Cleaning up the Mesh

Making AREDN more usable, reliable, and fun

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Who am I

Why am I here. How did this happen. Are you in the right room

- Tim Wilkinson - KN6PLV - tim@sfwem.net
  - Got my HAM license July 2021 because of AREDN
  - Developer on AREDN team
  - SFWEM Board member

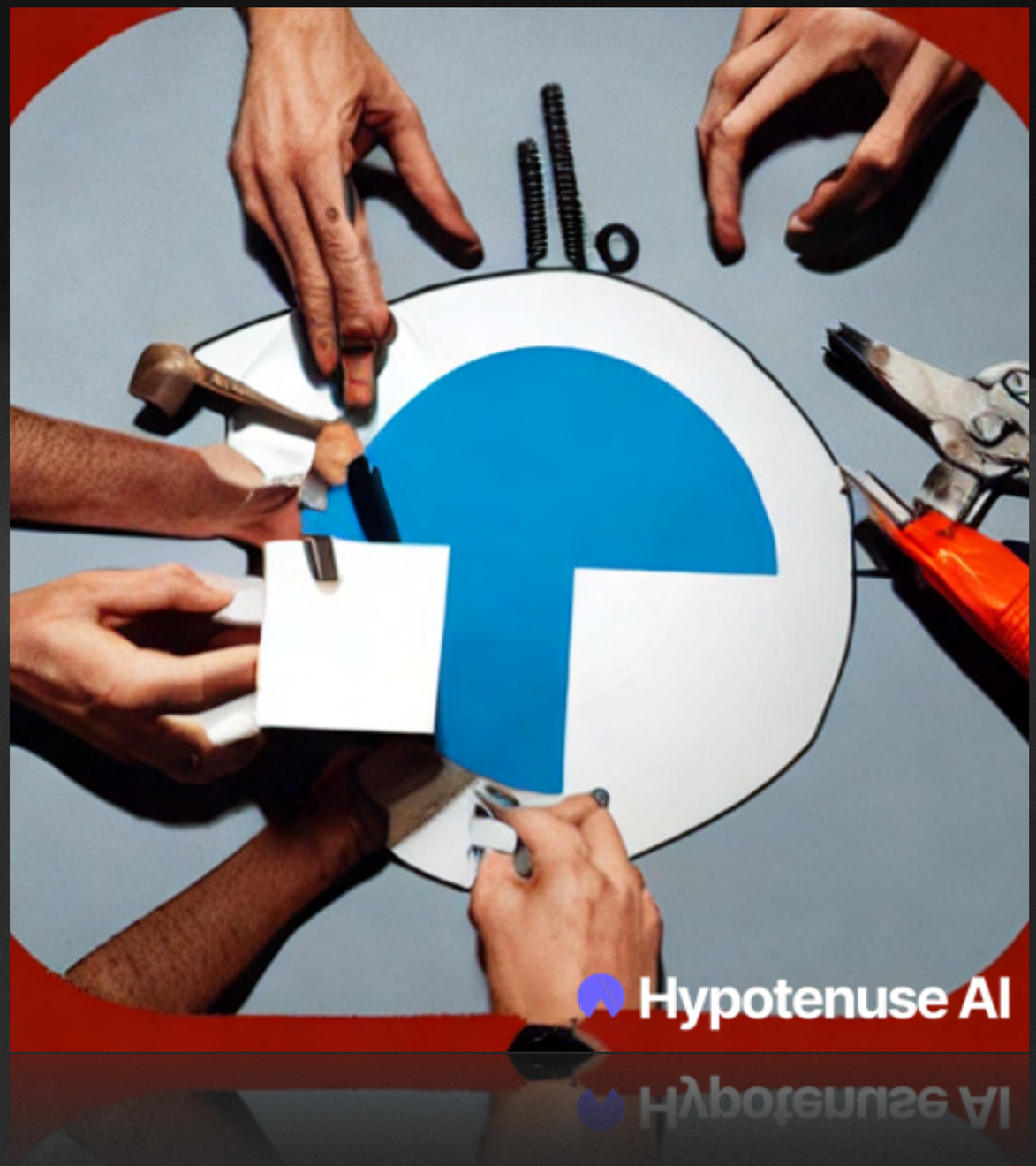
“This is what happens when you tell people you’re retired and have some free time”

Fixing things

- Fixing the updates
- Fixing the network
- Fixing the services

*When I needed an image, but didn’t have one, I created an AI image using Hypotenuse.AI

Fixing Things*



Fixing the Updates

Updates

They fail, and fail, and fail

- Updates often fail
- We’ve become superstitious about how to make them work
- What is the real problem?

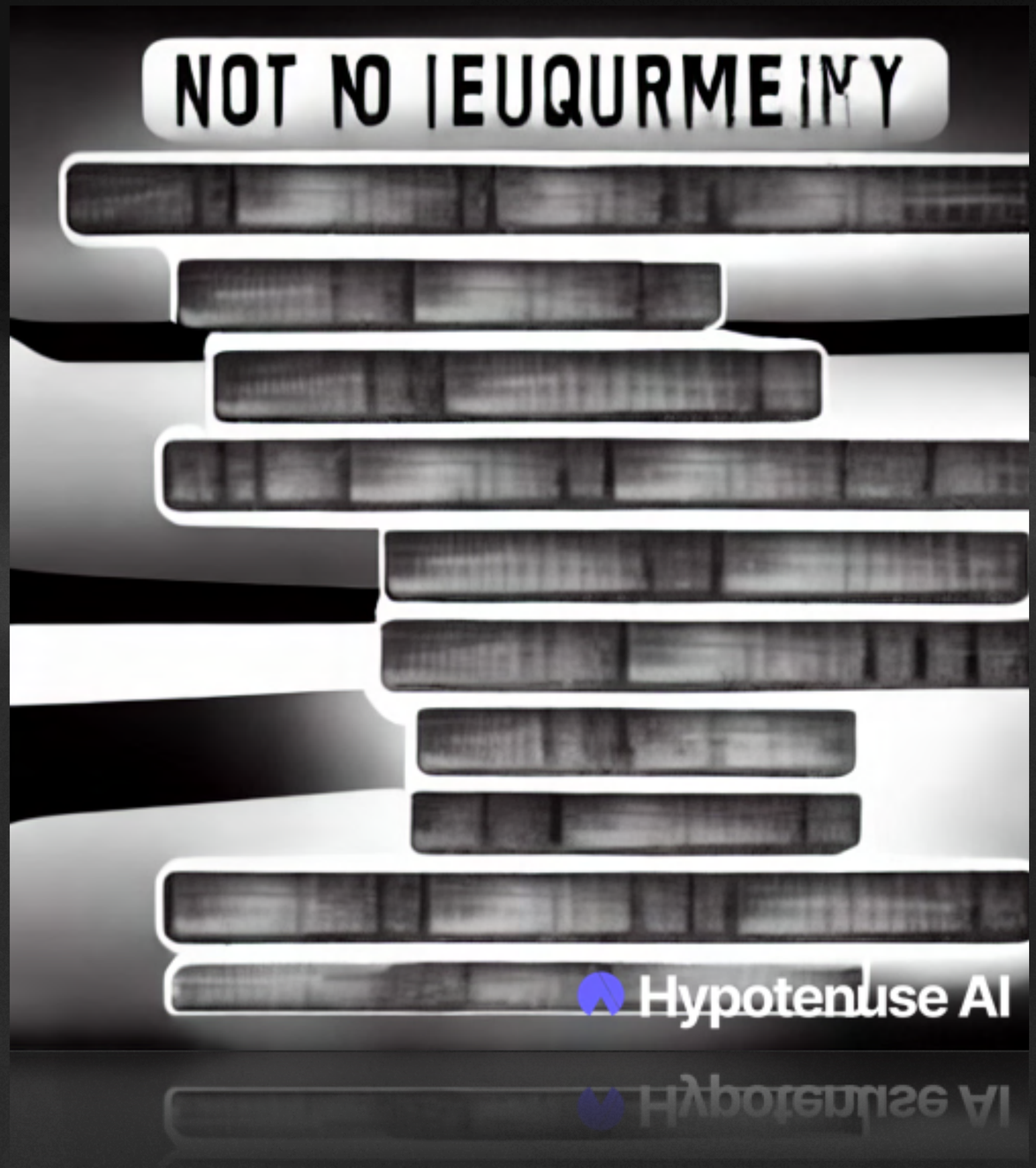
Failed updates

Updates

Not enough memory

- The updates images are too big
- There’s too little RAM to process an update while the node is running

