



Needs Tailored Interoperable Railway Infrastructure

Smart technology interfaces for data transmission and interlocking

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- Monitoring System of the CEM installation

The purpose of the systems

- The two systems presented are designed for installation in the two railway traffic safety systems:
 - mechanical interlocking systems
 - electro mechanical interlocking systems with relays
- The focus and objectives of these upgrades are:
 - to increase the safety of the assembly interaction operator - installation by providing information in real time;
 - the data base of all the operations achieved, in long time registration, will have an increasing of the operator responsibility .



Current situation (1)

Currently there are three types, different operating systems, used to ensure traffic safety:

Mechanical and electromechanical installations

- Are characterized by manual handling on-site, in the field area, or from the control cabin located on heads of the stations.
- These commands are for switches and signals on the lines.
- Main disadvantage: the presence of rolling stock on station lines or switches are not monitored.



Current situation (2)

The centralized installations using relays (CED - Electro-dynamic centralization or "relays based interlocking")

- Are characterized by remote electrical control, from a central station;
- Used for manipulating switches equipped with electro-mechanisms and for lighting the signals
- The field devices are controlled and monitored constantly by the CED system, which transmits information to the railroad operator.



Current situation (3)

Electronic equipment - type of "electronic interlocking, computer based interlocking"

- This category of interlocking systems meet all safety functions of CED's;
- Operational reliability is given by the redundancy of equipment and used software
- Provide also extra functions for interconnection with other railways entities.
- Control large geographical area from a central point.



Current situation (4)

- For the main lines, which must meet the requirements of European interoperability, the stations are continuously upgraded so as to be equipped with "electronic interlocking".
- High costs of modernization and the lack of tangible benefits, conduct to keep old facilities for secondary lines with low traffic.
- The two systems, designed and presented, complement installations in the first two categories.

Functions of the Systems (1)

For CED:

- **Real-time monitoring of all relays** considered to have important position in the installation and also, checking of the main supply voltages;
- **Registering and creating a database** of all status changes of the installation, completed with time mark; will be registered the operator commands and their execution by the installation;
- The possibility of **unloading a database to an external support** for analysing the activities of the station.

Functions of the Systems (2)

For EMC:

- **Real-time monitoring of change for the mechanical elements;** these are ordered from station:
 - Mechanical signals as: pre signalling, input signals, output signals, signals for branching lines in the station, etc.;
 - Switches;
- **Transmission of acquired information is performed entirely wireless,** using a standard communication for short distance.
- **Displaying the monitored elements on the screen of a computer system** (PC desktop or laptop) with automatic update and when requested;
- **Monitoring and registering of the elements status changes;** these registrations have attached a time mark;
- Possibility to **download the database on external support** for off-line analysis of the actions taken by the installations.



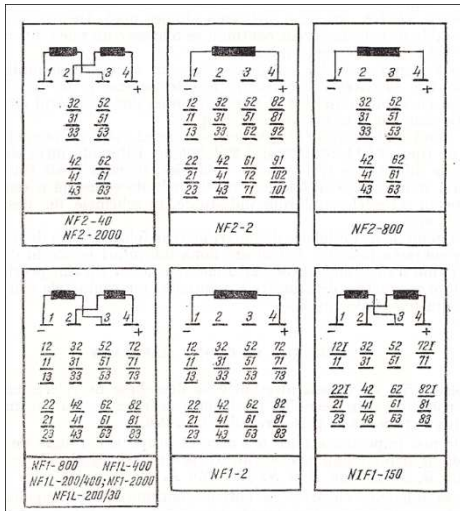
Monitoring System of the CED installation (1)

- **CED facility includes a large number of relays**, which form a diagram check of the safety conditions.
- **Relays used have special construction**, very secure, which have a preferential status in the event of failure: the repose contacts ("break contacts") are closed and the working contacts ("make contacts") are open. Therefore, all permissive states are done by work contacts.
- **The relays are mounted on the relays frame**, sometimes in standard modules.

