



INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X

Impact factor: 4.295

(Volume 5, Issue 3)

Available online at: www.ijariit.com

Testing Mobile Application Part (MAP) protocol using MAP-simulator tool in a mobile communication testing laboratory

Parsa Swetha

parshaswetha96@gmail.com

RV College of Engineering,
Banglore, Karnataka

Dr. Nagaraja G. S.

nagarajags@rvce.edu.in

RV College of Engineering,
Banglore, Karnataka

Prasad Vasa

prasad.vasa@nokia.com

Nokia Networks India Pvt Ltd,
Banglore, Karnataka

ABSTRACT

Employee engagement is normally the degree of dedication and attachment a working person has towards his or her company and its nuclear values and viewpoints. An engaged employee is supposed to be conscious of the business situation, and work dynamics with contemporaries and peer groups to improve accomplishment within the job for the advantage and excellence of the company. It is a positive approach held by the employees towards the company and its values. Therefore there is a huge necessity for HR professionals to emphasize more attention not only on holding on to the existing workforce but also on having them actively occupied. The Employee Engagement Index is an online examination in which employees evaluate their own commitment at work. Most of the Agencies which provide Employment believe employee engagement to be one of the lead requisites to enhancing PES (Performance Evaluation System) performance. This presentation is an attempt to the acquaintance with the digitization of employee engagement by what is known as the Employee Engagement Index.

Keywords— Functional testing, Performance testing, Conformance testing, Load and stress testing, Protocol simulator (Independent protocol simulator)

1. INTRODUCTION

Network Signaling is done by signaling system no 7(ss7). It's mainly used to mainly establish connection and tear down the connection between two end network elements. Connection between two entities here refer to call setup and tear down and it's mostly used in public switched telephone network. The IETF define protocol suite named SIGTRAN that implements level 2, 3, 4 protocols compatible with ss7(pseudo ss7). This protocol has been developed to address the overloaded problem of ss7 due to 16 channel limitation in TDM.

Using SIGTRAN protocol the PROTOCOL SIMULATOR tool can be inserted at every interface in the GSM architecture successfully, this would emulate the rest of the network without affecting the overall functionality. This Tool is used to learn specific about specific equipment in various scenarios. It's

mainly used for debugging the interfaces and check the interoperability between network elements. It is one of the easiest ways of learning the black box approach where the functionality of the equipment it totally neglected, the main focus being the input and especially the output.

1.1 SIGTRAN

Its also called signaling Transport. It's a telephony protocol suite used to transmit ss7 signals in the internet and handles calls using special commands. Packet switched connections are used to exchange to voice and other forms of information but earlier it uses circuit switched connection in PSTN. Calls over internet are transmitted as packets. It basically has 4 layers, lower layer is IP upon that we have SCTP, UA (User Adaption) set and the ss7 upper layer. SIGTRAN has 4 ss7 adaptation layers like M2UA (message transfer part layer 2 adaptation layer), message transfer part level 2 peer-to-peer(M2PA), message transfer part level 3 adaptation layer(M3UA), SCCP user adaptation layer(SUA).

M2UA provide services of MTP2 in client server situation such as SG-MGC and the user will be MTP3. M2PA layer provides the services of MTP2 in peer-peer situation such as SG-SG. M3UA layer provides the services of MTP3 in a client server situation such as SG -MGC. The SCCP UA provides services of SCCP in a client server architecture, such as SG-IP. User would be TCAP or any application part.

SCTP a new transport protocol designed or defined as a replacement for TCP by Sigtran. It's manily used for time-sensitive signalling of data. TCP is not suitable for transporting real-time signalling data like TCP is byte-streamed, TCP timers defined in terms of seconds. ISUP protocol carries signalling messages for many PSTN resources. Suppose there are 3 calls then one of the calls experiences a loss of data which should not cause a delay in transmission of messages with another call.

