



THREAD DEVELOPMENT ECOSYSTEM

This page is designed for developers to identify tools, components, solutions and support available to aid in designing Thread applications. This includes silicon, software, development boards, modules and solutions.



TOOLS

Wireshark

[Wireshark](#) - A free, broadly-used packet analyzer for observing and analyzing network protocol behavior. Paired with a Thread network sniffer (available in numerous development kits listed below), Wireshark is a valuable tool for developers to see the Thread protocol in action and troubleshoot implementation issues. Wireshark is also utilized by the Thread Test Environment.

Thread Border Router Best Practices

[Thread Border Router Best Practices](#) - A white paper detailing key considerations for implementing the Thread Border Router role, an optional but important feature of Thread networks. The Thread Border Router serves critical functions, including relaying data between Thread

and other IP-based networks, such as Ethernet, WiFi, or the Internet itself. In addition, Thread Border Routers enable the simple, user-friendly Thread device commissioning process via a smartphone or the Cloud.

Commissioning App

Functional Android and iOS implementations of the smartphone-based Thread 1.1 device commissioning process, wrapped in a skin and interface representative of an end product deployment. Aimed at helping developers quickly visualize and prototype Thread-based solutions, the Android app is available for public download in the [Google Play Store](#). Full source code for both Android and iOS are available to Thread Group members.

Thread Test Environment

An automated system of Thread reference implementations controlled by Thread Test Harness software. The Thread Test Environment, used for official Thread certification testing, is available to Thread Group members to do internal pretesting and debug - enabling a smooth certification experience. The test harness software also features an API and extensions that enable members to create custom test suites and integrate the Thread Test Environment into broader internal regression environments.

SUPPORTING INDUSTRY TECHNOLOGIES

IOT APPLICATION FRAMEWORK

Thread is a network layer connectivity technology, similar to Wi-Fi. This gives Thread device manufacturers the flexibility to choose how their product will interact with other devices. In some case, manufacturers can use their own application and connect to other products through the cloud. In other cases, open-standards based application framework can be used to enable their device to interact locally with other devices on the same network.

Check out the [Application Layer Interop White Paper](#) which describes an Interop event Thread Group hosted to demonstrate a variety of device classes from different vendors operating on the same Thread network.

CoAP

- Regardless of data layer, companies can use CoAP as the application layer to do any kind of communication they want.
- Cloud services that support CoAP directly can enable native IP based communication from device to cloud in a secure and encrypted manner with CoAP and DTLS.

Dotdot

- Dotdot is a common language for smart objects so they speak to each other effortlessly on any network. It's based on the Zigbee Alliance's application library "Zigbee Cluster Library" and now adapted to work over IP.

KNX

- KNX and Thread Group are working together to provide a solution incorporating Thread's IP-based networking layer with KNX's well-established and interoperable application that developers can easily implement into a product. KNX has chosen Thread as the low-power wireless communication protocol for KNX IoT. Look for availability and more details in early 2020.

OpenWeave

- OpenWeave is an open-source implementation of the Weave network application layer, the secure, reliable communications backbone for Nest products. It is a versatile and lightweight solution for low-powered devices and its features were driven by requirements Nest identified while building their ecosystem of products.
- OpenWeave works across multiple link technologies such as Ethernet, Wi-Fi, Bluetooth Low Energy, and Thread for a complete end-to-end IoT solution, leveraging the underlying network attributes of each technology. Run OpenWeave over Thread to enhance the Weave network application layer with Thread's mesh resiliency, device-to-device communications, and built-in security.

OCF

- [OCF smart home](#) is an open-source secure application framework enabling an Intelligent and Interconnected Home Ecosystem. The OCF smart home is a secure IoT solution based on IPV6 that benefits from using the low-power meshed IP-based Thread network.
- [OCF smart commercial](#) is an open-source project that enables IP connectivity for building automation. This project can carry data models of other established organizations like BACnet and KNX over the secure OCF communication layer

enabling existing applications to use secure communications based on the OCF Core running over the secure low power mesh IP-based Thread network.

NEAR FIELD COMMUNICATION (NFC)

NFC technology complements Thread by providing consumers easy, secure two-way wireless interactions between electronic devices, access to digital content and the ability to perform contactless transactions with a single tap of any NFC enabled device like a smartphone. NFC Forum and Thread Group are collaborating to provide a new Internet of Things (IoT) user interface experience (UX) by using NFC technology when installing and configuring a device to a Thread network.

