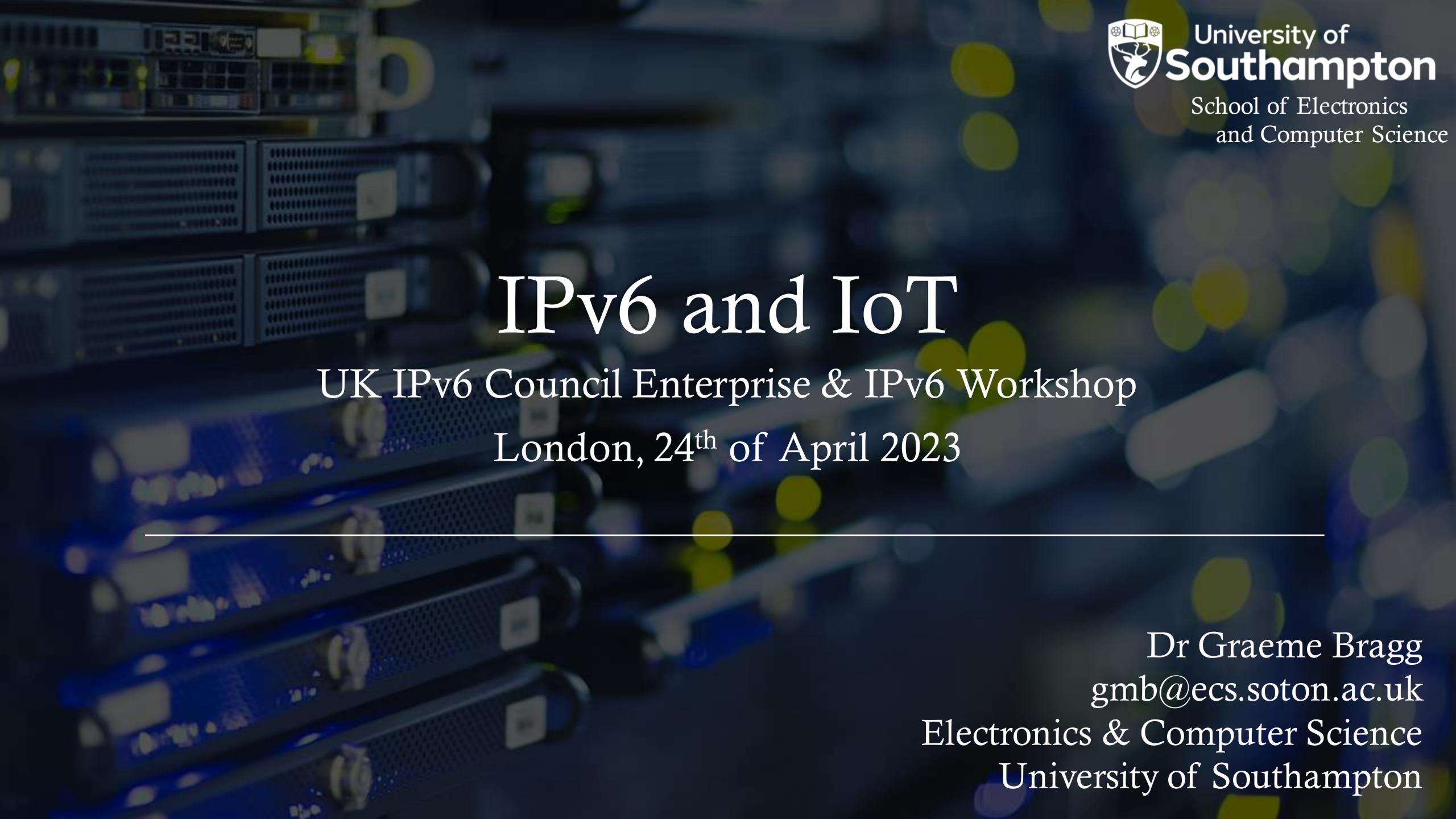

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IPv6 and IoT

UK IPv6 Council Enterprise & IPv6 Workshop

London, 24th of April 2023

Dr Graeme Bragg
gmb@ecs.soton.ac.uk
Electronics & Computer Science
University of Southampton

What do I mean by IoT?

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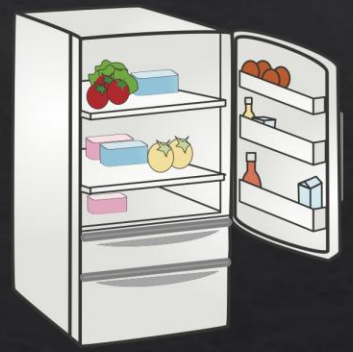
Internet of Things



Things:

- Physical objects that are instrumented/ actuated with a digital presence

Internet:

- and can be interacted with remotely

  (but not necessarily over the Internet)

The Home-Automation IoT Landscape

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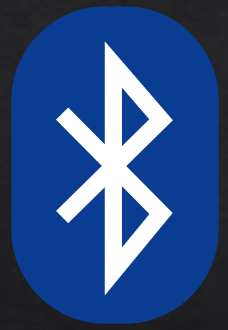
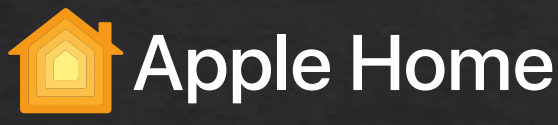
- There are lots of technologies and systems out there…





Internet Without an IP Address?

