Complete Development Platforms for Secure IoT Systems

NXP IoT & SECURITY SOLUTIONS

JUNE 2017
AGENDA

• IoT System Challenges
• NXP Modular IoT Framework
• NXP Integrated Development Experience
• Walk through our IoT System kit
IoT Systems Challenges Today

Stand alone IoT components do not function as full IoT systems

IoT application prototyping involves connecting multiple components/modules, that don’t always work together

Complex software integration

Substantial effort required to integrate connectivity and security software for each board

Interoperability not guaranteed across individual components

Hardware, Software, Connectivity, Security, Web/Cloud infrastructure must be carefully selected

Pain Points at the System Level
## Complexity of IoT System Development

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<th>EDGE DIRECT TO TOWER</th>
<th>EDGE NODES</th>
<th>CONNECTIVITY</th>
<th>GATEWAY / ROUTING</th>
<th>COMMUNICATIONS TO THE CLOUD</th>
<th>CLOUD PLATFORMS</th>
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- **Integration / Interfaces / Glue**

### SOFTWARE SERVICES

- **MCU OS and BSP:** FreeRTOS, mbed OS, Zephyr OS
- **MPU OS and BSP:** Linux, OpenWRT, Android Things, Windows10
- **Generic System:** Security, Over-the-Air-Programming (OTAP), OOBE Configuration
- **Application Layer Support:** BT Profiles, CoAP, Fairhair, IoTX, MQTT, OCF, OpenAIS, Weave, ZCLIP, ZigBee 3.0
- **NFC Commissioning:** Tap and Connect, BLE Commissioning, Intrepid Smart App Commissioning
- **Application HMI:** Computer GUI interface, iOS/Android Phone App, Voice Control

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Fragmented market with thousands of use case combinations
IoT System Functionality Requirements

1. **Easily pair** Edge Nodes, Gateway & Cloud through secure commissioning

2. Exchange data between Edge Nodes and Gateway via secured connectivity

3. Exchange data between Gateway and Cloud with secure protocols

4. Monitor and Control Edge Nodes via Cloud using Application HMI
Introducing the NXP Modular IoT Framework

• Provides a selection of secure connectivity capabilities along with IoT edge services and a defined set of interfaces for building IoT Systems.

• Hardware and software components leverage the Framework to ensure system level compatibility and interoperability.

• Enables efficient development of IoT systems with pre-integrated security, wireless connectivity, and cloud services.
Modular IoT Framework: *Integrated Development Experience Kits*

Based on the Modular IoT Framework, NXP provides optimized, Integrated Development Experience (IDEx) Kits to accelerate system development for specific IoT use cases, out-of-the-box.

- Each kit is pre-integrated, comprehensive and fully documented

- Optimized for quick evaluation, rapid prototyping, demonstration, iteration and IoT field trial deployments

- Kits include production-ready connectivity software and hardware
  - Decreases amount of work and lowers risk for development teams
  - Fills skill gaps in wireless mesh connectivity and security

- Cloud reference design examples with source code

ALL IDEx Kit components are TESTED and VERIFIED to work together
Modular IoT Framework: **Hardware Platforms**

Rich selection of hardware platforms that enable faster development of IoT Systems
Modular IoT Framework: **Software Architecture**

- **Cloud Services**
  - Real-Time Data Management
  - Device Management
  - Analytics

**NXP Modular IoT Gateway**
- Security
  - Fog Application
  - Gateway Framework
  - Protocol Stacks
  - Device Drivers
  - Operating System
- Management

**NXP Modular Edge-node**
- Security
  - Protocol Stacks
  - Device Drivers
  - Operating System
- Management

Complete Security, Connectivity, Management, Cloud and Application Software with compatibility and interoperability between IoT Gateway and Edge-nodes
Integrated Development Experience (IDEx) for General Purpose IoT Systems

- Includes Pre-Configured Modular IoT Gateway and Modular Edge Node Platform

**Modular IoT Gateway**
- Modular IoT Gateway Base board
- i.MX6UL SOM
- Wi-Fi/BT/BLE 4.1
- Thread/BLE Radio
- ZigBee Radio
- NFC Reader
- A7x Secure Element

**Modular Edge Node Platform (MENP)**
- Simple Edge Node Base board
- ZigBee Radio
- Thread/BLE Radio
- NFC Tag
- RGB Click Module

- Includes Connectivity and Security Software

**Modular IoT Gateway**
- Linux OS and component drivers (BSP)
- Connectivity and Cloud Protocols
- NFC Connectivity and Cloud commissioning
- Secure Over-The-Air Programming
- Application software

**Modular Edge Node Platform (MENP)**
- FreeRTOS with SDK peripheral drivers
- Connectivity Stacks (ZigBee, Thread)
- NFC Connectivity commissioning

Shipping TODAY as NXP Part-Number: SLN-IOT-GPI
Modular IoT Gateway: Overview

Hardware Modules

Radio Modules
- KW2xD Thread
- KW41Z Thread
- JN5169 Zigbee
- JN5179-001-M1x Zigbee

