

# **SDSU MASTERS of HOMELAND SECURITY**

## **GEOL600 SENSOR NETWORKS**



### **RFID**

### **Radio Frequency Identification**



RFID

History of RFID

Active & Passive tags

Regulation

Current usage

Human Implants

RFID Principle

Block Diagram

Data dilemma

Evaluation hardware

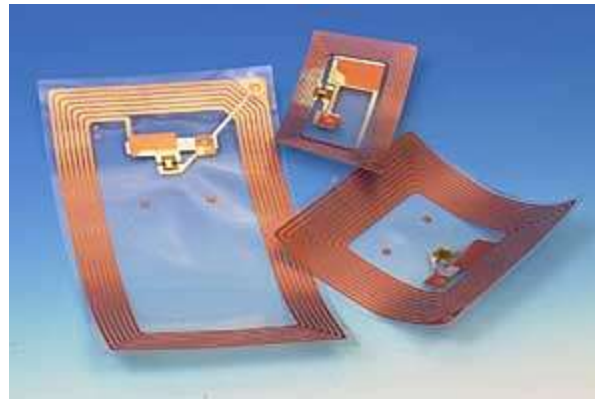
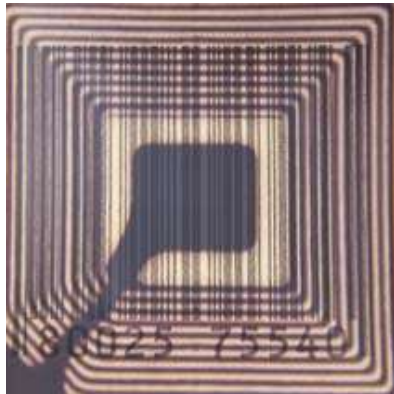
Controversy / Paranoia

RFID encryption cracked

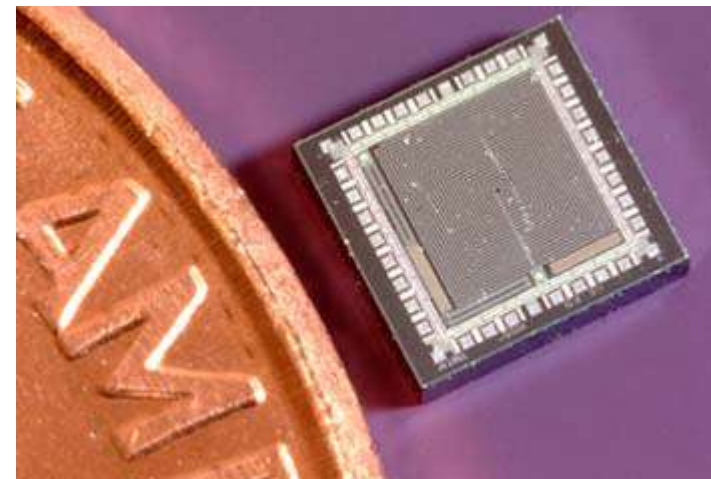
# RFID

Radio frequency identification (RFID) is a method of remotely storing and retrieving data using devices called RFID tags.

RFID tags are small object, such as an adhesive sticker, that can be attached to or incorporated into a product. They contain antennas to enable them to receive and respond to radio-frequency queries from an RFID transceiver.



David Friedman / Getty Images file



# HISTORY

The first real usage of RFID devices dates back to World War II. RFID devices were used to distinguish returning British airplanes from inbound German ones. At first, RADAR was only able to signal the presence of any plane.

A system was developed whereby a transponder was placed on Allied aircraft so that by giving the appropriate response to an interrogating signal, a "friendly" aircraft could automatically be distinguished from a "foe".

This is the IFF (**Identify: Friend or Foe**) system upon which present day commercial and private aviation traffic control is still based.



## **TYPES OF RFID TAGS (active | passive)**

Passive RFID tags do not have their own power supply: the minute electrical current induced in the antenna by the incoming radio-frequency scan provides enough power for the tag to send a response. Due to power and cost concerns, the response of a passive RFID tag is necessarily brief: typically just an ID number (GUID). Lack of its own power supply makes the device quite small: commercially available products exist that can be embedded under the skin. In 2004, the smallest available measure  $0.4 \text{ mm}^2$  and cost from US\$0.40. Passive tags have practical read ranges from about 10 mm up to 5 metres.

