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Irrigation techniques — Remote monitoring and control for irrigation —

Part 3: Interoperability

Techniques d'irrigation — Surveillance et commande à distance pour l'irrigation —

Partie 3: Interoperability

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry,* Subcommittee SC 18, *Irrigation and drainage equipment and systems.*.

A list of all parts in the ISO 21622 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

The purpose of this document is to allow interoperability between the different elements of an irrigation system that exist side by side in the same installation. The introduction of a standard in irrigation control systems will lead to improvements in irrigation programming practice and establish a clear separation between decision making and decision implementation.

This document establishes the specification and location of communication interfaces to be implemented in order to enable the data exchange on commercial products, as well as its integration in an interoperable architecture.

This document defines the mechanisms to exchange and integrate data from remote monitoring and control systems (RMCS) for irrigation, making it available to any management information system (MIS) with permissions.

A manufacturer can adopt this document in all the described levels or specifically in one of them, implementing only the speficications of application to its product.

— The application of this document to a subsystem (RMCS) involves:

a) the implementation of the architecture defined at Clause 4, including the subsystem and the event interfaces, exclusively with the actions supported by this subsystem. Clauses 5 and 6 are related to the kinds of irrigation entities that can be controlled and/or monitored. Its data will be available to any consumer with permissions that implements the defined interface.

b) the implementation of one of the proposed technologies for the subsystem and the event interfaces. The available implementations are described in the Annexes B or G for subsystem interface, and Annexes C or H for event interface. The developer can use any of these sets (Annexes B and C, or Annexes G and H) to implement this document. The implementation can be validated using the tests for subsystems. included in the Annex D.

— The application of this document to a management information system (MIS) involves:

a) the implementation of the architecture defined at Clause 4, including the management interface, exclusively with the actions supported by this MIS. To access data from a subsystem the MIS requires permissions.

b) the implementation of one of the proposed technologies for the management interface. The available implementations are described in the Annexes A or F. The developer can use any of the two to implement the standard. The implementation can be validated using the tests for MIS. included in the Annex D.

— The application of this document to a coordination broker involves:

a) the implementation of the architecture defined at Clause 4 and all its interfaces.

b) the implementation of the interfaces performed using all the technologies used in the implementation annexes (Annexes A, B, C, F, G and H). The implementations can be validated using the tests for coordination brokers, included in the Annex D.

c) Annex E, defines two sets of functionalities for the development of a coordination broker.

Irrigation techniques — Remote monitoring and control for irrigation systems —

Part 3: Interoperability

1 Scope

This document establishes requirements for interoperability among systems developed for management and/or control of irrigation facilities. It can be applied under any technological platform and in any type of irrigation system, regardless of the water management scheme.

This document does not define hardware or software requirements for any of the systems to which it applies. It only concerns externally visible interfaces and places no restriction on the underlying implementations. It has been designed to avoid interference with proprietary solutions subjected to intellectual property. From the point of view of the data exchange, and to guarantee interoperability based on the previous premises, this document defines three communication interfaces (interface with management, interface with events and interface with subsystems) and the architecture to which these interfaces apply. Three levels of architecture has been defined to accommodate these interfaces:

— The Management Level, where any MIS conforming with this document is located. Out of all available data exchange methods, each MIS only implements those required to execute its functionalities.

— The Higher Control Level: coordination. At this level is performed the data integration among RMCS and the access control to it. A software element, called coordination broker, ensures this integration and allows the use of different technologies in its interfaces.

— The Lower Control Level: RMCS. These can also be referred to as irrigation subsystems. The RMCS perform the duties of the irrigation entity(s) under its control.

A coordination broker can be developed as a product by any of these manufacturers or by an independent developer using the standard specifications for this kind of software.

2 Normative reference

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 8601, *Data elements and interchange formats. Information interchange — Representation of dates and times*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

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

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

3.1
action
application of a *method* (3.7) to exchange data leading to accomplish typical irrigation duties

3.2
coordination broker
message broker pattern aplication responsible for the mapping of irrigation entities, for the collection and consolidation of their data, and for the management of the *procedural elements* (3.13) executed by them

Note 1 to entry: It shall conform with the management, *subsystems* (3.20) and events interfaces.

