

Designing User-Centric Wi-Fi Networks

Jussi Kiviniemi



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Jussi Kiviniemi

Wi-Fi Janitor (Products, Marketing, Strategy)

Helsinki, Southern Finland, Finland · [500+ connections](#)

[Contact info](#)

Mist Systems

LUT University

Show recruiters you're open to work — you control who sees this

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About

Track record? Headed Ekahau's Wi-Fi Design Tools from zero to industry standard with tens of thousands of customers, and eventually to what the VC called "their best exit ever". That's not a big deal per se, but the team enjoyed the journey very much: no compromises were made keeping the team happy and motivated... see more

Agenda

1. Business and Technical Requirements
2. Wi-Fi design
3. Deployment / configuration
4. The first live day / week
5. Ensuring the network delivers 24/7
6. The buzzwords: What's hot in Wi-Fi right now

Business and Technical Requirements

Business Requirements

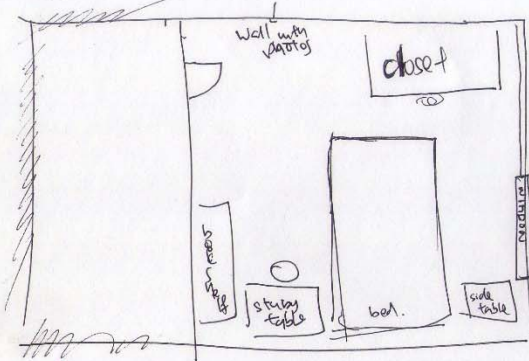
- What does the company do?
- What does this facility do?
- What main groups of people work here?
 - What do they do?
- How does IT support the goals?
 - What role does the network & wireless do?

Technical Requirements

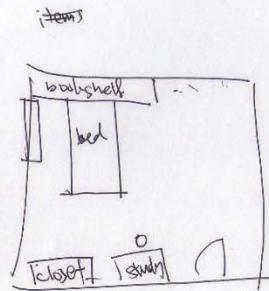
- Floor plans!!
- Areas to be covered
- Number of people using Wi-Fi
 - Applications they use
 - Number of devices per person
 - Types of devices per person
- Same for IoT devices

Spencer

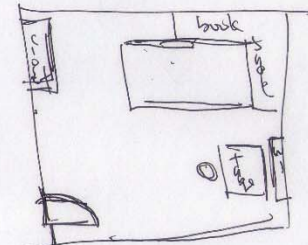
Girl's Room.



1

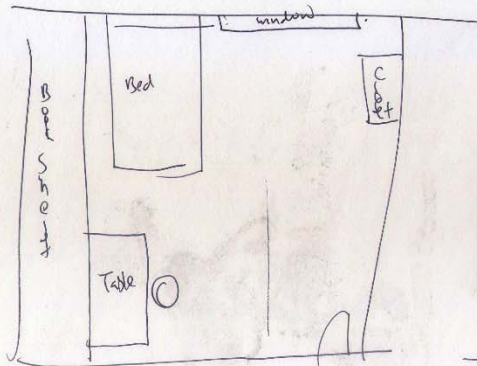


2

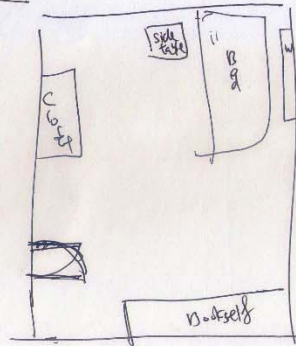


3

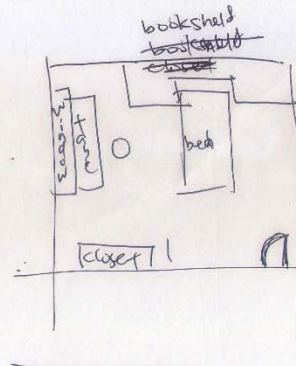
- items needed
- closet
 - bed
 - table
 - bookshelf?
 - camera/photos.
 -



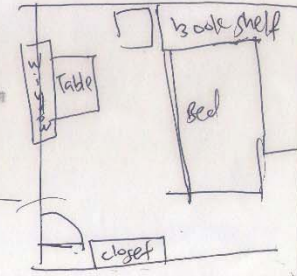
4



5



6



7





Format Picture



Picture Corrections

Sharpen/Soften

Presets



Sharpness



0%

Brightness/Contrast

Presets



Brightness



0%

Contrast



0%

Reset

Picture Colour

Picture Transparency

Crop





Adapters Connected

Access Points | Surveys | Building

Search

Quick Select | Actions

Expand All APs

Planning | Survey

No maps

Signal Strength for My Access Points on 2.4 5 Both

Please add map

Live | Survey | 2.4 | 5 | Duration 5 seconds | Radio Filter Any SSID

The image shows a software interface for network planning. At the top right, a green button indicates 'Adapters Connected'. Below this is a navigation bar with tabs for 'Access Points', 'Surveys', and 'Building'. A search bar is located on the left side of this bar. To its right are 'Quick Select' and 'Actions' buttons. Below the search bar is a blue link that says 'Expand All APs'. The main workspace is divided into two sections. The top section has tabs for 'Planning' and 'Survey'. Below these tabs is a toolbar with various icons for map manipulation. The main area of this section contains a dropdown menu set to 'No maps', a 'Signal Strength' dropdown, and a filter for 'My Access Points' on channels '2.4', '5', and 'Both'. A 'Please add map' button is visible in this section. The bottom section of the interface contains a status bar with 'Live' and 'Survey' modes, channel filters for '2.4' and '5', a 'Duration' of '5 seconds', and a 'Radio Filter' set to 'Any SSID'.

