

# WI-FI DESIGN DAY 2019

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<https://wifininjas.net>

# THE MOST EXCITING THING ABOUT WIFI

## REAL TIME LOCATION SERVICES (RTLS)



Cisco CMX



Meraki & Purple



Mist BLE

Cisco DNA Spaces

purple

# RTLS

## WHAT

1

Technologies  
Tracking methods  
Functionality  
RTLS RF Design  
Examples & Demos

## WHERE

Tracking  
Indoor  
Manufacturing  
Engagement  
Presence



## WHEN

Retail  
Sports  
Logistics  
Warehouses  
Offices  
Public spaces  
Events

## HOW

4

WiFi Trilateration  
WiFi Hyperlocation  
vBLE Array Location  
API integration & Mobile SDK

# WIFI vs BLE

## WIFI

Most popular tracking technology, as it also provides access to the network and provide network-wide presence & analytics stats

Different methods and levels of accuracy

Client's applications are optional and challenging

APs track clients' signal and send it to the server/cloud to compute station location

## BLE

BLE and vBLE – what's the difference?

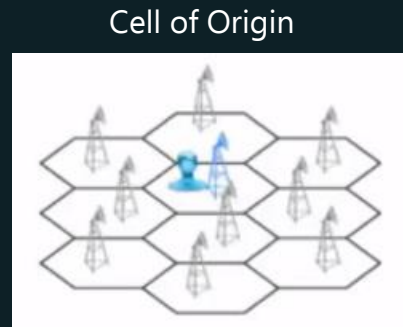
Potentially more accurate than WiFi

Is BLE transmitting or receiving data?

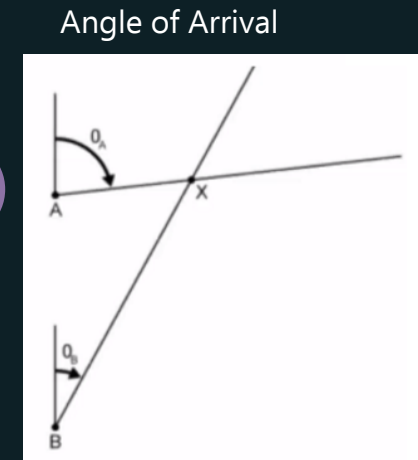
Client's applications are optional but recommended

Clients track BLE beacons' beams and send it to the server/cloud to compute station location

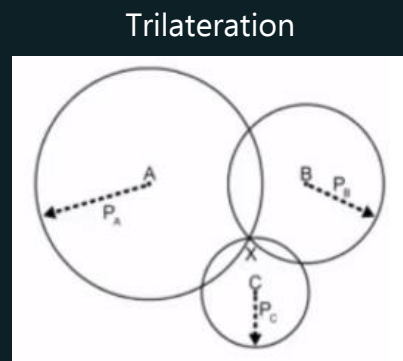
# RTLS TRACKING



1

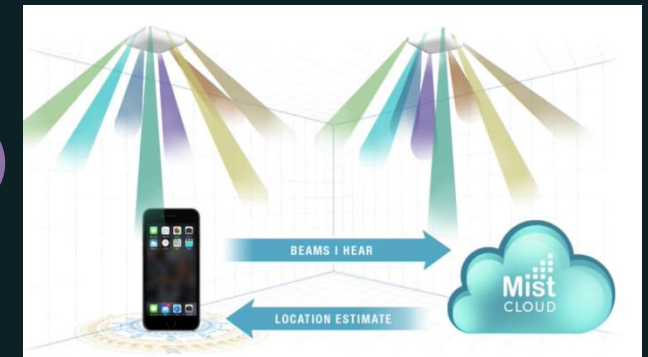


3

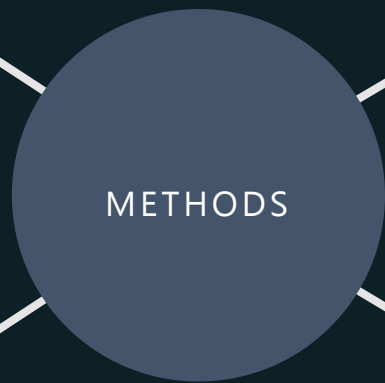


2

(Mist) vBLE Array and Probability Surfaces



4



# RTLS FUNCTIONALITY

01

Presence &  
Analytics

Typically relies on WiFi

02

Location

Typically relies on WiFi,  
BLE/vBLE, GPS, Mobile

03

Engagement &  
Actions

Use Presence, Analytics and  
Location insight to create  
personalised user experience

# RTLS RF DESIGN TIPS

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1

APs should be located around zone perimeters to create a convex-hull

2

Each client should be within convex-hull of at least 3 APs with solid RSSI (-65dBm is OK)

3

Ideally, use dedicated radio or module for RTLS

4

Ensure LOS is maintained between APs and clients (AP behind ceiling tiles is a no-no)

5

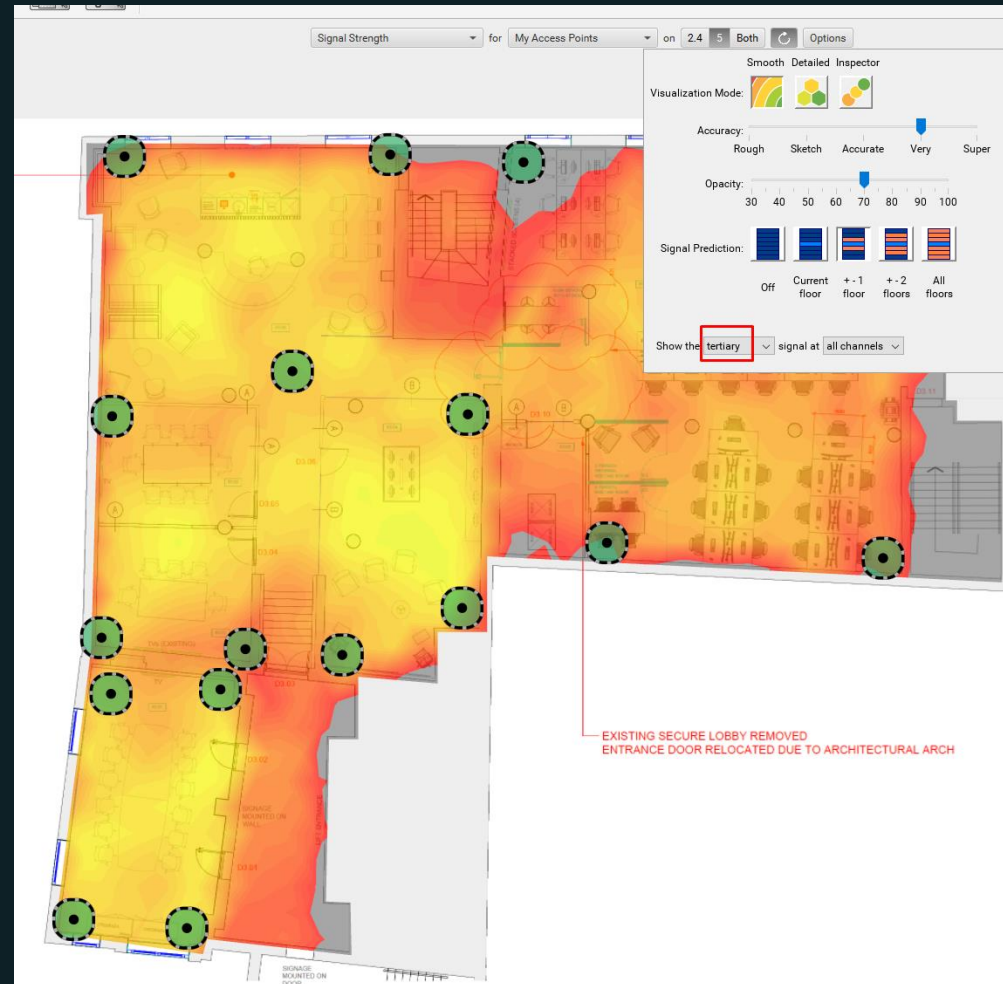
Don't mount APs too high! Not higher than 4.5m is OK

