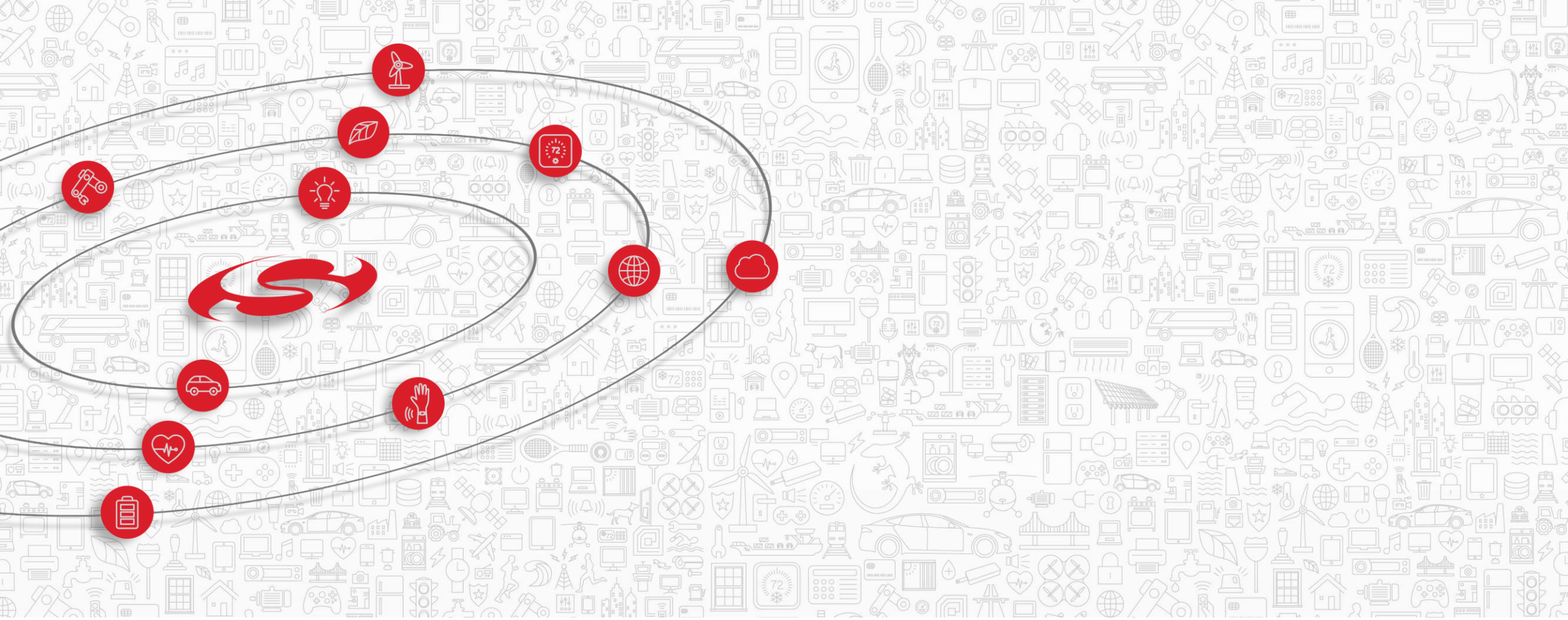


Understanding Wireless Protocol options for enabling smart connected lighting

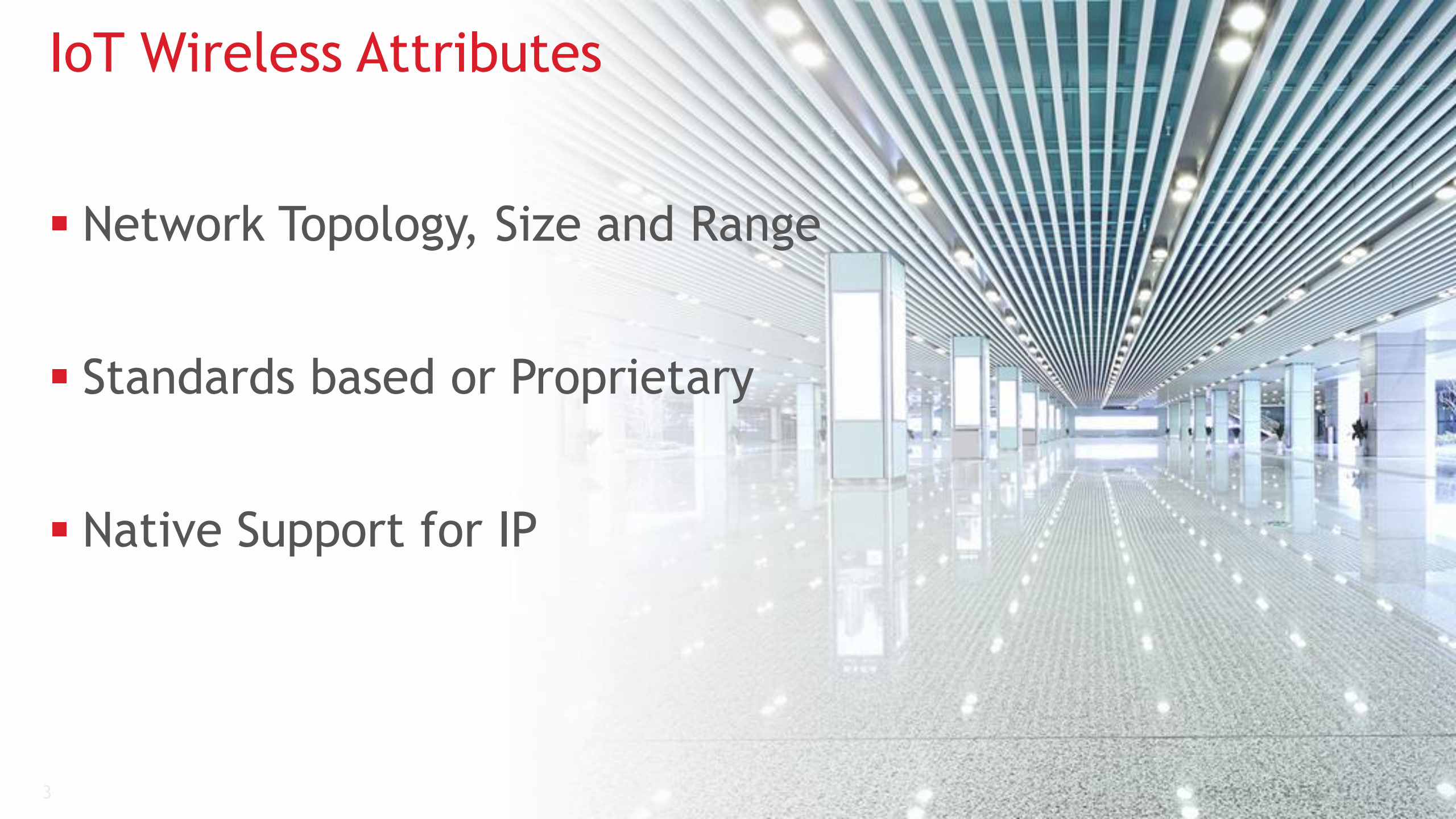
Anders Pettersson| Field Marketing Manager - IoT | November 2016

