





Fig. 2 Impact of additive overlay in the SFN for MISO and with SISO. There is no correlation between the signals from transmitter 1 and transmitter 2.

Using network planning software, the team determined which test locations would be most relevant for the planned drive tests. The software simplified the selection thanks to its comprehensive maps and diagrams that clearly show the calculated field strengths, impulse responses and locations with the same delay differences, etc.

Equipped with T&M equipment from Rohde&Schwarz, vehicles belonging to BR and the Munich Broadcast Technology Institute (Institut für Rundfunktechnik, IRT) completed numerous drive tests in the SFN. A pivotable, directional test antenna located on Rohde&Schwarz grounds provided supplemental field strength values. GPS time and frequency standards synchronized the SFN with the transmitter sites. The Rohde&Schwarz gateway was synchronized via an NTP server with GPS connection.

Using the R&S®ETL test receiver, the test team evaluated the receive situation with respect to level, constellation, MER, spectrum and impulse response at all measurement locations. The Bavarian Broadcasting Corporation test vehicle was equipped with a horizontally polarized omnidirectional antenna with a known antenna gain or k factor. A precision attenuator was attached to attenuate the input signal in precise increments. The R&S®ETL and other consumer receivers were connected alternately to the attenuator. On each receiver, the test team measured the maximum possible attenuation of the signal or fall-off-the-cliff point with a resolution of one tenth of a decibel – at each measurement location and with various network configurations (SISO, MISO,

### Technical parameters of the field test

- ▮ **Frequency:** 706 MHz, channel 50
- ▮ **Transmitter sites** in the SFN
  - Freimann:** 5 kW ERP, 800 W transmitter output power, 110 m omnidirectional antenna
  - Ismaning:** 5 kW ERP, 600 W transmitter output power, 210 m directional antenna SW
  - BR broadcasting center:** 5 kW ERP, 600 W transmitter output power, 90 m directional antenna NO
- ▮ **Ismaning playback center:** with live content adjusted to the data rate (SD and HD programs from ARD (German Public Broadcaster) and the Bavarian Broadcasting Corporation), first with T&M components, then with standard headend components and finally with the new R&S®AVHE100 headend from Rohde&Schwarz
- ▮ **Transmitter operating parameters** usually 32 K ext., code rate =  $2/3$ ,  $g = 1/16$ , MPLP with one PLP (T2 network parameters were varied)

etc.). This attenuation value was determined based on manual visual and acoustic evaluation of the receiver's video and audio signals. The higher this value, the better the particular receiver was able to handle the receive situation or the set network parameters.

### Summary

The field tests delivered useful, practical information about numerous design parameters in DVB-T2 SFNs. This information can be used to optimize network coverage.

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### Abbreviations

ERP	effective radiated power
g	guard interval
MER	modulation error ratio
MFN	multifrequency network
MIMO	multiple input multiple output
MISO	multiple input single output
NTP	network time protocol
PLP	physical layer pipe
SFN	single-frequency network
SISO	single input single output