通过恩智浦ZIGBEE3.0 MCU实现IOT产品的快速开发

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SECURE CONNECTIONS
FOR A SMARTER WORLD

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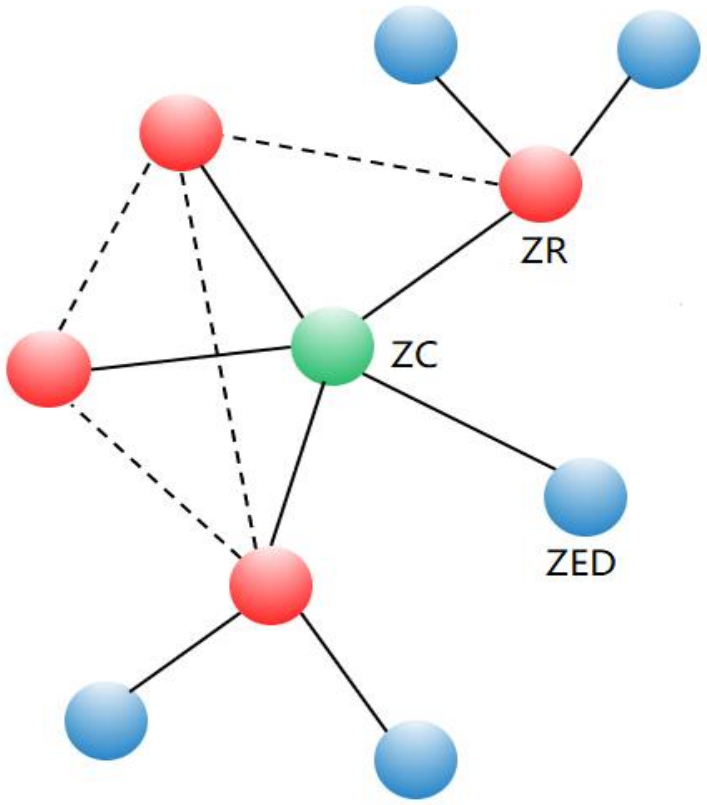
ZIGBEE 3.0在IOT设备互联通信中的优势

ZigBee简介

- 基于IEEE 802.15.4的低功耗短距无线通信

- 设备类型：
  - 协调器Coordinator（ZC）：网关功能，通常只有１个
  - 路有Router（ ZR）：路由功能，如灯等常电设备
  - 终端EndDevice（ZED）：可休眠的低功耗设备，如各种电池供电的传感器



