



Industrial Wireless: Driving Connectivity Beyond the Carpeted Space



Executive summary

The value of wireless connectivity across the enterprise is well recognized. However, establishing wireless connectivity in an industrial environment — which often includes plants located miles down the road and extremely remote areas — presents a unique set of challenges not found in the typical office environment. The presence of equipment, large machinery and a lot of metal surfaces that can reflect RF signals add a level of difficulty in the design of a wireless solution that can reliably extend voice and data connectivity to workers regardless of their location. There is a need for heightened reliability to protect against unplanned downtime in the production process; there may be other wireless technologies currently in use or planned, such as RFID and machine-to-machine SCADA networks. And finally, there is a need to enable mobility but at a reasonable cost — despite the additional challenges and extensive physical area that must be covered.

Understanding these issues and how to address them is key to deploying an industrial wireless solution and successfully connecting an enterprise,. This white paper takes an in-depth look at driving connectivity beyond the carpeted space and how today's technologies can be leveraged to enable the cost-efficient design of a wireless backbone that can successfully deliver mobility throughout the demanding environment of the industrial enterprise.

Background

The challenges associated with extending mobility in the industrial environment are very different from the office environment. Achieving success and cost-efficiency in industrial mobility solutions requires an in-depth understanding of the unique issues in the industrial environment, and how those issues translate into specifications for the mobility backbone — the wireless infrastructure.

Regardless of what is being produced — from power and petrochemicals to vehicles, electronics and more — the coverage area is far more expansive than the typical enterprise. Where some enterprises may have a campus environment with a number of buildings clustered in a fairly close proximity, the industrial environment often includes large outdoor areas that may extend for miles, plants that may be down the road or many miles away as well as workers spread throughout dispersed locations — from a remote area inside the enterprise campus to a customer site. Not only is the physical area vast, it consists of varying physical environments — inside and outside the four walls — where reliable wireless connectivity must be established in spite of elements that might include environmental factors such as extreme temperatures or wind as well as obstacles like buildings or large equipment.

While the physical size of the entire area requiring coverage is larger than the average enterprise, so are the buildings themselves — often hundreds of thousands of square feet. And within those buildings are even more physical challenges. The large volume of metal typically found in the construction of the building as well as within the environment, such as large vessels, piping and machinery, can wreak havoc with RF signals — as can equipment that emits electromagnetic noise, such as large motors. The presence of multiple fixtures and equipment can create RF ‘blind spots’. Very high ceilings can translate into the need for high-cost specialized labor for wiring and installation of wireless infrastructure. Industry regulations can also add significantly to these costs, since, for example, some wiring may need to be run through metal conduit. And hazardous and/or explosive materials found in many industrial environments add yet another level of complexity.

In addition to differences in the physical environment, there are many application differences as well. Many enterprises simply require the ability

to connect mobile computers wirelessly on an ad hoc basis. While industrial enterprises have similar requirements, they in fact need much more. In addition to enabling quality, asset management and other applications on a mobile device, the industrial enterprise may also need to track personnel. Other physical assets must be tracked to ensure that the right equipment and materials are available when needed to keep business running smoothly. And the extension of mobility to sensor networks can provide real-time plant or equipment information that is crucial to the general health of the business by revealing a pending machinery issue that can be resolved — before it impacts production levels, profitability, or employee safety.

Achieving success in the challenging industrial environment is dependent upon understanding the unique requirements, and how those requirements translate into criteria for the selection of the most crucial aspect of any mobility solution — the wireless infrastructure. The selection of the right infrastructure will:

- Ensure the performance and functionality needed today
- Ensure that the system selected can grow as the business needs change and grow
- Reduce risk
- Enable maximum success — and return on investment

Wireless infrastructure requirements in the industrial environment

The extension of mobility in the industrial space can require wireless connectivity inside the four walls, out in the plant, in warehouses or yards, between campuses and plants, and even in outlying areas. Achieving this kind of true inside/outside coverage will often involve the selection of a wireless infrastructure ecosystem capable of seamless interconnectivity — which might include wireless LANs, point-to-point and point-to-multipoint networks and private wide area networks.

The RF switch is the key in this ecosystem, providing device connectivity as well as a platform for the integration of whatever wireless technologies are required by the enterprise. Regardless of



Industrial environments present a unique challenge for mobile voice and data solutions — unlike the typical office space, these environments often include large outdoor areas that may extend for miles. Providing mobile voice and data services for workers often requires the seamless integration of a variety of types of networks, including the traditional wireless LAN as well as mesh networks, point-to-point and point-to-multipoint solutions.

whether workers remain inside the enterprise compound or spend a good portion of the day in the field, seamless voice and data connectivity is required to maintain peak workforce efficiency. But all wireless technology is not created equal. It is important to understand the types of features and functions that are available to best meet the needs of extending mobility in an industrial enterprise.