SILICON LABS

Five Primary Wireless Connectivity Technologies today

Proprietary	Bluetooth	Bluetooth SMART	Wi Fi	ZigBee / THREAD
Closed systems	I/O and audio	Smart phone	Infrastructure	Ecosystems
Device to device	Device to PC	Device to phone	Device to AP	Device to device
Long range	Streaming	Beaconing	High bandwidth	Reliable mesh
Large network	Point to point	Point to point	Med network	Large network

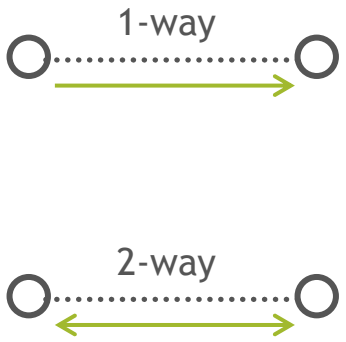
IoT Wireless Attributes



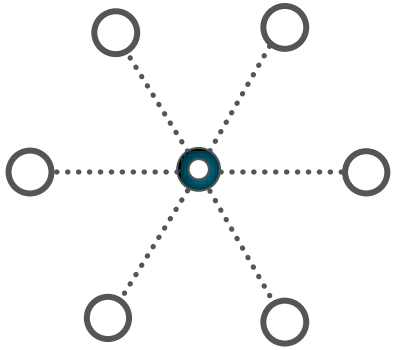
- Network Topology, Size and Range
- Standards based or Proprietary
- Native Support for IP

Network Topology

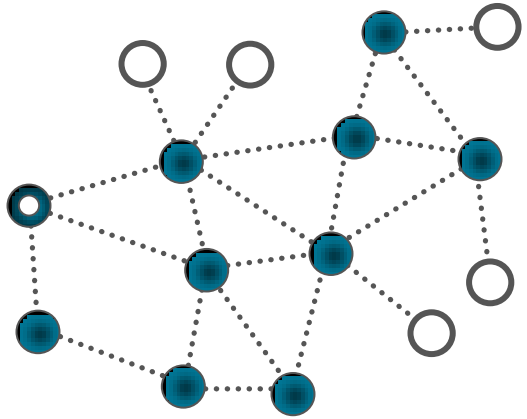
Point to Point



Star



Mesh



Lowest Cost

Highest Reliability

Different Networks for Different Needs

	Range	PHY Rate	Power	Typ. Size	Use Case
Wi Fi	90 m	54 - 1300 Mbps	High	32	Data, Audio, Video
Bluetooth	60 m	1-3 Mbps	Medium	7	Audio, PC Peripherals
Bluetooth SMART	20 m	1 Mbps	Low	10	Simple Connectivity
ZigBee THREAD	**140 m**	**250 kbps**	**Low**	**250**	**Automation + Control**
Proprietary	Varies	1-1000 kbps	Low	100	Varies

Standards-Based or Proprietary Protocols

Standards-Based

- Interoperability with:
  - Heterogeneous networks
  - Devices from different vendors
- Bigger requirements:
  - Software Overheads
  - Hardware resources

Proprietary

- Interoperability within:
  - Homogenous networks
  - Devices typically from one vendor
- Optimised for:
  - Smaller software stacks
  - Simple hardware systems

Proprieta
ry

Native Support for IP

- Existing protocols in IoT applications: mix of IP and non-IP stacks

- IP benefits:
  - Variety of addressing, routing and security mechanisms
  - End addressability and routing without application layer translation
  - A mix of underlying technologies

- Innovation surrounding IP-based solutions
  - Applications needing high bandwidth continue with Wi-Fi
  - Power sensitive / low power applications can use Thread

