DIGI 工业物联网产品冬季研讨会

后疫情时代联网设备的方案设计和选型参考

Robin Tu
高级系统工程师
迪进国际 DIGI International

Who Is Digi?

Digi International (迪进国际) 是一家专注服务于物联网的纳斯达克上市公司，也是一家引领无线通讯技术和设备联网的全球性的半导体及设备厂商。

DGII	**1985**	**800**	**19**	**$388**	**100M+**
NASDAQ	**Year Founded**	Employees Worldwide	**Consecutive Years of Profitability**	**Million In Revenue**	Devices Connected

Who Is Digi?

物联网产品

片上系统模块
无线模块和网关
工业无线路由器
联网设备

物联网软件和服务

Digi Remote Manager®设备云
Digi TrustFence®安全框架
SmartSense 远程监控解决方案
无线设计服务
专业服务

服务行业

工业
医疗
交通运输
智慧城市
能源/电力
零售

HEADQUARTERS: HOPKINS, MN — WWW.DIGI.COM

Our Mission

通过提供从嵌入式模块到成品设备，以及各种工具和M2M应用服务来**简化**和**加速**物联网设备和解决方案的开发，部署和管理，并不断为客户提供服务，确保他们成功。

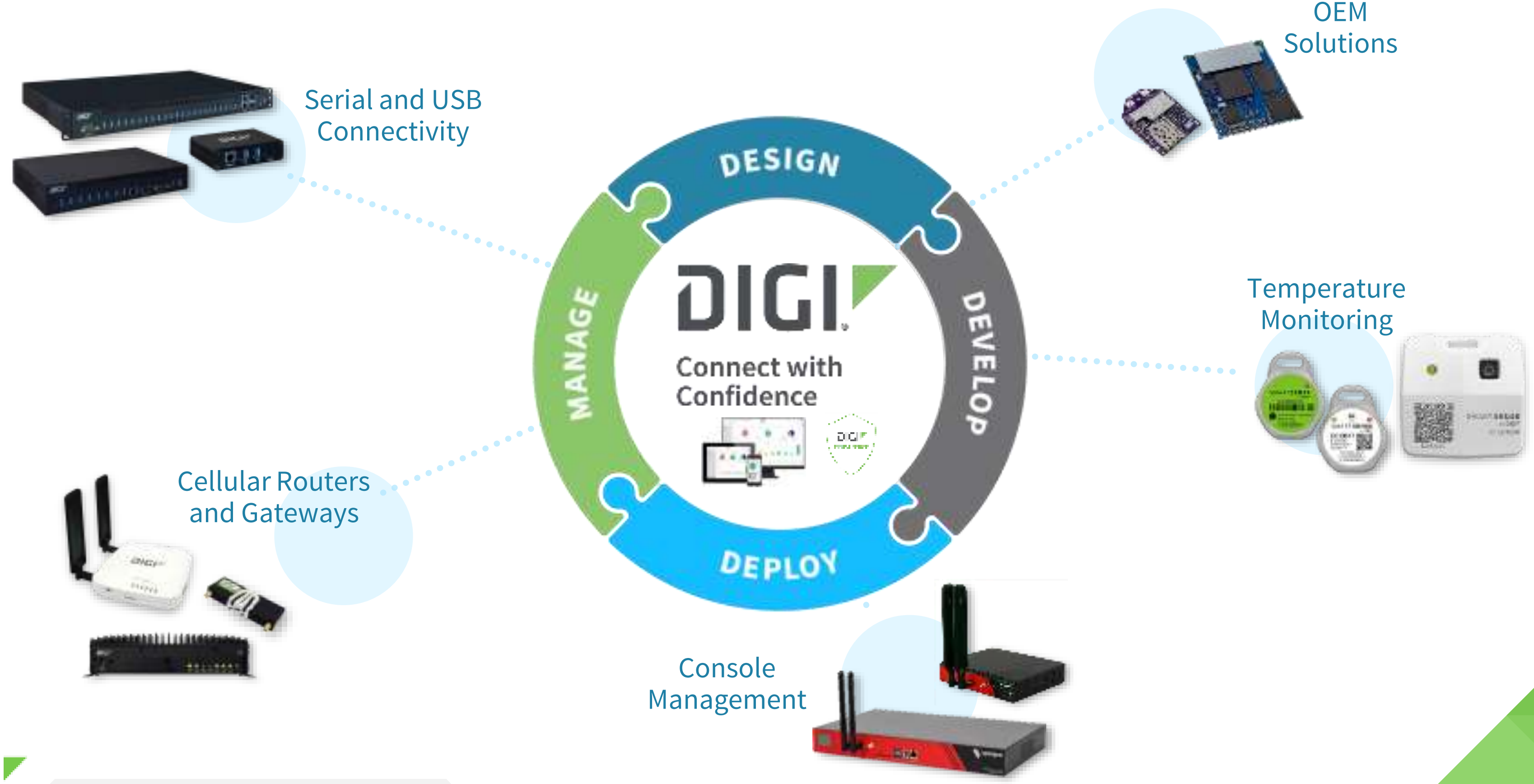
嵌入式模块®

通讯设备

管理平台

M2M应用

Digi Divisions and Capabilities



Serial and USB Connectivity

OEM Solutions

DESIGN

MANAGE

DEVELOP

DEPLOY

Connect with Confidence

Temperature Monitoring

Cellular Routers and Gateways

Console Management

不同应用方案产品选型

DIGI 嵌入式片上系统 最近更新

选型痛点

MCU还是MPU?

ARM还是RSIC-V ?

什么才是真正的工业级?

云端和边缘侧特性实现的选择

安全因素的考虑

如何缩短开发周期?

从MCU到MPU的迁移

设备联网已经无处不在，传统设备正向全新的MPU方案设计

- MCU方案

不适合复杂多任务，存储空间小，网络功能有限，开源软件移植困难，开发语言单一，可扩展性差

- X86工业计算机

功耗高，故障率高，网络安全维护成本高，无硬件加密/视频解码，系统稳定性差，接口扩展能力依赖于厂商。

- 新兴的RSIC-V方案

以替代MCU的低功耗芯片为主，山头林立，尚未出现工业级通用处理器芯片的领军企业

✓ Digi基于ARM的工业级核心模块方案

专为物联网准备，高度安全可靠的嵌入式Linux或Android主控平台，可实现无风扇设计，零基础开发嵌入式设备。

SOM核心模块= MPU处理器+DDR+Flash+PMIC电源管理+wifi/蓝牙和处理器各原生接口支持+片上系统，核心模块引出所有处理器引脚以供用户选用。

用统一的核心主控平台去匹配不同的应用需求

简单

- 简单或不带屏显
- 有线或无网络连接
- 基本485/串口和IO口
- 超低功耗
- 成本敏感

中端

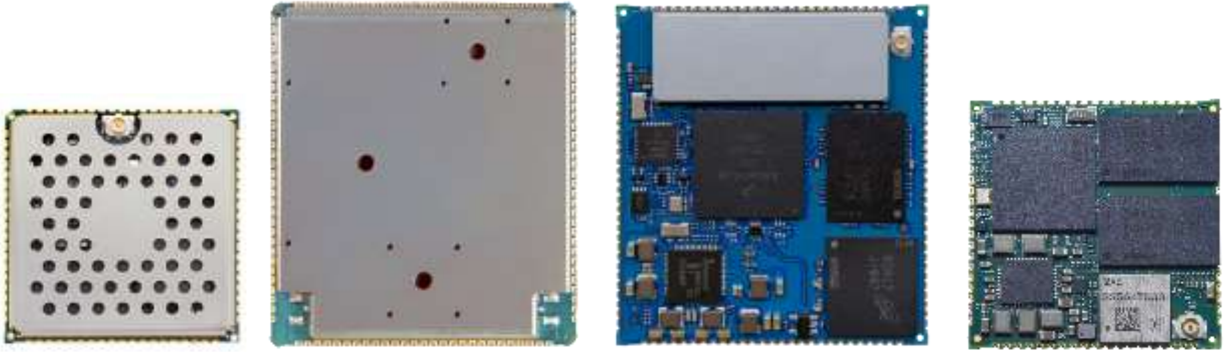
- 图形触控显示界面
- 有线，无线和LTE连接
- 更多高速IO接口
- 较强CPU算力

高端

- 高清视频流硬件编解码
- 先进超高带宽的无线连接
- 多路高清显示和高速IO
- 人工智能和机器学习
- 云服务支持

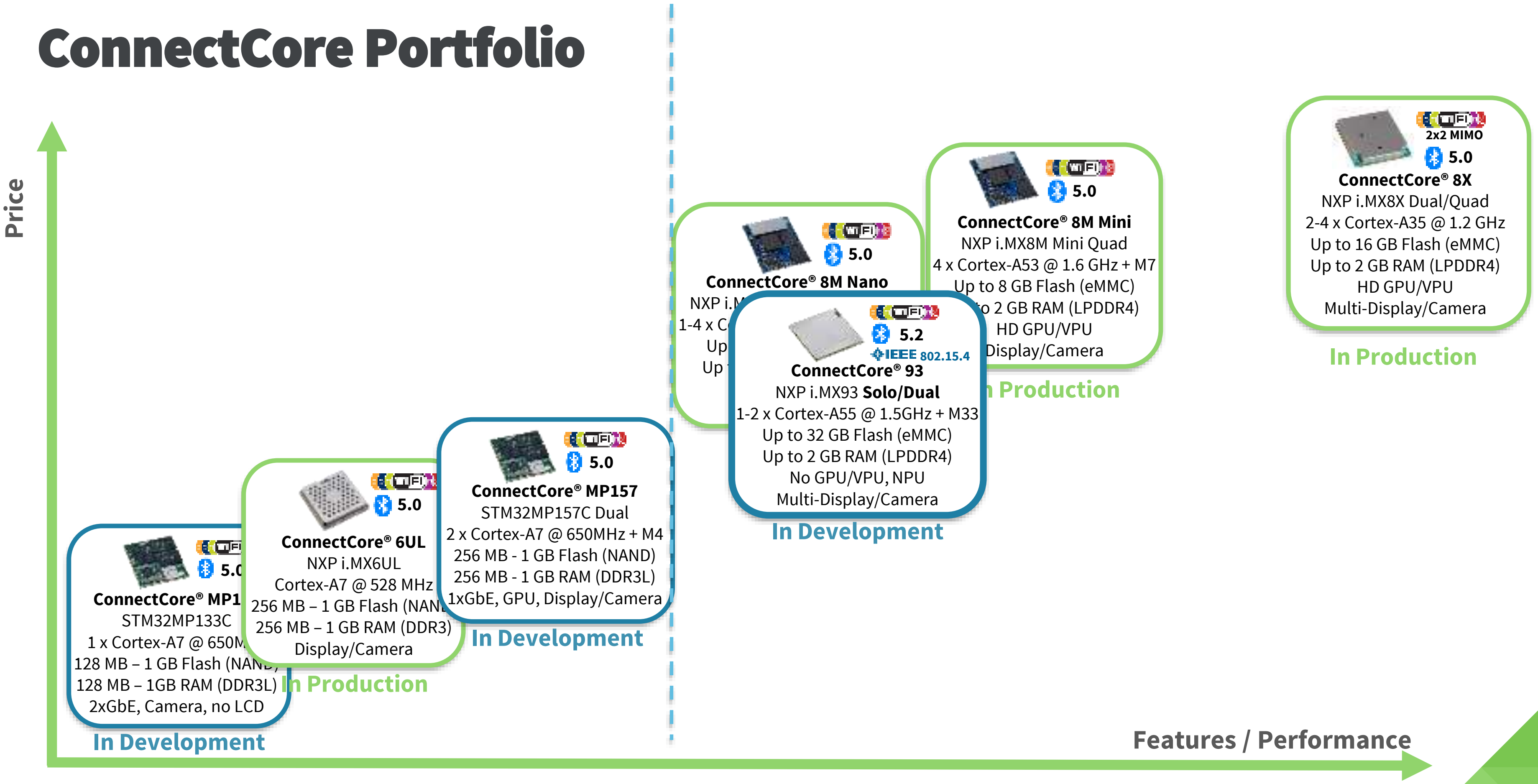
DIGI ConnectCore片上系统核心模块

- Security
- Software
- Tools
- Cloud
- Connectivity
- SOMs



Industrial-Grade
10+ Year Longevity

ConnectCore Portfolio



5.

ConnectCore® MP1
STM32MP133C
1 x Cortex-A7 @ 650M
128 MB – 1 GB Flash (NAN
128 MB – 1GB RAM (DDR3L)
2xGbE, Camera, no LCD

In Development

5.0

ConnectCore® 6UL
NXP i.MX6UL
Cortex-A7 @ 528 MHz
256 MB – 1 GB Flash (NAN
256 MB – 1 GB RAM (DDR3)
Display/Camera

In Production

5.0

ConnectCore® MP157
STM32MP157C Dual
2 x Cortex-A7 @ 650MHz + M4
256 MB - 1 GB Flash (NAND)
256 MB - 1 GB RAM (DDR3L)
1xGbE, GPU, Display/Camera

In Development

5.0

ConnectCore® 8M Nano
NXP i.M
1-4 x C
Up
Up

5.2
IEEE 802.15.4

ConnectCore® 93
NXP i.MX93 **Solo/Dual**
1-2 x Cortex-A55 @ 1.5GHz + M33
Up to 32 GB Flash (eMMC)
Up to 2 GB RAM (LPDDR4)
No GPU/VPU, NPU
Multi-Display/Camera

In Development

5.0

ConnectCore® 8M Mini
NXP i.MX8M Mini Quad
4 x Cortex-A53 @ 1.6 GHz + M7
Up to 8 GB Flash (eMMC)
o 2 GB RAM (LPDDR4)
HD GPU/VPU
Display/Camera

n Production

2x2 MIMO
5.0

ConnectCore® 8X
NXP i.MX8X Dual/Quad
2-4 x Cortex-A35 @ 1.2 GHz
Up to 16 GB Flash (eMMC)
Up to 2 GB RAM (LPDDR4)
HD GPU/VPU
Multi-Display/Camera

In Production

DIGI低端SOM概览

主频在800MHz以下，不带VPU，无mini PCIe接口

现役主力： ConnectCore i.MX6UL

即将发布： ConnectCore MP157

未来发布： ConnectCore MP133

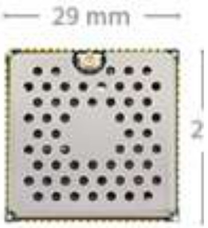
应用参考：

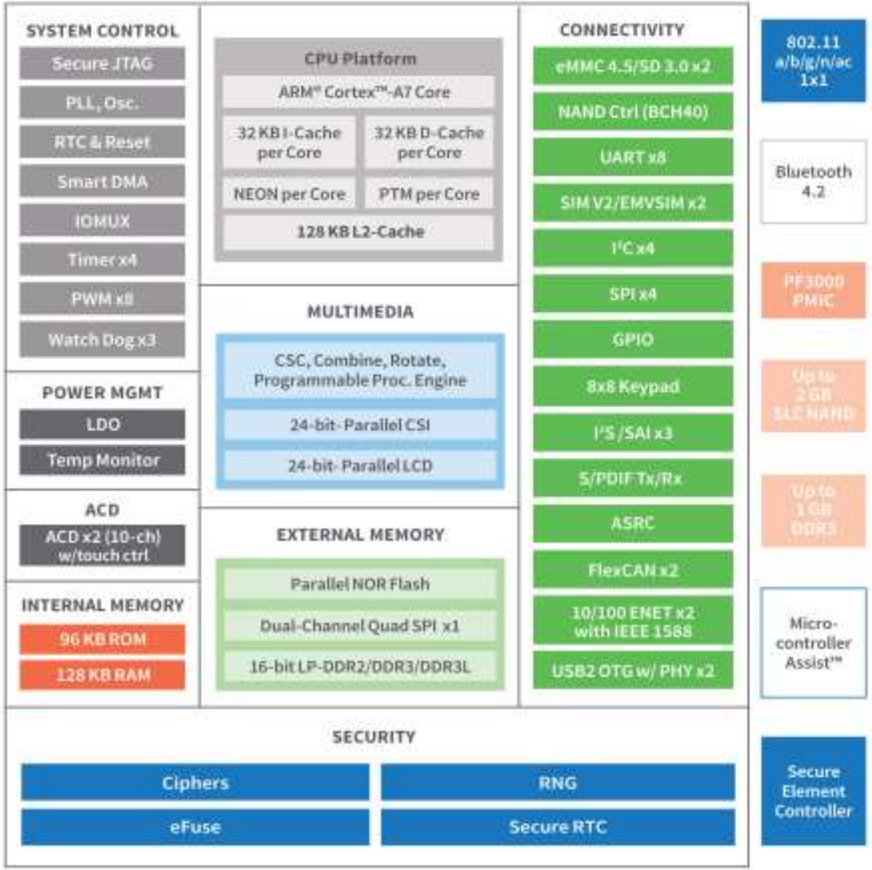
- 网关设备
- 工业领域的人机界面和显示设备
- 仪器仪表
- 充电桩，加气站
- 医疗设备
- 穿戴式设备

