2G, 2.5G GSM GPRS Wireless Lab Simulation

GL Communications Inc.
818 West Diamond Avenue - Third Floor, Gaithersburg, MD 20878
Phone: (301) 670-4784 Fax: (301) 670-9187 Email: info@gl.com
Website: https://www.gl.com

Communications Networks Lab (CNL)

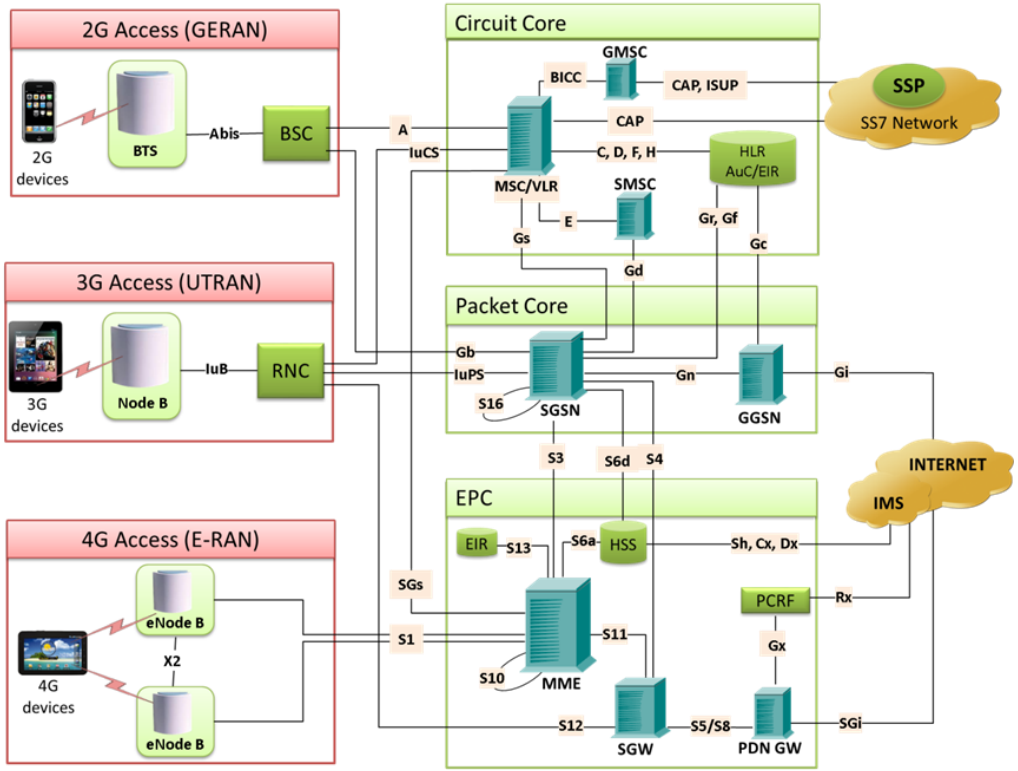
- Each LAB test system emulates all the 2G network elements and traffic types within the Wireless infrastructure
- Provides a base network environment that enables the researchers to test applications, devices, and services prior to deployment on real-time networks

2G 3G 4G Communications Networks

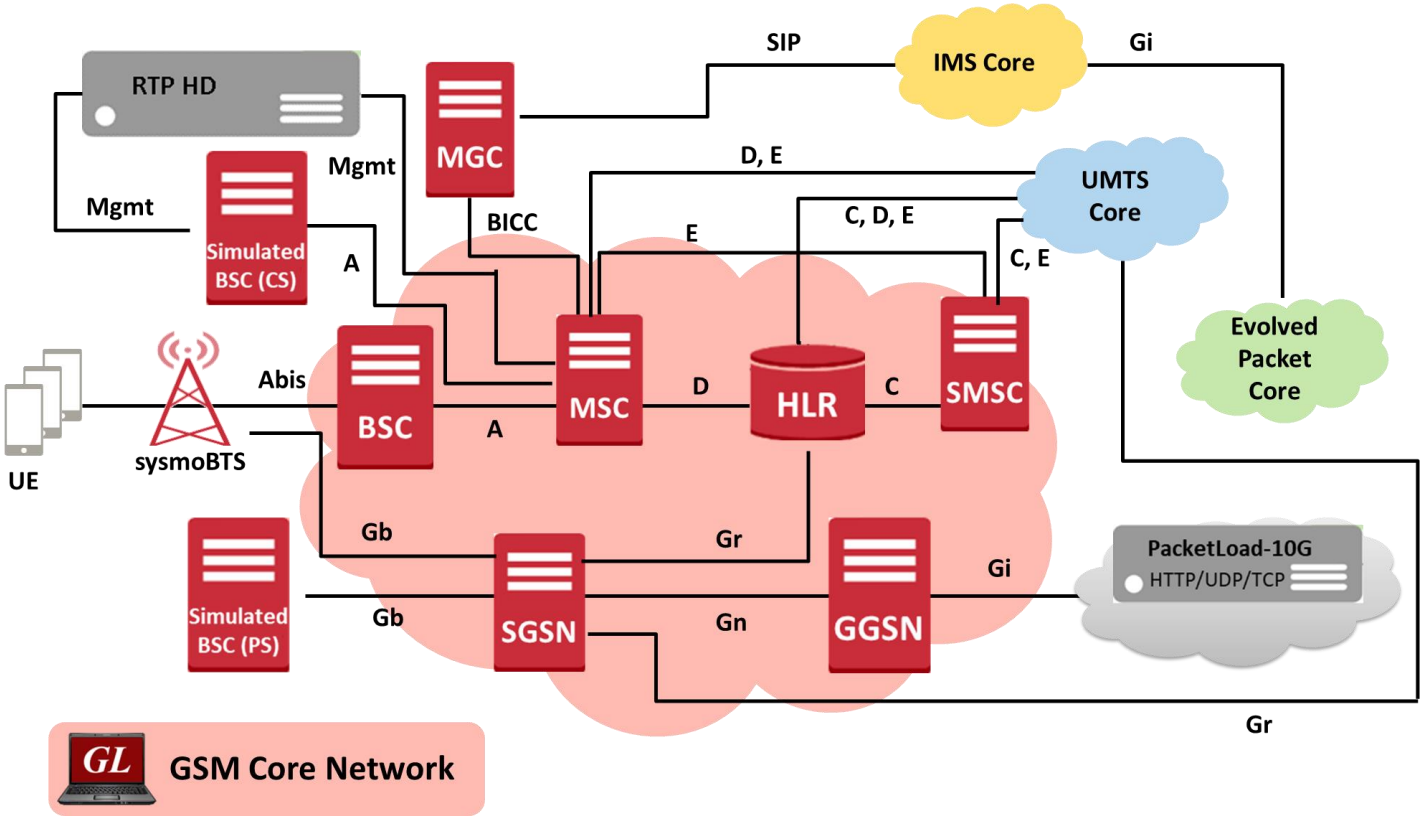
GSM, TDM and TDMA, Core interfaces T1 E1 but now migrating to IP

WCDMA, Same Core network as 2G

LTE, OFDMA, SC-FDMA, All IP

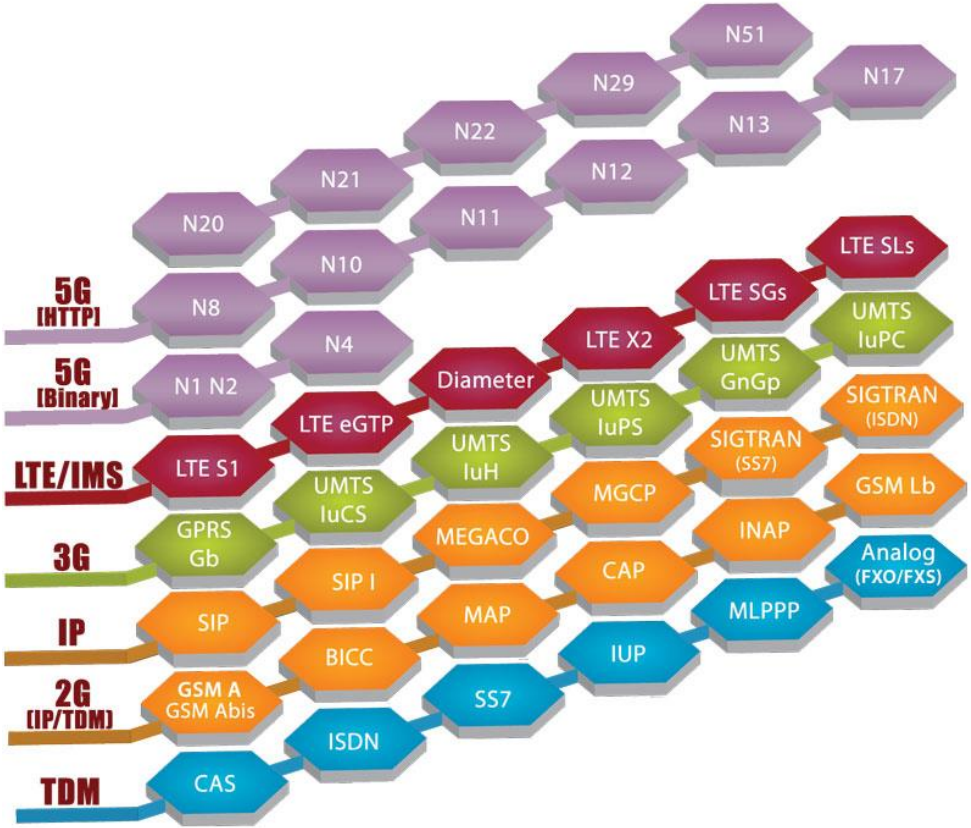


2G Lab Diagram



MAPS™ (Message Automation and Protocol Simulation)

- **Multi-protocol, Multi-technology** Platform
- Simulate any node, and any interface in network with MAPS™ (except Air interface)
- Supports **Emulation, Conformance**, and **Load** testing of a variety of protocols over IP, TDM, and Wireless networks

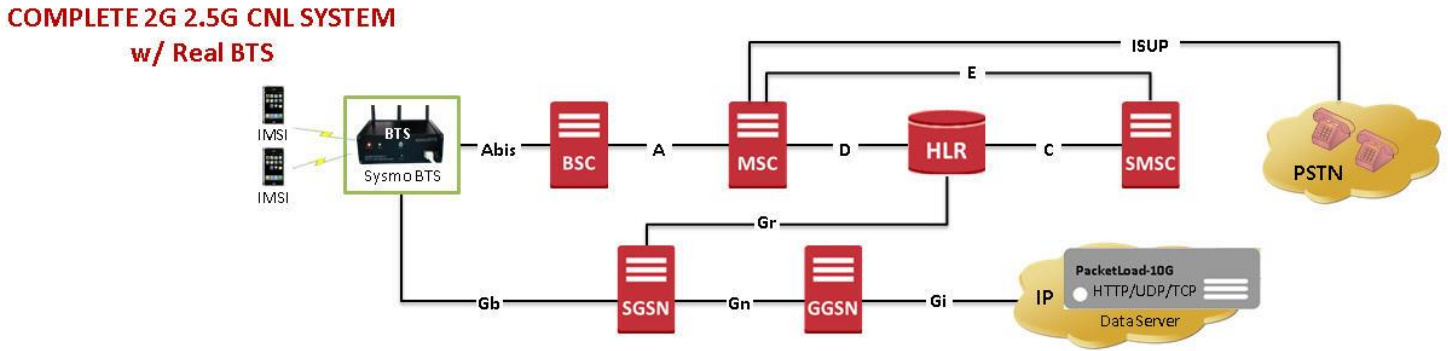


2G Call Scenarios

Various GSM GPRS network procedures are supported simulating the 2G elements and multi-interfaces:

- Mobile-to-Mobile Voice Call (CS)
  - Mobile Originated Call (MOC)
  - Mobile Terminated Call (MTC)
- Simulated UE to mobile voice call (CS)
- Mobile to Simulated UE voice call (CS)
- Simulated UE to simulated UE voice call (CS)
- Mobile-to-Mobile SMS Call (CS)
  - Mobile Originated SMS
  - Mobile Terminated SMS
- Simulated UE to mobile SMS (CS)
- Mobile to simulated UE SMS (CS)
- Mobile Web Browsing (PS)
- Simulated UE web browsing (PS)
  - Attach Procedures
  - Identity Procedures
  - PDP Context Creation, Activation, Update Deactivation and Deletion Procedures
  - Web Browsing GPRS Session
  - Detach Procedures

Complete 2G and 2.5G CNL System w/ Real BTS



Mobile-Mobile

- **Real BTS**
  - Sysmo BTS GSM Cell
  - Mobile Phones
  - SIMs
- **Abis**
  - PKS134 MAPS™ GSM Abis IP
- **A**
  - PKS137 MAPS™ GSM A IP
  - PKS102 RTP Core (only @ MSC)
- **C, D**
  - PKS132 MAPS™ MAP IP
- **High Density Bulk Calling**
  - MAPS High Density RTP Generator

Mobile-SMS CS

- **Real BTS**
  - Sysmo BTS GSM Cell
  - Mobile Phones
  - SIMs
- **Abis**
  - PKS134 MAPS™ GSM Abis IP
- **A**
  - PKS137 MAPS™ GSM A IP
- **C, D, and E**
  - PKS132 MAPS™ MAP IP
- **High Density Bulk Calling**
  - MAPS High Density RTP Generator

Mobile-Landline

- **Real BTS**
  - Sysmo BTS GSM Cell
  - Mobile Phones
  - SIMs
- **Abis**
  - PKS134 MAPS™ GSM Abis IP
- **A**
  - PKS137 MAPS™ GSM A IP
  - PKS102 RTP Core (only @ MSC)
- **C, D**
  - PKS132 MAPS™ MAP IP
- **ISUP**
  - XX649 MAPS™ SS7 TDM with T1 E1 Hardware
  - PKS145 Media Gateway Conversion
- **Analog Simulation**
  - XX624 MAPS ™ FXO FXS tProbe™ T1 E1 Hardware

