Visible Assets, Inc.

High Security Government and Healthcare IEEE P1902.1 (RuBee) Applications

The Elimination of Eavesdropping, Tempest and Target Risk in Wireless Networks.

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IEEE P1902.1 RuBee Licensees

- Seiko/Epson Electronics – Full Chip Set 09
- Sig Sauer Inc. – Weapons Visibility Networks
- US Air Force – Tool Visibility Networks
- Trimble Inc. - Mobile Visibility (Vans, Trucks)
- Visible Assets – Healthcare, Livestock, HV Assets
- CERT, Abu Dhabi (UAE) - Healthcare
- MidTown Technologies - Construction
- 2 Fortune 100's, 1 Fortune 500, many SmallCo's

The Problem

Healthcare:

+ Patient Visibility Reduces Cost by $168/ Patient –
- HIPAA Patient Privacy Requirement

DoE:

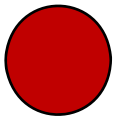
+ Asset Visibility Essential
- Evil Dark Spies With Unlimited Capital in Bushes
- Visibility in facilities with highest security requirement in the world.

DoD:

+ Weapons Visibility Pedigree Essential + Safety
- The Enemy Looking for RF Targets

The Problem

Base Station



0.5 Watts

Transceiver

Active

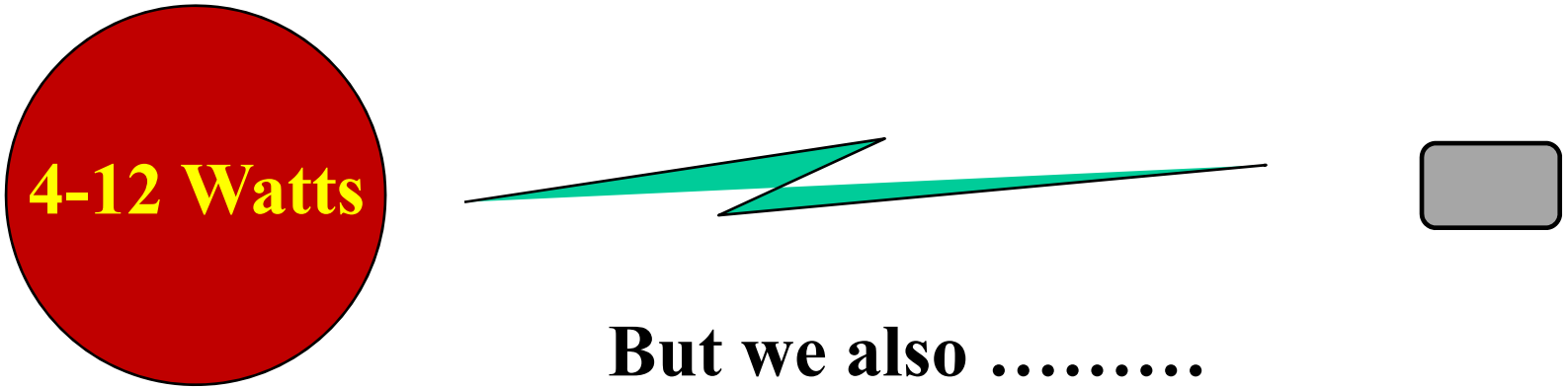
Passive

Transponder

The Wireless System is Not Working as Well as We Would Like

The Problem

So Let's Increase The Base Station Power
And Get Longer Range, More Reliable Performance

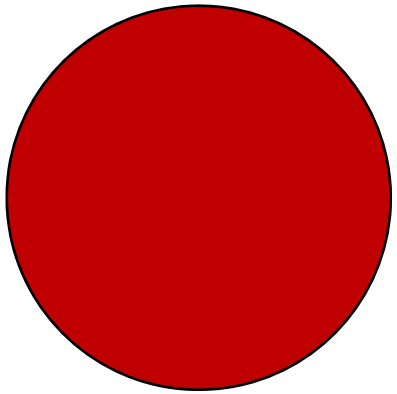


But we also ……

- ✓ **Create New Human Safety Issues**
- ✓ **Create New Security Issues**

The Problem

Our Focus Today is on Four Key Security Issues

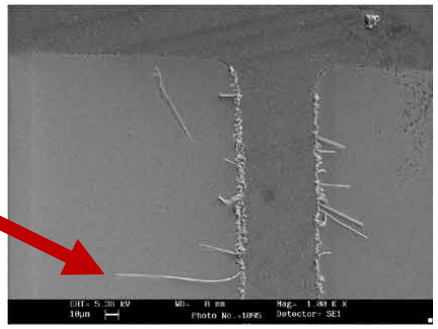


1. Clone-ability
2. Eavesdropping
   (Tempest)
   (Target)
3. Authentication
4. Packet Security

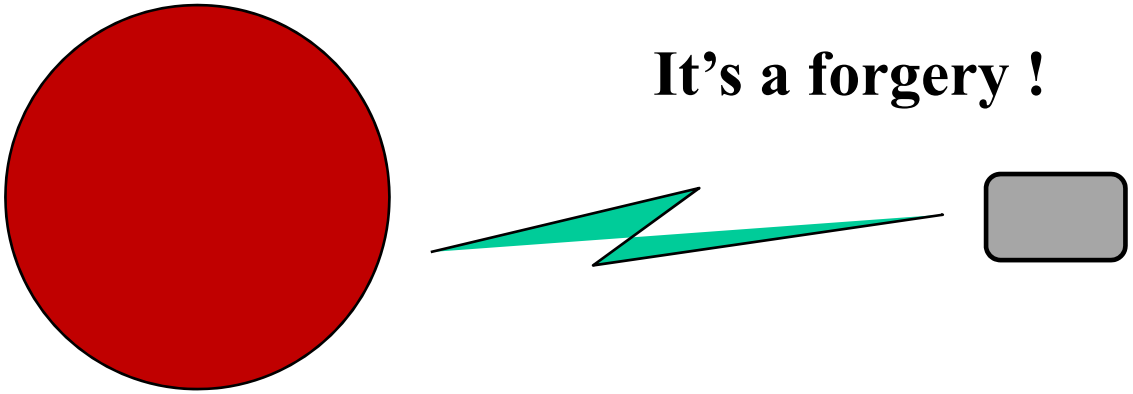
The SecurityProblem

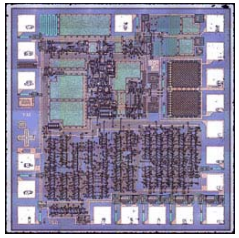
Clone-ability

Detectable “1” trace



It’s a forgery !



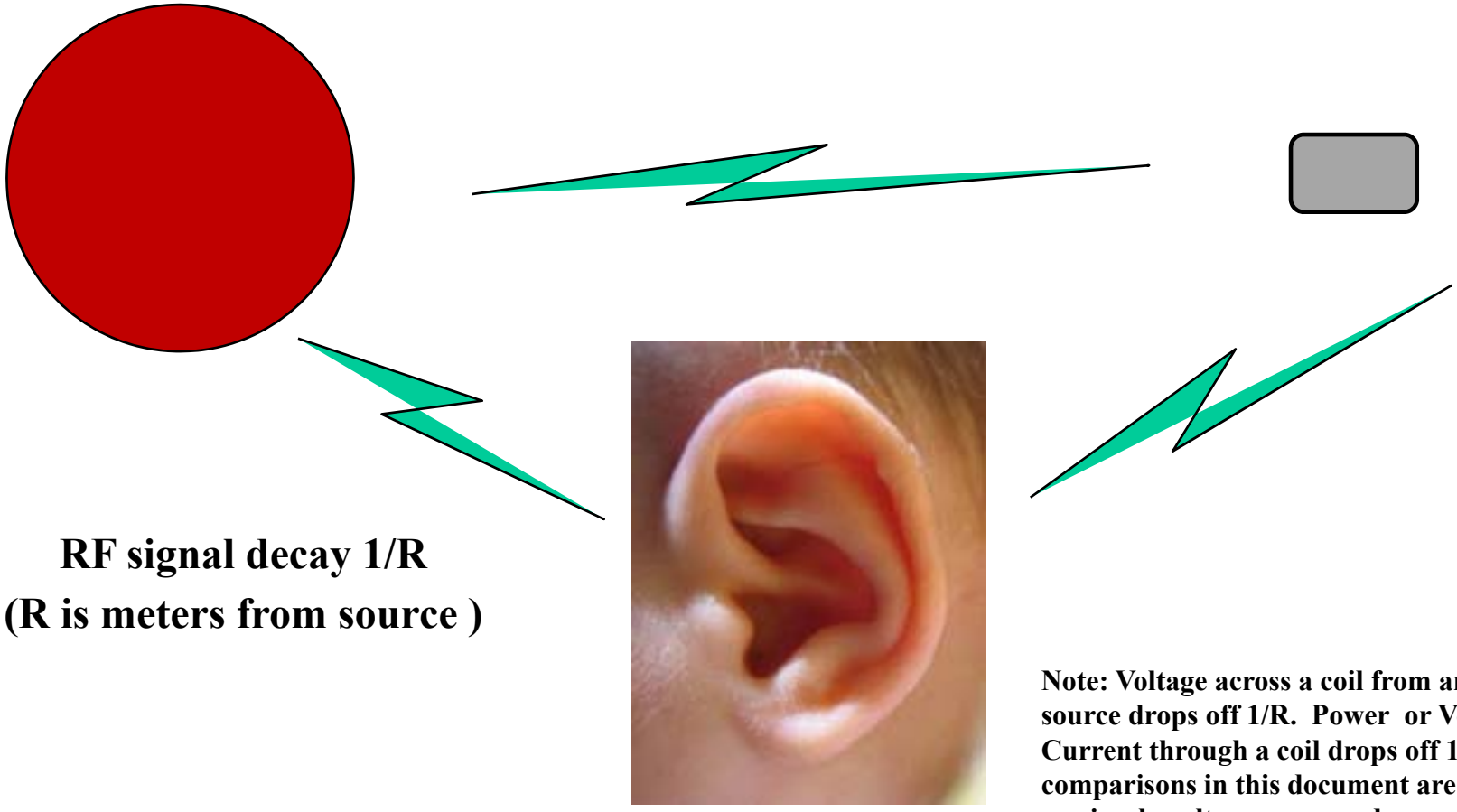


All forms of solid state memory leave, detectable traces for a 0 and a 1. These traces may be reverse engineered at low cost even months after removal of power. With access to modest cost equipment, this makes it easy for any attacker to clone or spoof any tag. Any RFID tag maybe reversed engineered for $5,000 to maximum of $50,000 from multiple sources in the US, Canada, EU, and Asia.

The Security Problem

Tempest, Eavesdropping Target

Because RF voltage decays at a rate of 1/R (R is distance in meters) from the source, most RF signals may be, monitored (listened to) many miles away. Eavesdropping is the major security risk in any RF wireless network. The eavesdropper may require expensive specialized equipment, but as shown in next slides this not always true.



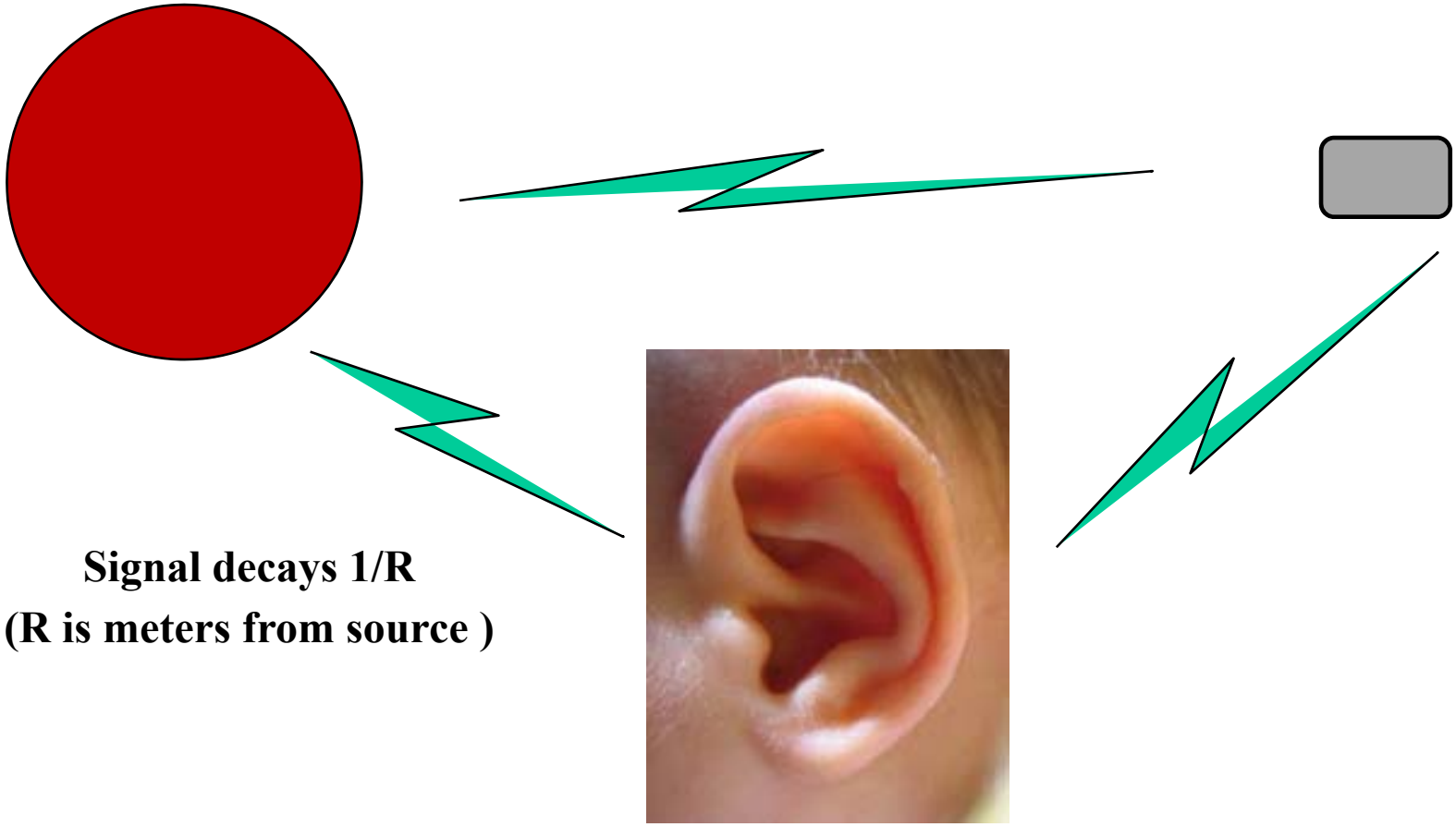
RF signal decay 1/R
(R is meters from source)

Note: Voltage across a coil from an RF source drops off 1/R. Power or Voltage x Current through a coil drops off $1/R^2$. All comparisons in this document are based on simple voltage measured across a coil.