Not enough memory

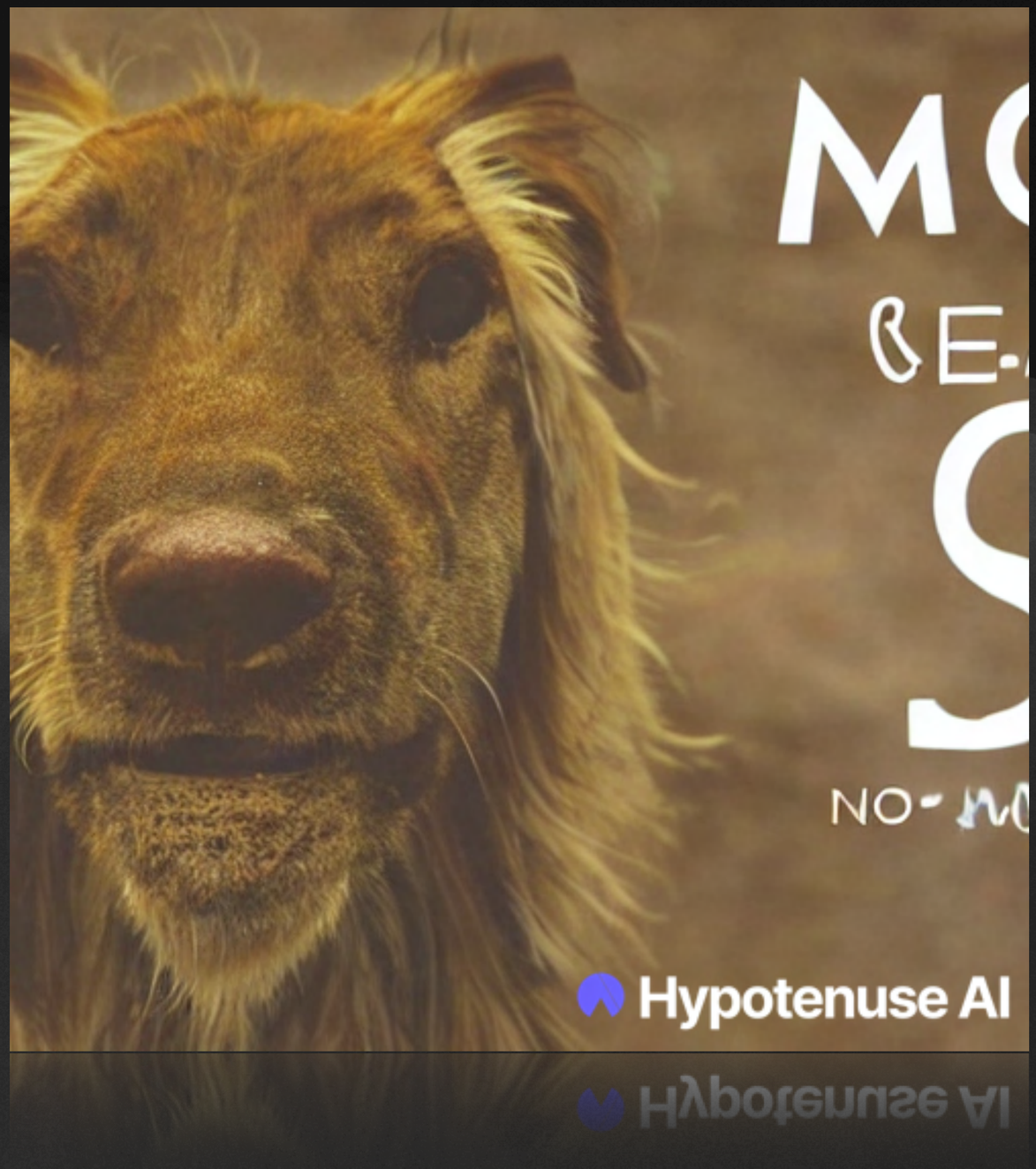


Updates

Stop the services and kill the Perl

- We can get more RAM for the update if we shutdown services
  - The old code tried, but failed
- We need less RAM if we have smaller images
  - Perl was half of the uncompressed image
  - Moved to LUA

No more perl or services



Fixing the Network

Network Storms

Network Storms

Storm Breaks

- We route using OLSR
  Optimized Link State Routing
- My first storm was August 2021
  - But they weren’t new
- Work from Pascal (KN6GFJ) identified the same packets going round the network many, many times
  - This clogs up the network making is useless

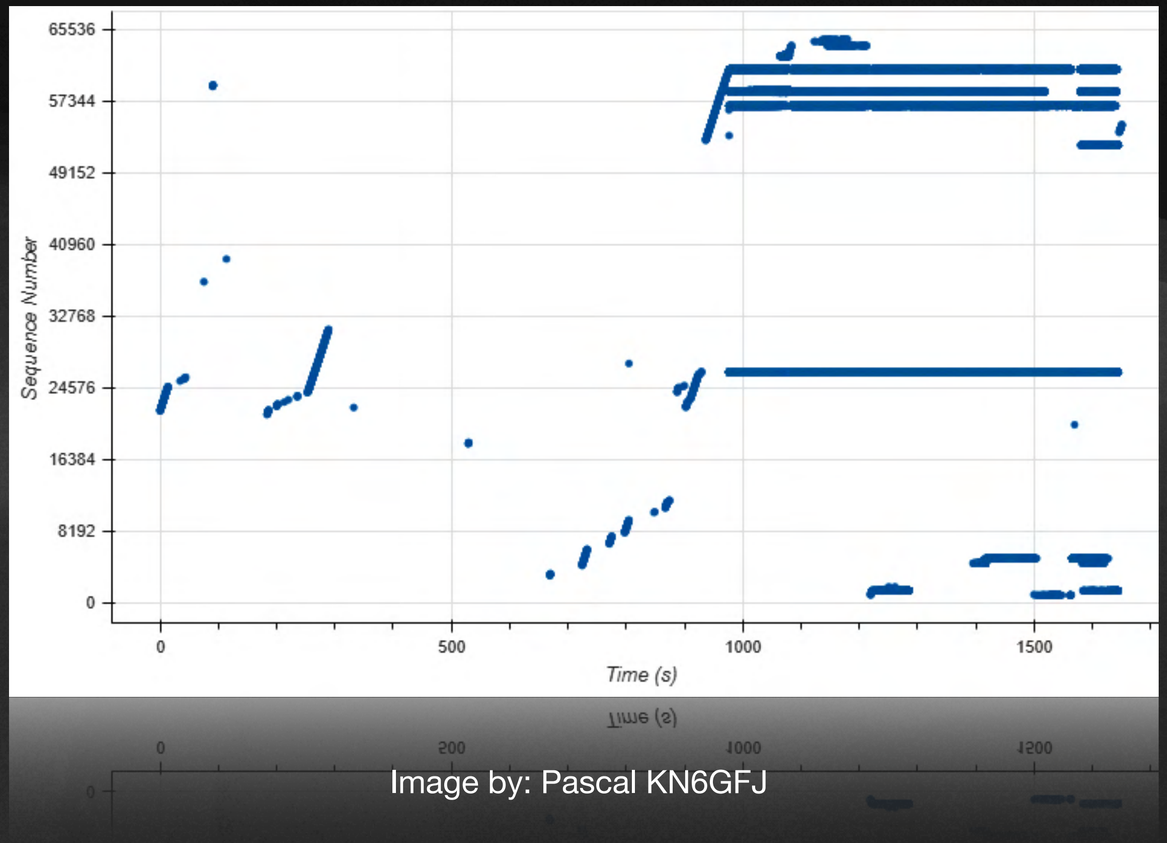


Image by: Pascal KN6GFJ

Network Storms

Calm after the storm

- Storms eventually subside
- Why do they start?
- Why do the end?
- How do we stop them?

