

Distribution Management System - DMS

Product description

Document Revision List

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1. Introduction

The package eXPert DMS is the solution proposed by s.d.i. automazione industriale for the management and analysis of electricity distribution networks.

eXPert DMS comes from thirty years experience of s.d.i. automazione industriale in the management of distribution systems of energy, as a natural extension of eXPert system used to control industrial equipment and remote control of gas distribution networks, water and electricity of primary public company.

eXPert DMS is an integrated package designed to make it easier to use, in terms of:

- initial system configuration;
- data consultation and viewing;
- inserting of data relating to service interruptions.

In following paragraphs are described the main characteristics of each feature made available by the system.

2. General characteristics

2.1 Operation mode

eXPert DMS operates on PC platforms and Microsoft operating system in "Stand Alone", "In Network" or "Distributed" architecture.

The package provides the ability to distribute both the functionality of interfacing to the field (I/O Server to acquire information from peripheral devices) and those of access by operators for network management, analysis and reports data generation. The applications that make up the suite eXPert DMS can be installed on one computer or on multiple workstations networked LAN TCP / IP.

eXPert DMS operates both on acquired data automatically from remote devices that data entered manually by the operator.

2.2 Functionality available

eXPert DMS manages in a integrated way the operating functions necessary for the conduct of distribution networks, including:

- Graphic representation of the network through a Functional to Director or voltage levels;
- Automatic data acquisition from remote telecontrolled cabins;
- Topological network synoptics animation based on the state of the elements present in system;
- "Functional" maneuvers for remote cabins not telecontrolled;
- Integration with the data acquired from primary cabins;
- Network trunk failure research.

2.3 Interruptions management

The eXPert DMS suite can be equipped with an additional tool, called RIRE (Register of Electrical Network Interruptions), to be used in the recording and management of distribution service disruption.

The operating functions available from RIRE tool meet the Authority requirements on quality of distribution services, measurement and sale of energy (AEEG - Authority of the Electrical Energy and Gas).

2.4 System layout

All software tools that make up the package eXPert DMS can be distributed on a network in a very flexible architecture using client / server based structure on which they were designed. In particular way can be identified as functional elements:

- SCADA DMS: management module run-time data network;
- I / O Server: module of communication to remote peripheral devices;
- HMI DMS: module that display the network topology and information relating thereto; allows also operators to operate interactively on the network using the same topological interface;
- Engineering: module for network configuration (topological, customers information, ...);
- RIRE: tool for recording and managing interruptions of distribution service;

The figure below shows a possible system architecture of eXPert DMS solution in which each application is installed on a different station and interconnection is achieved through a LAN communications.

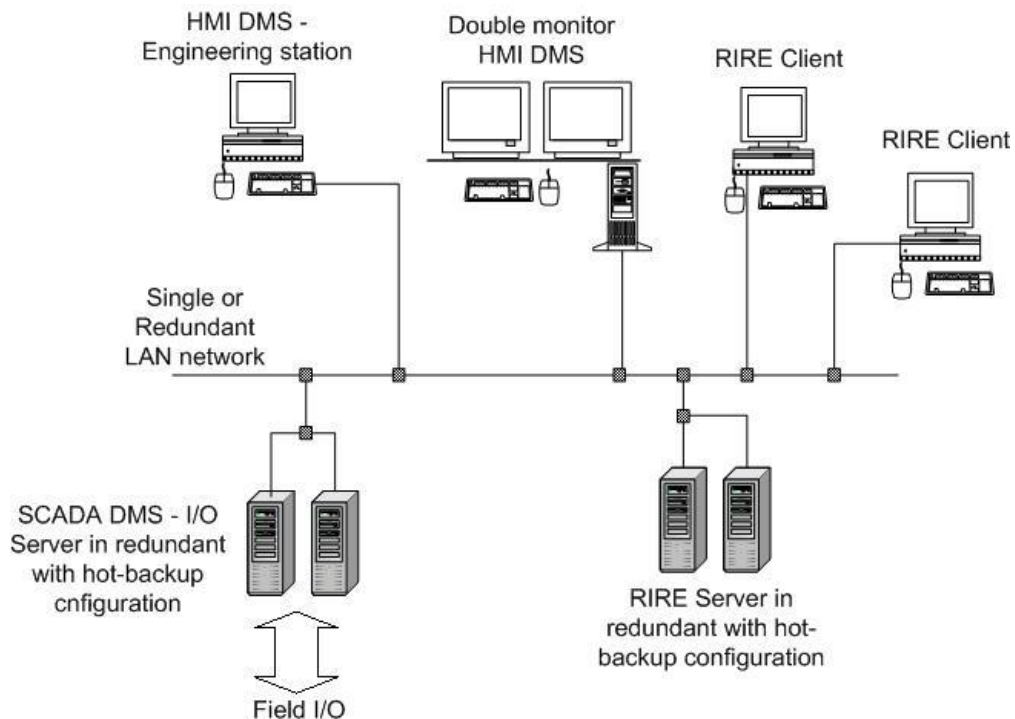


Figure 1: Example of eXPert DMS system layout

Other configurations can be implemented in different ways such as:

- All software modules are installed on the same computer;
- Some computers are dedicated to system data management and others only to operator interface;
- ...

3. eXPert DMS

3.1 Network status analysis

The eXPert DMS package is proposed as a useful tool for management and analysis of the electricity networks to allow operators to continuously monitor the status of the distribution network and interact with it.

