

Tekelec EAGLE[®] 5
Integrated Signaling System

Systems Overview

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TEKELEC

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Introduction

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Scope

This manual provides customers and system planners with a basic understanding of Tekelec Signaling systems and subsystems. The high-level overview describes how the EAGLE 5 Integrated Signaling System (EAGLE 5 ISS) works with those systems in a network. The descriptions includes the main features of the system, their functions and basic hardware requirements. This manual does not describe how to install or replace hardware.

For installation information, refer to the *Installation Manual* included in your current documentation suite. For replacement procedures of existing hardware components, refer to the *Maintenance Manual* included in your current documentation suite.

Manual Organization and Conventions

This *Systems Overview Manual* is organized into the following chapters:

- *Chapter 1, "Introduction"*—contains general information about the scope of this manual, manual organization, typical content of a Documentation Suite delivered with each system and how to get technical assistance.
- *Chapter 2, "SS7 Networks"*—provides an overview of common channel signaling networks, the role of STPs in those networks, the connectivity of STPs with other network elements, and the administration of STPs within a signaling network.
- *Chapter 3, "Tekelec Signaling Systems"*—describes the components of the EAGLE 5 ISS system, and provides a high-level theory of its operation.

The *Systems Overview Manual* uses the following conventions:

- Components used only in a specific system are clearly labeled.
- Components that are specific to a release are labeled with the system and release number; for example, (EAGLE 27.2 or earlier).

Related Publications

The *Systems Overview* is part of the EAGLE 5 ISS documentation set and may refer to one or more of the following manuals:

- The *Commands Manual* contains procedures for logging into or out of the EAGLE 5 ISS, a general description of the terminals, printers, the disk drive used on the system, and a description of all the commands used in the system.
- The *Commands Pocket Guide* is an abridged version of the *Commands Manual*. It contains all commands and parameters, and it shows the command-parameter syntax.

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- The *Commands Quick Reference Guide* contains an alphabetical listing of the commands and parameters. The guide is sized to fit a shirt-pocket.
- The *Commands Error Recovery Manual* contains the procedures to resolve error message conditions generated by the commands in the *Commands Manual*. These error messages are presented in numerical order.
- The *Database Administration Manual – Features* contains procedural information required to configure the EAGLE 5 ISS to implement these features:
 - X.25 Gateway
 - STP LAN
 - Database Transport Access
 - GSM MAP Screening
 - EAGLE 5 Integrated Monitoring Support.
- The *Database Administration Manual - Gateway Screening* contains a description of the Gateway Screening (GWS) feature and the procedures necessary to configure the EAGLE 5 ISS to implement this feature.
- The *Database Administration Manual – Global Title Translation* contains procedural information required to configure an EAGLE 5 ISS to implement these features:
 - Global Title Translation
 - Enhanced Global Title Translation
 - Variable Length Global Title Translation
 - Global Title Translation Modification
 - Intermediate GTT Load Sharing
 - ANSI-ITU-China SCCP Conversion
 - Flexible GTT Load Sharing
 - Origin-Based SCCP Routing
 - Hex Digit Support for GTT
 - Weighted GTT Load Sharing
 - Transaction-Based GTT Load Sharing.
- The *Database Administration Manual - IP⁷ Secure Gateway* contains procedural information required to configure the EAGLE 5 ISS to implement the SS7-IP Gateway.

- The *Database Administration Manual – SEAS* contains the EAGLE 5 ISS configuration procedures that can be performed from the Signaling Engineering and Administration Center (SEAC) or a Signaling Network Control Center (SNCC). Each procedure includes a brief description of the procedure, a flowchart showing the steps required, a list of any EAGLE 5 ISS commands that may be required for the procedure but that are not supported by SEAS, and a reference to optional procedure-related information, which can be found in one of these manuals:
 - *Database Administration Manual – Gateway Screening*
 - *Database Administration Manual – Global Title Translation*
 - *Database Administration Manual – SS7*.
- The *Database Administration Manual – SS7* contains procedural information required to configure an EAGLE 5 ISS to implement the SS7 protocol.
- The *Database Administration Manual – System Management* contains procedural information required to manage the EAGLE 5 ISS database and GPLs, and to configure basic system requirements such as user names and passwords, system-wide security requirements, and terminal configurations.
- The *Dimensioning Guide for EPAP Advanced DB Features* is used to provide EPAP planning and dimensioning information. This manual is used by Tekelec personnel and EAGLE 5 ISS customers to aid in the sale, planning, implementation, deployment, and upgrade of EAGLE 5 ISS systems equipped with one of the EAGLE 5 ISS EPAP Advanced Database (EADB) Features.
- The *ELAP Administration Manual* defines the user interface to the EAGLE 5 ISS LNP Application Processor on the MPS/ELAP platform. The manual defines the methods for accessing the user interface, menus, screens available to the user and describes their impact. It provides the syntax and semantics of user input and defines the output the user receives, including information and error messages, alarms, and status.
- The *EPAP Administration Manual* describes how to administer the EAGLE 5 ISS Provisioning Application Processor on the MPS/EPAP platform. The manual defines the methods for accessing the user interface, menus, and screens available to the user and describes their impact. It provides the syntax and semantics of user input and defines the output the user receives, including messages, alarms, and status.

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- The *Feature Manual - A-Port* provides an overview of a feature providing the capability for IS41 mobile subscribers to change service provider while retaining their original Mobile Directory Number (MDN). This manual gives the instructions and information on how to install, use, and maintain the A-Port feature on the Multi-Purpose Server (MPS) platform of the EAGLE 5 ISS.
- The *Feature Manual - ECAP* provides instructions and information on how to install, use, and maintain the Integrated Accounting Feature Application feature on the Eagle Collector Application Processor (ECAP). This feature collects raw MSU data from the EAGLE 5 ISS, categorizes the data into groups, and feeds those groups to another system for accounting activities. Additional features will be added to this manual at a later date.
- The *Feature Manual - EIR* provides instructions and information on how to install, use, and maintain the EIR feature on the Multi-Purpose Server (MPS) platform of the EAGLE 5 ISS. The feature provides network operators with the capability to prevent stolen or disallowed GSM mobile handsets from accessing the network.
- The *Feature Manual - G-Flex C7 Relay* provides an overview of a feature supporting the efficient management of Home Location Registers in various networks. This manual gives the instructions and information on how to install, use, and maintain the G-Flex feature on the Multi-Purpose Server (MPS) platform of the EAGLE 5 ISS.
- The *Feature Manual - G-Port* provides an overview of a feature providing the capability for mobile subscribers to change the GSM subscription network within a portability cluster while retaining their original MSISDNs. This manual gives the instructions and information on how to install, use, and maintain the G-Port feature on the Multi-Purpose Server (MPS) platform of the EAGLE 5 ISS.
- The *Feature Manual - INP/AINPQ* provides the user with information and instructions on how to implement, utilize, and maintain either the INAP-based Number Portability (INP) feature or the ANSI-41 INP Query (AINPQ) feature or both features on the Multi-Purpose Server (MPS) platform of the EAGLE 5 ISS.
- The *Feature Manual - Migration* provides an overview of a feature providing the capability for IS41 subscribers to migrate to a GSM network and GSM mobile subscribers to migrate to an IS41 network. This manual gives the instructions and information on how to install, use, and maintain the Migration feature on the Multi-Purpose Server (MPS) platform of the EAGLE 5 ISS.
- The *FTP-Based Table Retrieve Application (FTRA) User Guide* describes how to set up and use a PC to serve as the offline application for the EAGLE 5 ISS FTP Retrieve and Replace feature.

- The *Hardware Manual - EAGLE 5 ISS* provides an overview of each system and its subsystems, details of standard and optional hardware components in each system, and basic site engineering. These include the EAGLE 5 ISS, OEM-based products such as the ASi 4000 Service Control Point (SCP), and the Netra-based Multi-Purpose Server (MPS).
- The *Hardware Manual - Tekelec 1000 Application Server* provides general specifications and a description of the Tekelec 1000 Application Server (T1000 AS). This manual also includes site preparation, environmental and other requirements, procedures to physically install the T1000 AS, and troubleshooting and repair of Field Replaceable Units (FRUs).
- The *Hardware Manual - Tekelec 1100 Application Server* provides general specifications and a description of the Tekelec 1100 Application Server (T1100 AS). This manual also includes site preparation, environmental and other requirements, procedures to physically install the T1100 AS, and troubleshooting and repair of Field Replaceable Units (FRUs).
- The *Installation Manual - EAGLE 5 ISS* contains cabling requirements, schematics, and procedures for installing the EAGLE 5 ISS along with LEDs, connectors, cables, and power cords to peripherals. Refer to this manual to install components or the complete systems.
- The *LNP Database Synchronization Manual - LSMS with EAGLE 5 ISS* describes how to keep the LNP databases at the LSMS and at the network element (the EAGLE 5 ISS is a network element) synchronized through the use of resynchronization, audits and reconciles, and bulk loads. This manual is contained in both the LSMS documentation set and in the EAGLE 5 ISS documentation set.
- The *LNP Feature Activation Guide* contains procedural information required to configure the EAGLE 5 ISS for the LNP feature and to implement these parts of the LNP feature on the EAGLE 5 ISS:
 - LNP services
 - LNP options
 - LNP subsystem application
 - Automatic call gapping
 - Triggerless LNP feature
 - Increasing the LRN and NPANXX Quantities on the EAGLE 5 ISS
 - Activating and Deactivating the LNP Short Message Service (SMS) feature.

