- This is an introduction course. Terminology and concepts have been simplified to better facilitate learning.



Meshtastic 101

WELCOME TO THE MESH



Off-grid messaging & location sharing with LoRa –

no cell service or WiFi needed!

Why “Meshtastic 101”?

My Initial Experience:

- Frustrating
- Confusing
- No successful communications
- Time and money wasted

Other Meshtastic Presentations:

- Cool scenarios - just not my scenario
- Custom-built hardware - not off-the-shelf
- Assumed more experience/understanding than I had

Meshtastic 101: the VERY basics

1. What is Meshtastic?
2. What **ISN'T** Meshtastic?
3. Why use Meshtastic?
4. What is a Mesh?
5. What is LoRa?
6. Hardware
7. Software/Firmware
8. Configuration
9. Getting Started
10. Tips & Troubleshooting
11. Fun Things You Can Do on the Mesh



What is Meshtastic?

What is Meshtastic?

TL/dr:

- Meshtastic is off-grid messaging & location sharing with LoRa – no cell service needed!

- Think of it as a “Walkie-Textie”

What is Meshtastic?

- Open-source, decentralized, off-grid mesh network
- Runs on affordable ($20–$100), low-power devices (“radios”, “nodes”)
- Text messaging, GPS location sharing, and basic telemetry
- Works without internet*, cell towers, or any central infrastructure*
- Community-driven project (100% volunteer-built)
- 200 maximum characters per message (LongFast)
  - The longer the message, the more likely it is to NOT be delivered
  - Emojis are okay, but each one counts as 4-characters
- Line of sight
- ISM Band (915 MHz in the USA)
- Record Transmission: 331km / 205 Freedom Units



What ISN'T Meshtastic?

What ISN'T Meshtastic?

- Fast
- Everywhere
- Voice
- Video
- Attachments / file transfers

What ISN'T Meshtastic?

LoRaWAN: Licensed/gateway-based version of LoRa (star topology, for IoT sensors, requires infrastructure & often fees)

MeshCore: Another open-source LoRa mesh project (similar hardware, but different routing: more repeater-focused, higher hop limits, better for large-scale fixed networks; not compatible with Meshtastic); very popular in England

Reticulum: ("RNS") is a cryptography-based networking stack designed for building resilient, decentralized networks using whatever hardware and mediums you have available — including LoRa, packet radio, Wi-Fi, Ethernet, I2P, and more

Wi-Fi HaLow (IEEE 802.11ah): "long-range Wi-Fi" designed specifically for IoT and low-power, wide-area use cases. It operates in the sub-1 GHz band (like 900 MHz in the US, same unlicensed spectrum as LoRa/Meshtastic), which gives it much better range and wall/terrain penetration than regular 2.4/5/6 GHz Wi-Fi.



Why use Meshtastic?

Common Use Case Scenarios

- Hiking, hunting, camping
- Skiing, snowboarding, snowshoeing
- Emergencies, disasters, grid-down
  - Recent Verizon outage
- Events
  - Especially in dense areas (arena, convention, etc.) where cellular may be overwhelmed
- Tracking assets / children
- Communication without needing cellular / WiFi
  - Kids at school / on the bus (i.e., old phone, no cellular plan)

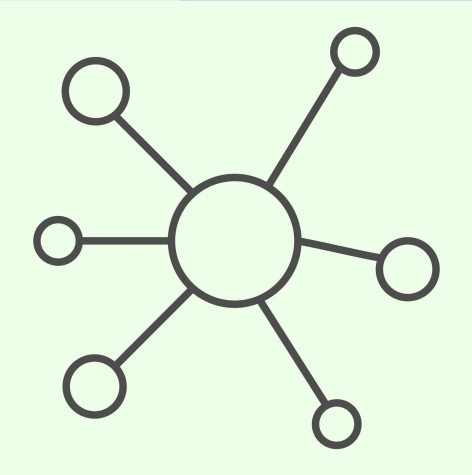


What is a "Mesh"?

What is a "Mesh"?

