

Bluetooth®: Why It Improves Mobile Printing and How to Take Advantage



A ZEBRA BLACK&WHITE PAPER





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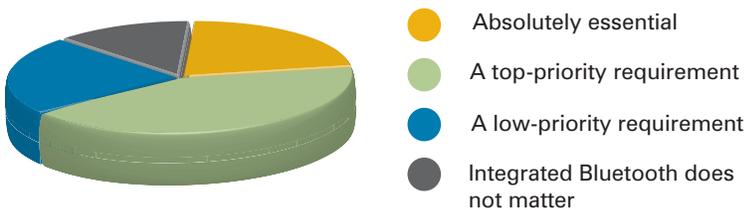
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Executive Summary

Bluetooth connectivity enhances the convenience and productivity that mobile printing provides by taking cables and clutter out of the workspace. Bluetooth enhances the bottom line by eliminating cable-related costs. Those are the main reasons Bluetooth quickly went from a funny-sounding, misunderstood emerging technology to one of the most-valued features demanded by enterprise mobile computer users today. Already there are more than 1 billion Bluetooth-equipped devices in use, and in 2007 manufacturers shipped 13 million new Bluetooth computers, printers and other devices each week, according to the Bluetooth Special Interest Group, which developed and maintains the standard.

Many of these devices are shipped for enterprise applications. Each day the technology is used to securely complete millions of communications among mobile computers and printers, scales, bar code scanners and other peripherals. Enterprises recognize Bluetooth as one of the most valuable features of their peripherals—63.9 percent say Bluetooth connectivity is considered “a top-priority requirement” or “absolutely essential” according to market research firm Venture Development Corp. (VDC).¹

Figure 1: How Enterprise Users View Bluetooth



Source: VDC

Cable-free connectivity is especially valuable for operations where workers are frequently mobile and for active direct store delivery (DSD), route accounting, field service, inspection, ticketing, warehouse, materials handling and other operations. There are well-documented safety, convenience and productivity benefits for replacing cables with Bluetooth in these operations.

Cutting Your Blue Teeth—Basics of Bluetooth Technology

What is Bluetooth?

A short-range wireless communication technology. Zebra® printers have optional Bluetooth connectivity to communicate with mobile computers (including forklift- and other vehicle-mounted models), POS terminals, scales, PCs and other devices.

Frequency: 2.4 GHz

Is Bluetooth interoperable with Wi-Fi® (802.11)?: No

Can Bluetooth be used in proximity to Wi-Fi?: Yes

Range: about 30 feet

Recommended for cable replacement?: Yes

Recommended for networking applications?: No

Can any Bluetooth device access a Zebra Bluetooth printer?: No. See the Security section of this white paper and the FAQs for more information.

1. “Bluetooth Technology Pushes Sales of Mobile Computer/Device Accessories” Venture Development Corp., July 25, 2007.



This white paper explains the benefits of Bluetooth printing in these and other enterprise environments. The paper:

- Provides a brief overview of the technology and how it is used for mobile printing;
- Summarizes the benefits of Bluetooth printer connectivity;
- Provides guidance for measuring benefits and calculating potential savings;
- Presents use cases and successful user profiles for a variety of mobile, retail and industrial operations;
- Includes a glossary of Bluetooth terminology, and;
- Includes FAQs with detailed information about how to use Bluetooth with Zebra® mobile printers.

