
Introduction
to
THREAD

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About Thread Group

About Thread Group

Launched in July 2014

- Delivering an impactful networking technology through a market-driven approach
- Educating the market on the benefits and uses of this technology
- Ensuring a great user experience through rigorous, meaningful product certification
- A Delaware 501 (c) (6) Non-Profit Corporation for the mutual benefit of its members

Through industry collaboration, **Thread Group's mission** is to deliver an open and global wireless mesh networking protocol that extends IP infrastructure in homes and buildings. This low-power, reliable, and secure network enables the most diverse ecosystem of IoT devices.






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Intellectual Property

Copyrights & Trademarks

- Licensed to participants royalty free

Other Intellectual Property Policy

- Policy is designed to maximize the adoption of the Thread technology and accelerate market acceptance
- Policy for Thread Group membership balances interests of all stakeholders
- Applies to all Thread members
- Commitment to grant a RAND-RF (royalty free) license to members for patents essential to the Thread specification

Access to Technology and Spec	Reduce time for development and implementation using a proven solution
Access to the IP	Gain IP rights for the Thread technology with no royalty payments
Access to Thread Certification Program	Guarantee network interoperability with other Thread devices and broaden your ecosystem
Use of the Thread Test Harness and Commissioning App	Save time and resource investment by completing in-house testing for spec conformance and network interoperability
Participation in Marketing and PR Campaigns	Leverage Thread's marketing, social media and PR tools to extend marketing efforts
Participation in Committees	Provide a voice to help influence the direction of Thread
Networking with an Ecosystem of Companies	Collaborate with other members to optimize investment

MEMBERSHIP BENEFITS BY TIER

Member Benefits	Academic	Affiliate*	Associate**	Implementer	Contributor	Sponsor
Access To Members-Only Website	✓	✓	✓	✓	✓	✓
Use Of Alliance Member Logo	✓	✓	✓	✓	✓	✓
Participate In All-Member Sessions of General Meetings	✓	✓	✓	✓	✓	✓
Participate In Promotional Materials	✓	✓		✓	✓	✓
Access To Pre-Publication Draft Specification	✓	✓		✓	✓	✓
Access to IP Rights As Defined with Certification			✓	✓	✓	✓
Ability To Certify Devices By Inheritance For Approved Scenarios			✓	✓	✓	✓
Participate In Committee Sessions Of General Meetings				✓	✓	✓
Access To Thread Test Harness				$5k/seat/yr	FREE	FREE
Ability To Pre-test And Certify Devices At Thread Group ATLs					✓	✓
Ability To Purchase Thread Test Bed					✓	✓
Access All In-Process Draft Specifications					✓	✓
Access To Thread Developed Apps					✓	✓
Authorize And Refer Associate Members					✓	✓
Participate And Vote In Work Groups and Committees					✓	✓
Chair Work Groups And Committees					✓	✓
Initiate Work Groups Or Committees						✓
Approve Operating Budget						✓
Approve Final Deliverables						✓
Automatic Seat On Board Of Directors						✓

MEMBERSHIP COSTS

	Academic	Affiliate*	Associate**	Implementer	Contributor	Sponsor
Annual Fee	$-	$1,000	$-	$7,500	$20,000	$85,000
One-Time Initiation Fee						$45,000

CERTIFICATION COSTS

Certification Type	Associate**	Implementer	Contributor	Sponsor
Tested component (ea) + ATL testing fees			$1,250	$1,250
Tested end product (ea) + ATL testing fees			$2,500	$2,500
Inheritance, component (ea)		$1,500	$1,000	$1,000
Inheritance, end product (ea)	$2,000	$1,500	$1,000	$1,000
Product family certification fee (zero added cost for >3 end products)		$4,500	$3,000+	$3,000+

Liaison Partners

ASHB
Association for Smarter Homes & Buildings

ASHRAE BACnet™

DALI®

csa
connectivity
standards
alliance

KNX

Thread Benefits

What is Thread?

A secure and reliable low power mesh network for connected products in homes and buildings

- Low power
- Resilient (mesh)
- IP-based
- Open protocol
- Secure and user friendly
- Fast time to market
- Existing radio silicon

- No single point of failure
- Self-healing
- Interference robustness
- Self-extending
- Reliable enough for critical infrastructure

What Thread Delivers

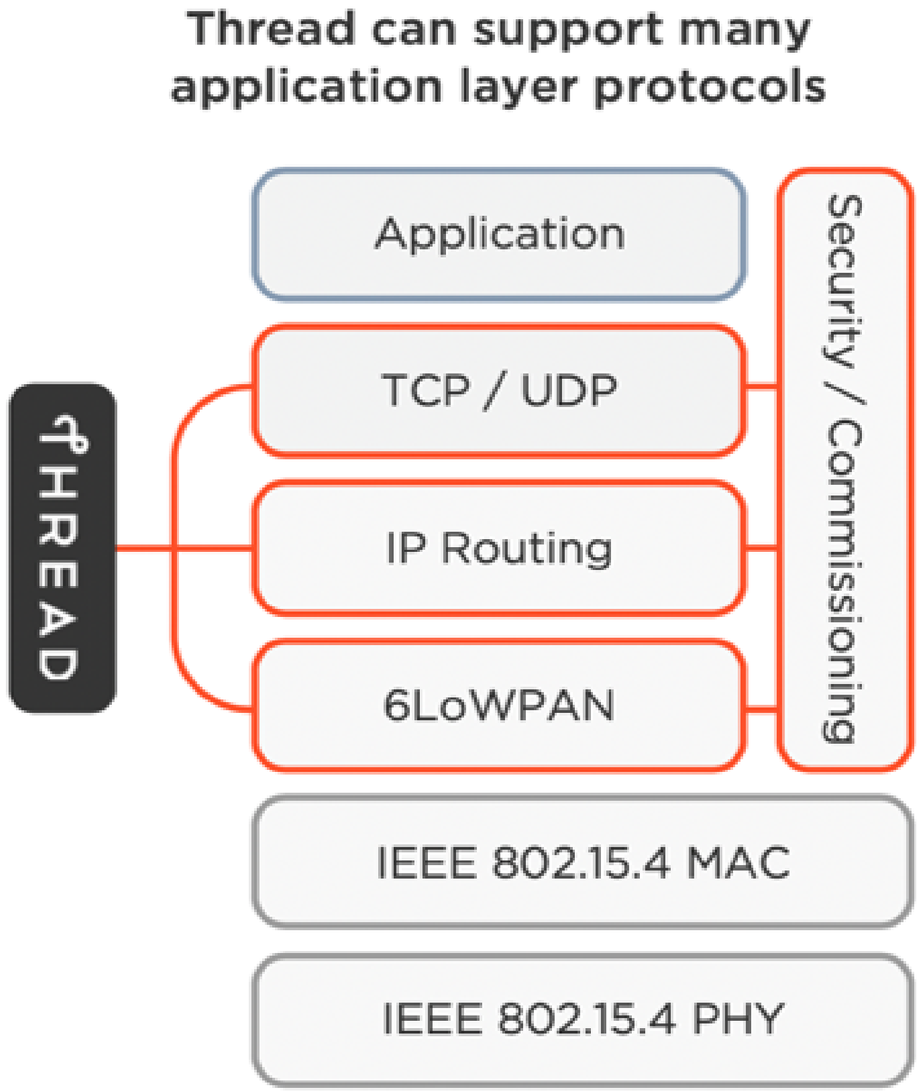
Built on proven, widely available, and supported technologies

Uses IPv6

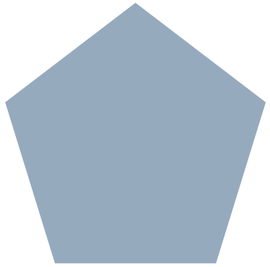
Runs on existing 802.15.4 silicon from multiple providers

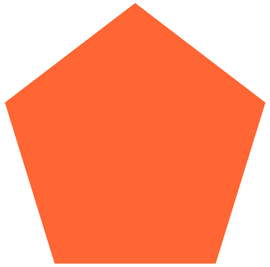
Architected to simply and securely add and remove products, keep communications secret, and prove identity

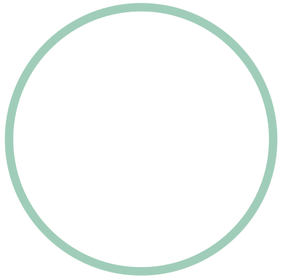
Tested and trusted to control devices in thousand-person office buildings, simple and affordable enough for a one-room apartment



Network Topology Roles – Scalability







Border Router

Forwards data to and from cloud/other networks

Provides optional Wi-Fi connectivity

Thread Leader

Manages network parameters

Coordinates commissioners

Makes network decisions

Assigned independently by the Thread network

Mesh Extender

Routes traffic among devices

Form the mesh topology

Eligible to become the leader

End Device

Designed for low power operation

May be powered or sleepy

May be mesh extender eligible if powered

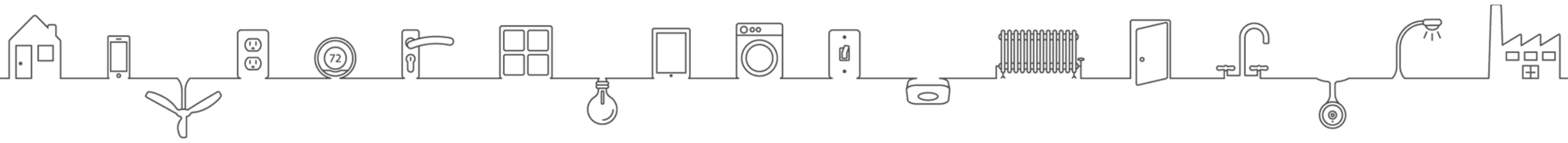
One or Many + One + Up to 32 + Up to 511 Per Mesh Network

Hundreds of Devices per Network

Thread in Homes

Secure, reliable, low latency connectivity for **low power** products to each other, to cloud services, and to consumers via their mobile devices supporting applications

Access Control	Lighting	Window Shades
HVAC Controls	Safety	Water Management
Energy Management	Security	And More...



