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Network Signaling Group

Dimensioning Guide for EPAP Advanced DB Features

EAGLE 5 ISS 37.5 and later

CHANGE HISTORY

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1 INTRODUCTION

1.1 REFERENCES

1. *EAGLE® 5 ISS Feature Guide*, 910-1225-01, Rev I, Tekelec, December 2003.
2. *EAGLE® 5 ISS Planning Guide*, 908-0124-01, Rev K, Tekelec, December 2003.
3. *EIR on MPS/EPAP Technical Reference*, TR005450, Rev 2.1, September 2003.
4. *ELAP/EPAP UI 2.0 for EAGLE 28.0 Technical Reference,* TR005112, Rev 2.0, January 2003.
5. *EPAP Provisioning Database Interface Technical Reference,* TR003029, Rev 2.7, April 2004.

1.2 ACRONYMS

ANSI-41	American National Standards Institute 41
DN	Directory Number
DSM	Database Services Module
EIR	Equipment Identity Register
EPAP DB	EPAP Advanced Database features
EPAP	EAGLE Provisioning and Application Processor
GB	Gigbyte
G-Flex	Global Flexible numbering
G-Port	GSM mobile number Portability
GSM	Global System for Mobile communication
HLR	Home Location Register
IMEI	International Mobile Equipment Identity
IMSI	International Mobile Subscriber Identity
INAP	Intelligent Network Application Part
INP	INAP-based Number Portability
IS-41	Interim Standard 41 (same as ANSI-41)
ISDN	Integrated Services Digital Network
ISS	Integrated Signaling System
ITU	International Telecommunications Union
MDN	Mobile Directory Number
MIN	Mobile Identification Number
MNP	Mobile Number Portability
MPS	Multi-Purpose Server
MSISDN	Mobile Station ISDN number
PDB	Provisioning Database
PDBI	Provisioning Database Interface
RTDB	Real Time Database
vHLR	Virtual HLR

1.3 PURPOSE

The purpose of this document is to provide planning and dimensioning information to aid Tekelec personnel and EAGLE customers in the sale, planning, implementation, deployment and upgrade of EAGLE 5 ISS systems which are equipped with one of the EAGLE's EPAP Advanced Database Features. As of EAGLE Release 37.5, these features include:

- G-Port Mobile Number Portability (G-Port MNP)
- G-Flex Virtual HLR (G-Flex vHLR)
- GSM Equipment Identity Register (EIR)
- INAP-based Number Portability (INP)
- IS-41 to GSM Migration (GSM Migration)
- A-Port Mobile Number Portability (A-Port MNP)
- AIN NPReq Number Portability (AINPQ)
- G-Port SRI Query
- IDP Prepaid Query Relay (IDPR)

All of the EPAP DB features utilize the same EAGLE+MPS architecture for the purposes of provisioning data and for message processing. For the purposes of background information, some brief details on the system architecture are included in Section 2 below.

All EPAP DB features include a common set of static components that are always included for any installation. In addition, the EPAP DB features include a variable set of components based on the number of database entries purchased and the number of transactions per second purchased. See Section 2 for details.

This document is intended to complement, but not replace, the EAGLE 5 ISS Planning and Feature Guides, Refs [1] and [2].

1.4 DOCUMENT ORGANIZATION

Section 1 of this document is administrative in nature.

Section 2 of this document is introductory in nature and provides background technical information which helps to explain the reasoning behind the dimensioning rules for the EPAP DB features.

Section 3 of this document contains the commercial dimensioning rules for configuration of an EAGLE 5 ISS system with EPAP DB features. These rules are to be used for all quotations for new installations and for quotations to increase the database capacity of existing installations.

Section 4 of this document includes an interactive tool which allows the user to enter different configurations of feature sets and database number entries and provides detailed statistics regarding the memory space used and the memory space allocated for each configuration. This tool is for informational purposes only, and is not used to derive the commercial dimensioning guidelines for these features. The commercial guidelines are per Section 3.

2 TECHNICAL BACKGROUND

This section provides a high level technical overview of the provisioning side of the EAGLE 5 ISS system when equipped with one of the EPAP DB features. This background is intended to familiarize the reader with some of the concerns that should be considered when dimensioning such a system and the technical reasoning for those concerns.

