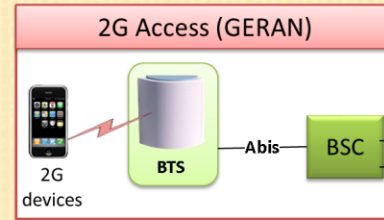
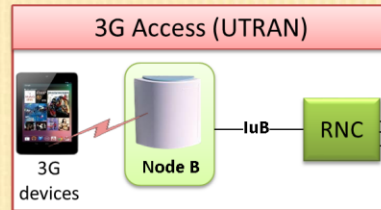


2G 3G 4G COMMUNICATIONS NETWORKS

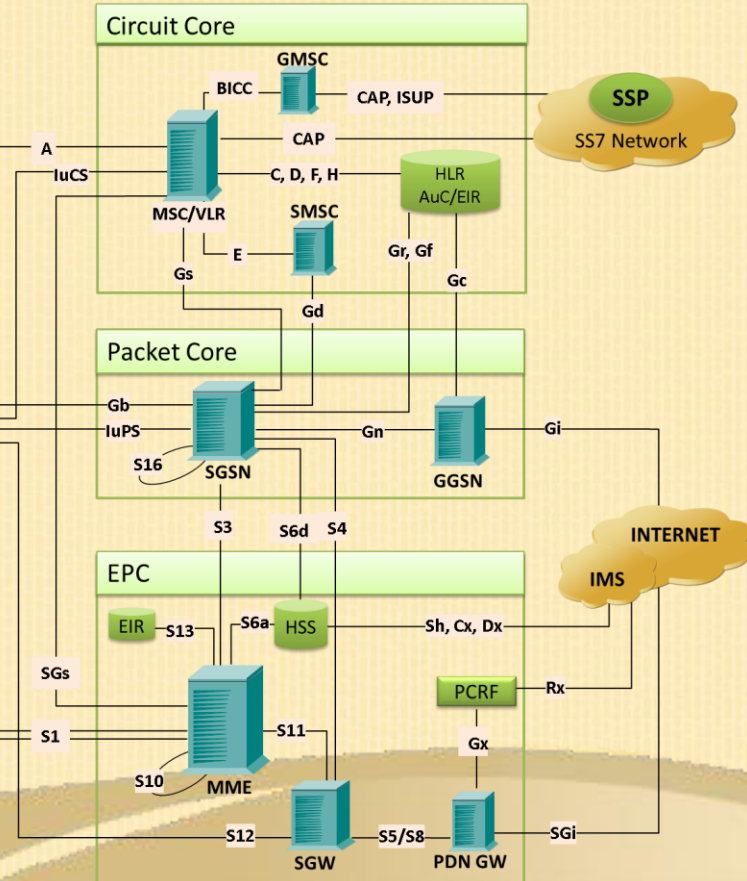
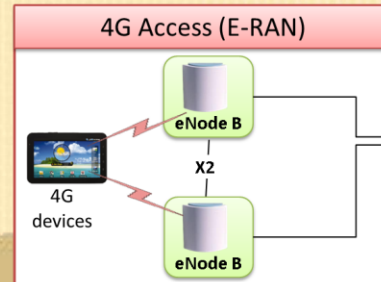
GSM, TDM and TDMA,
Core interfaces T1 E1 but
now migrating to IP



WCDMA, Same Core
network as 2G



LTE, OFDMA, SC-FDMA,
All IP



COMMUNICATIONS NETWORKS LAB (CNL)

- ❑ Each LAB test system emulates all the 2G/3G/4G 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

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.

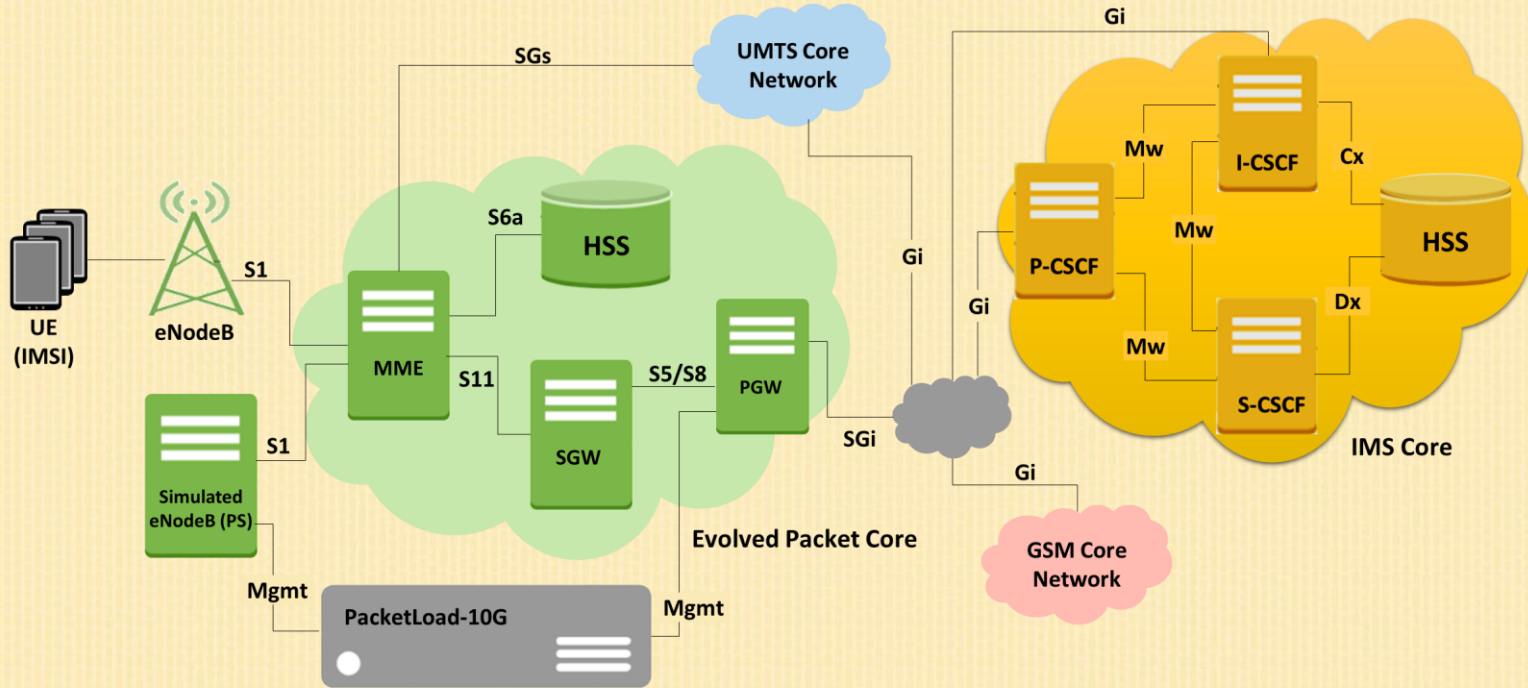
COMMUNICATIONS NETWORKS LAB (CNL)

4G LTE Diameter



GL Communications Inc

4G LAB DIAGRAM



 **4G LTE + IMS Core Network**

4G CALL SCENARIOS

Various LTE network procedures are supported simulating the 4G elements and multi-interfaces:

- ⊗ Mobile to mobile voice call
- ⊗ Simulated UE to mobile voice call
- ⊗ Mobile to Simulated UE voice call
- ⊗ Simulated UE to simulated UE voice call
- ⊗ Mobile web browsing
- ⊗ Inter and Intra Handovers
- ⊗ **Simulated UE web browsing**
 - Attach procedure
 - UE context setup procedures
 - Web browsing sessions
 - Detach procedures
 - Authentication information procedures

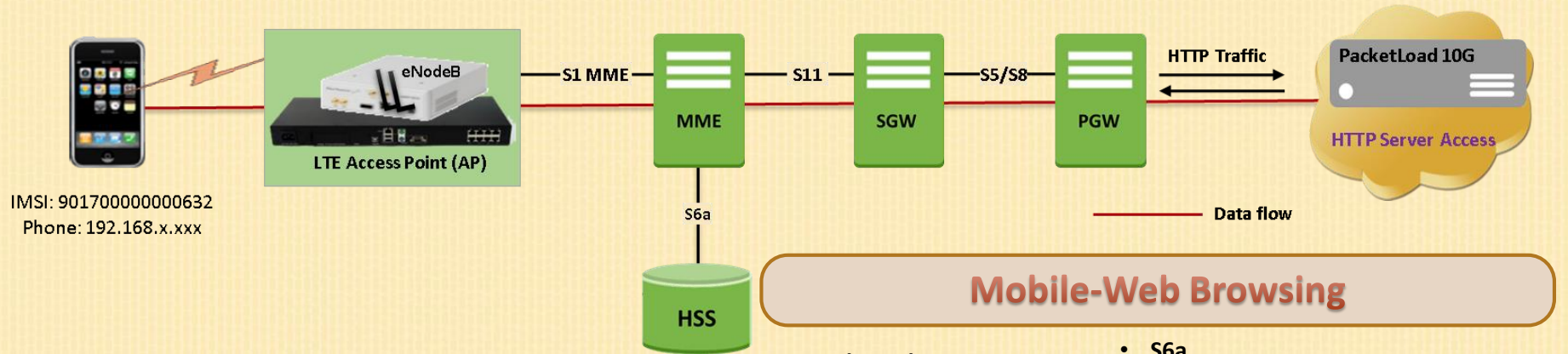
The following SGsAP procedures are supported when associations between MME and VLR (MSC) are established:

- ⊗ Paging for non-EPS Services
- ⊗ Location Update for Non-EPS Services
- ⊗ Non-EPS Alert
- ⊗ Explicit IMSI Detach from EPS Services
- ⊗ Explicit IMSI Detach from Non-EPS Services
- ⊗ Tunneling of NAS Messages

Traffic Generation: High Density packet (data sessions) traffic simulation using MAPS™ PacketLoad Server

- ⊗ Voice, Fax, Video
- ⊗ SMS, MMS, Email, FTP
- ⊗ Supplementary IN Services
- ⊗ Internet connectivity
- ⊗ Multiple PDP contexts

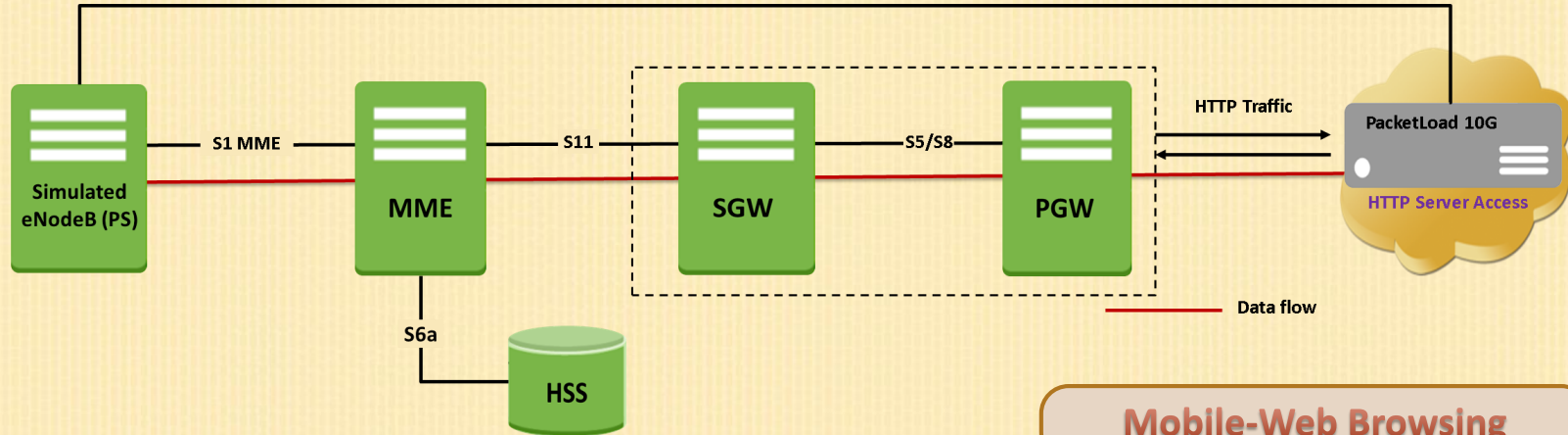
COMPLETE 4G CNL SYSTEM w/ Real eNodeB



Mobile-Web Browsing

- **Real eNodeB**
 - Rack PC
 - Real eNodeB UMTS cell
 - (x6) Phones with SIM cards
- **S6a**
 - MAPS™ Diameter (PKS139)
- **S1 MME**
 - MAPS™ LTE – S1 (PKS140)
- **S6a**
 - MAPS™ SGs (PKS 146)
- **S11**
 - MAPS™ LTE eGTP (PKS142)
 - MAPS™ Remote Controller (PKS111)
 - MobileTrafficCore-GTP (ETH101)
 - MobileTrafficCore-Gateway (ETH102)
- **High Density Bulk Call**
 - PacketLoad 4x10G Data Traffic Generator

