Wireless Observations on Apple Devices

Lightning Talk
SANOG 43

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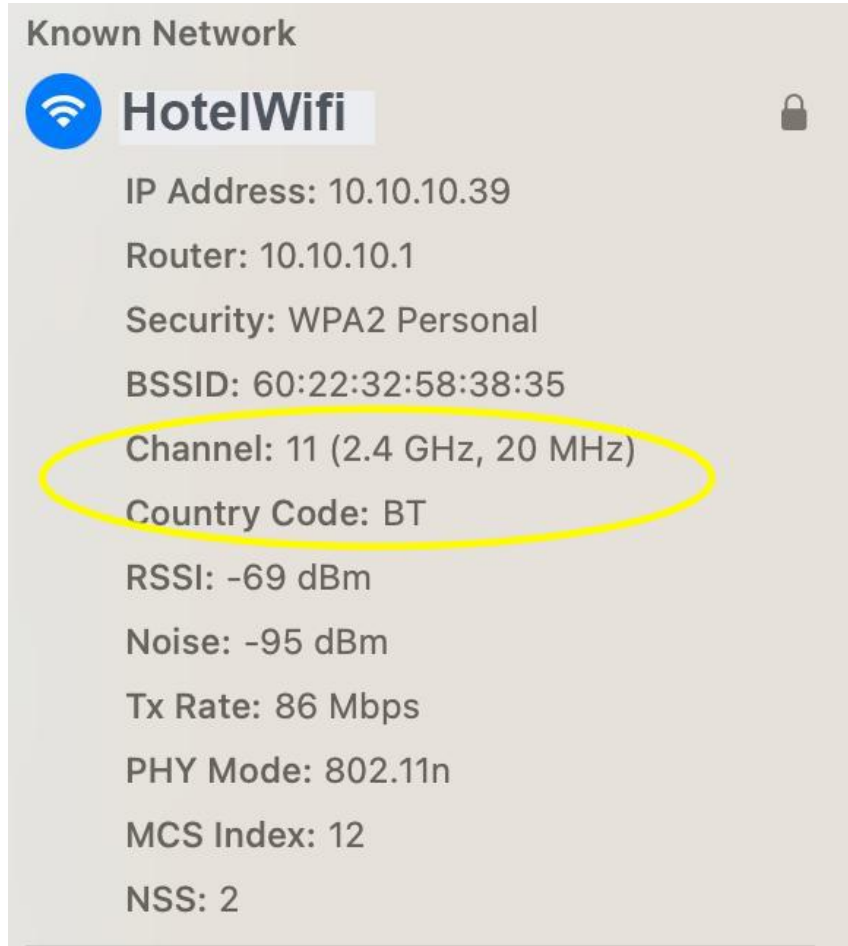
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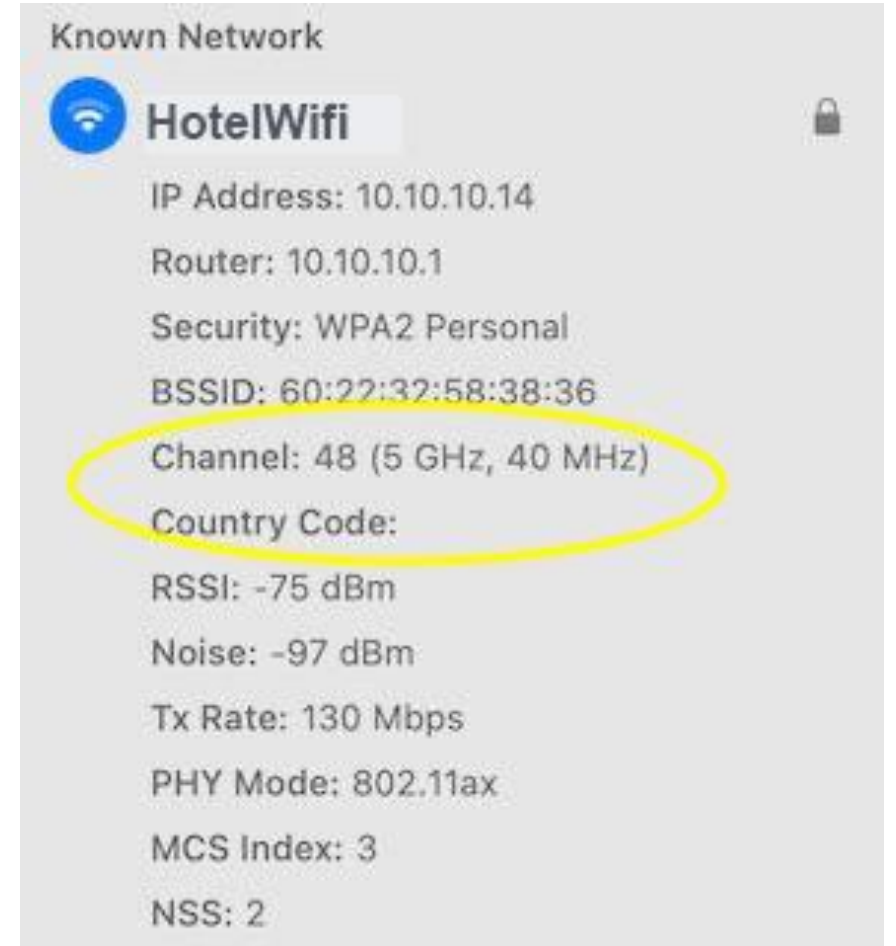
Failure to Connect @ 5GHz

