Build a Smart Thermostat and Save on Energy Costs

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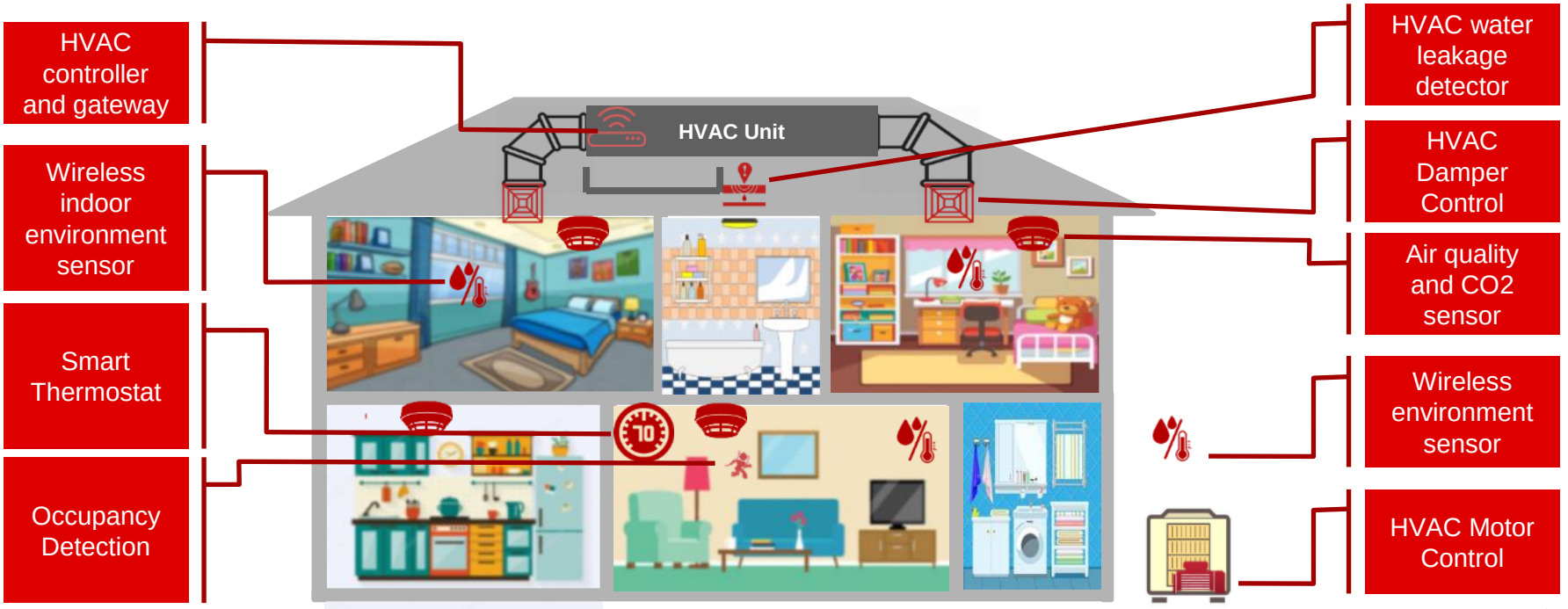
What you'll learn

- Why add connectivity in your home HVAC system?
- Key care-abouts when designing your connected HVAC system
- How to design your low power, cost-effective smart thermostat
- TI SimpleLink™ solution and resources to get started

