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An introduction

September 30th 2014
The need for a new wireless network

A new era of connected products

Existing wireless mesh protocol didn’t meet requirements

Other companies shared the same concerns
The need for a new wireless network

Requirements:
New wireless home network

- ✔ Low power
- ✔ Resilient (mesh)
- ✔ IP-based
- ✔ Open protocol
- ✔ Secure and user friendly
- ✔ Fast time to market
- ✔ Existing radio silicon
The need for a new wireless network

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- ✔ 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
The need for a new wireless network

A new era of connected products

Existing wireless mesh protocol didn’t meet requirements

Other companies shared the same concerns
Why IP

IPv6 - A unified Convergence Layer for the home

Application 0

Application Protocol

802.15.4

Application n

Application Protocol

802.11

Bluetooth 4.x
A secure wireless mesh network for your home and its connected products

Built on well-proven, existing technologies
Uses 6LoWPAN and carries IPv6 natively
Runs on existing 802.15.4 silicon
New security architecture to make it simple and secure to add / remove products
250+ products per network
Designed for very low power operation
Reliable for critical infrastructure

Can support many popular application layer protocols and platforms

Application
UDP
IP Routing
6LoWPAN
IEEE 802.15.4 MAC
IEEE 802.15.4 PHY

A software upgrade can add Thread to currently shipping 802.15.4 products
Support for many application layers
Any low bandwidth application layer that can run over IPv6

Some existing examples are
CoAP and Smart Objects
ZigBee Smart Energy 2.0
ECHONET Lite
Thread Group Confidential

Target applications

Thread is designed for all sorts of products in the home

- Appliances
- Access control
- Climate control
- Energy management
- Lighting
- Safety
- Security

Devices working together to form a cohesive mesh network
A version of Thread is shipping today in Nest products

Millions of Thread devices
Organization overview

Sujata Neidig - Freescale
A Delaware 501(c)(6) Non-Profit Corporation for the mutual benefit of its members
Independent, vendor-neutral and open to all - Any entity can join

Organizational membership only - one membership, one vote

Thread Group manages the delivery of enabling solutions: Specifications, Certification Programs, Website, Trademarks, Copyrights, Logos/Seals
7 companies founded the Thread Group

Not another standards body

A market education group offering product certification

Promoting Thread's use in connected products for the home

Thread will offer rigorous product certification to ensure security and interoperability

Board of Directors

President: Chris Boross - Nest Labs
VP of Marketing: Sujata Neidig - Freescale
VP of Technology: Skip Ashton - Silicon Labs
Secretary: Bill Curtis - ARM
Treasurer: Kevin Kraus - Yale Security
Director: Landon Borders - Big Ass Fans
Director: Benny Getz - Samsung Electronics
Thread launched on July, 15th 2014

Tremendous press and interest generated

Over 100 articles within a day of launch

Top-tier mainstream and industry press
800+

membership interest signups in 90 days
The Thread Group now open to any company who wishes to join

Membership applications open tonight

Technical documentation will become available in early November, and on a regular cadence throughout 2015

Thread Development Kits will be available to members for evaluation and aid product development
Membership to Thread comes with its benefits:

- Access to the technology
- Immediate product planning and development
- Access to technical documentation prior to spec release
- Use Thread Certification Program and test suite
- Participation in Marketing and PR campaigns
- Network with an ecosystem of companies building connected products for the home
- Help promote Thread and Thread-enabled products
There will be some great marketing benefits:

The Thread Group will help promote your Thread-compliant products
Engage in press activities and receive media coverage
Participate in industry events with Thread
Evangelize at high exposure speaking opportunities
Use Thread Group marketing collateral and assets
Build awareness through Thread online and social media
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<td>Approve Final Deliverables</td>
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<td>Initiate Work Groups or Committees</td>
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<tr>
<td>Can be admitted as Sponsor after launch</td>
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<td>Automatic Seat on Board of Directors</td>
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<tr>
<td>Annual Fee</td>
<td>$2,500</td>
<td>$15,000</td>
<td>$100K</td>
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You can join NOW

Submit Application via www.threadgroup.org

Agreements provided for legal and business review

Membership complete once agreements signed and payment processed

Members will be granted access to the Thread Group Members Only Portal

The Portal will include technical documentation, certification info and marketing plans (as available)
Our IPR policy is designed to maximize the adoption of the Thread technology.

IPR Policy for Thread Group membership balances interests of all stakeholders.

Commitment to grant a RAND-RF (royalty free) license to members for patents essential to the Thread specification:
- Applies to all Thread members
- Avoids patent confusion
- Accelerates market acceptance

Thread Group copyrights, trademarks are licensed to participants royalty free.
We recognize that much of the innovation in the Connected Home is coming from start-up companies who can’t necessarily afford membership fees. We want to help these small, innovative companies launch Thread-enabled products.

To do this we’ll give away a free membership to the Group.