The integrated environment eXPert DMS can operate on MV electricity grids and HV substations without any distinction for a maximum number of cabins around 2500 for each network, can be administered to more than 2000 remote cabins connected with different types of communication media (dedicated line, dial PSTN or GSM, network Ethernet, ...).

Not being bound to a set of fixed network (for example, structures such as fixed "primary station and substation"), the system can be adapt to manage very interconnected structures allowing to achieve topological network representation also for very complex grids.

eXPert DMS provides a kind of intuitive graphic that allows the operator to monitor the status of all the features of the electricity grid (boxes, lines, switchgears, circuit breakers, transformers) and, where required, operate on the same only in a local way or by acting directly from remote sites.

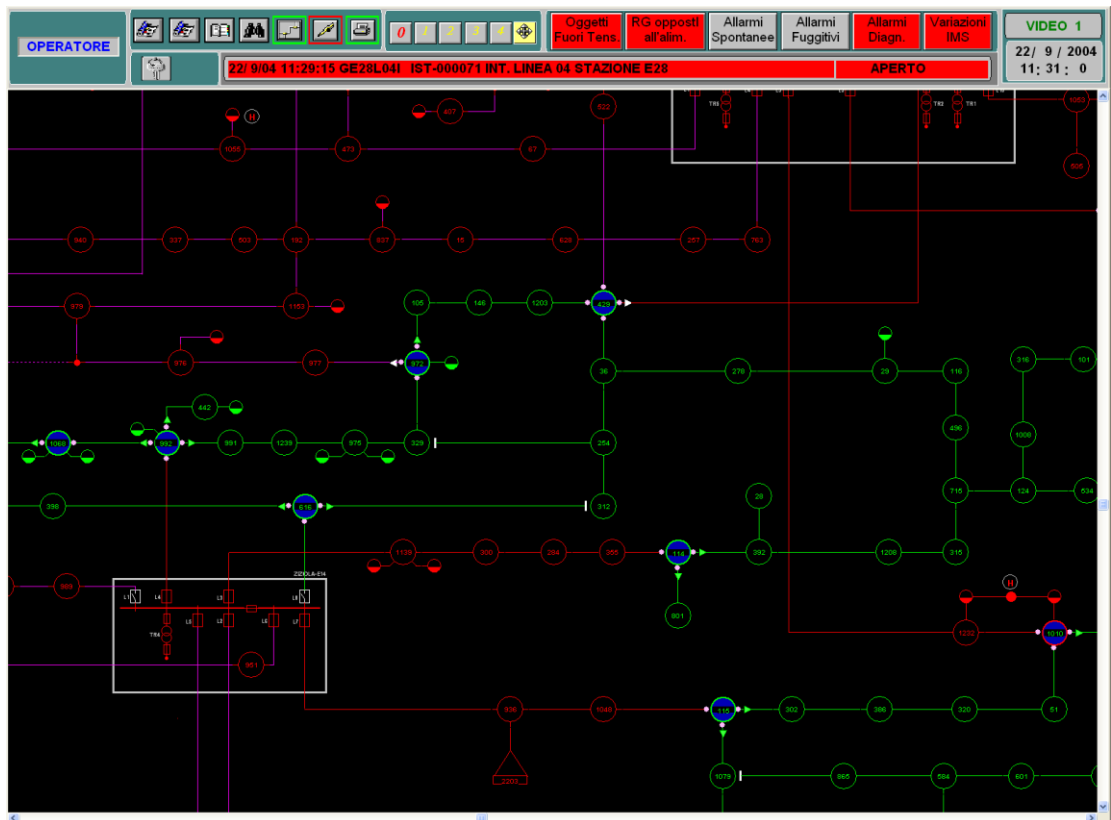


Figure 2: Example of a electricity distribution network as is shown using eXPert DMS platform

System is equipped with different types of graphical representations, that can be switched in on line mode, designed to meet needs of analysis and behavior of the system:

- Functional representation: the color of the elements of the network changes only in relation to state powered/ unpowered of each of them;
- Main Line representation: network elements belonging to different main lines are represented by different colors and their color also changes as a result of changes in the normal state / alarm in each of them;
- Voltage levels representation: network elements can be represented in different ways with regard to the level of voltage line of belonging.

The graphical interface available ensures also features for topological interface navigation which allows scroll, pan, zoom (8 levels), and detailing / decluttering functions for showing a network at different levels of detail.

3.2 Network topology configuration

3.2.1 Network Graphical Editor

The configuration of topological graphical representation of the network and each element of run-time system required for eXpert DMS platform, is implemented using a single graphical tool of eXpert platform called GIPE (Graphical Interface Page Editor).

GIPE allows the staff to set up the system and to draw the entire distribution network using predefined items available in the library in order to build the network to manage.

