

TOMORROW starts here.



Cisco *live!*

Deploying MSE - Connected Mobile Experiences, Adaptive WiPS

BRKEWN-2012

Will Blake

Consulting Systems Engineer

Agenda

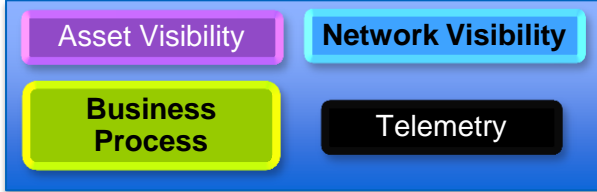
- Technology Overview
- WIPS
- Connected Mobile Experiences
 - CMX Engage
 - CMX Analytics
- Design and Planning



Technology Overview

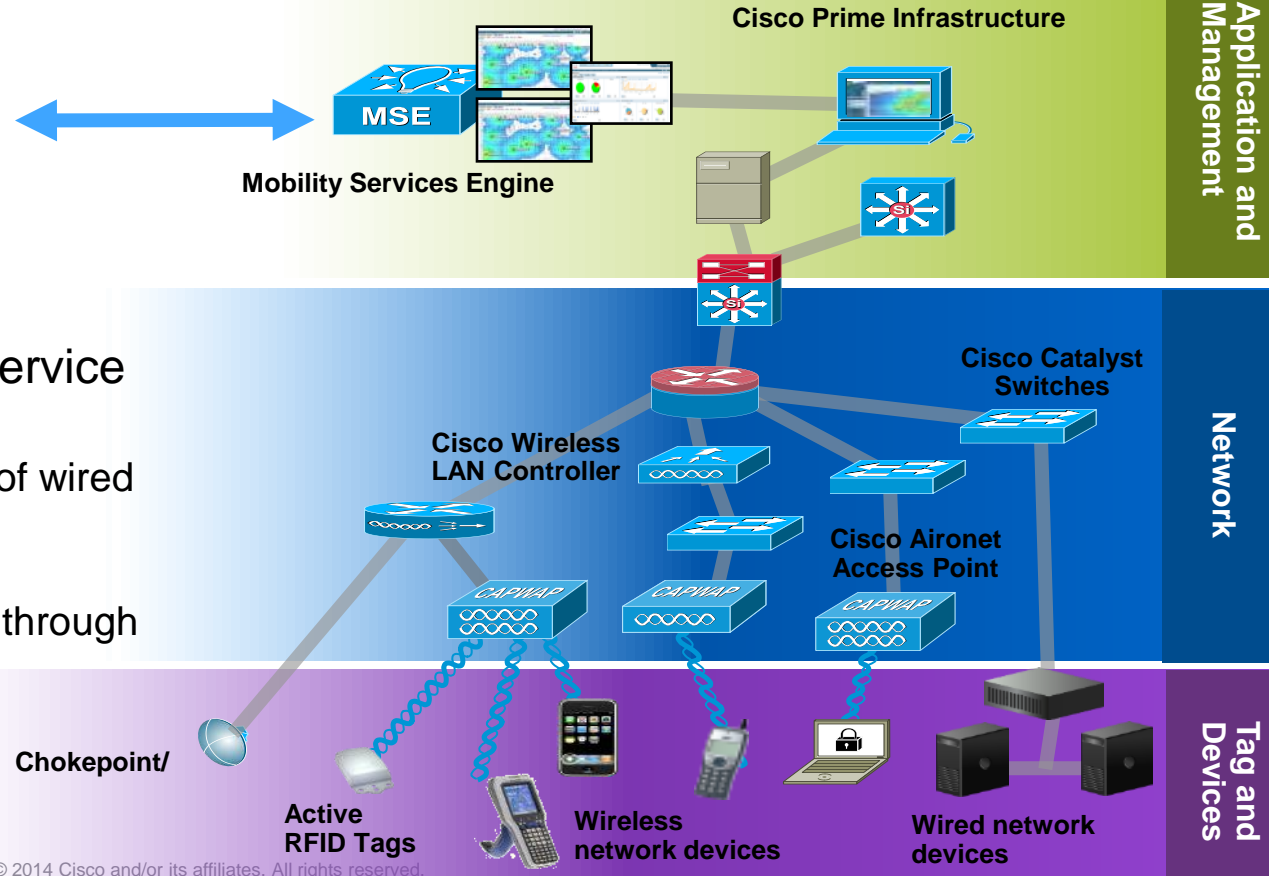
Context-Aware Architecture

Context-Aware Applications

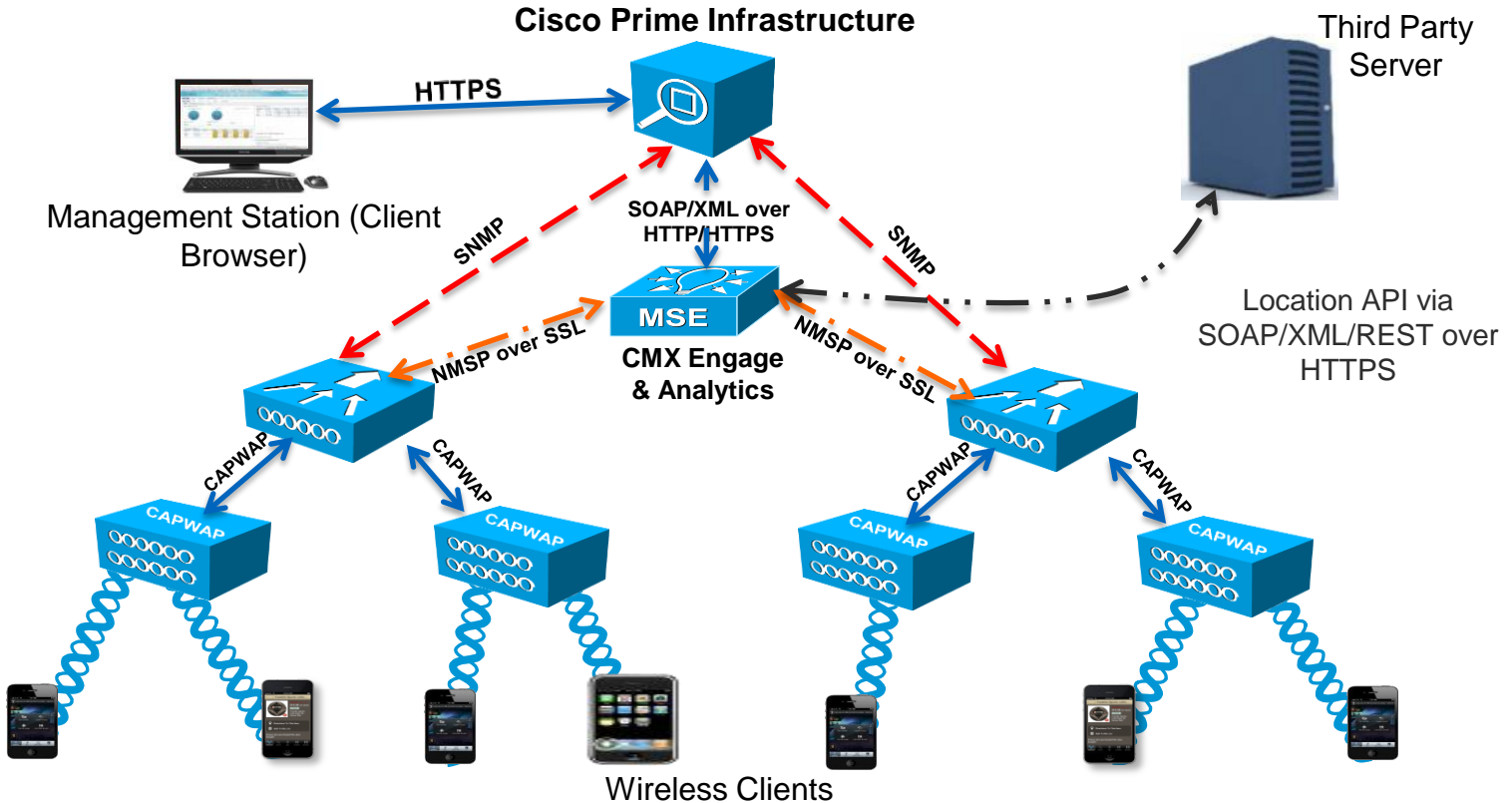


Cisco MSE Context Aware Service

- Provides contextual information of wired and wireless IP enabled devices
- Contextual information provided through SOAP/XML/REST API

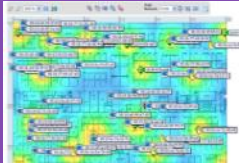


Location Services Topology



Context-Aware Services (CAS) Use Cases

Network Visibility & Control



Enhanced WLAN Security



CleanAir



Medianet



Asset Management



Telemetry



Worker Safety/ Workflow



NETWORK VISIBILITY SOLUTIONS

ASSET VISIBILITY SOLUTIONS



WIPS

Wireless Security Threats

On-Wire Attacks

Over-the-Air Attacks

Ad-hoc Wireless Bridge

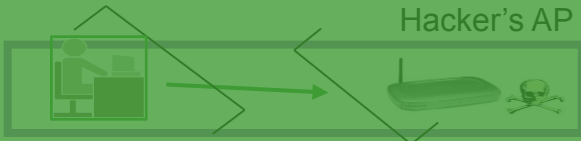
Hacker



Client-to-client backdoor access

Evil Twin/Honeytrap AP

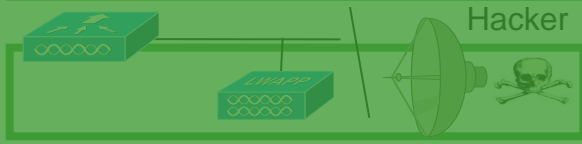
Hacker's AP



Connection to malicious AP

Reconnaissance

Hacker



Seeking network vulnerabilities

Cisco WIPS Detects These Attacks

Rogue Access Points

Hacker



Backdoor network access

Denial of Service

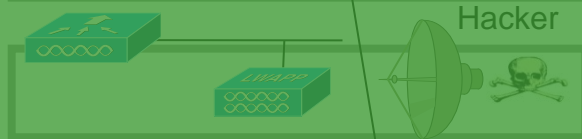
DENIAL OF SERVICE



Service disruption

Cracking Tools

Hacker



Sniffing and eavesdropping

Cisco Spectrum Intelligence

Detects These Attacks



Backdoor access

Video Cameras

Service disruption

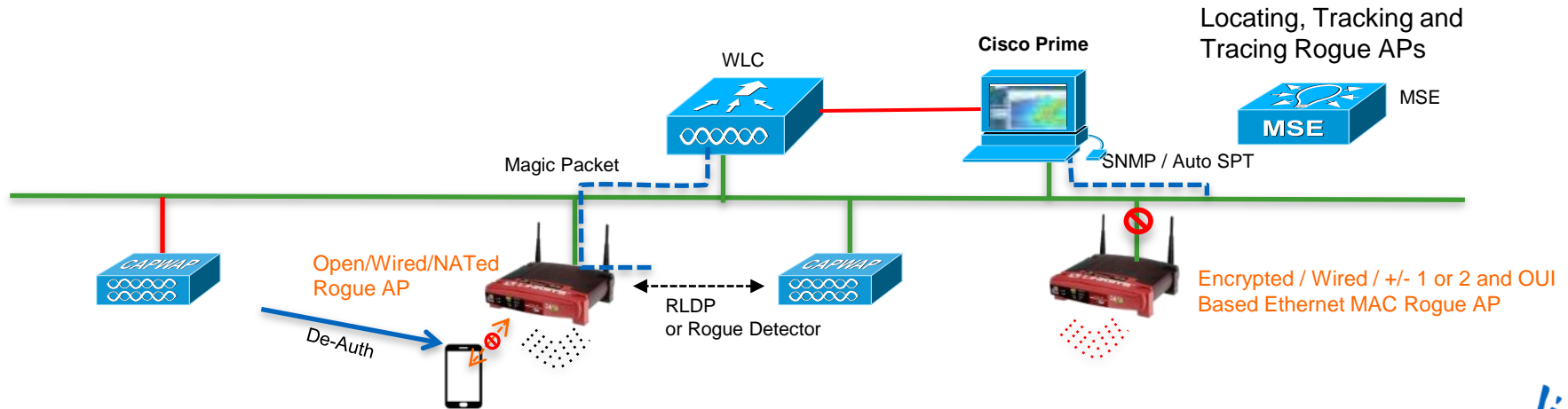
Microwave

RF JAMMERS



Cisco WIPS Review

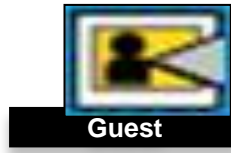
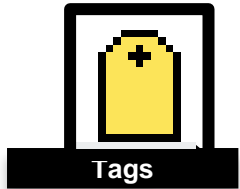
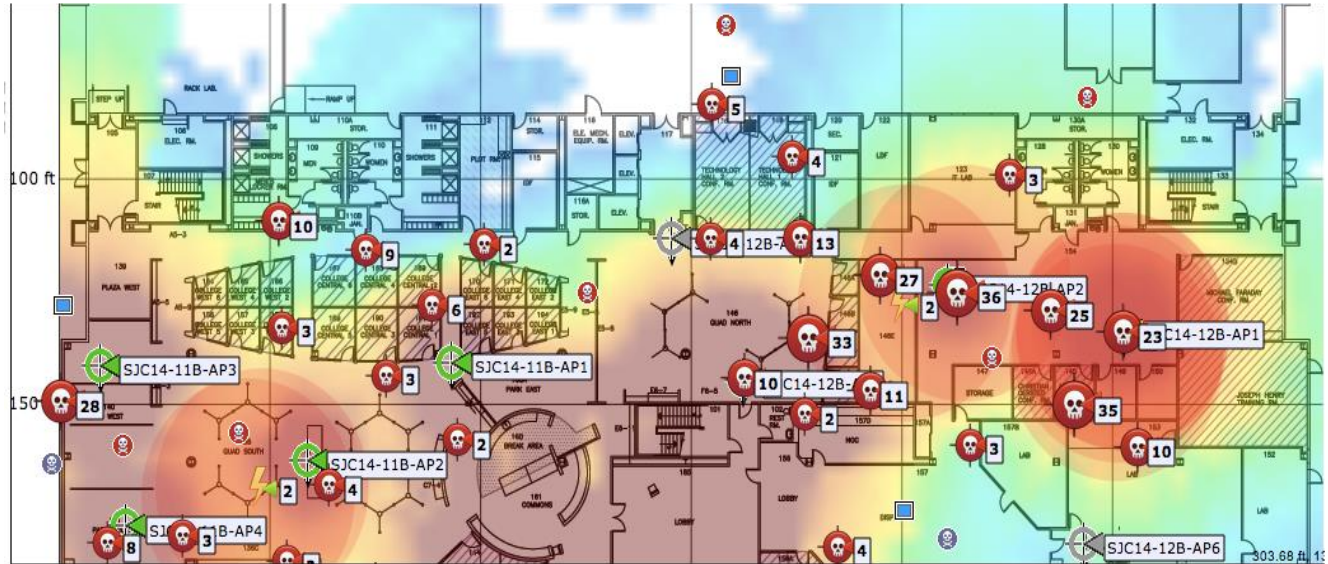
- Detecting extensive DoS attacks and security penetration – Base WIPS + Adaptive WIPS
- Locating Rogue APs, attackers and victims with new rogue zone of impact.
- Manual or fixed auto containment policy for rogue AP/client with updated auto-immune features.
- New signature-based attacks allowing auto containment and enhanced blacklisting
- Comprehensive wired rogue detection algorithm using Auto SPT, RLDP or Rogue Detector AP



Network Visibility



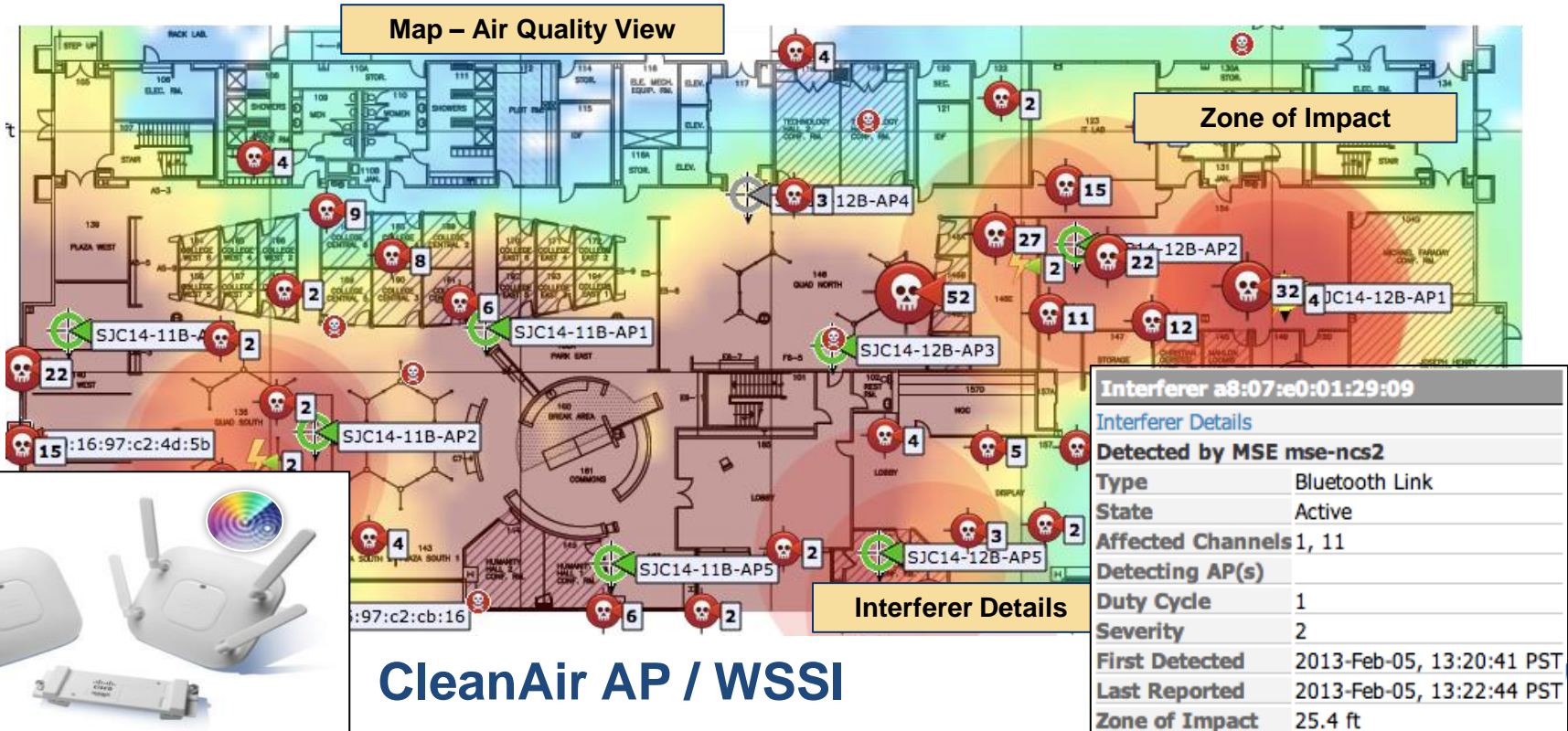
- Single view showing clients, rogues, tags, interferer, etc.
- Enhanced with clear icon indicators.
- Location data can be tracked historically.



