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Integrated control centre

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Abstract

The new Control Centre developed by DIMETRONIC S.A., has been conceived as a system capable of integrating as much as the functions performed in a modern railway traffic running.
The main characteristics of the system are:

- Architecture based on LAN Ethernet
- LAN protocol, TCP/IP
- PA-RISC machines
- UNIX environment
- Integration of functions
- Distributed process
- Operator's interface based on X-Windows
- High availability based on duplication of LAN and computers
- Easily expandable
- Conectivity to others systems under commercial standards
- User tools for data base and system configuration

System configuration

The system architecture consists of a dual Ethernet LAN, as shown in the figure, control computers, operators desks and communications computers.
The system comprises 3 subsystems:

- Control and supervision
  It is a dual computer set in hot stand-by configuration. They performs the functions or subfunctions common to all the system. This set can be expanded according to the size of the network.

- Operators desks
  Based on workstations with two or more VDU's, Keyboard and mouse or track-ball.
  They performs the man-machine interface tasks, such as graphics display, train descriptions, alarms logging, etc.
- Communications
  A dual computer set based on microprocessor cards allocated in a VME bus, configuring a multi-CPU computer. Each card or group of cards are devoted to a different communication system: interlockings, passenger information equipment, stations equipment, etc.
  The software in each CPU consists of:
  - Communications protocol specific to each telemetry system.
  - Addressing of field stations according to their own characteristics
  - Errors detection
  - Detection of changes of state and mailling them to control computers

  This organization makes the signalman operations transparent to the type of interlocking or subsystem to be controlled. By other hand it allows the integration of different communications systems from different suppliers and different characteristics.

Functions

The system performs the following functions:

a) Signalling control
   I can be connected to every type of interlocking, relay type through W-S2 telemetry field stations, and electronic interlockings (SSI, WESTRACE)
   The man machine interface provided to signalman, makes the operations transparent to the type of interlocking under control.
   Manual controls are performed by using a track-ball or mouse, selecting graphics elements on VDU's and associated graphics Keys. This is called "interactive screen."
   The system provides also other methods to send controls; graphic board and nested windows.

b) Automatic and semiautomatic Route Setting.
   According to train number and its position in the line, the routes are

generated automatically for every train in the system.
The program checks whether a route can be set according to the actual situation of interlocking, before execute the command. This control is performed during a period of time (that can be configurated).
If the status of interlocking doesn't allow to perform a particular route, the route setting for a particular train changes to semiautomatic.
At this stage all the possible alternative routes for this train are shown
to the operator, in a window display. He can select other route by pointing the cursor on the route desired and the process changes to automatic again.

c) Traffic Regulation

There are various programs that performs two possible types of regulation: time table or interval.
The method used is described, in the paper "Traffic regulation and simulation. A predictive adaptative control systems".

d) Passenger Information

The Control Centre sends information in real time to the stations equipment at regular intervals to indicate:

- Trains position
- Changes of time tables performed by operator
- Train abnormally stopped
- Update of time (day, hours, minutes)
- Special messages on operator's demand

The local computer located at every station, has its own time table, and line data base that permits to perform all the logic to display automatically:

- Next 4 or 8 train arrivals or departures
- Actual waiting time for the next trains
- Changes of trains and destinations
- Incidents of traffic
- General information

The information can be displayed on TV monitors, LED panels, etc..
Public address messages are triggered automatically under certain conditions e.j. when a train is approaching or changes the expected platform etc.

e) Maintenance

There are several types of displays and windows that show the status of:

- Failures of signalling equipment

- Communications equipment
- Telemetry System
- Local equipment at stations

All the changes of status received by Central Computers are stored into disc.

A play-back program can be executed to display all the sequences of the last 24 hours, showing to the operator all the signals aspects, routes and train steps as they were received in real time.

The motion of pictures can be accelerated up to 3 times. This allows to display 1 hour sequences in 20 minutes. The pictures can be frozen at any time under operator demand.

f) Management Information

The system provides statistical reports about:

- Punctuality of trains
- Running speed of trains, average and between stations
- Signalling equipment failures

g) Station equipment control

There is a supervisory system that monitors the status of mechanical stairs, elevators, ballast pumps, ventilators, etc. in the stations.

This can be displayed on the operator VDU's or on a dedicated workstation.

