2024 Embedded Seminar

Navigating smart home connectivity: Unlocking TI’s affordable Zigbee-enabled low-power MCUs

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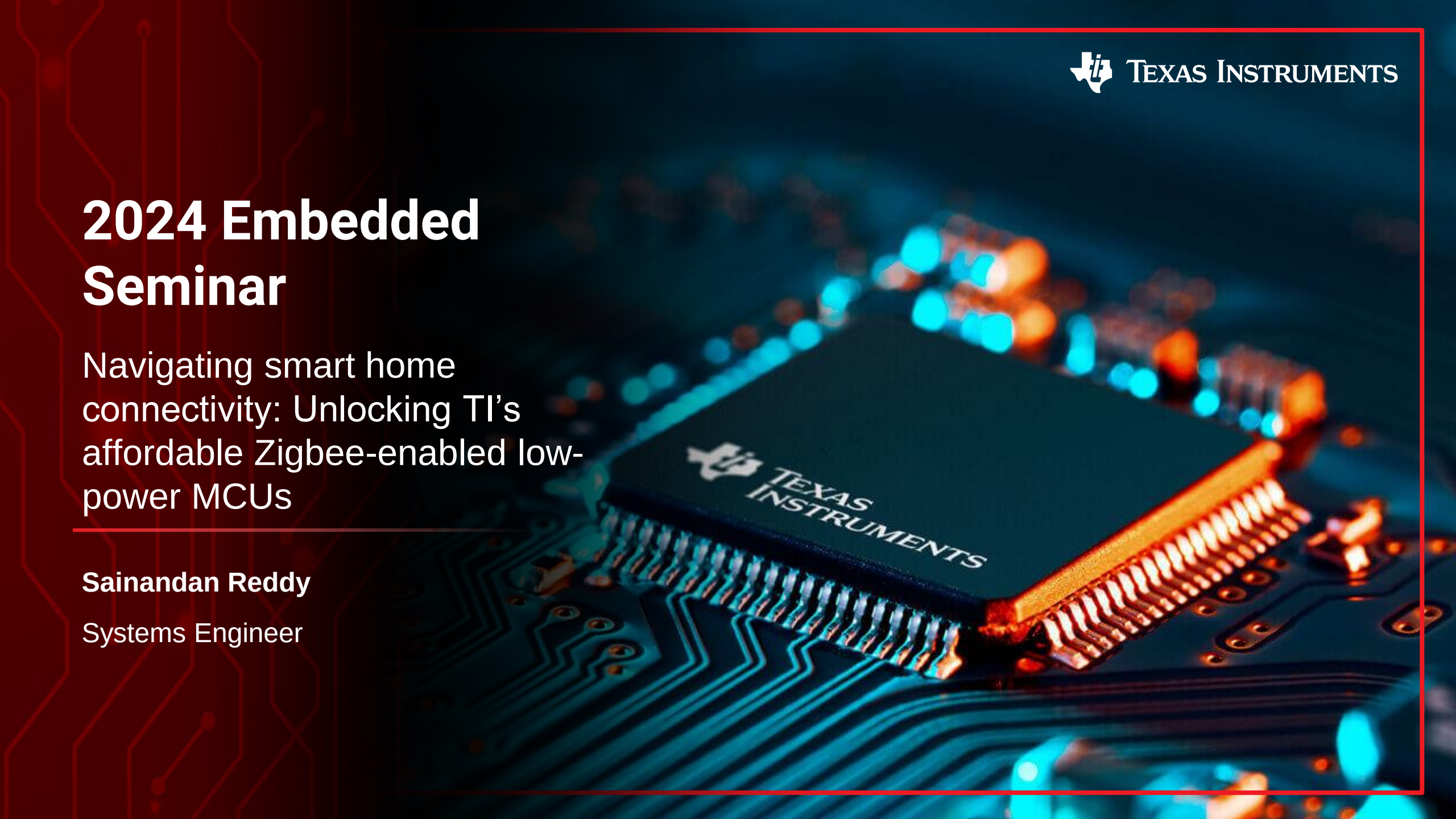
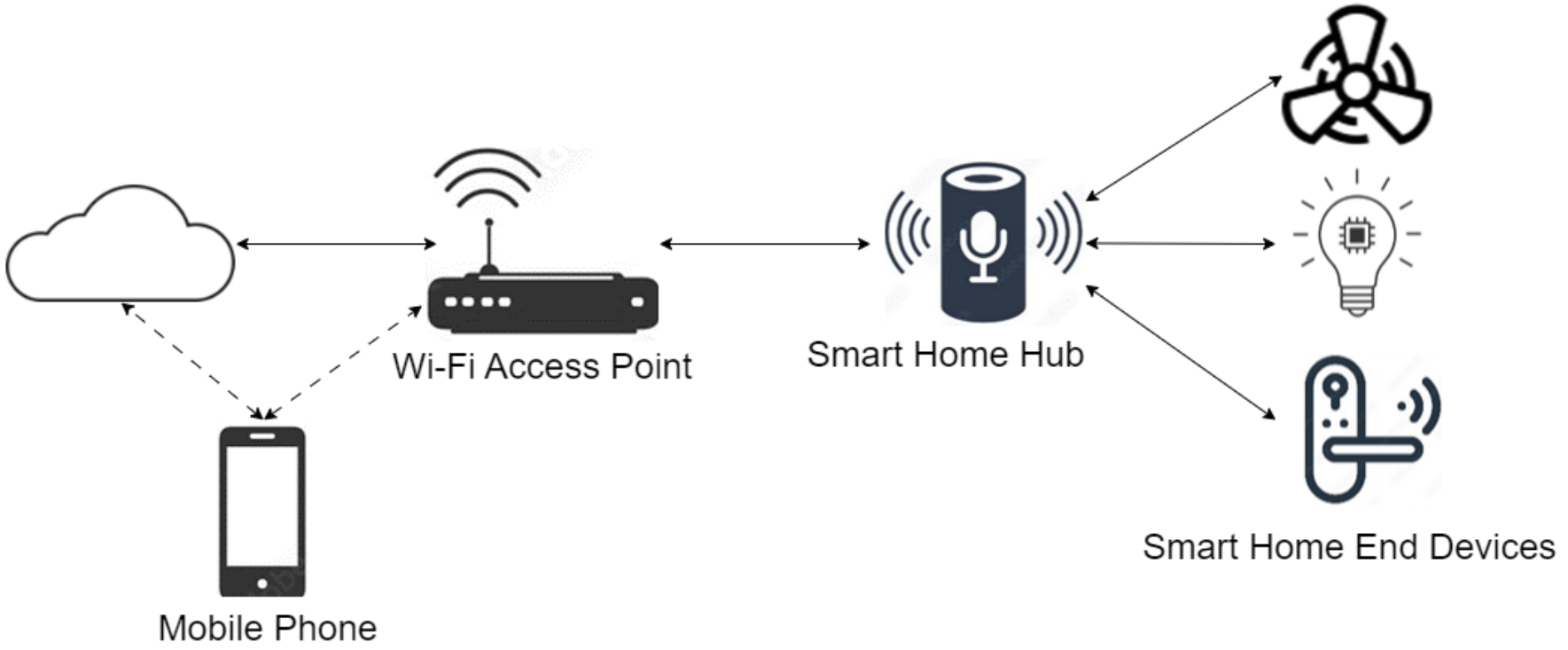