SOLVING CHALLENGES

SUPPORT BATTERY OPERATED DEVICES THAT NEED ALWAYS-ON CONNECTIVITY

Thread is a low power wireless technology that enables devices to maintain a permanent connection to the internet, without requiring a mobile phone or proprietary gateway to be in range.

NEED DEVICES AND NETWORKS TO BE PROTECTED

Protection is built into every Thread network across a wide variety of IoT applications in homes and buildings because it uses versions of the same types of security technologies (cryptography) that make applications across the “big Internet” safe – the ones that keep banking transactions, Amazon purchases and social media sessions secure. Thread simply adapts them to the special situation of IoT devices that are heavily power-managed and must automatically maintain network security with little or no user interaction. This cryptography not only keeps communications secret, but is also used to prove identity. Proof of identity then provides access control—this prevents random devices from connecting to the network, and prevents an attacker from controlling your thermostat or turning your lights on and off.



NEED A COMPLETE ARCHITECTURE - DEVICE-TO-DEVICE, DEVICE-TO-CLOUD, CLOUD FACILITIES




Best Practices: In a Thread network, the Border Router is an important piece of infrastructure. It facilitates communication of Internet Protocol (IP) packets into and out of the Thread network. In most Thread networks the Border Router will be responsible for providing full Internet communication to Thread devices. Our [Border Router Best Practices](#) white paper guide provides guidance on best practices and optimal technology selection for vendors looking to create a Thread Border Router.

Reference Designs: Many companies in the Thread developer ecosystem provide reference implementations of a Thread Border Router. See table below for options.



GETTING STARTED WITH THREAD

Company	Product / Component Type	Product / Component Name	Description
arm	Operating System	<u>mbed.org</u>	An open source embedded operating system which features full support for Thread.
	Silicon	<u>NXP K64F MCU</u> <u>Atmel AT86233</u> <u>802.15.4 Transceiver</u>	

	Development Hardware	NXP FRDM-K64F Atmel ATZB-RF-233	
	Software Stack	OpenThread	
	Operating System	Linux, RTOS, Baremetal	Cross-platform design
	Silicon	Cascoda CA-8211 Wireless Transceiver with integrated MAC Available Q2 2019.	Long range, low power transceiver with integrated MAC, optimized for Thread.
	Software Stack	Openthread with Cascoda SDK	Support for Linux and Bare Metal platforms with cross-platform API.
	Development Environment	Configuration tools: CMake Supported Compilers: GCC: Native Cascoda Chili Clang: Native Keil: Free for Cascoda Chili IAR: Paid	Flexible development environments.
	Reference Design	Cascoda Chili (coming soon)	
	Module	Cascoda Chili (coming soon)	
	Development Hardware/Kit	YarN Development Kit Available through Centro. Submit Request.	Centro's YarN development kit includes the components and tools needed to develop and deploy Thread compliant products and systems. It includes WEE wireless modules that run the Thread stack and development boards suitable for development of Thread routers/REEDs and sleepy end devices.
	Enterprise Platform	FabriK Enterprise Communication Platform Available through Centro. Submit Request.	Centro's FabriK™ communication platform is a highly-scalable Thread compliant solution for the Residential, Commercial, Industrial and Medical Internet of Things. It is a standards-based, end-to-end solution that provides device connectivity, security, monitoring, control and management tailored to meet the requirements present in a wide array of market verticals and applications.
	Border Router	WHeeL IoT Gateway Available through Centro. Submit Request.	The WHeeL IoT Gateway is a deployment ready Thread Border Router used to deploy, configure and manage highly scalable Thread mesh networks. It hosts the WHeeL Network Operation and Management System which boasts an intuitive interface used to interact, configure, monitor and manage all facets of Thread compliant field devices and mesh networks.
	Module	WEE Wireless Module	The WEE OEM wireless module is a key component of Centro's




