ekahau

WIRELESS DESIGN

#WiFiDesignDay

Cockney Rhyming Slang GB

Apples and Pears 🍏 🍐

Stairs!

Proprietary & Confidential

ekahau
WIRELESS DESIGN

How about

Wi-Fi Rhyming Slang? 🛜

Proprietary & Confidential

ekahau
WIRELESS DESIGN

Bridal Flannels

Channels

“Looks like we need to change the Bridal, too much noise on this one."

Proprietary & Confidential

ekahau
WIRELESS DESIGN

Dentist Convention 🦷

Contention

"The network's slow due to too much Dentist."

Proprietary & Confidential

ekahau
WIRELESS DESIGN

Ride Quick

Sidekick

"Let's use the Ride for the site survey."

Proprietary & Confidential

ekahau
WIRELESS DESIGN

L'ORÉAL
ekahau

L'ORÉAL

10 x Football Fields 🤯

Existing Challenges

- Complaints of “slow” Wi-Fi
- Bad roaming
- Losing connectivity
- Causes headache for the IT team
- Small disconnections add up
- High ceilings (13m / 45ft),
- High and long racking aisles (100m / 238ft in length)
- Massive open spaces
- Mezzanines with no walls
- Current APs installed on the ceiling

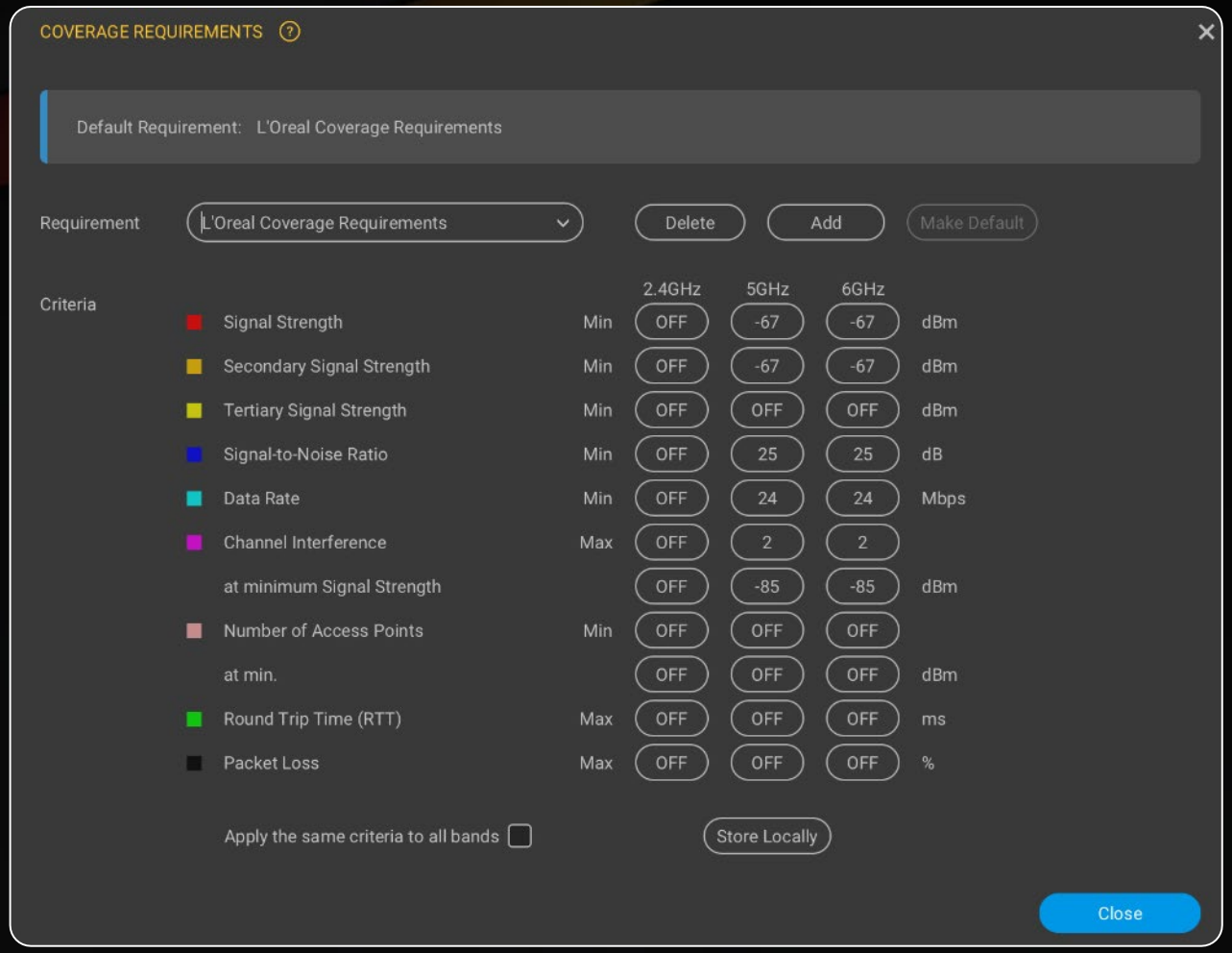
ekahau
WIRELESS DESIGN

Understanding and Defining the Requirements for the Wi-Fi

ekahau
WIRELESS DESIGN

Warehouse Wi-Fi Network Redesign

The Requirements



- Fully Future-Proofed
- Fully 6 GHz Enabled
- No Support for 2.4 GHz
- Seamless Roaming
- RF Redundancy

ekahau WIRELESS DESIGN

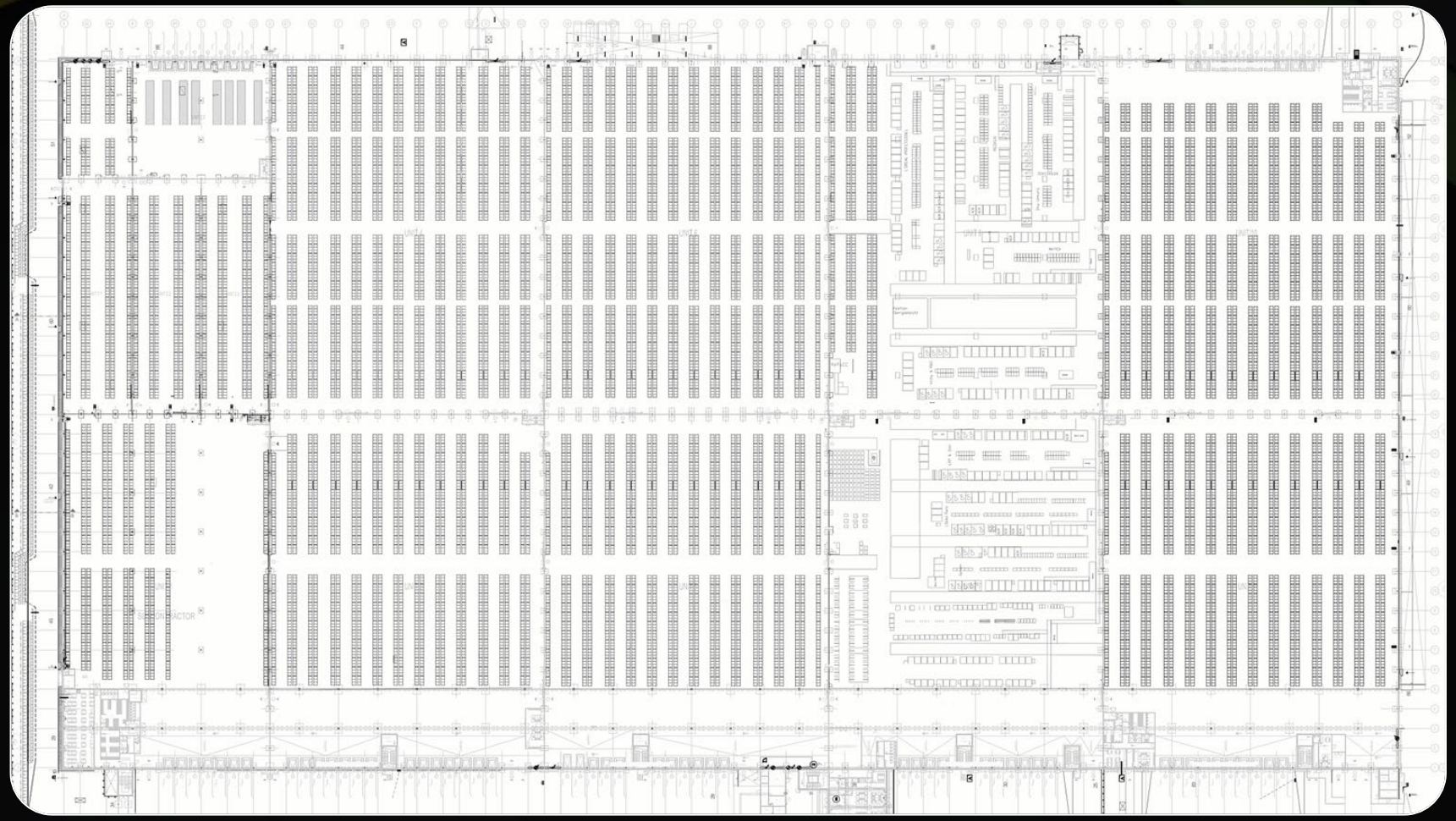
Different Requirement Areas

Green
High Rack Aisles
13m high racks, over 100m long

Blue
Open Space Packing
13m High Ceilings

Orange
Mezzanine
No physical walls

Red
Out of Scope
No APs 😭



ekahau
WIRELESS DESIGN

Best Practice Design

for Warehouses

ekahau
WIRELESS DESIGN

6 GHz Wi-Fi Access Points

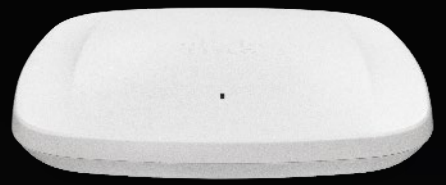
Cisco Meraki CW Series APs

CW 9166D1

Integrated directional antennas (including 6 GHz!)

4x4:4

High racking aisles, open space areas and 1st floor mezz

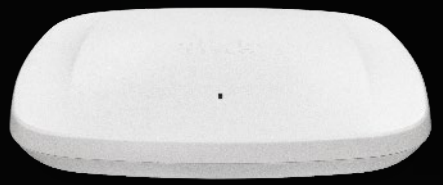


CW 9164i

Integrated omni-directional antennas

4x4:4

Offices and ground floor mezz

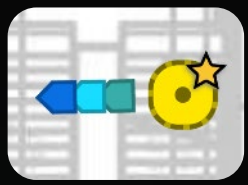


CW 9162i

Integrated omni-directional antennas

2x2:2

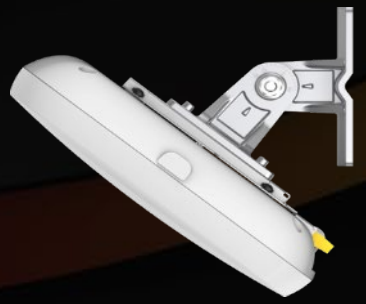
Stairwells



Proprietary & Confidential

ekahau
WIRELESS DESIGN

High Racking Aisle Example



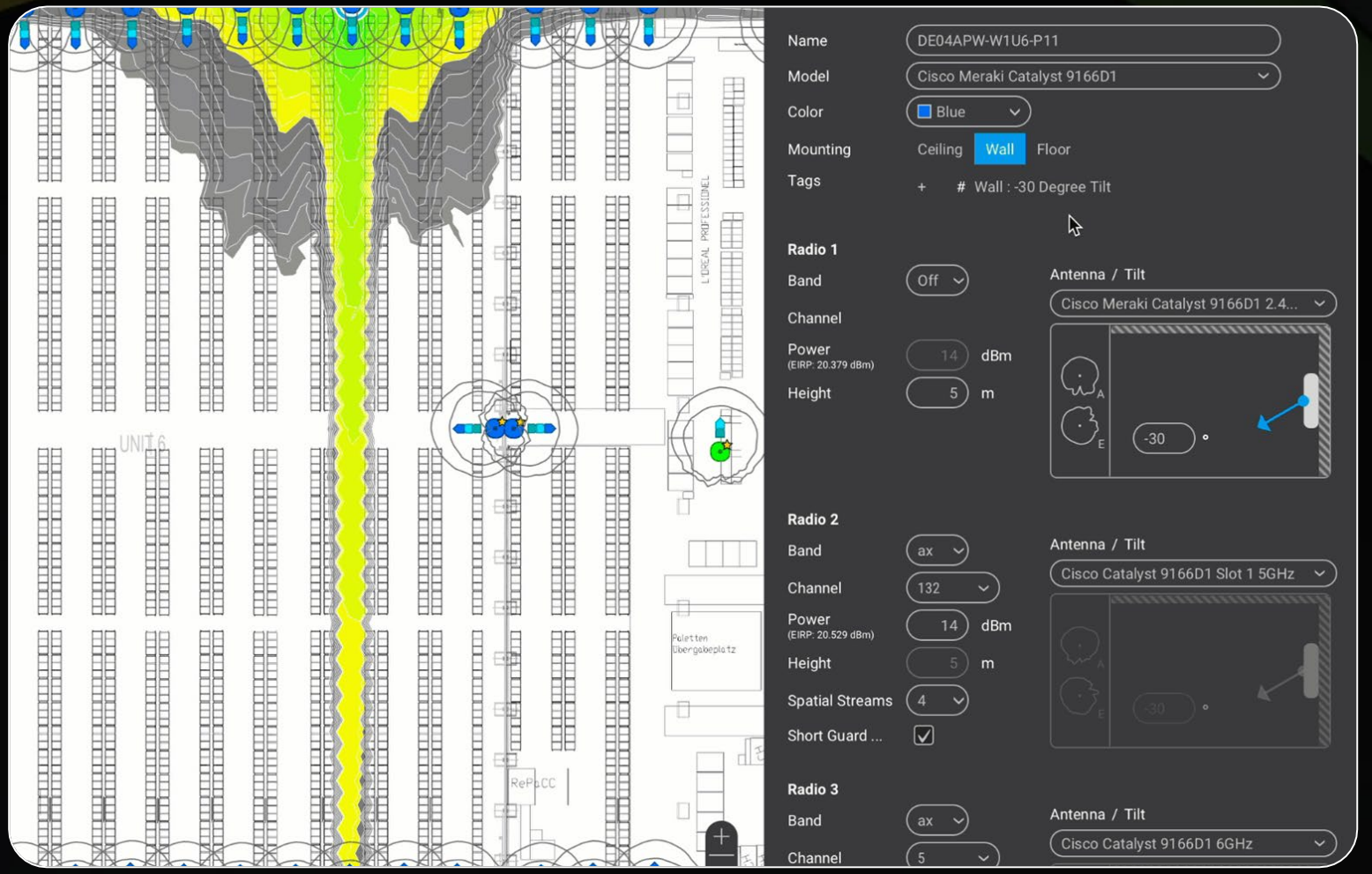
Cisco Meraki 9166D1

Install height: 5m

Mounting: Wall

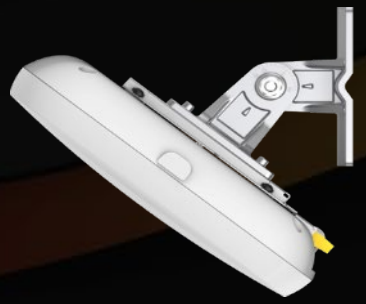
Angle of tilt: -30 degrees

Tx Power: 14 dBm



ekahau WIRELESS DESIGN

Large Open Space Example



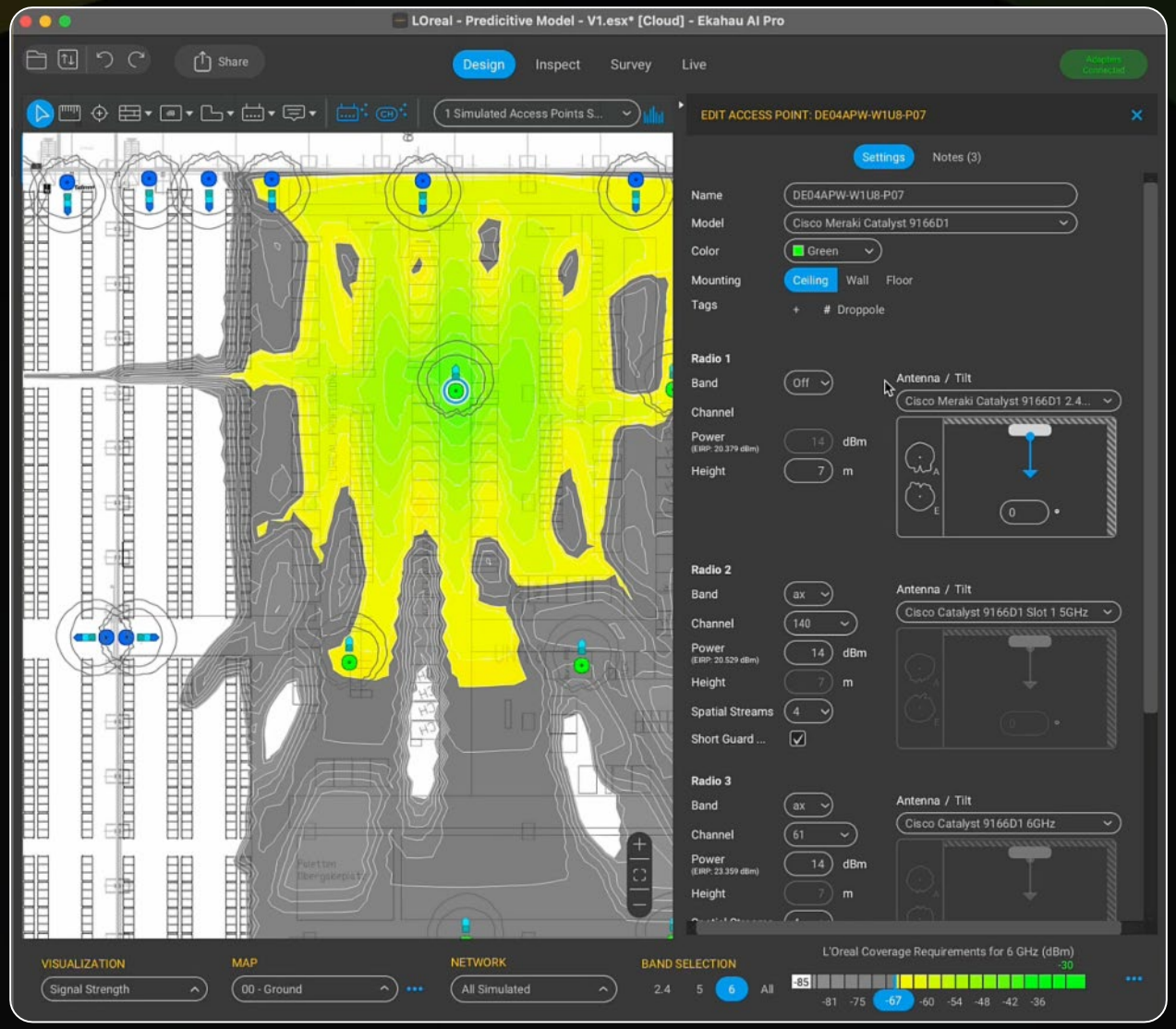
Cisco Meraki 9166D1

Install height: 7m
(Via a drop pole)

Mounting: Ceiling

Angle of tilt: 0 degrees
(shooting down)

