PACiS SYSTEM

V4

System Guide

PACiS/EN TG/C11

PACiS SYSTEM
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SAFETY & HANDLING

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1. INTRODUCTION

The present document is a chapter of PACiS SYSTEM documentation binders. It describes the safety, handling, packing and unpacking procedures applicable to PACiS SYSTEM elements.

2. SAFETY

WARNING: THIS SAFETY SECTION SHOULD BE READ BEFORE COMMENCING ANY WORK ON THE EQUIPMENT.

2.1 Health and Safety

The information in the Safety Section of the PACiS System documentation is intended to ensure that products are properly installed and handled in order to maintain them in a safe condition. It is assumed that everyone who will be associated with the PACiS System equipments will be familiar with the contents of the different PACiS System Safety Sections and all Safety documents related to the PC and Communication networks.

2.2 Explanation of symbols and labels

The meaning of symbols and labels may be used on the PACiS System equipment's or in the PACiS System product documentation, is given below.

2.3 Installing, Commissioning and Servicing

Equipment operating conditions

The PACiS System equipments should be operated within the specified electrical and environmental limits.

Fibre optic communication

Where fibre optic communication devices are fitted, these should not be viewed directly. Optical power meters should be used to determine the operation or signal level of the device.

2.4 Decommissioning and Disposal

Disposal:

It is recommended to avoid incineration and disposal of the PACiS System elements (hardware and software supports). The PACiS System elements should be disposed of in a safe manner.

3. GUARANTIES

The media on which you received AREVA T&D Automation software are guaranteed not to fail executing programming instructions, due to defects in materials and workmanship, for a period of 90 days from date of shipment, as evidenced by receipts or other documentation. AREVA T&D Automation will, at its option, repair or replace software media that do net execute programming instructions if AREVA T&D Automation receive notice of such defects during the guaranty period. AREVA T&D Automation does not guaranty that the operation of the software shall be uninterrupted or error free.

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4.1 Copyrights

4.2 Trademarks

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In any application, including the above reliability of operation of the software products can be impaired by adverse factors, including -but not limited- to fluctuations in electrical power supply, computer hardware malfunctions, computer operating system, software fitness, fitness of compilers and development software used to develop an application, installation errors, software and hardware compatibility problems, malfunctions or failures of electronic monitoring or control devices, transient failures of electronic systems (hardware and/or software), unanticipated uses or misuses, or errors from the user or applications designer (adverse factors such as these are collectively termed "System failures").

Any application where a system failure would create a risk of harm to property or persons (including the risk of bodily injuries and death) should not be reliant solely upon one form of electronic system due to the risk of system failure to avoid damage, injury or death, the user or application designer must take reasonably steps to protect against system failure, including -but not limited- to back-up or shut-down mechanisms, not because end-user system is customised and differs from AREVA T&D Automation testing platforms but also a user or application designer may use AREVA T&D Automation products in combination with other products.

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INTRODUCTION

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1. INTRODUCTION

1.1 Scope of the document

This document is a chapter of PACiS System documentation binders. It introduces the user to the PACiS system and his elements. documentations.

1.2 Introduction to PACiS

The PACiS range will continue to be expanded. The general features of PACiS will also be enhanced, as we are able to adopt new technology solutions.

For up-to-date information on any PACiS product, visit our website:
www.areva-td.com

2. DOCUMENTATIONS

The guides provide a functional and technical description of the PACiS elements and a comprehensive set of instructions for the PACiS elements's use and application.

A System Guide is provided at system level : it contains chapters described below. More detailled guides (Operation Guide, Technical Guide, Getting Started Guide) are provided at equipment level.

Due to the specific construction and application of each PACiS element, the content of each PACiS element is adapted and some chapters do noty exist in the relevant documents

2.1 Chapters description

2.1.1 Chapter Safety & Handling (SA)

This chapter contains the safety instructions, handling and reception of electronic equipment, packing and unpacking parts, Copyrights and Trademarks.

2.1.2 Chapter Introduction (IT)

This document contains the description of each documents, and an outline of the product features.

2.1.3 Chapter Functional Description (FT)

This chapter contains a description of function supported by the product.

2.1.4 Chapter Installation (IN)

This chapter contains the installation procedures.

2.1.5 Chapter Lexical (LX)

This chapter contains lexical description of acronyms and definitions.

INSTALLATION

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1. INTRODUCTION

1.1 Scope of the document

This document is a chapter of PACiS System documentation binders. It describes the global system installation with reference to each IN (installation) chapter of the system devices. These references are described in the chapter PACiS System IT (Introduction). Reference of non PACiS equipment is made here, with their specific and proprietary documentation.

2. SYSTEM INSTALLATION

A system installation is defined since at least two of system devices should work together. As they work together, a third component need to be checked with the system network.

The system installation is then composed of several of the following installation:

- **1- Maintenance PC** (laptop) that might include:
  - ⇒ PACiS SCE (System Configuration Editor) to build/modify data bases,
  - ⇒ PACiS Station Bus Agency for communication on the SBUS,
  - ⇒ PACiS ES (Equipment Simulator) for test/commissioning SBUS,
  - ⇒ PACiS SMT (System Management Tool) to download database and manage the system
  - ⇒ PACiS CMT (Computer Management Tool) to manage the C264 computer range
  - ⇒ PACiS Documentation, system version release note and PACiS software components.
  - ⇒ Non PACiS Tools (ISAGRAF Workbench, terminal console, Serial communication spies like ASE SCADA simulator, XML Spy, FTP server…)
- **2a- MiCOM Computer** installation that may include:
  - ⇒ connected IED on Legacy BUS,
  - ⇒ Computer RTU communication to SCADA (Telecontrol BUS),
  - ⇒ wiring and cubicles.
- **2b-Operator Work Station** based on industrial PC that may include
  - ⇒ needed peripheral (printers, modem)
  - ⇒ PACiS Station Bus Agency for communication on the SBUS,
  - ⇒ PACiS Operator Interface
  - ⇒ PACiS System Management Tool
  - ⇒ Third-party applications
  - ⇒ PACiS Watch, to supervise at least the OI and SMT applications
- **2c-PACiS Gateway** device on industrial PC
  - ⇒ PACiS Station Bus Agency for communication on the SBUS,
  - ⇒ PACiS Gateways Applications for protocol communication on TBUS,
- **3a-Station BUS network** based on Ethernet network optical/copper, switch, repeater…

2.1 Installation ordering

System installation ordering follows usually the number indicated. Maintenance PC is needed at any step even network installation to check via “ping” the correct wiring.

Operator workstation, gateway and computer with their cubicle are installation task that can be lead in parallel.

2.2 Kind of PACiS system Installation

Installation is a step between engineering studies and commissioning. The main goal of installation is do it into and electric plant. Further, the word “Application” is reserved for this target.

Into the standard system manufacturing process, three levels of installation are done:

- **Experimental set-up**, that uses a reduce set of devices, with the aim to validate special features and/or configuration of a set of PACiS devices ; missing system devices are replaced by PACiS ES for example. Set-up is use to validate: SCADA mapping and communication, SOE or alarm labels, automation, communication to IED…
- **Factory set-up** that integrates usually all system devices, not necessary mounted into cubicles, and use **some of** system external devices like IED, or simulate them like SCADA or switch-gears. Aim is to validate customer Application needs into a FAT (Areva/VAR Factory Acceptance Test) before final delivery.
- **Site installation** is the final Application installation with all defined system interfaces fully wired and operational. The SAT (Site Acceptance Tests) ends fully this installation.

Requirements, constraints, and commissioning tests are different for each installation, and specific for final site installation power-up. The devices and configuration is specific to a given business and associate manual are defined in DCS business.

This chapter defines minimal requirement for installation procedure without particular implementation. The CM (Commissioning) chapter of each device defines how to check that PACiS device are operational and correctly installed.

Tests lead to check that system behave correctly for a given application (with specific functions) are part of the business plan and out of scope of standard PACiS documentation. Customer found FAT and SAT validation test into their specific business plan.

3. REQUIREMENTS

System is complex. Even if its manufacturing can been done by steps, several requirements are needed before.

3.1 General PACiS system requirement

Before any installation, a versioned plan or array is need where is defined the network parameters. It is an output of business and technical staff.

- **SBUS devices list** to install or to simulate, with
  - ⇒ **Naming**, correct alias name on Ethernet **is mandatory**
  - ⇒ **IP address is mandatory** on Ethernet, address of IED on Legacy BUS is mandatory
  - ⇒ Hardware version and its hardware configuration (boards, voltage)
  - ⇒ Software and database version can be useful but subject to modification during commissioning
- Networks scheme is mandatory with
  - ⇒ Networks topology drawing (ring, star) with devices reference, length between connections, additional switch, repeater
  - ⇒ Physical link to use (RS232, 422, 485, 10T, 100T, 100F)
  - ⇒ Protocol (UCA2, IEC61850, MODBUS AREVA, IEC 60870-5-103, IEC 60870-5-101, DNP3.0, IEC 60870-5-T104, ...)

Network name and IP address is needed before any PACiS system device installation. The network name and IP address must be identical to one configured in the PACiS SCE database. Change remains possible as described in maintenance manuals, but is time consuming operation. If address is changed all devices communicating with this past address should be reconfigured with the new address.

Clear definition of the network avoid also to change later on the communication means (physical link, speed, additional repeater) usually integrated into any Ethernet device.

3.2 Basic requirement

Even if it is trivial in engineering, before installation several checks has to been done. The above list is also a way to control that system devices ordered match installation constraints:

- PACiS system components should be present and in their ship box,
- Non PACiS components should have been correctly installed and operational. For example an other PC than the recommended one should have the needed operating software, special peripheral like printers or modems should have appropriate drivers to the PACiS OS
- Power Supply source is available with compatible voltage, power capability, stability, power source protected, and well defined power wiring
- Location for set-up has to be compatible with human security and device utilisation (mechanical support including chairs, temperature, humidity, electromagnetic field, radiation, local emergency stop…)
- Correct and operational network connection to non PACiS equipment (LBUS or SBUS link to non PACiS IED, TBUS link like PSTN to SCADA …)
- Normalised and operational wiring to electric devices (scheme, wiring, cable, shield, earthing…)
- People with correct habilitation
- Certified test material and tools

3.3 Installation end requirement

Any installation process end with a commissioning part to verify that devices operate.

PACiS devices are operational with databases. Also it is not possible to check installation in a commissioning part without downloading database into devices and check that through networks they can communicate.

Commissioning database can be an abstract of application database, or a test database with same hardware configuration and same IP address (and device name)

It is highly recommended to prepare this commissioning database before the end of installation.

3.4 System Commissioning Application requirement

Application requirement is out of scope of this document, but few requirements are here summarised.

- Process
  - ⇒ Voltage topology (with interlock…)
  - ⇒ Bay definition with additional I/O (measurements, …)
  - ⇒ Modules definition (Switch/transformer/motors..) with its I/O, control kind and delays…
  - ⇒ Protective function and devices
  - ⇒ Measurement, monitoring, metering function and devices
  - ⇒ Control functions and devices (uniqueness, mode control, AR, Synchrocheck, AVR)
  - ⇒ Non electric process (I/O GIS, security, supply control…)
- Mapping
  - ⇒ Desired information acquired from IED on Legacy BUS
  - ⇒ Desired information acquired from IED on Station BUS
  - ⇒ Desired information provided to non PACiS device on Station BUS
  - ⇒ Desired information provided to SCADA for each Tele-control BUS
- Wiring
  - ⇒ Mapping to computer connectors
  - ⇒ I/O kind AC/DC voltage or current
- Human Interface I/O
  - ⇒ Computer configurable LED definition on computer
  - ⇒ Computer Bay Panel definition
  - ⇒ PACiS OI and computer Alarms
  - ⇒ PACiS OI Archiving (with viewers)
  - ⇒ PACiS OI SOE and log printing (with labels)
  - ⇒ PACiS OI Mimic displays and module control
  - ⇒ PACiS OI and Computer Right definition

4. PACiS DEVICES INSTALLATION

PACiS devices installation is lead by administrator user with:

- Hardware device (with its OS for PC applications)
- System Release note
- Software package
- Each device installation manual

Installation of application software on PC request administrator password.

A few devices specific recommendation are summarised below, but only each device installation manual gives the correct procedure.

4.1 PACiS SCE installation

PACiS SCE can be installed on any PC respecting its requirement.

PACiS SCE IN chapter describes fully its requirements and install procedure. SCE MF (Maintenance) describe common trouble shooting.

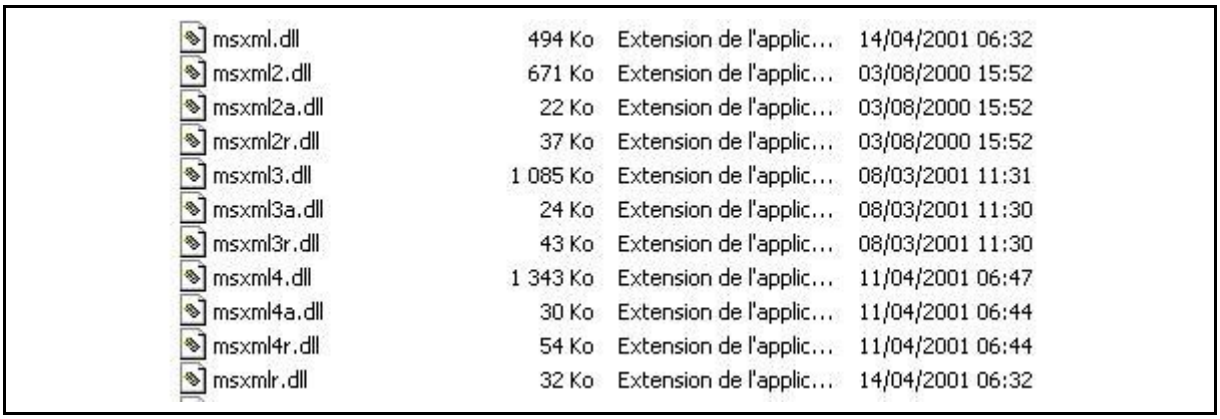
PACiS SCE must not run on the same PC and at the same time than PACiS OI server.

Briefly, a SCE software installation is as follows :

1. If a previous version of SCE application is installed, uninstall it
2. Launch the **SCE installer** program and follow instructions
3. If a previous version of the PACiS XML parser application is installed, uninstall it
4. Launch the **XML Parser installer** program and follow instructions

IMPORTANT :

- the “sce.lax” file (available in the installation folder) must be modified to update the lax.nl.java.option.java.heap.size.max attribute depending on the memory size of your PC (to 400 Mb if the memory size is 1Gb).
- Check the date of the msxml.dll files, available in C:\WINNT\system32 folder. It must be as follows :



msxml.dll	494 Ko	Extension de l'applic...	14/04/2001 06:32
msxml2.dll	671 Ko	Extension de l'applic...	03/08/2000 15:52
msxml2a.dll	22 Ko	Extension de l'applic...	03/08/2000 15:52
msxml2r.dll	37 Ko	Extension de l'applic...	03/08/2000 15:52
msxml3.dll	1 085 Ko	Extension de l'applic...	08/03/2001 11:31
msxml3a.dll	24 Ko	Extension de l'applic...	08/03/2001 11:30
msxml3r.dll	43 Ko	Extension de l'applic...	08/03/2001 11:30
msxml4.dll	1 343 Ko	Extension de l'applic...	11/04/2001 06:47
msxml4a.dll	30 Ko	Extension de l'applic...	11/04/2001 06:44
msxml4r.dll	54 Ko	Extension de l'applic...	11/04/2001 06:44
msxmlr.dll	32 Ko	Extension de l'applic...	14/04/2001 06:32

If no, re-install these dll provided in the msxml_dlls.zip file (copy them in the C:\WINNT\system32 and C:\WINNT\system32\dllcache folders – be careful, dllcache is an hired folder)

4.2 PACiS Station Bus Agency installation

PACiS Station Bus Agency is composed of a set of software to be install in any PC supporting an Ethernet UCA2 / IEC61850 connection. For other devices such as MiCOM C264, Station Bus agency is part of the product and do not requires any specific installation

PACiS Station Bus IN chapter describes fully the install procedure.