		Available through Centro. Submit Request.	FabriK Thread compliant communication platform for the emerging Commercial, Industrial and Medical Internet of Things.
	Service	Thread Rapid Prototyping Service	<p>Thread connected product/platform development requires cross disciplinary expertise that a lot of companies do not have in-house. This includes a good understanding of Thread standards-based technologies, hardware, embedded firmware and software engineering capabilities, wireless engineering and compliance expertise. Depending on the level of in-house expertise and available resources, this can translate into lengthy development projects and delayed product market launch.</p> <p>Using Centro's Rapid Prototyping Service product companies can have a Thread connected, functional product prototype within 4-6 weeks. This can reduce the product development cycle and time to market by 3-5 months. Centro's teams have hardware, firmware, software, wireless engineering and regulatory compliance expertise and a proven track record in developing IoT/IIoT connected products and enterprise platforms.</p>
	Development Environment	X-WARE IoT PLATFORM Download	Industrial Grade platform is lightning fast, real-time responsive, fully supported, easy to learn and use — proven to deliver the highest standard of commercial software available today.
	Module	KTWM102 Available through the online form or sales@kirale.com .	Complete Thread Certified Solution with a small PCB footprint. Surface-mount component which can be handled by host processors through USB and UART interfaces and is FCC/IC/CE certified.
	Software Stack	KiNOS Download the Kirale Real-Time Network Operating System.	A high-performance, secure, robust and scalable Thread Certified Stack tailored for wireless low-power IP-enabled embedded devices and suitable for all Thread roles.
	Development Hardware	KTDG102 Purchase from the online store or through TESSCO .	Used to evaluate all available types of roles in a Thread Network without additional programming tools. It can be configured as a powerful device that transforms into a Thread Border Router or as an ultra-low-power Sleepy Device, or it can be set up as a Sniffer to capture all IEEE 802.15.4 network traffic.
	Border Router	KTBRN1 Purchase from the online store	Kirale Border Router is a first-of-its-kind device that breaks low-power wireless mesh network barriers. With its extremely small form factor but with powerful processor hidden inside, KTBRN1 is designed to face present and future challenges of Thread Networks.
	Development Hardware / Kit	RapidConnect Development Board Available through MMB Networks. Submit Request.	The RapidConnect Development Board provides interfaces to connect a RapidConnect Module to other devices. The socket makes it easy to use different modules during programming and testing. It also features a USB interface to allow it to be connected to a PC running RapidConnect Desktop software.


	Development Environment	RapidConnect Desktop Available through MMB Networks. Submit Request.	RapidConnect Desktop is a simple UI to assist customers in their Thread or Zigbee development, testing, and troubleshooting. With the RapidConnect Development Kit, and RapidConnect Desktop, a developer with limited Thread knowledge can set up a Thread demonstration out-of-the-box.
	Module	RapidConnect Module (BSB03PA1X, CSB04PA1X)	Featuring industry-leading size, power efficiency, and RF performance, MMB modules are coupled with our RapidConnect software which dramatically reduces development time and cost. Most modules address the RF design challenge, but leave you with the challenge of building and supporting a substantial IoT application. All RapidConnect Modules are pre-loaded with MMB's RapidConnect application to enable rapid integration.
	Silicon	nRF52840 Wireless MCU	Multi-protocol SoC supporting Bluetooth 5 / ANT / 802.15.4 / Thread / 2.4 GHz proprietary, built around a 32-bit ARM® Cortex™-M4F CPU with 1MB flash and 256kB RAM on chip.
	Software Stack	OpenThread	OpenThread released by Nest is an open-source implementation of Thread®.
	Development Hardware/Kit	nRF52840 DK	The nRF52840 DK is a versatile single board development kit for Thread applications on the nRF52840 SoC.
	Development Environment	nRF5 SDK for Thread and Zigbee	A complete SDK for developing Thread based products, it includes a pre-built OpenThread stack for nRF52840.
	Silicon - Wireless MCU	KW41/21Z Wireless MCUs Order Samples	A single-chip Arm® Cortex®-M0+ MCU family that enables Bluetooth® Low Energy and IEEE® 802.15.4 RF connectivity for portable, extremely low-power embedded systems.
	Development Hardware	FRDM-KW41Z Order a Development Kit	Development platform e that includes a flash programmer, a virtual serial port and classic programming and run-control capabilities. additional shield boards for new features can be added, form-factor compatible with the Arduino™ R3 pin layout.
	Development Hardware	USB-KW41Z Order USB Dongle	Can be used as an IEEE® 802.15.4 and/or Bluetooth Low Energy packet sniffer in conjunction with standard protocol analyzer tools such as Wireshark®. Alternatively, the USB dongle can be used as a wireless network node providing a simple Thread interface to a PC or other USB enabled device.
	Software Stack	NXP Thread Stack	A feature-complete certified Thread protocol software stack.
	Software Stack	OpenThread	The KW41Z/21Z Wireless MCUs family also supports running the open-source implementation of the Thread networking protocol form Nest/Google.
	Development Environment	MCUXpresso SDK, IDE, and Configuration tools	One Enablement platform including an SDK, IDE and Config tools.
	Module	Weptech SPARROW	Integrated module based on KW41Z/21Z Wireless MCUs. The modules include an on-board chip antenna and are supplied with a development board. An external antenna can be connected to the antenna pad.

