

INTELLIGENT NETWORK SERVICES MIGRATION

MORE VALUE FOR THE
VOICE OVER LTE SUBSCRIBER

TECHNOLOGY WHITE PAPER

Mobile operators have invested a lot of time and money in Intelligent Network (IN) services for 2G and 3G circuit-switched voice networks. Today, these provide popular services such as number portability, pre-paid service, virtual private network (VPN) and so on. Yet what about the all-IP network of 4G LTE? When mobile operators deploy Voice over LTE (VoLTE), they must analyze and determine how to migrate 2G/3G IN services. This paper examines the needs, challenges and methods for IN services migration.

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1. INTRODUCTION

Popular mobile data services are driving operators to quickly implement 4G Long Term Evolution (LTE) to provide more capacity, higher bandwidth, reduced latency and improved pricing. Voice over LTE (VoLTE) is specifically designed for 4G LTE networks, and it unlocks all-IP communications such as video calling [1]. However, in such all-IP networks — VoLTE, and also fixed Voice over IP (VoIP) — operators must determine how IN services are delivered.

Operators have invested years in their IN services: in Global System for Mobile Communications/Universal Mobile Telecommunications System (GSM/UMTS) networks, these are often implemented as Customized Applications of Mobile Enhanced Logic (CAMEL) or Capability Set 1 (CS1) services. These services are invoked by a query from the Mobile Switching Center (MSC) toward an applications database. Sample services include pre-paid with online charging system (OCS), toll free/free phone, number portability, charging, call limits, home zones, VPN, and so on. Because of the value of these applications, many operators prefer to migrate IN services to work with VoLTE.

In GSM/Wideband Code Division Multiple Access (W-CDMA) (hereafter GSM) networks, IN services are usually triggered using CAMEL or IN CS1. In IP Multimedia Subsystem (IMS) networks, an Application Server (AS) is triggered using Session Initiation Protocol (SIP), and an OCS is triggered using the Diameter Ro protocol. Operators face challenges in the following cases:

- GSM subscribers are anchored in an IMS network or an operator wants to replace a legacy fixed or circuit mobile network with an IMS network. The operator may prefer to keep the legacy IN platform, triggered using CAMEL, while waiting to migrate to a similar AS triggered by SIP.
- An operator may want to deliver the same user experience when an IMS subscriber makes a VoLTE call under LTE coverage as when a GSM or IMS-anchored subscriber is under 3G coverage.

No major issues arise if the same IN and OCS services are triggered from the IMS network in any of the following three cases:

1. The IN service triggered using CAMEL or IN CS1 from a GSM or fixed network can be also triggered using SIP, consequently behaving as an IMS AS in the IMS model. The same IN service is triggered using the relevant protocol, offering the same user experience whether the subscriber is a plain GSM user, a GSM user anchored in IMS or a VoLTE user.
2. The pre-paid server triggered using CAMEL or IN CS1 can be also triggered using Diameter Ro, consequently behaving as an OCS in the IMS model. The use of Diameter Ro assumes that the Attribute Value Pairs (AVPs) dedicated to IMS are supported by both the OCS and the IMS. In this case:
 - If the user is under GSM coverage, the OCS is triggered using CAMEL.
 - If the user is a GSM user anchored in IMS or a VoLTE user under LTE coverage, the OCS is triggered using Diameter Ro from the IMS.

Whatever protocol is used, the OCS must be able to trigger the same rating rules in the rating engine of the OCS. This capability is supported by the Alcatel-Lucent 8610 Instant Convergent Charging (ICC) Suite.

The ability to play OCS announcements — welcome announcement, remaining credit, warning tone, and so on — when triggered with Diameter Ro is not supported by Third Generation Partnership Project (3GPP™) standards. However, this ability is supported using AVPs by Alcatel-Lucent SurePay™ and Alcatel-Lucent 5420 Converged Telephony Server (CTS) plus IMS gateway function.

