MAN-11100-002 Rev. B

SUNRISE TELECOM
INCORPORATED

SunSet® E20

User's Manual
for
GSM
SS266-2

Version 2.01

Sunrise Telecom®... a step ahead

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⚠ Warning!

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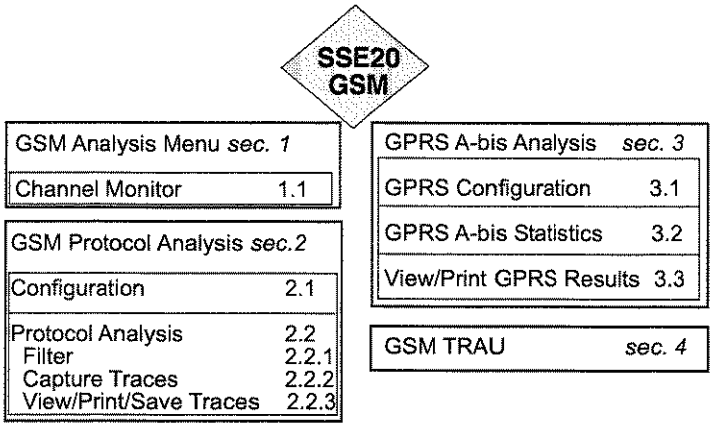
1 GSM Analysis Menus

The GSM ANALYSIS menu, as shown in the menu tree below, contains the GSM and GPRS features. You must be in PCM-31 framing to access GSM.



The SunSet E20's GSM (Global System for Mobile communication) and GPRS (General Packet Radio Service) testing features enhance the measurement capabilities of a technician or an engineer to ensure the performance of GSM networks. Figure 1 shows the GSM/GPRS menu.

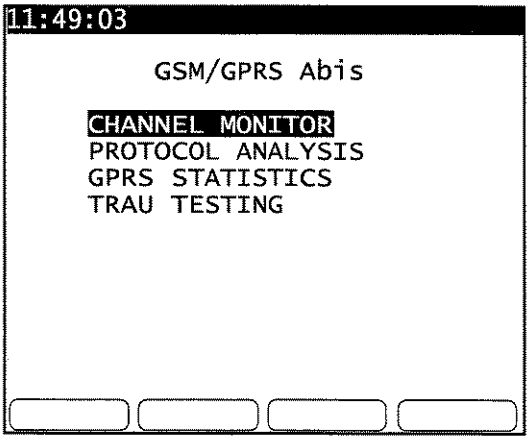


Figure 1 GSM/GPRS Main Menu

Note on this manual

The SunSet E20 is available in both black and white and color (E20c) models, which is why a sample figure in this manual may not be identical to the screen you see on your unit. This manual contains samples of both types of screens. The data is the same in both versions, merely the screen format changes. There are also minor differences in the header; in the black and white units you will see 'FILTER' and 'SHIFT' if appropriate; in the color units, you will see 'Filt' and 'Shift'.

1.1 Channel Monitor

Enter CHANNEL MONITOR in the GSM/GPRS Abis menu. See Figure 2. Use this procedure to monitor GSM traffic and channel occupancies on the GSM network lines.

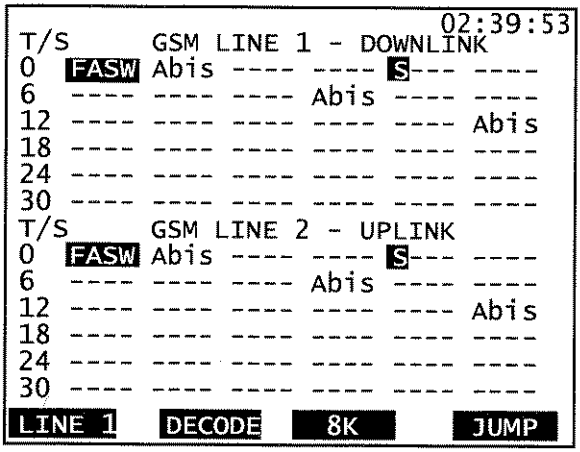


Figure 2 GSM Monitor screen, E1 Dual Mode

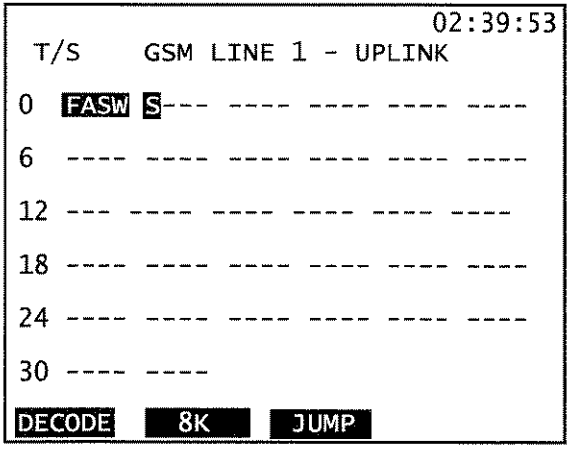


Figure 3 GSM Monitor, E1 SINGL Mode

The format of the display will depend on if you are in E1SINGL or E1DUAL mode, and in an 8K or 16K display. Refer to the TEST CONFIGURATION section in *Chapter 3* of the *SunSet E20 User's Manual* for set up information.

Figure 2 is a sample of E1DUAL mode, where information for both lines is displayed on one screen. Press F1 to move to the individual line (Line 1 or Line 2) screen. Press F1 again and you will return to the L1+2 display.

When only one line has been selected in E1DUAL mode, the screen will appear as in Figure 3, except for changes in the F-keys; F1 will be the LINE 1/ LINE 2 choice, F2 the DECODE choice, while F4 remains JUMP.

In E1SINGL mode the screen will appear as in Figure 3.

- Use the 8K/16K F-key to monitor the 8 kbit/s and 16 kbit/s subchannels. 8K is used for half-rate speech channels.

When monitoring the link, the physical line and framing information are reported:

- In case of a lost frame, a "FRM LOSS" message will be displayed.
- In the case of a loss of signal, a "SIG LOSS" message will be displayed for the specific line.

- Observe the Uplink and/or Downlink direction, and the received timeslot/subchannel activity, reading the timeslots across the screen.

Here are the symbol definitions:
A = 16 kbit/s Abis signalling

Abis = 64 kbit/s Abis signalling

D = Data

I = Idle (speech idle)

O&M = Operations & Maintenance

S = Speech (Full Rate, Enhanced Full Rate, Half Rate)

- = Idle channel

FASW: Frame Alignment Signal Word

- Press JUMP to cursor between timeslots groups. Use the arrow keys to move between individual timeslots. Note that the Uplink and Downlink channels move simultaneously if you are in DUAL mode, so that you continue to monitor both sides of a single link.
- Press DECODE when the cursor is on an active speech channel, which is shown by a highlighted "S" for Speech, and you will hear the channel as well as see a VOICE DECODING screen. The test set speaker plays the selected voice channel. See the following figures for sample screens:

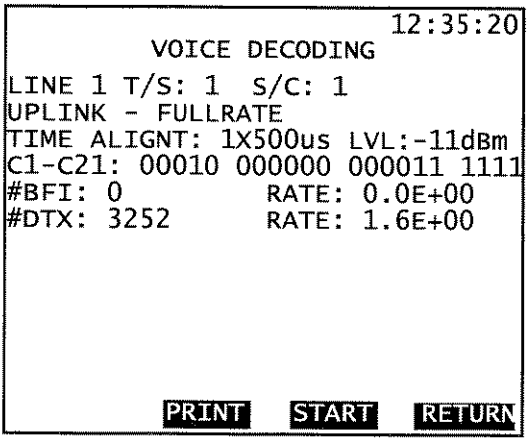


Figure 14 Line 1 Voice Decoding

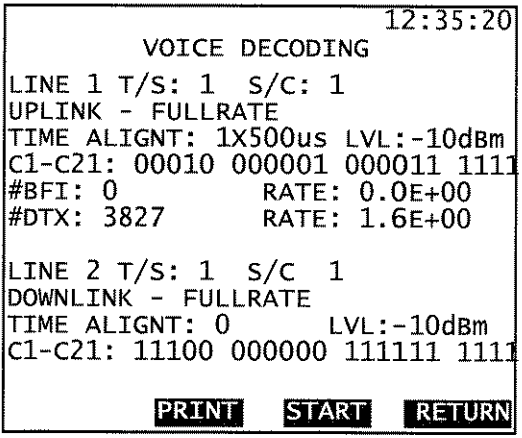


Figure 5 Dual Voice Decoding Screen (Uplink and Downlink)

If you are in E1DUAL mode and monitoring both sides of a conversation, when you hit DECODE you will hear both lines on the SunSet speaker. If you are using a headset, you will hear one direction in each ear. Line 1 will be in your left ear, and Line 2 will be in your right.

Note that if you are in E1DUAL mode, but on a single line display screen, you will only hear the line for the displayed screen when you press DECODE.

You must be in START mode to listen to the decoded RPE-LTP speech signal. Press STOP (F3) to mute the speaker, and START (F3) to listen.

Here are the screen definitions:

Line 1/2 T/S: Line in use (1 or 2), and individual timeslot (which you're looking at)

S/C: Sub-Channel

UP/DOWNLINK: Link direction, as well as the voice encoding

TIME ALIGNT: Time Alignment

LVL: Level of the A-law PCM voice, in dBm

C1—C21: Overhead C-bits of the TRAU frame; displayed grouped by the information they present

For Uplink Decoding:

#BFI: Number of Bad Fame Indicators; errored frames

#DTX: Number of Discontinuous Transmission Mode frames; frames transmitted not carrying data

For Downlink Decoding:

UFE: Uplink Frame Error

2 GSM Protocol Analysis

- Configure for A-bis monitoring.
- Analyze protocol.

