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GUVERNUL ROMÂNIEI

ROMANIAN GOVERNMENT

PROJECT FINANTAT DE UNIUNEA EUROPEAN

EUROPIAN UNION FINANCED PROJECT

CLIENT / CLIENT

C.N.C.F. "C.F.R."- S.A.

ITALFERR

GRUPPO FERROVIE DELLO STATO

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Reabilitarea liniei de cale ferăta Braşov - Simeria, parte componentă a coridorului IV Pan European, pentru circulatia trenurilor cu viteza maxima de 160 km/h,

Sectiunea 1 : Brasov-Sighisoara

Rehabilitation of the railway line Brasov – Simeria, component part of the IV Pan-European Corridor, for the trains circulation with maximum speed of 160 km/h.

Section 1 : Simeria-Sighisoara

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Functional Specification of Centralized Control System in Brasov OCC

Codificare / Codification System:

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1. SCOPE OF THE REPORT

The aim of this document is to provide functional specifications for a Centralized Control System (**CCS**) for Section 1 Brasov-Simeria railway Traffic, Diagnostic and Supervision Management.

This document describes the main Functional Features of **CCS** system, showing the reference architectures and operational levels of the system, both within the Control Operating Centre (**OCC**), and within the peripheral stations - Peripherical Installation (**PI**), showing the organizational model of the control centre and the operators terminals, available for the various professional functions involved.

2. GLOSSARY (to be related to the content of this document)

EIS	ELECTRONIC INTERLOCKING SYSTEM
ADM	ADD DROP MULTIPLEXER
BTS	BASE STATION TRANS RECEIVER
CA	INTRUDER DETECTION SYSTEM
CC	NODE EXCHANGE
CCR	CENTRAL CONTROL ROOM
CCS	CENTRALIZED CONTROL SYSTEM
CEM	ELECTROMAGNETIC COMPATIBILITY
CRI	FIRE DETECTION SYSTEM
CTC	CENTRALIZED TRAFFIC CONTROL
HVAC	VENTILATION AIR CONDITIONING
CTS	PHONES SELECTIVE CONCENTRATOR
DMR	DIGITAL MOBILE RADIO
DWDM	WAVELENGTH DIVISION MULTIPLEXING
D&M	DIAGNOSTIC AND MAINTENACE
DMC	DIAGNOSTIC AND MAINTENACE COORDINATOR
ERTMS	EUROPEAN RAIL TRAFFIC MANAGEMENT SYSTEM
ETSI	EUROPEAN TELECOMMUNICATION STANDARDS ISTITUTE
FDMS	RELIABILITY, AVAILABILITY, MAINTAINABILITY AND SAFETY
GC	MAIN EXCHANGE
HDSL	HIGH SPEED DIGITAL SUBSCRIBER LINE
IS	SIGNALING INSTALLATIONS
IST	TRANSPORT INFORMATION SYSTEM
MSC	MAIN SWITCH CONTROLLER
OCC	OPERATION CONTROL CENTER
PABX	PRIVATE AUTOMATIC BRANCH EXCHANGE
PCM	PPULSE CODE MODULATION
PDH	PLESIOCHRONOUS DIGITAL HIERARCHY
PI	PERIPHERAL INSTALLATION
PIS	PASSENGER INFORMATION SYSTEM
PP	PERIPHERAL WORKSTATION
PS	SERVICE WORKSTATION
QIM	MECHANICAL SYSTEMS PANEL
RC	REMOTE CONTROL
SC	SATELLITE EXCHANGE
SDH	SYNCHRONOUS DIGITAL HIERARCHY
SHDSL	SINGLE-PAIR HIGH-SPEED DIGITAL SUBSCRIBER LINE:
STM	SYNCHRONOUS TRANSPORT MODULE
TG	TRAIN GRAPH
TD	TRAIN DESCRIBER
TLC	TELECOMMUNICATIONS
VSS	VIDEO SURVEILLANCE AND SECURITY SYSTEM
UIC	INTERNATIONAL UNION OF RAILWAYS
UP	PERIPHERAL MONITORING UNIT
UTA	AIR TREATMENT UNIT
VLAN	VIRTUAL LOCAL AREA NETWORK

xADSL	X-ASYMMETRIC DIGITAL SUBSCRIBER L

Glossary in agreement to UIC/ETSI definition.

3. STANDARDS AND REFERENCES

The list of standards included in the present chapter is only to be used as reference for describing the expected technical and functional performance of the solution to be proposed
All communication systems shall be designed and built according to appropriate industry standards and in compliance with the Romanian, ITU-T, ETSI, EIRENE and OSI standards and references.

ITU -T Series D	Principles of billing and accounting;
Series E	PSTN, numbering and routing, service quality, network management;
Series G	Analogue and digital transmission systems
Series M	Maintenance
Series O	Measurement equipment
Series P	Telephony transmission quality
Series Q	Switching, value-added services, signalling systems
Series V	Data communications over the telephone network
Series X	Data networks, open system communications and security

IEEE Std. 802.11d-2001 Wireless LAN

EN/ISO 11064-1-2-3-4		Ergonomic design of command centres - Parts 1 , 2, 3 and 4
EN/ISO 13407		Human-centred design processes for interactive systems
EN/ISO 9241		Ergonomic requirements for terminal work whit visual display terminals
EN ISO 6385		Ergonomic principles in the design of work systems
EN 50173		Standard for structured cabling systems installed
EN 50126		Railway systems – operational reliability - FDMS
SDH		Synchronous Digital Hierarchy
EN 61000		Standards on the electromagnetic compatibility
IEC 60364		Electrical Installations for Buildings
EN 41003		Particular safety requirements for equipment to be connected to telecommunications networks

EN 62040 -1-2		Uninterruptible power supply (UPS) –general requirements and safety rules for UPSs used within locations which are accessible to operators
EN 50091 - 1-1		Uninterruptible power systems (UPS). General and safety requirements for UPS used in operator access areas
ISO/IEC 9126		Software engineering – Software quality
UIC 912		Principles for the elaboration of unified messages for information exchange at international level
UIC 917-1		Technical requirements for the interconnection of international data transmission networks within railway networks
CEI EN 60870	Remote control systems and devices	
CEI EN 60529	Degrees of protection of layers (Cod IP)	
CEI EN 60721	Classification of environmental conditions	
CEI EN 50123	Railway applications for tramways, trolleybuses and subway – Fixed installations	
CEI EN 50126	Railway applications - The specification and demonstration of Reliability, Availability, Maintainability and Safety (RAMS)	
EN 50128	Railway applications - Software for railway control and protection systems	
EN 50129	Railway Applications: Safety related electronic systems for signalling	

MIL-SDT-781D	Reliability testing for Engineering development, qualification and production
MIL-STD-785 B	Reliability Program For Systems And Equipment Development And Production
MIL- HDBK -2164-A	Environmental Stress Screening Process For Electronic Equipment
MIL-HDBK-470A	Designing And Developing Maintainable Products And Systems

EN 50155 Railway Applications
– Electronic equipment used on rolling stock

Subcontractors shall submit to the Client's representative, for approval, the list of standards they intend to use during the project.

REF	EMITTED BY	DOCUMENT
[REF1]	ITALFERR/Scott Wilson/Obermeyer/Tecnic	EA5101C00TSSE00100010 ' SIGNALLING TECHNICAL SPECIFICATION'
[REF2]	ITALFERR/Scott Wilson/Obermeyer/Tecnic	EA5134C00TRSE00100010 ' SIGNALLING TECHNICAL DESCRIPTION'
[REF3]	CFR	CFR CMT Requirements – Beneficiary'

4. CCS CONTEXT – GENERAL LINE LAYOUT DRAWING –

CCS (Centralized Control System) will be located in the OCC of Brasov and will manage the Section1 Brasov- Sighisoara railway line.

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This system carries out centralized management and diagnostic for the following installations:

- Signalling systems;
- Fire detection and climate conditioning systems for Interlooking container and GSM-R shelter;
- Intruder detection and access control for technology rooms;
- Audio and Visual public announcement systems;
- Power supply system for signaling equipments;
- Video surveillance system

In Fig 1 it is schematically shown the line controlled by **CCS** system with **OCC** located in **Brasov**
If a definition/procedure related to a specific system requirement is described in this document in a different way compared with CFR documents (see [REF3]), this last one shall prevail.

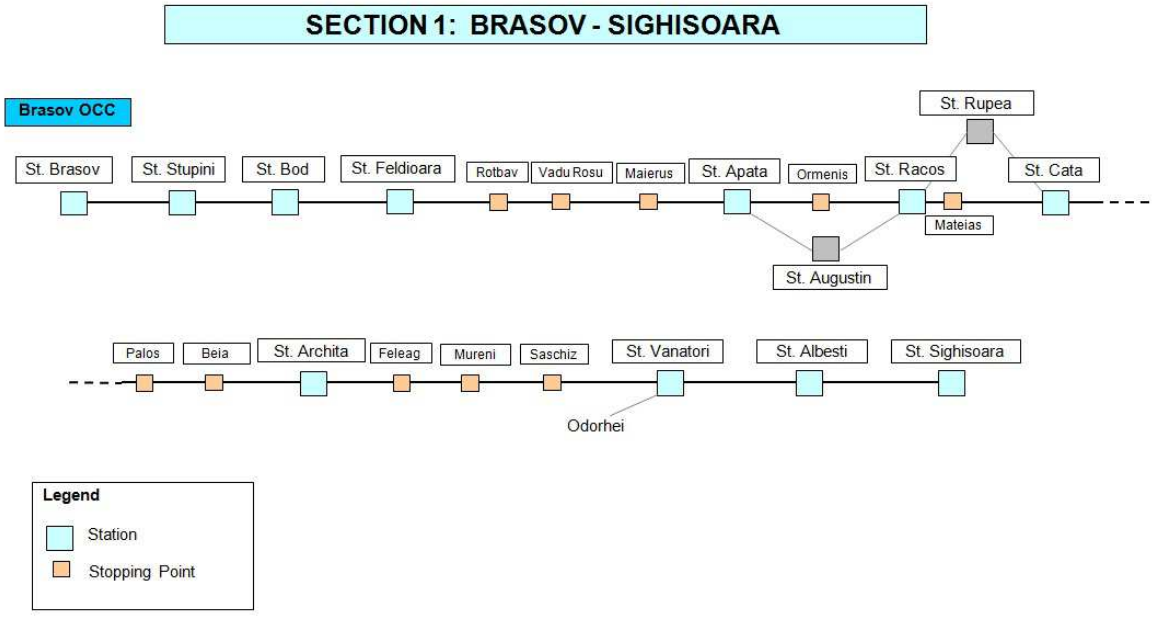

Fig. 1: Section 1 Brasov- Sighişoara schematic diagram

5. CCS OBJECTIVES

The objectives of the Centralized Control System (**CCS**) are part of the context of the development of railway traffic along the Romanian part in Corridor IV in especially:

- Remote control of the sections;
- Improvement of railway transport efficiency;
- Reduction of management costs;
- Improvement of the quality of the offered in terms of service:
    1. regularity
    2. services for the users
- Improvement of the maintainability of the systems and infrastructure;
- Improvement of the management of emergency situations.

In order to achieve these objectives, **CCS** requires complete automation of management processes and the use of modern technologies to implement a distributed system, where from a single Control Centre it shall be carried out all the activities of command, control and coordination.

6. MAIN CHARACTERISTICS

Hereinafter it's shown, in a summarized way, the functional principles and characteristics which **CCS** system should have.

a. Integration and modular character

- Unique database management for both traffic and maintenance purposes maintenance
- Integration within the existing systems

b. Centralization

- Centralization of the activities of command, control and coordination within a single centre (control room) with an wide extension of the controlled geographical area;
- Integrated management of all the (statistical, dynamic, documentation, manuals, messages between operators, statistics).

c. Flexibility and Maintainability

- Territory distributed system;
- Configurability and expandability of the system ;
- Modular and standardized architecture;
- Self diagnosis functions;
- Commercial basic hardware and software;

d. Efficiency

- Automation of management processes;
- Simplification of procedures;
- High reliability and availability;
- Survivability.

6.1 GEOGRAPHICAL ARCHITECTURE

The extension of the controlled geographical area and the diversity of the functions require a distributed architecture, both physically and functionally.

The Operation Control Centre (**OCC**) is the superior hierarchical element that centralizes the functions of supervision and coordination of the controlled area.

The core of the distributed architecture is the signalling network. Two optical fiber cables will be laid one on each outer side of the Railroad track and they will be used to realize an optical ring along the entire Railroad line.

Inside each optical ring, transport equipment, based on Gigabit Ethernet technology (IEEE 802.3z), shall be foreseen for each site; the conclusion is that a Gigabit Ethernet LAN will be involved inside each optical ring.

The backbone transport network of optical ring will be interfaced with others IP networks through transport equipments, based on IP/MPLS technology to guarantee the transport of the traffic coming from the different GSM-R, ERTMS sites located along the track.

The Public information equipments installed in station and stopping point will connect with Brasov OCC using the existing SDH transport network

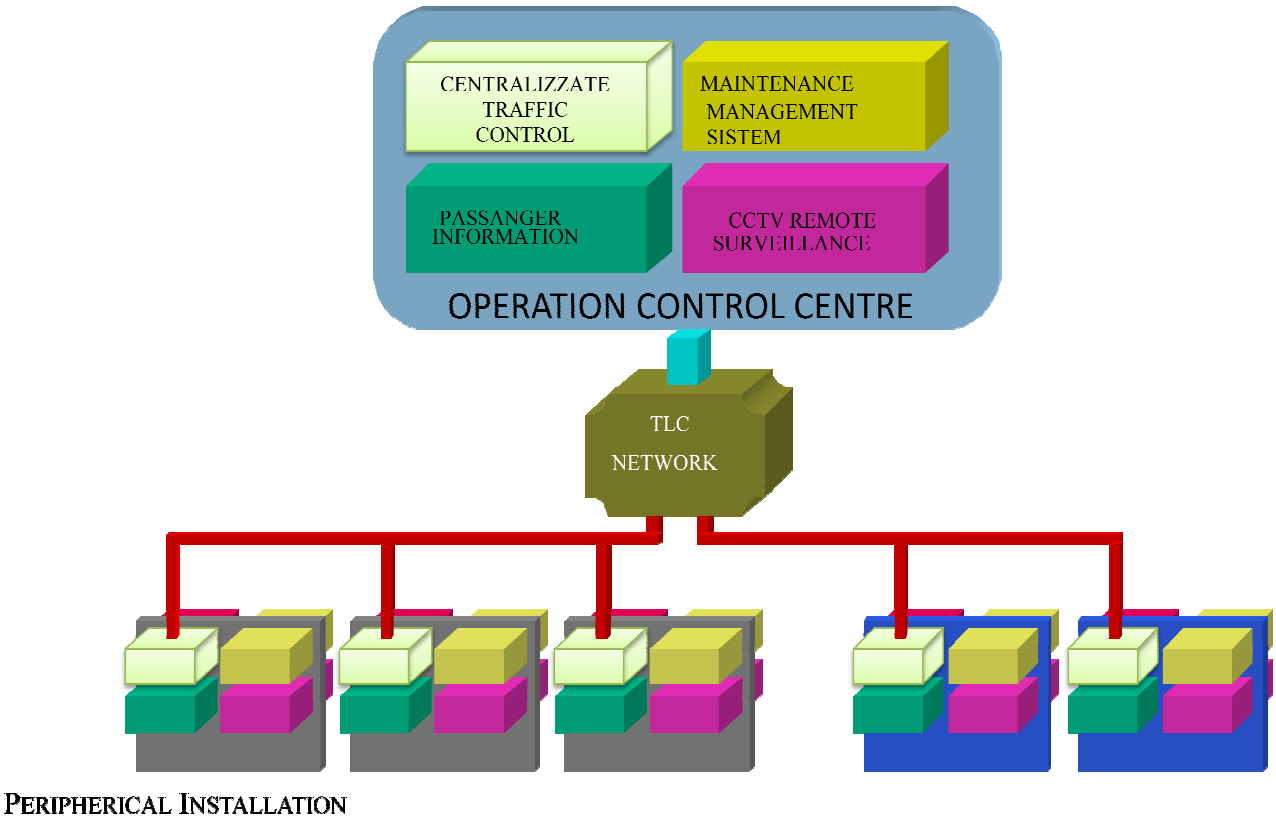

Figure 2: Geographical architecture of CCS system

6.2 FUNCTIONAL ARCHITECTURE

From a logical and functional point of view, the system will have to carry out four macro functions:

- Centralized Traffic Control;
- Maintenance Management ;
- Passenger Information;
- Video Surveillance and security system

These functions shall be performed at two levels (**OCC** and **PI**).

6.2.1 Traffic Functions

The Traffic Functions are:

- Dispatch remote commands;
- Real time monitoring of current train position;
- Traffic regulation;
- Data exchange with external systems related to train traffic management. *(including IRIS system, IT tool used by CFR for making operational plan and traffic monitoring).*

At the Operating Control Centre (OCC) traffic functions allow operators to manage and supervise the traffic, while at the remote sites (PI) they mainly carry out data exchange with the station interlocking (acquiring indications and sending commands) in addition to specific operator interface functions as a subset of those provided in OCC.

