

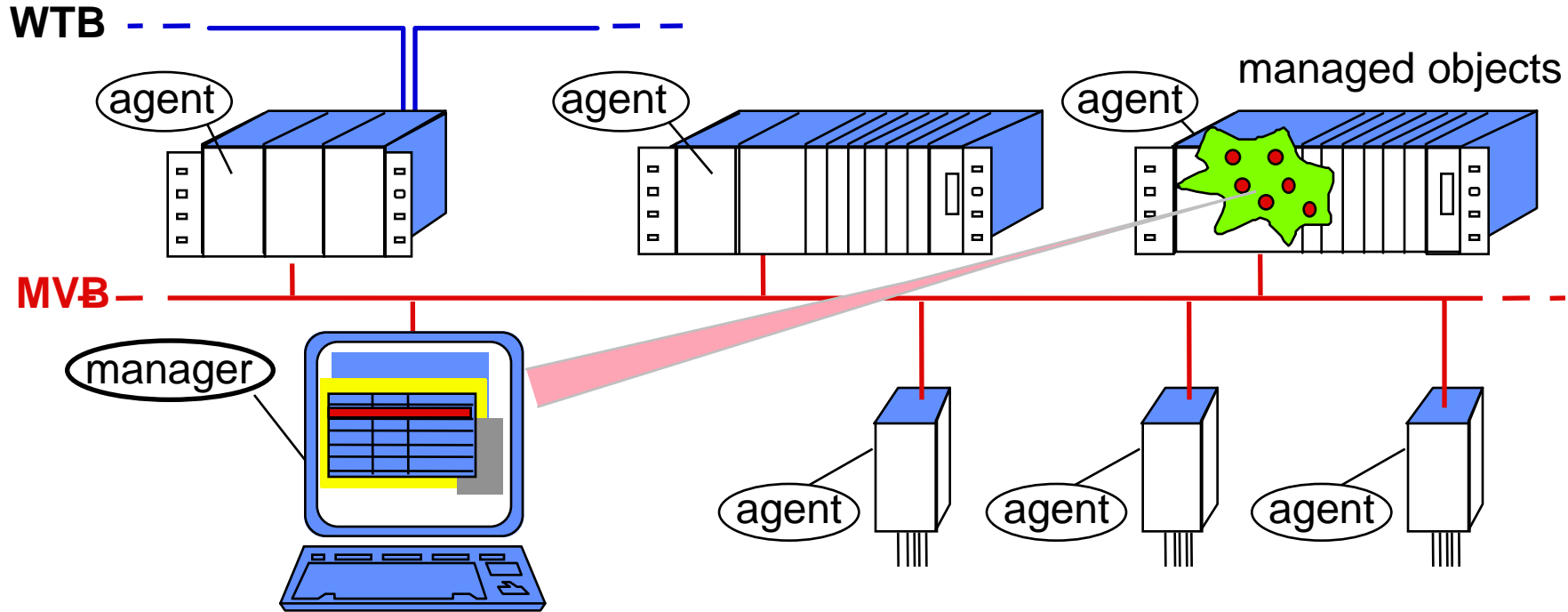
Train Network Management

Services for remote device configuration, monitoring and diagnostics

standardized in IEC 61375

application to ROSIN Maintenance System (RoMain)

Train Network Management



Network Management defines a set of services for:

- development, testing and conformance testing
- commissioning: configuration, downloading, routing and marshalling
- operation: error and performance monitoring
- maintenance: evaluation of error reports, access to equipment information

Train Network Management Services

Train Network Management is a set of services implemented in each device, allowing:

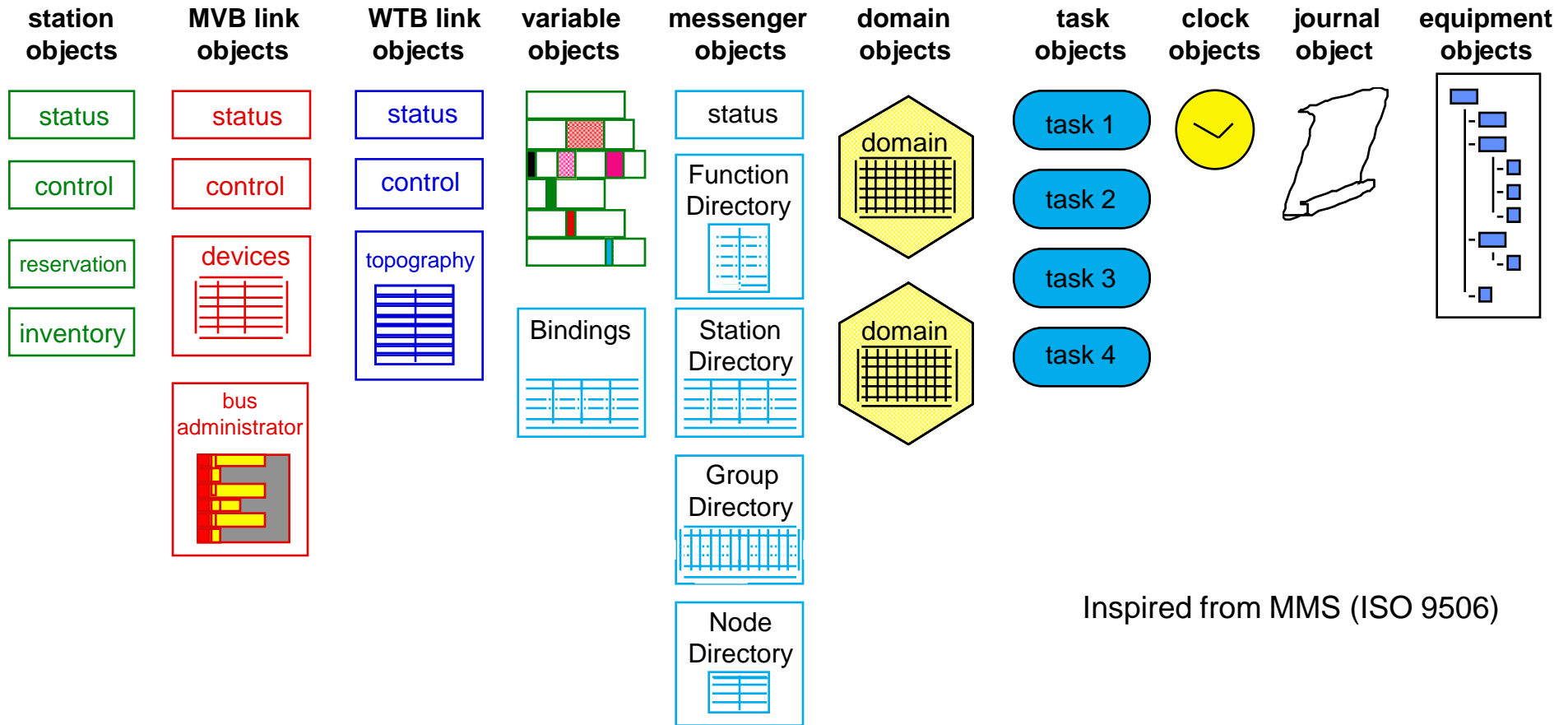
- **Remote Identification of the device**
- **Reservation of the device for configuration**
- **Download and Upload**
- **Start and Stop of tasks on the device**
- **Inventory of the supported functions**
- **Inventory of the exported and imported variables**
- **Remote access to network and internal variables**
- **Clock synchronisation**
- **Error Log reading (redundancy support)**
- **Identification of the supported equipment**

