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Approved EAB/UZ/DL (Kjell Isacson)	Checked	Date 2005-03-31	Rev D	Reference

RPS-B Regional Processor Subsystem

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1 REVISION INFORMATION

- Rev A Based on 1551-ANZ 212 08 Uen Rev. D
- Major update.
- New template used.
- Rev B Update for APZ 11.2
- Introduction of a new processor, GARP.
- Introduction of Function Change of Regional Firmware.
- Rev C Updated for APZ 11.3.
Introduction of Ethernet based RP bus (RPB-E).
- Rev. D Updated for APZ 12.0.
- Introduction of bulk signals on RPB-E.
- RPNM function updated with functionality for turning on or off the MIA LED on GESB.

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2 GENERAL

This document is meant for the following groups and purposes:

- As the basis for internal presentations to Ericsson marketing personnel.
- For designers who require an overview of the subsystem (for example new employees).
- For customer presentations that are to provide a general knowledge of the subsystem.

This RPS-B Subsystem Description includes the various support and maintenance functions that are common to all Regional Processors (including all EMRP products). Regional Processor Subsystem (RPS) functions that reside in the Central Processor (CP) and that interact with the above Regional Processor (RP) support and maintenance functions are also included.

Note that no hardware functionality is included in this document.

Some very frequently occurring terms:

RPS	Regional Processor Subsystem
CP	Central Processor – An AXE system is composed of two processor sides, side-A and side-B.
RP	Regional Processor
RPB	Regional Processor Bus – The bus connecting the RPs to the CP.
EM	Extension Module. Originally, the manner in which telecommunications applications (hardware and software) were interfaced to an AXE exchange.
EMRP	Extension Module Regional Processor
Path	An access-way between a CP-side and the RPs. Two paths exist, one for each CP-side.
Branch	A subdivision of a path. An path may be composed of a maximum of 32 branches.
EM	Extension Module.
OS	RP or EMRP Operating System.
SW	Software – stored programs.
HW	Hardware.
HW driver	RP software and/or firmware specifically for the operation of hardware and hardware interfaces. Drivers may be either those that are included as part of RPS software or special purpose drivers constructed specifically for a particular application.

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2.1 Traditional bus structure

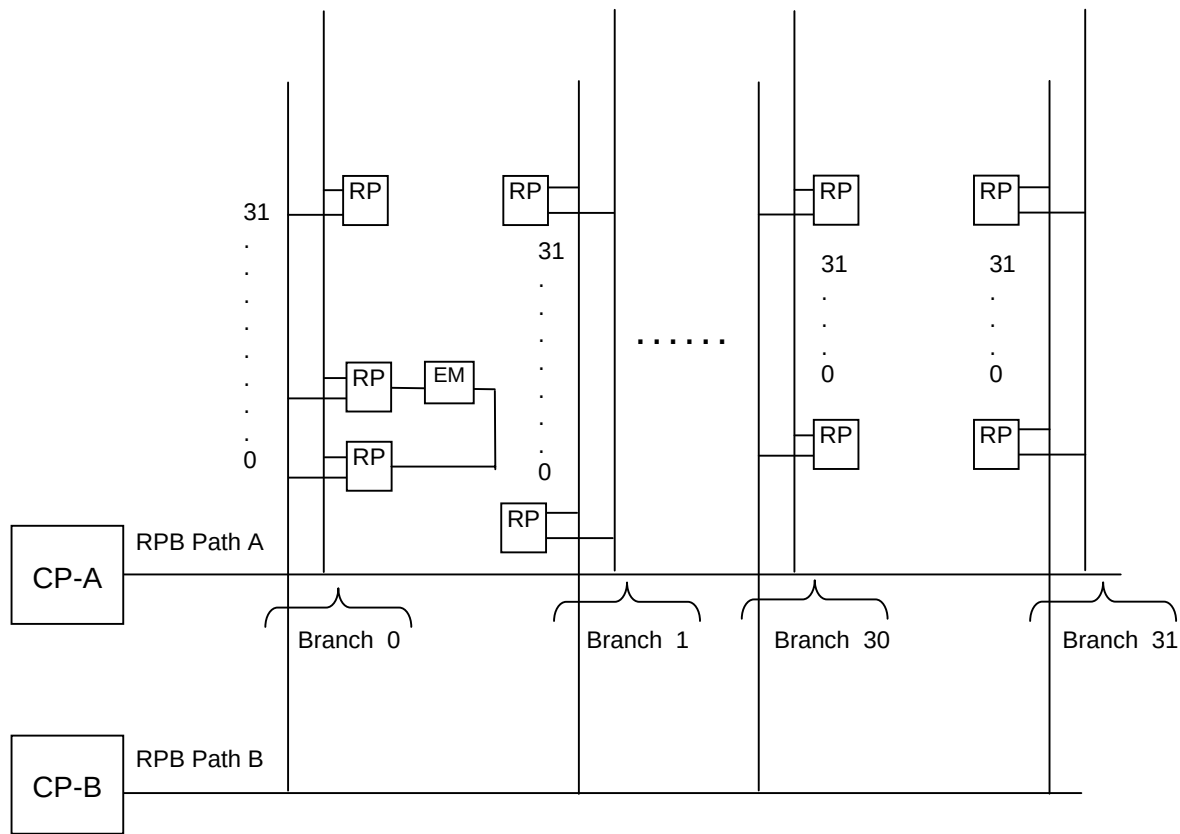


Figure 1. A simplified illustration of the connection of the RPs to the CPs.
Each path may contain a maximum of 32 branches.

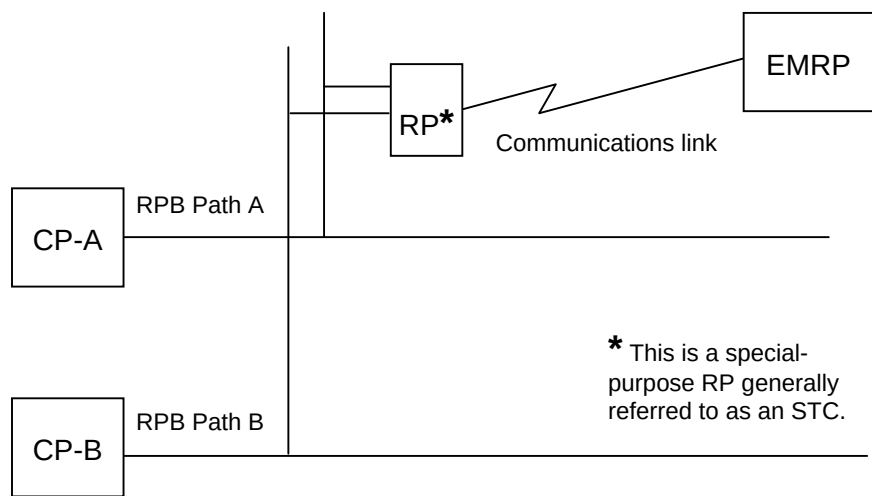


Figure 2. A simplified illustration of the connection of an EMRP to the CPs.

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2.2 RP bus structure based on Ethernet

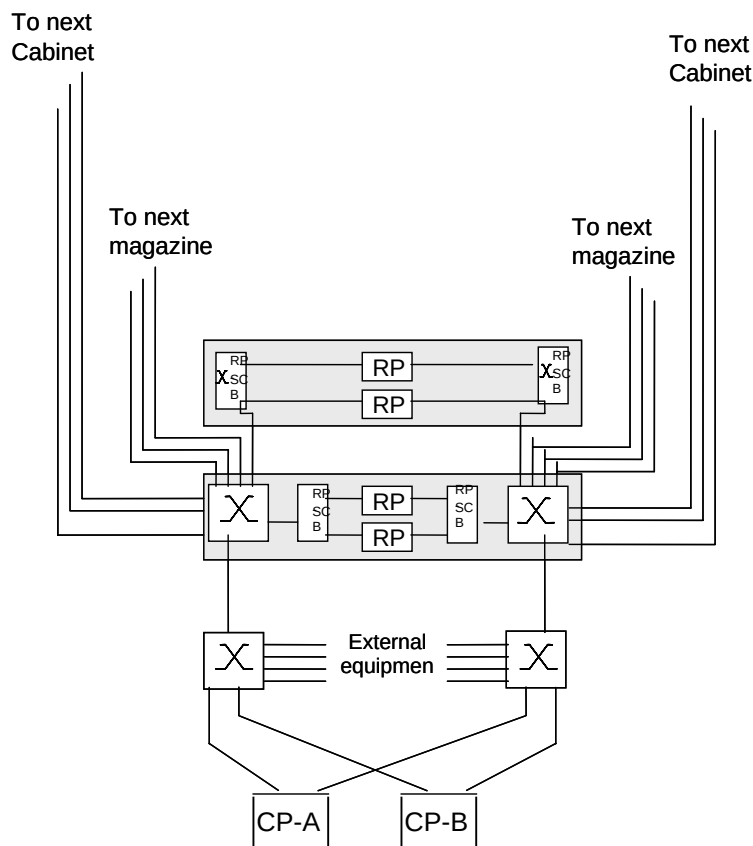


Figure 3. The illustration shows a simplified picture of a large RPB-E network configuration.

The RPs are connected to the RPB-E via a network of a Support and Connection Board with RP (SCB-RP) pair and one or several Gigabit Ethernet Switch Board (GESB) pairs. The SCB-RP transfer the bus into the magazine backplane while the GESB distributes the bus to different magazines and cabinets. The switches are always working in pairs, which constitutes two redundancy nets.

The GESB has eight Ethernet ports placed on the front. One port is connected to the previous GESB, four ports are used to connect the magazines switches SCB-RP placed in the same cabinet and the remaining three ports are used to connect GESBs in other cabinets. In some cases the existing IPN Switch (IPNX) can be used as the first switch seen from the CPs perspective instead of an GESB.

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2.3 Introduction

The information contained in this section summarizes all currently active¹ RP configurations.

RPS comprises the following subsystems:

- RPS-B
- RPS-1 See Ref. 1 Note! Excluded from APZ 212 30 and newer source systems
- RPS-2 See Ref. 2
- RPS-M See Ref. 3

Please consult Tables 1, 2 and 3 below when reading the following.

The RPS-B subsystem includes the support and maintenance software functions that all RPs and EMRPs require for their operation.

RPS-1 includes the hardware functions, microprograms and Executive Functions of members of the RP Group, RP1. The subsystem includes software for program test (a support function) and for fault detection (a maintenance function).

RPS-2 includes the hardware functions, microprograms (where applicable) and the OS functions for members of the RP Groups RP2, RPD, RPP, GEM-RP and RPI. The subsystem includes software for restart dump (a maintenance function) plus software for program test and program correction (support functions).

RPS-M includes the hardware functions, Operation & Maintenance Functions and OS functions required for the operation of the Extension Module Group (EMG) control system. The entire subsystem is optional and is not required for the general operation of an AXE node.

¹ "Active" refers to RPs that are currently installed in the field and supported by the AXE system.

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Any of the RPs shown in the tables below can exist in a currently operational AXE exchange.

RP CLASSIFICATION

<u>Group name</u>	<u>Products included in the group</u>
RP1	RP1, RWMRP
RP2	RP2, RP3, RP4
RPD	RPD, RPG, RPG2, RPG3
RPP	RPP, RPPETA1
GEM-RP	GARP, RPALI, SCB-RP, GESB ² , Application board with RPI building block
STC-E	STC, STCE
STC-G	STCG1, STCG2, STCG3
RPBC	RPBC
RPI	RP Building block implemented on application boards

EMRP CLASSIFICATION

<u>Group name</u>	<u>Products included in the group</u>
EMRP-N	EMRP1, EMRP2, EMRP3, EMRP4, EMRP4L, EMRP42
EMRP-D	EMRPD1, EMRPD2, EMRPS
EMRP-T	EMRPI

STR CLASSIFICATION

<u>Group name</u>	<u>Products included in the group</u>
STR-E	STRE
STR-T	STRT

Table 1. Currently existing RP, EMRP and STR products.

² Gigabit Ethernet Switch Board (GESB) includes an Ethernet switch and a processor. Currently the processor is not activated as an RP.

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RP CLASSIFICATION

<u>Group name</u>	<u>Group attributes</u>
RP1	Makes use of the EMB (EM bus). Software is programmed using an assembler programming language. Operating system is an in-house proprietary design.
RP2	A modernized and smaller version of the RP1 group including a new architecture and an improved Support and Operations & Maintenance functionality. The new architecture requires a new assembler language.
RPD	The RP group that did away with the EMB. Applications hardware is connected directly to the microprocessor's bus. This group also introduced the use of C language programming for both the operating system and applications. The operating system kernel (OSE) is procured from an external source.
RPP	The RP group that introduced the use of the PCI bus. Both RP platform and applications hardware utilize the PCI. This group uses the C language programming for both the operating system and applications. The operating system kernel (OSE) is procured from an external source.
RPI	The RP implemented as a building block to be included in all applications requiring RP functionality.
GEM-RP	Includes all RPs that are carried on boards that are to be mounted in a GEM magazine. This group uses the C language programming for both the operating system and applications. The operating system kernel (OSE) is procured from an external source.
STC-E	First-generation STC. All control functionality was located in PROM.
STC-G	Second-generation STC based on the use of the RPG, RPG2 or the RPG3 plus applications software. This group uses C language programming for both the operating system and applications. The operating system kernel (OSE) is procured from an external source.
RPBC	The amalgamation of the STCE and STR into a single unit.

Table 2. Classification of currently existing RP products.

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EMRP CLASSIFICATION

Group name

Group attributes

EMRP-N	Used in the EMG (Extension Module Group). Programmed in Plex-M, an in-house programming language. Used in the control of Type 1 EMGs.
EMRP-D	Used in the EMG. A more modern EMRP version programmed in C and utilizing the OSE kernel. Used in the control of Type 1 EMGs.
EMRP-T	Used in the EMG. The most modern EMRP employing a considerably advanced degree of hardware integration. Used in the control of Type 2 EMGs.

STR CLASSIFICATION

Group name

Group attributes

STR-E	A Signal Terminal Remote used in conjunction with Type 1 EMGs.
STR-T	A Signal Terminal Remote used in conjunction with Type 2 EMGs. The STR is Time Switch connected and is integrated into the EMRPI.

Table 3. Classification of currently existing EMRP and STR products.

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2.4 Other available documentation

Documentation is available that describes each of the RPS subsystems (see references 1, 2 and 3).

Summarizing:

- The RPS-1 subsystem description deals with the RP1 and the RWMRP.
- The RPS-2 subsystem description deals with the RP2, RP3, RP4, RPG1, RPG2, RPG3, RPD, RPP, RPPETA1, RPI, GARP and the SCB-RP.
- The RPS-M subsystem description deals with the STC, STCG1, STCG2, RPBC, STR, EMRP1, EMRP2, EMRP3, EMRP4, EMRP4L, EMRP42, EMRPD1, EMRPD2, EMRPS and the EMRPI.
- Each of the above documents also includes descriptions of the software that is required for the direct support of the particular RPs or EMRPs that are dealt with.

2.5 Interfacing with RPS

RPS interfaces with the following AXE subsystems as illustrated in the figure below.

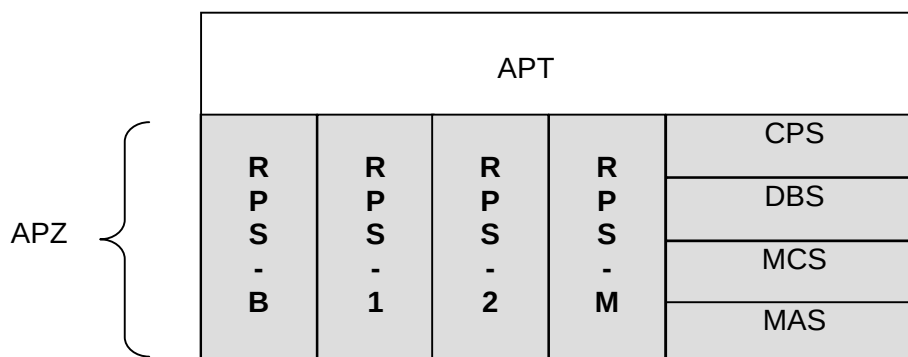


Figure 4. *RPS including its components RPS-B, RPS-1, RPS-2 and RPS-M.*

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RPS provides an API (Application Program Interface) which essentially all AXE telecom applications make use of. Telecom applications such as POTS (ordinary telephony), ISDN, Voice Over IP, ADSL, GSM and HSL and many more are supported by the RPS platform. In general, RPS may be seen as the means by which a subscriber to a particular telecom application is connected to the AXE system that supports the particular application in question.

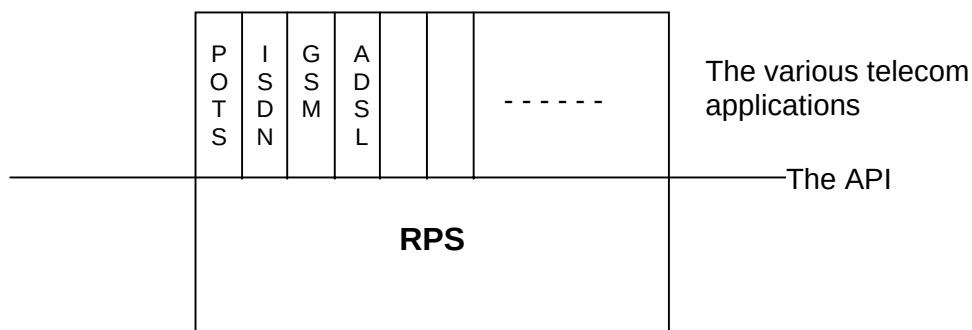


Figure 5. *The various telecommunication applications that interface with the RPS platform via its API.*

Basically, the API is the interface between the telecom application that always resides partially in the CP and partially in an RP (that is, an RP or EMRP, as the case may be). The interface may be illustrated as shown below.

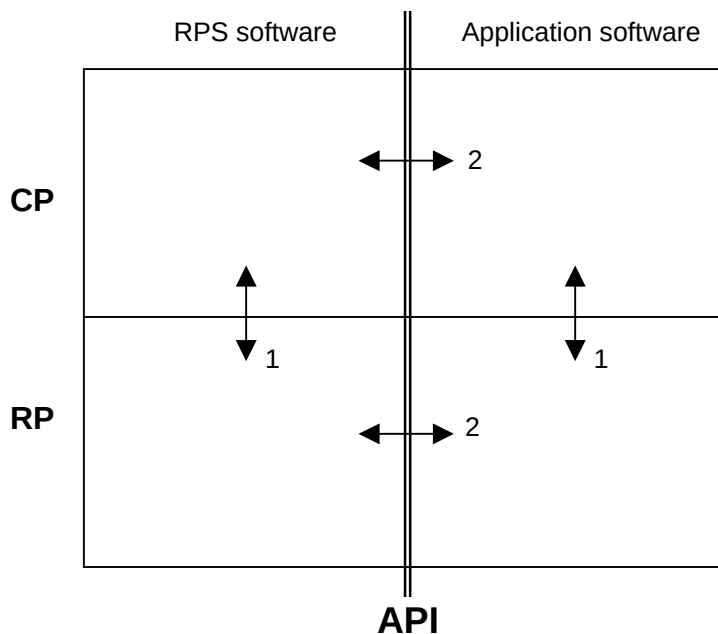


Figure 6. *The API interfaces between the application and RPS Software (2 in the illustration above).*

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In essence, the API consists of two parts, **A** and **B**. Each part interfaces application software with RPS software - one section is located in the CP and the other interfaces software located in the RP. Typical uses of the API are illustrated below.

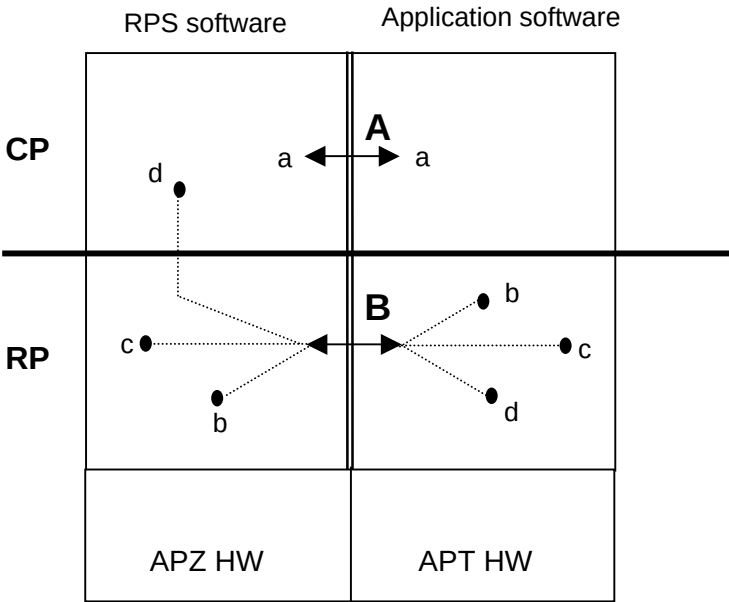


Figure 7. The API interfacing application and RPS software.

A

- a Used in connection with configuration set-up and status changes.

An example is the initiation of the Distributed RP table. RPS supplies the application with information and the application is responsible for updating of the table. When sending a signal to a device controlled by the RP, the application in the CP accesses the table in order to address the RP (RP number). The CP microprogram supports this function via a hardware instruction.

RPS software informs the application software of changes in state that have taken place in RP hardware and/or software. For example, when RPS software residing in the CP wishes to notify an application of the fact that a given RP is blocked or that a given application in a certain RP has been started.

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B

- b Used extensively by the RP application. The RPS software referred to here is the operating environment which includes the RP operating system and its utility functions.
- c Applications make use of this interface when communicating with hardware via so-called hardware drivers that are either included as part of the RPS platform or specifically designed for a particular APT application.

The interface is also used by RPS software in connection with the resetting of application hardware, for example, in the event of a fault.

If the RP should detect a fault in the APZ or in the APT section, then the RP's OS may elect to reset hardware. Depending on the type of fault, either APZ and APT hardware or only APT hardware will be affected. APT hardware is reset via the API.

- d All RPS software, application, and hardware status and fault reporting takes place via this interface.
RP start and restart functions make use of this interface.

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2.6 Background information

2.6.1 Introduction

The AXE system has been designed with the objective of combining high capacity with high reliability, at an acceptable cost.

A major attribute of the AXE system is its block structure that facilitates a very high degree of flexibility.

Analysis of the functions involved in telecommunications systems indicate that repetitive functions require a significant proportion of the total processor capacity that is available at a large telecom operation. In addition, such functions are frequently carried out in close connection with the direct control of switches or other communications hardware equipment.

The AXE system is therefore divided into a CP subsystem and an RP subsystem, see Figure 7. A powerful CP has been designed for the execution of functions that are of an analytical or administrative nature. A number of smaller RPs, designed for the execution of "simpler" repetitive functions, are used for the direct control of the hardware equipment directly related to telecommunications tasks.

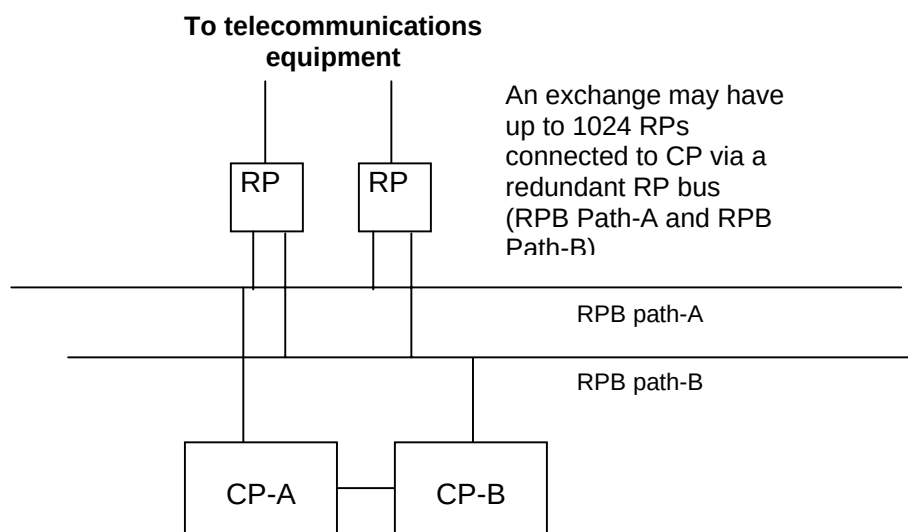


Figure 8. *The RPs are connected to the CP complex which is composed of two CP sides for the provision of reliable, fault-free operation. Depending of the bus type the bus can be divided into branches (RPB-P and RPB-S) or built as a network (RPB-E).*

This type of structure permits the gradual expansion of an installation and allows operators to adapt to increased processor and telecommunication capacity requirements in a controlled manner.

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2.6.2 RP development history

Early AXE RP products were composed of physically discrete hardware components that may have spanned more than one circuit board.

RPs (single or duplicated) were connected to the CP via the parallel or serial RP bus (RPB-P or RPB-S). EMs were connected to an RP via an EMB. EMRPs ("remote" RPs) were connected to the RP bus via a signal link that included bus-converter functionality. Local EMRPs were connected via RPBCs (RP Bus Converter).

Note that early RP configurations generally consisted of two RPs connected as an RP-pair for redundancy purposes. See the figure below.

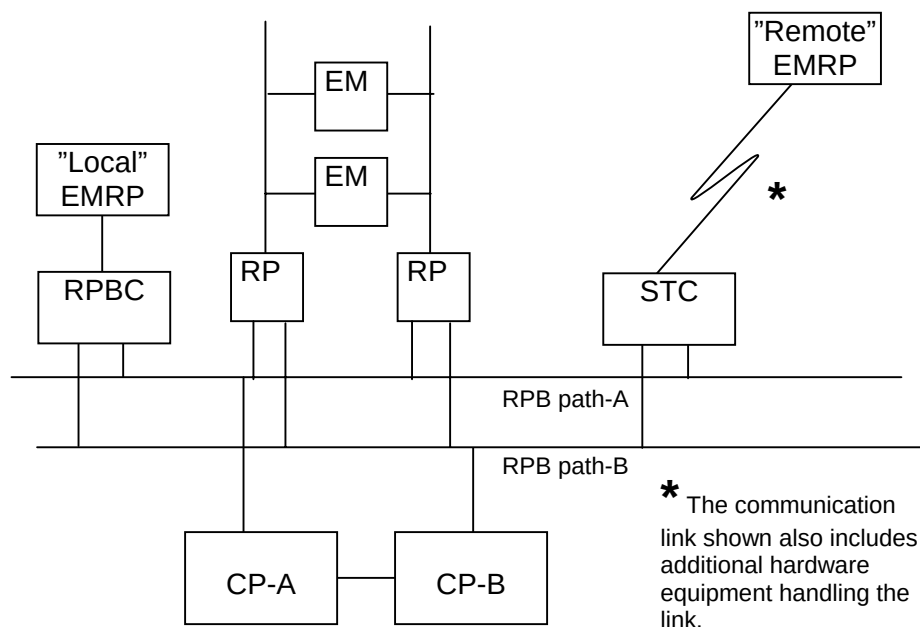


Figure 9. The connection of RPs and EMRPs to the CP.

Applications hardware was organized into a number of EMs in such a way that each EM contained a specified amount of hardware equipment (generally devices or switches). The number of units per EM varied depending on the device type.

The EMs of these early AXE systems often controlled a fixed number of subscribers and the loss of one RP of the RP-pair did not affect subscriber services.

For the most part, RP configurations no longer employ the RP-pair strategy. Instead, responsibility for maintaining the required reliability has been moved to the applications. For example, applications may be configured so that one or more application boards (including their built-in RPs) act as spares and are only "activated" in the event of a fault in one of the operational boards. The process of removing the faulty RP and activating the spare RP causes some degree of telecommunications disruption.

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Most of the above hardware still exists in the field and is in fact supported by the AXE system.

During the years, improved RP hardware architecture and technology have resulted in the extreme miniaturization of AXE's hardware and the discrete units that once existed have, in many instances, become "virtual hardware", that is, they exist only for the purpose of software addressing and/or for maintaining continuity with the past. The EM included in the RPD group and later is an example of such evolution.

For RPs that do not support the EMB, the EM is now a "virtual" concept and is entirely incorporated into internal board circuitry.

Devices are nowadays often referred to as applications hardware and are in the process of "taking over" practically all available circuit-board surface area. Yesterday's multiple-board RP is well on its way towards becoming an embedded processor.

System evolution:

- First-generation AXE systems contained RPs that were introduced in the late 70s. Active marketing of such equipment ceased around 1986.
- Second-generation AXE systems contained RPs that were constructed in accordance with the BYB202 equipment practice which was introduced around 1986. Active marketing of this equipment practice has come to an end 2002.
- Third-generation AXE systems contained RPs that are constructed in accordance with the BYB501 equipment practice which was introduced in 1998 and remains the current equipment practice. The BYB 501 equipment practice includes a 1800mm cabinet that can house either a combination of full and half-height GDM magazines (GDM-F and GDM-H) or a combination of the GEM magazine and only half-height GDM magazines.
- The fourth-generation AXE systems contained a new CP concept based on third party hardware with a UNIX operating system. An Ericsson designed APZ layer (APZ-VM) ensure the compatibility to older systems. To utilize the higher capacity of the CP a new RP bus type was introduced based on Ethernet technology.

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2.6.3 The RP bus

As illustrated in Figure 8 above, RPs are connected to a bus that serves as the communications link between the RP and the CP.
Two RPB paths are shown which provide redundant CP-RP interconnection.

Three different types of RPBs exist - a parallel bus referred to as the RPB-P, a serial bus referred to as the RPB-S and an Ethernet based bus referred as RPB-E.

The parallel bus transfers bit-parallel data, in both directions, between the CP and the RPs. The cable contains a large number of conductors and both the cable and the connectors are therefore considerably bulky.

The serial bus transfers data serially, in both directions, between the CP and the various RPs.