  Or
  - XX651 MAPS ™ CAS with T1 E1 Hardware and APS

Mobile-Web Browsing

- **Real BTS**
  - Sysmo BTS GSM Cell
  - Mobile Phones
  - SIMs
- **Gb**
  - PKS131 MAPS™ SGSN Multi-Interface
  - ETH102 Mobile Traffic-GW
- **Gn Gp**
  - PKS166 MAPS™ Gn Gp
  - ETH102 Mobile Traffic-GW
- **Gr**
  - PKS132 MAPS™ MAP IP
- **High Density Bulk Calling**
  - PacketLoad 4x10G Data Traffic Generator

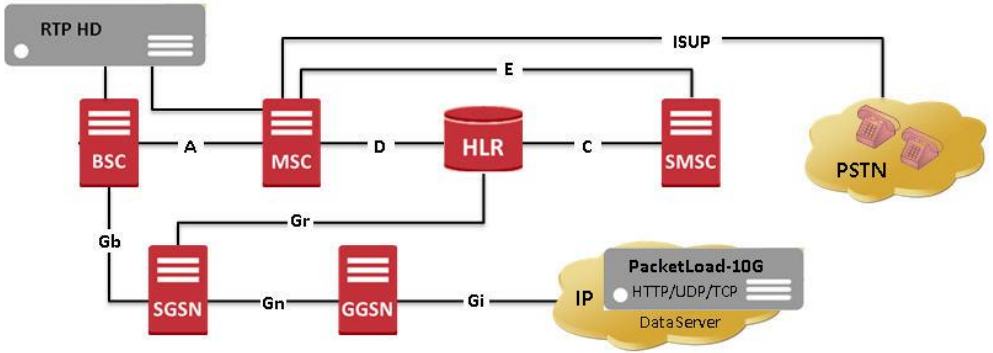
Mobile-SMS PS

- **Real BTS**
  - Sysmo BTS GSM Cell
  - Mobile Phones
  - SIMs
- **Gb**
  - PKS131 MAPS™ SGSN Multi-Interface
- **Gr, Gd**
  - PKS132 MAPS™ MAP IP
- **High Density Bulk Calling**
  - PacketLoad 4x10G Data Traffic Generator

GL Communications

Complete 2G and 2.5G CNL System w/ Simulated BTS

COMPLETE 2G and 2.5G CNL SYSTEM w/ Simulated BTS



Mobile-Mobile

- **Abis**
  - PKS134 MAPS™ GSM Abis IP
- **A**
  - PKS137 MAPS™ GSM A IP
  - PKS102 RTP Core (only @ MSC)
- **C, D**
  - PKS132 MAPS™ MAP IP
- **High Density Bulk Calling**
  - MAPS™ High Density RTP Generator

Mobile-SMS CS

- **Abis**
  - PKS134 MAPS™ GSM Abis IP
- **A**
  - PKS137 MAPS™ GSM A IP
- **C,D, and E**
  - PKS132 MAPS™ MAP IP
- **High Density Bulk Calling**
  - MAPS™ High Density RTP Generator

Mobile-Landline

- **Abis**
  - PKS134 MAPS™ GSM Abis IP
- **A**
  - PKS137 MAPS™ GSM A IP
  - PKS102 RTP Core (only @ MSC)
- **C, D**
  - PKS132 MAPS™ MAP IP
- **ISUP**
  - XX649 MAPS™ SS7 TDM with T1 E1 Hardware
  - PKS145 Media Gateway Conversion
- **Analog Simulation**
  - XX624 MAPS™ FXO FXS tProbe™ T1 E1 Hardware

  Or
  - XX651 MAPS™ CAS with T1 E1 Hardware and APS

Mobile-Web Browsing

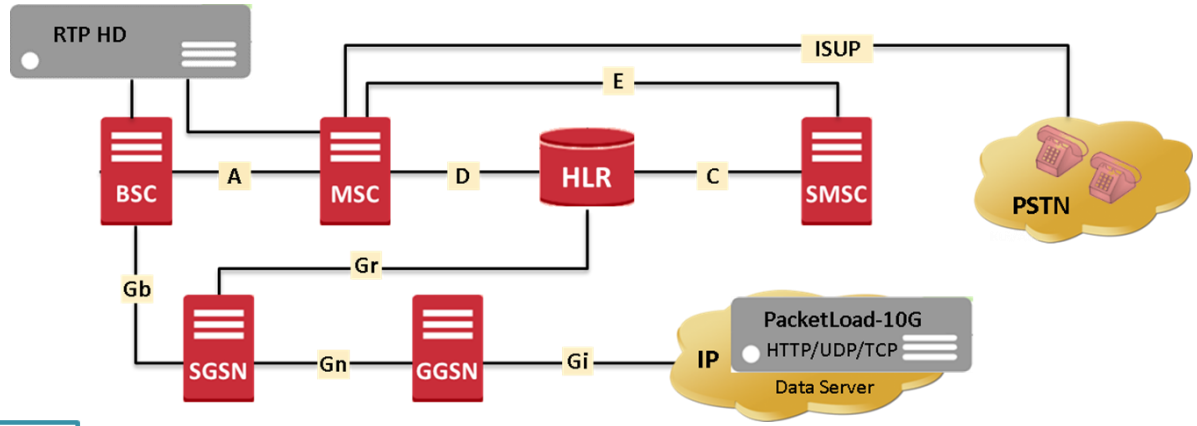
- **Gb**
  - PKS131 MAPS™ GPRS Gb
  - PKS131 MAPS™ SGSN Multi-Interface
  - ETH103 MobileTrafficCore Gb
  - ETH102 MobileTrafficCore GW
- **Gn Gp**
  - PKS166 MAPS™ Gn Gp
  - ETH102 MobileTrafficCore GW
- **Gr**
  - PKS132 MAPS™ MAP IP
- **High Density Bulk Calling**
  - PacketLoad 4x10G Data Traffic Generator

Mobile-SMS PS

- **Gb**
  - PKS131 MAPS™ GPRS Gb
  - PKS131 MAPS™ SGSN Multi-Interface
  - ETH103 MobileTrafficCore Gb
- **Gr, Gd**
  - PKS132 MAPS™ MAP IP
- **High Density Bulk Calling**
  - PacketLoad 4x10G Data Traffic Generator

GL Communications

Protocol Stack Specification



GTP-u	SM
SNDCP	GMM
LLC	
BSSGP	
NS	
Physical Layer	
Gb	

MM | CC | RR | SMS
BTSM
TCP
IP
Abis

CM | MM | RR | SMS
BSSAP
SCCP
M3UA
SCTP
IP
A

MAP	
TCAP	
SCCP	
M3UA	MTP3
	M2PA
SCTP	
IP	
C, D, E, Gr	

GTP-u
GTP
UDP
IP
Gn

ISUP
MTP Level 3
MTP Level 2
MTP Level 1
SS7

Protocol Stack Specification (Contd.)

Supported Protocols	Standard / Specification Used
SCCP	Q.713, CCITT (ITU-T) Blue Book
MTP3	ITU-T Q.704
BSSMAP / DTAP	3GPP TS 08.08 V8.9.0
MM	3GPP TS 04.08 V7.17.0
CC	3GPP TS 04.08 V7.17.0
RR	3GPP TS 04.18 V8.13.0
SMS	3GPP TS 03.40 V7.5.0 & 3GPP TS 04.11 V7.1.0 GSM 03.38 version 7.2.0 Release 1998

Supported Protocols	Standard / Specification Used
MAPR4	3GPP TS 29.002 V4.18.0 (2007-09)
TCAP	ANSI T1.114-1996
SCCP	Q.713, CCITT (ITU-T) Blue Book
MTP3	ITU-T Q.782
M2PA	RFC 4165
M3UA	RFC 3332
SCTP	RFC 4960
GTP	TS 29.060 V9.2.0 (2010-03)

Protocol Stack Specification (Contd.)

Supported Protocols	Standard / Specification Used
BSSGP	3GPP TS 08.18 V8.10.0 (2002-05)
LLC	3GPP TS 04.64 V8.7.0 (2001-12)
NS (Network Service)	GSM 8.16 (ETSI TS 101 299 V8.0.0)
GMM	3GPP 24.008
SMG (GPRS Session Mgmt)	3GPP TS 24.008 V5.16.0 (2006-06) (Release 5)
SNDCP	3GPP TS 04.64 V8.7.0 (2001-12)

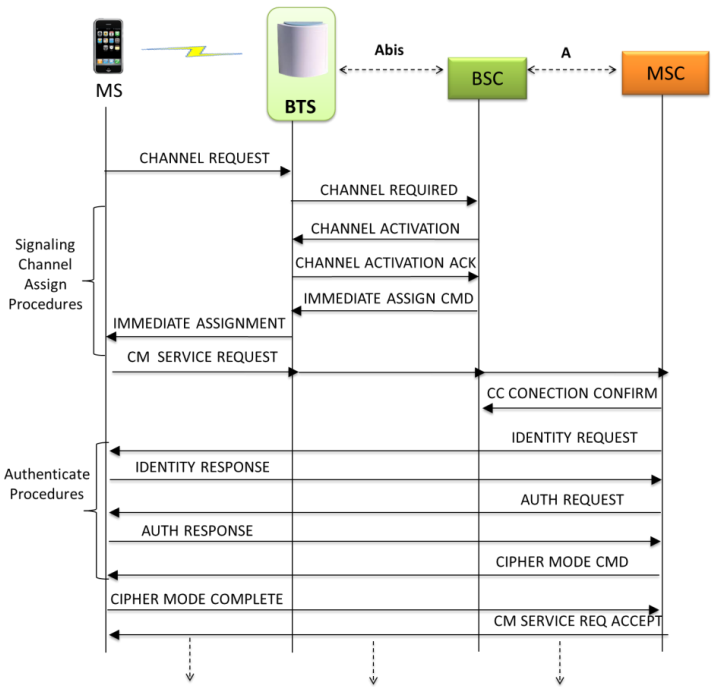
Supported Protocols	Specification Used
SCCP	Q.713, CCITT (ITU-T) Blue Book
SCTP	RFC 4960
TCP	RFC 793
M3UA	RFC 3332
BSSMAP/DTAP	3GPP TS 08.08 V8.9.0, 3GPP TS 48.008 V10.0.0 (2011-01)
MM / CC	3GPP TS 04.08 V7.17.0
RR	3GPP TS 04.18 V8.13.0
SMS	3GPP TS 03.40 V7.5.0 & 3GPP TS 04.11 V7.1.0 GSM 03.38 version 7.2.0 Release 1998

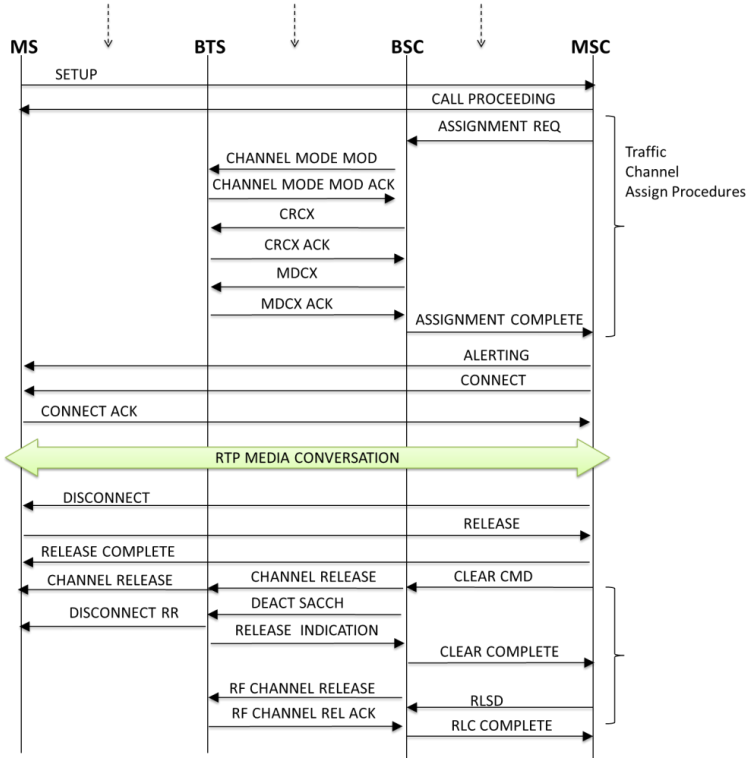
MOBILE-TO-MOBILE VOICE LAB

Procedures

- **Mobile Originated Call (MOC)**
  - CHANNEL REQUEST
  - AUTHENTICATION, CIPHERING, VALDATION
  - CALL SETUP REQUEST
  - ALLOCATING DEDICATED VOICE CHANNEL OVER AIR INTERFACE
- **Mobile Terminated Call (MTC)**
  - PAGING
  - IDENTITY & AUTHENTICATION, CIPHERING
  - LOCATION UPDATE
  - CALL SETUP REQUEST
  - ALLOCATING DEDICATED VOICE CHANNEL OVER AIR INTERFACE
- **Location Update (LU) Call**