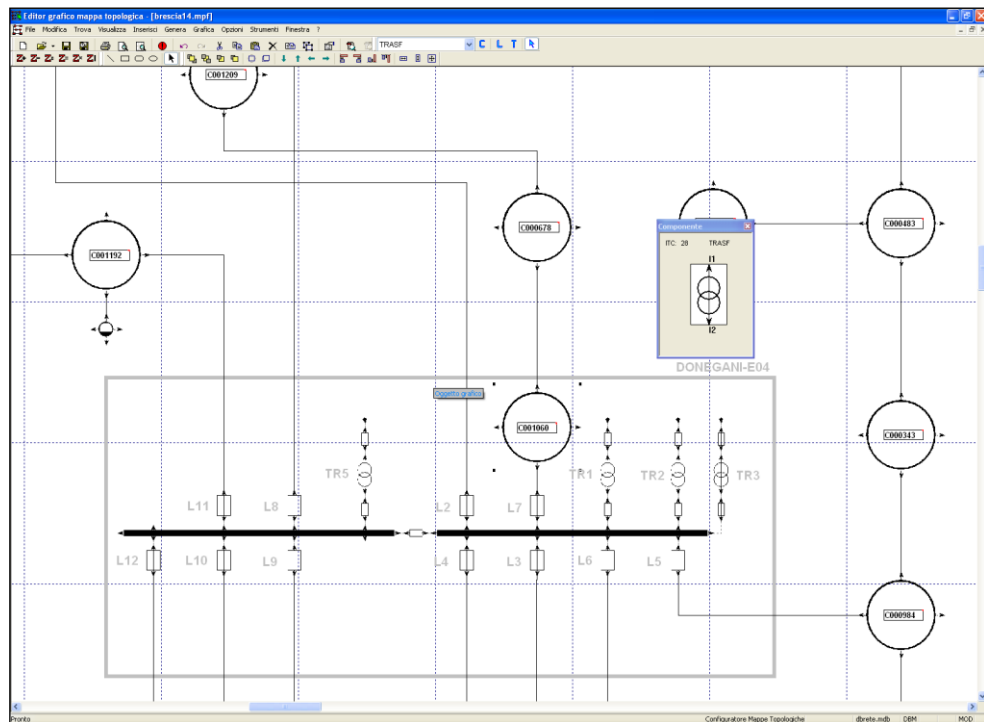


Figure 3: GIPE tool used for DMS system configuration, is shown inserting operation of a transformer device

The configuration tool is integrated with the NEPLAN simulation and analysis software from which can be imported the entire structure and list of customers of the network and to which you can send changes through the tool GIPE.

The configuration tool provides the most common feature of moving, resizing, zoom, pan, ... in order to minimize the time devoted to the construction of topological representation and allow replication of the network as real as possible.

3.2.2 Library of components

The system make a library of components available for the construction of topological representation of network from which can be extracted new elements to grow the system in relation to the needs of the operator.

Some of the items present in eXPert DMS for an immediate use are:

- Cabin telecontrolled or not telecontrolled;
- Line (cable, area, air cable);
- Users;
- PTP (Transformation Point on Pole);
- Vacuum sectioner;
- Loaded sectioner telecontrolled or not telecontrolled;
- Node;
- RG (Line fault detector) ;
- Switch protections;
- Switch Without protections;
- High voltage generator;
- Transformer;
- Bar;
- Junction.

Each component part of the network can be customized by appropriate interface dialog box with which can be defined the characteristics; the figure below shows an example of the interface customization features of a network cabin.

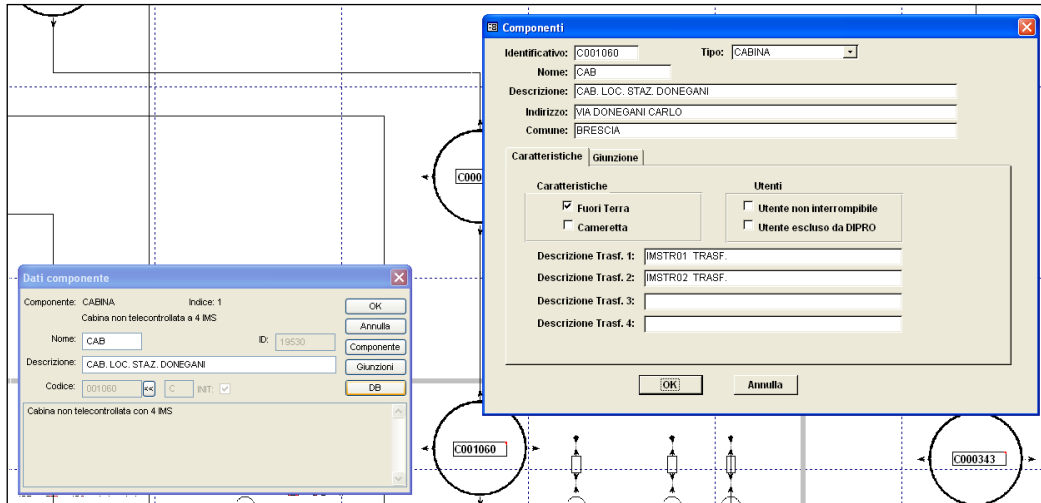


Figure 4: Dialog box for network cabins customization

3.3 Interoperability

The eXPert DMS system provides functions that allow the operator to manually operate on plants that aren't telecontrolled (power switch, change states of network elements, insert comments, ...), thus on the topological network representation is updated with the real state of field variables.

An example of a dialog box that allows to operate on an IMS is shown in the figure below.

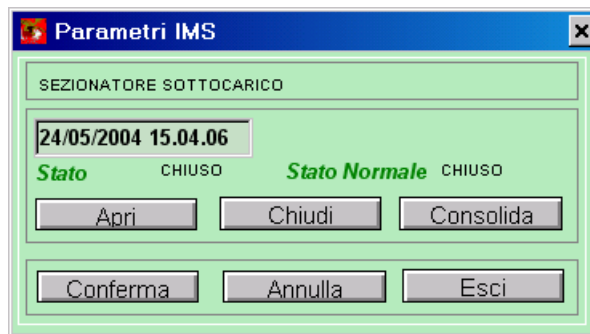


Figure 5: IMS command dialog box

An operator can enter manually, using command dialog box, the date and time of the event in order to align the events stored on the DMS system with the maneuvers carried out in the field.

