3G UMTS Wireless Lab Simulation

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COMMUNICATIONS NETWORKS LAB (CNL)

- Each LAB test system emulates 3G network elements and traffic types within the Wireless infrastructure.

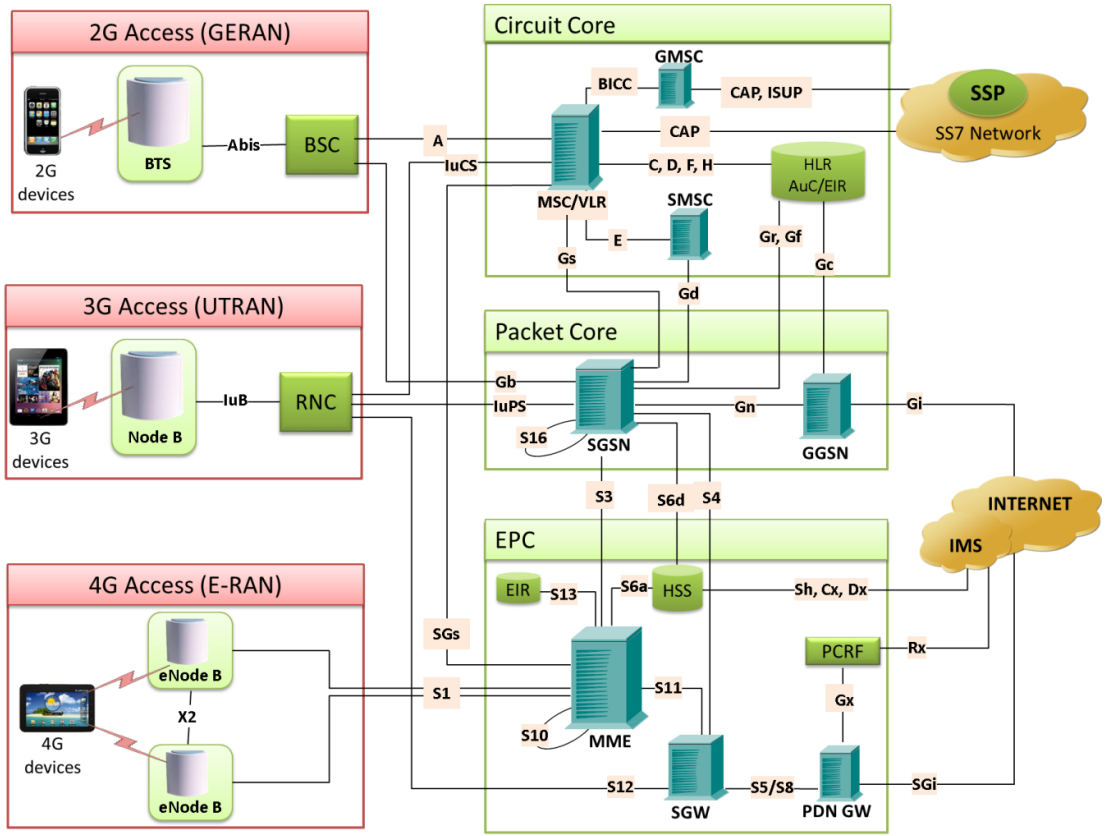
- Provides a base network environment that enables the researchers to test applications, devices, and services prior to deployment on real-time networks

2G 3G 4G COMMUNICATIONS NETWORKS

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

WCDMA, Same Core network as 2G

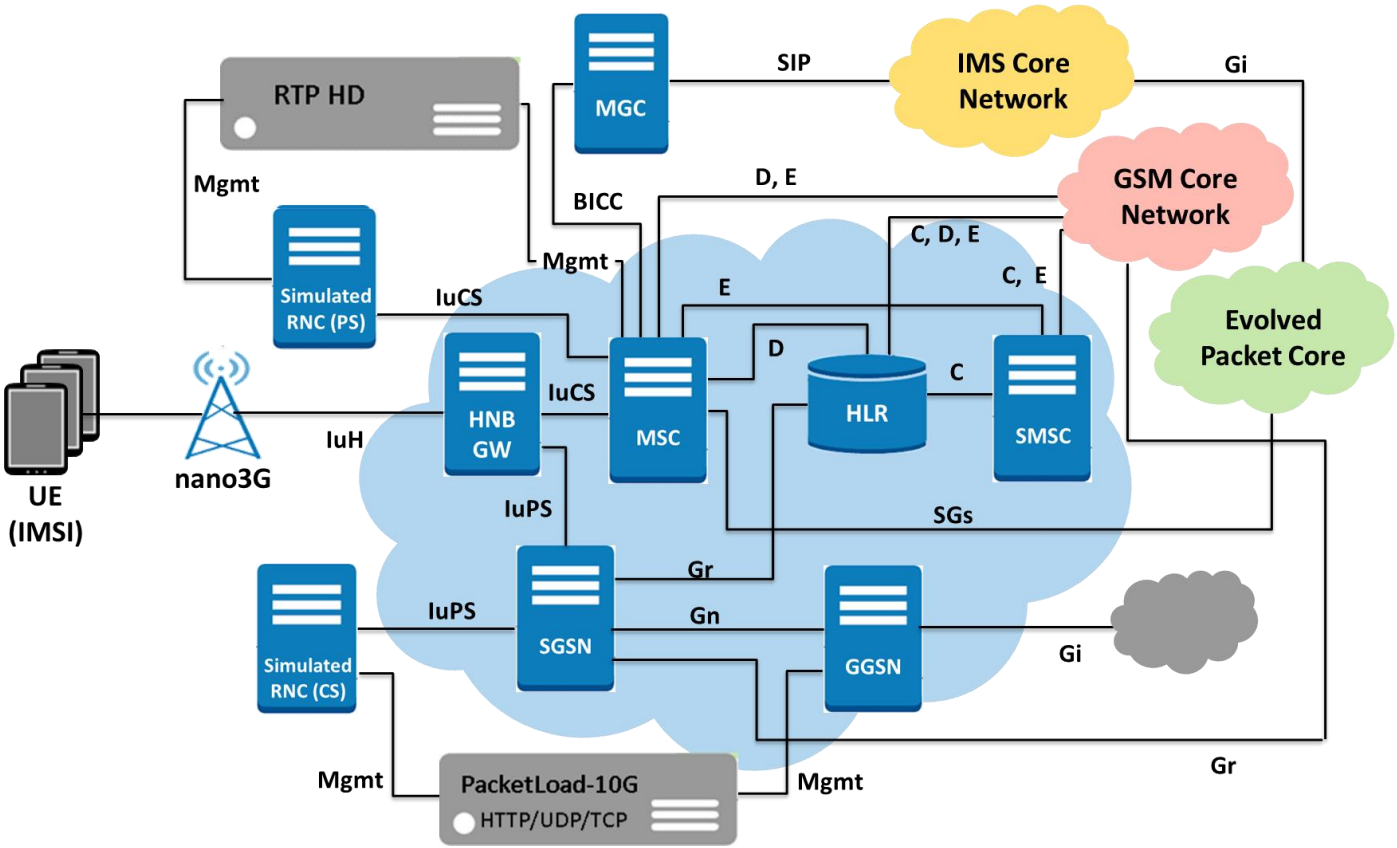
LTE, OFDMA, SC-FDMA, All IP



MAPS™ (Message Automation & 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.

3G LAB Setup


RTP HD
MGC
SIP
IMS Core Network
Gi
Mgmt
BICC
D, E
GSM Core Network
C, D, E
C, E
E
Mgmt
Simulated RNC (PS)
IuCS
Evolved Packet Core
D
C
HNB GW
IuCS
MSC
HLR
SMSC
IuH
nano3G
UE (IMSI)
IuPS
SGs
Gr
IuPS
SGSN
Gn
GGSN
Gi
Simulated RNC (CS)
Mgmt
PacketLoad-10G
HTTP/UDP/TCP
Mgmt
Gr

3G CNL - EMULATION OPTIONS

- Mobile to Mobile Call Emulation
- Mobile to Mobile SMS Emulation in CS Network
- Mobile to Landline Call Emulation
- Mobile Traffic and Web Access Emulation in PS Network

Complete 3G CNL System w/Real NodeB

Mobile-Mobile

- **Real NodeB**
  - IP Access NodeB
  - Mobile Phones
  - SIMs
- **Iuh**
  - PKS160 MAPS™ IuCS IuH
- **IuCS**
  - PKS160 MAPS™ IuCS IuH
  - PKS102 RTP Core (only @ MSC)
- **C, D**
  - PKS132 MAPS™ MAP IP
- **High density Bulk Calling**
  - MAPS™ High Density RTP Generator

Mobile-SMS CS

- **Real NodeB**
  - IP Access NodeB
  - Mobile Phones
  - SIMs
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Mobile-SMS PS

- **Real NodeB**
  - IP Access NodeB
  - 2 Mobile Phones
  - 2 SIMs
- **Iuh**
  - PKS160 MAPS™ IuCS IuH
- **IuPS**
  - PKS164 MAPS™ UMTS IuPS
- **Gr, Gd**
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Mobile-Landline

- **Real NodeB**
  - IP Access NodeB
  - Mobile Phones
  - SIMs
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  - PKS160 MAPS™ IuCS IuH
- **IuCS**
  - PKS160 MAPS™ IuCS IuH
- **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 NodeB**
  - IP Access NodeB
  - Mobile Phones
  - SIMs
- **Iuh**
  - PKS160 MAPS™ IuCS IuH
- **IuPS**
  - PKS164 MAPS™ UMTS IuPS
  - ETH102 MobileTrafficCore GW
- **Gn Gp**
  - PKS166 MAPS™ Gn Gp
  - ETH102 MobileTrafficCore GW
- **Gr**
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  - MAPS™ High Density RTP Generator

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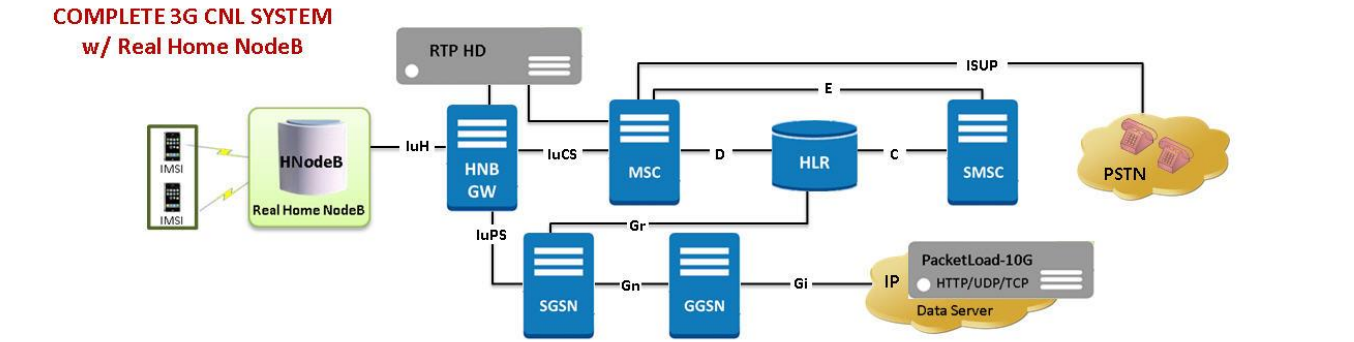
Complete 3G CNL System w/Real NodeB