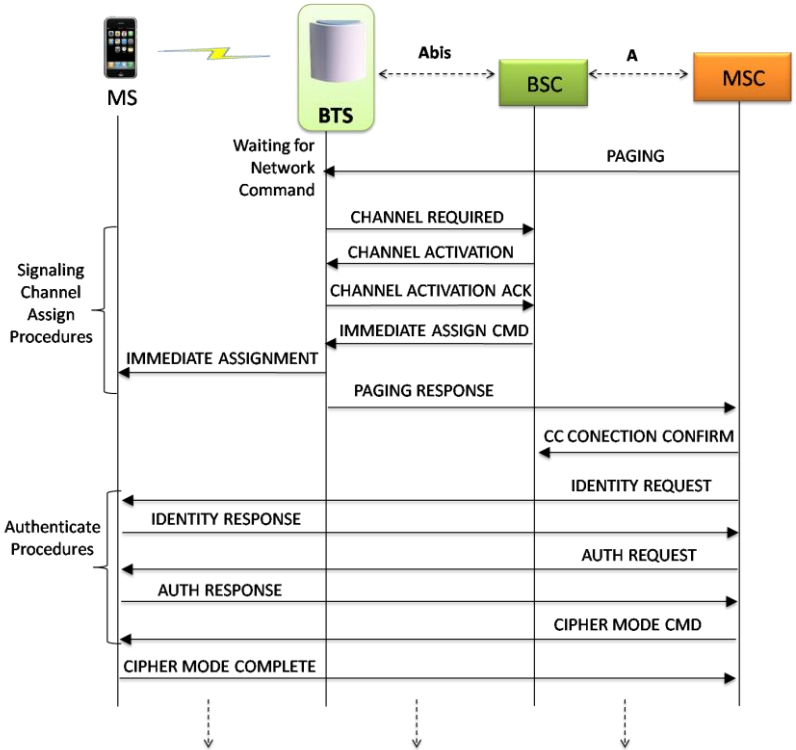
Mobile Originating (MOC) Call Flow

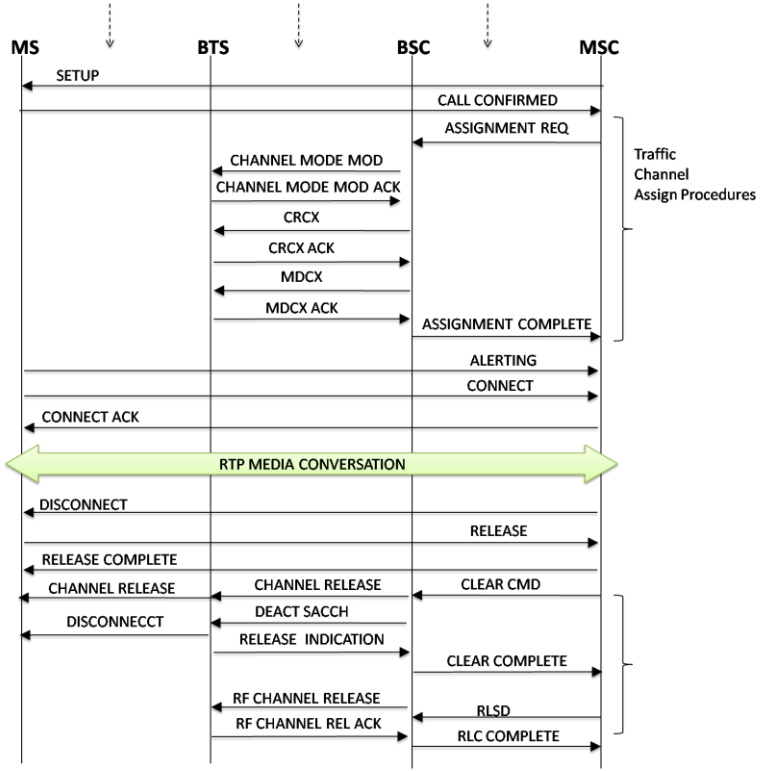




GL Communications

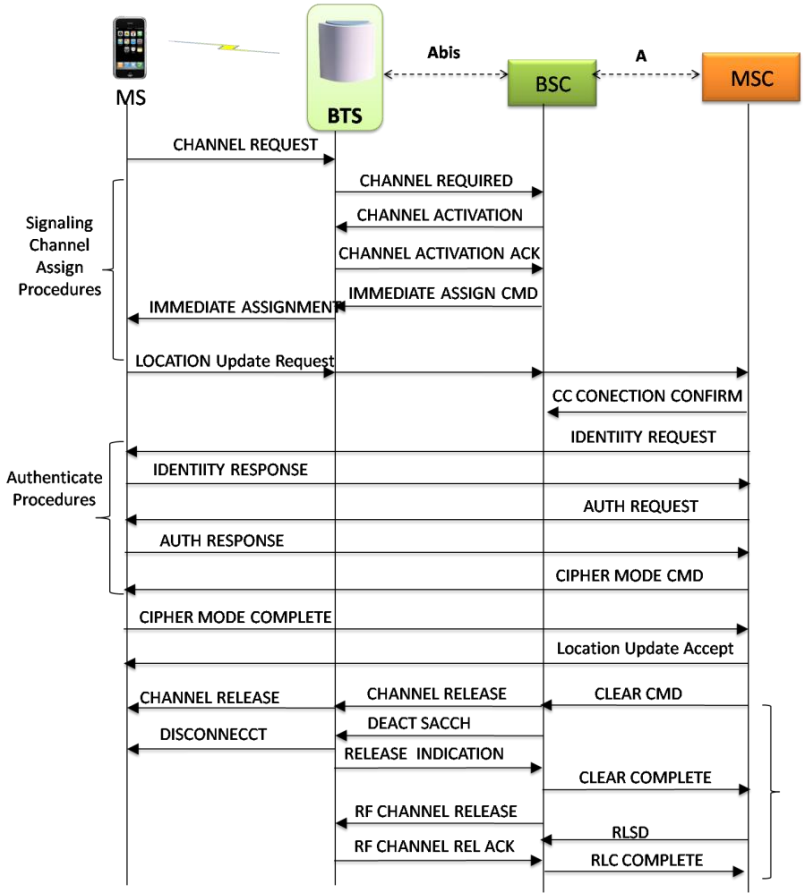
Mobile Terminating (MTC) Call Flow





GL Communications

Location Update (LU) Call Flow



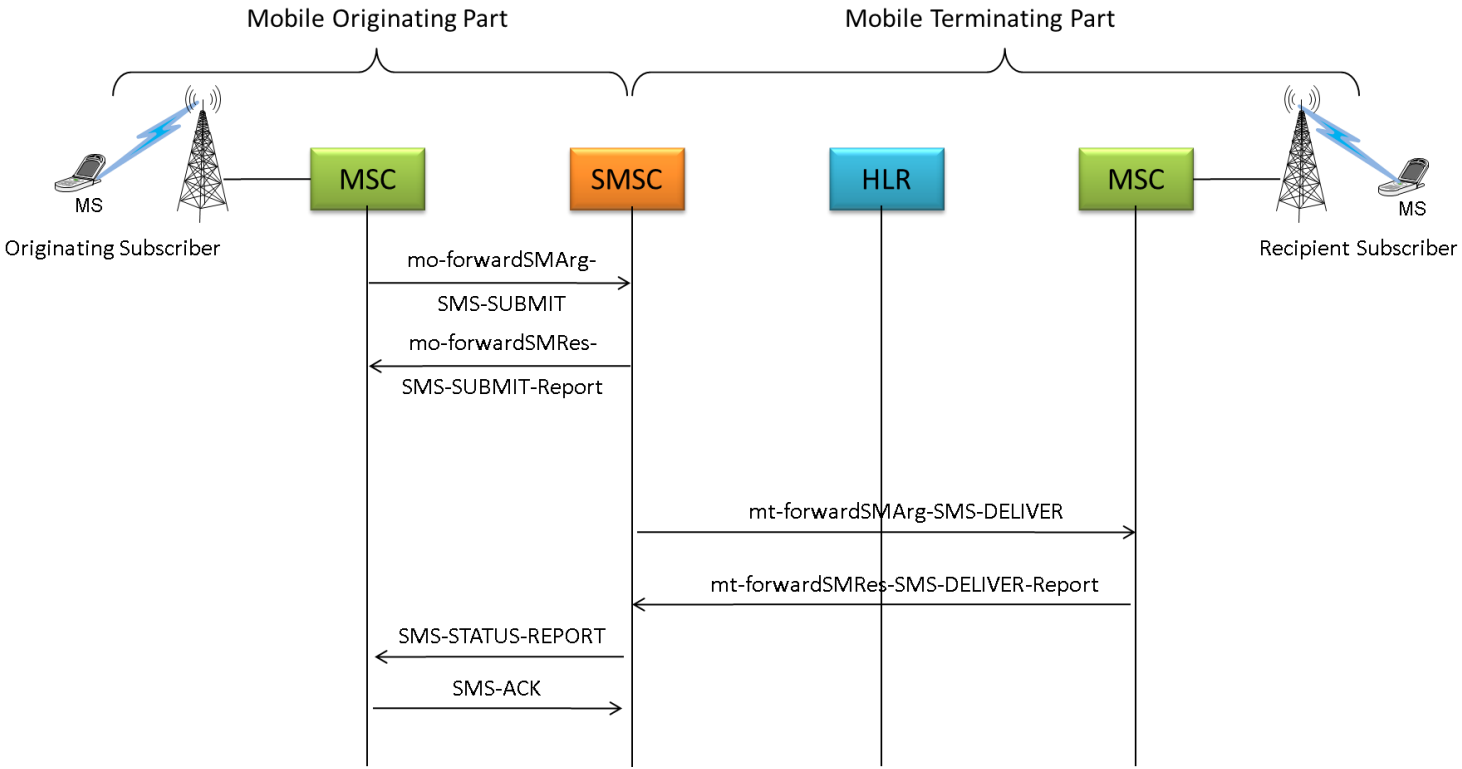
GL Communications

Mobile-To-Mobile SMS Lab

Mobile-To-Mobile (GSM-GSM) Procedures

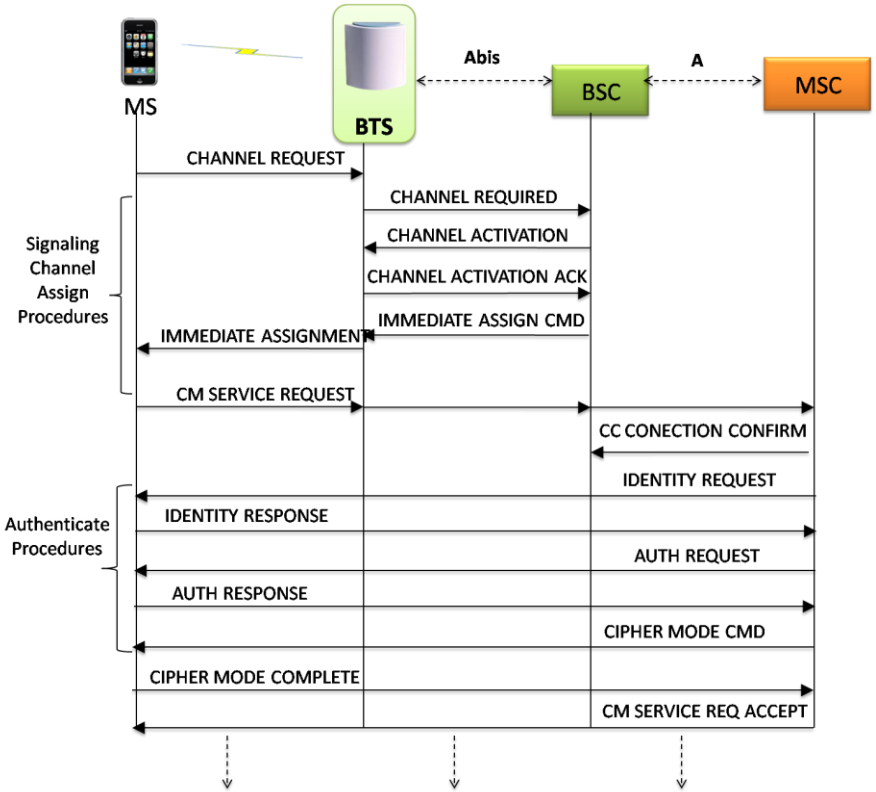
- Mobile Terminated SMS
- Mobile Originated SMS