2.1 EAGLE+MPS SYSTEM OVERVIEW

This is a brief overview of the EAGLE+MPS system used for provisioning and message processing of the EPAP DB features, and is not intended to give an in depth explanation of the EAGLE 5 ISS or the MPS system.

Figure 1 shows a block diagram of the EAGLE+MPS platform. The diagram shows a mated pair of EAGLE 5 ISSs, each with an MPS (Multi Purpose Server). The EAGLE 5 ISS handles all SS7 message processing functionality, while the MPS is responsible for receiving database updates from the customer's IP provisioning network, storing those updates for redundancy, and passing those updates to the EAGLE 5 ISS's SCCP handler cards (Service Modules, or SMs) for SS7 message processing. There are two types of SMs used for EPAP DB features – the Database Service Module (DSM) and the E5-Service Module (E5-SM4G or E5SM). The large red-shaded cube represents the EAGLE 5 ISS proper. The entities shown above (EPAP A and EPAP B) represent the MPS platform attached to the EAGLE 5 ISS.

An MPS system consists of two TekServers (each running the EPAP application) and associated hardware (circuit breakers, Ethernet hub, etc.). Each EAGLE 5 ISS in a mated pair has one MPS system attached. The two MPS systems are referred to as a mated MPS system. Within one MPS system (i.e. the MPS system for one EAGLE 5 ISS), the two TekServer EPAPs would be considered mated EPAPs and would be referred to as an EPAP A and EPAP B.

The EPAP (EAGLE 5 ISS Provisioning and Application Processor) application includes the software application needed for provisioning of the EPAP databases and the EAGLE 5 ISS's SM SS7 processing cards. This software is referred to as the PDBA (Provisioning Database Application). The EPAP houses two kind of databases, including the PDB (Provisioning Database) and RTDB (Real Time Database). The PDB is the human-readable "golden copy" of the customer provisioned data. This is the database which is directly updated by the customer's provisioning systems. The RTDB is a binary version of the PDB which is generated by the PDBA application and is optimized for performance. This is the format of the data which is replicated on the EAGLE 5 ISS's SM cards for use in SS7 message processing.

EPAP A and EPAP B are slightly different in their configuration. EPAP A holds a copy of both the PDB and the RTDB. EPAP B contains a redundant copy of the RTDB, but does not contain a copy of the PDB. This architecture is duplicated on the mated MPS system on the mated EAGLE 5 ISS. Thus, within a single mated pair of EAGLE 5 ISSs, there are two redundant copies of the PDB version of the data, and four redundant copies of the RTDB version of the data. This does not include the copies of the RTDB which are resident on the SM cards. Each SM card in the EAGLE 5 ISS holds a copy of the RTDB in its entirety. The EPAP is connected to the SM cards via a 10/100 base T Ethernet for downloading of the RTDB to the SM cards.

