Tekelec EAGLE® 5 Integrated Signaling System

Release 38.0

Systems Overview

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April 2008

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U.S. Patent Numbers:

5,732,213; 5,953,404; 6,115,746; 6,167,129; 6,324,183; 6,327,350; 6,456,845; 6,606,379; 6,639,981; 6,647,113; 6,662,017; 6,735,441; 6,745,041; 6,765,990; 6,795,546; 6,819,932; 6,836,477; 6,839,423; 6,885,872; 6,901,262; 6,914,973; 6,940,866; 6,944,184; 6,954,526;6,954,794; 6,959,076; 6,965,592; 6,967,956; 6,968,048; 6,970,542; 6,987,781; 6,987,849; 6,990,089; 6,990,347; 6,993,038; 7,002,988; 7,020,707; 7,031,340; 7,035,239; 7,035,387; 7,043,000; 7,043,001; 7,043,002; 7,046,667; 7,050,456; 7,050,562; 7,054,422; 7,068,773; 7,072,678; 7,075,331; 7,079,524; 7,088,728; 7,092,505; 7,108,468; 7,110,780; 7,113,581; 7,113,781; 7,117,411; 7,123,710; 7,127,057; 7,133,420; 7,136,477; 7,139,388; 7,145,875; 7,146,181; 7,155,206; 7,155,243; 7,155,505; 7,155,512; 7,181,194; 7,190,702; 7,190,772; 7,190,959; 7,197,036; 7,206,394; 7,215,748; 7,219,264; 7,222,192; 7,227,927; 7,231,024; 7,242,695; 7,254,391

Foreign Patent Numbers:

EP1062792; EP1308054; EP1247378; EP1303994; EP1252788; EP1161819; EP1177660; EP1169829; EP1135905; EP1364520; EP1192758; EP1240772; EP1173969; CA2352246

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Introduction

Scope

This manual provides customers and system planners with a basic understanding of Tekelec Signaling systems and subsystems. This high-level overview describes how the EAGLE 5 Integrated Signaling System (EAGLE 5 ISS) works with those systems in a network. The descriptions include 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.

Related Publications

For information about additional publications that are related to this document, refer to the *Related Publications* document. The *Related Publications* document is published as a part of the *Release Documentation* and is also published as a separate document on the Tekelec Customer Support Site.

Documentation Availability, Packaging, and Updates

Tekelec provides documentation with each system and in accordance with contractual agreements. For General Availability (GA) releases, Tekelec publishes a complete EAGLE 5 ISS documentation set. For Limited Availability (LA) releases, Tekelec may publish a documentation subset tailored to specific feature content or hardware requirements. Documentation Bulletins announce a new or updated release.

The Tekelec EAGLE 5 ISS documentation set is released on a CD-ROM. This format allows for easy searches through all parts of the documentation set.

The electronic file of each manual is also available from the Tekelec Customer Support site. This site allows for 24-hour access to the most up-to-date documentation.

Printed documentation is available for GA releases on request only and with a lead time of four weeks. The printed documentation set includes pocket guides for commands and alarms. Pocket guides may also be ordered as a set or individually. Exceptions to printed documentation are:

- Hardware or Installation manuals are printed only without the linked attachments found in the electronic version of the manuals.
- The Release Notice is available only on the Customer Support site.

NOTE: Customers may print a reasonable number of each manual for their own use.

Documentation is updated when significant changes are made that affect system operation. Updates resulting from Severity 1 and 2 PRs are made to existing manuals. Other changes are included in the documentation for the next scheduled release. Updates are made by re-issuing an electronic file to the customer support site. Customers with printed documentation should contact their Sales Representative for an addendum. Occasionally, changes are communicated first with a Documentation Bulletin to provide customers with an advanced notice of the issue until officially released in the documentation. Documentation bulletins are posted on the Customer Support site and can be viewed per product and release.

Content changes are indicated with change bars, the revision of the manual part number is incremented, and the month of publication is updated.

Documentation Admonishments

Admonishments are icons and text throughout this manual that alert the reader to assure personal safety, to minimize possible service interruptions, and to warn of the potential for equipment damage.

	**DANGER**: (This icon and text indicate the possibility of *personal injury*.)
	**WARNING**: (This icon and text indicate the possibility of *equipment damage*.)
	**CAUTION**: (This icon and text indicate the possibility of *service interruption*.)

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- Tekelec, USA

  Phone:

  +1 888 367 8552 (US and Canada only)

  +1 919 460 2150 (international)

  Email: *support@tekelec.com*

- Tekelec, Europe

  Phone: +44 1784 467804

  Email:*ecsc@tekelec.com*

When a call is received, a Customer Service Report (CSR) is issued to record the request for service. Each CSR includes an individual tracking number.