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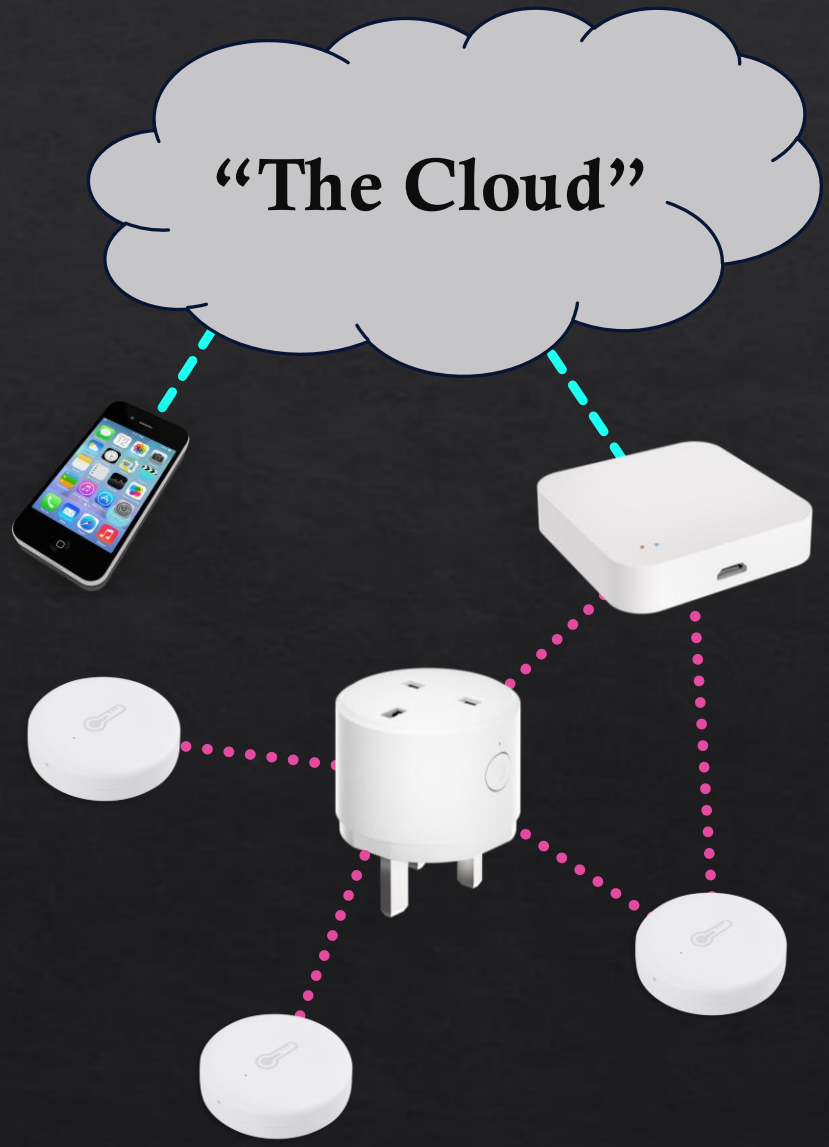
- A lot of technologies used for IoT don't give devices a globally unique ID or address
- Manufacturer-specific hubs with proprietary control software and cloud services are common.
- For many deployments, devices cannot be interacted with directly…



Globally Accessible with IPv4?

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- My hot take:

IPv4 is holding back IoT

- The lack of addresses encourages centralised, proprietary solutions that can't interact with each other.
- The prevalence of NAT, and now CG-NAT, makes direct-access harder.
- We are sitting on a potential e-waste mountain of locked-down IoT devices…

Is IPv6 the Answer?

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Partially

- It helps solve the addressing/accessibility problem
- BUT how do you give an IPv6 address to a low-power, low-performance battery operated device?
- AND we still have an application layer problem.

6LoWPAN

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- IPv6 over 802.15.4 radio links.
- 802.15.4 only has 127-byte frames, so 6LoWPAN relies on fragmentation and header compression.
- Header Compression:
  - 48-bytes of IPv6 and UDP headers compress to 6 bytes
  - Relies on assumptions and link-layer addresses
- Multi-hop mesh networking is possible with RPL routing