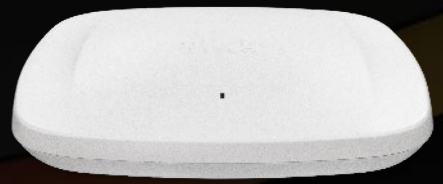
Tx Power: 14 dBm



Proprietary & Confidential

ekahau
WIRELESS DESIGN

Ground Floor Mezzanine Example



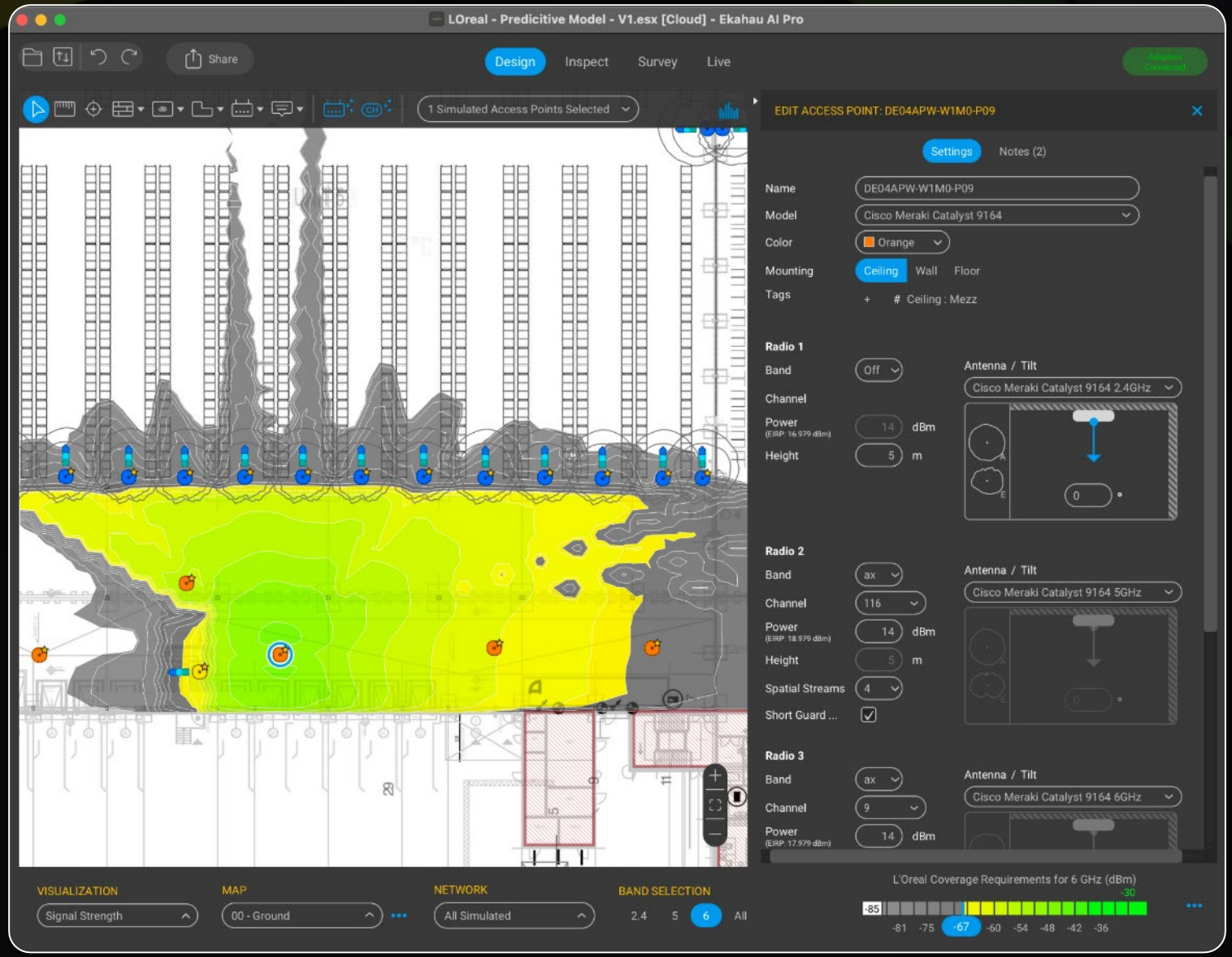
Cisco Meraki 9164i

Install height: 5m

Mounting: Ceiling

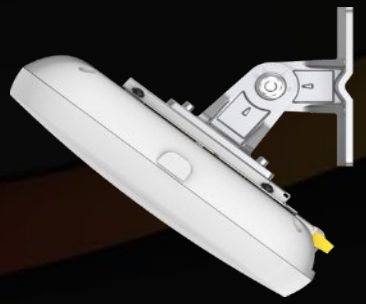
Angle of tilt: 0 degrees (shooting down)

Tx Power: 14 dBm



Proprietary & Confidential

1st Floor Mezzanine Example



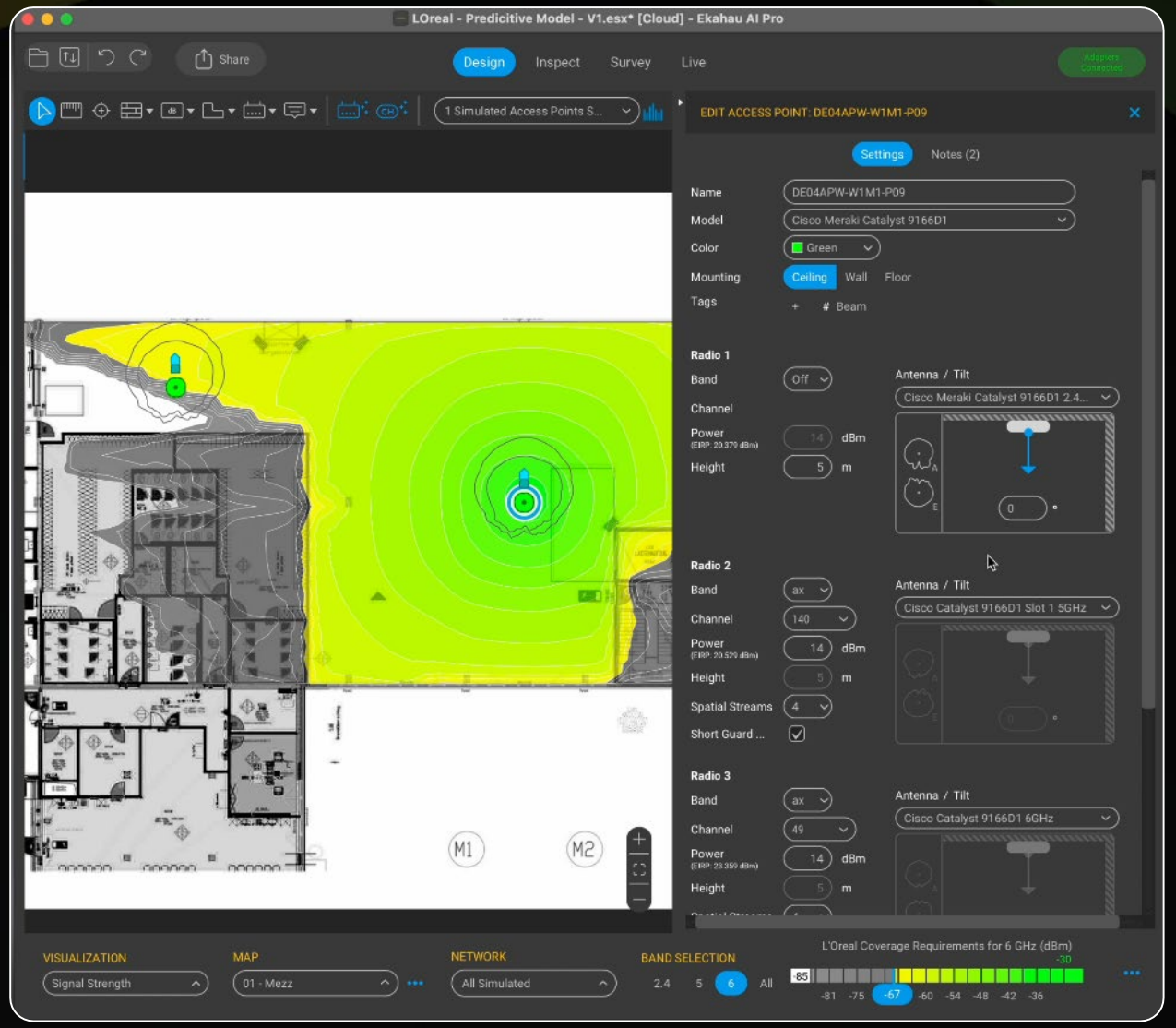
Cisco Meraki 9166D1

Install height: 5m

Mounting: Ceiling

Angle of tilt: 0 degrees (shooting down)

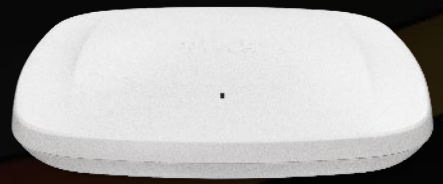
Tx Power: 14 dBm



Proprietary & Confidential

ekahau
WIRELESS DESIGN

Stairwell Example



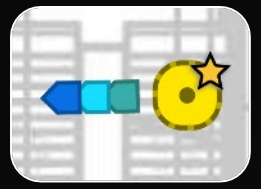
Cisco Meraki 9162i

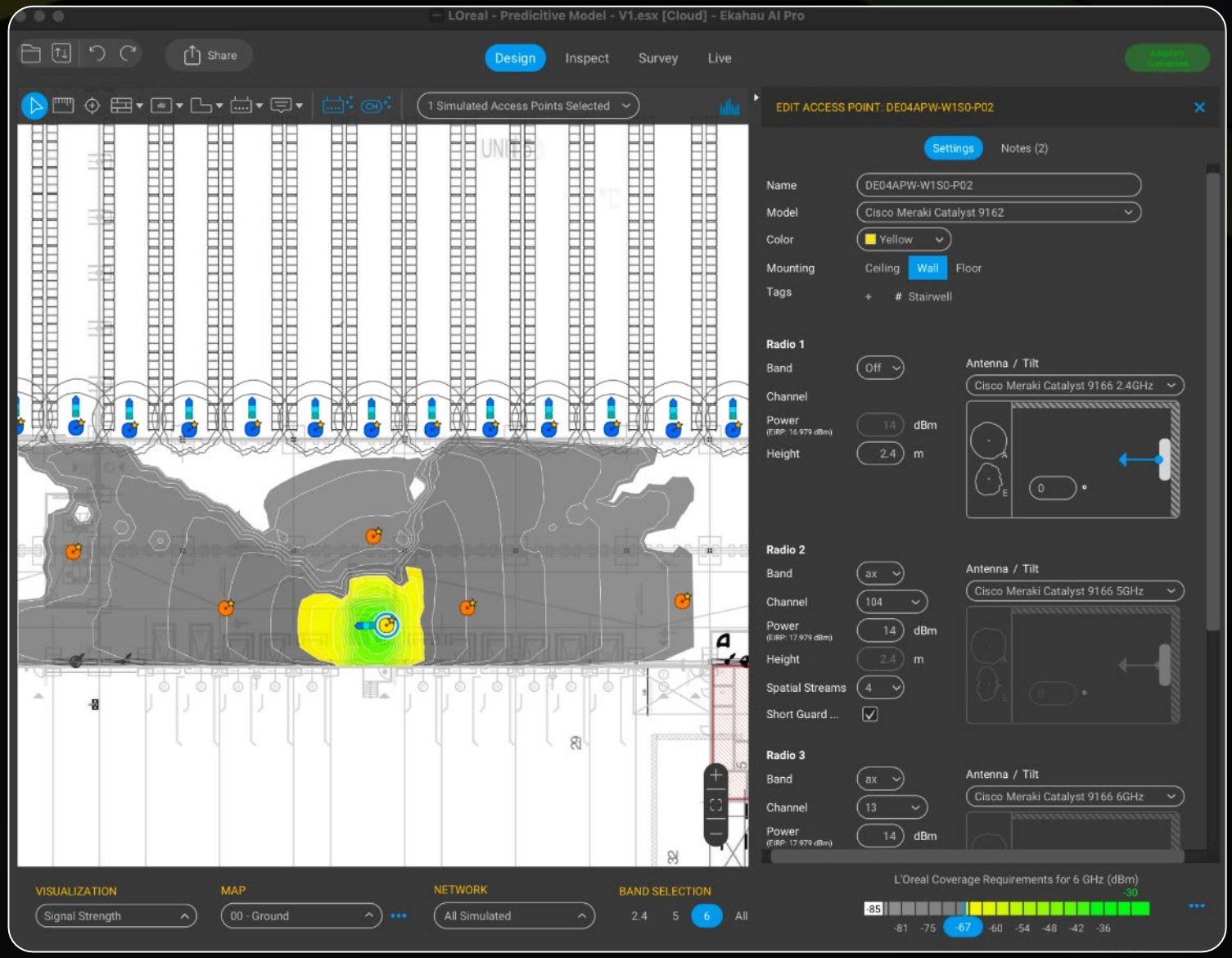
Install height: 2.4m

Mounting: Wall

Angle of tilt: 0 degrees

Tx Power: 14 dBm

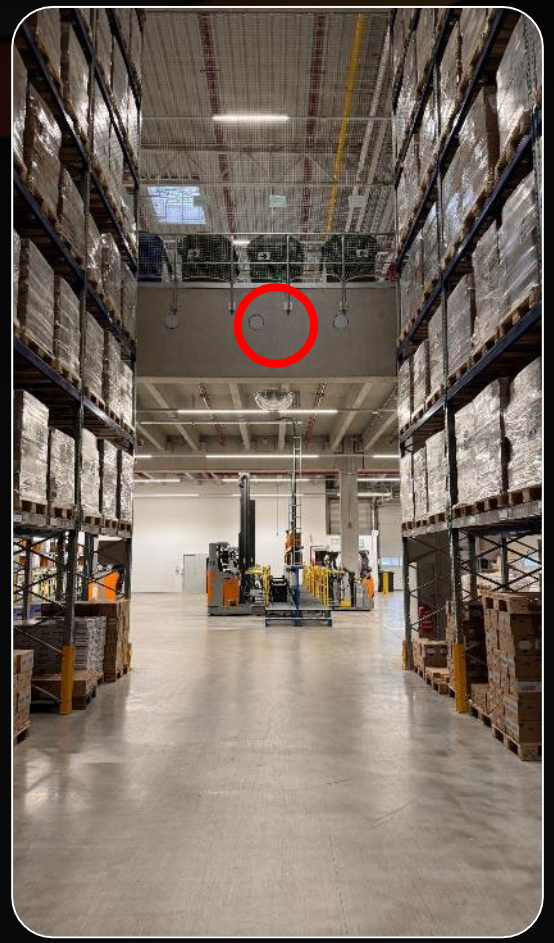




Proprietary & Confidential

APoS (AP on a Stick Survey)

Test 1 - High Racking Aisles



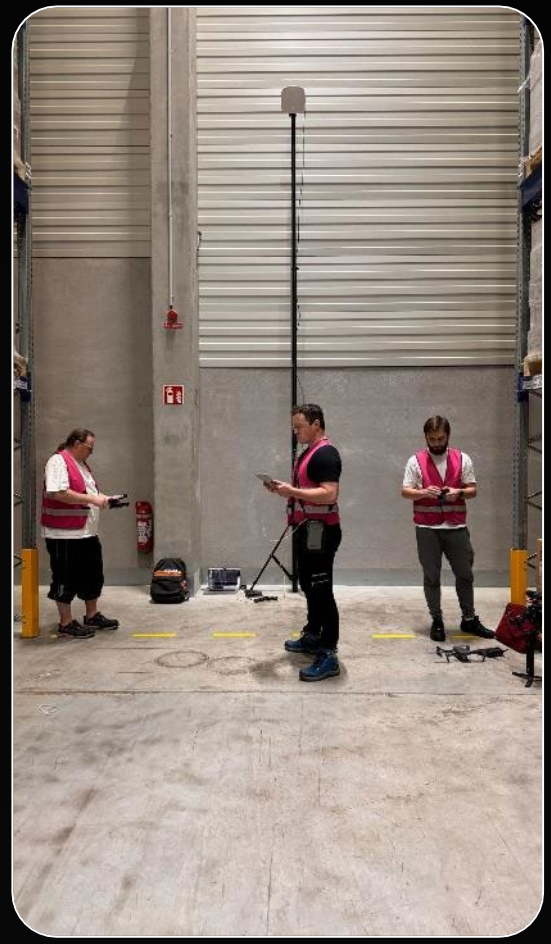
Cisco Meraki 9166D1

Install height: 5m

Mounting: Wall

Angle of tilt: -30 degrees

Tx Power: 14 dBm



Proprietary & Confidential

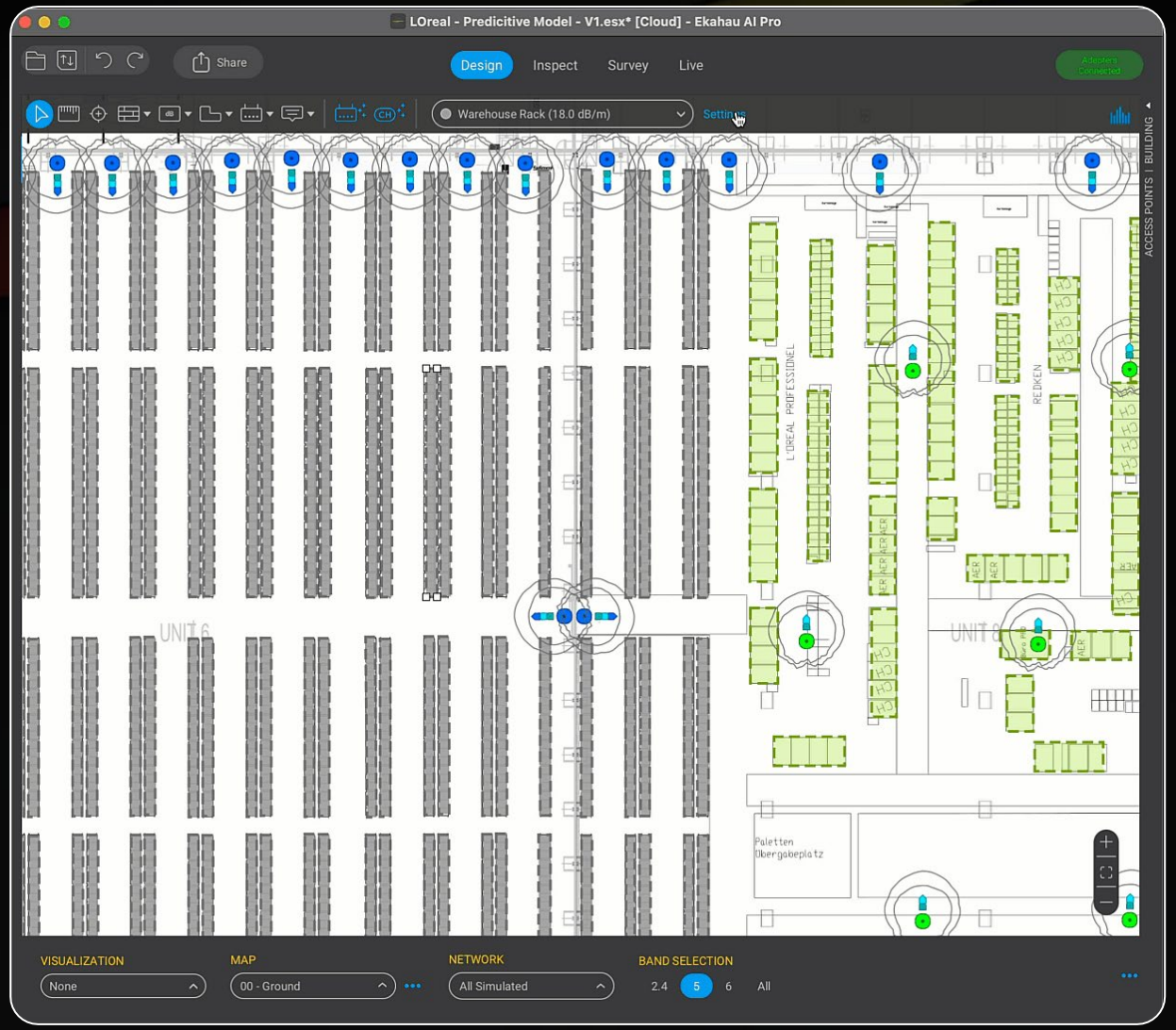
ekahau
WIRELESS DESIGN

So then you go for a walk…

Proprietary & Confidential

ekahau
WIRELESS DESIGN

Using Data to Update Our Predictive Model



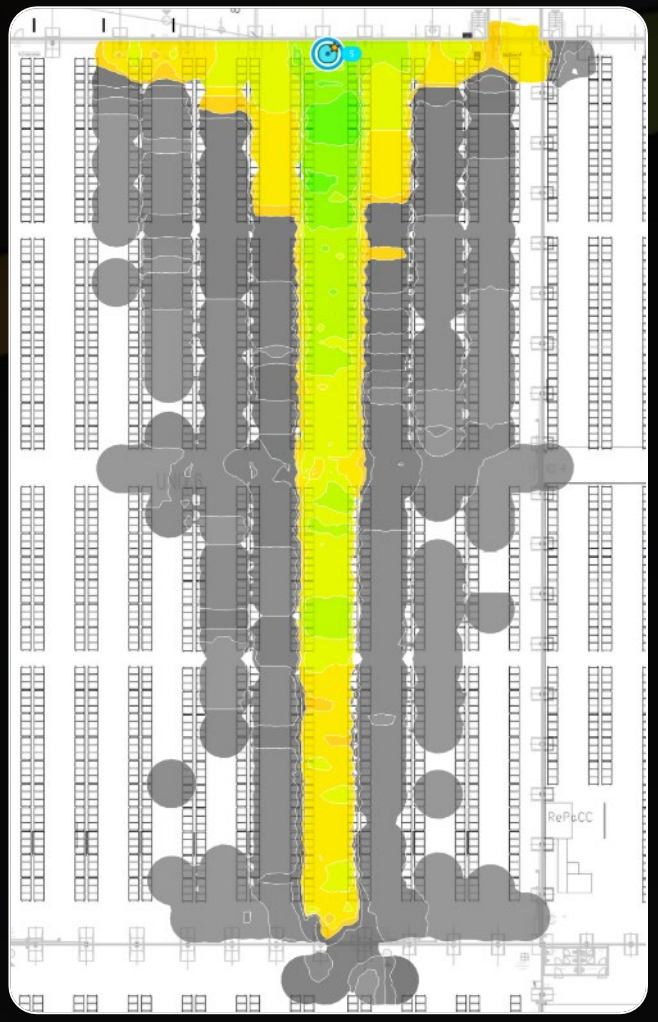
Updated:

- Attenuation value of walls ✅
- Attenuation value of racks ✅
- Height of racks ✅
- Added & relocated simulated APs ✅

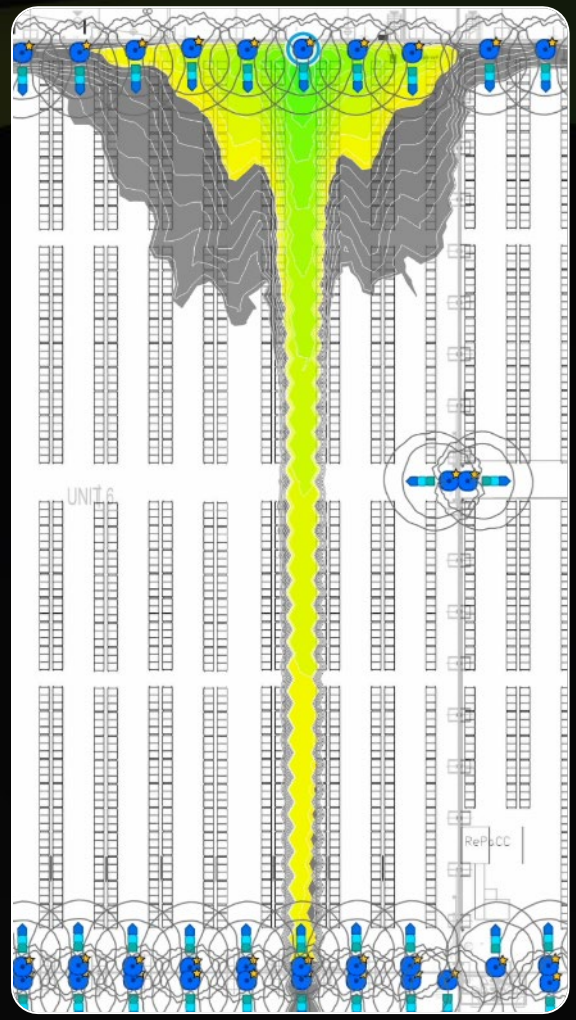
Proprietary & Confidential

ekahau
WIRELESS DESIGN

6 GHz



Measured



Simulated

ekahau
WIRELESS DESIGN

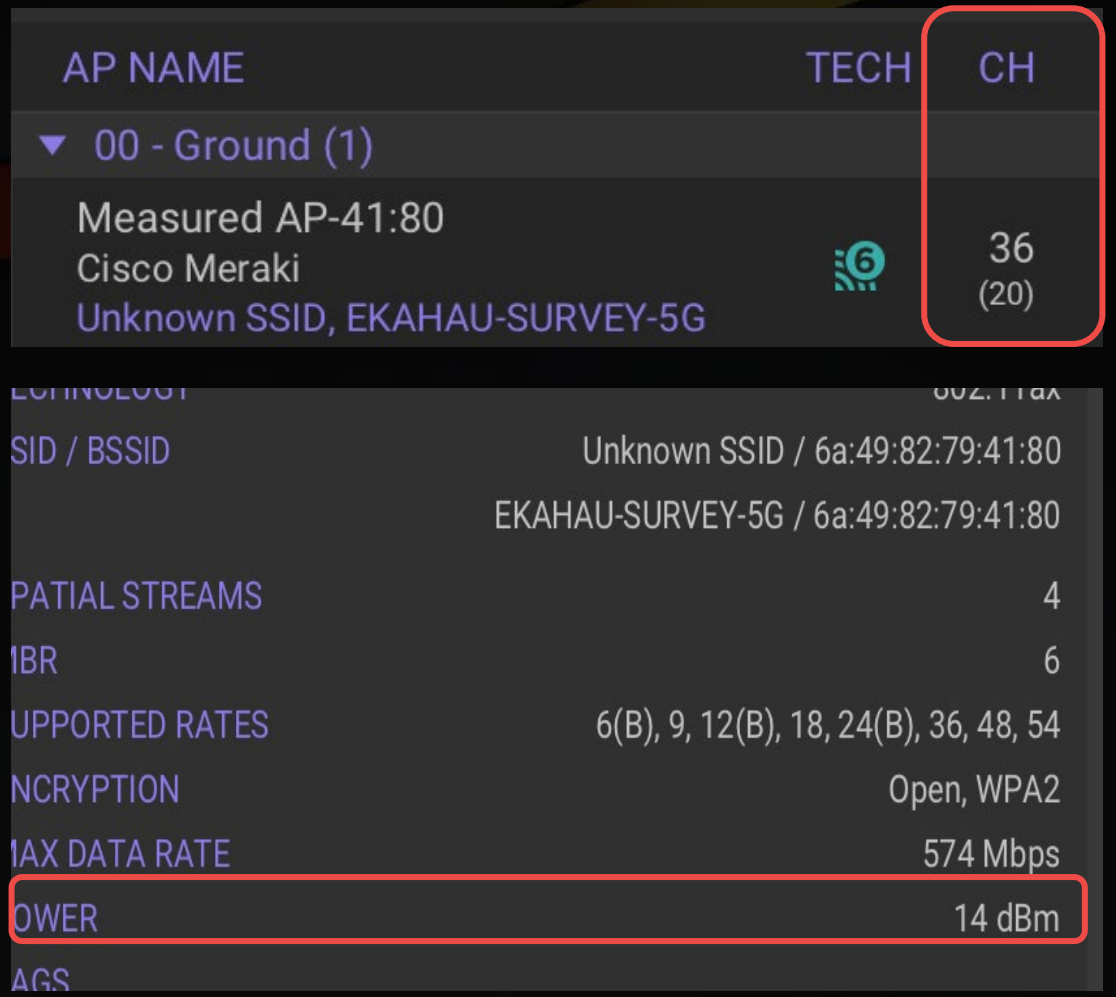
What is the Difference Between

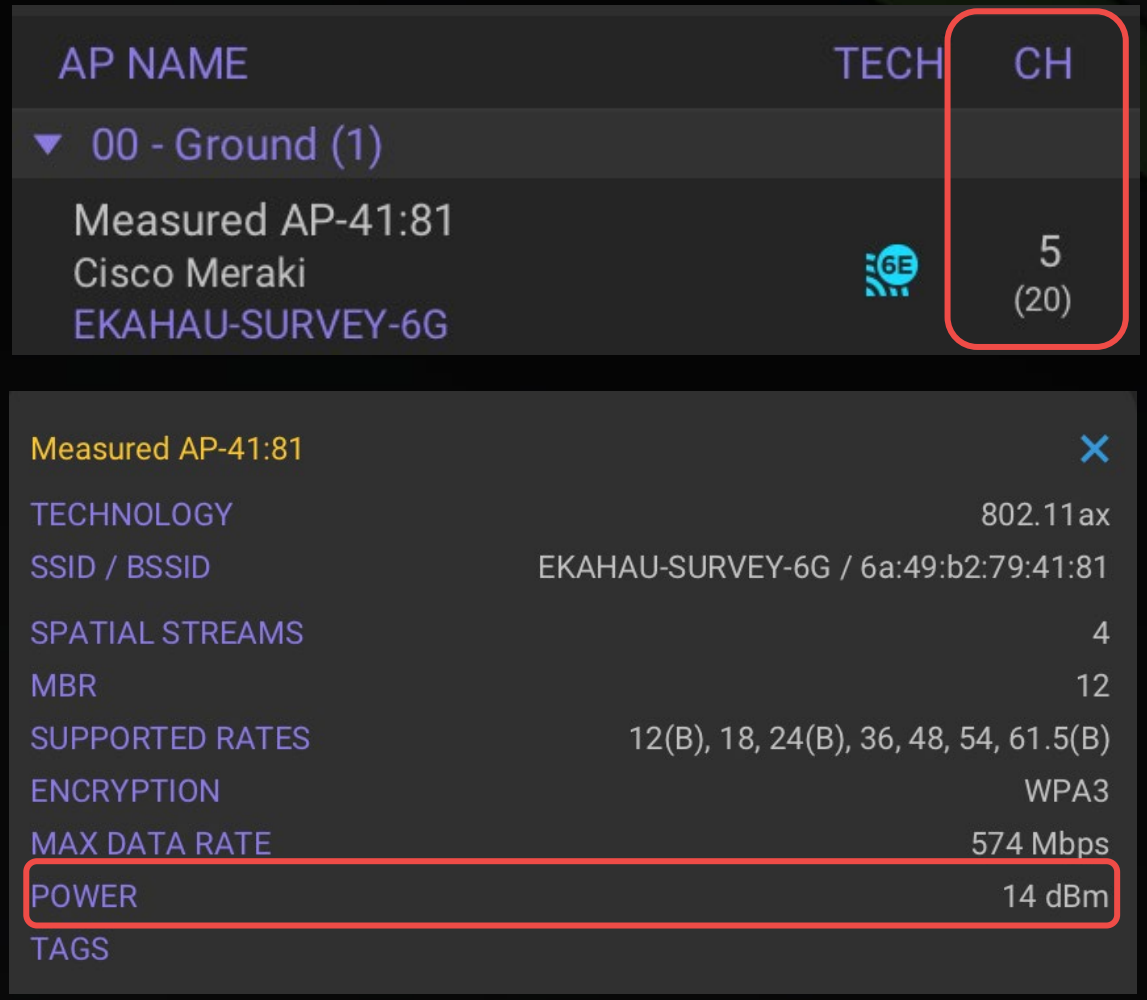
5GHz vs 6GHz

Proprietary & Confidential

ekahau
WIRELESS DESIGN

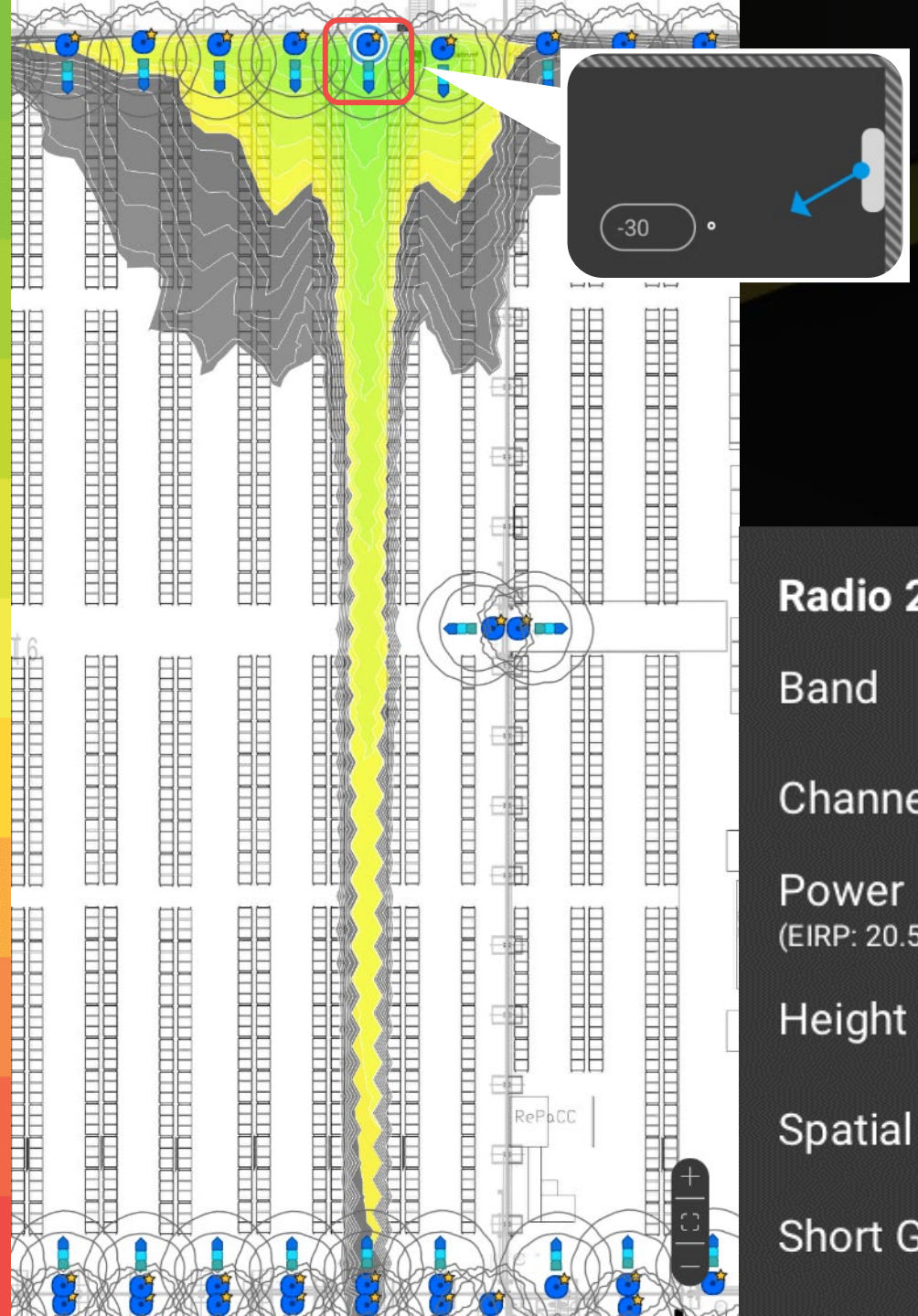
How are they Configured





Proprietary & Confidential

ekahau
WIRELESS DESIGN



APs Mounting & Configuration

Radio 2		Radio 3	
Band	ax	Band	ax
Channel	36	Channel	5
Power (EIRP: 20.529 dBm)	14 dBm	Power (EIRP: 23.359 dBm)	14 dBm
Height	5 m	Height	5 m
Spatial Streams	4	Spatial Streams	4
Short Guard ...	☑	Short Guard ...	☑

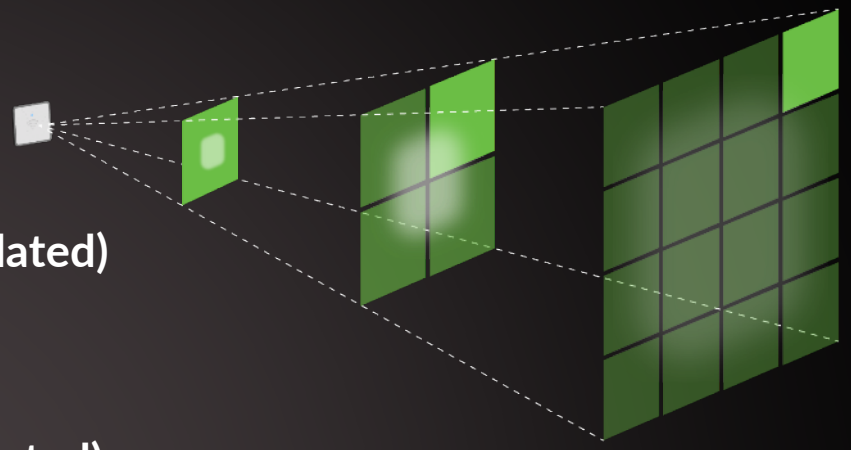
What's your Expectations for the Difference Between

5 and 6 GHz?

Proprietary & Confidential

ekahau
WIRELESS DESIGN

Free Space Path Loss



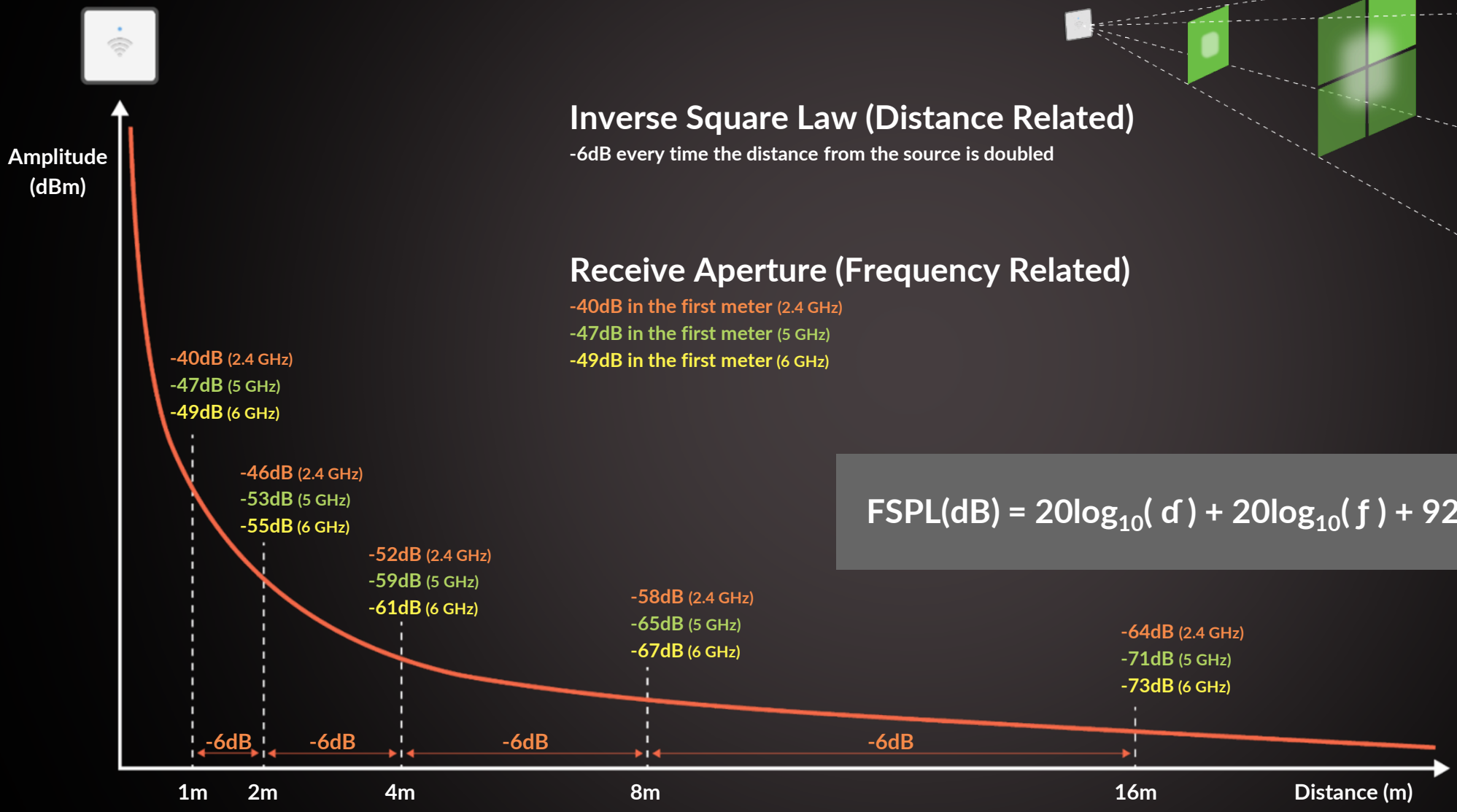
Inverse Square Law (Distance Related)

