

Foreword

The ISA Standards and Practices board granted the ISA112 SCADA Systems Standards Committee a charter to develop a series of ISA standards and technical reports that address long-term planning, system design, implementation, operation and maintenance of supervisory control and data acquisition (SCADA) systems for pipelines, water/wastewater, power, oil and gas and other industries to support the overall integrity and reliability of these systems.

The ISA112 Committee, consisting of representatives from a wide range of industries, including municipal water/wastewater, pipelines, oil and gas upstream/midstream/downstream, mining, manufacturing and other industries, has developed this document. Committee membership includes representatives from around the world, in various roles, including end users, vendors, consultants, contractors, governments, operating companies, designers, system integrators, operators, owners and operations/maintenance personnel.

The result of the committee's work since 2016 was the development of a standardized ISA-112 SCADA lifecycle, a common SCADA system model architecture diagram, standardized terminology and technical guidance for each of the work processes outlined in the ISA-112 SCADA lifecycle. The resulting three-part standard plus related technical reports and recommended practices is meant to provide a complete framework and guidelines governing the planning, engineering, design, installation, testing, commissioning and operation/maintenance of SCADA systems for both the long-term management of existing systems and the execution of new installation/upgrade/expansion/replacement projects.

The requirements and guidance presented in this document are general in nature and should be applied to each system as appropriate by personnel knowledgeable in the processes and control systems to which they are being applied.

Abstract

The ISA112 SCADA Systems Standards Committee was formed to develop a series of ISA standards and technical reports that address system design, implementation, operation and maintenance of supervisory control and data acquisition systems for industry to support the overall integrity and reliability of these systems. This document, part 1 of the ISA-112 SCADA systems standards series, provides a framework, model architecture and lifecycle that can be used for the long-term planning, design, implementation and operation/maintenance/upgrades of SCADA systems. This document, ANSI/ISA-112.00.01-2025, is the first of a series of standards, recommended practices and technical reports.

Preamble

The ANSI/ISA-112.00.01-2025 standard is part 1 of ISA's first standard series that is focused on the long-term management of SCADA systems. This document provides a framework that includes a reference model architecture, terminology and lifecycle that represents the minimum requirements to build and maintain an effective SCADA system. This document also provides recommended best practices as well as a list of design and operational aspects to be addressed when looking after the long-term management of a SCADA system, including undertaking expansion and upgrade projects. For SCADA projects, the document also includes a detailed workflow that can be used to effectively manage the design, implementation and commissioning of new SCADA components.

Introduction

0.1 Document structure

This document is part 1 of a multipart ISA-112 SCADA systems series of standards:

- Part 1: SCADA Lifecycle, Diagrams and Terminology;
- Part 2: SCADA Lifecycle Work Processes;
- Part 3: SCADA Architectures.

Part 1 contains a diagram of the ISA-112 SCADA systems lifecycle, a general reference architecture diagram and a description of the lifecycle work processes for SCADA systems. Part 1 also defines how SCADA systems are typically used and how the usage of the term SCADA can vary across industries, geographic areas and amongst specific end-user organizations. Common terminology used between different types of SCADA systems is defined, and guidance is provided for several terminology-based aspects of SCADA systems.

Part 2 provides an in-depth set of requirements and guidance for the ISA-112 SCADA systems management lifecycle and its associated lifecycle work processes.

Part 3 provides requirements and guidance for using the ISA-112 SCADA system model architecture.

0.2 How to use this document

The three parts (1, 2 and 3) of this series of ISA-112 documents should be used in a way that corresponds to the scope of an organization's definition of what its SCADA system encompasses.

Figure 1 shows several possible example definitions of SCADA that an organization could choose to use for its purposes. The Company A to Company E examples show various definitions of SCADA that are used in several industries, geographic areas and organizations.

In the Company A example in Figure 1, a manufacturing organization could define its SCADA system as only encompassing the monitoring of existing pieces of machinery, so it would likely only use the "higher level" SCADA elements of the ISA-112 standards series for the SCADA system.

In the Company B example, an upstream oil and gas organization could choose to define its SCADA system as consisting of "backhaul-related elements only" and thus may elect to use only the backhaul-related parts of this standard.

Two additional possible SCADA system definitions are shown in the Company C and Company D examples.

In contrast, in the Company E example, for those organizations that use a "whole control system" definition for the term SCADA (e.g., most municipal water/wastewater utilities in North America), all the elements of the ISA-112 series of standards should be used.

Different groups can also use this document in different ways, such as:

- System owners:
 - to help justify developing plans and documents for the SCADA system;
 - to give examples of what to include in plans and documents;
 - to create the SCADA governance and standards documents;
 - to create a SCADA long-term plan document.

- Engineering consultants:
 - to establish a common reference point with owners and contractors on projects instead of having to rely on “industry best practice”;
 - to ensure designs include all important components of a SCADA system.
- Vendors:
 - to develop products that help owners achieve compliance with this standard.
- System integrators:
 - to establish a baseline for project delivery and execution.

0.3 Evolution of SCADA

0.3.1 General

SCADA systems are computer-based control systems employed to gather and analyze data to track, monitor and control processes and equipment in many industries. Historically these systems were typically isolated to industrial settings, but with lower costs and increased prevalence of the technologies used, these systems are becoming more widespread.