3. The OCS can be triggered with both CAMEL (or IN CS1) and SIP. In this case, to avoid charging issues, the OCS is triggered after or before another AS such as the Telephony Application Server (TAS), provided that the AS sends early answer messages — for example, for user interaction — or translates the received number as discussed in Section 2.4.1.1.

In this case, the OCS plays the role of an AS. Playing announcements using SIP presents no issues.

Section 2 describes how to solve the issue that arises when an operator that owns an IN service triggered using only CAMEL or IN CS1 wants to trigger the same IN service from an IMS network (for example, for VoLTE users or GSM users anchored in IMS).

2. TRIGGERING OF CAMEL/IN CS1 SERVICES FROM AN IMS NETWORK (VoLTE USERS OR GSM USERS ANCHORED IN IMS)

The alternative solutions to this issue depend on the type of IN service or OCS to be triggered:

- Standardized or operator-proprietary service
- Simple or complex service

2.1 Applications supported by the Alcatel-Lucent 5420 CTS

In the case of an anchored or IMS user, the TAS — such as the 5420 CTS — plays the role of the multimedia telephony service (MMTel) AS and is always triggered from the IMS core to support supplementary services, such as call forwarding and conferencing. The 5420 CTS also supports multiple other IN applications, such as personal ringback tone (PRBT) and VPN.

If numerous operators already have a similar IN service triggered using CAMEL or IN CS1 from the GSM network, it could be worth enriching the 5420 CTS with a similar application. If the user experience is not identical to the legacy IN service, the feature could be customized in the 5420 CTS.

2.2 Applications supported by other SIP Application Servers

An IN service can be provided by a SIP AS other than the 5420 CTS. For example, the Alcatel-Lucent 8610 ICC is an OCS that supports multiple protocols: CAMEL voice, CAMEL Short Message Service (SMS), CAMEL General Packet Radio Service (GPRS), IN CS1, Ericsson™ IN CS1 + , Wireless Intelligent Network (WIN) Code Division Multiple Access (CDMA), SIP, Diameter Ro, and so on. Because of its SIP and Diameter Ro interfaces, the 8610 ICC can be also triggered from the IMS for VoLTE users.

Based on an analysis of the cost, features and age of the legacy product, the operator can:

- Choose to keep its legacy product (IN service or OCS) and trigger it from the IMS through an IP Multimedia Service Switching Function (IM-SSF) that translates SIP into CAMEL (see Section 2.4)
- Choose to replace its legacy product (IN service or OCS) with another product that supports SIP

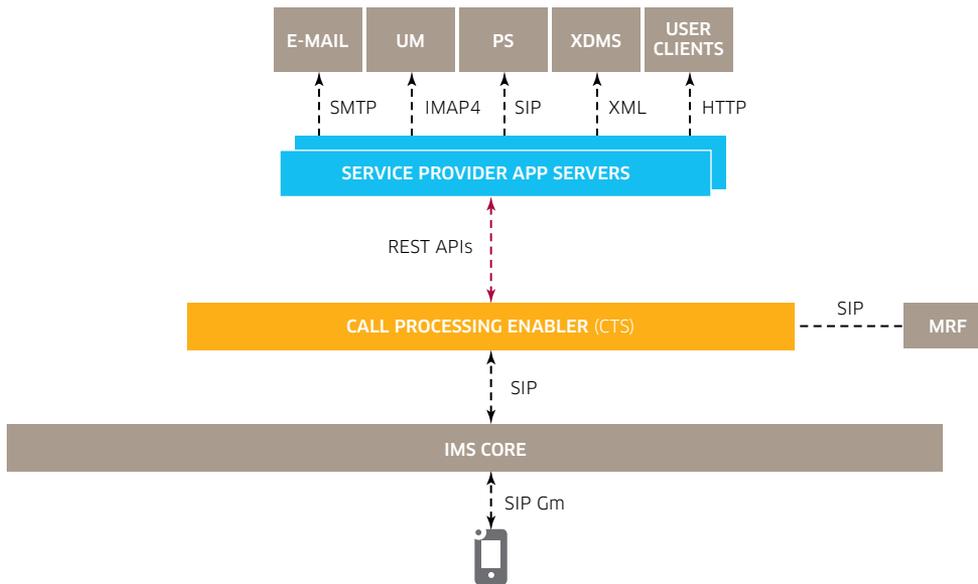
2.3 Applications supported by the 5420 CTS service agility feature

An IN service can be provided by a dedicated AS, triggered by the 5420 CTS Representational State Transfer (REST) interface using its service agility feature (see Figure 1).

