Advanced Location Based Services & Active RFiD

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Agenda

- Visibility Solutions
- Location Appliance Architecture Design
- Deployment Considerations
- 3rd Party LBS Applications
- New Features and Functionality
Visibility Solutions

4 key pieces of information

- What Do We Have?
- How Many Do We Have?
- Where Is It?
- What Is It’s Status?

Real-time Location Tracking

Presence

Choke-point

Baby X is in room Y
Expensive equipment in ward H1
‘Alarm’ patient left building door b2
Location Based Services Applications

Problems areas addressed:

- **Lack of visibility** into the location of valuable assets and key staff
- **Inefficient allocation** and use of people and equipment
- **Excessive cost** of leasing & equipment purchases to offset lost or stolen items
- **Unsatisfactory service** resulting from long wait times & wasted search times
- **Security issues** linked to lack of insight into the location and movement of goods and people
Location Appliance Architecture Design
Browser-Based Remote Console for Cisco WCS

HTTPS

WCS

3rd party Integrated Applications: E911, Asset Tracking, ERP, Workflow Automation...

Location Appliance

Notifications
EMAIL
SYSLOG
SOAP/XML
SNMP TRAP

Cisco Wireless LAN Controller

LWAPP

Access Point

LWAPP

Access Point

LWAPP

Access Point

LWAPP

3rd Party RFID Proximity Reader

Wi-Fi Handsets, clients, rogues & Wi-Fi Tags
WCS, Controllers, and Location Appliance

- WCS is the single “front end” for location
- All configuration and management of the Location Appliance is done through WCS
- Visual representation, as well as historical replay of location data is performed by WCS
- Network Designs kept in both WCS and the 2710
- Device information is temporally stored on controllers and polled or pushed to the Location Appliance
Location Information Flow

Location engine uses Real time data to ensure triangulation or uses Exciter coordinates

A=-41dB 10Sec
B=-63dB 10Sec
C=-70dB 300Sec
D=-83dB 10Sec

x,y coordinates etc. available for lookup

x,y coordinates, map timestamp stored in database

3rd party Integrated Applications:

Cisco WCS

Cisco WCS Configuration & alert traps

Wireless Location Appliance

SNMP/Email alert traps

Raw Data

Data Temp.

Data Long. term

Location Information Flow

WLAN Controller

NMSP Asynchronous Timers

Raw Data

-41dB

-63dB

-70dB

-83dB

A

B

C

Cisco WCS
Location Appliance Deployment Considerations

- Location appliance accuracy
  - 10 meters 90% and 5 meters 50% (new accuracy considerations)

- Higher density AP deployment (Enterprise WLAN)
  - Supports enterprise WLAN
  - Higher location tracking accuracy

- RF coverage provided outside of building perimeter
  - Higher location tracking along building edges?

- Location appliance only functions with active 802.11 RFID tags or any WiFi devices
  - Passive 802.11 RF ID tags will not work
  - Cisco working with many vendors towards passive-active RF ID convergence

- Location appliance only functions effectively with fingerprinting for indoor devices
  - RF pattern key to RF fingerprinting algorithm
Deployment Premises

- 2700 Location Appliance tracks up to 2500 combined elements (Clients, Tags, Rogues).
- Controller can track up to 2,500 Tags.*
- Controller can track up to 5,000 Clients.*
- Designs limitation based on Campus and Buildings.
- Customer makes a projection up to how many elements are going to coexist in a Network Design.

*Caveat - Please note it depends on the specific WLAN Controller Model how many Clients or Tags can handled.
Deploying with Location in Mind

- AP placement and density are crucial

- General guidelines:
  
  Each device needs to be heard at better than -75 dBm by **no fewer** than 3 APs
  
  The more APs that hear a device, the better
  
  Optimal AP density is approximately one every 50 to 70 linear feet (17 – 25 meters), depending on the environment and WLAN requirements
  
  AP Placement from the perimeter of coverage areas towards the middle.
  
  AP placement crucial to avoid RF inter-floor bleedthrough in multistory buildings.
Deploying a Location Capable Infrastructure - Location-Aware WLAN Design

Access Point Placement considerations

- Proper placement and density of access points is critical to achieving the quoted location tracking performance
  - Original design might have been based on coverage model
  - Evolving needs may require different AP deployment model
- Location Aware deployments will generally require a higher density of AP’s
Avoid Mounting AP Antennas Too High

- As a general rule, antenna heights of 10 feet or less are most conducive to consistent positioning accuracy.
- As a general rule, antenna heights of over 20 feet should be avoided.
- It is reasonable to expect some variation to occur between different antenna types and orientations.
Deploying a Location Capable Infrastructure
- Location-Aware WLAN Design

Antenna Orientation

- Both the placement and the orientation selected for access point antennas is critical when adding to WCS maps
- Must match actual physical AP placement and antenna orientation as closely as possible, especially with directional antenna
- Ensures accuracy and precision in both location tracking as well as RF heatmap prediction
- Both of these processes account for environmental path losses
  These are calculated using AP location, antenna gains and antenna propagation patterns
- Vertical Elevation support since 4.1
Deployment Note!

