



GSM/GPRS Interference Analyzer ROGER (R&S TS9958)

Quick and easy detection of BCCH, TCH and adjacent-channel interference for mobile applications

- ◆ Fully automatic measurements, no manual control necessary
- ◆ Mobile and portable measurement detects interference everywhere
- ◆ Easy and simple evaluation of the real source of interference
- ◆ For all GSM/GPRS networks with hopping or non-hopping channels
- ◆ Not only experts can make reliable mobile C/I measurements
- ◆ Quick graphical evaluation
- ◆ A MUST for GPRS networks due to high data transmission rates
- ◆ Drastic reduction of all measurement costs
- ◆ Significant improvement of results
- ◆ Real interferer identification within seconds

Is your customer really happy? Everywhere? At all times?

Customer's view

There is still a terrific growth on the market for mobiles. The use of mobiles just anywhere is becoming more and more widespread and is standard meanwhile.

Network operators as well as service providers are coming up with new services every day, with more attractive prices and no contractual commitments. Thus the customer/GSM subscriber is free to choose the network of his preference.

If the GSM subscriber is not really happy with the network performance, he can simply migrate from one network to another.

After all, customers want to use their GSM mobile phones at any time of the day and wherever they may be.

Therefore there is a real need for optimized GSM signalling of high quality, everywhere and at any time: in urban and rural areas, at airports, railway stations, on the road and highway. In standard GSM networks it is important to localize and eliminate interference to improve quality. In GPRS networks this is a must since these networks can exchange more data than GSM networks. This means that the GPRS network is more susceptible to interference because of the higher payload.

