

Erfahrungen mit WLAN im schulischen Umfeld

Am Beispiel des BSZ Leonberg

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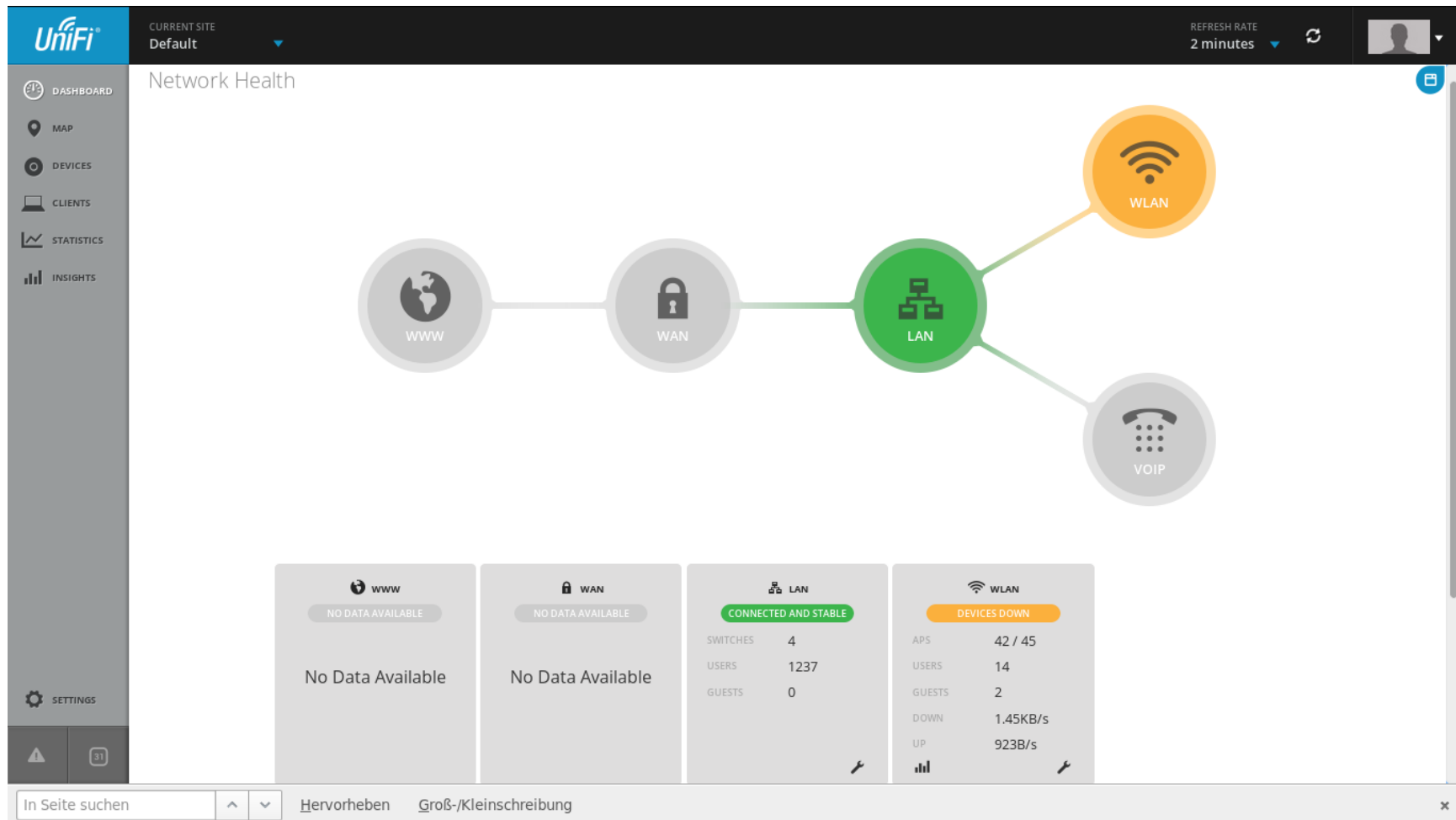
Zielsetzung

- verschiedene WLAN-Netze (MultiSSID)
 - für schuleigene Geräte
 - Bring your own device (BYOD) für Lehrkräfte und Tabletklassen
 - Freifunk (offenes WLAN) für alle
- leichte Skalierbarkeit
- geringer Wartungsaufwand

Umsetzung mit Ubiquiti UniFi

- zentrales Management: UniFi Controller
- PoE-fähige UniFi Accesspoints
- UniFi PoE-Switch

UniFi Controller - Dashboard





UniFi Controller

1. plattformunabhängig (Debian/Ubuntu, Mac, Windows)
2. Open Source (GPL Lizenz)
3. notwendig zur Konfiguration
4. praktisch für's Monitoring

Systemvoraussetzungen UniFi Controller

- Server (x86 oder virtualisiert)
- JRE > 1.6
- Speicherplatz mind. 20 GB
- RAM bei 2 GB
Mem 1145/2012
Swap 35/1086
- bei zwei virtualisierten CPUs (je 2 GHz):
load average: 0,00, 0,08, 0,15

UniFi Accesspoints

Modell	Lan	WLAN	SSIDs	PoE
AP AC 	2 x GBit	2,4 GHz 450 Mbit/s 5 GHz 1.300 Mbit/s	4 x	48V 802.3at
AP LR 	1 x GBit	2,4 GHz 300 Mbit/s	4 x	24V (proprietär)

Konfigurationsmöglichkeiten UniFi APs

- keine Weboberfläche → Konfiguration via Controller
- Loadbalancing
- Auto-Kanalwahl
- unterschiedliche SSID-Gruppen

UniFi Switch 24 Port

- keine Weboberfläche → Konfiguration via Controller
- verschiedene VLAN-Gruppen
- PoE abschaltbar (max. PoE Leistung 500/250W)

Wifi-Netze am BSZ Leonberg

Wireless Networks WLAN Group Default + - ⚙️ OPTIONS

Name ↕	Security ↕	Guest Network ↕	Actions
Passwort "BSZLeonberg"	wpa2psk	Yes	📄 EDIT 🗑️ DELETE
Freifunk	open	No	📄 EDIT 🗑️ DELETE
BSZLeonberg	wpa2psk	No	📄 EDIT 🗑️ DELETE

⚙️ CREATE NEW WIRELESS NETWORK *A maximum of 4 wireless networks are allowed per WLAN group*

SSID Passwort "BSZLeonberg"

Settings

Site

Wireless Networks

Networks

Guest Control

Admins

User Groups

VOIP

Controller

Maintenance

Wireless Networks ▶ Edit Wireless Network - Passwort "BSZLeonberg"

Edit Wireless Network - Passwort "BSZLeonberg"

WLAN Group: Default

Name/SSID

Passwort "BSZLeonberg"

Enabled



Security

OPEN

WEP

WPA-PERSONAL

WPA-ENTERPRISE

Security Key

●●●●●●●●●●

Guest Policy



Apply guest policies (captive portal, guest authentication, access)

Advanced Options ▼

VLAN



use VLAN ID

33

(2-4095)

Hide SSID



WPA Mode

WPA2 Only

Encryption

AES/CCMP Only

SSID Passwort "BSZLeonberg"