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- The *Maintenance Manual* contains procedural information required for maintaining the EAGLE 5 ISS and the card removal and replacement procedures. The *Maintenance Manual* provides preventive and corrective maintenance procedures used in maintaining the different systems.
- The *Maintenance Pocket Guide* is an abridged version of the Maintenance Manual and contains all the corrective maintenance procedures used in maintaining the EAGLE 5 ISS.
- The *Maintenance Emergency Recovery Pocket Guide* is an abridged version of the Maintenance Manual and contains the corrective maintenance procedures for critical and major alarms generated on the EAGLE 5 ISS.
- The *MPS Platform Software and Maintenance Manual - EAGLE 5 ISS with Tekelec 1000 Application Server* describes the platform software for the Multi-Purpose Server (MPS) based on the Tekelec 1000 Application Server (T1000 AS) and describes how to perform preventive and corrective maintenance for the T1000 AS-based MPS. This manual should be used with the EPAP-based applications (EIR, G-Port, G-Flex, A-Port, Migration, AINPQ, and INP).
- The *MPS Platform Software and Maintenance Manual - EAGLE 5 ISS with Tekelec 1100 Application Server* describes the platform software for the Multi-Purpose Server (MPS) based on the Tekelec 1100 Application Server (T1100 AS) and describes how to perform preventive and corrective maintenance for the T1100 AS-based MPS. This manual should be used with the ELAP-based application (LNP).
- The *Provisioning Database Interface Manual* defines the programming interface that populates the Provisioning Database (PDB) for the EAGLE 5 ISS features supported on the MPS/EPAP platform. The manual defines the provisioning messages, usage rules, and informational and error messages of the interface. The customer uses the PDBI interface information to write his own client application to communicate with the MPS/EPAP platform.
- The *Previously Released Features Manual* summarizes the features of previous EAGLE, EAGLE 5 ISS, and IP⁷ Secure Gateway releases, and it identifies the release number of their introduction.

- The *Release Documentation* contains the following documents for a specific release of the system:
 - *Feature Notice* - Describes the features contained in the specified release. The Feature Notice also provides the hardware baseline for the specified release, describes the customer documentation set, provides information about customer training, and explains how to access the Customer Support website.
 - *Release Notice* - Describes the changes made to the system during the lifecycle of a release. The Release Notice includes Generic Program Loads (GPLs), a list of PRs resolved in a build, and all known PRs.

NOTE: The *Release Notice* is maintained solely on Tekelec's Customer Support site to provide you with instant access to the most up-to-date release information.
 - *Systems Overview* - Provides high-level information on SS7, the IP⁷ Secure Gateway, system architecture, LNP, and EOAP.
 - *Master Glossary* - Contains an alphabetical listing of terms, acronyms, and abbreviations relevant to the system.
 - *Master Index* - Lists all index entries used throughout the documentation set.
- The *SEAS Commands Error Messages Manual* lists the error messages generated by the EAGLE 5 ISS that are specific to the Signaling Engineering and Administration System (SEAS). It includes the SEAS commands that trigger the error messages, the equivalent system error messages and commands, and the explanatory text.
- The *SS7-over-IP Networks Using SIGTRAN* manual examines the reasons for transitioning to an SS7-over-IP network, the considerations that go into planning and dimensioning, and helpful information for implementing the network using EAGLE 5 ISS.
- The *System Manual – EOAP* describes the Embedded Operations Support System Application Processor (EOAP) and provides the user with procedures on how to implement the EOAP, replace EOAP-related hardware, device testing, and basic troubleshooting information.

Customer Care Center

The Customer Care Center offers a point of contact through which customers can receive support for problems that may be encountered during the use of Tekelec's products. The Customer Care Center is staffed with highly trained engineers to provide solutions to your technical questions and issues seven days a week, twenty-four hours a day. A variety of service programs are available through the Customer Care Center to maximize the performance of Tekelec products that meet and exceed customer's needs.

To receive technical assistance, call the Customer Care Center at one of the following locations:

- Tekelec, USA

Phone (US and Canada) +1 888-FOR-TKLC or 888-367-8552

Phone (international) +1 919-460-2150

Fax +1-919-460-2126

Email: support@tekelec.com

- Tekelec, Europe and UK

Phone +44 1784 467 804

Fax +44 1784 477 120

Email: ecsc@tekelec.com

Once a Customer Service Request (CSR) is issued, Technical Services, along with the customer, determines the classification of the trouble.

Acronyms

A.....	Ampere
ACL.....	Application processor Code Loader
ACM	Applications Communications Module
AIN	Advanced Intelligent Networks. Set of standards for advanced intelligent services
AINF	Application Interface Applique
ANSI	American National Standards Institute.
AP.....	Application Processor
APD	Application Processor DCM bootstrap code
API	Application Interface
AS.....	Application server
ASM	Application Services Module
ATM.....	Asynchronous Transfer Mode
BHCA	Busy Hour Call Attempts
BITS.....	Building Integrated Timing System
BM.....	Buss Master (Cognitronics)
BOM.....	Bill Of Materials
BP	Boot Prom
BPDCM	Boot Prom DCM
Bps.....	Bit per second
CAP.....	Communication & Application Processor
CAR	Corrective Action Report
CCS7	Common Channel Signaling System #7
CE CISPR A	Compliance European, Comite Internationale Special des Perturbations Radioelectrique (European Compliance, International Special Committee on Radio Interference, Class A)
CDR	Call Detail Record
CDU	CAP Downloadable Utility
CLEI.....	Common Language Equipment Identifier
CF	Control Frame
CLLI.....	Common Language Location Identifier
CNAM.....	Calling Name Delivery Service

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COTS.....	Commercial Off-the-Shelf
CP	Communications Processor
CSR.....	Customer Service Request
D1G	Database Communication 1 Gigabyte Expansion Memory Module
DCM.....	Database Communications Module
DMS.....	Disk Management Service
DRAM.....	Dynamic Random Access Memory
DS0	Digital Signal Level-0 (64 Kbits/sec)
DS1	Digital Signal Level-1 (1.544Mbits/sec)
DSM.....	Database Services Module
E1	European Digital Signal Level-1 (2.048 Mbits/sec).
EBI	Extended Bus Interface
EDCM	Enhanced Database Communications Module
EF.....	Extension Frame
EILA	Enhanced Integrated LIM Applique
EMM.....	Extended Memory Management
EMP.....	EAGLE Monitor Protocol
EOAM.....	Enhanced OAM GPL
EOAP	Embedded Operation Support System Applications Processor
ESD.....	Electro-Static Discharge
ESP.....	Extended Services Platform
FAP	Fuse and Alarm Panel
FR.....	Flight Recorder
FTP.....	File Transfer Protocol
FTRA	FTP-based Table Retrieve Application
GB.....	GigaByte
GLS.....	Generic Loader Services
GPL.....	Generic Program Load
GPLM.....	GPL Management
GPSM-II	General Purpose Service Module
GTT.....	Global Title Translation
GWS	Gateway Screening

HCAP	High-Speed Communications & Applications Processor
HCAP-T.....	Improved HCAP card
HDLC	High-Level Data Link Control
HIPR	High-speed IMT Router
HMUX.....	High-speed Multiplexer
IAD.....	Integrated Access Device
ICM.....	IMT configuration manager task
ILA	Integrated LIM-AINF module
ILDR.....	IMT loader task
IMT	Inter-processor Message Transport
IMTC.....	IMT Control task
IP	Internet Protocol
IP ⁷	Tekelec's Internet Protocol to SS7 Interface
IPD	IMT Processor DCM operational code
IPMX.....	IMT Power and Multiplexer card
ISDN	Integrated Services Digital Network.
IS-NR	In Service – Normal
ISR.....	Interrupt Service Routine
ITU	International Telecommunications Union
IWF	Inter-Working Function
KHz.....	Kilohertz (1000 Hertz)
LAN	Local Area Network.
LFS	Link Fault Sectionalization
LIM	Link Interface Module
LNP.....	Local Number Portability
LIM-AINF	A LIM with a software-selectable interface
LOM.....	Lights out Management
LSMS.....	Local Service Management System
M256	256 Megabyte Memory Expansion Card
MAS	Maintenance and Administration Subsystem
MASP.....	Maintenance and Administration Subsystem Processor
MBUS.....	Maintenance Bus