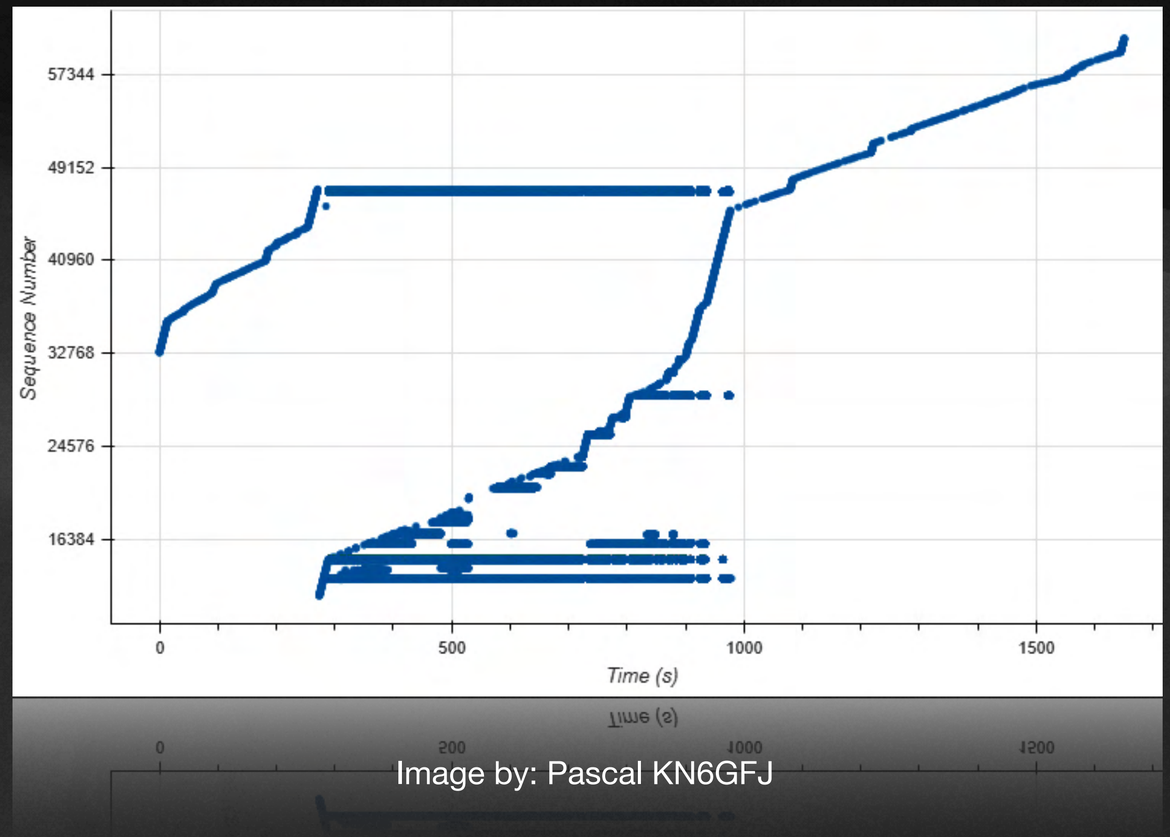


Image by: Pascal KN6GFJ

Network Storms

Circular sequence numbers

- Packets use a circular set of sequence numbers
- A packet is always valid if its sequence number < last sequence number + 5
  - But we can get loops

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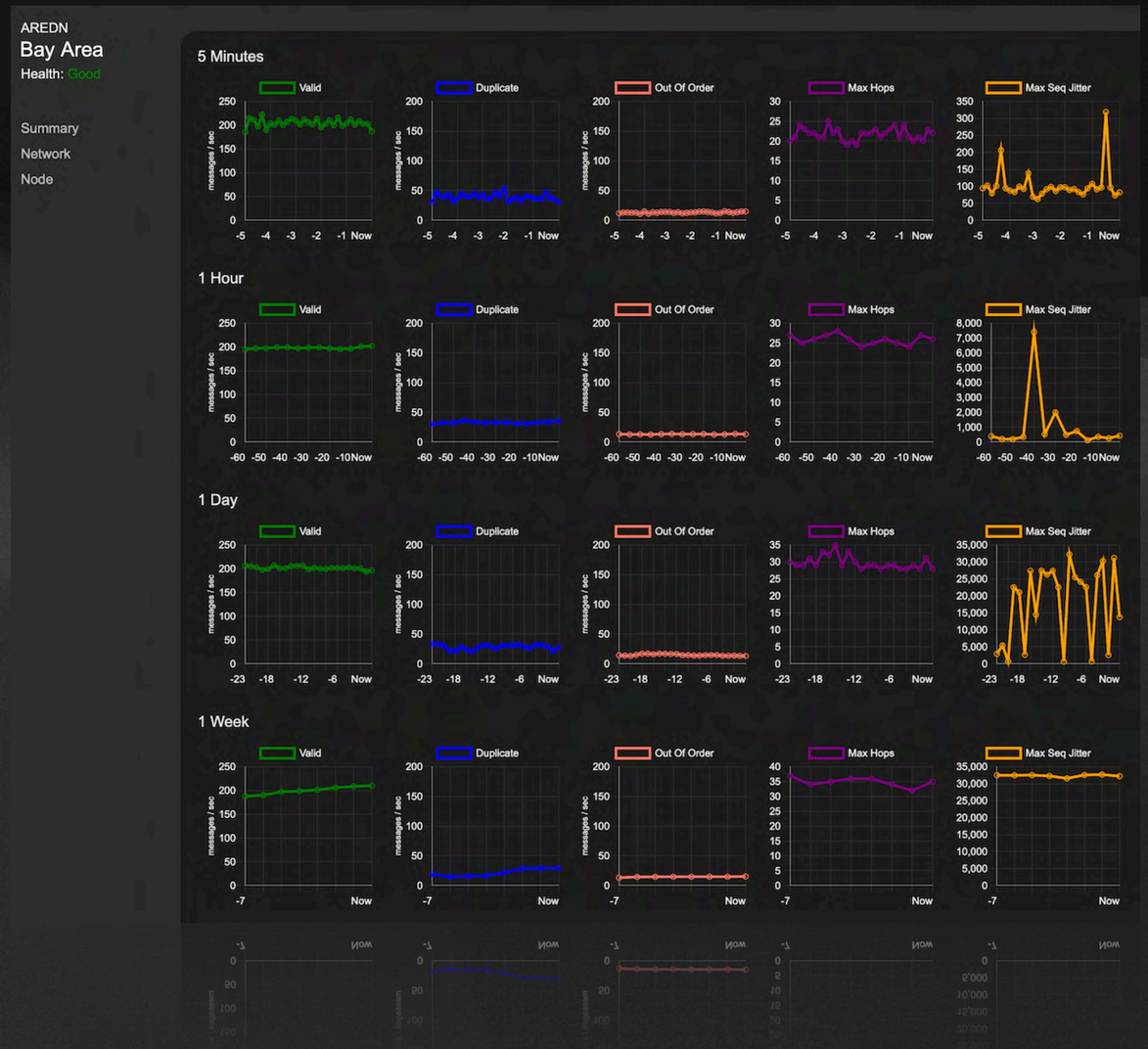
  - But we can get loops
- Remove the loops
  - Limit what is a valid packet by limiting valid sequence numbers

https://sfmon.xojs.org/

Network Storms

Can’t fix what you don’t measure

- SFWEM now monitors its network so it can log any storms
- Upside:
  - Interesting data about the state of the network
  - SMS alerts when storms are detected
- Downside:
  - Storms don’t happen anymore
- But what caused them?