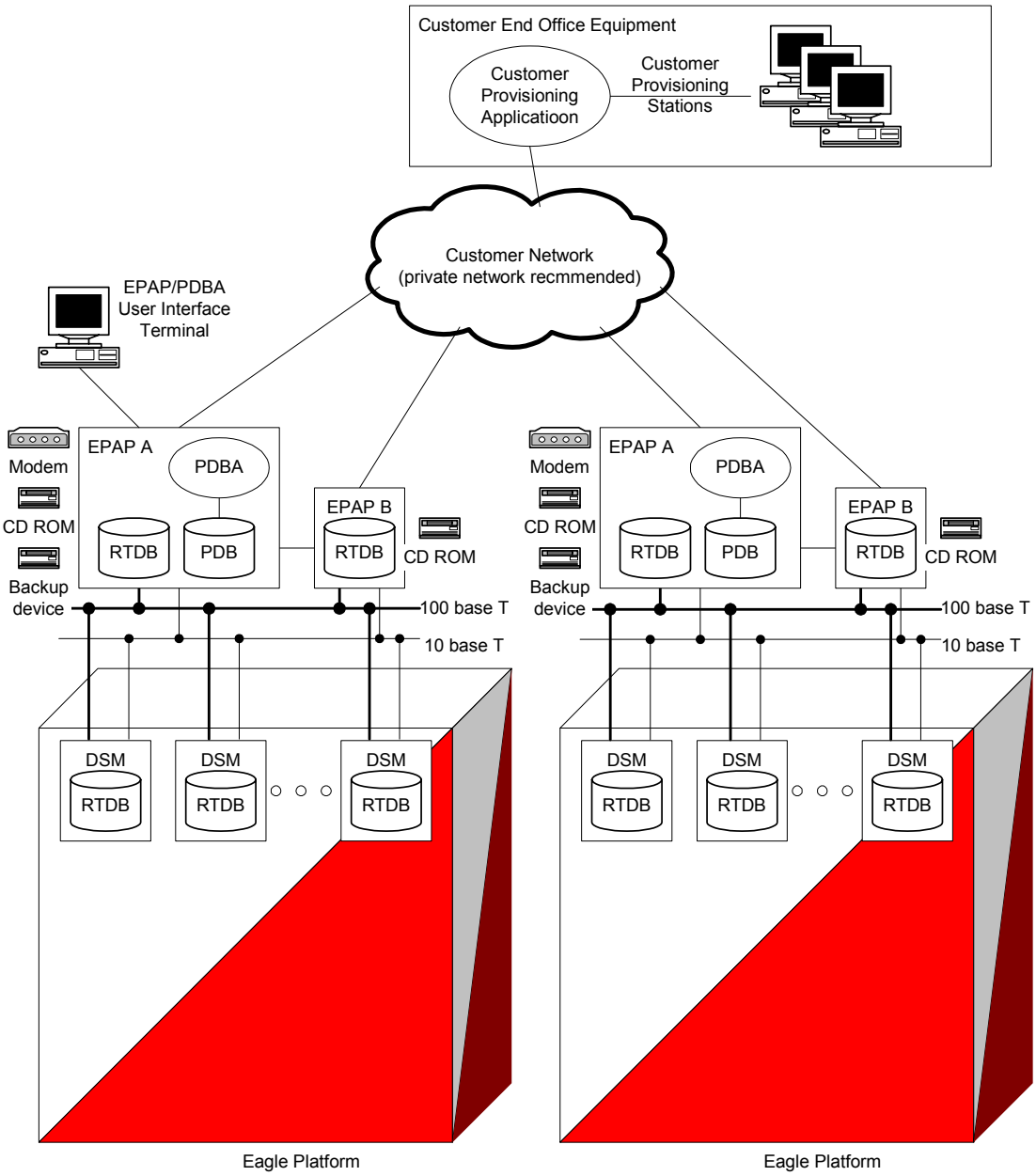

Figure 1: EAGLE 5 ISS/MPS System Architecture

2.2 PROVISIONING FLOW OVERVIEW

This section offers an overview of the provisioning flow process, which is relevant to the subject of this document in that this mechanism has a bearing on the dimensioning of the hardware in the EAGLE 5 ISS systems for EPAP DB features. Again, this is a high level overview and is not intended to be an in depth explanation of all aspects of the EPAP provisioning process. See Ref [5] for more details regarding the EPAP process.

Referring again to Figure 1, the two EPAPs on the mated sites are in an active/standby relationship such that the customer provisioning system only needs to update one of the sites, and the PDBA application on the active EPAP automatically replicates the data to the standby EPAP on the mated site. (The EAGLE 5 ISS system currently supports automatic replication for up to 8 EAGLE 5 ISS nodes from a single source).

When data is provisioned by the customer provisioning system, the following sequence of actions is taken by the PDBA application on the active EPAP (Active PDBA):

1. Data is committed to the PDB on the active EPAP
2. Data is replicated to the PDB on the standby EPAP on the mated site
3. Data is converted to RTDB format and is committed to the RTDBs on local EPAP A and EPAP B (the RTDBs on the active MPS site). NOTE: If Selective Homing is set to Active, the Active PDBA will also replicate the RTDB data to the RTDBs on remote EPAP A and EPAP B at the standby MPS site.
4. If Selective Homing is not set to Active, the Active PDBA will not replicate data to the RTBDs on the remote EPAP A and EPAP B. Rather, the Standby PDBA will replicate locally after having been updated by the Active PDBA.