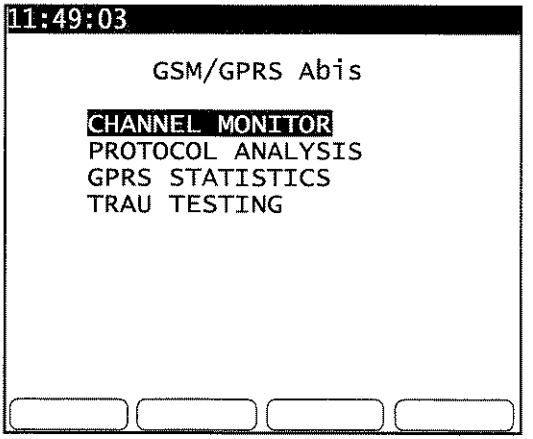


Figure 6 GSM A-bis Analysis Menu

See *Section 6* for the *Technology Overview* if you need definitions or information about GSM.

2.1 Configuration

You must be in E1 Single or Dual Mode, full rate, to enter GSM A-bis. You will see a "SYSTEM CONFIGURATION" message (and an SRAM card formatting question if necessary) before the screen appears. The unit will be configured to PCM-31 line coding if it isn't already. Figure 7 shows a sample screen.

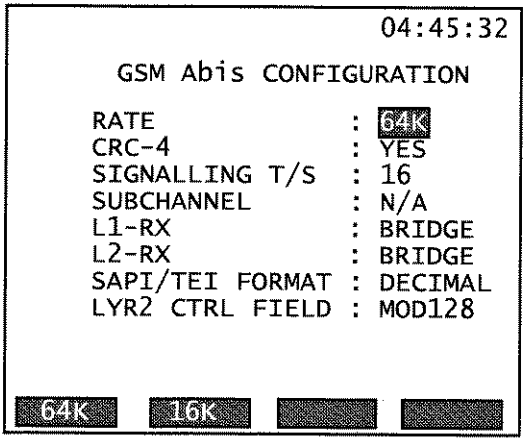


Figure 7 GSM Configuration Screen

RATE

Options: 64K (F1), 16K (F2)

Select the A-bis rate.

- Signalling channels are 64K.
- 64K channels are used when the TRAU is on the BTS side.
- Traffic channels are 16K.
- 16K channels are used when the TRAU is on the BSC/MSC side.
- If you select 16k, you will need to configure the subchannel.

CRC-4

Options: ON (F1), OFF (F2)
Determine if CRC-4 error checking will be enabled.

SIGNALLING T/S

Options: 1—31

Specify the received timeslot.

- Use the F-keys, PREV (F1) and NEXT (F2), to select the desired number.

SUBCHANNEL (N/A at 64K rate)

Options: 1—4

Select the receive subchannels, from 1—4, if using a 16K rate.

- Use the PREV (F1) and NEXT (F2) F-keys to select the desired number.

L1-RX/L2-RX

Options: TERM (F1), BRIDGE (F2), MONITOR (F3)

- You must specify the line interface mode for your testing. TERM is the most common mode used for out-of-service testing. Bridge is most commonly used for testing live circuits.

TERM: The Term mode is used when you wish to send and receive an E1 signal. The test set terminates the received signal with a low impedance termination, and requires that the circuit be disrupted for testing. A 75 ohm termination is used for BNC and 1.6/5.6 mm connectors. A 120 ohm termination is used for BR2 and 3-pin banana connectors.

BRIDGE: The Bridge mode is similar to the Monitor mode. However, in Bridge mode, the test set applies high impedance isolation resistors to the circuit under test. This isolation circuitry will protect the signal from any possible disruption.

If a connection is made from the MON jack of a network element to the test set, and if the Bridge access mode is being used, this may result in two isolation circuits on the signal. In this case, the test set will likely report a loss of signal and be unable to perform any measurements.

MONITOR: The Monitor (protected monitoring point) mode is used for monitoring. The signal is provided from the MON jack of an E1 network element. The network element has isolated the monitor signal from the live signal with high impedance resistors. The test set has an Automatic Gain Control (AGC) circuit to compensate for the resistive loss from -15 dB to -30 dB. If the signal source is not a resistively attenuated monitor output signal, the AGC will not operate properly, and as a result, code error and/or other problem indicators will be shown on the test set.

The Monitor mode is useful because it protects the live signal from possible disruptions caused by the testing process. It allows the technician to observe the line while the circuit is carrying customer traffic.

SAPI /TEI FORMAT

Options: HEX (F1), DECIMAL (F2)

Select the formatting of the SAPI and TEI.

LYR2 CTRL FIELD

Options: MOD8 (F1), MOD128 (F2)

Select the Layer 2 control field.

- MOD8 is Modulo 8 sequence numbering.
- MOD128 is Modulo 128 sequence numbering, the ETSI specified method.

2.2 Protocol Analysis

This menu lets you configure filters for capturing messages, and allows you to view stored messages.

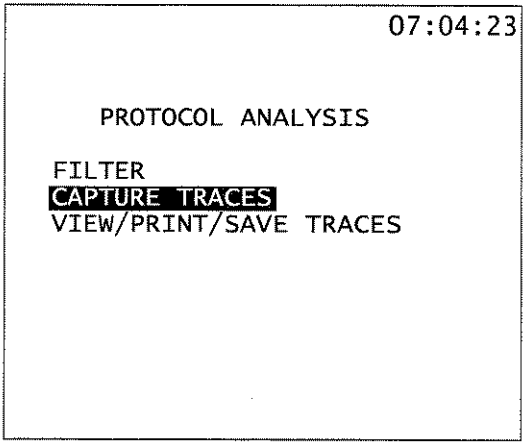


Figure 8 Protocol Analysis Menu

2.2.1 Filter

Enter Filter in the PROTOCOL ANALYSIS menu. The FILTER SETUP screen appears as in the following figure:

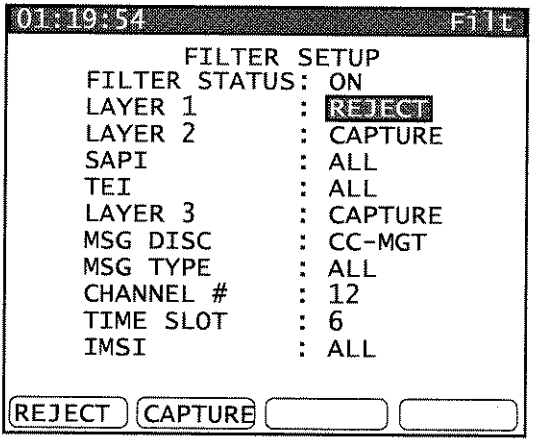


Figure 9 A-bis Filter Setup

FILTER STATUS

Options: ON (F1), OFF (F2)

- If set to ON, you will be able to set Layers 1, 2, and 3 filters, as explained below. A 'FILTER' or 'Filt' message appears at the top of the screen when filtering is enabled.
- If set to OFF, no filters will be used; therefore *all* messages will be captured.
- Note that filtering may be done before (prefilter) or after (postfilter) capturing traces.

LAYER 1

Options: REJECT (F1), CAPTURE (F2)

- Press REJECT to not capture Layer 1 alarm information.
- Press CAPTURE to have the SunSet capture Layer 1 information.

LAYER 2

Options: REJECT (F1), CAPTURE (F2)

- Press REJECT to not capture Layer 2 messages.
- Press CAPTURE to have the SunSet capture Layer 2 messages.

To enter digits in the following items, use this procedure:

- The number may be entered using the keypad.
- Use the <- (F2) key to backspace within the line.
- If a number is already present, and you wish to change it, press EDIT (F1). The 'SHIFT' indicator will appear at the top of the screen. Arrow (F2) within the number to the digit you want to change, and enter the new number. Any digits to the right of the digit you are correcting will vanish. When you have finished editing, press DONE (F1). The 'SHIFT' indicator will vanish.

SAPI

Options: ALL (F3), any 1 or 2 digit number

- Select ALL and all SAPIs (Service Access Point Identifier) will be captured.
- You may also enter a specific number.
- SAPI identifies the Layer 3 signalling protocol.

TEI

Options: ALL (F3), any 1 or 2 digit number

- Select ALL and all TEIs (Terminal Endpoint Identifier) will be captured.
- You may also enter a specific number.
- The TEI identifies the TRX.
- TEI values 0—63 (00 to 3F, hex) are reserved for fixed addresses.
- Values 64—126 (40 to 7E, hex) are used for additional addresses to TRXs needing more than one signalling link.

LAYER 3

Options: REJECT (F1), CAPTURE (F2)

- Press REJECT (F1) to not capture Layer 3 messages.
- Press CAPTURE (F2) to have the SunSet capture Layer 3 messages.

MSG DISC

Options: ALL (F1), RLL_MGT (F2), DC_MGT (F3), CC_MGT (more, F1), TRX_MGT (more, F2), RESERVD (more, F3)

The Message Discriminator allows you to discriminate between radio link (RLL), dedicated channel (DC), common channel (CC), and TRX management. Reserved messages are reserved for

future use; they may be proprietary to their constructors, reserved for the government, etc.

MSG TYPE

Options: Hex code from 00 to 7F.

This filter allows you to capture a specific message. The following tables, Figures 10 to 13, outline the different message types implemented on the SunSet E20.

Hex Code	Message Type
01	Data Request- ._sent in BCS-BTS direction to request sending of a message in multiframe mode
02	Data Indication- sent in BTS-BSC direction to indicate the reception of a message in multiframe mode.
03	Error Indication - sent from BTS to BSC to indicate an abnormal case for a RLL connection
04	Establish Request - sent in BSC-BTS direction to request the establishment of a radio link layer connection in multiframe mode.
05	Establish Confirm -sent in BTS-BSC direction to confirm the establishment of a radio link layer connection in multiframe mode.
06	Establish Indication- sent in BTS-BSC direction to indicate the establishment of a radio link layer connection in multiframe mode
07	Release Request- sent in BSC-BTS direction to request the release of a radio link layer connection in multiframe mode.
08	Release Confirm- sent in BTS-BSC direction to confirm the release of radio link connection in multiframe mode.
09	Release Indication- sent in BTS-BSC direction to indicate the release of a radio link layer connection in multiframe mode.
0A	Unit Data Request- sent in BSC-BTS direction to request the sending of a message in unacknowledged mode on a radio link layer connection
0B	Unit Data Indication- sent in BTS-BSC direction to indicate the reception of a message in unacknowldeged mode on a radio link layer connection.