Mountain Sensing

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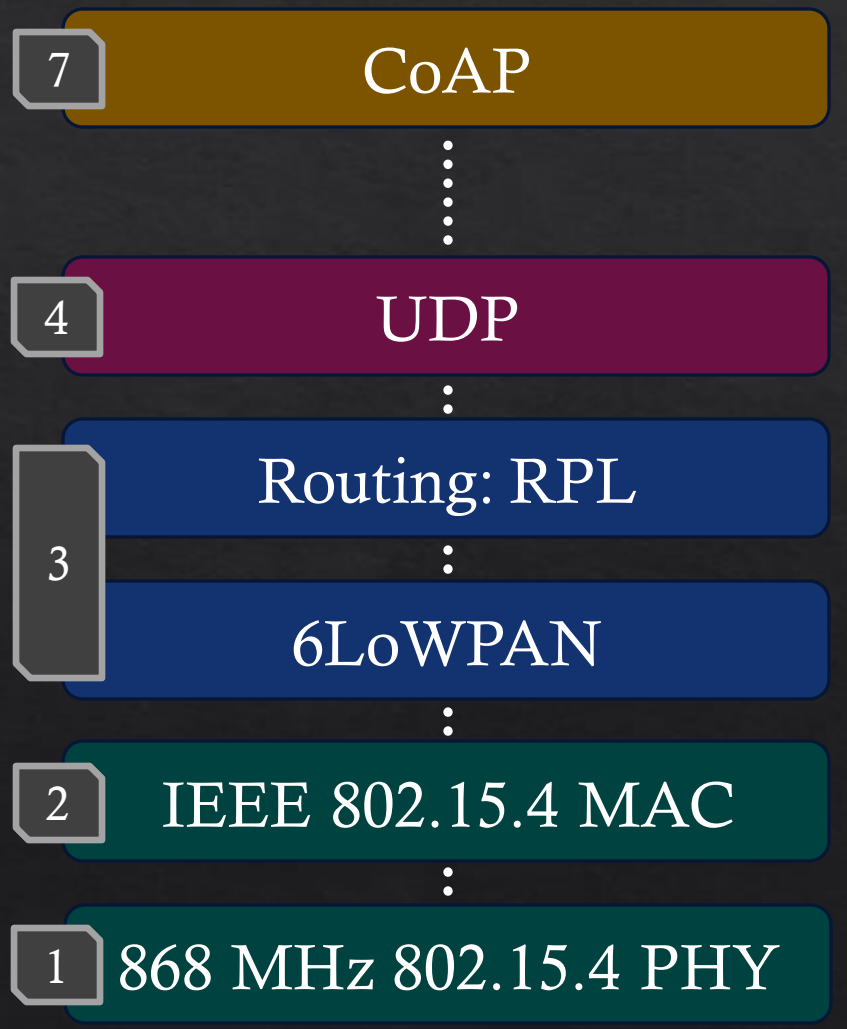
- A 2014/15 NERC-funded proof-of-concept project to deploy an IoT sensor network in the highlands of Scotland.
- Used a standards-based network stack for communication
- Sensor nodes were microcontroller-based and battery powered



Mountain Sensing Deployment

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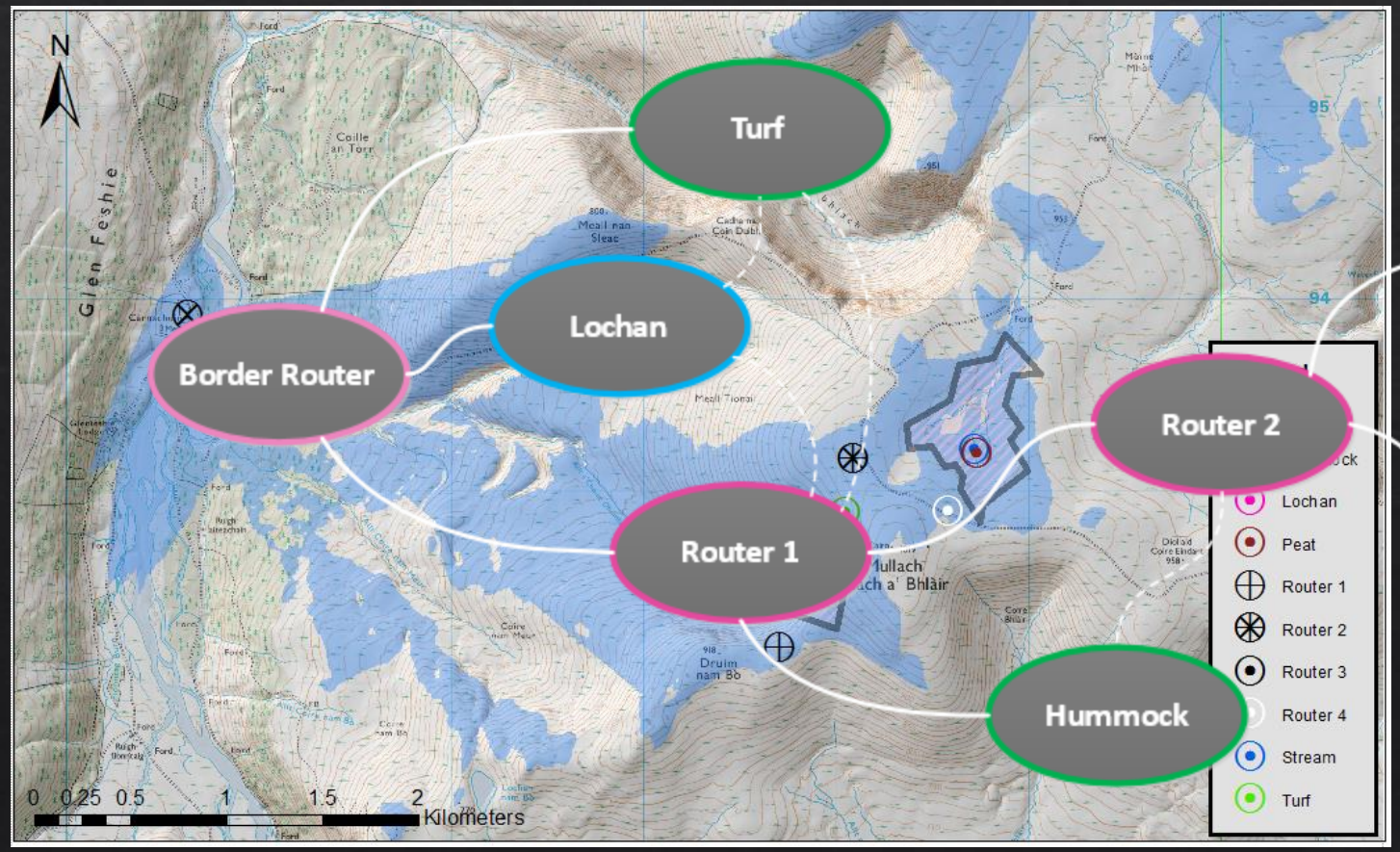
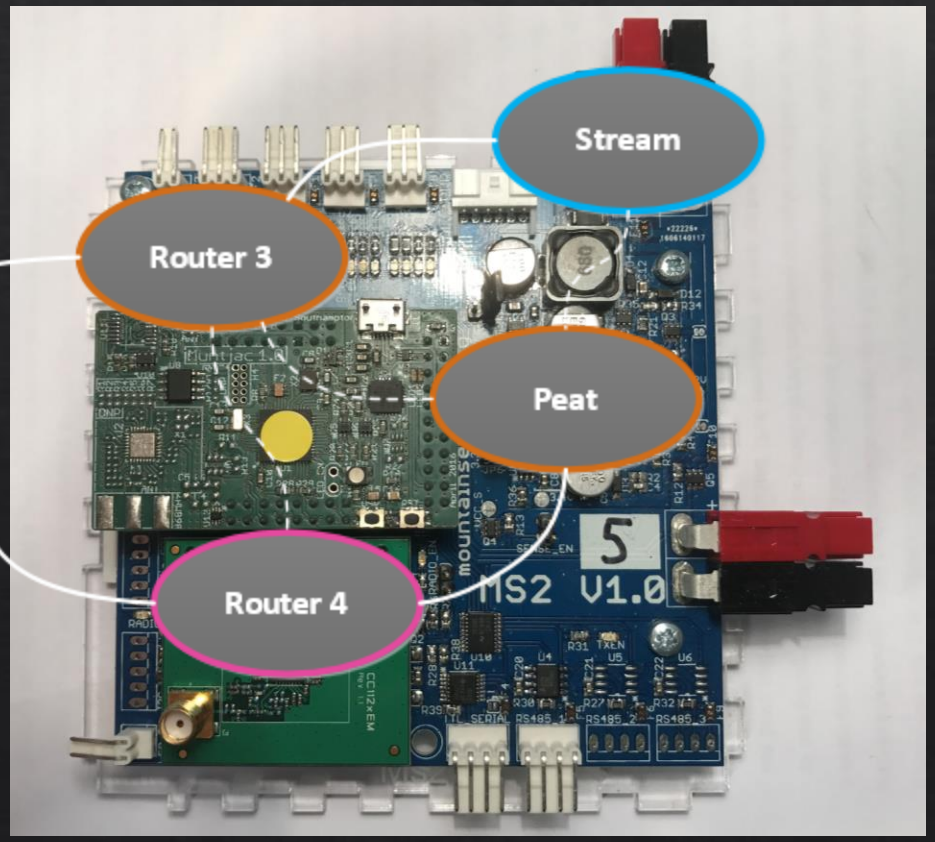
- We achieved 3km+ low-power IPv6 radio links…
- In a deployment ~5km across using microcontrollers and a mesh network