Agenda

- Smart home introduction
- Key design challenges and considerations
- Zigbee a smart home enabler
- Introducing TI’s affordable Zigbee solution

Introduction | Smart home

- Advancements in wireless connectivity have been driving smart home evolution
- Various wireless connectivity technologies have evolved to address growing smart home needs
- Smart home hubs (and the associated ecosystems) play a key role – allow integration, automation, control and interaction with various smart home devices

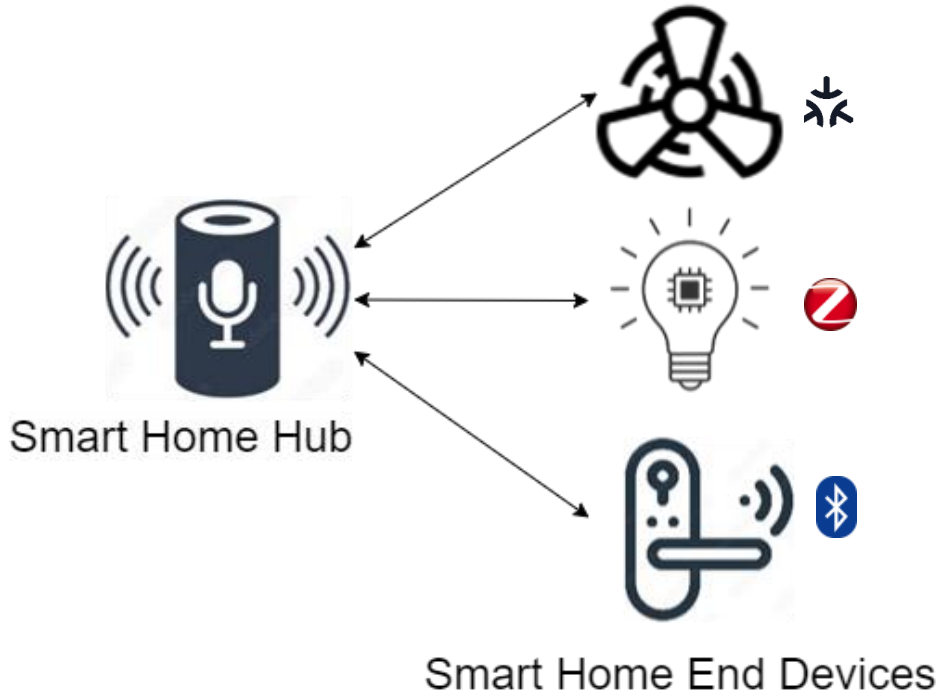


Smart Home | Key challenges

Smart home evolution demands affordable, robust and secure wireless connectivity solutions

Key design challenges for smart home products

- Interoperability
- Scalability
- Extended range
- Low power
- Ecosystem support
- Enhanced security
- Affordability



Zigbee | Addresses key smart home design challenges

Low power, wireless, **mesh** networking solution that allows smart objects to work together

Reliable smart home technology used globally with wide ecosystem support – helps with building affordable products

Reliable

- Stable – first introduced in 2005
- Proven – Millions shipped over multiple years from different suppliers
- Self healing mesh network, eliminates single point of failure

Interoperable

- Certification for IoP required
- Unified data model with standardized application layer
- Globally adopted across multiple applications and companies

Flexible

- Scalable – Support over 250 devices, easy to deploy (Self-organizing mesh)
- Extended Range – Provides coverage for the entire home
- Multiple roles supported – choose based on range and power needs

Low power

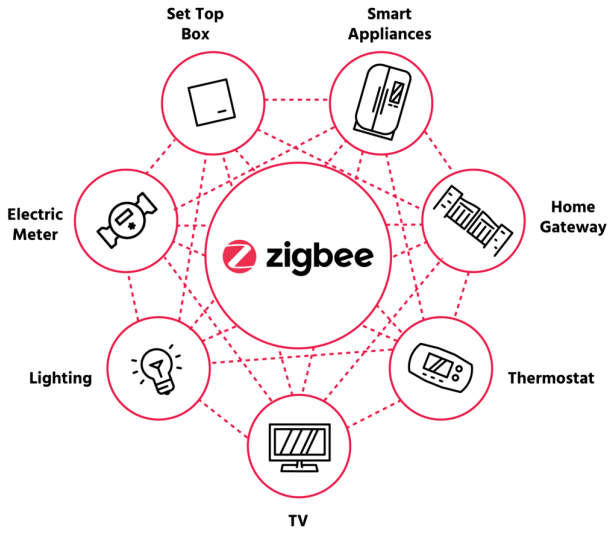
- Designed to support low data rate and green power applications
- Energy harvesting product support across the network

Ecosystem

- Wide smart home ecosystem support
- Large collection of products that work seamlessly together

