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Planning of Single Frequency Networks

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Subjects

Single Frequency Network

"A network of synchronised transmitting stations radiating identical signals in the same RF channel"

- General aspects
- Network gain
- Internal network interference
- Practical cases
- References

Pros and Cons of SFNs

Pro

- Spectrum efficient due to power distribution
- Network gain due to simultaneous reception of multiple useful signals
- No need to retune when travelling through area (mobile reception)

Con

- No option for local windows in programming
- Reduced bitrate due to long guard interval
- Relay transmitters more complicated
- More complicated frequency planning

- MFNs and SFNs are based in principle on the same network topology (main transmitters with auxiliary gap fillers if necessary)

Example DVB-T 64QAM

D/T_u	Mbit/s
1/4	19.9
1/8	22.1
1/16	23.4
1/32	24.1

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Application of SFNs

- SFNs can be used in small and large areas
  - Extent of area is limited by internal network interference
- SFNs can be used with all reception modes
  - Most applications are in relation to indoor and mobile reception
- SFNs can be used in a mixed configuration with MFNs, e.g.
  - Main transmitters in MFN and additional fill-in transmitters in SFN mode
  - Main transmitter supplemented by lower power transmitters in towns to improve indoor reception

Network gain

- Network gain consists of two components
  - Statistical gain due to higher change to receive a signal. Location variation of the field strength is the dominating factor
  - Additive gain due to the increase in field strength because of the incidence of two or more signal at the receiving antenna
- Network gain varies:
  - From point to point depending on the relative field strength values
  - Location variation for which the coverage is calculated

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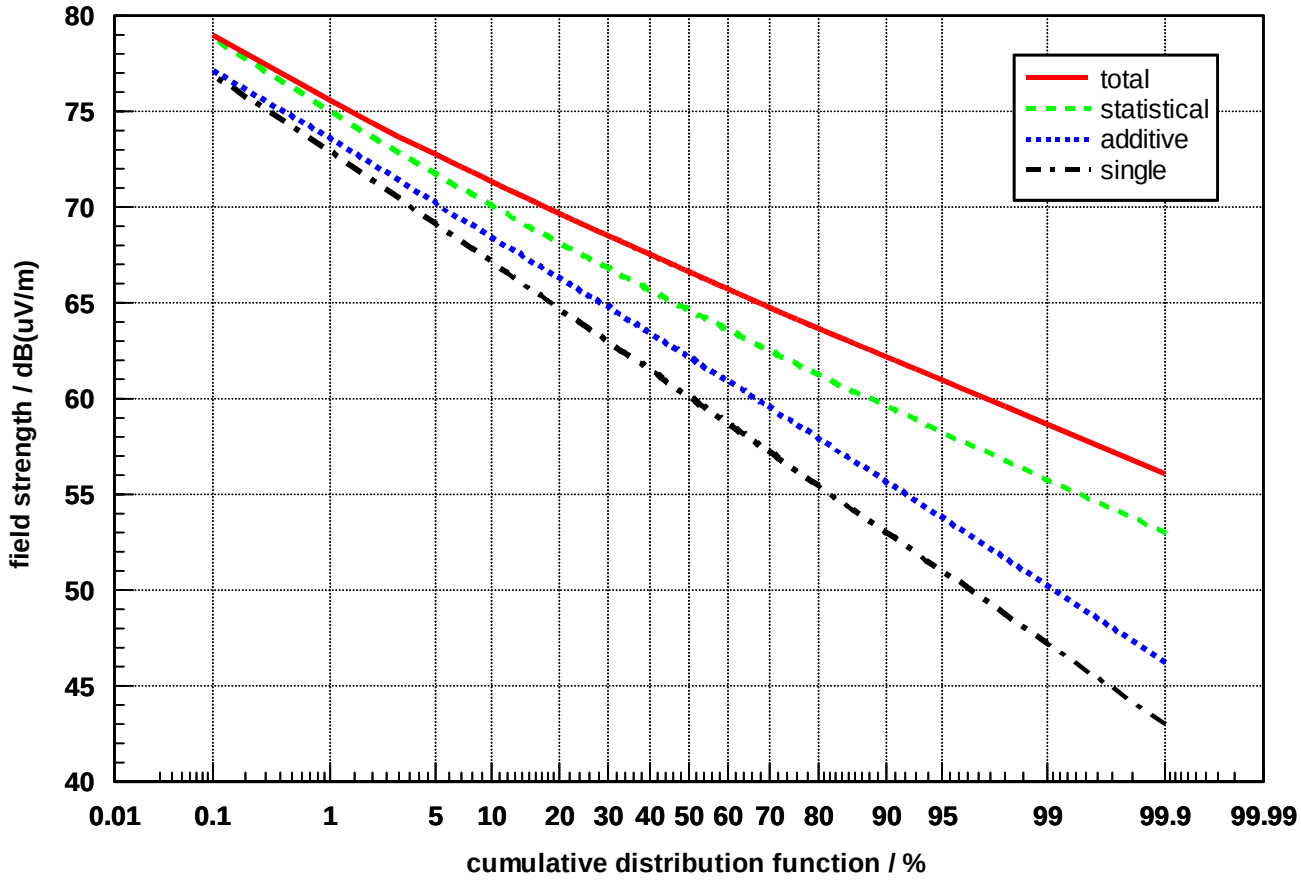
Example 1

