# OpenSS7 Media Gateway Platform High-Level Design

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**Abstract:**

This document provides a High-Level Design for the OpenSS7 Media Gateway Platform.

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**The OpenSS7 Project** <http://www.openss7.org/>

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## Notice:

## Short Contents

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# Executive Overview

This document provides a High-Level Design for the OpenSS7 Media Gateway Platform. The initial and primary purpose of this equipment is to provide a scalable, carrier-grade platform for terminating TDM voice circuits from the PSTN and providing Media Gatway capabilities for those terminated circuits. The purpose is both one of *hard switching*, where circuits are directly connected, as well as *soft switching*, where circuits are converted to RTP sessions and passed to another Media Gateway.

### The OpenSS7 Project

The OpenSS7 Project is an open source software project that has developed many protocol components within the SS7, SIGTRAN, ISDN and VoIP protocol stacks. Intellectual property rights for the OpenSS7 Project are held by OpenSS7 Corporation. All OpenSS7 Project software is eventually licensed under the GNU Affero General Public License Version 3. OpenSS7 Corporation also provides commercial licensing of OpenSS7 Project software under terms less restrictive than the AGPL.

### OpenSS7 Media Gateway (MG) Platform

OpenSS7 can provide VoIP gateway capabilities in a high-performance, low-cost, small-footprint platform leaveraging the GNU/Linux operating system distributions and tools, and utilizing low-cost commodity, or high-quality standardized hardware.

For details on platform applications, see Chapter 2 [Application Architecture], page 11, Chapter 3 [Network Architecture], page 13, Appendix A [Optional Application Support], page 43, and Appendix B [Optional Network Support], page 45.

### Open Source Software

The OpenSS7 Project leverages the widespread use of GNU/Linux operation systems, distributions, and FSF tools such as '`autoconf`' and *RPM*. For example, this document was formatted for PDF, HTML, info and plain text using the GNU *texinfo* system, '`autoconf`', and the TEX formatting system.

The open source model avoids proprietary lock-in and permits in-house or outsourced development. All source code is available for use and modification by the end customer. All build tools, documentation and associated resources are generally available. The availability of the source code and complete documentation eases problem resolution and can offer upgrades and fixes even in advance of client problem reports.

For details on software solutions, see Chapter 7 [Protocol Architecture], page 23, Chapter 8 [Software Architecture], page 27, Appendix E [Optional Protocol Support], page 51, and Appendix F [Optional Software Support], page 53.

### Commodity Hardware

By best utilizing commodity PC or standardized CompactPCI hardware, OpenSS7 makes available the highest performance platforms available on the market at back-to-school prices. When carrier-grade and large scale is not essential, 3GHz Pentium class servers in hardened rack mount chassis can be used at a fraction of the cost, and yet outperform, other solutions. Where carrier-grade is necessary, embedded Linux on standardized PICMG 2.16 NEBS compliant chassis make for a higher cost, but more reliable alternative.

For details on hardware solutions, see Chapter 6 [Platform Architecture], page 21, Chapter 10 [Hardware Architecture], page 35, and Appendix G [Optional Hardware Support], page 55.

### Integrated Management

Utilizing open source management tools, such as `net-snmp` and `OSIMIS`, OpenSS7 protocol stacks provide integrated management support for SNMPv2c, SNMPv3, or CMISE/CMIP. The entire platform, from alarms to provisioning, can be provided using integrated SNMP agents.

For details on management solutions, see Chapter 6 [Platform Architecture], page 21, Chapter 11 [Management Architecture], page 39, and Appendix H [Optional Management Support], page 57.

### Rapid Development

The OpenSS7 Project has already developed protocol components completing the SS7 and SIGTRAN signalling stacks including MTP Level 2 and Level 3, ISUP, SCCP, TCAP; and SCTP, M2PA, M2UA, M3UA, SUA and TUA. Development of a Carrier VoIP Switch to meet initial field requirements needs only the development of some intermediate and auxillary modules.

For details on scheduling, see Chapter 12 [Logistics], page 41.

### An Evolving Solution

The OpenSS7 Project is evolving to support more protocol stacks including ISDN and VoIP. Support for an ever expanding capability is demonstrated by the additional options available as described in Appendix A [Optional Application Support], page 43, Appendix B [Optional Network Support], page 45, Appendix E [Optional Protocol Support], page 51, Appendix F [Optional Software Support], page 53, and Appendix G [Optional Hardware Support], page 55.

### Conclusions

In summary, an OpenSS7 Carrier VoIP Switch an excellent application of the OpenSS7 SS7 and VoIP stacks and can be provided at a affordable price on short time-lines, while offering an evolution path for future deployment applications.

Brian Bidulock
The OpenSS7 Project

# Preface

## Document Information

### Abstract

This document provides a High-Level Design for the OpenSS7 Media Gateway Platform.

### Objective

The objective of this document is to provide a High-Level Design for the development of a low cost, high-performance, OpenSS7 Media Gateway Platform using OpenSS7 protocol components, software, and compatible systems and hardware.

### Intent

The intent of this document is to act as a High-Level Design for a project for an High-Level Design. As a High-Level Design, this document discusses components and systems which are not necessarily complete. OpenSS7 Corporation is under no obligation to provide any software, system or feature listed herein.

### Audience

This document is intended for a technical audience. The reader should be familiar with most ETSI, ITU-T and ANSI, Signalling System No. 7 recommendations, H.323, H.225, H.245, as well as IETF drafts and RFCS for RTP, SIP, SIP-T, MEGACO, MGCP, and SIGTRAN protocols.

### Revisions

Take care that you are working with a current version of this document: you will not be notified of updates. To ensure that you are working with a current version, contact the Author, or check The OpenSS7 Project website for a current version.

### Version Control

```
$Log: mg.texi,v $
Revision 1.1.2.4  2011-08-07 11:14:29  brian
- mostly mandriva and ubuntu build updates

Revision 1.1.2.3  2011-07-27 07:52:16  brian
- work to support Mageia/Mandriva compressed kernel modules and URPMI repo

Revision 1.1.2.2  2011-02-07 02:21:35  brian
- updated manuals

Revision 1.1.2.1  2009-06-21 10:46:55  brian
- added files to new distro
```

### ISO 9000 Compliance

Only the TEX, texinfo, or roff source for this document is controlled. An opaque (printed or post-script) version of this document is an **UNCONTROLLED VERSION**.

### Disclaimer



## Document Organization

This document is organized as follows:

# 1 Introduction

This document provides a High-Level Design for a platform to provide the OpenSS7 Media Gateway Platform capabilities. The primary driver for the OpenSS7 Media Gateway Platform is to provide a system capable of interconnecting a VoIP backbone to the PSTN using SS7. This document provide a high-level design and proposal for a production system to provide this capability at a number of scale points.

The proposal utilizes, where possible, existing OpenSS7 protocol stack components and provides a development plan for components that are specific to the OpenSS7 Media Gateway Platform initial requirements.

This document discusses the resulting software configuration that will be put in place on the production system, the platform configuration for the production system, and a network configuration for deployment. Also discussed is an overview of the project management logistics for successful completion over the course of this development project.

It is intended that this document be a “living” document, that is updated over the course of this development project.

## 1.1 The OpenSS7 Media Gateway

This project provides an OpenSS7 Media Gateway Platform that provides interconnection to the PSTN using TDM circuits and is capable of routng call to and from the PSTN and a VoIP backbone network using *hard switching*, physical circuit switching, or *soft switching*, RTP transport.

## 1.2 Project Drivers

The lead purpose of the OpenSS7 Media Gateway Platform is to provide PSTN interconnection to an existing VoIP backbone deployment infrastructure that lacks same.

## 1.3 Scope

Because the focus on low cost, high performance, and production stability, the OpenSS7 Media Gateway Platform is constructed using commodity computing platforms and PCI based hardware cards, but using hardenned NEBS-3/ETSI compliant chasses in an active/standby failover configuration. This will result in a cost-effective carrier grade system for mid- to low deployment cost.

Because of early deployment drivers yet requirements for scale, the OpenSS7 Media Gateway Platform platform is constructed using standardized PICMG 2.16 telephony hardware in a NEBS 3/ETSI compliant chassis providing carrier-grade serviceability and reliability. Non-carrier-grade platforms utilizing commodity PC hardware for lower scale installations are possible.

### 1.3.1 Phases

The longer term project is broken into the following phases:

*Phase 1* The initial phase of the project is intended to provide the capabilities of the OpenSS7 Media Gateway Platform operation for the deployment platform.

*Phase 2* The second phase of the project is intended on performing SS7 signalling interoperability testing for live deployment of the signalling gateway production platform.

*Phase 3* The third phase of the project is to integrate the deployment platform with the OpenSS7 VoIP Switch using the Internet Protocol suite.

