Interoperability among Different IMS Cores

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Abstract. The IMS as core for operators' network is imminent. However, the interconnection is still an issue on basic call layer, but also on services layer. In this article, we present the NetLab project approach, which has the aim to create a testing environment for research and development of new services and applications based on the IP Multimedia Subsystem (IMS). The results of interconnection tests between several IMS platforms are also provided here.

Keywords: IMS, IPTV, NGN, IM.

1 Introduction

NetLab project aims to sustain research and experimentations that will ascertain the convergence and interoperability of different test beds, protocol variants and services based on IP Multimedia Subsystem (IMS). The choice of IMS is considered a key factor by the project for obtaining a sustainable and generic interconnection proof testbed where the user can discover and select the network and services used to perform his

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tests. Particular emphasis is placed on interoperability of the test beds, the interconnection and sharing of software tools, the experimentation and validation of protocols and services, and in providing trusted access to services.

IMS was originally designed by the standardization body "3rd Generation Partnership Project" (3GPP). However standards may slightly differ in their implementation, causing some interoperability issues among different manufactures.

In order to be able to accomplish these objectives, various IMS cores have been used for testing. The tests have been done from different locations at different countries. Each partner has set up a lab environment to connect to the Netlab network. Two technologies have been used in order to deploy this network:

- A virtual private network (VPN) which does not need any special infrastructure but a simple connection to the Internet
- GEANT. This is a high bandwidth network for research and education purposes.

As long as Netlab project pretends to create a testing environment for research and development of new services and applications based on the IMS the first set of tests have been oriented towards the interoperability of different IMS cores and IMS clients.

Netlab test bed is composed of three vendor-different IMS cores from:

- Nokia IMS core
- Ericsson SDS
- Fokus OpenIMS core

Netlab consortium has dedicated their efforts to study these multimedia platforms and their interoperability. Every partner has been able to connect to all the available IMS cores and test different services from them.

The article is organized as follows: Section 2 describes interconnection of IMS cores and provides further details. Section 3 deals with test detailed description and also with their evaluation. This is the core section of whole article. Concluding remarks and open question for future work are given in Section 4.

2 Network Interconnection

The GÉANT project was a collaboration project between 26 National Research and Education Networks representing 30 countries across Europe, the European Commission, and DANTE. Its principal purpose was to develop the GÉANT network - a multi-gigabit pan-European data communications network, reserved specifically for research and education use. The project also covered a number of other activities relating to research networking. These included network testing, development of new technologies and support for some research projects with specific networking requirements. This European Network is continuously being increased on size and bandwidth features.

The VPN is a network that is constructed using the Internet as the medium for transporting data. This system uses encryption and other security mechanisms to ensure that only authorized users can access the network and that the data cannot be intercepted. The technology we are using for implementing this virtual private network is called “transport layer security (TLS)” an application layer technology which allows tunneling an entire network's traffic over the Internet. In particular we are using “openVPN” which is an open source solution available for general usage.

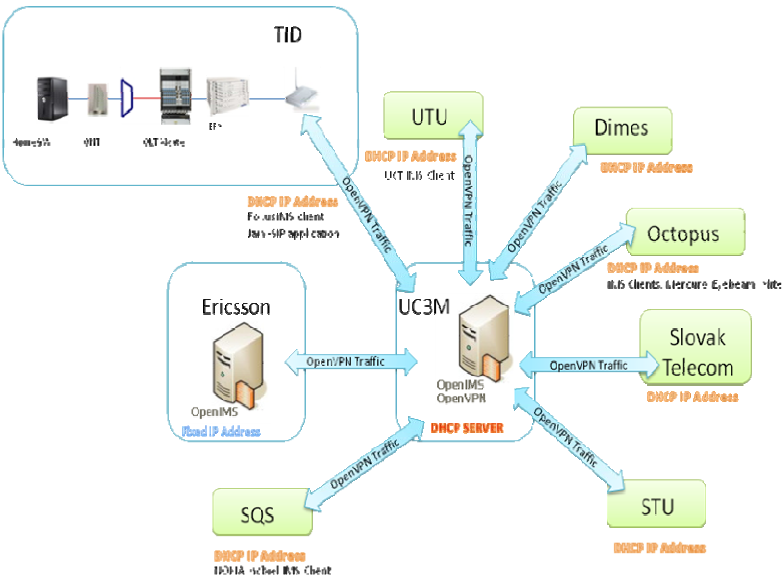

Fig. 1. Netlab interconnection

2.1 Netlab IMS Cores

Netlab project includes international partners participating in testing IMS cores interconnection in all network layers. IMS networks cores are deployed by different vendors (OpenIMS, Ericsson and Nokia).