Fixing the Network

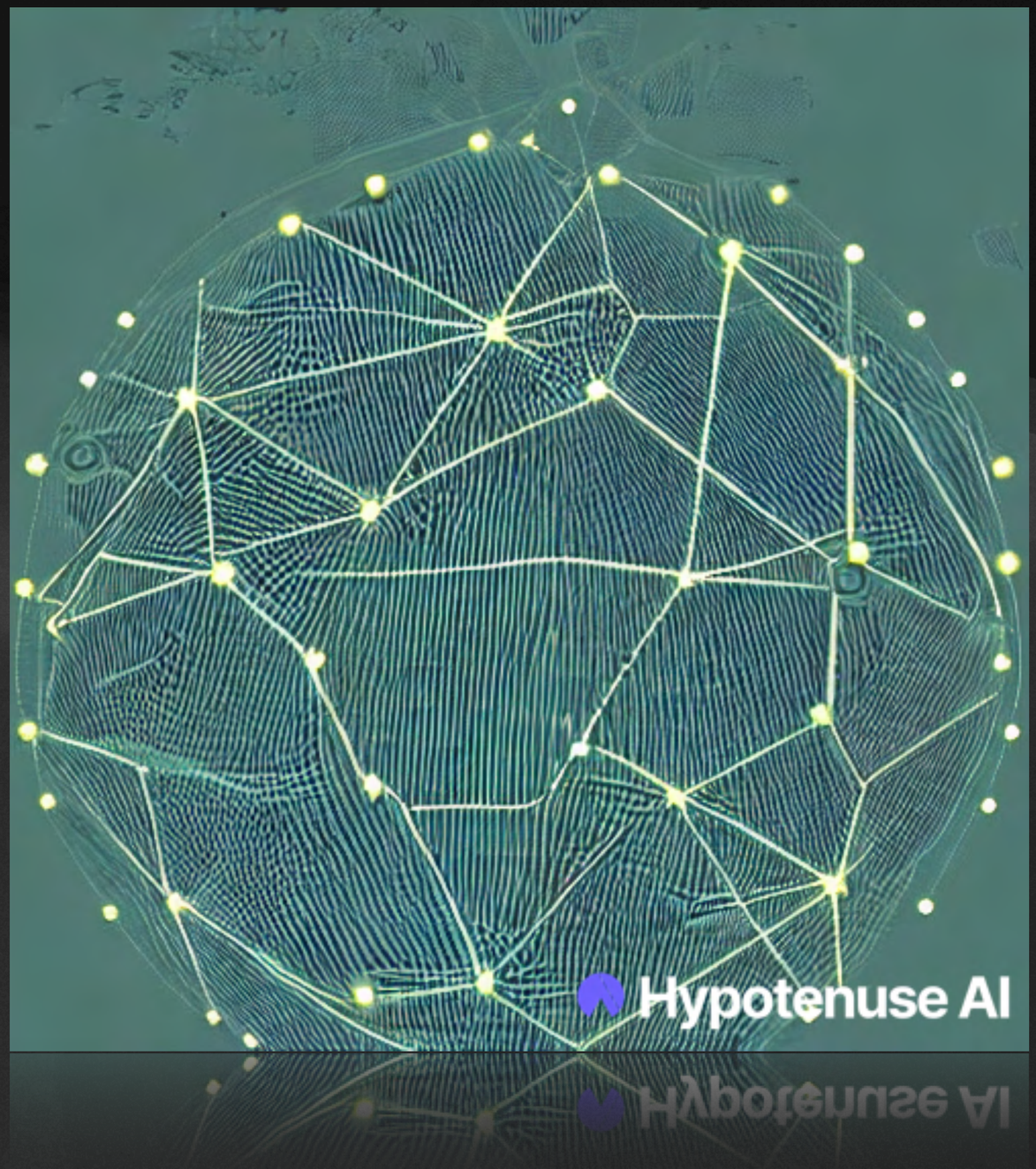
Link Speed and Quality

Link Quality

Slooooooowwwwww….

- Why are links slow?
- Sometimes we know
  - Lower power, high noise
  - Trees
  - Poor SNR
- Sometime we don’t
  - Great SNR
  - Short distances
  - Still terrible!
- Why is the speed between two nodes on my desk so bad!

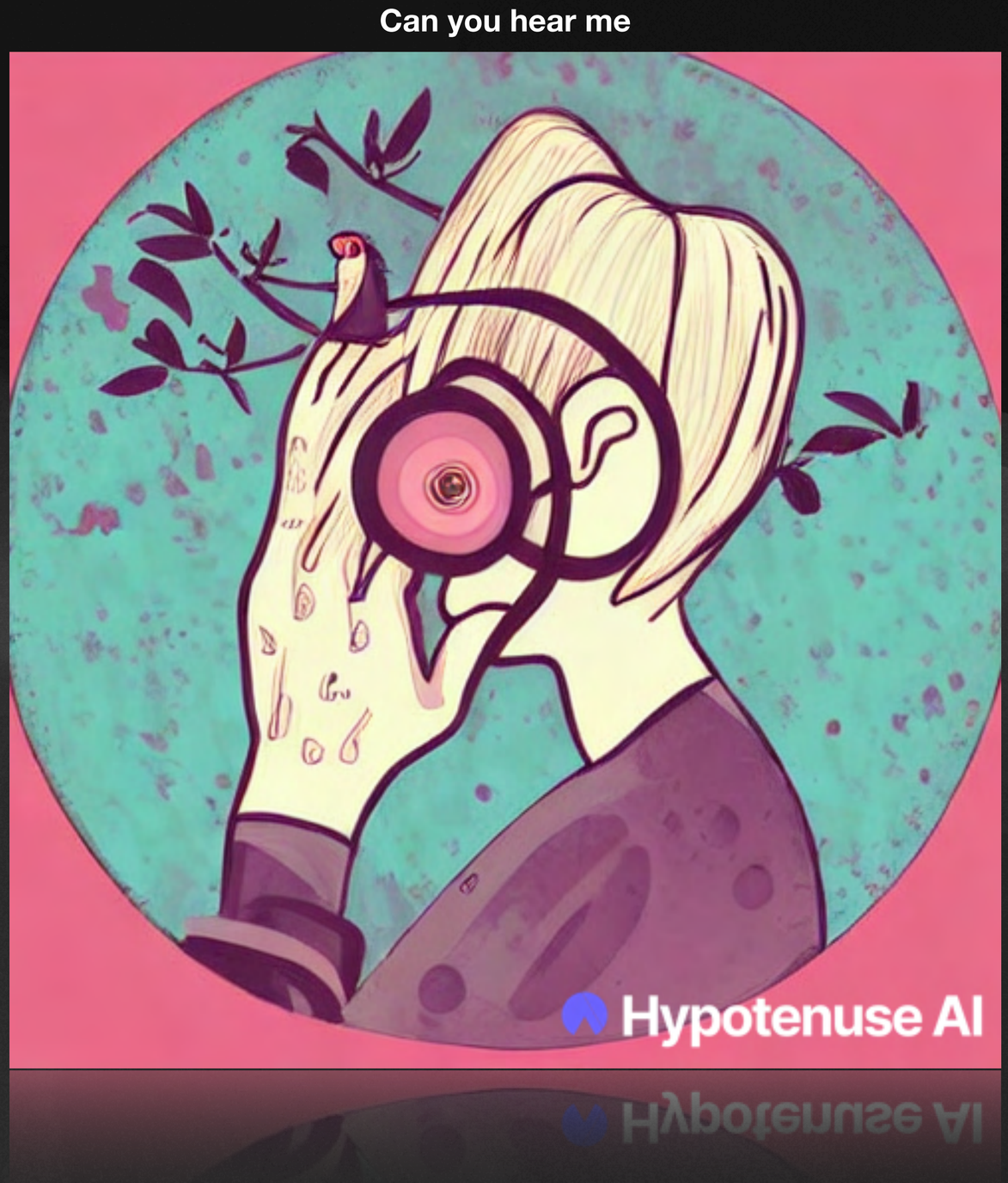
Slow network link



Link Quality

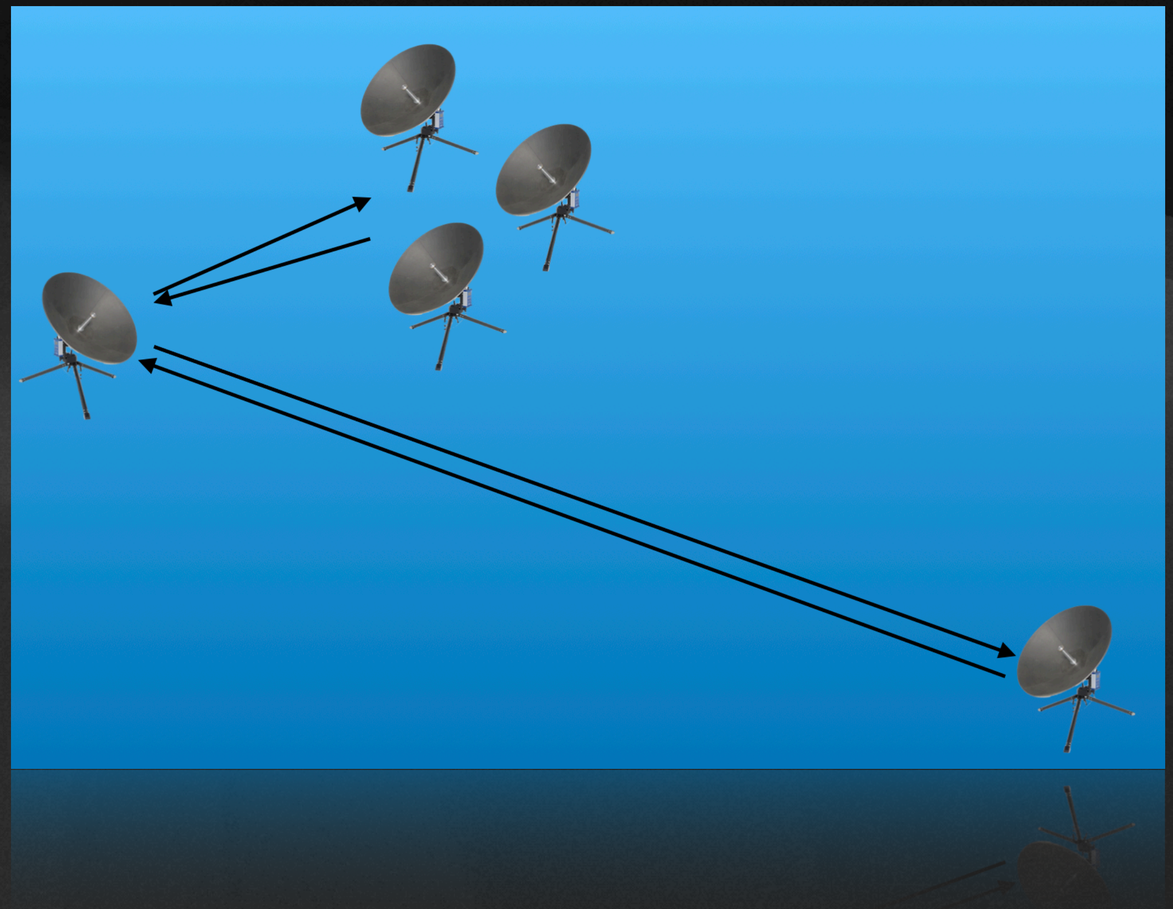
Can you actually hear me?

