



*TOMORROW  
starts here.*

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# Creating a Connected Mobile Experience with the Mobility Services API and Mobility Application SDK

BRKEWN-2665

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#clmel

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# Agenda

- Connected Mobile Experience
- Understanding Indoor Location
- CMX Engage
- Mobility Services Engine API
- CMX Mobile SDK
- Apple and Android
- Meraki CMX
- Looking Forward



# Connected Mobile Experience



Presence and Location

Mobile Device  
Detection



Network Access

Simple Wi-Fi Guest Access

User Experience

Location-Based  
Content and Services

ANALYTICS

# Business Relevant Data



Number of people by venue or zone



Peak and dwell times



Customer Loyalty



Traffic patterns



Real-Time Location and Heatmaps

# Relevance Across Every Vertical



## Retail & Shopping Centres



- Engage shoppers
- Drive visits
- Increase AOV
- Enhance customer service & loyalty

## Hotels & Convention Centres



- Service residents & guests
- Sell capacity
- Drive incremental services sales
- Event navigation

## Transportation



- Service the traveller
- Increase in-airport spend
- Promote airport retailers

## Healthcare & Education



- Reduce patient and visitor stress
- Promote health
- Unique mobile experiences for foreign and disabled students
- Build brand loyalty

## Stadiums & Outdoor Arenas



- Build fan excitement
- Increase in-venue spend
- Sell more tickets
- Guided tours

## Museums & Attractions



- Enhance education
- Promote visits
- Increase loyalty
- Increase donations





# Understanding Indoor Location

# Understanding Location

## Time Delay of Arrival

A WIFI device seen by one AP could be located anywhere within the “**circle**”

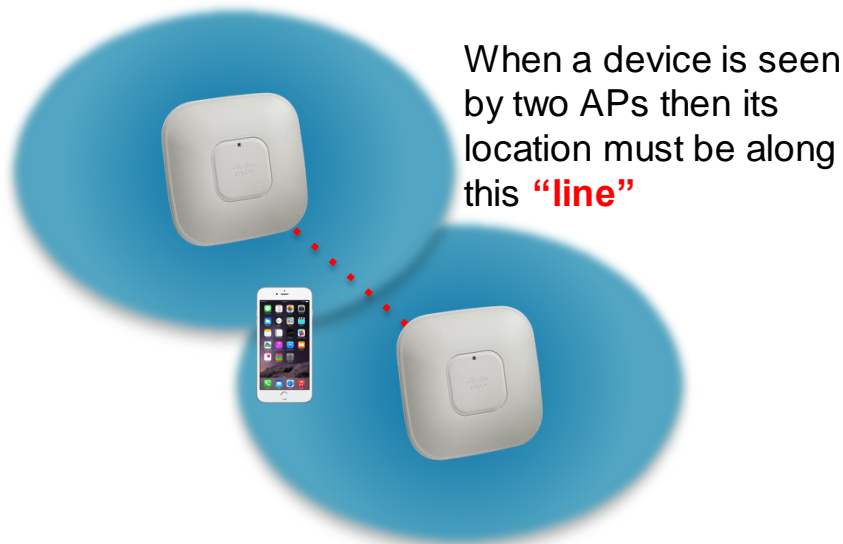


- Distance is measured not by line of sight, but by received signal strength
- Signal strength can be impacted by any number of reasons



# Understanding Location

## Time Delay of Arrival



- Distance is measured not by line of sight, but by received signal strength
- Signal strength can be impacted by any number of reasons

# Understanding Location

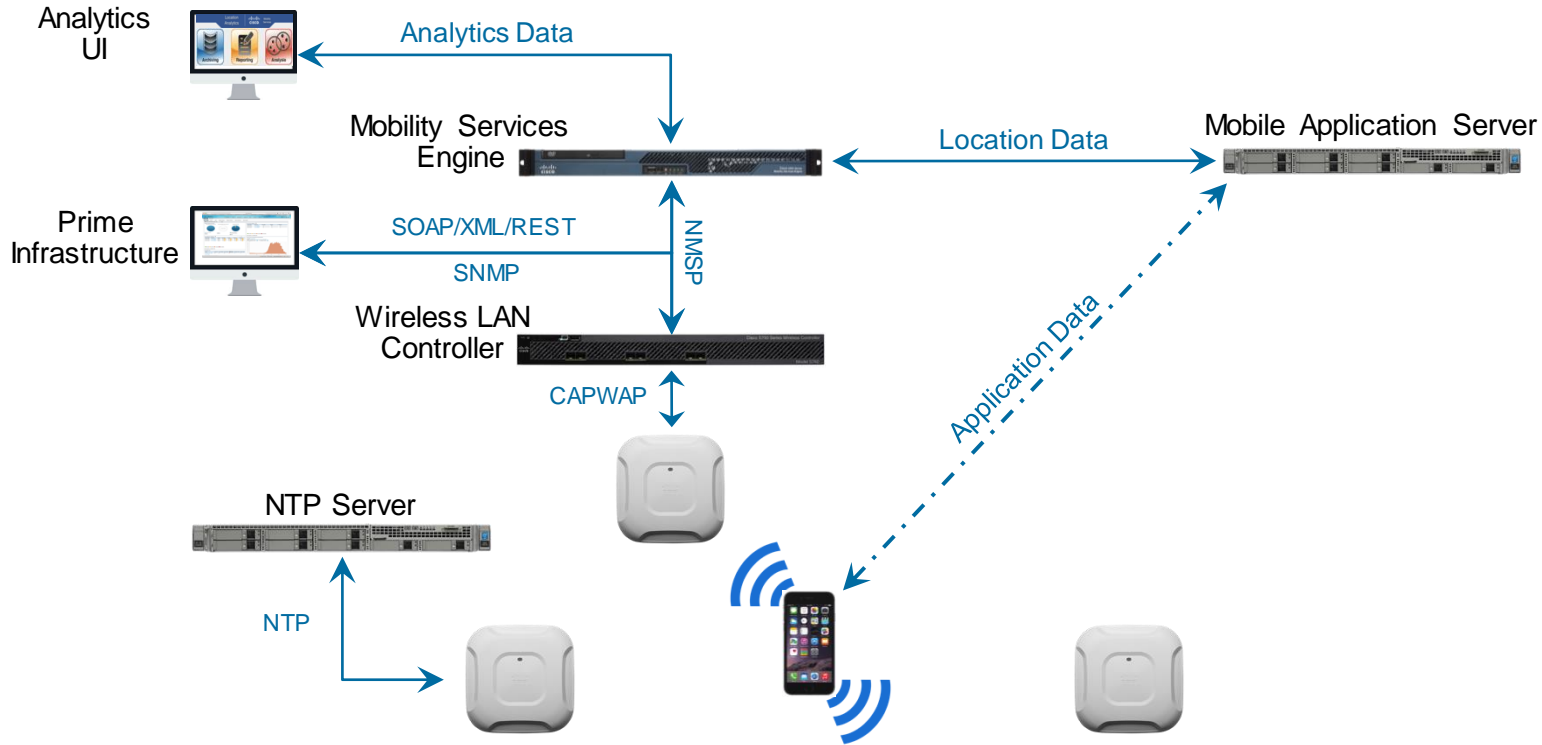
## Time Delay of Arrival



When a device is seen by at least three APs then its location must be at a **“point” of intersection**

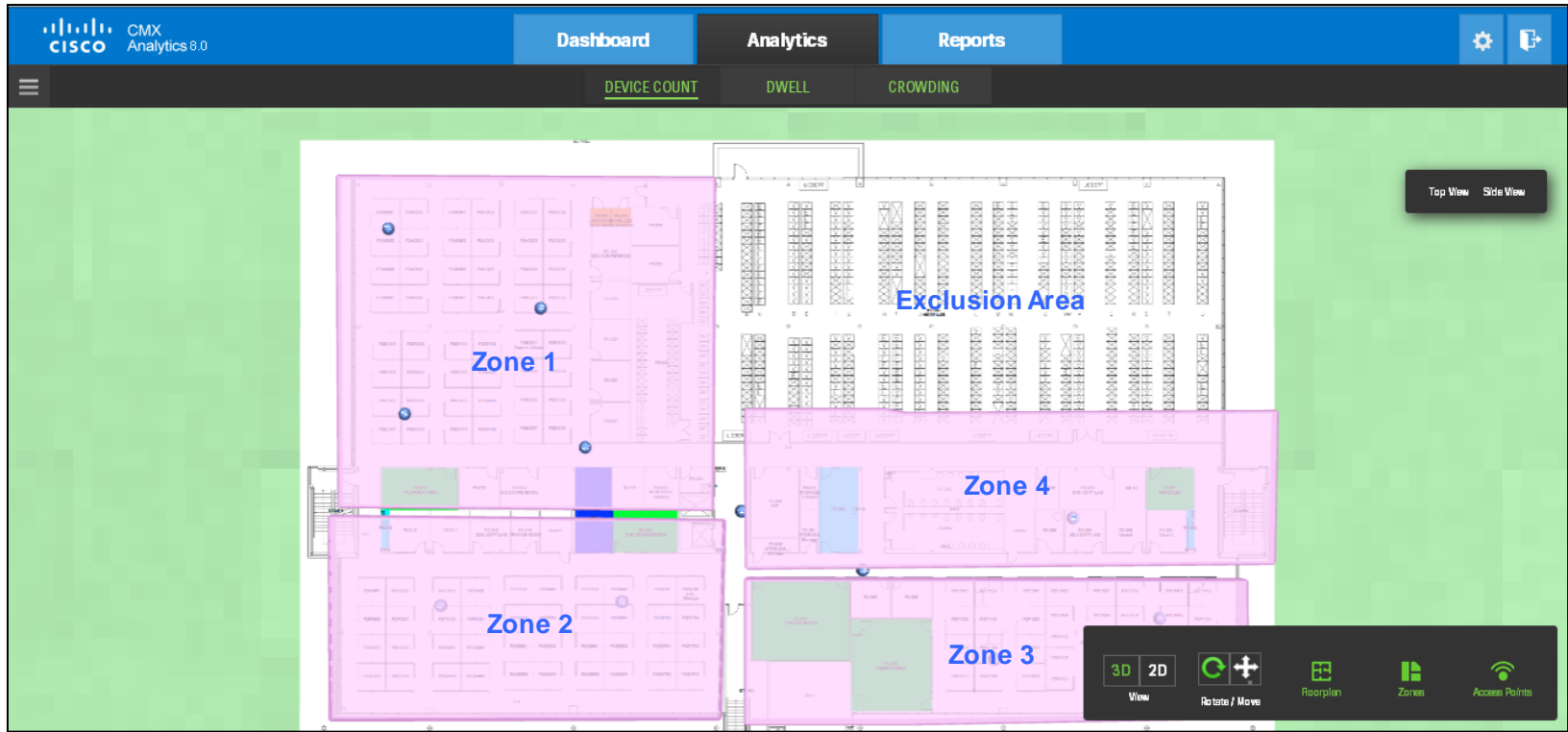
- Distance is measured not by line of sight, but by received signal strength
- Signal strength can be impacted by any number of reasons
- Accuracy will be highest when a device is seen by 4 or 5 APs

