The role of Intelligent Network technology in future telephone network evolution

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Abstract: - The aim of this paper is to analyze the influence of new network architectures, like UMTS or NGN, over Intelligent Network evolution. First, it identifies the main drivers that can modify service platform paradigm, both from technical and market perspective. Moreover, those drivers cause the existence of alternative ways of designing and deploying value added services, like Open Service Architecture (OSA) or SIP Application Servers, and therefore it signifies a challenge for a mature technology like IN. Finally, it concludes with the expected role of IN according to previous analysis: staying as reference solution for voice control, but weakening position for multimedia session control.

Key-Words: - Intelligent Network, IN, CAMEL, INAP, CAP, VAS, OSA, IMS, SIP

1 Introduction

During almost two decades, intelligent network (IN) architecture and protocols has been the proper solution to provide advanced flexible voice services in existing fixed and mobile public networks. The main service offered by operators was voice telephony service, which was the principal -and almost unique- revenue stream. Therefore the Value Added Service (VAS) concept was limited to flexible handling of calls, beyond two-parties basic call.

Nevertheless, data traffic is becoming important and there are substantial changes in network architectures in latest standards and implementations. And those network changes also imply a different view of service deployment architectures. Therefore, some doubts and questions arise regarding the role of IN technology in forthcoming networks.

This paper will try to explain the key drivers of network evolution that would be able to modify the important current role of IN, and the challenges that those drivers connote for IN future development.

IN technology is a concept that actually means a variety of different international standards and protocols. The sense that has to be taken for 'IN technology' concept in the scope of this paper is the following:

- Service architecture with centralized remote control of core network switches -either circuit switching (CS) or packet switching (PS).
- The switch will implement an abstract model of voice call or data session, with transitions handled by remote control point node, using a signaling protocol on top of Transaction Capabilities Application Part (TCAP) layer.
- The control protocol will be Intelligent Network Application Part (INAP) or Camel Application Part (CAP), in any of its current or future releases or capability sets.

For further information about Intelligent Networks please see references [1], [2] or check the standard recommendations [3] and [4].

2 Network evolution drivers

Last generation core network architectures –in both fixed and mobile networks- have a common characteristic: the separation between the transport layer and the control layer. The transport layer accomplishes the 'actual switching' according to the rules configured in the control layer. There is also a third layer, which contains the converged voice and data application, called 'service layer'.

This is the main network issue which will influence in the future the value added services solution design and the intelligent network evolution in particular. But there are many other, that can be classified in either market/business driven or technology /standard driven:

- **Technology innovation**: Next Generation Networks (NGN) and Voice over IP (VoIP)

in fixed networks, Universal Mobile Telecommunication System (UMTS) in mobile networks.

- **Market influence**: Appearance of service providers unlinked to telecom operators, concentration among mobile operators becoming eventually global, mobile data service growing demand and finally, the convergence of voice and data services and fixed mobile convergence.

This section will go further with the mentioned drivers and we will try to explain why those facts influence the Intelligent network evolution.

2.1 NGN in fixed networks

NGN deployment means an important change in traditional telephone network architecture and a forward step towards multimedia service offering for wireline users.

Trying to summarize the requirements that define the NGN architecture, we can highlight the following keys:

- Access layer. Different kind of access technologies and user terminals allowed: DSL, POTS SL, ISDN BRI/PRI, cable modem, LMDS, PLC, Ethernet IP phones (H.323/SIP)...
- Transport layer. Packet switching for all kind of media. There will be a access/media gateway to perform the real switching of any media (voice, data or a mixture of them, i.e. videotelephony). Preferred technology options to implement this data backbone are ATM and MPLS IP network. This backbone will handle both the payload and the signaling.
- Control layer. As mentioned before, there will be a new network element to control the behavior of several switching elements, the Control Agent or also called 'Softswitch'. This softswitch remotely controls the media gateways through Megaco / MGCP / H.248 protocol.
- Service layer. The service layer will be flexible enough to allow standard Application Servers to access network resources using open APIs through a service framework, which hides network complexity and protocols.

Obviously there will exist an interface with existing legacy networks using a signaling and trunk gateway that interfaces with TDM (Time Division Multiplex) voice networks and SS7 signaling systems.

More information about NGN architecture model and its influence over IN can be found in [5].

