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Topics

- What is Meshtastic?
- How does it work?
- Hardware examples.
- Use case examples.
- Q&A / Show and Tell

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What is Meshtastic?



- A. Its a open network for building decentralized communications.
- B. Its a low data / long range / low power communications protocol.
- C. It's an ad hoc / decentralized mesh network.
- D. It's an encrypted off-grid texting / data network.
- E. It's an low cost technology that does not require a license to use.

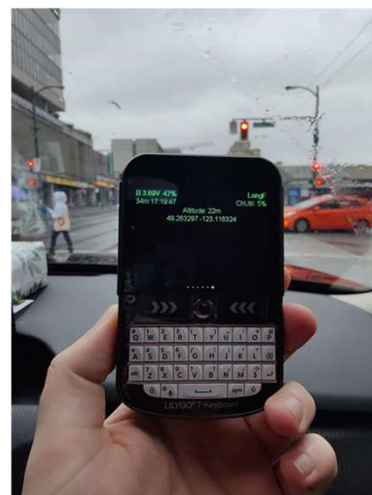
Answer: **All of the Above!**

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What does Meshtastic actually do?

What's the big deal? We already have cell phones, wifi and ham radios??

- Meshtastic is very good at sending text messages and small amounts of data.
 - Text messages can be broadcast to all nodes, or sent as direct messages to a single node.
- Meshtastic can work without any help from anything else. No cell towers, no internet, no dependencies.
- No cell service? No problem
- No wifi? No problem
- Lots of noise? No problem
- No license? No problem



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Quick Overview

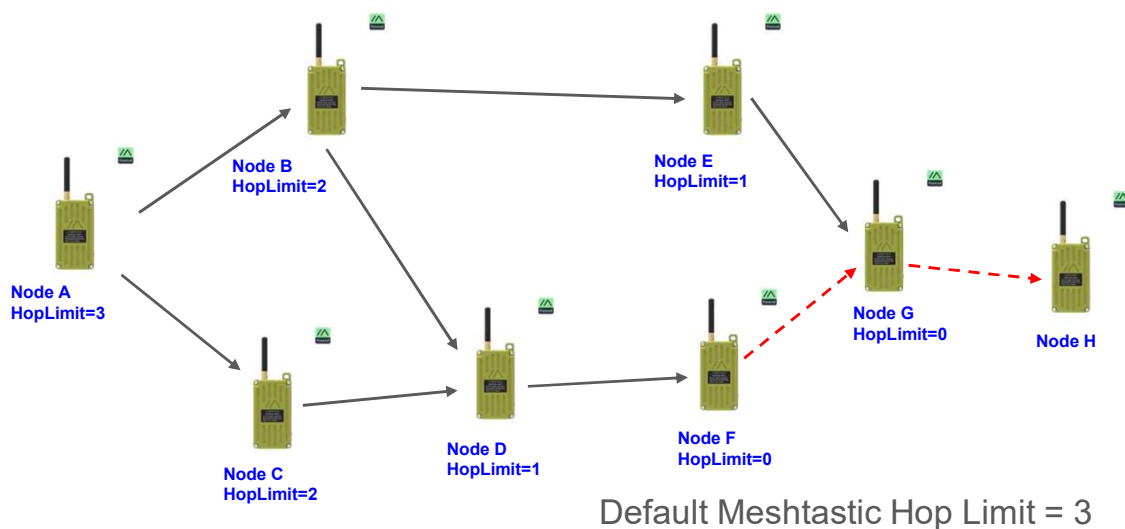
An open source data network that rides on top of the existing LoRa IoT protocol.

- It's a full mesh network up to 7 hops deep (3 is default).
- In the United States it uses the license free ISM band from 902 to 928 MHz, using **104 frequency slots** for data using +27 to +30 dBm (0.5W to 1W) ERP.
- Node-to-node communication is **line-of-sight**.
- Default LongFast mode yields about 1kbps data rate.
- Typical node range is from 1 to 5 miles (record is 200+ miles).
With three well positioned nodes, the mesh size can potentially be 15+ miles.
- *It can optionally connect to the Internet using **MQTT** (Message Queuing Telemetry Transport) to bridge isolated mesh networks.