After a CSR is issued, the Customer Care Center determines the classification of the trouble. If a critical problem exists, emergency procedures are initiated. If the problem is not critical, information regarding the serial number of the system, COMMON Language Location Identifier (CLLI), initial problem symptoms (includes outputs and messages) is recorded. A primary Customer Care Center engineer is also assigned to work on the CSR and provide a solution to the problem. The CSR is closed when the problem is resolved.

Emergency Response

In the event of a critical service situation, emergency response is offered by the Tekelec Customer Care Center 24 hours a day, 7 days a week. The emergency response provides immediate coverage, automatic escalation, and other features to ensure that the critical situation is resolved as rapidly as possible.

A critical situation is defined as a problem with an EAGLE 5 ISS that severely affects service, traffic, or maintenance capabilities, and requires immediate corrective action. Critical problems affect service and/or system operation resulting in:

- A total system failure that results in loss of all transaction processing capability
- Significant reduction in system capacity or traffic handling capability
- Loss of the system's ability to perform automatic system reconfiguration
- Inability to restart a processor or the system
- Corruption of system databases that requires service affecting corrective actions
- Loss of access for maintenance or recovery operations
- Loss of the system ability to provide any required critical or major trouble notification

Any other problem severely affecting service, capacity/traffic, billing, and maintenance capabilities may be defined as critical by prior discussion and agreement with the Tekelec Customer Care Center.

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1. Log in with your user name and password. (Click on "Need an Account?" if you need to register).
2. Select EAGLE from the Product Support menu.
3. Select the release number from the Release menu.
4. Locate the Notices section to view the latest Feature Notice.
5. Locate the Manuals section to view all manuals applicable to this release.

   The documentation is listed in alphabetical order by the manual name. Only the first three manuals display. Click **more…** to see the remaining manuals.
6. Locate the latest revision of the manual name.

   Confirm the release number and last available revision.

   Select the 936-xxxx-x01 part number to download the complete documentation set with all linked files.

   NOTE: The electronic file for this part number is quite large.
7. To view a manual, double-click the manual name.
8. To download a manual, right-click and select Save Target As.

   NOTE: Customers may print a reasonable number of each manual for their own use.