Network Visibility



- Context Aware Services enable PI to show aWIPS and Interferer's location.



CleanAir AP / WSSI

ClearAir with and without MSE

| | CleanAir Without MSE | CleanAir With MSE |
|---|----------------------|-------------------|
| Rogue Mitigation | Yes | Yes |
| <i>Track and Trace Rogues</i> | <i>No</i> | <i>Yes</i> |
| <i>Security Penetration and Denial of Service Attack Mitigation</i> | <i>No</i> | <i>Yes</i> |
| Detect Interferers | Yes | Yes |
| Classify Interferers | Yes | Yes |
| Mitigate Interferers | Yes | Yes |
| Maintain Air Quality | Yes | Yes |
| Detect Layer 1 Exploits | Yes | Yes |
| <i>Systemwide Interferer Details and Event Correlation</i> | <i>No</i> | <i>Yes</i> |
| <i>Zone of Impact and Interferer Notification</i> | <i>No</i> | <i>Yes</i> |
| <i>Track and Trace Interferers and Layer 1 Exploits</i> | <i>No</i> | <i>Yes</i> |

Wireless Security & Spectrum Intelligence Module

- Leverages the AP 3600/3700 and their modular radio design
- Future-proof AP investments with flexibility to add new functions now and later
- Self contained 2.4 and 5 GHz XOR radio, with integrated antennas
- Always-on, complete spectrum visibility for security and interference scanning - all channels in both bands
- Offloads all monitoring and security services from the data serving radios to the security monitor module:
 - CleanAir Technology
 - wIPS
 - Rogue Detection
 - Radio Resource Management

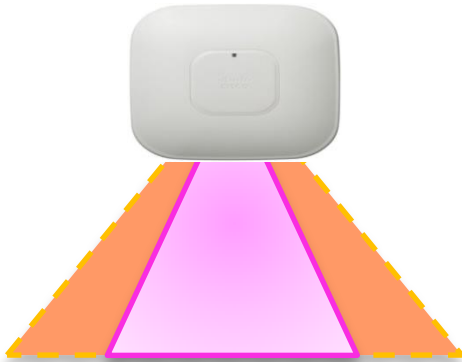


wIPS Deployment Modes



Enhanced Local Mode

Data, wIPS & CleanAir AP

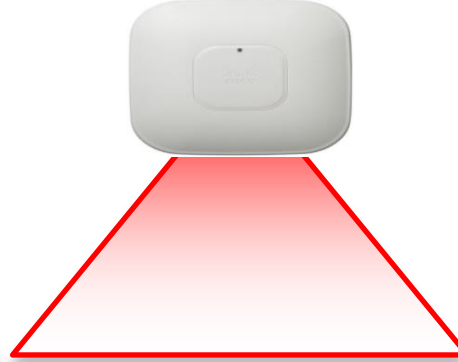


Monitor Mode AP

Data Serving

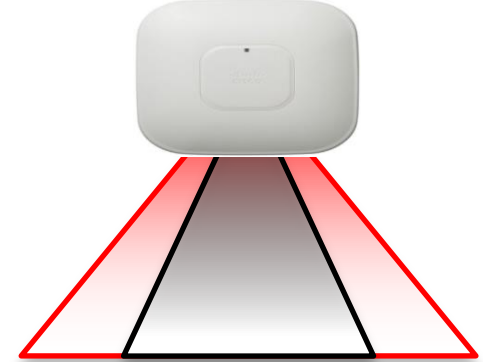


Monitor Mode with wIPS



AP3600 with WSSI Module

Data, Monitor with wIPS



Data Serving with wIPS & CleanAir
"On Channel" coverage



Best Effort "Off Channel" wIPS coverage

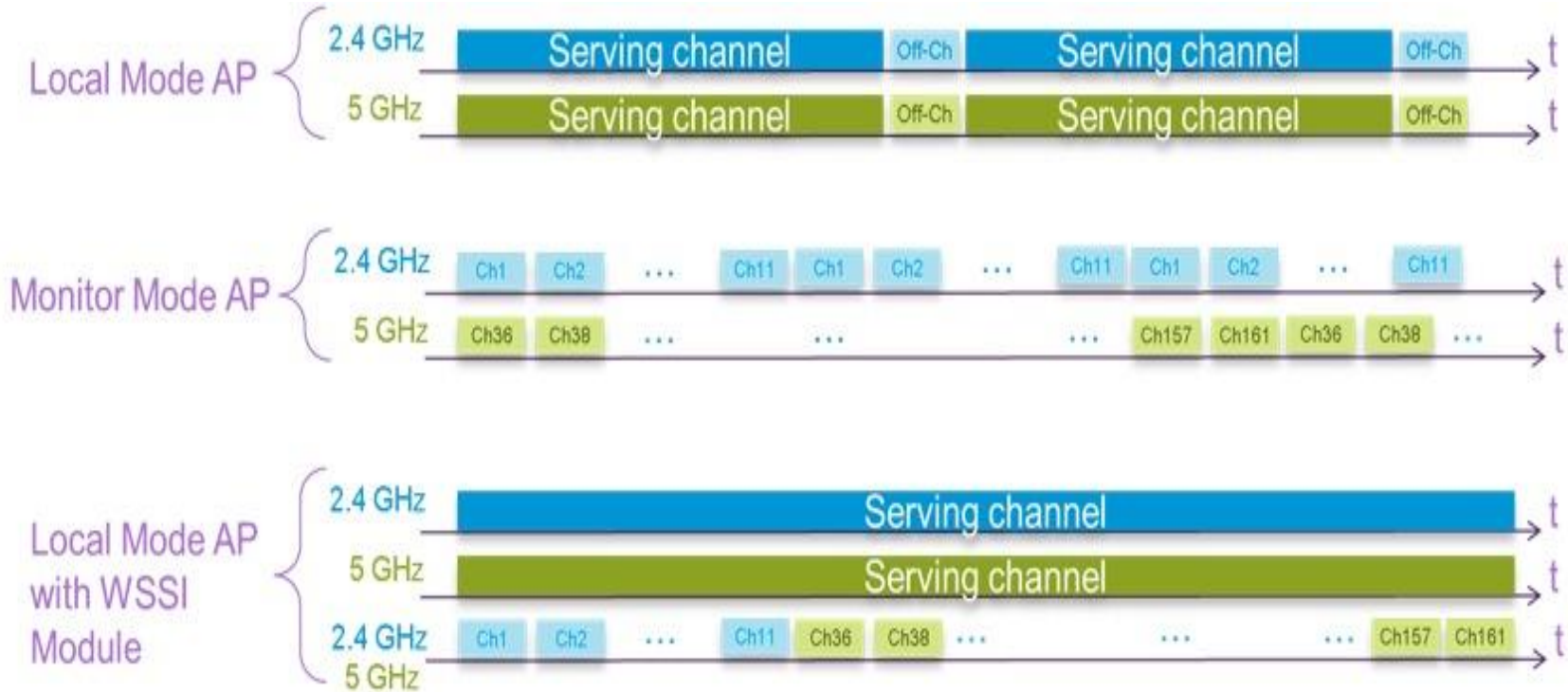


wIPS & CleanAir "All Channel" coverage



Data Serving "On Channel" coverage

On-Channel vs. Off-Channel



Adaptive WIPS

Good

Better

Best

| Features | ELM (1:1) | Monitor Mode AP (1:5 or better) | WSSI (2:5 or better) |
|--|--|--|---|
| Serving Wireless data clients | Y | N | Y |
| WIPS Security Scanning | <ul style="list-style-type: none">• On-channel wIPS monitoring• Best effort off channel wIPS monitoring | <ul style="list-style-type: none">• Full spectrum (all channels) wIPS monitoring• No impact to data serving clients | <ul style="list-style-type: none">• On-channel & Full spectrum (all channels) wIPS monitoring• No impact to data serving clients |
| CleanAir Spectrum Intelligence for troubleshooting & forensics | <ul style="list-style-type: none">• On-channel RF visibility | <ul style="list-style-type: none">• Full spectrum (all channels) RF visibility | <ul style="list-style-type: none">• On-channel• Full spectrum (all channels) RF visibility |
| Feature off-load for improved AP throughput | N | N | Y |
| Dedicated Ethernet network connection required | N | Y | N |

Advanced WIPS 7.5 Features

1. Auto MAC learning and client validation

Cisco WIPS can now automatically contain an employee device's which is connected to unapproved rogue AP. MSE will auto learn the mac addresses of clients and can validate the clients without any pre-configuration.

2. aWIPS Signatures

Three new aWIPS signatures were added in 7.5 release

1. AirDrop Session detected
2. DHCP Starvation Attack detected
3. WiFi Protected Setup Pin brute force

3. aWIPS Auto Containment

aWIPS auto containment action is added for 10 aWIPS alarms which can be configured from PI.

Advanced WIPS 7.5 Features

4. **aWIPS Alarm Consolidation**

A way to focus on the most important security alarms amongst the hundreds of alarms generated. Alarm consolidation combines all the alarms generated by the same event and displays only one alarm to the user.

5. **Global Forensics**

A troubleshooting feature which allows a user to capture and examine the packets received by the AP. This can be used for debugging if a valid attack is not being detected and for identifying new attacks.

6. **New wIPS UI** An easier way of configuring and deploying wIPS. In 7.5 we have introduced new wIPS workflows for deploying wIPS (including Rogue and aWIPS) in PI 1.4. We have also refreshed the security dashboard.

wIPS Forensics

- Available in data capture files as .pcap format:

```
Administrator: C:\Windows\system32\cmd.exe - ftp 172.31.255.4
Microsoft Windows [Version 6.1.7601]
Copyright (c) 2009 Microsoft Corporation. All rights reserved.

C:\Users\jerhenry>ftp 172.31.255.4
Connected to 172.31.255.4.
220 Service ready for new user
User (172.31.255.4:(none)): ftp-user
331 User name okay, need password for ftp-user
Password:
230 User logged in, proceed
ftp> ls
200 Command PORT okay
150 File status okay; about to open data connection
3602aWLC_222022013_203148.pcap
3602aWLC_222022013_202425.pcap
2602cWLC_222022013_202424.pcap
2602cWLC_222022013_203148.pcap
226 Closing data connection
ftp: 128 bytes received in 0.00Seconds 128000.00Kbytes/sec
ftp> _
```

Example of capture file



3602aWLC_222022013_203148.pcap

| No. | Time | Source | Destination | Protocol | Length | Info |
|-----|----------|-------------------|-------------------|----------|--------|--|
| 1 | 0.000000 | IntelCor_dc:68:ec | Cisco_49:b5:42 | 802.11 | 100 | QoS Data, SN=161, FN=0, Flags=p....T |
| 2 | 0.000000 | Cisco_49:b5:42 | IntelCor_dc:68:ec | 802.11 | 100 | QoS Data, SN=309, FN=0, Flags=p....F |
| 3 | 0.028303 | IntelCor_dc:68:ec | Cisco_67:8b:0e | 802.11 | 36 | QoS Null function (NO data), SN=0, FN=0, Flags=...P...T |
| 4 | 1.003479 | IntelCor_dc:68:ec | Cisco_49:b5:42 | 802.11 | 100 | QoS Data, SN=162, FN=0, Flags=p....T |
| 5 | 1.003479 | Cisco_49:b5:42 | IntelCor_dc:68:ec | 802.11 | 100 | QoS Data, SN=310, FN=0, Flags=p....F |
| 6 | 1.031798 | IntelCor_dc:68:ec | Cisco_67:8b:0e | 802.11 | 36 | QoS Null function (NO data), SN=0, FN=0, Flags=...P...T |
| 7 | 2.010116 | IntelCor_dc:68:ec | Cisco_49:b5:42 | 802.11 | 100 | QoS Data, SN=163, FN=0, Flags=p....T |
| 8 | 2.010116 | Cisco_49:b5:42 | IntelCor_dc:68:ec | 802.11 | 100 | QoS Data, SN=311, FN=0, Flags=p....F |
| 9 | 2.035276 | IntelCor_dc:68:ec | Cisco_67:8b:0e | 802.11 | 36 | QoS Null function (NO data), SN=0, FN=0, Flags=...P...T |
| 10 | 3.013610 | IntelCor_dc:68:ec | Cisco_49:b5:42 | 802.11 | 100 | QoS Data, SN=164, FN=0, Flags=p....T |
| 11 | 3.016753 | Cisco_49:b5:42 | IntelCor_dc:68:ec | 802.11 | 100 | QoS Data, SN=312, FN=0, Flags=p....F |
| 12 | 3.041914 | IntelCor_dc:68:ec | Cisco_67:8b:0e | 802.11 | 36 | QoS Null function (NO data), SN=0, FN=0, Flags=...P...T |
| 13 | 4.020232 | IntelCor_dc:68:ec | Cisco_49:b5:42 | 802.11 | 100 | QoS Data, SN=165, FN=0, Flags=p....T |
| 14 | 4.020232 | Cisco_49:b5:42 | IntelCor_dc:68:ec | 802.11 | 100 | QoS Data, SN=313, FN=0, Flags=p....F |
| 15 | 4.045408 | IntelCor_dc:68:ec | Cisco_67:8b:0e | 802.11 | 36 | QoS Null function (NO data), SN=0, FN=0, Flags=...P...T |
| 16 | 4.070568 | Cisco_4d:6e:2f | ff:ff:ff:ff:ff:ff | 802.11 | 232 | Probe Response, SN=2414, FN=0, Flags=....., BI=102, SSID=none |
| 17 | 4.070568 | Cisco_4d:6e:2f | ff:ff:ff:ff:ff:ff | 802.11 | 258 | Probe Response, SN=2414, FN=0, Flags=....., BI=102, SSID=Local |
| 18 | 4.070568 | Cisco_4d:6e:2f | Broadcast | 802.11 | 232 | Beacon frame, SN=2414, FN=0, Flags=....., BI=102, SSID=none |
| 19 | 4.070568 | Cisco_4d:6e:2f | Broadcast | 802.11 | 258 | Beacon frame, SN=2414, FN=0, Flags=....., BI=102, SSID=Local |
| 20 | 4.070568 | Cisco_4d:6e:2f | ff:ff:ff:ff:ff:ff | 802.11 | 232 | Probe Response, SN=2414, FN=0, Flags=....., BI=102, SSID=none |
| 21 | 4.070568 | Cisco_4d:6e:2f | ff:ff:ff:ff:ff:ff | 802.11 | 257 | Probe Response, SN=2414, FN=0, Flags=....., BI=102, SSID=ACTES |
| 22 | 4.073711 | Cisco_4d:6e:2f | ff:ff:ff:ff:ff:ff | 802.11 | 258 | Probe Response, SN=2414, FN=0, Flags=....., BI=102, SSID=Local |
| 23 | 4.073711 | Cisco_4d:6e:2f | Broadcast | 802.11 | 232 | Beacon frame, SN=2414, FN=0, Flags=....., BI=102, SSID=none |
| 24 | 4.073711 | Cisco_4d:6e:2f | Broadcast | 802.11 | 257 | Beacon frame, SN=2414, FN=0, Flags=....., BI=102, SSID=ACTES |
| 25 | 4.073711 | Cisco_4d:6e:2f | Broadcast | 802.11 | 258 | Beacon frame, SN=2414, FN=0, Flags=....., BI=102, SSID=Local |
| 26 | 5.023726 | IntelCor_dc:68:ec | Cisco_49:b5:42 | 802.11 | 100 | QoS Data, SN=166, FN=0, Flags=p....T |

Advanced WIPS 7.6 Features

1. WIPS MSE powered features

Detection of Soft AP, Good Guy Gone Bad (A valid client turning into Rogue AP).

2. aWIPS Signatures

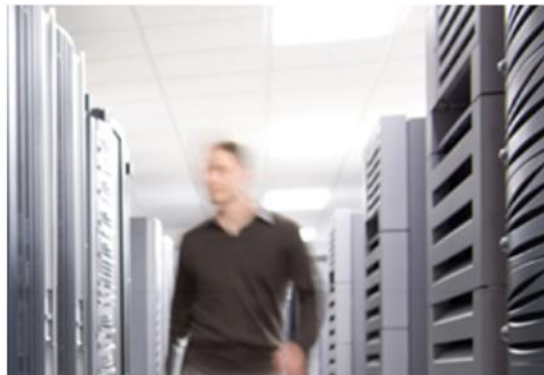
- 27 new signatures added,
- 110 total signatures supported by Cisco WIPS.

3. Enhanced Rogue Reporting and Visualisation

Customer can now drill down into detected rogues to look at details of the valid clients associated with rogues , association times, rogue rule classification and authentication information.