6.2.2 Diagnostic and Maintenance Functions

Diagnostic and Maintenance Functions allow:

- Monitoring of devices and equipments situated within the area controlled by the system, in order to locate defects, where it is possible even in a provisional way;
- Remote command and remote control of auxiliary devices (Power Supply, Power Supply Panels, diesel generator, Fire Detection System and Intruder detection System.)
- Monitoring of the hardware and software components of the system.

These functions are carried out at two levels:

- **OCC** is intended for supervision, monitoring and coordination, for the logistical support for interventions;
- At **PI** level where are allocated the interface with equipment and devices, functions support the operators during maintenance interventions.

6.2.3 Passenger Information Functions

Passenger Information functions allow automatic display of visual messages on monitors and broadcasting of vocal announcements along all the controlled stations. Therefore, service is improved in currently attended stations and fully provided in unattended stations. Announcement and visual messages are based upon current traffic status and relevant events processed buy the traffic functions. Within **OCC** control and supervision functions are carried out, within **PI** it is allocated the management of the local devices for viewing and sound broadcasting.
OCC shall also be placed within an adequately equipped area, the “Control Room”, which provides functions and instruments for the management of emergency situations

6.2.4 Video surveillance and security system function

The Video Surveillance System will enable the remote monitoring of technological and passengers areas in each stations, as well as local areas and present technological OCC.
The OCC will collect images from peripheral video cameras and alarms generated by intrusion and fire detection systems, located in each **PI**

6.3 PLANNED PERIPHERAL INSTALLATIONS

The **PI** of the line will be in terms of the CCS subdivided and equipped in the following manner:

N	Peripheral Installation	Type	CTC	D&M	VSS	PIS
1	Brasov	Station	X	X	X	X
2	Site 0	GSM-R site			X	
3	Site 2	GSM-R site			X	
4	Level crossing 175+054	Level crossing 175+054			X	
5	Stupini	Station+GSMR site	X	X	X	X
6	Bod	Station+GSMR site	X	X	X	X
7	Level crossing 185+505	Level crossing 185+505			X	
8	Level crossing 186+900	Level crossing 186+900			X	
9	Feldioara	Station+GSMR site	X	X	X	X
10	Level crossing 194+118	Level crossing 194+118			X	
11	Rotbav	Stopping point				X
12	Level crossing 196+117	Level crossing 196+117			X	
13	Vado Rosu	Stopping point				X
14	Site 6	GSM-R site			X	
15	Maierus	Stopping point				X

16	Maierus	Sub Station			X	
17	Apata	Station+GSMR site	X	X	X	X
18	Site 8	GSM-R site			X	
19	Ormenis	Stopping point				X
20	Tunnel Ormenis Brasov side	GSM-R site + control area+ Tunnel emergency systems		X	X	
21	Site 9b	GSM-R site			X	
22	Site 9c	GSM-R site			X	
23	Tunnel Ormenis Sighisoara side	GSM-R site + Tunnel emergency systems		X	X	
24	Racos	Station+GSMR site	X	X	X	X
25	Site 10 bis	GSM-R site			X	
26	Site 10 ter	GSM-R site			X	
27	Site 10 quat	GSM-R site			X	
28	Mateias	Stopping point				X
29	Rupea	Sub Station			X	
30	Tunnel Homorod Brasov side	GSM-R site + control area+ Tunnel emergency systems		X	X	
31	Site 11b	GSM-R site			X	
32	Site 11c	GSM-R site			X	
33	Tunnel Homorod Sighisoara side	GSM-R site + Tunnel emergency systems		X	X	
34	Site 12	GSM-R site			X	
35	Cata	Station+GSMR site	X	X	X	X
36	Level crossing 242+400	Level crossing 242+400			X	
37	Palos	Stopping point				X
38	Site 14	GSM-R site			X	
39	Beia	Area contoller		X	X	
40	Beia	Stopping point				X
41	Level crossing 247+644	Level crossing 247+644			X	
42	Tunnel Beia Brasov side	GSM-R site+Tunnel emergency ligth		X	X	
43	Tunnel Beia Sighisoara side	GSM-R site			X	
44	Tunnel Archita 1 Brasov side	GSM-R site+Tunnel emergency ligth		X	X	
45	Tunnel Archita 1 Sighisoara side	GSM-R site			X	
46	Tunnel Archita 2 Brasov side	GSM-R site+Tunnel emergency ligth		X	X	
47	Tunnel Archita 2 Sighisoara side	GSM-R site			X	
48	Level crossing 257+110	Level crossing 257+110			X	
49	Archita	Station+GSMR site	X	X	X	X
50	Level crossing 260+770	Level crossing 260+770			X	
51	Feleag	Stopping point				X
52	Site 19	GSM-R site			X	
53	Tunnel Beia Brasov side	GSM-R site+Tunnel emergency ligth		X	X	

54	Tunnel Beia Sighisoara side	GSM-R site			X	
55	Level crossing 267+448	Level crossing 267+448			X	
56	Mureni	Stopping point				X
57	Mureni	Sub Station			X	
58	Site 21	GSM-R site			X	
59	Vanatori	Station+GSMR site	X	X	X	X
60	Level crossing 274+940	Level crossing 274+940			X	
61	Albesti	Station+GSMR site	X	X	X	X
62	Level crossing 279+630	Level crossing 279+630			X	
63	Sighioara	Station+GSMR site	X	X	X	X

Table 1: Planned Peripheral Installations - Line Brasov - Sighisoara

6.4 OPERATION CONTROL CENTRE

OCC is the core of the system and is intended for carrying out all the activities of coordination and supervision within the controlled area.
The reference architecture of the system shall be based on the client – server model, all the critical parts shall be redounded supplemented. A high level of availability and maintainability shall be guaranteed. The equipment shall be widespread on the market.

6.5 CENTRALIZED TRAFFIC CONTROL (CTC) FUNCTIONS

The traffic functions present within **OCC** are mainly intended for providing the instruments for a completely automated management of the railway traffic and for supporting the operators, in critical situations, for conflict detection and resolution.

Starting from timetable data and of the schedule **(imported from IRIS system)**,, from the current status of the trains and installations, from the traffic constraints imposed by the operator and from the adjustment criteria which have been introduced, the system defines a train schedule according to optimization of the traffic within the controlled area, detecting and solving any possible conflicts.
Depending on the defined train schedule, and in the absence of any other indications of the operator, the system automatically sets the train route within the stations, for each controlled train and for the part of the path which has been set as “automatic service”. The system executes its own elaborations according to the information having another origin:

- Data directly collected from remote sites (indications from station and line devices);
- Static databases (configurations, characteristics of the installations, theoretical timetables, etc.);

- Data from the external adjacent systems;
- Operators' interventions.

The result of the elaborations of the system is shown by:

- Direct actions on the site (remote control of the station devices);
- Recording of the significant events (archiving within the mass memories);
- Sending data to the external adjacent systems;
- Presentation of the data to the traffic operators and to other operators.

6.6 PASSENGER INFORMATION FUNCTIONS

The objective of this subsystem consists in providing information to the public in the large/medium stations within the controlled area. Starting from these premises, the architecture of the system assigns to **OCC** the functions of supervision and control, while it allocates to the various **PI** the functions of issuing of the information messages, by local management and control of the devices for viewing and sound broadcasting.

During normal operation, **PIS** elaborates and coordinates the activities which have been assigned to it, in a completely automatic manner, and the operators are called to manage only the exceptional conditions or in case of system failure.
In particular, the main functions which must be carried out are the following:

- Broadcasting within all the stations of sound/visual information referring to the current status of train traffic, by highlighting any possible delays or any situations which are different from those planned in the current seasonal schedule;
- Broadcasting scheduled information, such as danger announcements, and improvised announcements both automatically and directly by the local station operator and by the **OCC** operator**,** using a reserved sound channel;
- Broadcasting information related to emergency situations.

6.7 DIAGNOSTIC AND MAINTENANCE FUNCTIONS

Diagnostic and Maintenance can be further subdivided into the following subsets:

- Diagnostic and Maintenance of the installations, this including all the diagnostic activities, on-line and forecast activities, which concern all the apparatus, devices, systems that exist within the line and/or within the various **PI** and which are the following:
  1. Signalling Installations;
  2. Signalling power supply installation;
  3. Signalling transport network;
  4. Intruder detection and access control installations, fire detection installations for signaling container, OCC and GSM-R shelter;
  5. Climate conditioning installations for signaling container, OCC and GSM-R shelter;

6. Hot axel detector;
7. Emergency light system in tunnel;
8. Heating for turnout

- Diagnostic and Maintenance of the Centralized Control System, that mainly concerns the diagnostic for the electronic apparatus of **CCS** and the software installed on them.

In both cases, **CCS** must provide to the operators the procedures for searching and locating defects, and an operator's guide, as help for the intervention activities in order to correct any inadequate operations.

In **OCC** it shall exist specific work terminals where it shall be able to operate technicians specialized in various types of installations and/or components of the controlled systems.

6.8 VIDEO SURVEILLANCE AND SECURITY SYSTEM FUNCTIONS

The functions that will be carried out in Simera OCC are listed below:

- collect and management images coming from station, power supply substation, level crossing, GSM-R shelter, OCC Building
- collect data and alarms (fire detection/intruder detection from signalling container, power supply substation, GSM-R shelter, OCC Building);
- centralized video recording;
- emergency procedure management for the operator;
- centralized video recording for relevant frame in external support;

7. PERIPHERICAL INSTALLATION

Peripheral Installations are components of the Centralized Control System which are distributed within the territory, and which is connected to **OCC** through the signaling transport network, that carries out the commands coming from the OCC and which gathers and sends to the OCC the data (control and measurement data) about the status of the devices and infrastructures.
In addition to the functionality which is specific to **CCS**, the main requirements which **PI** must comply with are the following:

- High availability, by mean of the redundancy of the devices involved in critical functions;
- Possibility of diagnostic and maintainability of all the installed hardware and software components;
- Modularity.

7.1 TRAFFIC FUNCTIONS

The main role of **PI** for Traffic functions consists in the interface with the station Interlocking.
In particular, **PI** carries out remote commands sent by the OCC, directly interfacing the interlocking and collects the indications which will be processed by the OCC. At local level, **PI** provides Human Machine interfaces which can be used when the station is controlled by local operator.
The activities carried out by **PI** for Traffic are the following:

1. Interface with the station interlocking, mainly for:
   - Acquiring indications
   - Execution of remote commands
2. Human Machine Interface:

Graphic displays (Train Describer Peripheral - TDP)

- Train List
- Messages (formal messages between operators)
- Information Management

3. Interface systems for the management of the train numbers located at boundary stations, i.e. those stations situated at the extremities of the section or the internal branch stations towards lines which are not controlled by **CCS**.

PI can operate in various ways named “Modes”, which establish the relation with the centre referring to the use of the remote control and which can be summarized as follows:

- Unattended and Remotely Controlled station
- Gate Station
- CCS Exclusion

In all cases, anyway it keeps its function of sending the interlocking indications to the Centre.

7.2 DIAGNOSTIC AND MAINTENANCE FUNCTIONS

In **PI** it is carried out the functions of:

- Data collecting;
- Elaborations of diagnostics;
- Self diagnosis for the remote control devices;
- Execution of possible remote controls;
- Help for the maintenance activity.

Data collecting:

Through an interface compatible with the various systems and installations which must be monitored, **PI** obtains the states and/or measures that will be used at the upper level of **OCC** for the elaborations for the purpose of diagnosis, archiving and chronological recording of the events.

Diagnostic elaborations:

The states and measures obtained from the installations are processed according to some specific algorithms capable to establish the operational status of these installations and to generate adequate alarms if any anomalies are detected.

Self diagnosis:

All the hardware and software components of **CCS** must be monitored in real time in order to urgently detect any possible anomalies that might affect its functions.

Remote controls:

The peripheral installations must be controlled directly from **OCC**.

Support for maintenance:

A proper terminal at the **PI** shall supply diagnostic information, in alphanumeric or graphic format, which can be used by the maintenance technicians for their activities of searching and locating of defects, and for the execution of reparation interventions.

7.3 PASSENGER INFORMATION SYSTEM FUNCTIONS

The Passenger Information Functions carried out by **PI** are the following:

- Generating and issuing pre-recorded automatic sound messages, with the execution of the commands from **OCC** or from the local operator;
- Generating and issuing messages to the monitor, boards with blades or display, with the execution of the commands from **OCC** or from the local operator;

- Management of External devices;
- Generating self diagnosis and status signaling.

7.4 VIDEO SURVEILLANCE AND SECURITY SYSTEM FUNCTIONS

Video surveillance and security plant must be structured in order to realize the following functions, using standard products:

- Collect images from camera installed in critical areas in the station (platform, underpass, waiting room, etc)
- collect and images coming from signalling container, power supply substation, level crossing, GSM-R shelter, OCC Building
- In case of alarm the system must show the automatically the video camera related to the alarmed area;
- Recording image in peripheral server for at least 7 days.
- Sent to OCC the image requested from the OCC operators;
- Remote control from OCC of peripheral recording system to get the image recorded in peripheral server using search criteria related to specific alarm event or specific time interval
- Collecting of any alarm related to intruder detection and fire detection system in order to be sent to the OCC operators

8. ORGANIZATIONAL MODEL

The functional model considered for **CCS** aims at concentrating in **Brasov OCC** all the activities of coordination and traffic regulation, the remote control of each interlocking, the maintenance management and the public information and video security control service.
As regards the train Traffic, as long as a station is attended by the Local IDM, it shall not be remotely controlled.
The communications between the operators at the remote sites, such as Local IDMs, the personnel of the Maintenance Teams, the personnel of the trains, are carried out through GSM-R terminals, video terminals, etc.
Passenger information, under the form of sound and graphic variables, is automatically managed by the system, which must anyway allow the introduction of unplanned textual announcements or communications, by the operators in charge of it, both central and local operators.
The structure of the **CCS** must be adapted to the various possible operating modes of the line. These are as follows:

- The centralized mode;
- The local mode;

8.1 CENTRALIZED MODE

This is the normal mode. The system receive signals from the line, generate processing operations and send the required commands.
The main functions performed by the automation systems are:

- Traffic management;
- Maintenance assistance;
- Passenger and information;
- Video surveillance and security control.

Man intervention is reduced to the minimum. The operating personnel stand by to manage any anomaly.

8.2 LOCAL MODE

The CCS system is controlled by local operators, any command sent from OCC will not have any effect on the peripheral equipments.
The central operators will receive the status of each peripheral installation.
The management is ensured in the terminal of the operating room of the peripheral station.
The operators can communicate with the drivers using GSM-R.

In case of CTC System, it'll be provide also a **mixed mode** and the detail regarding on how this modality are described in doc [REF3]

8.3 OPERATION CONTROL CENTRE ORGANIZATION

OCC organization is aimed at concentrating, within the centre, all the activities of coordination and control of the operation of the railway system, and therefore such organization must provide for the centre all the services which are necessary for its efficient operation.

The OCC operators will located in specific rooms according to the following organization:

Control Room

Traffic management and infrastructure supervision in real time are carried out in the Control Room.

The operators foreseen in Control Room are:

1. *Central IDM:* Responsible for the command and control of each stations. The authority of the sections managed by each traffic operator (central IDM) will have to be able to be dynamically and with maximum flexibility assigned, in order to allow the optimal use of the resources, and this means that under abnormal circumstances or in cases when the traffic is especially disturbed, it must be possible to adequately dimension the authority section, so that the operator can focus on the management of the problem that occurred. On the contrary, during the hours with low traffic it must be possible to "extend" the controlled section, in order to reduce the number of necessary operators.

2. *Traffic Coordinator:* with functions of regulation, who coordinates, and has the power of decision, all the concerned activities in real time, including the management of the traffic provisions and of infrastructure maintenance interventions.

3. *Diagnostic Coordinator:* for diagnostic activities it shall also stay an operator responsible for the coordination of infrastructure interventions, both in case of defect and during normal maintenance, for diagnostic and maintenance activities this operator will be supported by other diagnostic operators located in the "Diagnostic Room" , and they are also in charge of the maintenance of HW and SW within CCS.

4. *Public information operator:* responsible for the management of the acoustic and visual announcement for all the stations controlled by the Brasov OCC

5. *Power supply dispatcher:* Responsible for the management of power supply substation, sectioning post, sub sectioning post, and other

disconnector/switch for contact line. This Power supply dispatched will be foreseen by the contractor of power supply and contact line.

The various terminals within the Control Room must be placed so that they support as much as possible, from an ergonomic point of view, the relations between various operators. The various terminals must be sufficiently protected from an acoustic point of view, against any possible disturbances from the adjacent terminals.

Diagnostic Room

The diagnostic operators, supporting the D&M Coordinator (DMC), shall be placed in special rooms, outside the Control Room, but however allowing the exchange of information with DMC.

The diagnostic and maintenance of each specific system (peripheral and central) will be managed in Diagnostic room where a will be located the general diagnostic operators and the specific diagnostic console for all the main system:

- RBC diagnostic console
- BSS diagnostic console (OMC-R)
- Network manager for IP/MPLS Transport network
- Remote diagnostic console for Interlocking
- Etc.