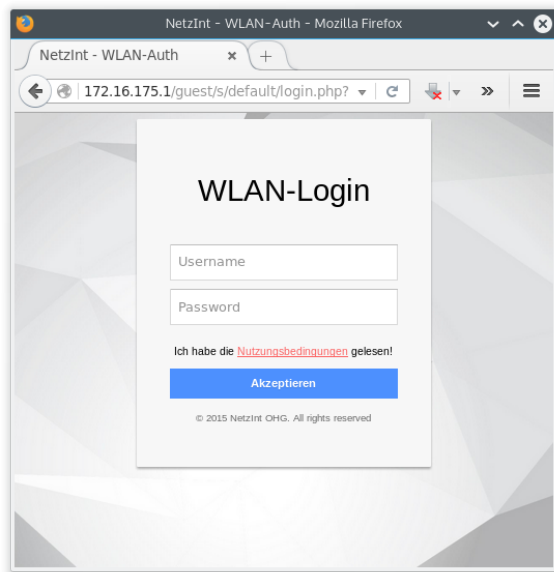
Nutzergruppe	Verschlüsselung	Authentifizierung	Gateway
Lehrkräfte & Tabletklassen	WPA2	Captive Portal via LDAP Anbindung → Schulserver	IP Fire (blaues Netz)

Guest Policy für BYOD

- External Portal Server auf UniFi
- Client Isolation
- Hosts im Subnetz 172.16.175.0/24 erreichbar, z.B. WLAN-Drucker

The screenshot shows the 'Guest Policies' configuration page in the UniFi controller. The 'Enable Guest Portal' checkbox is checked. Under 'Authentication', the 'EXTERNAL PORTAL SERVER' tab is selected. The 'Custom Portal' section shows the 'IP Address' as 172.16.175.1. The 'Portal URL Hostname' section has the 'Redirect using hostname' checkbox unchecked and the 'unifi' text in the adjacent field. The 'Access Control' section is divided into 'Restricted Subnets' and 'Allowed Subnets'. The 'Restricted Subnets' list contains three entries: 192.168.0.0/16, 172.16.0.0/12, and 10.0.0.0/8, each with a blue 'x' icon to its right and an 'ADD NEW' button below. The 'Allowed Subnets' section has a single entry: 172.16.175.0/24, with an 'ADD NEW' button below it.

Captive Portal (BYOD Netz)



- läuft lokal auf UniFi Controller
- Authentifizierung via LDAP (Schulserver)
- manuelles "Deauthentifizierung" via UniFi Controller möglich

Clients & Deauthentifizierung

Clients

Search:

ALL WIRELESS WIRED ALL USERS GUESTS

Items per page: 50

Name/MAC Address	IP Address	Connection	AP/Port	Down	Up	Activity	Uptime	Actions
	172.21.22.42	Freifunk	L120	21.0M	1.09M	■■■	2m 51s	BLOCK RECONNECT
	172.21.7.68	Freifunk	100.09	94.8M	5.80M	■■■	39m 25s	BLOCK RECONNECT
	172.21.22.8	Freifunk	A113-Schulsozialarbeit	5.18M	630K	■■■	16m 22s	BLOCK RECONNECT
	172.21.4.41	Freifunk	B327	3.63M	477K	■■■	30m 43s	BLOCK RECONNECT
	172.21.22.83	Freifunk	B327	1.91M	29.3M	■■■	12m 35s	BLOCK RECONNECT
	172.21.20.56	Freifunk	H272	24.8M	3.20M	■■■	48m 17s	BLOCK RECONNECT
	172.21.23.119	Freifunk	B329	3.17M	1.56M	■■■	4h 23m 40s	BLOCK RECONNECT
	172.21.7.59	Freifunk	H272	38.0M	3.68M	■■■	28m 18s	BLOCK RECONNECT
	172.16.160.184	Freifunk	B324	2.41M	255K	■■■	1m 20s	BLOCK RECONNECT
	172.16.160.46	Passwort "BSZLeonberg"	100.09	15.8M	1.06M	■■■	16m 36s	BLOCK RECONNECT UNAUTHORIZE
	172.21.22.191	Freifunk	L130	25.6M	2.55M	■■■	23m 9s	BLOCK RECONNECT
	172.21.23.141	Freifunk	C251	34.5M	3.75M	■■■	22m 1s	BLOCK RECONNECT
	172.21.22.46	Freifunk	B277	2.06M	183K	■■■	15m 46s	BLOCK RECONNECT

SSID Freifunk

Settings

Site

Wireless Networks

Networks

Guest Control

Admins

User Groups

VOIP

Controller

Maintenance

Wireless Networks ▶ Edit Wireless Network - Freifunk

Edit Wireless Network - Freifunk

WLAN Group: Default

Name/SSID

Freifunk

Enabled

☒

Security

OPEN

WEP

WPA-PERSONAL

WPA-ENTERPRISE

Guest Policy

☐ Apply guest policies (captive portal, guest authentication, access)

Advanced Options ▼

VLAN

☒ use VLAN ID

35

(2-4095)

Hide SSID

☐

User Group

Default ▼

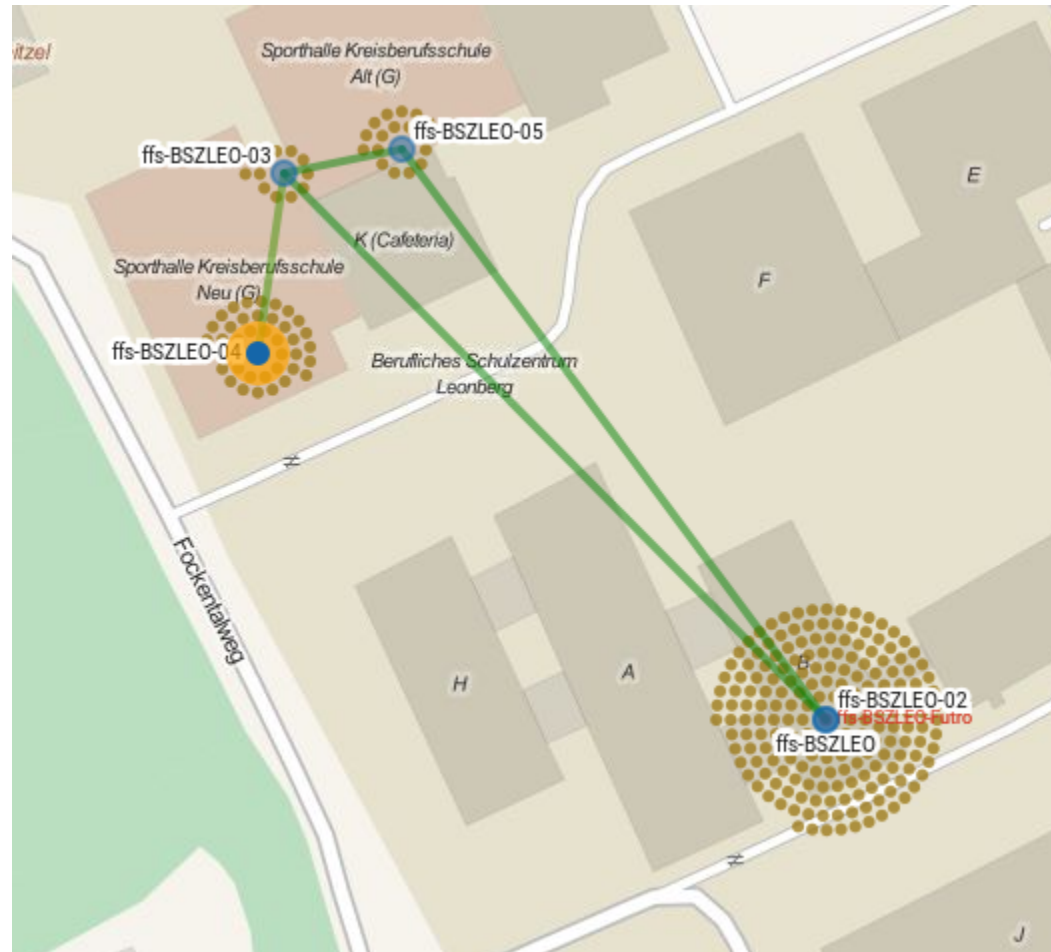
SSID Freifunk

Nutzergruppe	Verschlüsselung	Authentifizierung	Gateway
alle	offen	keine	Freifunk Knoten

