

Business happens everywhere – it's not limited to the inside of office walls. However, that's exactly the limitation of many corporate networks in use today. Taking advantage of mesh technology, Symbol Technologies offers a convenient, flexible, scalable and cost-effective way to extend those corporate networks beyond the walls to reach warehouses, shipping yards, and other difficult-to-cable parts of your business. Mesh networks use RF to provide both network access and data backhaul, making it possible to extend the traditional network to less traditional locations without installing additional cable or fiber.

Business applications for mesh networks exist in a variety of settings and industries, including corporate campuses, industrial environments, healthcare facilities, and transportation and logistics. Symbol Technologies, a proven leader in enterprise wireless infrastructure, provides quality, scalable, high performance mesh networking solutions to suit a wide variety of business needs.

## ENABLING ENTERPRISE BEYOND OFFICE WALLS

As the business enterprise evolves, it continues to demand more from its networking infrastructure. And as it has for over a decade, Symbol Technologies continues to provide innovative ways to anticipate and meet those networking demands.

One such innovation is the use of wireless mesh technology to bring the corporate network beyond the office walls. After all, business doesn't just happen in office buildings; it happens everywhere – shipping yards, distribution centers, warehouses, oil refineries, airports – anywhere people go.

However, until recently, adding network access in all these places has not been practical—in some cases, not even possible. Consider a security kiosk at the entrance of a corporate campus. At one time, allowing the security personnel in that kiosk access to the corporate network and mission-critical applications such as e-mail meant installing cable or fiber – a costly and potentially impractical proposition.

Fortunately, mesh-enabled products from Symbol now provide a fast, simple, cost-effective way to extend the existing network to that kiosk—without cable or fiber.

## Advantages of mesh networking

One of the key advantages of mesh technology is its flexibility. Therefore, the precise definition of a mesh network depends to some degree on the applications it enables. In the context of allowing business networking to reach outside traditional corporate boundaries – the focus of this discussion – mesh networking can be described as a series of “nodes”, each of which is capable of providing wireless network access to local users, while also intelligently backhauling traffic wirelessly among the network to its destination.

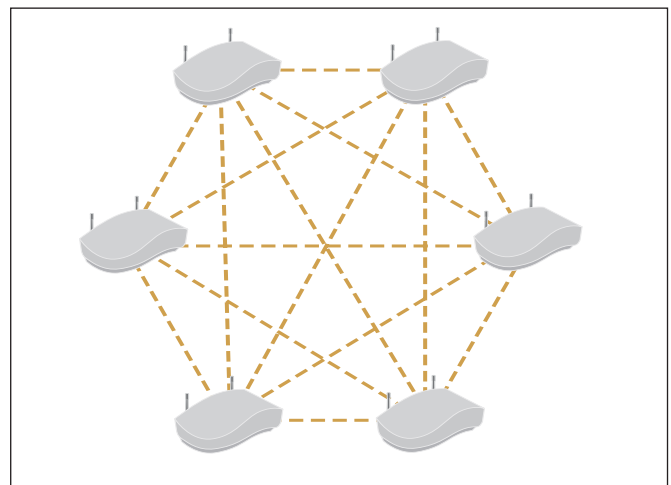


Figure 1: Mesh networking

Built on redundant, interconnected network nodes, mesh technology offers a cost-effective solution for extending wireless coverage inside an enterprise and outside its walls, resulting in a complete and reliable wireless network available to expansive campuses and manufacturing facilities.

Such a network structure offers several benefits to the enterprise:

- **Mobility and convenience**

Because the corporate network can now extend to cover even the more remote parts of the campus, including places where installing cable or fiber might not be practical, workers can use mobile devices to access mission critical network applications at the point of activity. Employees don't need to go to the network – the network comes to them.