Active RFID tags have a power source, and may have longer ranges and larger memories than passive tags, as well as the ability to store additional information sent by the transceiver. At present, the smallest active tags are about the size of a coin. Many active tags have practical ranges of 10s of metres, and a battery life of up to several years.

There are four different kinds of tags commonly in use. They are categorized by their radio frequency:

Low frequency tags (**125 -134 kHz, 140-148.5 kHz**)

High frequency tags (**13.56 MHz**)

UHF tags (**868 - 928 MHz**)

Microwave tags (**2.45 GHz**)

# REGULATION

There is no global public body that governs the frequencies used for RFID. In principle, every country can set its own rules for this.

LF and HF RFID tags can be used globally without a license.

UHF RFID tags cannot be used globally as there isn't one single global standard. In North America, UHF can be used unlicensed for 908 - 928 MHz, but restrictions exist for transmission power.

In Europe UHF is under consideration for 865.6 - 867.6 MHz. Its usage is unlicensed for 869.40 - 869.65 MHz only, but restrictions exist for transmission power. The North-American UHF standard (908-928 MHz) is not accepted in France as it interferes with its military bandwidths.

For China and Japan, there is no regulation for the use of UHF. Each application for UHF in these countries needs a site license, which needs to be applied for at the local authorities, and can be revoked. For Australia and New Zealand, 918 - 926 MHz for unlicensed use, but restrictions exist for transmission power.

Additional regulations exist regarding health and environmental issues. For example, in Europe, the WEEE regulation (Waste Electrical and Electronic Equipment) does not allow for RFID tags to be thrown away. This means that RFID tags in cardboard boxes have to be removed before disposal.

## CURRENT USAGE

**Low-frequency RFID tags** are commonly used for animal identification, beer keg tracking, and automobile key-and-lock, anti-theft systems. Pets are often embedded with small chips so that they may be returned to their owners if lost. In the United States, two RFID frequencies are used: 125 kHz (the original standard) and 134.5 kHz, the international standard.



ISO 11784 /11785 : International Standard for RF Identification of Animals based on 134.2 kHz technology  
ICAR (International Committee for Animal Recording) [www.icar.org](http://www.icar.org).

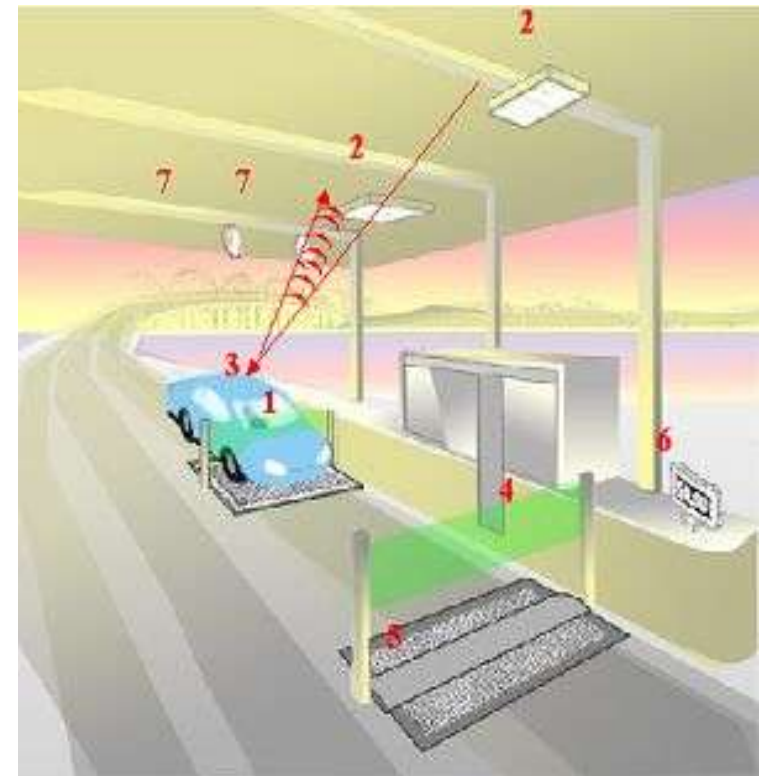
**High-frequency RFID tags** are used in library book or bookstore tracking, pallet tracking, building access control, airline baggage tracking, and apparel item tracking. High-frequency tags are widely used in identification badges, replacing earlier magnetic stripe cards. These badges need only be held within a certain distance of the reader to authenticate the holder.