The serial bus has the following advantages over the parallel bus:

- Equipment incorporating this bus technique has a much smaller footprint.
- Cabling is simpler and less bulky.
- Equipment incorporating this bus technique usually requires less power, that is, less power and less cooling are required.
- Bus speed is considerably higher.
- Improved fault tolerance.

The Ethernet based RP bus has the following advantages over the serial RP bus:

- Ethernet is a widely used Local Area Networking (LAN) technology
- Capacity improvements are easy to introduce into an existing system. Possibility to run different parts of the network at different speed.
- The network is offering higher bandwidth to each RP and each magazine, which makes the possibility to decrease the systems footprint.
- Flexible utilization of the bandwidth.

The original intention was, regardless of the type of RP bus, that interaction or interworking between the CP and the associated RPs was to be carried out by means of transmitted messages (signals) that were to be sent only between the RPs and the CP and vice-versa. RP design has modified this approach and today's RPs are able to communicate with each other via Ethernet in addition to the traditional RPB signaling.

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2.6.3.1 The parallel RPB (the RPB-P)

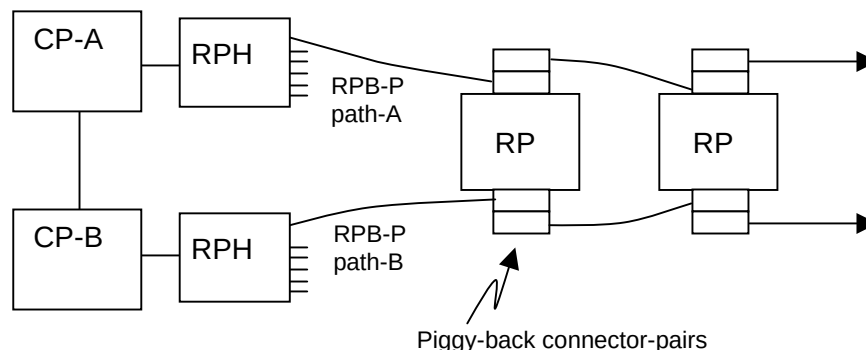


Figure 10. *The RPB-P, the parallel RP bus.*

The CP feeds the RP handler (RPHM) which in turn allows a maximum of 32 RPB branches to be connected to the CP.

RPs used in first and second generation AXE systems employing the parallel RP bus technique required a complete magazine, occupying a $\frac{1}{4}$, $\frac{1}{2}$ or a complete, cabinet shelf³.

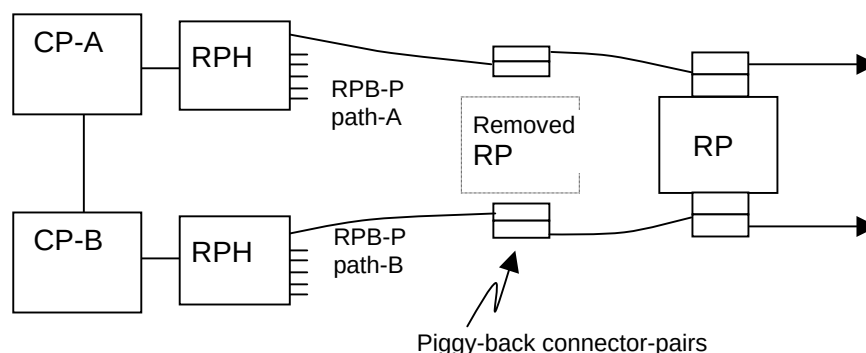


Figure 11. *An RP is removed from its magazine.*

Note that, as shown in Figure 11 above, an RP connected to the RPB-P can be removed from the system without disturbing the RPB path to which the other RPs are connected, since the piggy-back connectors are still making contact.

³ An early RP occupied cabinet space amounting to approximately 63,000 cm³. The space taken by a modern RP is less than 150 cm³, a volume reduction of approximately 400 times. This is equivalent to downsizing a Boeing 747 Freighter so that it fits into a room that is approximately 9 x 10 x 2.7 meters - that is, into a small single-story home. Note that the above comparison does not include capacity increases that have been attained over the years. If capacity were factored into the comparison, then the above aircraft would fit into a small room.

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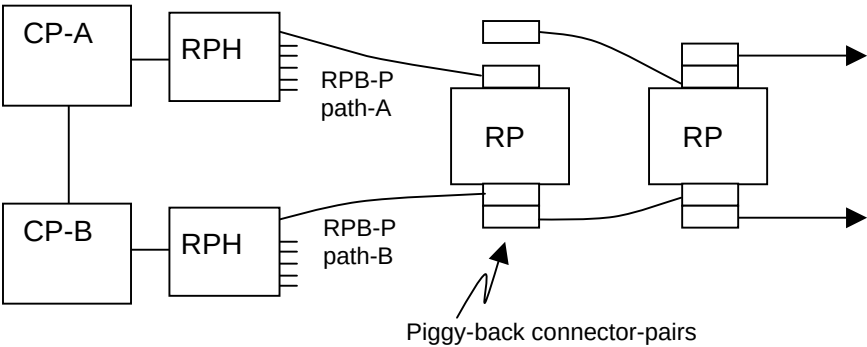


Figure 12. *Path-A has been broken due to the disconnection of a piggy-back connector.*

If however, a “connector-pair” is disconnected (see Figure 12 above), then the RPs “down the line” will lose contact with that RPB path. If the contacts are indeed separated, then it is very likely that a CP-side switch will occur in order to resume contact with the “lost” RPs (the loss of two or more RPs will cause a side switch with restart).

Note: RPs that are connected to a parallel RP bus are housed in BYB202 cabinets.

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2.6.3.2 The serial RPB (the RPB-S)

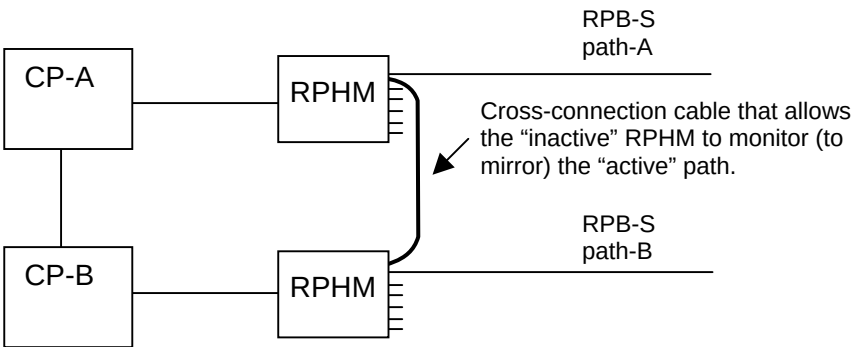


Figure 13. The RPB-S, the serial RP bus.

The motivation and the function of the cross-connection cable will be made evident in the discussion below. First some basic configuration facts concerning the serial RP bus.

A third-generation RPHM consists of one magazine that is capable of supporting any mix of parallel and serial RPs (see figure below). Earlier RPHM generations required considerably more space than a single magazine since their RP bus interface boards (RPBI-P and RPBI-S boards) generally supported only one interface per board.

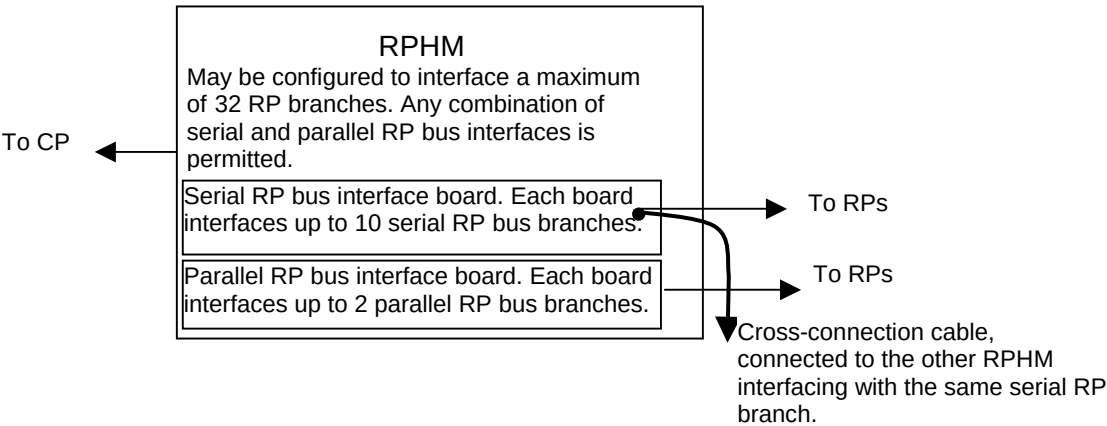


Figure 14. A third-generation RPHM.

Note again that all RPs that are to be connected via a RPB-P will be mounted in BYB202 cabinets.

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2.6.3.3 The RPH and the RPB structure

The RPH is the interface between the CP sides and the RPs.

All CPs up to and including the APZ 212 30⁴ family run in lockstep - meaning that the “standby/working” or backup processor is a number of cycles behind the “executive” or currently active processor and is, as a result, constantly updated and able to assume immediate control in the event of a fault in the active processor side.

Lockstep is not only maintained between the CPs - it is maintained all the way out to and including the RPB interface.

Lockstep is maintained differently in the case of parallel and serial RPs.

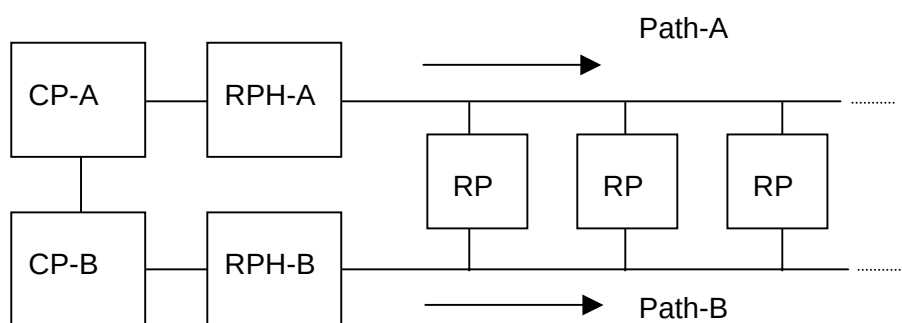


Figure 15. Lockstep and RPB-P operation.

In the case of the RPB-P, lockstep⁵ is maintained out to the RP as follows. CP-A, running in executive mode, sends data to the RPs via RPH-A (that is, via Path-A).

At the same time, CP-B (running in standby/working mode) sends the same data (as that sent by CP-A) to the RPs via RPH-B (that is, via Path-B).

A number of different checks are performed on the received data and if no errors are found then an acknowledge is sent individually back to the CPs along both paths.

⁴ Lockstep and parallel synchronous operation are synonymous.

As of the APZ 212 40 its successors, lockstep will no longer exist between the CP sides. The new approach will only affect the design of the CP-RPH interface. Furthermore, there is no impact on the operation of the RPB-S. Due to the design of the CP and specifically the introduction of a cross-connect between the CPs and the RPHs, the operation of the RPB-P is somewhat improved in that no CP-side switch will occur in the event of the separation of the piggy-back RP connectors as is the case for earlier CP models. Instead of accessing the RPs via CP-A/RPH-A/Path-A, the “lost” RPs will be accessed via CP-A/RPH-B/Path-B.

⁵ Note that in order to maintain synchronization between the two CP sides, the RP bus cable lengths for the two paths of an RPB-P may not differ by more than 2 meters.

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- Note: 1. Only signals from the executive CP-side are placed in the RP's input buffer.
2. Every word in the signal is parity checked and acknowledged along both paths.
3. After the RP has processed the signals that were placed in its input buffer, the RP will transmit its response (signal) back along both paths A and B, that is to both CP sides.

RP buffer congestion will cause repeated CP signal sending until no buffer congestion exists or until an RPH time-out. If the time-out occurs then the RP is assumed to be faulty and will be blocked.

The following deals with the operation of the RPB-S.

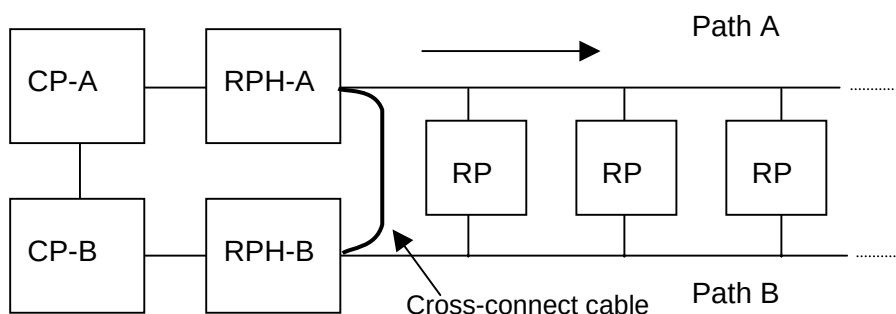


Figure 16. Lockstep and RPB-S operation.

The transfer rate of the RPB-S is approximately 30 times faster than that of the RPB-P - RPB-S pulse widths are therefore shorter by about that same factor. As a result, the approach taken in the implementation of lockstep in the case of the RPB-P is not viable for the RPB-S.

The approach taken is as follows:

CP-A, running in executive mode, sends and receives data to and from the RPs via RPH-A.

CP-B (running in standby/working mode) sends signals to RPH-B – however, no data is sent out along Path-B.

RPs connected to the RPB-P always send signals back to the CP along both paths. RPs connected to the RPB-S act differently.

A cross-connect cable has been introduced which makes it possible for RPH-B to “listen to” or mirror RP responses that are sent back to the CP along Path-A – so that RPH-B receives the response just as if the RP responses were sent back along Path-B.

In the case of the RPB-P, both paths are used and as a result, both paths are being constantly operational and tested so that fallback is ensured in the event of a fault. Since, as described above, only one path is used operationally in the case of the RPB-S, the subject of guaranteeing fallback is treated in a different manner.

In order to ensure that both Paths A and B (in figure 16 above) function correctly, the RPB-S paths are switched every 15 seconds.

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Assume, initially, that CP-A is running in executive mode and CP-B is running in standby/working mode. Assume also that paths A and B contain 32 branches each.

CP-A initially sends signals to the RPs along Path-A (that is, to all branches via Path-A). The transmission of signals to and from the RPs will change at intervals of approximately 15 seconds as follows:

Interval	The active branch on :	
	Path-A	Path-B
0	0 1 2 3 31	none
1	1 2 3 31	0
2	2 3 31	0 1
3	3 31	0 1 2
.		
.		
.		
. etc.		
30	30 31	0 1 2 3 29
31	31	0 1 2 3 29 30
32	none	0 1 2 3 29 30 31
33	0	1 2 3 29 30 31
34	0 1	2 3 29 30 31
.		
.		
.		
. etc.		
64	0 1 2 3 31	none

Note that no CP side switching occurs as a result of the above. CP-A is still executive. Note also that the switching mechanism above can only be maintained while the two CP sides are in lockstep.

In this way we are assured that both paths are operational and that a fault requiring an RPB-S path change will not be catastrophic.

NOTE-1: The above does not apply to any RPB-P branches. Parallel RPB operation is performed as usual, that is, as described earlier.

NOTE-2: In the event of a fault in a certain branch, that branch will be locked to the path that is operational.

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An additional advantage of the cross-connect cable is the fact that certain serial RP faults have less system impact than their parallel RP counterparts had.

For example, if the connector-pair halves, as shown in Figure 12, are separated; then all RPs further “down the line” will no longer have contact with the executive CP-RPH side and a side switch will take place. Naturally this is something that should be avoided.

The removal of an RP4 is analogous to the above parallel RP bus fault caused by the separation of the two connectors.

2.6.3.4 The Ethernet based RPB (RPB-E)

The regional processor bus of Ethernet type (RPB-E), is intended to replace the serial RP-bus for applications that require high bandwidth between CP and RP. RPB-E provides more bandwidth than RPB-S to each RP, which means more compact systems can be built.

The RPB-E is implemented on the APZ 212 40 and its successors. RPB-E offers a service to the application up to layer 6 in the OSI model where the two lowest layers consist of Ethernet DIX version. On top of Ethernet an Ericsson developed protocol, TIPC, is used. TIPC takes care of the layer 3 to layer 5 in OSI. The RPB Conversion layer provides mechanisms to make the bus to fit into the AXE system. That layer corresponds to the presentation layer, layer 6, in the OSI model. See figure18.

To utilize the available bandwidth on Ethernet signals are bundled during intensive signaling cases. The bundling mechanism is implemented in the RPB conversion layer. The signals are delayed for a short period (less than 300 µs) to fill up the frame which size is specified at the system design.

The AXE principles of redundancy to ensure robustness and reliability are kept. See figure17.

The RPB-E consists of two independent nets that are continuously supervised and in case of permanent failure in one of the communication nets between the processors in the system an alarm is issued and an automatic switch of the signaling is performed to the redundant net. After repair of the faulty unit (cable or switch) the signaling will automatically return to the original net.

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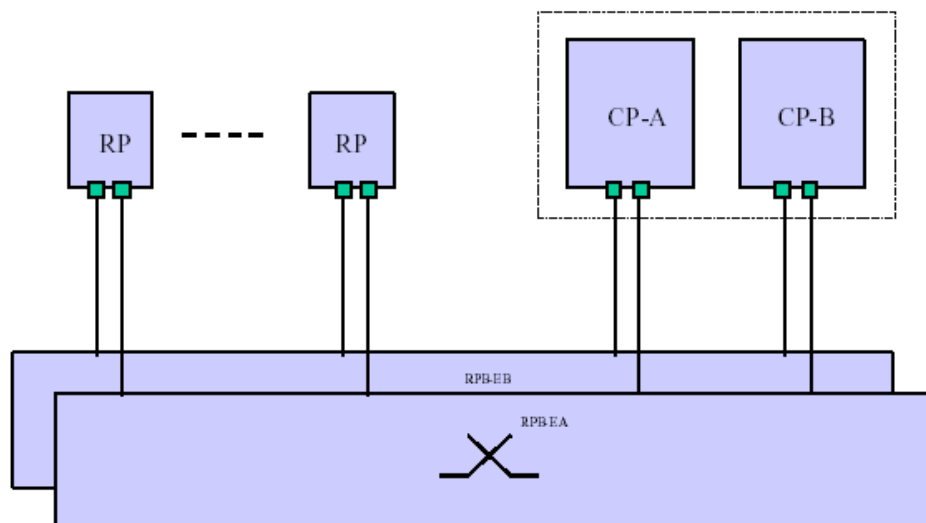


Figure 17. The principle of RPB-E: double separate Ethernet nets as a means of creating secure, reliable CP-RP-CP communication without any single point of failure for the system

The TIPC protocol handles the network, transport and session layers for the RPB-E. This ensures good real-time capacity as well as robustness features such as fail over mechanisms. TIPC has been chosen because of the mechanisms to handle redundant links and the included mechanisms in the protocol to address the executive part of the cp without distribution of physical address, so called location transparency.

The figure 18 illustrates structure of the RPB-E protocol. The RPB conversion layer on top of TIPC guarantees that the bus is compatible with the previous busses from the users point of view and have all expected capabilities.

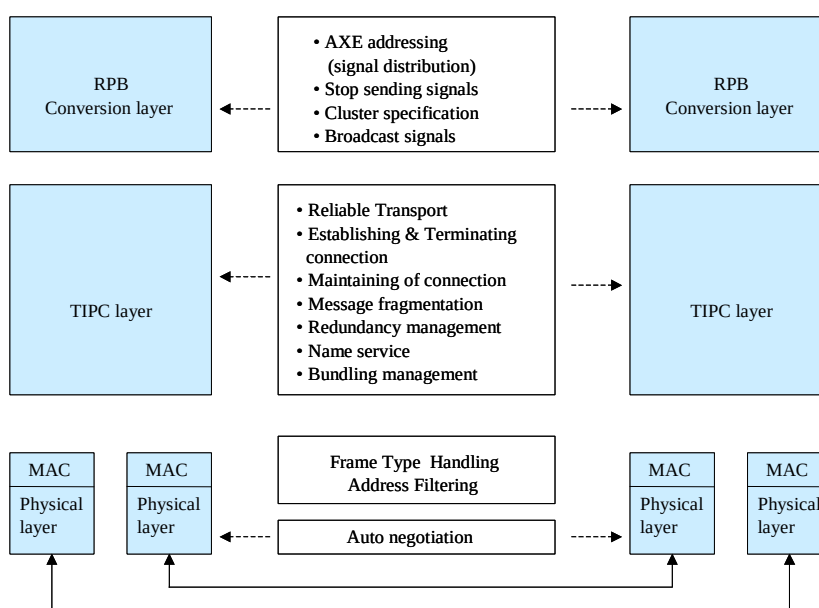


Figure 18. Illustration of the RPB-E protocol structure.

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2.6.3.4.1 Signals on the RPB-E.

Two types of signals can be used when signalling between CP and RP through the RPB-E:

- Ordinary signals.
- Bulk signals.

A detailed information about signals on the RPB-E can be find in the document "RPB-E Protocol Description", see ref.5.

When transferring a large amount of data, between CP and RP, by ordinary (packed) signals the application chops up the Internet frame data (in case if it exceeds 48 bytes) at the sending side and reassembles the data at the receiving side, see fig.19.

To be able to reassemble the data correctly some more information (packet information etc.) must be included in each signal, which further reduces the number of sent data and increases the number of signals.

The chopping of data decreases of course transmission capacity due to the fact that:

- A part of the RP capacity must be used up for the chopping.
- Handling of several signals consumes RP capacity because the processor must go through through RPB-E protocol stack more often.
- The bandwidth, available for the payload, is decreased because an extra address information (H_{Sig}) must be added to every sent signal.

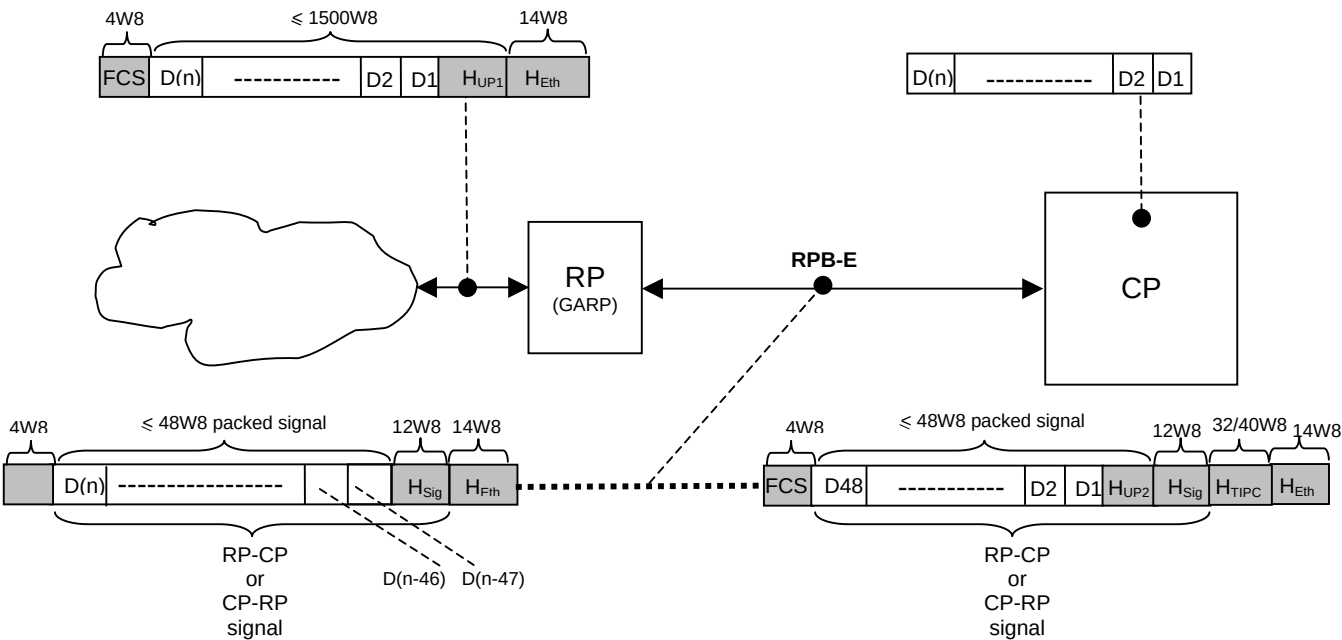


Figure 19. A principal illustration of ordinary signals on the RPB-E.

H_{UP1} A Header according to User Protocol 1 (UP1).

H_{UP2} A Header according to User Protocol 2 (UP2).

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- H_{Sig.} A Header according to applicable format for CP-RP-CP signals, (Frame information field and signal address field).
- H_{TIPC} Header, Telorb Inter Process Communication protocol, 32W8 or 40W8 depending on direction.
- H_{Eth} A Header, Ethernet Protocol.
- D1-D(n) User data.
- FCS The Frame Check Sequence.
- Introduction of Bulk Data Signals should eliminate disadvantages in relation with split up of data into several parts (RPB-E signals). The amount of data that can be sent with one signal can vary from zero up to almost 8 Kbytes. The size of the data elements is defined in the signal declaration to 8 or 16 bits.
- Only relevant data is sent on the bus. Bulk data declared as 16 bits is sent in two bytes whilst 8 bits data is sent as one byte with no padding between the data elements.

In the RP both the signal part and the bulk of data will be stored in the same signal buffer. In the general case the signal part and the bulk is separated with some unused area between

Incoming frames are stored in RP buffers which have spare data in front. This data can be used for the headers (Ethernet, TIPC etc.) that are needed when the frame is forwarded to the CP, this making it possible to send the frame through the RP without copying the data.

For further information see ref. 5.

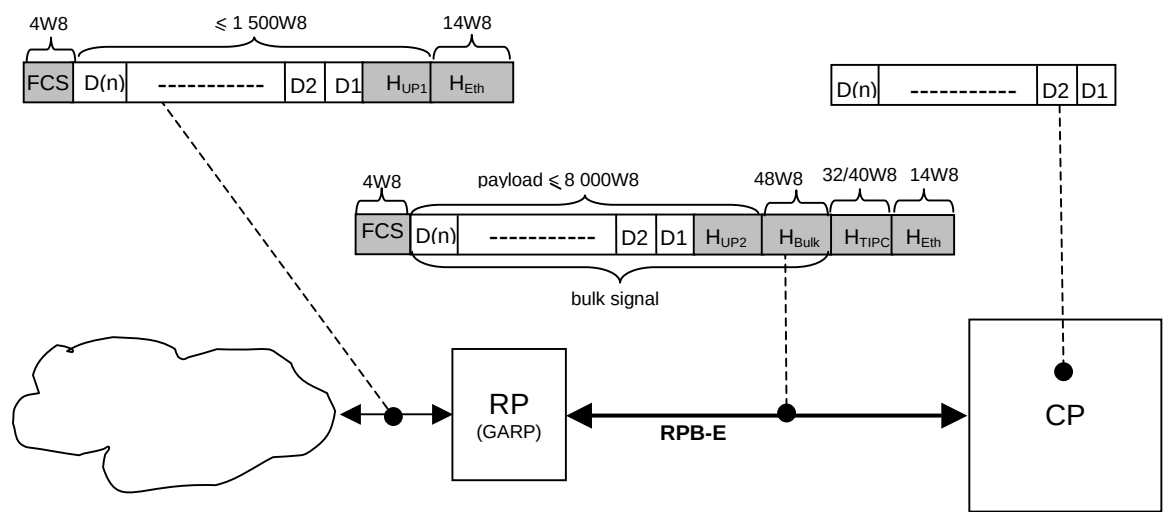


Figure 20. A principal illustration of bulk signals on the RPB-E.

H_{UP1} Header according to User Protocol 1 (UP1).

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- H_{UP2} Header according to User Protocol 2 (UP2).
If the RP does not terminate UP1 the H_{UP2} = H_{UP1}.
- H_{Bulk} Header, bulk signals.
- H_{TIPC} Header, Telorb Inter Process Communication protocol,
32W8 or 40W8 depending on direction.
- H_{Eth} Header, Ethernet Protocol.
- D1-D(n) User data.
- FCS Frame Check Sequence.

CP (APZ 212 40 and its successors) and RPs have been adapted to handle bulk signals. Applications, which want to use this facility, must be redesigned according to a modified APZ-APT interface, see ref. 9.
For Interface Description for handling of ordinary signals see ref 8, please.

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- The removed RP4 will be blocked.
- If that RP4 distributes an active bus path then also an immediate swap of that bus path will take place. For example if path-A is active, then CP-A/RPH-A/Path-A will be immediately switched to CP-A/RPH-B/Path-B, for all RPs along that branch.

Note: CP-A remains in EX mode.

In principle, the AXE system is designed to be able to recover from single faults. Unfortunately, multiple faults can occur and it should be noted that the occurrence of multiple RP4 faults is not addressed here and can be a highly complex matter to repair.

Note that the RPs shown on the RP4 boards in Figure 21 contain the software, both operating system and applications, required to drive the Device Boards that are shown mounted in the GDM magazine.

Note that the serial RP boards shown in the figure are self-sustaining in that they include the required hardware (RP plus applications devices) and the software (operating system and applications) to support the board's functionality.

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2.6.4.2 The GEM magazine

Note that GEMs no longer provide a backplane EMB connection as does the GDM. All boards mounted in a GEM are application boards which contain both an on-board RP and the EMs required to satisfy the requirements of the particular application.
The SCB-RP provides backplane support for the RP bus much the same as the RP4 in the case of the GDM.

GEMs always require fans for forced-air cooling.

The magazine may contain a total of 26 boards which means that a fully configured GEM contains 26 RPs.

GEM boards contain about 25% more surface area than do GDM full-height boards.

Unlike the situation in the case of the GDM and the RP4, all GEM application boards now include their own RPs and the SCB-RPs do not take part in the operation of the applications! The SCB-RP simply supports the operation of the magazine and the transport of the RPB to the various application boards.

