SS7–Internet Interworking – Architectural Framework

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Abstract

This document describes an architectural framework for SS7–Internet interworking, onto which existing protocols and future protocols in this space can be mapped. It also provides an ordering of importance for the standardization of these protocols.

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1.0 Introduction

This architecture document covers subject terminology and defines at a high
level a set of individual scenarios for SS7-Internet interworking. These scenarios include dial-up internet access, Voice over IP transit, and transport of SS7 signaling over IP. It then proposes a series of steps for standardization.

2.0 Terminology

The following functions are commonly identified in related work [4,5]:

1-media gateway (MG): terminates PSTN facilities (trunks, loops), packetizes the media stream for IP and delivers packetized traffic to the IP network. Examples of MGs are NAS (Network Access Servers) and VoIP gateways. The NAS and VoIP functions may or may not be combined in one gateway.

2-media gateway controller (MC): handles the registration and management of resources at the MG. The MC may have the ability to authorize resource usage based on local policy, for example, based on the attributes of both the end-user and the ISP. NAS Controllers [5], for instance, provide MC functionality.

3-signalling agent (SA): An SA realizes the signalling mediation function within the IP network, for instance, for MG-to-MG, MG-to-SG, and SG-to-SG interworking. A "Call Agent" in [4] includes an instance of an SA.

4-signalling gateway (SG): An SG is a signalling agent that receives/sends PSTN native signalling at the edge of the IP network. The SG function may relay, translate or terminate SS7 signaling in an SS7-Internet Gateway.

5-other servers (OS): provide address translations, feature information, authentication services. IN-SCPs and RADIUS servers are instances of OS.

Depending on the document, these functions are grouped into nodes such as an SS7 Gateway, NAS Controller, Call Controller, Call Agent, VoIP gateway or NAS as discussed below.

3.0 Base Configurations

SS7-Internet interworking today covers dial-up access and VoIP applications. This section presents base configurations that serve to illustrate the open interfaces in the architecture, labeled by ----O----- in the figures below.

The figures also illustrate possible groupings of the functions enumerated above, and propose an ordering of importance for standardization of the protocols (the ordering of the figures implies an ordering of importance).

3.1 A Reference Architecture

```
+-----+ |IP  | +-----+
SCP   |database.   
```

PSTN IP Network PSTN
Notes:
- SG, MC, and MG are functions that can be arranged in many ways with the IP network. For example, [SG] and [MC] can be an SS7 gateway and/or NAS controller, co-located or separate, and [MC] on its own can be a call controller, and [MG] can be a Network Access Server (NAS) or VoIP Gateway
- IP database is any database accessible over IP
- CO is a central office, or PSTN switch,
- communication between MGs and SG/MCs may depend on whether the communication is for dial-up access or VoIP

Figure 1: Reference Architecture

3.2 Dial-up Access Configuration

3.2.1 SS7 Dial-Up Access Configuration

Figure 2 is a simplified description of an SS7 dial-up access configuration. Details related to end-user authentication have been left out for the sake of clarity.

Figure 2: SS7 dial-up access configuration
The architecture in figure 2 has one open interface. Today, two alternatives for this protocol are represented by products in the industry. On one hand, \cite{1,2,3} advocate an architecture in which some of the MC resource management function resides in the NAS, and some MC functions such as registration reside in the Signaling Gateway. \cite{1,2,3} propose a Q.931-based protocol for the interface between Signaling Gateway and NAS. On the other hand, \cite{5} integrates the entire MC function in the SG, and removes it from the MG. \cite{5} proposes the use of DIAMETER \cite{6,7,8,9,10,11} extensions for the open interface.