Mountain Sensing: Results

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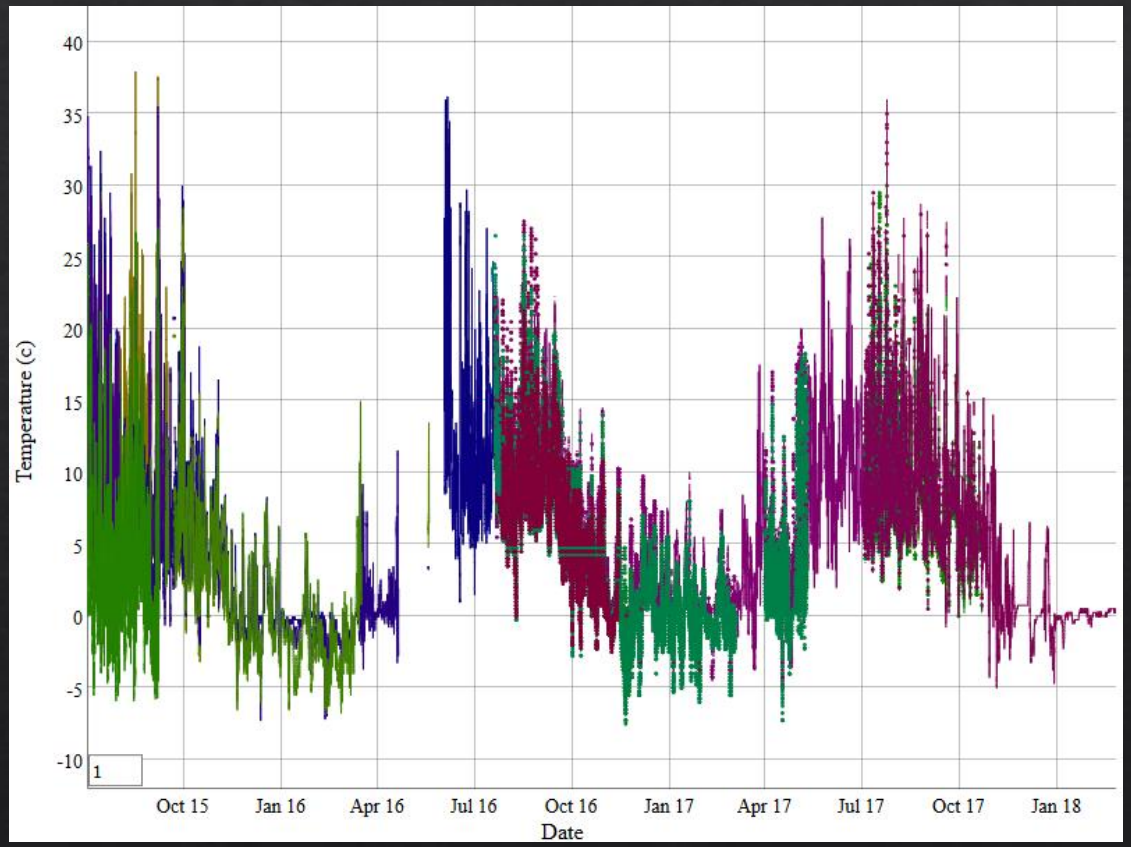
- The first published sub-GHz, 6LoWPAN environmental sensor network.
- Demonstrated that low-power, IP-based sensor networks can be used for real-world deployments.
- Gathered years of data that gave never-before-seen insights into natural processes.



