

## **Near Field Communication Sensors**

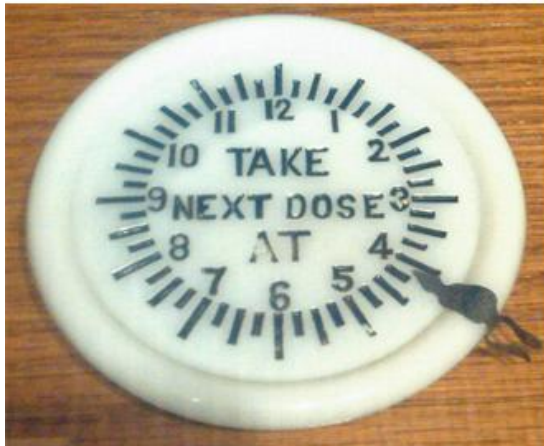
### **ISA PASSIVE WIRELESS SENSOR WORKSHOP**

**GENTAG, INC.**

3299 K Street, Suite 100  
Washington, DC 20007

**MAY 22, 2013**

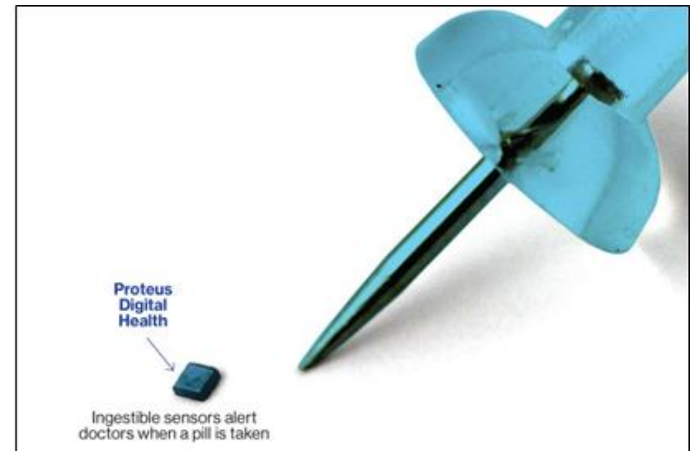
## Where Are we Headed ? Evolution of Medication Reminders Example



1880s



INGESTIBLE SILICON CHIPS ?



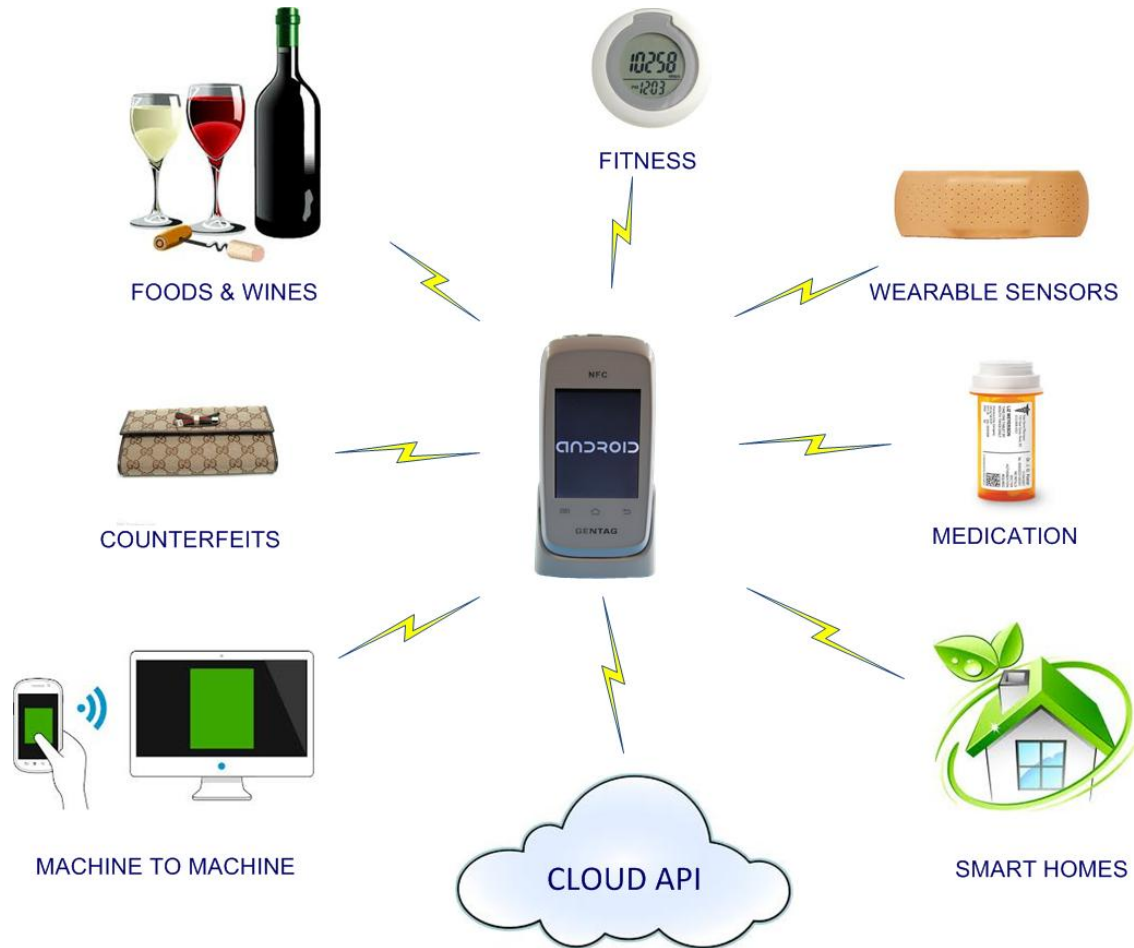
2014 ?