2

SS7 Networks

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

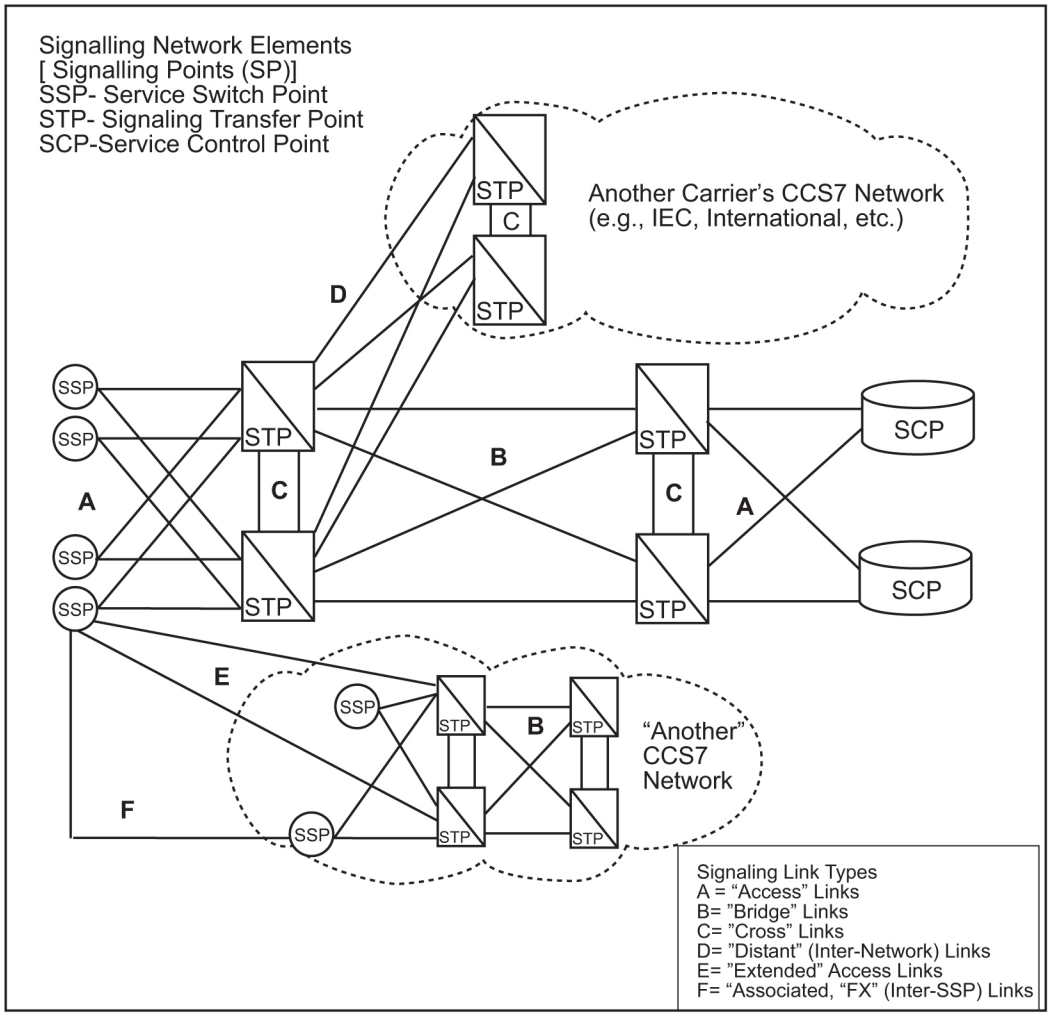


Figure 2-1 shows the three principal network elements of SS7 common channel signaling networks, interconnected by the six standard types of signaling links currently in use. Signaling links are data transmission links that ordinarily operate on digital carrier facilities at 56,000 bits per second in 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 (MTP and SCCP) of the SS7 protocol. The MTP 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 SCCP signaling connection control part to translate addresses (Global Titles) from signaling messages that *do not contain* explicit information allowing the message transfer part MTP to route the message. For example, an STP translates a dialed “1+800” number to an SCP's DPC destination point code for message transfer part MTP 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 SCCP signaling connection control parts management takes responsibility for rerouting signaling traffic, based on information received via the message transfer part MTP 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-fink." 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 via a C-link only in cases of 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

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
- Embedded OSS Applications 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/E1ATM 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 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

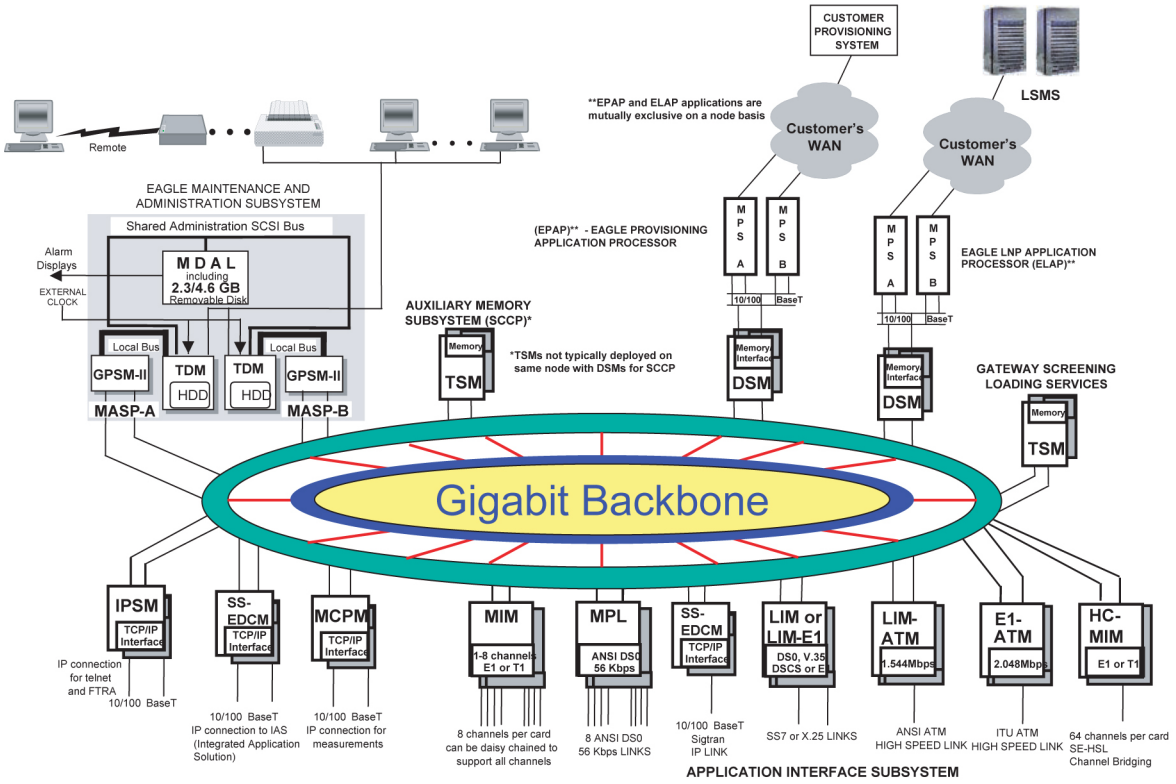
The EAGLE 5 ISS implements SS7 MTP function, level 2 and level 3, through software contained entirely within the Link Interface Modules (LIMs). No separate central processing unit exists within the EAGLE 5 ISS. All message processing logic, including the links, link sets, and routes associated with each 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

