

TEMS[™] Investigation GSM

The industry-leading air interface test tool



Troubleshoot, verify, and optimize wireless networks

TEMS[™] **Investigation GSM** is an air interface test tool for troubleshooting, verification, optimization, and maintenance of mobile networks. TEMS Investigation measures radio parameters, assesses speech quality, and decodes air interface messages. The data is presented in real time along with information on cell sites and channels, and can be saved for later use.

Key features

- E-GSM 900, 1800, and 1900, all in one powerful tool
- C/I measurements in idle or dedicated mode, and also on hopping channels
- C/A measurements, even on hopping channels
- Channel Verification tool for testing traffic channels
- Data measurements (HSCSD/CSD/GPRS)
- Simultaneous data and measurement calls
- High performance frequency scanning
- · Decoding and modification of Layer 3 messages
- Summaries of logfile(s) in HTML format
- · Command sequence tool for automating test procedures

Data measurements

Data service performance measurements can be performed on the air interface layers (RLCMAC/LLC for GPRS, and RLP for HSCSD/CSD) and on the application layer (TCP). Typical services that can be used for data testing are HTTP, FTP, and Ping. Measurements can be utilized from the command sequence tool in order to automate repeated procedures. A number of measurements and events, such as throughput, retransmissions, and C/I per timeslot can be displayed on the map, in linecharts, or in status monitors.

Some of the available GPRS information elements are:

- RLC/LLC Throughput Downlink/Uplink (kbit/s)
- RLC/LLC Retransmissions Downlink/Uplink (%)
- Number of used time slots
- PDP context
- Coding scheme

C/I measurements

C/I is the ratio between the signal strength of the current serving cell and the signal strength of interfering signal components. C/I is measured in real time in both idle and dedicated mode (also in frequency hopping networks). The C/I parameter enables the identification of frequencies exposed to particularly high levels of interference.

Channel Verification tool

The Channel Verification tool allows the user to check the availability of a set of traffic channels (FR and EFR), typically those used in a cell or site. Each timeslot can be verified separately. TEMS Investigation lets one or several TEMS mobiles make calls repeatedly on the chosen channels until all timeslots of interest have been tested. Verification is either manual or automatic. In automatic verification, TEMS Investigation decides whether to accept the timeslot based upon the call setup signaling.

Speech Quality Index (SQI)

SQI assesses the speech quality as perceived by the mobile station user. The SQI values are based on bit error and frame erasure rates and their respective distributions, as well as handover events, DTX percentage, and the choice of speech codec.

Status presentation

To help users monitor the status of the network, special presentation views have been created. These predefined views include information such as:

- Serving cell and neighboring cells (up to 32)
- Current traffic channel
- Radio environment parameters
- Decoded Layer 2 and Layer 3 messages
- Modified MS behavior

Uplink data in logfiles

Uplink measurements from Ericsson BSCs can be incorporated into and time-aligned with the TEMS logfiles. Uplink data helps the analyst draw more informed conclusions.

Frequency scanning

The user can scan any channels from the E-GSM 900, 1800, and 1900 bands. The TEMS[™] Scanner can also measure unmodulated carriers.



🔳 Laye	r 3		×					
Source	Direction	Message						
MS1	Downlink	System Information Type 13					From left	to right.
MS1	Downlink	System Information Type 2ter	🔠 Hadio Parameters	MS1]		×		to ngini
MS1	Downlink	System Information Type 3		-			1) The La	iver 3 message wir
4S1	Downlink	System Information Type 4	Element	Full	Sub			,
451	Downlink	System Information Type 1	Byley	-79	-79		2) The qu	iality parameters m
451	Uplink	Attach Request	DuQual		5			
401	Downlink	System Information Type 2 Channel Request	Fixqual	0	9		3) The PL	JP context window
451	Downlink	Sustem Information Tupe 3	FER	50	50			
451	Downlink	Immediate Assignment	ISQL	13			DC DDD Contor	
451	Downlink	Packet Uplink Ack/Nack	C/13//101			aa ur	na FDF Contes	
151	Downlink	Packet Uplink Ack/Nack	C/I Worst[U]			Eleme	ent	Value
4S1	Downlink	Packet Polling Request	TxPower	5		Active	PDP Contexts	1
4S1	Downlink	Packet Downlink Assignment	DTX	50		PDP N	SAPI	5
4S1	Uplink	Packet Downlink Ack/Nack	ТА	1		PDPL	LC SAPI	3
4S1	Downlink	Authentication And Ciphering	IIA .	1		PDPD	elau Class	Delau class 1
4S1	Uplink	Packet Downlink Ack/Nack	RL Timeout Counter(Act)	20		PDPB	eliabilitu Class	Unacknowledged GTP a
4S1	Uplink	Packet Downlink Ack/Nack	BL Timeout Counter(Max)	20		PDPP	recedence Class	Normal prioritu
451	Uplink	Authentication And Ciphering	MC halo suite and dig d	20		DNDD	alk Throughput	Up to 256 000 pototo/o
151	Downlink	System Information Type 4	MS behavior modified	4			eak miloughput	E0 000 000 a state //s
451	Uplink	Custom Information Turne 10					reari i moughput	Distingtion of the state
451	Downlink	System information Type 13				FUP H	adio Priority	Priority level 1 (1 = highe
MOT	Downlink	Pook of Holink Ack (Mook				PUPA	ccess Point Name	1010000
MOT	DOWFIIIFIK	Facker opink ACK/Nack				PUP A	dress	10.160.38.6