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MCAP	Maintenance Communications & Applications Processor
MDAL	Maintenance, Disk, and Alarm card
MG.....	Media Gateway
MGB	Master Ground Bar
MGC.....	Media Gateway Controller
MGCP	Media Gateway Controller Protocol
MIB.....	Maintenance Information Base utility
MIM.....	Multi-Channel Interface Module
MPL.....	Multi-Port LIM
MPS	Multi-Purpose Server
MSU.....	(SS7) Message signaling Unit
MS.....	Media Server
MTOS	Multi-Tasking Operating System, Industrial Programming Inc.
NEBS	Network Equipment Building System
NOC	Network Operations Center
NS	Network Server
OAM	Operations, Administration, & Maintenance
OA&M	Operations, Administration, & Maintenance
OAP.....	Operations System Support/ Applications Processor
OAPF.....	Operations System Support/ Applications Processor Frame
OCU	Office Channel Unit
OEM	Original Equipment Manufacturer
OOS-MT-DSBLD	Out of Service –Maintenance Disabled
PMTC	Peripheral Maintenance task
PSTN	Public Switched Telephone Network
RAID	Redundant Array of Inexpensive Disks
RAM.....	Random Access Memory
RMA	Return Material Authorization
SAI/P	Serial Asynchronous Interface PCI Adapter
SCP	Service Control Point (SS7 Network)
SCCP	Signal Connection Control Part

SCM	System Configuration Manager
SCN.....	Switched Circuit Network
SCSI.....	Small Computer Systems Interface
SEAC.....	Signaling Engineering and Administration Center
SEAS	Signaling Engineering and Administration System
SG.....	Secure Gateway
SIP	Session Initiation Protocol
SS7.....	Signaling System Seven
SSP	Service Switching Point (SS7 Network)
STC.....	Signaling Transport Card
STP	Signal Transfer Point (SS7 Network)
STPLAN	Signaling Transfer Point Local Area Network
T1.....	The North American telecommunications standard defining a circuit that multiplexes and switches 24 channels and operates at speeds of 1.544 Mbps
TCU.....	Table Creation Utility
TCP	Transport Control Protocol
TCP/IP	Transmission Control Protocol/Internet Protocol
TDM.....	Terminal Disk Module
TEKCC.....	Tekelec Composite Clock
TEKOS	Tekelec Operating System
TMOAP	Texas Micro processor chassis hosting the OAP application
TOS486	Tekos Operating System for the 486
TOS4M.....	Tekos Operating System for the 486 implemented via MTOS
TSC.....	Time Slot Counter
TSM.....	Translation Services Module
UAM.....	Unsolicited Alarm Output
UD1G.....	Updated Database Communication 1 Gigabyte Expansion Memory Module
UIM.....	Unsolicited Information Messages
V.35.....	ITU Interface Recommendation, V.35
VPN	Virtual Private Network
WAN	Wide Area Network

2

SS7 Networks

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Introduction

This chapter provides an overview of common channel signaling networks, the role of STPs in those networks, the connectivity of STPs with other network elements, and the administration of STPs within a signaling network.

Common Channel Signaling Networks

Signaling System No. 7 (SS7) is a signaling protocol that has become a worldwide standard for modern telecommunications networks. The U.S. implementation is based on the International Telecommunications Union-Telecommunications Section (ITU-TS) and TIX I Committee of the Exchange Carriers Standards Association (ECSA). SS7 is a layered protocol following the OSI reference model. It offers all of the same call setup advantages as CCS6, but also enables network elements to share more than just basic call-control information through the many services provided by the SS7's Integrated Services Digital Network-User Part (ISUP), and the Transaction Capabilities Application Part (TCAP).

The functions of the TCAP and ISUP layers correspond to the Application Layer of the OSI reference model, and allow for new services such as User-to-User signaling, Closed-User Group, Calling Line Identification, various options on Call Forwarding and the rendering of services based on a centralized database (e.g., 800 and 910 service). All of these services may be offered between any two network subscribers, not just to subscribers served by the same telephone switch.

SS7 Link and Message Types

An SS7 Network consists of a flat non-hierarchical configuration enabling peer-to-peer communication. Figure 2-1 depicts the makeup and connectivity of SS7 common channel signaling networks currently installed and in use.

Figure 2-1. SS7 Common Channel Signaling Networks

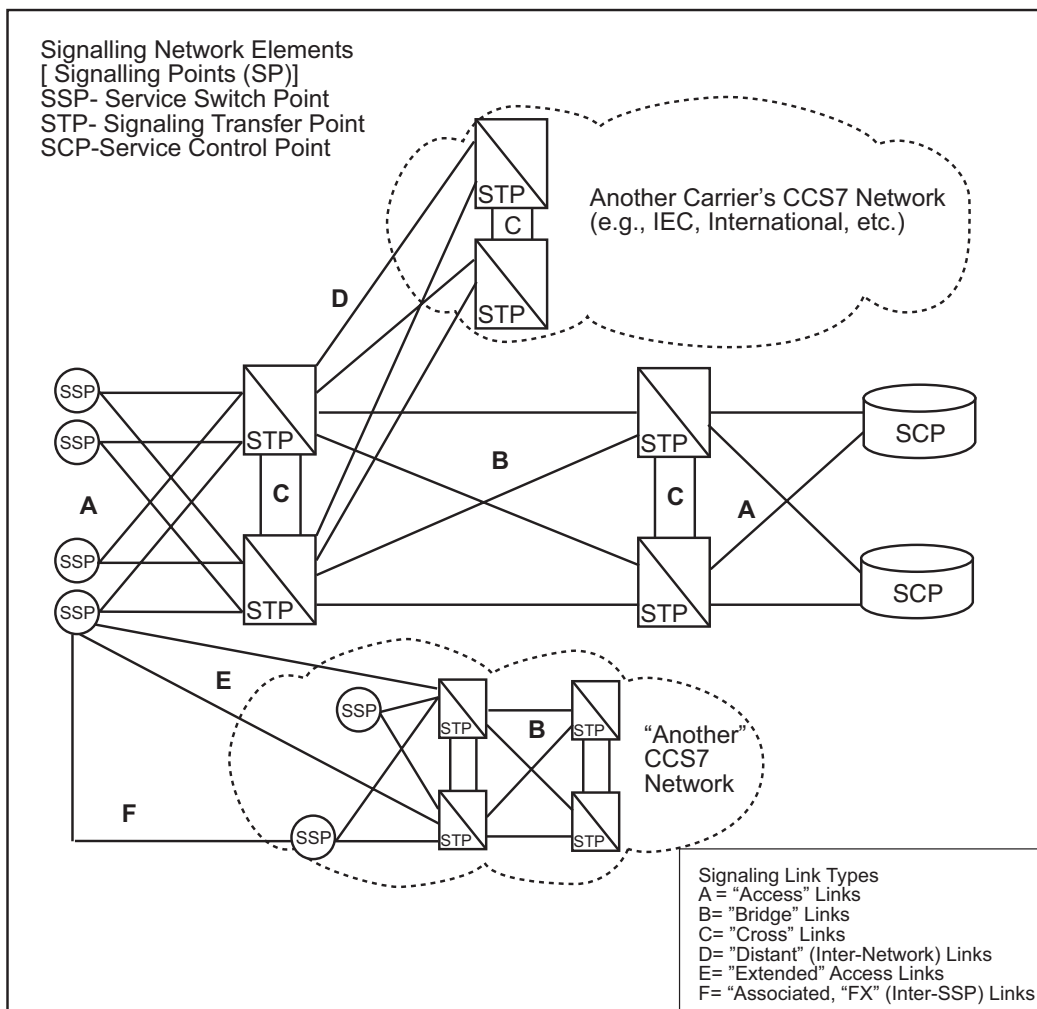


Figure 2-1 shows the three principal network elements of SS7 common channel signaling networks, interconnected by the six standard types of signaling links currently in use. Signaling links are data transmission links that ordinarily operate on digital carrier facilities at 56,000 bits per second in North America, and at 64,000 bits per second in most other regions of the world. High Speed Links (HSLs) at 1.54 M bps are beginning to be used in North America.

Signaling links between any two signaling network elements are deployed in groups called "link sets," dimensioned to carry the estimated signaling traffic between two STPs. Because STPs like the EAGLE 5 ISS are deployed in pairs, as shown in Figure 2-1, an alternate route always exists between any two STPs.

One combination of the link sets interconnecting an SSP or SCP with both members of the STP pair is called a "Combined link set." The traffic carried between any two signaling network elements is load-shared across links in a link set, rotating through all links available according to the rules of the SS7 protocol.

Traffic destined for any network element via the STP pair is further load-shared over the combined link set, unless restricted by network management rules also established by the SS7 protocol.

Role of SSPs, STPs and SCPs in SS7 Networks

Service Switching Points (SSPs)

In conventional telephone networks, Service Switching Points (SSPs) are usually telephone central offices, also known as "End-Offices," or "Access Tandems." In the cellular mobile or "wireless" communications environment, an SSP is frequently located at the Mobile Switching Center (MSC). In either case, the SSPs perform circuit switching functions, and are capable of using the SS7 protocol to signal other SSPs for call setup, or to query the centralized databases that are stored in Service Control Points (SCPs).

Signaling Transfer Points (STPs)

STPs, like the EAGLE 5 ISS are ultra-reliable, high speed packet switches at the heart of SS7 networks, which terminate all link types except "F" links. For reliability reasons, they are nearly always deployed in mated pairs.