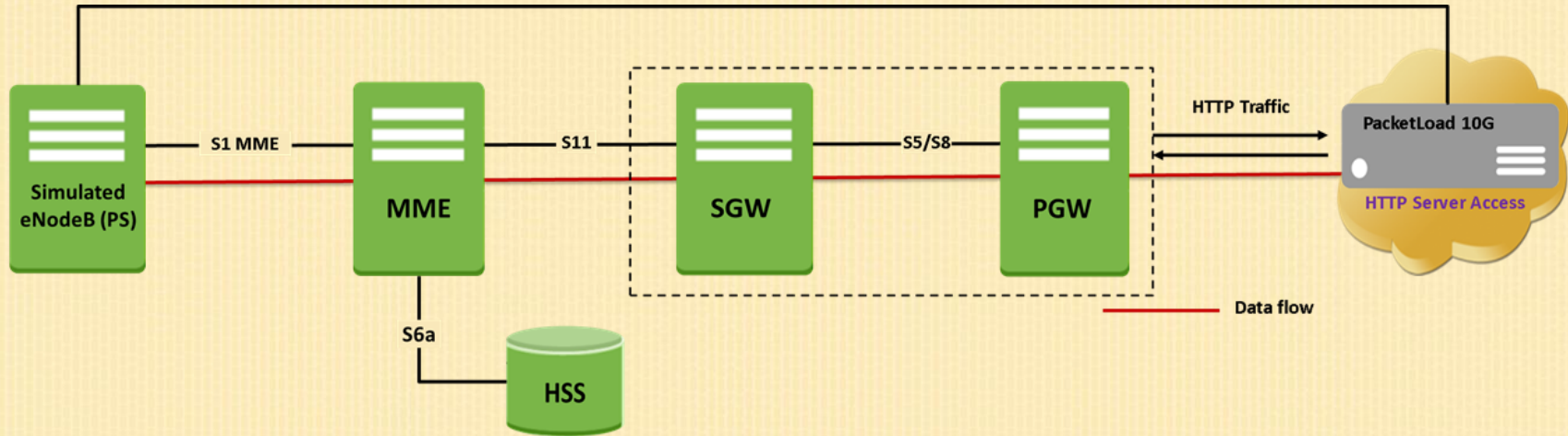
COMPLETE 4G CNL SYSTEM w/ Simulated eNodeB



Mobile-Web Browsing

- **S1 MME**
 - MAPS™ LTE S1 (PKS140)
- **S6a**
 - MAPS™ Diameter (PKS139)
- **S11**
 - MAPS™ LTE eGTP (PKS142)
 - MobileTrafficCore GTP (ETH101)
- **S5/S8**
 - MAPS™ LTE eGTP (PKS142)
 - MobileTrafficCore GTP (ETH101)

PROTOCOL STACK SPECIFICATION



NAS
S1-AP
SCTP
IP
S1

Diameter
SCTP
IP
S6a

GTP-u
GTP-C
UDP
IP
S11, S5/S8

PROTOCOL STACK SPECIFICATION

Supported Protocols	Specification Used
S1 Interface	
S1 Application Protocol (S1-AP)	3GPP 36.413 9.0.0 (2009-09)
Non-Access-Stratum (NAS)	3GPP TS 24.301 V9.0.0 (2009-09)
S11, S5/S8 Interface	
Evolved GTP (eGTP) for EPS	3GPP TS 29.274 V8.0.0 (2008-12)
Evolved GTP (eGTP) for EPS	3GPP TS 29.274 V9.2.0 (2010-03)
S6a Interface	
Diameter	IETF RFC 3588 S6a - 3GPP TS 29.272 V10.3.0

MOBILE TO MOBILE VOICE LAB



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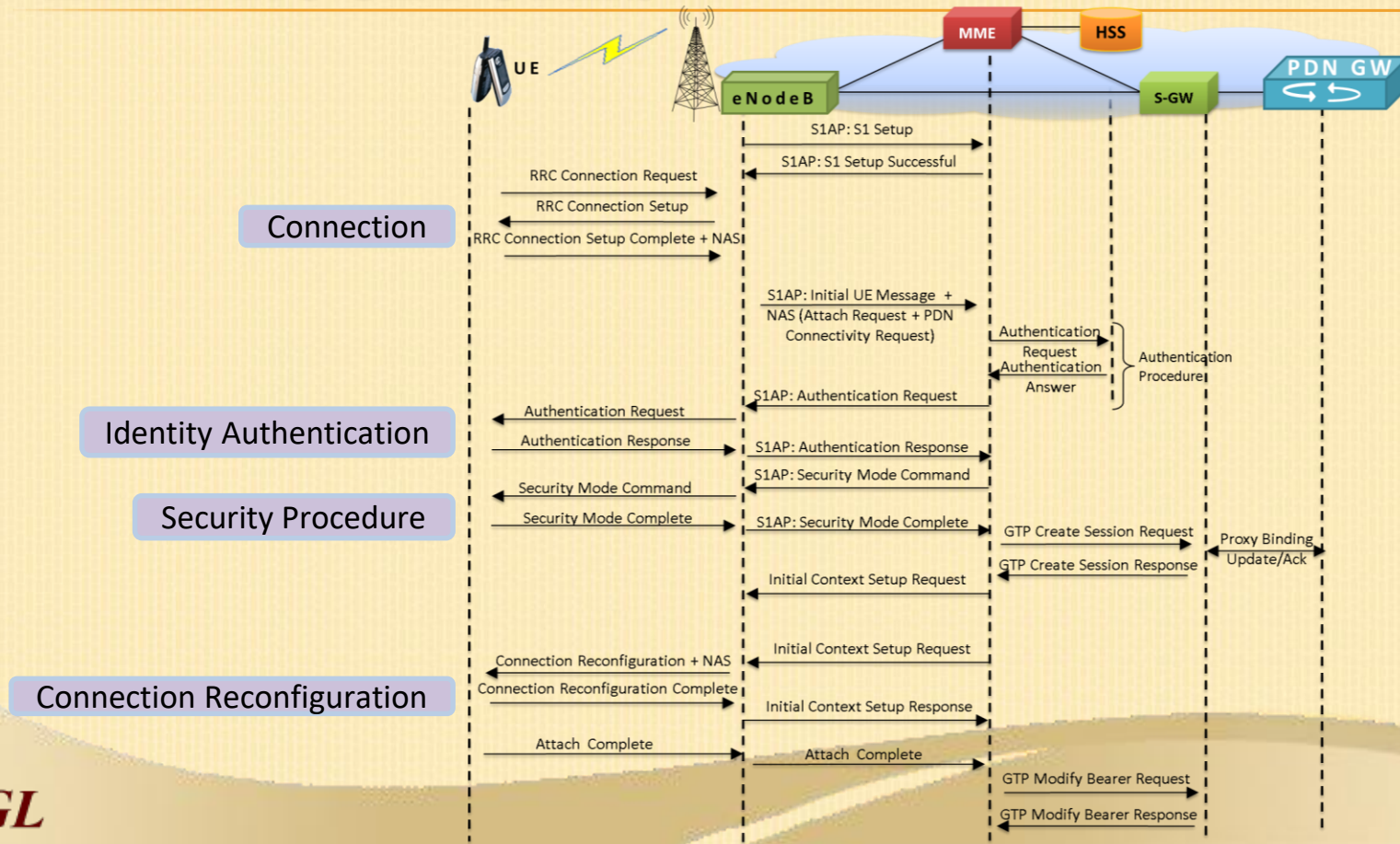
PROCEDURES - CS

- ❑ Mobile to mobile voice call
- ❑ Simulated UE to mobile voice call
- ❑ Mobile to Simulated UE voice call
- ❑ Simulated UE to simulated UE voice call
- ❑ Voice over LTE
- ❑ Inter and Intra Handovers

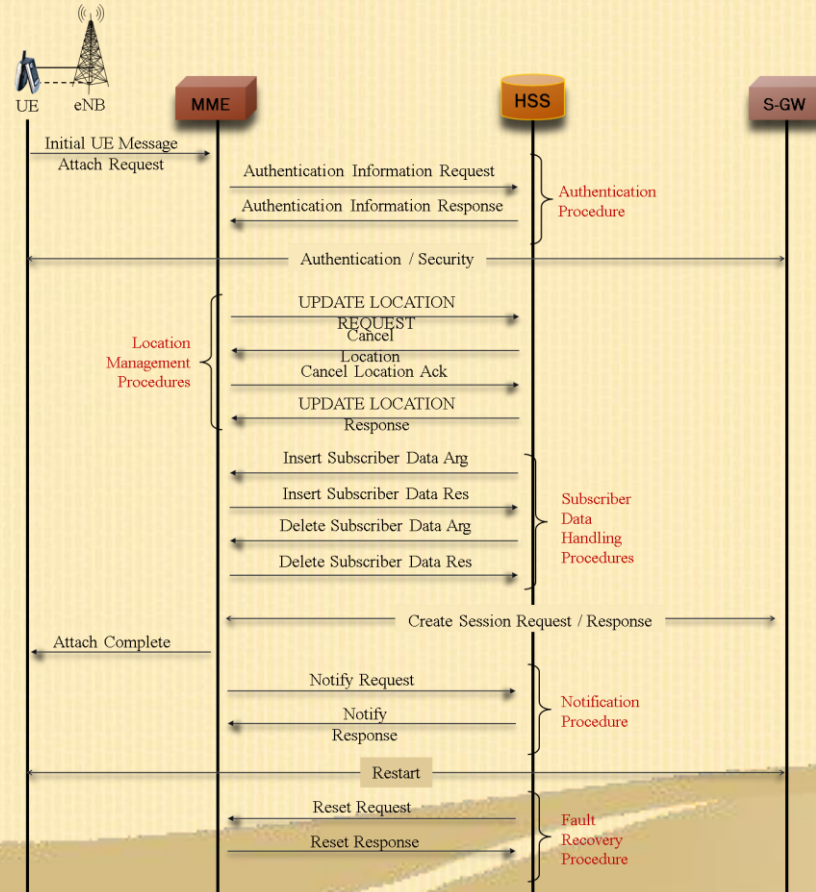
LTE and DIAMETER PROCEDURES - PS

- ❑ **ATTACH PROCEDURE**
- ❑ **UE CONTEXT SETUP PROCEDURES**
- ❑ **HTTP TRAFFIC and WEB BROWSING PROCEDURES**
- ❑ **DETACH PROCEDURES**
- ❑ **AUTHENTICATION INFORMATION PROCEDURE**