Security

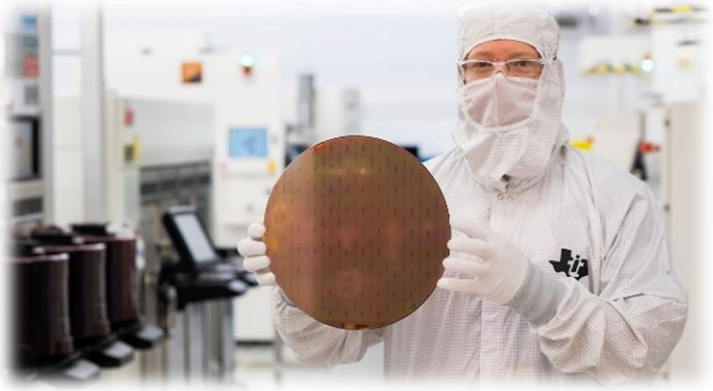
- Well defined security procedures to request and change keys
- Secure network joining with install codes



Smart Home

TI Zigbee | Executive Summary

Leadership



- Member of **CSA** for 10+ years, and member for **ZBOSS open initiative (ZOI)**
- **Lead** Participant in Zigbee R23 with Golden Unit for R23 standard
- Trusted partner with **end-to-end flexible supply chain**

Innovation

- **Most affordable** Wireless MCU, CC2340R, now supports Zigbee
- **Leader in low power** with standby at less than 850nA (Full SRAM retention)
- **Scalable portfolio** covers all Zigbee applications

Readiness

SCAN ME

- Certified Zigbee Stack with **out of box examples and training modules**
- **Out-of-box interoperability** with industry leading smart hubs, like Amazon Alexa and Samsung SmartThings
- **Extensive interoperability testing** by TI and ZOI teams

Zigbee | Network topology and end equipment

Zigbee Coordinator

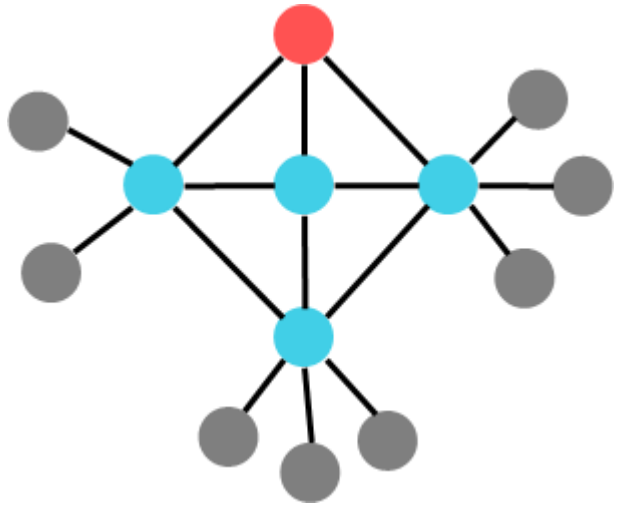
- Smart home hubs
- Monitoring & control
- HVAC
- Gateway

Zigbee Router

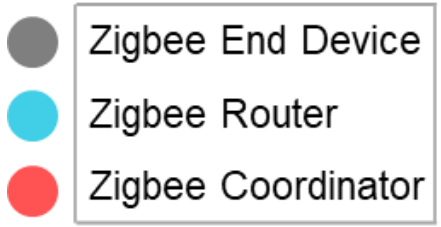
- Lights
- Shades/blinds
- Fans
- Thermostat
- Displays
- Smoke/gas detectors

End Device

- Portable switches
- Sensors –
  - Door/window
  - Motion
  - Ambient
- Smoke/gas detectors



