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Wireless (RF) Systems In Warehouse Inventory Control

It has been our experience that the one application that can most easily be cost-justified using Radio Frequency Data Communications (RFDC) technology is in the area of warehouse inventory control. It has been quoted that when RF technology is used in conjunction with real-time software and bar code, inventory accuracy of 99+ % and error rates of less than 1% are achievable. In some situations, the RFDC investment can pay for itself in less than a year.

An RF system, for brevity's sake, utilizes RF wireless terminals that can be man- or vehicle-mounted. Often, a bar code scanner is built into the terminal. Alternately, it is cable-attached. There is always an LCD screen (output) and keyboard (input) integral to the RF terminal. RFDC technology assumes that the terminals are going to be used within a given, limited physical space, such as a warehouse or small yard. They are not really meant for covering a city!

An RF terminal is basically a "dumb" device, relying on what it's connected to to provide it with some smarts. At the host end, is equipment dedicated to "talking" to many RF terminals simultaneously. This device, which can be one or many in an RF system, is referred to as a transceiver/antenna. Simply speaking, the host computer software is simultaneously involved in one or many conversations with remote RF terminals. These conversations are of the question-and-answer type and are referred to as data collection prompts and responses.

A transceiver/antenna system (base station) covers a specific physical area with propagated RF waves. In a perfect environment, they may cover an area as large as, say, 50,000 square feet. In an imperfect space, with many obstacles to radio waves, it could be as small as a bathroom. Most RFDC systems, fortunately, are scaleable. This means that RF communication problems can usually be fixed by connecting multiple hard-wired base stations together to provide extended or better coverage. Each base station will hypothetically cover a circular area (cell) with overlapping cells. Mobile users, as they moved from one cell to another would be "handed off" automatically by the RF system, just like cellular phone systems. Suffice it to say that no RFDC system would ever be installed without performing an RF site survey

to determine just how many base stations would be required to cover a specific area.

RF vs. Batch

RFDC systems are compared all the time to portable batch systems, because they are visually and functionally similar. (A portable batch reader allows the data collection operator to roam away from the host computer system, collect the data in the portable device, then upload the data in a batch to the host computer system.) However, despite their higher hardware cost, RFDC systems are often more economical in the medium- to long-term than batch-based data collection systems. Why?

Inventory accuracy is achieved through the accurate recording of material movement transactions and the elimination of "information float" that is caused by delayed data entry. Transaction accuracy is increased with on-line validation to prevent errors and real time transmission of data eliminates inaccuracies immediately.

Batch portable terminals usually have proprietary or off-standard operating systems, and often do not use industry-standard software tools for programming. Therefore, software programming for these devices is high. Comparatively, RF terminals are not normally programmable. Rather, they simply act as dumb terminals to a host PC. Since the host PC software can be built using common programming languages, these costs are typically lower.

There is no data liability with RFDC. If a wireless terminal were to suddenly experience spontaneous combustion or be run over by a forklift, only the last line of the last transaction would be lost. By comparison, hours or days of collected data can be stored in a portable batch terminal and lost by destruction of the portable data collector or by erasing the collected data file inadvertently or on purpose.

When uploading batches of data from portable batch readers to a PC, many things need to happen:

- ❖ A physical connection needs to be engaged.
- ❖ Communications software at both ends (batch reader and PC) needs to be executed.
- ❖ A file needs to be copied from the reader to the host.
- ❖ The host needs to test the validity of the uploaded file.

- ❖ Upon a valid receipt of the file, the batch reader operator needs to be prompted to delete the collected data file from the batch reader.
- ❖ The operator must delete the file.
- ❖ The uploaded file needs to run through a routine to test if any of the records have previously been uploaded (and were forgotten to be deleted) from the batch reader.
- ❖ The uploaded file needs to be imported, merged, appended (whatever) to the main database.

Imagine the compounded workers' time that is expended over and over again to perform the above steps! Most of these steps are completely eliminated in an RFDC system. Those that are, are handled in a few seconds.

Some of the hardware accouterments of a batch portable system are not required in an RFDC system. For instance, upload/download/recharge cradles are replaced by simple battery charger systems since the physical exchanging of files rarely occurs between RF terminals and host systems.

How an RF Data Collection System Typically Operates

Originally, wireless terminals were created to operate with large, mainframe computer systems. Obviously, large companies that used such expensive computers were the original targets for RF implementations, as they could probably cost-justify them more easily than small-scale users. Therefore, the terminals were made, via some software and hardware tricks, to emulate industry-standard mainframe terminals such as VT100 and 5250. Of course, this also meant the software programming (or reprogramming) to support wireless terminals was accomplished on the mainframe system—a long and obtuse process, to say the least!