**UHF RFID tags** are commonly used commercially in pallet and container tracking, and truck and trailer tracking in shipping yards.

**Microwave RFID** tags are used in long range access control for vehicle detection and identification with electronic gate security

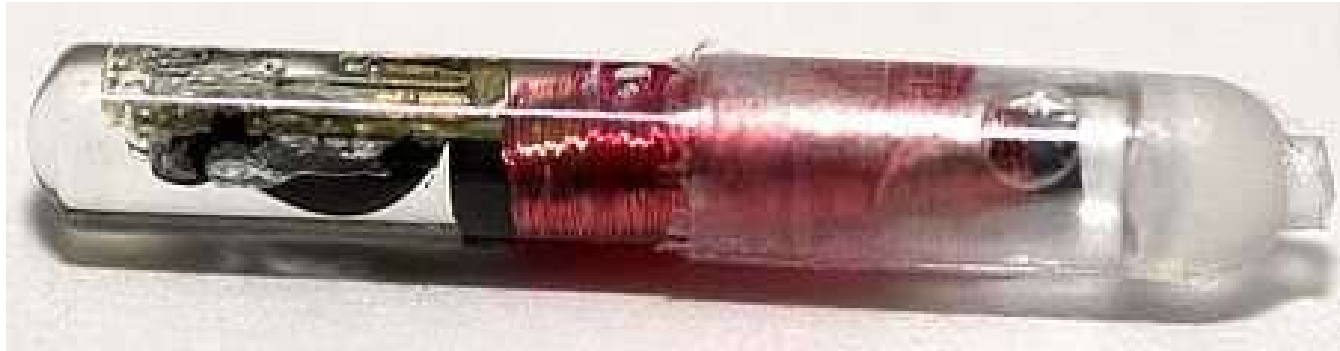


Sensors (1) detect the vehicle as it enters the toll lane. The two-antenna configuration (2) reads a transponder (3) mounted on the vehicle's windshield. As the vehicle passes through the exit light curtain (4), it is electronically classified by the treadle (5) based on the number of axles, and the ETC account is charged the proper amount. Feedback is provided to the driver on an electronic sign (6). If the vehicle does not have a transponder, the system classifies it as a violator and cameras (7) take photos of the vehicle and its license plate for processing. .





# HUMAN IMPLANTS



October 13th 2004

FDA CLEARS VERICHIP™ FOR MEDICAL APPLICATIONS IN THE UNITED STATES

Applied Digital (NASDAQ: ADSX) and Digital Angel Corporation (AMEX:DOC) announce that VeriChip™, the world's first implantable RFID microchip for human use, has been cleared by the U.S. Food and Drug Administration (FDA) for medical uses in the United States.

Applied Digital Solutions proposes their chip's "unique under-the-skin format" as a solution to identity fraud, secure building access, computer access, storage of medical records, anti-kidnapping initiatives and a variety of law-enforcement applications. Combined with sensors to monitor body functions, the Digital Angel device could provide monitoring for patients.

The **Baja Beach Club** in Barcelona, Spain uses an implantable Verichip to identify their VIP customers, who in turn use it to pay for drinks.

The **Mexico City Police Department** has implanted approximately 170 of their police officers with the Verichip, to allow access to police databases and possibly track them in case of kidnapping.

About the size of a grain of rice, each VeriChip contains a unique verification number, which can be used to access a subscriber-supplied database providing personal related information. And unlike conventional forms of identification, VeriChip cannot be lost, stolen, misplaced or counterfeited.