-6dB every time the distance from the source is doubled

Receive Aperture (Frequency Related)

-40dB in the first meter (2.4 GHz)
-47dB in the first meter (5 GHz)
-49dB in the first meter (6 GHz)

$$FSPL(dB) = 20\log_{10}(d) + 20\log_{10}(f) + 92.45$$



Copyright © 2022 Ekahau

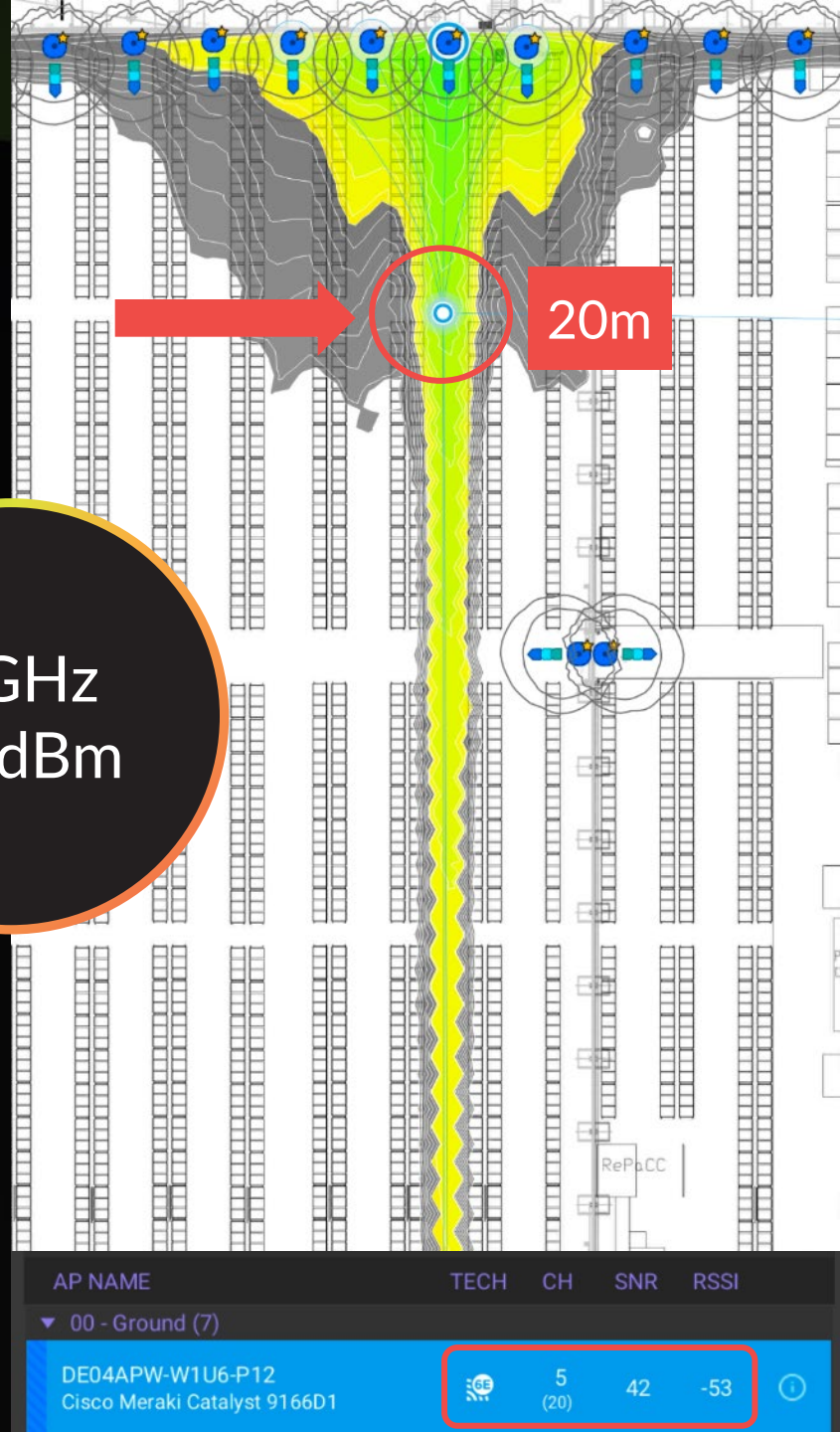
ekahau
WIRELESS DESIGN

SIMULATED

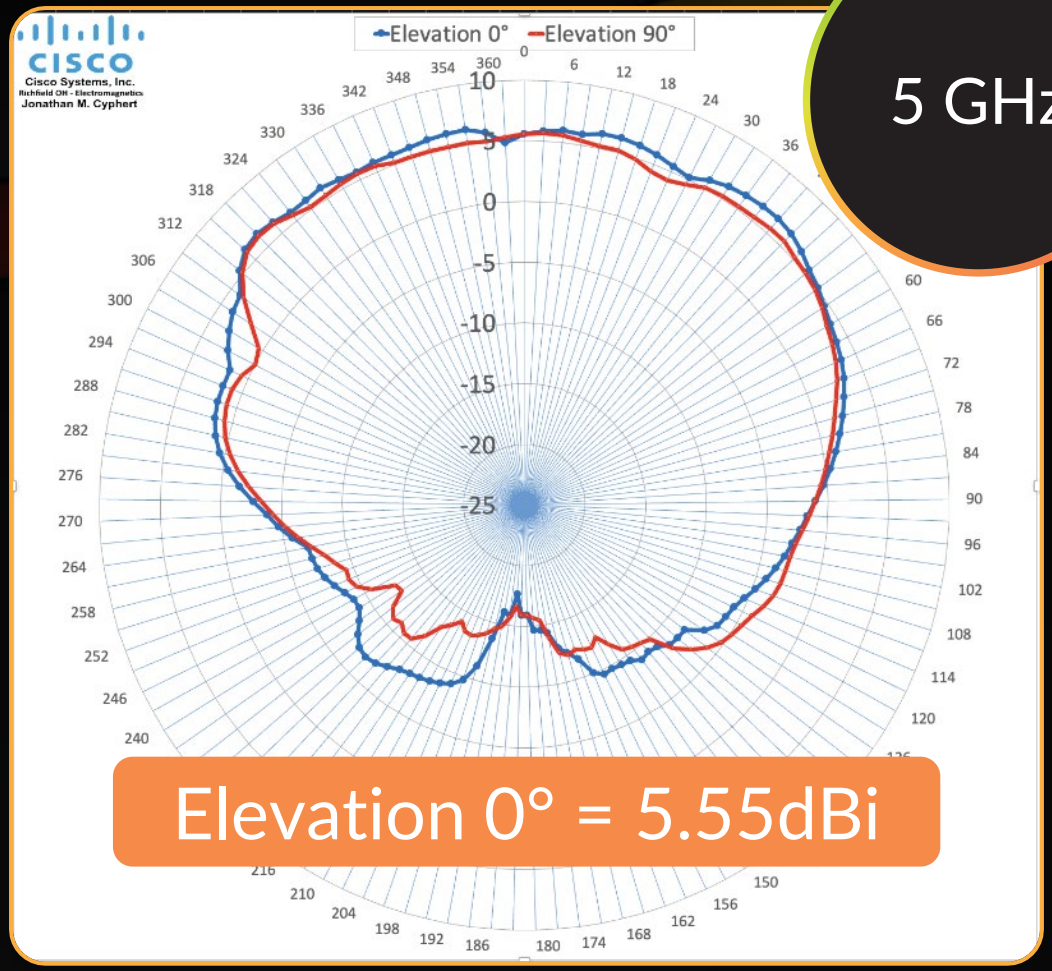
5 GHz
-54dBm

VS

6 GHz
-53dBm

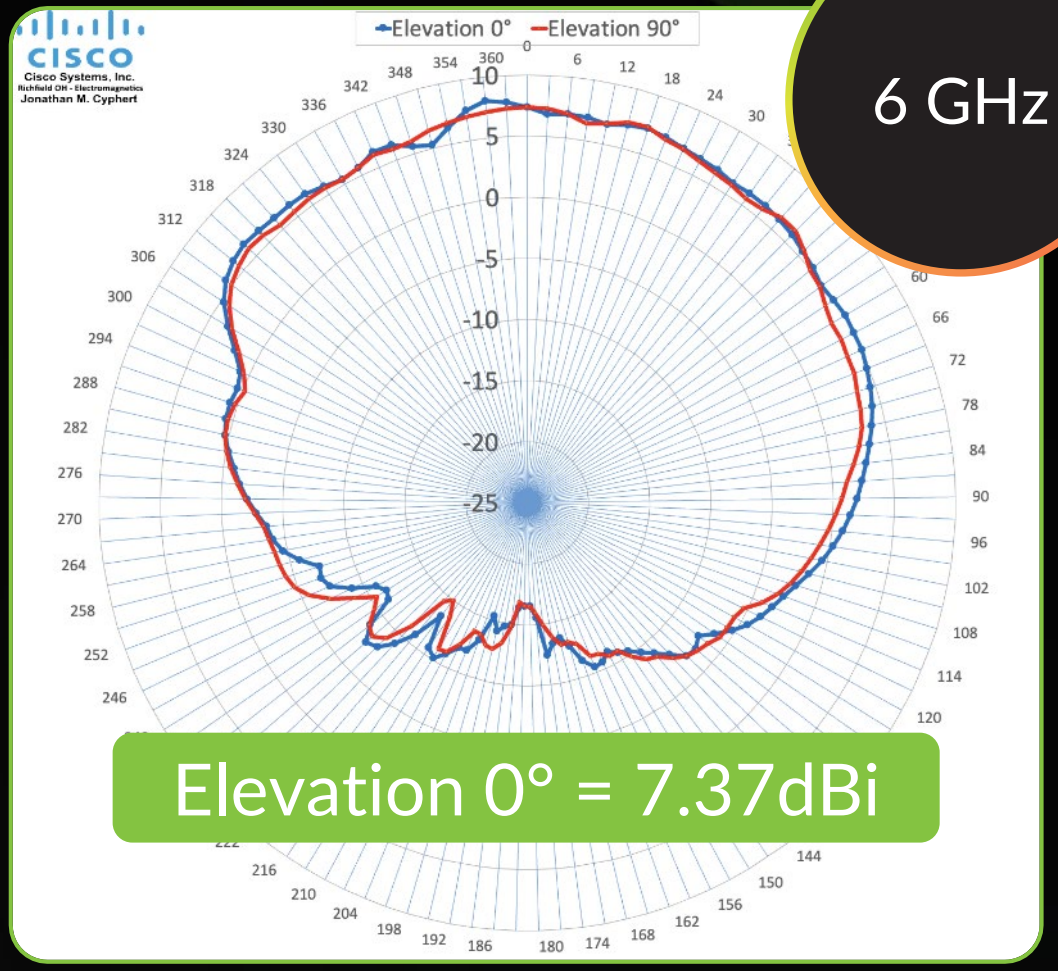


CW 9166D1 Antenna Gain



5 GHz

Elevation 0° = 5.55dBi



6 GHz

Elevation 0° = 7.37dBi

Nearly +2 dBi on 6GHz

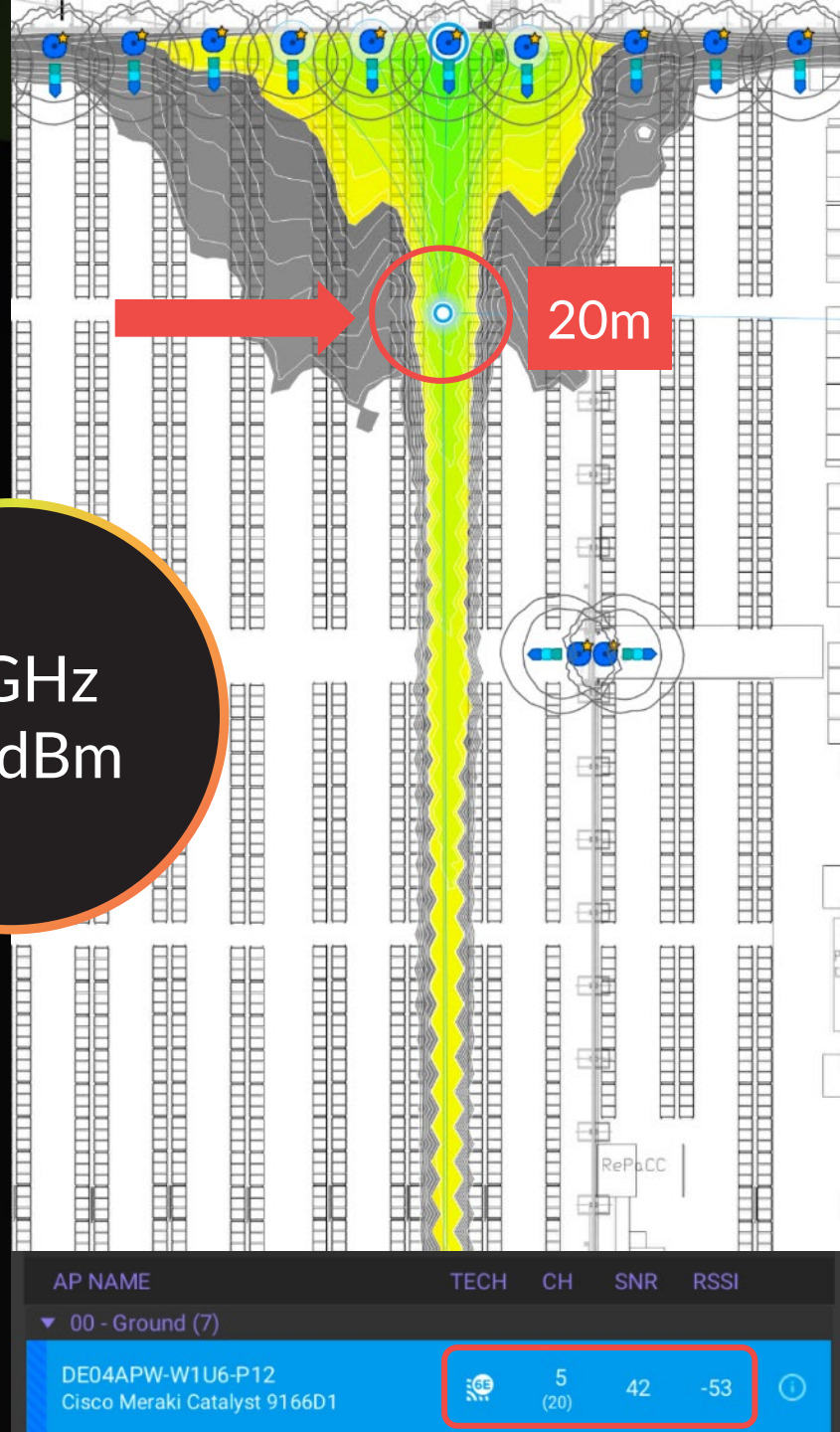
ekahau WIRELESS DESIGN

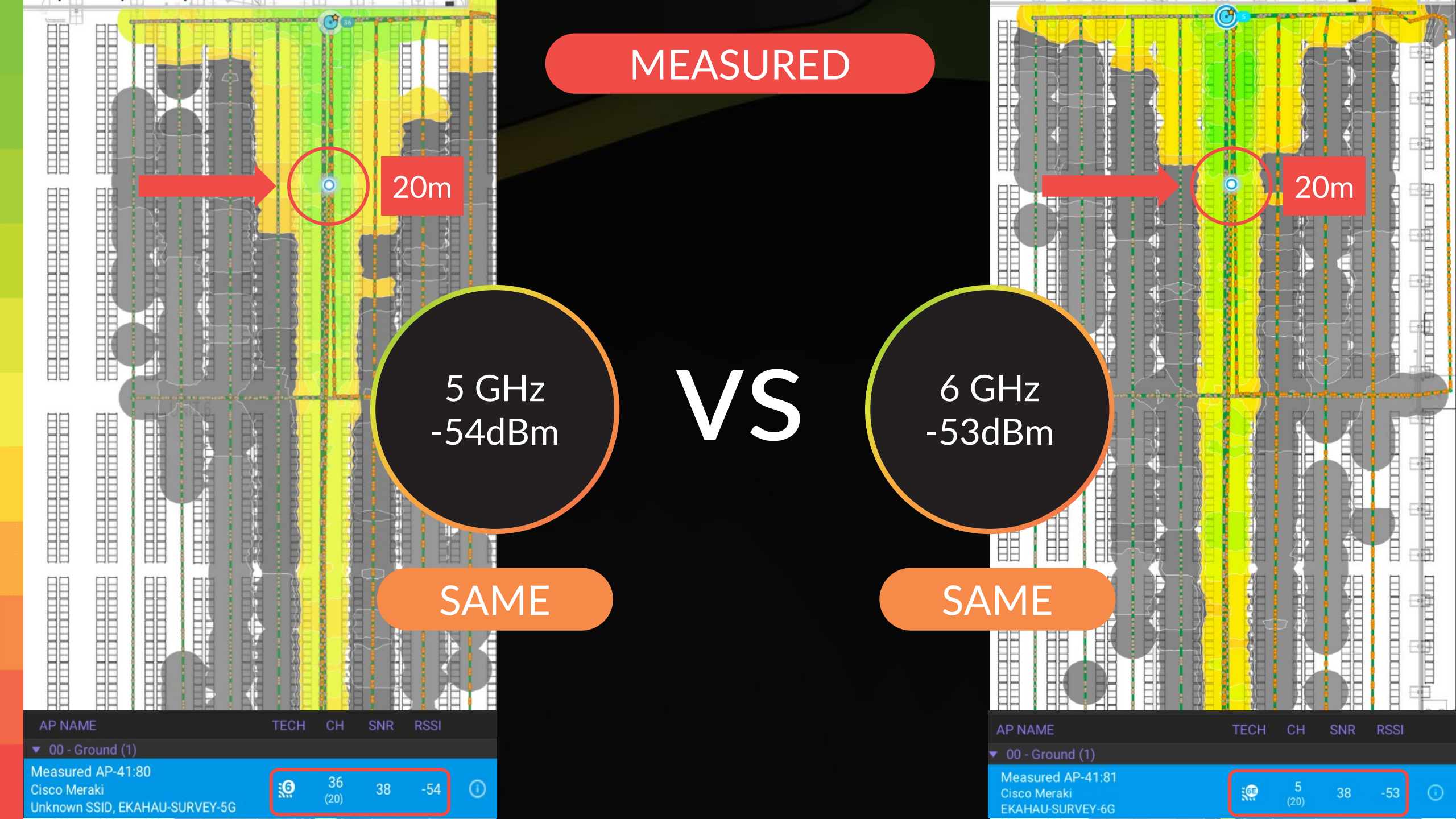
SIMULATED

5 GHz
-54dBm

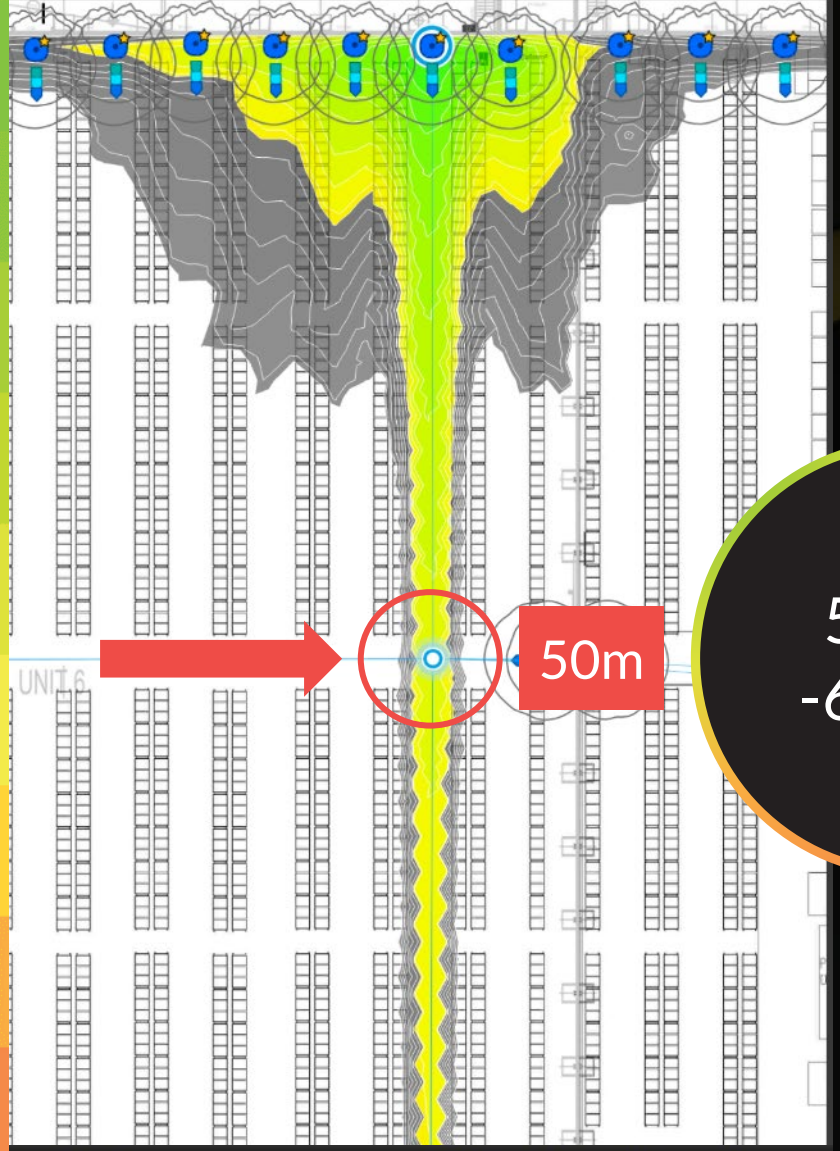
VS

6 GHz
-53dBm




MEASURED
20m
5 GHz
-54dBm
VS
6 GHz
-53dBm
20m
SAME
SAME
AP NAME TECH CH SNR RSSI
00 - Ground (1)
Measured AP-41:80
Cisco Meraki
Unknown SSID, EKAHAU-SURVEY-5G
36
(20)
38
-54
AP NAME TECH CH SNR RSSI
00 - Ground (1)
Measured AP-41:81
Cisco Meraki
EKAHAU-SURVEY-6G
5
(20)
38
-53

