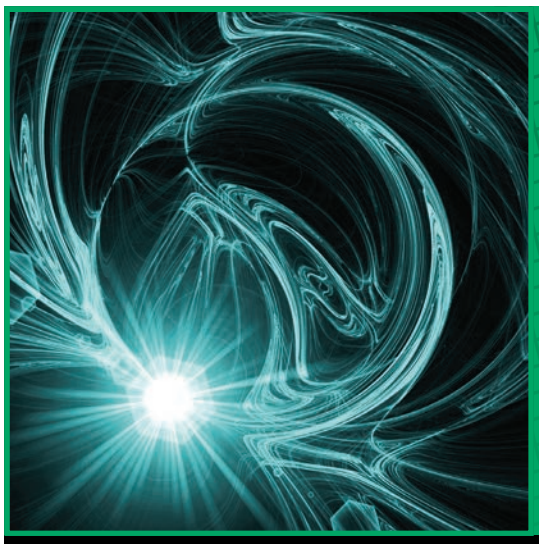

Full Redundant Field Wireless Automation Solutions Based on the ISA100.11a Standard

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Communication between field devices and control systems started with 4-20 mA analogue communication, and has evolved via hybrid communication systems such as HART and Brain, to digital communication technologies such as FOUNDATION™ Fieldbus and PROFIBUS, and finally to wireless communication based on the ISA100.11a standard.

These communication technologies have significantly increased the amount of information that can be used for plant operations, and have led to major innovations in field instrumentation. Activities such as asset management and proactive maintenance have been realised using extensive information such as multiple process values and diagnostic results, which can now be sent from field devices to higher-level systems such as Distributed Control Systems (DCS) and Plant Asset Management (PAM) systems.

Field wireless technology that enables wireless communication between field devices and control systems will bring further advanced innovation in the instrumentation sector. Field wireless communication has many advantages, such as the ability to reduce wiring, engineering and commissioning costs, the ability to install devices in areas where wiring is difficult, and the ease of adding or removing devices. By making best use of these advantages, it is possible to use instrumentation to implement functions that were impossible before. Both wireless technology and the instrumentation that makes best use of wireless communication will also continue to evolve.

The ISA100.11a wireless communication standard was established in September 2009 by the ISA100 Committee of the International Society of Automation (ISA). It was approved as a National Standard by the American National Standards Institute (ANSI) in December 2011, and has been submitted (as CDV IEC 62734) to the IEC SC65C Subcommittee for approval as an international standard.