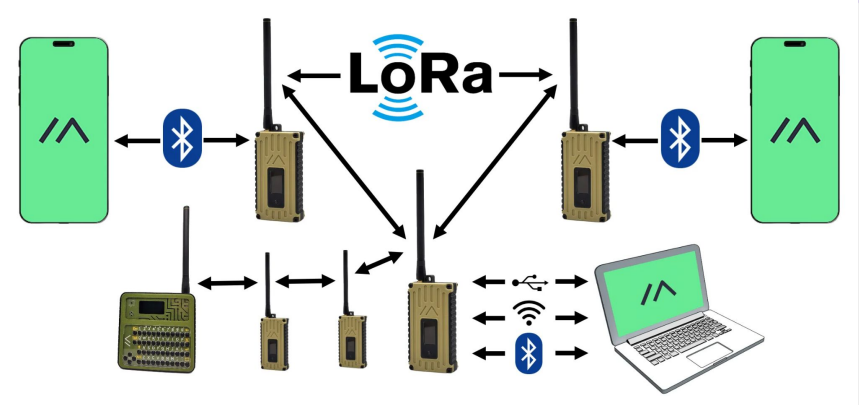
In a traditional cellular network →

Every device talks to a centralized tower (star topology)



In a mesh →

Devices pass messages along and across the crowd until it reaches the device you want (or until it runs out of hops)





What is LoRa?

What is LoRa?

LoRa: a wireless modulation technique; “Long Range”

Operates in unlicensed sub-GHz bands (e.g., 915 MHz in US, 868/433 elsewhere; ISM bands)

Key advantages: Very long range (miles to tens of miles line-of-sight), low power, penetrates obstacles better than Wi-Fi/Bluetooth

Low data rate: Perfect for short text messages & small data packets (not for voice/video)

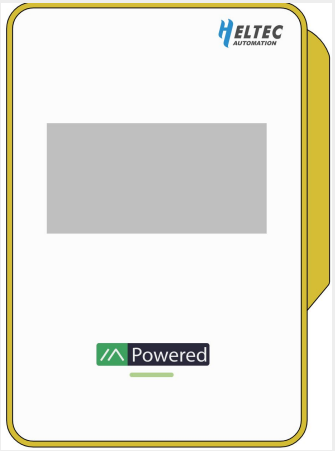
Interference resistant: Different spreading factors are orthogonal (they don't interfere much), so many devices can talk at once; chirp



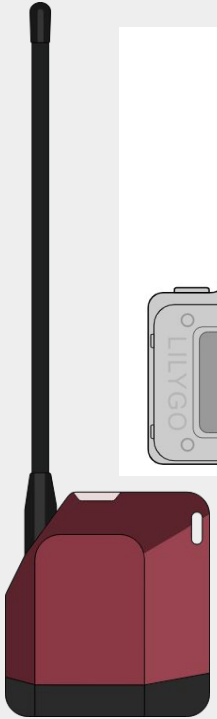
Hardware ("nodes" / radios)

Devices


ThinkNode-M3

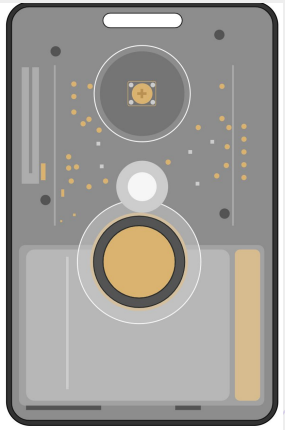

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Devices









Device Roles

CLIENT: This is the right choice for most situations; CLIENT nodes receive, send, and intelligently repeat messages to help the mesh.

CLIENT_MUTE: Use with a personal handheld device when located near a more powerful node (such as a rooftop/cartop node: “CLIENT_BASE”) in a congested or sparse mesh.

CLIENT_BASE: Use for a stronger or well-positioned attic/roof “base station” node to distribute messages more widely from your own weaker, indoor, or less-well-positioned nodes; Set your other nodes as “favorites” on the CLIENT_BASE.

Devices Roles

TRACKER: this is a specialty role designed to do just what it says - track stuff.

Ideally, only use a node in this role which:

- Has GPS built-in
- Will **not** be used as a CLIENT to send/receive non-tracker messages

To conserve battery, nodes in this configuration try to “sleep” as much as possible, and only wake up to send updated telemetry to the mesh.