Thread

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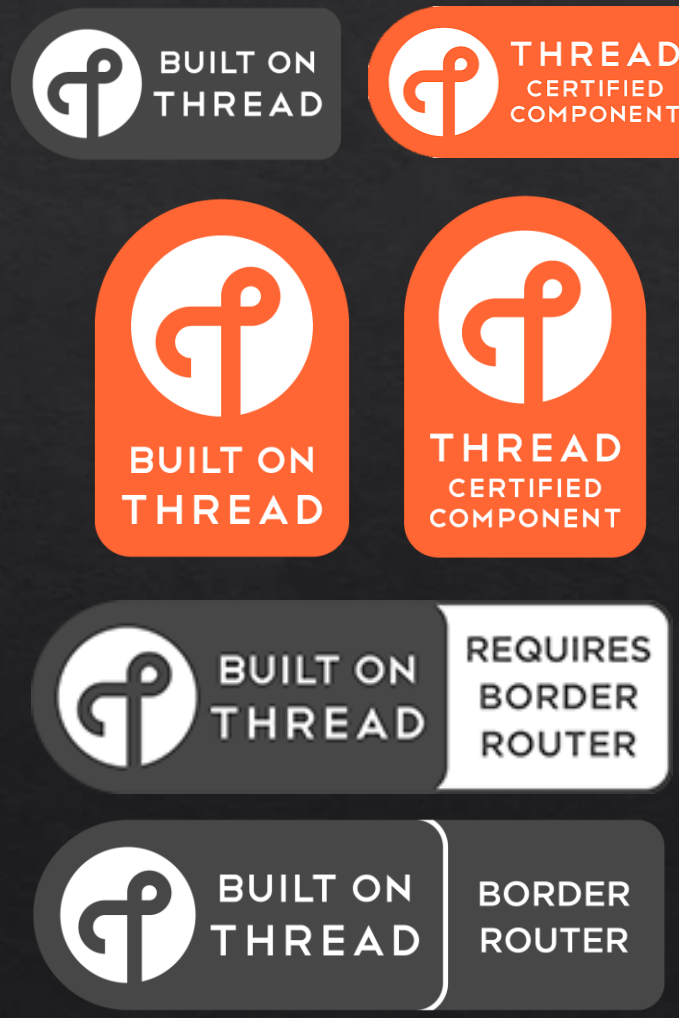
- A royalty-free open industry standard designed for connected home applications.
- Certification (and use of the logos on products) requires membership
- Open-source implementation: OpenThread
- Used by Google Nest, Apple HomePod Mini, Amazon Eero, and a whole host of home and industrial automation products from Siemens, SmartThings, Eve, Aqara, Tuya, etc.



Thread: the Tech

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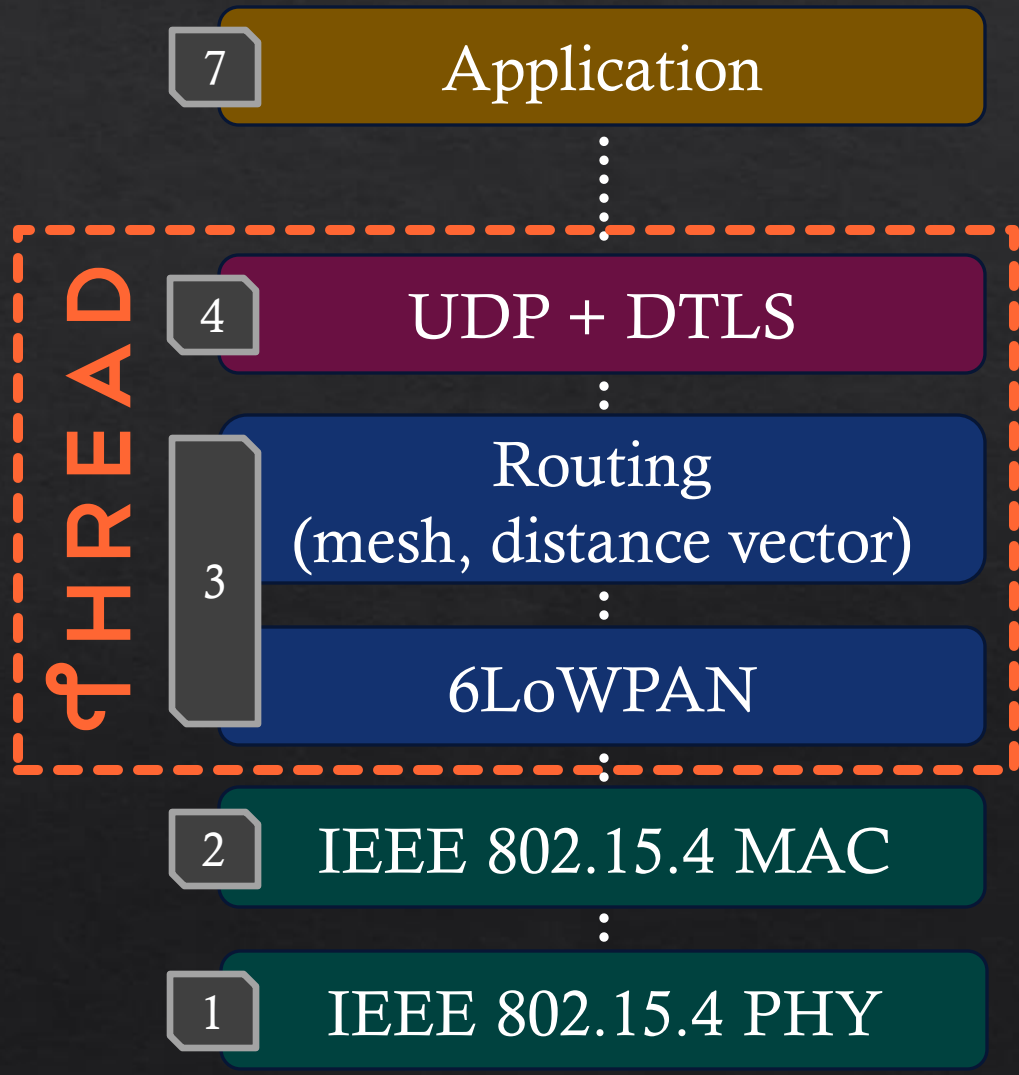
- IP-based, encrypted, self-healing, resilient mesh networking
- Based on 802.15.4 and 6LoWPAN
- Uses UDP with DTLS for transport
- Security and Commissioning occur throughout the Thread stack