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What is a Mesh Network?

Broadcast messages are distributed by Flooding the network.



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How Does Meshtastic Route Packets

Meshtastic uses a modified version of a flooding algorithm known as Managed Flood Routing.

When a node receives a packet with a hop limit > 0 , it decrements the limit and plans to rebroadcast it. However, if it hears another node retransmit the same packet within a short window, it suppresses its own transmission.

Packets are limited in how many times they can be relayed to prevent infinite loops in the network. The default Hop Limit is 3.

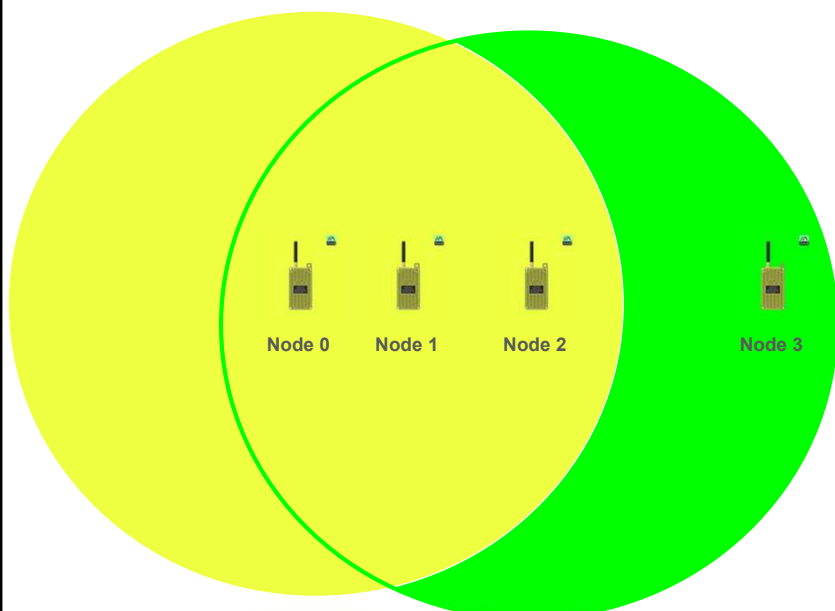
Most types of Meshtastic nodes listen before acting, waiting for a short time to see if another node has already relayed the message, thereby reducing network congestion. This delay is called a Contention Window.

Nodes that receive a packet with a lower Signal-to-Noise Ratio (SNR)—indicating they are further away—have a smaller contention window and are more likely to retransmit first. This ensures that "edge" nodes help propagate the message rather than closer nodes.

Note: For Direct Messages, v2.6+ introduces a form of next-hop routing to reduce overhead, where the network learns the best path, but falls back to managed flooding if the optimized path fails.

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Managed Flooding Example - Contention Window



1. Node 0 sends a broadcast message. HopLimit = 3.
2. Nodes 1 & 2 receive the message.
3. Since Node 2 received SNR is lower it's Contention Window is shorter, so it starts rebroadcasting earlier than Node 1. HopLimit = $3 - 1 = 2$.
4. Node 1 heard the rebroadcast by 2, so it will not rebroadcast.
5. Node 0 receives the rebroadcast, which it treats as an acknowledge.
6. Node 3 receives the message for the first time from Node 2, and the HopLimit is not yet zero, so it starts a rebroadcast for potential other receivers.

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Preset Modes

Channel setting	Alt Channel Name	Data-Rate	SF / Symbols	Coding Rate	Bandwidth	Link Budget
Short Range / Turbo	Short Turbo	21.88 kbps	7 / 128	4/5	500 kHz ¹	140dB
Short Range / Fast	Short Fast	10.94 kbps	7 / 128	4/5	250 kHz	143dB
Short Range / Slow	Short Slow	6.25 kbps	8 / 256	4/5	250 kHz	145.5dB
Medium Range / Fast	Medium Fast	3.52 kbps	9 / 512	4/5	250 kHz	148dB
Medium Range / Slow	Medium Slow	1.95 kbps	10 / 1024	4/5	250 kHz	150.5dB
Long Range / Fast	Long Fast	1.07 kbps	11 / 2048	4/5	250 kHz	153dB
Long Range / Moderate	Long Moderate	0.34 kbps	11 / 2048	4/8	125 kHz	156dB
Long Range / Slow	Long Slow	0.18 kbps	12 / 4096	4/8	125 kHz	158.5dB
Very Long Range / Slow	Very Long Slow	0.09 kbps	12 / 4096	4/8	62.5 kHz	161.5dB