**AN ESTIMATED 1.95 BILLION DEVICES WILL HAVE NFC BY 2017**

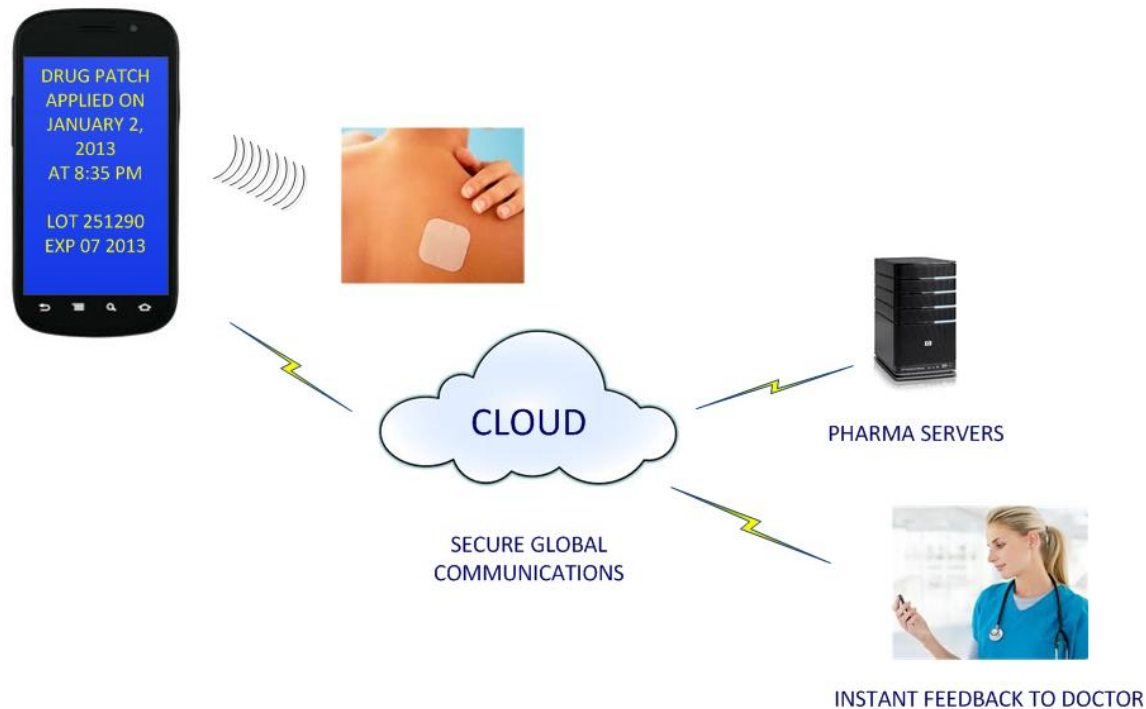
[http://www.phonearena.com/news/ABI-Research-Close-to-2-billion-NFC-enabled-devices-to-ship-by-2017\\_id36962](http://www.phonearena.com/news/ABI-Research-Close-to-2-billion-NFC-enabled-devices-to-ship-by-2017_id36962)