The operations carried out manually by the operator that entail network changing will be readily displayed by the system in accordance with the display mode choice. The figure below shows a change in representation as a result of an opening of a power interrupter.

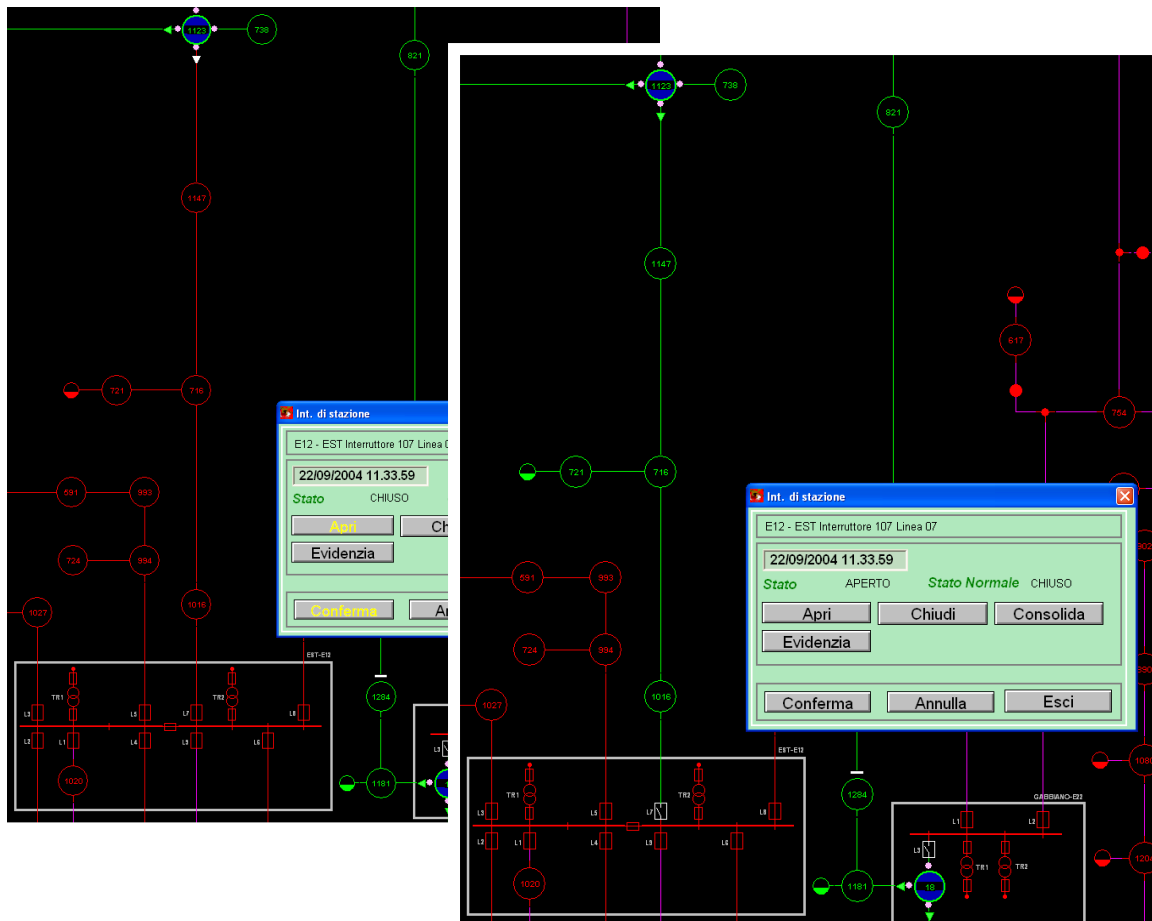


Figure 6: Dynamic visualization of network topology after manual opening operation referred to a power interrupter

The versatility of the eXPert DMS system also allows integration of the information contained in the DMS system through data from field collected by interfacing the remote telecontrolled devices. Information about the network can in this mode automatically flow in the DMS system that will ensure, in any case, the possibility to intervene manually on devices.

3.4 Network Trunk Failure research

The feature referred to network trunk failure search allows the distribution network analyzing and guides the operator to identify the trunk network with electrical problems and disruptions, in order to use this function is necessary that RG malfunction detector devices are installed in the cabins and interconnected with a peripheral apparatus.

The disruption is identified by the opening of one of the switches with guards of the station (source network) and accordingly topological electricity system is animated by highlighting that is no longer powered.

The operator can, working on in the pop-up associated to the switch, execute an examination of disservice. The telecontrol system executes polling of remote cabin involved in disservice collecting all data from field devices.

The operator, examining the events (short circuit and homopolar) ordered chronologically, may through an assisted procedure execute an automatic search of the trunk failure.

3.5 “Study and analysis” mode

The “Study and analysis” platform of eXPert DMS suite is a set of features that allow the operator of the electricity grid to make analysis and studies on the same network monitored.

These opportunities are obtained:

- Adding to the SCADA DMS system dedicated to network telecontrol, a station dedicated to “Study system” in which there are not operational functions of acquisition and control of the field. In practice the SCADA DMS is replicated on a separate station connected to SCADA DMS and application RIRE but not related to the field under control;
- Aboard the SCADA DMS will enable features:
 - storage facility situations, ie photographs of the network at a given time
 - recording events and related to changes of state;
- Using the studio system functions:
 - importing network photos;
 - application on network status of events stored by SCADA DMS platform.

All the features described above allows the system, after uploading a network photo from SCADA DMS database, to evolve the network step by step, using the events that SCADA DMS has experienced since the photos uploaded, or by manually editing the state of field devices.

