Global System for Mobile Communications (GSM)
What is GSM?

- Global System for Mobile (GSM) is a second generation cellular standard developed to cater voice services and data delivery using digital modulation.
What is GSM?

Based on ETSI standards

- GSM is a digital system with an over-the-air bit rate of 270 kbps. The frequency range is 1,850 to 1,990 MHz (mobile station to base station)

- GSM utilizes the time or frequency division multiple access (TDMA / FDMA) concept

- GSM uses Gaussian minimum shift keying (GMSK)

- GSM specifications follow the stipulations for the bottom three layers (physical, data link, & network layers) of the OSI model.
Advantages of GSM over Analog System

• Capacity increases
• Reduced RF transmission power and longer battery life
• International roaming capability
• Better security against fraud (through terminal validation and user authentication)
• Encryption capability for information security and privacy
• Compatibility with ISDN, leading to wider range of services
GSM Specifications

• **GSM 900**
  - Mobile to BTS (uplink): 890-915 Mhz
  - BTS to Mobile(downlink): 935-960 Mhz
  - Bandwidth: 2* 25 Mhz

• **GSM 1800**
  - Mobile to BTS (uplink): 1710-1785 Mhz
  - BTS to Mobile(downlink): 1805-1880 Mhz
  - Bandwidth: 2* 75 Mhz
  - PCS 1900 or DCS 1900
  - The only frequency used in the United States and Canada for GSM
GSM System Architecture

• Network Switching Subsystem (NSS) – Its main components include:
  ➢ Mobile Switching Center (MSC)
  ➢ Home Location Register (HLR)
  ➢ Visitor Location Register (VLR)
  ➢ Authentication Center (AUC)
  ➢ Equipment Identity Register (EIR)

• Base Station Subsystem (BSS) – Its main components include:
  ➢ Base Transceiver Station (BTS)
  ➢ Base Station Controller (BSC)

• Mobile Station (MS) – Its main components include:
  ➢ Mobile Equipment (ME)
  ➢ Subscriber Identity Module (SIM)

• Operation SubSystem (OSS) – Its main components include:
  ➢ Operations and maintenance center (OMC)
  ➢ network management center (NMC)
  ➢ administration center (ADC)
GSM System Architecture

UMTS
- Mobile Station
  - Node B
- Mobile Station
  - Node B

GSM
- Mobile Station
  - BTS
  - BSC
  - MSC/VLR
  - GMSC

Umts
- RNC
- SGSN
- HSS (HLR/AuC)
- GGSN

GSM
- RNC
- SGSN
- HSS (HLR/AuC)

GL's TRAU, GPRS, GSM, UMTS Analyzer
GL's MAPS™ GSM A, GSM Abis, GSMA over IP, MAP, MAP over IP Emulators

GL Communications Inc.
T1 E1 Analyzer Hardware Platforms

- Dual T1 E1 Express (PCIe) Board
- Quad / Octal T1 E1 PCIe Card
- Dual HD Universal T1 E1 PCI Card
- 16-Port T1 E1 Breakout-Box
- PCIe Board
- tProbe™ - Portable USB based T1 E1 VF FXO FXS and Serial Datacom Analyzer
- Portable USB based Dual T1 E1 Analyzer Unit
Base Station Subsystem (BSS)

• **Base Transceiver Station (BTS)**
  - Encodes, encrypts, multiplexes, modulates and feeds the RF signals to the antenna.
  - Frequency hopping
  - Communicates with Mobile station and BSC
  - Consists of Transceivers (TRX) units

• **Base Station Controller (BSC)**
  - Manages Radio resources for BTS
  - Assigns Frequency and time slots for all MS’s in its area
  - Handles call set up
  - Transcoding and rate adaptation functionality
  - Handover for each MS
  - Radio Power control
  - It communicates with MSC and BTS
Network Switching Subsystem (NSS)

• Carries out switching functions and manages the communications between mobile phones and the PSTN.
• Allows mobile phones to communicate with each other.
• Includes the following elements –

➢ Mobile Switching Center (MSC) –
  – Capable of receiving a short message from a Service Center (SC),
  – Interrogating an HLR for routing information and message waiting data, and delivering the short message to the MSC of the receiving MS.