Video Surveillance and Security Room

The video surveillance and security activities for each station and other relevant peripheral installation will be carried out in a specific room equipped with one console and a certain number of monitors for the visualization of the video, in the same room will be located also the console for the building automation of the OCC, in detail this desk will be equipped with console for the management of Brasov OCC fire detection, Intruder detection, control access, video surveillance and air conditioning.

Crisis Room

The crisis room is special meeting room equipped with monitor that show the traffic situation in real-time for all the sections controlled by this OCC, in order to facilitate the decision management in special critical situation

Training Room

it must be provided a room adequately equipped for the training of the traffic personnel, with work terminals able to reproduce, by simulation, significant traffic cases.

Other office

For the traffic chef and for the maintenance chef will be foreseen two office equipped with standard PC, printer and other standard facility.

9. HUMAN MACHINE INTERFACE FOR CCS OPERATORS IN OCC

The operator terminals within **OCC** must be equipped with TFT/LCD monitors with dimensions which must not be lower than 21", which can be used for the normal interface operations, and two or several TFT/LCD monitors of high dimensions, which must not be lower than 46" which, placed side by side, shall form an adequate viewing screen.
For completion, within the terminals there is a printer, a keyboard and a mouse and a telephone console equipped with a touch screen monitor and a micro-telephone/headset.
Each terminal shall have the displays referring to a set of functions dedicated to the specific role of the operator for whom they are meant.
The positioning of the components and equipment must provide to the operator an easy access to them, without losing the control upon the current situation.
The positioning of the equipment on the work layout must comply with the criterion of «priority of use», favouring the proximity and the access to the equipment according to a decreasing order of the frequency of use.
It must be reduced to minimum the necessary moves of the operator in order to get to the devices supplied and to the visual consultation of each video terminal within his/her competence.
The common functions, which all the terminals must be able to perform, are the following:

- alarm management;
- electronic mail;
- access to the documentary units;
- help operator functions;
- generic functions for the management of the operator interface within the terminal.

In the next figure it is represented the typical architecture of a work terminal

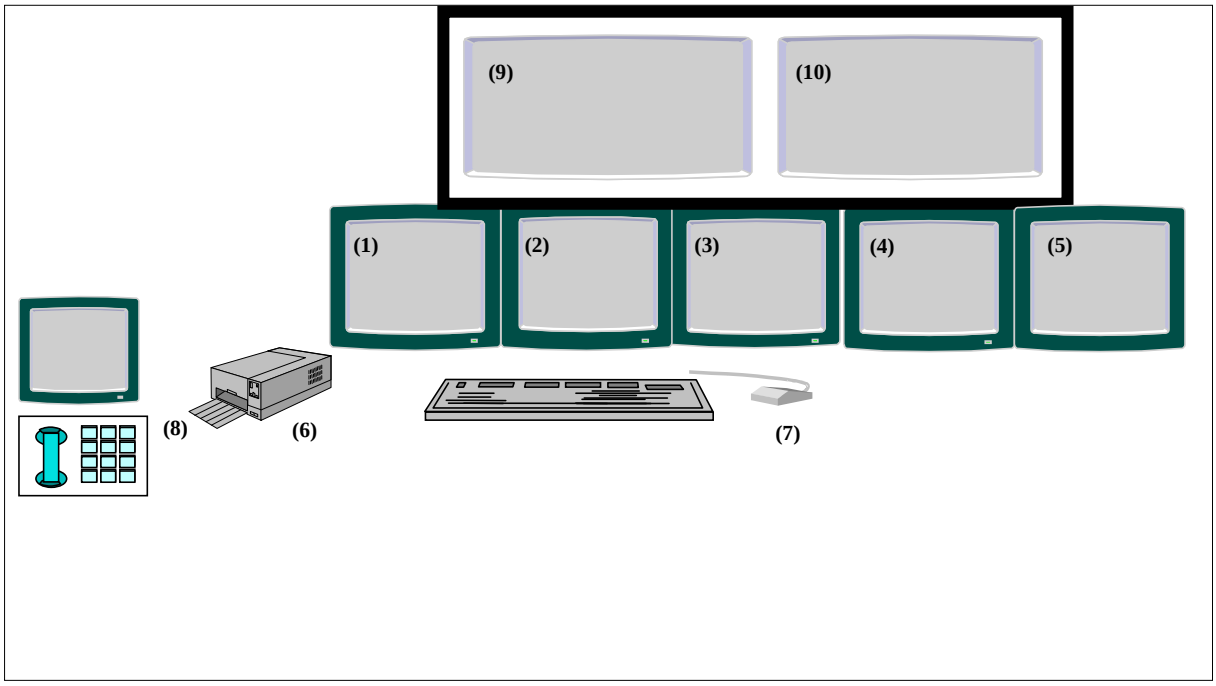

Fig. 3: Example of terminal configuration

Legend:

Reference	Description
1,2, 3, 4, 5	TFT/LCD video of minimum 21” for the operator interface.
6	Office printer
7	Keyboard and mouse
8	Telephone terminal (touch screen interface and micro-telephone/headset)
8, 9	TFT/LCD video of minimum 46” of high dimensions which placed side by side, shall form an adequate viewing screen.

The typology of the operator’s table will have to stipulate, as it is shown in the previous figure, the presence of TFT/LCD screens of high dimensions, of minimum 46”, placed in a row, TFT/LCD monitors of minimum 21” placed in a frontally tilted position against the supporting plane.

9.1 CTC OPERATORS TERMINAL

The CTC operators in OCC will be two type: Central IDM and Traffic Coordinator. Each terminal for the CTC operator must be equipped with a system software and with application software procedures, which are necessary for being able to perform, based on the data acquired from the server computers, the data manually entered by the operator and the data acquired from the coupled systems, all the functions stipulated for the specific operations.

9.1.1 CENTRAL IDM TERMINAL

Central IDM terminal will be a combination of two systems: RBC and CTC.
RBC system will have:

- The high dimension TFT/LCD monitor for ERTMS synoptic representation
- One normal dimension TFT/LCD monitor for ERTMS command interface (speed restriction, emergency stop)

CTC system will have:

- Four normal dimension TFT/LCD monitor for the CTC functions:
  1. Train Describer (Current Train Position);
  2. Train Graph;
  3. Train Route Selection;
  4. Station Symbolic Panel;
  5. Dynamic planning and positioning in the station
  6. Data label (under the form of chart);
  7. Dialogue windows for data entry or for consulting the available information;
  8. A proper interface to transmit formal Messages between operators.

CTC visualizations and functions are described in next paragraphs, RBC visualizations and functions are described in the: “ERTMS level 2 Functional specification”

9.1.2 TRAFFIC COORDINATOR TERMINAL

Traffic Coordinator terminal LCD/TFT monitors with high dimensions must be used for the summarized displays the entire area where he have function of “Coordinator”, in order to indicate the position of the trains in real time (Train Describer Function), and also for viewing the routes which the system assigns to the trains (Itinerary Selection Function).
On the monitors it shall be normally displayed:

- Train Graph (inclusive the timetable for the next minimum 10 hours);
- Station Symbolic Panel;
- Dialogue windows for data entry or for consulting the available information;
- A proper interface to transmit formal Messages between operators.

On the high dimensions monitor it must be able to be displayed, without the need of a scroll-bar, the Train Describer including the entire jurisdiction area of the system or, alternatively, the Train Route Selection, also this one representing the entire area.

9.2 DIAGNOSTIC AND MAINTENANCE OPERATOR TERMINALS

The Diagnostic and Maintenance Coordinator, with this terminal shall be able:

- To carry out the Command and Control of the peripheral installations for signaling power supply, container conditioning system, fire detection and intruder detection , etc.

- To carry out the supervision and monitoring of the status of the installations, including those of signalling, the control of the normal execution of the maintenance works, scheduled or unexpected, that refer to the lines managed by CCS;

- To manage the alarms notified by the system, by starting the interventions which are necessary for re-establishing normality. Identifying the defect that caused the disturbance.

Other terminals used by Diagnostic Operators, for supporting the Maintenance:

These operators collaborate with the DMC for monitoring the status of the infrastructures, managing the alarms, even those of forecast type, sent by the System

The graphical displays and the functions managed by this terminal must be:

- Synoptic representation of the managed installations, with
- the function of chronological recording of the vents;
- defect management;
- Messaging;
- Management of the installation diagnostic (Power supply equipment, Fire detection, Intruder detection, Signalling system, Climate conditioning and various components of the command and control system)
- management, preservation and updating of the technical software documentation of the system;
- management of all the SW configurations of CCS system;
- management, preservation and updating of the technical hardware documentation of CCS system;

9.3 PASSENGER INFORMATION OPERATOR TERMINAL

The system must have a completely automated operation, with the role of broadcasting the information to the passengers, consisting in sound announcements and visual information displayed on a monitor or displays.
The terminal will be equipped with :
One or several LCD/TFT monitors with dimensions of minimum 21", on which it shall be displayed

1. Detailed PIS information;
2. Data labels (under the form of a chart);
3. Archives for sound recording and visual information for the public;
4. Legends for the information for the Passenger

- LCD/TFT monitor with high dimensions that must not be lower than 46 " to display:
  1. Train Describer , only for reading;
  2. Train Graph , only for reading;
  3. General PIS synoptic;

from which the operator obtains immediate information referring to the position of all the trains, especially in case of disturbance or in case of traffic which is especially disturbed
The General PIS synoptic must indicate the operating status of the peripheral installation.

9.4 VIDEO SURVEILLANCE AND SECURITY TERMINALS OPERATORS

The video surveillance and security operator terminal will be composed by a console with:

- at least two LCD/TFT colour monitors 21", keyboard and mouse in order to manage the system functions
- one or more LCD/TFT monitor with dimension at leas 46", that will be used to show a certain number of video images, in cyclic sequences, coming from peripheral cameras and OCC cameras

The operator terminal interface must have a synoptic representation of the line and a user friendly interface, that will permit the easy management of the systems functions and configuration:

- selection of the video cameras to show in the main monitor
- modify the number and the dimension of each image in the main monitor
- modify cyclic sequences
- detect the peripheral installation in alarm
- alarms management (acknowledge, search, list, etc)
- show the recorded image
- activate or deactivate the antitrusion system

10. HUMAN MACHINE INTERFACE FOR CCS OPERATORS IN PERIPHERAL INSTALLATION

10.1 TRAFFIC OPERATOR IDM WITHIN STATIONS

This terminal is used by the Local IDM, who supervises the Station either in the mode of Gate Station, or in Local Mode.
The Local IDM regulates the traffic within his station, in accordance with the indications of the Traffic Coordinator and he is in charge of safety. This terminal is formed of a monitor on which it is displayed the station and its lines, and the position of the trains in real time (Peripheral Train Describer Function).

10.2 DIAGNOSTIC AND MAINTENANCE OPERATOR TERMINALS WITHIN STATIONS

The terminal will be used by the local diagnostic operator and it will have the same functions and visualizations foreseen for the central diagnostic operator but restricted at the station where the terminal is installed.

10.3 PASSENGER INFORMATION TERMINAL WITHIN STATIONS

Within large stations, it shall exist an operator in charge of informing the public, with tasks which are similar to those of the responsible operator from the Central Terminal, but with an authority which is limited to the station where he/she works.
The terminal shall be equipped with an interface that gathers the data from OCC for the management of the installation for local public information.
Within medium/small stations, permanently or temporarily attended, this function can be assigned to the Local Terminal Operator, who shall have a terminal with integrated interface.

11. CENTRALIZED TRAFFIC CONTROL FUNCTIONS

11.1 OBJECTIVES AND FUNCTIONS

Within the train traffic, the system provides:

- The timetable for the next minimum 10 hours;
- Automatic route setting at the adequate moment and also allowing direct remote control of the station interlocking by the operator;
- Traffic regulation, intervening according to the requirements and in real time for re-scheduling of the train schedule, so that any possible traffic conflicts should be solved, based on its own strategies or in compliance with the operator's indications and constraints;
- Supplying information on current traffic status and train position in real time to the operators, controlling the status of the devices, identifying the trains;
- It allows the exchange of information between operators;

Starting from the data of the theoretical timetable and of the schedule, (imported from IRIS) from the current position of the trains, the status of the infrastructure, and from the traffic selections and constraints defined by the operator, the system elaborates a train schedule which shall regulate the traffic within the controlled area, thus solving any possible conflicts.
Depending on the elaborated train schedule, and in the absence of any other indication from the operator, the system automatically sets the routes, in the various **PI**, for each controlled train,
The Traffic functions can be classified in:

- Centralized Traffic Control functions (command and control, monitoring of train schedule);
- Regulation functions (traffic forecast, conflict detection and resolution management of critical aspects);
- Messaging functions (management of messages between operators).

11.2 COMMAND AND CONTROL FUNCTIONS

The system must carry out typical activities of Centralized Traffic Control, such as:

- continuous detection, and in real time, of the status of the physical al logical devices of the station and of the line (remote control management);
- remote control of the physical and logical devices of the installation (remote control management).

The control function allows the continuous monitoring of the train schedule and of the status of the infrastructures by gathering and processing the data from various installations through the station interlocking. The peripheral device status elaboration allows the operator to obtain, by graphic displays and alarms, the «on-line photo» of the real situation regarding the train position.

The remote control function allows, automatically or by the intervention of the operator, the management of train traffic both in normal operating situations and in cases of disturbance.

The command and control functions are executed together by **PI** and by **OCC**.
CTC PI are direct connected with **Interlocking** for sending the commands from **CTC in OCC** and to receive the status of each device controlled by interlocking.
The CTC in OCC must:

- obtain the control of the device from **PI** and process them;
- forward to **PI** the command for interlooking.

11.2.1 Remote control Management

The remote control from OCC, must allow:

- Viewing the status of all the devices within the controlled stations and lines;
- Monitoring the train position;
- Checking the feasibility of the commands;
- Activating the alarms which highlight traffic disturbances and general service disturbances;
- Activating the alarms referring to defects within peripheral installations.

The system will have to perform the determinations necessary for the interpretation of the control and to determine the status of the devices to which it shall associate the symbols for viewing.
If, by processing the remote indications, the system finds an inadequate operation of one or several devices of an installation (for example the indication that a switch or a signal is in an undetermined position or any other disturbance which might prevent the route setting), then it must send the operator an alarm.

11.2.2 Remote Control Management

The commands sent to the installation could be derived from:

- Actions based on the operator's decisions;
- Actions planned by the theoretical timetable;
- Actions based on the new schedule defined by the system.

For the actions decided by the operator, the remote controls shall be sent "manually" while in the other cases, the remote controls shall be automatically sent by the system, for the purpose of adjusting the traffic within the controlled area, depending on the actions planned in the theoretical timetable or depending on the further rescheduling of the train schedule, after the settlement of possible conflicts.
For each command concerning the route set by the operator or automatically sent by the system, must be done a preventive feasibility verification.

In fact, before sending a command to CTC in **PI**, CTC in **OCC** checks if this command can be performed, depending on the current status of the installation, in

order to prevent the sending to the devices of some commands which cannot be executed (because the safety conditions are not met).
If a certain command cannot be performed, the system must send an alarm to the operator.

11.2.3 Manual command

The station devices will be able to be controlled by Central IDM by remote control, through the « Symbolic Panel» or some of these even through «Train Describer»
After the entry of the command by the operator, the system must immediately send it towards the peripheral equipment.

11.2.4 Train Position Monitoring Function

The system must determine the position of each train which is present within the controlled area.
In particular, the system must associate the identification number of each train within its origin station or upon entering the controlled area and it must process the inherent data necessary for moving the train along the controlled section.
In order to calculate the moving of the train, the system must comply with the following restrictions:

- The occupying of the section situated downstream the train position must cause the advance of train symbol an train describer along the section block which is being occupied,
- The occupying of the itinerary must cause the advance of train symbol along the block section or along the station tracks situated downstream the route,
- The release of the block section on which the train is situated must cause the advance of train symbol along the next automatic blocking section.

It will have to be foreseen all movement cases (from left side to right side, from right side to right side, from left side to right side and vice versa), both in the presence and in the absence of the equipment which allows the traffic in both directions on a certain line.
The identification of the trains shall be performed by:

- Obtaining the automatic identification from any possible adjacent systems;
- Manual entry performed by the Local IDM
- Manual entry performed by Central IDM

In case of insufficient information, the operator will have to be alerted, for manual identification.

11.2.5 Route Automatic predisposition

According to the train schedule, the system must give the automatic commands necessary for determining the planned route for trains (route commands, block inversion, granting approvals, etc.).

In other words, the system automatically sends commands to the trains for which the movement has been scheduled, for the parts of their path which concern the stations which are in automatic mode.
The activation of automatic remote control for a part of the train path can be performed by the system based on the train schedule which has been established in case of regulation or manually determined by the operator.
The effective sending of the automatic commands to the **PI** concerned shall be performed when the train reaches the pre-determined points of the line, in order to don't introduce speed restriction for the train.
Each automatic command which has been sent must be recorded, associating it to the information referring to the train for which that command has been given.

11.3 REGULARIZATION

The system will have to allow traffic management within its authority area so that it should reduce to minimum train delays and so that it should guarantee the continuity of the service in case of disturbance.
The regulation shall be based on the elaboration of traffic forecasts, starting from the data on train position and on infrastructure status, obtained in real time and from the railway operational programs.