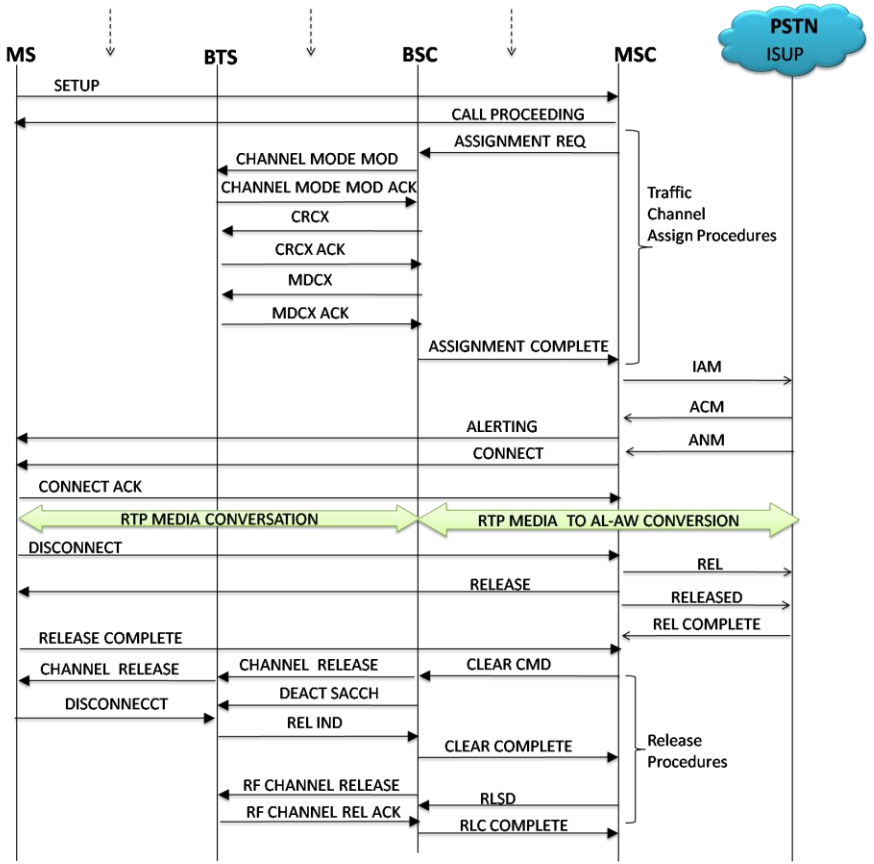
MO and MT SMS Call Flow



Mobile-To-Landline Lab

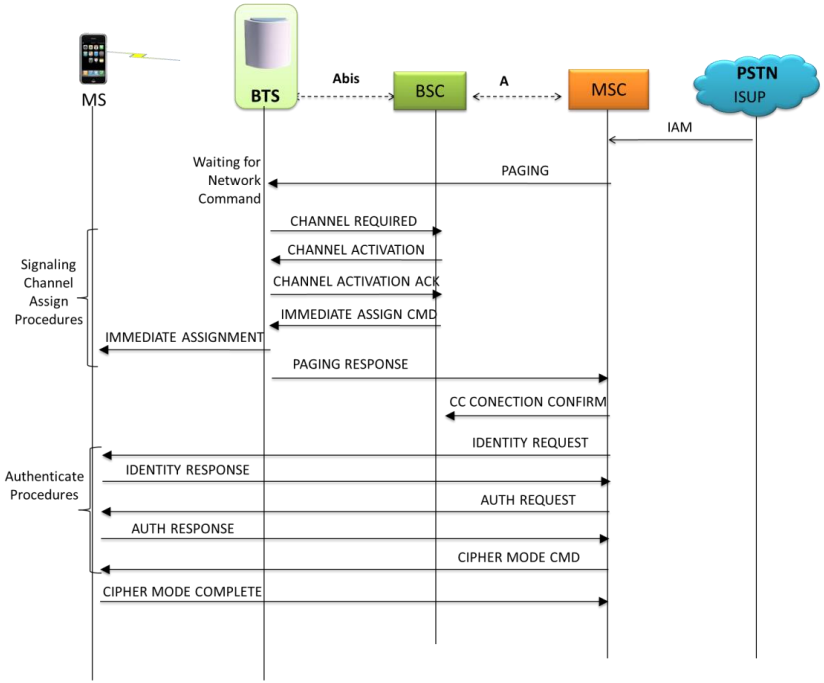
Mobile-To-Landline (MOC) Call Flow

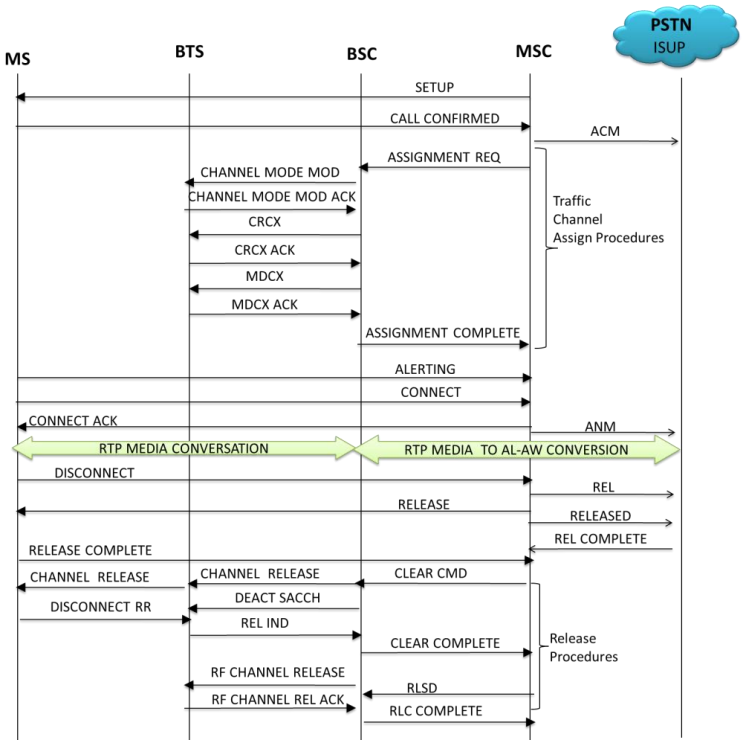




GL Communications

Mobile-To-Landline (MTC) Call Flow





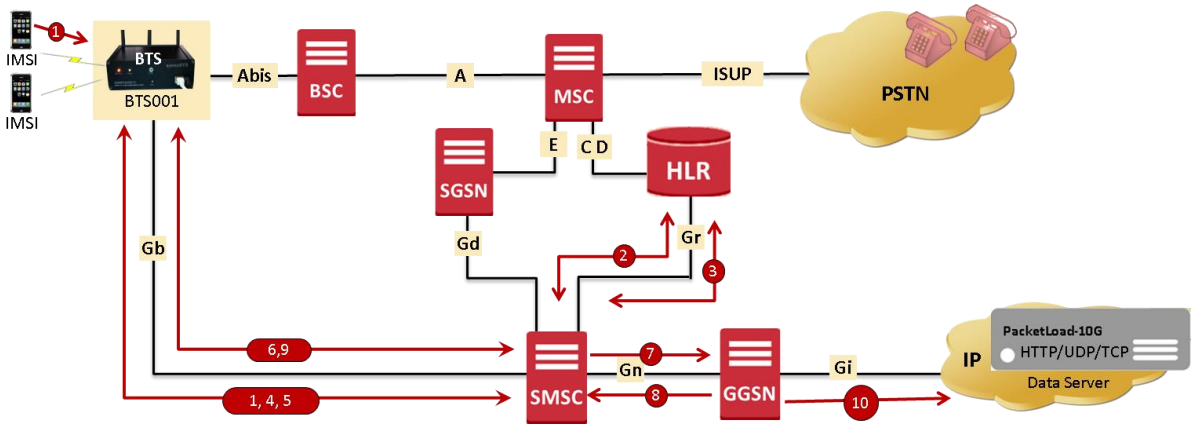
Mobile-To-Landline (GSM-PSTN) Procedures

- Channel Request Procedure
- Signaling Channel Assign Procedures
- CM Service Request Procedures
- Authentication Procedures
- Traffic Channel Assign Procedures
- Rtp Media Procedures
- Release Procedures

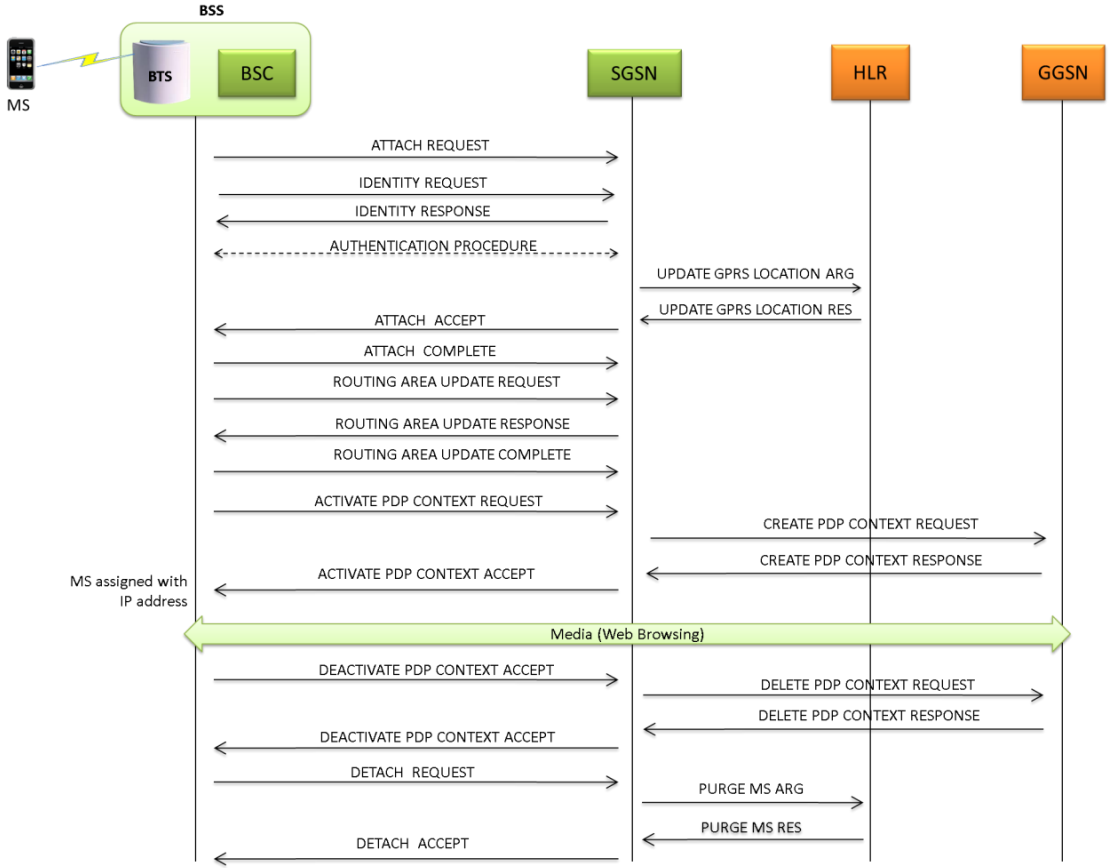
Mobile Traffic & Web Access Lab

GPRS Session

1. Attach Request
2. Authentication
3. Update GPRS Location
4. Attach Accept
5. Attach Complete
6. Activate PDP Context
7. Create PDP Context
8. Respond with IP/DNS Address
9. Activate PDP Context Response
10. HTTP Traffic



GPRS Session Call Flow



GL Communications

High Density Traffic Generation Appliances

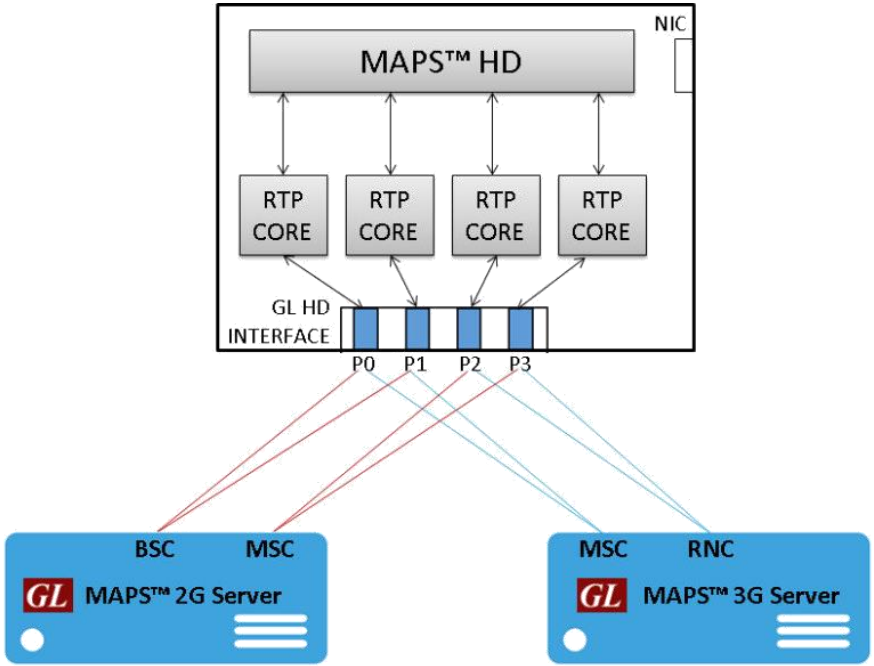
RTP HD System

- The RTP HD server network appliance supports generation of high volume of calls with traffic for load testing 2G/3G networks
- Specialized 1U rackmount appliance, achieve up to 20,000 endpoints per appliance (5000 simultaneous calls with duplex traffic per port)
- Available with 4 x 1 Gbps NIC ports (SFP)

GL Communications

Remote RTP HD System

- The load (high density real-time traffic and signaling) simulated in the above lab setup across 2G/3G/4G networks can be evenly distributed in round-robin fashion over the 4x HD ports on the RTP HD system, so that incoming requests may be evenly distributed among all of them
- Each HD port is capable of 5000 simultaneous calls with duplex traffic. Once the port limit is reached the load is distributed across the remaining HD ports available in the system
- 2G Setup
  - BSC connected to Port 0 (P0), Port 1 (P1)
  - MSC connected to Port 2 (P2), Port 3 (P3)
- 3G Setup
  - MSC connected to Port 0 (P0), Port 1 (P1)
  - RNC connected to Port 2 (P2), Port 3 (P3)



PacketLoad™ 10G

- PacketLoad™ 4 x 10Gbps (PKS174) is a Data Traffic Generator 2U Rack Appliance with 4 x 10Gbps NIC interfaces: total capacity of up to 40 Gbits/sec Stateful TCP/HTTP Traffic
- It supports massive simulation of UEs (up to 500,000) with high density (up to 4 Gbps or 40 Gbps) mobile data traffic simulation for both UMTS, and LTE networks
- The solution allows to encapsulate the generated packet data within GTP headers and transmit through the gateway points such as SGSN & GGSN, or SGW & PGW. It allows simultaneous simulation of multiple sessions per user to verify bearer allocation bandwidth at the end points. Currently, the solution offers stateful TCP/HTTP, and PCAP Replay traffic types
- PacketLoad™ supports HTTP traffic simulation with the base requirements such as port number, server IP address, and pre-canned HTTP traffic file

