TOMORROW starts here.
Delivering Location Based Services with Cisco Enterprise Mobility Services Platform

Christian Gauer, TME Enterprise Solutions Group
Create Business Impact with Cisco’s CMX

**Detect**
- Presence and location detection
- Visibility

**Connect**
- Easy Wi-Fi login, custom or social
- Zone-based, custom splash pages

**Engage**
- App-based mobile engagement
- Context-aware in-venue experiences

Analytics
How CMX Works
Built on Cisco Unified Access

- ANALYTICS DATA
- MSE (Virtual/Physical)
- APPLICATION DATA
- Mobile Application Server
- LOCATION DATA
- Analytics UI
- DEVICE-BASED DISCOVERY
- Depending on Application Layer

Cisco Connect 2015
Indoor Positioning
Cell of Origin

• One of the simplest mechanisms of estimating approximate location in any system based on RF cells is the concept of ‘cell of origin’ (or ‘associated access point’ in Wi-Fi 802.11 systems)

• To better determine which areas of the cell possess the highest probability of containing the mobile device, some additional method of resolving location within the cell is usually required.

• When receiving cells, provide received signal strength indication (RSSI) for mobile devices; the use of the highest signal strength technique can improve location granularity over the cell of origin.

• With CMX this level of positioning granularity would only suffice to provide presence information
Distance-Based (Lateration) Techniques Received Signal Strength (RSS)

- Lateration can be performed by using RSS in place of time (TDOA)
  - Measured by either the mobile device or the receiving sensor
- Path loss represents the level of signal attenuation present in the environment due to the effects of free space propagation, reflection, diffraction, and scattering
  - Path loss exponent indicates the rate at which the path loss increases with distance; the value depends on frequency and environment
  - Is highly dependent on the degree of obstruction (or clutter) present in the environment

Typical path loss exponent for:
- Indoor office environment - 3.5
- Dense commercial or industrial environment - 3.7 to 4.0
- Dense home environment - as high as 4.5
Angle-Based (Angulation) Techniques
Angle of Arrival (AoA)

- The AoA locates the mobile station by determining the angle of incidence at which signals arrive at the receiving sensor
- Requires two receiving sensors for location estimation, with improved accuracy coming from at least three or more receiving sensors (triangulation)
- Requires multiple element antenna arrays or mechanically-agile directional antennas
- Works well in situations with direct line of sight, but suffers from decreased accuracy and precision when confronted with signal reflections from surrounding objects
- In dense urban areas, AoA becomes barely usable because line of sight to two or more base stations is seldom present
Relationship Between RSSI & Distance

- RF fingerprinting uses a client's RSS from probe requests to localize a tracked client.
- This localization works best when the relationship between the RSS and the distance from the AP poses a clearly monotonic relationship.
- Monotonic means Y only moves up or down in relation to X.

The closer the distance the greater the rate of change in RSS in relationship to distance.

The change in RSS in relationship to distance flattens out at greater distances.
WiFi Based Location Calculation Basics (Trilateration)

A WIFI device seen by one AP could be located on anywhere in this **circle**

When a device is seen by two AP then location must be in this **line**

When a device is seen by four AP then location must be at this **point**.

Accuracy highest when a device is seen by at least 4 Access points
Basic Example of Location-Aware Access Point Deployment

If possible, mount antennas such that they have an unencumbered 360° view of all areas around them, without being blocked at close range by large objects.
Presence and Location Comparison

- Device is in/out of the store
- Based on distance to an access point

- Device is in a department of the store
- Based on X, Y coordinates
Probe RSSI vs. Data RSSI

Location Resolution is Critical to Actionable Business Intelligence

Business Intelligence is Critical to Proper Decision Making…

…And It Needs To Scale
How Location Is Calculated with FastLocate

- Access points detect mobile devices or tag signals and measure RSSI from all frames sent over Wi-Fi.
- Controllers send RSSI information signal to the Cisco MSE for location calculation.
- RF fingerprinting and triangulation, based on signal strengths, are used to calculate device location.
- Out of Data Path for Higher Scalability

**Derived D1**
- Measured Strength: -33 dBm

**Derived D2**
- Measured Strength: -40 dBm

**Derived D3**
- Measured Strength: -50 dBm
When a client is constantly sending packets on a channel, network will get a packet EVERY 4 seconds (250ms x 16 channels) and be able to gather values once every 4 seconds.