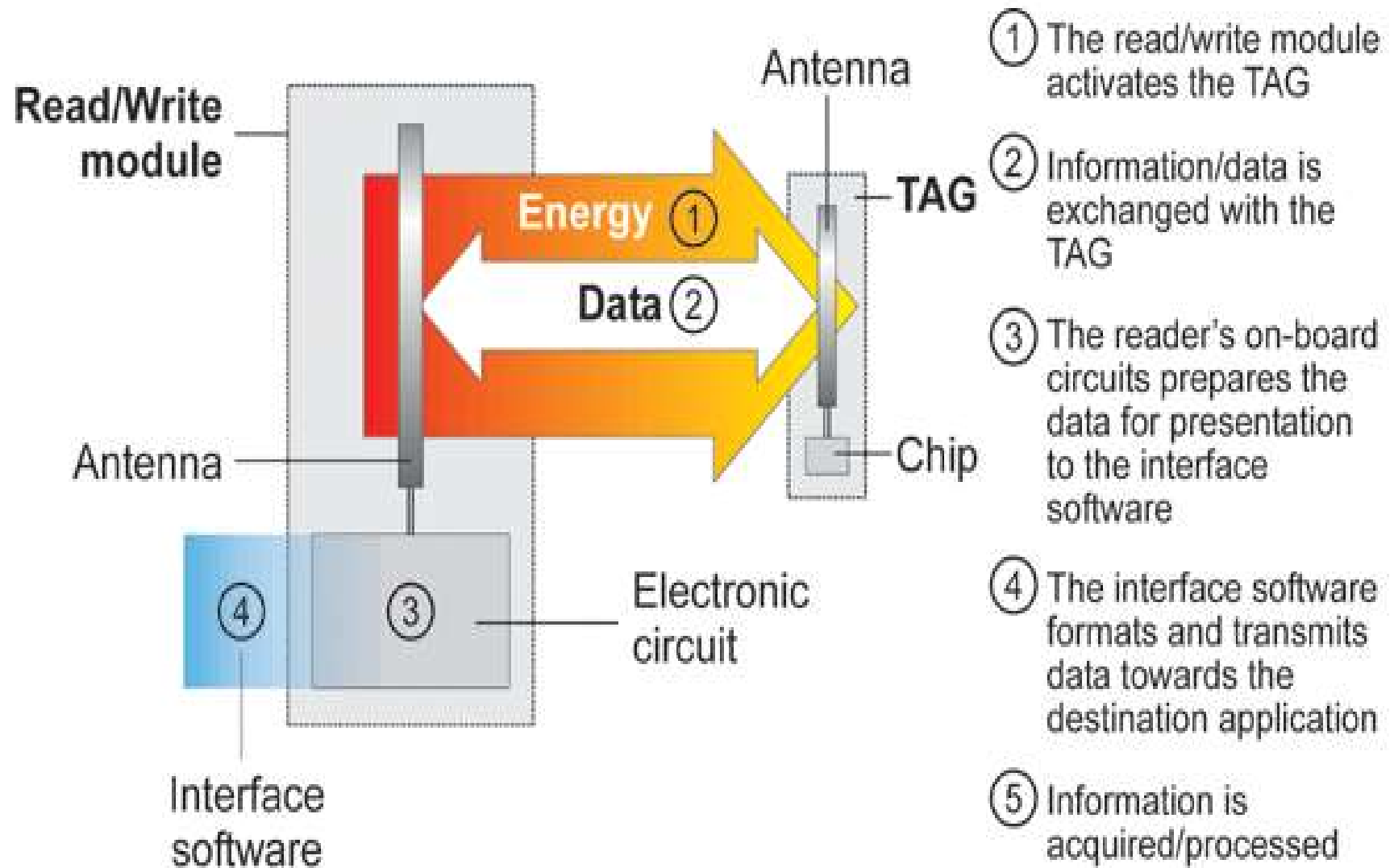


Once implanted just under the skin, via a quick, simple and painless outpatient procedure (much like getting a shot), the VeriChip can be scanned when necessary with a proprietary VeriChip scanner. A small amount of radio frequency energy passes from the scanner energizing the dormant VeriChip, which then emits a radio frequency signal transmitting the individual's unique personal verification (VeriChip ID) number. The VeriChip Subscriber Number then provides instant access to the Global VeriChip Subscriber (GVS) Registry – through secure, password-protected web access to subscriber-supplied information. This data is maintained by state-of-the-art GVS Registry operations centers in Riverside, California and Owings, Maryland.



