Location Services for Healthcare

Class 2: Tags and Sensors

August 22, 2017
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This Week's Agenda

Monday	Overview
Tuesday	Tags and Sensors
Wednesday	Systems and Software
Thursday	Implementation Issues
Friday	Available Products and Future Trends

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Course Description

Location service refers to a set of devices and software that allow the tracking of all manner of items in an enterprise. In general these are real time tracking services. Thus, an enterprise has a real time picture of where everything that needs to be tracked is and can deploy, resupply and maintain all these items in a consistent manner. This is a truly Internet of Things (IoT) environment. In the healthcare environment, this level of management can be critical, and can also lead to major efficiencies. In this course we will review the general field of Real Time Location Services (RTLS) and then discuss their application of and use in a healthcare setting.

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Today's Agenda

- Tag Types
- Tag Uses
- Sensors
- Conclusion/Next Class

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Tag Types

- We have discussed tags in their broad categories, but there is much more detail to consider

- We will look at several aspects, attributes or dimensions of tags:

  – Category, locating style, telemetry, human interface (where applicable), etc.

Tag Types

- We have talked about passive, semi-passive and active tags
  - These refer to the technology of the tag
- We also need to consider tag category:
  - Simple tag
  - Identifiable
  - Mobile
  - These refer to the function of the tag

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Tag Types

- Locating style: each tag will have a specific locating style based on its own technology and use.
  - Self locating tags: these tags report on their own location
  - Indirect: most tags use this style, where the locating infrastructure actually determines the location

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Tag Types

- Communication technology: tags communicate in various ways.

  – Simple passive and Semi-passive tags are driven by the locating device

  – Other communication protocols can also be used, especially for active tags:

    - Wi-Fi

    - Bluetooth/Zigbee

    - Infared

    - Ultrasound

Tag Types

- Human to Machine Interface (HMI): tags can interact with human operators in several ways
    - Passive tags, if visible, will generally have some readable markings
    - Active tags may have buttons, lights, and/or small displays
    - Facilitate working with tags for various functions such as identification at the point of use or reading of status/telemetry locally

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Tag Uses

- Tags are used for a wide variety of purposes
  - Tracking of supplies and equipment
  - Locating equipment and people
  - Telemetry or measurement of environmental conditions
    - Useful in monitoring either patients or equipment
  - Use determines requirements for tag physical characteristics (such as enclosures; see standards such as NEMA 250-2003)

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Tag Uses

- Supply/equipment locating:
  - Typically will have a bar code and identifier
  - On passive tags set at the factory and not changeable
    - Single use
  - On Semi-passive and active tags the identifier can be changed
    - Semi-passive tags are programmable, at least as far as stored data is concerned

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Tag Uses

- Telemetry/monitoring
  - Patient
    - Semi-passive and active tags can be fitted with various sensors, such as heart rate or glucose level, temperature, humidity, CO_2
    - Active tags can integrate several attached sensors
  - Equipment
    - Locate and track use of equipment
    - Metering
    - Status
      - Useful for ensuring equipment is ready for use as needed

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Sensors

- In this section we will look at the sensors that locate the tags. In our layered architecture this is the Locating Infrastructure
  - Some tags are self reporting, but this is rare. Even with these tags there must be some way to determine location
  - Most tags will be located by the infrastructure

Sensors

- The requirements for locating an item will vary
  - In some cases we need precise location
  - In other cases we just need to know what room the item is in
  - We may locate tags by proximity to another tag
- Precision of location requirements will drive how we set up the infrastructure and what specific equipment is used

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Sensors

Beacon

Transmitter Beacon

Receiver Beacon

| Transmitter | Receiver |

Locatable
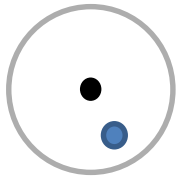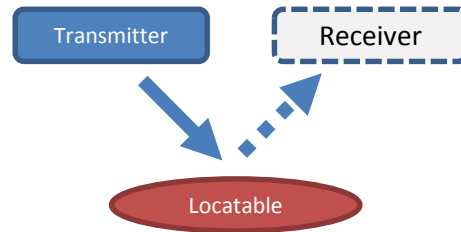
Example Technologies: IR, LF, US

Receiver

Locatable
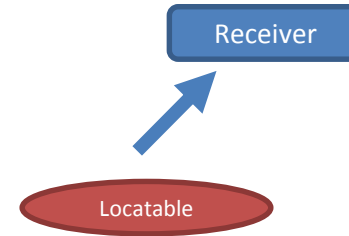
Example Technologies: IR, LF, US

