

Challenges and achievements during integration of IMS platform into OSS/NMS environment

S. Nestić, N. Pekić and M. Tutman

Hrvatski Telekom d.d./Service Management and Network Operations Sector, Zagreb, Croatia
{sanjin.nestic|nikolina.pekic|mihaela.tutman}@t.ht.hr

Abstract - IP Multimedia Subsystem (IMS) is a core network architecture standard for mobile, fixed and cable networks that defines a collection of functional entities and concepts for delivering multimedia services based on IP protocol and next generation telecommunications network model. It was developed through collaboration of few leading standardization societies, such as 3GPP, ETSI/TISPAN and IETF, so it represents a strong guideline of future development. Along with the implementation in the network, IMS has to be integrated into operator's Operations Support Systems / Network Management Systems environment in order to fulfill expectations of having cost-effective service provisioning and assurance, system Fault and Performance management and efficient device and subscriber management. Besides problems and solutions already solved and implemented, this paper describes plans and challenges which are yet to be researched and developed in near future.

I. INTRODUCTION

IP Multimedia Subsystem (IMS) is an architectural solution for delivering innovative, high quality multimedia telecommunication services over fixed and mobile networks. It is a global standard specified by telecommunication standards bodies 3GPP, 3GPP2 and TISPAN [1], [2]. It provides framework for delivering advanced IP-based, consumer and enterprise services to the fixed, mobile and cable communities. IMS multimedia services include sharing of text, voice, pictures, data and video, or any combination of these services with the existing ones (messaging, telephony, ...).

Once implemented in operator's network, IMS offers operator more active role in service delivery and intention to exceed users' expectations with more quality and new exciting capabilities and services. In the end this should lead not only to better position and reputation on the market but it should also enhance customer loyalty. These new features are possible due to development of Session Initiation Protocol (SIP), which is widely used for controlling multimedia sessions, such as voice and video calls, between two or more agents that use different IP addresses. SIP protocol also provides a standard support for inter-network connections (SIP Network-to-Network Interface). Therefore, different telecom networks can communicate in a standard way so a user can normally use his provider's services, even though he's connected through other providers' access and core network. In the end this leads to creating an all-IP telecom network that follows the global internet standards and allows the user to access his own set of services and share his everyday

experience, no matter where he is or what device he is using.

As IMS is not merely replica of the existing voice and data platforms, all services from existing platforms cannot be directly migrated to IMS, hence new or adapted services have to be developed from existing ones. After implementation of new services, existing customers have to be migrated to new platform and to new or modified services.

Although the prioritization and speed for adopting IMS architecture is still in some cases matter of discussions, most incumbent operators will have to decide to implement IMS at some point.

Along with the implementation in the network, IMS has to be integrated into operator's Operations Support Systems / Network Management Systems environment in order to fulfill expectations of having cost-effective service provisioning and assurance, system Fault and Performance management and efficient device and subscriber management.

This paper describes issues taken into account during the planning of integration of IMS system in HT-Croatian Telecom Inc. – Croatian incumbent wireless and wireline operator landscape. IMS is at this moment introduced as core network that will substitute the existing PSTN network. However, it is foreseen that IMS will be used as enabler for the development of new multimedia services and as platform for fixed to mobile (F2M) convergence.

The following section describes in short the main features of IMS architecture that impacted the design phase and implementation itself. In section III, it is discussed the OSS/NMS readiness for IMS integration in general. Section IV points out the major changes in HT's OSS/NMS systems implemented as a part of IMS integration. Finally, section V gives OSS/NMS features currently developed in the foreseeable future.

II. IMS ARCHITECTURE

Basic functionality of IMS can be divided into three layers – access layer, control and connectivity layer and application layer (Fig. 1).

Through access layer, users can connect to IMS in various ways, mostly through devices that support IP protocol.

