RF/Wireless Basics

An Intro to the Latest in Wireless Data Collection Networks, Products, Standards and Solutions

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Introduction

Companies look for any advantage to remain competitive in today's high-speed business climate. They work to streamline their supply chain management systems, knowing that even a few minutes in order processing time can make a huge difference in getting product to end user. And that can be the difference between who gets the job and who doesn't - even who gets to stay in business and who doesn't. One of the ways to save minutes that turn into competitive advantages is to save seconds on highly repetitive tasks by using fast, accurate radio frequency (RF) technology.

More and more companies are evaluating RF technology because they have learned that wirelessly transmitting data can provide tremendous time and cost savings. Does RF make sense for your business? This guide is intended to get you started in your evaluation.

What is RF?

When you hear someone say "RF," he or she is generally referring to radio frequency data communications. In the past, it has also been referred to as RFDC, to differentiate it from radio frequency identification (RFID), which is a different and potentially complementary technology. (See page 18 for more on RFID, or download our RFID primer at www.lxe.com.) Wireless local area networks (WLANs) are a very popular form of RFDC.

RF is the wireless transmission of data by digital radio signals at a particular frequency. It maintains a two-way, online radio connection between a mobile terminal and the host computer. The mobile terminal, which can be portable, even worn by the worker, or mounted on a forklift truck, collects and displays data at the point of activity. The host computer can be a PC, a minicomputer or a much larger mainframe.

The end result is a seamless flow of information to and from the host, allowing workers to go wherever they need to go to get their job done without fear of being out of touch with the data they need. RFDC improves the timeliness of information, and therefore the value of information, especially in time-sensitive operating environments like cross-dock, make-to-order manufacturing and just-in-time replenishment.

System overview

A basic RF system consists of up to three components:

- A mobile RF terminal;
- A base station (sender/receiver); and
- A network controller.

The mobile terminal forms the link (interface) between the user and the RF system. It collects the data to be sent, receives instructions or data from the host, and allows the user to view the data or messages on its display screen. The terminal also has a radio sender/receiver and antenna to provide communication with the rest of the system.

The base station has a system antenna and acts as a bridge between wireless and wired networks. It is connected to a controller, (controller can be a separate device or included in the base station), which in turn is connected to the host. The "controller" receives and processes information it gets from the host computer and passes this information to the mobile terminals via the base station.

The RF advantage

The advantages of a RF communication system are many. Start with the simple fact that if it is wireless, you don't have to lay cable all over your facility. Cable is expensive, less flexible than RF coverage and is prone to damage. For new facilities, implementing a wireless infrastructure may be more cost effective than running cable through industrial environments, especially if the space configuration may change to support different storage space allocation or flexible manufacturing stations.

Accessibility is a key benefit. If workers are within range of the system and they always should be if a proper site survey is performed (as explained on page 8) they are always in touch with their data. This advantage cannot be overstated. To always have your data literally at your fingertips whenever needed means there is no break in productivity and no empty or "deadhead" trips to a stationary terminal, docking station or dispatch location to receive pick or putaway instructions. Critical decisions can be made and action taken immediately at the point of activity. Less wasted time means you can do significantly more, faster, without adding additional employees. Would that make a difference in your business?

Other general advantages of real-time RF communication include a significant improvement in order accuracy (>99%), the elimination of paperwork, replacement of time-consuming batch processing by rapid real-time data processing, prompt response times and improved service levels. Complementing a real-time data collection system with automated data entry by bar code scanning or another automatic data collection technology improves the accuracy of information and eliminates the need for redundant data entry, which provides another set of time- and cost-saving advantages.

Many points in the supply chain can realize important advantages of accurate, real-time data that RF provides. Here are some examples of RF applied to a few common environments.

RF in warehouses and distribution centers

Shipping and receiving

When goods arrive at receiving, the bar code on the pallet is scanned and the data is sent to the host computer. At virtually the same moment, the quantity of goods received can be compared with the quantity ordered to immediately determine if there is any disparity. If goods received are different from the order, or are damaged, immediate action can be taken. The goods are therefore quickly processed and sent along to their destination, be it the warehouse, production department or shipping/staging area.

