BUILDING MULTIPROTOCOL IOT NODES

WITH THREAD, BLE, AND ZIGBEE

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SECURE CONNECTIONS FOR A SMARTER WORLD





Summary

- Benefits of Multiprotocol Systems
- Protocol Standards
- Use Cases
- Platforms and Stacks
- Application Considerations
- Examples



Speaker: Alin Lazar

Software Engineering Manager at NXP Semiconductors

10+ years experience with low power wireless protocols

Shipped ZigBee, Thread, BLE network stacks and tools for microcontrollers

Focus on standardization and certification

Vice Chair of Thread Group Technical Committee





Benefits of Multiprotocol Systems



Benefits of Multiprotocol Systems

Connect++











Expanded, flexible connectivity from the same Device

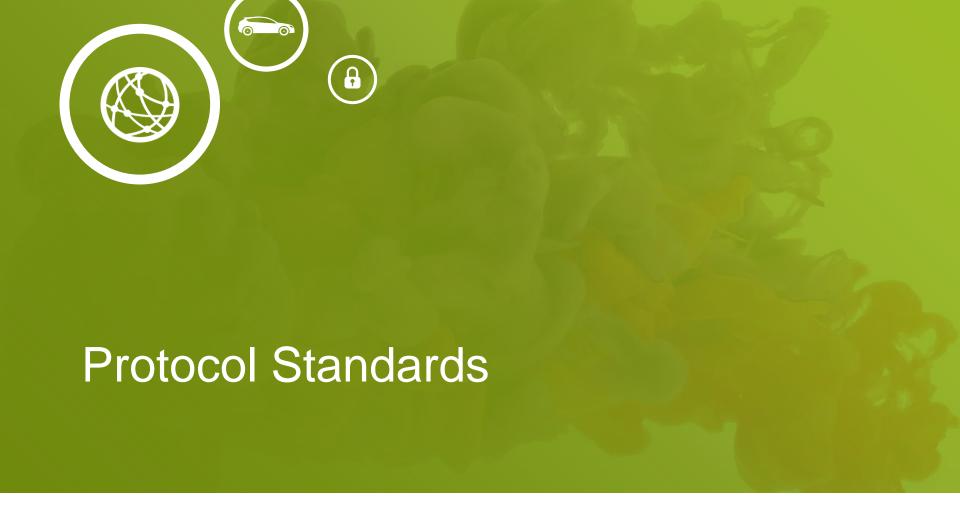
Reduce Design Costs

One SKU, single firmware build

Opens Path to IoT Convergence

Applications can leverage best aspects of multiple standards, reduce lock-in







Wireless Protocol Standards of Focus



Bluetooth LE (4.0+)
Connect to smartphones, PCs
Accessories, Wearables, Beacons

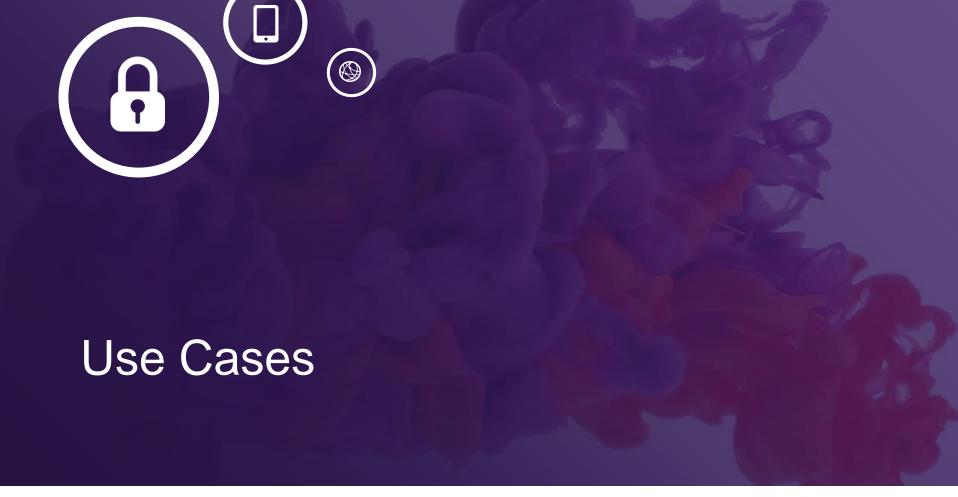


Low power mesh protocol
Connect to smart home hubs
100s of smart home & lighting certified products