➢ Home Location Registers (HLR) –
  – Connection of mobile subscribers and definition of corresponding subscriber data.
  – Maintenance of a database of mobile subscribers and corresponding subscriber data.
  – Subscription to basic services.
  – Registration/deletion of supplementary services.
  – Activation/deactivation of supplementary services
Network Switching Subsystem (NSS)...

- Visitor Location Registers (VLR) –
  - Functions for setting up and controlling calls, including supplementary services.
  - Functions for handling speech path continuity for moving subscribers (handover).
  - Functions for updating mobile subscribers’ location (location updating and location canceling) in the different location registers.
  - Functions for updating mobile subscriber data.

- Authentication Center (AUC) -
  - a RANDom number (RAND)
  - a Signed RESponse (SRES)
  - a Ciphering Key (Kc)
    - generates user specific authentication parameters on request of a VLR authentication parameters used for authentication of mobile terminals and encryption of user data on the air interface within the GSM system

- Equipment Identity Register (EIR)
  - registers GSM mobile stations and user rights stolen or malfunctioning mobile stations can be locked and sometimes even localized
GSM Signaling Interfaces

• Um - Air interface used for exchanges between a MS and a BSS

• Abis - Abis interface allows control of the radio equipment and radio frequency allocation in the BTS.

• A - A interface is between the BSS and the MSC. The A interface manages the allocation of suitable radio resources to the MSs and mobility management.

• B - The B interface between the MSC and the VLR uses the MAP/B protocol. Most MSCs are associated with a VLR, making the B interface "internal".

• C - The C interface is between the HLR and a GMSC or a SMS-G. MAP/C protocol over the C interface is used to obtain the routing information required to complete the call.
Interfaces...

• D - The D interface is between the VLR and HLR, and uses the MAP/D protocol to exchange the data related to the location of the MS and to the management of the subscriber.

• E - The E interface interconnects two MSCs. The E interface exchanges data related to handover between the anchor and relay MSCs using the MAP/E protocol.

• F - The F interface connects the MSC to the EIR, and uses the MAP/F protocol to verify the status of the IMEI that the MSC has retrieved from the MS.

• G - The G interface interconnects two VLRs of different MSCs and uses the MAP/G protocol to transfer subscriber information, during e.g. a location update procedure.

• H - The H interface is between the MSC and the SMS-G, and uses the MAP/H protocol to support the transfer of short messages.

• I - The I interface (not shown in Figure 1) is the interface between the MSC and the MS. Messages exchanged over the I interface are relayed transparently through the BSS.
Comparing GSM layers with OSI model

<table>
<thead>
<tr>
<th>OSI model</th>
<th>Application in GSM</th>
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<tr>
<td>7 Application</td>
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<td>6 Presentation</td>
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<td>2 Data Link</td>
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<td>1 Physical</td>
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</table>

Tasks of User:
- Call Control
- Mobility Management
- Radio Resource Management

Tasks of Fixed Network:
- Block Building and Concatenation of Messages
- Acknowledgement Code

Tasks of GSM Network:
- Error Protection Coding
- Channel Coding
- Modulation
GSM Protocol Layers for Signaling

- CM – Connection Management
- MM – Mobility Management
- RR – Radio Resource Management
- LAPDm – Link Access Protocol D-Channel Modified
- BSSMAP Base Station Subsystem Mobile Application Part
Logical Channels