ConnectCore i.MX6UL核心模块主控

低功耗，丰富接口，自带Wifi蓝牙的贴片式SOM

- NXP i.MX6UL-2, 最高2GB NAND (SLC)和1GB DDR3
- Cortex-A7 主频达528 MHz (1.9 DMIPS/MHz)
- 集成功能性协处理器 (MKL03Z32CAF4R)
- 灵活易用和低开发成本的Digi SMTplus™ 封装形式
- 集成极低休眠功耗和唤醒管理机制
- 预认证的Wifi 802.11a/b/g/n/ac和蓝牙4.2无线
- U.FL天线接头或通过引脚连接天线
- 片上集成安全引擎
- 双网口，UART, USB, SD, CAN, SPI, I2C, I2S, ADC, PWM, GPIO, LCD等等
- 工业级温宽和长期供货保证
- 提供单板机开发套件、预编译嵌入式Linux及SDK方便程序开发调试





SYSTEM CONTROL
Secure JTAG
PLL, Osc.
RTC & Reset
Smart DMA
IOMUX
Timer x4
PWM x8
Watch Dog x3

POWER MGMT
LDO
Temp Monitor

ACD
ACD x2 (10-ch) w/touch ctrl

INTERNAL MEMORY
96 KB ROM
128 KB RAM

CPU Platform
ARM® Cortex™-A7 Core
32 KB I-Cache per Core
32 KB D-Cache per Core
NEON per Core
PTM per Core
128 KB L2-Cache

MULTIMEDIA
CSC, Combine, Rotate, Programmable Proc. Engine
24-bit-Parallel CSI
24-bit- Parallel LCD

EXTERNAL MEMORY
Parallel NOR Flash
Dual-Channel Quad SPI x1
16-bit LP-DDR2/DDR3/DDR3L

CONNECTIVITY
eMMC 4.5/SD 3.0 x2
NAND Ctrl (BCH40)
UART x8
SIM V2/EMVSIM x2
I²C x4
SPI x4
GPIO
8x8 Keypad
I²S /SAI x3
S/PDIF Tx/Rx
ASRC
FlexCAN x2
10/100 ENET x2 with IEEE 1588
USB2 OTG w/ PHY x2

SECURITY
Ciphers
RNG
eFuse
Secure RTC

802.11 a/b/g/n/ac 1x1
Bluetooth 4.2
PF3000 PMIC
Up to 2 GB SLC NAND
Up to 1 GB DDR3
Micro-controller Assist™
Secure Element Controller

已量产

Digi ConnectCore MP1 系列

产品细节和亮点

- 性能可延展性
  - 可选单核/双核Cortex-A7 @650 MHz
  - 额外自带一个Cortex-M4 用于实时任务(MP157)
- 接口与外设
  - GPU和摄像头支持
  - MIPI 显示接口
  - CAN-FD
  - 千兆网络接口
- 邮票孔贴片和LGA双重封装， 29 x 29 mm迷你芯片外形
  - 主要引脚和ConnectCore 6UL兼容
  - 业界最小的STM32MP1 无线核心模块
- Wi-Fi 802.11a/b/g/n/ac 双频+ Bluetooth 5.0
- 高度集成的软硬件设计，预认证和固件BSP长期维护

何谓工业级?

- 硬件

车规级处理器+主要部件车规级+SLC工业级闪存(1G以上大容量为MLC emmc闪存） +硬件加密和加速+硬件看门狗+双启动uboot+超高温自动保护和自动恢复

- 软件

自带uboot+BSP长期维护+接口扩展API库+完全开源嵌入式Linux+开箱即用Wifi/LTE+Android支持+开箱即用安全框架（端口访问保护与加密，防反向工程和安全OTA升级）+实时内核支持+

- 认证

全球预认证的Wifi/BT，支持WiFi快速漫游

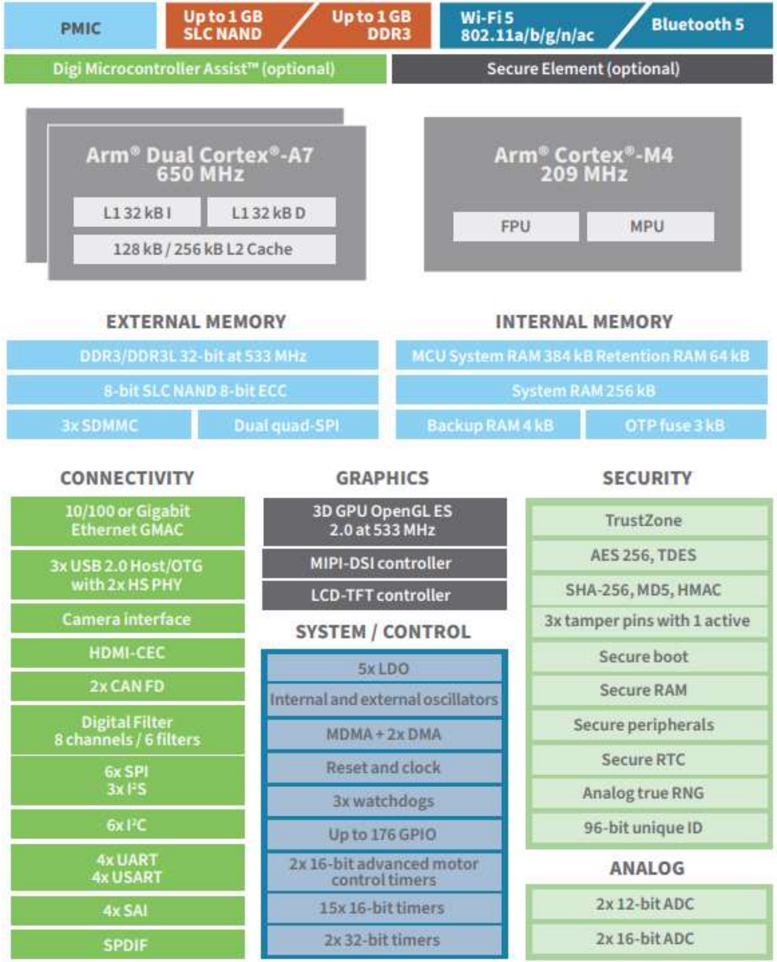
- 供应周期

所选的处理器芯片厂家均承诺10年以上的供货保证(NXP系列为15年)

Digi ConnectCore MP157

- STM32MP157C - 2 x Cortex-A7 @ 650 MHz, 1 x Cortex-M4 @ 209 MHz (支持全功能安全特性)
- 高达1 GB SLC NAND Flash / 1 GB DDR3 (最高32 bit位宽)
- 内置电源管理芯片
- 过认证的 802.11ac 1x1 Wi-Fi和 Bluetooth 5.0 (支持 DLE)
- 开箱即用的无线蜂窝网络支持
- 1 x Gigabit Ethernet, 2 x CAN-FD
- 3D GPU, 显示接口(MIPI/parallel) 和摄像头接口
- Digi SMTplus 迷你邮票孔和LGA双重封装， 仅29 x 29 x 3 mm大小
- 同CC6UL SOM主要引脚兼容 (main functions)
- Digi TrustFence 安全框架
- Digi Embedded Yocto Linux support
- Industrial temperature range (-40 to +85° C)
- 3-year hardware warranty

可预定时间
2023 Jan 24



PMIC
Up to 1 GB SLC NAND
Up to 1 GB DDR3
Wi-Fi 5 802.11a/b/g/n/ac
Bluetooth 5
Digi Microcontroller Assist™ (optional)
Secure Element (optional)

Arm® Dual Cortex®-A7 650 MHz
L1 32 kB I
L1 32 kB D
128 kB / 256 kB L2 Cache

Arm® Cortex®-M4 209 MHz
FPU
MPU

EXTERNAL MEMORY
DDR3/DDR3L 32-bit at 533 MHz
8-bit SLC NAND 8-bit ECC
3x SDMMC
Dual quad-SPI

INTERNAL MEMORY
MCU System RAM 384 kB Retention RAM 64 kB
System RAM 256 kB
Backup RAM 4 kB
OTP fuse 3 kB

CONNECTIVITY
10/100 or Gigabit Ethernet GMAC
3x USB 2.0 Host/OTG with 2x HS PHY
Camera interface
HDMI-CEC
2x CAN FD
Digital Filter 8 channels / 6 filters
6x SPI
3x I²S
6x I²C
4x UART
4x USART
4x SAI
SPDIF

GRAPHICS
3D GPU OpenGL ES 2.0 at 533 MHz
MIPI-DSI controller
LCD-TFT controller

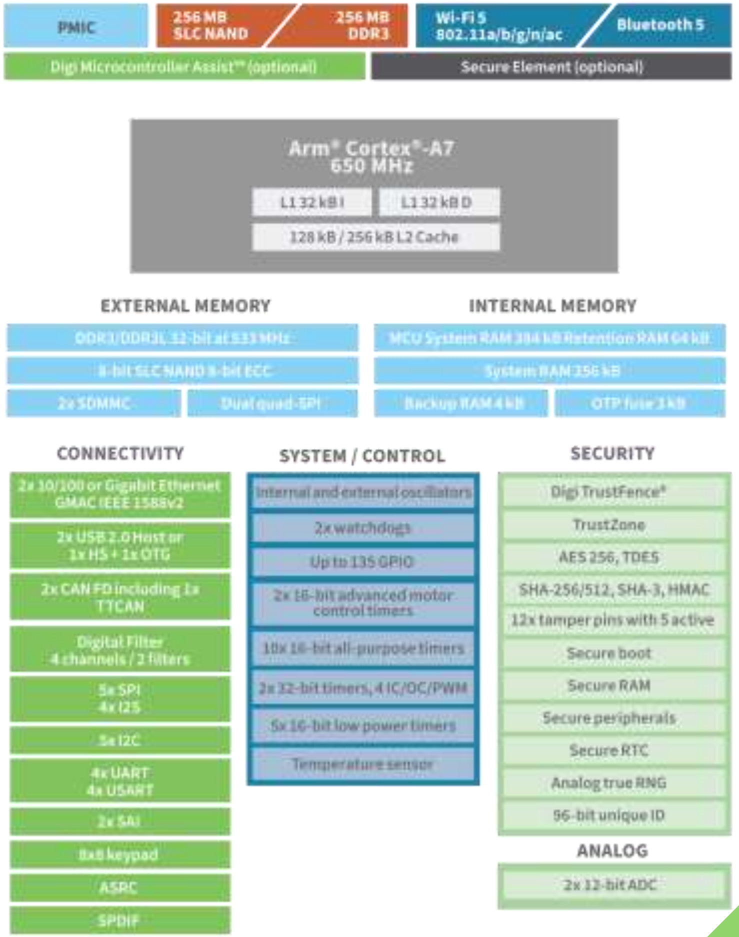
SYSTEM / CONTROL
5x LDO
Internal and external oscillators
MDMA + 2x DMA
Reset and clock
3x watchdogs
Up to 176 GPIO
2x 16-bit advanced motor control timers
15x 16-bit timers
2x 32-bit timers

SECURITY
TrustZone
AES 256, TDES
SHA-256, MD5, HMAC
3x tamper pins with 1 active
Secure boot
Secure RAM
Secure peripherals
Secure RTC
Analog true RNG
96-bit unique ID

ANALOG
2x 12-bit ADC
2x 16-bit ADC

Digi ConnectCore MP133

- STM32MP133C (full security, industrial) – Cortex-A7 @ 650 MHz
- Up to 1 GB SLC NAND Flash / 1 [illegible] bit)
- Power manageme [illegible]
- Pre-certi [illegible] 5.0 (incl. DLE)
- Seaml [illegible] (Digi XBee®, 3rd party)
- 2 x Gigab [illegible] t, 2 x CAN-FD
- Digi SMTplus form factor 29 x 29 mm
- High level of pin-compatibility with CC6UL SOM (main funct.)
- Digi TrustFence® security framework
- Digi Embedded Yocto Linux support
- Industrial temperature range (-40 to +85° C)
- 3-year hardware warranty



PMIC
256 MB SLC NAND
256 MB DDR3
Wi-Fi 5 802.11a/b/g/n/ac
Bluetooth 5
Digi Microcontroller Assist™ (optional)
Secure Element (optional)

Arm® Cortex®-A7
650 MHz
L1 32 kB I
L1 32 kB D
128 kB / 256 kB L2 Cache

EXTERNAL MEMORY
DDR3/DDR3L 32-bit at 533 MHz
8-bit SLC NAND 8-bit ECC
2x SDMMC
Dual quad-SPI

INTERNAL MEMORY
MCU System RAM 384 kB Retention RAM 64 kB
System RAM 256 kB
Backup RAM 4 kB
OTP fuse 3 kB

CONNECTIVITY
2x 10/100 or Gigabit Ethernet GMAC IEEE 1588v2
2x USB 2.0 Host or 1x HS + 1x OTG
2x CAN FD including 1x TTCAN
Digital Filter 4 channels / 2 filters
5x SPI
4x I2S
5x I2C
4x UART
4x USART
2x SAI
8x8 keypad
ASRC
SPDIF

SYSTEM / CONTROL
Internal and external oscillators
2x watchdogs
Up to 135 GPIO
2x 16-bit advanced motor control timers
10x 16-bit all-purpose timers
2x 32-bit timers, 4 IC/OC/PWM
5x 16-bit low power timers
Temperature sensor

SECURITY
Digi TrustFence®
TrustZone
AES 256, TDES
SHA-256/512, SHA-3, HMAC
12x tamper pins with 5 active
Secure boot
Secure RAM
Secure peripherals
Secure RTC
Analog true RNG
96-bit unique ID

ANALOG
2x 12-bit ADC

Positioning

Specific Need	CC6UL	CCMP13	CCMP15
Low Power Modes	★★★ Digi MCA Lowest power modes / event trigger mode	★ Standard MPU power modes no MCA	★★ Higher performance Higher power consumption Digi MCA for low power sleep modes
Display Graphical UI	★ + Simple LCD (24 bit parallel), simple HMI	- No LCD option	★★★ +++ 3D GPU, MIPI display, rich HMI
Performance Heterogeneous Compute	★ + Single Core Cortex-A7 – 528 MHz	★ + Single Core Cortex-A7 – 650 MHz	★★★ +++ Dual Core Cortex-A7 – 650 MHz Cortex-M4 – Realtime / MCU ecosystem
Longevity	NXP longevity program 15 years 2030 (extension very likely)	ST Micro longevity program 10 years (rolling) 2032 (extension very likely)	ST Micro longevity program 10 years (rolling) 2032 (extension very likely)
Wireless design ownership / control	★★★ Digi has full control over wireless design Qualcomm	★★ Murata wireless module (Infineon/Cypress) + Infineon FW support	★★ Murata wireless module (Infineon/Cypress) + Infineon FW support
Bluetooth	★ Bluetooth 5.0	★★ Better Bluetooth 5.0 features as e.g. DLE for higher throughout	★★ Better Bluetooth 5.0 features e.g. DLE for high throughout
Manufacturer preference	NXP	ST Micro	ST Micro
Ruggedized	★ SMTplus, smaller pad size	★★★ Improved SMTplus, bigger LGA pads Drop testing	★★★ Improved SMTplus, bigger LGA pads Drop testing
Security	★★★ Additional Secure Element	★★ + Advanced Security IP in the MPU	★★ Advanced Security IP in the MPU

