RFID: IoT w/ smartphone attachments instead of terminals for short/long-range HF & UHF/RAIN cycle counts, picking, & finding the needle in a haystack!

Presented by:
Paul A. Whitney, VP of AsReader, Inc. and Elected Chair of AIM RFID Experts Group (“REG”)
Paul Archuleta Whitney
Vice President & COO
AsReader, Inc.
and Elected Chair of AIM RFID Experts Group (“REG”)
Today’s Topics

**TITLE of talk:** “RFID: IoT w/ smartphone attachments instead of terminals for short/long-range HF & “RAIN” UHF RFID cycle counts, picking, & finding the needle in a haystack!”

What You Will Learn / Key Takeaways:

- Compare Handheld Terminals to Smartphones with Sleds & Gun-types
  - Sleds & gun-types for Barcode & RFID Scanning, Reading, & Writing
  - Advantages of hardwired devices over Bluetooth
  - Compactness: Drivers can carry a 9ft RAIN RFID reader/writer in their shirt-pocket
  - For large areas, use cellular data or collect the tag data and sync when you return to WiFi

- Compare Hardware Barcode Scanning with “SoftScan” using the smartphone’s camera
  - Advantages and Disadvantages of hardware vs software and some tips on how to improve

- Compare RFID & Barcode: What’s so special about RFID?
  - Basic anatomy of barcodes & Passive HF/UHF RFID Tags (similarities & differences)
  - RFID: Special sensor tags for temperature & moisture
  - Speed of Cycle counts & What about Shielding?
  - Basic anatomy of a RFID Reader/Writer (Linear vs Circular)
  - Use of Phasing to locate the X, Y, & Z of Passive RFID Tags
Handheld Terminals vs Smartphones

1.) PRICE:
“Dedicated handheld terminals” are specialty devices that you pay a premium for, but have very limited functionality.

2.) FUNCTIONALITY & TECHNOLOGY:
• The latest technologies and well-developed hardware parts, CPU memory ...including many extra functions, such as the Camera, GPS, Sensors, etc.
• Millions of Applications are available throughout the world. ...and you can make more apps on a standardized system.

3.) USABILITY:
• Most users are familiar with smartphones and this reduces the cost of installation and training.
• User-friendly and familiar functions, interfaces, and notifications reduce mistakes.
Bringing them together. It used to look like this:

Not that long ago... it looked more like this.

Some folks said they “needed a Batman toolbelt!”
Bringing them together. Now it looks like this:

Now, all those functions come together in to one, shirt-pocket sized device…

Yet include all the above functionality and more:
- Telephone
- Barcode Scanner
- RFID Reader & Writer
- GPS
- Camera/Video
- And any other apps you choose to add
But How to Connect the Smartphone?

Bluetooth is a common method of communicating with Smartphones. It’s GREAT when you need the reader and smartphone to separate, but it has its drawbacks:

- Dropped-data: Have you ever done a call over Bluetooth? Now Imagine your data trying to have that conversation!

- Power-usage: Broadcasting and receiving signals takes power and processing power.

When you are hard-wired, via a Lightning Connector, microUSB, or USB-C Connector, then there is no question about data droppage or power-usage. It creates a dependable, hard-wired connection.
When you say compact...

Shirt-pocket sized and powerful.

Similar devices can read a standard squiggle-tag at 3m (9 feet) line-of-sight.

At 27dBm (500mW), that’s enough to read inside a pallet, yet conserves enough power to last as long as your regular smartphone without RFID.

And many such devices have charging options available, like simple magnetic charging, and external battery packs for extra-long-shifts.
What if . . . I’m out of range for the WiFi?

Good question!

There are basically two options to consider:

A.) Use Cellular Data

B.) Collect the data and “sync” when you return to cellular data or WiFi.
Hardware vs Software Barcode Scanning 1 of 3

What’s the buzz about “SoftScan”?  

SoftScan is using your smartphone’s camera as a barcode reader. It utilizes the smartphone’s processor to decode the barcode from the camera’s image. As Smartphone Processors and Cameras get better, so does SoftScan.

Not quite there for mission-critical items or heavy usage, but great for small numbers of scans.
Hardware vs Software Barcode Scanning 2 of 3

Strengths of SoftScan:
- Size (it’s literally just your smartphone with nothing attached.)
- Price (although after paying a monthly license, it’s a close call.)