LOGICAL CHANNELS

Traffic

Speech

- Full Rate
  - Bm 22.8 kb/s

Data

- Half Rate
  - Lm 11.4 kb/s

SIGNALING

- BROADCAST
  - BCCH
  - SCH
  - FCCH

- COMMON CONTROL
  - PCH

- DEDICATED CONTROL
  - RACH
  - AGCH
  - SDCCH
  - SACCH
  - FACCH

FCCH — FREQUENCY CORRECTION CHANNEL
SCH — SYNCHRONISATION CHANNEL
BCCH — BROADCAST CONTROL CHANNEL
PCH — PAGING CHANNEL
RACH — RANDOM ACCESS CHANNEL
AGCH — ACCESS GRANTED CHANNEL
SDCCH — STAND ALONE DEDICATED CONTROL CHANNEL
SACCH — SLOW ASSOCIATED CONTROL CHANNEL
FACCH — FAST ASSOCIATED CONTROL CHANNEL

GL Communications Inc.
GSM Services

• Tele-services Telecommunication services that enable voice communication, fax transmission via mobile phones
  ➢ Offered services - Mobile telephony, Emergency calling

• Bearer or Data Services Include various data services for information transfer between GSM and other networks like PSTN, ISDN etc at rates from 300 to 9600 bps
  ➢ Offered services - Short Message Service (SMS), Unified Messaging Services(UMS), Group 3 fax, Voice mailbox, Electronic mail.

• Supplementary Service
  ➢ Call related services - Call Waiting, Call Hold, Call Barring, Call Forwarding, Multi Party Call Conferencing, CLIP, CLIR, CUG.
GSM Operation

Speech coding

Channel Coding

Interleaving

Burst Formatting

Ciphering

Modulation

Speech decoding

Channel decoding

De-interleaving

Burst Formatting

De-ciphering

Demodulation

Speech

13 Kbps

22.8 Kbps

22.8 Kbps

33.6 Kbps

33.6 Kbps

Radio Interface

270.83 Kbps
Message Format

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**Figure 1.4(a)** Format for messages over the Air-Interface (LAPDm, GSM 04.08).

- Shows direction
- LAPDm message type (Layer 2) from GSM 04.06/04.07
- Sublayer of Layer 3 to which this message belongs (CC, MM, RR)
- Message type as defined by GSM 04.08
- Most important parameters within the message

**Figure 1.4(b)** Format for messages over the Abis-Interface (LAPD, GSM 08.58).

- Shows direction
- LAPD message type (e.g., O frame, SABM frame, UA frame)
- Abis message type (RLM = Radio link management, CCM = Common channel management, DCM = Dedicated channel management)
- Abis message type as defined in GSM 08.58
- GSM 04.08 message from/to the Air-Interface (optional)
- Most important parameters of a message

**Figure 1.4(c)** Format for messages over the A-interface [SS7, Signaling connection control part (SCCP), GSM 08.06, GSM 08.08].

- Shows direction
- SCCP message type
- BSS transparency indicator (DTAP = transparent, BSSM = not transparent)
- GSM 08.08 message type (only for BSSM)
- Most important parameter of the GSM 08.08 message
- Transported GSM 04.08 message (optional)
Figure 1.4(c) Format for messages over the A-interface [SS7, signaling connection control part (SCCP), GSM 03.06, GSM 08.08].

- Shows direction
- SCCP message type (always UDT)
- TCAP message type as defined in ITU Q.773
- MAP Local Operation Code (from GSM 09.02)

Figure 1.4(e) Format for ISUP messages between MSCs and toward the Integrated Services Digital Network (ISDN) [SS7 and the ISDN user part (ISUP)].

- Shows direction
- User part = ISUP from ITU Q.703, Q.764
- Abbreviated ISUP message type
- Whole name of ISUP message type
Mobile Application Part (MAP) Signaling for GSM and UMTS Networks

- The components in the MSCs such as HLR, AuC, EIR, and the VLR are interconnected by MAP signaling.
- MAP uses Signaling System No. 7 (SS7) as carrier and provide services to mobile phone users such as roaming, call handling, non-interruptive handover, and more.
Mobile Application Part (MAP) Signaling...