IMS terminals like mobile phones and computers can register directly using a basic SIP client. Fixed access (DSL, cable modems, Ethernet), mobile access

(W-CDMA, CDMA2000, GSM, GPRS) and wireless access (WLAN, WiMAX) are all supported. Other phone systems like POTS (Plain Old Telephony Service), H.323 and non-IMS compatible VoIP systems are supported through gateways.

Centre of the control and connectivity layer is the Call Session Control Function (CSCF), used to process SIP signaling and control the user sessions. It communicates with the Home Subscriber Server (HSS) through Diameter protocol to retrieve the needed user and subscriber information from the master database located on the HSS. Media Gateway Control Function (MGCF) and Media Gateway (MGW) are nodes that are used for control and media conversions between different media transport formats, for example between RTP/UDP/IP and TDM in case of connecting to POTS (Plain Old Telephony Service).

Service layer consists of various amounts of application servers where all the applications and services are being executed. A server can be used for one or more services, but also more than one service from different application servers can be used to create unified user experience for the end users. Benefits of having all the applications in the same place are ease of maintenance, upgrade and further service development.

Architecture provides a significant number of common functions that are generic and can be reused by virtually all services in the network. Some common functions are for example group/list management, presence, provisioning, operation and management, directory, charging and deployment, etc.

Common functions provide many benefits for service development, for example high level of abstraction for developers, less parallel development and more reliability, since the key functionality is already tested. All the advantages lead to a quicker, more efficient and innovative development, since the application developers can mainly focus on the application instead on basic functionality. IMS represents a bridge that gives the web application developers all the advantages of the telecom industry.

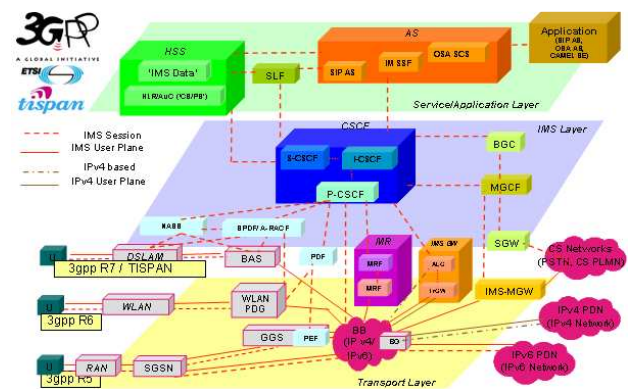


Figure 1. Basic IMS architecture

IMS architecture also separates service creation from service delivery, meaning that all the possible services are delivered through the same distribution channels, unlike before when services were usually circuit-switched. This gives provider flexibility to take a wider range of slightly

differentiated services to the market, in order to create artificial competition and offer users from every tightly defined market share the best service that meets its needs.

IMS also allows every user to order and activate services directly. Since the service can be consumed instantly on demand, it leads to a greater consumer satisfaction and reduced customer defections in the long term.

On the other hand, ease of use for the consumers and service designers; come with the following downsides [3]:

- Leads to a more complex network.
- Touchpoints become distributed rather than centralized.
- Rising complexity in the operations.
- Request for the high automation and low fallout rate.
- Constant complexity growth in management systems in time.

IMS implementation dynamics depends on several characteristics of operator, but the main distinction is seen between incumbent and greenfield operators.

While for greenfield operators IMS is usually the first choice for core network, incumbent operators with existing network architectures and technologies are more cautious when making time plans for the abandoning the existing and keeping IMS as core system. Until that final step, IMS is perceived as coexisting or overlaying architecture with existing ones.

IMS requires a lot of re-thinking, new investments and very delicate strategy decisions regarding timeline for implementation and migration of existing services and customer to IMS from incumbent operators.

III. IMS INTEGRATION INTO OSS/NMS SYSTEMS

Regarding standardization activities in OSS/NMS domain related to IMS architecture, there are some built in prerequisites and features inside the IMS architecture itself. Besides that, ITU-T M-series [4], [5], [6] define Telecom Management Network (TMN) which provides the architecture and interface definition for managing a diverse set of telecommunication networks. Additionally, the Telecom Operations Map (TOM) [7], [8], [9] from the TeleManagement Forum extends TMN to address customer specific operations support and management. 3GPP and TISPAN recommend the management framework based on these two standards [10].