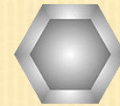
LTE PROCEDURES



HSS PROCEDURES



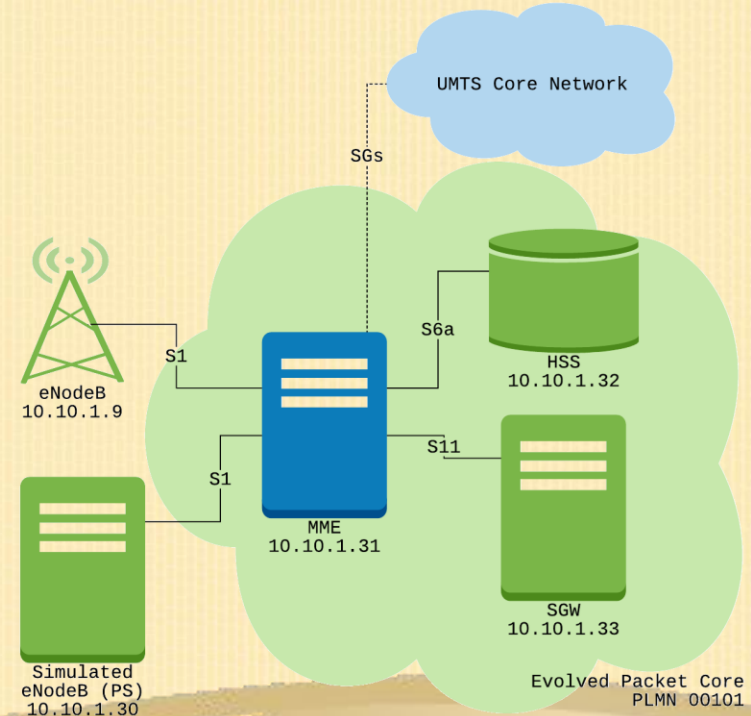
4G LAB CONFIGURATIONS



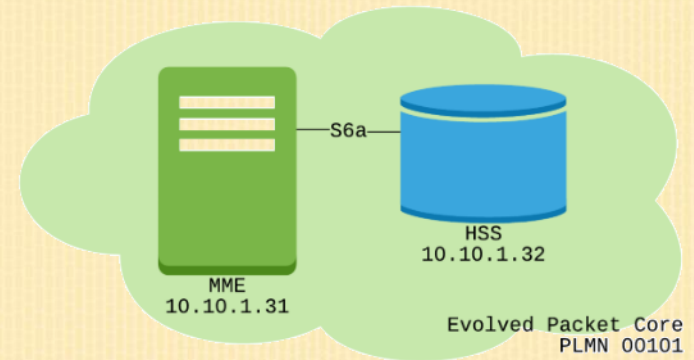
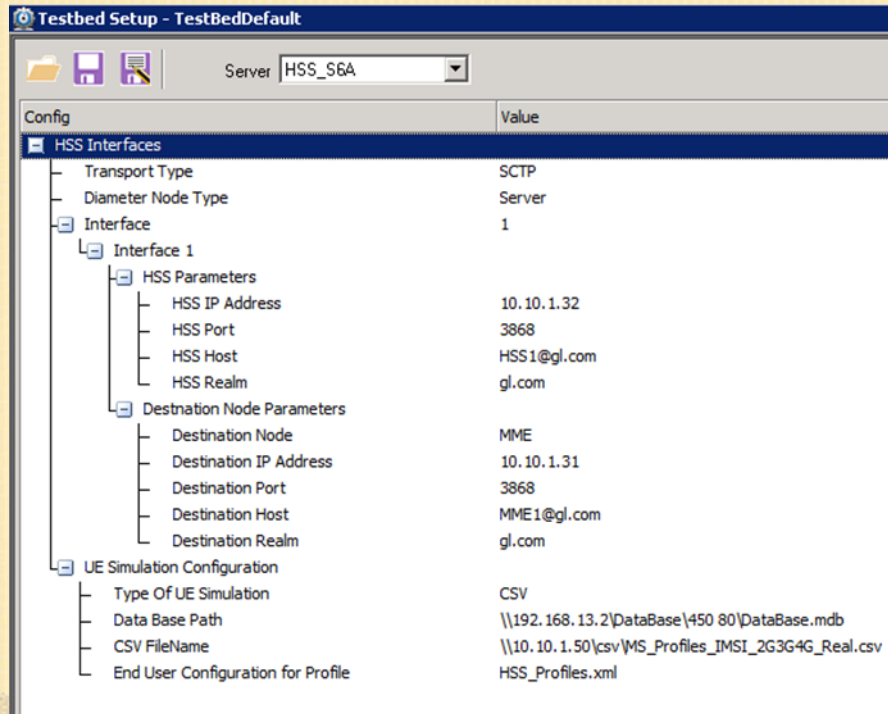
GL Communications Inc

TESTBED SETUP: 4G MME

Config	Value
TestBedDefault	
MME	1
MME1	
MME IP Address	10.10.1.31
PLMN Id	
Mobile Country Code	001
Mobile Network Code	01
MME Group Id	0328
MME Code	52
MME Name	MME01
SupportedNBs	2
SupportedNBs 1	
eNodeB1	
eNodeB IP Address	10.10.1.30
eNodeB Port	36412
MME Port For eNodeB	36412
Source SCTP Mode	Server
eNodeB Id	197094
eNodeB Name	eNB01
TAC	0002
SupportedNBs 2	
eNodeB1	
eNodeB IP Address	10.10.1.9
eNodeB Port	36412
MME Port For eNodeB	36412
Source SCTP Mode	Server
eNodeB Id	197094
eNodeB Name	eNB02
TAC	0001
MME Diameter Configuration	
MME Parameters	
MME IP Address For HSS	10.10.1.31
MME Host	MME1@gl.com
MME Realm	gl.com
HSS Parameters	1
HSS Parameters 1	
HSS IP Address	10.10.1.32
HSS Port	3868
MME Port For HSS	3868
Source SCTP Mode	Client
HSS Host	HSS1@gl.com
HSS Realm	gl.com
HSS PLMN	00101

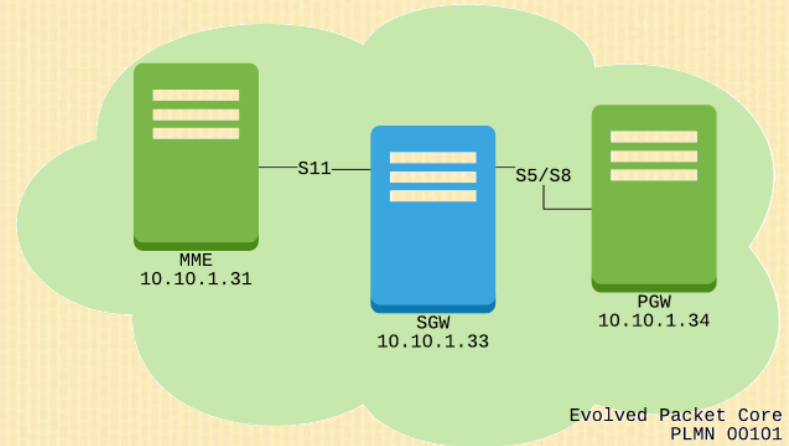


TESTBED SETUP: 4G HSS



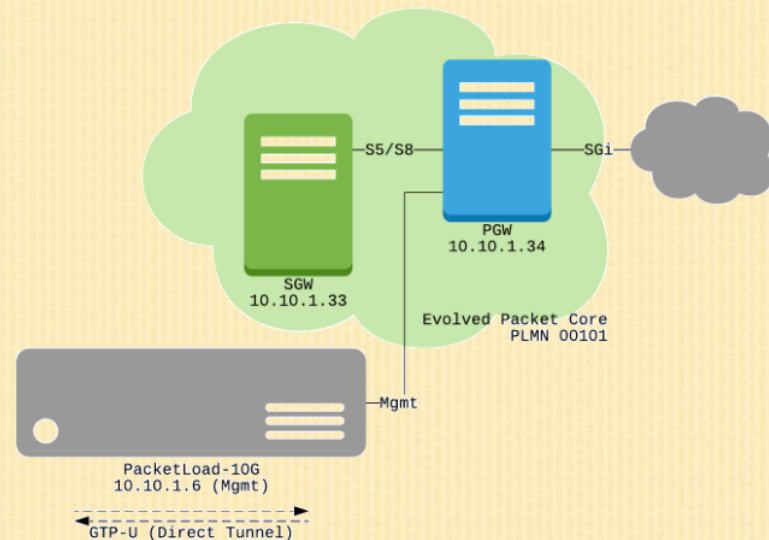
TESTBED SETUP: 4G SGW

Config	Value
SGW Configuration	
Adapter Index	1
Direct Tunnel	Enable
SGW	
SGW IP Address	10.10.1.33
SGW Port	2123
SGW IP Address For S11u	10.10.1.33
GTP Port For Traffic	2152
MME Configuration	
MME IP address	10.10.1.31
MME Port	2123
PGW Configurations	
PGW IP Address	10.10.1.34
PGW Port	2124
SGW IPAddress For PGW	10.10.1.33
SGW IPAddress for SSS8U	10.10.1.33
SGW Port For PGW	2124
Traffic	Disable
Traffic Type	GatewayTraffic

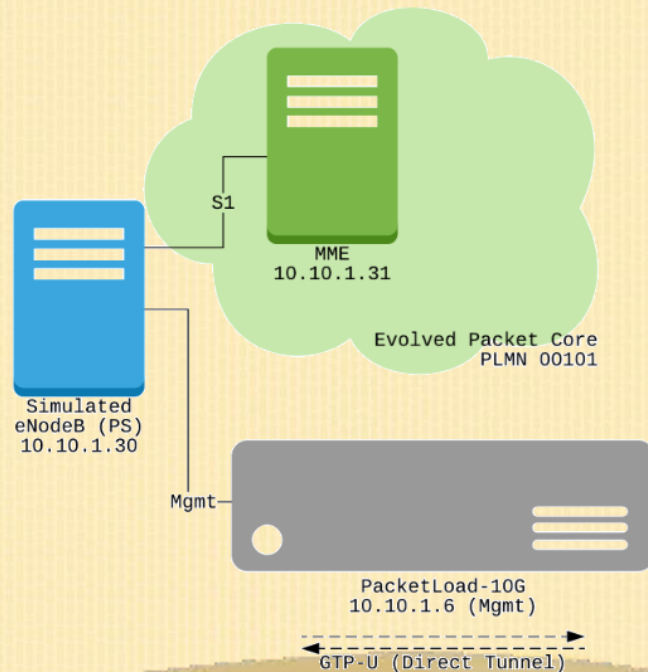
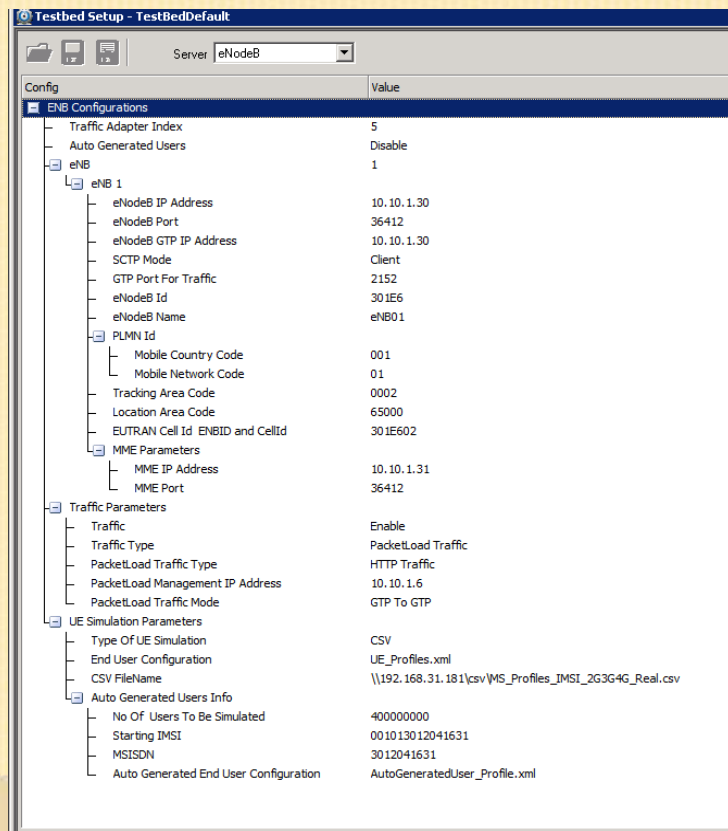