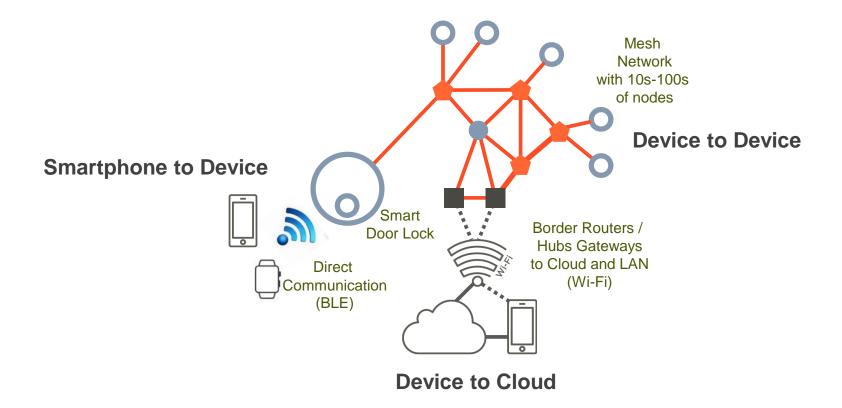
IPv6 network layer scalable to low power IoT
Mesh network without Single Point of Failure
Border Routers: IP network gateways for mobile and cloud