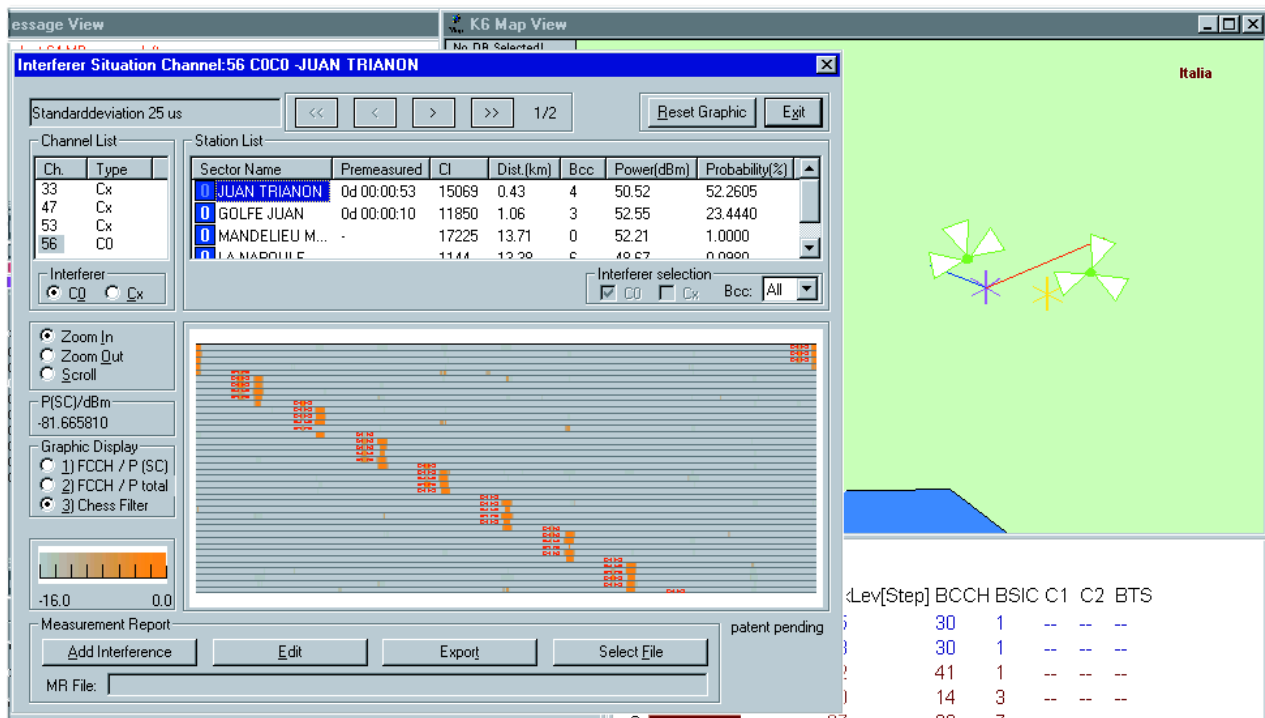
Supplier's view

To ensure high-quality GSM coverage everywhere and at any time really is a challenge and a problem due to the fact that only a limited number of frequencies (BCCH and TCH) are available. The rate of repetition and distribution of those frequencies is one reason for the generation

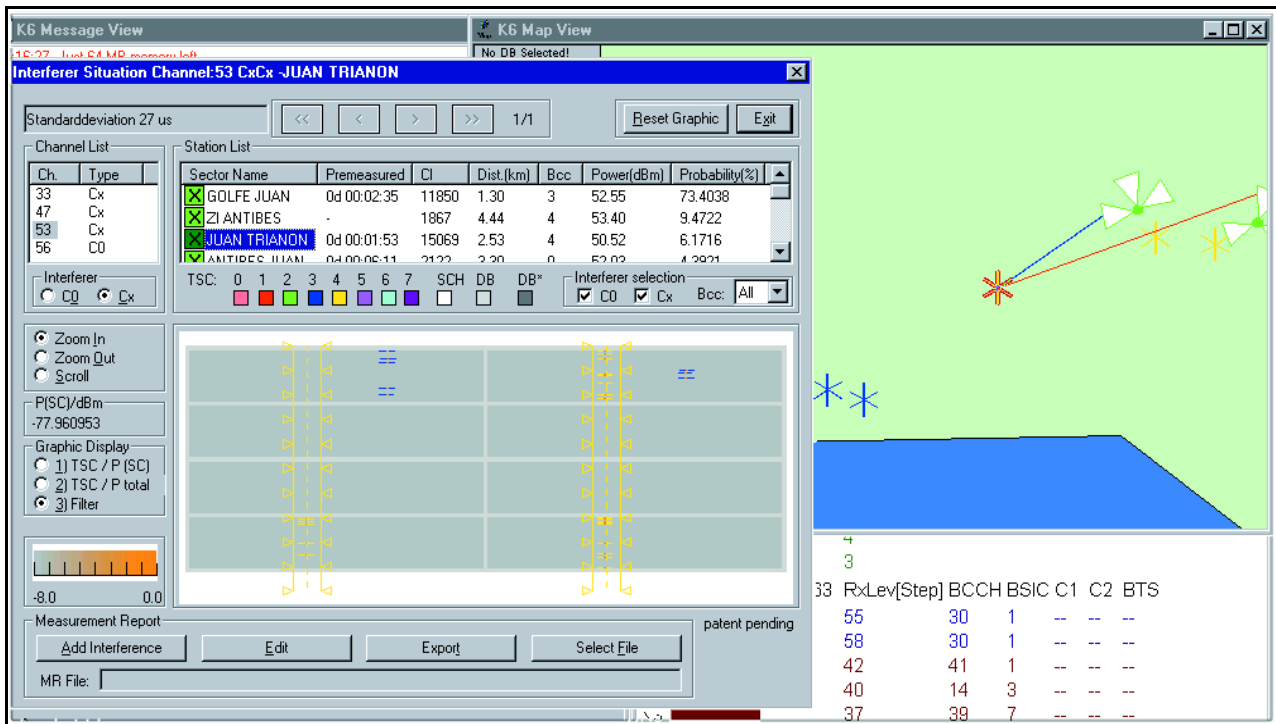
of interference. The incorrect installation of BTS antennas (downtilt, direction, RF power, etc) might be another reason for interference.