Technical Requirements #2

- Acceptable time to connect to network
- Acceptable roaming time
- Desired throughput per user
- ...

And Then There's Security

- We won't even go to that here...
- More than...
 - Do not use WEP or such
 - WPA2 minimum
 - WPA2/3 enterprise for all capable devices

Location Tracking, Anyone?

- Need to track employees or guests or devices?
- A whole another project
 - Different stakeholders
 - Different requirements
 - Different goals
- Start small. Use a trusted consultant.

Location Tracking Tags

People Visibility



Card Tag
CT18-3



Bracelet Tag
BT19-4

Asset Tracking



Universal Tag
UT19-1



Asset Tag
S18-3

More info on RTLS tags: kontakt.io , HID

Locations > Hospital

Search

Search by entity name, type, location in the last 4m

Entity ↑	Type	Zone
Addison Montgomery	Hospital Employee	Entrance Hall
Alice Wong	Hospital Employee	Visitor Room
Allison Cameron	Hospital Employee	Admin Office
Allison Kepner	Hospital Employee	Entrance Hall
Dr. Andrew Deluca	Hospital Employee	Entrance Hall
Dr. George O'Malley	Hospital Employee	Emergency Room
Dr. Lawrence Kutner	Hospital Employee	Hallway South-West
Dr. Mark Sloan	Hospital Employee	Entrance Hall
Dr. Owen Hunt	Hospital Employee	Hallway South-West
Dr. Robert Gale	Hospital Employee	Hallway South-West
Medical Fridge	Fridge	Emergency Room
Meredith Grey	Hospital Employee	Entrance Hall

Entity types

- Visitor
- Storage
- Patient
- Object
- Hospital Staff
- Hospital Employee
- Hospital Employee

Leaflet | © MapTiler © OpenStreetMap contributors

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Today's Wi-Fi Networks

Pay Attention to Choice of Wi-Fi Architecture

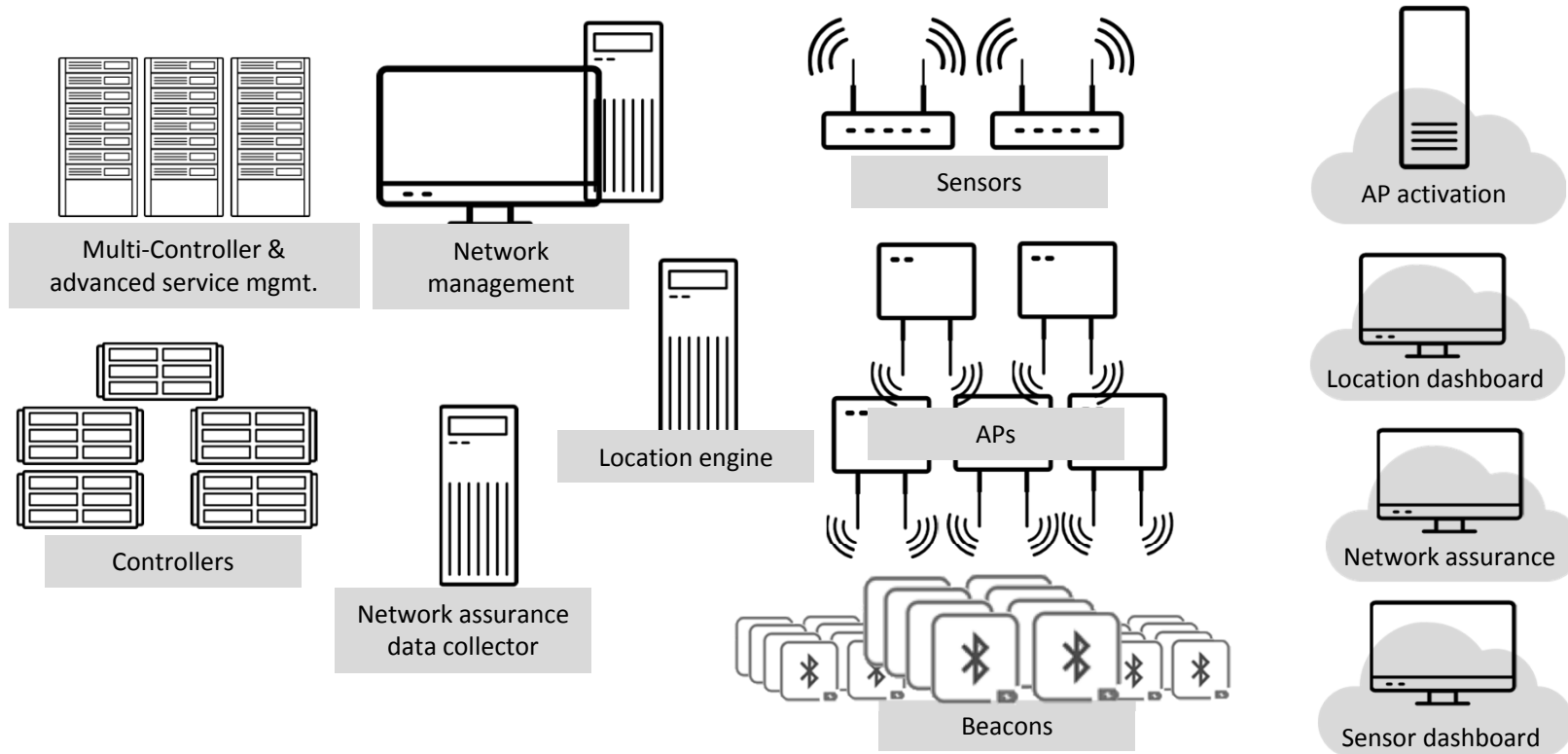
Consider:

- Cloud managed
- Simple architecture
 - Less boxes = better
- Rich in automation / API / AI
- Frequently updated

Avoid

- Legacy controller based systems
- Any extra on-prem / cloud boxes you manage
- “AI” without substance
- Sparse update schedule

Legacy Controller Architecture = Extensive Amount of “Boxes”







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Bicsi



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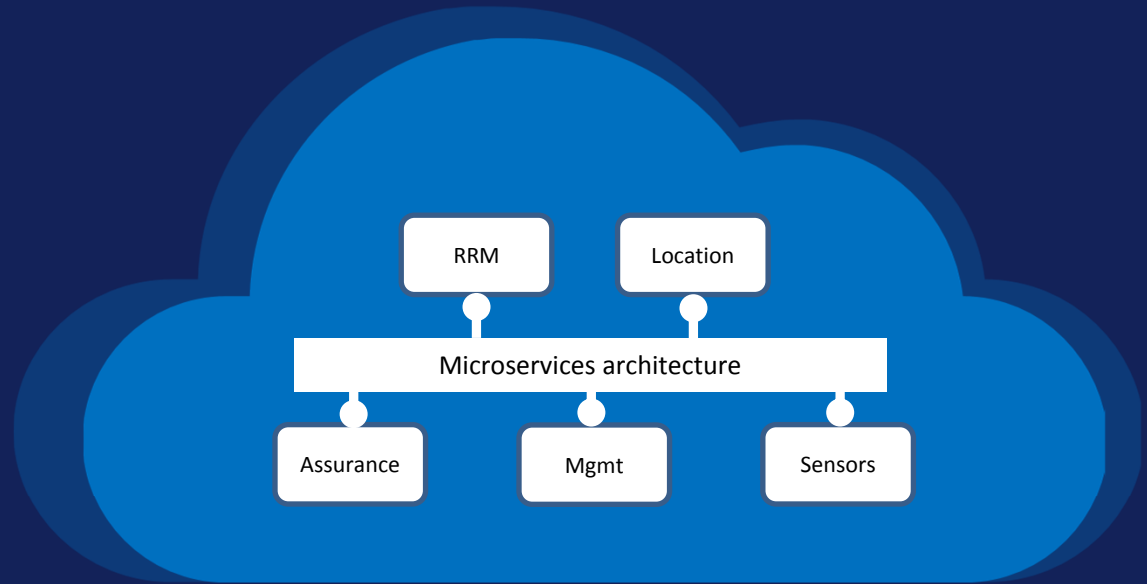
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Cloud + Microservices Architecture



Wi-Fi Design

Wi-Fi Design: Pre-site Visit

- Up-front, on-site
 - Visit the site, perform a visual inspection, analyze the existing Wi-Fi network
 - Understand the RF attenuation and generally the existing RF environment
 - Most importantly: Talk to as many people as you can

New concept: Remote Pre-visit

- Talk with customers over video
- Customer can walk through as you talk, show facility and existing install on video
- Discuss infrastructure remotely using screen share (existing equipment, configs, floor plans)
- Send customer analysis software to diagnose Wi-Fi network

Customer Wi-Fi On-site Check REMOTELY

1. Share customer laptop screen
2. Install Wi-Fi Explorer Pro or Win-Fi on customer laptop
3. Analyze Wi-Fi installation
4. Walk to known problematic location, analyze Wi-Fi again