Digi SMTplus® form factor （Connectcore i.MX6ul/MP1)

独有的SMTplus 封装设计简化生产

  - 245-pad LGA (完整引脚), or 76-pad (外围邮票孔)
  - 减少产品PCB层级，简化设计

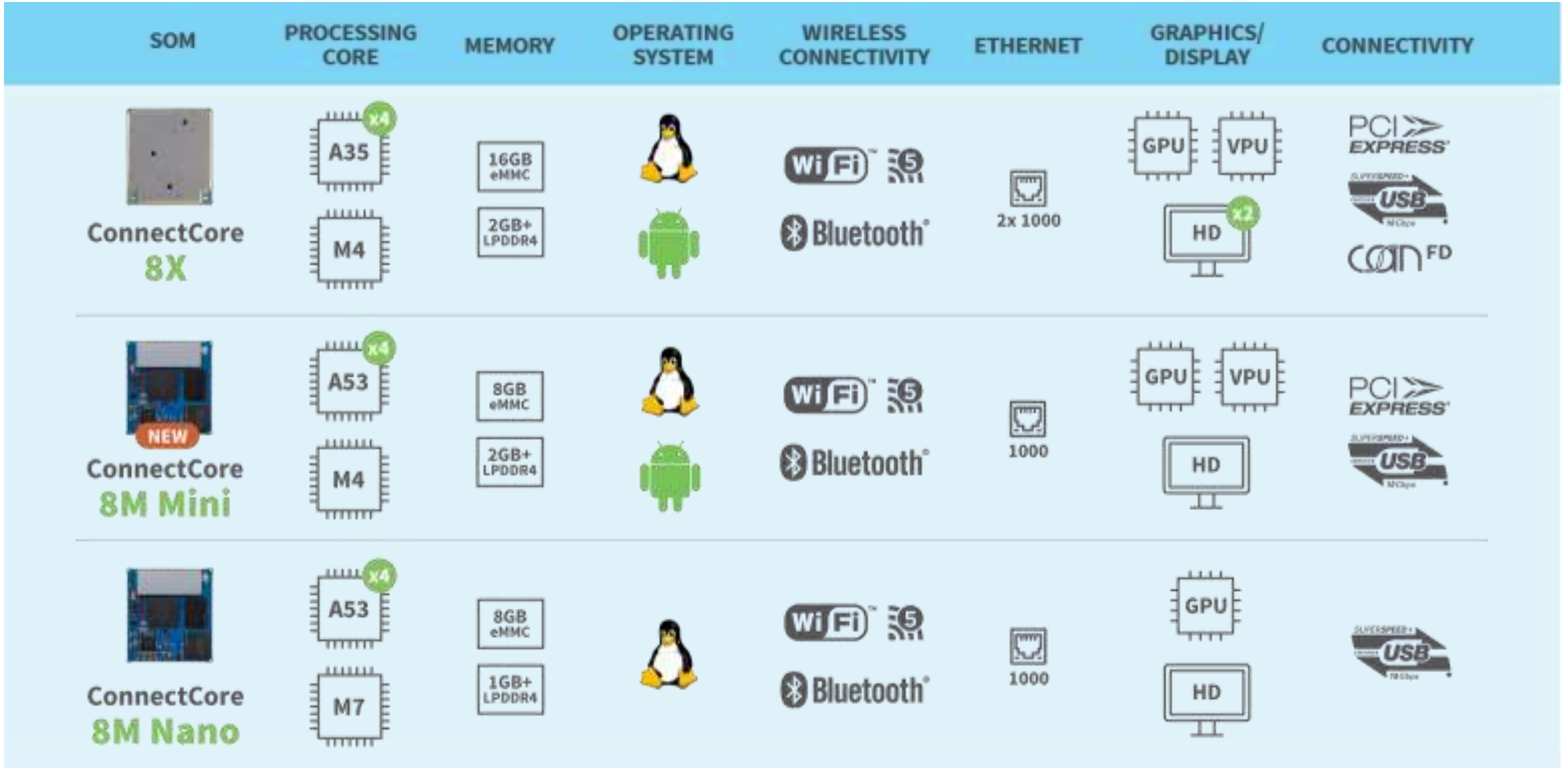
便 于SMT自动化生产加工时的拾起和放置

- 超低厚度，类芯片
- 迷你尺寸 29 x 29 x 3.5 mm
- 高效生产
- 类邮票孔设计允许手动焊接调试

相同封装和引脚选项

- 可选集成无线wifi和蓝牙，封装相同
- 板载天线接口，亦可通过管脚引出射频信号

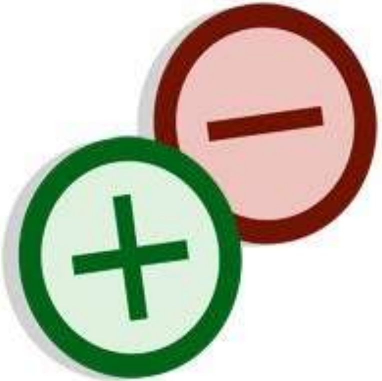
Digi ConnectCore® 8 Family Comparison



SOM	PROCESSING CORE	MEMORY	OPERATING SYSTEM	WIRELESS CONNECTIVITY	ETHERNET	GRAPHICS/ DISPLAY	CONNECTIVITY
ConnectCore 8X	A35 x4 M4	16GB eMMC 2GB+ LPDDR4	🐧 🤖	Wi Fi 5 Bluetooth	2x 1000	GPU VPU HD x2	PCI EXPRESS USB CAN FD
NEW ConnectCore 8M Mini	A53 x4 M4	8GB eMMC 2GB+ LPDDR4	🐧 🤖	Wi Fi 5 Bluetooth	1000	GPU VPU HD	PCI EXPRESS USB
ConnectCore 8M Nano	A53 x4 M7	8GB eMMC 1GB+ LPDDR4	🐧	Wi Fi 5 Bluetooth	1000	GPU HD	USB

NXP i.MX8M Nano / Mini Processor

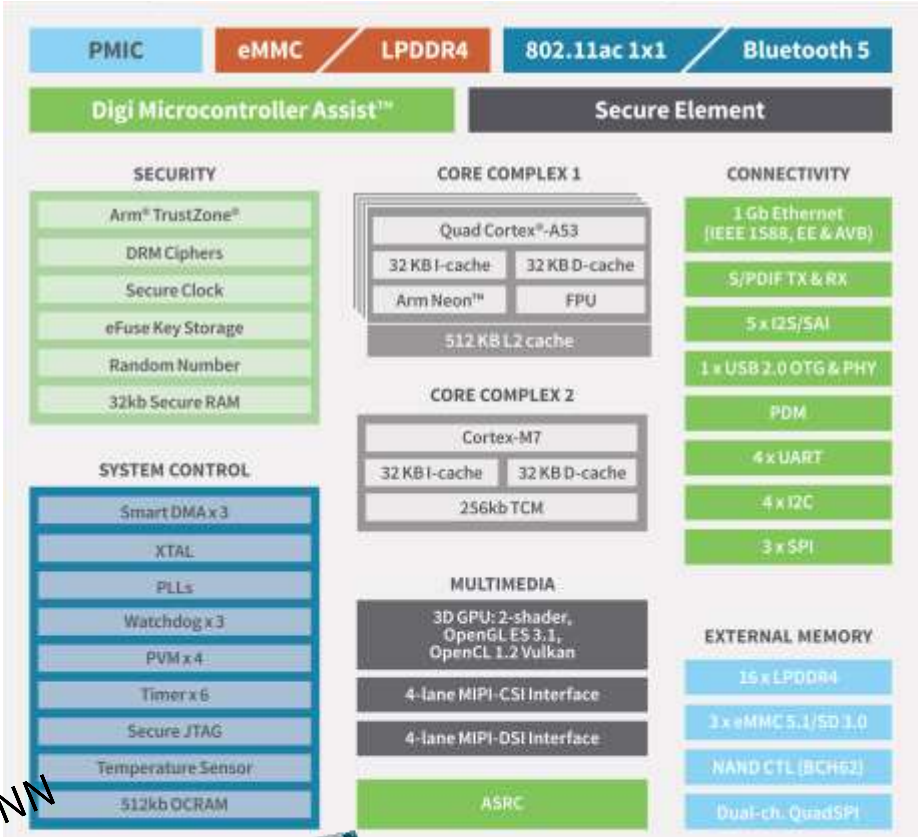
- **Pros**
  - **CPU performance** – 1/4 Cortex-A53@1.4GHz (@1.6GHz Mini)
  - **Heterogeneous** multicore - **Cortex-M7** @600MHz (Cortex-**M4** @400MHz for Mini) available
  - LPDDR4 option– long term support, performance, **lowest power**
  - Best in class **GPU** support
  - **VPU** support on the Mini
  - Best in class audio capabilities
  - Flexibility – multiple variants
- **Cons**
  - No industrial display interface available
    - MIPI DSI (limited industrial LCD options available)
    - No LVDS, no HDMI (LVDS and HDMI provided through Digi reference design)
  - Peripherals:
    - No CAN bus (CAN-FD provided through Digi reference design)
    - No ADCs (ADCs provided through Digi Microcontroller Assist (MCA) on the SOM)



Digi在模块中解决NXP 8M nano/mini芯片的作为工业应用的缺失环节，使其成为完整功能的工业级核心模块

Digi ConnectCore® 8M Nano SOM

- NXP i.MX 8M Nano (1-4 x Cortex-A53 @ 1.4 GHz + 1 x Cortex-M7 @ 600MHz)
- 高达8 GB 闪存 (eMMC) / 1 GB 内存 (LPDDR4)
- 集成先进的图形处理单元 (GPU GC7000UL / Display / Audio)
- Digi SMTplus 邮票孔封装
- 集成功能性协处理器：电源管理，安全，扩展接口，RTC，硬看门狗等
- 预认证 802.11 a/b/g/n/ac WiFi + BT5
- 无缝的LTE集成(Digi XBee, 移远)
- 引脚兼容同系列产品CC8M Nano/Mini 和 CC8X (primary pin function)
- Digi TrustFence 安全框架，嵌入式Linux/Digi Embedded Yocto
- 工业级温宽(-40 to +85°C)
- CAN-FD /HDMI 开发板参考设计 和驱动支持



PMIC

eMMC / LPDDR4

802.11ac 1x1 / Bluetooth 5

Digi Microcontroller Assist™

Secure Element

SECURITY

Arm® TrustZone®

DRM Ciphers

Secure Clock

eFuse Key Storage

Random Number

32kb Secure RAM

SYSTEM CONTROL

Smart DMA x 3

XTAL

PLLs

Watchdog x 3

PVM x 4

Timer x 6

Secure JTAG

Temperature Sensor

512kb OCRAM

CORE COMPLEX 1

Quad Cortex®-A53

32 KB I-cache | 32 KB D-cache

Arm Neon™ | FPU

512 KB L2 cache

CORE COMPLEX 2

Cortex-M7

32 KB I-cache | 32 KB D-cache

256kb TCM

MULTIMEDIA

3D GPU: 2-shader, OpenGL ES 3.1, OpenCL 1.2 Vulkan

4-lane MIPI-CSI Interface

4-lane MIPI-DSI Interface

ASRC

CONNECTIVITY

1 Gb Ethernet (IEEE 1588, EE & AVB)

S/PDIF TX & RX

5 x I2S/SAI

1 x USB 2.0 OTG & PHY

PDM

4 x UART

4 x I2C

3 x SPI

EXTERNAL MEMORY

16 x LPDDR4

3 x eMMC 5.1/SD 3.0

NAND CTL (BCH62)

Dual-ch. QuadSPI

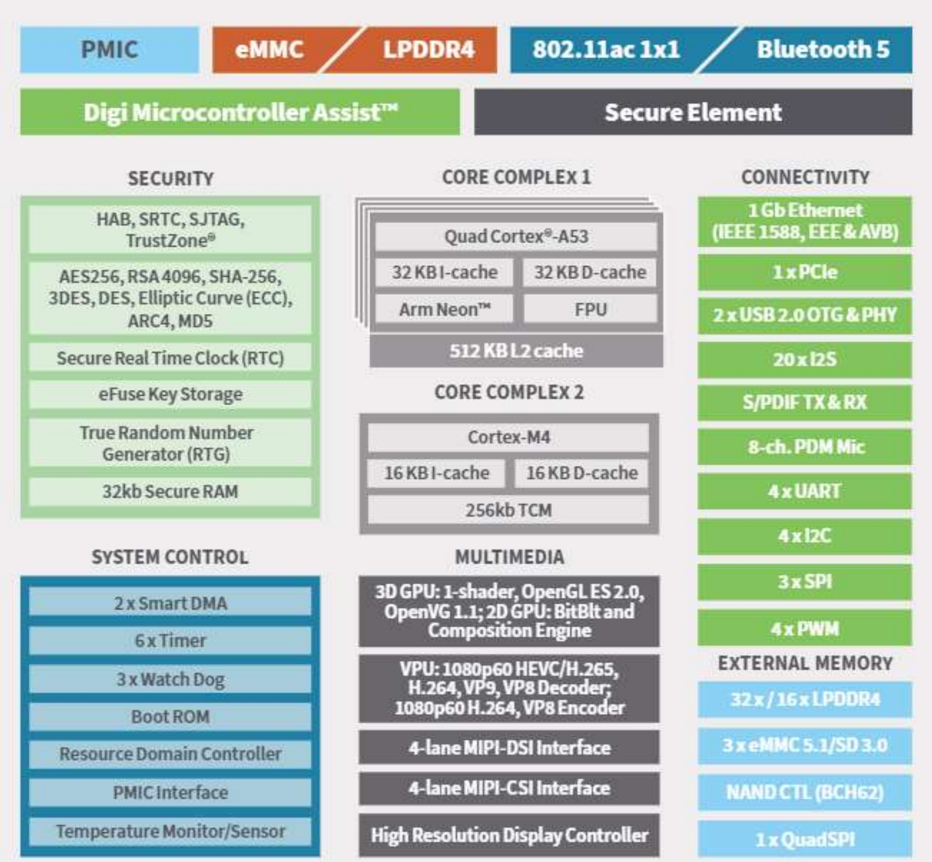
已量产

CC-WMX-FS7D-NN

Digi ConnectCore® 8M Mini SOM

- NXP i.MX 8M Mini (4 x Cortex-A53 @ 1.6 GHz + 1 x Cortex-M4 @ 400MHz)
- 高达8 GB 闪存 (eMMC) / 2 GB RAM (LPDDR4, 32-bit)
- 集成先进图形/视频处理单元(GPU GCNanoUltra 3D + GC320 2D + VPU / MIPI display 4-lane / camera / audio)
- 集成功能性协处理器：电源管理，安全，扩展接口，RTC，硬看门狗等
- 预认证 802.11 a/b/g/n/ac WiFi + BT5
- PCIe 2.0 (1-lane)
- 无缝的LTE集成(Digi XBee, 移远)
- 引脚兼容同系列产品CC8M Nano/Mini 和 CC8X (primary pin function)
- Digi TrustFence 安全框架，嵌入式Linux/Andoid
- 工业级温宽(-40 to +85°C)
- CAN-FD 开发板参考设计

已量产



PMIC
eMMC / LPDDR4
802.11ac 1x1 / Bluetooth 5
Digi Microcontroller Assist™
Secure Element