3.3
interface with events
functional connection that enables the exchange of information about events (according to IEC 62682) between the *coordination broker* (3.2) and the *subsystems* (3.20)

3.4
interface with management
functional connection that enables the exchange of information between MIS applications and the *coordination broker* (3.2)

3.5
interface with subsystems
functional connection that enables the exchange of information between the *coordination broker* (3.2) and the *subsystems* (3.20)

3.6
message broker pattern
architectural software pattern for message validation, transformation and routing

Note 1 to entry: A message broker is a software product designed as an intermediary to facilitate interactions between third-party applications. The message broker can also be called interface engine or integration broker.

3.7
method
mechanisms established for the exchange of data between interoperable systems

3.8
MIS application
computer program aimed at administrative and/or Operational decision-making in the irrigation entities

Note 1 to entry: A MIS is a tool acquired for an organization (like a User Community or an Irrigator) to execute one or more of the following specific functions (This list is descriptive and not restrictive.):

— administrative control;

— accounting control;

— maintenance;

— behavior modeling;

— operational management; and

— any other purpose aiming at improving decision-making.

3.9
optional conditioned parameter
parameter (3.12) that can be used once a conditioning parameter of an *action* (3.1) is set up

3.10
optional conditioning parameter
parameter (3.12) set up as a part of an action (3.1), that requires the activation of one or more additional required or *optional conditioned parameters* (3.9)

3.11
optional parameter
parameter (3.12) that is not required but can be activated for an *action* (3.1) without requiring the support of additional parameters

3.12
parameter
basic information contained by an *action* (3.1) in the interfaces

3.13
procedural element
specific application of a recipe in an irrigation entity

3.14
procedural model
representation of the reality used to describe the different parts [*procedural elements* (3.13)] of the process to be performed by the elements included in the physical model

3.15
property
required attribute to define an irrigation entity

Note 1 to entry: Note the difference between a parameter, which characterizes an *action* (3.1), and a property, which characterizes an entity

3.16
required parameter
parameter that shall be included when an *action* (3.1) is set up

3.17
required conditioned parameter
parameter required when an *action* (3.1) is set up including an optional or required conditioning parameter

3.18
physical model
representation of the reality used to describe the relations, dependences and hierarchy among the physical assets designed to perform a process

Note 1 to entry: The model is divided in seven levels, being the three upper levels focused on administrative purposes and the four lower levels in the process to be performed.

3.19
standard history
recorded set of values of a *property* (3.15) covering a daily time interval and recorded according to a predefined frequency

3.20
subsystem
term used by RMCS in terms of interoperability

Note 1 to entry: A remote monitoring and control system for irrigation (RMCS), is a set of hardware devices and software programs used to monitor and/or control – according to predefined parameters or user decisions – one or more irrigation entities. Typical components of a RMCS include:

— control software, linking data transmission/acquisition and process control;

— devices controlling or monitoring irrigation entities;

— other intermediate devices required for data integration and/or communication purposes.

4 Interoperability I: System architecture

4.1 Levels and components of an interoperable architecture

4.1.1 General

The levels and components are presented in Figure 1.

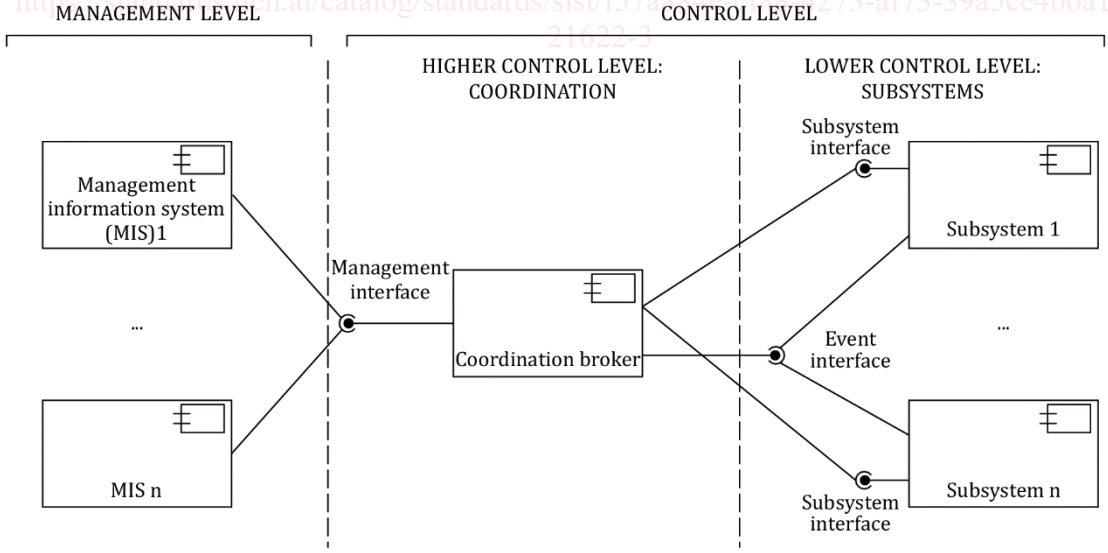

Figure 1 — Levels and components of an interoperable architecture

These architecture levels can be used by irrigators or user communities. Both uses the architecture defined in this document to integrate those management tools and subsystems involved in the management and control of his/her/its own property irrigation entities.