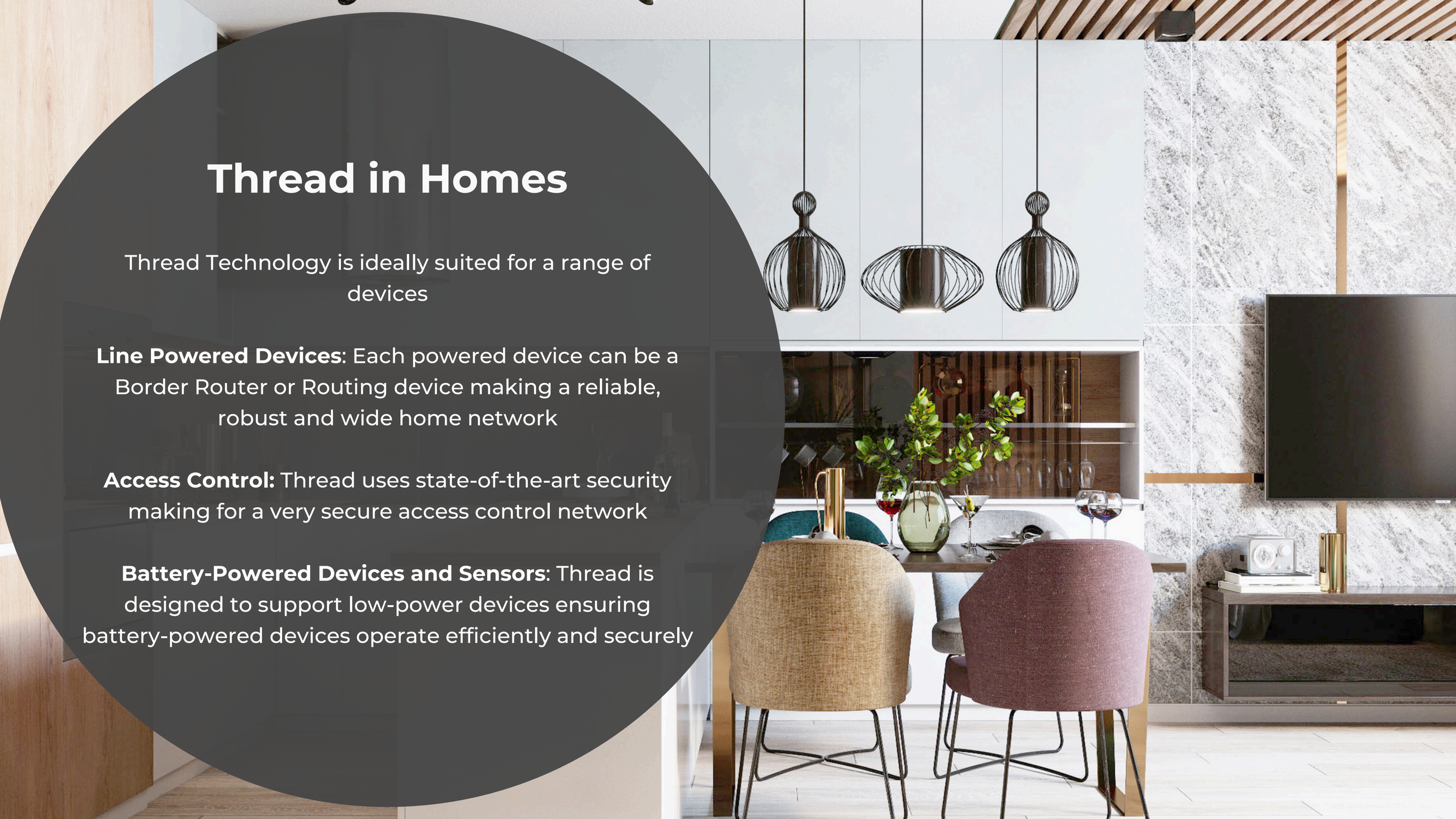
Thread in Homes

Thread Technology is ideally suited for a range of devices

Line Powered Devices: Each powered device can be a Border Router or Routing device making a reliable, robust and wide home network

Access Control: Thread uses state-of-the-art security making for a very secure access control network

Battery-Powered Devices and Sensors: Thread is designed to support low-power devices ensuring battery-powered devices operate efficiently and securely



Thread in Buildings

Benefits

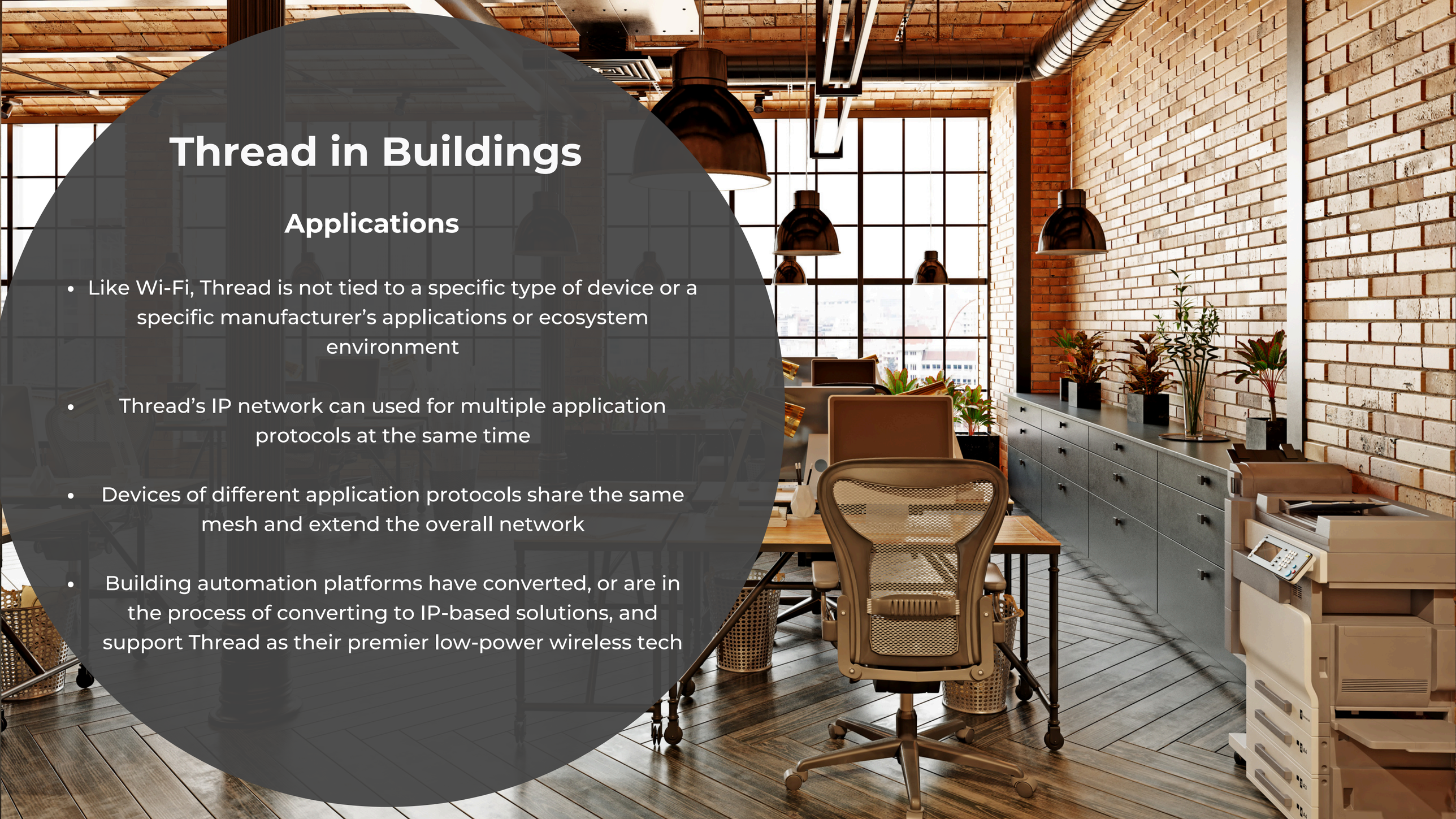
Thread’s IPv6 basis makes it the only wireless, low-power, mesh networking technology that seamlessly integrates into enterprise networks

Using proven security technologies allows IT planners to extend security certificates to also be used on lighting, climate systems, access control, etc.

New application domains and device types can be added at any point without the need for an overhaul of the network infrastructure

Mesh technology increases reliability and reach with every device added

Thread uses existing technologies in all its layers, enabling familiar configuration. Its 2.4GHz 802.15.4 radio allows for global deployment.



Thread in Buildings

Applications

- Like Wi-Fi, Thread is not tied to a specific type of device or a specific manufacturer’s applications or ecosystem environment
- Thread’s IP network can used for multiple application protocols at the same time
- Devices of different application protocols share the same mesh and extend the overall network
- Building automation platforms have converted, or are in the process of converting to IP-based solutions, and support Thread as their premier low-power wireless tech

Thread is...

... a low power, secure and flexible mesh networking protocol for IoT products.

BUILT FOR IOT
Low power, secure and robust wireless mesh built on IP

CONVERGENCE & COEXISTENCE
IP as a point of convergence

GLOBAL SOLUTION
Open standard for smart homes and buildings

FLEXIBLE & FUTURE PROOF
Enabling interoperability

Thread is...Built for IoT

Low power wireless mesh networking protocol built on IEEE 802.15.4 radio

Mesh network that is self-managed and self-healing with no single point of failure

Extends the Internet to constrained devices by using the Internet's proven, open standards to create an Internet Protocol-based mesh network

Integrates with IP networks without proprietary gateways or translators

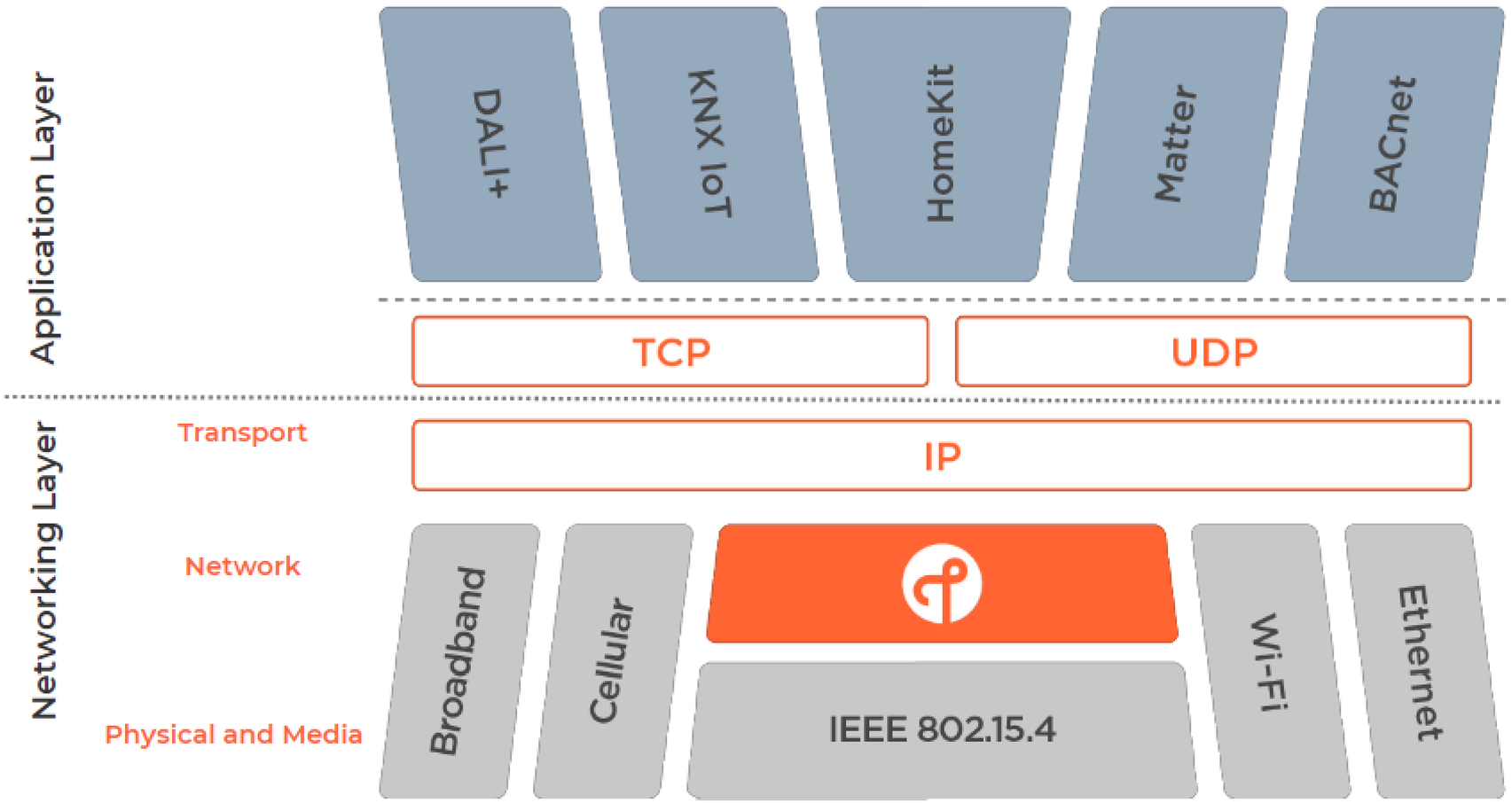
- Reduces infrastructure investment, complexity, and maintenance burdens
- Removes potential points of failures