Nutzerzahlen Freifunk

▲	Node	◆	Clients	◆	Model
	ffs-BSZLEO		245		TP-Link TL-WR1043N/ND v2
	ffs-BSZLEO-04		48		TP-Link TL-WR2543N/ND v1
	ffs-BSZLEO-05		17		TP-Link TL-WR2543N/ND v1
	ffs-BSZLEO-03		13		TP-Link TL-WR2543N/ND v1
	ffs-BSZLEO-02		0		TP-Link TL-WR2543N/ND v1
✖	ffs-BSZLEO-Futro		0		Mobile AMD Sempron(tm) Processor 2100+

Meshviewer Freifunk



SSID BSZLeonberg

Settings

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User Groups

VOIP

Controller

Maintenance

Name/SSID

BSZLeonberg

Enabled

☒

Security

OPEN

WEP

WPA-PERSONAL

WPA-ENTERPRISE

Security Key

●●●●●●●●●●●●●●●●

Guest Policy

☐ Apply guest policies (captive portal, guest authentication, access)

Advanced Options

VLAN

☒ use VLAN ID

230

(2-4095)

Hide SSID

☒

WPA Mode

WPA2 Only

Encryption

AES/CCMP Only

User Group

Default

UAPSD

☐ Enable Unscheduled Automatic Power Save Delivery

SSID BSZLeonberg

Nutzergruppe	Verschlüsselung	Authentifizierung	Gatew
schuleigene Devices	WPA2 63 Zeichen Schlüssel	MAC Adresse → Schulserver	IP Fire (grüne Netz)

Konfiguration der VLANs

Networks				
Name ↕	Purpose ↕	Subnet ↕	VLAN ▾	Actions
ff-mesh	vlan-only		37	EDIT DELETE
w-freif	vlan-only		35	EDIT DELETE
w-byod	vlan-only		33	EDIT DELETE
Kollegium	vlan-only		250	EDIT DELETE
GebM	vlan-only		230	EDIT DELETE
GebJ	vlan-only		200	EDIT DELETE
GebH	vlan-only		180	EDIT DELETE
GebB	vlan-only		120	EDIT DELETE
w-managm	corporate	192.168.0.254/24		EDIT
CREATE NEW NETWORK				

Mangement VLAN

Networks

Name ↕	Purpose ↕	Subnet ↕	VLAN ▼	Actions
ff-mesh	vlan-only		37	EDIT DELETE
w-freif	vlan-only		35	EDIT DELETE
w-byod	vlan-only		33	EDIT DELETE
Kollegium	vlan-only		250	EDIT DELETE
GebM	vlan-only		230	EDIT DELETE
GebJ	vlan-only		200	EDIT DELETE
GebH	vlan-only		180	EDIT DELETE
GebB	vlan-only		120	EDIT DELETE
w-managm	corporate	192.168.0.254/24		EDIT DELETE

[CREATE NEW NETWORK](#)

- UniFi Management VLAN ID 30
- bei UniFi Geräten immer untagged









Konsequenzen des Mangement VLANs

1. notwendig zur Kommunikation der UniFi Geräte
2. liegt an jeder Dose eines APs an
→ Trennung von WLAN
3. keine Internetanbindung, um Zugriff ohne Authentifizierung auszuschließen
4. WLAN Drucker im BYOD → untagged VLAN 33
= Internetzugriff !

Übersicht Switche

Devices

ALL GATEWAY/SWITCHES APS PHONES

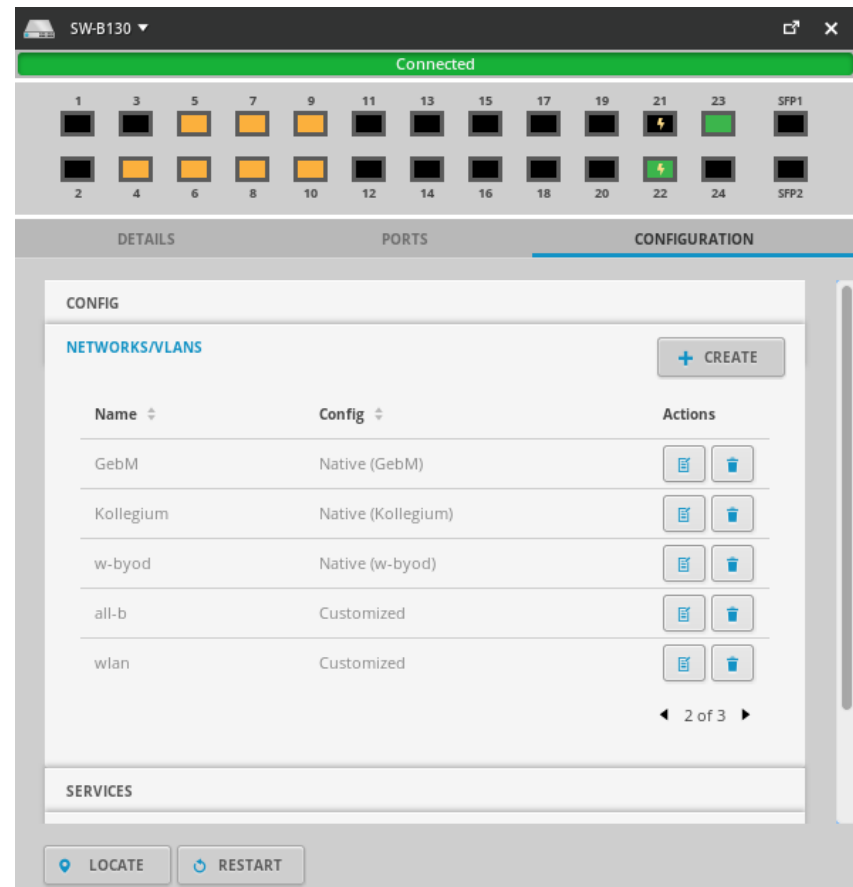
Name/MAC Address ▾	IP Address ▾	Status ▾	Model ▾	Down ▾	Up ▾	Actions
 SW-B234	192.168.0.118	Connected	UniFi Switch 24 POE-500W	383M	30.5M	 LOCATE
 SW-B130	192.168.0.107	Connected	UniFi Switch 24 POE-250W	76.7G	2.20G	 LOCATE
 SW-H	192.168.0.128	Connected	UniFi Switch 24 POE-500W	415M	23.2M	 LOCATE
 SW-I	192.168.0.112	Connected	UniFi Switch 24 POE-500W	118G	10.2G	 LOCATE