# Context Aware Service Architecture



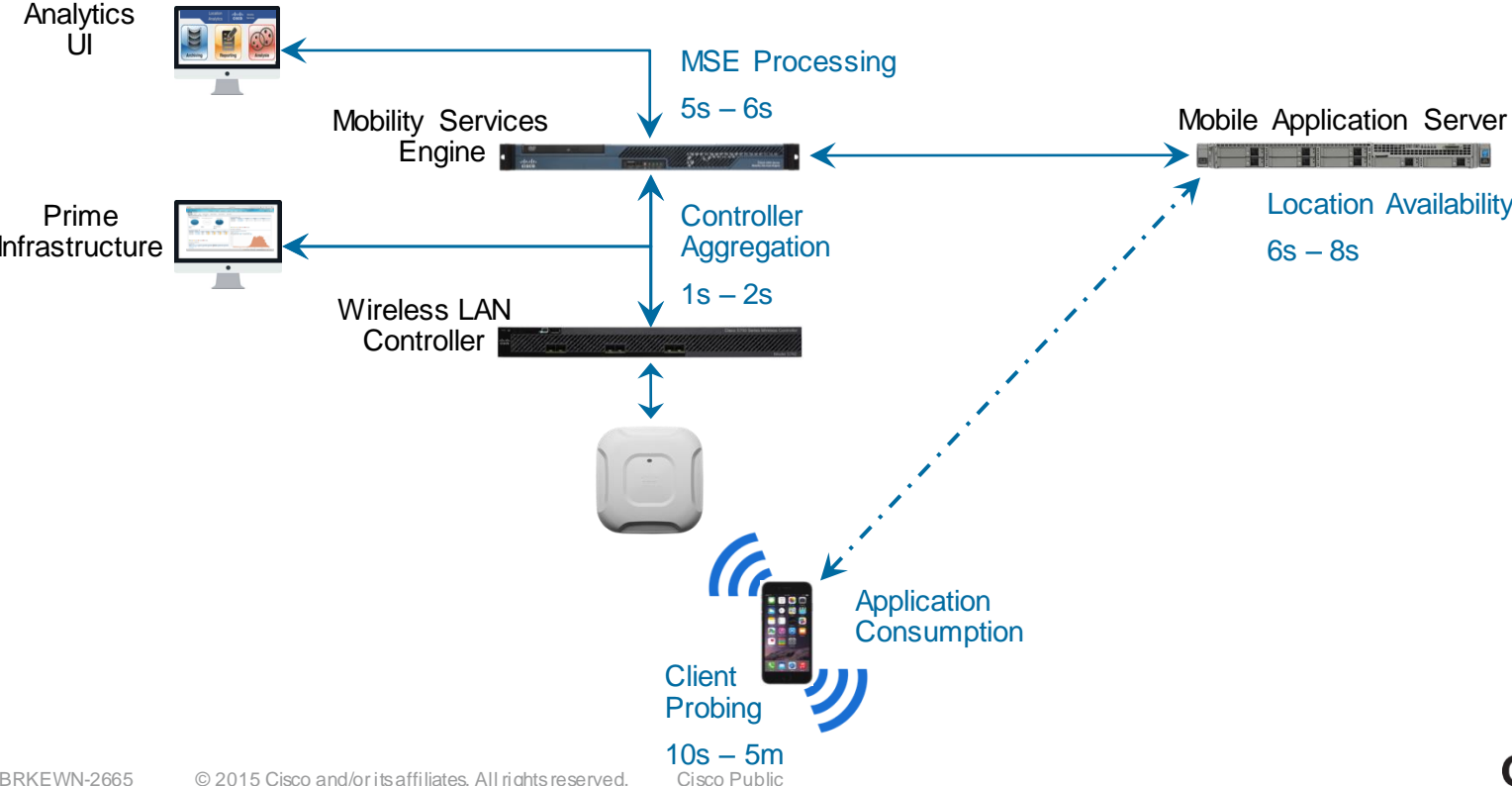


# Location Analytics Zones



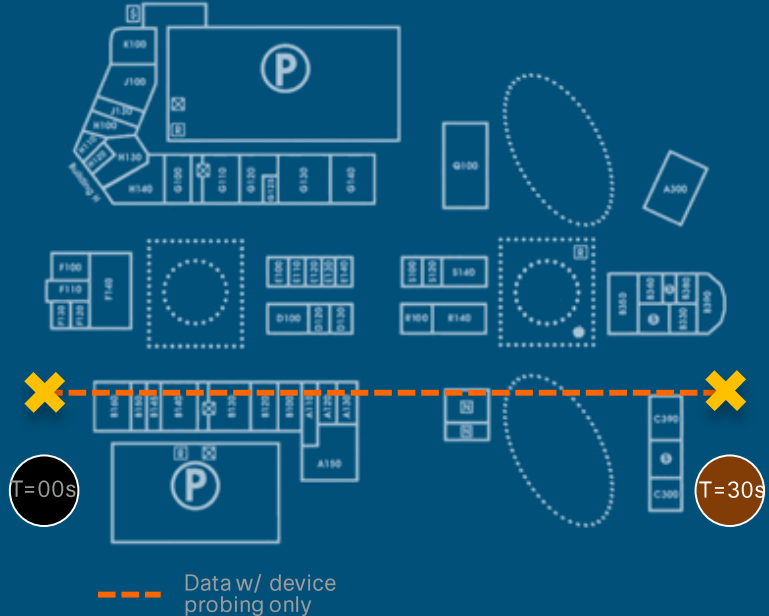


# Understanding Latency





# Understanding FastLocate

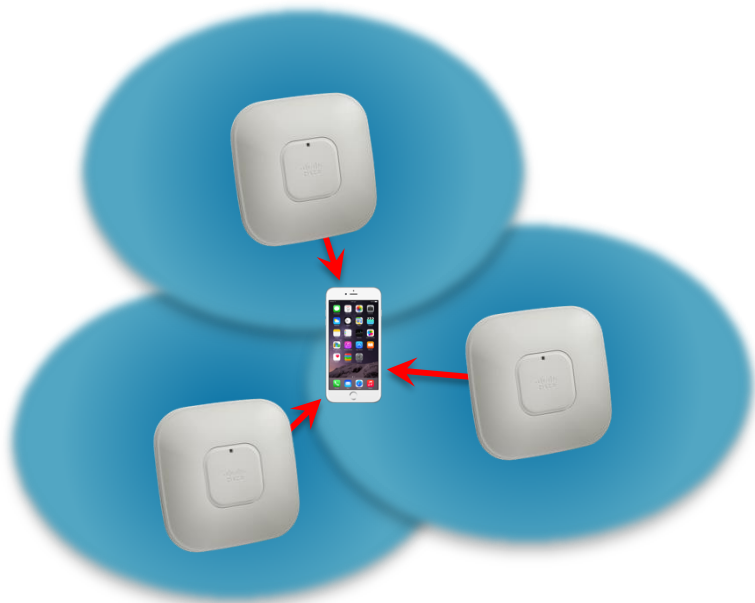


2 Data Points Per Minute



# Understanding Location

## Angle of Arrival

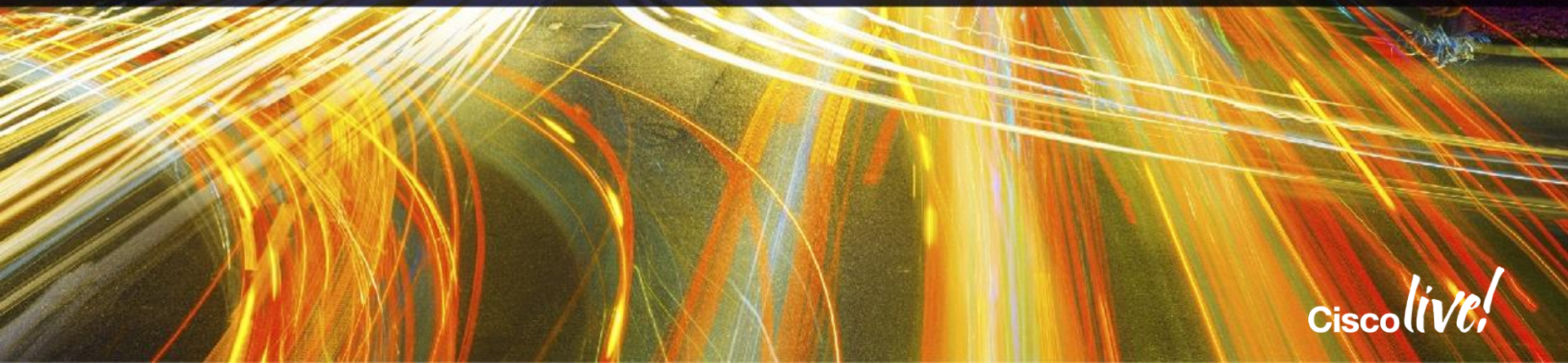


- TDoA calculates distance without any indication of direction
- This introduces potential errors in the calculations
- Angle of Arrival adds a sense of direction into the calculations
- This increases accuracy while reducing the number of APs required
- Multiple antennas are necessary





# CMX Engage



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# Cisco Developer Network

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## CMX Mobility Services

Build Compelling Experiences for your Mobile Customers.


Triangulate device location using wifi, and track location via device's mac address. Improve customer experience by providing coupons, promotions, or helpful push notification messages, such as "how to connect to the store's wifi".

Learn more



### 1. CMX Mobility Services API


Find out what CMX Mobility Service API is all about. How and why should you use it?



Check out Overview →

### 2. Build Mobile Apps


Learn how to build compelling mobile apps on Android and Apple iPhone that use CMX



Getting Started NOW →

### 3. Learn the API

Learn how to use the REST API for CMX



API Reference Manual →

## CMX Mobility Services

Learn how to use the Mobility Services API that is part of the Cisco Mobility eXperience offerings to provide indoor location based services within your mobile apps.

Enterprise Networks

Start Lab →

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# DevNet Learning Lab

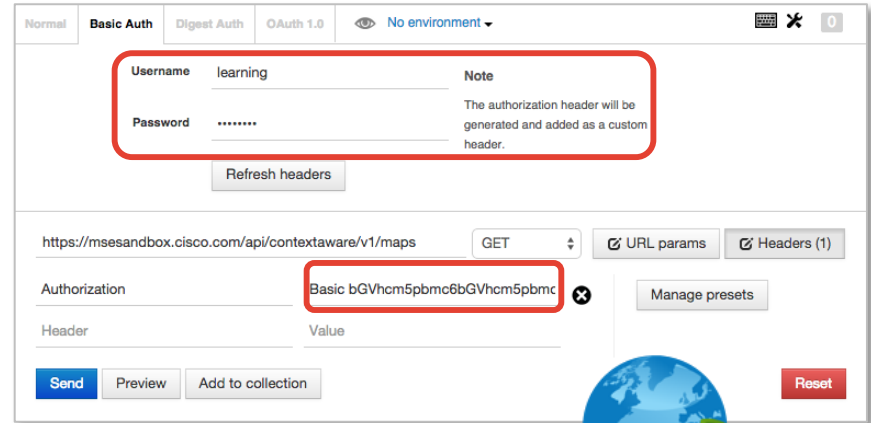
## Mobility Services Engine REST API

```
$curl -i -k --user learning:learning https://msesandbox.cisco.com/api/contextaware/v1/maps
```

```
HTTP/1.1 200 OK
Date: Tue, 06 Jan 2015 01:29:57 GMT
Server: Jetty(8.1.7.v20120910)
Content-Type: application/xml
Authorization: Basic bGVhcm5pbmc6bGVhcm5pbmc=
X-Forwarded-Server: www.example.com
User-Agent: curl/7.37.1
X-Forwarded-Host: 64.103.26.61
X-Forwarded-For: 10.67.252.185
Accept: */*
breadcrumbId: ID-mse-abc-inc-26742-1419010388400-0-214117
Transfer-Encoding: chunked
```

```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<Maps>
  <Campus objectVersion="9" name="DevNetCampus">
```

...





A nighttime photograph of a city street. In the background, there are modern buildings with lit windows and a pedestrian bridge with blue lighting. The foreground shows a road with light trails from vehicles, creating a sense of motion. The text 'Mobility Services Engine API' is overlaid in white on a dark horizontal band across the middle of the image.

