MAPS™ UMTS for IuCS, IuH Interfaces Emulator

(IuCS Emulation over IP and ATM; and IuH Emulation over IP)
Highlights

• Simulates RNC, MSC, Home NodeB (HnB) and Home NodeB Gateway (HN GW) entities.
• Generates and process all Mobility Management, Session Management, RANAP, ALCAP, and DTAP messages over SSCOP.
• User controlled access to RANAP, and DTAP signalling messages over SCTP.
• Ready scripts for Mobile Originating, Mobile Terminating, Location Updating procedures for quick testing
• Supports RAB Assignment, Authentication, TMSI Reallocation, Encryption, and other optional procedures
• SSCOP links over which RANAP and ALCAP signalling will be carried further for making calls
• SSCOP Server (GL's WCS based server module) provides SSCOP, AAL5 and AAL2 layer services
• Supports various traffic types including Tone, Digits and File playback over AAL2
• Supports traffic over Iu UP protocol layer and also over normal RTP sessions (requires additional licenses).
Hardware Platforms

OC3/OC12 PCIe Card LightSpeed1000™

HD RTP Generator Hardware
(w/ 2 x 10G cards; w/ 4 x 1G cards)

OC3/OC12 Portable USB LightSpeed1000™
UMTS IuCS IP Protocol Stack

<table>
<thead>
<tr>
<th>Control Plane</th>
<th>User Plane</th>
</tr>
</thead>
<tbody>
<tr>
<td>CC</td>
<td>MM</td>
</tr>
<tr>
<td>RANAP</td>
<td>SCCP</td>
</tr>
<tr>
<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Supported Protocols</th>
<th>Specification Used</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IuCS IP Interface</strong></td>
<td></td>
</tr>
<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>
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<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>
</tr>
<tr>
<td>Iu-UP (User Plane)</td>
<td>3GPP TS 25.415</td>
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<tr>
<td>SCTP</td>
<td>RFC4960</td>
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## UMTS IuCS ATM Protocol Stack

<table>
<thead>
<tr>
<th>CC</th>
<th>MM</th>
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<tbody>
<tr>
<td>ALCAP</td>
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<td>MTP3B</td>
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<td>SSCF-NNI</td>
<td>Codec</td>
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<td>SSCOP</td>
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<td>AAL5</td>
<td>AAL2</td>
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<td>ATM</td>
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### Supported Protocols

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<tr>
<th>Protocol</th>
<th>Specification Used</th>
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<tr>
<td><strong>IuCS ATM Interface</strong></td>
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<td>SSCOP</td>
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<tr>
<td>MTP3b</td>
<td>ITU-T Recommendation Q.2210</td>
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<tr>
<td>AAL Type 2 (ALCAP)</td>
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<td>RANAP</td>
<td>3GPP TS 25.413 V9.1.0</td>
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<td>MM / CC</td>
<td>3GPP TS 24.008 V5.16.0 (2006-06)</td>
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<td>RR</td>
<td>3GPP TS 04.18 V8.13.0</td>
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<td>SMS</td>
<td>3GPP TS 03.40 V7.5.0 &amp; 3GPP TS 04.11 V7.1.0 GSM 03.38 version 7.2.0 Release 1998</td>
</tr>
<tr>
<td><strong>Iu-UP</strong></td>
<td><strong>Iu User Plane Interface</strong></td>
</tr>
<tr>
<td></td>
<td>3GPP TS 25.415</td>
</tr>
</tbody>
</table>
Location Updating (LU) Call Flow

Call Simulation over IP

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
Mobile Originating Call Procedure

Call Simulation over IP

- CM Service Request
- CC Connection Confirm

- CM Service Accept
  - Setup
  - Call Proceeding

- Alerting
  - Connect
  - Connect Acknowledgement

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

- 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
Mobile Terminating Call Procedure

Call Simulation over IP

- 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
Mobile to Mobile SMS Call Procedure