en0: Scanning | Nakatomi Plaza | Ch. 48 | 20 MHz | 802.11ac | 288 Mbps

All | 2.4 GHz | 5 GHz | Open | Secure

Network Name	Count	BSSID	Annotations	Vendor	Signal	Channel	Channel Width	Band	Mode	Generation	Max Rate	Security
DNA-WLAN-A5D...	1	00:22:07:A5:D7:83		Inteno Broadband...	-70 dBm	1	20 MHz	2.4 GHz	b/g/n	Wi-Fi 4	144.4 Mbps	WPA2 (PSK)
DNA-WLAN-2G-...	1	52:22:07:A5:D7:80		Inteno Broadband...	-81 dBm	1	20 MHz	2.4 GHz	b/g/n	Wi-Fi 4	144.4 Mbps	WPA2 (PSK)
HOME_WPA	1	B0:98:2B:74:79:26		Sagemcom Bra...	-83 dBm	1	20 MHz	2.4 GHz	b/g/n	Wi-Fi 4	216.7 Mbps	WPA2 (PSK)
▶ Nakatomi Guest	10	<Multiple Values>		Mist Systems Inc.	-44 dBm	1, 6, 11, 40,...	20 MHz	2.4, 5 GHz	a/g/n/ac/ax	Wi-Fi 4, 5, 6	288.9, 385...	
▶ TestNaka	12	<Multiple Values>		Mist Systems Inc.	-21 dBm	1, 6, 11, 100,...	20 MHz	2.4, 5 GHz	a/g/n/ac/ax	Wi-Fi 4, 5, 6	144.4, 173.4...	WPA2 (PSK)
▶ Nakatomi 1x	12	<Multiple Values>		Mist Systems Inc.	-21 dBm	1, 6, 11, 100,...	20 MHz	2.4, 5 GHz	a/g/n/ac/ax	Wi-Fi 4, 5, 6	144.4, 173.4...	WPA2 (802...
ASUS	1	2C:56:DC:87:91:08		Mist Systems Inc.	-39 dBm	6	20 MHz	2.4 GHz	b/g/n	Wi-Fi 4	144.4 Mbps	
▶ Backup AiJu	4	<Multiple Values>		Mist Systems Inc.	-39 dBm	6, 11, 52	20, 80 MHz	2.4, 5 GHz	a/b/g/n/ac	Wi-Fi 4, 5	144.4, 1733...	WPA2 (PSK)
Scenarum	1	58:8B:F3:99:C1:F8		ZyXEL Commun...	-84 dBm	11	20 MHz	2.4 GHz	b/g/n	Wi-Fi 4	144.4 Mbps	WPA2 (PSK)
Kettunetti	1	60:14:66:C0:5E:4F		ZTE Corp.	-87 dBm	11	40 MHz	2.4 GHz	b/g/n	Wi-Fi 4	450 Mbps	WPA2 (PSK)
▼ Nakatomi Plaza	6	<Multiple Values>		Mist Systems Inc.	-44 dBm	40, 48, 14...	20 MHz	5 GHz	a/n/ac/ax	Wi-Fi 5, 6	385.2, 573...	WPA2 (PSK)
Nakatomi Plaza	1	5C:5B:35:68:61:D4		Mist Systems Inc.	-57 dBm	40	20 MHz	5 GHz	a/n/ac/ax	Wi-Fi 6	573.5 Mbps	WPA2 (PSK)
Nakatomi Plaza	1	D4:20:B0:0B:2D:D4		Mist Systems Inc.	-64 dBm	40	20 MHz	5 GHz	a/n/ac	Wi-Fi 5	385.2 Mbps	WPA2 (PSK)
Nakatomi Plaza	1	5C:5B:35:3D:24:C9		Mist Systems Inc.	-44 dBm	48	20 MHz	5 GHz	a/n/ac	Wi-Fi 5	385.2 Mbps	WPA2 (PSK)
Nakatomi Plaza	1	5C:5B:35:68:A5:84		Mist Systems Inc.	-58 dBm	140	20 MHz	5 GHz	a/n/ac/ax	Wi-Fi 6	573.5 Mbps	WPA2 (PSK)
Nakatomi Plaza	1	5C:5B:35:58:A8:35		Mist Systems Inc.	-57 dBm	161	20 MHz	5 GHz	a/n/ac/ax	Wi-Fi 6	573.5 Mbps	WPA2 (PSK)
Nakatomi Plaza	1	5C:5B:35:68:61:F5		Mist Systems Inc.	-64 dBm	165	20 MHz	5 GHz	a/n/ac	Wi-Fi 6	573.5 Mbps	WPA2 (PSK)
▶ Hidden Network	2	<Multiple Values>		Mist Systems Inc.	-42 dBm	52	80 MHz	5 GHz	a/n/ac	Wi-Fi 5	1733.3 Mbps	WPA2 (PSK)