When a call is been established , the sender first transmits the ss7 signal to the switch which sends to signaling gateway and this converts signals to packets for transmitting over IP either to next switch or destination or other PSTN.

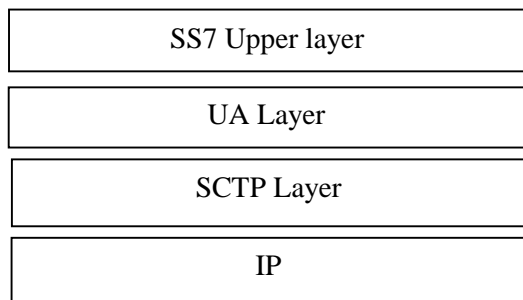


Fig. 1: SIGTRAN Layers

1.2 Mobile Application Part (MAP)

It's a GSM protocol and it's an application layer protocol of the SS7 protocol stack. This GSM protocol provides services to different nodes in GSM, UMTS over the application layer. As explained in 1.1 (SIGTRAN) it uses all the intermediate layers like MTP,M2PA,M3UA etc. it uses TCAP layer services and it provides specifications like roaming, messaging and data. MAP interfaces are specified by ETSI/3GPP. Mobile application part (MAP) protocol functions/operations are mainly concerned with information exchange between switches and registers in the networks with the possibility for a MS to roam. For information transfer between functional units MAP utilizes the services provided by Signaling System No. 7.

MAP layer receives encoded data from a MAP end user, for example, from a HLR application, a VLR application, or a SMS application, and sends the data in a standardized format, ASN.1 format, to a peer network element. Need some additional demands for non-call-related signaling or the mobility of subscribers. An example of a MAP procedure is the location update in which MAP protocol is used for signaling between VLR and HLR.

Map protocol interfaces are listed below: C interface between MSC-HLR, for example, routing information for Mobile-Terminated (MT) calls D interface between the VLR-HLR, for example, location update, subscriber data management E interface between two MSC, for example, handovers, Mobile-Originated and Mobile-Terminated messages F interface between the MSC and Equipment Identity Register (EIR), International Mobile Equipment Identity status checking G interface between the two VLR, International Mobile Subscriber Identity (IMSI),and authentication triplet retrievals from the previous VLR , Gc interface between the HLR and GGSN, mobile terminated PDP context activation.

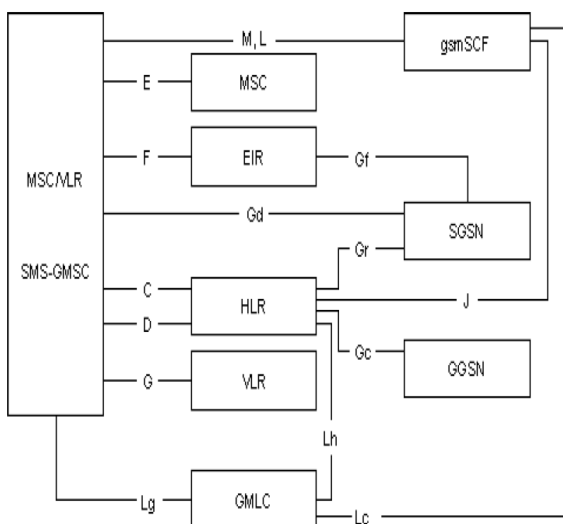


Fig. 2: Interfaces covered by MAP protocol

This interface has not been implemented Gd interface between the SMS-GMSC and Serving GPRS Support Node ,for example General Packet Radio Service (GPRS) short messages ,Gf interface between EIR and SGSN, GPRS IMEI checking Gr interface between HLR and SGSN, for example, GPRS location update J interface between the HLR and gsmSCF, for example, Unstructured Supplementary Service Data (USSD) or any time handling of subscriber data L interface between MSC and GSM Service Control Function (gsmSCF), supplementary service notification.