Licensing

- Monitor Mode
 - L-WIPS-MM-1AP Supports 1 Monitor Mode Access Point
 - L-WIPS-MM-100AP Supports 100 Monitor Mode Access Points
 - L-WIPS-MM-1000AP Supports 1000 Monitor Mode Access Points
- Enhanced Local Mode
 - L-WIPS-ELM-1AP Supports 1 Enhanced Local Mode Access Point
 - L-WIPS-ELM-100AP Supports 100 Enhanced Local Mode Access Point
 - L-WIPS-ELM-1000AP Supports 1000 Enhanced Local Mode Access Point
- Maximum on 10,000 MM/ELM access points per MSE (depending on MSE resources)



Connected Mobile Experiences

Introducing Connected Mobile Experiences (CMX)

Leverages the Ability to Detect and Locate Devices in an Indoor Environment in Order to Provide:

Enhanced
Customer
Engagement

Context-aware
Marketing
Opportunities

On-premise
Customer
Visibility

CMX ENGAGE

CMX
ANALYTICS

Improved Business Outcomes

Connected Mobile Experiences

Key Elements



DETECT



GUEST PRESENCE

Mobile device and characteristics detected before they enter the venue



CONNECT



GUEST ACCESS

Seamless and secure Wi-Fi connectivity
Preferences, profile, device and roaming credentials identified



ENGAGE

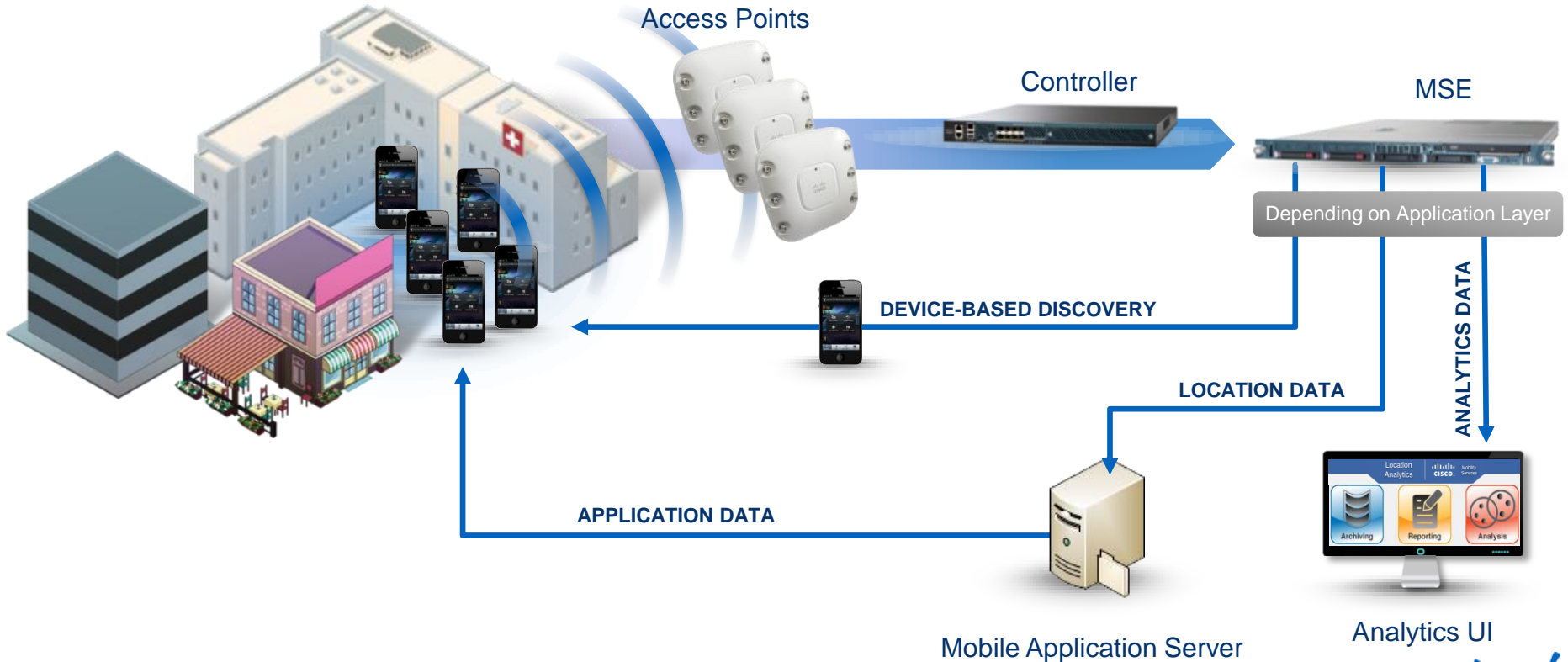
GUEST EXPERIENCE

Highly-relevant content and services based on user attributes and real-time location

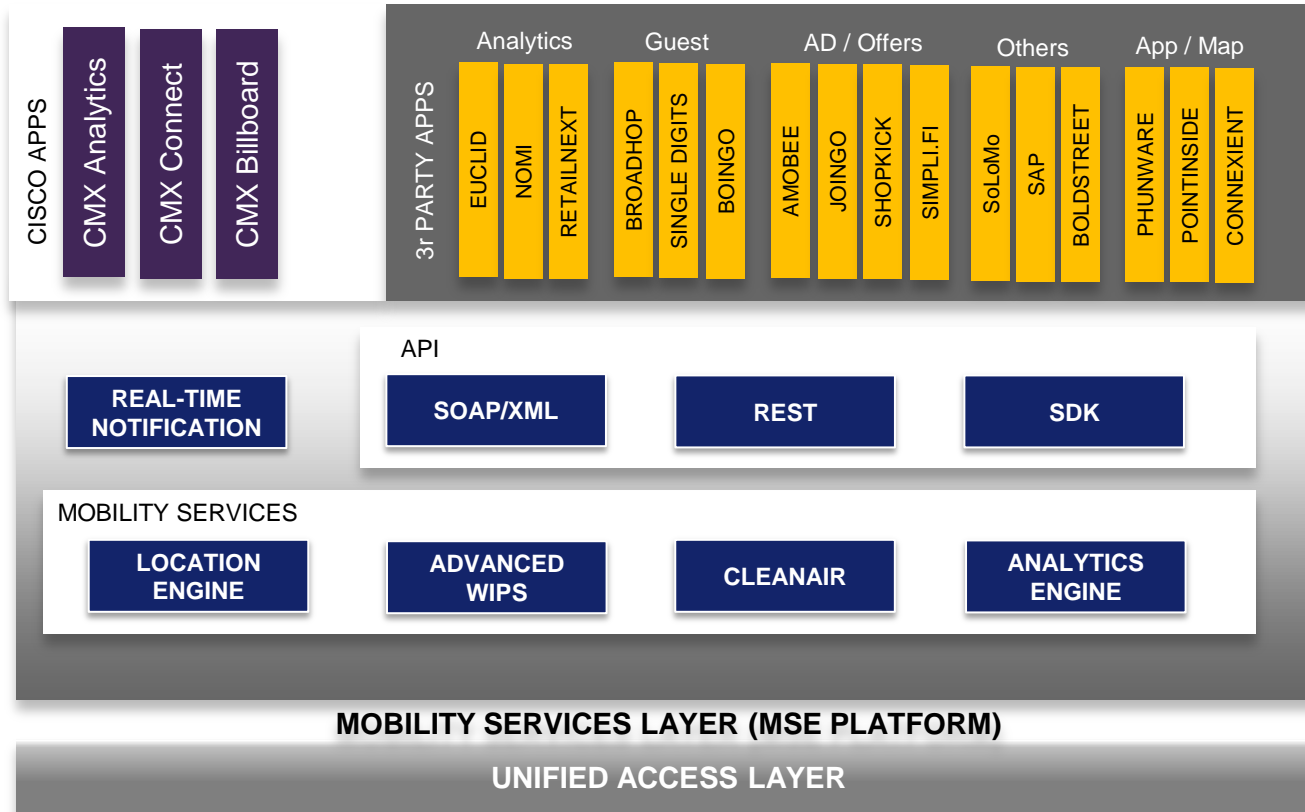
LOCATION ANALYTICS

Insights into customer online and onsite behaviour, traffic paths, dwell times, location density etc.

How CMX Works



CMX Solution Architecture



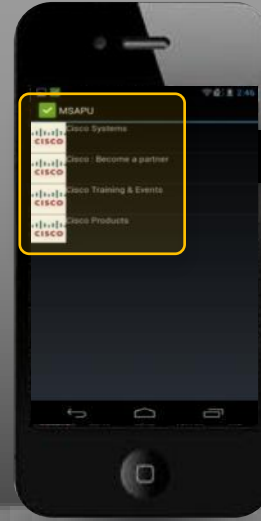


Qualcomm Indoor Positioning Solution

- Device-based Engagement —802.11u / MSAP



Devices with the new Qualcomm chipset discover services without having to download a venue specific application



Enables organisations to automatically show local services to in-range mobile users

CMX Visitor Connect

Functional Highlights

- A simple, flexible and easy to use captive portal to quickly on-board guests on to Wi-Fi (B2C)
- Highly customisable & Location sensitive
- Highly customisable splash flow and splash pages
- Based on Web pass-through methodology
- Portal to allow user registration with dynamic input fields
- Portal that facilitates the user login with social networks, i.e., FB, LN and G+ using OAuth
- Available in MSE release 7.6

Setup

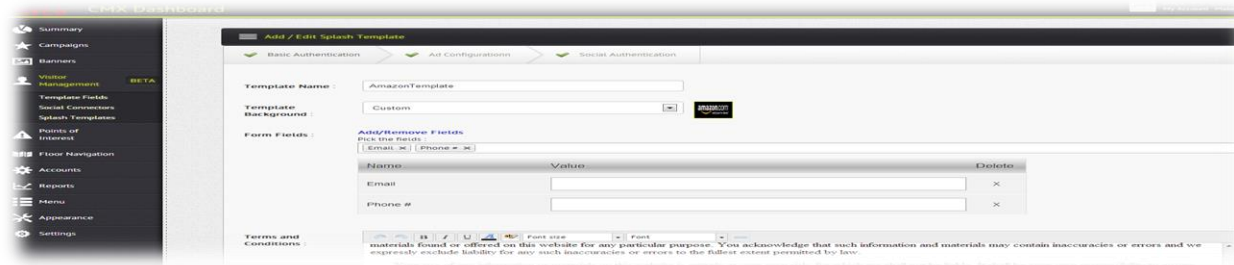
1) Configure controllers with Web pass-through WLANs

The screenshot displays the Cisco WLAN configuration interface. The top navigation bar includes 'MONITOR', 'WLANs', 'CONTROLLER', 'WIRELESS', 'SECURITY', 'MANAGEMENT', 'COMMANDS', 'HELP', and 'FEEDBACK'. The left sidebar shows 'WLANs' with sub-items 'WLANs' and 'Advanced'. The main content area is titled 'WLANs > Edit 'zs-vconnect'' and features tabs for 'General', 'Security', 'QoS', 'Policy-Mapping', and 'Advanced'. Under the 'Advanced' tab, the 'AAA Servers' sub-tab is active. The configuration includes:

- Layer 3 Security: Web Policy (dropdown)
- Authentication options:
 - Authentication
 - Passthrough
 - Conditional Web Redirect
 - Splash Page Web Redirect
 - On MAC Filter failure¹⁰
- Preauthentication ACL: IPv4 (vconnect-wlan dropdown), IPv6 (None dropdown), WebAuth FlexAcl (None dropdown)
- Email Input
- Over-ride Global Config: Enable
- Web Auth type: External(Re-redirect to external server) (dropdown)
- URL: http://173.37.206.7:8081/Mario/jsp/runtime/auth/auth1

Setup

2) Setup CMX Visitor Connect on CMX Dashboard



Setup

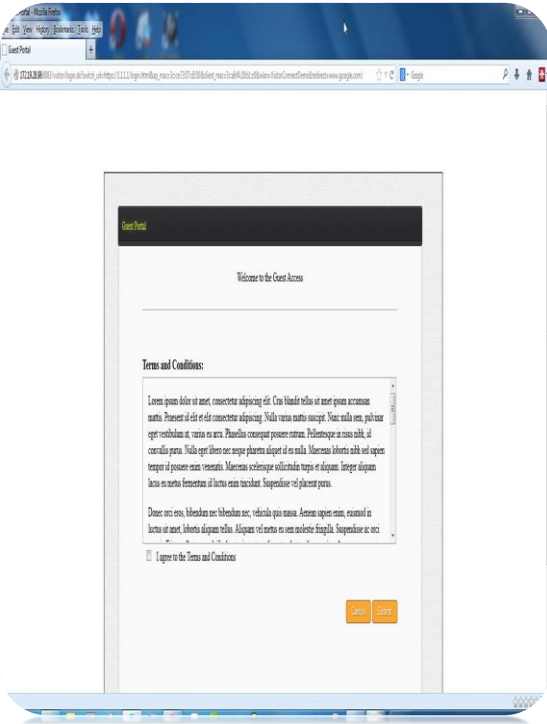
3) Assign POI/Location where Web Portal will be served

The screenshot displays a web management interface with a sidebar on the left containing navigation items: Summary, Campaigns, Banners, Visitor Management (marked BETA), Points of Interest, Floor Navigation, Accounts, Reports, Menu, Appearance, and Settings. The main area shows a tree view of 'PointOfInterests' with 'System Campus' expanded to show 'Building 14', 'Floor 3', and 'Floor 4'. A floor plan image is visible in the center. On the right, the 'Add/Update Point of Interest' form is shown with the following fields:

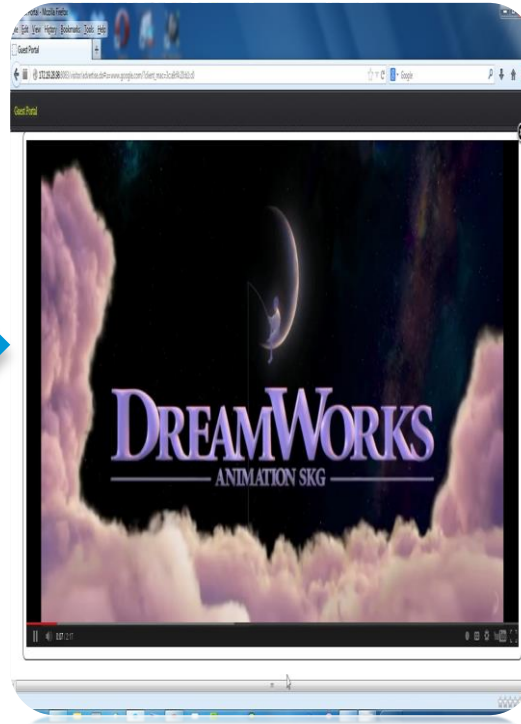
- Name: *
- Description:
- Service Categories: Select Some Options
- Domain Mapping: Select Some Options
- Splash Template: AmazonTemplate (highlighted with a red box)
- Tags / Keywords:
- Choose Image: Click to upload a Logo

Additional text below the 'Choose Image' field reads: "**Click or drag and drop on existing image to upload a new image, Recommended logo size is 45px by 45px. Bigger files will be".

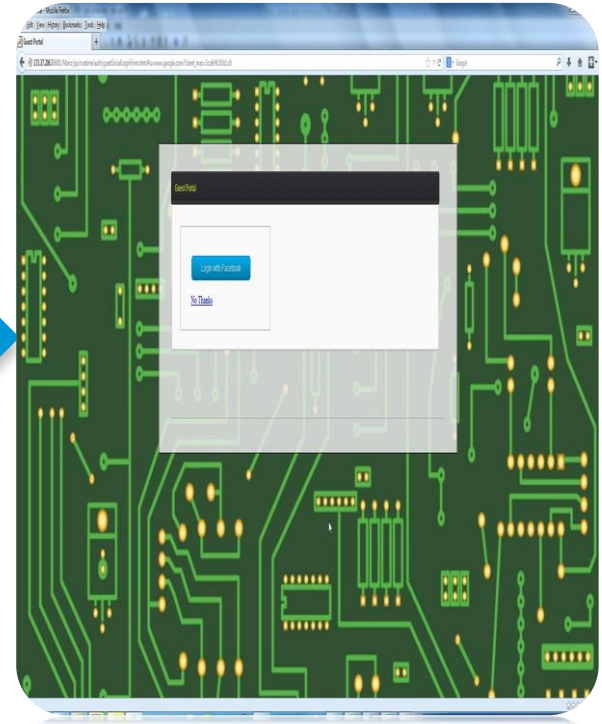
Final Portal



BRKEWN-2012



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Cisco Public

Cisco *live!*

Logon via Social Media

Shopping Mall

Terms and Conditions: [-]

Welcome to the wireless high-speed Internet access system ("Wi-Fi System") at Bao Networks ("BAO"). These "Terms and Conditions of Use", govern your rights and responsibilities and our rights and responsibilities relating to the use of the Wi-Fi System at BAO.

Acceptance of Terms and Conditions of Use
BY CLICKING ON "Logon" ON THE WI-FI SYSTEM SIGN-UP PAGE, YOU REPRESENT that:

By clicking Submit, I accept the Terms & Conditions

**TERMS AND CONDITIONS;
REGISTRATION**

Skip Ad in 8 seconds

5/5/13 - 5/4/13 - SOCIAL COUPON PAGE

2 DAYS ONLY!

YOU DESERVE AN EASY WAY TO STOCK UP FOR SPRING

**\$10
OFF**

your purchases of \$25 or more
Friday, May 3, through Saturday, May 4

online code: **8U725**



MC449852000200000060210

*\$10 off your purchase of \$25 or more, including taxes and shipping charges. 5/3/13-5/4/13/13

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**CUSTOM LANDING
PAGE/VIDEO**

Sign in with Social Networks

No thanks. Continue browsing >>

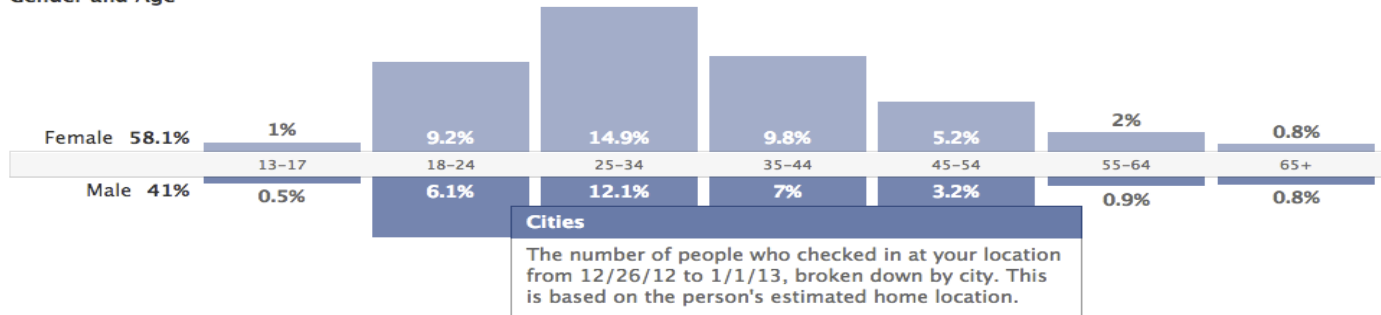
Powered by Cisco CMX

**SIMPLIFIED SOCIAL
LOGIN**

Guest Demographic Visibility

People Who Checked In

Gender and Age?