- ***亮点: Mesh网络***
  - 自组织，自愈
  - 通过路由，可使网络节点规模达到200

Zigbee3.0的特点

统一了以前的各种应用（Profile）

- ZHA
- ZLL

引入了BDB（Base Device Behaviour）的概念

- Network Formation
- Network Steering
- Finding and Binding
- Touch link

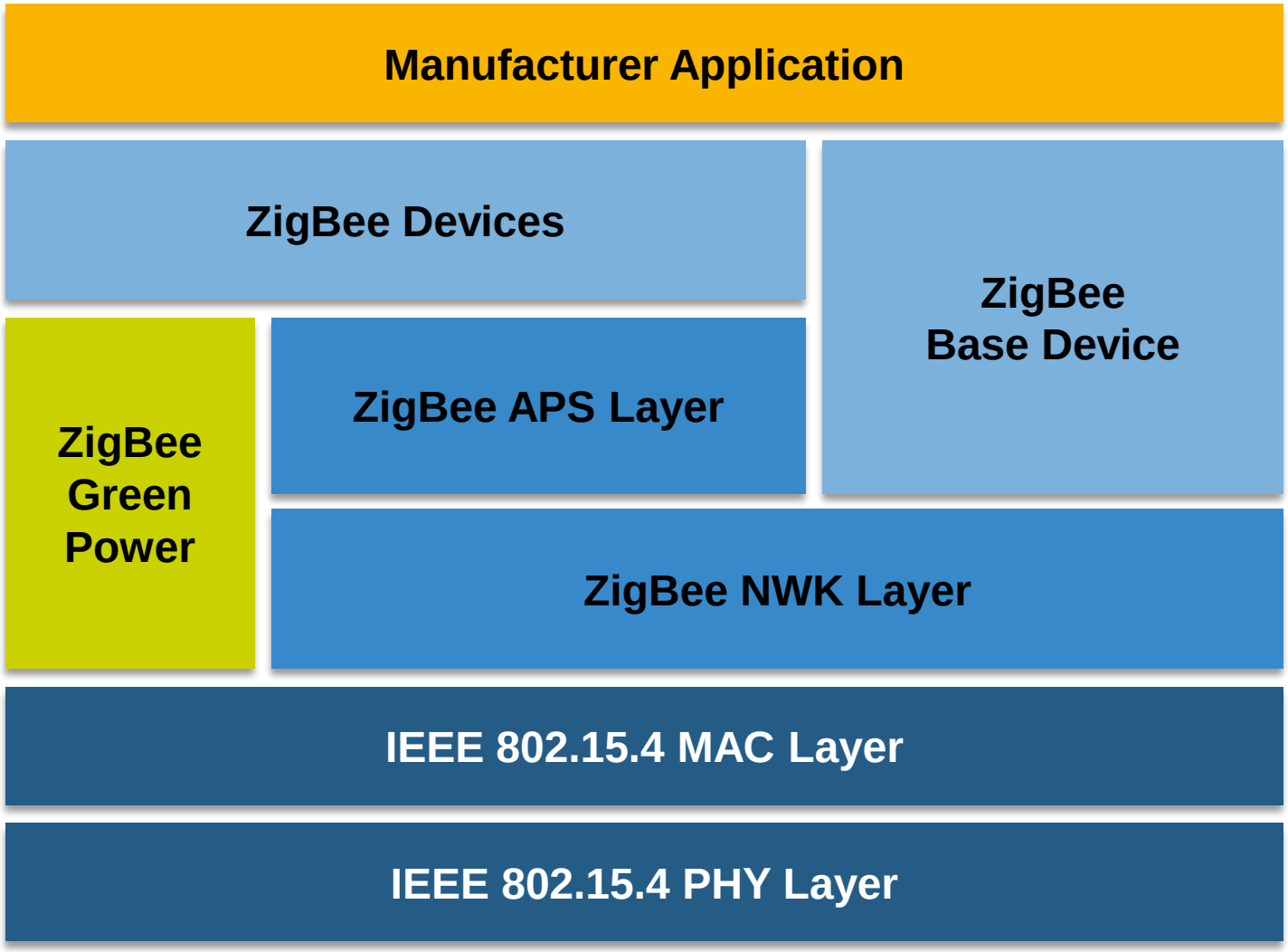
加强了安全性

- Installation Codes

支持Green Power超低功耗应用

ZigBee® 3.0