Switch Konfiguration



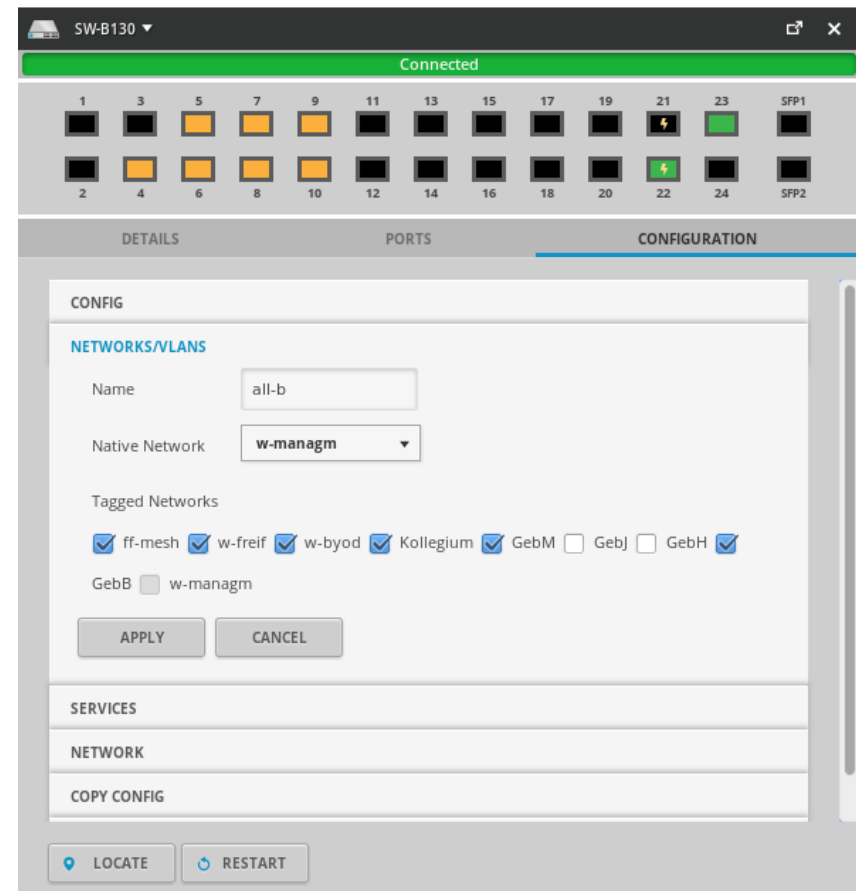
VLAN Gruppen SW-B130

- **GebM** → VLAN 230
untagged
- **Kollegium** → VLAN 250
untagged
- **w-byod** → VLAN 33
untagged
- **all-b** → VLANs 30u, 33,
35, 37, 120, 230, 250
- **wlan** → VLANs 30u, 33,
35, 230

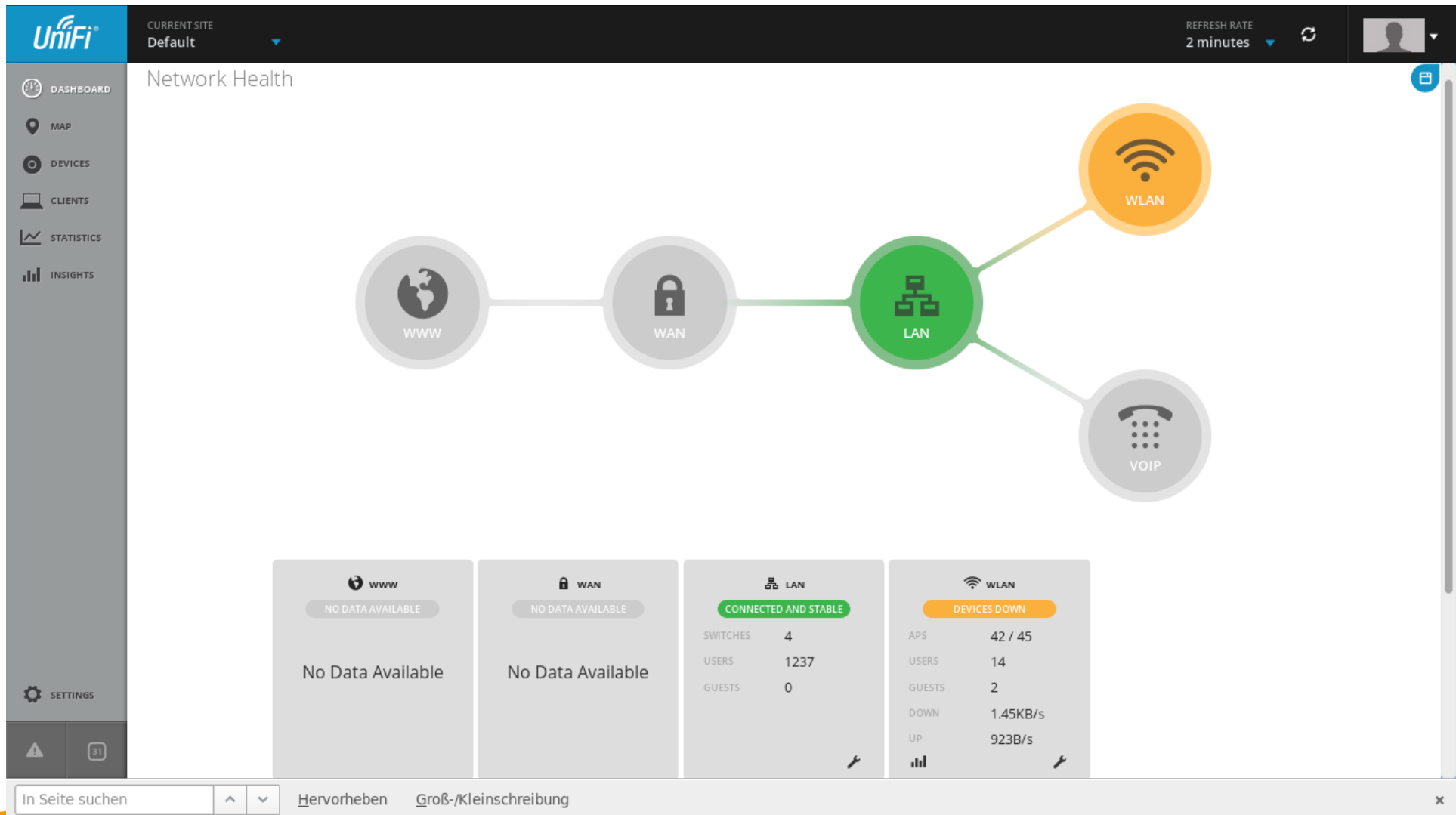


Konfiguration VLAN Gruppe all-b

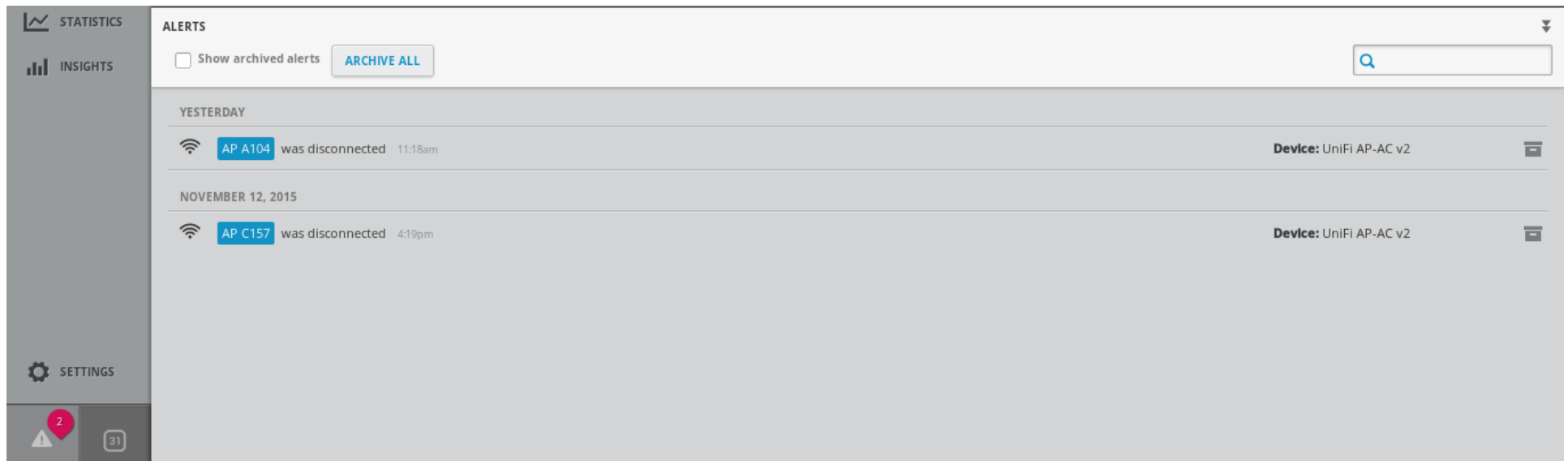
- z.B. für **Uplink-Port**
- **untagged** → VLAN 30 (Management)
- **tagged** alle für Gebäude B notwendigen VLANs:
33, 35, 37, 120, 230, 250