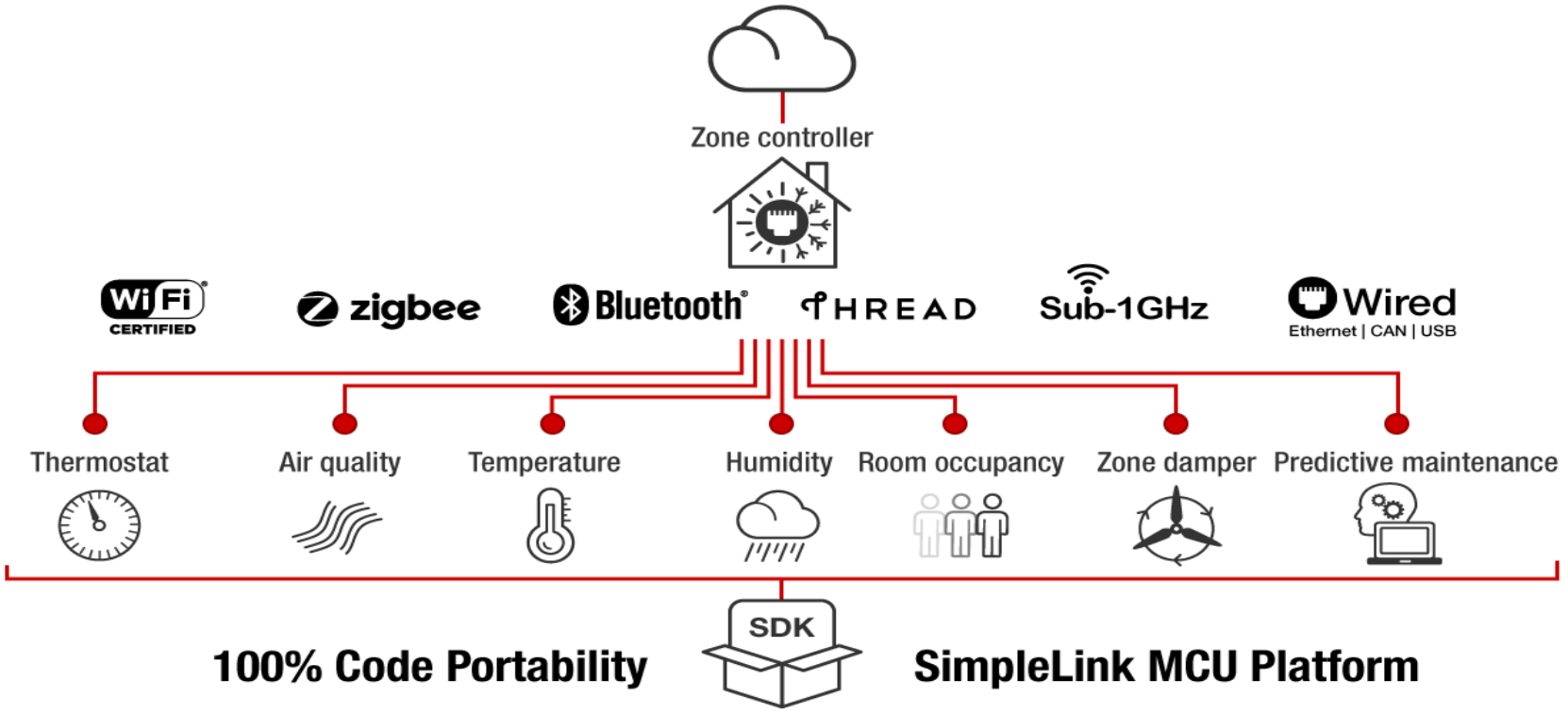
Why add connectivity in your home HVAC system?

- Average house-hold energy consumption in US for heating/cooling is ~42% of total energy cost
- Adding energy efficiency while keeping a comfortable house temp **requires** closed control, monitoring and communication between HVAC system components
- Wireless connectivity provides a cheaper and easier way to deploy and maintain connectivity in order to increase energy efficiency in the home



Choosing a connectivity protocol for your HVAC system

- Wide choice of wireless/wired protocol available based on connectivity needs
- Choice of a particular protocol depends on data throughput, level of security, range and battery life needs for individual EE
- **TI offers wide range of devices to support current and emerging protocols**



HVAC customer key care-abouts

Time to Market

- Device and module offering for a faster hardware design cycle
- Extensive resources, Reference designs & examples for faster software design
- Ready support for cloud clients – HomeKit, IBM, Azure, AWS, AVS
- Expert answers to your technical questions through E2E community forums

Security

- SimpleLink devices are built with security in mind
- Secures all exposure points - storage, runtime and transfer
- Multiple layer security enables
- HW crypto accelerator, secure file system storage, unique device identity key