• Some of the GSM/UMTS Circuit Switched interfaces transported over SS7 using MAP signaling are:
  ➢ B -> MSC to VLR
  ➢ C -> MSC to HLR
  ➢ D -> VLR to HLR
  ➢ E -> Inter-MSC handover
  ➢ F -> MSC to EIR

• There are also several GSM/UMTS PS interfaces transported over SS7 using MAP signaling:
  ➢ Gr -> SGSN to HLR
  ➢ Gd -> SGSN to SMS-C
  ➢ Gc -> GGSN to HLR
  ➢ Gf -> SGSN to EIR
The Mobile Application Part (MAP) is the application-layer protocol that resides on top of the SS7 protocol stack, and is carried within Transaction Capabilities Application Part (TCAP) messages.
GL's GSM Protocol Analysis and Simulation
GL's GSM Analyzer
Key Features

• Monitor GSM network real-time, offline, as well as remote

• Multiple streams of GSM traffic on various T1/E1 channels can be simultaneously decoded with different GUI instances

  ➢ Displays Summary, Detail, Hex-Dump, Statistics, and Call Detail View

• Any protocol field can be added to the summary view, filtering, and search features providing users more flexibility to monitor required protocol fields.

• Captured frames can later be used for traffic simulation
• Remote monitoring capability using GL's Network Surveillance System

GL Communications Inc.
Protocol Standards

- A Interface - MTP2, MTP3, SCCP, BSSMAP, SMS, MM, & CC
- Abis Interface – LAPD, BTSM, RR, SMS, MM & CC
- Gs Interface – MTP2, MTP3, BSSAP+
- Lb, Ls, Lp Interface – RRLP, BSSLAP, SMLCPP, LLP, BSSAP-LE, SCCP, MTP3, & MTP2
- UP Interface - UMA Protocols , TCP, UDP, IP, &MAC
- Motorola Proprietary Mobis Interface
Call trace defining important call specific parameters such as call ID, status (active or completed), duration, CRV, release complete cause etc are displayed.
Applications

• Can be used as independent standalone units as "probes" integrated in a network surveillance systems
• Triggering, collecting, and filtering for unique subscriber information and relaying such information to a back end processor
• Collecting Call Detail Records (CDR) information for billing
MAPS™ GSM A Emulator
(Testing over T1 E1)
MAPS™ - GSM A Emulator (XX692)

- Scripted GSM A Interface simulation over TDM (E1/T1) using GL’s MAPS™
- Simulates BSC and MSC entities
### Supported Protocol Standards

<table>
<thead>
<tr>
<th>Protocol</th>
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<tr>
<td>SCCP</td>
<td>Q.713, CCITT (ITU-T) Blue Book</td>
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<tr>
<td>MTP3</td>
<td>Q.703, ITU-T Blue Book</td>
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<tr>
<td>BSSMAP/DTAP</td>
<td>3GPP TS 08.08 V8.9.0</td>
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<tr>
<td>MM / CC</td>
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<td>SMS</td>
<td>3GPP TS 03.40 V7.5.0 &amp; 3GPP TS 04.11 V7.1.0 GSM 03.38 version 7.2.0 Release 1998</td>
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</tbody>
</table>
GSM A Mobile Originating Call Flow
GSM A Mobile Terminating Call Flow
Location Updating Call Flow

1. LOCATION UPDATING REQUEST
2. CC Connection Confirm
3. AUTHENTICATION REQUEST
4. AUTHENTICATION RESPONSE
5. IDENTITY REQUEST
6. IDENTITY RESPONSE
7. CIPHER MODE COMMAND
8. CIPHER MODE COMPLETE
9. TMSI REALLOCATION COMMAND
10. TMSI REALLOCATION COMPLETE
11. LOCATION UPDATING ACCEPT
12. CLEAR COMMAND
13. CLEAR COMPLETE
14. RLDS Released
15. RLC Release Complete
16. Service Request
17. Authentication Procedures
18. Identity Procedures
19. Ciphering Mode Settings
20. Connection Release
GSM A Call Generation