TESTBED SETUP: 4G PGW

Config	Value
PG Configuration	
Traffic Adapter Index	0
PGW	1
PGW	
PGW IP Address	10.10.1.34
PGW Port	2124
PGW IP Address for Traffic	10.10.1.34
PGW Port for Traffic	2152
SGW Configuration	
SGW IP Address	10.10.1.33
SGW Port	2124
Traffic Parameters	
Traffic	Enable
TrafficType	Gateway Traffic
PacketLoad Traffic Type	HTTP Traffic
PacketLoad Management IP Address	10.10.1.6
Protocol Configuration Options	
Primary DNS IP Address	8.8.8.8
Secondary DNS IP Address	192.168.1.3
Gateway IP Address	10.10.1.40
Subnet Mask	255.255.0.0
APN Configuration	3
APN Configuration 1	
APN Name	default
Start IP	10.30.5.1
End IP	10.40.7.250
APN Configuration 2	
APN Name	internet
Start IP	10.50.8.1
End IP	10.60.10.250
APN Configuration 3	
APN Name	ims
Start IP	10.10.1.150
End IP	10.10.1.250
End User Configuration	
Type Of UE Simulation	MS_Profiles.xml
CSV FileName	CSV
Auto Generated Users Info	\\192.168.31.181\csv\MS_Profiles_IMSI_2G3G4G_Real.csv
PCSCF IP Address	10.10.1.40
HTTP Web Server IP Address	192.168.45.65

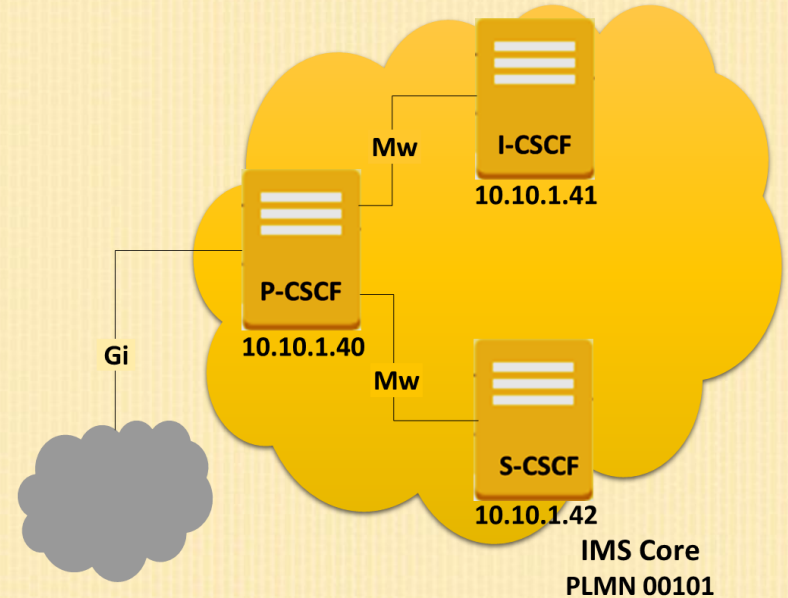


TESTBED SETUP: 4G Simulated eNB



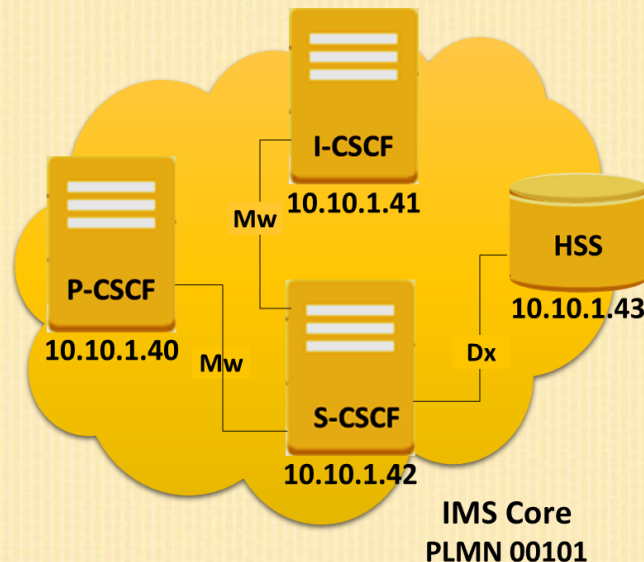
TESTBED SETUP: IMS P-CSCF

Config	Value
PCSCF Configuration	
PCSCF Address	10.10.1.40
PCSCF Port	5060
Address Of Record	pcscf.ims.mnc001.mcc001.3gppnetwork.org
Transport	UDP
Visited Network Id	ims.mnc001.mcc001.3gppnetwork.org
PCSCF Diameter Configurations	
Interface	1
Interface 1	
PCSCF Parameters	
PCSCF Port	3871
PCSCF Host	PCSCF.ims.mnc001.mcc001.3gppnetwork.org
PCSCF Realm	ims.mnc001.mcc001.3gppnetwork.org
Destination Node Parameters	
Destination Node	PCRF
Destination IP Address	192.168.13.151
Destination Port	3868
Destination Host	PCRF.ims.mnc001.mcc001.3gppnetwork.org
Destination Realm	ims.mnc001.mcc001.3gppnetwork.org



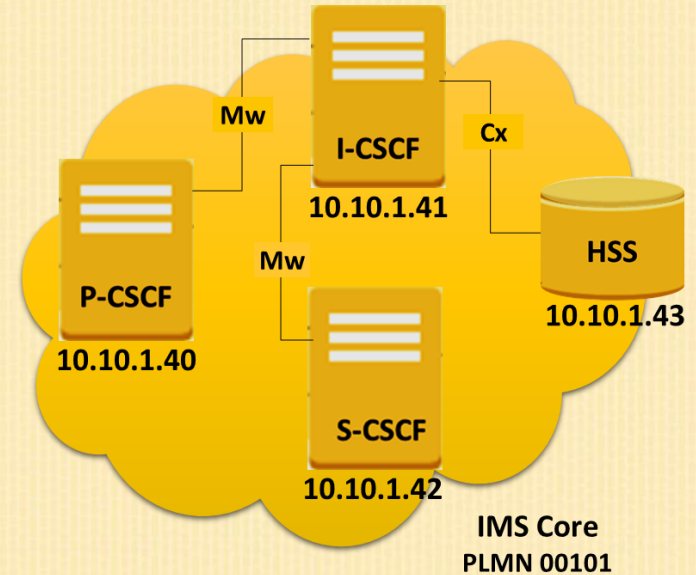
TESTBED SETUP: IMS S-CSCF

Config	Value
SCSCF Configuration	
Transport type	SCTP
Diameter Node Type	Client
SCSCF IP Address	10.10.1.42
SCSCF Port	5060
SCSCF Domain	scscf.ims.mnc001.mcc001.3gppnetwork.org
Enable or Disable Diameter Protocol	Enable
Enable or Disable MAP/IP Protocol	Disable
SCSCF Diameter Configurations	
Interface	1
Interface 1	
SCSCF Parameters	
SCSCF Port	3868
SCSCF Host	scscf@ims.mnc001.mcc001.3gppnetwork.org
SCSCF Realm	ims.mnc001.mcc001.3gppnetwork.org
Destination Node Parameters	
Destination Node	HSS
Destination IP Address	10.10.1.43
Destination Port	3868
Destination Host	HSS@ims.mnc001.mcc001.3gppnetwork.org
Destination Realm	ims.mnc001.mcc001.3gppnetwork.org
SCSCF MAP Configuration	
SCSCF	1
SCSCF 1	
SCSCF Point Code	0.0.1
SCCP Routing Indicator	Route on GT
SCSCF E164 Global Title Address	234674368
SCSCF E214 Global Title Address	234674368
SCSCF Address Indicator	International
Nature Of SCSCF Address Indicator	International Number
Connected Destination Nodes	2
Connected Destination Nodes 1	
Node or Interface Type	SMSC
Source SCTP Mode	Client
Destination IP Address	192.168.13.7
Destination Port	4905
SCSCF Port	5905
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
Destination SCSP Routing Indicator	Route on GT



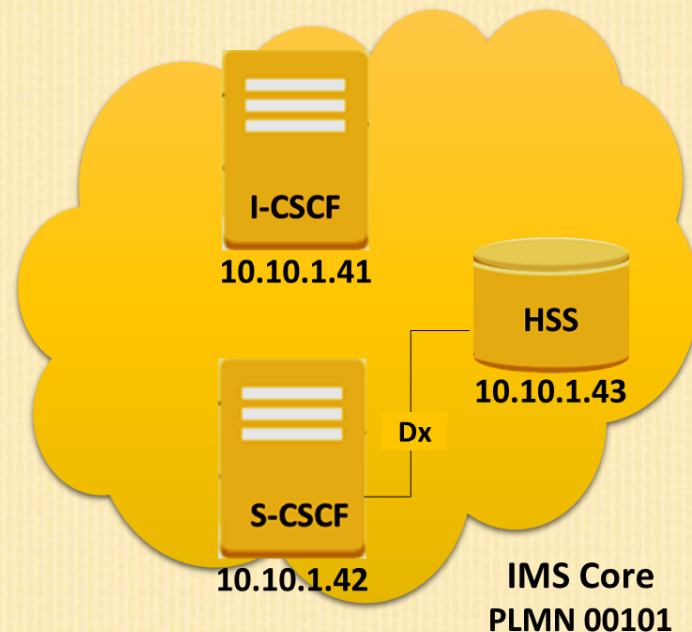
TESTBED SETUP: IMS I-CSCF

Config	Value
ICSCF Configuration	
Tranport type	SCTP
Diameter Node Type	Client
ICSCF Address	10.10.1.41
ICSCF Port	5060
ICSCF Diameter Configurations	
Interface	1
Interface 1	
ICSCF Parameters	
ICSCF Port	3868
ICSCF Host	icscf@ims.mnc001.mcc001.3gppnetwork.org
ICSCF Realm	ims.mnc001.mcc001.3gppnetwork.org
Destination Node Parameters	
Destination Node	HSS
Destination IP Address	10.10.1.43
Destination Port	3868
Destination Host	HSS@ims.mnc001.mcc001.3gppnetwork.org
Destination Realm	ims.mnc001.mcc001.3gppnetwork.org



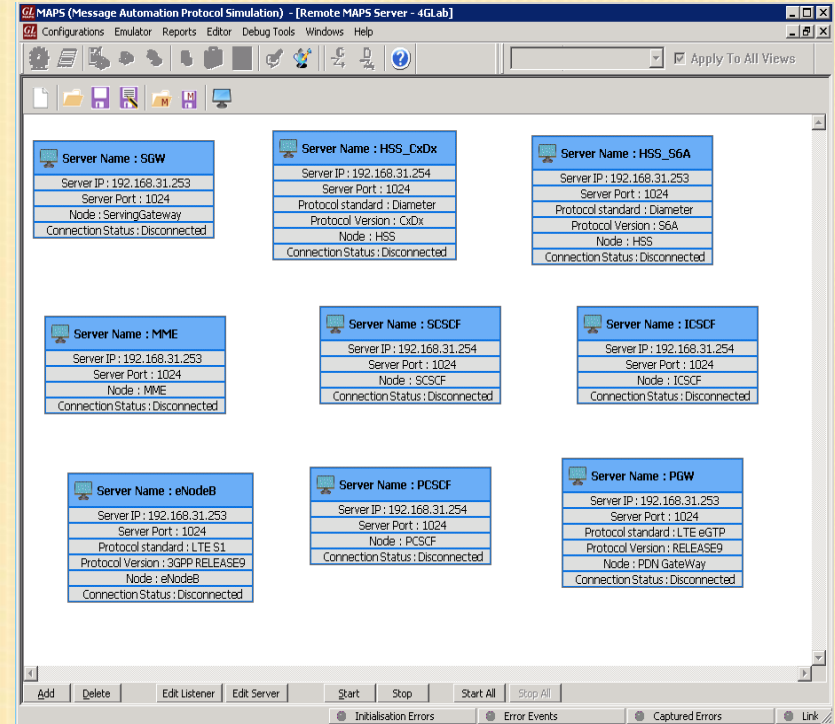
TESTBED SETUP: IMS HSS (Cx Dx)

