Technical Specification

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Intelligent transport systems — Roadside modules AP-DATEX data interface —

Part 2: Generalised field device basic management

Systèmes de transport intelligents — Interface de données AP-DATEX pour les modules en bord de route —

Partie 2: Dispositif de terrain généralisés — Gestion de base

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Foreword

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This document was prepared by Technical Committee ISO/TC 204, *Intelligent transport systems*.

A list of all parts in the ISO 22741 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

0.1 Background

The need for standardized communication with field devices is growing around the world. Several countries have already adopted application profile data exchange (AP-DATEX) based field device communication standards.

There is a growing opinion, supported by empirical evidence, that standardizing this activity will result in improved intelligent transport service (ITS) performance, reduced cost, reduced deployment time and improved maintainability. The ISO 22741 series extends ISO 15784-3 by defining the management information necessary to monitor, configure and control features of field devices. The data elements defined in all parts of the ISO 22741 series can be used with any protocol, but were designed with an expectation that they would be used with one of the ISO 15784-3 protocols.

By using the approach described in this document, agencies can specify open procurements and systems can be expanded geographically in an open and non-proprietary manner, which reduces the costs, speeds and deployment, and simplifies the integration.

0.2 Overview

AP-DATEX is a collection of proven concepts and principles. AP-DATEX employs the principles of abstraction and standardization. This has led to AP-DATEX being widely accepted as the prime choice for communication between management systems and devices on the Internet, and other communications networks.

This document defines management information for ITS field devices following the AP-DATEX conventions.

0.3 Document approach and layout

This document defines:

a) user needs that are deemed to be common to many types of field devices (Clause 7);

b) requirements for implementing the identified user needs, organized by major feature (Clause 8);

c) security vulnerabilities (Clause 9).

Intelligent transport systems — Roadside modules AP-DATEX data interface —

Part 2: Generalised field device basic management

1 Scope

Field devices are a key component in intelligent transport systems (ITS). Field devices include traffic signals, message signs, weather stations, traffic sensors, roadside equipment for connected ITS (C-ITS) environments, etc.

Field devices often need to exchange information with central devices (managers). Field devices can be quite complex necessitating the standardization of many data concepts for exchange. As such, the ISO 22741 series is divided into several individual parts.

This document identifies basic user needs for the management of virtually any field device and traces these needs to interoperable designs. This includes the ability to identify the device, its capabilities and its status.

ISO 22741-1 provides additional details about how the ISO 22741 series relates to the overall ITS architecture.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 22741-1, *Intelligent transport systems — Roadside modules AP-DATEX data interface — Part 1: Overview*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 22741-1 apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

4 Abbreviated terms

I/O input and output

PROM programmable read-only memory

RAM random-access memory

UPS uninterrupted power supply

5 Conformance

This document specifies conformance tables based on the requirements of ISO 22741-1. These tables identify the user needs associated with the part, indicate whether they are mandatory or optional for conformance to that part and trace each feature to the requirements.

6 Architecture

6.1 General

This document defines data for the management and control of roadside field equipment. Figure 1 (ISO/TS 20684-1:2021) depicts the physical view of an interface between manager and field equipment. Manager, which is the manager of the field equipment, can be a central system, another field device, a maintenance laptop or any other device that supports the defined interface.

The field equipment located in the field (e.g. along the roadside) shall have a connection to the manager and may have any number of connections to other ITS-S or external systems.

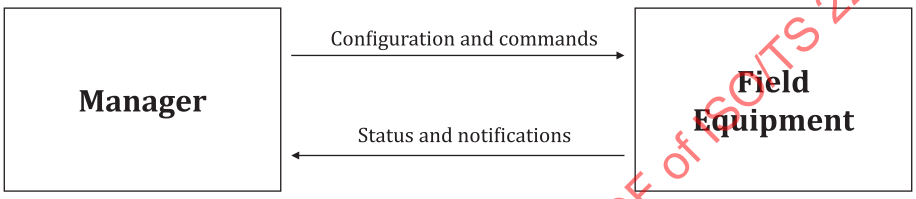

Figure 1 — Physical view of interface

6.2 Functional view of the interface

This document specifies the data concepts used to manage a field device. This document does not define the logic used to manage the field device or the protocols used to exchange the defined data elements. However, the data concepts defined in this document have been defined with the assumption that they would be exchanged using an AP-DATEX.