Monitoring mit UniFi Controller



Warnungen auf dem Dashboard



- Dashboard links unten Alarme
- Hier: AP A104 und C157 sind offline gegangen

Ansicht Switch B130

The screenshot shows the UniFi Network Controller interface for switch SW-B130. The top bar indicates the switch is 'Connected'. Below this is a grid of 24 ports, numbered 1 to 24, arranged in two rows. Port 21 is highlighted with a red box and a red lightning bolt icon, indicating it is powered but not connected. A red line points from this port to the overview section below. The overview section displays the following information:

OVERVIEW	
MAC Address	04:18:d6:f0:45:b7
Model	UniFi Switch 24 POE-250W
Version	3.3.11.3850
<hr/>	
IP Address	192.168.0.107
Power Consumption	16.70 W
Temperature	44°C
Fan Level	0
Uptime	20d 9h 48m

Accesspoint A104 wird mit Strom versorgt, ist aber nicht verbunden.






































Auflistung der Accesspoints

Devices

START ROLLING UPGRADE

ALL GATEWAY/SWITCHES APS PHONES OVERVIEW CONFIG PERFORMANCE

Items per page: 50

Name/MAC Address	IP Address	Status	Model	Clients	Down	Up	Channel	Actions
 H173	192.168.0.139	Connected	UniFi AP-AC v2	22	18.6G	1.63G	6 (ng), 36 (ac)	 LOCATE  RESTART
 B326	192.168.0.117	Connected	UniFi AP-AC v2	20	8.53G	1.04G	6 (ng), 36 (ac)	 LOCATE  RESTART
 A216	192.168.0.144	Connected	UniFi AP-AC v2	17	7.78G	746M	6 (ng), 36 (ac)	 LOCATE  RESTART
 J10.04	192.168.0.102	Connected	UniFi AP-AC	16	16.5G	2.02G	1 (ng), 36 (ac)	 LOCATE  RESTART
 B225	192.168.0.135	Connected	UniFi AP-AC v2	16	5.43G	625M	6 (ng), 36 (ac)	 LOCATE  RESTART
 J00.09	192.168.0.101	Connected	UniFi AP-AC	15	8.66G	1.63G	1 (ng), 44 (ac)	 LOCATE  RESTART
 B233	192.168.0.136	Connected	UniFi AP-AC v2	13	8.57G	836M	6 (ng), 44 (ac)	 LOCATE  RESTART
 B227	192.168.0.134	Connected	UniFi AP-AC v2	12	7.67G	847M	1 (ng), 36 (ac)	 LOCATE  RESTART
 B229	192.168.0.129	Connected	UniFi AP-AC v2	12	7.27G	1.21G	11 (ng), 36 (ac)	 LOCATE  RESTART
 B327	192.168.0.132	Connected	UniFi AP-AC v2	12	8.34G	1.07G	1 (ng), 44 (ac)	 LOCATE  RESTART
 A111-Aufenthaltsraum	192.168.0.122	Connected	UniFi AP-AC v2	12	5.06G	581M	1 (ng), 36 (ac)	 LOCATE  RESTART
 C251	192.168.0.105	Connected	UniFi AP-AC v2	11	13.0G	1.33G	1 (ng), 44 (ac)	 LOCATE  RESTART  UPGRADE








































APs sortiert nach Clients

Devices


START ROLLING UPGRADE

ALL GATEWAY/SWITCHES APS PHONES OVERVIEW CONFIG PERFORMANCE

Items per page: 50

Name/MAC Address	IP Address	Status	Model	Clients	Down	Up	Channel	Actions
 A202	192.168.0.145	Connected	UniFi AP-AC v2	33	6.81G	1.32G	6 (ng), 44 (ac)	 LOCATE  RESTART
 C157	192.168.0.133	Connected	UniFi AP-AC v2	30	7.68G	1.03G	6 (ng), 44 (ac)	 LOCATE  RESTART
 B329	192.168.0.110	Connected	UniFi AP-AC v2	24	11.9G	1.33G	1 (ng), 36 (ac)	 LOCATE  RESTART
 I10.04	192.168.0.102	Connected	UniFi AP-AC	24	17.0G	2.07G	1 (ng), 36 (ac)	 LOCATE  RESTART
 A113-Schulsozialarbeit	192.168.0.124	Connected	UniFi AP-AC v2	21	5.42G	851M	1 (ng), 44 (ac)	 LOCATE  RESTART
 B324	192.168.0.138	Connected	UniFi AP-AC v2	21	11.4G	1.30G	11 (ng), 44 (ac)	 LOCATE  RESTART
 C247	192.168.0.119	Connected	UniFi AP-AC v2	20	11.6G	954M	11 (ng), 36 (ac)	 LOCATE  RESTART
 I00.09	192.168.0.101	Connected	UniFi AP-AC	19	10.1G	1.72G	1 (ng), 44 (ac)	 LOCATE  RESTART
 H272	192.168.0.123	Connected	UniFi AP-AC v2	14	7.04G	854M	6 (ng), 36 (ac)	 LOCATE  RESTART
 B326	192.168.0.117	Connected	UniFi AP-AC v2	14	9.05G	1.13G	6 (ng), 36 (ac)	 LOCATE  RESTART
 H173	192.168.0.139	Connected	UniFi AP-AC v2	14	19.1G	1.66G	6 (ng), 36 (ac)	 LOCATE  RESTART
 H164	192.168.0.120	Connected	UniFi AP-AC v2	14	12.9G	2.34G	1 (ng), 36 (ac)	 LOCATE  RESTART
 C241	192.168.0.146	Connected	UniFi AP-AC v2	14	5.05G	578M	6 (ng), 36 (ac)	 LOCATE  RESTART

Übersicht AP H173



The screenshot displays the UniFi Network Controller interface for a specific access point, H173. The interface is divided into several sections: a top status bar, a navigation menu, and a main content area. The status bar at the top shows the device name 'H173' and a green 'Connected' indicator. The navigation menu includes tabs for 'DETAILS', 'USERS', 'GUESTS', and 'CONFIGURATION', with 'DETAILS' currently selected. The main content area is titled 'OVERVIEW' and contains a table of device information. This table is organized into three sections: basic identification (MAC Address, Model, Version), network details (IP Address, Uptime), and user statistics (# Users, # Guests). Below the table, there are three expandable sections for 'UPLINK (WIRE)', 'RADIO (11N/B/G)', and 'RADIO (11N/A/AC)'. At the bottom of the interface, there are two buttons: 'LOCATE' and 'RESTART'.