0 LongFast

Edit

Short Range / Turbo

Short Range / Fast

Short Range / Slow

Medium Range / Fast

Medium Range / Slow

Long Range / Fast

Long Range / Moderate

Long Range / Slow

Reset Scan

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Channels - Default Channel

Out of the box your node is setup for a single Long_Fast preset with a default encryption key ("AQ=="). It will be set to frequency slot 20 on the LoRa side and centered at 906.875. Any newly flashed node will be able to communicate with any other node on this frequency slot.

So flash the node, set the region for the radio, and now you can chat on the Long_Fast preset in the messenger. It's that easy!

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Channels

Channels are, basically, encrypted texting rooms.

Eight Channels are available.

PRIMARY or 1

This is the first channel that is created for you on initial setup. There must be one Primary Channel.

There can only be one Primary Channel, however it's settings can be changed.

SECONDARY or 2 - 8

You should use a unique encryption key (PSK).

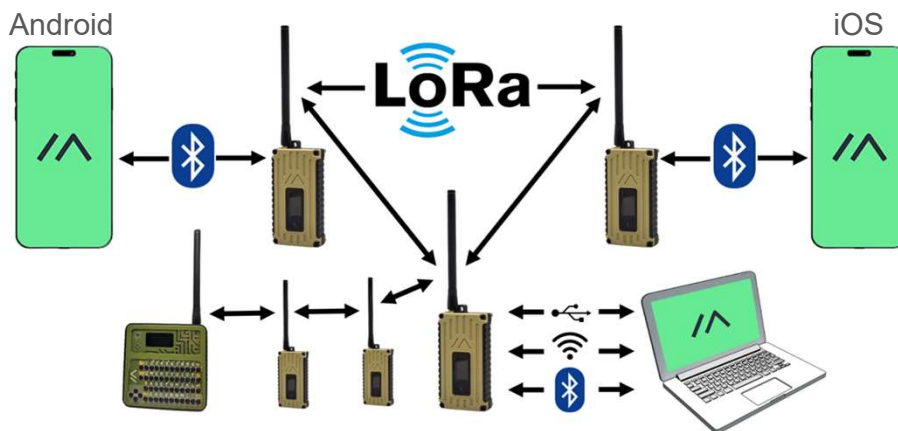
Secondary Channels are mostly for private group chats.

Index	Channel	Default Role	Purpose
0	1	PRIMARY	Used as default channel
1	2	DISABLED	User defined
2	3	DISABLED	User defined
3	4	DISABLED	User defined
4	5	DISABLED	User defined
5	6	DISABLED	User defined
6	7	DISABLED	User defined
7	8	DISABLED	User defined

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How Do I Communicate With My Node?

You'll need a computer for initial set up. For general use, unless your Node has a keyboard you'll use either a mobile phone or a computer. There are Companion Apps for iOS and Android.



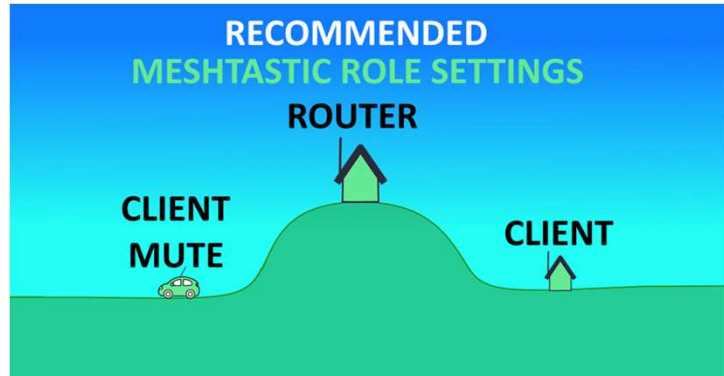
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Node Operating Roles

Meshtastic nodes have roles for operation.