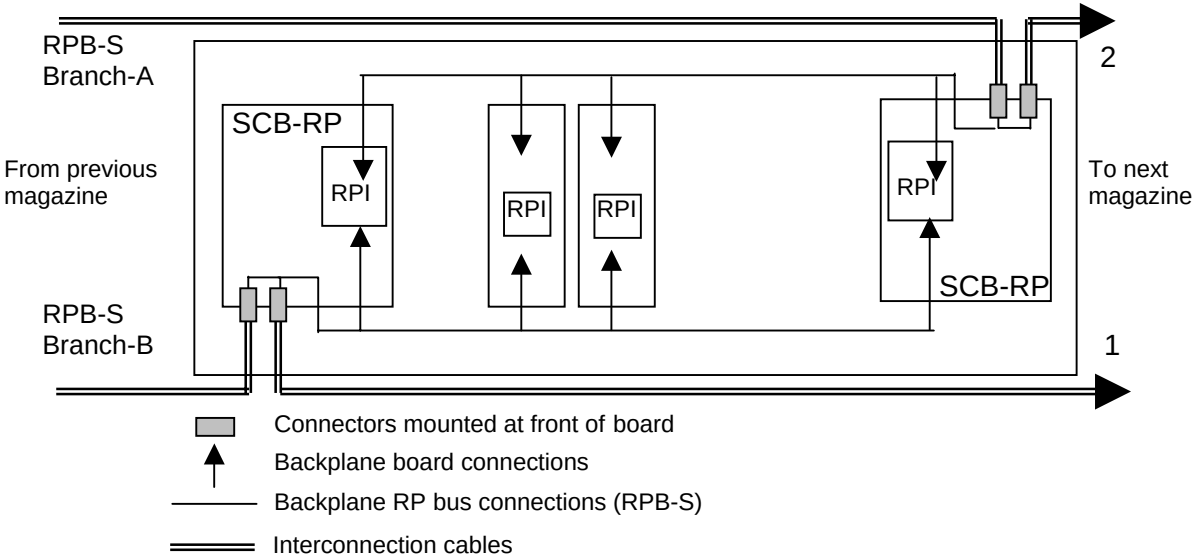


Figure 22. Example of a GEM magazine connected to RPB-S

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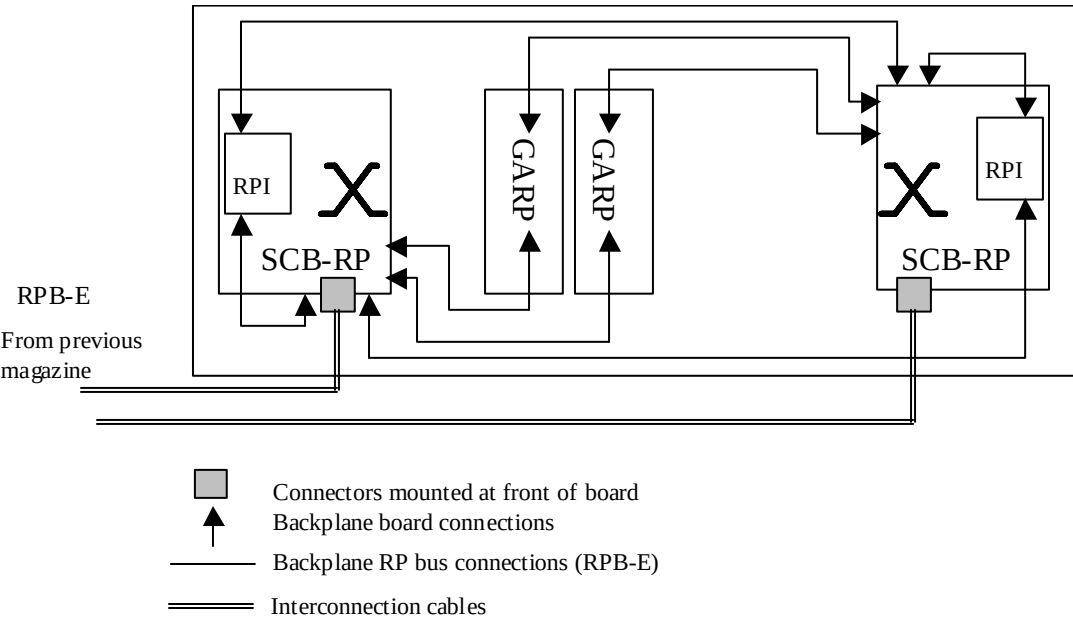


Figure 23. Example of a GEM magazine connected to RPB-E

The GESB are equipped with an Ethernet switch that can distribute the signals to the next level switch for further distribution from the CP. The SCB-RP in the GEM magazine provides 100 Mb/s bandwidth to all GARPs through the backplane. The connection from SCB-RP to the next level switch (for example GESB) provides a bandwidth of 1000 Mb/s. It is depending on the speed of ethernet ports in the CP how high bandwidth that can be used.

In the first implementation of RPB-E only the high intensity signalling GARPs will have the capability to use RPB-E. The RP part of the SCB-RPs, which performs magazine supervision, will be connected to RPB-S.

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2.6.5 The Maintenance Bus (MB)

Two functions make use of the MB, they are the BRI function (Board Repair Indication) and the HWI function (HardWare Inventory).

Both the GDM and GEM magazines include the MB. That is, only BYB501 cabinets include this functionality.

Both functions are dependent on the operation of the MB and they are not fault tolerant since there is no backup (fault tolerance) built into the MB. That is, if an RP4 or SCB-RP board is faulty then the slaves driven by the masters of these boards will not function (see the illustration of the GDM on the next page).

It should be mentioned that the slave logic circuitry, power supply and board contacts (that support the BRI and HWI functions which make use of the MB) are entirely separated from the board's operational circuitry and its contacts. This prevents any interference from any non-related BRI or HWI board faults.

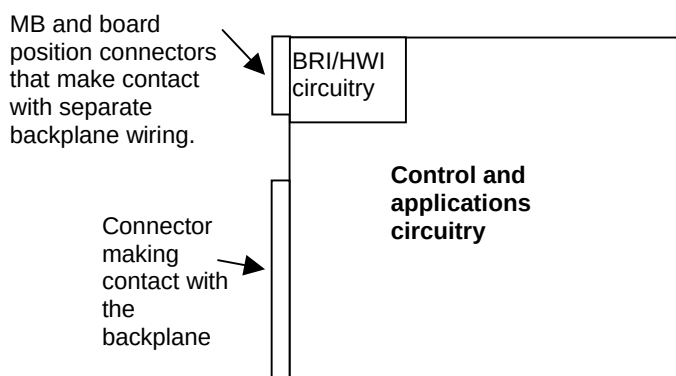


Figure 22. A simplified sketch of a GDM or GEM board showing the separation of BRI and HWI circuitry and connectors from the rest of the board.

Note also that the BRI and HWI portions of the board are the only circuitry that makes contact with the magazine's MB and the board position connectors.

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Slot 0 8 19

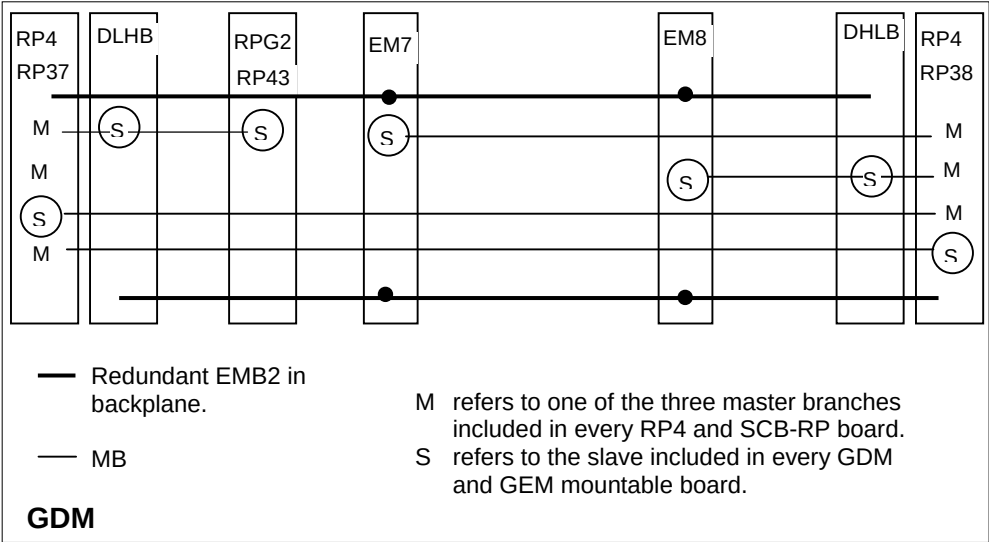


Figure 25. The GDM and its MB.

The MB plus the BRI/HWI circuitry supplies the following services:

- Lighting the board' LED.
- Check the presence of a board.
- Retrieval of a serial number, product number, board revision information, product name, and manufacturing date.

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2.6.6 Special-purpose GDM versions

An ordinary GDM can accommodate up to a maximum of 16 EM addresses, that is up to 16 EM boards. Remember that all EMs mounted in a given GDM are controlled by the RP4s located at each end of the GDM. Remember also, that each RP4 feeds an RPB-S branch plus an EMB to the magazine's EMs via the magazine's backplane.

A certain amount of load sharing exists between the two RP4s however since they are configured for availability purposes, each RP4 must be capable of supporting the entire application load required by the EMs mounted in a particular GDM.

A number of special-purpose GDM variations exist. One variation is the GDDM which supports an Ethernet bus in its backplane and allows a certain amount of CP off-loading in that RPs may now communicate directly with one another via the Ethernet bus. Ordinarily, all RP-to-RP communication must be conducted via the CP.

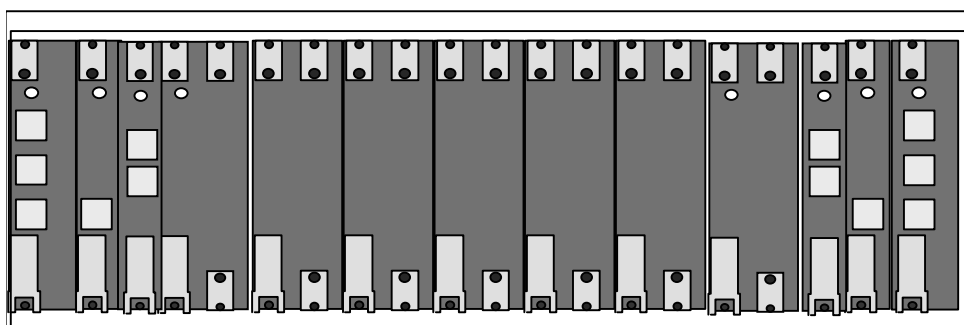


Figure 26. *Board types in a GDDM-H magazine for a PCU.*
From left to right: RP4-H, DLHB, EPS/EPSB, RPP_BASIC,
5 dummy fronts, RPP_BASIC, EPS/EPSB, DLHB, RP4-H.

The above configuration includes two EPS/EPSB boards suitable for a GPRS Packet Control Unit application.

Communication between the RPPs and the EPS/EPSB is performed by the OSE Link Handler protocol over the Ethernet link.

Each EPS/EPSB-DLHB pair takes two EM positions so that the number of additional EMs that may be mounted in the above GDDM is 14 (the space taken by 2 x 5 dummy fronts). Ten additional EMs may be configured (assuming that each EM consists of one board and that the RP4s are capable of carrying the load). Note that the operation of the EPS/EPSBs and the RPPs does not affect the load on the RP4s.

Unlike the GDM magazine which has space for 16 EMS, the GDDM magazine only has space for 14 EMs because of the space taken by the two EPS/EPSBs. The space may contain only 14 EMs or 7 RPPs. Alternatively, the space may contain a combination of RPPs and EMs.

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2.6.7 EMs and CMs

RP's that are members of the RP1 and RP2 families interface with telecom applications equipment (EMs and devices) via their EMBs.

Each of the EMs generally comprise one or more boards.

Every EM on an EMB has an address so that it could be accessed from an RP.

The actual software application that drives these EMs resides in the RP and is called a CM or Control Module.

These older EMs could be checked for fault conditions, could be blocked and unblocked and could be replaced when faulty.

Modern telecom application boards have a built-in RP, the EMB plus the EMs of the past no longer exist. Everything is packaged into one, and occasionally, into two or more boards.

The earlier relationship between CMs and EMs (see table below) is no longer valid and one application (that is, one CM) may now only be affiliated with only one EM. In effect, the EMB and the EMs have now been integrated into the board's hardware and/or software.

Essentially, the EM only exists as a configuration parameter used in the construction of an address conversion table so that communication can be carried out between the AXE's CP and the telecommunications devices located on the various application boards.

Up to sixteen different application EMs may be defined for any RP with the exception of the STC-E, STC-G and the RPBC. For the STC-E and the RPBC only 1 EM may be defined. For the STC-G 4 EMs may be defined.

The relationship between EMs per CM depends on RP group.

<u>RP group</u>	<u>EM/CM relationship</u>
RP1 and RP2	• Normally 1 EM/CM, meaning 16 EMs/RP. • It is possible to associate more than one CM with one RP application.
RPD, RPP, GEM-RP and RPI groups	• Restricted to one EM/CM. • It is not possible to associate more than one CM with one RP application.
STC-E	• 1 EM/STC-E (the remaining 15 cannot be used).
STC-G	• 4 EMs/STC-G (the remaining 12 are used for EMG control).
RPBC	• 1 EM/RPBC.

An RPBC is a combination of an STC-E and an STR.

Table 4. *EM and CM relationships as a function of RP group.*

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2.6.8 The EMRP

Two types of RPs exist – those that are connected directly to an RP bus, herein generally referred to as RPs, and those that are not directly connected to an RP bus, referred to as EMRPs.

EMRPs are the means by which various subscriber types are connected to an AXE exchange. These subscribers may be fixed analog telephone subscribers, mobile subscriber systems, ISDN subscribers, etc.

EMRPs are either located close to the exchange, as in the case of central subscribers – or located at some distance from the exchange, as is the case for remotely connected subscribers.

Please refer to Ref. 3, “SUBSYSTEM RPS-M REGIONAL PROCESSOR, EMG” description for a more detailed description of the EMG, the various EMRPs and their related equipment

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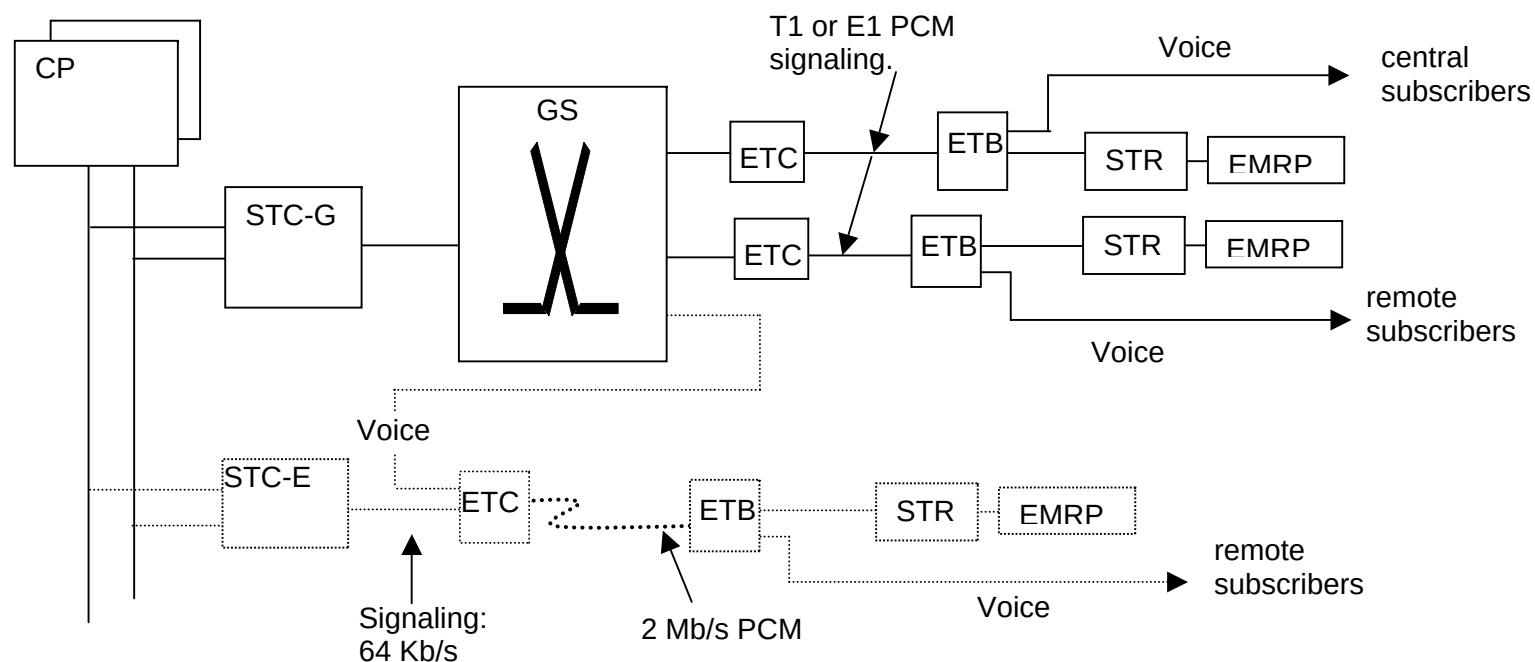


Figure 27. Replacement of the STC-E by the STC-G.

Remote subscribers are connected to an exchange via remote EMRPs that are in turn driven by STRs. These STRs were originally connected to the exchange via a 64Kbit/sec channel that was driven by local STC-Es (connected to the RP bus of the exchange).

The advent of the RPG (the hardware of the STC-G) allowed remote EMRPs to be connected via the exchange's Group Switch, whereby one of the digital time slots carries control information that is required by the remote EMRPs. The ETCs carry 32 time slots containing signaling and voice data in predetermined time slots. The ETBs extract time slots containing signaling information and transmits it to a remote signaling terminal (STR) for the control of the EMRPs. If required, the application can be assigned 1, 2 or 4, 64 kb/s PCM signaling channels. If the STC-G is based on the RPG3 then more than 4 channels can be assigned.

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2.6.9 The EMG

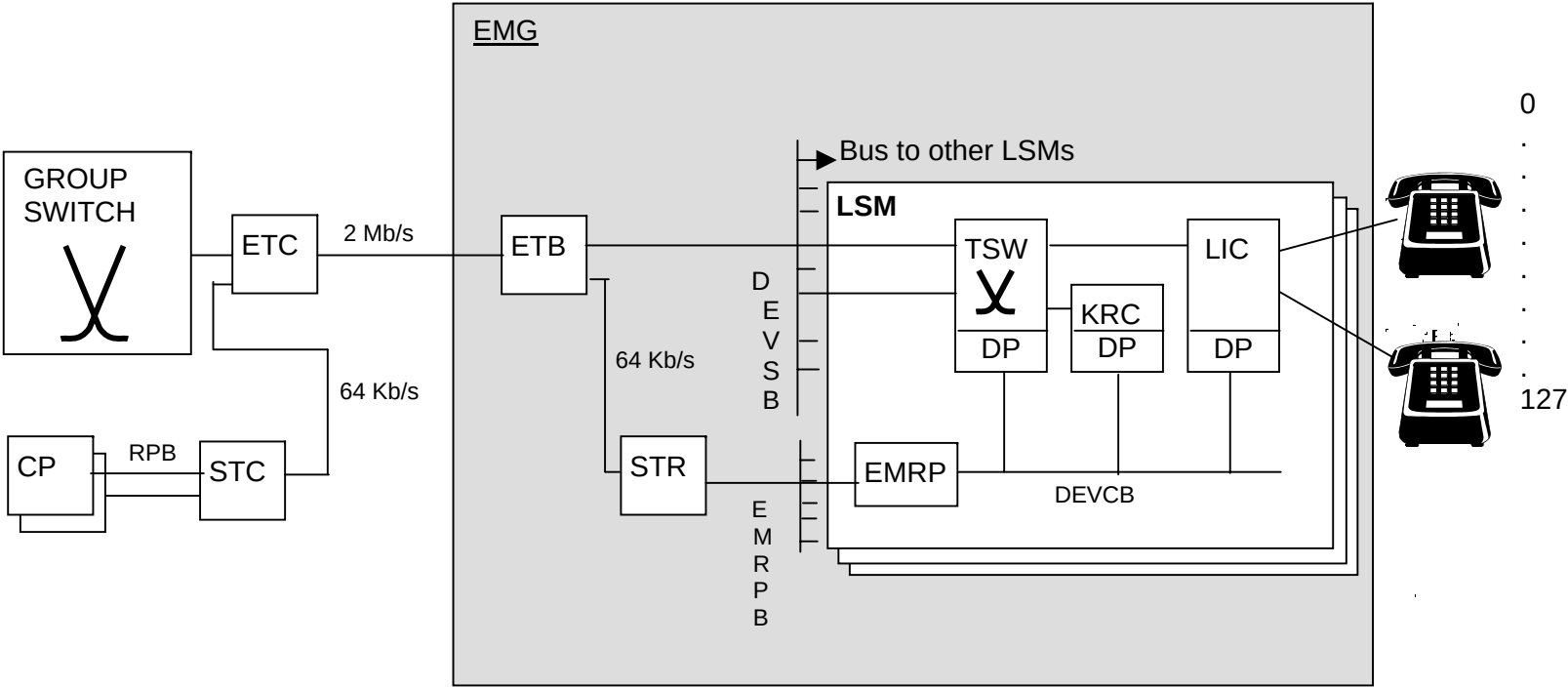


Figure 28. An EMG version.

The EMG version (EMG type 1) supported from 1 to 16 LSMs each containing 128 extensions giving a total of 2048 telephone subscribers.

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2.6.9.1 EMG type 1 vs. EMG type 2

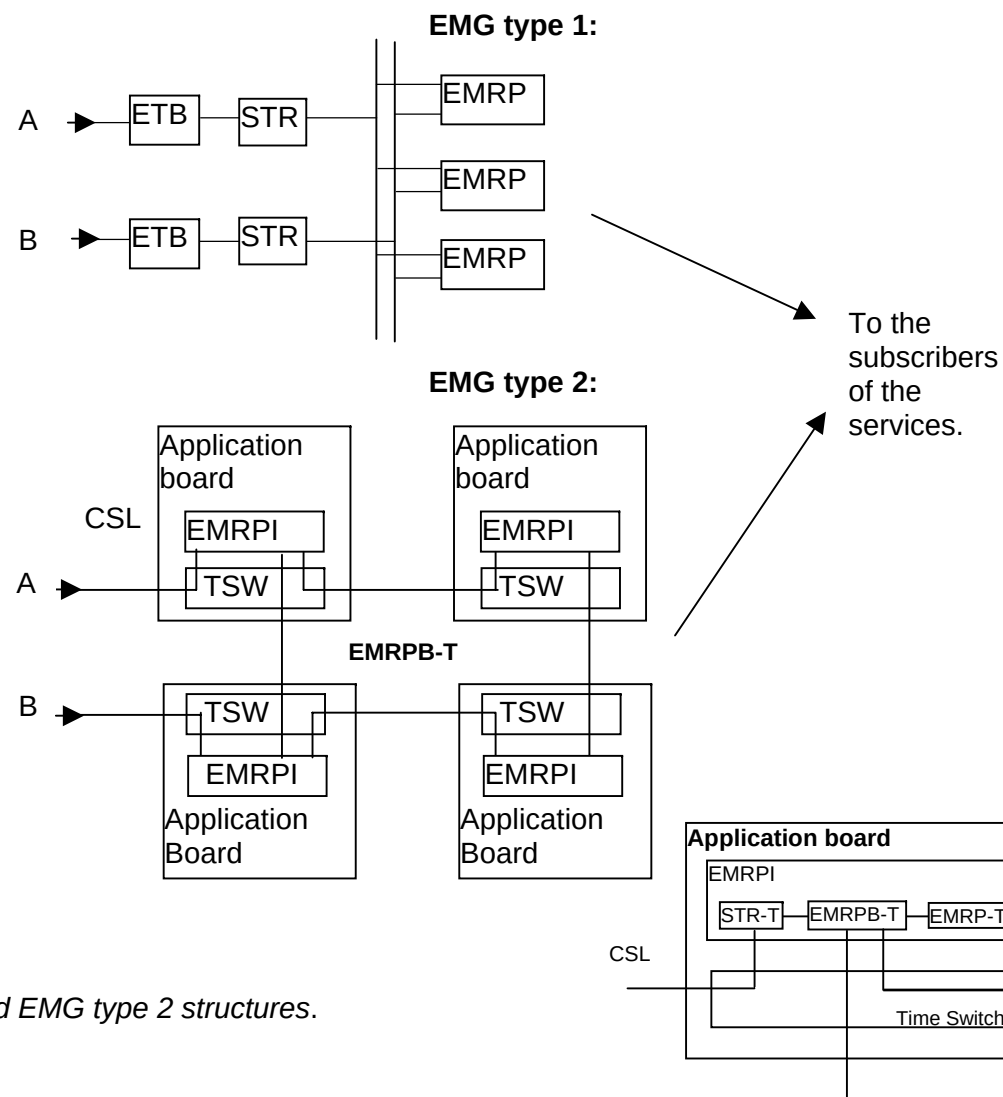
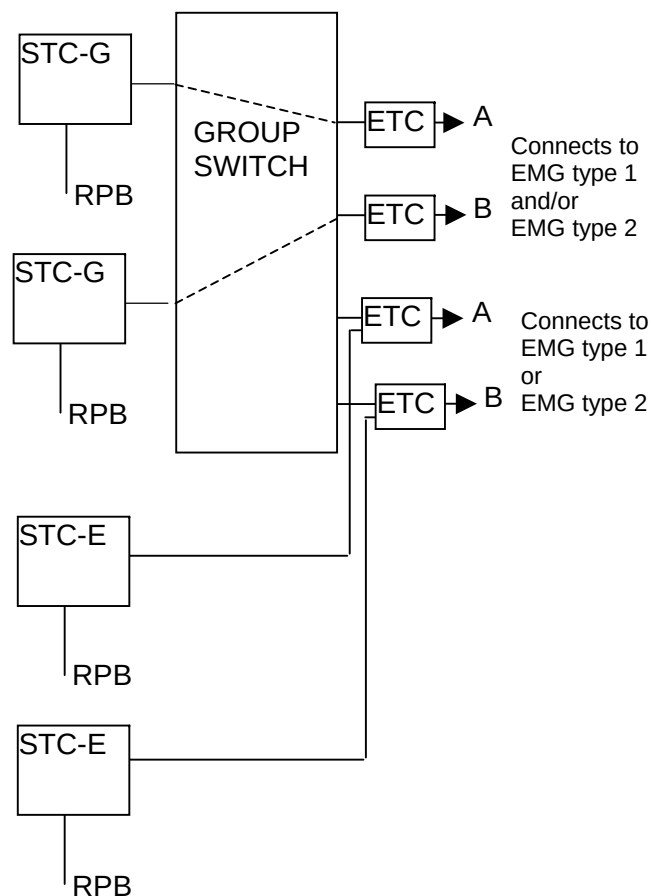


Figure 29. EMG type 1 and EMG type 2 structures.

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The primary objectives of the EMG type 2 development effort were to reduce the size and cost of the EMG control system.

These objectives were realized through:

- The integration of both the control system (in the form of a building block) and the application so that they reside on a single board.
- Control system signaling through the regional time switch.
- The implementation of the STR, EMRPB and the EMRP functions in one processor.

Possible applications areas for the EMG type 2 were originally seen in systems requiring a new and more advanced:

- Remote Subscriber Switch
- Radio Base Station

As shown in the Figure 27 above, the control path of a type 1 EMG connects the STC and STR and makes it possible to control processors of the EMRP-N and EMRP-D families.

The type 2 EMG is composed of an STR-T, an EMRPB-T and an EMRP-T.

The entire control system of a type-2 EMG is integrated into the application board. The STR-T, EMRPB-T and EMRP-T functions are included in one processor, the EMRPI.

Communication between the STR-T and the EMRP-T is provided for by the EMRPB-T which employs communication paths through the regional time switch. These communication paths consist of five time slots of the digital links (2 Mb/s) and are semi-permanently connected through the time switch. The time switch is part of, and is configured by, the application.

Communication with application hardware is performed through the regional time switch or via an open processor bus interface.

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EMRP group	Model(s)	OS	Type of EMRPB.	Some important attributes.	Building Practice	Most common application area(s)
EMRP-N	N = 1 2 3 4 42	- An in-house developed operating system - Released 1983 - Written in Plex-M	EMRPB-S (serial)	- Device Control Bus (DEVCB) - Serial transmission - Max 256 devices/EMRP - Devices and EMRP in same magazine	BYB202	Ordinary telephony, mobile and ISDN-PRA
EMRP-D	EMRPD EMRPS Originally for the USA & Japan.	- Based on OSE Classic - Released 1991 - C programming language Released 1993, otherwise same as above (see external communication facilities)	EMRPB-S (serial)	- DEVCB - Max 256 devices/EMRP - ISDN subscriber access applications connected to the processor bus for greater data throughput - Device Speech Bus (DEVSB), no DEVCB. Base station devices controlled by the EMRPS via its DEVSB interface for greater control-data throughput	BYB202	ISDN-BRA Mobile control
EMRP-T	EMRPI	- Based on OSE Delta - Released 1998 - C programming language	Time switch connected, EMRPB-T.	Time Switch connected	Not related to any particular equipment practice – to be integrated into an application's circuit board	Integrated ISDN plus analog telephony. Mobile control

Table 5. EMRP group attributes.