The TEMS mobile station can scan up to 1,083 samples per second. The scanner function also gives the user a number of advanced features, such as:

- Precise scanning of hopping channels (requires two mobiles)
- Displaying the path loss on the carrier by adjustable sample density per distance, thus avoiding the Rayleigh and slow-fading phenomena that gives erroneous signal strength

Control of Layer 3 signaling

The flow of Layer 3 messages exchanged between the mobile station and the network can be controlled and modified.

Portable troubleshooting with TEMS[™] Pocket

TEMS Pocket is now included in TEMS Investigation mobile stations. With strengthened GPRS functions, this handy tool combines small size with powerful capabilities. TEMS Pocket can function as a regular phone or act as a stand-alone troubleshooting tool.

Cell reselection and handover behavior

The behavior of the TEMS mobile can be manipulated in various ways:

- Idle mode:
 - Lock on a specific channel set
- Dedicated mode:
 - Force handover
 - Prevent handover to specific channels
 - Disable handover entirely

Logging and export

All measurements can be saved to logfiles, where they are time-stamped (and positioned geographically, if a GPS receiver is used). Data from four TEMS mobiles and a TEMS scanner can be logged simultaneously. Using command sequences, various tests can be automated. Logfiles can be exported as a user-defined tab-delimited text or in the old TEMS /98 format.

Logfile reports

A logfile or a set of logfiles can be summarized in an HTML file (logfile report). The report contains charts and statistics for SQI, RxLev, RxQual, and TxPower, as well as statistics on events.

Intelligent user assistance

- Automatic detection of PC-connected equipment
- Automatic color-coding of neighbor cells in presentation windows
- Frequency scanning with dynamic channel selection (for example BCCHs within a given distance from the vehicle)
- Missing neighbor detection

Events

Events such as handovers and dropped calls are indicated by symbols and (optionally) audio signals. Users can also define events of their own.

User interface

The collected data is presented on a map, in line charts, and in text format windows, all of which are synchronized. Events and air interface messages are listed separately and can be inspected in detail. Decoded Layer 3 messages can be filtered to facilitate spotting the important messages during analysis. The user interface can be freely configured, and users can build their own presentation windows. Commonly used ranges and views can also be shared on a departmental or even a corporate level in "workspaces". The easy set-up leaves more time for collecting data.

Minimum hardware and software requirements

- For one mobile station + GPS receiver:
- PC: Pentium 266 MHz, 128 MB RAM
- OS: Windows 2000, Windows NT 4.0 or Windows 98
- GPS protocol: NMEA 0183 General, TAIP or TSIP

For multiple mobile stations + GPS receiver:

- PC: Pentium 500 MHz, 256 MB RAM
- OS: Windows 2000, Windows NT 4.0 or Windows 98
- GPS protocol: NMEA 0183 General, TAIP or TSIP

