ISA100 and Wireless Standards Convergence

By Harry Forbes

ISA100 is one of three standards competing in industrial wireless sensing. What is distinctive about ISA100? What are the prospects for convergence of standards? What would convergence be worth to the industrial wireless market?

The ISA100 Initiative
ISA100 is a major standards initiative managed by the International Society of Automation (ISA). In addition to standards development, a new organization, the ISA100 Wireless Compliance Institute (WCI), is charged with delivering compliance certification services for the work of ISA100.

In 2006, at about the same time ISA100 was forming, the ISA also created the non-profit Automation Standards Compliance Institute (ASCI). This organization manages certification, conformance, and compliance assessment activities in the ISA’s automation domain. ASCI extends the standards work of ISA by facilitating the effective implementation and independent testing of ISA standards. It creates a vital link between the development of standards and industries’ implementation of the standards. The ISA100 Wireless Compliance Institute (WCI) functions as an operational group within ASCI. Operating the ISA100 Wireless Compliance Institute within ASCI allows it to leverage the infrastructure of ASCI, which in addition to WCI, is shared by several ASCI compliance programs.

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ISA100WorkingGroups
The WCI is tasked to:

- Conduct independent testing/certification of devices and systems to the ISA100 family of standards
- Provide education, tools, and technical support to users and suppliers
- Certify that devices and systems meet a common set of specifications
- Assure interoperability via standards, tests, and conformance processes

The most important aspect of ACSI and WCI from the end user’s standpoint is that important future ISA standards will be provided with independent certification testing services for conformance to the standards. This is a critical advantage, which provides assurances of product interoperability. Standards that lack effective independent compliance services are of little value to end users, regardless of their origin.

**ISA100 Scope**

The ISA100.11a standard is focused on field devices in process manufacturing applications. ISA100.11a has defined specific classes of automation applications and has excluded ISA100 only from process safety and low latency applications. The standard defines a number of roles for field devices and networks, though not restricting these roles to dedicated devices (see Figure).

The ISA100.11a standard defines an OSI protocol stack (Physical, Data Link, Network, Transport, and Application layers) along with system management and security functionality. It does not specify any “backbone” or backhaul network, nor any higher-level automation. It presumes that gateway, system management, and security functionality may reside outside the field networks, but ISA100.11a specifies the interfaces between these remote functions and the field network.
While comprehensive, the ISA100 standard often incorporates existing proven technology rather than defining its own. Most notably it uses IEEE 802.15.4 standard radios at the physical layer. The “layering” approach is critical, in that it creates a degree of independence between these layers. The independence is provided by the defined layer-to-layer interfaces, which persist through technology changes. This independence enables any layer within the standard to be modified without disturbing the others. It is the basis on which any standard is “future-proof”, meaning capable of absorbing both innovations to the existing technologies and new technologies without wholesale obsolescence.

Integration with existing systems and protocols poses a challenge for any new industrial standard. Radio coexistence is provided by using a common radio technology at the Physical Layer. But no standard can specify the integration path for each potential network and protocol encountered in the field. ISA100.11a provides informative material pertaining to the integration of HART, Profibus, Foundation Fieldbus, and MODBUS protocols through device adapters, network protocol pass-through tunneling, via mapping using interface objects, or a combination of the above. The challenge here is that any timing-sensitive behavior of a protocol may be difficult or even impossible to guarantee when it is encapsulated and carried as a payload by another network.

However within its own domain, ISA100 functionality specifies technology that meets the end user convergence requirements outlined in NAMUR report NE 133, which is to prescribe:

- Sensor node network connectivity
- Host node network connectivity
- Multi-vendor device interoperability among field devices
- Multi-vendor device interoperability between routers and field devices
- Multi-vendor device interoperability between gateways and devices
- Data flows for sensor data
- Network health metrics, metric collection, and presentation
- Field device parameterization/configuration.

**Prospects for a Converged Wireless Standard**

Recognizing the scope overlap between ISA 100.11a and IEC 62591 (WirelessHART®), ISA100 formed a convergence subcommittee, designated as ISA100.12. Charged with convergence of ISA100 and IEC 62591, this team
has independently solicited input from end users regarding their needs and priorities. End user input was solicited through a “Convergence User Requirements Team” (CURT). The CURT made its recommendations available to both ISA100 and the NAMUR organization. Likewise, ISA100 has also accepted convergence recommendations from NAMUR and incorporated them into the requirements produced by CURT. The ISA100.12 convergence work thus far has developed an RFP (request for proposals). These proposals must define a roadmap for convergence of these global wireless standards. The RFP went out for ballot and passed on September 24, 2010. Now that it is approved by the ISA100 Committee, convergence proposals will be submitted to ISA100 in 4Q2010.