Weaknesses of SoftScan:
- Drains smartphone’s battery as fast as taking video because:
  a.) you’re using the camera and screen to line-up the barcode
  b.) you’re using the processor to decode that barcode
- Speed is impaired because you can’t look at the barcode itself, you have to look at the screen and try to figure out which barcode you’re pointing at and then trigger the read.
A famous use-case happened in Germany with a well-known SoftScan solution where the markets purchased thousands of smartphones and rolled out a SoftScan solution. After just a few months, the phone’s batteries are dying after 3-4 hours. Unfortunately, this model of phone has soldered-in batteries, so they aren’t easily replaced.

Could something be done to shore-up the weaknesses of SoftScan? YES!

Using an independent laser-pointer to SHOW where the camera is pointed:
- Saves battery because it removes the need to show video on the user’s screen for finding barcodes – saving battery-life.
- Speeds up work because the user knows exactly what they’re pointing at and doesn’t need to look at the screen.
The Anatomy of Barcode & RFID Tags 1 of 5

• 1D Barcodes

• 2D Barcodes

• RFID
  (UHF Band & HF samples)
Everyone is familiar with Barcodes because they are in such common use for everything from retail stores like groceries & clothing to tracking inventory or shipments, etc.

...but what about RFID? You’re probably familiar with things like:
• Pet Microchipping (small)
• FasTrak (large)

You’re going to see more & more of these in the near future:
<table>
<thead>
<tr>
<th></th>
<th>Barcodes</th>
<th>RFID Tags</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line-of-sight</td>
<td>Required</td>
<td>Not Required</td>
</tr>
<tr>
<td>Read Rate</td>
<td>One at a time</td>
<td>Simultaneous</td>
</tr>
<tr>
<td>Identification</td>
<td>Usually General (like UPCs)</td>
<td>Unique to each item/asset</td>
</tr>
<tr>
<td>Read/Write</td>
<td>Read Only</td>
<td>Many are R/W</td>
</tr>
<tr>
<td>Technology</td>
<td>Optical (Laser)</td>
<td>RF (Radio Frequency)</td>
</tr>
<tr>
<td>Interference</td>
<td>If dirty, torn, etc</td>
<td>Water &amp; Metal</td>
</tr>
</tbody>
</table>
The Americas and Asian Pacific Rim tend to be in the 902-928 MHz range.

The EU, Africa, India, and the Middle East tend to be in the 858-868 MHz range.

Wider adoption of the 900+ MHz bandwidth is slowly taking place worldwide.

Image from blog.AtlasRFIDStore.com

*Please Note: This map is GENERAL and NOT entirely accurate.
## The Anatomy of Barcode & RFID Tags 5 of 5

<table>
<thead>
<tr>
<th>Frequency</th>
<th>HF/NFC (High Freq.)</th>
<th>UHF (Ultra-high Freq.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Read Range</td>
<td>&lt; 1m (almost touch)</td>
<td>3m, 10m, 15m+ long-dist.</td>
</tr>
<tr>
<td>Cost of Tags</td>
<td>Less Expensive</td>
<td>Least Expensive</td>
</tr>
<tr>
<td>Applications</td>
<td>Security Badges, Library Books, etc</td>
<td>Pallets/Cases/Products, Baggage, Apparel, Parts, etc</td>
</tr>
<tr>
<td>Read/Write</td>
<td>Many are rewriteable</td>
<td>Many are rewriteable</td>
</tr>
<tr>
<td>Read Multiple Tags</td>
<td>Good. Fast.</td>
<td>Very good. Fastest!</td>
</tr>
<tr>
<td>Water &amp; Metal</td>
<td>Somewhat affected</td>
<td>Very affected</td>
</tr>
</tbody>
</table>
Writing to RFID Tags

Barcodes and QR Codes have limited space for data. And they cannot be re-written without a printer.

UHF RFID Tags can store 512 bits, 2KB, 4KB, 8 KB, depending on the vendor.

RFID tag information can be “password protected” and encrypted.

RFID tag information can be “killed” or “zombied.”

Washable tags made of thread now exist too!
Use Case 1: Automobile Dealer: Controlling/Managing Car Inventory – 1 of 2

TOYOTA Motors, Thailand (http://response.jp/article/2014/10/09/234518.html)

PROBLEM: Dealers are responsible for controlling stock, accessories, delivery, maintenance, and related tasks, but finding 1 car in a lot of 400 cars can be time consuming and labor intensive.

BEFORE:

• Most cars for sale are usually stored at the dealer.
• After receiving cars from the factory and payment from a customer, the dealer adds extra accessories and inspects the car.
• To reduce the time and cost, the dealer rents about 10,000 square meters of land.
• However, finding cars was a difficult and time-consuming task.
Use Case 1: Automobile Dealer: Controlling/Managing Car Inventory – 2 of 2

METHOD:
1. RFID tags are placed at each parking space.
2. Each car from the factory gets an RFID tag.
3. Scan and save both RFID tags: car’s & parking space’s.
4. Scanned data is sent to the central server.
5. Looking at their smartphones, the staff can find cars immediately.