Five Primary Wireless Connectivity Technologies

Proprietary

Proprietary Protocols on Sub-GHz Bands

- Longer range, 1KM or more
- Bespoke security
- Lower cost per device
- Frequency bands differ by region
- Possible duty cycle / bandwidth limits

- Standardised protocols on Sub-GHz
  - W-Mbus for metering
  - SigFox and LoRa for ultra long range

Bluetooth Protocols

- Ubiquitous technology
- No need for special gateway
- Small network size
- Point-to-point
- 3Mbps bandwidth
- Limited range (60 m)

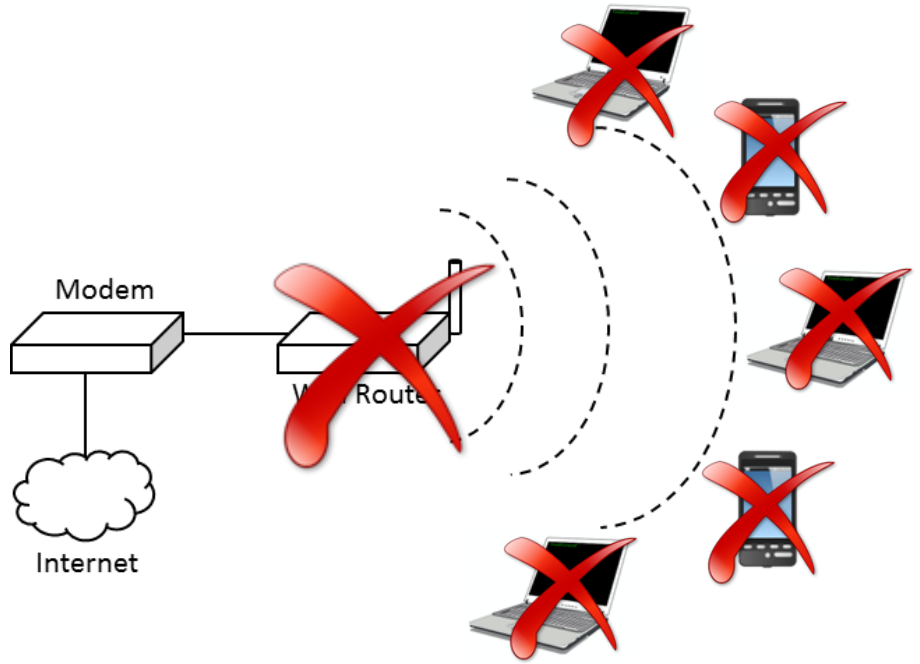
- Native support in phones / tablets
- >10x lower power than Bluetooth
- 20 nodes in a network
- 1Mbps bandwidth
- Short Range (20 m)
- Bluetooth Based Mesh awaiting SIG specification approval

Coming soon!

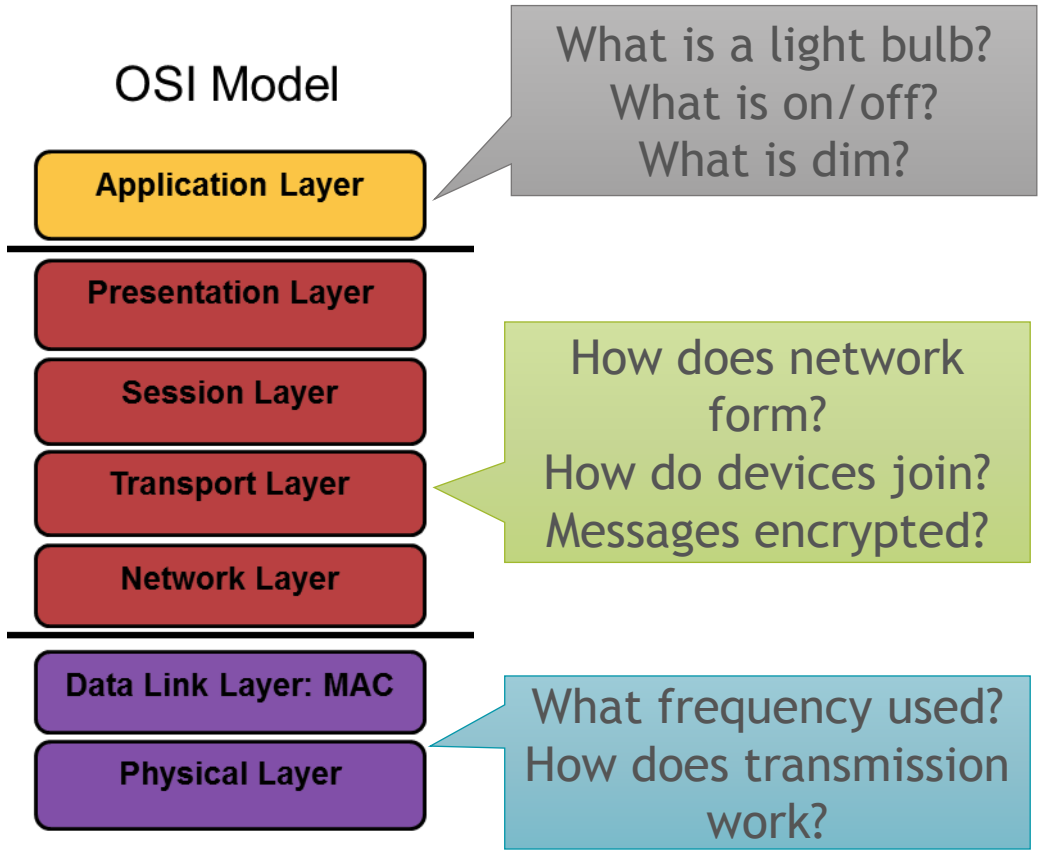
Wi-Fi

- Most widely used protocol
- IEEE for standards and Wi-Fi Alliance for branding
- Considered ‘easy to use’ by consumers
- Defines MAC layer and security only