They don’t help to “build-out” the mesh.

Avoid ROUTER and REPEATER roles!

Using **ROUTER**, **ROUTER_LATE**, and **REPEATER**, roles unnecessarily can cause serious network issues:

- Increased risk of packet collision
- Reduced message delivery rates
- Decreased effective network range due to unnecessary hop consumption

These roles are for very specific applications. **Coordinate with your local community before deploying a node in these roles.**



Software & Firmware

Software & Firmware

“Firmware” runs on the node:

- Firmware is installed (“flashed”) on most devices via USB/Serial in “DFU” mode
- Difficult to remotely flash updates (keep in mind for remote nodes)
- https://flasher.meshtastic.org

“Software” runs on a separate device:

- iPhone/iPad or Android phone/Android tablet: App Store/Play Store
  - Bluetooth, USB/Serial
- Web Browser: https://client.meshtastic.org
  - Bluetooth, Ethernet, Wi-Fi, USB/Serial
- Python CLI: https://meshtastic.org/docs/software/python/cli/installation
  - typically via USB/Serial

Software & Firmware

Once the app is installed on your phone or tablet, it **does not** need a cellular or WiFi connection to the Internet.

Your phone or tablet is basically the **screen**, **keyboard**, **notification** sound/LED, and **GPS**.

The “Current” stable version is the latest “beta”.



Configuration

Configuration

Many devices (“nodes”) come with the latest version of the Meshtastic **firmware** already installed, and the device set in the **CLIENT** role.

When setting up your node for the first time, make sure to select the correct “**Region**”.

Presets are used to configure your node’s radio. The most common Presets are:

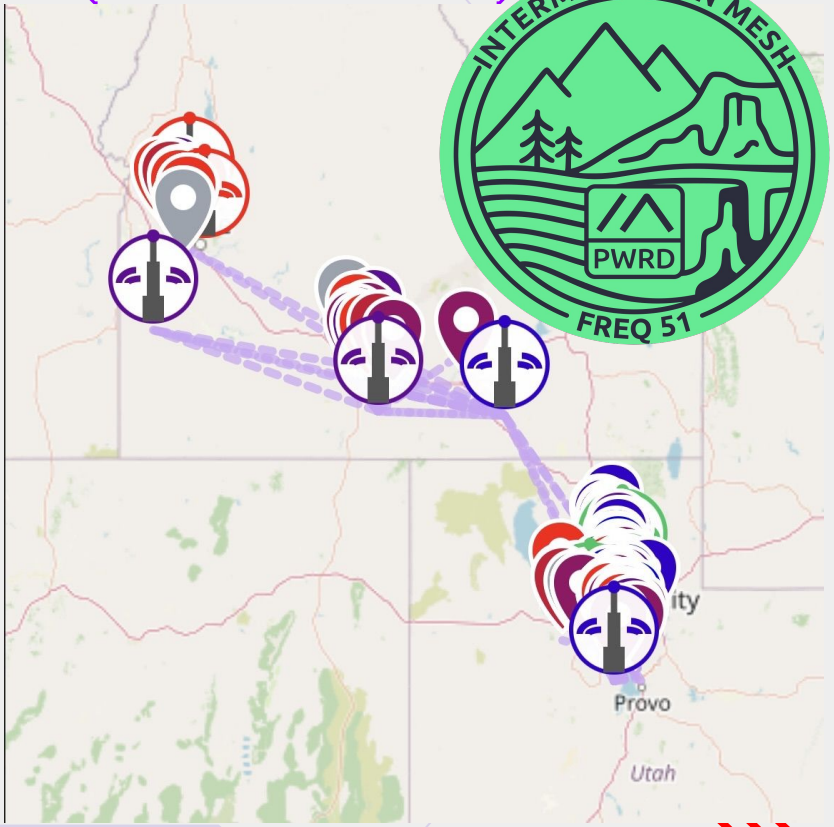
- Long Range - Fast (“LongFast”)
- Medium Range - Fast (“MediumFast”)

Configuration - Long Range - Fast ("LongFast"):

- Default
- Most commonly used
- Longest distance in an uncongested area
- Less dependent upon infrastructure