The Network Management services allow full control of all attached devices.

It is the base for tool access to own devices and foreign devices

TNM controls the control system, not the applications (except start/stop).

Summary of managed objects

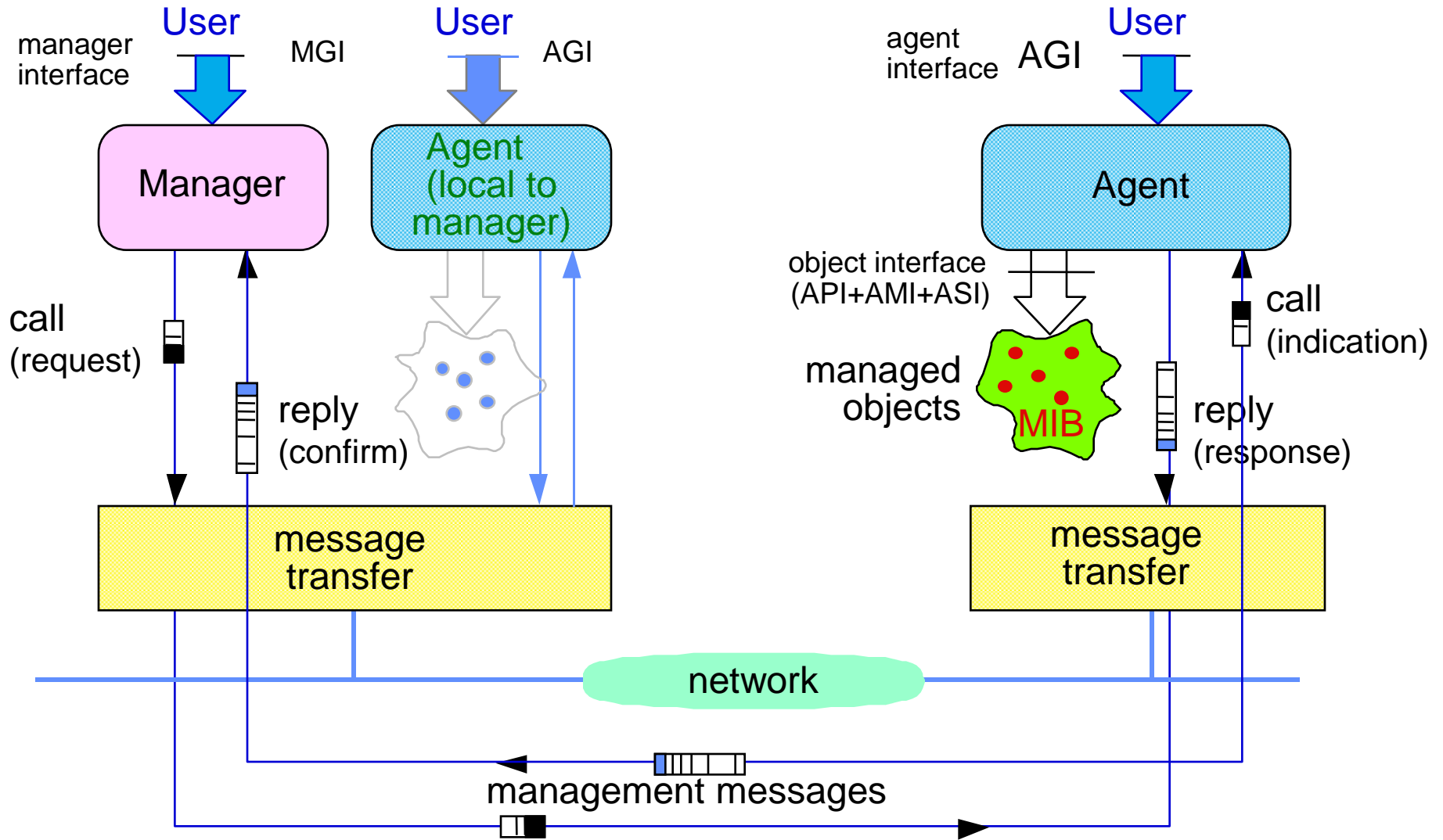


Inspired from MMS (ISO 9506)