- **Ease of set-up and management**

Mesh nodes automatically detect each other, set up communication links and dynamically route data between nodes, adapting to network changes on the fly, making set-up and management of the network quick and simple. Additionally, Symbol's AP-5131 Access Point and WS5100 Wireless Switch offer superior remote management functionality either through integration into existing network management systems or via Symbol's Mobility Services Platform (MSP). MSP provides network managers with full visibility and control of the network from a single centralized location.

- **A flexible and scalable network**

Mesh networked nodes automatically detect the presence of new nodes and the absence of previously existing nodes, and adapt accordingly, so adding or removing nodes is simple. Because a wireless mesh network requires no cables, administrators can easily change the configuration of an existing network in a matter of minutes. The use of dual-radio access points or wireless switches improves performance and provides scalability, since access is provided on one band of one radio while data backhaul happens simultaneously on a different band of the second radio. This "self-assembling" and "self-healing" network offers the performance to support the most demanding voice and data applications.

- **Cost savings**

The fact that an enterprise can install, extend or modify its network without the use of cable or fiber significantly reduces the cost of that network. The reduction in installation time and materials translates directly into cost savings.

## **ANATOMY OF A SYMBOL MESH NETWORK**

Symbol's wireless mesh solution addresses the need for extension of the WLAN beyond the boundaries of the wired network. Today's wireless switch infrastructures are comprised of a number of access ports which provide RF coverage, connected to a wired local area network (LAN). On the same LAN, a wireless switch detects the access ports, downloads the configuration, manages the ports and processes all wireless data received and transmitted through them.

The extension of this infrastructure to enable deployment of access ports in locations where cabling is cost-prohibitive or otherwise not practical requires wireless backhaul of data to and from the access port. In essence, the access port routes its data via RF through the other access ports, or nodes, to the LAN, and hence the wireless switch. The ability of ports and points to operate wirelessly to both provide network access and data backhaul, and the ability of the wireless switch to support this mode of operation together constitute the mesh functionality. While other manufacturers require two devices to create each node – one to provide network access and another for data backhaul – a single Symbol access point carries out both tasks, reducing hardware requirements and simplifying network set-up.

The Symbol AP-5131 access point fully supports mesh networking to enable an array of scenarios where deployment would be costly without the advantage of wireless backhaul of data. A single-configuration parameter enables Wi-Fi service to mobile units through the same APs that are being used to backhaul data to the LAN. Providing service to mobile units via the same radio used for wireless backhaul allows users to deploy single-radio AP-5131s while still taking advantage of mesh features, although single-radio mesh solutions sacrifice line speed and scalability. With dual-radio hardware, both the 2.4 and 5 GHz frequency bands can be leveraged, yielding better overall performance and creating a far more scalable network.

A Symbol mesh network can easily be scaled by simply adding AP-5131 Access Points in range of one another, configured with the same mesh network name. The APs automatically detect each other, set up communication links, adapt to changes in the mesh and route data between nodes. In automatic mode, the mesh network is self-assembling and self-healing, so changes in the environment are

always taken into account, yielding the most efficient configuration at any point in time – the user need only define a mesh network name and configure the desired services on each radio.

As with all Symbol wireless infrastructure solutions, the mesh-enabled AP-5131 Access Point supports the highest level of encryption for Wi-Fi, including AES and TKIP encryption. These are the same algorithms specified by the 802.11i standard, which has been widely accepted as the de facto standard for Wi-Fi security. As mesh nodes, the AP-5131 Access Points automatically negotiate pair-wise master keys and set up secure tunnels between each node so that data is never transmitted in the clear.

Local or remote management of the AP-5131 Access Point is simple, using either existing network management tools or Symbol’s Mobility Services Platform (MSP), which provides administrators with visibility and control of the network from one centralized location.

## MESH IN ACTION: PRACTICAL APPLICATIONS

### Traditional enterprise

Many large corporations have multi-building campuses. Finance may be in a different building than manufacturing or shipping and receiving, but all need access to the corporate network. While cable has already been installed in most modern office buildings, there may still be very practical reasons to use mesh technology to complement existing networks.