Whether outgoing goods are cross-docked or simply transported from storage and loaded onto the truck, shipments can be directed efficiently to trucks and confirmed via the RF system. Invoices, advanced ship notices (ASNs) and other necessary forms and reports can be initiated the moment truck doors are closed.

Internal transport

Goods don't sit when instructions are sent wirelessly direct to the mobile terminal. Forklift truck operators no longer have to go somewhere specific to get their instructions; rather, the instructions come to them, saving time, eliminating deadhead trips and making more productive use of personnel and materials. Also, a RF system allows stock retrieval and replenishment to be combined, dramatically reducing the number of movements involved in the internal transport of material and the number of empty runs.

Stock and location management

The moment palletized goods are put away, forklift operators can use their computer to notify the host system of their location and that they are ready for another job. This allows warehouse space and workers' time to be used in a more efficient manner. Users typically report significant gains in the number of picks or putaways processed per hour after implementing RF-directed operations.

Order picking

RF supports all possible order picking principles: individual selection, batch selection or splits between articles and packaging. Picking information is received by the terminal, and inquiries and transaction/activity data are sent from the terminal to the host, all in real time. Once the order is picked, a forklift truck operator can then be given delivery instructions from a warehouse management system (WMS) via RF. Providing real-time updates of picking activity and order status enables the WMS to continually recalculate the most efficient pick/putaway routes and order assignments.

Stock control

Using RF for stock control offers huge savings in time and money. Because all events are recorded in real time, the computer is continually aware of the current inventory. This high level of monitoring essentially makes separate cycle counting unnecessary. Many companies reduce the number of formal inventory counts they conduct each year, and in some cases eliminate them altogether, because the RF system provides accurate, real-time inventory information.

Depending on the order picking method, RF offers a range of possibilities for speedy verification of previous activities/transactions. For example, after a certain number of transactions, the remaining stock at the pick-up location can be counted for extra verification. If the physical stock is not the same as the administrative stock, those mistakes can be rectified before the goods are moved or shipped.

Stock replenishment

Each time stock is removed, the transaction is recorded by the mobile terminal and sent to the host. When stock reaches minimum, preset levels, the system can be set to alert a supervisor or automatically generate a replenishment request. When bulk stock reaches order level, a purchase order is automatically created and an order placed. Reordering is instantaneous; stocks can be kept low.

RF in manufacturing

In manufacturing, RF can help automate the production, maintenance and repair processes. Typical medium and large manufacturers must stock, control and ensure the availability of thousands of items from raw materials through finished products. Production of those items must be carefully coordinated so the company can meet order commitments and productivity goals.

Companies can unravel this complexity using manufacturing software with automated inventory status reporting, order processing, production scheduling and invoicing features. Adding RF technology to the system guarantees up-to-date information is always available to operators, keeping production interruptions to a minimum.

Just-in-time

Real-time data transfer is a critical piece of the just-in-time (JIT) environment. The whole communication system is geared to the processing of JIT shipments so they arrive at their destinations right when needed. RF speeds ordering and guarantees replenishment is handled efficiently, resulting in product moving that much faster.

The stock control and inventory applications described in the Warehouse section can also be used by manufacturers to manage raw materials, subassemblies and finished goods inventory.

Just-in-sequence

The next evolution in manufacturing is to just-in-sequence production, in which components are installed to customize assemblies, often to exact requirements for a specific customer order. Just-in-sequence production requires real-time, item-level control in shop floor and shipping operations to ensure products are built and routed correctly. To ensure accuracy, workers can scan a bar code ID on the assembly to receive build instructions via an RF link to the manufacturing control system. Parts and components may be scanned before they are installed for real-time verification that they belong in the particular assembly. The process can be repeated at the dock door to ensure products are loaded to meet just-in-sequence shipping requirements. Making real-time verification part of the production process can actually reduce labor and expenses by preventing errors and costly rework.

Quality control

The verification techniques described above can be adapted for use in any manufacturing environment. RF makes quality control an efficient process through prompt communication. Should a problem arise that needs to be corrected, such as a bad batch of materials reaching the assembly line, instantaneous messages can be sent to as many workers as necessary, and their inquiries can be answered and reports taken immediately. The problem is corrected much more quickly than with a non-RF system, causing less waste and saving money.