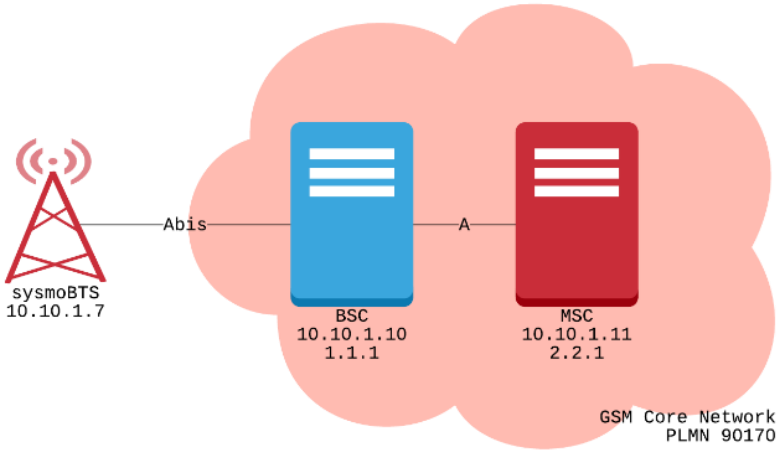
Test Lab Configurations

GSM-GPRS Procedures

- Attach Procedures
- Identity Procedures
- Routing Area Procedures
- PDP Context Creation, Activation, Updation, Deactivation And Deletion Procedures
- Web Browsing Session
- Detach Procedures

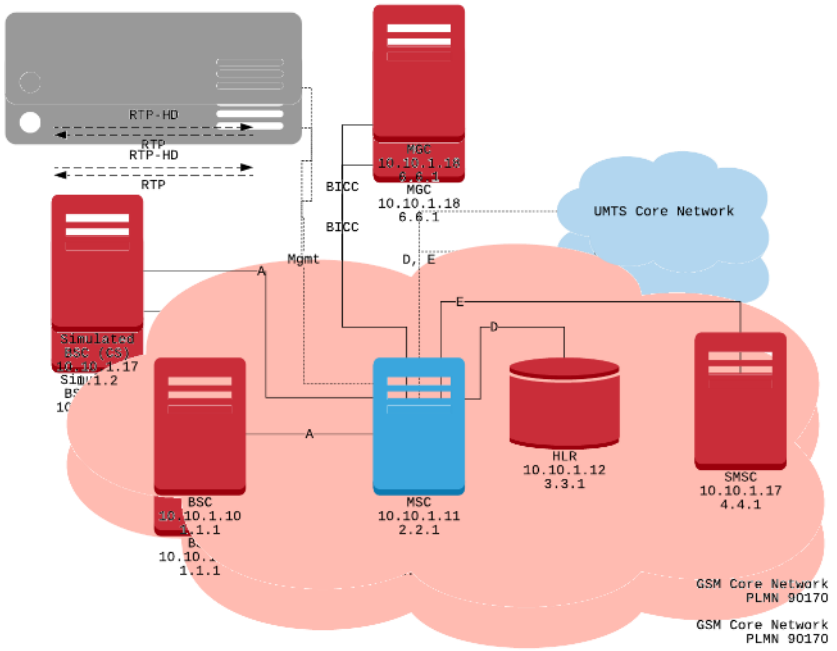
Testbed Setup: 2G BSC GW

Config	Value
BSC Configuration	
BSC	1
BSC 1	
Abis Configuration	
BSC IP Address	10.10.1.10
BSC Port	3003
Mobile Country Code	901
Mobile Network Code	70
Location Area Code	10000
BTS	1
BTS 1	
BTS IP Address	10.10.1.7
Cell Identifier	1
TRX	1
TRX 1	
ARFCN	871
Signaling Channel Type	SDCCH 4
Timeslot	8
Timeslot 1	
Timeslot	CCCH+SDCCH4
Timeslot 2	
Timeslot	SDCCH8
Timeslot 3	
Timeslot	TCH/F
Timeslot 4	
Timeslot	TCH/F
Timeslot 5	
Timeslot	TCH/F
Timeslot 6	
Timeslot	PDCH
Timeslot 7	
Timeslot	PDCH
Timeslot 8	
Timeslot	PDCH
GSMA Configuration	
BSC Port	2905
GSMA M3UA Termination Type	IPSP
Source SCTP Mode	Client



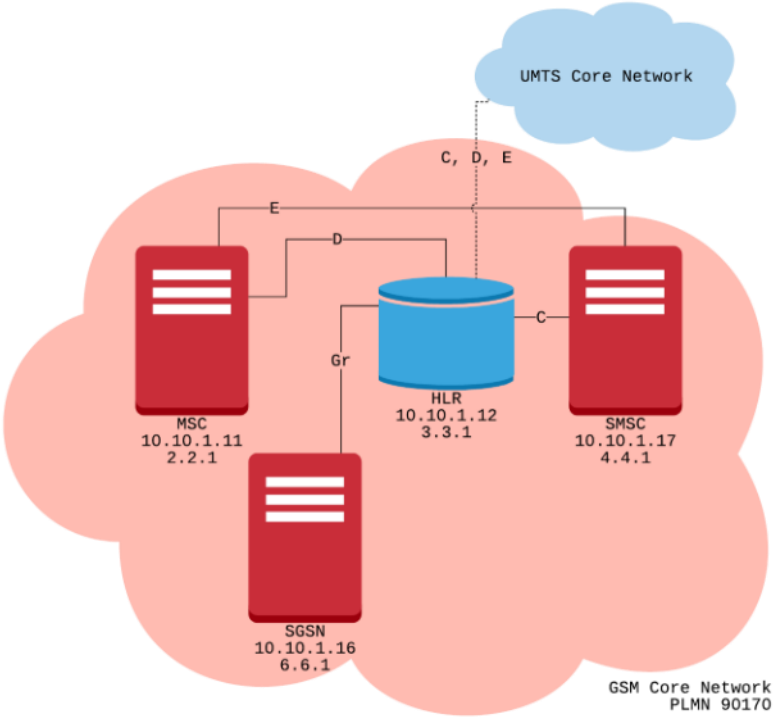
Testbed Setup: 2G MSC

Config	Value
MSS	
Enable or Disable RTP	Enable
RTP Hardware Interface Type	PC NIC
Exchange Type	Non Control
CIC Handling Method	Odd
MSC	1
MSC 1	
MSC IP Address	10.10.1.11
MSC Name	VLRGL01
MSC Point Code	2.2.1
SCCP Routing Indicator	Route on GT
MSC E164 Global Title Address	234674369
MSC E214 Global Title Address	234674369
VLR E164 Global Title Address	234674369
VLR E214 Global Title Address	234674369
MSC Address Indicator	National
Nature Of MSC Address Indicator	Unknown
PLMN Identifiers	
Mobile Country Code	901
Mobile Network Code	70
Routing Area	
Handover Number Range	
Min	5555553000
Max	5555554000
Roaming Number Range	
Min	5555570000
Max	5555580000
RNC Parameters	
BSC Parameters	
Supported BSCs	2
Supported BSCs 1	
Source SCTP Mode	Server
MSC Port to BSC	2905
GSMA M3UA Termination Type	IPSP
BSC IP Address	10.10.1.10
BSC Port	2905
BSC Point Code	1.1.1
BSC Address Indicator	National
Signaling Link Selection	1
Network Indicator	International
Location Area Parameters	1
Location Area Parameters 1	
Location Area Code	10000



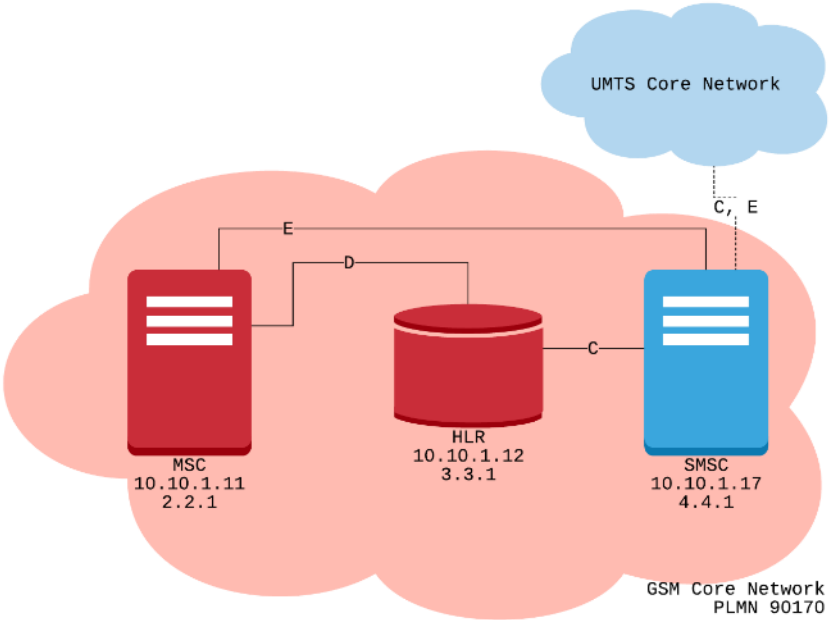
Testbed Setup: 2G HLR

Config	Value
HLR Interfaces	
HLR	1
HLR 1	
HLR IP Address	10.10.1.12
HLR Port	3906
HLR Point Code	3.3.1
SCCP Routing Indicator	Route on GT
SCCP Point Code Indicator	Absent
HLR E164 Global Title Address	234674368
HLR E214 Global Title Address	234674368
HLR Address Indicator	National
Nature Of HLR Address Indicator	Unknown
HLR Global Title TranslationType	0
Connected Destination Nodes	6
Connected Destination Nodes 1	
Node or Interface Type	MSCVLR
Source SCTP Mode	Server
Destination IP Address	10.10.1.11
Destination Port	3906
Source M3UA Termination Type	IPSP
Destination Point Code	2.2.1
Network Indicator	National
Signaling Link Selection	1
M3UA Routing Context Indicator	Absent
M3UA Routing Context	1
Destination SCCP Routing Indicator	Route on GT
Destination SCCP Point Code Indicator	Absent
Destination E164 Global Title Address	234674369
Destination E214 Global Title Address	234674369
Destination Address Indicator	National
Nature Of Destination Address Indicator	Unknown
Destination Global Title Translation Type	0
Connected Destination Nodes 2	
Node or Interface Type	SMSC
Source SCTP Mode	Server
Destination IP Address	10.10.1.17
Destination Port	4906
Source M3UA Termination Type	IPSP



Testbed Setup: 2G SMSC

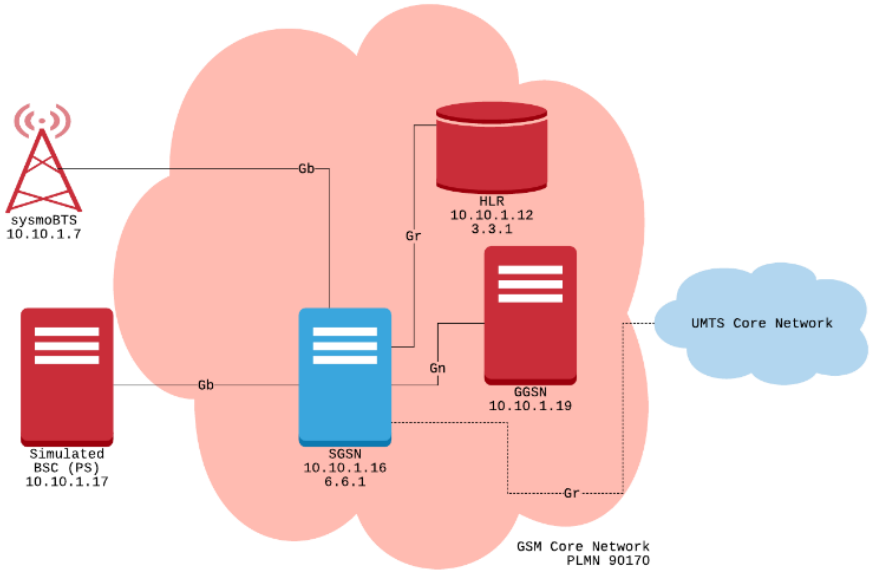
Config	Value
SMSC Interfaces	
SMSC	1
SMSC 1	
SMSC IP Address	10.10.1.17
SMSC Port	4906
SMSC Point Code	4.4.1
SCCP Routing Indicator	Route on GT
SCCP Point Code Indicator	Absent
SMSC E164 Global Title Address	234674368
SMSC E214 Global Title Address	234674368
SMSC Address Indicator	National
Nature Of SMSC Address Indicator	Unknown
SMSC Global Title TranslationType	0
Connected Destination Nodes	6
Connected Destination Nodes 1	
Node or Interface Type	MSCVLR
Source SCTP Mode	Server
Destination IP Address	10.10.1.11
Destination Port	4906
Source M3UA Termination Type	IPSP
Destination Point Code	2.2.1
Network Indicator	National
Signaling Link Selection	1
M3UA Routing Context Indicator	Absent
M3UA Routing Context	1
HLR PLMN	90170
HLR MSISDN Range	
MSISDN Min	9017000000
MSISDN Max	9017090000
Destination SCCP Routing Indicator	Route on GT
Destination SCCP Point Code Indicator	Absent
Destination E164 Global Title Address	234674369
Destination E214 Global Title Address	234674369
Destination Address Indicator	National
Nature Of Destination Address Indicator	Unknown
Destination Global Title Translation Type	0
Connected Destination Nodes 2	
Node or Interface Type	HLR