- Limited applications in connected home
  - No mesh support
  - Reliance on a single gateway
  - Introduces a ‘single point of failure’

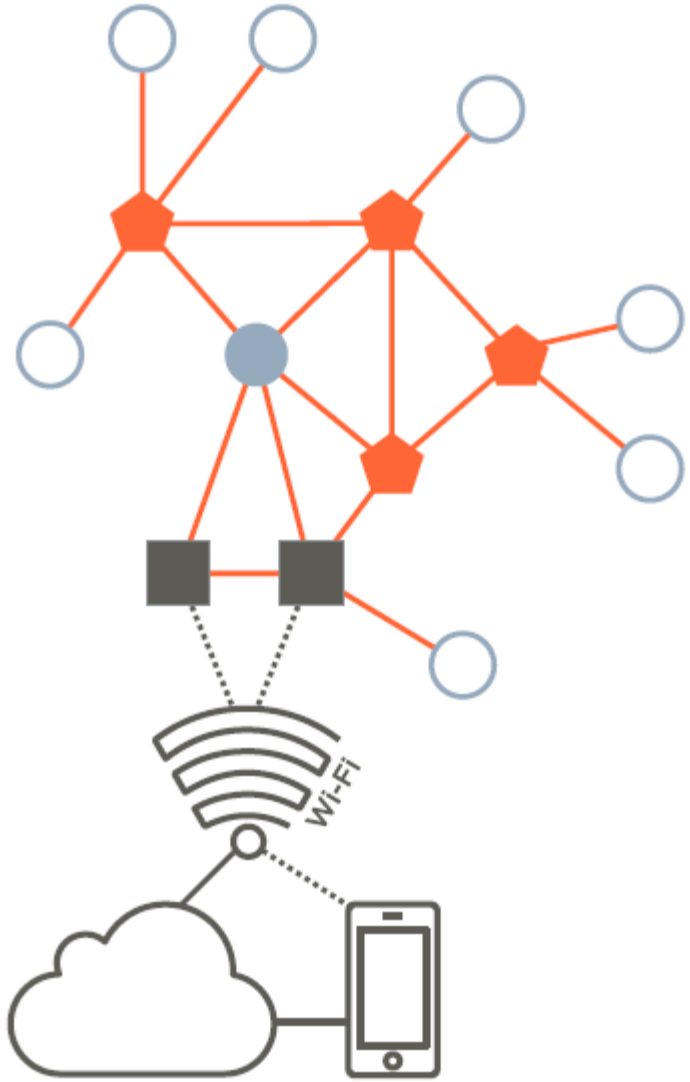


ZigBee



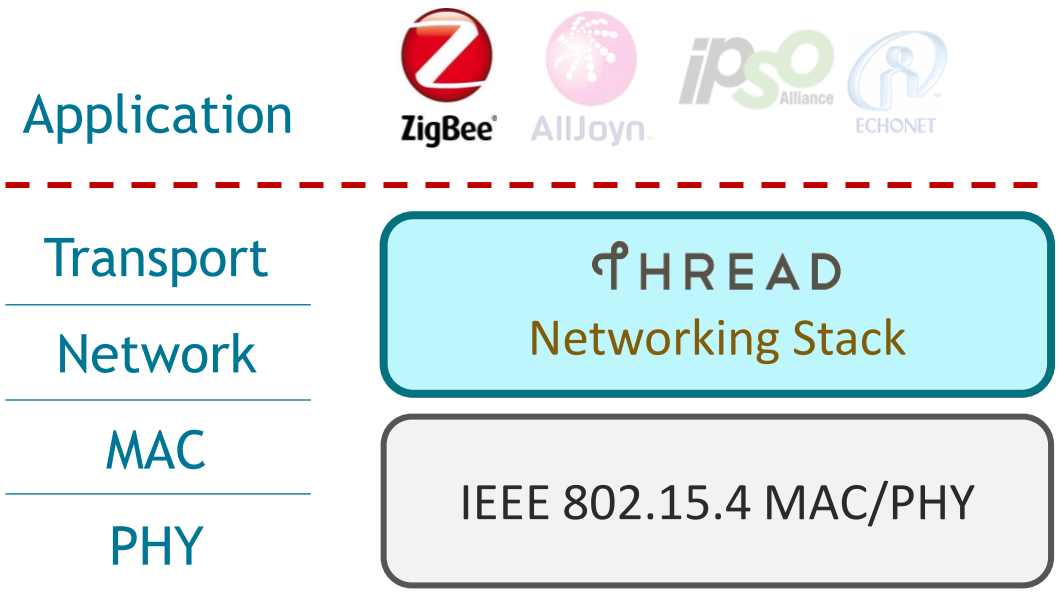
- Standardised in 2004
- Uses IEEE802.15.4 radio specification
- Mesh Network
  - Robust, Scalable, Self-healing
- Defines every layer
  - Including application layer
  - Ensures interoperability for vendors
- No native support for IP
  - Requires gateway for address translation

Thread



- Built on standards: 6LoWPAN / 802.15.4 radios
- Secure, wireless mesh networking protocol
- Reliable:
  - Self-healing networks with no single point of failure
- Secure:
  - Uses banking class encryption
- Simple:
  - Simple yet secure commissioning of new nodes to a network
- Low Power:
  - Optimised to support battery powered devices