Geometric
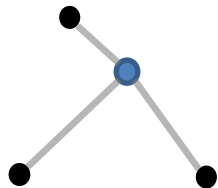
Transmitters Geometric

Receivers Geometric

| Transmitter | Receiver |

Locatable

Receiver

Locatable
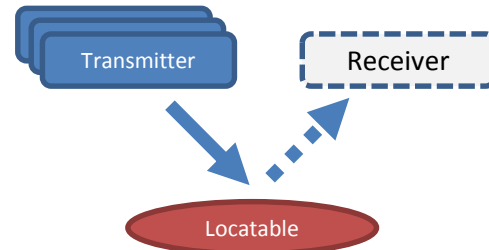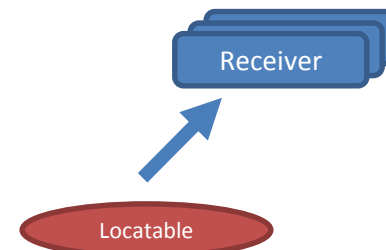
Example Technologies: Wi-Fi, Zigbee, UWB

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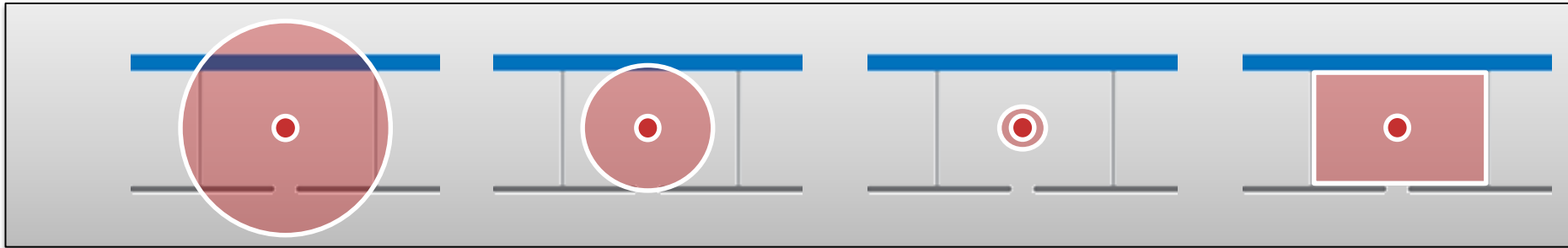Digi-Key ELECTRONICS