Why It's Good to Go Blue

Cables are often the weak link for even the most ruggedly designed mobile computers and printers. Cables get cut or frayed, pins are prone to breaking, and any tugging or twisting can also damage the connector ports on the devices, necessitating longer and more expensive repairs. Damage often carries a much higher cost—lost productivity because workers can't use their devices in the field. Productivity losses resulting from hardware failure account for a 49.1 percent of the total cost of ownership for mobile computing devices—more than three times the cost of the device itself, according to VDC.²

Even when in good condition, cables create a danger for tangling, catching and tripping, which is at best an inconvenience and at worst a safety hazard. More than a quarter million Americans are injured in workplace falls annually, according to the U.S. Bureau of Labor Statistics.³

Besides improving safety and convenience, Bluetooth connectivity can also provide a total cost of ownership (TCO) advantage. Over time, cable-free configurations are often the most cost-effective. The cables to connect mobile printers and specialized handheld computers can easily cost \$50 or more, and may need to be replaced two to three times during the life of the mobile equipment, which is easier to make rugged and to protect than its cables.

A 100-store retail chain that uses five mobile printer-computer combinations in each store studied the cost-of-ownership issues related to its printer cables. The company determined its annual cable-related repair and replacement costs to be \$60,000, and calculated that lost productivity related to downtime and repair cost even more than the direct expenses. Another retailer studied the issue and determined that its employees spent an

Bluetooth Delivers for Route Drivers

“Drivers like the Bluetooth connectivity better because the cord isn’t dangling everywhere. Plus, we don’t ever have to worry about replacing cables,” reports the MIS manager of J.J. Taylor, a beer distributor that issued Bluetooth wireless printers to more than 200 route drivers.

See the complete J.J. Taylor case study at www.zebra.com.

2. “Mobile Device Downtime Destroys Mobile Workforce Productivity” Venture Development Corp., July 26, 2007.

3. “Survey of Occupational Injuries and Illnesses” U.S. Bureau of Labor Statistics, October 2006.



Blue Devil Fans are Bluetooth Fans

Duke University uses Bluetooth-enabled handheld computers and mobile printers for a variety of retail and student services around campus, including the book buyback program at the end of each semester, yearbook distribution and mobile point-of-sale and inventory management at university-operated retail stores.

One of the highest-profile uses is mobile concessions at sporting events and other large gatherings. Fans don't have to leave their seats and miss any action to purchase food and beverages, increasing enjoyment for them and sales for Duke.

"Once we got away from a tethered solution, we could use our mobile devices in places where it was difficult in the past," says Matthew Drummond of Duke University. "The system is very convenient to use, and lets us offer mobile concessions at sporting events, concerts and other events. That's opened up new revenue streams for us."

See the complete Duke University case study at www.zebra.com.

average of two minutes per day troubleshooting printer cables, which added up to significant non-productive labor time chain-wide. In each case, the companies quickly converted to wireless connections between their mobile printers and computers.

To estimate if Bluetooth will be cost-effective for your operations, multiply the number of devices in use by the expected cable failure rate (e.g., 40 devices times 25 percent failures each year = 10 failed cables/year) and multiply that figure by the cost of replacement cables. Multiply this expense by the number of years the mobile printer is expected to be in service, and compare the total to any incremental expense that would be incurred by configuring mobile printers for Bluetooth.

Organizations also take advantage of Bluetooth to create more efficient processes. For example, Bluetooth printers can be mounted on forklifts to interface with mobile computers and bar code scanners so workers don't need to drive to a central location to pick up pick tickets or shipping labels. Duke University in Durham, N.C., uses Bluetooth receipt printers in its bustling concession stands so there are no cords on the crowded counters, and also for mobile concession sales (see sidebar).

Zebra Technologies conducted a time-motion study of receiving operations at an actual distribution center, in which the warehouse worker only had to take nine steps to travel from the pallet with items to be labeled to the workstation where labels were printed. Pallets were labeled in 42 percent less time (28.11 seconds compared to 49.74) when belt-worn mobile printers were used to eliminate the short walk to the central printing station.

A Free Pass at Crowded Counters

"Concessions can get pretty hectic. There's a lot of reaching and passing, and people are working quickly. The cable is just one more thing that can get in the way, so it's good not to have to worry about it."

Matthew Drummond
Duke University

See the complete case study at www.zebra.com.