Location is calculated approximately 1 every 8 seconds. (~8 times per Minute)
What is Bluetooth Low Energy (BLE)?

- Bluetooth Low Energy (BLE) is a subset of the Bluetooth 4.0 spec
  - Ultra-low power consumption – run for years on a coin battery
  - Low-cost system-on-chip solutions – proliferate in small devices
  - Simplified communication protocol – easy to implement & extend

- Operates on the 2.4GHz ISM band (2400-2483.5MHz)
  - 40 channels in-between & overlapping WiFi Ch 1,6,11
  - 1 Mbps GFSK, frequency-hopping
  - Reliable signaling up to 100m

- Devices identify themselves with UUIDs
  - Like a MAC address, but also encodes a “profile”
  - Sensors, health monitors, alarms, etc.
What is BLE being used for?

- Battery operated BLE Beacon and App for management (sometimes crowd sourced)
- Retailers are using this to quickly test drive location based services
- Healthcare facilities are using this to improve patient experience.
- Museums are using this for personalizing tour experience
- Use cases:
  - Target marketing messages and Ads
  - Display patient location and map of the hospital for navigation
  - Gather Analytics
Cisco’s BLE Strategy

**BLE Aware**
- Use CleanAir to detect BLE
- Check Beacon Health
- Track Assets with BLE
- Alert on rogue beacons

**MSE 10.x and WLC 8.0MR1**
**Q1CY15**

**BLE Capable**
- Integrated BLE radio with Hyperlocation module
- Reduce number of beacons
- Transmit multiple UUIDs

**MSE 10.x and WLC 8.1**
**Q2CY15**

**BLE Gateway**
- Combined WiFi + BLE Location and Analytics
- Extend CMX SDK to BLE

**MSE10.x and WLC 8.x**
**Q3CY15**

Cisco Connect 2015
Where does BLE fit in Location strategy

BLE can be part of your location strategy if you already have or will have an App

- **Opportunities for BLE only**
  - Proximity-based messaging
  - Easy to deploy
  - Lower CapEx

- **Challenges for BLE only**
  - Requires App to be downloaded and running
  - Limited Use Cases if deployed without Wi-Fi
  - Higher OpEx
Beacon and Wi-Fi Location Deployment

- AP’s for Wi-Fi
- Beacons for Location
- Beacon rogues difficult to detect
Beacon and Wi-Fi Location Deployment

- Hyperlocation - BLE integrated with APs
- Fewer beacons to deploy/track
- Rouges can be detected and removed
BLE Monitoring – Visibility and Alerts

- Unique beacon identifier decoded
- Beacon type classified as an active rogue
- Major ID typically identifies store or branch while minor ID typically identifies aisle or dept. within
- BLE mac address
- 22
Introducing the Cisco Hyperlocation Module

- **Angle of Arrival (AoA) Triangulation**
  1-3 m accuracy, <1m with beacons

- **Integrated BLE Beacon**
  Reduce BLE deployment size

- **Centralized Management**
  BLE and Wi-Fi visibility

- **Enhanced FastLocate**
  Faster refresh rates

- **Improved Security Coverage**
  Integrated Wireless Security Module
Location Accuracy

Today: Approx. distance via RSSI, but no idea which direction → more error in calculation

Solution: Determine direction to client in addition to distance → dramatic error reduction
Innovation: Angle of Arrival (AOA) = ~meter accuracy

- Different antenna elements hear the signal a little earlier/later than others, measured by the phase of the signal.
- Favors line-of-sight with stellar accuracy in cone under AP.
Context Aware Services Architecture
Context Aware Service (CAS) Hardware and Data Flows

HTTP/HTTPS

Network Administrator Workstation

Cisco Prime Infrastructure

SOAP/XML over HTTP/HTTPS

SNMP

Network Mobility Services Protocol (NMSP)

HTTPS

CAPWAP

Cisco Wireless LAN Controller

CAPWAP

Cisco Access Point
2.4 GHz Channel 6
5 GHz Channel 40

Network Mobility Services
Protocol (NMSP)

Cisco Mobility Services Engine

Cisco Access Point
2.4 GHz Channel 1
5 GHz Channel 36

HTTPS

Setup

Cisco Access Point
2.4 GHz Channel 11
5 GHz Channel 44
Context Aware Service (CAS) Hardware and Data Flows