Train schedule forecast allows detection of any possible conflicts; the system must solve the conflict based on the criteria which reduce to minimum the sum of the delays of the involved trains, weighted by train priority.
Two or several trains create a circulation conflict when they must use simultaneously the same resource of the infrastructure (stopping/parking, route or a part of it, line block section).
It can be defined the following conflicts:

- conflicts for the interference in the same direction or in the opposite direction (regarding the traffic on the line).
- intersection conflicts (intersection conflicts regarding the traffic nearby the junctions and within the station).

The system must highlight all the detected conflicts and it must provide to the operator decision support tools to solve them. Traffic coordinator or Central IDM will be able to modify the traffic selections indicated by the system for the settlement of the conflicts.
The system must elaborate, according to the established rules, the best solution for traffic conflicts, considering the selections performed directly by the operator and it must elaborate a train schedule forecast within the controlled area.

11.3.1 **Forecast for train running**

The system will have to foresee the traffic situation, starting from the current traffic conditions.
The result of the determinations which have been performed shall be used for:

- Displaying on a space-time cartesian graph of the train current and past movement between the stations, and the traffic forecast (TRAIN GRAPH);
- Display the scheduled sequence of ingoing and outgoing trains for each station (TRAIN LIST);
- Highlighting on geographical representation of the path planned for each train (on the line section and within the station), indicating the trains with which it shall be in conflict (TRAIN ROUTE SELECTION);
- Updating the times foreseen for the arrival of the trains in the stations or stops, for the purpose of passenger information;

Anyway, the main purpose of the elaboration of the traffic forecast consists in detecting the interferences between the trains circulating in the same direction or in opposite direction, on that line, nearby junctions or within the stations.

In order to perform the regulation of the train traffic within the stations, the system must settle the intersection conflicts generated both by the real traffic situation and by the selections of the places where the line conflicts shall be solved, managing in real time the station tracks. Depending on the train schedule forecast referring to the arriving trains or to the departing trains, the system must calculate the time starting from which it must be available the track and the involved arrival, departure and/or transit route.
If the considered route and/or the station track are not available, the system must choose or propose, if there are alternative solutions. In particular, as regards station tracks, the selection of the system will have to take into account its compliance with the characteristics of the train which will arrive (composition, length, service to be performed, etc.).

11.3.2 Conflict Presentation and solving

Upon operator's request, the system will have to show a list of the foreseen conflicts.
For each conflict, the system will have to provide the following data:

- Identification Number of involved trains;
- Indicating the «successful» train and the «unsuccessful» train;
- The place where the system detects the conflict (intersection conflict) or the place found for settling the conflict;
- The place indicated in the timetable for the settlement of the conflict;
- Train delays based on the performed selections;
- The author of the selection (**System, Central IDM, Traffic Coordinator**).

The indication of «successful» train and «unsuccessful» train shall be carried out according to train priority.
The operator must be able to simulate various forecast scenarios, in order to be able to adopt the solution (understood as all the traffic selections) which he/she considers as being the best, starting from the indications of the system.
The system shall also display in real time, after the selection entered by the operator, any possible additional indications, referring, for example, to the

availability of a platform in case of housing of a passenger train with stop, and its length depending on the train composition.
After the settlement of a conflict by the system or by the operator, the system will have to update the schedule (and sometimes the path) referring to the concerned trains on the train graph and the indications regarding the delay forecasts.
In any case, the system will have to regulate the traffic by settling the conflicts automatically and so that it can achieve the objectives of regulation of all the circulating trains. For this purpose, the system shall use the dynamic priority of the trains and the generated rules starting from the history archive of the traffic conflicts and from the further assessments of the adopted solutions.

11.3.3 Management of Critical Situation

Critical Situation management» means that the system can manage an event (current or foreseen) which is critical for the traffic, which involves, in general, the suspension of the automations and the sending of alarm messages to the concerned operators. The «critical» event can be detected or foreseen by the system or the data can be entered by any operator.

11.3.4 Unavailability of Signalling Devices

The unavailability of the devices affects the activities which are automatically managed by the system, such as traffic forecast and automatic route setting.
So, the system must elaborate the data referring to the availability of the devices, in order to determine the availability of line sections or station sections and of the routes and in order to be able to perform both a correct forecast on the future train schedule and the automatic route setting.

In detail, the system declares as being unavailable those devices affected by an circulation interruption, either accidental interruption, service interruption, planned interruption or an interruption caused by a « fault», caused by a disturbance of one or both lines of a line with double direction or of a single line, or of a generic line within the station. The unavailability of the devices is considered as such by the system after an action of the operator (entry of an interruption or of a fault.
The entry of an accidental interruption must be immediately executed and must cause the suspension of the automatic processes for the trains directed towards the interrupted areas.

11.3.5 Management of Disturbances

By traffic disturbance it is understood any accidental or unforeseen event that affects the regularity of the train schedule.
Disturbances, from the point of view of their type, can be classified as follows: infrastructure defects, rolling stock defects, accidents (derailment, collisions, etc.).

OCC operator or even the Local IDM within the station shall be able to enter a «Disturbance», in order to notify to the various operators the presence of a disturbance.
The disturbance can be entered starting from the data of a defect alarm, or of an alarm received after a defect declaration performed by an Diagnostic and Maintenance operator.
After entering a disturbance, the system must automatically send a message to the concerned terminals, identifying the terminal which has access to the detailed data.

11.4 MANAGEMENT OF MESSAGES

The communications between the operators from Traffic and those from Maintenance are of two types:

- Informal

The informal communications are exchanged between all the operators by means of an electronic mail standard service, provided by the system.

- Formal.

The formal communications between the operators from Traffic or between the operators from Traffic and those from Diagnostic, are exchanged by recorded communications consisting of the date and time of transmittal/receiving, issuer (terminal), recipient, contents of that message and an unequivocal and centralized protocol number.
The operator who has received a message is announced by a specific alarm; when the alarm is identified, the system will view the message and it shall generate a control number, which is sent to the sender, with the role of acknowledgement.
Within the messaging service, an operator shall be able:

- To view the messages list,
- To view and print each message which has been sent/received,
- To acknowledge the receiving of the messages which were sent to him/her (if it is required an acknowledgement procedure),
- To transmit messages,
- To send messages.

11.5 MANAGEMENT OF DISPATCHES

The system must manage, for each terminal:

- The name of the operator who, on the basis of the system recording (login) is on duty;
- An adequate field where it can be entered some free text, filled in by the operator who ends his/her work programme and addressed to the operator who replaces him/her, by indicating the special situations which cannot be seen form viewings or from the consultation of the informative charts.

For each terminal, upon the opening of each work session, the system must display for the replacement operator the field containing the messages written by the operator who ended his/her work programme.
Upon the closing of each work session and for each terminal, the system must record, archive and keep for a period (which shall be determined) the messages written for the replacement operator.

11.6 OPERATIONAL MODE FOR CTC FUNCIONS

The operational mode for CTC functions refer to:

- The remote control mode for **PI**;
- Operational conditions of the Regularization;
- The service allocation mode .

11.6.1 The remote control mode for Positions Installations

The remote control mode for control for each **PI** can be automatic or manual.
The normal method is that of «automatic remote control», when the system automatically sends the commands specified for regulation, excepting some possible suspensions of the service.
In case of disturbances, each **PI** will be able to be set in the mode of «manual remote control»: in this configuration, the control of the PI is carried on manually by the operator instead of the system.

11.6.2 Operational Conditions of Regulation

The Regulation Function, as regards its overall activity, for the purpose of defining the train schedule, by detection and solving possible conflicts, shall be set in one of the following operational modes:

- Automatic,
- Manual,

The «automatic Regulation » is normal mode.
If the Regulation is automatic, the train schedule elaborated by the system (which takes into account both the traffic selections performed by the system itself and those set by the operator) is carried out directly, without being required any acknowledgement, excepting the cases of directing on an alternative and parallel route and which, having strong consequences upon the traffic, shall always be approved by the operator.
If the system finds some conflicts which cannot be settled by the use of the stipulated rules or whose settlement does not allow the achievement of the established quality objectives, it must inform the operator and it must show the conflict as being unsettled. Anyway, the system must records the traffic selections which have been carried out under the form of settled conflicts.

Even in the case of the automatic regulation, the operator must be able to determine the selections which he/she considers as being adequate, and which shall become constraints to be considered by the system.

In the mode of «manual Regulation» the system does not elaborate any alternative, but it is limited to executing the indications of the theoretical timetable, possibly modified by the operator. In manual mode, the operator, if he/she considers it as being necessary, must determine alternative routes/paths and stops and he/she must define the localities where the conflicts shall be settled eventually. The regulation continues to produce forecasts but, in order for these to be correct, it is necessary that the operator should settle all the conflicts.

11.7 INTERFACE WITH OTHER SYSTEM

The CTC system must be interfaced with other subsystem in order to receive alarm that will not have effect on the system:

- *Diagnostic and Maintenance system:* CTC will receive from D&M critical alarms that could modify the traffic regularity
- *Hot Axel Detector:* The CTC will receive from Hot axel detector all the alarms concerning the train measurements

11.8 OPERATIONAL PRINCIPLES

Under normal operation circumstances, in the absence of any defects or of any special severity disturbances, the operator can see the performance of the traffic by means of his/her own interfaces, without being asked to carry out any intervention. When a disturbance occurs, the system must autonomously react: the operator continues to limit himself/herself to noting and assessing the corrections of the system. Only in case of some special disturbances, which could be resolved by interventions against highly relevant consequences, the system will be able to request an acknowledgement from the operator.
If, on the basis of the information which is unknown to the system, the operator assesses the solutions determined as being insufficiently adequate, then he/she can enforce upon the system some selections, and such selections must continue to ensure the automatic performance of the traffic, by adapting its own strategies to the operator's indications.
Any possible modifications of the current operation programme, communicated by the external systems or by the operator, are acquired and fulfilled in a completely automatic way.
In any case if, for any reason, the operator would like to check the solutions of the system, before their execution, he/she can enforce some operational methods on the condition that they are acknowledged by him/her or he/she can enforce some suspensions in certain points of the line.

Finally, the operator is allowed to have direct control upon some functions for all the line or for a part of the line, for example by remotely controlling directly a station, giving the system the task of continuing to automatically manage the remaining part.
The interventions of the operator, after finishing a feasibility verification, are accepted unconditionally by the system.

11.8.1 Methods of awarding of the Service

The method of awarding of the service determines which is the condition for providing services for the trains which are «taken» by the system.
The award of the service can be put in one of the following operational modes:

- Automatic award of the service,
- Manual award of the service.

If the method of awarding of the service is automatic, the system allocates the service on all the line to each train which is «taken» by the system.
If the method of awarding of the service is manual, the system suspends the service on all the line for each train which is «taken» by the system.

A train will have to be «taken» by the system a certain period before it enters the controlled area, and such period must be sufficient in order to avoid the delay condition, if the service can be automatically awarded.

12. PASSENGER INFORMATION SYSTEM FUNCTIONS

The main objective of public information functions is that of improving the information service offered to the clients.
Normally, the system must operate in a completely automatic way; this means that the operator within **OCC** (or, possibly, the local operator) must manage only the exceptions and the cases of severe functional deterioration.
The system must manage the broadcasting of the information to the public in all stations, either attended or not attended stations, including within the area which is controlled by CCS, for all the trains scheduled for traffic.
In particular, it must be provided acoustic information, transmitted through a public address system, and through a visual broadcasting system, supplied through specific viewing peripheral terminals (for example, remote indicators and monitors).
The local management of each installation for broadcasting of sound and visual announcements shall be carried out at **PIs** level which are installed in each controlled station, while at **OCC** level the system shall perform its basic functions.
OCC and **PI** communicate through Telecommunication network.

12.1 TIME WINDOW GENERATION

Starting from the data base of the theoretical timetable and from the traffic “day plan” the system will have to take into consideration, for each station, a «time window» including, for each scheduled train, the necessary data for the viewing devices and to allow to pre-arrangement of the sound messages. For example, for each locality and for each train, it must be calculated the origin, destination, arrival and departure times, the line where they are received, the scheduled stops and the connection trains.
This window must have a configurable time duration.
It must be provided adequate mechanisms in order to avoid that, because of any time unavailability, the situation of a train situated upstream from the current position of the concerned train is not updated (with the effect of continuing to view, on the peripheral parts of **PIS,** the data referring to the trains which have already arrived in the next localities). For example, a train which has arrived, or it is in transit, or is just leaving or it has already left towards a certain locality, must be put into a coherent situation in all the localities situated upstream according to the path of this train.

12.2 SENDING THE DATA TO THE PERIPHERAL INSTALLATIONS

OCC must send to the stations the data of the timetable and the data for train scheduling, taking into account the dimension of the «time window», which

determines by what advance, against the train schedule, it must be supplied that information to the public.
The transfer of the timetable data must be organized so that **OCC** can send the complete data of the trains circulating within the authority area, within a certain time interval (for example, 6 hours) and afterwards it can send to the stations the modifications of the traffic events.
The data for train scheduling consists mainly in: the estimation and cause of the delay upon arrival and departure; the line reserved by **CCS** within the regulation of the traffic, which can coincide or not with the scheduled track or with the track of effective receiving; the allocated track, identified according to the actual ingoing route or the actual track for receiving the train.
OCC must send to the concerned stations the data necessary for issuing announcements for the connection trains and for controlling the issuance of unplanned messages.

12.3 OPERATOR INTERVENTIONS

The operator within **OCC** must be able to carry out all the interventions which are possible for the operator within the Station and also he/she can:

- Allocate or modify a delay cause (valid for the purpose of informing the public);
- Modify the data referring to the composition of a train, by the share referring to the information which shall be broadcast;
- View all the data on the composition of a train;
- Modify the general data of the train (origin, destination, etc.).

After the modifications performed by the operator, the system must update the data base and it must align the entire system (for example, it must re-elaborate the train situation or it must update the views).
The operator within **OCC** has the possibility of sending unplanned announcements to various stations, either by ordering the broadcasting of improvised announcements by broadcasting through the data channel, or by broadcasting announcements though direct sound systems, by the microphone on the consoles and through the data transmission network.
The operator must be able to control the broadcasting of unplanned messages (both those which are automatically broadcast and those which are sent through direct sound systems) to several stations simultaneously.
By using the same direct sound channel provided for direct broadcasting, the operator within **OCC** must be able to listen (live) to what it is broadcast at the peripheral terminals.
The operator within **OCC** can control the viewing of the unplanned messages, and the same command of viewing of the unplanned messages must be able to be sent to several stations simultaneously.

12.4 OPERATIONAL MODES

The operational modes of a train refer to the methods of operation of the peripheral components.
The operator shall be able to force or even to suspend the automatic broadcasting of the sound announcements and the display of data on the peripheral viewing devices for each train, by direct intervention.
In particular, each train can be set in the «manual» mode, understanding by this that the sound announcements are broadcast and the information is viewed on those peripheral devices within the station, only manually, by the operator.
The management of the sound and visual announcements must normally be automatic, that means that the operational status of a train is updated by the system according to its movements received from CTC system, and the operator has the possibility of intervening at any moment.
The operational mode for a train, referring to the management of its «operational statuses», is communicated to each **PI** and it can be modified by the operator.
If a **PI** is managed by the local operator, he/she will have to determine for which of the trains it shall operate in the manual mode.
The viewing peripheral devices can be «put out of service» one by one.
The operator interface for setting the operation mode for the peripheral devices must offer the possibility of selecting a certain station out of all stations, and also of selecting each individual peripheral device within a station.
When a peripheral device is «put out of service» by the operator, the system must suspend the transmission of the data.
Also, in the absence of receiving of any data, after a certain time-out interval, the peripheral device must automatically be put in the status of out of service.
The status of «out of service» of the peripheral viewing device must be indicated to the operator by displaying the text «Peripheral device put out of service».

13. DIAGNOSTIC AND MAINTENANCE MANAGEMENT SYSTEM FUNCTIONS

Diagnostic and Maintenance Functions are intended for providing a significant support in detecting, searching and locating failures and disturbances which occurred both at railway installations and at the hardware and software components of **CCS** system and in the activities which follow after reparation.
For the purpose of complying with the requirement of getting a satisfactory capacity regarding data gathering which is oriented towards the detection and location of the defect and for intervention planning. Finally, in order to minimize, in case of the maintenance intervention, any negative impacts on the traffic, the Diagnostic and Maintenance functions shall be distributed on two levels:

- Station **(PI)**,
- Operation Control Centre (**OCC**).

The function allocated to **PI** (Station) are the following:

- Acquiring data from installations;
- Updating the local data structures and sending the data to **OCC**;
- Elaboration of the forecast diagnostic;
- Indicating any existing or imminent inadequate operations, to **OCC**;
- Help for the maintenance personnel during the interventions, through the local terminal.

The functions allocated to **OCC** are the following:

- Acquiring and managing the diagnostic data from **PI** situated within the controlled area;
- Managing the alarms;
- Specialty assistance for interventions;
- Archiving the diagnostic data.