Low Cost

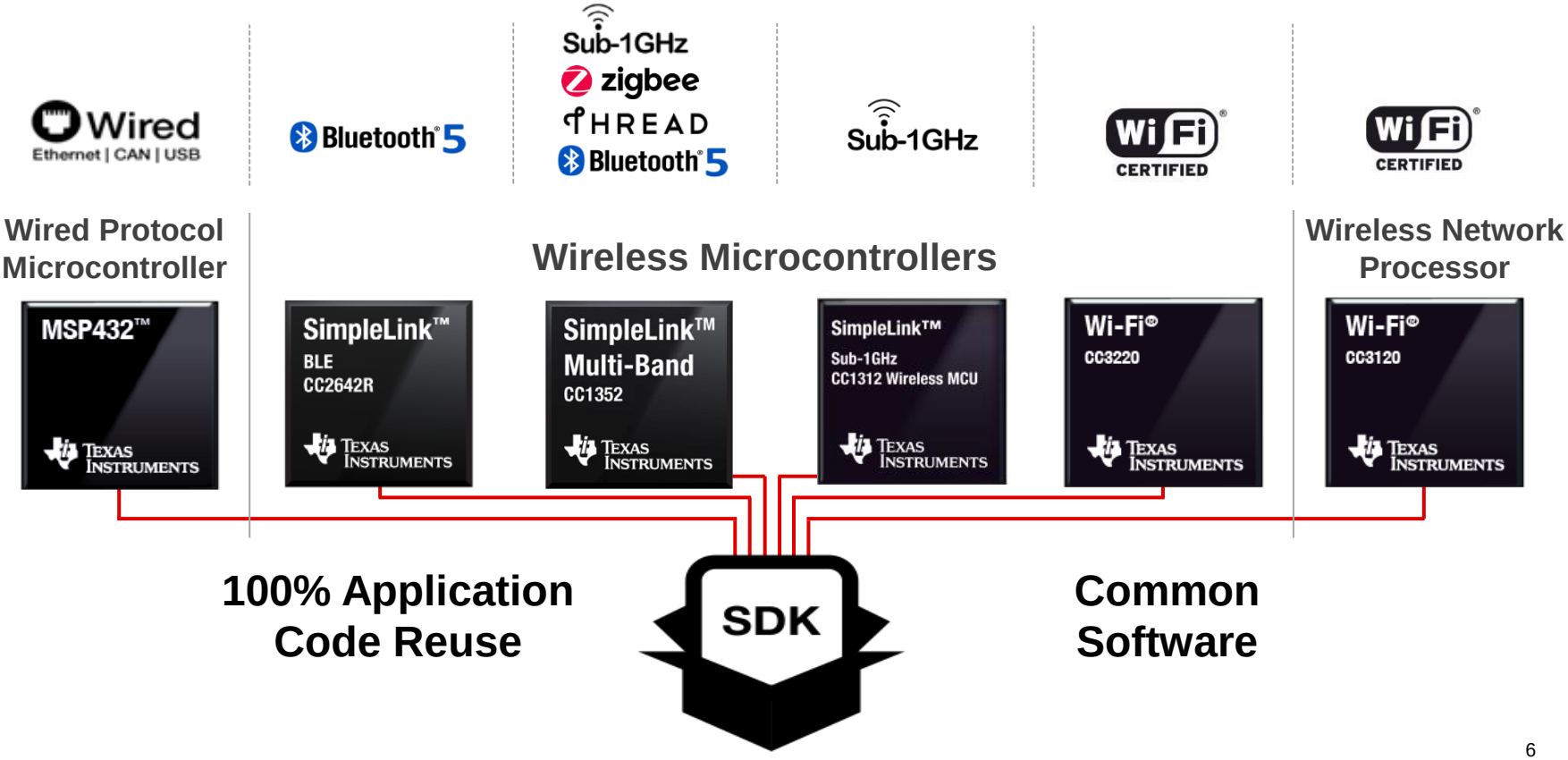
- Integrated MCU for application development with Network processor
- Reduced system R-BOM
- Rich peripherals enabling tighter integration
- Single device to support multiple protocols

Low Power

- Customizable low power design to enable battery operated applications
- SimpleLink Wi-Fi based applications can be realized using 2AA batteries (1-5yr battery life)
- SimpleLink BLE and Sub-1GHz can be realized using coin cell batteries

TI SimpleLink™ connected MCU family

- Industry leading connectivity solutions with TI's proven ARM®-based MCUs
- Single development environment with 100% application code portability
- Multiple protocol support to cover all industrial requirements
- Rich analog content and peripherals



End-to-end development resources

- Shorter development cycle
- Faster time to market
- Application specific design examples
- Integrated cloud partner SW

HVAC applicable reference designs

- ✓ **Smart Thermostat**
- ✓ HVAC System Controller
- ✓ HVAC Gateway
- ✓ Wireless Environment Sensor