**NAMUR Input to ISA100**

NAMUR is an international association of process industry end users, primarily European. NAMUR promotes pooling of experience among members. The results of its work are published and submitted to standardization bodies as proposals for standardization. In 2010, recognizing the challenges of converging three wireless standards, NAMUR developed report NE 133 (“Wireless Sensor Networks: Requirements for convergence of existing Standards”) as a recommendation detailing end user requirements for convergence of these three standards. NAMUR NE 133 states:

> “Several wireless standards have appeared in the market place. At least three of these emerging standards specifically address the industrial markets. They are IEC/PAS 62591 (WirelessHART®), WIA-PA (IEC/PAS 62601) and ISA100.11a. The recommendation also applies to any future appearing wireless sensor network standard(s), which target process industry use. All of these standards essentially address the same physical space where wireless can be used for industrial applications. In the history of wired field networks, supporting multiple network protocols due to competing specifications has increased both operational and capital costs. This severely hampered the widespread implementation of wired field networks. The user community has therefore strongly recommended that wireless sensor network standards have to converge into one single standard which addresses the long term lifecycle required for an industrial application network installation. This single converged standard has to provide a common network structure that will afford
the greatest diversity of wireless instrument applications that can now, or in future, be available to the end users.”

NAMUR did not demand that a future converged network standard preserve the installed base of wireless sensor networks. Rather, they specified eight key activities that a future standard must prescribe “throughout the entire device lifecycle”. These requirements were listed earlier. While these requirements are satisfied by ISA100, the end users speaking through both ISA100 and NAMUR are pleading that these same requirements be met in a single future standard that represents a convergence of all the existing multiple existing standards.

**Market Value of Standards Convergence**

From the standpoint of a market, standards convergence is important because it enables more rapid market growth. But how much is that expansion really worth to suppliers? It is impossible to estimate the value precisely; however it is possible to develop an “order of magnitude” estimate. Such an estimate includes a wide range of values, but it also can provide upper and lower bounds. We can be fairly certain that the actual value of standards convergence falls within these bounds.

ARC has developed such a market model for the adoption of industrial wireless sensing, and applied the model to this question. Wireless, like any technology penetrating an established market, penetrates only slightly at first, and then grows as customers and suppliers understand its value and capability. At some point the fully mature technology reaches a level of “saturation”, where it has penetrated the market to the full extent possible. Standards convergence can “shift the adoption curve”, growing the market faster and thus bringing additional revenue to suppliers. But how much additional revenue can it bring?
ARC’s market model uses a base case of 20 years for market penetration and a saturation level in which wireless represents about 75 percent of field measurement devices. Two different cases are tested as bounds. First we consider a “pessimistic” case, where the effect of standards convergence shortens the adoption period by only a single year, or 5 percent. Second we evaluate an “optimistic” case, where standards convergence reduces the adoption period by five years, or 25 percent.

The results of the analysis are shown in the chart above. Along with the optimistic and pessimistic cases, ARC has plotted a mean case, which represents the midpoint between these extremes. This is not to say that the mean is an expected value. However, the expected value is in the range between the bounds. The supplier revenue from more rapid adoption grows with each year, reaching between $21M and $280M after 5 years. This range represents the “order of magnitude” estimate of the value of a converged standard to this market.

**Technical Challenges for Standards Convergence**

From a technical standpoint, the challenges to converge even two standards are very difficult, and trying to combine three global standards is even harder. The challenge is more difficult because the “voice of the end user” is not a single voice by any means. Most importantly though, the recommendations of both the ISA100 CURT and NAMUR NE 133 have stated their highest priority is to achieve a single standard going forward in order to minimize Total Cost of Ownership.
At a more technical level, there are many differences among these standards. Some of these derive from the scope of the work. For example IEC 62591 was written as a revision to the HART protocol. ISA100.11a and WIA-PA had a much more comprehensive scope. Other differences result from choices made during the development process, and there are any numbers of these differences. They extend from the Data Link Layer up to System Management. The challenge facing the standards organizations going forward is to converge these works as quickly as possible, with minimal repeating of the laborious processes that were involved in their creation, and in a manner that the convergence is also maintained in future.

**Conclusion**

The obstacles to achieving a converged standard are significant, through ISA100.12 has now begun that task. ARC believes the supplier community should now work cooperatively to provide a single converged standard which is in the best interest of their end users. A definitive roadmap to convergence - a roadmap that is both technically sound and universally supported - needs to be created soon. If such a plan can be developed, standards groups such as ISA100 and IEC will have a chance to provide what end users seeking convergence are asking for.

Such a roadmap must to the greatest extent possible leverage the existing standards in the interest of speed and time-to-market. Besides giving clarity to end users, standards convergence would bring additional supplier revenue, possibly in the range of hundreds of millions of dollars annually within five years.

This paper was written by ARC Advisory Group on behalf of the ISA100 Wireless Compliance Institute. The opinions and observations stated are those of ARC Advisory Group. For further information or to provide feedback on this paper, please contact the author at hforbes@arcweb.com. ARC Briefs are published and copyrighted by ARC Advisory Group. The information is proprietary to ARC and no part of it may be reproduced without prior permission from ARC Advisory Group.