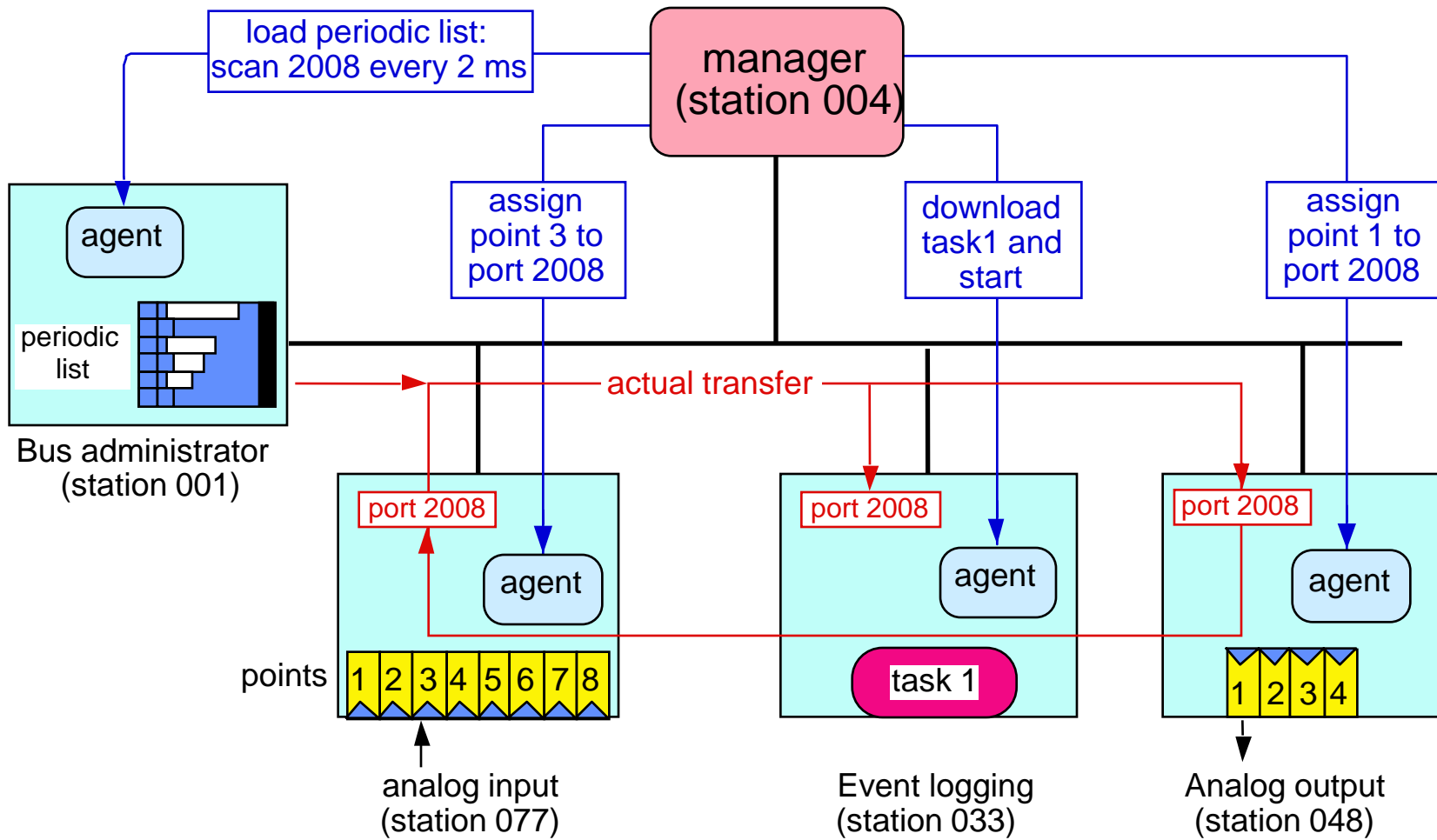
All objects have read or write services, and special services such as:

- | | | | |
|---------|----------|---------------|-------|
| reserve | force | set_up | start |
| release | unforce | download | stop |
| | bindings | upload | |
| | attach | verify_domain | |