The Security Problem

Tempest, Eavesdropping Target

Again, because RF decays 1/R it may also can be used transmit unauthorized information a distance from a site. For example, an attacker could secretly design a microphone into a RFID base-station, and transmit everything said in the room without the knowledge of the owner. It would look like RFID data but actually represents major security risk. This is known as a The Tempest threat

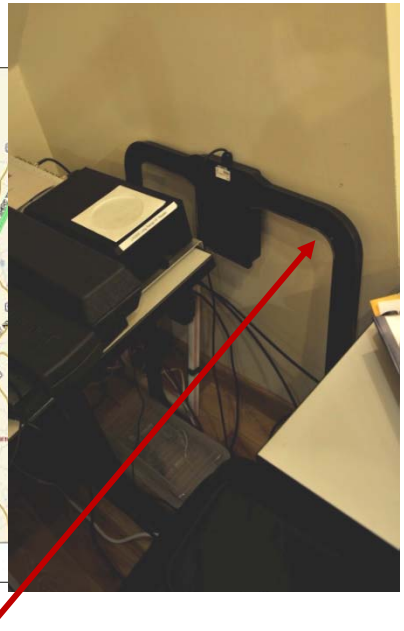


Signal decays 1/R

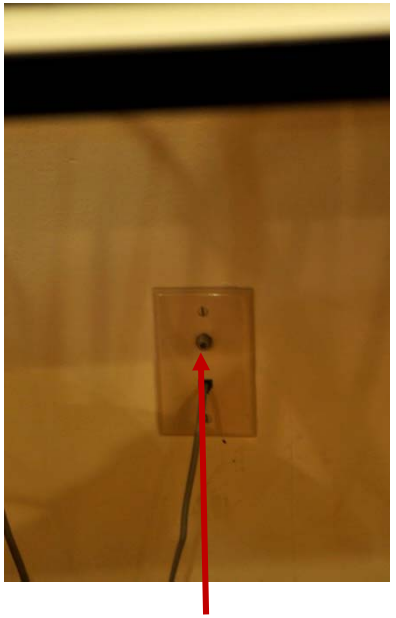
(R is meters from source)

The Security Problem

Eavesdropping Tempest Case Study – 20 mile radius 13.56 Mhz



13.56 System

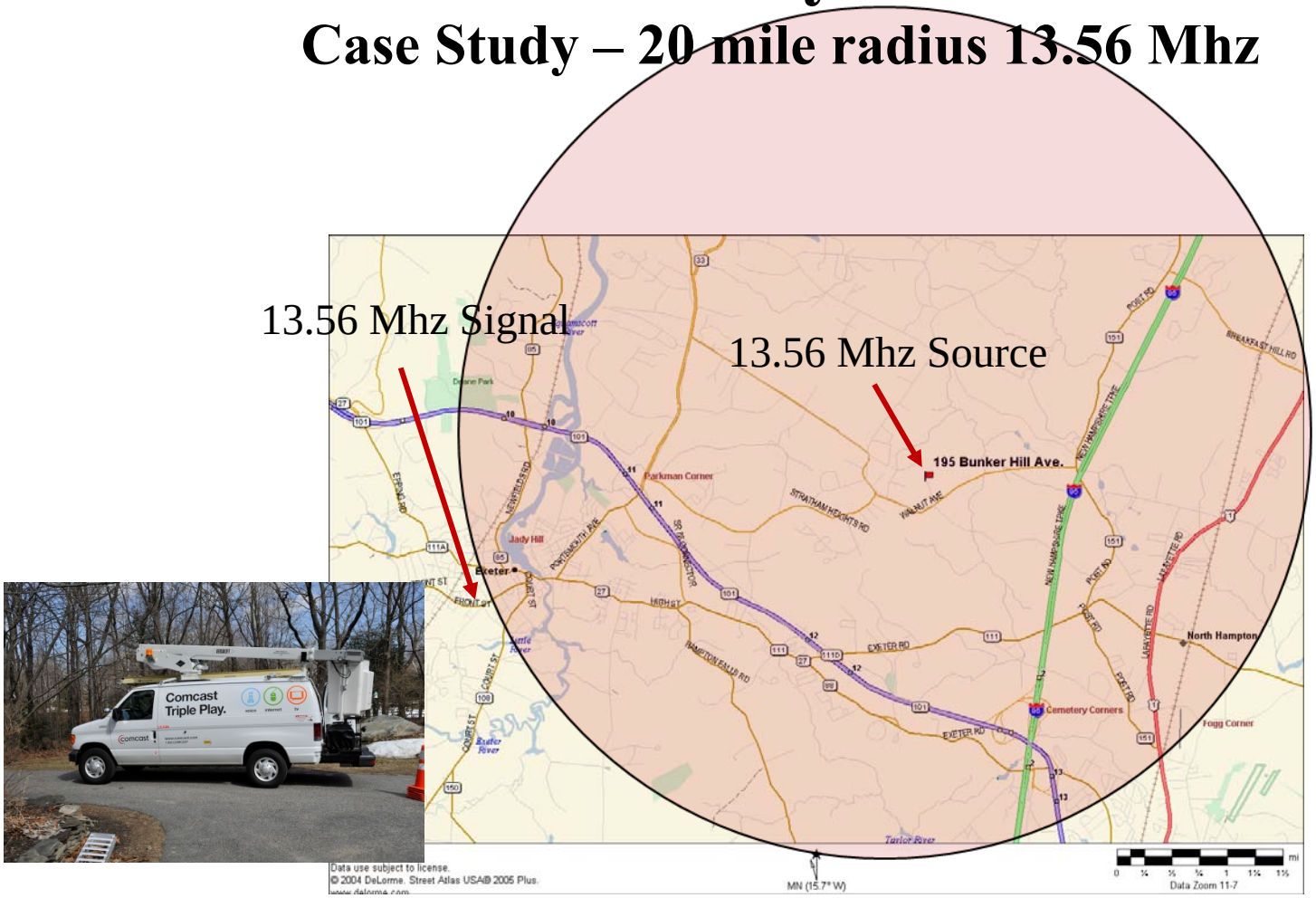


Poorly installed cable connector 21’ feet away

Case Study: A conventional 13.56 MHz RFID system was accidently left “Power On” for two months (2 months). A poorly installed cable connector twenty one feet away picked up the signal and injected into the entire Comcast cable network.

The Security Problem

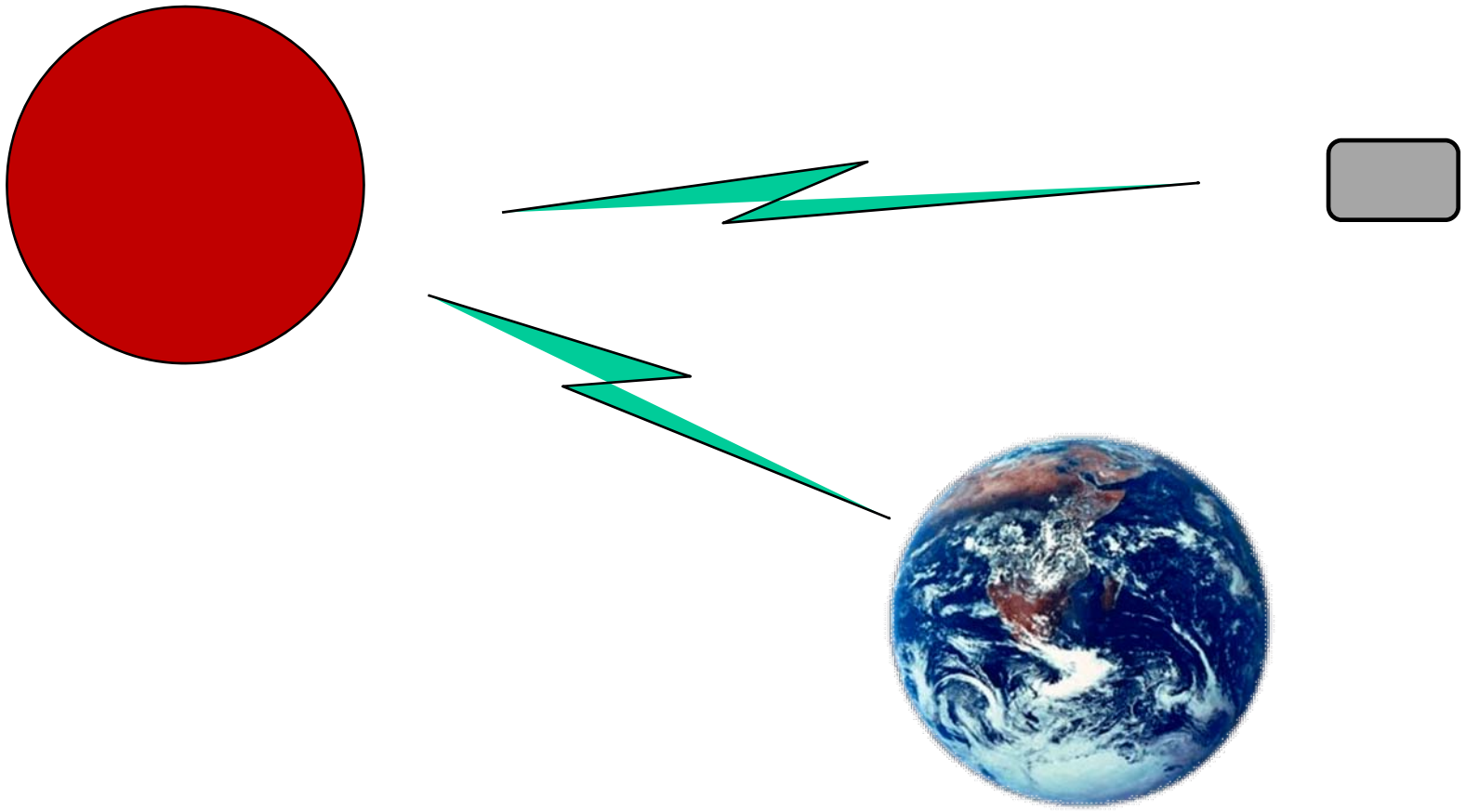
Case Study – 20 mile radius 13.56 Mhz



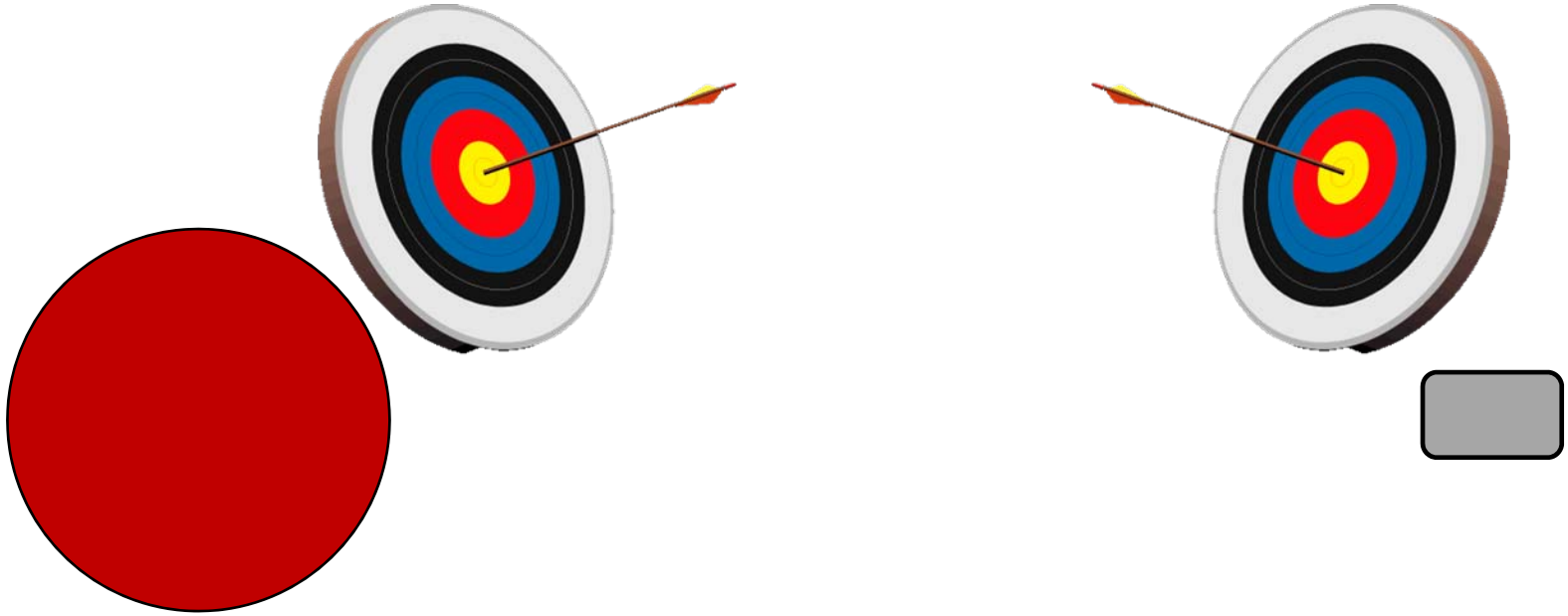
The injected 13.56 Mhz signal was detectable in the cable network for a 20 mile radius, disrupted pay-per-view and lowered internet bandwidth for two months. It took Comcast two months to track down the source. It is easy to eavesdrop and the tempest threat is real.