OpenIMS. The Open IMS Core is an Open Source implementation of IMS core functions. It has been developed by the Fraunhofer institute and it is composed of IMS Call Session Control Functions (CSCFs) and a lightweight Home Subscriber Server (HSS), which together form the core elements of all IMS/NGN architectures as specified today within 3GPP, 3GPP2, ETSI TISPAN and the PacketCable intiative. The four components are all based upon Open Source software (e.g. the SIP Express Router (SER) or MySQL). This core is deployed at UC3M and STUBA cores. Slovak partners provide their NGN lab for Netlab tests. OpenIMS core is installed in a virtual machine (Sun Virtual Box environment). It has 512 MB of RAM memory reserved for the virtual machine and a Pentium IV at 2.4 Ghz. The operating system is Ubuntu Jaunty.

Ericsson SDS (Service Development Studio)**.** This is a emulation for the Ericsson IMS core. SDS is a tool for development and end-to-end testing of both the client and server side of new convergent all-IP (IMS) applications. SDS contains a standards- based IMS network simulator with communication services (CoSe) emulators. SDS supports clients and devices for Mobile, Fixed Broadband, and WLAN access. It uses Java community common practices and de-facto standards and provides high-level APIs to hide the network and terminal device complexity from the designer. This core is provided by Ericsson. This IMS core is installed in a virtual machine (VMware environment). It has 512 MB of RAM memory reserved for the virtual machine and a Pentium IV at 2.4 Ghz. The operating system is Windows XP.

Nokia IMS CORE. Nokia release 2.0 is based on Nokia FlexiServer Platform. The platform supports high availability and load balancing for applications and services running on the platform. Nokia IMS has a static subscriber capacity of 500 000 and is able to process dynamically 10 000 SIP messages per second. The Nokia IMS solution is implemented according to 3GPP/3GPP2 Rel.6 IMS specifications and ETSI TISPAN architecture. Software used: Nokia release 2.0 IMS consists of Connection Processing Server (CPS) and Nokia IP Multimedia Register (IMR). Nokia CPS provides the Call State Control Function (P/I/S-CSCF) functionalities and IMR provides HSS functionality. Hardware used: Both CPS and IMR have been built on top of fault tolerant FelxiServer 3 platform. FlexiServer 3 platform uses FlexiServer Blade hardware which provides flexible and scalable platform for achieving carrier grade availability. Each server blade has two 1.6 GHz Intel Pentium 4 Xeon processors, memory and back panel interfaces like Ethernet and FC-AL (Fiber Channel Arbitrated Loop). The PMC card has two 1 Gbps Ethernet ports for communication to the outside.

3 Tests

Tests described in this article have been completed in environment of interconnected IMS cores using VPN technology. However, involved universities have been interconnected through GEANT network. OpenIMScore was located at Leganes, Madrid and in Bratislava, Slovakia. SDS (Ericsson IMS core) was located at Fuenlabrada, Madrid. Nokia IMS core was located at Oulu, Finland.

The tester has remote access to all of the IMS cores in order to be able to retrieve log information. The remote access is provided by Remote Desktop connection for Windows XP operating systems and VNC technology in case of Linux based cores.

The proof of correct interconnection of IMS cores has been done using following scenarios:

- Registration of client in different labs
- Voice session establishment
- Instant messaging service provisioning
- Presence service provisioning
- Roaming scenario.