Anyway, there is one question not answered yet: ¿what is the influence of this new architecture in IN evolution? The answer is that the NGN is strongly linked to some network interfaces directly related with IN services:

- **Open Service Architecture (OSA) /Parlay** interface as Call control enabler
- **Session Initiation Protocol(SIP)** application server as an alternative to traditional IN applications for voice services and beyond (any multimedia session)

2.2 UMTS in mobile networks (3G)

Universal Mobile Telecommunication System is the international standard for third generation digital mobile network as an evolution of existing narrow-band cellular digital networks (GSM and CDMA networks). Third Generation Partnership Project (3GPP) specifications are divided in different releases as the features of 3G network evolves. In the first release (release 99), the core network specifications are quite similar to GSM/GPRS specs –General Packet Radio Service-, but with a different radio access network (Wideband Code Division Multiple Access, W-CDMA), called UMTS Terrestrial Radio Access Network (UTRAN). The actual core network evolution starts in release 4 and it is enhanced in release 5. The main aspects to be considered (from the IN service point of view) are:

- Switching Subsystem split into transport layer and control layer (remember NGN architecture). This applies for CS in R4 and for CS and PS in R5
- Packet switching and circuit switching domain share the transport mechanism and switching element (Media Gateway)
- New domain included: IP Multimedia Subsystem (IMS), adopting SIP as signaling protocol.
- Service layer based upon Open Service Architecture (OSA) model, with Application Servers interfacing with the OSA Framework element for authentication and authorization and using Service Capability Servers to access network resources, in a transparent way and independently of the underlying existing network technology. This services will be delivered to the user regardless the visited mobile network where the mobile

user is located, so creating the image of a virtual home environment.

See [6] for further information about 3G networks. Below you can find a network diagram of UMTS circuit switch architecture, showing the layered view of core network already explained.

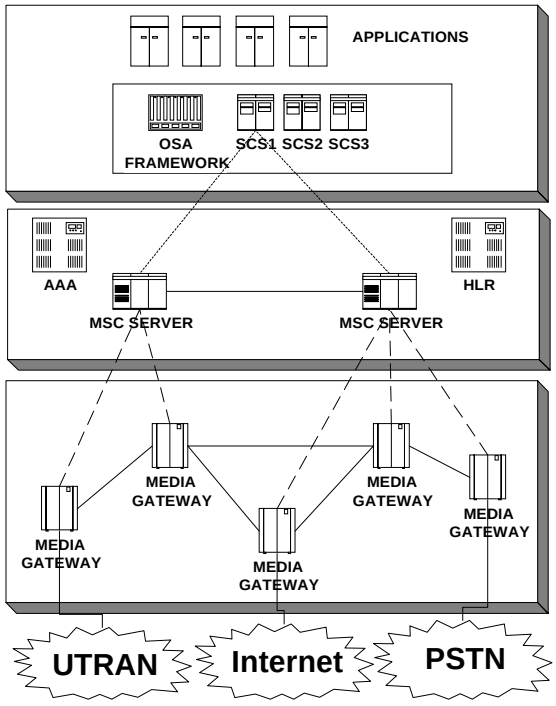

Fig.1 CS network architecture in UMTS

Therefore, the main architectural elements that affects the IN model within 3G network are:

- **OSA/Parlay** as service layer architecture
- **Roaming services** deployment using Camel protocols
- Enhanced **mobile data services** with the introduction improved data rates for PS session in UTRAN
- **IMS** domain for end-to-end data sessions
- **SIP** as IMS signaling protocol and thus as an enabler for application development

2.3 Service providers

The usage of Short Message Service (SMS) has increased from its origins in the early 90s in an exponential matter. Now is the most important data service in mobile networks and therefore the most important basic service excluding voice. But SMS has been the 'spearhead' of a new business model: the external Value Added Service Providers (VASP). The SMS interface is an easy way to access content providers' applications to request any kind of information delivered in SMS format (ringtones, small images, news, weather forecast...).

Large companies have also the opportunity to offer information services to their employees through a mobile access.

These companies can enhance their services with location information, USSD (Unstructured Supplementary Service Data), voice services and more. But those are network resources under operator control so they are not offered to external companies.

One of the aims of **OSA/Parlay** architecture is to offer to external companies a controlled and authenticated access to network resources.

2.4 Mobile data services

Although nowadays voice is the main revenue source for mobile operators, data traffic is becoming an important differentiation element and an increasing alternative revenue stream.