Wired & wireless ARM®-based MCUs

ti.com/simplelink

Common software

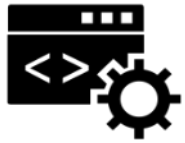
ti.com/simplelinksdk

Development Kits

ti.com/launchpad

TI Resource Explorer

dev.ti.com/tirex/#/



Code Composer Studio™ IDE

ti.com/ccs

SimpleLink Academy

ti.com/simplelinkacademy

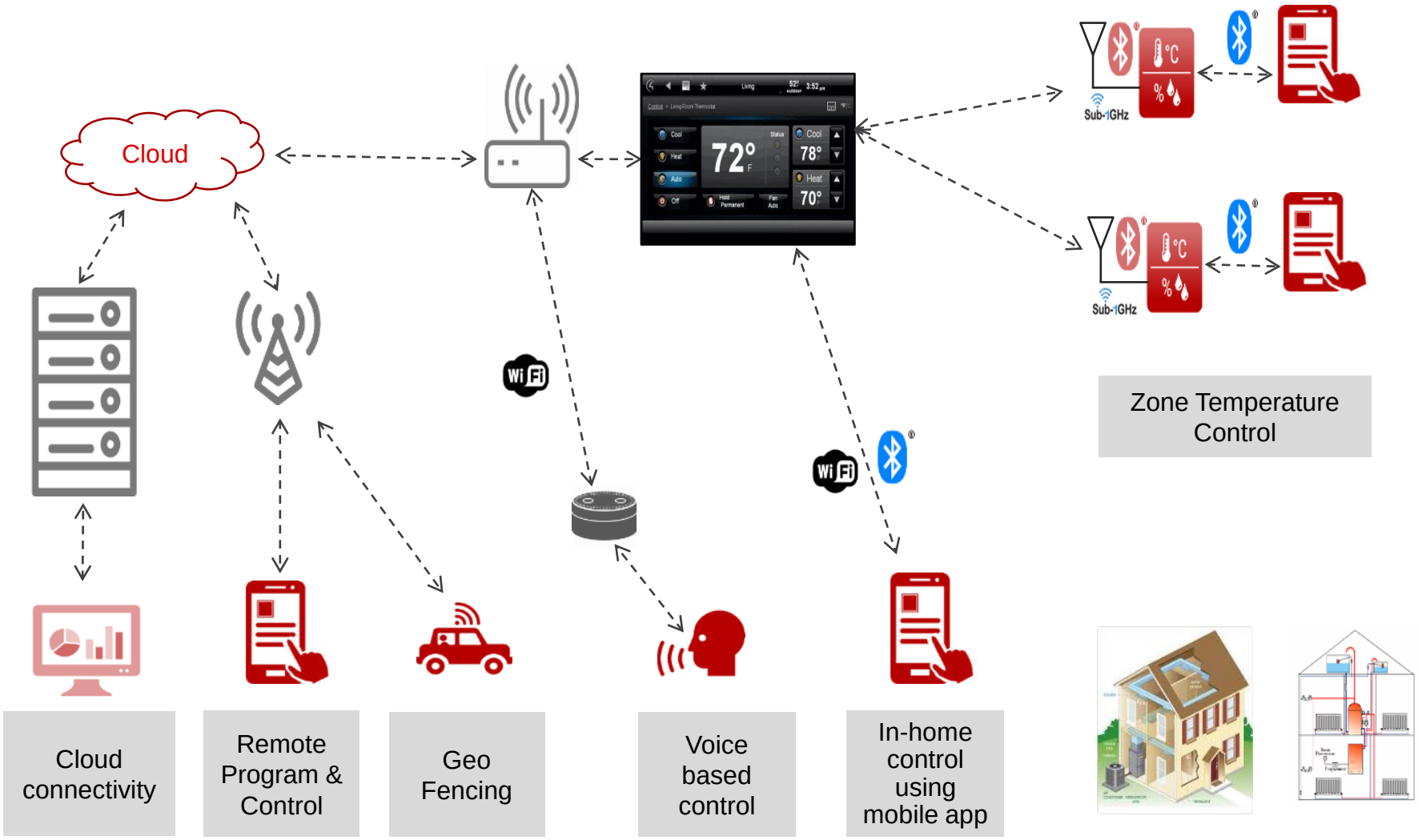
SimpleLink™ thermostat system's example

LOW POWER

SECURITY

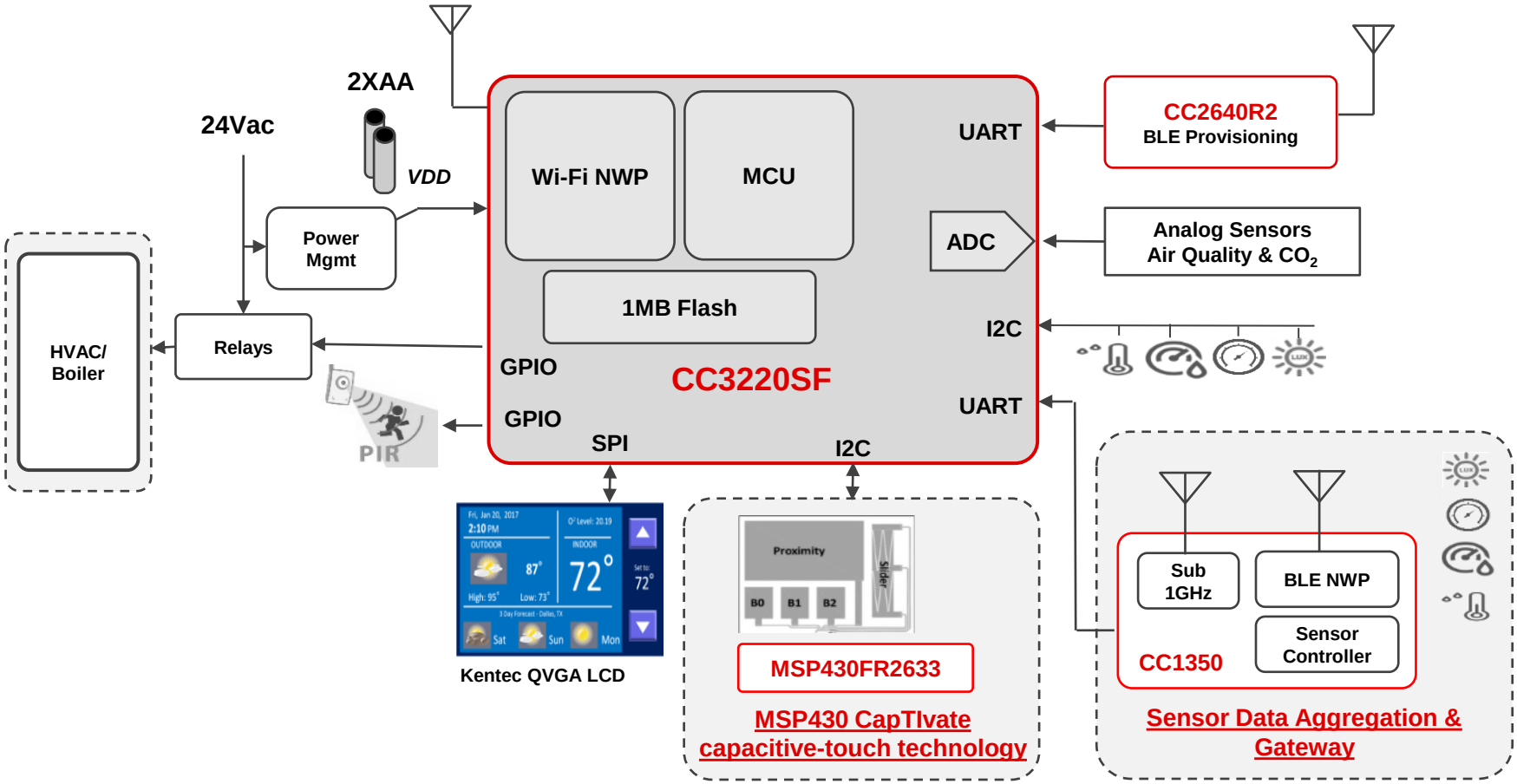
TIME TO MARKET

HVAC thermostat use cases



Thermostat TI Design system block diagram

Problem statement: Creating a **low power**, **connected MCU** based Smart Thermostat that links a variety of sensors, **securely** to the Cloud that enables remote monitoring and control is the goal of most smart thermostat designers



SimpleLink Wi-Fi based smart thermostat design features

Features

Low power optimizations

- Low power consumption reduces load on 24VAC line powered devices
- TI's proprietary Network learning algorithm

Security

- Embedded end to end security enhancements
- Embedded hardware cryptographic engine for fast connections
- End-to-end security enablers: Networking, Wi-Fi & applications level security, secure OTA