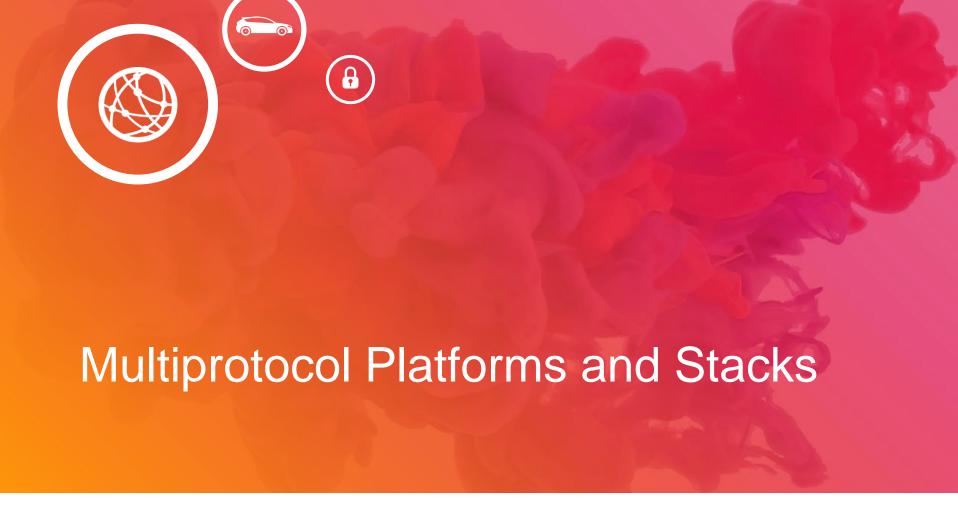




Use Cases for Multiprotocol Edge Nodes



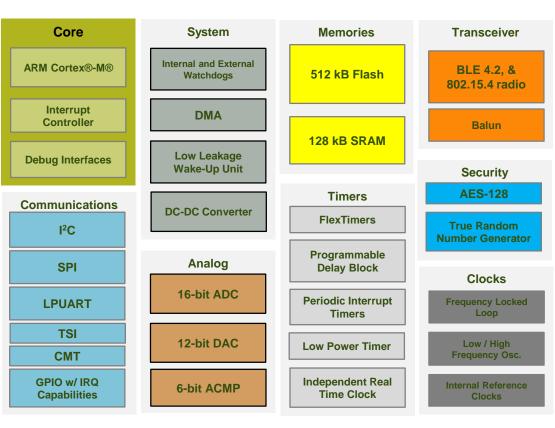






Integrated Microcontrollers with Multimode Radios

- Available from several MCU vendors
- Commonly based on ARM® Cortex®-Mx
- Most common multimode Transceiver configuration: BLE and IEEE 802.15.4
- Various on-chip memory sizes
- Optimized for deep sleep low power
- Integrated security/TRNG acceleration





Multi-Protocol Stacks for IoT Edge Nodes







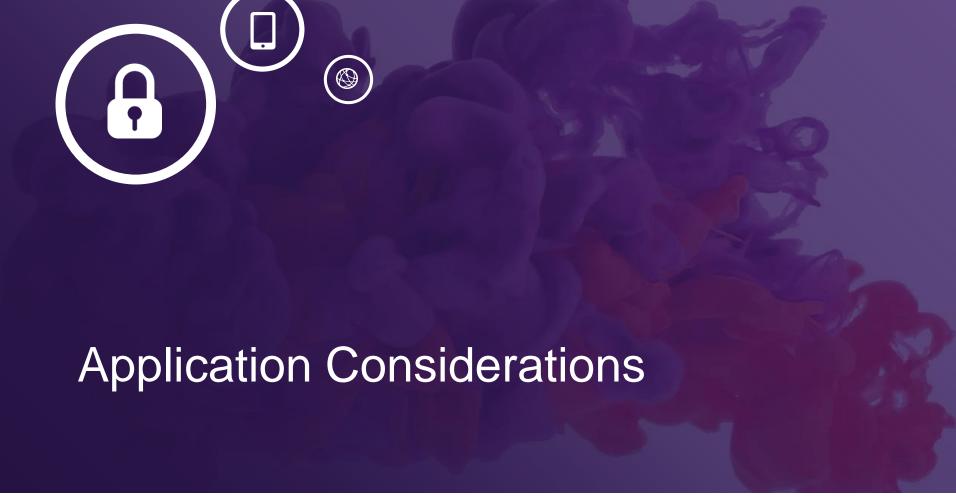






Device Application		
GAP GATT Profiles	ZigBee Clusters Library Framework (e.g.: ZigBee 3.0)	IPv6 App Layer IoT Frameworks (e.g.: based on CoAP)
BLE Host	ZigBee PRO	UDP Sockets
		Thread 1.1 IPv6 Routing 6LoWPAN
BLE Controller	IEEE 802.15.4 MACPHY	
Multimode Transceiver		







Multiprotocol MCU Application Considerations

Firmware System and RTOS

Manage Radio Concurrent Operation and Co-Existence

Sleep modes and wake-up patterns

OTA Updates

Application layer protocol and ecosystem

Security



Concurrent Radio Protocol Operation API

```
typedef enum
    gMWS BLE c,
    gMWS 802 15 4 c,
    gMWS ANT c,
    gMWS GENFSK c,
    gMWS None c
} mwsProtocols t;
                            (mwsProtocols_t protocol, pfMwsCallback cb);
mwsStatus t MWS Register
                            (mwsProtocols t protocol, uint8 t force);
mwsStatus t MWS Acquire
mwsStatus t MWS Release
                            (mwsProtocols t protocol);
mwsStatus t MWS SignalIdle (mwsProtocols t protocol);
mwsStatus t MWS Abort
                            (void);
uint32 t MWS GetInactivityDuration (mwsProtocols t currentProtocol);
mwsProtocols t MWS GetActiveProtocol (void);
```