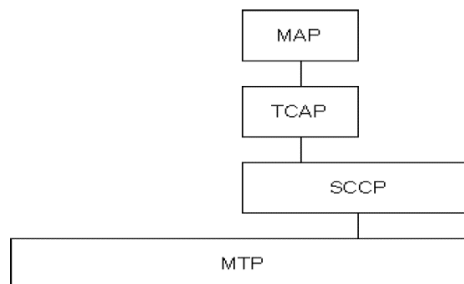


Fig. 3: MAP support protocols

Lh interface between HLR and Gateway Mobile Location Centre (GMLC), location services Lg interface between the MSC and the GMLC, location services M interface between the VLR and gsmSCF, Mobility Management (MM) notification. Map support other protocols like: TCAP, SCCP, MTP as shown in figure 3.

1.3 Transaction-Capabilities-Application Part (TCAP)

This describes communication between application using protocol and messages in different nodes. Signalling transport is transparent to TCAP application by using TCAP/IP. The application using signaling message over SS7 network/IP network is not impacted. TCAP/IP networking includes interfaces between ss7 and IP network. The TCAP/IP networking function performed on gateway which establishes interface between IP and ss7 network .it basically addresses 3 inter-domain scenarios: IP server and SS7 entity communication, communication between IP entity and SCP, Ip signaling between 2 SS7 networks.

These messages are sent between machines on wire and primitives are exchanged between application and local stack of TCAP. Messages are primitives but not all primitives' messags. TCAP primitives have following types: unidirectional, begin, continue, end, abort, and cancel.

The Begin primitive or message have originating Transaction-ID. Continue have originating and destination transaction ID and these primitives have optional and dialogue portions and they are unidirectional primitives which are mandatory.

These dialogue portions carry control PDU like AARD (dialogue-request), AARE (dialogue-response), ABRT (dialogue-abort) and it has many components like invoke, return result last, return result not last , return error , reject.

1.4 Signalling Connection Control Part (SCCP)

It's a network layer protocol and provides advance routing, management control feature, flow control, connection management control features are offered by SCCP and TCAP. This provides both connection oriented and connection less network services above MTP. This layer directly access their primitives and they have the option of using only their services or can use the services of both SCCP and TCAP service.

Connectionless services involve: specialized routing, transfer data, management control. SCCP along with MTP used as network layer and they are used TCAP-Based services. For every component of SS7, SCCP provides different services for its user and they are referred as sub-system. SCP (Service Control Point) is a subsystem which provides SCCP with a database, SSP is an application software package, and STP provides global title translation.

TCAP along with SCCP provide host with services by providing primitives for both and these events are carried by PPL event (request and indication API messages). SCCP messages contain different parameters which describes the type of address used and the messages are routed using: address indicator (routing-indicator), global title indicator, subsystem indicator, point code indicator and global title. It basically provides 4 classes for protocol application: class 0 (basic-connectionless), class1 (sequenced-connectionless), class 2 (basic connection-oriented), class 3(flow control connection oriented). The connection-less protocol provides classes which in turn provide the capabilities to transfer one (NSDU) network service data unit in the data field of XUDT, LUDT or UDT

1.5 Message Transfer Part (MTP)

It's a part of SS7 used for communication in PSTN. Its major responsibility is to provide unduplicated, reliable and in sequenced transmission of messages between communication elements. Different countries use different MTP protocols. In sigtran the stack is separated in 4 different functional levels. Level1, level2, level3, and level 4. Level 1-3 compromises with MTP and level4 is the MTP user and the level3 is known as MTP3, level 2 is MTP2, the MTP and SCCP are referred as Network Service Part.

One-to-one mapping is not available from level 1-3 in MTP on OSI model. MTP provides functionality of layer1-3 as part of OSI model. The 3rd layer is not provided by MTP but by SCCP. MTP1 represents physical layer in OSI model and hence responsible for connection of SS7 signaling points into transmission network where communication takes place. Here electrical signals are converted to messages, level 2 ensures end-to-end message transmission across link to be accurate. It also provides FISU (Fill-In-Signal), LSSU (Link Status Signal Unit), MSU (Message Signal Unit), flow control, retransmit unacknowledged messages, flow control etc. Level 3 basically provides routing functionality to transmit message to the requested endpoint and then comes the MTP user which is the top most layer.