*Phase 4* The fourth phase of the project is to perform interoperability testing and a field trial of the deployment platform.

*Phase 5* The fifth phase of the project is to complete management system integration for remote monitoring and provisioning for production service.

### 1.3.2 Gates

Each phase of the project consists of seven gates. The seven gates are defined as follows:

*Gate 0 — Concept*
*Gate 0* is passed when the initial concept has been elucidated and work is begun on a High-Level Design. This is an internal OpenSS7 gate.

*Gate 1 — High Level Design*
*Gate 1* is passed when the high-level design has been reviewed to the satisfaction of the consumers of the project. This is an external review gate. OpenSS7 internally passes this gate once the High-Level Design has been published and work is begun on a detailed design.[1]

*Gate 2 — Detailed Design*
*Gate 2* is passed when the detailed design has been reviewed to the satisfaction of the consumers of the project and the developers on the project. This is an external as well as an internal review gate. OpenSS7 passes this gate once the Detailed Design has been published and work has begun on development and implementation of the design.[2] Passing this gate moves from the design stage to the development stage of the project.

*Gate 3 — Deployment and Implementation*
*Gate 3* is passed when the software and systems development and implementation to the detailed design is complete and testing has begun. This is an internal review gate. OpenSS7 internally passes this gate when software is code complete and hardware has been installed for testing.

*Gate 4 — System Test*
*Gate 4* is passed once the product implementation meets all internal ad hoc and formal conformance test suites and internal testing is complete. This is an internal review gate. OpenSS7 passes this gate internally once conformance testing is complete. Passing this gate moves from the development stage to the support stage of the project.

*Gate 5 — Acceptance Test*
*Gate 5* is passed once the product implementation has passed external Gamma client acceptance testing. This is an external review gate. OpenSS7 passes this gate internally once participation in external acceptance testing is complete.

*Gate 6 — Project Complete*
*Gate 6* is passed once all support obligations for the product implementation have been discharged. This is an internal review gate. OpenSS7 passes this gate once support agreements have terminated.

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[1] This document is a High-Level Design document and it meets the internal requirements for passing Gate 1 of Phase 1 and Phase 2 of the project. An external review of this document by a Beta or Gamma client or sponsor is pending.

[2] OpenSS7 requires a contractual commitment for purchase from a Beta or Gamma client, or funding from a Sponsor of the OpenSS7 Project, before this gate can be passed and development started.

For more details on Gate scheduling for Phase 1, 2 and 3 of the project, see Section 12.4 [Schedule], page 41.

# 2 Application Architecture

The OpenSS7 Media Gateway Platform is intended to provide high performance and high-density PSTN to VoIP backbone gateway.

## 2.1 Application Background

## 2.2 Application Objectives

## 2.3 Application Requirements

Application requirements have been broken into 5 phases using the timeboxing approach.

### 2.3.1 Phase 1 Requirements

Phase 1 requirements provide an OpenSS7 Media Gateway Platform capability that will connect an existing H.323 VoIP network to the PSTN using SS7 ISUP trunks.

### 2.3.2 Phase 2 Requirements

Phase 2 requirements provide SIP-T capabilities.

### 2.3.3 Phase 3 Requirements

Phase 3 requirements provide network service capabilities.

### 2.3.4 Phase 4 Requirements

Phase 4 requirements expose internal interfaces to provide softswitch capabilities.

### 2.3.5 Phase 5 Requirements

Phase 5 requirements complete full VoIP (NGN) switching.

## 2.4 Solution Architecture

Although the functions of *Media Gateway Controller*, *Media Gateway* and *Signalling Gateway* have been decomposed, and in the past these functional groups have been implemented on separate physical platforms, modern compute capacity and densities permit these functions to be integrated into a single physical platform without limitation. Open standard interfaces are utilized internal to the platform to permit a decomposed model to be split out and to permit ETSI Tiphon Version 4 compatibility as well as Multi-Services Forum Version 2 compatibility.

### 2.4.1 OpenSS7 Media Gateway Platform for Deployment

In light of the foregoing, the solution architecture takes the form of an integrated media gateway capable of providing a number of functional groups in the traditional models. The OpenSS7 Media Gateway Platform integrates the following functional groups while still permitting standard interfaces to be exposed for maximum deployment flexibility:

—
—
—
—

## 2.5 Message Flows

This section provides some illustrative application call flows:[1]

[1] This section is not intended as a *Detailed Design*, but provides illustration only for these *High-Level Design*.

# 3 Network Architecture

Figure 3.1 illustrates the call path for various calls within the softswitching complex.

1. Intra-MG calls originate on a network SSP and terminate on a network SSP, both attached to the same MG. This is an intra-MG call in that the call never traverses more than one MG.
2. Inter-MG calls originate on a network SSP and terminate on a network SSP, each attached to a different MG. This is an inter-MG call within the same switching complex as the call traverses two MGs.
3. Trans-MG calls originate on a network SSP and terminate on a network VoIP gateway.

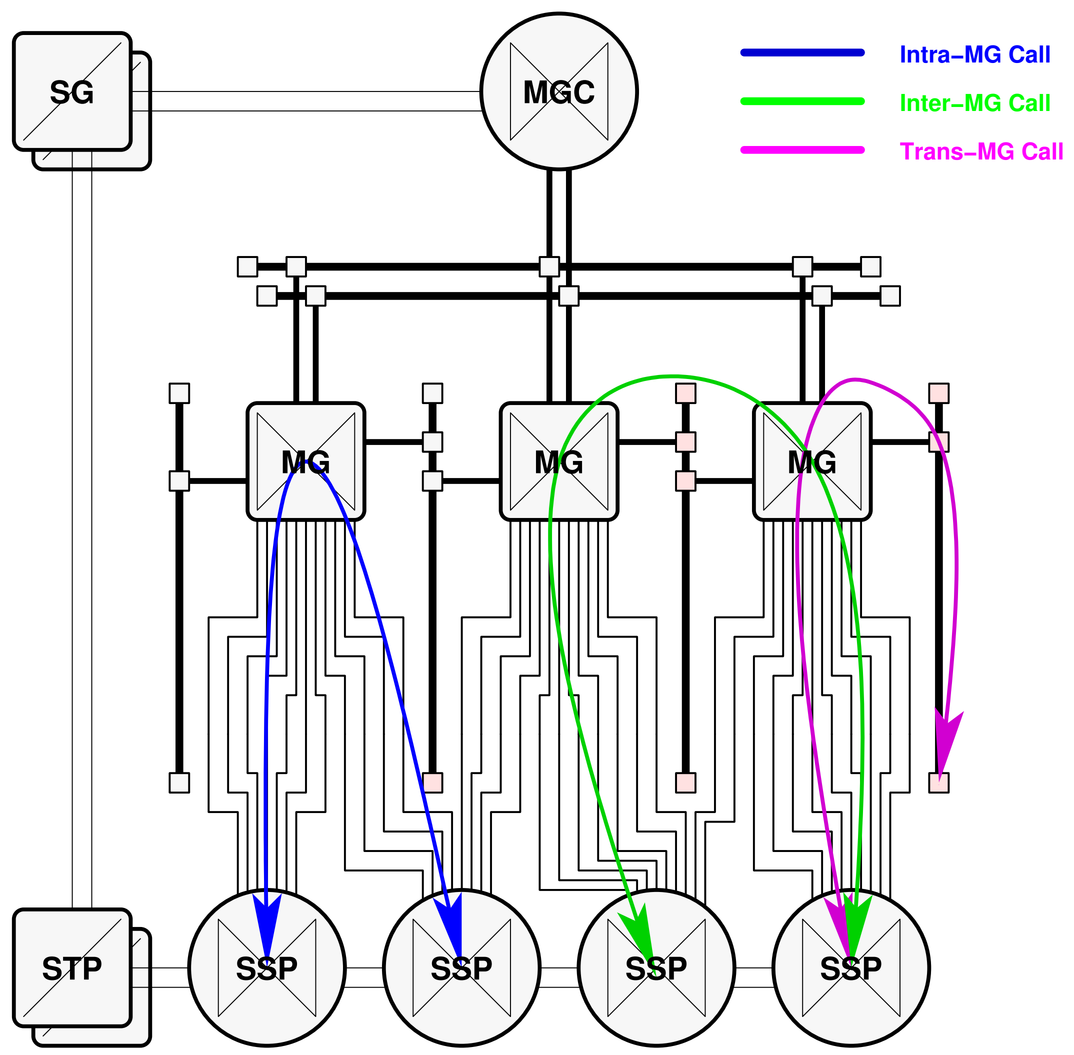


Figure 3.1: *Network Architecture*

Signalling is via a path typically separate from the MG. In the illustration in Figure 3.1, the signalling is via external STPs that are attached to switching complex Signalling Gateways (SGs) that communicate with the Media Gateway Controller. In some arrangements, the MG is possibly also a Signalling Gateway.

