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.
MAPSTM
(Message Automation & Protocol Simulation)

- Multi-protocol, Multi-technology Platform.
- Simulate any node, and any interface in network with MAPSTM (except Air interface).
- Supports Emulation, Conformance, and Load testing of a variety of protocols over IP, TDM, and Wireless networks.
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
- Mobile to Mobile SMS Emulation in PS Network
**COMPLETE 3G CNL SYSTEM w/ Real NodeB**

### Mobile-Mobile
- **Real NodeB**
  - IP Access NodeB
  - 2 Mobile Phones
  - 2 SIMs
- **Iuh**
  - PKS160 MAPS™ IuCS IuH
- **IuCS**
  - PKS160 MAPS™ IuCS IuH
  - PKS102 RTP Core (only @ MSC)
- **C, D**
  - PKS132 MAPS™ MAP IP

### Mobile-SMS CS
- **Real NodeB**
  - IP Access NodeB
  - 2 Mobile Phones
  - 2 SIMs
- **Iuh**
  - PKS160 MAPS™ IuCS IuH
- **IuCS**
  - PKS160 MAPS™ IuCS IuH
- **C, D, and E**
  - PKS132 MAPS™ MAP IP

### Mobile-Landline
- **Real NodeB**
  - IP Access NodeB
  - 2 Mobile Phones
  - 2 SIMs
- **Iuh**
  - PKS160 MAPS™ IuCS IuH
- **IuPS**
  - PKS160 MAPS™ IuPS
- **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
  - XX651 MAPS™ CAS with T1 E1 Hardware and APS
- **Gr, Gd**
  - PKS132 MAPS™ MAP IP

### 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**
  - PKS132 MAPS™ MAP IP

### Mobile-Web Browsing
- **Real NodeB**
  - IP Access NodeB
  - 2 Mobile Phones
  - 2 SIMs
- **Iuh**
  - PKS160 MAPS™ IuCS IuH
- **IuPS**
  - PKS164 MAPS™ UMTS IuPS
  - ETH102 MobileTrafficCore GW
- **Gn Gp**
  - PKS166 MAPS™ Gn Gp
  - ETH102 MobileTrafficCore GW
- **Gr**
  - PKS132 MAPS™ MAP IP
COMPLETE 3G CNL SYSTEM w/ Simulated NodeB

**Mobile-Mobile**
- IuCS
  - PKS160 MAPS™ IuCS IuH
  - PKS102 RTP Core (only @ MSC)
- C, D
  - PKS132 MAPS™ MAP IP

**Mobile-SMS CS**
- IuCS
  - PKS160 MAPS™ IuCS IuH
  - C, D, and E
  - 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
  - XX651 MAPS™ CAS with T1 E1 Hardware and APS

**Mobile-SMS PS**
- IuPS
  - PKS164 MAPS™ UMTS IuPS
  - PKS132 MAPS™ MAP IP
- Gr, Gd
  - PKS132 MAPS™ MAP IP

**Mobile-Landline**
- IuCS
  - PKS160 MAPS™ IuCS IuH
- C, D
  - PKS132 MAPS™ MAP IP
- ISUP
  - XX649 MAPS™ SS7 TDM with T1 E1 Hardware
  - PKS145 Media Gateway Conversion

**Mobile-Web Browsing**
- IuPS
  - PKS164 MAPS™ UMTS IuPS
  - ETH101 MobileTrafficCore GTP
- Gn Gp
  - PKS166 MAPS™ Gns Gp
  - ETH101 MobileTrafficCore GTP
- Gr
  - PKS132 MAPS™ MAP IP
# Protocol Stack Specification