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2.6.10 The members of the Regional Processor Subsystem – a summary

RP CLASSIFICATION

<u>Group name</u>	<u>Products included in the group</u>
RP1	RP1 ³ , RWMRP ³
RP2	RP2 ³ , RP3 ³ , RP4 ²
RPD	RPD ³ , RPG ³ , RPG2 ² , RPG3 ²
RPP	RPP ¹ , RPPETA1 ²
GEM-RP	GARP ⁷ , RPALI ⁷ , SCB-RP ² , Application board with RPI ² , GESB ⁶
STC-E	STC ³ , STCE ³
STC-G	STCG1 ³ , STCG2 ² , STCG3 ²
RPBC	RPBC ³
RPI	RPI ² Building Block for application boards

EMRP CLASSIFICATION

<u>Group name</u>	<u>Products included in the group</u>
EMRP-N ⁴	EMRP1, EMRP2, EMRP3, EMRP4, EMRP4L, EMRP42
EMRP-D ⁴	EMRPD, EMRPS
EMRP-T ⁵	EMRPI

STR CLASSIFICATION

<u>Group name</u>	<u>Products included in the group</u>
STR-E ⁵	STRE
STR-T ⁵	STRT

Table 6. *RPS members.*

¹ Available for both the serial and parallel RP buses.

² Available only for the serial RP bus.

³ Available only for the parallel RP bus.

⁴ Connected to the RP bus via an STC-E, an STC-G or an RPBC.

⁵ Connected to the RP bus via an STC-E or an STC-G.

⁶ Used for switching Ethernet packages, not connected to any RP bus.

⁷ Can connect to RPB-S or RPB-E

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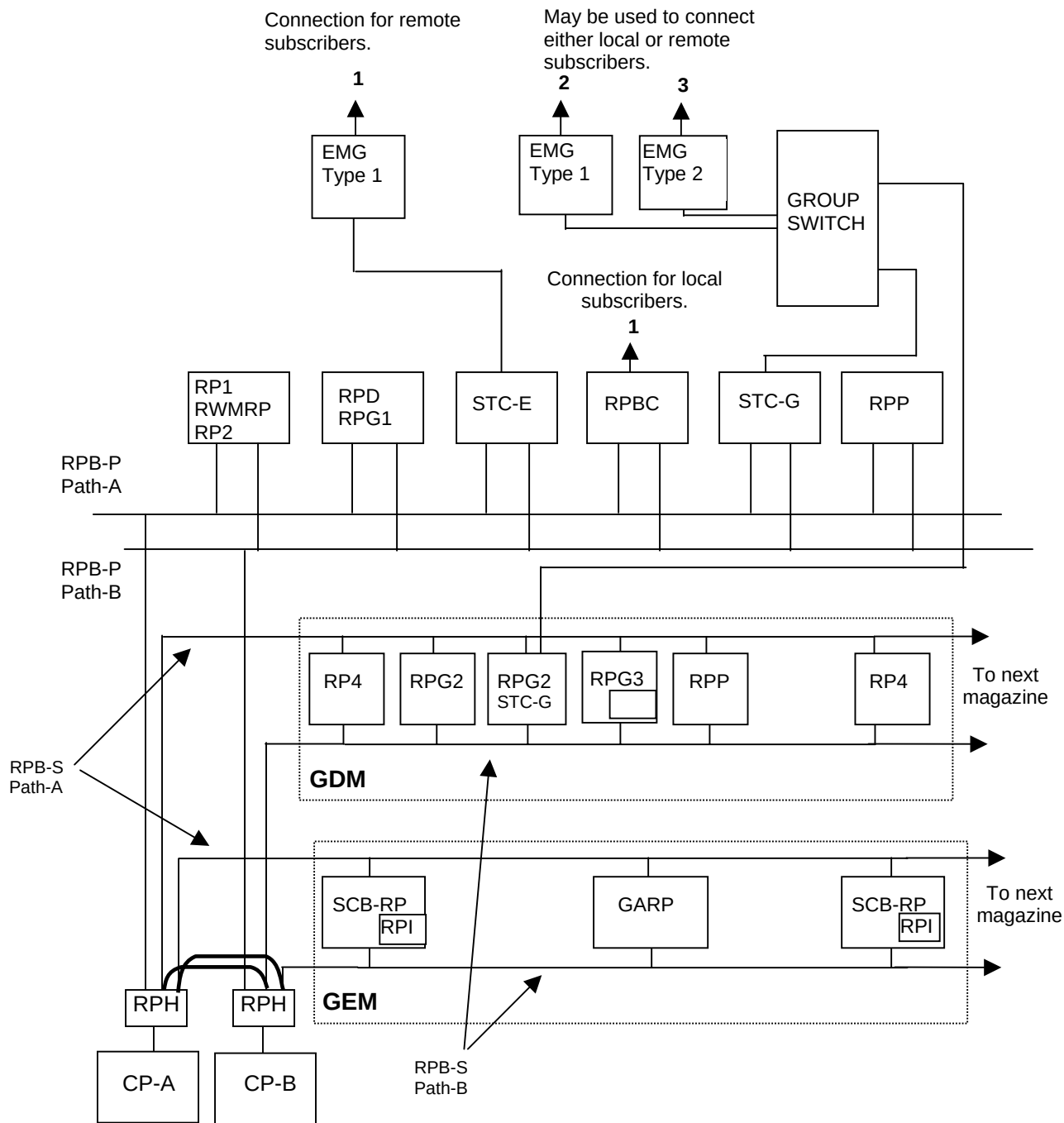


Figure 30. An illustration of the use of the different Regional Processor types. Traditional (RPB-P and RPB-S) bus types are shown

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In the above illustration, the alternative methods of connecting subscribers are designated as 1, 2 and 3.

Alternative 1 is the classic method.

Alternative 3, is another version of alt. 2, including improved redundancy, greater flexibility, smaller footprint and a high level of hardware integration.

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2.7 Interactions with other subsystems

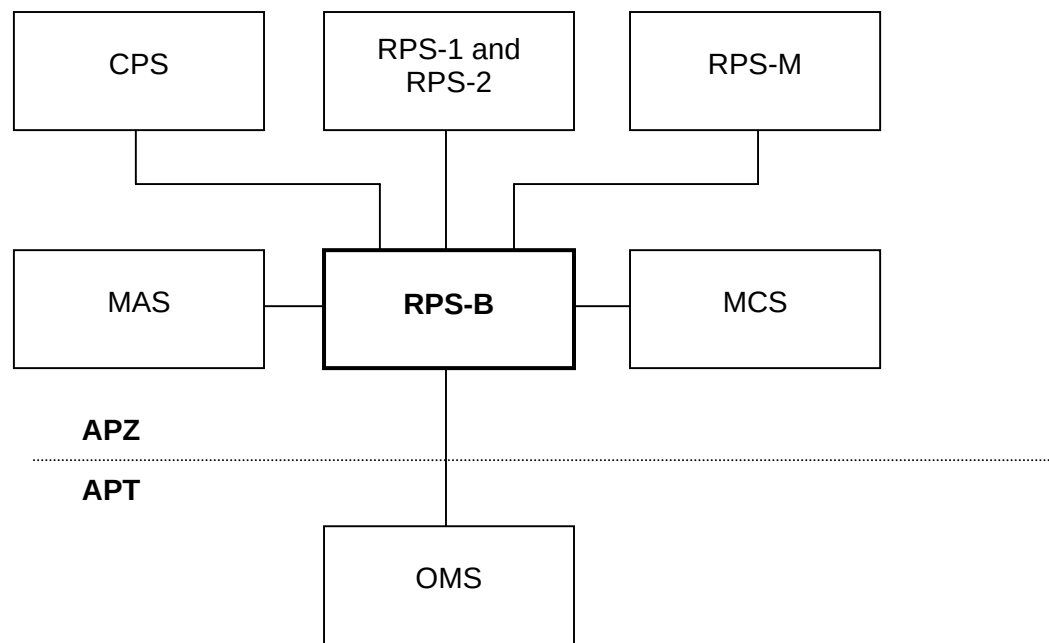


Figure 31. *RPS-B subsystem's interaction with other subsystems*

CPS	Central Processor Subsystem
MCS	Man-machine Communication Subsystem
MAS	Maintenance Subsystem
OMS	Operation and Maintenance Subsystem
RPS-1	Regional Processor Subsystem, executive variant 1
RPS-2	Regional Processor Subsystem, executive variant 2
RPS-B	Regional Processor Subsystem, Basic
RPS-M	Regional Processor Subsystem, EMG

Table 7. *Terms used in the above illustration.*

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3 FUNCTION SPECIFICATION SUMMARY

3.1 Function Specification Descriptions

RP support and maintenance programs are implemented in both central and regional software. These programs are described in more detail in Sections 3.2 and 3.3. They represent two major categories, support and maintenance.

Support functions	
Loading	- Administration of RSU in CP and loading of EMRP, RP and DP - APZ supported loading of PDSPL boards
Program output	Output of regional programs, backup copy function
Function change	Function change, change of EM in EMG and loadable RP
Function change of Regional Firmware	Function change, change of FLASH programs for GEM-RP, RPP and RPG1, RPG2, RPG3
Program correction	RP program correction
Program test	Debugger for RP and EMRP with REOS interface
Flow control	CP-RP signaling flow control
Maintenance functions	
Equipment and administration	RP administrative function
Start and restart	RP start function
Fault detection	RP error detecting function
Recovery	RP recovery function
Diagnosis	RP diagnostics function
Repair	RP repair function
Alarm	RP alarm function
Board Repair Indication	Board repair indication function in BYB501
Hardware Inventory	Hardware inventory function in BYB501
Magazine address supervision	Magazine address supervision
Magazine power supervision	Magazine power supervision
Supervision of RP intercommunication	RP intercommunication supervision function
Fan Supervision	Includes the monitoring of alarms and temperature. Reports to OMS. Not part of RPS.
RPB-E Supervision	RPB-E Network Maintenance function
GESB and SCB-RP Ethernet switch function	Ethernet switching in GEM

Table 8. RPS-B support and maintenance functions.

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3.1.1 Support Functions

3.1.1.1 Loading, Administration of RSU in CP and loading of EMRP, RP and DP

This section deals with those portions of the loading function that are related to the commands and printouts that are common to the loading of both RP and EMRP programs.

Loadable software resides on an external medium, such as, tape cassette, floppy, hard or optical disc. The software is loaded from the external medium to the Central Processor's Program Store (CP-PS).

RSUs (Regional Software Units) are allocated to be loaded into an EMRP or RP either by means of an operator command or via a preprogrammed script. The programs are automatically transferred (loaded) to the EMRP or RP when the unit is placed into operation. Such program transfer always occurs in connection with the power-up of the processor or in connection with the occurrence of a checksum fault. The aforementioned program transfer only occurs if the program is not resident in the Secondary Flash File System. In other cases, such as in the case of an operator command to deblock an RP or EMRP, program transfer may or may not occur, depending on the circumstances.

In other words, when starting or restarting an EMRP or RP, RSUs are only loaded/reloaded from the CP when necessary. Software is reloaded in the case of a checksum fault, because the software that resided in the RP is no longer considered reliable and must therefore be reloaded.

The loading function consists of the following subfunctions:

- The reading of EMRP or RP programs from an external medium to
- the CP-PS and the allocation of entries in the Regional
- Software Unit table.
- The handling of EMRP or RP programs stored in the CP-PS, including the commands and printouts required for the identification of the software-units' properties.
- The loading of RP programs to one or more RPs in accordance with the order received from the maintenance function.

The loading rate is regulated to account for traffic load.

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3.1.1.2 Loading, APZ supported loading of PDSPL boards

This function is applicable only to the RP4.

This loading function is activated by the user "Enhanced loading of DP/DSP program for PDSPL applications".

The RP Administrative function will inform the user in conjunction with the deblocking of an EM and the RP Repair function will inform the user in conjunction with the repair of an EM. A load is performed if requested by the user.

The DSUs (Device Software Unit) must be previously stored in CP-PS by command. The DSUs may either be compressed or non-compressed. In the case of a compressed DSU, decompression must be performed by the application.

A DSU can be removed from CP-PS by command. Removal is performed if the DSU download process is not in progress.

It is possible to have up to eight simultaneous DSU downloads. However only one download may be active per RP at a time.

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3.1.1.3 Program output, Output of regional programs, backup copy function

Program output allows an RP or EMRP program to be saved. The function is initiated via an operator command, whereby the RP or EMRP program unit(s) is (are) stored to an external medium, for example, tape cassette, floppy or hard disc. One or more program units can be stored to an external medium at the same time.

3.1.1.4 Function change, change of EM in EMG and loadable RP

Function Change is used in connection with RP or EMRP software changes as well as for hardware changes that are closely associated with software changes. Hardware changes that are independent of, and that are not in any way related to software changes, are performed without the aid of the function change system - in which case ordinary blocking and deblocking commands are used.

To begin with, the new software is loaded into the CP.
At this point, any hardware that is to be replaced is blocked via operator command, and the hardware replacement process is carried out.

Next, function change is executed. First, the CP sides are separated (to make it possible to revert back to the old system in the event of a fault). The RP software-change can now be performed by restarting the system.

The method described here is referred to as Method 1 - there exists another system for function change which is referred to as Method 2 that entails a side-switch.

Similarly, EMRP software is changed by restarting the EMRP.

A trial operation period is initiated following the performance of the function change – if successful, the CP is once again returned to parallel operation.

Older RP versions (members of the RP1 and RP2 families) normally work in pairs in order to minimize traffic-handling disturbances caused by RP faults. Function change implies first updating one of the RPs in the pair and then switching EM control so that the other RP may be updated. This process does, unfortunately, cause a brief disturbance each time control is switched between the RPs of the pair. The disturbance involves the disconnection of calls that are in the dialing state for the RP in question.

Modern RPs (starting with the RPD) no longer operate in pairs. In order to minimize the time required when performing a function change, the RP is generally loaded with the new program code while still in operation – referred to as pre-loading. The RP is then ordered to restart and the new code is put into operation. Naturally all ongoing communication is lost during the brief period required to stop and restart the RP.

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In certain cases where communications loss is considered unacceptable and function change only involves the modification of RP software (that is, no software change is required centrally in the CP) a technique referred to as Sequential Program Change may be used. In essence, this process involves informing the application that a function change is about to be made and that the application should gracefully switch its use of the RP to one of the spare RPs. RPs can therefore be updated sequentially without any noticeable affect on ongoing traffic handling.

There is also a brief disturbance when an EMRP is loaded with new program contents. Again, the disturbance involves the disconnection of calls that are in the dialing state for the EMRP in question.

3.1.1.5 Function Change, change of FLASH programs for GEM-RP, RPP and RPG1, RPG2, RPG3

The function allows fault corrections and function upgrades of RP firmware. The new firmware is packed in a Firmware Replacement Package (FRP). The FRP contains and replaces all the firmware previously loaded. It is also possible to change or add optional parameters.

Change of RP firmware has currently been performed by a hardware change of the RP boards.

With this function it is possible to handle RP firmware as loadable software, which means it is possible to upgrade RPs from the CP instead of having to order new RP boards. This improves the speed and logistics to introduce and deploy fault corrections and functional upgrades of the RPs.

The function is divided in three phases, Specification, Execution and Conclusion.

One RP can only have one FRP defined under the specification phase. However it is possible to include different FRPs (to different RPs) within one upgrade session.

The execution of firmware replacement is performed, without a system restart, without separating the CP sides and in sequence, one RP at the time.

The execution is interrupted if the upgrade in one RP fails. In this case the operator can either end the whole upgrade or continue the execution.

Handling of FRP is described in Ref. 4.

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3.1.1.6 RP program correction

This is a facility that allows a command to initiate the read/write of a program's binary code. This function may be performed on program code that is residing in the RP or in the CP (that is, the function may also be performed on the copy of the software unit that resides in the CP).

The Program Correction function is only implemented for members of the RP1 and RP2 families. The function supports the reading and writing of regional software.

Reading may be performed for both RP1 and RP2 programs.

Writing (patching) may only be performed for RP1-RWMRP and RP2 programs.

Note that if the patch is performed to the RP-PS copy then any reload of the program from the CP will result in the original (non-modified) version residing in the RP.

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3.1.1.7 Debugger for RP and EMRP with REOS interface

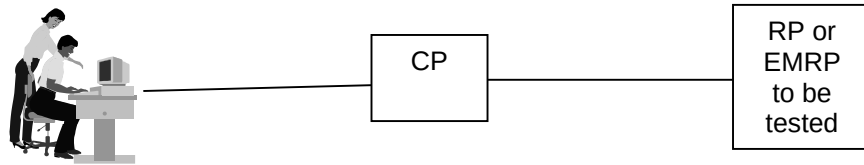


Figure 32. *RP and EMRP testing.*

The debugger interface makes it possible to access the system debuggers (included with all RPs and EMRPs that have the REOS interface) from an AXE I/O device.

3.1.1.8 RP2 program test administration

See figure 32 above.

A CP program receives operator issued test commands (Test System commands) which in turn interfaces with the RP program environment that is to be tested. The results of test and software traces are output to the operator.

3.1.1.9 CP-RP signaling flow control

This function makes it possible to control CP to RP signaling capacity during system restart. Its function is to avoid RP buffer congestion and to maximize CP resource utilization so as to reduce system restart time.

The function provides a means for keeping track of the number of signals sent during a certain time interval to EMRPs and RPs during system restart.

Allowable signaling intensity to EMRPs and RPs is a function of the type of EMRP and RP connected. This information is available to the function.

In order to control signal flow, the application will ask the function if sending is permitted before sending signals to an EMRP or RP. The application will then receive an immediate answer if sending is permitted. If any of the signal control levels exhibit signal intensities that are above a given threshold level then sending will not be permitted.

If sending is not permitted the application is not held in a wait state, that is, it may then take other actions. For example make a request to send to another address.

When the sending is permitted, the application is allowed to send a number of permitted signals to the requested EMRP or RP address. Thereafter, a sort of suspension period is in effect, during which fewer or no signals are permitted to be sent to that EMRP or RP.

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3.1.2 Maintenance Functions

3.1.2.1 Equipment and administration, RP administrative function

The RP administrative maintenance function includes:

- Functions for defining and removing regional hardware o and software.
- The establishment of signal interaction and the collaboration between programs in the CP and those in the RP.
- The printout of data that defines regional hardware and software.
- The blocking and deblocking of an RP or an EM.
- The change of RP type (applies to a limited number of RP types connected to the RPB-P).

3.1.2.2 RP start function

The start function controls the start or restart sequences for all RPs in connection with the performance of a system start or a system restart. Two restart sequences exist, a minimal and a complete restart sequence.

The "minimal" sequence is selected for the majority of system restart situations that occur during the operation of an exchange.

This is to ensure minimum impact on exchange traffic handling.

RPs in the state "Automatically Blocked" are not started.

During the minimal sequence both OS and applications are running but RP applications are prohibited from placing any signals in the RP outbuffer (no RP->CP application signaling allowed).

The objective of the "complete" sequence is to set the system in a reliable and well-defined state. This sequence attempts to place RPs that were in the state "Automatically Blocked" back into service again.

It is possible to mix these RP start sequences – meaning that certain RPs follow a minimal restart sequence and others follow a complete restart sequence. RPs that are restarted as a result of the execution of a function change (meaning that a new RSU is to be loaded) will always follow the complete restart sequence. All other RPs in the exchange will be restarted according to the minimal start sequence.

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3.1.2.3 Fault detection, RP error detecting function

The occurrence of a fault in a deblocked RP can be detected either by the CP-RP test-signaling routine ("echo-test") or by the RP supervisory functions. Processor functions are tested via internal fault detection programs that are run on a regular basis.

A fault in an EM will be detected by means of the "echo-testing" of all deblocked EMs connected to an EMB. This is part of the routine testing that is built into an RP.

The EM test is only performed by those RPs for which a physical EMB exists.

3.1.2.4 RP Recovery Function

The primary purpose of the recovery function is to ensure that all the EM user equipment can be returned to full operation as rapidly as possible following the detection and correction of an RP fault. Faults that are not successfully corrected result in a blocked RP.

In connection with the detection of a fault in an RP, all EM users are temporarily stopped. At this point, the recovery process is immediately initiated.

All recoveries and their causes are recorded in an event log used by the diagnosis function.

3.1.2.5 RP diagnostics function

The diagnosis function contains an event log in which all faults and significant, RP and EM, events are recorded.

In connection with the repair process, an analysis of the above mentioned log is performed that facilitates the identification of the faulty circuit board.

Upon a request from the recovery function the diagnostic function will check the RP's error rate.

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3.1.2.6 RP repair function

The function handles both RP and EM faults.
Repairs are carried out based on alarm printouts in combination with Operational Instructions (OPIs).

A repair check is performed after the replacement of a faulty board. If the repair was successful, the alarm will be reset and the repaired equipment will be restored to operation.

Three commands are issued in connection with the repair process:

- Initiate diagnosis and board indication
- Block the board while repair is carried out
- Initiate the repair check and the deblocking of the board

A printout is associated with each of the above commands.

In any case, an RP or EM alarm indication must be present for the particular unit before a repair process may be started. An RP repair may also be initiated if an RP bus fault alarm exists.

Since the RPS HWI function is continuously scanning the status of all boards located in GDM and GEM magazine-types, it is relatively simple to determine whether any configuration changes have been made to these magazines. (This scanning mechanism is explained in further detail in the section covering HWI, Hardware Inventory Function).

An OMS function allows the O&M operator to follow the replacement process by requesting information from the RPS HWI function regarding configuration changes that occur during the replacement process.

3.1.2.7 RP alarm function

The alarm function autonomously handles all RP and EM alarms. The function is informed by other functions in connection with an RP or EM change of state. By checking the alarm patterns and the state of the RP or EM, the alarm function is able to determine whether an alarm is to be generated or removed.

Alarm class varies, depending on the extent of operational disturbance. EM alarms only occur for RPs that include EMB functionality.

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3.1.2.8 Board Repair Indication

All boards designed for the BYB 501 equipment practice must include a MIA LED (Manual Intervention Allowed Light Emitting Diode). The BRI function therefore only applies to RPs and EMs that are mounted in BYB501 cabinets.

The purpose of this function is to light the MIA LEDs of boards that may be removed from their magazine positions without causing undue traffic disturbances. A board's LED is lit so that it may be easily identified even by non-technical persons.

OMS is contacted when the MIA LED of an EM is to be lit.

3.1.2.9 Hardware Inventory

All circuit boards located in the BYB 501 equipment practice have an on-board PROM containing Hardware Inventory (HWI) information. This function will read this information and store it in a database table.

BYB501 magazines and boards are adapted to a MB in the magazine backplane. Each MB is also connected to an RP (an RP4 or SCB-RP). The RP can read HWI data from the boards in the magazine.

As discussed in section 2.6.5, "The Maintenance bus (MB)", the HWI sequence is the third scanning sequence related to the MB.

A special magazine that also could be located in the BYB 501 equipment practice is the fan magazine. The RP is capable of reading HWI data from the boards in the fan magazine.

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3.1.2.10 Magazine address supervision

RP bus branches are designed to support a maximum of 32 RPs. GDM magazines contain a special strap board, often referred to as an address plug, that sets the address of the magazine. Address range is 0 to 15, since each GDM contains at least two RPs (RP4s), and a total of 16 magazines amounts to 32 RPs. To this end, the strap board contains five pins, of which four are address bits (which allows for a maximum of 16 magazines) and one is a parity bit. Naturally if the magazines connected to a given RP bus branch contain additional RPs, over and above the two RP4s found in each GDM, then less than 16 magazines may be connected to one and the same RP bus branch and not all magazine addresses will be used.

GEM magazines have three such strap boards of which the first has the same function as in the case of the GDM. The second and third are used for Group Switch configurations.

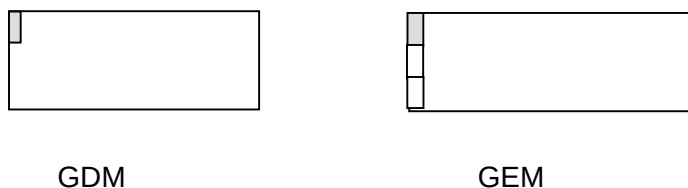


Figure 31. *GDM and GEM magazine address plugs.*

The strap boards provide the magazine with a unique magazine address for the particular RP bus branch to which the magazine is connected.

In order to be assured that the magazine address plugs will be readable in the event that a total restart is required, they are recurrently read by each of the magazine's RP4s or SCB-RPs. If the address plug has been removed or if a fault has occurred, then one or both of the RP4s (or SCB-RPs) will register the occurrence and then inform the CP of the situation - which will result in an alarm.

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3.1.2.11 Magazine power supervision

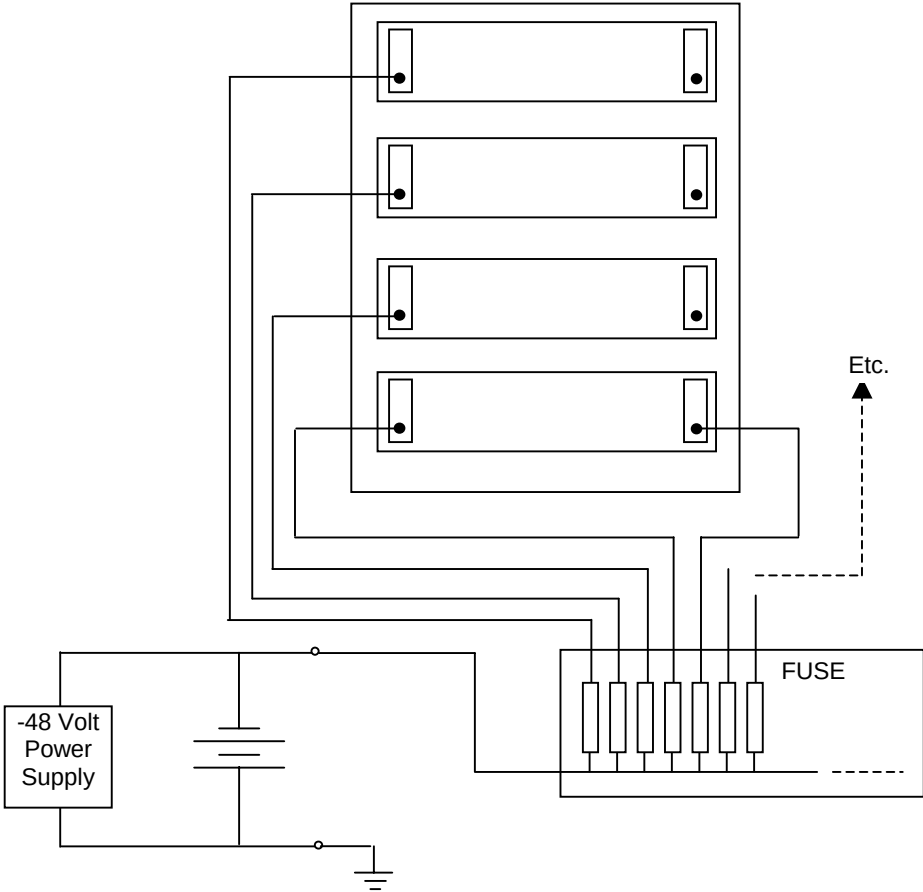


Figure 34. -48 volts is fed to each of the RP4s as shown above.

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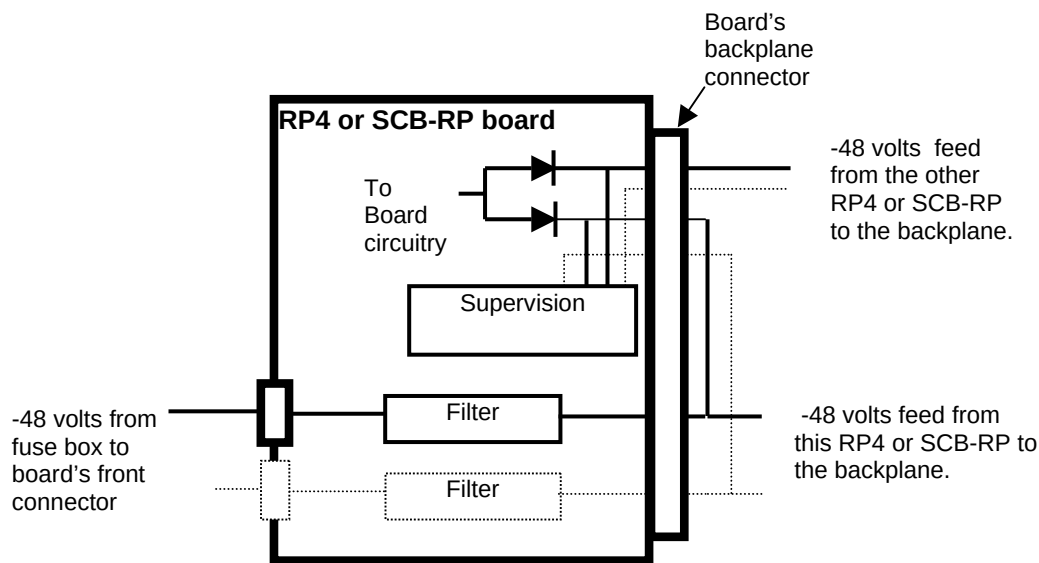


Figure 35. RP4 and SCB-RP -48 voltage supervision.

Each RP4 or SCB-RP will monitor the -48 voltage feeds and will, in the event of a power loss, inform the CP which will result in an alarm.

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3.1.2.12 RP intercommunication supervision

The following only applies to RPs that support RP-to-RP Ethernet communication, for example the RPP.

The main purpose of the RP Intercommunication Supervision (RPIS) function is the supervision of Ethernet communications between the RPs in an RP Intercommunication Group (RPIG). The function logs errors and issues alarms in the event of faults. It also provides RP Intercommunication Nets (RPIN) status reports to applications on a demand basis. The function includes operational procedures for the repair of faulty equipment and is intended for maintenance personnel and designers.

The supervisory function is separated from real network communications. RP intercommunication supervision utilizes the link handler function provided by the RP's Operating System. Several independent applications may use the same RPIG.

RPIGs are created by means of two database tables resident in the CP.