Better Together

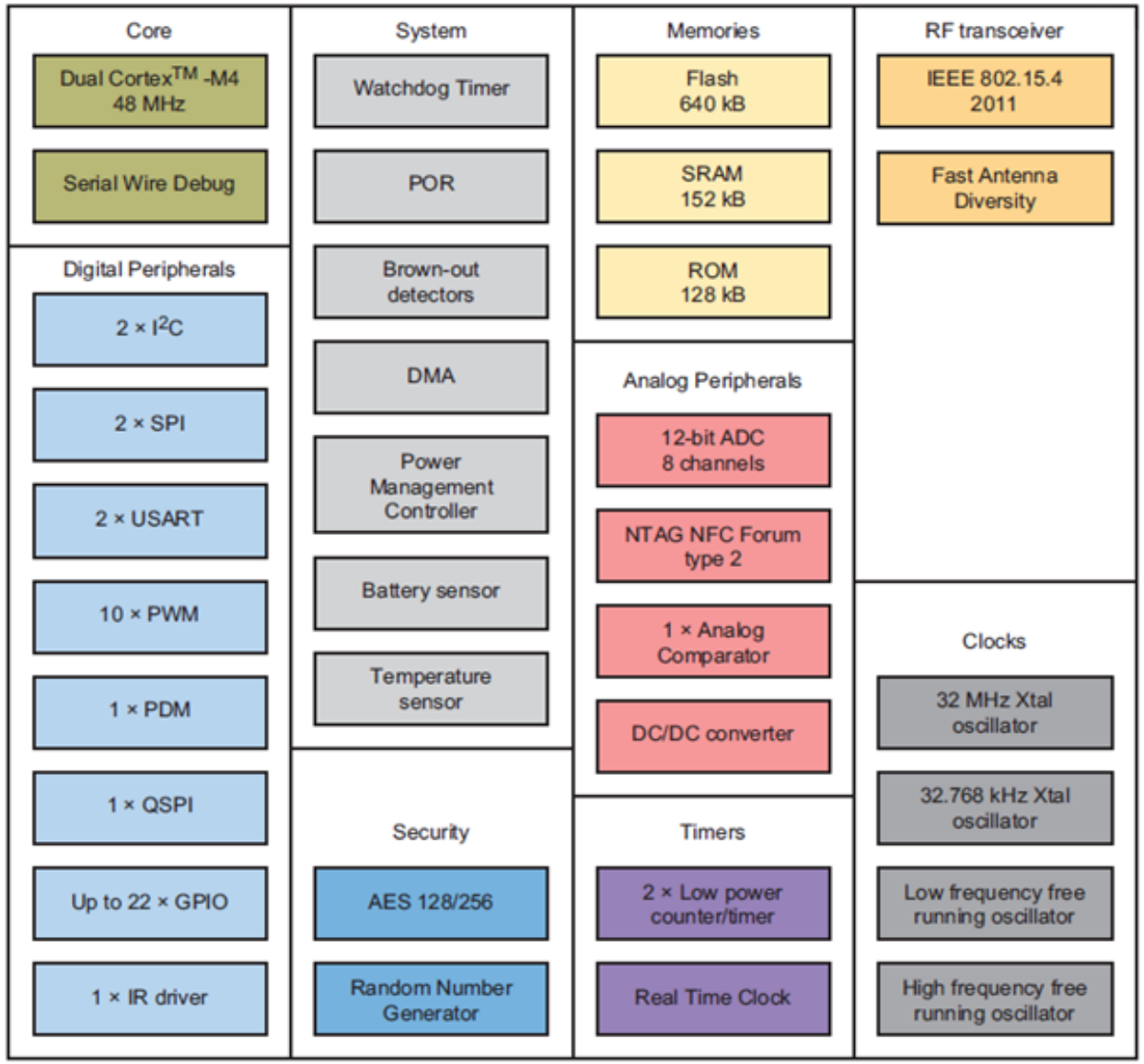
ZigBee3.0协议栈



恩智浦最新ZIGBEE 3.0 MCU JN5189特性解读

JN5189参数

- Cortex-M4核，48M主频，
- 152KB RAM，640KB FLASH
- Tx最大输出：10dBm
- Rx灵敏度：-100dBm
- RF发送电流：
  - 7.4mA@0dBm
  - 20.3mA@10dBm
- RF接收电流：4.3mA
- 内置NTAG
- 温度：-40 ~ 125
- 面积：6mmx6mm
- 引脚：40
  - 22个PIO