6

Validate secondary and tertiary signal strength in your favourite survey tool

# RTLS RF DESIGN

## EKAHAU: TERTIARY COVERAGE

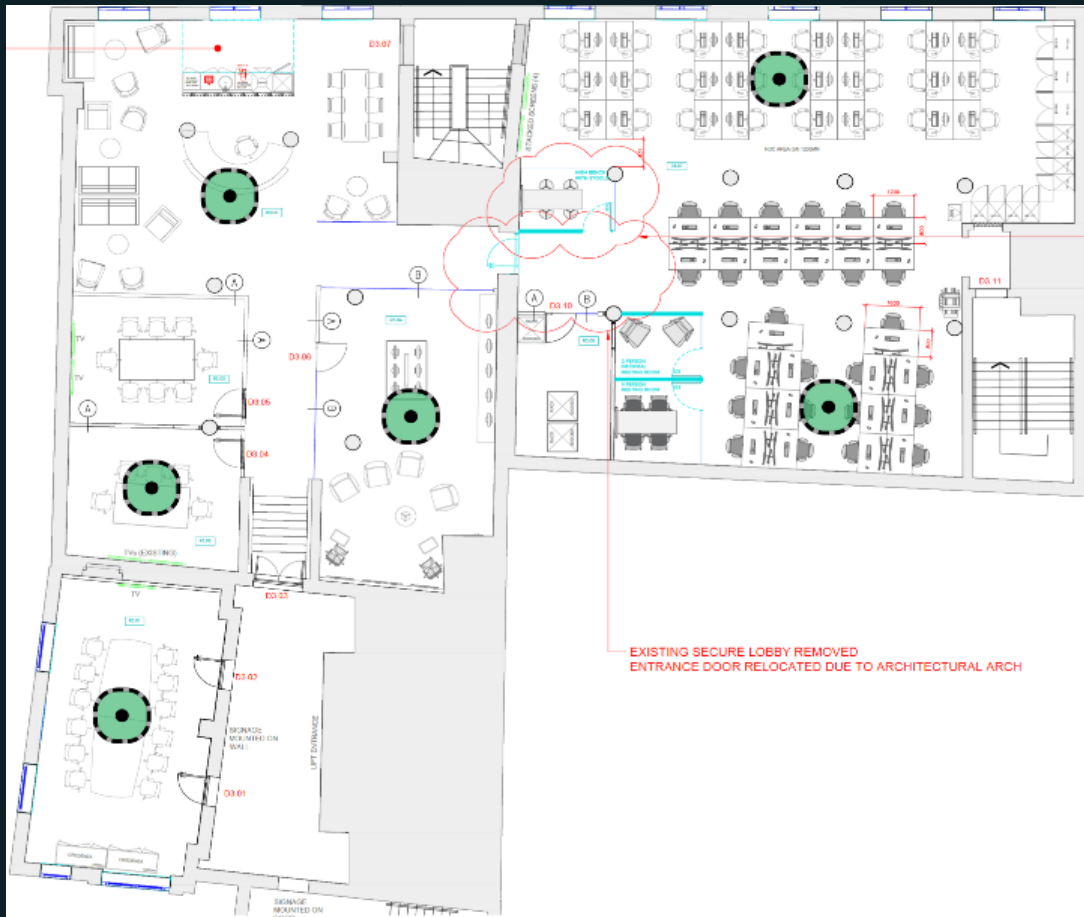




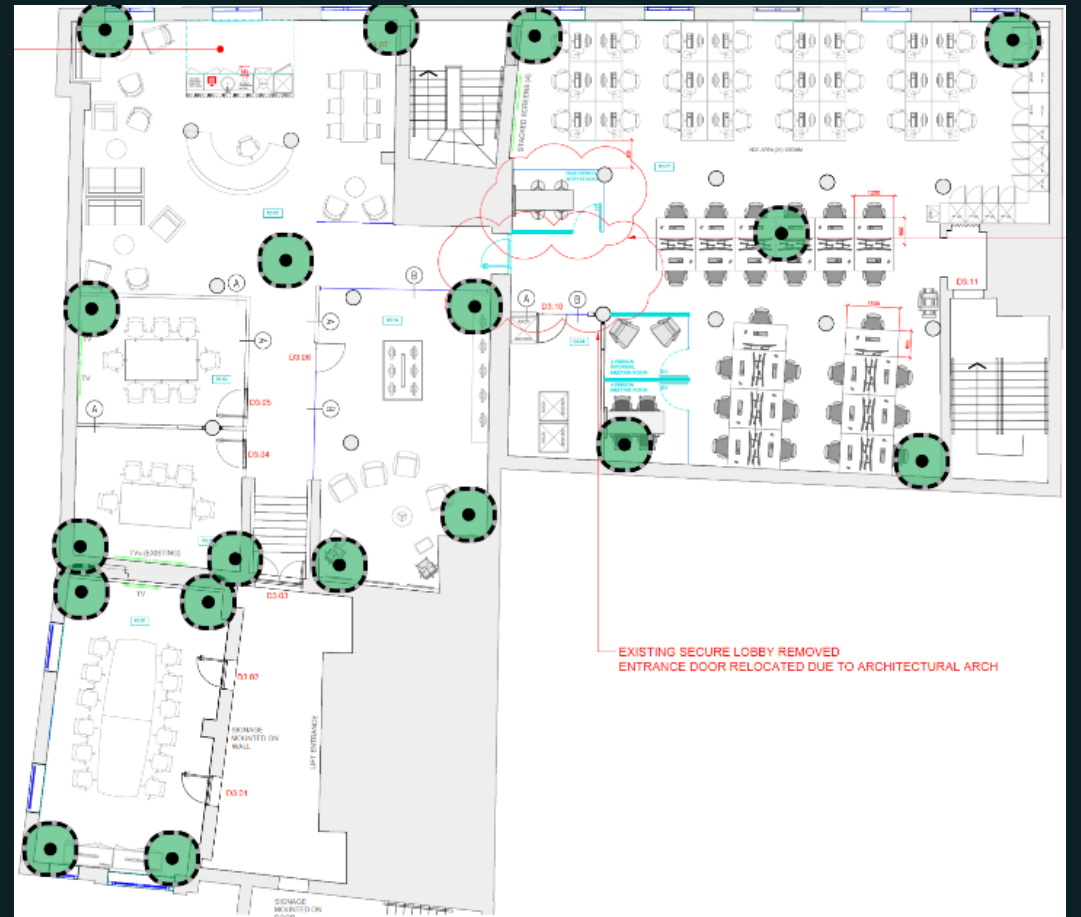
# RTLS RF DESIGN

## EXAMPLE

Data = 6 x APs



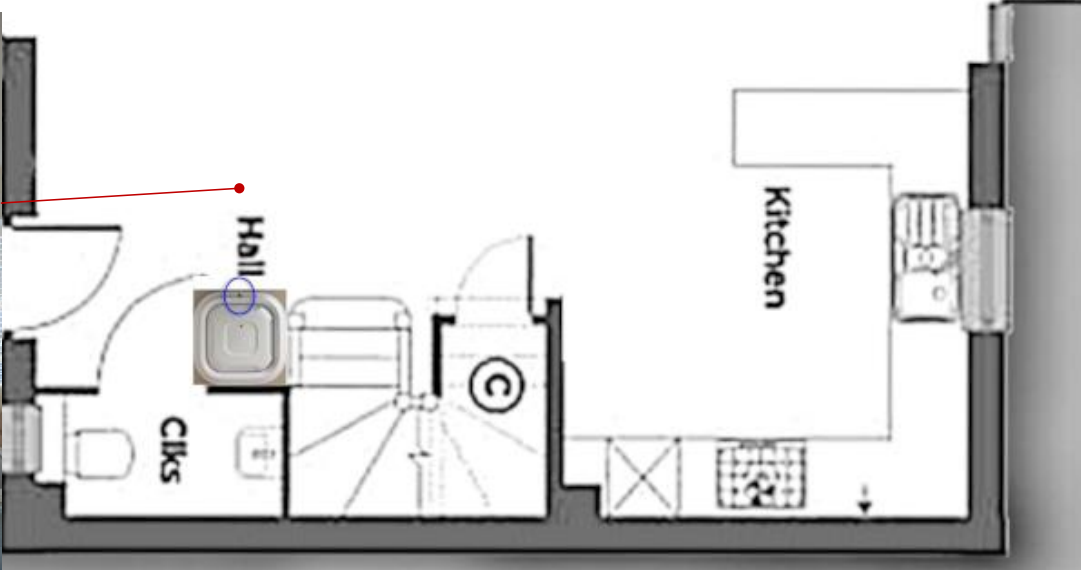
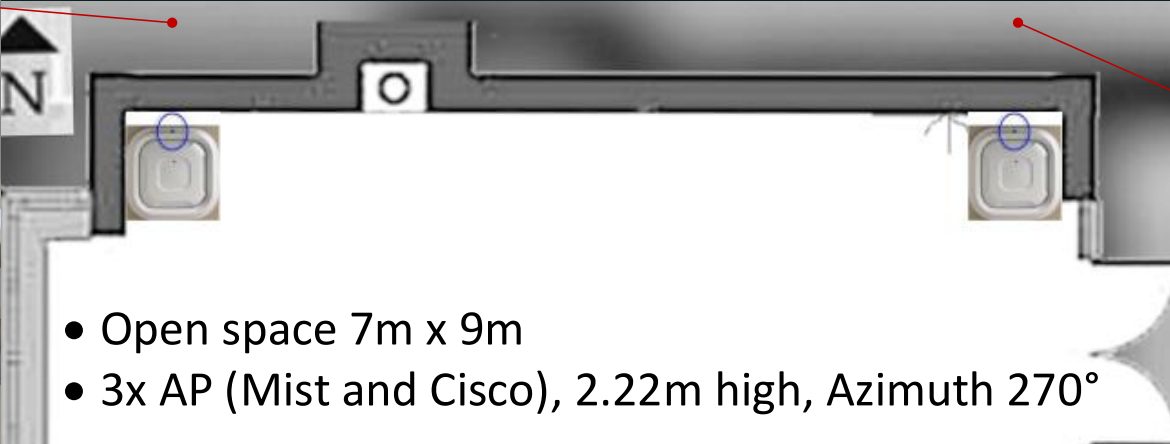
RTLS = 18 x APs



Number of APs has tripled!

DEMO TIME!

# TEST ENVIRONMENT



# WIFI TRILATERATION

# WIFI TRILATERATION

## COMPONENTS

Cisco with DNAs:



APs



WLC



Cisco Prime



Cisco CMX

and / or



Cisco DNAs

one day?



Meraki with Purple:



APs



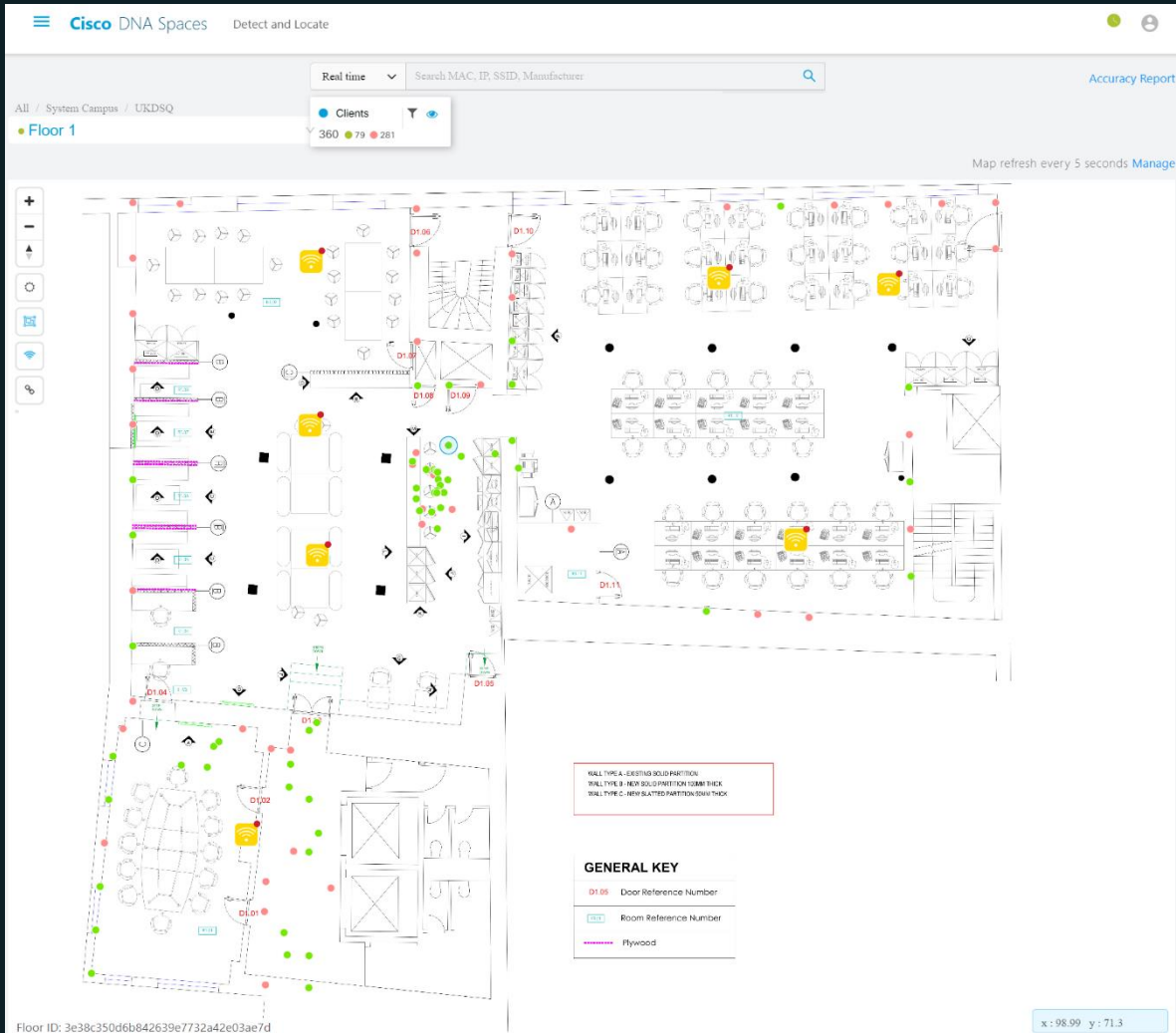
Meraki Dashboard



Purple Dashboard

# WIFI TRILATERATION

## LIVE LOCATION – DNAS & PURPLE



Meraki with Purple

Cisco with DNAS

# WIFI TRIANGULATION

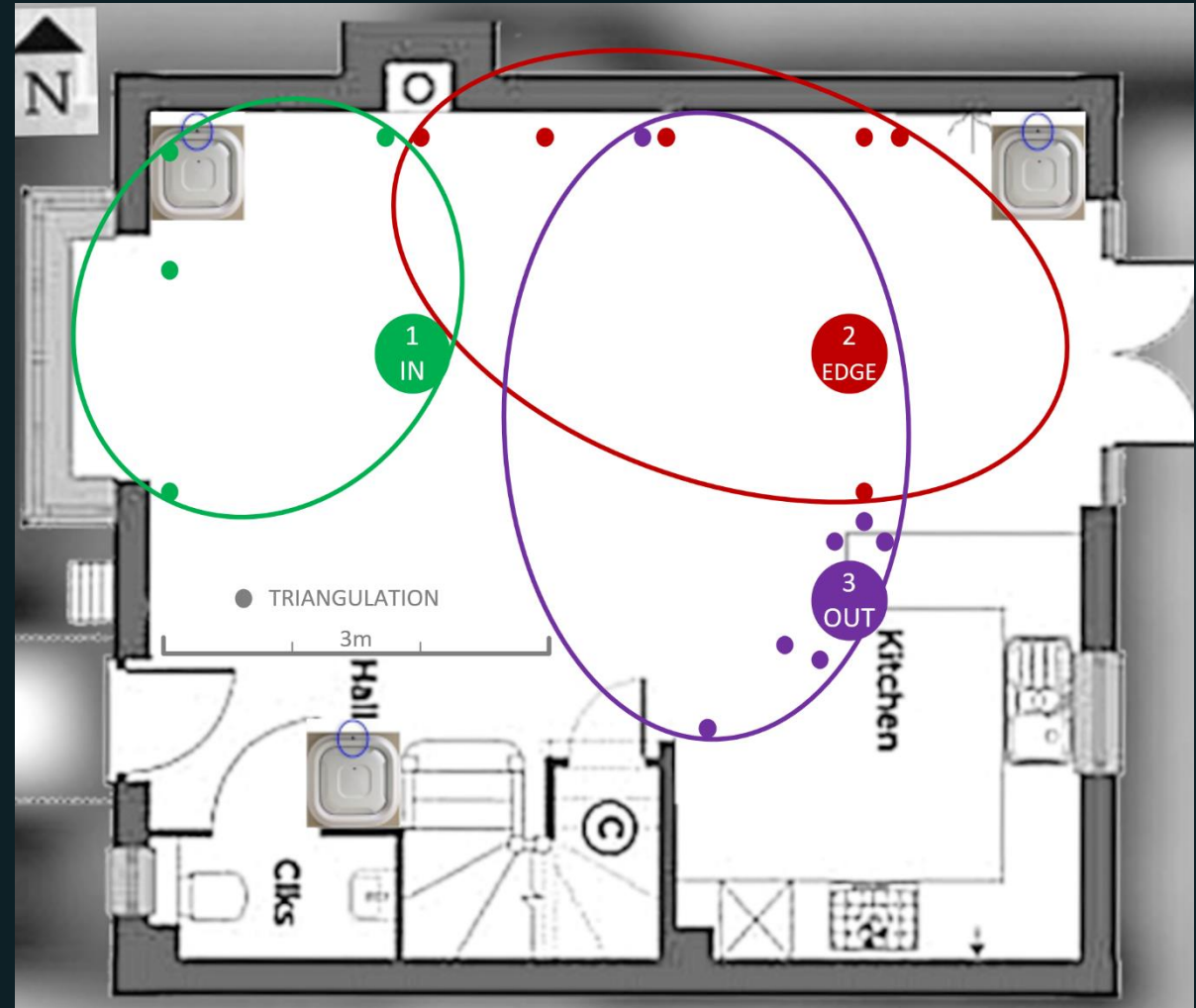
## ACCURACY

### Inside convex-hull

Location Computation Frequency (s)	Measurements on Correct Floor (%)	10m Accuracy (%)	Average Error Distance (m)	90% Error Distance (m)
14.7	100	100.0	2.55	2.69

### Edge of convex-hull

Location Computation Frequency (s)	Measurements on Correct Floor (%)	10m Accuracy (%)	Average Error Distance (m)	90% Error Distance (m)
12.6	100	100.0	2.57	3.38



Lab: 3-4m  
Marketed: 5-7m  
Real: 7-10m

# WIFI HYPERLOCATION



# WIFI HYPERLOCATION

## COMPONENTS



Hyperlocation  
APs



WLC



Cisco Prime  
Infrastructure



Cisco CMX



optionally ->

Cisco DNAS

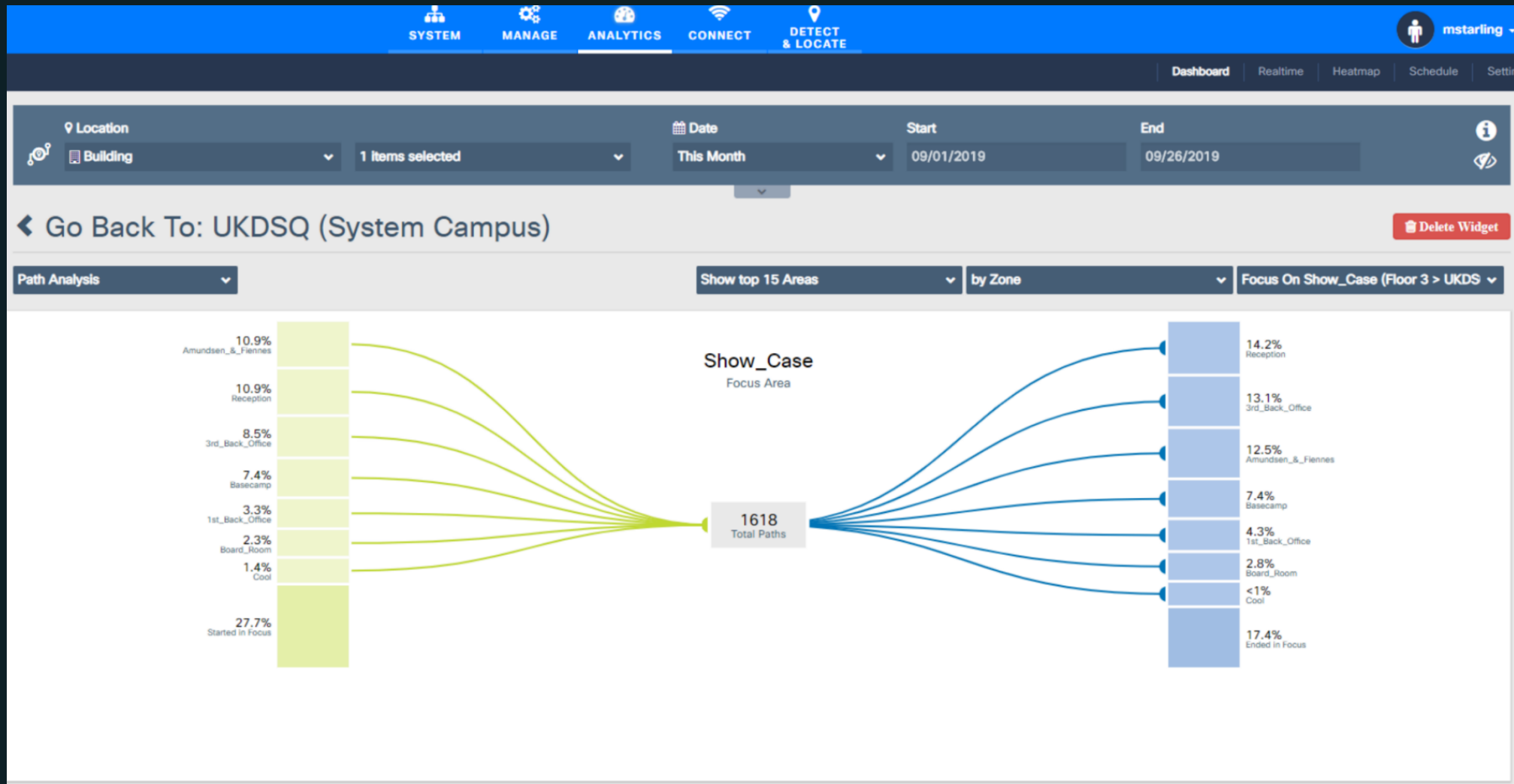
# WIFI HYPERLOCATION

## LIVE LOCATION - CMX

The screenshot displays the Cisco CMX (Cisco Mobility Manager) interface for WiFi Hyperlocation. The top navigation bar includes 'SYSTEM', 'MANAGE', 'ANALYTICS', 'CONNECT', and 'DETECT & LOCATE'. The user 'mstarling' is logged in. The left sidebar shows a tree view of the system campus: 'System Campus' > 'UKDSQ' > 'Floor 1' > 'Floor 3' (selected) > 'Unassigned'. The main area shows a 3D floor plan of the 'THIRD FLOOR' with various rooms and live location data points. The rooms shown are: 'Reception', 'Amundsen & Finnes', 'Board\_Room', 'Show\_Case', and '3rd\_Back\_Office'. The floor plan is color-coded by room type, and the live location data points are represented by small colored circles with numbers. The interface also includes a 'Map' button and a 'Troubleshoot' button in the top right corner.