# Mobility Services Engine API

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# Mobility Services Engine Location

- Locating Wi-Fi Sources
  - Smartphones and Tablets
  - Laptops
  - Wi-Fi Tags
  - Printers
  - Access Points
- CleanAir Sources
  - Bluetooth
  - DECT Phones
  - Wireless Video Cameras
  - Microwave Ovens
  - Wi-Fi Jammers

## Rogues

Unauthorised Access Points and clients attached to them pose security threats to Enterprise wireless networks

Security and Industry Compliance

## Tags

Small battery operated devices with Wi-Fi Radios and other sensors

Track assets and attributes: temperature, pressure, motion, etc

## Interferers

Non-Wi-Fi transmitters in 2.4/5GHz band which can degrade Wi-Fi performance

Performance monitoring, RF troubleshooting and Security



# Understanding RESTfulness

## REpresentational State Transfer

- Six Constraints
  - Uniform Interface
  - Stateless
  - Cacheable
  - Client-Server
  - Layered System
  - Code on Demand

```
curl -i "http(s)://<MSE  
IPADDRESS>/api/contextaware/v1/notifications/$name" -  
XGET  
-H "Accept: application/json"
```

```
curl -i "http(s)://<MSE  
IPADDRESS>/api/contextaware/v1/notifications/$name" -  
XDELETE -H "Accept: application/json"
```

Resource	GET	PUT	POST	DELETE
<b>Collection URI</b> <small>https://&lt;MSE IPADDRESS&gt;/api/contextaware/v1/maps/info</small>	List the URIs and other details of the collection's members	Replace the collection with another collection	Create a new entry in the collection	Delete the entire collection
<b>Element URI</b> <small>https://&lt;MSE IPADDRESS&gt;/api/contextaware/v1/maps/info/ DevNetCampus/DevNetBuilding</small>	Retrieve a representation of the addressed member of the collection	Replace the addressed member of the collection, or if it doesn't exist, create it	Treat the addressed member as a collection and create a new entry within it	Delete the addressed member of the collection

Source: Wikipedia - Representational state transfer

# Open Data Sharing

## XML – eXtensible Markup Language

- A markup language which defines a set of rules for encoding documents in a format which is both human and machine readable
- Widely used for the representation of arbitrary data structures
- Extensible to allow the storage of any data type, including images, videos and executables

## JavaScript Object Notation

- While originally derived from JavaScript, JSON is language independent
- Limited to classic data types:
  - Number
  - String
  - Boolean (true or false)
  - Array
  - Object
  - null

# Maps API

## Maps

GET https://<MSE IPADDRESS>/api/contextaware/v1/maps

```
<?xml version="1.0" encoding="UTF-8" standalone="yes" ?>
<Maps>
  <Campus objectVersion="9" name="DevNetCampus">
    <Dimension length="1000.0" width="1000.0" height="10.0" offsetX="0.0" offsetY="0.0" unit="FEET"/>
    <Building objectVersion="7" name="DevNetBuilding">
      <Dimension length="200.0" width="200.0" height="10.0" offsetX="300.0" offsetY="300.0" unit="FEET"/>
      <Floor objectVersion="5" name="DevNetZone" isOutdoor="false" floorNumber="1">
        <Dimension length="103.3" width="185.3" height="20.0" offsetX="0.0" offsetY="0.0" unit="FEET"/>
        <Image imageName="domain_0_1413901498194.png"/>
        <AccessPoint name="T1-10" radioMacAddress="00:2b:01:00:0b:00" ethMacAddress="00:2b:01:00:0b:f0"
          ipAddress="10.10.20.250" numOfSlots="2" apMode="LOCAL">
          <MapCoordinate x="170.87" y="80.99" unit="FEET"/>
          <ApInterface band="IEEE_802_11_B" slotNumber="0" channelAssignment="11" channelNumber="11"
            txPowerLevel="4" antennaPattern="Internal-1140-2.4GHz" antennaAngle="1.57"
            antennaElevAngle="0.0" antennaGain="0"/>
          <ApInterface band="IEEE_802_11_A" slotNumber="1" channelAssignment="1" channelNumber="64"
            txPowerLevel="5" antennaPattern="Internal-1140-5.0GHz" antennaAngle="1.57"
            antennaElevAngle="0.0" antennaGain="11"/>
        </AccessPoint>
      </Floor>
    </Building>
  </Campus>
  ...
  <LocationFilterRegion regionType="OUTSIDE">
    <MapCoordinate x="0.0" y="0.0" unit="FEET"/>
    <MapCoordinate x="185.3" y="0.0" unit="FEET"/>
    <MapCoordinate x="185.3" y="103.3" unit="FEET"/>
    <MapCoordinate x="0.0" y="103.3" unit="FEET"/>
  </LocationFilterRegion>
</Maps>
```

# Maps API

## Map Count

GET [https://<MSE\\_IPADDRESS>/api/contextaware/v1/maps/count](https://<MSE_IPADDRESS>/api/contextaware/v1/maps/count)

```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<MapCounts totalCampuses="1" totalBuildings="1" totalFloors="1">
  <CampusInfo campusName="DevNetCampus" totalBuildings="1">
    <BuildingInfo buildingName="DevNetBuilding" floorCount="1"/>
  </CampusInfo>
</MapCounts>
```

# Maps API

## Maps Info

GET https://<MSE IPADDRESS>/api/contextaware/v1/maps/info/\$campusName/\$buildingName/\$floorName

GET https://<MSE IPADDRESS>/api/contextaware/v1/maps/info/DevNetCampus/DevNetBuilding

```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<Building objectVersion="7" name="DevNetBuilding">
  <Dimension length="200.0" width="200.0" height="10.0" offsetX="300.0" offsetY="300.0" unit="FEET"/>
  <Floor objectVersion="5" name="DevNetZone" isOutdoor="false" floorNumber="1">
    <Dimension length="103.3" width="185.3" height="20.0" offsetX="0.0" offsetY="0.0" unit="FEET"/>
    <Image imageName="domain_0_1413901498194.png"/>
    <AccessPoint name="T1-10" radioMacAddress="00:2b:01:00:0b:00" ethMacAddress="00:2b:01:00:0b:f0"
      ipAddress="10.10.20.250" numOfSlots="2" apMode="LOCAL">
      <MapCoordinate x="170.87" y="80.99" unit="FEET"/>
      <ApInterface band="IEEE_802_11_B" slotNumber="0" channelAssignment="11" channelNumber="11" txPowerLevel="4"
        antennaPattern="Internal-1140-2.4GHz" antennaAngle="1.57" antennaElevAngle="0.0"
        antennaGain="0"/>
      <ApInterface band="IEEE_802_11_A" slotNumber="1" channelAssignment="1" channelNumber="64" txPowerLevel="5"
        antennaPattern="Internal-1140-5.0GHz" antennaAngle="1.57" antennaElevAngle="0.0"
        antennaGain="11"/>
    </AccessPoint>
    ...
    <LocationFilterRegion regionType="OUTSIDE">
      <MapCoordinate x="0.0" y="0.0" unit="FEET"/>
      <MapCoordinate x="185.3" y="0.0" unit="FEET"/>
      <MapCoordinate x="185.3" y="103.3" unit="FEET"/>
      <MapCoordinate x="0.0" y="103.3" unit="FEET"/>
    </LocationFilterRegion>
  </Floor>
</Building>
```

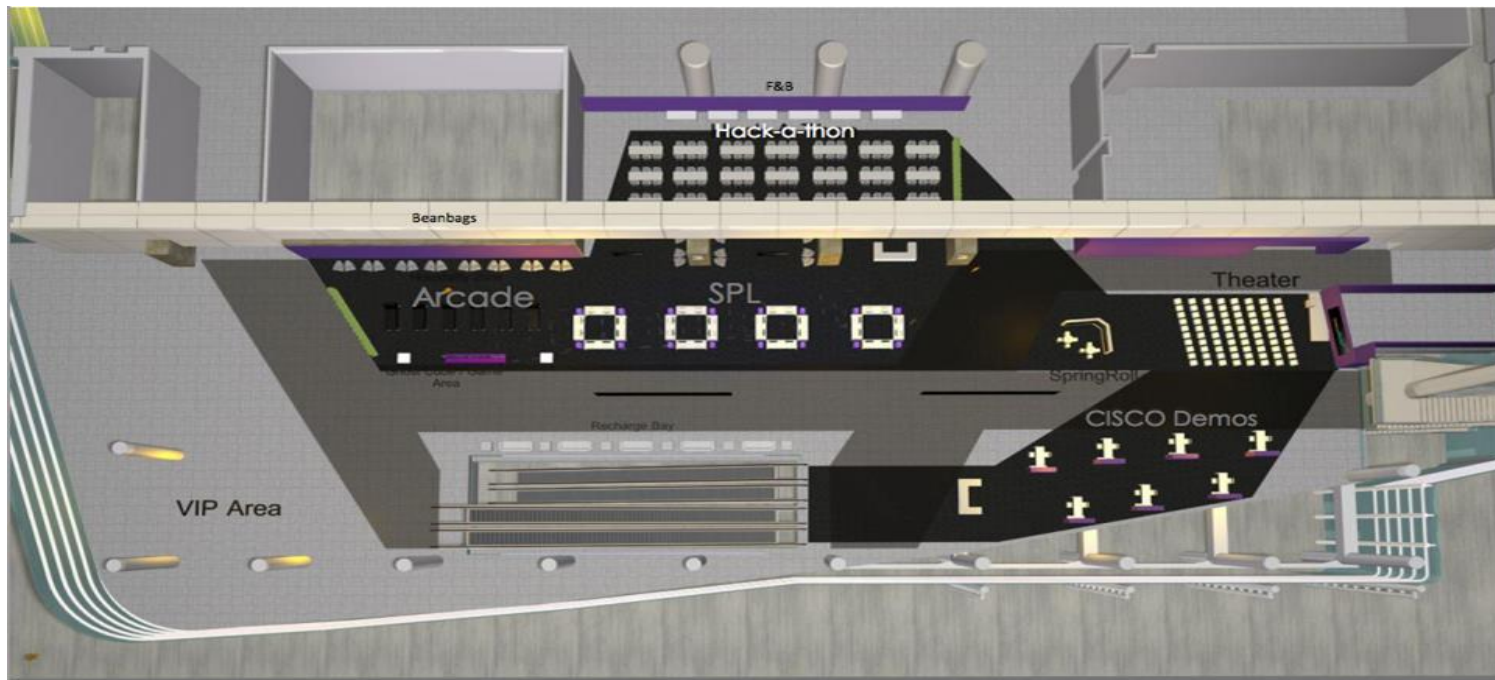


# Maps API

## Map Images

GET <https://<MSE IPADDRESS>/api/contextaware/v1/maps/image/DevNetCampus/DevNetBuilding/DevNetZone>

GET [https://<MSE IPADDRESS>/api/contextaware/v1/maps/imagesource/domain\\_0\\_1413901498194.png](https://<MSE IPADDRESS>/api/contextaware/v1/maps/imagesource/domain_0_1413901498194.png)



# Maps API

## Zones

GET <https://<MSE IPADDRESS>/api/contextaware/v1/maps>

```
<?xml version="1.0" encoding="UTF-8" standalone="yes" ?>
<Building objectVersion="25" name="BLD 14">
  <Dimension length="200.0" width="301.0" height="10.0" offsetX="1606.0" offsetY="1148.0" unit="FEET" />
  <Floor objectVersion="6" name="2nd floor" isOutdoor="false" floorNumber="2">
    <Dimension length="197.6" width="301.0" height="10.0" offsetX="0.0" offsetY="0.0" unit="FEET" />
    <Image imageName="domain_0_1128556963328.gif" />
```

...

```
<Zone name="SJC14-2nd-Floor">
  <ZoneCoordinate x="3.09" y="7.27" unit="FEET" />
  <ZoneCoordinate x="298.35" y="7.73" unit="FEET" />
  <ZoneCoordinate x="298.79" y="181.35" unit="FEET" />
  <ZoneCoordinate x="2.65" y="182.26" unit="FEET" />
</Zone>
<Zone name="Stairs-1">
  <ZoneCoordinate x="137.7" y="146.81" unit="FEET" />
  <ZoneCoordinate x="163.3" y="145.44" unit="FEET" />
  <ZoneCoordinate x="161.98" y="159.08" unit="FEET" />
  <ZoneCoordinate x="136.82" y="159.53" unit="FEET" />
</Zone>
<Zone name="Stairs-2">
  <ZoneCoordinate x="259.95" y="93.63" unit="FEET" />
  <ZoneCoordinate x="289.97" y="94.08" unit="FEET" />
  <ZoneCoordinate x="290.85" y="109.08" unit="FEET" />
  <ZoneCoordinate x="259.95" y="108.63" unit="FEET" />
</Zone>
```

...