Briefly, the agency software installation is as follows :

1. If a previous version of the agency is installed, uninstall it
2. Launch the **Station Bus agency installer** program and follow instructions. 3 components are available :
   - ⇒ the Microsoft Windows™ 2000 Station Bus agency,
   - ⇒ the OdFoundry component, which should be installed only on the PC which supports the Equipment Simulator
   - ⇒ the IED tunelling component, which should be installed if a IED setting software is used in tunelling mode
3. Install the OSI LLC driver

IMPORTANT :

If the PC on which the agency is installed has 2 Ethernet ports, you have to modify a configuration file as follows to indicate that the agency has to used the chosen port :

- open the “lean.cfg” file, located in the “exe” binder of the agency installation binder
- add :

```
Begin_Remote
        Common_Name     = localIP
        AP_Title        = 1 3 9999 23
        AE_Qualifier    = 1
        Psel            = 00 00 00 01
        Ssel            = 00 01
        Tsel            = 00 01
        Transport       = TCP
        NSAP            = 49 00 01 53 49 53 43 09 01 01
        Ip_addr         = <IP @>
End_Remote
```

With <IP @> the IP address of the port the agency has to connect to.

4.3 PACiS SMT installation

PACiS SMT is composed of 2 applications: server and client.

The station maintenance PC has licence for both applications.

SMT Server application is normally installed on main OWS that support PACiS OI server. It should be installed after PACiS OI server, even if needed to commission it.

PACiS SMT IN chapter describes fully the install procedure.

For commissioning it is remind that client application should be only started after server application part (or kernel). When client application is remote, communication link (via ping function) should be tested before commissioning SMT client.

Briefly, a SMT software installation is as follows :

1. If a previous version of the SMT is installed, uninstall it
2. Launch the **SMT installer** program and follow instructions. 3 components are available :

   ⇒ the kernel, or server : only one kernel could be installed in a PACiS system

   ⇒ the HMI, or client : one client can be installed on the PC which supports the kernel. Other clients can be installed on other PC

   ⇒ the HMI set-up, which allows to install HMI on other PC, without using the installation CD-ROM

The SMT doesn't install the Station Bus agency. If it has not previously done, the agency must be installed.

4.4 PACiS ES installation

PACiS Equipment Simulator installation is fully described in its IN chapter. It can be installed on any PC (whatever its IP address), but it is highly recommended to run it onto a separate maintenance PC and not on PACiS OWS or Gateway (in any case, the PACiS ES **cannot be launched** at the same time than an other PACiS application). PACiS ES replaces devices on SBUS, and replacement of present device lead to major failure on both simulator and replaced device.

Briefly, a ES software installation is as follows :

1. If a previous version of the ES is installed, uninstall it
2. Launch the **ES installer** program and follow instructions.

The ES doesn't install the Station Bus agency. If it has not previously done, the agency must be installed.

4.5 PACiS OI installation

PACiS OI is composed of 2 applications: server and client.

The Operator Interface package is composed of server part (connected on SBUS) and client part displaying mimics. The PACiS OI IN chapter described fully installation requirement and procedure.

Let remind from this documentation that Microsoft Windows™ 2000 should be correctly installed before with IP and name. With remote client applications, Microsoft Windows™ 2000 SERVER should be installed first. The client commissioning suppose to check first communication to server application. Evolution from local OI client(s) to remote OI client(s) need to reinstall a Microsoft Windows™ 2000 with SERVER licence.

Station Bus agency installation should be done before PACiS OI Server application.

Briefly, a complete (client and server) OI software installation is as follows :

1. Check if SQL Server 2000 is installed. If no, install it. If yes, delete the "Historian" database
2. If a previous version of OI application is installed, uninstall it
3. If a previous version of SCADA 2000 application is installed, uninstall it
4. If OI and/or SCADA 2000 applications have been uninstalled, reboot the PC
5. Launch the **SCADA 2000 installer** and follow instructions
6. Reboot the PC
7. Launch the **OI installer** and follow instructions
8. Reboot the PC

4.6 PACiS Gateway installation

PACiS gateway installation is described in its IN chapter.

Kind and number of SCADA communication (T-BUS) impact the hardware, and it is important to check clearly this definition before installation.

Briefly, a Gateway software installation is as follows :

1. If a previous version of gateway application is installed, uninstall it
2. Launch the **Gateway installer** and follow instructions
3. Station Bus agency is installed with the Gateway. Nevertheless, it could be necessary to install an other version of the agency, regarding the PACiS version coherency table given in each system release note.

4.7 MiCOM C264 installation

Installation is described in IN and MF (name and IP modification) chapter.

Computer is received with default IP address that need to be changed as defined into MF manual. This installation contains additional parts on networks referenced also later in this document.

Briefly, a Computer software installation is as follows :

1. If a previous version of computer application is installed, uninstall it
2. Launch the **Computer installer** and follow instructions. Several components are available :

   ⇒ 3 versions of C264 computer, depending on the available hardware (CPU type). **Be carefull in the choice of the version**

   ⇒ a FTP server, to allow software download in computer from the PC

   ⇒ the COMTRADE IED conversion files, if needed by third-party application. These conversion files are already installed with the SMT.

   ⇒ The PACiS CMT (Computer Maintenance Tool)

   At least one computer version, the FTP server and the CMT must be installed. The CMT will be used to set the computer for software installation.

4.8 PACiS Watch installation

PACiS Watch installation is described in the OI IN chapter.

Briefly, a PACiS Watch software installation is as follows :

1. If a previous version of PACiS Watch application is installed, **don’t uninstall it**. This is recommended to keep settings of the previous version.
2. Launch the **Watch installer** and follow instructions
3. If needed, modify the PACiS Watch setting to define which applications shoould be supervised

5. NETWORKS INSTALLATION

Systems are based on networks. Practice shows that lot of troubles (even after some time) come from incorrect installation of the networks. Here are referenced some installation practices in 3 sub-chapters for each kind of functional network

- L-BUS Legacy B-US between Computer and IED on field bus
- S-BUS Station BUS between PACiS devices and other IED based on Ethernet with protocol part UCA2 or IEC 61850.
- T-BUS Tele control BUS between system and Remote Control Point or SCADA

5.1 Legacy BUS installation

Installation of Legacy BUS or field BUS is described into computer IN chapter. Cable definition and maximum length is defined in chapter CO (Connection)

Two kind of cables can be used with copper and optical. Installation common problem are slightly different.

Copper cables are installed in daisy chain with computer usually in one extremity. For RS422, 485 terminal resistor (150ohms) has to be installed at both end. When LBUS is connected on computer BIU a jumper on the board can put a calibrated resistor for LBUS end. Another common installation problem is that LBUS cable is correctly protected from perturbation: not correctly shielded at both end, and/or installed into cubicle in contact with CT/VT or power digital signal.

Optical connection is done point to point. Optional box allows to make kind of Hubb (several input/output). The common trouble is that fiber bending under a 15cm radius raise permanently signal attenuation until glass breaking. With time and electromagnetic field the glass attenuation raise a bit, then signal level over attenuation lead to perturbation in communication.

5.2 Station BUS installation

Installation of Station BUS based on Ethernet is lightly described in all PACiS devices IN chapters, and more in detail into IN chapter of MiCOM Hxxx range devices.

The Ethernet network is composed of cables and switches (possibly repeaters). The network scheme ask as mandatory define cable length, physical layer, speed. The chapter CO of MiCOM Hxxx range devices and MiCOM C264 computer defines cable characteristic (example class 5 for 100T). PACiS system has defined a range of network switch defined in MiCOM Hxxx range devices and MiCOM C264 documentation (chapter HW & FT) with number of connection and power voltage.

Copper cable installation problem come often from cable quality compared from environment (class, shielding, protection against animal). For optical cable the handling during installation is a standard problem to not bend or even brake glass. Especially with glass fiber shelding is recommended especially for mice. Optical cable has emitter/receiver fibers to clearly distinguish before starting the install. As remind in SA chapter glance into fiber can damage eye and specific tool is recommended to commission one by one the fiber.

PACiS provides via specific switch a redundant Ethernet. Because it is redundant a single test can hide a wrong installation of master/secondary network. It is recommended to make commissioning after each switch installation and not globally.

5.3 Telecontrol BUS installation

Two PACiS devices Computer or gateway can have connection to SCADA via S-BUS. The basic installation is described into their IN chapter.

In both case TBUS communication might need a modem to get into PSTN or RNIS networks. Modem are country dependant and not part of the system. Modem should be configurable for all communication parameters.

6. NON PACiS DEVICES INSTALLATION

6.1 PACiS OI printer

In standard installation PACiS OI printers are installed on same OWS that the server part of PACiS OI. Printer has normally to be powered and connected before starting installation to use “Plug in” and automatic detection during driver installation on PC.

Using Microsoft Windows™ 2000 Parameters/Printer makes a standard “Add Printer” to start windows installer assistant. Assistant propose a kind of printer:

- local (OWS serial port) and the printer driver is installed from printer manufacturer or
- network (browse then OWS neighbouring to found network printer).

Printer name should match the associated attribute name in database, and it has to be defined as default printer.

Network printer can be a printer managed by and other PC. If the network PC is not Microsoft Windows™ 2000, PC installation of printer on network PC suppose to install printer as local on LPT, then to add a second “local port” on network PC for the remote access.

When printer is defined it needs to be configured. Select the printer, right click on property and select the thumb Ports. Chose in the list the selected port and double click. Define “local port” and enter its network/alias name then tick the printer in list and leave Port menu by Ok.

6.2 MiCOM C264 printer

Printer directly on MiCOM C264 computer has its installation fully described in computer IN chapter.

Printer is a serial 7 bit printer RS232C for listing. It can be installed later on one free port among 4 of the computer. Data printed are defined in database. It is important to notice in this installation that a file has to be copied into the computer (defining used port, and communication speed).

6.3 PACiS System Master clock

The external master clock receive absolute time synchronisation. In PACiS case, the standard means is to receive the absolute time synchronisation from GPS (Global Positioning Satellite system). This may be done with Hopf radio clock.

Installation of ***Hopf*** device is described in detail in its documentation. It is based on the ***Hopf*** 6870 GPS radio clock as a separate device that transmit time synchronisation via IRIGB signal.

The electronic device has link to antenna and maintenance software. Antenna should be installed on building top to see maximum of GPS satellite (4 or more). Care should be taken during this operation on roof against fall and possible power line neighbouring. Special protection against thunder lightning should be taken (at antenna neighbouring and limited distance from all electronic devices to common ground usually 10m). Link between antenna and ***Hopf*** radioclock is made by 25 meter cable (70m can be reach with another special cable after line amplifier should be added).

Maintenance software helps to commission correct detection of position then time, and definition of transmitted synchronisation.

Hopf 6870 should be powered 18-60V DC.

Once the hardware is installed, and maintenance software has been used to configure synchronisation, save the set-up and install system synchronisation.

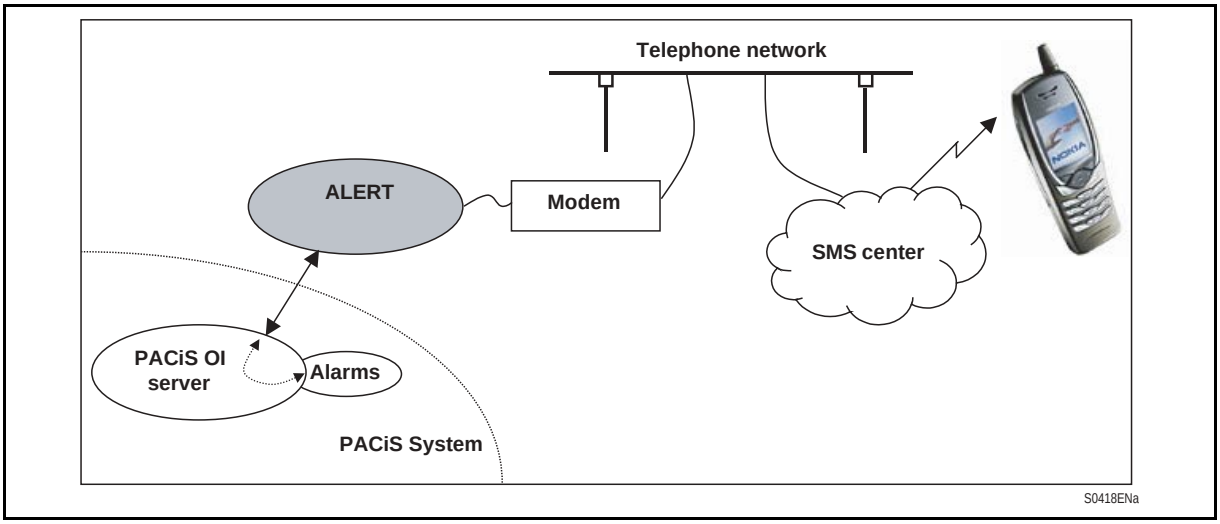
The time synchronisation scheme is to distribute the IRIG B synchronisation to one MiCOM Computer C264 with IRIG B based on BNC cable, T, and 50ohms impedance termination. This computer will then synchronise the other SBUS equipment through the Ethernet network.

7. NON PACiS APPLICATIONS INSTALLATION

7.1 ALERT Software

The ALERT software is used for alarm notification into PACiS.

ALERT is produced by MICROMEDIA International.



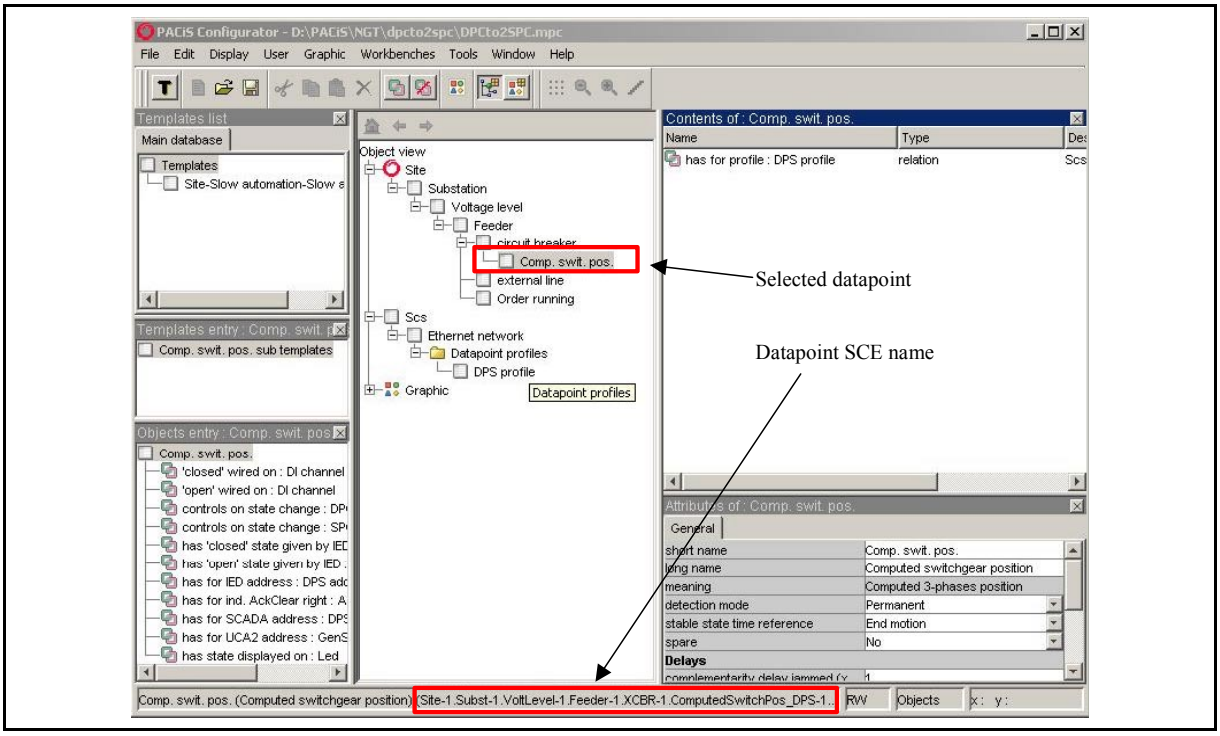
ALERT manages a list of application variables (PACiS OI Server) to supervise. The variables declared in this list are **OPC** variables, ALERT takes in charge the polling of their current state.