Mobile-Mobile

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  - PKS166 MAPS™ Gn Gp
  - ETH102 MobileTrafficCore GW
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- **High Density Bulk Calling**
  - PacketLoad 4x10G Data Traffic Generator

Mobile-SMS PS

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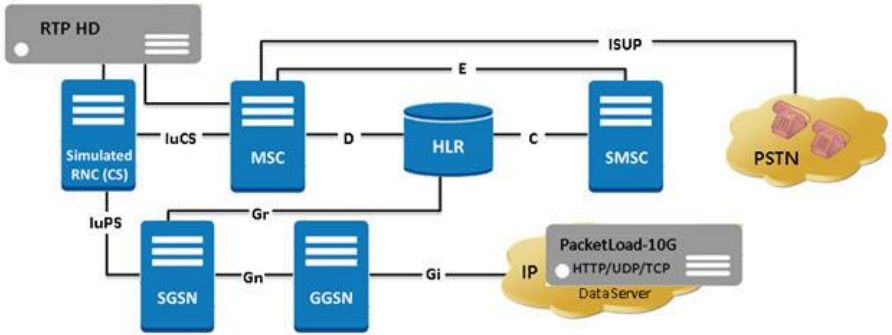
Complete 3G CNL System w/ Simulated NodeB

COMPLETE 3G CNL SYSTEM
w/ Simulated Home NodeB



Mobile-Mobile

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Mobile-Web Browsing

- **IuPS**
  - PKS164 MAPS™ UMTS IuPS
  - ETH101 MobileTrafficCore GTP
- **Gn Gp**
  - PKS166 MAPS™ Gn Gp
  - ETH101 MobileTrafficCore GTP
- **Gr**
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Mobile-SMS PS

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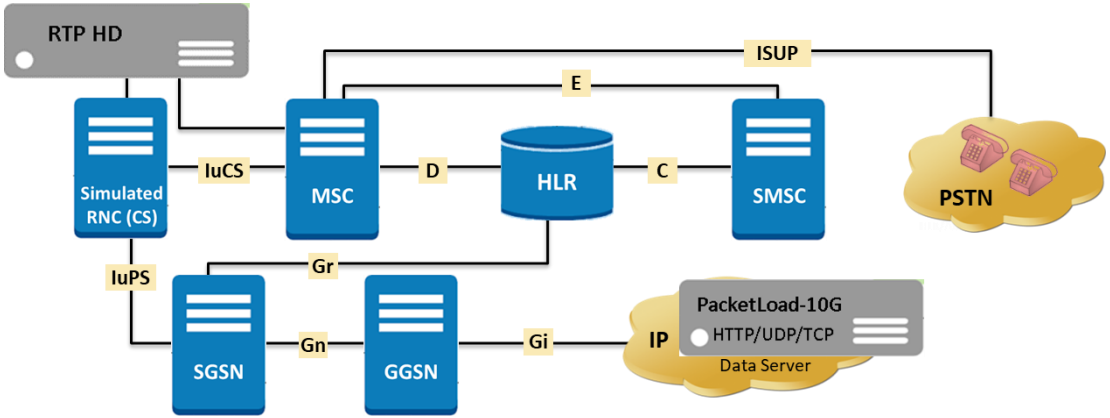
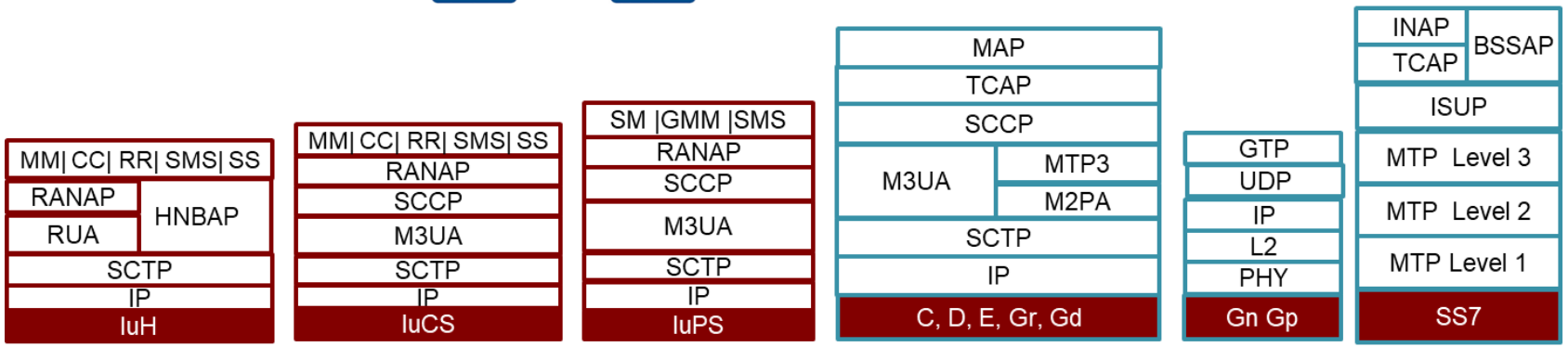
PROTOCOL STACK SPECIFICATION





PROTOCOL STACK SPECIFICATION

Supported Protocols	Specification Used
SCCP	Q.713, CCITT (ITU-T) Blue Book
M3UA	RFC 3332
RANAP	3GPP TS 25.413 V9.1.0
GMM / SM	3GPP TS 24.008 V5.16.0 (2006-06)
SMS	3GPP TS 03.40 V7.5.0 & 3GPP TS 04.11 V7.1.0 GSM 03.38 version 7.2.0 Release 1998

PROTOCOL STACK SPECIFICATION

Supported Protocols	Specification Used
SCCP	Q.713, CCITT (ITU-T) Blue Book
MTP3	Q.703, ITU-T Blue Book
RANAP	3GPP TS 25.413 V9.1.0
MM / CC	3GPP TS 24.008 V5.16.0 (2006-06)
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

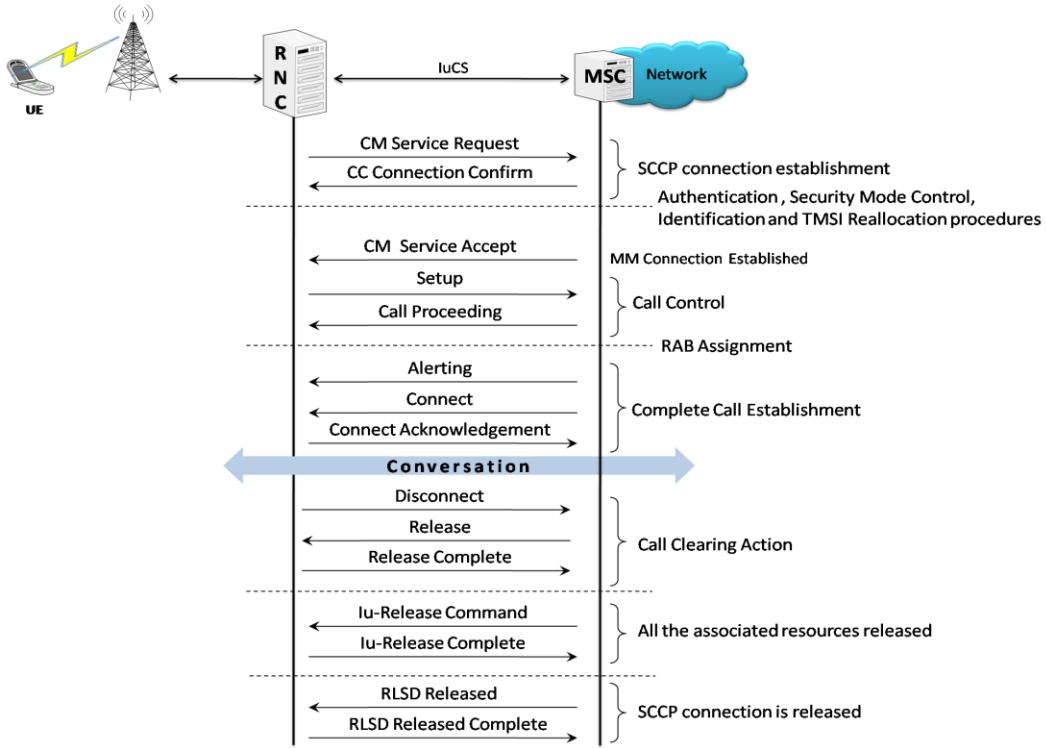
UE-TO-UE (UMTS) PROCEDURES

- **Mobile Originated Call (MOC)**
  - CHANNEL REQUEST
  - AUTHENTICATION, CIPHERING, VALIDATION
  - 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 Call (LUC)**

UE-TO-UE (UMTS) PROCEDURES (MOBILE ORIGINATING CALL -MOC)



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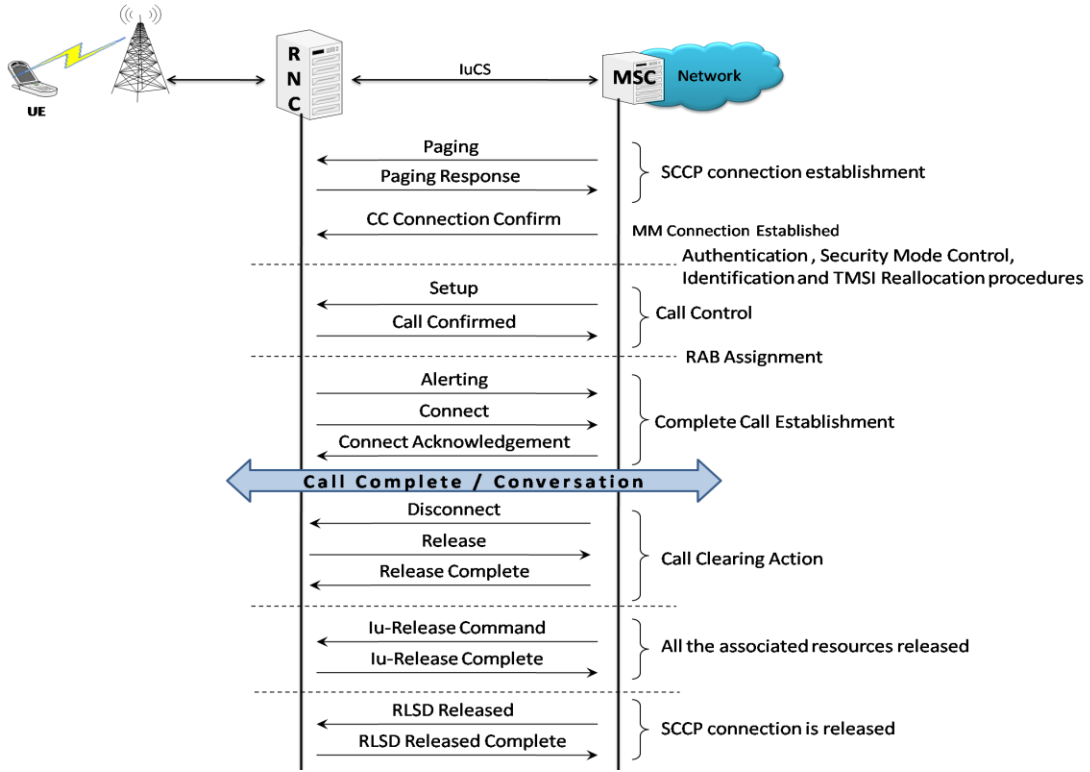
UE-TO-UE (UMTS) PROCEDURES (MOBILE TERMINATING CALL -MTC)