Figure 10 Radio Link Layer Message Types

Hex Code	Message Type
11	BCCH_Information - sent from BSC to BTS to indicate new information to be broadcast on BCCH.
12	CCCH Loa Indication - sent from BTS to BSC to indicate current load on CCCH.
13	Channel Required- sent in BTS-BSC direction to indicate the reception of a Channel Request message from a MS.
14	Delete Indication - sent from BTS to BSC to indicate the deletion of an access grant message (IMMediate ASSIGN) due to overload of downlink CCCH.
15	Paging Command- sent in BSC-BTS direction to request the paging of a MS.
16	Immediate Assign Command- sent in BSC-BTS direction to request the transmission of an immediate assign message to the MS.
17	SMS Broadcast Request - sent from BSC to BTS to request the paging of an MS.
1D	SMS Broadcast Command
1E	CBCH Load Indication.
1F	Notification Command

Figure 11 Common Channel Message Types

Hex Code	Message Type
19	RF Resource Indication sent from BTS to BSC to indicate the interference level on idle channels of a TRX.
1A	SACCH Filling- sent in BSC-BTS direction to indicate the new broadcast information to be used as filling information on SACCH.
1B	Overload- sent in BTS-BSC direction to indicate an overload situation.
1C	Error Report - sent from BTS to BSC to report a detected error which can't be reported in any other message.

Figure 12 TRX Message Types

Hex. Code	Message Type
21	Channel Activation- sent in BSC-BTS direction to activate a radio channel.
22	Channel Activation Acknowledge- sent in BTS-BSC direction to indicate requested radio channel activation has been completed successfully.
23	Channel Activation Negative Ack.- sent in BTS-BSC direction to indicate requested radio channel could not be performed.
24	Connection Failure - sent from BTS to BSC to indicate an active connection has been broken.
25	Deactivate SACCH - sent from BSC to BTS to deactivate the SACCH of an active channel.
26	Encryption Command- sent in BSC-BTS direction to start cyphering mode operation
27	Handover Detection- sent in BTS-BSC direction when BTS detects a Handover Access message from a MS on the Handover activation channel.
28	Measurement Result- sent in BTS-BSC direction to report to BSC the results of radio channel measurements for a particular MS.
29	Mode Modify Request - sent from BSC to BTS to request a change of channel mode of an active channel.
2A	Mode Modify Ack. - sent from BTS to BSC to confirm the change of channel mode of an active channel.
2B	Mode Modify Neg. Ack. - sent from BTS to BSC to indicate the channel mode modification could be performed.
2C	Physical Context Request - sent from BSC to BTS to request the "physical context" of an active channel.
2D	Physical Context Confirm - sent from BTS to BSC as a response to #44; contains "physical context" info.
2E	RF Channel Release - sent from BSC to BTS to inform that a radio channel is no longer needed.
2F	MS Power Control - sent from BSC to BTS to change the MS power level of the parameters used by the TRX to control the MS power.
30	BS Power Control - sent from BSC to BTS to change the TRX transmission power level of the parameters used by the TRX to control its transmission power.
31	Preprocess Configure - sent from BSC to BTS to modify the preprocessing parameters used by the BTS.
32	Preprocessed Measurement Result - used by BTS to report the results of radio parameter preprocessing.
33	RF Channel Release Ack. - sent from BTS to BSC as an ack-knowledge to a RF Channel release message.
34	SACCH Info Modify.
35	Talker Detection.
36	Listener Detection.

Figure 13 Dedicated Channel Message Types

CHANNEL #

Options: ALL (F1), 00 to 1F

- Use the F-keys to enter a value from 00—1F in hexadecimal code.
- This filter corresponds to the last 5 bits of the 2nd octet of the channel number information element.
- This filter allows the user to capture messages with a specific physical channel/subchannel number.

TIMESLOT

Options: ALL (F1), 0 to 7

- Use the F-keys to enter a value from 0 to 7.
- This filter enables you to capture messages using a specific timeslot number.
- This filter corresponds to the first three bits of the second octet of the channel number information element.

IMSI

Options: ALL (F1), any up to ten digit number

Choose whether to filter for messages containing the International Mobile Subscriber Identity information.

- Use the F-keys to enter a value.
- Select ALL to capture all messages containing IMSI information.

2.2.2 Capture Traces

Observe the live transfer of messages, on one or both lines. Make sure the unit is properly configured for Rx-1 and Rx-2, Bridge or Monitor mode, before attempting to monitor line 1 and or line 2. See GSM A-bis CONFIGURATION if you need further information.

If you are in Line 1 configuration only, all of the trace messages will be L1. If you are monitoring both sides of a line, you will see L1 and L2 messages, on separate screens. Following is a sample screen:

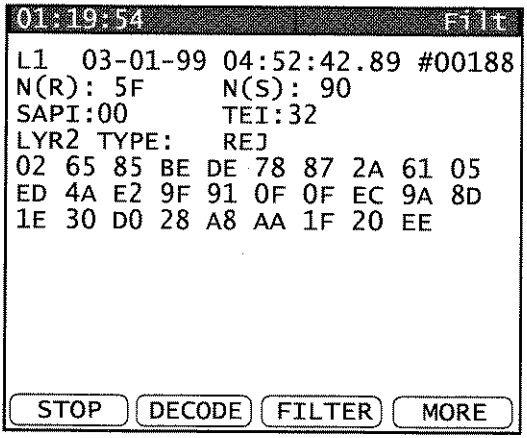


Figure 14 A-bis Capture Traces Sample

F-keys

STOP/START (F1): Begin or halt the tracing process. When live capturing has been halted, new F-keys will appear.

PAGE-UP (more, F1)/ **PAGE-DN** (more, F2): Press these keys to scroll through the selected messages.

SAVE (more, F3) : Press to save the trace:

1. You will enter the VIEW/PRINT/SAVE TRACES screen. CURRENT will be highlighted. See Figure 15. Press SAVE (F4). You will enter the SAVE TRACES screen.
2. Press TOGGLE (F3). The "A" in the alphabet grid be highlighted, and SELECT (F4) will appear.
3. Use the SELECT key to choose the letters for your label. Each time you press SELECT, the highlighted letter will appear at the LABEL line. Cursor between the letters in the

grid.

4. When the label is complete, press TOGGLE again to exit the grid.
5. When you're through, press ENTER. The selected traces will be saved under the label you have entered.
6. Press ESC to return to the CAPTURE TRACES screen.

DECODE/HEX (F2): Select the display format of the data. The message is shown in hex format on the sample screen.

FILTER (F3): Press FILTER and you will enter the FILTER SETUP screen (as in Figure 9). You may reconfigure the filters. Press ENTER or ESC to return to the CAPTURE TRACES screen.

2.2.3 View/Print/Save Traces

The VIEW/PRINT/SAVE TRACES screen presents a list of any previously stored traces. See Figure 15. You may also save a trace from this screen.

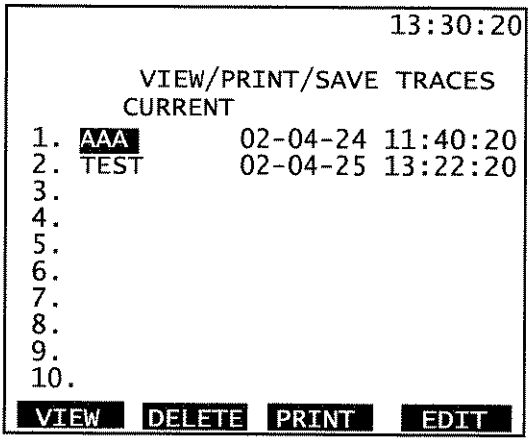


Figure 15 View/Print/Save Traces Screen

View a Saved Trace

1. In the VIEW/PRINT/SAVE TRACES screen, cursor to the name (label) of the trace you want to view. It will be highlighted.
2. Press VIEW (F1).
   A. You will enter a screen showing you the label of the saved traces, and showing the number(s) of the messages saved under that label. See Figure 16.

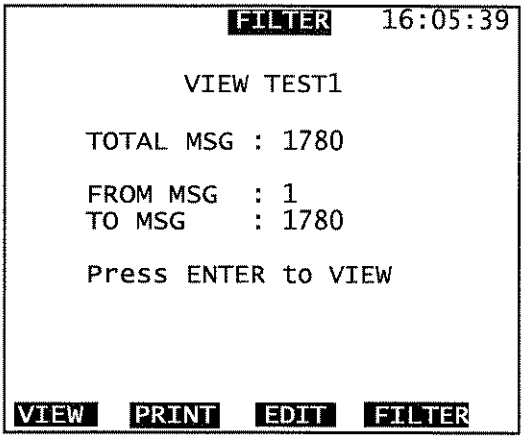


Figure 16 View Saved Trace

You may edit the saved trace; both the label and the numbers of the traces saved. You will enter an EDIT TRACES screen.

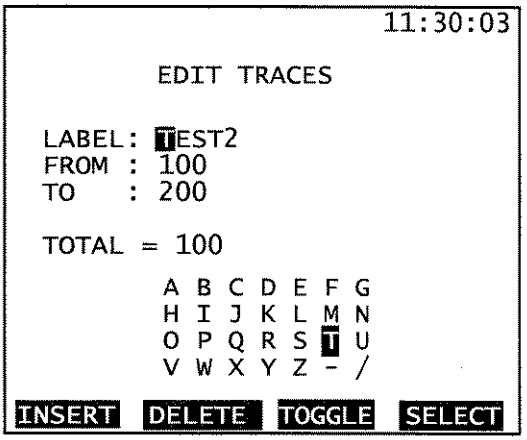


Figure 17 Edit Traces

The EDIT TRACES screen also gives you a total number of messages saved in the trace. Follow the instructions for *Save a Current Trace* at the end of this section if you want to edit the saved trace.