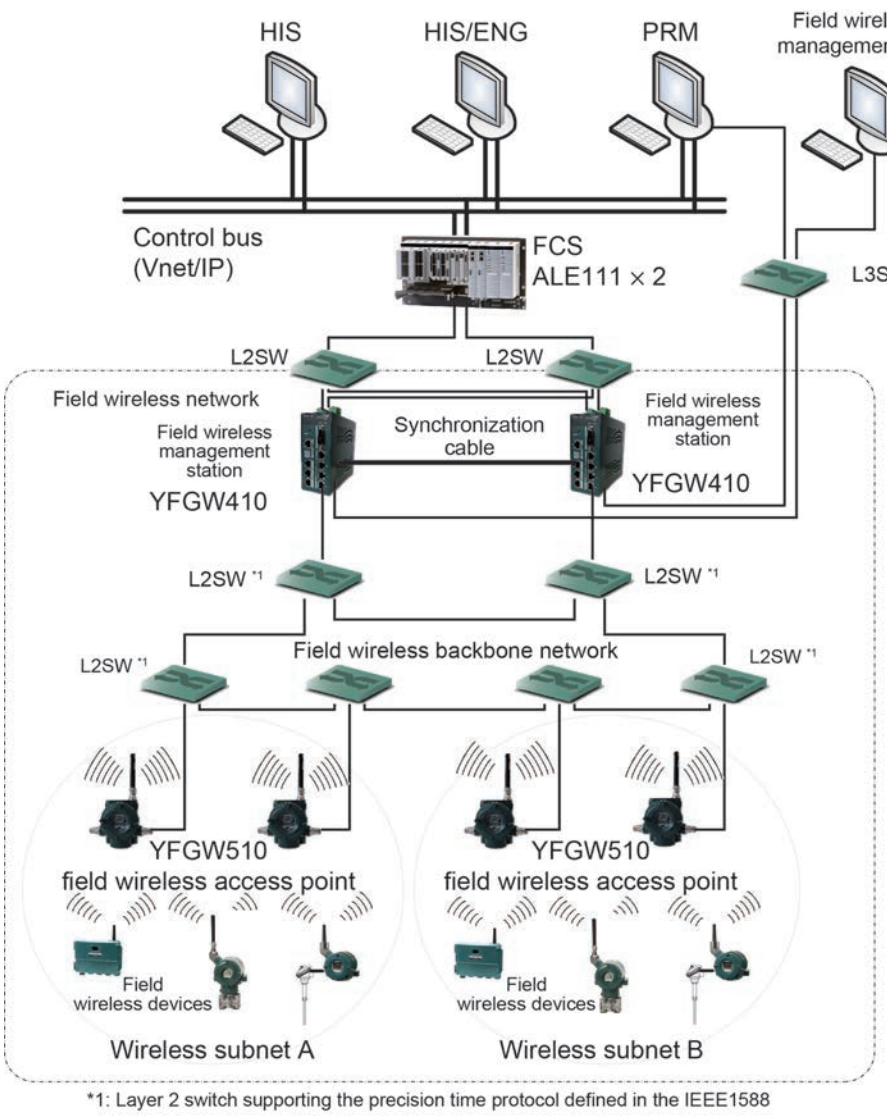

Figure 1: Field wireless system based on ISA100.11a

ISA100.11a system configuration

Fig.1 shows a typical field wireless system configuration based on the ISA100.11a standard, incorporating wireless field devices and a field wireless management station (gateway) which acts as an interface between the wireless network and its applications and higher-level control and plant asset management systems. The field wireless access point (sometimes referred to as a backbone router) functions as the connection between the wireless field devices and the field wireless access point. The system manager and security manager control and manage the behaviour and security of the wireless network. As shown in Fig.1, it is possible to provide redundant paths between the controller and wireless field devices via redundant field wireless access points, and to provide multiple communication paths from the wireless field devices to multiple redundant field wireless access points. The ISA100.11a standard defines the many basic functions which improve data transfer reliability in communication. Therefore within an ISA100 based wireless network devices can have different roles: I/O (input/output), routing and I/O plus routing.

Based on these general concepts, a practical realisation of an ISA100.11a based field wireless system must achieve three additional goals which can be summarised as "control proof", "power proof" and "future proof". "Control proof" means that the wireless architecture meets the requirement for real-time control applications. "Power proof" refers to the ability of the wireless solution to provide reliable and long lasting power, while "future proof" refers to the ability of the solution to keep up with the rapid changes taking place in the world of IT.

Control proof

To be suitable for control applications, wireless networks must possess the necessary reliability and deterministic data transfer capabilities. ISA100.11a supports reliable radio technology and offers excellent coexistence with other wireless networks such as Wi-Fi. With bidirectional digital wireless networks based on ISA100.11a, the measurement values, device diagnostics, and parameter data transferred between a control system and field devices are securely encrypted. This wireless technology is ideal for control applications in addition to status monitoring and device diagnostics, enabling proactive maintenance.

Network topology also affects performance and reliability. Yokogawa's field wireless strategy calls for a redundant star topology network. In Yokogawa's view, redundant star topology (I/O devices communicating in duo cast with a redundant field wireless access point) provides the best determinism, high communication speed (500 ms data transfer), low latency, and the multiple route communications needed to provide the level of reliability needed for process control applications.

For less critical applications such as monitoring, where determinism is not required and higher latencies can be tolerated, a mesh network topology or a mix of a star and mesh networks could be considered.

Figure 2: Battery case design allows the use of low cost, commercially available, off-the-shelf, general-purpose lithium thionyl chloride batteries in wireless transmitters. The battery case can easily be replaced, even in a hazardous area environment.

Power proof

A primary advantage of wireless transmitters is that they do not require wiring for either data transmission or power supply. However, reliable and long lasting power has been a long-standing challenge for wireless process sensor applications. Yokogawa has addressed this issue with its own "open battery" concept. The company has designed a unique battery case that allows the use of low-cost commercially available off-the-shelf general-purpose lithium thionyl chloride batteries in its wireless transmitters (Fig.2). An essential feature of the battery case is that it can easily be replaced, even in a hazardous area environment. The (redundant) star topology network functions highly efficiently and provides low energy consumption, resulting in longer battery life. Yokogawa also plans to develop easy-to-maintain alternative power sources for use with these devices.