Monitoring System of the CED installation (2)



Neutral relay plug - picture



Location and notation for contacts of plug relays



Example of relays frame



Monitoring System of the CED installation (3)

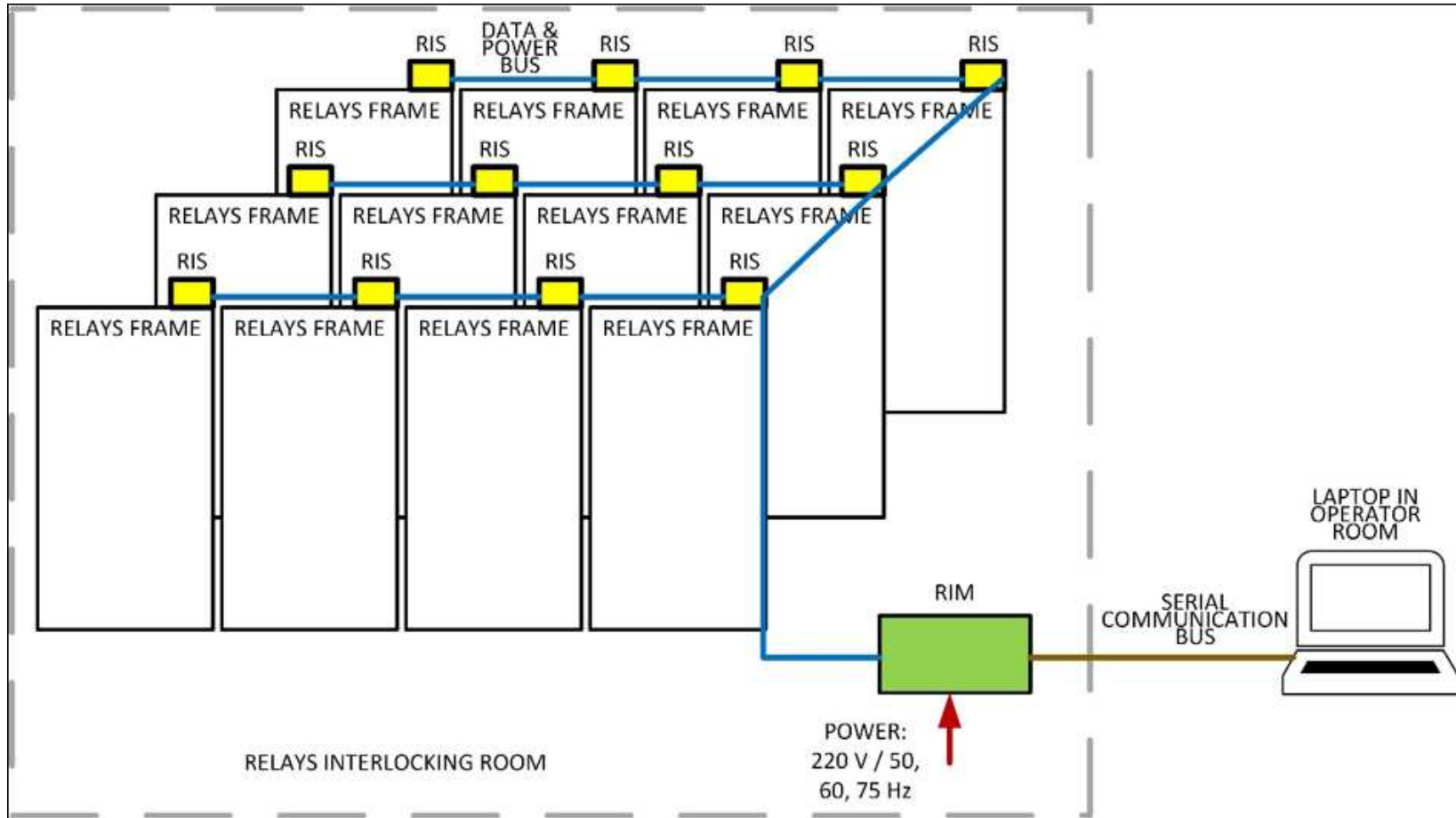
- The designed system contains:
 - A master unit (**RIM - Relays Interlocking Master**)
 - More slave units (**RIS - Relays Interlocking Slave**);
- **Data transfer** between the **Master** and **Slave** units was designed to be a **CAN type interface**, with specialized modules.
- Master will power supply the slave units, through the same cable used for data communication.

Monitoring System of the CED installation (4)



- **Slave unit (RIS)** has 128 available entries. Relays room is locked and sealed, access is only permitted in certain cases.
- **Master unit (RIM)** is supplied from the voltage reserved for the station, and also having its own power supply reserve on the battery. RIM will connect to a PC desktop or Laptop, which is located as generally in the room of the signals operator.