SECURITY
HAB, SRTC, SJTAG, TrustZone®
AES256, RSA 4096, SHA-256, 3DES, DES, Elliptic Curve (ECC), ARC4, MD5
Secure Real Time Clock (RTC)
eFuse Key Storage
True Random Number Generator (RTG)
32kb Secure RAM

CORE COMPLEX 1
Quad Cortex®-A53
32 KB I-cache
32 KB D-cache
Arm Neon™
FPU
512 KB L2 cache

CORE COMPLEX 2
Cortex-M4
16 KB I-cache
16 KB D-cache
256kb TCM

CONNECTIVITY
1 Gb Ethernet (IEEE 1588, EEE & AVB)
1 x PCIe
2 x USB 2.0 OTG & PHY
20 x I2S
S/PDIF TX & RX
8-ch. PDM Mic
4 x UART
4 x I2C
3 x SPI
4 x PWM

SYSTEM CONTROL
2 x Smart DMA
6 x Timer
3 x Watch Dog
Boot ROM
Resource Domain Controller
PMIC Interface
Temperature Monitor/Sensor

MULTIMEDIA
3D GPU: 1-shader, OpenGL ES 2.0, OpenVG 1.1; 2D GPU: BitBlt and Composition Engine
VPU: 1080p60 HEVC/H.265, H.264, VP9, VP8 Decoder; 1080p60 H.264, VP8 Encoder
4-lane MIPI-DSI Interface
4-lane MIPI-CSI Interface
High Resolution Display Controller

EXTERNAL MEMORY
32 x / 16 x LPDDR4
3 x eMMC 5.1/SD 3.0
NAND CTL (BCH62)
1 x QuadSPI

Digi ConnectCore® 8X SOM

- NXP i.MX 8DualX/8QuadXPlus (2-4 x Cortex-A35 @ 1.2 GHz)
- 高达16 GB 闪存(eMMC) / 2 GB RAM (LPDDR4)
- 先进的多媒体处理能力，集成有GPU GC700L/VPU/音频
- 集成功能性协处理器：电源管理，安全，扩展接口，RTC，硬看门狗等
- 预认证 802.11 a/b/g/n/ac WiFi + BT5
- 无缝的LTE集成(Digi XBee, 移远)
- 引脚兼容同系列产品CC8M Nano/Mini
- Digi TrustFence 安全框架，嵌入式Linux/Andoid
- 工业级温宽(-40 to +85°C)

已量产

PMIC | eMMC / LPDDR4 | 802.11ac 2x2 / Bluetooth 5

Digi Microcontroller Assist™ | Secure Element

CORE COMPLEX 1

- 2–4 x ARM® Cortex®-A35
- 32 KB I-cache
- 32 KB D-cache
- 512 KB L2 cache with ECC

MULTIMEDIA

GPU
- 1 x 2- or 4-Shader, OpenGL ES 3.0 or 3.1 3.1, Vulkan® VX Extensions

VPU
- Video: h.265 dec 4k, h.264 enc/dec 1080p

AUDIO
- DSP CORE
  - Tensilica® HiFi 4
  - 32 KB I
  - [illegible]
  - [illegible]
  - 512 KB SRAM

DISPLAY AND CAMERA I/O

- 2 x MIPI-DSI/LVDS Combo PHY*
- 1 x Parallel Display
- 1 x Parallel CSI
- 1 x MIPI CSI

CORE COMPLEX 2

Cortex-M4F	1 x I²C
16 KB I-cache	1 x UART
16 KB D-cache	6 x GPIO
256 KB SRAM	1 x TPM Timer

MEMORY

- LPDDR4 @ 1200 MHz (no ECC)
- 2 x SDIO3.0/eMMC5.1
- RAW NAND-BCH62
- 2 x Quad/1 x Octal SPI

SECURITY

- HAB, SRTC, SJTAG, TrustZone®
- AES256, RSA4096, SHA-256
- 3DES, ARC4, MD-5
- Flashless SHE, ECC
- Tamper, Inline Enc Engine

SYSTEM CONTROL

- Power Control, Clocks, Reset
- BootROMs
- PMIC interface (dedicated I²C)
- Domain Resource Partitioning

CONNECTIVITY

- 5 x UART
- 6 x I²C
- 4 x SPI
- 2x Gbit Ethernet AVB
- 3.3 V/1.8 V GPIO
- PCIe 3.0 with L1 Substate-1-lane (wired only)
- 1 x USB3 OTG w/PHY
- 1x USB2 OTG w/PHY
- 3 x CAN/CAN FD
- MOST 25/50
- 4 x 4 Keypad
- 4 x PWM
- 1 x 12-bit ADC
- 2 x ASRC, SPDIF
- 4 x SAI, ESAI, MQS

NXP i.MX 9 Series – Key Features

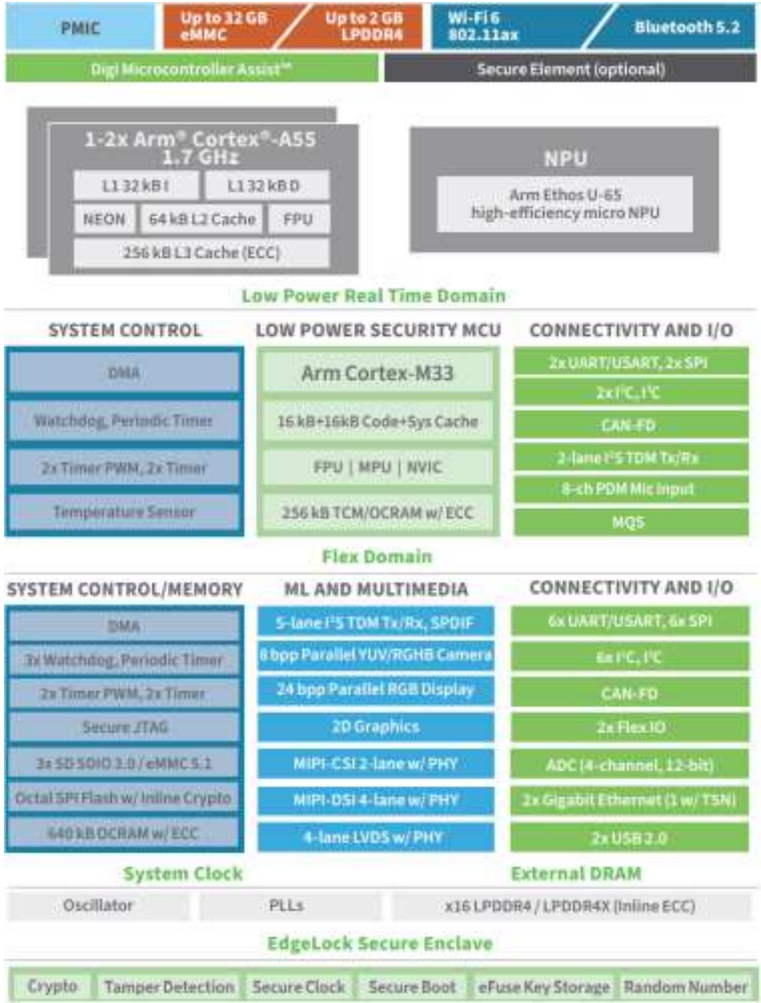
Digi ConnectCore® 9 系列

产品细节和亮点

- 无线演进
  - 首个集成Wi-Fi 6 (802.11ax)的片上系统平台
  - 最新Bluetooth 5.2
  - 可选 802.15.4 无线
  - 弹性架构和性能
  - 涵盖低端中端和高端的片上系统核心模块
  - 高计算性能 Cortex A55 @ 1.5 GHz
  - 极佳能效
- 机器学习
  - 可延展的ARM Ethos NPU – AI/ML accelerator
- Digi SMTplus封装
  - 和现有的ConnectCore SOM主要引脚兼容
  - SMTplus 40 x 45 (mid- , high-end SOMs)
  - SMTplus 29 x 29 (smaller SOMs)

Digi ConnectCore 93

- NXP i.MX 93 (1-2 x Cortex-A55 @ 1.5 GH 1 x Cortex-M33 @ 250MHz)
- Up to 32 GB Flash (eMMC) / R4/LPDDR4X RAM
- AI/ML Arm Eth
- N ecture for maximum power efficiency
- Digi t (MCA) for adv. power management, security, perip and system reliability
- Pre-certified 802.11ax Wi-Fi + Bluetooth 5.2 + 802.15.4 (NXP IW61x) wireless
- Seamless cellular integration (Digi XBee, 3rd party)
- Digi SMTplus form-factor 40 x 45 x 3.5 mm
- High level of pin-compatibility with ConnectCore 8 SOM family
- Digi TrustFence security framework
- Digi Embedded Yocto Linux support
- Industrial temperature (-40 to +85°C)
- 3-year hardware warranty



PMIC
Up to 32 GB eMMC
Up to 2 GB LPDDR4
Wi-Fi 6 802.11ax
Bluetooth 5.2
Digi Microcontroller Assist℠
Secure Element (optional)

1-2x Arm® Cortex®-A55 1.7 GHz
L1 32 kB I
L1 32 kB D
NEON
64 kB L2 Cache
FPU
256 kB L3 Cache (ECC)

NPU
Arm Ethos U-65 high-efficiency micro NPU

Low Power Real Time Domain

SYSTEM CONTROL
DMA
Watchdog, Periodic Timer
2x Timer PWM, 2x Timer
Temperature Sensor

LOW POWER SECURITY MCU
Arm Cortex-M33
16 kB+16kB Code+Sys Cache
FPU | MPU | NVIC
256 kB TCM/OCRAM w/ ECC

CONNECTIVITY AND I/O
2x UART/USART, 2x SPI
2x I^{3}C, I^{2}C
CAN-FD
2-lane I^{2}S TDM Tx/Rx
8-ch PDM Mic Input
MQS

Flex Domain

SYSTEM CONTROL/MEMORY
DMA
3x Watchdog, Periodic Timer
2x Timer PWM, 2x Timer
Secure JTAG
3x SD SDIO 3.0 / eMMC 5.1
Octal SPI Flash w/ Inline Crypto
640 kB OCRAM w/ ECC

ML AND MULTIMEDIA
5-lane I^{2}S TDM Tx/Rx, SPDIF
8 bpp Parallel YUV/RGHB Camera
24 bpp Parallel RGB Display
2D Graphics
MIPI-CSI 2-lane w/ PHY
MIPI-DSI 4-lane w/ PHY
4-lane LVDS w/ PHY

CONNECTIVITY AND I/O
6x UART/USART, 6x SPI
6x I^{3}C, I^{2}C
CAN-FD
2x Flex IO
ADC (4-channel, 12-bit)
2x Gigabit Ethernet (1 w/ TSN)
2x USB 2.0

System Clock
Oscillator
PLLs

External DRAM
x16 LPDDR4 / LPDDR4X (Inline ECC)

EdgeLock Secure Enclave
Crypto
Tamper Detection
Secure Clock
Secure Boot
eFuse Key Storage
Random Number

Wi-Fi 6 (802.11ax) Technologies & Benefits

Benefits

- MU-MIMO – Speed
- **OFDMA – Capacity, Latency**
- Beamforming – Range, Speed
- 1024 QAM – Speed
- Increased Symbol Time – Range
- BSS Coloring – Capacity
- Target Wake Time – Battery Savings

Digi SMTplus® form factor （Connectcore i.MX8/9)

高可靠性和高自由度设计

迷你尺寸 40 mm x 45 mm x 3.5 mm

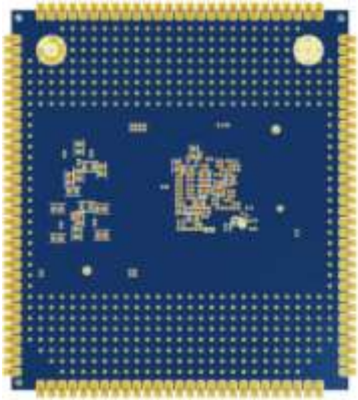
邮票孔和LGA两种焊盘引脚

可用于震动和冲击等恶劣场景下

Cc8m/9的屏蔽罩仅在RF器件上

- **邮票孔**
  - **118 pads**
  - 简化产品设计
  - 减少底板层数
  - 成本效益经济
  - 可手工焊接

- **LGA**
  - 474 pads
  - 提供处理器所有接口
  - 完整的设计自由度



Digi Microcontroller Assist™ (MCA)

模块附带的Cortex-M0功能协处理器

- 先进的电源管理
- 防拆安全检测（模拟或数字电平）
- 系统可靠性维护
- SOM reset逻辑
- 灵活的唤醒配置
- 与主处理器通过I2C连接A
- 扩展接口(ADCs, GPIOs, UARTs, ...)

工具

- MCA 配置工具 (启动模式设置，防拆引脚, ...
- MCA 管理工具(fw update)

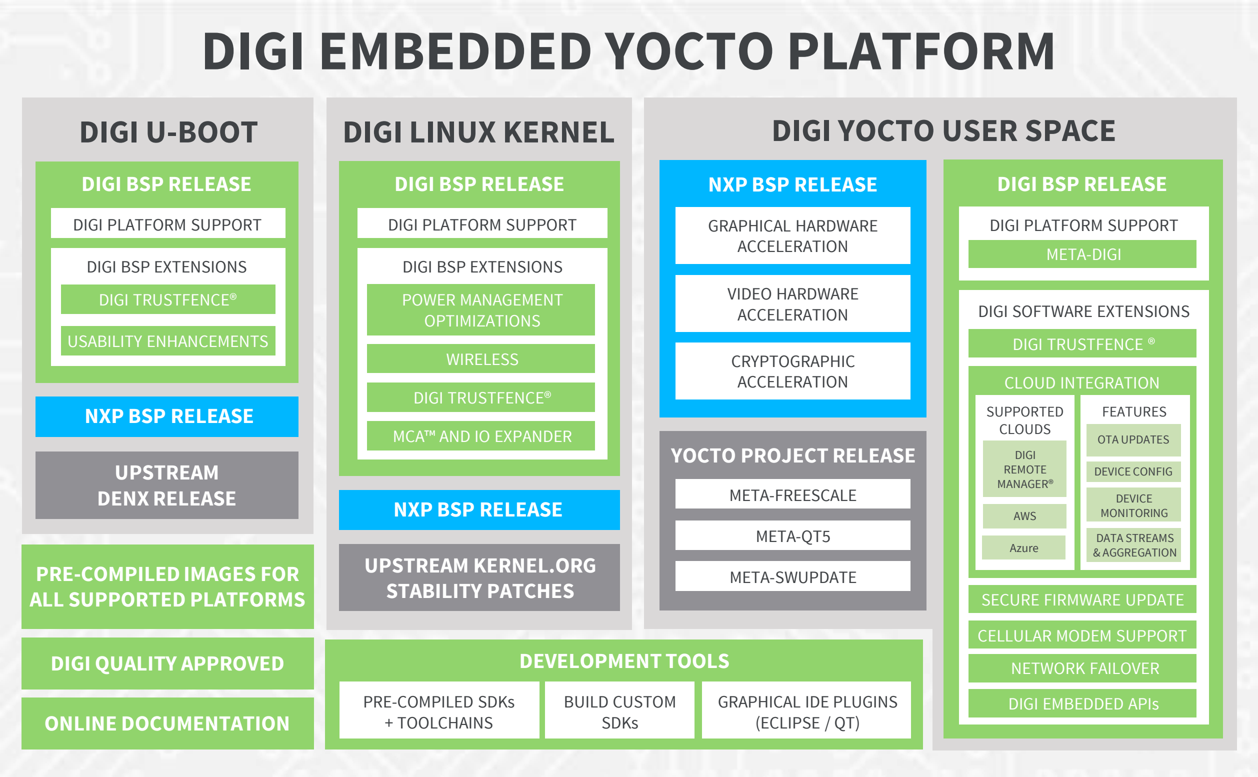
唤醒 机制

- 可从RTC, 电源按钮，防破坏引脚，GPIOs, ADCs, keypad, UARTs, ...