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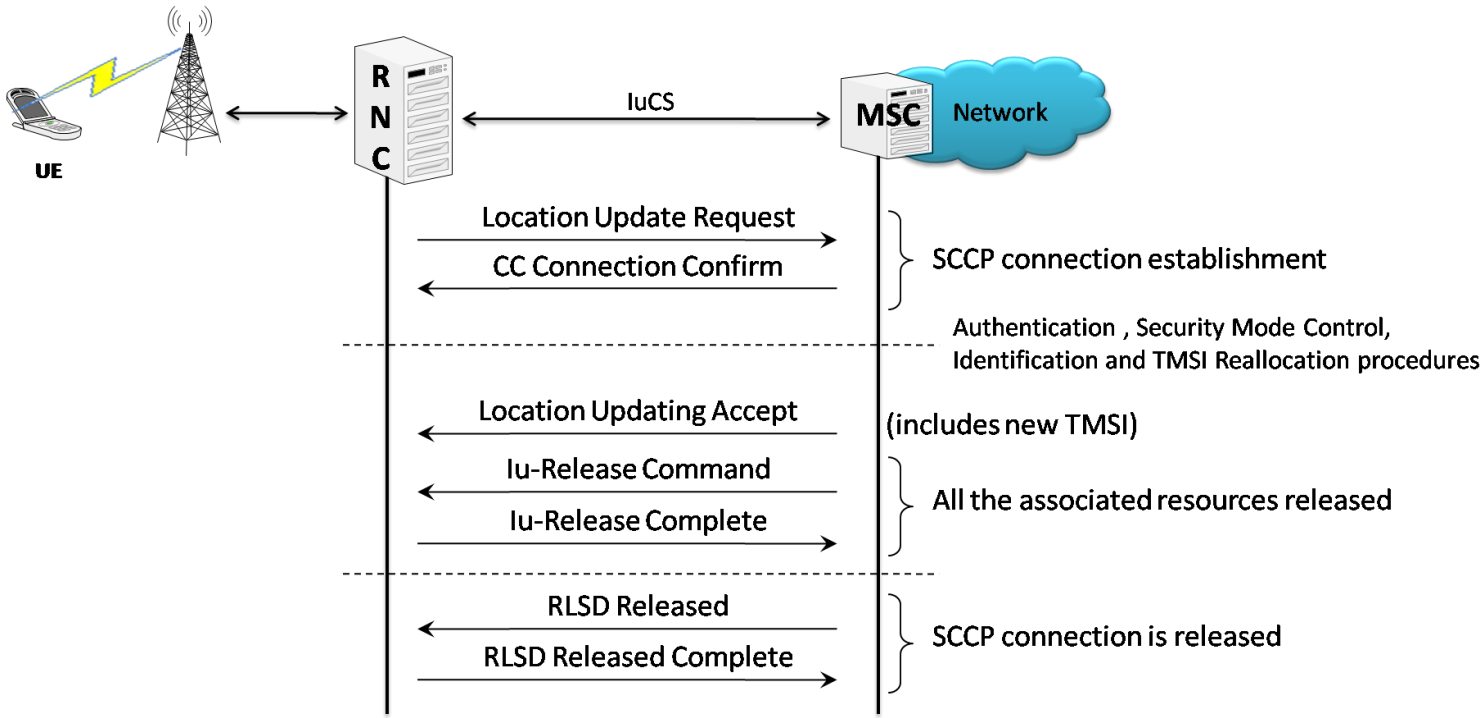
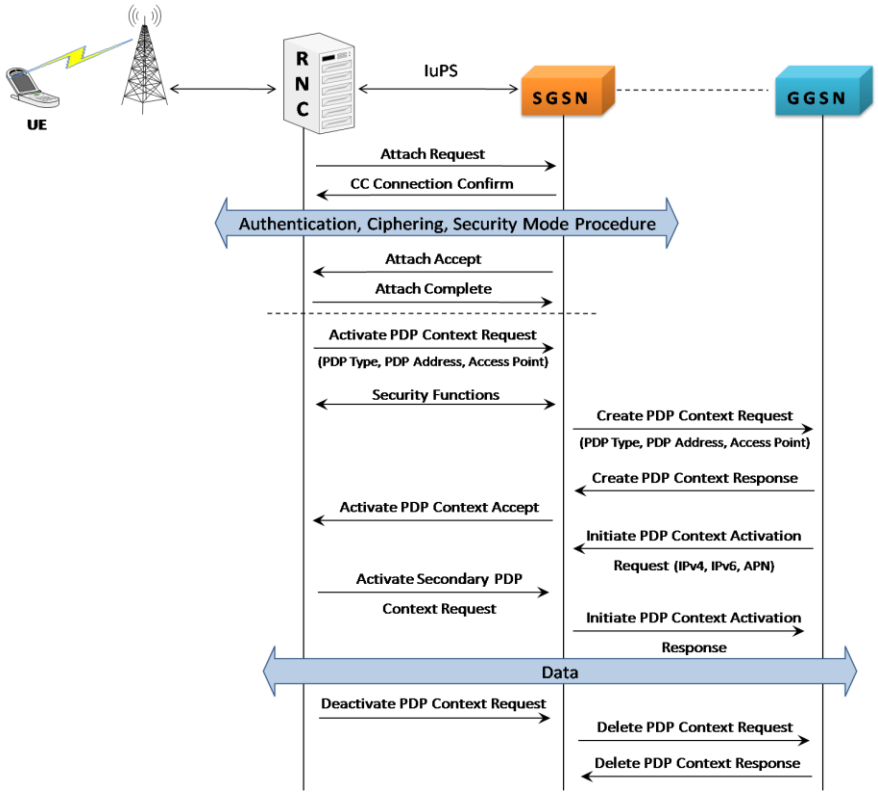
UE-TO-UE (UMTS) PROCEDURES (LOCATION UPDATE CALL - LUC)



UMTS IuPS PROCEDURES

- ATTACH PROCEDURES
- IDENTITY PROCEDURES
- ROUTING AREA PROCEDURES
- PDP CONTEXT CREATE, ACTIVATE, DEACTIVATE, AND DELETE PROCEDURES
- WEB BROWSING SESSION
- DETACH PROCEDURES

UMTS-GPRS MOBILITY MANAGEMENT PROCEDURE



HD RTP and Packet Data 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)

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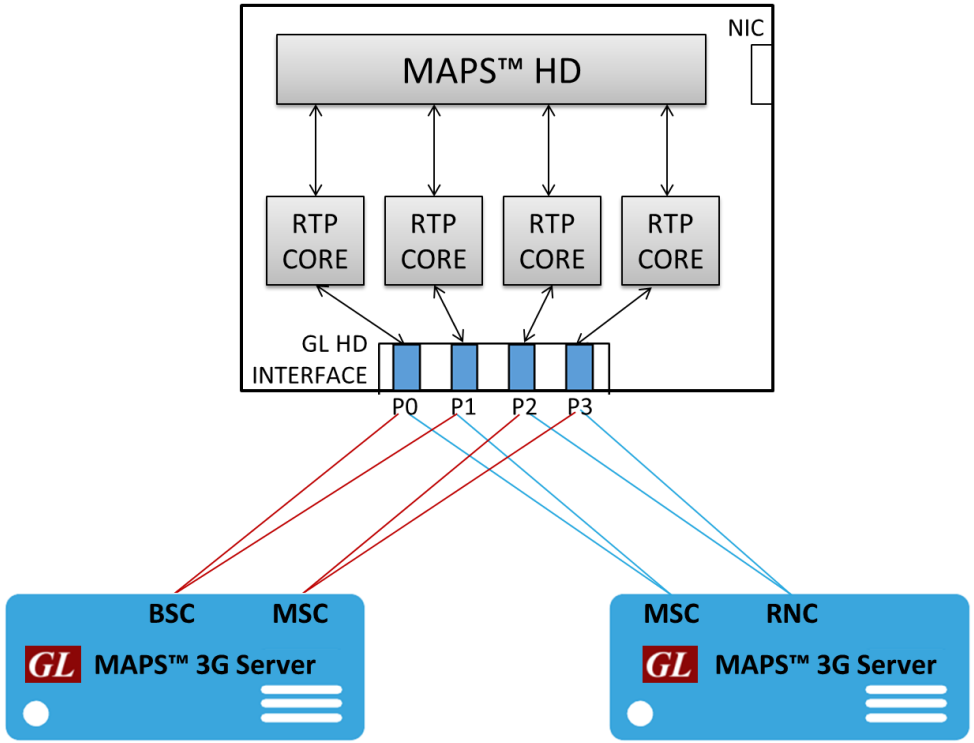
Remote RTP HD System

- 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.



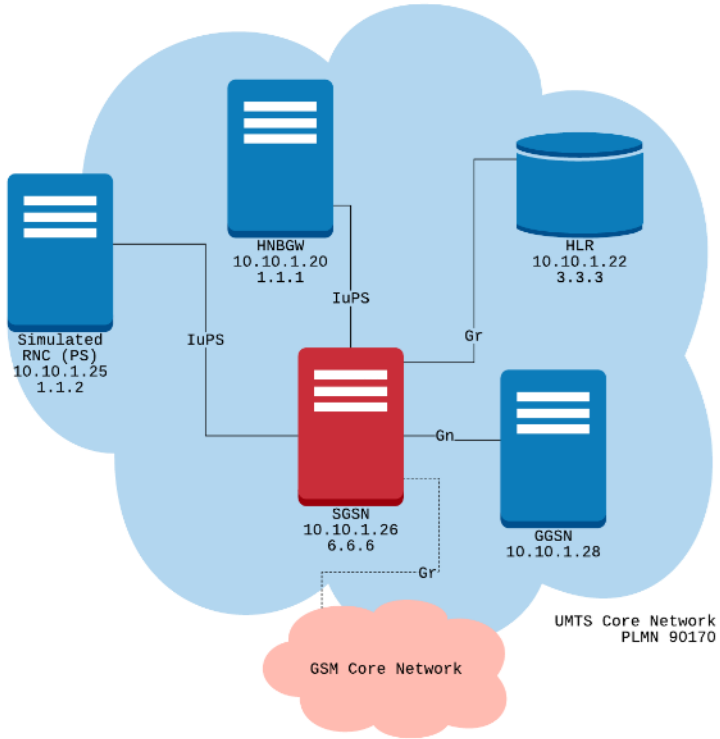
PacketLoad 10G

- 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.