During btNOG-12 multiple macBooks could not see 5GHz channels in workshop classrooms or at the workshop hotel

- Similar behavior was noted by local participants who have clients to their networks in Bhutan.

- PCs (Windows and Linux) both connected fine. Cellular devices connected, as well.

- UniFi and other Access Points configured with 5GHz SSIDs were not visible to the macBooks.

- With UniFi and other Access Points configured with 2.4/5GHz shared SSIDs only had 2.4GHz channels as visible to macBooks.

Failure to Connect @ 5GHz

Known Network

📶 **HotelWifi** 🔒

IP Address: 10.10.10.39

Router: 10.10.10.1

Security: WPA2 Personal

BSSID: 60:22:32:58:38:35

Channel: 11 (2.4 GHz, 20 MHz)

Country Code: BT

RSSI: -69 dBm

Noise: -95 dBm

Tx Rate: 86 Mbps

PHY Mode: 802.11n

MCS Index: 12

NSS: 2

Seen by macBooks

Known Network

📶 **HotelWifi** 🔒

IP Address: 10.10.10.14

Router: 10.10.10.1

Security: WPA2 Personal

BSSID: 60:22:32:58:38:36

Channel: 48 (5 GHz, 40 MHz)

Country Code:

RSSI: -75 dBm

Noise: -97 dBm

Tx Rate: 130 Mbps

PHY Mode: 802.11ax

MCS Index: 3

NSS: 2

Seen by others

Failure to Connect @ 5GHz

We started digging. Google, friends, Apple support lists, even some AI tools. Putting together all the responses, here is what we got:

"How macOS determines the Wi-Fi regulatory domain"

1. **Access Point Beacon Information (Primary Source)**
2. **Most modern Wi-Fi access points include an 802.11d / 802.11h country information element in their beacons.**
3. **This tells the client device (your Mac) what regulatory domain to apply (e.g., US, EU, JP).**

The claim is that macOS will adopt the regulatory domain advertised by the access point it is connected to. After this…macOS may fall back on system location services, using things like