Reliability

In a production environment, maximum uptime is crucial — the wireless system must offer the same level of reliability as the wired network. For example, if wireless communications on the assembly line are unavailable even for a short

period of time, a call for material replenishment may not be received in time to prevent unplanned shutdown of the production line — a potentially costly situation. For sensor networks, lack of real-time connectivity can obscure a small deviation in Key Performance Indicators (KPIs) long enough to spiral into a reduction in production capacity.

A wireless system that offers maximum mean time between failure specifications (MTBF) and multiple levels of redundancy is crucial to ensuring the uninterrupted network availability required to protect productivity and profitability. The following features can ensure continuity of services — even in the event of infrastructure failure — providing the reliability required for critical data and applications:

RELIABILITY	
Feature	Benefit
Active/active and active/standby modes	Enables instant cutover to another wireless switch.
Clustering	The ability to cluster multiple switches enables a wireless switch to immediately and automatically adopt any access ports and access points associated with a failed switch.
Self healing	If an access port should fail, neighboring access ports can automatically adjust power to fill the resulting gap in coverage.

Performance-enhancing features that contribute to reliability provide granular control over the availability and quality of the wireless connection. For example, make sure the wireless system enables users to roam to the next access port or access point before connection erodes. Equipment that can automatically change to a different channel if there is too much noise ensures that users maintain a robust connection in spite of challenging environmental conditions. Traffic control features provide granular control over types of traffic — for example, the ability to segment voice and data traffic helps ensure the quality of voice calls. And finally, look for wireless systems that reduce processing requirements on the mobile devices themselves to ensure ample battery power during shifts as well as to improve the overall lifecycle of the battery.

Security

Security plays a big part in ensuring reliability. The network must be protected from unauthorized users who could initiate attacks that can lead to downtime, the introduction of erroneous information or the theft of company data.

To achieve a level of security on the wireless system equal to that of the wired LAN, the wireless system should offer a comprehensive portfolio of security features that can be layered as needed to achieve the right level of security for different applications. In addition to controlling who accesses the wireless system, data should be protected as it travels over the wireless infrastructure. And the ability to monitor the wireless system in real time is critical to enabling the swift action required to minimize the effects of any security breach.

SECURITY	
Feature	Benefit
Integrated firewall	An integrated firewall can effectively separate the wired and wireless infrastructures, ensuring that a breach of security in the wireless network does not automatically grant an unauthorized user access to the wired network.
Access control	<p>Authentication: A wide variety of authentication protocols — access control lists (ACLs) to integrated AAA/RADIUS servers — allow the verification of user identity prior to granting network access</p> <p>IPSec VPN Gateway: Look for support for DES, 3DES and AES encryption to provide maximum protection for your most sensitive data.</p>
Data protection	<p>Encryption: Support for WPA2 offers maximum protection, utilizing sophisticated encryption protocols to protect data as it travels over the wireless LAN. And since WPA2 is part of the IEEE 802.11 standard, interoperability between wireless infrastructure and mobile devices is assured.</p>
Monitoring	<p>While access control and data protection are typically standard with most wireless LANs, one additional security tool is mandatory — comprehensive around-the-clock monitoring capabilities including:</p> <p>Day to day proactive protection through the ability to identify and correct weaknesses in the wireless system</p> <p>Wireless intrusion detection for instant visibility in the event a security breach occurs, enabling an immediate response to protect uptime and company data</p> <p>Forensics data repository of security incidents that can be analyzed to reveal how to prevent that type of security breach in the future</p>

Comprehensive integration capabilities... including RF technologies, existing technology investments and mobile devices

At the center of mobility solutions, the wireless system should offer the flexibility to easily integrate the various technologies and devices that are in use in your environment today — as well as those required to meet business needs tomorrow. While today only a wireless LAN may be needed, the feasibility of deploying RFID in the yard and the warehouse may

be under evaluation. To future proof the wireless infrastructure investment and enable the integration of the technologies and services that will best serve the enterprise, consider wireless infrastructure that supports the features outlined in the table below.

The selection of an RF agnostic wireless infrastructure provides a true foundation capable of supporting the technology building blocks of the future that will best benefit the company.