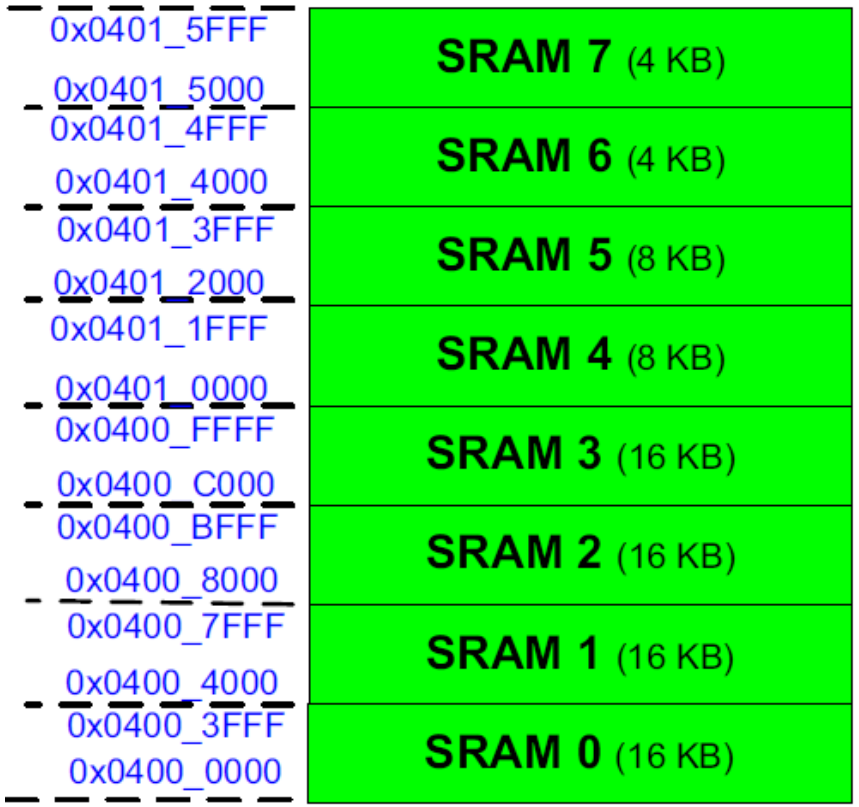
JN5189灵活的引脚配置

- 2路UART/SPI/I2C，8通道12bit ADC，10路PWM，内置NTAG等

I/O Names	FUNC0	FUNC1	FUNC2	FUNC3	FUNC4	FUNC5	FUNC6	FUNC7	Default at reset / during boot	Default internal pull-up / pull-down	ISP mode
PIO0_0	GPIO 0	USART0_SCK	USART1_TXD	GPIOSEC 0	PWM0-PU	SPI1_SCK	PTA0	PDM0_DATA	GPIO0 (I)	pull-up	
PIO0_1	GPIO 1	FLICKER_CTRL	USART1_RXD	GPIOSEC 1	PWM1-PD	SPI1_MISO	PTA1	PDM0_CLK	GPIO1 (I)	pull-down	
PIO0_2	GPIO 2	SPI0_SCK	USART0_RXD	GPIOSEC 2	PWM2-PD	SPI1_MOSI	ISO7816_RST	MCLK	GPIO2 (I)	pull-down	
PIO0_3	GPIO 3	SPI0_MISO	USART0_TXD	GPIOSEC 3	PWM3-PU	SPI1_SSELN0	ISO7816_CLK	PTA2	GPIO3 (I)	pull-up	
PIO0_4	GPIO 4	SPI0_MOSI	USART0_CTS	GPIOSEC 4	PWM4-PU	SPI1_SSELN1	ISO7816_IO	RFTX	GPIO4 (I)	pull-up	
PIO0_5	GPIO 5	SPI0_SSELN	USART0_RTS	GPIOSEC 5	SPI1_MISO	SPI1_SSELN2	PTA3	RFRX	GPIO5 (I)	pull-up	ISP_ENTRY
PIO0_6	GPIO 6	SPI0_SCK	USART0_RTS	CT32B1_MAT0	PWM6-PD	I2C1_SCL	USART1_TXD	ADE	GPIO6 (I)	pull-down	
PIO0_7	GPIO 7	SPI0_MISO	USART0_CTS	CT32B1_MAT1	PWM7-PD	I2C1_SDA	USART1_RXD	ADO	GPIO7 (I)	pull-down	
PIO0_8	GPIO 8	SPI0_MOSI	USART0_TXD	CT32B0_MAT0	PWM8-PU	ANA_COMP_OUT	RFTX	PDM1_DATA	USART0_TXD	pull-up	UART_ISP
PIO0_9	GPIO 9	SPI0_SSELN	USART0_RXD	CT32B1_CAP1	PWM9-PU	USART1_SCK	ADO	PDM1_CLK	USART0_RXD	pull-up	UART_ISP
PIO0_10	GPIO 10	CT32B0_CAP0	USART1_TXD	GPIOSEC 10	RFTX	I2C0_SCL	SPI0_SCK	PDM0_DATA	GPIO10 (I)	external pull-up	
PIO0_11	GPIO 11	CT32B1_CAP0	USART1_RXD	GPIOSEC 11	RFRX	I2C0_SDA	SPI0_MISO	PDM0_CLK	GPIO11 (I)	external pull-up	
PIO0_12	GPIO 12	IR_BLASTER	SWCLK	GPIOSEC 12	PWM0-PU	I2C1_SCL	SPI0_MOSI	ANA_COMP_OUT	SWCLK	pull-up	