# WIFI HYPERLOCATION

## LOCATION – CMX ZONE PATHS



# WIFI HYPERLOCATION

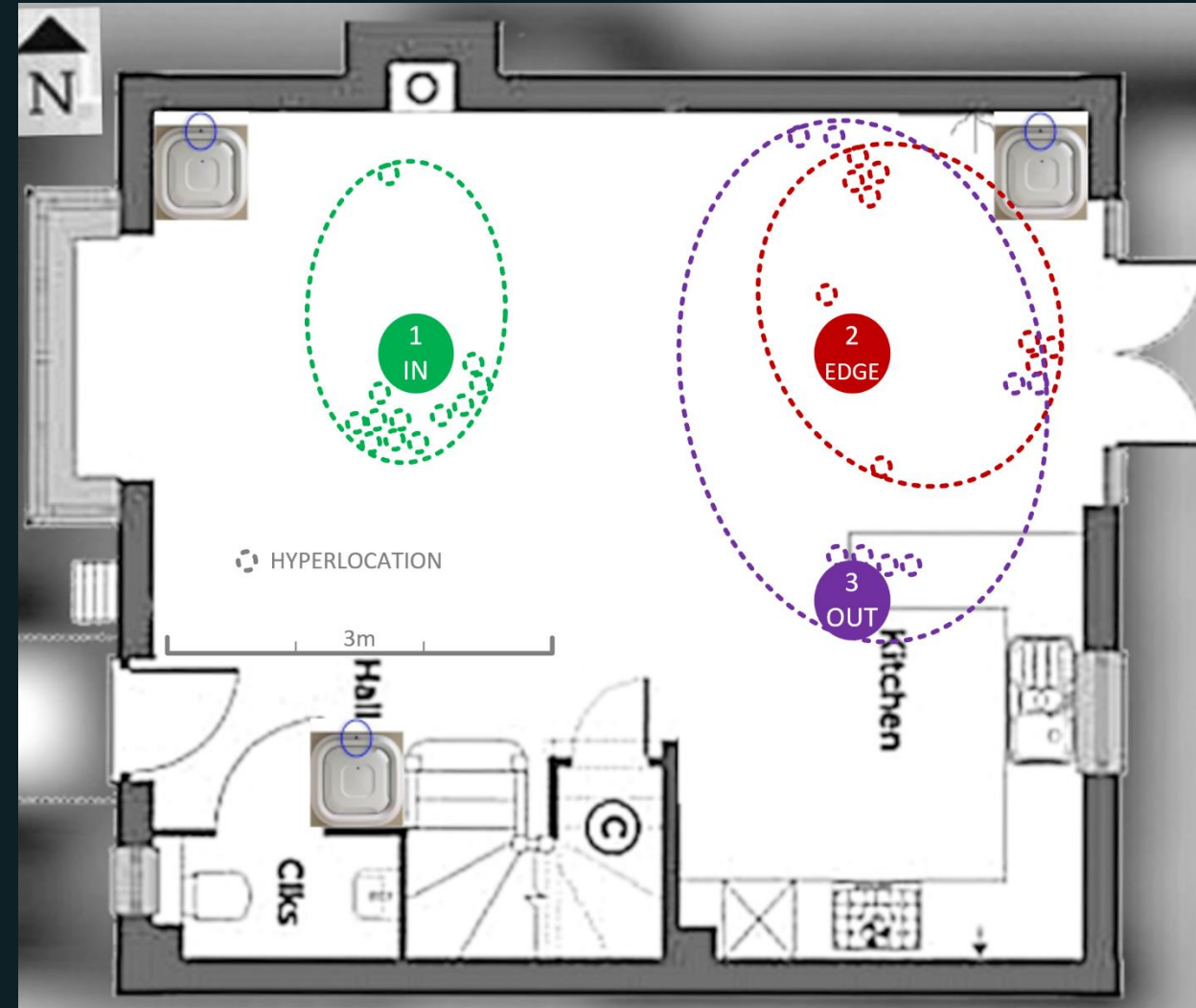
## ACCURACY

Inside the convex-hull

Location Computation Frequency (s)	Measurements on Correct Floor (%)	10m Accuracy (%)	Average Error Distance (m)	90% Error Distance (m)
2.4	100	100.0	0.73	0.73

Edge of the convex-hull

Location Computation Frequency (s)	Measurements on Correct Floor (%)	10m Accuracy (%)	Average Error Distance (m)	90% Error Distance (m)
2.3	100	100.0	1.78	2.03



Lab: 1-3m

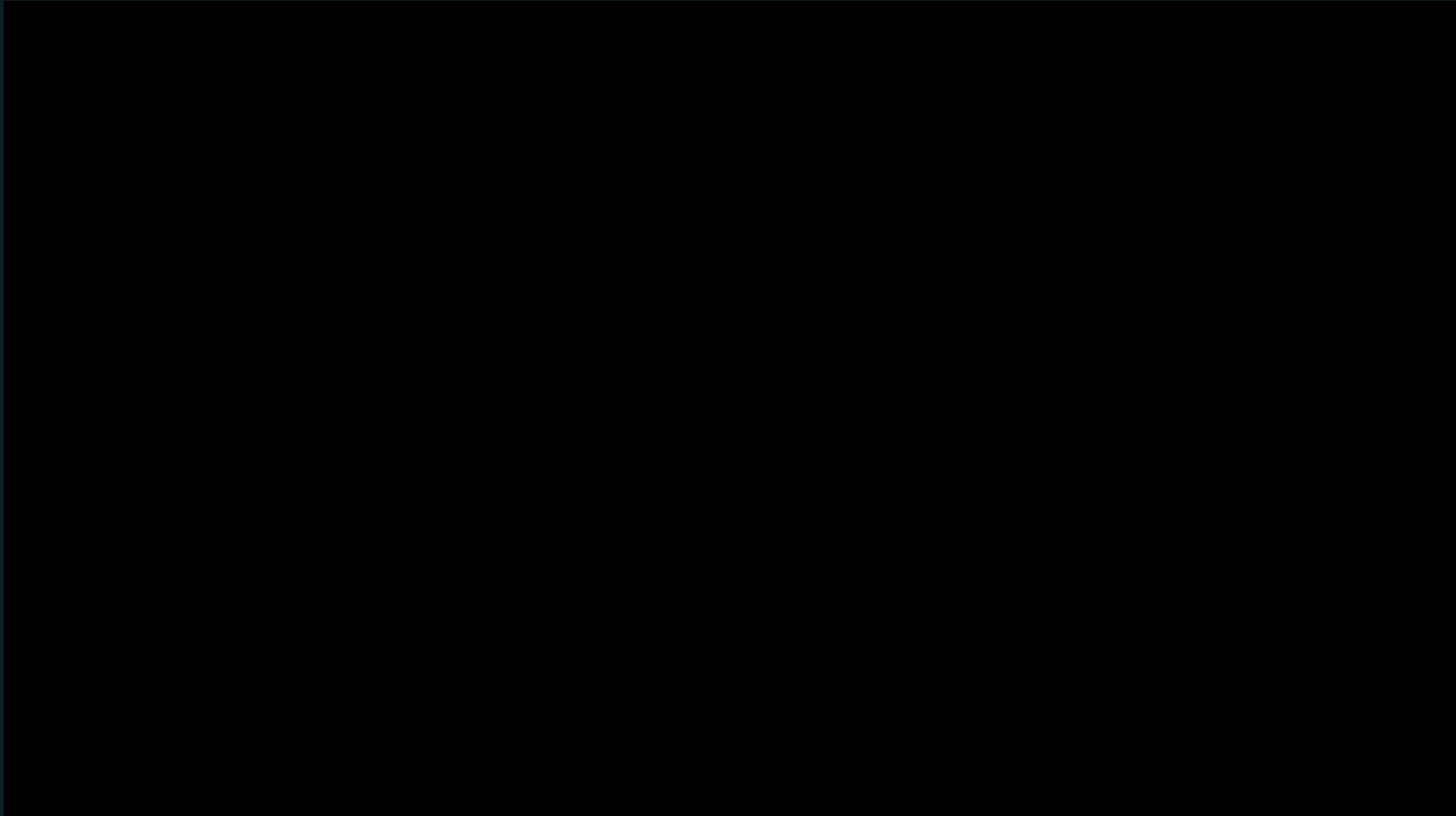
Marketed: 1-3m

Real: Depends (moving or not)

# WIFI HYPERLOCATION

## ACCURACY

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# MIST: vBLE ARRAY LOCATION

# MIST: vBLE ARRAY LOCATION

## COMPONENTS



APs



Mist Dashboard

# MIST: vBLE ARRAY LOCATION

## MIST LOCATION

WIFI NINJAS

FRI, 11:18 AM

Live View: Buckton Fields
11:18:23

Ruler
Wayfinding Paths
Beacons and Zones
Setup Floorplan

**LIVING ROOM**  
3.99 x 3.81 (13'1" x 12'6")

**KITCHEN / DINING AREA**  
3.16 x 6.64 (10'4" x 21'10")

**MASTER BEDROOM**  
4.57 x 3.79 (15'0" x 12'5" Max)

**BEDROOM 2**  
3.56 x 3.20 (11'8" x 10'6")

**BEDROOM 3**  
3.66 x 3.59 (12'0" x 11'10") Max

**BEDROOM 4**  
2.35 x 3.36 (7'9" x 11'0")

Total Floor Area: 132.10m<sup>2</sup> (1422ft<sup>2</sup>)

\*Measured to the 1.50m (5'0") high wall, ---- Skelling Line. C - Cupboard. L - Hot water cylinder or boiler cupboard.