OVERVIEW	
MAC Address	04:18:d6:70:10:8d
Model	UniFi AP-AC v2
Version	3.2.12.2920
<hr/>	
IP Address	192.168.0.139
Uptime	33d 21h 23m
<hr/>	
# Users	16
# Guests	14

UPLINK (WIRE)

RADIO (11N/B/G)

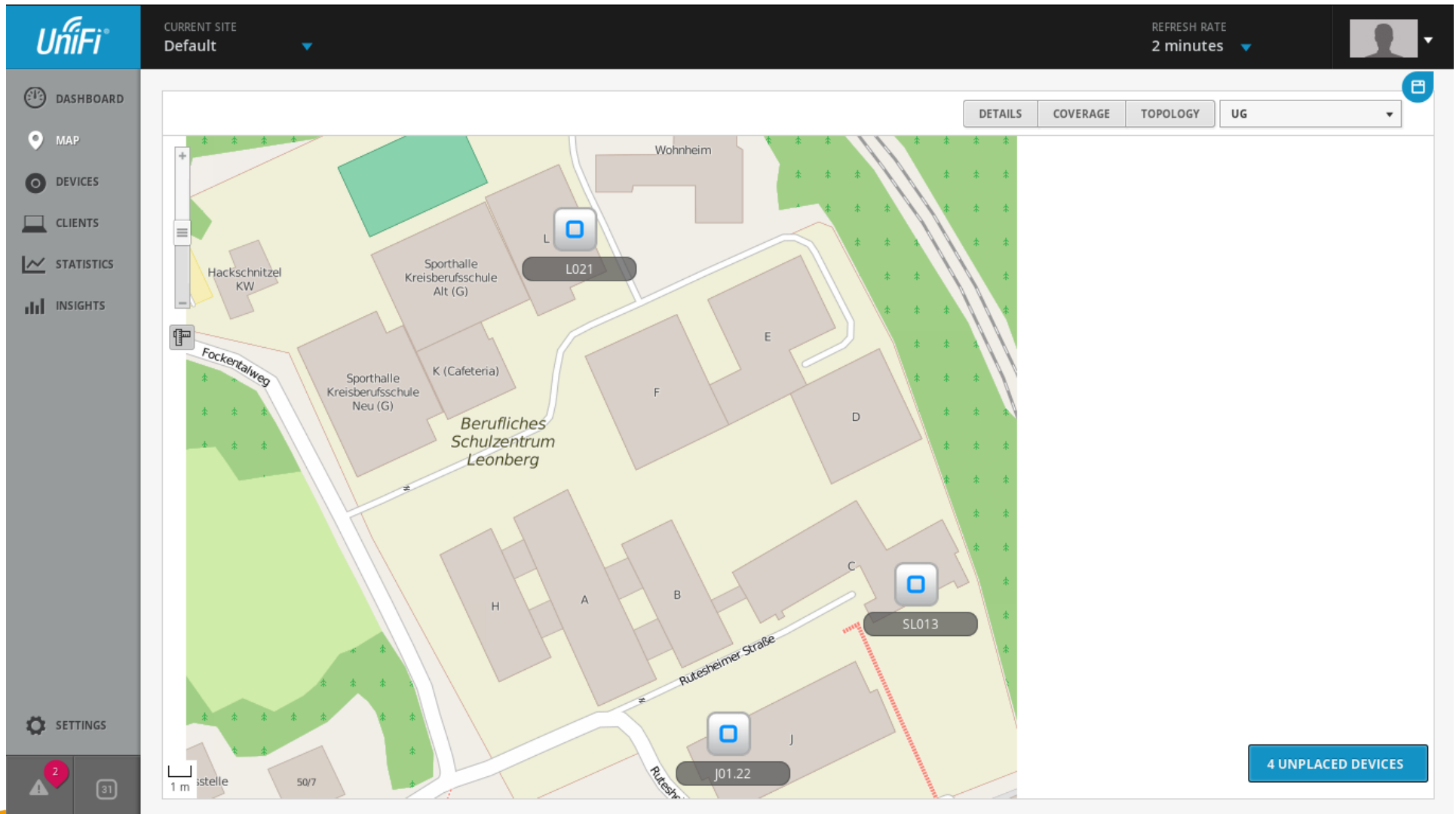
RADIO (11N/A/AC)