Thread

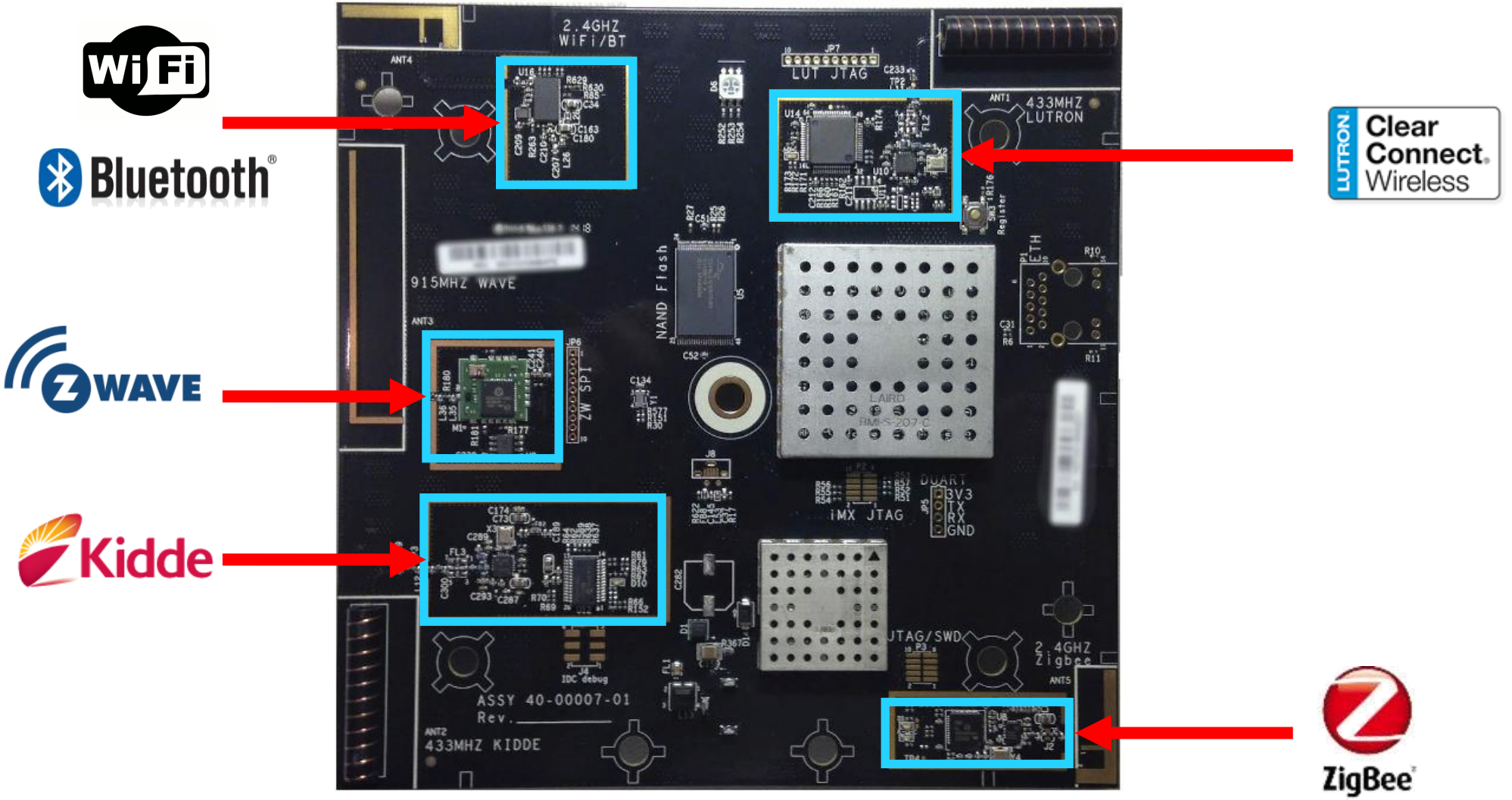


- Defines how data is sent, not interpreted
- Supports IP-based application layers
- Zigbee Alliance and Thread Group co-op