PIO0_13	GPIO 13	SPI1_SSELN2	SWDIO	GPIOSEC 13	PWM2-PU	I2C1_SDA	SPI0_SSELN	FLICKER_CTRL	SWDIO	pull-up	
PIO0_14/ADC	GPIO 14	SPI1_SSELN1	USART0_SCK	CT32B0_CAP1	PWM1-PU	SWO	MCLK	RFTX	GPIO14 (I)	pull-up	
PIO0_15/ADC	GPIO 15	SPI1_SCK	ANA_COMP_OUT	FLICKER_CTRL	PWM3-PU	I2C0_SCL	PDM1_DATA	RFRX	GPIO15 (I)	pull-up	
PIO0_16/ADC	GPIO 16	SPI1_SSELN0	ISO7816_RST	GPIOSEC 16	PWM5-PU	I2C0_SDA	PDM1_CLK	SPIFI_CSN	GPIO16 (I)	pull-up	
PIO0_17/ADC	GPIO 17	SPI1_MOSI	ISO7816_CLK	SWO	PWM6-PD	CLK_OUT	PTA0	SPIFI_IO3	GPIO17 (I)	pull-down	
PIO0_18/ADC	GPIO 18	SPI1_MISO	ISO7816_IO	CT32B0_MAT1	PWM7-PD	USART0_TXD	PTA1	SPIFI_CLK	GPIO18 (I)	pull-down	
PIO0_19/ADC	GPIO 19	ADO	USART1_RXD	CLK_IN	PWM4-PD	USART0_RXD	PTA2	SPIFI_IO0	GPIO19 (I)	pull down	
PIO0_20/ACM	GPIO 20	IR_BLASTER	USART1_TXD	GPIOSEC 20	PWM8-PD	RFTX	PTA3	SPIFI_IO2	GPIO20 (I)	pull-down	
PIO0_21/ACP	GPIO 21	IR_BLASTER	USART1_SCK	FLICKER_CTRL	PWM9-PU	RFRX	SWO	SPIFI_IO1	GPIO21 (I)	pull-up	

JN5189的低功耗实现

- 休眠期保存(Retention)的RAM由小到大放置（Block7…6…0)
- 休眠期可放弃(Discard)的RAM由大到小放置（Block0…1…7)
- 休眠期电流
- 4K　RAM Retention： 1.2uA
- 16K RAM Retention： 1.8uA
- 32K RAM Retention： 2.6uA



- 附注:
- 休眠时芯片内部32K时钟仍在运行，可定时
- 唤醒设备而无需ColdStart的HW初始化步骤

JN5189的推荐应用

- 智能家居/智能照明/智能楼宇/工业物联网的网关及各类智能控制器
- 尤其适用于各类低功耗应用
  - 电池供电的各类传感器及Green Power设备
  - 机械能取电（Energy Harvesting）设备

Smoke Sensor

Motion Sensor

Door Lock

On-Off Switch

JN5189平台兼容性认证

芯片已通过Zigbee联盟的兼容性平台(Compliant Platform)认证

https://zigbeealliance.org/zigbee_products/nxp-jn518x-zbpro-r22-gp-proxy-basic/

https://zigbeealliance.org/zigbee_products/nxp-jn518x-zbpro-r22/

NXP JN518x ZBPro R22 + GP Proxy Basic

By NXP Semiconductors Netherlands B.V.