Mobile users -mainly business users- are requesting data access everywhere, regardless of user location. They want to surf the web from their laptop, read the e-mail, or access the company's intranet information. The extension of WiFi (IEEE 802.11) has created a new demand, making wireless internet access something habitual and easy. So WiFi is at the same time a throat (it steals GPRS traffic) and an opportunity (it increases the demand and obviously there is no WiFi coverage everywhere, so far...).

Nevertheless, private users also are using GPRS data services more and more (although they even does not know it), because MMS (Multimedia Message Service) messaging and WAP (Wireless Application Protocol) use GPRS as data carrier. There is no new mobile terminal sold in the without any kind of GPRS support. And the smooth but growing usage of UMTS, with higher data rates available, also would increase the data traffic. And finally, it was already mentioned that SMS is the most popular data service, and probably the second revenue source in mobile networks.

Thus, the **Camel control of data** becomes important, in order to monitor and control the Packet Data Protocol (PDP) context establishment (GPRS Camel control) and SMS sending/receiving Camel control.

2.5 Global operators

During the last 5 years, the European operators have been involved in a concentration process where major operators have acquired others in order to

reach as many countries as possible. This leads to the creation of global operators, like Vodafone, or the creation of operator's alliances to be able to compete in a global market.

The creation of a homogeneous image worldwide is quite important to retain business customers, who want identical service when going abroad, that is to say, they want **roaming services** like being at home.

Thus, nowadays there are three mobile operator associations, which covers most of the GSM mobile customers worldwide:

- Vodafone
- FreeMove
- Starmap

2.6 Fixed/mobile & voice/data convergence

As you could easily notice, service layer for NGN and UMTS shares the same architecture. Moreover, some papers regarding NGN extend the transparency in the access layer to fixed or mobile access, sharing a common transport layer. The signaling protocol for session setup and release is SIP both in fixed NGN and mobile IMS. The multimedia services allow the creation of combinational services between mobile and fixed user (for example, gaming services between fixed PC users and a mobile users, sending game data with multiconference voice information at the same time). Therefore we can conclude that mobile and fixed networks are getting closer from an architectural perspective, but also from an end-user application perspective. This new generation of services will handle any kind of media, from voice to data (including video), or any combination of several media streams.

This double convergence phenomenon (voice-data and fixed-mobile) affects the potential usage of the following technologies:

- **OSA/Parlay** model, due to the fact that OSA can offer a unified fixed-mobile service platform, in a transparent manner for the application logic.
- **SIP protocol** as a potential future alternative to SS7 signaling for both fixed and mobile (at least in IMS domain) networks.

3 Challenges of IN

The previous chapter tried to identify the technological keys that will influence what will be the role of IN for the coming years in telecom networks. Each of these single elements are, at the same time, a threat and an opportunity for the development of IN technology. In other words, depending on the balanced importance in future of the drivers already explained, the IN services will maintain or even develop its usage as VAS alternative, or otherwise, they can lead to a decreasing usage of such technology and eventually, in the long term, to migrate all IN solutions to newest (and maybe cheaper) technologies.

The following paragraphs will analyze how those technological keys, threaten and simultaneously can cause IN services usage extension.

3.1 OSA/Parlay

Open Service Architecture (OSA) brings off network transparency to application service logic, by means of a standard API to control several network resources in a high-level abstraction model of features. Resources capable to be handled are: voice calls, user interaction (voice, short messages, e-mail, USSD...), user location/status/presence... and everything without knowing anything about the underlying network interfaces. The OSA application (running on standard application servers, like J2EE) authenticates on the OSA Framework and connects to the authorized Service Capability Servers (SCS) to control the network resources. In order to control voice in release 4 the Generic Call Control (GCC-SCS) and the Multiparty Call Control are defined. In release 5, both SCS are joined in a single SCS: Call Control.

And of course the easiest way to control call remotely is intelligent network, so Core INAP CS1 (or CAP v1/v2/v3 in mobile networks) are the usual protocols for GCC SCS implementation and INAP (proprietary extensions, CS2, or CAPv4 for mobiles) is also the usual way for MPCC. OSA allows offering the CC SCS depending on the underlying network or the needed capabilities, and the OSA framework will be responsible for assigning one SCS implementation or another. But again, this will be transparent for application developers.

