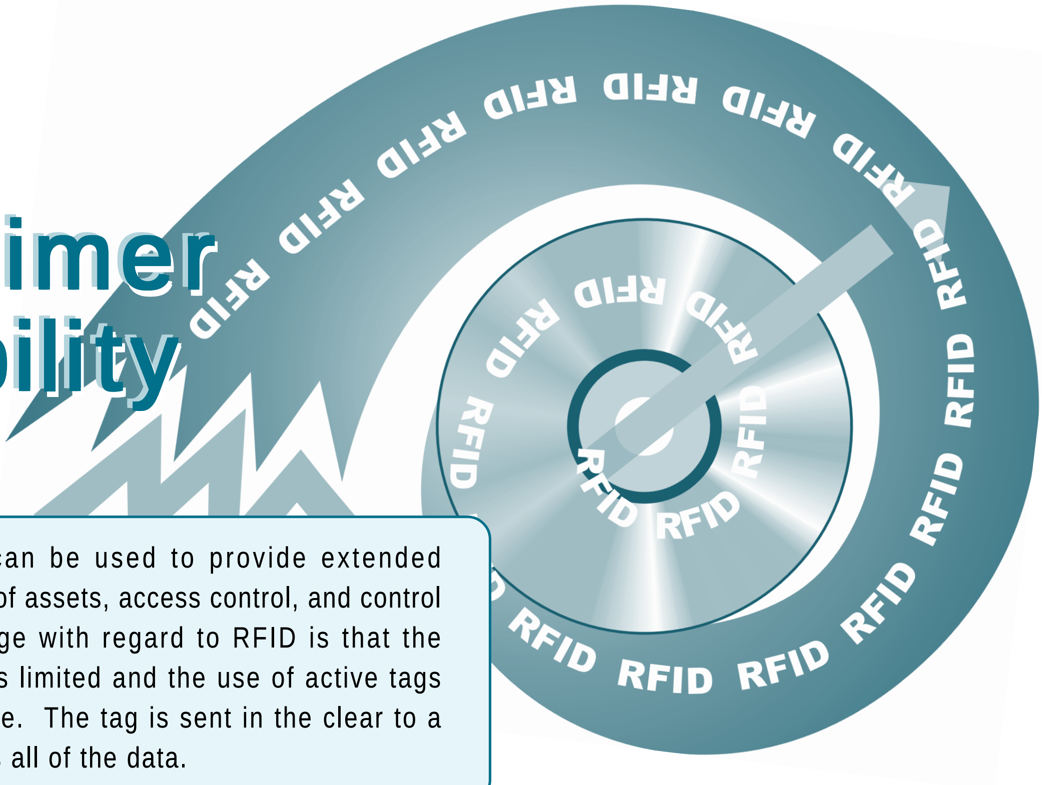
RFID Primer for Mobility



Mobile Ad hoc Networks can be used to provide extended capabilities such as tracking of assets, access control, and control identification. The challenge with regard to RFID is that the distance to intercept a tag is limited and the use of active tags requires extended battery life. The tag is sent in the clear to a back end server which stores all of the data.

RFID theory

RFID is short for Radio Frequency Identification, a technology similar in theory to bar code identification. RFID consists of an antenna and a transceiver, which read the radio transponder, or tag, which is an integrated circuit containing the RF circuitry and information to be transmitted.

RFID systems can be used just about anywhere, from clothing tags to missiles - anywhere that a unique identification system is needed. The tag can carry information as a name and address or instructions on how to clean a garment or as complex as how to assembly a car. Auto manufacturers use RFID systems to move cars through an assembly line and at each successive stage of production, the RFID tag instructions the computers what the next step of the automated assembly is to occur.

The key difference between RFID and bar code technology is RFID eliminates the need for line-of-sight reading required by bar coding. The RFID scanning can be done at greater distances than bar code scanning.

The RFID reader may be a fixed antenna or it may be portable, like a bar code scanner. The tag itself is an intelligent bar code label. The advantage, unlike barcode tracking systems, an RFID system can read the information on a tag at a distance without line of sight or having to be placed in a particular orientation. This means that RFID systems can be largely automated and eliminates the need for manual scanning.

The back end computer system stores all collected data within a database. The tag is used to retrieve data from the database and to display the contents or provide instructions for a particular process.

RFID is also called dedicated short range communications (DSRC).

Tag types and tag selection

The general performance characteristics and the regulatory requirements associated with the permitted frequencies for your country of operation must be considered.

There are two types of RFID tag: active and passive.