Securely connects devices to the cloud, making it easier to control IoT products and systems from devices such as mobile phones and tablets

Thread is...A Global Solution

- Open standard to address market requirements
- Seamless integration into existing infrastructure
- Based on available 802.15.4 radio: multiple suppliers

Thread is...Convergence and Coexistence with IP



Thread is...Flexible and Future Proof

- Developers can bring their apps, devices, systems, and services to market faster because they're using the same rich set of tools available for the Internet
- Application layer and cloud services in Thread devices can be changed over time because Thread is application-layer agnostic
- Thread can simultaneously support multiple application protocols on the same network, making it a cost-effective and future-proof solution for a wide range of applications
- Thread is IP-based so manufacturers can maintain a direct connection to their products and their users while enabling interoperability across a broad range of connected devices

Smart Home Benefits

Thread

Fast, long-range, and reliable network technology built to elevate and secure your smart home experience.

RESPONSIVE

Low latency

Instant control, automation

Delivers positive user experience

Reliable (it just works)

SHARED MESH

Eliminates need for dedicated hub

More Thread devices means stronger and wider coverage network

No dropped connections (self-healing network)

ENERGY SAVING

Thread-enabled devices require less power

Lower energy footprint

Supports small battery powered devices

Extends battery life

FLEXIBLE

Works with range of ecosystems and application layers

Pairs with any device that acts as Thread Border Router

Communicates with other Wi-Fi devices and cloud services

SECURE

Devices authenticated before joining network

Proven security algorithms

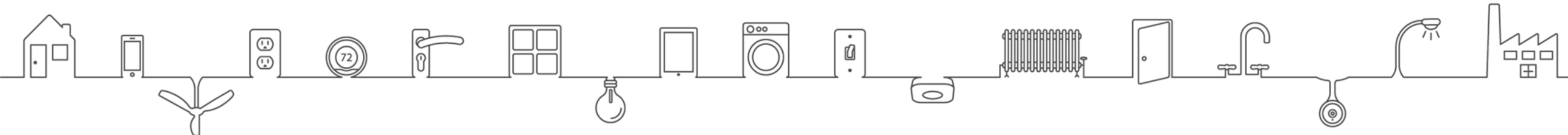
Messages on Thread networks encrypted to prevent unauthorized access

Thread with Matter

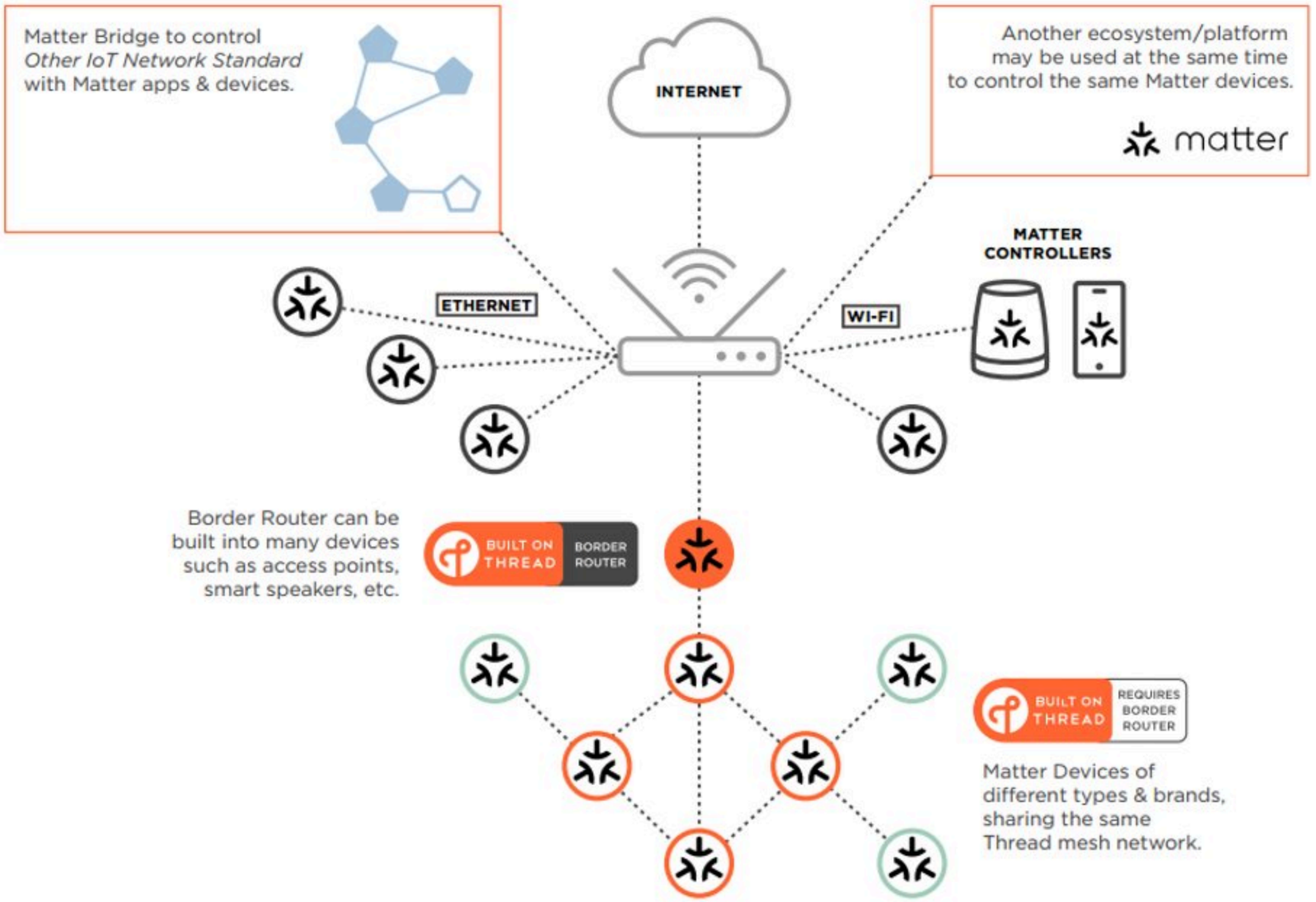
Thread enables power-constrained Matter devices to easily join existing home networks

- Reliable mesh technology
  - Long range
  - Self-healing
- Low bandwidth data
  - Extended battery life
  - Reduced latency

Border Routers can be built into many devices and connect a Thread network to other IP-based networks, such as Wi-Fi or Ethernet



Thread in a Smart Home with Matter Devices



Key

- Matter Device
- Thread Border Router
- Thread Mesh Extender
- Thread Battery Operated Device
- Matter Bridge
- Non-IP Device
- IP Connection

Smart Building Benefits

Thread

An IP-based, low-power, secure, and future-proof mesh networking technology for IoT products.

IP-BASED

Extends existing wireless network for use with battery-powered devices

Various ecosystems use the Thread network simultaneously

Secure device-to-device and device-to-cloud communication

Security based on X.509
Multiple border router

CONVERGENCE & COEXISTENCE

Existing IP networks in buildings can be enhanced very easily using Thread border routers

Multiple ecosystems use the whole IP infrastructure simultaneously

COMMERCIAL USE

No more cyber security transitions through gateways when using wireless battery-operated devices, real end-to-end encryption

Global Solution

Use of IP standards (e.g., DHCP)

LOW ENERGY

Power consumption is minimized by leveraging ultra-low duty cycle

Based on IEEE 802.15.4 standard for low power consumption

Multiple end devices serve as sleepy devices

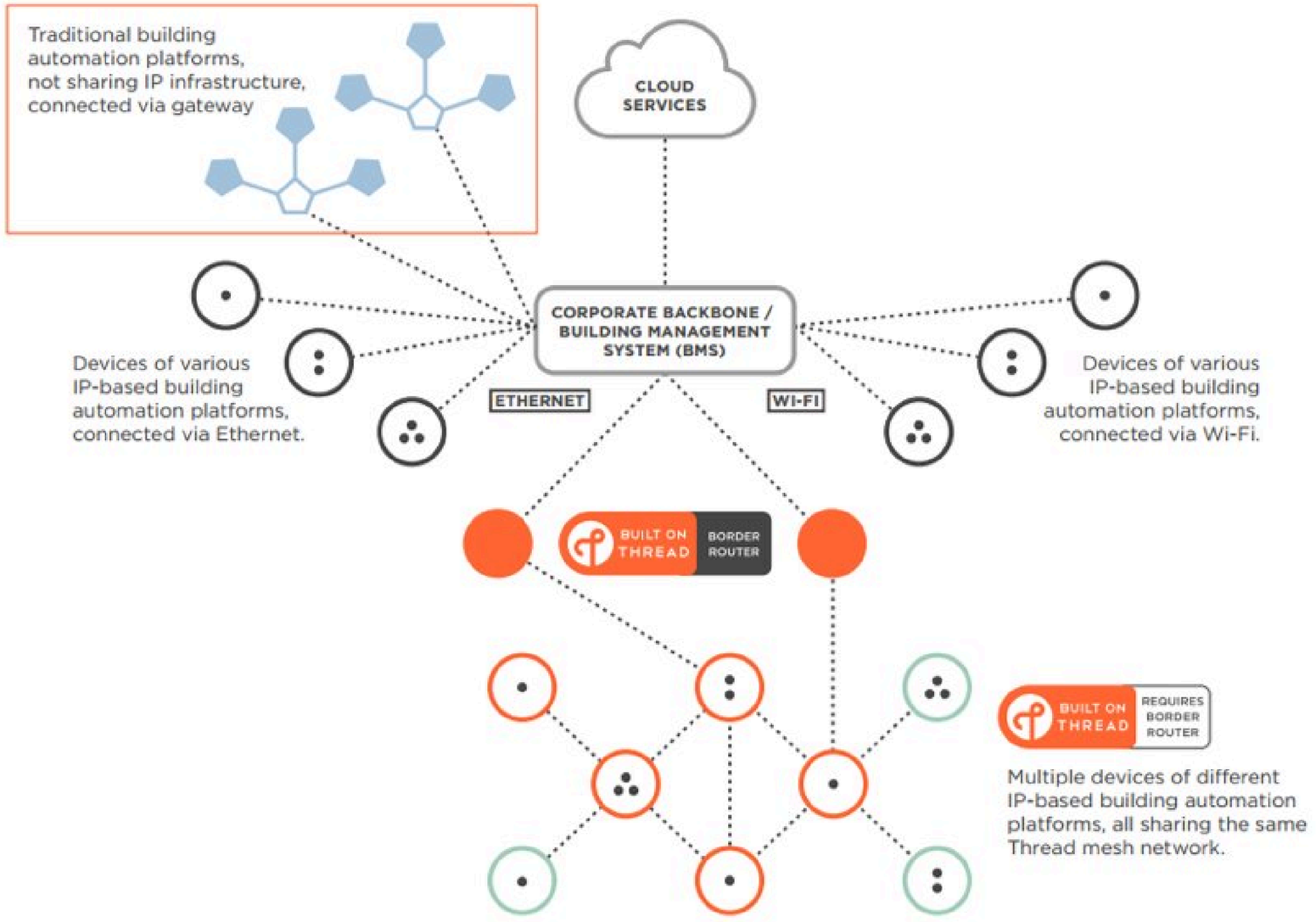
Long battery lifetime

INVESTMENT AND FUTURE SAFE

Can be flexibly adapted to the usage requirements of a building over the building's life cycle