Call Simulation over IP

Mobile Originating Part

Location Update

Mobile Originating Signaling

SMS Submit

CP ACK

SMS Submit Response

Mobile Terminating Part

Location Update

Mobile Terminating Signaling

SMS Deliver

CP ACK

RP ACK (MS → SC)

CP ACK

Originating

Recipient

UE1

RNC

MSC

Network

UE2

RNC

GL Communications
Supplementary Service Call Flow

Call Simulation over IP

CM Service Request

CC Connection Confirm

Authentication, Security Mode Control

DirectTransfer, processUnstructuredSS-RequestArg

DirectTransfer, unstructuredSS-RequestArg

DirectTransfer, unstructuredSS-RequestRes

DirectTransfer, unstructuredSS-RequestArg

DirectTransfer, SS RELEASE COMPLETE

Iu-Release Command

Iu-Release Complete

Call Clearing Action

All the associated resources released

SCCP connection is released

Supplementary Service Messages

Call Release

UE

RNC

IuCS

MSC

Network
Relocation Call Procedure

Call Simulation over IP

Source RNC

Target RNC

DUT (MAPS™ MSC)

1. UE → UE
2. Source RNC
3. Target RNC
4. DUT (MAPS™ MSC)
5. Relocation Request
6. Relocation Request Ack
7. Relocation Command
8. RAN Mobility Information
9. RAN Mobility Information Confirm
10. Relocation Complete
11. Iu-Release Command
12. Iu-Release Complete
MO Call Procedure

Call Simulation over ATM
MT Call Procedure

Call Simulation over ATM

Call Establishment

- Paging
- Paging Response
- CC Connection Confirm
- Setup
- Call Proceeding
- RAB Assignment Request
- ALCAP Establish Request
- ALCAP Establish Confirm
- RAB Assignment Response
- Alerting
- Connect
- Connect Acknowledgement

SCCP connection establishment
Authentication, Security Mode Control, Identification and TMSI
Reallocation procedures
MM Connection Established

Traffic

- Disconnect
- Release
- Complete
- Iu-Release Command
- Iu-Release Complete
- RLSD Released
- RLSD Released Complete

Call Clearing Action
All the associated resources released
SCCP connection is released
Testbed Configuration
Profile Configuration
Call Simulation over IuCS IP