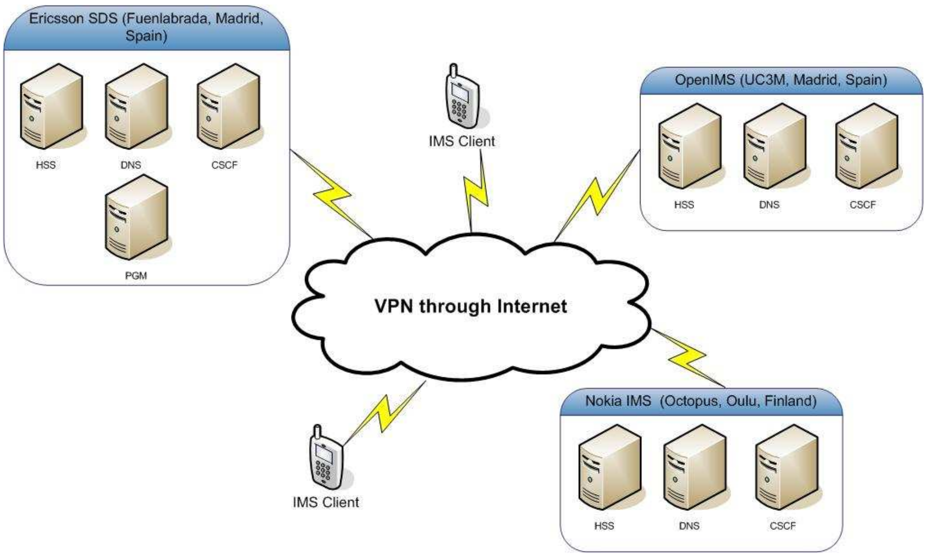

Fig. 2. Netlab laboratory

3.1 IMS Registration

3.1.1 Test Objective

IMS-level registration is the procedure where the IMS user requests authorization to use the IMS services in the IMS network. The IMS network authenticates and authorizes the user to access the IMS network.

IMS-level registration is accomplished by a SIP REGISTER request. A SIP registration is the procedure whereby a user binds his public URI to a URI that contains the host name or IP address of the terminal where the user is logged in. Unlike regular SIP procedures, registration with the IMS is mandatory before the IMS user's terminal can establish a session.

The IMS registration procedure uses a SIP REGISTER request. However, this procedure is heavily overloaded in the IMS, in contrast to SIP registration, and this overload is for the sake of fulfilling the 3GPP requirement of a minimum number of round trips.

Two algorithms have been used for registering: AKAv1-MD5 and basic username/password.

3.1.2 Test Procedure

To test registering process in Netlab we propose to register a user in IMS cores included in Netlab project – NGNLAB (SK), Octopus (FI), Ericsson (ES), UC3M (ES) and SQS.

User registers from different locations (from different labs of Netlab partners) using different IMS User Agent applications: UCT IMS client, X-lite, Monster and Mercuro.

3.1.3 Test Results

Following table shows the fact that most of the registration tests have been successful. We can see the different IMS clients and the different cores tested.

Table 1. IMS registration results

Client/Core	*OpenIMS*	*SDS*	*Nokia*	*Remarks*
X-lite	Ok (basic user/pwd algorithm)	Ok (basic user/pwd algorithm)	Ok (basic user/pwd algorithm)	Registration without two round-trip authentication.
UCT	Ok (both algorithms)	Ok (basic user/pwd algorithm)	Ok (both algorithms)	
Monster	Ok (both algorithms)	Ok (basic user/pwd algorithm)	Ok (both algorithms)	
Mercuro	Ok (both algorithms)	Ok (both algorithms)	Ok (both algorithms)	

X-lite application is pure SIP client. It supports only registration without two round-trip authentication while it does not support MD5 authentication. X-lite is not prepared for two round trip authentication which can be accomplished only by an IMS client.

UCT and Monster do not support MD5 authentication in Ericsson SDS core. The reason is that the UCT and Monster do not include *cnonce* in the authenticated request for the qop reply. qop support is optional and should not be forced by the core, as UCT and Monster simply ignore it and this backward compatibility is aspired by RFC 2617.

In case that we want to use different IMS/SIP clients for registration tests, we should use simple authentication method without two round-trip algorithm as some clients do not support complex algorithms.