So the circumstances that can **benefit** IN usage regarding OSA are:

- Spreading of INAP/CAP SCS commercial implementation of CC SCSs, packaged with OSA framework platforms.
- Appearance of OSA third party developers with enough knowledge of OSA API or, even better, simplified access methods like SOAP (Simple Object Access Protocol) and Parlay/X.

On the other hand, OSA can **negatively** affect the IN existence: as the API is not necessarily linked to IN, future network protocols can appear and this is application independent (the API does not change) so

OSA makes easy a migration form IN to other alternative network interface.

3.2 CAMEL data session control

Customized Application for Mobile networks Enhanced Logic (CAMEL) is the 'mobile version' of INAP architecture. First and second phase of Camel are focused on voice call handling (although some simple User Status and location features are also defined). Actually, CAPv2 features are a subset of CS1 INAP features. Nevertheless, Camel ph.3 (i.e. Capv3) makes a significant change, extending Camel features beyond voice, defining the SMS and GPRS CAP operation and procedures. So the CSE (Camel Service Environment) can control voice and data session as well.

So Camel data session control benefits IN in the sense that:

- There is a extension of combined voice and data value added services. For instance, shared black and white lists for SMS, MMS and calls.
- Prepaid subscriber GPRS traffic increase, making real time control of consumed prepaid credit necessary.

Nevertheless, the inconvenience is that the degree of development of latest Camel standards (phase 3 and 4) is slowest than expected, mainly due to the trend of R&D investment reduction in switching manufacturers, caused by the delays in 3G network launches.

3.3 Roaming services

The main contribution of CAMEL architecture, and the actual reason of existing Camel deployments is the ability of control services when the subscriber is roaming out, that is, attached in a visited foreign mobile network.

Therefore, the roaming service demand is positive for Camel (which means is **positive** for IN model), as seen below:

- Global VPN demand. As explained before, large multinational companies request the operators to have homogeneous behavior in voice services in all different countries where they have premises. So Camel has a role in offering the same service despite of roaming of users.
- Regulatory affairs. In some large countries national laws that control telecom market, force the operators to use different Mobile Country Codes in different regions of the country. So if an operator has a license in several of those areas, Camel become a good alternative to share infrastructure and to save investments.

One **negative** issue to remark is that the commercial agreements between operators have to accommodate to the different kind of Camel services offered by gsmSSF: so far the agreements allowed registration in visited network, or SSF usage for Camel services. This agreements need to be extended to permit different phases of Camel in order to make easy the support of advanced features abroad.

3.4 SIP signaling and IMS domain

Service layer in IP Multimedia Subsystem is based upon three different technical solutions: OSA, SIP Application Servers and Camel. The Serving Call Status Control Function (S-CSCF) can connect to any of those three service platforms through SIP protocol.

The Camel Service Control Point (or Camel Service Environment, CSE) use CAP to control IMS sessions, by means of the IP Multimedia-Service Switching Function (IM-SSF) which implements a BCSM.

The SIP AS will include the service logic, with no relation with IN at all and allowing many of the classical IN service features. OSA SCS can be implemented in IMS using SIP, offering the same API to application as INAP-based or CAP-based call control SCS. That means that we can avoid IN protocols and reuse previous OSA applications anyway. In fact, SIP SCS can behave as CC SCS , UI SCS or messaging SCS. But SIP SCS is able to offer capabilities beyond voice, like Presence and availability Management (PAM) SCS or Multimedia conference call control (MCCC).

Thus, we can see that SIP service control faces up to call control IN hegemony. An interesting paper about IMS service architecture can be found in [7].

4 Conclusion

So we have seen that the intelligent network is now a mature technology. In previous chapters, we have analyzed some facts that can influence whether IN will remain as a valuable VAS technical solution or not.

And we can conclude with several considerations about the possible role of network intelligence:

- There is no a clear path for IN evolution: the VAS technological keys linked to network architecture changes, can be either an 'enemy' and an allied influence.

- Anyway it seams reasonable that IN will continue being the main solution in CS and PS domain for 2G and 3G networks.
- The major threat for IN substitution is the SIP application server concept, which can control voice or other media sessions, and also can behave like OSA MPCC-SCS in IMS or NGN domains.
- Advanced future VAS very likely will combine several different media streams, and will need the cooperation of such a different technologies: SIP for multimedia, IN for Voice and GPRS sessions and even the terminal, because client application in terminals will become an important issue for providing end to end VAS solutions, and therefore 'moving the intelligence' to the edge of the network.

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