HTTPS

Network Administrator Workstation

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Cisco Wireless LAN Controller

CAPWAP

Cisco Access Point
2.4 GHz Channel 6
5 GHz Channel 40

CAPWAP

Cisco Access Point
2.4 GHz Channel 1
5 GHz Channel 36

NTP

NTP Server
(Needed for FastLocate)

Cisco Access Point
2.4 GHz Channel 11
5 GHz Channel 44
Context Aware Service (CAS) Hardware and Data Flows

- **Network Administrator Workstation**
  - HTTPS
  - Cisco Prime Infrastructure
  - SNMP

- **Cisco Prime Infrastructure**
  - SOAP/XML over HTTP/HTTPS

- **Network Mobility Services Protocol (NMSP)**

- **Cisco Mobility Services Engine**
  - HTTPS

- **Cisco Access Point**
  - 2.4 GHz Channel 1
  - 5 GHz Channel 36
  - Probe Request or Data from Wireless Client on Channel 36
  - CAPWAP

- **Cisco Wireless LAN Controller**
  - CAPWAP

- **Cisco Access Point**
  - 2.4 GHz Channel 6
  - 5 GHz Channel 40
  - Probe Request or Data from Wireless Client on Channel 40

- **Cisco Access Point**
  - 2.4 GHz Channel 11
  - 5 GHz Channel 44
  - Probe Request or Data from Wireless Client on Channel 44

- **Cisco Wireless LAN Controller**
  - NTP
  - NTP Server (Needed for FastLocate)
Detect – CMX Analytics
Create Connected Experiences with Cisco’s CMX

Presence & Analytics
- Presence detection
- On-premise visibility

Visitor Connect
- Easy Wi-Fi login, custom or social
- Zone-based, custom splash pages

Contextual Experience
- Location-based push notifications
- App-based mobile engagement
Understand How People Interact in the Location

- Number people by venue and zones
- Peak time in venue
- New compared to repeat visitors
- Common traffic patterns
- Where people spend time
High-level overview of Hardware and Information Flows for CMX Location Analytics

HTTP

HTTPS

Network Administrator Workstation

Cisco Prime Infrastructure

SNMP

Network Mobility Services Protocol (NMSP)

Cisco Wireless LAN Controller

CAPWAP

Cisco Access Points

MSE Running CAS

HTTPS

End-User Viewing Analytics Information

MSE Running CMX Analytics Service

DB Connection

SOAP/XML/REST over HTTP/HTTPS

SOAP/XML/REST over HTTP/HTTPS

HTTPS

HTTPS

WiFi Clients
CMX Analytics Dashboard
Multiple Zones Comparison in Dashboard

Today - Device Count - 4 zones

- South-South Level 0-Collab
- South-South Level 0-DC
- South-South Level 0-EN
- South-South Level 0-Security
Report: Detected vs. Connected Devices

Detected vs. Connected
Date from: January 26th 2015 to: January 26th 2015
Time from: 00:00:00 to: 23:59:00
Zone: South-South Level 0
Preview - Analytics MSE 10

Last Weeks Mall Activity Report

Visitors

28,185 Total Visitors

9,622 Repeat Visitors - 34%
18,563 New Visitors - 66%

Compared to:

Two Weeks Ago
06% 01%
Repeat Visitors New Visitors

Weekly Average
03% 09%
Repeat Visitors New Visitors

Average Dwell Time
1HR 2MINS

1hr 27mins
Repeat Visitors
50mins
New Visitors

Compared to:

Two Weeks Ago
00% 00%
Repeat Visitors New Visitors

Weekly Average
00% 00%
Repeat Visitors New Visitors
Enterprise Mobility Services Platform
Challenge for Today’s Enterprise

Line of Business Challenges
• Delivering personalized content to drive sales and loyalty
• Incorporating existing application functionality into mobile apps
• Being able to get the application built quickly and affordably

IT is challenged delivering on the LOB needs and timelines….

- Multiple Devices and Platforms to Support
- Resource Intensive Development
- Scale Across Locations, People Environments
- Deliver Highly Secure Solutions
What Is Cisco EMSP?