Processor Module
- i.MX6UL SOM

NFC Module
- PN7120

PN7120 Explorer Board (NFC)

Ethernet / 2*USB ports / Wifi SMA antenna
USB debug / uSD card slot / 5VDC-3A

Wifi module

i.MX6UL SOM on App specific base board

Kinetis KW41Z Module on Mezzanine (Thread)

JN5169 Module on Mezzanine (ZigBee)
Modular IoT Gateway: Summary

Fastest Time to Market
Modular solution reduces development time for Thread and ZigBee Gateway/Border Router applications

Path to Manufacturing
BOM, design files and software source code limit risks with wireless connectivity

Optimized Hardware Design
Includes best practices for IoT Gateway application design

Robust Software
Includes everything from embedded drivers to cloud connectivity - optimized and easy to use

NXP Hardware, Software & Services
Drivers, protocol stacks, Linux BSP support

Target Segments/Applications
• Commercial Building/Lighting
• Smart Home
• Low Power WAN

Key Features
Performance: ARM Cortex®-A7 @ 696MHz
Local Connectivity in Large Networks 255+ nodes: ZigBee, Thread
Cloud Connectivity: Wi-Fi and Ethernet
Authentication: Secure Element
Set up: NFC Commissioning w/Smart App
Update: Over the Air Programming via Multicast
Certifications: FCC/CE/IC

Design Resources
Design files: Schematic, Layout, Bill of Material
Application program (Image + Source code)
Android Application (App + Source code)
Professional Support and Services

Software Enablement
(Open source and free)
UBOOT, Linux BSP
Board Component Drivers
Protocol Stack
Modular IoT Gateway: *Hardware Block Diagram*

- **Microprocessor**: ARM® Cortex®-A7 up to 500MHz
- **RAM DDR3L**: 4Gb/512MB
- **Flash NAND**: up to 8Gb/1GB
- **Power Management IC**
- **Ethernet PHY**: 10/100Mbps
- **USB 1.1 Port**
- **802.11/b/g/n WIFI & BLE 4.1 Module Radio**
- **ZigBee Module Radio**
- **NFC Reader Module Identification**
- **Authentication IC Security**
- **Ethernet Port**
- **ETH**
- **USB**
- **SD-Card**
- **uSD Card Slot**
- **Ethernet PHY 10/100Mbps**
- **ATL/AX Real Time Clock IC Clock**
- **Serial to USB**
- **JTAG**
- **USB Interface**
- **SMA Antenna Port**

**Board to Board Connector**

**Base Board**
Modular IoT Gateway: Software Architecture

- **Security**
  - App/Cloud
    - App Security
    - OTA Update
    - Cloud Platform
  - Connectivity
    - TLS
    - DTLS
    - NFC
    - WIFI
    - Zigbee
    - Thread
  - Device
    - Crypto
    - Key Mgmt
    - Secure Boot

- **Fog Application**
  - SW Download Manager
  - Fog Analytics
  - Local Fog Manager

- **Modular IoT Gateway Framework**
  - Zigbee Config
  - Thread Config
  - NFC Commissioning
  - Cloud Integration
  - SW Update
  - WIFI Config

- **Protocole Stacks**
  - MQTT
  - CoAP
  - TCP
  - UDP
  - DHCP
  - ARP
  - IPv4
  - IPv6

- **Device Drivers**
  - WIFI
  - ETHERNET
  - USB
  - SDIO
  - UART
  - SPI
  - I2C
  - GPIO

- **Linux Yocto BSP**

- **Management**
  - Cloud Management
  - Key Management
  - BLE Control
  - WIFI Control
  - Zigbee Control
  - Thread Control
  - OTA
Modular Edge Node Platform and Modules: Overview

- Add-on Module Socket
- Power Supply
- Programming and Debug
- Radio Module Socket
- NTAG Connector

Hardware Modules

- Radio Modules
  - KW2xD Thread
  - KW41Z Thread
  - JN5169 ZigBee
  - JN5179-001-M1x ZigBee

- Sensor/Actuator Add-on Modules

NXP
Modular Edge Node Platform: Summary

Fastest Time to Market
Modular solution reduces development time for Thread and ZigBee Edge Node applications

Path to Manufacturing
BOM, design files, software source code – all accessible to limit risks wireless connectivity

Optimized Hardware Design
Optimized hardware design with best practices for designing Edge Node IoT applications

Robust Software
Includes everything from embedded drivers to connectivity stacks - all optimized & easy to use

NXP Hardware, Software, Services
Includes drivers, connectivity stacks & support

Target Segments / Applications
- Home Automation
- Healthcare / Wellness
- Utilities and Energy