# Real-Time Location API

GET https://<MSE IPADDRESS>/api/contextaware/v1/**location**/**<clients|tags|rougeaps|rogueclients|interferers>**

GET https://<MSE IPADDRESS>/api/contextaware/v1/**location**/clients

```
<?xml version="1.0" encoding="UTF-8" standalone="yes" ?>
<Locations totalPages="1" currentPage="1" pageSize="1006">
  <WirelessClientLocation ipAddress="171.70.241.31 fe80:0000:0000:0000:bae8:56ff:fe18:8386" userName="ssidha"
    ssid="blizzard" band="UNKNOWN" apMacAddress="64:d9:89:42:45:a0" isGuestUser="false"
    dot11Status="ASSOCIATED" macAddress="b8:e8:56:18:83:86"
    currentlyTracked="true" confidenceFactor="24.0">
    <MapInfo mapHierarchyString="Cisco San Jose - Site 5>BLD 14>3rd floor" floorRefId="-6046961950133321699">
      <Dimension length="198.6" width="299.9" height="10.0" offsetX="0.0" offsetY="0.0" unit="FEET"/>
    </MapInfo>
    <MapCoordinate x="98.12" y="157.53" unit="FEET"/>
    <Statistics currentServerTime="2015-01-15T18:57:42.471+0000" firstLocatedTime="2015-01-15T17:32:12.605+0000"
      lastLocatedTime="2015-01-15T18:07:43.436+0000"/>
  </WirelessClientLocation>
  <WirelessClientLocation ssid="blizzard" band="UNKNOWN" apMacAddress="b8:38:61:43:73:f0" isGuestUser="false"
    dot11Status="ASSOCIATED" macAddress="9c:f3:87:4b:20:2e" currentlyTracked="true" confidenceFactor="96.0">
    <MapInfo mapHierarchyString="Cisco San Jose - Site 5>BLD 14>3rd floor" floorRefId="-6046961950133321699">
      <Dimension length="198.6" width="299.9" height="10.0" offsetX="0.0" offsetY="0.0" unit="FEET"/>
    </MapInfo>
    <MapCoordinate x="170.15" y="108.25" unit="FEET"/>
    <Statistics currentServerTime="2015-01-15T18:57:42.471+0000" firstLocatedTime="2015-01-15T18:49:37.917+0000"
      lastLocatedTime="2015-01-15T18:57:21.718+0000"/>
  </WirelessClientLocation>
  ...
</Locations>
```

# Real-Time Location API

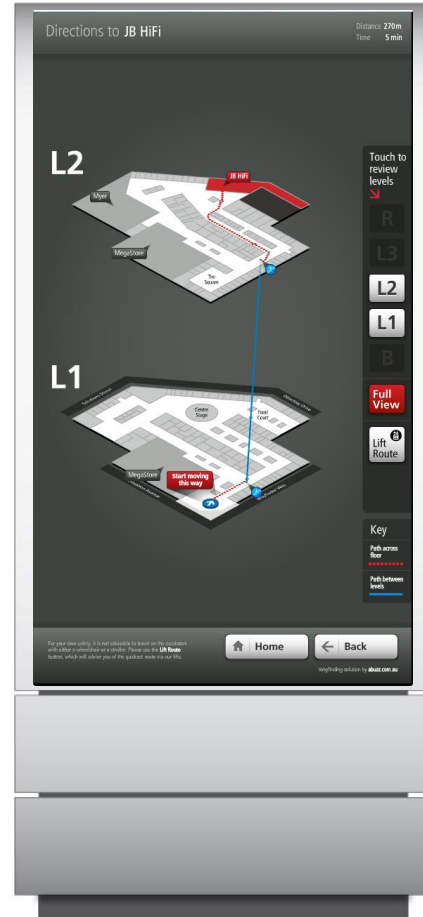
## Client Count

GET https://<MSE IPADDRESS>/api/contextaware/v1/**location**/**<clients|tags|rougeaps|rogueclients|interferers>**

GET https://<MSE IPADDRESS>/api/contextaware/v1/**location**/clients/count

```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>  
<DeviceCount deviceType="Wireless_Client" count="527"/>
```

# Wayfinding





# Location History API

GET https://<MSE IPADDRESS>/api/contextaware/v1/location/history/<clients|tags|rougeaps|rougeclients|interferers>

GET https://<MSE IPADDRESS>/api/contextaware/v1/location/history/clients/b4:18:d1:8f:2a:be

```
<?xml version="1.0" encoding="utf-8"?>
```

```
<Locations totalPages="1" currentPage="1" pageSize="785">
```

```
<WirelessClientLocation band="UNKNOWN" isGuestUser="false" dot11Status="PROBING" macAddress="b4:18:d1:8f:2a:be"
  currentlyTracked="true" confidenceFactor="152.0" historyLogReason="NETWORK_STATUS_CHANGE">
```

```
<MapInfo mapHierarchyString="Cisco San Jose - Site 5>BLD 14>3rd floor" floorRefId="-6046961950133321699">
```

```
<Dimension length="198.6" width="299.9" height="10.0" offsetX="0.0" offsetY="0.0" unit="FEET"/>
```

```
</MapInfo>
```

```
<MapCoordinate x="135.68" y="119.52" unit="FEET"/>
```

```
<Statistics currentServerTime="2015-01-19T17:00:49.388+0000" firstLocatedTime="2015-01-05T12:11:37.444+0000"
  lastLocatedTime="2015-01-05T12:11:40.542+0000"/>
```

```
</WirelessClientLocation>
```

```
...
```

```
<WirelessClientLocation band="UNKNOWN" isGuestUser="false" dot11Status="PROBING" macAddress="b4:18:d1:8f:2a:be"
  currentlyTracked="true" confidenceFactor="168.0" historyLogReason="NETWORK_STATUS_CHANGE">
```

```
<MapInfo mapHierarchyString="Cisco San Jose - Site 5>BLD 14>2nd floor" floorRefId="-6046961950133321701">
```

```
<Dimension length="197.6" width="301.0" height="10.0" offsetX="0.0" offsetY="0.0" unit="FEET"/>
```

```
</MapInfo>
```

```
<MapCoordinate x="168.82" y="88.98" unit="FEET"/>
```

```
<Statistics currentServerTime="2015-01-19T17:00:49.398+0000" firstLocatedTime="2015-01-18T17:56:35.459+0000"
  lastLocatedTime="2015-01-18T17:56:42.693+0000"/>
```

```
</WirelessClientLocation>
```

```
</Locations>
```

# Notifications

- Device Detection
  - Presence Event
  - Movement Event
  - Absence Event
  - Containment Event
  - Streaming Notifications
- RFID Tags
  - Battery Event
  - Exciter Event
  - Emergency Event
- System
  - MapInfoChange Event


```
{
  "NotificationSubscription": {
    "name": "presence-event-trigger",
    "notificationType": "EVENT_DRIVEN",
    "dataFormat": "JSON",
    "NotificationReceiverInfo": {
      "transport": {
        "type": "TransportHttp",
        "hostAddress": "1.2.3.4",
        "port": "5555"
      }
    }
  },
  "subscribedEvents": [
    {
      "type": "PresenceEventTrigger",
      "existingPresence": "true",
      "eventEntity": "WIRELESS_CLIENTS"
    }
  ]
}
```

# Notification API

GET https://<MSE IPADDRESS>/api/contextaware/v1/notifications

```
<?xml version="1.0" encoding="utf-8"?>
```

```
<NotificationSubscriptions>
  <NotificationSubscription name="64_102_254_33-containment-event-trigger" notificationType="EVENT_DRIVEN"
    dataFormat="JSON" lastModifiedTime="2014-12-05T19:37:30.213+0000">
    <NotificationReceiverInfo>
      <TransportHttp uriPath="/api/v1/notify" https="false" hostAddress="64.102.254.33" port="80"
        macScramblingEnabled="false"/>
    </NotificationReceiverInfo>
    <MovementEventTrigger moveDistanceInFt="1.0" eventEntity="WIRELESS_CLIENTS"/>
  </NotificationSubscription>
  <NotificationSubscription name="65_189_194_140-movement-event-trigger" notificationType="EVENT_DRIVEN"
    dataFormat="JSON" lastModifiedTime="2014-12-19T07:10:52.790+0000">
    <NotificationReceiverInfo>
      <TransportHttp uriPath="/notifications" https="false" hostAddress="178.62.215.212" port="5000"
        macScramblingEnabled="false"/>
    </NotificationReceiverInfo>
    <MovementEventTrigger moveDistanceInFt="1.0" eventEntity="WIRELESS_CLIENTS"/>
  </NotificationSubscription>
  <NotificationSubscription name="ac-test-movement-event-trigger" notificationType="EVENT_DRIVEN" dataFormat="JSON"
    lastModifiedTime="2014-12-17T06:44:50.017+0000">
    <NotificationReceiverInfo>
      <TransportHttp uriPath="/notifications" https="false" hostAddress="178.62.215.212" port="5000"
        macScramblingEnabled="false"/>
    </NotificationReceiverInfo>
    <MovementEventTrigger moveDistanceInFt="1.0" eventEntity="WIRELESS_CLIENTS"/>
  </NotificationSubscription>
</NotificationSubscriptions>
```

A long-exposure photograph of a city street at night. The image shows a multi-lane road with a pedestrian bridge crossing over it. In the background, there are several tall buildings with lit windows and some flags on poles. The foreground and middle ground are dominated by numerous bright, curved light trails in shades of yellow, orange, and red, which are the result of light trails from moving vehicles. The overall scene is vibrant and dynamic, capturing the energy of a city at night.

# CMX Mobile SDK

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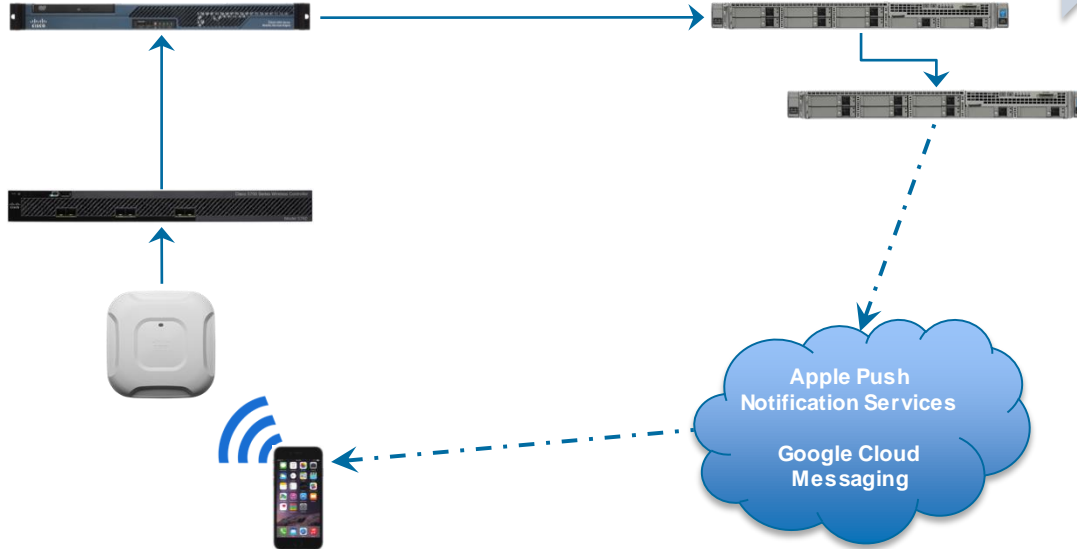
# Mobility Services SDK

- Improves App Usage
  - Push notification sent when app user comes in range of Wi-Fi network
  - User accepts, launches loyalty app, and connects to guest Wi-Fi
- Enhance Customer Experience
  - Integrates indoor location and navigation (maps and points of interest) into loyalty app
  - Wayfinding provides routes between specific points of interest





# Mobile Application Experience



# CMX Mobile Application Server

Mobile App Server

Server IP Address Not Available

Server Port Not Available

Sync to Mobile App Server **Sync**

Last sync success time 1 January 1970 10:00:00 am AEST

Last sync attempt time 1 January 1970 10:00:00 am AEST

Remove Setup from Mobile App Server **Remove**

BETA: Upload BLE Beacon File Click to select .txt

Add / Edit Banner

Banner title: Cisco Live Melbourne 2015

Description: Cisco Live Melbourne 2015 is the industry's premier education and training event for IT, networking, and communications professionals.