The Cisco Enterprise Mobility Services Platform enables the rapid delivery of context-aware mobile experiences that exceed business and customer expectation. It binds Cisco network infrastructure capabilities with enterprise and open cloud systems, creating ready-to-use modules for mobile, web and native applications.
EMSP Delivers New Experiences

- Gives applications context awareness, allowing customer engagement like never before
- Prebuilt integration to infrastructure, applications and cloud services
- Robust analytics and admin consoles that empower business users to manage content
- Leverages real-time data to influence and drive behavior
Finding and Engaging Loyal Customers
Cisco EMSP in Retail

• Engage with shoppers when in store
• Differentiation between retail locations
• Flexibility for store manager to make updates to mobile experience/content
Finding and Engaging Loyal Customers
Cisco EMSP in Retail

Proposed Solution (Workflow Enabled)

- Store manager identifies excess inventory of Bedding
- Using the management control app, store manager updates and pushes a targeted ad for Bedding
- Customer detected on arrival
- Welcome notification encouraging customer to open store app
- Using the management control app, store manager updates and pushes a targeted ad for Bedding

Benefits

- **Superior customer experience:** Engage shoppers with experiences unique to that store
- **Successful targeted advertisement:** Notify shoppers of any relevant promotions, promotion of the day, etc., when in store, to influence buying patterns

Personalized promotion of the day via wayfinding, push ads, etc.
Targeted Offers Delivered to your Application
EMSP Location Services

Geo Location
- Devise GPS via WiFi or cellular connectivity

Premise
- WiFi Access Point association

Zone (x,y,z)
- WiFi Triangulation
- BLE
Context Aware Mobile Experiences For The Hybrid Enterprise

Enterprise Service Mobility Platform delivers context aware mobile experiences by bringing together infrastructure, enterprise apps, and cloud services.

Network Enriched Engaging Experiences
Leverage intelligent network services to deliver engaging context aware mobile experiences.

Expose Cloud and App Services
Integrate, expose and mobilize business intelligence, cloud services, and enterprise app services.

Operational Efficiencies
Pre-built, ready-to-use, and device agnostic application experiences to meet industry and LoB needs.
Native Application Development:
- Use EMSP Studio and app builder to develop iOS or Android native applications
- Leverage hundreds of pre-built experiences for rapid app development

Hybrid Application Development:
- Use the EMSP AppX SDK and Studio to provide feature rich hybrid application experiences embedded within your native application

Web Application Development:
- Use the EMSP Studio to rapidly build, host, and update web-based applications
- Primary vehicle to deliver context experiences
EMSP Dashboard
EMSP Demo

- Connect to SSID
- Login with your E-Mail
- Subscribe to SMS Service

For more details visit the Enterprise Networks Demo Booth
Mobility Services API
Mobility Services API and CMX App SDK

- Supports SOAP/XML and REST (new)
- Exposes current and historical location information for tracked devices
- Enables numerous use cases – apps, analytics, equipment tracking, etc.
- Offers a pull model: XML or JSON, based on the requesting client
- Offers a push model: XML, JSON, and protocol buffer formats Can be streamed over HTTP, HTTPs, or TCP
Mobility Services SDK

LOCATION DATA

APPLICATION DATA

CMX Mobile Application Server

Apple Push Notification Service

Google Cloud Messaging

Controller (Virtual/Physical)

MSE (Virtual/Physical)
CMX Tools: API
REST API - Examples

• Just use your Webbrowser to:
  • Get Maps Information:
  • https://MSE-IP/api/contextaware/v1/maps

• Get Map Image:
  • https://MSE-IP/api/contextaware/v1/maps/imagesource/domain_0_1363174316182.jpg
REST API - Examples

- Get Client Location by MAC Address:
- https://MSE-IP/api/contextaware/v1/location/clients/5c:0a:5b:b0:04:14

This XML file does not appear to have any style information associated with it. The document tree is shown below.

```
<WirelessClientLocation ipAddress="10.4.0.208 2001:4d38:000a:0400:9092:f856:137b:6f32 fe80:0000:0000:0000:5e0a:5bfe:feb0:0414" ssid="CiscoLive2015" band="UNKNOWN" apMacAddress="88:f0:31:e6:a2:40" isGuestUser="false" dot11Status="ASSOCIATED" macAddress="5c:0a:5b:b0:04:14" currentlyTracked="true" confidenceFactor="408.0">  
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</WirelessClientLocation>
```
HALO Module is a Mainstream AoA Solution