Service agility in the 5420 CTS offers the ability for service providers to access easy-to-use call-control application programming interfaces (APIs). The APIs enable service providers to rapidly create innovative services themselves or with application partners or contracted developers.

The 5420 CTS is an MMTel AS with many valuable capabilities that application developers can leverage to create services and enhance existing services. Operators can then compete and differentiate their communication services from over-the-top (OTT) services such as Google Talk™ or partner with OTTs to create collaborative services in new business models.

Figure 1. General architecture of 5420 CTS service agility



2.4 Applications supported by legacy IN service using CAMEL/IN CS1

In the case of a complex and/or customer-specific IN service or for an OCS, the operator may want to keep the existing IN service or OCS and trigger it using SIP or Diameter Ro from the IMS network. There are two solutions:

- Enhance the IN service with SIP support or enhance the OCS with Diameter Ro support
- If a legacy IN service or OCS cannot be triggered from the IMS core network directly using SIP or Diameter Ro, it must be triggered from the IMS core using CAMEL or IN CS1 through an IM-SSF

The rest of this section focuses on the IM-SSF. Depending on the protocol used — CAMEL or IN CS1 — the proposals may differ.

2.4.1 IM-SSF and CAMEL

This section describes the general architecture and handling of user interactions for operators that plan to use CAMEL and an IM-SSF.

2.4.1.1 General architecture

CAMEL is a fully standard protocol, so a standalone IM-SSF can be provided by a third party or by the operator.

The Serving Call Session Control Function (S-CSCF) successively triggers several ASs using SIP IMS Service Control (ISC), including the TAS (5420 CTS) and one or several IM-SSFs. One IM-SSF then triggers one IN service using CAMEL.

However, depending on the operator environment — for example, legacy IN services, services to be processed in the TAS, or OCS — a standalone IM-SSF may have restrictions on its support for interactions between legacy IN services to be triggered using IM-SSF and TAS services.

For example, if the TAS sends a “200 OK” early answer message to the calling user to process a user interaction, translates the called number — for example, into collected digits — and the IN service to be triggered using the IM-SSF is an OCS:

- A standalone IM-SSF cannot be triggered by the S-CSCF before the TAS because the OCS will wrongly charge the call. Charging must not start with reception of the TAS’ 200 OK message for user interaction but with reception of the answer message from the called party.
- The S-CSCF cannot trigger a standalone IM-SSF after this TAS service because the OCS will wrongly charge the call using the translated called number instead of the original called number. For example, a call to an Advanced Free Phone number should be free and must be rated at 0 currency units because of the user-dialed 0800 number.

Therefore, depending on the context — CAMEL- or IN CS1-triggered service or TAS-offered services — events received by the IN service through a standalone IM-SSF may be wrong and the IN service may not work correctly.

2.4.1.2 IM-SSF and user interaction

An IM-SSF can work with a Specialized Resource Point (SRP) or a Media Resource Function (MRF).

In most GSM networks, IN servers are triggered using CAMEL and support direct link or assisting SSF mode. There is a risk in moving a legacy IN service from, for example, direct link mode to relay mode.

For migration to an IMS network, legacy CAMEL servers should continue to work with the same direct link or assisting SSF mode. The handling of user interactions with direct link mode can be supported by the legacy SRP or the MRF.