B. Press VIEW (F1) to view the saved trace. Note that if the Filter is on, the messages will be filtered before they are presented.

Here are some sample screens:

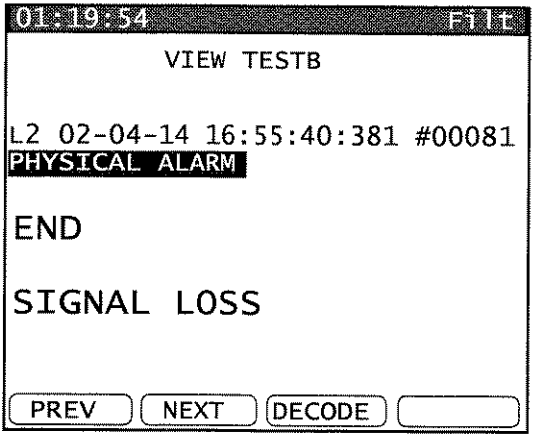


Figure 18 Sample View Screen, Physical Alarm

Figure 18 is an example of a Layer 1 screen. It shows the end of a physical alarm (Loss of Signal). The Layer 1 filter was set to CAPTURE.

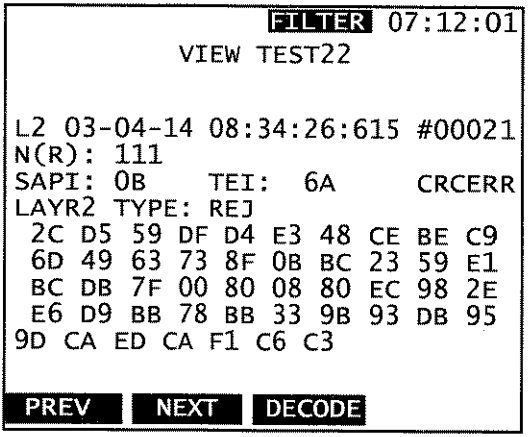


Figure 19 Sample View Screen, Layer 2

Figure 19 shows Layer 2 messages. Note that CRC errors are also shown (right center).

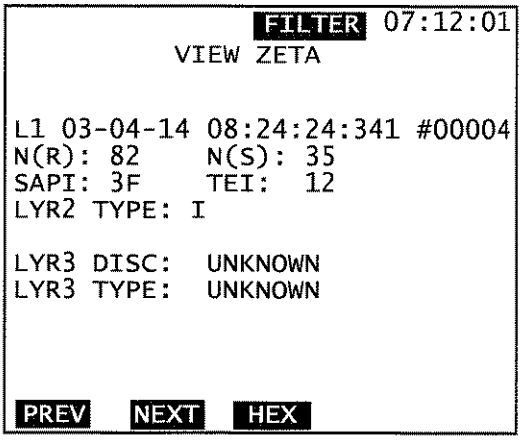


Figure 20 Sample Layer 3 and Layer 2 Info

This figure shows Layer 3 as well as Layer 2 information. Note that the message was received on Line 1.

Here are some definitions:

L1/2: This is the line the message was received on.

Date and Time of the message are also shown on the first line, as is the message number.

N(R): Receive Sequence number of this message

N(S): Send Sequence number of this message

SAPI: SAPI number

TEI: TEI number

LYR2 TYPE: Layer 2 message type (Supervisory, Unnumbered Format, Information)

LYR3 DISC: Layer 3 Message Discriminator value

LYR3 TYPE: Layer 3 message type

F-keys

Use the **PREV** (F1) and **NEXT** (F2) F-keys to page through the available messages. **DECODE/HEX** (F3) changes the display of the information.

If additional screens are available for a message, a "Page 1" (2, etc.) message will appear on the right side center of the screen. A PAGE-DN (F4) key will appear, so that you may page through the additional screen(s).

Print a Saved Trace

1. Cursor to the name of the trace you want to print.
2. Make sure a printer is connected to the SunSet's serial port.
3. Press PRINT (F3). You will enter a PRINT screen:

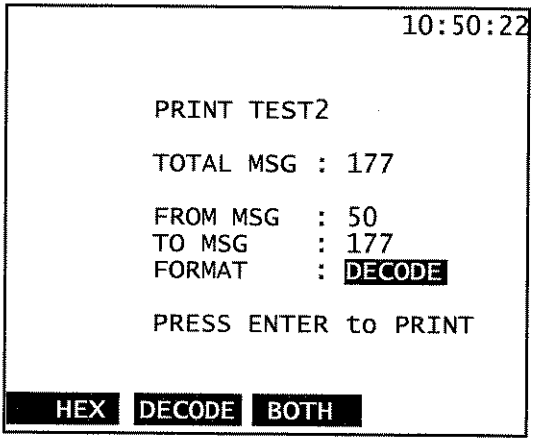


Figure 21 Print a Trace

4. You may edit the messages to be printed at the FROM MSG and TO MSG lines.
5. **FORMAT**

Options: HEX (F1), DECODE (F2) , BOTH (F3)

Determine the printing format.

- Press ENTER after making the selections, and the results will be sent to the serial port for printing.
- If a printer is not connected, or improperly configured, you will see a "PRINTER NOT READY" warning message.

Save a Current Trace

On entering the VIEW/PRINT/SAVE TRACES screen, CURRENT will be highlighted. To view the Current Trace, press VIEW (F1). You will be taken to the CURRENT TRACE screen.

F-keys

CLEAR (F2) deletes the current traces, so traces may be saved anew.

PRINT (F3) sends the messages to the serial port for printing,

SAVE (F4) sends you to the SAVE TRACES screen, as in the following figure:

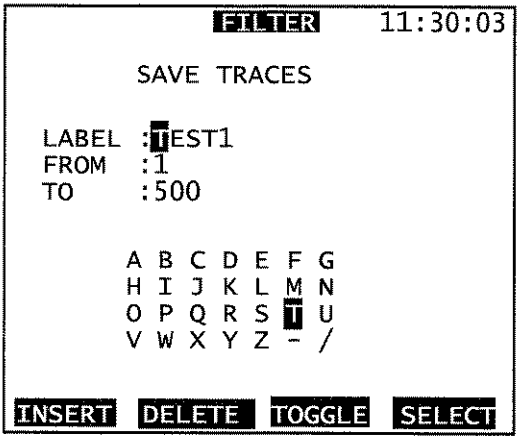


Figure 22 Save Traces Label Screen

Here you can give a label to the trace you want to save. Use this procedure:

1. Press TOGGLE (F3). The "A" in the alphabet grid will be highlighted, and SELECT (F4) will appear.
2. Use the SELECT key to choose the letters for your label. Each time you press SELECT the highlighted letter will appear at the LABEL line. Cursor between the letters in the grid.
3. When the label is complete, press TOGGLE again to exit the grid.
4. When you're through, press ENTER. The selected traces will be saved under the label you have entered. The label will appear in the VIEW/PRINT/SAVE/TRACES list.

The trace will be saved into the first available stored message location. You will return to the VIEW/PRINT/SAVE/TRACES screen. If no space is available to save the message, you will see a "VIEW/PRINT/SAVE/TRACES Full" message. You must then delete a stored trace in order to save a new one.

Deleting a Trace

1. Cursor to the trace name you want to delete.
2. Press DELETE (F2). You will see a brief message telling you the trace has been deleted.

When CURRENT is highlighted, F2 will show as CLEAR rather than DELETE. Press CLEAR to erase the current trace, so you may save messages anew.

3 GPRS A-bis Analysis

The GPRS, General Packet Radio Service, feature enhances a technician or engineer's measurement capabilities for ensuring the performance of a GPRS network, including GPRS over GSM. GPRS Analysis conforms to ETSI Recommendations for GSM Phase 2+GSM 04.08,GSM 08.56, and GSM 08.58. Deployment of this 2.5 G Mobile technology in Europe and worldwide calls for a reliable tester, the SunSet E20.

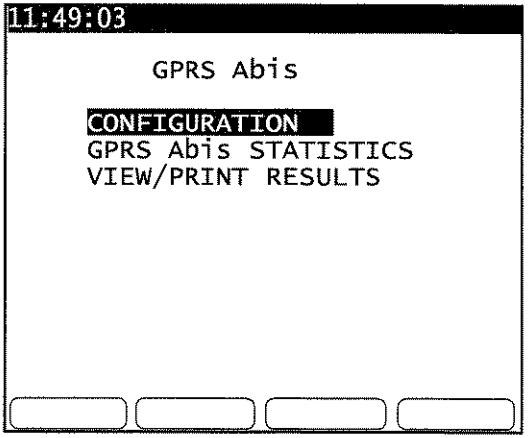


Figure 23 GPRS A-bis Menu

Set your L1-Rx and L2-Rx to Bridge or Monitor in the TEST CONFIGURATION in order to use GPRS functions.

3.1 GPRS Configuration

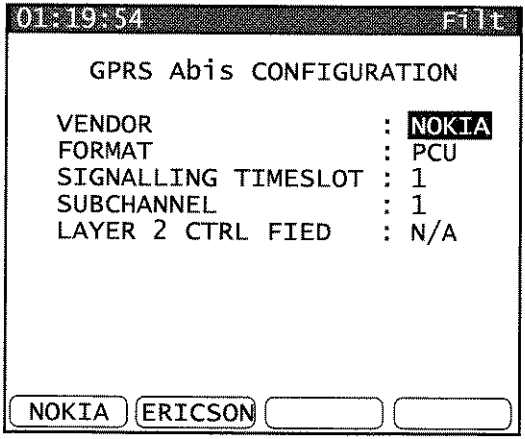


Figure 24 GPRS A-bis Summary

VENDOR

Options: NOKIA (F1), ERICSON (F2)

GPRS results will be presented according to the specifications used by the vendor selected here.