Future proof

The ISA100.11a standard allows for multiple application processes in the application layer of the ISO OSI-model as well as multiple physical layers. This allows the support of multiple protocols moving forward, including HART and FOUNDATION™ Fieldbus and so on, making Yokogawa's wireless solution future proof. In addition, Yokogawa will continue to be "radio agnostic", meaning that alternative suitable radio technologies will be considered when these become available, and will continue to provide a solution that can incorporate changing IT technologies. Part of being future proof also means providing seamless integration of both wired and wireless technologies, as the two will continue to coexist in process plants for many years in the future.

System elements

In July 2010, Yokogawa released the world's first ISA100.11a compliant field wireless devices. The initial system elements in the company's field wireless offering included a field wireless integrated gateway/backbone router, a differential pressure/pressure transmitter series, a temperature transmitter and a low level signal multiplexer.

This initial offering has recently been enhanced through the introduction of a field wireless management station, a field wireless access point, and a field wireless media converter (Fig.3).

Figure 3: Yokogawa field wireless products based on the ISA100.11a standard

The YFGW410 field wireless management station has a gateway function to connect the wireless field instruments with the host system, and has the function of the system manager and security manager. Communication with the higher-level system utilises a Modbus/TCP protocol, with the Modbus protocol implemented on top of the Ethernet TCP/IP protocol. The field wireless management console software, consisting of a configuration and a management tool, supplied with the YFGW410 is used to build and manage a field wireless network. The PC on which the software is installed is connected to the YFGW410 via Ethernet communication.

The field wireless configurator tool is used for setting and maintaining the field wireless network, while the field wireless management tool manages and monitors the operating status of the field wireless network and field wireless instruments.

The YFGW510 field wireless access point is a router device for connecting field wireless devices and gateways and has the function of the backbone router specified in the ISA100.11a standard. It supports communications with 100BASE-TX, 100BASE-FX, and wireless LAN networks, allowing for both the expansion of plant wireless networks and the full use of existing assets.

The YFGW610 field wireless media converter is a device that converts data from the 100BASE-FX to the 100BASE-TX format.

The EJX B series differential-pressure/pressure transmitter inherits the features of the existing EJX series, such as the high reliability and stability of the sensor, multi-sensing function, and enhanced self-diagnostic functions, as they are. A low-power consumption electronics design was implemented in order to extend the life of the built-in batteries, while keeping the capabilities and functions of the wired equivalent product.

The YTA510 high-performance dual channel temperature transmitter accepts input signals from IEC standard thermocouples (eight types including Type K, E and J), inputs from IEC or other standard resistance temperature detectors (RTD) (three types including Pt100), DC current corresponding to resistance, and DC millivolts.

The unique YTMX580 universal wireless multiplexer accepts an industry-leading eight analogue input channels, and is capable of accepting thermocouple, millivolt, RTD and 4-20 mA inputs, all of which can be independently configured for each channel.

These transmitters come with an antenna that can be removed and mounted in a separate location, extending the communications range. Measured values are sent to the higher-level system. Furthermore, they send diagnostic information and receive provisioning data and setting parameters via wireless communication.

Each of the field wireless system devices offers dual redundancy via a backup device. If the communications link is broken or a hardware failure occurs in any of these devices, automatic switchover to the backup device is implemented and the communications link is restored, ensuring uninterrupted communications with field wireless devices and increased reliability in process monitoring and process control. In addition each field wireless transmitter supports the ISA100.11a "Duo Cast" function providing redundant communication paths between the transmitter and a redundant set of field wireless access points.

Each (redundant) field wireless network management station can support multiple (redundant) field wireless access points creating subnets. These subnets provide efficient plant-wide coverage, while supporting a large number of field wireless devices (Fig.4).