### 3.2.2 Alternate Architecture for SS7 Dial-Up Access Configuration

An alternate architecture (figure 3) is to separate the NAS controller and Signalling Agent functions from the Signalling Gateway and to place them in a Call Controller.

```
+--------------+
|              |
--SS7--------> [SG]      |
|        |       |
|        |       | SS7 Signalling Gateway
|          |
+--------+-----+
|      |      |
+------|----- -+  [SA/MC]
|      |       |
|      |       | Call Controller/
|      |       | NAS Controller
+------|----- -+
|      |      |
+------|----- +  ([MC])

---IP/dial-up->[MG] -----IP/tunnel-- >
+-----------------+ NAS
```

Figure 3: SS7 dial-up access configuration, with a separate call controller

This alternate architecture is assumed in \cite{4}. It presents two open interfaces, one between the Signalling Gateway and the Call Controller, and a second one between the Call Controller and the NAS. An open interface between SG and SA allows an SA to access the SS7 network through multiple redundant interfaces, e.g. the classic "quad" configurations of SS7 networks.
3.2.3 Comparing Approaches

While the highest priority of work should be to standardize the protocol for PSTN native signalling between SG and MC/MG functions, discussion should take into account the other functions in the architecture that are required to provide working services. The three approaches identified above can be compared as follows:

1- Q.931+ extensions [1, 2, 3] follow a standard protocol for call signalling messaging and add new messages for resource control, configuration, and SS7 maintenance procedures such as busying of trunks and channels, graceful and abrupt shutdown of trunks, and continuity testing.

2- Use of a protocol framework such as Diameter with resource control extensions [6, 7, 8, 9, 10, 11], or a similar suite of protocols [IPDC-TAC internet-draft – to be provided], adds generic support of other functions such as security, end-user authentication extensions, dynamic association of SG and MC to MGs, etc.

3- Use of an open interface between SG and SA, based for example on some form of transport of ISUP over IP, combined with the protocol proposed in [4], allows to concentrate all call-state in a Call Controller, enables calls to survive the failure of an individual SG, and provides for compatibility with VoIP solutions.

3.3 VoIP Transit Configuration

VoIP transit adds new requirements to the architecture. For example, there will be more than one VoIP gateway involved in a call, and possibly even more than one call controller or equivalent. One approach is that documented in [4].

Figure 4 is a simplified description of a VoIP transit application as found in [4]. This configuration shows a potential open interface between the Signalling Gateway and a Call Controller. This may not be necessary if the Call Controller and SS7 Gateway are implemented in one system.

Note that a Call Controller interworks with a second VoIP MG to complete a call, and this may or not be through a second Call Controller (see section 3.4).

In fact, the architecture described here is just one of perhaps many that could be used to provide VoIP transit.

SS7 gateway
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3.4 ISUP and TCAP Signalling over IP

In this section, scenarios involving both SS7 TCAP (Transaction Capabilities) and ISUP (ISDN User Part) signaling over IP are described.

TCAP signaling within IP networks may be used for access to a database. In the VoIP case the database could be available from the Call Controller. In a NAS dial-up access case, it could be available from the Signalling Gateway/NAS Controller. Alternatively, the Signalling Gateway may provide access from SS7 network systems to an IP database (terminating TCAP), or may provide access to SS7 network databases from an IP system (originating TCAP), subject to services supported by the SS7 network.

ISUP signaling within IP networks may be used in the context of VoIP. If more than one Call Controller is used by an implementation of VoIP, then an open interface between Call Controllers needs to be considered. This interface could be supported by extensions to SS7 ISUP (ISDN User Part) protocol, carried over
IP (see section 3.5). However, non-SS7 protocols such as H.323 (ITU-T SG16) and SIP (IETF mmusic) may also apply to this interface. See figure 5.

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**Figure 5: ISUP/TCAP Signalling over IP in a particular VoIP Transit Configuration with >1 Call Controller**

### 3.5 Transport of SS7 Signalling (ISUP+TCAP) over IP

SS7 utilizes its own message transport protocol and has defined performance requirements. Supporting SS7 signaling at the SS7 Gateway or within IP networks requires transport of signaling over IP.

### 4.0 Next Steps

This document provides a framework to identify the open interfaces that are relevant to introduce useful services that have SS7-Internet interworking as a major component. From the ordering of the figures in section 3, it proposes an ordering of importance for standardization of the protocols.
The goal of an SS7-Internet working group would be to decide which protocols are to be standardized, with what priority, and the functionality necessary in each protocol.

5.0 References and related work


[IPDC-TAC internet-draft] - to be provided

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