Integration

- Dual core connected wireless MCU technology enabling two separate execution environments.
- Support for a variety of Cloud partners
- Supports SimpleLink™ MCU Platform
- Provisioning (AP mode, SmartConfig™, over BLE)
- HMI via Resistive Touchscreen
- Configurable Sensor Update Rate

Benefits

Years of battery life

- Extend to up to **6mos*** with 2xAA (3600mAh) in always connected or can be 24VAC line power
- Tested with >210 access points ensures robust, low power, performance for WW deployments

Users can anticipate and protect against threats on their products

- Enhanced data integrity and confidentiality from the edge node to the cloud
- Assists against theft and hostile takeover of identity, keys, data and code without the need for any other external components

Future proof and expansion of applications

- Dedicated Wi-Fi Certified network processor and dedicated ARM® M4 offering options with 256KB RAM with optional 1MB XIP Flash and a variety of peripherals for sensor connections
- Support for AWS, Azure, HomeKit & IBM Watson
- Common SDK core enable easier platform (BLE, Sub 1GHz and MCU's) expansions

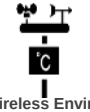
Featured Applications


Thermostat


Boilers/Tank-less Water Heater

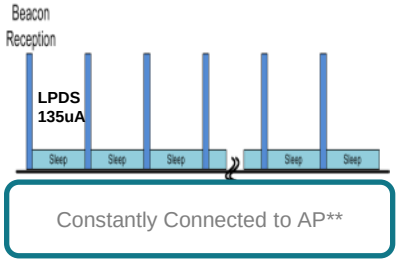
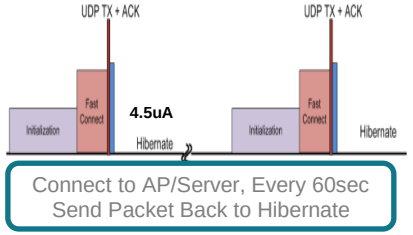
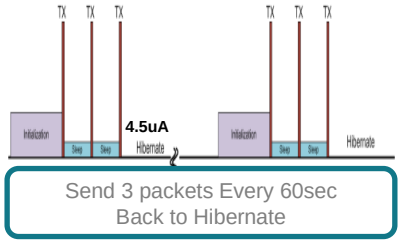

HVAC System Controller

Air quality & Gas detection



Wireless Environ. Sensors/Stations

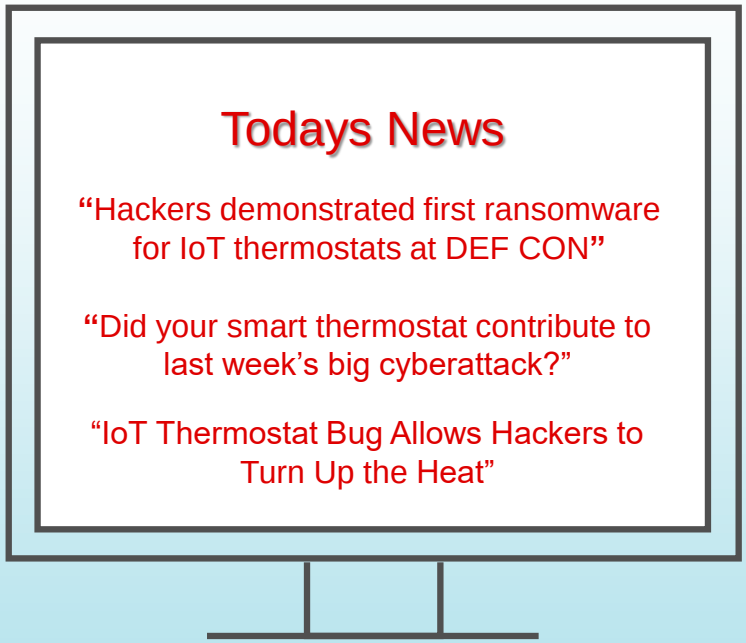
Customized power modes for every use case

Use cases	Low power profiles	Lifetime* batteries with 2AA	Low power features	
Building Automation **Wireless Audio**	**Always Connected**	**1 year**	• **135uA Low Power Deep Sleep (LPDS) mode** while maintaining connection • Proprietary real time Network Learning optimization algorithm	
Security Systems **Smart Energy** **Industrial Control**	**Intermittently Connected**	**Up to 3 years**	• **4.5uA hibernate mode** • Fast secure TLS\SSL connection establishment in <200msec, • DCHP renew feature and more	
Asset Tracking	**Transceiver**	**Up to 5 years**	• **4.5uA - Hibernate mode** • Fast sequence of wake up, transmit and re-hibernate	