One such example would be to provide network access to legacy buildings on campus, such as the security kiosk discussed earlier, that don’t currently have network access because the cost of bringing network cable out to small, remote buildings was too high. Another example is a campus that was originally a multi-tenant industrial park where each building was intended to house a different company so cable between the buildings was never installed. Still another example is a campus undergoing expansion, where workers are briefly housed in temporary structures. Running network cable to these buildings is basically “throw-away” work, given that the structures will be removed once new buildings are complete.

By adding Symbol AP-5131 Access Points, the corporate network can easily be extended to any part of the campus, either permanently or temporarily, without requiring additional cable or fiber. This is a

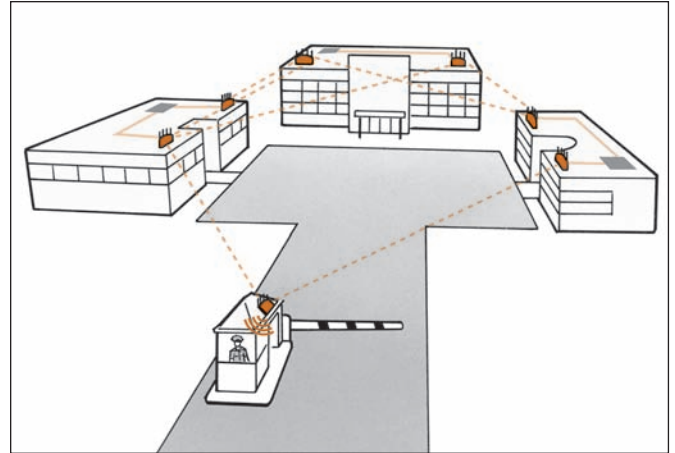


Figure 2: Mesh in the enterprise environment

cost-effective way to bring network access to the security kiosk and to provide wireless backhaul to all buildings in the campus. Such a solution also offers a far more flexible and affordable way to provide network access to the temporary structure: as building progresses and network requirements change, nodes can easily be added, removed, or relocated as necessary.

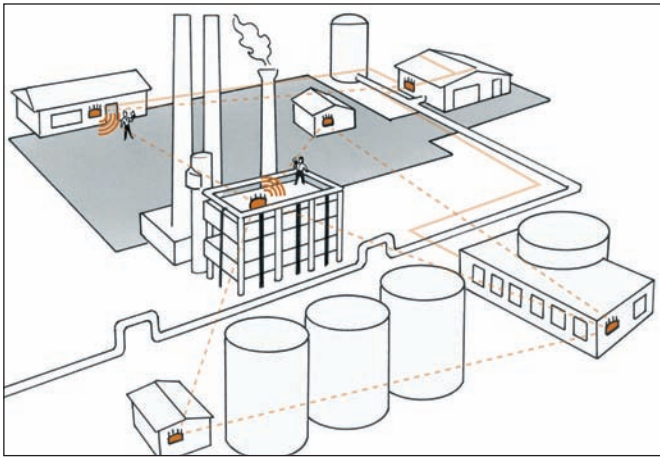
Because no cable installation is required, an enterprise can save both time and money extending its network using Symbol mesh-enabled products. In the case of the temporary structure, the waste of installing cable to a temporary location is also eliminated.

### Industrial environments

Industrial environments such as manufacturing plants, petrochemical processing facilities, and utility plants are generally removed from the corporate offices, although they still need to share corporate data and network resources. These environments also tend to be harsh, and often partially or largely outdoors.

Networking in a heavy industrial environment poses some unique problems. Even when technically possible, cabling outdoors can be cost-prohibitive, and deployment of Wi-Fi infrastructures in industrial environments is often challenging due to multipath issues caused by metal obstacles reflecting radio signals and other sources of RF noise. Additionally, in cases where there are no IT resources on site, network administration can be difficult.