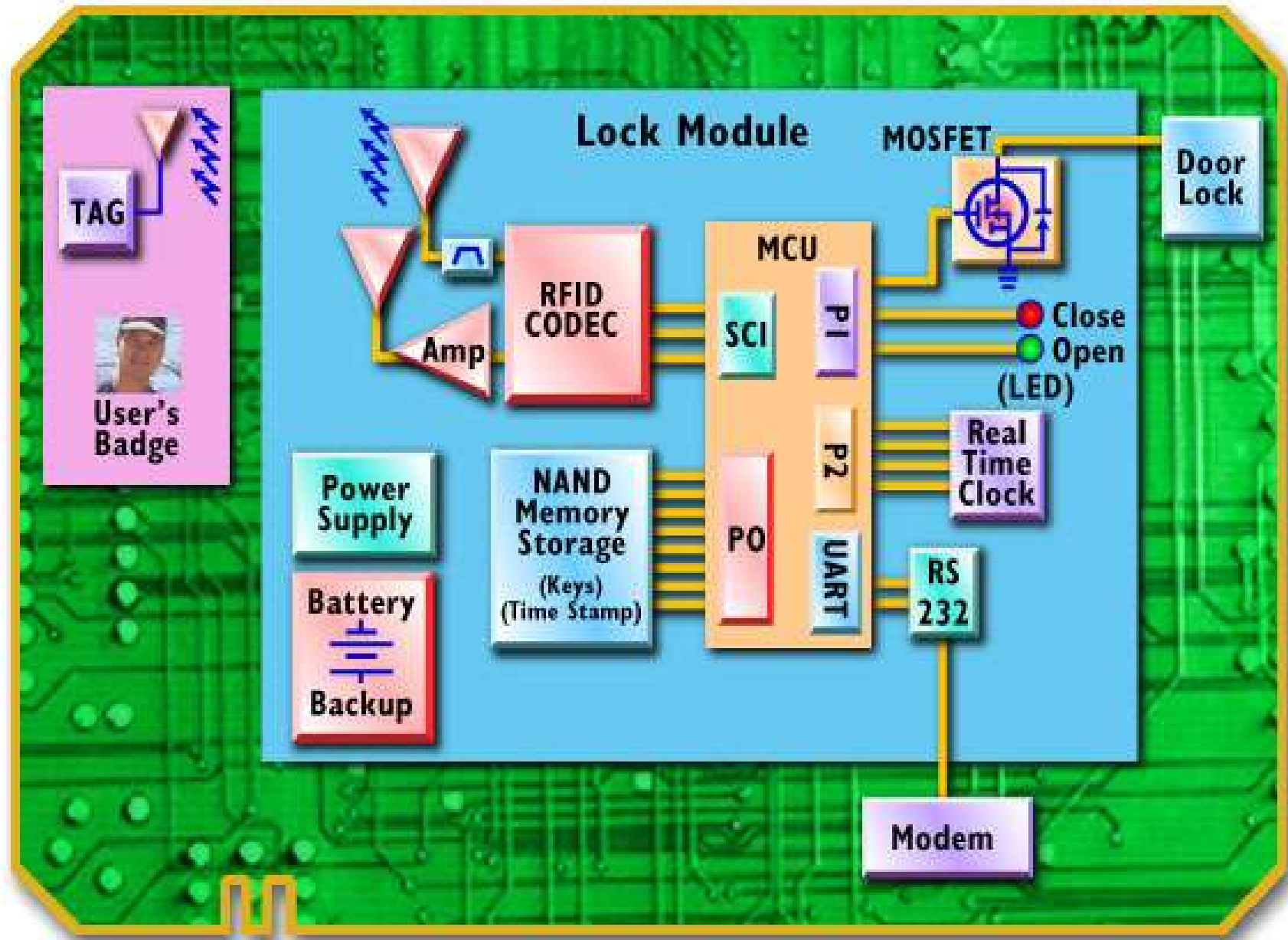
# RFID PRINCIPLE

[www.mbbs.ch/Tech/TechE/TechE.htm](http://www.mbbs.ch/Tech/TechE/TechE.htm)