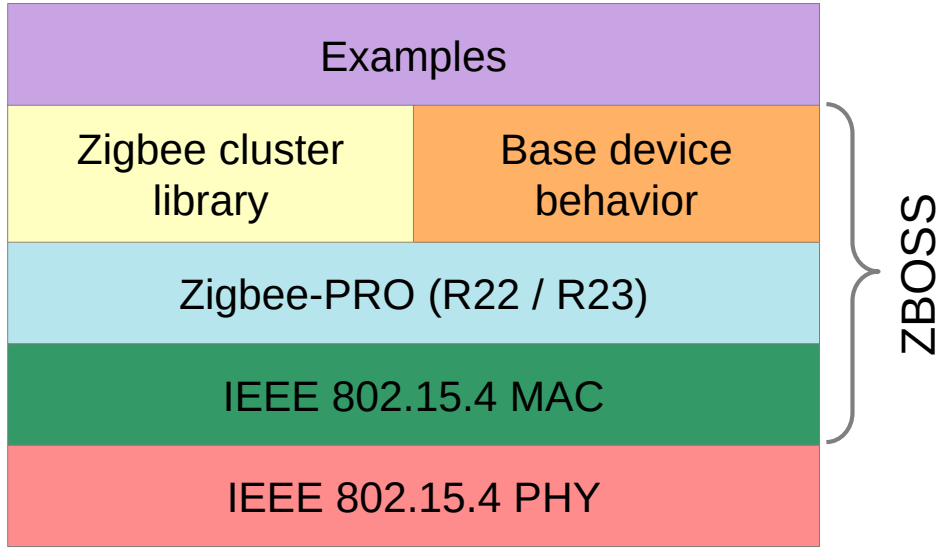
Zigbee mesh topology



TI Zigbee | Software

TI has partnered with ZOI to bring ZBOSS to the most affordable Wireless MCU – CC2340R
ZBOSS is an Industry-proven, cross-platform Zigbee stack

- **ZBOSS:**
  - Optimized for low-power resource constrained systems
  - Feature-rich with support for all Zigbee roles and latest specifications
  - Used in many certified Zigbee products for multiple years
- ZBOSS stack is **distributed in TI SimpleLink™ SDK**
  - Zigbee® 3.0 certifiable out of box examples
  - Out-of-box interoperability with industry leading smart hubs, like Amazon Alexa and Samsung SmartThings
  - On-chip and off-chip over-the-air update supported
- No royalty for TI customers



TI Zigbee | Affordable and scalable portfolio

Arm® Cortex®-M0+
48 MHz
Up to 512kB Flash
Up to 64kB SRAM

2.4 GHz radio
Integrated Balun
- TX output power: -20dBm to +8dBm
- RX sensitivity: -98dBm

Integrated DC/DC
1.71 v – 3.8V
-40 C to +125 C

Up to 26 GPIO
4x4 QFN24, 5x5 QFN40, WCSP
Integrated Temp sensor, Battery monitor

Key features

	CC2340R21 (256kB / 28kB)	CC2340R22 (256kB / 36kB)	CC2340R52 (512kB / 36kB)	CC2340R53 (512kB / 64kB)
End device, GPD	✓	✓	✓	✓
Router	x	x	✓	✓
Coordinator	x	x	✓	✓
On-chip OTA	x	x	✓	✓

