

Apple Wireless Direct Link: Apple's Network Magic or Misery

Christoff Visser



Has this ever happened to you?



Note: The stuttering is not on your side

What would cause such behaviour?

- Strange almost rhythmic stuttering
- Is it:
 - The application
 - My device
 - My network
 - Something else

- Moonlight is FOSS
 - Time to check GitHub
- Application statistics point to it being a network problem

🕒 **Sound and video stutter on iPad Pro M4**

#627 opened 3 weeks ago by ollebro

✅ **Occasional micro stuttering**

#427 by cooldna2 was closed on Feb 7, 2022

🕒 **Rhythmic/Pattern Stuttering on Vision Pro (iPad app)**

#607 opened on Feb 7 by 1kuna

✅ **(iPadOS 14.7.1) Audio and video stutter every second** stale

#475 by DJLevel3 was closed on Apr 28, 2022

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Frames dropped by your network connection: 0.00%
Average network latency: 20 ms (variance: 25 ms)
Host processing latency min/max/avg: 3.9/6.0/4.3 ms
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- Application statistics point to it being a network problem
- Swap to wired connection
 - Issue resolved

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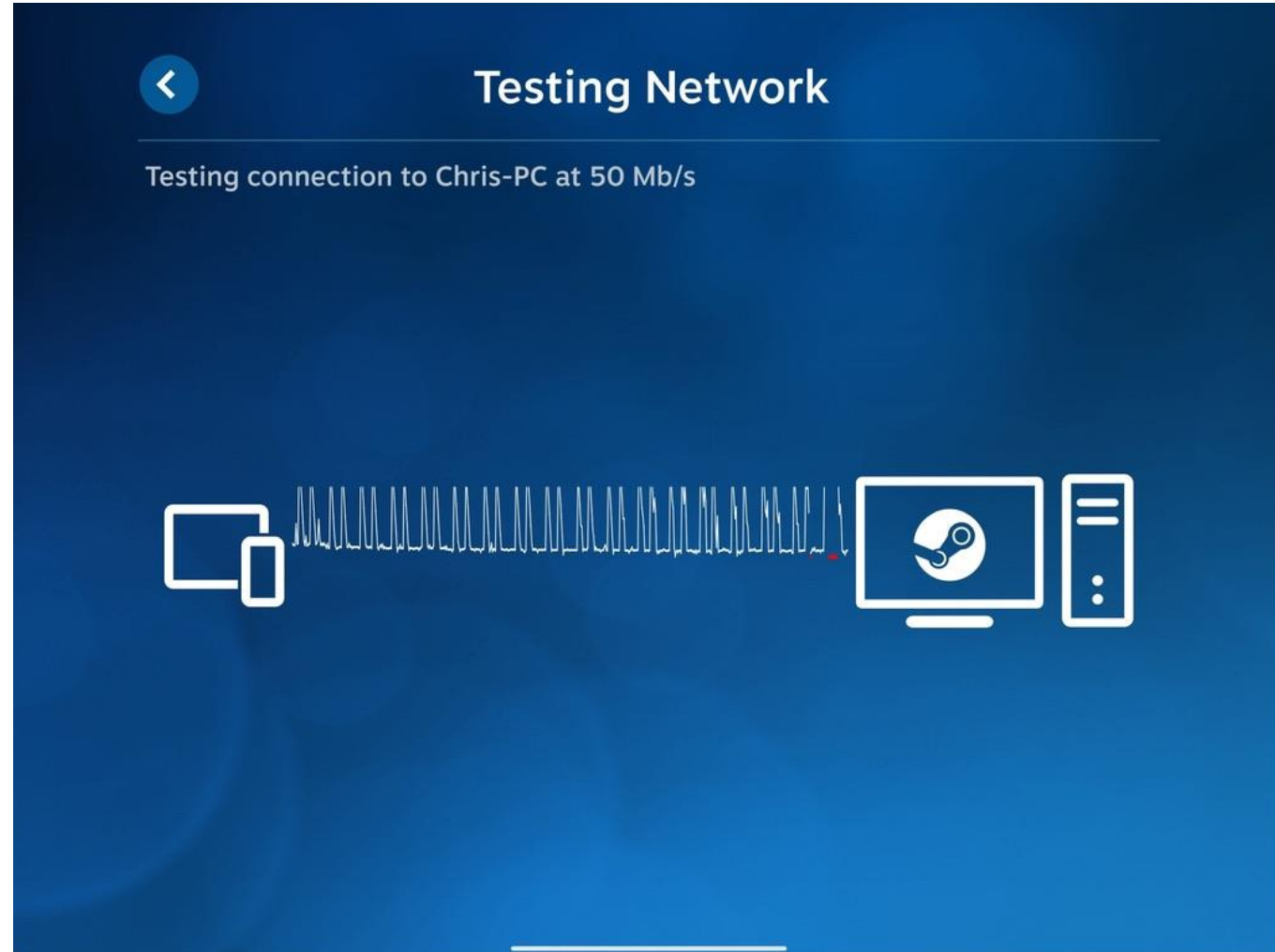
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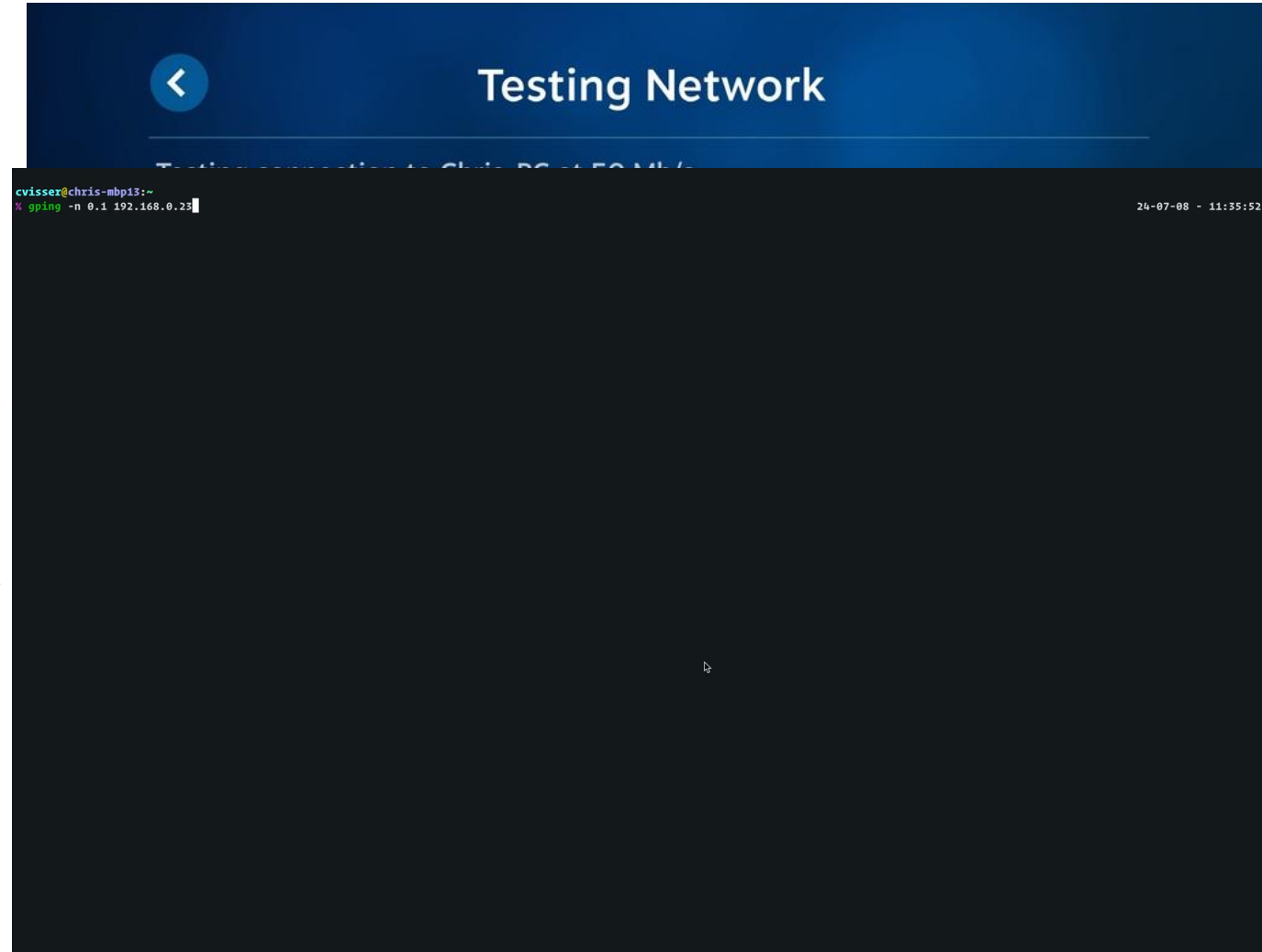
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- Steam Link
 - Same issue
 - But clearer to see the issue