Linux 多功能驱动
ADC channels (no ADC on i.MX8M Nano/Mini)
GPIOs
PWMs
Power button
Real time clock (RTC)
UART
Watchdog timer
Keypad controller (CC8X, CC8M Nano/Mini)
LED controller (CC8X, CC8M Nano/Mini)


Microcontroller Assist™

Digi Embedded Yocto



DIGI EMBEDDED YOCTO PLATFORM

DIGI U-BOOT

DIGI BSP RELEASE
- DIGI PLATFORM SUPPORT
- DIGI BSP EXTENSIONS
  - DIGI TRUSTFENCE®
  - USABILITY ENHANCEMENTS

NXP BSP RELEASE

UPSTREAM DENX RELEASE

DIGI LINUX KERNEL

DIGI BSP RELEASE
- DIGI PLATFORM SUPPORT
- DIGI BSP EXTENSIONS
  - POWER MANAGEMENT OPTIMIZATIONS
  - WIRELESS
  - DIGI TRUSTFENCE®
  - MCA™ AND IO EXPANDER

NXP BSP RELEASE

UPSTREAM KERNEL.ORG STABILITY PATCHES

DIGI YOCTO USER SPACE

NXP BSP RELEASE
- GRAPHICAL HARDWARE ACCELERATION
- VIDEO HARDWARE ACCELERATION
- CRYPTOGRAPHIC ACCELERATION

YOCTO PROJECT RELEASE
- META-FREESCALE
- META-QT5
- META-SWUPDATE

DIGI BSP RELEASE
- DIGI PLATFORM SUPPORT
  - META-DIGI
- DIGI SOFTWARE EXTENSIONS
  - DIGI TRUSTFENCE ®
  - CLOUD INTEGRATION
    - SUPPORTED CLOUDS
      - DIGI REMOTE MANAGER®
      - AWS
      - Azure
    - FEATURES
      - OTA UPDATES
      - DEVICE CONFIG
      - DEVICE MONITORING
      - DATA STREAMS & AGGREGATION
  - SECURE FIRMWARE UPDATE
  - CELLULAR MODEM SUPPORT
  - NETWORK FAILOVER
  - DIGI EMBEDDED APIs

PRE-COMPILED IMAGES FOR ALL SUPPORTED PLATFORMS

DIGI QUALITY APPROVED

ONLINE DOCUMENTATION

DEVELOPMENT TOOLS
- PRE-COMPILED SDKs + TOOLCHAINS
- BUILD CUSTOM SDKs
- GRAPHICAL IDE PLUGINS (ECLIPSE / QT)

Digi Embedded Yocto 亮点

- Digi TrustFence 安全框架
- 安全的本地和无线固件升级
- 无线wifi蓝牙集成，自恢复网络和即时可用的LTE无线支持
- 电源管理优化和功能性MCA资源API支持
- 基于Eclipse的应用程序开发IDE，SDKs 和例程
- QT Creator 和 QT5 支持
- APIX libraries –扩展的接口库方便应用程序调用
- WPE Webkit 引擎针对嵌入式的优化，包括VPU 和 GPU硬件加速
- 云服务集成(Digi Remote Manager, Amazon AWS IoT, MS Azure)
- 完备的在线文档

基于Eclipse/QT深度定制的IDE

Digi Embedded Android 亮点

- Digi TrustFence安全框架
- 安全的本地和无线固件升级
- 无线wifi蓝牙集成，自恢复网络和即时可用的LTE无线支持
- 电源管理优化和功能性MCA支持
- Android Studio集成化IDE，包括SDKs和运用程序例程
- APIX libraries –扩展的接口库方便应用程序调用
- 云服务集成(Digi Remote Manager)
- 完备的在线文档

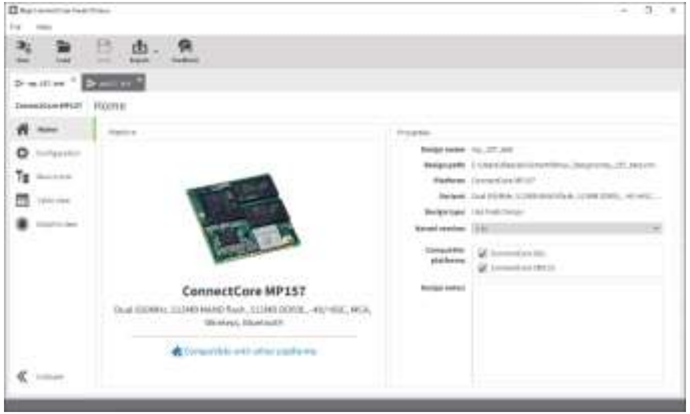
Digi ConnectCore Smart IOmux 2.0

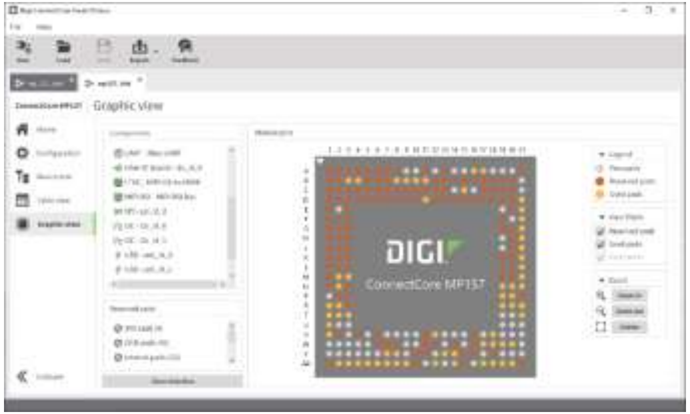
Platform Support 6UL 8X 8M MP1

Digi ConnectCore Smart IOMux

Key Features

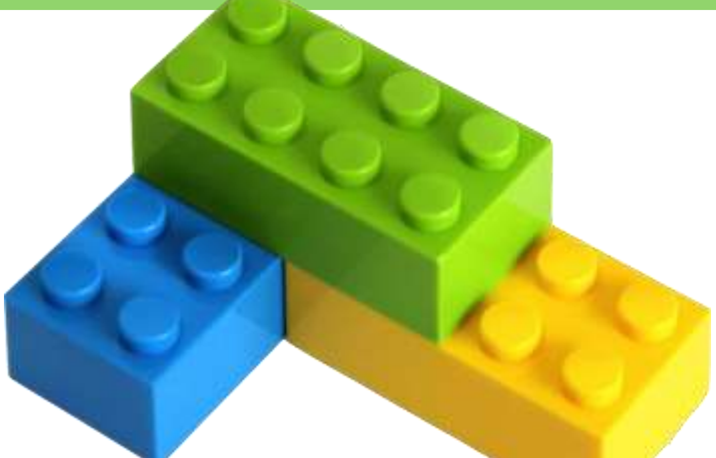
- Support for ConnectCore MP157
- Updated „Design Compatibility” feature (SOM family vs form factor)
- Compatibility option for CC6UL and CCMP1
- New pin-out tab with visual representation of pads

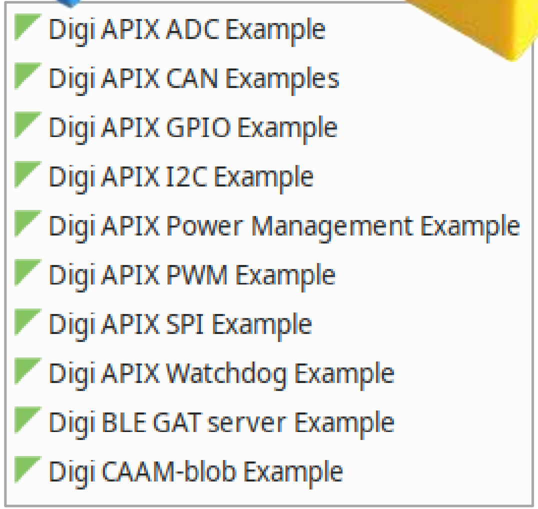




Digi Extension APIs „APIX“

- 简单易用的硬件API来加速应用程序开发
- C / Java 库，使得访问和管理接口变得容易
- 定义更具可读性的接口别名
  - 比如给GPIO5_IO5 定义别名为“USER_BUTTON”
- 接口示例程序代码
- 升级和恢复库(firmware update)
  - API for firmware update and recovery commands
  - Support for encrypted filesystem
- 和Linux/Android的IDE完美集成





Digi APIX ADC Example
Digi APIX CAN Examples
Digi APIX GPIO Example
Digi APIX I2C Example
Digi APIX Power Management Example
Digi APIX PWM Example
Digi APIX SPI Example
Digi APIX Watchdog Example
Digi BLE GAT server Example
Digi CAAM-blob Example

Crank Storyboard

Development

Embedded GUI development framework

Rapidly create your device user interface

- Import content directly from Photoshop
- Animate objects with built-in animation timeline
- Deliver rich 3D graphics (Autodesk FBX, OBJ & OpenGL ES support)
- Clean architectural separation between GUI and application
- GUI test and validation capabilities

Prebuilt ConnectCore demo image ready to evaluate

DEY recipes to build demo apps

Documentation

CRANK SOFTWARE

AMETEK

Digi ConnectCore® — Hardware-Enabled, Software-Defined

Complete solution for industrial/medical OEMs with deep HW/SW integration plus support to accelerate time-to-market and enable the lowest total cost-of-ownership

CLOUD INTEGRATION

Azure

aws

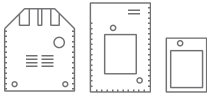
DEVICE MANAGEMENT

Digi Remote Manager®

CONNECTIVITY

Wi Fi™

Bluetooth®



DIGI XBee

zigbee

DigiMesh®

lte Cat-1 LTE-M NB-IoT

868 MHZ

900 MHZ

SOFTWARE & TOOLS

yocto PROJECT

android

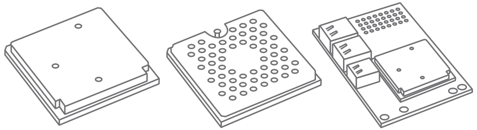
Smart IOMux

Digi XCTU

DIGI TRUSTFENCE

Microcontroller Assist™

EMBEDDED SOMs



arm NXP PARTNER

Industrial Qualified

3 YEAR WARRANTY

SUPPORT & DESIGN SERVICES

Global Technical Support

Design Services

Development

Certifications

Manufacturing

+10 YEARS

Longevity

DIGI

语音控制和人机界面解决方案

语音识别和控制的优势

Hands-free

Eyes-free

Efficiency

Comfort

Hey Machine, please turn the machine on and dim the light to fifty percent for 30 minutes

Digi ConnectCore 离线语音识别与控制解决方案

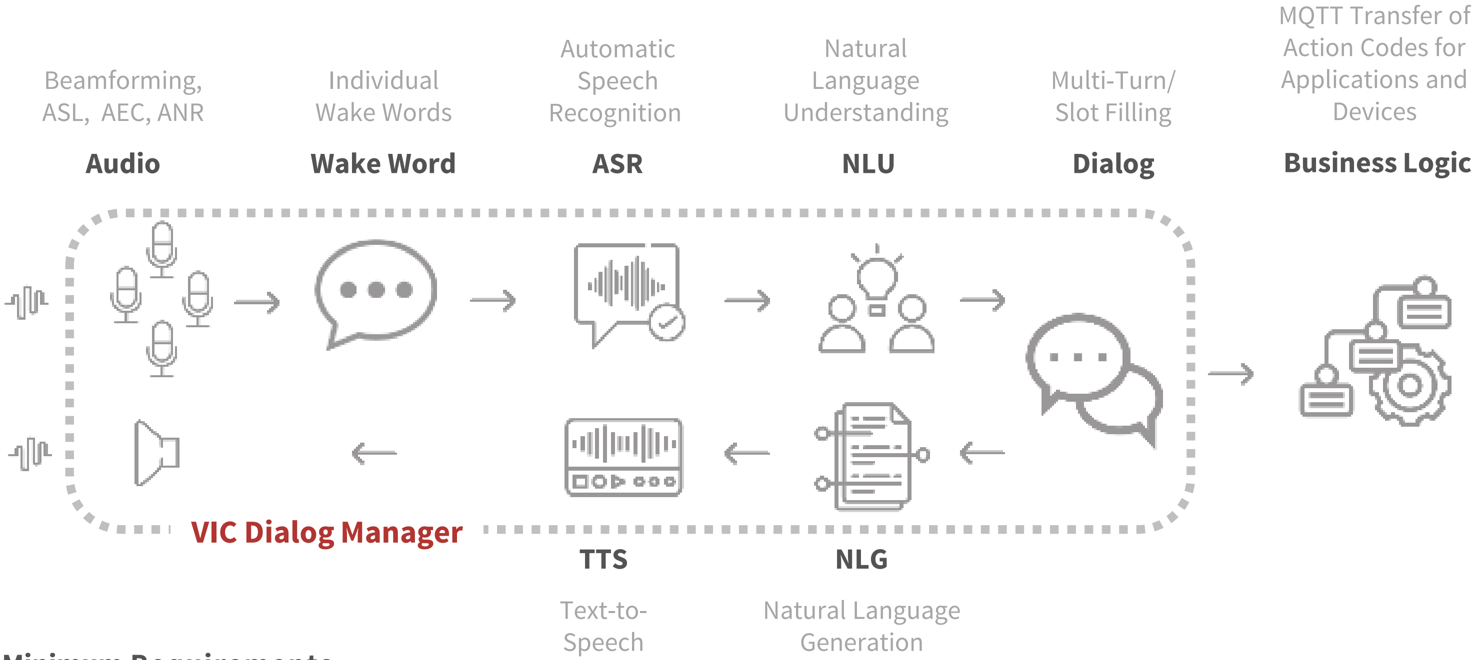
- 工业级的语音控制功能
  - Powered by voice INTER connect **vicCONTROL industrial**
  - Fully integrated into Digi Embedded Yocto (Linux)
  - **Software kit** for Digi ConnectCore 8M Nano Development Kit
    - Support for other ConnectCore SOMs can be made available

voice INTER connect

Key Features

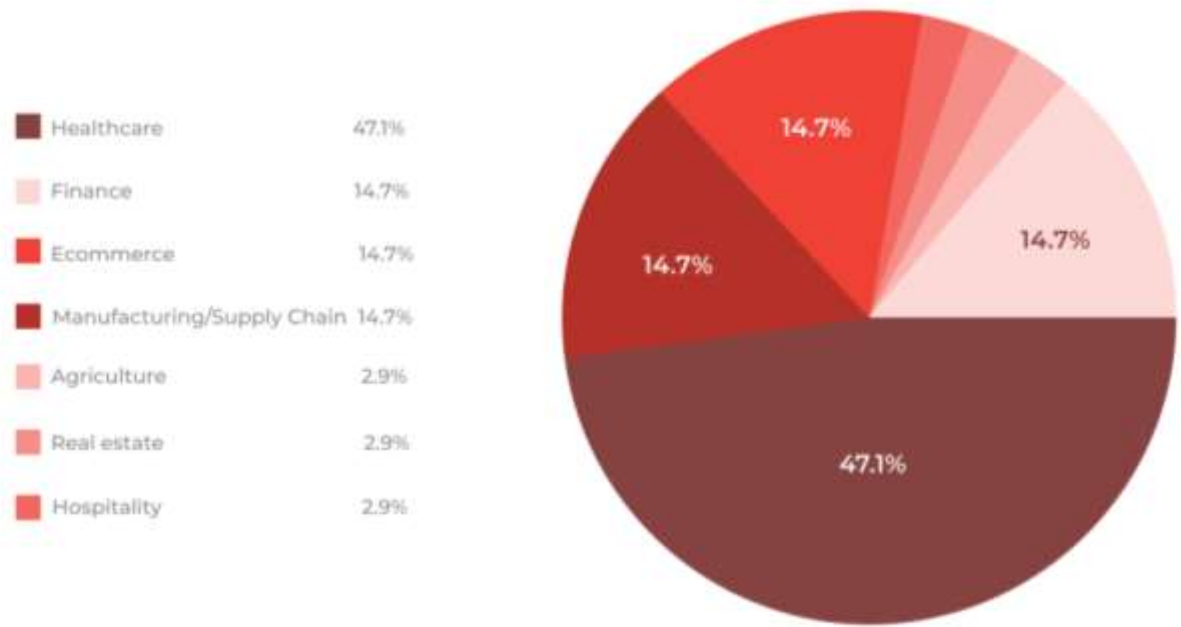
- 无需联网，无云服务费用，
- 低成本嵌入式语音识别
- 工业级实时响应 (reaction < 100 ms)
- 文本语音合成
- 安全和隐私保证
- 基于特定域的语言模型
- 通过web接口训练额外的语音命令
- 30种语言支持
- 无需NPU

vicCONTROL industrial



Minimum Requirements
ARM Cortex A7, 10 MB RAM, 10 MB Flash

语音控制领域的市场趋势



Healthcare represents almost half of the speech recognition market, expected to reach 1.5 Billion+ by 2024