6 Clients

- MACF-
- Matthe
- Matthe
- MIMIX
- MSTAR

Location Analytics

site Primary Site | floorplan Buckton Fields | zone Entire Floorplan | Today

**Dwell Time**

10h34m  
Max Dwell Time

5h6m  
Avg. Dwell Time

1h  
Empty Time

**Visits**

5  
Max Visits

3  
Avg. Visits

6  
Num. Visits

**Distribution**

**Time Series**

**Heatmap**

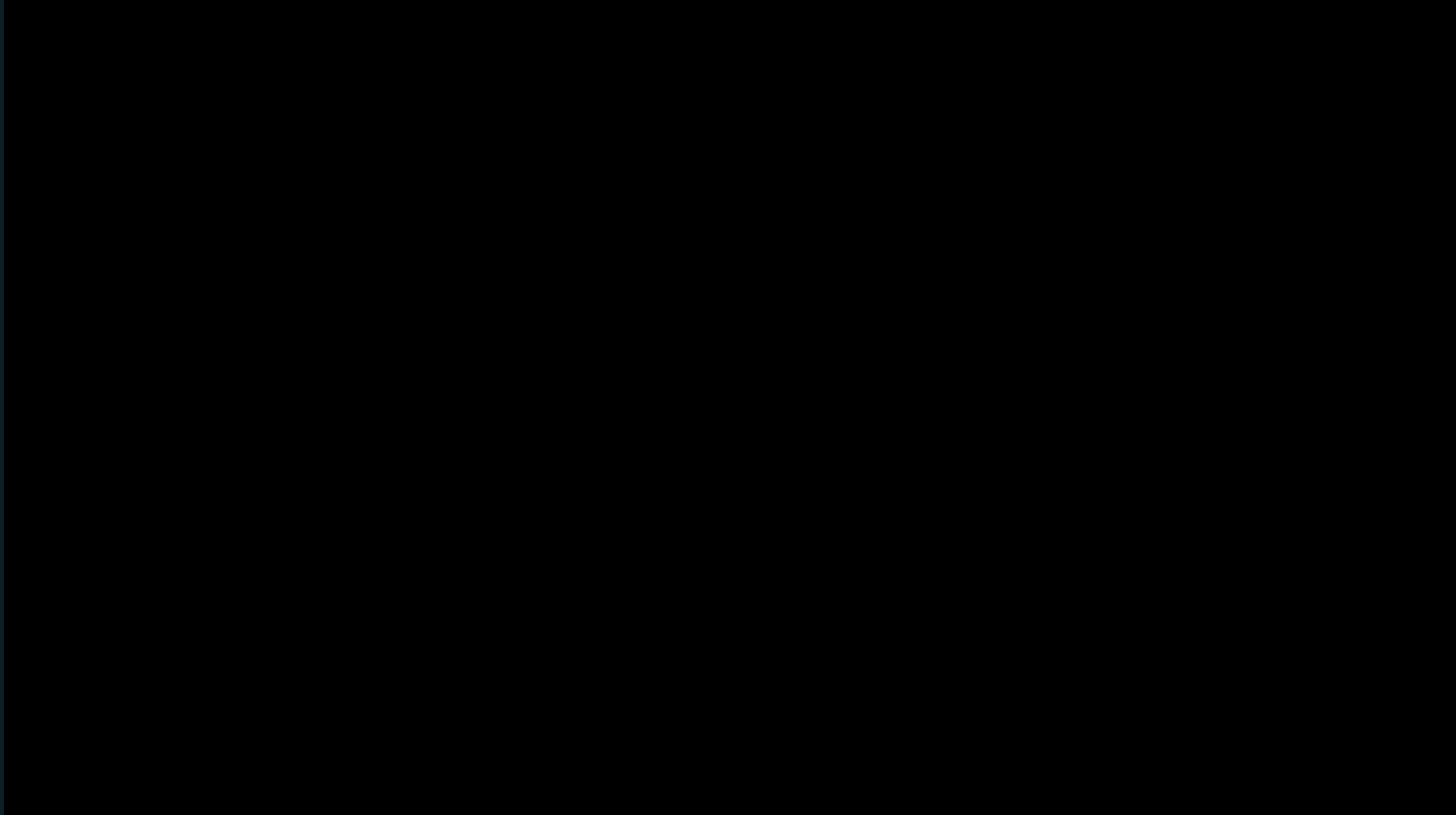
6 Visitors to this zone

Visitor	Visits	Total Time	Longest Visit	Shortest Visit	Avg Visit
4c369d4e4cf9/	1	1h 42m 26s (13.1%)	1h 42m 26s	1h 42m 26s	1h 42m 26s
802b03d133b4c/	1	1h 52m 3/5 (14.4%)	1h 52m 3/5	1h 52m 3/5	1h 52m 3/5
a430484d4bca9/	1	2h 27m 18s (18.9%)	2h 27m 18s	2h 27m 18s	2h 27m 18s
b484fc3e89e/	1	1h 52m 40s (14.4%)	1h 52m 40s	1h 52m 40s	1h 52m 40s
c4988040e24f/	1	1h 52m 3/5 (14.4%)	1h 52m 3/5	1h 52m 3/5	1h 52m 3/5
016a07cbcbff/	1	1h 52m 36s (14.4%)	1h 52m 36s	1h 52m 36s	1h 52m 36s



# MIST: vBLE ARRAY LOCATION

## ACCURACY



# LOCATION API: LIBERTY LONDON

# LOCATION API: LIBERTY LONDON

MERAKI API – CELL OF ORIGIN – BACKGROUND



# LOCATION API: LIBERTY LONDON

## MERAKI API – CELL OF ORIGIN – CHALLENGE



Data/Voice design in place

Presence & Analytics working like a charm

Zone analytics is now required

1 or 2 APs per zone, atriums

Meraki + Purple = pre-calculated Meraki XY; can we leverage it?