Apple Android

Apple Push Notification details

Push Notification File Click to select file

Push Notification File Password

Push Notification Server  Sandbox  Production

**Submit** **Reset**

**Cancel** **Submit**



3 large scale MSEs supporting 150,000 clients



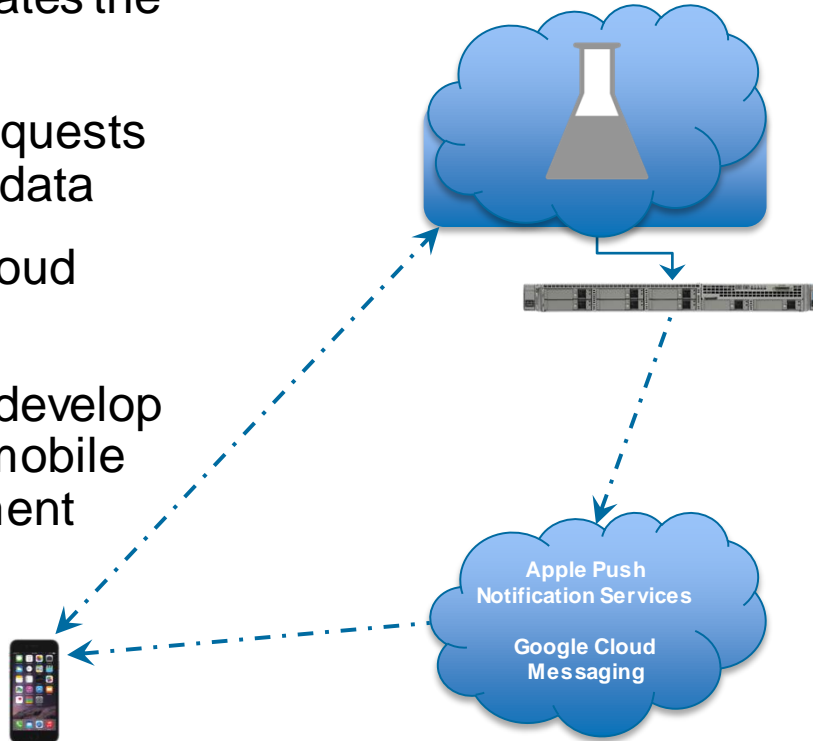
150 transactions per second  
16 vCPU with 25GB RAM



Mobile Application Server can support sending notifications and updates to 150,000 clients

# CMX Mobile Application Server Simulator

- A node.js server which simulates the CMX Mobile Application
- The server listens for https requests and responds with simulated data
- DevNet provides the CMX Cloud Services Simulator
- These solutions allow you to develop and test CMX SDK enabled mobile apps in a simulated environment





# Apple and Android



# Push Notifications

- Mobile Apps can use local and remote notifications
- Local notifications can be triggered by *geofencing* using the iOS CoreLocation framework or Google Play Services location API
- The Apple Push Notification service acts as the gateway for remote notifications
- Similarly the Google Cloud Messaging service provides similar functionality for Android devices
- For indoor locations, the CMX Mobile Application Server communicates with the APNs and GCMs when triggered by Notification Subscriptions
- These remote notifications are sent directly to the app which has registered with the APNs or GCMs





A long-exposure photograph of a city street at night. The image shows a wide road with a pedestrian bridge crossing over it. The street is filled with light trails from cars, creating a sense of motion. In the background, there are modern buildings with lit windows and a few flags on poles. The overall scene is vibrant and urban.

# BLE Beacons

# iBeacon

- iBeacons are BLE Beacons implemented to Apple's technology standard
- Support is specific to Apple iOS devices with a Bluetooth 4.0 radio
- The Apple implementation is built around the CoreLocation framework
- Region monitoring is similar to geofencing, with iBeacons triggering local notifications when the iBeacon advertisement is detected for registered applications
- Passbook passes can leverage iBeacons as well as geofences
- Any iOS device can act as a beacon which creates for interesting possibilities for customer and staff application interactions



# iBeacons



- iBeacon technology is based on Bluetooth Low Energy (BLE)
- BLE beacons' small size and low transmit power allow them to operate for extended periods
- Beacon advertisements consist of UUID, major and minor values.
- While Bluetooth operates in the same 2.4GHz band as 802.11n, the radio technology is different
- Cisco CleanAir Spectrum Intelligence can detect BLE beacons

Field	Size	Description
UUID	16 bytes	Application developers should define a UUID specific to their app and deployment use case.
Major	2 bytes	Further specifies a specific iBeacon and use case. For example, this could define a sub-region within a larger region defined by the UUID.
Minor	2 bytes	Allows further subdivision of region or use case, specified by the application developer.

iBeacon Advertisement

# iBeacons



- iBeacon technology is based on Bluetooth Low Energy (BLE)
- BLE beacons' small size and low transmit power allow them to operate for extended periods
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- Cisco CleanAir Spectrum Intelligence can detect BLE beacons

Location		Sydney	Melbourne	Auckland
UUID		D9B9EC1F-3925-43D0-80A9-1E39D4CEA95C		
Major		1	2	3
Minor	Clothing	10	10	10
	Home	20	20	20
	Electrical	30	30	30

iBeacon Advertisement Example



# Region Monitoring and Ranging

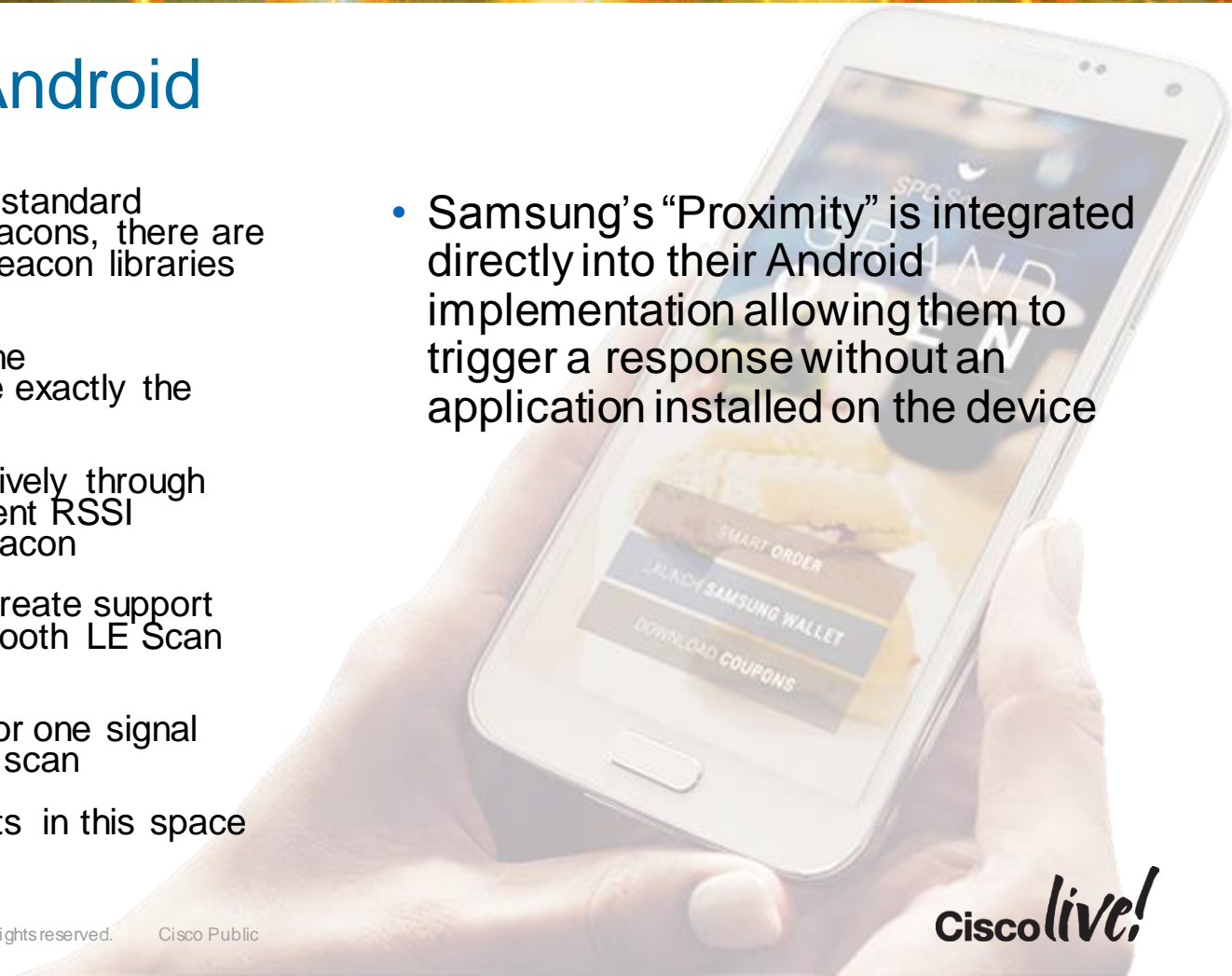


- iOS also has the concept of ranging, which allows for the determination of proximity
  - Immediate
  - Near
  - Far
  - Unknown
- Ranging allows the app to determine what beacons can be heard and proximity
- “Ranging APIs are not expected to be used in the background. For best results, ranging should be used when your app is frontmost and the user is interacting with your app.” –Getting Started with iBeacon

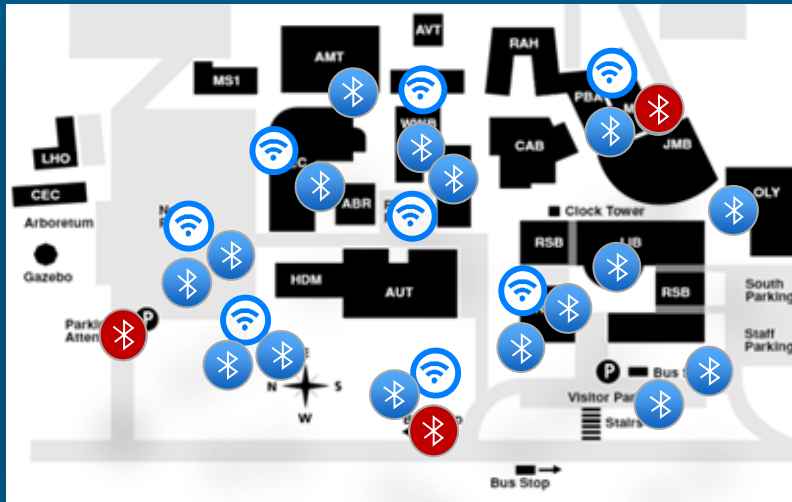


# iBeacons and Android

- While iBeacon is an Apple standard implementation for BLE beacons, there are some implementation of iBeacon libraries for Android
  - The experience between the implementations will not be exactly the same
  - Apple provides support natively through iOS and can provide different RSSI measurements for each beacon
  - Android developers must create support themselves using the Bluetooth LE Scan API
  - Currently this only allows for one signal strength measurement per scan
  - Expect future enhancements in this space
- Samsung's "Proximity" is integrated directly into their Android implementation allowing them to trigger a response without an application installed on the device



