Vocollect® by Honeywell®

Bluetooth® in the Warehouse Environment

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A Vocollect White Paper

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Introduction

Bluetooth® is a popular technology for communications between devices, most evident in the area of cell phones. Unlike cell phones, the application of Bluetooth technology to commercial or industrial use adds complexity and technical considerations that need to be addressed as part of the IT and operations design process. This paper combines technical notes on Bluetooth technology with pointers on its implications when applied to the warehouse environment.

Specifications and Features

Bluetooth Architecture

Bluetooth communications occurs between master radio and a slave radio. The architecture is symmetric in that a radio can operate both the master and the slave. Two or more devices communicating together form a piconet with each device having a unique 48-bit address. All of the devices on a piconet share the same channel. Each piconet contains one master and up to seven active slaves. More than seven devices may be configured for the piconet, but only seven may be connected at one time.

Wireless Interface

Bluetooth transmissions use the 2.4 GHz ISM band. This is the same license free band that is used by IEE802.11/WiFi wireless LAN devices. Although there has been some technical effort in cooperatively sharing the band between Bluetooth and WiFi devices, interference is a reality when radio devices are in close proximity.

Output Power

Bluetooth devices are classified by output power. The classes are numbered opposite of what one might think. The lower the class number, the greater the range:

Class 1 – 100 mW – approximate range of up to 100 m or 328 ft

Class 2 – 2.5 mW – approximate range of up to 10 m or 33 ft

Class 3 – 1 mW – approximate range of up to 10 cm or 3.9 ft

Class 2 devices are the most common, followed by Class 1 and Class 3.

Specifications and Features (continued)

Bluetooth Versions

As with any communications standard, Bluetooth has evolved over time with increased capabilities with each subsequent version: Bluetooth v1.0 and v1.0B – These are early versions of Bluetooth and as such, had interoperability problems. Also, the mandatory requirement for transmission of the hardware device address made security a concern.

Bluetooth v1.1 – This is the first mainstream version. Many of the errata were fixed and a few enhancements were added. Most notably, a signal strength indicator (RSSI) was added to the protocol and support for non-encrypted channels.

Bluetooth v1.2 – Backwards compatible with v1.1. Added Adaptive Frequency Hopping (AFH) which improves interference immunity due to crowded airwaves realized higher transmission speeds, and better voice performance. Also added better low level programming accessibility for Bluetooth applications.

This is a case where less is more. While it may seem that more range would be a good thing, in warehouse environments where a WiFi 802.11 wireless network is in use, or where there are many Bluetooth devices in use, Class 1 devices can cause significant interference.

Bluetooth v2.0 – Backwards compatible with v1.x. Main features are the Enhanced Data Rate (EDR) of 2.1 Mbits/sec (was 1 Mbit/sec in previous versions) and improved power consumption from the resultant reduced duty cycle.

Bluetooth Profiles

Profiles are used by the Bluetooth protocol layers as a library of behaviors for certain communications applications. For example, in order for a headset to work with a phone they would both have to follow the same conventions to establish communications and pass data. In the case of this example, the convention is the Headset Profile.

There are dozens of profiles, too many to list in this paper, and many profiles depend on other profiles to function. The main profile groups are: Generic Access Profile Group – A basic requirement for one Bluetooth (BT) device to communicate with another. It provides the basic connection, power control, link management, and basic security. The Service Discovery Application Profile (SDAP) is part of this group.

Serial Port Profile Group – All profiles in this group use RFCOMM serial port emulation. It is just as it sounds – serial port emulation. It is the basis for Bluetooth as a wireless cable replacement.

Generic Object Exchange Group – All profiles in this group use OBEX object exchange protocol. Example applications are synchronizing calendars and pushing business card info.

Telephony Control Protocol Specification Group – All profiles in this group use the Telephone Control Specification (TCS) binary which defines call control signaling for exchange of speech and data.

Specifications and Features (continued)

The important thing to understand is that two devices need to support the same profile in order to communicate with each other. Just because they are both Bluetooth certified doesn't result in interoperability. Check with your device manufacturers to ensure interoperability

Pairing

Pairs of devices may establish communications through a process called pairing. The pairing process establishes a "trusted" relationship by authenticating devices using an encrypted "passkey" that is shared between devices. Once devices are paired, communications between devices can be encrypted and secured. Even though the 48-bit hardware addresses of the Bluetooth radios are used in the process, the user is generally not exposed to the address. Instead, the user establishes pairings using user assignable device name. Up to seven active slave devices (radios) can be paired to a master device.

Pairing in a warehouse scenario can be a challenge. Since many devices are in close proximity to each other during a shift change, pairing can become complete chaos as terminals get misspaired with unintended printers or scanners in close proximity Static pairing of devices ahead of time gets around the problem but creates a significant configuration chore and an ongoing device management burden. Your Vocollect representative can help address these and other integration challenges.

References and Additional Information

There is so much information on Bluetooth on the web that it can be cumbersome to sort through. Below are some links to the most authoritative sites, including some that this paper drew from:

www.bluetooth.org

www.bluetooth.com

www.uwbforum.org

http://en.wikipedia.org/wiki/Bluetooth

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