3.2 Voice Call

3.2.1 Test Objective

The objective for this test is an establishment of a voice call between two IMS clients registered IMS cores deployed at different labs in different countries. We use the infrastructure being given by the VPN and the GEANT networks.

Test prerequisites

The clients need to be registered at IMS cores before starting the voice call.

3.2.2 Test Procedures

The main idea for this test is setup of a voice call through IMS cores included in Netlab project. At this testing stage a call is established always only through one of involved IMS cores (to involve several cores for voice calls we propose different test). An objective of this scenario is to repeat the voice call establishment process from different locations (different labs of different partners) using different IMS/SIP clients (UCT ims client, X-lite, Monster or Mercuro).

3.2.3 Test Results

The process of the voice call establishment through one core has been successful for all Netlab project partners' cores. The tests were successful for all chosen IMS/SIP clients. There were no problems while we tried to setup a voice call between X-lite client on both communicating sides.. Same result was achieved while using UCT IMS client, Monster and also Mercuro.

However some problems came up when we tried to establish a voice call using two different IMS clients. We could successfully test a voice call between X- lite and Monster client and vice versa. Also calls from X-lite to Mercuro and vice versa were successful.

3.3 Instant Messaging

3.3.1 Test Objective

There are two modes of operation of the instant messaging (IM) service - standalone instant messages or messages which are part of a session of instant messages.

Pager mode instant messaging is IM mode where message is sent as a stand-alone message not having any relation with previous or future instant messages. The name of the mode comes from the way a two-way pager works. The model is also similar to the SMS (Short Message Service) in cellular networks.

Session-based instant message is IM mode where message is sent as part of an existing session, typically established with a SIP INVITE request.

Both models have different requirements and constraints; hence their implementation is different.

We focus on pager mode instant messaging.

3.3.2 Test Procedure

At this testing stage we send and receive instant messages through each one of the IMS cores included in Netlab project. The messages are sent from one IMS core to another one.

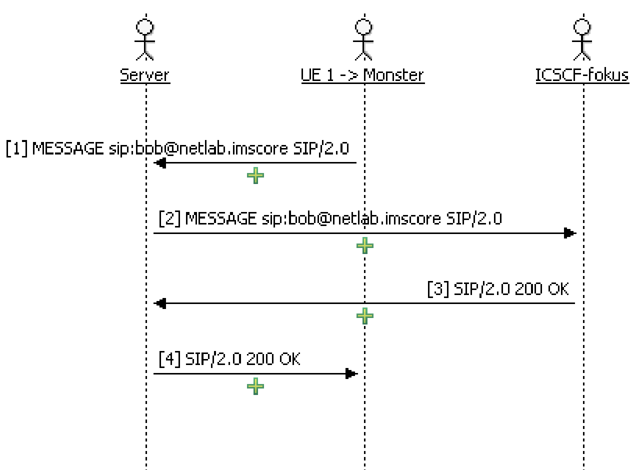

Fig. 3. IM flow diagram

Instant messages are are sent from different locations (different labs from different partners) using different IMS clients.

Test prerequisites
The clients must be registered to the IMS core before starting the session.

3.3.3 Test Results

The following table of tests results shows that all of IM tests have been successfully passed. We can see the different IMS clients and the different cores tested:

Table 2. IM results

Client/Core	*OpenIMS*	*SDS*	*Nokia*	*Remarks*
X-lite	Ok	Ok	Ok	
UCT	Ok	Ok	Ok	
Monster	Ok	Ok	Ok	
Mercuro	Ok	Ok	Ok	

Some problems were raised when trying to execute instant messaging with different IMS clients at the end of the communication. Probably because of internal implementations on the IM service within the IMS clients.

UCT crashed occasionally when messaging with Monster or Mercuro. UC3M modified the UCT IMS client code in order to avoid this kind of crashes.

3.4 Presence Service

3.4.1 Test Objective

The presence service enables any user to subscribe to the presence information of his friends, publish his own presence information or decide if he wants to provide others with his presence information. The presence interconnection assures that the presence information is exchanged through different operators' networks, assuring rich communication between end users. The objective of this test is to demonstrate how presence service works through different IMS cores.

