THREAD GROUP

THREAD IN COMMERCIAL

Thread in Commercial Backgrounder

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An introduction to Thread,
its Network Topology and Application Support

What is Thread

Thread is an open standard for wireless communication providing a native IP (Internet Protocol) solution for reliable, secure, device-to-device, application agnostic communication. It is the premier IPv6 based solution running on existing and broadly supported 802.15.4 radio technology.

Thread offers a number of benefits compared to other solutions. Its IPv6 base enables flexible set-up, monitoring, data-analysis, provisioning and a direct connection without compromising encryption and security, from individual devices all the way up to the cloud. Thread also offers flexibility in choosing which application protocols to run, even allowing multiple applications to run concurrently, enabling flexible integration with other technologies and maintaining an open path to future developments.

Since Thread is based on IPv6, its application layers can also run on existing IP infrastructure like Wi-Fi and ethernet, allowing for the most suitable networking technology to be used. For example, a network could consist of lighting end points connected with Thread and lighting end points connected via PoE, all operating in one fully integrated environment.

Today, the majority of commercial building spaces consist of technology silos with minimal interoperation. Thread connectivity serves to provide a common IP (Internet Protocol) networking solution for easy integration in enterprise networks. This enables more flexibility in functionality planning, better system features, easier maintenance and lower cost. It scales to thousands of wireless, robustly connected IP devices and handles both local communication between devices as well as cloud connectivity over the internet.

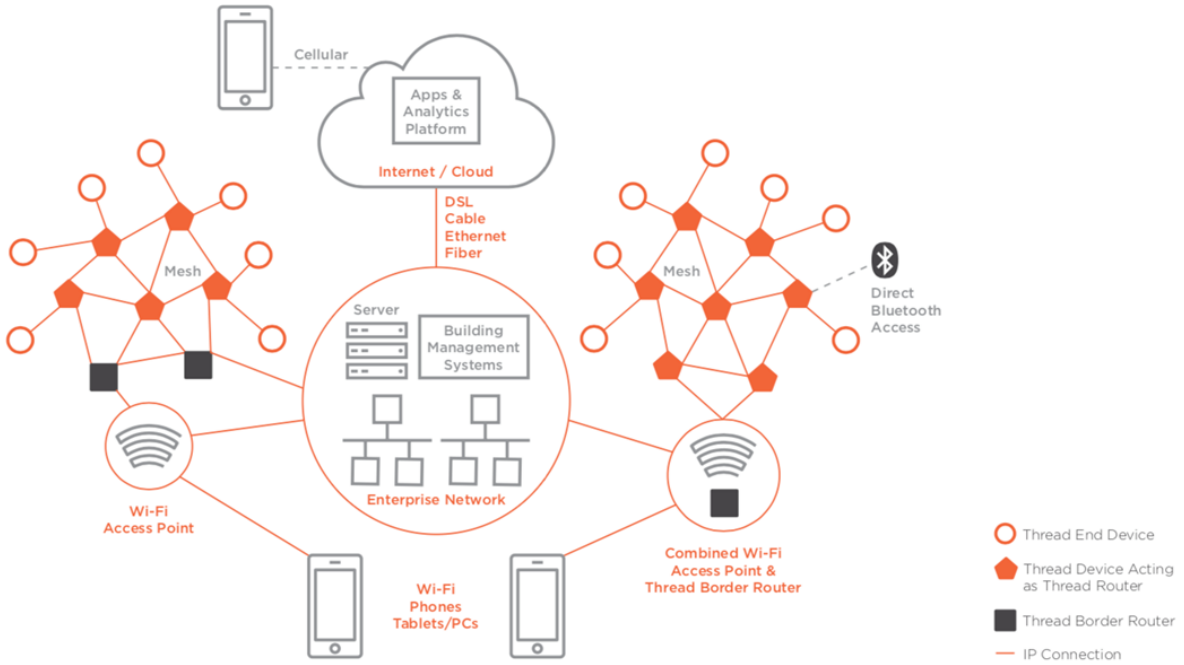
Thread is a seamless part of the enterprise network and allows the usage of various application-level protocols to integrate with existing infrastructure while maintaining the security and flexibility to commission and maintain end-devices. It also allows for the creation of various individual and group profiles and domains, even spanning multiple individual Thread mesh-networks.

The proven, secure and widely deployed Thread-specification is currently in use for residential and commercial IoT applications. With its powerful enhanced features for specific commercial use cases, it now scales to reliably connect thousands of wireless products in commercial grade buildings. Thread is IPv6 based and self-configuring and re-configuring, bringing a familiar way of setting up and managing the network for system administrators, without the need to worry about address and topology assignment. End-to-end routing and addressability allows IPv6 packets to securely move from one end point to the other, whether on the same Thread mesh network, or across the world. Its 6LowPAN foundation is based on low power IEEE 802.15.4 radio technology that supports sleepy nodes and reduces network overhead.