FORMAT

Options: SIGNAL (F1), PCU (F2)

Determine the format used.

- Select SIGNAL to monitor the A-bis signalling channel.
- Select PCU (Packet Control Unit) to monitor the PCU channel (GPRS data channel).

SIGNALLING T/S

Options: 1—31

Specify the received timeslot.

- Use the PREV (F1) and NEXT (F2) F-keys to select a timeslot.

SUBCHANNEL

Options: 1—4, ALL (SIGNAL Format only)

Select the receive subchannel, from 1—4 or ALL, if using a 16K rate.

- Use the PREV (F1) and NEXT (F2) F-keys to select a subchannel.
- Select ALL to monitor a 64K A-bis signalling channel.

LYR2 CTRL FIELD

Options: MOD8 (F1), MOD128 (F2)

Select the Layer 2 control field.

- MOD8 is Modulo 8 sequence numbering.
- MOD128 is Modulo 128 sequence numbering, the ETSI specified method.
- This selection is available only in a SIGNAL format.

3.2 GPRS A-bis Statistics

Upon entering this function, the SunSet E20 starts monitoring GPRS on the GSM A-bis link and automatically save the traces and statistic result into the internal memory. You will see a "Connect Line 1 to Uplink, Connect Line 2 to Downlink" message before the results screens appear.

F-keys

The following F-keys are available on all of the Statistics screens.

PAGE-UP (F1)/ **PAGE-DN** (F2): Press these keys to scroll through the screens.

STOP/START (F3): Begin or halt the measuring process.

PRINT (more, F1): Press to send the results to the serial port for printing.

SAVE (more, F2) : Press to save the results directly to the GPRS VIEW/PRINT TRACES screen.

Figures 25—33 present sample Statistics screens. The statistics gathered will depend on the VENDOR and FORMAT selected in the GPRS Abis CONFIGURATION screen. See the vendor specifications for the expected message requirements and definitions.

Summary Screen

This screen summarizes the GPRS setup and layer results.

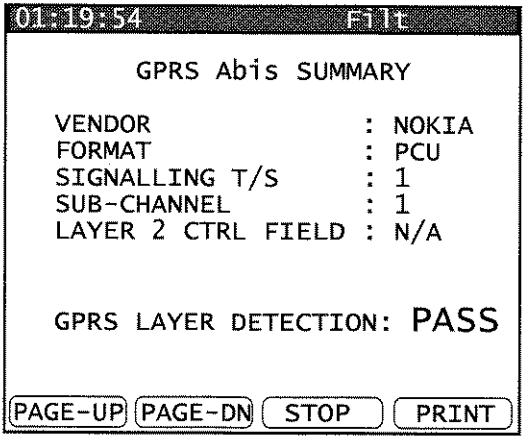


Figure 25 GPRS Statistics Summary Screen

A-bis Statistics Screens

These screens present GPRS statistics monitored on the A-bis link.

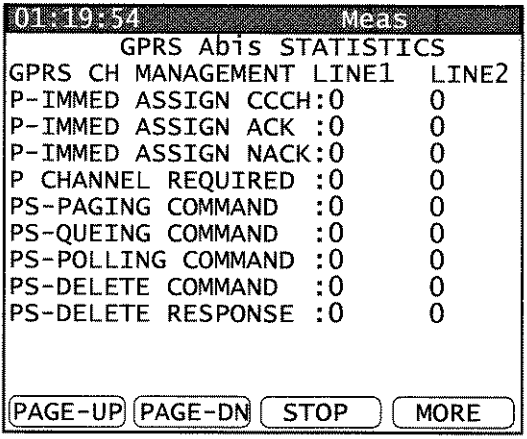


Figure 26 GPRS Statistics, Nokia Signalling Channel

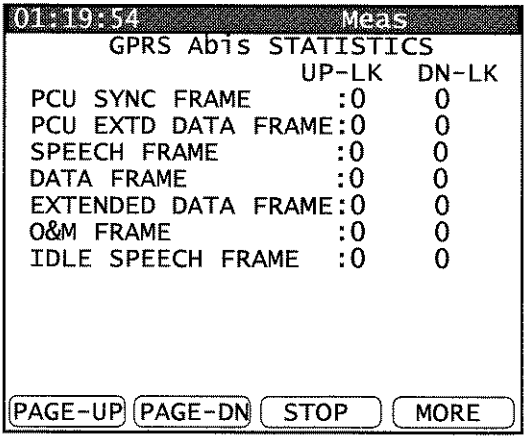


Figure 27 GPRS Statistics 1, Nokia PCU Channel

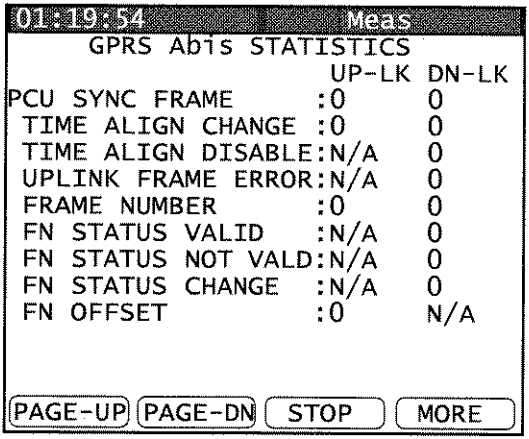


Figure 28 GPRS Statistics 2, Nokia PCU Channel

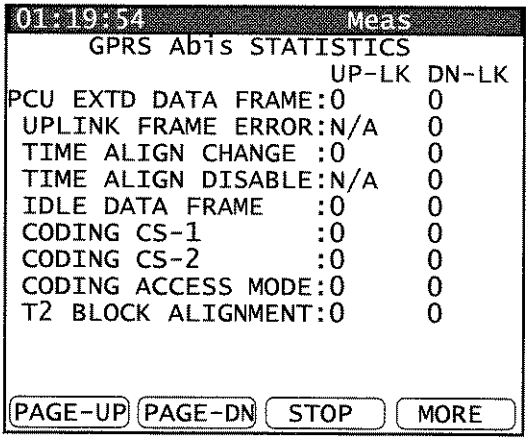


Figure 29 GPRS Statistics 3, Nokia PCU Channel

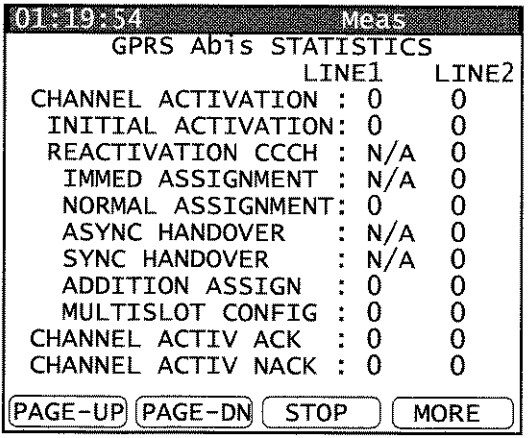


Figure 30 GPRS Statistics, Ericsson Signalling Channel

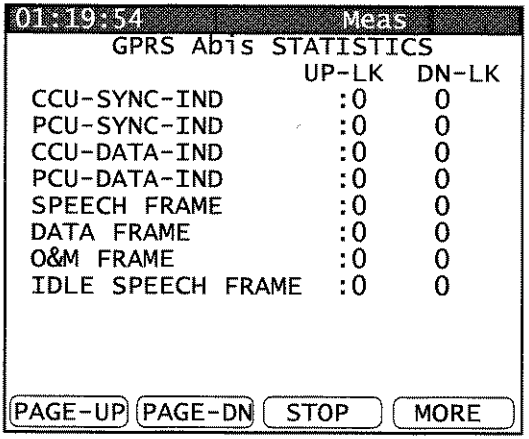


Figure 31 GPRS Statistics 1, Ericsson PCU Channel

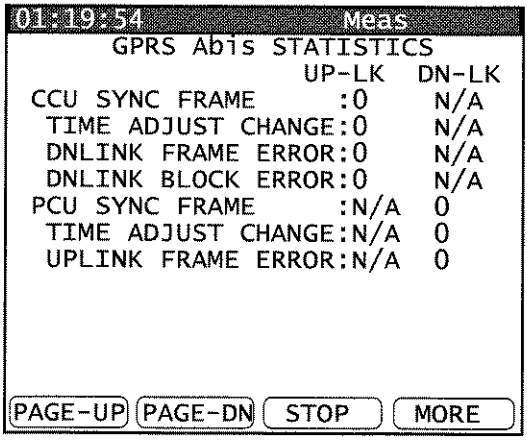


Figure 32 GPRS Statistics 2, Ericsson PCU Channel

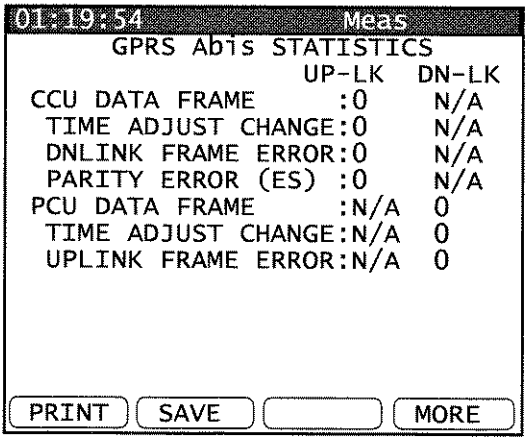


Figure 33 GPRS Statistics 3, Ericsson PCU Channel

3.3 View/Print GPRS Results

A total of 20 records may be stored in this menu, including the current results (record 01; stored in the unit's memory). See the next figure for the VIEW TEST RECORDS screen. Records are stored by pressing the SAVE F-key in a GPRS screen.