SMS over Voice Call Simulation

Relocation Procedure Simulation
Call Simulation over IuCS ATM

Call Control MO Procedure

Call Control MT Procedure
### Events Log

<table>
<thead>
<tr>
<th>Date/Time</th>
<th>Captured Events</th>
<th>Call Trace Id</th>
<th>Script Name</th>
<th>Script Id</th>
</tr>
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<tbody>
<tr>
<td>2018-12-28 12:26:36.863000</td>
<td>SCTP Up On ConnectionId = 1005</td>
<td></td>
<td>Check_SCTP_Status.gls</td>
<td>ProtScriptId-40-7481902-689...</td>
</tr>
<tr>
<td>2018-12-28 12:26:36.883000</td>
<td>ASP Acknowledged</td>
<td>1005</td>
<td>M3U3.gls</td>
<td>ProtScriptId-42-7483736-689...</td>
</tr>
<tr>
<td>2018-12-28 12:26:36.883000</td>
<td>4S Status Notified</td>
<td>1005</td>
<td>M3U3.gls</td>
<td>ProtScriptId-42-7483736-689...</td>
</tr>
<tr>
<td>2018-12-28 12:26:36.899000</td>
<td>ASP Active Ack Received</td>
<td>1005</td>
<td>M3U3.gls</td>
<td>ProtScriptId-42-7483736-689...</td>
</tr>
<tr>
<td>2018-12-28 12:26:36.899000</td>
<td>4S Status Notified</td>
<td>1005</td>
<td>M3U3.gls</td>
<td>ProtScriptId-42-7483736-689...</td>
</tr>
<tr>
<td>2018-12-28 12:26:36.899000</td>
<td>M3U3 Up On ConnectionId = 1005</td>
<td></td>
<td>Check_SCTP_Status.gls</td>
<td>ProtScriptId-40-7481902-689...</td>
</tr>
<tr>
<td>2018-12-28 12:26:36.910000</td>
<td>Subsystem-Status-Test</td>
<td>1005</td>
<td>SCMIG.gls</td>
<td>ProtScriptId-43-7483772-689...</td>
</tr>
<tr>
<td>2018-12-28 12:26:36.910000</td>
<td>Subsystem-Allowed</td>
<td>1005</td>
<td>SCMIG.gls</td>
<td>ProtScriptId-43-7483772-689...</td>
</tr>
<tr>
<td>2018-12-28 12:26:36.916000</td>
<td>Subsystem-Allowed</td>
<td>1005</td>
<td>SCMIG.gls</td>
<td>ProtScriptId-43-7483772-689...</td>
</tr>
<tr>
<td>2018-12-28 12:26:54.500000</td>
<td>Location Update Requested</td>
<td></td>
<td>iUCS.gls</td>
<td>ProtScriptId-44-7501373-689...</td>
</tr>
<tr>
<td>2018-12-28 12:26:54.500000</td>
<td>CC Connection Confirmed</td>
<td></td>
<td>iUCS.gls</td>
<td>ProtScriptId-44-7501373-689...</td>
</tr>
<tr>
<td>2018-12-28 12:26:54.501000</td>
<td>MM Connection Requested</td>
<td></td>
<td>iUCS.Call.gls</td>
<td>ProtScriptId-44-7501373-689...</td>
</tr>
<tr>
<td>2018-12-28 12:26:54.501000</td>
<td>Authentication Requested</td>
<td></td>
<td>iUCS.Call.gls</td>
<td>ProtScriptId-44-7501373-689...</td>
</tr>
<tr>
<td>2018-12-28 12:26:54.521000</td>
<td>Authentication is Successful</td>
<td></td>
<td>iUCS_Call.gls</td>
<td>ProtScriptId-44-7501373-689...</td>
</tr>
<tr>
<td>2018-12-28 12:26:54.521000</td>
<td>Ciphering Requested</td>
<td></td>
<td>iUCS_Call.gls</td>
<td>ProtScriptId-44-7501373-689...</td>
</tr>
<tr>
<td>2018-12-28 12:26:54.544000</td>
<td>Ciphering Complete</td>
<td></td>
<td>iUCS_Call.gls</td>
<td>ProtScriptId-44-7501373-689...</td>
</tr>
<tr>
<td>2018-12-28 12:26:54.547000</td>
<td>Location Update Completed</td>
<td></td>
<td>iUCS.gls</td>
<td>ProtScriptId-44-7501373-689...</td>
</tr>
<tr>
<td>2018-12-28 12:26:54.591000</td>
<td>SCCP Release Initiated</td>
<td></td>
<td>iUCS.gls</td>
<td>ProtScriptId-44-7501373-689...</td>
</tr>
<tr>
<td>2018-12-28 12:26:54.591000</td>
<td>RTP Stats Query Script started</td>
<td></td>
<td>RTP_Stats_Display.gls</td>
<td>ProtScriptId-41-7483513-689...</td>
</tr>
</tbody>
</table>
Bulk Call Generation using CSV Profiles
MAPS™ UMTS for IuH Interfaces
Key Features of IuH Network

- Simulates RNC, MSC, Home NodeB (HnB) and Home NodeB Gateway (HN GW) entities.
- Transmitting Voice Files
- Transmitting DTMF, MF Digits and other Tones and Dual Tones
- Recording Voice Files
- Monitoring Single and Dual Tones, DTMF, and MF digits
- Loopback, Talk using Microphone, Play to Speaker
# UMTS IuH Protocol Stack