<table>
<thead>
<tr>
<th>Supported Protocols</th>
<th>Specification Used</th>
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<tbody>
<tr>
<td>SCCP</td>
<td>Q.713, CCITT (ITU-T) Blue Book</td>
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<tr>
<td>M3UA</td>
<td>RFC 3332</td>
</tr>
<tr>
<td>RANAP</td>
<td>3GPP TS 25.413 V9.1.0</td>
</tr>
<tr>
<td>GMM / SM</td>
<td>3GPP TS 24.008 V5.16.0 (2006-06)</td>
</tr>
<tr>
<td>SMS</td>
<td>3GPP TS 03.40 V7.5.0 &amp; 3GPP TS 04.11 V7.1.0 GSM 03.38 version 7.2.0 Release 1998</td>
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## Protocol Stack Specification

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<tr>
<td>SCCP</td>
<td>Q.713, CCITT (ITU-T) Blue Book</td>
</tr>
<tr>
<td>MTP3</td>
<td>Q.703, ITU-T Blue Book</td>
</tr>
<tr>
<td>RANAP</td>
<td>3GPP TS 25.413 V9.1.0</td>
</tr>
<tr>
<td>MM / CC</td>
<td>3GPP TS 24.008 V5.16.0 (2006-06)</td>
</tr>
<tr>
<td>RR</td>
<td>3GPP TS 04.18 V8.13.0</td>
</tr>
<tr>
<td>SMS</td>
<td>3GPP TS 03.40 V7.5.0 &amp; 3GPP TS 04.11 V7.1.0 GSM 03.38 version 7.2.0 Release 1998</td>
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</table>
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)

CM Service Request
CC Connection Confirm
CM Service Accept
Setup
Call Proceeding
Alerting
Connect
Connect Acknowledgement
SCCP connection establishment
Authentication, Security Mode Control,
Identification and TMSI Reallocation procedures
MM Connection Established
Call Control
RAB Assignment
Complete Call Establishment
Call Clearing Action
All the associated resources released
SCCP connection is released
UE-TO-UE (UMTS) PROCEDURES
(MOBILE TERMINATING CALL - MTC)

- Paging
  - Paging Response
- CC Connection Confirm
- Setup
  - Call Confirmed
- Alerting
- Connect
  - Connect Acknowledgement

Call Complete / Conversation
- Disconnect
- Release
  - Release Complete
- Iu-Release Command
  - Iu-Release Complete
- RLSD Released
  - RLSD Released Complete

SCCP connection establishment
- MM Connection Established
  - Authentication, Security Mode Control, Identification and TMSI Reallocation procedures
- Call Control
  - RAB Assignment
- Complete Call Establishment

Call Clearing Action
- All the associated resources released
  - SCCP connection is released
UE-TO-UE (UMTS) PROCEDURES
,LOCATION UPDATE CALL - LUC

Location Update Request
CC Connection Confirm

Location Updating Accept
Iu-Release Command
Iu-Release Complete

RLSD Released
RLSD Released Complete

SCCP connection establishment
Authentication, Security Mode Control, Identification and TMSI Reallocation procedures
(includes new TMSI)
All the associated resources released
SCCP connection is released
UMTS IuPS PROCEDURES

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

**SCCP Configuration**
- **SCCP Transaction Type**: Server
- **Stream Id**: 1
- **Number Of Inbound Streams**: 500
- **Number Of Outbound Streams**: 500
- **Payload Protocol Id**: 3

**Default Profile**
- **Network Adapter**: 1
- **Number Of Connections**: 1

**Connection 1**
- **GGSN IP**
  - **IP Address**: 192.168.1.74
- **GGSN GTP IP**
  - **IP Address**: 192.168.1.74
- **GGSN Point**
  - **IP Address**: 35000
- **RNC IP**
  - **IP Address**: 192.168.1.74
- **RNC Port**
  - **Port**: 26000

**MTP Configuration**
- **SGSN Point Code**: 3.3.3
- **RNC Point Code**: 4.4.4
- **Adjacent Link Identifier**: National
- **Signaling Link Selection**: 1

**Connection 2**
- **WCS Server Configuration**
  - **WCS Server Listen Port**: 17991
  - **Server IP Address**: 192.168.1.182
  - **Server Version**: 4
  - **WCS Server Message Option**: ASCII
  - **WCS Server Traffic Type**: Pedestrian
- **Adaptor**: 0