SCADA systems typically are used for monitoring and controlling a vast range of manufacturing and industrial processes. In each process, large amounts of data are collected via remote input/output (I/O) modules and/or local controllers (e.g., programmable logic controllers [PLCs] or remote terminal units [RTUs]) connected to field devices. The collected data is processed by control systems and algorithms to automate control of motors, pumps, valves and various other system hardware components, facilitating the operation of sequential, batch, discrete and continuous processes.

SCADA systems may also have additional data management modules and servers to facilitate batch and recipe management. Extended operator interface/human machine interfaces (HMIs) and data historians are usually included for a more comprehensive automated approach to managing real-time operations. An increasing number of industries also incorporate alarm management and reporting.

0.3.2 History

First-generation SCADA systems became popular in the 1970s with the evolution of “big data” collection and analysis. Early systems typically used mainframe computers that were expensive and manually operated. These early monolithic SCADA systems were developed when network services were not readily available and were thereby unable to easily share information with other systems.

Second-generation SCADA systems used information and command processing that was distributed across multiple stations using local area network (LAN) and wide area network (WAN) connectivity. Information could be shared between function modules in near real time. Each module was responsible for a particular function or task, which reduced the system cost to build and maintain. However, communication protocols between stations and modules typically remained highly complex and often proprietary, lacking standards for communicating across different hardware devices, operating systems and software platforms.

Third-generation SCADA systems and distributed control system (DCS) technologies blurred the lines between SCADA and DCS by reducing them to functional modules with components connected to the network using standard internet protocols. This enabled communications between multiple vendors and many different types of ancillary instruments and control equipment. With more readily available WAN-enabled architecture, a SCADA system could then be spread across

more than one LAN and benefit from server technology providing a single supervisor and historian to support multiple systems, offering a cost-effective solution for larger scale systems.

Current modern SCADA systems have begun to incorporate virtual, web or cloud-based servers, allowing users to view data, exchange information between vendor equipment, control processes and other equipment, such as cybersecurity and business systems, from anywhere in the world. This makes it possible for users to securely access the SCADA system from various platforms or web browsers and allows connection to personal computers and mobile applications.

SCADA systems can range from single controller systems with just a few I/O points to vast systems with numerous controllers and thousands of I/O points. SCADA systems are typically sized by the number of inputs and outputs. Some SCADA systems are contained within a single facility, while others extend across multiple sites spread over large geographical areas. Example processes include industrial, infrastructure and facility-based processes. Industrial systems can include manufacturing, process control, power generation, fabrication and refining. Infrastructure includes public transportation, rail and highway systems, water/wastewater treatment, water distribution, wastewater collection, oil and gas installations, pipelines, electric power transmission and distribution and many other processes. Facility uses can include heating, ventilation, and air conditioning systems (HVAC), security/access controls and energy management/consumption systems for buildings, airports and ships, as well as smart city SCADA solutions.

0.4 Industry/geographical definitions of SCADA

Although the term SCADA is used throughout the world, there is not a universally agreed upon definition of which components are included in a SCADA system. Depending on the industry, the geographic area, government regulations and an end user's own internal conventions, SCADA may include all of the control and monitoring system components or only very specific parts. There are many reasons for this, which can be influenced by historical factors such as when automation was introduced to the sector, locally available automation vendors or consultants, a company's history, specific government regulations and the activities of nearby companies and competitors.

Some of the possible variations in end-user-specific definitions of components included in SCADA systems are shown in Figure 1.

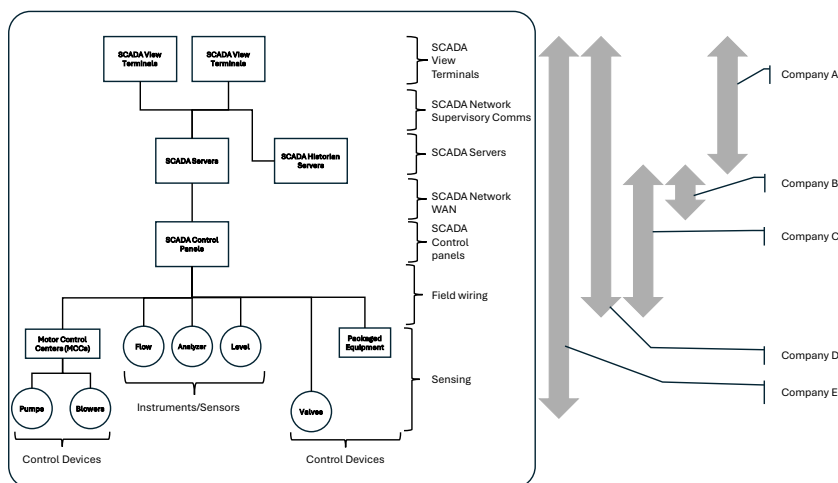


Figure 1 – Examples of various end-user-specific SCADA definitions

The ISA-112 series of SCADA standards have been developed so that guidance can be applied to all of the above possible end-user-specific definitions for SCADA systems, and variations thereof. Depending on the industry, geographic location, local regulations and end-user preferences, large facilities may or may not be considered to be part of the SCADA system. For example, in the North