Source: Voice Tech Landscape: 150+ Infrastructure, Horizontal and Vertical Startups Mapped and Analyzed
[Using Speech Recognition Technology in Healthcare - CodeIT]

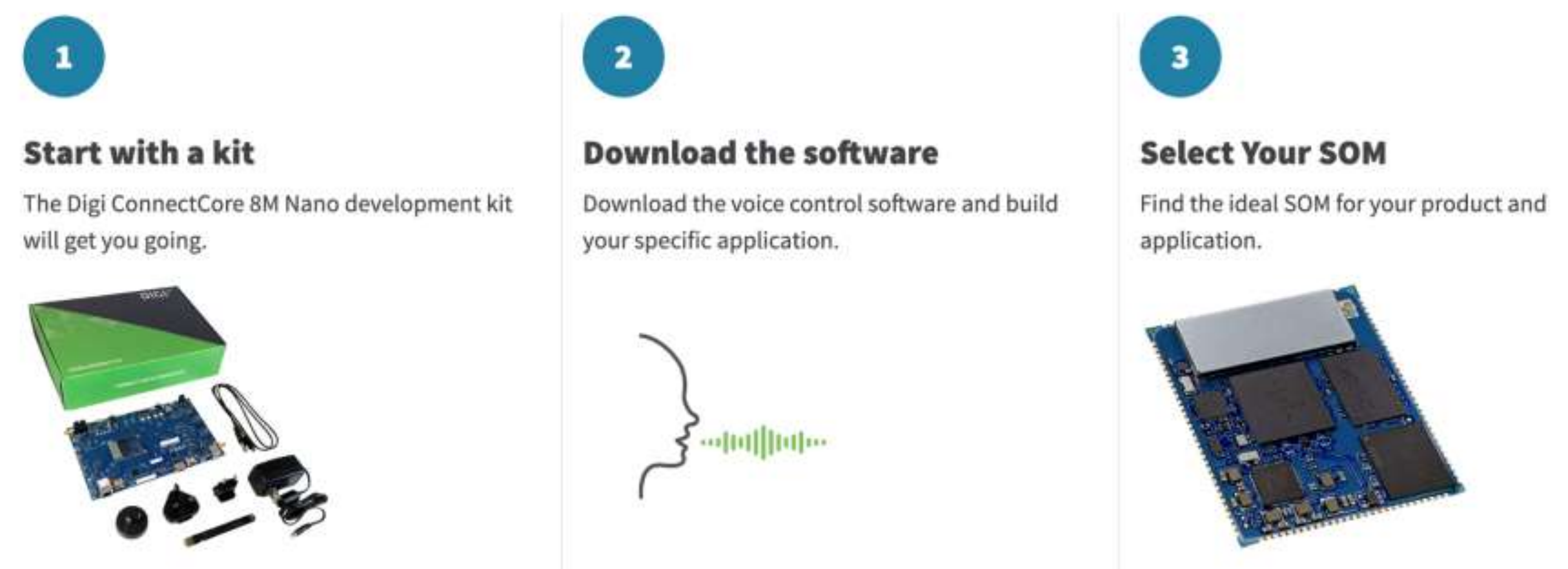
医疗设备的语音识别控制功能示例

- 医护人员可以访问数据而无需被病人或病情转移注意力
  - 在手术过程中访问病人信息
  - 根据诊疗记录实现无接触式语音信息
  - 无需查阅显示屏来检索关键信息
- 切换设备的显示内容和设置，无需手动操作
- 文本语音合成来提供准确的示警信息，而非简单的蜂鸣声和警示灯
- 由病人直接语音控制
- 回复或提示医护人员设备的使用步骤和操作方式
- 检查药物剂量和上次给药记录等
- 命令和回复全在本地，无需通过网络或云端
- 响应实时性

Use Case 1: 医疗设备

Use Case 2: 机器设备

Use Case 3: 停车付费



1

Start with a kit

The Digi ConnectCore 8M Nano development kit will get you going.

2

Download the software

Download the voice control software and build your specific application.

3

Select Your SOM

Find the ideal SOM for your product and application.

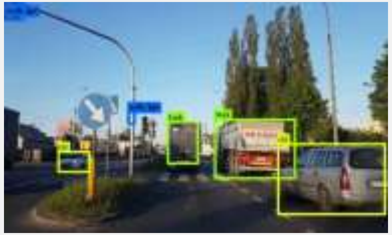
https://www.digi.com/solutions/by-technology/voice-control

嵌入式机器学习和人工智能方案

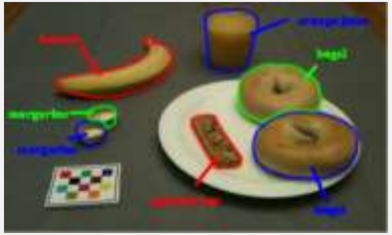
Face Recognition

Gesture Recognition

Voice Recognition

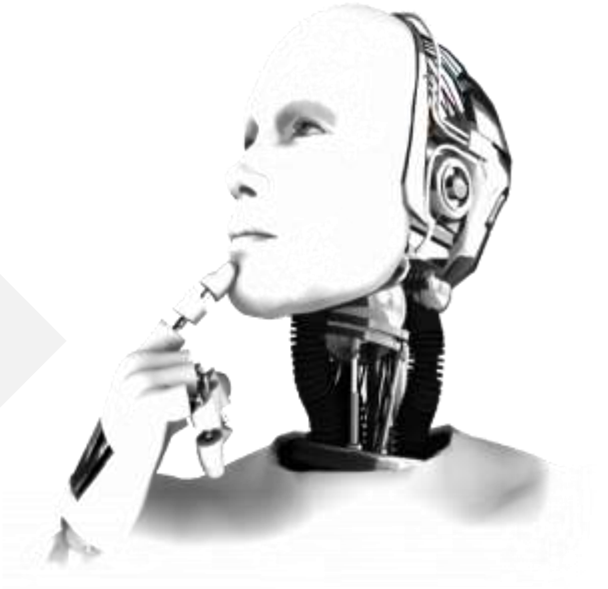


Object Detection



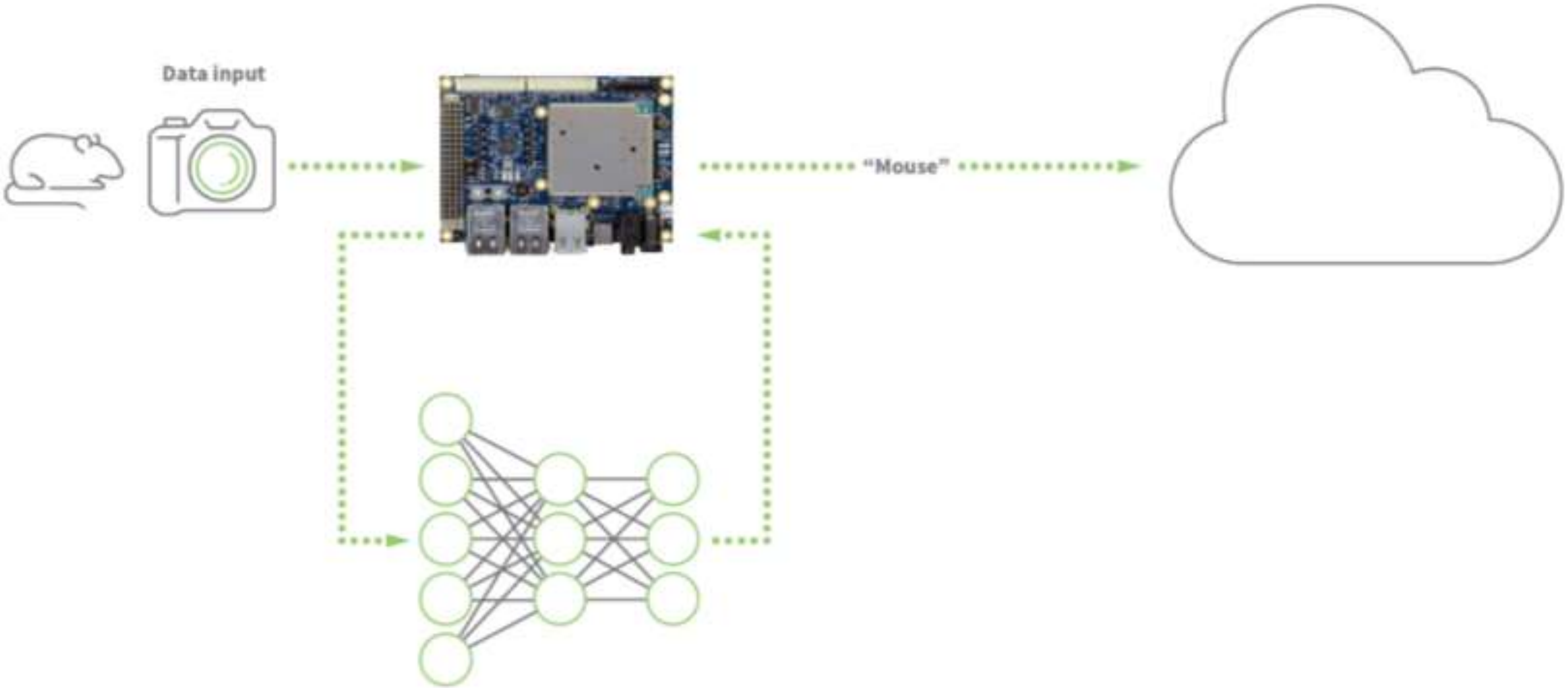
Food Classification

Robotic Agents



Limitless Possibilities

Deep Learning at the Edge



Benefits of Machine Learning at the Edge

Latency
No round-trip to a server

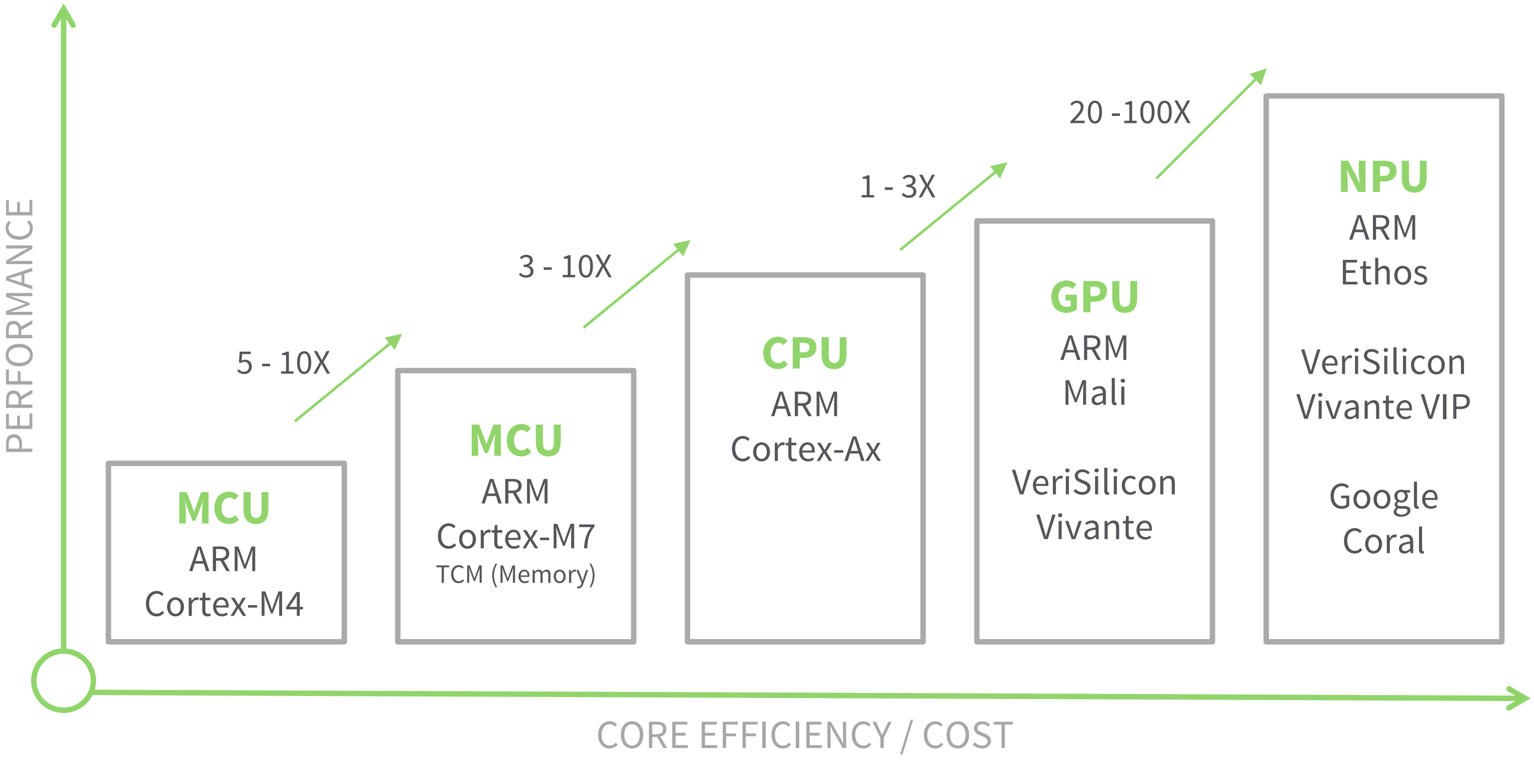
Connectivity
Operate offline

Cost
Reduce data amounts

Power consumption
Network connections are power hungry

Security / Privacy
No data needs to leave the device

Scalable inference at the edge



PERFORMANCE

MCU
ARM
Cortex-M4

5 - 10X

MCU
ARM
Cortex-M7
TCM (Memory)