INTEGRATION CAPABILITIES	
Feature	Benefit
RF agnostic support	To protect the wireless solution investment and to simplify and reduce the costs of the wireless architecture, the wireless system should reach beyond 802.11a/b/g Wi-Fi based wireless networking to also enable the integration of RFID, WiMAX, mesh networking, Bluetooth, locationing and 802.15.4 for machine-to-machine networking such as Zigbee.
Support for a wide range of mobile devices and operating systems	An open standards-based architecture will ensure compatibility with whatever mobile devices are most appropriate for the specific application and environment — from rugged handheld integrated voice and data mobile devices to personal digital assistants (PDAs), laptops, GPRS and 3G cell phones and walkie-talkies.
Support for a complete range of voice services	To ensure the ability to extend cost-effective voice services to the expansive industrial environment, the wireless system should support a wide range of voice services, including dedicated voice networks, cost-effective Voice-over-IP communications for workers inside the enterprise walls and seamless integration with public networks to support workers outside the enterprise premises. To take full advantage of today's integrated voice... <i>(Continued in next column)</i>

INTEGRATION CAPABILITIES (continued)	
Feature	Benefit
Support for a complete range of voice services (continued)	...and data devices, the wireless infrastructure must support advanced features such as push-to-talk and fixed mobile convergence (FMC). With FMC, existing telephony investments can be fully leveraged by enabling the extension of the desk phone to the worker's mobile device — including the phone number and full feature set. The return on investment for current telecommunications equipment is improved, worker productivity is increased, and telephony costs are reduced through the extension of cost-saving PBX-style features to mobile devices. And since voice is key in ensuring 'reachability' for workers moving throughout extensive industrial facilities, whether they are inside the four walls, out in the yard or out in the field — a wireless LAN should offer rich control over voice traffic to ensure the quality of voice calls. Features should include the ability to segment voice traffic to a separate wireless system as well as give priority to all voice packets.
Secure public access	Secure public access allows the extension of convenient Internet connectivity to visitors. The wireless system should provide complete control over who has access, how they access, and when access is granted — without risking network or data security.



Workers in industrial environments often spend time in remote areas of the enterprise campus, outside the four walls, in areas where hazardous materials are present as well as in areas where many obstacles for RF signals are present. Implementation of a successful mobility solution in this challenging environment is dependent upon an in-depth understanding of the unique requirements, and how those requirements translate into criteria for the selection of the most crucial aspect of any mobility solution — the wireless infrastructure.

Management

A key IT concern is the overall manageability of wireless solutions — from the infrastructure to the many mobile devices and applications that may be deployed throughout the enterprise. Wireless infrastructure in a production environment can span large areas — throughout a single metropolitan area or at multiple sites throughout the world. Management of wireless solutions often ripple into ongoing operational costs that may be even more costly than the capital required to purchase and deploy the system itself — and can actually erode the benefits of the mobility solution. To address this issue, your solution provider should offer comprehensive management solutions that provide central and remote management of many possible aspects of the mobility solution, including:

- The Wi-Fi infrastructure (including wireless switches, access ports and access points)
- Mobile devices, including bar code scanners and handheld mobile computers
- RFID readers
- Sensor networks
- Locationing networks (for visibility into the location of an Wi-Fi mobile device or asset with an RFID-tag)

With centralized visibility and control, IT personnel will no longer need to physically check network equipment, traveling to the various areas where infrastructure is installed, and down time can be significantly reduced. The resulting savings in time and cost yields a better return on investment — and lower total cost of ownership. For maximum benefits, look for management solutions that

provide complete control over all the aspects of your mobility solution, reaching beyond the wireless infrastructure to encompass other RF networks as well as the mobile devices on the network — and the applications, operating system and firmware installed on those devices. Look for fully featured management solutions that allow you to:

- Remotely stage all your infrastructure and devices to simplify deployment
- Remotely provision devices, allowing rapid and push-button upgrading of applications and configurations as well as loading of any operating system updates and firmware patches
- Remotely monitor the many metrics on your wireless switches, RFID readers, mobile devices and more to keep your mission-critical applications up and running, 24 hours a day, seven days a week
- Secure devices that could be compromised through loss or theft

Physical environmental challenges inside and outside the four walls

The industrial environment poses a number of significant environmental challenges not found in the carpeted space, from the sheer size and reach of the facilities to the presence of hazardous materials and a lot of RF ‘noise’, RF blind spots, and more. To deliver reliable wireless connectivity in such an environment, the industrial enterprise will need a comprehensive wireless product portfolio that can effectively address these challenges:

PHYSICAL CHALLENGES	
Feature	Benefit
Mesh	Access points with mesh capability will enable the cost-effective extension of network availability in areas that are difficult or expensive to wire — for example, extremely large buildings.
Plenum ratings	Plenum rated access ports and points can be mounted above ceiling tiles, increasing installation flexibility.
Power-over-Ethernet (PoE)	Power-over-Ethernet (PoE) support for access ports and points simplifies installation by eliminating the need for power — which can be delivered over the LAN connection.