- WLAN deployments designed for data will not perform optimally for voice and location deployments.

- Proper AP density and AP placement when deploying for Location together with Voice support, it is recommended to follow the voice deployment guidelines for AP density but use the Location guidelines for deployment.

- New deployment guidelines and recommended best practices will be available soon!
Wi-Fi Active RFID Tags

- Interoperability:
  Interoperable with any standards based 802.11 tag
  Proven interoperability with PanGo & Aeroscout tags

- Battery life:
  3-5 years, depends on beacon/blink rates
  Unassociated tags promote battery life; intelligent motion
  detectors provide intelligent alerting only, which can prolong
  battery life

- Security mechanisms:
  802.11i/WPA2 & VLANs
  Unassociated tags not using security

- Rich Device Information Relay:
  Serial telemetry information capable

- Dimensions:
  Varies slightly by vendor but approximately
  2.44” x 1.57” x 0.67” - 62mm x 40mm x 17mm
  Weight:1.2oz (35g) -2.5oz (w/batteries)

- Environmental Durability:
  Operating Temperature: varies by vendor: -30°C to +75°C (-22°F
  to 167°F) to 32 to 130°F (0 to 54° C)
  Dirt/Dust/Water resistance, includes rubber lining IP-67, IP-68
G2 Microsystems G2C501

- 10mm x 10mm RFID chip with:
  - Multiple location modes.
    - 2.4 GHz WiFi (RSSI), ANSI 371.1 TDoA and UHF EPC Gen 1 passive tag.
  - 125 KHz configuration channel.
  - Multiple security protocol support
    - WEP, WPA, WPA2 initially
  - Telemetry support* (temp, pressure, radiation, humidity, shock, tamper) and motion sensitive.
  - Designed to maximize battery life.

- Tag vendors add battery, antenna, flash for complete product.

- [http://www.g2microsystems.com/products.htm](http://www.g2microsystems.com/products.htm)

* With external sensors
Chokepoint Exciters

- When an active RFID Tag moves to within a defined proximity of the exciter the active RFID Tag begins transmitting packets advertising its location in relation to the exciter.
- These packets are captured by the infrastructure and forwarded to the location server with high priority.
- Allows for very precise localization (per shelf, per cabinet, entry, exit, etc.).
- Uses 125Khz based chokepoints
3rd Party LBS Applications & Solutions
Cisco Wireless Location Appliance

- Industry’s 1st Integrated Location Solution
- Real-time Location Services
- Advanced RF Fingerprinting
  - High accuracy location resolution within a few meters
  - Granular rogue detection
- Simultaneous real-time tracking of thousands of devices
- API Third Party Applications
- RF capacity management and historical location trending
- Intuitive management through Cisco WCS GUI

Cisco 2710 Series Wireless Location Appliance
Cisco Wireless Location Appliance

Cisco LBS is all you need for a complete Enterprise location management solution.

Cisco 2710 Series Wireless Location Appliance
Cisco Location Solution
The right partners for the right solution

Network as one Platform

Tag and Devices
Cisco Wireless Location Appliance
Cisco Wireless Location Appliance Open API
Cisco Wireless LAN Controller
Cisco Compatible eXtension tag
Chokepoint 125 kHz
Multiple Frequency Tags
Active Tags
Chokepoints
Cisco Wireless Access Point
Cisco Wireless Control System (WCS)
Network as one Platform
Cisco Location Solution
The right partners for the right solution

Network as one Platform
Location Application Middleware
Why do I need Third-Party Middleware if I already have Cisco LBS?

- Intuitive user interface for true asset visibility – designed for business users (vs. IT personnel)
  - Floor plan or table view of asset location and information
  - Sophisticated asset search and filtering
  - Industry-specific (e.g., healthcare) asset icons and group representation
- Event management
  - Location-based, state-based (e.g. motion), and battery status e-mail notifications and alerts
- Reporting
  - Current and historical location, movement and asset/tag information
  - Custom reporting using ODBC/SQL
- Asset tag and Exciter configuration and management tools
  - Define asset information (name, type, owner, serial #, etc.) for tracking, search and filtering
  - Link tags with assets and related asset description data
  - Define network, reporting frequency and security settings
- System Integration
  - Asset import tools
  - External Hyperlinks: Information, Video, E-mail
  - Additional APIs for enterprise integration
Safety and Environmental Application
GROTTE DELL’ANGELO DI PERTOSA

- **Problem**
  - Cave owner in Italy identified that heat and lighting, together with CO2 discharge from visitors was effecting the cave environment.