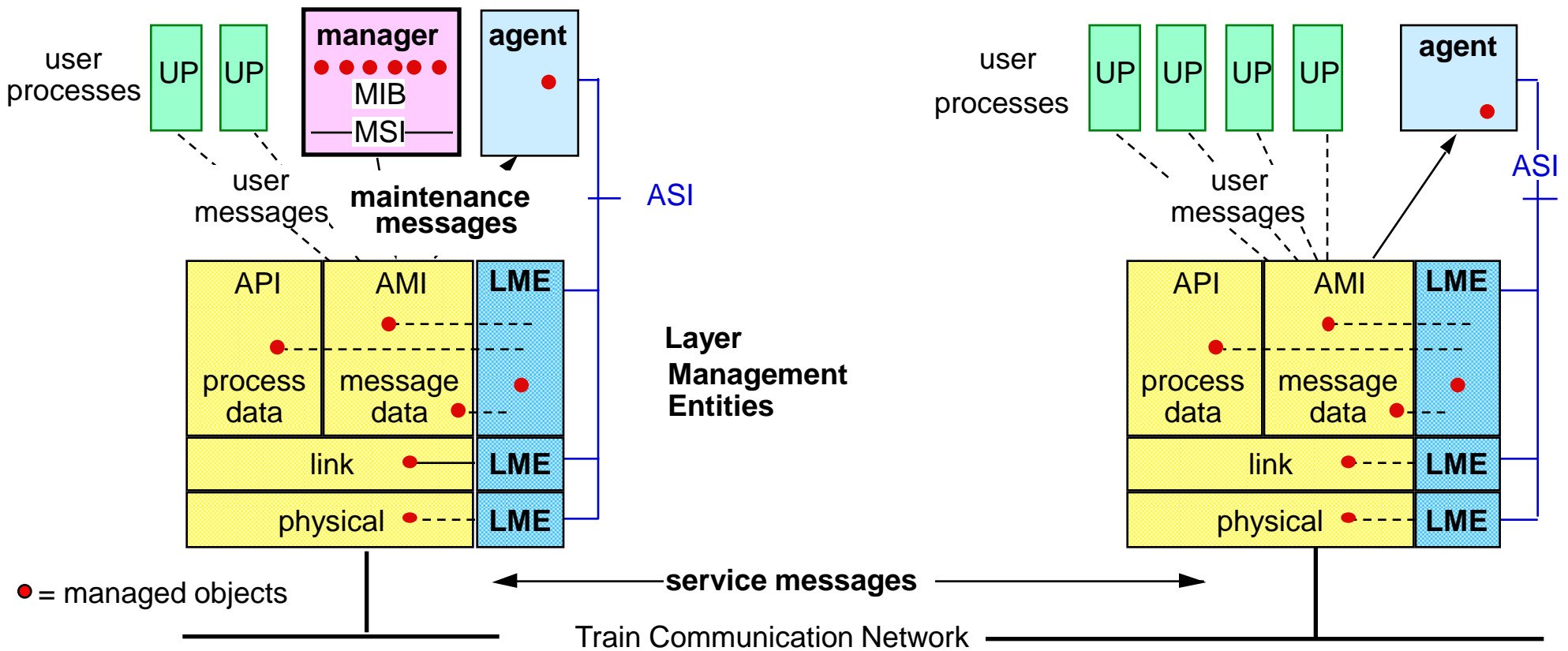
Access to Managed Objects



Example of use: configuring Class 2 devices and bus administrator

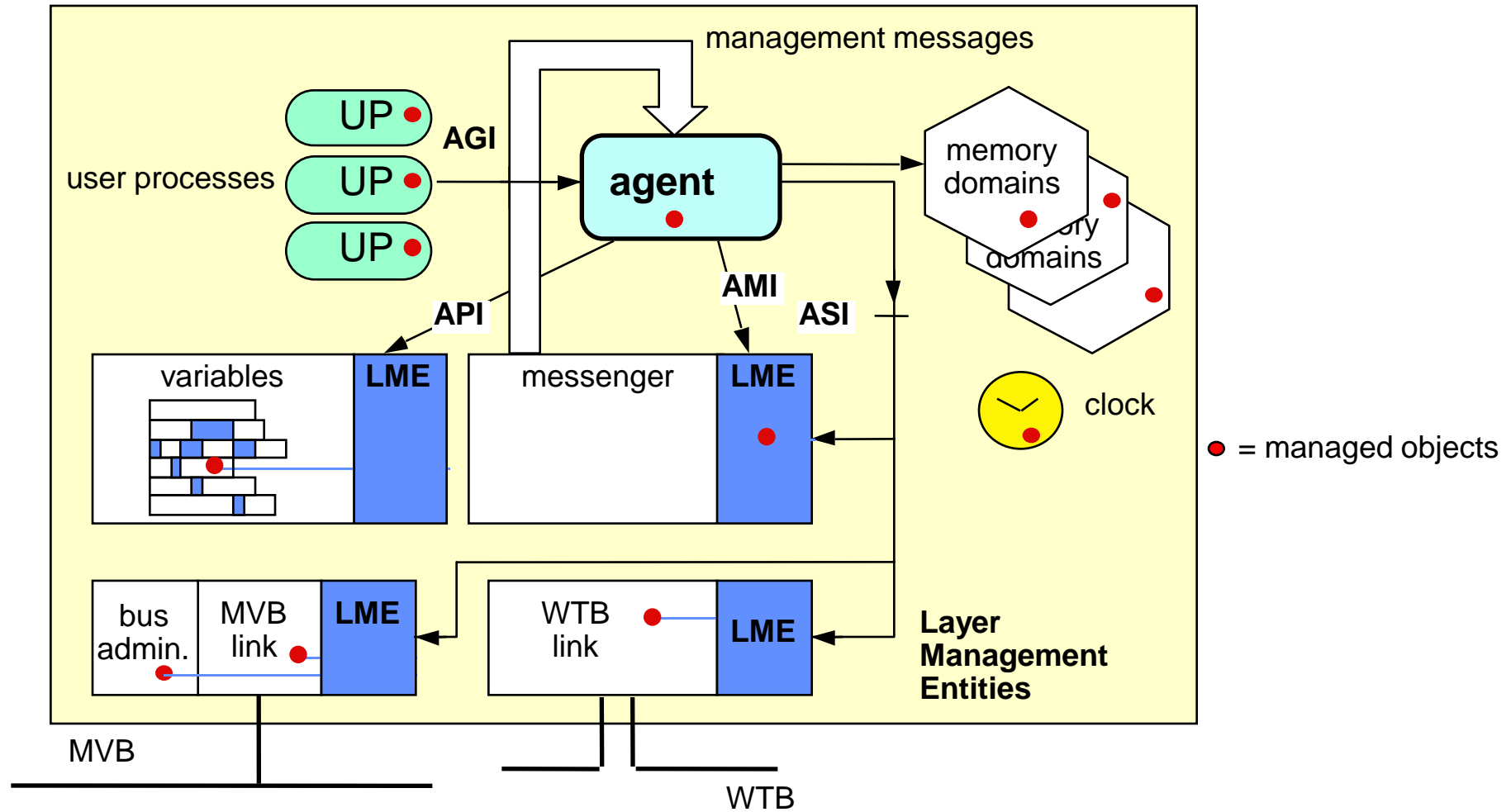


TNM access to managed objects



The manager commands remote agents by reading and writing their managed objects

Access to Local Objects

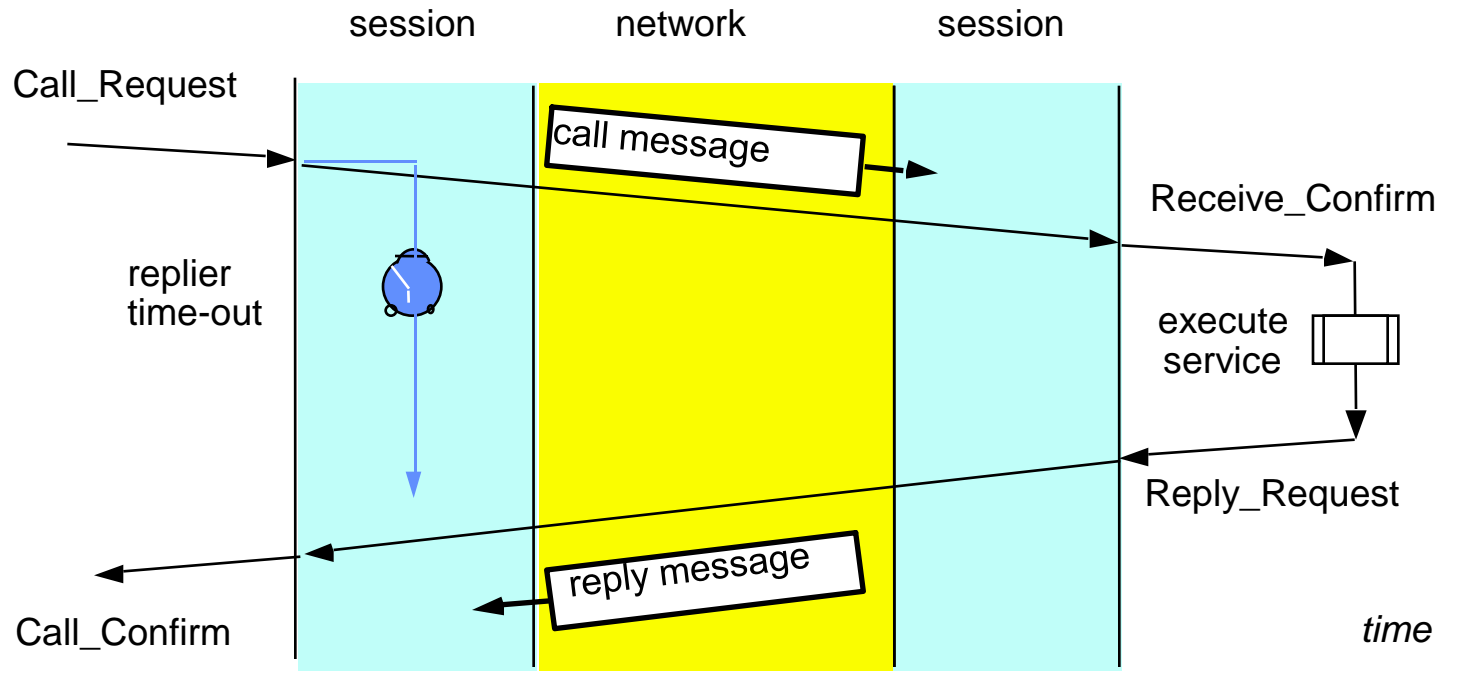


The agent accesses its objects through interfaces called LME (Layer Management Entity)