Labor/Human resources management

Managers always know where their workers are and what they are doing with an RF system. This allows them to make quick adjustments when necessary; for example, if one worker stops to handle a problem, another can be reassigned to continue filling an order that needs to ship. RF systems are typically used with warehouse management and production control software applications that use transaction data to analyze productivity and provide a variety of reports.

Beyond that, job costing and payroll become much more streamlined and efficient because all data entered into the mobile terminal can be date- and time-stamped, and sent continuously to the host system. Tedious hand entry of job information is eliminated, and any discrepancies can be flagged and handled right away, keeping processing delays to a minimum.

RF purchasing considerations

A wireless system is a serious investment. It's important to consider all factors before making your decision. Following is a brief guide to the major topics and purchasing considerations that must be evaluated before committing to a system, including site planning, wireless technology options and standards, and an overview of the computers and input technologies commonly used in industrial radio frequency network applications.

Current environment

First, take a look at your current infrastructure, including the networks and enterprise IT systems that are in place and the physical environment of the area where you intend to use RF. The age, effectiveness and expected lifespan of existing systems and facilities all play important roles in selecting the wireless system that will best meet current and future needs. Here are some questions that can help get started evaluating the current environment: How old are your systems? Are they fully integrated and seamless, or are they more like “silo” applications that prevent the real-time flow of information? Are proprietary, legacy interfaces and file exchange protocols necessary for data sharing? Are systems scaleable? Do they meet current standards?

Site survey

There are countless things in the physical environment that could impact the extent and quality of your wireless coverage, from walls and poles to metal and temperature. System designers need to obtain information on coverage, equipment placement, power considerations and wiring requirements to ensure that mobile workers will not lose the RF signal--and therefore access to their data--as they move around the facility. The way to get that information is to conduct a site survey.

The site survey serves as a guide for the network design and for installing and verifying the wireless communication infrastructure. It also helps customers clearly understand the impact of the addition of wireless local area networking on their overall networking and system requirements. It determines whether a site has unusually high interference issues to resolve, or if capacity is greater than anticipated. Finally, a well-done site survey enables accurate quotes on equipment requirements to guide financial decision-making.

You can do a site survey yourself; however, it is strongly recommended to have someone experienced handle it. Wireless vendors and value-added resellers (VARs) can usually provide this service.

Network considerations

Next, it's important to consider the type of network that will work best for your application. The major decision points are to choose the communication technique (narrowband or spread spectrum), frequency (900MHz, 2.4.GHz 5GHz) and architecture (centralized or distributed).

Communication Technology: Narrowband

In the 1980s, the only solutions for wireless data networks were in the licensed frequency bands of 450 MHz or 900 MHz. These bands have relatively little bandwidth (hence the name "narrowband") and therefore support low data rates, from 4800 to 9600 baud (bits per second). Narrowband systems are not available at 2.4 GHz. There are still efficient narrowband systems operating today that have been in use for years; however, very few green field wireless networks are utilizing narrowband technology. As a result we will not discuss the merits/shortcomings of this technology.

Communication Technology: Spread Spectrum

A spread spectrum or wide band system can operate within the unlicensed 902 MHz to 928 MHz, 2.4 GHz to 2.48 GHz, or 5.725 GHz to 5.850 GHz bands. It provides immunity to interference by spreading the broadcast signal across a broad range of frequencies or by continually changing frequencies within those bands. These systems have a medium range (approximately 30 to 300 meters/100 to 1,000 feet) and a low transmission capacity of 0.1 Watt. Communication can be significantly faster than narrow band--one standard specifies 54 Megabit per second (Mbps) throughput for 2.4 GHz spread-spectrum transmissions. *Spread Spectrum presents the best option for wireless networks for supply chain managers.*

Frequency: 900MHz

Although there are many older 900MHz systems in existence today, very few green field wireless networks are utilizing the 900MHz frequency. As a result we will not discuss the merits/shortcomings of this frequency.