The figure 4 describes the SS7 layers in OSI model. Its shows the detailed structure of the protocols used at different layers. As mentioned above the MTP1 is mapped to physical layer and the MTP2 is mapped to data link layer where bssgp,ns-network,lapv5are used for communicating with network layer and for location updating bssgp is used and in this way the mapping of an SS7 protocol stack is being mapped with OSI model.

2. MAP-Simulator TOOL AND PROCEDURE TO USE THE TOOL

Protocol Simulator is powerful tool which uses high level programming language and support dozens of telecomm protocol, provide control message flow between network elements in mobile communication. Protocol simulator is basically used to test the call flow between these network elements. Protocol Simulator is a tool that can simulate the network elements irrespective of its protocol. It is integrated with different interfaces to simulate the call flow between them during the call testing phase. Usage of Protocol Simulator tool in different architectures: The scripts have been written for different network elements with different protocol used. The tool is initialized then the test data from variable file like subscriber information, device capabilities are been loaded to the simulator and the message parameters are inserted into the universal scripts.

These scripts are given to a container and enters the data collection and analysis phase .in the data collection and analysis phase the wire shark capture and error log collection happens and it return the result to analyzer containers where we can check whether the call flow is established between subscribers or not and later delete the subscriber. The scripts in protocol simulator are written in language (independent protocol simulator language).the protocol simulator tool usually is initialized by reading the control files which internally calls the source and configuration file. And the result or any error is written into trace file .these scripts only execute if they are written according to the appropriate protocol (refer rfc).

These scripts are given to the protocol simulator-interpreter with all the resources loaded and the interpreter finds the simulation and intermediate layers from the configuration files and hence can use many protocols to establish a call flow between two nodes. These protocols use .asn files to send and receive messages between layers. One script can execute one communication flow. But for some test cases it is necessary to combine two or more communication flows. These flows may use different protocols and for this different test devices too. In most cases a synchronization of the flows is possible by the normal communication events.

But in some cases this is not sufficient. For such cases it is possible for the scripts to communicate on a separate channel. The inter script communication is done by messages. These messages are called internal messages. Internal messages may be sent between scripts in the same simulator or in different ones. There is no difference in the scripts in both cases. There are two methods to address a different script: a pattern string and a numerical address of the target script. The addressing by a pattern string is used to initiate an internal communication, to find a partner script. It is even possible to invoke the partner script with that kind of addressing. After having received a message, the numerical address of the source may be obtained. This address then may be used to send messages directly to that script.

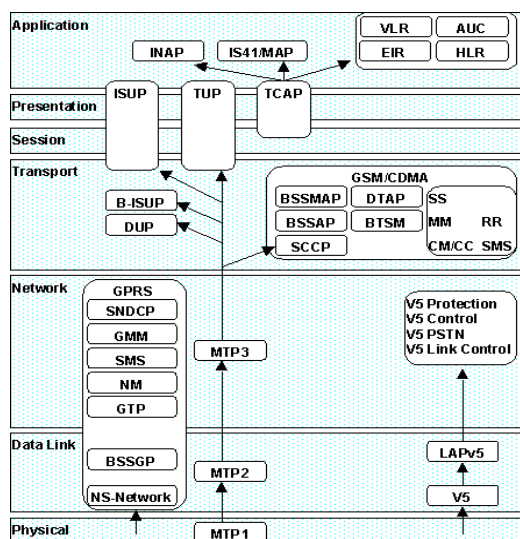


Fig. 4: SS7 protocol stack on OSI model

An internal message may contain user data as a string to transmit information from on script to the other one. If a script fails it may be useful to automatically cancel a connected script too. A mechanism for this is provided. The Protocol Simulator tool uses the control file, the source file, the configuration file, upp and macros. The trace file is also required. The output is written to the trace file and written to the .cpp file when there is an error. The detailed procedure: the source, control and the configuration file have been written in sim script and should have been compiled successfully. These files are placed in a particular folder where the protocol simulator tool is loaded using control file which internally calls the configuration file. The existence of configuration file is checked if present continues or else exits the process. If present checks for trace file and later the upp files for the particular protocol is been loaded. After loading the upp files it import all the headers and macros into the protocol simulator.

