Transmitters in DVB-T/H single frequency networks must operate under strictly specified conditions.

The R&S®ETX-K10 option for the R&S®ETX-T DTV monitoring receiver makes sure that these specifications are met (FIG 1).

Advantage of single frequency networks

DVB-T/H transmitter networks are able to broadcast several programs at a single frequency. They do this economically and across the entire network. You can also use them as single frequency networks (SFN) in which all transmitters send the same program content at exactly the same frequency and same time. Advantage: While, in analog terrestrial transmission, the simultaneous reception of the same frequencies in adjoining regions may cause unwanted cancelation or amplification of the signals, you can profit from this overlapping in single frequency networks with digital modulation to improve reception. This “positive” interference allows you to get by with a lower transmit power. Single frequency networks thus make efficient use of the scarce frequency resource, leave more room for frequency planning, and allow you to carry out a far more accurate coverage planning and, last but not least, contribute to cost-efficient operation, particularly in areas with difficult geographic conditions.

DVB-T/H signals in single frequency networks are received at different times due to distance-dependent path delays. The signals have a guard interval of time-specific length so that the receivers can compensate different path delays. All the signals have to be received during this guard interval. In a single frequency...
network, the length of the guard interval determines the maximum permissible distance difference of two transmitters to the receiver at which theoretically undisturbed reception is still possible. To optimize single frequency networks – e.g. to take special ranges of individual transmitters into account – an individual delay can additionally be set for each transmitter.

Only a small step from an intact transmitter to a failure

To ensure that all transmitters comply with the time-specific synchronization and the transmit frequency, they are linked to a reference time standard. GPS information is provided for this purpose. But if GPS fails, for example, an intact transmitter may soon become the source of a failure. In this case, the transmit frequency and the set delay time of the transmitter will slowly drift and violate the limits of the guard interval. The signal of the transmitter concerned will then be superimposed on the signals of the other transmitters and will cause interference. It will thus become a co-channel interferer.

Similar problems occur if the delay time, the guard interval, or even the transmit frequency is incorrectly set due to an operator error on site. This may result in reduced radio coverage, a loss of synchronization at a receiver, or even the complete failure of the single frequency network.

Recognizing changes automatically and early

The R&S®ETX-K10 option for the R&S®ETX-T [*] monitoring receiver solves this problem. It can automatically monitor transmitter signals, recognize changes in the network early on, and immediately respond to faults. For monitoring, the option uses the highly precise measurement offered by the channel impulse response provided in the R&S®ETX-T and compares the permanently measured channel impulse responses with a reference. It records the individual transmitter signals as pulses with an accuracy of ≤0.5 dB in the level range and of ≤20 ns in the time domain. With a patented method, the option determines the frequency drift for every measured transmit pulse – with reference to the main transmitter – with an accuracy of <0.3 Hz. This is more than sufficient since the permissible frequency drift in single frequency networks is ≤1 Hz.

Central monitoring of transmission areas

The R&S®ETX-T monitoring receiver – which is available for the 2k and 8k FFT modes – has a selective frontend. This makes it ideal for direct monitoring at the transmitter and also within a transmission area. You need to select a monitoring location where the antenna can receive all the transmitters of the single frequency network. Since the determined signal delays and frequency drifts are referenced to the main pulse (i.e. to the strongest transmit signal), you need to make sure that the main pulse is stable. You can do this by using an antenna with a suitable directional pattern. The R&S®ETX-T can then be easily addressed via its LAN interface and can be integrated into central monitoring systems via the simple network management protocol (SNMP).

Configuration at the press of a button

The channel impulse response used as a reference is configured at the press of a button. With Auto Setup, you can add up to 16 measured pulses to a table (FIG 2). Pulses relevant for monitoring can be selected individually and can be furnished with a comment. Since the receiver can be operated in the Scan mode to monitor several frequencies,
the R&S®ETX-K10 option allows you to define an individual reference for each frequency. You can then activate monitoring for the desired frequencies in a separate frequency list.

Fast error detection and signaling

A straightforward diagram shows the measured pulses and frequency drifts (FIG 3). The frames within this diagram mark the position of the pulses selected as a reference. The size of the frames corresponds to the tolerances for level, signal delay, and frequency drift that have been defined for all pulses. The color of the frames clearly indicates the current state of the single frequency network. A green frame indicates that the pulses are within tolerance, and a red frame indicates impermissible drifts.

In case of an error, the option sends SNMP traps to a parent monitoring system or generates an alarm report that informs you which pulses caused the alarm. The interferer is thus identified and a potential transmitter network failure can be prevented by taking immediate action.

FIG 3 Checking the state of an SFN at a glance: Pulse number 3 is out of tolerance.