Once the data has been provisioned to the EPAP RTDBs, it will then be forwarded to the EAGLE 5 ISS's SM cards over the private IP network that exists between the EPAP and each SM. Only after this step is the data active in the SM card, and therefore active for SS7 routing. In this step, each set of SMs are updated by their respective EPAP RTDB on the local MPS. In this manner, each EAGLE 5 ISS's SM cards are updated by the EPAPs at that particular site. There is no option for an EAGLE 5 ISS's SMs to be updated from the EPAP RTDBs on a remote MPS.

2.3 EPAP DATA TYPES

The EPAP system is used by all of the EPAP DB features for provisioning of data and for replication of this data to the EAGLE 5 ISS's SM cards for SS7 routing. For the provisioning of these features, the customer's provisioning IP network connects to the EPAP an API known as the PDBI (Provisioning Database Interface). Because the PDBI and the EPAP databases (i.e. PDB and RTDB) are shared among all of the EPAP DB features, the PDBI has adopted six generic data types which are utilized by one or more of the EPAP DB features. These data types are DN, IMSI, IMEI, DN Block, IMEI Block, and Network Entity, and are described below. Again, this is relevant to the subject of this document because the data type has a bearing on the dimensioning of the EAGLE 5 ISS system.

In terms of dimensioning of the system, only the DN, IMSI, and IMEI are factors in the size of DSM cards needed because each of these data types are priced and sold separately, and have different impacts on the memory usage in the DSM card. Network Entity, DN Block, and IMEI Block are automatically factored into the base system. The E5SM is available in only one size, so this is not an issue.

The DN, IMSI, and IMEI data types are known collectively as Subscriber Numbers. The total system capacity currently supported is 96 Million Subscriber Number entries for a DSM and 84M for an E5SM. These 96 or 84 Million number entries are divided among the DN, IMSI, and IMEI data types.

2.3.1 DN

The DN (Dialed Number) data type corresponds to the E.164 number assigned to a subscriber as their "telephone number". This is the number dialed by someone trying to call the subscriber. The DN data type is used by the INP, G-Port MNP, and GSM Migration features, and optionally by the G-Flex vHLR feature.

For the G-Port MNP feature, the DN data type corresponds to the subscriber's GSM MSISDN. For the GSM Migration and G-Flex vHLR features, the DN data type corresponds to the subscriber's GSM MSISDN on a GSM network and the subscriber's IS-41 MDN on the IS-41 network. For the INP feature, the DN data type corresponds to the subscriber's ETSI/ITU DN.

In terms of data storage in the PDB and RTDB, whether the number is a GSM MSISDN, IS-41 MDN, or ETSI/ITU DN, it is stored as a DN data type.

Up to 96 Million DN data types may be purchased and provisioned on an EAGLE 5 ISS system with DSMs, and 84M with E5SMs. However, the actual number of DN data types allowed on a particular system is dependent on (1) the number or other data types (IMSI and IMEI) coexisting on the system, and (2) the size of DSM card installed in the system (1 or 4GB).

2.3.2 IMSI

The IMSI (International Mobile Subscriber Identity) data type corresponds to the E.212 number assigned to a particular subscriber. Unlike the DN, this is not a "telephone number" which can be dialed to reach the subscriber. This is a number used to identify a particular mobile subscriber in the network. The IMSI data type is used by the G-Flex vHLR and EIR features.

For the EIR feature and for G-Flex used in a GSM environment, the IMSI corresponds to the subscriber's GSM IMSI. For G-Flex used in an IS-41 environment, the IMSI data type corresponds to the subscriber's IS-41 MIN.

In terms of data storage in the PDB and RTDB, whether the number is a GSM IMSI or IS-41 MIN, it is stored as an IMSI data type.

Up to 90 Million IMSI data types may be purchased and provisioned on an EAGLE 5 ISS system with DSMs, and 75M with E5SMs. However, the actual number of IMSI data types allowed on a particular system is dependent on (1) the number or other data types (DN and IMEI) coexisting on the system, and (2) the size of DSM card installed in the system (1 or 4GB).