Key Features:
Performance: Wireless System On Chip (MCU with memory and radio)
Local Connectivity for Large Networks over 255 nodes: Zigbee, Thread
Setup: NFC Tag for Commissioning
Update: Over the Air Programming via SPI Flash
Power: 5V USB and DC input
Extension: compatible with 200+ Click™ modules

Design Resources
Design files: Schematic, Layout, Bill of Material
Application program (Image and Source code)
Professional Support and Services

Software Enablement
(Open-source and free)
Kinetis Design Studio
Kinetis SDK
FreeRTOS
Protocol Stack
Modular Edge Node: *Hardware Block Diagram*

- **4x4 RGB Click**
- **RADIO module**
  - KW2xD Thread module RADIO
  - KW41Z Thread module RADIO
  - JN5169 ZigBee module RADIO
  - JN5179 ZigBee module RADIO
- **Click module**
- **Add-on Module Socket**
- **Terminal connector**
- **OMRON G6D relay**
- **OMRON G6D relay**
- **Terminal connector**
- **MCP1826 regulator**
- **4x4 RGB Click**
- **Radio Module Socket**
- **SPI, I²C, UART, ADC, PWM, GPIO**
Modular Edge Node: Software Architecture

NXP Modular Edge-node

Security
- DTLs
- SHA
- AES

Thread End-node Application
- OTA
- Registration
- Console
- Border Router
- LED

Middleware / Protocol Stacks
- MAC
- CoAP
- IPv4
- IPv6
- DHCP
- TCP
- UDP
- 6LowPAN

Device Drivers
- ADC
- TIMER
- RTC
- GPIO
- UART
- SPI
- I2C
- DMA

FreeRTOS BSP

Management
- Radio
- Power
- Memory
- Serial
- Timer
- OTA
IoT Framework Radio: *Kinetis KW41Z Module*

Key Features

- 32-bit **ARM Cortex®-M0+** MCU core @ 48MHz
- 512KB Flash and 128KB SRAM memory
- SPI Flash to support **Over-The-Air Programming** (OTAP)
- AES 128 hardware accelerator
- **Thread** and **Bluetooth** Network Stack
- **Integrated chip antenna** and uFL antenna connector
- Easy integration to reduce time to market
- Industry standard **SWD programming** and debug connectivity
- Pads are side castellation for easy soldering & optical inspection
- RoHS Compliant
- **FCC and CE certification**
- **MikroBUS™ compatible** connector
- Ultra compact size: **21 x 16 mm**
IoT Framework Radio: JN5169 Modules

Key Features

JN5169 Modules are Hardware compatible with JN5168 Modules

All modules include JN5169 chip plus support components

✓ Surface mountable on motherboards

Standard power modules

✓ JN5169-001-M00-2: Medium power module (16 x 30mm)
  ❖ Printed antenna
  ❖ +10dBm

✓ JN5169-001-M03-2: Medium power module (16 x 21mm)
  ❖ uFL antenna connector
  ❖ +10dBm

✓ JN5169-001-M06-2: High power module (16 x 30mm)
  ❖ uFL antenna connector
  ❖ +22dBm

Module value proposition

✓ Fast time to market
✓ Reduced support burden
✓ Meets FCC and EU regulations
✓ No need for RF design resource for board and test design
Tap and Connect with Modular Edge Node Platform (MENP) using NFC commissioning

1. **Edge Node**
   - CoAP protocol

2. **Gateway**
   - Exchange data via MENP ZigBee/Thread connectivity

3. **Cloud**
   - Communicate data with secure Cloud protocols via MQTT

4. **Mobile App**
   - Monitor and Control ZigBee/Thread Edge Nodes via Cloud with mobile application

**Web Services**
- Running MQTT Broker

**NXP Part-Number:** SLN-IOT-GPI

**IDEx for General Purpose IoT Systems: Functional Specifications**
IDEx for General Purpose IoT System Use Case: *Lighting Control*

Voice Recognition

Internet Connectivity through Router/AP

Mobile App

Web Services

Cloud IoT

HTTP/Rest API

Web Services

Cloud EC2

WiFi/4G

MQTT

WiFi/Ethernet

Gateway

Thread/ZigBee

LoRA

Edge Node

8x8 Animated Thread/ZigBee Edge Node Lighting Grid

EC2

32* Thread

32* ZigBee

IDEx for General Purpose IoT System Use Case: *Lighting Control*
The widespread adoption of the Internet of Things will take time, but the timeline is advancing thanks to improvements in underlying technologies. - McKinsey & Company

NXP’s Modular IoT Framework & IoT Use Case Specific IDEx Kits:

- Reduce the complexity of building IoT Systems with an optimized platform for quick evaluation, rapid prototyping, demonstration, iteration and IoT field trial deployments.

- Eliminate the need for in-house expertise with built-in wireless connectivity and security capabilities.

- Complete, use case specific, out-of-the-box IoT solution, significantly reduces development time up to 12 months.

All you need to get your IoT system to market faster!
SECURE CONNECTIONS FOR A SMARTER WORLD

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