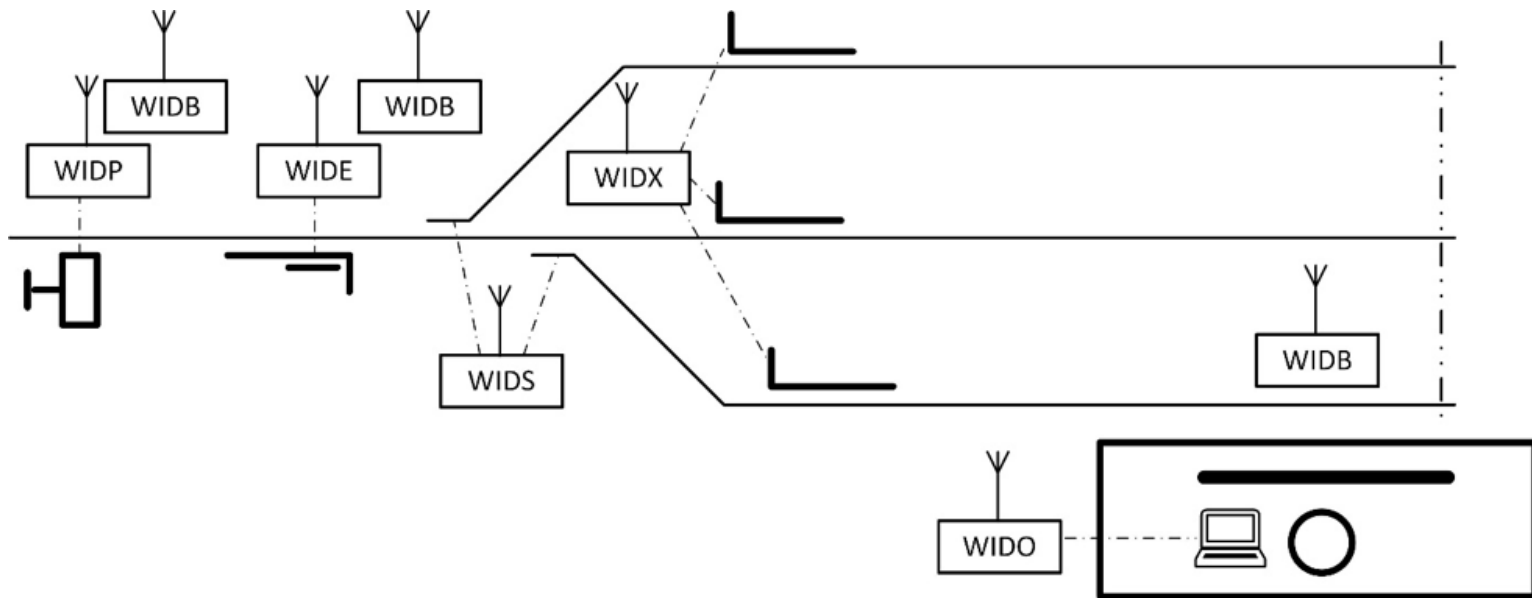
Monitoring System of the CED installation (5)



Location of the monitoring system for CED installation

Monitoring System of the CEM installation (1)

The designed monitoring system is composed of **several autonomous units**, in terms of energy - the energy supply will be photovoltaic cells dimensioned for each device type



System positioning for one end of station



Monitoring System of the CEM installation (2)

- The railway elements which are monitored are:
 - the **pre entry signals**,
 - the **entry signals**,
 - the **exit signals**,
 - the **branches of the line**,
 - the **status of the switches**.
- This system will be a real upgrade of interlocking installations as typically the “shunting movements” are not controlled by signals for cases of small stations and secondary lines.



Monitoring System of the CEM installation (3)

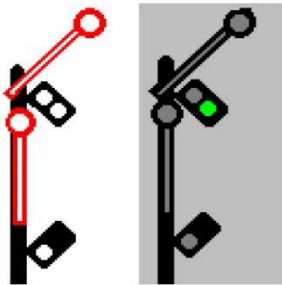
The devices presented in the previous figure have the following meanings:

- **WIDP:** **W**ireless **I**nterface **D**evice for **P**re-signalling – monitors the signals from the pre signalling area;
- **WIDE:** **W**ireless **I**nterface **D**evice for **E**nter signalling - monitors the signals from the entry area;
- **WIDX:** **W**ireless **I**nterface **D**evice for **E**xit signalling - monitors the signals from the exit area;
- **WIDS:** **W**ireless **I**nterface **D**evice for **S**witch monitoring - monitors the status of the switches;
- **WIDB:** **W**ireless **I**nterface **D**evice for **B**ooster communication – allow the extension of communication range;
- **WIDO:** **W**ireless **I**nterface **D**evice for **O**perator data concentration – concentrates data from the field area which is monitored, into a PC Desktop or Laptop computer.