“Compromising Emanations” Detection From Space

An attacker with a budget (any government) , may monitor RF signals using line of sight satellites in outer space. Cell phone traffic (under 1 watt power), is routinely monitored around the world from strategically placed satellites. These are known in the government as “compromising emanations”.



“Compromising Emanations”
Source becomes Target



The key outcome: an attacker can use the RF source as a target. This is known as the RF Target risk.

The Security Problem

Packet Security is and Always will be Weak.

2007: TJX or TJMax/ Marshalls 200 million identities

2007: RSA Conference 32 Evil Twin Attacks

2005: FBI cracked WEP 128 encryption under 3 minutes

Free On-Line Programs: aircracker-rig, weplab, WEPCrack, airsnort, cracks WEP, WPA and WPA2.

RuBee
Technology Summary

Maxwell's Equations

$$\nabla \cdot \vec{E} = \frac{\rho}{\varepsilon_0}$$ (Gauss' Law - electrostatics)

$$\nabla \cdot \vec{B} = 0$$ (Gauss' Law - magnetostatics)

$$\nabla \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$$ (Faraday's Law)

$$\nabla \times \vec{B} = \mu_0 \vec{J} + \mu_0 \varepsilon_0 \frac{\partial \vec{E}}{\partial t}$$ (Ampère-Maxwell Law)

RuBee

Is a Transceiver Mode Active Radiating Protocol

131 KHz Battery + Crystal + $\nabla \cdot \vec{B}$

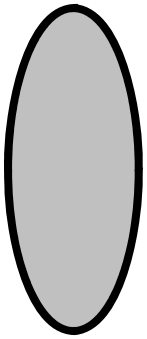
Base Station

Tag

RuBee is Magnetic (Inductive)
Water Immune
Steel Friendly
Human Safe

RuBee

Low frequency means low power consumption. 20 year life has been achieved in the field Li coin size batteries



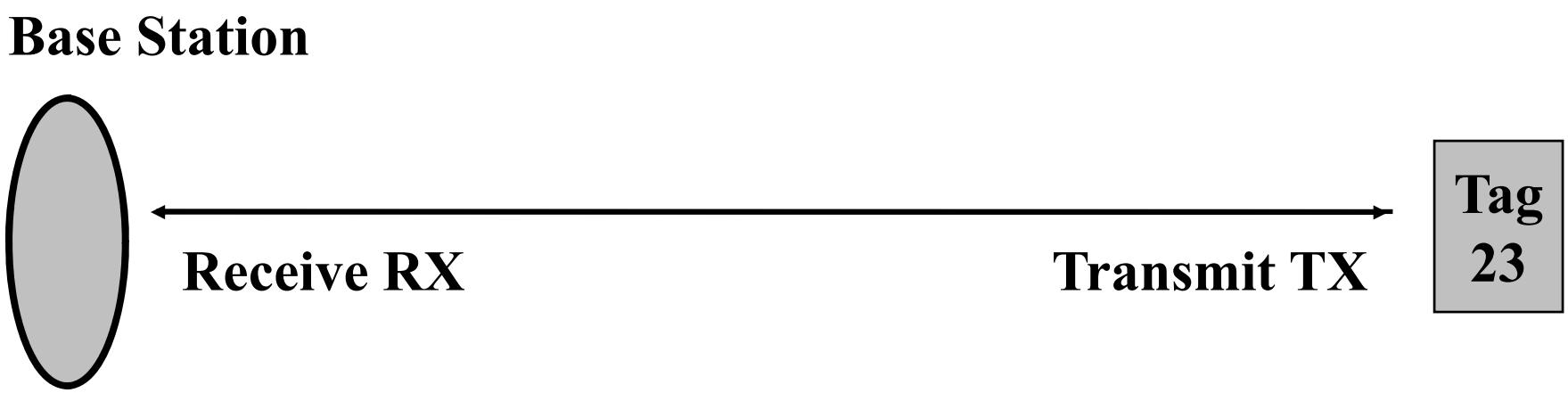
Assumes 280 mA-hr Li Battery

Freq.	Power (uA/hr)	Predicted Life	Units
128kHz	1	31.00	Years
13.56 MHz	102	3.78	Months
915 MHz	7,031	1.66	Days

Tag 23

RuBee
Long Open Tag Range

25-35 Feet Volumetric Air Tag Range



Because RuBee is in Transceiver Mode

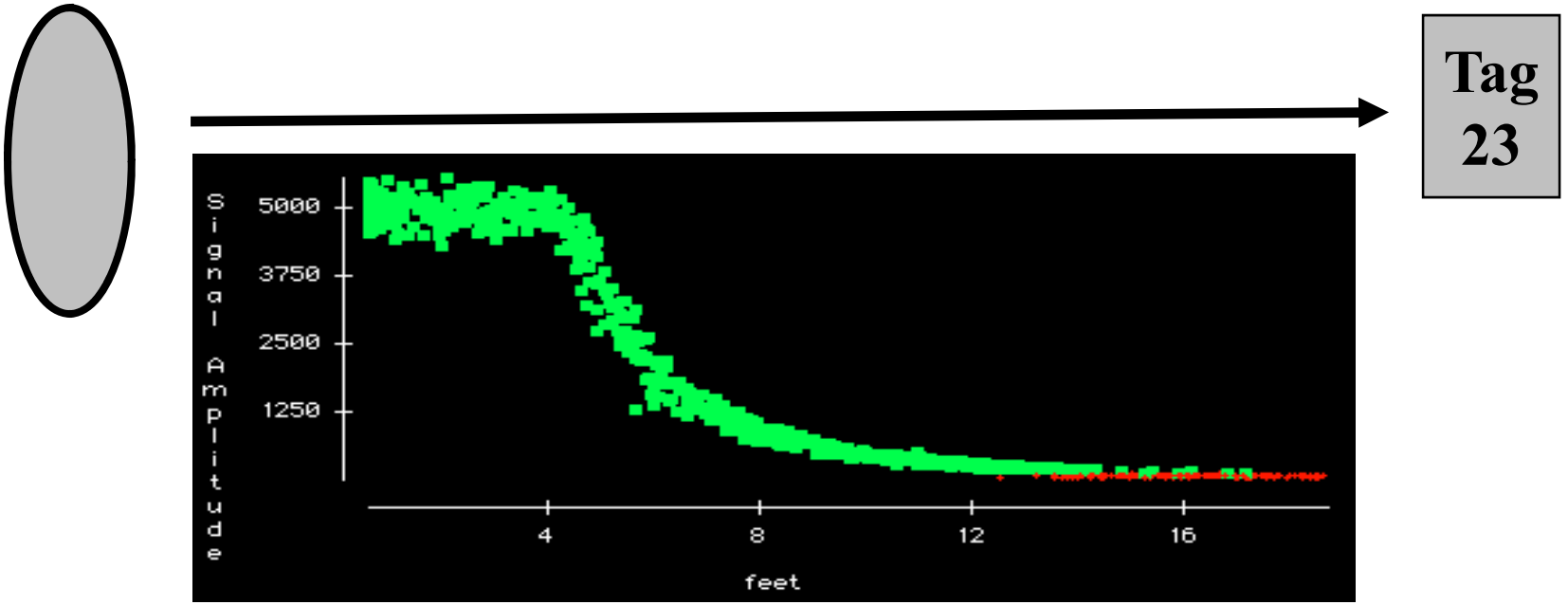
RuBee

Long Range and Undetectable E Power

RuBee Wireless Does not Transmit using RF, “it has no detectable RF power”

Base Station

10^{-9} Watts of E Power
40 Nanowatts



17 Feet (34 volume feet)

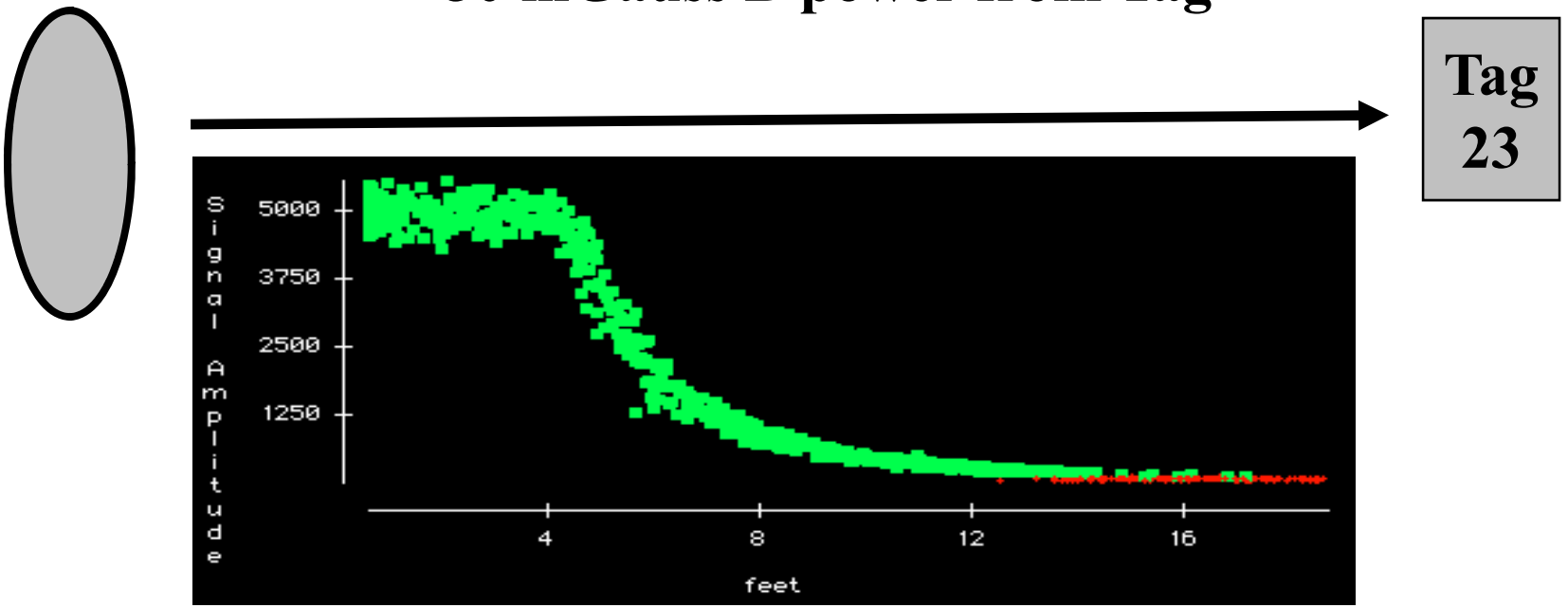
RuBee

RuBee is Low Power B (magnetic energy)

RuBee wireless uses 1/5 to 1/30th the magnetic power found in many consumer exposed sites. Examples: airport metal detectors, and anti-theft protection systems in retail stores are all 5-10 times the power found in RuBee.

Base Station

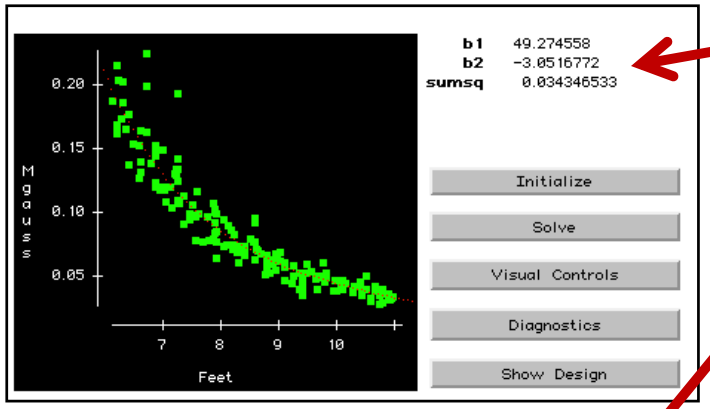
600 mGauss B power from Base
50 mGauss B power from Tag



17 Feet (34 volume feet)

RuBee

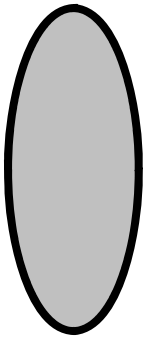
Range and Low Power H 600 mGauss



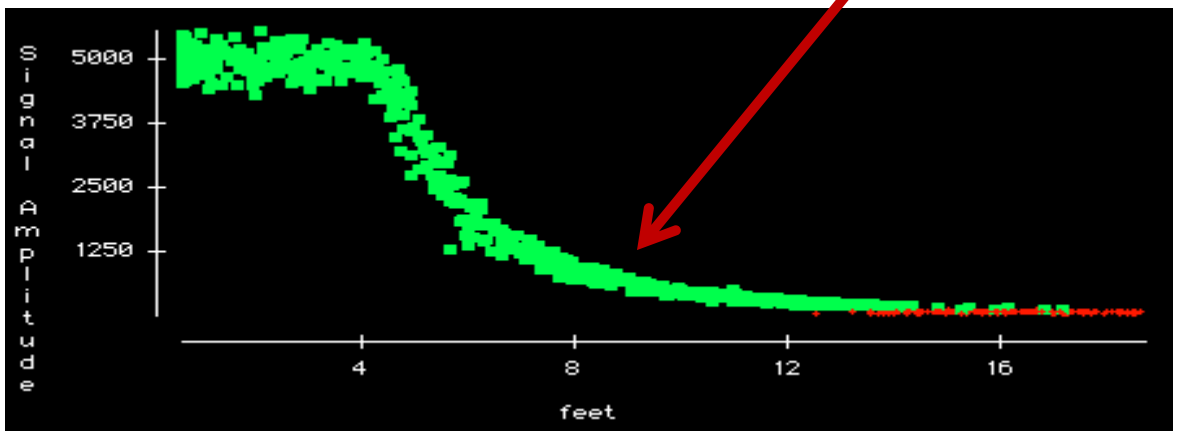
3.0516772 best fit exp

Signal $1/R^3$

Base Station



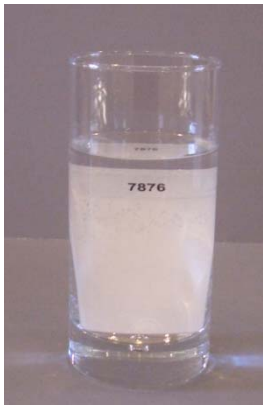
Tag 23



RuBee signals (voltage across a coil) drop off at $1/R^3$ not 1/R with 17' range.
RuBee power actually drops off much faster at $1/R^6$.