Use Cases for Bluetooth Printing

Most people tend to associate Bluetooth with handheld computers and peripherals, but as Duke's stationary concession application shows, other processes can also benefit from cable-free connectivity. There are four primary ways Bluetooth printing is used to support enterprise operations:

- Interface between mobile computer and mobile printer;
- Forklift-mounted printing;
- Vehicle-mounted printing;
- Stationary printing and sharing a stationary printer.

Printing from Mobile Computers

The best-known examples of Bluetooth printing involve handheld computers and a printer that is either clipped to a belt, worn on a strap or holster, or carried by hand. This configuration is widely used for a variety of operations including receipt, invoice, work order, and ticket printing; shelf labeling; and inventory marking. Bluetooth makes it easy for workers to print wherever receipts, labels or tickets are needed because they aren't hampered with cables that crisscross their bodies—and workers themselves don't have to crisscross the workplace to use stationary printers.

Forklift-Mounted Printing

Mobile printers are commonly mounted on forklifts and other material handling equipment to complement wireless mobile computers that interface with warehouse management systems (WMS) or other enterprise systems. Operators typically receive picking and putaway instructions from the host system via a wireless local area network (LAN) transmission to the mobile computer. The computer communicates to the printer via Bluetooth to create putaway labels, pick tickets and shipping labels on demand. Printing labels in real time at the proper location minimizes the chance that labels will be misapplied, which frequently happens when preprinted labels are used. On-site, on-demand printing also eliminates time-consuming trips to a central printing location. See Zebra's white paper: *Productivity Through Portability: Mobile Printing Delivers ROI in the Warehouse* for a more detailed explanation, information about warehouse and industrial mobile printing applications, and formulas for calculating time and cost savings.

Just the Ticket

“Wireless printing is perfect for our officers. The printers are tough enough for the environment, and the small size is also important because our motorcycle officers can't lug around something designed to be used on a desk or in a squad car. This system is very convenient and easy to use. Our officers were clamoring for it after they first saw it.”

Corporal Tom Labombarda
Aventura (Fla.) Police Department

See the complete case study at
www.zebra.com.

Vehicle-Mounted Printing

Bluetooth can also save time and improve productivity even when the printer does not accompany the user. Delivery drivers, field service technicians and public safety officers often have non-removable printers securely mounted in their vehicles. This configuration usually requires an extra trip back to the vehicle to produce an invoice, work order, receipt, ticket or other form once the activity is completed. The time required to complete the process can be reduced by using Bluetooth to send the print job from a mobile computer to the printer as the worker is walking back to the vehicle. Bluetooth has a range of about 30 feet, so often the print job will be completed and waiting by the time the worker reaches the vehicle.

Stationary and Shared Resource Printing

The same principles and value potential apply to other operations where the user is mobile and the printer is stationary. Duke University's concession stand application is a good example of Bluetooth-enabled shared resource printing, which is not a widely used application. The benefits are reduced equipment needs and less cable clutter. Electronic scales and other Bluetooth devices may also share printers. Sharing a printer has potential drawbacks. It creates the danger that users will pick up the wrong receipt or label, and adds time to the process because users have to verify what they pick up.

These are just a few general ways Bluetooth is used in retail, hospitality, field service, DSD, public safety and other operations. Zebra supports Bluetooth throughout its extensive line of mobile printers so almost any Zebra mobile printing application can be a Bluetooth application. The following sections explain how Bluetooth is implemented in Zebra printers, including supported specifications and security protocols, configuration options and general performance information.

Using Bluetooth with Zebra Mobile Printers

Bluetooth is an available option for Zebra's Cameo®, MZ™, RW™, QL™ and QL Plus™ series mobile printers. QL Plus and RW series printers are available in dual-radio models that support Bluetooth and 802.11 connectivity for connection to wireless LANs and communication with Bluetooth mobile computers. However, the printers cannot use the two radios simultaneously.