It is sometimes perceived that introduction of IMS into operator's network reduces the need for OSS because many operational aspects of service management will be taken care of automatically in the network. However, as more service providers engage in IMS trials and start to go to market with IMS-based services, evidence is proving the opposite. The particular requirements of IMS actually generate more demanding features to be supported by OSS/NMS, to the delivery of IMS-based services.

For incumbent operators the maturity and flexibility of existing Business Support (BSS), Operations Support (OSS) and Network Management (NMS) Systems become very important. Because of low operating expenditure expectations, along with high customer satisfaction, BSS/OSS/NMS systems should fully support the following from the very start:

- Integration of IMS system into NMS landscape from the very first day of production.
- Seamless integration of IMS platform into existing data models and processes implemented into OSS/NMS systems.
- Smooth adaptation of business and technical end-to-end processes.
- Maximization of automated provisioning steps.
- Efficient processes for migration of existing customers' services on new platform with the main goal of having minimal customer service downtime.
- End-to-end (E2E) troubleshooting both on the network and service layer.

To conclude, this paper points out that during the planning of IMS implementation; two important issues have to be resolved:

- It is necessary to analyze the capabilities of existing BSS/OSS/NMS architecture for IMS adoption. If it is within reasonable capital and operating expenditures perhaps it is more efficient to use the existing architecture vs. big transformation of BSS/OSS landscape carrying it out into the parallel of IMS introduction.
- The understanding of overall organization for the necessity of high level of IMS system integration from the very first customer service on the system.

Some of these services needed to be integrated with the existing OSS/BSS infrastructure, in order to have efficient and centralized supervision. In this paper we will describe only the components that were integrated with existing OSS systems.

IV. INTEGRATION OF IMS INTO HT LANDSCAPE

HT implemented Ericsson's IMS solution [11], delivered with management capabilities inside the Operation Support System for Radio & Core (OSS-RC) and Ericsson Multi Activation (EMA) nodes.

The paper describes integration of IMS into existing HT's OSS/NMS landscape [12] without introduction of any major OSS system into landscape or major upgrade of existing systems.

Fig. 2 depicts the integration of IMS nodes into HT landscape. The following system integrations were done:

- OSS-RC is integrated into HT's umbrella Fault Management (FM) and Performance Management (PM) systems.

- EMA is integrated with Service Activation platform for service provisioning on IMS.
- Home Subscriber System's (HSS) export capabilities are used to support Service Inventory discrepancy and reconciliation functionalities.
- The existing functionalities of Automatic Configuration System (ACS) are extended to support device management of IMS-based VoIP services that are accessing to IMS through the xDSL access network.

For IMS itself and IMS-based services, the existing systems and processes in this moment support the most of functional requirement including planning, fulfillment and assurance, comparing to level of integration of existing platforms and services.

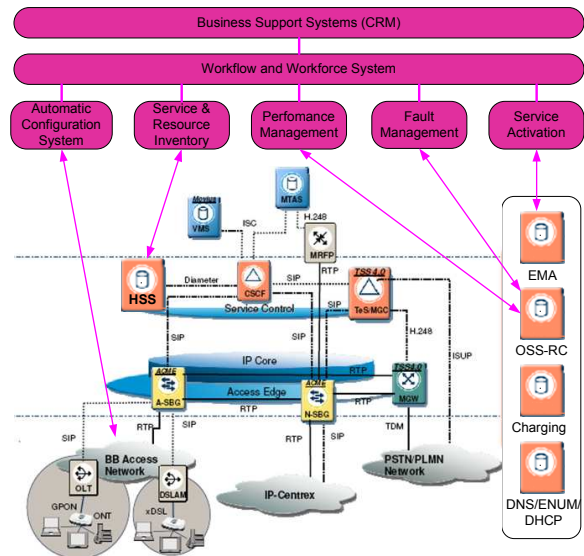


Figure 2. Integration of IMS into HT BSS/OSS/NMS environment

A. Fault Management integration

OSS-RC [13] is a component that is used for Fault, Configuration, Inventory and Security Management of the IMS components. Fault Management Basic (FMB) module receives, pre-processes, stores and forwards alarms from the network. It has several interfaces for alarm export, such as Corba, BNSI, XML, etc.