Switch between modes in real time

* Estimated, actual life time depends on customer system configurations
** Using TI's proprietary "Long sleep interval" configuration

Smart thermostats security vulnerabilities in the news

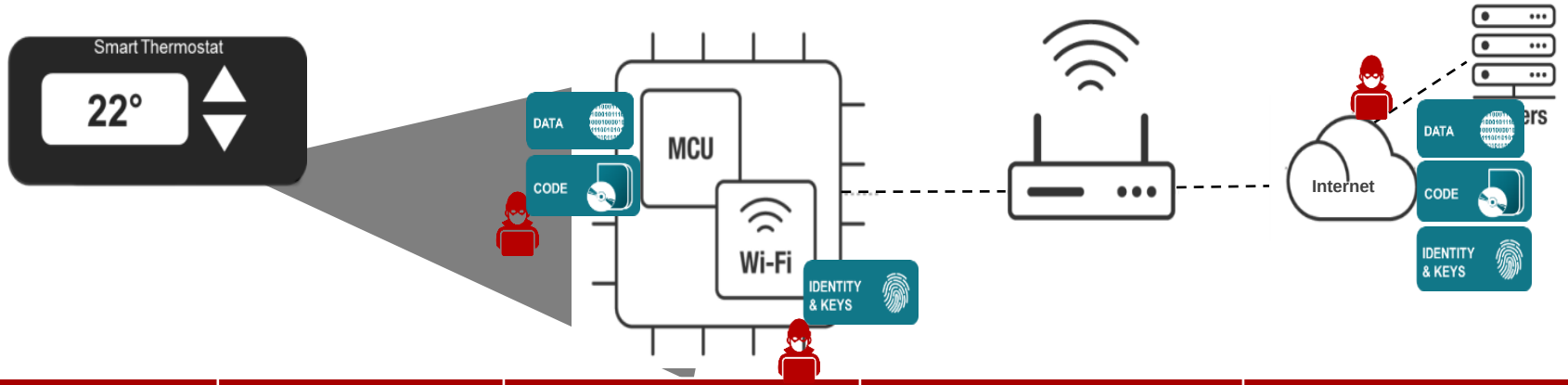


Can someone really hold my thermostat for ransomware?

Can someone detect my presence at home?