3 equal signals



Network gain

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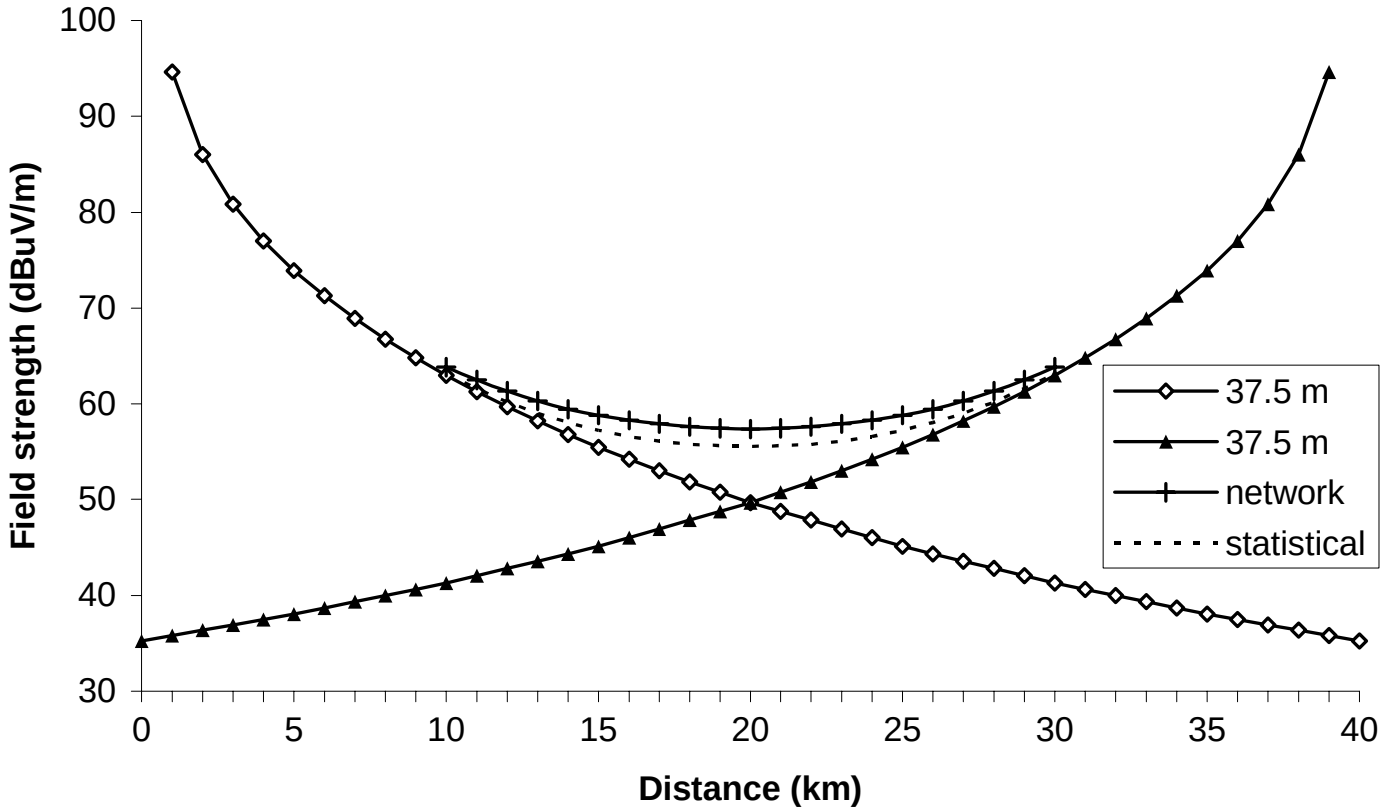
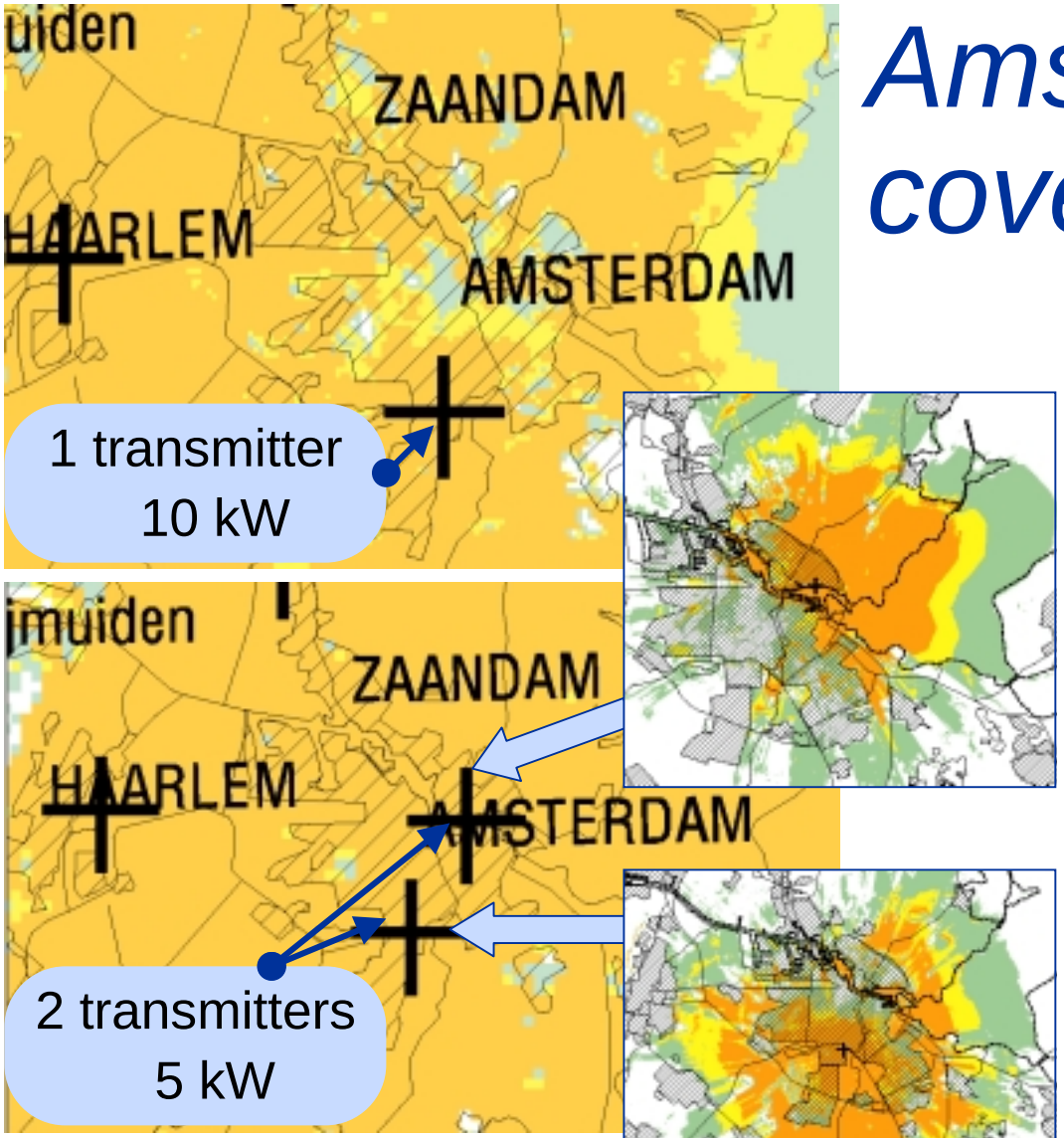
Example 2

Network gain as function of distance between two equal transmitters



Network gain

Amsterdam coverage



Splitting of one transmitter into two with same total power to improve coverage

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Aspects regarding internal network interference (1)