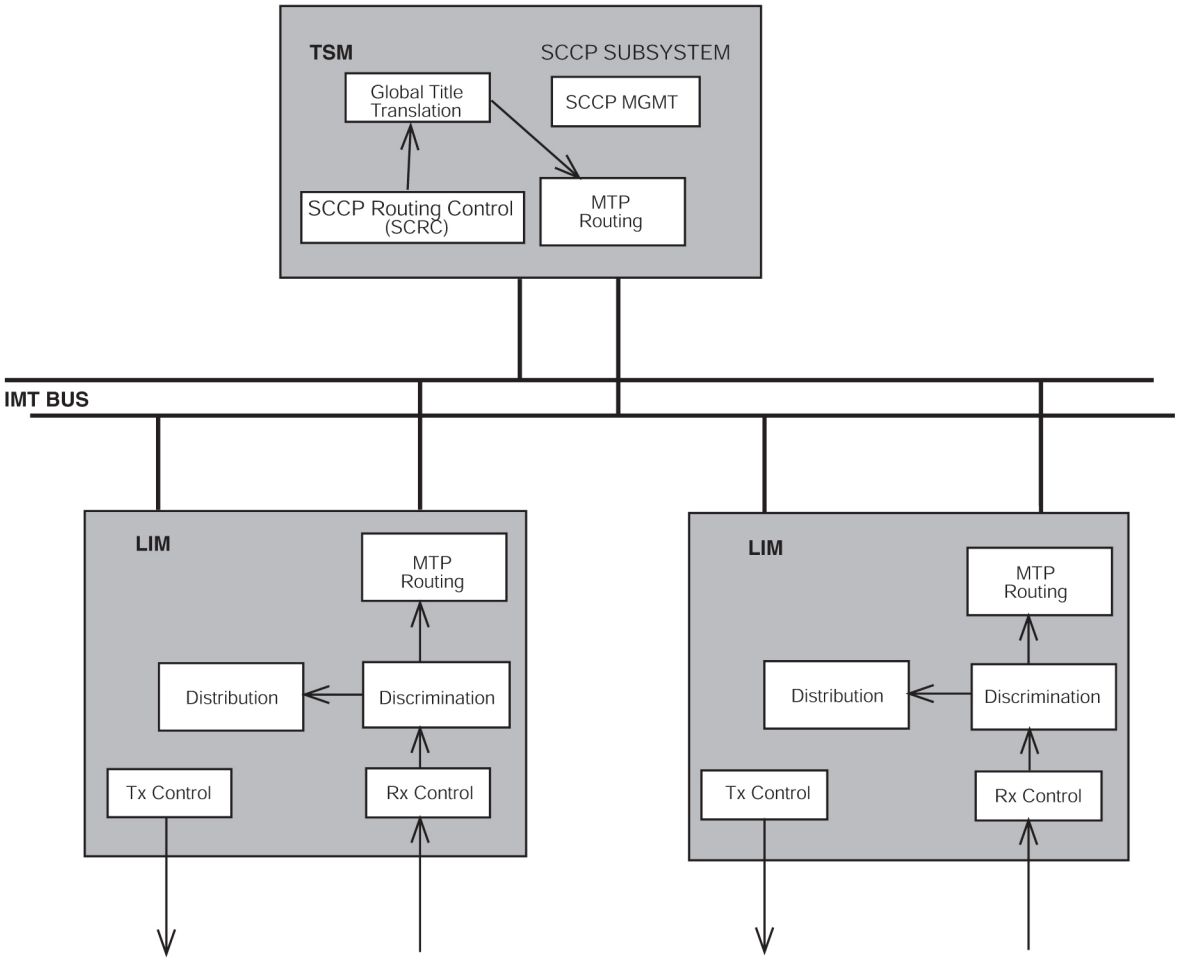


The following illustrates incoming messages that are routed through an EAGLE 5 ISS. If gateway screening is activated, the messages are screened before they are examined for further processing. The message discrimination function determines whether the message can be routed based solely on the MTP routing 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