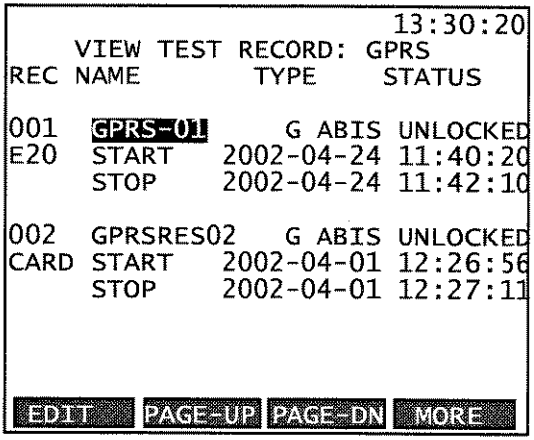


Figure 34 GPRS View Records

- The record numbers are shown in accordance with the GPRS results that are in memory, along with their associated information, such as START and STOP time, and the LOCKED/UNLOCKED status.

1. Scroll to select the GPRS record you want to view.
2. Press VIEW (more, F1).

In addition to PAGE-UP (F2) and PAGE-DN (F3), the following **F-keys** are available:

EDIT (F1): Allows you to relabel the highlighted record. See Figure 35.

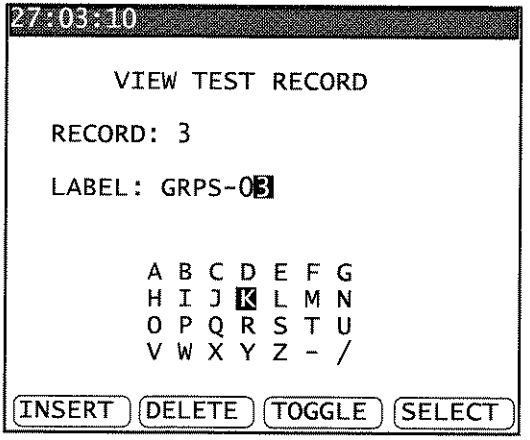


Figure 35 Record Label

- Press TOGGLE (F3). The first letter in the alphabet grid will be highlighted.
- Cursor to each letter you want to select, and press ENTER, until you have the label you want.
- Use the INSERT (F1) and DELETE (F2) keys if you need to correct an error.
- Press ENTER to return to the VIEW RECORDS screen.

VIEW (more, F1): Press to view the highlighted record. You will view the saved Statistics screens. Press ESC to return to the VIEW TEST RECORD screen.

LOCK (more, F2)/ **UNLOCK** (more, F3): Press LOCK to lock the record, so it can not be deleted. Press UNLOCK to open the record.

CLR (more, F1): Press to delete the highlighted record. If 20 records are already stored, you will need to delete a record before storing a new one.

CLR-ALL (more, F2): Press to clear (delete) all of the records, except the current record.

PRINT (more, F3): Press to send the record to the serial port for printing.

- Transmit a prerecorded speech message on Line 1.
- Observe received C-bits.
- Conduct a 16K BERT on a data transmission.

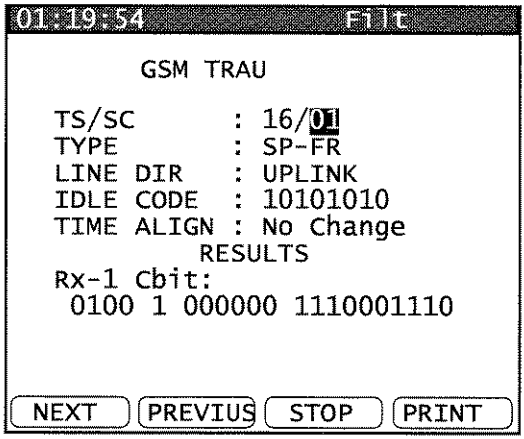


Figure 36 TRAU Configuration Screen

TS/SC

Select the Timeslot (1—31) and Subchannel (1—4) to transmit on.

- Use the NEXT (F1) and PREVIUS (F2) keys to make the selections.

TYPE

Determine the type of message to transmit.

- Press SELECT (F1) to enter the SELECT TYPE screen, where you will be presented with the list of messages:
  SP-FR: Speech, Full Rate
  SP-EFR: Speech, Enhanced Full Rate
  SP-1010: Speech identified within 1010 pattern transmission
  IDLE SP: Speech identified within Idle code transmission
  2e15: Pseudo random bit sequence pattern; 15-stage register
  2e11: Pseudo random bit sequence pattern; 11-stage register
  1111: All ones test pattern
  1010: Alternating ones and zeros test pattern
  0000: All zeros test pattern

1. Highlight the desired message.
2. Press enter to return to the TRAU configuration screen.
3. If you select a data test pattern, you will enter the 16K BERT screen:

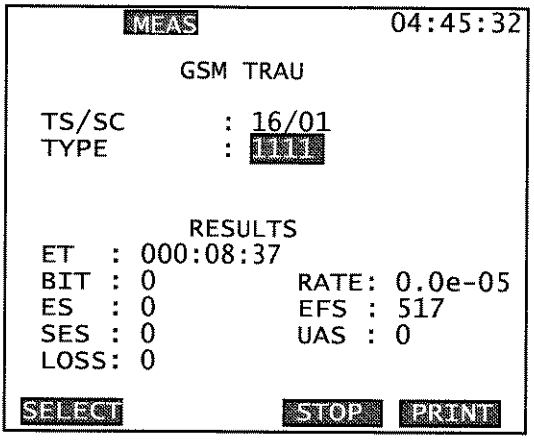


Figure 37 16K BERT

Observe the measurements:
ET: Elapsed Time; measurements begin when you enter the screen; the time since measurements began is reported here.
BIT: A count of bit errors.
RATE: The rate at which errors are being received.
ES: A count of errored seconds.
EFS: A count of error free seconds.
SES: A count of Severely Errored Seconds; seconds with an error rate of 10-3 or higher.
UAS: A count of Unavailable Seconds; unavailable time begins at the onset of 10 consecutive SESs, or at loss of signal or loss of frame.
LOSS: A count of Loss of Signal Seconds; seconds during which signal was lost.

- See the Measurements section in *Chapter 3* of the main User's Manual if necessary.
- Note that you may STOP (F3) and START (F3) the measurements.
- You may also press PRINT (F4) to send the results to a connected printer via the serial port.

- Press SELECT (F1) to return to the SELECT TYPE screen where you may select another pattern or speech type to transmit.
- Press ESC to return to the GSM ANALYSIS menu.

LINK DIR

Options: UPLINK (F1), DNLINK (F2)

- Select the link direction to transmit. See the following figure:

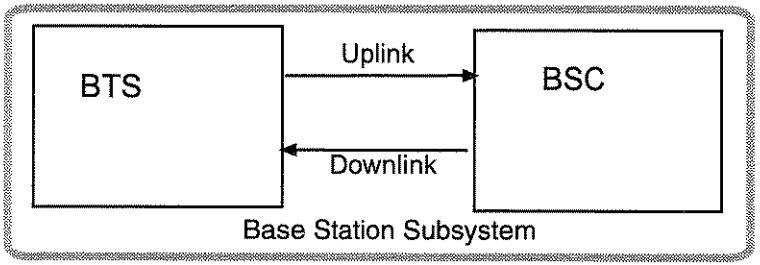


Figure 38 Uplink/Downlink Directions

IDLE CODE

Set the idle code inserted on the non-selected channels.

- Use the SHIFT and number keys to enter the digits.
- Use the arrow keys to move between digits as required.

TIME ALIGN

- The default is no delay ('No Change') to the voice signal.
- You may change the delay time by pressing the F-keys:
  Press INC+1 (F1) to increment the delay by steps of 500 ms.
  Press DEC-1 (F2) to decrement the delay by steps of 500 ms.
  Press INC+10 (F3) to increment delay by steps of 10 x 500 ms.

RESULTS

Observe the received C-bits at the Rx-1 line.

Additional F-keys

START/STOP (F3): Press START to begin TRAU transmission. Press STOP (F3) to halt transmission.

PRINT (F4): Press to print the results.

5 Applications

5.1 A-bis Monitoring

Monitor both directions of A-bis signalling to get a complete picture of the state of the line.

1. From the main menu, enter TEST CONFIGURATION.
   A. Configure the set as follows:
   TEST MODE: E1 DUAL
   Tx/INSERT: L1-TX
   RX/DROP: L1-RX
   TxSOURCE: TESTPAT
   FRAMING: PCM-31
   CRC-4: as required
   TEST RATE: 2.048M
   L1-Rx Port: BRIDGE
   L2-Rx Port: BRIDGE
   TX CLOCK: RECEIVE
   B. When your settings are correct, press ENTER.
2. Enter GSM Analysis via the PROTOCOLS menu or the GSM icon, as appropriate.
   A. Enter GSM A-bis. You will see a "CONFIGURING SYSTEM" message for a few moments.
3. In the GSM Abis ANALYSIS screen, enter CONFIGURATION.
   A. Configure the unit for testing. Here is a sample setup:
   RATE: 64K
   CRC-4: OFF
   SIGNALLING T/S: 16
   SUB-CHANNEL: N/A
   L1-Rx: BRIDGE
   L2-Rx: BRIDGE
   SAPI/TEI FORMAT: DECIMAL
   LYR2 CTRL FIELD: MOD128
   B. Press ENTER when the settings are correct.
4. Connect the SunSet to two pieces of equipment using A-bis signalling, as in the following figure:

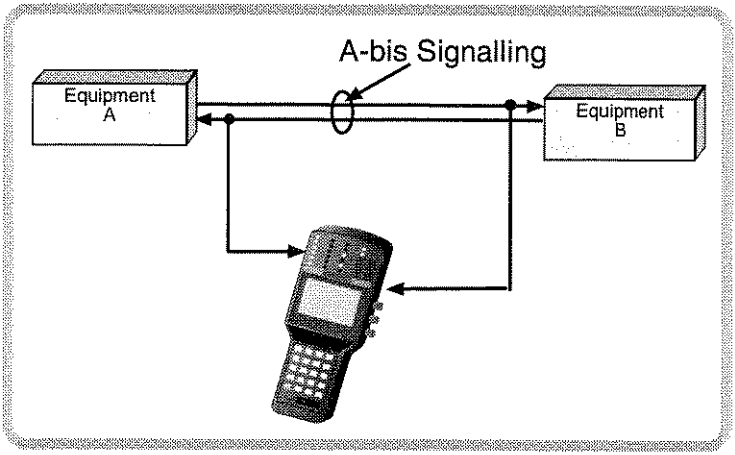


Figure 39 A-bis Monitoring

A. Press the LED key to turn off any blinking lights.

5. Enter the CAPTURE TRACES feature.
   A. Observe the live passage of traces in both directions. See the next sample figure:

```
                                07:12:01
            CAPTURE TRACES


L2 02-04-14 10:59:27:415 #00349
N(R): 80     N(S):21
SAPI: 3C     TEI: 55
LAYR2 TYPE: I
 2C D5 59 DF D4 E3 48 CE BE C9
 6D 49 63 73 8F 0B BC 23 59 E1
 BC DB 7F 00 80 08 80 EC 98 2E
 E6 D9 BB 78 BB 33 9B 93 DB 95
 9D CA ED CA F1 C6 C3 84 7A ...

 START  DECODE  FILTER  MORE
```

Figure 40 Sample A-bis Monitor Traces Screen

Note that the ellipsis indicates more results are available. To see them, press MORE (F4), then PAGE-DN (F2).

6. Press FILTER (F3) if you want to apply filters to the captured messages. You will enter the FILTER SETUP screen:

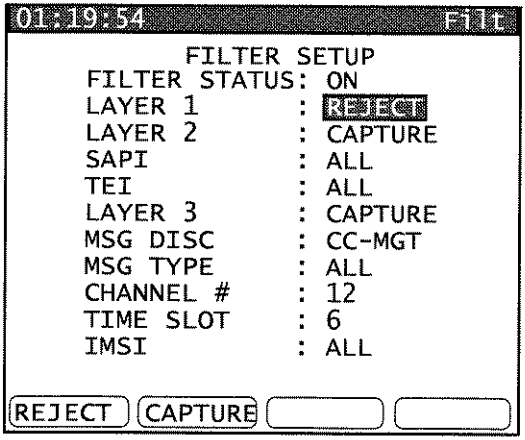


Figure 41 Filter Setup Screen

   A. Configure the filters as desired.
   B. Press ENTER when you are done. You will return to the CAPTURE TRACES screen. Traces will now be captured according to your FILTER settings. A 'FILTER' (or 'Filt') message will appear at the top of the screen.

7. Press STOP (F1) if you want to halt the capturing of live data. You may then use the PAGE-UP (F1) and PAGE-DN (F2) keys to scroll through the trace. Press SAVE (more, F3) if you want to save the trace. You will enter the SAVE TRACES screen where you may give the trace a label to be saved under in the VIEW/PRINT/SAVE TRACES screen. See the *Save a Trace* in *Section 2.2.3* for instructions if necessary.

6.1 GSM Network Architecture

GSM, Global System for Mobile communication, is governed by ETSI transmission standards. GSM technology uses a digital standard for voice and data applications. Figure 42 shows the different parts of a GSM network.

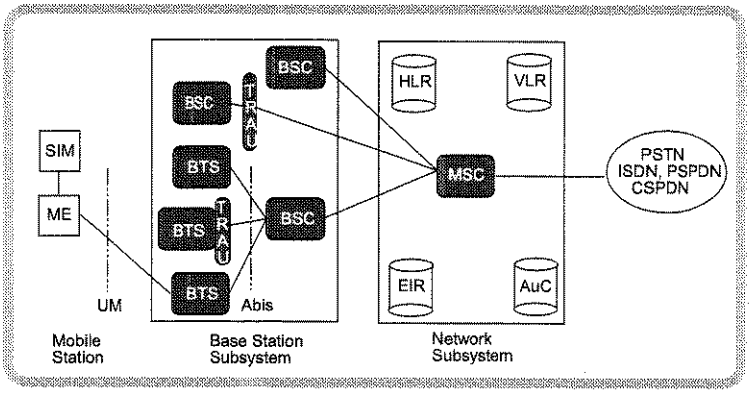


Figure 42 GSM Network

The three major components of a GSM network are the Mobile Station (MS), Base Station Subsystem (BSS), and Network Subsystem. This GSM network is then connected to a fixed network like the Public Switched Telephone Network (PSTN).

A Mobile Station (MS) consists of a Mobile Equipment (ME) and a Subscriber Identity Module (SIM). The SIM is physically a smart card which identifies the subscriber to the GSM network. It also authenticates and encrypts a subscriber's voice, identified by the International Mobile Subscriber Identity (IMSI). Once a SIM card is inserted to a GSM terminal, or Mobile Equipment (ME), it becomes a Mobile Station (MS). Like the SIM, the ME can also be identified using the International Mobile Equipment Identity (IMEI).

While a subscriber roams or is stationary, the Mobile Station transmits a radio signal to one of the many Base Transceiver Station (BTS). These rugged, compact BTS cells are equipped with radio transceivers to send and receive signals using a radio-link protocol via a Um interface.

The BTSs are in turn managed by a Base Station Controller (BSC). Using the A-bis interface, the BSC handles radio-channel setup, frequency hopping for security measures, and handovers. In some instances a Transcoder Rate Adaption Unit (TRAU) is placed at a BTS to perform transcoding between 64 kbit/s A-law speech and 13 kbit/s RPELTP speech. The TRAU may also be located at or in conjunction with the BSC. The BSC then connects the Mobile Station to the Mobile Switching Center (MSC) using the A-interface.

Using four registers, the Mobile Switching Center (MSC) handles subscriber registration, authentication, location updates, handovers, and call roaming. The Home Location Register (HLR) is the central database for all subscribers holding identity of the subscriber, services accessible to the subscriber, and current location of the Mobile Station. Given a Mobile Subscriber ISDN (MSISDN) number, a call can be routed by looking up the corresponding IMSI found in the HLR.

The Visitor's Location Register (VLR) contains information about all Mobile Stations within the area served by the MSC. Information such as the Mobile Station's identity, the area in which it was last registered, additional information pertaining to the subscriber, and any supplementary services available are found in the VLR.

A MSC refers to the VLR each time a Mobile Station receives or makes a call. A security register called the Authentication Centre (AUC) validates a SIM and performs complex mathematical calculation on the same secret information stored in SIM. Another security register is the Equipment Identity Register (EIR). Using a list of three categories, the EIR ensures that all ME's being used are valid and authorized to function on the Public Land Mobile Network (PLMN). Together, the MSC, HLR, VLR, AUC, and EIR make up the Network Subsystem that connects the GSM network to a fixed network.

6.2 GSM Radio Transmission

At the physical layer, Mobile Stations and Base Station Subsytems use a combination of Frequency-Division Multiple Access (FDMA) and Time-Division Multiple Access (TDMA) to send information. The 890—915 Mhz range is used for uplink transmission from MS to BSS and the 935—960 Mhz range for downlink from BSS to MS transmission.

Each 25 Mhz bandwidth is divided into 124 carrier frequencies spaced 200 Khz with one or more carrier frequency allocated to each base station. A GSM Traffic Channel TCH multiframe comprises of 26 TDMA frames as shown in Figure 43, GSM Framing.

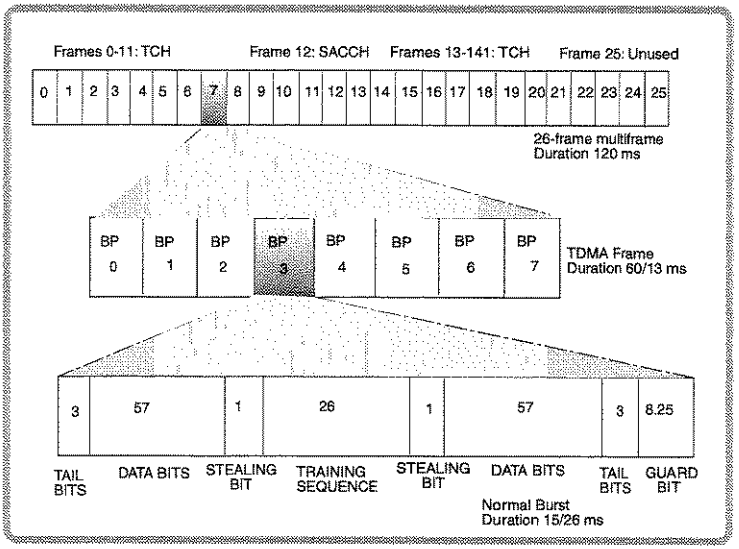


Figure 43 GSM Framing

Traffic Channels (TCH), used to carry speech and data, represent frames 0-11 and 13-24. Frame 12 is occupied by the Slow Associated Control Channel (SACCH) used for radio-signal measurement. Frame 25 is set to idle.

Each TDMA frame consists of eight Burst Periods (BP) lasting approximately 0.577 ms. A normal burst consists of two 57 bits of information, 26 bits Training Sequence for equalization, 1 stealing bit for each information block used for the Fast Associated Control Channel (FACCH) for handover purposes, 3 tail bits at each end, and an 8.25 bit guard sequence.

In addition to TCHs, there are Control Channels (CCH) framed in a 51 TDMA format. The following table lists the different types of CCH or common control channels and their functions.