Frequency: 2.4 GHz

2.4 GHz systems present the best option for wireless networks for supply chain managers. This band has significantly greater bandwidth and hence supports higher data rates well above 11 Mbps. The power output varies between 35-100 mW depending on the manufacturer, and the range is 50 to 200 meters (165 to 660 feet) depending on the technology used. The advantages of using the higher bandwidth available at 2.4 GHz is that response times are reduced and a host of new applications are possible. These include speech input (e.g. the use of headsets by operators), the integration of telephone systems, the use of buzzers and beepers with single-line displays, and the incorporation of devices such as laptops, desktops and printers.

Frequency: 5 GHz

Interest in the 5.15 to 5.35 GHz range for wireless networking peaked in 2003, following the ratification of the 802.11a standard that will be discussed in an upcoming section. This frequency band offers fast data throughput similar to 2.4 GHz, but limited coverage ranges. This frequency band also is limited in its ability to travel through material. Also, it is not available for use in Europe and other parts of the world and can only be used indoors in the U.S. These limitations do not make the 5.15 to 5.35 GHz band a viable choice for enterprise wireless networking at this time.

Network Architectures: Distributed Access Points

In the ‘distributed access point architecture’, all of the WLAN functionality is placed within the access point. Distributed access points implement the complete 802.11 specification. They provide the wireless to Ethernet layer 2 bridging function. They also implement the WLAN-specific security, including access control and encryption, as well as QoS functions. All “enterprise” class access points also provide some higher layer functionality, such as protocol filtering, address filtering, access control lists and configuration tools.

The great beauty of the distributed access point architecture is that the AP is the only network component required to provide wireless LAN capabilities.

Network Architectures: Centralized WLAN ‘Switches’

The Centralized WLAN switch architecture requires two devices to provide wireless network. The access point is still an edge device and provides the wireless to Ethernet layer 2 bridging function. All other functionality is moved off the access point and implemented in the WLAN switch.

One essential characteristic of all Centralized WLAN Switch architectures is that all traffic, either to or from the wireless network, must pass through the switch. This allows the WLAN switch to be the traffic cop and to completely control the flow of wireless traffic.

The line between the two architecture types is blurred as are the benefits to each. *Our experience has taught us that a wireless LAN can be operated based on either architecture, and that the architecture itself is not the primary concern.* The real issue is the functionality delivered by the specific vendors being considered. The architecture contributes to the manner in which certain functionality is implemented, but is never a gating factor. More important is the wireless LAN vendor's vision, understanding of the marketplace, and their ability to execute on their plan.

For a detailed look at the pros and cons of both architectures please go to www.lxe.com and download our white paper, "Wireless LAN Architectures".

Developing technologies

Mesh Networks

In technical terms, wireless mesh networks are decentralized, many-to-many communications among devices. In less technical terms, it means that, theoretically, any authorized wireless device, whether fixed or mobile, could serve as an access point or repeater in a wireless network. That's the theory -- and it's quite feasible.

In the near term, the most promising application of mesh networks is to provide wireless backhaul for WiFi wireless LANs (WLANs). Mesh networks can extend the wireless network all the way back to the host gateway. All a fixed location mesh network node needs is power -- and that power can come from a wall plug or even solar panels.

Is there a mesh in your future? Probably. The big question is whether you will need it sooner or later. There are options for mesh networks in logistics applications available to you today. To date, however, we've yet to see a warehouse, DC, or container port install the technology.

For more information on Mesh Networking, please see our "Mesh Networks – Promise & Practice" whitepaper on **www.lxe.com**.

WiMax, Ultra Wide Band, ZigBee

High-speed wireless communication doesn't stop with 802.11. WiMax, Ultra Wide Band (UWB) and ZigBee offer specific benefits in certain applications. Although still evolving, these wireless options need to be on your radar.

Security

In today's world, how much security your data should have is a critical decision. However, it's equally critical to evaluate what needs to be protected and to what level it needs to be protected. Not everything on your network is a corporate secret, and in most cases hackers are not looking to steal your part numbers. Still, most systems should implement at least basic security measures. That means protocols for all access points to start.

Let's consider, as an example, a typical data collection network installed in a distribution center warehouse. It may cover from 100,000 to several hundred thousand square feet of floor space, will have 40 foot ceilings and several rolling metal bay doors. Exterior walls are made of cinder block. There is quite a large paved area around the warehouse for access and parking lots. This warehouse will require between a half-dozen to 20 access points to provide RF coverage. Access points are mostly installed on the ceiling in the interior of the warehouse. An occasional access point may be placed on a wall with a directional antenna pointing back into the interior of the warehouse.