## NFC Tomorrow: mHealth, M2M, IoT and "Big Data"



## iTunes Model for Any Sensor, Anywhere

**PATENTED 1 UID – 1 SENSOR – 1 “APP” MODEL**



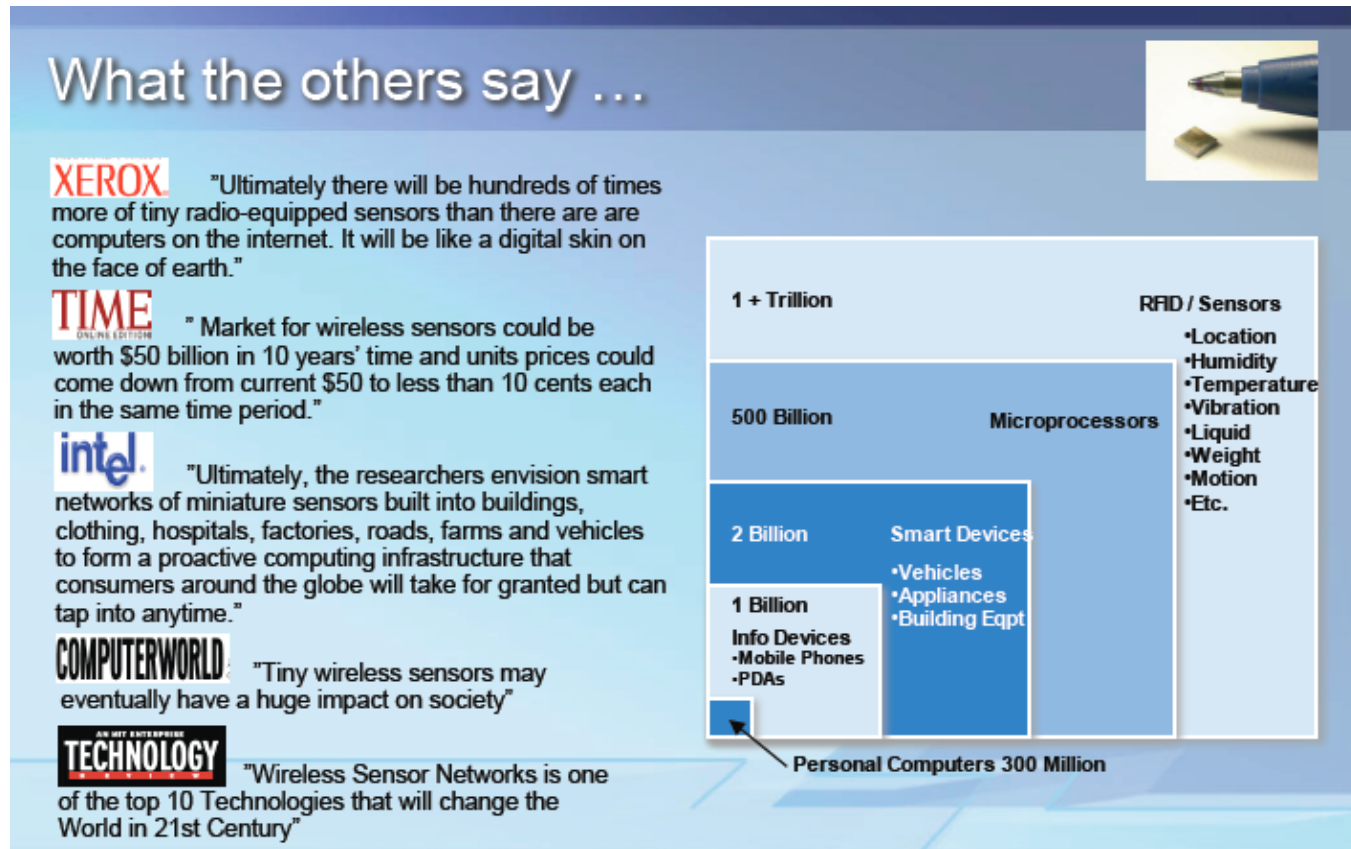
**APIs MODEL**

**LEADING MEDICAL  
INSTITUTION OR  
PHYSICIAN**



**CUSTOM APP**

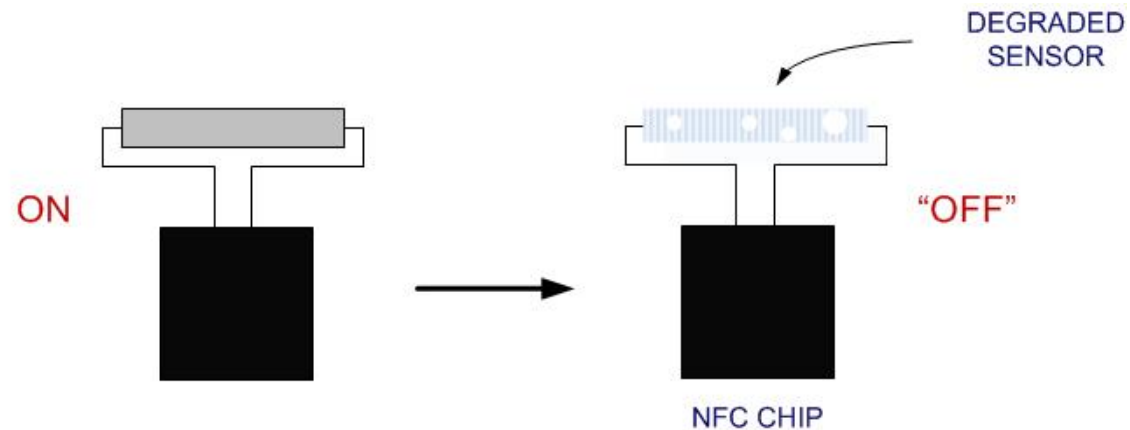
## Emerging Global Opportunity: The “Internet of Everything” - \$14 Trillion Dollars