Basic root cause analysis logic is implemented on the OSS-RC itself, but for a network level insight, alarms are exported into HT umbrella Fault Management system – Netcool (Fig. 3) [14], where they can be immediately correlated with active alerts from other dependent devices and network technologies.

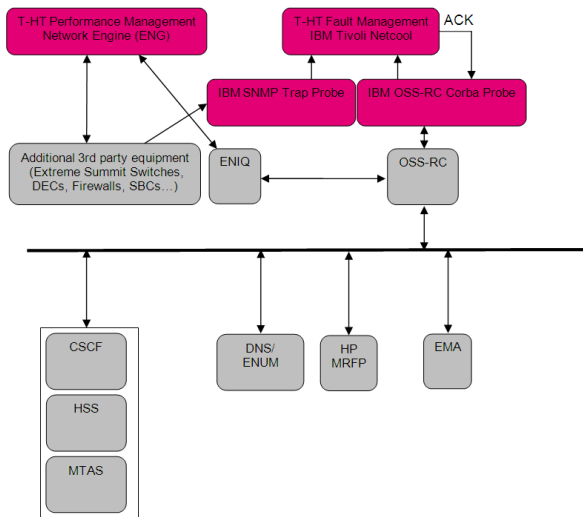


Figure 3. Fault and Performance Management integration

Alerts are forwarded to Netcool through proprietary IBM software made for that purpose. Netcool OSS-RC Probe (Fig. 3) [15] uses Corba protocol to connect to OSS-RC, retrieve alerts and information, and insert them into Netcool. For active alerts to be deleted from the OSS-RC active alarm list, they need to be acknowledged by a user. Acknowledgment was implemented over custom made Netcool tool that runs a special script, connects via telnet protocol to the OSS-RC Probe and executes a special acknowledge command followed by alarm identification number, which in the end acknowledges the alert on OSS-RC.

Third party equipment, like Extreme Networks' Summit switches [16] and Acme Packet's Session Border Controllers (SBCs) [17] are also integrated into Netcool in a standard way - through SNMP traps that are forwarded to the Netcool SNMP Probe when certain events occur.

B. Performance Management integration

Ericsson Network Intelligence Quotient (ENIQ) [18] is Ericsson's solution for Performance Management and determination of network KPIs (Fig. 3). It collects statistics files from network elements, loads them into an internal database and provides the ability to create reports over the stored data.

HT internally developed Performance Management system called Network Engine (ENG), which is able to connect to any relational database (MySQL, PostgreSQL, Oracle, etc.) and periodically extract data of interest. In this manner, several statistics and counters are extracted (SIP session counters and statistics, HSS user counters, etc.) from ENIQ to ENG and displayed them graphically on the intended page. Also, third party equipment is integrated in a standard way by periodically polling values through SNMP.

C. Integration into E2E processes

The most complex examples of IMS integration into E2E processes are related to service provisioning where two particular scenarios were developed: provisioning of a new customer and migration of existing customer.

The migration process is further differentiated to the following three scenarios:

- Field technician is doing the installation of new customer-premises equipment (CPE).
- New CPE is shipped to the customer with the instructions how to perform self-installation.
- Customer is already using adequate CPE and is remotely instructed how to do necessary changes on the CPE.

The following text will describe migration process where field technicians are doing the installation of a CPE in the customer premises. This is done in chunks by main distribution frames (MDF).