Today, we work with RF hardware that utilizes PC computer technology to administer the RF network. Simply speaking, the RF network becomes a sub-network to the host system. The host passes files to the PC controlling the RF network, the RF network processes the transactions called for in the files, then passes completed transaction files back to the host system. The exchanges of data between the RF and host networks can be as frequent as every few seconds or once a day. They can be event- or time-driven.

There is some substantial software at work in the RF subsystem. Depending on the number of wireless terminals in use at any given moment, dozens of "conversations" may be in play between the terminals and RF network PC. As well,

many different types of transactions may be performed on any given terminal. For instance, a couple of terminals may be directing pickers to pick products from inventory, while another couple of terminals may be allowing warehouse personnel to record the movement of goods from one stocking location to another. It is typical to allow any terminal on the network to perform any type of transaction in order to deploy terminals and personnel to activities that demand their attention. Of course, just like with desktop terminals, employees can be restricted to certain functions through the use of passwords or i.d. badges.

RF Technologies

There are two basic technologies used for radio frequency data communications: narrow band and spread spectrum. Narrow band is the older of the two and provides very wide coverage with comparatively low data communication rates. A yearly licence for a specific frequency in a particular geographic location must be applied for to the federal government. Spread spectrum is the more common RF technology in warehousing systems these days. It does not require any licence or government approval and has significantly higher data throughput than narrow band. These advantages come at the cost of a smaller area of coverage for each transceiver/antenna.

As previously mentioned, greater wireless communications coverage can be obtained by linking together transceiver/antenna base stations. The cabling type between these stations is common coaxial cabling, used in Ethernet LANs.

Suffice it to say that the RF system hardware takes care of all the "grunt" work with regards to conversing with the host system. Partially-received messages are automatically re-sent and the technical difficulties of staying in contact with a quickly-mobile forklift truck driver as he moves throughout the warehouse are handled automatically.

Budgetary Costs

There are many ways to build a wireless warehouse inventory control system, using different mixes of hardware and software. However, the following costs are reasonable ballpark numbers:

Description	Cost Range
Man-mounted RF Terminal and Bar Code Scanner	\$3500-5000

Truck-mounted RF Terminal and Bar Code Scanner	\$5500-7500
Transceiver/Antenna System (each)	\$2000-2500
Warehouse Management Automated Data Collection Software	\$10,000-\$25,000

In addition to the above costs are those associated with installation (transceiver/antennas, PCs, LANs, etc.) as well as PCs and LAN software, training, label printing equipment, etc. Such costs can vary greatly depending upon the installation size and environment.

Cost Justification

Any investment pays for itself by:

- ❖ increasing or retaining sales
- ❖ improving gross margins, or
- ❖ reducing overhead

Right?!

- ❖ RFDC can have a significant impact on all three in the following ways:
- ❖ Sales lost to inventory shortages can be reduced, especially in companies that don't have the option of back ordering merchandise.
- ❖ Warehouse inefficiencies related to unexpected stock outs or locator system errors can be dramatically reduced.
- ❖ Transportation and labour charges related to picking and shipping errors can also be reduced
- ❖ A shipping error is one of the most common problems in today's warehouses. The adoption of RF technology to pick orders may virtually eliminate mis-shipments from occurring. What's the cost of a shipping error?

Administration costs to research the error and prepare documentation \$ _____

Transportation costs to return and re-ship merchandise \$ _____

Labour costs to re-stock and re-pick merchandise \$ _____

Cash flow if customers delay payment on incorrect invoices \$ _____

Customer replacement costs or lower sales if customers become dissatisfied \$ _____

Sales force productivity \$ _____

Inventory obsolescence if products have a limited shelf life \$ _____

When you consider all the error correction costs, each shipping error can easily cost over \$100 each and error rates of 2.5% are not unusual.

Conclusions

Wireless data communication technology is doing the same thing for data that mobile radios did for voice communication years ago—it provides portable, real-time communications. Twenty years ago, voice radios were considered new in industrial applications. Today, productivity and worker safety depends on voice radio technology. Voice radio technology is a common communications tool and it's taken for granted as such.

A similar attitude change is occurring today with radio frequency data communications.

As the cost of RF equipment drops and as integration into existing information systems gets easier, the obstacles to implementation of RFDC are eliminated. At the same time, the need to question old ways of feeding our information systems increases. Rising labour costs, increased customer expectations and margin pressure make yesterday's performance benchmarks inadequate for tomorrow. Together, the combination of reduced equipment cost, easier integration and increased costs of

errors have dramatically changed the economics of RF equipment—even for small- and medium-scale operations.

Wireless data collection systems can help small and large warehouses and distribution centres because, regardless of size, every operation needs or can benefit from an accurate inventory, on-line validation and real-time data entry. Improving performance in these areas generates income in the form of increased sales, improved labour productivity, reduced data entry payroll, reduced transportation costs and reduced inventory carrying costs.

In ten years, companies of all sizes will look back at RFDC and wonder how they ever got along with it. Companies that implement today, will be better off than those who wait.

