

White Paper

IEEE 802.11 Suitability for Factory and Industrial Applications

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OVERVIEW

Standards are good things for the high technology industry. They promote interoperability between vendors and produce competition, which results in lower prices. Multi-vendor support increases buyer confidence that they will not be stuck with an investment in a dead end technology. This higher confidence can lead to broader market acceptance that increases production volumes which also lead to lower costs.

So, are standards ever bad? They can be detrimental when they stifle innovation. They can also be bad when they are forced on applications where they do not fit. In these instances, standards may require functionality that is not required and thereby increase the cost. On the other hand, standards may exclude functionality that is important to the application. This exclusion can result in the needed functionality being added on in a less efficient way, increasing cost.

Standards that contribute to the development of technology in an orderly, non-threatening way are clearly advantageous to all involved. However, applying a standard just to say there is a standard serves no purpose—and can have negative consequences.

IEEE 802.11 BACKGROUND

Of the many new technologies of the 1990s, wireless had its share of publicity. The concept of replacing all cables and wires associated with communications is compelling—or so it would seem. While many have embraced the concept, few have implemented it. In trying to understand the dichotomy between words and actions, the wireless data industry decided that the lack of a standard was all that stood in the way of broad market acceptance. Not only would a standard create a sense of confidence through multi-vendor product availability, but it would allow standard component parts, which would reduce manufacturing cost and hence the price of wireless network interface cards. As a result, several wireless vendors got together with the IEEE to develop a standard for digital wireless data.

Not surprisingly, since the vendors already had products in the marketplace, business considerations entered the standards process more than usual. No vendor wanted to be at a competitive disadvantage in bringing its products into compliance with this new standard. Another consideration that influenced the process was the desire to develop a standard that would open the largest market. This was perceived to be the wireless office LAN market. At the time, 10 megabit Ethernet was the overwhelming leader in wired office LANs, and 100 megabit Ethernet capability was not far behind.

Upon review of the IEEE 802.11 standard, these two influences are very apparent. First, three device classes are covered by 802.11. Both direct sequence spread spectrum (DSSS) and frequency hopping spread spectrum (FHSS) devices are compliant even though they cannot interoperate. Infrared (IR) communications, a third class covered by 802.11, obviously cannot talk to the other two. Second, because of the high-speed operation of Ethernet-based LANs, the data rate would need to be high enough to prevent the wireless nodes from becoming a bottleneck, but low enough to allow the vendors to quickly implement products. Thus, an initial air data rate of 2 megabits per second (Mbps) was chosen with plans for a higher rate in the future. (As of this writing the high-rate 11 Mbps extension to 802.11 is nearing release by the IEEE. It is interesting to note that backward compatibility with 2 Mbps systems is planned by slowing down the 11 Mbps systems to run at 2 Mbps)

How well does the IEEE 802.11 standard meet the needs of the wireless office LAN application? At present, it is hard to say. Having both frequency hopping and direct sequence devices adds a layer of complexity to the interoperability equation. 802.11 direct sequence devices will be able to operate with other 802.11 direct sequence, but not 802 frequency hopping devices. Currently, the

interoperability between 802.11 devices of the same spread spectrum method is not complete. One of the major hurdles remaining to be cleared is interoperable seamless roaming. Presumably, interoperability issues will be resolved in due time, as standard component parts are available and prices drop. So the goals of the vendors in developing the standard will eventually be realized.

IEEE 802.11 IN INDUSTRIAL AND FACTORY APPLICATIONS

But what about non-office LAN applications? In the office LAN application, the needs of the wireless nodes are the same as for wired nodes. The three major applications are file transfer, print spooling and Internet access. All three are concerned with moving multi-tens of kilobyte files between nodes, hosts, and gateways. Thus, the 10- and 100-Mbps wired Ethernet speeds and the aim of wireless office LAN products to come close to wired speeds has value. But let's look at industrial and factory floor wireless applications. Typical applications involve sending back periodic status information on such parameters as temperature, actuator position, liquid levels, etc. These transmissions are made up of tens of bytes of information per transmission. In these so-called "bursty" applications, the over the air data transmission rate is not as important as for office LANs.

Wouldn't a higher air data rate provide more system throughput? That is, couldn't more nodes be accommodated? Absolutely. But the higher data rate of the 802.11-compliant products does not come cheaply. A higher air data rate results in less range. The 802.11 products on the market state ranges of 150 to 300 feet. For an office application, that range is probably sufficient. But in a processing plant or a warehouse or an industrial facility ranges well in excess of 300 feet are common if not the norm. As a result, if 802.11-based products were deployed in this environment, repeaters would be required, or possibly additional base stations. This represents additional cost and network complexity without additional benefit. Many would characterize the additional network complexity as a definite negative.

Another requirement that arises in factory and industrial applications that is not present in office LAN applications is the need for guaranteed bandwidth for each remote node. Ethernet is a Carrier Sense Multiple Access scheme in which nodes wishing to transmit first listen to see if anyone else is transmitting. If all is clear, the node is free to transmit. If someone else is transmitting, the node waits a random period of time and tries again. Under this scheme, all nodes will get to transmit eventually; it's just not known how frequently any given node will be able to transmit. In an environment that requires guaranteed bandwidth, a time division multiplexing scheme is essential. In this scheme, each node has a pre-assigned slot in which to transmit. The frequency with which a node will be able to transmit is determined by the number of nodes and is known in advance. The 802.11 standard does not allow for this mode of communication.

CONCLUSION

Standards are good things. They promote interoperability, competition, and lower cost. They encourage the market by enabling multi-vendor sources for products and lower prices. For a standard to be effective, it must address specific application issues and therefore cannot be a "one-size-fits-all" standard. As illustrated above, 802.11 is in its early days in terms of fulfilling the promise of a standard. And it certainly appears that it will meet its potential for office LAN applications. But when it comes to factory floor and industrial applications, 802.11 does not address market needs. To reap the benefits that a standard can offer, wireless factory floor and industrial products need a separate standard. Attempts to force fit the 802.11 products into these applications will only result in poor performance and higher costs.