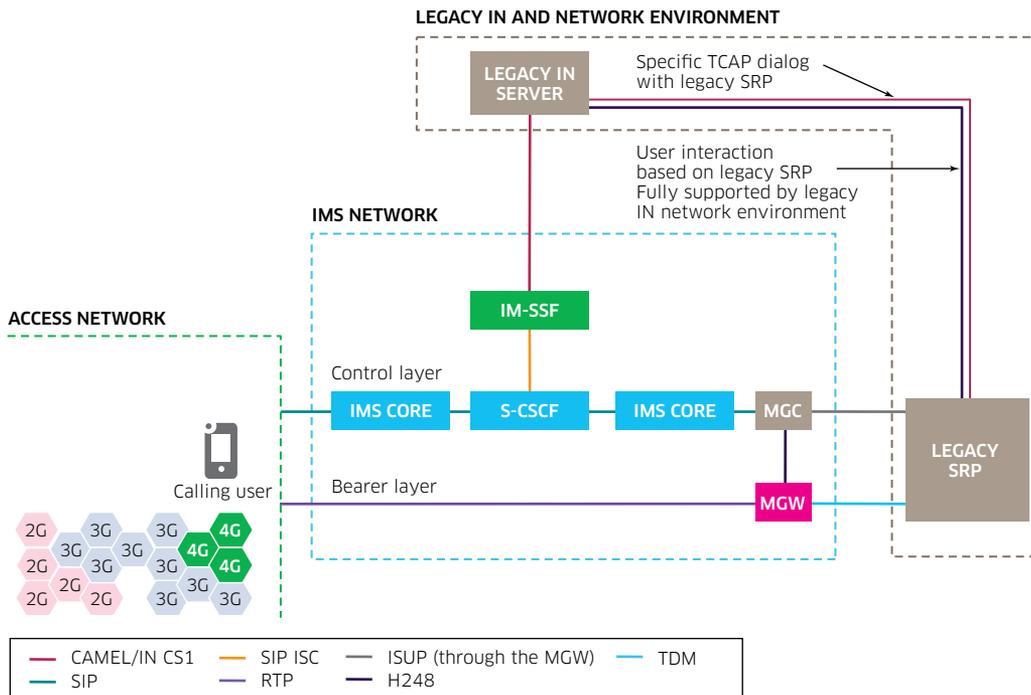
User interaction with SRP

Handling user interactions with the legacy SRP has multiple advantages for the operator:

- SRP resources are reused, with no need to use new resources on the MRF.
- Announcements to be played by the IN service are already configured in the SRP.
- Risks are limited because the handling of user interactions is exactly the same in the IMS and GSM contexts, for both the IN server and SRP, because the interface between them is unchanged.

Keeping the legacy SRP for user interactions is therefore the preferred option for migrating a legacy IN service from a GSM or fixed network to IMS. Figure 2 shows the general architecture based on an SRP.