This environment provides plenty of vulnerabilities. For example, directional antennas have "back lobes." Even if they are pointed toward the interior of the warehouse, a certain amount of energy is radiated out the back. RF signals from the antennas mounted on the interior ceilings may also extend significantly beyond the intended edge of coverage. Site surveys that are done to define coverage areas generally assume a client device with a 0 to 2 dBi antenna. A more directive client antenna will extend coverage significantly beyond the limits indicated by the site survey, leaving data sent available to interception.

There are many others examples, but the point is to be clear about your vulnerabilities and what level of security should be used to protect them. A good integrator will help you through this evaluation, and a good network security administrator will ensure its integrity is maintained. Numerous third-party firewall, encryption and authentication products can be used with 802.11-standard technology. The standard itself also has several security features and enhancements that can be activated.

For more information on securing your wireless network, go to www.lxe.com and download our “Keep The Bad Guys Out of Your 802.11 Wireless Network” whitepaper.

Wireless standards

Most countries set their own standards for RF power output allowable frequencies. While standards for some wireless technologies, notably cell phones, vary widely by geographic region, wireless networking is fairly homogeneous thanks to coordination by international standards bodies and support from wireless technology manufacturers.

802.11 series

IEEE 802.11 standards for wireless LANs were developed by the Institute of Electrical and Electronics Engineers (IEEE) and are recognized throughout most of the world. IEEE 802.11 defines three different ways wireless LANs can transfer data: diffused infrared

(IR) light, direct sequence spread spectrum (DSSS) radio frequency, and frequency hopping spread spectrum (FHSS) radio frequency. Infrared technology is extremely prone to interference and is rarely used for wireless networking. RF-based 802.11 standards dominate the current installed base of wireless LANs.

With IEEE 802.11 systems, access points from one vendor can interoperate with client devices from another vendor, provided all components are either DSSS or FHSS. The IEEE 802.11 standard does not, however, specify that access points from different vendors must interoperate. The same specifications apply to DSSS products complying with the IEEE 802.11b standard.

802.11b

802.11b is by far the most widely used open standard within the supply chain/logistics field. It utilizes the 2.4 GHz frequency band and provides 11 megabits per second (Mbps) data throughput. This is sufficient data transfer speed for most wireless data collection applications in warehouses, distribution centers, ports and manufacturing facilities. 802.11b systems can be used throughout the world.

802.11a

802.11a operates on a wider band of the frequency spectrum, between 5.15 GHz and 5.35 GHz. 802.11a products can transmit at 54, 48, 36, 24, 18, 12 or 6 Mbps, so they can be significantly faster than 802.11b networks. The 54 Mbps speed is necessary for large file transfers such as streaming video. This frequency band offers fast data throughput but limited coverage ranges. This frequency band also is limited in its ability to travel through material and is currently only available in the Americas and Asia/Pacific regions. It is not interoperable with 802.11b. Although fine for the office, these limitations do not make 802.11a a viable choice for enterprise wireless networking.

802.11g

802.11g is a newer standard that also offers a data rate up to 54 Mbps. However, it utilizes the 2.4 GHz band and by definition is backward-compatible with 802.11b systems. That means 802.11g devices can function on 802.11b networks; however, using an 802.11b device on an 802.11g network will not improve its throughput. Because 802.11g is compatible with 802.11b but significantly faster, it will end up being its replacement. Fourteen channels are available, though only 11 are useable in the US because of FCC regulations, and there are only three non-overlapping channels.

802.11n

Sure, IEEE 802.11g's data throughput of 54 Mbps seems sufficient for current WiFi networks, but IEEE is already looking ahead to boost that to 100 Mbps and possibly even 320 Mbps. Why? Because applications are becoming increasingly complex and bandwidth hungry. It's just in the discussion stages now, but it's good to know that WiFi throughput won't be a constraint in the future.

Wi-Fi

Short for wireless fidelity, Wi-Fi is often used generically when referring to any type of 802.11 network, whether 802.11b, 802.11a, dual-band, etc. However, products seeking to call themselves Wi-Fi must be certified by the Wi-Fi Alliance, and many 802.11 products have not been certified.