Program kick-offs 1st Quarter 2015
One start-up chosen per quarter
We’ll take submissions from start-up companies later in 2014.
Thread Group Milestones

2014
- Jul: Thread Group Announce
- Aug: Thread Group Open House
- Sept: Technical Documentation Phase 1
- Oct: Technical Documentation Phase 2
- Nov: Technical Documentation Phase 3
- Dec: Thread 1.0 Specification Release

2015
- Jan: Thread Group Member meeting
- Mar: Technical Documentation Phase 2
- Apr: Technical Documentation Phase 3
- May: Cert Program Launched
- Jun: Thread Compliant Products in market
- Jul: Thread Group Member meeting
Technical overview

Skip Ashton - Silicon Labs
THREAD Technical overview agenda

Key Connected Home requirements
Thread Technical Overview
Key highlights of Network and Technology
Certification Process
Connected home requirements

Direct addressability to all devices – device to device or device to cloud

Simplified forming and joining of network

Limit special devices or customer knowledge of concepts like coordinator vs. router vs. end device

Scalable to 250-300 devices in a home

Latency less than 100 milliseconds for typical interactions

Allow the use of multiple border routers

Seamless connectivity to user interaction on device of choice in the home (dedicated display, smart phone, tablet, etc.)

Battery operated devices with years of expected life – door locks, security sensors etc
Thread Group Confidential

Connected home requirements

Normally Powered
- Gateway
- Lighting
- Appliances
- Smart Meter
- Garage door opener
- HVAC equipment
- Smart Plugs
- Fans

Powered or battery
- Thermostat
- Light switches
- Smoke Detectors
- CO detectors
- In home display
- Shade or blinds control
- Door bell
- Glass break sensors
- Robots/cleaners

Normally Battery
- Door sensors
- Window sensors
- Motion sensors
- Door locks
- Radiator valves
- Body sensors (health care)

Consideration for devices that rely on energy harvesting is also a requirement
Cloud Connectivity
Cloud connectivity for control when not at home
When within the home, phone or tablet must go direct to gateway to eliminate latency of going to the cloud
Has to be seamless to consumer using device

Border Router
Border Router forwards data to cloud
Also provides WiFi connectivity to phone or tablet in the home

Device Communication
Expect device to device communication within HAN for operations in the home
Thread Overview

IPv6 based
Lightweight and low latency
Not a whole new standard
Collection of existing IEEE and IETF standards
Runs on existing 802.15.4 based products
250+ devices on a PAN
  Direct Addressability of devices
  Flexible network with full point to point connectivity of all devices
  No single point of failure
  Enable low cost bridging to other IP networks
  Simple security and commissioning
  Low Power support for sleeping devices

Overview

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<td>Distance Vector Routing</td>
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<td>6LowPAN (IPv6)</td>
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<td></td>
<td>IEEE 802.15.4 MAC (including MAC security)</td>
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<tr>
<td></td>
<td>IEEE 802.15.4 PHY</td>
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| RFC 768, RFC 6347, RFC 4279, RFC 4492v RFC 3315, 5007 |
| RFC 1058, RFC 2080 |
| RFC 4944, RFC 4862, RFC 6775 |
| IEEE 802.15.4 (2006) |
| IEEE 802.15.4 (2006) |
Network architecture

- End Device Router Eligible
- Thread Router
- Leader
- Border Router
- Thread Link
All devices have IPv6 addresses plus short address on HAN

DHCPv6 used for router address assignment

Home Network can directly address devices through Border Routers

Cloud Services can address devices from the Internet

Devices can address local devices on HAN or off network devices using normal IP addressing
Devices join as router eligible or end devices

Router eligible can become routers if network agrees it is needed

All routers maintain state to all other routers through trickle mechanism and MLE

All routers maintain state of border routers through trickle mechanism and MLE

Sleeping end devices route through parent router

Router eligible devices can also maintain state

Leader used to make decisions within network
No single point of failure

No need to recognize specialized devices within the network

Leader makes decisions but can fail and another router will become Leader
No single point of failure

No need to recognize specialized devices within the network

Leader makes decisions but can fail and another router will become Leader

Network will add routers to improve connectivity when required
Multiple border routers can be used for off network access

Devices operate without Border Router
Simple Commissioning

User authorizes devices onto the network using smart phone, computer

GUI rich device within network can be used to authorize devices

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 used based on device requirements
Sleeping devices poll parents for messages (or remote device if application configured)

Sleeping device not required to check in to allow lower power operation

Parents hold messages for sleeping devices

Sleeping device automatically switches parent if it loses connectivity
Thread provides basic services required for applications
  UDP messaging and ack
  Multicast messaging

Thread allows use of many application layers using IP services

Those application layers not using IP services would need some adaptation
THREAD Certification

All Thread devices will require network certification

Validation of device behavior

Commissioning
Network functionality and interoperability
Device operation in network

Members will have access to free standard test harness

Certification through a 3rd party test lab

Certification program will launch in 1H 2015
Interoperability testing underway with 3 stacks
2 test events completed
2 more events planned

Specification being used as part of testing, being refined and completed
Publishing on June 1 2015
Technical documentation available from Nov 2014

Certification test plan / test harness in development
Certification program will launch in 1H 2015
Recap
Membership is now open to all companies