No vendor lock due to the use of global standards and ecosystem-agnostic

Thread in a Smart Building with Multiple Automation Standards



Key

- Thread Border Router
- Thread Mesh Extender Device
- Thread Battery Operated Device
- Wi-Fi or Eternet Device
- Building Automation Standards
- Bridge
- Non-IP Device
- IP Connection

Commercial Building-Focused Applications

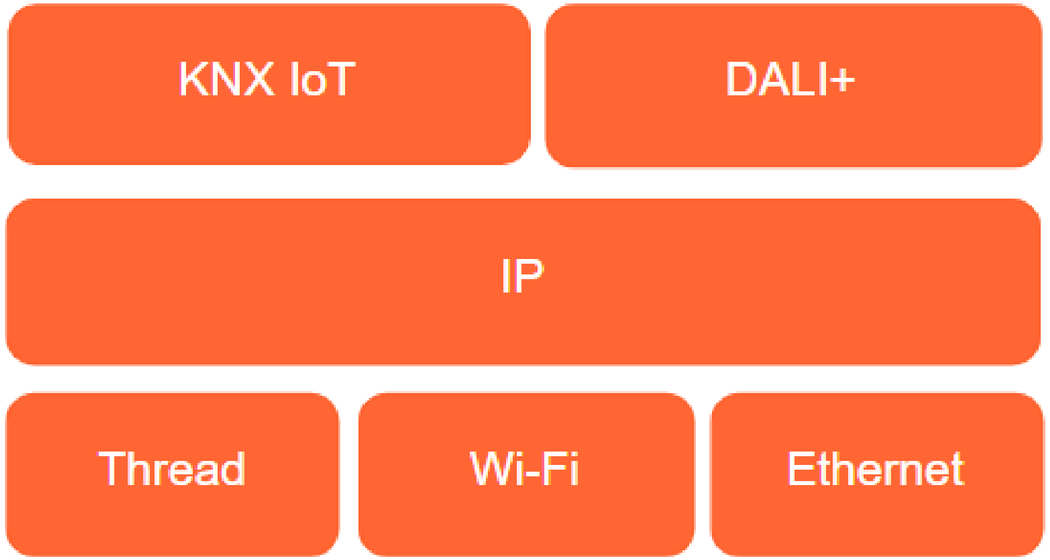
Thread enables even the smallest IP-based and battery-powered devices for these applications

Supporting the world's goal of carbon neutrality by 2050 - quickly and easily renovating buildings for minimal wiring

Providing multi-year battery life cycles along with the cyber security required for commercial buildings

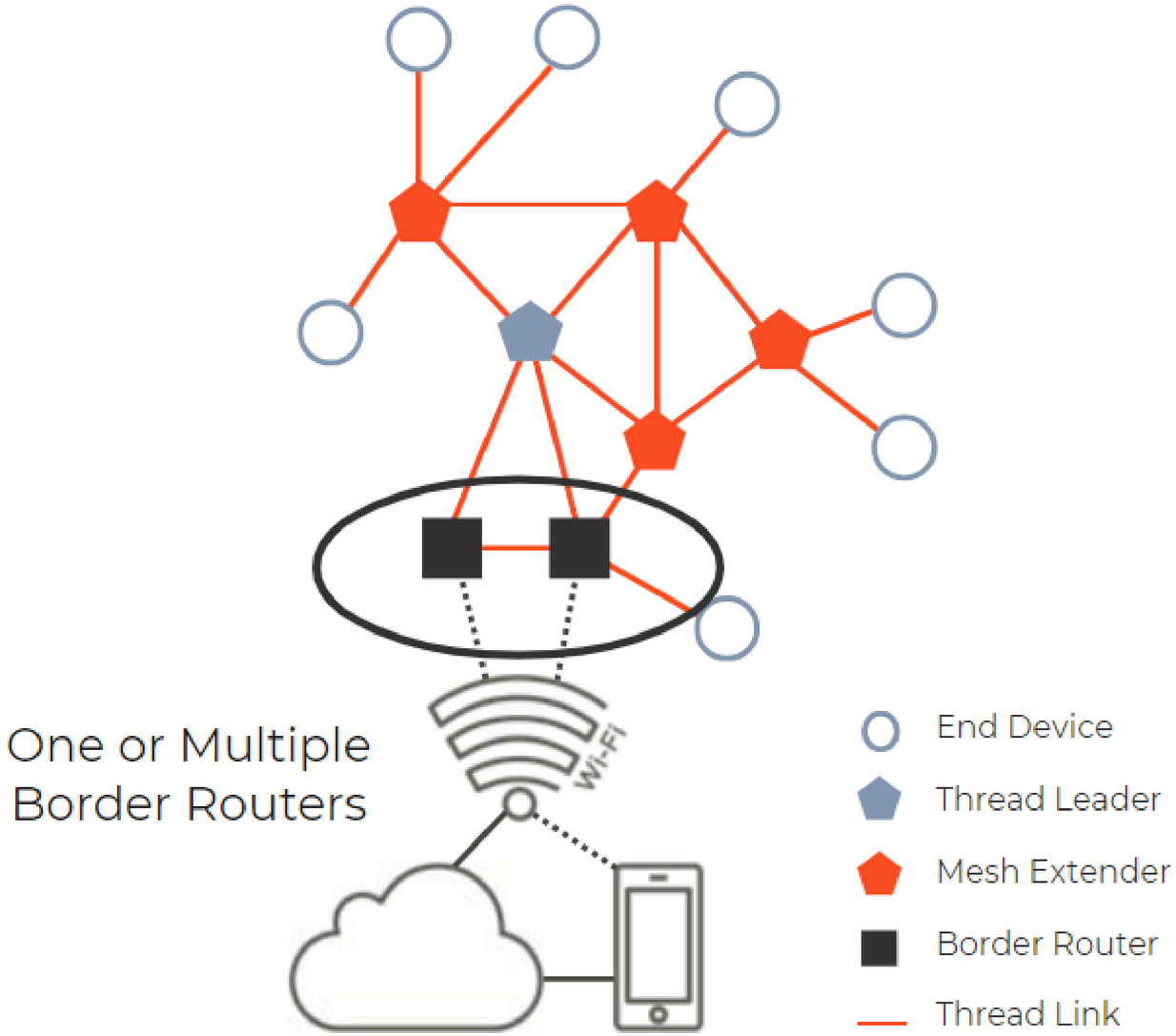
Thread is supported by a growing number of applications (i.e., KNX, DALI+, etc.)

Optimizing functionality, total cost and commissioning speed



Thread Capabilities

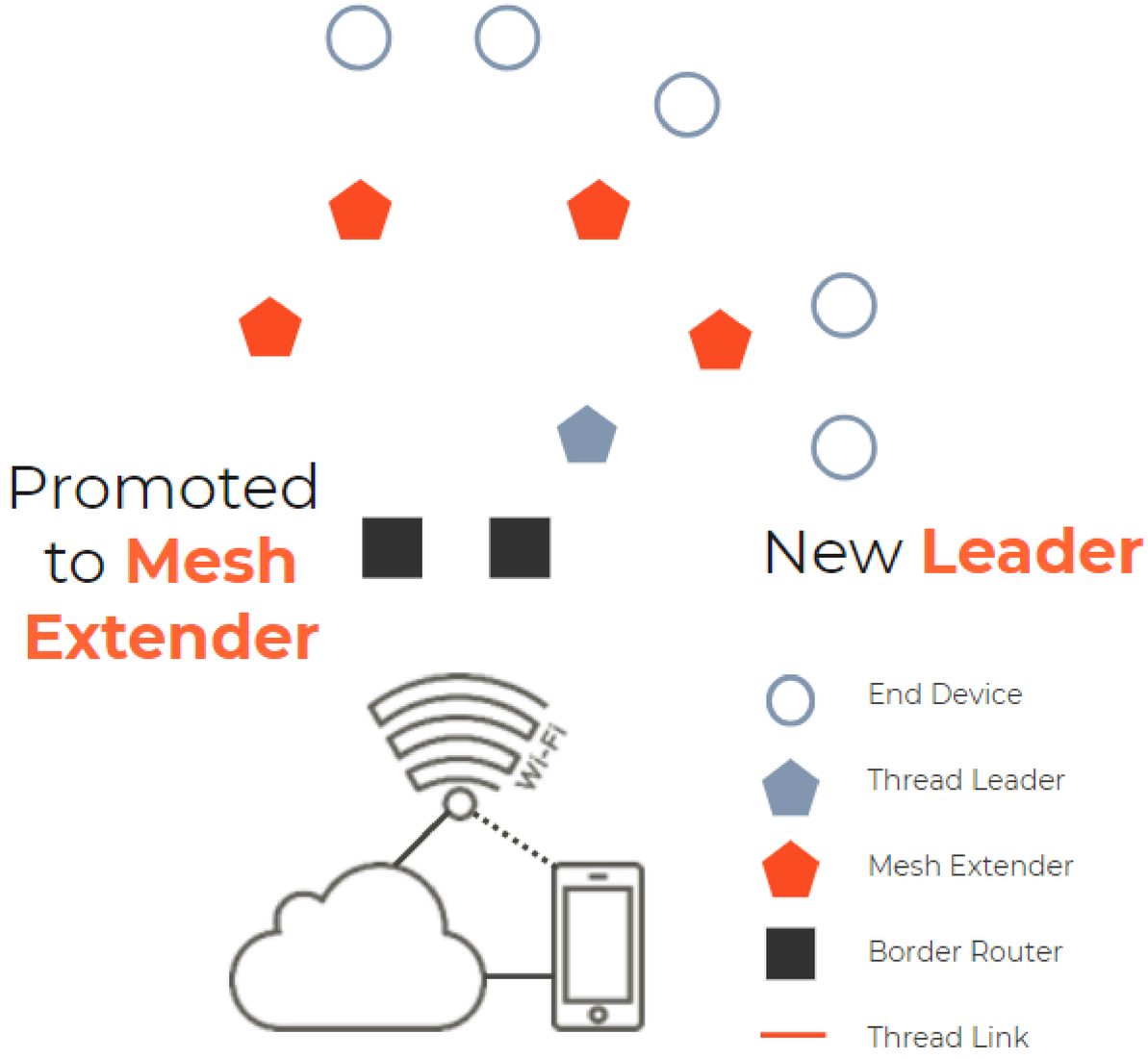
Thread Border Router



Thread Border Router Securely and Transparently Connects Thread Networks to Other IP Networks Such as Wi-Fi or Ethernet