This in order:

- analyze specific offline behavior of the network;
- generate the events of failure, possibly correcting mistakes being booked or manual data to monitor real-time, in order to feed the system RIRE with the necessary accuracy.

During standard operation activities, the operator can take the synchronization of the “Study system” with the SCADA DMS, which involves loading the latest photos available and the automatic execution of all events following the installation of photos and previous to the request for synchronization.

The interfaces between “Study system” and the RIRE tool, makes available the use of “Study station” to produce or reproduce in a semi-automatic way of interruption records referring to past situations, the generation of events for RIRE can be enabled / disabled by user through the appropriate menu.

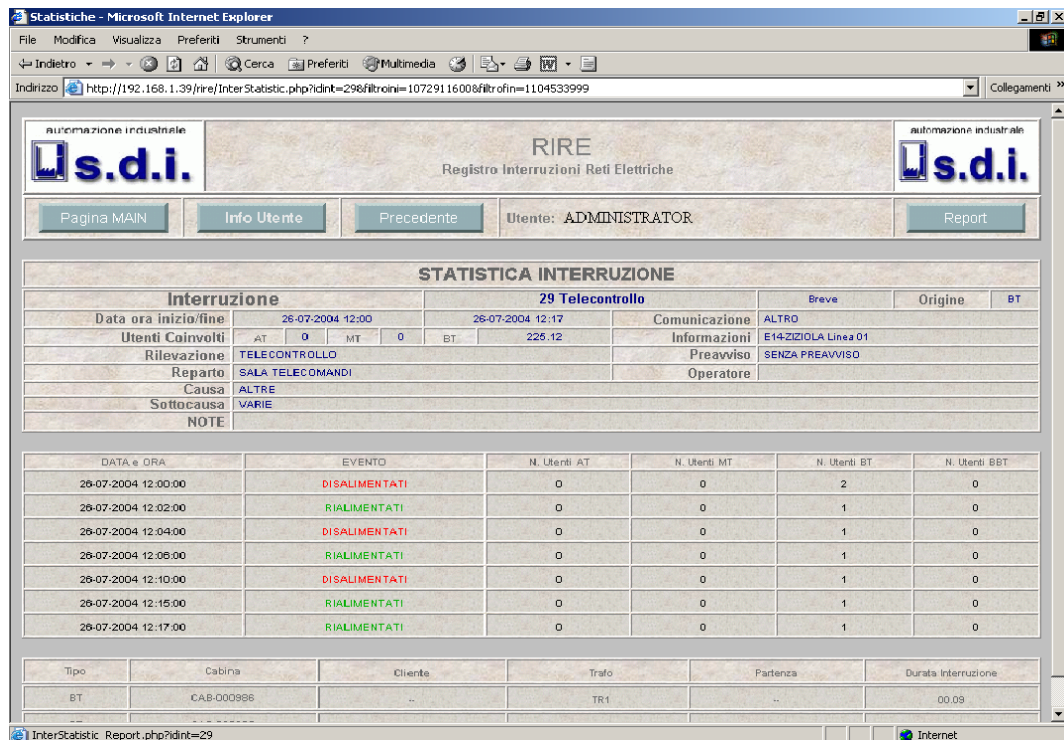
4. RIRE

4.1 Introduction

The RIRE (Register of Electrical Network Interruptions) application provides all the functionality necessary for the management of interruptions in the manner required by energy authority on quality of distribution services, measurement and sale of electricity (Authority Electricity and Gas - Resolution No. 4 / 04 and its annexes).

RIRE is realized according to a client / server architecture where a database manager (server) is interrogated by an application interface (client).

The operator interface to the data is developed in PHP language (recursive acronym for Hypertext Preprocessor), a choice that ensures easy access to data and independence platform (PC and operating system) used in client stations. The window interfaces are provided to the web page where navigation is ensured through the Internet access browser.



Interruzione		29 Telecontrollo		Breve	Origine	BT
Data ora inizio/fine:	26-07-2004 12:00	26-07-2004 12:17		Comunicazione	ALTR0	
Utenti Coinvolti	AT 0 MT 0	BT 225.12		Informazioni	E14-ZIZIOLA Linea 01	
Rilevazione	TELECONTROLLO			Preavviso	SENZA PREAVVISO	
Reparto	SALA TELECOMANDI			Operatore		
Causa	ALTRE					
Sottocausa	VARIE					
NOTE						

DATA e ORA	EVENTO	N. Utenti AT	N. Utenti MT	N. Utenti BT	N. Utenti BBT
26-07-2004 12:00:00	DISALIMENTATI	0	0	2	0
26-07-2004 12:02:00	RIALIMENTATI	0	0	1	0
26-07-2004 12:04:00	DISALIMENTATI	0	0	1	0
26-07-2004 12:06:00	RIALIMENTATI	0	0	1	0
26-07-2004 12:10:00	DISALIMENTATI	0	0	1	0
26-07-2004 12:15:00	RIALIMENTATI	0	0	1	0
26-07-2004 12:17:00	RIALIMENTATI	0	0	1	0

Tipo	Cabina	Cliente	Trafo	Partenza	Durata Interruzione
BT	CAB-000988	..	TR1	..	00.03

Figure 7: RIRE interface using IE 6.0

The solution adopted ensures portability of features related to interaction with the database on all machines connected to the server machine LAN without having to install them on any additional package.

The features available on the application are listed in the following paragraphs.

4.2 Archive data management

4.2.1 Login management

Access to features available on the application is governed by user accounts protected by password identification, for each user can set different levels of action to be taken on the data in archives.