Config	Value
HSS Interfaces	
Transport type	SCTP
Diameter Node Type	Server
Interface	2
Interface 1	
HSS Parameters	
HSS IP Address	10.10.1.43
HSS Port	3868
HSS Host	HSS@ims.mnc001.mcc001.3gppnetwork.org
HSS Realm	ims.mnc001.mcc001.3gppnetwork.org
Destination Node Parameters	
Destination Node	SCSCF
Destination IP Address	10.10.1.42
Destination Port	3868
Destination Host	SCSCF@ims.mnc001.mcc001.3gppnetwork.org
Destination Realm	ims.mnc001.mcc001.3gppnetwork.org
Interface 2	
HSS Parameters	
HSS IP Address	10.10.1.43
HSS Port	3868
HSS Host	HSS@ims.mnc001.mcc001.3gppnetwork.org
HSS Realm	ims.mnc001.mcc001.3gppnetwork.org
Destination Node Parameters	
Destination Node	ICSCF
Destination IP Address	10.10.1.41
Destination Port	3868
Destination Host	ICSCF@ims.mnc001.mcc001.3gppnetwork.org
Destination Realm	ims.mnc001.mcc001.3gppnetwork.org
UE Simulation Configuration	
Type Of UE Simulation	CSV
Data Base Path	\\192.168.13.2\DataBase\001 01\DataBase.mdb
CSV File Name	\\192.168.31.181\csv\MS_Profiles_IMSI_2G3G4G_Real.csv
End User Configuration for Profile	HSS_Profiles.xml



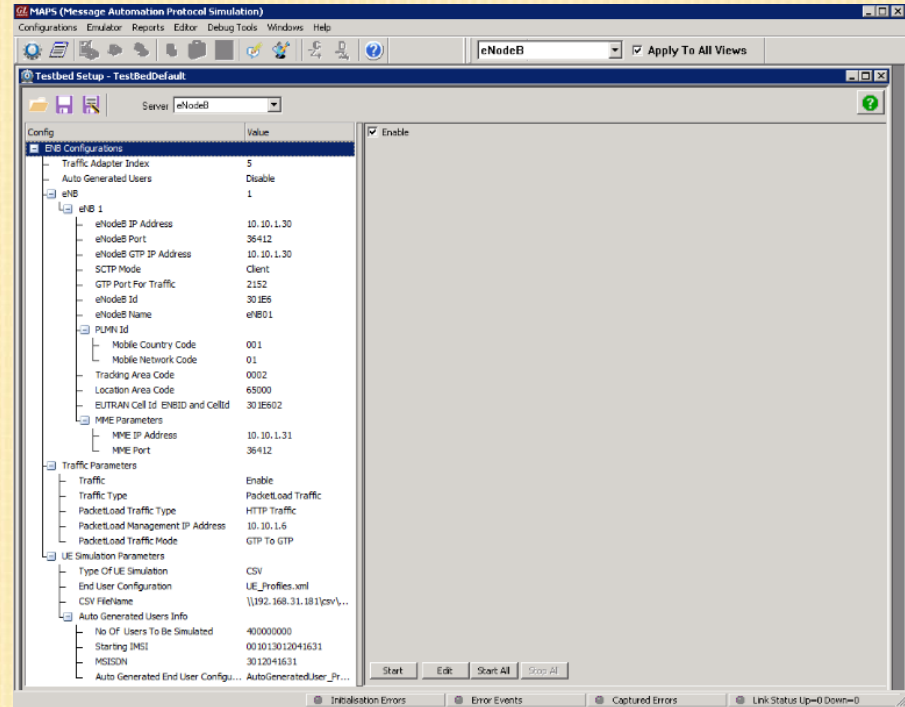
SYSTEM QUICK START - START REMOTE CONTROLLER

- ⊗ 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 4G system Desktop.
- ⊗ The Controller is configured to control the following MAPS™ nodes: eNodeB, MME, HSS (S6a and CxDx), SGW, PGW, P-CSCF, S-CSCF, I-CSCF
- ⊗ Click Start All to connect to all MAPS™ server nodes. The MAPS™ server nodes should turn green once connected



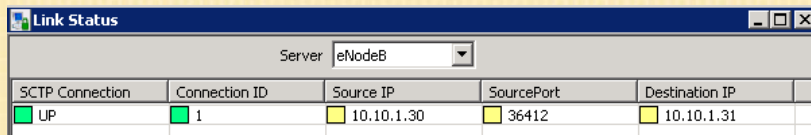
SYSTEM QUICK START - START TESTBED

- ⊗ Open the Testbed Setup view
 - ⊗ Click the “Start All” button to start all testbeds
- ** When generating simulated GTP traffic using PacketLoad, make sure MAPS™ PacketLoad is running prior to starting testbeds in Remote Controller



SYSTEM QUICK START – LINK STATUS

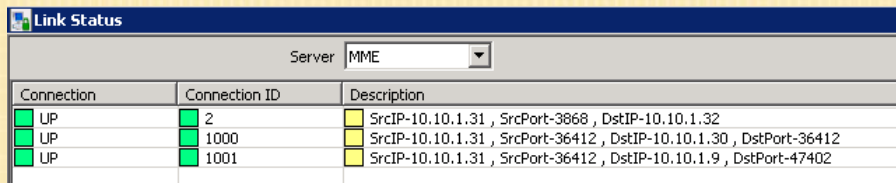
- ⊗ Cycle through the nodes in Remote Controller and verify the Link Status of the following nodes:



The screenshot shows the 'Link Status' window with the 'Server' dropdown set to 'eNodeB'. The table below displays the SCTP connection details.

SCTP Connection	Connection ID	Source IP	SourcePort	Destination IP
UP	1	10.10.1.30	36412	10.10.1.31

eNB \leftrightarrow MME



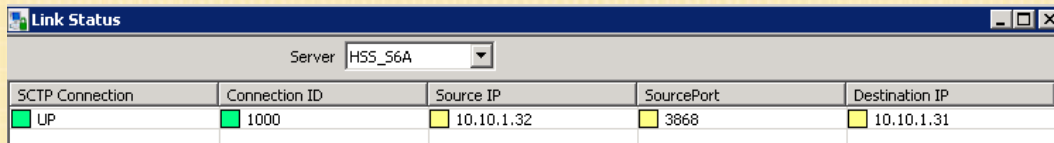
The screenshot shows the 'Link Status' window with the 'Server' dropdown set to 'MME'. The table below displays the connection details.

Connection	Connection ID	Description
UP	2	SrcIP-10.10.1.31, SrcPort-3868, DstIP-10.10.1.32
UP	1000	SrcIP-10.10.1.31, SrcPort-36412, DstIP-10.10.1.30, DstPort-36412
UP	1001	SrcIP-10.10.1.31, SrcPort-36412, DstIP-10.10.1.9, DstPort-47402

MME \leftrightarrow eNB (10.10.1.9, real)

MME \leftrightarrow eNB (10.10.1.30, simulated)

MME \leftrightarrow HSS (10.10.1.32)



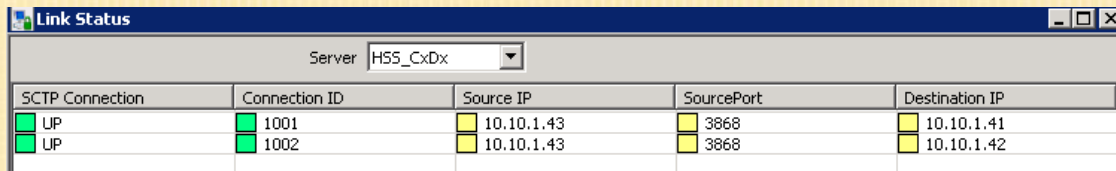
The screenshot shows the 'Link Status' window with the 'Server' dropdown set to 'HSS_S6A'. The table below displays the SCTP connection details.

SCTP Connection	Connection ID	Source IP	SourcePort	Destination IP
UP	1000	10.10.1.32	3868	10.10.1.31

HSS \leftrightarrow MME

SYSTEM QUICK START – LINK STATUS

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

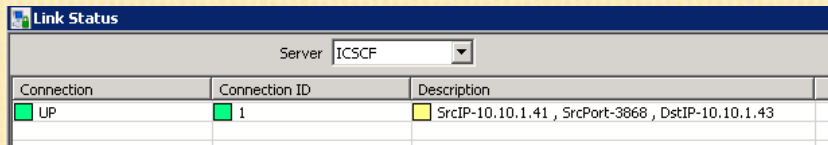


The screenshot shows the 'Link Status' window with the 'Server' dropdown set to 'HSS_CxDx'. The table below displays the connection details for two SCTP connections.

SCTP Connection	Connection ID	Source IP	SourcePort	Destination IP
UP	1001	10.10.1.43	3868	10.10.1.41
UP	1002	10.10.1.43	3868	10.10.1.42

HSS (CxDx) \leftrightarrow I-CSCF (10.10.1.41)

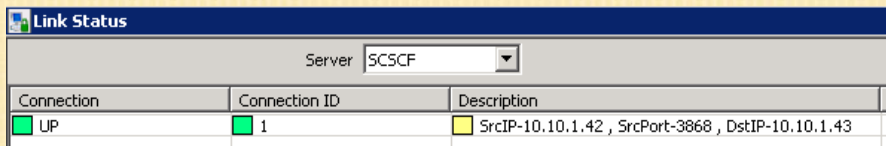
HSS (CxDx) \leftrightarrow S-CSCF (10.10.1.42)



The screenshot shows the 'Link Status' window with the 'Server' dropdown set to 'ICSCF'. The table below displays the connection details for one connection.

Connection	Connection ID	Description
UP	1	SrcIP-10.10.1.41 , SrcPort-3868 , DstIP-10.10.1.43

I-CSCF \leftrightarrow HSS (CxDx)



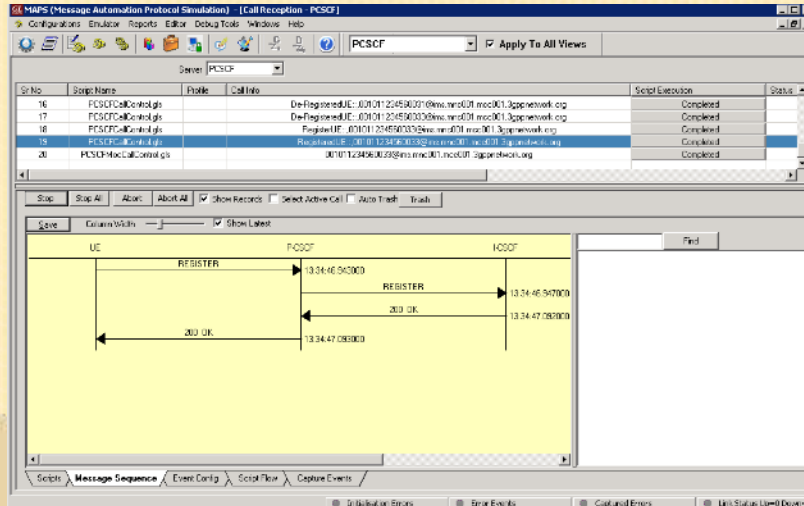
The screenshot shows the 'Link Status' window with the 'Server' dropdown set to 'SCSCF'. The table below displays the connection details for one connection.