Matter

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- An open-source protocol standard for IoT and smart home applications.
  - Version 1.0 published 10/2022, version 2 imminent.
- Designed to simplify smart home setup, control and interoperation.
- Already integrated into Amazon Alexa, Apple Home, Google Home, and Samsung SmartThings
- Devices expected soon™. Many devices announced at CES 2023.

Matter: Just Another Standard?

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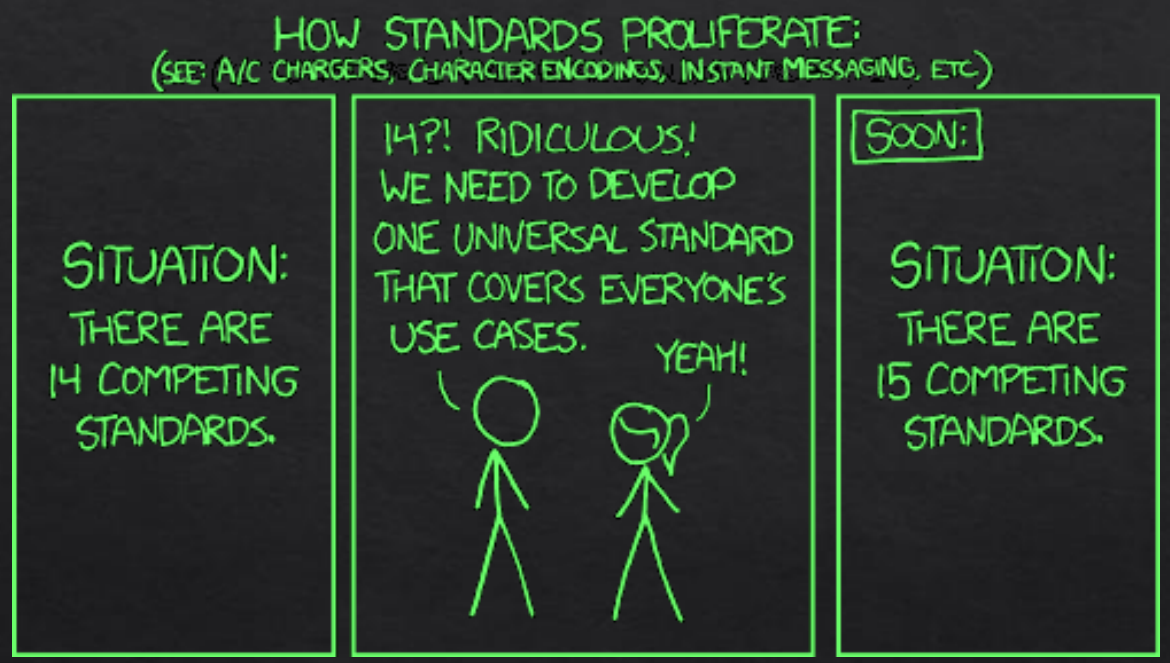

No:

- Matter is a unifying application layer standard that leverages existing communications standards
- Non-Matter devices can be bridged into a Matter network
- Most of the big players in the home automation scene are onboard and have already added support to their hubs via software update