Countries?

| | |
|-------|--------------------------|
| 9,432 | United States of America |
| 664 | Mexico |
| 434 | Canada |
| 405 | Brazil |
| 350 | United Kingdom |
| 218 | Australia |
| 168 | Germany |

Cities?

| | |
|-------|-------------------|
| 1,140 | Las Vegas, NV |
| 871 | Los Angeles, CA |
| 295 | San Diego, CA |
| 200 | San Francisco, CA |
| 158 | San Jose, CA |
| 151 | New York, NY |
| 149 | Phoenix, AZ |

Languages?

| | |
|--------|---------------------|
| 10,511 | English (US) |
| 464 | Spanish |
| 450 | Spanish (Spain) |
| 371 | English (UK) |
| 353 | Portuguese (Brazil) |
| 213 | German |
| 172 | Japanese |

Show All ▾

Engagement Services



Engaging with Customers via Different Media

APP

- Personalise in-venue customer experience by making app contextually aware
- Auto-prompt app when in range
- REST API enables integration of location information in apps

DEVICE

- Devices with the new Qualcomm chipset will automatically discover services without having to download a venue specific application
- Greater accuracy with frequent probing

BROWSER

- Engage customers/visitors when they are browsing on their mobile in the venue
- Can be customised with context-sensitive banners and services