RuBee

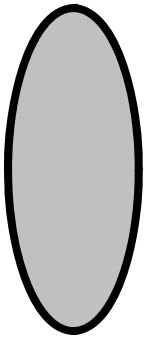
Range and Power



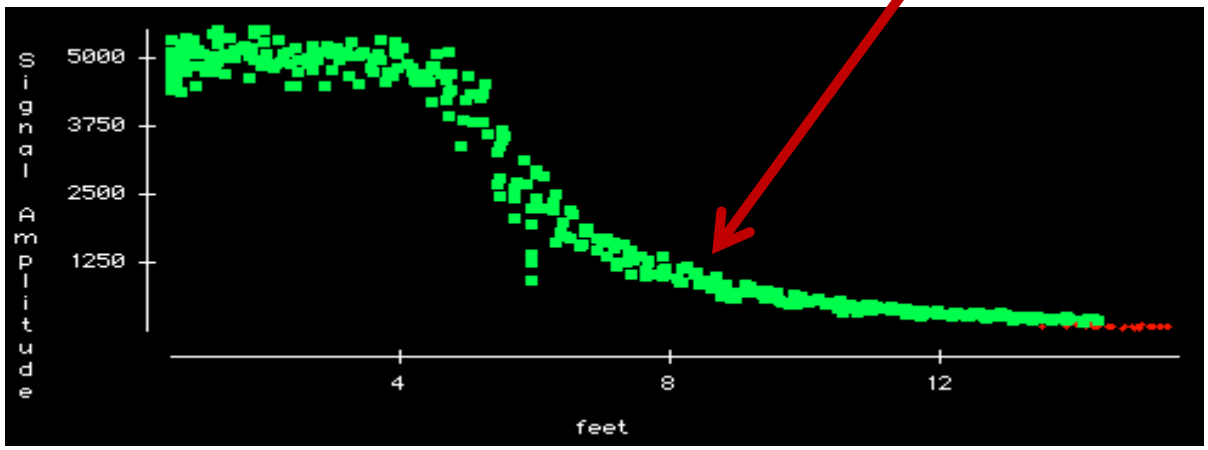
Water has little or no affect

Signal $1/R^3$

Base Station



Tag 23



16.5 Feet (33 volume feet)

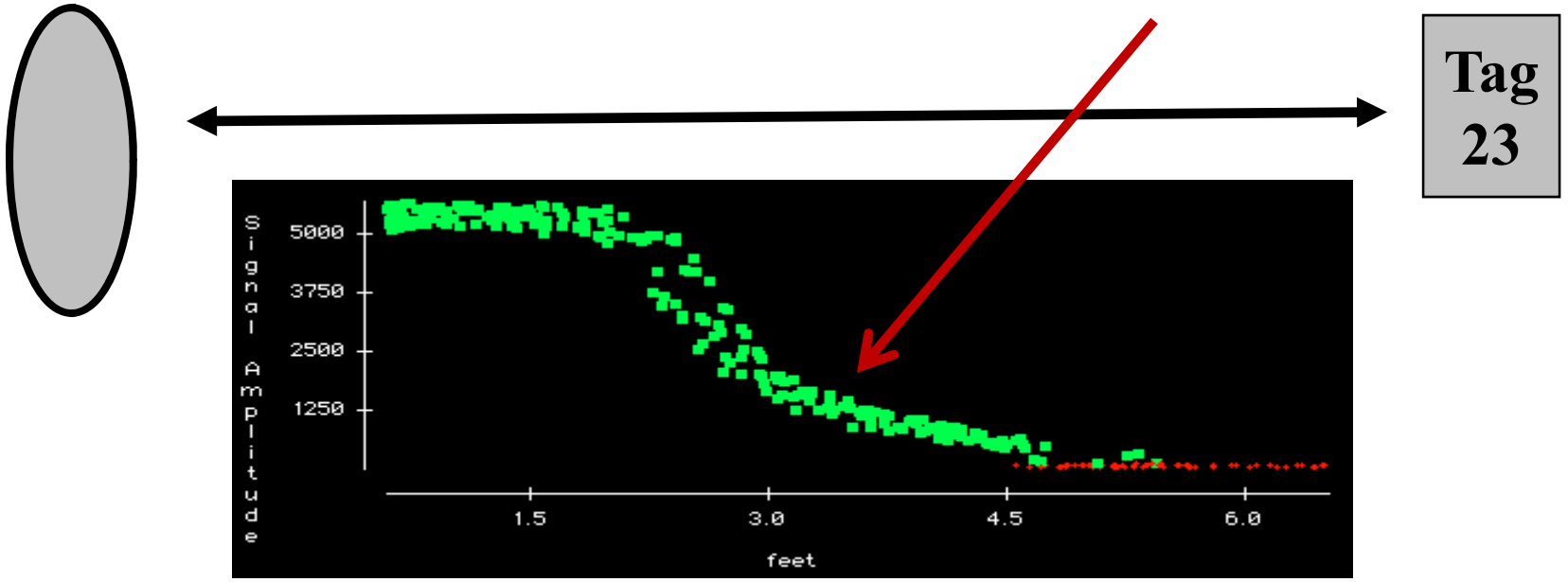
RuBee

Range and Power

Still works in steel reduced range

Base Station

Signal $1/R^3$



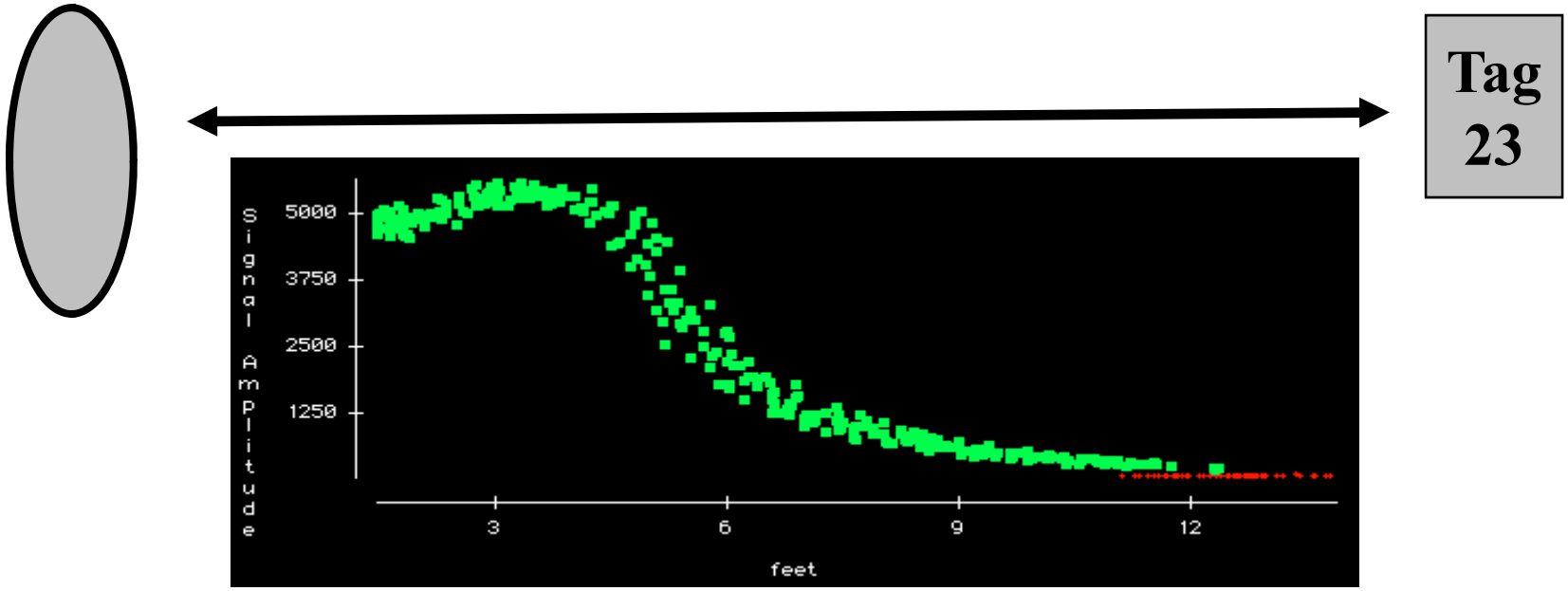
5 Feet (10 volume feet)

RuBee

Range and Power

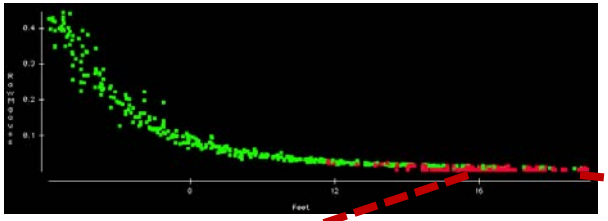
Still works on steel
Range enhanced if tuned

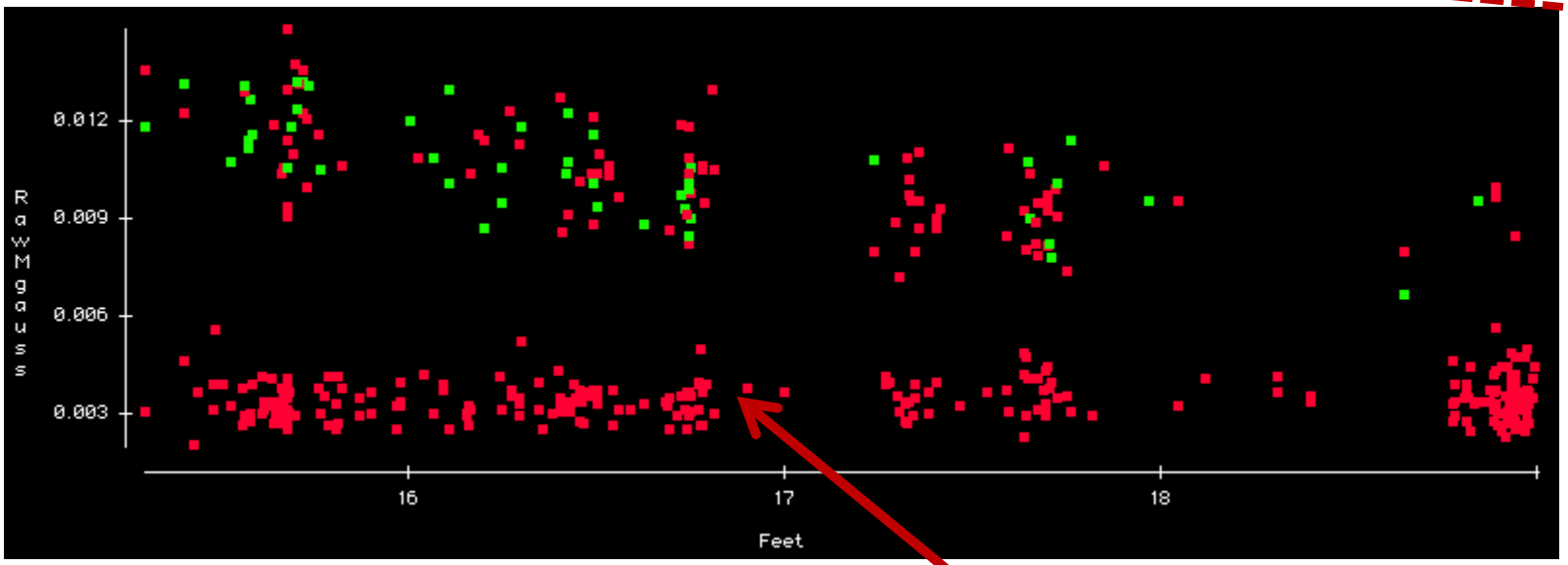
Base Station



12.5 Feet (25 volume feet)

RuBee
Tag Range Limited by Constant Deep Space Noise

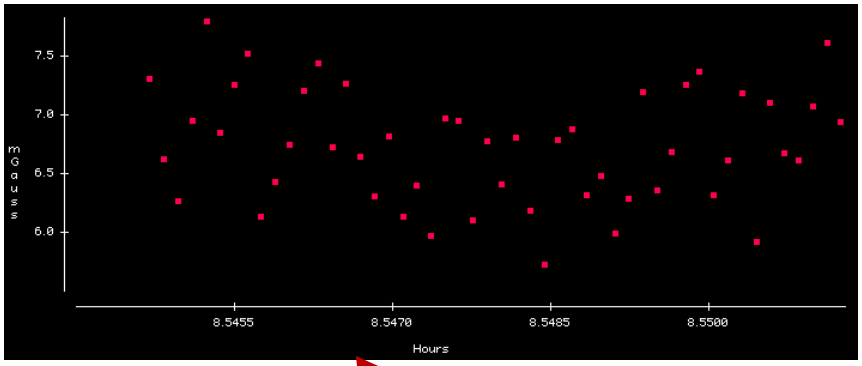




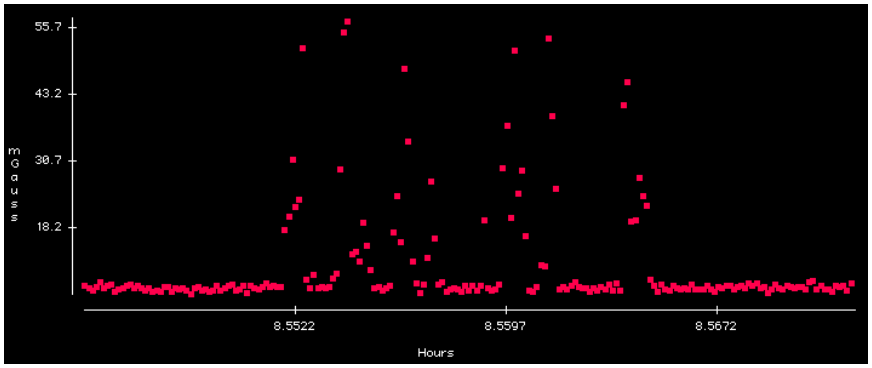
0.06 to 0.006 mGauss
Deep space background noise