	Module	Panasonic: PAN4620	Integrated module for the Internet of Things from Panasonic based on the KW41Z Wireless MCUs.
	Module	Volansys - VOL KW41Z	Ultra-compact, low power, high sensitivity module from Volansys based on the KW41Z Wireless MCUs. Provides an integrated chip antenna and mikroBUS™ compatibility to connect to third-party products with a single click.
	Reference Design	IoT Gateway Solution	A development platform that brings together the building blocks for secure, production-ready IoT systems including hardware, software, connectivity, security and cloud services. The IoT Gateway Solution includes the NXP Modular IoT Gateway and Modular Edge Node reference designs which are tested and verified for Thread and Zigbee® connectivity, as well as secure cloud services communications through Wi-Fi, Ethernet and cellular.
	Software Stack	OpenThread Released by Nest <i>Platform support:</i> Nordic - nRF52840-DK - nRF52840-DONGLE NXP KW41Z Qorvo - GP712 - QPG6095 Silicon Labs EFR32 STMicroelectronics - STM32WB Texas Instruments - CC2538 - CC2652 Zephyr RTOS	OpenThread is an open-source implementation of the Thread networking protocol that is OS and platform agnostic with a radio abstraction layer that is supported on multiple platforms.
	Software Stack	OpenThread Border Router Platform support: BeagleBone Black Raspberry Pi 3B Linux Docker	OpenThread's implementation of a Border Router.
	Operating System	Particle Device OS	Device OS is a lightweight operating system for embedded IoT devices. It features an easy-to-use programming framework to help you write your applications.
	Silicon	Thread: Nordic Semiconductor nRF52840 SoC Supported coprocessors for border	The Nordic nRF52840 is the main processor on Particle Mesh devices and used for Thread-based mesh networking and Bluetooth provisioning. In addition to the Nordic SoC, the Argon and Boron feature additional radio coprocessors (Wi-Fi and LTE respectively).

		<p>router/gateway:</p> <p>Wi-Fi: Espressif 2.4 GHz coprocessor</p> <p>Cellular: ubox LTE & 2G/3G modems</p> <p>Ethernet: WIZnet W5500 chip</p>	<p><u>Wi-Fi</u> <u>LTE</u> / <u>GSM</u> <u>Ethernet</u></p>
	Software Stack	Particle Device Cloud	<p>Device Cloud is a secure, scalable, and reliable cloud platform to manage your fleet of IoT devices.</p> <p>Features include:</p> <ul style="list-style-type: none"> - Device registry: organize and query devices in your fleet - Event logs: see what's happening with devices in real time - Device groups: segment your fleet for more granular control - SIM management: change SIM state and manage data usage - Access controls: manage who has access to your devices - Diagnostics: actively monitor the health of your devices
	Development Hardware/Kit	<p><u>Argon</u>: Wi-Fi + mesh</p> <p>Boron: Cellular (<u>LTE</u> or <u>2G/3G</u>) + mesh</p> <p><u>Xenon</u>: mesh</p> <p><u>Ethernet Featherwing</u>: ethernet</p>	<p>Argon: features the nRF52840 with a Espressif Wi-Fi coprocessor</p> <p>Boron: features the nRF52840 with a ubox SARA R410 LTE modem</p> <p>Xenon: features the nRF52840</p> <p>Ethernet FeatherWing: features the WIZnet W5500</p>
	Development Environment	<p>Web IDE</p> <p>Particle Workbench (Desktop IDE)</p> <p>Device Cloud API</p> <p>Command-Line Interface</p> <p>SDKs (JavaScript, iOS, and Android)</p>	<p><u>Web IDE</u>: Create and deploy device apps right from your browser —Fully integrated with Device OS, and Device Cloud.</p> <p><u>Particle Workbench</u>: An all-in-one desktop tool for Particle development. Build, debug, and deploy code from a local environment with zero setup.</p> <p><u>Device Cloud API</u>: Send commands through a cloud-based RESTful interface.</p> <p><u>Command-line interface</u>: The Particle CLI is a powerful tool for interacting with your devices and the Particle Device Cloud.</p> <p>SDKs: Create mobile and web interfaces with Particle's open source SDKs for <u>JavaScript</u>, <u>iOS</u>, and <u>Android</u>.</p>
	Module	<p>A Series: Wi-Fi and mesh</p> <p>B Series: LTE and mesh</p> <p>To order https://store.particle.io/</p> <p>For more information https://docs.particle.io/</p>	<p>The A Series (Wi-Fi + mesh) and the B Series (LTE + mesh) use an M.2 connector and provide a path to scale from our dev kits to mass production.</p>
	Development Kit	<u>QCA 4020/ 4024/ 4025</u>	802.15.4 / Wi-Fi / Bluetooth LE application processor with Thread stack.