AFTER/RESULTS:
• Average lead-time was reduced from 4 to 3 days.
• The ratio of on-time deliveries dramatically increased from 49% to 98%.
Use Case: Logistics Warehouse & Tracking Control

REQUEST:
Customer wanted to increase the accuracy of delivery times and customer satisfaction by gaining control over parcel and driver locations and situations in “real-time.”

BEFORE:
- Detailed information, such as departure or arrival times were unknown.
- Center wanted to know delivery times.
- Controlling slips from customers was cumbersome.

Diagram:
- Collection to Center
- Delivery from Center to Depot
- Delivery from Depot to Consignee

Use Case Diagram: Logistics Warehouse & Tracking Control
Use Case: Logistics Warehouse & Tracking Control

AFTER:

◆ With scanning, the status of deliveries can be monitored in real time.
◆ Signature from the consignee is digitalized, eliminating unnecessary paperwork.

RESULTS:
By grasping real-time delivery status, information to customers could be provided more accurately, and that increased customer satisfaction.
The delivery center could control situations more effectively.
Digitalized slips reduce the time and labor required for managing unnecessary paperwork.
Use Case: Clothing Manufacturer: Inventory Control for Distribution – 1 of 2

Problems:

• Incoming shipments took a lot of time to count because of the large quantity of goods.

• Inventory checks and restocking of goods in shops were inefficient.

---

The goods were packed with a list/slip placed on the box.

The containers were checked by opening each box and checking the slip against the contents of the box. Then, the data was saved into the system as a separate process.
Use Case: Clothing Manufacturer: Inventory Control for Distribution – 2 of 2

RAIN RFID tags and RFID reader improved business efficiency.

**AFTER:**

- **Shipping**

  ![Image of a box and a slip]

  Scan the tags of goods in the box and issue a slip from the system and place it on the box.

- **Upon Arriving**

  Scan tags and check with the slip

  - Send data

- **Inventory Check / Cycle Count**

  Scan all the tags in the shop

  ![Image of a phone scanning a tag]

  Without opening the box, the number of goods could be checked thanks to RAIN RFID.

**Results:**

It is now possible to check the number of goods in the box without opening it! This resulted in significant time and labor savings while increasing accuracy. Using the scanned data, the process became more efficient and more effective.
Sensor RFID Tags

Axzon (formerly known as RF Micron), MetalCraft, Farsens, and Asygn are 4 well-known companies who manufacture “Sensor Tags” for RFID.

These tags can sense things like:
- Temperature
- Moisture
- Pressure
...and more...

Imagine the possibilities of these sensor-tags with no wires or batteries!
Speeds & Shielding

UHF has a higher data rate than HF or LF and even in mobile readers with 1Watt, they can reach speeds over 600 tps (“tags per second.”)

Some smaller 0.5W readers might get speeds closer to 20-50 tags per second, but this is still SO much faster than barcode.

TWO TYPES OF SHIELDING:
- Reflective
- Absorptive
Basic Anatomy of an RFID Reader’s Antenna

Two basic types of RFID Reader antennas (although there are hybrids):

- Circular
  - Reads 360 degrees
  - Compact

- Linear
  - Can be somewhat directional
  - Can provide “Phasing” data (for XYZ radar-like locating of tags)
Using Phasing information from the Linear Antenna, find the X•Y•Z positioning data of each tag on each box. Display the horizontal/vertical directions and distance of the RFID tags.
Concluding Today’s Topics

Compared Handheld Terminals to Smartphones with Sleds & Gun-types
- Advantages of hardwired devices over Bluetooth, Compactness, Sync with WiFi

Compare Hardware Barcode Scanning with “SoftScan”
- Some advantages and disadvantages of hardware vs software looking at the smartphone’s camera.

Compare RFID & Barcode: What’s so special about RFID?
- Basic anatomy of barcodes & Passive RFID Tags
- Sensor tags for temperature etc, Speed of cycle counts & Shielding?
- Basic anatomy of a RFID Reader/Writer (Linear vs Circular)
- Use of Phasing to locate the X, Y, & Z of Passive RFID Tags
For more information

Paul Whitney: paul@asreader.com
https://AsReader.com

Visit AsReader’s ProMat Booth #N6654

*Please feel free to approach me with any questions immediately following this talk* or at our Booth #N6654.

Thank you