Commands can be sent to connect or disconnect equipments.

Alarm functions are provided.

Software

The software has been developed in "C" language

The operating system in control computers and operator's workstations is UNIX.

The communications computers run under VRTX, a real time multitasking operating system.

The programs have been made to achieve the following requirements:

- Modularity
- Function independency
- Subsystem distribution: Control and supervision, communications and man-machine interface.

System design has been made, following a-methodology according to ISO 9000 standards.

In addition of application programs a package of user tools are supplied with the system. These tools provide an easy method to mantain and introduce future changes in the system, that can be performed by the user without any special software skills.

The tools package comprises:

. Graphics tool
. Menu configuration tool
. Trains data base

- Graphics tool

Provides the following facilities:

. Editing library elements (signals, tracks, etc..)
. Logic equations to display the different status of elements, according to indications received from the field
. Editing of complete screen layouts
. Logic links of elements, such as track circuits
. Interface for interactive displays and controls

- Menus configuration tool

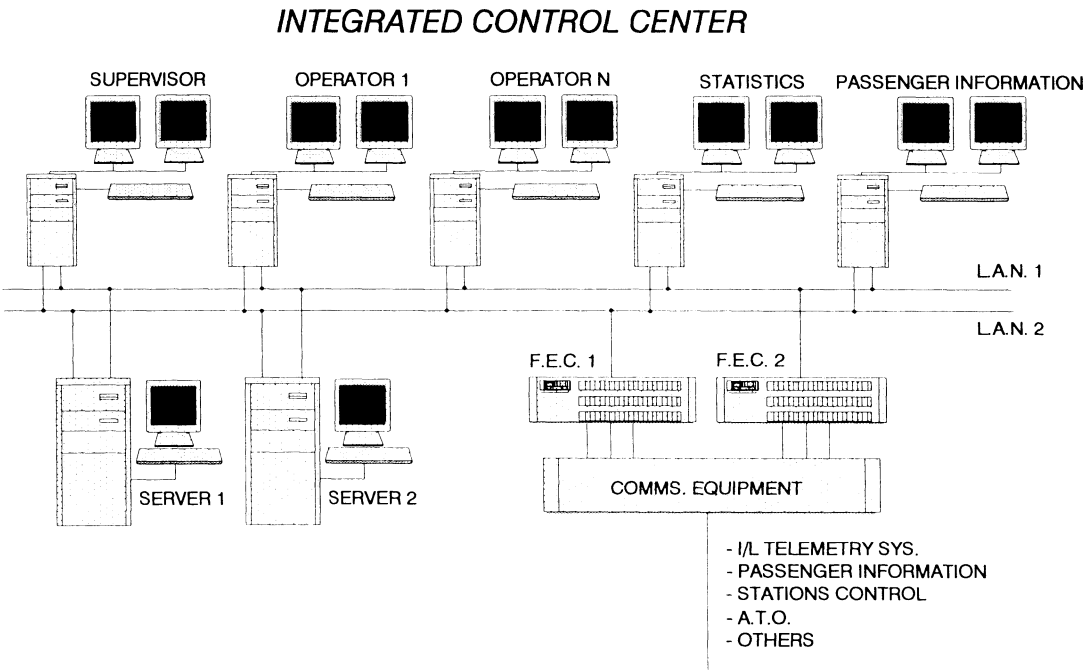
It allows to create menus and windows according to the needs of the user. It provides the following facilities:

. User's menus: size, colour, text, number of cells.
. Nested menus and submenus.
. Type of windows, number of nested windows. Attributes can be defined to make them; automatic, on demand, display only or interactive

- Trains data base

This tool allows to create the trains data base by using a P.C. and it provides:

. Up to ten different services according to the day of the week, season, etc..
. Time table generation for each service
. Characteristics of trains and routes associated to every run.


INTEGRATED CONTROL CENTER
SUPERVISOR
OPERATOR 1
OPERATOR N
STATISTICS
PASSENGER INFORMATION
L.A.N. 1
L.A.N. 2
F.E.C. 1
F.E.C. 2
SERVER 1
SERVER 2
COMMS. EQUIPMENT
- I/L TELEMETRY SYS.
- PASSENGER INFORMATION
- STATIONS CONTROL
- A.T.O.
- OTHERS