The different profiles and their features are listed below.

PROFILE	DESCRIPTION OF PRIVILEGES
Administrator	Can execute any activity related to user accounts, interruptions and events.
Configuration	Can execute any operation related to interruption and events.
Modification	Can execute any operation related to interruption and events, except of modification of consolidated/not-consolidated state of an interruption.
Operator	Same as Modification profile but allowed to execute modification only on already existing interruption.
Report	Can execute only report generation, without any capability to operate on data stored in RIRE system.

The profiles and responsibilities assigned may be changed in the course of use, an example of interface associated with the management of user profiles is shown in the illustration below.

Nome Utente	report			
Password	*****			
Descrizione	report			
Privilegi Utente				
Amministratore	Configuratore	Modifiche	Report	Operatore
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
NOTA: la modifica dei dati della LogIn con cui si è connessi impone la disconnessione automatica				
SALVA MODIFICHE		ANNULLA		
MESSAGGI:				

Figure 8: User profile modification form with only reporting privilege allowed

4.2.2 User data inserting

The user data entry of un-powering and re-powering events can be done using dedicated windows specialized for this purpose. Inserting of a new event occurs in a driven way (to prevent the construction of events without logical sense), a clear hierarchy is followed in order to avoid errors by the operator.

An example of integration event in manual mode for the transformer TR1, cabin MT CAB-000010, on 16/06/2004 at 15:19:20 is shown in the figure below.

INSERIMENTO prima parte DATI Alimentazione / Rialimentazione			
Tipologie		Codice e Nome Descrittivo	
AT	Cabina AT	-- nessuna --	
	Utente AT	--	
MT	Cabina MT	CAB-000010 ----- S.URBANO > CASTELLO	
	Utente MT	--	
	Trasformatore	--	

INSERIMENTO prima parte DATI Alimentazione / Rialimentazione			
Tipologie		Codice e Nome Descrittivo	
AT	Cabina AT	--	
	Utente AT	--	
MT	Cabina MT	CAB-000010 --- S.URBANO > CASTELLO --- CONTRADA S. URBANO	
	Utente MT	--	
	Trasformatore	TR1	

INSERIMENTO DATI Alimentazione / Rialimentazione			
Tipologie	codice	nome descrittivo	Trasformatore
AT	Cabina AT	--	--
	Cabina AT	--	--
MT	Cabina MT	CAB-000010	S.URBANO > CASTELLO
	Cabina MT	--	--
CLIENTE	CLIENTE	--	--
PARTEZZA	LINEA	2 ----- E10-CHIESANUOVA Linea 06	
DATA EVENTO	GIORNO	16	MESE
	ORA	15	MINUTO
			ANNO
			SEC
VALIDATO	VALIDATO	<input checked="" type="radio"/>	NON VALIDATO
ORIGINE	TELECONTROLLO	<input type="radio"/>	MANUALE
TIPO	Disalimentazione	<input checked="" type="radio"/>	Rialimentazione
		<input type="button" value="SALVA"/> <input type="button" value="Cancella"/>	

Figure 9: Manual inserting sequence of a un-powering event

4.2.3 Automatic data inserting

Inserting of data relating to interruptions in the RIRE database, can be performed automatically through the system eXPert DMS.

Automatic inserting guarantees following features:

- Cabins information: directly from the GIPE configuration tool;
- Network Topology: directly from the GIPE configuration tool;
- Events of un-powering/re-powering: directly from SCADA DMS records archived when arrive from the field through remote control devices or when the operator acts on the topological network manually executing operations done in field.

4.3 Events and Interruptions management

The RIRE application prepares the events of un-powering and / or re-powering of the following items:

TYPE OF EVENT	DESCRIPTION
AT	Cabin - Customer HV/HHV
MT	Cabin - Customer MV
BT	Transformer of a MV cabin
BBT	LV trunk

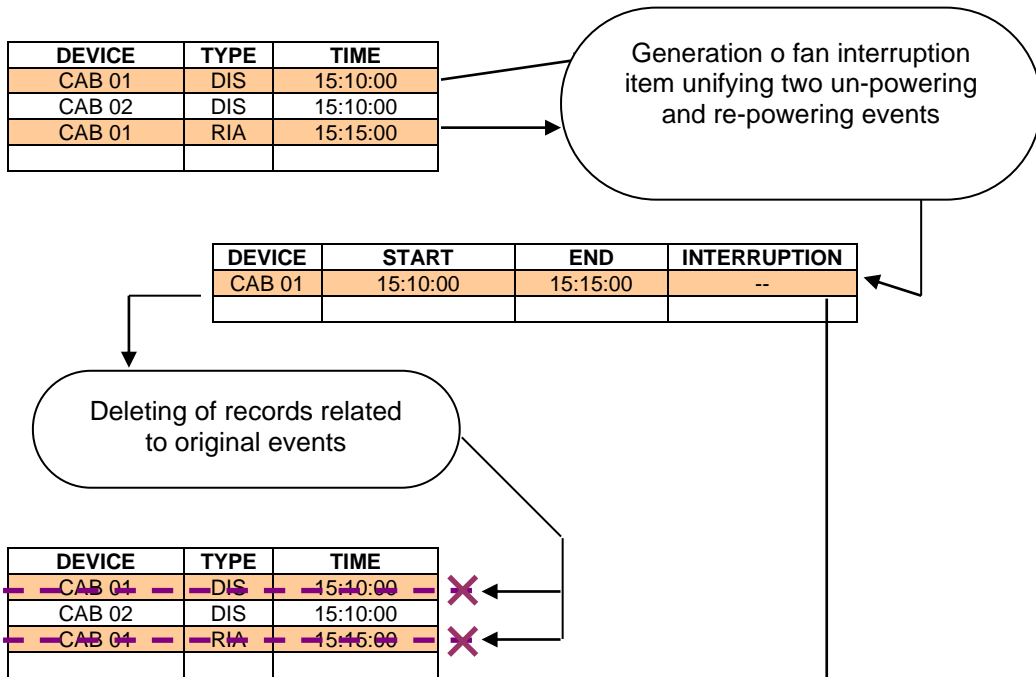
The events of un-powering and re-powering collected automatically through the SCADA DMS-I/O Server application from cabins in telecontrol way or manually entered by the user, are stored in a database that resides in database support level.