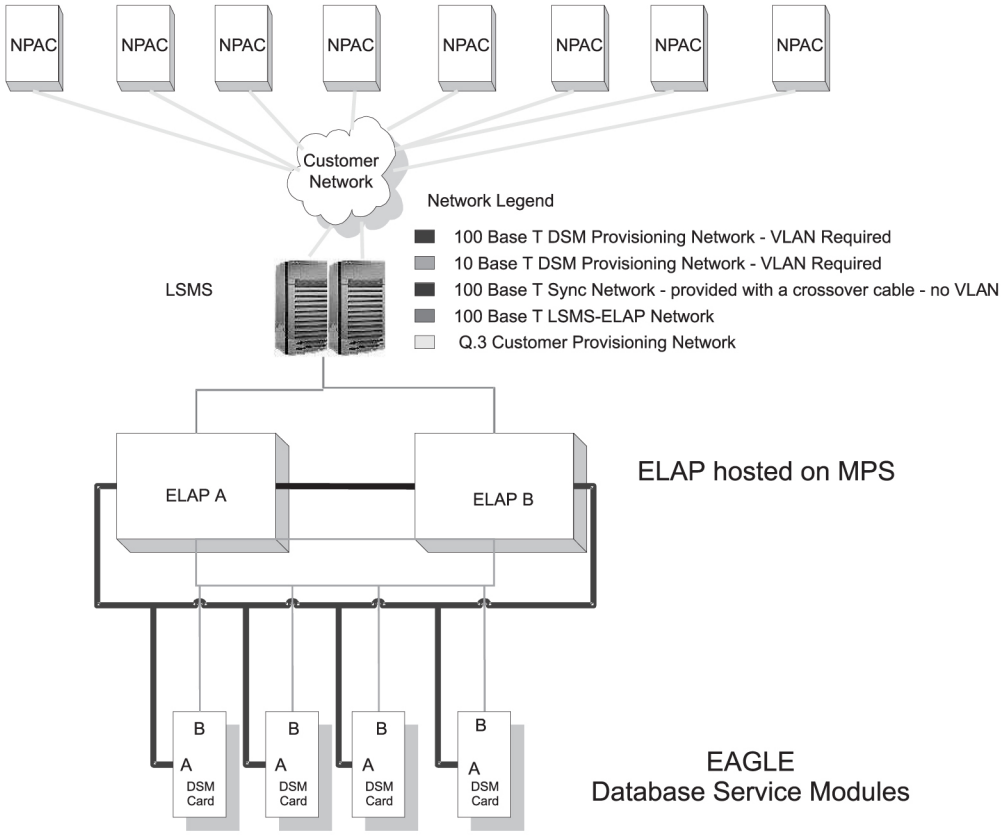
LSMS functions include:

- Receiving LNP data from NPACSMS
- 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 NPACLNP data and service provider LNP data on a persistent local database
- Supporting data audit function between NPACSMS and LSMS; The audit is initiated by NPACSMS
- Initiating audits and reconciliation between LSMS and the EAGLE 5 ISSLNP
- Supporting connection management for NPAC and EAGLE 5 ISSLNP communication
- Handling local failures, NPAC communication failures, and EAGLE 5 ISSLNP communication failures and recovery
- Event Logging
- Providing internal data security using one-way encrypted passwords

- Providing a secure interface to NPACSMS 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 an 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 EAGLELNP 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 DSM cards using an IP multicast protocol (for more information, refer to the *ELAP Administration Manual*). No user action is required at the network element.

Integrated Data Acquisition

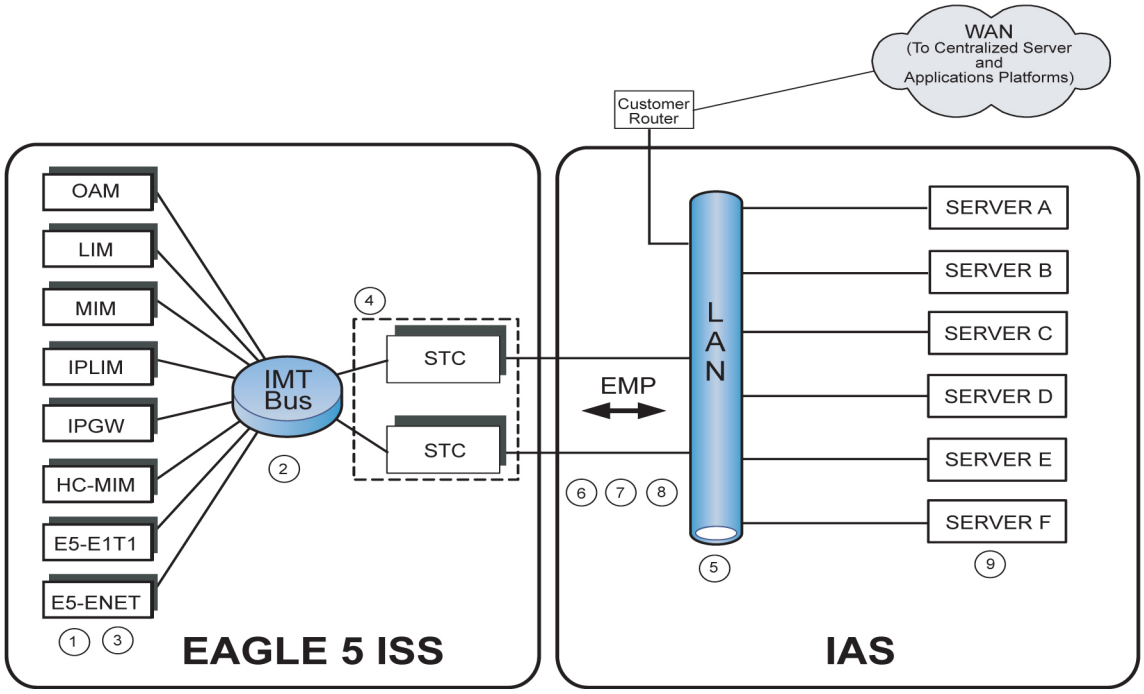
The EAGLE 5 ISS platform supports an integrated data acquisition interface to Tekelec's Integrated Applications System (IAS).