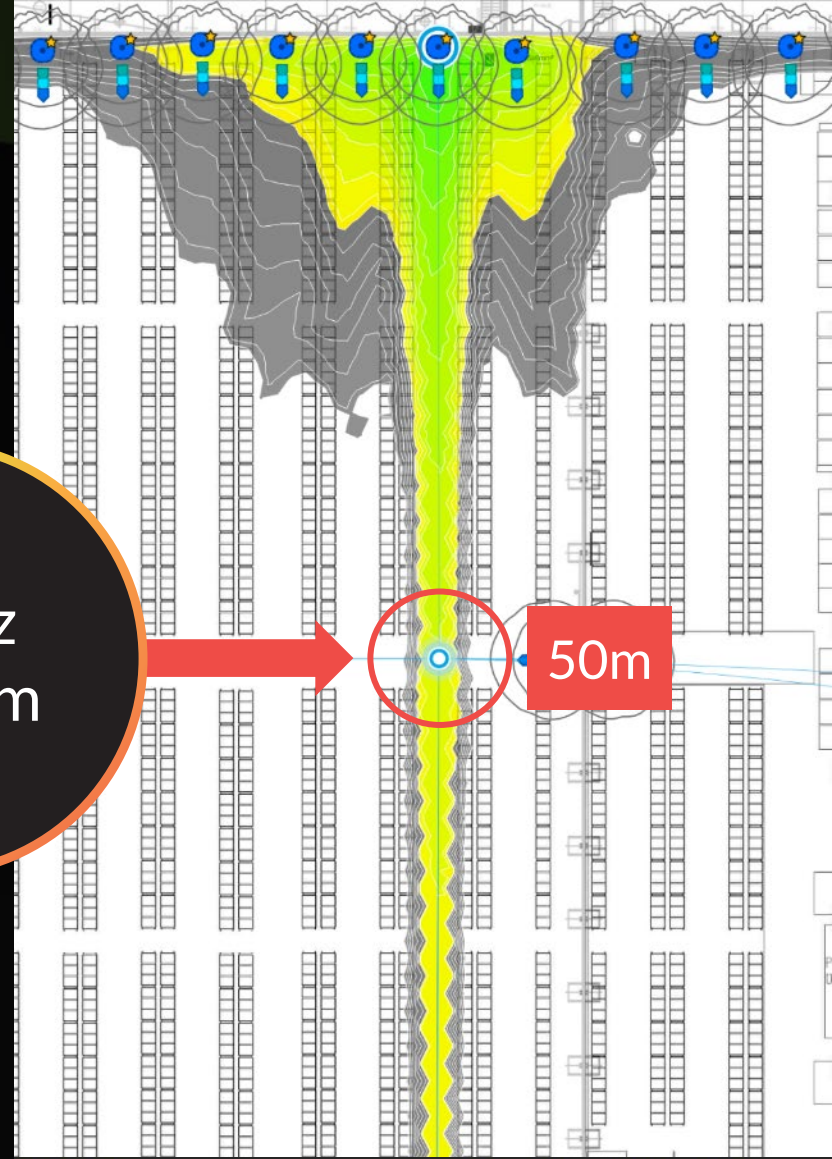
SIMULATED



5 GHz
-62dBm

VS

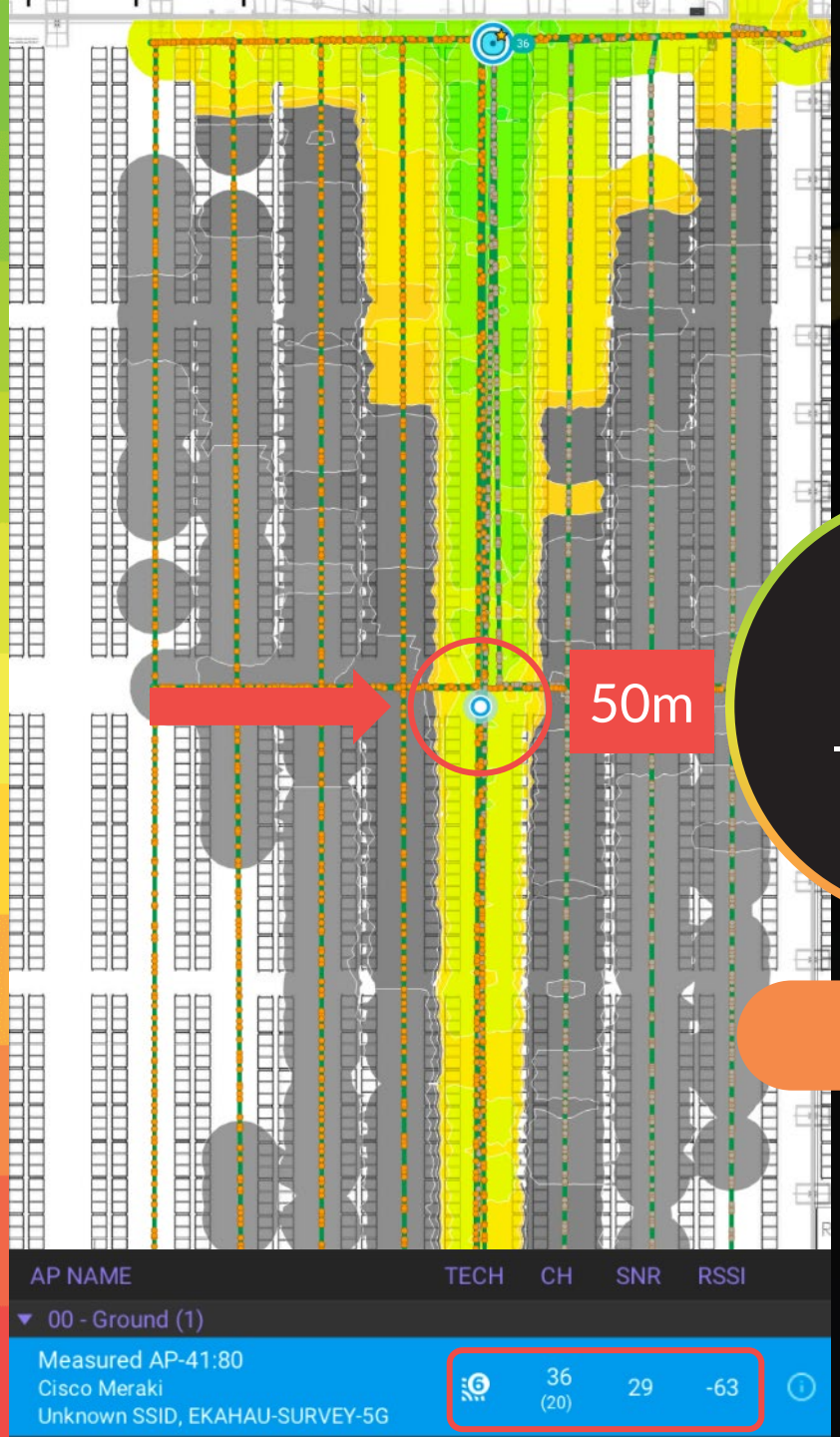
6 GHz
-61dBm



AP NAME	TECH	CH	SNR	RSSI
00 - Ground (9)				
DE04APW-W1U6-P15 Cisco Meraki Catalyst 9166D1	6	100 (20)	46	-49
DE04APW-W1U6-P12 Cisco Meraki Catalyst 9166D1	6	36 (20)	33	-62

AP NAME	TECH	CH	SNR	RSSI
00 - Ground (9)				
DE04APW-W1U6-P15 Cisco Meraki Catalyst 9166D1	6E	25 (20)	48	-47
DE04APW-W1U6-P12 Cisco Meraki Catalyst 9166D1	6E	5 (20)	34	-61