- What does a good SNR look like?
  - AREDN recommends 15 dB
  - People often use 10 dB
  - AREDN nodes seem happy to try using 3 dB
- AREDN software only cares about packet loss
  - Slow and fast links are the same!



Link Quality
Distance matters

- Every data packet sent get an acknowledgement in return
  - When an “ack” goes missing, a packet is retransmitted
- How long to wait for an ack?
  - It depends on how far away it is (the speed of light isn’t so fast that we can ignore it)

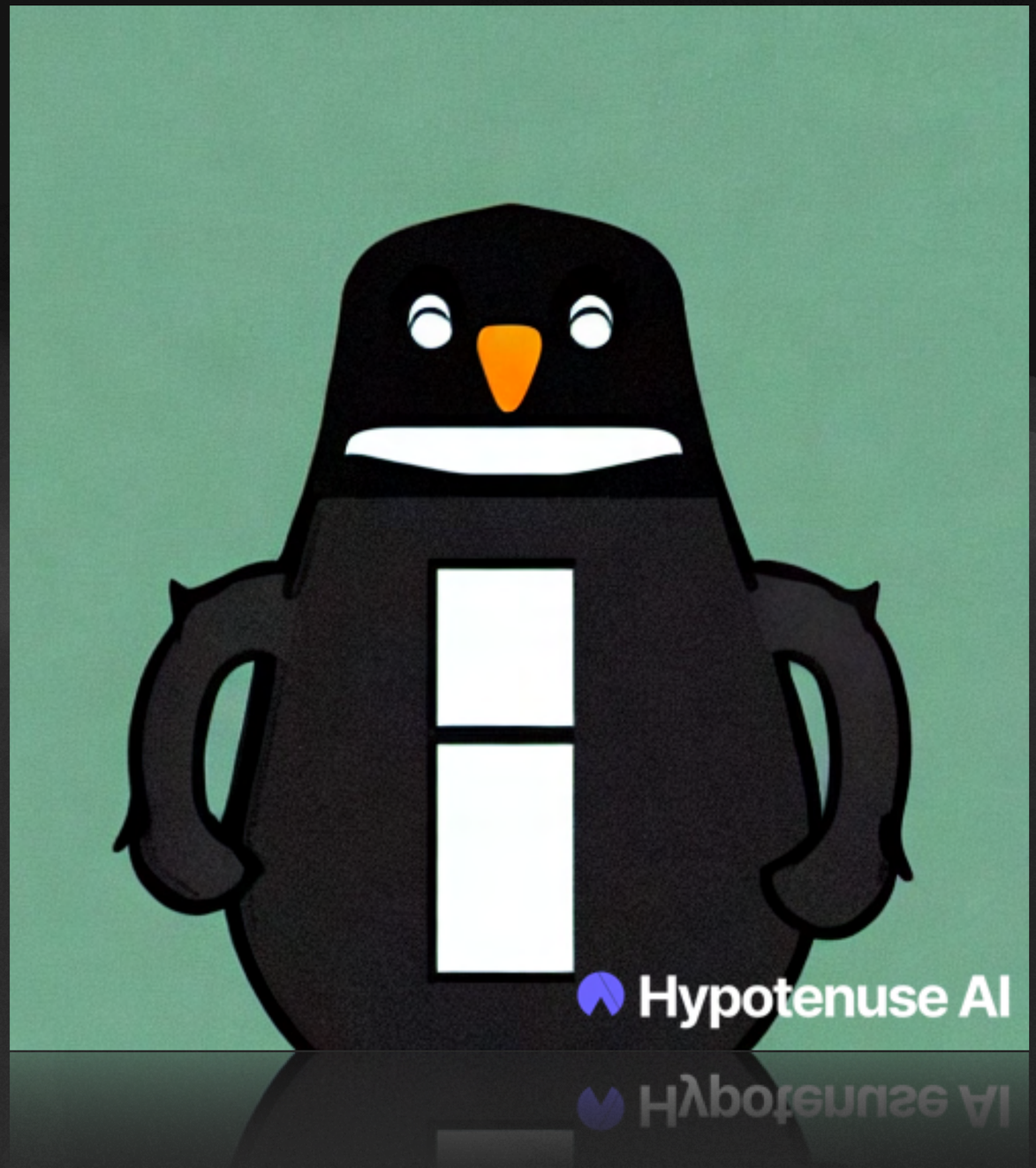


Link Quality

Linux can be dumb

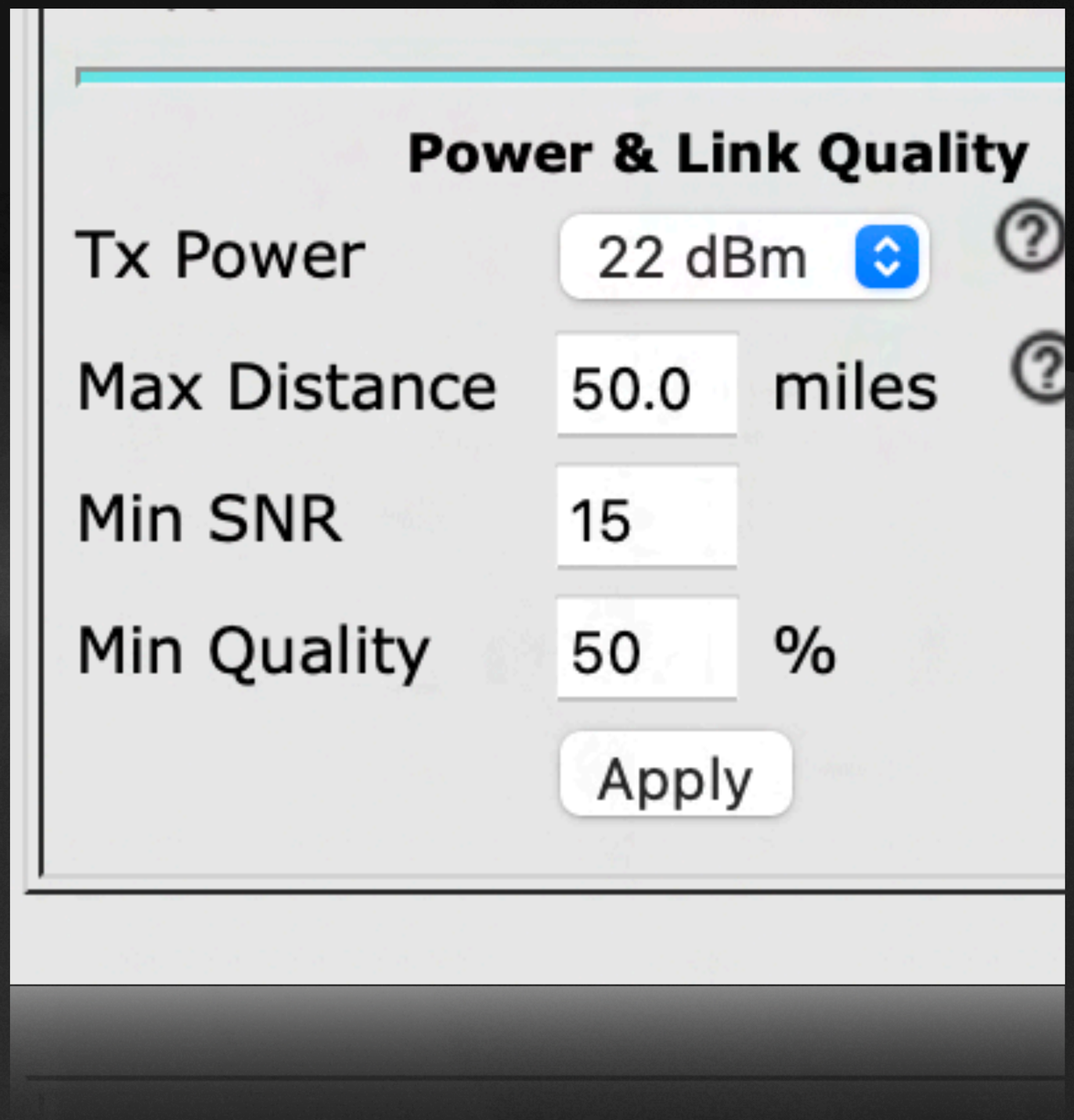
- The distance between nodes matters
  - We wait longer for acks from nodes which are farther away
- 802.11 WiFi spec allows us to specify the distance between radios
  - But only **one** distance for all nodes
  - Specification - “coverage”
- Linux will calculate this
  - And gets is wrong because low, unused SNRs are just as valid