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<tr>
<th>Sr</th>
<th>Script Name</th>
<th>Profile</th>
<th>IMSI</th>
<th>Script Execution</th>
<th>Status</th>
<th>Events</th>
<th>Ev.</th>
<th>Result</th>
<th>Total Try</th>
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<td>SCCP Connection Released</td>
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<td>Pass</td>
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<td>Start</td>
<td>SCCP Connection Released</td>
<td>None</td>
<td>Pass</td>
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<td></td>
</tr>
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</table>

**Message Flow Diagram**

- **BSC to MSC**
  - LOCATION UPDATING REQUEST
  - CC connection confirm
  - AUTHENTICATION REQUEST
  - AUTHENTICATION RESPONSE
  - OTHER MODE COMMAND
  - OTHER MODE COMPLETE
  - LOCATION UPDATING ACCEPT

**MSC to BSC**

- **MSC**
  - 18.07.44.0100000
  - 18.07.44.0200000
  - 18.07.44.0300000
  - 18.07.44.0400000

**Higher Layer Data**

- Message Type
- Mandatory Fixed Parameters
- Source Local Reference Parameter
- Source Local Reference Parameter
- Protocol Class Parameter
- Class
- Message Handling (Class 0 and 1 only)
GSM A Call Reception
MAPS™ GSM Abis Emulator
(Testing over T1 E1)
MAPSTM - GSM Abis in the Network

Base Station Subsystem (BSS)

Network Sub System (NSS)

- Scripted GSM Abis Interface simulation over TDM (E1/T1) using MAPSTM
- Simulates BSC and BTS entities

GL Communications Inc.
Supported Protocol Standards

<table>
<thead>
<tr>
<th>Available Standards</th>
<th>Supported Protocols</th>
<th>Standard / Specification Used</th>
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<td>GSM Abis 900</td>
<td>BTSM</td>
<td>3GPP TS 08.58 V6.6.0</td>
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<td>MM</td>
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<td>3GPP TS 04.08 V7.17.0</td>
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<td>CC</td>
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<td>3GPP TS 03.40 V7.5.0 &amp; 3GPP TS 04.11 V7.1.0 GSM 03.38 version 7.2.0 Release 1998</td>
</tr>
</tbody>
</table>
GSM Abis Mobile Originating Call Flow

- Channel Required
- Channel Activation
- Channel Activation ACK
- Immediate Assignment
- CM Service Request (Type Of Mobile Identity)
- Authentication Request
- Authentication Response
- Cipher Mode Command
- Cipher Mode Complete
- Identity Request
- Identity Response
- CM Service Accept
- Setup (Called Number)
- Call Proceeding
- Channel Activation
- Channel Activation Acknowledgement
- Assignment Command
- Assignment Complete
- RF Channel Release

Channel Activation Procedure

MOC Call Procedure

MS
BTS
MOC
BSC
GSM Abis Location Updating Call Flow
GSM Abis Call Generation
GSM Abis Call Reception
MAPS™ - GSMAoIP (GSM A over IP) (PKS137)
• Scripted GSM A simulation over IP using MAPS™
• Simulates BSC or MSC entities
• User-friendly GUI for configuring the SCTP Layer parameters
GSMAoIP Mobile Originating Call Flow

CALL ESTABLISHED / CONVERSATION

DISCONNECT
RELEASE
RELEASE COMPLETE
CLEAR COMMAND
CLEAR COMPLETE
RLEO Released
RLC Release Complete