Radio Co-Existence with MWS API

```
void MWS CoexistenceEnable (void);
void MWS CoexistenceDisable (void);
mwsStatus t MWS CoexistenceInit(void *rfDenyPin, void *rfActivePin, void *rfStatusPin);
mwsStatus t MWS CoexistenceRegister (mwsProtocols t protocol, pfMwsCallback cb);
void MWS CoexistenceSetPriority(mwsRfSeqPriority t rxPrio, mwsRfSeqPriority t txPrio);
mwsStatus t MWS CoexistenceRequestAccess(mwsRfState t newState);
mwsStatus t MWS CoexistenceChangeAccess(mwsRfState t newState);
uint8 t MWS CoexistenceDenyState(void);
void MWS CoexistenceReleaseAccess(void);
typedef uint32 t(*pfMwsCallback) (mwsEvents t event);
typedef enum
    gMWS Init c.
    gMWS Idle c,
    gMWS Active c,
    gMWS Release c,
    gMWS Abort c,
    gMWS GetInactivityDuration c
}mwsEvents t;
```



Multiprotocol IoT Gateways

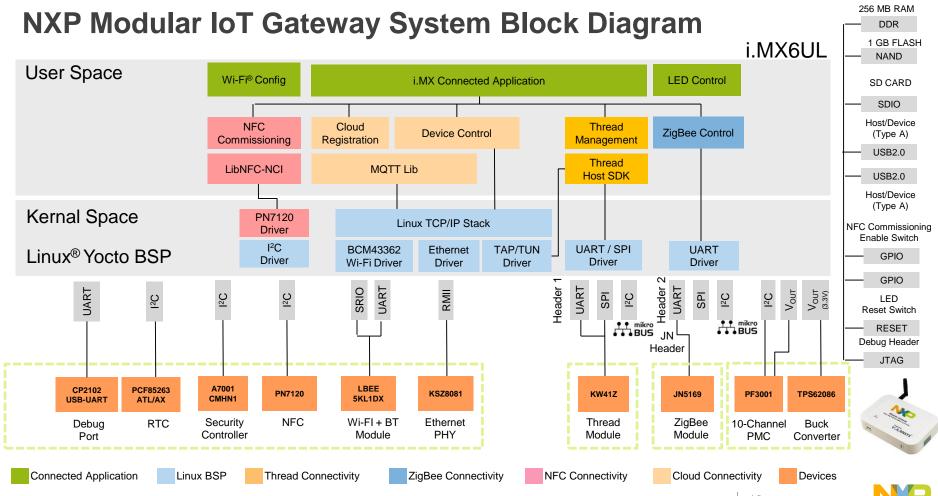


Gateways, Hubs, Border Routers

Gradual Transition from Application Layer Gateway to Network Layer Gateway











What's Next for Multiprotocol IoT



What's Coming Next for Multiprotocol IoT Systems

Even more standards / protocols integrations at the edge:

Wi-Fi

LPWAN

Commercial / Professional use cases

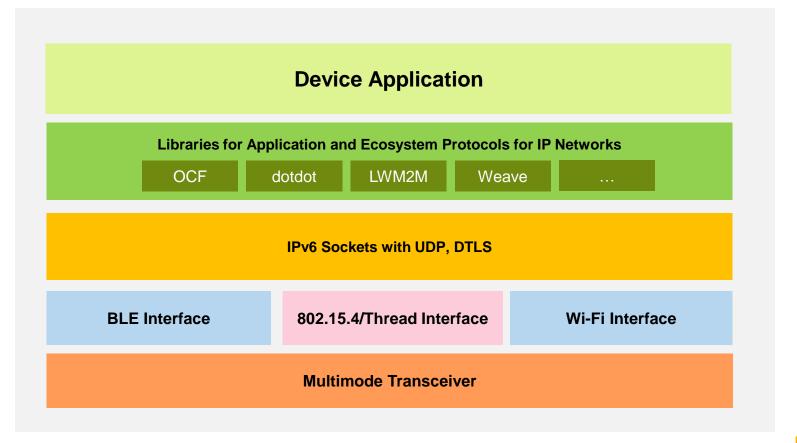
Even more flexible radios

Mesh networks everywhere!

IPv6 (and end-to-end) everywhere!