The traditional way of selecting interference zones by postprocessing RxLev and RxQual and then performing stationary measurements outdoors with directional antennas and GSM test mobiles is very time-consuming and thus extremely expensive. And there are many situations where it is simply impossible to carry out a stationary measurement (on highways, railroad tracks, etc).

In addition, the operator cannot easily use the conventional measurement tools of outdoor applications because they are just too big, too heavy, too slow, and not suitable for mobile use. Neither are the results of the measurements reliable.



R&S TSK25A (R&S PCSD-K6) Evaluation Display (here BCCH (CO) with interference from another BCCH (CO))



R&S TSK25A (R&S PCSD-K6) Evaluation Display (here TCH (Cx) with interference from another TCH (Cx))

The solution

The use of the traditional method which does not allow quick and reliable results is no longer state of the art.

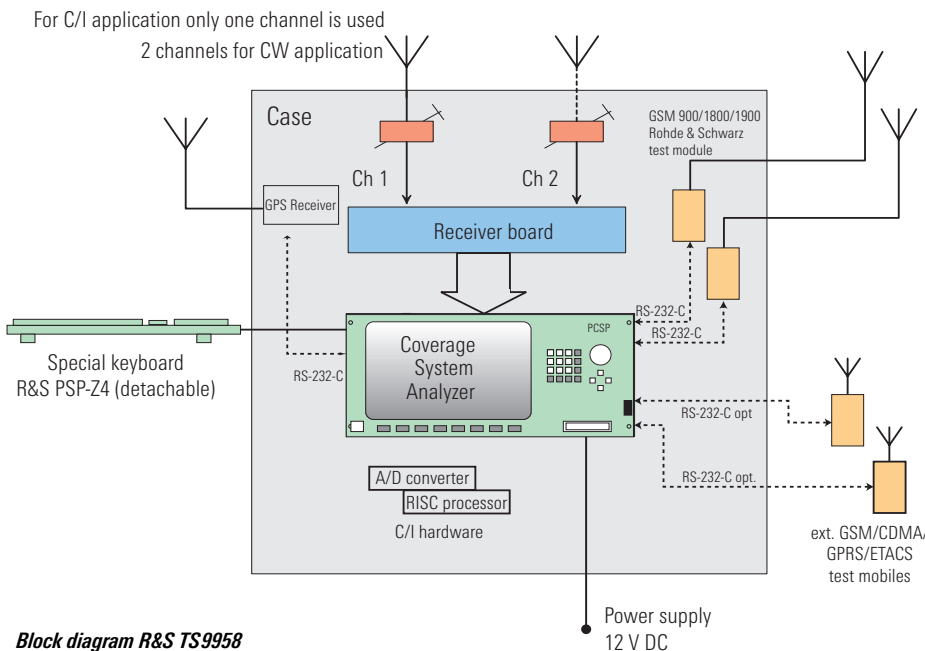
Those responsible for good quality of GSM coverage have to collect the measurement data during a measurement tour and record the results in a file. This is necessary because the operator needs to know about the true interference situation to be able to take corrective measures and finally has to prove that everything is up to expectations.

A really good co-channel interference measurement system has to meet the following requirements:

- ◆ Mobile measurement at high driving speed
- ◆ Fully automatic measurements with no need for manual control
- ◆ Easy and simple evaluation of the real source of interference
- ◆ Adjacent-channel interference measurement

Only Rohde & Schwarz provides a highly practical solution for co-channel interference measurements that are mobile and fully automatic, making the way for simple analysis.

The GSM Interference Analyzer R&S TS9958 is designed to make the GSM operator's life easier and to save running costs.