- Steam Link
 - Same issue
 - But clearer to see the issue
- Run ping test from my MacBook
 - Same thing
 - Issue is not limited to my iPad



Maybe it is the network then?

- Again, what would cause such rhythmic issues?
- Tried:
 - Less congested Wi-Fi channels
 - 2.4 GHz
- Issue remains
- More digging required
- Google time:
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• Aga



r/VisionPro · 4 mo. ago

asikuna

Vision Pro Owner | Verified

• Tried

FIX: Streaming Stuttering (Moonlight, Virtual Mac, etc.)

- I've been seeing some posts about people stuttering when streaming games from their PC through Moonlight (and some other streaming methods, including the built-in Virtual Mac streaming). I also had this issue and
- sought a solution on Github. Thanks to the big brains over there, we seem to have one.

• Issue

If you're having issues with consistent "rhythmic" lag/stuttering, we found that changing your Wi-Fi channel to 149 (on 5 GHz in the US) completely solved the issue.

• More

This is allegedly due to AWDL (Apple Wireless Direct Link) intermittently switching to channel 149 to query and process peer-to-peer operations between other Apple devices, before switching back to whichever channel it was originally on. This is just my summation and understanding of what the fine people over there discovered, if you want to read more or join the conversation, [the link is here](#).

• Good

- [the moonlight streaming stuttering error screenshot](#)

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What is AWDL?

How does AWDL work?

In technical terms, [we found](#) that AWDL works essentially works as follow:

In short, each AWDL node announces a sequence of Availability Windows (AWs) indicating its readiness to communicate with other AWDL nodes. An elected master node synchronizes these sequences. Outside the AWs, nodes can tune their Wi-Fi radio to a different channel to communicate with an access point, or could turn it off to save energy.

We published an [Wireshark dissector for AWDL](#) if you are interested in the frame format details or if you want to know which other protocols might use AWDL.

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| Service | AWDL | BLE | Wi-Fi |
|------------------------------|------|-----|-------|
| Handoff (HO) | ✓ | ✓ | ✓ |
| Universal Clipboard (UC) | ✓ | ✓ | ✓ |
| Phone | ✗ | ✗ | ✓ |
| SMS | ✗ | ✗ | ✓* |
| Instant Hotspot | ✗ | ✓ | ✗ |
| Auto Unlock | ✓ | ✓ | ✗ |
| Continuity Camera | ✓ | ✓ | ✓ |
| AirDrop | ✓ | ✓ | ✗ |
| Apple Pay | ✗ | ✓ | ✗ |
| Wi-Fi Password Sharing (PWS) | ✗ | ✓ | ✗ |
| Sidecar | ✓ | ? | ✗ |
| Continuity Markup and Sketch | ✓ | ? | ✗ |

Table 1: Overview of Apple *Continuity* services and used link-layer protocols. Only one requires online iCloud access (✓*). All others communicate via local networks only.