- **No communication with visitor groups**

- **Photosynthesis causing flora to grow and destroying the exhibits**

- **Solution**
  - Reduce heat & light by activating lighting only during visits

- **Install a communication system for tracking information and emergency**
Cave Layout

GROTTE DELL’ANGELO DI PERTOSA
Location WiFi Network

GROTTE DELL’ANGELO DI PERTOSA

- 16 access switches for Wi-Fi
- 40 Access Points CISCO 1242
- Full WiFi VoIP coverage
- Double fiber optic backbone forming a redundant Network infrastructure
Additional Location Partners

- Emergin: healthcare alarm/integration middleware
  http://www.emergin.com/

- Cardiac: healthcare alarm/integration middleware
  http://www.cardiac.no/

- HP: Enterprise data center target asset tracking / management
  http://www.hp.com/

- WhereNet: manufacturing and healthcare tags/exciters, asset tracking application
  http://www.wherenet.com/

- Airetrak: NHS healthcare alarm/integration inventory middleware
  http://www.airetrak.com/
New Features & Functionality
Cisco Unified Wireless Network Software Release 4.2

Standalone Access Points
- Cisco WCS Monitoring and Unified migration tool

High Availability
- Remote Locations
- HREAP Enhancements

Ease-of-Use and Operations
- Enhancements to Cisco WCS and WLAN Controllers

Spectrum Intelligence
- Cisco WCS and Cognio Spectrum Expert enhancements

Increased Scalability
- Cisco WCS Navigator supports 30,000 access points

Outdoor Mesh
- New Cisco WCS reports and map enhancements

Mobility Services

Guest Access
- Wired and wireless
- Improved security, monitoring, reporting, and bandwidth usage

Voice Services
- Voice ready tools
- Simplified calibration

Security Services
- Expanded Intrusion Detection System (IDS)

Location Services
- More accurate location assessment
Cisco Location Solution
Unified Wireless Software Release 4.2

- **Increased Flexibility**
  - Customization for specific requirements, scalability and desired accuracy level
  - For example, multiple configurations for inter-floor differentiation

- **Enhanced Performance**
  - Improved building coverage
  - Improved response time and accuracy of devices

- **Manageability**
  - Effective resource management of devices
  - Ease of management
Inter-floor Configurations

- **Chokepoint Technology Only**
  - Notifications are triggered by chokepoints (AeroScout/WhereNet) as the Wi-Fi tags come within range of a chokepoint.
  - CCX Tags can store the 5 last chokepoints (perimeter) crossed where one is reserved for storing entry/exit chokepoint.

- **RSSI Algorithm only**
  - Inter-floor differentiation even if chokepoints are not preset

- **Simultaneous use of both methods**
  - Chokepoints + RSSI Algorithm
  - For location calculations, algorithm makes use of RSSI values and Perimeter Chokepoint information
Immediate Location Updates

Features

- Sends location information to Third Party Application once the location event is detected
- Location event can be client, Wi-Fi phone, client rogue access point, rogue client and Wi-Fi tag

Benefits

- Improved response time and accuracy of devices
- Essential for time critical applications such as locating a maintenance person or monitoring perishable items

Before
Location updates based on pre-set polling time

Now
Location updates sent immediately from devices
Element Partitioning

Features
- Clients, tags and rogue devices can be divided into groups for easier tracking
- Once placed in group, the individual client, tag or rogue is tracked as a member of a group

Benefits
- Ease of management
- Effective Resource Management by tracking elements per group
802.11n and Aironet 1250 Support

- The Aironet AP1250 is the industry’s first 802.11n ready upgradeable access point
  - Designed to support 5 GHz 802.11a/n and 2.4 GHz 802.11b/g/n radio modules
  - Initial release supports the 802.11N draft 2.0 radio modules

- Support for 2 spatial streams with Maximum data rate of 304 Mbps

- Performance benefits and Location enhancements are still being characterized and will only be realized under certain conditions (traffic type, proximity to AP, etc.)
Summary

- Business operations are enhanced through location services
- Fully integrated location solution leverages existing WLAN infrastructure
- Easy-to-use, flexible, tracks 802.11 and Wi-Fi Active RFID devices
- Foundation for location based security
- Support for third party location applications and Wi-Fi tags through Location Appliance API
What is 802.11n?

- Next Generation 802.11 high rate 2.4 GHz and 5 GHz specification
- Greatly increased data throughput and range
- Support for MIMO and Spatial Multiplexing
- Addition of wider channel use (40 MHz) channel bonding modes
- Support for higher modulation rates (more subcarriers) and support for MCS data rates.
- Support for frame aggregation A-MPDU & A-MSDU
- Introduces support for guard intervals
- Support for MRC (Maximum Ratio Combining) transmitter combining
- Support for Beam-forming
- Other improvements as well (QOS, MAC)
MIMO overview

Spatial Multiplexing
- Increases bandwidth
- Transmitter and receiver participate
- Multiple antennas txmt concurrently on same channel

Transmit beam forming
- Increases receive sensitivity
- Performed by transmitter
- Ensures signal received in phase

Maximal Ratio Combining
- Increases receive sensitivity
- Performed by receiver
- Combines multiple received signals
Benefits of MIMO with 802.11a/g client

- **Beamforming**
- **Spatial Multiplexing**
- **Maximal Ratio Combining (MRC)**

Diagram:
- **Multiple Out**
- **Single In**
- **Multiple In**
- **Single Out**
- RF Channel