Management Messages

Manager (caller)

Agent (replier)

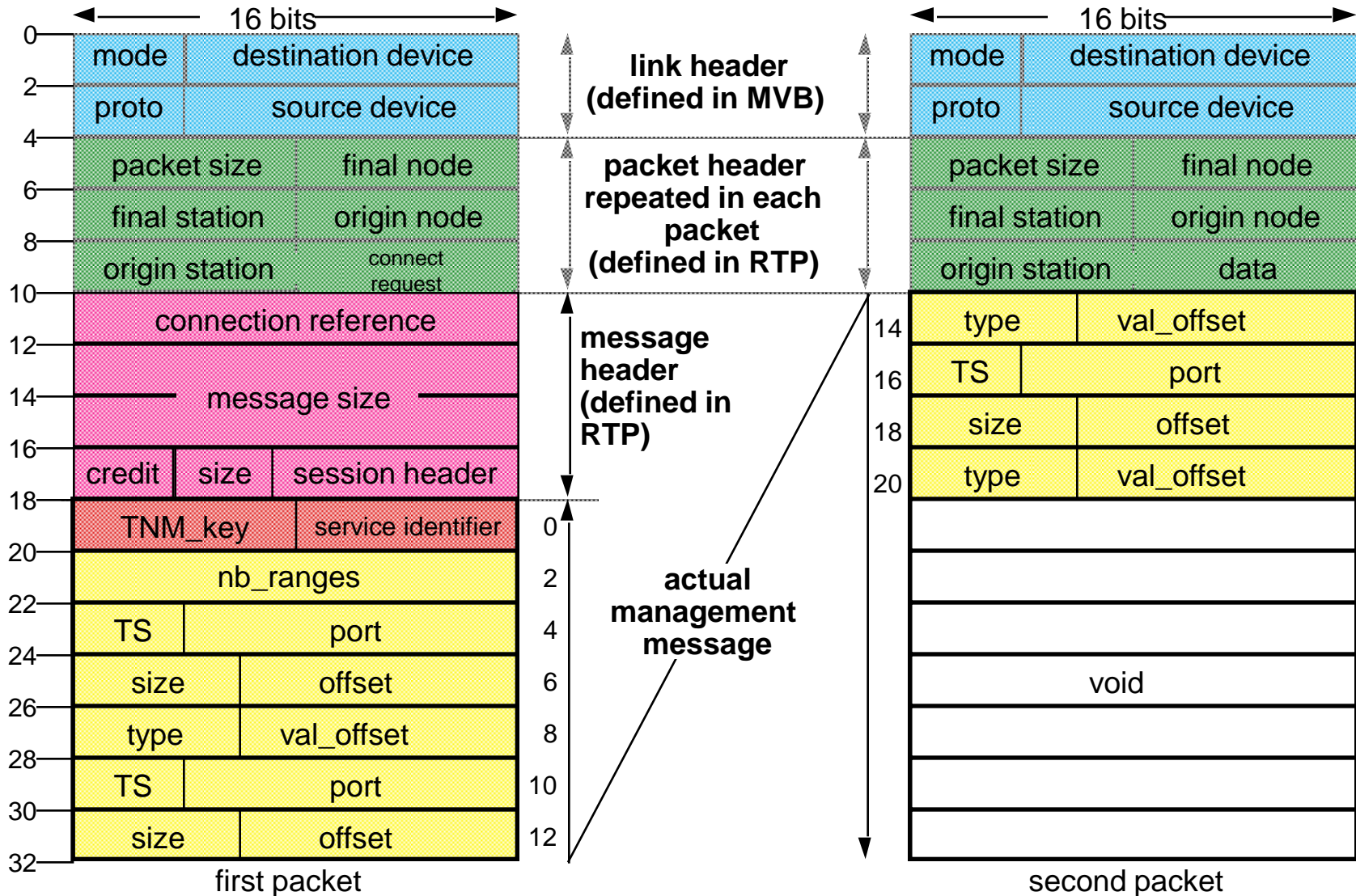


Management messages use the RTP's Call-Reply Message Transfer Protocol.

The manager sends a call message, the agent responds by a reply message.

A time-out supervises the presence of the agent. The agent does not send spontaneously

Management Message Format (example)



TNM Messages Syntax

The message syntax specifies each bit and its position in the message.

A graphical view allows an intuitive view for the programmer.

A textual syntax based on ASN.1 (IEC/ISO 8824) allows to parse the messages

Graphical view

Text View

| | | |
|-----------------|-----------------------|--|
| ... | | |
| suitable_period | UNSIGNED8, | -- suitable period of the variable as power of 2 of 1 ms (e.g. 4 = 16 ms). If the variable should be asked on demand, it equals 'FF'H. |
| standard_type | ENUM16, | -- application-defined standard type. |
| desc_length | UNSIGNED8, | -- length of the description in octets. |
| description | ARRAY[desc_length] OF | -- description of the meaning of the variable. |
| { | | |
| char | CHARACTER8, | |
| } | | |
| ... | | |

Station Objects

Static information

Vendor, Serial Number, Version, Station ID and Station Name

List of services supported by the agent

Device class: (class 2/3, bus administrator, gateway)

List of supported link layers

Dynamic information

List of supported functions

Software Version

Station identifier (some device have a static identifier)

Services

Read inventory

Read status

Write reservation

Write control

Attach ports (Class 2 devices)

MVB Link Management

Static information

Identification (Hardware, software)

Dynamic settings

Configuration of the bus administrator:

Periodic List

Known Devices List

Bus Administrators List

Turn duration

Reply Time

Control: enable, disable; switch lists, pass mastership

Dynamic status

Device Statuses

Line redundancy

Link Error Counter

Device List

Services

read status, read devices_list, write control, write configuration

WTB Link Services

Static information

Identification (Hardware, software)