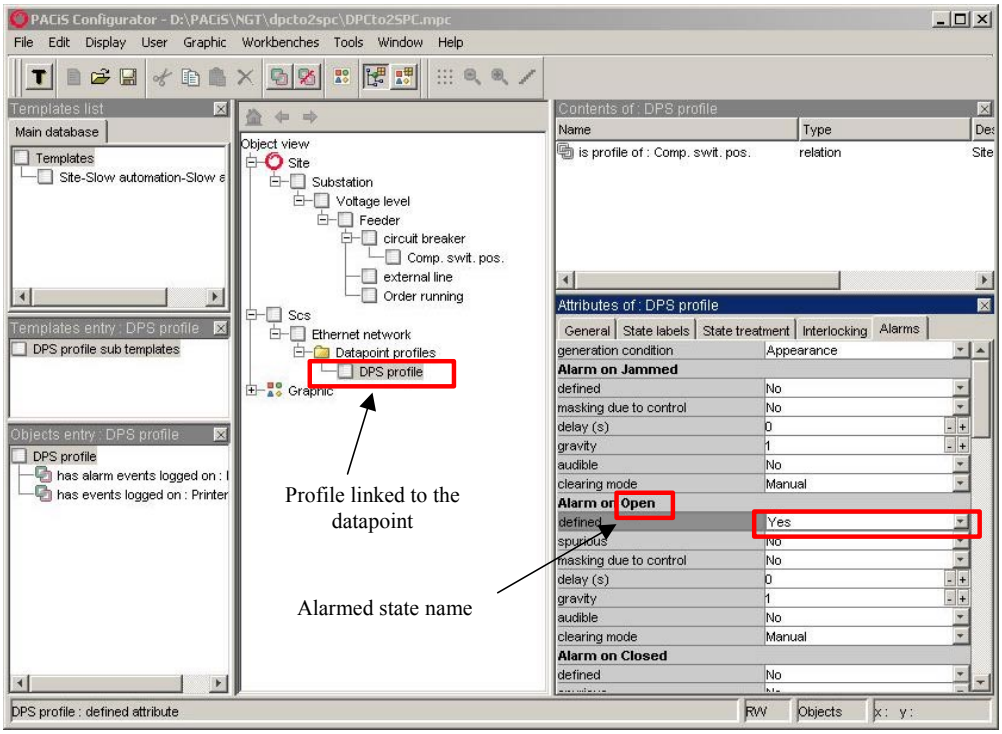
7.1.1 Identification of the PACiS alarms to be notified

Thanks to the SCE, it is possible to retrieve the name of the OPC variable that corresponds with the alarm to be notified.

During this phase you will manually collect the list of alarm to be notified, writing them in an ASCII file for instance. Doing that could be useful as we will see later.

The OPC name of an alarm is : <datapoint SCE name>.<alarmed state name>





In this example, the name of the OPC variable will be :

“Site-1.Subst-1.VoltLevel-1.Feeder-1.XCBR-1.ComputedSwitchPos_DPS-1.Open”

It corresponds to the PACiS OI alarm on the opened state of the datapoint.

NOTE : You must be aware on how alarms are managed :

⇒ In the STATE BASIS mode, all the defined alarms are visible as different items as presented above. According to the example, you will see the “...**DPS-1.Jammed**” and “...**DPSP-1.Open**” items.

⇒ In the DATA BASIS or GRAVITY BASIS, only the first state is visible as an OPC item. According to the example, you will see only the “...**DPS-1.Open** item.

7.1.2 Connection between ALERT and PACiS alarms

This phase occurs at run-time, when both the PACiS OI server and ALERT have been launched.

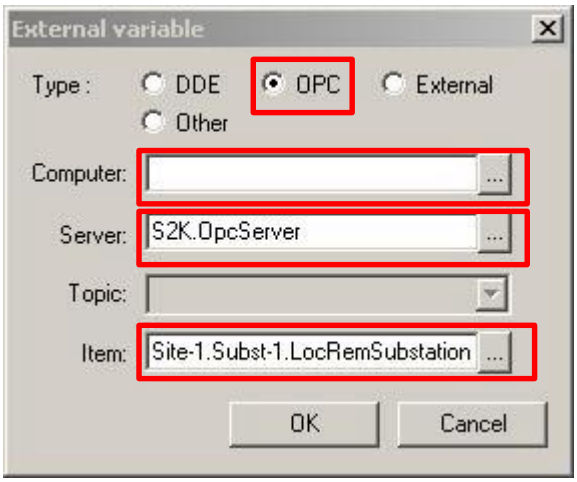
NOTE : ALERT may be started automatically by the way of Windows/Start/Program/Startup.

The main activity consist in setting in ALERT the list of PACiS alarms to be notified. Here, the name described in §7.2 is used.

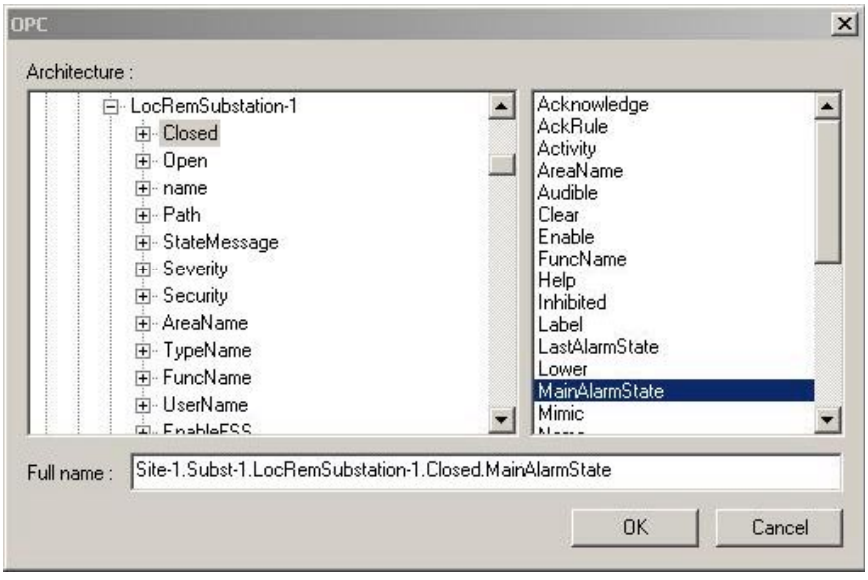
ALERT allows to enter ‘Tags’ (refer to the ALERT user manual for detailed information on how to configure it). In our case thy correspond to the PACiS alarms.

For all 'Tags' :

- add a tag



- select OPC
- computer : name of computer which supports the OI server
- server : always S2K.OpcServer
- item : 2 ways are possible to enter the item name :
  1. using the created ASCII file (see § 9.1), add "**.MainAlarmState**" at the end of each OPC variable in the ASCII file, then copy each line in the Item box
  2. using the ALERT browser :

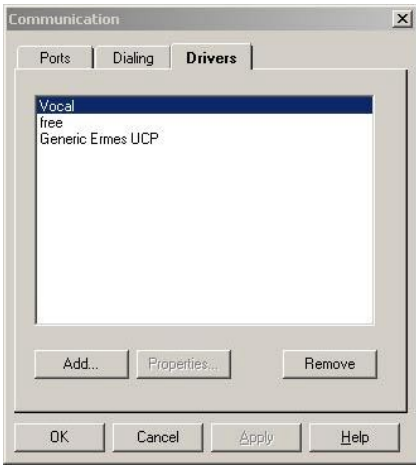


7.1.3 ALERT configuration for SMS

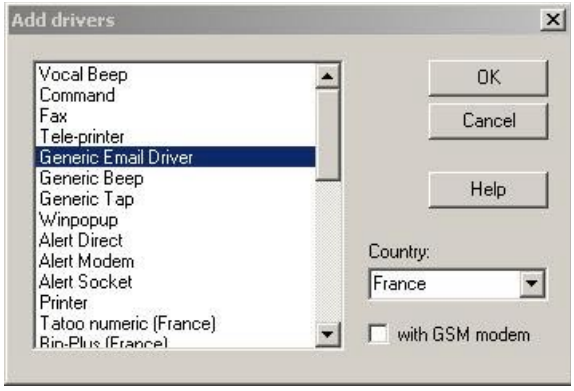
Here is described the case of SMS sent through e-mail using SMSToB service in France (www.smstob.com). A lot of services are available, depending on the country in which PACiS is used.

7.1.3.1 Driver configuration

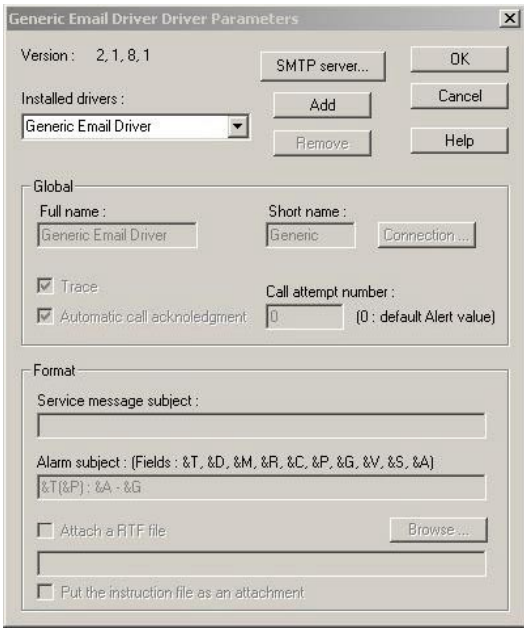
- select the “configuration / communication” menu
- select "drivers", click on "Add…"



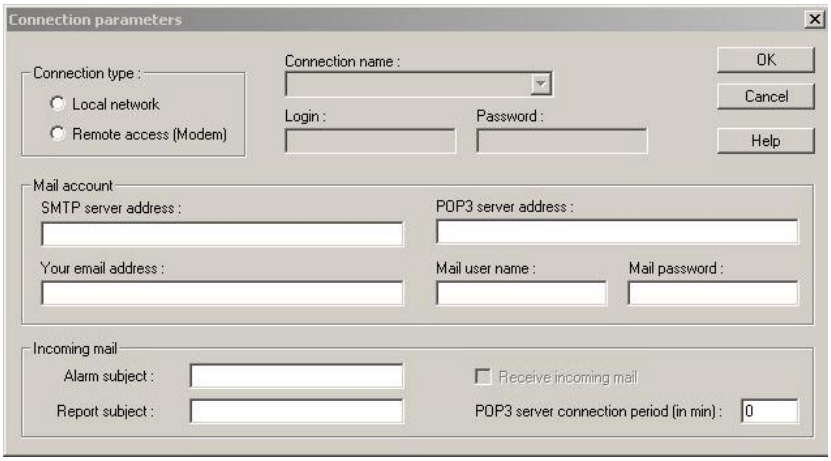
- select country and driver type (generic email driver)



- select created driver et click on “Properties...”



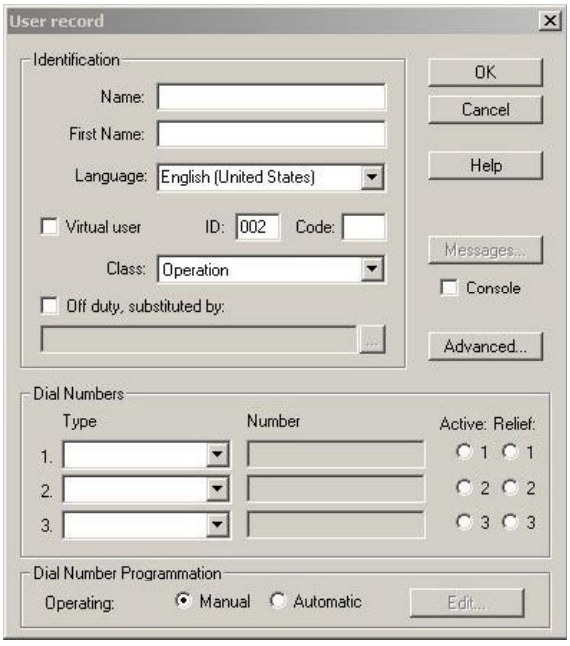
- click on “Add...”. In Global part click on “Connection ....”



- define all parameters attached to your Internet access (warning : the e-mail address must be the same than the address used to have an account on SMSToB service)
- in Format part ; alarm subject : remove all fields

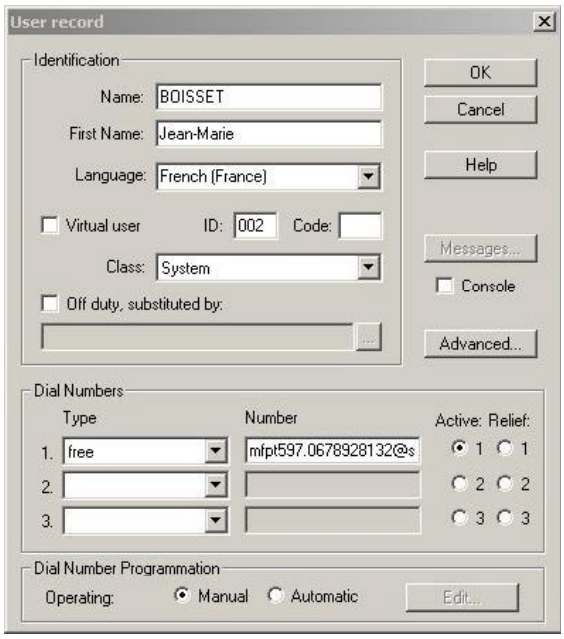
7.1.3.2 User definition

- add a user

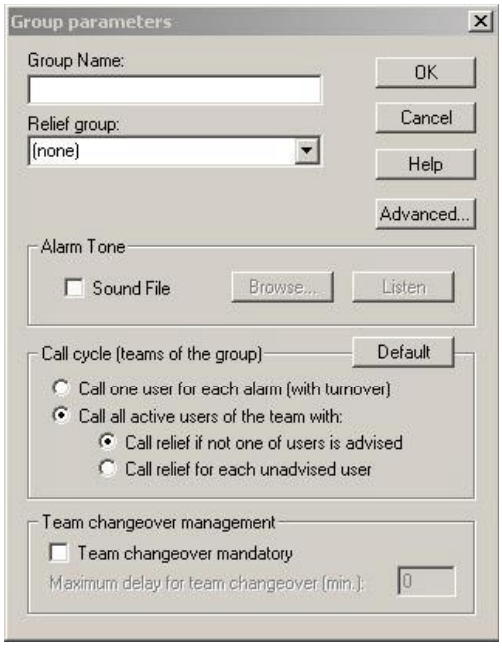


- type the name, the first name, the language, the class

- in “Dial Number” part, line 1 :



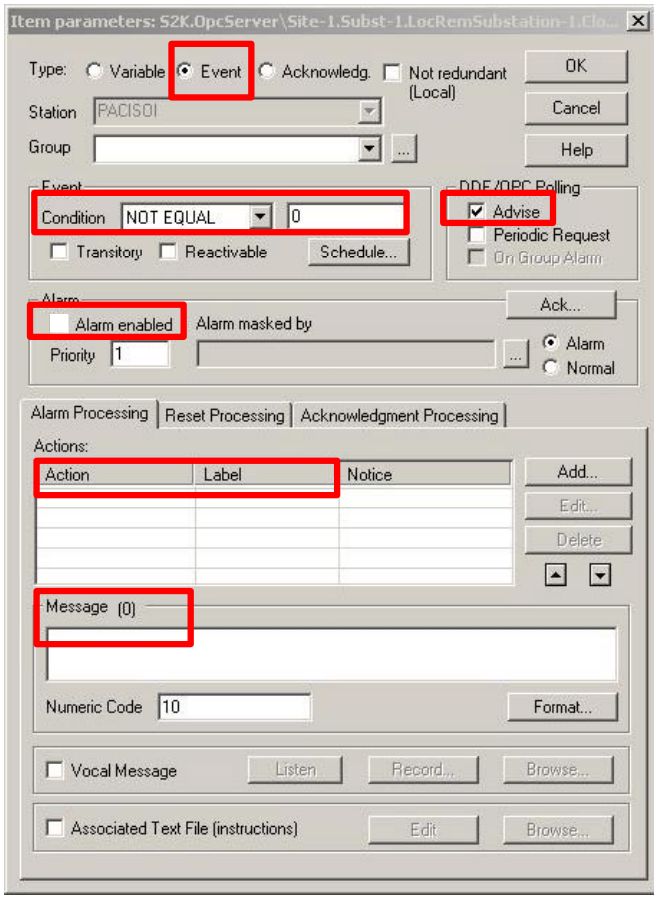
  - type : select the driver you have created
  - number : <password>.<phone number>@smstob.com
- you can define several user if several people have to receive a SMS when an alarm occurs
- if the same action (i.e. send the same SMS) must be performed when an alarm occurs, the users can be attached to a group :
  - add a group



  - define the group name
  - select "call all active users of the team"
  - drag and drop users to the group

7.1.3.3 Tag properties

For each tag (cf. § 9.2), you have to define the properties :



Type = event

Alarm = not enabled

DDE/OPC polling = Advise

Condition should be defined depending on what the user wants. The values of the alarm tag are :

Alarm state	Value
NO_SIGNIFICANT	0
DISABLED	1
INACTIVE	2
INACTIVE_ACK	6
ACTIVE_ACK	8
INACTIVE_UNACKI	18
INACTIVE_UNACKA	34
ACTIVE_UNACK	40

If the user wants to receive a SMS each time an alarm becomes active unacknowledged, the condition will be “EQUAL 40”.