Is available a function of 'Automatic interruption generation' that removes from this archive all records of events that can be unified in a single un-powering record and related re-powering only as specified by energy authority (an example of operation of this algorithm is shown in the figure below).

The application also has features for monitoring and verifying the matching of data, elimination of manual entries, manual input of events and modification of data already on file.

RIRE also operates in an independent manner, breaks and events related to distribution networks distinguishing between geographically or skills, for example in case of acquisition by the manager of new electrical distribution networks.

Algorithm – First part



Algorithm – Second part

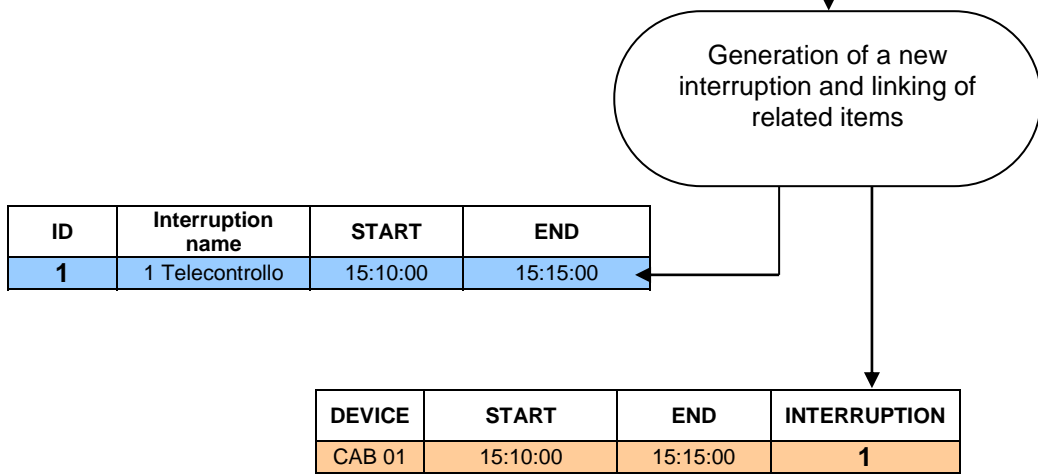


Figure 10: Operative way of algorithm for interruption events list

4.4 Reporting

The application can generate in a automatic way, reports to supply to energy authority as it enacted legislation reference, in particular:

- The report related to **Continuity of service indicators - Reference art. 15 paragraphs 15.1, 15.2, 15.3, 15.4 and 15.5.**

In particular are calculated:

- number of interruptions for each customer, following the suspension notice and for the interruption without notice long, short and transitional;
- duration for each customer, following the suspension notice and for long breaks without warning, brief and transitory;
- The report related to **Continuity of service indicators - Reference art. 15 paragraphs 15.6 and 15.7.**

In particular, for each single customer and HV/MV are calculated:

- number of interruptions, divided into breaks with prior notice and without notice long breaks, short and transitional;
- duration, divided into breaks with prior notice and without notice long breaks, brief and transitory;
- The report relates to the requirements in **Article 16 paragraph 1 in reference to the model shown in the 'Scheme N. 2'** of the resolution;
- The report on the value of the **Di** indicator as defined in **Article 19 paragraphs 19.1 and 19.2;**

- A summary report containing the list of breaks with or without notice, long or short as required by **Article 16 paragraph 16.4**, with specified:


- Code interruption;
- Date and Start Time;
- Type of notice;
- Type of interruption (Long / Short);
- Causes;
- Origin;
- Type of communication;
- Indicator paragraph 15.2;
- Indicator paragraph 15.4;

- A summary report as required by **Article 16 paragraph 16.1**, for each HV and MV user is reported:

- User code and information;
- List of disruptions related to the user with specified: code for the interruption, date and start time, type of warning, type of interruption (long, short or transient, cause and origin.

The figure below shows examples of reports produced in specific reference to Article 15, 16 and 19 of authority, is also shown a summary report about the interruption.

automazione industriale



RIRE
Registro Interruzioni
Reti Elettriche

Data Report: 22-9-2004 14:28 Operatore: ADMINISTRATOR

Indicatori di continuità (Art.15)
Dal: 01-01-2004 al: 31-12-2004

223A


INTERRUZIONI SENZA PREAVVISO LUNGHE PER CLIENTE BT

Numero Medio per Cliente	Orig.SE (Distacchi Prog.)	Orig.SE (Black Out)	Orig.RTN	Orig.AT	Orig.MT	Orig.BT	Totale
Cause Forza Maggiore (o E.P.R.)	-	-	0.000	0.000	0.000	0.000	0.000
Cause Esterne (*)	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Altre Cause	-	-	0.000	0.000	0.000	0.206	0.206
Totale	0.000	0.000	0.000	0.000	0.000	0.206	0.206