The JN518x is an ultra-low power, high performance wireless microcontroller supporting Zigbee 3.0, Thread, Zigbee PRO networking stacks to facilitate the development of Home Automation, Light Link and Remote Control applications. The device also supports Bluetooth.
The JN518x embeds an ARM Cortex-M4 to run the customer application code and the connectivity stacks. The product has 640 kB embedded Flash, 152 kB RAM and 128 kB ROM memory. The embedded flash can support Over The Air (OTA) code download of SW stacks. The JN518x includes a 2.4 GHz IEEE802.15.4 and Bluetooth Low Energy compliant transceiver and a comprehensive mix of analog and digital peripherals. Ultra-low current consumption in both radio receive and transmit modes allow use of coin cell batteries.

visit NXP Semiconductors Netherlands B.V. website.

NXP JN518x ZBPro R22

By NXP Semiconductors Netherlands B.V.

The JN518x is an ultra-low power, high performance wireless microcontroller supporting Zigbee 3.0, Thread, Zigbee PRO networking stacks to facilitate the development of Home Automation, Light Link and Remote Control applications. The device also supports Bluetooth.
The JN518x embeds an ARM Cortex-M4 to run the customer application code and the connectivity stacks. The product has 640 kB embedded Flash, 152 kB RAM and 128 kB ROM memory. The embedded flash can support Over The Air (OTA) code download of SW stacks. The JN518x includes a 2.4 GHz IEEE802.15.4 and Bluetooth Low Energy compliant transceiver and a comprehensive mix of analog and digital peripherals. Ultra-low current consumption in both radio receive and transmit modes allow use of coin cell batteries.

visit NXP Semiconductors Netherlands B.V. website.

基于JN5189快速实现IOT产品的开发

JN5189 DK6开发套件

- ZC ：Control Bridge (带NFC Reader)
- ZR ：灯 (亮度可调LED及RGB三色灯)
- ZED: 按键开关及传感器 (照度/温度)
- USB Dongle