3 - 10X

CPU
ARM
Cortex-Ax

1 - 3X

GPU
ARM
Mali

VeriSilicon
Vivante

20 -100X

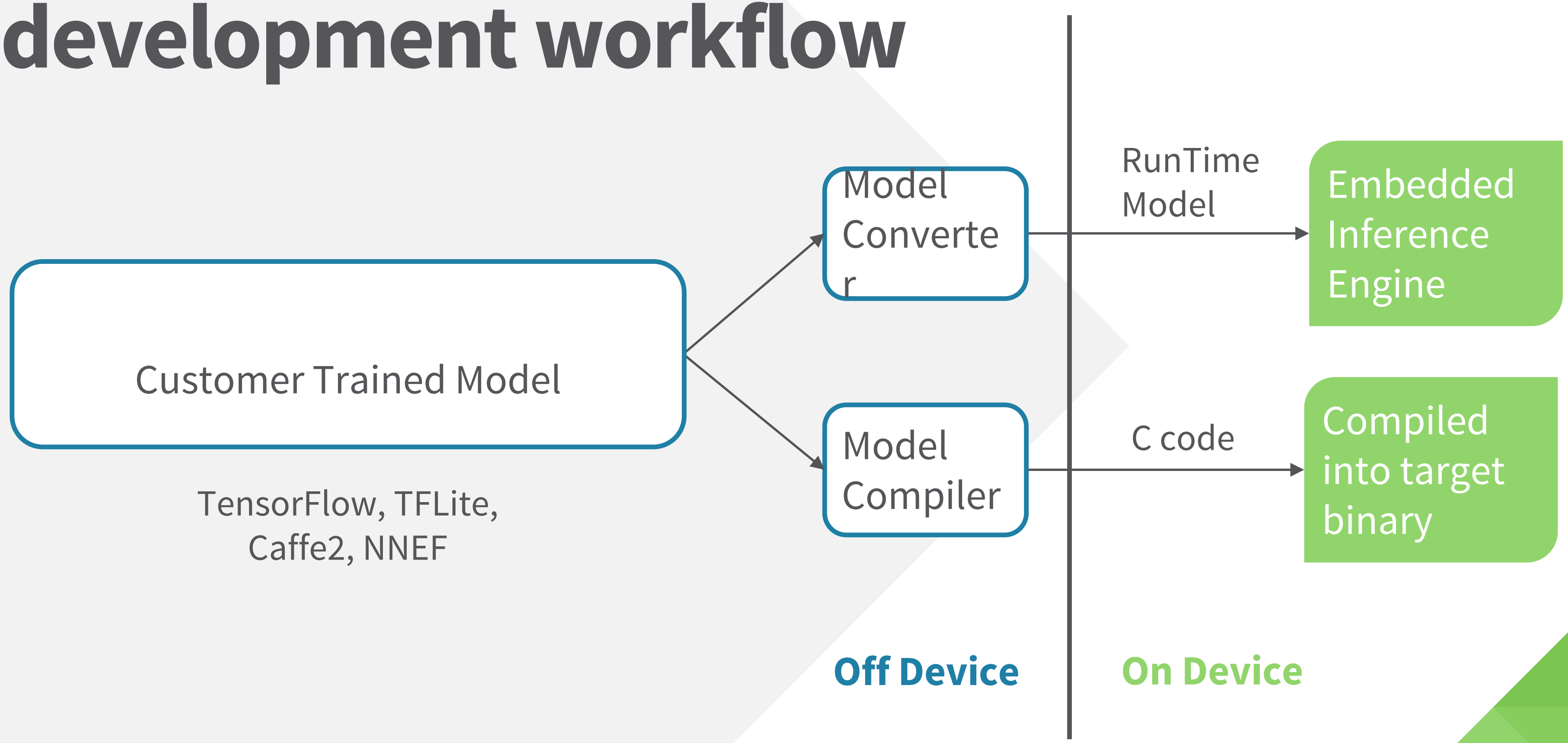
NPU
ARM
Ethos

VeriSilicon
Vivante VIP

Google
Coral

CORE EFFICIENCY / COST

Bring Your Own Model (BYOM) development workflow



Customer Trained Model

TensorFlow, TFLite,
Caffe2, NNEF

Model Converter

Model Compiler

RunTime Model

C code

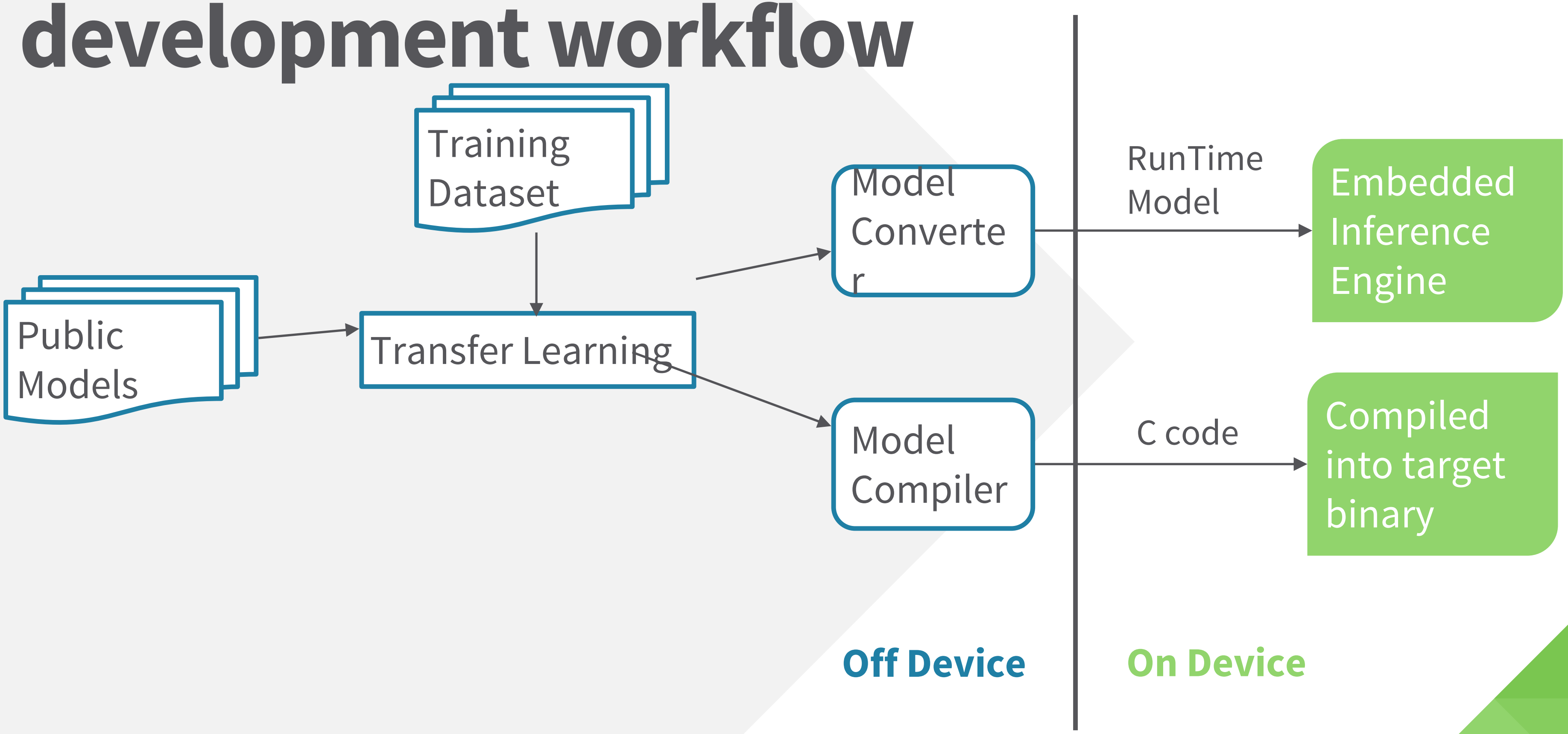
Embedded Inference Engine

Compiled into target binary

Off Device

On Device

Bring Your Own Data (BYOD) development workflow



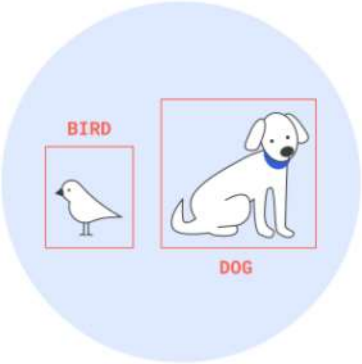
Digi ConnectCore and Google Coral

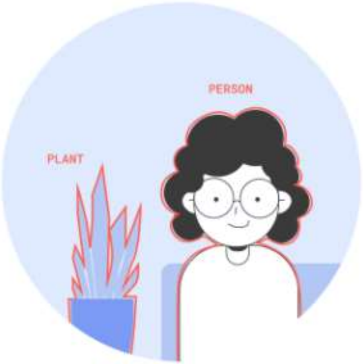
Digi ConnectCore – NXP SOC Comparison

		i.MX8X	i.MX8M Plus	i.MX93 Solo/Dual	i.MX95 Dual+/Quad/Hex
General	Package	21x21mm, 0.8mm	15x15mm, 0.5mm de-pop	11x11mm, 0.5mm de-pop	11x11mm, 0.5mm de-pop
	Silicon Process	28 nm FD-SOI	14nm FinFET	TSMC 16nm FinFET	TSMC 16nm FinFET
	Primary Core	2-4 x Cortex-A35 (1.2 GHz)	2-4x Cortex-A53 (1.8 GHz)	1-2x Cortex-A55 (1.7 GHz)	2-6x Cortex-A55 (2.0 GHz)
	Secondary Core	1x Cortex M4F @ 266MHz	Cortex-M7 (800 MHz)	Cortex-M33 (250 MHz)	Cortex-M33 (250 MHz) +) + M7(800 MHz)
	NPU (ML/AI accelerator)	-	Verisilicon 2.3TOPS	Ethos U65 0.5TOPS	Ethos U65 **1.0TOPS**
	Memory Interface	32-bit DDR3(ECC)/LPDDR4 (noECC)	32-bit LPDDR4/DDR4 (Inline ECC)	16 bit LPDDR4/4X Inline ECC	32 bit LPDDR4X/LPDDR5 Inline ECC
	Security		CAAM, RDC, TrustZone	Edgelock-500B Secure Enclave	Edgelock-500B Secure Enclave + SMMUs + V2X accel.
Multimedia	GPU	GC7000Lite (2-/4-Shader), OpenGL ES 3.1 / Open CL, Vulkan	GC7000UL (2 shaders), OpenGL ES 3.1, OpenVG 1.1, Vulkan, OpenCL 1.2	PXP Engine	3D GPU: 50GFLOPS, OpenGL ES 3.2, Vulkan 1.2, OpenCL 3.0
	VPU	Decode: 4K h.265, 1080p h.264 Encode: 1080p h.264	Decode: 1080p60 HEVC, H.264, VP9, VP8 Encode: 1080p60 H.265, H.264	-	Decode: 4Kp30 HEVC, H.264, H.265 Encode: 4Kp30 H.264, H.265
	Display	2x 1080p60 MIPI DSI (4-lane) or 2x 1080p60 LVDS + 1x (WXGA)	HDMI 2.0a Tx, MIPI DSI (4-lane) LVDS (4/8-lanes)	1080p60 MIPI DSI (4-lane) or 720p60 LVDS (4-lane) or 18-bit parallel RGB	1080p60 MIPI DSI (4-lane) or 1080p60 LVDS (4- or 8-lane)
	Resolution	up to 1080p60	up to 4K resolution	up to 1080p60	up to 4Kp30
	Camera	1x MIPI CSI (4 lanes), 1x Parallel CSI	2 x MIPI CSI (4-lanes each)	1080p60 MIPI CSI (2-lane) or 8-bit parallel YUV/RGB	500M Pixel, 1080p60 MIPI CSI (2x 4-lane)
	ISP	-	2 x ISP up to 12 MP Resolution	-	w/ISP
	Audio	4x SAI, Tensilica® HiFi 4 DSP *	18 x I2S TDM (32 bit @ 384 kHz)	7x I2S TDM (32-bit @ 768KHz)	17x I2S TDM (32-bit @ 768KHz)
Connectivity	Wireless	-	-	-	-
	Ethernet	2 x GbE	2 x GbE (1x TSN)	2x GbE (1x TSN)	2x GbE (TSN Switch)
	USB	1 x USB 3.0, 1 x USB 2.0	2 x USB 3.0	2x USB 2.0	1x USB 3.0
	CAN	3x CAN-FD	2x CAN-FD	2x CAN-FD	3x CAN-FD
	PCIe	1 x PCIe Gen 3	1 x PCIe Gen 3	-	1x PCIe Gen 3

Google Coral Introduction

- Hardware / software platform for accelerating neural networks
- Toolkit to build applications with local AI and Machine Learning
- Supports Tensor Flow Lite models, C++ and Python programming
- More information at www.coral.ai





Digi ConnectCore and Google Coral

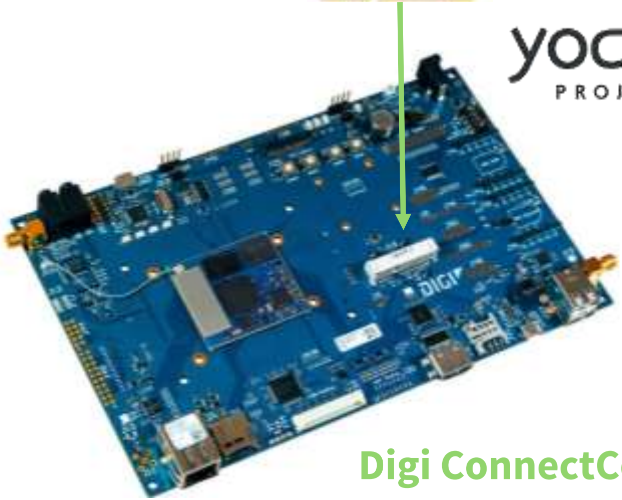
- Coral PCIe minicard plugs into the Digi ConnectCore® 8M Mini development board
- Full Coral support in Digi Embedded Yocto – Digi's fully maintained secure Linux distribution
- Test powerful AI/ML technology and software with Digi ConnectCore today
- Great for AI/ML prototyping with a path to production
- More information at Google Coral with Digi ConnectCore

TPU对CPU算力的提升：
https://coral.ai/docs/edgetpu/benchmarks/

Coral


g650-04528-01

yocto PROJECT



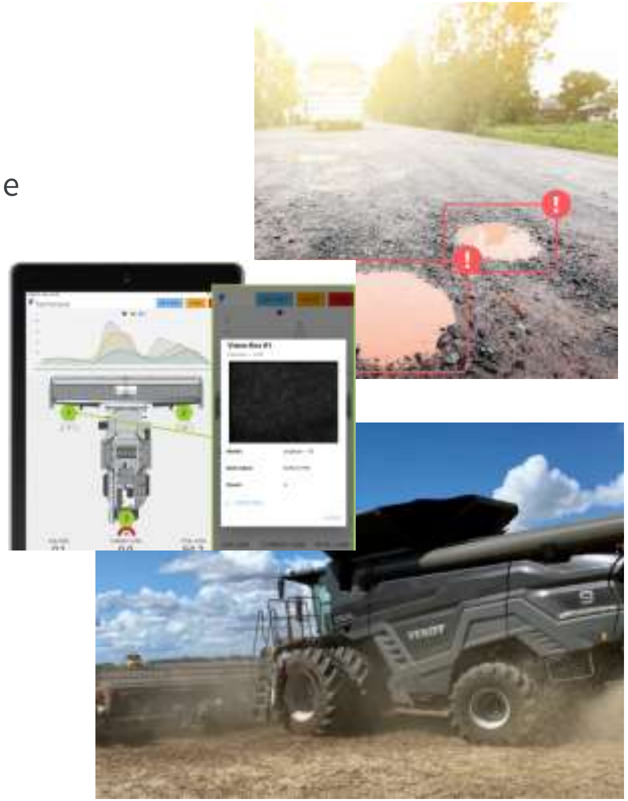
Digi ConnectCore

Example Use Cases

- **AI powered endoscope to fight cancer (Medical)**
  - Spotting polyps and precancerous growths
    - “There’s up to a 3% miss rate, even in the best hands”
  - Analyze visual information real-time with Coral rather than waiting for cloud processing
  - Demo system developed within 5 weeks
- **Water utility – meter health solution (Industrial)**
  - Measuring water meter / flow accuracy and financial impact
  - Camera, magnetic sensor and acoustic sensor to monitor meter and actual water flow in pipe
  - Solar powered, low energy edge processing solution based on Coral

Example Use Cases

- **“Double-duty” sanitation truck (Smart City)**
  - Sanitation: waste disposal + pothole spotting for highway department
  - Truck equipped with ARM based system and cameras mounted on the side
  - Onboard AI enabled by Coral, spotting / logging potholes for servicing
  - Plan to detect other things such as fires in the future as well
- **Harvesting optimization system (Agriculture)**
  - AI-powered tool prevents losses during harvest
  - Real-time adjustments to conditions in the field
  - ML models, a harvester-mounted box with cameras,
    an in-cab display, and on-device AI acceleration from Coral