Active

- Battery powered
- Read-write and read only versions available
- Longer read ranges (25 to 100 feet)
- Higher tag costs ($20 to $70 per tag)
- 2D location systems possible
- Example: Toll booths

Passive

- Powered by reader
- Read-write and read only versions available
- Shorter read ranges (Inches to 20 feet)
- Lower tag costs (at least $1 per tag)
- Item ID
- Example: Item management

RFID deployments tend to use unlicensed frequencies for their obvious cost benefits. There are four commonly used frequencies: low frequency (LF) 125/134.2 KHz, high frequency (HF) 13.56 MHz, ultra high frequency (UHF) (including 869 and 915 MHz) and microwave (at 2450 MHz).

The ability to read a tag at a distance is usually considered the primary gauge of its suitability for a particular application and not all applications require maximum range.

Tags in the LF-HF band have a range of 1 to 18 inches, while passive UHF tags can reach up to 20 feet, and microwave tags can reach 1 to 6 feet. The ranges greatly depend upon the surface on which the tag is mounted.

Each tag can be "tuned" to work with the material it is mounted on, whether metal, glass, plastic, wood, or air. If you take a tag designed for a glass windshield at 915 MHz, and attach it to a wooden pallet, you may not be able to read it. Experienced RF users will know that each frequency requires a slightly different antenna shape.

Tag issues

RFID tags capabilities and performance will vary by brand. Tags are designed and tuned for particular target items, environments, and mounting materials, with each presenting different challenges to the tag designer.

Each vendor's IC chip function is varies in temperature rating, radiation tolerance, arbitration (handling data collisions), simultaneous multiple tag reads and read rates, reading groups of tags (group select), reading only particular tags (item search), are vendor specific features and conditions and will have a slightly different antenna shape based on its frequency of operation.

Tags that are mounted on metal surface require a separation between the tag and the item to which the tag is attached. If the separation changes due to deformation of the material, the tag will be detuned.

There are interference issues related to tags that are too close in proximity to each other.

RFID readers

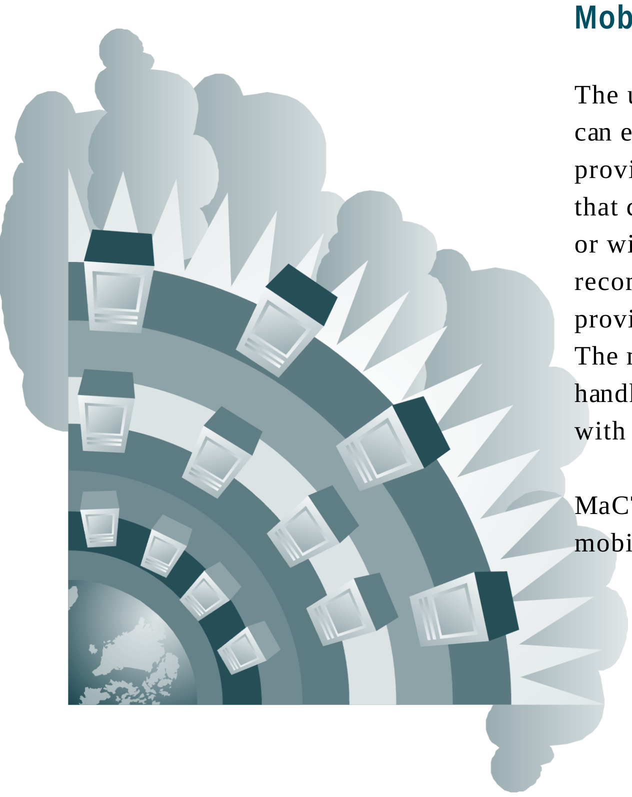
Tags transmit data to readers. They can be fixed mounts, handheld, or PCMCIA cards.

Each reader can have several

antennas. For example, a fixed reader on a factory's conveyor belt might need only one antenna but a fixed reader on the same factory's massive doors might need several. Linear polarization is usually appropriate for applications such as conveyor belts where both antenna and tag will be aligned in a fixed manner. PCMCIA card readers can be used to enable RFID data collection in places where the other two options would not work. For example, the PCMCIA card can provide data collection on computers mounted on forklifts.

For handheld readers, circular polarization is usually appropriate. People are accustomed to lining up infrared readers with barcode tags, but they can see the infrared whereas they cannot see RF. Since RF is invisible, its alignment cannot be determined by sight alone.

Handheld readers typically have only one antenna, and can use linear or circular polarization. A handheld typically performs at 60 percent to 70 percent shorter ranges than a fixed mount, and writing to a tag can also reduce range by 70 percent. For example, the maximum read distance for a fixed antenna operating in the 915 MHz band is 20 feet. Its write distance is about 14 feet. A handheld using the same frequency band could read at about 15 feet and write at about 9 feet.