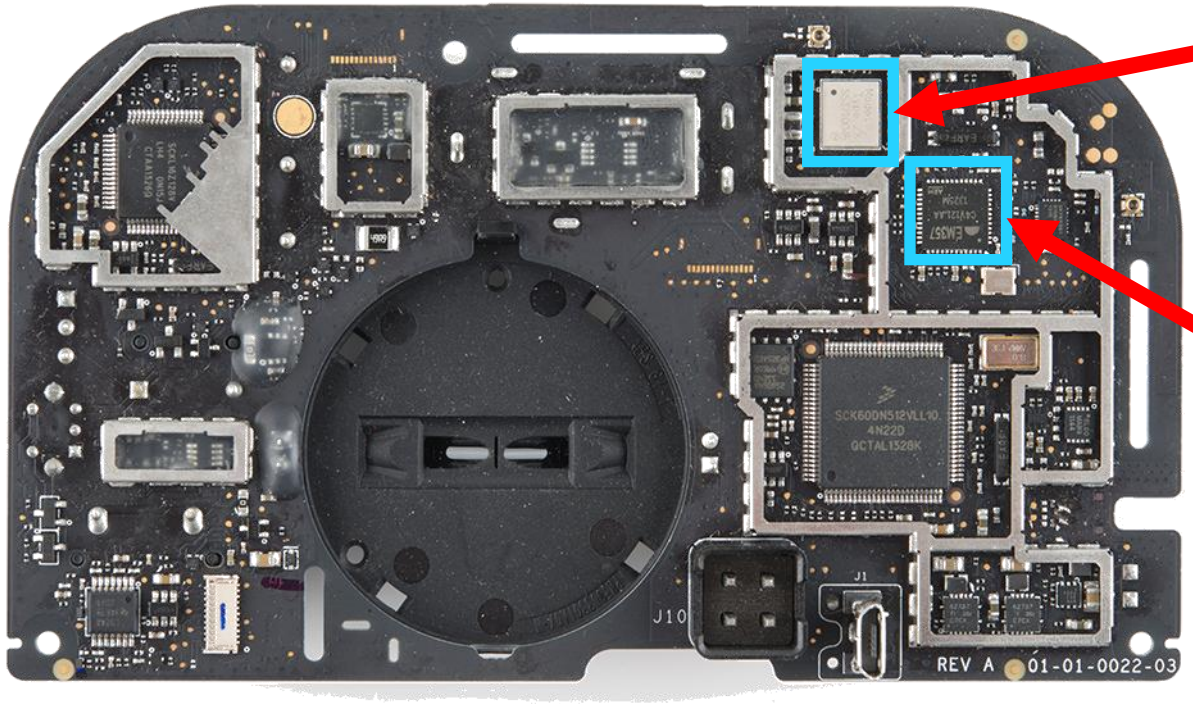
Which protocol should I choose?

The IoT Requires Networking Coexistence

Multi-Radio Product Example – Wink Hub



Multi-Radio Product Example – Nest Protect



Radio 1:

Murata Type ZX Wi-Fi module

Radio 2:

Silicon Labs EM357

Do I have to use multiple radios?

Multiprotocol capabilities are the future

Name	Description	Example Use Case
Programmable	One-time decision	Production-line decision
Switched	Bootload to change protocols	BLE Commissioning of ZigBee
Dynamic	Time slice between networks	Primary Thread Network, periodically transmit BLE beacon
Concurrent	Actively participates on 2 similar networks	One chip living on Thread and ZigBee networks
Multi-Radio	Actively participates on 2 different networks	Gateway with BLE, and Thread/ZigBee

Multi-Protocol Use Case Example

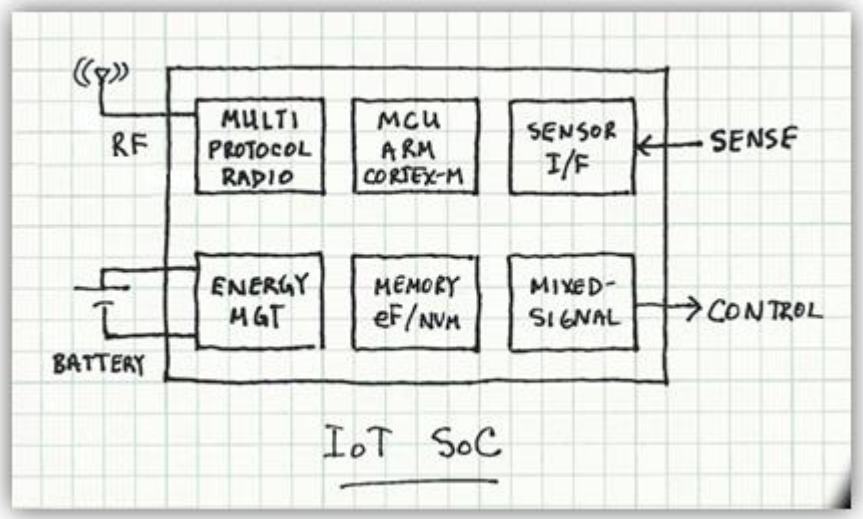
- Product Needs:
  - Easy commissioning onto network
  - Lighting function using Zigbee or Thread
- Solution:
  - Use a ‘switched’ multi-protocol for configuration
  - Requires a single 2.4GHz radio
- Procedure:
  - Boot device in Bluetooth Smart
  - Obtain commissioning data with smartphone as gateway
  - Store commissioning data – encrypted, in flash
  - Re-boot and operate as ZigBee or Thread bulb

Introducing the Wireless Gecko Platform

Wireless SoC

Multi-protocol radio
2.4 GHz +19.5 dBm PA
Sub-GHz +20 dBm PA
Antenna Diversity

ARM Cortex-M4, 40 MHz
HW Crypto Accelerator (AES, ECC, SHA)
RTC, Timers, Oscillators



Integrated DC/DC
Low active/sleep currents
1.85-3.8 V

32-256 kB Flash
16-32 kB RAM
QFN, CSP options

ADC, USARTS, I2C
Timers/PWM/Comparator
Pulse counter

Tools, Modules, SDK, & Ref Designs

Software Stacks
- IEEE15.4 ZigBee/Thread
- Bluetooth Smart
- Proprietary RAIL, Connect, Sigfox

Reference Designs
- Home Automation
- Lighting

Modules
- BLE
- Mesh

Simplicity Studio
- Application Notes
- Data sheets
- Reference Manuals
- Driver Libraries
- Application Builder
- Network Analyzer
- Advanced Energy Monitor
- Part configuration
- Modem calculator
- Packet configurator

Wireless Gecko Portfolio

	THREAD	ZigBee	Bluetooth SMART	Proprietary
Mighty Gecko	✓	✓	✓	✓
Blue Gecko			✓	✓
Flex Gecko				✓