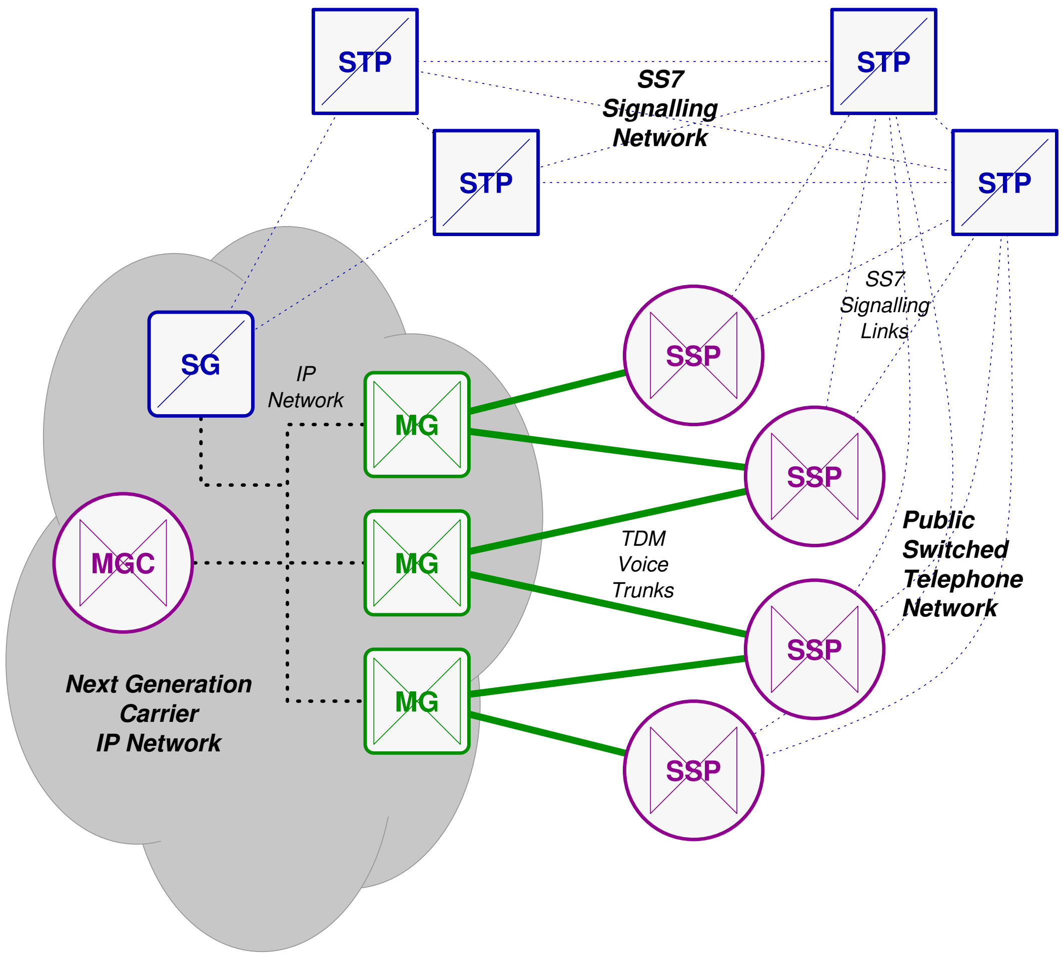


Figure 3.2: *Network Architecture*

Figure 3.2 illustrates the placement of the Media Gateway (MG) within the decomposed Service Switching Point and its connection to Media Gateway Controllers within the switching complex as well as to Service Switching Points (SSPs) in the external network. As illustrated, the MG terminates media gateway control messaging from the Media Gateway Controller (MGC) and attaches to external network SSPs using TDM voice trunks.

# 4 Reference Architecture

## 4.1 ETSI TIPHON

Figure 4.1 illustrates the ETSI TIPHON reference architecture.

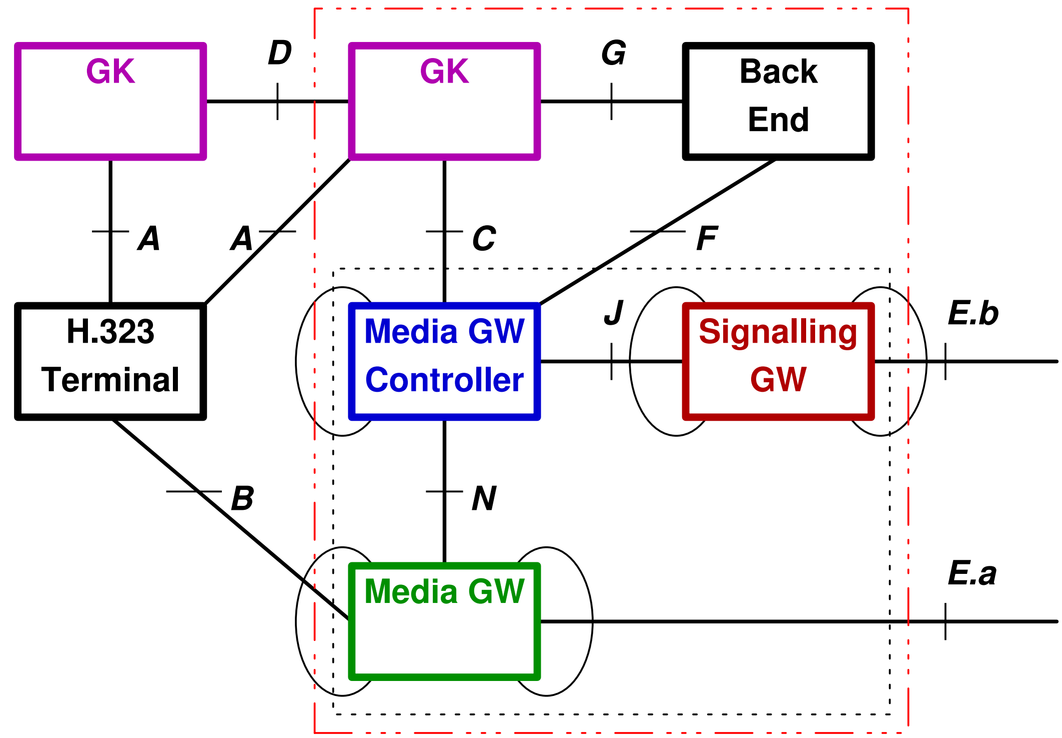


Figure 4.1: *Reference Architecture*

### 4.1.1 ETSI TIPHON Entities

The ETSI TIPHON model illustrated in Figure 4.1 contains the following reference entities:

*Terminal:* The H.323, SIP or MEGACO *Terminal* support the *A* or *B* interface. The *A* interface is used for communicating with an H.323 *Gatekeeper*; SIP Forwarding Server, Proxy Server or User Agent.

*Terminal* devices are external to the NG switching complex. In initial phases, *Terminal* device interface *A* (see ⟨undefined⟩ [⟨undefined⟩], page ⟨undefined⟩) will only be supported via external H.323 Gatekeepers; SIP Forwarding Server or SIP Proxy Server. Direct *Terminal* device attachment for H.323, SIP and H.248 *Terminals* will be supported in later phases.

*Gatekeeper:*

The H.323 *Gatekeeper*, SIP Forwarding Server, or SIP Proxy Server, supports the *A*, *C*, *D* and *G* interfaces.

The NG switching complex will support an internal *Gatekeeper* function that will intially support the *D* and *C* interfaces, and will support the *A* interface in later phases. Intitially the *G* interface will be internal to the platform, and will be exposed in later phases.

In the NG switching complex, the *Gatekeeper* performs the role of a call-by-call server (and is termed the CBC) which performance access authorization, routing and other functions on a call by call basis, for FGD, H.323 and SIP calls.

*Media Gateway Controller:*

The H.323 or SIP *Media Gateway Controller* supports the *C*, *F*, *J* and *N* interfaces. The NG swtiching complex will incorporate an integral *Media Gateway Controller* function. In the field deployment the *C*, *F*, *J* and *N* interfaces will be exposed.

The SIP *Media Gateway Controller* is primarily responsible for conversion of SCN signalling from the PSTN on the *J* interface to VoIP signalling tot he SIP Redirect/Proxy server on the *C* interface. Also, the SIP MGC must coordinate this conversion with the control of media conversion from G.703/704 G.711 A- and mu-law circtuis from the PSTN to RTP/RTCP channels within the VoIP network.

*Media Gateway:*
*Signalling Gateway:*
*Back End:*

*Session Border Controller:*

The *Session Border Controller* is not illustrated in the ETSI TIPHON illustration, Figure 4.1.