Qualcomm			
	IEEE 802.15.4 Multi-Stack Multi-Channel Communications Controller	GP712 GP712 - OpenThread	IEEE 802.15.4 multi-stack multi-channel communications controller, enabling the development of fully scalable Thread and Zigbee Smart Home and IoT products. The GP712 supports concurrent operation of Thread, Zigbee RF4CE, Zigbee 3.0 (including Green Power) protocols, operating on different channels simultaneously, combined with full antenna diversity support.
	Zigbee / BLE Smart Home Communications Controller	QPG6095 QPG6095 - OpenThread	The QPG6095 Zigbee/Thread/Bluetooth Low Energy Smart Home Communications Controller provides a fully integrated solution for ultra-low power wireless communications for Smart Home sentroller devices such as thermostats, motion sensors, smart plugs, key pads and door/window sensors.
	Operating System	Linux-based solution <hr/> Custom OS	
	Silicon	Transceiver For sampling info and submitting a request . <hr/> ARM Cortex-M4 based SOC For sampling and to submit a request .	Transceiver part number is GP712. <hr/> SOC part number is QPG6095.
	Software Stack	OpenThread	
	Operating System	Bare Metal (no RTOS) Micrium OS	Micrium OS includes an RTOS kernel, communication stacks, a file system, and graphical user interface.
	Silicon	EFR32 Mighty Gecko	The Mighty Gecko supports Thread and Zigbee wireless connectivity. Devices in the family also include Bluetooth low energy and 2.4 GHz and Sub-GHz proprietary protocol support.
	Software Stack	Silicon Labs Thread Stack	Silicon Labs Thread stack.
	Software Stack	OpenThread	Silicon Labs Thread Open source Thread stack. OpenThread released by Nest.
	Development Hardware/Kit	Mighty Gecko Starter Kit	The Mighty Gecko Wireless Starter Kit (SLWSTK6000B) includes an integrated debug adapter and provides access to a Thread software stack and sample code. Multiple radio boards enable developers to create a mesh network and evaluate Mighty Gecko Module and SoCs.
	Development Environment	Simplicity Studio IAR Embedded Workbench for ARM	Simplicity Studio includes a powerful suite of tools for energy profiling, configuration and wireless network analysis, as well as demos, software examples, complete documentation, technical support and community forums.