6.3 Physical view of interface

This document addresses interfaces between field equipment and the physical objects that can potentially manage the field equipment, typically centres and other field equipment. Specific information flows considered within the scope of this document include:

a) device identification;

b) information used to initialize, configure and control the field device.

This document also defines other flows as deemed necessary during the development of detailed designs.

6.4 Communications view of interface

This document addresses the data within the application and management entities of the ITS-S architecture reference model as depicted in Figure 2.

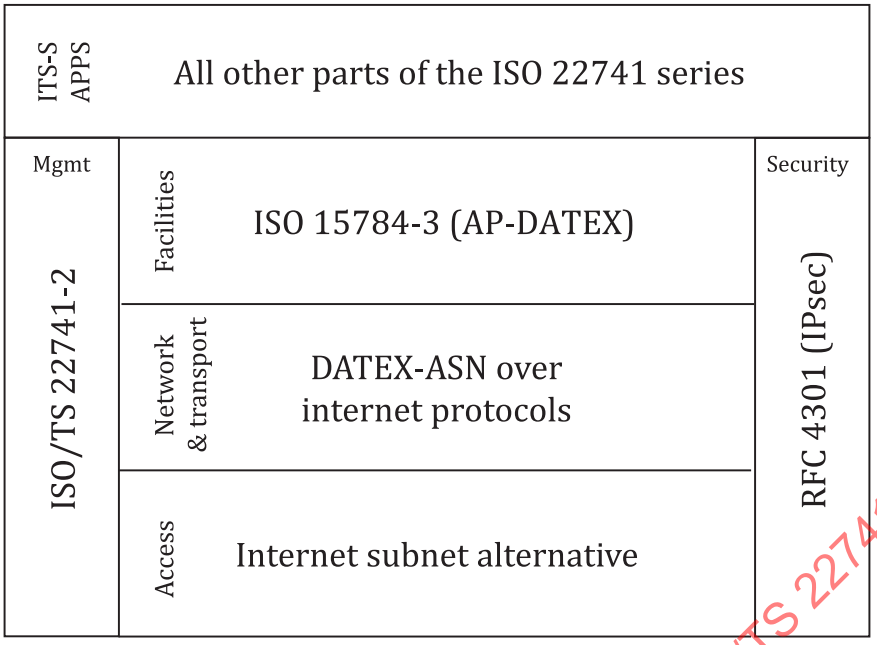

Figure 2 — Architecture reference model

6.5 Security and data protection

DATEX-ASN is typically exchanged using well-known internet protocols, such as UDP/IP or TCP/IP, and can then use IPsec, DTLS, TLS, etc. for security.

7 User needs

7.1 Monitor the field device

A manager needs to be able to identify and monitor the overall capabilities and health of each field device controller and its cabinet to discover anomalous conditions that can potentially affect its operation or security. This will assist the manager in confirming which controller(s) may be in a cabinet, as well as the type and specific instance of each controller and the high-level capabilities offered by the device as well as performing proper maintenance actions.

EXAMPLE A manager that is receiving unexpected errors can wish to verify which device it is communicating with as a part of a debugging process. The manager can also wish to determine if the device configuration has been changed since its last known state so that the appropriate action can be taken if access has not been authorized.

7.2 Monitor and control single-value inputs and outputs

Field devices may be equipped with auxiliary input ports or output ports, or both, that can be connected to simple external devices. It can be necessary for a manager to be able to monitor input ports to enable remote monitoring of simple external devices or control of output ports, or both, to enable remote control of simple external devices.

EXAMPLE 1 A field device can use an auxiliary output to remotely open or close a gate.

EXAMPLE 2 A field device can use an auxiliary input to report current gate position in percentage open.

7.3 Monitor cabinet

7.3.1 Monitor cabinet doors

It can be necessary for a manager to monitor the open/close status of each cabinet door to determine when equipment is being physically accessed.

7.3.2 Monitor and control cabinet fans

It can be necessary for a manager to monitor and control the on/off status of each cabinet fan to manage the cabinet temperature.