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: SSEDCM 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 EAGLELIMs 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. STCsNTP sync to the T1100 Application Servers, which NTP synchronize to a network NTP server.

4. **Transport Redundancy**

   Redundant STCs provide 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 EAGLELIM 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 downstream 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*.

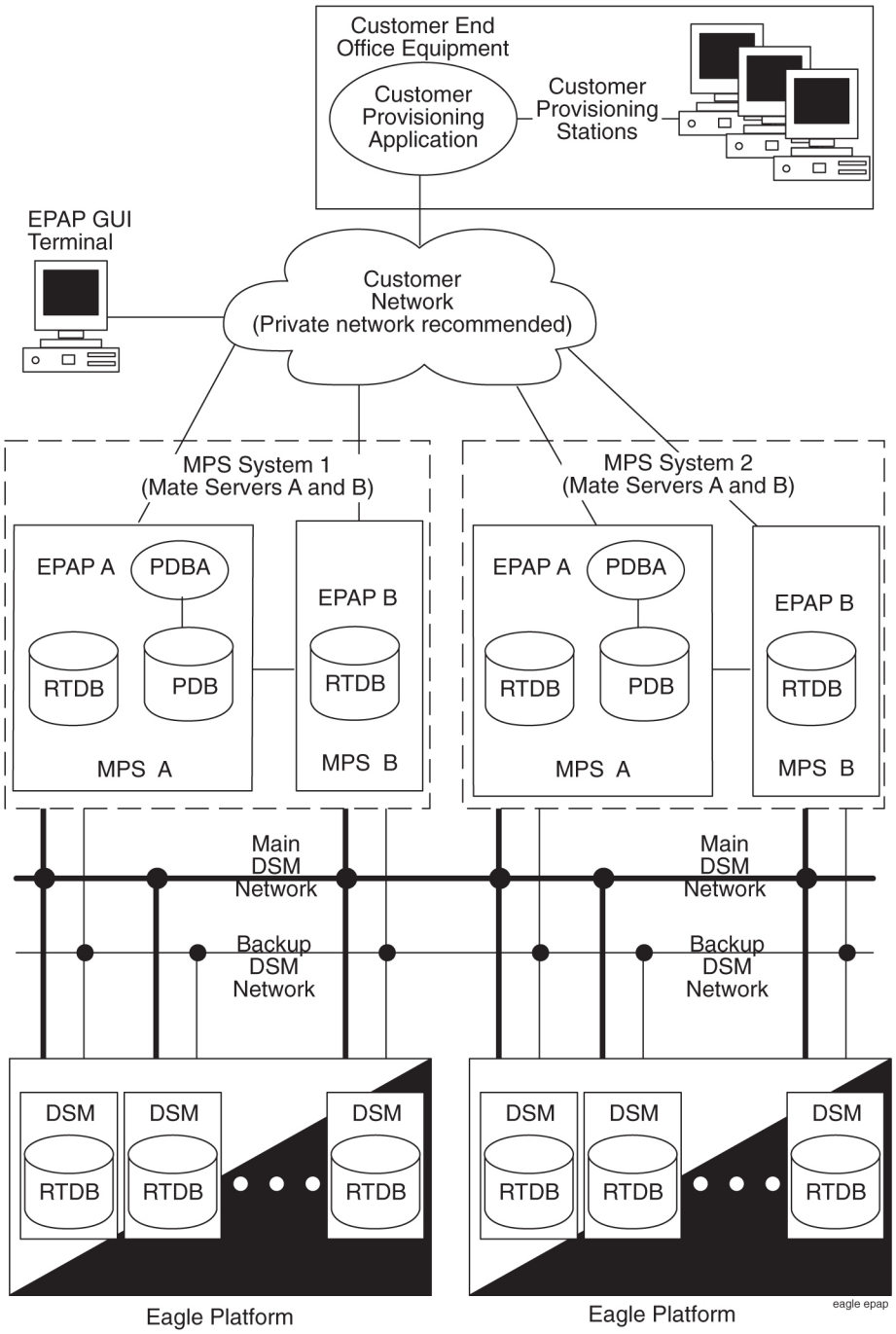
MPS on the Tekelec 1100 Application Server (T1100 AS) supports the ELAP. The ELAP application includes support for the Local Number Portability (LNP) 228 Million Numbers feature. For hardware information, see the *Tekelec 1100 Application Server Hardware Manual*.

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 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.