Block diagram R&S TS9958

Product Line R&S TS995x

Portable System
R&S TS9951



Transmitter System
R&S TS9953



High-performance System
R&S TS9955



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R&S ROSEVAL
Evaluation Software

First-hand experience gained by a GSM operator

A test tour was made with the R&S TS9958. The tour covered all kinds of roads and highways in both rural and urban areas and took around an hour and a half. The fully automatic working system detects 28 points (zones) of interfer-

ence. Most of the zones were known to the operator (he made conventional measurements before), but a few were unknown which were then determined on the highway.

The interferer is identified very quickly within only half an hour (by means of graphical evaluation, see Figs.).

The operator reported that the time usually needed for measuring and analyzing 28 zones of interference in the conventional way is around 2 weeks.

This clearly speaks for our C/I Interference Analyzer ROGER (R&S TS9958).

How ROGER works

Just a short configuration of ROGER, and the test tour can start. The test run is automatically controlled by up to four mobile phones, doing away with any manual control. High vehicle speeds are no problem for ROGER either. Interference measurement is performed in three steps:

- ◆ detection of interference
- ◆ measurement of interfered/interfering signals
- ◆ assignment of these signals to base stations

The signals found can be assigned to the emitting base stations already during the test tour or afterwards on a conventional PC.

Signal display

There are signal displays for two test modes: for C0 (BCCH) and Cx (TCH) measurements. From the disturbed composite signal, ROGER filters out frequency-correction bursts (FCCHs) for the identification of C0 carriers and displays them. The time axis is structured in lines comparable to a TV frame, arranged such that neighbouring FCCHs of an M51 frame (51 TDMA frames) come vertically one below the other. Because of the idle burst at the end of each M51 frame, a staircase pattern is obtained for each detected C0 carrier. So the graphical presentation of the C0 channel of the serving cell (SC) reveals a staircase with the FCCHs of the SC itself and further patterns in the case of C0 interference. In the analysis window for adjacent channels or TCH channels of the SC, each staircase pattern indicates the presence of C0 interference.

In Cx measurement, the composite signal is analyzed in greater detail. Synchronization as well as dummy-burst and training sequences are filtered and visualized grouped according to timeslots. The mea-

sured sequences of different base stations are shown in time grids corresponding to two vertical stripes in the Cx display. Different base stations are represented by stripes at different positions along the x axis. Interference can be identified immediately: from any further stripes displayed next to the two SC stripes. In mobile measurements, the selected signals fluctuate due to fading, reflection and other external influences, resulting in a variety of signal patterns. ROGER therefore processes interference signals for graphical representation, as the human eye can analyze complex patterns with high reliability.

Fast identification of base stations

To trace interference back to the emitting base station, a feature characteristic of each BTS is used: the expected arrival times of specific signals at the measuring instrument. The times are determined from the measurement position, the expected sending time and the site of the BTS. When a BTS is selected, the expected arrival time is superimposed on the displayed sequences in the form of a template. If this matches a signal measured, the latter can be assigned to the selected BTS. In the case of Cx measurements, the number of possible base stations is reduced by a factor of eight to those whose base-station colour code and training-sequence code are identical. The selected BTS is additionally shown on a map, allowing comparison of the propagation conditions of server and interferer.

Power measurement

In the interference charts, the power values are colour-coded, allowing a basic evaluation of interference. For purposes of optimization, the measurement system provides the dynamic C/I value for each base station after the SC and interference

signals have been selected. The measured and averaged power values can be visualized and if necessary modified. Modification enables evaluation of the range of interference obtained with mobile measurements. The results of power analysis are stored in a file, and a test report of the analyzed interference signals is generated. The latter may serve as a basis for network modifications.

Hardware

ROGER consists of:

- ◆ Test Receiver R&S TS55-RX
- ◆ up to four test mobiles of different make
- ◆ a GPS receiver
- ◆ a process controller equipped with A/D converter card and signal-processing card

Test Receiver R&S TS55-RX is accommodated in the controller, making ROGER a highly compact, lightweight unit. The system uses Coverage Measurement Software R&S ROMES3, affording a state-of-the-art operating concept and the repeated use of position data sources and mobile-phone linkups. Using an indoor module, the software even allows interference detection inside buildings.