CISCO: “MORE DEVICES AND PEOPLE CONNECTING TO THE INTERNET WILL CREATE  
A **\$14.4 TRILLION** OPPORTUNITY OVER THE NEXT DECADE”

## NFC SENSOR EXAMPLES

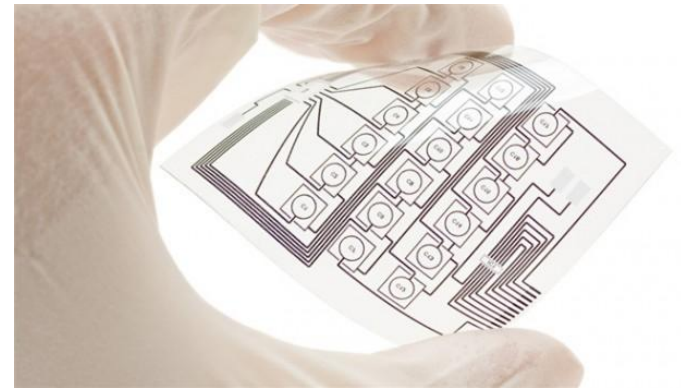
## Thin Passive Wireless Surface Sensors: Rust Monitoring Example



RUST  
UV  
STRESSES  
PACKAGE INTEGRITY  
MOISTURE  
PRESSURE  
BIOLOGICAL REACTIONS  
CHEMICAL REACTIONS  
ETC



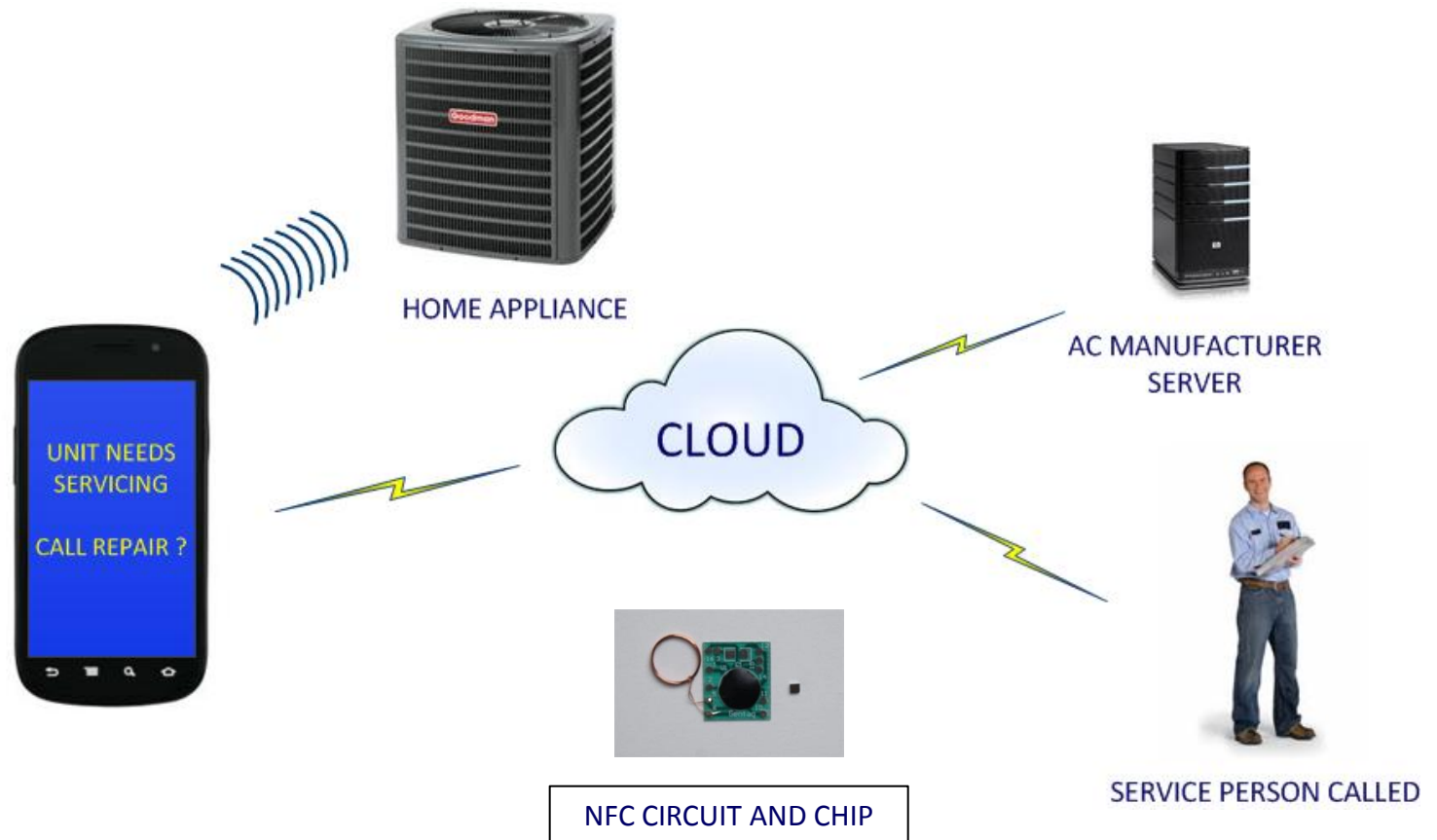
## Custom NFC Pharma Sensors (Adherence)