Figure 2. User interaction with legacy SRP

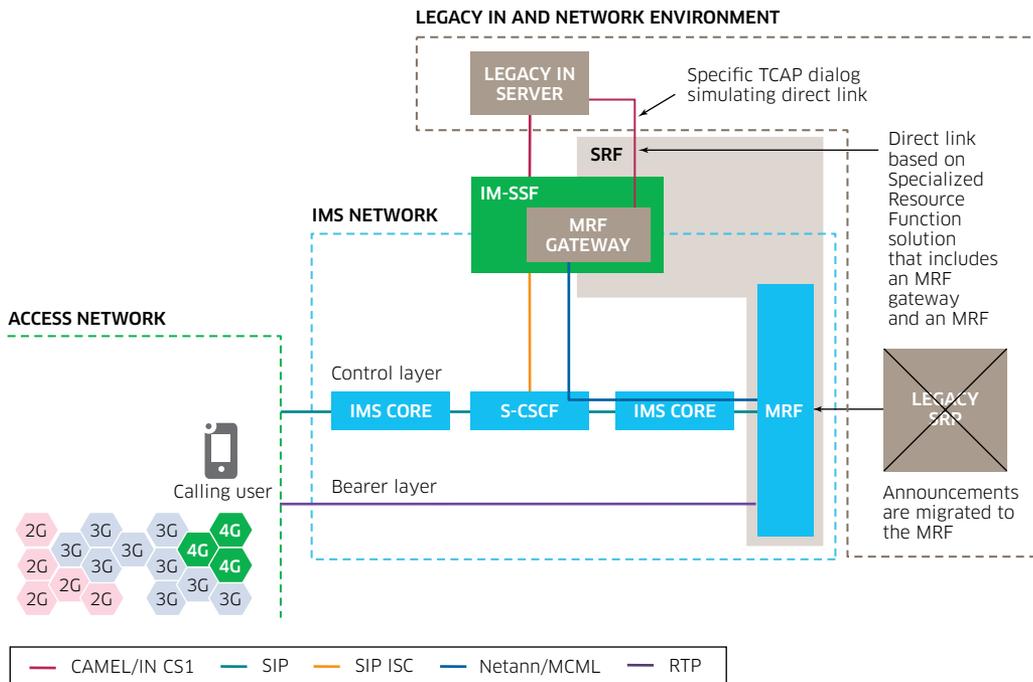


User interaction with MRF

The operator may prefer to process user interactions with an MRF even if the IN service supports direct link or assisting SSF mode. The operator may want to use the MRF that is deployed in practically all IMS networks instead of maintaining the legacy SRP.

Figure 3 shows the general architecture based on an MRF.

Figure 3. User interaction with MRF



2.4.2 IM-SSF and IN CS1

IN CS1 protocols are highly customized and are often specific to the operator, vendor or even specific products. In particular, charging operations are not specified in standards, so each product has its own charging signaling. The IM-SSF must therefore be customized to the specific IN CS1 protocol requested by the operator.

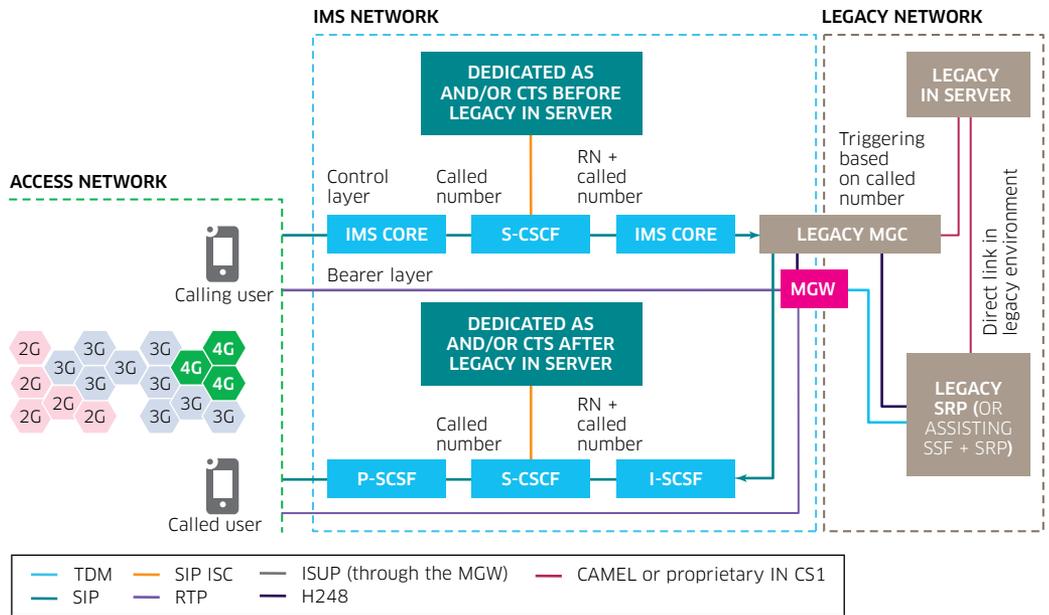
Such customization and limited usage means that the IM-SSF method must be carefully cost-justified for IN CS1 services. However, alternative methods to achieve IN service migration may be more economically beneficial, such as replicating the IN service in a new SIP AS or utilizing the MGC-based method described in section 2.4.3.