MEASURED



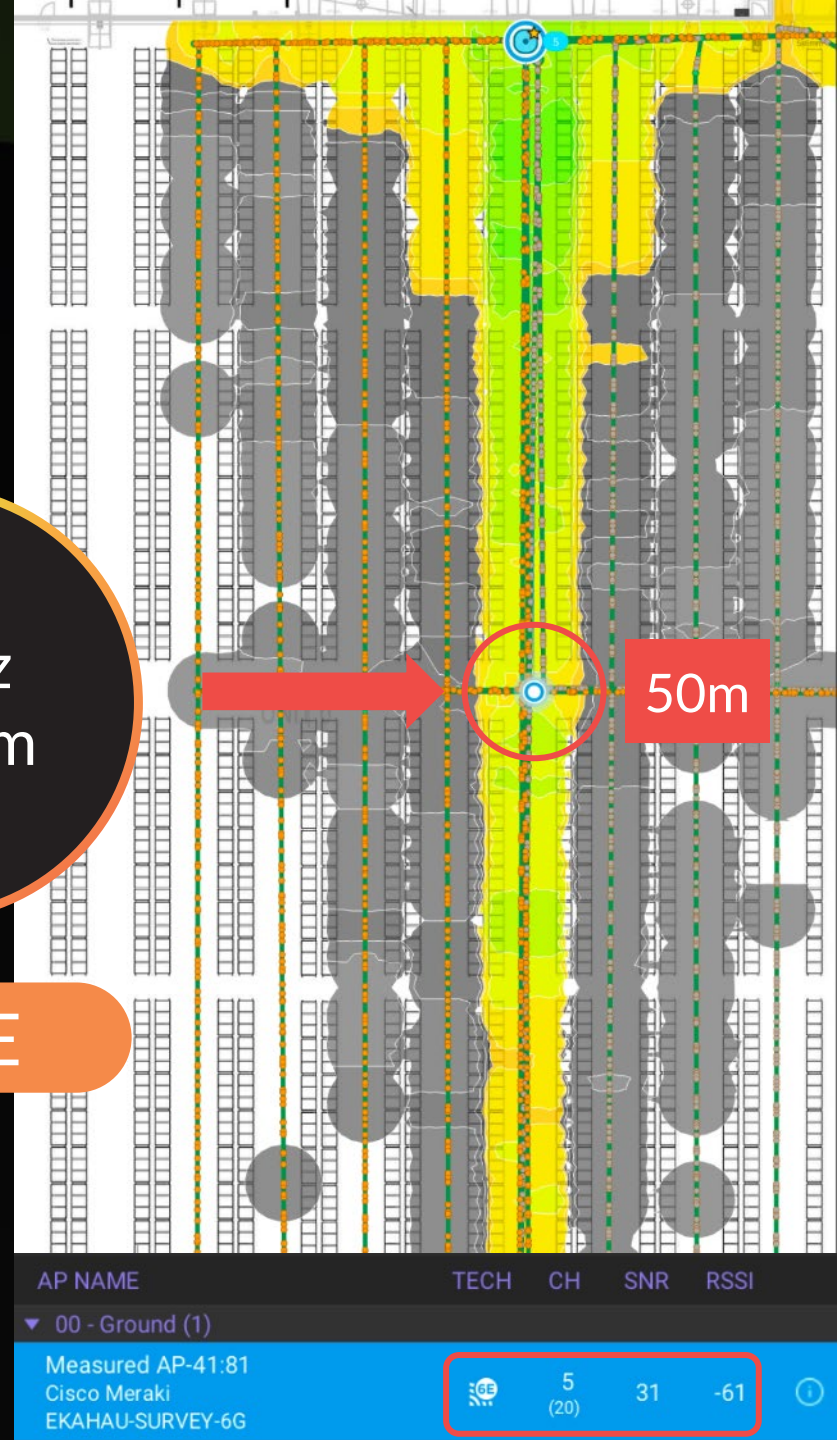
5 GHz
-63dBm

VS

6 GHz
-61dBm

+1dB

SAME

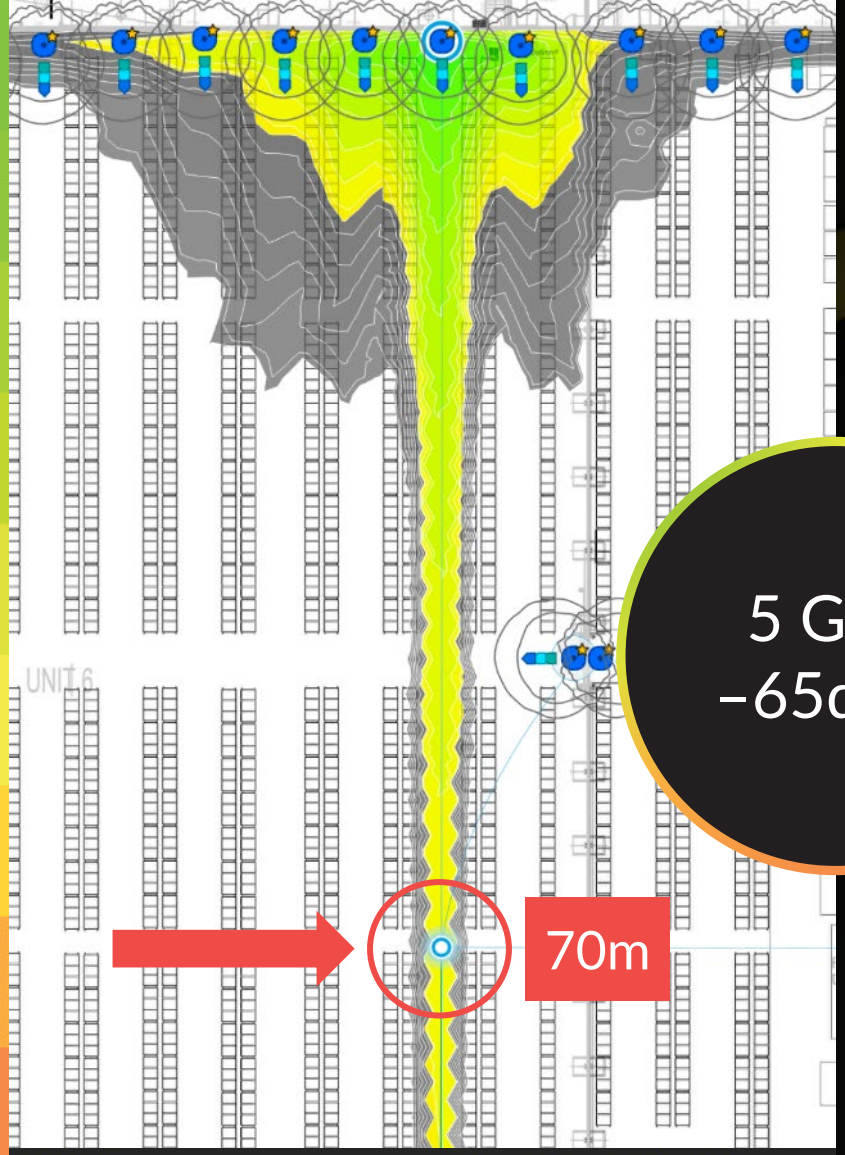


SIMULATED

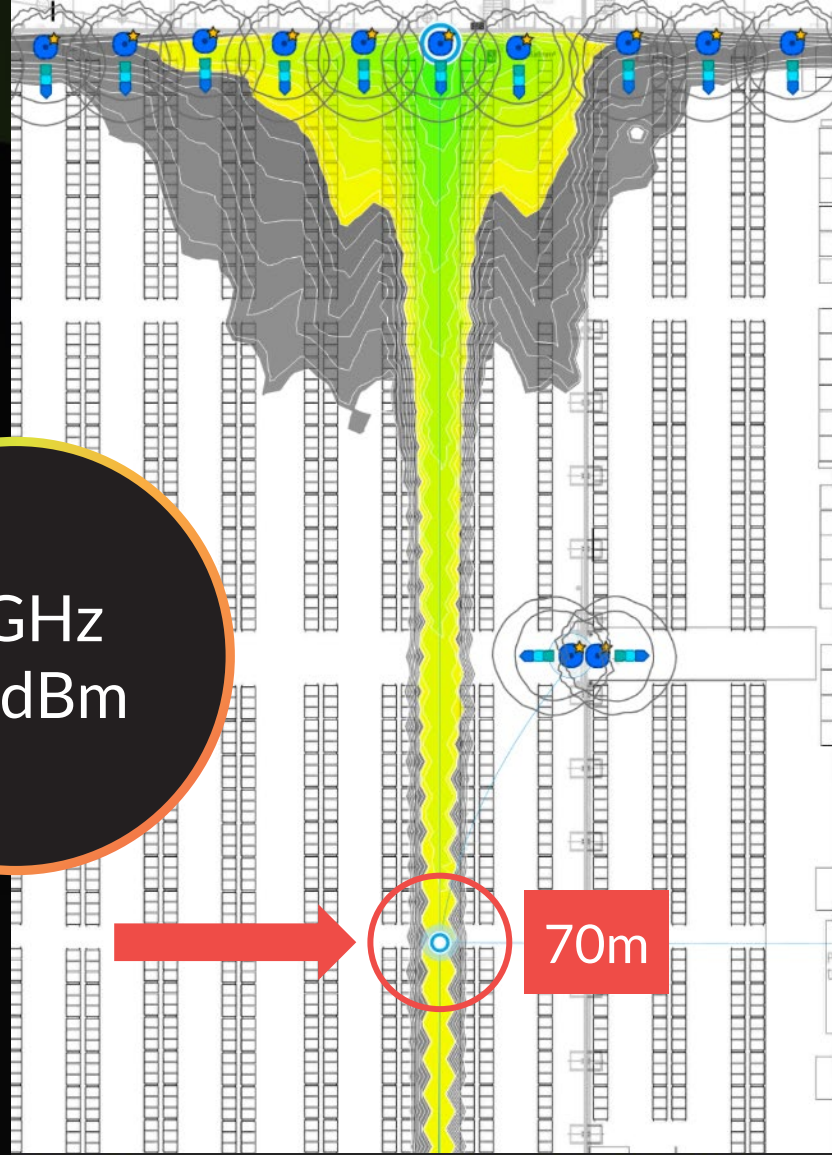
5 GHz
–65dBm

VS

6 GHz
-64dBm

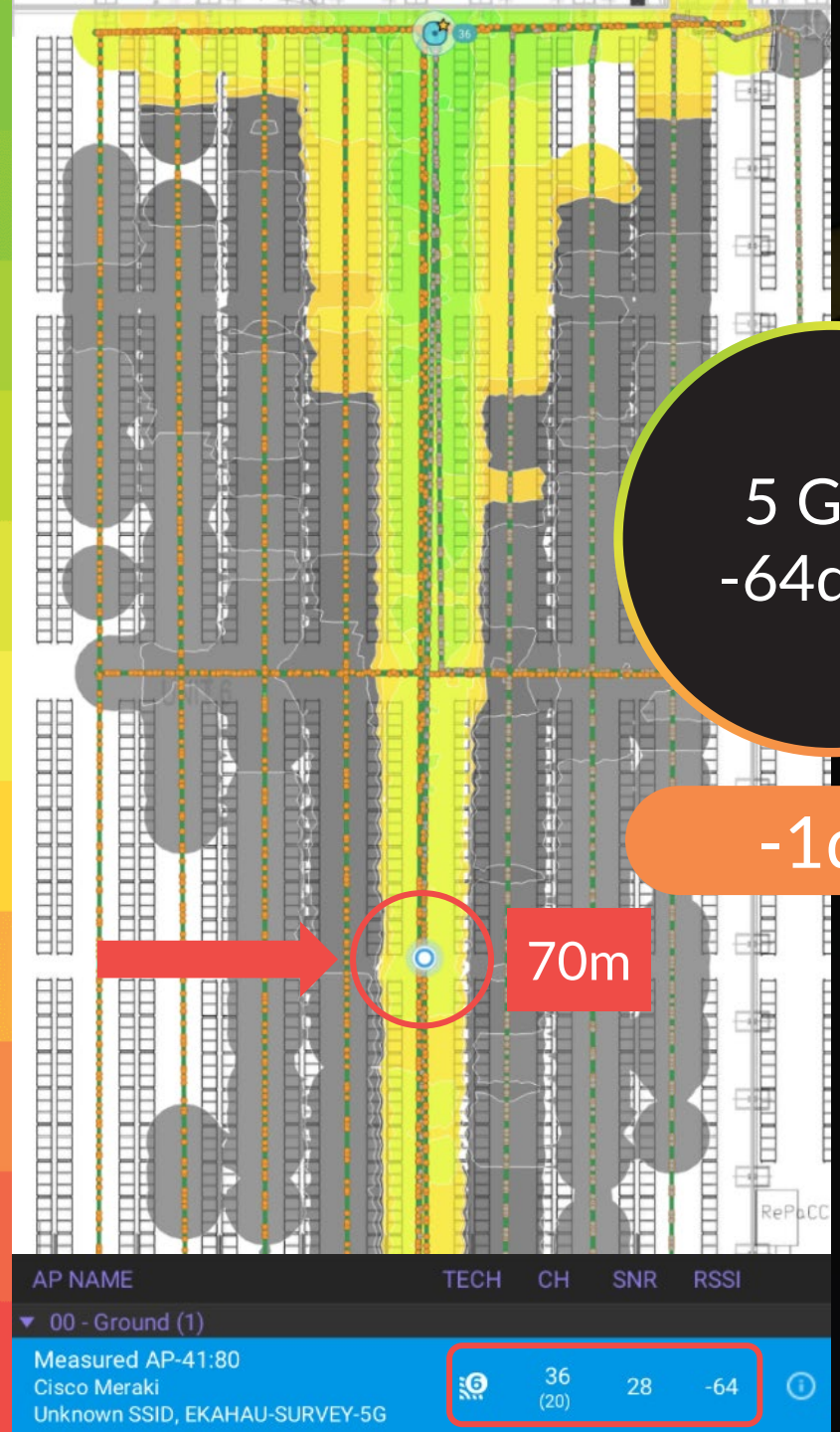


AP NAME	TECH	CH	SNR	RSSI
00 - Ground (6)				
DE04APW-W1U6-P27 Cisco Meraki Catalyst 9166D1	6	112 (20)	36	-59
DE04APW-W1U6-P12 Cisco Meraki Catalyst 9166D1	6	36 (20)	30	-65



AP NAME	TECH	CH	SNR	RSSI
00 - Ground (5)				
DE04APW-W1U6-P27 Cisco Meraki Catalyst 9166D1	6E	73 (20)	38	-57
DE04APW-W1U6-P12 Cisco Meraki Catalyst 9166D1	6E	5 (20)	31	-64

MEASURED

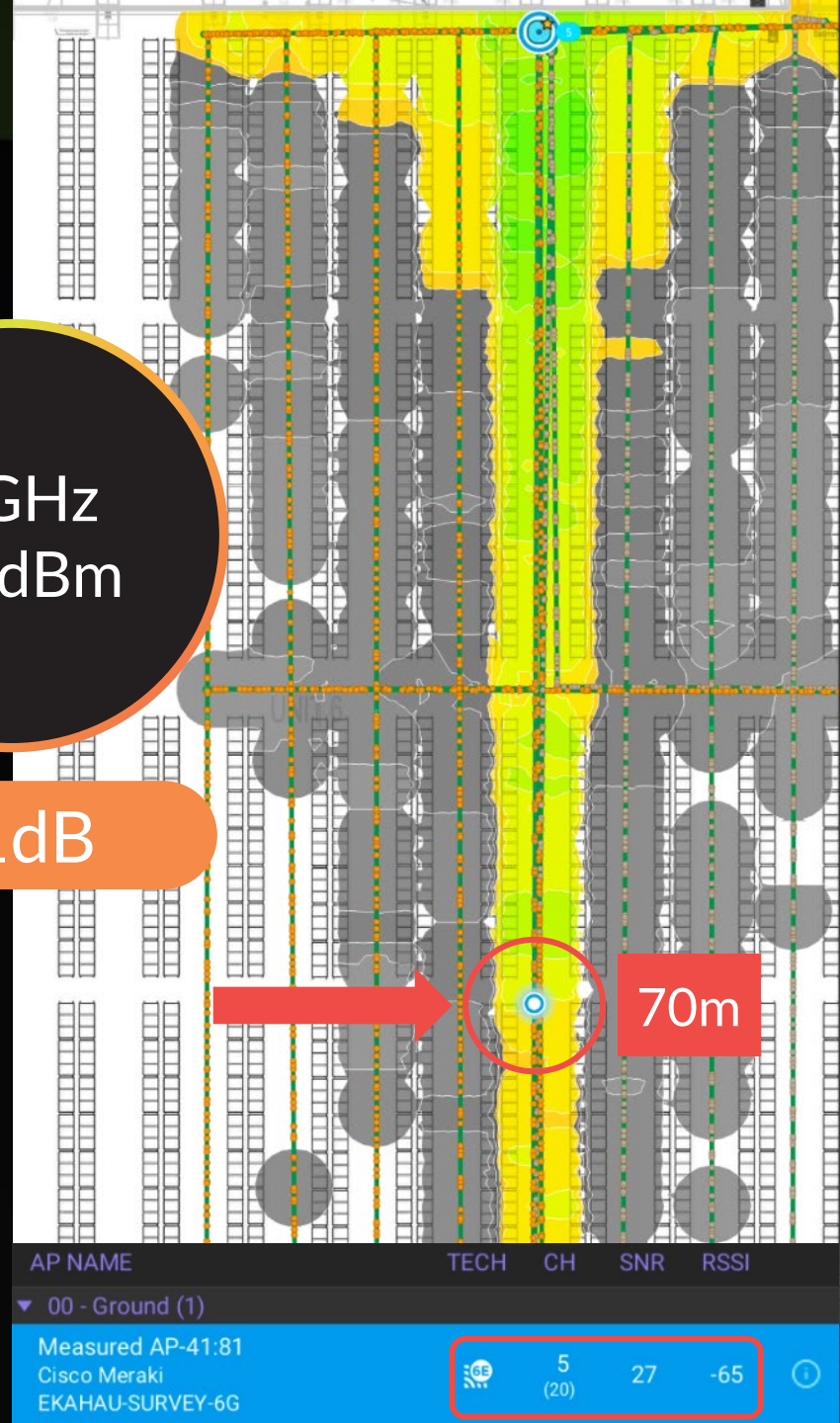


5 GHz
-64dBm

-1dB

70m

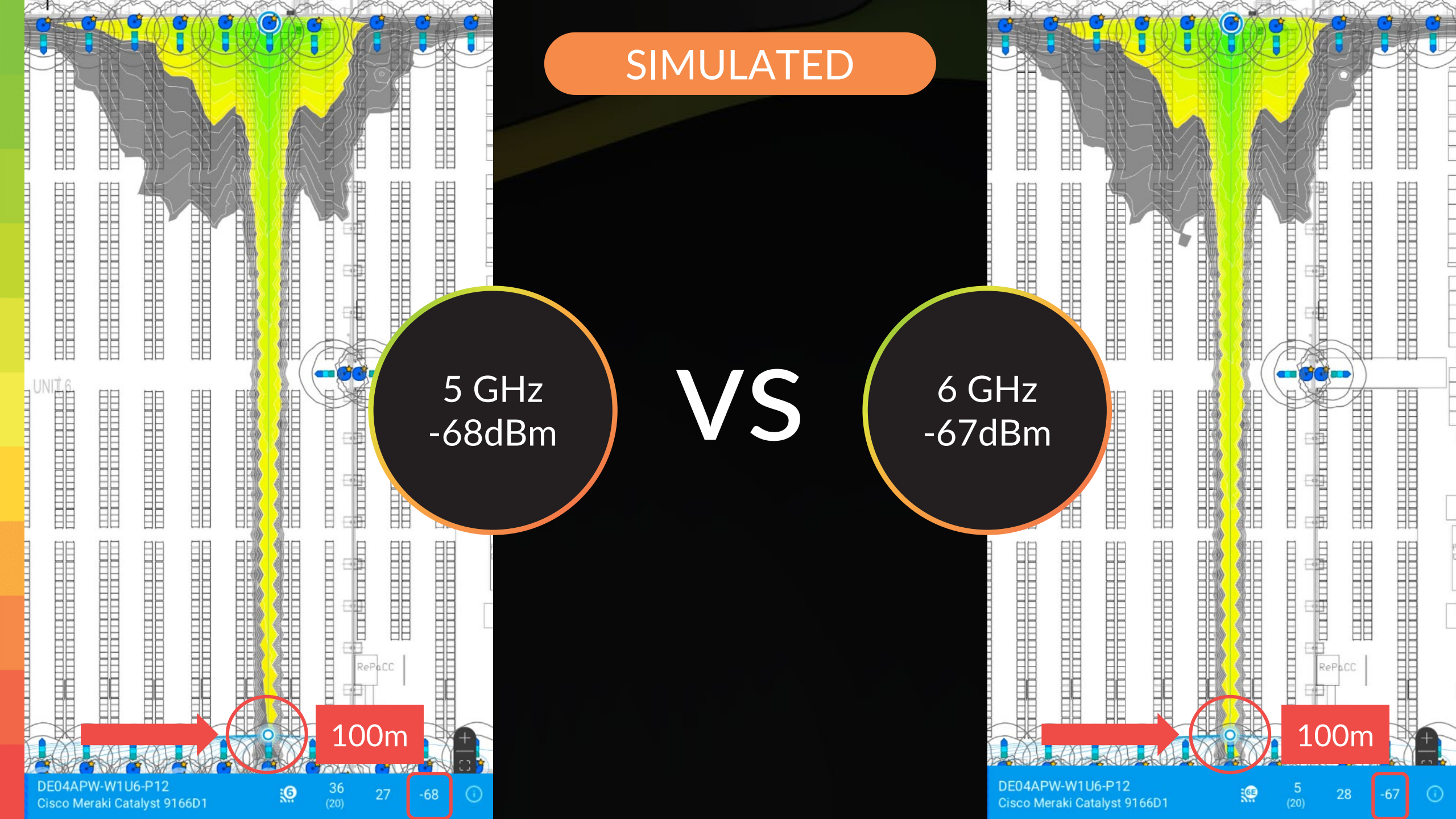
VS

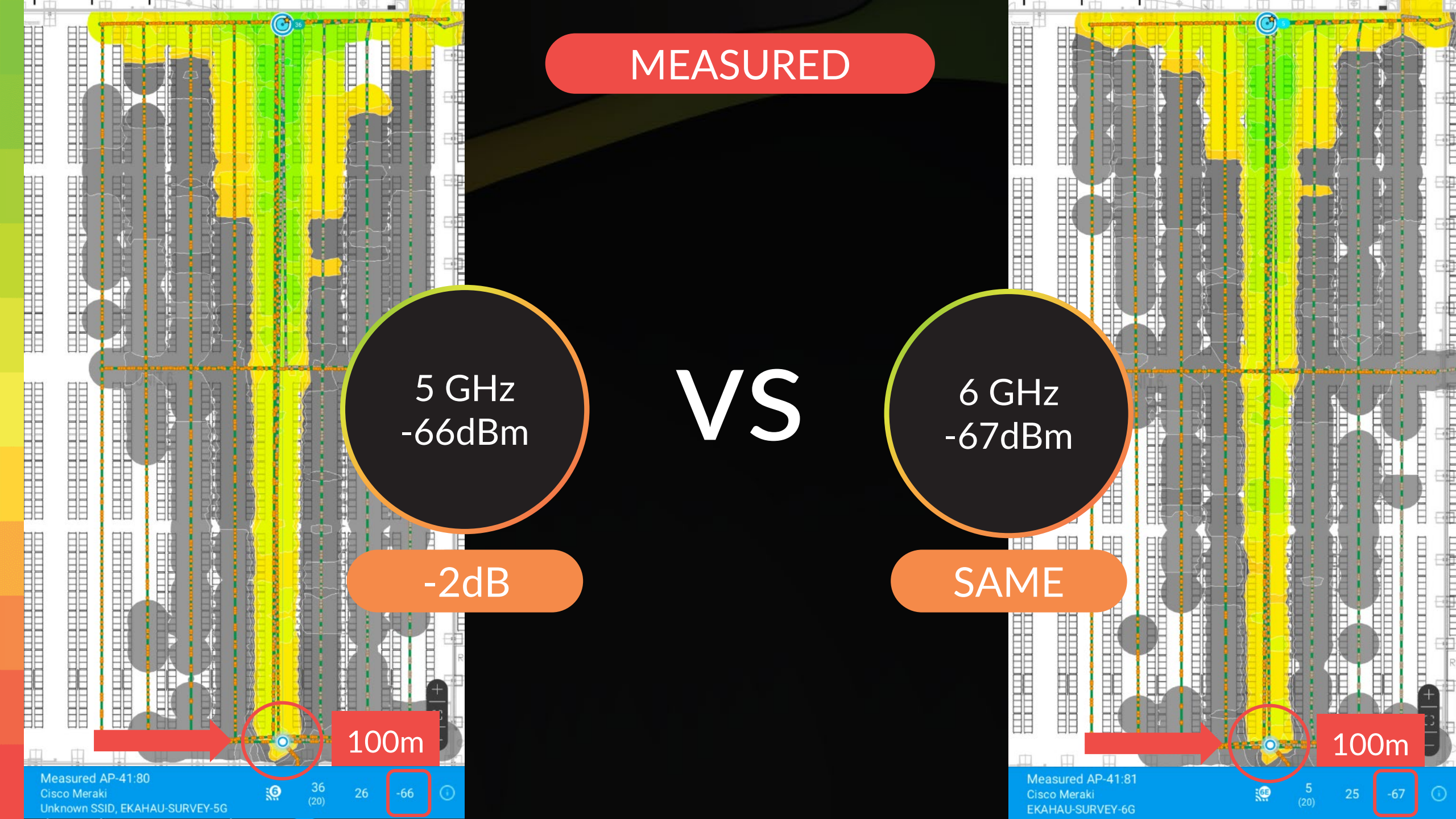


6 GHz
-65dBm

+1dB

70m


SIMULATED
5 GHz
-68dBm
VS
6 GHz
-67dBm
100m
DE04APW-W1U6-P12
Cisco Meraki Catalyst 9166D1
36
(20)
27
-68
100m
DE04APW-W1U6-P12
Cisco Meraki Catalyst 9166D1
5
(20)
28
-67


MEASURED
5 GHz
-66dBm
VS
6 GHz
-67dBm
-2dB
SAME
100m
100m
Measured AP-41:80
Cisco Meraki
Unknown SSID, EKAHAU-SURVEY-5G
36
(20)
26
-66
Measured AP-41:81
Cisco Meraki
EKAHAU-SURVEY-6G
5
(20)
25
-67

5GHz Vs 6GHz Conclusion

Simulation Matched Measured

SK2 designed to be close to FSPL

No Need for an SK2?

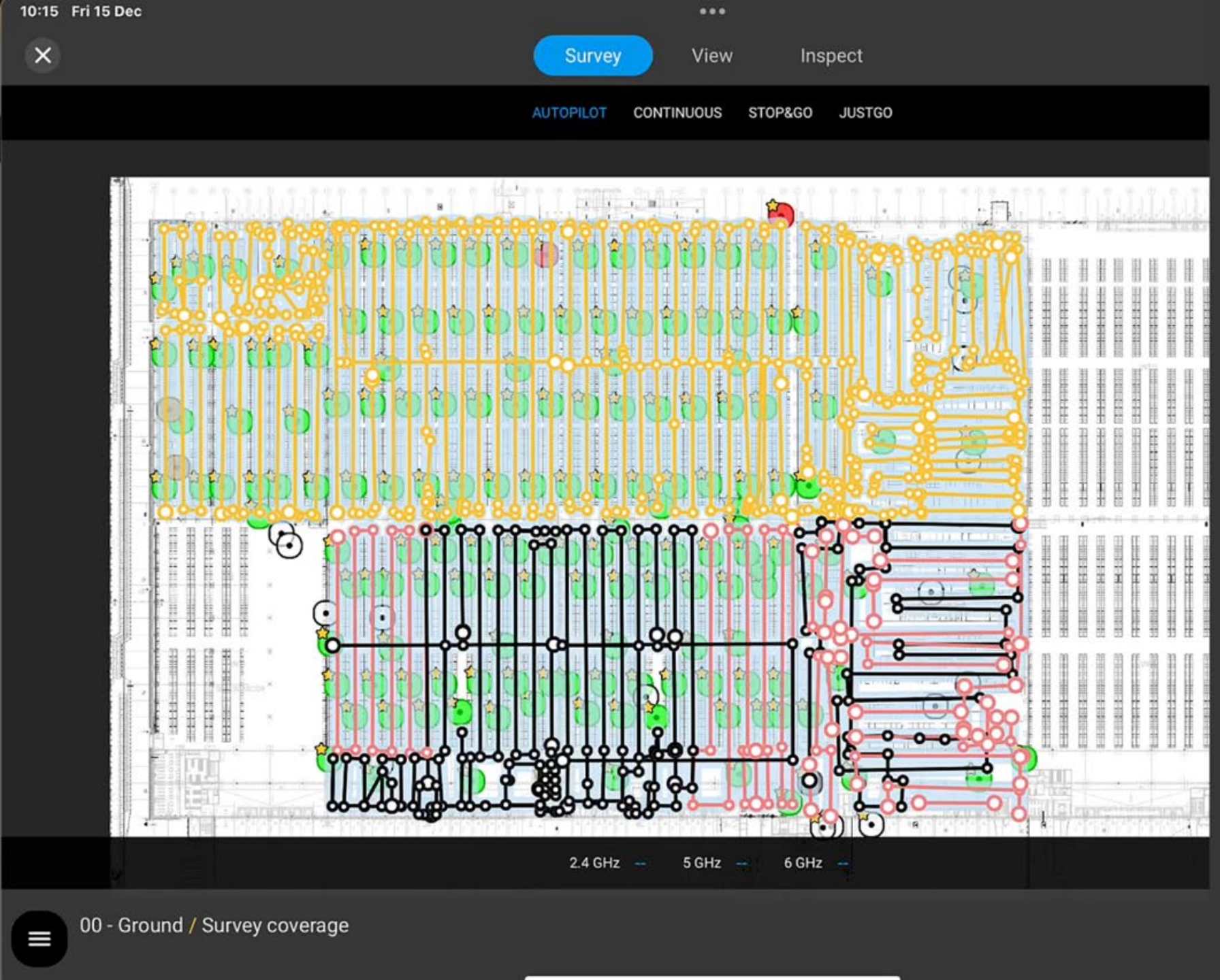
Of course you do :)

Do I Need to do a New Design for 6GHz?