Browser Engage



Icon or banner
appears on every
page viewed on
the browser

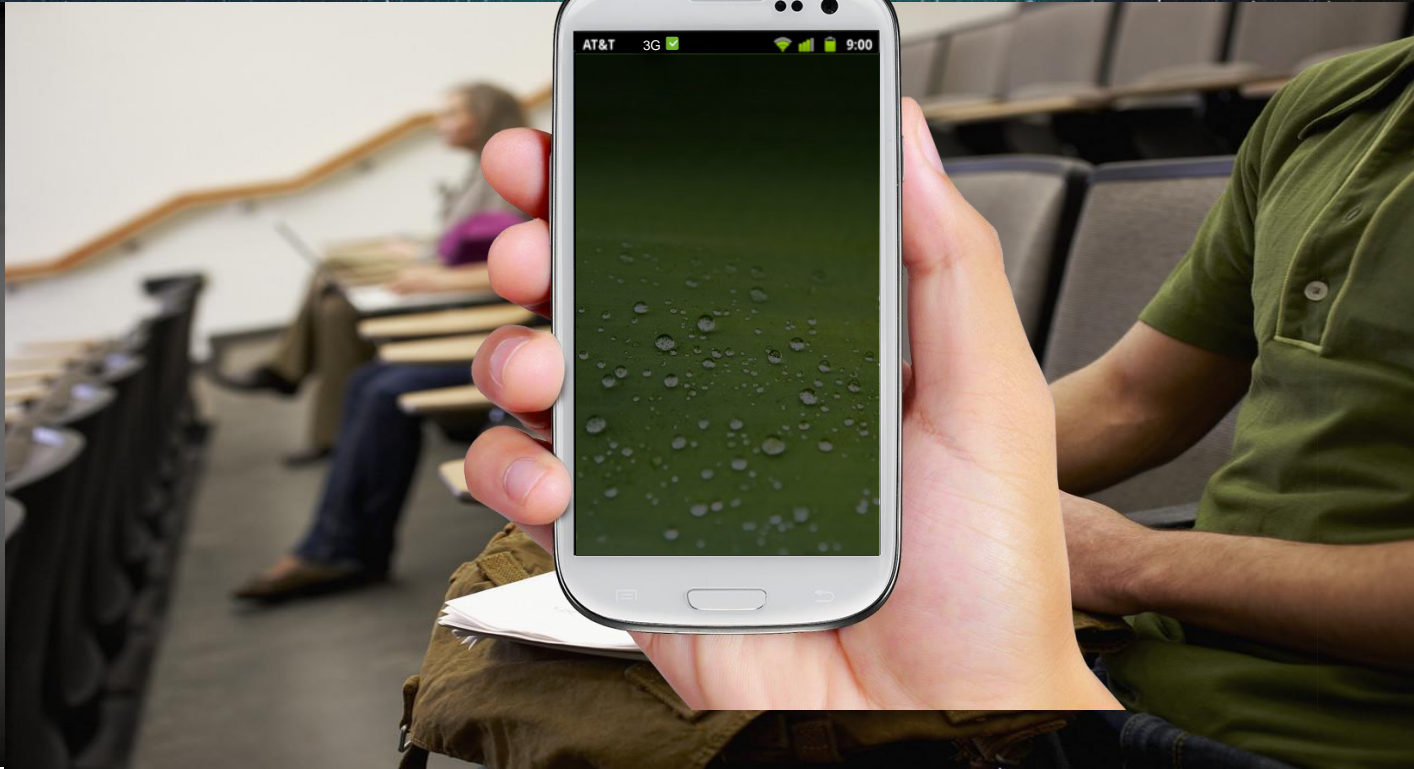
Browser Engage



Click the icon,
menu appears

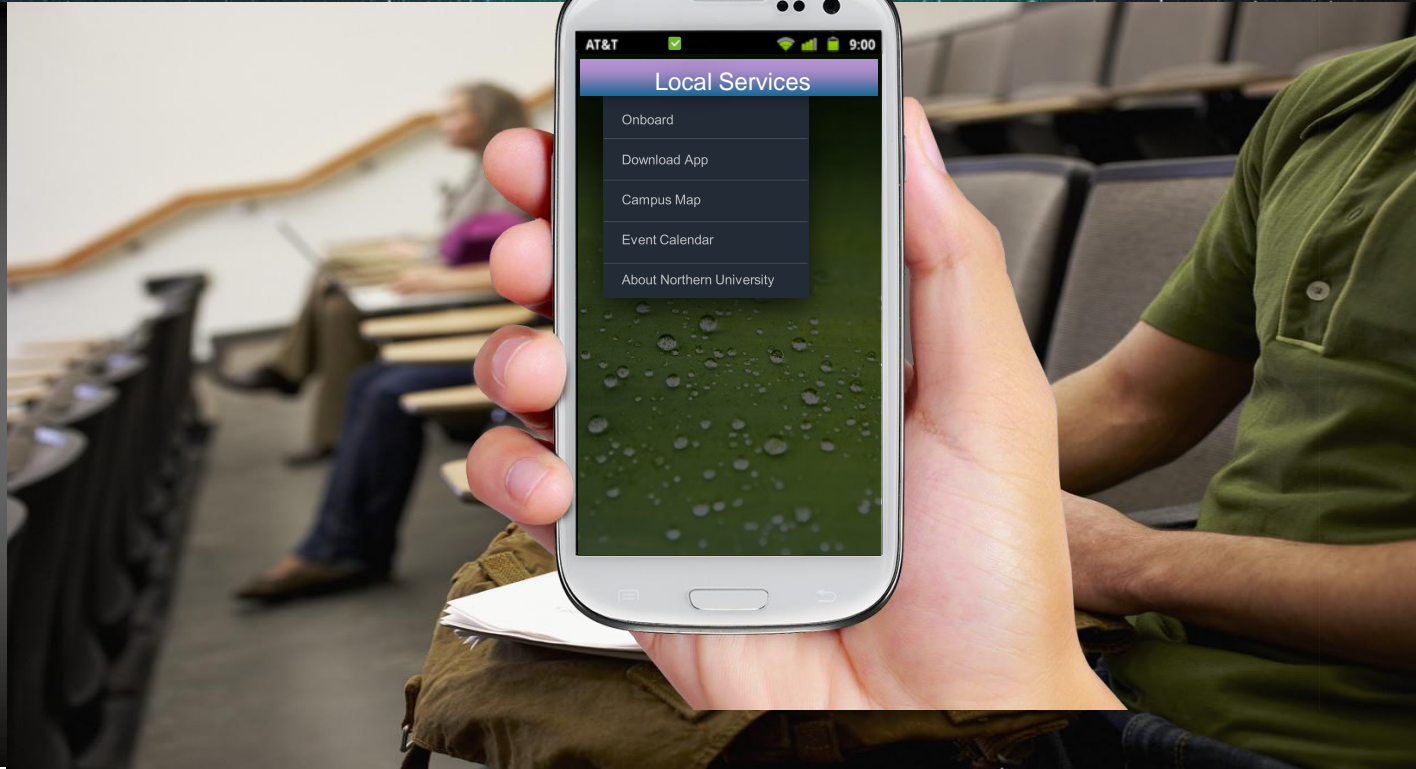
Application Engage

- Pre-Authentication:
Network Services
Discovery on
the Device



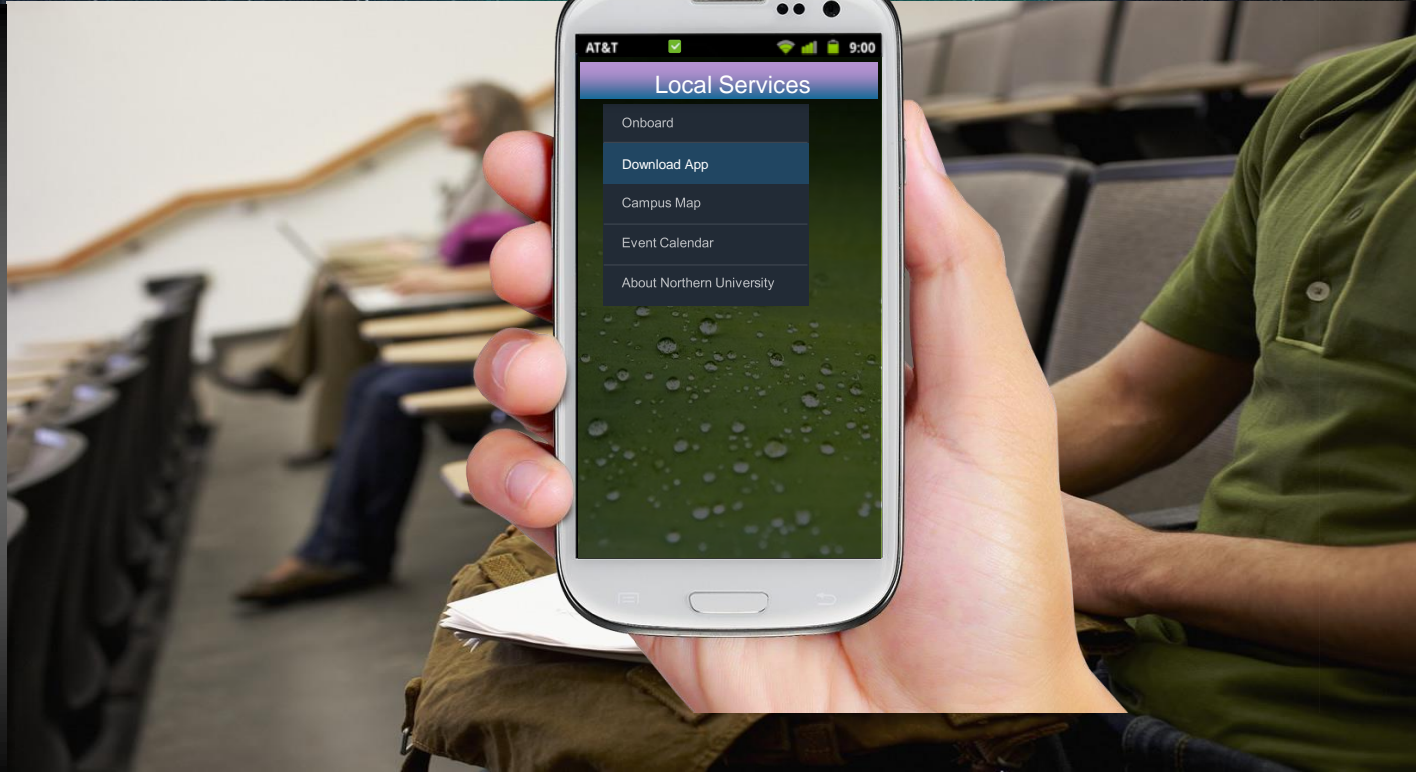
Application Engage

- Service Discovery Pre-Authentication



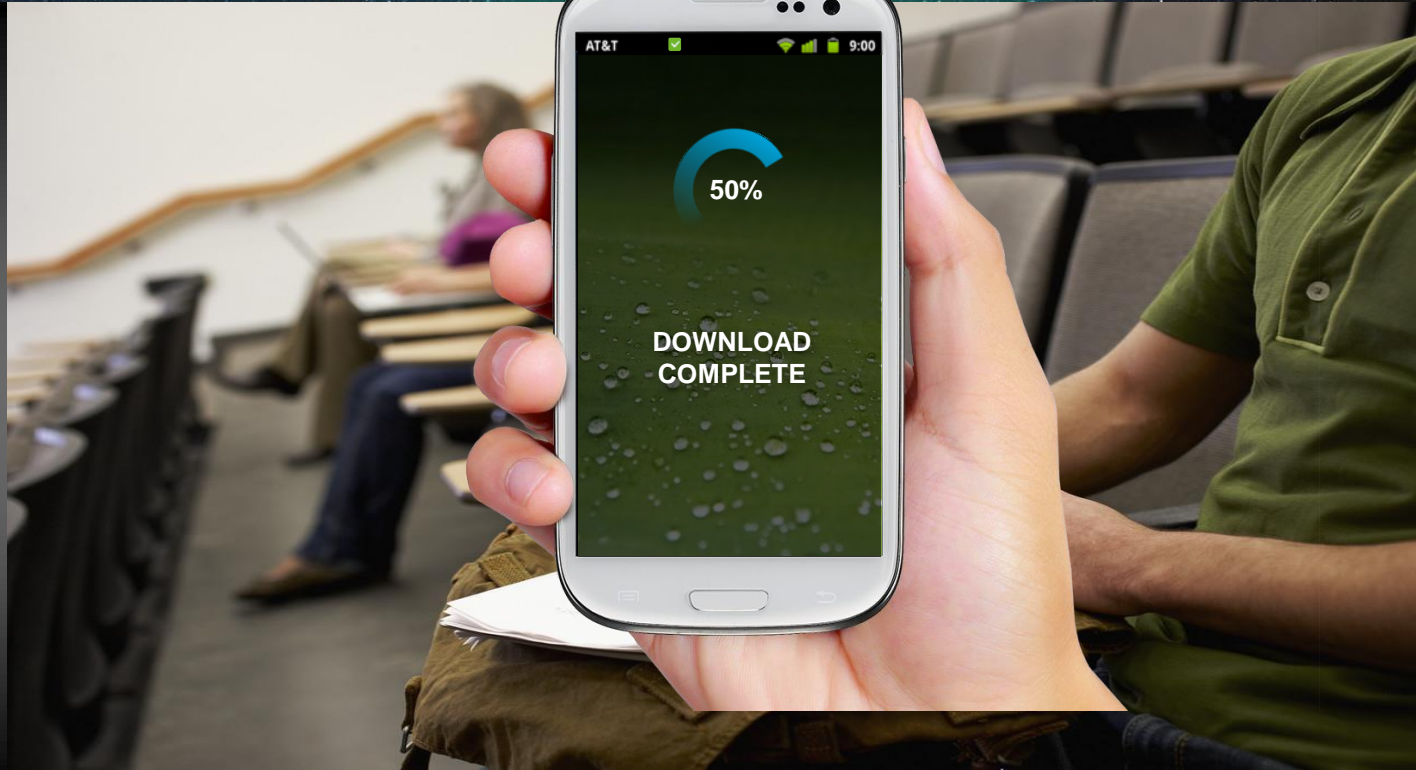
Application Engage

- Seamless Handoff from 3G/4G to Wi-Fi

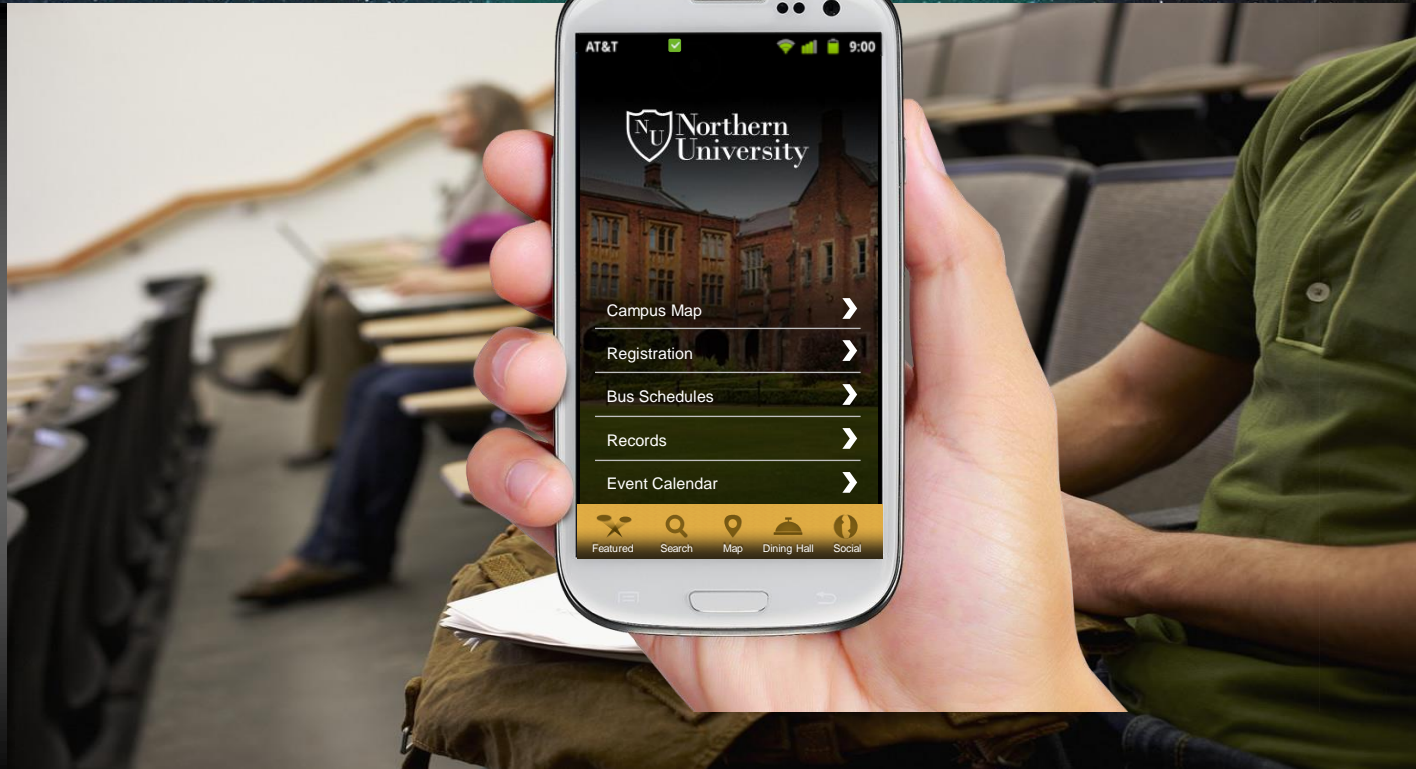


Application Engage

- Application Downloaded

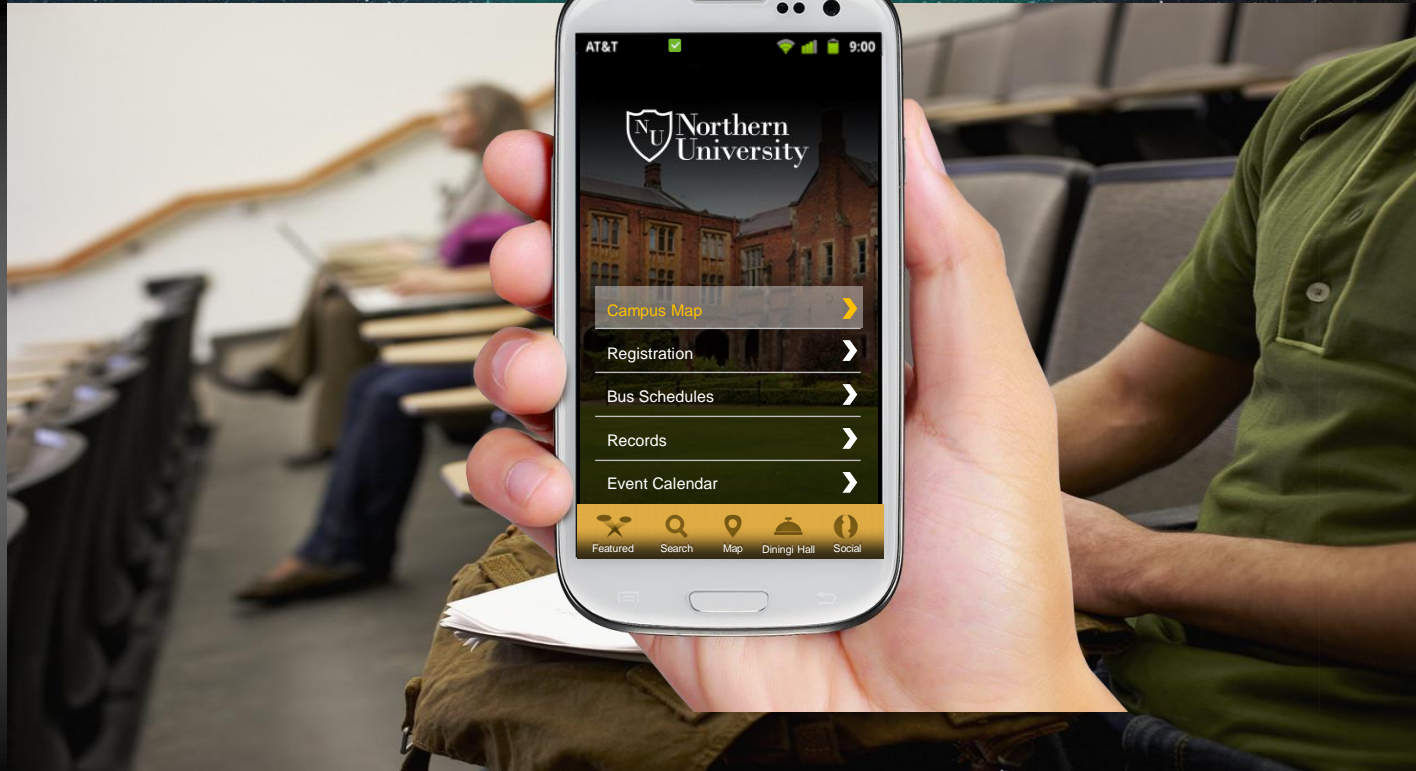


Application Engage



Application Engage

- Navigation Integrated into Student App



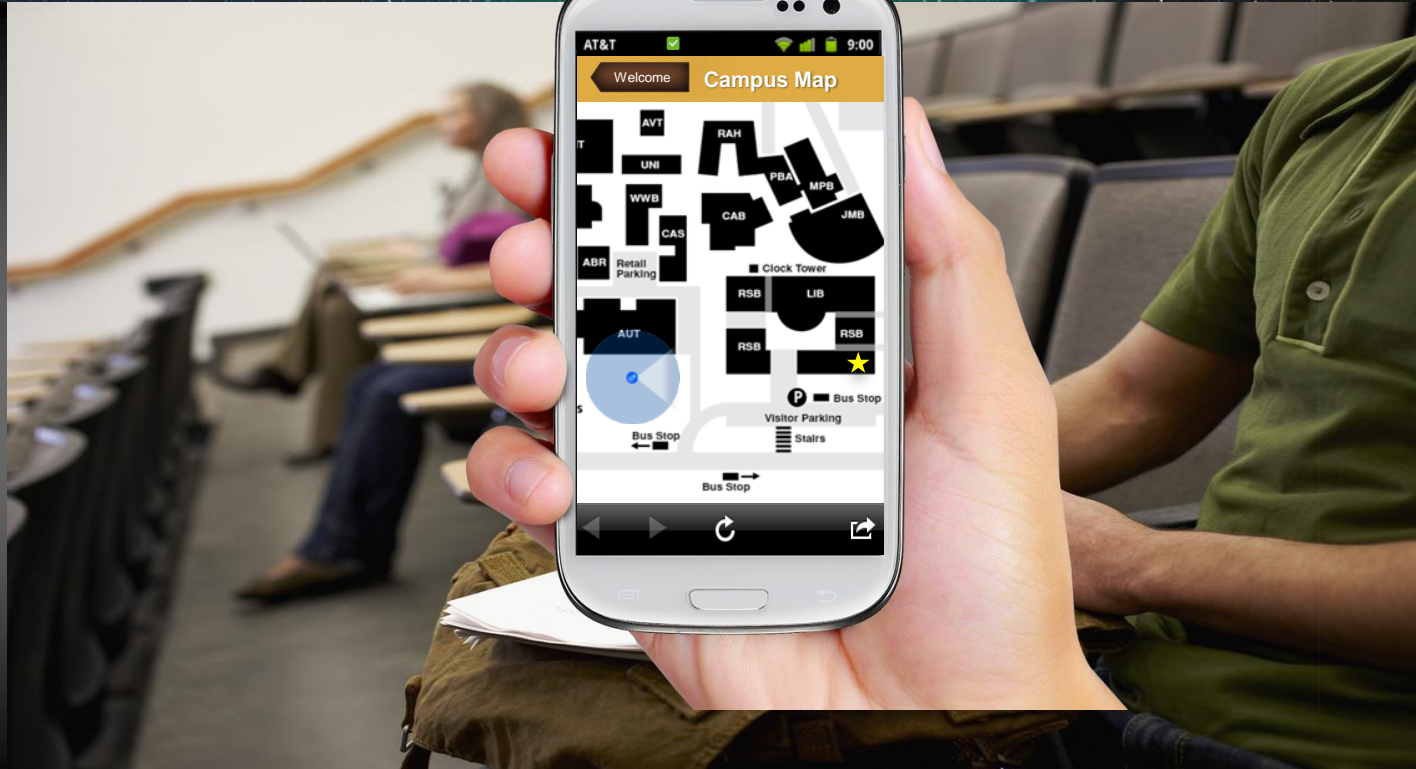
Application Engage

- Example: Personalised Tour Guide



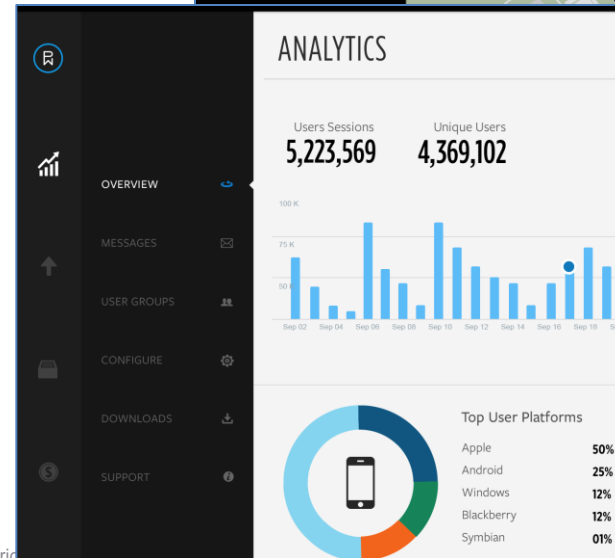
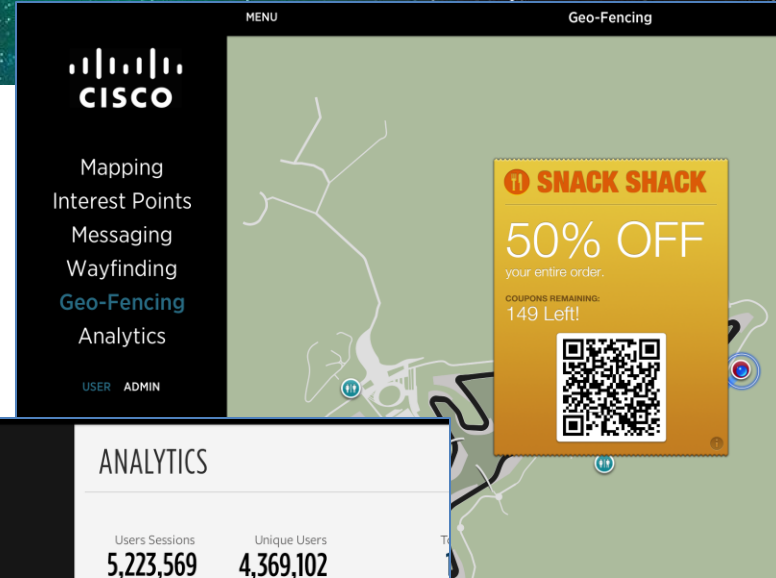
Application Engage

- Example: Turn-by-Turn Navigation based on Location



MSE APIs

- The MSE has always had interfaces to enable apps – be it SOAP/XML or notification for location triggers
- SOAP/XML is a strong framework for enterprise apps
- For mobile apps, REST is becoming the dominant API model
- REST is simple, flexible and fast; our customers and app partners are increasingly standardising on REST
- REST API support introduced as part of the 7.5 release





CMX Analytics

Copenhagen Airport

Improving business operations through real-time analytics

What's New

- Location Analytics

Security Personnel



Check-In Personnel



Customs Personnel



Traffic Flow



Advertising Placement



Location Data Usage Before 7.4 Release

- The MSE collects and maintains device location data obtained from Wi-Fi enabled devices such as smartphones, tablets and laptops as they pass through the Cisco Wi-Fi network, saving it “as is” in the database
 - The basic data is of the form, <MacAddress, time, coordinates, attribute1... attributen>
- In previous versions of the Cisco Wi-Fi network architecture, this data was simply retrieved by an API call from the Cisco Prime Infrastructure and used to display device location information to the user via the GUI or in a simple report
- In 7.4 the Advanced Location Analytics engine has been **directly integrated into the Mobility Services Engine**
 - Analytics GUI is served directly from the MSE platform
 - Shares the same database while using a separate table space

Location Data Usage in Current 7.4 and Above

- Location Analytics information in the MSE database to create knowledge for:
 - Dwell times
 - Paths Taken
 - Choice of direction
 - Routes taken
- Location data converts device movement and behavioural patterns into actionable Business Intelligence
- Can be a shop, mall, airport, city centre, or any location that has a network of wireless access points enabling devices moving within that space to be located.

The Analysis Process

- Full data analysis is comprised of six individual processes:
 - Data cleaning
 - Tagging
 - Filtering
 - Parameter estimation
 - Behaviour mining
- MSE can correlate very large amounts of data to be analysed.
- Analysed data is summarised and visualised on screen or in report format.
- Visual results available in both 2D or 3D formats simplify and improve user understanding of data
 - For example, in a multi-story environment where paths and dwell times must take vertical movement into account

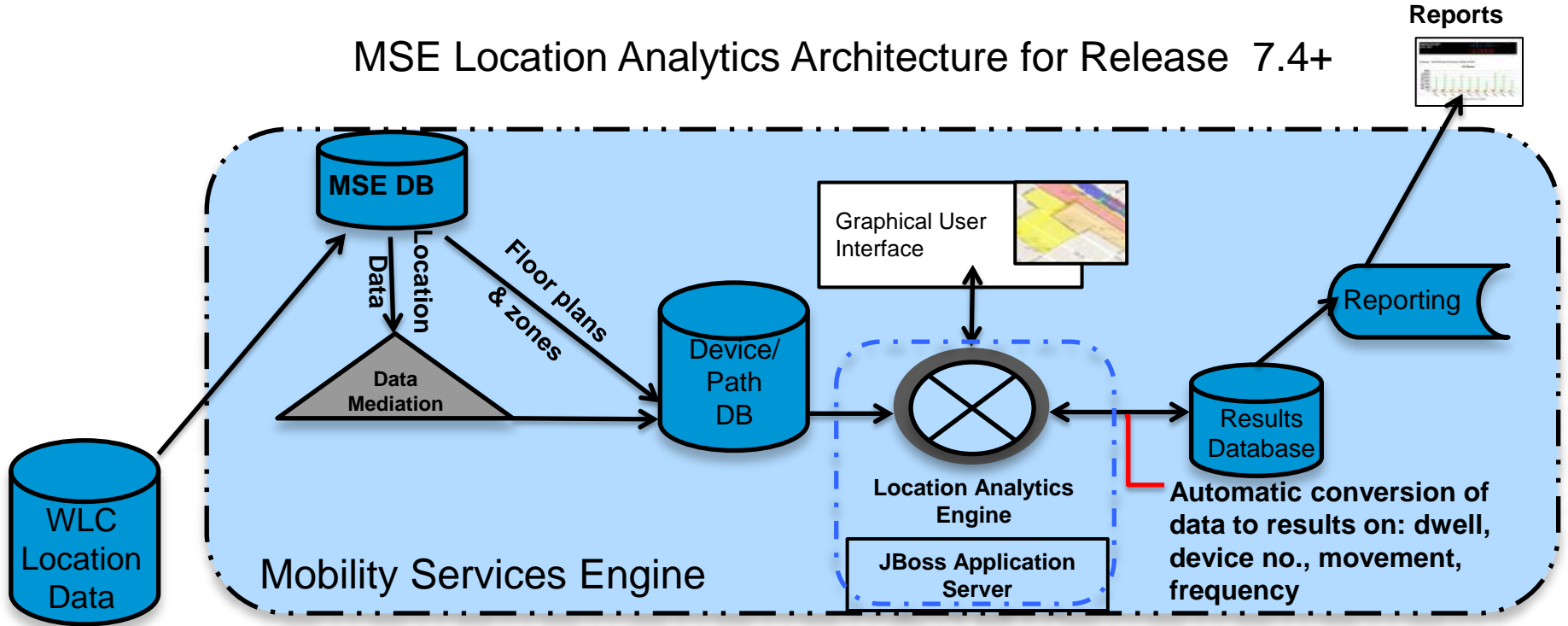
Visualising the Data

- Both 2D and 3D views are available, with 3D as the default
 - 3D building representation requires using a browser that supports **WebGL**



Cisco Analytics Architecture

MSE Location Analytics Architecture for Release 7.4+



Enabling the Analysis Engine

- The Location Analytics engine is installed on the MSE during the 7.4 software installation process
- Must be enabled for use via the PI before the Web interface is accessible.
 - Requires an Advanced Location Services license for the PI which is managing the MSE

| Mobility Services | | | | |
|-------------------------------------|----------------------------|------------|----------------|--------------|
| Admin Status | Name | Version | Service Status | License Type |
| <input checked="" type="checkbox"/> | Context Aware Service | 7.5.1.35 | Up | Evaluation (|
| <input type="checkbox"/> | WIPS | 1.2.6102.0 | Down | Evaluation (|
| <input type="checkbox"/> | Mobile Concierge Service | 3.0.0.25 | Down | Evaluation (|
| <input checked="" type="checkbox"/> | Location Analytics Service | 2.0.0.16 | Up | Evaluation (|
| <input type="checkbox"/> | Billboard Service | 1.0.0.3 | Down | Permanent |
| <input type="checkbox"/> | HTTP Proxy Service | 1.0.0.1 | Down | Permanent |