The two levels shall use the signaling transport network in order to exchange the information which is necessary for the execution of their own functions: this information will be able to be automatically sent from one level to another (cyclic query, transmission about the event, etc.) or upon the operator's request.
From the point of view of the monitored and managed objects, the Diagnostic and Maintenance functions can be classified in two main categories:

- Diagnostic and Maintenance for the installations,
- Diagnostic and Maintenance for **CSS** system (Self diagnosis).

Within the category of Diagnostic and Maintenance for the installations it is included all the activities of diagnostic and support for maintenance, either automatic or executed by the operators by means of the instruments provided by the system, which refer to all the equipment, devices, installations situated on the line and/or in the stations.
Diagnostic and Maintenance for **CSS** system mainly refer to the electronic equipment within **CCS** and to the software installed on such equipment.

13.1 DIAGNOSTIC AND MAINTENANCE FOR INSTALLATIONS

The main functions of Diagnostic functions for Installations within **OCC** are the following:

- **Maintenance Staff** within the authority area of **CCS,** who gets information on the operating conditions of the installations and on the location of the defects and who also gets information which they can use as support during the interventions and their activation;
- **Traffic Staff**, that must be urgently informed about any disturbance conditions which have been found or forecast for the installations related to train traffic, in order to prevent any possible critical situations affecting the normality of the operation, in order to prevent any possible critical situations affecting the normal operation and in order to adopt the most efficient regularization procedures which should take into account the disturbance conditions of the installations.

For the implementation of the Diagnostic functions for Railway Installations, it must be used the software instrument named «**SCADA**» (Supervisory Control And Data Acquisition system).
The main purpose of the D&M is to provide an innovative transformation of the infrastructure's maintenance procedures in order to prevent failures and manage maintenance interventions.
This subsystem also assumes the additional task of remote monitoring for the following peripheral systems along the entire line:

- Signalling systems:
- Fire detection and climate conditioning systems in interlooking container and GSM-R shelter ;
- Intruder detection and access control for technology rooms in container and GSM-R shelter;
- Signalling Power supply system
- Hot Axel detector

In order to prevent failures and/or minimize their consequences, operators of this subsystem have access to instruments and procedures that allow them to:

- Monitor events;
- Maintenance support, i.e., operational support during the intervention phase, with special attention to the impact of such activities on train traffic;
- Alarm signals generated by the monitored systems.

For the installations that can/must be remotely managed, in addition to the Diagnostic function, **D&M** subsystem will have to carry out their management by sending remote commands which do not have any impact on traffic safety (for example, power supply installations, electric panels, etc.);
In any case, the SCADA functions of the **OCC** shall use the Acquiring data in order to display it in the most adequate forms, for the purpose of supervision, management of alarms and as support for searching and locating any failures.
In the following table it is listed the main installations and systems which are monitored and managed by **D&M** subsystem;

Installations/devices/ systems	Diagnostic Monitoring	Commands Management
Interlooking system	X	
RBC system	X	
GSM-R equipments	X	
IP/MPLS-Transport network	X	
Level crossing	X	
Main Switchboard (IXL-GSMR Container and OCC)	X	X
UPS (IXL-GSMR Container and OCC)	X	X
Diesel Generator (IXL-GSMR Container and OCC)	X	X
Fire detection (IXL-GSMR Container and OCC)	X	
Climate conditioning (IXL-GSMR Container and OCC)	X	X
Safety Telephone system	X	
Intruder detection	X	X
Hot Axel detector (IXL-GSMR Container and OCC)	X	
Audio and visual Passenger Information system	X	
Hw and Sw of CCS system	X	
Emergency light system in Tunnel	X	X
Heating for turnout	X	

List of the installations to be diagnosed and controlled.

13.2 ON-LINE DIAGNOSTIC

This function is intended for detecting the existing failures and inadequate operations of the monitored installations, at peripheral level and within **OCC**. The alarms shall be notified and managed (acknowledged, archived, etc.) at **OCC** or within **PI**.
The model of the database and of the algorithms for the monitoring of the diagnostic is supplied by SCADA.

13.3 FORECASTING DIAGNOSTIC

For some installations it must be possible to carry out some forecasting determinations and that means that starting from the current conditions and according to the parameters and specific models of the installation or equipment, it must be possible to obtain useful indications for the prevention of the failures caused by wear or by other causes.

13.4 DIAGNOSTIC AND MAINTENANCE OF THE SYSTEM (SELF DIAGNOSIS)

CCS system is characterized by a significant component of information technology, both at **OCC** and within **PI**.
Within **OCC** and within **PI** it shall be processing units of various classes and types, on which it is installed the most important part of the basic and application software.
The Contractor will have to implement the self diagnosis functions having the role of complying with the following requirements:

- The execution of a valid monitoring of the diagnostic at all hardware and software components operating within **OCC**, and within **PI**;
- Having an adequate environment for carrying out the maintenance operations which are proven to be necessary during planned interventions, inadequate operations or for making the necessary alterations to the system configuration;
- Having adequate instruments for managing, in a centralized way, the complex operations of activation / deactivation of the equipment and software within **OCC** and within **PI**.

In order to comply with the requirement referring to an efficient monitoring of the system, the basic software and the software for applications must have adequate capacities of self diagnosis and must be able to identify the failures and inadequate operations within the operational context falling into its competence (software and hardware).
The diagnostic information thus acquired must be provided to the operators in charge of Diagnostic and Maintenance at **OCC**.
Self diagnosis functions concern all the electronic devices of **CCS** (computers, work stations) both within **OCC** and within the peripheral area.

13.5 INTEGRATION WITH TRAFFIC FUNCTIONS

D&M operators within **CCS** will have to coordinate themselves efficiently with the operators in charge of traffic management, in order to facilitate:

- The urgent adoption of any efficient procedures in case of any failures which might affect the normal performance of the service;
- The optimal planning of line interruptions, track interruptions or other type of interruptions, in order to minimize the difficulties for the users.

Also, it must be available the messaging functions between operators for the exchange of information which cannot be automatically acquiring.

13.6 CHRONOLOGICAL RECORDS OF EVENTS (RCE)

One of the important instruments for the diagnostic analysis of the disturbances occurred during the operation consists in the accession to the records of status changes of the installations and of the hardware and software components of the system.
This function must be able to be activated from the diagnostic terminal and it will have to allow the accession both to the data acquiring directly from the Diagnostic functions and from the Traffic functions.

13.7 SUPPORT FOR MAINTENANCE ACTIVITIES

The support for the maintenance staff shall be provided by:

- the management of the alarms, by broadcasting graphical and alphanumeric displays, sound signals, etc., by the management of the identification and of the returns, and by archiving the alarms generated by the On-Line Diagnostic and by the Forecasting Diagnostic;
- Graphic and/or alphanumeric views of the equipment which has been scheduled to be put out of service, of the unavailable installations, of the forecasting assessments on the failures, etc.;
- Functions for the guidance of the operator for the replacement and restoration of the defect components, by guided procedures and with the possibility of having access to the technical documentation of all the equipment included in the system;
- Auxiliary functions for the management of the intervention (statistical, forms, recordings, etc.).

13.8 ON–LINE OPERATOR'S GUIDE FOR DIAGNOSTIC AND MAINTENANCE

In case of a disturbance reporting, the system will have to allow the operator to find all the available information, by guided procedures, in order to precisely identify the damaged component or section within the installation, by examining the various schematic displays, with more and more details, up to the level of each plate.
The On-Line Operator's Guide shall include the procedures for the execution of the Diagnostic and Maintenance activities.
In accordance with some operational steps of the viewed procedures it must be associated the specific technical documentation (sketches, drawings, specifications or manuals), which can be accessed on the screen.
In accordance with some diagnostic events, it must also be configured the operational instructions which the system will have to automatically view at the moment of occurrence of such events.

13.9 OPERATIVITY OF D&M FUNCTIONS AT OCC

From the Diagnostic and Maintenance terminals, the operator will have to:

- receive the reporting concerning any abnormal events;
- view the current status of the system or have access to RCE;
- require the elaboration of statistics of the viewing of the already elaborated values;
- activate an «Operator's Guide» in order to carry out more detailed investigations following a reporting of disturbance and, if applicable, to activate the specific diagnostic tests;
- be able to see the scheduled operations or to activate the automatic execution of the procedures for the activation/deactivation of the hardware or software components of the system;
- access the technical documentation;
- issue declarations on failures;
- manage the transmission of messages;
- activate the «Interruption Management» functions.

13.10 MANAGEMENT OF EMERGENCY SITUATIONS

The system shall also provide the support instruments for the management of the emergency situations, offering a set of services and procedures to the officers who shall have a meeting within an equipped authority of **OCC** («Crisis Room») on the occasion of some specific events which have a significant impact on railway traffic within the area which is controlled by **CCS** or that require extraordinary criteria of intervention management.
Within this category of events it is included, for example:

- Railway accidents;
- Natural disasters;
- Demonstrations or social events with relevant impacts on railway activity,
- Service emergency situations determined by causes which are internal or external to the railway organization.

This part of the system will have to allow the execution of a logistics basis, equipped and structured, from a structural point of view, for the emergency coordination and management, with the objective of improving the efficiency, rapidity and quality of the interventions, completing the functional and operational involvement of the various structures involved in such special situations.

14. GENERAL FUNCTIONS

14.1 MANAGEMENT OF THE OPERATION TIMETABLE AND SCHEDULES

The operation of the system is based on the use of the data referring to train schedule and to the operation schedules.
The data are normally acquiring from the external systems (IRIS system) and they are processed so that it can be used by the system for the controlled area.
The uploading of the data must be carried out automatically.
The operator must be able to check and possibly change manually all the data which exist within the system.

The system, for each day, will have to indicate a real schedule, which should be used by all the concerned functions (Traffic, PIS) and which should take into account both the alterations of the schedule and the traffic periodicity and the procedures adopted for that day.

So, for the determination of the schedule, the system will have to consider, in addition to the theoretical data, the extraordinary trains, the suspension of the scheduled trains, the additional or cancelled stops, any possible modification of the stop time and the times of passage from one or several stations (acquired by the introduction of a delay or of a scheduled advance), periodicity.
The system will also have to automatically manage the legal time and the change of the timetable.

14.2 MANAGEMENT OF THE SCHEDULES FOR INFRASTRUCTURE WORKS

The infrastructure maintenance works are carried out during the periods of time when the trains do not run (schedule intervals), or according to the programs within the schedule, when it is scheduled train traffic (schedule interruptions), or according to the schedules which are especially elaborated according to the type and priority of the works to be executed. On double track lines, the latter schedules normally stipulate the interruption of the track on which the works are executed and the circulation of all the trains on the sole track remaining in operation.

Some type of works, especially those executed for tracks, can refer to the introduction of some speed restrictions, or they can require that some trains should run on a line section at a lower speed than the scheduled speed.
The system must manage an archive of data referring to the infrastructure schedules.

14.3 MANAGEMENT OF ALARMS

The system must detect any alarm conditions and it must notify them to the operators within **OCC**. In particular, the system will have to identify:

- any traffic alarms, referring to disturbances within the service;
- any alarms referring to the operation of the peripheral devices and installations, to the disturbances or defects which have been found at the devices and/or technological installations by **PI**;
- any alarms for failures;
- any system alarms, referring to the disturbances, failures and inadequate operations of the equipment and software of the system;
- any operation disturbances of the peripherals for Passenger information;
- any alarm signals referring to the peripheral safety installations or to the Building Automation system (operational alarms);

The alarms shall be notified to the concerned operators situated in the work stations, by visual and acoustic signals which should draw their attention under any work conditions.
The alarms will have to be configurable so that they can be selectively sent to the concerned staff, depending on the competence authority and on the type of operator.
If, after a configurable period, an entered alarm is not identification by the local operator of an assisted **PI**, such alarm will have to be identification by the operator within **OCC**.

14.4 RECORDS

Both during the phase of development and during the phase of management of the system it seems to be especially useful the possibility of having some records for analyzing both the operation of the system and the actions of the users, and for creating a teaching support.
Therefore, all the events which are significant and useful for fiscal and statistical purposes, regardless if they are generated by the process or by the operator, shall be recorded under the most adequate forms in order to allow any possible analysis and processing, even after a long period of time from the moment when these occurred.
Upon the occurrence of the event, regardless of its nature, the system shall record; depending on the situation, the recording shall be performed on a special support or within an archive.
In general, such recording will have to be performed by associating to the event all the information allowing the identification of the operational and time context in which it occurred, so that the finding of the data can be carried out with various search keys, such as data type (alarms, operativity, type of the sent commands, traffic event, train number, etc.), time intervals (hours, days, months, ...), authority areas, terminal, operators and so on.
All the recorded data will have to include all the information which is necessary for being understood easily by the operators.

The system will have to record the messages (formal or not) exchanged between the terminal within **OCC** and **PI**, between the various terminals within **OCC** and between the various terminals of **PI**.
All the records must include the date and time of their entry into the data base and the operator's identification number (or the identification number of the SW process) who performs the operation.
The system will have to obtain, record and process all the diagnostic data referring to the installations, in order to provide the final or forecasting data, either real or significant, about the status of the infrastructure, about their degree of wear and about the quality of the performances carried out by them. Such data shall be fundamental for the organization of the maintenance and general operation activity.

14.5 SYSTEM TIME

The system will have to be automatically synchronized both with **OCC** and with **PI**.
Also, it must be provided a procedure for the manual entry of the date and time.
The date and time within the system shall be viewed on each requested display on the monitor of the work terminals, and it shall be associated with each significant event managed by **OCC** functions.
It must be managed the changes of the legal time, by avoiding any contradiction regarding the internal management of the various functions and regarding the recording of the events.

14.6 UPLOADING AND MAINTENANCE OF THE CHARACTERISTIC DATA OF THE JURISDICTION AREA FOR THE SYSTEM

Based on the system data, it must be saved the characteristic data of the authority area of the system, so that they can be used by all the elaborations of the system and for the graphic and alphanumeric displays.
It must exist the possibility of configuring the system in order to allow geographic extension (increase of **PI**) and the increase of the number of the Passenger Information installations which are controlled by each **PI**.

14.7 GENERATING AND UPDATING OF SYNOPSIS

The operator interface will have to allow the entry/modification, among other things, of the video displays of the following controlled installations: Station Symbolic Panel, Train Graph, Train Describer, peripherical Train Describer, Train Route Selection, Diagnostic and Maintenance synoptic, PIS, Video surveillance and Security etc.
On each synoptic, the operator must have libraries of railway object which are already designed according to **CFR** standards and which are shown on that synoptic. The objects within the library shall include both the graphical displays and the structures of the data of that case.

The operator in charge of the configuration must be able to modify the format of the displays on the monitor within **PIS** and to define them again, to chose the type of viewing which will be associated to each peripheral display (for example: arrivals, departures, arrivals-departures), to set and modify the association announcements-stations, to select the language of the announcements according to the stations where they are broadcast.
Based on criteria which are similar to the aforementioned ones, it must be also managed the characteristic data of the system.

14.8 HARDWARE CONFIGURATION

The operator must be able to configure the installation data which describe the quantities and connections of the equipment forming the CCS system.
It shall also be possible to allocate and modify (for example for adding a new device) the association of the drivers for the installed hardware devices, if they are different from those which can be automatically provided by the system.

14.9 CONFIGURATION OF WORK TERMINALS

By specific procedures, which can be activated within the operator terminals by authorized agents, the various work terminals situated within **OCC** will have to be able to be specialized, by the allocation of functional roles from the terminals (for example by **Central IDM, Traffic Coordinator**, **Passenger Information operator**, **Maintenance Coordinator or Video surveillance and Security**).

By specific procedures, which can be activated at terminals, it must be possible to customize all operator interface functions. The customized data must be saved and used depending on the user who works at that terminal. In other words, the system must save the settings of each user.
It must be possible to allocate various competence areas (Authority) to various **Central IDM** and to modify such allocations according to service requirements and according to operation conditions.
The allocation will have to be carried out during the normal operation of the system, by a procedure which can be activated by **Traffic Coordinator**.

14.10 SUPPORT FOR DOCUMENTATION

The technical documentation of the system and the other supporting documents which are necessary to central and peripheral **CCS** operators (sketches, drawings, specifications, manuals, norms, etc.) will have to be saved, in adequate formats, within **OCC** and they shall be provided to all the users within **CCS**, and within **PI** for search, consultation and printing.

14.11 ELECTRONIC MAIL

The system will have to provide a standard electronic mail function (including all the functions provided by the regular commercial software programs) for all the system operators.
The operators will be able to send messages only within **CCS** or to any authorized external addresses.
The system will keep track of the messages exchanged between the operators, by associating the data with information on the date and time related to sending and receiving, sending operator, recipient.

14.12 REMOTE DIAGNOSTIC FOR THE SYSTEM

The system will have to be able to be connected by «remote diagnostic» to any remote terminals, typically for maintenance interventions or for the interventions for failures searching by the Company for main hardware and/or software components.
The remote diagnostic will have to allow to an expert and authorized technician to have access, from a remote terminal, to the resources of the system in order to perform the maintenance operations on some system components, by explicitly excluding any critical functions and any reserved data.
The operations requiring any alterations of the system configuration must be performed by means of procedures that guarantee maximum safety and integrity of the system: it will have to avoid the possibility of performing any uncontrolled and uncontrollable alterations as effects on the rest of the system. All the operations performed by remote diagnostic, even if they are only for checking, must be authorized and recorded within a special archive, from which it can be acquired specific reports containing all the significant elements of the intervention (author, authorizations, concerned component, date and time of beginning/ending of the intervention, description of the intervention).

