

# MISO Traffic Control System (TCS)

## for Supervising Low Volume Railway Networks

## 1 The System

### 1.1 Modular and cost effective system for modernizing railroad traffic supervision

The TCS has been developed together with the customers and end-users in order to fit in the gap between traditional manually operated railroad control systems and massive interlocking systems.



In many cases the problem is not finding a solution to the high volume traffic system. The focus is there, the market is there and the manufacturers are there.

Still there are tens of thousands of kilometers active track lines with manually operated train control systems and wayside equipment. How to maintain the operations of such systems with limited budgets and resources?

The base for this system is the understanding of the train control and interlocking. The utilization of field-proven certified safety PLC technologies forms a solid platform for the railway control applications..

TCS introduces the usage of modular industry standard safety technologies and modern object oriented system design approach to revamp existing railroad systems and marshalling yards. The TCS system is capable interfacing several types of existing point machines, interlocking, signaling, track circuit, train detection and ATC (automatic train control) equipment.

The hardware and system engineering platform of TCS is based on a modern programmable product family provided by the market leader of safety oriented PLC equipment HIMA GmbH & Co., Germany.

### 1.2 Background

The system approach and implementation principles have been created in close co-operation with Finnish Railway Authorities (RHK), VR-Rata Oy, Raittelia Oy and Mipro Oy.

The Railway Authorities have set the specifications for the system functionality, safety and the economical framework. VR-RATA Oy has nationwide services for maintaining and constructing the railway infrastructure, control and safety systems. Raittelia Oy is a telecommunication company providing the expertise in railway communication systems.



Mipro Oy (founded 1980) combines in-depth knowledge of technology in the safety related automation systems, remote control applications and water treatment processes and networks with extensive expertise in data processing. The company has designed, developed and installed numerous SCADA, plant control, emergency shutdown and energy management systems for a variety of customers.

### 1.3 Object oriented design philosophy

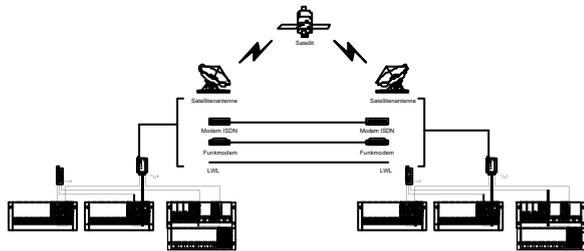
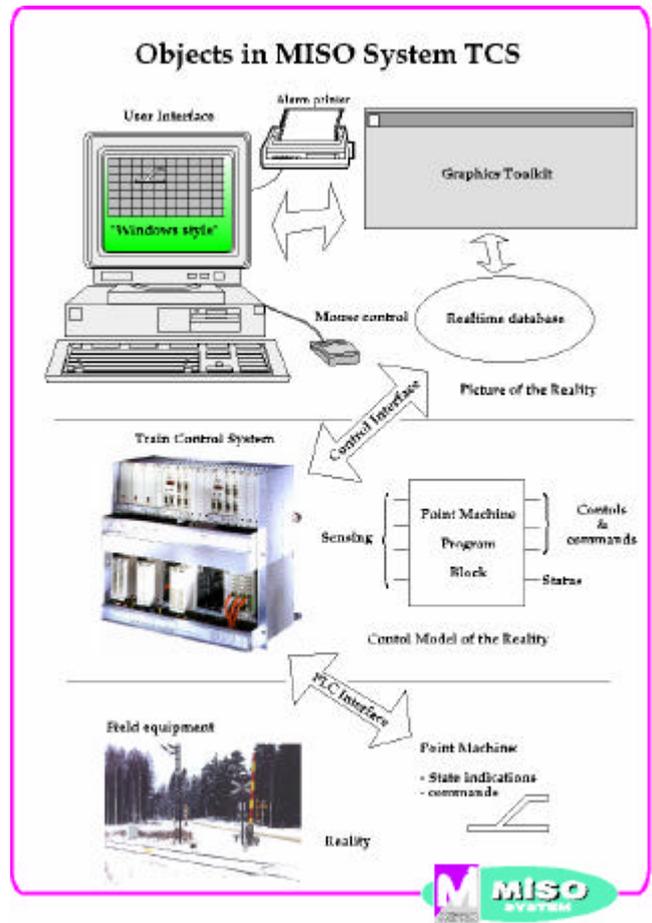
In order to be able to conform the requirements of a train control system it is essential to find out a method to communicate information among the members of a design team (customer, system operators, constructor, safety authority, communication system provider, system integrator) . Normally the team is a collection of individuals with different engineering and cultural backgrounds.

By combining modern design methods (like UML, SA) and existing knowledge of the interlocking systems currently in use it is possible to create the model for the project. As the TCS philosophy is based on an object oriented approach it is important to divide the total project in to smaller pieces which may be handled (defined, programmed, tested) as individual objects.