Most of the time you will use CLIENT role as it will repeat messages and allow you to pair and act as a client.

We'll talk about a few special roles next.



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Common Roles

Preset	Description	Example
Client	General use for individuals needing to communicate over the Meshtastic network with support for client applications. See also Client-Mute & Client-Base	General Purpose, General Messaging
Router	Infrastructure node for extending network coverage by relaying messages. Contention Window = 0. Use sparingly / carefully. See also Router-Late	Event Coverage, Mountain Top Relays
Tracker	Broadcasts GPS position packets as priority.	Vehicle Tracking, Participant Tracking
Sensor	Broadcasts telemetry packets as priority.	Weather Stations, Water Level Measurements, Physical Security Alerts

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Hardware (Key Differences)

ESP32 based units offer WiFi and Bluetooth as well as tons of I/O and Fast dual core 240mhz MCU, At the expense of battery usage, typically around 140~240ma

Nordic N52840 Based units offer only Bluetooth and a single core 64mhz MCU but consume much less power typically around 80~200ma so it may be a better choice for remote battery operated nodes.



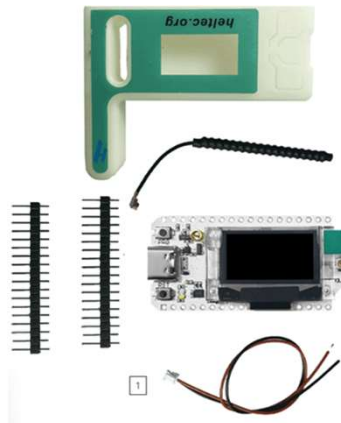
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Hardware (Some Examples)

Heltec Automation

LoRa 32 v3

Or variant.



Heltec WiFi LoRa 32(V3) US915 MHz
with optional plastic shell

\$29.97

★★★★★ 4.38

Shell: With Plastic Shell

Without Plastic Shell

With Plastic Shell

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Hardware (Some Examples)



Wio Tracker L1 Pro

SKU 114993649

★★★★★ [11 Reviews](#)

The Wio Tracker L1 Series is a low-power, scalable Meshtastic node featuring LoRa (862-930 MHz), an nRF52840 for efficient processing, and an L76K GPS for precise location tracking. The L1 Pro version is a fully integrated, ready-to-deploy solution featuring an OLED display, rechargeable battery, and durable 3D-printed enclosure. Built for field use with no assembly required.

USD **\$47.99**

10+: \$47.99

Ships from California
Import Duties Included

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Hardware (Some Examples)



Heltec MeshPocket - Integrated Qi2 Power Bank

\$79.00 USD

[Shipping](#) calculated at checkout.

Pay in 4 interest-free installments of **\$19.75** with

[shop](#) [Pay](#) [Learn more](#)

★★★★★ 6 reviews

Color

Yellow

Battery Capacity

5000mAh

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Hardware (Some Examples)



LILYGO® T-Deck Portable Microcontroller Programmer LoRa 915 MHz

\$99.97 **Stock: 14**

★★★★☆ 4.29

Style: Plus (case, GPS, 2000 mAh battery, NO antenna port)

Base (NO case, NO GPS, NO battery)

Plus (case, GPS, 2000 mAh battery, NO antenna port)

EXT Plus (External Antenna, Case, 2000 mAh battery, GPS)

Complete (case, 3000 mAh battery, GPS, external antenna)

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Hardware (Some Examples)



WisMesh | Starter Kit WisBLOCK / ^

WisMesh 1W Booster Starter Kit

High-power Meshtastic solution with
nRF52840, SX1262, and SKY66122 PA for
extended mesh range

RAK10724

SKU:116217

\$39.00

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Example Use Cases

1. Create a public off-grid mesh network for your neighborhood, community, etc.
 - a. Create a private (encrypted) channel that uses the public mesh.
2. Stay connected with family & friends in areas where cellular phone service is unavailable (hiking, camping, hunting).
 - a. Install a fixed node in camp, then carry portable nodes while hiking or hunting.
3. Stay connected to family members in areas where the cellular phone service is overloaded / overwhelmed (music festivals, community events, emergency situations).
4. Keep track of participants during charity and public service events (bicycle races, running events).