The connection methods for the equipment which is necessary for the communications with the remote station from where the remote diagnostic is activated will have to be in accordance with the provisions included in the characteristics of the system and they must not alter in any way the hardware and software architecture of the system, and also they must not cause any operational perturbations or disturbances.

14.13 CHRONOLOGICAL RECORDING OF THE EVENTS

The function of CHRONOLOGICAL RECORDING OF THE EVENTS is aimed to generate the system archives where it is recorded all the events related to the activities and functions which are specific to **CCS** (modifications of status of the controlled devices, given commands, executed commands, diagnostic alarms, etc.).

Such archives must be able to be accessed on-line, if they are available within the memory of the system, and anyway, they must be able to be transferred on external mass supports for final archiving or in order to be used for statistical and/or fiscal purposes.
It must be carried out the adequate procedures allowing the analysis of such recordings even at a later moment, for the periods of time, installations or devices selected by the operator.
Data display must be provided both in alphanumeric form (for example charts) and in graphical form and it must be possible to print the viewed data.

14.14 METHODS OF STARTING/STOPPING THE SYSTEM

In order to start and stop the system, completely or of some specific parts of the system, it must be performed some procedures allowing the automatic execution, according to a scheduled sequence, of the basic operations for:

- power supply/interruption of power supply for the devices,
- checking the operation status of all the devices and of the local network,
- activation/deactivation of the application software and of the basic software,
- execution of all the auxiliary operations for bringing the system or a part of it in the desired status, properly, without losing or altering any data or programs.

14.15 METHODS OF ACCESS TO THE SYSTEM

The access to the system, regardless of the reason of its request, will have to be regulated and controlled in order to be authorized.
The basic requirement, common to all the operational situations requiring the use of the system or of a component of the system, is that the access to the basic hardware or software of the system and the performance of any operations which are unknown to the application software cannot be allowed by any means, or anyway, it cannot be allowed any actions that could alter even to a small extent the data and function environment.
Such types of intervention will have to be exclusively performed during the maintenance, by such staff that is authorized by CFR or by the Company, under in safety way for the each part of the system that are not directly concerned by the maintenance intervention and according to the regulated procedures.

14.15.1 Management LOGIN/LOGOUT

There must be a specific data base which should indicate all the data related to the management of the accesses, saved within **OCC** according to the operation and safety requirements which are equal or superior to those used for the data base including the command/control data.
Each access to the administrator's data base must be recorded.

The data base must show, in addition to the operators' identification data, also the various rights established for each of them for the access to the system, both within **OCC** and within **PI**.

14.15.2 Access to the work terminals

All the terminals intended for the use of the staff within **OCC** and **PI** must be configurable by the operators who have access to them by the selection of a specific access role.
Depending on the pre-set role, the terminal will have to be equipped with a customized interface, with a set of operator interface instruments which can be activated.
Following the selection of a right, or following the acceptance of a current right, the operator will be able to access the system by filling in two fields, one of such fields is for the name, clearly stated or associated to an unambiguous value (for example the individual identification number within the company), and the other field is for the individual password.
The password of each operator must be unique and it must not depend on the place where the system is accessed, both within **OCC** and within **PI**.
The duration of the password must be able to be configured by the network administrator and it must be specific to each operator: thus it will also be possible to manage the «occasional» operators.

15. GENERAL PROPERTIES OF THE OPERATOR INTERFACE

The critical aspects of the controlled process, Traffic, Diagnostic and Passenger Information require that the **CCS** system which is the object of this Specification should be equipped with highly efficient operational instruments; these instruments will have to be characterized by satisfactory homogeneity within the basic operational procedures (for example searching information, selecting data and options, etc.).
Operator Interface will have to be carefully and thoroughly designed, because it will have to comply both with the requirement of getting in real time credible, significant and easily interpretable information, and the requirement of having simple but efficient operational procedures for information management, command setting and auxiliary function activation.
The operator interface will have to be based, in general, on standard information instruments, namely:

- Highly performant graphical software, which will allow an efficient use of colours, of customized graphical symbols and the management of windows, icons and buttons which can facilitate the selection of the functions;
- One or several high resolution colour graphical monitors;
- Keyboard and mouse.

The software products used for the execution of the operator interface will have to be of the type which is normally used on the commercial platforms and within the standard operational environments, and therefore they will consist in products which can be found on the market and which are characterized by a high flexibility and ample possibilities of customization.
As regards the graphical displays, the project and the operator interface must take into account some ergonomic restrictions referring, for example, to the possibility of reading and interpretation of the symbols, to the use of colours, etc., considering their intensive use.
The functions carried out by the operator interface can be divided, synthetically, in:

- Views of the numeric data, of the messages and images;
- Entry of data and commands.

The main views shall be:

- Graphical displays of the installation synoptic;
- Icons of the alarms;
- Data outputs in alphanumeric and graphical form.

The functions of data and commands entry shall include:

- The management of the commands entry;
- The management of the alphanumeric data entry by the operator under the form of labels or messages;
- The management of the commands entry for the activation of the operator functions.

15.1 ORGANIZATION OF GRAPHIC INTERFACES

The graphic interfaces provided by the system, must be summarized and permanently updated displays on the status of the controlled installations, will allow the operators to perform the scheduled interventions.
In general, on each monitor within the operator terminal it shall be shown a main window of the entire screen, containing at its upper part an environment by which the functions can be activated.
In the lower part of the window it will have to exist an area reserved for the buttons by which commands are given and text fields for viewing the messages and alarms.

In the remaining central part of the screen it will have to be able to be viewed the graphical and alphanumeric displays scheduled by the system, in addition to the windows containing the labels for entering and viewing the data.

15.2 OPERATOR INTERFACE – CTC

The CTC interface will have to be:
Graphic displays of geographical type (such as Station Symbolic Panel, Train Graph, Train Describer, Train Route Selection) which informs the operator regarding the position of the trains running within the Authority area, regarding the traffic forecasts, or the status of the infrastructures;
Displays under the form of a chart, useful for quick and immediate accession, for the synthesis of train schedule data, infrastructure status, traffic schedules, timetable data and conflicts.

15.2.1 Station Symbolic Panel

Station Symbolic Panel is the display on the monitor of the colors graph of the platform diagram within a station, on which it is represented the devices of the installation (in analogy with those represented on Station Symbolic Panel of station interlocking, the status of each one of them and any possible additional information generated by internal processing or by the actions performed by the operator.
From such a terminal, the operator will be able to access the desired Station Symbolic Panel and possibly several Stations Symbolic Panels

15.2.2 Views on Station Symbolic Panel

The Station Symbolic Panel will have to display the entire summarized diagram of the station, with a numbering which should be the same as the one used by the station interlocking.
The information displayed on Station Symbolic Panel can be subdivided into fixed information (represented by graphical objects, possibly completed with their attributes, as denomination or numbering), and variable information (represented by the variations of the graphical attributes of the objects forming the synoptic).
The fixed information can be summarized as follows:

- Layout of the station blocking sections;
- Layout of the station lines;
- Numbers of the circuits of the lines and blocking sections;
- Indication of the Passenger Building and its position in relation to the lines;
- Upon request, the numbers of the switchgears, the lengths, expressed in meters, of the receiving lines in the two traffic directions, the lengths, expressed in meters of the platforms, the existence of the underground passageway;
- Layout of the protection and station signals;
- Layout of level crossing ;
- The numbers of the line points and of the station tracks.

The variable information is:

- Aspect of signals;
- Status of the circuits of the lines and blocking sections;
- Status of switch point (normal, reversed)
- Status of the initial and final points of the itineraries;
- The existence of the status of “put out of service” of the line;
- Orientation of the blocking on the sections with double direction or with a single direction;
- The line with interrupted traffic on the sections which are not equipped for the traffic in both directions;
- Authorization of the manual handling of the centralized and non-centralized railway switch point;
- Existence of the ongoing alarms within the station;
- The number of each train occupying the parking lines;
- Status of level crossing (open/closed);
- The areas that can be excluded from traffic and which are in the status of «excluded»;
- Operating mode of the Peripheral Terminal;
- Operational status of the connection with **PI**;
- Method of sending the commands to **PI.**

The system must indicate the position of the trains, by showing the train number in relation to the related stops and block sections.
The viewing of the train number must include the complete train number plus delay.

Station Symbolic Panel will have to be updated by the real status of the lines, referring to the interruptions, ongoing itineraries, tracks circuit situation, of the signals, of the railway switch points, alarms, etc.
On Station Symbolic Panel it must also exist an area intended for containing any possible diagnostic alarms and signals.

15.2.3 Display of Block Sections

The display of the block sections must have a length which should allow the display of the train number.
It will have to be displayed only the first blocking section of the station, one for each direction.
The colour of the bloc sections must be different, in order to indicate if:

- The section is free/occupied by a train (for which it must displayed the number or the logo of unknown) or it is fault;
- The section is excluded from the monitoring of the train schedule;
- It has not been acquired the control for it.

If the viewed block section is affected by an interruption, its display must be provided with that graphical object.

15.2.4 Display of Stopping/Parking Areas

The display of the stops must be:

- Of a length allowing the display of the train number;
- The colour, adequately differentiated, must indicate if the stopping area is free, occupied by a train (for which it must be indicated the number or the logo of unknown);
- Uncontrolled.

15.2.5 Operation on Station Symbolic Panel

The operator must be able to give the commands by using the positions within the menu or any possible accelerating buttons.
In some cases, the selection will immediately activate the execution of the requested command; in other cases , it will show a dialogue window in which it will have to be possible to perform others selections until the final confirmation of the desired command. For example, to activate the route formation, the system must show the list of the possible itineraries. The operator must be able to perform a selection and to confirm it for the system.
Also, it must be possible to select the remote control devices directly by the mouse on Station Symbolic Panel.
The operator must be able to directly select by the arrow of the mouse the train whose number must be modified or cancelled or the stopping area or the bloc section on which he/she should place the train number.

From the Station Symbolic Panel, the operator must be able to:

- Select the station to be displayed;

- Modify or enter the operational mode of the station, set the method of sending the commands for the station;
- Send remote controls to the devices;
- Perform operation on a train (by changing the number, identifying a train, viewing the information);
- Request the display of any additional information, possibly in some special windows
- View the train list;

15.2.6 Train Describer

TRAIN DESCRIBER will have to graphically display the area which is controlled by the system, including all the line sections connecting the stations and, for each of them, all the block section in which their statuses are subdivided and, schematically, the display of these stations, by indicating all the controlled stopping areas, of the signals of first category.
Also, it is displayed in real time the position of each running train, both on a full line and on the lines within the stations, stating the difference.
Train Describer must be the instrument with which the operator can control in real time the global status of the traffic and which allows him/her to directly intervene for the most usual commands or by activating the operator interfaces for the command and control of each **PI** (Station Symbolic Panel) or for the selection of the regularization strategies (Train Route Selection).
The displays will have to be executed by graphical symbols, colours and alphanumeric information: the symbols and colours shall univocally identify the various elements of the «traffic» process and their current status; the alphanumeric information must be able to be viewed both automatically and upon the operator's request and it shall be used for completing the information contents supplied by the graphics part.
The operativity must be ensured by an operator interface which will allow the use of the mouse and of the keyboard for the selection of objects and functional options on Train Describer.

15.2.7 Views on Train Describer

The information displayed on Train Describer, graphical or alphanumeric, can be both fixed and variable.
The fixed information shall refer to:

- Layout of the block sections;
- Diagram of the stations by indicating the names of the stations, level crossing (with the same methods as for Station Symbolic Panel);
- The secondary line not controlled by **CTC**;
- Position of the protection and the departure signals in stations;
- Indication of level crossing.

The variable information shall refer to:

- Operational mode of each peripheral installation;
- Status of the connection of **PI** with **OCC**;
- Methods of sending the commands;
- Status of the block sections and of the stopping track in station (free/occupied);
- Aspect of the protection and the departure signals in stations;
- Out of service line, interrupted line, speed restriction;
- Orientation of the block along the sections with double direction or with traffic in a single direction;
- Presence, for each **PI**, of the current alarms referring to the installation;
- Current routes;
- Localization of the trains, identified by their own number, and delay;
- Status of opening/closing of level crossing and the existence of alarms.

TD will have to be updated by the real status of the lines, referring to interruptions, unavailable, current itineraries, signals, alarms, etc.
The displays on Train Describer, will have to comply with and, anyway, will be derived from those defined for Station Symbolic Panel, bringing on it graphical unifications and simplifications.

15.2.8 Operativity on Train Describer

The operator must be able to give commands by using the menu and any possible accelerating buttons.
In some cases, the selection will be able to immediately activate the execution of the requested command; in other cases, it will be able to determine the occurrence of a dialogue window in which it will be possible to perform other selections until the final confirmation of the desired command.

15.2.9 Train Graph

The traffic diagram or TRAIN GRAPH consists in the graphical display of the real and scheduled train traffic, by dividing a space-time grid.
Train Graph is the basic instrument for viewing the results of the forecast elaborations within the Regularization functions.
The operator interface Train Graph shall also include a main menu, by means of which the operator can perform interventions, by activating the specific procedures.

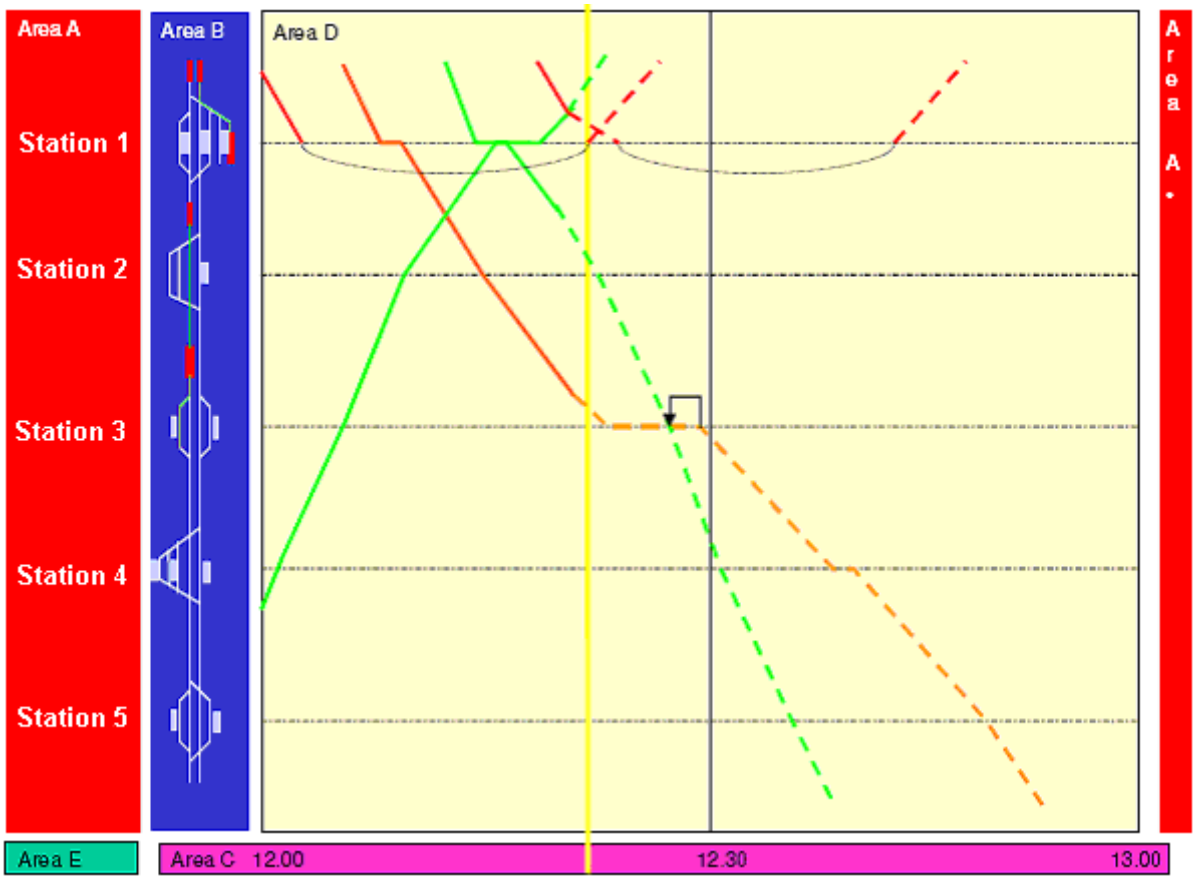

Fig. 4:Train Graph

15.2.10 Train Graph Operator Interventions

The operator will be able to:

- Select the viewed time interval;
- Print the graphs;
- View and settle any conflicts;
- Check the validity of the traffic selections;

Upon request, the operator will be able to view:

- Information on the train (for example, the real and forecast difference of schedule);

- Theoretical routes of the extraordinary trains;
- The operator will have to be able to move the time window represented on the screen, thus obtaining the view of the past or scheduled situations.