On top of this robust foundation, Thread offers numerous benefits specifically targeted at large scale enterprise implementations, including:

- Enterprise-level security requirements
- Scaling up to thousands of devices
- Automatic roaming to nearby networks
- Ability to assign an identity to every device in the network
- Direct access to advanced analytics and the easy handover from installers to networks commissioners.

Topology of Thread in an enterprise network



The above topology diagram shows an example of how Thread can be implemented in an enterprise network environment. The diagram illustrates Thread's key advantage over other networking technologies: it is fully based on IPv6. Unlike other networking technologies, communication is end-to-end even across different link technologies – there is no need for translators or gateways to convert IP-packets to proprietary protocols. This not only allows a Thread device to be individually and directly addressed in a way that's consistent with the larger enterprise network, but it also offers superior security as no further "weak spots" are introduced along the communication path where application messages are fully decrypted.

Thread is a mesh network technology, which means a device on the network can not only receive data, but also pass data along to other devices. In this way, these devices act as *Thread Routers*. This results in a very stable network with a large reach, without the need for additional repeaters that rebroadcast wireless signals to devices that are located further away.

Thread End Devices are devices on the network that generally operate "on-demand," like light switches. They don't re-route data and can be "sleepy" devices to save energy, only to be activated and immediately become part of the Thread network upon use.

A *Thread Border Router* is a device that forms the link between the enterprise Wi-Fi or Ethernet-network, to the IEEE 802.15.4 energy-efficient wireless radio standard that is being used by Thread. It does not require application-layer translation, since Thread uses the same IPv6 protocol as the enterprise network, making Thread Border Routers straightforward devices. Thread supports having multiple Border Routers on the same network that dynamically take over the function, so there's no single point of failure.

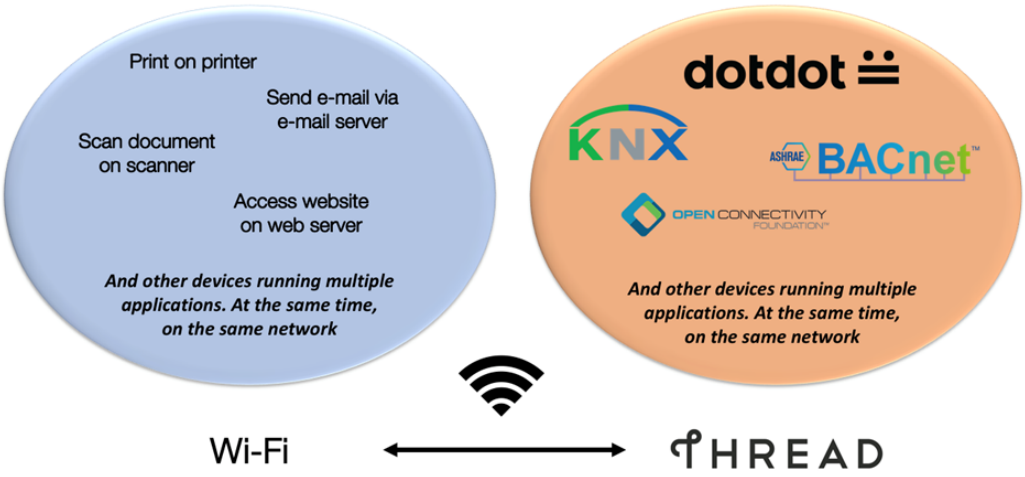
As shown in the above diagram, in some situations it might be desirable to set up multiple Thread networks, each of them consisting of devices that are part of their own mesh infrastructure, connecting to their own Thread Border. Think of individual floors in a building., Every Thread network is part of the overall IPv6 infrastructure of the enterprise network, and

devices on any Thread network can be controlled and monitored from every location on the network transparently by authorized devices.

Some Thread devices offer direct control using non-IP technologies like Bluetooth. These devices can be operated independently from the enterprise network. When such a device is controlled via these technologies, its new status is immediately available to other Thread devices or the rest of the enterprise network, as they still form a part of the overall IPv6 infrastructure.

A Building Management System (BMS) may be part of the enterprise network. Such a BMS can directly address each individual Thread device, as Thread's IPv6 connectivity is fully transparent to and consistent with the existing enterprise network. Likewise, authorized PCs, laptops and mobile devices like smartphones and tablets are directly connected to the enterprise network and can also immediately access Thread devices using the existing IPv6 networking protocol. It is also possible to control the Thread network and individual Thread devices using some type of an Apps & Analytics platform that is hosted in the cloud. This allows for easy remote control, data collection and monitoring from anywhere in the world, while maintaining full end-to-end encryption.