7.3.3 Monitor and control cabinet heaters

It can be necessary for a manager to monitor and control the on/off status of each cabinet heater to manage the cabinet temperature.

7.3.4 Monitor cabinet humidity

It can be necessary for a manager to monitor the relative humidity within the cabinet to disable the controller or subsystems in extreme conditions.

7.3.5 Monitor cabinet temperature

It can be necessary for a manager to monitor the air temperature inside of the cabinet to either determine when climate control equipment should be activated or to disable equipment to prevent overheating, or both.

7.3.6 Monitor cabinet AC power

It can be necessary for a manager to monitor the status of the incoming main AC power line, which is typically provided by the power grid to detect when this power is lost or becomes unstable.

7.3.7 Monitor cabinet battery power

It can be necessary for a manager to monitor the status of the battery power system to determine the quality of power and amount of charge available.

7.3.8 Monitor cabinet generator power

It can be necessary for a manager to monitor the status of the cabinet generator power to determine the quality of power being produced and the fuel reserve.

7.3.9 Monitor cabinet solar power

It can be necessary for a manager to monitor the status of the solar power system to determine the amount of power being generated.

7.3.10 Monitor cabinet wind power

It can be necessary for a manager to monitor the status of the wind power system to determine the amount of power being generated.

8 Requirements

8.1 Field device requirements

8.1.1 Field device definition

The field device represents the whole deployed unit including the controller and any attached equipment (e.g. sensors or displays that are alongside or embedded in the roadway).

8.1.2 Field device data exchange requirements

8.1.2.1 Discover basic capabilities of the field device

The field device shall allow a manager to discover the basic capabilities of the field device, including:

a) the maximum message size supported by the field device;

b) the amount of memory supported and available within the field device;

c) the communication services provided by the field device.

8.1.2.2 Configure the field device's identity

The field device shall allow a manager to configure the field device's identity, including its:

a) contact;

b) name;

c) location.

8.1.2.3 Identify the field device

The field device shall allow a manager to identify the field device by retrieving the identity information that was configured for the device along with:

a) a description of the field device implementation; and

b) the unique identifier of the field device implementation.

8.1.2.4 Monitor the field device configuration identifier

The field device shall allow a manager to quickly identify any change to the field device's configuration by monitoring a single parameter.

8.1.2.5 Monitor controller operation

The field device shall allow a manager to determine if any of the following errors are detected:

a) PROM integrity error;

b) RAM integrity error;

c) program/process error;

d) display interface error;

e) general-purpose I/O error;

f) other detected error (specific to make, model and version of device).

8.1.2.6 Monitor controller up time

The field device shall allow a manager to monitor the amount of time the controller has been operating since the last reboot and the number of reboots.

8.1.2.7 Monitor watchdog failure count

The field device shall allow a manager to determine the number of watchdog failures that have occurred.

8.1.2.8 Reset the controller

The field device shall allow a manager to remotely reset the controller.

8.1.3 Field device capabilities

8.1.3.1 Field device performance requirements

The maximum response time for any non-standard request shall be calculated as follows:

a) Identify the minimum number of standardized request messages that contain all of the objects included in the request for which the calculation is being made.

b) The maximum response time for the non-standard request shall be the sum of the maximum response times for all of the standardized requests identified in Step a).

8.1.3.2 Support changeable memory

The field device shall support an amount of changeable memory as specified by the specification.

8.1.3.3 Support volatile memory

The field device shall support an amount of volatile memory as specified by the specification.

8.1.4 Field device design constraints

8.1.4.1 Control access

Under all circumstances, the field device shall only allow each manager to access data to which it is explicitly authorized.

NOTE This includes data that is recorded in logs, sent in notifications, and other indirect access mechanisms.

8.1.4.2 Coordinate multiple managers

Tables that are likely to contain different definitions for different managers shall be designed to easily restrict access to authorized managers and avoid inadvertent conflicts.

EXAMPLE Different managers can have different access rights and can wish to log different information for retrieval. Thus, the log needs to be designed to support a scheme where an administrative manager that has universal rights does not inadvertently change the definition of a log for another manager.

8.2 General-purpose I/O

8.2.1 General-purpose I/O definition

The general-purpose I/O feature indicates whether the device supports any general-purpose I/O functionality, such as external ports, internal sensors, etc., that allow for the input or output, or both, of single-value data. Each port may be input-only, output-only, or bidirectional.