However, it is possible to enable other permissions to facilitate the exchange of data with third parties, always with the prior authorization of the data owner.

4.1.2 Control level

The control level comprises:

— the coordination broker; and

— one or more subsystems.

The subsystem interface is established between these two components.

4.1.2.1 Subsystem

The control of an irrigation entity, understood as the acquisition and continuous monitoring of process variables, execution of operations, changes of set points and emergency stops, among others, is always performed at the subsystem level.

4.1.2.2 Coordination broker

The coordination broker performs the following basic functions:

— mapping irrigation entities and their association to the subsystems controlling them;

— establishing an abstraction layer so that MIS applications do not require information on the subsystems responsible for each irrigation entity;

— collecting and consolidating properties, histories, events and procedural elements inherent to irrigation entities;

— coordinating subsystems, providing them with the information they may require, regardless of its origin;

— managing access permissions among the different components integrated in the interoperable architecture; and

— managing the access to irrigation entities and available methods for any component integrated in the interoperable architecture.

4.1.3 Management level

This level comprises all computer applications necessary for the efficient operation of the hydraulic infrastructure, as well as the processes required for the optimum use of water and energy. MIS applications retrieves the data they require from the control level.

The management interface is stablished between the management level and the upper control level.

4.2 Interface specifications

4.2.1 General

All data exchanged between the architecture levels defined shall be in accordance with the specifications included in this document.

The specifications in this document are not tied to any specific implementation, and only establish the foundations and minimum criteria required to guarantee an effective interoperability performance. The application of this document requires a specific communications protocol at the choice of the manufacturer or developer and adapted to its particular needs. The communication protocol, as well as the security criteria for all the defined interfaces, shall be in accordance with the proposed

implementation annexes, Annexes A, B, C for SOAP Web Services or Annexes F, G or H for REST Web Services, depending on the communication protocol selected by the manufacturer.

4.2.2 Data access authorizations

All the interfaces defined in this document shall be secured using authorization systems appropriate for the technology or protocol to be implemented in order to identify the data consumer. The implementation annexes establish the security requirements to be applied in each case.

Any data consumer wishing to use a certain interface shall authenticate itself. The authentication methods to be used for interface access are those described in the implementation annexes.

From its user interface, and in addition to the authorization requirements established, any element of the interoperable architecture (MIS applications, coordination brokers and subsystems) should manage the access permissions for authorized consumers when using its interfaces, allowing:

— the creation of new permissions;

— the deletion of permissions; and

— the modification of this permissions.

This permissions for a data consumer can include access levels restrictions related to:

— the accessible irrigation entities; and

— the allowed methods from those defined for each interface.

Any action not meeting these conditions should be denied.

4.2.3 Irrigation entity identification

The access to any irrigation entity, in all levels of the interoperable architechture, shall be performed using its EntityID, in order to guarantee its univoque identification. This identifier shall be unique among the irrigation entities of an irrigation system.

When introducing or modifiying an irrigation entity, shall be checked that no duplicate irrigation entity identifiers (EntityIDs) exist.

4.2.4 Common methods to management and subsystem interfaces

4.2.4.1 General

Unless otherwise stated, all defined parameters are required and shall be separated by commas.

4.2.4.2 Writing a property of an entity (Write method)

Table 1 — Input parameters of the Write method

Input			
Name	**Type**	**Description**	**Specification**
ActionID	string	ID of the action.	Contains a character string that identifies the action. Generated and known by the element executing the method.

Input			
Name	**Type**	**Description**	**Specification**
EntityID	string	ID of the entity where the user wishes to execute the action.	Contains a character string that corresponds to an irrigation entity. This is a unique ID within the system.
PropertyName	PropertyName	Name of the property on which the action shall be executed.	Contains one of the possible names from the list of entity properties.
Value	string	Value of the property to be written.	Contains a character string with the fields corresponding to the value of the property to be written, separated by commas. Only used for non read-only properties.