Linux can be dumb



Link Quality
Management

- We can improve radio bandwidth in various ways:
  - Limit distance to nodes
  - Require a minimum SNR
  - Ignore links with lots of retransmissions
- Take control of the radio “coverage”

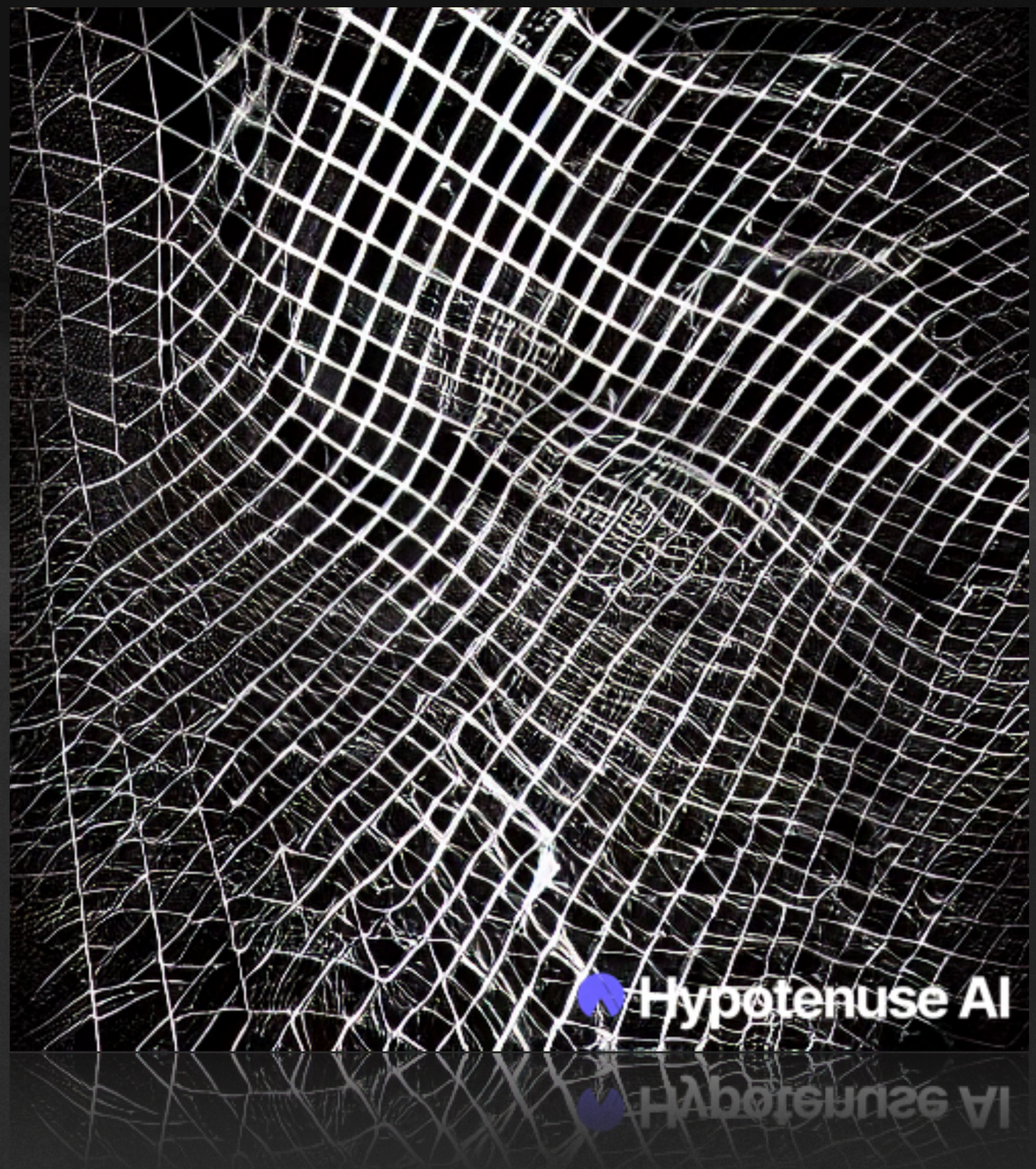


Fixing the Services

Names and Services

- The mesh can seem broken
  - Click on a node which isn’t really there
  - Click on a service which isn’t available
- It’s a poor user experience

The mesh appears broken



OLSR

Limitations of old

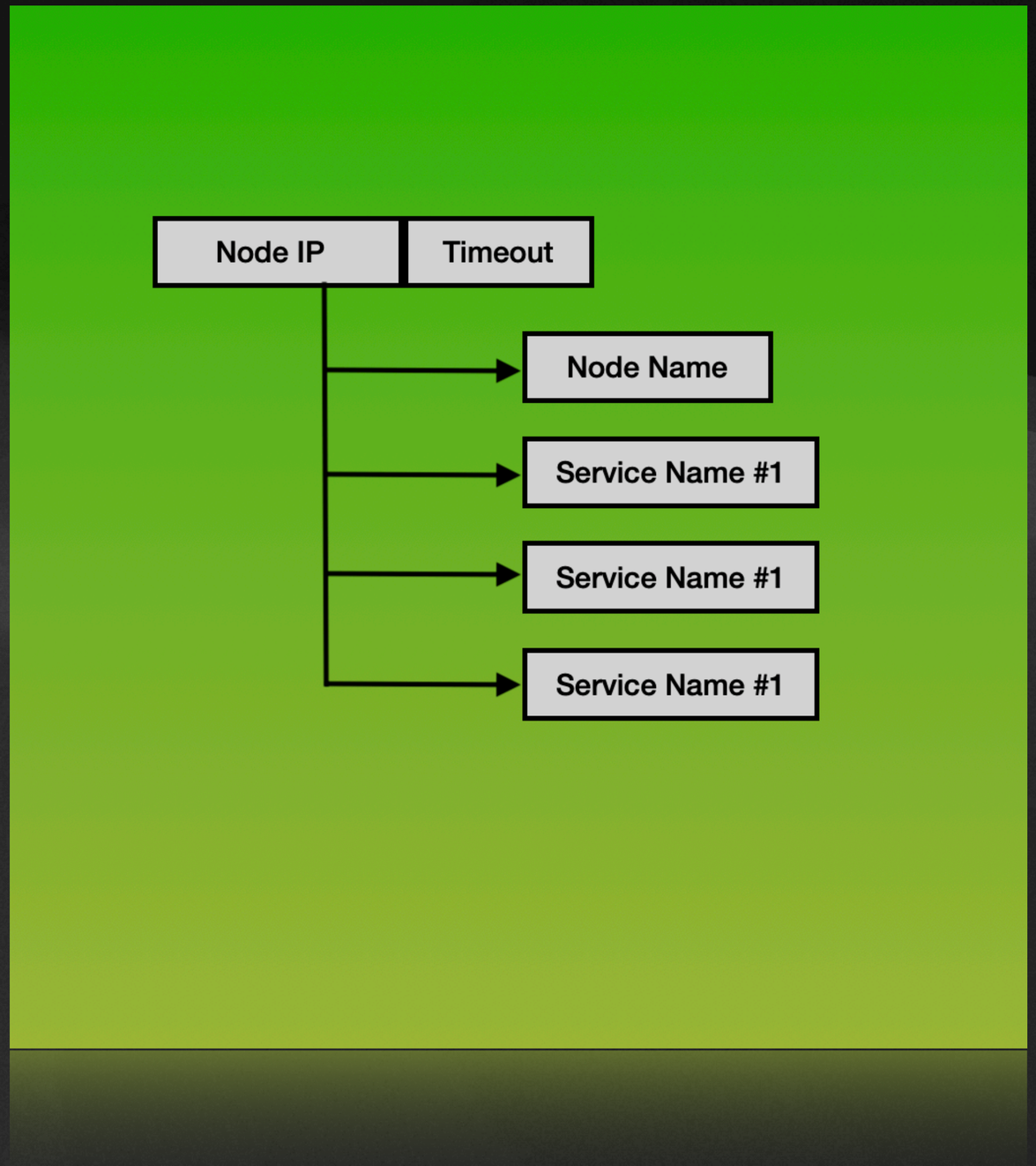
- If a node is on the network
  - Every name it has every had will exist on the network
  - Every service it ever published will exist on the network
- The only way to fix this is to power off the node for 30-40 minutes!
  - Not a great solution

Nothing ever dies

OLSR

Why did this happen?