# iBeacon Support



- Provides visualisation of BLE beacons in addition to Wi-Fi clients, RFID tags and other wireless devices
- Assists with management of the iBeacon environment, identifying if beacons are moved or stolen, as well as monitoring battery life
- Can also identify rogue beacons

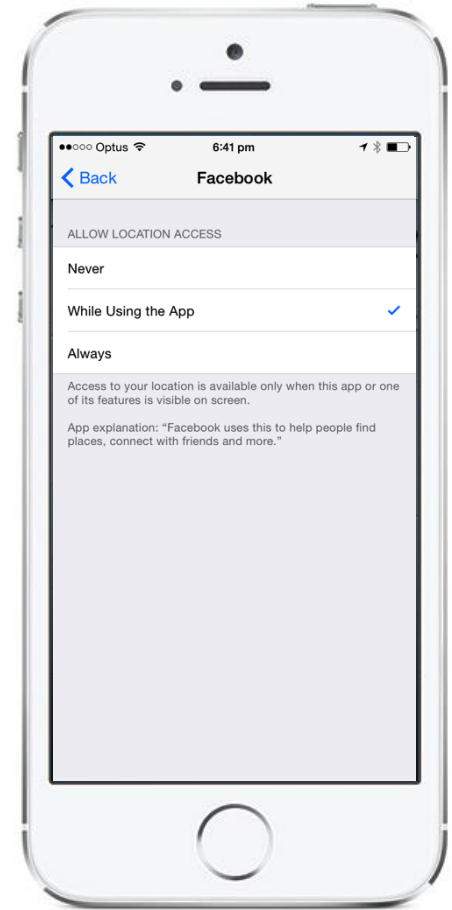


# Privacy Considerations



# iOS, Privacy and Location

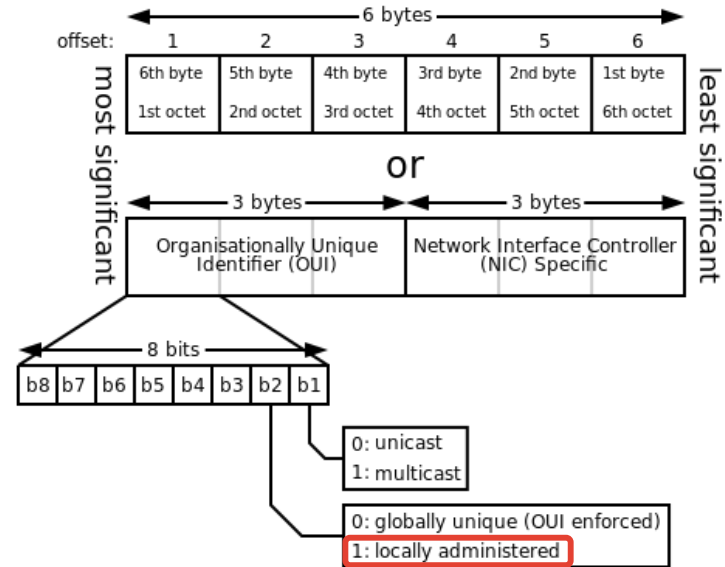
- Wi-Fi Location uses the device MAC address as a unique identifier
- Apple has consistently used privacy as a differentiator
- iOS7 removed programmatic access to the MAC address, introducing identifierForVendor as a unique device identifier for applications
- iOS8 introduces controls to restrict applications from accessing the device location
  - “Your location is used to find relevant apps nearby.”
  - “This app will use your location information to identify what’s happening at nearby Apple Retail stores and to notify you about and access services available in store.”
  - “Facebook uses this to help people find places, connect with friends and more.”



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# iOS8 MAC Randomisation

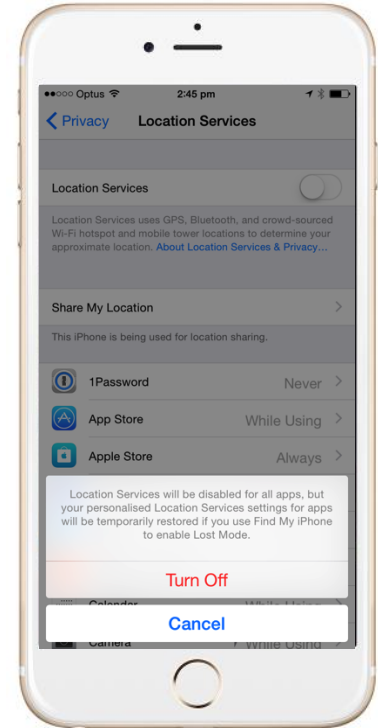
- To further increase privacy, iOS8 also introduces MAC randomisation to provide location masking
- iOS8 MAC randomisation is implemented using locally administered MAC addresses
- Use of the locally administered MAC appears to occur only in very limited conditions:
  - Not associated to a wireless network
  - No active applications with screen off *and* in sleep mode
  - Not connected to mobile broadband and location disabled
- When in use:
  - Initial probes are with the real MAC address
  - Locally administered MAC address begin after 2-3 minutes and only broadcast probes are sent
  - Real MAC addresses are used when the device wakes up, even for background processes





# iOS8 MAC Randomisation Summary

- Random MAC addresses will not be seen frequently for the majority of iPhone users
- Where they are seen, they are easily identified so data set is not corrupted
- Has potential to reduce visibility where iPhone use is limited
- Encouraging connection to Wi-Fi and active mobile application use removes this as an issue



# Customer Data Privacy

The screenshot shows the Cisco configuration interface for 'Edit Notification'. The interface is divided into a left sidebar and a main content area. The sidebar contains a navigation menu with sections for SYSTEM, CONTEXT AWARE SERVICE, and NOTIFICATIONS. The main content area is titled 'Edit Notification' and contains several configuration fields: Name (Default Northbound Notification), Type (Streaming), Data Format (Legacy SOAP/XML), Receiver Transport (TCP), Receiver Host Address (Host Address), Receiver Host Port (Host Port), Stream Type (Raw Location), and a checkbox for 'Scramble MAC addresses' which is highlighted with a red box.

**Navigation Menu:**

- SYSTEM
- CONTEXT AWARE SERVICE
  - Tracking
  - Filtering
  - History
  - Presence
  - Asset Information
  - Advanced Configuration
- NOTIFICATIONS
  - Subscriptions**
  - Statistics

**Edit Notification Configuration:**

- Name: Default Northbound Notification
- Type: Streaming
- Data Format: Legacy SOAP/XML
- Receiver Transport: TCP
- Receiver Host Address: Host Address
- Receiver Host Port: Host Port
- Scramble MAC addresses
- Stream Type: Raw Location

# CMX Mobile SDK Android Permission

```
<?xml version="1.0" encoding="utf-8"?>
<uses-permission android:name="android.permission.INTERNET" />
<uses-permission android:name="android.permission.ACCESS_WIFI_STATE" />
<uses-permission android:name="android.permission.ACCESS_NETWORK_STATE" />
<uses-permission android:name="android.permission.CHANGE_WIFI_STATE" />

<!-- GPS -->
<uses-permission android:name="android.permission.ACCESS_FINE_LOCATION" />
<uses-permission android:name="android.permission.ACCESS_COARSE_LOCATION" />

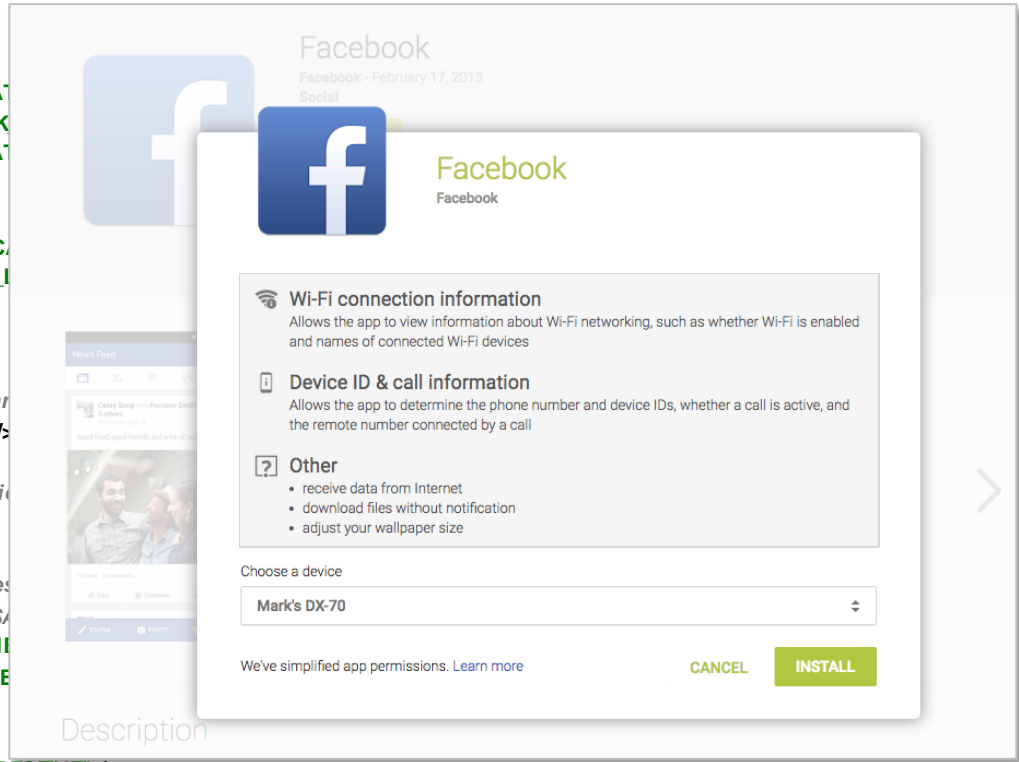
<uses-feature android:name="android.hardware.wifi" />


<!-- GCM requires a Google account. (necessary only if the device is running Android 4.0+) -->
<uses-permission android:name="android.permission.GET_ACCOUNTS" />

<!-- Keeps the processor from sleeping when a message is received. (Optional) -->
<uses-permission android:name="android.permission.WAKE_LOCK" />

<!-- Creates a custom permission so only this app can receive its messages -->
NOTE: the permission *must* be called PACKAGE.permission.C2D_MESSAGE
<permission android:name="com.cisco.cmx.app.permission.C2D_MESSAGE"
    android:protectionLevel="signature" />
<uses-permission android:name="com.cisco.cmx.app.permission.C2D_MESSAGE" />

<!-- This app has permission to register and receive data message. -->
<uses-permission android:name="com.google.android.c2dm.permission.RECEIVE" />
```



A long-exposure photograph of a city street at night. The foreground is dominated by vibrant, multi-colored light trails from moving vehicles, creating a sense of motion and energy. In the background, a modern urban landscape is visible, featuring a pedestrian bridge with blue lighting, traffic lights, and several illuminated buildings. The overall scene is a blend of natural light trails and artificial city lights.