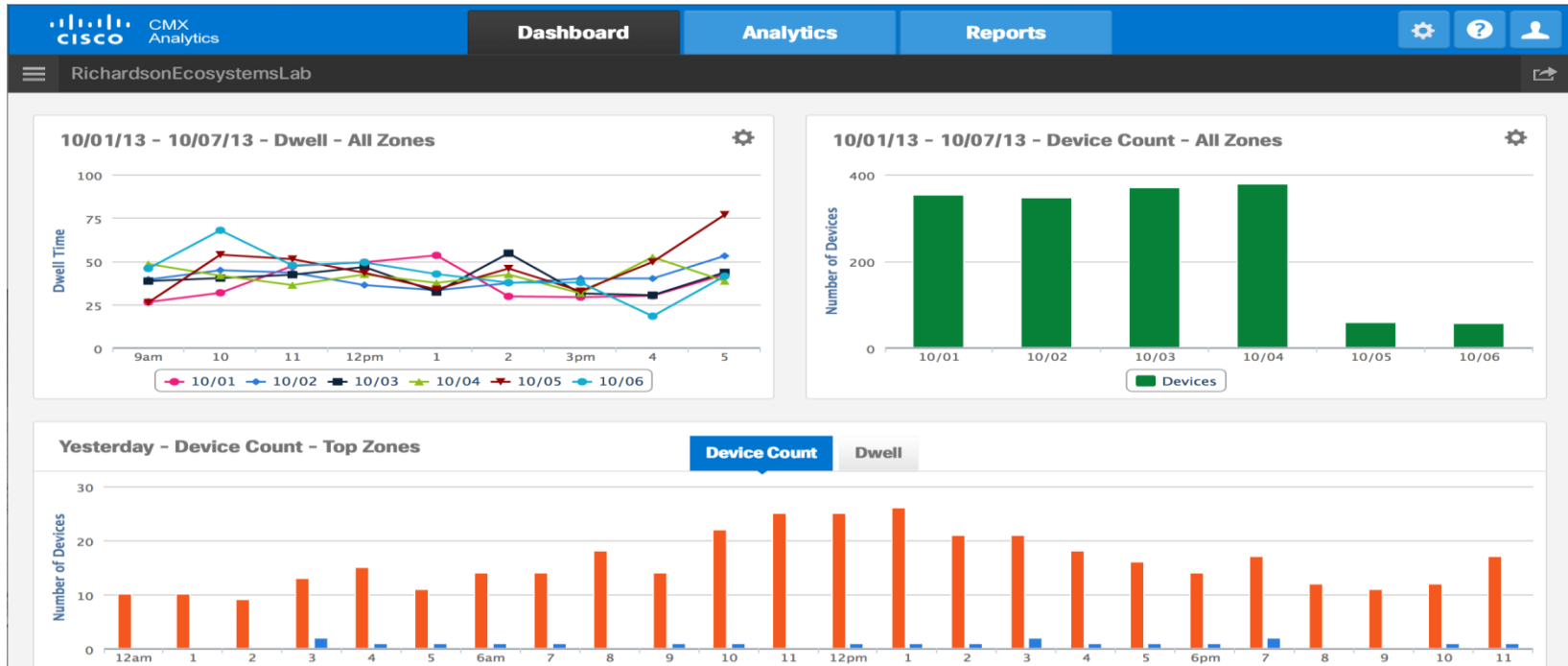
Network Preparation

- Enable CMX licensing
 - L-AD-LS-1AP Support for 1 AP
 - L-AD-LS-100AP Support for 100 AP's
 - L-AD-LS-1000AP Support for 1000 AP's
- Define floor plans and coverage areas in the PI
- A coverage area in the MSE correlates to a zone for the purpose of analysis
 - A zone is a user defined space with a name and can be used for reporting or path description purposes
 - Zones can be overlapping and need not cover all the building
 - For example: If a customer wants to analyse user behaviour within a specific area of a location, such as an individual store within a larger mall complex, then a coverage area defining that store must be defined in the PI.
- Synchronise with the MSE

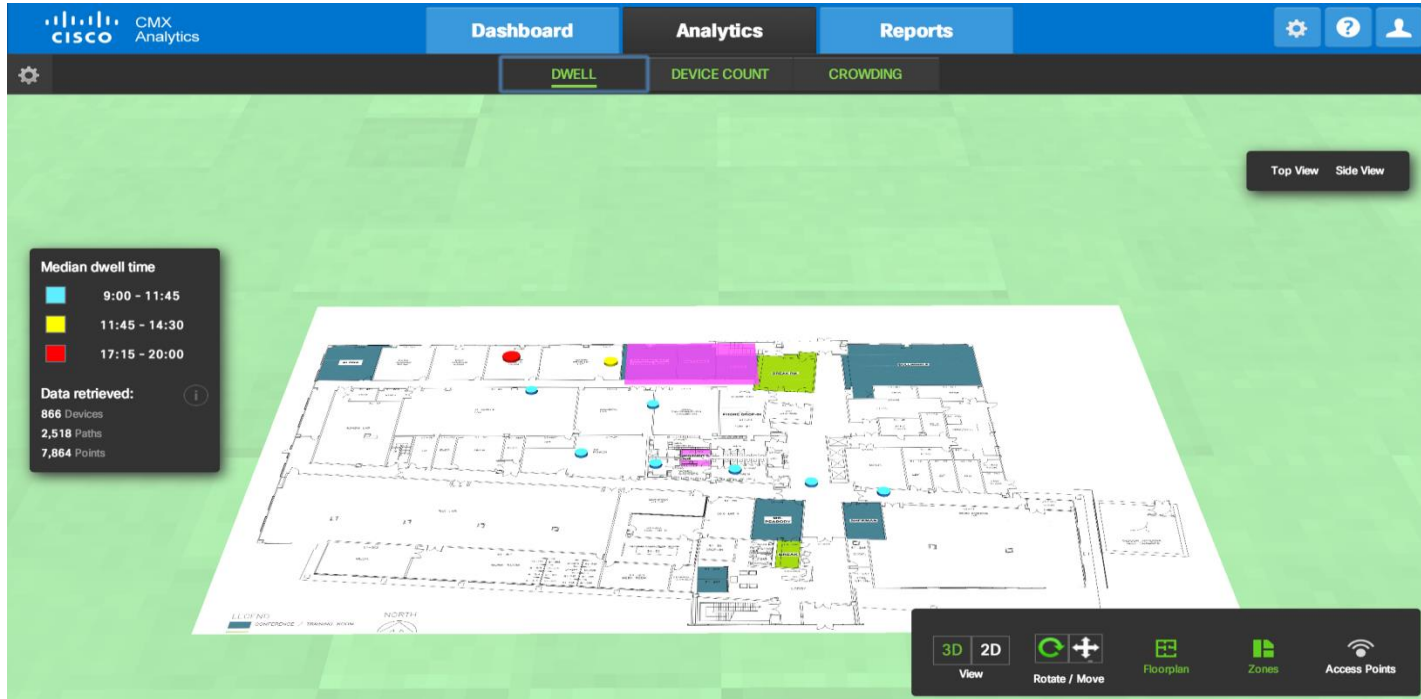
CMX Analytics – 7.6 New Features

- **Real path** definition feature available to network admin providing more meaningful path representations.
- New aggregated database model. Raw data is retrieved, processed, and stored in a separate table, then used by CMX Analytics for report generation. **This speeds up the data analysis process by eliminating the need to perform this activity on raw data. This improves scale. Reports will take 1/3 time that it took in 7.5 vs 7.6.**
- API to retrieve/save navigation path and/or modify existing navigation paths defined in UI.

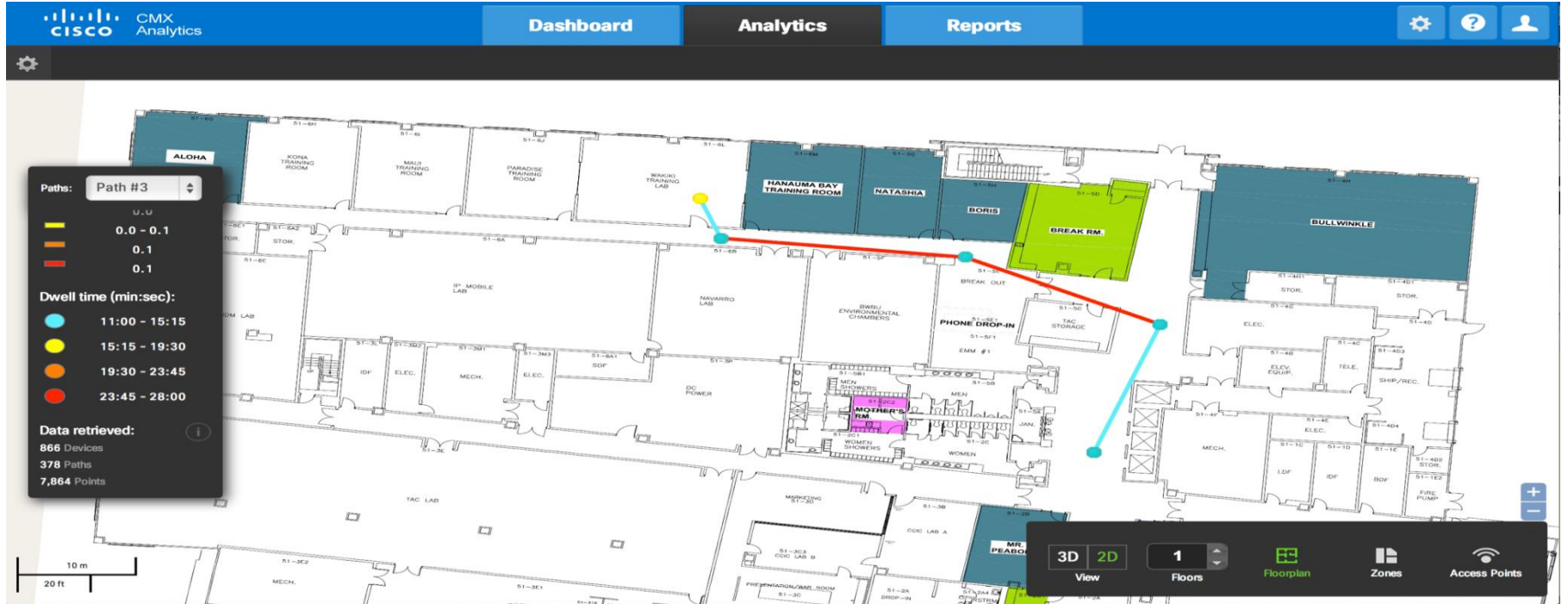
Dashboard



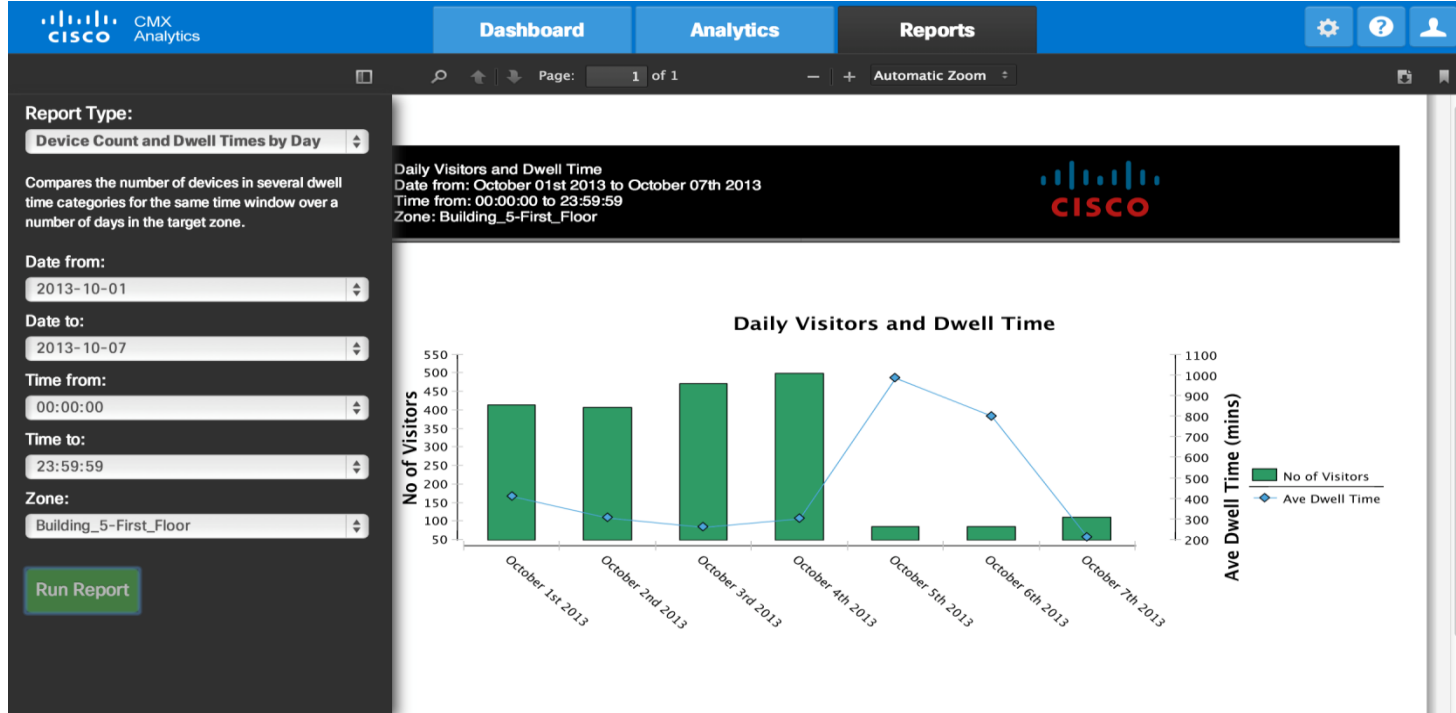
Analytics Visualisation



Realistic Path Display



Reports



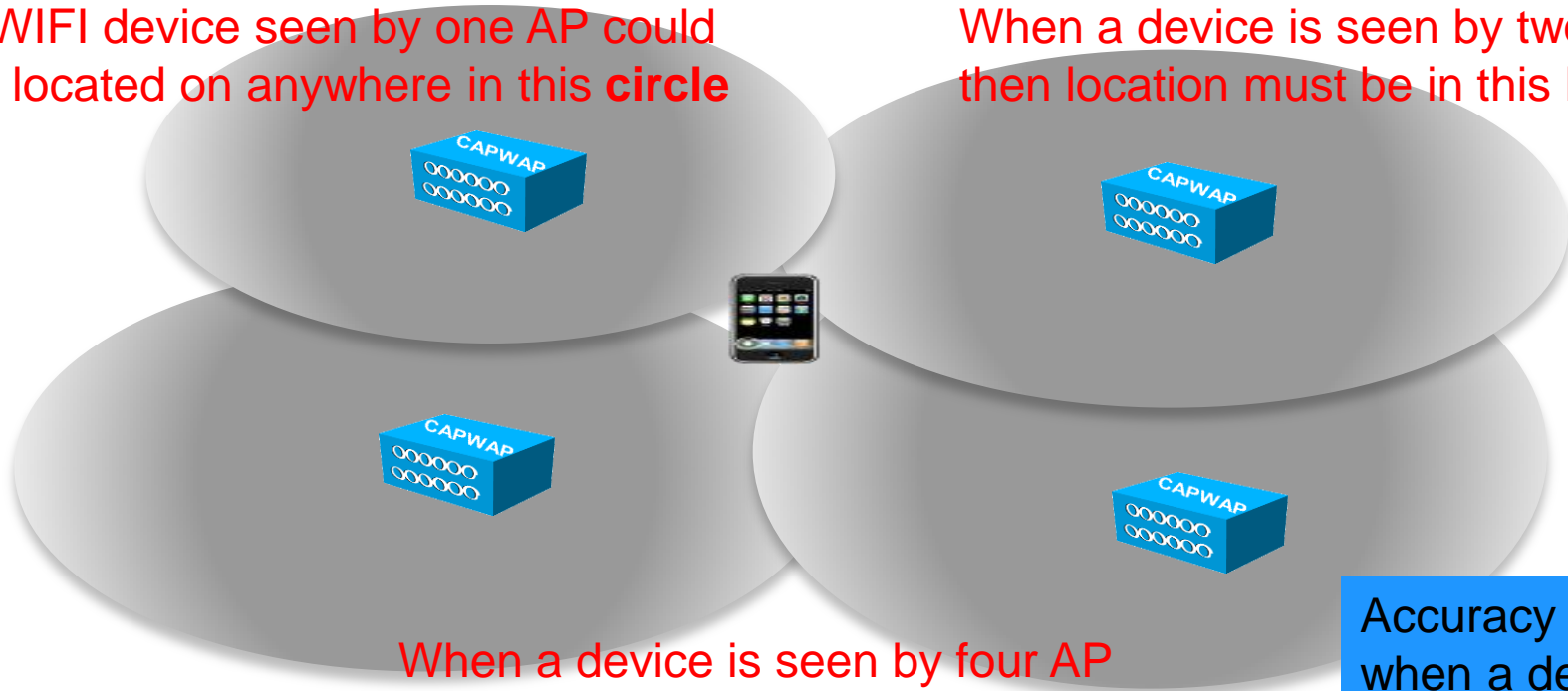


Design and Planning

WiFi Based Location Calculation Basics

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**

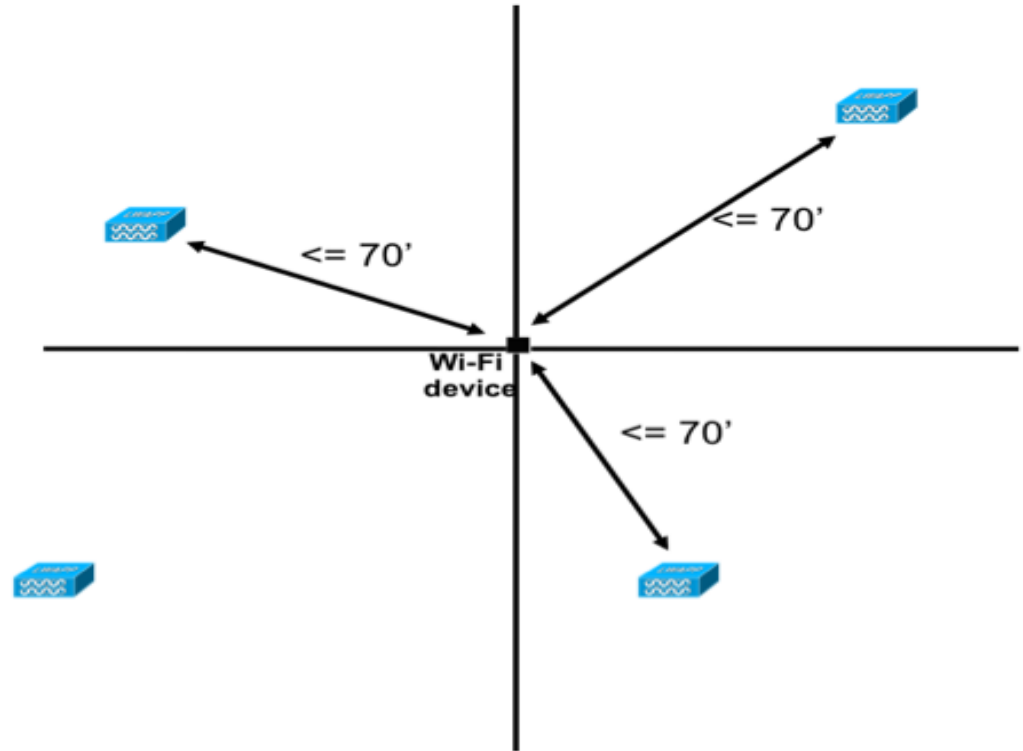


When a device is seen by four AP then location must be at this **point.**

Accuracy highest when a device is seen by at least 4 Access points

Location Readiness

- A point on a floor map is location-ready if:
 - min. of 4 AP's are deployed
 - min. of 3 AP's are within 20 metres (~70 feet)
 - At least 1 AP placed in each of at least 3 surrounding quadrants.