Bluetooth

Bluetooth is another wireless technology of note, though it is not an alternative to the other standards noted above. Rather, Bluetooth outlines a short-range wireless data transfer method that works best as a cable replacement. For example, a scanner, PDA or cell phone could use Bluetooth technology to communicate data to a terminal, printer or other device up to 30 feet away. It has a data rate of up to 2 Mbps in the 2.45 GHz band. Bluetooth was originally developed as a networking technology for personal area networks (PANs), but it lacks the robustness, range and scalability for use in enterprise networking applications. Extensive testing has proven Bluetooth and 802.11b devices can be used simultaneously in the same area, even though they share a frequency band. This enables Bluetooth-enabled cordless bar code scanners and other peripheral devices to relay information to wireless computers that are broadcasting in 802.11b networks.

Hardware considerations

In addressing hardware needs for your wireless application, the first thing to do is fully outline what actions both the product and workers need to take to get the job done. From there, determine what products exist that mesh with those actions. For example, are your forklift drivers frequently on and off their vehicles? How many workers are on foot? How high are the cases or pallets stacked? Are they working in harsh environments, cold, heat, etc?

How complex is your sortation system? How many lanes and docks do you have? How much repacking of cases/split shipments do you handle?

Knowing the intricacies of the actual situation will allow you to make the right choices.

Terminals

Wireless computers fall into three main categories: handheld, hands-free and vehicle-mounted.

Handheld terminals (HHTs) are useful when the operator is on the move, either on foot, or getting on and off the forklift often. HHTs can be carried or worn, and can be mounted to a forklift if necessary. They are battery-powered for the most part, although they can be adapted to pull power from a warehouse vehicle.

Hands-free terminals are terminals that are traditionally worn on the arm or around the waste freeing the operator’s hands for whatever task is at hand. Handsfree terminals are traditionally used in picking applications. Some handsfree terminals used in voice directed picking applications come without keyboards or screens. Handsfree terminals worn on the arm traditionally have a screen and a keyboard and include a ring mounted barcode scanner.

Vehicle-mounted terminals (VMTs) work when the operator doesn't stray far from the forklift. A tethered (hardwired or wireless) scanner can provide some mobility. VMTs are powered by the vehicle's electrical system, offering energy consumption advantages over HHTs.

Operating systems

Historically, mobile computing has relied on DOS systems, generally using Intel 386 or 486 processors. The primary use of these computers is to run host emulation packages like VT200, IBM 5250 or IBM 3270 due to the overwhelming use of mainframe-based applications that require these emulations.

Today, thanks to the explosion of laptops, PDAs, faster wireless networks and new operating systems specifically designed for mobile use, both hardware and software are now available to perform true desktop computing on rugged mobile devices.

Microsoft's mobile operating systems have played a large part in this development. For Pentium based mobile computers, Microsoft's Windows XP is the operating system that provides the optimum combination of features, performance and desktop compatibility.

For handheld computers and newer vehicle mounted computers that take advantage of Intel's XScale® family of processors, Microsoft® leads the operating system pack with Windows CE and Mobile 2003 for PocketPC. The Windows CE family of operating systems were designed from the ground up for small footprint real-time computing environments. Microsoft is continuing to enhance the Windows CE line to include enhanced desktop compatibility without sacrificing its highly optioned small footprint core design. These new features aid developers in maintaining consistency in their applications across their desktop and mobile computing infrastructures.

Ruggedness

To decide if a wireless computer you are considering is tough enough, know your ruggedness requirements and make sure the hardware meets or exceeds those requirements, which run from IP ratings, drop specifications and MIL specs to operative temperature range.

Hardware evaluations should involve also the screen (How visible is the screen? Should it be a touchscreen? Is color important? Is it readable in sunny, humid and cold conditions?); the keyboard (How much data and how often do workers have to key enter? Are the keys easy to see? Big enough if workers wear gloves? Coated to resist abrasion and harsh chemical damage?); and processors (the more speed you have, the less battery life you'll get).

For more information on wireless computer ruggedness, go to www.lxe.com and download our "What You Need to Know Before Purchasing A Rugged Mobile Computer - A Buyers Guide to Interpreting Rugged Mobile Computer Specs" whitepaper.