Dynamic settings

Node Types

Control: enable, disable mastership

Dynamic status

Link Status

Nodes List

Topography

Services

read status, read nodes list, read topography, write control

Process Variables Management

Objects

clusters of variables in traffic stores identified by their PV_NAME

Services

read (with sink time supervision)

force

unforce

unforce_all

read traffic store configuration

included in supervisory interface:

- creation of traffic store

- definition of variables

- definition of dataset lists

- definition of cluster lists

Messages Transfer Management

Static objects

- Messenger ID and version

- Settings

- Number of Instances

Dynamic objects

- Error Counter

- Retries

- Reply time-out

- Packet life-time

Routing objects

- function directory

- station directory (if implemented)

- group directory

Services

- read status, read/write directories

Memory Domain Management

Objects

Domains are down-loadable memory regions

Domains may be loaded into RAM or flash-EEPROM

Domains may contain configuration tables, parameters, programs

Services

download_set_up prepares downloading, verify, boot

download_segment downloads a segment

read_memory accesses individual variables

write_memory

Task, Clock and User Services

Tasks

Managed objects

tasks (all tasks are treated as a whole)

Services

start, stop, reset, synchronize

Clock

Services

read clock, set clock

User-defined services

Services

call mechanism (server subscription)
description (short string)

Differences with other Network Management

| | TNM services | MMS, FMS |
|--------------------|--------------------------|------------------------------|
| encoding | plain | BER (ISO) |
| protocol | remote procedure call | own protocol (MMFS) |
| station descriptor | yes | Virtual Manufacturing Device |
| variables | read, write force | read, write (remote) |
| domains | upload, download, verify | upload, download |
| tasks | start/stop all | program invocations control |
| semaphores | reservation | various |
| events | done by messages | event management |
| journal | done by diagnostic task | journal management |
| files | none | uses FTAM |
| clock | read, set | none |

Strengths of TCN Network Management

- builds on MAP (MMS), Profibus (FMS), OSI (10164) and TCP/IP (SNMP)
- minimum set of objects and services
- no encoding information in PDU: all data types are predefined, simple parsing
- user-defined services can be included
- comprehensive domain download
- supports several link layers and routing
- tailored to the needs of the Train Communication Network

Toward Plug & Play

The information provided by network management in the devices allows plug & play

All devices are self-identifying (manufacturer, software version, etc)

A (known) device can be replaced by an off-the-shelf device and downloaded.

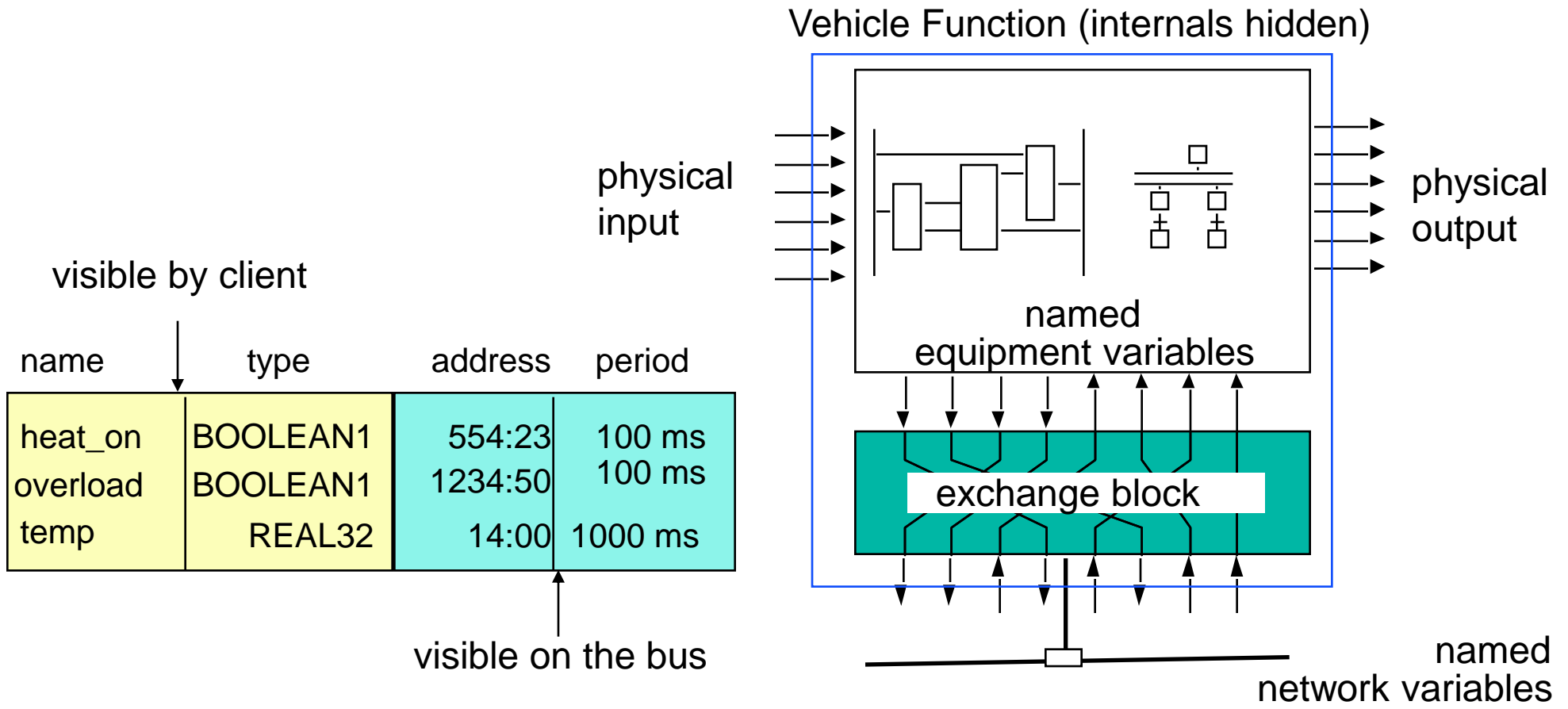
An unknown device can be inspected and its variables bound into the network

Network variables and Network functions can be bound separately

All equipment information is available as visible names of devices, variables, functions)