The root cause

- AWDL negotiates on 3 fixed social channels (6, 44, 149)
- As part of AWDL the device needs to:
 - Listen if anyone nearby wants to talk to it
 - Advertise that is available to other devices
 - Negotiate which Wi-Fi channel to use when sending data
- But I like to optimise my network
 - Use channels that are empty
 - Big mistake
- In other words: periodically hopping between Wi-Fi channels

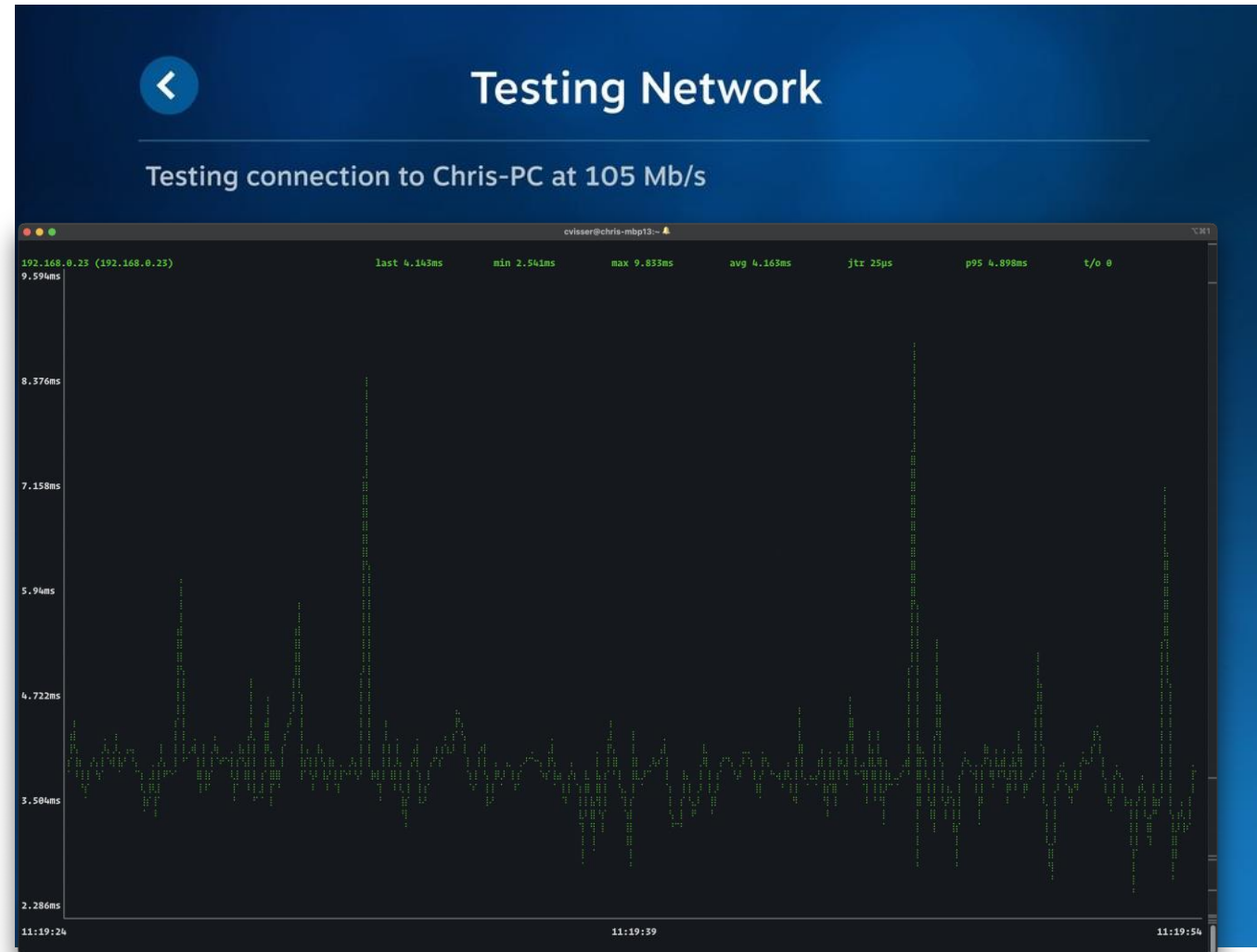
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- It works!
- Stable speed also increased
 - 50 Mb/s to 105 Mb/s