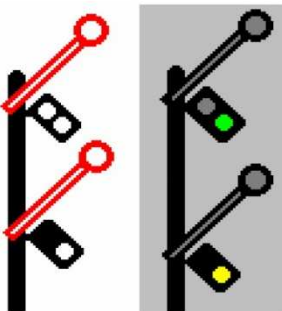
Monitoring System of the CEM installation (4)

Signals appearance, according to the Romanian signal regulation:

Entry signalling



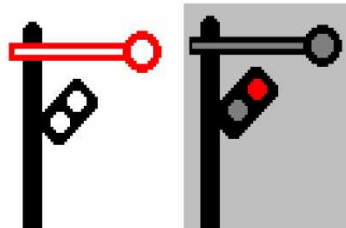
- Signal on free for direct way (first direction)



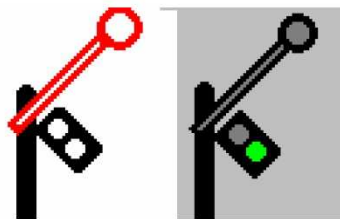
- Signal on free for deviation way (second direction)

Exit signal

Exit signal on simple line, ramification (branching); signal on the switch heel

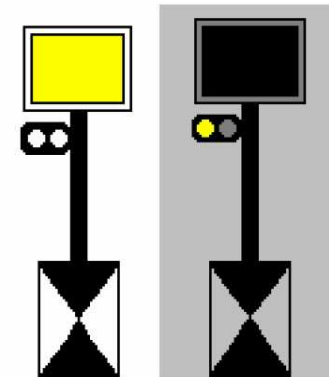


- Signal on stop



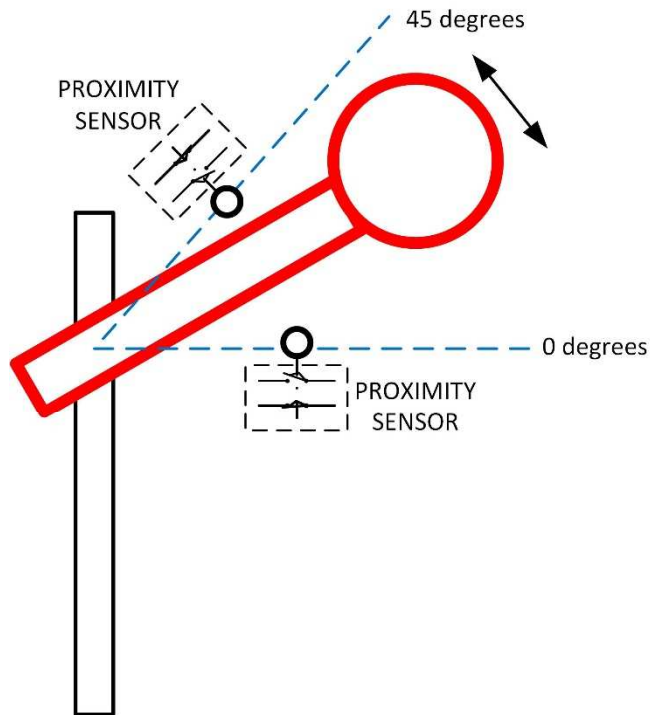
- Signal on free

Pre Signalling



Pre signal with two indications – the signal can't order to stop. The signal shows that the next signal it is on stop or it is free for deviation.

Monitoring System of the CEM installation (5)



- Monitoring the position for each mobile part of the signals is done using a pair of mechanics proximity sensors; these proximity sensors are outdoor placed, each with a normally closed contact and normally open contact.
- The range movements of the mobile elements of the signal are high, and the final position is not particularly accurate, so, could be used general purpose proximity sensors.
- Sensors state changes when the movable element reaches the heads of his running range.

Monitoring System of the CEM installation (6)

For switches is necessary to use specialized position sensors, switches designed and certified for the track. In the next figure it is presented an example of Siemens device, **ELP model 319**, which is used to CFR.



Monitoring of the switches position cannot be performed with general purpose sensors due to lower tolerance of their end positions.

ELP 319 allows monitoring movement of each pin. Inside the box are containing four groups of contacts, of which WIDS unit can use one as normally closed contact and another as normally open contact, corresponding to each pin of the switch.

The contacts can be wired on the same way as those of the pair of proximity sensor used for the signals monitoring (WIDP, WIDE, etc.).



Thank you!