TNM is the base for integrating off-the-shelf and foreign devices

Variables Marshalling



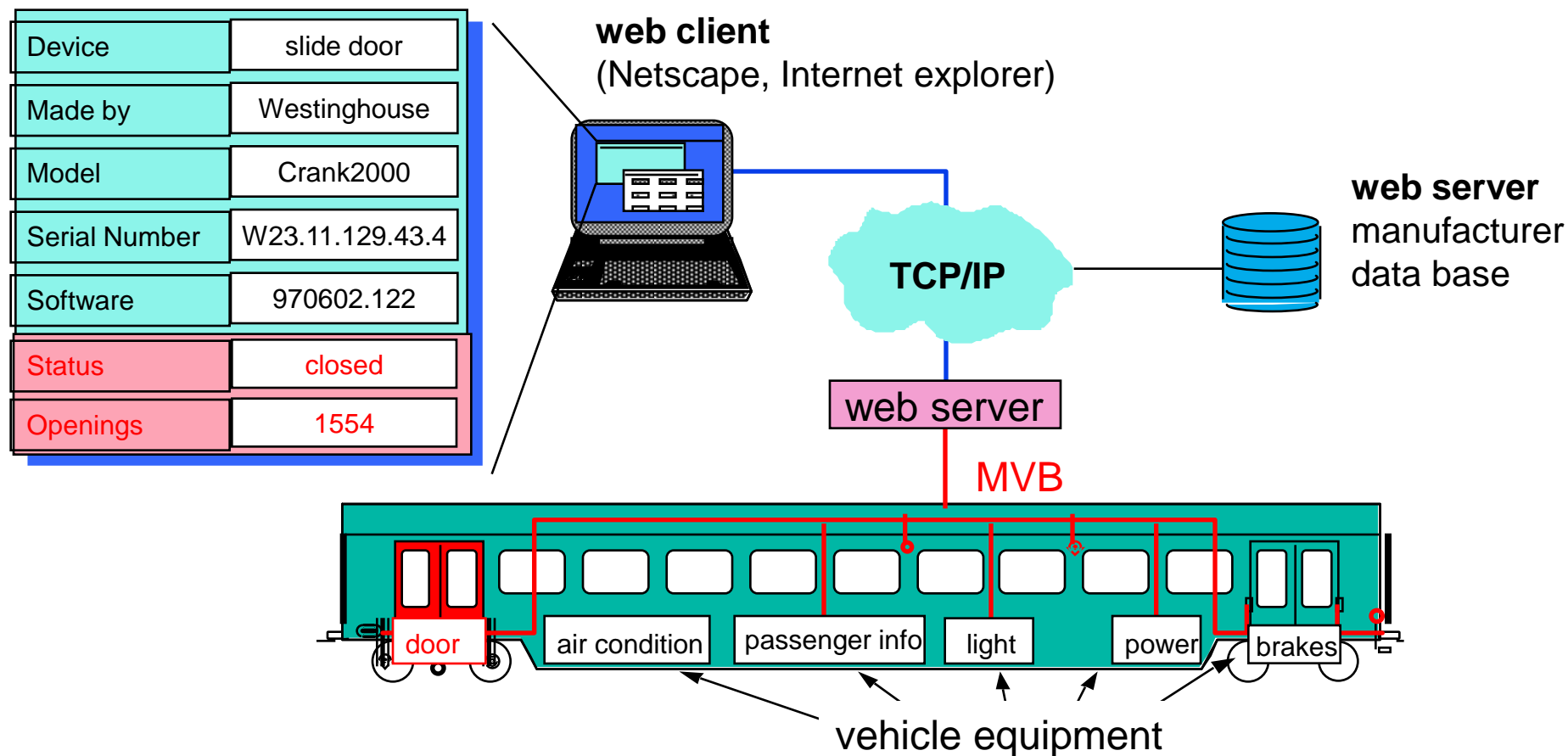
The exchange block can be parametrized by network management services
 The vehicle function itself is not user-programmable (but parametrizable)

RoMain: Equipment Access over the Internet

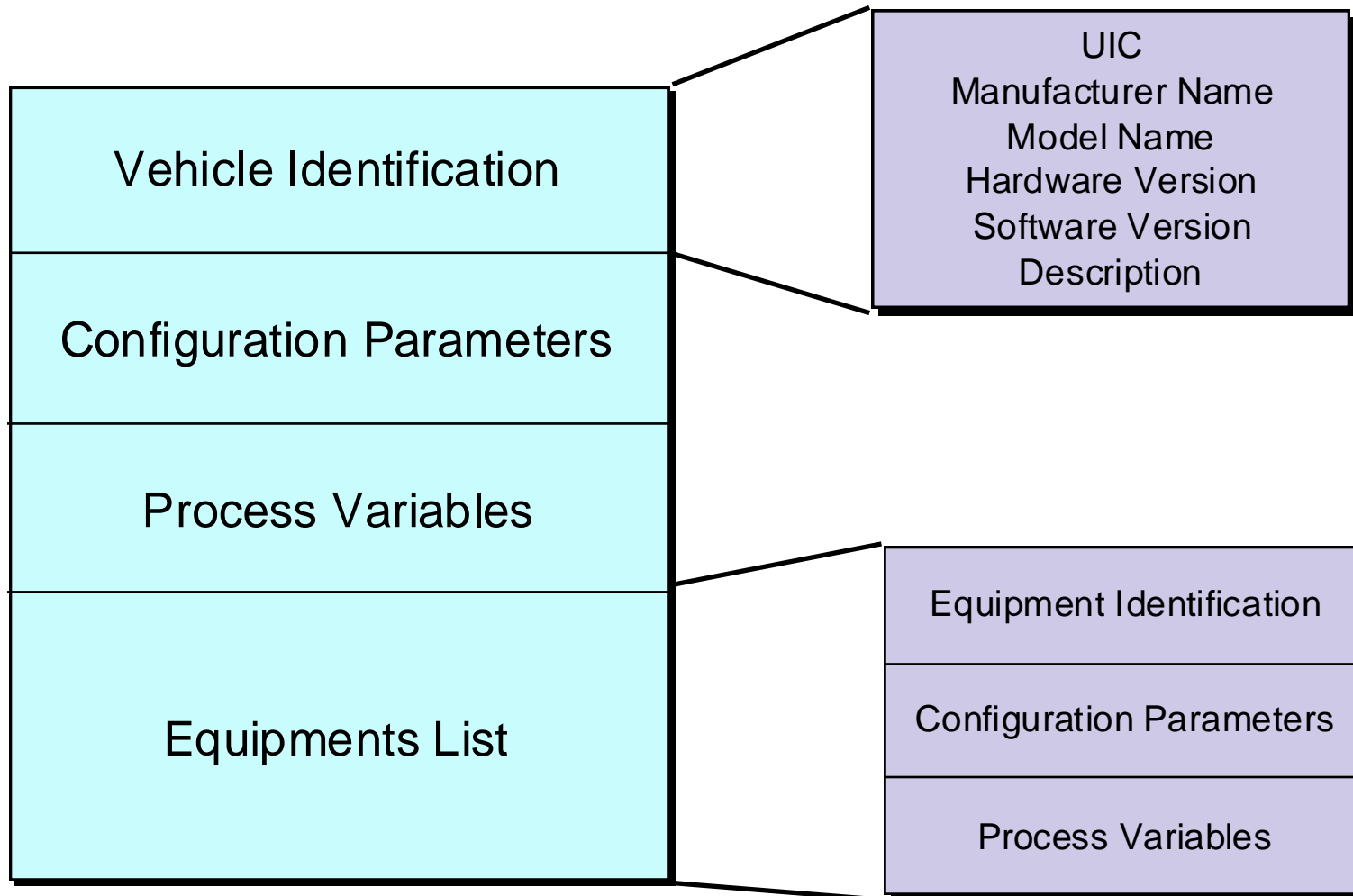
Communicate with on-board equipment without previous knowledge