CALL INITIATION

CALL PROCEEDING
ASSIGNMENT REQUEST
ASSIGNMENT COMPLETE
ALERTING
CONNECT
CONNECT ACKNOWLEDGE

CALL ACCEPTED

CALL CLEARING

SERVICE REQUEST
AUTHENTICATION REQUEST
AUTHENTICATION RESPONSE
IDENTITY REQUEST
IDENTITY RESPONSE
CIPHER MODE COMMAND
CIPHER MODE COMPLETE
TMSI REALLOCATION COMMAND
TMSI REALLOCATION COMPLETE
CM SERVICE ACCEPT
SETUP

USER ALERTING

ASSIGNMENT OF A TRAFFIC CHANNEL

CALL INITIATION

CALL CLEARING

AUTHENTICATION PROCEDURES
IDENTITY PROCEDURES
CIPHERING MODE SETTINGS
GSMAoIP Location Updating Call Flow
GSMoIP Call Generation

[Image of software interface for GSMoIP call generation]

GL Communications Inc.
GSMoIP Call Reception

GL Communications Inc.
GSM Packet Data Analysis (PDA)
Packet Data Analyzer over TDM

- Monitors live TDM networks including capture, analysis, and reporting of every call-in detail. Supported protocols include CAS, ISDN, ISUP, CAMEL, MAP, INAP, and GSM.

**GL's Packet Capture Module**
PacketScan, LightSpeed1000, T1 E1 T3 E3 Analyzer Pods

**GL's Packet Analysis Module**
H.323, LTE, IMS, SIP, MGCP, MEGACO, UMTS, GPRS, GSM A, BICC, CAP, MAP, SIGTRAN
### Main Features

| CDR, Call Flow, Statistics, and Report Generation | - Isolates call specific information for each individual call from the captured data and displays the information in an organized fashion  
- A host of call and message counters gives the user an instantaneous snapshot of the traffic on the network.  
- Pictorial representation of the statistics including ladder diagrams for the calls of various protocols.  
- Ability to export and analyze call detail records of completed calls in CSV file format.  
- These reports can be further fed to DB and accessed using GL's NetSurveyorWeb™ Lite for analysis.  
- Isolates calls, a graphical call flow diagram can be created from a call trace.  
- Filters on CDR information feature is used to search required calls by using “key” as CDR parameters.  
- Event counters on CDR information provides over all count of completed events such as total calls, active calls, completed calls, purged calls, failed calls, calls per second, remaining calls and more.  
- Flexible options are provided to interchange/hide the columns as required. |
| Traffic Recording | - Supports capturing of voice, digits, tones and FAX etc to *.PCM file format. |
| Triggers and Actions | - Filter captures based on protocol parameters such as OPC, DPC or CIC in case of ISUP followed by a set of actions such as save call, send mail, trigger alarm notification etc for the completed calls. |
| Exporting Calls | - Supports saving the selected calls from traffic analyzer into *.HDL, *.PCAP, or *.PCAPNG formats. |

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**GL Communications Inc.**
### Data Link Group

#### GSMA CIC Mapping

**Device Selection**
- East: 1
- West: 2

**Point Codes**
- OPC: 1, 1, 1
- DPC: 2, 2, 2

#### Circuit Group Configuration

- CIC Quantity: 31
- CIC Start: 1
- Timeslot Start: 1

**Skip**
- TS16
- CIC Numbering

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<th>OPC</th>
<th>DPC</th>
<th>CIC Start</th>
<th>CIC Quantity</th>
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<td>4</td>
<td>1</td>
</tr>
<tr>
<td>1.1.1</td>
<td>2.2.2</td>
<td>63</td>
<td>31</td>
<td>5</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>1.1.1</td>
<td>2.2.2</td>
<td>94</td>
<td>31</td>
<td>7</td>
<td>8</td>
<td>1</td>
</tr>
</tbody>
</table>

**Buttons:**
- Add
- Delete
- Delete All

**Close**
Traffic Recording Configurations

Traffic Recording Configuration

File

Traffic Recording

- Recording (Non Segmented)
  - Directory: C:\Program Files\GL Communications Inc\...
  - Record Duration: 0 sec (0 to Record Entire Call Duration)
  - Include Absolute Path in CDR