In essesnce a *Session Border Controller* is a security devices but may also be a protocol conversion device. The *Session Border Controller* sits on the *A*, *B* or *D* interfaces, when those interfaces span an administrative, security or protocol domain.

### 4.1.2 ETSI TIPHON Reference Points

The ETSI TIPHON model illustrated in Figure 4.1 contains the following reference interfaces:

*Interface A*

*Interface B*

*Interface C*

*Interface D*

*Interface E.a*
*Interface E.b*
*Interface F*

*Interface G*

*Interface J*

*Interface N*

## 4.2 Interfaces

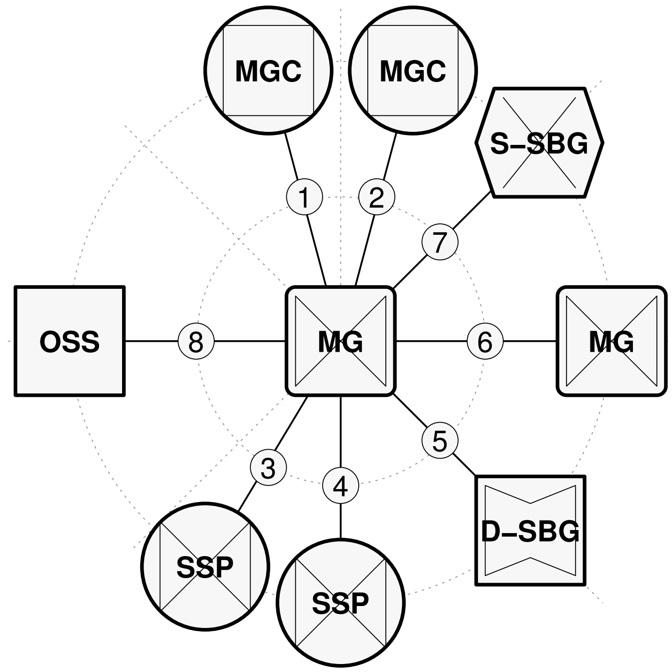


Figure 4.2: *Interfaces*

The interfaces suppored by the OpenSS7 Media Gateway Platform are illustrated in Figure 4.2. The interfaces are enumerated as follows:

1. Primary Media Gateway Controller (MGC) Interface

   This interface provides primary MGC circuit switching control. Typical protocols include an H.248/MEGACO and Q.1950 profile. The profile should include an Intra-MG and Inter-MG switching package in the profile.

2. Secondary Media Gateway Controller (MGC) Interface

   This inteface provides secondary (backup) MGC circuit switching control. Typical protocols include an H.248/MEGACO and Q.1950 profile. The profile should include an Intra-MG and Inter-MG switching package in the profile.

3. Service Switching Point (SSP) Interface Type I

   This interface is an Inter-Machine or PABX Trunk based on CAS signalling, with Type I signalling (customer). The physical interface is T1, E1, J1, T3, E2, OC3, OC12 or OC48.

4. Service Switching Point (SSP) Interface Type II

   This interface is an FGD Inter-Machine Trunk on SS7 or CAS signalling, with Type II signalling (local or toll tandem). The physical interface is T1, E1, J1, T3, E2, OC3, OC12 or OC48.

5. Data Session Border Gateway (D-SBG) Interface

   This interface is RTP/RTCP over UDP over Internet Protocol (IP). The D-SBG provides pinhole firewall control over RTP/RTCP sessions under control of the S-SBG.

6. Media Gateway (MG) Interface

   This interface is an MG to MG interface. This interface multiplexes TDM signals over an IP network connection using a profile of ITU-T and IETF NGN protocols. Switching to and from these interfaces are controlled via an Inter-MG switching package on the MG. Multiple MG can be ganged together in this fashion to appear as a signle switching fabric to the MGC.

7. Signalling Session Border Gateway (S-SBG) Interface

   This interface is unused.

8. Operations Support System (OSS) Interface

   This interface provids OAM&P for the MG platform. The protocol is a management profile that can include SNMPv2c, SNMPv3, CMISE/CMIP, CMOT, IPMI, CIM, DTMF, WS-MAN, etc.

These interfaces and the protocol profile requirements are detailed in the sub-sections that follow:

### 4.2.1 Primary MGC Interface

### 4.2.2 Secondary MGC Interface

### 4.2.3 SSP Type I Interface

### 4.2.4 SSP Type II Interface

### 4.2.5 D-SBG Interface

### 4.2.6 MG Interface

### 4.2.7 S-SBG Interface

### 4.2.8 OSS Interface

# 5 System Architecture

This section details the solution system architecture. The solution system architecture consists of the computing platform and it placement within the locale installation environment.

The solution system has the following requirements:

— 19" rack.

— -48 VDC electrical power.

— CO cooling.

— Bantam to RJ-48c patch pannel.

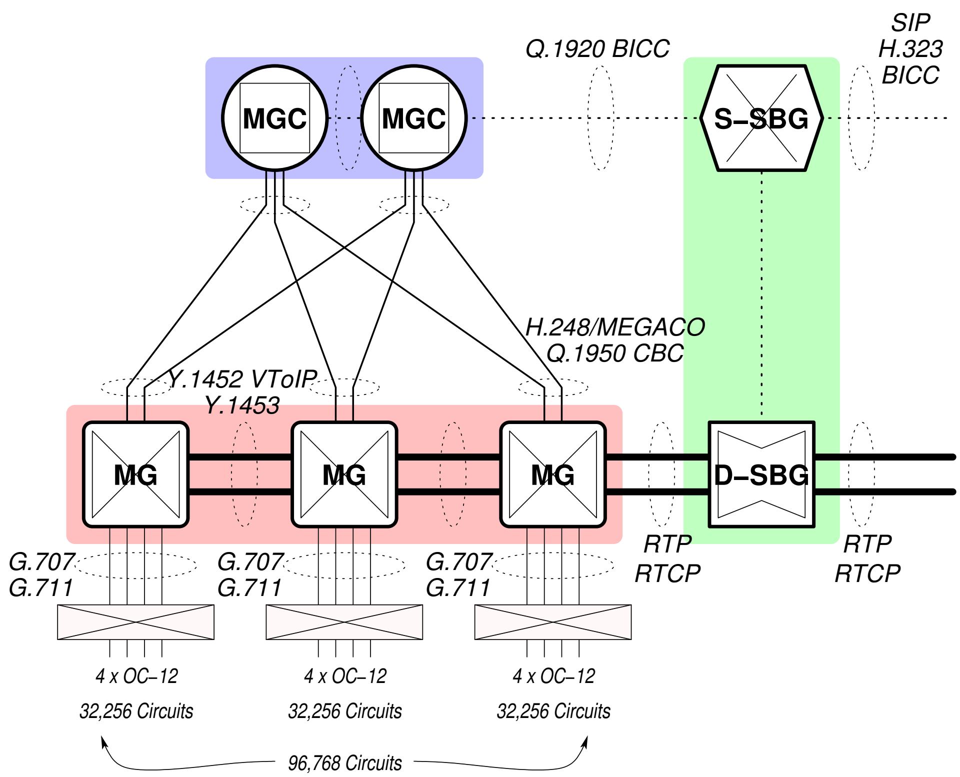


Figure 5.1: *System Architecture*

# 6 Platform Architecture

This section details the platform architecture. The solution platform architecture consists of the computing platform and associated hardware, interfaces and peripherals.

Figure 6.1 illustrates the solution platform rack configuration.

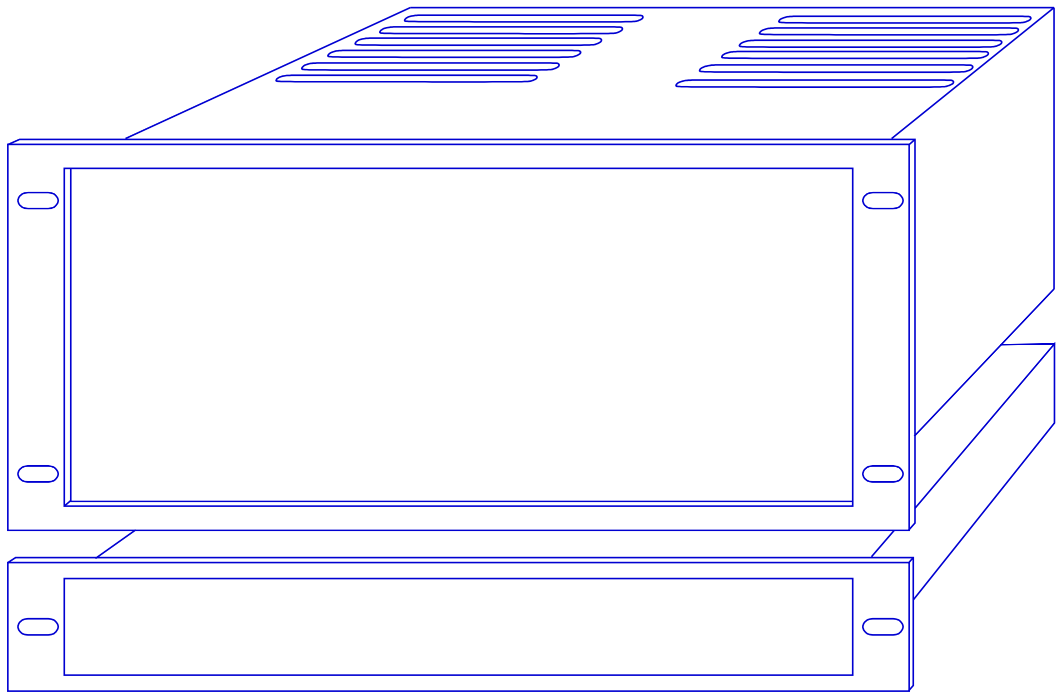

Figure 6.1: *Rack Mount Components*

The solution platform consists of the following:

— Two hardened PC (2U) chassis per system.
— Two GigE (1000baseT) RJ-48c Layer 2 Ethernet Switches.
— Two 1-1 DSX 14 T1 patch pannels.