We Help Developers Overcome These Challenges

Multiprotocol wireless SoCs

Mighty Gecko | Blue Gecko |Flex Gecko

The right protocols and application layers

Proven stacks and software

THREAD ZigBee Bluetooth SMART Proprietary wireless

Development tools for system-level design

Ready-to-use development tools

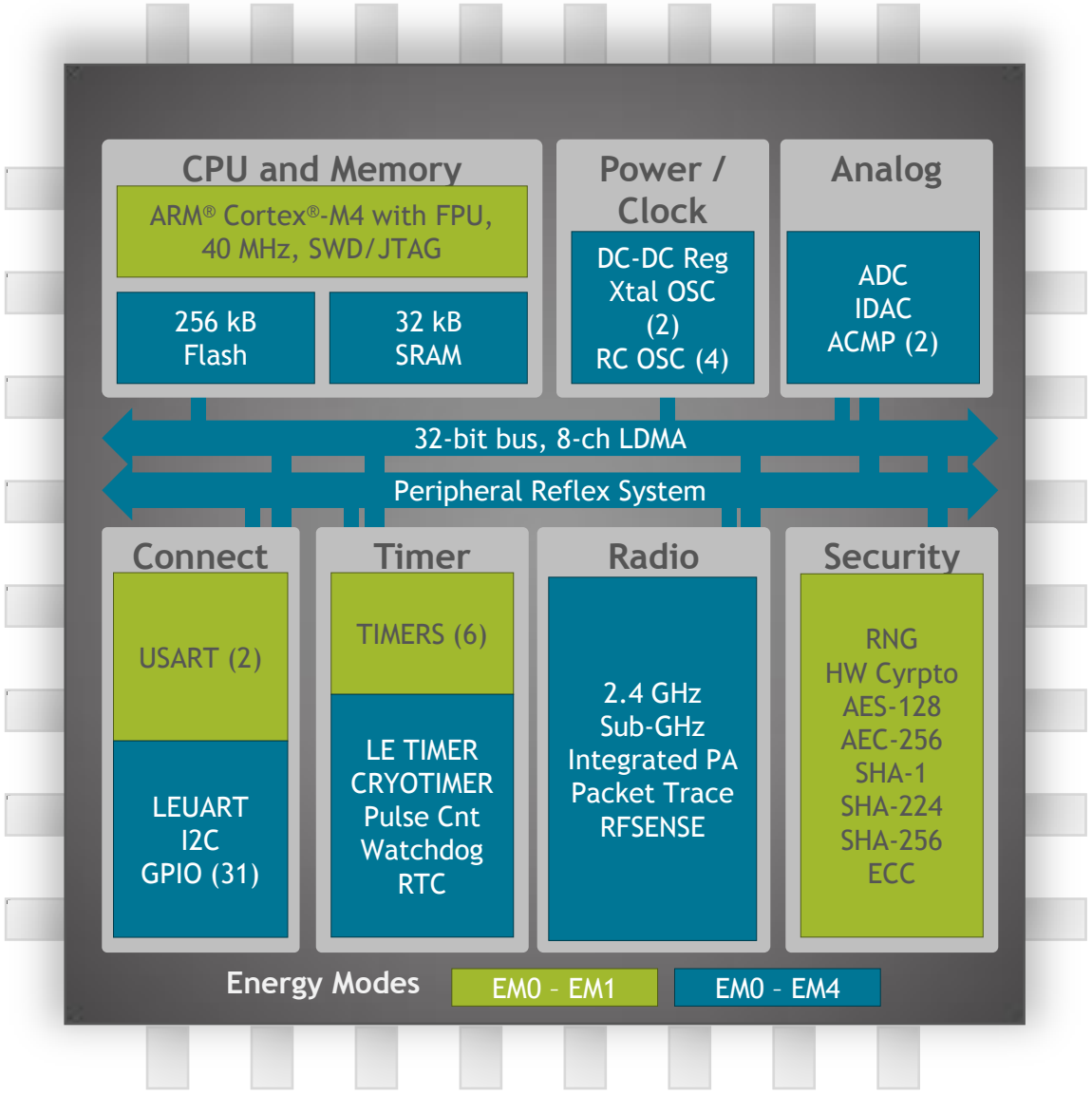
Getting to market faster

Wireless modules, kits and reference designs

Protocol Stack Leadership

- Leaders in ZigBee, Thread and BLE networking
  - Founding members of both the ZigBee Alliance and the Thread Group
  - Silicon Labs ZigBee is most widely deployed solution in the market
  - Bluetooth Smart software has been successfully deployed in millions of products
- Focus on simplicity, developer experience and customer service
  - Faster time-to-market with advanced APIs, software development environment and tools
  - Highly experienced application engineers who are able to solve the most challenging problems
- Trusted partner for automation and control platforms and ecosystems
  - Lead vendor for eco-systems such as iControl, SmartThings, HomeKit & Eddystone
  - Lower risk and faster time to market
- Interoperability and Scalability
  - Certify our software for new releases
  - Attend numerous interoperability events at different locations around the world
  - System test labs and large networks (400+ node mesh) are part of software quality assurance