Important Information Elements available in TEMS Investigation GSM

Name		Comment					
	App. Bytes Sent/Received	Sent/received number of bytes on application layer					
	App. Throughput UL/DL	Current application data throughput in kbit/s					
	Attach Time	Time from Attach Request to Attach Complete					
	BER/timeslot Full/Sub (% and RxQual)	Bit Error Rate for each used timeslot					
	Coding Scheme Usage	Percentage of used coding scheme					
	FER/timeslot Full/Sub	FER for each used timeslot in %					
	LLC Retransmissions DL/UL	Percentage of decoded errors (DL) or retransmitted (UL) LLC data blocks					
	LLC Throughput DL/UL	Displayed in kbit/s or % of max					
	PBCCH Timeslot	Which timeslot is used for PBCCH/PCCCH (if any)					
	PDP Access Point Name	Host name or network address					
	PDP Address	User address, IPv4/IPv6					
	PDP Context Time (ms)	Time from PDP Context Activation Request to PDP Context Activation Accept					
	PDP Contexts Active	Number of active PDP contexts					
	PDP Precedence Class	Precedence class (Subscribed/High/Normal/Low priority)					
	PDP Radio Priority	1:Highest, 4:lowest priority					
	PDP Reliability Class	Reliability class					
	Ping Delay	Mean delay in Ping session (ms)					
	Ping Size	The size of the Ping in bytes					
	RAC	Routing area code, 8 bits. Valid in GPRS networks. RA <= LA					
	RLC Retransmissions DL/UL	Percentage of decoded errors (DL) or retransmitted (UL) RLC data blocks					
	RLC Throughput DL/UL	Number of data blocks x block size. Displayed in kbit/s or % of max					
	RLP Throughput DL/UL	Number of data blocks x block size. Displayed in kbit/s or % of max					
	RPL Retansmission DL/UL	CSD/HSCSD decoded errors (DL) and retransmissions (UL) in %					
SIS	Session Appl. Througput UL/DL	Mean application data session throughput in kbit/s					
ete	Session information	Description of the session, for example "HTTP Get www.ericsson.com/file.html"					
am	Timeslot Channel Type DL/UL	Bi-directional, uni-directional, Main link, etc.					
a	Timeslot List DL/UL	Used timeslots on downlink/uplink					
S	Timeslot Used DL/UL	Maps a timeslot to a real timeslot value					
8	TLLI	32-bit value identifying a GPRS subscriber					
Q	Used Timeslots on DL or UL	Number of TS used					
Brs	ARFCN BCCH	BCCH ARFCN (Broadcast Control Channel – Absolute Radio Frequency Channel Number)					
	ARFCN TCH	TCH ARFCN (Traffic Channel – Absolute Radio Frequency Channel Number)					
	BSIC	Base Station Identity Code					
	Cell Id	Cell Identity					
	CGI	Cell Global Identity					
	Frequency Band	900, 1800, 1900, 900E					
	Hopping Frequency	The hopping frequency list					
lete	LAC	Location Area Code					
am	MAIO	Mobile Allocation Index Offset					
ľď	MCC	Mobile Country Code					
¥	MNC	Mobile Network Code					
<u>Š</u>	Neighbor ARFCN	ARFCN for neighbor cells					
let	Neighbor BSIC	Base Station Identity Codes for neighbor cells					
4	Neighbor Cell Name	Names of neighbor cells					
ŝ		The timeslot number used for the current call (valid only in Dedicated mode)					
0	Training Sequence Code	Current training sequence code					
	Pred. GPRS BLER	Estimated probability that a radio block cannot be decoded correctly (%)					
ĝ	Pred. GPRS Inroughput	Estimated GPRS through-put in kbit/s					
0	Adiagant Byl av	Speech Quality Index					
		Signal strength of aujacent channel(s)					
	C/L Hopping List	C/L values for the channels in the honning list					
	C1: C2	Path loss criterion parameter and re-selection criterion parameter					
s	DTX Bate Downlink	Lise of DTX (Discontinuous Transmission)					
ent	EEB Full and Sub	Frame Erasure Bate in %					
Ê	MS TxPower (dBm)	Mobile Station transmission power (valid only in dedicated mode)					
3 nr	Neighbor C1	Path loss criterion parameter for neighbor cells (sorted by channel number)					
eas	Neighbor C2	Cell reselection criterion parameter for neighbor cells (sorted by channel number)					
Σ́	Neighbor RxLev	Received signal strength of neighbors (sorted by channel number)					
응	Radio Link Timeout (Actual and Max)	Actual & Max number of undecoded radio blocks allowed before call terminated					
Ba	RxLev Full and Sub	Received signal strength level					
Σ	RxQual Full and Sub	Received signal quality level					
S	ТА	Timing Advance					
		-					

Above is a list of some of the parameters TEMS Investigation GSM can handle.