GL Communications

Testbed Setup: 2G SGSN

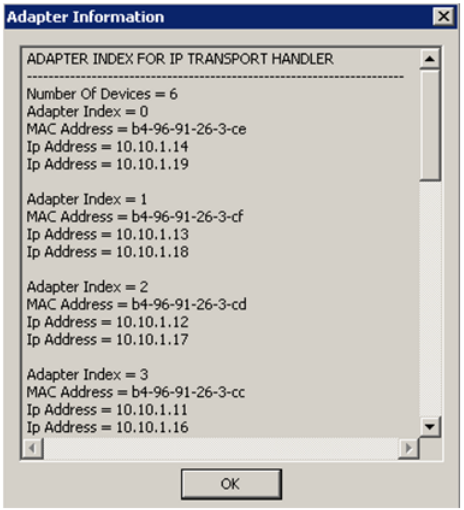
Config	Value
SGSN Configurations	
IuPS M3UA Termination Type	IPSP
SGSN	1
SGSN 1	
SGSN IP Address	10.10.1.16
Traffic IP Address	10.10.1.16
PLMN Identifiers	
Mobile Country Code	901
Mobile Network Code	70
MTP Parameters	
SGSN Point Code	6.6.1
Signaling Link Selection	1
Network Indicator	International
BSC Parameters	
Supported BSCs	1
Supported BSCs 1	
BSC IP Address	10.10.1.7
BSC Port	23000
SGSN Port For BSC	23000
Location Area Identifier	
Location Area Code	10000
Cell Identifier	1
Cell Identifier 1	
Cell Identity	1
SGSN Parameters	
SCCP Routing Indicator	Route on GT
SGSN E164 Global Title Address	234674369
SGSN E214 Global Title Address	234674369
VLR E164 Global Title Address	234674369
VLR E214 Global Title Address	234674369
SGSN Address Indicator	National
Nature Of SGSN Address Indicator	Unknown
Connected Destination Nodes	2
Connected Destination Nodes 1	
Node or Interface Type	HLR
SGSN Port	3906
Source SCTP Mode	Client
Destination IP Address	10.10.1.12



GL Communications

Testbed Setup: 2G GGSN

Config	Value
UMTS GnGp	
Adapter Index	0
GGSN Configurations	1
GGSN Configurations 1	
GGSN IP Address	10.10.1.14
GGSN Port	2123
GGSN IP Address For Traffic	10.10.1.14
GTP Port For Traffic	2152
Supported SGSN	
SGSN IP Address	10.10.1.16
SGSN Port	2123
Traffic	Enable
PacketLoad Management IP Address	192.168.12.60
Traffic Type	PacketLoad Traffic
PacketLoad Traffic Type	HTTP Traffic
End User Configuration	MS_Profiles.xml
APN Configuration	3
APN Configuration 1	
APN Name	default
Start IP	10.10.101.1
End IP	10.10.101.250
APN Configuration 2	
APN Name	internet
Start IP	192.168.86.1
End IP	192.168.150.254
APN Configuration 3	
APN Name	ims
Start IP	192.168.151.51
End IP	192.168.253.254
Protocol Configuration Options	
Primary DNS Address	192.168.1.2
Secondary DNS Address	8.8.8.8
Subnet Mask	255.255.0.0
Gateway IP Address	10.10.10.1
Auto Generated Users Info	
Auto Generated Users	Disable
No Of Users To Be Simulated	4000000000
Starting IMSI	001013014041741
Auto Generated Users Info	
Auto Generated Users	Disable
No Of Users To Be Simulated	4000000000
Starting IMSI	001013014041741
Starting End User Address	192.168.165.1
Auto Generated End User Profile	AutoGeneratedUser_Profile.xml
UE Simulation Parameters	
Type Of UE Simulation	CSV
CSV File Name	\\10.10.1.50\csv\MS_Profiles_IMSI_2G3G4G_Real.CSV
HTTP Web Server IP Address	10.10.100.65

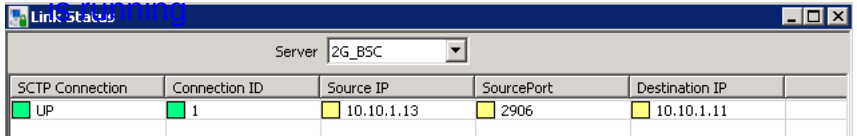


GL Communications

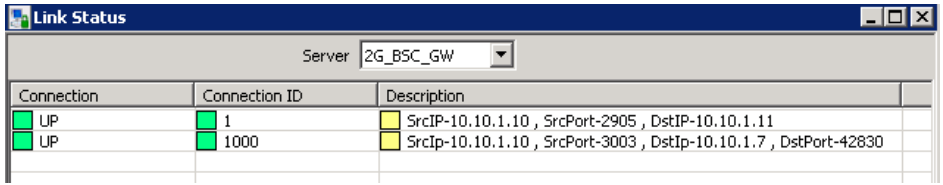
System Quick Start - Link Status

- Cycle through the nodes in Remote Controller and verify the Link Status of the following nodes:

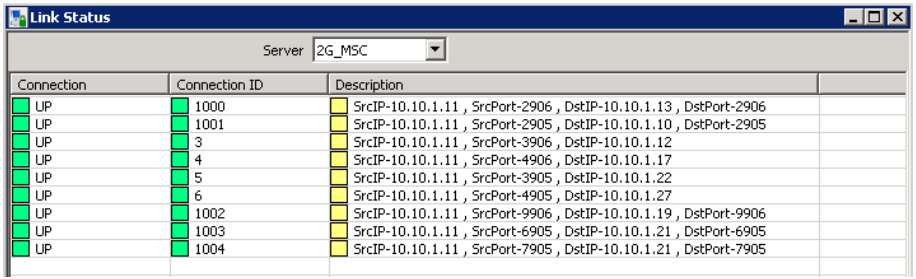
Link Status for 3G connections are available if the 3G setup is running



Simulated BSC (AoIP) ⟷ MSC



BSC GW (Abis + AoIP) ⟷ MSC (10.10.1.11)
BSC GW (Abis + AoIP) ⟷ BTS (10.10.1.7)



MSC ⟷ BSC (10.10.1.13)
MSC ⟷ BSC GW (10.10.1.10)
MSC ⟷ HLR (2G) (10.10.1.12)
MSC ⟷ SMSC (2G) (10.10.1.17)
MSC ⟷ HLR (3G) (10.10.1.22)
MSC ⟷ SMSC (3G) (10.10.1.27)
MSC ⟷ MGC (10.10.1.19)
MSC ⟷ MSC (3G) (10.10.1.21) (6905)
MSC ⟷GMSC(3G) (10.10.1.21) (7905) BICC

GL Communications

System Quick Start – 2G Calls W/ Real Mobiles

- Phone numbers are defined in the table below
- Dial the MSISDN of the desired phone

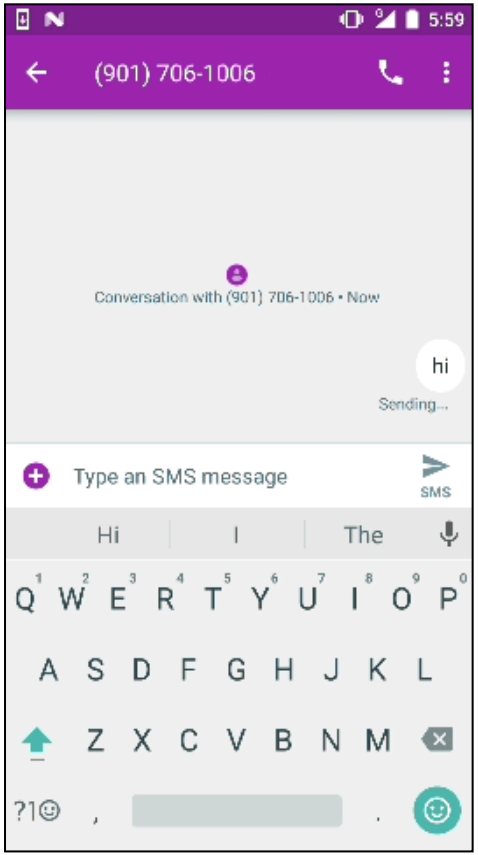
IMSI	MSISDN
901701234561001	9017061001
901701234561002	9017061002
901701234561003	9017061003
901701234561004	9017061004
901701234561005	9017061005
901701234561006	9017061006

GL Communications

System Quick Start - Simulated 2G Calls

- Phone numbers are defined in the table below
- Send SMS to the MSISDN of the desired phone

IMSI	MSISDN
901701234561001	9017061001
901701234561002	9017061002
901701234561003	9017061003
901701234561004	9017061004
901701234561005	9017061005
901701234561006	9017061006



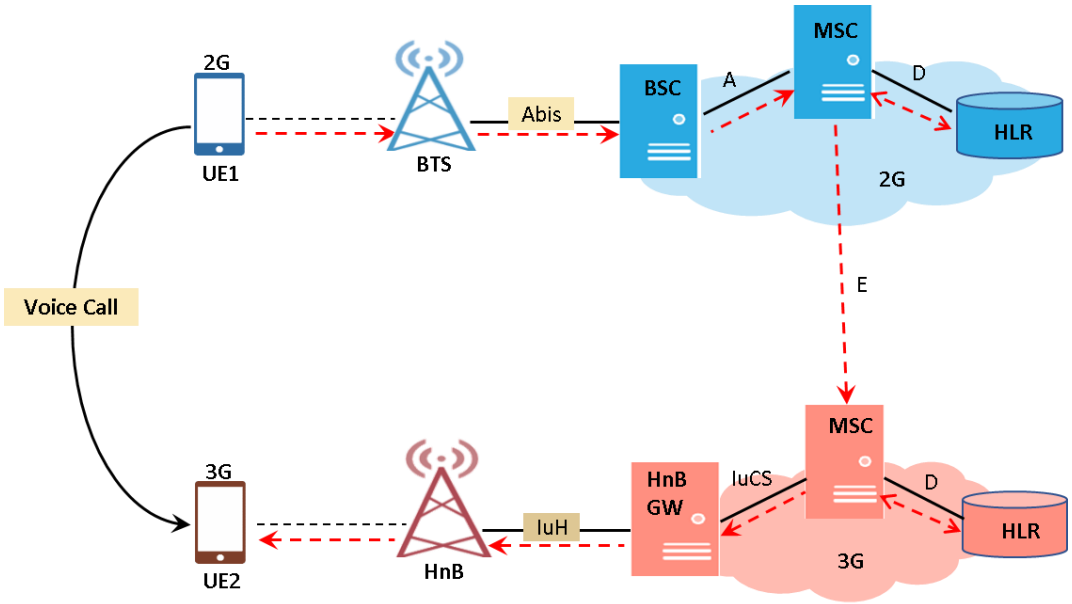
Combined 2G Network with 3G/4G Lab Inter-operability

Combined 2G Network with 3G/4G Lab Inter-Operability

- **Inter Network Calls**
  - 2G USER CALLING 3G USER
  - 2G USER CALLING 4G USER
- **Roaming Calls**
  - 2G USER CALLING 3G ROAMING USER
  - 2G USER CALLING 4G ROAMING USER

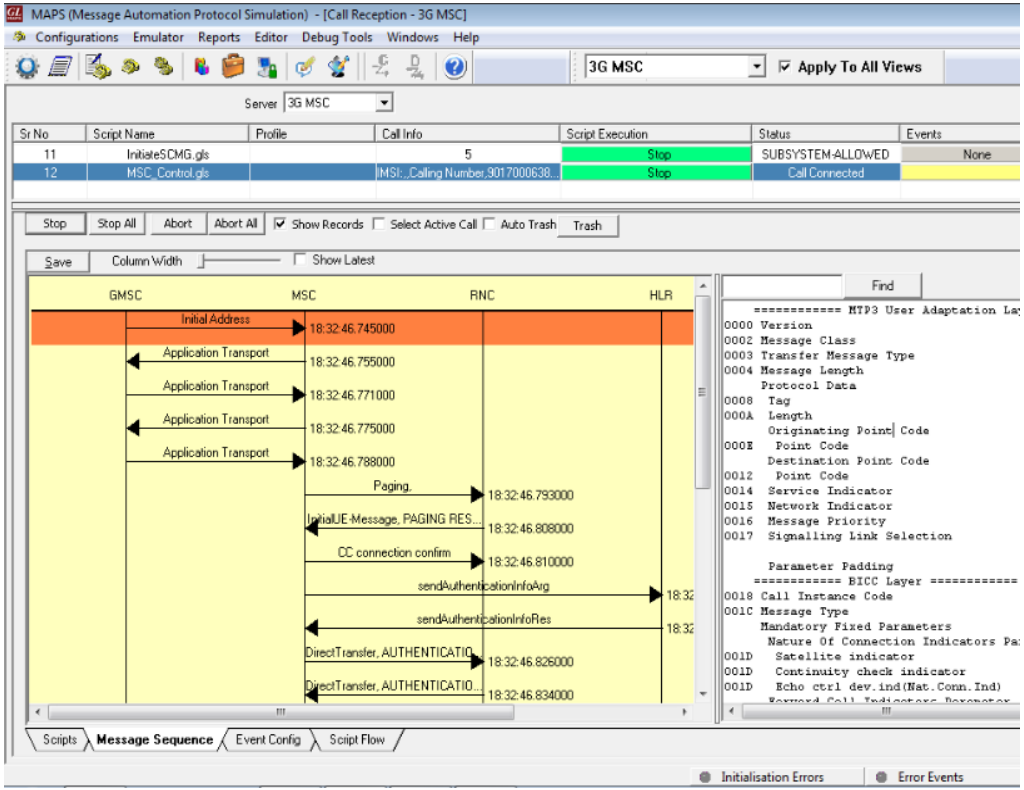
Inter-Network Calls - 2G Calling 3G

- When a voice call or SMS call is placed from UE1 to UE2, MSC on 2G network receives call from UE1 and checks for the received MSISDN registration using MAP table
- If MAP is found, then call is routed within same network otherwise call is routed to 3G MSC. MSC in the 3G network routes the request to 3G user