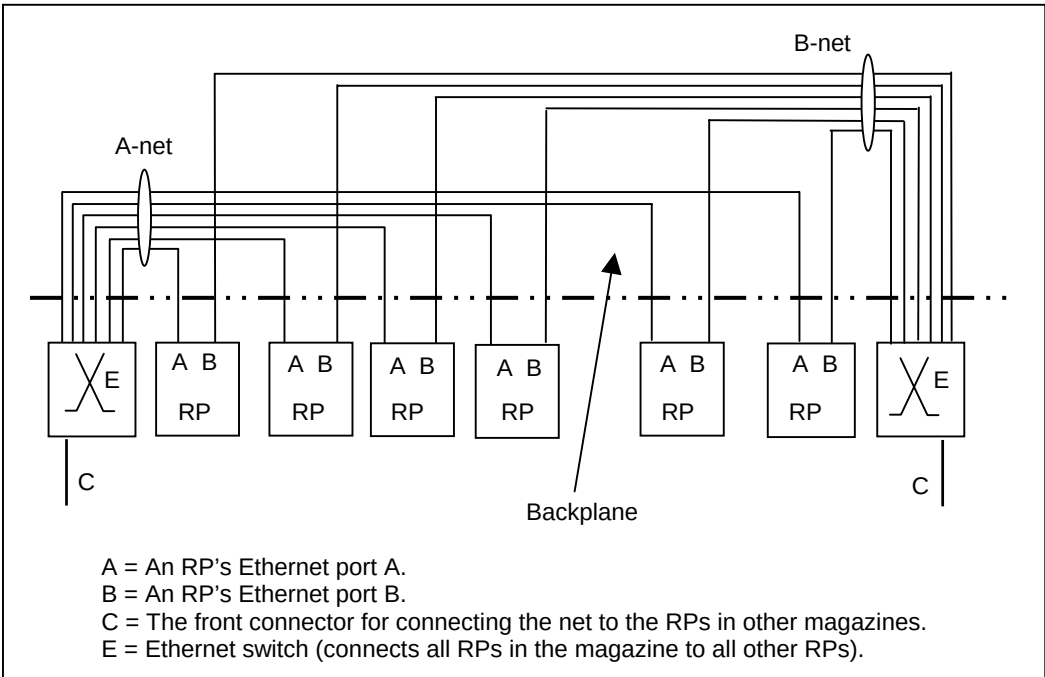


Figure 36. Example of a GDDM Ethernet configuration.

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Communication faults occurring between RPs are analyzed in order to localize the fault and to determine the actions to be taken. Network status is reported to the applications on a demand-basis via the RP Intercommunication Net Status interface.

Important events are registered in an event log.

An RP Intercommunication Group Fault alarm is initiated in the event of a network fault. OPIs are available that support the corrective action necessary to remedy the fault.

3.1.2.13 RPB-E Network maintenance function

The principles for bus supervision differ between the bus types.

The classic CPs (up to APZ 212 3x) consists of two parallel executing processors. Normally, one is working executing and the other is working standby. That means that both parts of the CP must receive the same information from the RPs. For the parallel bus this is solved by connecting one bus path to the CP WO/EX and the other path to CP WO/SB and that the RPs always are sending on both bus paths. As both CP parts are working in parallel both parts are sending signals to the RPs. The RPs always ignores the signals from the WO/SB part of the CP. By matching the information from the two CP parts any malfunctions of the bus can be detected.

The principle for the serial RP bus is slightly changed from the one for the parallel bus. The CP parts are still working in parallel but the RPH only transfer the signals from the WO/EX CP part to the RPs. To verify correct function of bus the traffic is regularly switched between the bus paths.

The principle for the Ethernet based RP bus (RPB-E) is completely changed from the two others.

1. The bus is only implemented on the APZ 212 40 and its successors, which are non-parallel working CP.
2. Both bus paths are used at the same time.
3. Between each RP and both CP parts two separate logical links are established. One active and one redundant logical links per RP are established. The active and the redundant logical link are never running on the same bus net.
4. A link switch to the redundant link is automatically performed when the active link fails.
5. An alarm is always raised when a link failure occur independent if the interruption has affected the active or its redundant link.

The task for the "RPB-E Network Maintenance Function" (RPNM) is to raise an alarm and to identify faulty RPB-E network units in a situation when the CP cannot communicate with several RPs on RPB-E.

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RPNM will interact with the protocol function (TIPC) in the CP side where it executes.

The RPNM block will subscribe on information from TIPC regarding changes in the communication status on RPB-E.

If one or several links becomes "Not Working" an alarm is raised to indicate that something is wrong. In case of link failure the protocol will automatically switch over to the Standby link and continue the communication. It is possible to print out the link status for all links between CP and all RPB-E connected RPs in order to see the overall CP-RP communication. An OPI guides the operator to find the most likely error location.

3.2 List of Function Specifications

FUNCTION SPECIFICATION	DOCUMENT NUMBER
ADMINISTRATION OF RSU IN CP AND LOADING OF EMRP, RP AND DP	10/155 17-ANZ 212 12
APZ SUPPORTED LOADING OF PDSPL BOARDS	28/155 17- ANZ 212 08
BOARD REPAIR INDICATION	26/155 17-ANZ 212 08
CP-RP SIGNALING FLOW CONTROL	23/155 17-ANZ 212 08
DEBUGGER FOR RP AND EMRP WITH REOS INTERFACE	16/155 17-ANZ 212 12
FUNCTION CHANGE, CHANGE OF EM IN EMG AND LOADABLE RP	14/155 17-ANZ 212 12
FUNCTION CHANGE OF REGIONAL FIRMWARE	4/155 17-ANZ 212 12
MAGAZINE ADDRESS SUPERVISION FUNCTION	11/155 17-ANZ 212 12
MAGAZINE POWER SUPERVISION FUNCTION	15/155 17-ANZ 212 08
OUTPUT OF REGIONAL PROGRAMS, BACKUP, COPY FUNCTION	14/155 17-ANZ 212 08
RP ADMINISTRATIVE FUNCTION	7/155 17-ANZ 212 12
RP ALARM FUNCTION	8/155 17-ANZ 212 08

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RP DIAGNOSTIC FUNCTION	7/155 17-ANZ 212 08
RP ERROR DETECTING FUNCTION	15/155 17-ANZ 212 12
RP INTERCOMMUNICATION SUPERVISION	22/155 17-ANZ 212 08
RP PROGRAM CORRECTION	12/155 17-ANZ 212 05
RP RECOVERY FUNCTION	16/155 17-ANZ 212 08
RP REPAIR FUNCTION	9/155 17-ANZ 212 12
RP START FUNCTION	13/155 17-ANZ 212 12
RPB-E NETWORK MAINTENANCE FUNCTION	17/155 17-ANZ 212 12

Table 9. *RPS-B function specifications.*

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3.3 Miscellaneous Function Specifications

SUB SYSTEM	FUNCTION SPECIFICATION	DOCUMENT NUMBER
RPS-2	RPPETA1, REGIONAL PROCESSOR FOR ETA-155	1/155 17-ANZ 212 14
	RPG3, REGIONAL PROCESSOR WITH GROUP SWITCH INTERFACE	2/155 17-ANZ 212 14
	GARP SOFTWARE FUNCTIONS	3/155 17-ANZ 212 14
	Ethernet switching in GEM	5/155 17-ANZ 212 14
	RPALI Software functions	6/155 17-ANZ 212 14
	RPP, REGIONAL PROCESSOR WITH PCI BUS	7/155 17-ANZ 212 14
	PROGRAM TESTING IN RP2	10/155 17-ANZ 212 05
	LOAD PROTECTION IN RP2	13/155 17-ANZ 212 05
	RPD HARDWARE FUNCTIONS	3/155 17-ANZ 212 10
	RPG, REGIONAL PROCESSOR WITH GROUP SWITCH INTERFACE	6/155 17-ANZ 212 10
	BYB501 EQUIPMENT PRACTICE HARDWARE IN NONE RPB-S ADAPTED APZs	8/155 17-ANZ 212 10
	RP RESTART DUMP FUNCTION	9/155 17-ANZ 212 10
	RPI, Regional processor Integrated	11/155 17-ANZ 212 10

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RPS-M	GS CONNECTED CONTROL SIGNALING LINK	1/155 17-ANZ 212 15
	EMG ADMINISTRATIVE FUNCTIONS	2/155 17-ANZ 212 15
	EMG RECOVERY FUNCTION	3/155 17-ANZ 212 15
	PROGRAM CORRECTION IN EMRP	3/155 17-ANZ 211 02
	WITH SIMULATED LINK INTERRUPT	5/155 17-ANZ 211 02
	EMRPD HARDWARE FUNCTIONS	1/155 17-ANZ 212 11
	OPERATING SYSTEM FUNCTIONS FOR EMRPD	3/155 17-ANZ 212 11
	OVERLOAD PROTECTION (OLP), EMRPD	4/155 17-ANZ 212 11
	CONTROL SIGNALING LINK	6/155 17-ANZ 212 11
	EMG EM RESTART DUMP FUNCTION	11/155 17-ANZ 212 11
	EMG FAULT DETECTION FUNCTIONS	12/155 17-ANZ 212 11
	EMG REPAIR FUNCTION	14/155 17-ANZ 212 11
	EMG ALARM FUNCTION	16/155 17-ANZ 212 11
	EMRPI REGIONAL CONTROL SYSTEM, INTEGRATE	17/155 17-ANZ 212 11
	EMRPI – EMRP-T, EMRP CONNECTED TO THE REGIONAL SWITCH TIME-SWITCH	18/155 17-ANZ 212 11

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	EMRPI – STR-T, SIGNAL TERMINAL REMOTE, TIME- SWITCH CONNECTED	19/155 17-ANZ 212 11
	EMRPI – EMRPB-T, EMRPB CONNECTED TO THE REGIONAL TIME SWITCH	20/155 17-ANZ 212 11
	PROGRAM TEST IN EMRP	21/155 17-ANZ 212 11
	EMG START FUNCTION	4/155 17-ANZ 212 15
	EMG DIAGNOSTIC FUNCTION	24/155 17-ANZ 212 11
	PROTOCOL FOR CONTROL SIGNALING LINK	2/155 17-ANZ 215 01
	EXECUTIVE FUNCTIONS	3/155 17-ANZ 215 01
	EXECUTIVE FUNCTIONS IN STR	4/155 17-ANZ 215 01
	EXECUTIVE FUNCTIONS IN STC	5/155 17-ANZ 215 01
	EMERGENCY TRAFFIC FUNCTIONS	6/155 17-ANZ 215 01
	PROTOCOL FOR CONTROL SIGNALING LINK	7/155 17-ANZ 215 01

Table 10. *Miscellaneous function specifications that affect RPS-B.*

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4 IMPLEMENTATION

4.1 Support Functions

4.1.1 Loading, Administration of RSU in CP and loading of EMRP, RP and DP

Deals with the loading of the writeable memories employed in members of the EMRP-N, EMRP-D, EMRP-T, RP2, RPD, GEM-RP, RPP and RPI groups plus the RWMRP.

Also deals with preloading:

- For all EMRP members with the exception of members of the EMRP-N group.
- All RPD group members with the exception of the RPG and RPG2 products.
- All members of the RPP, RPI and GEM-RP groups.

The loading of writeable memories in DPs is also supported.

Ordered by command, EMRP-, RP- and DP-programs are read from load media and stored in CP-PS.

The RSUs residing in CP-PS are copied to program stores in the EMRP and RP when so ordered from the RP- or EMRP- maintenance function or from the regional function change. If an RSU is to be preloaded, the RSU may also reside on an IO device, thus eliminating the need to store the RSU in CP-PS. If the RSU is stored in compressed form on the CP, decompression will take place in the target processor.

Several loading/preloading processes can execute in parallel.

An EMRP loading/preloading process consists of the loading/preloading of one RSU to one or several EMRP within the same EMG that is (or are) accessed by the same control link.

For members of the EMRP-T and RP groups such as the RPP, RPI, GEM-RP and the RPG3 only those RSUs that are changed need be reloaded. Such is the case when a function change is performed or in the event of a checksum error. In the case of members of all other RP/EMRP groups, all RSUs are reloaded even if, in reality, only one of them requires reloading.

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The function is implemented as follows:

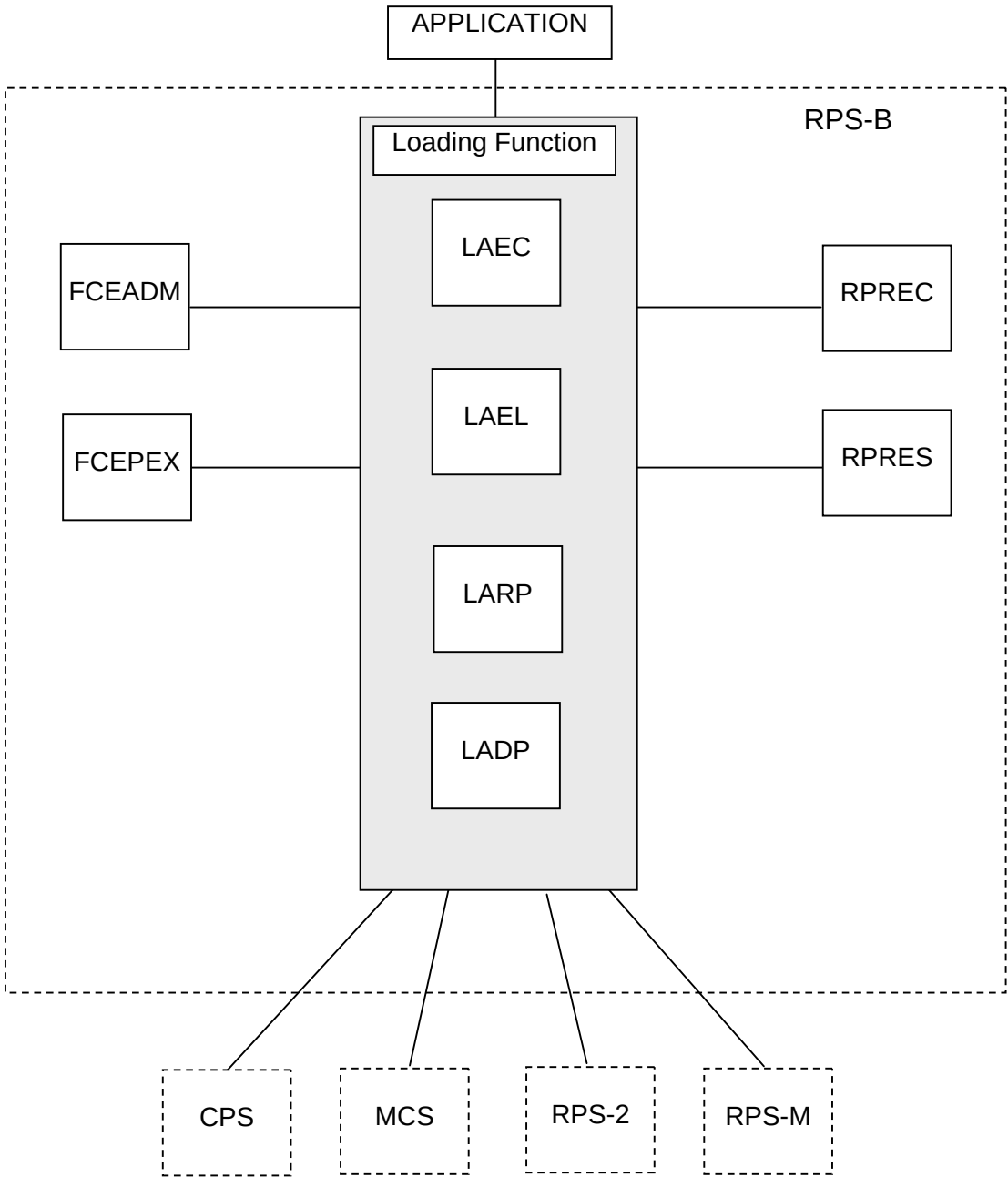


Figure 37. Loading function interwork.

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LADP

- Includes APZ support for loading of device processors connected to RPs and EMRPs.
The load can be initiated by the command or by a request from the application.
- Includes commands for the handling of ties between the device software units and the application block and/or equipment.

LAEC

- Receives and analyzes commands.
- Administers the RSUs and the device software units.
- Handles product identities.
- Includes service functions for the identification and printout of the names/identities of software units.

LAEL

- Stores and deletes RSUs and device software unit information.
- Supports the reading of regional program code stored in CP-PS or directly from an IO device when loading or preloading an RP or EMRP.

LAEO

- Receives, analyses and executes commands for printout of data concerning the RSUs and the device software units.
- Prints out information concerning the regional program products that are loaded in the CP.

LARP

- Upon the request of the start or recovery functions RP program code is transferred to the indicated RP.
- Handles the preloading of RPs that are members of the RPD, RPP, GEM-RP, RPI and STC-G groups with the exception of first-generation RPGs (RPG and RPG2). The load is performed by loading program code from CP-PS or directly from an IO device. Function Change requests the load.
- Deals with orders from the maintenance functions, and transmits program codes from the CP to the RP.

FCEADM

Initiates the conversion of the SU pointer.

FCEPEX

Orders the preloading of EMRP-D, EMRP-T and processors in the RPD group, except first generation RPGs, during normal program execution.

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RPREC

Orders loading of RP in case of recovery.

RPRES

Orders loading of RP in case of start/restart.

CPS

- Controls audit functions. Orders calculation of global checksums.
- Contains the audit function that orders the control of the CP-PS checksum.

RPS-M

- Includes OS functions for the different EMRP types.
- Receives and stores OS-information. Also stores program information in flashprom memory if such memory exists in the EMRP.
- Loads RSU into the EMRP while the EMRP is in passive mode.
- Loads the correction area (patch area) into the EMRP-N.
- Preloads RSU into an EMRP-D/EMRP-T upon the request of Function Change.

MCS

Transfers load information from CP to EMRP through STC-E or STC-G (IO-transfer) at loading and preloading EMRP.

RPS-2

- Includes the operating systems for different RP types that include the REOS interface.
- Receives and stores OS-information located in RP reference table and program information in RP program store. Also stores program information in flashprom memory if this exists in the RP.

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4.1.2 Loading, APZ supported loading of PDSPL boards

This function supports the loading of DSUs from CP-PS into the regional part of the user function “APZ Supported Loading of PDSPL Boards”. The load is activated by the user.

The function is initiated in connection with the repair or deblocking of an EM (that is, by the Repair or Administrative Functions).

The PDAL1 block is an OS user and is different from an EM user which ordinarily handles a telecommunications related issue. When an EM is deblocked, a check is performed as to whether or not there exists a function containing a specific function code (FCEMDBLOREQ). If such an RSU exists, a check is made as to whether or not DPs require reloading. If so, then PDAL1 (the owner of the function code) requests that a load be performed.

The function is implemented as follows:

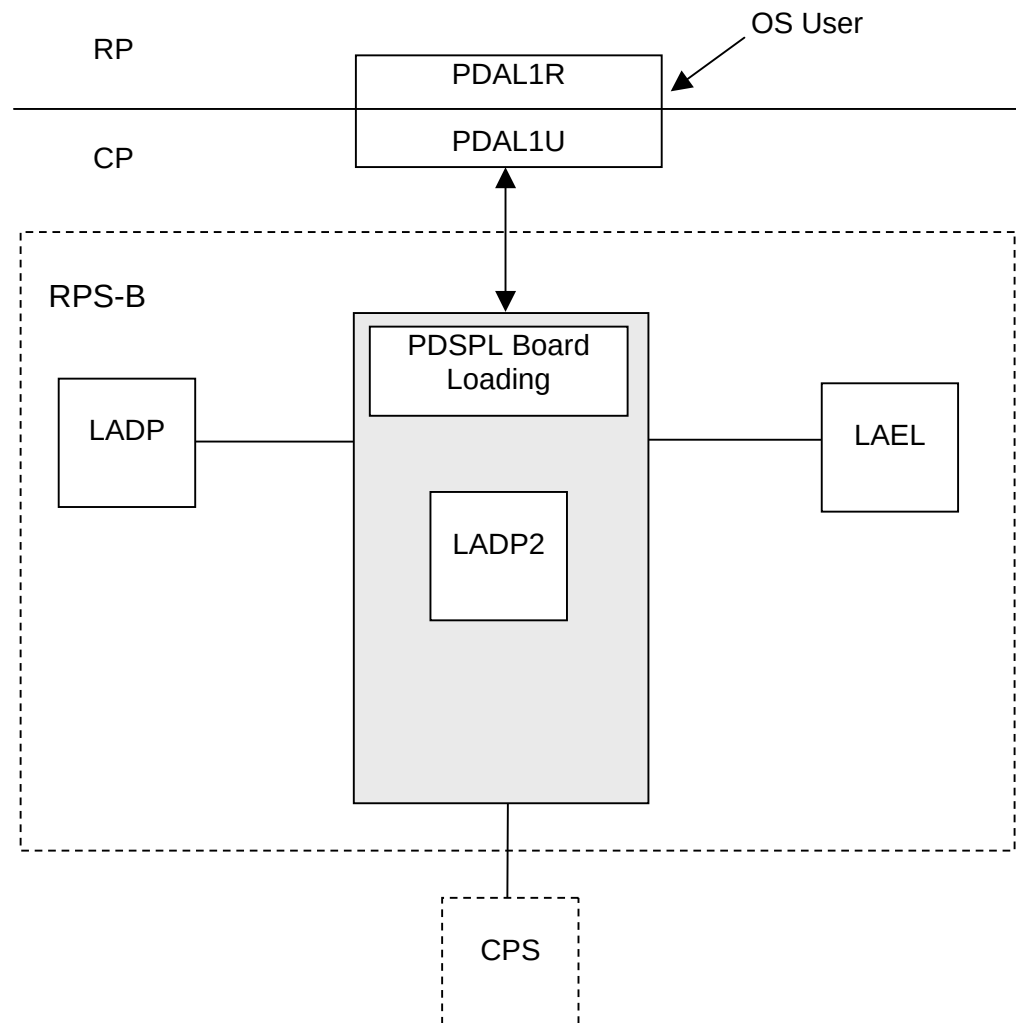


Figure 38. PDSPL board loading interwork.

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LADP2

Block functionality is described above.

LADP

Provides information concerning the DSU.

LAEL

Provides information concerning the RSU.

PDAL1 (user)

Block functionality described above.

CPS

Contains service functions for reading DSU program code stored in CP-PS.

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4.1.3 Output of regional programs, backup copy function

This function enables the output of one, several or all RSUs stored in the CP to an optional file-orientated outer media. All output information is fetched from the CP copy of the regional program.

The function is implemented as follows:

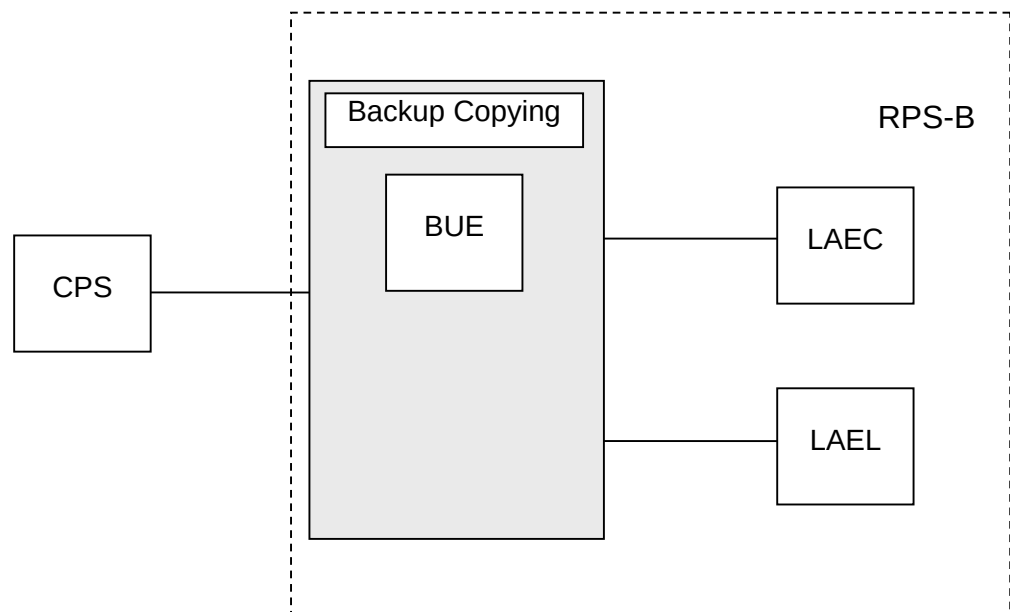


Figure 39. Backup copying function interwork.

LAEC

Administers RSUs stored in CP. Contains service functions for analysis of command parameters as well as other service functions for accessing RSUs.

LAEL

Contains service functions for reading of program, data, file and variable information to all RSUs stored in CP.

CPS

Contains service functions for reading program code stored in CP-PS.

BUE

Receives, analyzes and executes the command for output of RSUs. Prints output result.

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4.1.4 Function change, change of EM in EMG and loadable RP

Regional function changes of EMs in EMG or loadable RPs is used in conjunction with the replacement or regional software or the addition of new regional software.

Software replacement can be coordinated with any changes that are required in the corresponding EM-HW.

The regional function change can be performed independently from, or coordinated with, a function change of central software.

The function is implemented as follows:

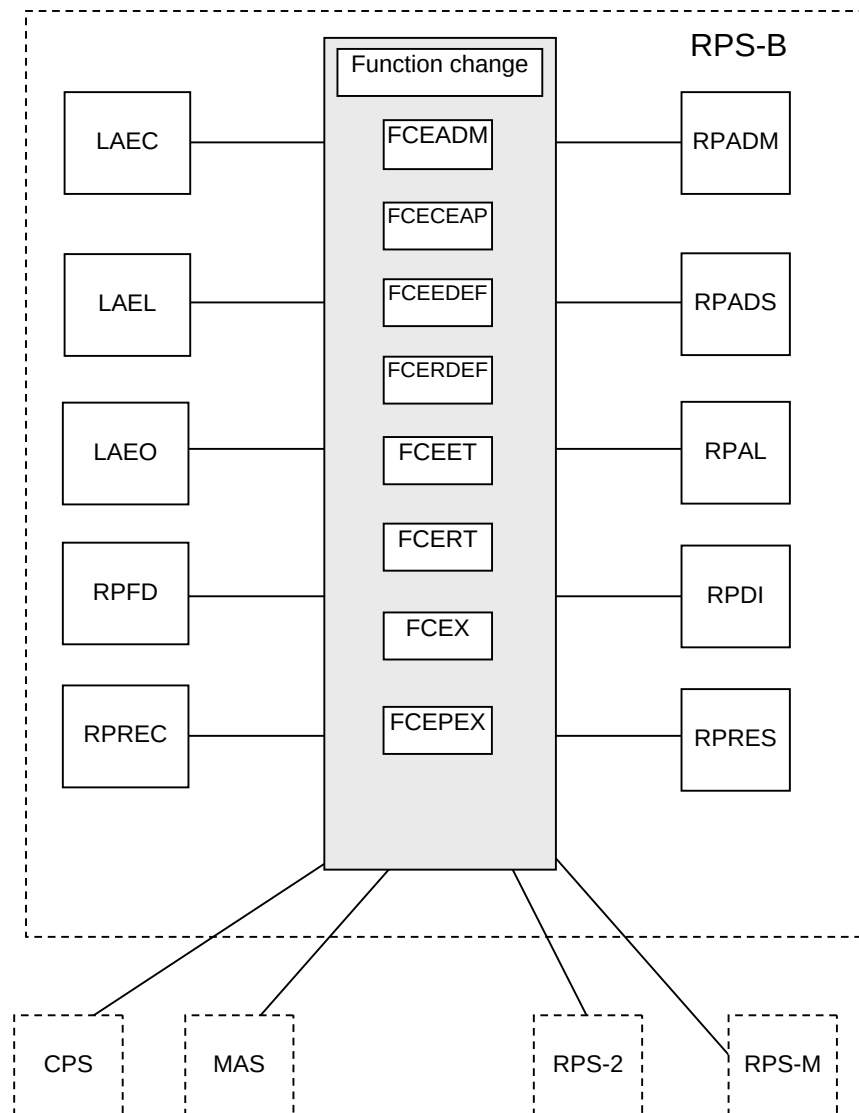


Figure 40. Function change interwork.

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FCEADM

- Operator input commands are checked by this block.
- Operator input commands are checked to ensure that they conform to OPI specifications.
- Administration of the regional function change-state is performed by this block.

FCEPEX

Performs the RSU pre-load.

FCECEAP

Executes most of the commands and produces most of the printouts.

FCEEDEF

- Performs an analysis of commands in which EMG function changes are either specified, changed or deleted.
- Handles the man-machine dialogue in connection with the definition of a function change pertaining to an EMG EM.

FCERDEF

- Performs an analysis of commands in which RP function changes are either specified, changed or deleted.
- Handles the man-machine dialogue in connection with the definition of a function change pertaining to an RP EM.

FCEET

- Stores all information concerning EMG function changes.
- Stores the function change definition tables for EMG EMs.

FCERT

Stores all information concerning specified RP function changes.

FCEX

- Executes function changes for both RPs and EMGs.
- Executes function changes for RPs and EMGs for function changes in which a CP system restart has not been requested.

LAEC

Executes command for loading of RSU file content.

LAEO

Prints RSU information.

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The following blocks provides services to the regional FC function to carry out the function change.

LAEC

Deletes unconnected RP and EMRP RSUs from CP-PS.

LAEL

Provides information about RSUs.

RPADM

Handles RP administration such as operating and maintenance state functions

RPADS

- Provides information to EM owning blocks in connection with blocking, deblocking and restart of RP EMs.
- Handles modifications of RSUs during the execution of a function change.

RPAL

Handles alarms for RPs and RP EMs

RPDI

Event numbers for RP events

RPRES

Starts RPs and RP EMs

RPS-M

- Handles operating and maintenance state functions for EMG EMs and STRs
- Loads RSUs to EMRPs
- Supplies information about memory availability for the pre-load function.
- Handles modifications of RSUs during the execution of a function change.

CPS

Handles FC methods 1 and 2.

RPS-2

- Loads RSUs to RPs
- Supplies information about memory availability for the pre-load function.