Alarm processing = click on "add" – The action can be “call user” or “call group” depending on the user definition

Message = the button “Format…” allows to define the SMS message.

FUNCTIONAL DESCRIPTION

CONTENTS

1. SCOPE OF THE DOCUMENT

This document is a chapter of PACiS SYSTEM documentation binders. It is the functional description of PACiS SYSTEM and all elements available.

2. FUNCTIONAL DESCRIPTION

2.1 Control points

2.1.1 Remote control points

PACiS allows control of a substation from remote control points (SCADA) generally located some kilometres from the substation and usually able to control several substations.

PACiS can communicate simultaneously with different Remote Control Points (RCP) using separate communication protocols and separate databases.

PACiS can manage up to 4 RCP and provides several SCADA interfaces corresponding to a wide range of protocols:

International standards :

- IEC60870-5-101
- IEC60870-5-104

« de facto » standards :

- DNP 3.0
- ModBus

Specific protocol :

- GI74

If needed other specific protocols can be taken into account and implemented.

Definition of number and types of communication protocols is user selectable using the PACiS Configuration Editor.

2.1.2 Substation control points

The whole substation can be controlled from one or several Operator Workstation usually situated inside the substation or in a communication room. This control is done via several dedicated Operator Interface, running on PC-like computer (called the Operator WorkStation), which provide to the user the following functions :

Control functions

- alarms acknowledgement and clearing
- control of switching devices (circuit breaker, switch, …)
- locking of switching devices
- control of transformers
- control of secondary devices
- control of internal automation

Maintenance functions

- full graphic representation of the system
- modify the settings
- system maintenance functions (databases)
- disturbance files upload
- monitoring analysing functions

Supervision functions

- access authorisation
- topological view of single line diagram
- full graphic representation of switching devices
- full graphic representation of analogue values
- full graphic representation of additional process information
- display of automations state
- display and modification of counters
- display of alarms in list form
- display of events
- display of states
- viewing of curves for archived or real-time analogue and digital data
- forcing, substitution, suppression of datapoints
- memo function
- discordance management
- online help
- hardcopy
- tooltips

NOTE: Depending on the different types of PACiS architectures, the system can exist in a configuration without any OI but with SCADA interface.

2.1.3 Bay control points

At bay level, the control can be done via :

- a LCD Panel integrated to the MiCOM computers (C26x) which allows :
  - Displays of bay Panels, events, measurements, alarms,…)
  - Control of devices, set on/off Automatisms, alarm acknowledgement,…)

  pushbuttons or remote contacts (electrically wired) which allows mainly to display and control the switchgear and transformers.

2.2 Plant data interface

2.2.1 Digital inputs

Digital inputs (DI) are binary information related to the presence or to the absence of an external signal, delivered by a voltage source. The input nominal voltage Un can take one of the following DC values according to IEC 38 : 24 V, 48 V, 60 V ,110 V,125 V,220 V.

The DI is equal to 1 if the signal is present and is equal to 0 if it is absent. The signal polarity can be positive or negative. The configuration allows if is necessary to invert DI value by the software.

The acquisition period of digital inputs is fixed and is equal to 1 ms in MiCOM C264 computers range. Debouncing and stability filtering is applied in order to confirm the change of state of a digital input.

Every change of state is time tagged as soon as it has been detected.

2.2.2 Digital measurement

PACiS computes digital measurements issued from wired inputs associated to the following different encodings (16 or 32 bits): BCD, Binary, Gray code, 1-among-N, decimal encoding (1 among 6 for tens and 1 among 10 for units).

Digital measurements are read according to a user-selectable cycle and are filtered (multiple scan process).

A digital measurement is invalid under the following conditions:

- more than one tens-bit or units-bit is set (decimal encoding)
- more than two bits are set (1 among N encoding)

2.2.3 Counters

The energy metering devices deliver pulses corresponding to a calibrated quantity of energy. Each valid pulse increments the value of an accumulator used to compute the quantity of energy delivered during a given period.

Counters are acquired on the same boards as the digital inputs and may be single (one contact) or double counter (two contacts, the true contact “TC”, and the complemented contact “CC”).

For a single counter (SCT) , the value of the accumulator is incremented after a low to high transition, confirmed after a filtering time. Up to 32 SCT can be acquired on a per MiCOM computer basis.

For a double counter (DCT), pulses are detected in the same manner as for SCT, on the TC (True contact) variations. The pulse CC (the complemented contact) must be inverted regarding the TC contact.

The maximum frequency of the pulse is 20 Hz.

2.2.4 Analogue inputs

Analogue inputs (AI) are voltage or current DC signals delivered by transducers, and representing an external value.

Input ranges are :

- For voltage: ± 10 V, ± 5 V, ± 2.5 V, ± 1.25 V
- For current: ±1mA, ±2,5 mA, ±5 mA, ±10 mA, ±20 mA, 4-20 mA

The analogue inputs are acquired on a periodical basis. It exist two acquisition cycle:

- a short cycle (N_{sc} x 100ms, N_{sc} configurable from 1 to 10 with a default value of 1)
- a long cycle (Nlc x 500ms, Nlc configurable from 1 to 20, with a default value of 2)

The accuracy of the complete acquisition chain is 0.1 % of the full scale for each range at a reference temperature of 25 °C.

The Analogue to Digital Converter has a 16 bits resolution (15 bits + sign bit) and the zero offset value is computed by the conversion of a 0 V voltage reference. An AI is time stamped with the date/time of the scanned value.

2.2.5 Conventional ct/vt inputs

CT´s and VT´s are available at a 50 Hz or 60 Hz nominal frequency (f_{nom}).

They are acquired via a dedicated CT/VT board embedded in the MiCOM computer.

2.2.6 Digital outputs

Digital outputs are used to apply a switching voltage to an external device in order to execute single or dual, transient or permanent commands. The applied voltage is fed from an external power supply.

The external voltage is connected to the controlled device by a relay, thus isolating the logic part of the board from the external power supply. The relays can be single pole (one contact) or double pole (two contacts) N/O relays. There are also inverter relays (N/C) with one normally open and one normally closed contact, which can be used when positive security is required.

2.2.7 Digital setpoints

Digital Setpoints are digital values sent on multiple parallel wired outputs. Each wired output represents a bit of the value. Digital Setpoints are used to send instruction values to the process or to auxiliary devices.

The Digital Setpoints are processed on the same boards as the Digital Outputs. The Digital Outputs characteristics described above apply on Digital Setpoints.

Digital Setpoints can be encoded to BCD, Binary, Gray, Decimal, 1 among N code.

Moreover a supplementary bit can be used for the sign and a dedicated binary output can be used to allow or forbid the reading of the value by the external device.

2.2.8 IED Interface

The IED Interface is used for a line-to-line or multipoint interconnection between the different system devices. The data transfer take place with different specific serial protocols.

The provided interface are EIA RS-232 transmission, EIA RS -485 transmission, Fibre optic transmission

2.3 Process and apparatus data management

2.3.1 Binary inputs

PACiS system manage five types of Binary inputs:

- single Point (SP) derived from one Digital input
- double Point (DP) derived from two Digital inputs
- multiple Point (MP) derived from N Digital inputs (up to 16 in case of states, up to 64 for TPI)
- System Input (SI) information related to the system, to configurable and built-in automations or to electrical process but without acquisition possibilities
- group, logical combination of BI

SP, DP and MP are acquired via digital input boards or via IEDs connected by a serial link. SI and Groups are generated by the computer application layer.

2.3.1.1 Single, double and multiply points processing

The following table shows filterings applied to digital input according to its type.

	SP input	DP input	MP input
Toggling filtering (1)	X	X	X
Persistence filtering (2)	X	X	
Motion filtering (3)		X	
Undefined state filtering (4)			X

- A toggling filtering : applied in order to eliminate toggling transitions.
- Persistence filtering : DI must stay in the same state on a certain period of time T otherwise are not taken in account.
- Motion filtering is applied to double points in order to avoid take in account transient states: (00, 11).
- Undefined states of multiply points are filtered in order to avoid take in account transient states: all DI in the SET state, all DI in RESET state, or more than one are in the SET state.

Toggling parameters, persistence time, motion and MP filtering time are configurable.

No filtering (except persistence one) is applied to SI and Groups inputs.

Binary input can be manually suppressed (they are not processed until unsupression), or substituted by an other state. When a binary input becomes invalid, the operator can force it by a valid state. The binary input is automatically unforced when it becomes valid again. The configuration allows also to the user to define automatic forcing when a binary input becomes invalid.

Binary resulting states after processing

	Single Point	**Double Point**	**Multiply Point**
CONFIRMED STATES	RESET SET	OPEN CLOSE	STATE1 to STATE32
MOTION FILTERING/ MP FILTERING		JAMMED UNDEFINED	UNDEFINED
TOGGLING FILTERING	TOGGLING	TOGGLING	TOGGLING
FAULTY INPUT (1)	SELFCHECK FAULTY	SELFCHECK FAULTY	SELFCHECK FAULTY
LOSS OF COMMUNICATION	UNKNOWN	UNKNOWN	UNKNOWN
SUPPRESSED BY OPERATOR	SUPPRESSED	SUPPRESSED	SUPPRESSED
SUBSTITUTED BY OPERATOR	SUBSTITUTED RESET SUBSTITUTED SET	SUBSTITUTED JAMMED SUBSTITUTED OPEN SUBSTITUTED CLOSED	SUBSTITUTED STATE 1 to 32
FORCED BY OPERATOR/ AUTOMATICALLY	FORCED RESET FORCED SET	FORCED JAMMED FORCED OPEN FORCED CLOSED	FORCED STATE 1 to 32

Faulty indication : Following a faulty indication of a physical DI during hardware acquisition, the associated SP, DP or MP becomes SELFCHECK FAULTY.

An automation, called "DI/DO association" is available : it allows to directly activate a digital output depending on the current state of the digital input. It applies for SP and DP.

2.3.1.2 System Inputs (SI)

System inputs are binary information related to:

- an equipment or system internal state, such as hardware faults or system faults.
- configurable or built-in automation (status of the automation, binary input created by the automation, …).
- electrical process information which have no acquisition possibilities (i.e. no acquisition through DI or through serial communication) but which must be managed by the MiCOM computer : the status of these information are saved in non-volatile memory.

A SI is of SP, DP or MP type and can belong to any type of group. The processing of a SI is the same as the SP / DP / MP but there is no motion filtering nor MP filtering) on SI.

2.3.1.3 IED Inputs

These inputs are acquired from IEDs or protective relays via the station bus or legacy bus.

An IED input is of SP, DP or MP type and is processed as described above.

2.3.1.4 Groups

A group is a logical OR or AND or NOR or NAND combination of binary inputs described above or other groups.

A group is processed as a SP and so can take the following states : Set, Reset, Invalid, Suppressed. A group can be manually or automatically suppressed, forced or substituted.

A group is time stamped with the date / time of the last datapoint which has modified the group status.

2.3.1.5 Digital inputs transmission

The BI are transmitted on a client-server basis on the Station Bus network (IEC61850). A BI can be transmitted using two modes:

Report based mode:
A BI can be configured to be transmitted in Report mode. In this mode, a confirmed change of status is spontaneously transmitted to the subscribers with the time stamping and the reason for change.

GOOSE based mode :

IEC61850 GOOSE :
In this mode, the change of status is transmitted in multicast to the configured receivers. Only the BI unfiltered states with their time stamping are transmitted, the reason for change is not.

Basically, the Report mode is used to transmit filtered data for displaying, printing and archiving. The GOOSE mode is used to transmit data as soon as possible after their acquisition and as quickly as possible, for automation purpose.

During a loss of communication between a client and a server, all server BI are set to UNKNOWN on the client.

2.3.2 Measurement

A measurement can be acquired using :

- an analogue input
- a digital measurement
- a serial communication link with an IED
- a CT/VT input

2.3.2.1 Measurement processing

Configuration process allows to the user to define for each measurement a scaling law (linear, quadratic) and up to 6 thresholds for which the detection caused by a measurement variation can create an event and alarm.

Moreover, for 4-20 mA transducers, a special feature is implemented to avoid fleeting values around 4 mA.

Measurements can be manually suppressed (they are not processed until unsupression), or substituted by an other value. When a measurement becomes invalid, the operator can force it by a valid value. The measurement is automatically unforced when it becomes valid again. The configuration allows also to the user to define automatic forcing when a measurement becomes invalid.

Measurement resulting states

State	Comment
VALID	Not in one of the below states
SELFCHECK FAULTY	Detected “faulty” by the acquisition component
SUBSTITUTED	By operator
FORCED	By operator / Automatically
SUPPRESSED	By operator
UNKNOWN	Loss communication.
SATURATED	Detected “saturated” by the acquisition component
UNDEFINED	Scaling management
OPEN CIRCUIT	Open Circuit Management
OVERSHOOT[1..3]	Threshold management
UNDERSHOOT[1..3]	Threshold management

Measurements Transmission

The measurements are transmitted on a client-server basis on the Station Bus network., using the report mechanism and/or the GOOSE mechanism only in IEC61850.