2.3.3 IMEI

The IMEI (International Mobile Equipment Identity) data type corresponds to the unique identification number assigned to a particular mobile handset in a GSM network. This data type is used only by the EIR application. In terms of data storage in the PDB and RTDB, the IMEI data type corresponds directly to the GSM IMEI.

Up to 32 Million IMEI data types may be purchased and provisioned on an EAGLE 5 ISS system, either with DSM or E5SM. However, the actual number of IMEI data types allowed on a particular system is dependent on (1) the number or other data types (DN and IMSI) coexisting on the system, and (2) the size of DSM card installed in the system (1 or 4GB).

2.3.4 DN Block

This data type offers the ability to enter ranges of DN numbers for the INP, G-Port MNP and GSM Migration features (and optionally the G-Flex vHLR feature). Up to 50,000 DN Blocks are allowed on an EAGLE 5 ISS system. DN Blocks are part of the base system, and the full capacity is configured regardless of the other data types present on the system, the size or type of SM cards. As a result, the actual number of DN Block data types used has no impact on the dimensioning of an EAGLE 5 ISS system.

2.3.5 IMEI Block

This data type offers the ability to enter ranges of IMEI numbers. Up to 50,000 IMEI Blocks are allowed on an EAGLE 5 ISS system. IMEI Blocks are part of the base system, and the full capacity is configured regardless of the other data types present on the system, or the size of the SM cards. As a result, the actual number of IMEI Block data types used has no impact on the dimensioning of an EAGLE 5 ISS system.

2.3.6 Network Entity

This data type corresponds to the HLR or other SS7 node address translations used by the G-Port, G-Flex, INP, and GSM Migration features. Up to 150,000 Network Entities are allowed on an EAGLE 5 ISS system. Network Entities are part of the base system, and the full capacity is configured regardless of the other data types present on the system, or the size of the SM cards. As a result, the actual number of Network Entity data types used has no impact on the dimensioning of an EAGLE 5 ISS system.

2.4 SM MEMORY ALLOCATION

The EPAP replicates the entire RTDB database to each of the SM SCCP processing cards on the EAGLE 5 ISS system. Each SM stores a copy of the entire RTDB, which contains all of the provisioned data types for all of the EPAP DB features. Each SM will contain all of the DNs, IMSIs, and IMEIs that have been provisioned for the EPAP DB features. All SS7 processing and routing occurs on the SM cards.

The EAGLE 5 ISS supports two types of DSM cards which differ only in the amount of memory installed on the card. There are 1GB and 4GB DSM cards. The EAGLE 5 ISS supports one type of E5SM card, sized at 4GB.

The currently supported system maximum of 96 Million total Subscriber Numbers requires a 4GB DSM/E5SM minimum.

2.4.1 Memory Allocation on SM Card

Subscriber Number data is written to three different types of tables on the EAGLE 5 ISSs SM cards: DN table type, IMEI table type, and IMSI table type.

When data is written to the SM card from the EPAP RTDB, the SM's memory is allocated in chunks per data type. For example, when DN data (MSISDN, MDN, or DN subscriber numbers) is written to the SM, memory is allocated in chunks of 6 Million number entries. Likewise, when IMSI data (IMSI or MIN subscriber numbers) is written, SM memory is allocated in chunks of 7.5 Million number entries; and IMEI data is allocated in chunks of 2 Million number entries. This is an important aspect of the architecture as it has direct impact on the dimensioning of the SM cards.

Due to the fact that memory is allocated in chunks, the actual space used in a SM card (and thus the amount of space available for new entries) is not a *direct* correlation between the actual number of entries provisioned. It is related, but not in a one-to-one manner. Table 1 illustrates graphically the breakpoints of provisioning which would cause the next chunk of memory allocation on a SM card.