Configuration - Medium Range - Fast ("MediumFast"):

- Used in more dense/congested environments
- Not "default" (less "inexperienced" users on the mesh)
- Better in areas with planned out and coordinated infrastructure (ROUTER and ROUTER_LATE nodes on mountain tops, etc.)
- https://freq51.net



Configuration - Short Range - Turbo ("ShortTurbo"):

- Used in VERY dense/congested environments
- For Hamvention 2025, the firmware was pre-configured with:
  - **Preset:** Short_Turbo (20× bandwidth of LongFast)
  - **Frequency Slot:** 31 (917.25 MHz)
  - **Default channels:** Hamvention, NodeChat, YardSale
  - You can flash the event firmware via https://hamvention.meshtastic.org

Configuration - Channels:

Channels are basically “chat rooms”; they are **encrypted** with their own key.

Each Preset has a **“Default”** Channel with a basic encryption key.

You can share your **location** with varying levels of precision to different channels (i.e., not shared with public; within 1,000-feet for community; precise for family).

Channel configurations can be shared with **QR codes** and/or **hyperlinks** - but this can override Presets, so **use with caution!!**



Getting Started

Getting Started - Pick your hardware:

Nodes with an **external antenna** are harder to carry, but have **better range**.

Nodes with an **internal antenna** are easier to carry, but **may need help** of a CLIENT or CLIENT_BASE to reliably get out to the mesh.

Battery life can range from a day, to several days depending on the **device** and its **configuration**.

Do you want an integrated screen/keyboard, or will you use your phone/tablet?

Getting Started - Public Mesh or Lone Wolf:

Decide if you want to be part of the “public mesh” or go it on your own.

If you have no personal infrastructure, your range and coverage will be limited.

Check for a local club/organization to see what they use, & configure accordingly - check Discord.

You **can** have private, encrypted channels over the “public mesh”.

A poorly configured “public mesh” might have poor coverage due to misconfigurations; starting over with a MediumFast mesh with well-planned and executed infrastructure may be beneficial.

Getting Started - Your First Time on the Mesh:

Start with LongFast and all the defaults: you should start to see nodes in your list within 5 to 10 minutes.

Chat with a buddy: there's nothing worse than sending a message out into the mesh and not hearing a response. Set your buddy up with with a node, and practice when you know each other will be online.

Name your node something smart: my family nodes follow this pattern:

- "LV1e" for the short-name (max 4 characters, or 1 emoji)
- " 👖 Joe" for the long-name

Getting Started - Next Steps:

Direct Messaging: Send messages directly to another person's **node**

Think about channels: After you're successfully up and running with default configs on the public channel, you'll want to add come private channels.

You can have up to 8 channels (including the default). Examples:

- LongFast (public)
- 👖 Levi (family)
- ✅CV Prep (community prep group)
- 🦺NwtnEOC (town emergency operations center)
- Friends

Getting Started - Other Channel Examples:

Hamvention 2025:

- Hamvention
- NodeChat
- YardSale

College:

- 📰CampusNews
- 🚨Alerts
- 🏢Dorm
- 🪜DormFloor

Emergency Operations:

- 1️⃣StateEOC
- 2️⃣CountyEOC
- 3️⃣ZoneEOC
- 4️⃣CityEOC
- 👮Sheriff
- 🚓Police
- ⛑️Medical



Private Channels

Private Channels: Adding an already existing channel

- Contacts & Channels are stored on the radio, NOT in the app!
- Via QR Code:
  - Open your QR Code Scanner
  - Scan a shared QR Code
- Via URL:
  - Navigate to the URL
  - Your Meshtastic app will handle the link
- You may then **REPLACE** or **ADD TO** your existing Channel Set
- **WARNING:** both methods can override your existing settings and move you off your Frequency Slot!