Integration and Scalability

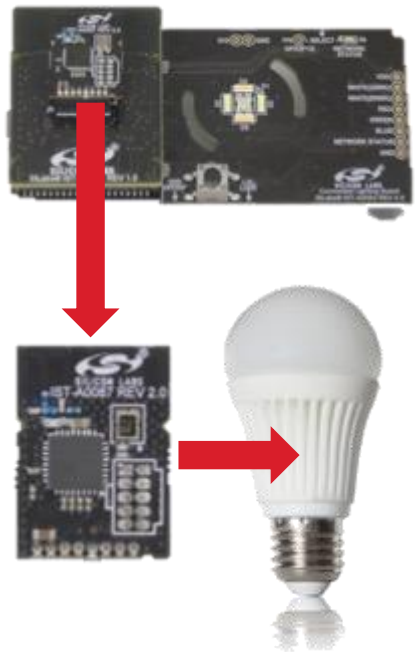


- Dual 2.4GHz and SubGHz radio
- Integrated +20 dBm power amplifier
- Integrated 2.4 GHz balun
- Designed for Low Power operation
- Comprehensive HW crypto support
- Memory options from 32 to 256 kB
- Peripheral mix provides robust features
- Package options provide flexibility

Lighting Reference design

Connected Lighting

- ZigBee HA 1.2
- Color (RGB), color-tunable, dimming
- 125°C



Gen 2 Lighting Reference Design

Small:

- 14mm x 20mm
- ~31% smaller than the smallest module from competitor, and
- Flexibility for customers to place into their design

High Performance:

- Module rated for 125°C applications
- +16 or +19.5dBm output power
- Capable of supporting multi-protocol and OTA
- Pre-certified (FCC/CE)

Low Cost:

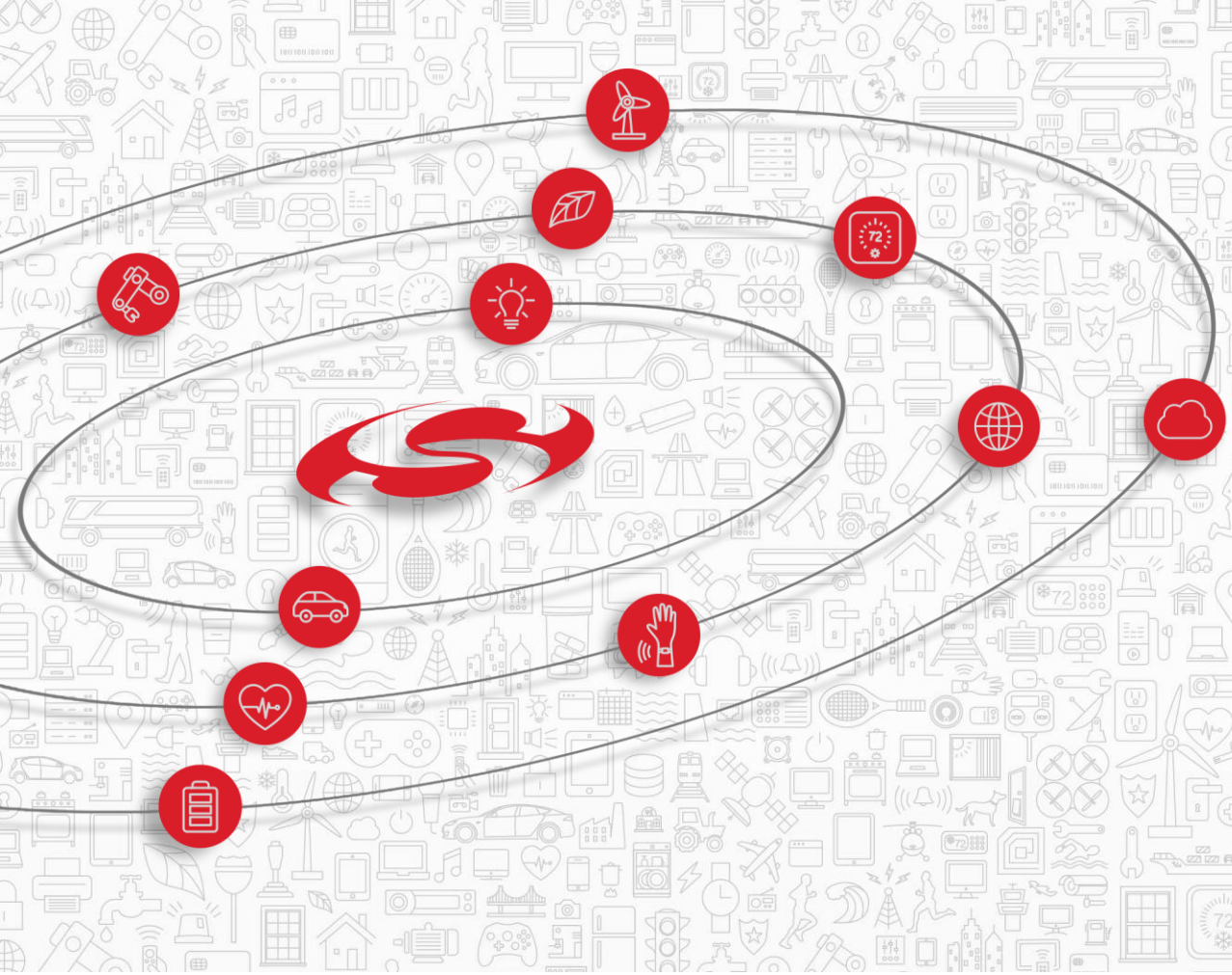
- Internal PA and balun
- Minimal components (20 total)

Standardized Firmware/SW:

- ZigBee Ember stack Z-Net PRO, pre-certified HA1.2
- Supported by Silicon Labs Gateway Reference Designs

Making the right connection…

- One size does NOT fit all
- Understand your technology choice
- Integration of Hardware, stacks and development tools is not trivial
- Multiple protocol capable radios provide the greatest flexibility



Thank you

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