EPAP Data Type	Number of entries actually provisioned on the SM	Amount of space actually allocated on the SM (in terms of reserving space for entries)
DN	0 (i.e. feature active, no entries provisioned)	0
	1 – 6,000,000	6M
	6,000,001 – 12M	12M
	12,000,001 – 18M	18M
	18,000,001 – 24M	24M
	24,000,001 – 30M	30M
	30,000,001 –36M	36M
	36,000,001 – 42M	42M
	42,000,001 – 48M	48M
	48,000,001 – 54M	54M
	……..	……..
	78,000,001 – 84M	84M (current system limit for E5SMs)
	……..	……..
	90,000,001 – 96M	96M (current system limit for DSMs)
IMSI	0 (i.e. feature active, no entries provisioned)	0
	1 – 7,500,000	7.5M
	7,500,001 – 15M	15M

	15,000,001 – 22.5M	22.5M
	22,500,001 – 30M	30M
	30,000,001 – 37.5M	37.5M
	37,500,001 – 45M	45M
	45,000,001 – 52.5M	52.5M
	……..	……..
	67,500,001 – 75M	75M (current system limit for E5SMs)
	……..	……..
	82,500,001 – 56M	90M (current system limit for DSMs)
IMEI	0 (i.e. feature active, no entries provisioned)	0
	1 – 2,000,000	2M
	2,000,001 – 4M	4M
	4,000,001 – 6M	6M
	6,000,001 – 8M	8M
	8,000,001 – 10M	10M
	10,000,001 – 12M	12M
	12,000,001 – 14M	14M
	14,000,001 – 16M	16M
	……..	……..
	30,000,001 – 32M	32M (current system limit for DSMs and E5SMs)

Table 1: SM Memory Allocation

NOTE: The numbers in the tables are maximums for each data type in seclusion. If multiple data types exist on the same node, the stated allocations are made for each data type. See Section 2.4.2 for more details.

2.4.2 Effect of Multiple Data Types on SM Memory Allocation

As mentioned in the note under Table 1, if multiple data types are provisioned on the same node, the total amount of memory allocated on the SM is the sum of the memory allocations for each data type.

For example, if a system is running both G-Flex and G-Port, then both DN and IMSI data types will be provisioned on the system, and the SM will allocate chunks of memory for both data types. The following table gives some examples the memory allocations for this scenario.

Number of DN Entries Provisioned	Number of IMSI Entries Provisioned	Amount of space actually allocated on the SM (in terms of reserving space for entries)
8M	6M	12M DNs + 7.5M IMSIs
8M	8M	12M DNs + 15M IMSIs
31M	8M	36M DNs + 15M IMSIs

Table 2: Effect of Multiple Data Types on a Node

As seen in the first entry in Table 2, the actual number of provisioned entries is 14M (8M DNs + 6M IMSIs). However, the SM has allocated memory space for up to 19.5M entries (12M DNs + 7.5M IMSIs).

In the second entry, the number of provisioned IMSIs has increased to 8M, but the number of DNs has remained the same at 8M, for a total of 16M provisioned entries. However, the SM has now allocated memory space for up to 27M entries (12M DNs + 15M IMSIs).

The importance of this point is that in both of these cases, due to the way in which the SM allocates memory, going from 6M IMSIs to 8M IMSIs causes another 7.5M entry block of memory to be allocated, even though the amount of entries in the database is only increased by 2M.

Likewise, in the third entry, the number of provisioned DNs has been increased to 31M, but the number of provisioned IMSIs has remained the same at 8M. Again, the SM is allocating space for 36M DNs + 15M IMSIs for this case.

This point is key to understanding the dimensioning of DSMs for an EAGLE 5 ISS system with EPAP DB features. Due to the way in which SMs allocate memory, the minimum required size of DSM card on an EAGLE 5 ISS system is dependent upon how much memory the DSM will allocate, NOT how many entries will actually be provisioned on the database. Since E5SMs are only sold in one size, this point is not important for configuration of the hardware, but it is important in understanding how the database works.

Section 1 of this document includes a tool which can be used to enter any combination of data types/database entries, and will give the actual memory consumed as well as the amount of memory allocated by the SM. This tool will give the absolute minimum supported SM card for the entered configuration.

3 COMMERCIAL GUIDELINES FOR DIMENSIONING EAGLE EPAP DB FEATURES

Section Deleted. This information is now kept in a common location within the sales online tool and will not be repeated in this document in order to avoid disagreement between data sources.