Of course you do :)

**All based on our testing, our configuration, specific AP with different antenna patterns and environment*

ekahau



Different survey path color = different person completing the survey

Ekahau Measure and Measure Plus

NEW Survey-Only Licenses for Simplified Wi-Fi Data Collection

NEW

SUBSCRIPTION

Ekahau Measure

$1,295 USD/yr

Annual subscription per user

What's included

Ekahau Survey Mobile App (iOS/Android)
New Just Go Survey Mode
Cloud Project Sync with Guest Sharing
Software & Firmware Updates
Global Customer Support

Ekahau Sidekick or Sidekick 2 Required

NEW

SUBSCRIPTION + HARDWARE

Ekahau Measure Plus

$4,995 USD

Includes FREE 1-year subscription

What's included

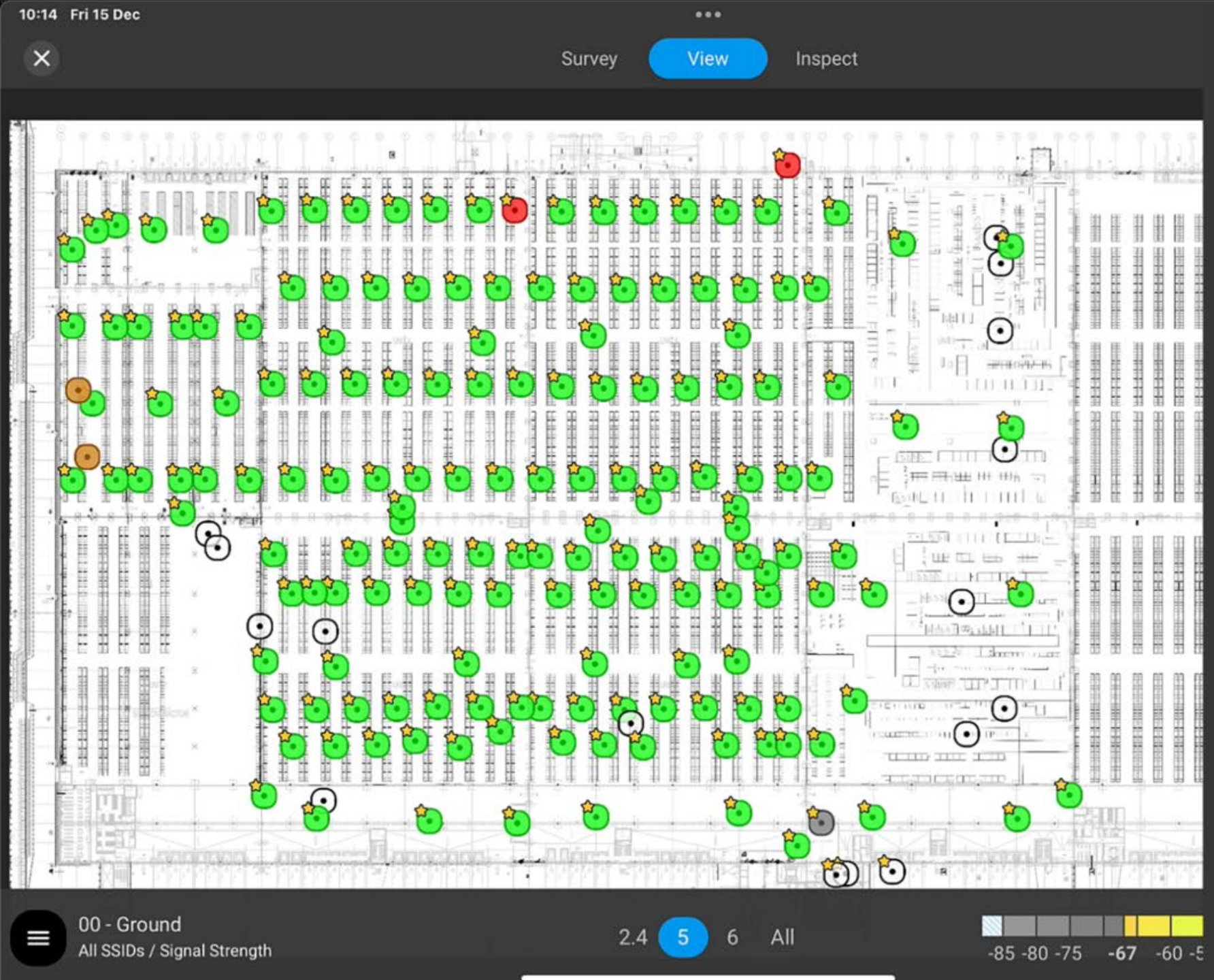
Ekahau Survey Mobile App (iOS/Android)
New Just Go Survey Mode
Cloud Project Sync with Guest Sharing
Software & Firmware Updates
Global Customer Support
PLUS Ekahau Sidekick 2 Measurement Device

Ekahau Measure License Renewal $1,295 USD/yr

Delegate Data Collection

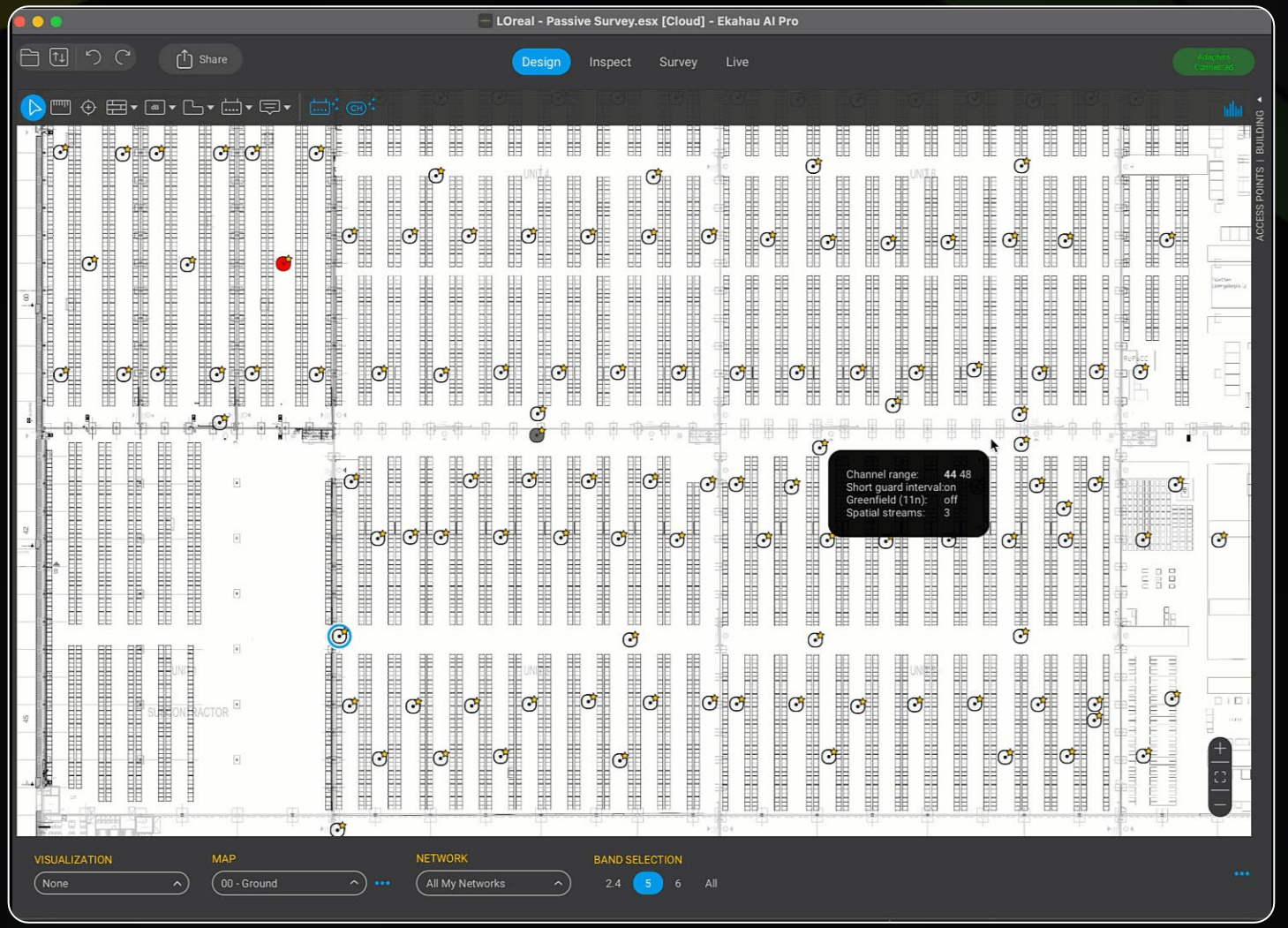
Reduce Travel and Time-to-Resolution

Divide and Conquer Large Surveys



Currently Deployed Access Point Locations

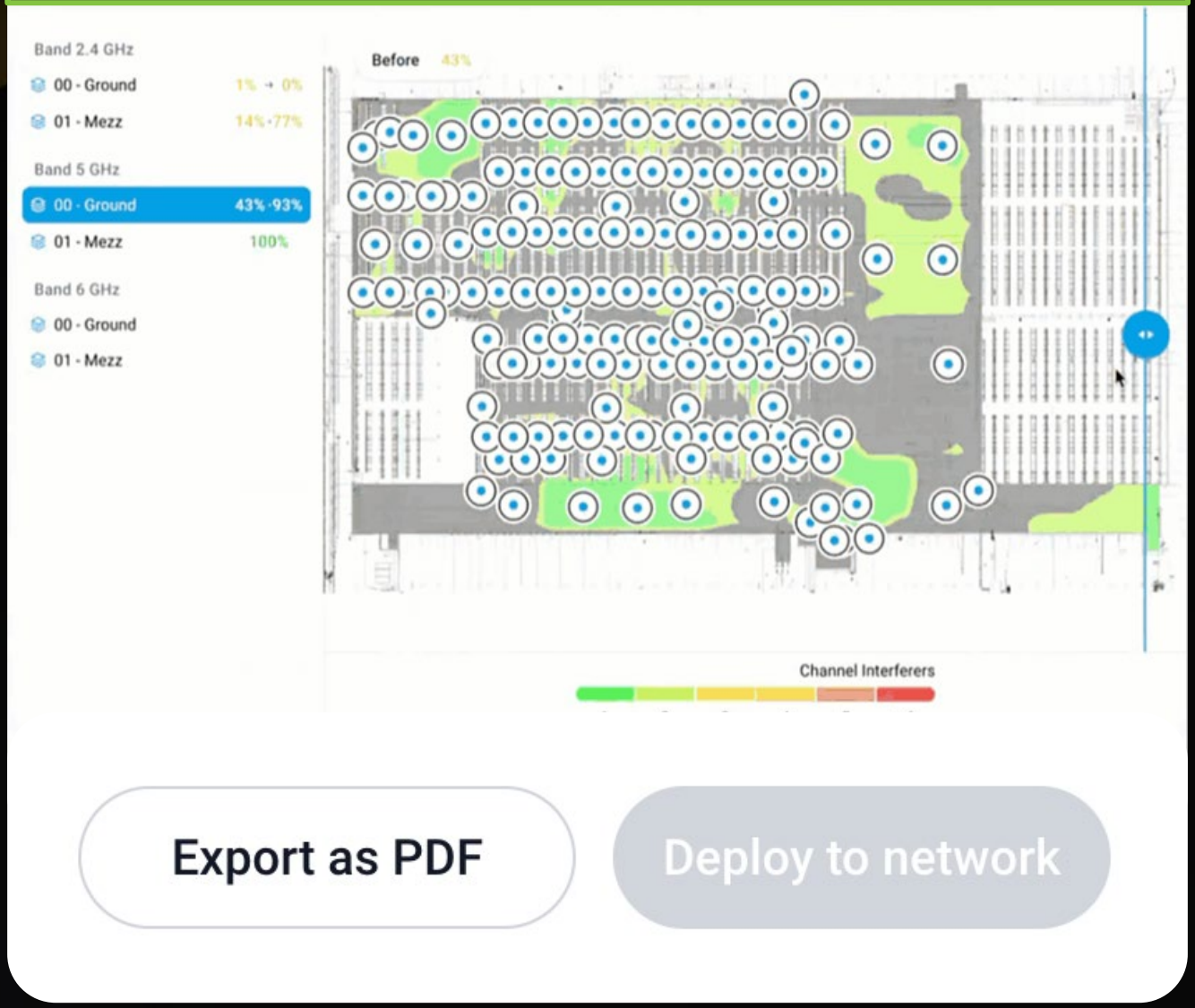
AP Note Images - Existing APs



Proprietary & Confidential

ekahau
WIRELESS DESIGN

Ekahau Optimizer



Proprietary & Confidential

ekahau
WIRELESS DESIGN

SURVEY 1

Pre Design

Capture accurate survey data

Understand attenuation

Discover interferers

SURVEY 2

Pre Design

Move APs to their real location

Reuse data points

Export existing APs to Dash

DESIGN *draft*

Predictive Design

Use surveys to design new Wi-Fi

Get it almost right the first time

SURVEY 3

Pre Deployment

Validate predictive design with APoS

1:1 match between APoS and predictive design

Grab pictures of proposed new APs location

DESIGN *final version*

Predictive Design

Make the design perfect

Model should match reality

OPTIMIZE

Fix Existing Wi-Fi

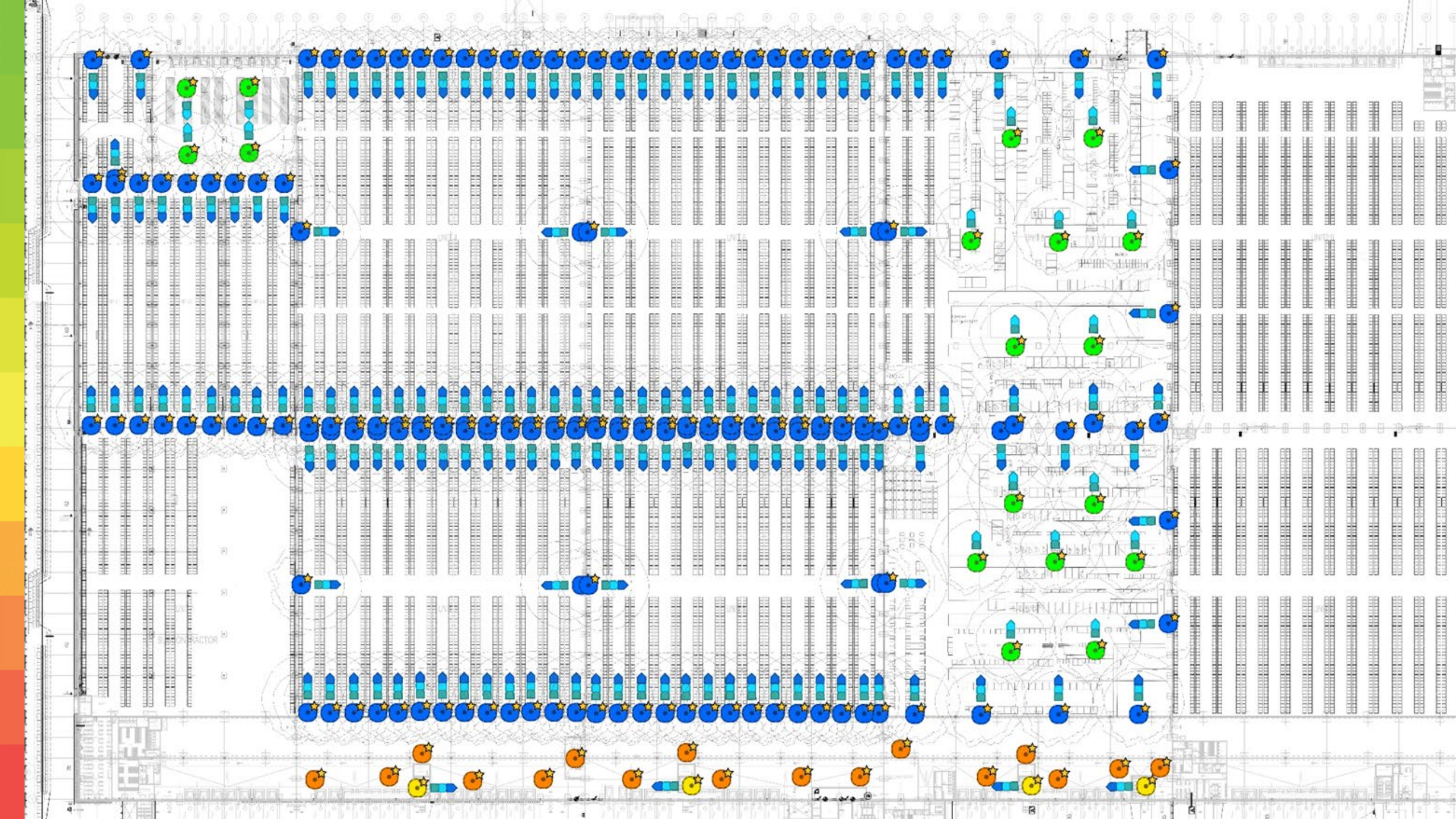
Use survey data

Run it through the Optimizer

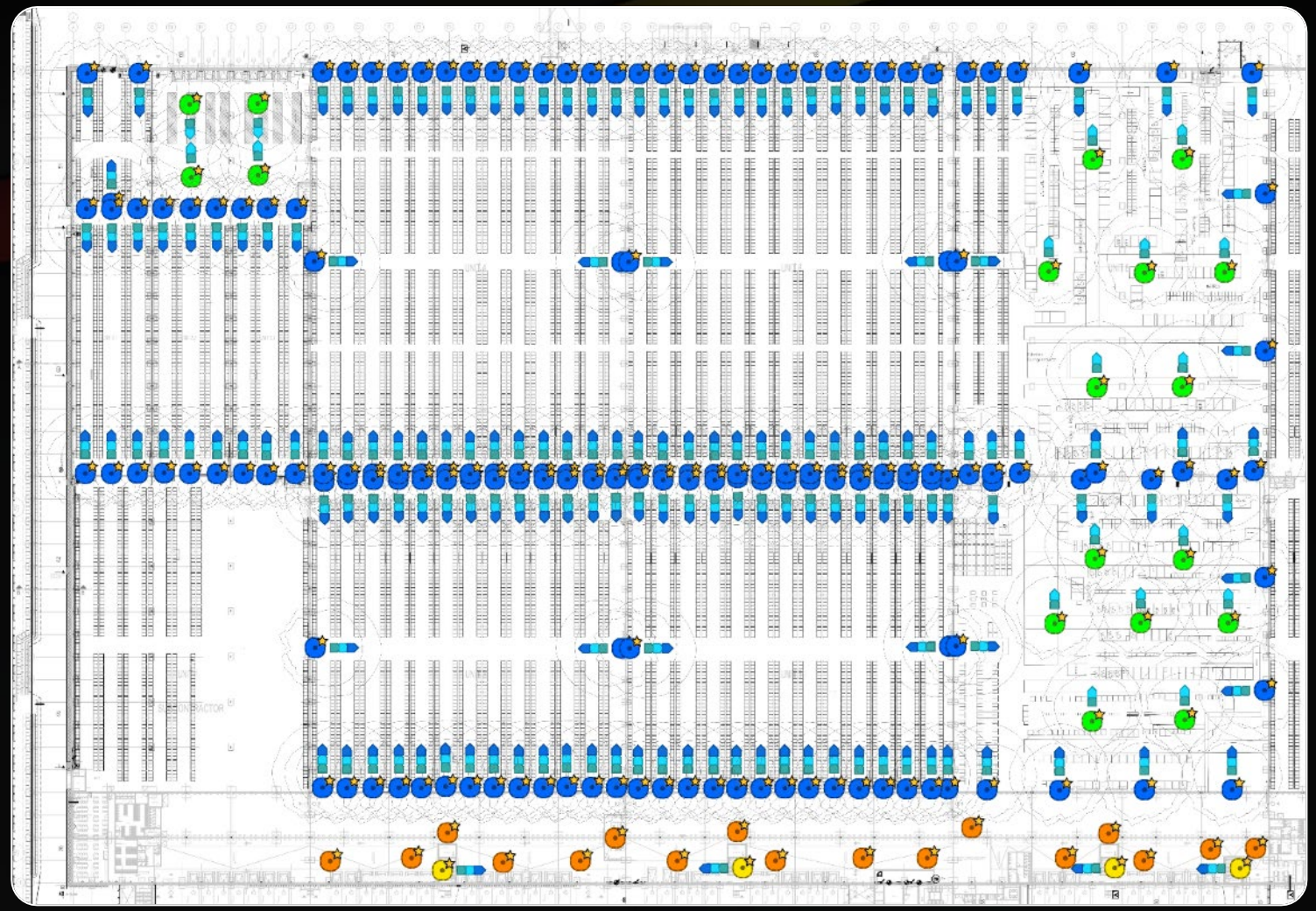
Reconfigure manually or automatically

DESIGN NEW WI-FI

OPTIMIZE EXISTING WI-FI



Our Final Design Numbers



Total APs: 211

- Cisco Meraki CW 9166D1s: 190
- Cisco Meraki CW 9164i: 17
- Cisco Meraki CW 9162i: 4