Matter: The Concept

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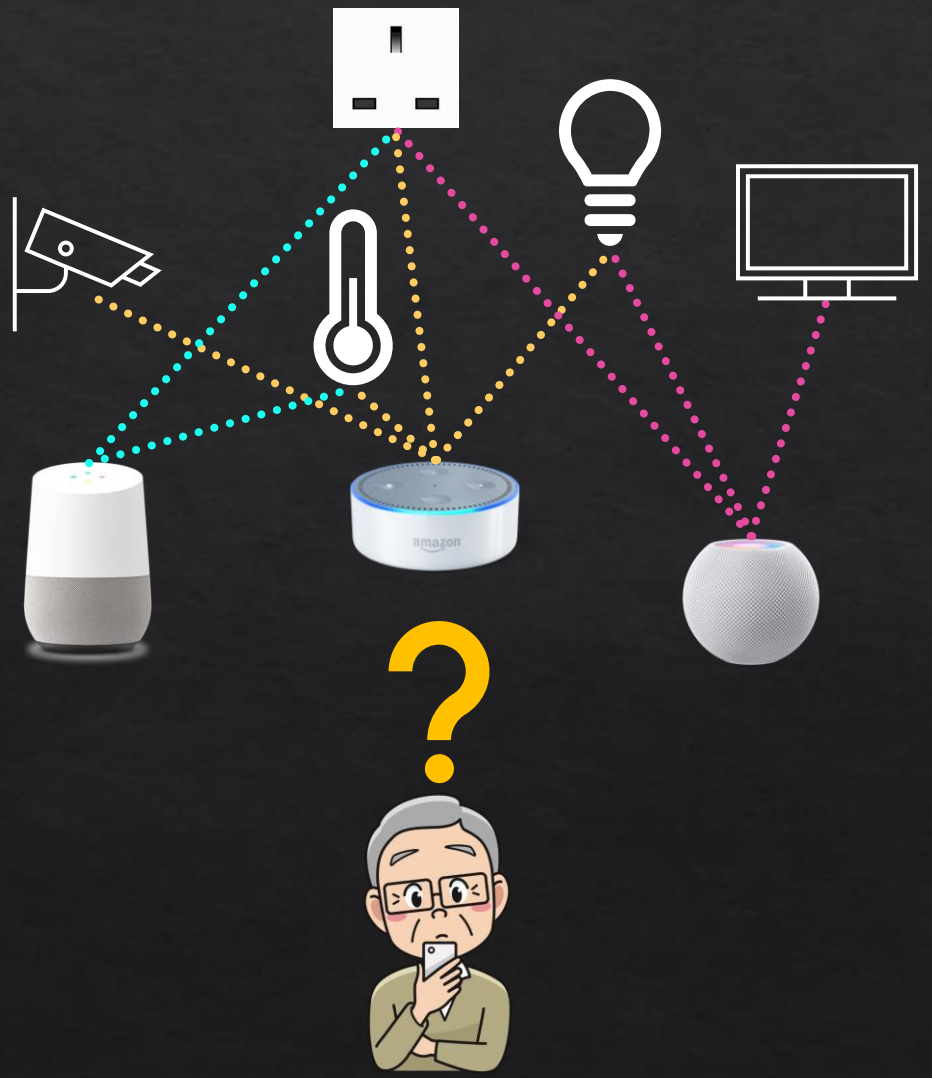
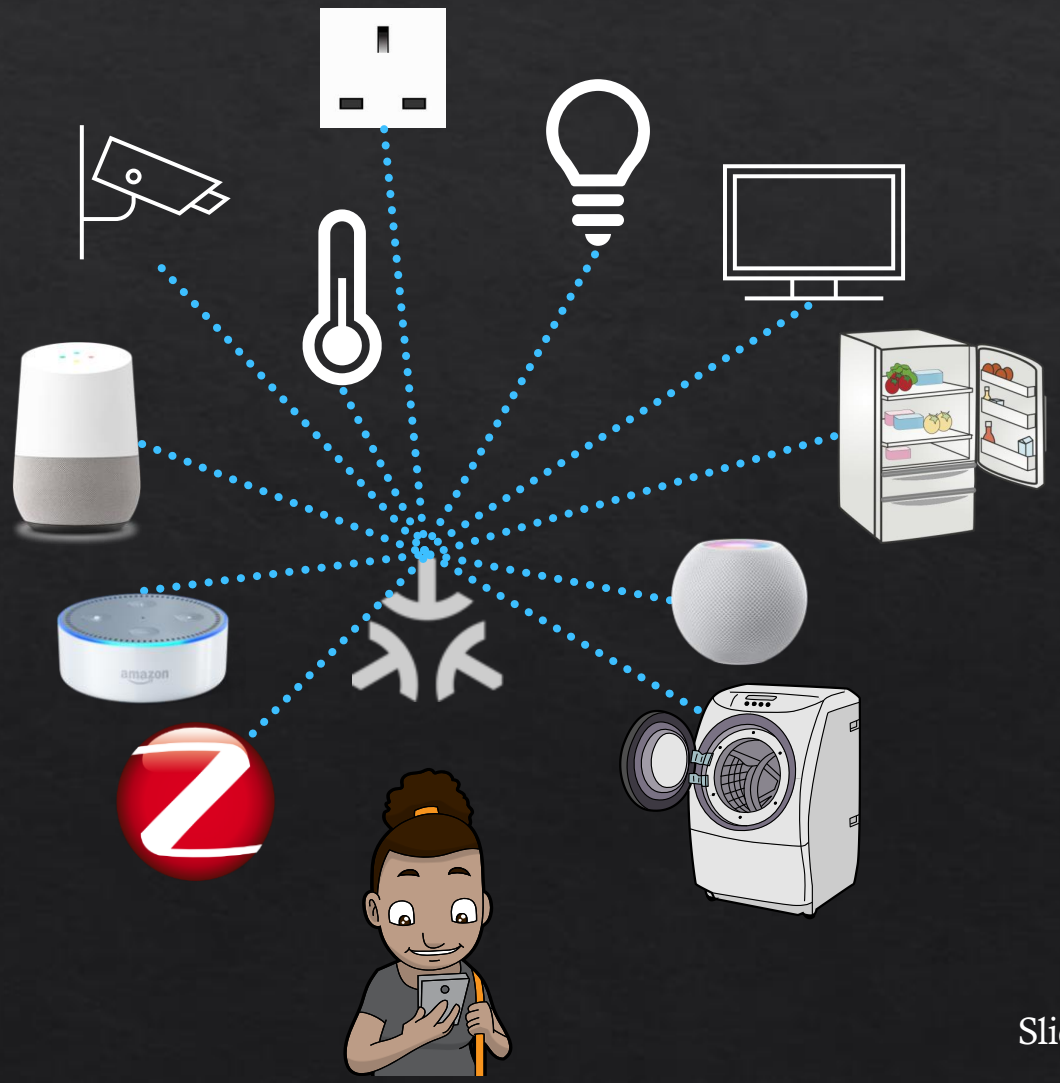
Before Matter