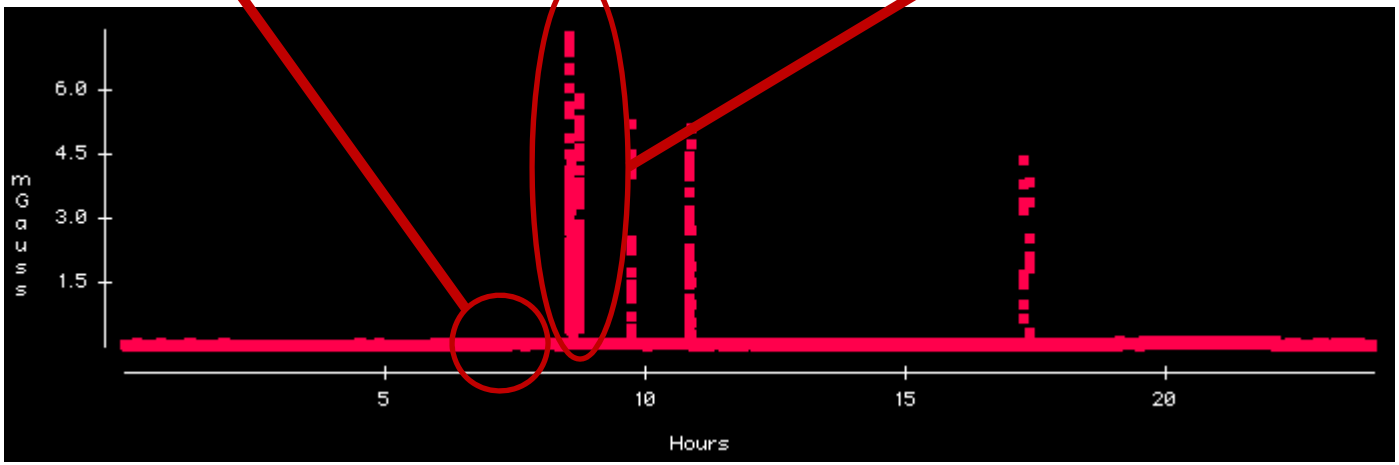
24 hours/day, 7 days/week Deep Space Noise

Deep Space



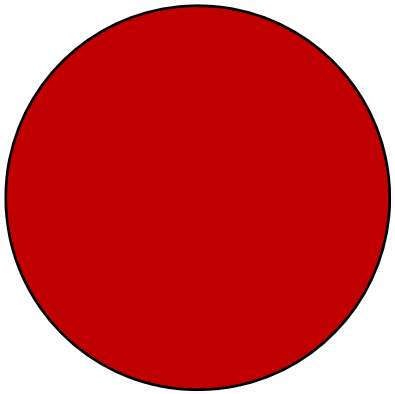
Local Transient Spikes (Lightening)





The Security Problem

How has RuBee Addressed Each Item ?

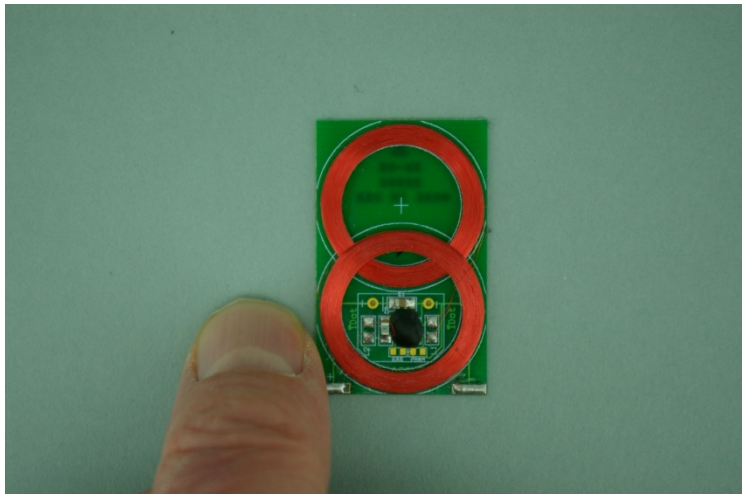


1. Clone-ability
2. Eavesdropping
   (Tempest)
   (Target)
3. Authentication
4. Packet Security

RuBee Tags
Form Factors

Rubee t-Tags
2mm - 0.78mm thick

iDots™



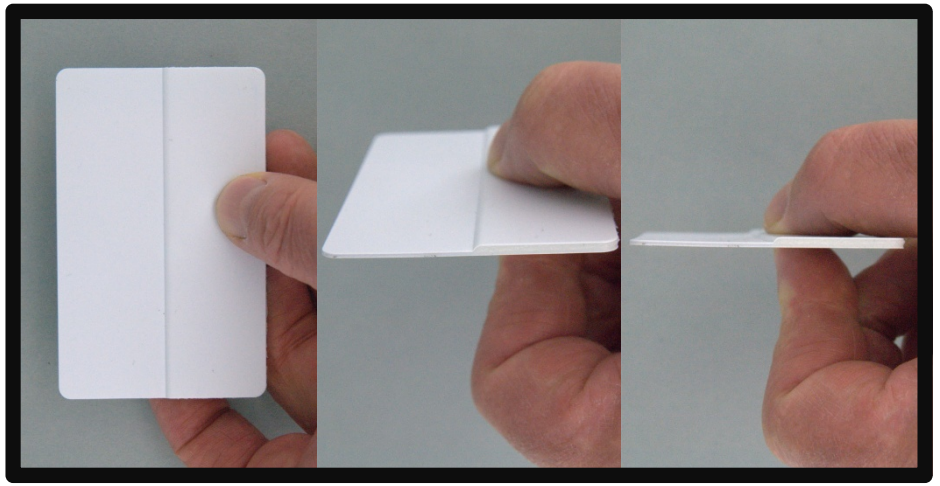
RuBee Tags
Form Factors

Small t-Tags
Cell Phones

Large t-Tags
For Heavy Steel

The RuBee Tags
Form Factors

ID Tag – 3.2” x 2.4”
x 2mm thick.



2T Wallet Tag – 3.2” x 2.4” x 1mm thick on edge and 2mm on top. 2T cards work in your wallet.

RuBee Security

The Data is in The Tag

MCU 4 – 32 Bit

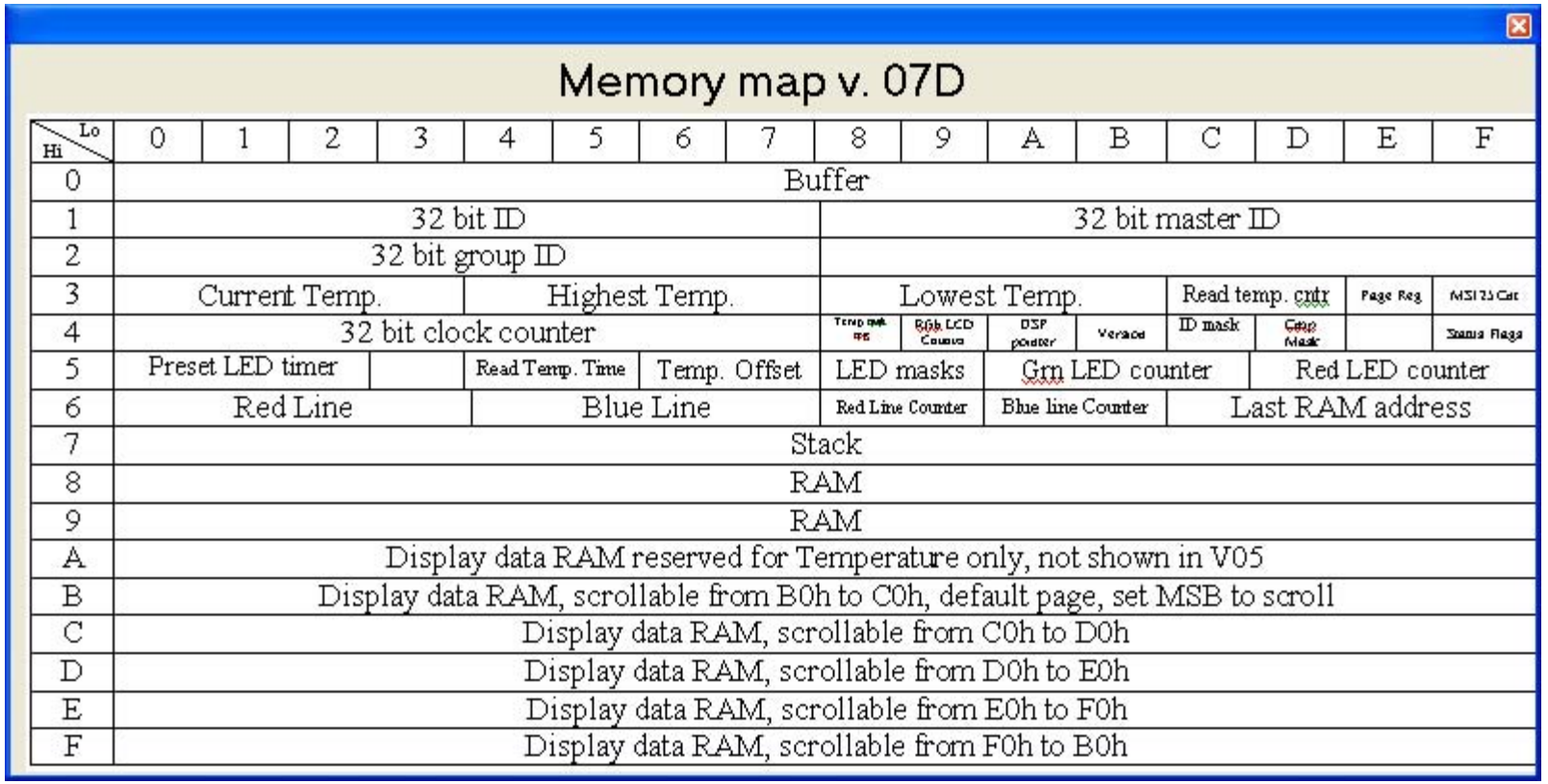
500 Byte – 7KBytes

10K-25K bytes EE

Tag IP	11.11.11.00
Tag Subnet	11.11.11.1
MAC:	77-AC-D8-9A-99-AC
Object Name	Hip 23678
Size	23mm x 18mm
Birthdate	11/23/2004
Expirydate	11/2007
Serial Number	6778895
Lot Number	7878789905
Manf. Site	Ireland
Manufacture	Medco
CRC	34567

RuBee Security

Data is Stored in SRAM Memory



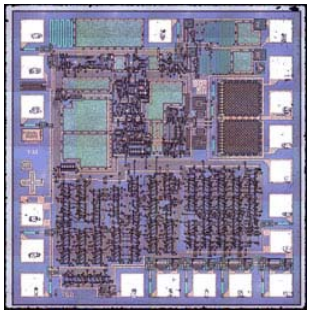
Memory map v. 07D

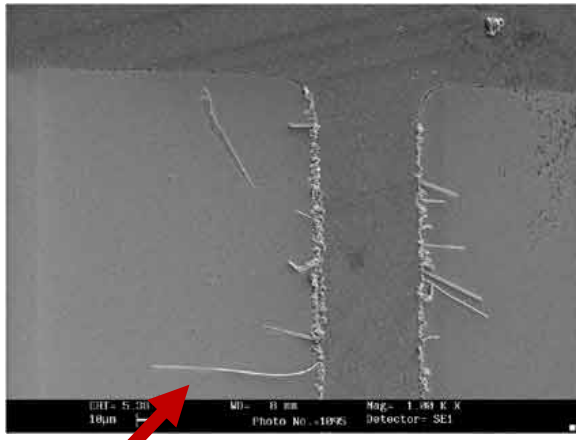
Hi \ Lo	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	Buffer															
1	32 bit ID								32 bit master ID							
2	32 bit group ID															
3	Current Temp.				Highest Temp.				Lowest Temp.				Read temp. cntr		Page Reg	MSI 2s Cat
4	32 bit clock counter								Temp mark RE	R/Gb LCD Counter	DSP pointer	Versace	ID mask	Comp Mask		Status Flags
5	Preset LED timer			Read Temp. Time		Temp. Offset			LED masks		Grn LED counter			Red LED counter		
6	Red Line				Blue Line				Red Line Counter		Blue line Counter		Last RAM address			
7	Stack															
8	RAM															
9	RAM															
A	Display data RAM reserved for Temperature only, not shown in V05															
B	Display data RAM, scrollable from B0h to C0h, default page, set MSB to scroll															
C	Display data RAM, scrollable from C0h to D0h															
D	Display data RAM, scrollable from D0h to E0h															
E	Display data RAM, scrollable from E0h to F0h															
F	Display data RAM, scrollable from F0h to B0h															

Several key items are stored in memory.
The tags IP address, master ID, subnet (group) asset data.

RuBee Security

Safe SRAM Data Storage



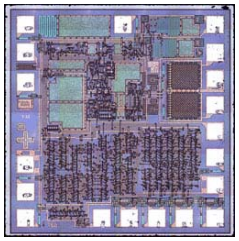


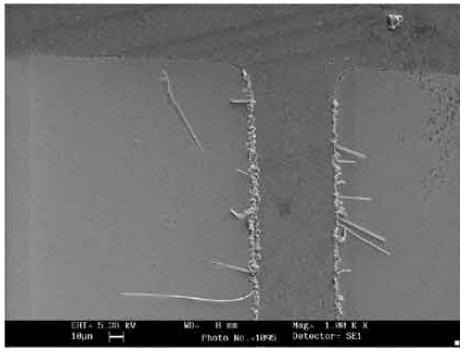
Bit swapping removes

RuBee uses static memory (SRAM) and can therefore also use optional advance bit swap keys/data algorithms, to rewrite a secure word once every 10 minutes. This guarantees no one can reverse engineer a RuBee tag or clone a Rubee tags' pedigree. Bit swapping is near impossible with EEPROM, due to long write times, high power considerations, and limited read/write life.