All Zebra Bluetooth radios conform to the version 1.2 of the Bluetooth standard specification and support the Serial Port Profile (SPP), which essentially emulates RS-232 serial communication to interface with a handheld computer or other device. Zebra plans to support version 2.0 in all its Bluetooth printers by the first quarter of 2008.

Bluetooth 1.2 provides about 30 feet of range, which varies greatly depending on the environment. The specified data rate is 1 Mbps. Actual transmission rates depend on network traffic and are usually slower; however, Bluetooth provides very fast throughput for common receipt, label and ticket printing.

Warehouse productivity perks up

“Mobile printing saves time because workers don't need to go back to a print station. To travel that distance was about three or four minutes round trip. Eliminating that is a huge time saver. The associates thought the mobile printers were a breath of fresh air. We bought them to use as backups for our stationary printers, but they ended up being primary because they were so much of a benefit.”

Randy Lewey
Green Mountain Coffee Roasters

See the complete case study at
www.zebra.com.



Zebra Bluetooth printers can communicate with any other Bluetooth devices that support the Serial Port Profile. Security can be set to prevent communication with unknown devices (more details are in the Security section). Almost any data that can be communicated by serial cable can be transmitted over Bluetooth to a Zebra mobile printer, including label formats, receipts, tickets, bar code data and graphic files. Zebra provides an ActiveX® control to set up device interfaces to Zebra Bluetooth printers.

Security

Bluetooth poses a very low security risk because its limited range (typically 30 feet or less) and slow transmission speeds (compared to wireless LANs, which are at least 10 times faster) mean hackers would have to be in close proximity to the target device and would likely be noticed as they tried to intercept enough transmissions needed to crack the communication. The Bluetooth specification supports authentication and encryption, which make transmissions secure, and Zebra offers added other security features for its Bluetooth wireless printers.

Encryption and authentication work hand-in-hand as part of the Bluetooth specification. Devices authenticate each other with a 16-character passkey. When authentication is enabled, all traffic between two Bluetooth devices becomes encrypted.

Zebra has implemented several additional security measures in its Bluetooth wireless printers. First, Zebra Bluetooth printers only support the Serial Port Profile, which somewhat limits the devices they can associate with. The Discovery Mode is configurable and can be turned off, which means the printer itself will never initiate a link with another Bluetooth device. The printer will only communicate if a handheld computer initiates the exchange, and the printer can be configured to authenticate the computer. See the FAQs section for more detailed information about security and configuration options.

C o n c l u s i o n

Bluetooth has become a “must-have” feature for many enterprise mobile computer users because of the reliability, convenience and cost savings it provides. Bluetooth is a fast, secure option for mobile printing that can be used indoors or out to support productivity-improving processes. Any operation where printer cables can tangle, break or otherwise inconvenience the user is a candidate for improvement with Bluetooth connectivity.

Zebra offers a complete range of mobile printers with flexible, configurable Bluetooth connectivity options. Contact Zebra today to learn more about how our products and expertise can help improve your route accounting operations. Zebra Technologies Corporation helps companies identify, locate and track assets, transactions and people with on-demand specialty digital printing and automatic identification solutions. In more than 100 countries around the world, more than 90 percent of Fortune 500 companies use innovative and reliable Zebra printers, supplies, RFID products and software to increase productivity, improve quality, lower costs, and deliver better customer service. Information about Zebra and Zebra-brand products can be found at www.zebra.com.



Appendix A: Bluetooth Terminology

Authentication: The Bluetooth specification includes authentication as an option. A server device may allow itself to connect to any potential client, or it may restrict itself to a subset of potential clients. The server restricts itself by requiring the client to authenticate. This means that the client must know the right password to access the server. A client without the password is not “authentic” and will not be serviced.

Bluetooth: Bluetooth is a specification for short-range wireless communications based on low power 2.4 GHz frequency hopping RF technology.

Client: The master device (see below) is usually also a client device. The master seeks a service from the slave. Any terminal that talks to a Zebra printer is a client device.