- Halo module wraps around AP
- 32 extra antennas to turbo-charge Angle of Arrival
- The Halo module will include Bluetooth capability as well
Analytics Configuration

- Enable History Logging for Client Stations on Context Aware MSE
Fan Wifi On-boarding In-Stadium

Business Problem
- Mode to publish Mobile apps to non-frequent fans In- Stadium
- Capture new fans coming into the Stadium
- Visibility to In-Stadium activity

Solution Pre-requisites
- Cisco WLAN Infrastructure Design for Location Capability
- CMX provides location info
- CRM with fan history Dbs w/API Integration capability

Business Outcomes
- Personalized experience – Based on Profile and Likes
- In-Stadium Analytics-Track behavior and actions

Stadiums can track Fan activity when In-Stadiums moving forward
## EMSP Cisco Infrastructure Requirements

<table>
<thead>
<tr>
<th>Feature</th>
<th>Infrastructure Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobile Application Development (Native, Hybrid, Web)</td>
<td>N/A, infra independent</td>
</tr>
</tbody>
</table>
| WiFi Engage Portal w/ Location based web experience* | **Meraki:**  
  - Wireless LAN Cloud Controller  
  - Minimum of 1 AP (MR12, MR18, MR26, MR34, MR62, MR66)  
**Cisco:**  
  - Wireless LAN Controller  
  - Minimum of 1 AP (Aironet 700, 1700, 2700, 3700)  
  - MSE 7.6 or 8.0 (highly recommended) |
| Location Services API’s (‘where am I’, POI, etc) | **Cisco:**  
  - Wireless LAN Controller  
  - Minimum of 4 (high density) AP’s (Aironet 1700, 2700, 3700) w/ Fast Locate Modules/WSM  
  - MSE 8.0 |

*The minimum bandwidth cap we recommend is 5mbps per user to ensure the initial page load experience is acceptable. With a 1:3 sharing, 50mbps can support ~30 users connecting simultaneously.*
## EMSP Deployment Requirements

<table>
<thead>
<tr>
<th>Tool</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EMSP Studio</strong></td>
<td>Operating System</td>
</tr>
<tr>
<td></td>
<td>MAC OS 10.6 and above (64 bit)</td>
</tr>
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<td>Microsoft Windows XP and above (32 bit)</td>
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<tr>
<td></td>
<td>RAM</td>
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<td>2GB</td>
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<td>Other</td>
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<td><strong>WiFi Engage Portal</strong></td>
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<td><strong>Location Services API’s</strong></td>
<td>N/A, full cloud hosted solution</td>
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<td><strong>Cisco Integration Platform – ESB</strong></td>
<td>Hardware Requirements</td>
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<td>• 2GHz, dual-core CPU, or 2 virtual CPUs in virtualized environments</td>
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<td>• 2GB of RAM</td>
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<td>• 4GB of storage</td>
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<td>Java Runtime Environments</td>
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<td>AIX V7.1</td>
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CMX Connect
Location-Specific Guest Access

Simplify Access with User Opt-In

Offer Clear Terms and Conditions

Multiple Access Methods

Custom or Social Media

Customized Access and Promotion

Proximity-Based Landing Pages and Video

Understand Who Is in Your Location

Enhanced Analytics
Location-Specific Guest Access – Cisco CMX Connect

- Customize the Wi-Fi guest access experience
- Gain valuable analytics about who is in venue
- Simplify the user experience while offering clear terms and conditions

Registration, Terms, and Conditions

Custom Landing Page/Video

Simplified Login
Captive Portal Configuration

- Login to: [https://mse/dashboard/](https://mse/dashboard/)
Login Procedure – First Login

- User connects to SSID
- User opens Safari
- Redirect to Captive Portal
  - User enters E-Mail etc.
- Play Advertisement Video
  - User can skip after 10sec
- Select Social Login and enter credentials
- Redirect to original page or Redirect URL
Guest Access – Cisco CMX for Facebook Wi-Fi

- Increase brand recognition and gain insights through Facebook Wi-Fi.
- User connects to Wi-Fi, opens browser, and checks in.
- Venue gains exposure through news feeds, notifying friends.