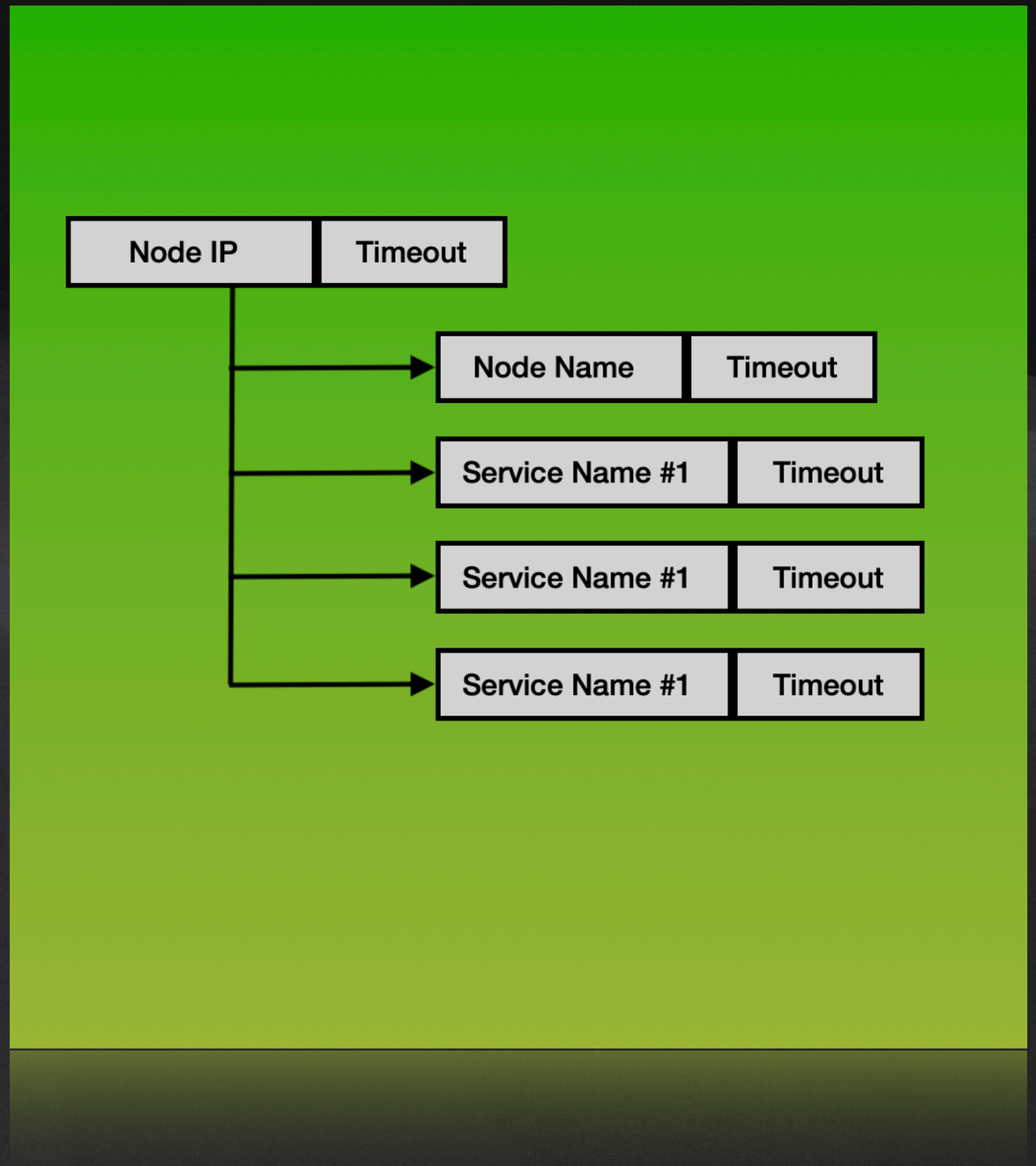
- One timeout per IP address
  - Each node advertises itself to the network every so often
  - Each node advertises its services to the network every so often
  - As long as the node is seen, everything it every said about itself is remembered



OLSR

How it was fixed

- Now we keep a timer for each name and service
  - Even if a node exists, if the service hasn’t been advertised in a while, it will be forgotten
  - Same for old node names

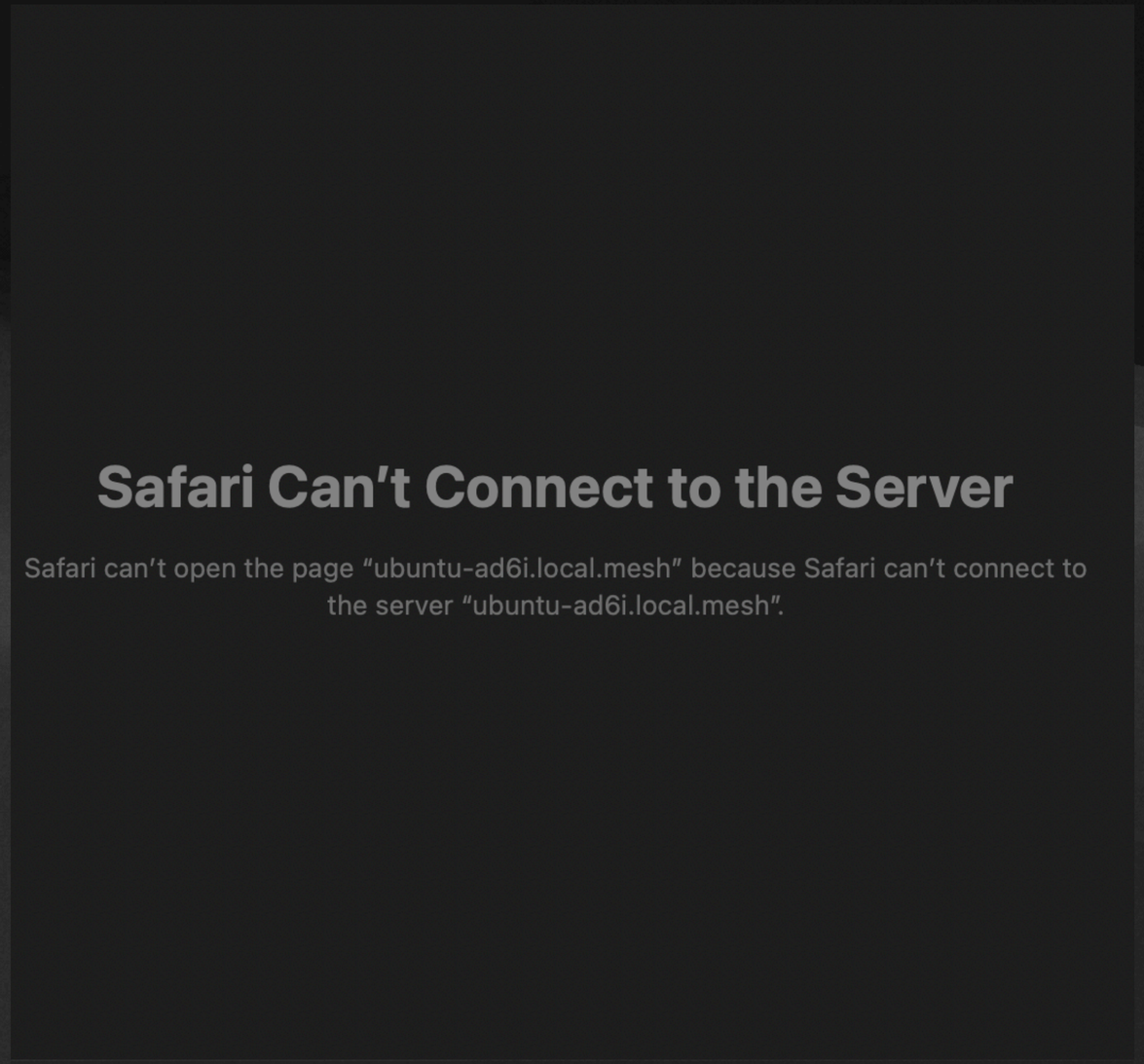


Okay … but what if a service isn’t actually working?