The object orientation in TCS goes throughout the total system from the input/output connectors to the visual appearance in the graphical operator terminal.

### 1.4 Hierarchy of modular interlocking

In the internal system level the TCS system forms an object oriented picture of reality. The control and interlocking functions may be located in a single TCS unit



In more complex and geographically disperse systems the functions and collections of objects will work on separate physical interlocking units.

The interlocking and system data is transferred through the communication system across the TCS network.

The total system may contain several parallel interlocking

subsystems as well as several hierarchy layers.

### 1.5 Combined functionality

The functional possibilities of the HIMA safety PLC family have made it possible to combine several types of functions in a single unit. One example is a small station interlocking system with railroad crossing functionality. The system provides the functions of a level-crossing control, local track interlocking, remote operations and even support for local operator terminal.

### 1.6 Standard signal interfaces

The basic signal level is 24VDC. The input circuits use potential free relay contacts. With a special wire-test board the input wires may be tested against short circuit or wire brake safely up to the contact.



The system can accept 4-20 mA analog signals, which may be used for temperature etc. measurements. The output is 24VDC / from 500 mA to 2 A per channel. Also the output boards may contain the external wire testing feature. This makes it possible to detect various types of problems in actuators even before they cause active problems.





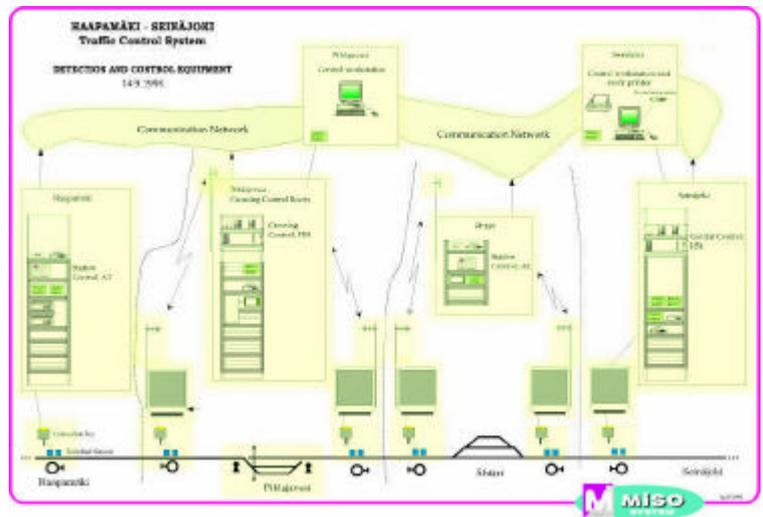
## 3 Connectivity

### 3.1 Remote operations through the telecom infrastructure

Railroad operators have usually built extensive telecommunication systems along the railroads and facilities. They are needed for station to station safety communication purposes as well as carrying the voice channels for the train radio systems.

The communication system may be an analog telephone network with only limited channels up to modern multi-functional digital telecommunication network with combined voice and data communication capabilities.

It's possible to configure the TCS system from only double telephone channel, multi-drop, system structure up to modern TCP/IP networking scheme.



### 3.2 Networking of the operator workstations.

The operator terminals may be connected together in the railroad operators intranet (TCP/IP) to form a multi-operator environment or to conduct the train operations from a remote location. The network connection also makes it possible to use the event and alarm information for maintenance personnel. The user management of the terminal may be configured so that unauthorized users may not use the services of the unit.

### 3.3 Interfacing to existing systems

In railway applications it is very rare that the application will be made from scratch. There are always existing systems to connect to. The most common way to connect to the relay based systems is to use the TCS input/output circuits with safety approved relays.

The standard interfaces to external computerized systems are made either by using industry standard protocols like OPC, Profibus or Modbus. Some manufacturers also provide proprietary protocol specifications for external interfaces.

### 3.4 Universal wayside signal interface

The Universal Wayside Signal Interface (UWSI) may be configured to interface several types of signal units and ATC equipment. The mechanical part of the unit is based on well-proven safety relay interlocking circuits. The control of the unit is part of the TCS module or a totally separate – stand alone TCS unit.

### 3.5 Universal point machine interface

The universal point machine interface (UPMI) handles the interface functionality of a modern point machine. The principal design of the unit is similar to UWSI.

### 3.6 Train Detection Unit

For train detection TCS introduces wheel detection and axle-counting subsystem (TDU) for detecting trains in the various points of the network. The TDU unit has two sensors and two separate processors to perform the calculations.

The unit may be connected to higher level systems via a communication link. The final calculations and interlocking decisions are performed in the controlling TCS unit.

The TDU may be used in several types of railway applications like detecting train speed and direction as well as to sense the train in level-crossing applications.