TEST LAB CONFIGURATIONS

Testbed Setup: 3G SGSN

Config	Value
SGSN Configurations	
Adapter Index	4
IuPS M3UA Termination Type	IPSP
SGSN	1
SGSN 1	
Traffic	Enabled
SGSN IP Address	10.10.1.26
SGSN Traffic IP Address for RNC	10.10.1.26
GTP Port For Traffic	2152
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
PLMN Identifiers	
Mobile Country Code	450
Mobile Network Code	80
MTP Parameters	
SGSN Point Code	6.6.6
Signaling Link Selection	1
Network Indicator	International
RNC Parameters	
Supported RNCs	2
Supported RNCs 1	
RNC IP Address	10.10.1.20
RNC Point Code	1.1.1
SGSN Port	2905
RNC Port	2905
Source SCTP Mode	Server
RNC Address Indicator	International
Location Area Identifiers	
Location Area Identifier	1
Location Area Identifier 1	
Location Area Code	0001
Service Area Code	0001
Routing Area Code	01
RNC ID	01
Supported RNCs 2	
RNC IP Address	10.10.1.25
RNC Point Code	1.1.2
SGSN Port	2906
RNC Port	2906



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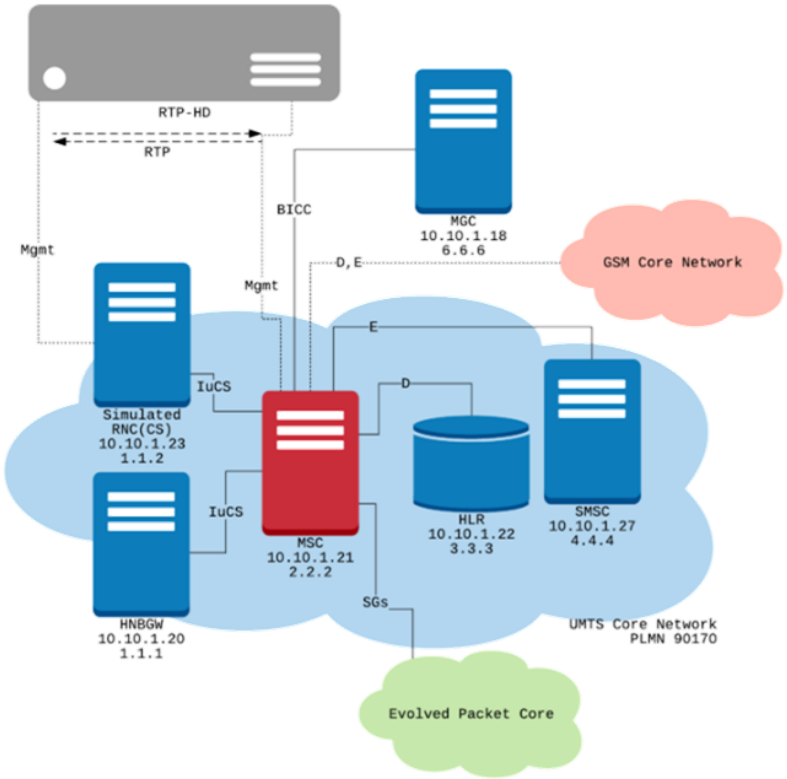
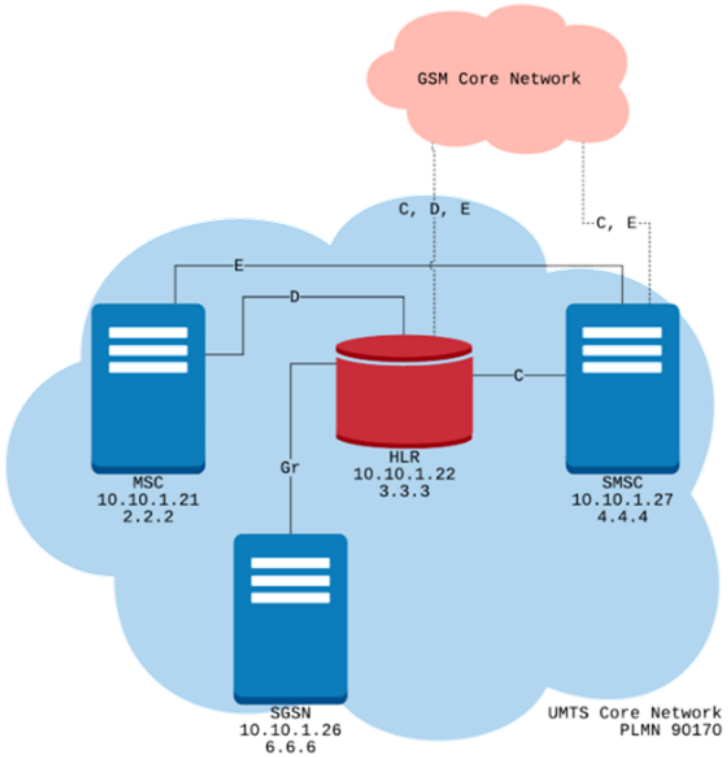
Testbed Setup: 3G MSC

Config	Value
MSS	
Enable or Disable RTP	Enable
RTP Hardware Interface Type	PC NIC
Exchange Type	Control
CIC Handling Method	Even
MSC	1
MSC 1	
MSC IP Address	10.10.1.21
MSC Name	VLRGL01
MSC Point Code	2.2.2
SCCP Routing Indicator	Route on GT
MSC E164 Global Title Address	234674368
MSC E214 Global Title Address	234674368
VLR E164 Global Title Address	234674368
VLR E214 Global Title Address	234674368
MSC Address Indicator	National
Nature Of MSC Address Indicator	Unknown
PLMN Identifiers	
Mobile Country Code	450
Mobile Network Code	80
Routing Area	
Handover Number Range	
Min	2222223000
Max	2222223010
Roaming Number Range	
Min	2222220000
Max	2222230000
RNC Parameters	
Supported RNCs	2
Supported RNCs 1	
MSC Port to RNC	2905
IuCS M3UA Termination Type	IPSP
RNC IP Address	10.10.1.20
RNC Port	2905
RNC Point Code	1.1.1
RNC Address Indicator	National
Signaling Link Selection	1
Network Indicator	International
Location Area Identifier	1
Location Area Identifier 1	
Location Area Code	0001
Service Area Code	0001
Routing Area Code	01
RNC ID	01



Testbed Setup: 3G HLR

Config	Value
HLR Interfaces	
HLR	1
HLR 1	
HLR IP Address	10.10.1.22
HLR Port	3905
HLR Point Code	3.3.3
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	10.10.1.21
Destination Port	3905
Source M3UA Termination Type	IPSP
Destination Point Code	2.2.2
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	234674368
Destination E214 Global Title Address	234674368
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	10.10.1.27
Destination Port	4905
Source M3UA Termination Type	IPSP
Destination Point Code	4.4.4
Network Indicator	National
Signaling Link Selection	1
M3UA Routing Context Indicator	Absent
M3UA Routing Context	1



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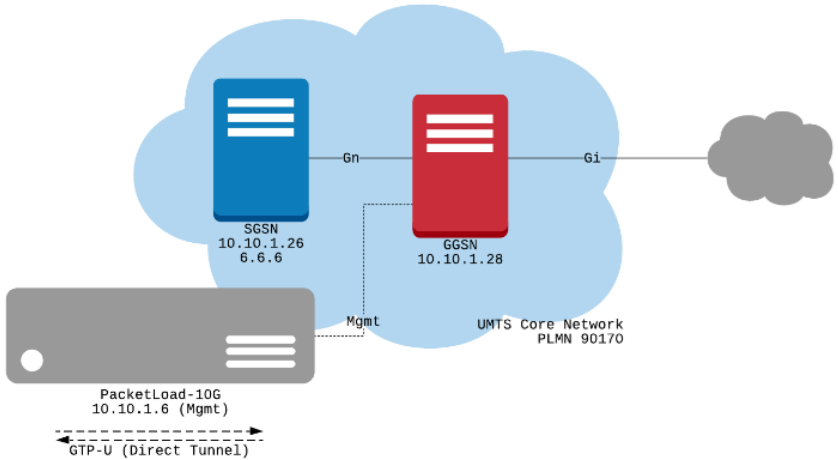
Testbed Setup: 3G GGSN

Config	Value
Adapter Index	2
GGSN Configurations	1
GGSN Configurations 1	
GGSN IP Address	10.10.1.28
GGSN Port	2123
GGSN IP Address For Traffic	10.10.1.28
GTP Port For Traffic	2152
Supported SGSN	
SGSN IP Address	10.10.1.26
SGSN Port	2123
Traffic	Enable
PacketLoad Management IP Address	10.10.1.6
Traffic Type	Gateway Traffic
PacketLoad Traffic Type	HTTP Traffic
End User Configuration	MS_Profiles.xml
APN Configuration	3
APN Configuration 1	
APN Name	default
Start IP	10.10.3.1
End IP	10.10.83.254
APN Configuration 2	
APN Name	internet
Start IP	10.10.101.1
End IP	10.10.200.254
APN Configuration 3	
APN Name	ims
Start IP	192.168.151.51
End IP	192.168.253.254
Protocol Configuration Options	
Primary DNS Address	8.8.8.8
Secondary DNS Address	8.8.4.4
Subnet Mask	255.255.255.0
Gateway IP Address	10.10.1.1
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	192.168.35.65



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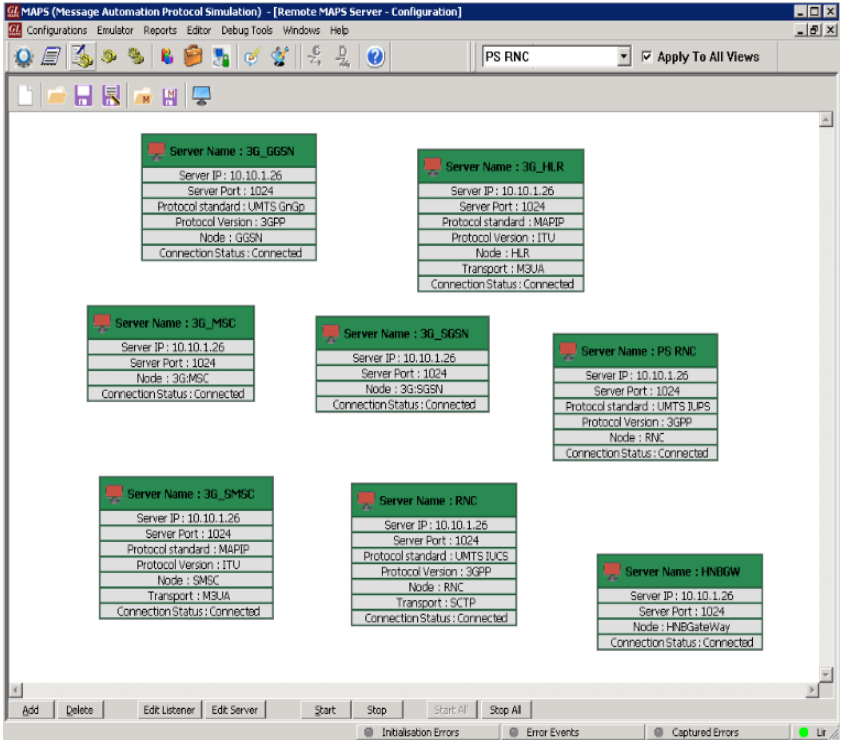
System Quick Start - Start Remote Controller

- The MAPS™ Listener is configured to run on start-up. While running an icon should be displayed in Windows notification area. If the icon is missing, invoke MAPSListener_x64 from the Desktop.
- Invoke MAPS™ Remote Controller from the 3G system Desktop.
- The Controller is configured to control the following MAPS™ nodes: RNCs (IuCS and IuPS), HNBGW, HLR, SMSC, SGSN, GGSN
- Start All to connect to all MAPS™ server nodes.



