RAMO : MANAGEMENT NETWORK FOR TELECOMMUNICATIONS ENVIRONNEMENT EQUIPMENT

RAMO : UN RESEAU D'AIDE A LA MAINTENANCE ET A L'OBSERVATION POUR LES EQUIPEMENTS DE L'ENVIRONNEMENT DES TELECOMMUNICATIONS

D. MARQUET - J.P. LEBLANC

FRANCE TELECOM/CNET

38-40, rue du Général Leclerc

92131 ISSY-LES-MOULINEAUX

Résumé

Le réseau RAMO constitue l'outil fondamental pour l'exploitation des équipements de l'environnement technique qui regroupent l'alimentation en énergie, le conditionnement d'air, la surveillance bâtiment, le contrôle d'accès, la sécurité, l'environnement CEM et électrostatique. Il met en oeuvre des fonctionnalités permettant de faire l'analyse de la qualité de fonctionnement des équipements, d'identifier précisément les défaillances du matériel, de réduire leur MTTR. Les principes mis en oeuvre ont pour objectif :

- d'améliorer le savoir faire par une conception de l'exploitation analogue à celle des systèmes alimentés,
- de diminuer les événements imprévus par la mise en oeuvre de tests périodiques automatiques sur tout ou partie d'une installation d'énergie et le suivi dans le temps du fonctionnement des matériels, par l'examen des défaillances et des résultats d'essais,
- d'accroître l'efficacité de l'intervention grâce à une meilleure qualité de l'information destinée à l'exploitant : richesse du message d'alarme et convivialité du logiciel de relation homme/machine, comme par exemple usage de synoptiques animés.

Les matériels pris en compte par ce réseau sont de type différent selon l'importance du centre dans lequel ils sont situés. On trouve les systèmes d'alimentation composés d'un groupe électrogène, d'une armoire de distribution alternative, d'une armoire de conversion et de stockage d'énergie appartenant à la gamme ALFATEL, couvrant l'ensemble des besoins pour les puissances comprises entre 2,5 kVA et 60 kVA, et à la gamme GEODE pour les puissances supérieures à 100 kVA auxquels s'ajoutent les systèmes de conditionnement d'air, et les alimentations sans interruption ASI.

La mise en réseau de l'ensemble de ces équipements réalisé sur un support X25 et utilisant l'architecture de l'exploitation de FT constitue le réseau RAMO.

L'article présente :

- l'architecture de réseau ainsi que les différents protocoles utilisés et les flux d'échange d'informations,
- une description de la gamme des équipements de surveillance utilisée dans chaque type de centre de télécommunications ainsi que les équipements assurant la supervision distante, leurs principales fonctionnalités, et l'administration du réseau,
- une description de l'ergonomie, menus déroulants, synoptiques animés,
- les caractéristiques des échanges sur le réseau X25, et les choix adoptés pour résoudre les cas difficiles.

De plus les aspects intégration du réseau RAMO dans l'architecture du réseau général des télécommunications R.G.T. sont abordés.

Abstract

The RAMO network is the fundamental tool for operating the technical environment equipment of telecommunications centres which concern the power supply, cooling system, building surveillance, access control, security, EMC and electrostatic environment.

It implements functions which make it possible to analyse the quality of the equipment's performance in operation, to precisely identify equipment failures to reduce their Mean Time To Repair. Principles are brought into question with the aim of :

- + reducing unforeseen events by the use of automatic periodic tests on all or part of a power plant and of monitoring the performance of items of equipment with time, by the use of failure examinations and test results,
- + increasing the effectiveness of intervention by improving the quality of the information which the operator receives, through the wealth of information conveyed by the alarm message and by the user-friendly nature of the man-machine interface software, as with the use of animated synoptics,
- + accumulating know-how by designing the operating system in line with the design of the systems supplied.

The type of equipment included in this network varies depending on the size of the centre which houses it. It comprises the power supply systems, consisting of an electrical generator, an a-c distribution cabinet, a conversion and power storage cabinet from the Alfatel range, catering for all power requirements from 2.5 kVA to 60 kVA, and from the Geode range for power greater than 100 kVA, together with the cooling systems and uninterruptible power supplies.

The networking of all these items of equipment on an X.25 protocol using France Telecom operating architecture comprises the RAMO network.

This paper sets out :

- + the network architecture as well as the various protocols used and the information exchange flows,
- + a description of the range of surveillance equipment used in each type of telecommunications centre as well as items of equipment providing remote supervision, their main functionalities and network administration,
- + a description of the network ergonomics, pull-down menus and animated synoptics,
- + the characteristic features of exchanges on the X.25 network, and the solutions adopted for difficult cases.

In addition, the paper deals with the problems of integrating the RAMO network into the architecture of the Telecommunications Management Network (T.M.N.).

