

# Adding Radio Frequency Technology to the Warehouse

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A successful RF implementation is far more sophisticated than simply specifying and installing the networking and radio frequency data communications equipment. Significant changes will affect not only the departments where RF is installed, but also the departments that send and receive goods and information to that area.

You'll need to address such questions as: How much paper can be eliminated? Which old procedures can be discarded? What training will the RF system users need? How can you prepare your organization?

The following steps will guide you through the process and help you develop realistic expectations about the results.

- Create a project team. Put together a diverse project team with members from distribution, information services and manufacturing. Do not let the IT department drive the project simply because it may be more familiar with the hardware and the technology. Even the best technology will only cause automated chaos if you don't properly address the critical functions of the affected operations.

An undertaking of this complexity cannot be effectively steered by the seat of the pants. The team needs to identify functional, technical, and training milestones, and include realistic dates for completion of all steps. Throughout the project, update the action plan frequently and insist on hard dates for events. The team should develop flowcharts for the affected operations, identifying host interfaces and data flows, calculating or estimating transaction volumes.

- Define the problem to be solved and the application for which the RF system will be used. In order to do this, compare the proposed system to the way you are currently managing operations. Identify

the problems with the current approach and determine which of these problems RF will help resolve, such as the ability to have real-time data.

- Define anticipated benefits. If you can identify problems with the existing process, such as high error rates, then you can forecast the benefits you should expect from an RF system. If these benefits can be defined up front, you will be able to measure the success of the system once it is implemented.

- Define typical data transactions. This will help you determine the throughput needs of the system. If the transaction rate is large, then higher data rates and larger data packet sizes may be needed for the RF system to minimize response times.

- Identify the physical environment. This will help set realistic expectations about RF equipment needs. If the environment is highly reflective, you should expect RF coverage to be good. If lift trucks are used as opposed to people on foot, then vehicle-mounted devices may be required. Map out the area of coverage: Is it campus or single building? Check the building(s) to see if they have high ceilings or low ones. Identify conditions that may create potential dead spots.

- Consider the user interface. Selecting the proper equipment and RF units is crucial and offers the most potential for future problems if the equipment doesn't match the application. Questions to ask include: Are the devices easy for the workers to hold and operate? Are workers educated enough to use the equipment or will training be required to ensure successful use by personnel? It is essential to ask for the input of those who will be the day-to-day users of the RF systems. If workers use lift trucks, they may want RF vehicle mount units. If they walk around, they may want portables. If printing is

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required in many places, RF portable printers may be appropriate so they can be moved from location to location. Another item to consider is the length of the battery life in the portable required for the typical user, the amount of time necessary to recharge and the accessibility of outlets for this purpose.

- Define a path for growth. Determine how the system will be used now and in the future so that you maximize the return on investment. Make sure the equipment being considered will meet the requirements over the long term and that the system can be expanded without significant financial impact. Understand what the future system needs will be in terms of data processing capability, host system, networks, response time requirements, and coverage needs.

### Technical Considerations

Following are some of the technical areas that you should examine when considering the implementation of an RF system.

#### *Radio Frequency Coverage*

In an RF system, coverage will depend on the base radio, which may be integrated into the controller or external to it. If the base radio does not provide adequate coverage, it might be necessary to use a repeater to extend the coverage area, which could add to the overall cost of the system. The best way to determine the equipment required to provide adequate coverage for a specific facility is to have a site survey performed to analyze and determine the radio profile of the area.

#### *Data Throughput*

When implementing an RF system, the warehouse manager should consider how many end devices will be used at any given time on the system and how much data will be passed between end devices and the host. In data collection applications, usually the manual data entry requirements are minimal if barcodes are being scanned. Response times in these systems, usually close to a second or less, will not be noticeable by the operator. In wireless networking applications, data files and print files may be sent to end devices and data throughput will become strained. Because the data stream is large, faster data rates may be required to minimize response time. However, you should keep in mind that data rates affect coverage. If higher data rates are required, coverage will be reduced. Higher data rates also will reduce the available coverage area.

### Preparing for a Site Survey

The hardware and technology associated with RF applications is highly customized to fit a vast variety of applications and environments. A detailed site survey of your facility and its functions are necessary to design an RF system with the best performance for your operations. A site survey is typically conducted by the RF vendor you selected or a systems integrator. You will need to address the following questions with your surveyor:

1. How many RF sites will be installed? Is it better to plan for one large system or several smaller, interconnected systems?

2. What is the specific layout? How big is the area needing coverage?

3. Will existing equipment or environments interfere with an RF system? For example, materials such as metal storage racks as well as the inventory itself may absorb or reflect RF signals. Some operations, such as arc welding, create high-frequency noise that may interfere with communications. Some existing computer systems may also contribute to interference.