Measurements can be transmitted:

Periodically (a short period from 0 to 60 seconds (step 0,1 second), a long period, from 0 to 60 seconds (step 0,5 second):
Periods are user selectable

Variation:
A value is sent if the acquired value is different from more than a specified amount from the previously transmitted value (variation is user selectable)

Threshold violation:
If an overshoot or an undershoot occurs, the measurement is transmitted. The measurement is also transmitted at the end of an overshoot or at the end of an under shoot, e.g. threshold minus hysteresis. (Thresholds and hysteresis are is user selectable)

Upon trigger:
Upon change of state of a SP, a DP or a SI, one measurement or a group of measurements are transmitted. (the association Measurements and SP, DP, SI are user selectable)

Change of state:
Measurements are always transmitted when the change state (VALID, AKNOWN, SUBSTITUTED,…)

2.3.2.2 CT/VT Calculations

The following measurement values are provided using the CT/VT inputs acquisition:

- RMS currents and voltages
- Frequency (with a 0,01 Hz precision)
- Active power P (Watts – total and on a per phase basis – with a 0,2% precision)
- Reactive power Q (Vars – total and on a per phase basis)
- Apparent power S (VA – total and on a per phase basis)
- Power factor pf (total and on a per phase basis) – pf = P / S
- Sequence components (I_d, I_i, I_0, V_d, V_i, V_0)
- Phase angles (with a 1° precision)
- Total Harmonic Distortion (THD) & Total Demand Distortion (TDD) – Harmonics are evaluated up to the 15^{th} order.
- Magnitudes
- Synchrocheck information : ΔF, ΔV, $\Delta \varphi$

2.3.3 Tap position indication processing

The tap position indication (TPI) can be acquired on digital input boards . It could be:

- A Multiple Point
- A digital measurement (Decimal, Gray, BCD)

On analogue inputs (measuring a current input), a minimum value Imin (mA) corresponds to the lowest position 1 of the tap , and a maximum value Imax corresponds to the highest value N.

TPI can be suppressed, substituted and forced like digital inputs and measurements.

TPI resulting states after processing

State	Comment
VALID	Not in one of the below states
SELFCHECK FAULTY	Due to an AI board fault or a DI board fault
SUBSTITUTED	By an operator
FORCED	By an operator
SUPPRESSED	By an operator / automatically
UNKNOWN	If the tap position is acquired via a transmission link, the information is unknown when the link is disconnected.
UNDEFINED	Due to a wrong encoding for a digital acquisition, or a saturation, an open-circuit or an out-of-range value for an analogue acquisition
OVERSHOOT[1..3]	It exists 3 “Overshoot” states, one for each upper threshold violation. Only one could be set at one time
UNDERSHOOT[1..3]	It exists 3 “Undershoot” states, one for each lower threshold violation. Only one could be set at one time

TPI transmission

The TPI are transmitted on a client-server basis on the Station Bus network using the report mechanism and/or the GOOSE mechanism only in IEC61850. They are transmitted as soon as a value change or a status change is detected.

2.3.4 Metering

Metering values (non-tariff metering) are issued from single and double counters, they represent the number of pulses taken into account (32 bits values).

Digital counter acquisition is stored to accumulators in non-volatile memory. The accumulator is incremented at each valid counter pulse.

IEDs Counters transmitted cyclically are stored to the periodic register and FIFO memory.

An operator can force the metering values. The modification could be a reset of the counter.

Counter resulting states after processing

State	Comment
VALID	not in one of the below states
SELFCHECK FAULTY	Due to the SELFCHECK FAULTY of the DI
UNKNOWN	If the counter is acquired via a transmission link, the information is unknown when the link is disconnected.
UNDEFINED	Due to a counting failure of DCT (non-complementarity of the 2 contacts)
OVERRANGE	when the maximum value is reached

Counters Transmission

The counters are transmitted on a client-server basis on the Station Bus network using the report mechanism and/or the GOOSE mechanism only in IEC61850.

2.4 Data logging and archiving

2.4.1 Data logging

The Data Logging function is the logging of PACiS information on printers. Three types of printers are available:

- the SOE printers (Sequence Of Event)
- the LB printers (Log Book)
- the HC printers (Hard-Copy)

PACiS manages :

- a maximum of 2 redundant SOE printers (i.e. 4 SOE printers) and 2 redundant LB printers (i.e. 4 LB printers) at a system level, managed by the OI. These printers can be serial or network ones.
- a maximum of 1 LB printer at a computer level (serial printer)

2.4.1.1 Sequence Of Event (SOE) printer

SOE printer is a dedicated printer for printing only SP, DP and MP events attached to the primary process only.

The 5 following BI properties can be printed. The position of each property in the printed line (i.e. position 1, 2, 3, 4 or 5) is defined in configuration :

Chronology :

TimeStamp and synchronisation status (the synchronised / not synchronised)

Origin - substation name, voltage level name, bay name, module name

ObjectName - BI name

ObjectMessage - BI resulting state.

2.4.1.2 Log Book (LB) printer

Types of events printed on the LB printer can be :

- Binary inputs (SP, DP, MP, SI and Groups)
- Tap position indication
- Measurement
- Operator action (Log-in and log-off, Devices control)
- Alarm acknowledgement / clearing

One or several types of events can be printed : the choice is made by configuration. The selection of the LB printer destination (1, 2, or both, for printer at system level) is made by configuration on a per data basis.

The list of event states (for BI, Tap Position Indication and measurements) which will be printed can be defined in configuration. A printed information will be also archived.

Properties printed are the same than SOE printers above.

2.4.1.3 Hard-copy printer

Hard-copy printers allow printing “hardcopy” views of the Operator Workstation

2.4.2 Data archiving

The Data Archiving function is the historisation of PACiS information :

- at computer level : local archiving
- at OI level : central archiving

2.4.2.1 Local archiving

Local archives are implemented at the level of the equipment that acquires or process the information (i.e. the MiCOM Computers). Events are stored in non-volatile memory.

The number of events recorded into a local archive depends on the type of equipment.

The archived events can be viewed on the computer local HMI.

Events

The data archiving of events is configurable on a per event basis. The following events can be archived :

- changes of state of Binary Inputs (SP, DP, MP, SI, Groups)
- changes of state of Measurements
- changes of state and value of Tap Position Indications
- devices Control actions and acknowledgements

The archived events can be viewed on the computer local HMI.

Fast Waveform Recording

Fast Waveform recording allows to store samples at the maximum sampling frequency.

Waveform records are stored using COMTRADE 97 binary format.

Slow Waveform Recording

Slow Waveform recording allows to store measurements on a long period.

Waveform records are stored using COMTRADE 97 binary format.

2.4.2.2 Central archiving

Events central archiving

PACiS allows to have central archives on the hard-disk of the Operator Workstation, using a SQL Server database.

Measurements central archiving

The measures and associated mean values are archived in the central SQL server database, as the events in the following tables:

Daily table for the mean values of the day. These tables are stored during 35 days.

Monthly table for the minimum, maximum, mean values, computed at a reference time (configurable) of a day. Monthly tables are stored during 15 months.

Yearly table for the minimum, maximum, mean values, computed at a reference time (configurable) of a month. Yearly tables are stored during 5 years.

Backup central archiving

A backup of the central archive (i.e. of the SQL database) is allowed at a configured date / time

Waveform and Disturbance Files

These files, generated at a local level, can be automatically uploaded from a device. Only one central file archiving is defined in the system. The automatic upload could be activated / de-activated by the operator.

A storage policy is defined to avoid filling up the hard disk :

- a maximum of 10 files can be stored on a per device basis : the oldest is automatically removed when a new one is uploaded
- this principle defines a storage area per system database version
- global disk space of storage area is defined in local setting

2.4.3 Reporting

PACiS provide a mechanism for creating reports showing:

- real-time information
- information collected by central archiving function

2.5 Control sequences

2.5.1 Control sequence behaviour

The control sequences can be initiated from any control point (RCP, SCP, BCP and DCP).

By configuration a control may be executed to one of the following modes:

"**Select Before Operate once**" mode (**SBO once**):
Usually for circuits breakers and disconnect switches. The device must be select before allow the execution. In that case the device is managed in tow phases: selection and execution. Device unselection is done automatically by the computer.

"**Select Before Operate many**" mode (**SBO many**):
Usually for tap positioning of transformers. The device must be selected before execute one or more controls before reach the expected position (low/raise). In that case the device is managed in tow phases: selection and execution. The execution phase is repeated for every new control. The deselection of the device must be done by the initiator of the request.

"**Direct Execute**" mode:
Usually for ancillary devices a control may be performed directly without need selection.

Control sequences are executed if the computer is in "operational" mode. However PACiS system allow to perform control sequences in "test" mode in order to simulate controls for devices. In this mode output relays are not activated, controls are not sent to IEDs or on station bus, and only the control acknowledge is managed. Some system outputs controls such as "switch database", "change computer mode" are allowed in maintenance mode.

The following checks (user-selectable) can be performed before the acceptance of the control:

- the Inter-control delay has expired (time between two sequence in the same device)
- substation, bay and SBMC mode allow the control
- interlock equation and topological interlocking allow the control
- no automation is running for the device
- the device is not locked
- the current status of the device is on the opposite state
- uniqueness control : only one control at a time for the device

If these checks are configured, they are checked by the MiCOM computer in each phase of the control sequence (allowing the switching devices to operate in security).

An acknowledgement (positive or negative) can be issued, sent to the different control points, archived and printed.

"Interlocks" can be by-passed by the operator, depending on its access rights.

The operator request is also printed and archived.

2.5.2 Control sequence of switching devices

PACiS control switching devices such as circuit breaker, disconnector or earth switch. They are managed in "Direct execute" or "SBO once" mode.

The allowed controls are open and close commands. Moreover the "close/open" control the device may have, by configuration, a "selection" output control. In this case the device is managed in "SBO once" mode. The device is selected in the selection phase.

2.5.3 Close control of synchronised circuit breakers

Synchronised circuit breakers may have specific features. These features ere user-selectable and are taken in account by the control sequence upon a close request:

- the device is controlled by an external synchrocheck module or internal automatic function
- the synchrocheck module (internal or external) is setting on/off manually or automatically

Moreover, during waiting the closing of the device by the synchrocheck module the initiator of the request may:

- cancel the request
- close the device by forcing request

2.5.4 Control sequence of transformers

PACiS control transformers by dealing with associated tap changer positions.

The allowed controls are « raise » command (current tap position+1) and « lower » command (current tap position-1).

Additionally of the common checks of control sequence the computer proceed to the following verifications:

- only raise command is allowed if the tap position value is the smallest one authorised
- only lower command is allowed if the tap position value is the higher one authorised

Transformers can managed in the three modes (Direct Execute, SBO once and SBO many) :

Direct Execute:
Only one control raise or low is performed in the control sequence. The initiator of the request must perform many “Direct Execute” sequences before reach the expected position.

SBO once:
The sequence is similar to the “Direct Execute” but the execution phase is preceded by a selection phase. In this phase are performed all controls checks and the selection of the device (if it is configured).

SBO many:
After the selection phase, many controls raise or low can be performed in the same sequence in order to reach the expected position. The sequence ends only after an unselect request from the initiator.

2.5.5 Control of secondary devices

PACiS control secondary devices like protective relays or IED allowing to (non-exhaustive list) :

- Modify the setting groups parameters used by a protection equipment (e.g. 1 among N command type if N setting groups are available for the protection)
- Reset some internal indication (e.g. single command type to reset alarm indication on a protective relay)
- Set active or inactive an external equipment or apparatus (e.g. ON/OFF or IN/OUT single or double command type)
- Send analogue or digital Setpoints to external apparatus or equipment
- De-active the alarm klaxon
- Control the substation / room lights

2.6 Automatic control functions

2.6.1 Interlocking

Interlocking function provides authorisation to control a HV or MV switching device (circuit breaker, disconnector, earthing switch), protective devices and auxiliary equipment from any control point (RCP, SCP, BCP, DCP, automation).

Interlocking equations are written using logical equations of all process information. The interlocking equation does not only use the value of the information but also the validity of the information.

The configuration process allows to define or not for each transition (open/close) an interlocking equation.

Each MiCOM computer manages the interlocking equations of its own switching devices.

2.6.2 Configurable automations (PLC)

PACiS allows the user to configure specific control sequences or automations (e.g. switching sequences, busbar transfer, load shedding, GIS-pressure supervision, etc …) during the configuration phase. The language used (PLC-program) takes into account the IEC 61131-3 standard.

The execution of the automation sequences is cyclic : nevertheless, a dedicated mechanism is provided to avoid data lost. Maximum number of cyclic PLC-programs is 32.

Each PLC-program runs on one computer, which means a PLC-program cannot be distributed within the system. However, it is possible to use information obtained by other computers.

Automations can be triggered:

- by operator request
- by events (digital or analogue input state changes)
- other automation request

PACiS embeds the ISAGRAF™ tool (provided by Altersys company) to provide the PLC

2.6.3 Fast configurable automation (PSL)

Due to the range of PLC cycle time (no less than 50 ms), an other type of fast automation is provided in PACiS : the Programmable Scheme Logic automations.

These automations are event-driven : they are calculated each time an input changes (i.e. there is no cycle time). Inputs can be BI and Measurements.

PSL are logical equations that use the following functions:

- AND, OR, XOR, NOT, NAND, NOR operators
- “bistable” function
- pickup and drop-off timers (from 10 ms to 60 seconds, by step of 10 ms)
- BI setting – the system BI is:
  - SET if the PSL is TRUE
  - RESET if the PSL is FALSE
  - INVALID if the PSL is INVALID
- Digital Output setting – the DO is:
  - closed if the PSL is TRUE
  - opened if the PSL is FALSE or INVALID (only in case of permanent DO)

2.6.4 Built-in automatic functions

PACiS performs a wide range of automatic functions for the substation control activity.

These functions can be activated, by-passed, deactivated (and re-activated) by authorised operators.

2.6.4.1 The Automatic Voltage Regulation

The Automatic Voltage Regulation (AVR) function is used to automatically maintain the correct voltage at the lower voltage of transformers. Secondary voltage is changed by controlling the tap changer of transformers.

2.6.4.2 Synchrocheck

The PACiS synchrocheck function is designed to measure two voltages with respect to phase angle, frequency and magnitude to safeguard against the interconnection of two unsynchronised systems. The voltage measures come from VT's.

2.6.4.3 Auto-Recloser

PACiS provides a build-in auto-recloser function for transient or permanent fault elimination. Auto-reclosing cycles and cycles temporisation can be defined during configuration process.

2.6.4.4 Pole discrepancy protection

PACiS provides a build-in pole discrepancy protection to allow circuit breaker trip in case of pole discrepancy.

2.6.4.5 Trip Circuit Supervision

The Trip Circuit Supervision function allows to raise an alarm into PACiS if a circuit breaker is still closed after a relay trip order.

The MiCOM computers are able to support the 2 diagrams used in Trip Circuit Supervision:

- Trip Circuit Supervision with one Digital Input + external resistor.
- Trip Circuit Supervision with two Digital Inputs without external resistor.

2.7 Alarms management

2.7.1 Types and definition

Alarms can be generated by a change of state of a digital point, a measurement threshold violation, a PACiS internal fault (e.g.: loss of communication, computer faulty).

Digital points and measurements involved in alarms management can be issued from wired inputs or from IED or protective relays or from PACiS internal computation (e.g. digital groups).

Alarms can be defined as immediate or differed (with an associated user-selectable delay) and can have an associated audible alarm. The audible alarm can also being immediate or differed.

Alarms can be associate to each state of event (open, close, jammed,..) or to each a measurement threshold (in case of violation) and may have a different gravity level (0..5).

Four types of alarm management are available on PACiS system and are user-selectable during configuration process:

- « state basis » alarm management: one alarm for each state is displayed
- « gravity level basis » alarm management: only one alarm for each gravity level is displayed. The previous one is replaced by the current one with same gravity level
- « data basis » alarm management: only the last alarm is displayed: the previous one is replaced by the current one
- « Spurious alarms » management: are defined for events, which appear but never disappear (control acknowledgement for example)

Only the « data basis » alarm processing is managed by the MiCOM computers.

2.7.2 Alarm display

SCP level: The alarms are displayed via the HMI at SCP level, using:

- dedicated windows displaying:
  - the chronologically sorted list of the alarms (with additional sorting criteria as geographic or functional)
  - the last N alarms (N being user-selectable during configuration phase)
  - with different colours for each line of the previous lists, depending on the alarm state
- graphic pictures defined during configuration phase, displayed in the different views, which can be associated to the presence and the states of alarms for a device, for a bay, for a voltage area, for the whole substation, etc.

BCP level:Alarms are displayed in the form of one list in the panel. This list is a circular queue and is displayed in a scrollable view.

2.7.3 Alarm aknowledgement and clearing

An alarm can be acknowledged by an operator, to signify that it has been taken into account. Acknowledgement can be done by the operator from the SCP or BCP level.