The primary functions of STPs are to provide access to SS7 networks and routing of signaling messages. The SS7 protocol itself defines destination routing for both circuit related signaling (inter-SSP) and non-circuit related data base inquiries to Service Control Points (SCPs). Many STPs contain additional routing information concerning the exact location of specific databases stored at different SCPs, so that an SSP can request information without knowing in which specific SCP it is stored.

STPs operate using the message transfer and signaling connection control parts of the SS7 protocol. The message transfer part (MTP) provides basic message handling and network management procedures, and the signaling connection control part (SCCP) adds the capability to transmit database queries and other non-circuit related signaling messages across the network. SCCP also provides a non-SS7 specific addressing interface (Global Title), as explained below.

In SS7 networks, STPs perform the following three basic functions:

- **Message routing** - by using the originating and destination point codes (OPC and DPC) contained in the MTP's "routing label," in a "datagram" environment (i.e. where a separate route may be chosen for each message)

packet). Routing tables, which are structured to allow message transport between any given pair of SSPs over different routes, are stored and maintained within STPs. The STP's signaling Network Management functions control message routing during periods of link congestion or failure.

- **Specialized routing (Global Title Translation)** - by using the signaling connection control part to translate addresses (Global Titles) from signaling messages that *do not contain* explicit information allowing the message transfer part to route the message. For example, an STP translates a dialed "1+800" number to an SCP's destination point code for message transfer part routing, and gives a subsystem number (SSN) for delivery to the "800" database application at the SCP. In case of congestion or failures, the STP's signaling connection control parts management takes responsibility for rerouting signaling traffic, based on information received via the message transfer part concerning the point code's routing status, and SSNs allowed or prohibited.
- **Carrier signaling access (Gateway Screening)** - by using the MTP and SCCP to allow or deny access to the "Home" SS7 network for transport of signaling messages from another network.

To establish and maintain trunk connections between two SSPs, and to notify both when the connection is to be released, a pre-defined sequence of SS7 messages is exchanged between the two SSPs. Except where "F-links" have been installed between the concerned SSPs, these messages are routed to one of a pair of STPs in the local ("Home") SS7 network over an "A-link," or to one of a pair of STPs in another SS7 network over an "E-link." An example of the STP function is illustrated by the following cases:

- For an ordinary customer-dialed call to a 7- or 10-digit domestic station address (I±NPA+NXX+XXXX), the STP, after consulting its routing tables, will route its received SS7 messages towards the designated SSP over the appropriate A, B or D-link. (Note: A message will be rerouted over a C-link only in cases where the use of the other B or D link sets are restricted or unavailable.)
- For calls to be given special billing or routing treatment, as indicated by other dialed prefix digits (e.g., I+NOO+..., IOXX +..., 0+..., etc.), an intermediate step requires the STP to retrieve routing information from a non-resident routing table or database. This retrieval process ordinarily involves translation of the signaling address and a completely separate message transaction with an SCP.

As shown in Figure 2-1, STPs are the hub of the signaling network infrastructure. A less efficient, and more expensive, signaling network might have each SSP connected to every other SSP by an "F" type signaling link. This approach would be much more costly than the hubbed network shown in Figure 2-1, due to the total number of links that would be required. For example, a fully-connected, ten node network would require 45 "F links," or 90 "F links" if each link was redundant. The alternative hubbed network approach for ten SSPs utilizing STPs (deployed in pairs for increased availability) requires only 20 links, one link to each member of the STP pair.

Service Control Points (SCPs)

Service Control Points (SCPs) are network intelligence centers where databases of call processing information is stored. The primary function of SCPs is to respond to queries from other SCPs, by retrieving the requested information from the appropriate database within the SCP node, and sending it back to the originator of the request.

SCPs currently serve as centralized databases to translate logical numbers (e.g., 1+N00 numbers) into network physical addresses, or to verify credit card data and status. Future plans call for expanding the SCPs' centralized resource responsibilities to include greater interaction in call processing. This expansion of responsibilities will be attained through newly defined "call models" implemented in SSPs that may invoke assistance from SCPs more than once for the same call.

The information managed by an SCP can be modified or updated without affecting any other node in the SS7 network. This ease of data administration is a major appeal of SS7 implementation. The first applications of SCPs for 1+800 calls and credit card verifications could also have been implemented by storing the respective databases at each network switching node. This approach was rejected, however, due to the unmanageable task of administering multiple decentralized databases.

To appreciate the expediency and economy of centralized databases, consider adding a new service to a 100 node network by updating 100 databases. The ease of administration and greater control of new service offerings are obvious when one compares the two alternatives.

STP System Link Administration

After an STP is installed, system administration consists primarily of the following:

- Addition of signaling link hardware and software
- Creation and maintenance of data tables for links, link sets, and routes
- Addition of hardware and software required for global title translation
- Creation and maintenance of global title translation tables
- Addition of hardware and software for gateway screening
- Creation and maintenance of gateway screening tables
- Updating software

When required, hardware must always be installed at the affected STP site. However, there are three methods that can be employed to load software and administer data tables:

1. Local administration via user interface(s) and portable storage media (disks or tapes).
2. Remote administration via modem using vendor-proprietary methods and commands to load and update data.
3. Centralized, remote administration via modem or dedicated digital data link, using industry or network operator's standard operations support system (e.g., SCCS, SEAS, etc.).

3

Tekelec Signaling Systems

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Introduction

Tekelec uses different systems to support its processor and feature applications that include the following:

- EAGLE 5 Integrated Signaling System (ISS)
- Local Service Management System (LSMS)
- Integrated Data Acquisition
- Multi-purpose Server (MPS)
- Tekelec 1000 and Tekelec 1100 Application Server
- Tekelec 1000 and Tekelec 1100 Application Server
- Embedded OSS Application Processor (EOAP)

EAGLE 5 Integrated Signaling System (ISS)

The EAGLE 5 ISS is a large-capacity, multi-functional, fully scalable Signaling Transfer Point (STP). High capacity and scalability allow this system to grow from a single-shelf, 80-link STP to a multi-frame, 2000-link STP.

The EAGLE 5 ISS can handle increasing voice and data traffic loads and all of the signaling routing within a core network for signaling applications and services. The EAGLE 5 ISS performs key functions such as signal transfer, signaling gateway and number portability. Integrated applications, dramatic database size, signaling capacity and transaction speed coupled with next-generation IP connectivity provide the transition to the converged network model.

EAGLE 5 ISS-based products are NEBS-compliant (GR-63-CORE, Network Equipment-Building Systems). These products are configured in standard equipment frames to provide services to SS7 telephony networks.

Because of the distributed processor design, the EAGLE 5 ISS does not have a separate central processing unit to bottleneck traffic throughput. Application and interface cards provide plug and play type functionality that facilitates future growth. These cards generally do not have specific shelf or frame limitations and allow you to fully customize and define how your STP is configured. The EAGLE 5 ISS also supports a variety of interface cards to support connectivity to a wide range of network elements. EAGLE 5 ISS provides connectivity interfaces for IP, ATM, DS0A, V.35, OCU, T1, and E1 protocols.

Features

- **Exceptional Capacity.** The system supports up to 2,000 links, one million global title translation (GTT) table entries and 228 million subscriber records.
- **High Performance.** Transaction speeds of up to 640,000 message signaling units (MSUs) per second.
- **Flexible Interconnection.** Supports multiple link interface types, including: 100 Base-T, DS0A, V.35, OCU, T1/E1 ATM HSL, channelized E1 and T1 and E1 synchronous HSL.
- **Network Security.** Signaling connectivity to other service providers is centralized at the EAGLE 5 ISS, so gateway screening is also centralized and not required at multiple switches.

IP Connectivity

The EAGLE 5 ISS provides connectivity between SS7 and IP networks, enabling messages to pass between the SS7 network domain and the IP network domain. It receives and sends switched circuit network (SCN) native signaling at the edge of the IP network. This signaling gateway function may relay, translate, or terminate SS7 signaling in an SS7-Internet gateway. The signaling gateway function may also be co-resident with the media gateway function to process SCN signaling associated with line or trunk terminations controlled by the media gateway.

LNP

Local Number Portability (LNP) functionality allows a subscriber to change location, service provider, or service while keeping the same directory number. LNP ensures that subscribers receive the same freedom of choice for local service as they do with long-distance service providers. LNP requires the Local Service Management System (LSMS), which provides the interface between the number portability administration center (NPAC) service management system and the EAGLE 5 ISS. The LSMS is composed of hardware and software components that interact to create a secure and reliable LNP system.

The EAGLE 5 ISS with Local Number Portability (LNP) solution provides fully scalable transaction rates from 1,700 to 40,800 TPS. Tekelec simplifies number portability by integrating advanced database management and signaling functions directly into its EAGLE 5 ISS platform. Using a memory-based approach, LNP functions are combined with EAGLE 5 ISS capabilities in a single network node.