- Flexibility
  - Devices with an 802.15.4 radio and another physical layer, e.g., Home Wi-Fi router, Set-top box, Smart Speaker
  - One or multiple Border Routers
  - Eliminates the need to build proprietary hubs
- Accessibility
  - Securely accessed from applications on a mobile phone, smart speaker, or tablet, or from an optional cloud-based online service

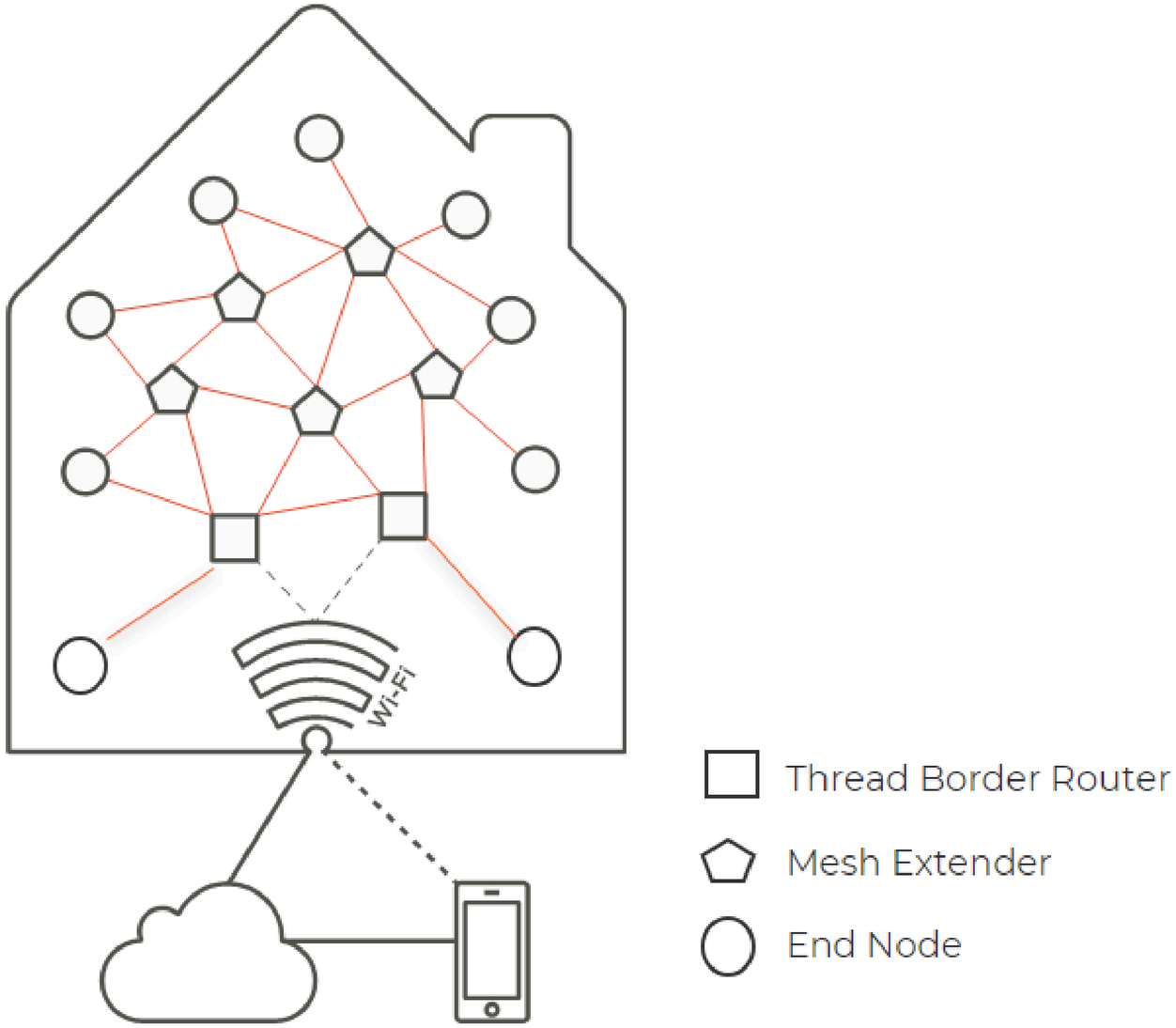
Robust, Resilient and Simple



Thread Networks are Self-forming and Self-healing with No Single Point of Failure

- Will self-heal and reconfigure when a device is added or removed
- Simple to set up and use
- Dynamic Leaders
  - If the Leader fails, another Router will become the Leader
- Mesh Extender Promotion
  - Leader can promote Mesh Extender Eligible devices to Mesh Extenders to improve connectivity if required

Extended Range



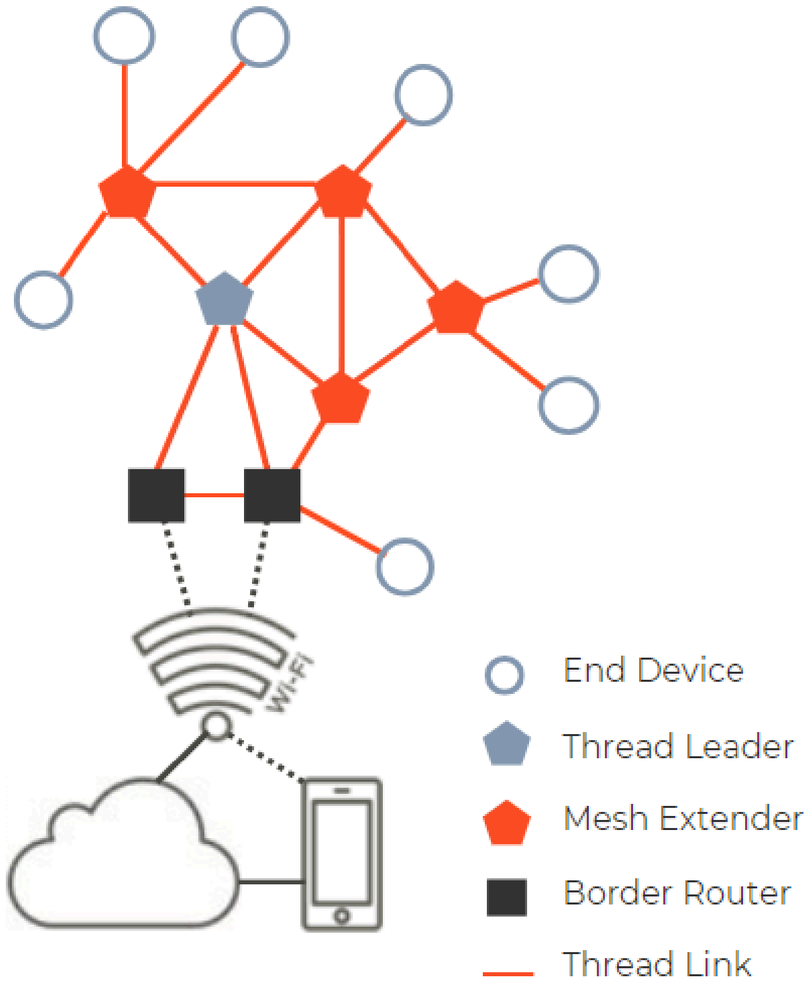
Mesh Network Extends Range

- Mesh Extenders repeat signals
- Thread network expands automatically as more devices are added
- Builds a stronger, more reliable network
- Extends reach to far corners of homes and building

Low Power Operation

Based on Broadly Supported IEEE 802.15.4 Radio Standard

- Designed from the ground up for extremely low power consumption and low latency
- Enables battery-operated Thread devices to maintain a permanent connection to the Internet



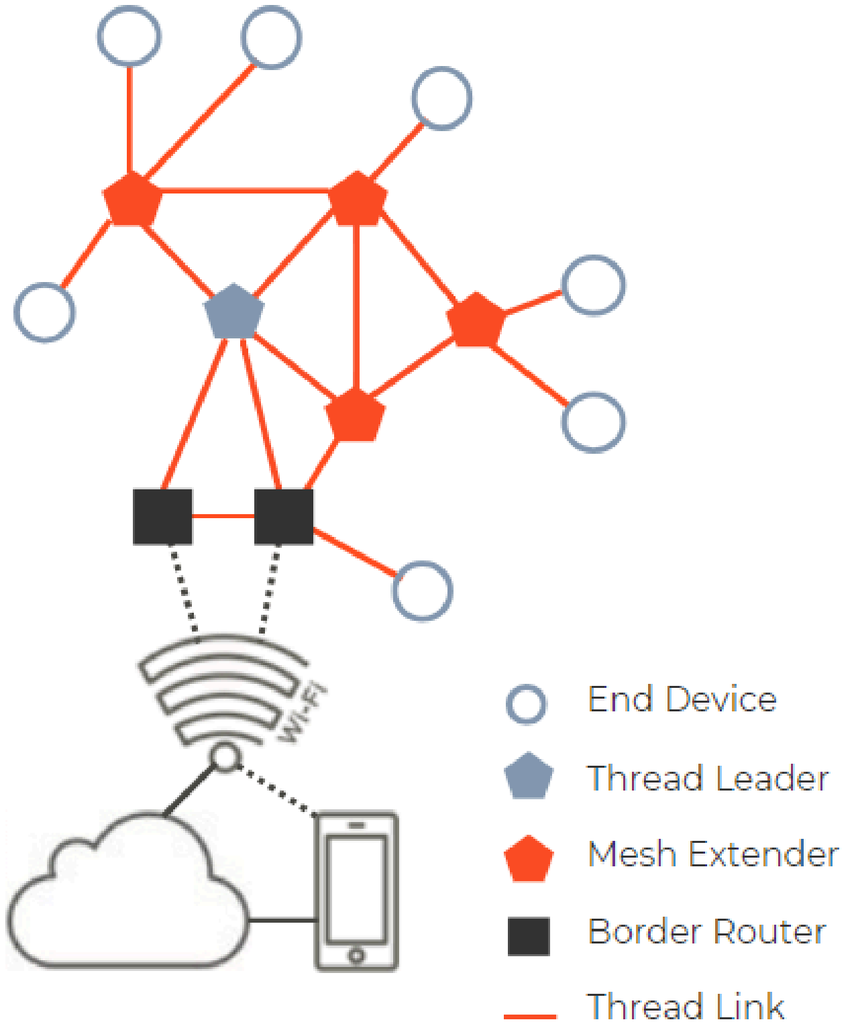
Sleepy Devices

- Sleeping devices poll parents for messages (or remote device if application configured)
- Sleeping devices not required to check which allows lower power operation
- Parents hold messages for sleeping devices
- Sleeping device automatically switches parent when connection is lost