Connectable: A Bluetooth server (slave) enters Page Scan mode to become connectable with potential clients. Only in Page Scan mode can a client link to a server.

Discoverable: A Bluetooth server (slave) enters Inquiry Scan mode to announce its presence and make itself known to potential clients. When in Inquiry Scan mode, the server is said to be discoverable—it is broadcasting its Bluetooth address. A client can then connect with a discoverable server to form a piconet. Only in Inquiry Scan mode is a server discoverable.

Master: The frequency hopping nature of Bluetooth radios requires that each piconet have a master device. The master selects which hopping sequence the piconet will use. All of the other devices in the piconet (“slaves”—see below) synchronize themselves to the master. Zebra Bluetooth printers are always slaves, never masters.

Piconet: Bluetooth networks are called piconets. Bluetooth allows up to eight devices to link in a piconet.

Slave: All of the other devices in the piconet are slaves. Slaves may only communicate with the master, never with each other. In this procedure we will only set up simple piconets with one master (the terminal) and one slave (the printer).

Server: The slave device is usually also a server device. The slave provides a service to the master. A Zebra printer is always a server device.

Standard Password: Zebra has defined a standard password for use in authentication. This password is based on the WRF protocol address generation algorithm. This algorithm generates a unique WRF address based on the serial number of the printer. Zebra uses this unique WRF address as our standard password.



Appendix B: Zebra Bluetooth FAQs

FAQs are updated as necessary, so check www.zebra.com for the latest version. The site also has additional FAQs with specific information about how to configure Zebra Bluetooth printers.

What is Bluetooth?

Bluetooth is a global standard for a small radio module to be plugged into computers, printers, mobile phones, etc. A Bluetooth radio is designed to replace cables by taking the information normally carried by the cable, and transmitting it over radio frequency in the unlicensed 2.4 GHz frequencies to a receiver Bluetooth radio chip.

What specification does the Zebra Bluetooth radio comply with?

The Bluetooth radio inside Zebra mobile printers complies with Bluetooth Specification 1.2 and supports the Serial Port Profile (SPP). All print jobs sent to the printer will be done through the SPP, which is nothing else than a Bluetooth emulation of a RS-232 serial communication. Zebra plans to support Bluetooth version 2.0 in the first quarter of 2008.

What range does Bluetooth connectivity have in Zebra mobile printers?

The ZBR (Zebra Bluetooth Radio) has a nominal 30-foot (10 m) range in accordance with the Bluetooth Specifications 1.2 and 2.0 for power output. Range will depend greatly on the environment in which the equipment operates.

What devices can communicate with Zebra Bluetooth printers?

Any computer or handheld that has a Bluetooth radio inside and supports the Serial Port Profile (SPP) of the Bluetooth specification can communicate with Zebra mobile Bluetooth printers. However, due to their mobility, handheld computers are the devices of choice. Handheld computers can be Bluetooth-enabled through Bluetooth radios in the form of Compact Flash (CF) cards, or they can have an embedded Bluetooth radio installed when manufactured.

What information can be transmitted via Bluetooth to Zebra mobile printers?

Most data that can be sent over a serial cable to a Zebra mobile printer can be transmitted via Bluetooth to a printer. The practical and intended uses are data that has been formatted for printing of receipts, labels and bar codes in media up to 4 inches wide, depending on the printer model. Zebra provides a label creation utility called Label Vista™ to facilitate the formatting of labels or text. A programming manual and wireless configuration guide are also available.

What is the Friendly Name?

The Friendly Name is a string of up to 20 characters long that is intended to be unique to each printer; on Zebra printers the Friendly Name will default to the printer serial number if not changed by the user. The printer provides its Friendly Name during Service Discovery (see below).

What are the configurable Bluetooth settings in my printer?

1. Authentication
2. Discoverable Mode
3. Friendly Name



How do I configure the Bluetooth settings in my printer?

