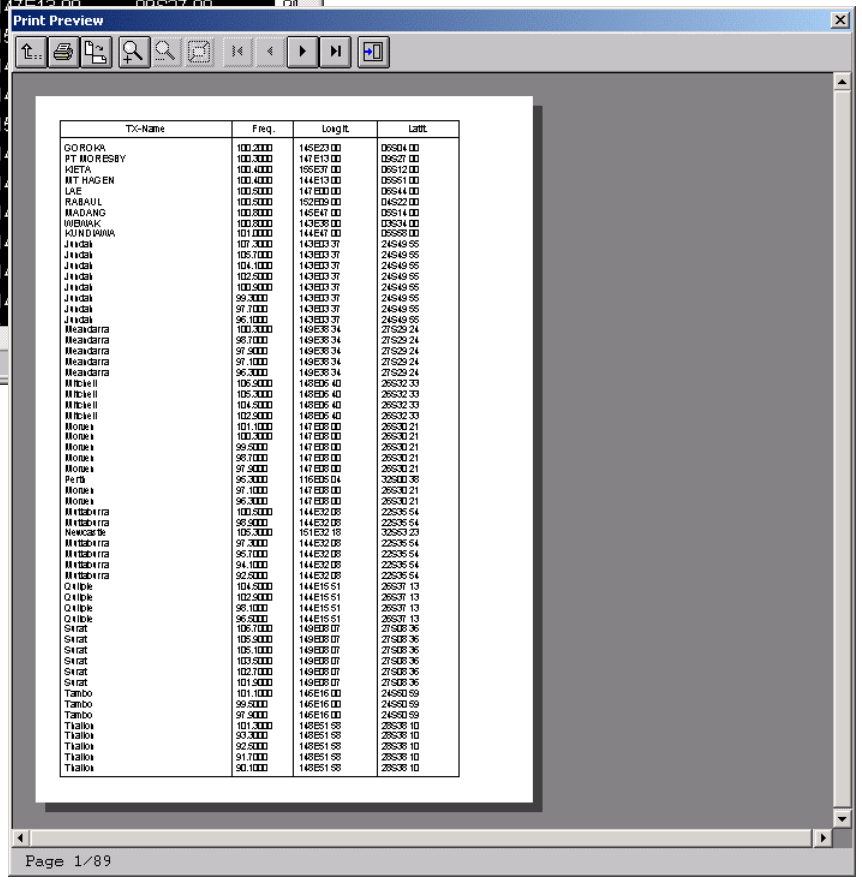


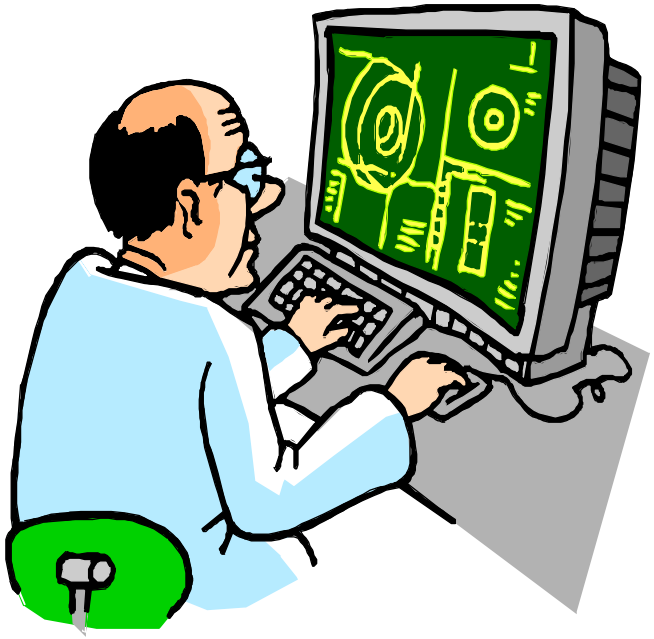
Printing of Database Lists

Data / Result Output









Live
Planning Tool Demonstration

One fits All?

for:

- **basic coverage maps?**
- **interference calculations?**
- **network analysis?**

Network Planning Tools for
Wireless Communication Systems

Mobile Communication

- analog
- GSM
- 3G / UMTS
- Trunking
- TETRA
- Land Mobile Systems

Fixed Communication

- Microwave (PtP)
- Point to Multipoint (PMP)
- Wireless Local Loop

Broadcast

- FM
- TV
- T-DAB
- DVB-T

„Special“ Systems

- Satellite
- Air Traffic Control
- Maritime Services

Is there anything else we can do for you?

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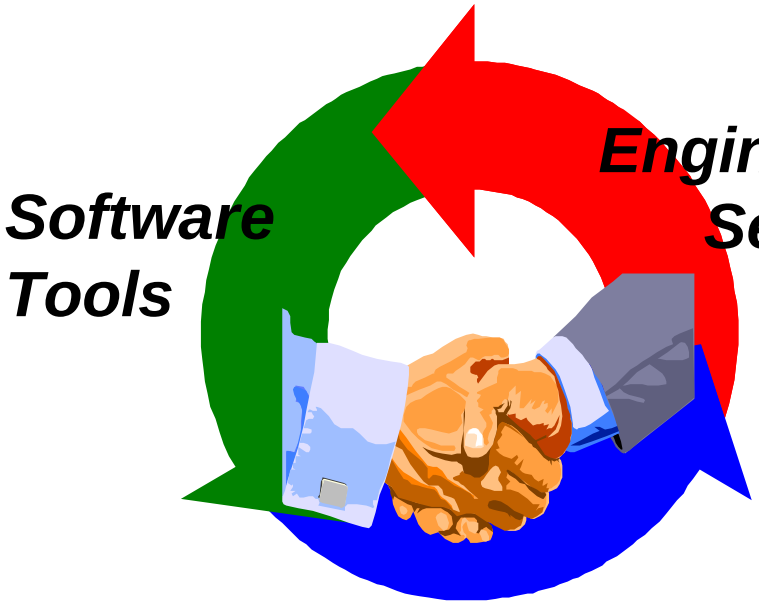

Solutions for Spectrum Management, GSM900, GSM1800, Microwave Links, PMP, LMDS, Radio/TV Broadcast, DVB, DAB, Trunked Radio, TETRA, Paging, Satellite Services

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