Security and Commissioning

Secure, End-to-end IP Network

- Protection is built into every Thread network across a wide variety of IoT applications in homes and buildings
- Uses banking-class AES encryption and an advanced device-authentication scheme
- Keeps communications secret and provides proof of identity
- Access control prevents random devices from connecting to the network, and prevents an attacker from controlling devices



Simple Commissioning

- User authorizes devices onto the network using smartphone or web
- Can be done on network if there is a device with a graphical interface
- DTLS Security session established between new device and commissioning device to authenticate and provide credentials
- Once commissioning session is done, device attaches to network
- MAC security used for all messages
- Application-level security is based on end-device requirements and application layer being used

Thread Evolution

Thread 1.1

Low Power

Resilient (mesh)

IP-based

Open Protocol

Secure and User Friendly

IEEE 802.15.4 Radio

Thread 1.2

Thread 1.1 +

Low Power Enhancements

Domain Unicast Addressing

Multicast Extensions

Thread 1.3

Thread 1.2 +

Bidirectional IPv6 Connectivity

Supports Matter

Thread 1.4

Thread 1.3.0 +

Credential Sharing

More Ubiquitous Internet Connectivity

Thread Over Infrastructure

Network Diagnostics

Secure Commissioning at Scale

Enhanced Robustness and Scalability

Thread 1.4 Features

Credential Sharing

- Standardizes the way Thread Border Routers and devices from different vendors can share credentials, simplifying the process of adding a new Thread Border Router or Thread device to an existing Thread network

- Enables the creation of a single, shared Thread mesh network which can encompass multiple Border Routers, extending the range and reliability of the network

More Ubiquitous Internet Connectivity

- Thread 1.4 networks now require Thread Border Routers to provide a standardized path to the Internet for connected devices

- Product manufacturers can leverage the cloud for dynamic features in their Thread devices, such as a thermostat that responds to weather changes in real time

- Facilitates better technical support by sending software updates and performing diagnostics remotely

- Enables simpler and remote commissioning without the need for a dedicated hub

Thread 1.4 Features

Thread Over Infrastructure

- Allows Thread Border Routers to connect over existing infrastructure like Wi-Fi or Ethernet
- Leverages these connections as additional paths in the Thread network, making it easier to relocate a device to add a new device to the network
- Users experience improved connectivity with less complexity through the reuse of these links

Network Diagnostics

- Standardized methods for Thread devices to provide network configuration and status data
- Enhanced visibility into Thread networks for product developers and installers
- Simplified device testing and network troubleshooting
- Reduction in support costs
- Opportunities for delivering more robust network performance to end-users
- Increased insight for installers and access to advanced troubleshooting features
- Potential for developing commercial-grade network monitoring and diagnostic tools

Thread 1.4 Features

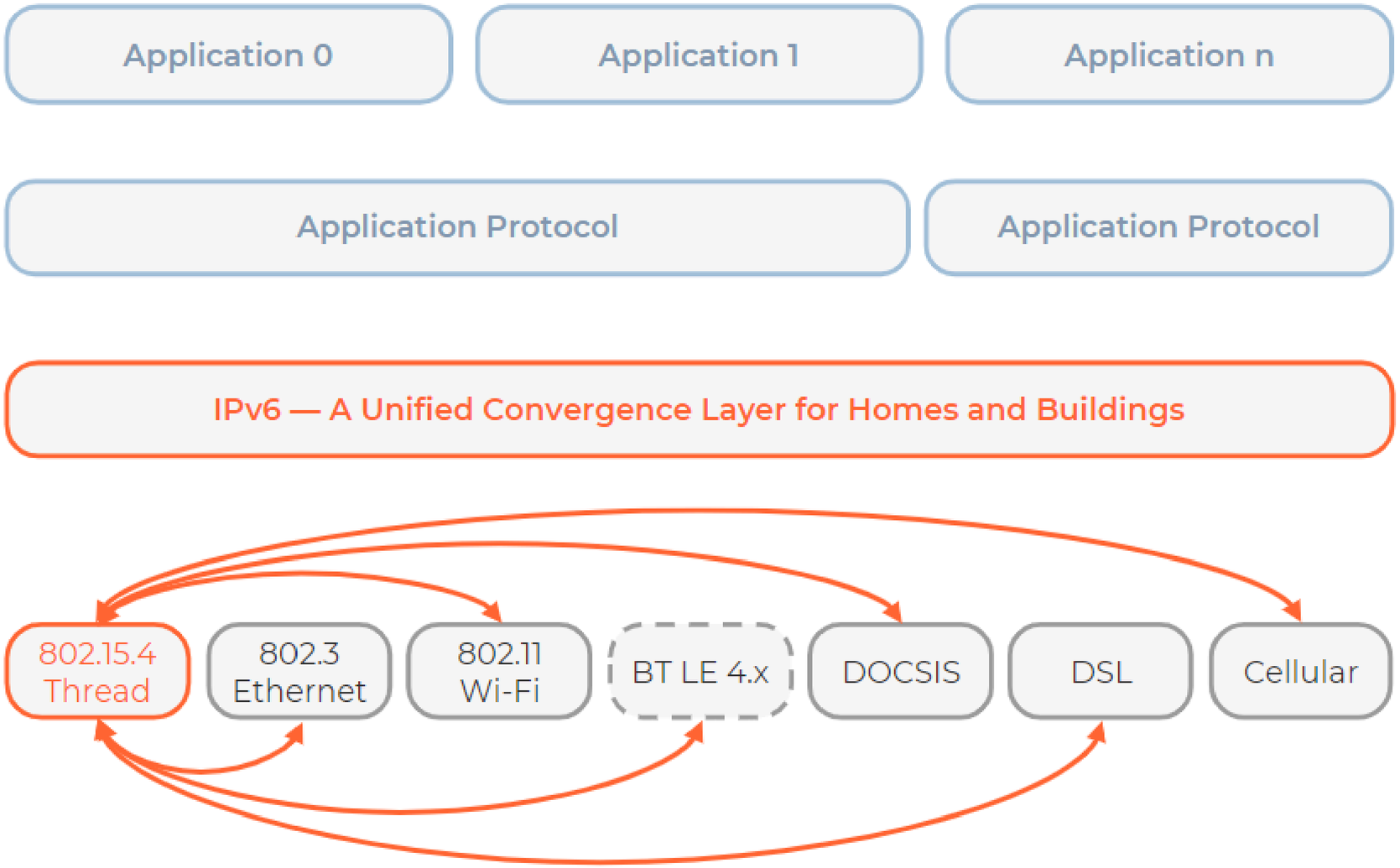
Secure Commissioning at Scale

- Commissioning at scale designed for professional installation and commercial building scenarios
- Simplifies wireless onboarding of Thread devices pre-installed in hard-to-reach areas
- Eliminates the need to scan physical install codes post-installation
- Implements authenticated TLS for commissioning by exchanging security certificates
- Commissioning performed while in proximity using a mobile device over Bluetooth Low Energy radio

Robustness and Scalability

- Maintenance updates implemented to ensure more robust operation and performance in Thread mesh networks
- Enhancement of deployment and performance of Thread-enabled devices and networks
- Improvement of user experiences with Thread-enabled devices

IP-based: Application Layers



Unified convergence layer across all networks in homes and buildings

- Reuse software stacks

Direct device-to-device, device-to-mobile, and device-to-cloud, and one-to-many communication

- Nodes can communicate directly with each other and with multiple apps or backend services
- Eliminates need for dedicated translators / hubs

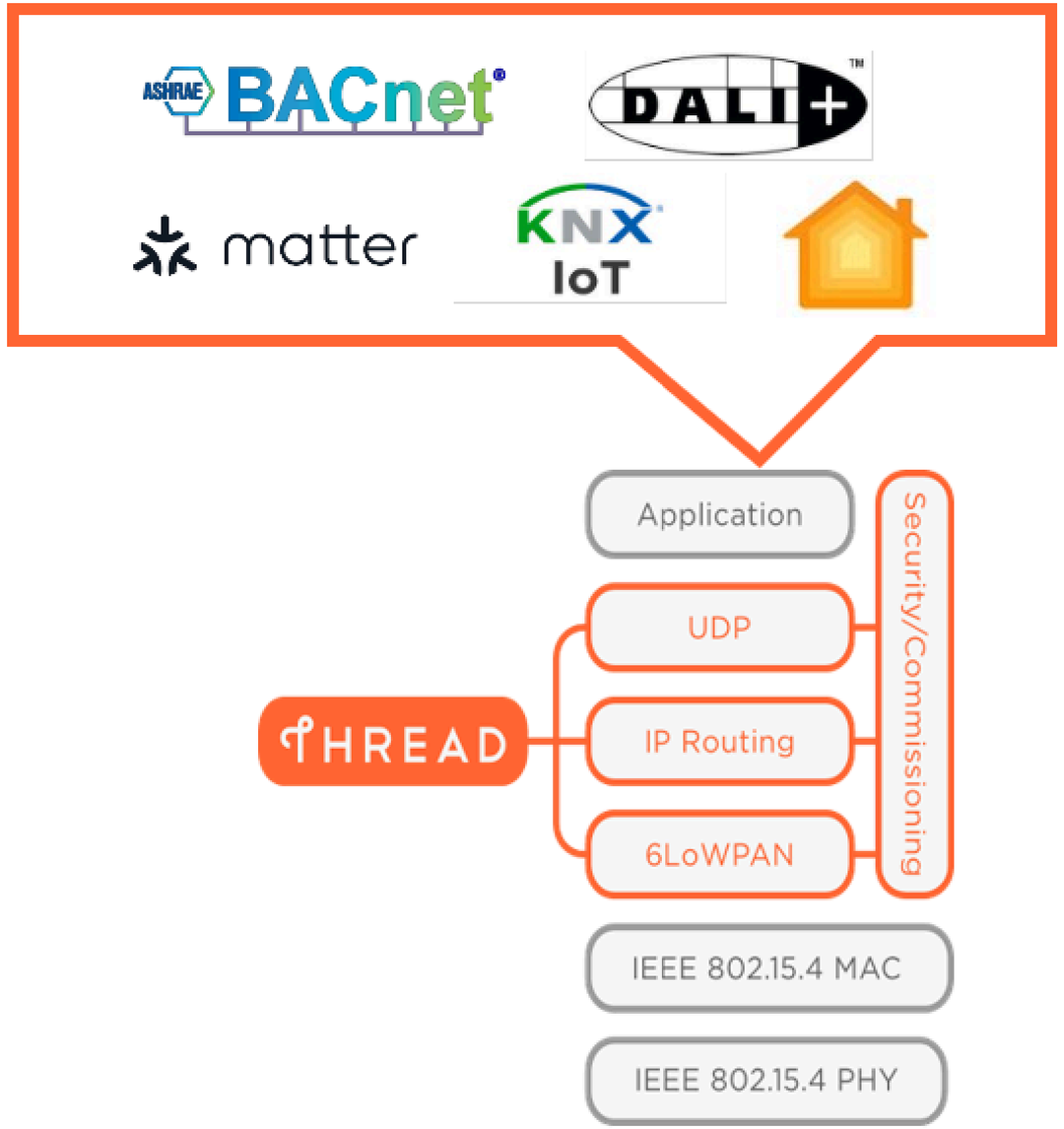
Support for many application layers

- Any low bandwidth application layer that runs on IPv6 can run over Thread

Application Layer Diversity

Thread is an IP Network & Transport Layer Specification

- Application Layer: A protocol running over an IP network layer
- Network Layers: Ethernet, Wi-Fi, cellular … and Thread
- Application layers can use multiple IP networks
- Thread can support multiple application layers
- App layers typically interoperate via services through public interfaces



Thread Plus Many Coexistence

Choosing Link Technologies

Network Links

Choose One

- [x] Thread
- [ ] Wi-Fi
- [ ] Ethernet
- [ ] Bluetooth
- [ ] Cellular
- [ ] DOCSIS
- [ ] DSL

With Thread and IP, you are not forced to choose a single link technology to the exclusion of others.