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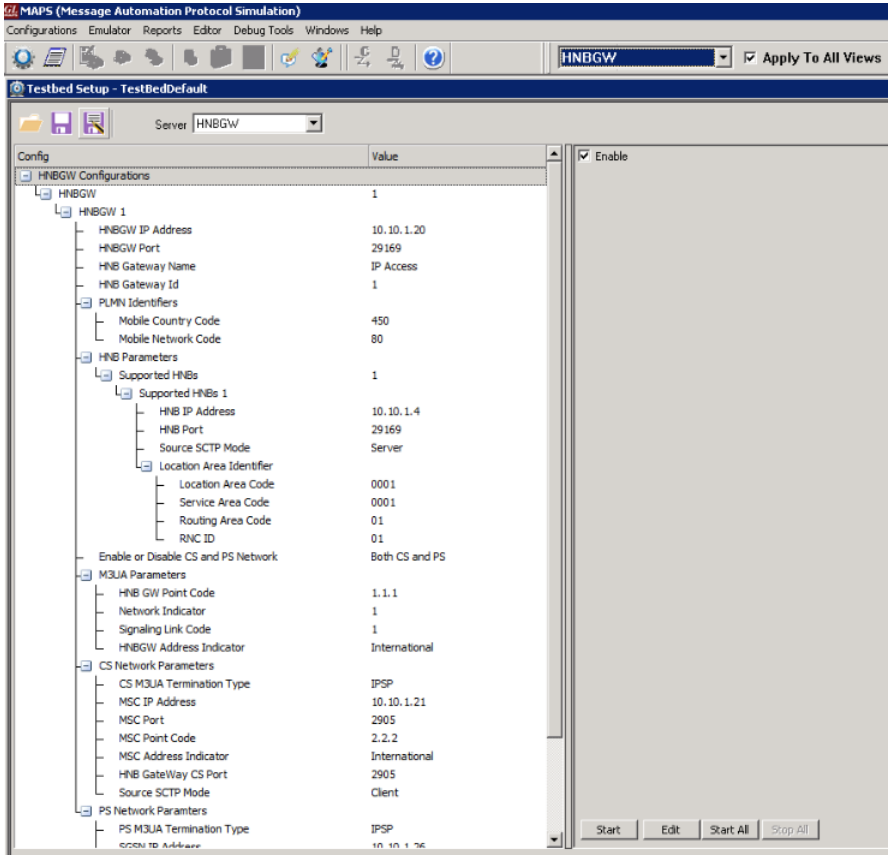
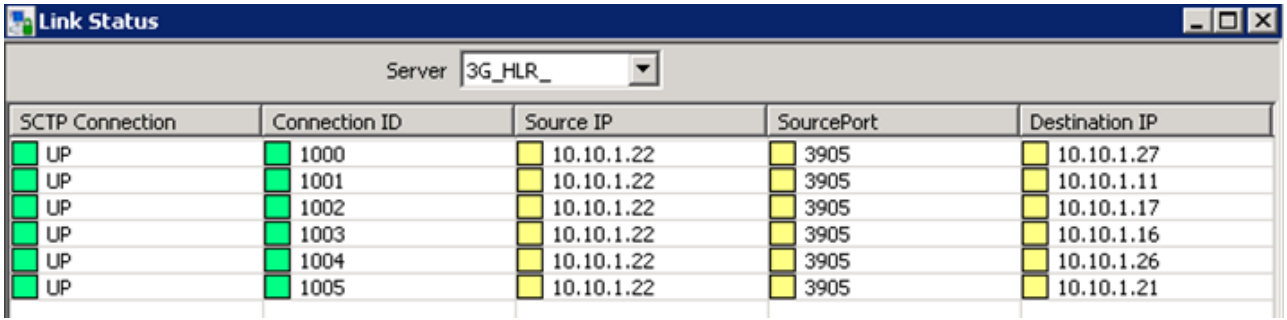
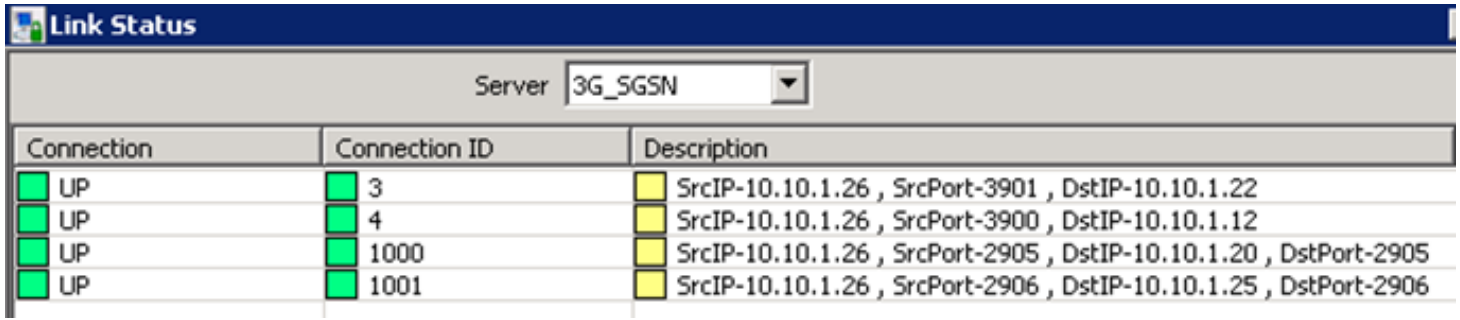
System Quick Start - Start Testbeds



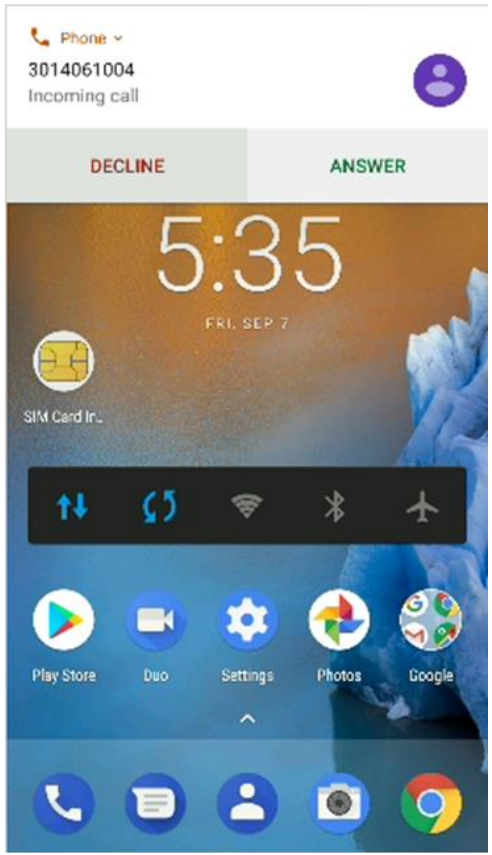
System Quick Start - Link Status

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



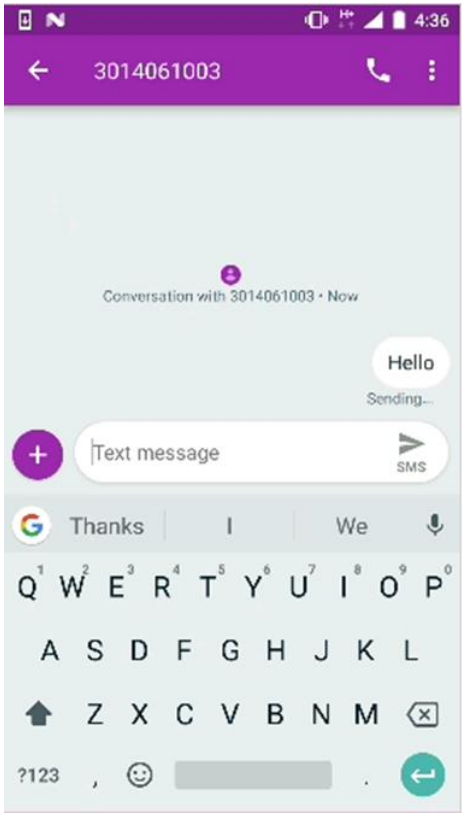


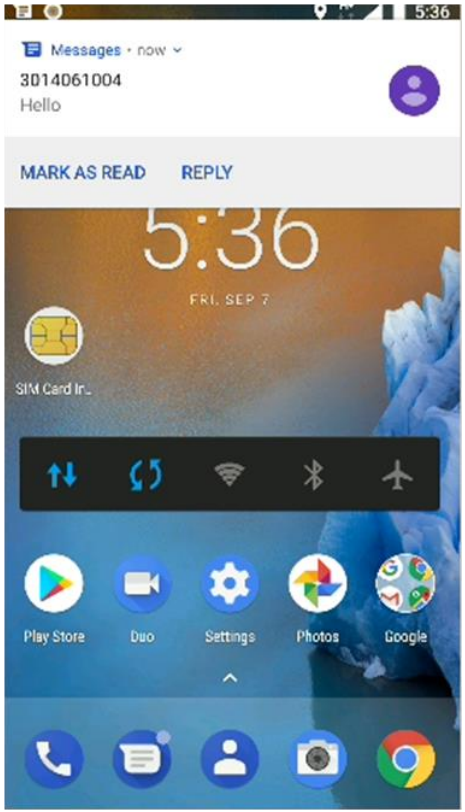
System Quick Start - 3G Calls w/ Real Mobiles