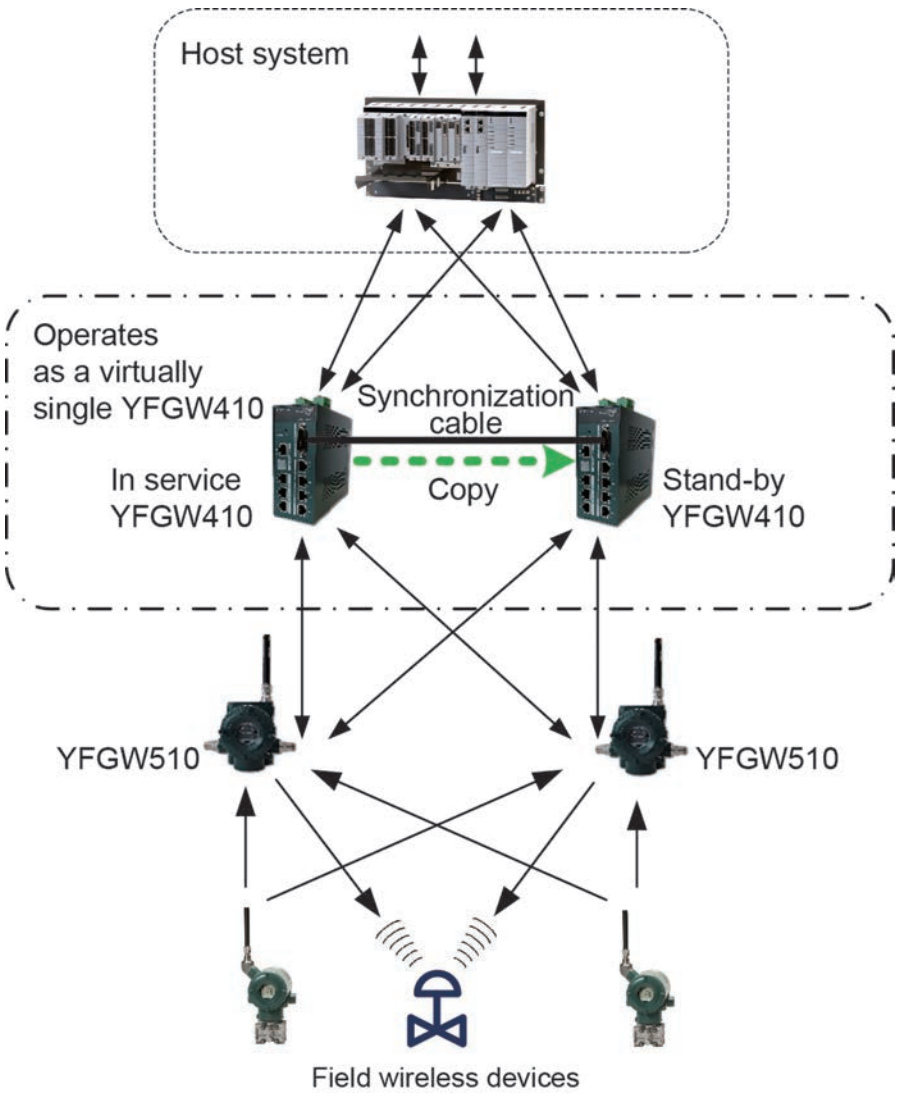

Figure 4: Full redundant field wireless system architecture

Yokogawa uses the protocol-independent open FDT technology for device integration and management in device and plant asset management systems, and has developed a communication DTM for its gateway and device DTMs for its devices through which the devices can efficiently be configured and managed in any FDT frame application. In addition an interpreting DTM is incorporated in Yokogawa's device and asset management solutions, creating a DTM from other device suppliers' device descriptions. Hence, a unified GUI for device configuration and management is realised.

Other existing products which contribute to the overall field wireless solution are a versatile device management tool known as FieldMate, the PRM plant resource manager, a field wireless device OPC server, and the YFGW communication package used to connect the field wireless system to a DCS such as CENTUM VP or SCADA system such as FAST/TOOLS.

Last, but not least, Yokogawa has the expertise to successfully plan and implement wireless networks.

Conclusions

This article has described wireless communications and other field digital technology solutions that help companies to optimise their plant operations. Support of the ISA100.11a standard ensures high reliability, application flexibility, network expandability, and compatibility with a variety of wired communication standards.

The wireless products discussed can be used to construct highly reliable large-scale plant networks, and may also be incorporated in small- and medium-sized networks that already utilise Yokogawa's existing products, substantially expanding their capability. This is in line with the company's "Grow" concept of enabling customers to expand their plant wireless networks while making full use of existing assets.

As the industry's support of the ISA100.11a standard gains momentum, the number of ISA100.11a products is rapidly increasing. Yokogawa will continue to enhance interoperability for seamless connection with other companies' products and will develop sophisticated wireless control solutions for continuous processes. By making possible the expansion of wireless systems, educating users about wireless solutions, and improving convenience, Yokogawa aims to help its customers to grow their plant operations. In the longer term, Yokogawa's field digital network will cover the entire plant site and provide integration of any sub-network, both wired and wireless.

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