MAS

- Provides information on CP operation state

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4.1.5 Function change, change of FLASH programs for GEM-RP, RPP and RPG1, RPG2, RPG3

Function change of RP Firmware is used for fault corrections and function upgrades of RP Firmware.

The function is similar to function change of loadable Regional Software Units (RSU).

The firmware that shall be changed is included in an RSU together with software that handles the unpacking and switch-in of the new firmware. The package, called FRP, contains all software programs and possible optional parameters that should be replaced even if some of the software programs are not changed.

Function Change of RP Firmware and other function changes must not be performed at the same time.

The function is implemented as follows:

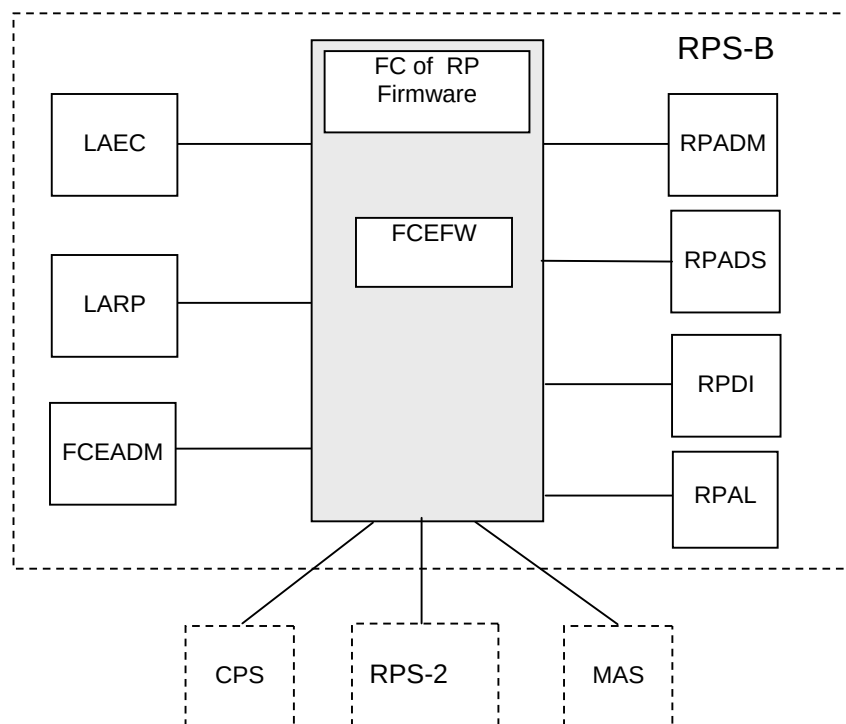


Figure 41. Function change of firmware interwork.

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FCEFW

This is the main block in this function

- Handles all commands and printouts.
- Holds data files for specification of firmware change cases and results.
- Controls the execution of the firmware function change.

FCEADM

FCEADM is the main block for the RSU function change function.

LAEC

Handles RSUs in the Central Processor Program Store. It stores information of the RSU such as type, identity and block.

LARP

Deals with orders from the maintenance functions, and transmits program code from the CP to the RP.

RPADM

Includes RP administration information such as RP maintenance state, RP state and RP tables.

RPADS

Includes services for changing FRP definition in RP tables and administers start of RP including updating of an FRP.

RPAL

Handles alarms for RPs and RP-EMs

RPDI

Handles RP and RP-EM diagnostics. It stores detailed information about RP and RP-EM events.

RPS-2

Includes the operating systems for different RP types that include the REOS interface.

Receives and stores OS-information located in RP reference table and program information in RP program store. Also stores program information in flashprom memory if this exists in the RP.

CPS

Central Processor Subsystem, where the service function for division of integers is used.

MAS

CP Maintenance Subsystem, which handles system restarts and has service functions to read CP states.

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4.1.6 RP Program correction

This block analyzes and executes commands for writing to and reading from RP program memories.

The function is implemented as follows:

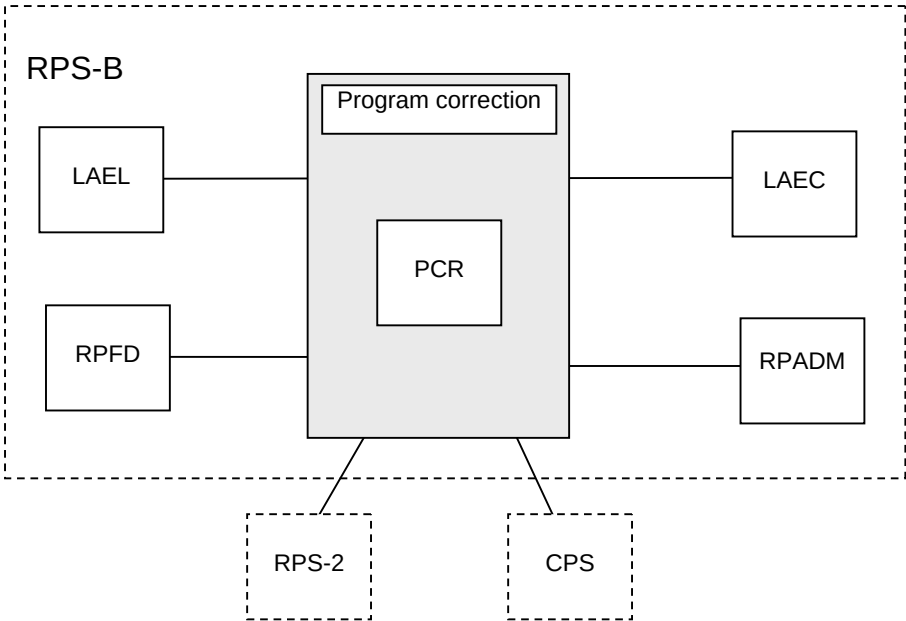


Figure 42. *Program correction function interwork.*

PCR

The primary block for the function (see above description).

RPFD

Involved in the deactivation and restoration of the program checksum controls.

RPADM

Involved in the general administration required for the read/write process.

LAEC

Interfaces with the operator commands to extract command parameters.

LAEL

Contains information concerning the specified RSU's program volume and checksum.

RPS-2

OS functions included in RP2 group.

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CPS
Involved in the CP process for the reading/writing of the RSU.

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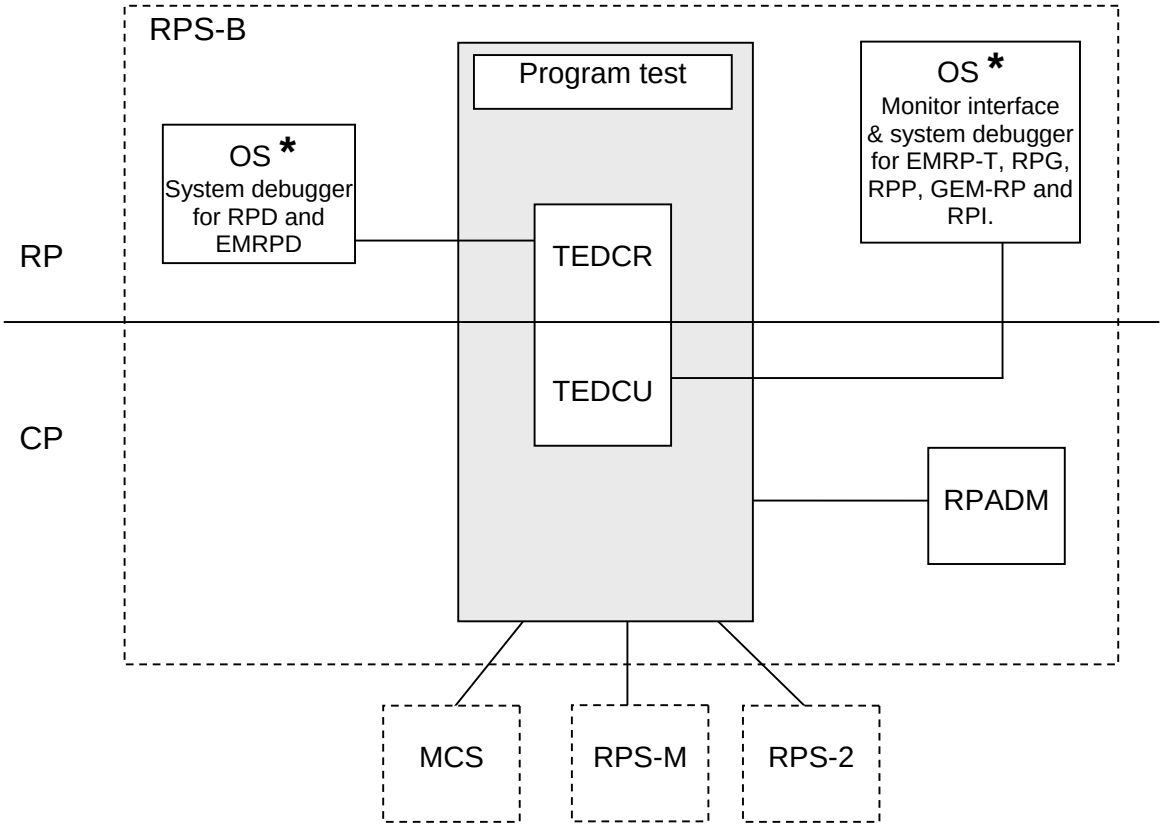
4.1.7 Program test, Debugger for RP and EMRP with REOS interface

This function applies to all RPs and EMRPs with REOS interface.

The function makes it possible to use the RP/EMRP system debugger and monitor in the RP/EMRP.

A command is used to establish a path between the IO device and the RP/EMRP system debugger and monitor. As the path is opened, the operator works in a dialogue mode and can use RP/EMRP system debugger and monitor commands. The path between the IO device and the RP/EMRP system debugger and monitor is closed by a dialogue command.

The function is implemented as follows:



* RP OS functions are included in RPS-2.
EMRP OS functions are included in RPS-M.

Figure 43. Program test interwork.

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TEDC

Makes it possible to use the system debugger from an AXE 10 device when testing an RP or EMRP with REOS interface.

RPADM

Involved in the general administration required for the RP test process.

RPS-2

- Includes OS functions including those for RPs with REOS interface.
- Supports debugger activities for the RPD, the RPP, RPG and the RPI processors.

RPS-M

- General administration required for the EMRP test process.
- Includes OS functions including those for EMRPs with REOS interface.

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4.1.8 RP2 program test administration

The function is implemented as follows:

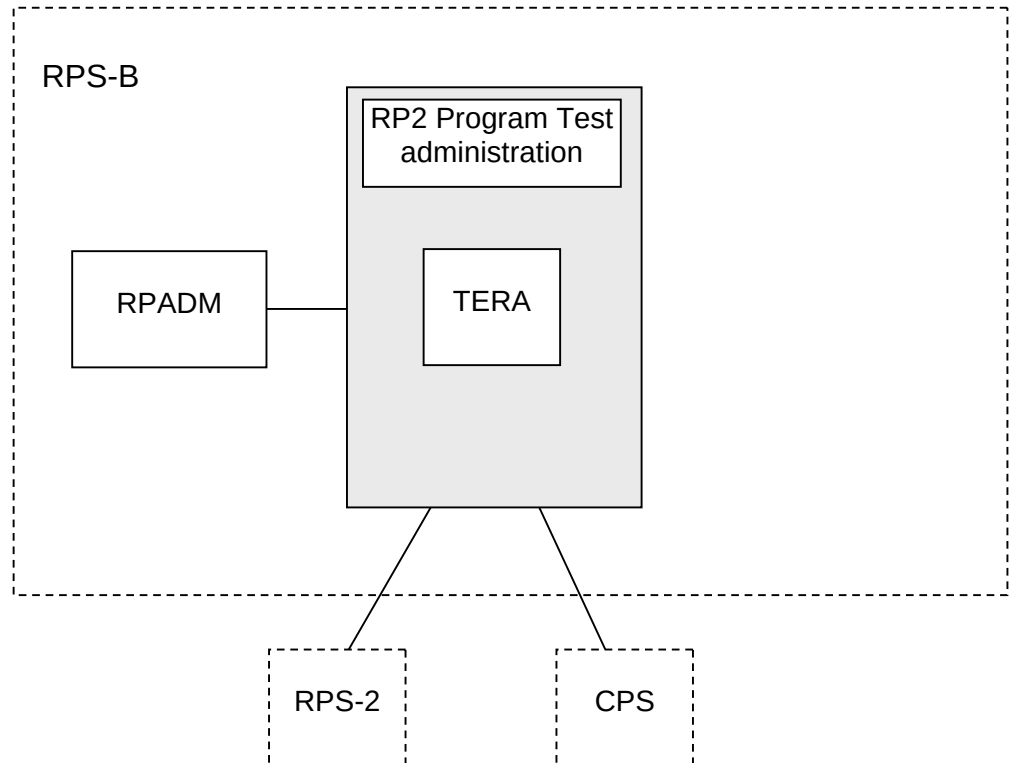


Figure 44. *RP2 program test administration interwork.*

TERA

Contains administrative functions required for software testing when members of the RP2 group are involved.

The CP contains a set of commands that are used for the test of CP programs. TERA allows a subset of these commands to be used for the testing of RP2 software.

RPADM

Handles RP administration such as RP properties.

RPS-2

This function, which is optional, facilitates the testing of RP2 software by providing the user with the ability to manipulate data and to trace events by means of commands.

CPS

Includes the CP software test system that is fully integrated with RP2 program test facilities.

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4.1.9 Flow control, CP-RP signaling flow control

This function implements the ability to control the signaling rate between the CP and RP during system restart (applies to APZ 212). This APZ flow control function will allow the user to send signals at a rate that all processors along the signaling path can cope with. The intention is to avoid RP buffer congestion and to maximize user resource utilization during system restart.

The function is implemented as follows:

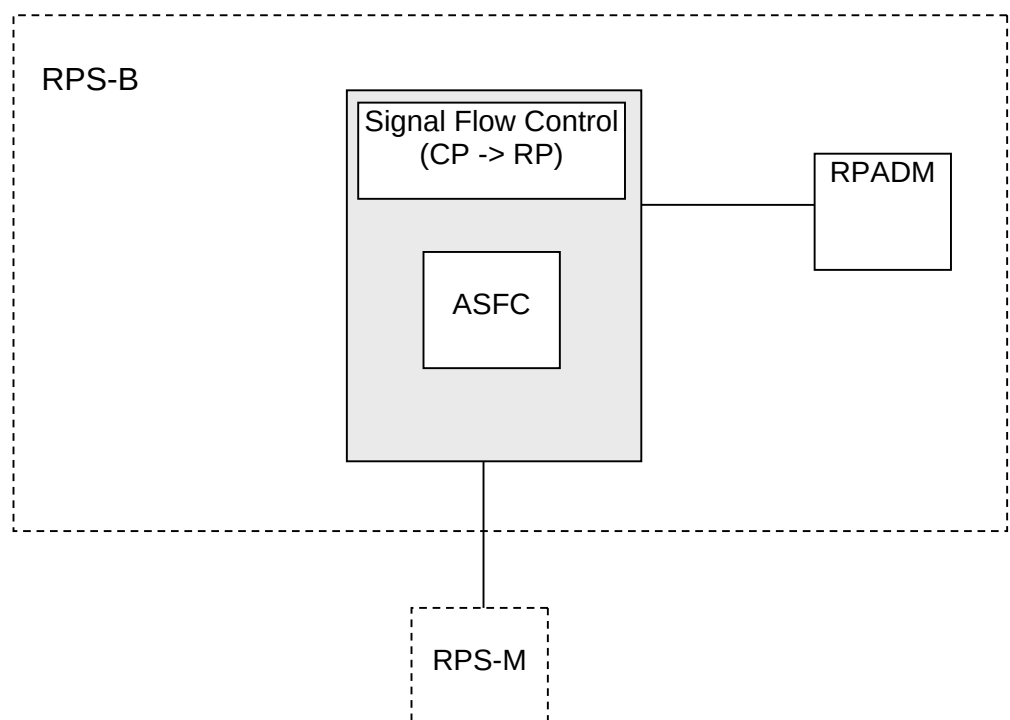


Figure 45. *CP -> RP signal flow control during system start/restart interwork.*

ASFC

Keeps track of the signaling intensity of signals sent from the CP to each and every RP. This applies to all RP group types.

RPADM

Contains all data stored for RP and supplies routines for reading these data.

RPS-M

Administration of Control Signaling links.

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4.2 Maintenance Functions

4.2.1 Equipment and administration, RP administration function

The administrative maintenance part of the RPS consists of functions for the establishing of signaling connections between EM applications in the CP and RPs.

To accomplish this, functions for the definition and undefining of RPs and EMs are required, as well as printing and other service functions.

The function is implemented as follows:

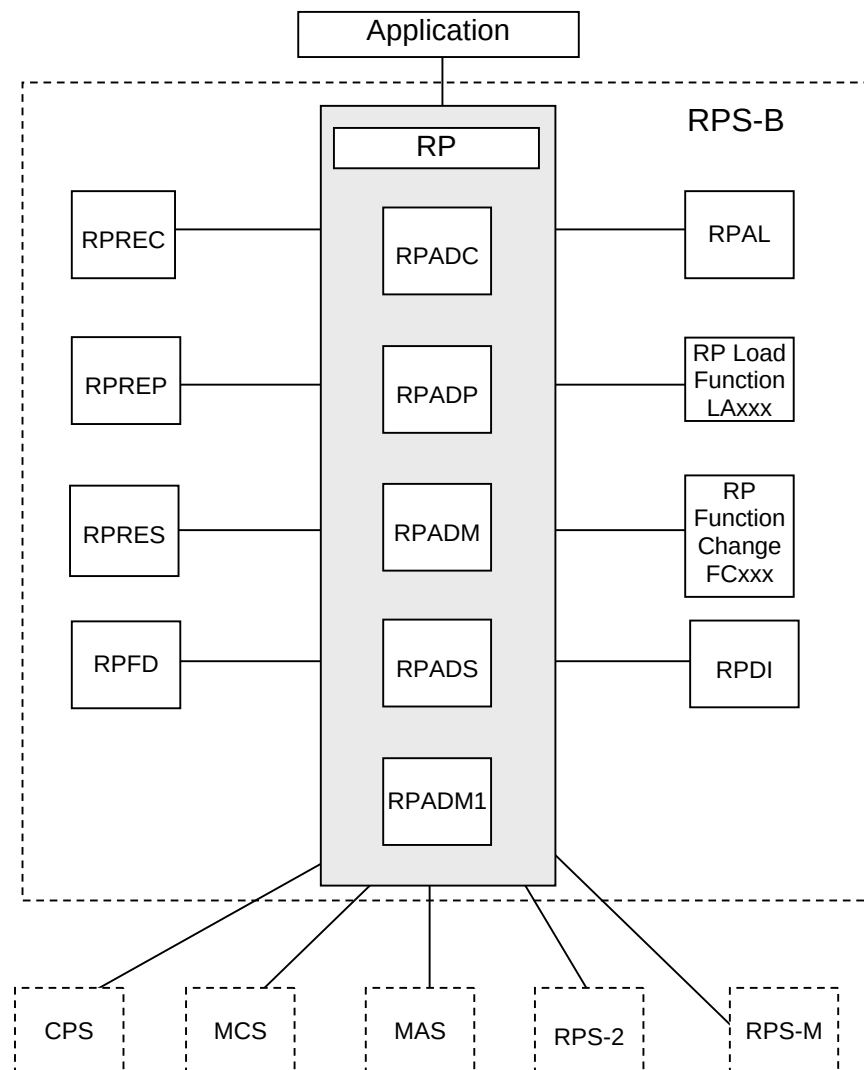


Figure 46. RP administration interwork

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RPADC

This block contains functions for the definition and the removal of definitions relating to RP, EM and software units. The block also contains a function for the change of RP-type.

This function allows an existing RP to be replaced by a more up-to-date version, with minimum telephone-traffic disturbance.

RPADM

The block performs service functions for handling of permanent equipment data and RP state information. It also contains tables, used by the CP microprogram when distributing signals from an RP to the receiving block.

RPADM1

Offers service functions for external RP definition.

RPADP

Primarily, the block realizes administrative RP blocking and printing functions, as follows:

- Blocking of RPs
- Deblocking of RPs
- Blocking of EMs
- Deblocking of EMs
- Switching of EM control
- Printing of RP data
- Printing of EM data
- Printing of defined RSUs and equipment data

It also realizes the following functions:

- Changing of Control Module (CM) control
- Changing of RP state at function change
- Initiating size alteration of RPB-S
- Ending size alteration of RPB-S

RPADS

Contains service functions, participating in events, handled by other functions. The block contains functions for, for example, start and stop of the RP OS, OS applications, and EM applications. The block handles sending of Real Time Clock information to RPs.

FCxxx

The function is divided into several blocks, containing functions for change, addition and deletion of programs in RP.

LAXxx

The function is divided into several blocks containing functions for the administration and storage of RSUs.

RPAL

Contains functions for initiating and removal of alarms.

RPDI

Offers service functions for co-ordination of maintenance activities within

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an RP pair.

RPFD

Contains RP fault detecting functions.

RPREC

Contains functions for start of the RP executive system.

RPRES

Checks RP Program Pages (PPs) on request.

RPREP

Diagnoses and repairs RPs and EMs in case of an RP deblocking failure.

RPS-M

Contains Extension Module Group (EMG) administration functions, ordering RPs to be tied or untied to EMGs.

RPS-2

Includes OS functions including those for RPs with REOS interface.

CPS

Standard functions.

MAS

CP dependent functions.

MCS

Administration of alphanumeric data.

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4.2.2 RP start function

The block includes functions for the initiation of an exchange's RPs in connection with system start and restart.
The block contains management and control functions applicable to the following activities that are part of the startup sequence:

- Checking the RPs that are to be started and blocking those RPs that do not pass the check.
- Determining whether or not there is a need for RP program load and if so, ordering the load.
- Starting the RP executive system.
- Starting of the EM users.

The function is implemented as follows:

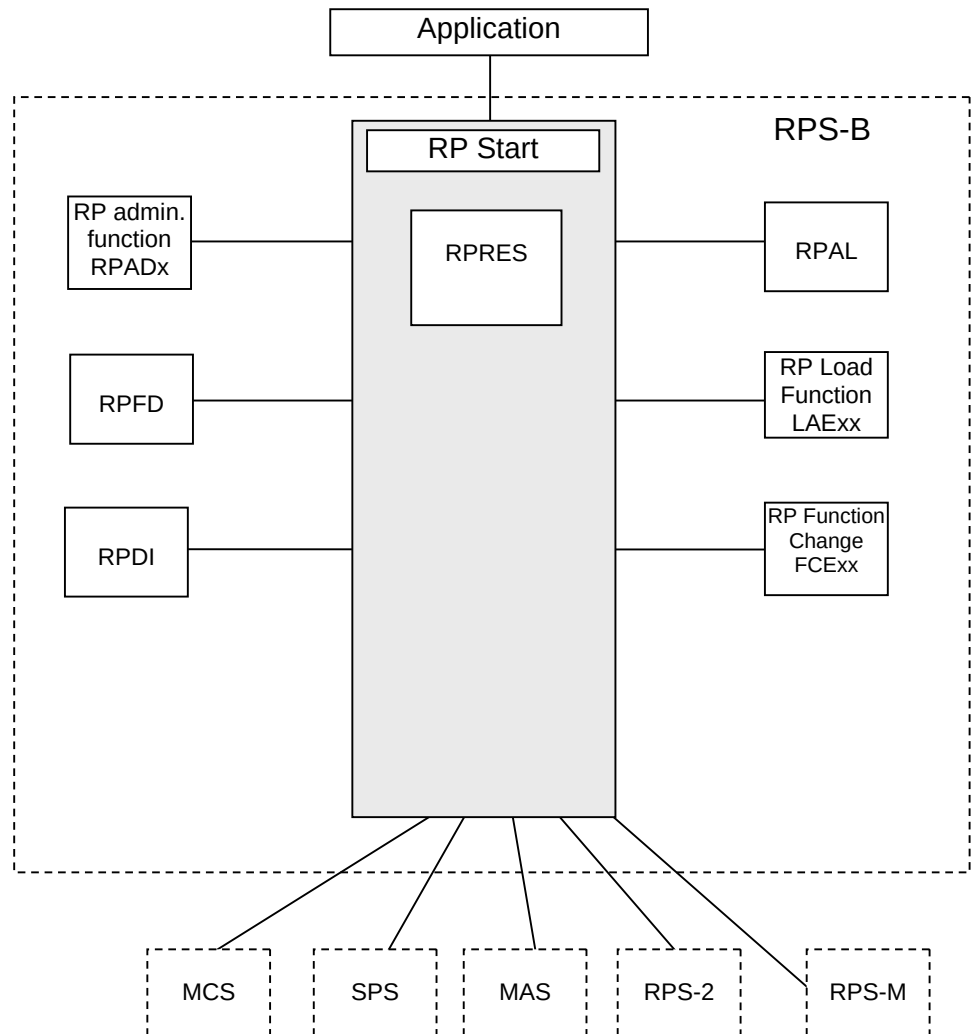


Figure 47. RP start function interwork.

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RPRES

Controls and administers RP starts and RP restarts at system restarts.

RPS-2

Performs the regional part of the start sequence.

RPAL

Initiates alarms for blocked units.

LAExx

Provides an equalization constant and checksum for RP program units.
Loads RP.

FCExx

Provides information at function change system restart regarding if data transfer will be performed or not.

Keeps information about if an RP is involved in a function change.

RPADx

- Keeps equipment and state information for the RPs and the EMs.
- Keeps information about which type of RP bus every RP is connected to.
- Keeps, by use of DBS tables, information about RP properties including the connection between the physical and the logical address for RPs on the serial RP bus.
- Keeps information for each RP pair about if the RP maintenance state was seized when the system restart occurred.
- Provides service functions for reading and changing of equipment and state information.
- Provides service functions for administering of CM control configurations.
- Informs EM users about current control configuration.
- Updates signal group location in the central RP table.
- Deactivates application programs in RP.

RPFD

Tests RP. Provides information on detected errors.

RPMI

Records current error symptoms and events.

RPS-M

Stops initiation of stand alone functions in the Extension Module Group (EMG).

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MAS

- Intermediary between RPRES and RP operating system at CP/RP signaling.
- Keeps information about which type of RP Handler (RPH) an RP is connected to.
- Supplies system information (restart reason and so on) in conjunction with system starts and system restarts
- Administers system starts and system restarts.

SPS (Maintenance of Special Equipment Connected to RP Bus)
Receives blocking information from the start function.

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4.2.3 Fault detection, RP error detecting function

The RP error detecting function detects hardware and software errors as follows:

- Disturbances and errors in RPs
- Disturbances and certain errors in Extension Module Buses (EMBs)
- Certain RPB errors are handled (both for the RPB-P and the RPB-S).

The function is implemented as follows:

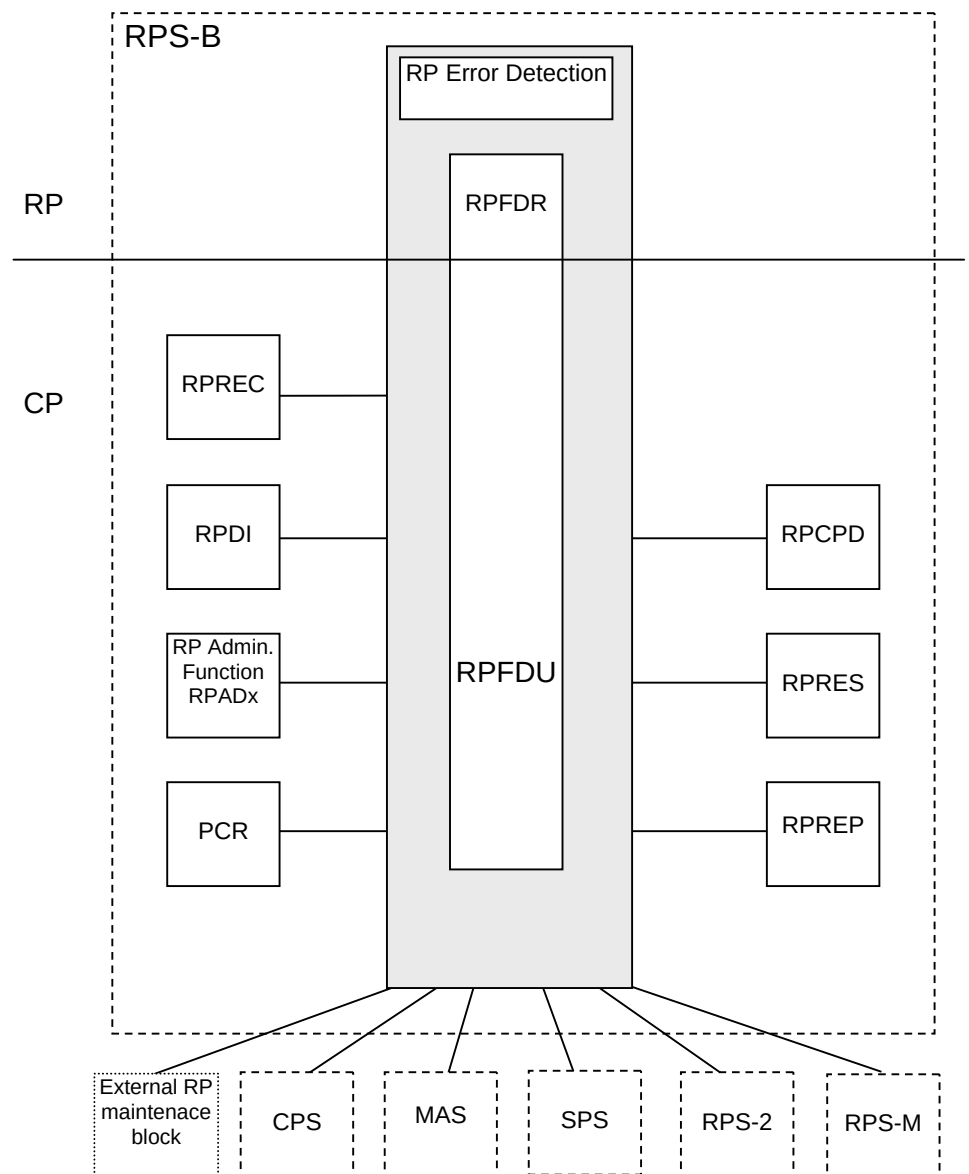


Figure 48. RP error detection interwork

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The function is implemented as follows:

- **RPFD**
- Receives and forwards information concerning RP, RPB, EM and EMB faults.
- Performs tests on all of the aforementioned.