PHYSICAL CHALLENGES (continued)	
Feature	Benefit
Customizable RF coverage patterns	The ability to customize RF coverage patterns: Inside a manufacturing facility, there may be a number of areas that present a physical challenge. The ability to customize access ports and access points with a complete family of antennas ensures the ability to achieve the coverage pattern and range required for each node on the wireless LAN.
Rugged access points that offer mesh networking, NEMA 4x and IP56 ratings	Access points offering these features are built to extend wireless network connectivity in outdoor areas — in the yard, at the entrance gate and between buildings. Designed to endure the most severe weather, the devices can withstand high winds, rain and extreme temperatures and humidity. And mesh capabilities eliminate the need for cable or fiber for very cost-effective installation.
Access points certified for hazardous areas	In order to extend wireless connectivity into areas where hazardous materials are present, wireless infrastructure must offer the right level of certification to meet regulatory codes and ensure the safety of workers.
Seamless integration with wide area connectivity solutions	The geographically expansive reach of the industrial enterprise can include an extremely large campus with very remote areas or facilities that may be ten or fifty miles down the road. Providing access throughout such a broad area can require a variety of wireless networks and technology that can be easily and seamlessly integrated into one homogenous network — from WiMAX and dedicated private voice networks to point-to-point and point-to-multipoint connectivity solutions.
Proper site planning for challenging RF environments	The industrial environment typically includes a lot of metal surfaces that can reflect RF signals — from tanks and pipes to vessels, pumps, compressors and more. In this challenging multi-path environment, a very thorough and careful site survey is required to ensure successful deployment — and to protect against the need for major and often costly adjustments post-implementation.

Mobility support — inside and outside

A mobility solution enables employees to conduct business and automatically capture data while on the move throughout the workday. Enabling mobility in the wide physical geography of the industrial enterprise requires a true wireless network ecosystem — comprised of multiple wireless infrastructure components needed to provide the most cost-effective and reliable extension of voice and data services. For example:

- Wireless LANs with mesh capabilities enable the extension of wireless connectivity into outdoor areas and hard to wire areas indoors, as well as the connection of two wired networks — all without the expense of installing additional cable or fiber.
- Point-to-point solutions provide low-cost networking between facilities.
- Point-to-multipoint private wide area networks enable the extension of voice and data virtually anywhere, ensuring that employees have coverage wherever it is needed and the network is always available when needed, while reducing the use and cost associated with public WWAN use.

The need to integrate these various types of wireless networks to obtain coverage where it is needed does increase the level of effort required to mobilize the industrial enterprise. But the selection of an end-to-end solution provider offering a wide range of wireless solutions designed to be layered can ensure ease of integration and deployment of a wireless ecosystem — significantly simplifying the seemingly overwhelming complexity of extending mobility throughout the expanded geographical area required by the typical industrial enterprise.

Cost

Deploying a wireless system in an industrial environment can be a costly endeavor. For example, regulations that may require conduit for wiring and more driving wiring costs alone up to \$100 per foot in a typical processing plant.¹ As a result, installing a wireless system in an industrial environment can be 10 times more than the cost of the infrastructure itself.

The right wireless infrastructure with the right feature set can dramatically reduce the high cost of deployment in this challenging environment.

For example:

- Backhaul capabilities: Mesh-enabled access points can wirelessly connect to other access points for data backhaul, eliminating the need — and associated cost — for Ethernet or fiber cabling.
- Point-to-point bridging: Mesh-enabled access points can create a point-to-point bridge to connect two wired networks, or a complex multi-node multi-link network, providing a highly reliable and very cost effective means to extend the network outdoors and to other remote areas.
- Cost-effective power solutions: Power-over-Ethernet can eliminate the need to run power to access ports and points, reducing the high cost of wiring.
- A full suite of antennas: A broad range of antennas enables the creation of flexible RF coverage patterns that reach into odd shaped areas and around fixtures — instead of requiring the purchase of additional access ports or access points.

Making seamless inside/outside industrial wireless a reality

When it comes to selecting a provider to enable mobility in your industrial environment, technical expertise, deep vertical experience, a systems approach and a strong ecosystem of application and solution providers are key to ensuring a successful deployment. Motorola and its global network of partners brings the right mix of products, technology, applications, industry expertise, and professional and customer support services to address your industrial wireless needs — both indoor and outdoor. We offer the ease of integration and innovative proven technology required to deliver reliable integrated voice and data services wherever and whenever needed.

For more information about the challenges and opportunities of industrial wireless deployments, and how Motorola can help you achieve a connection to all your business-critical applications across your enterprise contact us at +1 800.416.8593 or visit us on the web at www.symbol.com/wireless.

1 - ABI Research; Wireless Sensor Networking (WSN) in Industrial Automation/Market Assessment for Monitoring and Control Applications; 2007



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