Table 2 — Output parameters of the Write method

Output			
Name	**Type**	**Description**	**Specification**
ActionID	string	ID of the action.	Same parameter included in action input.
Response	string	Response obtained.	Contains two fields separated by commas: Value1, Value2 Where: Value1: closed list of integer numbers identifying the response. Possible values: 0, 1, 2, 3, 4 and 5. Value2: closed list with explanatory texts corresponding to each Value1: If Value1=0, “Action successfully executed”. Generated at recipient. If Value1=1, “Execution error”. Generated at recipient. If Value1=2, “Lexical error”. Generated at recipient. If Value1=3, “Not supported”. Generated at recipient. If Value1=4, “Communication error”. Generated by coordination when communication with reception subsystem is not obtained. If Value1=5, “Coordination error”. Generated by coordination when there is a failure in the application. Value2 might be extended using a hyphen with as many explanatory texts as errors can be discriminated by a subsystem or a coordination broker.

Properties admitting Write method are specified for each entity type. The Response shall have Value1=3 when executed on a read-only property (see Table 26).

4.2.4.3 Reading a property of an entity (Read method)

For the reading of the properties, it is the decision of the subsystem if it returns data stored in the database of its control application or if it forces communication with its remote controller(s) or terminal(s).

Table 3 — Input parameters of the Read method

Input			
Name	**Type**	**Description**	**Specification**
ActionID	string	ID of the action.	Contains a character string that identifies the action. Generated and known by the element executing the method.
EntityID	string	ID of the entity where the user wishes to execute the action.	Contains a character string that corresponds to a irrigation entity. It is a unique ID within the system.
PropertyName	Property Name	Name of the property on which the action shall be executed.	Contains one of the possible names from the list of properties of the entity.

Table 4 — Output parameters of the Read method

Output			
Name	**Type**	**Description**	**Specification**
ActionID	string	ID of the action.	Same element included in action input.
Response	string	Response obtained.	Contains two fields separated by commas: Value1, Value2 Where: Value1: closed list of integer numbers identifying the response. Possible values: 0, 1, 2, 3, 4 and 5. Value2: closed list with explanatory texts corresponding to each Value1: If Value1=0, “Action successfully executed”. Generated at recipient. If Value1=1, “Execution error”. Generated at recipient. If Value1=2, “Lexical error”. Generated at recipient. If Value1=3, “Not supported”. Generated at recipient. If Value1=4, “Communication error”. Generated by coordination when communication with reception subsystem is not obtained. If Value1=5, “Coordination error”. Generated by coordination when there is a failure in the application. If Value1=6, “Unavailable”. Generated at recipient for a request about a supported but not in use property. Value2 might be extended using a hyphen with as many explanatory texts as errors can be discriminated by a subsystem or a coordination

Output			
Name	**Type**	**Description**	**Specification**
			broker.
Value	string	The value corresponding to the property requested.	Contains a string of fields separated by commas with the value corresponding to the property requested, respecting its format.
TimeStamp	string	Date/time when the read value was generated.	Date when the value was generated at source, using coordinated universal time (UTC) ISO 8601 format YYYYMMDDhhmmss±hhmm.

4.2.4.4 Reading the standard history of a property (ReadStandHist method)

The preparation of the standard history is performed at the control level. The values included in the standard history represents the ones registered during a natural day, establishing three different number of daily values samples: 24 (hourly sample), 48 (half hourly sample) or 96 (quarter hourly sample). The Response should have Value1=2 in requests for the current day.

Table 5 — Input parameters of the ReadStandHist method

Input			
Name	**Type**	**Description**	**Specification**
ActionID	string	ID of the action.	Contains a character string that identifies the action. Generated and known by the element executing the method.
EntityID	string	ID of the entity where the user wishes to execute the action.	Contains a character string that corresponds to an irrigation entity. It is a unique ID within the system.
PropertyName	PropertyName	Name of the property on which the action shall be executed.	Contains one of the possible names from the list of properties of the entity.
Date	string	Date for which execution of the action is requested.	Date of the historic values in coordinated universal time (UTC) ISO 8601 format 3.17 MMDDhhmmss±hhmm.
NumHist	integer	Number of samples contained in the daily standard history requested.	The number of samples per day have one of the following values: 24, 48 or 96. The default value is 24.
Statistics	string	Name of the statistical variable for which the standard history is generated.	Type of statistical variable for the calculation of the standard history. It contains one of the following listed values: — last — average — minimum — maximum The default value is last.