## 6.1 Platform Capacity

The PC chasses is equipped with the following:[1]

- 2 x 3.2GHz Xeon class E7520 based Motherboard.
- 2 x 100MHz PCI-X 2.1 bus.
- 4G DDR memory.
- 2 x Ultra320 SCSI hard drives.
- 2 X GigE Ethernet NICs.

[1] For detailing sizing considrations, see Appendix J [Platform Sizing], page 61.

- 3 x V401PT Quad T1 interface cards.

# 7 Protocol Architecture

Figure 7.1 illustrates the protocol configuration of the OpenSS7 Media Gateway Platform system. The protocol stack uses the following OpenSS7 stack components:

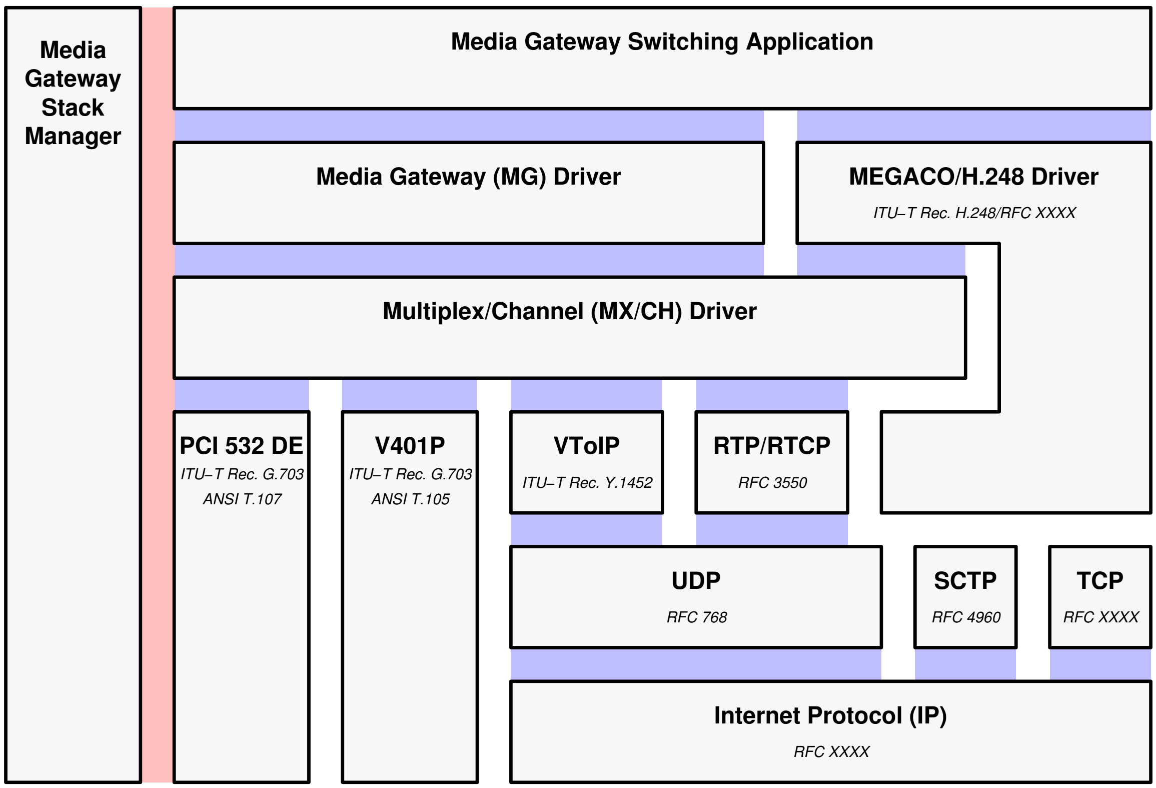


Figure 7.1: *Protocol Architecture*

## 7.1 Protocol Components

The following Protocol Components are provided as part of the OpenSS7 MG stack:

### 7.1.1 Media Gateway (MG) Stack Manager

The *Media Gateway (MG) Stack Manager* provides management of the MG stack components. It is discussed in more detail in Chapter 11 [Management Architecture], page 39.

### 7.1.2 Media Gateway (MG) Switching Application

### 7.1.3 Media Gateway (MG) Driver

The *Media Gateway (MG) Driver* provides a unified interface to local switching functions, remote switching functions, and media gateway server functions. The driver controls a local MX driver to perform local switching functions and accesses the client version of the MEGACO/H.248 driver to perform remote switching functions. The server version of the MEGACO/H.248 driver is accessed by the MG driver to provide control of MG functions to a remote MGC.

### 7.1.4 MEGACO/H.248 (H248) Driver

The *MEGACO/H.248 (H248) Driver* provides a media gateway interface to local or remote switching functions using the MEGACO/H.248 protocol and packages. A client version of the driver is located at the Media Gateway Controller and a server version of the driver is located at the Media Gateway. This project uses the server version of the driver.

### 7.1.5 Multiplex/Channel (MX/CH) Driver

The *Multiplex/Channel (MX/CH) Driver* performs soft-switching of multiplex Streams as well as channel access to channels within multiplex Streams. This driver links multiplex interfaces beneath it and presents both multiplex and channel interfaces to it users. For this project, the MX/CH driver is used to link PCI 532 DE, V401P, VToIP or RTP/RTCP MX Streams beneath the driver and provide channel access to DS0, DS1 or full DS3 channels within the multiplex for use by the Media Gateway. Multiplex streams present an MX interface to its users. Channel streams present a CH interface to its users. The CH interfaces are converted to appropriate Streams using additional modules.

The MX/CH drivers supports T1, E1 and J1 operation, as well as T3 and E2 operation, both for locally attached TDM trunks, locally terminated VToIP trunks, and RTP/RTCP streams. The driver provides a specialized MX and CH interface to its users.

This is an existing OpenSS7 channel stack component; for documentation see `mx(4)` and `ch(4)`.

The Multiplex/Channel (MX/CH) driver is responsible for providing CH services to its users.

### 7.1.6 PCI 532 DE Multiplex (MX) Driver

The *PCI 532 DE Multiplex (MX) Driver* provides MX services for locally attached DSX-3 or E3 facilities. This driver provides hardware interface to TDM facilities and allows the MX driver to provide transparent switching capabilities for DSX-3 or E3 TDM facilities.

The PCI 532 DE MX driver supports DSX-3 and E3 oepration for locally attached TDM trunks. The driver provides a specialized MX interface at the DS3 rate to its users. Neither a DS1 rate MX interface nor a NxDS0 CH interface is provided. A DS1 rate MX interface and NxDS0 CH interface can be acessed by linking this driver under the generic MX/CH driver.

This is an existing OpenSS7 channel stack component; for documentation see `pci532(4)` and `mx(4)`.

### 7.1.7 V401P Multiplex (MX) Driver

The *V401P Multiplex (MX) Driver* provides MX services for locally attached DSX-1 or E1 facilities. This driver provides hardware interface to TDM facilities and allows the MX driver to provide transparent switching capabilities for DSX-1 or E1 TDM facilities.

The V401P MX driver supports DSX-1, E2 and J2 operation for locally attached TDM trunks. The driver provides a specialized MX interface to its users. A CH interface is not provided but can be accessed by linking this driver under the generic MX/CH driver.

This is an existing OpenSS7 channel stack component; for documentation see `v401p(4)` and `mx(4)`.

