



The Increasing Use of Cordless Handheld Bar Code Readers, Technology, and Applications

A White Paper by Datalogic Scanning, Inc.

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Cordless Scanning Technology Using Handheld Bar Code Readers

Introduction

Since the mid 1990's it has become more evident that there is a growing demand for cordless bar code readers, mainly for industrial and logistics applications but also increasingly for use in retail, healthcare, bill payment, banking, and other general purpose applications

The reasons for this are obvious:

- **Mobility:** For warehousing applications the need for cordless mobility is clear, but mobility is also important for shop floor data capture applications where the user may need to move within a limited area, such as automotive production lines where an operator may need to walk around the car on the line. In these applications bar code readers with 10 - 15 meter long cables were often used to give the user mobility but this was both restrictive and hazardous. In retail and office automation applications the operator can benefit by using the same reader for POS or front desk operations, as well as for inventory or filing activities.
- **User productivity:** Often, taking the bar code reader to the object to be scanned can be faster and safer than the other way round. Using a longer cable to achieve this results in the cable being continuously entangled and wastes the time of the operator who is constantly trying to untangle it.
- **Safety:** Long cables do not just cause reductions in productivity but are also major safety risks. For example, objects can be tangled up and pulled off of shelves, injuring workers. The operator and their colleagues are also at risk of getting tripped up by the cable, which can result in industrial accidents.
- **Cost:** Cordless devices are more expensive to purchase when compared to tethered readers but when all of the above benefits are taken into consideration combined with the added downtime caused by broken cables and the cost for cable replacement (cables may only last about six months in the most stressful conditions), the Total Cost of Ownership (TCO) of the cordless scanner is lower.

Cordless Solutions

Several solutions have been proposed by different bar code equipment manufacturers over the years, however not all are reliable and not all are comparable in terms of performance.

Consider the following key points when selecting cordless devices:

- **Reliability of the radio connection:** The operator is often a great distance from the host and cannot easily input the data into the host manually.
- **Bi-directionality of the communication (at lower protocol levels):** This is useful to guarantee data integrity and to manage the data flow (with protocols like ACK/NAK, Xon/Xoff etc).
- **Radio range:** Depending on the application, the range required can vary from a few meters up to tens of meters. Generally, the greater the radio coverage, the better the device as it decreases the number of times an operator moves out of radio coverage which results in a loss of efficiency as he is either (1) stopped from working or (2) has to work "offline" which increases the risk of errors. However, increasing radio coverage is not always possible or convenient for a number of reasons:

- the maximum radiated power is normally regulated by national legislation;
 - higher radiated power may interfere with other radio systems;
 - higher radiated power may limit the maximum number of devices able to work in the same area (or drastically reduce the communication speed when the number of devices increases);
 - higher radiated power means higher power consumption which reduces battery life.
- **Battery life:** Batteries must be able to last a full shift to avoid changing the battery mid-shift, resulting in loss of time and efficiency, especially if the operator has to walk back to the office to do this. The use of an “on site” charger provides the best solution for most applications, except extensive three-shift applications where the device is always in use and there is no opportunity for battery changes.
 - **Modularity and expandability:** Cordless products can not only be used to eliminate cable replacement, but can do much more by opening the door to a completely different scenario where several operators can work in the same area connected to the same information system at the same time, moving in wider areas using advanced features such as networking, roaming etc. Modularity and expandability of the radio system offers investment protection.
 - **Coexistence:** More and more equipment, tools and machines are becoming cordless. It is therefore critical that devices are designed to work alongside each other without causing interference.

Different hardware manufacturers offer different solutions. At Datalogic we divide them into two categories:

- Standard Radio Systems
- Proprietary Radio Systems

Standard Radio Systems:

- **Advantages:**
Being based on a standard, bar code readers supplied by different manufacturers should be able to communicate with each other and therefore, can be combined and mixed. In theory the user could use readers from different manufacturers for the same application. Over time as newer models are released the user could replace old units or add new ones choosing the best offer he can obtain at that time.
- **Disadvantages:**
 - In reality this compatibility is quite rare. In fact, most of the suppliers offer “closed” solutions (i.e. devices that, although based on a standard radio, can only communicate with components supplied by the same manufacturer) in order to satisfy the customer’s desire for a “plug & scan” solution.
 - The typical disadvantage is that the standard has been normally defined and specified for something else (i.e. a different kind of application and usage; it usually has not been optimized for the basic and simple needs of bar code readers). Furthermore, standards are never stable forever: continuous updates are required to keep communications in line with the latest release.