GL Communications

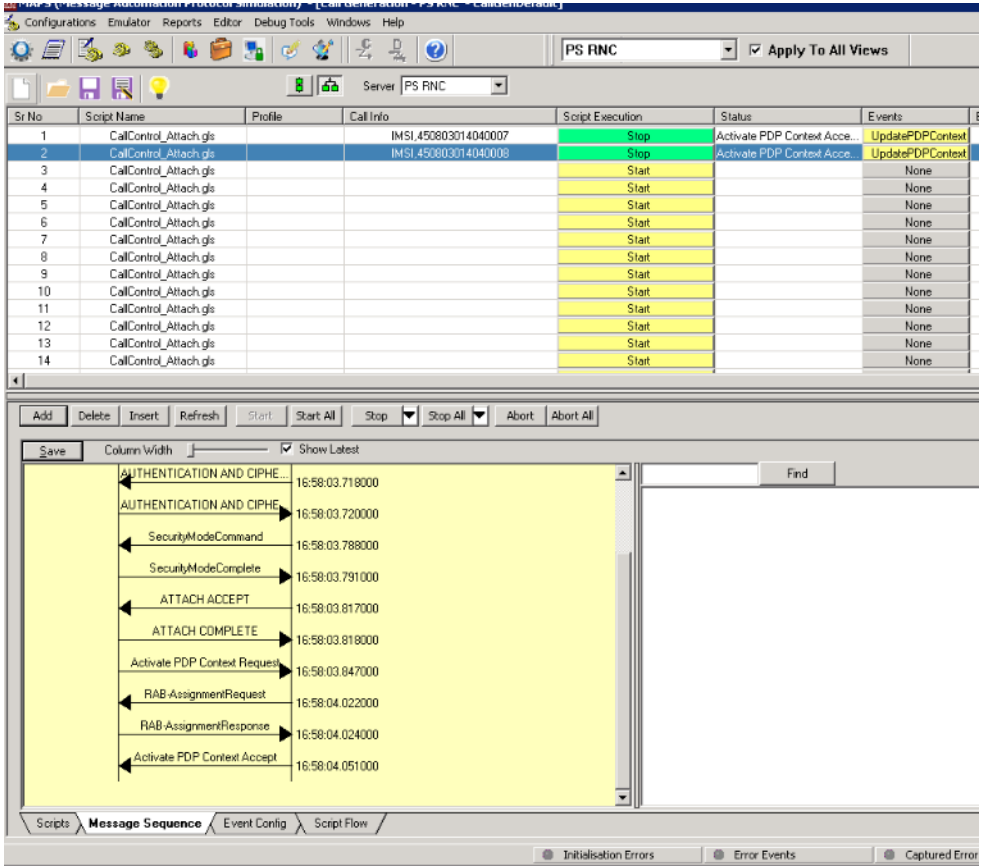
System Quick Start - 3G SMS w/ Real Mobiles





GL Communications

System Quick Start - Simulated Mobile Traffic



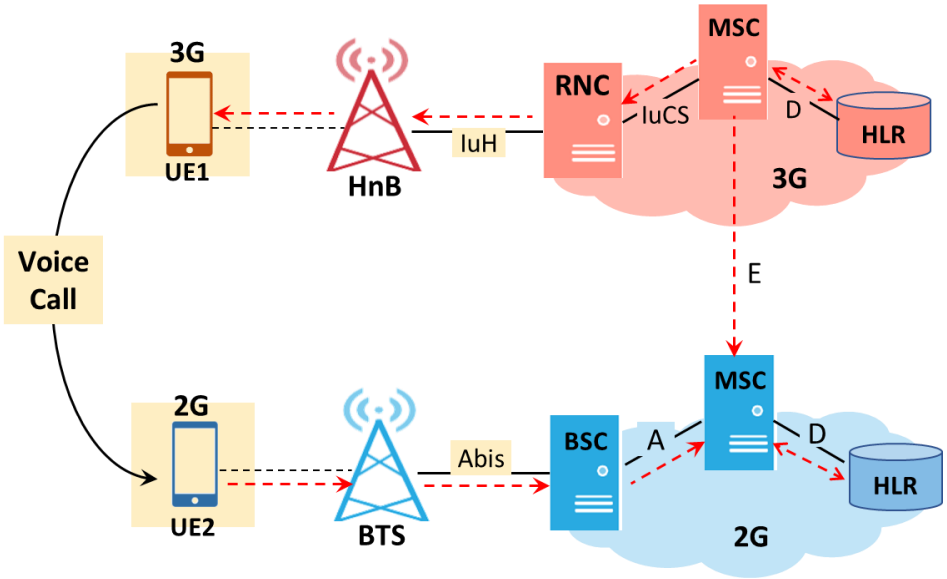
Inter-Networking 3G with 2G and 4G Lab (Inter-Operability)

Inter-Network Calls

- Inter-Network Calls
  - 3G user calling 2G user
  - 3G user calling 4G user
  - 3G user sending SMS to 2G user
  - 3G user sending SMS to 4G user
- Roaming calls
  - 3G user calling 2G roaming user
  - 3G user calling 4G roaming user

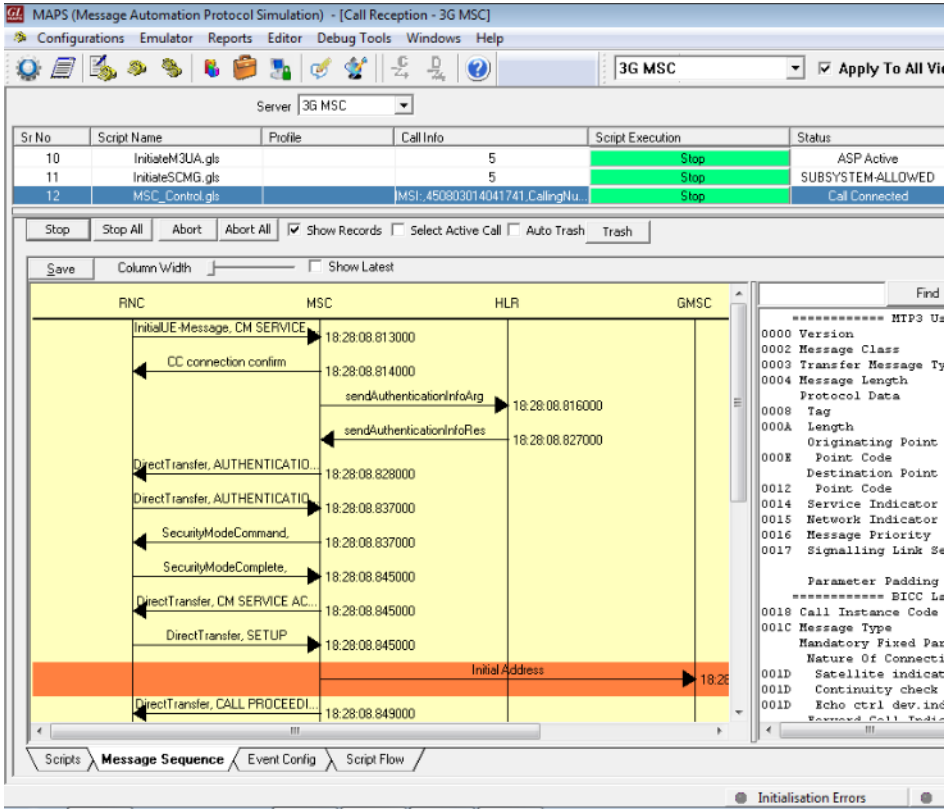
Inter-Network Calls- 3G calling 2G

- When a voice call or SMS call is placed from UE1 to UE2, MSC on 3G 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 2G MSC. MSC in the 2G network routes the request to 2G user.

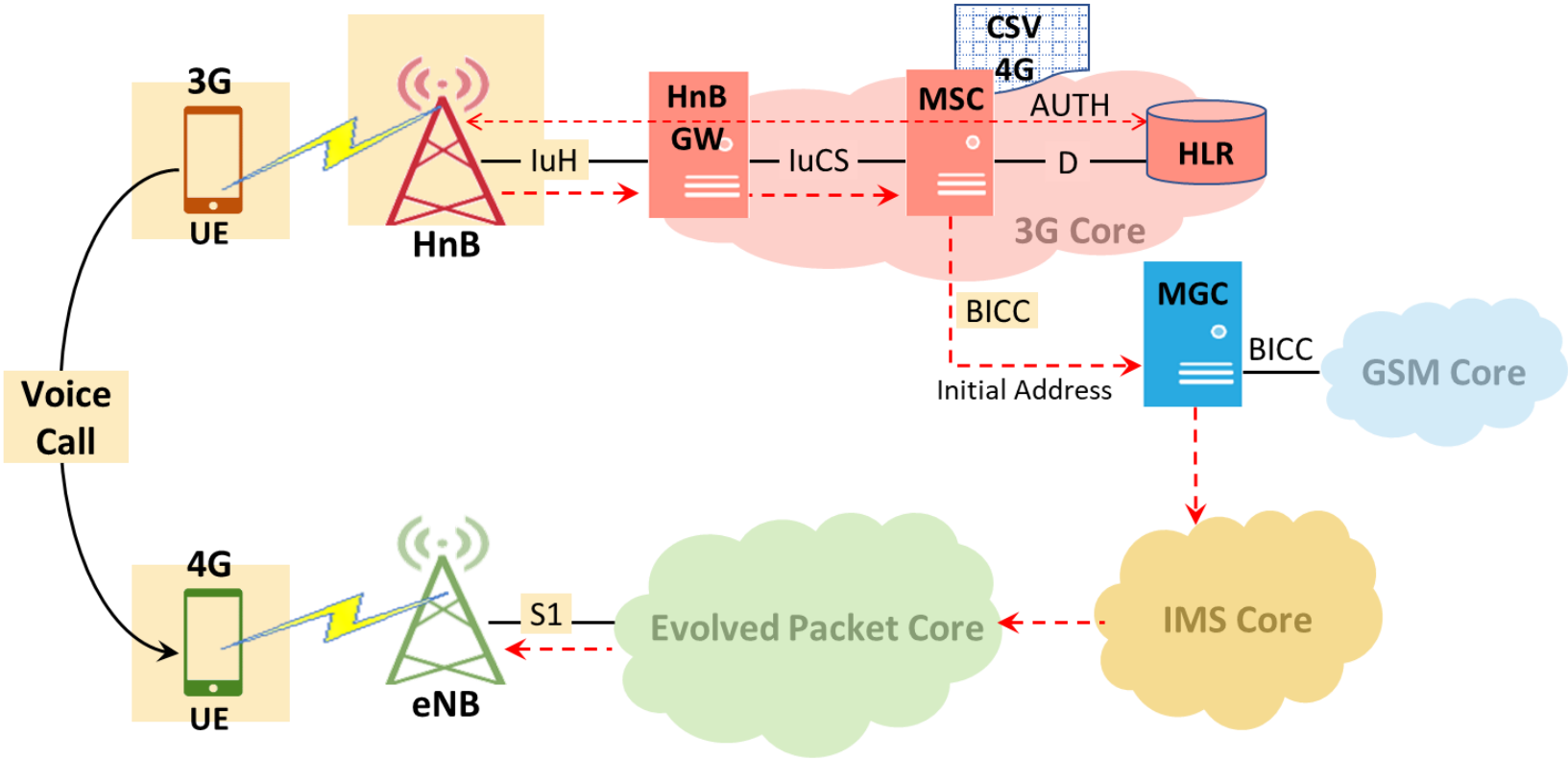


Inter-Network Calls- 3G calling 2G

- CM SERVICE REQUEST message is sent to 3G MSC
- Authentication procedure is initiated at the HLR Node
- When Setup Message (Voice Call) is received, MSC checks whether Called MSISDN is registered to 3G Network. If not, the Initial Address (BICC Call is initiated) towards GMSC.