Theory of Operation

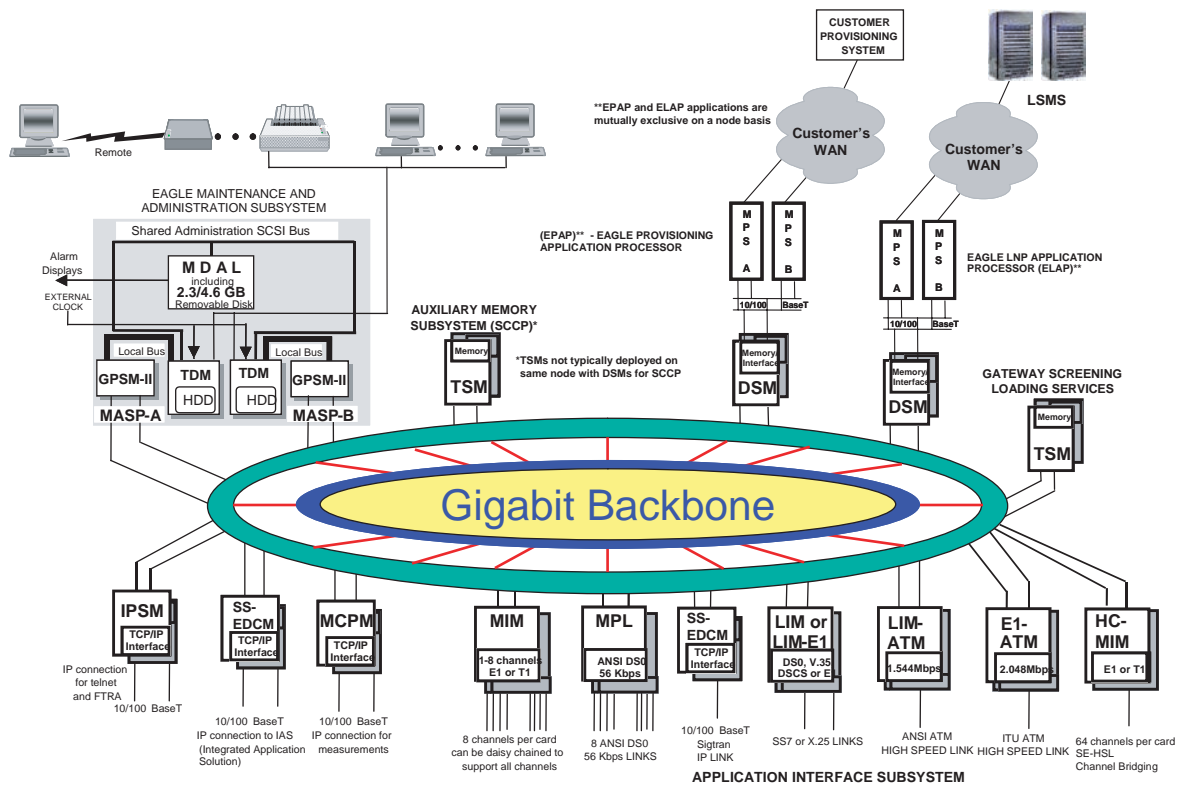
The EAGLE 5 ISS implements SS7 MTP function, level 2 and level 3, through software contained entirely within the Link Interface Modules (LIMs). No separate central processing unit exists within the EAGLE 5 ISS. All message processing logic, including the links, link sets, and routes associated with each origination point code/destination point code in the signaling network are included within the MTP routing feature module. The STP offers full point code routing. (For rapid recovery from processor faults, copies of this software are also stored on the hard disk.) The LIMs can handle a 100% traffic load on each link, assuming a small MSU size.

The EAGLE 5 ISS consists of the following subsystems:

- Maintenance and Administration Subsystem (MAS)
- Communication Subsystem (Gigabit backbone)
- Application Subsystem

Figure 3-1 provides a high-level overview of the EAGLE 5 ISS subsystems and functions.

Figure 3-1. EAGLE 5 ISS System Functional Diagram

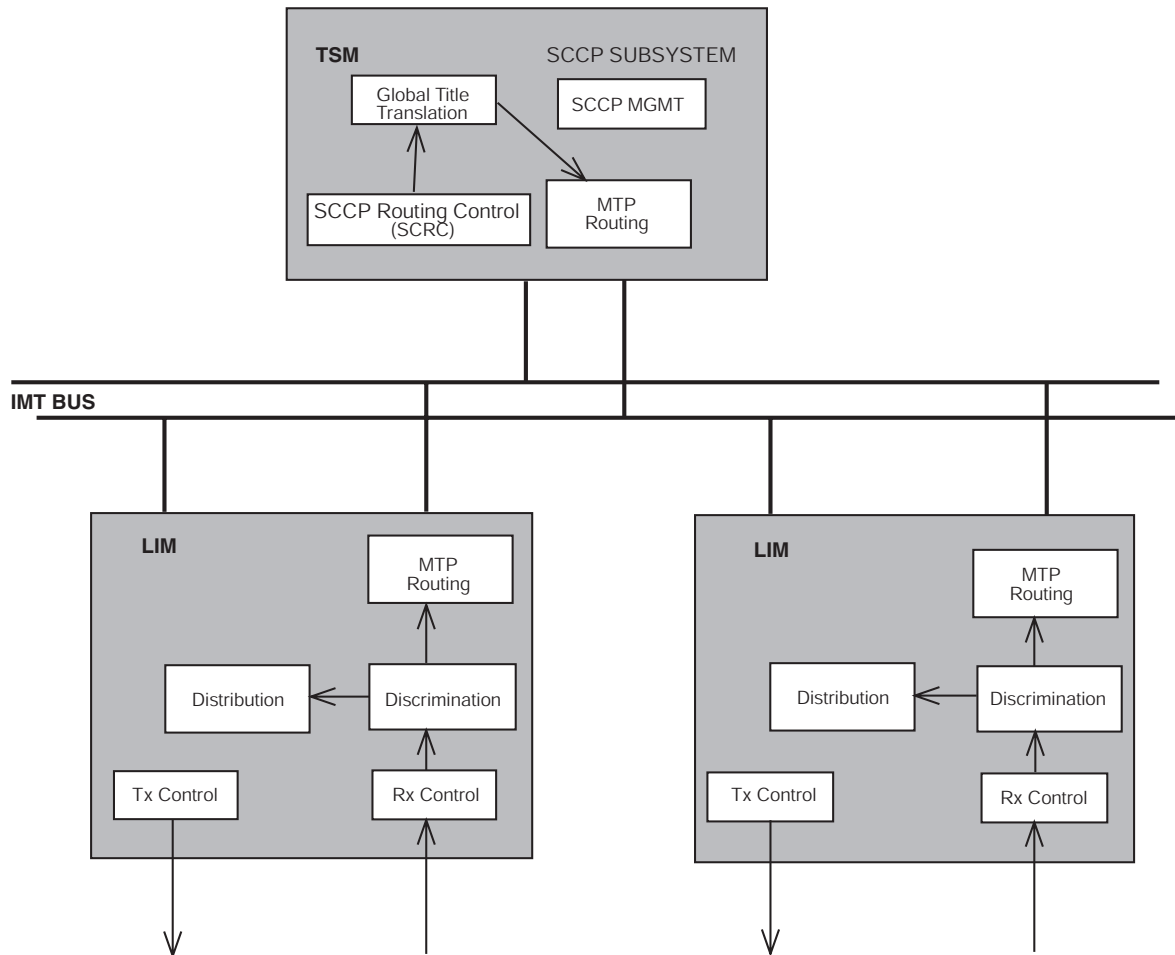


The following illustrates incoming messages that are routed through an EAGLE 5 ISS. If gateway screening is activated, the messages are screened before they are examined for further processing. The message discrimination function determines whether the message can be routed based solely on the MTP routing label. If so, the outgoing link is identified with its equipment address (LIM), and the message is transferred through an Inter-processor Message Transport (IMT) bus to that LIM for transmission to the designated destination point code (DPC).

If the discrimination function determines that a global title translation (GTT) is required, the message is sent, through the message distribution function, to SCCP routing that routes the message.

After the message arrives at the designated module, the destination point code (DPC) and subsystem number for this message are determined by global title translation, and the message is transferred through an IMT bus to the appropriate LIM for transmission to the designated DPC. See Figure 3-2.

Figure 3-2. Example EAGLE 5 ISS message flow



Administration Subsystem

The Maintenance and Administration Subsystem (MAS) provides services to other subsystems

- Maintenance communication—Maintenance functions poll each application card and receives trouble reports. These are reported to the alarm function in the MASP to generate alarms, or to the event messaging function for output to the printer.
- Measurements—Collection and reporting of system performance data.
- Peripheral services—Provides access to all peripherals attached to the system, terminals, disks, alarms, clocks, and others.
- Alarm processing—Provides audible and visual alarms.
- System disks—Provides for storage of application or system software.

Communication Subsystem

The communication subsystem consists of two separate sets of buses and includes:

- Small Computer System Interface (SCSI) buses
- Inter-processor Message Transport (IMT) buses

Small Computer System Interface Buses

There are two independent Small Computer System Interface (SCSI) buses, one to the fixed disks on Terminal Disk Module (TDM) cards and the other to the shared administration SCSI bus that runs on the backplane between TDMs and the Maintenance Disk and Alarm (MDAL) card. Each SCSI bus has a block of memory that allows transfers from memory to occur without delaying the application processor.