Safety and regulatory issues can be further impediments to network installation in such environments. For example, safety regulations for installation of electronic components in explosive environments, such as petroleum refineries, require that all conduits and enclosures be Class 1 Div 1 certified. In essence, this translates into very high installation costs. Before finding Symbol's wireless mesh solution, one customer in the petrochemical industry reports having received a quote for installation upwards of ten times the cost of the access point hardware itself. Any effort to reduce the amount of cabling required translates in significant cost savings.



**Figure 3: Mesh in a refinery environment**

Use of a Symbol mesh network eliminates the need for cabling, which makes it a far simpler task to bring a network to an industrial environment, inside or outside. Additionally, Symbol products have significant multipath resistance, minimizing the problems that traditional products encounter in an environment with challenging RF characteristics. Symbol wireless infrastructure products available today embody over a decade of RF expertise in industrial deployments.

Another advantage of using Symbol AP-5131 Access Points in a mesh topology in a typical industrial setting is that the network can be configured to be self-assembling and self-healing, and the AP-5131 can be managed remotely by IT staff in the corporate offices.

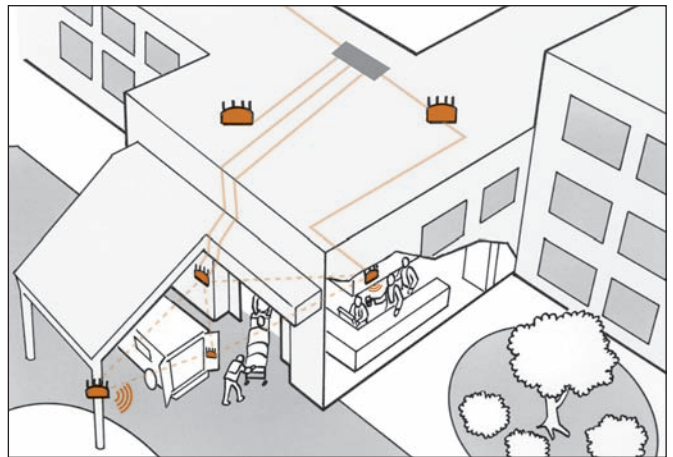
The time and money saved in deploying a Symbol wireless mesh network in an industrial environment can be significant versus the cost of implementing a traditional wired network. This is particularly

true in hazardous environments where installation of cable is even more costly. In any industrial installation, the flexibility of managing the network either locally or remotely can be another significant cost saving feature.

### Healthcare

The business of healthcare, whether at a doctor's office or a hospital, is often a delicate balancing act of urgency, privacy, regulations and technology. When information sharing is essential, a secure network aids medical professionals in making critical decisions required to provide effective patient care.

Obviously, getting a patient's medical information to the right place quickly is essential in a healthcare setting. When a patient is admitted to a hospital, that patient's medical records need to be forwarded from his or her doctor. When an ambulance brings a patient in, it is imperative that all patient information gathered by the paramedic be transferred to hospital medical staff immediately and accurately. In both these scenarios, a network can be a valuable tool, assuring quick, accurate transfer of patient data. The first requires simply that the doctor transmit electronic records securely to the hospital. The second could be easily accomplished if the paramedic were using a mobile computer, which could then be connected to the network and the data downloaded to the appropriate application. This data transfer could happen even more efficiently if the ambulance carried an access point acting as a mobile node upon entering the hospital's mesh network.