The most common standard radio systems are:

- **Wi-Fi:** Normally used for high performance radio systems like WLAN, including laptops, PDAs, mobile computers, printers etc. Networking, high mobility and high data communication speed are key factors of this system.
 - This standard was defined following the natural evolution of the traditional LAN adding mobility to the operators allowing them to have access to key business systems including the Internet via mobile devices. It is a powerful standard but it is too feature-rich for a “simple” bar code reader: it requires a powerful microprocessor, an operating system, high capacity batteries and is too expensive and too over-engineered for standard bar code scanning applications. It uses the ISM band (Industrial, Scientific and Medical) centered at 2.4 GHz.
- **Bluetooth® Wireless Technology:** Initially designed to eliminate cables and to create a WPAN (Wireless Personal Area Network). Normally used for:
 - Cordless communications at the operator’s desk
 - Occasional WLAN access
 - File sharing and synchronization between devices such as PDAs, laptops and mobile phones
 - Wireless headsets for mobile phones or Internet use

This standard was defined to allow a user to quickly and easily create his own Wireless Personal Area Network (called “Personal” as radio coverage normally limits the network to a single room, and it connects peripherals normally used by a single person such as a wireless keyboard and mouse, printer etc). The WPAN is “dynamic” as it doesn’t require an access point and can be created anywhere by simply connecting and disconnecting devices.

The WPAN is a good solution for applications that need a permanent wireless connection of static devices, such as connecting a printer to a PC, or for applications that require occasional connection of mobile devices for limited data exchange, for example data synchronisation between a PDA and a laptop. Bluetooth® wireless technology is also based on the ISM band centered at 2.4 GHz.

- Other emerging standards:
 - ZigBee (offered both at ISM band and in narrow band 433.869 and 910 MHz)
 - WUSB (Wireless USB based Multiband OFDM ranging from 3.1 to 10.6 GHz).

Proprietary Radio Systems:

Proprietary radio systems use “available” frequencies, building on the proprietary protocol. Different manufacturers offer different solutions. Some use a narrow band (433.869 and 910 MHz) and others use the ISM band (2.4 GHz).

- **Advantages:** As developed by bar code reader manufacturers, it has been designed for the unique needs of bar code and data capture applications. All of the radio parameters are completely under the control of the protocol developer who also controls secondary parameters such as battery consumption. The bar code reader manufacturer owns and manages both the hardware and the software of its radio products, guaranteeing the stability and continuity for the customer.
- **Disadvantages:** Different radio systems from different manufacturers are not usually compatible and cannot communicate with each other. However, this may also be the case with closed standard based systems.

Datalogic Scanning has been a pioneer in cordless technology with the following cordless products:

- The Dragon™ mobile family in 1998
- The PowerScan® RF in 2000
- The Gryphon™ mobile family in 2000
- The QuickScan® 6500BT in 2006
- The PowerScan® 7000BT SRI in 2007
- The QuickScan® Mobile in 2007
- The PowerScan® 8300 M in 2008

This has resulted in more customers understanding the importance and benefits of “going cordless”, not only in industrial applications but also in retail and office automation applications. Today it is estimated that around 16% of the bar code reader market is cordless and this sector is growing faster than its tethered counterpart.

The price gap between the tethered and the cordless solution is still too high to allow a complete mass migration of all applications to cordless, but Datalogic’s goal is to reduce this gap to make the cordless solution more accessible for all customers. With the QuickScan® Mobile handheld reader, the ratio of price to performance has never been so favorable for the tethered-cordless migration.

More recently there has been a proliferation of cordless solutions: some bar code reader manufacturers offer **proprietary radios and protocols**, just like Datalogic, while others use **existing standards** which offer the advantage of a standard, with the disadvantage of not having been created specifically for bar coding.

Datalogic knows that one system is not always better than another: each situation is unique and depends upon the customer’s needs and the requirements of their application. This is why Datalogic offers both systems: radios based on 433 and 910 MHz (called the Datalogic STAR Cordless System™) and standard radios based on Bluetooth® wireless technology.