Inter-processor Message Transport

The Inter-processor Message Transport (IMT) bus is the main communications artery for all subsystems in the system. This high-speed communications system is composed of two counter-rotating serial buses. The IMT bus uses load sharing, so messages from the various subsystems are divided evenly across both buses. If one bus should fail, the other immediately assumes control of all messages.

The IMT buses can function as a private LAN assigning internal IP address to LIM cards. By addressing cards on an internal LAN the EAGLE 5 ISS/Sentinel Integration feature allows monitoring of SS7 links without external connections. SS7 link information from the EAGLE 5 ISS LIM cards is collected by Signaling Transport Cards (STC) and transferred to Integrated Data Acquisition system such as a Tekelec Extended Service Platform (ESP) forwarded to a Sentinel server.

Application Subsystem

The application subsystem consists of application cards. Application cards are capable of communicating with other cards through the redundant IMT buses. A Communications Processor (CP) on each application board provides control of communications from the cards to the IMT buses.

Software is downloaded to application cards on initial power-up from the Maintenance and Administration Subsystem Processors (MASP). Once EAGLE 5 ISS is loaded, software is downloaded to cards by the Generic Loader Services (GLS) and Operation Administration and Maintenance (OAM).

Generic Program Loads

Application software is downloaded to individual application cards by means of Generic Program Loads (GPLs). A GPL is a specific instance of an application for a specific piece of hardware. Hardware is defined to EAGLE 5 ISS by means of a series of administration commands. Software is then loaded from the fixed disk over the IMT bus directly to the cards. The type of the GPL loaded depends on the card and card function that is chosen.

Local Service Management System (LSMS)

Tekelec's Local Service Management System (LSMS) supports the administration of Tekelec's North American LNP solution. The LSMS provides the interface between the Number Portability Administration Center (NPAC) Service Management System (SMS) and the EAGLE 5 ISS's Element Management System (EMS). It supports provisioning of the EAGLE 5 ISSs with NPAC data as well as locally administered service provider specific data.

The LSMS is composed of hardware and software components that interact to create a secure and reliable LNP system. The LSMS is equipped with a graphical user interface to administer subscription, service provider, and network data.

Features

LSMS features include:

- Eight industry standard Q.3 NPAC interfaces
- Supports administration of override data internal to the service provider's network
- Supports up to eight EAGLE 5 ISS pairs
- Ability to partition databases according to area of portability service (AOPS), eliminating the need for database replication on all nodes
- Data auditing and reconciliation between EAGLE 5 ISS and the LSMS
- Connection management for communications links, including automatic error detection and failure recovery
- Enhanced security, including key management and firewall

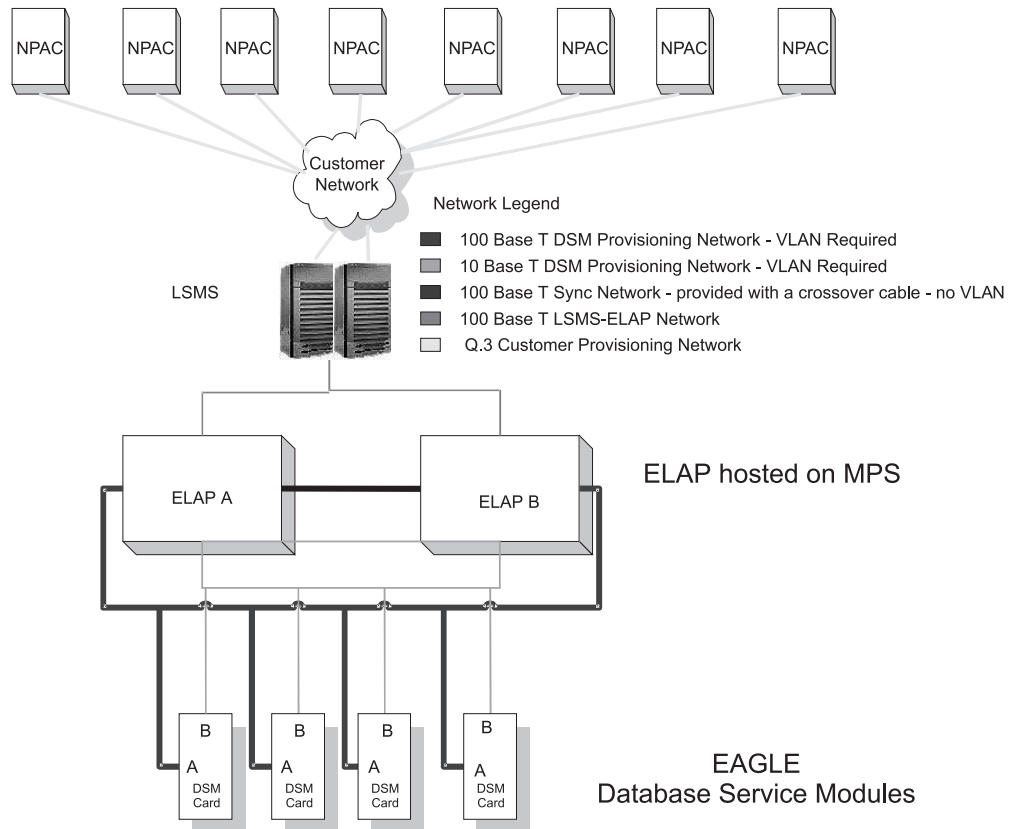
Functions

LSMS functions include:

- Receiving LNP data from NPAC SMS
- Distributing data to the EAGLE 5 ISS/LNP
- Administering internal service provider LNP data to support the final global title translation for various services (LIDB, CNAM, CLASS, ISVM, WSMSC)
- Storing NPAC LNP data and service provider LNP data on a persistent local database
- Supporting data audit function between NPAC SMS and LSMS; The audit is initiated by NPAC SMS
- Initiating audits and reconciliation between LSMS and the EAGLE 5 ISS LNP
- Supporting connection management for NPAC and EAGLE 5 ISS LNP communication
- Handling local failures, NPAC communication failures, and EAGLE 5 ISS LNP communication failures and recovery
- Event Logging
- Providing internal data security using one-way encrypted passwords
- Providing a secure interface to NPAC SMS using key list management
- Reporting event notifications and alarms

Figure 3-3 provides an overview of the hardware components needed to support LNP. ELAP servers transmit data from the EAGLE 5 ISS to LSMS servers. ELAP Servers use Tekelec’s Multi-purpose Server (MPS) platform.

Figure 3-3. LNP Hardware Overview



Tekelec’s LSMS operates on a MPS server system in an active and hot-standby configuration for high availability. Each Tekelec LSMS is configured with dual processors for fail-over conditions and shares a disk array capable of storing 96 million LNP data entries.

Theory of Operation

Normal updates are sent from the LSMS to the active EAGLE LNP Application Processor (ELAP) at a rate of 25 TNs per second over a connection that uses the proprietary High Speed Operations Protocol (HSOP) over TCP/IP protocol. The ELAP forwards the messages to all the DSMs using a IP multicast protocol (for more information, refer to the ELAP Administration Manual). No user action is required at the network element.

Integrated Data Acquisition

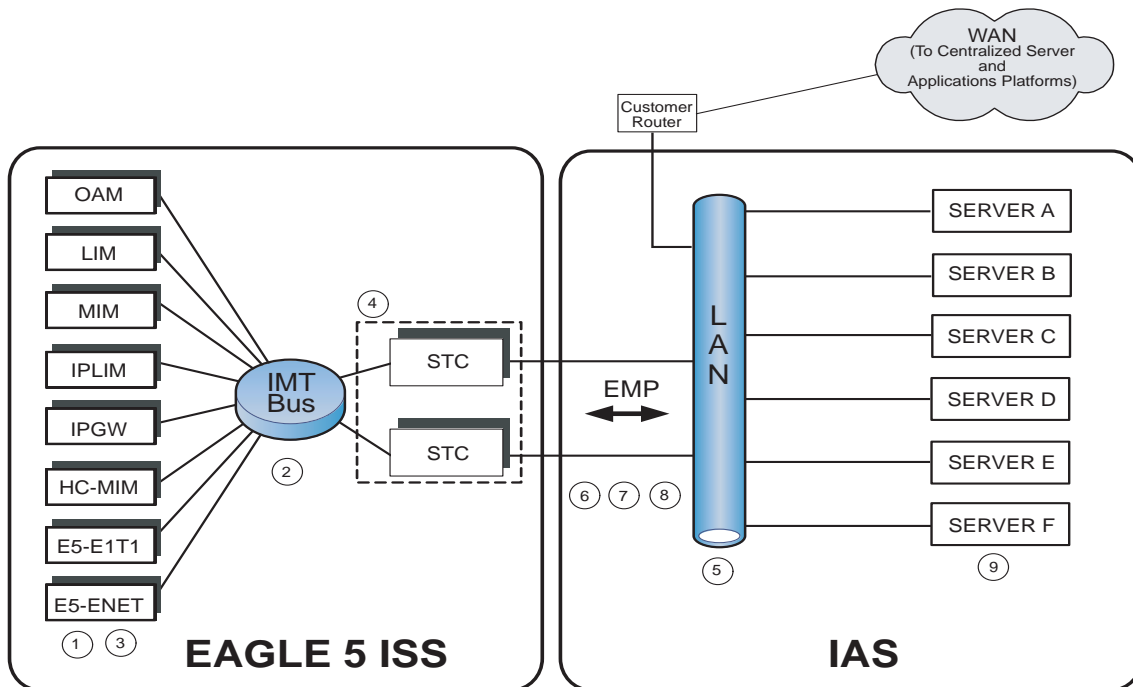
The EAGLE 5 ISS platform supports an integrated data acquisition interface to Tekelec's Integrated Applications System (IAS).