E2E service provisioning starts with customers screening and selection of planned migration dates and quantities (Fig 4.). Customers are marked for the migration, which includes setting a wish date of migration and type of migration in technical service and resource inventory system (DIS) [19]. After the customers are marked for the migration, internally developed Customer relationship management (Donat), will initiate migration order on the planned date. Workflow and workforce system (WWMS) is taking care of provisioning sequence in the E2E service environment. WWMS generates and coordinates automated tasks according to process book definitions insuring proper execution order of necessary actions which was one of the major challenges of the whole migration process.

Automatic tasks on activation platform [20] (Activator) are triggered by WWMS. They include IMS configuration, local number portability setup on IN and local exchange (LE), DSLAM service activation and automatic CPE configuration via Automatic Configuration System (ACS) [21].

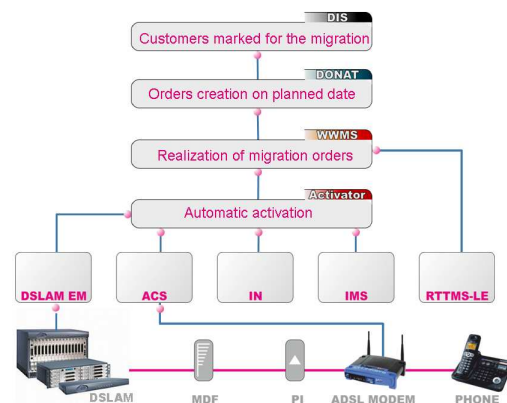


Figure 4. High level diagram of migration E2E process

The simplified flow in Fig. 5 is showing sequential and parallel dependencies of tasks emphasizing importance of simultaneous execution of certain actions as well as necessity of splitting the IMS configuration in two parts. IMS NEW task configures customer services with activated Operator Controlled Outgoing Barring Programs in order to prevent outgoing SIP calls before field technician is at the customer premises.

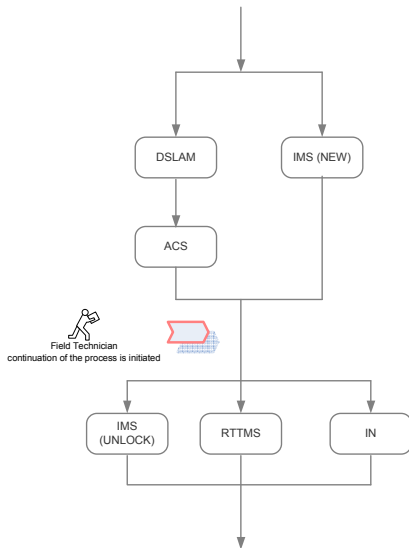


Figure 5. Automated provisioning tasks

After the successful installation of CPE, technician initiates further activation tasks. The process continues with IMS UNLOCK task that removes barring and sets local number portability feature for the customer phone number on both LE and IN nodes.

D. EMA integration into activation platform

WWMS sends a request to Activator with action and customer path information. Activator reads the request and retrieves from DIS all necessary information for automatic service provisioning on IMS (Fig 6.). Activator then sends request to EMA [22] containing the information about user to be subscribed to services, unsubscribed from services or services to be modified. After receiving a request from the Activator, EMA as northbound node, is responsible for interaction with the appropriate southbound nodes (MTAS, HSS and DNS) using specific logic for each node that shall be provisioned.

HSS is the master subscriber database, containing the subscription-related information, performing authentication and authorization of the users. MultiMedia Telephone Application server (MTAS) is the application server for MMTel service. Domain Name System/ Telephone Number Mapping (DNS/ENUM) node is used to resolve the IMS nodes name into an IP address providing node redundancy when required, ENUM resolution from an E.164 number to an operator solve external network SIP Gw IP addresses.