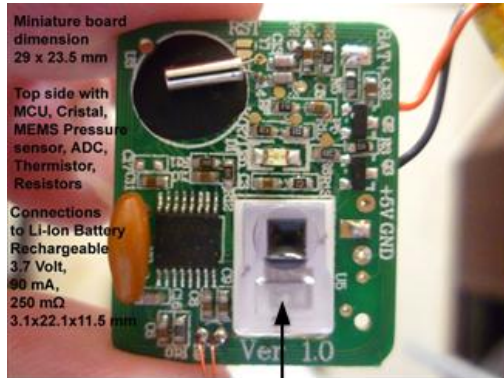
**PRINTABLE CUSTOM BACKING**

**COSTS OF NON MEDICATION COMPLIANCE IN THE US: \$177B**

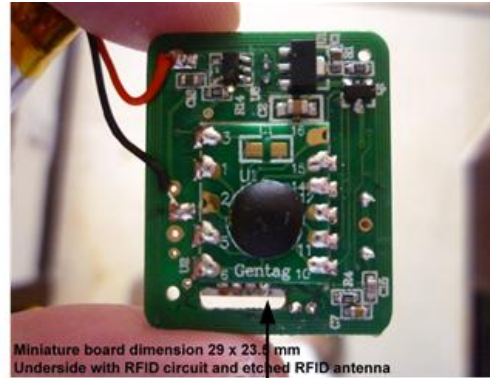
## NFC for Smart Appliances Machine to Machine (M2M)



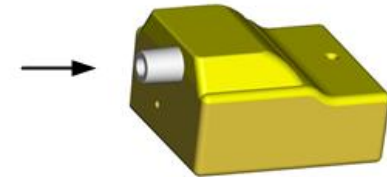
## Technology Can be Adapted to Any Sensor: Medical Grade MEMS Pressure Sensor Example



MEMS PRESSURE SENSOR



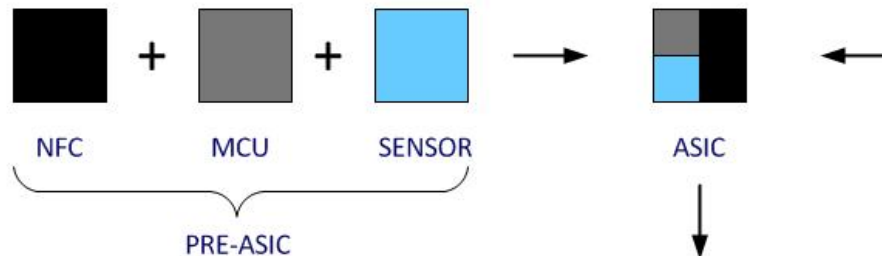
NFC CHIP



PRE-ASIC DEVICE



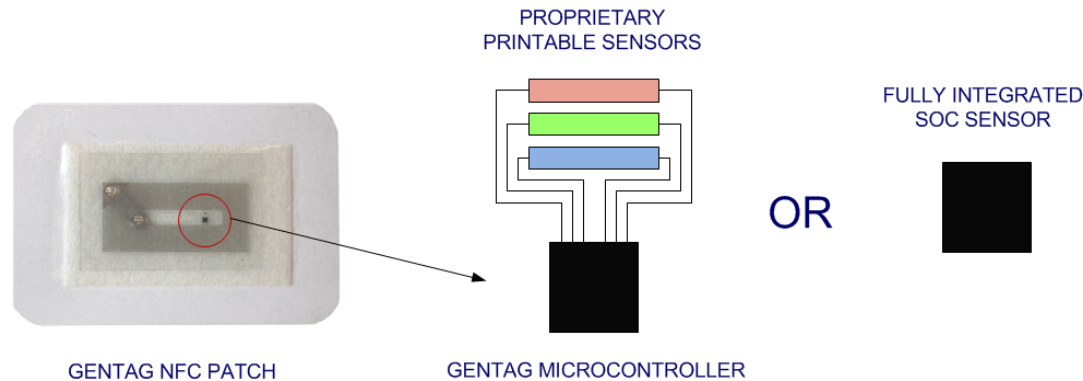
TESTING



PRESSURE MONITORING SKIN PATCH

## WEARABLE SENSORS

## NFC Passive Sensors Comparison to Bluetooth or ANT+



### NEAR FIELD COMMUNICATION SENSORS

- BATTERY-LESS TECHNOLOGY
- COMPATIBLE WITH NFC CELL PHONES
- ISO STANDARDS. 13.56 MHz
- VERY SMALL SILICON FOOTPRINT
- PRINTABLE SENSORS POSSIBLE