-81 isn't a good Signal strength

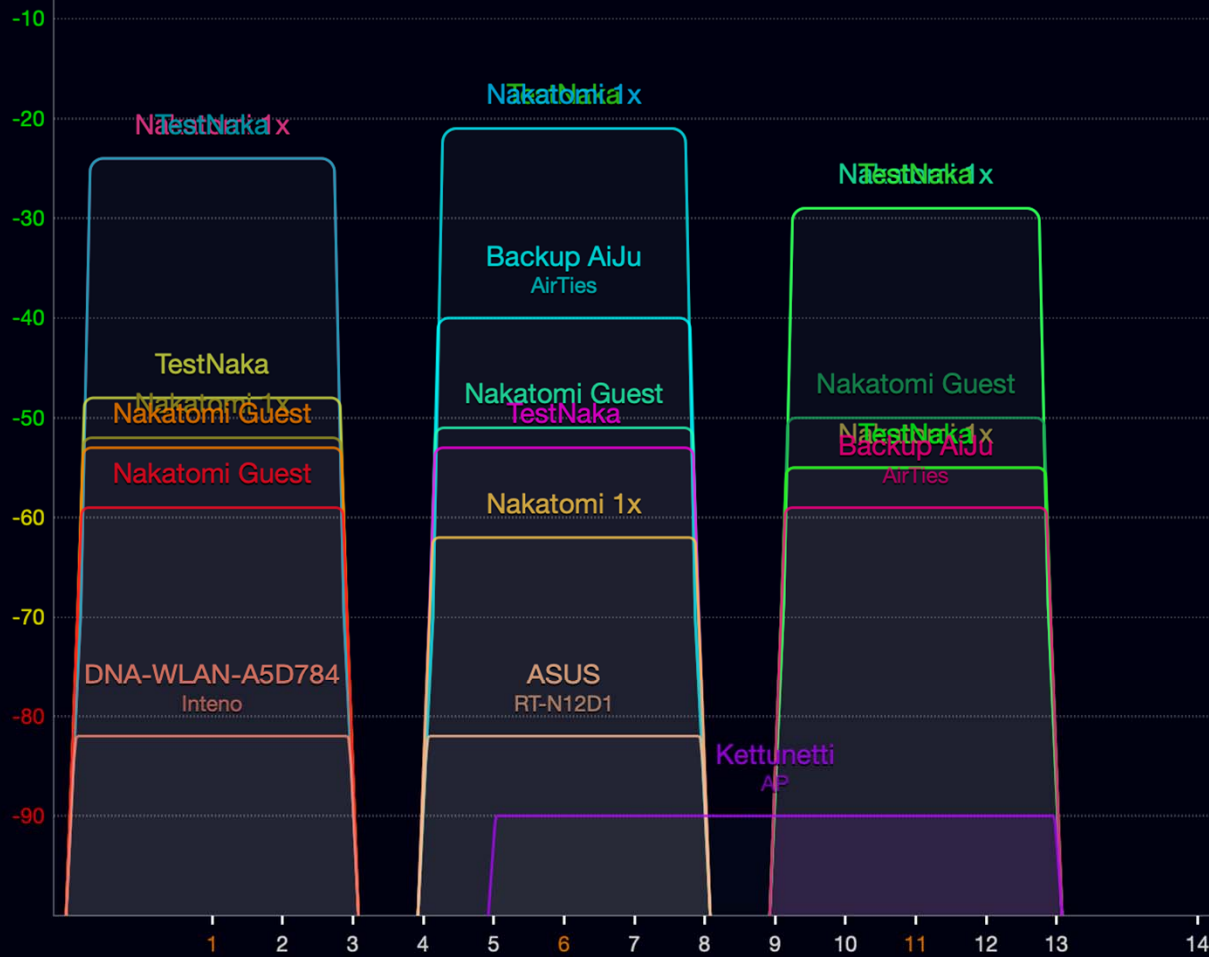
B is bad!

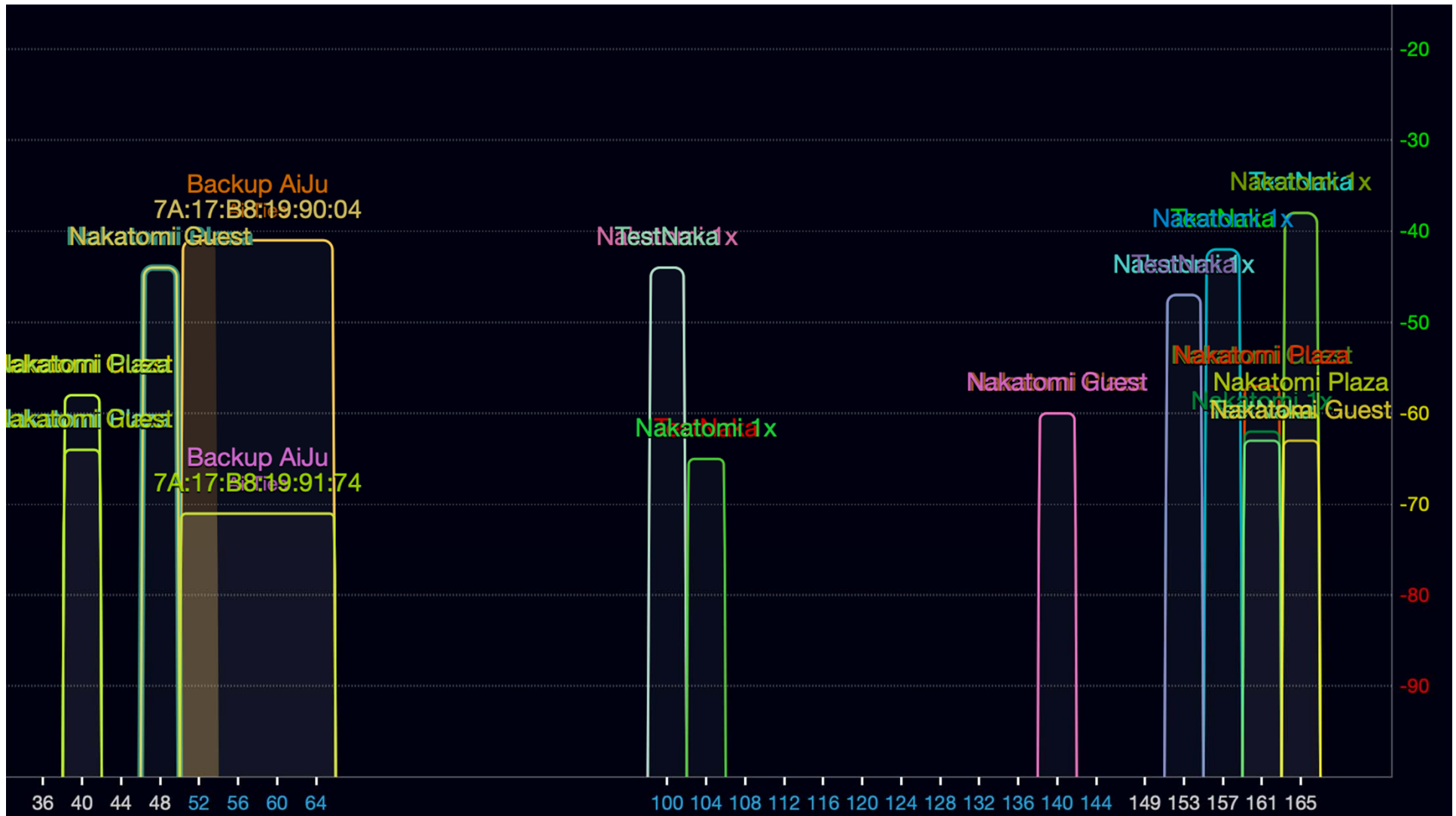
Network Details | Signal Strength | Spectrum | **Advanced Details**