Broadcast Control CHannel (BCCH)	Downlinks info., e.g. base station id, frequency allocation, & frequency hopping sequences.
Frequency Correction CHannel (FCCH)	Synchronizes TS structure
Synchronization CHannel (SCH)	Synchronizes TS structure
Random Access CHannel (RACH)	Uplinks requests for access to GSM network
Paging CHannel (PCH)	Downlinks alert signal to MS for use
Access Grant CHannel (AGCH)	Downlinks access to use network using a Stand-alone Dedicated Control Channel (SDCHH)

Figure 44 CCH Functions

6.3 GSM Protocol

The GSM signalling protocol uses a combination of GSM, modified ISDN, and SS7 standards between the Um, Abis, and A interfaces. Figure 45, GSM Signalling Protocol, shows the different standards that govern the physical, data link, and network layers of GSM.

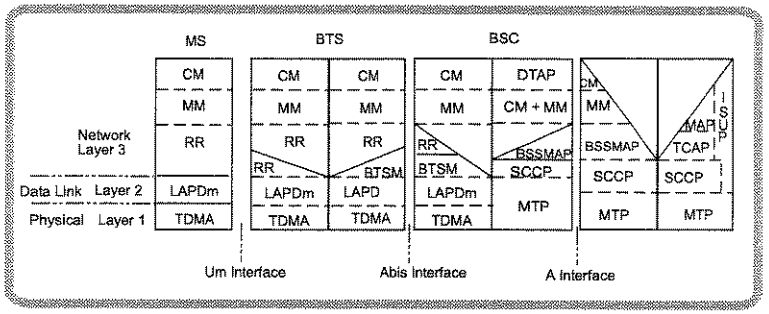


Figure 45 GSM Signalling Protocol

As seen, TDMA frames are sent at the physical layer between the Mobile Station and the Base Transceiver Station via the Um interface. At the Data Link Layer, a modified version of the Link Access Protocol-D channel (LAPD-m) is used. Layer 3 GSM Signalling protocol includes the Call Management (CM), Mobility Management (MM), and Radio Resource Management (RR). A table of these protocols and functions is shown in the next figure.

Call Management (CM)	Handles Call Control (CC), Supplementary Services, & Short Message Services (SMS)
Mobility Management (MM)	Manages roaming update, registration, security, & authorization
Radio Resources (RR)	Controls setup, maintenance, & termination of radio & fixed channels

Figure 46 Layer 3 Protocols

The GSM signalling protocols, CM, MM, and RR, are passed through the BTS transparently and via the A-bis interface. However, in some cases, RR messages are mapped directly to the BTS Management (BTSM) protocol which handles major BTS functions, such as paging.

At the A-bis interface, the Link Access Protocol-D channel is used for transferring signalling through the data link. The BSC uses the BTSM protocol and RR to control signals. RR then gets mapped to the BSS Management Application Part (BSSMAP).

Again at Layer 3, CM and MM pass transparently through the BSC with the BSC using the Direct Transfer Application Part (DTAP) to transfer both the CM and MM via the A interface.

Sending information through the A interface, the BSC uses the Message Transfer Part (MTP) and the Signalling Connection Control Part (SCCP) of Signalling System 7 (SS7). On top of the SCCP are the BSSMAP, MM, and CM.

Between MSCs, the MTP of SS7 sends both ISUP and TUP messages dealing with circuit related information. Also, the MTP, SCCP, Transaction Capability Application Part (TCAP) are used by the SS7 Mobile Application Part (MAP) which transfer information such as authentication, location, security, and handover procedures for an MSC.

6.4 TRAU Frames

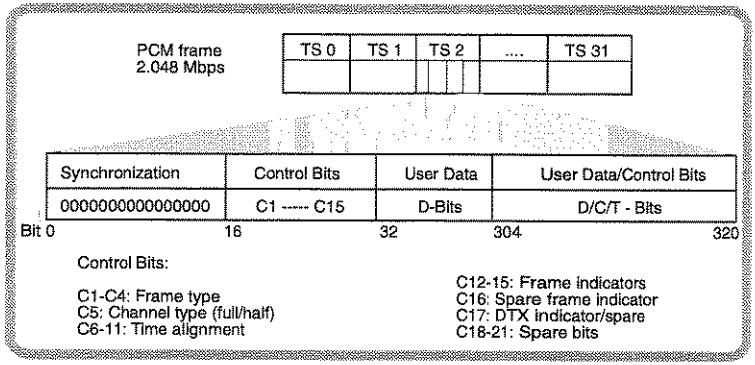


Figure 47 16 kbit TRAU Frame

The 64 kbit/s timeslots are divided into four 16 kbit/s subchannels. Each devotes 13 kbit/s to voice, with 3 kbit/s remaining for spare bits. A Transcoder and Rate Adaption Unit (TRAU) does the required transcoding between the 64 kbit/s and 16 kbit/s channels. A TRAU may be located at the BTS, BSC or MSC. If located outside the BTS, the TRAU can be controlled by in-band signalling, using some of the spare bits.

A TRAU frame, containing 320 bits, is used to send signals between the BSC and the TRAU. Its use is mandatory when the A-bis interface is applied. See Figure 47. The specific C-bit coding for speech frames is shown in Figure 48.

Speech Frame Coding

Bit	Uplink	Downlink
C1-C5 (FR) (EFR)	00010(speech) 11010(speech)	11100 11010
C6-C11 (Time Align.)	000000 No change in timing 000001 1x500µs delay 000010 2x500µs delay 100111 39x500µs delay 101000 Not used 111101 Not used 111110 1x250µs delay 111111 250µs advance	
C12-16 (Frame Ind.) C12	 0: BFI=0 1: BFI=1	 Spare Spare
C13&C14 (DTX Indicator)	C13 0 C14 0	Spare
	C13 0 C14 0 SID=0 C13 0 C14 1 SID=1 C13 1 SID=2 C14 0	C12-C15 Spare IF FR, Speech ELSE C12:UFE 0:UFE=0; bad uplink 1:UFE=1 good uplink
C15	0 TAF=0 1 TAF=0	C13-C15 Spare
C16	Spare	0 SP=0 1 SP=1
C17 (DTX Indicator)	0 DTX=no 1 DTX=yes	Spare
C18-C21	Spare	Spare

BFI: Bad FrameIndicator DTX: Discontinuous Trans.
SID: Silence Descriptor SP: Speech Indicator
TAF: Time Alignment Flag

Figure 48 TRAU Speech C-bit Coding

6.5 GPRS

GPRS, General Packet Radio Service, is known as the 2.5 Generation wireless system. It is also known as GSM-IP. GPRS deploys Packet Switched Technology in order to deliver bursty data over an existing GSM or Frame Relay network. Users are always on-line, and may make voice and data calls at the same time (depending on the phone).

In theory, the data rate of a GPRS phone is up to 171.2 kbit/s over GSM 8 timeslots. In practice, many mobiles share the bandwidth and the GPRS phase 1 mobile will support only two or three timeslots on the air interface. The initial data rate in GPRS phase 1 is expected at 28 kbit/s. Figure 49 gives an overview of the GPRS network and testing.

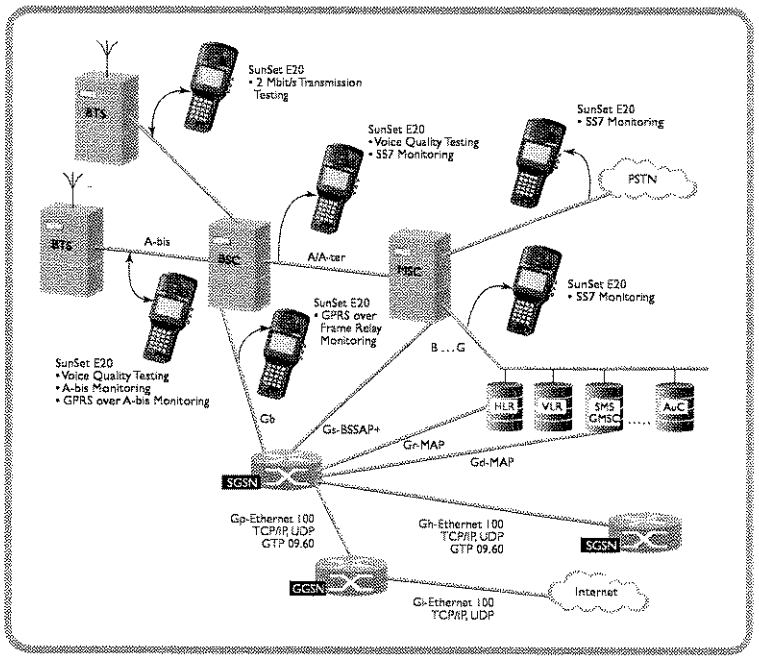


Figure 49 GPRS Network

There are two main GPRS elements over the GSM network, SGSN and GGSN.

Servicing GPRS Support Node (SGSN)

SGSN controls all aspects of connection between the network and Mobile Station by providing:

- Session Management
- Authentication and Mobility Management: handover
- Connect to VLR (Visitor's Location Register) using Gs based on BSSAP+ (Base Station Subsystem Application Part)

Gateway GPRS Support Node (GGSN)

GGSN provides the following functions:

- Counts the number of packets for billing purposes
- Gateway to PDN (Public Data Network): authentication and location management function
- Firewall

Packet Control Unit (PCU)

PCU locates at Base Station Controller (BSC) to convert packet data into a radio format that can be transferred over the air interface.

- Radio Resource Management
- Quality of Service (throughput, delay, reliability, priority)

Packet Data Protocol (PDP)

PDP opens a session for a mobile to request a temporary IP address (supporting IPv4 32-bit addressing).

GPRS Gb Protocol Stack

Layer 1: Frame Relay Forum FRF 1.1
Layer 2: Network Service
Layer 3: BSSGP (Base Station System GPRS Protocol)
Layer 4, 5: LLC (Logical Link Control)
Layer 7: SNDCP (Subnetwork Dependent Convergence Protocol)

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