Services

Are you there?

- We’re publishing only what we mean to … but …
  - What if the service is down?
  - What if the service has been badly configured?
  - What if the service was once installed and now forgotten?
- It’s still a poor user experience

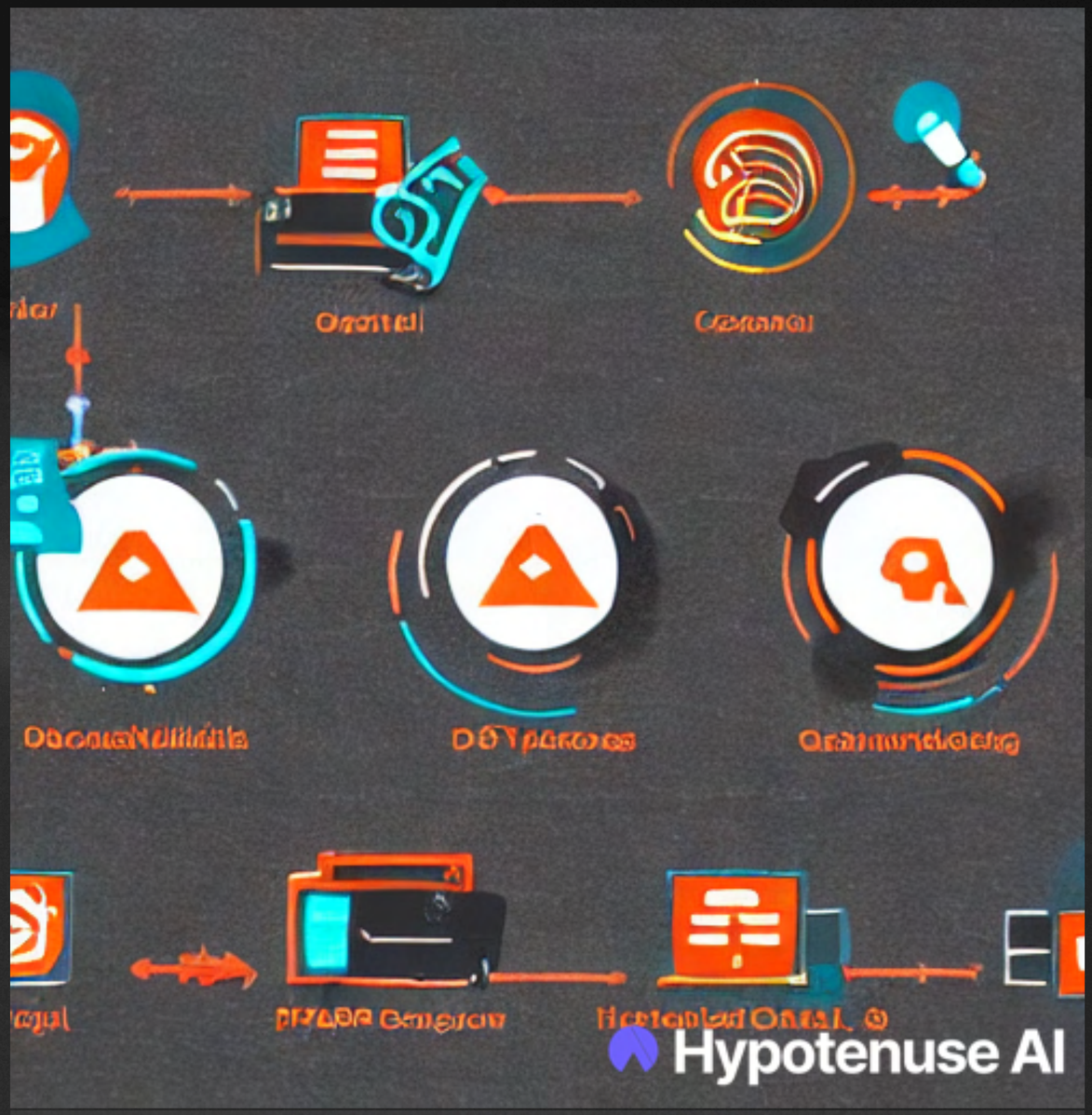


Services

Arp, ping and curl them

- Check services are really available
  - Can we ping the hostnames?
  - Can we fetch the webpages we publish?
  - Is that NTP server really there?
- If not … we stop publishing them until they are available again

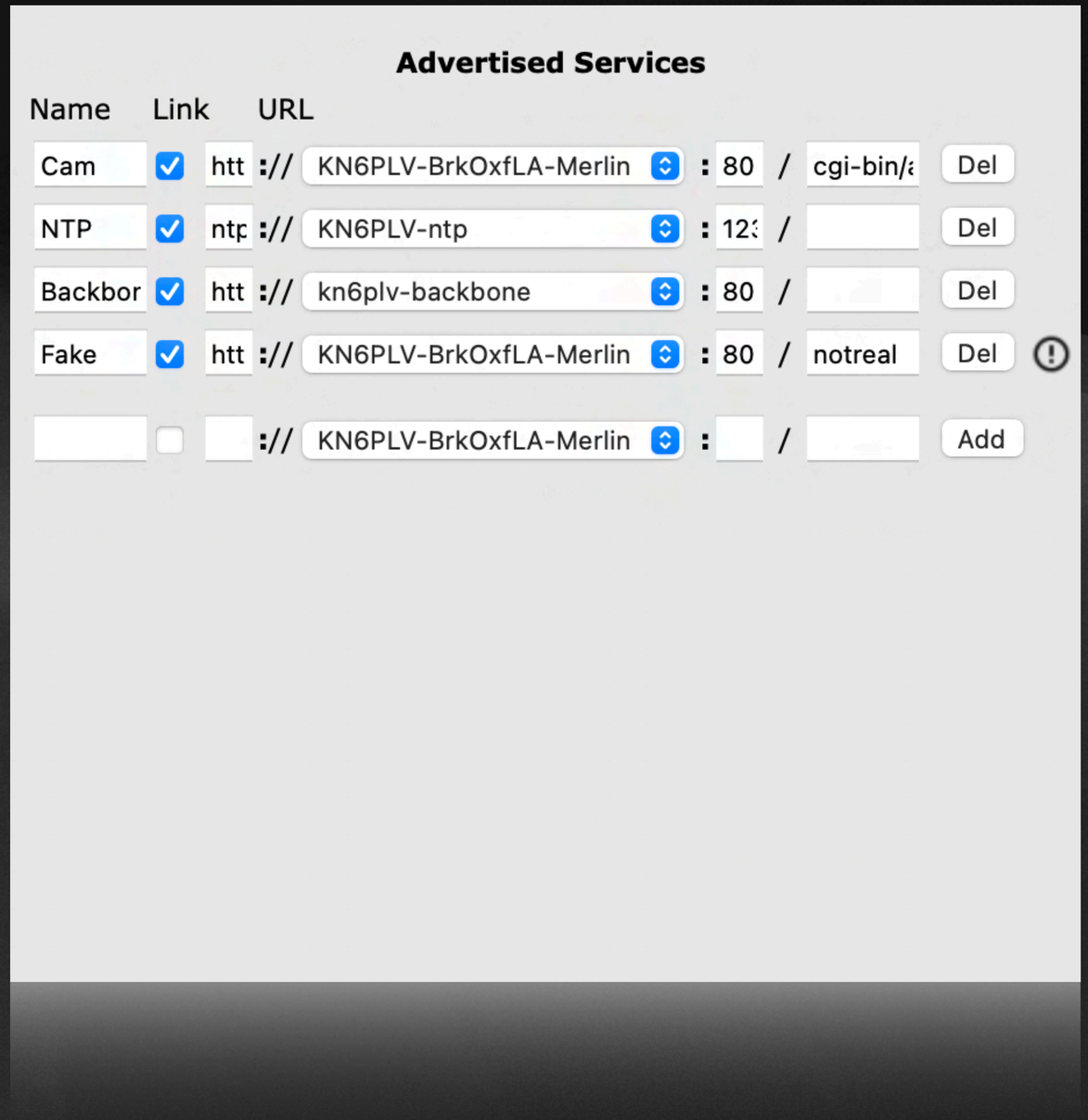
arp ping and curl services to check they're available



Services

Not advertising failure

- We mark services we are no longer publishing
- Better for the consumer, but we can do better for the publisher
  - Why is this service failing?
  - Good consumer experience … but a bad producer one



Conclusions

Conclusions

More better … but …

- Outlined improvements and changes to make AREDN “better”
  - Updates are easier
  - Network is more resilient
  - Services are actually available
- BUT…
  - Still more network improvements needed
    - OLSR changes, or …?
  - Are things too complex now?