RuBee Security

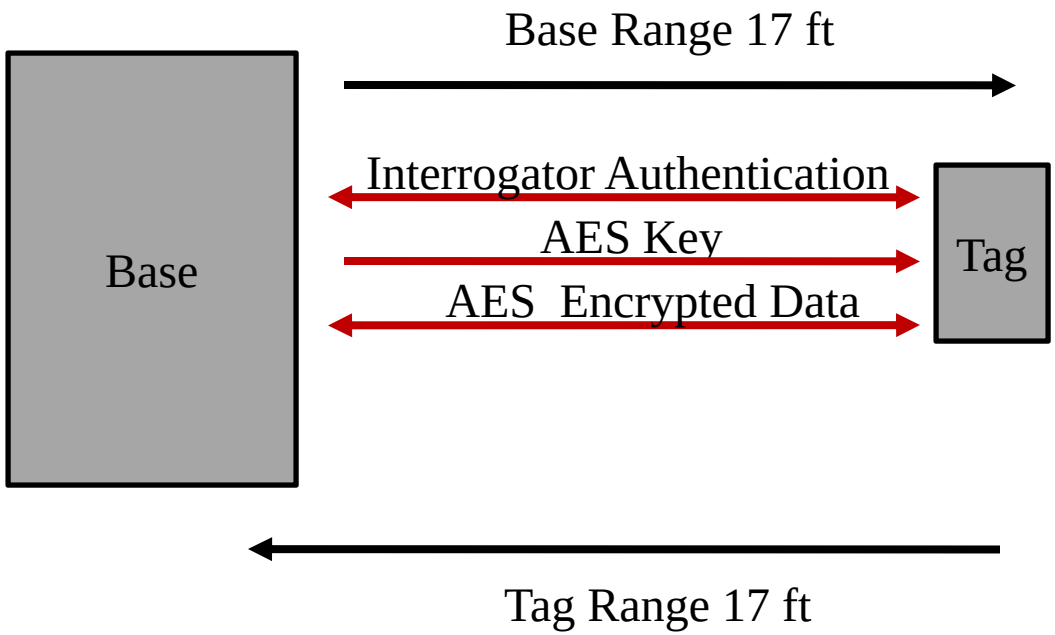
Safe SRAM Data Storage



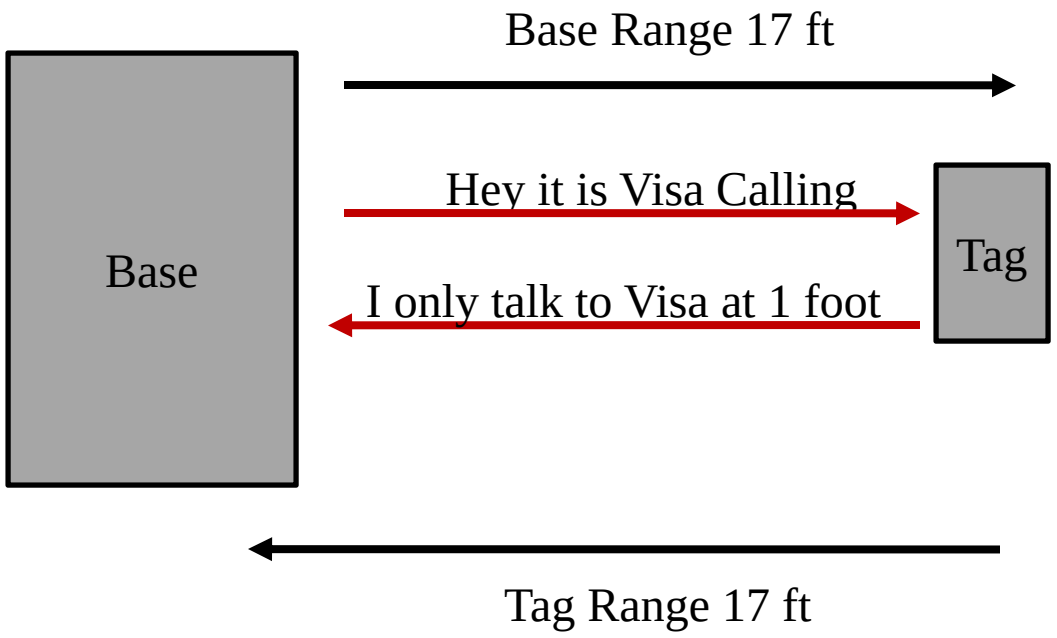


"A RuBee Tag's hardware can be reversed engineered (same as any electronic device), but critical tag content remains secure, minimizing clone-ability risk"

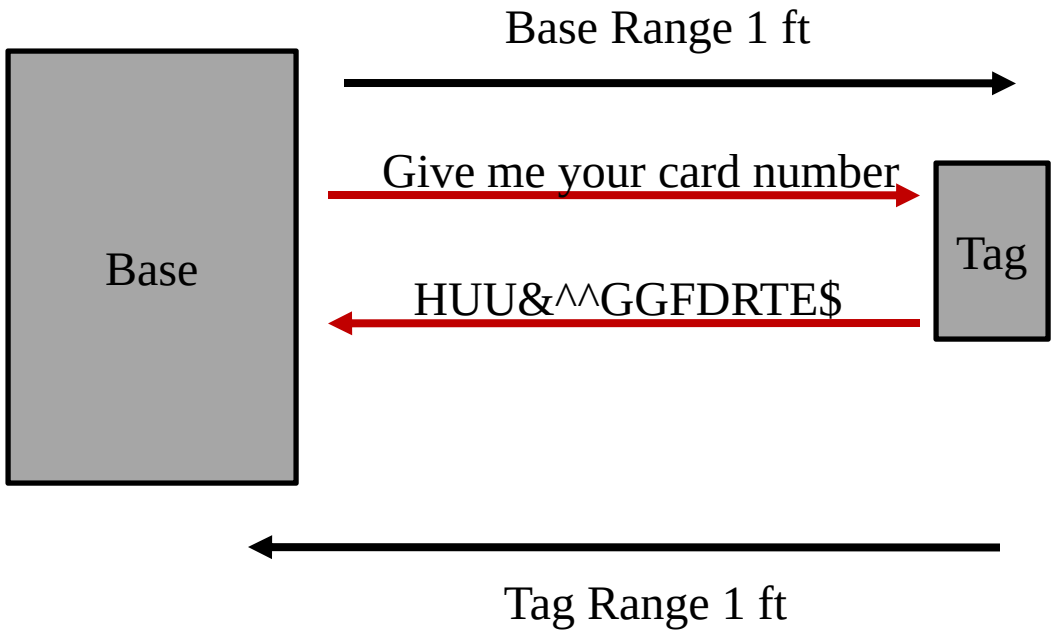
RuBee Tags can use Real-Time AES Encryption Similar to TLS protocol. We have strong packet layer authentication security.



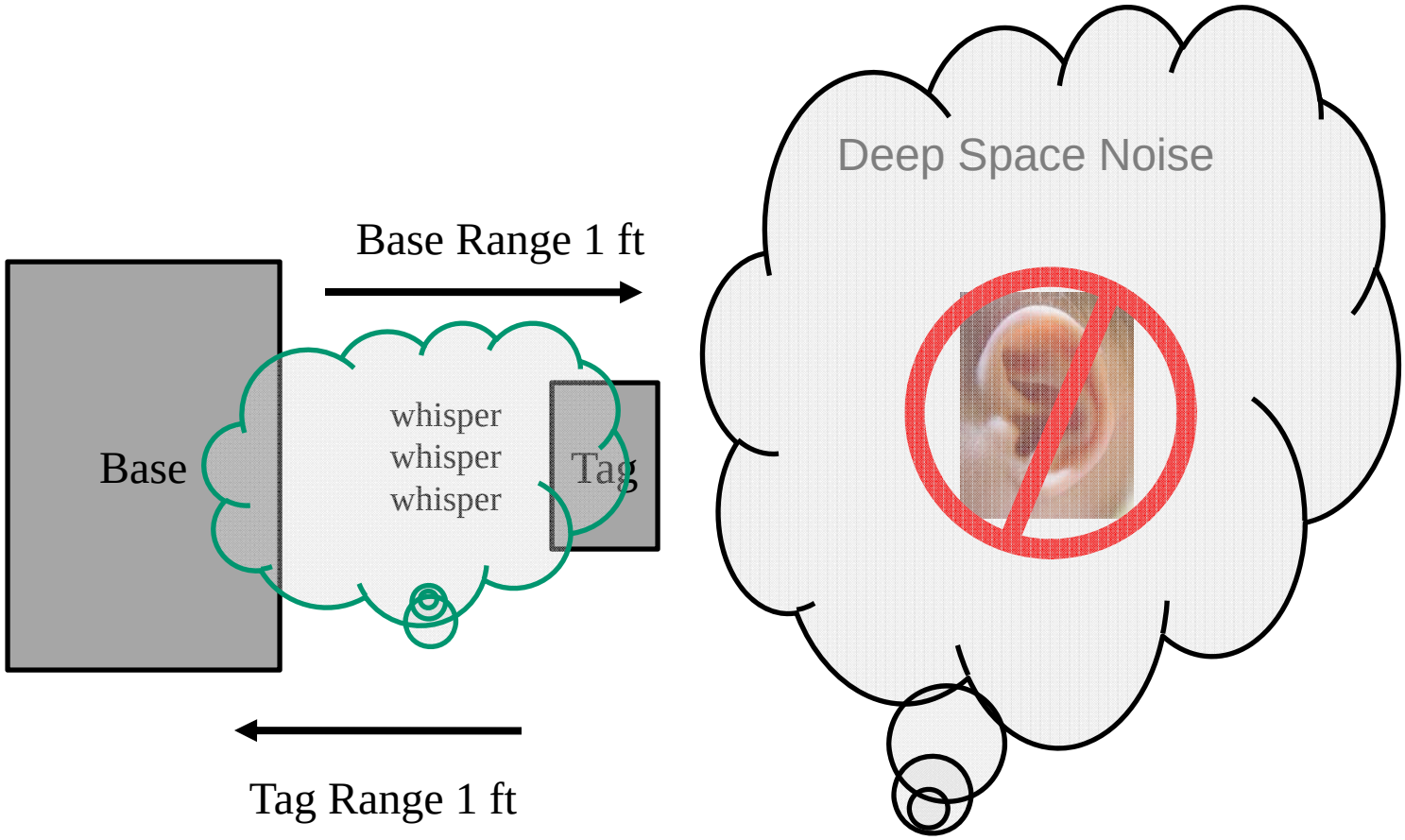
RuBee Tags can use Real-Time AES Encryption



RuBee Tags use Real-Time AES Encryption, But we also have strong physical layer security.



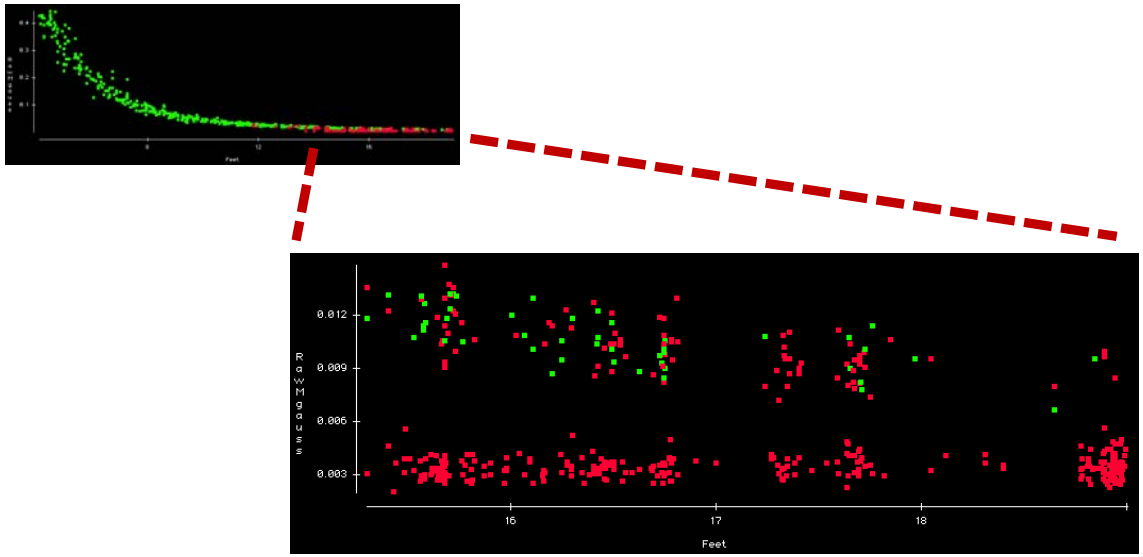
RuBee Real-Time Range Management
Makes eavesdropping impossible



No Detectable RuBee Signal @ 2ft
All eavesdropping blocked
by deep space kilometric noise

RuBee

Tag Range Limited by Constant Deep Space Noise



"An attacker with a near unlimited budget can provide only a few feet of additional listen range, beyond the tag range obtained with the lowest possible cost RuBee Tag and lowest possible cost RuBee base station range."