Integrated data acquisition enables data mining of signaling information sent to the EAGLE 5 ISS platform. The SS7 signaling information is from high speed links (IP or ATM) and low speed links connected to the EAGLE 5 ISS.

Integrated data acquisition enables Tekelec to provide an integrated monitoring system hosting business intelligence applications and mission-critical next-generation services for Performance Management and Revenue Assurance. For example, Integrated data acquisition supports business intelligence applications including fraud detection, billing verification analysis, quality of service, sophisticated trouble shooting, and network monitoring.

The following diagram represents the interfacing of EAGLE 5 ISS to the IAS. The following numbered paragraphs correspond to numbered areas of the diagram.

Figure 3-4. EAGLE-IAS interfacing.



NOTE: SSEDCEM and E5-ENET card types are supported.

1. Probeless Data Collection

Integrated data acquisition supports a powerful, probe-less data collection system by eliminating external taps. Integrated data acquisition eliminates the need for probes, significantly saving central office space. Any or all links on EAGLE LIMs can be selected for monitoring relieving the burden of applying taps and cable changes typically associated with probe based systems.

2. Intra/Inter Shelf Data Processing

Signaling Transport Cards (STCs) are allocated per EAGLE shelf to maximize the effectiveness of the integrated monitoring by capturing and sending signaling data intra-shelf. Where necessary, signaling data may be sent via the IMT to an STC inter-shelf. STCs are inserted into the EAGLE 5 ISS shelves, as additional link monitoring capacity is required.

3. Message Time Stamping

Accurate time stamping is done using the TSC sync functions of the TDM and the Network Timing Protocol (NTP) to provide a time stamp accuracy of +/- 5 ms. STCs NTP sync to the T1100 Application Servers which NTP synchronize to a network NTP server.

4. Transport Redundancy

Redundant STCs provides a scalable and reliable transport for sending captured signaling information to the IAS. STCs utilize the ticket voucher group (TVG) selection mechanism to grant data sending requests from EAGLE LIM cards that copy signaling information in real-time. The TVG provides load shared STCs when LIMs send captured signaling data to the IAS.

5. Redundant LAN

Monitoring support for integrated data acquisition is provided over a redundant LAN connection to the IAS. Each STC card has two Ethernet Ports for connecting to the Redundant LAN realized by Ethernet Switches in the IAS frame.

6. Monitoring Interface

The EAGLE integrated data acquisition is provided using the EAGLE Monitoring Protocol (EMP) over a reliable TCP/IP transport.

7. Automatic Provisioning Updates

Integrated data acquisition provides automatic updates to the IAS when new links are provisioned on the EAGLE 5 ISS. These recent changes are sent to the IAS through the EMP interface.

8. Alarm Event Reporting

Integrated data acquisition provides for alarm event sending to the IAS. EAGLE 5 ISS alarms associated with monitored links and status are sent to the monitoring system alarm management subsystem via the EMP interface.

9. Highly Reliable Servers

Integrated data acquisition is based on the highly reliable, carrier-grade EAGLE 5 ISS equipment that connects to T1100 Application Servers that store, process, filter, and forward signaling data to down stream correlation and application servers. TekServers provide mirrored drives for storage of captured signaling data.

Multi-purpose Server (MPS)

Tekelec's Multi-purpose Server (MPS) is a hardware and software platform that can be configured to support EAGLE Local Number Portability Application Processor (ELAP) or EAGLE Provisioning Application Processor (EPAP).

MPS on the Tekelec 1000 Application Server (T1000 AS) supports the EPAP. The EPAP application includes the INP, G-Flex, and G-Port®. In addition to the software application, additional third-party software may be required to support the application. For hardware information, see the *Tekelec 1000 Application Server Hardware Manual*.

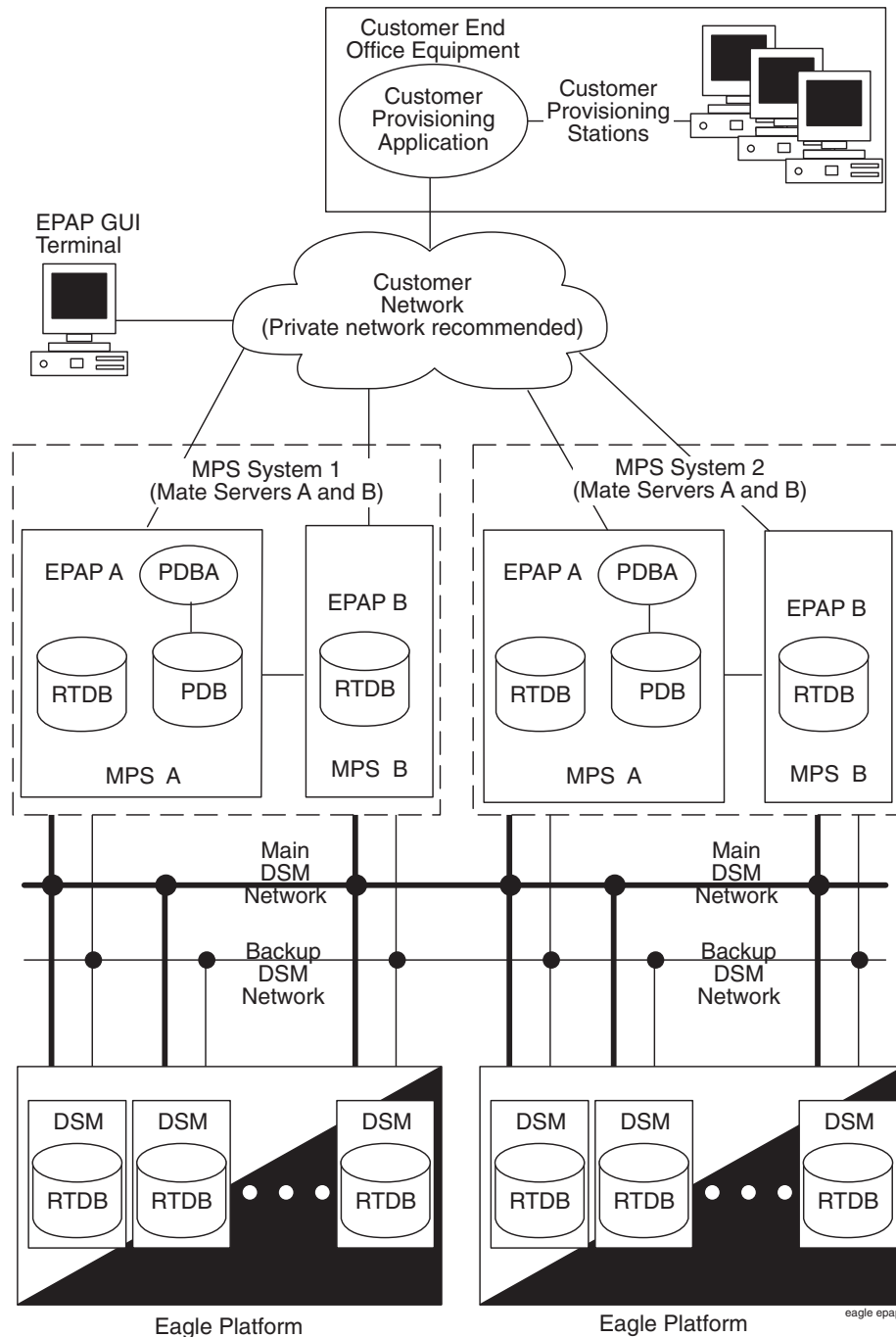
MPS on the Tekelec 1100 Application Server (T1100 AS) supports the ELAP. The ELAP application includes support for the Local Number Portability (LNP) 228 Million Numbers feature. For hardware information, see the *Tekelec 1100 Application Server Hardware Manual*.

This section provides an overview of the hardware and software that comprises the MPS on Tekelec 1000 Application Server. For information about the EPAP application and how it interacts with the EAGLE 5 ISS, refer to the *EPAP Administration Manual*. For information about the ELAP application and how it interacts with the EAGLE 5 ISS, refer to the *ELAP Administration Manual*.