ROHDE&SCHWARZ

Sensors

Geometric Calculated Location

Room Beacon

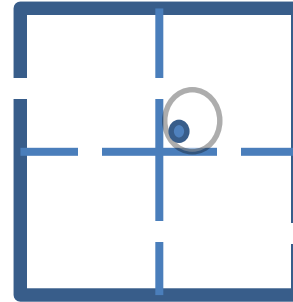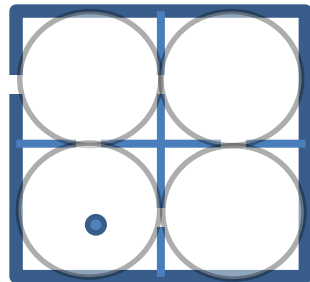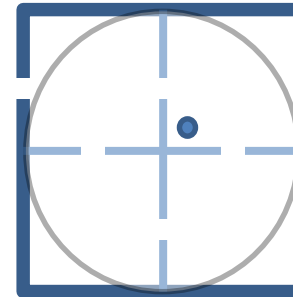Good   Better   Even Better
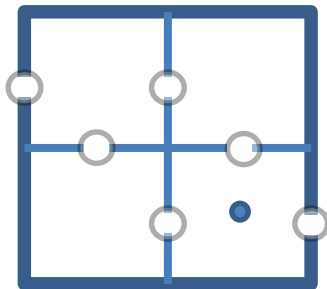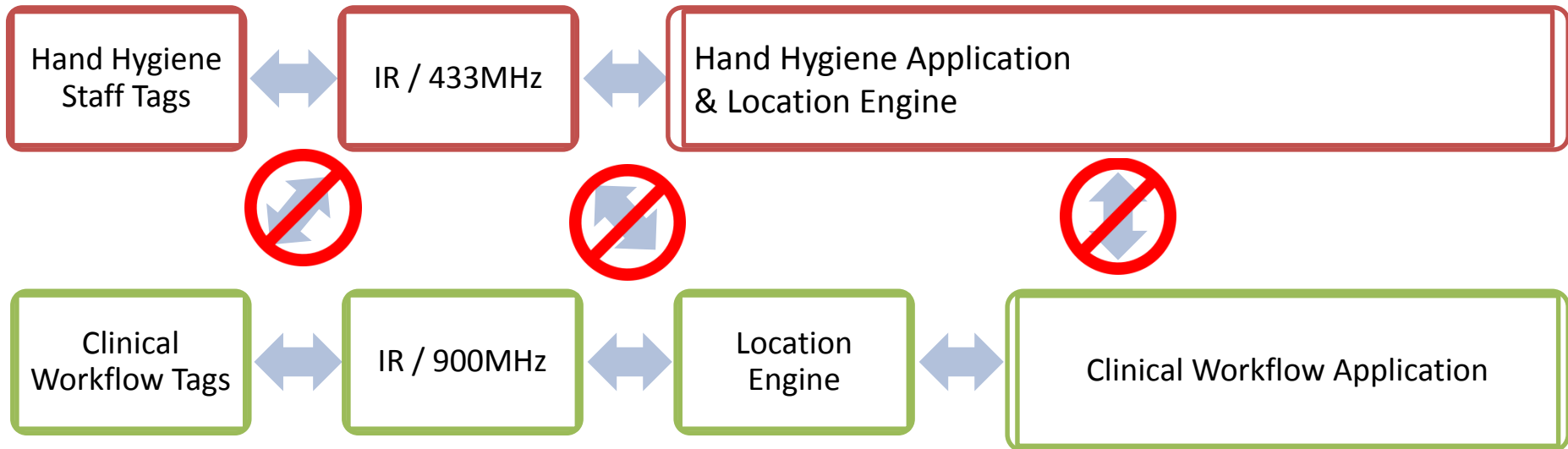
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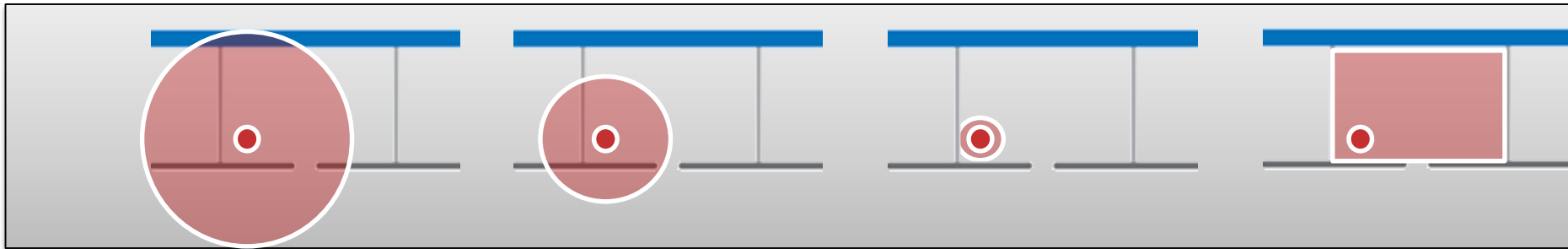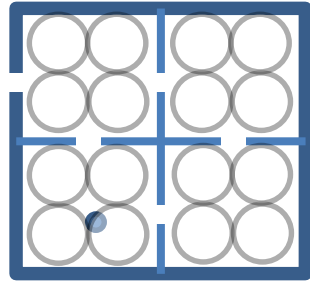
Sensors

Sub
Room

Association

Room

Other Levels

Floor
Building
Campus
System (Presence)

Chokepoint

Sensors

Some examples of tags and sensors in a healthcare setting

RTLS Hand Hygiene Niche

Hand Hygiene Staff Tags	⟷	IR / 433MHz	⟷	Hand Hygiene Application & Location Engine

Clinical Workflow Tags	⟷	IR / 900MHz	⟷	Location Engine	⟷	Clinical Workflow Application

RTLS Clinical Workflow

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Sensors

- Determining location can be done in several ways
  - As we have seen, proximity to the sensor can locate the tag in a finite area
  - Using multiple sensors gives more precise location
  - Using information as signal time of flight, if possible, will give ranging information
  - This area presents many alternatives and cost profiles

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Conclusion/Next Class

- We have looked at the tags and the sensors that are used to locate them

- We have explored a different dimension of tag types which includes their uses and attributes

- We have explored some of the attributes of the sensors and how they might be paced and used

- Tomorrow we will look at the systems and software that ties all of this together

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