LOCATE RESTART

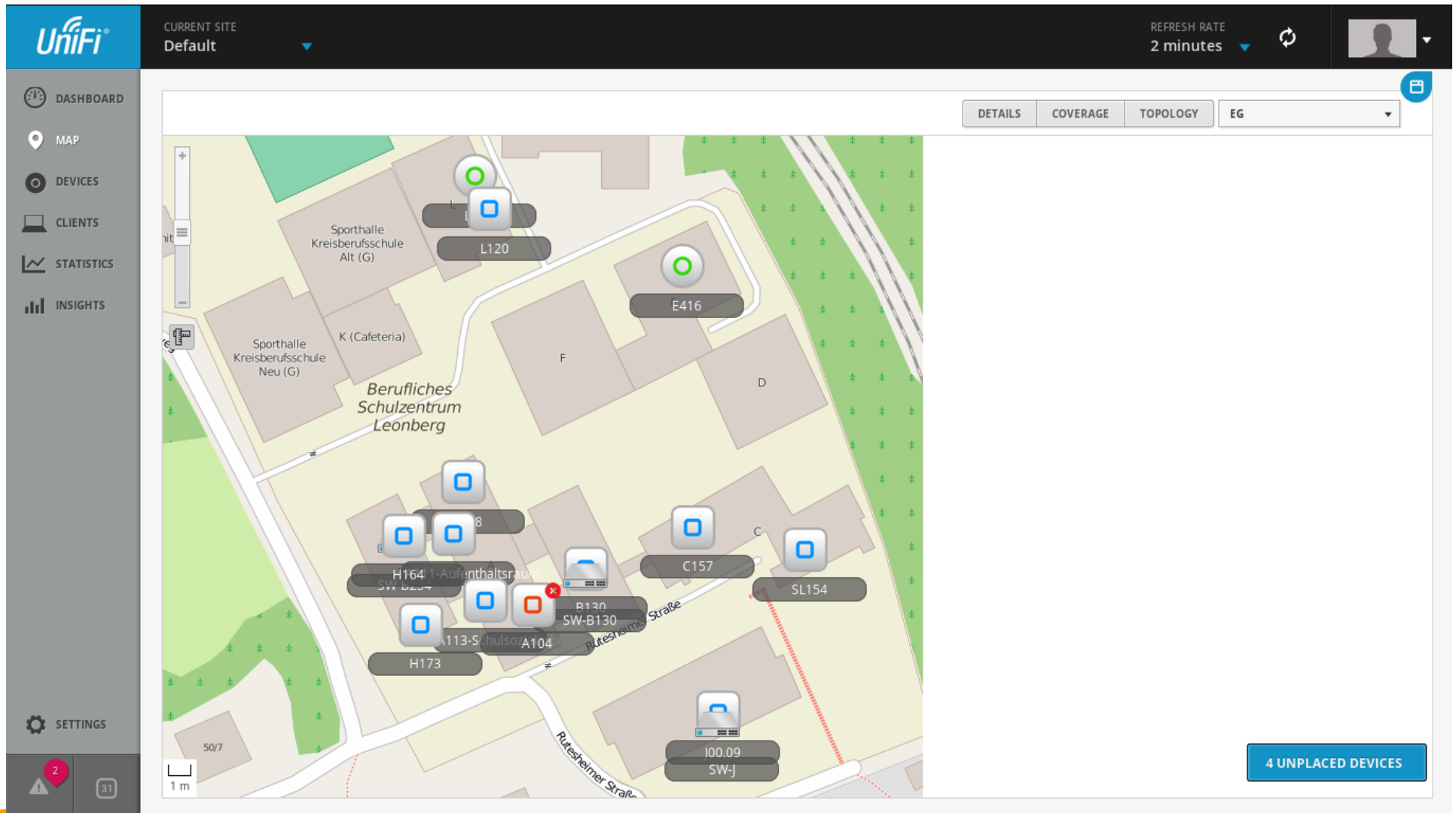
Übersicht Clients

Clients									
<div><input type="text" value=""/></div> <div>ALL WIRELESS WIRED ALL USERS GUESTS</div> <div>Items per page: 50</div>									
Name/MAC Address ▾	IP Address ▾	Connection ▾	AP/Port	Down ▾	Up ▾	Activity ▾	Uptime ▾	Actions	
	172.21.22.42	Freifunk	L120	21.0M	1.09M	■■■	2m 51s	BLOCK	RECONNECT
	172.21.7.68	Freifunk	J00.09	94.8M	5.80M	■■■	39m 25s	BLOCK	RECONNECT
	172.21.22.8	Freifunk	A113-Schulsozialarbeit	5.18M	630K	■■■	16m 22s	BLOCK	RECONNECT
	172.21.4.41	Freifunk	B327	3.63M	477K	■■■	30m 43s	BLOCK	RECONNECT
	172.21.22.83	Freifunk	B327	1.91M	29.3M	■■■	12m 35s	BLOCK	RECONNECT
	172.21.20.56	Freifunk	H272	24.8M	3.20M	■■■	48m 17s	BLOCK	RECONNECT
	172.21.23.119	Freifunk	B329	3.17M	1.56M	■■■	4h 23m 40s	BLOCK	RECONNECT
	172.21.7.59	Freifunk	H272	38.0M	3.68M	■■■	28m 18s	BLOCK	RECONNECT
	172.16.160.184	Freifunk	B324	2.41M	255K	■■■	1m 20s	BLOCK	RECONNECT
	172.16.160.46	Passwort "BSZLeonberg"	J00.09	15.8M	1.06M	■■■	16m 36s	BLOCK	RECONNECT UNAUTHORIZE
	172.21.22.191	Freifunk	L130	25.6M	2.55M	■■■	23m 9s	BLOCK	RECONNECT
	172.21.23.141	Freifunk	C251	34.5M	3.75M	■■■	22m 1s	BLOCK	RECONNECT
	172.21.22.46	Freifunk	B277	2.06M	183K	■■■	15m 46s	BLOCK	RECONNECT

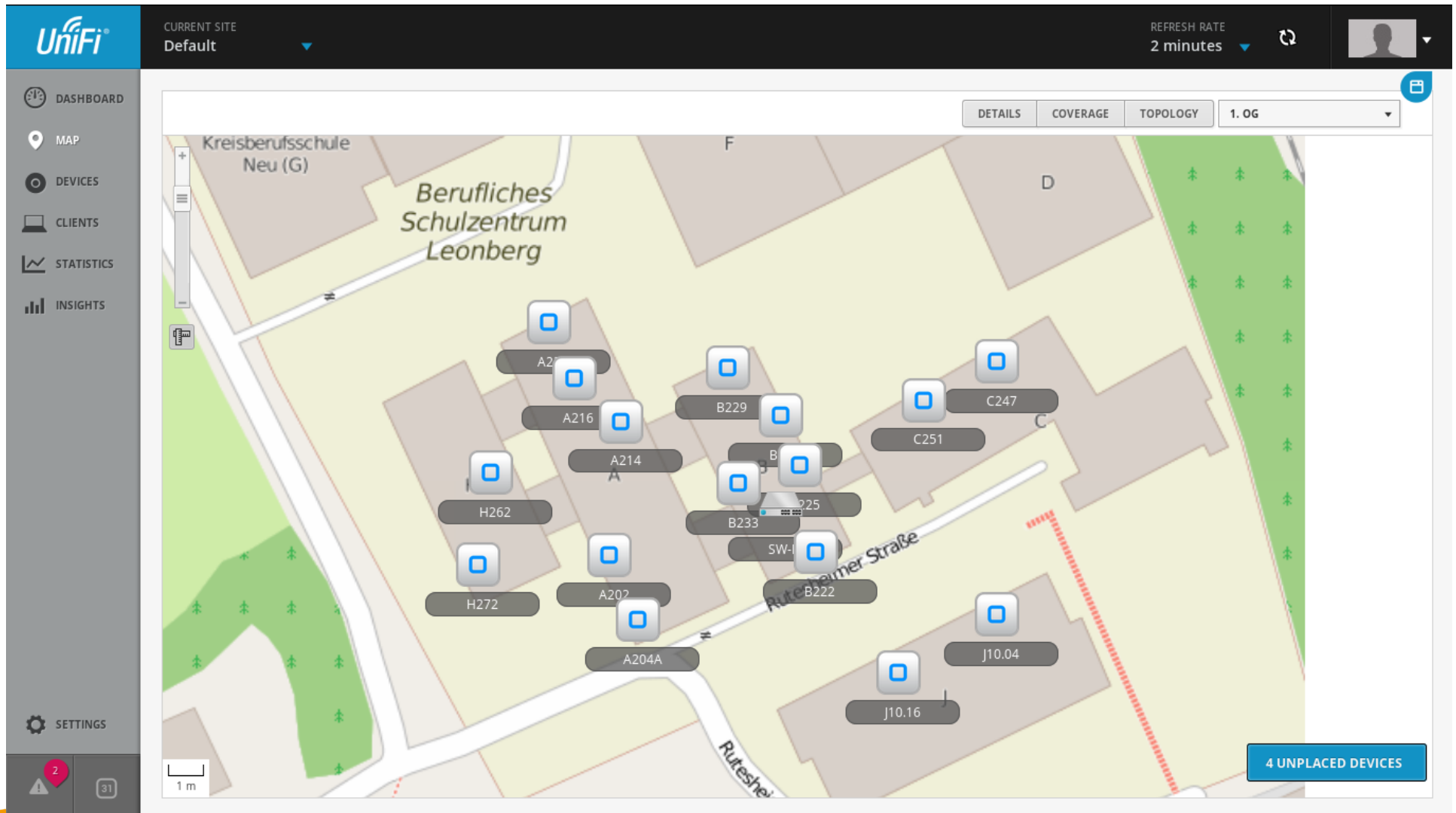
Karte mit APs (UG)