## NFC Diagnostic Skin Patches



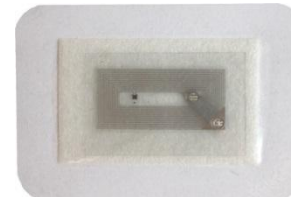
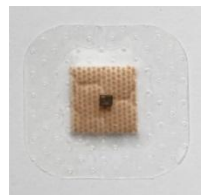
### MARKET EXAMPLES

- FEVER
- DRUG DELIVERY
- UV (SUN EXPOSURE)
- DIABETES
- CARDIAC
- SKIN MOISTURE
- INFECTIONS

**PATENT 7,969,307; OTHERS**

➤ ORGANIC SEMICONDUCTOR FILMS:	~8-30Å	↓	BREAKING POINT
➤ PLASTIC FILMS:	~0.01mm		
<hr/>			
➤ NFC ANTENNA ON PET:	~0.06mm		ANTENNA TUNING
➤ HUMAN HAIR:	~50μ - 0.1mm		
➤ DOLLAR BILL:	~0.1mm		
➤ BAND-AID FLEXIBLE SURFACE:	~0.14mm		
➤ MOUNTED NFC CHIP WITH ANTENNA:	~0.23mm		
➤ ULTRA THIN BATTERY:	~0.48mm		
➤ BAND-AID (PAD AREA):	~0.79mm		

→ SUB 1mm WIRELESS DIAGNOSTIC PATCHES WITH BATTERY ARE POSSIBLE



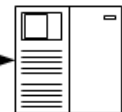
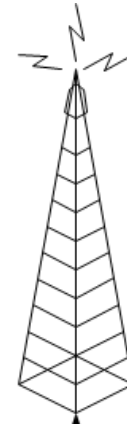
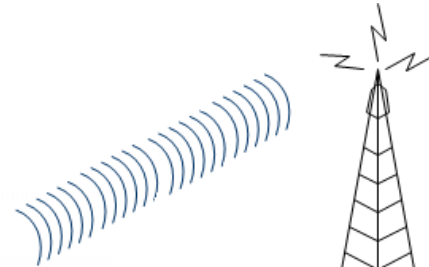
## NFC for Hospital Discharge Kits: Post Surgery Compartment Syndrome Patch



MEMS PRESSURE PATCH



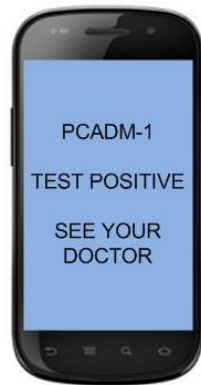
NFC CELL PHONE



REMOTE MEDICAL  
CENTER



## Printable NFC Biosensors



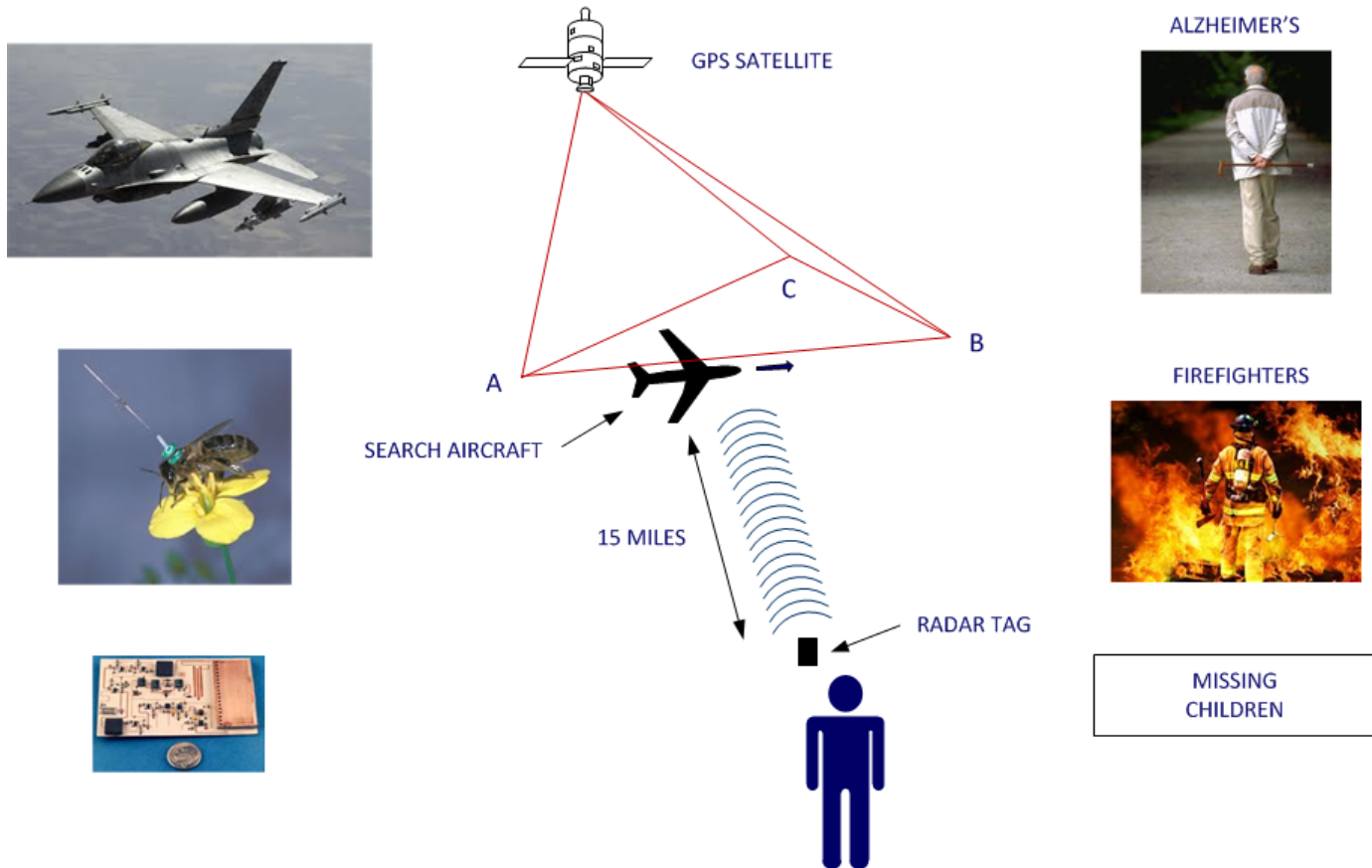
### APPLICATIONS INCLUDE:

- DRUG TOXICITY
- PATHOGENS
- ALLERGENS
- OTC TESTS
- CANCER DETECTION
- BIOMARKERS
- FOOD SAFETY

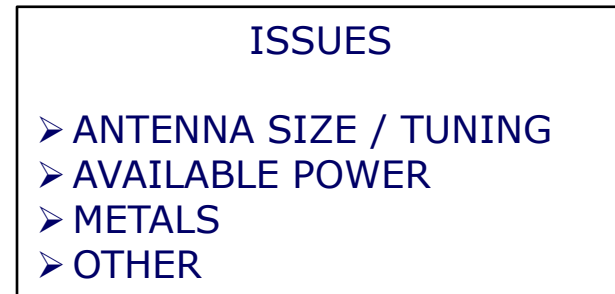
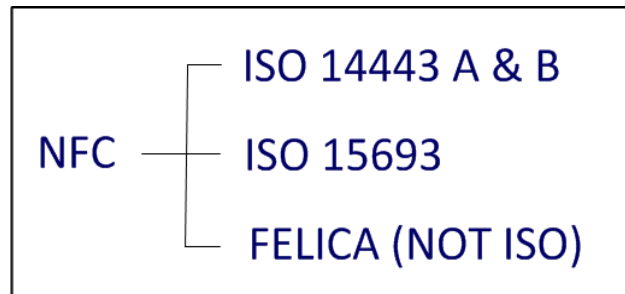
<http://siliconinvestor.advfn.com/readmsg.aspx?msgid=27035270>