**Protocol Configuration Options**
- **Primary DNS Address**: 125.32.47.125
MSC CONFIGURATION

- M3UA layer Parameter settings
- Registration Parameters
- Mobile Identity Parameters

Location Area Identification parameters such as MCC, MNC, LAC, RAC and others
SGSN CONFIGURATION

- Create Stream for packet traffic
- Frame Pattern
- Frame Size: Min & Max Size
- Traffic Type: Continuous & Limited

- TCP Server IP: Server IP
- Traffic File Name: text (*.txt) file name from which the HTTP traffic details are obtained
- SIM IMSI
- End User Address: designated Phone IP address
REPORTING CAPABILITIES

- GGSN Server log for the phones attached
- SGSN Call Reception
  - Notice the SIM IMSI number for each connected phone
### Packet Traffic Statistics Log

<table>
<thead>
<tr>
<th>Date/Time</th>
<th>Call Trace Id</th>
<th>Script Id</th>
<th>Captured Events</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013-3-29 10:34:08.640000</td>
<td>2.40400600000000000001</td>
<td>ProtScriptId_755520320-5013</td>
<td>TaskId=1</td>
</tr>
<tr>
<td>2013-3-29 10:34:08.640000</td>
<td>2.40400600000000000001</td>
<td>ProtScriptId_755520320-5013</td>
<td>TxFrames = 452</td>
</tr>
<tr>
<td>2013-3-29 10:34:08.640000</td>
<td>2.40400600000000000001</td>
<td>ProtScriptId_755520320-5013</td>
<td>RxFrames = 0</td>
</tr>
<tr>
<td>2013-3-29 10:34:08.640000</td>
<td>2.40400600000000000001</td>
<td>ProtScriptId_755520320-5013</td>
<td>LostFrames = 0</td>
</tr>
<tr>
<td>2013-3-29 10:34:08.640000</td>
<td>2.40400600000000000001</td>
<td>ProtScriptId_755520320-5013</td>
<td>OutOfOrderFrames = 0</td>
</tr>
<tr>
<td>2013-3-29 10:34:08.640000</td>
<td>2.40400600000000000001</td>
<td>ProtScriptId_755520320-5013</td>
<td>PatternErrorFrames = 0</td>
</tr>
<tr>
<td>2013-3-29 10:34:08.640000</td>
<td>2.40400600000000000001</td>
<td>ProtScriptId_755520320-5013</td>
<td>GoodFrames = 0</td>
</tr>
<tr>
<td>2013-3-29 10:34:08.640000</td>
<td>2.40400600000000000001</td>
<td>ProtScriptId_755520320-5013</td>
<td>BitErrorRate = 0</td>
</tr>
<tr>
<td>2013-3-29 10:34:08.640000</td>
<td>2.40400600000000000001</td>
<td>ProtScriptId_755520320-5013</td>
<td>BitErrorCount = 0</td>
</tr>
<tr>
<td>2013-3-29 10:34:08.640000</td>
<td>2.40400600000000000001</td>
<td>ProtScriptId_755520320-5013</td>
<td>SyncLossCount = 0</td>
</tr>
<tr>
<td>2013-3-29 10:34:08.640000</td>
<td>2.40400600000000000001</td>
<td>ProtScriptId_755520320-5013</td>
<td>TxRate = 97.885109</td>
</tr>
<tr>
<td>2013-3-29 10:34:08.640000</td>
<td>2.40400600000000000001</td>
<td>ProtScriptId_755520320-5013</td>
<td>RxRate = 0.000000</td>
</tr>
<tr>
<td>2013-3-29 10:34:08.640000</td>
<td>2.40400600000000000001</td>
<td>ProtScriptId_755520320-5013</td>
<td>PCStatus = -NA-</td>
</tr>
</tbody>
</table>
HTTP traffic file being transmitted
set in the node configuration
Packet Traffic Log at SGSN
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.
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.