RPFD is subdivided into a central and a regional part.

The central software unit performs the following functions:

- Reception of spontaneous error signals from RPs
- Reception of signals concerning faulty RPs, detected by other CP functions when signaling to RPs
- Functions for testing of RPs
- Forwards RP or EM fault information to the concerned functions
- RP echo testing

RPFDR routinely execute RP tests for the RPD and RPG products as well as for RPs that are members of the RP2 group.

PCR

Orders the deactivation of checksum supervision in connection with the program correction of an RP so that no spurious errors occur. Checksum is deactivated so that memory can be written to without causing a checksum error.

RPADM

Block RPADM provides the following service functions:

- Management of OPERating system Signal pointers, known as OPS pointers.
- Provides information about RP and EM states.
- Provides information about RPB type.
- Provides information about the physical address of an RP.
- Provides information about RP properties.

RPAL

Initiates and removes alarms.

RPDI

Checks the RP and EM error rate.

RPREC

Receives error messages from block RPFD and is responsible for error recovery.

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RPRES

- Executes RP start and restart.
- Orders the start of RP error detecting tests in connection with start and restart procedures.
- May also order that certain fault signals occurring during the restart process be ignored.

RPS-2

Includes OS functions including those for RPs with REOS interface.

RPS-M

- Provides information on errors in STCs.
- Provides information on software errors, detected in STCs of type STC2.
- Executes RP routine tests.

MAS

- Checks the RP interface to the RPB through intensive supervision of error interrupts.
- Informs the RPH of detected errors occurring during the transmission of signals to RPs.
- Initiates a test of the RPB (both RPB-P and RPB-S).
- Initiates echo test supervision of RPs.
- Sends RPH error information to RPFd concerning RPB-S and RP disturbances.

CPS

- Indicates if the MIP has detected an error during the plausibility check of a signal from an RP.
- Informs when an overloaded job buffer in the CP is caused by an RP.

SPS (Maintenance of Special Equipment Connected to RPB)

Deals with errors, detected in RPs, for which the RPS has no maintenance obligation.

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4.2.4 RP Recovery Function

This block contains functions for the return of an RP or an EM to operational status following the detection of an RP or an EM fault.

If a fault is detected in the RP during the recovery process, the RP is automatically blocked and all EM users are switched to the twin RP (applies only to members of the RP1 and RP2 groups), if a twin RP exists and is operational. If no twin exists or is not operational the EMs will be control blocked.

If the RP recovery process is successful, all EM users will be restarted and assigned to the recovered RP.

If the recovery process requires that the RP be reloaded (for example in connection with the recovery from a checksum fault), all EM users will be switched over to the twin RP during the recovery process - if a twin exists. Otherwise, the EM users will be temporarily blocked until it is recovered and operational once again.

An RP is also regarded as faulty if it has exhibited a high error intensity.

The function is implemented as follows:

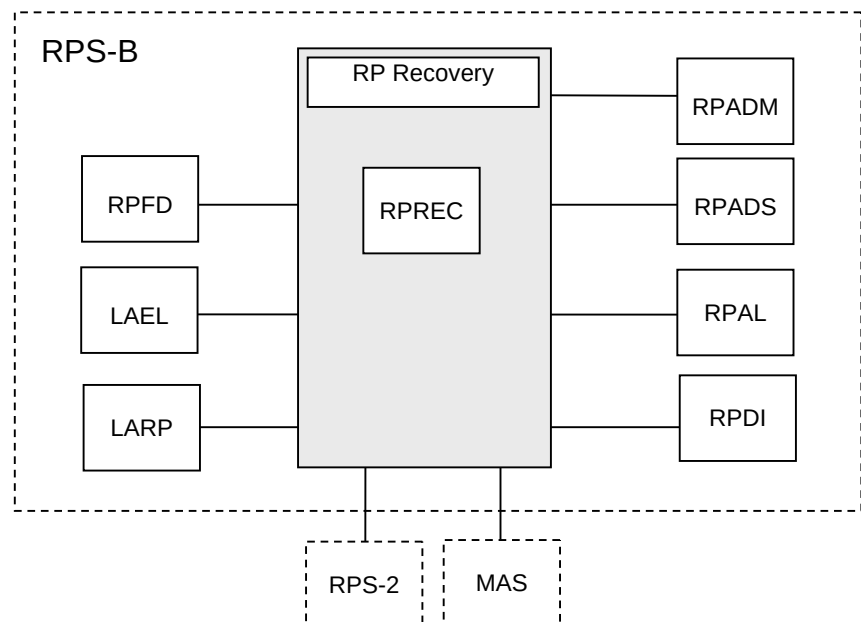


Figure 49. RP recovery interwork.

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RPREC

- Decides whether or not a recovery should be performed, and executes the recovery action in the event of an error.
- Performs repeated recoveries for RPs having a given property.

RPADM

- Contains all stored RP and EM data plus functions for the reading and writing of such data.
- Contains service functions for the co-ordination of maintenance pertaining to RP pairs.

RPADS

Contains the following service functions:

- Building of the RP CM table.
- Clearing of the RP Data Store (DS).
- Ordering the EM users to block/deblock their functions.
- Ordering the EM users to stop/restart their functions.
- Ordering OS users to start/block their functions.
- Sending real time clock to the RP OS.

RPAL

Decides on whether or not to initiate an alarm following the conclusion of a recovery.

RPDI

- Calculates the error rate for a specified RP or EM.
- Records all relevant error symptoms.
- Locates EMB errors to a specific RP or EM.

RPFD

Indicates RP and EM errors, tests supervision circuits, and fetches additional error information.

RPRES

Blocks RPs found faulty during a system start or system restart.

LAEL

Contains RP RSU data plus functions for reading of this data.

LARP

Loads specified RP when ordered by RPREC.

RPS-2

The particular regional operating system co-operates with RPREC during RP start.

MAS

Contains a function for the sending of signals to the RP in connection with the RP's start.

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4.2.5 RP diagnostic function

The function, on request, executes different types of diagnostics. The suspected RPs and/or EMs and their boards will be identified.

Significant events as well as faults detected by the maintenance function are recorded in the event log, which may be printed if desired.

An RP and EM event log is maintained.

RPDI uses the event log for diagnostic purposes (for example as the basis for a decision to initiate an RP or EM alarm, or to identify the fact that RP error-intensity has reached a predefined level).

The function is implemented as follows:

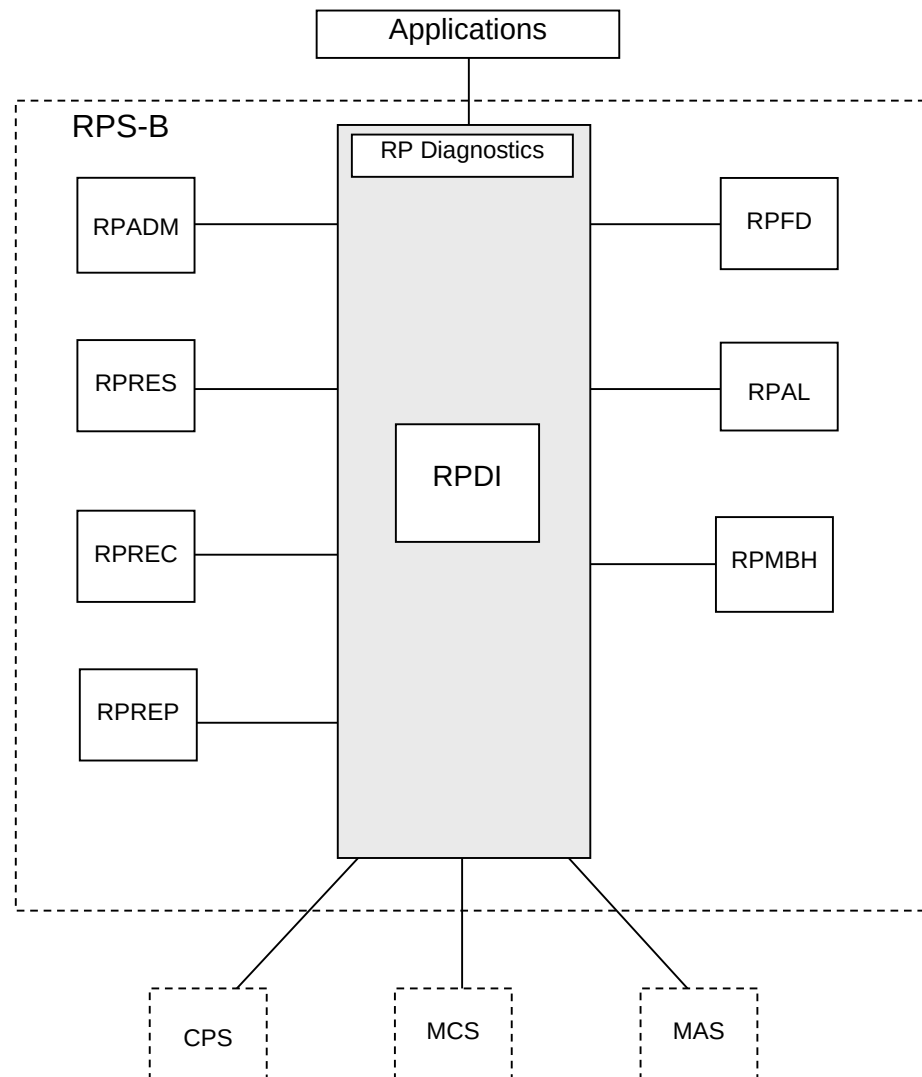


Figure 50. RP diagnostics interwork.

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RPDI

- Administrates the event log for the registration of RP and EM fault events, for application repair requests, and events which relate to the maintenance system.
- Upon request, the diagnostic function will execute an analysis of the faults registered in the event log.

RPADM

- Contains all stored RP and EM data plus functions for the reading and writing of such data.
- Contains service functions for the co-ordination of maintenance pertaining to RP pairs.

RPAL

- Initiates the registration of alarm initiation/removal.
- Diagnostics and board identification are initiated in conjunction with the initiation of an RP alarm.
- Initiates control of whether or not the alarm limit has been reached in conjunction with RP or EM temporary faults.

RPFD

Provides supplementary fault information in connection with the registration of faults. In the event of a fault during echo testing the fault will be registered.

RPMBH

Administrates a database table that contains hardware inventory data. The board name (included in the table) is used as an identifier in connection with diagnostics. This is valid only for certain RP types.

RPREC

In the event of an EMB fault, requests that an analysis be performed that will points out the actual faulty unit (RP or EM).

RPREP

- Requires printout of diagnostic results with a signal which means supplementary diagnostics and board identification at temporary faults.
- Requires registration of faults during the repair phase and a check of string indication for circuit boards.
- Reports fault events detected by applications.

RPRES

Requires registration of start/restart and faults in connection with start of RP. The registration includes date on which type of restart has been selected for the RP.

Applications

An application, that uses the RP repair function for repairing its hardware connected to the RP, gives name and weight of suspicion for application boards during diagnostics.

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CPS and MAS

Provides service routines for reading of exchange clock, addition of the number of days up to the indicated date and check if the indicated time is passed.

MCS

Fetches and checks the indicated device for printout in the command.

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4.2.6 RP repair function

This function contains the commands and printouts that are required for the repair of APZ, RP and EM hardware.

In brief, the function entails the following steps:

- Diagnosis with indication of fault-suspected circuit boards.
- Blocking of the unit, affected by the fault. A result printout, containing the manual actions, required when changing the circuit board, is also provided.
- Deblocking and repair check of the unit.

The commands must be entered in the sequence specified in the OPI under “RP FAULT” and “EM FAULT” respectively.

The function is implemented as follows:

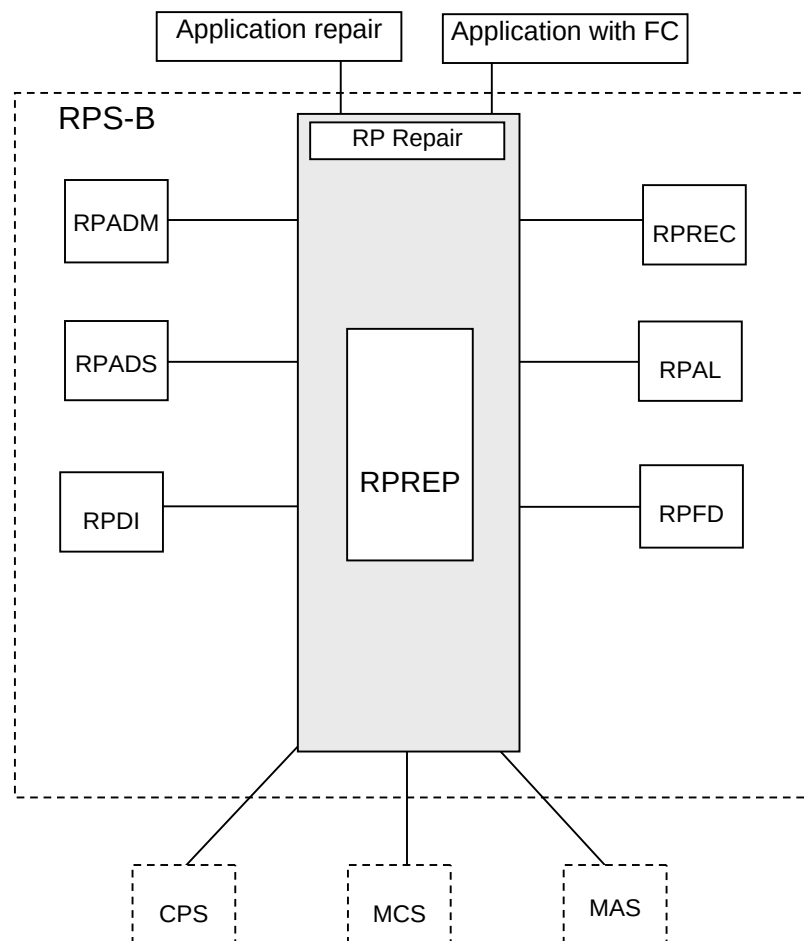


Figure 51. RP repair function interwork.

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RPADM

Stores operating state for RPs and EMs. Provides service functions for co-ordinating maintenance sequences within an RP pair.

Sends an inquiry signal to EM users to check if these EM users permit the repair.

RPADS

Sends blocking and deblocking signals to EM and Operating System (OS) users in connection with blocking and deblocking of EMs and RPs.

RPAL

Initiates alarms, prints alarm information, and removes alarms.

RPAI

Performs calculation for indicating circuit boards, suspected of being faulty in RPs or EMs. A list of fault-suspected boards is printed at reception of an order from block RPREP.

Records current fault symptoms.

RPFD

Carries out the following RP tests at reception of an order from block RPREP:

- Memory test
- Central Processing Unit (CPU) test
- DS addressing test
- EMB test
- Performs ordered routine EM test

RPREC

Contains functions for RP start.

MAS

Contains functions, dependent on the CP version.

- Administers information about the CP state and ongoing MAS activities.
- Administers repair tests of RPB-S branches in connection with repair of an RP bus fault.
- Administers the RP bus fault alarm and the corresponding system state.

MCS

Fetches and controls the printout devices, given in the command.

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CPS

- Administers information about system state RPB MAINTENANCE WORK IN PROGRESS.
- Administers information about system state RP BUS FAULT.
- Administers information about function codes.

Application subsystems (APT)**Appl repair**

- The application requests support from the RP repair function for the repair of so-called applications hardware, that is, hardware that is not supported by the operating system (APZ) but is under direct control of the application itself.
- The application supplies information regarding the suspected board(s) such as board name and probability of fault.

Appl with FC

Block with function code FCEMDBLOREQ, meaning that it shall be informed about an EM deblocking with command RECRI.

The only known user is block PDAL1 which administers loading of DP software for certain applications during RECRI.

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4.2.7 RP alarm function

This block contains functions for the generation of RP and EM alarms. The various alarm printouts specify the RPs and EMs that are either manually or automatically blocked.

The alarm function interworks with the MCS and MAS subsystems, in addition to other functions within RPS.

The function is implemented as follows:

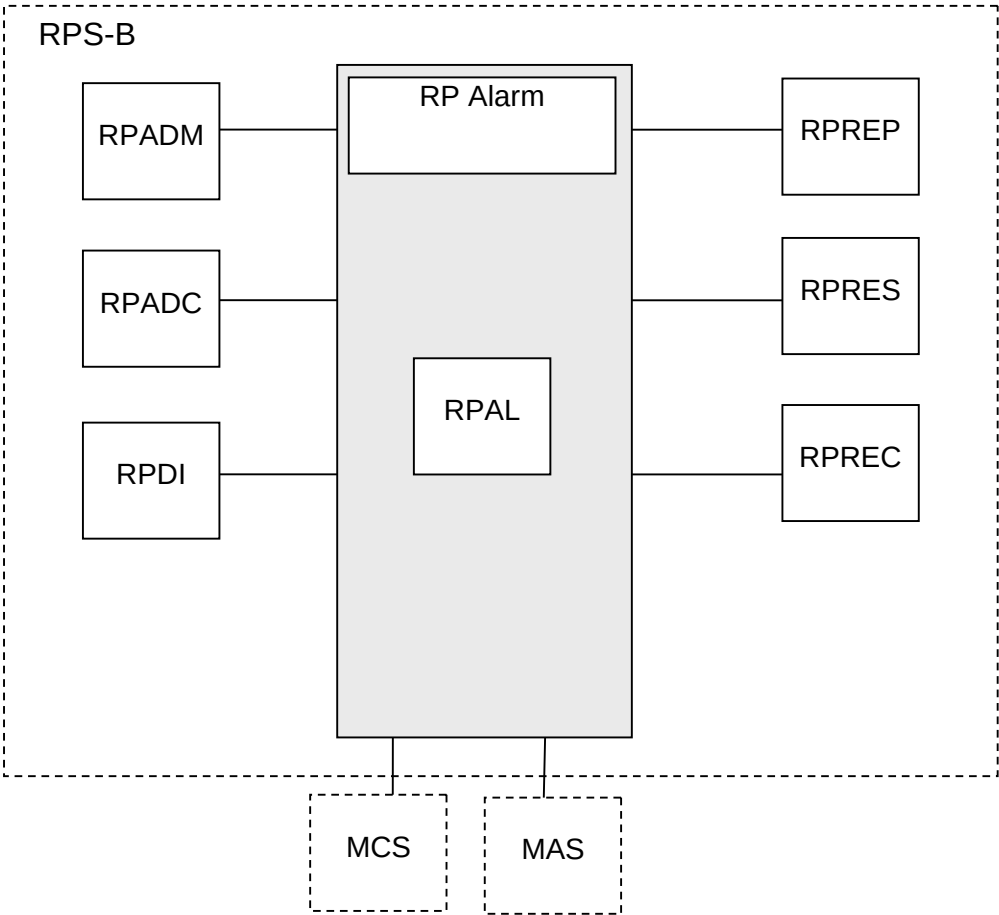


Figure 52. *RP alarm function interwork.*

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RPADM

- Handles permanent equipment data and RP state information.
- Contains tables used by the CP micro-program for a number of uses. One such table is the Central RP Table used for the distribution of application program signals from the RP to its counterpart located in the CP.

RPADC

- Orders the alarm function to update alarms in conjunction with RP and/or EM configuration changes.
- Also orders the update of alarms after manual blocking/deblocking of an RP/EM.

RPDI

- Administers event number.
- Checks if RP or EM alarm limits have been reached.

RPREC

Orders the alarm function to update alarms after an RP/EM recovery.

RPREP

Orders the alarm function to update alarms after a repair request has come from the application or after the repair of an RP/EM.

RPRES

During system start/restart, orders the alarm function to update alarms after the blocking of an RP.

MAS

Provides information concerning CP state.

MCS

- Contains I/O device references.
- Administers alarm printout

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4.2.8 Board repair indication

The BRI function provides the technician or the operator with an indication that a board can be removed, for example to be repaired or replaced by a new board. BRI indicates this by changing the state of the MIA LED. The MIA LED is controlled via the MB. The LED can be turned on or off. The diode is turned on if manually intervention is allowed.

In some cases, the operator may wish to reconfigure the system and will light the LEDs (by blocking those board that are involved in the reconfiguration).

Three scanning sequences make use of the MB:

- 1) Highest priority – any LEDs that are to be lighted will be lit by the associated masters of the RP4 or SCB-RP (BRI functionality).
- 2) All board positions will be scanned to determine whether or not a board exists in each of the particular slots covered by the master in question.
- 3) All boards that have been located in scanning sequence 2 are interrogated as to the board's information (HWI functionality)

The above sequence is then repeated over and over again.

The function is implemented as follows:

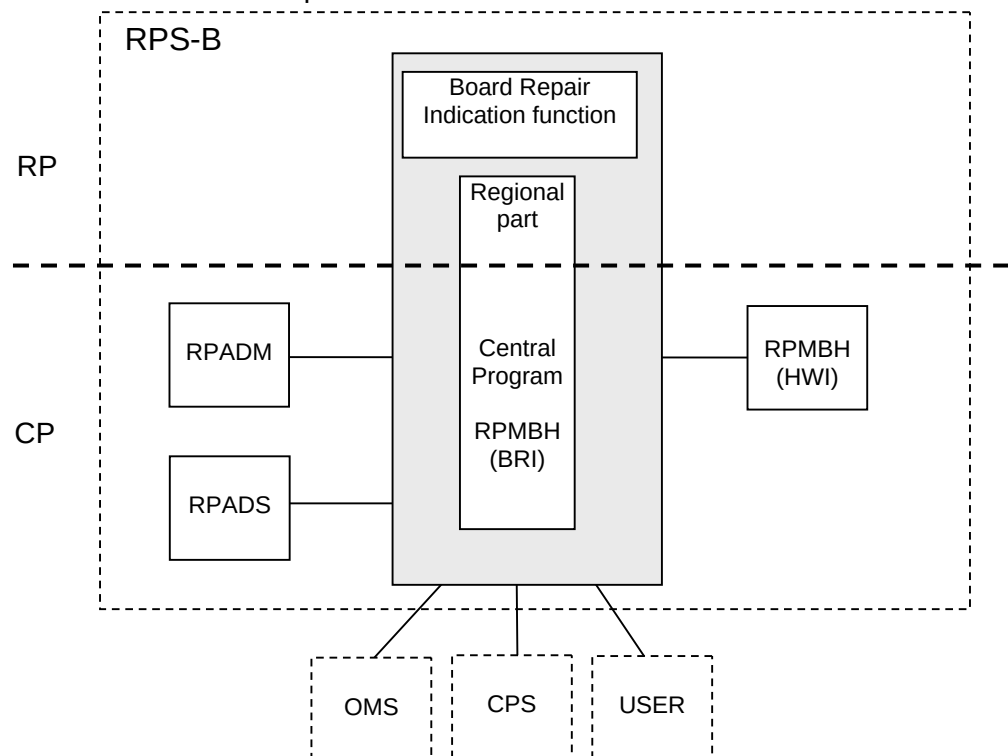


Figure 53. *Board repair indication interwork.*

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RPMBH

Contains the BRI and HWI functions. It is divided in the central program (RPMBHU) and in the regional program (RPMBHR) part. The central part receives orders about which RPs, EMs or slots are to be affected. It then translates the information to one or several boards. The information is sent then to the regional part which takes the proper action on the MIA LED of the board. The regional part of the BRI function access the MIA LED circuitry of a board through the MB.

RPADM

- Contains service functions for RP administration.
- Translation of the RP address to the corresponding Bus number, Magazine number and slot number of the RP.
- Is also used for receiving information concerning RP state and properties.
- Sends information to RPMBH when the state of an RP or EM has been changed.

RPADS

- Contains service functions, participating in events, handled by other functions.
- Handles starting and blocking of RP OS users. One OS user is RPMBHR.

CPS

Stores information for system structure. It can determinate if block OMDB has been loaded and if the block is active or not.

OMS

Contains a number of database tables which contain information about the APT hardware in the system. These data can be fetched by the BRI function in order to perform the translation of EM numbers to one or several slot positions in a magazine.

Application

A user could be any block in any subsystem, for example GSS, that requires LED state action to be taken for a specific slot number in a subrack.

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4.2.9 Hardware inventory

All circuit boards located in the BYB 501 equipment practice have an onboard PROM containing HWI information. The responsibility of the HARDWARE INVENTORY FUNCTION IN BYB 501 is to read this information and store it in a database table.

Normal magazines and boards in the BYB 501 equipment practice are adapted to a MB in the magazine backplane.
Each MB is also connected to an RP. In this way the RP can read the HWI data from the boards in the magazine.

A special magazine that also could be located in the BYB 501 equipment practice is the fan magazine. This magazine is, however, not adapted to the MB. Instead a fan magazine is connected to an RP through a serial (V24) interface. In this way the RP can read the HWI data from the boards in the fan magazine.

By means of one or several RPs in each magazine, the HWI function autonomously reads the on-board PROM data from all applicable boards. The data is stored in a database table to make it available for other functions for example for OMS.

It is then the responsibility of a superior function, a part of OMS, to read and use the data according to superior unit's function. This is, however, not described in this document.

An RP which is reading HWI information from one or several boards is further on referred to as a Master RP.

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The function is implemented as follows:

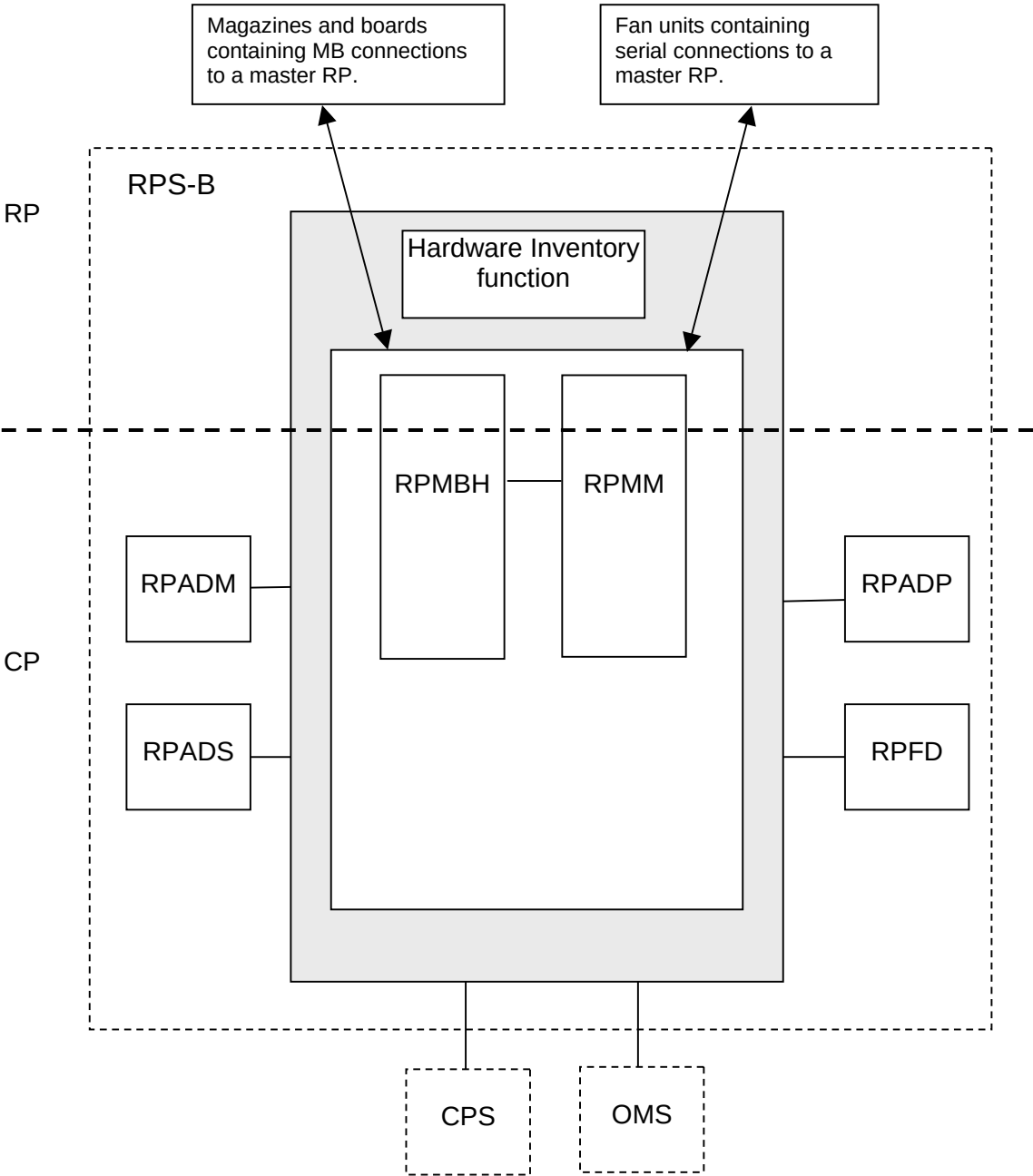


Figure 54. Hardware inventory interwork.

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RPADM

Stores data about RPs.

Stores information (RP properties) about which RPs that shall be used as Master RPs. Informs subscribers (RPMBH included) about changes in the RP states.

RPADP

Handles commands for deblocking of RPs Rejects deblocking of a Master RP if the RPMBHR RSU has not been defined for the RP.

RPADS

Service functions Handles starting and blocking of OS users. One OS user is RPMBH.