Segmented Recording

- Directory: C:\Program Files\GL Communications Inc\...
- No. of Segments: 3
- Segment Length: 8 sec

Max Simultaneous Recordings: 200

Create Subfolder Every: 1 min

Activate Close
GSMA Call Summary
### Active Call Graph

#### Packet Data Analyzer - Summary View

<table>
<thead>
<tr>
<th>Call #</th>
<th>Call Type</th>
<th>IMSI</th>
<th>Caller</th>
<th>Callee</th>
<th>Presentation Indicator</th>
<th>Duration</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Location Update</td>
<td>46109650000002002</td>
<td>NA</td>
<td>NA</td>
<td>00:00:07:994</td>
<td>Success</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>MM  SMS</td>
<td>46109650000003002</td>
<td>9483892834</td>
<td>9483892834</td>
<td>00:00:10:781</td>
<td>Success</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>MC  Speech Call</td>
<td>46109650000004002</td>
<td>9483892834</td>
<td>9483892834</td>
<td>00:00:42:025</td>
<td>Success</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>MT  Speech Call</td>
<td>46109650000005002</td>
<td>9483892834</td>
<td>9483892834</td>
<td>00:00:25:785</td>
<td>Success</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>MT  SMS</td>
<td>46109650000006002</td>
<td>9483892834</td>
<td>9483892834</td>
<td>00:00:09:390</td>
<td>Success</td>
<td></td>
</tr>
</tbody>
</table>

#### Active Calls Graph

- **Counters**
  - Total Calls: 5
  - Active Calls: 5
  - Completed Calls: 5
  - Plugged Calls (deleted): 0
  - Failed Calls: 0
  - Calls Per Second: 0
  - Remaining Calls: 5
  - Total Frames: 103
  - Last Frame Processed: 103
  - Total Processed Frames: 103
  - Frames Purged Before Processing: 0
  - Queue Task Decode Decoded: 0

---

**GL Communications Inc.**
## Summary View

### Call Summary

<table>
<thead>
<tr>
<th>Call #</th>
<th>Call type</th>
<th>IMSI</th>
<th>CN</th>
<th>CN</th>
<th>Presentation Indicator</th>
<th>Duration</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>MO SMS</td>
<td>4049560000000002</td>
<td>9486542034</td>
<td>9334114.1785</td>
<td>0</td>
<td>0000010.078</td>
<td>Success</td>
</tr>
<tr>
<td>3</td>
<td>MO Speech Call</td>
<td>4049560000000002</td>
<td>9486542034</td>
<td>924114.1495</td>
<td>0</td>
<td>0000042.025</td>
<td>Success</td>
</tr>
<tr>
<td>4</td>
<td>MT Speech Call</td>
<td>4049560000000002</td>
<td>8667640421</td>
<td>9334114.1785</td>
<td>0</td>
<td>0000025.708</td>
<td>Success</td>
</tr>
<tr>
<td>5</td>
<td>MT SMS</td>
<td>4049560000000002</td>
<td>8667640421</td>
<td>9334114.1785</td>
<td>0</td>
<td>0000009.390</td>
<td>Success</td>
</tr>
</tbody>
</table>