4. What is the building composition? Concrete, steel, elevator shafts and fire walls reflect RF signals differently. This can affect the type of RF system needed and can determine installation requirements.

5. Are there physical constraints? Does the system need to operate in conditions of extreme cold, heat or dust? Are there ignitable or explosive elements present in the area of use? RF terminals will need to be able to operate reliably on the expected environments.

6. What is your anticipated transaction volume over the RF network? How much information will be in each transaction? Transaction rate is a critical measure needed to determine the best system design.

7. What is the proximity to other communications? If the installation is located within a heavily populated or industrial area, existing signals may interfere. Interference can be a deciding factor on whether an RF system should use narrow band or spread spectrum communication.

Once the site survey is completed, you should know the number of terminals needed, the placement and number of antennas/radio link controllers, and the type of communication (narrow band or spread spectrum) for best meeting your facility's needs.

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### *Transition Rates and Response Times*

One of the measures of the performance of an RF data communication system is response time. Response time is the amount of time required for information to travel from the RF terminal to the host and back. You should be prepared to provide your site survey staff with the estimated number of transactions the system will need to handle at peak times. This information is necessary for proper system design, in assessing the trade-offs between polling and contention strategies, between narrow band and spread spectrum, and between frequency hopping and direct sequence.

A good grasp of your peak transaction rate is the first and best step toward designing optimal response times for your system. However, even the most optimal RF equipment configuration cannot guarantee the exact response time expected. Why is this?

There are a variety of factors that can affect overall response time, including:

**Network Load.** Even if the host is dedicated to supporting the RF system and nothing else, there will be some network loading. A good analogy is to compare your drive to work at 3 a.m. versus the morning rush hour. High levels of traffic generally produce lower average throughput. In general, the more systems the host controls, the greater the load. Some sources of network load are the network operating system, the network transport protocol used, network access methods and topology, application software traffic, and any other source of network packet collisions.

**System or Hardware Bottlenecks.** Proper design of the system components and topology is essential. Using RF terminals with fast processors will not help if they are coupled to a radio link controller with a slow processor; system throughput will be no faster than its slowest link. Likewise, if the network path between the RF system and the host has heavy loading from other applications, this will slow overall response rates.

**Transaction Volume.** The number of transactions, the number of concurrent live terminals, and the amount of data in each transaction contribute to the load on the RF segment of the network. Higher transaction rates will negatively affect the response time if not planned for.

**Number of Radio Channels.** The more pathways there are for data to travel through, the faster the response time. If you anticipate high

transaction rates or heavy throughput, look at multiple channels.

### *Signal Strength*

The success of different systems to communicate over distances is dependent upon signal strength. The farther the transmission has to be sent, the more power will be required. There are other factors that will affect the distance that transmissions can be sent effectively. One example is the sensitivity of the receiver to capture the transmission. Big “ears” are more sensitive than smaller ones because they can catch more of the signal wave. A reflective environment can also affect transmission distance. If there are a lot of reflective materials, such as metal, for the signal to bounce off, it may go farther. Substances such as paper absorb signals, and may limit transmission distances.

### **Selecting a Vendor**

There are a number of RF vendors, but your warehouse management system vendor can supply you with a list of those that work well with your WMS. Or you can go through a more formal research process to come up with a short list of RF vendors. Once you have narrowed the field down to three or four RF vendors, set aside some time to allow those vendors to come in and meet with you. Do not give any vendor special consideration. If time does not allow you to have all the vendors come in and view your facility ahead of time, then do not allow any vendor to do so. If you keep the playing field level, you will save yourself many headaches in the future.

Be sure to include some operations people to get their opinion on the look and feel of the units. They will be working with these on a daily basis and you will need to have their buy-in. Also include a technical person to address the technical issues and questions that will arise.

### **Implementation Tips**

Your vendor or systems integrator can help you through the remaining steps of implementation. However, there are several key tips you’ll want to keep in mind throughout this process.

- **Education.** Educate everyone about the operational change, from top management to hourly warehouse workers. Explain the focus in terms of what needs will be met, what growth will be enabled and how procedures will change. Do not forget the big

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picture, and remember to detail the effects the system will have on departments and the entire organization.

- Hands-on. Emphasize hands-on training before, during and after the project. Even the most computer-savvy workforce will require time to adapt.

- Going live. It is not a good idea to “go live” all at once. You should begin testing early in the places where the equipment is going to be used. Gradually build pieces of the new system and functionality into your action plan.

- Create backup plans. Bugaboos happen, often at bad times. Prepare contingency plans whenever possible. Be sure to order spares of critical components, such as RF terminals, batteries, and power supplies. Have backup plans for those first few days the whole RF segment is up.

- Measure performance continuously. Track the system’s performance against the measures you identified before the project. You may be surprised to find out that even in the chaos of a new system start-up, you are still surpassing the performance of the old methods.