RPFD

Handles RP faults RPFD is notified when an RP does not answer correctly to a signal. It is then the responsibility of RPFD to execute the necessary fault actions.

RPMBH

Reads on-board PROM data from all boards, connected to a Master RPs through an MB, and stores applicable parts of the data in a database table to make it available for other functions.

RPMM

Reads on-board PROM data from all fan units, connected to a Master RPs through a serial interface, and sends the data to RPMBH to be stored in the database table owned by RPMBH.

CPS

- Stores information concerning loaded blocks.
- Is aware of whether or not OMS has been loaded and whether or not it is active.
- Is aware of whether or not OMS has been adapted to handle hardware inventory functions (older OMS versions may not have been adapted).

OMS

Collects Hardware Inventory data from different subsystems.

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4.2.10 Magazine address supervision

The Magazine Address Supervision Function (MASF) supervises the address plug found in magazines.

The function is applicable only to magazines using the RPB-S.

One or two RPs in each magazine are used for the supervision. The RPs are the same RPs which distribute power and RPB-S into the magazine. When the function detects an address fault, an alarm is issued. An OPI supports the repair of the fault.

The function is implemented as follows:

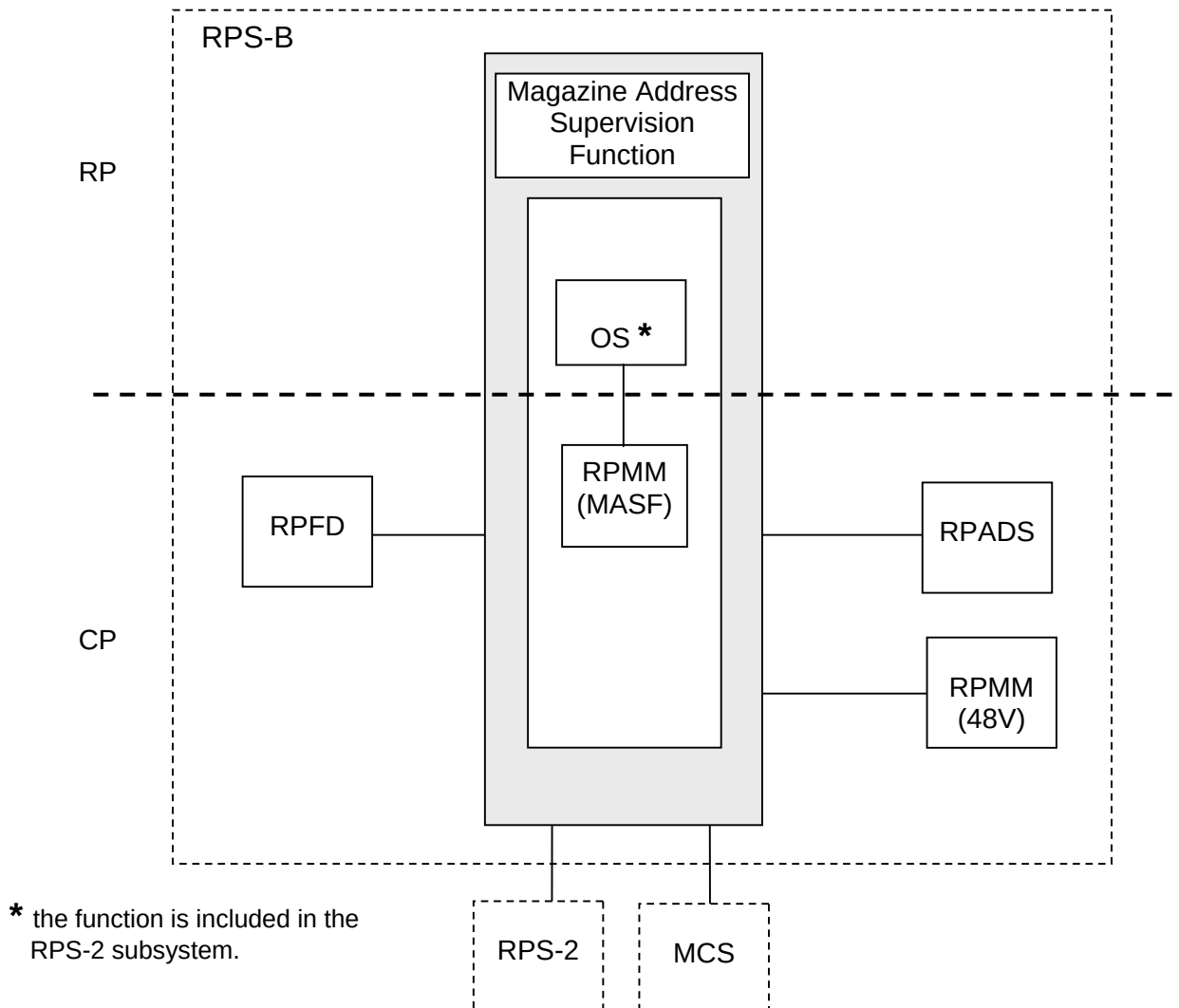


Figure 55. *Magazine address supervision interwork.*

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RPADS

Service functions. Handles starting and blocking of OS users.

RPFD

Fault handling when an RP does not answer correctly to a signal.

RPMM

RPMMU is informed by the OS of changes of addresses in the magazine. If there is any change in the physical magazine address (plug), an alarm is issued.

MCS

Handles, together with RPMM, the alarm printouts connected with address supervision alarms. Controls the printout devices.

RPS-2

The OS in the RP reads the addresses in the magazine and reports changes and errors in the address plug to RPMMU.

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4.2.11 Magazine power supervision

The Magazine Power Supervision Function supervises the power (-48V) in magazines.

The function is applicable only to magazines using the RPB-S.

Each of the two RP4s in a GDM magazine supervises the two power branches feeding the magazine's backplane. In the case of the GEM, each SCB-RP supervises all four of the power branches feeding the magazine's backplane. The RPs are the same RPs that distributes power and RPB-S into the magazine.

When the function detects a power fault on a branch, an alarm is issued. An OPI supports the repair of the fault. Repair entails replacement of fault suspected equipment such as boards, cables, etc.

The function is implemented as follows:

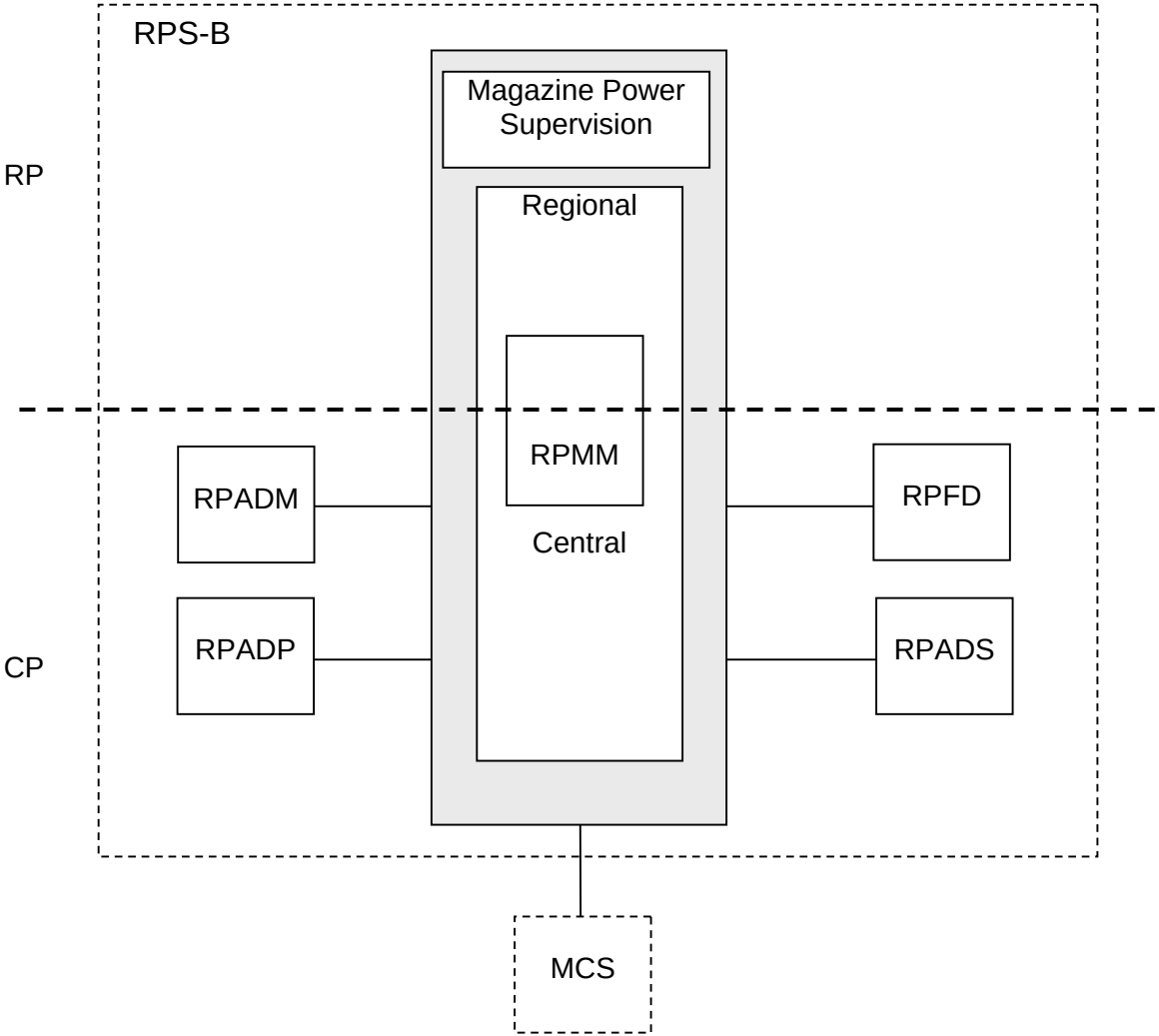


Figure 56. Magazine power supervision interwork.

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RPMM

Divided in one central part (RPMMU) and one regional part (RPMMR). The regional part supervises the power state (-48V present/-48V not present) in magazine back-planes.

If the power state in a magazine is changed, the central part is notified about the change. The central part analyses the new power state and determines if a power supervision alarm should be issued or not.

RPADM

Stores operating state for RPs. Stores information about which RPs that distributes the power (-48V) into magazine backplanes.

RPADS

Service functions. Handles starting and blocking of OS users.
One OS user is RPMMR.

RPADP

Handles blocking and deblocking of RPs.

RPFD

Fault handling when an RP does not answer correctly to a signal.

MCS

Handles, together with RPMM, the alarm printouts connected with power supervision alarms. Controls the printout devices.

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4.2.12 RP intercommunication supervision

The main purpose of the RPIS function is to supervise the communication between the RPs in an RPIG. Each group consists of two independent RP Intercommunication Nets (RPIN).

The function logs errors and initiates alarms at faults. It also reports the status of the RPINs to the applications on demand.

The function includes commands for blocking and deblocking of the RPINs. These commands are intended to be used at repair.

Database tables are used for definition of RPIGs and for logging of events.

The function is implemented as follows:

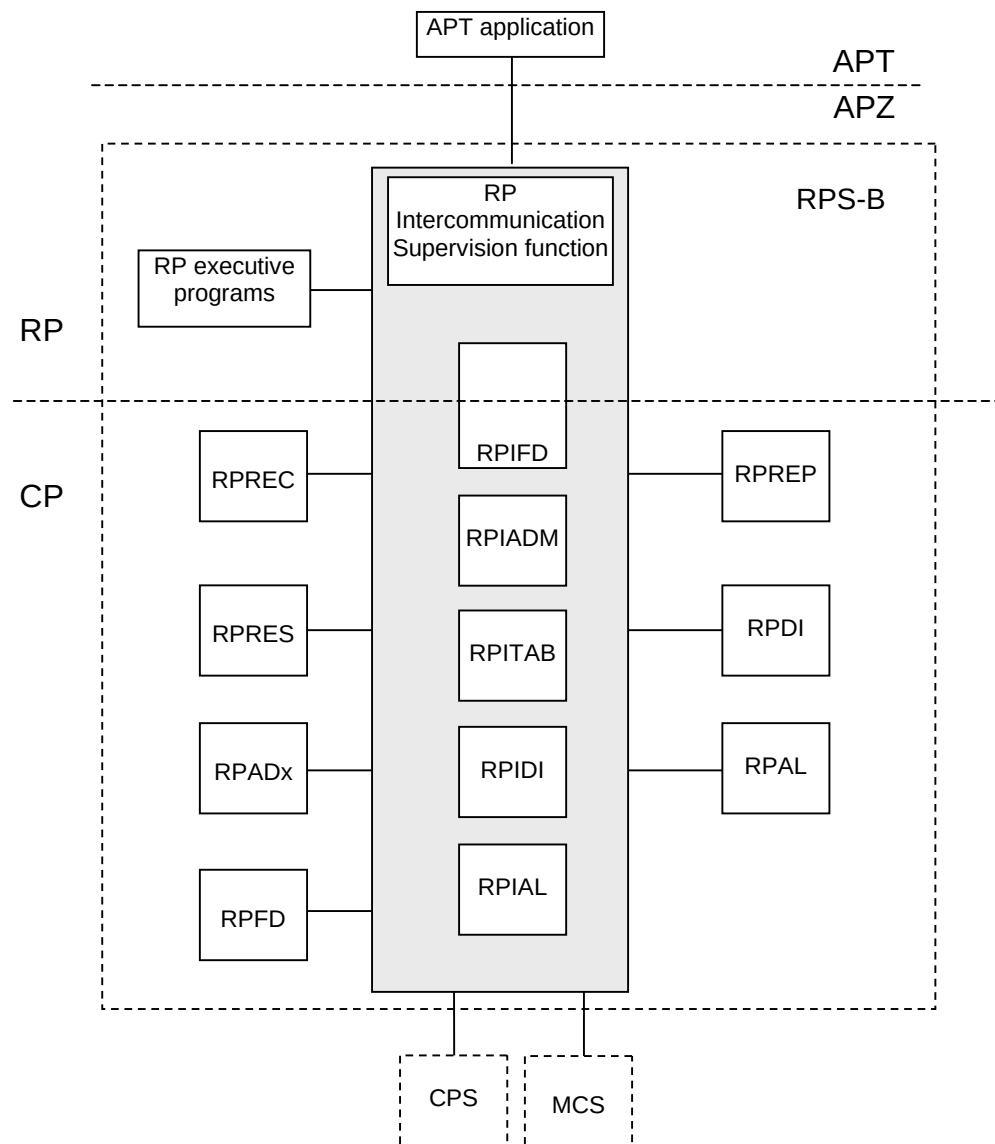


Figure 57. RP intercommunication supervision interwork.

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RPIADM

- Handles commands for blocking and deblocking of RP intercommunication nets.
- Prints deblocking result.

RPIAL

- Initiates alarms.
- Prints alarm information.
- Removes alarms.

RPIDI

Records information in an event log on request from the other blocks.

RPIFD

Supervises the communication between RPs in an RP intercommunication group and analyzes the faults. The RP intercommunication supervision utilizes the link handler function provided by the OS program in the RP. The block consists of one central unit and one regional unit. The regional unit is tied as an operating system unit to the RP. This means that block RPIFD is an OS user.

RPITAB

Owns database tables for definition of RP intercommunication groups and connection of RPs to the groups.

Other RPS Blocks**RPADM**

Stores administrative data for RPs and answers questions on:

- Operating state for RP
- RP properties for RP
- RPB type for RP
- Physical position on the RPB-S for the RP

RPADP

Handles command for deblocking of RP. If the RP is connected to an RP intercommunication group then RPADP checks that the regional unit of RPIFD has been tied to the RP.

RPADS

Contains service functions for informing OS users in connection with blocking and deblocking of RPs.

OS

Provides a link handler function which is used for RP intercommunication between RPs. It uses the RP addresses to create unique process names in the RPs. It also provides a function for blocking and deblocking of the Ethernet bus driver.

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RPDI

Fetches application boards as support to the function APZ Repair Support For Application Hardware Connected to RP. This function is used by RPIFD.

RPFD

Receives RP error information from block RPIFD.

RPREC

Starts an RP after a recovery or a deblocking.

At the start, RPREC informs the OS program about the RP address.

RPREP

Handles the function APZ Repair Support For Application Hardware Connected to RP. This function is used by RPIFD.

RPRES

Starts RPs after a system restart. At the start, RPRES informs the OS program about the RP address. RPRES also informs, on request, RPIFD about the actual type of an ongoing restart. The information makes it possible for RPIFD to handle each RP corresponding to the actual restart type.

CPS

Provides a function for reading current time.

Handles storing of function codes and checking for function codes.

MCS

Handles, together with block RPIAL, the alarm printouts related to the RPIS function. The block controls the printout devices.

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4.2.13 RPB-E Network Maintenance Function

The RPB-E Network Maintenance (RPNM) function shall detect faults in the units that make up the Regional Processor Bus of Ethernet type (RPB-E). These units are the Ethernet switches that belongs to RPB-E, the connection points towards RPB-E in the Regional Processors (RPs), and all the cables in between. A fault in an RPB-E network unit causes communication errors between the CP and one or several RPs on RPB-E.

If an RPB-E network unit becomes faulty, the alarm RPB-E NETWORK FAULT is raised by the RPNM function.

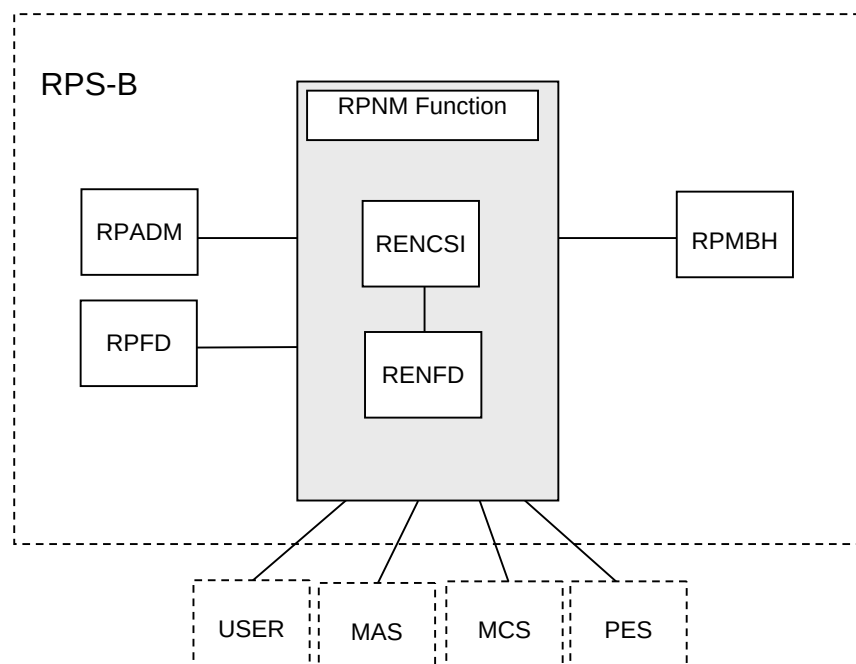


Figure 58. RPB-E Network Maintenance interwork

RENCSI

- Interacts with APZ-VM. It receives information about CP-RP communication state changes on RPB-E from APZ-VM. This information is passed on to block RENFD where it is analyzed.
- On request, fetches CP-RP and CP-CP communication state information from APZ-VM

RENFD

- Receives information about CP-RP communication state changes from block RENCSI. The received information is analyzed within block RENFD in order to find out if the alarm RPB-E NETWORK FAULT shall be raised or ceased.

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- Contains functionality for identification and repair of faulty RPB-E network units inclusive turning on or off the MIA LED on the GESBs that belongs to RPB-E.
- Handles command for printing data about one or several RPs that are connected to RPB-E. This command is used in order to identify faulty RPB-E network units.

RPADM

- The RP administrative function reports to the RPNM function when the logical state of an RP changes.
- The RPNM function also in various situations reads data from the RP administrative function

RPFD

- The RP Fault Detecting Function receives information about suspected RP faults from the RPNM function

RPMBH

- The block (a part of Hardware Inventory Function in BYB 501) interacts with RPNM function when turning on or off the MIA LED on a GESB that belongs to RPB-E.

Subsystem MAS

- MAS receives information from the RPNM function when the executive CP side has lost contact with all RPB-E RPs and a CP side switch should be performed.
- MAS reads data about First level switches from the RPNM function and orders the RPNM function to turn on or off the MIA LED on a first level GESB when it shall be repaired.
- MAS also administers the CP start and restart actions.

Subsystem MCS

- The RPNM function interacts with MCS in order to raise and cease the RPB-E NETWORK FAULT alarm.

Subsystem PES

- PES (APZ-VM) provides information about the communication state between the CP and each RPB-E RP.
- It also informs the RPNM function when a CP side switch has occurred.

User

- A user may order RPNM to handle an RP as it would be manually blocked. This makes it possible to avoid unnecessary fault indications or alarms.

4.3

Miscellaneous

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5

Hardware

-

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6 Block List

Block Acronym	Block Function
BUE	Backup Copying
DATAMOD-RPS	DBS Tables for RPS
FCEADM	Function Change EMRP/RP Administration
FCECEAP	Function Change EMRP/RP Commands and Printouts
FCEEDEF	Function Change EMRP Definition
FCEET	Function Change EMRP Table
FCEFW	Function Change of RP Firmware
FCEPEX	Function Change EMRP/RP pre-load execution
FCERDEF	Function Change RP Definition
FCERT	Function Change RP Table
FCEX	Function Change EMRP/RP Execution
LADP	Loading of Device Processors
LADP2	Loading of Device Processors (PDSPL boards)
LAEC	Loading EMRP/RP Commands
LAEL	Loading EMRP/RP RSU data
LAEO	Output of Loading information
LARP	Load/pre-load RP Programs
PCR	Program Correction in RP
RENCSI	RPB-E network communication information
RENFD	RPB-E network fault detect
RPADC	RP Administration, SW Definitions
RPADM	RP Administration
RPADM1	RP Administration, Service functions
RPADP	RP Administration, Block/deblock and Printouts
RPMBH	RP HW Inventory and Board Replacement indicator
RPMM	RP Magazine Address and Power Supervision
RPADS	RP Administration, Service functions
RPAL	RP Alarm
RPDI	RP Diagnostics
RPFD	RP Fault Detection
RPREC	RP Recovery
RPREP	RP Repair
RPRES	RP Restart
RPROUT	RP Service

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Block Acronym	Block Function
TEDC	System Debugger interface EMRP/RP
TERA	Program Test System RP2
ASFC	CP-RP Signal Flow Control
RPIAL	RP Intercommunication Supervision Alarm
RPIDI	RP Intercommunication Supervision Diagnostic
RPIFD	RP Intercommunication Supervision Fault Detection
RPITAB	RP Intercommunication Supervision Tables
RPIADM	RP Intercommunication Supervision Administration

Table 11. *Blocks included in RPS-B.*

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7 GLOSSARY

ADSL	Asymmetrical Digital Subscriber Line
API	Application Program Interface
APT	Application Part of AXE
APZ	Control part of AXE
AXE	Ericsson's System for Telephony and Data Communication
branch (RP bus)	A subdivision of an RP bus path. A maximum of 32 branches may constitute a path.
BRI	Board Repair Indication
BYB202	An AXE packaging system (Equipment Practice).
BYB501	An AXE packaging system (Equipment Practice).
CM	Control Module
	A logical part of an RP, controlling one or more RP's EMs.
CP	Central Processor
CP-PS	Central Processor Program Store
DBS	Data Base System
DEVCB	Device Control Bus
	Controls device processors. The device bus is a internal magazine bus between the EMRP in group EMRP-N, EMRPD and the device boards. It is a serial bus of 64 kHz. Separate lines in the bus are used for the addressing of the device boards.
DEVSB	Device Speech Bus
	Carries digital speech or data, switched by the time switch in type-1 EMGs.
DLHB	Digital Link Half-Board
DP	Device Processor Part of APT hardware.
DS	Data Store
DSU	Device Software Unit
EM	Extension Module
	16 EMs may be driven by one RP or RP-pair. Each EM may drive a maximum of 256 devices.
EMB	Extension Module Bus
EMB2	Extension Module Bus version 2
EMG	Extension Module Group
	A group of EMG's EMs that are controlled by the CP where signals are sent between the CP and the EMs through one or two CSPs, (CSP-A and CSP-B). There are two types of EMGs (see below).
	Can be implemented as either central or remote versions. Central EMGs are installed at the exchange site. Remote EMGs are installed at a considerable distance from the exchange site.
	EMGs are generally used for the connection of ordinary telecom subscribers (such as subscribers of ISDN, PSTN and mobile services).
EMG Type 1	EMG with EMRPB-S, RPBC, or STR-E and EMRP types, belonging to the EMRP-N and EMRP-D families.

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EMG Type 2	EMG with EMRPB-T, STR-T, and EMRP types, belonging to the EMRP-T group.
EMRP	Extension Module Regional Processor An RP within the EMG, controlling the application equipment associated with the EM. For EMRPs of group EMRP-N, one or two EMRPs, (A and B), are used for each EM, depending on redundancy requirements. For EMRP families EMRP-D and EMRP-T, only one EMRP, (A), is used. Up to 32 EMRPs may be connected to one EMG. Each EMRP may drive up to 256 devices.
EMRPB	Extension Module Regional Processor Bus There are two types of EMRPBs, (EMRPB-S and EMRPB-T).
EMRPB-S	Extension Module Regional Processor Bus, Serial
EMRPB-T	Extension Module Regional Processor Bus, Time switch connected
EMRPD	Extension Module Regional Processor, Devices Is directly connected to the processor bus and with device control bus EMRPs of type EMRPD1 and EMRPD2.
EMRP-D	Extension Module Regional Processor, Devices Group Name used to group EMRPs of type EMRPD and EMRPS.
EMRPI	Extension Module Regional Processor, Integrated Generic name, including the regional hardware and software parts of the integrated control system, that is, APZ functions EMRP-T, EMRPB-T, and STR-T on the same board. The STR-T function is only enabled for an EMRPI that is connected to an STC.
EMRP-N	Extension Module Regional Processor, type N with device control bus Group name used to group EMRPs of type EMRP1, EMRP2, EMRP3, EMRP4, and EMRP42.
EMRPS	Extension Module Regional Processor, Speech Bus Interface For EMRPs of type EMRPS1.
EMRP-T	Extension Module Regional Processor, Time switch connected Group name used to group EMRP types with time switch connection.
EPS	Ethernet Packet Switch
EPSB	Ethernet Packet Switch Board
ETB	Exchange Terminal Board Remotely located exchange terminal board.
ETC	Exchange Terminal Circuit Centrally located exchange terminal board.
FLASH	A nonvolatile memory
FRP	Firmware Replacement Package
GARP	Generic Application Resource Processor
GDDM-H	Generic Datacom Device Magazine, Half-height
GDM-F	Generic Device Magazine, Full-height

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GDM-H	Generic Device Magazine, Half-height
GEM	Generic Ericsson Magazine
GESB	Gigabit Ethernet Switch Board
GPRS	General Packet Radio Services
GS	Group Switch
GSM	Global System for Mobile communication
HSL	High Speed Link
ISDN-BRA	Integrated Services Digital Network, Basic Rate Access
ISDN-PRA	Integrated Services Digital Network, Primary Rate Access
LSM	Line Switch Module
MASS	Magazine Address Supervision Function
MB	Maintenance Bus
MIA	Maintenance Intervention Allowed
OMS	Operation and Maintenance Subsystem
OPI	OPERational Instruction
OPS	Operating system Signal CP <-> RP operating system signal.
OS	Operating System
OSE	Operating System ENEA
path (RP-bus)	An access way between a CP side and the RPs. See "Branch".
PCU	Packet Control Unit
PDSPL	Pooled Digital Signaling Platform
POTS	Plain Old Telephone Service
PROM	Programmable Read Only Memory
RP	Regional Processor
RPALI	RP core part of ALIEB (ATM Link Interface, in GEM).
RP4	RP version 4. Supports EMB and the RPB-S.
RPB	Regional Processor Bus Connects the RPs with the CP.
RPBC	Regional Processor Bus Converter Used to connect centrally located EMGs. Converts the RPB to the EMRPB. From the system point of view, an RPBC is both an STC and an STR. ETC or ETB are not needed. Used for the connection of central EMGs to an exchange. Product is being considered for phase-out
RPBI-P	Regional Processor Bus Interface, Parallel
RPBI-S	Regional Processor Bus Interface, Serial
RPB-E	Regional Processor Bus, Ethernet
RPB-P	Regional Processor Bus, Parallel
RPB-S	Regional Processor Bus, Serial
RPD	Regional Processor for Device Control
RPG, RPG2	Regional Processor with GS interface, with the parallel respective the serial bus interface
RPG3	Regional Processor with GS interface, based on the RPI (designed based on the PIA ASIC)
RPHM	Regional Processor Handler Magazine
RPI	Regional Processor Integrated
RPIG	RP Intercommunication Group
RPIN	RP Intercommunication Net
RPIS	RP Intercommunication Supervision
RPNM	RPB-E Network Maintenance
RPP	Regional Processor with PCI interface

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RPPETA1 RSU	RPP in ALI –ETA155 (ATM Link Interface, in GDM). Regional Software Unit Loadable software for EMRPs or RPs.
SCB-RP	Support and Connection Board with RP
SPS	Support Processor Subsystem
STC	Signaling Terminal Central From the system point of view, STCs are RPs.
STC-E	Signaling Terminal Central, single channel with direct Exchange terminal circuit or modem connection Group name used to group STC types directly connected to an exchange terminal circuit or a modem.
STC-G	Signaling Terminal Central with Group Switch interface Group name used to group STC types with Group Switch Interface.
STR	Signaling Terminal Remote
STR-E	Signaling Terminal Remote with direct Exchange terminal board or modem connection Group name used to group STR types directly connected to an exchange terminal circuit or a modem.
STR-T	Signaling Terminal Remote, Time switch connected Group name used to group STR types with time switch connection.

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