4. GPS (on devices that have it, e.g., some iPads/iPhones, but Macs generally don't have GPS).
5. Known Wi-Fi access point databases (crowdsourced by Apple, similar to Google's Wi-Fi location service).
6. Hardware Defaults (Last Resort)
7. If neither the AP nor location services can determine a country, the Wi-Fi chipset uses a default regulatory domain that complies with the broadest safe set of rules (often US-like but with restrictions). This usually results in fewer available channels (e.g., DFS, radar, satellite, weather channels may be blocked).
8. Multiple APs in Range with Different Country Codes. For scanning (before joining), it will restrict its channel set to what's valid across the union of domains it's aware of. That means you may see fewer channels until you associate.
9. Connected AP vs. Location Services Conflict. If you're physically in Country A (location services knows this), but you join an AP that broadcasts Country B:
10. No Country Code from APs, but Location Known. If the AP doesn't advertise, macOS will rely on location services to pick a country code. This is common with some older/cheap routers that don't set 802.11d.
11. No Country Code + No Location Info: macOS falls back to the Wi-Fi chipset's safe default domain. This usually looks like X0 or ZZ in diagnostics and only allows a very limited set of channels/power.

Failure to Connect @ 5GHz

It's messy – imho

Feel free to read the previous slide for details. To resolve this, here is what we did on macOS:

System Settings→Privacy & Security→ Location Services→System Services

Leads us to the screen on the right →

Set "Networking and wireless" to "off"

System Services Can Access Your Location For

Alerts & Shortcuts Automations

Suggestions & Search

Setting time zone

System customisation

Significant locations   Details...

Find My Mac

HomeKit

Networking and wireless

Mac Analytics

Show location icon in Control Centre when System Services request your location

Done

Failure to Connect @ 5GHz

Before turning "Networking and wireless" location services off, using the command:

```
% sudo system_profiler SPAirPortDataType | grep "Supported Channels"
```

displayed:

Supported Channels: 1 (2GHz), 2 (2GHz), 3 (2GHz), 4 (2GHz), 5 (2GHz), 6 (2GHz), 7 (2GHz), 8 (2GHz), 9 (2GHz), 10 (2GHz), 11 (2GHz), 12 (2GHz), 13 (2GHz), 149 (5GHz), 153 (5GHz), 157 (5GHz), 161 (5GHz), 165 (5GHz)

After turning "networking and wireless" locations services off, we saw:

Supported Channels: 1 (2GHz), 2 (2GHz), 3 (2GHz), 4 (2GHz), 5 (2GHz), 6 (2GHz), 7 (2GHz), 8 (2GHz), 9 (2GHz), 10 (2GHz), 11 (2GHz), 12 (2GHz), 13 (2GHz), 36 (5GHz), 40 (5GHz), 44 (5GHz), 48 (5GHz), 52 (5GHz), 56 (5GHz), 60 (5GHz), 64 (5GHz), 100 (5GHz), 104 (5GHz), 108 (5GHz), 112 (5GHz), 116 (5GHz), 120 (5GHz), 124 (5GHz), 128 (5GHz), 132 (5GHz), 136 (5GHz), 140 (5GHz), 144 (5GHz), 149 (5GHz), 153 (5GHz), 157 (5GHz), 161 (5GHz), 165 (5GHz)*

*Sometimes less, but standard 5GHz was seen

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And, in the end macBooks could see 5GHz again ➜

Some final explanation (comments by some)

"The problem comes from the implementation of 802.11d : wifi location and country ID conflicts. If there are different wifi Access points broadcasting mixed countries ID, Mac OS may shut down certain frequencies."

So…

"Turning off 'Networking and Wireles' under Location Services in macOS means your Mac will not use nearby Wi-Fi networks and Bluetooth devices to determine its location."

Known Network

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IP Address: 10.10.10.39

Router: 10.10.10.1

Security: WPA2 Personal

BSSID: 60:22:32:58:38:36

Channel: 48 (5 GHz, 40 MHz)

Country Code:

RSSI: –81 dBm

Noise: –96 dBm

Tx Rate: 68 Mbps

PHY Mode: 802.11ax

MCS Index: 1

NSS: 2

Failure to Connect @ 5GHz

Did this completely solve the issue?

- Near as we can tell, no.
- We tried turning "Networking and wireless" location services back on…
  - No reverse change
  - Results of `system_profiler` command stayed the same
  - More work to really understand the issue, unless someone today has a clear answer?

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