# RFID SYSTEM BLOCK DIAGRAM

[www.toshiba.com/taec/applications/rfid.shtml](http://www.toshiba.com/taec/applications/rfid.shtml)



# **RFID DATA DILEMMA**

RFID will generate somewhere between 10- and 100-times the data volume of conventional bar code technology. Estimates put RFID data quantities at terabytes a day for large retail and supply chain organizations.

Need intelligent data integration (DI) and business intelligence (BI) to ensure not being overwhelmed by quantities of non-essential data.

Data integration technology has to be customizable to capture, filter, and move just the right data at the right time in the right amounts.

Changed-data capture: Data volumes are reduced by orders of magnitude by only capturing and propagating data changed since the last transfer.

## **Supply Chain Optimization**

To improve logistical efficiency and automated inventory replenishment, RFID data needs to be channelled to downstream and upstream applications and transformed to appropriate formats in order to deliver genuine value.

BI platforms feature built-in alert functionality. With real-time feeds from the DI engine, this capability can trigger alerts if a problem arises. Managers can react immediately if RFID data indicates, for instance, theft of merchandise.

## **Build RFID Systems on a Sound Data Foundation**

# EVALUATION HARDWARE



USB RFID tag reader allows you to remotely identify tagged objects at a distance of about 4 - 6 inches. Dimensions: 2.5" x 3.25"

Since the interface to the PC is via the USB port, the unit auto-installs and identifies itself to Windows (it also powers the receiver so no power supply is needed).

The RFID Reader board connects to a PC via a standard USB cable. It generates a 125 KHz RF field which, when a tag is brought close enough, powers the tag and reads the unique code stored in it. This information is then passed to the PC.

The reader has 4 controllable outputs:

- 1) RF Field: The 125 KHz RF field can be turned on and off
- 2) On-Board LED: The on-board LED can be turned on and off
- 3) Remote LED: A connector is provided to connect a remote LED (20 mA). This can be turned on and off via the USB port
- 4) Switched 5 Volt: A connector is provided to allow connection of a 5 -volt device (such as an electric door latch) which can be controlled via USB

[www.hvwtech.com/pages/products\\_view.asp?ProductID=184](http://www.hvwtech.com/pages/products_view.asp?ProductID=184)

# CONTROVERSY / PARANOIA

RFID technology is subject to controversy. The main concerns relate to privacy, and include:

Whether the purchaser of an item will be aware of the presence of the tag or be able to remove or deactivate it;

Whether the tag can be read at a distance without the knowledge of the individual;

If a tagged item is paid for by credit card or in conjunction with use of a loyalty card, whether it would be possible to tie the unique ID of that item to the identity of the purchaser

The standard proposed by EPCglobal includes privacy-related guidelines [www.epcglobalinc.org/public\\_policy/public\\_policy\\_guidelines.html](http://www.epcglobalinc.org/public_policy/public_policy_guidelines.html) that include the requirement to give consumers clear notice of the presence of tags and to inform them of the choice to discard, disable or remove tags.

Popular paranoia:

People microwave \$20 bills to remove suspected RFID tags

[www.prisonplanet.com/022904rfidtagsexplode.html](http://www.prisonplanet.com/022904rfidtagsexplode.html)



## RFID ENCRYPTION CRACKED (Feb 2005)

Researchers at John Hopkins University and RSA uncovered a vulnerability in Texas Instruments Registration and Identification System,

More than 150 million transponders are embedded in keys for newer vehicles built by at least three leading manufacturers.

More than 6 million key chain tags used for wireless gasoline purchases.



Poor encryption and inadequate protection from wireless hacking, could allow access to automobiles or accounts that rely on the RFID tags.

The researcher team recommended a program of distributing free metallic sheaths to cover radio frequency devices when they are not being used. This could make it more difficult to electronically steal the secret keys when not in use

<http://rfid-analysis.org/>