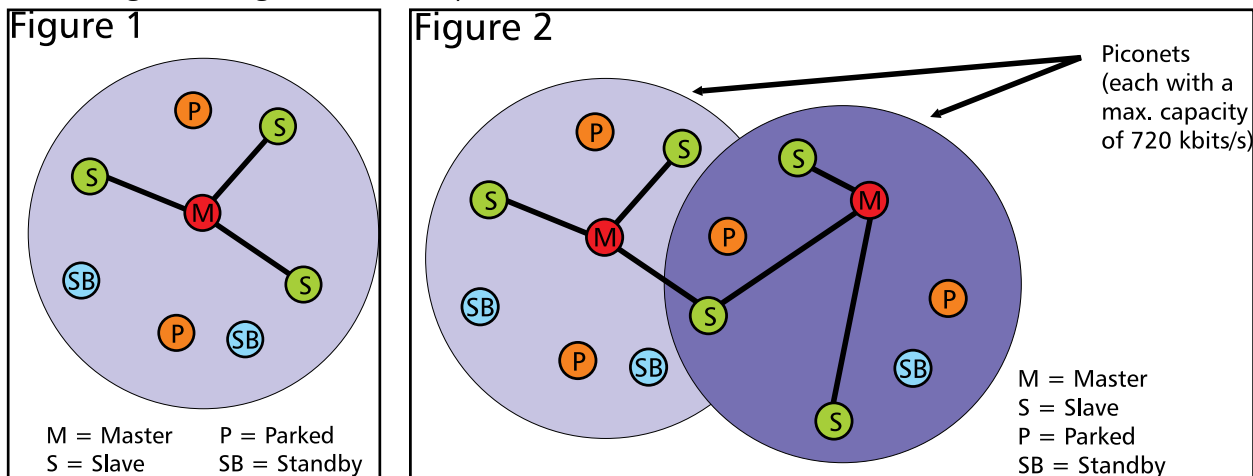
Datalogic Scanning feels that its STAR radio is superior as it has been specifically developed to meet the needs of most bar code applications. Nevertheless, there may be some cases where a Bluetooth® wireless solution is preferable.

On the next page there is a table comparing Datalogic’s STAR with Bluetooth® Wireless Technology radio systems. The score, assigned with stars, ranges from 1 (lower value) to 5 (top value).

The scores are summed up above and the average score calculated show the higher value of the Datalogic STAR Cordless System™.

Key Factors	Datalogic STAR Cordless System™	Bluetooth® Wireless Technology	Notes
AMBIENT PROPAGATION	*****	***	Bluetooth® is more sensitive to obstacles and in particular to some materials (like water).
SENSITIVITY TO NOISE	****	**	2.4 GHz is a "crowded" band; Bluetooth's® bandwidth is higher; It is a connection oriented system (transmits even when not required by the user)
TRANSMISSION SPEED	***	*****	Bluetooth® is nominally faster working at 1 MB/sec. This is useful for large amounts of data but negligible below some hundreds of characters.
MAXIMUM DISTANCE	****	*****	50m vs 100m but only with Bluetooth® class 1 radio (high emitted power: up to 100mW vs less than 10mW for STAR). Class 2 BT guarantees just 10m.
NETWORK CAPABILITY	*****	**	Hundreds of devices can be used simultaneously vs 7, because Bluetooth® was developed and designed purely for cable replacement purposes.
POWER CONSUMPTION	*****	**	Bluetooth® is a "connection oriented" system: this requires a permanently live connection.
STABILITY OF STANDARD	*****	***	Bluetooth® is continuously evolving.
CONTROL OF TECHNOLOGY	*****	*	Proprietary radio ensures full technological control.
PROTECTION/ENCRYPTION	*****	*****	Both protocols provide data protection.
Average Score:	4.6	3.1	