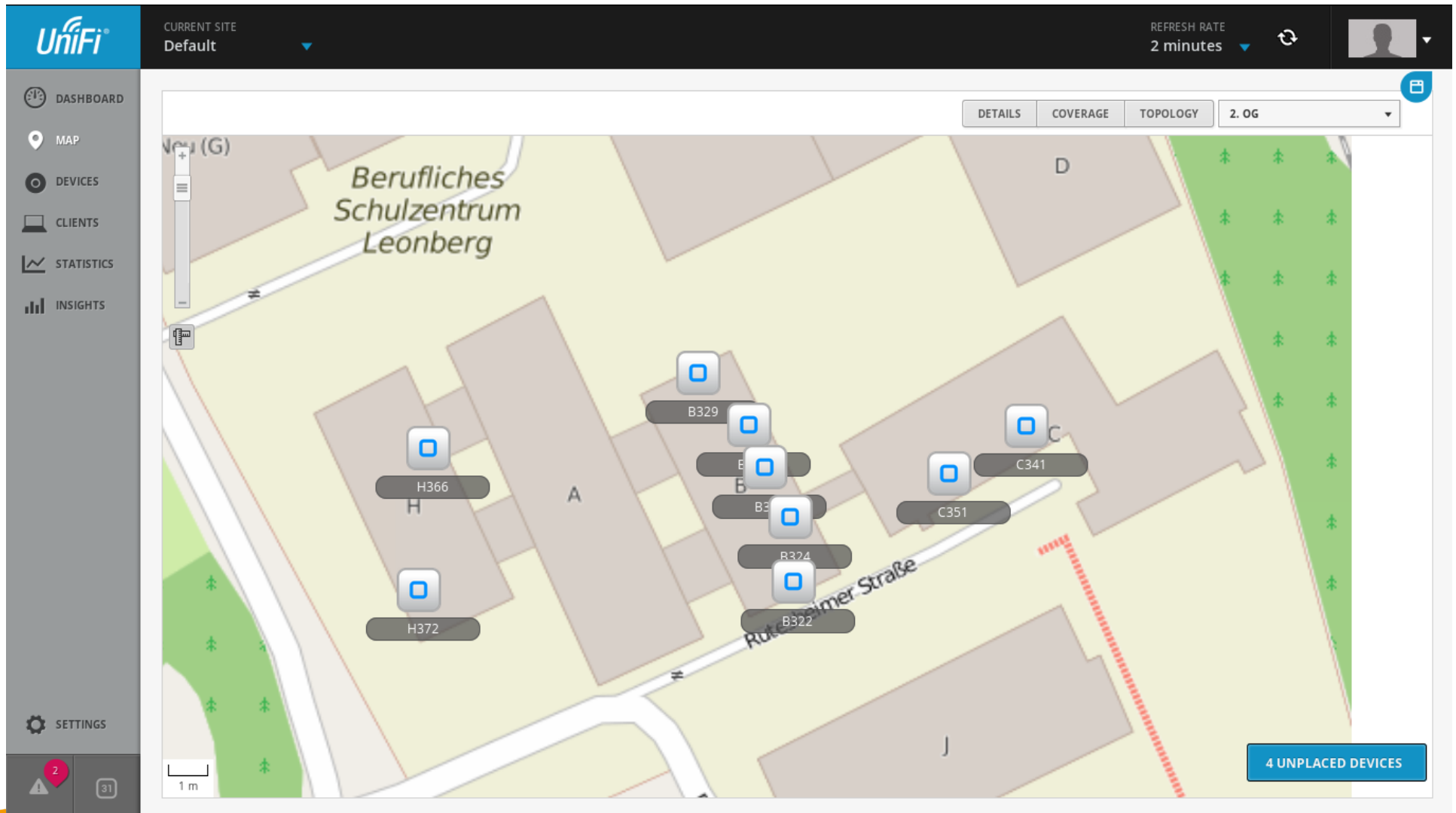
Karte mit APs (EG)



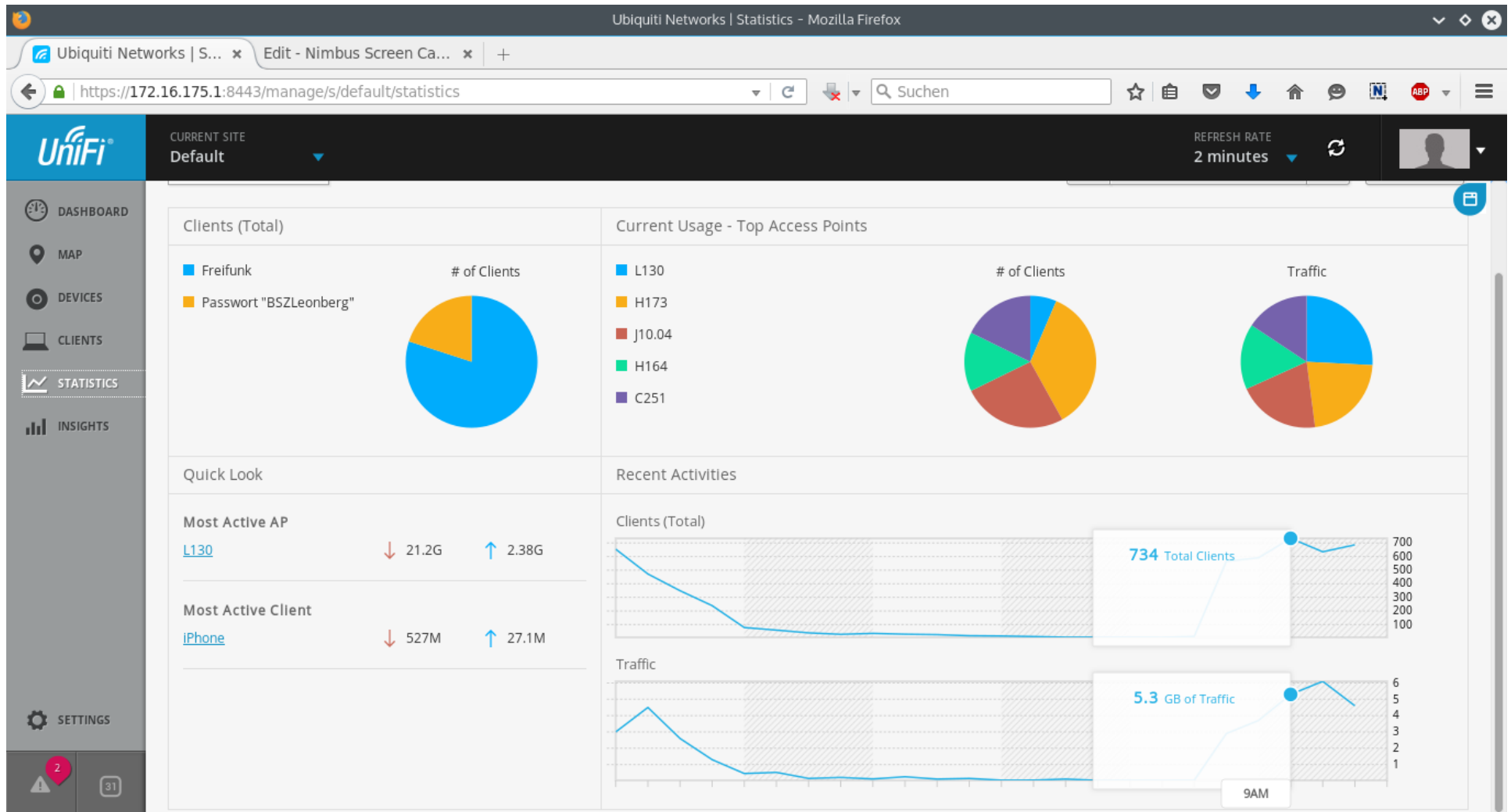
Karte mit APs (1. OG)



Karte mit APs (2. OG)



Statistik




Weitere Möglichkeiten

- max. Bandbreite/Client
- max. Anzahl Clients/AP
- WLAN zeitgesteuert an-/abschalten
- einzelne MAC Adressen blockieren
- Authentifizierung BYOD
 - Radius
 - Coova Chili
 - ...

Bandbreitenbegrenzung

User Groups

Name ↕	Bandwidth Limit ↕	Actions
Default	Download: Unlimited, Upload: Unlimited	EDIT
guest	Download: 2048 Kbps, Upload: 1024 Kbps	EDIT DELETE

 CREATE NEW USER GROUP

weiterführende Informationen

Links

<https://www.ubnt.com/products/#unifi>

freifunk.net

freifunk-stuttgart.de

Kontakt

Christoph Altrock

christoph.altrock@bszleo.de