By default a Zebra Bluetooth printer comes with the following settings: Authentication turned OFF, discoverable turned ON, and the “Friendly Name” of the printer will be the printer serial number. The Bluetooth radio in the printer will always be a “slave device.” In other words, the printer will never be able to look for other Bluetooth devices to connect to, and will never start the link itself. Those are “master” device functions. (Handheld computers will be the master devices).

The settings that can be changed by the user are: Turn Authentication ON or OFF, turn Discoverable Mode ON or OFF, and change the Friendly Name of the printer to some other unique alpha-numeric string (like an asset tracking number).

To change these settings the user can use “Label Vista” or send printer programming language commands to do so. Either way, the printer needs to be connected to a PC through a serial cable P/N BL11757-000. For programming commands, please refer to the “Bluetooth Parameters” section of Zebra’s “Mobile Printing Systems Programming Manual” or the “Zebra Mobile Printers—Wireless Configuration Guide.”

What is the transmitting rate through a Bluetooth connection?

According to Bluetooth specification, the over-the-air transmission rate is 1 Mbps. This is the raw data rate; the actual data rate will be somewhat less depending on a variety of factors (mostly how much traffic is present on the Bluetooth piconet). Note: The internal Bluetooth module in the printer has a UART interface to the printer processor set at 57.6 Kbps baud for version 1.2 and 115.2 Kbps for version 2.0. This rate is totally independent from the over-the-air transmission rate.

What is Device and Service Discovery?

A handheld with Bluetooth will have a Bluetooth manager or “user interface program” to manage the Bluetooth radio functionality. One of the functions of the Bluetooth manager program is the capability to send inquiries over the air to discover what other Bluetooth devices are in the vicinity (this is a Bluetooth master or client seeking to discover what Bluetooth servers are available). Once a server device is found, another inquiry poll is sent to discover what service the device is providing. In Zebra’s case, the service provided by the printers is Serial Port Profile (SPP) printing.

What is Zebra Print ActiveX control?

The Zebra Print ActiveX control is a set of codes that provides a simple interface to Zebra mobile printers. It currently supports four connection methods: serial (COM Port), infrared (IrDA®), TCP and Bluetooth. Bluetooth is supported via a simulated serial/modem connection.

After the Zebra Print ActiveX control is installed on the target Windows® Pocket PC or CE device, it can be used from within any HTML document using Microsoft’s Jscript® Web scripting language. The control can also be used from within any other programming language that supports ActiveX, such as Visual Basic or Visual C++. This control is available to users and developers of applications using the Bluetooth mobile printers.

Can 802.11b/g and Bluetooth coexist in the same environment?

Bluetooth and 802.11b/g share the same spectral band (2.4 GHz). Therefore, cross-interference will be inevitable. A reduction in throughput can result. In general, Bluetooth devices are less susceptible to coexistence problems because of the following reasons:



- Bluetooth is a frequency-hopping spread spectrum (FHSS) technology, which means if a channel is busy, Bluetooth will immediately hop to a different channel to transmit the packet of information. 802.11b/g uses direct sequence spread spectrum (DSSS) technology, which has a different method to transmit signals.
- Shorter packets—Bluetooth packets are typically a fraction of a millisecond long compared with a few milliseconds for 802.11b/g. This reduces their collision susceptibility.
- Bluetooth is less considerate. An 802.11b/g station first waits for silence and only then transmits. A Bluetooth, on the other hand, is inconsiderate of surrounding transmissions—it simply “barges in” whenever it has something to transmit.

In summary, these technologies can coexist. Several manufacturers have developed coexistent schemes. However, if the number of Bluetooth devices is very large around a wireless network (802.11b/g), most likely the throughput of the 802.11b/g devices will be affected. Zebra QL Plus and RW series mobile printers can include both Bluetooth and 802.11b/g radios, but can't use the two radios simultaneously.



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