## Supported Protocols

<table>
<thead>
<tr>
<th>Protocol</th>
<th>Specification Used</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IuH Interface</strong></td>
<td></td>
</tr>
<tr>
<td>RUA</td>
<td>3GPP TS 25468 V9.1.0</td>
</tr>
<tr>
<td>RANAP</td>
<td>3GPP TS 25.413 V9.1.0</td>
</tr>
<tr>
<td>MM / CC</td>
<td>3GPP TS 04.08 V7.17.0</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>
</tr>
<tr>
<td>SCTP</td>
<td>RFC 4960</td>
</tr>
</tbody>
</table>
Femtocells Overview

Customer Premises

Femtocell

Home NodeB

Broadband access Gateway

Internet

Femto Gateway

Mobile Core Network

SGSN

CS Core

PS Core

MSC

IMS Core
Location Update Call over IuH IP

User → Uu

Femto
Home Node B

IuH

Home Node Gateway

Location Update Request →
Activates Ciphering, Identification, Authentication

Allocate new TMSI
(includes new TMSI)

Location Updating Accept

Iu-Release Command

Iu-Release Complete

All the associated resources released
Mobile Originating Call over IuH IP

User → Femto Home Node B → IuH → Home Node Gateway

CM Service Request → MM Connection Established

Security Mode Control, Identification and TMSI Reallocation

CM Service Accept → Initiates Authentication Procedure
Setup → Initiates Call Control
Call Proceeding → RAB Assignment

Alerting → Complete Call Establishment
Connect →
Connect Acknowledgement

Call Complete / Conversation

Disconnect → Call Clearing Action
Release →
Release Complete → All the associated resources released
Iu-Release Command →
Iu-Release Complete
Mobile Terminating Call over IuH IP

User → Femto Home Node B → Home Node Gateway

- Uu
- IuH

- Paging
  - Paging Response

- Security Mode Control, Identification and TMSI Reallocation
  - Setup
  - Call Confirmed
  - Alerting
  - Connect
  - Connect Acknowledgement

- Complete Call Establishment

- Conversation
  - Disconnect
  - Release
  - Release Complete
  - Iu-Release Command
  - Iu-Release Complete

- MM Connection Established
- Initiates Authentication Procedure
- Initiates Call Control
- Complete Call Establishment
- Call Clearing Action
- All the associated resources released
PS Domain IuH Call Procedure

Authentication, Ciphering, Security Mode Procedure
- Attach Request
- CC Connection Confirm
- Attach Accept
- Attach Complete
- Activate PDP Context Request
- Activate PDP Context Accept
- Deactivate PDP Context Request
- Deactivate PDP Context Accept

RAB Assignment Procedure
- Detach Request
- Detach Accept
- Iu-ReleaseCommand
- Iu-ReleaseComplete
IuH over IP Testbed Configuration
IuH over IP Profile Configuration
IuH over IP Incoming Call Handler Configuration
IuH over IP Call Generation

Active Calls

Call Status

Call Events

Loading Scripts and Profiles

Message Sequence
IuH over IP Call Reception
IuH over IP Event and Traffic Log

Server Traffic Log

Events Log
High Density (HD) RTP Traffic Simulation

- Rackmount network appliance with 4x1GigE NIC
- Transport over UDP and TCP, IPv4 and IPv6, and TLS for secure transport
- Easily achieve up to 20,000 endpoints per appliance (5000 per port)
- Up to 350 calls per second (with RTP traffic)
- Scales to around 100,000 to 200,000 endpoints with use of Master Controller for single point of control
- Manage 10+ MAPS™ systems with single point of control from Master Controller
Bulk Call Generation using XML profiles
Bulk Call Generation using CSV Profiles
Bulk Call Reception using CSV Profiles
# Message Statistics