Meraki CMX

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# Meraki CMX Dashboard

The screenshot displays the Meraki CMX Dashboard interface, which is used for monitoring and managing wireless networks. The interface is organized into several sections:

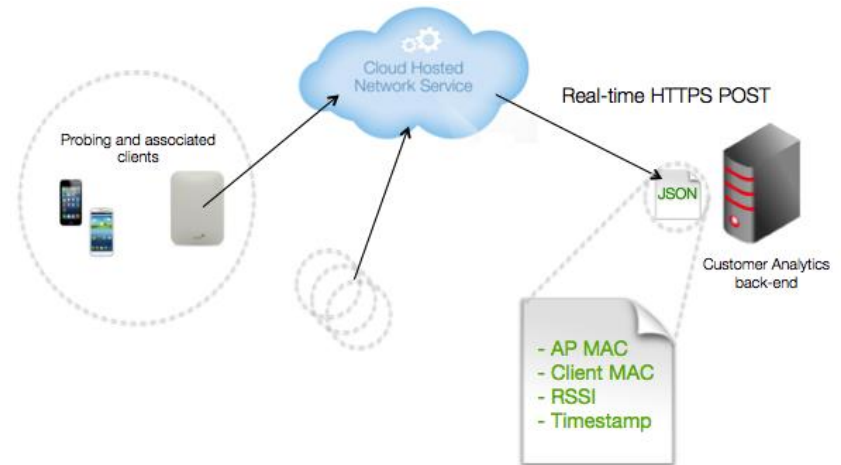
- Navigation Menu (Left):** Includes sections for Monitor, Configure, Organization, Overview, Configuration templates, Change log, Settings, MDM, Administrators, Configuration sync, License info, Create network, Inventory, and Help.
- Monitor Section (Top Left):** Contains sub-sections for Monitor, Configure, and Organization, with a list of items like Overview, Location analytics, Configuration templates, Change log, Security report, Settings, MDM, Administrators, Configuration sync, License info, Inventory, and Branding.
- Analytics (Middle Left):** Features three charts: "Visitors" (line chart), "Engagement" (bar chart), and "Loyalty" (bar chart), all showing data for "Thu 08".
- Map (Right):** A "CMX locations map" showing a geographic area with a heatmap overlay. The map includes street names like Mission Bay Boulevard South, Bridgeway Way, and Pierpoint Ln. A legend indicates "connected" (blue) and "not associated" (green) devices. The map also shows a timeline for "End time: 16:15 01/16/2015".
- Header and Footer:** The top header shows the Meraki logo and navigation links. The bottom footer includes the text "© 2015 Cisco Systems, Inc." and "© 2015 Cisco and/or its affiliates. All rights reserved. Cisco Public".



# Meraki CMX API

## Version 1

- The Meraki solution can be configured to POST real-time data
- Version 1 of the location API provides the following information:
  - AP MAC address
  - Client MAC address
  - RSSI
  - Timestamp
- The POST will occur as soon as the client's probe MAC address data is seen. After the initial POST, data may be send in periodic batches depending on client probe frequency



# Meraki CMX API

## Version 2

- Version 2 of the location API operates in a different format, providing additional information including location.
- Currently a single event type is supported
  - DevicesSeen

```
{
  "apMac": <string>,
  "apFloors": [<string>, ...],
  "observations": [
    {
      "clientMac": <string>,
      "ipv4": <string>,
      "ipv6": <string>,
      "seenTime": <string>,
      "seenEpoch": <integer>,
      "ssid": <string>,
      "rssi": <integer>,
      "manufacturer": <string>,
      "os": <string>,
      "location": {
        "lat": <decimal>,
        "lng": <decimal>,
        "unc": <decimal>,
        "x": [<decimal>, ...],
        "y": [<decimal>, ...]
      }
    },
    ...
  ]
}
```

CMX ⓘ

Analytics

CMX API

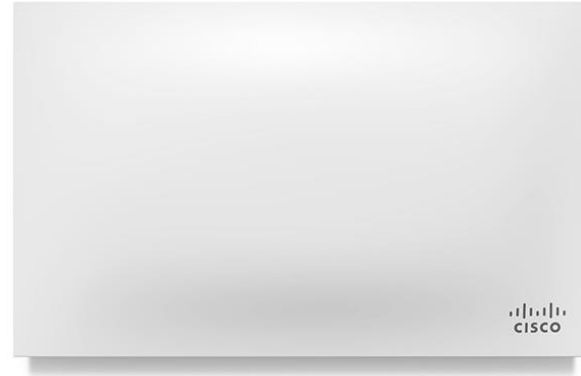
Post URLs ⓘ

Post URL	Secret	API Version	Validator
<input type="text"/>	<input type="text"/>	2.0 <input type="button" value="v"/>	ac78891acb2e5f11c60e971d304b5df8956f166a <input type="button" value="Validate"/> <input type="button" value="X"/>

[Add a Post URL](#)

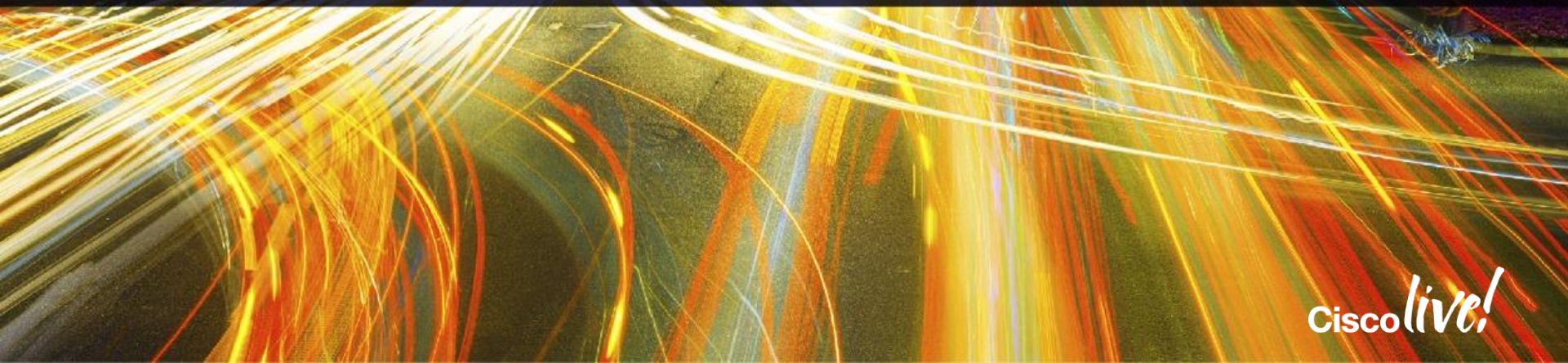
# iBeacon Support

- Meraki have recently released the indoor MR32 and outdoor MR72 APs supporting both 802.11ac and BLE
- This will enable the APs to act as iBeacons, which will be particularly beneficial for Region Monitoring





Looking Forward



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# Looking Forward

## Location Innovations



### Understand Consumers

---

- Hyperlocation
- FastLocate
- BLE Aware

## User-Centric Design



### Simplify Tools

---

- Role-based Access
- Work flow driven UI
- Integrated Visibility Wi-Fi Location, BLE, Video\*
- Verticalised Analytics Solutions

## Scale as You Grow



### Prepare Any Enterprise

---

#### **MSE 10.0**

- 3X scaling per box + clustering
- Real Time Analytics
- 5X latency improvement

#### **EMSP 2.0**

- EMSP Cloud Offer



# Looking Forward

## Online Documentation

https://<MSE IPADDRESS>/docs

### Configuration API

Username:

Password:

[Toggle All Endpoints](#) | [Toggle All Methods](#)

[Map resources API](#)

[List Methods](#) | [Expand Methods](#)

[Alerts API](#)

[List Methods](#) | [Expand Methods](#)

[History alerts API](#)

[List Methods](#) | [Expand Methods](#)

[Users API](#)

[List Methods](#) | [Expand Methods](#)

[Mail service API](#)

[List Methods](#) | [Expand Methods](#)

[Notification subscription API](#)

[List Methods](#) | [Expand Methods](#)

[Heterarchy API](#)

[List Methods](#) | [Expand Methods](#)

### Location API

Username:

Password:

[Toggle All Endpoints](#) | [Toggle All Methods](#)

[Clients History API](#)

[List Methods](#) | [Expand Methods](#)

[List Methods](#) | [Expand Methods](#)

[List Methods](#) | [Expand Methods](#)

[List Methods](#) | [Expand Methods](#)

[List Methods](#) | [Expand Methods](#)

[List Methods](#) | [Expand Methods](#)

[List Methods](#) | [Expand Methods](#)

[Attributes API](#)

[List Methods](#) | [Expand Methods](#)

[/api/location/v1/beacon](#)

[address](#) [/api/location/v1/beacon/:macaddress](#)

[macaddress](#) [/api/location/v1/beacon/:macaddress](#)

[/api/location/v1/beacon](#)

[present on the given floor](#) [/api/location/v1/beacon/floor/:floorrefid](#)

[ore](#) [/api/location/v1/beacon](#)

[List Methods](#) | [Expand Methods](#)

# Looking Forward

## Analytics API

Overview API

GET Retrieve overview data for the target areas for brochure view /api/analytics/v1/overview BETA

Parameter	Value	Type	Location	Description
type	<input type="text" value="required"/>	query		The type of data requested Allowed values/formats: deviceCount deviceDwell grossShopping deviceCrossover
period	<input type="text" value="required"/>	query		The period of interest, either specified as a date range, or one of the predefined names Allowed values/formats: yyyy-mm-dd yyyy-mm-ddyyyy-mm-dd today yesterday this week last week last 2 weeks this month last month last 3 months this year last year forever
timeRange	<input type="text"/>	query		The time window of interest on each day Allowed values/formats: HH:mm-HH:mm now
areas	<input type="text" value="required"/>	query		The list of areas of interest. If none are given, all are considered Allowed values/formats: A comma-separated list of area ids, or heterarchy levels
yAxis	<input type="text" value="required"/>	query		Whether individual visits should be reported on, or summed by device Allowed values/formats: absoluteDevices absoluteVisits
durationCategories	<input type="text"/>	query		Whether to break down the count between certain ranges of dwell time Allowed values/formats: nn-mm, where nn is the lower bound (in minutes) of dwell time considered and mm the upper bound.
includeStationary	<input type="text"/>	query		Whether to include stationary devices (default=false) Allowed values/formats: true false
entirePeriod	<input type="text"/>	query		Whether to include device visits that occur any time during the entire period or only within a single day (default=false) Allowed values/formats: true false

[Try It!](#)

### Analytics API

Username:

[List Methods](#) | [Expand Methods](#)

[List Methods](#) | [Expand Methods](#)

period and areas /api/analytics/v1/deviceDwell BETA

[List Methods](#) | [Expand Methods](#)

at areas for brochure view /api/analytics/v1/overview BETA

[List Methods](#) | [Expand Methods](#)

a single heterarchy element and time frame

ntId:/timeFrame BETA

a single heterarchy element /api/analytics/v1/notifications/deviceCount/:elementId BETA

/api/analytics/v1/notifications/deviceCount BETA

[List Methods](#) | [Expand Methods](#)

ytics/v1/summary BETA

KPIs, or a list of available ones /api/analytics/v1/summary/:summaryItem BETA

[List Methods](#) | [Expand Methods](#)

n period and areas /api/analytics/v1/deviceCount BETA

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# Introducing the Cisco Hyperlocation Module