Independently of the alarm acknowledgement, the audible annunciation can be acknowledged by an operator or automatically after a user-selectable delay

An alarm can be cleared only if the reason of its apparition disappear (becomes inactive) and was acknowledged by an operator.

An alarm can also be configured as « to be cleared automatically » when it becomes inactive and is acknowledged.

2.8 IED management

A wide range of IED can be fully integrated into PACiS via connection to different types of legacy busses or IEC61850 protocols.

Protocols implemented:

IEC61850	on station bus
IEC 60870-5-101	on legacy bus
IEC 60870-5-103	on legacy bus
Modbus	on legacy bus
DNP 3.0 (level 2)	on legacy bus

These protocols are fully implemented in PACiS.

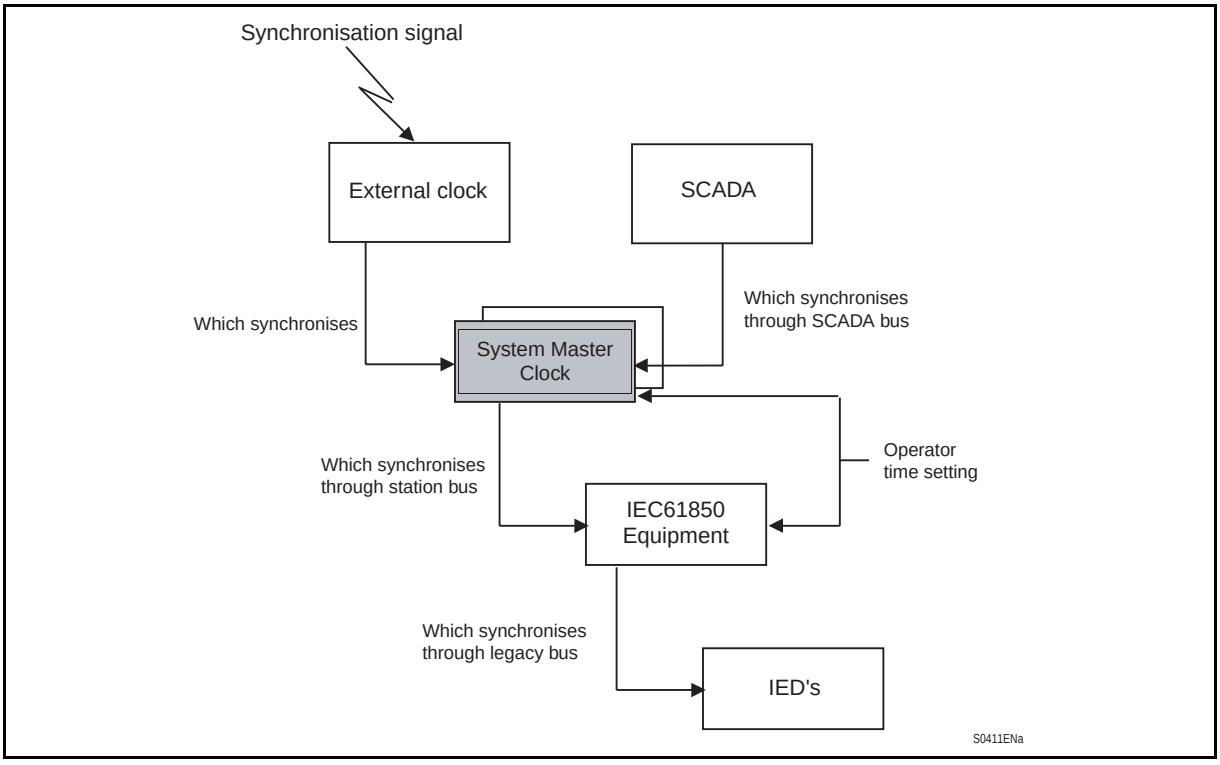
Third party protocols will implemented using external converter over legacy bus protocols or station bus protocols.

2.9 Time management

PACiS system provides a time synchronisation mechanism, which allows having the same date/time on all connected devices. This synchronisation allows particularly the time tagging of events, the synchronising of the reports and programmed actions at source.

In a PACiS system, the external clock is connected to one MiCOM computer (or 2 in case of computer redundancy) which will be the “System Master Clock”.

The System Master Clock equipment is considered the unique time-date reference to the whole system. It is connected on the Station Bus and it re-distributes the time-date reference to the other PACiS component (MiCOM computers, IEDs). The equipment connected on the Station Bus can communicate with IEDs connected on Legacy Bus. In this case, they synchronise their IEDs through the legacy protocols.



In case that external clock does not exist or is lost, the master clock equipment can be synchronised by a SCADA (only if the Master Clock computer manages a SCADA protocol) or by an operator. Synchronisation priority of the System Master Clock is in the following order:

- From the external clock (if it exists)
- From the SCADA (if it exists) in case of failure of the External Clock
- From the operator in case of failure of the External Clock and the SCADA

Each Station Bus equipment after reception of a synchronisation message perform its local update procedure:

- MiCOM computers: If the delta between the local clock and the synchronisation message is less than 20 ms, a “smooth” increase/decrease of the local clock is done. Otherwise, the local clock is immediately set with the date / time of the synchronisation.
- PC computers local clock is updated using Microsoft Windows™ 2000 procedures.

PACiS system is capable to deal automatically with seasonal time changes by using indications coming from the external clock or using the Time Zone table.

In case of lost synchronisation to one of the different equipment (master clock equipment, Station Bus equipment, legacy equipment) is signalled (printed archived, alarmed).

2.10 System monitoring

2.10.1 Equipment operating modes

PACiS system equipment (MiCOM computers, gateway, OI server) may work in one of the following operating modes:

Operational:
The equipment is working correctly (all the functions are executed)

Test:
All functions are executed except activation of the relays of local output controls. The computer simulate a positive acknowledgement for control sequences simulation. Note the output controls continue to be sends to the IEDs or to other computers.

Maintenance:
The equipment is working but only some functions are executed, generally the "supervision functions" (download and display data base information, communications state,…).This mode is requested by the operator or reached automatically in case of data base incoherence.

Faulty (only for MiCOM computers):
The equipment is working but only some functions are executed, generally the "supervision functions ", functions not involved in the management of the electrical process. This mode is a consequence of a failure detected on the equipment.

Initialisation (boot):
Transitory mode between equipment power-up and operational, maintenance or faulty mode

Halt:
The equipment is out of service due to detection of fatal error

Operating mode can be changed locally at each equipment or from Operator workstation.

2.10.2 Equipment redundancy

2.10.2.1 PACiS OI redundancy

More than one PACiS OI can be present inside the substation allowing:

- operators to control the substation from some different places
- to continue to control the substation from SCP level if a single failure occurs involving one PACiS OI

Two types of redundancy are available:

- server redundancy : the OI servers are redundant, allowing redundancy of alarms, events and historian functions. An OI client will switch from a server to the other one after a delayed failure detection.
- client redundancy : up to 8 OI clients can be configured, allowing multiple points of control for the operator

NOTE: Printers attached to PACiS OI can be redundant

2.10.2.2 Station Bus redundancy

The station bus can be redundant within PACiS. The switchover from a network to the other one is handled automatically by the system and is transparent for all PACiS equipment. The maximum switching time is 4 ms. It can be used rail-din switches or internal switches.

2.10.2.3 MiCOM gateway redundancy

The transmission link of a gateway can be redundant to allow RCP to continue to control the substation on a port single failure.

2.10.2.4 MiCOM computer redundancy

At substation level and/or at bay level an optional second computer can be used to avoid the loss of functions at these levels. The two computers have the same configuration and support the same functions.

2.10.3 Local/remote control operating modes

2.10.3.1 Substation Local/Remote mode

A substation can be in remote or local control mode.

The Remote mode indicates that the substation is controlled from RCP, via gateway. No controls can be sent from SCP level (except if the concerned bay is in SBMC mode, see below).

The Local mode indicates that the substation is controlled from PACiS OI. The controls issued from RCP are not taken into account by the system, they are refused.

Some controls, defined during the configuration phase, can be independent of the substation control mode : it means they can be issued from SCP or RCP whatever was the current control mode. Controls from configurable automation (ISAGRAF) are accepted whatever was the mode.

2.10.3.2 Bay Local/Remote mode

Each bay can be independently in Remote or Local mode.

The Remote mode indicates that the bay is controlled from the upper level (RCP or SCP depending on the current substation control mode). No controls can be sent from BCP level.

The Local mode indicates that the bay is controlled from BCP. The controls issued from upper level are not taken into account by the bay.

Some controls, defined during the configuration phase, can be independent of the bay control mode : it means they can be issued from any control points whatever was the current control mode. Controls from configurable automation (ISAGRAF) are accepted in remote mode.

2.10.3.3 SBMC mode

Each bay can be set in SBMC mode (Site Based Maintenance Control mode).

A bay in SBMC mode does not take into account the commands issued from RCP, even if the substation is in remote control mode. All the information issued from the bay are sent to the SCP. Nevertheless for the RCP, PACiS system provides “automatic suppression” facility: by configuration some information of the bay are not sent to the RCP when the bay is in SBMC mode but a pre-configured value.

2.11 Engineering tools

The engineering tools are the set of tools associated to PACiS. They cover several domains:

- system and equipment configuration tools
- equipment simulator tools

Tools are used at different steps of the life cycle of a PACiS system and by different departments.

The PACiS system configuration is the core of the engineering toolset, the aim of this activity is to create and dispatch all the static data, objects, programmable functions and parameters into the MiCOM equipment.

2.11.1 Configuration tool

There are two configuration activities that are:

- Modelling: this activity consists in the creation/mofication of object classes and corresponds to a development phase of the PACiS system
- Manufacturing: this activity consists in the instantiation of objects to generate a PACiS system database according to a customer substation

The pre configuration is constituted by the set of object models.

The configuration is constituted by the real objects of a PACiS system database.

2.11.1.1 Missions

The different missions of the system configuration are:

- create/update the objects for system devices according to customer and substation requirements
- check coherency and consistency between the objects before deployment into the system
- database versions management with the « delta » capability
- automatic documentation generation

2.11.1.2 Objects Modelling

The modelling define several families of objects which are handled by the system configuration:

- electrotechnical architecture objects which defines the substation topology (e.g. bays, switchgears, transformers, measurands)
- system architecture objects which defines the SCS architecture (e.g. equipment of the system)
- functions description objects which define the functions accomplished by the SCS (e.g. overcurrent protection function)
- real time exchanged data which define the communications between equipment and functions

2.11.2 Equipement simulator tool

The Equipment Simulator tool was created to simulate the data exchange on the station bus with the various devices of system PACiS. It can behave as:

- Bay Computers Simulator
- Substation Computers Simulator
- HMI and Gateway Simulator
- Protective Device Simulator

Its role is not to simulate the equipment itself but only the data exchanged through the communication interface via the station bus.

The Equipment Simulator can be configured via the SCE importing device descriptions via XML files. This files are automatically created during the configuration of the devices.

It provides also facilities to create scenario for automated simulations.

3. SYSTEM ARCHITECTURES

The PACiS System architecture is always based on a Station Bus on which are connected MiCOM equipments used for the customer solution. These equipments are:

- the Operator Workstation
- the Computers C264
- the Telecontrol gateway
- the IEDs (protective devices, disturbance and quality recorder, **when available on Station Bus**)
- the Ethernet switches

The Station Bus is based on the IEC61850 protocol, over an Ethernet / TCP-IP network. Additional busses (called legacy busses) are also available in the PACiS System architectures.

The structure of MiCOM equipment is:

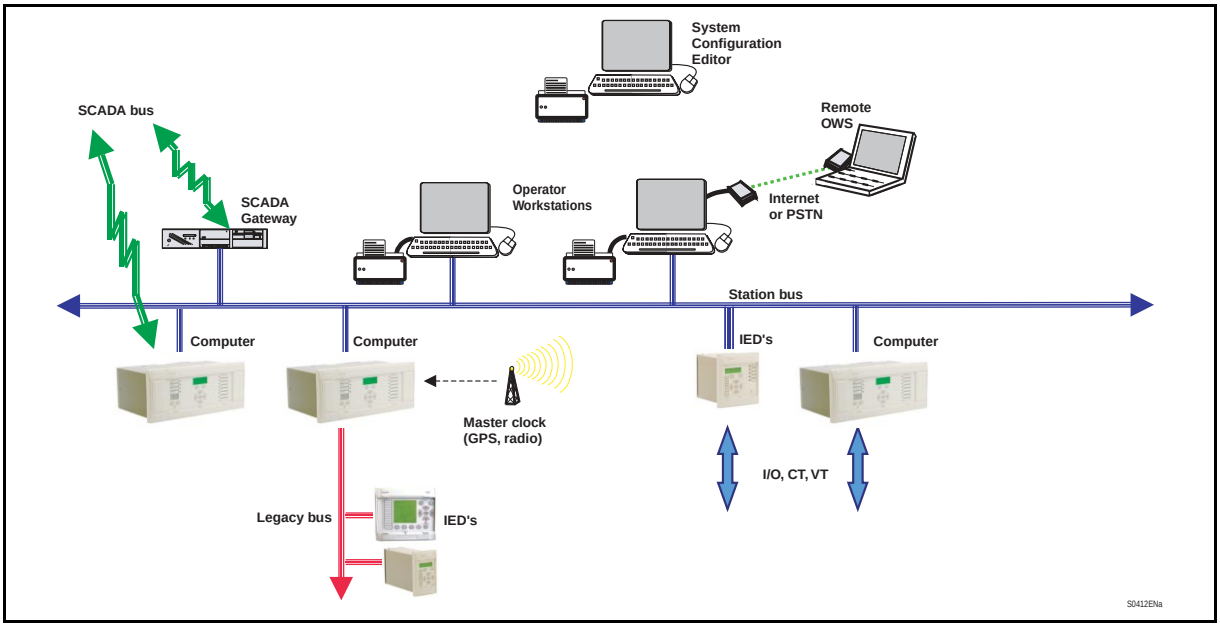
- rack-based for MiCOM Computers C264
- rack-based for all MiCOM P and M available over Ethernet
- PC-based for MiCOM Telecontrol Interface and Operator Workstation
- Ethernet switch, this equipment is used for Ethernet redundancy

Any combination of equipment around the Station Bus is allowed to match with the required application.