Private Channels: Creating your own channel

- In the Meshtastic app, navigate to Settings -> Channels
- Click the + icon
  - Give your channel a name (emoji’s are okay)
  - A PSK (pre-shared encryption key) will be automatically generated, but you can regenerate it, or supply your own
  - Choose if you want traffic for this channel to be uplinked and/or downlinked via MQTT to the internet (or networked MQTT server)
  - Choose if you want broadcast positions on the Channel & what location precision you want
  - Save -> Send (to the radio)

Private Channels: Sharing your own channel

- In the Meshtastic app, navigate to the Conversations tab -> Share icon
- Share Channels QR Code
- Select the Channel(s) you want to share -> Generate QR Code
  - You can share one or several channels with the generated QR code
  - It’s best to NOT share the default “LongFast”, “MediumFast”, etc. channels
  - You can screenshot the QR code for sharing on a printout or website
  - Tap the copy icon to copy the URL to share with others

Private Channels: WARNINGS!

- **WARNING:** scanning your QR code or opening its URL can override your friend's existing settings and move them off their Frequency Slot!

- **WARNING:** changing the order of your channels can move you off your Frequency Slot!

You may need to reset your preferred Frequency Slot to be able to communicate on your previous channels, which will likely break being able to communicate on your new channels. This is a "feature".



Pitfalls, Tips, & Troubleshooting

Stumbling Blocks:

- **Presets** use different **Frequency Slots** and cannot intercommunicate
- If you are adding a **Channel** via a **link** or **QR code**, they can override your **Frequency Slot** and other settings causing your existing Channels to break
- “Licensed amateur radio (HAM)”:
  - **Avoid** enabling this
  - Will **disable** encryption
  - Is **not compatible** with the default Meshtastic network
  - Might be good for long-range infrastructure connections (higher-power output, higher-gain antennas, etc.)

Stumbling Blocks:

Connecting to a lot of nodes on your phone/tablet will get confusing:

- Try and limit the number of nodes you have stored to one or two
- You can remove other nodes front your phone/tablet's Bluetooth devices list
- You can always re-add a node

Bluetooth can be finicky:

- The Bluetooth stack (drivers, etc.) on some devices can be "weird"
- If you run into problems connecting to your node, try turning Bluetooth off/on
- If it doesn't reconnect right away, power-off then power-on your phone/tablet

Important things to keep in mind:

BE PATIENT: every change you make to your node will probably require a reboot/reconnect which can take 10-20 seconds.

BE PATIENT: nodes take a while to advertise themselves the mesh, it may take minutes or even hours to see a node show up on the mesh.

Bluetooth: Changing the name or Bluetooth PIN of your node will mean you'll need to remove the "old" device and "discover" and "add" the "new" device.

Beta: Meshtastic firmware and software are described as "beta".

Slow: A message can take minutes to navigate the mesh.

Familiar Analogies:

If you have your ham radio turned off, if you are out of range, or if you aren't there to hear a message, or if you're transmitting, you won't receive it.

Similarly, if your mesh node is turned off, out of range of the "greater mesh", or if your node is transmitting, you won't receive it.

If your mesh node is on & in range of the "greater mesh", but your phone/tablet/computer isn't connected to it, when you reconnect, you should be able to see the messages your node received while you were offline.

Tips:

If you don’t have a robust mesh in your area, or generally improve your experience:

- Consider adding home and vehicle **CLIENT_BASE** nodes with high-quality, external antennas mounted as high as you can get them.
- “Favorite” the **ROUTER** and **CLIENT/CLIENT_BASE** nodes which you know to be positioned well - when “favorited” they won’t count against your **HOP COUNT**, thus increasing your range.
- Increase your “**HOPS**” from 3 to 5 or 7; experiment with this as your mesh deployment dictates.
- Recruit others to join (**and use**) the mesh.

Fun things you can do on the mesh:

Run a BBS: https://github.com/TheCommsChannel/TC2-BBS-mesh

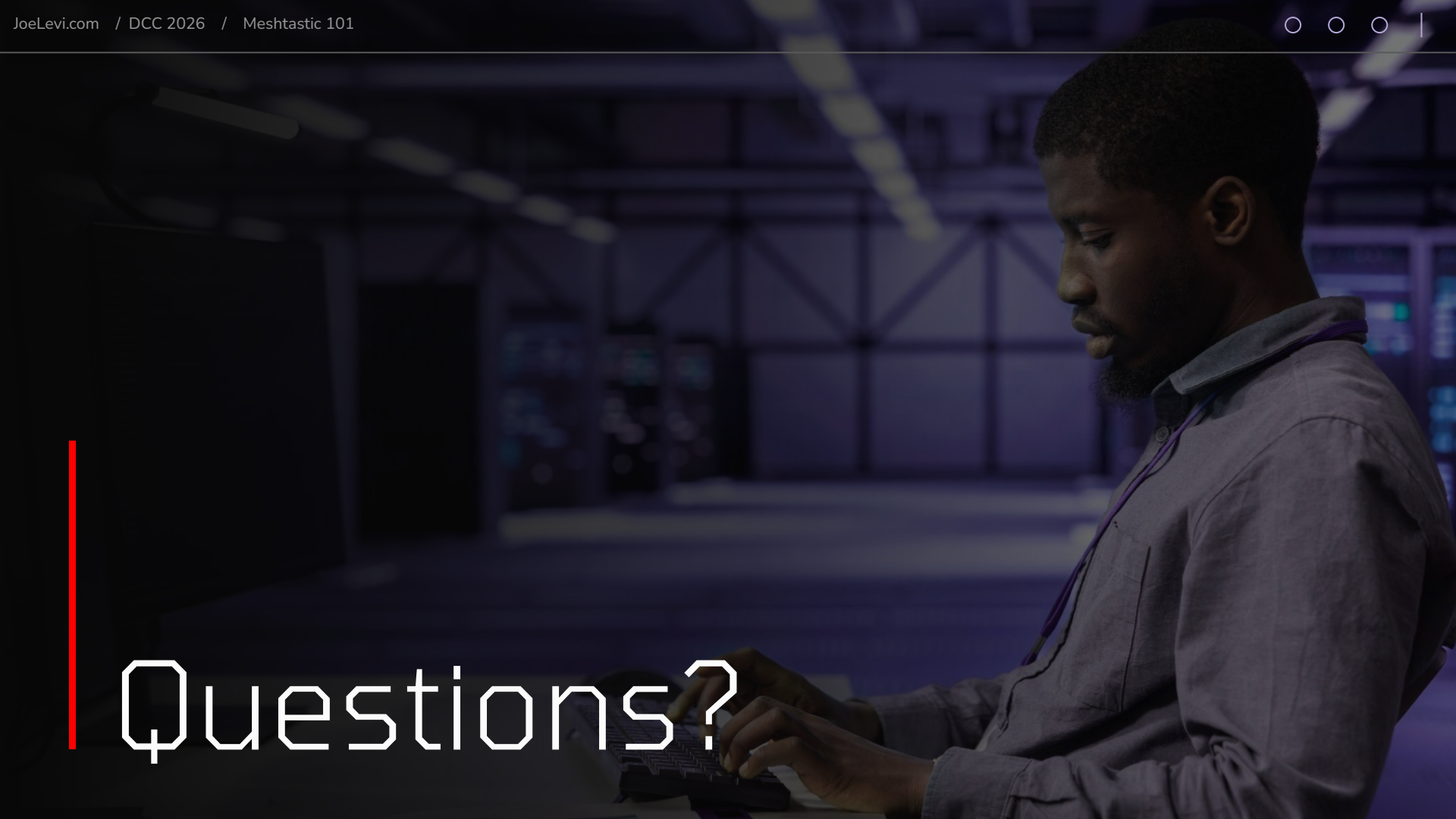
- Offline Mail, Read & Post Bulletins, Share Channels, Wall of Shame, Mesh Statistics, JS8Call, “Fortune” (random quotes), Synchronize BBS nodes (redundancy & speed)

Hook up Home Assistant: https://github.com/meshtastic/home-assistant

- Weather Forecasts, Severe Weather Alerts, Earthquake Alerts, Amber Alerts, Tsunami Alerts, Silver Alerts, Traffic Incidents, “Dad Joke of the Day”

Run ATAK-CIV (Android Team Awareness Kit): https://tak.gov/products

- Real-time Position Location Information (PLI), GeoChat messages, Relay CoT events to a TAK server if one node has internet (hybrid on/off-grid)



Questions?

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I'll "see" you on the Mesh!



Thank you!