Durata Complessiva per Cliente

Orig.SE (Distacchi Prog.)	Orig.SE (Black Out)	Orig.RTN	Orig.AT	Orig.MT	Orig.BT	Totale
Cause Forza Maggiore (o E.P.R.)	0.000	0.000	0.000	0.000	0.000	0.000
Cause Esterne (*)						
Altre Cause						
Totale						

automazione industriale



RIRE
Registro Interruzioni
Reti Elettriche

Data Report: 14-9-2004 16:59 Operatore: ADMINISTRATOR

Indicatori di continuità (Art.16) per Classi di Servizio: Clienti AT e MT
Dal: 01-01-2004 al: 31-12-2004


223A : Interruzioni senza preavviso Brevi e Lunghe
Numero Clienti MT

	Fino a 1 Lunga	2 Lunghe	3 Lunghe	4 Lunghe	5 o più Lunghe	Totale
Fino a 1 Breve	252	0	0	0	0	252
Da 2 a 3 Brevi	0	0	0	0	0	0
Da 4 a 5 Brevi	0	0	0	0	0	0
6 o più Brevi	0	0	0	0	0	0
Totale	252	0	0	0	0	252

223A : Interruzioni senza preavviso Brevi e Lunghe
Numero Clienti AT

	Nessuna Lunga	fino a 1 Lunghe	2 o più Lunghe	Totale
	0	0	0	0
	0	0	0	0
	0	0	0	0
	0	0	0	0

automazione industriale



RIRE
Registro Interruzioni
Reti Elettriche

Data Report: 22-9-2004 14:32 Operatore: ADMINISTRATOR

223A

Indicatore di riferimento (Art.19)

Art. 19.1	Anno: 2003	Anno: 2004
Numero Utenti BT	33000	11457
Indicatore di riferimento	0	378

Indicatore effettivo di riferimento (Art.19) 2004: 46.13


225A

Indicatore di riferimento (Art.19)

Art. 19.1	Anno: 2003
Numero Utenti BT	1
Indicatore di riferimento	0

Indicatore effettivo di riferimento (Art.19) 2004: 0.00

automazione industriale



RIRE
Registro Interruzioni
Reti Elettriche

Data Report: 22-9-2004 14:33 Operatore: ADMINISTRATOR

Interruzione 21 Telecontrollo 1B Lunga Origine: BT

Data ora inizio: 23-07-2004 11:00:00 Data ora fine: 23-07-2004 11:15:00 Operatore: VAL

Utenti Coltevoli: AT: 0 MT: 0 BT: 225.12 Rapporto: SALA TELECOMANDI

Preavviso: SENZA PREAVVISO Rilevazione: TELECONTROLLO

Causa: ALTRE Comunicazione: ALTRO

Sollecitazione: VARIE

Informazioni: E14-ZIZIOLA Linea 01

NOTE:

Disalimentazioni e Rialimentazioni

DETTAGLIO BT

Ass.	Data-Ora INIZIO	Data-Ora FINE	Cabina	Trasf.	Comana	N°ut.	RIL.	Durata
A	23-07-2004 11:00	23-07-2004 11:05	CAB-000985	TR1	BRESCIA	112.56	T	00:05
A	23-07-2004 11:00	23-07-2004 11:15	CAB-000988	TR1	BRESCIA	112.56	T	00:15

Figure 11: Example of reports produced by RIRE tool

5. Operative environment

5.1 Introduction

This chapter describes hardware and software characteristics of calculators to be adopted for eXPert DMS and RIRE software module installation.

In next paragraphs are shown differences, if any, between server and client stations.

5.2 eXPert DMS

5.2.1 Hardware and Software requirements

Elements of DMS system necessary for network study and analysis are:

- SCADA;
- HMI;
- CONFIG.

Minimum hardware and software characteristics related to computers where is done software installation, supposing that are adopted different machines in order to monitor a network composed by 1300 cabins, are following:

- SCADA:
 - PC Pentium 4 2.4 GHz, 256 MB Ram, 40 GB Hard disk
 - Server Intel Itanium 2, 1.3 GHz, 2 Gbyte Ram, 40 GB Hard Disk.
- HMI: PC Pentium 4 2.8 GHz, 512 MB Ram suggested 1 GB Ram, 40 GB Hard disk, AGP graphical interface with 64 MB Ram and minimum resolution 1600x1280 and adequate monitor;
- CONFIG: PC Pentium 4 2.8 GHz, 1 GB Ram, 40 GB Hard disk, AGP graphical interface with 64 MB Ram and minimum resolution 1600x1280 and adequate monitor.

Previous characteristics of machines proposed could change related to number of cabins present in network and complexity of network interconnection.

Operating system supported are Windows 2000 Professional, Windows XP Professional, for SCADA module is possible to install software on Server Itanium, HP-UX 11i v2 servers.

5.3 RIRE

5.3.1 Hardware and Software requirements

RIRE Server station must be a station equipped with one of following operating systems:

- Windows 2000 Professional;
- Windows 2000 Server;
- Windows XP Professional;
- Windows 2003 Server.

Minimum Ram memory required is 1 GB and minimum HD memory required is 40 GB.

Data archiving database to be installed on RIRE Server station can be one of the following:

- Oracle 9 or greater;
- MSDE.

Other relational database can be used on demand except MS Access.

For RIRE Client station the only requirement is that is installed Internet Explorer ver 6.0 or greater, none limitation is present on operation system adopted or PC characteristics.