The wide-ranging and varied nature of the technical environment

The telecommunications technical environment is an area which assembles various items of equipment and applies constraints and norms intended to create and preserve the environment in which the telecommunications systems perform their functions.

It also contributes to the profitability of the network and to the quality of the service offered, insofar as investment and operating costs are optimised and low. One of the factors which reduces telecommunications network operating costs is the mode of operation, which must be based on the principles of remote surveillance and remote management.

To this end, the varied nature of the environment components necessitates the creation of adjusted devices for each type of equipment under surveillance. The equipment which makes up the technical environment varies according to the size of the telecommunications centres, and makes use of operating devices suited to its design. Large centres are fitted with the GEODE type of power installation with a supervision unit (US) and a command unit (UC) integrated into those items of equipment which interface with the operating network. Only the surveillance unit is present in small centres fitted with "Alfatel" type power installations, and is external to the items of equipment.

There are presently two types of surveillance unit : the universal supervision device (ECU) and the optimised supervision device (ECO).

These units monitor all the types of technical environment equipment installed in small or large centres, namely :

- + the cooling system,
- + computer power supply inverters for switching systems,

- + uninterruptible power supplies needed for certain items of computer equipment,
- + generally all items of equipment involved in the security systems of a telecommunications centre (fire detection, intruder detection systems, cable surveillance and even distribution points installed on public property).

The RAMO operating tool : a process of gradual installation

The RAMO application, until now limited to a local area network inside a single building, was introduced into France Telecom sites together with the Geode power installation.

In its first version, RAMO consisted of a local supervisor (SL) to concentrate all the supervision devices installed in a single centre and to enable the remote surveillance and remote management of technical environment equipment from a central station (Figure 1).

This local supervisor is installed in all sorts of centres, consisting of one or more surveillance units up to a maximum of eight. It is linked to the switched telephone network in order to allow connection to a remote Minitel viewdata terminal. The functions performed by the local supervisor are identical whatever the level of intervention by the operator (remote Minitel viewdata system or local supervisor). The main functions are :

- + reading of alarms as they arise ;
- + storage and printout of their identifiers ;
- + connection with one of the supervision units of the technical environment equipment to allow display of current states, counter values, operating parameters and log-books ;
- + the sending commands and start-up of equipment tests.

High-risk actions, such as changing parameters or writing commands, are protected by passwords.

One further milestone has now been reached. The centre equipments are networked on an X.25 network.

The structure of this network corresponds to the internal organisation of a France Telecom regional directorate, and to its favoured communication methods. To set out the characteristics required for the return of information of the alarm and operating data type, this network concentrates these flows on a minimum number of large-capacity dedicated lines, limits the number of nodes to transit, and has a backup path for each flow. It can be used to withdraw a node or link from service with the minimum of disturbance, and to reconfigure at frequent intervals.

Fig. 1
RAMO : Network architecture

The RAMO application borrows the operating structure architecture. Each centre is interconnected to a remote supervisor located at the Main Operating Centre, all remote supervisors being interconnected to a regional supervisor. The main sorts of information circulating between items of equipment are alarms. Provision has also been made for a procedure to check the various individual units of the network; it is used to detect failure of network equipment (for both the local and remote networks) by the periodic exchange of special information. The communications software used complies with ISO standards.

This stage also corresponds to the introduction of a more ergonomic system of operation. In addition to the above functions, the man-machine interface allows the use of synoptics and a mouse. The user can move between screens in accordance with a hierarchy which can be changed upon request to obtain the desired degree of detail. Each synoptic is animated by the alarms present on the items of equipment, and by the system states recorded at a given moment which are periodically refreshed (voltage, current, temperature and states: on, off, open, closed, for example).

The widespread application of RAMO requires the implementation of a system to administrate the RAMO network. Additional hardware (PC) and software tools were developed; they are used to configure the RAMO applications for the individual sites, and to manage changes in the network and the equipment under surveillance.

The functions developed concern the surveillance software applications to integrate into the supervision units, as well as the development of the configuration of individual sites using a library containing pre-defined graphics files. A drafting program was also developed for entering additional graphics files and information specific to the sites such as equipment inventory data, and to edit text on existing drawings.

All the configurations developed are remotely loaded via the X.25 network towards each item of equipment in the RAMO network.

Basic equipments for the RAMO tool

The supervision units, whether these are universal supervision devices, or optimal supervision devices depending on their destination constitute, with regard to technical environment equipment, the interface with an operator and with the RAMO network. They are housed either in the items of equipment, and hence occupy a single rack together with the command units, or in a special cabinet.

Two types of supervision units (shown in table 1) can be installed.