Target Availability – H2CY15



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



**Integrated BLE Beacon**  
Reduce BLE deployment size



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



**Enhanced FastLocate**  
Faster refresh rates



**Improved Security Coverage**  
Integrated Wireless Security Module





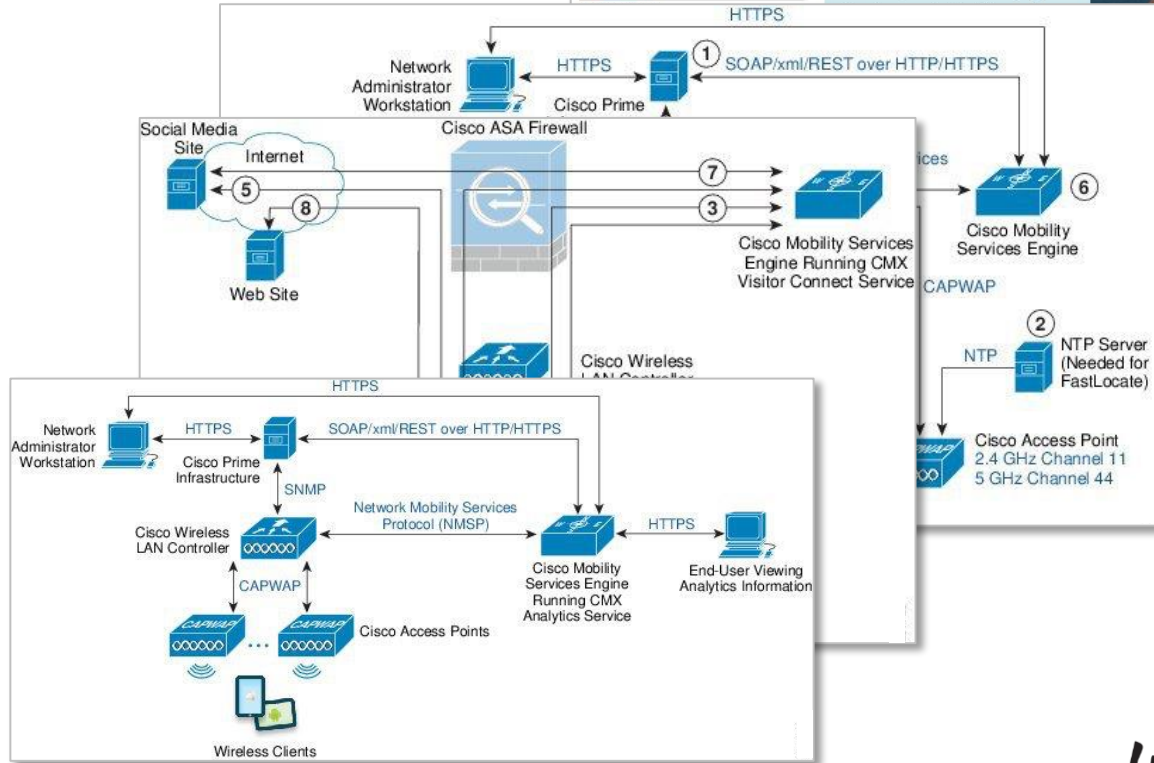
# Creating a Connected Mobile Experience

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# CMX Cisco Validated Design

- ☐ Cisco Connected Mobile Experiences (CMX) CVD
  - ☐ CMX Introduction
    - ☐ CMX Preface
    - ☐ Connected Mobile Experiences Solution Overview
  - ☐ CMX Design Overview
    - ☐ Summary of CMX Design Overview
    - ☐ CMX Solution Components
    - ☐ CMX Deployment Models
    - ☐ CMX Security Considerations
    - ☐ CMX Additional Considerations
  - ☐ CMX Use Cases
    - ☐ CMX Use Case Stories
  - ☐ CMX Radio Frequency and Location Based Design
    - ☐ Summary of Radio Frequency and Location Based Design
    - ☐ Radio Frequency Operating and Data Rates
    - ☐ Radio Frequency Fundamentals
    - ☐ Antenna Fundamentals
    - ☐ 802.11 Fundamentals
    - ☐ Location Fundamentals
    - ☐ Pre-Deployment Radio Frequency Site Survey
    - ☐ Access Point Placement and Capacity Planning
    - ☐ Predictive Radio Frequency Planning
    - ☐ Multi-Floor Deployments
    - ☐ Capacity Planning and High Density
    - ☐ Location Voice and Data Co-Existence
    - ☐ Post-Deployment Radio Frequency Tuning
    - ☐ Best Practices Checklist
  - ☐ CMX Configuring the Infrastructure
    - ☐ Summary of CMX Configuring the Infrastructure
    - ☐ Configuring Cisco Wireless LAN Controllers
    - ☐ Configuring Cisco Prime Infrastructure
    - ☐ Configuring the Mobility Services Engine for CMX
    - ☐ Configuring CMX Analytics
    - ☐ Configuring CMX Visitor Connect
  - ☐ CMX Appendices
    - ☐ CMX Software Versions
    - ☐ CMX System Release Notes
    - ☐ 802.11 Data Rates
    - ☐ CMX Use Case Example Upgrade VoWLAN Ready Network to Location/CMX Ready
    - ☐ CMX Troubleshooting



Products & Services | Support | How to Buy | Training & Events | Partners

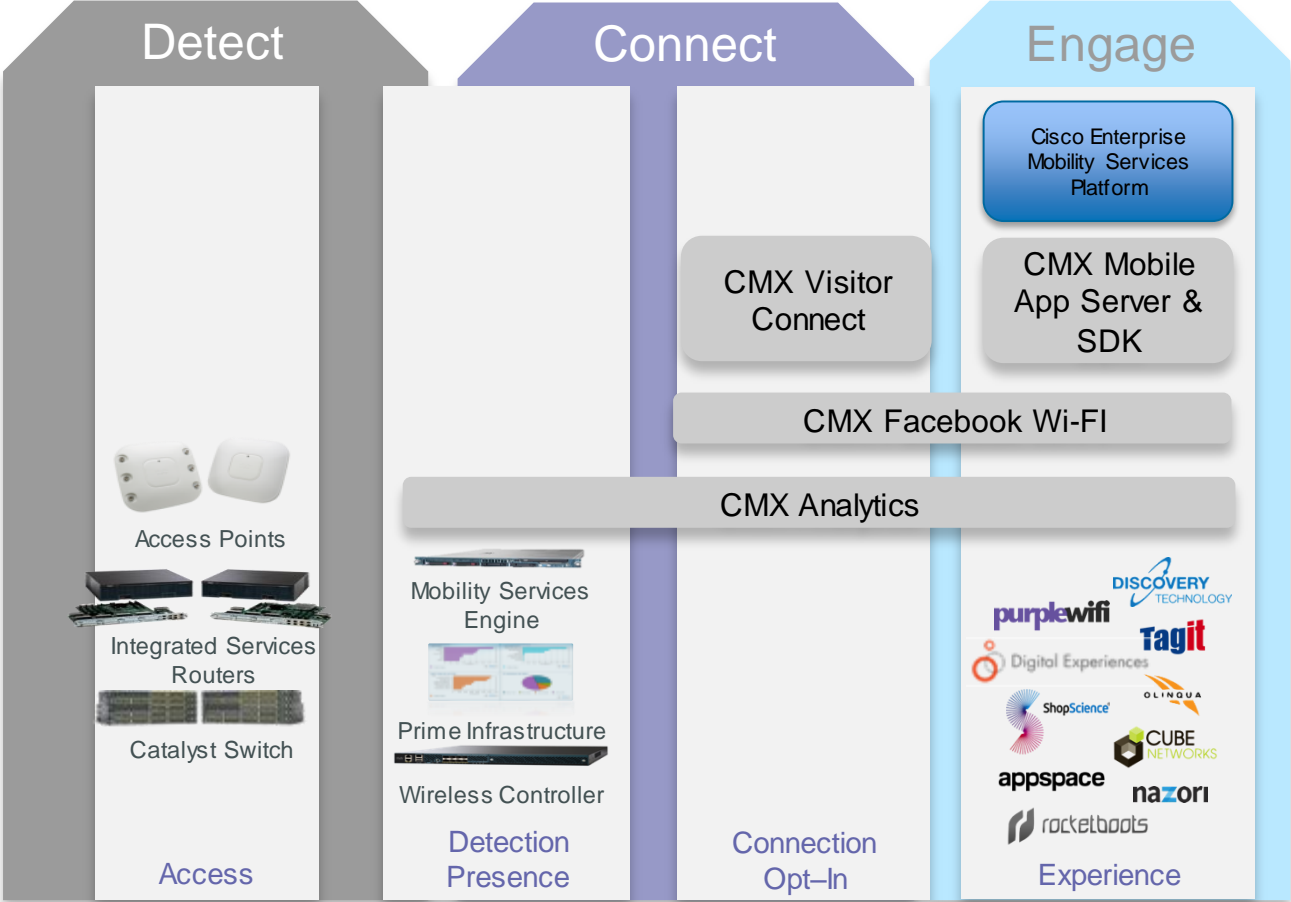
## Cisco Connected Mobile Experiences (CMX)

HOME | SOLUTIONS | Detect, Connect, Engage

# Connected Mobile Experience Solution



Mobile Devices



# Ten Rules for a Connected Mobile Experience

1. Make the Wi-Fi experience better than Mobile Broadband
2. Let the use-case determine the required level of accuracy
3. Latency can be more important than accuracy
4. Presence can provide value where location is not feasible
5. Use BLE Beacons for increased accuracy at specific POIs
6. Analytics validate initiatives
7. For indoor deployments wayfinding is more accurate and valuable than blue-dot
8. Give customers a reason to use the app
9. Follow the principle of least privilege
10. Deliver value for your customers and value for your business will follow

# Further Reading

## Cisco

- Cisco CMX Overview
  - <http://cisco.com/go/cmxcmx>
- CMX Cisco Validated Design
  - <http://www.cisco.com/c/en/us/solutions/enterprise/design-zone/cmxcmx.html>
- DevNet - CMX Mobility Services
  - <https://developer.cisco.com/site/cmxcmx-mobility-services/>
- DevNet - Learning Labs
  - <https://developer.cisco.com/site/devnet/learningLabs/overview.gsp>

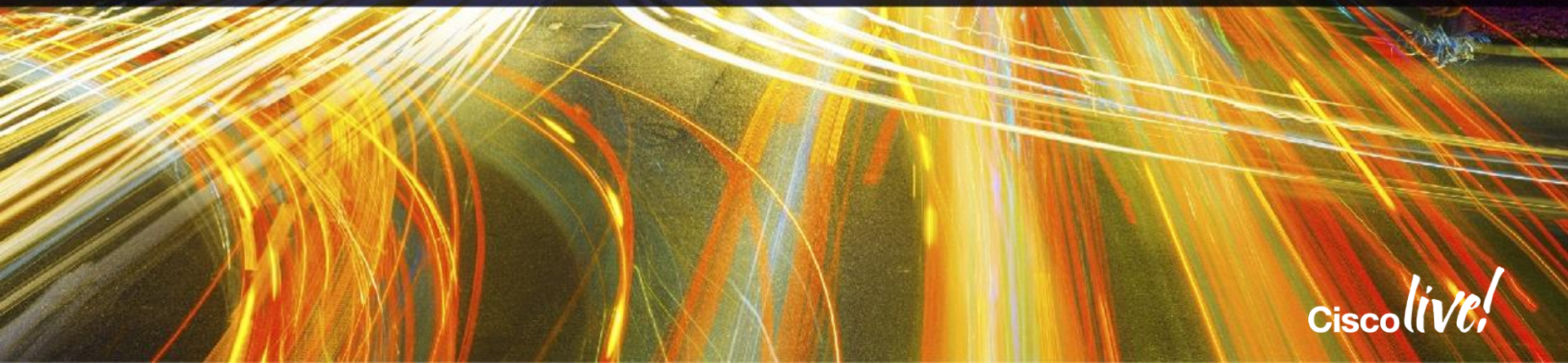
## Meraki

- Meraki CMX Overview
  - <http://meraki.cisco.com/solutions/cmxcmx>
- Location API
  - <http://docs.meraki.com/display/MR/Location+API>
- Bluetooth Low Energy Beacons
  - <http://meraki.cisco.com/technologies/bluetooth-low-energy>





Q & A



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