Length	ID	Information Element	Details
15 by...	0	▶ Service Set Identifier	DNA-WLAN-A5D784
8 bytes	1	▶ Supported Rates	1(B), 2(B), 5.5(B), 11(B), 18, 24, 36, 54 Mbps
1 bytes	3	▶ DSSS Parameter Set	Current channel: 1
1 bytes	42	▶ ERP	
4 bytes	50	▶ Extended Supported Rates	6, 9, 12, 48 Mbps
20 by...	48	▶ RSN Information	Group Cipher: AES (CCMP); Pairwise Cipher(s): AES (CCMP); AKM Suite(s): PSK
5 bytes	11	▶ BSS Load	Stations: 0, Channel Utilization: 31%
26 by...	45	▶ HT Capabilities	20 MHz, Short GI for 20 MHz, 2 Spatial Streams
22 by...	61	▶ HT Operation	Primary Channel: 1 (20 MHz Channel Width Only), Nonmember protection mode

Network Name	Count	BSSID	Annotations	Vendor	Signal	Channel	Channel Width	Band	Mode	Generation	Max Rate	Security	Seen
DNA-WLAN-A5D...	1	00:22:07:A5:D7:83		Inteno Broadband...	-82 dBm	1	20 MHz	2.4 GHz	b/g/n	Wi-Fi 4	144.4 Mbps	WPA2 (PSK)	Just now
HOME_WPA	1	B0:98:2B:74:79:26		Sagemcom Broad...	-84 dBm	1	20 MHz	2.4 GHz	b/g/n	Wi-Fi 4	216.7 Mbps	WPA2 (PSK)	30 sec ago
DNA-WLAN-2G-...	1	52:22:07:A5:D7:80		Inteno Broadband...	-87 dBm	1	20 MHz	2.4 GHz	b/g/n	Wi-Fi 4	144.4 Mbps	WPA2 (PSK)	3 min ago
Nakatomi Guest	10	<Multiple Values>		Mist Systems Inc.	-44 dBm	1, 6, 11, 40,...	20 MHz	2.4, 5 GHz	a/g/n/ac/ax	Wi-Fi 4, 5, 6	288.9, 385,...		Just now
TestNaka	12	<Multiple Values>		Mist Systems Inc.	-21 dBm	1, 6, 11, 100,...	20 MHz	2.4, 5 GHz	a/g/n/ac/ax	Wi-Fi 4, 5, 6	144.4, 173.4,...	WPA2 (PSK)	Just now
Nakatomi 1x	12	<Multiple Values>		Mist Systems Inc.	-21 dBm	1, 6, 11, 100,...	20 MHz	2.4, 5 GHz	a/g/n/ac/ax	Wi-Fi 4, 5, 6	144.4, 173.4,...	WPA2 (802,...	Just now







Where to Place the Access Points?

- Tons of ways to determine!
 1. Uber-simplified: One AP per classroom (or sq ft)
 2. Auto-Planner: Input requirements, output Wi-Fi plan
 3. Manual
 1. Off-site, on-site or combo?