Connection	Connection ID	Description
UP	1	SrcIP-10.10.1.42 , SrcPort-3868 , DstIP-10.10.1.43

S-CSCF \leftrightarrow HSS (CxDx)

SYSTEM QUICK START – ATTACHING MOBILE

- ⊗ Turn on 4G mobiles (or turn off airplane mode). The phones should automatically attempt to connect to the 4G network
- ⊗ Verify in the MME's Call Reception view that the UEs have attached
- ⊗ Verify in P-CSCF's Call Reception view that the UEs have registered to the IMS network



SYSTEM QUICK START – VoLTE Calls w/ Real Mobiles

- ⊗ Phone numbers are defined in the table below
- ⊗ Dial the MSISDN of the desired phone
- ⊗ While placing call, observe that the mobiles stay on 4G network during call

IMSI	MSISDN
001011234560031	3012061001
001011234560032	3012061002
001011234560033	3012061003
001011234560034	3012061004
001011234560035	3012061005
001011234560036	3012061006



SYSTEM QUICK START – Simulated VoLTE Calls

- ⊗ Below script is the eNB's Call Generation view for VoLTE calls:
 - ⊗ S1SessionControl_Outgoing_4G.gls
- ⊗ The '4G' call script places a simulated VoLTE call to another simulated 4G UE

GL MAPS (Message Automation Protocol Simulation) - [Call Generation - eNodeB]

Configurations | Emulator | Reports | Editor | Debug Tools | Windows | Help

Server: eNodeB | Apply To All Views

Sr No	Script Name	Profile	Call Info	Script Execution	Status	Events
1	S1SessionControl_Incoming.gls		IMSI: 001013012055003	Stop	VoLTE Call Connected	SIP_TerminateCall
2	S1SessionControl_Outgoing_4G.gls		IMSI: 001013012055003	Stop	VoLTE Call Connected	SIP_TerminateCall
3	S1SessionControl_Outgoing_3G.gls			Start		None
4	S1SessionControl_Outgoing_2G.gls			Start		None
5	VoLTEIncoming.gls			Start		None

Add | Delete | Insert | Refresh | Start | Start All | Stop | Stop All | Abort | Abort All

Save | Column Width | Show Latest

InitialContextSetupResponse, 14:46:12.813000

UplinkNASTransport, Attach Complete, Activate Default Bearer, 14:46:12.813000

UplinkNASTransport, PDN Connectivity Request, 14:46:12.814000

E-RABSetupRequest, Activate Default EPS Bearer Context, 14:46:12.906000

E-RABSetupResponse, 14:46:12.907000

UplinkNASTransport, Activate Default EPS Bearer Context, 14:46:12.908000

REGISTER, 14:46:17.939000

401 Unauthorized, 14:46:18.213000

REGISTER, 14:46:18.219000

200 OK, 14:46:18.377000

INVITE, 14:46:51.967000

100 Trying, 14:46:52.005000

180 Ringing, 14:46:52.194000

200 OK, 14:46:53.202000

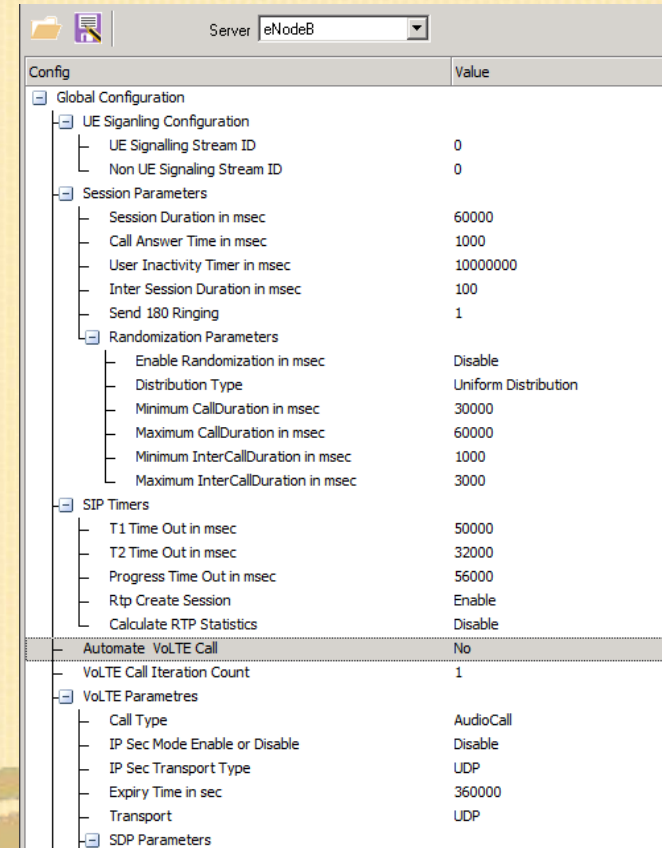
ACK, 14:46:53.204000

SYSTEM QUICK START – VoLTE Calls w/ Real Mobiles

- ⊗ Each instance of S1SessionControl_Incoming.gls preps one simulated UE to be ready to receive incoming VoLTE call. Immediately after starting the eNodeB testbed, the first script instance reads the UE in CSV row 55,027. The second script instance reads the UE in row 55,028, and so on.
 - ⊗ 55,027 to 56,526 are reserved for incoming VoLTE calls from 4G UEs
- ⊗ This means the VoLTE UE instance would not be configured to receive 3G calls until 1000 instances of the script have been invoked, and it would not be configured to receive 2G calls until 1500 instances of the script have been invoked.
- ⊗ To minimize the effort needed, another script - VoLTEIncoming.gls - was created to automatically invoke all 2,500 receiving scripts. This readies all 2500 UEs to receive calls, regardless of the source. Note that ~5 minutes are needed to invoke all 2,500 script instances. Invoked scripts are displayed in the Call Reception window.
- ⊗ Once all 'Incoming' UEs are registered, place an outgoing call using S1SessionControl_Outgoing_4G.gls
- ⊗ Use the "Global Configurations" setting to modify the iterations of calls to place.

SYSTEM QUICK START – Simulated VoLTE Calls

- ⊗ Each outgoing call script places N iteration of calls as defined by the eNodeB Global Configuration
- ⊗ Set Automate VoLTE Call to “Yes” to enable VoLTE calls for multiple iteration.
- ⊗ When Iteration Count is greater than 1, the script will perform the following tasks:
 - ⊗ Attach UE and Register to IMS network
 - ⊗ Place SIP call and keep call active for “Session Duration”
 - ⊗ Disconnect call, wait for Inter Session Duration, and place another SIP call.
- ⊗ These steps are performed until the Iteration Count is satisfied



The screenshot shows a configuration window for an eNodeB. The 'Server' dropdown is set to 'eNodeB'. The configuration is organized into a tree view on the left and a table on the right. The table has two columns: 'Config' and 'Value'.

Config	Value
Global Configuration	
UE Signaling Configuration	
UE Signalling Stream ID	0
Non UE Signalling Stream ID	0
Session Parameters	
Session Duration in msec	60000
Call Answer Time in msec	1000
User Inactivity Timer in msec	10000000
Inter Session Duration in msec	100
Send 180 Ringing	1
Randomization Parameters	
Enable Randomization in msec	Disable
Distribution Type	Uniform Distribution
Minimum CallDuration in msec	30000
Maximum CallDuration in msec	60000
Minimum InterCallDuration in msec	1000
Maximum InterCallDuration in msec	3000
SIP Timers	
T1 Time Out in msec	50000
T2 Time Out in msec	32000
Progress Time Out in msec	56000
Rtp Create Session	Enable
Calculate RTP Statistics	Disable
Automate VoLTE Call	No
VoLTE Call Iteration Count	1
VoLTE Parametres	
Call Type	AudioCall
IP Sec Mode Enable or Disable	Disable
IP Sec Transport Type	UDP
Expiry Time in sec	360000
Transport	UDP
SDP Parameters	

SYSTEM QUICK START – Simulated Mobile Traffic

- ⊗ Simulated GTP mobile traffic is achieved through the GL PacketLoad appliance. Ensure the MAPS™ PacketLoad application is running prior to starting MAPS™ eNodeB and MAPS™ PGW testbeds.
- ⊗ The S1SessionControl.gls script is designed to perform simulated mobile traffic. Each script instance represents one UE. Place calls from Call Generation or Load Generation
- ⊗ UE traffic rate is defined in the eNodeB Global Configurations

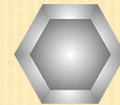
APNName	internet
PacketLoad Configurations	
Traffic Rate	Fixed Bandwidth
Bandwidth Per User	15.00
Graph	Enable
For Random Bandwidth	
Minimum Bandwidth	2.00
Maximum Bandwidth	15.00
HTTP Web Server IPAddress	192.168.45.65

The screenshot displays the MAPS (Message Automation Protocol Simulation) - Call Generation - eNodeB interface. The top section shows a table of script executions with columns for SrNo, Script Name, Profile, Call Info, Script Execution, Status, Events, Events Profile, and Result. The bottom section shows a detailed view of the MME (Mobility Management Entity) traffic flow, including messages like InitialUEMessage, Attach Request, PDN Connectivity Request, DownlinkNAS Transport, Authentication Request, UplinkNAS Transport, Authentication Response, DownlinkNAS Transport, Security Mode Command, UplinkNAS Transport, Security Mode Complete, DownlinkNAS Transport, ESM Information Request, UplinkNAS Transport, ESM Information Response, InitialContextSetupRequest, Attach Accept, Activate De..., InitialContextSetupResponse, and UplinkNAS Transport, Attach Complete, Activate De....

SrNo	Script Name	Profile	Call Info	Script Execution	Status	Events	Events Profile	Result
1	S1SessionControl_Incoming.gls		IMSI_001013012055003	Start	UE Deregistered	None		Pass
2	S1SessionControl_Outgoing_4G.gls		IMSI_001013012057503	Start	UE Deregistered	None		Pass
3	S1SessionControl_Outgoing_3G.gls			Start		None		Unknown
4	S1SessionControl_Outgoing_2G.gls			Start		None		Unknown
5	VolTEIncoming.gls			Start		None		Unknown
6	S1SessionControl.gls		IMSI_001013012040002	Stop	UE REGISTERED	Create Context		Pass

Message	Time
InitialUEMessage, Attach Request, PDN Connectivity Request	15:41:32.919000
DownlinkNAS Transport, Authentication Request	15:41:33.493000
UplinkNAS Transport, Authentication Response	15:41:33.493000
DownlinkNAS Transport, Security Mode Command	15:41:33.519000
UplinkNAS Transport, Security Mode Complete	15:41:33.520000
DownlinkNAS Transport, ESM Information Request	15:41:33.551000
UplinkNAS Transport, ESM Information Response	15:41:33.552000
InitialContextSetupRequest, Attach Accept, Activate De...	15:41:33.685000
InitialContextSetupResponse	15:41:33.688000
UplinkNAS Transport, Attach Complete, Activate De...	15:41:33.688000