## Long Range & Geolocation: Radar Responsive Sensor Tags

MISSING PERSON SAMPLE SETUP



## Wireless Tags Read Ranges



- NFC CELL PHONES (0.1W)
- ISO 15693 (2-5W READERS)
- MAGNETIC

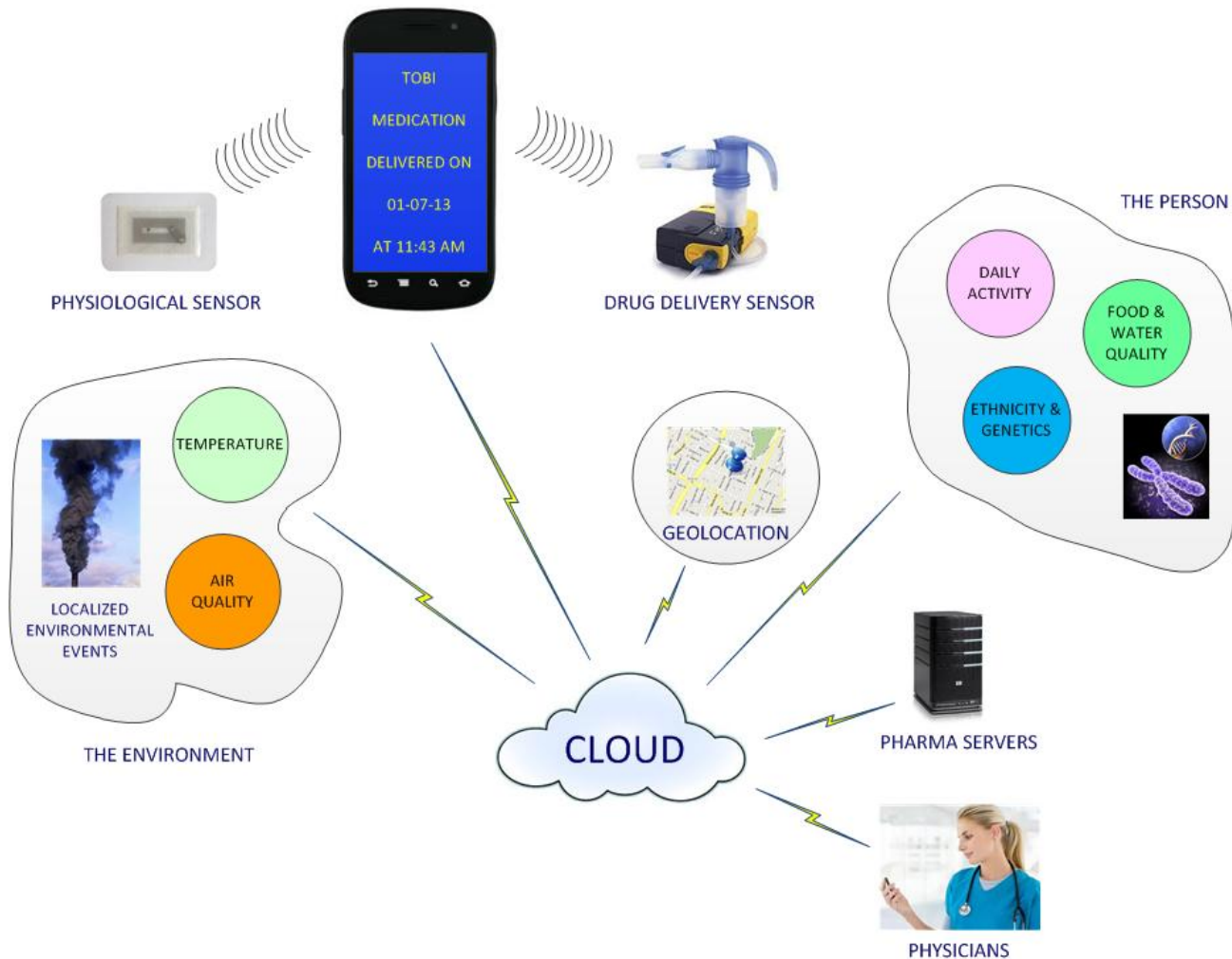
8 CM (OPTIMIZED ANTENNA)  
60-80 CM  
1.5 M ?

NFC

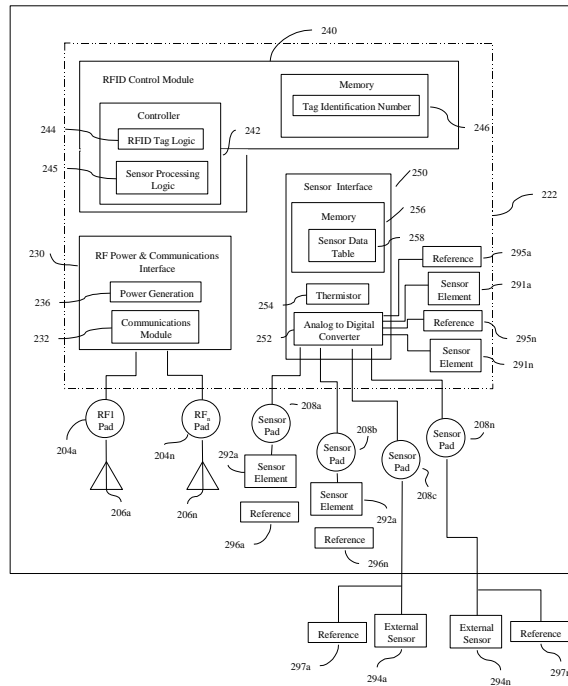
- -----
- RFID UHF
- CELL PHONES (100W)
- RADAR RESPONSIVE TAGS

~10 M  
35-50 KM (GSM-CDMA)  
15-100+ MILES

## NFC and “Big Data”: Drug Effectiveness Example



## NFC Micro-Controller



**US PATENT 7,148,803**

- OPERATING FREQUENCY: 13.56 MHZ  
(ACCREDITED FOR MEDICAL USES WORLDWIDE)
- COMPATIBILITY WITH NFC AND ISO STANDARDS
- NO BATTERY
- READ RANGE (WITH CELL PHONES): 8 CM
- POWER AVAILABLE TO SENSOR:  $\sim 100 \mu\text{W}$  (EST.)
- AVAILABLE VOLTAGE TO SENSOR: 1-3V
- ESTIMATED *MINIMAL* RESISTANCE CHANGE  
REQUIRED FOR SENSORS:  $2\text{k}\Omega$
- CUSTOM ASIC DESIGN