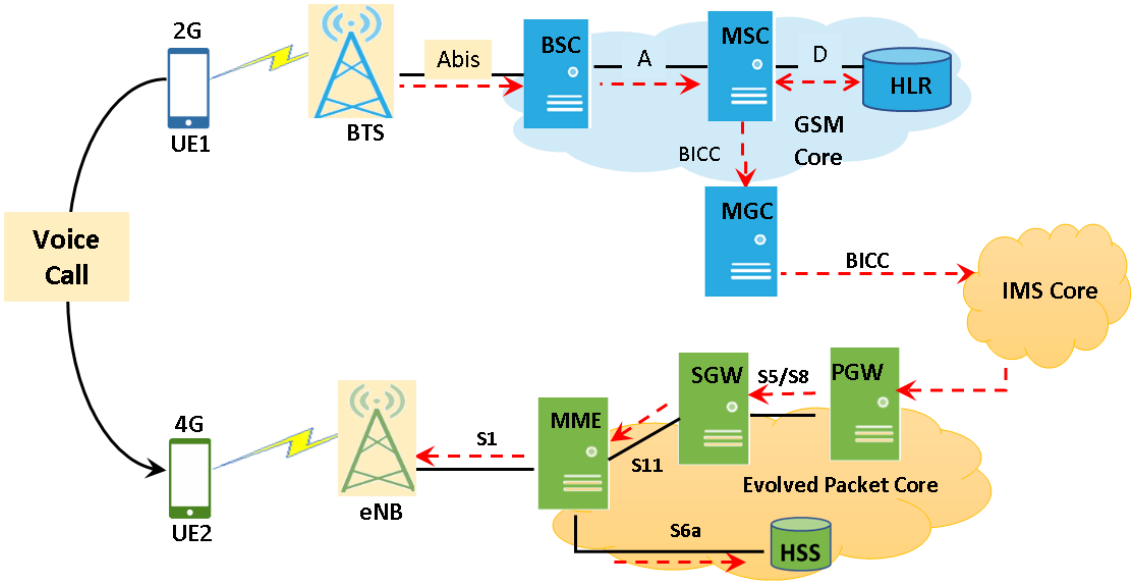
Inter-Network Calls - 2G Calling 3G

- 3G MSC extracts called MSISDN from the received Initial Address Message and if the user registration is verified with the network, Paging is initiated towards RNC
- 3G MSC On reception of PAGING, RNC will respond with Paging Response and end-to-end call is established from 2G user to 3G user

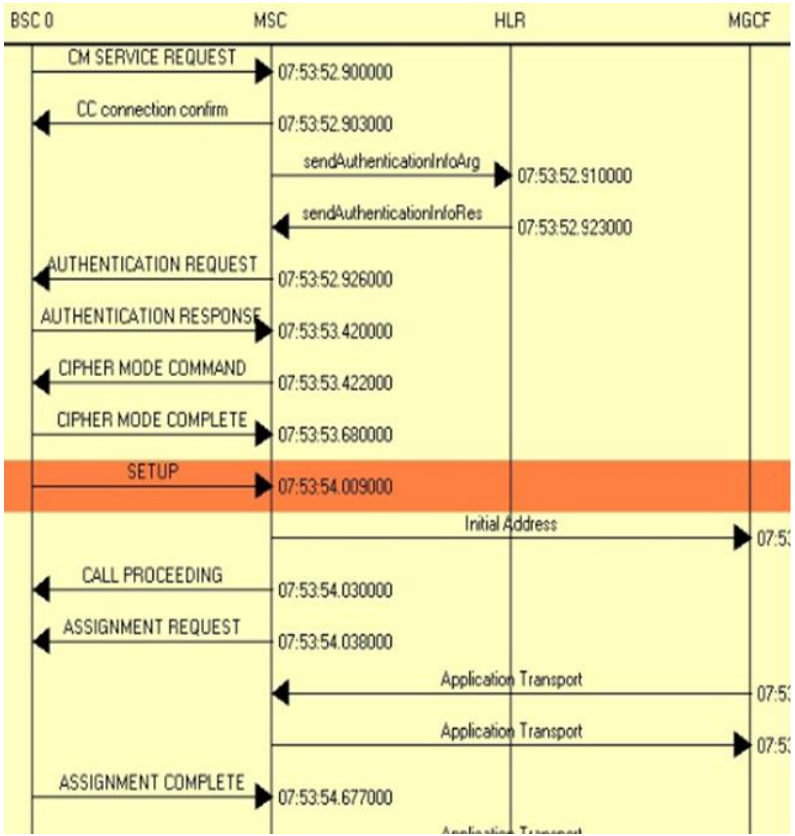


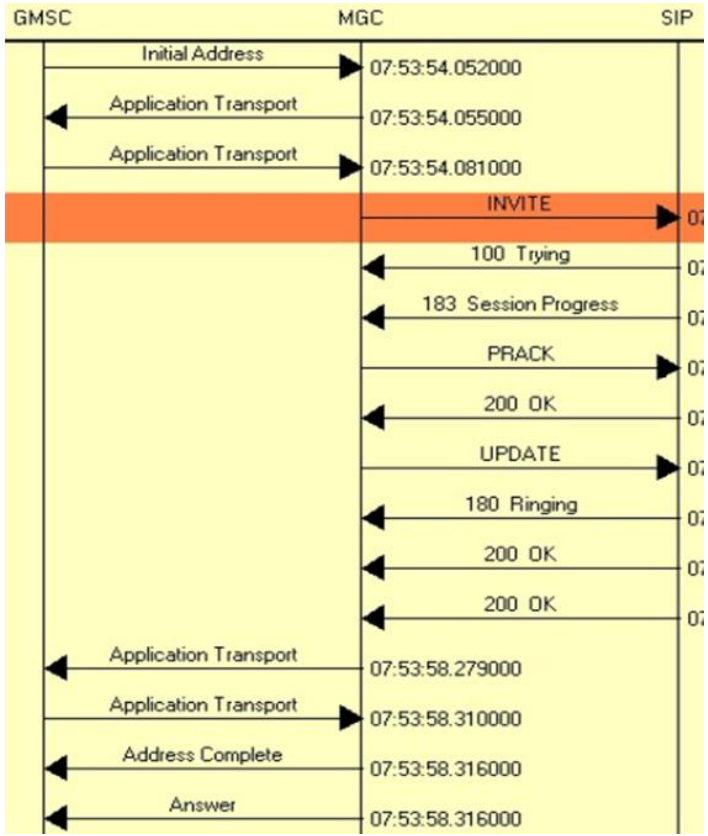
Inter-Network Calls - 2G Calling 4G

- When a voice call is placed from UE1 to UE2, MSC on 2G network receives call from UE1 and checks for the received MSISDN registration using MAP table
- If MAP is found, then MSC checks 4G CSV. If MSISDN is available in 4G CSV, then call is routed to MGC