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



GL Communications Inc

INTER-NETWORK CALLS

⊗ Inter network calls

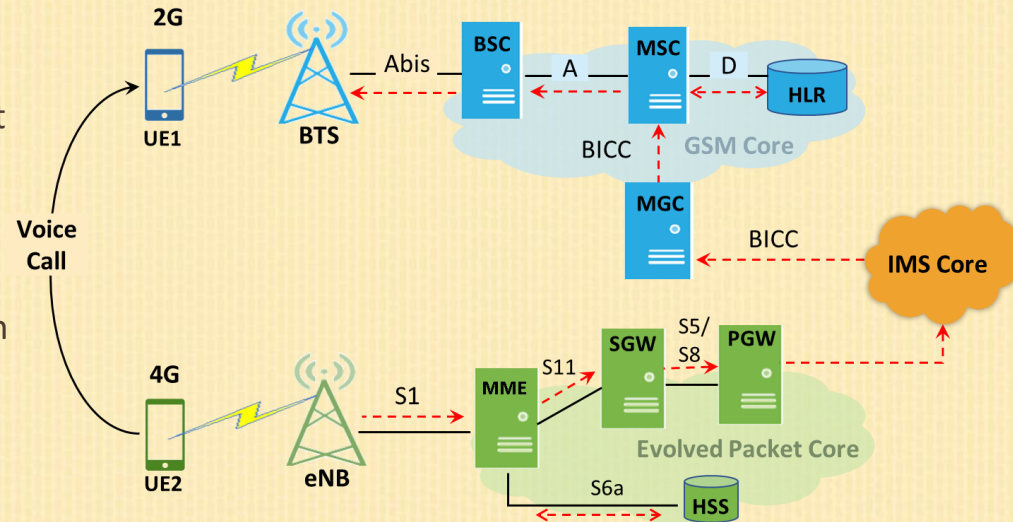
- ⊗ 4G user calling 2G user
- ⊗ 4G user calling 3G user
- ⊗ 4G user sending SMS to 2G user
- ⊗ 4G user sending SMS to 3G user
- ⊗ 4G user calling 3G user via CSFB

⊗ Roaming calls

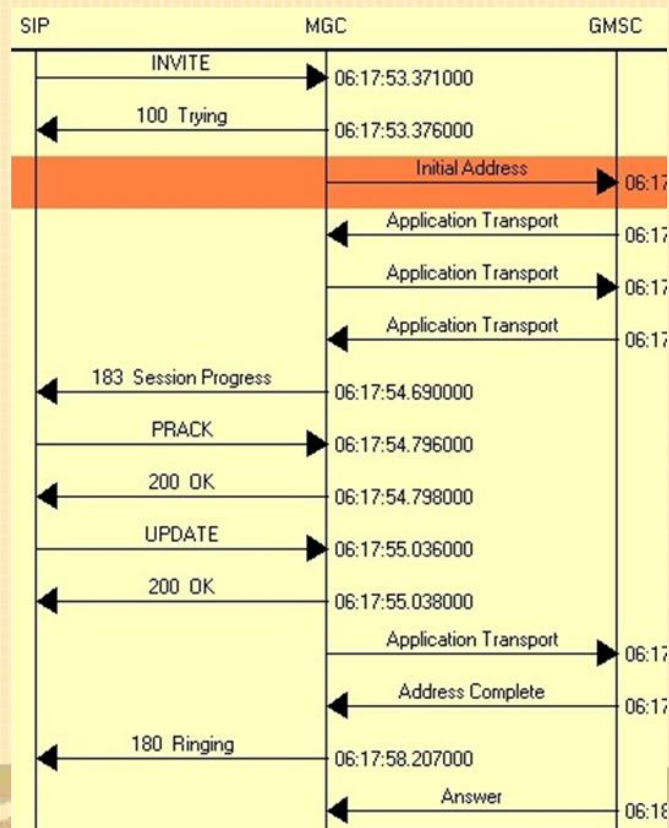
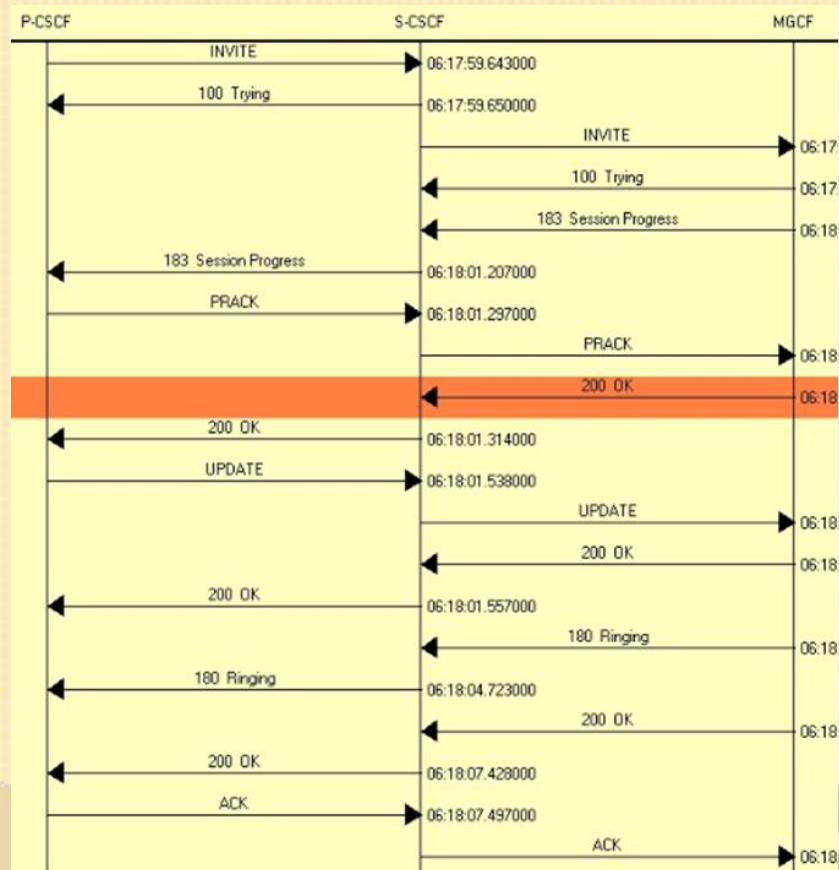
- ⊗ 4G user calling 3G roaming user
- ⊗ 4G user calling 2G roaming user

INTER-NETWORK CALLS – 4G Calling 2G

- ⊗ UE2 placing call to UE1 while both users reside in their home network.
- ⊗ The user is registered to IMS services so the Invite will reach the IMS network. If IMS confirms that called MSISDN does not belong to 4G, the call will be routed to MGC.
- ⊗ MGC, on Reception of Invite Message, routes call to 2G MSC or 3G MSC based on MSISDN Range configured in Testbed by sending IAM.
- ⊗ When MSC receives call from MGC, if received MSISDN is registered, Paging is initiated to connected BSC's

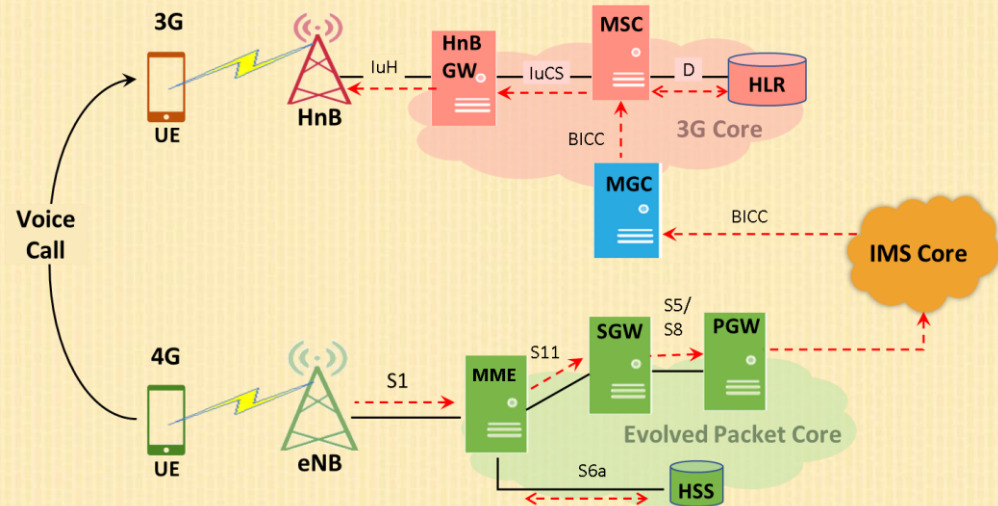


INTER-NETWORK CALLS – 4G Calling 2G Call Flow

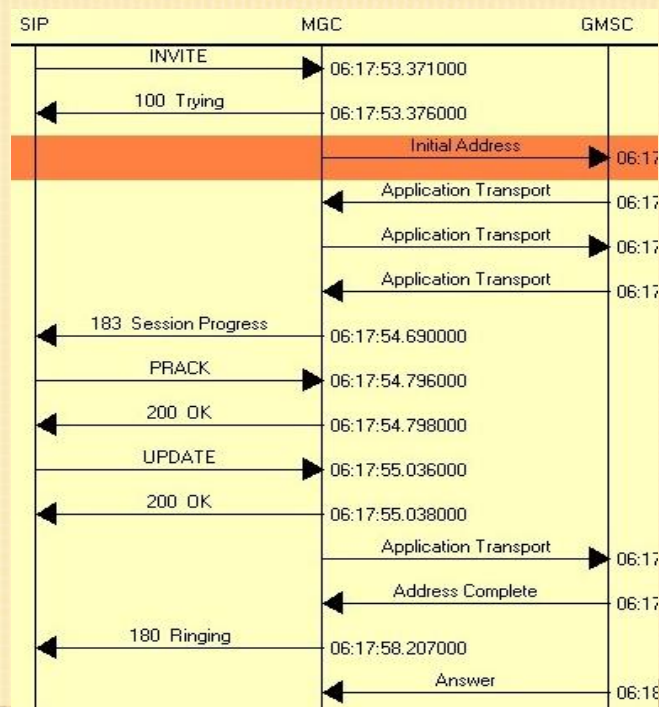
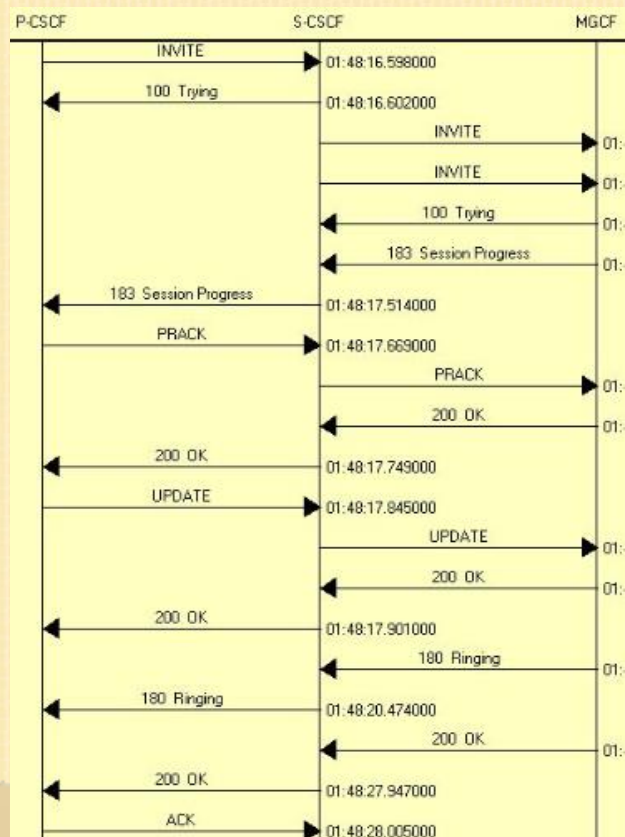