Deployment and Configuration

Configuration

- CLI is getting rarer
- Small / medium sites = one by one, web GUI
- Large multi-site environments: Automation
 - Templates
 - GUI rules
 - API

Auto-Provisioning



Site Assignment

AP Name Generation

Profile Assignment

Enabled Disabled

Source (Device Profile name based on)

AP Name

Divide into segments separated by and select the segment

Ignore the first characters and the last characters

Select first characters

Add a prefix

Add a suffix

Try various AP names to see the site assignment resulting from your selections

AP name

Device Profile Name

OK

Cancel

Auto-Provisioning



Site Assignment

AP Name Generation

Profile Assignment

Enabled Disabled

Deriving AP Name from LLDP Port Description

Divide into segments separated by and select the segment

Ignore the first characters and the last characters

Select first characters

Try various Port Description to see the name resulting from your selections

LLDP Port Desc.

AP Name

OK

Cancel

Deployment

- Take pictures as much as possible
 - Catch costly mistakes in time (APs placed wrong, antennas oriented wrong, cable issues, etc)
- Installer apps help reduce install time
 - Pics
 - AP placement
 - AP claiming, etc.

Switches: Airport Access Switch 1

Utilities Save Cancel

Invalid name

EX2300-C-12P CPU Memory Temp PoE PSUs Fans

RJ-45 SFP+ Uplink

0	2	4	6	8	10	0
1	3	5	7	9	11	1

METRICS

Switch-AP Affinity	PoE Compliance
VLANs	100% Version Compliance
100% Switch Uptime	

PROPERTIES

INSIGHTS	Switch Insights
MAC ADDRESS	0c:59:9c:83:0f:e2
MODEL	EX2300-C-12P
VERSION	18.2R3-S2.9

STATISTICS

STATUS	Connected
IP ADDRESS	10.0.0.10
MIST APS	5
WIRELESS CLIENTS	6
TOTAL POWER DRAW	34.80 W
UPTIME	42d 2h 51m
LAST SEEN	03:54:21 PM, Aug 14

Switch Configuration



Wi-Fi Site Survey

- Just like you want all the cables checked
- You want someone to test the Wi-Fi
- Walk-through site survey
 - Before install?
 - After install – absolutely required

Pre-install Survey



Post Install Survey



The First Day / Week

- **WI-FI IS NOT A
“IT WORKED TODAY, SO IT’LL WORK FOREVER”
TECHNOLOGY**
- Do not start the “ice age”
- Pay extra attention to site
- Follow key metrics closely
- Perform extra tests

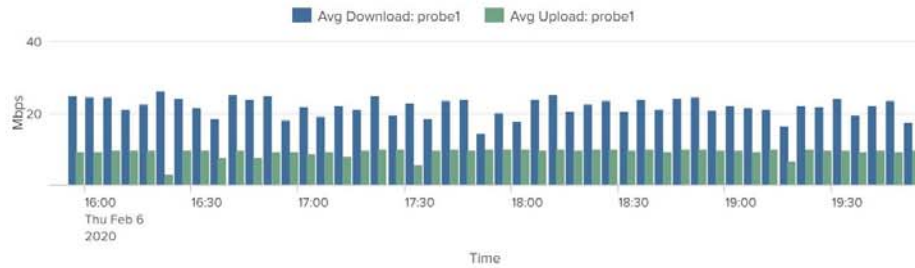


01 - Probe Summary

Edit Export ...