2.4.3 Alternative solution: looping through the MGC in the legacy network

This alternative solution is based on a simple AS that routes the call through a Media Gateway Controller (MGC) in the legacy network using a dedicated routing number, as shown in Figure 4. The MGC triggers the IN server based on this routing number using CAMEL or a specific IN CS1 protocol.

If the MGC already supports the IN query (or the call could be routed through the legacy network to perform the query), this method can be very convenient for some IN services. It is more easily provisioned in the IMS network and re-uses the legacy network's query and SRP resources. However, it works only for originating calls because a Class 4 or Transit MGC supports triggers only on originating calls. In addition, it also consumes Media Gateway resources because the MGC requires a bearer element, and only one IN service per legacy network loop-through is supported. This alternative solution is not convenient for standard IN services and standard protocols with high traffic (for example, mobile pre-paid), but is convenient for specific IN services, specific IN CS1 protocols and low-traffic scenarios.

Figure 4. Loop through legacy MGC



3. CONCLUSION

Today’s IN services for 2G/3G circuit-switched voice networks provide tremendous value for subscriber services and consequently for mobile operators’ business results. The deployment of VoLTE service poses a challenge to this long-established model. Which IN services should be migrated, and how should they be migrated? We have examined the key methods for making such services available for VoLTE subscribers:

- Build new services:
 - IMS AS, such as the Alcatel-Lucent 5420 CTS or another SIP AS. Because the new IMS ASs are natively built in SIP, old IN services can be rebuilt as native SIP applications.
 - The 5420 CTS provides REST APIs and service agility, so that application developers do not need to understand IMS and SIP to rapidly build new features.
- Migrate old services:
 - Enhance the existing IN service to support SIP and/or Diameter Ro protocols, so that it directly interfaces with the new IMS network.
 - Deploy an IM-SSF, so that SIP is translated into the protocol of the existing IN service. The IM-SSF provides a signaling gateway between new and old, and the existing IN service does not need new software enhancements.

Operators should plan the migration of IN services using a variety of methods. Each service should be carefully analyzed to determine the advantages and disadvantages of various methods to make it available for VoLTE subscribers. Alcatel-Lucent is helping VoLTE operators to determine the best solutions for their IN service migration. Contact us to learn how your IN services can be migrated to VoLTE.

4. ACRONYMS

2G	Second Generation wireless, such as GSM
3G	Third Generation wireless, such as UMTS/W-CDMA
3GPP™	Third Generation Partnership Project
4G	Fourth Generation wireless, such as LTE
API	application programming interface
AS	Application Server
AVP	Attribute Value Pair
CAMEL	Customized Applications of Mobile Enhanced Logic
CDMA	Code Division Multiple Access
CS1	Capability Set 1
CTS	Converged Telephony Server
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communications
IMS	IP Multimedia Subsystem
IM-SSF	IP Multimedia Service Switching Function
IN	Intelligent Network
IP	Internet Protocol
ISC	IMS Session Control
LTE	long term evolution
MGC	Media Gateway Controller
MGW	Media gateway
MMTel	multimedia telephony service
MRF	Media Resource Function
MSC	Mobile Switching Center
OCS	online charging system
OTT	over-the-top
PRBT	personal ringback tone
PS	Presence server
REST	Representational State Transfer
RTP	Real Time Protocol
S-CSCF	Serving Call Session Control Function
SIP	Session Initiation Protocol
SMS	Short Message Service
SRP	Specialized Resource Point
SSF	Service Switching Function
TAS	Telephony Application Server
TDM	Time Division Multiplex
UM	Unified messaging
UMTS	Universal Mobile Telecommunications System
VoIP	Voice over IP
VoLTE	Voice over Long Term Evolution
VPN	virtual private network
W-CDMA	Wideband Code Division Multiple Access
WIN	Wireless Intelligent Network
XDMS	XML document management server

5. REFERENCES

- [1] Alcatel-Lucent. Voice over LTE: The New Mobile Conversation, strategic white paper. May 2012. www.alcatel-lucent.com/4g-consumer-communications