JN5189的软件开发工具包SDK

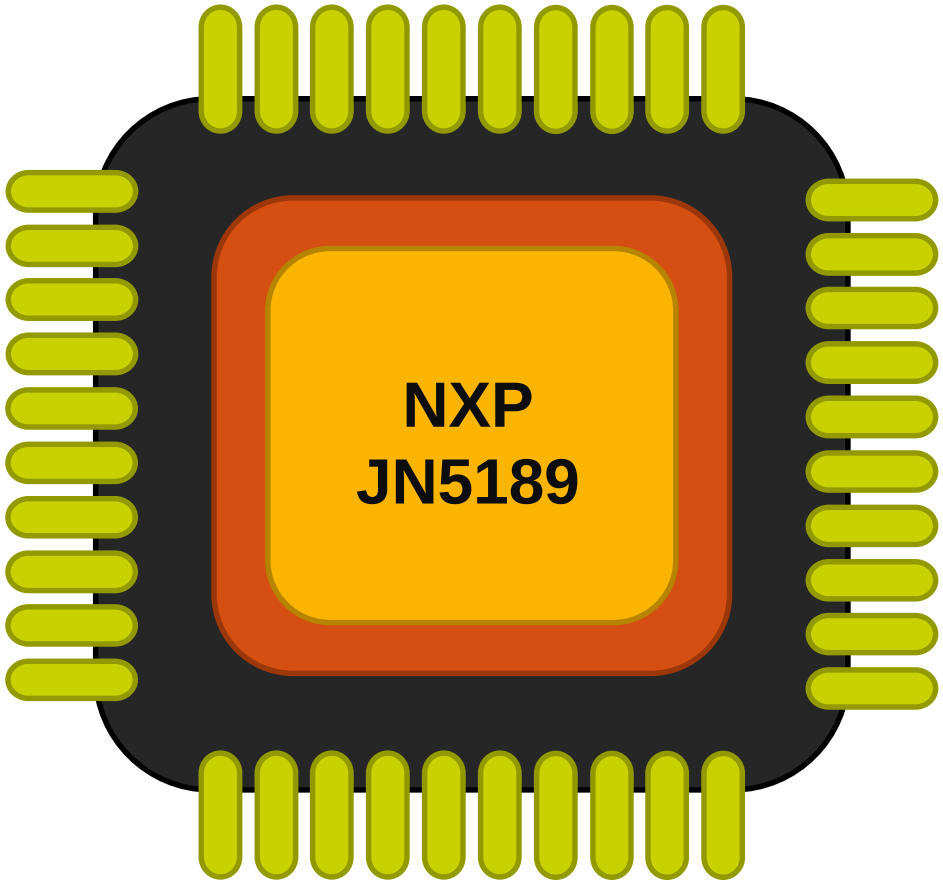
IDE：MCUExpresso_v11.1.0_3209

交叉编译工具链：GCC

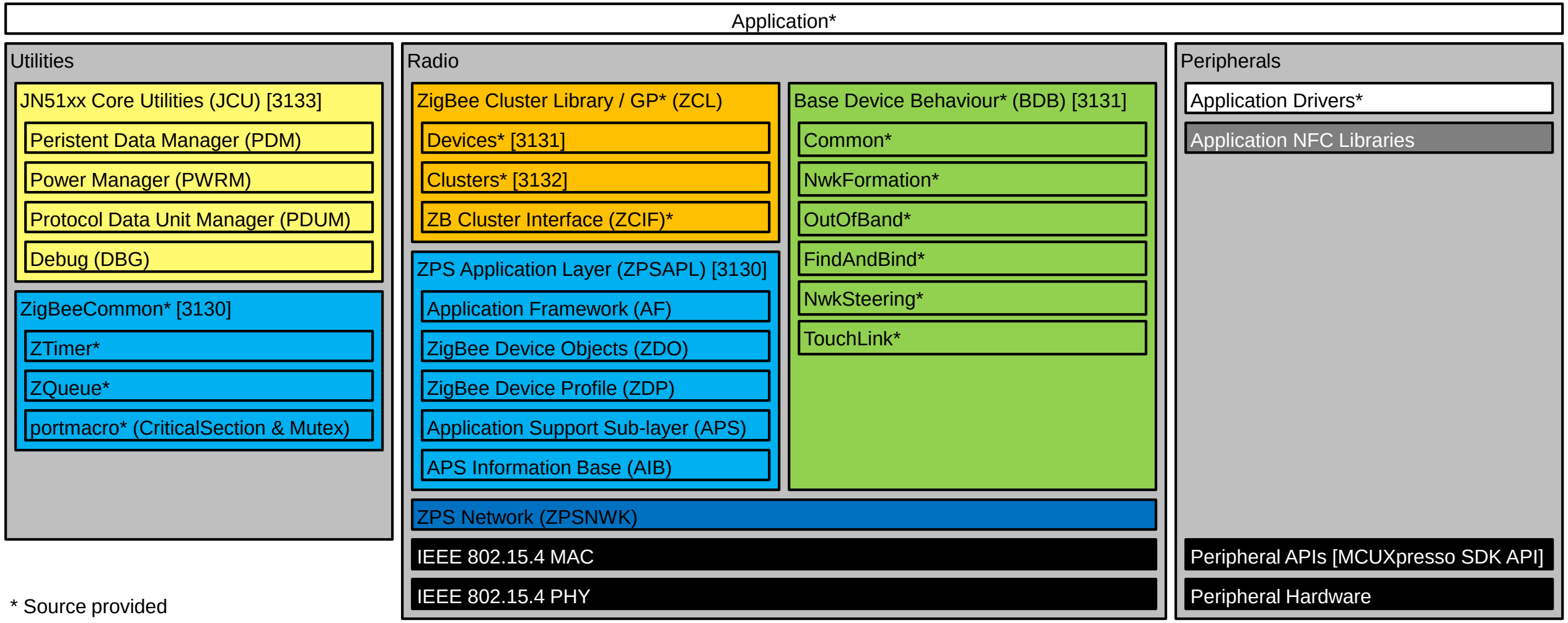
无操作系统 (Bare Metal)