3.4.2 Test Procedure

For this test we use the following functional entities:

- PGM (Presence and group management) - presence application server provided by Ericsson.
- Two different IMS cores - Ericsson SDS and OpenIMS.
- Two different IMS clients

- X-lite which subscribes to Ericsson SDS
- Monster which is registered at OpenIMS core

Both cores are configured to point to the same presence server.

3.4.3 Test Results

We proved that presence service worked between chosen IMS cores and clients. Following figure shows the flow of SIP messages exchanged.

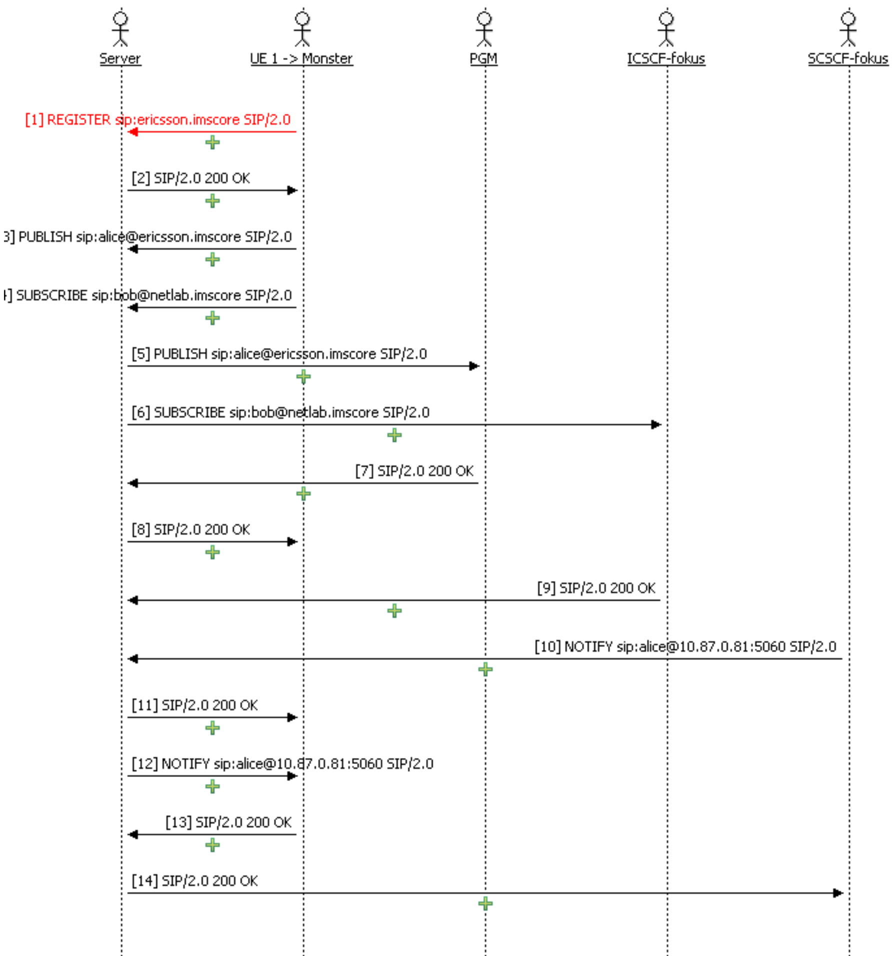

Fig. 4. Presence test flow of SIP messages

In Figure 4 we can see how a client (Alice) registered into SDS core, published her status and subscribed to the presence status of Bob (which was registered into the OpenIMS core) . At that moment Bob notified Alice about his status.

3.5 Voice Call among Different Cores

3.5.1 Test Objective

The aim of this test is to demonstrate the interconnection among different IMS cores. In order to accomplish this test we have to configure the IMS cores to be able to reach each another. We also had to configure the DNS servers from every IMS core so that they were able to reach the I-CSCF of other cores.

3.5.2 Test Procedure

In this test we use following infrastructure:

- Two different IMS cores - Ericsson SDS and OpenIMS.
- Two different IMS clients
  - X-lite which is registered at Ericsson SDS
  - Monster which is registered at OpenIMS core.