15.2.11 Views on Train Graph

The space-time grid consists in a cartesian plan in which on the y-axis it is shown the stations and on the x-axis it is shown the time.
The distance between the stations will have to be, as much as possible, proportional to the real distance, but without affecting the possibility of reading the graph.
It will have to be shown the stations of the confluent or branch lines and the names of the stations or of the branch lines will have to be differentiated from the alignment of the stations of the main line.
The displayed time interval will have to be able to be selected by the operator and it must range between a minimum value of two hours and a maximum value of six hours.
The time grid will have to be formed of vertical continuous thin lines in order to indicate the ten minute interval and it must be in bold lines in order to indicate the hours.
The current time must be adequately shown on the graph, for example by an arrow moving along with the lapsing of the minutes, on the upper time axis.
The running of each train will have to be shown by a broken line, formed of oblique segments, each of them joining the extremities of the vertical signs on the x-axes of the stations met on the route.
Train Graph must be executed so that the trains cross the display from the upper part to the lower part and from the left side to the right side.
The stopping of the trains in the stations will have to be shown by a horizontal segment.
The routes of the regular and periodical trains will have to be shown by a continuous line, while the extraordinary ones shall be shown by a dotted line.
The colours of the routes will have to be differentiated according to the train type and they must be configurable.
The plotting will have to allow the calculation at half a minute and it shall be marked by the number of the train to which it refers.
On the Train Graph must be distinctly shown the past, present and future situation.
The historical progression of the train schedule will have to be adequately differentiated from the future progression, by a different thickness of the line representing the advance.
Forecast trace of the trains, that is the future ones, will have to be drawn according to the calculations regarding the traffic forecast.
It shall be shown the scheduled and current line interruptions.
By selecting the route of a train with the mouse, it must be activated a menu, with the selection of any possible operations on the train (viewing the train schedule on Itinerary Selection, composition, progression, etc.).

On the graph it shall be also shown any special situations related to infrastructures, which affect the normal traffic (decelerations, line interruptions, etc.)
On Train Graph must be possible operations of ZOOM and PANNING by means of the mouse and keyboard and by selecting them within the menu.

15.2.12 Train Graph Printing

The operator must be able to request the desired graph type (theoretical or real), the date, section and time interval.
The operator must also be able to select the peripheral equipment (both the configured printers and plotters) with which he/she can perform the printing.

The space-time grid will have to consists of continuous horizontal lines in relation to the stations and of vertical lines of progressively increasing thicknesses, starting from the indication of two minutes, ten minutes, half an hour and one hour.
The printing of the real graph must supply a graph which is analogous to that shown on the video screen.

15.2.13 Train Route Selection

Train Route Selection consists in a geographical display of the controlled area on which it is shown the route allocated to the selected train.
The fixed information mainly consists in the summarized display of the lines and stations (each of these with its own stopping lines).
The variable information shall consist mainly in the entire route of the studied train, in the parts of the train routes which are in conflict with this, in the number of these trains and in any possible messages (graphical and alphanumeric) which will inform the operator on the foreseen effects of the selections which have been made (for example, the quantification of the delay, special indications about the conflicts, etc.)
Itinerary Selection is the instrument by which it is regulated operator's intervention for the selection of the route, including the stops which will be allocated t the trains situated within operator's jurisdiction, namely for all the controlled area if the operator is Traffic Coordinator or on the section which is administered by the terminal if the operator is Central IDM.

15.2.14 Train Route Selection Operator Interventions

By selecting the itineraries, the operator must be able to:

- Select a train and view the chart of the scheduled route;
- Modify the scheduled route for the selected train (allocating an alternative route between two stations, odd or even, or on an alternative track on the adjacent line, or allocating another line within a station);
- View the conflicts of the selected train;

For all the terminals, Train Route Selection shows all the area which is managed by **CCS**, but the interventions of the operator will be possible only within that authority.

15.2.15 Display of Routes

The route of the currently selected train must be shown by adequately highlighting, for example with different colours or graphical symbols, the adequate routes for:

- The scheduled route, namely allocated to the train according to the train schedule established by the system, according to the current situation of the traffic, of the infrastructure and according to the settlement of the traffic conflicts;
- The reserved route, a route which is ready to be executed or remotely controlled with an executed itinerary, which can be modified only by the transmission of manual commands;
- The route which has been just executed, that can't longer be modified by the system or by the operator.

15.2.16 Display of Conflicts

Where the system foresees any conflicts, it will have to be shown the number of the train which is in conflict with the selected train and by using a colour that indicates such train as being the successful train (that is the train which has priority to run, because it «stops» the examined train) or as unsuccessful train (that is the train which does not have any priority to run, because it allows the examined train to run freely).
In any case, if there is a conflict, within a special label it must be shown the indication on the size of the delays which shall be allocated to the examined trains following the various possible solutions, identified by the system or selected by the operator.

15.2.17 Station train planning and disposition

The Station train planning disposition in station is a graphical map that show the station tracks occupation for the for arrival departeur train.

In this schedule map are represented for each train: the category, the number, place of origin, the destination, the arrival and departure time (or the transit time) and the tracks assigned to this train.
The train planning and disposition can be:

- STATIC: the theoretical planning with the tracks assignments for the day

- DYNAMIC: this is related to the management of the station tracks in real time, due to the real traffic situation taking in consideration also special traffic modification or restriction

The Dynamic Station train planning and disposition will be represented in a chart in witch the X-axis is the time and the Y-axis are the station tracks
In this chart will show the position of the trains and related data in interval time at least tree hour long. The time interval could be changed using specific menu function and with a tool bar must be possible to change the position of that time interval.
The chart will flow automatically in order to follow the flow of time and to show the actual time in the centre of the chart. The passed time and the future time must be represented with two different colour. Each station tracks will associated to an horizontal line of the chart and on this line will be represented the scheduled train for that track.
If the track is not available for train circulation, his name must be pointed out in order to show the not availability to the operator, in this case also on the X-axis (time) will be shown a special marks.
Each train in the chart is represented using a coloured segment, the dimension of that segment is proportionally to the time occupation of the track, the colour is red during the transit of the train on the track and yellow when the train is standing near each segment the train number is shown, in the next picture there's an example:

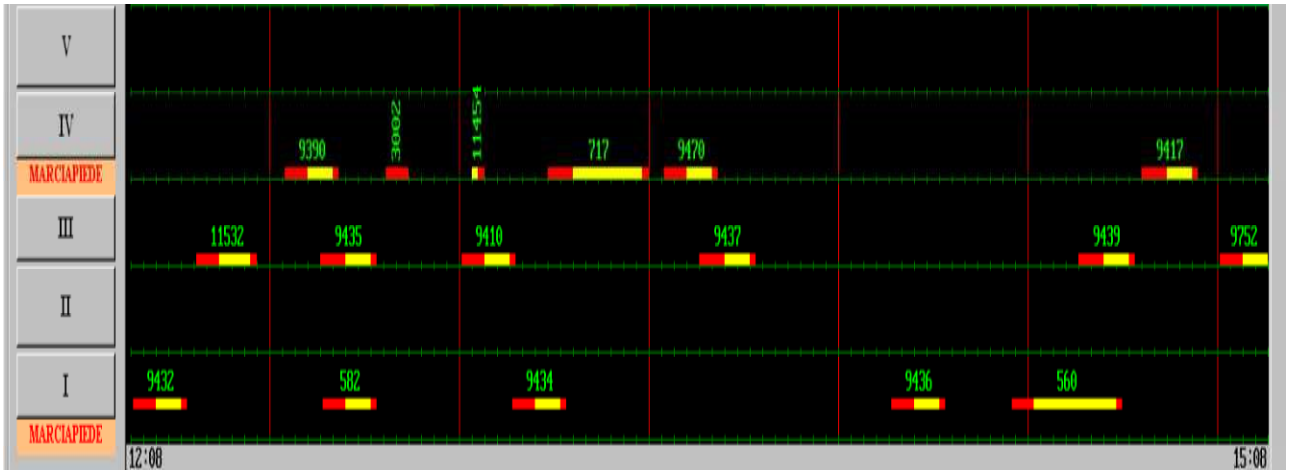

Fig.5 Example of planning and positioning chart

For each train will be possible to display detail information through a simple mouse click on the segment associated to the train number.
In the main form that show the chart must have the following function

- train search
- solve the conflict with automatic proposed solution
- solve the conflict with manual command

In case of conflict with other special combination of colour must be used, special colour must be used also for shunting route.

15.3 DISPLAYS AS TABLE

In order to complete the active graphical information, it must be performed specific procedures, which can be accessed at any moment on the graphical monitors of the work terminal, by which it must be possible to view any alphanumeric, static and dynamic information.

15.4 OPERATOR INTERFACE - PASSENGER INFORMATION SYSTEM -

The interfaces which are available within the functions of Passenger Information must be of two types:

- Synoptic representation
- Displays as table.

15.4.1 Synoptic representation

The graphical interfaces provided at **OCC** within the functions of Passenger Information, must be:

- General Passenger Information Synoptic;
- Detailed Passenger Information Synoptic.

Both types of Synoptic must show automatically updated information (for example, the operational status of the viewing peripheral devices).
By mean of the buttons and of the menu existing on the Synoptic, the operator within **OCC** will be able to perform the interventions falling within his/her competence.
The symbols must be sensitive to the selection by mouse; for example, the selection of the peripheral equipment for sending commands must be able to be performed also directly from synoptic.

15.4.1.1 General Passenger Information Synoptic

Within the synoptic it must be indicated schematically the stations with Passenger Information service, according to the geographical sequence within the line.
The form of the symbols representing the Peripheral Passenger Information terminal and their colouring must indicate:

- The type of installation existing within the peripheral area;
- Operational status (highlighting any possible alarms) for each type of peripheral device (including the computers and the various available functions);
- Presence of the local traffic operators (assistance of the station by the Terminal Operator);
- Presence of the local operators for Passenger Information management.

The operational disturbances of some peripheral equipment or functions of the Peripheral area will have to be highlighted graphically on the synoptic (for example, with flickering upon the change of the colour).

15.4.1.2 Detailed Passenger Information Synoptic

By selecting a locality, the system must show a synoptic containing:

- A layout of the station (including the area for passenger services, the platforms associated to the lines, a possible underground passageway, the hall and all the rooms containing peripheral equipment);
- Layout of the viewing equipment;
- For each equipment, the operational status (in operation, in alarm, deactivated).

Within the window it must also be indicated, with adequate symbols:

- The presence of the local operator
- The presence of the terminal operator
- The operational status of the computers and available functions;
- The operational status of the connection to the Central Terminal (connected, disconnected, in error).

Following the selection of the synoptic symbols representing the viewing peripherals of the locality (monitor, etc.) the system must show a label containing all the information viewed on the selected peripherals.
Such information will have to be updated upon each modification.

15.4.1.3 Sound Announcements during Broadcasting

It will have to be viewed the list containing the sequence of sound announcements, which are scheduled or broadcast within the selected locality, correlated with all the necessary details (reference train, message type, message status: active/inactive, periodicity, date and time of the last broadcast, date and time of the following broadcast).
The system must provide a label for the operator containing a general situation of the trains, within the window it must be viewed all the running trains or the trains which are going to enter the controlled area.
For each train it will have to be viewed:

- the locality where the train is situated or the scheduled origin/entrance locality;
- number;
- arrival and departure times;
- differences against the schedule;
- origin and destination;
- the scheduled time for passing through the locality (transit, stop, etc.);
- the theoretical receiving line;
- the scheduled receiving line.

From the synoptic of the stations, the **PIS** operator will have to be able to select the Sound Broadcast of the specific site, in order to make a loud announcement.
Following the selection of the station, it must be indicated its status:

- Inaccessible: because of some defect or because of an interrupted line;
- Free: not occupied by other Sound Broadcasts;

- Current: from the Terminal Operator, from the operator who is in charge of the announcements made for the local public or automatic.

15.5 OPERATOR INTERFACE – DIAGNOSTIC and MAINTENACE

It is hereby described the main characteristics of the Operator Interface for the functions of Diagnostic and Maintenance, acquired with the application generated by SCADA.
The Operator Interface with SCADA application must allow:

- the viewing of the installation diagrams with the display of the current statuses (normality, disturbance, alarms, etc.);
- the viewing of the graphs;
- the searching and viewing of the alphanumeric information;
- the viewing and management of the alarms;
- the setting of the commands intended for the peripheral installations;
- the selection and activation of any auxiliary functions, such as: printers, statistical processing, diagnostic data archiving, updating/modification of the parameters for the monitored installations, messaging;

On the synoptic diagrams, which the operator will be able to retrieve from that menu, it will have to be shown, by adequate symbols, the current statuses of the installations and of its components and any possible conditions of disturbance and fault.
For a general diagram, it will also have to be possible to obtain displays at various levels of detail, maintaining the dynamic signalling referring to the operational statuses and, in particular, to the current disturbances.

15.5.1 Installation Synoptic

The diagnostic system will have to allow the viewing of two types of display of the information:

- The schematic display in a graphical form both of the entire controlled installation and of its component parts, which should allow the identification, first, functional blocking, and which should then allow, by exploring the next detail levels, to identify the minimal entity, managed by the diagnostic, which has identified a defect;
- The geographical display, that means the viewing of the physical position of the various elements forming the controlled installation, according to various detail levels, starting from the complete layout of the installation until it is reached the connection layouts.

From both views it must be possible to go to the next or previous detail levels, by simple operations of selection by means of the arrow of the mouse.
The viewed elements will have to be marked by a colour code which summarizes the operational status of each installation type.
It must be provided layouts of the rooms with the arrangement of the sensors for fire detection and of the Intruder detection sensors, with the indication of

the status of the fire detection central station and, the status of each sensor, the existence of any operational disturbances, the presence of any alarms.

15.5.2 Alarms and failures

The operators must receive the concerned alarm signals regardless of the mode in which the operator interface works.
The main information which is managed and viewed within the alarm page is the following:

- The indicator of «acknowledged alarm» which indicates that the operator has been informed about it;
- The indicator of «acknowledgement request» (it indicates that the alarm must be acknowledged by the operator);
- Date and time of its occurrence;
- Detailed description of the alarm;
- The locality where it occurred (when this is significant);
- Date and time when it ended;
- Status (ongoing, ended).

Within the labels for alarm viewing, the alarms must be entered according to the chronological order of their arrival, starting from the upper part, and the alarm which is the last one that arrived must be at the top of the list.
For special alarms it will also be provided the acoustic signalling.

15.5.3 Display of Alarms on Synoptic

As regards the views, the alarm signals must have different colours, associated or not with the «flickering», according to the severity of the defect, according to any possible interference on the normal operation.
In general, it must be adopted the following criteria for the viewing of the installation statuses (referring, for example, to a synoptic diagram showing the various types of installation, each of them represented by an icon):

- Green colour, in case of normal operation of all the equipment on that type of installation;
- Yellow colour in case of fault of one or several pieces of equipment on that type of installation, which does not affect the normal operation (the «mild» alarm);
- Red colour in case of fault of one or several pieces of equipment on that type of installation, which can affect the normal operation (the «severe» alarm).

Upon the occurrence of a fault referring to any component belonging to one of the displayed functional blocks, the icon is highlighted:

- in red flickering colour, if the fault can affect the essential functions;
- in yellow flickering colour, if the fault does not affect the essential functions.

The flickering remains active until the operator, by a specific procedure, acknowledges the alarm.

The acknowledgement of the alarm must be global, namely the acknowledgement from any of the operator terminals, regardless where this is placed, produces its effects on all the terminals showing that alarm; the acknowledgement operation shall be recorded and on this it shall be noted the identification number of the operator who performed the acknowledgement.

15.6 OPERATOR INTERFACE – VIDEO SURVEILLANCE AND SECURITY

The main representation on the monitor of the video surveillance and security operator is a synoptic that show the controlled area.
In the synoptic must be represented the schematic plan of each station controlled by the system, form the video surveillance and security point of view the OCC will be considered like a station.
The synoptic must show for each peripheral controlled area:

- the status (showing active alarms)
- the presence of the operator in the technological room
- the fault of the video surveillance and security equipments

15.6.1 Detail Synoptic For Video Surveillance And Security Operator

The detail synoptic of each peripheral controlled station must show:

- the layout of eche area controlled with the position of cameras, fire detection sensor, intruder detection sensor
- the status and the name of each video cameras with the indication of witch is in that moment in visualization
- the status for each sensor (in alarm, out of service)
- the status of fire detection and antitrusion and Video system main controller
- the status of the communication

Using the detail synoptic interface must be possible to send all command foreseen for this system:

- Activate/deactivate the intruder detection system;
- Activate the view of a specific camera;
- Activate a cyclic sequence;
- Recording management;
- Etc.