Software considerations

Connecting an RF system to existing systems does not have to be a complicated job. All software applications require data input, and perform better if the input is accurate and timely. RF is an input method, and most warehouse management, manufacturing control and yard management software vendors have built support for wireless data into their products. Because RF is an established technology that has been implemented in thousands of facilities, systems integrators also have developed many connectivity solutions over the years. Choosing wireless computers that use a mainstream, widely supported operating system also simplifies the integration task. Be sure the vendor you contract with can provide those solutions for your application.

Warehouse management systems (WMS)

Mobile terminals should be able to connect directly to WMS applications through the RF network, without the use (and additional expense) of middleware. Also, if you have a transportation management system (TMS) and/or a yard management system (YMS) that interlink with your WMS, consider adding a warehouse optimization engine.

Manufacturers have been using optimization for years, but it is a relatively new concept for the warehouse. Optimization is geared toward large distributions centers that are cross-docking, kitting and filling complicated, multi-line orders. Real-time data, provided by the RF system, is essential to this process and can help companies produce huge savings and increased efficiencies.

Enterprise resource planning (ERP) systems

Today, ERP systems form the core of strategic platforms for total resource planning and execution. Some systems, such as Oracle® Mobile Supply Chain Applications (MSCA) enable users to perform many common warehouse and shop floor transactions through handheld and truck mounted wireless computers. Oracle MSCA is an integral part of the Oracle E-Business Suite, so the software provides real time information and transaction processing as well as user validation for each transaction as the data is entered. Field level validation can inform the user of material restrictions and availability in addition to validating the data entered before the transaction is completed.

SAP users and developers now have the ability to create applications and transactions for mobile computer devices directly in SAP via the SAPConsole without the use of middleware. No need to learn third-party systems or use data mapping or proprietary middleware programming. Data entry for orders, stock transfers, shop floor/labor tracking information and other application functions transmit directly to SAP software applications in real time.

Many companies wanted to provide real-time input to their applications before ERP vendors had developed RF support. To fill the gap, many integrators specialized in providing ERP connectivity, and independent software developers created numerous middleware products for use with specific enterprise software packages. These offerings, combined with ever-increasing RF support from the ERP vendors themselves, provide options for integrating wireless data collection applications with virtually any legacy IT infrastructure.

Emerging complementary technologies

Bar code is the most common automated data collection (ADC) technology used in RF applications, but several other technologies are rapidly gaining acceptance. As you start to familiarize yourself with the different types of wireless communications technologies, it is also a good time to think about other data collection technologies that might work better than or in concert with bar code in some areas of your applications.

RFID

RFID is a means of uniquely identifying an object through a wireless radio link. The identification is accomplished by an interrogator, also called a reader or "master," and a tag, also called a transponder or "slave" that has a unique identification code. Data is exchanged between tags and readers using radio waves, and no direct line of sight is required for the transaction. The interrogator asks the tag for the code, or processes the signal being broadcast by the tag, decodes the transmission and transfers the data to a computer. The computer, in turn, may simply record the reading, or look up the tag ID in a database to direct further action. The computer may even, depending on the type of tag, direct the interrogator to write additional information to the tag.

RFID readers come in two flavors – fixed readers and mobile readers (handheld or vehicle-mounted).

Fixed readers have a place in the warehouse (ex. high speed sortation lines), but the majority of the benefits to be gained from RFID require a mobile RFID reader.

Mobile RFID readers, just as with barcode scanners, enable real-time data collection which will allow operators to accomplish traditional warehouse tasks - faster - thus reducing labor costs. However, a mobile RFID solution can offer advantages over traditional bar-coding, as the examples below portray:

- Case Picking. A well designed mobile RFID reader can automatically scan both the location and case tags as operators build their pallet, allowing them to focus on moving inventory - faster - not collecting data.
- Quality Control. With a mobile RFID reader you can validate in real-time that the correct product in the correct quantities is being picked. Errors can be corrected on the spot, where it is easiest and most cost effective to correct - which increases warehouse velocity and eliminates the need for expensive, time consuming and often redundant quality control checks on the back end.