### 7.1.8 Voice Trunking over IP (VToIP) Driver

The *Voice Trunking over IP (VToIP) Driver* provides MX services for virtual trunks using ITU-T Recommendation Y.1452, or transparent unstructured DSX-1, E1, DSX-3, E3 MX services using

ITU-T Recommendation Y.1453. This driver uses ATM AAL1 or AAL2 CPS PDUs encapsulated in RTP or UDP packets. The primary purpose of this driver for the OpenSS7 Media Gateway Platform is to provide Inter-MG switching capabilities utilizing distributed matrix control.

The VToIP MX driver supports unstructured DSX-3 and E3 operation, structured and unstructured DSX-1 and E1 operation, and structure NxDS0 operation. The driver provides a specialized MX or CH interface to its users. The driver can be linked under the generic MX/CH driver for transpartent matrix switching operation.

This is an existing OpenSS7 channel stack component; for documentation see `vtoip(4)`, `mx(4)` and `ch(4)`.

#### 7.1.9 Real-Time Transport (Control) Protocol (RTP/RTCP) Driver

The *Real-Time Transport (Control) Protocol (RTP/RTCP) Driver* provides MX services for RTP/RTCP voice channels. This driver maps individual RTP/RTCP streams into an MX group for use with the Generic MX/CH driver. The driver provides codec conversion to and from G.711 mu- or A-law, jitter buffering, digital padding, echo cancellation and other VoIP mechanisms including out-of-band DTMF.

The RTP/RTCP drivers supports audio profile streams. The driver provides a specialized MX or CH interface to its users. The driver can be linked under the generic MX/CH driver for transparent matrix switching operation.

This is an existing OpenSS7 channel stack component; for documentation see `rtp(4)`, `mx(4)` and `ch(4)`.

#### 7.1.10 User Datagram Protocol (UDP) Driver

The *User Datagram Protocol (UDP) Driver* is a STREAMS based driver providing access to the underlying UDP layer in the Linux kernel. The primary use of this component in the OpenSS7 Media Gateway Platform is to provide UDP services to the RTP/RTCP driver, the VToIP driver, and the MEGACO/H.248 driver. This is an existing OpenSS7 XNS stack component; for documentation, see `udp(4)`.

#### 7.1.11 Stream Control Transmission Protocol (SCTP) Driver

OpenSS7 has two implementations (STREAMS and Linux Sockets) that provide support for this new transport protocol and that provide transport for SIGTRAN and other protocols. The STREAMS SCTP implementation provides an NPI Revision 2.0 and TPI Revision 2.0 interface to its users. Alos supported is an X/Open XNS 5.2 XTI Library and ITOS (ISO over SCTP). The Linux Native SCTP implementation provides a Sockets interface.

This is an existing OpenSS7 SIGTRAN stack component; for documentation, see: `sctp(4)`. *Phase 1* activities for SCTP include integration testing with the SG components.

#### 7.1.12 Transmission Control Protocol (TCP) Driver

#### 7.1.13 Internet Protocol (IP) Driver

The *Internet Protocol (IP) Driver* is a STREAMS based driver providing access to the underlying IP layer in the Linux kernel. The primary use of this component in the OpenSS7 Media Gateway Platform is to provide IP services to the UDP, RTP/RTCP, and VToIP drivers. This is an existing OpenSS7 XNS stack component; for documentation, see `ip(4)`.

# 8 Software Architecture

# 9 Operations Architecture

This chapter details the software configuration of the OpenSS7 solutions. OpenSS7 stack software is based on the STREAMS facility running on the Linux Operating System. This provides for use of the Linux Operating System while maintaining portability and consistency with major UNIX operating systems that provide an *SVR 4.2 ES/MP STREAMS* facility.

## 9.1 Linux Operating System

The OpenSS7 STREAMS releases and stacks currently support the 2.4, 2.6 and 3.x Linux Kernel. A Linux kernel version greater than or equal to 2.4.18 is recommended for 2.4 kernels. The Linux 2.5 series kernels are not supported. A Linux kernel version greater than or equal to 2.6.9 is recommended for 2.6 kernels. Any kernel beginning with 3.0 in the 3.x kernel series is acceptable. Linux 2.4, 2.6 and 3.x kernels released by popular distributions are supported. These include kernel.org releases, RedHat (7.2, 9, EL3, AS/EL4, EL5, EL6), WhiteBox (EL3, EL4), Fedora Core (FC1-FC15), Debian (Woody-Wheezy), Ubuntu (6.10-11.04), SuSE (8.2-12.4 OSS, 9.0-12.1 SLES), CentOS(4, 5 and 6), Lineox (4 and 5), Scientific (5 and 6), PUIAS (5 and 6), Oracle (5 and 6). Currently our preferred distribution is CentOS 5 with all updates applied.

Although OpenSS7 STREAMS SS7 and SIGTRAN stacks are tested primarily on ix86 hardware, the stacks compile and install on PPC (MPC 8260, Freescale 440), HPPA, and other processor architectures supported by the Linux 2.4, 2.6 and 3.x kernels.

For the current project, RedHat AS/EL5 or CentOS 5 is recommended.

## 9.2 STREAMS Facility

OpenSS7 STREAMS SS7 and SIGTRAN stacks utilize a *SVR 4.2 ES/MP STREAMS* facility.

## 9.3 OpenSS7 SS7 and SIGTRAN Stacks

The OpenSS7 SS7 and SIGTRAN stacks are implemented using the STREAMS facility. Protocol moduels within the stack are implemented as STREAMS modules, device drivers, multiplexing drivers and pseudo-device drivers. The STREAMS facility has the ability to stack modules and multiplexing drivers above read or pseudo-device drivers using the STREAMS `I_PUSH(7)` an `I_LINK(7)` facilities. Since STREAMS modules and drivers run within the context of the Operating System Kernel using message-based scheduling, greatly increased performance is experienced over equivalent user-space applications. STREAMS modules and drivers communicate by passing priority. In addition, STREAMS provides memory management, timer, locking, syncrhonization, flow control and other facilities commonly used by protocol modules.

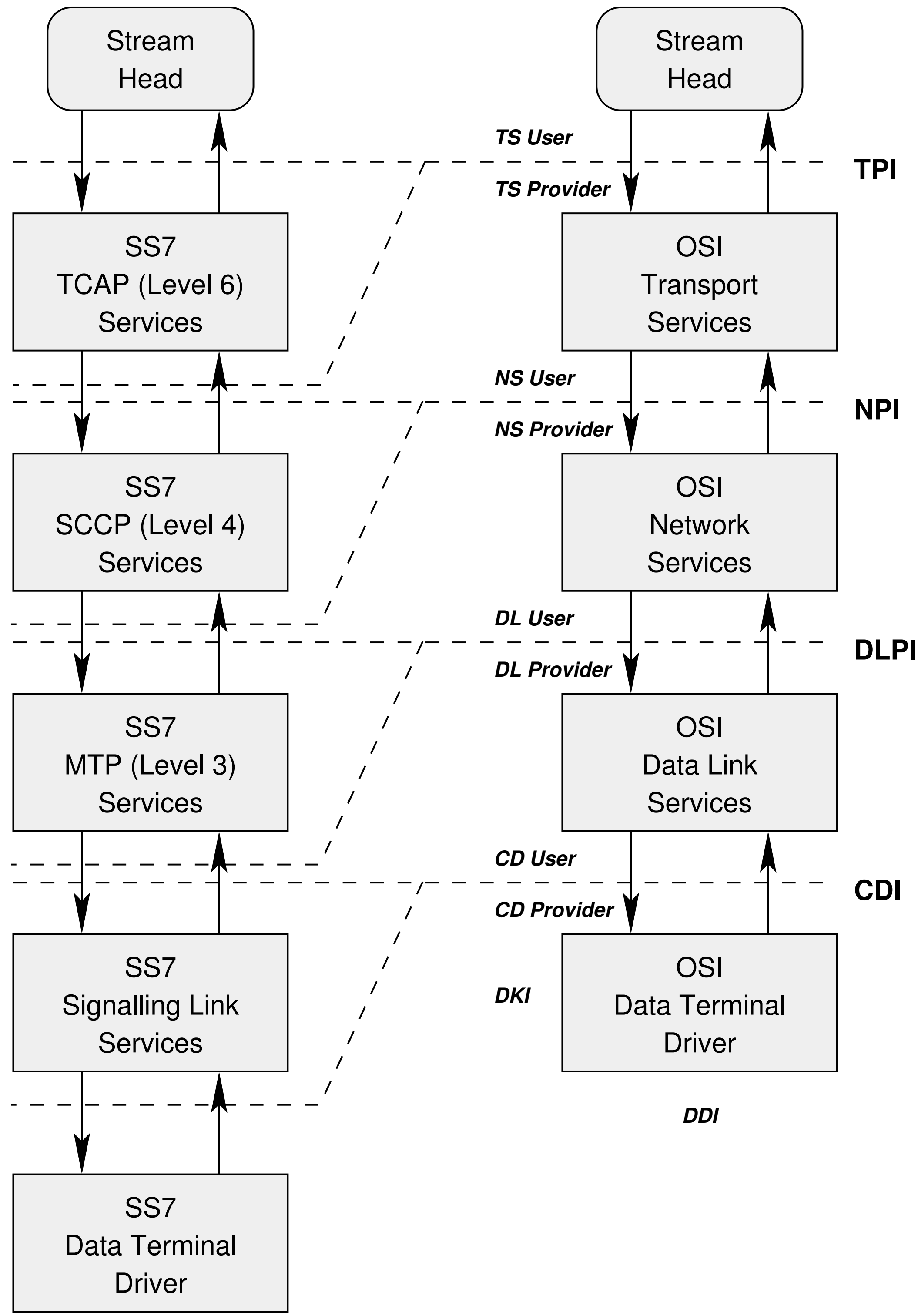


Figure 9.1: *SS7 to ISO/OSI Mapping*

Each OpenSS7 protocol module provides standardized X/Open ISO/OSI interfaces as well as more SS7 specialized interfaces. Many of the OpenSS7 protocol modules provide TPI Revision 2.0 interfaces with support fot he OpenSS7 XTI/TLI Library.