Protocol Simulator have some inbuilt values as well and these need to be loaded. When all the conditions have been satisfied it reads the .asn files and exchanges messages between two network elements in that particular interface used. If there is any error it is written to trace file if no error it exchange messages between both network elements and the call flow is been established between the network elements. We can check the call flow between network elements using internal message analyser and using trace file.

There are parameters to check the call flow like the number of call established or the number of packets dropped or message didn't reach destination etc these parameters checked using BHCA, BHCC, ASR. The messages are read from .asn file which are converted to hex format and stored in the buffer before transmission and at the receiver end it converts back to .asn and the message exchange happens. This tool can be executed in command prompt by loading the control and other files and the path should direct to protocol simulator32.exe or can be executed by loading the configuration file, .upp to protocol simulator tool.

3. PRACTICAL APPROACH TO EMULATE THE DIFFERENT OPERATIONS IN MAP PROTOCOL:

To emulate the operations of MAP protocol in GSM/UMTS architecture and these are the components used to implement these operations are MSC, HLR, VLR, MO, MT, EIR, IMEI, GPRS, SGSN, USSD (unstructured supplementary service data), gsm SCF (GSM service control function), GMLC (gateway mobile location center), MM (mobility management) as shown in figure 2. Map protocol supports different interfaces like C, D, F, G, Gc etc each interface has communication between two network elements and the operation performed. For emulation purpose let's consider location update between HLR and VLR which belongs to D interface.

This interface is between HLR and VLR where the protocol simulator scripts is written between network elements. The scripts is written in network elements. The scripts involve control , source and configuration file and these scripts are written based on the messages involved in the protocol .The results are shown in the GUI which has following features like standard windows application, state viewer for different layers and there is a trace viewer showing messages exchanged with different layers. Label 1 shows resource block used label 2 shows the status of protocol simulator link to the network and 3 shows the messages exchanged.

The messages exchanged can be further analysed by checking the internal analyser and the trace file, the trace file shows the

details about the message exchanged between the nodes in text file where the message exchanged between nodes are shown in GUI using internal message analyser.