Hostname
probe1 Last 4 hours Hide Filters

Speedtest - probe1



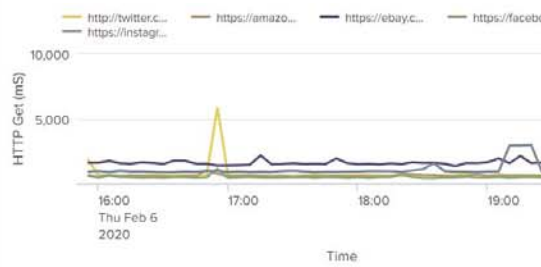
Wireless Connection - probe1



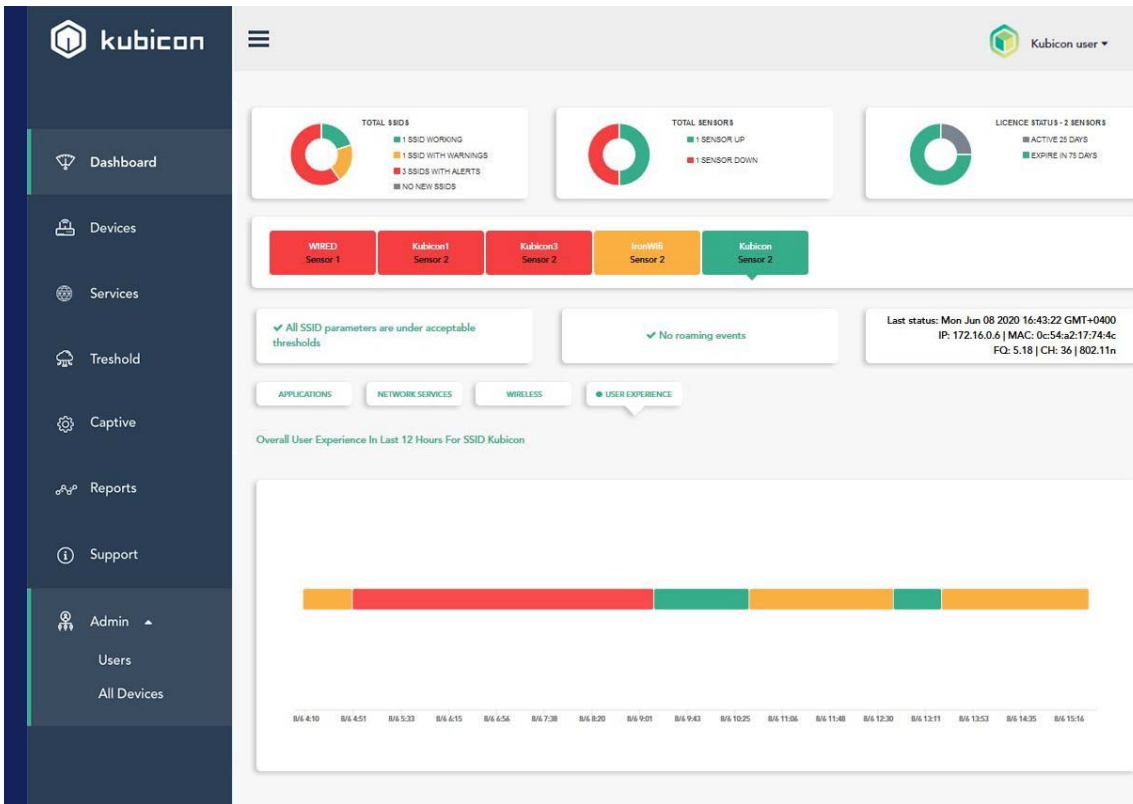
DNS Lookup Time (mS) - probe1



HTTP Get Time (mS) - probe1



More info on WiPerf sensors and WLAN Pi: wlanpi.com, wifinigel.blogspot.com



SENSOR

More info on Kubicon sensors: kubicon.io



Monitor

Wireless Network

Wired Network

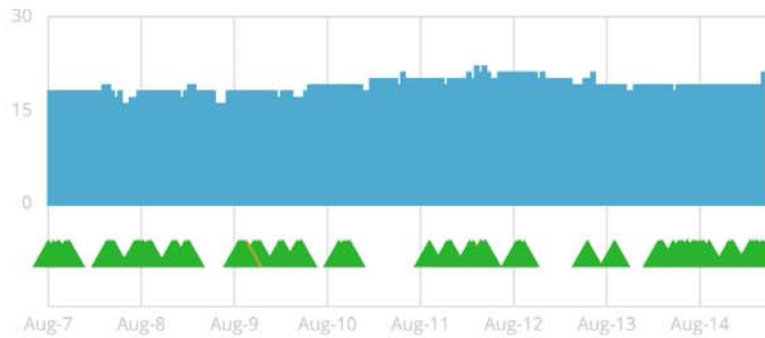
Location

Insights

site Nakatomi Plaza

Last 7 Days

Users



System changes

Success Rate

Values

All WLANs

Hide Excluded WLANs

Settings

Successful Connects ?

96% success



Authorization	75%
Association	< 1%
DHCP	25%

Time to Connect ?

88% success



Association	92%
Authorization	< 1%
Internet Services	< 1%
DHCP	8%

Ensuring That the Network Delivers 24/7

Is Someone Continually Overseeing Your Network?

- Human? No.
- AI? Absolutely.
- However, **nothing replaces human oversight of the network**

MARVIS


Examples

troubleshoot a device locate a client investigate an AP list clients devices on vlan 12 devices by type how many clients on SSID Guest count events of type Association channels by event count list events for client macbook list client events yesterday rank clients by event count



 Monitor

 Marvis™

 Clients

 Access Points

 Switches

 Location

 Analytics

 Network

 Organization

MARVIS

Examples

troubleshoot a device locate a client investigate an AP list clients devices on vlan 12 devices by type how many clients on SSID Guest count events of type Association channels by event count list events for client macbook list client events yesterday rank clients by event count



The Buzzwords: What's Hot With Wi-Fi Right Now

Wi-Fi 6: The New Standard. Business as Usual, Just Better.

Read More:
Google “Mist Wi-Fi 6 Poster”
and WLAN Pros Wi-Fi 6

Wi-Fi 6E

More Everything,
But Not Today.

Consider Not Being the First to Jump.

Read More:
Google “Mist Wi-Fi 6E” and
“Wi-Fi Now Wi-Fi 6E”

5G: It's Another G.

Read More:
[Google "Mist Game over Wi-Fi said 5G webinar"](#)
and [Google "Dean Bubley 5G"](#)

INDOOR LOCATION TRACKING:

It's becoming more popular.

Knowledgeable, trusted partner is essential.

Read More:

Google "Mist Game over Wi-Fi said 5G webinar"
and Google "Dean Bubley 5G"

Thank you!

Jussi@juniper.net

Google: *jussi wifi*

Twitter: @JussiKiviniemi

Linkedin: [linkedin.com/JussiKiviniemi](https://www.linkedin.com/company/JussiKiviniemi)