# LOCATION API: LIBERTY LONDON

MERAKI API – CELL OF ORIGIN – CHALLENGE

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# LOCATION API: LIBERTY LONDON

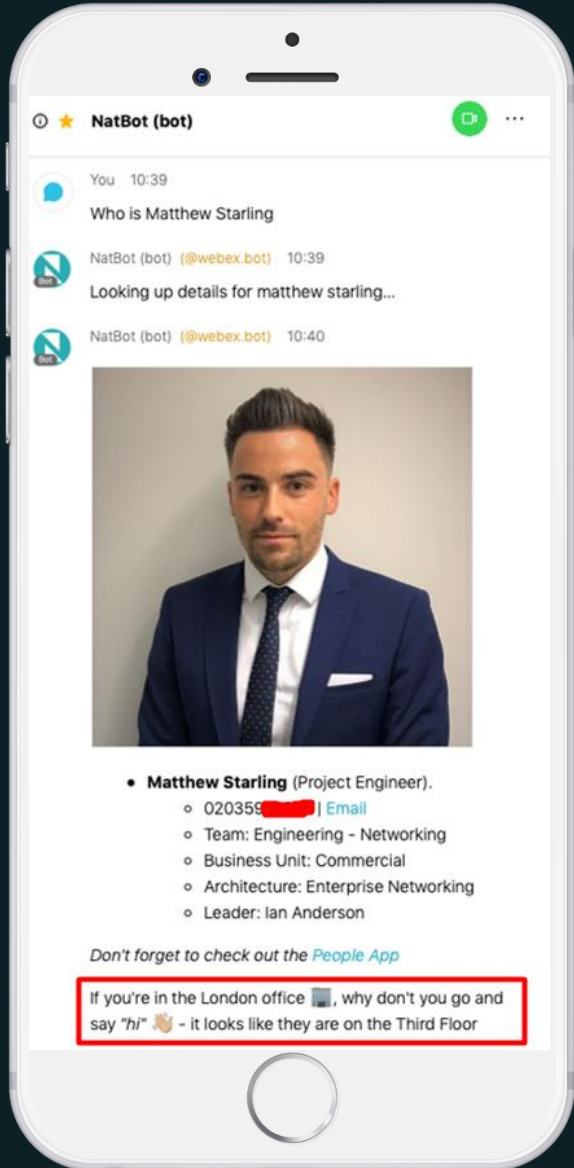
## MERAKI API – CELL OF ORIGIN – SOLUTION

ap_mac	lat	lng	seen_time	client_mac	rssi	venue	x	y
e0:cb:bc:50:6e:40	51.514015	-0.140037	2018-07-30 13:12	40:4e:36:b3	28	1dd9a5212bb4b3bbeec4356be456f593	62.9631	36.6979
e0:cb:bc:50:6e:40	51.513939	-0.139986	2018-07-30 13:13	40:4e:36:b3	29	1dd9a5212bb4b3bbeec4356be456f593	61.7213	27.4868
e0:cb:bc:50:6e:40	51.513924	-0.13997	2018-07-30 13:15	40:4e:36:b3	28	1dd9a5212bb4b3bbeec4356be456f593	61.9642	25.7169
e0:cb:bc:50:57:34	51.51358	-0.140389	2018-07-30 11:33	40:4e:36:b3	28	4945f5b1ac3e86d3b45447621a8cb0c5	16.6389	5.65055
e0:cb:bc:50:3e:fc	51.513615	-0.139944	2018-07-30 12:37	40:4e:36:b3	29	4945f5b1ac3e86d3b45447621a8cb0c5	45.0522	-6.73942
e0:cb:bc:50:3e:fc	51.513626	-0.139885	2018-07-30 12:39	40:4e:36:b3	29	4945f5b1ac3e86d3b45447621a8cb0c5	49.2222	-7.73104
e0:cb:bc:50:3e:fc	51.513809	-0.140383	2018-07-30 12:41	40:4e:36:b3	30	4945f5b1ac3e86d3b45447621a8cb0c5	29.8196	27.3251
e0:cb:bc:50:3e:fc	51.513641	-0.139812	2018-07-30 12:43	40:4e:36:b3	29	4945f5b1ac3e86d3b45447621a8cb0c5	54.4069	-8.80097
e0:cb:bc:50:3e:fc	51.513618	-0.139909	2018-07-30 12:45	40:4e:36:b3	30	4945f5b1ac3e86d3b45447621a8cb0c5	47.2594	-7.749
e0:cb:bc:50:3e:fc	51.513615	-0.139988	2018-07-30 12:47	40:4e:36:b3	30	4945f5b1ac3e86d3b45447621a8cb0c5	42.563	-5.02202
e0:cb:bc:50:57:34	51.513874	-0.140208	2018-07-30 12:51	40:4e:36:b3	27	4945f5b1ac3e86d3b45447621a8cb0c5	43.8015	27.3744
e0:cb:bc:50:57:34	51.513794	-0.140336	2018-07-30 12:57	40:4e:36:b3	27	4945f5b1ac3e86d3b45447621a8cb0c5	31.7262	24.1436
e0:cb:bc:50:5b:84	51.513859	-0.140129	2018-07-30 12:59	40:4e:36:b3	27	4945f5b1ac3e86d3b45447621a8cb0c5	47.7763	23.2555
e0:cb:bc:50:85:ba	51.513828	-0.140085	2018-07-30 13:00	40:4e:36:b3	28	4945f5b1ac3e86d3b45447621a8cb0c5	48.64	18.7081
e0:cb:bc:50:85:ba	51.514027	-0.139972	2018-07-30 13:03	40:4e:36:b3	30	4945f5b1ac3e86d3b45447621a8cb0c5	66.4547	33.7747
e0:cb:bc:50:85:ba	51.514046	-0.139966	2018-07-30 13:03	40:4e:36:b3	28	4945f5b1ac3e86d3b45447621a8cb0c5	67.8753	35.408
e0:cb:bc:50:5a:58	51.513988	-0.140022	2018-07-30 13:12	40:4e:36:b3	30	4945f5b1ac3e86d3b45447621a8cb0c5	61.3533	31.8824
e0:cb:bc:50:5a:58	51.513924	-0.140019	2018-07-30 13:14	40:4e:36:b3	31	4945f5b1ac3e86d3b45447621a8cb0c5	57.9161	25.6287
e0:cb:bc:50:5a:58	51.51405	-0.13983	2018-07-30 13:21	40:4e:36:b3	31	4945f5b1ac3e86d3b45447621a8cb0c5	76.3343	31.1981
e0:cb:bc:50:3e:fc	51.513683	-0.140014	2018-07-30 12:54	bc:54:36:28	30	4945f5b1ac3e86d3b45447621a8cb0c5	44.8139	2.43841
e0:cb:bc:50:85:ba	51.513931	-0.140046	2018-07-30 12:59	bc:54:36:28	28	4945f5b1ac3e86d3b45447621a8cb0c5	56.7491	27.2512
e0:cb:bc:50:85:ba	51.513969	-0.13999	2018-07-30 13:02	bc:54:36:28	28	4945f5b1ac3e86d3b45447621a8cb0c5	62.1245	28.8442

# LOCATION API: NATILIK

# LOCATION API: NATILIK

## CMX API – INTEGRATION WITH WEBEX TEAMS



Webex Teams Enterprise Messaging Integration

Provides supplementary information to directory lookup

Could be extended with calendar information / wayfinding etc.

Uses Cisco CMX API for location information

If you're in the London office 🏢, why don't you go and say "hi" 🙋 - it looks like they are on the Third Floor



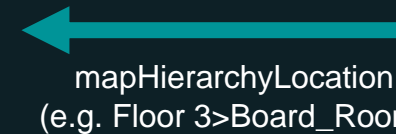
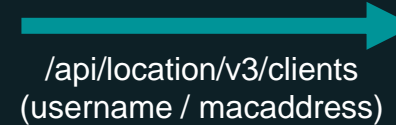
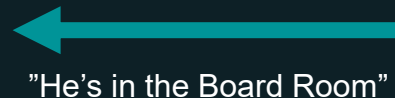
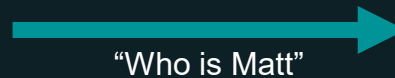
Webex Teams