Key Zigbee functionality

TI Zigbee | Stack testing overview

Features

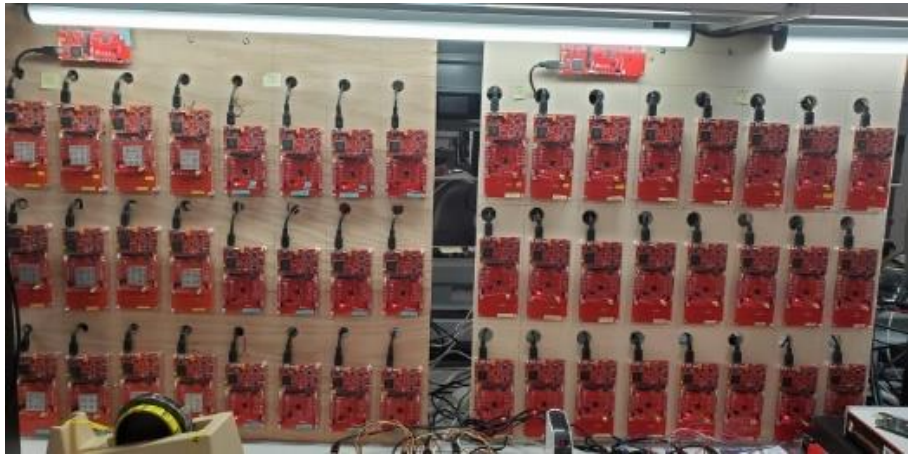
Robust & reliable solution

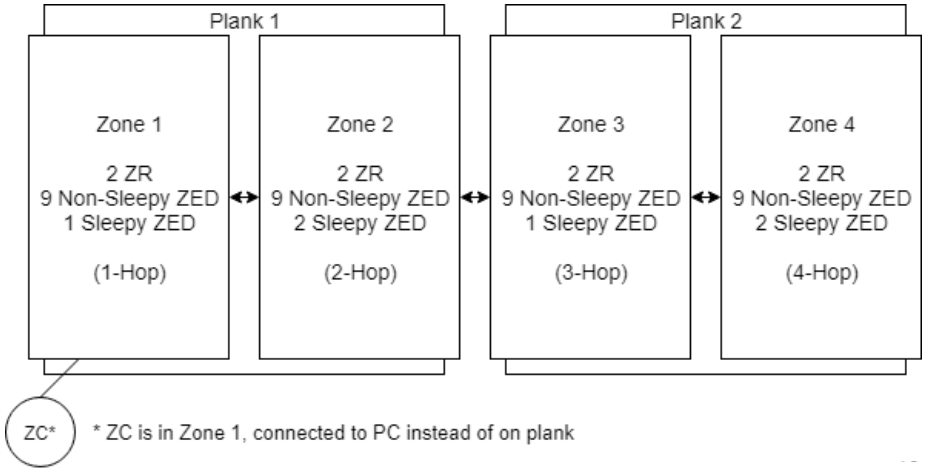
- Quarterly releases tested
- LNT: Stress tested for higher traffic with 50 node network
- Interoperability testing with
  - Smart hubs – Amazon Echo and Samsung SmartThings
  - Multiple off the shelf products across different Zigbee roles
  - R22 and R23 mixed devices
- Power consumption evaluated across profiles and devices
- Tests performed in shielded room and wireless congested environments

Large network test setup

Setup

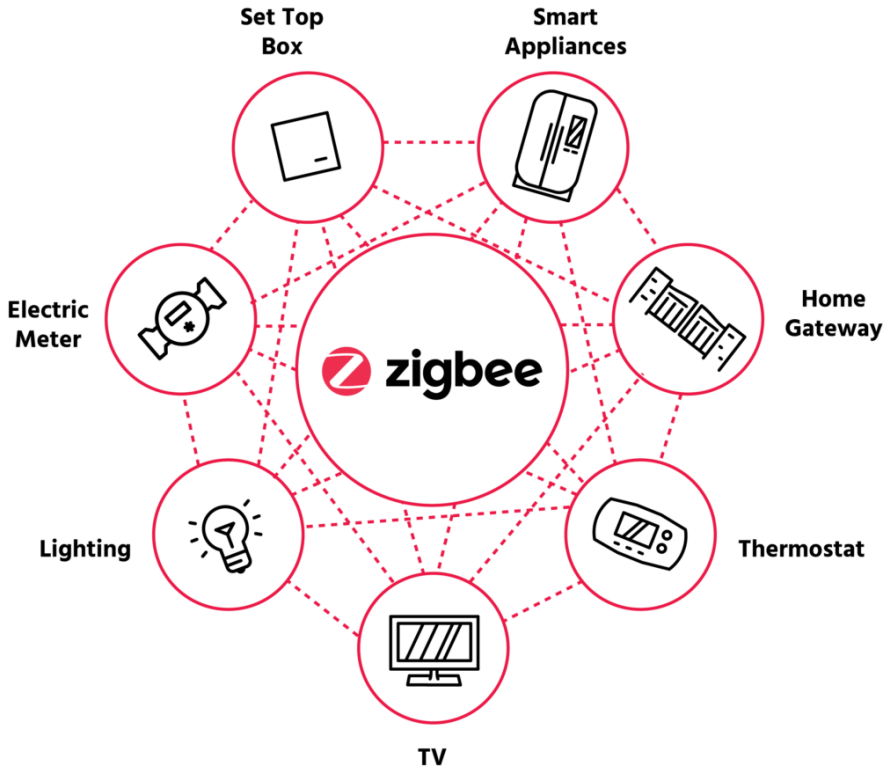
- 50 nodes tested across four zones
- Nodes send 68-byte application frames every 4 minutes
- DUTs in close proximity with physical or electrical interference
- End devices allowed to change parents





Number of hops from ZC	Final number of ZEDs
1	12
2	13
3	12
4	13

TI Zigbee | Development toolkit



Smart Home

Development tools
SmartRF Studio | Code Composer Studio

Hardware evaluation kit
CC2340R LaunchPad

Software development kit
SimpleLink™ LowPower F3 SDK

Technical support
E2E Forum

Partners
DSR | 3P Module Partners

Thank You!

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