Any maintenance workshop in Europe can determine the configuration of a vehicle

Internet technology offers a very comprehensive set of functions

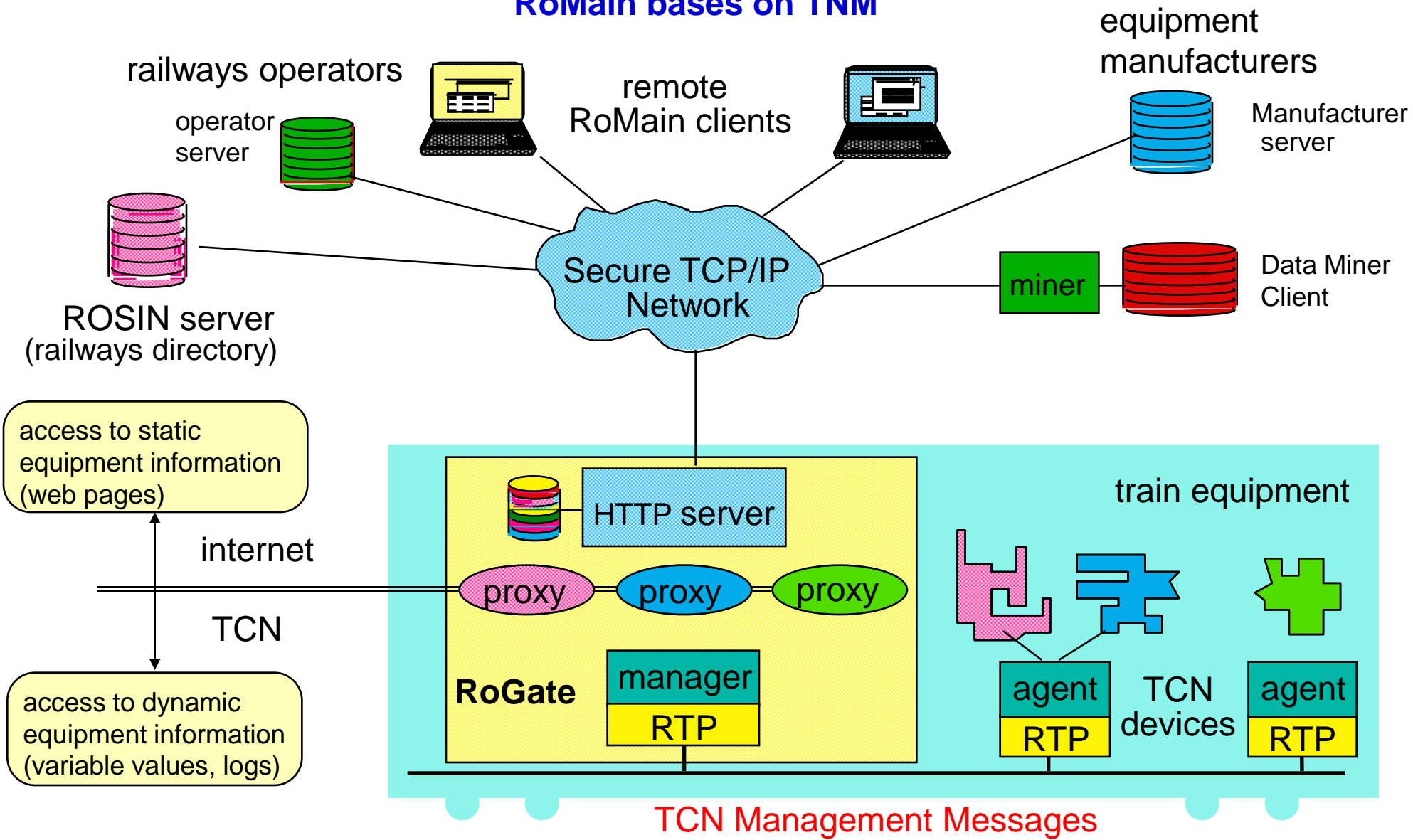


Vehicle and Equipment Identification



The Agent provides the equipment descriptors, which identify the equipment (not the device)

RoMain bases on TNM



TNM Services for RoMain

TNM allows the Web Proxy to access the TCN devices.

The alternative would be to implement directly TCP/IP (or DCE/IP) on each device.

Each device would become an internet server, which makes it too costly for simple I/O.

The following network management services have been added for RoMain:

- Equipment Descriptor: reads the static and dynamic basic information
- Bind / Unbind variables: read/write the variables exported and imported by the device
- Bind / Unbind functions: read/write the functions exported and imported by the device
- Read/Write physical variables (for retrofit)
- Files (event log for equipment, as opposed to journal for device)

Conclusion

TNM provides the base for simpler engineering of own and foreign equipment

ROSIN / RoMain require TNM services to avoid costly special solutions for each new device.

Agent Implementation is simple (just a simple parser), but requires a close cooperation with the devices builders.

The complexity lies in the implementation of the LME (Layer Management Entity), which is a functionality which every designer implements sooner or later.

Implementing TNM now rather than later pays off in terms of simpler commissioning.

Although there are TCN-specific functions, TNM can also be used for other networks.