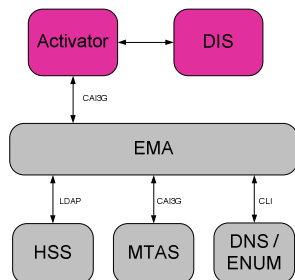


Figure 6. EMA integration

E. Fallout management

Special attention during the design phase was given to fallout of automated task scenarios and the costs of manual handling of fallouts. Analysis showed the following:

- Any delay in service delivery during the migration can result in reduced customer satisfaction and churn – which means immediate revenue loss and necessitates new customer acquisition.
- There is a high risk of introduction of errors through manual intervention, which in turn increases fallout rates.
- It is necessary to automate not only the regular processes, but also rollout/cancelation sub processes and to develop internal logic for retries mechanisms after the initial fallout of some activation steps.

Risks have been reduced by taking the following steps:

- Automation of rollout/cancelation processes wherever possible.
- Selection of high performance technicians based on their so far shown results, along with the additional education and certification of technicians.
- Additional quality of customer data checks among the systems and network platforms in the screening phase mentioned earlier. It is less expensive to resolve the inconsistency data issues prior to migration comparing to total fallout management cost.
- Increasing the fallout resolution efficiency by empowering the tools available to the field technicians.

Fallout resolution efficiency is being increased by allowing the field technicians to perform the following actions at the customer premises via mobile devices and laptops:

- Deeper investigation of customer service configurations.
- Service performance data.
- Service parameter modifications.
- Service current session information (physical and virtual MAC addresses, assigned IP address, current speed rate, SIP registration info, E2E service diagnostic data).

F. Implementation challenges

The main problem during implementation was necessary time for E2E testing of the systems. Because of many interfaces and complexity of existing and new business processes and their interactions, the testing phase took more then expected. To support the planned dates some compromises where made and some processes where launched in second and later phases.

V. FUTURE WORK

Although lots of work is done, after few months of migration activities, still several areas require additional attention.

In the FM and PM area it is considered to integrate 3rd party equipment (switches, SBCs) into OSS-RC component thus enabling the alarm and event correlation on the EM level.

Another activity whose purpose is to further reduce the fallout rate is targeting data cleaning processes and making customer screening and preparation more efficient. Currently, data preparation for the migration lasts for several days. During that time some customer services are changed (e.g. disconnected or changed) and almost all these cases directly transform into fallout scenarios once the migration starts.

There are still more ways to enhance service E2E troubleshooting in customer care centers, service management centers (SMCs) and technicians Web portal tools by introduction of more features and troubleshooting wizards. Any existing limitation is related to non-existing API on the underlying EMs/NEs or lack of time for the implementation on Web portals.

VI. CONCLUSION

The emergence and maturity of early IMS implementations imposed or accelerated the changes in the infrastructure of the incumbent operators towards IMS framework adoption, although the killer apps based on IMS platform still don't exist. It is evident that one of the certain ways to ensure the future revenue growth can be achieved by increasing the numbers and types of services offered to the customers and at the same time keeping high customer loyalty level.

There are great challenges in migrating from legacy networks and services to IMS-based next-generation networks. Post-migration, challenges will occur in delivering convergent services on fixed, mobile and wireless access networks.

Operations must be more efficient and automated to meet both cost and volume realities for new services under IMS. Such requirements put additional constraints on an anyway demanding OSS and NMS estate.

High integration of IMS into operators OSS/NMS landscape is a must, but at the same time any effort that leads to higher capital and especially higher operating expenditure costs than necessary, will be unacceptable in the face of low- and decreasing-margin services. When having price-sensitive services, the control over costs is essential to profitability. Operations are critical to that equation.

If some feature has to be pointed out, then it becomes necessary to increase autonomy (or to say the independency) of field technicians by using more extensively mobile devices and laptops at customer premises. Through Web portal, using powerful support tools in the background, field technicians should be capable of performing almost any provisioning or E2E

service troubleshooting activity on any system relevant for the service delivery as any SMC agent or network operator.

To conclude, OSS and NMS systems needs to be as much as possible automated – able to handle discussed issues through interrelated planning, fulfillment and assurance functions. Otherwise, it is not possible to profit from IMS implementation.

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