The fix: Networking the “Apple” way

- Swapping Wi-Fi channels to:
 - 6 for 2.4 GHz
 - 44 for 5GHz
 - (149 is not available in Japan)
- It works!
- Improved ping RTT
 - Max 92.4ms -> 9.9ms

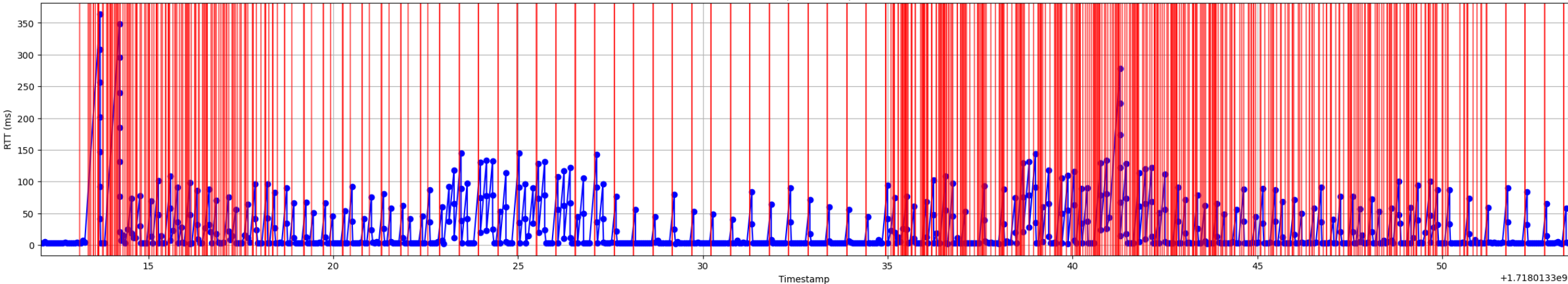


What is happening?

Comparing ping RTTs with AWDL packets seen

- Wi-Fi AP's channel set to 120
- Sniffing on a different laptop on channel 44
 - AWDL packets are hidden from the user on the host machine
 - All AWDL packets seen shown in red

RTT vs. Timestamp vs AWDL packets seen

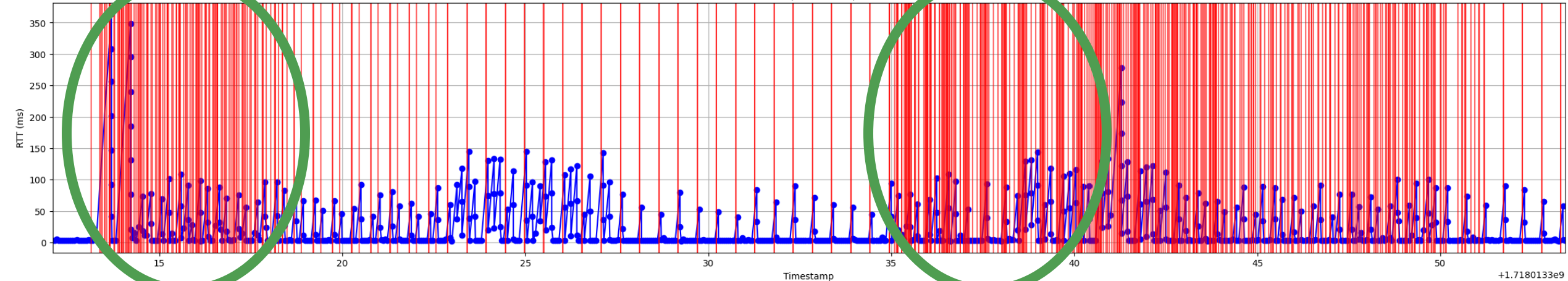


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RTT vs. Timestamp vs AWDL packets seen



Unlocked iPad

Unlocked iPhone

What are our options?