		GCC, the GNU Compiler Collection	
	Module	MGM13S	The MGM13S is a System In Package module for Thread, Zigbee, Bluetooth 5.0 LE and dynamic multiprotocol (Zigbee + Bluetooth) connectivity built around the EFR32MG13 Mighty Gecko SoC. in a small 6.5 mm x 6.5 mm package.
	Module	MGM13P	The MGM13P is a PCB module for Thread and Zigbee and Multiprotocol connectivity with Bluetooth 5 LE built around the EFR32MG13 Mighty Gecko SoC.
	Module	MGM12P	Silicon Labs' Mighty Gecko MGM12P module integrates the EFR32MG12 Mighty Gecko SoC into a small form factor module for Zigbee, Thread and Bluetooth low energy (LE) networks.
	Module	MGM111A	Silicon Labs' Mighty Gecko MGM111 module integrates the EFR32MG1 Mighty Gecko SoC into a small form factor module for Thread and Zigbee mesh networks.
	Silicon	Designware Transceiver silicon IP solution for IoT SoCs	Solution consists of PHY and MAC silicon IP for SoC integration. It supports concurrent connections to Thread, Zigbee and Bluetooth® low energy 5.1 networks.
	Silicon	CC1352R Wireless MCU CC2652R Wireless MCU	SimpleLinkCC2652R and CC1352R devices are members of the CC26xx and CC13xx family of cost-effective, ultra-low power, 2.4-GHz and Sub-1 GHz RF devices.
	Software Stack	SimpleLink CC13x2-CC26x2 SW Development Kit	The SimpleLink CC13x2-CC26x2 SDK includes application examples, trainings, documentation and source code to support Thread 1.1 networking based on OpenThread integrated within the SimpleLink ecosystem.
	Development Hardware/Kit	SimpleLink CC1352R LaunchPad™ Development Kit SimpleLink CC26x2R1 LaunchPad™ Development Kit	LaunchPad development kits are for the evaluation of CC13x2/CC26x2 devices, which are part of the SimpleLink™ microcontroller (MCU) platform and share a common, easy-to-use development environment with a single core software development kit (SDK). These kits support programming and debugging from Code Composer Studio™ and IAR Embedded Workbench® integrated development environments (IDEs).
	Development Hardware/Kit	Modular IoT Gateway	A customizable gateway development platform that brings together the building blocks for implementing secure, interoperable, and production-ready IoT systems including hardware, software, connectivity (Thread, Zigbee, Dotdot, Bluetooth LE, Wi-Fi, LoRaWAN, Sub-GHz), security and cloud services. The solution is FCC/IC/CE certified and available for re-branding.
	Development Hardware/Kit	Modular Edge Node Platform (MENP) Contact Volansys for ordering information business@volansys.com	VOLANSYS' Modular Edge Node Platform (MENP) is an advanced, powerful and multi-module (Thread, Zigbee®, Bluetooth LE) RF compatible end node, with mikroBUS™ standard compliant headers. It supports various hardware modules like VOLANSYS' KW41Z Thread/Bluetooth LE Module, NXP JN5169 Zigbee®

			module, NXP JN5179 Zigbee® module and mikroBUS™ standard modules through the mikroBUS™ header.
	Module	VOL KW41Z	VOL KW41Z is an ultra-compact, low cost, multi-protocol module supporting Thread/Zigbee®/Bluetooth LE. It has ARM® Cortex® processor at core, integrated chip antenna and offers mikroBUS™ compatibility option. The module is FCC/IC/CE-RED certified.
	Services	Product Engineering and Manufacturing Services for Thread enabled IoT Devices: Thread SDK Porting Thread Stack Validation Thread Certification Support Embedded Application Development Cloud Architecture, Development, and Integration Mobile Application Development	VOLANSYS is a one-stop solution enabler offering system integration services for Thread enabled IoT Devices, all the way from concept to product realization to manufacturing. Our Services include hardware, firmware and embedded application development, cloud development & integration, connected mobile application, quality engineering, and manufacturing services.
	Operating System	Zephyr RTOS	The Zephyr OS is an open source collaborative effort to build a real-time operating system (RTOS) for the Internet of Things (IoT). It is based on a small-footprint kernel designed for use on resource-constrained systems: from simple embedded environmental sensors and LED wearables to sophisticated smart watches and IoT wireless gateways.
	Software Stack	OpenThread	To start using OpenThread with Zephyr check out the Echo Server and Echo Client networking examples from the Zephyr project repository on GitHub. You can run these examples on SoCs that provide support for an IEEE 802.15.4 radio, for example the Nordic nRF52840.
	Supported By	NXP Thread Stack NXP's FRDM-KW41Z Nordic nRF52840 NXP's KW41Z MCU	

ACADEMIC PROGRAMS

Stanford's Tock Program

[Tock](#) is an embedded OS for low-power, low-memory IoT devices, that is designed with security as primary objective. It is implemented using the type safe Rust language, and enables mutually distrustful components to inter-operate securely. Tock has implemented 6LoWPAN over IEEE 802.15.4, and is currently working toward implementing the Thread networking protocol.

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