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Hardware Sources

Rokland (retailer)

<https://store.rokland.com/>

Amazon (retailer)

<https://www.amazon.com/>

AliExpress (retailer - China)

<https://www.aliexpress.us/>

Many manufacturers also sell direct to consumers.

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Resources:

Rochester Mesh: (w/ links to their Discord server)

<https://rocmesh.com/>

Main Meshtastic Website:

<https://meshtastic.org/>

Main Meshtastic Discord Server:

<https://discord.gg/meshtastic>

Meshtastic Site Planner:

<https://meshtastic.org/docs/software/site-planner/>

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Q&A / Show and Tell

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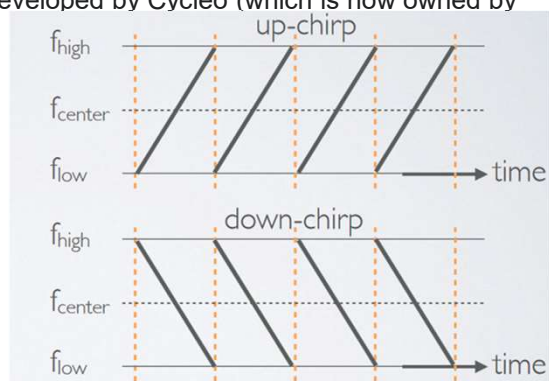
Backup Slides

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What is LoRa?

LoRa (from "Long Range") is a physical proprietary **radio communication** technology. It is based on **spread spectrum** modulation techniques derived from **chirp spread spectrum** (CSS) technology. It uses **Carrier Sense Multiple Access / Collision Avoidance** (CSMA/CA) to minimize transmission collisions.

LoRa is a proprietary communications standard, originally developed by Cycleo (which is now owned by Semtech) and is governed by the LoRa Alliance.



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902 - 928 MHz Frequency Band

The 902-928 MHz ISM Frequency Band is shared by several services:

- ISM (Industrial, Scientific, & Medical)
- LoraWAN
- Older cordless phones & baby monitors
- IoT and Smart Home Systems (e.g., Z-Wave)
- 33 cm Amateur Radio Band
- Meshtastic
- Meshcore
- Reticulum

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Device Role	BLE/WiFi/Serial	Screen Enabled	Power Consumption	Retransmit	Prioritized Routing	Visible in Nodes List
CLIENT	Yes	Yes	Regular	Yes	No	Yes
CLIENT_MUTE	Yes	Yes	Lowest	No	No	Yes
CLIENT_HIDDEN	Yes	Yes	Lowest	Local Only	No	No
TRACKER	Yes	No	Regular / Low	Awake Only ¹	No	Yes
LOST_AND_FOUND	Yes	No	Regular	Yes	No	Yes
SENSOR	Yes	No	Regular / Low	Awake Only ¹	No	Yes
TAK	Yes	Optional	Regular	Yes	No	Yes
TAK_TRACKER	Yes	Optional	Regular	Yes	No	Yes
ROUTER	No ²	No	High	Yes	Yes	Yes
REPEATER	Yes	No	High	Yes	Yes	No

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Ham Mode - Amateur radio operation



Privileges

- Increased Transmit Power
 - Up to 10W transmit power in the United States! [47 CFR 97.313\(j\)](#)
- Higher Gain Antennas

Restrictions

- Plain-Text Only
 - On amateur radio bands, encryption is illegal. [FCC Part 97.113.A.4](#)
- Lack of Privacy
 - As a ham operator, it is a requirement that you identify yourself by your call sign periodically transmitting. Your call sign will be publicly transmitted at least once every 10 minutes at minimum. [FCC Part 97.119.A](#)

Ham mode is not compatible with non-Ham mode!