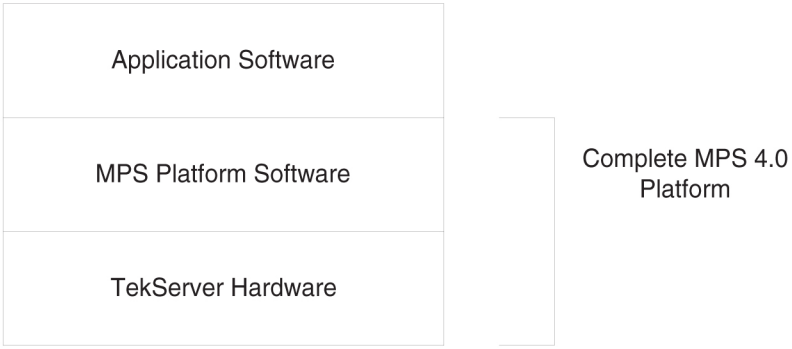
- MPS running the EAGLE LNP Application Processor (ELAP) software supports the LNP 228 Million Numbers Feature.

  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 **Figure 3-6**) 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 3-6. 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

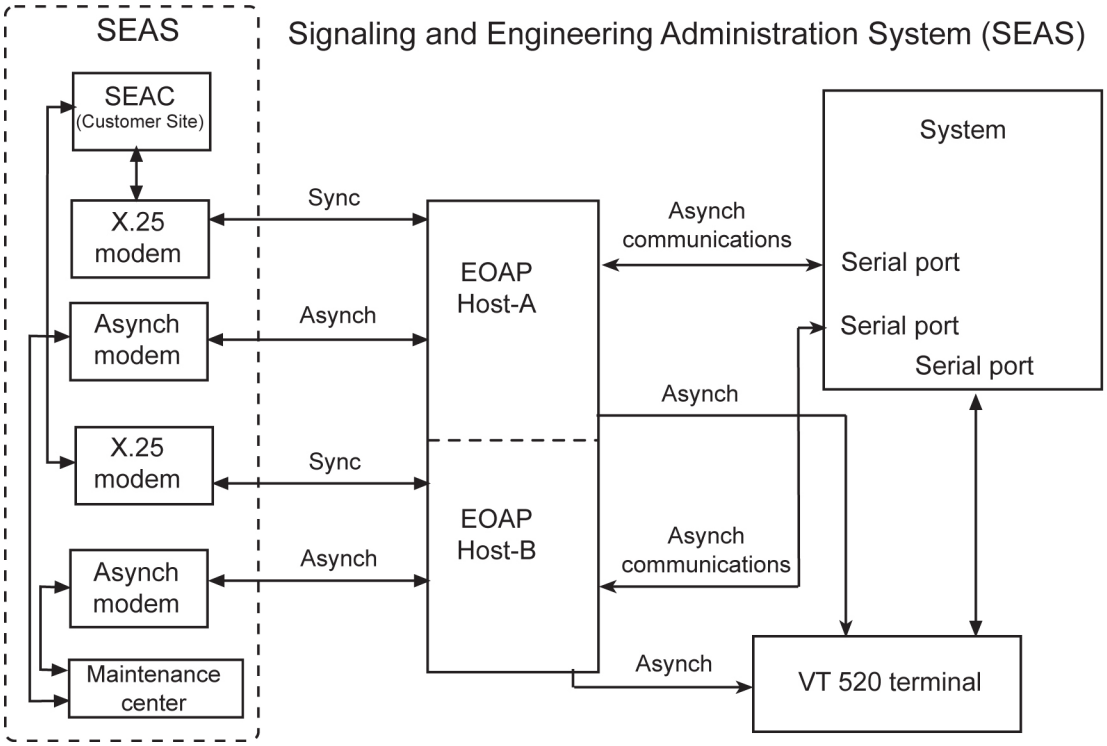
Embedded OSS Application Processor (EOAP)

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 3-7** .

Figure 3-7. 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.

Glossary

A

AIN	Advanced Intelligent Network
AOPS	Area of Portability Service
AS	Application Server
Association	An association refers to an SCTP association. The association provides the transport for protocol data units and adaptation layer peer messages.
ATM	Asynchronous Transfer Mode
ATM HSL	Asynchronous Transfer Mode High Speed Link
ATM HSL	ATM High Speed Link (a DS1 link in EAGLE)

C

CCS6	Common Channel Signaling System #6
CD	Carrier Detect
CD	Compact Disk
CLASS	Custom Local Area Signaling Service
CLASS	Custom Local Area Subscriber Services
CLLI	Common Language Location Identifier
CNAM	Calling Name Delivery Service
CP	Call Processing
CP	Communications Processor
CSR	Customer Service Request

D

DPC	Destination Point Code The point code of the signaling point to which the MSU is routed. This point code can be adjacent to the EAGLE 5 ISS, but does not have to be.
DS0A	Digital Signal Level - 0
DSM	Database Service Module.