NatBot



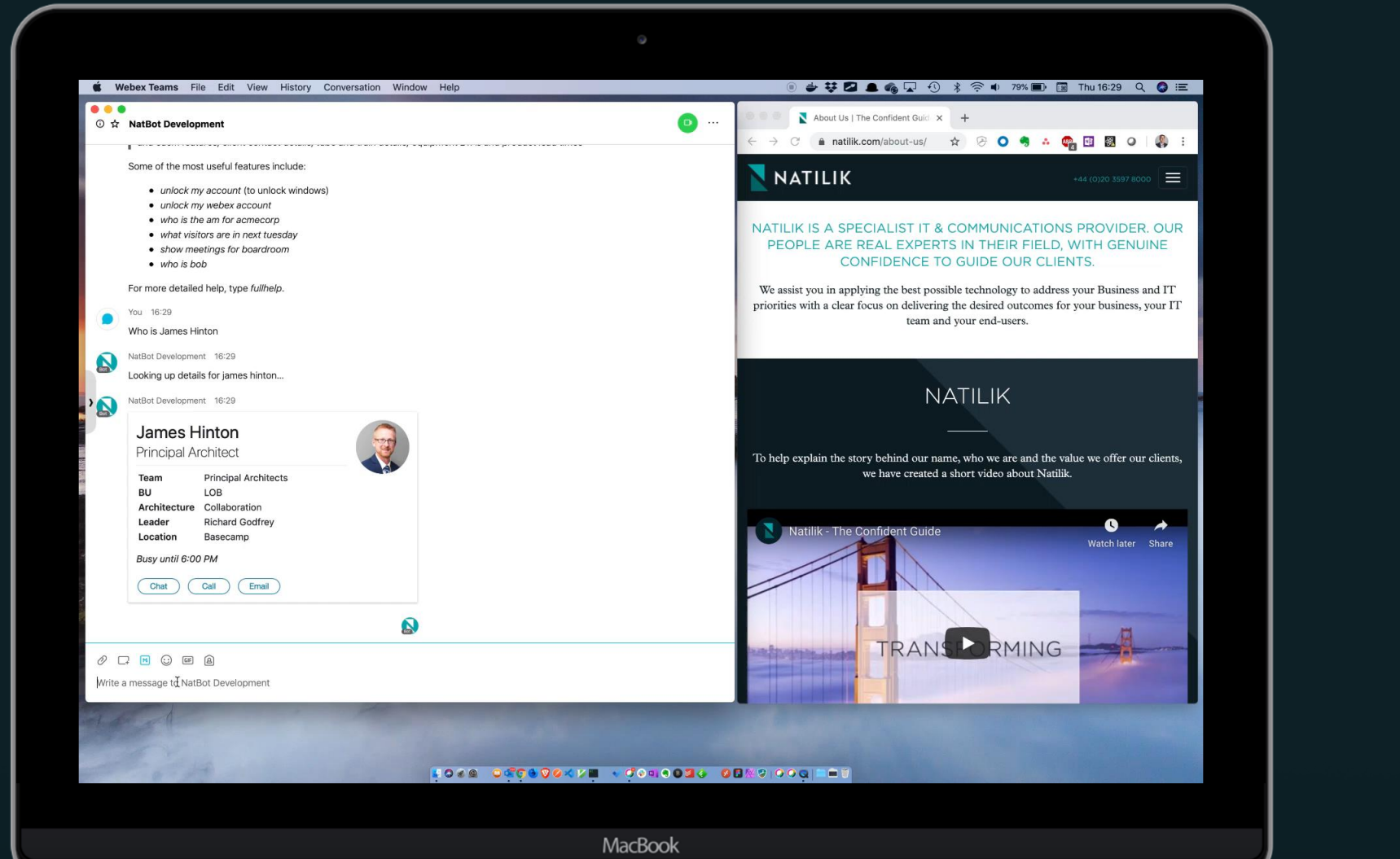
Cisco CMX





# LOCATION API: NATILIK

## CISCO CMX API – INTEGRATION WITH WEBEX TEAMS



# LOCATION API

## SKY IS THE LIMIT

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Add integration with voice assistants

Add integration with calendar

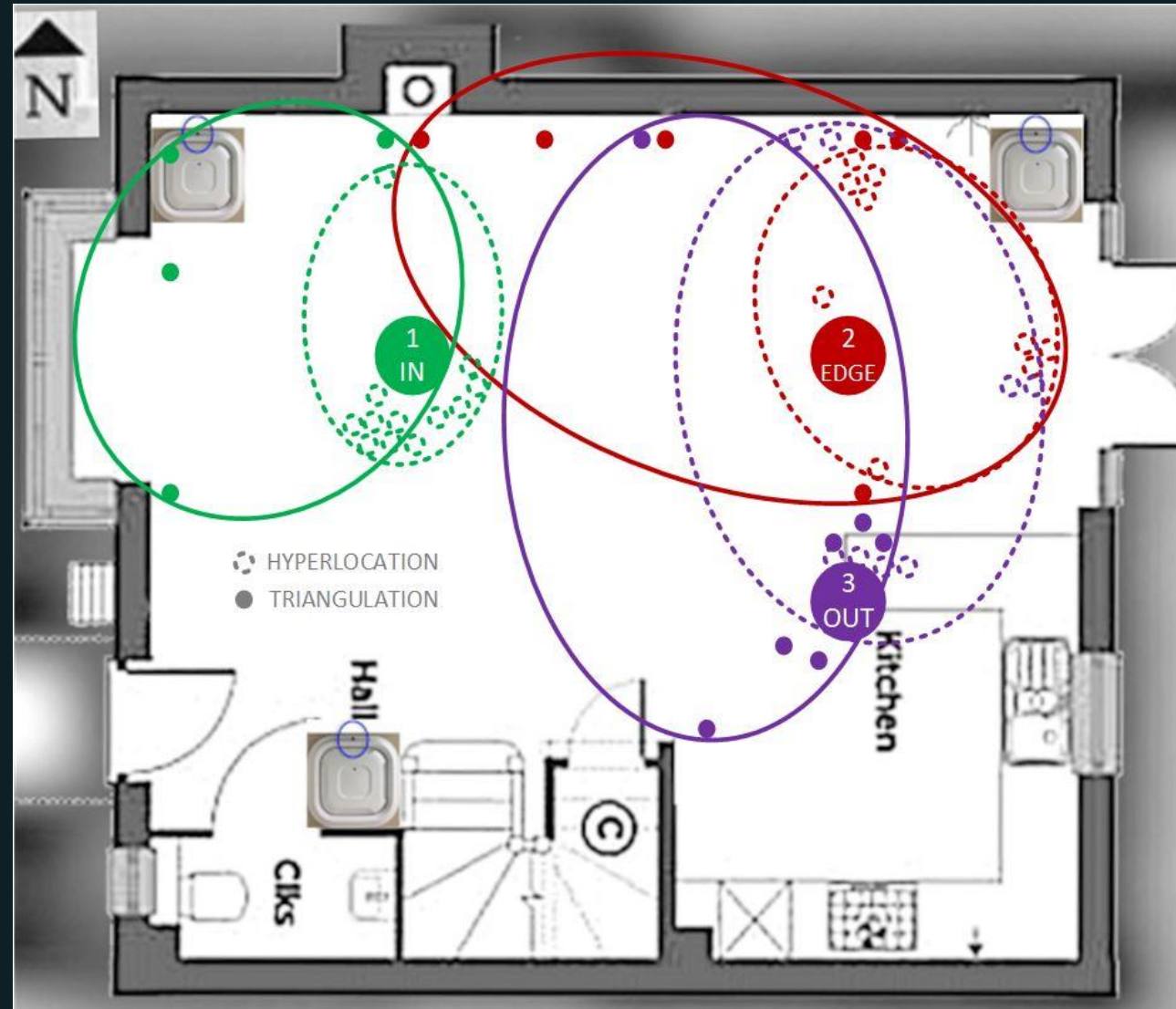
Add full wayfinding functionality leveraging mobile SDK

Leverage mobile sensors to enhance the blue dot experience

Offload indoor location to GPS and 5G outdoor

# RTLS

## SUMMARY – WIFI TRILATERATION vs HYPERLOCATION



# RTLS

## SUMMARY

Tech.	Method	Accuracy		
		Lab	Marketed	Real
WiFi	Trilateration	3-4m	5-7m	7-10m
WiFi	AoA	1-3m	1-3m	1-5m
vBLE	Probability Surfaces	0.7-2m	1-3m	1-3m

Vendor	Method	Location Computation Frequency	Location Samples Captured over 2 minutes
Cisco	RSSI	11-15s	9-11
Cisco	AoA	2.3-2.4s	43-50

Vendor	Method	Screen	Location Computation Frequency	Location Samples Captured over 2 minutes
Cisco	AoA	On	2.3-2.4s	43-50
		Off	4.5s	22-27

# GOTCHAS

## RTLS

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NTP

Components Compatibility

APs Mounting

Maps Services Fine-Tuning

Don't mix Hyperlocation with non-Hyperlocation APs

Associate WiFi Clients

Use Mobile Apps

Add C9800 to CMX as 'Unified WLC' using SSH, as opposed to 'WLC' using  
SNMP

THANK YOU

xXx