Thread's approach to multiple application layers



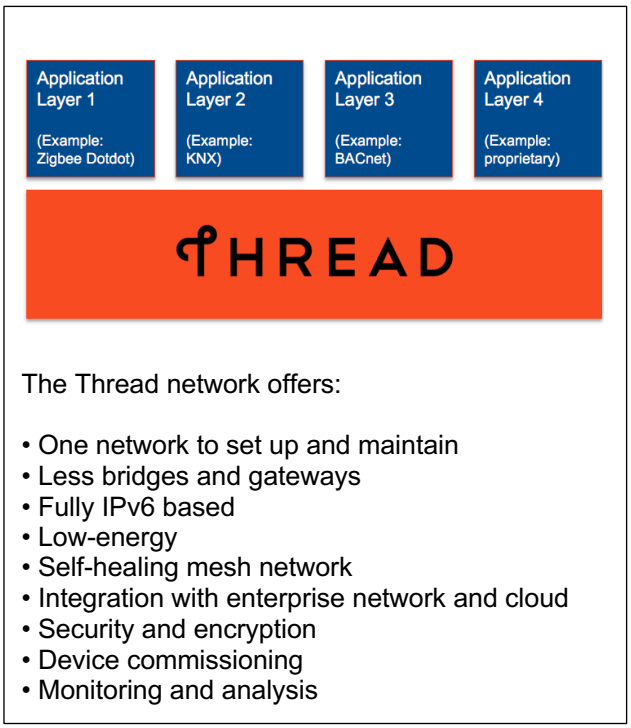
Thread's application support is comparable to the way Wi-Fi works with multiple applications. By simply joining one Wi-Fi network, due to the common Internet Protocol we can access every service, regardless of who is offering it or from where in the world it is being provided.

Today's wide offering of IoT solutions often require that we set up and maintain a network for every protocol we want to use. This not only requires surveillance and maintenance to keep them up-and-running, but networks might also interfere with each other. Furthermore, since they are separate networks, devices do not "talk" to each other and there is no way to control them effectively from a single location, monitor and analyze their data, or provision them over various locations and users, in an end-to-end secure manner.

This is where Thread comes in. Thread isn't yet another smart building protocol similar to those described above. Instead, it's like a Wi-Fi network, which is specifically designed for low-power, mesh IoT devices. Like Wi-Fi, it works with the Internet Protocol. And like Wi-Fi, it can run every modern IoT application that runs over IP, using a common physical network.

Thread is built on existing, widely-deployed standards. All the way from the physical radio technology based on IEEE 802.15.4 that has been in use for more than a decade, up to IPv6 routing and security mechanisms (defined and ratified by the Internet Engineering Task Force). Thread combines these technologies with the specific aim of providing reliability, security and scalability specifically aimed at battery-friendly, low-energy, low-cost, IoT-devices.

And Thread offers intelligent mesh-networking, meaning that almost every device in the network can be used to route data to other devices, extending the network's reach without the need for extra extender hardware and needlessly introducing multiple points of failure. A Thread border router connects a Thread network to the rest of the building's IP-based network, so that it can be controlled and monitored from the cloud or any PC, mobile phone or tablet that is connected to the network. More and more Wi-Fi base stations come with Thread radios built-in (like the popular and affordable eero and D-Link base stations), so there is no longer a need to set up extra hardware to get your Thread network up-and-running.



The Thread network offers:

- One network to set up and maintain
- Less bridges and gateways
- Fully IPv6 based
- Low-energy
- Self-healing mesh network
- Integration with enterprise network and cloud
- Security and encryption
- Device commissioning
- Monitoring and analysis

Having one single network for all your IoT devices provides major benefits. These devices do not interfere with each other, but instead can even work together to extend the reach of the network by forming a mesh. Since the entire network is IPv6-based and does not need some form of "conversion" for application data, encryption of data-packets remains intact throughout the entire chain, all the way from the individual device up to the cloud. Every device is uniquely addressable, making it easier for system administrators to commission them individually or as a group, and to flexibly change those arrangements. All devices can be managed and monitored from a single location, opening up the possibility for powerful data analysis.

What's more, Thread is designed in such a way that in networks consisting of devices that are based on different application protocols, all these benefits remain in effect. Thread can run multiple application layers concurrently on the same network. This is simply not possible with other IoT solutions on the market today. If you use multiple devices based on different systems, all devices require their own network which often creates maintenance issues. And if sometime in the future you want to replace or add an application layer, you need to replace the underlying wireless network. As with Wi-Fi, Thread allows you to simply start using the new application on the existing network.

All popular IoT-standards for building automation control recognize the importance of moving towards a universal, secure and interoperable IPv6-based network. And most of them have chosen Thread to be their future-proof solution. This includes the Zigbee Cluster Library (known as dotdot).

Other technologies that are designed for IP such as KNX, Weave, OCF, BACnet, Echonet, Lightweight M2M and many others can also be used on Thread. And remember, since Thread is fully agnostic to the application layer, it is even possible to design and develop a custom application layer to suit specific company needs (i.e. for dedicated factories and machinery, or medical applications).

Application standards will continue to focus on compelling new use cases, unlocking new IoT application requirements, and coexistence aspects between different applications on the same network.

Instead of developing yet another IoT protocol, Thread combines current and proven Internet-based technologies into a standard that's optimized for security and mesh-networking in low-cost, low-power devices. Thread is transparent to the applications that run on the network which makes it the only future-proof choice for modern IP-based networks for IoT devices.