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MQTT

MQTT allows isolated nodes and meshes to use the Internet to connect to other meshes

MQTT (Message Queuing Telemetry Transport) is a lightweight, publish-subscribe messaging protocol used for machine-to-machine communication:

MQTT is designed for devices with limited resources, such as sensors and wearables, that need to communicate over networks with low bandwidth or high latency.

Features

MQTT is easy to implement, efficient, and reliable:

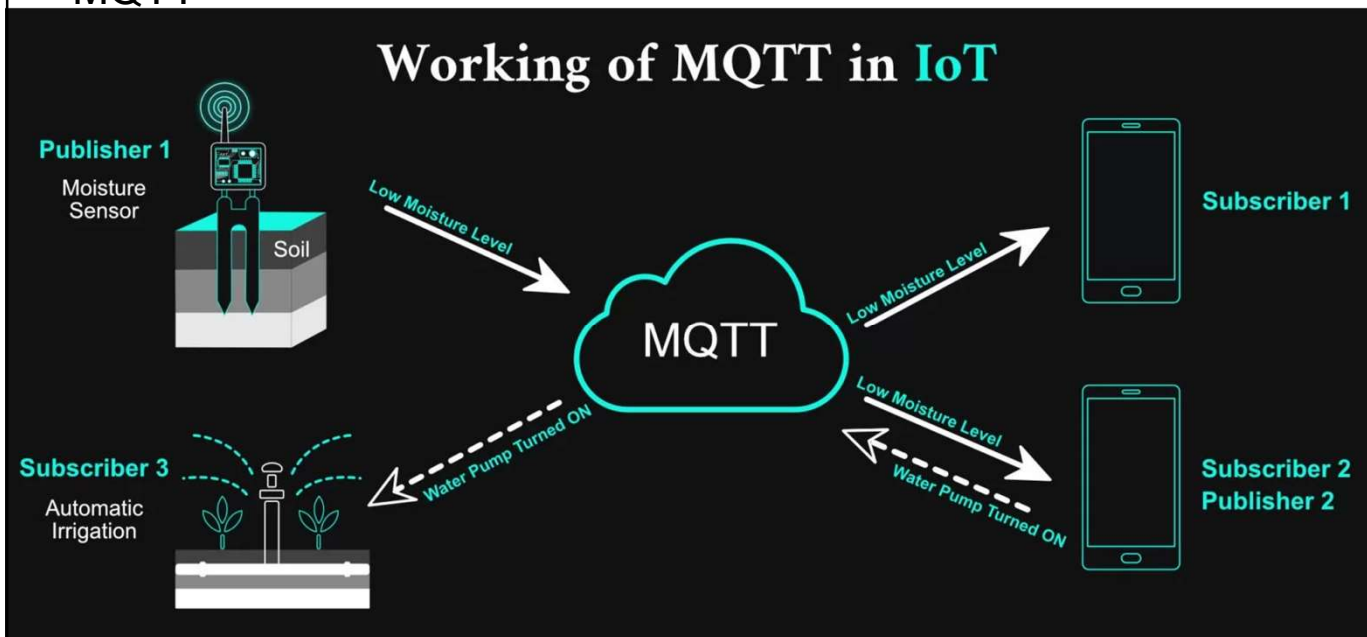
Lightweight: MQTT uses 10 times less bandwidth than HTTP.

Reliable: MQTT's pub/sub architecture allows the broker to buffer messages until a subscribed device is connected.

Flexible: Users can control the service level requirements for messages.

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MQTT



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MQTT

If you want to join the public mesh,

Meshtastic runs a public server that you can join your device to.

It has some limitation like zero hops, aka messages will only sync with your device you cannot uplink or downlink from over the air channels to the public MQTT server as this would cause tons of unnecessary traffic.

Setting	Acceptable Values	Default
mqtt.enabled	true, false	false
mqtt.address	string	mqtt.meshtastic.org
mqtt.username	string	meshdev
mqtt.password	string	large4cats
mqtt.encryption_enabled	true, false	false
mqtt.json_enabled	true, false	false
mqtt.tls_enabled	true, false	false
mqtt.root	string	
mqtt.proxy_to_client_enabled	true, false	false
mqtt.map_reporting_enabled	true, false	false

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