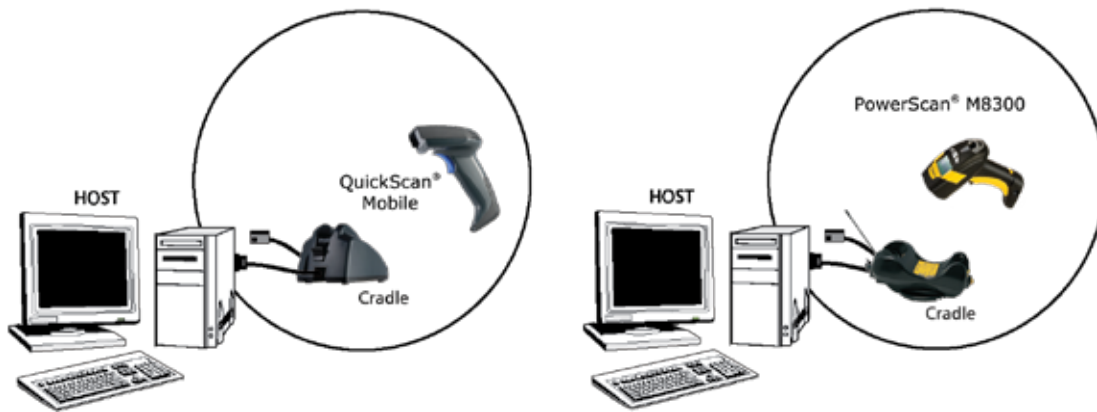
Below are some examples showing the superiority of Datalogic's STAR Radio System™ in terms of networking and configuration versatility.



The first 2 figures show the two possible configurations of a Bluetooth System: (Fig.1) a point to point connection between 2 devices (one master and one slave) as well as a point – multipoint system (max 8 devices: 1 master that has the responsibility of the network coordination and 7 slaves; more slaves can be included but they must be parked or in standby mode i.e. not really usable without drive out another device; this cluster is called piconet). (Fig.2) Two or more piconet can interact (but only because a slave device can move from one piconet to the other connecting itself to one or to the other master; this combination is called scatternet but it has not real utility in standard barcode applications).

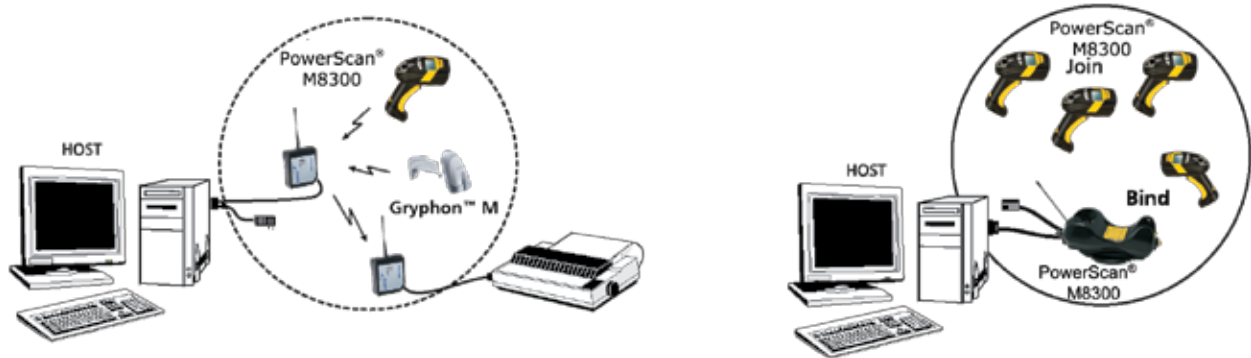
The following figures show the versatility of the STAR Cordless System™:

(1) Point-to-Point Connection



(2) Point-to-Multipoint Connection:

One receiver with up to 32 devices working simultaneously; Point-to-Multipoint connection with a bidirectional base (STAR-Modem™) that can both receive and transmit data.



(3) Network:

Up to 16 receivers connected via RS-485 to cover a wider area which allows up to 255 devices working simultaneously and moving in the whole coverage area. This is possible thanks to seamless roaming that automatically connects the device to the closest receiver.




Conclusions

To summarize and to provide general guidelines for selecting the best choice for different applications users should consider:

- Datalogic STAR Cordless System™ is the best solution for all applications where a limited amount of data needs to be transmitted (for example, codes of up to 100 characters). In fact, the only disadvantage of this radio compared with Bluetooth® wireless technology is a lower baud rate.
- Bluetooth® wireless technology is the best solution for applications where:
 - A high volume of data must be transmitted (e.g. 2D or stacked bar codes; image based applications);
 - The application requires the direct connection of the bar code reader to the host without the addition of an external receiver (e.g. direct transmission of the bar code to a laptop, PDA or mobile phone that already has its own embedded Bluetooth radio).



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