E

E1	The European equivalent of T1 that transmits digital data over a telephone network at 2.048 Mbps.
E5-ENET	EPM-based Ethernet card A high capacity single-slot IP signaling card (EPM card plus Gig Ethernet PMC cards).
ECSA	Exchange Carrier Standards Association
ELAP	EAGLE LNP Application Processor
EMP	EAGLE Monitoring Protocol

EMS	Element Management System A system used to provide a top level management view of the network elements.
EOAP	Embedded Operation Support System Applications Processor Also, Enhanced OSS Application Process.
EPAP	EAGLE Provisioning Application Processor
ESP	Expanded Services Platform

G

GB	Gigabyte — 1,073,741,824 bytes
G-Flex	GSM Flexible numbering A feature that allows the operator to flexibly assign individual subscribers to HLRs and route signaling messages, based on subscriber numbering, accordingly.
GLS	Generic Loading Services An application that is used by the TSM cards for downloading gateway screening to LIM cards.
GPL	Generic Program Load
G-Port	GSM Mobile Number Portability A feature that provides mobile subscribers the ability to change the GSM subscription network within a portability cluster, while retaining their original MSISDN(s).
GSM	Global System for Mobile Communications
GTT	Global Title Translation.

H

HMI	Human-to-Machine Interface
HSL	High-Speed Links
HSOP	High Speed Operation Protocol

I

IMT	Inter-Module-Transport The communication software that operates the inter-module-transport bus on all cards except the LIMATM, DCM, DSM, and HMUX.
IN	Intelligent Network
INAP	Intelligent Network Application Protocol
INP	INAP-based Number Portability
INP	Intelligent Network (IN) Portability
INP	INAP-based Number Portability
Integrated Services Digital Network	The network services that provide end-to-end digital connections to which users have access to a wide range of services through a limited set of standard user to network interfaces.
IP	Intelligent Peripheral
IP	Internet Protocol
IP^7	Tekelec's Internet Protocol to SS7 Interface
ISS	Integrated Signaling System
ISUP	ISDN User Part

ITU	International Telecommunications Union

L

LAN	Local Area Network See also STP LAN.
LIDB	Line Information Database
LIM	Link Interface Module
Link	Signaling Link
LNP	Local Number Portability
LSMS	Local Service Management System

M

MAS	Maintenance and Administration Subsystem A set of cards located in the Control Shelf, used to provide a central management point for the EAGLE 5 ISS. The MAS provides user interface, maintenance communication, peripheral services, alarm processing, system disk interface, and measurements using the following three subassemblies: GPSM-II, TDM, and MDAL.
MASP	Maintenance and Administration Subsystem Processor
MDAL	Maintenance Disk and Alarm Card
MPS	Multi-Purpose Server
MSC	Mobile Switching Center
MSU	Message Signaling Unit
MTP	Message Transfer Part
MTP	Module Test Plan

N

NEBS	Network Equipment Building Systems
NPA	Number Plan Area.
NPAC	Number Portability Administration Center
NTP	Network Time Protocol

O

OAM	Operations, Administration, and Maintenance
OAP	The application running on the OAP used for the SEAS and LNP features. The LNP feature can be enabled only for a quantity of 2 to 12 million numbers. This GPL does not support 24-bit ITU-N point codes. See also Operations Support System Application Processor.
OCU	Office Channel Unit
OPC	Originating Point Code
OSI	Open System Interconnection

R

ROM	Read Only Memory

S

SCCP	Signaling Connection Control Part
SCCS	Switching Control Center System
SCN	Switched Circuit Network
SCP	Service Control Point.
SCSI	Small Computer System Interface
SCSI bus	Small Computer System Interface bus
SEAS	Signaling Engineering and Administration System
	An interface defined by Bellcore and used by the Regional Bell Operating Companies (RBOCs), as well as other Bellcore Client Companies (BCCs), to remotely administer and monitor the signaling points in their network from a central location.
SIP	Session Initiation Protocol
SMG	Short Message Gateway
SMS	Short Message Service
SS7	Signaling System #7
SSEDCM	Single Slot Enhanced Data Communications Module
SSN	Subsystem Number
SSN	SS7 Subsystem Number
SSP	Subsystem Prohibited network management message.
	Subsystem Prohibited SCCP (SCMG) management message. (CER) Service Switching Point (SS7 Network)
STC	Sentinel Transport Card
STC	Signaling Transport Card.
STP	Signal Transfer Point.

T

T1	Transmission Level 1
	A T1 interface terminates or distributes T1 facility signals for the purpose of processing the SS7 signaling links carried by the E1 carrier. A leased-line connection capable of carrying data at 1,544,000 bits-per-second.
TCAP	Transaction Capabilities Application Part
TCP/IP	Transmission Control Protocol/Internet Protocol
TDM	Terminal Disk Module.
TPS	Transactions Per Second
TS	Test Strategy
TSC	Time Slot Counter
TS	Traffic Server
TSC	Time Slot Counter Synchronization
TVG	Group Ticket Voucher

U

UAL	User Application Layer

V

V.35	ITU Interface Recommendation, V.35 The interface used with the LIMV35 card.

W

WSMSC	Wireless Short Message Service Center

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