- Length of guard interval
- Delay between signals
  - Transmitter separation distance
  - Artificial delays
  - Delays in distribution links
- Nuissance field of interfering signal
  - Propagation path
  - ERP
  - C/N (system variant)

Example T-DAB
246 µsec

Example DVB-T 8k

D/T_u	µsec	km
1/4	224	67
1/8	112	34
1/16	56	17
1/32	28	8

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Solving internal network interference

- In most cases in frequency planning the following measures are possible:
  - Increase guard interval (one of the 4 options)
  - Adding artificial delay at one of tx
  - Reducing power
  - Add fill-in transmitter
  - Remove tx from SFN (that is: use different frequency)
- Some times it is possible:
  - Chose alternative site (with delay inside guard interval)
  - Use obstructions in propagation path

In general internal network interference is not a major problem with DAB

Internal network interference

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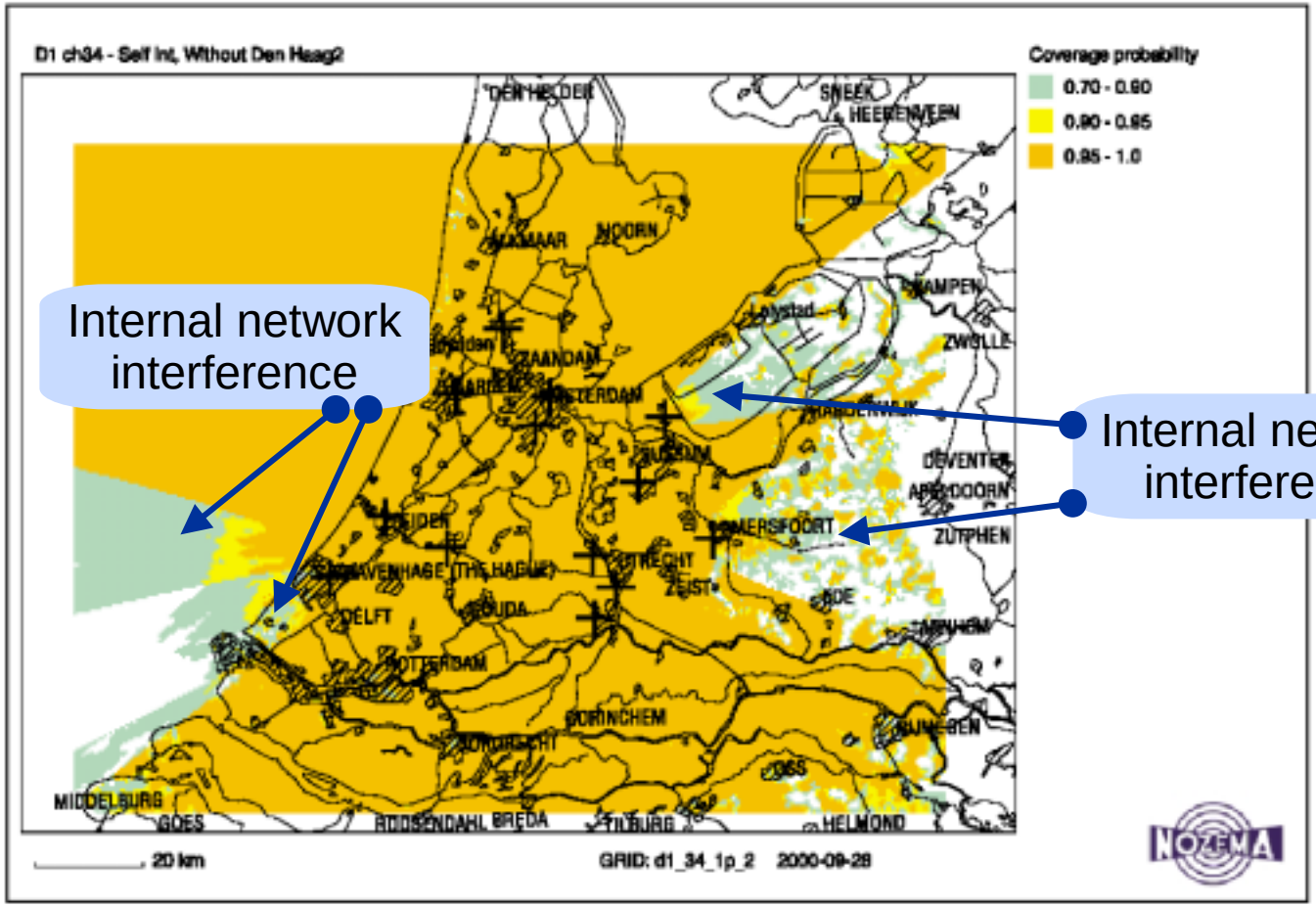
SFN CH 34