RuBee Security

The Data can be Private and Secure

Tag IP	11.11.11.00
Tag Subnet	11.11.11.1
MAC:	Locked
Object Name	Hip 23678
Size	23mm x 18mm
Birthdate	Encrypted
Expirydate	11/2007
Serial Number	6778895
Lot Number	7878789905
Manf. Site	Ireland
Manufacture	Medco
CRC	34567

RuBee Packet Security

Selective Optional Encrypted Security with Keys

Rijndael (AES), LZW, Eliptic, PGP, TWOFISH, BLOWISH, CAST, MARS, TEA

kapn ← John

Jsgh → John

Agtd → John

Htua → John

Because RuBee tags have a clock they can optionally use single Keys or OTP

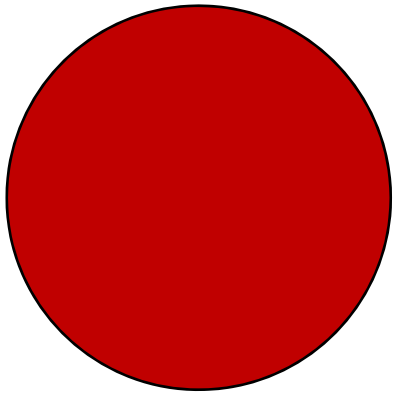
RuBee Packet Security

Selective Optional Encrypted Security with Keys

"Because RuBee Tags have a CPU, SRAM memory, high content mask ROM, a date and time (clock) – RuBee can employ the most advanced, authentication and Packet security possible, including One Time Pads"

The Security Problem

RuBee has addressed each item on the list



- ✓ Clone-ability
- ✓ Eavesdropping
  - (Tempest)
  - (Target)
- ✓ Authentication
- ✓ Packet Security

“A RuBee Tag
may be one of the most secure
wireless devices on the planet”

Application Examples
Procedure Room

Transforming The Procedure Area

Medical device implants today…

Hospital hall storage and the inventory is $5 billion/year…

Transforming The Procedure Area
Medical Device Smart Shelf

Transforming The Procedure Room

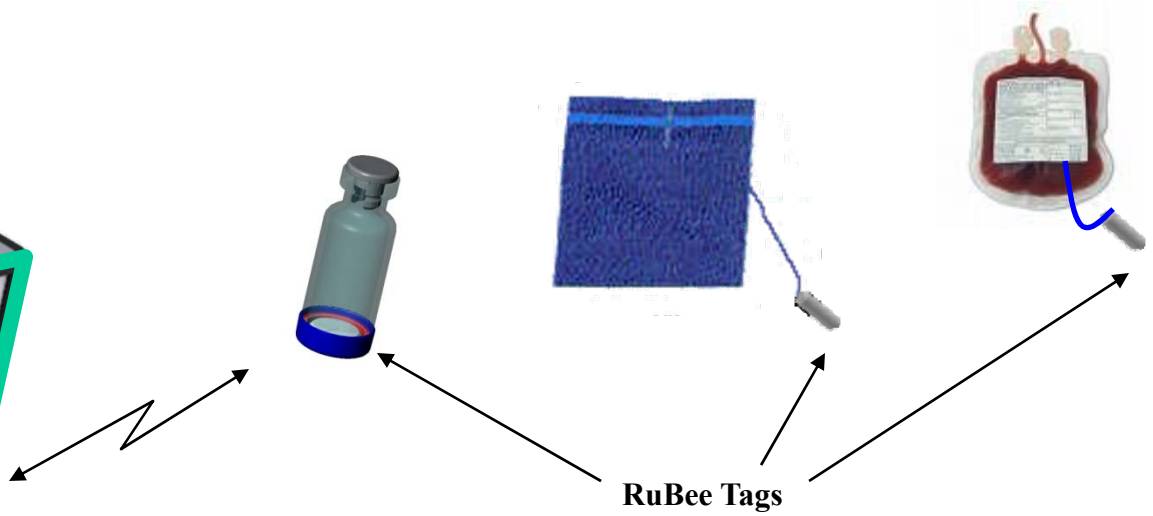
The Smart Cart and OR Visibility Project

Antennas

The RuBee Smart Cart is in use now with four multiplexed antennas that can read a RuBee tag anywhere in the operating room. Precise times for patient entry, product entry and product identity, Physician, Nurse identity and data logs are all captured with no change in process, and total safety.

Transforming The Procedure Area

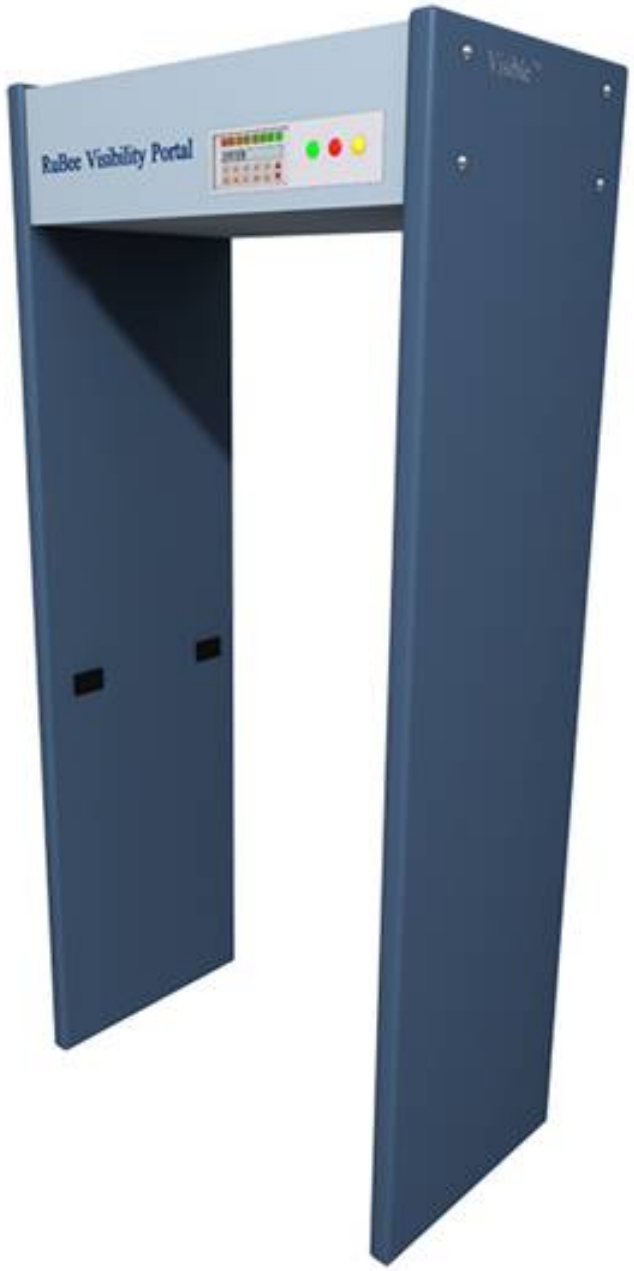
Smart Cart



<u>Step1</u>: Sponge + Pharmaceutical Dispensary + Blood Products + RuBee Access Control.

<u>Step2</u>: Sponge + Pharmaceutical + RuBee Access Control + RuBee Sponge Tag and Count + RuBee Drug Tags, Blood Product Tags and Part11 Data Log.

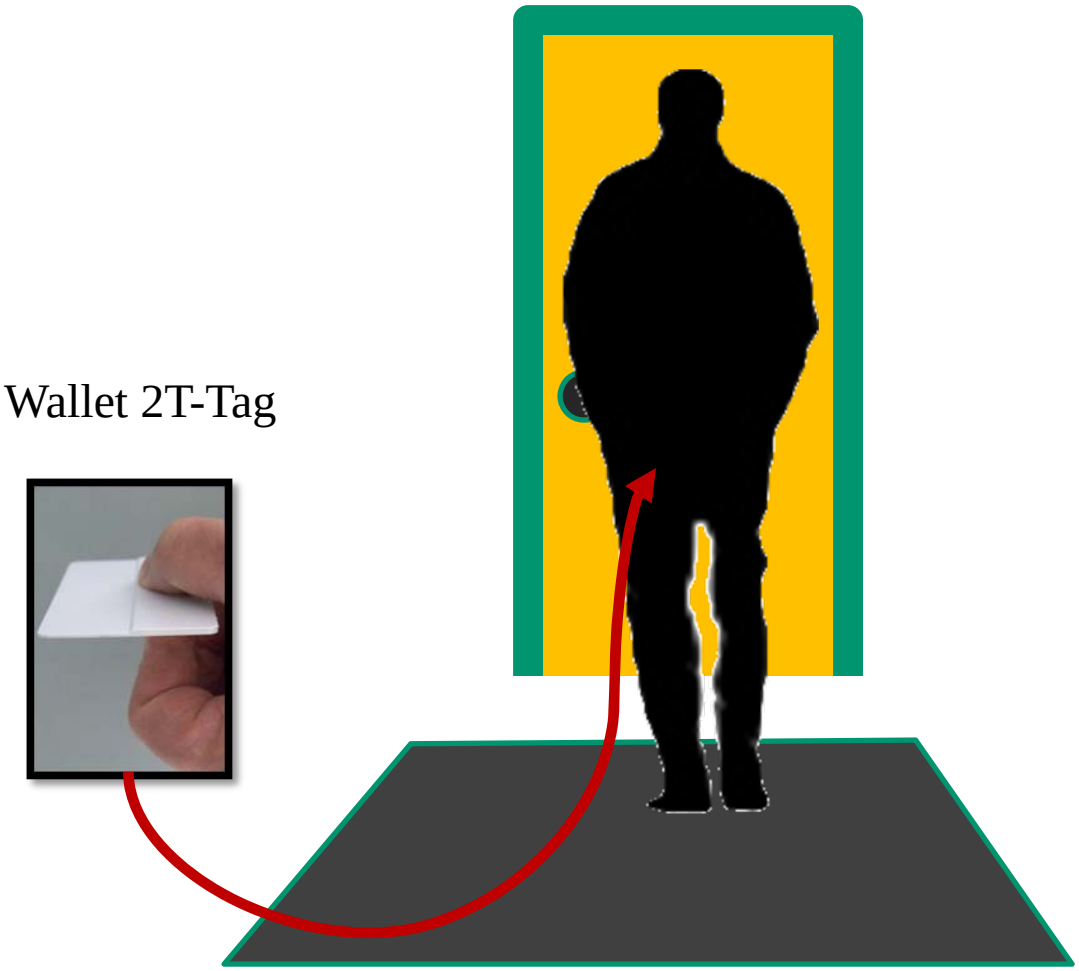
Application Examples
Security Portals



Visibility Portal

RuBee Mats and RuBee Appliances

In The Wallet 2T-Tag



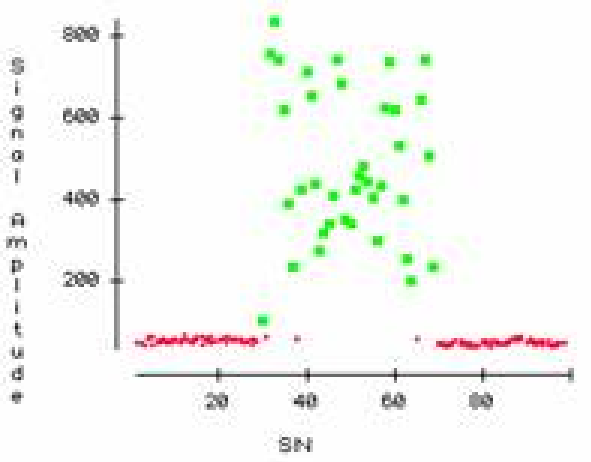
Cell Phones Wrapped in Aluminum Foil

Cell Phones 1-4 were wrapped with one layer of .001 inch Al foil and sealed. Tests in front breast pocket were repeated.

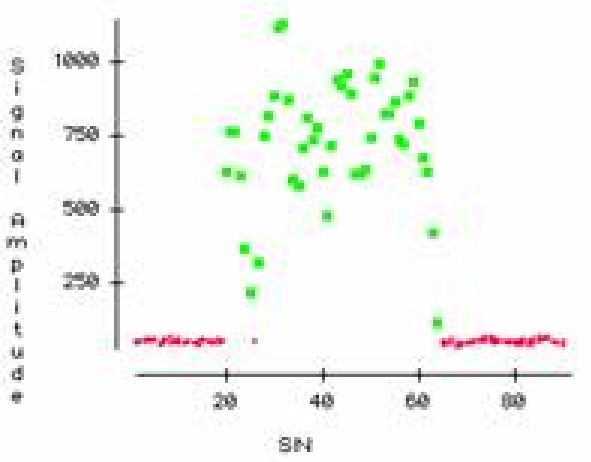
Test Portal Antennas

Cell phone test detection inside an aluminum brief case.