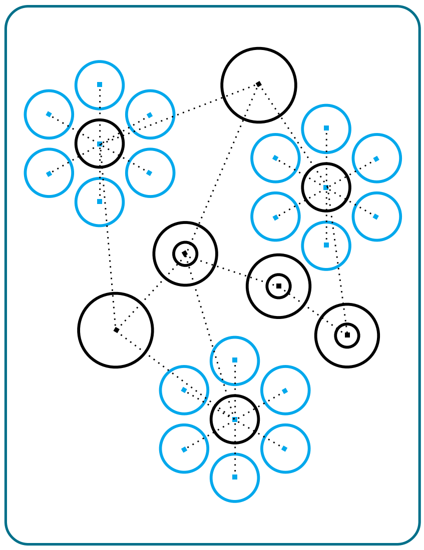
The reader and antenna are designed for a particular application. This includes design consideration for connecting the RFID subsystem to the client's network and backend systems. Switches, hubs, network traffic, port redirection software, client and network security, etc. are all important considerations in a RFID subsystem design and implementation.

Mobile Ad hoc Networks

The use of mobile ad hoc networks can eliminate wiring costs and provides secure virtual circuits that can extend over multiple wired or wireless hops. It is recommended to use UHF tags to provide extended range for RFID. The mobile ad hoc network allows handheld readers to communicate with servers on the wired network.

MaCT offers Wave Relay™ is mobile ad hoc network that can facilitate wired or wireless connections with multiple RFID readers via Ethernet. The resultant infrastructure has the added benefit that it provides extended device level security for un-tethered operations. The product currently makes use of the 2.4 GHz and 5.0 GHz bands employed by 802.11 and will support new bands of operation as they become available providing inter-band relay and bridging. It also includes a multi-rate capability to facilitate scalability as well as bandwidth available to enable the use of audio, video, and data traffic. In affect, as a RFID infrastructure is deployed, it enables extended capabilities.

The following diagram indicates the RFID in blue and the Wave Relay™ nodes in black :

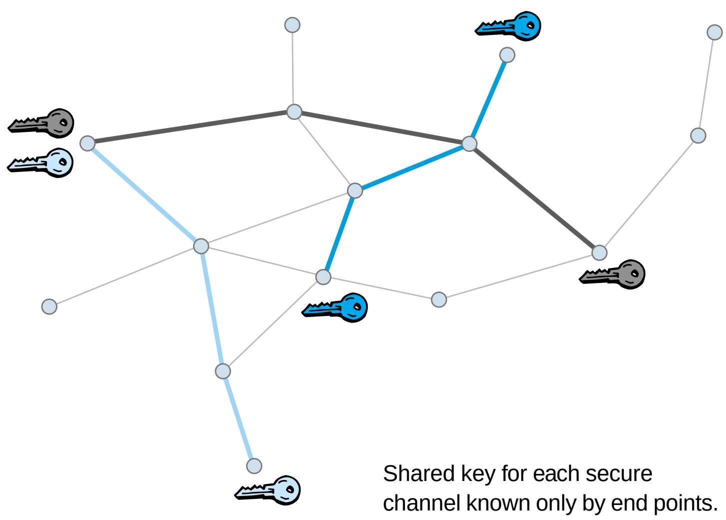


The Wave Relay™ system lets any device relay data over multi-hops between nodes.

RFID Security

RFID has all of the security problems posed by any wireless application. The deployment issues related to security can be greatly reduced through the use of Wave Relay™ includes SHA-1 and AES encryption. Wave Relay™ makes use of a Public Key Infrastructure (PKI) and x.509 digital certificates with a shared key that is changed over time for each secure channel which is known only by the end points.

The following diagram indicates the use of secure channels:



Shared key for each secure channel known only by end points.

The end points can extend to nodes on the wired or wireless network. RFID can co-exist with other services such as voice, video, or data. The wireless links are interoperable over different wireless bands. The combination of multi-hop capability provides extended range of use and the ability to reach areas where it would be impractical due to a lack of a wired infrastructure. Mobile ad hoc networks can be used for low data rate applications such as RFID today, but as the chip technology grows so will the need to move more data to the chip. As RFID deployments increase, the need for a security solution will need the capabilities of the Wave Relay™ system that provides a secure self-configuring multi-hop distributed switch architecture which can be used for today's low bandwidth applications and provides the scalability for high bandwidth applications.

References:

RFID Primer: **Where the WLAN Hits the RFID Fan** By Alex Goldman and Ken Crawford of Tech Center
http://www.wi-fiplanet.com/tutorials/article.php/3292521

RFID: http://www.webopedia.com/TERM/RFID.html

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