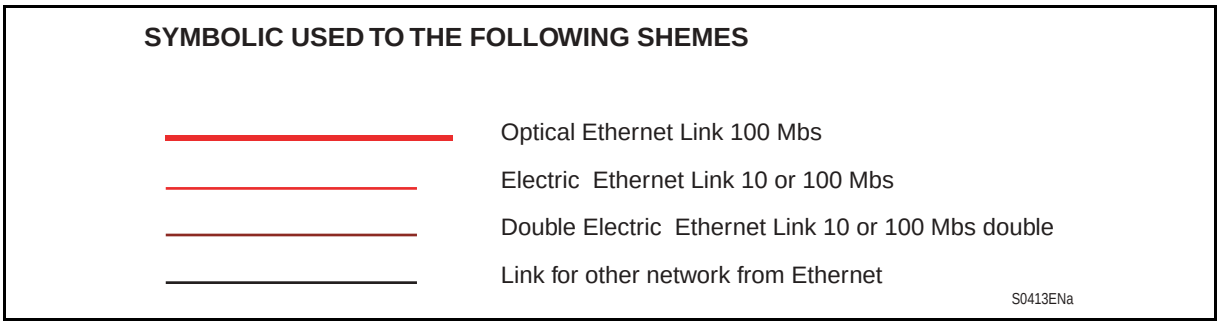
The typical **PACiS** architecture consists in a series of devices connected over the ETHERNET communication network, in order to:

- maximise the functional integration through fast exchanges between devices (10/100 Mbps)
- allow a flexible distribution inside or between substations
- integrate third party devices within the Digital Control System of the substation

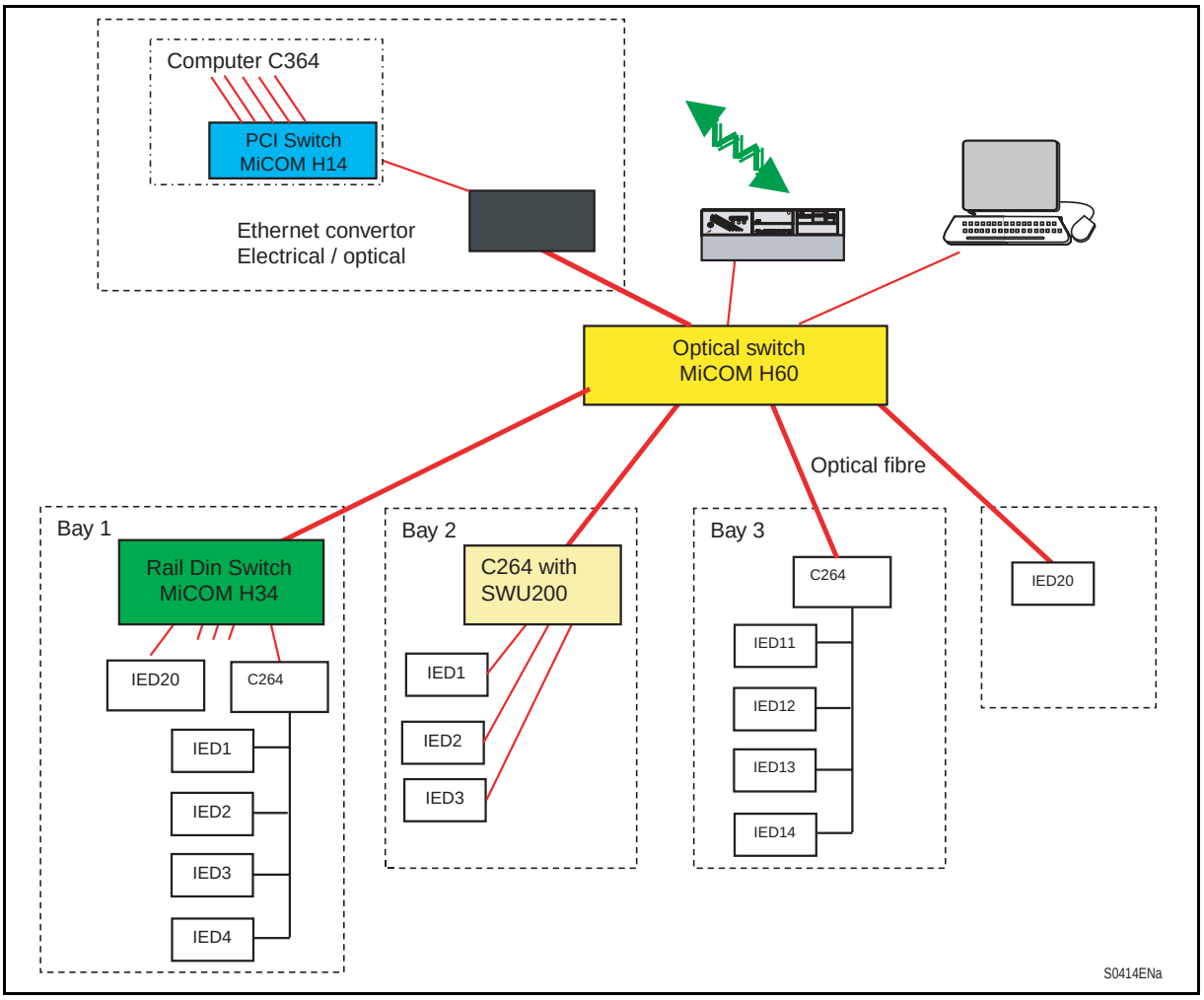
PACiS offers connection with legacy communication networks (RS485) in order to fully re-used past investments with the new generation.



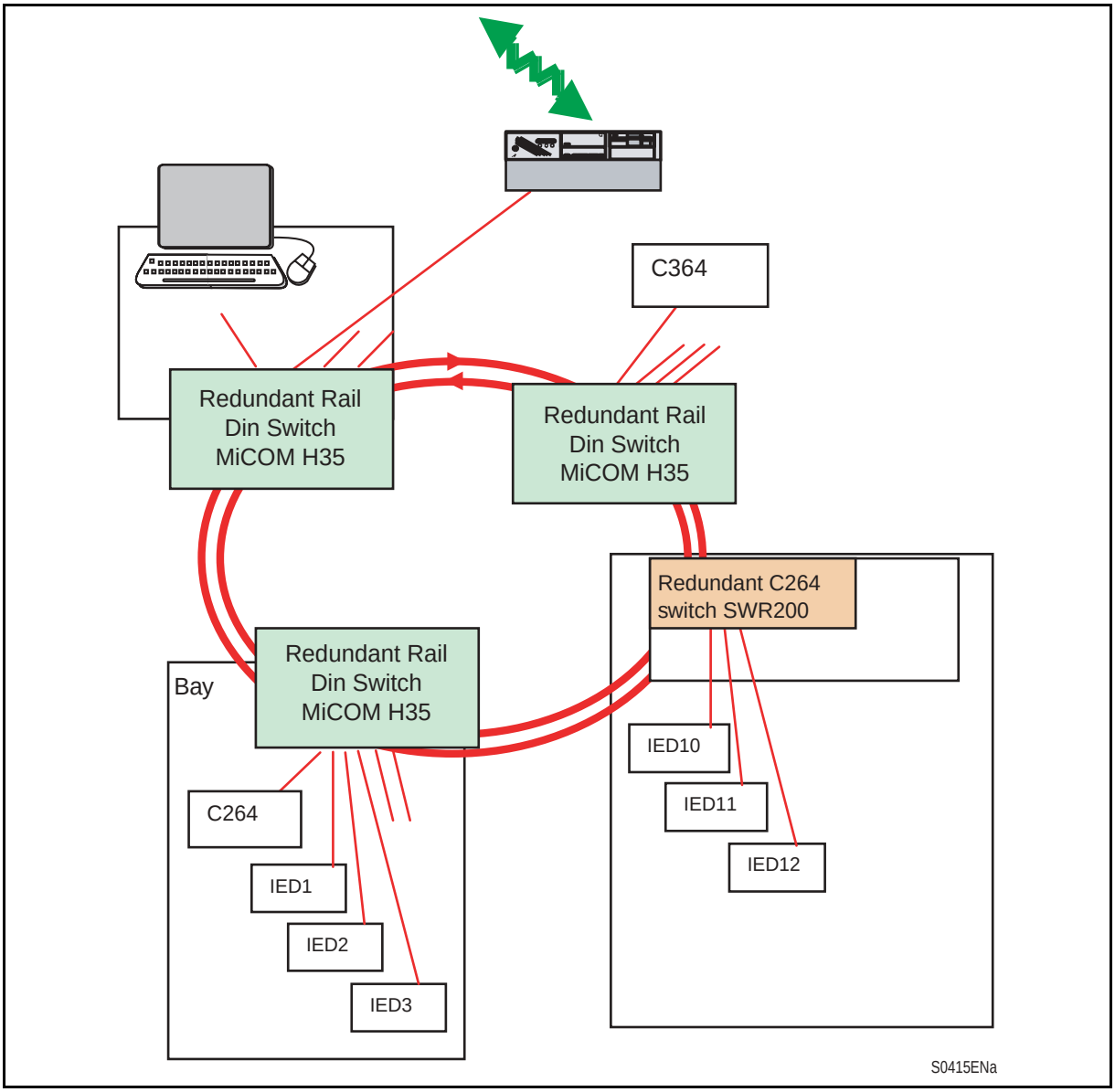
4. PACiS ETHERNET NETWORK ARCHITECTURES



4.1 Simple star network

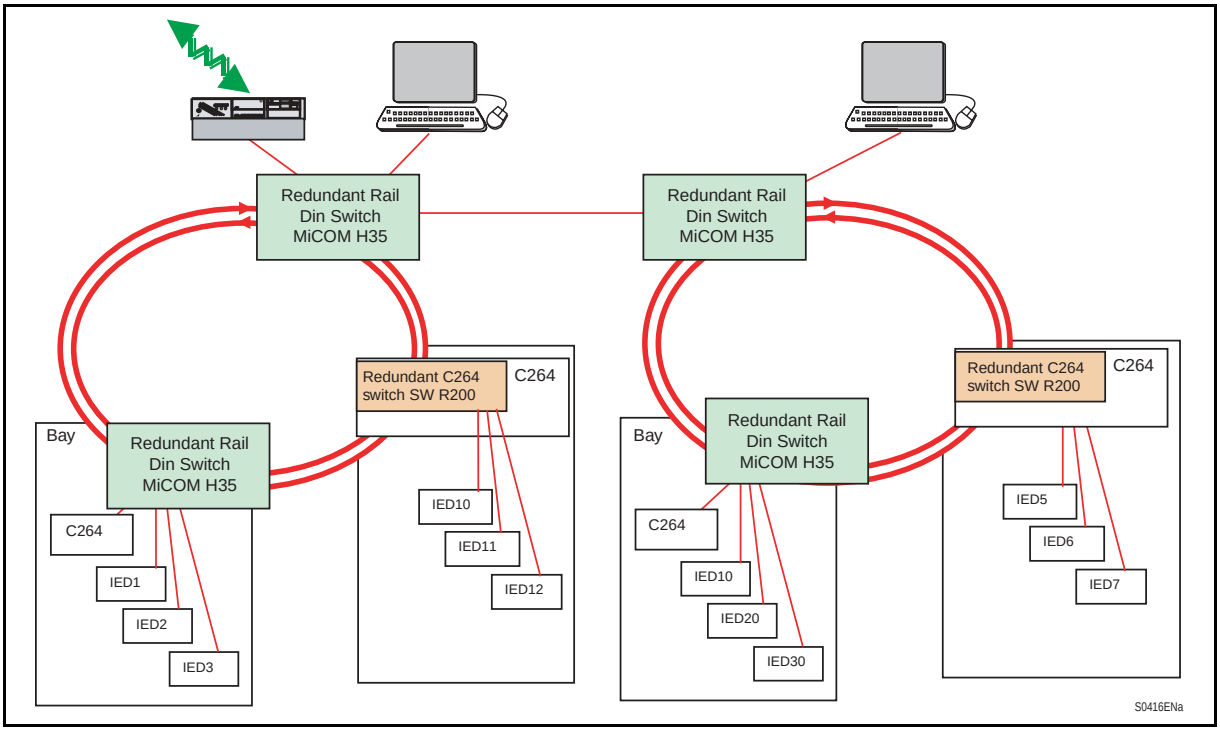


4.2 Redundant optical ring network

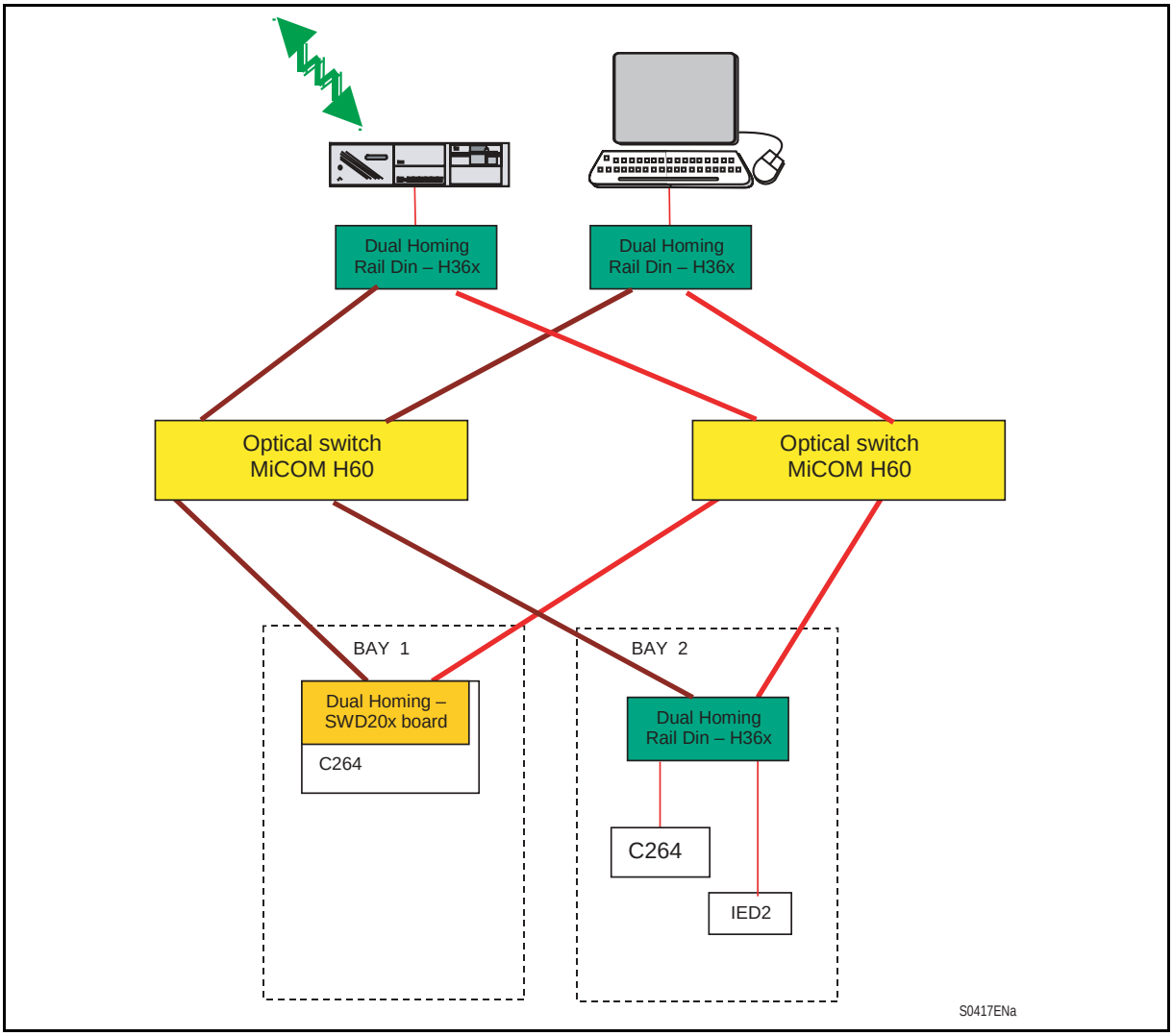


Use of double ring

In order to optimise the data flow on the network this one is cut in more than one ring. The link between the rings is made by two switches.



4.3 Dual Homing network



LEXICAL

CONTENTS

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1. SCOPE OF THE DOCUMENT

This document is a chapter of PACiS SYSTEM documentation binder. It is the lexical chapter.