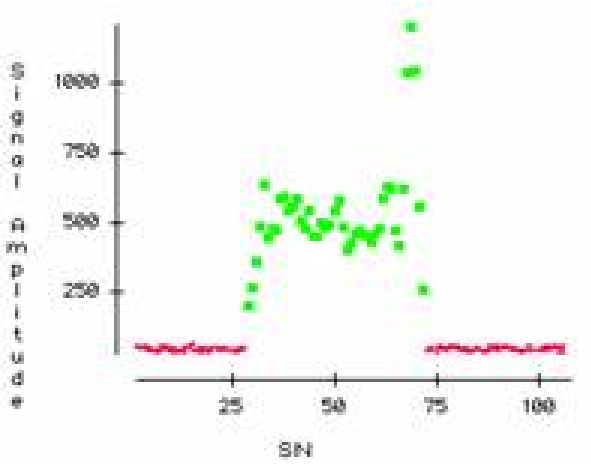
Cell Phones in Aluminum Brief Case



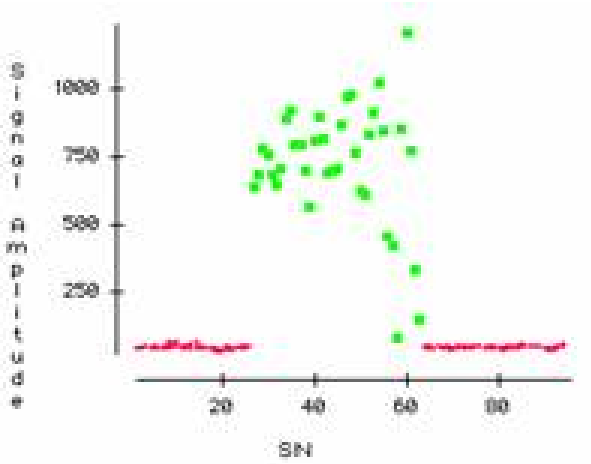
Cell Phone 1



Cell Phone 2



Cell Phone 3



Cell Phone 4

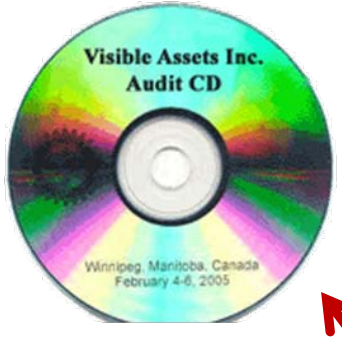
RuBee Security Issues
Security Plans Approved

- **Los Alamos**
- **Sandia**
- **Pantex**
- **Savannah River**
- **Oak Ridge**
- **Idaho National Labs**
- **Lawrence Livermore**

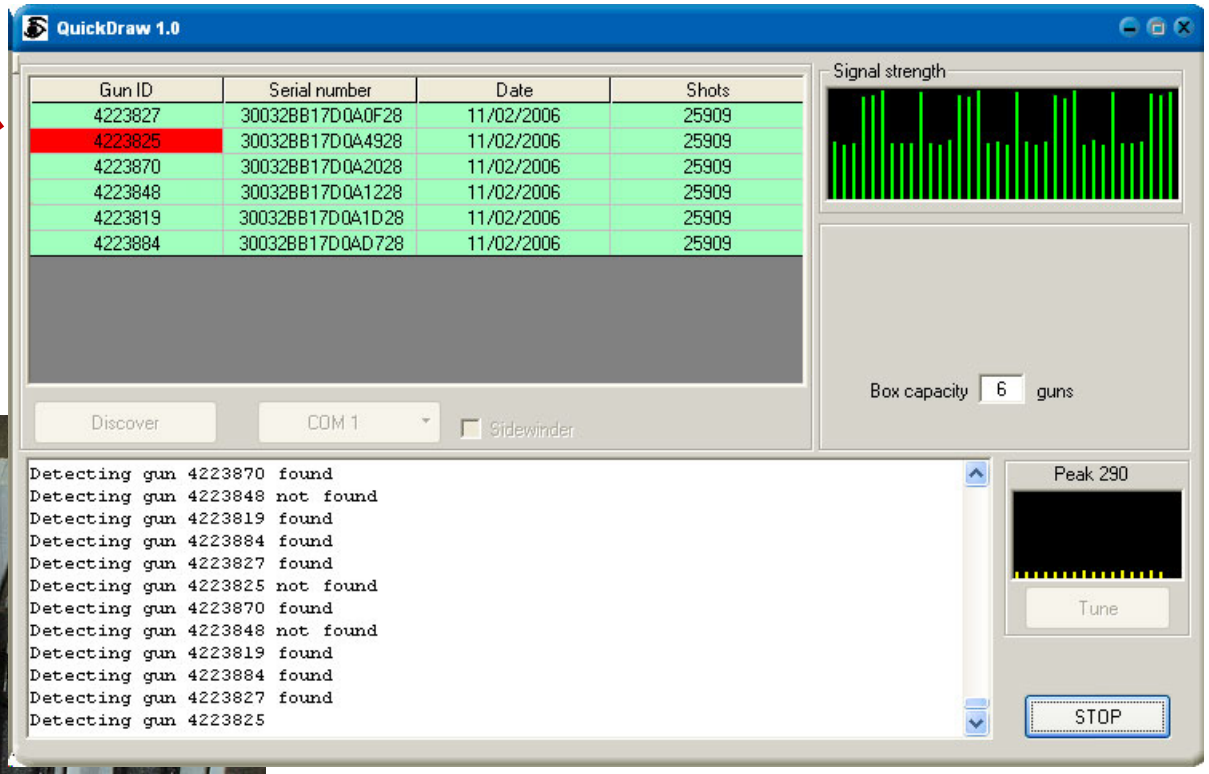
Application Examples
Weapons Visibility Rack
Sig Sauer

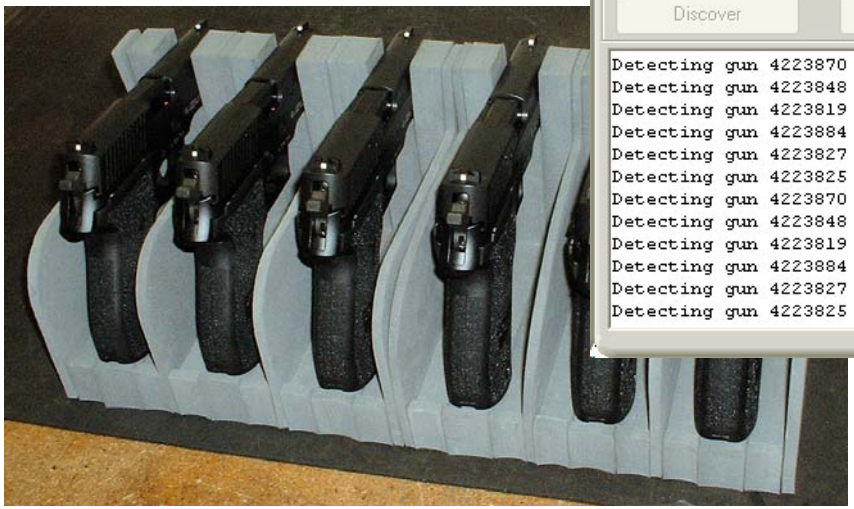
RuBee Enabled Weapons
Enhanced Safety Security

ATF Serial Number
Make Model
Manufactured Date
Number of Rounds Fired
Mean Round Kinetics (MRK)



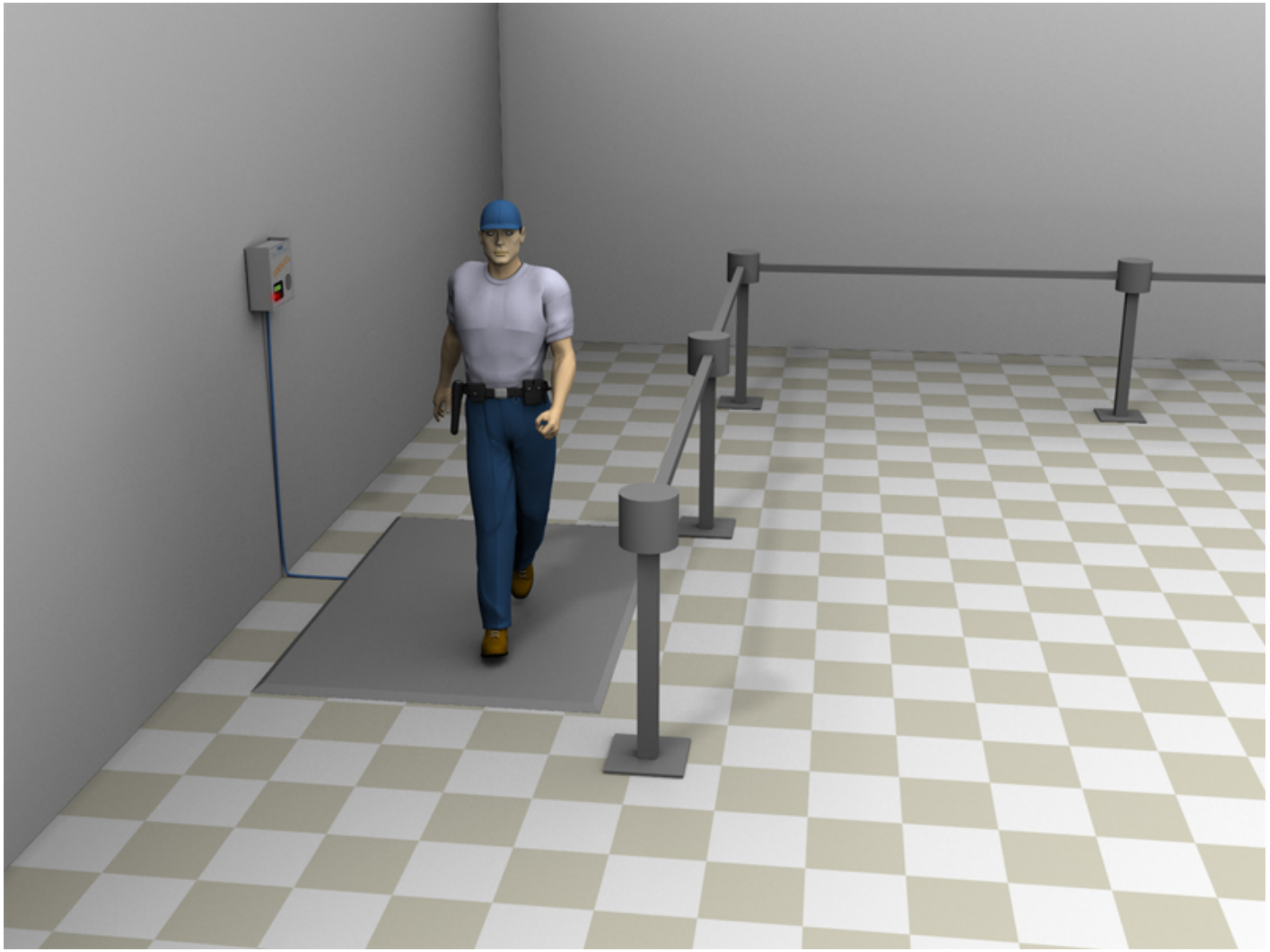
A weapon is removed from storage, the serial number turns to red and the date time event is stored the Part11 audit trail log.



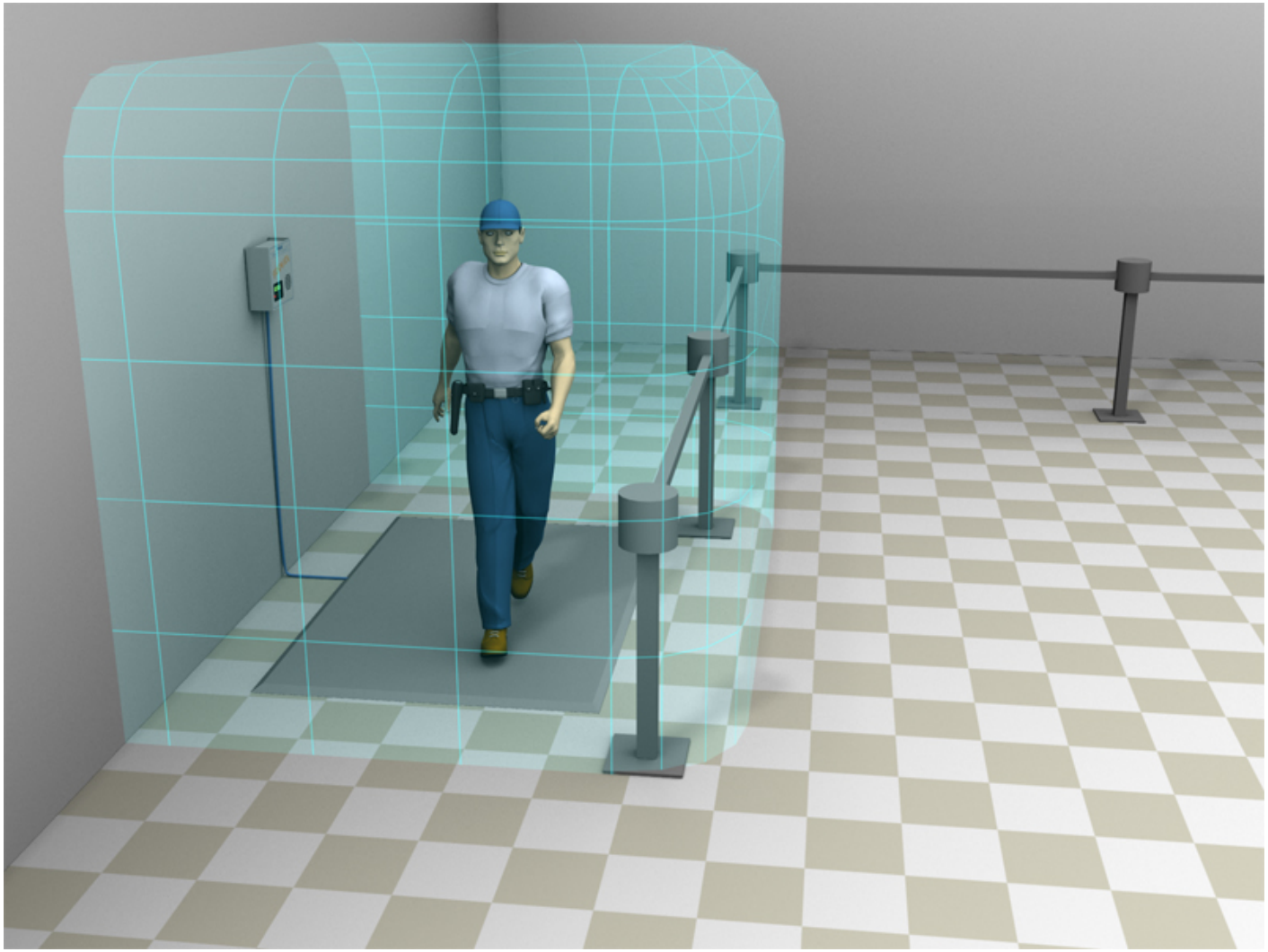


Firearms maybe stored on shelves with full physical inventory, check in check out and use records. Firearms maybe stored in original boxes or on specialized shelf.

Firearms and employees maybe detected and identified by existing standard DOE Industrial Visibility portals now used for cell phones.



Firearms and employees maybe detected and identified by existing standard DOE Industrial Visibility portals now used for cell phones.



Application Examples
Tool Visibility
US Air Force

RuBee Family of Tools

Shadow Board

Smart Mat

Long Ranger Portal

RuBee TVN
Confidential


R FORCE

Other Application Examples

Cervid Visibility
USDA NY CO
NASA Space Habitat

RuBee has Redefined Wireless Security

Thanks for your time