Visit www.threadgroup.org to sign up

Technical documentation available in Nov 2014

Released to members in phases

First Thread Group member meeting in Feb 2015

Millions of Thread devices already in the field

Running a version of Thread
Performing very well
Product companies can start developing Thread-based products NOW
Compatible silicon is already available

Thread stacks are going to be available from 3 sources
Please get in contact with the below companies

Thread Group Confidential
Board Member: Skip Ashton - VP Technology

About Silicon Labs
Silicon Labs (NASDAQ: SLAB) is a leading provider of silicon, software and system solutions for the Internet of Things, Internet infrastructure, industrial control, consumer and automotive markets. We solve the electronics industry's toughest problems, providing customers with significant advantages in performance, energy savings, connectivity and design simplicity. Backed by our world-class engineering teams with unsurpassed software and mixed-signal design expertise, Silicon Labs empowers developers with the tools and technologies they need to advance quickly and easily from initial idea to final product.

Why Thread?
Thread will unify the fragmented connected home into a clear extension of today's ubiquitous IP connectivity. This will provide consumers with new devices and services in their homes that are seamlessly connected to their phones and web applications.
Founding companies
Board Member: Kevin Kraus - Thread Treasurer

About Yale
Yale Locks & Hardware has provided dependable security since 1840. Yale Locks & Hardware is an ASSA ABLOY Group company with plant operations in Berlin, Connecticut. The company offers a broad range of door hardware, electronic and mechanical locks including an extensive selection of residential hardware, as well as a wide assortment of mid-tier commercial products. This includes an extensive array of cylindrical and mortise locks, exit devices, door closers, electromechanical products and key systems, as well as windstorm certified hardware, decorative levers, and photo luminescent and antimicrobial hardware coatings. For more information visit www.yalerealliving.com.

About Assa Abloy
ASSA ABLOY is the world’s largest lock company and a recognized global leader in door opening solutions, dedicated to satisfying end-user demands for security, safety and convenience. For more information visit www.assaabloy.com/en/com/.

Why Thread?
Yale/ASSA ABLOY believes Thread will provide a robust network for battery operated devices, providing a high level of lock performance and battery life. In addition, the Thread network allows Yale locks the ability to directly access the internet, and provides a high level of security.
Board Member: Skip Ashton - VP Technology

About Silicon Labs
Silicon Labs (NASDAQ: SLAB) is a leading provider of silicon, software and system solutions for the Internet of Things, Internet infrastructure, industrial control, consumer and automotive markets. We solve the electronics industry’s toughest problems, providing customers with significant advantages in performance, energy savings, connectivity and design simplicity. Backed by our world-class engineering teams with unsurpassed software and mixed-signal design expertise, Silicon Labs empowers developers with the tools and technologies they need to advance quickly and easily from initial idea to final product.

Why Thread?
Thread will unify the fragmented connected home into a clear extension of today’s ubiquitous IP connectivity. This will provide consumers with new devices and services in their homes that are seamlessly connected to their phones and web applications.
Board Member: Benny Getz

About Samsung
We are a global leader in technology and innovation. We seek to inspire the world with our technologies, products, and solutions, and through relentless innovation create a better future and richer experiences for our customers, partners and employees.

Why Thread?
Samsung is committed to make Internet of Things a reality by intelligently connecting people, devices and services. We want to lead and support an IoT ecosystem that enables seamless, reliable, efficient and secure connections. We believe Thread will become an important part of such ecosystem.
Board Member: Chris Boross - Thread President

About Nest Labs
We’re Nest. We reinvent things.

We take the unloved products in your home and make simple, beautiful, thoughtful things.

Why Thread?
Thread enables us to build the best, most secure and reliable products. Its going to help the industry deliver the Connected Home experiences that we all want to provide to our users.
Board Member: Sujata Neidig - VP of Marketing

About Freescale
Freescale is a global leader in embedded processing solutions. For the Internet of Things market, we are focused on providing smaller and lower power microprocessors, microcontrollers and connectivity solutions.

Why Thread?
Freescale believes Thread is the right technology at the right time to drive the Internet of Things evolution and make the connected home a reality. Our customers and partners need to create products that provide an ideal user experience to consumers – simple to install, easy to use, secure and seamless. Thread provides the solution with an IP-based simple and secure end-to-end mesh network that operates on standard 802.15.4 solutions.
Board Member: Landon Borders

About Big Ass Fans
Our provocative moniker originated with massive overhead fans, but today, Big Ass Fans is also smart home ceiling fans, LED fixtures, control systems and more. If it's Big Ass, it's bolder and better.

Why Thread?
Thread is key to achieving our vision of making homes more comfortable and energy efficient. With Thread, consumers can easily pair our technology with other devices. The result? A living, breathing, responsive system. That's the first step toward transforming the way we live.
Board Member: Bill Curtis - Thread Secretary

About ARM
ARM's technology's breadth and diversity combined with its robust partner ecosystem provide the quickest path to market for connected chips and platforms.

Why Thread?
Thread is the protocol that will bring industry-wide interoperability and mass-market scale to connected devices in homes worldwide.