Designing Location Services – Access Point Deployment Considerations

- Proper placement and density of access points is **critical** in achieving the quoted location tracking performance
 - Original design may have been based on **coverage model**
 - **Location Accuracy** may require a different AP-deployment model
- Access Point Density recommendations
 - Use smaller, overlapping cells (lower data rates disabled)
 - For wireless data only deployments: 10% AP cell overlap
 - For wireless data + voice deployments: **20% cell overlap**
 - AP density [Cell radius] **10m – 15m** (AP's 15 - 22m apart)
(Typically about one access point every 230 – 460 sq.m)
- Antennas should be oriented **horizontally** (vs. vertically)
- Antenna diversity should be enabled
- AP/Antenna height should be 3 – 6 metres

For accurate locations start with data +voice over WiFi as design baseline

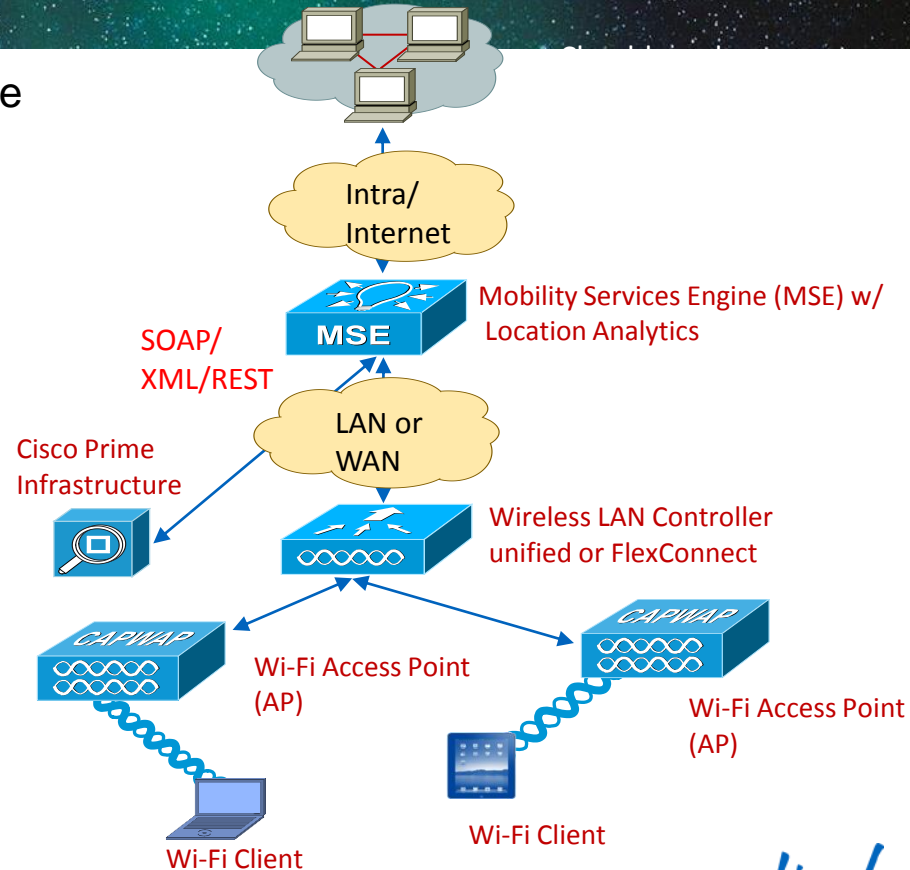
Client Device Behaviour

- Location tracking based on Probe RSSI
- Implication -> client probe timing needs to be considered
- Different client/OS combinations behave differently
- Smartphone v RFID tag
- Probe RSSI v Data RSSI



Location Based Services Architecture

- Wi-Fi AP measures and reports RSSI (Receive Signal Strength Indicator) to WLC (ie 5-300 seconds depending on endpoint)
- WLC (unified/Flexconnect) aggregates and periodically reports them to MSE via NMSP (ie 2 seconds, configurable)
- MSE applies advanced positioning algorithms (ie API real time, Analytics ever 15 mins)
 - Determine location (RF fingerprinting/modelling)
 - Location notifications (to outside app. Server)
 - Statistical processing for CMX Analytics
 - Displaying all devices on a map in Cisco Prime



Location Accuracy/Currency Examples

- Accuracy: function of AP density & AP height
- Currency: function of AP density and client type (client probes network at different rate)

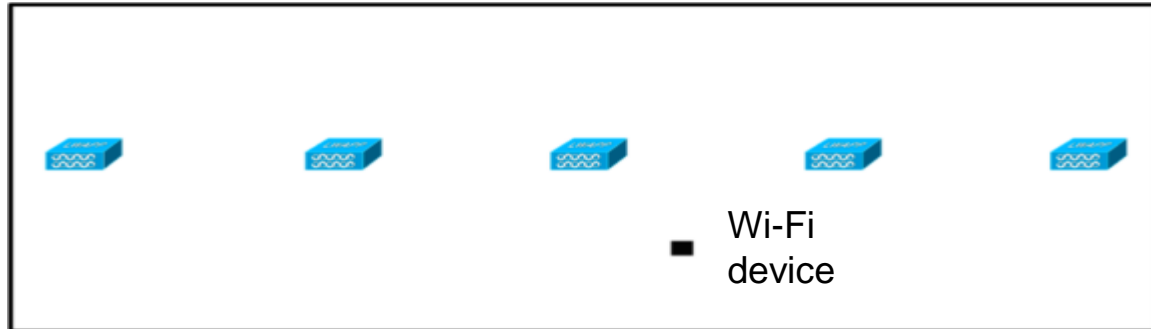
| Application | Venue type | AP density | Avg. Accuracy | Currency |
|-------------------|-------------------------|--------------------------|---------------|----------|
| Presence | Mall, airport ... | 10+K Sq ft 929 Sq m | 29.5ft 9m | N/A |
| Proximity | Retail ... | <2.5K Sq ft <232 Sq m | 16.4ft 5m | ~30s |
| Asset-tracking | Enterprise, mall ... | 5K Sq ft 464 Sq m | 22.96ft 7m | >> 1min |
| Mobility-tracking | Mall, airport ... | <2.5K Sq ft <232 Sq m | 16.4ft 5m | ~30s |

Designing Location Services – Best Practices

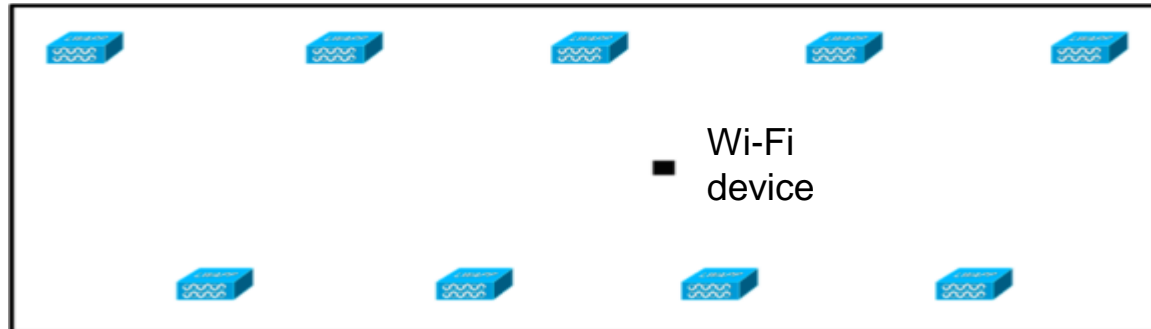
- Based on accuracy and environment type (office vs. indoor high-ceiling), the density of APs (average cell-radius) can be determined and maintain average cell-radius throughout the service area on each floor.
- Plan for location (e.g. using the PI planning tool)
 - Design for good coverage first (***RSSI of $\geq -85\text{dBm}$ on all channels clients support***)
 - Design for good cell-edge delineation (i.e. ensure client roams between adjacent cells)
 - ***Each client should be within convex-hull of 3+ APs (i.e 4)*** on the same floor
 - Place perimeter AP's first then place interior AP's to minimise coverage gaps
 - ***Staggered AP deployment*** (not in a straight line) [esp. in long narrow coverage areas like hallways, corridors, tunnels, etc.]
- Use location rails, exclusion regions, and inclusion regions to constrain the location prediction to valid areas of the map with the PI Map editor.

AP Placement – Best Practice

Poor AP placement and coverage for location – linear AP placement



Proper AP placement and coverage for location – staggered AP placement with perimeter coverage



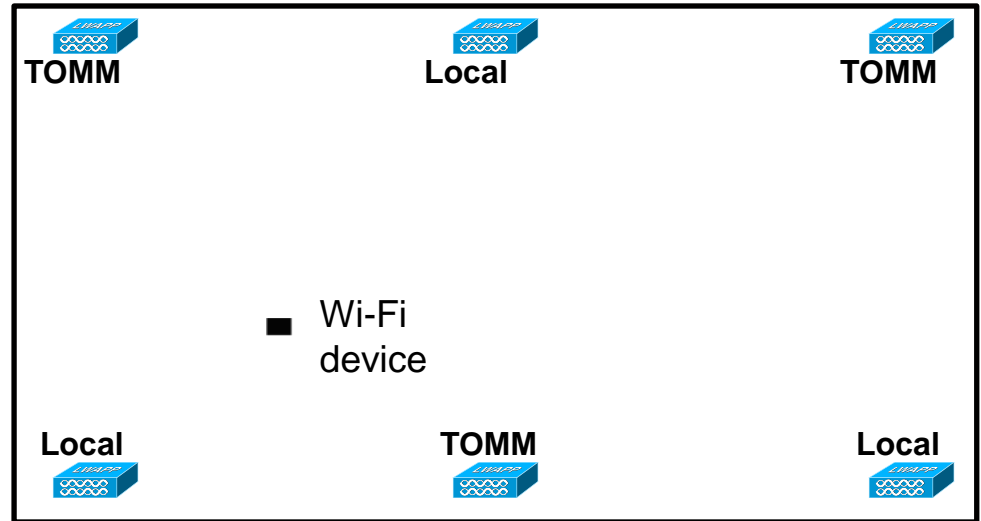
Designing Location Services – Best Practices

- Characterise the RF environment either using the pre-canned RF Fingerprinting models (preferred) or via RF calibration (measurement) followed by a location accuracy assessment.
- **Four default pre-packaged RF** models are provided with PI:
 - Cubes & walled offices
 - Drywall office only
 - Outdoor open space
 - Indoor high ceiling
- If the provided default RF models do not sufficiently characterise the floor layout, custom calibration models can be created using PI and applied to the floor to better represent the RF characteristics of a given environment.

Coverage Gaps – Voice and Location

- Local mode AP placement and density may be sufficient for data/voice applications
- Use Monitor AP's to fill in coverage gaps
- Monitor mode Aps (TOMM here or “Tracking Optimised Monitor Mode”) can be used also to do Wireless IPS and CleanAir
- Note: 2.4 GHz only, designed specifically to be used in conjunction with RFID tags

Tracking Optimised Monitor Mode APs



Location Accuracy Tool (Prime)

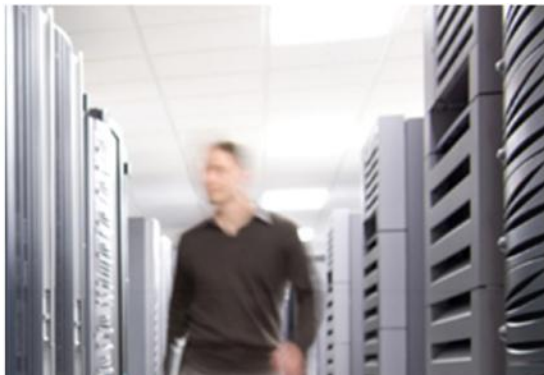
The screenshot shows the Cisco Prime Infrastructure web interface for the Location Accuracy Tool. The top navigation bar includes the Cisco logo, the text "Cisco Prime Infrastructure", and a search bar with "Virtual Domain ROOT-DOMAIN | root" and a search icon. The main menu has options for Home, Monitor, Configure, Services, Reports, and Administration.

Position Test Points
Tools > Location Accuracy Tool > Location_Tool_Demo > Position Test Points

Instructions:
1. Position the Test Point on the floor and click 'Start'. Wait for at least 2 minutes at this position, in order to collect enough data, and then click 'Stop'.
2. Move to the next test point and wait for about 1 minute before you repeat this process. When all test locations have been completed, click 'Analyze Results'.
3. The test should be run for at least 5 unique positions on the map to obtain Error Heatmap.

Form Fields:
Select a client/tag/interferer:
x: y:

Map:
A floor plan map is displayed with a grid overlay. The grid is labeled with distances from 0 ft to 250 ft in 50 ft increments. A red crosshair is positioned on the map. A vertical toolbar on the left side of the map contains navigation icons: a four-way arrow, a plus sign, a minus sign, and a refresh icon. The bottom right corner of the map area shows the coordinates "-235.42 ft, 4.89 ft".



Installation Tips

Services Mix

- Services on the Same MSE
 - *Context Aware Services* and *CMX Analytics* can and should be run on the same MSE.
 - *wIPS* should be run on a separate MSE without any additional services.
 - *Mobile Concierge Service* client device dependencies/mobile App Enablement
 - *CMX Dashboard* should be run on a separate MSE (if using the 3355, low end, or standard vMSE) unless using high end MSE. For **best performance it is recommended to host CMX dashboard on a separate MSE.**

Plan Zones in Advance

- Zones (Inclusion/Exclusion) = areas of interest
 - A zone is a user defined space with a name and can be used for reporting or path description purposes; zones can be overlapping and need not cover all the building
 - Although there is not a limit to the number of zones that you may include, choose them carefully.
 - *Definition of zones allows for more granular reporting.*
- Coverage Areas
 - *Additionally drawing accurate coverage areas on maps in Prime provides more granularity when reports are generated.*
 - For instance, in the case of a none standard floor layout (not square or rectangular) it is desirable to define the outlines of the floor so that areas on the map that have no coverage are omitted.

Don't forget to enable History Parameters

- In Prime/MSE insure to check that history parameters is selected
 - Without this box checked CMX Analytics will not save data for reports generation.

The screenshot displays the 'History Parameters: MSE12' configuration page. The breadcrumb trail is 'Services > Mobility Services Engines > MSE12 > Context Aware Service > Administration > History Parameters'. The page title is 'History Parameters'. The configuration includes:

- Archive for:** 30 (1 - 365 days)
- Prune data starting at:** 23 hours 50 minutes and also every 1440 minutes
- Enable History Logging of Location Transitions for:**
 - Client Stations
 - Wired Stations
 - Asset Tags
 - Rogue Access Points
 - Rogue Clients
 - Interferers





Buttons for 'Save' and 'Cancel' are visible at the bottom of the configuration area.