- Shipping and Receiving. With a mobile RFID reader you gain the shipping and receiving benefits often associated with a fixed reader – benefits that include faster, more accurate check-ins and shipments; faster invoice settlement; etc. And all for less cost. In a typical warehouse you have approximately 100 dock doors that are serviced by as few as 10 to 20 forklifts. In the fixed RFID portal world you'd need 100 fixed RFID readers. In the mobile RFID world you'd only need 10 to 20 mobile RFID readers – one for each forklift and a much more economical solution.

For a mobile RFID reader to consistently deliver the above benefits it has to be both tough enough for everyday warehouse use yet sophisticated enough to read only the tags you want.

For more information on RFID in the warehouse and DC, go to www.lxe.com and download either whitepaper - *RFID Technology for Warehouse and Distribution Operations - an RFID Primer* or *RFID in Motion, Don't Get Caught Standing Still.*

Voice over IP (VoIP)

Voice over IP (VoIP) is a telephony technique for sending real-time voice over data networks including the Internet or an internal IP network. Normal data traffic is carried between PCs, servers, printers and other networked devices through a company's wired or wireless TCP/IP network. Each device on the network has an IP address, which is attached to every packet for routing. VoIP packets are no different. To place a call from one device to another, users may enter the IP address of the called party using voice conferencing software.

This system is designed to coexist with other data transactions on the network, with minimum loss in sound quality and without the reliability glitches and traffic hang-ups still common in Internet communications. Since voice transmission is compressed to less than 1,000 bytes per second, dozens of simultaneous phone calls represent very little data traffic. Installation simply involves assigning an IP address to each wireless handset.

With the addition of a gateway, VoIP also allows users to make calls out to the regular wired PSTN phone system. Instead of passing the analog voice signal out through a telephone handset, the gateway places the signal over a telephone line. This line can run into a company's PBX system, or into the public switched telephone network, allowing users to make and receive traditional toll calls anywhere in the world. By adding VoIP to wireless industrial computers, companies could eliminate pagers and cell phones used for employee communication in warehouses, factories or retail locations.

Speech recognition

Speech recognition systems use software so computers can recognize spoken words, which enable operators to enter information, for example putaway locations or quantities picked, by speaking into a mobile computer. With speech recognition users can keep their eyes on the task at hand and their hands free because no bar code scan or keyboard action is required to enter data.

Speech recognition systems are either discrete or continuous. Discrete systems recognize a few key words or phrases spoken by the operator and are most commonly used in industrial data collection environments, where a user may say “OK” to signify that an assembly has passed inspection, or “three” in response to a computer query asking how many cases were picked for an order. Continuous speech recognition systems attempt to record continuous speech and are used in speech-to-text transcription applications.

Another distinguishing factor among systems is whether they are speaker dependent or speaker independent. Speaker dependent means the system needs to be trained to recognize the specific user's voice. This setup usually doesn't take very long and involves the user repeating some key words and phrases to set up parameters. Some systems are more tolerant than others, still recognizing the user's voice when he or she has a cold, for example.

Speaker independent means in theory any individual can speak commands to the computer without having to train the system. The main advantage here is the system is delivered in ready to use mode; the computer performs statistical matches between what any speaker says and a “canned” library of speech patterns.

Speech recognition technology has become much more reliable in recent years as developers have continually improved their word recognition accuracy and ability to screen out background noise.

Implementing and managing an RF project

Most companies are concerned with running their business and do not have the time, personnel or expertise to handle an RF installation project. So who can these businesses turn to for help with their project? A technology solutions provider or systems integrator can fill in gaps in expertise and allow your regular staff to continue to manage your other systems and keep your business running.

When searching for the right provider, make sure the company is focused on your industry/application and that it has a deep understanding of RF technology. A good provider should be able to customize solutions to your specific needs.

Ask for references, and then be sure to call those people to find out if the company delivered what was promised. Make sure the provider is committed to customer service and support and ask them to prove it. Make sure they are willing to work as a partner or not simply sell you hardware. Also, find out if they are profitable--you want to make sure they will be around in one, three or five years to support your products.

Conclusion

As with any large-scale project, adding an RF system into your business can seem a daunting task. But being properly prepared, along with finding the right assistance, will go a long way toward making the implementation a successful one, and one that will reap benefits for your company.

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