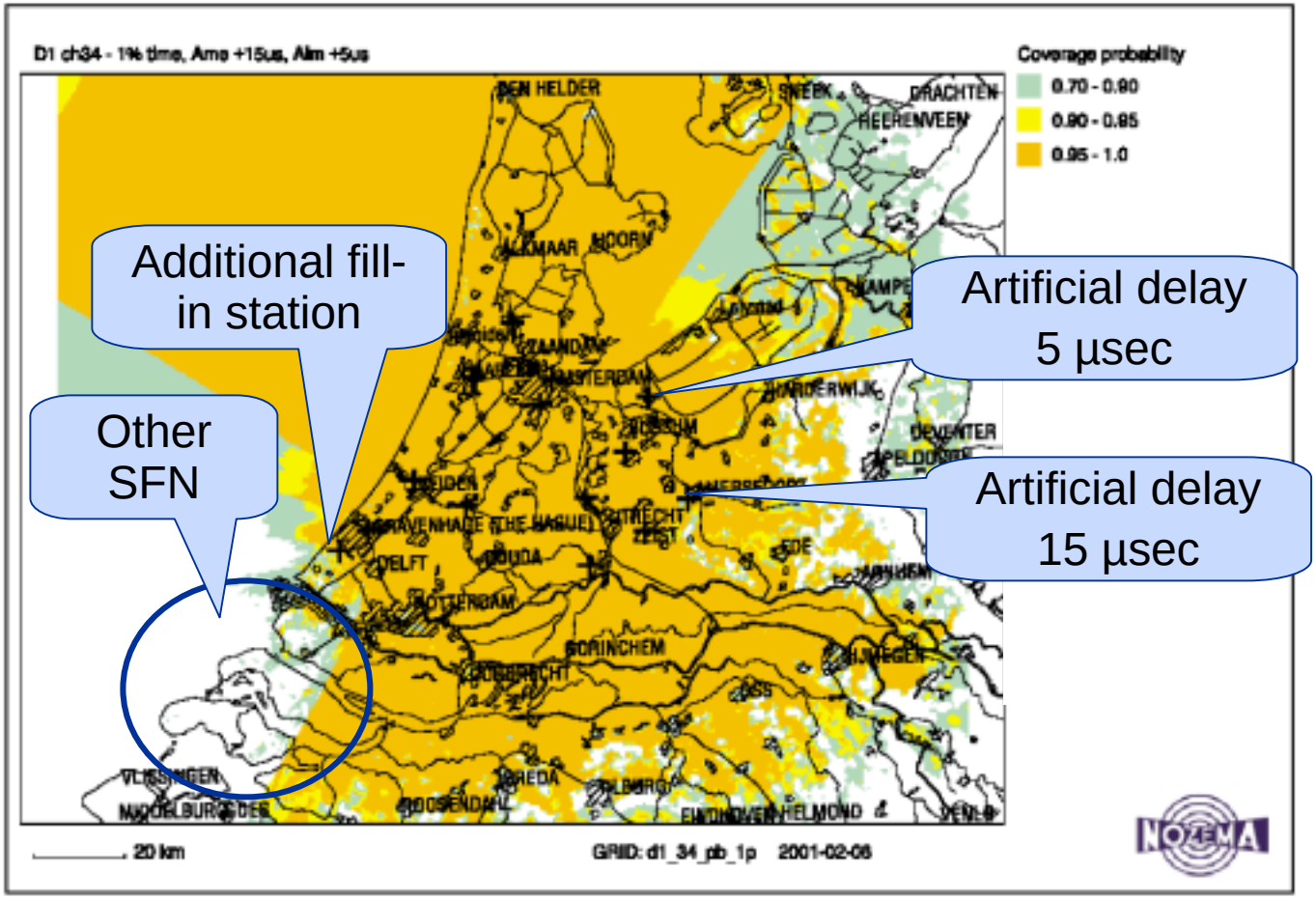
1% time



Practical case 2

SFN CH 34

1% time



Practical case 2

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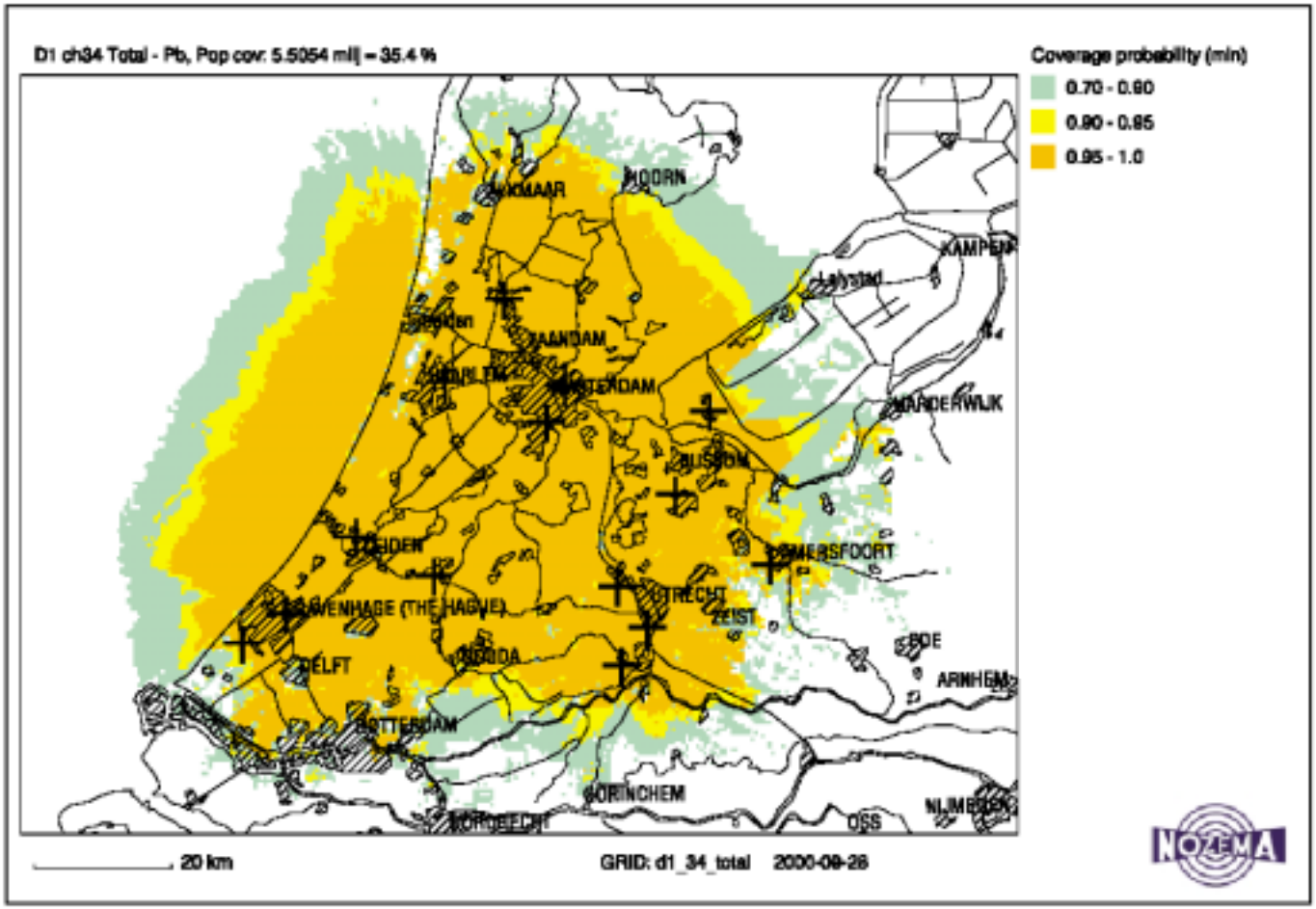
SFN CH 34

- Useful signals: 50% time
- All interferers: 1% time



Practical case 2

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References

- EBU report BPN 003. Technical bases for T-DAB services network planning and compatibility with existing broadcasting services - third issue. February 2003
- EBU report BPN 005. Terrestrial digital television planning and implementation considerations - edition 3. August 2003
- EBU report BPN 018. ERC/EBU report on planning and introduction of terrestrial digital television (DVB-T) in Europe. February 1999
- EBU report BPN 059. Impact on coverage of inter-symbol interference and FFT window positioning in OFDM receivers. August 2003

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