<table>
<thead>
<tr>
<th>Message Type</th>
<th>Tx Count</th>
<th>Rx Count</th>
<th>Retransmit Count</th>
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<tbody>
<tr>
<td>ALERTING</td>
<td>10003</td>
<td>0</td>
<td>0</td>
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<tr>
<td>ASP Active</td>
<td>0</td>
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<td>0</td>
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<tr>
<td>ASP Active Acknowledgement</td>
<td>1</td>
<td>0</td>
<td>0</td>
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<tr>
<td>ASP Up</td>
<td>0</td>
<td>1</td>
<td>0</td>
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<tr>
<td>ASP Up Acknowledgement</td>
<td>1</td>
<td>0</td>
<td>0</td>
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<tr>
<td>AUTHENTICATION REQUEST</td>
<td>10006</td>
<td>0</td>
<td>0</td>
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<tr>
<td>AUTHENTICATION RESPONSE</td>
<td>0</td>
<td>10006</td>
<td>0</td>
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<tr>
<td>CALL PROCEDURE</td>
<td>10003</td>
<td>0</td>
<td>0</td>
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<tr>
<td>CC connection confirm</td>
<td>10006</td>
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<tr>
<td>CM SERVICE REQUEST</td>
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<td>CONNECT</td>
<td>10003</td>
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<td>CONNECT ACKNOWLEDGE</td>
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<td>0</td>
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<td>DISCONNECT</td>
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<td>IDENTITY RESPONSE</td>
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<td>IT Inactivity test</td>
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<td>Iu-ReleaseCommand</td>
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<td>Iu-ReleaseComplete</td>
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<td>LOCATION UPDATING ACCEPT</td>
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<td>LOCATION UPDATING REQUEST</td>
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<td>RAB AssignmentRequest</td>
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<td>RAB AssignmentResponse</td>
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<td>RELEASE</td>
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<td>RELEASE COMPLETE</td>
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<td>RLC release complete</td>
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<td>SETUP</td>
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<td>SSA subsystem-allowed</td>
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<td>SSS subsystem-status-test</td>
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<tr>
<td>TMSI REALLOCATION COMPLETE</td>
<td>0</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>
Customizations - Statistics and Reports

MOS, R-Factor
Packet Loss
Packets Discarded
Duplicate Packets
Out-Of-Sequence
Packets
Jitter Statistics

Call Stats provide a running tabular log of system level stats, tracked stats include: Total Calls, Active Calls, Completed Calls, Passed Calls, Failed Calls, Instantaneous Calls/Sec
• API wraps our proprietary scripting language in standard languages familiar to the user:
  ➢ Python
  ➢ Java
  ➢ VB Scripts
  ➢ TCL
• Clients and Servers support a “Many-to-Many” relationship, making it very easy for users to develop complex test cases involving multiple signaling protocols.
The API is broken into High and Low level function calls / scripts.

For High Level scripts, all the fine-grained protocol control happen in the script running on the MAPS server, hidden from the API user.

Low Level scripts put the API user in complete control of the protocol stack. This makes Low Level scripts more flexible and powerful, but also correspondingly more complex.
CLI Support

Python 3.7.5 (tags/v3.7.5:5c02a39a0b, Oct 15 2019, 00:11:34) [MSC v.1916 64 bit (AMD64)] on win32
Type "help", "copyright", "credits" or "license()" for more information.

>>> = RESTART: C:\Program Files\GL Communications Inc\MAPS-IuCS\MAPSCLI\PythonClient\examples\IuCS\RNC\IuCS_PlaceCall.py
IuCS Server Connection... True
IuCS Testbed Starting ... True
IuCS Profile Loading... True
Check M3UA Health Status... True
IuCS Call Initiated... True
Call Connecting...
Call Answered...
Send File started
IuCS Call Status...CALL ACTIVE
IuCS Call Terminating... True
CMOS = 4.15625
LMOS = 4.15625
CR_FACTOR = 91
LR_FACTOR = 91
TX_PACKETS = 502
RX_PACKETS = 1604
LOST_PACKETS = 0
DISCARDED_PACKETS = 0
OUT_OF_SEQ_PACKETS = 0
DUPLICATE_PACKETS = 0
AVG_JITTER = 0.6875
IuCS Script Stopping... True
IuCS Server Disconnecting... True

>>>
THANK YOU

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