With Matter



Matter: The Tech

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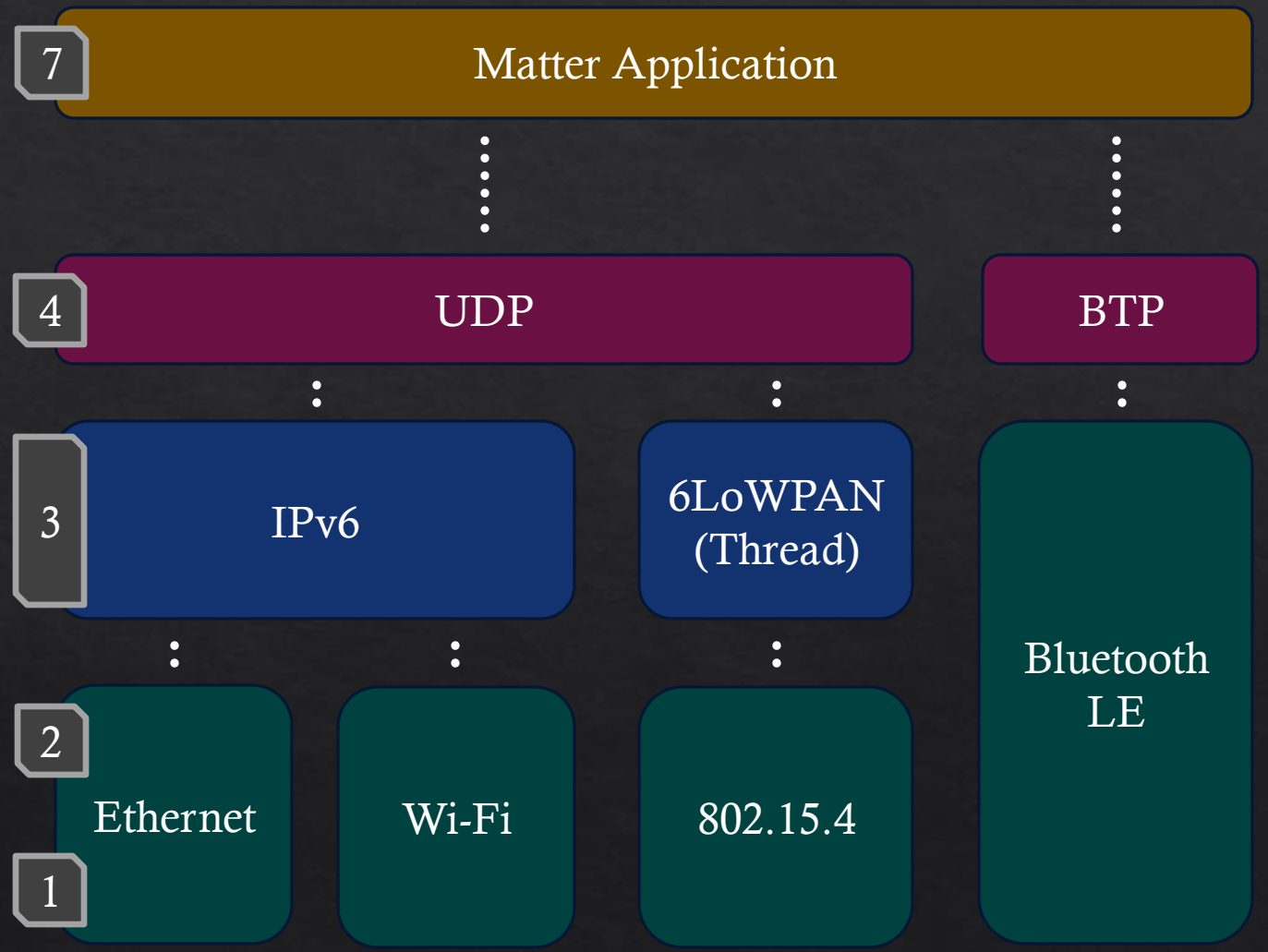
- Runs on top of Thread, Ethernet and WiFi
  - Support for IPv6 for BLE is planned
- Relies on IPv6 for operational communications
- Leverages multicast support for group control
- Multi-Admin support – multiple controllers can control the same matter devices



Summary

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- IPv4 is encouraging a disjointed, proprietary IoT landscape with a significant potential e-waste problem.
- IPv6 enables innovative Internet of Things applications and is a building block in a more open, compatible and secure IoT future.
- Home automation is embracing technologies that ***require*** IPv6.
- “Disable IPv6” is going to cause real problems with consumer setups in the (very) near future.

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Fin

Questions?