2. LEXICAL

AC	Alternative Current
AccI	Accumulator Input
ACU	Analog transduCerless Unit Computer C264 Additional Mezzanine on CPU for CT/VT
ADC	Analogue to Digital Converter
AI	Analogue Input (Measurement Value including state attribute) Commonly Voltage or current DC signals delivered by transducers, and representing an external value (refer to CT/VT for AC).
AI	Analog Input
AIS	Air Insulated Substation
AIU	Analogue Input Unit Computer C264 Board name for DC Analog Input
Alarm	An alarm is any event tagged as an alarm during configuration phase
AO	Analogue Output Value corresponding to a desired output current applied to a DAC.
AO	Analog Output
AOU	Analogue Output Unit C264 board name for DC AO
API	Application Programming Interfaces
API	Application program interface
ASCII	American Standard Code for Information Interchange
ASDU	Application Specific Data Unit Name given in OSI protocol for applicative data (T103, T103..)
ASDU	Unité de Donnée de Service d'Application
ASE	Applied System Engineering
ATCC	Automatic Tap Change Control Same as AVR, automation charged to regulate secondary voltage
AVR	Automatic Voltage Regulator Automatism used to regulate secondary voltage by automatic tap changer control (see ATCC). Set of features can be added, see chapter C264 FD
Bay	Set of LV, MV or HV plants (switchs and transformer) and devices (Protective, Measurement…) usually around a Circuit Breaker and controlled by a bay computer.
BCD	Binary Coded Decimal One C264 supported coding on a set of Digital Input, that determine a Digital Measurement, then Measurement value (with specif invalid code when coding is not valid). Each decimal digit is coded by 4 binary digit.
BCP	Bay Control Point Name given to the device or part used to control a bay. It can be Mosaic Panel , C264 LCD 'Local Control Display),… Usually associate with Remote/Local control.
BI	Binary Input (or Information) Name given into Computer C264 of information already filtered, before it becomes a SPS, DPS… with time tag and quality attributes
BIU	Basic Interface Unit Computer C264 Board for auxiliary power supply, watchdog relay, 2 DO, 2 RS232/485 insulated ports

BO	Binary Output
BTC	mimic editor
B-Watch	Monitoring and control device for GIS substation.
CAD	Computer Aided Design Computer application dedicated to design like wiring, protective setting…
CAS	CASe Computer C264 rack
CB	Circuit Breaker Specific dipole switch with capability to power on and break on fault current. Some has not isolation capability (nominal-earth at each side)
CBC	Compact Bay Controller Small capacity bay computer for Medium Voltage applications typically C264C
CCU	Circuit breaker Control Unit Computer C264 Board dedicated to switch control with 8DI, 4 DO
CCU	Circuit breaker Control Unit Computer C264 Board dedicated to switch control with 8DI, 4 DO
CCU	Circuit Breaker Control Unit Name of the C264 board with DI and power DO with inner SBO function controlling the DO health, and in charge to control directly switch gears.
CDM	Conceptual Data Modelling Is the modelisation of system/devices data using a hierarchy of structured data (called object of class) with their attributes, method or properties and the relations between themselves. It maps common data to devices or components of devices, with garanty of interoperability.
COT	Cause Of Transmission
CPU	Central Processing Unit Computer C264 main Board based on PowerPC
CR	Change Request
CRC	Cyclic Redundancy Check Coding result send with packet of transmitted data to garanty their integrity. Usually result of a division of transmitted data by polynom.
CSV	Character SeparateValues Asci values separated by predefined character or string like in Excel or ASCII Comtrade.
CT	Current Transformer Basically the electric device connected to process and extracting a current measurement. By extension part of a device (C264) that receives this AC value and convert it to numerical measurement value. CT are wired in serial.
CT/VT (Conventional)	Current and Voltage transformers By extension the C264 board and module (ACU, TVU, TCU) that capture via wiring and digitalise the DC measurement.
CT/VT (Non-Conventional or intelligent)	Current and Voltage transformers New generation of captor based for example on light diffraction under electric field, without transformer, that give s directly numerical measurement of voltage and current like communicating IED.
DAC	Digital to Analogue Converter Used to generate analogue signals (usually DC) from a digital value.
DAC	Data ACquisition component of the GPT

DB	DataBase Tool or set of data that define all configuration of a system or specific device like computer. Opposed to setting or parameter DB has a structure that can not be modified on line. DB are always versioned.
DBI	Don't Believe It Term used for undefined state of a double point when input are not complementary. DBI00 is state motion or jammed. DBI11 is undefined.
DBID	DataBases Identity Brick
DC, DPC	Double (Point) Control Two digit and/or relays outputs used for device control with complementary meaning (OPEN, CLOSE).
DCF77	Extern master clock and protocol transmission LF transmitter located at Mainflingen, Germany, about 25 km south-east of Frankfurt/Main, broadcasting legal time on a 77.5 kHz standard frequency.
DCO	Double Control Output
DCP	Device Control Point Located at device level (electric device or IED). It should have its own Remote/Local switch.
DCS	Digital Control System Generic name of system based on numeric communication and devices, to be opposed to traditional electrically wired control.
DCT	Double CounTer Counter based on 2 DI with complementary states (counting switgear manoeuvre for example)
DELTA	Phase to phase delta values
Device	Term used for one of the following unit: Protective relays, metering units, IED, switchgear (switching device such as CB, disconnector or earthing switch), disturbance or quality recorders.
DI	Digital Input Binary information related to the presence or to the absence of an external signal, delivered by a voltage source.
DI	Device Identity Brick
DIAG	Diagnostic Brick
DIU	Analogue Input Unit Computer C264 Board name for DC Analog Input
DLL	Dynamic Link Library. Available on Microsoft Windows™ 2000. A feature that allows executable code modules to be loaded on demand and linked at run time. This enables the library-code fields to be updated automatically, transparent to applications, and then unloaded when they are no longer needed.
DM	Digital Measurement Is a measurement value which acquisition is done by DI and a specific coding BCD, Gray, 1 among N…
DO	Digital Output Used to apply a voltage to an external device via a relay, in order to execute single or dual, transient or permanent commands.
DOU	Analogue Input Unit Computer C264 Board name for DC Analog Input
DOU	Digital Output Unit C264 board with output relays

DP	Double Point Information/control derived from 2 digital inputs/output; usually used for position indication of switching devices (OPEN, CLOSE).
DPS	Double Point Status Position indication of switching devices (OPEN, CLOSE).
DSL	Document Specification Logiciel
DVP	Design Validation Plan
EH90	Transmission protocol dedicated to time synchronisation and standardised by EDF. Specification document: D.652/90-26c, March 1991.
Event	An event is a time tagged change of state/value acquired or transmitted by a digital control system.
FAT	Factory Acceptance Test Validation procedures execution with the customer at factory.(SAT)
FBD	Functional Block Diagram One of the IEC61131-3 programming languages (language used to define configurable automation).
FR	Fault Report
Gateway	Level 6 session of OSI, the gateway is any device transfering data between different networks and/or protocol. The RTU function of C264 gives a gateway behaviour to SCADA or RCP level. PACIS Gateway is separate PC base device dedicated to this function. C364 or PCI is referenced also as a gateway between IED and upper lever of communication.
GHU	Graphic Human interface Unit Computer C264 Front Panel digital part (LCD, buttons, Front RS)
GIS	Gas Insulated Substation
GLOBE	GLOBE Brick
GMT	Greenwich Meridian Time Absolute time reference
GOOSE	Generic Object Oriented Substation Event
GPS	Global Positioning System Based on triangulation from satellite signal, that transmit also absolute GMT time used to synchronise a master clock
GPT	Generic Protocol Translator software, supplied by ASE
Group	Logical combination of BI (i.e. SP, DP, SI or other groups).
GTW	Gateway
Hand Dressing	Facility for an operator to set manually the position of a device (acquired by other means) from the HMI at SCP level; e.g. from OPEN to CLOSE (without any impact on the “physical” position of the electrical switching device).
HMI	Human Machine Interface Can be PACIS OI(Operator Interface) or C264 LCD (Local Control Display) or Leds, mosaic...
HSR	High Speed autoRecloser First cycles of AR
HTML	Hyper Text Mark-up Language Used as standard for formatting web display
HV	High Voltage (for example 30kV to 150kV)
I/O	Input/Output

IEC	International Electrotechnical Commission
IED	Intelligent Electronic Device General expression for a whole range of microprocessor based products for data collection and information processing
IRIG-B	Inter-Range Instrumentation Group standard format B. This is an international standard for time synchronisation based on analog signal.
JAMMED	Invalid state of a Double Point: Occurs when the two associated digital inputs are still in state 0 after an user-selectable delay (i.e. when the transient state “ motion ” is considered as ended).
Kbus (Kbus Courier)	Term used for the protocol Courier on K-Bus network (kind of RS422)
L-BUS	Legacy Bus Generic name of Legacy or field networks and protocols used to communicate between C264 (Legacy Gateway function) and IED on field bus. Networks are based on (RS232,) 422, 485. Protocols are IEC 60850-5-103 (T103 or VDEW), Modbus Areva or MODICON
LCD	Liquid Crystal Display or Local Control Display On C264
LD	Ladder Diagram One of the IEC1131-3 programming languages (language used to define configurable automation).
LED	Light Emitting Diode
LF	Low Frequency
LOC	Local Operator Console Dedicated to maintenance operation
Local / Remote Control Mode	When set to local for a given control point it means that the commands can be issued from this point, else in remote control are issue for upper devices.
Local / Remote Control Mode	When set to local for a given control point it means that the commands can be issued from this point, else in remote control are issue for upper devices.
LV	Low Voltage
MAFS	Marketing And Functional Specification
MC	Modular Computer
Measurements	Values issued from digital inputs or analogue inputs (with value, state and time tag).
Metering (non-tariff)	Values computed depending on the values of digital or analogue inputs during variable periods of time (time integration).
Metering (tariff)	Values computed depending on the values of digital or analogue inputs during variable periods and dedicated to the energy tarification. These values are provided by dedicated “ tariff computer ” which are external to the MiCOM Systems.
MIDOS	AREVA Connector Used for CT/VT acquisition
MMC	Medium Modular Computer
ModBus	Communication protocol used on secondary networks with IED or with SCADA RCP. 2 versions exist with standard MODICON or Areva one.
Module	Word reserved in PACIS SCE for all electric HV devices. It groups all switch-gears, transformer, motors, generators, capacitors, …

MOTION	Transient state of a Double Point Occurs when the two associated digital inputs are momentarily in state 0 (e.g. position indication when an electrical device is switching). The concept of " momentarily" depends on a user-selectable delay.
MPC	Protection Module for Computer
MV	Medium Voltage
NBB	Numerical Busbar Protection
NC	Normally Closed (for a relay)
NO	Normally Open (for a relay)
OBS	One Box Solution Computer which provides protection and control functions with local HMI. The prime application of this device is intended for use in substations up to distribution voltage levels, although it may also be used as backup protection in transmission substations. Likewise, the OBS may be applied to the MV part of a HV substation which is being controlled by the same substation control system.
OLE	Object Linking and Embedding OLE is a Microsoft specification and defines standards for interfacing objects.
OMM	Operating Mode Management
OPC	OLE for process control OPC is a registered trademark of Microsoft, and is designed to be a method to allow business management access to plant floor data in a consistent manner.
Operation hours	Sum of time periods, a primary device is running under carrying energy, e.g. circuit breaker is in Close-state and the current is unequal 0 A.
OSI	Open System Interconnection Split and define communication in 7 layers : physical, link, network, transport, session, presentation, application
PACiS	Protection Automation and Control Integrated Solutions
PLC	Programmable Logic Control Within the PLC-programs are defined the configurable control sequences or automations taken into account by the MiCOM Systems.
POW	Point On Wave Point on wave switching is the process to control the three poles of an HV-circuit breaker in a way, to minimise the effects of switching.
PSTN	Public Switched Telephone Network
PT100	Probes of temperatures providing analogue signals (non-linear captor).
RCC	Remote Control Center Is a computer or system that is not part of MiCOM system. RCC communicates with and supervises MiCOM system using a protocol.
RCC	Remote Control Computer
RCP	Remote Control Point Name given to the device or part used to control remotely several bay or sub-station. Usually associate with Remote/Local sub-station control. It is a SCADA interface managed by the MiCOM system through Telecontrol BUS. Several RCP's can be managed with different protocols.
RCP	Remote Control Point
Remote Control Mode	When set for a given control points it means that the commands are issued from an upper level and are not allowed from this point.

Remote HMI	Remote HMI is a client of the substation HMI server. The client may provide all or part of functions handled by the substation HMI.
RI	Read Inhibit This output indicates the availability of an analogue output (e.g. during DAC converting time)
RRC	Rapid ReClosure
RSVC	Relocatabled Static Var Compensator
RTU	Remote Terminal Unit Stand alone computer that acquires data and transmit them to RCP or SCADA. Typically it is the C964. RTU link is the TBUS.
SAT	Site Acceptance Test Validation procedures executed with the customer on the site.
SBMC	Site Based Maintenance Control mode A bay in SBMC mode does not take into account the commands issued from RCP; moreover, some of its digital points and measurements (defined during the configuration phase) are not sent anymore to the RCP (they are “ automatically ” suppressed).
SBO	Select Before Operate A control made in two steps, selection and execution. Selection phase give a feedback. It can be used to prepare, reserve during time, configure circuit before execution. Controls are done into a protocol, or physical (DO select with DI Select then DO execute).
S-BUS	Station Bus Federal network between PACiS devices, UCA2 and IEC 61850
SCADA	Supervisory Control And Data Acquisition Equivalent to RCC
SCE	System Configuration Editor
SCP	Substation Control Point Name given to the device or part used to control locally several bays or sub-station. Usually associate with Remote/Local sub-station control. It is commonly PACiS Operator Interface.
SCS	Substation Control System
SCT	Single Counter
Setpoints (analogue)	Analogue setpoints are analogue outputs delivered as current loops. Used to send instruction values to the process or to auxiliary devices.
Setpoints (digital)	Digital values sent on multiple parallel wired outputs. Each wired output represent a bit of the value. Digital setpoints are used to send instruction values to the electrical process or to auxiliary devices.
SFC	Sequential Function Chart One of the IEC1131-3 programming languages (language used to define configurable automation).
SI	System Indication Binary information that do not come from external interface. It is related to an internal state of the computer (time status, hardware faults…). It is the result of all inner function (AR, …), PSL, or ISaGRAF automation.
SI	Status Input Single Bit
SICU 4	Switchgear Intelligent Control Unit Control unit of an intelligent circuit breaker (fourth generation)
SIG	Status Input Group
SIT	Status Input Double Bit

SO	Sous-driver interface
SOE	Sequence Of Events Other term for the event list.
SP	Single Point
SPC	Single Point Control
SPS	Single Point Status
ST	Structured Text One of the IEC1131-3 programming languages (language used to define configurable automation).
Substation computer	Bay computer used at substation level.
Suppression (Automatic)	A binary information belonging to a bay in SBMC mode will be automatically suppressed for the remote control. However changes of state will be signalled locally, at SCP.
Suppression (Manual)	A binary information can be suppressed by an order issued from an operator. No subsequent change of state on a “ suppressed information ” can trigger any action such as display, alarm and transmission.
SVTF	Software Validation Test Folder
SWR	Switch Redundant Computer C264 board Ethernet switch with redundant Ethernet
SWU	Switch Unit Computer C264 board Ethernet switch
T101	Term used for IEC60870-5-101 protocol.
T103	Term used for IEC60870-5-103 protocol
TBC	To Be Completed
TBD	To Be Defined
T-BUS	Telecontrol Bus Generic name of networks and protocols used to communicate between PACiS Gateway or C264 Telecontrol Interface function and the RCP. Networks are based on RS232, 485, or Ethernet (T104). Protocols are IEC 60850-5-101 (T101), Modbus MODICON
TC	TeleControl
TCIP	Tape Change In Progress
TCU	Transformer Current Unit Computer C264 CT/VT Board : Current acquisition
TG	Telecontrol Gateway
TIU	Transformer Input Unit
TM	TeleMesure
Topological interlocking	Interlocking algorithm, based on evaluation of topological information of the switchgear arrangement in the HV network, the switchgear kind and position, and defined rules for controlling this kind of switch (e.g. continuity of power supply)
TPI	Tap Position Indication (for transformers) Frequently acquired via a Digital Measurement
TS	Telesignalisation
TVU	Transformer Voltage Unit Computer C264 CT/VT Board : Voltage acquisition

UCA	Utility Communications Architecture Communication standard (mainly US) used for PACiS SBUS communication
UPI	Unit Per Impulse Parameter of counter to convert number of pulse to Measurement value. Both data (interger and scaled float) are in common class UCA2 Accumulator.
UTC	Universal Time Coordinates (or Universal Time Code) Naming that replace GMT (but it is the same)
VDEW	Term used for IEC60870-5-103 protocol
Voltage level	Set of bays whose plants and devices are dealing with the same voltage (e.g. 275kV, 400 kV).
VT	Voltage Transformer Basically the electric device connected to process and extracting a voltage measurement. By extension part of a device (C264) that receives this AC value and convert it to numerical measurement value. VT are wired in parallel.
WYE	3 phases + neutral AI values

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