The purpose of this test is to test a voice call in both directions, from OpenIMS to SDS and from SDS to OpenIMS.

3.5.3 Test Results

The voice call was successfully established in both directions.

3.6 Roaming

3.6.1 Test Objective

The purpose of this test is to allow a user to register at visited network. This means that the subscriber could travel and connect to a different access network but he still would be able to access his home network although the operator which provides access network to him is not the one which he has contract with. We had to enable roaming and configure allowed visited networks to allow registration from a particular visited network.

3.6.2 Test Procedure

We use the Ericsson SDS core and the OpenIMS. We try to register at OpenIMS core configuring the Ericsson SDS as our P-CSCF. In this architecture the Ericsson SDS is the visited network and OpenIMS is customers' home network.

At the same time we register at Ericsson SDS using OpenIMS as P-CSCF. In this case we have the opposite configuration - Ericsson SDS is customers' home network and OpenIMS is the visited network.

3.6.3 Test Results

The test successfully proved that roaming scenario works in Netlab testing environment. Following figure shows the flow of SIP messages from the point of view of the visited network (the server is the SDS IMS core and the visited network). In the opposite direction (SDS as the home network and OpenIMScore as visited network) the test was also successful.

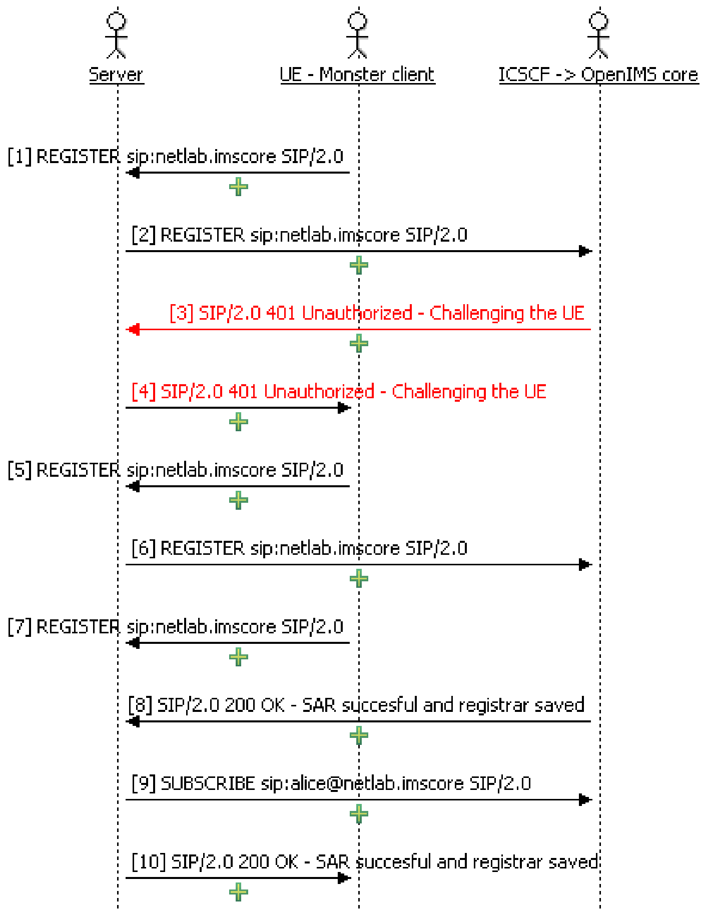

Fig. 5. Roaming flow of SIP messages

4 Conclusions

Within this paper, the Netlab consortium has established a distributed test bed for IMS interconnection tests. During the tests, we have executed several basic test cases and have addressed the difficulties. We were able to register at different IMS cores with several IMS clients, we were also able to establish voice sessions through different IMS cores, send instant messages, test presence through OpenIMS and SDS cores and prove that roaming scenario works in mentioned cores.

We have proved interoperability among different IMS cores although in some occasions specific configuration had to be done. We have achieved positive results however more work will be done before the project ends. The future work consits in more sophisticated scenario and also on sustainability of the NetLab project results.

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