Choosing Link Technologies

Network Links

Choose One

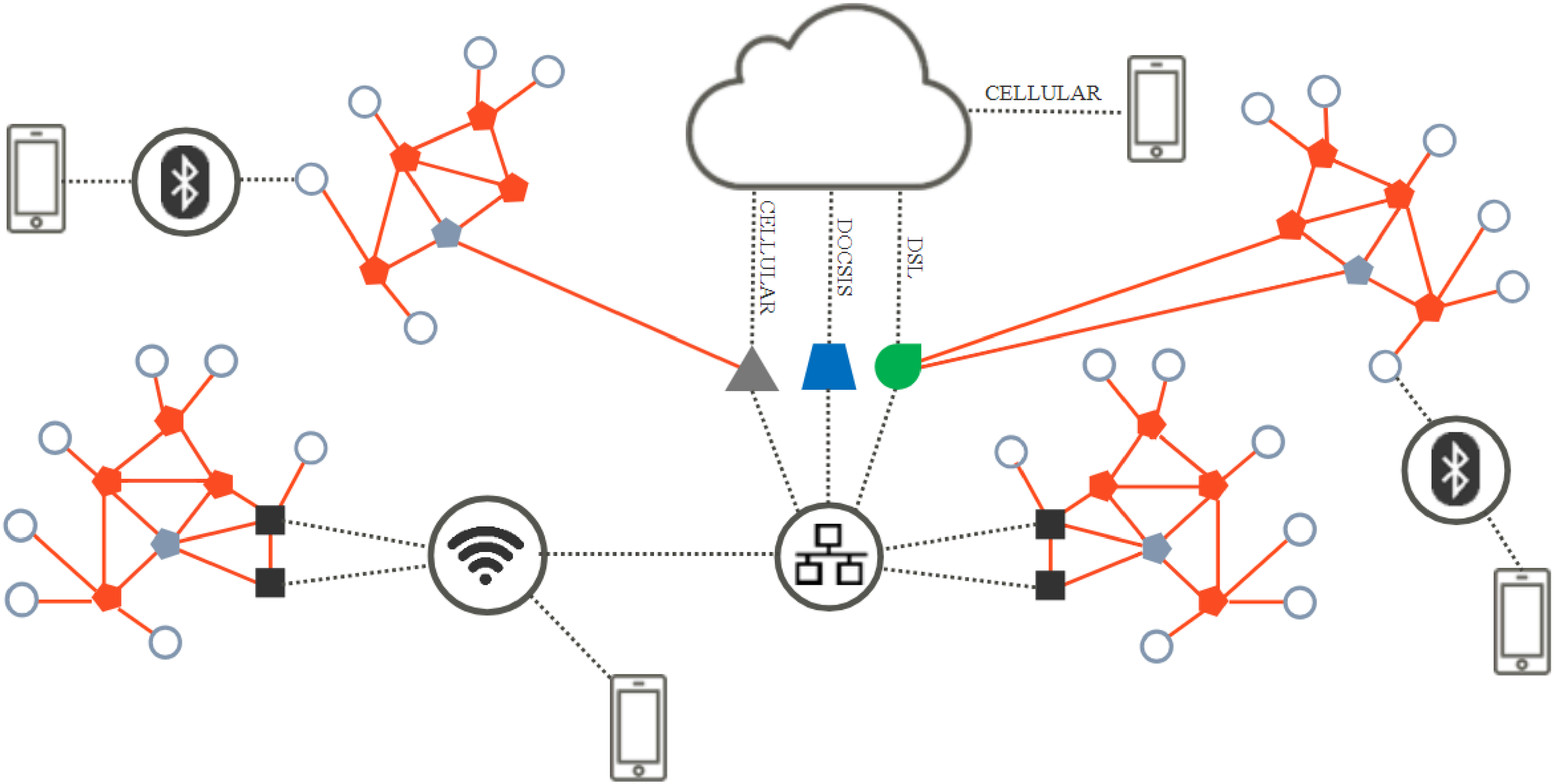
- [x] Thread
- [x] Wi-Fi
- [ ] Ethernet
- [ ] Bluetooth
- [x] Cellular
- [ ] DOCSIS
- [ ] DSL

Choose the right link technologies for your product and customer

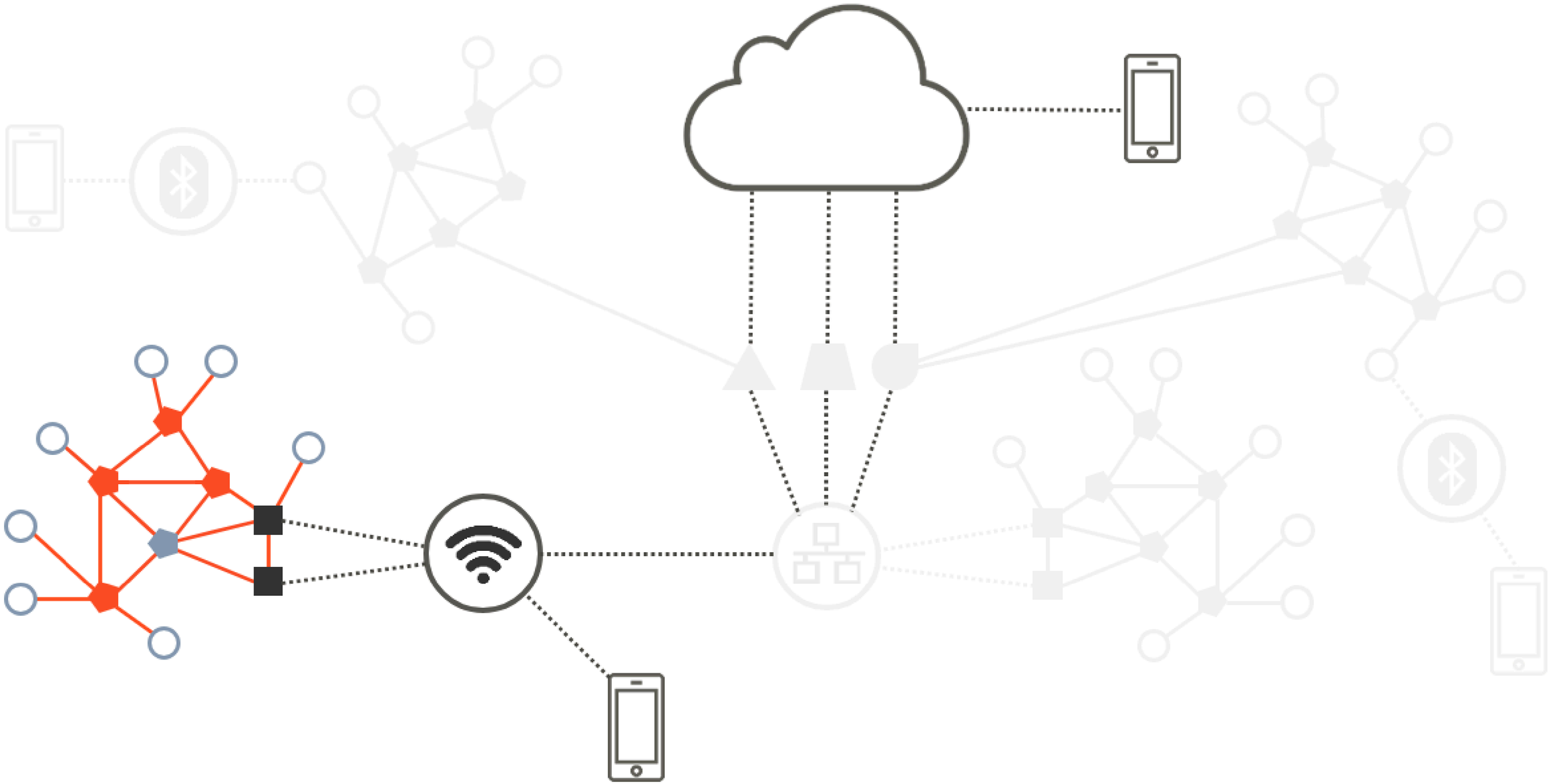
Choose the right application layer appropriate for the:

- Resources of your product
- Ecosystems your customers want to access

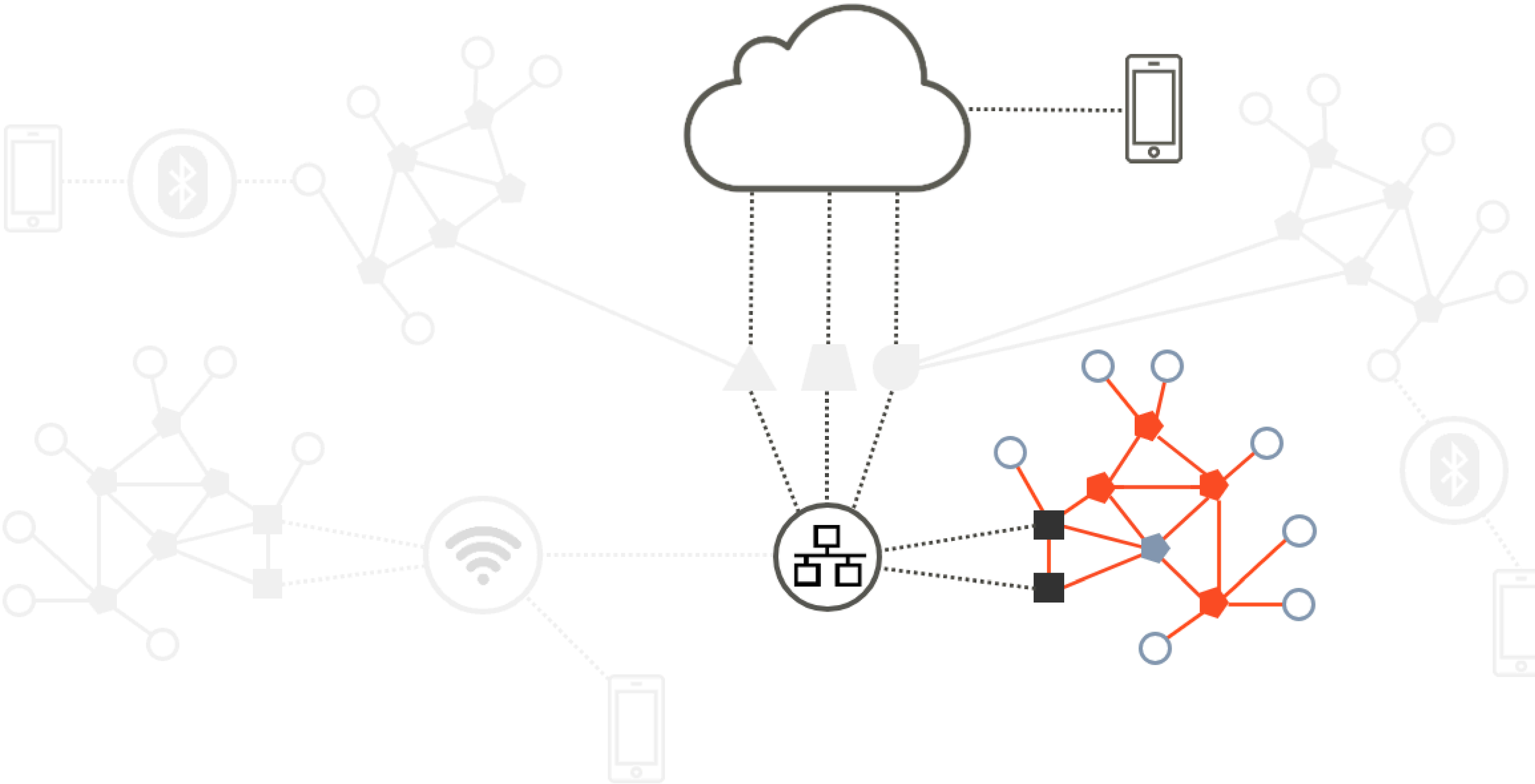
Thread + Many



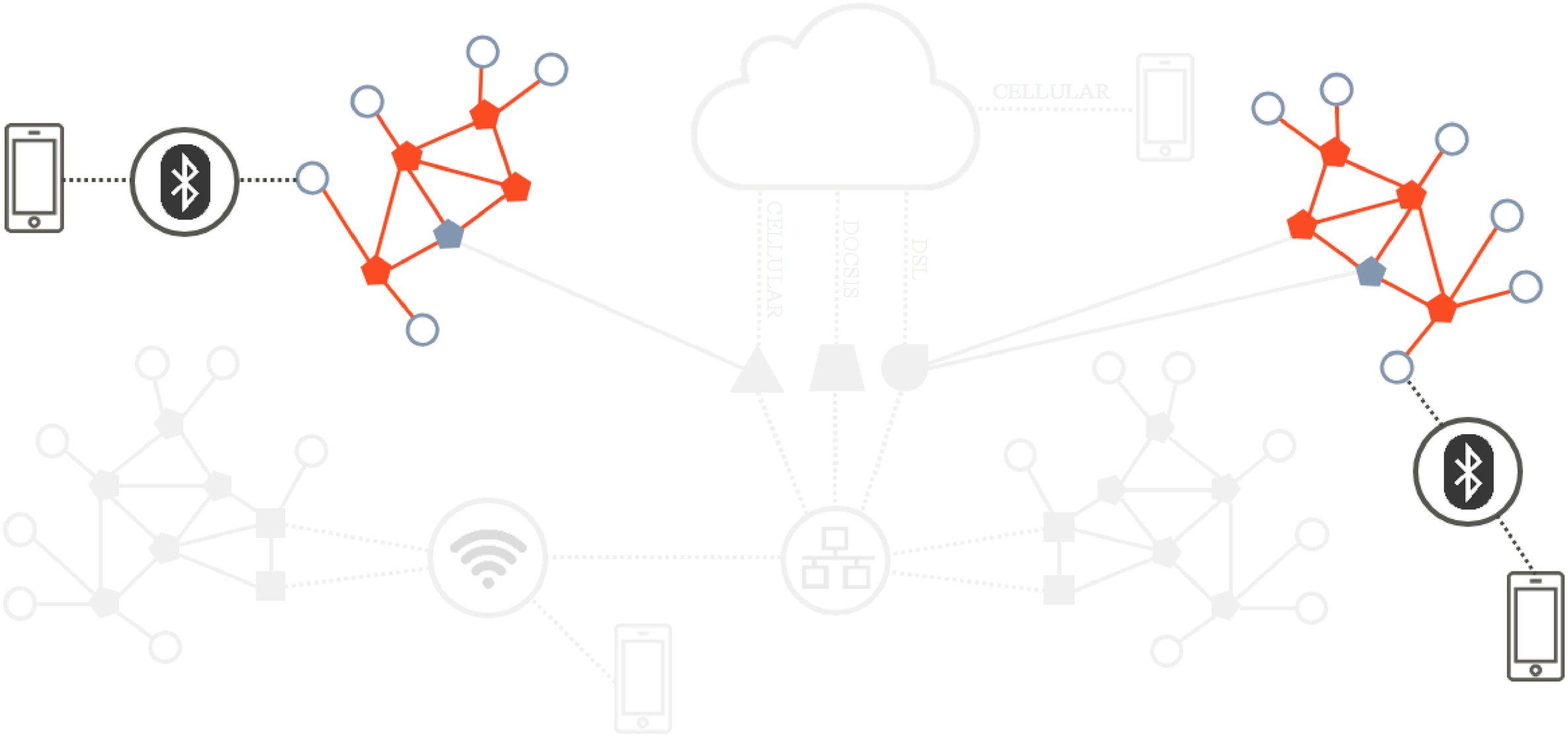
Thread + Wi-Fi



Thread + Ethernet



Thread + Bluetooth



Thread Certification

Certification

- True **multi-vendor interoperability** between ≥ 3 stacks
- We have many certified stacks
- We provide fast ramp tools
- Why certify
- Intellectual Property Rights for using Thread technology
- Official Thread Group certificate for compliance and interoperability
- www.threadgroup.org/certification

Authorized Test Labs

ALLION®

Asia – Nantou, Taiwan*

DEKRA

Europe – Malaga, Spain*

GRL

Asia – Taipei, Taiwan*

SGS

Asia – Gyeonggi-Do, Korea
Asia – Taipei, Taiwan

UL Solutions

Asia – Taipei, Taiwan*
Asia – Dongguan, China*
Europe – Basingstoke, UK*
N. America – Fremont, CA*

TÜVRheinland®

Europe – Lund, Sweden*

*CSA Lab

Built on Thread Border Router Badges

Preferred Version Above

Preferred Version Above

- Created to help educate and guide consumers on the need for a Border Router
- Help consumers identify products that include a Border Router
- Recommended for packaging and collateral materials for end user products that are consumer facing and in particular, for Matter devices

Thread Certified Products

BUILT ON THREAD BORDER ROUTER

Google
Nest
Hub Max

Google
Nest
WiFi Point

GL.iNet
GL-S200

SmartThings
Station

BUILT ON THREAD

Amazon
eero 6

Belkin
Wemo Stage
Scene Controller

Eve
Motion

Tuo
Smart
Button

Allegion
Schlage Encode Plus
Wi-Fi Deadbolt

THREAD CERTIFIED COMPONENT

Qualcomm
tuya
ESPRESSIF
NXP
SILICON LABS
NORDIC SEMICONDUCTOR
Texas Instruments
Telink
CASCODA
Unlocking Smart Building KNX IoT Connectivity

Thread Adoption

Adoption- Platforms and Ecosystems

matter

DALI+™

KNX® IoT

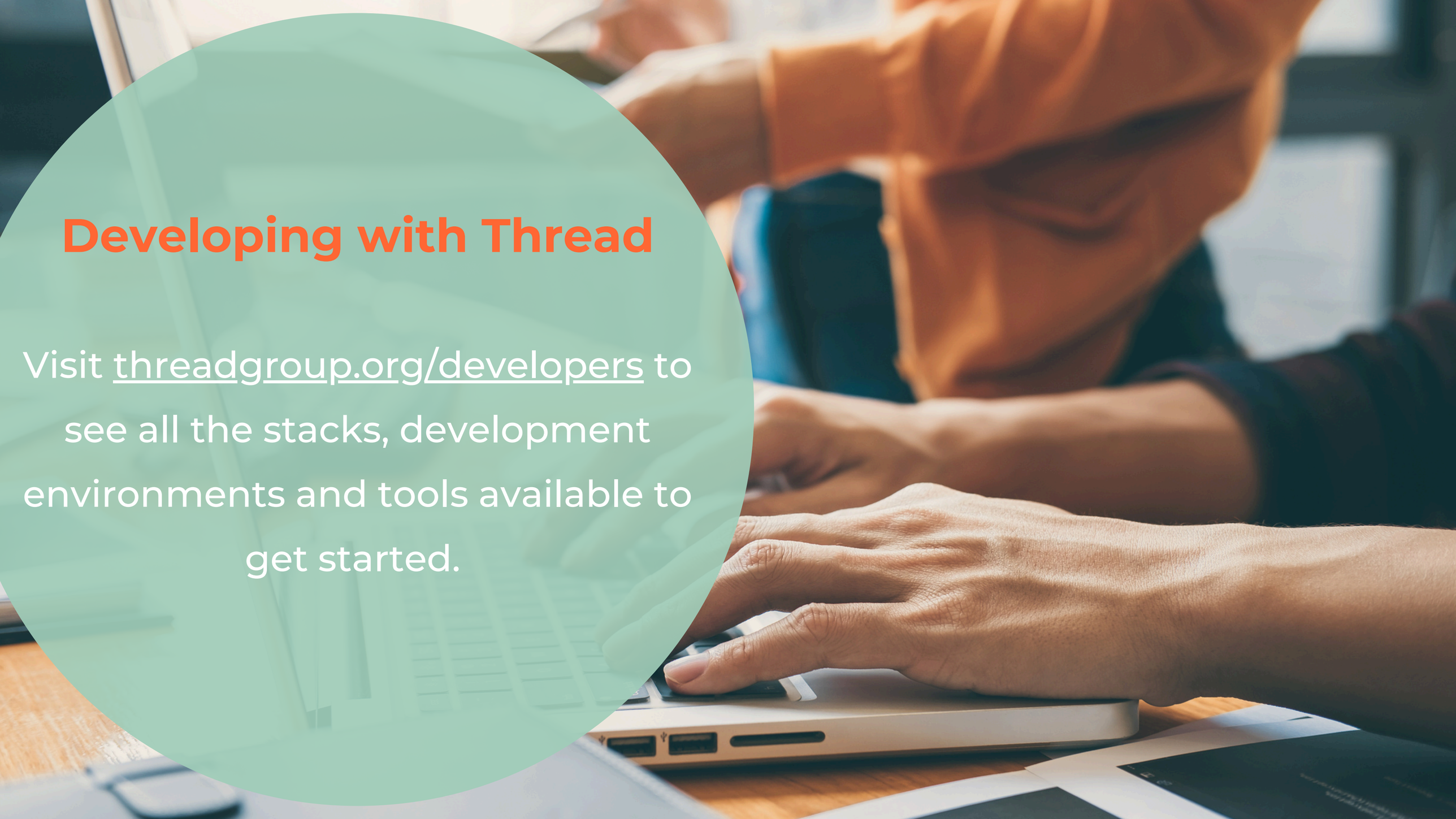
ASHRAE BACnet™

HomeKit

RIOT

Zephyr™

Getting Started with Thread



Developing with Thread

Visit threadgroup.org/developers to see all the stacks, development environments and tools available to get started.

Thread Resources

White Papers

Fact Sheets

Network Topology

Blogs

FAQs

Videos

Specification Downloads

www.threadgroup.org

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