15.6.2 Images Visualization

The big monitor, dedicated for the image display will permit to show in the in the same monitor the image coming from different cameras, selected by the operator, this means that the same monitor will be divided in a certain number of virtual sub monitor, and must be possible to select the number of sub monitors in the big monitor. in the following picture an example is shown:

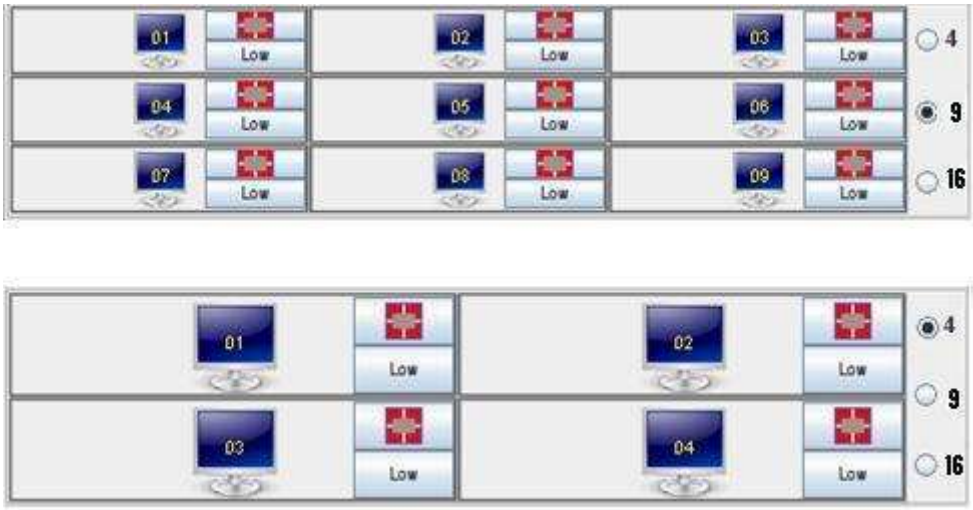

Fig. 6 Example of main monitor division

In each virtual sub monitor must be possible to display the selected cameras without interfering the other image.
The space on the main monitor will be organized in order permit the best visualization of the images taking into consideration the distance between monitor and operator, it will be possible to use zoom function for a specific image

16. Supervision systems for safety tunnel plants

Section 1 project include two Tunnel (Homorod and Ormenis) with length more than 1 km, for this type of tunnel the TSI 2007 for tunnel safety require the implementation of special plants for improve the safety of the Tunnel.
In this paragraph are described the installation that must be done in the OCC in order to have the remote control of these systems.
The functions of this systems could be partially or completely carried out by the systems already described before (D&M, PIS, VSS) or it will be possible an integration with them.
The equipments necessary for the supervision of railway tunnels Homorod and Ormenis include the following:

- Supervision Integrated Server (SVPI)
- Supervision Workstation Client Integrated with phone Console and sound diffusion console, placed inside the rack of the integrated supervision
- Supervision system for power supply installation in the tunnels (LFM)
- Workstation Client Supervision LFM
- Server for supervision of security plants in tunnel (PCA)
- Workstation Client PCA
- Server-IP-PBX VoIP

16.1 Supervision system LFM

The supervision function will be implemented in three distinct areas:

- in the management of the Middle Voltage network (MV): it processes and manages the data that define the operating conditions, received from the various protections of the MV system and on the basis of such information prevents the interconnection between different supply points and proceeds to the process of reconfiguration automatic network in the event of failure or out of service one of the sources. This reconfiguration ensure in a short time replenishment LV (Low Voltage) systems, eventually put out of service by the protection system and selection of network failure section MT;
- in the management of the 1kV network backbone;
- manage data related to other subsystems (or entities) such as:
  - electrical devices (MV and LV, UPS, transformers);
  - Lighting systems;
  - Fire protection and ventilation;

With regard to these subsystems the supervision monitors their status and their normal operation through the exchange of diagnostic information (faults and alarms).

16.1.1 LFM server and client equipment

The supervision system will prepare and will present effectively to the operators the information received from peripheral devices of LFM.
It will be physically consisting of:

- A server operating in standard Windows environment.
- Workstation (Client), to allow the personnel responsible for emergency management and the staff of technical diagnostic installations.

The system will allow the production of an alarm event on the screen in not more than 1 second of its receipt and during processing of events provides less time to 3 sec. between the demand and interactive video presentation of a page.
The archiving system will allow the historical record without overwriting for at least 5 years.

16.1.2 LFM supervision server

The server will be equipped with SCADA application program that will allow, through an adequate number of pages, graphics, the visualization of all the variables monitored in real time.
For each type of facility LFM (lighting, ventilation, electrical, ...) will be at least one page dedicated graphics highlighting the main variables related.

The server location will be complete with appropriate software licenses and operating system, both system development and use of the program of supervision (SCADA).
The minimum configuration of the server to monitor will be as follows:

- Construction on 19 " rack
- redundant power supply with hot-swap (extraction voltage power supply) with 300W power supplies;
- Intel ® Pentium M or higher, 866 MHz
- Expandable memory with 4 GB;
- hard drive with capacities> = 512 GB
- No. 2 10/100/1000 Ethernet interfaces Mbit / s;
- No. 2 9-pin Serial Port (RS485);
- No. 1 VGA port;

- Monitor 19 "LCD 1280 x 1024 resolution, viewing angle of 160 degrees vertically and 160 degrees horizontal, brightness 300 cd / m², contrast 300:1, with rack mount drawer 19".
- printer

Note that, given the rapid evolution of the market, the configuration of the PC will still be appropriate to what's available on the market at the time of system installation.

16.1.3 Client station supervision LFM

The supervision client station will Consist of PC.

The PC will be equipped with SCADA application program that will, through an adequate number of pages, graphics, allow the visualization of all the variables Monitored in real time.

For Each type of facility LFM (lighting, ventilation, electrical, ...) will be at least one page dedicated graphics highlighting the main variables related.

The station will be complete with appropriate software licenses and the operating system Windows 7, or higher, the system is using the program of supervision (SCADA).

The minimum PC configuration of the local supervision will be as follows:

- Intel ® Core i7 processor or higher clock> = 2.6 GHz
- RAM> = 4 GB
- Double single hard drive with Capacities> = 512 GB (with mirror function)
- CD / DVD
- GPU video card with 350 MHz RAMDAC, AGP 4x, 32MB,
- 2048 x 1536 resolution;
- color monitor 24 "LCD with 1920x1080 pixels resolution, viewing angle of 160 degrees vertically and 160 degrees horizontal, brightness 300 cd / m², Contrast 300:1
- 10/100/1000 Ethernet interfaces No. 2 Mbit / s;
- Italian keyboard and mouse
- Windows 7 operating system or higher
- Laser Printer

16.1.4 LFM supervision program

The software program will allow all the functionality and automation necessary for the proper running the plants LFM. The software will acquire all of the data detected by the PLC MASTER making it available on video by a sufficient number of graphic pages.

The overview of the system will be represented through the creation of a suitable number of pages, graphics core and pages dedicated to the "auxiliary functions",

typically verbal, statistical and maintenance installations.
Below is just a list of the most significant:

- General home page
- lighting installations
- ventilation systems by-pass
- firefighting equipment
- air conditioning systems
- electrical system in each cabin (MV and LV)
- Emergency Power System (UPS / energy storage systems)
- communication and system diagnostics
- alarms
- auxiliary functions

Briefly, the software will perform the following functions:

- Read and management of all the subsystems listed in the preceding paragraphs

- Representation "intuitive" alarms and faults of all the sensors, events in a synoptic view of the general one-page graphic represents the set of all plants

- Display of all measured data and commands currently operated in a single overview for each subsystem to manage and control

- Storage of analog archives on standards (example MY-SQL, MS Access) capable of recording the time course of these values. The system shall allow direct access to the data recorded for a period of at least six months

- Graphic display of analog signals, with the possibility of knowing, for each point on the graph, the exact value, date and time of registration. It should also be possible to set the time display and viewing of historical data

- protection through a password system on multiple levels in order to allow access to certain features only to authorized personnel. In particular, all the commands should be permitted only by authorized personnel via high-level passwords (system administrator). No changes to the display system can be accessed by unauthorized

- Ability to set and change various parameters of the system (with password) (example changing the values of alert thresholds, operating times, etc ...)
- Ability to create and delete users using the software

- The program will be questioned by one or more remote locations to enable the display of data and / or modification and setting commands

- Creating an event log (history log) where will be stored all the alarms, all events, malfunctions, changing standards or the entire behavior of the system with indication of the event description, type (on / off) and the date and time of reporting. The system must allow online viewing of data from at least six months, with storage of all data archives on standards (example MY-SQL, MS-Access). Should also be possible the following features:
    - Search and print all the events
    - Research and printing of a certain type of events
    - Search and print events for a given time interval
- animated graphic elements: the animations are as follows:
    - Rotation of objects
    - Color change
    - flashing
    - Displaying a dialog
    - Display numerical values
    - Text display
    - Diagram containing the trend curves
- time management: the role of time management identifies and manages all the events in chronological order so you can control applications;

- Alarm management: enables perform the following functions:

    - Control up to 15,000 alarms
    - Management of alarms by priority
    - Sorting of alarms based on the time occurrence, the priorities in the area, zero hour, the group in the state, the identifier and the first alarm is not reset
    - Alarm grouping according to different criteria
    - The appearance of acoustic warning alarms
    - Display of alarm conditions and associated messages
    - Selective reset the alarm or alarm group
    - Alarm recording in a file storage
    - Transmission of alarms and their messages to remote devices over a network.
- counters programmable function allows:
    - Control of the operating time
    - Control the number of operations
    - The creation of messages and information to reach the final value

  - Activation of the computing task
- trend: the trend function allows, together with the color feature graphic elements, to simulate the function of a chart recorder. Allows you to draw curves in the form of real-time information from the database or file from the storage of historical reports. Key Features:
  - Historical and real-time curves
  - Diagram Window
  - Direction of flow
  - Limit values
  - Interaction between the operator and curves
- calculations interpreted or compiled: the calculation functions allow you to perform math calculations, logical operations, and enable the production of many features offered by structured languages
- database interfaces: the database functions allow the transfer of data between different databases compatible with each other so you can:
  - Use, browse, edit relational databases
  - Add, delete, edit a record
  - Authorize the processing of data by the other supervisory functions. This makes the task of trend curves can manage data stored in a relational database
- relationships: the creation function allows you to print reports in free formats defined in the design phase, all information contained in the database. The user can then decide to print up to 2000 types of documents with different layouts. The relations thus created can then be transmitted over the network and stored to disk in ASCII format. This feature, coupled with the recipe management function, enables easily keep a written record of each new recipe in a form understandable by any operator

- file management: the function of file management controls through the application of different file management commands:
  - Copy: Copies a file
  - Delete: delete a file
  - Rename: rename a file
  - Directory: displays the contents of a directory
  - Type: Displays the contents of a file
  - Print: print a file
- loading and unloading of data programs: This feature allows the loading, unloading and control of application programs installed on several modular programmable controllers specific environment. It also allows loading, unloading and comparison of internal data
- communication networks - This feature allows you to create exchange

between different databases. Similarly, each station can use the Monitor server resources on a network: hard drives (such as a single unit for storing the set of recipes) and printer

16.2 Supervision of the Security equipments - PCA

Its required the realization of a supervision system, called PCA, which permits full remote management of the various security apparatuses of the tunnels (tunnel fire detection, fire detection in technical areas, access control, intrusion, Video surveillance), allowing to intervene on them from remote and to collect data, information and event listings.

The devices communicate with the server Security PCA through its own stations, through the data network.

At every cabin at tunnel entrances and at the Central Place is provided for client PCA, consisting of PC (with devices for data acquisition and display - press) able to communicate with the server PCA.

In addition, each PCA the supervision system will also be overseen by the supervision server integrated.

16.2.1 PCA Server

The function of management and archiving of events, alarms, images, data from the security system will be provided by a hardware system with the following characteristics:

- redundant power supply with hot-swap (extraction voltage power supply) with 300W power supplies;
- Expandable memory with 4 GB;
- Technology SCSI hard drives (SAS);
- No 4 hard drives, each with a capacity> = 1 TB RAID;
- Backup to DVD - RVV;
- Removable Disk Backup minimum capacity sufficient to contain at least the last 6 hours of recording images;
- No. 2 10/100/1000 Ethernet interfaces Mbit / s;
- No. 2 9-pin Serial Port (RS485);
- GPU video card with 350 MHz RAMDAC, AGP 4x32MB - 2048x1536 resolution;
- Monitor 19 "LCD 1280 x 1024 resolution, viewing angle of 160 degrees vertically and 160 degrees horizontal, brightness 300 cd / m², contrast 300:1, with rack mount drawer 19";
- Windows Server 2008 or higher

The server will be equipped with application programs of supervision of the various security systems (fire detection tunnels, technical rooms fire detection and bypass intrusion detection and access control in technical areas, video surveillance in the technical rooms and squares).

16.2.2 Workstation client security

The client workstation of the Security will consist of a personal computer connected to the system through the data network.
The PC will be equipped with application programs of supervision of the security systems.
The station will be complete with appropriate software licenses and the operating system Windows 7, or higher, and the use of system supervision program.

The minimum configuration of the PC local supervision will be as follows:

- RAM> = 4 GB;
- Double single hard drive with capacities> = 512 GB (with mirror function);
- CD / DVD player;
- GPU video card with 350 MHz RAMDAC, AGP 4x, 32MB - resolution 2048 x 1536;
- color monitor 24 "LCD with 1920x1080 pixels resolution, viewing angle of 160 degrees vertically and 160 degrees horizontal, brightness 300 cd / m², contrast 300:1;
- No. 2 10/100/1000 Ethernet interfaces Mbit / s;
- Italian keyboard and mouse;
- Windows 7 operating system or higher;
- Laser printer.

16.3 Central IP-PBX VoIP

The central IP-PBX must be made up as hardware, from a server on which is installed management software of the VoIP exchange.
The software, based on VoIP technology, will be designed to work on Windows-or Linux-based client-server architecture.
The software must be compliant with the IETF standard SIP and act in the management of at least 900 users.
The server, embedded Application Ready Platform (ARP) with no moving parts, must be of the latest technologies on the market.
The IP-PBX VoIP will allow the separate management of the various telephone circuits selective rail.

The center will be responsible for telephony establishing and route the calls between users and the central location, emulating the functionality of the various types of telephone circuits.

16.3.1 Server VoIP - IPBX

The management system of the emergency telephony and sound diffusion of the tunnels originates from the VoIP server (physically redundant in a "cluster"), referred to hereinafter as IPBX, housed in a dedicated 19 "rack.
The server will be equipped with the following main IPBX software:

- open source operating system,
- application management capabilities of IP PBXs, VoIP gateways and conference servers
- any open source software for managing databases.

Each server has redundant IPBX, through a second machine (configuration "clusters"), with the same hardware and software features.
The correct data redundancy on two servers and services will be managed through the following key software features:

- cluster management "Heartbeat" (rescue system in which the functions of a first component of a system are sent to a second component has a problem when the first "failover");
- data replication on physical media network, DRBD (Distributed Replicated Block Device).

In addition, each server will have a dual 100BaseTX Ethernet network interface, operating system constantly monitored to ensure, in the event of a malfunction or interruption of the two ports upstream of the connection (switch port fails), the constant flow of data peripheral device.
Each IPBX server can be maintained and managed locally through a single TFT 19 "and one keyboard (by means of suitable switches) installed in a 19" rack servers containing the same.

16.4 Supervision of emergency installations in the tunnel (SPVI)

The supervision system of the tunnel safety systems, is designed to allow, in the presence of an emergency scenario, the direct management from the OCC of all the safety installation of the tunnels.

The server SPVI overview of the data network of tunnels. The system will collect information relating to the operation of:

- LFM installations;
- main switch of the emergency tunnel data network (PLC);
- switch node data network emergency tunnel (PLC);
- emergency telephony system (PLC);
- sound diffusion system (PLC);
- supervision IP-PBX;
- public mobile radio system extension;
- Data Network LAN and WAN equipment;
- Fire protection system;
- Smoke control system;
- Security and Access Control system.

17. TELEPHONE OPERATIVITY OF OCC TERMINALS

The operators within OCC shall have within their own terminal a multifunctional telephone Console equipped with a touch screen monitor and with a micro-telephone/headset, by which the operator will be able to:

- answer to the received phone calls;
- make phone calls, only to the recipients defined in a list and to the trains situated within the jurisdiction of the terminal;
- end the active calls (received or made).
- use GSM-R functions

18. ANALYSIS OF RECORDED DATA

All the data characterizing the service conditions (traffic events, operativity, alarms, etc.) recorded by the system will have to be able to be viewed or printed, even when they are not on-line, stating the date and a clear or encoded text or, upon request, on-line.
The operator must have the possibility of selecting only the data which he/she wants to view or print, by making a query for this purpose.
The access to the archives for the recording of the data and of the sound messages shall be performed by means of a password which, in any case, will have to be differentiated for the various users.
The pre-determined time for the on-line accession to the archives must be of at least one month for the Maintenance operators and a lower configurable period, for the other operators.

19. INTERFACE WITH IRIS SYSTEM

The CTC system must have predisposition for the interface with IRIS system using LAN interface, the interface can be done at central level (in OCC) or at peripheral level.
The interface with IRIS must be realized for specific objective, limiting the data exchange for what is strictly necessary, the interface will be protect with opportune firewall with high availability in order to avoid external attach.
The interface with IRIS will be used for the following task:

- CTC will send information related to the real time train position and delay
- IRIS will send to CTC the timetable for the section controlled by the CTC
- IRIS will send to CTC the train number for each train that enter from gate station in the area controlled by the CTC