ROGER can optionally be fitted with a position trigger so that it can carry out classic measurement of coverage in addition to interference. In particular the option of extending the system by up to eight additional mobiles of different standards (GSM900/1800, CDMA, GPRS) allows space- and cost-saving performance of different tasks with a single unit.

Specifications

Processor AMD K6, 300 MHz minimum
RAM 64 Mbyte, 512 kbyte cache

Display

Screen LCD colour, 8.4", anti-glare

Mass storage

Hard disk >6 Gbyte
Disk drive 1.44 Mbyte, 3 1/2"

Interfaces

IEC/IEEE IEEE488.2, compatible with NI TNT
Serial 2 x RS-232-C
Printer Centronics LPT1 (ECP, EPP)
PCMCIA release 2.0, type III, connector
Keyboard 5-contact DIN, 5-contact PS/2 for mouse & keyboard

Interference measurements

Detection and analysis of CO and Cx interference on the CO (BCCH), Cx (TCH) and optionally on adjacent channel of the serving cell (SC)
Trigger on interference automatically or manually based on 1 to 4 GSM test mobiles

Displayed dynamic range

Type of interference	total ¹⁾	compared to SC ²⁾
CO - CO	-16 dB to 0 dB	-13 dB to 3 dB
Cx - CO	-16 dB to 0 dB	-13 dB to 3 dB
Adj - CO	-8 dB to 0 dB	-8 dB to 8 dB
CO - Cx	-8 dB to 0 dB	-10 dB to 6 dB
Cx - Cx	-8 dB to 0 dB	-10 dB to 6 dB
Adj - Cx	-8 dB to 0 dB	-8 dB to 8 dB

Software

Operating system Windows 98

¹⁾ compared to the total power in the underlying time slot.

²⁾ compared to an average power level of the SC, measured directly before and after the actual interference.

Graphics

With integrated LCD
For external monitors
VGA standard: 640 x 480 pixels
1280 x 1024, 1024 x 768, 800 x 600,
640 x 480 pixels, 2 Mbyte video memory

General data

Rated temperature range +5 °C to +45 °C
Operating temperature range 0 °C to +50 °C
Storage temperature range -25 °C to +60 °C

Temperature load

Standards complied with DIN IEC 68-2-1 and 68-2-2 as well as MIL-T-28000 class 5
Relative humidity 95% at +40 °C
Standards complied with DIN IEC 68-2-3

Mechanical load

Sinusoidal vibration 5 Hz to 150 Hz, max. 2 g at 55 Hz, 0.5 g for 55 Hz to 150 Hz
Standards complied with DIN IEC 68-2-6 and EN 61010-1/DIN IEC 1010-1 as well as MIL-T-28800 class 5
Random vibration 10 Hz to 300 Hz, 1.2 g rms
Standards complied with DIN IEC 68-2-36 and DIN 40046 T24
Shock 40 g, shock spectrum
Standards complied with DIN IEC 68-2-27, MIL-STD-810D, method 516.3, and MIL-T-28800 classes 3 and 5
Safety in compliance with low-voltage directive of EU
Standards complied with EN 61010-1: 1993
EN 60950: 1992
EMC in compliance with EMC directive of EU
Standards complied with EN 55022: 1994, class A
EN 61000-3-2: 1995
EN 61000-6-3: 1992
EN 61000-6-4: 1992
Quality standard development and manufacture in compliance with ISO 9001

Power supply

AC supply 100 V to 120 V ±10%,
50 Hz to 400 Hz ±5%
220 V to 240 V ±10%,
50 Hz to 60 Hz ±5%
DC supply DC, 12 V
Max. power consumption typ. 300 W (12 V DC/25 A)
Weight 19.8 kg
Dimensions (W x H x D) 500 mm x 200 mm x 800 mm



...making the right connections.



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