**Figure 4: Mesh in the healthcare environment**

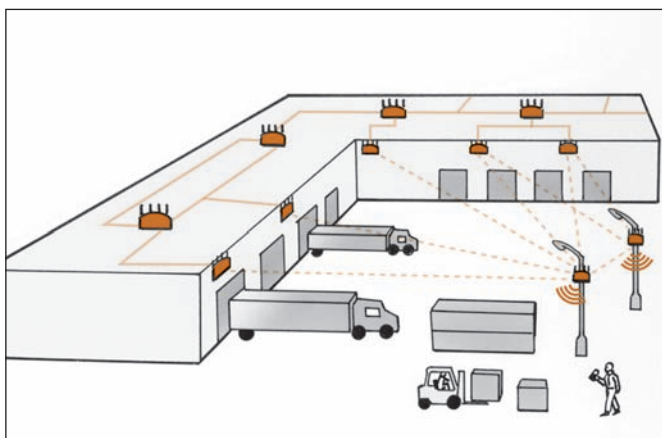
Another advantage mesh networks have over wired networks in a healthcare environment is the fast and non-intrusive installation. Most hospitals and health clinics are subject to safety regulations prohibiting the blocking of hallways at any time, making installation of network cable difficult and expensive. Extending the network using wireless mesh technology, on the other hand, can be done quickly and easily — no cables required.

All Symbol wireless networking products provide HIPAA-compatible data security, so data is never transmitted in the clear. A wireless network using dual-radio AP-5131 Access Points as mesh nodes is also capable of supporting bandwidth-intensive applications frequently used in healthcare, such as VOIP.

An additional benefit of a Symbol mesh network in healthcare applications is that, due to its somewhat mobile nature, a mesh network is flexible enough to allow the addition of nodes should temporary access to the network be required in an area not typically served by the network. For example, if a natural disaster or other crisis were to require hospital personnel to set up a triage area in the cafeteria, all that would be required to extend the network would be the addition of AP-5131 Access Points. Once the crisis abated, the access points could be removed.

### Transportation and Logistics

In transportation and logistics applications, the challenge for Wi-Fi systems is to provide real-time data access at the point of activity while guaranteeing the highest level of uptime. As competition in this space forces customers to continually decrease turnaround time, operations are constantly being redesigned to address this



**Figure 5: Mesh in the distribution center environment**

need. In the mail and logistics market, operators now require real-time data access outside the facility walls in order to initiate the receiving procedures as trucks approach the main facility. In the retail space, operations for the distribution of goods now require real time data access outdoors in shipping yards, where material is loaded and unloaded from trucks.

In general, the requirement for extending the Wi-Fi network coverage beyond the four walls is rapidly emerging in many markets. In the past, new facilities which factored in the requirement of network coverage in all areas have been wired to support traditional access points. However, the ability to wirelessly deploy a network node where only power is available is a significant advantage for sites which are not pre-wired with an Ethernet or fiber infrastructure.

A shipping yard adjacent to a distribution facility, where secondary buildings requiring connectivity may also exist, is a good example of how mesh networking can be a cost-effective and time saving way to extend the wireless network. Access points may be deployed on light poles where power is available and a secure mesh network is automatically established. Mesh nodes automatically anchor to APs within the facility to reach the wired network.

### Other applications

The applications for mesh networking are boundless, including use in education, metropolitan access, military, and so on. It would be impossible to provide an exhaustive explanation of all the ways mesh technology could be used to great advantage in all the different aspects of our lives. However, the concept and descriptions illustrated here should be an excellent starting point for those who wish to extend corporate networking beyond office walls.

### WHY SYMBOL?

#### Symbol Technology

With the introduction of its mesh-enabled access points and wireless switches, Symbol Technologies, holder of over 900 patents in mobile technology, continues a long tradition of innovation and global market leadership in mobile computing, RFID solutions, enterprise WLAN and wireless switching. The Symbol wireless infrastructure products available today embody over a decade of RF expertise and superior performance in industrial deployments.

In addition to its award-winning hardware, Symbol also offers a wireless management application – a critical component of any wireless system. All Symbol products can be deployed and managed

via an integrated set of tools and a management console called the Mobility Services Platform, or MSP. MSP offers real-time visualization of all networking components and mobile devices via one user interface. Mobile terminals can be deployed, managed and monitored individually or as part of groups. Multiple sites can be organized in a hierarchical fashion to facilitate browsing to single devices and obtaining health and status information of the network. Wireless infrastructure components, including mesh nodes are manageable via MSP over a secured SNMP v3 protocol. MSP provides network managers with full visibility and control of the mobile network from a single centralized location.