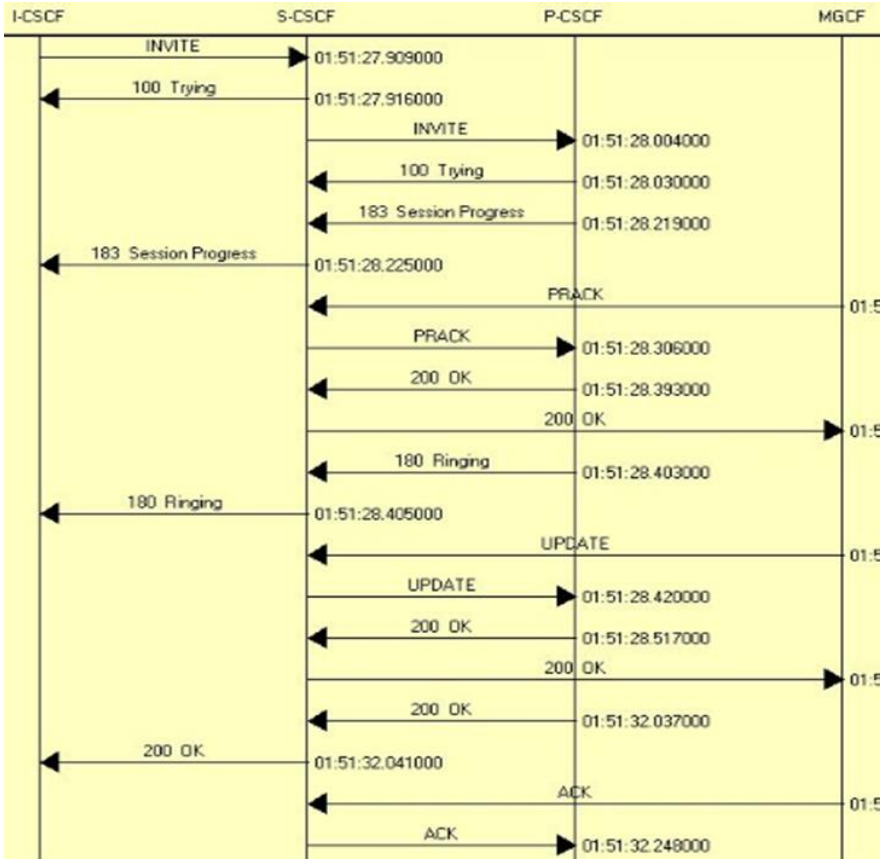


Inter-Network Calls – 2G Calling 4G Call Flow

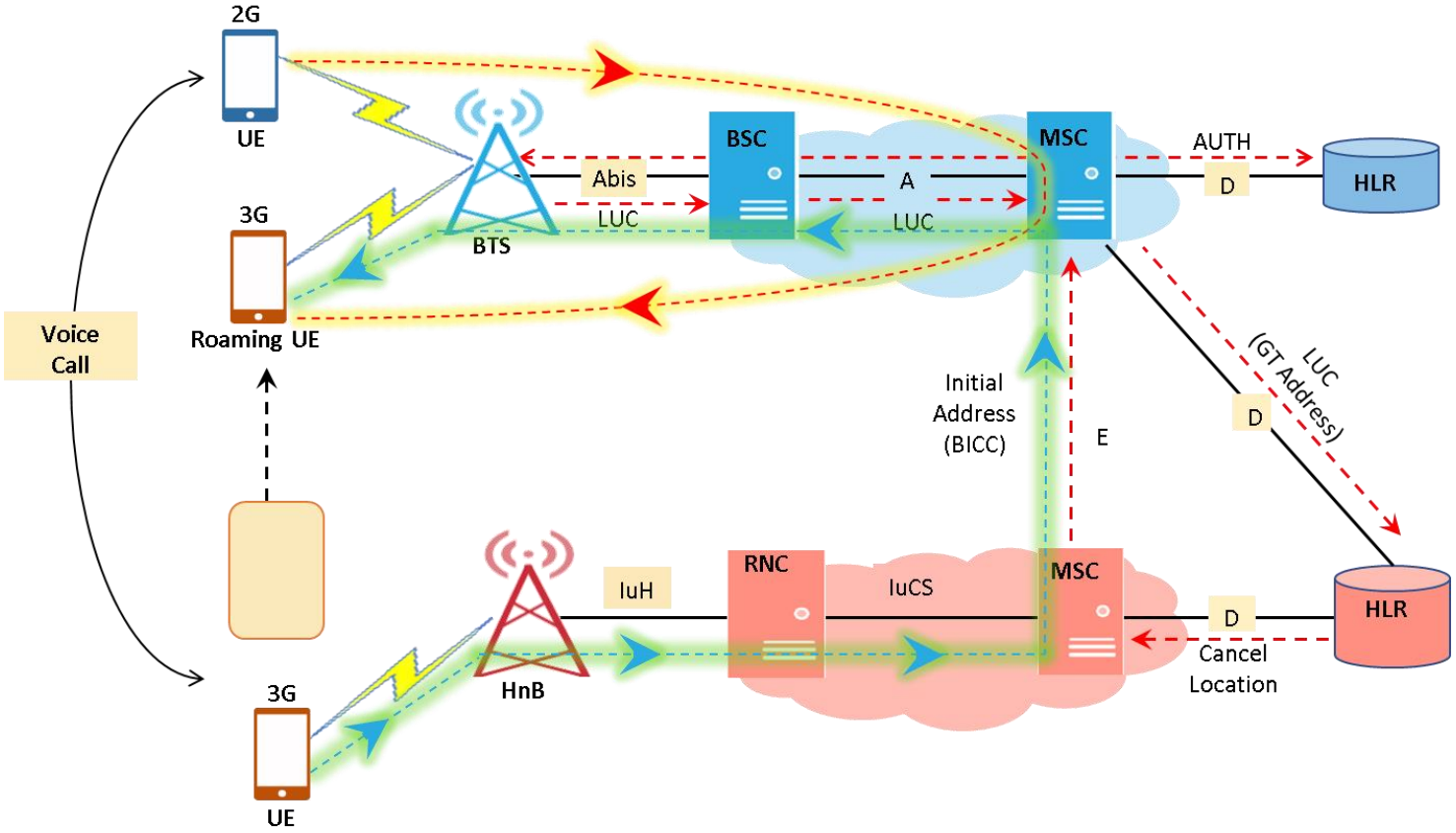




Inter-Network Calls – 2G Calling 4G Call Flow

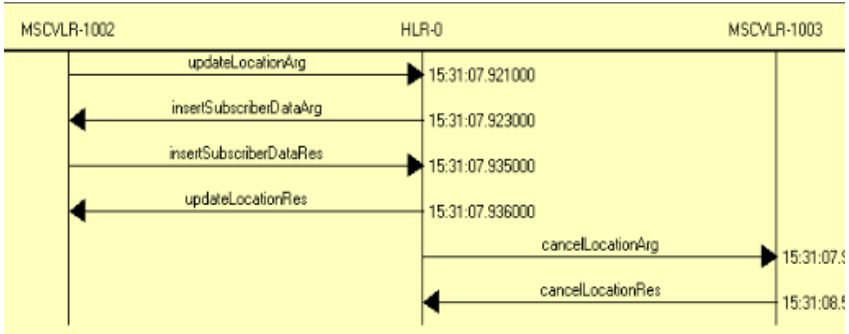


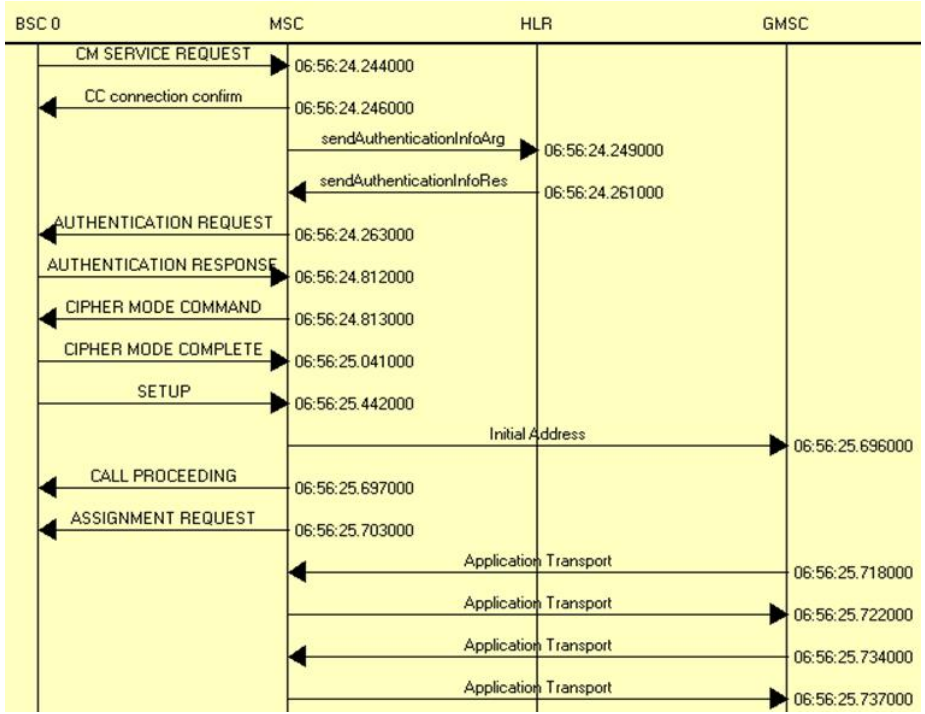
Roaming Calls – 2G Calling 3G Roaming UE



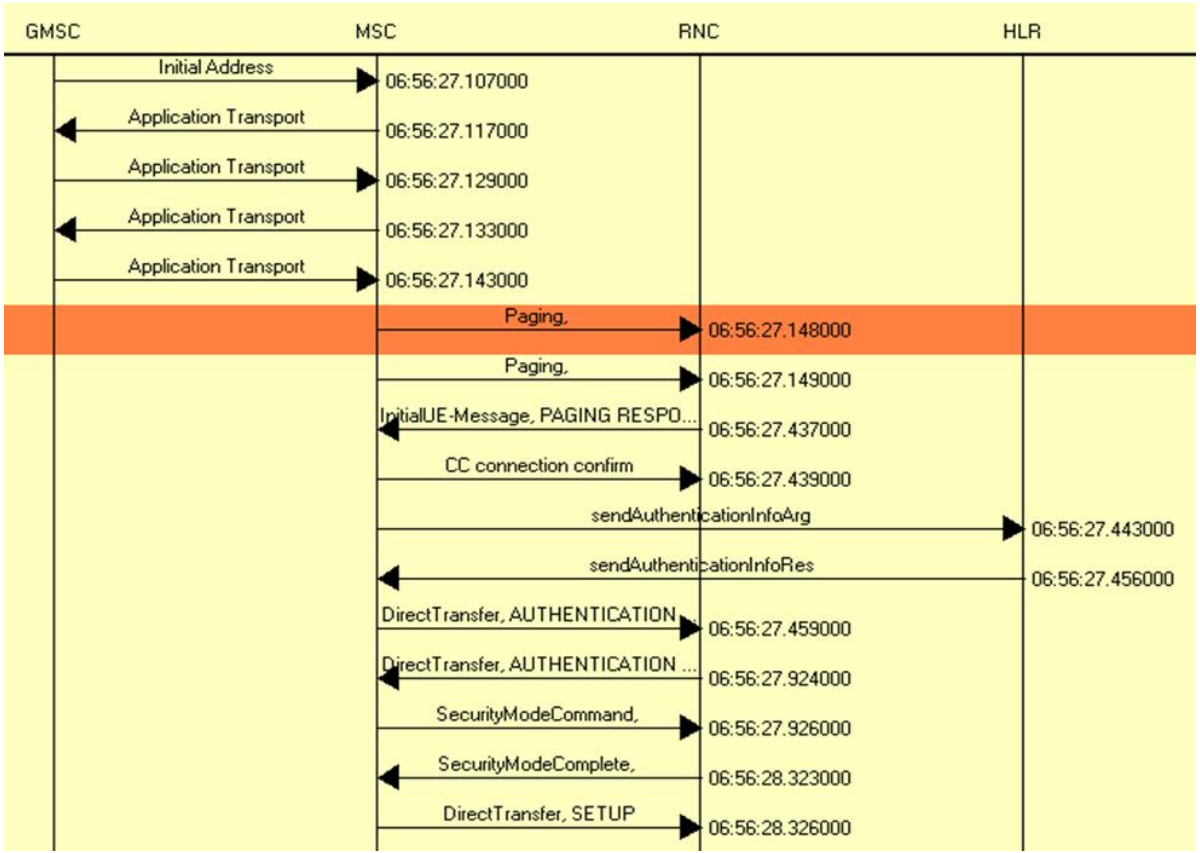
Roaming Calls – 2G Calling 3G Roaming UE

- HLR performing Cancel Location with Previous Registered MSC





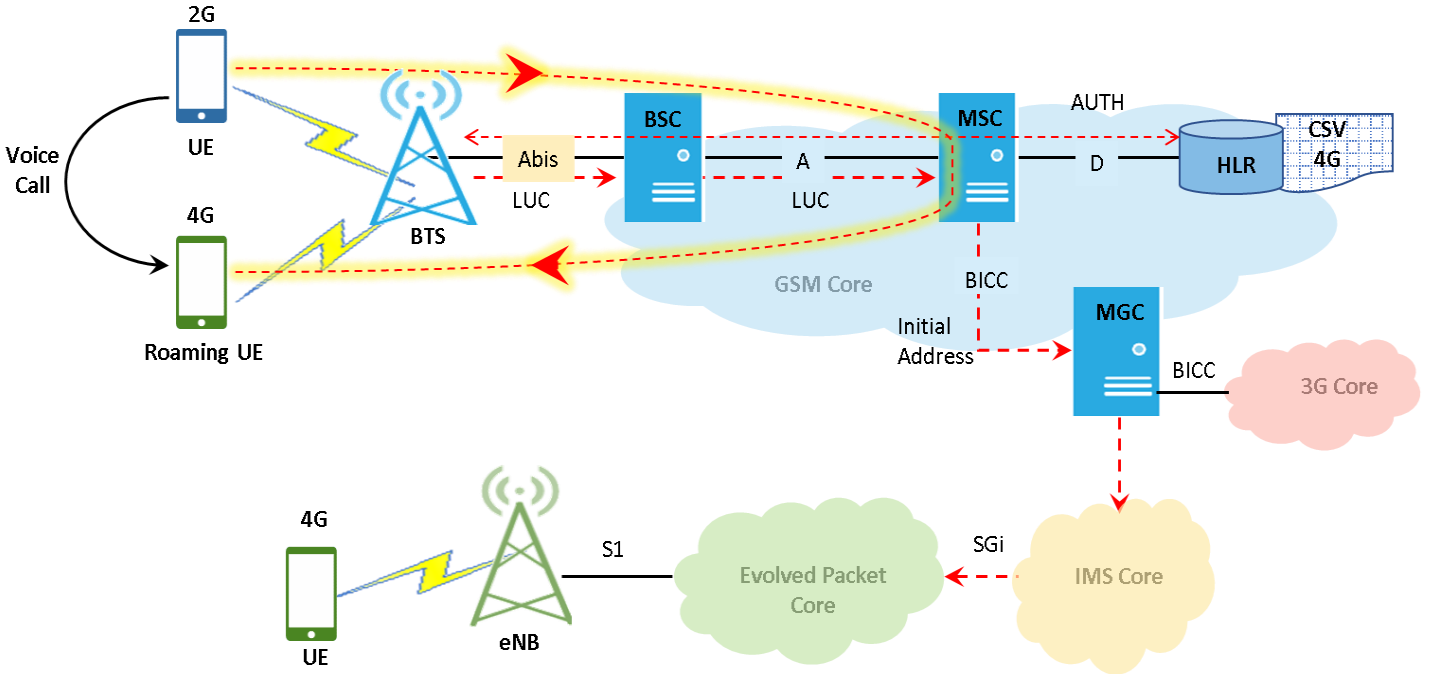
Roaming Calls – 2G Calling 3G Roaming UE



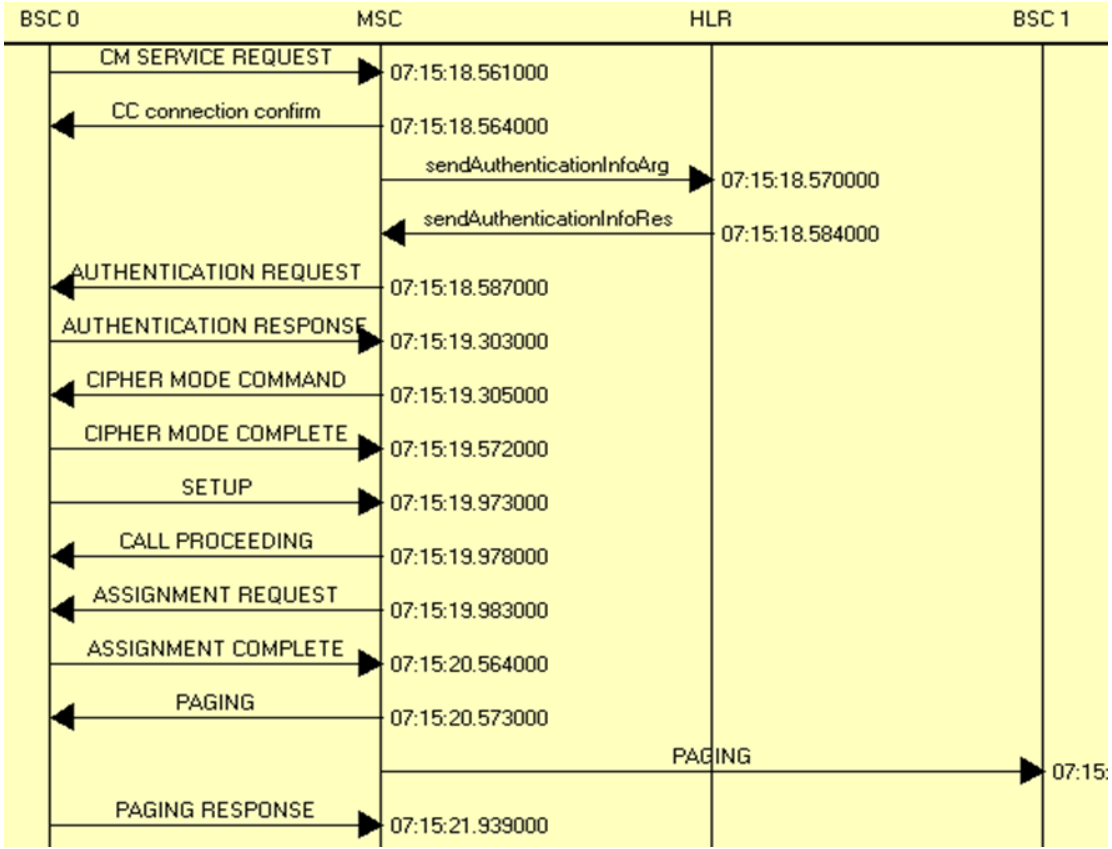
GL Communications

Roaming Calls – 2G Calling 4G Roaming UE

- When 2G user calls 4G roaming user, MSC receives Call and checks Called MSISDN registration in MSC



Roaming Calls – 2G Calling 4G Roaming UE



Performance

- Flexible MAPS™ architecture to test emerging technologies including UMTS, LTE better known as 3G, 4G, IP networks (such as SIP, MGCP, MEGACO, SIGTRAN), and legacy networks (such as CAS, SS7 and ISDN)
- Multi-Interface and Protocol Simulation over different transports layers - IP network (TCP, UDP, SCTP, IPv4 and IPv6), TDM network (MTP2, and LAPD) links
- Multi-Homing feature is supported in SCTP for simulating multiple nodes
- Automation Features –
    - Execution of the multiple calls sequentially or randomly to handle incoming and outgoing calls
    - Automation via CLI clients (Python and Java)
    - Scheduler to load pre-defined test bed setups and configuration files to automate test process at specified time.
    - Control multiple nodes via Remote Access and run tests

Performance (Contd.)

- Load, Stress, and Performance, Testing to measure the capability of an entity for various traffic conditions
- Load /Stress test with different statistical distribution patterns with capacity of 2000 simultaneous calls, @ 500 call per second rate
- Control and operate MAPS™ remotely, also gather statistics, logs and reports
- Traffic Simulation to perform end-to-end testing of various traffic - mobile traffic simulation over GTP, transmit/record real time voice traffic, DTMF and MF digits, user defined single/dual tones over established channels

Thank you