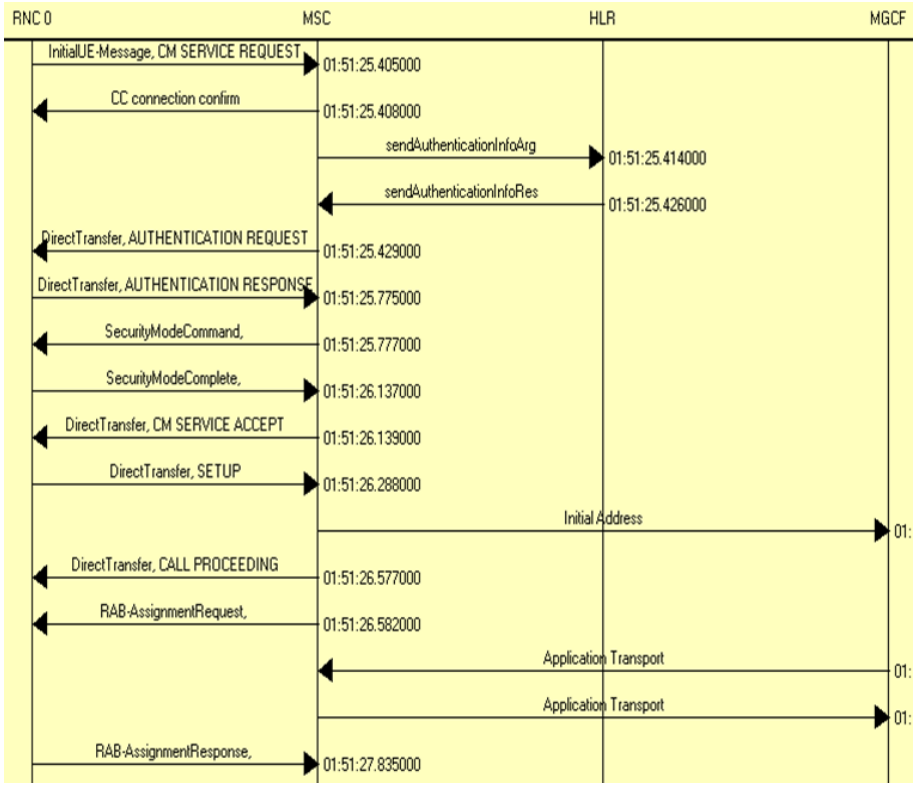


Inter-Network Calls - 3G calling 4G

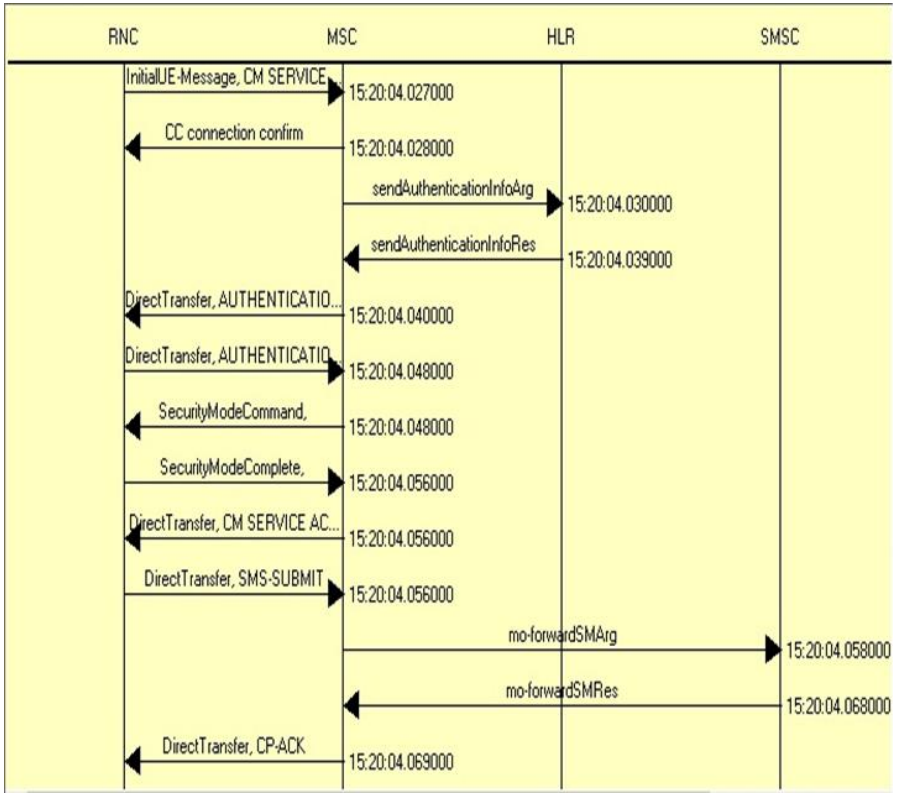


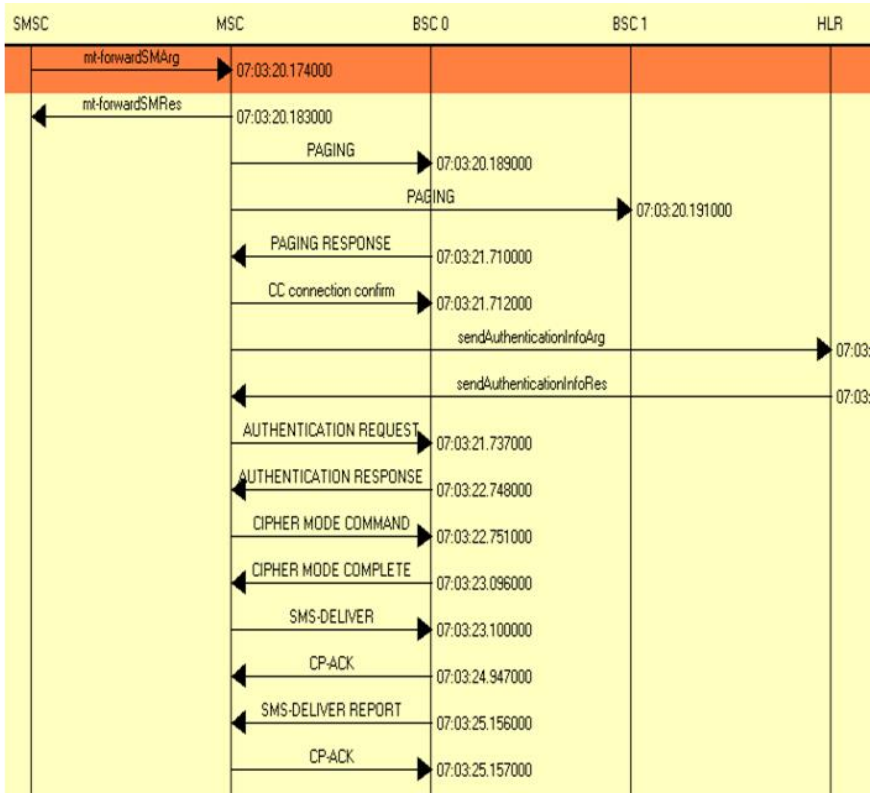
Inter-Network Calls - 3G calling 4G

- When a voice call is placed from UE1 to UE2, MSC on 3G network receives call from UE1 and checks for the received MSISDN registration using MAP table.
- If MAP is not found then MSC checks 4G CSV. If MSISDN is available in 4G CSV then call is routed to MGC using Initial Address Message.