Enable Services From Prime

- MSE with CAS and CMX Analytics Enabled

| Admin Status | Name | Version | Service Status | License Type |
|-------------------------------------|--------------------------|------------|----------------|-----------------------------|
| <input checked="" type="checkbox"/> | Context Aware Service | 7.5.1.48 | Up | Evaluation (350 days left) |
| <input type="checkbox"/> | WIPS | 1.2.6113.0 | Down | Evaluation (120 days left) |
| <input type="checkbox"/> | Mobile Concierge Service | 3.0.0.29 | Down | Evaluation (120 days left) |
| <input checked="" type="checkbox"/> | CMX Analytics | 2.0.0.57 | Up | Evaluation (105 days left) |
| <input type="checkbox"/> | CMX Browser Engage | 1.0.0.2 | Down | Permanent |
| <input type="checkbox"/> | HTTP Proxy Service | 1.0.0.1 | Down | Permanent |

Connected Mobile Experiences Software Requirements

| | Platform | Minimum Software Version |
|---|----------------------------|--------------------------|
|  | Wireless LAN Controller | 7.2 |
|  | Access Point | 7.2 |
|  | Cisco Prime Infrastructure | 1.4 |
|  | Mobility Services Engine | 7.4 |

Cisco MSE 3355 Appliance

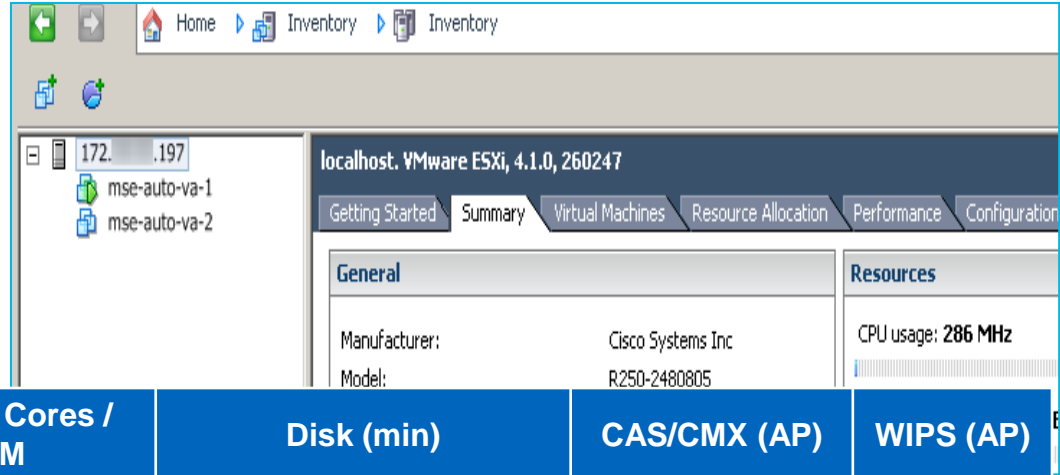


- Tracking performance ~900 movements per second, up to 25,000 elements
- IBM x3550M3 Platform / 1RU Form Factor
- 2 CPUs (Quad Core) – Intel Nehalem 2GHz, 4Mb cache
- 16G RAM
- 4 x 146GB Hot-swappable 6 Gbps SAS drives/10k RPM / HW RAID (1+0)
- Up to 20 MSEs / Prime Infrastructure

| CAS/CMX Limit (AP) | WIPS Limit (AP) |
|--------------------|-----------------|
| 2500 | 5,000 |

MSE Virtual Appliance

- Require activation license + CAS / WIPS license
- Virtual appliance will be distributed as OVA image (Low and Generic)
- Only SASU required for support
- Supported on ESX/ESXi 4.x and ESXi 5.x

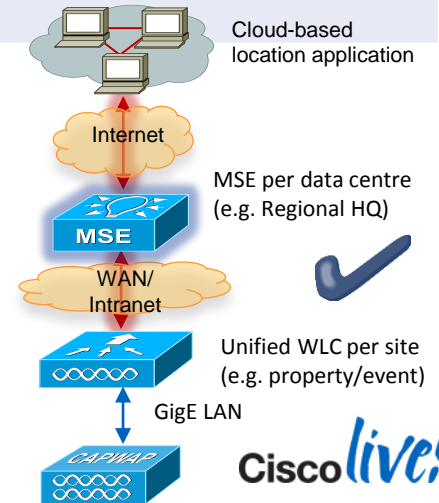
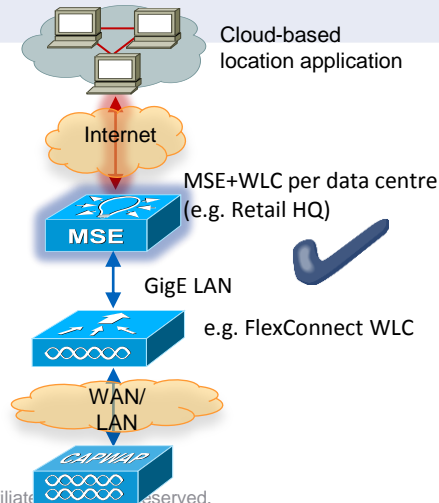
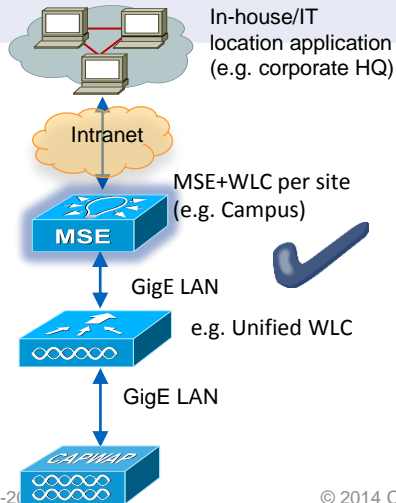


| Level | Server Reference | Physical Cores / RAM | Disk (min) | CAS/CMX (AP) | WIPS (AP) |
|--------------|--------------------------------------|--|--|--------------|---------------|
| Low | Cisco UCS C250 M2 rack mount server | 2 at 2.93GHz or better (2x Intel Xeon X5570)/ 6GB | Minimum 500GB, 900 IOPS with a bandwidth of 3000 Kbytes/sec | 200 | 2,000 |
| Med/Standard | Cisco UCS C250 M2 rack mount server | 8 at 2.93GHz or better (2x Intel Xeon X5570)/ 16GB | Minimum 500GB, 1100 IOPS with a bandwidth of 4000 Kbytes/sec | 2,500 | 5,000 |
| High | Cisco UCS® C460 M2 rack mount server | 16 at 2.13GHz or better (2x Intel Xeon E7-L8867)/ 20GB | Minimum 500GB, 1600 IOPS with a bandwidth of 6000 Kbytes/sec | 5,000 | 10,000 |

General Architecture Considerations

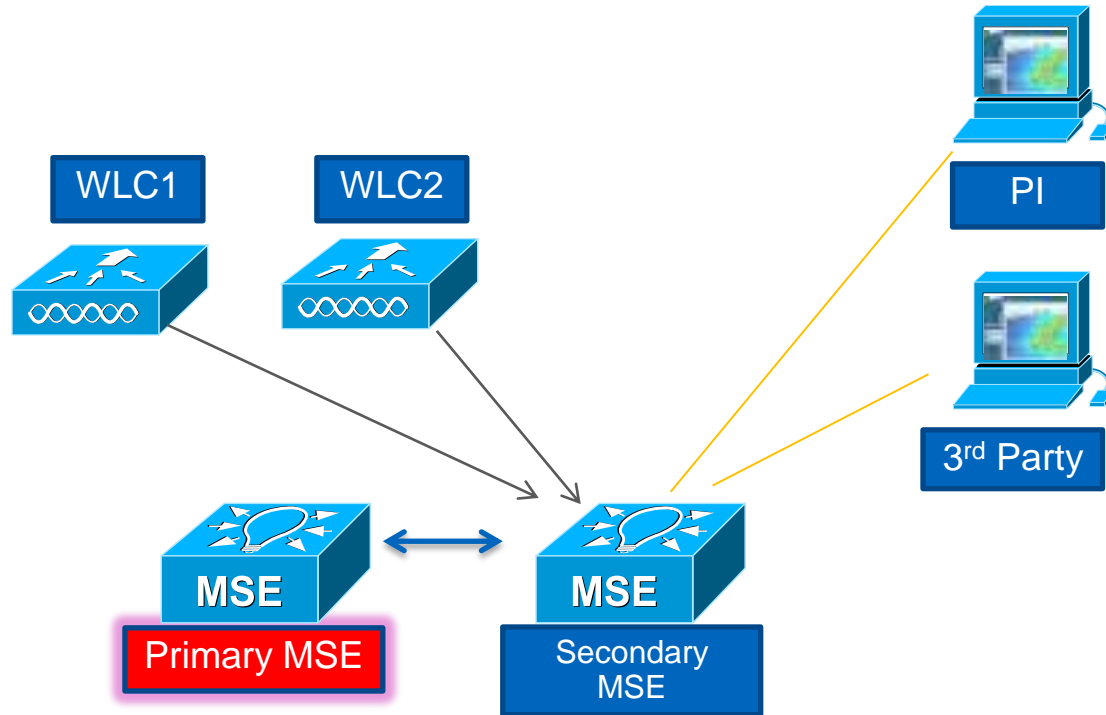
| | Co-located | Partly Distributed | Fully Distributed |
|--------------------------|-----------------------------------|-------------------------------------|--|
| Location application | In-house E.g. corporate HQ Server | Cloud based | Cloud based |
| MSE | MSE+WLC per site e.g. campus | MSE+WLC per DC e.g. retail HQ | MSE per DC e.g. Regional HQ |
| WLC | MSE+WLC per site e.g. unified WLC | MSE+WLC per DC e.g. FlexConnect WLC | Unified WLC per site e.g. property/venue |
| Bandwidth considerations | Low | Medium | High |

Flexible MSE deployment options



MSE High Availability

- Managed by PI using the MSE VIP
- Network L2 or direct connected
- Supports 1:1 configuration
- HA for all services supported; Failover times < 1 min
- Supports automatic & manual failover / failback
- Physical to physical & virtual to virtual HA supported



Location Services Calculator

- Calculates MSE BW and TPS due to location tracking & location altering (LT & LA)
 - Based on rate at which client roams between APs and
 - Rate at which client enters/exits user defined zones.
 - Above rates are estimated based on network topology (e.g. client, AP density) Venue type (e.g. retail, office) and building dimensions (floor size, number of floors ...)

MSE Bandwidth (BW) Calculator (7.4)

This version of the MSE calculator computes bandwidth (NMSP from WLC & SOAP/XML to application (e.g. Mobile Concierge - Meridian) including the effects of location-tracking (LT) and location-alerts (LA) on MSE BW, as well as transaction rates, accuracy & currency.

To use, select the client type (use "Generic" for a device mix) and either use density or volume based dimensioning of the network. For volume-based dimensioning, enter # clients, # AP and # WLC (presumed evenly distributed). For density-based dimensioning, enter client density (sq. ft. / client), AP density (sq. ft. / AP) & AP distribution (AP per WLC) and set the client/AP # fields to zero. Now, select the venue/building type (office/IT, retail/consumer) and dimension the building with coverage area (sq. ft./floor), # floors, average size of a containment events zone/area-of-interest (sq. ft./zone) and % of floor area actually zoned (i.e. for containment events) - if your zone size is smaller than the location accuracy area, it will be adjusted to the latter. For location-analytics application (LAA) specifics, enter the "analysis duration (days)"

Observe, NMSP bandwidth between a single WLC and MSE (kpbs/WLC) and all WLCs in the venue (Mbps/MSE), SOAP BW between MSE and app (i.e. Mobile Concierge - Meridian) both per client (bps/client) and per MSE (Mbps/MSE) for both Location Tracking (LT), Location Alert (LA) and combined activities, per MSE transaction rates (TPS) for LT, LA and combined activities, location accuracy (90%-ile) and currency (time and distance between last location prediction). NOTE that the "total accuracy error" is also computed which combines the location uncertainty (accuracy) plus the location drift or staleness (currency distance). For LAA, the database sizing (MB) is estimated based on all other parameters and the analysis duration.

Client/app: Generic (mix) | Retail

Density: 200 sq. ft./client, 10000 # clients | 2500 sq. ft./AP, 300 # AP, Square cells assumed | 100 AP/WLC, 1 # WLC

Desired/Actual: 30000 sq. ft./floor, 3 # floors, 5000 sq. ft./zone, 5000 sq. ft./zone, 25% % floor zoned, 90 LAA analysis duration (12-hr days)

Bandwidth: 18 kbps/AP, 1802 kpbs/WLC (NMSP), 1.8 Mbps/MSE (NMSP)

Transactions: 82 bps/client (MSE SOAP LT), 0.8 Mbps/MSE (MSE SOAP LT), 63 bps/client (MSE SOAP LA), 0.2 Mbps/MSE (MSE SOAP LA), 145 bps/client (MSE SOAP LA + LT), 1.0 Mbps/MSE (MSE SOAP LA + LT)

Storage: 327 TPS (MSE SOAP LT), 63 TPS (MSE SOAP LA), 390 TPS (MSE SOAP LA + LT), 304 GB (MSE DB - LAA)

Currency: 44 ft, 24 s

Accuracy: 98%-ile Total: 21 ft, 65 ft

Location tracking (movement & probing)
Location alerts (containment-based)

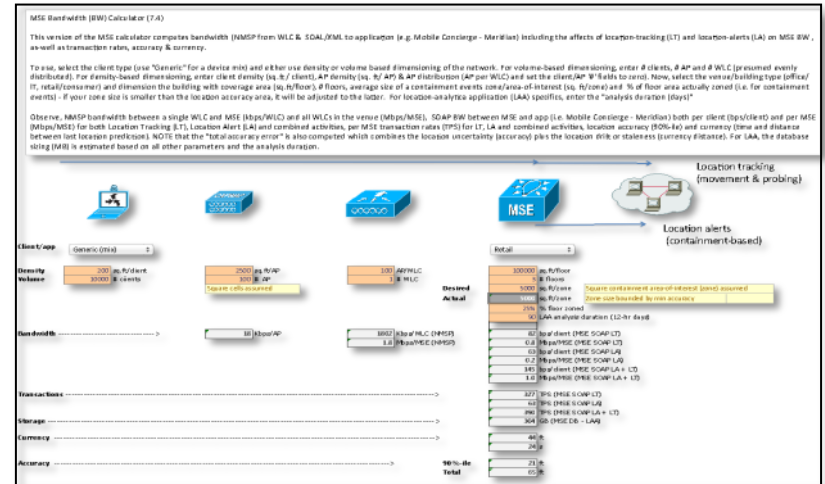
Location Services Calculator

Inputs:

- client types,
- network nodes in volume
- (# clients, # AP, # WLC) or density
- (sq.ft/client, sq.ft/AP),
- venue type and building parameters
- (sq.ft/floor, # floors).

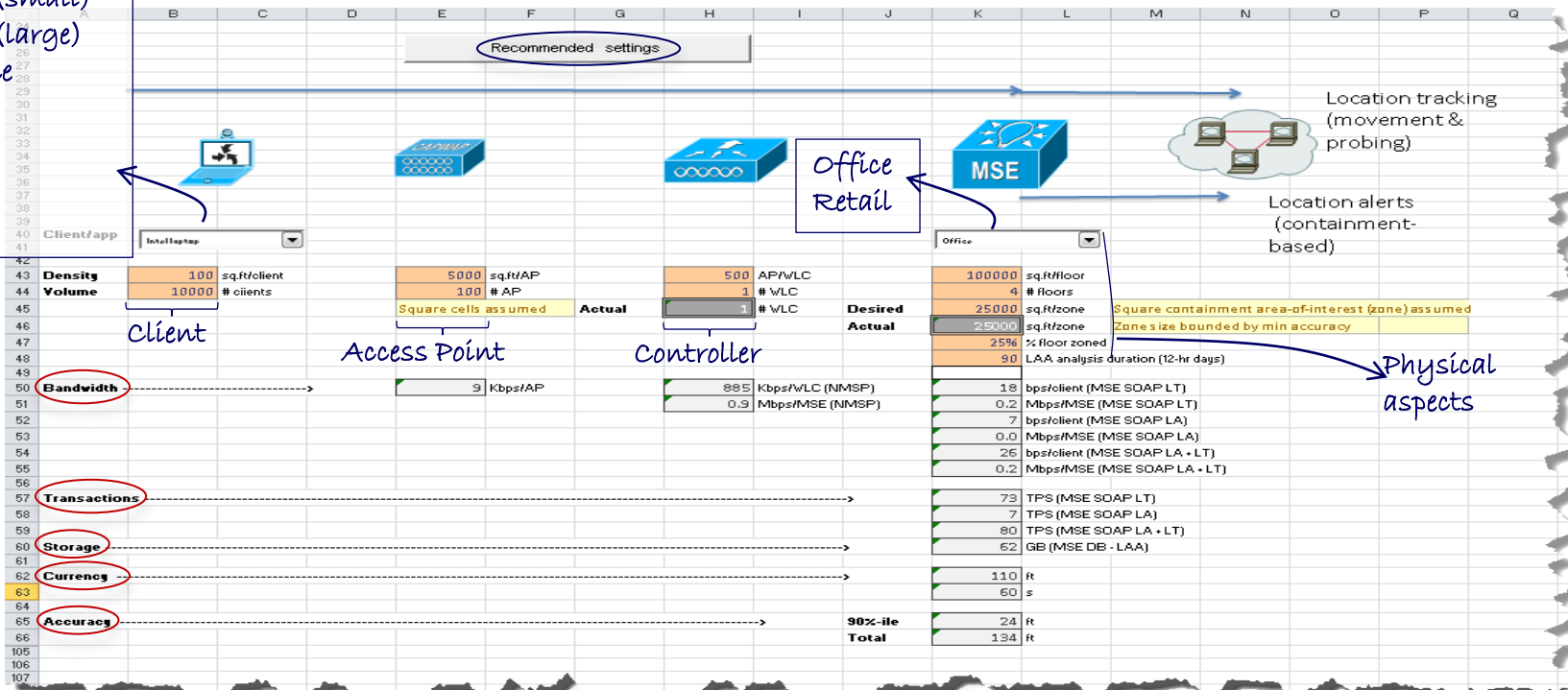
Outputs:

- NMSP Bandwidth per WLC (bps)
- NMSP Bandwidth per MSE (Mbps)
- SOAP/XML Bandwidth per client (bps) [due to both LT and LA activity]
- SOAP/XML Bandwidth per MSE (Mbps) [due to both LT and LA activity]
- MSE Transactions per MSE (TPS) [due to both LT and LA activity]
- Accuracy (ft)
- Currency in distance (ft) and time (s)
- Incremental Location Analytics storage (GB)



Location Services Calculator – BW, TPS, Storage, Currency and Accuracy

- Samsung Tab (small)
- Samsung Tab (large)
- Samsung Phone
- Intel Phone
- Apple iOS
- Intel Laptop
- Generic (mix)



- Bandwidth
- Transactions
- Storage
- Currency
- Accuracy



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