Figure 3-5 on page 3-13 shows an overview of how the MPS on the T1000 AS is used with the EAGLE 5 ISS system.

The MPS provides an interface between the customer provisioning network and the EAGLE 5 ISS DSM cards. As the customer's data is updated, the MPS stores the data and updates the DSM cards. An MPS is usually co-located with an EAGLE 5 ISS.

Figure 3-5. MPS on T1000 AS/EAGLE 5 ISS Overview



Features

Currently, the MPS supports the following features:

- MPS running the EAGLE Provisioning Application Processor (EPAP) software supports the GSM Flexible Numbering (G-Flex), GSM Mobile Number Portability (G-Port), and INAP-based Number Portability (INP) features.

These features allow a subscriber to change location, service provider, or service while keeping the same directory number and ensures that subscribers receive the same freedom of choice for local service as they do with long-distance service providers.

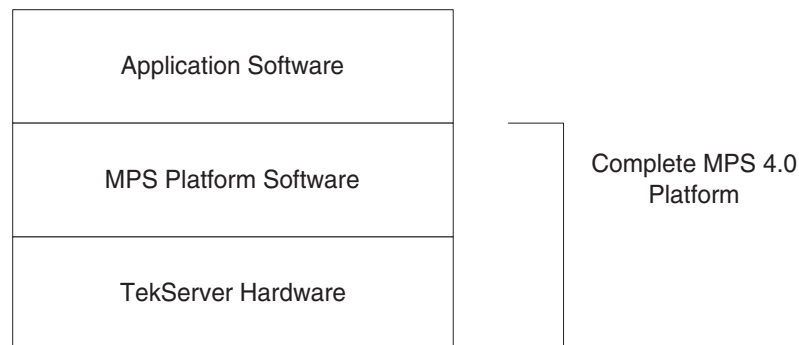
- MPS running the EAGLE LNP Application Processor (ELAP) software supports the LNP 228 Million Numbers Feature.

The Local Number Portability (LNP) 228 Million Numbers feature increases the number of provisionable telephone numbers (TNs) from 18 million to 48 million. The LNP 228 Million Numbers feature also relocates the LNP database from the OAM (Operation Administration and Maintenance) to the MPS.

Layered Design

MPS is based on the T1000 AS and uses a layered design (see Figures 3-1) with defined interfaces to enable application and platform changes to be made independently. This design provides an environment in which changes made to platform components need not cause changes in application.

Figure 3-1. Layered Design for MPS and Applications



Tekelec 1000 and Tekelec 1100 Application Server

The Tekelec 1000 and 1100 Application Servers (T1000 AS and T1100 AS) use a multi-processing architecture based on the latest and the most powerful Intel?? server-class processors, enabling operators to transition between legacy systems and next-generation networks. At the same time, the servers improve cost-revenue ratios for the deployment of new services by combining and provisioning multiple applications from the most efficient location in the network-the signal transfer point (STP). The T1000 AS and T1100 AS are fully integrated with Tekelec's EAGLE 5 Integrated Signaling System (ISS), providing the ability to implement and direct various network applications directly from the STP platform.

Key Benefits

The T1000 AS and T1100 AS provide an application hosting environment fully integrated with the Tekelec EAGLE 5 ISS. Some of the benefits of this architecture include:

- **Low latency, high-speed processing.** Processing time for enhanced services and applications is dramatically reduced as service-related signaling is efficiently routed directly to the server platform instead of across the network.
- **High-bandwidth connectivity.** A typical deployment of external databases or application platforms requires long-haul transport of signaling traffic over relatively slow 56 or 64 Kbps links. Network latency introduced by this transport delay has a direct effect on the utilization of network resources, which are tied up during the transaction. Full utilization of T1000 AS and T1100 AS processing power translates directly into cost savings as fewer applications platforms are required.
- **Reduced transport and maintenance costs.** The T1000 AS and T1100 AS are fully integrated with the Tekelec EAGLE 5 ISS, alleviating the need for transport links and the associated costs.
- **Application rich.** The T1000 AS and T1100 AS are high performance, server-class computing platforms designed to host powerful applications requiring high reliability and throughput.

Features and Capabilities

The EAGLE 5 ISS handles all of the signaling routing within the core network.

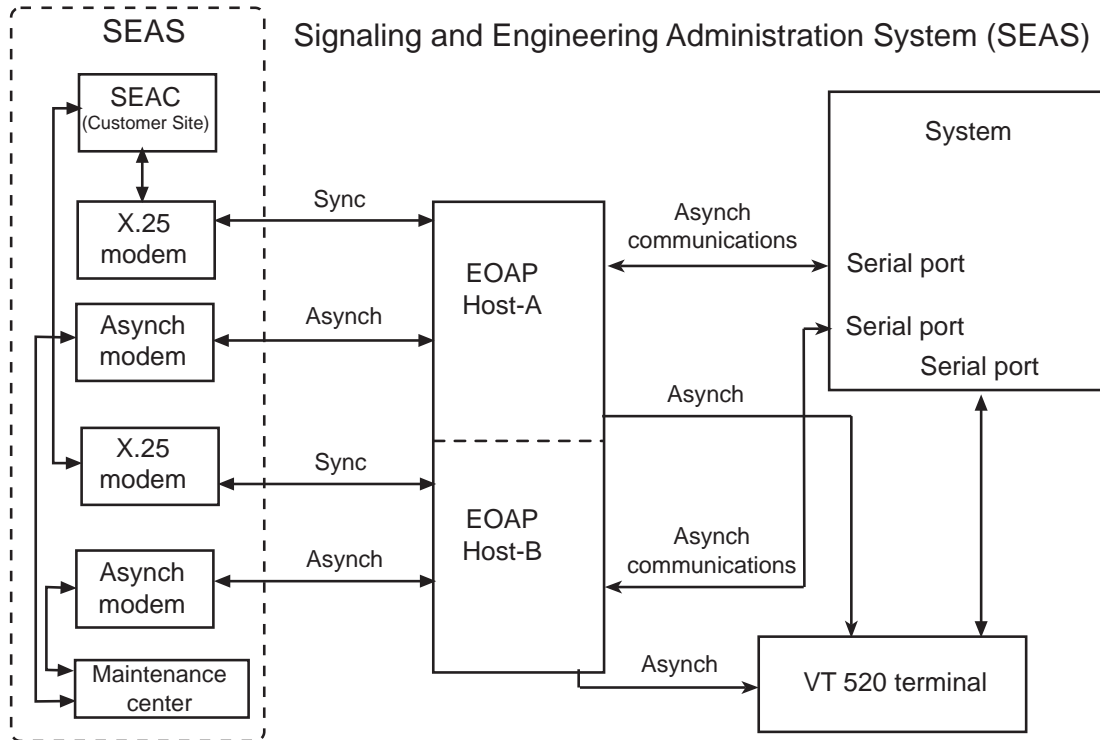
- The EAGLE 5 ISS can be upgraded with the T1000 AS and T1100 AS integrated application server capabilities at any time, without forklifts.
- Large memory space for complex applications and large databases: 32-bit (T1000 AS) and 64-bit (T1100 AS) architectures for hosting high-performance applications that require direct addressing of up to 16 GB of memory.
- The T1100 AS hosts a variety of Tekelec applications requiring large in-memory databases, including:
 - Local Service Management System (LSMS) to support number portability
 - Integrated Applications Solutions (IAS) - Traffic Management, Roaming Management, Fraud Management, Billing Management, Market Intelligence, Troubleshooting, etc.
 - Short Message Gateway (SMG)
 - SIP-SS7 Gateway
 - IMS solutions
- Protocol support: AIN, IN, INAP, CAMEL, WIN, SIP
- NEBS and ITU compliant

Embedded OSS Application Processor (EOAP)

The Embedded Operations Support System Application Processor (EOAP) is a general purpose interface module that provides the EAGLE 5 ISS system with a generic platform to develop and run software for feature-specific interfaces to the EAGLE 5 ISS. These interfaces, for example, include the optional Signaling and Engineering Administration System (SEAS).

The EOAP translates and converts higher layer protocols into asynchronous serial communication. It communicates with the EAGLE 5 ISS system through a serial interface port. For the SEAS interface, the EOAP provides translation and asynchronous-to-X.25 communication conversion. Refer to Figure 3-6.

Figure 3-6. EOAP Communication



Each EOAP reports to the EAGLE 5 ISS its general status as well as the status of its User Application Layer (UAL), X.25 links, PVCs on those links, and Q.3 associations. The EAGLE 5 ISS can then report the status of the EOAP and its components to the user through the EAGLE 5 ISS's HMI.

You can configure most aspects of the EOAP through the EAGLE 5 ISS terminal. For upgrade, debug, and maintenance functions, use a VT-520 terminal directly connected to the EOAP.

The EOAP is a modular unit with field-replaceable components. For upgrade purposes, the EOAP can replace an existing Texas Micro OAP.

The EOAP shelf is designed for a split system consisting of an EOAP-A and an EOAP-B. Each EOAP system in the dual configuration consists of a processor card, a serial interface card, a power supply card, a removable hard drive, and a removable CD-ROM drive.

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