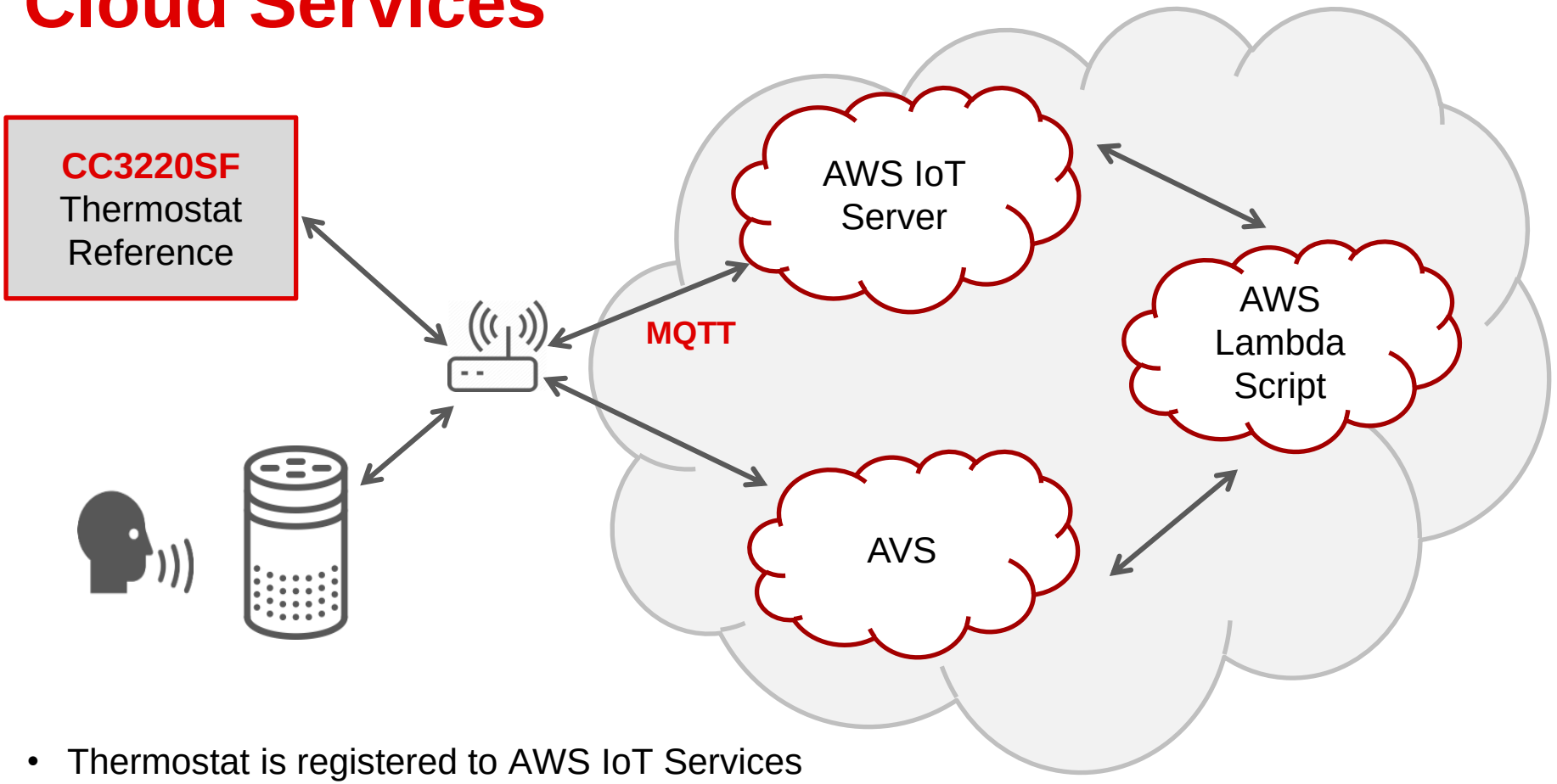
How am I protected against malicious attacks?

Thermostat Security Threats and Security Enablers



	Asset	Threat	Potential countermeasure	Security enablers
Detect if there is anyone home?	*Unauthorized access to sensor data and audio interface*	Hacker uses sensor data and/or audio to spy and understand homeowner patterns	Secure connection to the access point and the cloud	• Cryptographic Accelerators • Secure Boot • Secure Storage • Networking Security
Malicious attack and takeover	Availability of the thermostat to the user	Attack takes over thermostat for monetary payoffs	Secure content delivery, tamper detection, secure network interface	• Initial Secure • Programming • Networking Security • Secure Storage • Secure FW & SW Update
Protect your IP from being cloned	Intellectual property and security infrastructure	Software IP and keys stolen at the factory	1. Protect system against cloning 2. Prevent initial programming image from being read at the factory	• Initial Secure Programming • Software IP Protection • Secure Storage

SimpleLink Thermostat with Amazon Cloud Services



- Thermostat is registered to AWS IoT Services
- The voice commands are interpreted by the AVS service to an actionable commands
- The actionable commands are interpreted by the Lambda script and sent to the thermostat
- Updated thermostat settings are reported back to the cloud

Key takeaways

Adding wireless connectivity to your HVAC system will cut energy consumption costs

- TI SimpleLink™ MCU portfolio can help you get started!

Customers can leverage their design through the wide range of examples and resources to reduce time-to-market

Different low power options enables different power needs based on customer requirements

Built-in security measures on all devices to address security threats

SimpleLink™ HVAC resources

Collateral	Links
SimpleLink designs	• Using SimpleLink for your HVAC application or design • Reference design: Building a Smart Thermostat with Wi-Fi® • Reference design: Connect humidity and temp sensors with Sub-1 GHz
Applications & systems pages	• Thermostat • HVAC Gateway • Wireless Environmental Sensors
Technical content	• Thermostat overview : Enabling smart thermostats with SimpleLink Wi-Fi MCUs • Application Note: Use a sensor controller to significantly control power consumption • White paper: Creating an industrial gateway with SimpleLink Ethernet
Blogs and videos	• Blog: Being smart isn't enough for thermostats • Demo: Capacitive Touch ITO Thermostat with Wi-Fi & Bluetooth • Video: Create an HVAC Zone Controller • Video: Security features in smart thermostats

For more information, go to: ti.com/simplelink

Q & A