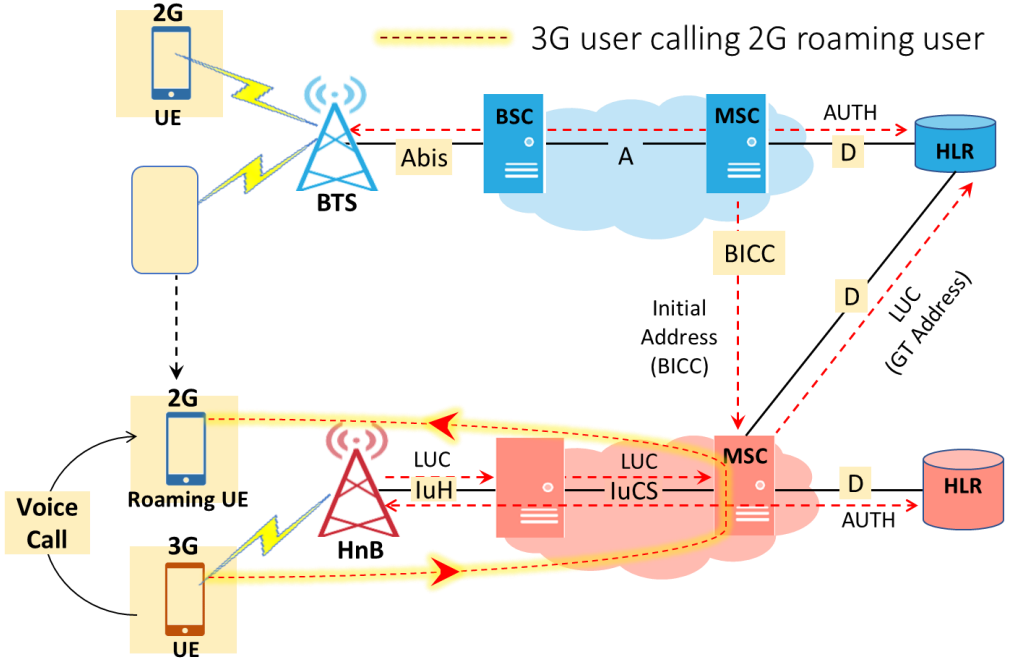
Inter-Network Calls - 3G SMS to 2G



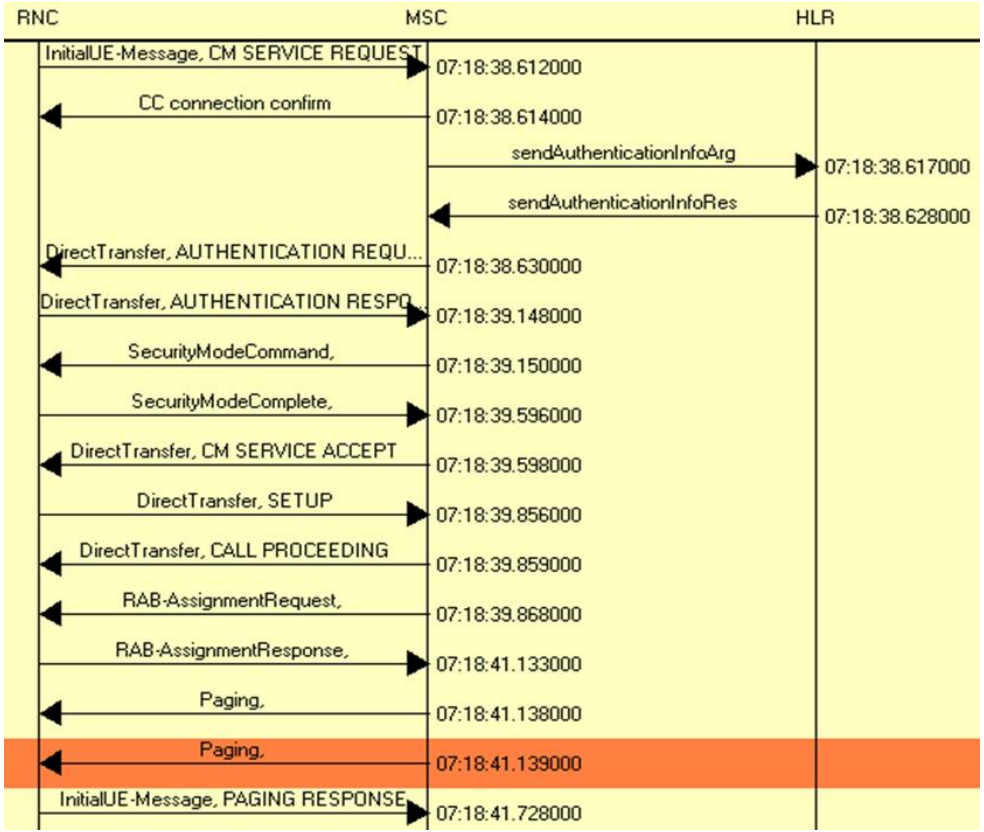


Roaming Calls - 3G Calling 2G Roaming UE

- When 3G user calls 2G roaming user, MSC receives Call and checks Called MSISDN is registered into MSC.
- If registered, Paging is initiated to RNC within 3G network to call 2G user.

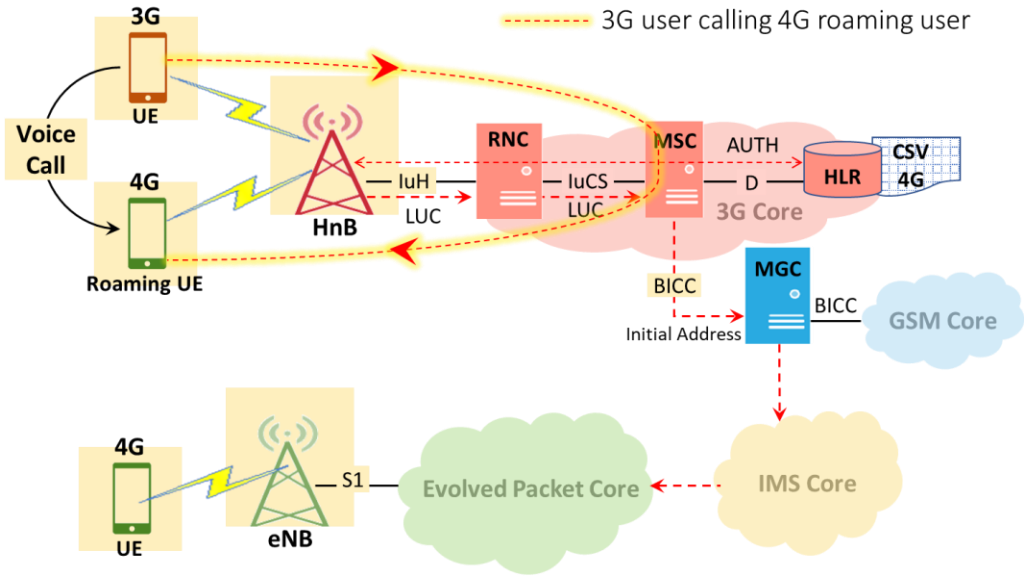


Roaming Calls - 3G Calling 2G Roaming UE



Roaming Calls - 3G Calling 4G Roaming UE

- 4G User when roaming into 3G Network registers to 3G MSC, i.e. Location update is performed and MSC has MSISDN vs IMSI MAP stored.
- When 3G user calls 4G roaming user, MSC receives Call and checks Called MSISDN is registered into MSC. If registered, Paging in initiated to RNC within 3G network to call 4G user.



PERFORMANCE...

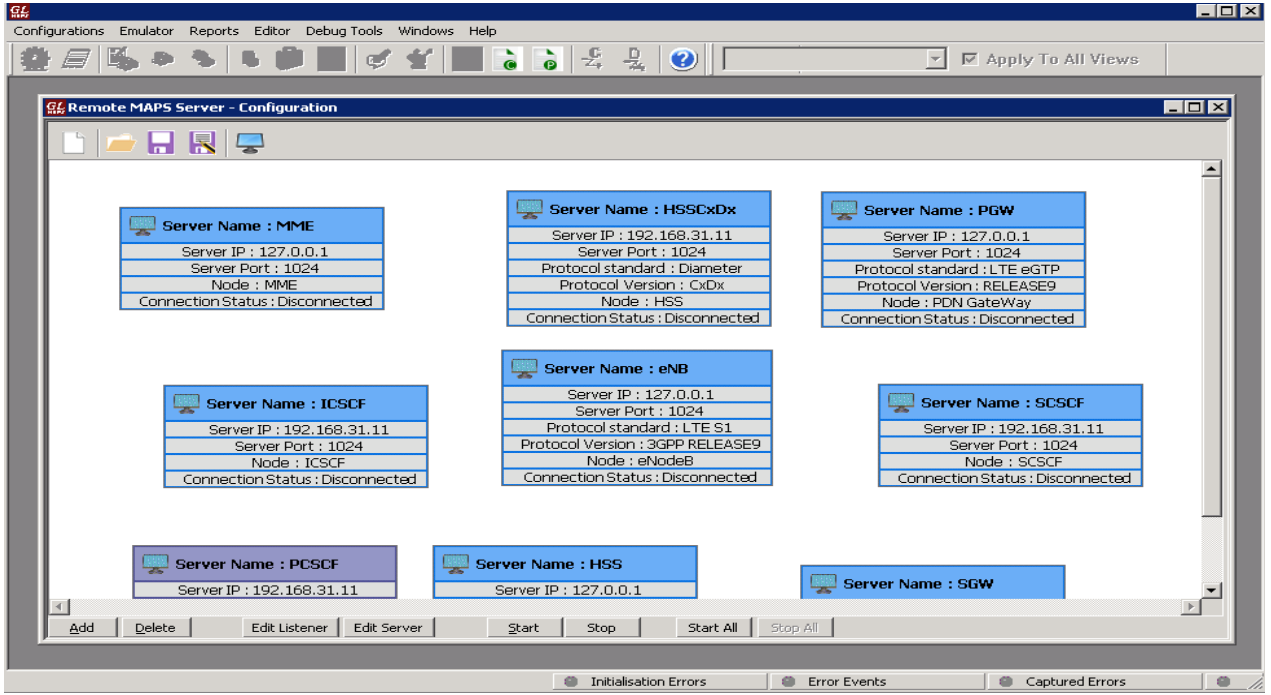
- Load, Stress, and Performance, Testing to measure the capability of an entity for various traffic conditions.
- Load /Stress test with different statistical distribution patterns with capacity of 2000 simultaneous calls,

  @ 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

MAPS™ Remote Controller

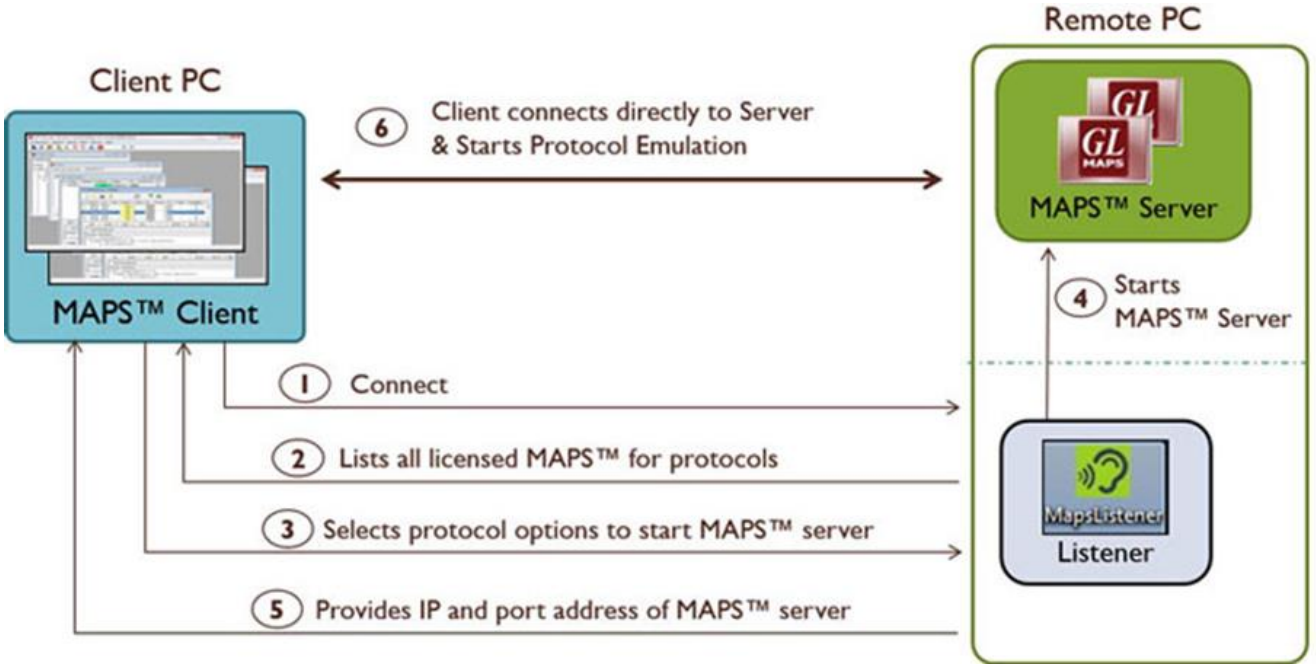
MAPS™ Remote Controller

- Remotely control multiple MAPS™ Servers running on different PCs from a single remote client application
- Allows multiple users to use MAPS™ products installed on a single MAPS™ server



MAPS™ Remote Controller

- Communicates with the multiple MAPS™ Server via Listener over TCP/IP.



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 (TCL, Python, Java and C#)
  - 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

THANK YOU