Table 1
Component elements of the RAMO network

FUNCTION	TYPE	APPLICATIONS	POSITION IN THE NETWORK
Large centre surveillance unit	Optimal Supervision Device (ECO)	Technical environment (Geode, cooling system INVERTER UPS)	Connection to the local supervisor via the X.25 network
Small centre surveillance unit	Universal supervision device (ECU)	Technical environment transmission Containers (cables)	Connection to the SD via the X.25 network
Local supervisor(SD) Regional supervisor (SR)	PC	Concentration and operation of surveillance units Redirection of technical environment regional alarms	Connection to the SR via the X.25 network

The Optimal Supervision Device

More specifically adapted to large centres, the optimal supervision device is intended for across-the-board adoption in the surveillance of technical environment equipment. Technical features include :

- + a reduced number of cards,
- + the adoption of a man-machine relationship program, simplifying operations through synoptics displays, and with a limited number of screens,
- + establishing reliable communication with the level above.

The optimal supervision device equipment takes the form of a plug-in interface card, varying in number depending on the type of equipment under surveillance.

The different interfaces are :

- + the Minitel viewdata interface used for operations,
- + interfaces with the sensors located in the technical environment equipment.

The Universal Supervision Device

The universal supervision device, intended to take between one and five software surveillance applications essentially in small centres, is composed of plug-in cards, variable in number, in a wall-mounted cabinet or integrated in a telecommunications system.

The configuration of equipment, however, varies according to the number and type of application supported by the

equipment.

The other universal supervision device interfaces concern connections with the external network and the operating terminals.

The X.25 interface is used to connect with the regional and remote supervisors and to send alarms as they arise. Furthermore, when the universal supervision device has a card to interface with the transmission systems, access to this X.25 is shared with communications specific to the transmission equipment operating services.

In the case of a small centre, the universal supervision device plays the roles of both local supervisor and surveillance unit.

The supervisors

The local and remote supervisors are identical items of equipment in terms of their hardware. They are both personal computers.

RAMO software and its integration into the telecommunications management network

The configuration set out earlier is on standardised hardware, which allows the RAMO application to be used in areas other than the technical environment.

RAMO is a real-time application; its program contains a sub-routine in which all the tasks are executed as basic actions. The main program then searches for sources which can generate events and, if it detects any, carries out a basic

action. However, certain priority tasks can interrupt the main sub-routine.

The RAMO application uses a specific program, not run on the UNIX system and hence not costly, in view of the hardware and the licence this requires; this does not, however, have an adverse affect on its performance or its capacities for adaptation.

In the case of a protocol on the local area network, between the optimal supervision devices and the local supervisor, the two modes of simultaneous communication are the foundation: flow of data between man and machine and between machine and machine in batch mode, which makes it possible to multiply applications which do not affect the basic RAMO software.

X.25 communication is by means of a dedicated card which manages all the ISO layers, thereby freeing the central processor from communication tasks.

Safety of operation is ensured by activating a "watch dog" at each pass through the main sub-routine. Should this fail, the PC automatically reboots.

At all levels of the network, whether this is the local supervisor, the remote supervisor, the universal supervision device or the optimal supervision device, the equipment informs its superior of the reboot by sending a special signal. This is followed by current alarms detected during this stage. This provision regenerates the alarm queues. These basic principles which favour current states over historic events, are a characteristic feature of RAMO and make the application extremely safe.

In addition to traditional supervisory functions (alarm display and animation, presented at each level of the network), the local and remote supervisors perform management functions. Files are created to this end to give a clear representation of technical information of use to the operator for guiding him through the maintenance operation.

Each node in the RAMO network creates a history of items of equipment located on its lower branches. There are two types of history:

- + alarm histories supplied with alarms as they arise,
- + the histories of log-books consisting of events and the results of periodic tests carried out by the optimal supervision devices and universal supervision devices. All these files can be saved to disk with a view to their future processing using a database application.

In the immediate future, the universal supervision devices, local supervisors and remote supervisors will be the alarm-issuing and service units in the context of the future telecommunications management network (TMN).

They will be connected to an item of equipment responsible

for the general supervision of all telecommunications hardware. This general supervisor, called Regina, carries out alarm management tasks according to the type of alarm, its degree of urgency, and its origin. Personnel involved in maintenance work on technical environment equipment are informed by Regina. To carry out its maintenance operations it has at its disposal the databases and tools contained in RAMO.

Fig. 2
RAMO : Integration in the telecommunication management network

Conclusion

The RAMO network has to date been tried out on three France Telecom Regional Directorates. In each of these zones, the RAMO network interconnects small centres, and large centres with switches and transmission systems.

An initial report was drawn up after one year's operation: it demonstrates how extremely easy it is to use and to learn how to operate the software installed on the network, thanks to the operator's clear view of the ergonomic requirements, as well as the advantage of having a database for each site. Indeed, examination of the performance of automatic periodic tests, and the frequency with which certain alarms reappear, has made it possible to undertake actions to design the sub-assemblies of the power supply systems. RAMO constitutes a valuable source of assistance in curative and preventive maintenance work.