### Column Width

<table>
<thead>
<tr>
<th>TimeStamp</th>
<th>Frame Number</th>
<th>Location Updating Request</th>
<th>Find</th>
</tr>
</thead>
<tbody>
<tr>
<td>00000000</td>
<td>0</td>
<td>CC connection confirm</td>
<td></td>
</tr>
<tr>
<td>00000571</td>
<td>1</td>
<td>Authentication Request</td>
<td></td>
</tr>
<tr>
<td>00000574</td>
<td>2</td>
<td>Authentication Response</td>
<td></td>
</tr>
<tr>
<td>00001349</td>
<td>3</td>
<td>Cipher Mode Request</td>
<td></td>
</tr>
<tr>
<td>00002012</td>
<td>4</td>
<td>Cipher Mode Complete</td>
<td></td>
</tr>
<tr>
<td>00002664</td>
<td>5</td>
<td>Identity Request</td>
<td></td>
</tr>
<tr>
<td>00003323</td>
<td>6</td>
<td>Identity Response</td>
<td></td>
</tr>
<tr>
<td>00003907</td>
<td>7</td>
<td>TMSI Reallocation Command</td>
<td></td>
</tr>
<tr>
<td>0004052</td>
<td>8</td>
<td>TMSI Reallocation Complete</td>
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</table>
### Call Summary - Signaling Parameters

#### Signaling Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Caller</td>
<td>NA</td>
</tr>
<tr>
<td>Called</td>
<td>NA</td>
</tr>
<tr>
<td>Call Status</td>
<td>Terminated</td>
</tr>
<tr>
<td>Call Initiated</td>
<td>2013-05-22 19:10:30.251</td>
</tr>
<tr>
<td>Call Established</td>
<td>2013-05-22 19:10:30.253</td>
</tr>
<tr>
<td>Call Started</td>
<td>2013-05-22 19:10:30.268</td>
</tr>
<tr>
<td>Call Duration</td>
<td>00:00:07.982</td>
</tr>
<tr>
<td>Call Terminated</td>
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<tr>
<td>Call Failure</td>
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<tr>
<td>Total Signaling</td>
<td>15</td>
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</table>

#### Call Log

<table>
<thead>
<tr>
<th>Call Type</th>
<th>DNIS</th>
<th>E164</th>
<th>Caller</th>
<th>Callee</th>
<th>Presentation Indicator</th>
<th>Duration</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location Update</td>
<td>444460000000022</td>
<td>9490139804</td>
<td>9491414851</td>
<td>9491414851</td>
<td>0</td>
<td>00:00:10.751</td>
<td>Success</td>
</tr>
<tr>
<td>MO Search Call</td>
<td>444460000000022</td>
<td>9551234567</td>
<td>9491414851</td>
<td>9491414851</td>
<td>0</td>
<td>00:00:42.025</td>
<td>Success</td>
</tr>
<tr>
<td>MT Speech Call</td>
<td>444460000000022</td>
<td>88676400121</td>
<td>9491414851</td>
<td>9491414851</td>
<td>0</td>
<td>00:00:26.205</td>
<td>Success</td>
</tr>
<tr>
<td>MT SMS</td>
<td>444460000000022</td>
<td>88676400121</td>
<td>9491414851</td>
<td>9491414851</td>
<td>0</td>
<td>00:00:09.300</td>
<td>Success</td>
</tr>
</tbody>
</table>
Triggers and Action Settings
• Allows the users to save the filtered files either in *.HDL, *.PCAP, or *.PCAPNG format.
Audio Recording

- Allows to save the filtered files as voice files in *.wav format.
• With this option, the Packet Data Analyzer sends an e-mail containing useful information about each filtered call.
• With this option, the user can set the alarm type and alarm message for the selected triggering type.
<table>
<thead>
<tr>
<th>Call#</th>
<th>Protocol</th>
<th>Message</th>
<th>Type</th>
<th>Threshold</th>
<th>Value</th>
<th>Caller</th>
<th>Callee</th>
<th>CallId</th>
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<tr>
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<td>Warning</td>
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<td>5552525</td>
<td>5552525</td>
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<td>5552525</td>
<td>5552525</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Call Detail Record (CDR)

- With this option, the Packet Data Analyzer can output call detail records (CDR) in the form of three Comma Separated Value (CSV) files such as Call Side Record, Call Master Record, and Call Events.
Load or Save Configurations
PDA Startup Options

- Allows user to configure start-up tasks which will be started automatically whenever PDA is launched.
- Loads the selected Triggers and Actions profile while invoking PDA.
THANK YOU!