8.2.2 General-purpose I/O data exchange requirements

8.2.2.1 Discover general-purpose I/O capabilities

The field device shall allow a manager to discover the capabilities of the general-purpose I/O feature.

8.2.2.2 Configure general-purpose I/O

The field device shall allow a manager to configure each general-purpose I/O port by defining its:

a) description;

b) minimum threshold (before it reports an error);

c) maximum threshold (before it reports an error).

8.2.2.3 Retrieve configuration of general-purpose I/O

The field device shall allow a manager to retrieve the current configuration of each general-purpose I/O port.

8.2.2.4 Monitor value from general-purpose I/O port

The field device shall allow a manager to retrieve the current value being reported from the general-purpose I/O port.

8.2.2.5 Monitor status of general-purpose I/O port

The field device shall allow a manager to retrieve the current status of the indicated general-purpose I/O port.

8.2.2.6 Monitor status of general-purpose I/O type

For each type of general-purpose I/O port supported by the field device, the field device shall allow a manager to determine if any of the entries of that general-purpose I/O type are reporting errors or outside-of-threshold conditions.

8.2.2.7 Control output value of general-purpose I/O port

The field device shall allow a manager to control the output value of the general-purpose I/O port.

8.2.2.8 Confirm output setting for general-purpose I/O port

The field device shall allow a manager to verify the last output value sent to the general-purpose I/O port.

8.2.3 General-purpose I/O capabilities

8.2.3.1 General-purpose I/O port capabilities

Each general-purpose I/O port shall be defined as one of:

a) input;

b) output;

c) bidirectional.

8.3 Cabinet

8.3.1 Cabinet definition

The cabinet represents the enclosure of the field device controller that hosts the agent that responds to the requests defined by this document.

8.3.2 Cabinet data exchange requirements

8.3.2.1 Configure the cabinet's physical components

The field device shall allow a manager to configure information about the cabinet and each of its major components. The information for each item shall include an alias and asset identifier.

8.3.2.2 Identify the cabinet's physical components

The field device shall allow a manager to identify information about the cabinet and each of its components. The information for each item shall include an alias, an asset identifier, make, model, version and related information. The information shall also indicate the arrangement of equipment, such as the field device controller being contained within the cabinet.

8.3.2.3 Determine power source

The field device shall allow a manager to determine the current power source for the cabinet.

8.3.3 Cabinet power capability requirements

8.3.3.1 Support power sources

The cabinet shall be supported by at least one of the following power sources:

a) mainline (alternating current) power;

b) battery power;

c) generator power;

d) solar power;

e) wind power.

8.3.3.2 Support UPS power

The field device shall support an uninterrupted power supply for the cabinet.

8.4 Cabinet doors

8.4.1 Cabinet door definition

The cabinet door feature indicates the open/close status of each cabinet door monitored by a sensor.

8.4.2 Cabinet door data exchange requirements

There are no cabinet door data exchange requirements beyond those defined for the general-purpose I/O feature.

8.4.3 Cabinet door capability requirements

The field device shall monitor the main cabinet door. The project specification may specify additional cabinet doors which require monitoring.

8.4.4 Cabinet door design constraints

For each cabinet door monitored, the field device shall provide an entry in the general-purpose I/O table where fdGPIOType equals "DO".

8.5 Cabinet fans

8.5.1 Cabinet fan definition

The cabinet fan feature indicates the on/off status of each cabinet fan.

8.5.2 Cabinet fan data exchange requirements

There are no cabinet fan data exchange requirements beyond those defined for the general-purpose I/O feature.

8.5.3 Cabinet fan capability requirements

8.5.3.1 Cabinet fans actively monitored

The field device should monitor each cabinet fan to determine if the fan blades are turning at a significant rate. This provision is an option and if it is selected, the fdGPIOPortDirection for each cabinet fan shall be either input or bidirectional.

8.5.3.2 Cabinet fan control

The field device should allow remote on/off control of each cabinet fan. This provision is an option and if it is selected, the fdGPIOPortDirection for each cabinet fan shall be either output or bidirectional.