### **Symbol vision**

There are three elements of wireless technology crucial to the enterprise within the RF networking space: voice, security, and management.

Business-critical wireless applications are at the intersection of these three elements, and this is where Symbol's strength in enterprise wireless infrastructure lies. Unlike other manufacturers who provide only pieces of enterprise mobility, Symbol offers the switching architecture, the infrastructure and the mobile devices necessary to provide seamless, reliable communications to a mobile workforce, as well as the management tools to administer the whole solution. Symbol truly understands mission-critical enterprise applications, and enables them at the point of activity.

### **SYMBOL MESH-ENABLED PRODUCTS**

Symbol's wireless switching and access point portfolio, comprised of the WS5100, the WS2000 and the AP-5131, is designed to offer a scalable solution to address wired and wireless infrastructure needs. Small retail outlets or branch offices that only require one cell of Wi-Fi coverage and services such as routing, VPN and authentication, can benefit from deploying a single-cell solution such as the AP-5131. Larger sites which may require up to six cells of coverage will benefit from the feature set of the WS2000. Sites requiring up to forty-eight cells of coverage utilize the WS5100, which offers superior capacity and throughput.

The AP-5131 offers mesh networking functionality in firmware release v. 1.1, along with other valuable new features such as AAA Server for wireless user authentication, and Hotspot Gateway functionality to enable public access Wi-Fi service without the need for additional hardware. Integration of the mesh functionality in the wireless switching portfolio is forthcoming via adoption of access point and access port devices by the WS5100 and WS2000 Series switches.

### **IN SUMMARY**

Flexible, convenient, cost-effective, and easy to manage, mesh networks are the next step in wireless connectivity, providing enterprise-class networking within and beyond enterprise walls.

Symbol Technologies, a proven leader in enterprise wireless infrastructure, provides quality, scalable, high performance mesh networking solutions to suit a wide variety of business needs.

To assist with the challenging needs for wireless network design and deployment – indoors or outdoors – contact a Symbol PartnerSelect partner or visit <http://www.symbol.com> to contact a local Symbol representative.



## About Symbol Technologies

Symbol Technologies, Inc., The Enterprise Mobility Company™, is a recognized worldwide leader in enterprise mobility, delivering products and solutions that capture, move and manage information in real time to and from the point of business activity. Symbol enterprise mobility solutions integrate advanced data capture products, radio frequency identification technology, mobile computing platforms, wireless infrastructure, mobility software and world-class services programs. Symbol enterprise mobility products and solutions are proven to increase workforce productivity, reduce operating costs, drive operational efficiencies and realize competitive advantages for the world's leading companies. More information is available at [www.symbol.com](http://www.symbol.com)



### *Corporate Headquarters*

**Symbol Technologies, Inc.**  
One Symbol Plaza  
Holtsville, NY 11742-1300  
TEL: +1.800.722.6234/+1.631.738.2400  
FAX: +1.631.738.5990

### *For Asia Pacific Area*

**Symbol Technologies Asia, Inc.**  
(Singapore Branch)  
Asia Pacific Division  
230 Victoria Street #05-07/09  
Bugis Junction Office Tower  
Singapore 188024  
TEL: +65.6796.9600  
FAX: +65.6337.6488

### *For Europe, Middle East and Africa*

**Symbol Technologies**  
EMEA Division  
Symbol Place, Winnersh Triangle  
Berkshire, England RG41 5TP  
TEL: +44.118.9457000  
FAX: +44.118.9457500

### *For North America, Latin America and Canada*

**Symbol Technologies**  
The Americas  
One Symbol Plaza  
Holtsville, NY 11742-1300  
TEL: +1.800.722.6234/+1.631.738.2400  
FAX: +1.631.738.5990

### **Symbol Website**

For a complete list of Symbol subsidiaries and business partners worldwide contact us at:

[www.symbol.com](http://www.symbol.com)

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