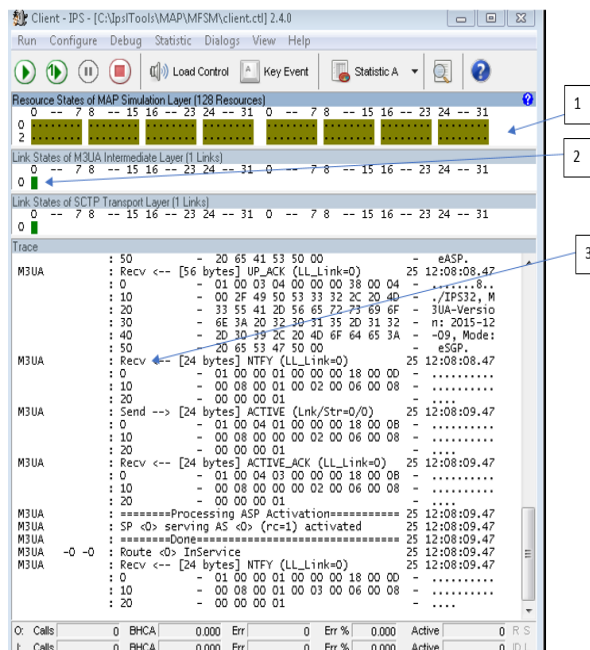


Fig. 5: GUI representation of message exchanged

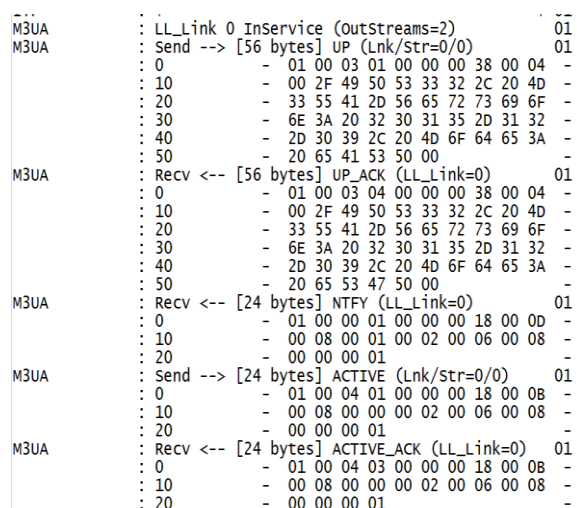


Fig. 6: Trace file

4. CONCLUSION

Based on the results obtained by performing experiments in the network, we can integrate the Protocol simulator tool to any architecture by writing respective scripts in protocol simulator language and the appropriate protocol loaded based on the configuration file and by intergrating this tool we can perform sanity test, performance test, functional test and load tests. This would help to check the call flow between network elements[SUT-system under test] as this tool is used for testing of communication interfaces and if there is any problem in establishing a call between nodes then it can be identified by trace file and internal message analyser.in this paper we have only considered SS7 and SIGTRAN protocol suite mainly focusing on MAP protocol with different interfaces .but this tool can be applied to different architectures and this tool has a major economic impact as the entire architecture can be tested without having the whole architecture.

5. REFERENCES

[1] Razvan Andrei VISAN, Marian ALEXANDRU, Dan Nicolae ROBU, SS7 signalling over ethernet using

- PROTOCOL SIMULATOR in a mobile communication testing laboratory, December 2017 ,DOI: 10.19062/1842-9238.2017.15.3.8
- [2] M. Sauter, From GSM to LTE-Advanced: An Introduction to Mobile Networks and Mobile Broadband, Revised Second Edition, ISBN: 978-1-118-86195-0;
- [3] M. Alexandru, G. Morariu, Comunicatii Mobile Celulare și Calcul Mobil. Evolutia de la 3G la 4G, Editura Universității Transilvania din Brașov, 2015, ISBN: 978-606-19-0567-6;
- [4] T. Balan, D. Robu, F. Sandu, Integrarea Sistemelor de Calcul și Telecomunicații, Editura Universității Transilvania din Brașov, ISBN 978-606-19-0609-3;
- [5] J. Eberspächer, H.J. Vögel, C. Bettstetter. GSM Switching, Services and Protocols, Second Edition, ISBN: 978-047-14-9903-9;
- [6] A. Z. Dodd, The Essential Guide to Telecommunications, Fifth Edition, ISBN: 978-0137058914;
- [7] Montesdeoca Contreras J.C, Avila Campoverde R. S, Cabrera Hidalgo J. C, Vintimilla Tapia P. E, Mobile Applications Using TCP/IP-GSM Protocols Applied to Domotic ISBN: 978-1-4673-8466-7/15, IEEE 2015
- [8] Kameswari Kotapati, Peng Liu, Thomas F.LaPorta, EndSec: An End-to-End Message Security Protocol for Mobile Telecommunication Networks. 978-1-4244-2100-8/08/\$25.00 2008 IEEE
- [9] M. Sauter, 3G, 4G and Beyond: Bringing Networks, Devices and the Web Together, Second Edition, ISBN: 978-1-118-34148-3.
- [10] Mohit Anugurala, Ankita Saini, " Comparison study of Routing protocol in wireless sensor- A road map", 16-18 March 2016 ,ISBN:978-9-3805-4421-2, IEEE.