8.5.4 Cabinet fan design constraints

For each cabinet fan, the field device shall provide an entry in the general-purpose I/O table where fdGPIOType equals "FO".

8.6 Cabinet heaters

8.6.1 Cabinet heater definition

The cabinet heater feature indicates the on/off status of each cabinet heater.

8.6.2 Cabinet heater data exchange requirements

There are no cabinet heater data exchange requirements beyond those defined for the general-purpose I/O feature.

8.6.3 Cabinet heater capability requirements

8.6.3.1 Cabinet heaters actively monitored

The field device should monitor each cabinet heater to determine if the heater is generating significant heat. This provision is an option and if it is selected, the fdGPIOPortDirection for each cabinet heater shall be either input or bidirectional.

8.6.3.2 Cabinet heater control

The field device should allow remote on/off control of each cabinet heater. This provision is an option and if it is selected, the fdGPIOPortDirection for each cabinet heater shall be either output or bidirectional.

8.6.4 Cabinet heater design constraints

For each cabinet heater, the field device shall provide an entry in the general-purpose I/O table where fdGPIOType equals "HO".

8.7 Cabinet humidity

8.7.1 Cabinet humidity definition

The cabinet humidity feature indicates the current relative humidity of the air within the cabinet.

8.7.2 Cabinet humidity data exchange requirements

There are no cabinet humidity data exchange requirements beyond those defined for the general-purpose I/O feature.

8.7.3 Cabinet humidity capability requirements

The field device shall support at least one cabinet humidity sensor. The project specification may specify support for additional cabinet humidity sensors.

8.7.4 Cabinet humidity design constraints

For each cabinet humidity sensor, the field device shall provide an entry in the general-purpose I/O table where fdGPIOType equals "CH".

8.8 Cabinet temperature

8.8.1 Cabinet temperature definition

The cabinet temperature feature indicates the current temperature of the air within the cabinet.

8.8.2 Cabinet temperature data exchange requirements

There are no cabinet temperature data exchange requirements beyond those defined for the general-purpose I/O feature.

8.8.3 Cabinet temperature capability requirements

8.8.3.1 Cabinet temperature monitored

The field device shall support at least one cabinet temperature sensor. The project specification may specify support for additional cabinet temperature sensors.

8.8.4 Cabinet temperature design constraints

8.8.4.1 Cabinet temperature monitored through general-purpose I/O

For each cabinet temperature sensor, the field device shall provide an entry in the general-purpose I/O table where fdGPIOType equals "CT".

8.9 Cabinet AC power

8.9.1 Cabinet AC power definition

The cabinet AC power feature indicates the status of the main AC power line into the cabinet, which is generally provided from the power grid.

8.9.2 Cabinet AC power data exchange requirements

There are no cabinet AC power data exchange requirements beyond those defined for the general-purpose I/O feature.

8.9.3 Cabinet AC power capability requirements

8.9.3.1 Cabinet AC power voltage

The field device shall support at least one voltage sensor for the cabinet AC power. The project specification may specify support for additional voltage sensors for the cabinet AC power.

8.9.3.2 Cabinet AC power current

The field device shall support at least one electrical current sensor for the cabinet AC power. The project specification may specify support for additional electrical current sensors for the cabinet AC power.

8.9.4 Cabinet AC power design constraints

8.9.4.1 Cabinet AC power voltage monitored through general-purpose I/O

For each cabinet AC power voltage sensor, the field device shall provide an entry in the general-purpose I/O table where fdGPIOType equals "LV".

8.9.4.2 Cabinet AC power current monitored through general-purpose I/O

For each cabinet AC power electrical current sensor, the field device shall provide an entry in the general-purpose I/O table where fdGPIOType equals "LA".

8.10 Cabinet battery

8.10.1 Cabinet battery definition

The cabinet battery feature indicates the status of the main cabinet battery, which is generally charged by an external source such as a solar array.

8.10.2 Cabinet battery data exchange requirements

There are no cabinet battery data exchange requirements beyond those defined for the general-purpose I/O feature.

8.10.3 Cabinet battery capability requirements

8.10.3.1 Cabinet battery voltage

The field device shall support at least one voltage sensor for the cabinet battery. The project specification may specify support for additional voltage sensors for the cabinet battery.