What is Radio Frequency Indentification (RFID)?

The Basic RFID system consists of three components:

- An antenna
- A transceiver (with decoder)
- A transponder (commonly called an RFID tag) is electronically programmed with unique information

The antenna emits radio signals to activate the tag and read and write data to it. Antennas are the conduits between the tag and the transceiver, which controls the system's data aquisition and communication. Antennas are available in a variety of shapes and sizes; they can be built into a door frame to receive tag data from persons or things passing through the door, or mounted on an interstate toll booth to monitor traffic passing by on a freeway. The electromagnetic field produced by an antenna can be constantly present when multiple tags are expected continually. If constant interrogation is not required, the field can be activated by a sensor device.

Often, the antenna is packaged with the transceiver and decoder to become a reader (a.k.a. interrogator) which can be configured either as a handheld or a fixed mounted device. The reader emits radio waves in ranges of anywhere from one inch to 100 meters or more, depending upon its power output and the radio frequency used. When an RFID tag passes through the electromagnetic zone, it detects the reader's activation signal. The reader decodes the data encoded in the tag's integrated circuit (silicon chip) and the data is passed to the computer for processing.

RFID tags come in a wide variety of shapes and sizes, animal tracking tags, inserted beneath the skin, can be as small as pencil lead in diameter and one half inch long in length. Tags can be screw-shaped to identify trees or wooden items, or credit card shaped for use in access applications. The anti-theft hard plastic tags attached to merchandise in stores are RFID tags. In addition, heavy duty 5" by 4" by 2" rectangular transponders used to track inter-model containers or heavy machinery, trucks and railroad cars for maintenance and tracking applications are RFID tags.

RFID tags are classified as either active or passive. Active RFID tags are powered by an interal battery and are typically read/write, i.e. tag data can be rewritten and / or modified. An active tag's memory size varies according to the application requirements; some systems operate with up to 1 MB of memory. In a typical read/write RFID work process, a tag might give a machine a set of instructions, and the machine would then report its performance to the tag. This encoded data would them become a part of the tagged part's history. The battery supplied power of an active tag generally gives it a longer read range. The trade off is greater size, greater cost, and a limited operational life, which may yield a maximum of 10 years, depending upon operating temperatures and battery type.

Passive RFID tags operate without a separate external power source and obtain operating power generated from the reader. Passive tags are consequently much lighter than active tags, less expensive, and offer a virtually unlimted operational lifetime. The trade off is that they have shorter read ranges than active tags and require a higher-powered reader. Read-only tags are typically passive and are programmed with a unique set of data (usually 32 to 128 bits) that cannot be modified. Read-only tags most often operated as a license plate into a database, in the same way linear bar codes reference a database containing modifiable product specific information.

RFID systems are also distinguished by their frequency ranges. Low frequency (30KHz to 500KHz) systems have short read ranges and lower system costs. They are most commonly used in security access, asset tracking, and animal identification applications. High frequency (850 MHz to 950 MHz and 2.4 GHz to 2.5 GHz) systems, offering longer read ranges and higher read speeds, are used for such applications as rail car tracking and automated toll collection. However, the higher performance of high-frequency RFID systems incurs higher system costs.

The significant advantage of all types of RFID systems is the non-contact, non-line-of-site nature of the technology. Tags can be read through a variety of substances such as snow, fog, ice, paint, crusted grime, and other visually and environmentally challenging conditions, where barcodes or other optically-read technologies would be useless. RFID

tags can also be read in challenging circumstances at remarkable speeds, in most cases responding in less than 100 milliseconds. The read/write capability of an active RFID system is also a significant advantage in interactive applications such as work-in-process or maintenance tracking. Though it is a costlier technology (compared with barcode), RFID has been indispensable for a wide range of automated data collection and identification applications that would not be possible otherwise.

Developments in RFID technology continue to yield larger memory capacities, wider reading ranges, and faster processing. It is highly unlikely that the technology will ultimatedly replace barcade, even when the inevitable reduction in raw materials couple with economies of scale, the integrated circuit in an RF tag will never be as cost effective as a barcode label. However, RFID will continue to grow in its established niches where barcode or other optical technologies are not effective. If some standard commonality is achieved, whereby RFID equipment from different manufacturers can be used interchangeably, the market will very likely grow exponentially.

For further information, please contact WAKE, Inc.