Proprietary & Confidential

ekahau
WIRELESS DESIGN

7 Tips - Warehouse Wi-Fi Configuration

1

TX POWER RANGE

11-17 dBm

Configured statically

Match LCMI transmit capabilities

2

DATA RATES

24 Mbps

Disable all lower, support all higher

Minimise management overhead

3

CHANNEL WIDTHS

20 MHz

Across both 5 & 6 GHz bands

Minimise contention; 2.4 GHz not used

4

CHANNEL PLAN

Static

Facility has no neighbors Wi-Fi

Exported optimal channel plan from Ekahau AI Pro

5

SSIDs CONFIG

Single band plan

Different SSIDs names per band

Ensure single band roaming for all devices

6

WI-FI SECURITY

.1X, PSK & SAE

Ensure strong encryption

5&6GHz Corp: .1X
5GHz scanners: PSK
6GHz scanners: SAE

7

ROAMING CONFIG

802.11k & r

Ensure fast roaming

802.11k for all SSIDs; 802.11r for .1X SSIDs

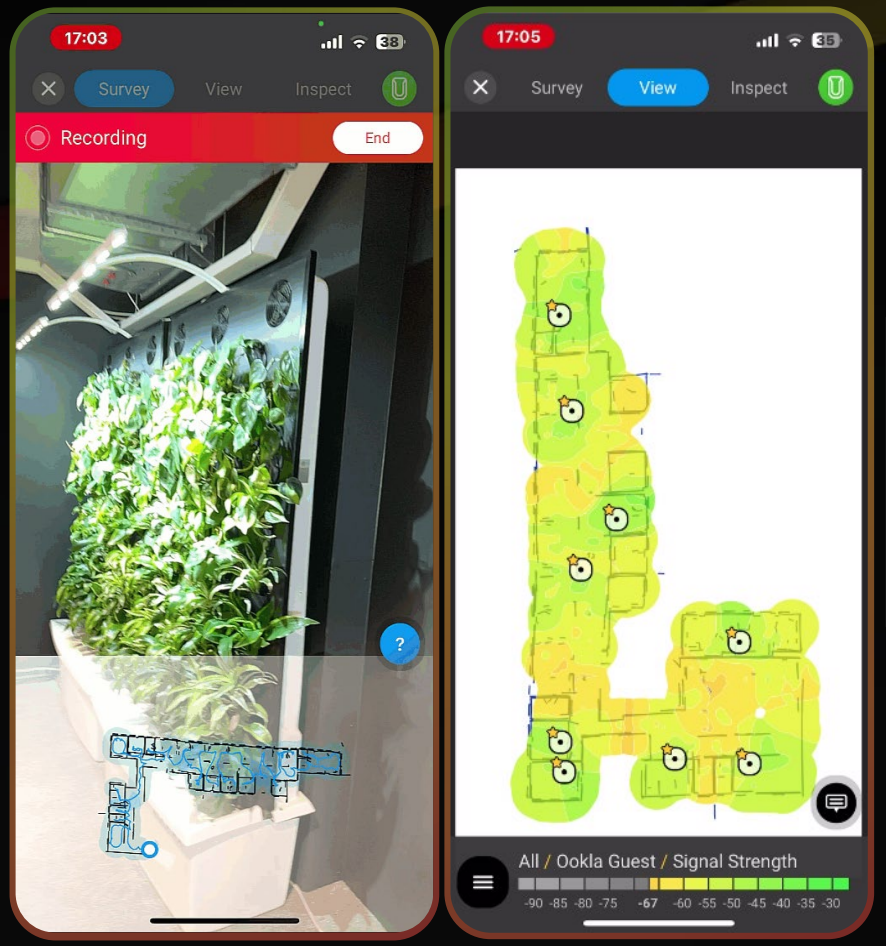
Proprietary & Confidential

ekahau
WIRELESS DESIGN

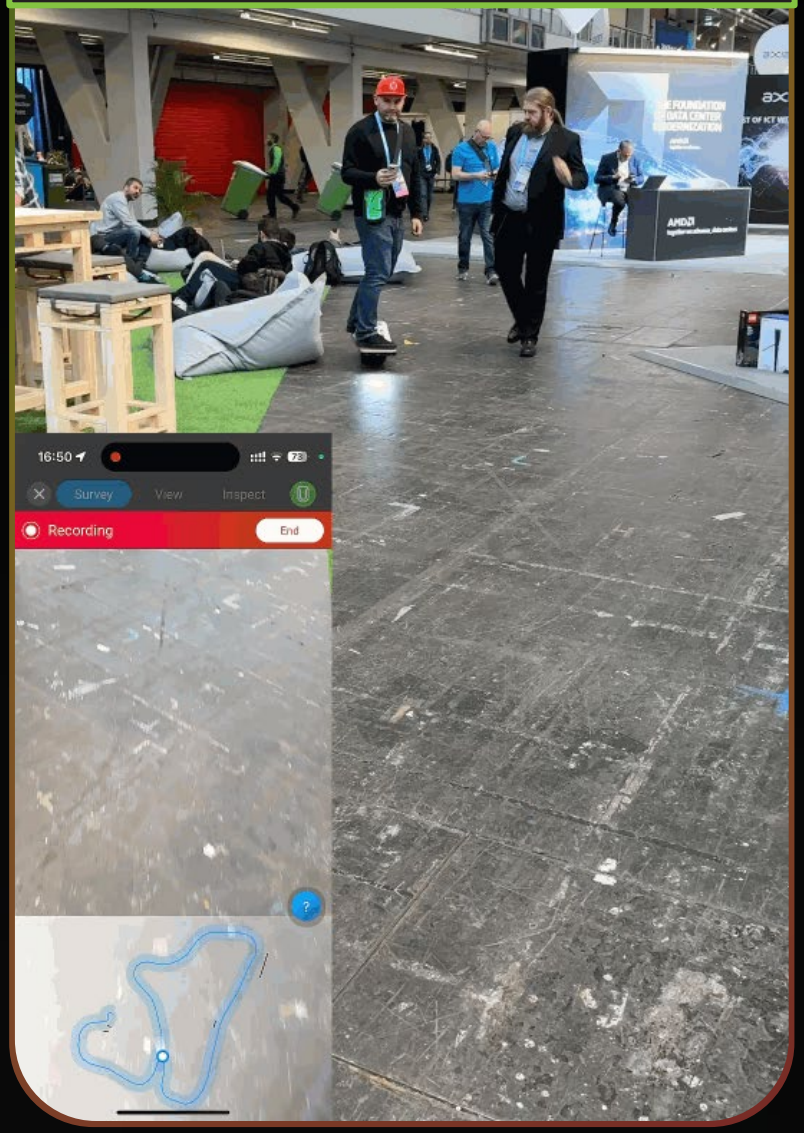
If you thought Autopilot Surveys were cool…

ekahau
WIRELESS DESIGN

Just Go

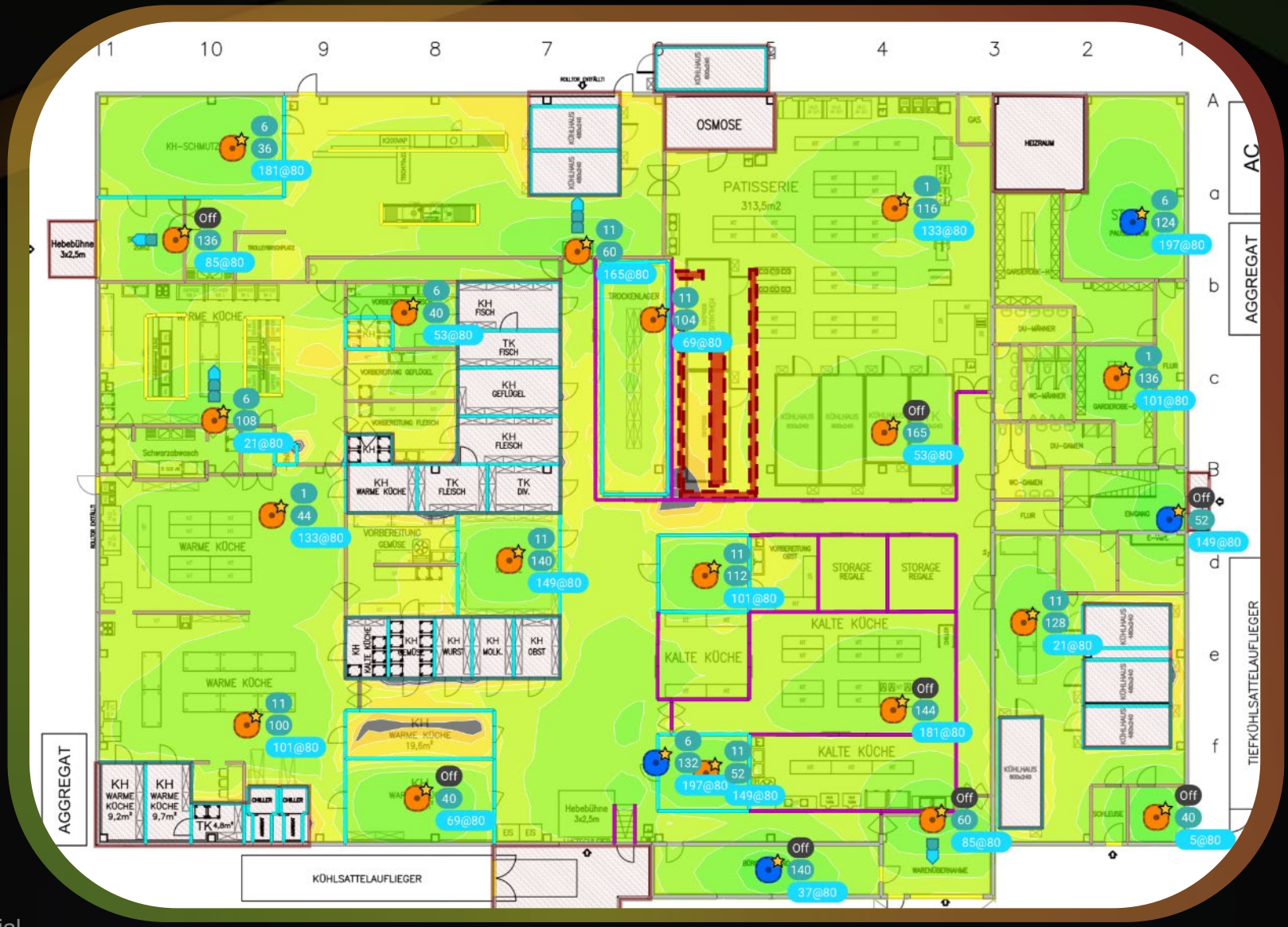


One Wheel Survey



ekahau
WIRELESS DESIGN

Factory Wi-Fi Design



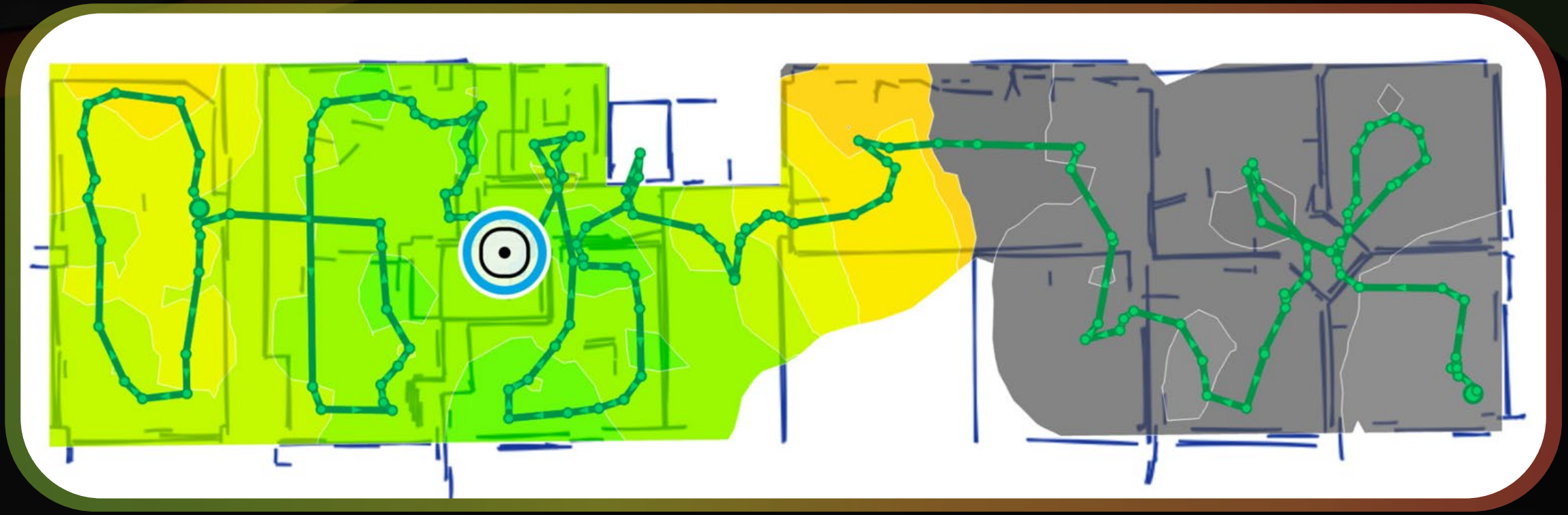
Proprietary & Confidential

ekahau
WIRELESS DESIGN

No First Floor Plan Available….

ekahau
WIRELESS DESIGN

No First Floor Plan Available, No Problem!



Proprietary & Confidential

ekahau
WIRELESS DESIGN

ekahau
WIRELESS DESIGN

The End Result

ekahau
WIRELESS DESIGN

Wi-Fi Design Day Secrets

Don’t tell anyone

Proprietary & Confidential

ekahau
WIRELESS DESIGN

Just Design

Just Go for a Survey

No Drawing Walls

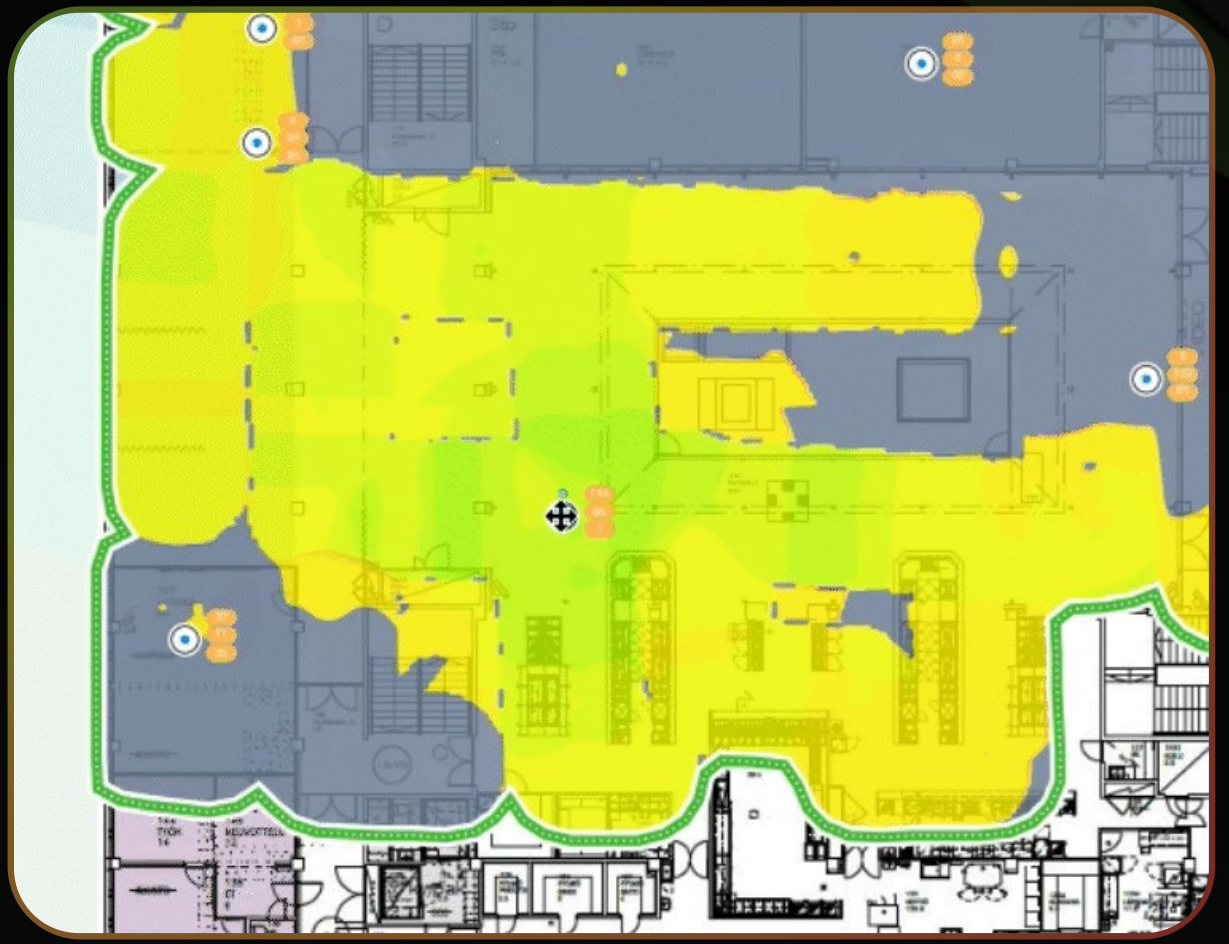
Adjust Tx, Channels

Relocate | Add new APs

Manually | Automatic

Measured Survey Data used to update heatmaps

🤯 🛜 😎



Proprietary & Confidential

ekahau
WIRELESS DESIGN

Mikko

Mike

Proprietary & Confidential

ekahau
WIRELESS DESIGN

If you thought Just Go Surveys were cool…

ekahau
WIRELESS DESIGN

AR Survey ⏳

Proprietary & Confidential

ekahau
WIRELESS DESIGN

THANKS!

XXXXX

ekahau
WIRELESS DESIGN

SURVEY 1	SURVEY 2	DESIGN *draft*	SURVEY 3	DESIGN *final version*	SURVEY 4	OPTIMIZE
Pre Design	**Pre Design**	**Predictive Design**	**Pre Deployment**	**Predictive Design**	**Pre Deployment**	**Fix Existing Wi-Fi**
Capture accurate survey data Understand attenuation Discover interferers	Move APs to their real location Reuse data points Export existing APs to Dash	Use surveys to design new Wi-Fi Get it almost right the first time	Validate predictive design with APoS 1:1 match between APoS and predictive design	Make the design perfect Model should match reality	Grab pictures of proposed new APs location Create installation report	Use survey data Run it through the Optimizer Reconfigure manually or automatically

DESIGN NEW WI-FI

OPTIMIZE EXISTING WI-FI