IP as Network Convergence Layer (Projection)





Your Next Steps

Get some Multiprotocol IoT platforms:

NXP KW41Z

FRDM-KW41Z

USB-KW41Z

Modular Gateway Reference Design







Get platform drivers, firmware SDKs, Linux Host SDKs:

NXP MCUXpresso Config Tools

KW41Z SDK Software and Design Tools

Join and contribute to the standard groups:

Influence standard spec definitions

Achieve quicker, certified interoperability

www.bluetooth.com www.threadgroup.org www.zigbee.org

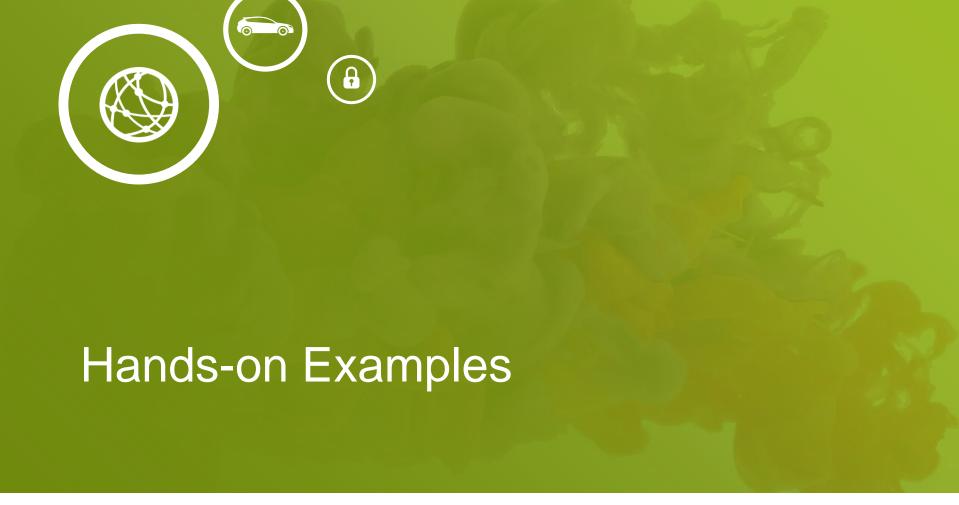
Public events: ZigBee Winter Summit – Monday March 6, Austin, TX

Thread Technology Workshop - Monday March 27, Mountain View, CA

Contribute to OSS (most OSS support is WIP and needs your help):

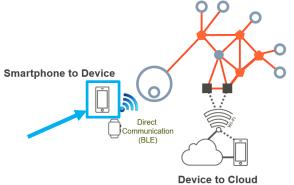
Zephyr, Mynewt, NimBLE, IoTivity, OpenThread







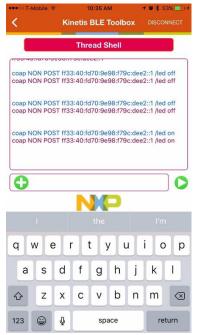
Example 1: Thread Network Shell with Kinetis BLE Toolbox App



Device to Device







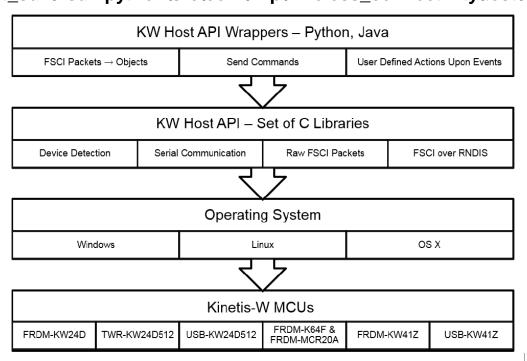




Example 2: Host SDK

Using Python Bindings (multimode.py) for Linux Host scenario

Available as part of KW41Z Connectivity Software Package
tools\wireless\host sdk\hsdk-python\src\com\nxp\wireless connectivity\test\multimode.py





Looking forward to your Questions

alin.lazar at nxp.com https://community.nxp.com/community/wireless-connectivity