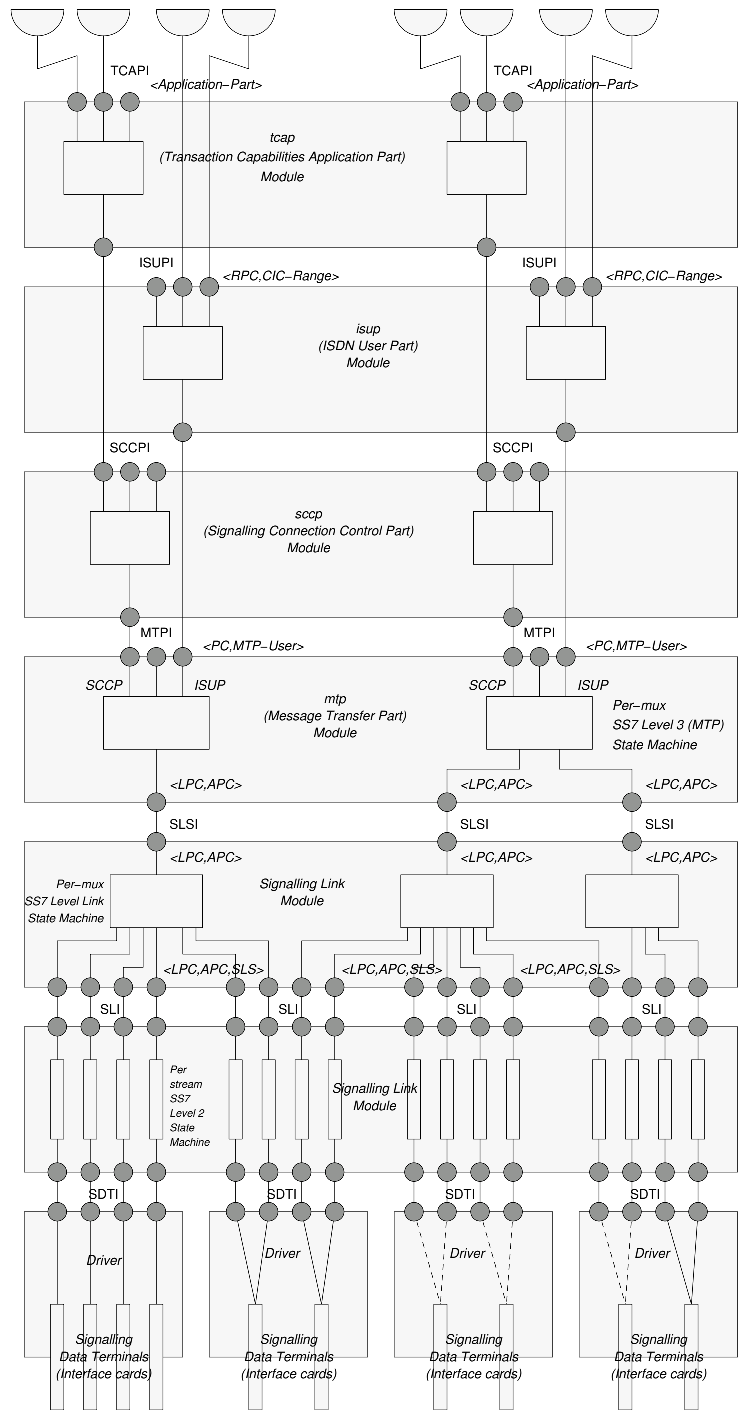


Figure 9.2: *STREAMS SS7/SIGTRAN Stack Architecture*

Figure 9.2 illustrates the organization of STREAMS modules, multiplexing drivers, pseudo-device drivers and real device drivers in the OpenSS7 SS7 stack. At each interface, the equivalent SIGTRAN User Adaptation Layer (UA) can be used. So, for example, between MTP Level 3 and its Users, the M3UA protocol can be employed. Each UA provides the same lower layer interface and upper layer interface. So, M3UA provides an MTP/MTP-User interface at its lower layer interface as well as at it supper layer interface.

# 10 Hardware Architecture

Figure 10.1 illustrates the hardware configuration for the OpenSS7 Media Gateway Platform.