INTER-NETWORK CALLS – 4G Calling 3G

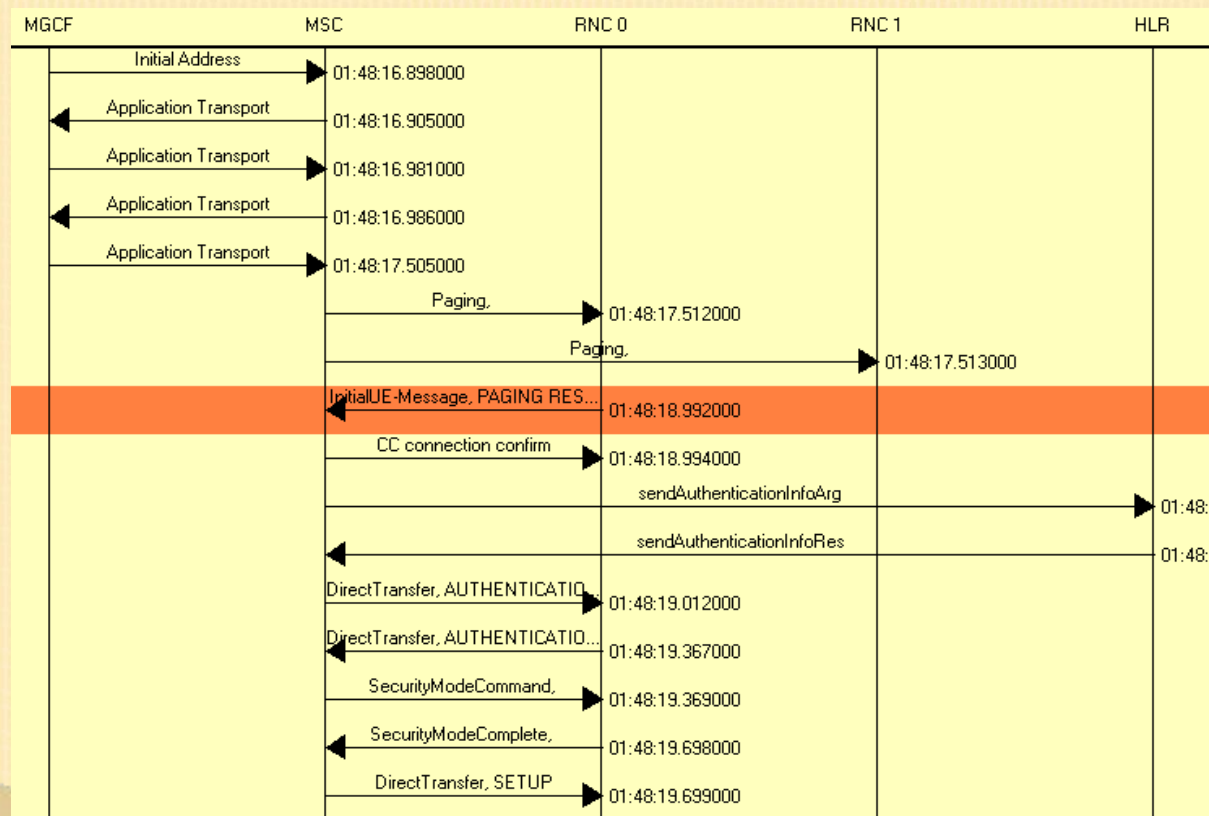
- ⊗ UE1 placing call to UE2 while both users reside in their home network.
- ⊗ The user is registered to IMS services so the Invite will reach the IMS network. If IMS confirms that called MSISDN does not belong to 4G, the call will be routed to MGC.
- ⊗ MGC, on reception of Invite Message, routes call to 2G MSC or 3G MSC based on MSISDN Range configured in Testbed by sending IAM.
- ⊗ When MSC Receives Call from MGC, If received MSISDN is registered, Paging is initiated to connected BSC's



INTER-NETWORK CALLS – 4G Calling 3G Call Flow

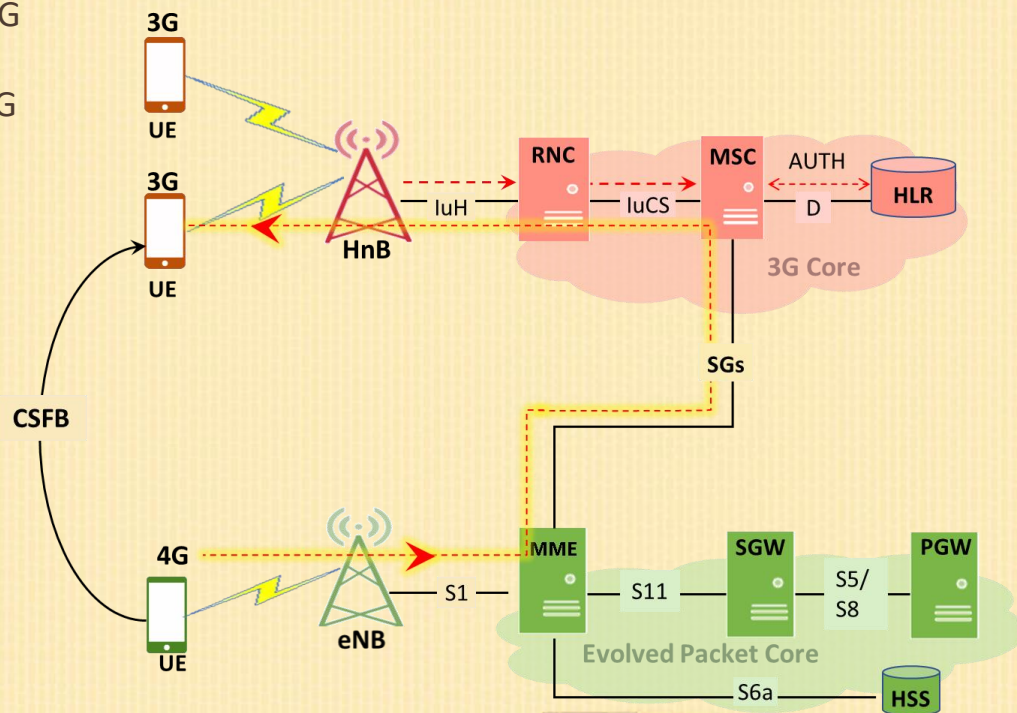


INTER-NETWORK CALLS – 4G Calling 3G Call Flow

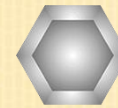


INTER-NETWORK CALLS – 4G Calling 3G (CS Fallback)

- ⊗ Circuit-switched fallback requires both 3G and 4G networks to be on the same PLMN. To accomplish this we'll set the 4G PLMN to 45080 (same as 3G) and use 45080 mobiles on both 3G and 4G networks
- ⊗ Enable the CSFB service in eNodeB, follow the Real eNodeB Configuration slide



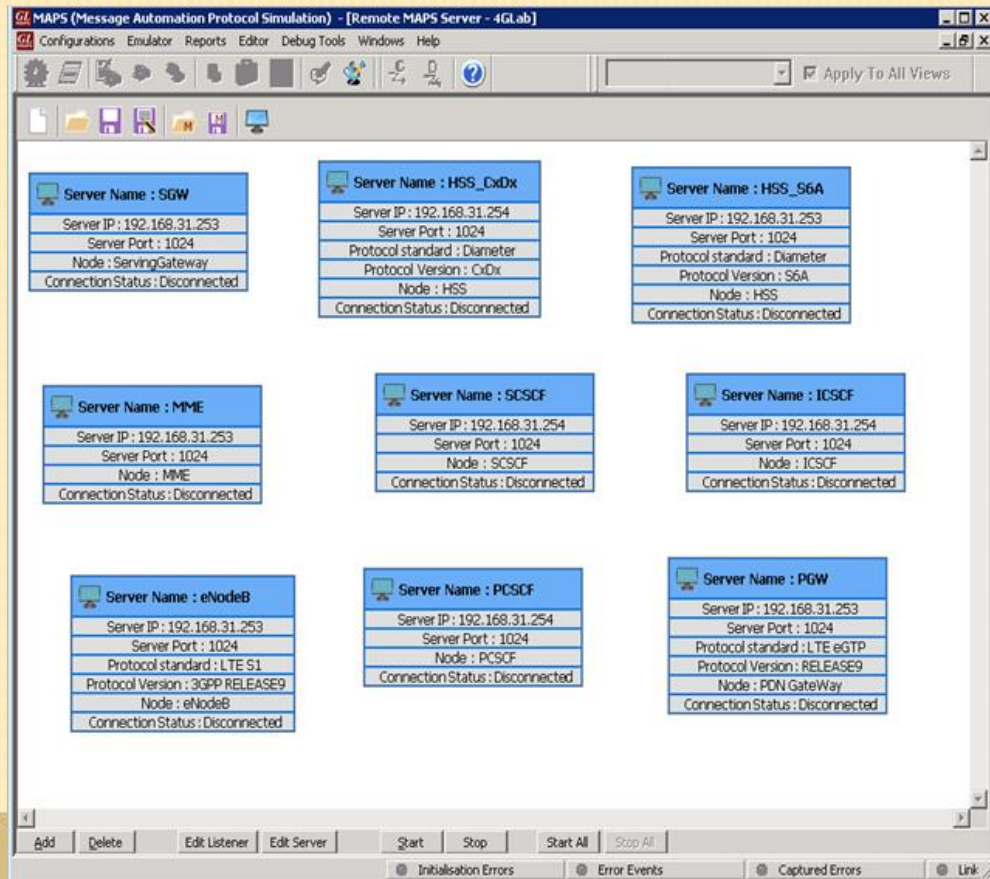
MAPS™ Remote Controller



GL Communications Inc

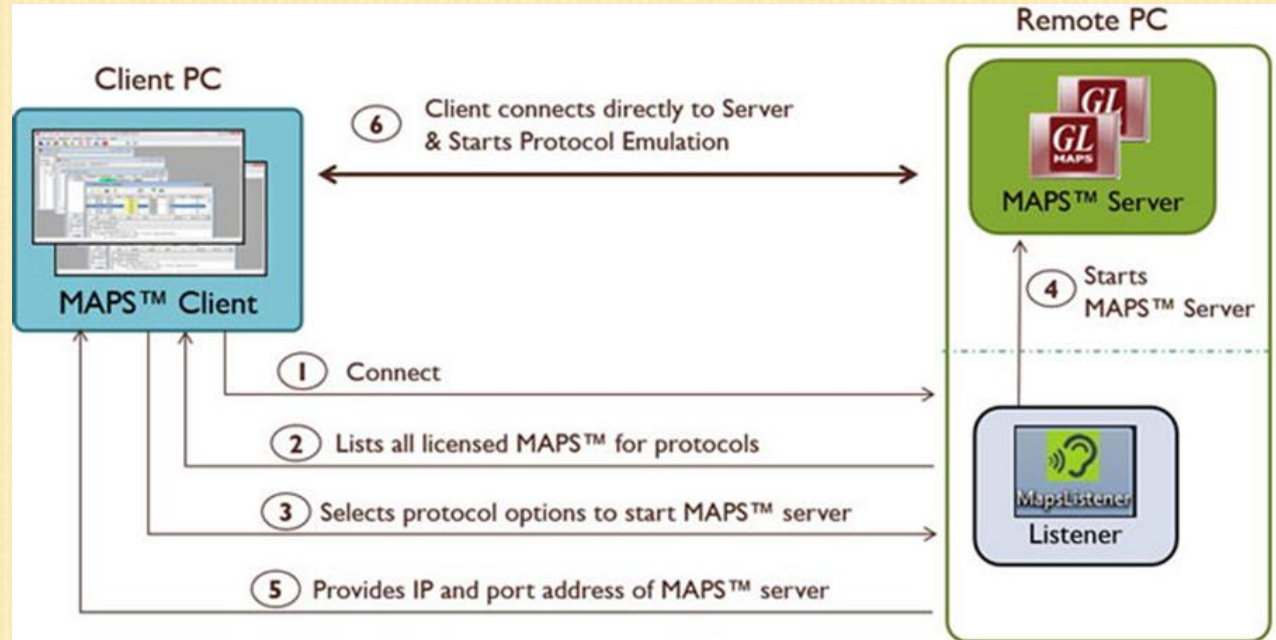
MAPS™ Remote Controller

- 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.



Packet Data Traffic Generation Appliance

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.



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, ...)
 - ❑ 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...

- ❑ 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