Option 1

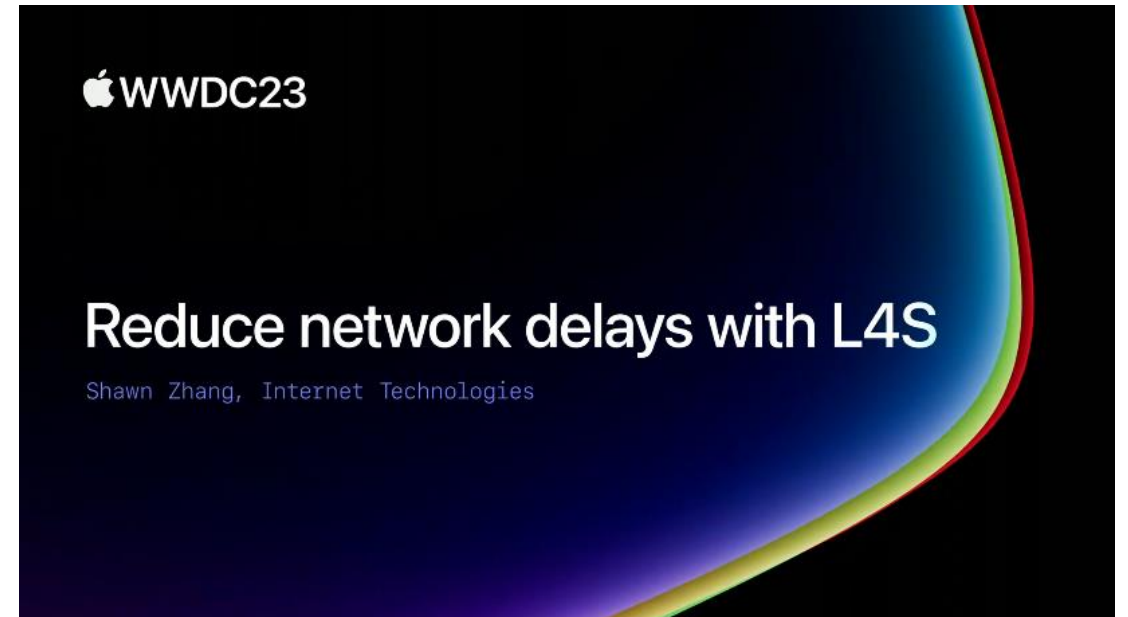
- Don't use AWDL
- No more:
 - AirPlay, AirDrop, Handoff
 - iPad Sidecar, iPhone Mirroring, Universal Clipboard
 - Auto Unlock, Continuity Camera, Continuity Markup and Sketch
- AKA, the Apple ecosystem
- But that only fixes the problem for me
- What about the other 1.5B iPhone users in the world?

Option 2

- The “Apple” way of networking
 - For the best experience use the same Wi-Fi channel as everyone else
 - Or suffer from jitter
- Newer faster APs won't fix this
 - Apple Wireless **Direct Link**
 - Social channels for 6GHz?
- RFC 9330 (L4S) won't fix this either
- Should Apple really decide how we do our networking?

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Where does this leave us?

- The “Apple ecosystem” is a double-edged sword
 - Is the convenience worth the potential disruption?
- “Bad” network practice can improve end user experience
 - Remember: Use Wi-Fi channels 6, 44, 149
- No “proper solution”
 - Unless you have one?
- Or is this not really a problem?
 - No packet loss, just increased latency during this time
 - Connection will stabilise... until another Apple device appears
- However, cloud gaming is still growing
 - Geforce now 20M, Xbox Cloud Gaming 34M

Questions?

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