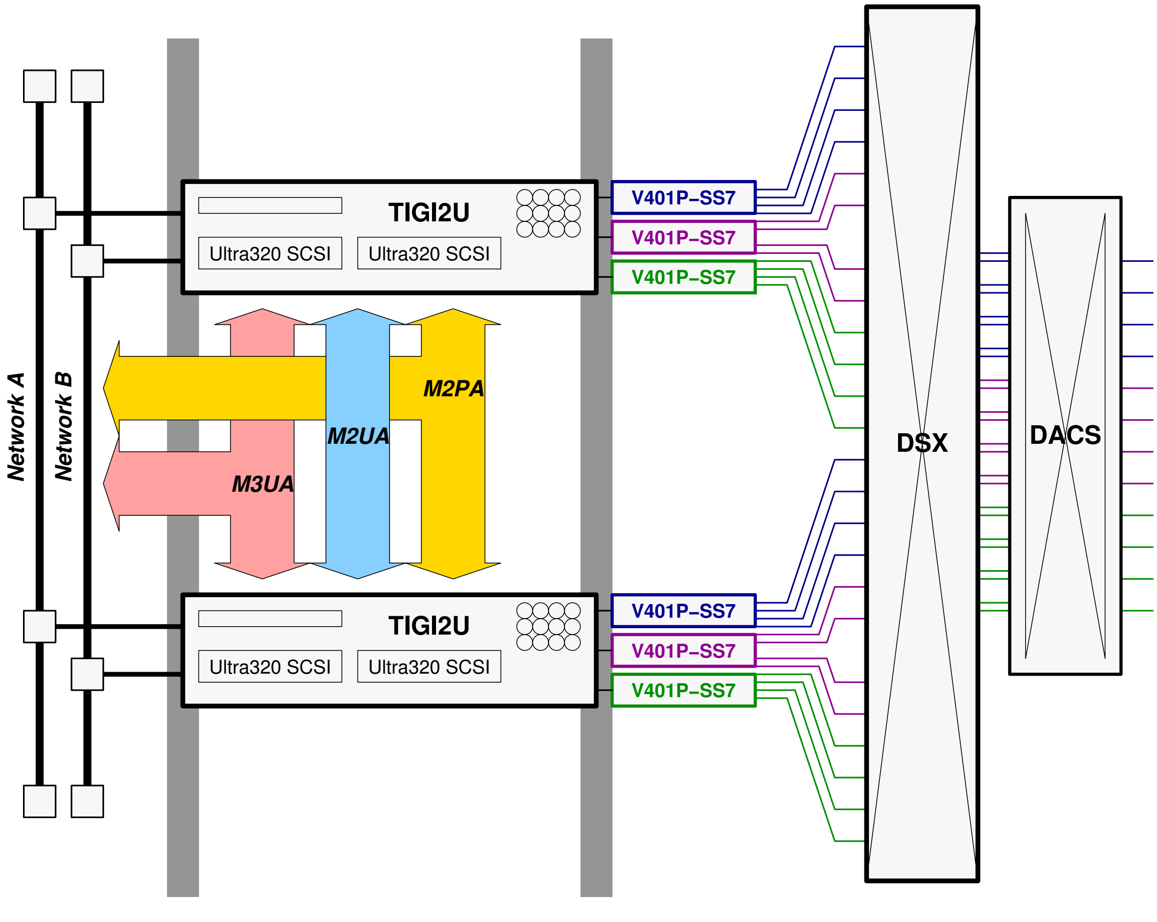


Figure 10.1: *Platform Architecture*

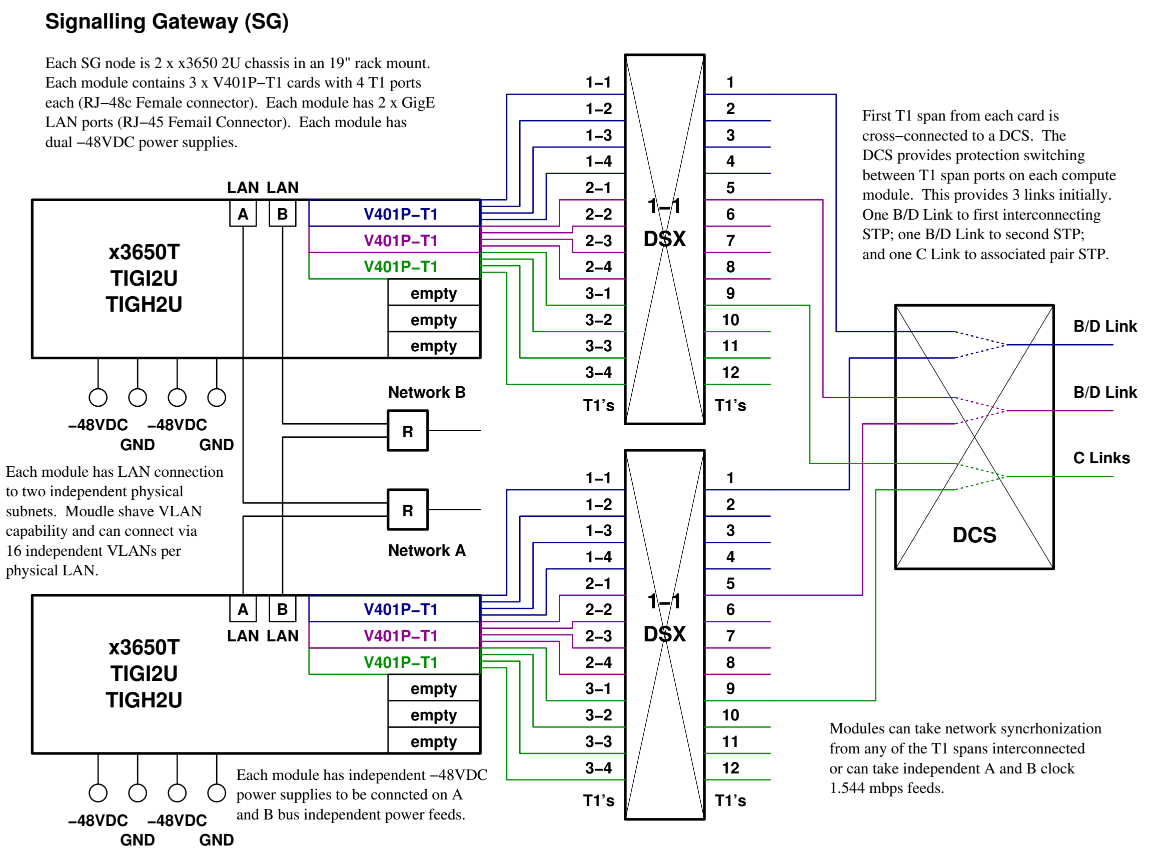


Figure 10.2: *Platform Architecture*

The configuration show in Figure 10.1 shows:

- Two compute nodes attached in a fully redundant configuration.
- Each compute node has 3 x V401P-SS7 cards proding quad DSX-1 connectivity per card, for a total of 12 DSX-1's per compute node.
- Each compute node is attached via cross-connect over 12 DSX-1's (each) to a DACS which has drop-down capability on each pair of DSX-1's consisting of one DSX-1 from each compute node.
- On the IP network side, each compute node supports 2 GigE NIC ports.
- Each NIC port on each compute node is attached to a GigE rail or swtich which subsequently attacheds to two Routers, one for Network A and one for Network B.
- The configuration shown supports up to 288 low-speed (56 or 64 kbps) signalling links or up to 12 high-speed (1.544 Mpbs) signalling links.
- Compute nodes communicate with each other over the IP network, either via local switch or remote router, using M2UA. This SIGTRAN protocol permits the compute node to logically share their V401P-SS7 hardware interfaces.
- Compute nodes communicate with the associated STP pair via TDM links as well as using the M2PA protocol. The M2PA SIGTRAN protocol provides an IP-based high-speed SS7 link and is used to augment TDM links to implement C-Links on the platform.

- Compont nodes act as SGP within the SG and provide MTP Level 3 and above connectivity to remote application servers using the M3UA SIGTRAN protocol. The M3UA SIGTRAN protocol exports the MTP to MTP-User interface and effectivley transports the interface to the application server from the signalling gateway.

# 11 Management Architecture

Characteristics of the management architecture are as follows:

1. The MG is a portion of a managed switching element. As such, the MG is a managed element that is only part of a managed switching element. Management Stations may correlate similar managed data that occurs both on the MGC and the MG, or the MGC might be capable of providing a single managed switching element view.

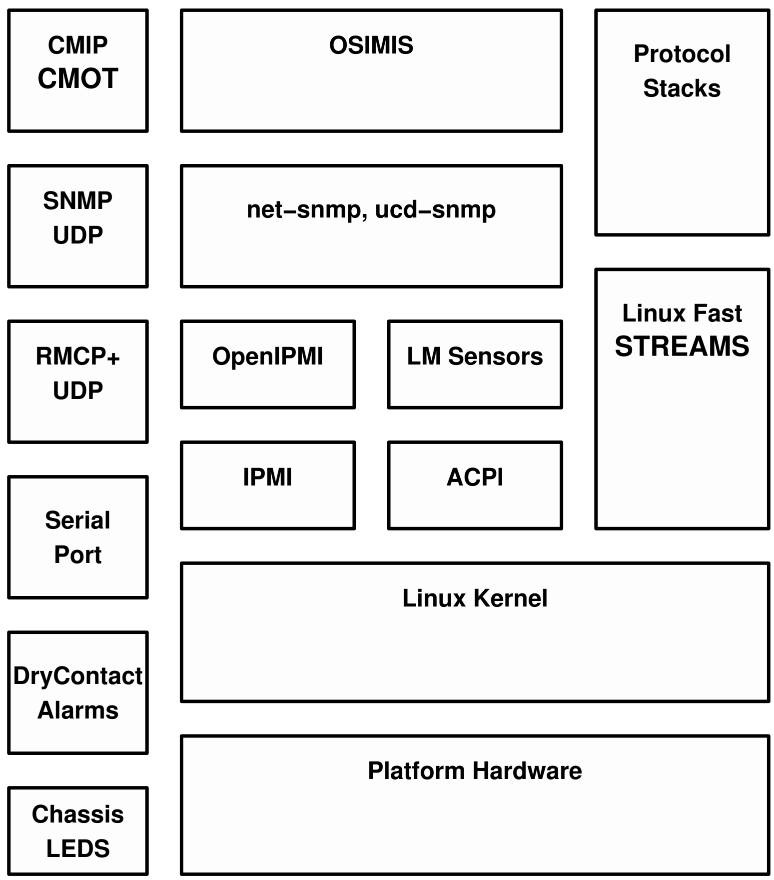


Figure 11.1: *Management Architecture*

The management facilities provided by the hardware platform, operating system and associated subsystems are illustrated in Figure 11.1. They are summarized as follows:

- *Platform Hardware*

  The platform hardware provides for physical management of hardware resources. Platform hardware is configured for rack-mount operation in a Telco environment. It provides for field replacable units. A number of hardware features provide for local physical managements, such as sliding rack mounts, cable management, chassis LEDS, unit identification, chassis LEDS, KVM, auxillary DCS panels, monitoring ports, front-panel management controls and ports.

- *Linux Kernel*
- *ACPI*
- *IPMI*
- *Linux Fast-STREAMS*
- *SNMP*
- *TMN*

# 12 Logistics

## 12.1 Hardware

### 12.1.1 Sizing Considerations

## 12.2 Software

## 12.3 Consulting

## 12.4 Schedule

### 12.4.1 Gate 0 — Concept

### 12.4.2 Gate 1 — High-Level Design

### 12.4.3 Gate 2 — Detailed Design

### 12.4.4 Gate 3 — Development and Implementation

### 12.4.5 Gate 4 — System Test

### 12.4.6 Gate 5 — Acceptance Testing

### 12.4.7 Gate 6 — Support Complete

## 12.5 Cost

# Appendix A Optional Application Support

# Appendix B Optional Network Support

# Appendix C Optional System Support

# Appendix D Optional Platform Support

# Appendix E Optional Protocol Support

# Appendix F Optional Software Support

# Appendix G Optional Hardware Support

# Appendix H Optional Management Support

# Appendix I Programmatic Interfaces

# Appendix J Platform Sizing

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