SDK包：JN5189DK6

- ZCL与BDB源码
- MAC/NWK/APL库
- IEEE802.15.4库
- 外设参考例程源码



JN5189的SDK软件结构



* Source provided

JN5189参考应用例程

AN	应用实例说明
AN1242	CMET(Customer Module Evaluation Tool)，评估用户射频性能，PER及不同休眠模式下的功耗等
AN1243	Zigbee3.0 BDB功能模板，ZC支持NCI，ZR/ZED支持NTAG，GP Proxy，NFC OTA等功能
AN1244	Dimmable,ColorTemperature和ExtendedColor三种灯，支持GP Proxy,GP Combo和OTA功能
AN1245	DimmerSwitch和ColorSceneController，支持深度休眠(DeepSleep)和普通休眠及OTA功能
AN1246	Light,Occupancy和LTO(Light/Temperature/Occupancy)Sensor，支持深度休眠和普通休眠及OTA功能
AN1247	ControlBridge，网关参考设计，支持GP及NFC，提供基于C#的ZGWUI代码便于用户二次开发
AN1261	提供Green Power的OnOff Sensor和DimmerSwitch示例

JN5189用户参考指南

UG	用户参考指南
JN-UG-3130	Zigbee协议栈（R22)
JN-UG-3131	Zigbee设备（Zigbee Basic Device及ZLO设备）
JN-UG-3132	Zigbee Cluster Library (R8)
JN-UG-3133	JN5189软件模块：PDM/PDUM/PWRM等
JN-UG-3134	Zigbee Green Power
JN-UG-3135	JN5189加密工具使用
JN-UG-3127	JN5189烧录工具使用

Zigbee产品开发必不可少的环节 - 大网络测试环境

- Zigbee Mesh特性及网络规模决定了大网络测试环节十分重要
  - 验证Zigbee网络整体性能，如长期运行的可靠性及稳定性
  - 基于不同芯片方案的产品兼容性测试与验证
  - 某些问题只能在大网络环境下才容易复现
- 便捷大网络：ezLNT

	优势	缺点
传统LNT	立足涵盖Zigbee协议栈的各项测试，网络连接各模块，整体数据分析功能较强	投入大，系统复杂，安装布局困难：以200节点为例，节点分布区域大，通常需要数百平方米的一层楼面，管控难度较高
ezLNT	立足于用户产品开发阶段涉及的各类相关应用性能测试；既能空口抓包，又可以通过节点串口发送命令及获取信息	投入少，占用空间小，系统安装及管理便捷：单台PC连接5个USB Hub可控制110个节点，两台PC就可以组成200个节点的网络规模

ezLNT系统实例

- 200个USB Dongle节点
- Zigbee基本功能验证
- 系统长期可靠性测试
- 系统极限运行测试
- 数据的统计分析
  - 空中接口 (Ubiqua抓包)
  - 串口（UART打印数据）
- 基于C#平台的二次开发

ezLNT工具界面


ZigBee Gateway User Interface
入网节点的串口号，网络短地址，MAC地址，PANID，基于网络短地址的可控节点
频道，IP地址，设备类型，软件版本，芯片系列等信息
空口控制命令
各节点的串口打印信息

JN5189相关资料

- JN5189快速入门（含视频教程）

https://www.nxp.com/document/guide/getting-started-with-jn5189:GS-JN5189

- JN5189规格书，用户手册及应用例程

https://www.nxp.com/products/wireless/thread/jn5189-88-t-high-performance-and-ultra-low-power-mcus-for-zigbee-and-thread-with-built-in-nfc-option:JN5189_88_T?tab=Documentation_Tab

- JN5189软件开发工具包(SDK)及原理图,PCB版图

https://www.nxp.com/products/wireless/thread/jn5189-88-t-high-performance-and-ultra-low-power-mcus-for-zigbee-and-thread-with-built-in-nfc-option:JN5189_88_T?tab=Design_Tools_Tab

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