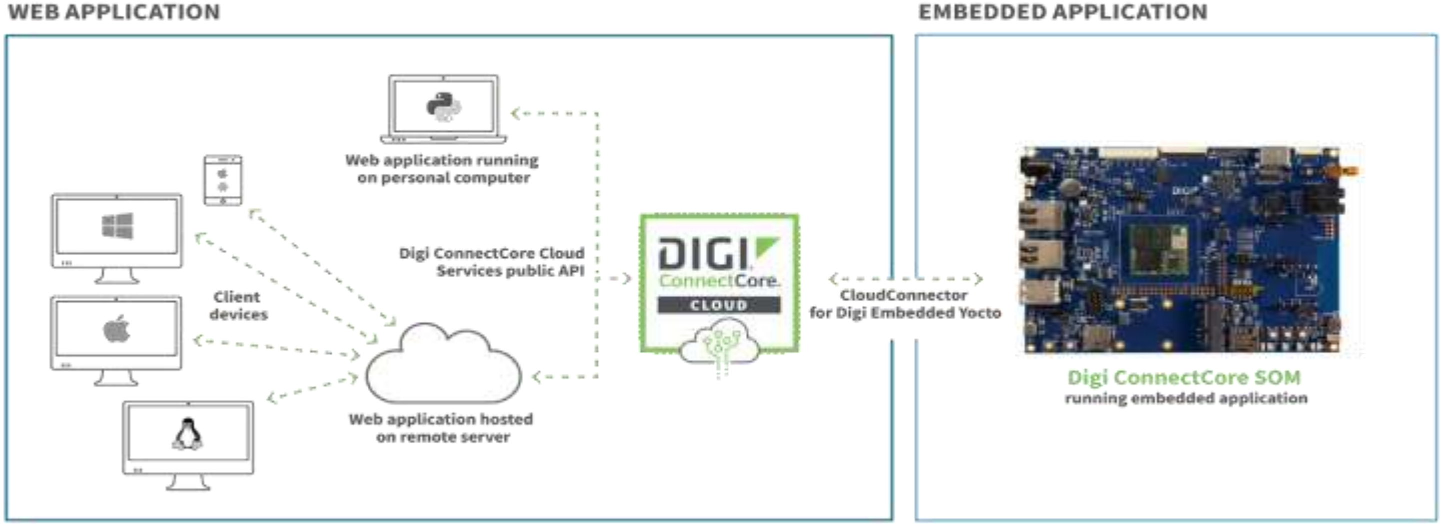


Digi ConnectCore Cloud Services

- **What is the OEM’s problem?**
- 越来越多的设备厂商希望嵌入式设备也能像手机等一样，自动获取软件和安全更新
- 最终用户希望有手机应用或厂商web界面来配置,监控和使用设备
- OEMs厂商需要设计，开发并交付智能连接设备，把软件升级作为一种服务交付给客户
- **What is the Digi solution?**
- Digi 的用户可以使用**Digi ConnectCore® Cloud Services** 来安全分发软件更新，并赋能应用程序控制它们的智能设备
- 更多

End-to-End Application Demo

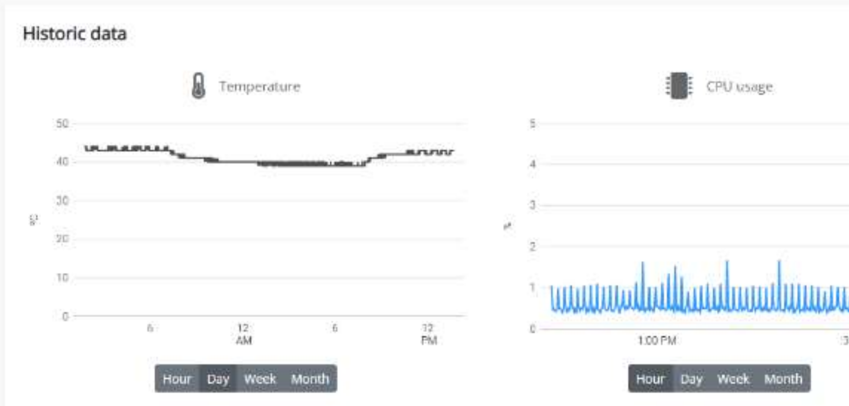
- Web Application
  - Reference implementation for customers
    - Python, HTML, JavaScript, CSS
  - Connecting to devices through Digi Cloud Services
    - Digi Cloud Services APIs
  - Hosted on a webserver / run locally on computer
- Embedded Application (*optional)*
  - Communicates with hardware and Cloud Services
  - WPE webkit browser engine / local display
- Provisioning / Smart Phone App (*future roadmap*)
  - Bluetooth communication
  - Initial configuration / provision device into Cloud Services



End-to-End Application Demo

Web Application Features / APIs

- Real time data - Monitor API
- Historic data - Streams API
- Remote user interaction - Device request API
- Remote console access - CLI API
- Remote file system access - Filesystem API
- Remote firmware update - Firmware Update API



DIGI 无线模块产品更新

Digi XBee®

The most complete, easiest to use wireless networking solution for IoT

- 简单
- 灵活
- 安全
- 面向未来

Digi XBee Is a Complete IoT Networking Solution

Cloud

DIGI REMOTE MANAGER

Device Management

Cellular
Ethernet
Wi-Fi

AWS

Microsoft Azure

Private Cloud

Cloud Integration

at&t

verizon

Deutsche Telekom

vodafone

+ Global Operators

Data Plans

Requirements

SW/FW

HW/RF/Certs

Gateways

Modules

zigbee

Bluetooth

DigiMesh® +

802.15.4

Short Range (2.4 GHz)

DigiMesh®

Star/P2P

Long Range (868/900 MHz)

lte Cat-1

LTE-M

NB-IoT

Cellular

Software and Tools

- Digi XCTU®
- XBee APIs
- XBee Libraries (C, Java, Python)
- Edge Compute
- PyCharm IDE Plug-In
- Network Assistant
- XBee Mobile App & SDK
- Multi Programmer
- Interface Boards
- GPS Daughter Board
- Security

Professional Services

Xbee的成本和供应链问题

- 两年以来，受受缺芯潮影响，传统的Xbee S2B,S2C模块价格高企
- 2019年底推出XBee3，原本作为全功能，低成本的传统XBee升级替代首选
- 受上游供应链影响，XBee3产能供不应求，交期较长

Digi XBee RR

Simple, Secure, Low-Power Connectivity

- 2.4GHz Protocols: ZigBee, 802.15.4 or DigiMesh®
- Digi TrustFence security
- Micro-Mount, Through-Hole and Surface Mount Form Factors
- Very minor differences in GPIO
  - DIO-10, DIO-11 (P0, P1 Commands are unavailable)
- No MicroPython support
- Bluetooth functionality is limited to support acting as a peripheral device
- Specifications:
  - Both the standard power (low) and PRO variants are available
  - Industrial temperature: -40 ° C to +85° C
  - Simple migration from XBee 3 2.4GHz families to XBee RR
  - Pre-certified for FCC, IC, AUS, NZ
  - Other Regions coming soon

XBee降成本设计

- **从S2C到XBee RR**

❖ 封装更小

原XBee标准封装的三分之一大小

❖ 成本更低

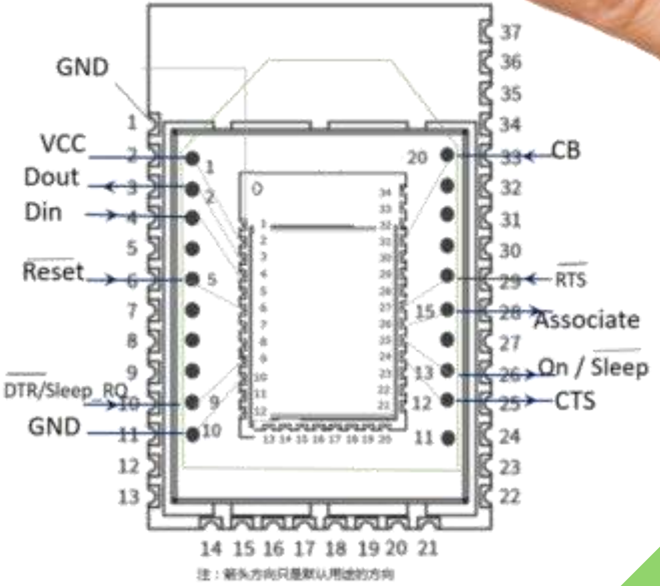
可节约成本5~10$

❖ 交期更短

三个月左右

❖ 自带基本蓝牙功能

❖ 无XBee3的Micro Python功能



Digi XBee RR 和XBee3差异

- 相比XBee3, XBee RR有两个不常用的引脚不可用
  - DIO10: PWM0/RSSI Indicator (AT command P0)
  - DIO11: PWM1 (AT Command P1)
- XBee3和XBee RR的ADC参考电平不同

Value of the AV parameter	Digi XBee RR analog reference	Digi XBee 3 analog reference
0	1.21 V	1.25 V
1	2.42 V	2.5 V
2	VCC	VCC

- 混合组网时，XBee RR与XBee3的OTA升级需要两种固件

XBee 3 XR?

- 下一代长距离Xbee: 900MHz, 868MHz
- 替代XBee SX900 和SX868
- 提供三种封装：插针，贴片，迷你邮票孔贴片
- XBee3系列： 蓝牙+MicroPython

Digi Sub-G 长距离无线模块

- 新一代 XBee 868/900MHz
  - 标装XBee封装
    - 双列直插 (TH)
    - 邮票孔 (SMT)
  - 多种发射功率
    - PRO 900MHz: 250mW 到1 Watt (+30dBm) 可调
    - Standard 900MHz: 80mW (+19dBm)
    - Standard 868MHz: 20mW (+14dBm)
  - 天线接口
    - Through-hole (TH): MMCX, U.FL, Wire
    - Surface mount (SMT): RF Pad, U.FL
  - 配套网关
    - Digi IX15
  - Bluetooth Low Energy 4.2 (TH, SMT)
    - Software upgradable to 5.0 with future SW updates
  - Digi TrustFence security
  - Edge Compute (TH, SMT)
  - Protocol Compatibility: XBee SX

Network Monitoring
Configuration Management
Firmware Updates
Detection & Troubleshooting

868 MHZ
900 MHZ
+

Up to +1W TX Power!

Programmable Edge Compute
MicroPython

XBee XR Family

Product Name	XBee 3 XR PRO	XBee 3 XR		XBee XR Micro	
Form Factors	 Wire MMCX U.FL Through-hole RF Pad U.FL Surface Mount	 Wire MMCX U.FL Through-hole RF Pad U.FL Surface Mount		 RF Pad U.FL Micro-Mount	
Sub-GHz Topologies	DigiMesh® Star/Point-to-point 				
Sub-GHz Frequency	900MHz		868MHz	900MHz	868MHz
Sub-GHz Output Power	Up to 1 Watt (+30dBm)	Up to 80mW (19dBm)	25mW (14dBm)	Up to 80mW (19dBm)	Up to 25mW (14dBm)
Sub-GHz Data Rate	10-250 kbps		10-80 kbps	10-250 kbps	10-80 kbps
2.4GHz Networking	Bluetooth® (BLE 5.0)			-	
Programmability	MicroPython (32kB Available Space)			-	
Protocol Compatibility	XBee SX				

Digi XBee Cellular无线模块

支持全球市场统一型号

- **XBee3 Global LTE-M/NBIOT**
  - GNSS 地理定位 *
  - 2G 回落 *
  - 低功耗蓝牙 (当前支持4.2，未来可通过软件升级支持5.0)
  - TrustFence 极致安全
  - 边缘计算能力(MicroPython)
  - 自带SIM迷你卡槽 (未来支持eSIM型号)
- **XBee3 CAT1 Global**
  - 全球统一型号: 2G+3G fall back
  - 北美型号: 3G fall back
  - 多国运营商认证
  - 低功耗蓝牙 (当前支持4.2，未来可通过软件升级支持5.0)
  - TrustFence 极致安全
  - 边缘计算能力(MicroPython)
  - 原生云连接支持（DRM，AWS，Azure）
  - 自带SIM迷你卡槽 (未来支持eSIM型号

DIGI REMOTE MANAGER

- Network Monitoring
- Configuration Management
- Firmware Updates
- Detection & Troubleshooting

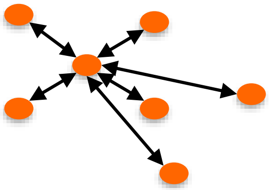
NB-IoT
LTE-M
GNSS
MicroPython
+2G Fallback

MicroPython

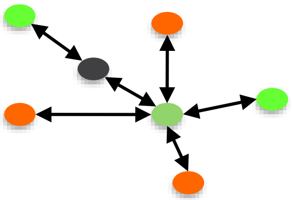
New:
XBee 3 North America LTE Cat 1
XBee 3 Global LTE Cat 1

Legacy:
XBee 3 LTE Cat 1 AT&T

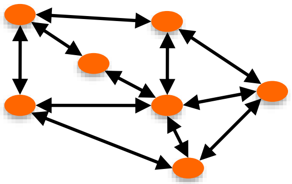
Digi XBee所支持五种协议



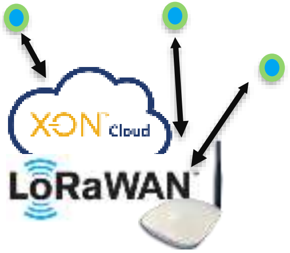
P2MP



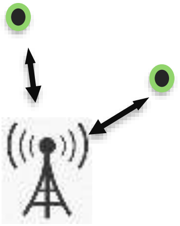
ZigBee Mesh



DigiMesh



Lora



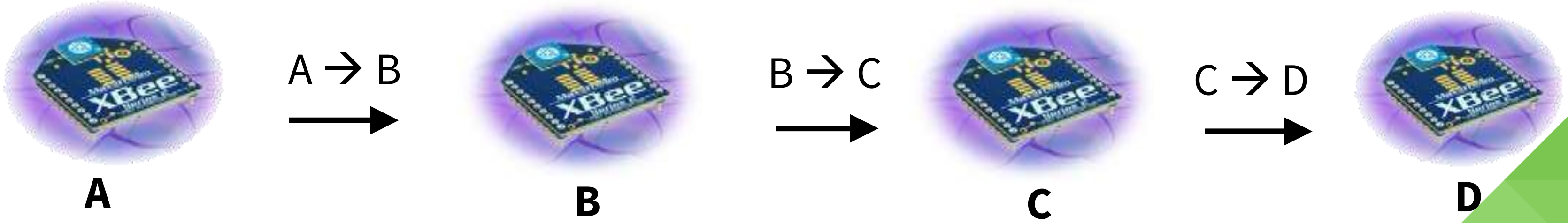
LTE

星状网络也称P2MP**网络，它的特点是带宽高，实时性好**

Mesh**可实现自组网，每个信息节点可以给别的节点作跳点，并且当路由中有失效节点时，网络可以自愈**

Lora**则是低带宽长距离的星状网络，通过网关扩展多个不同域的**Lora**接入点，由**XON**实现端到端解决方案**

LTE**是运营商运维的**NBIOT**或**4G,5G**网络，**XBee Cellular**实现全球统一型号接入不同运营商**



DIGI End-to-End LoRaWAN Solution for Enterprises

Client Devices

Gateways

Deployment Tool

Xbee LR Module

Industrial Edge Controller

Indoor Gateway

Outdoor Gateway

Scan & Go Provisioning App

Hybrid Cloud/Edge IoT Platform

Managed Applications

Real-time Data Streaming

XBee 桌面和手机客户端配置调试工具

- XCTU是免费，简单易用的Digi Xbee桌面工具，可用于配置，调试和测试Xbee通信。
- 图形化的网络视图
- API 帧创建和解析
- 简单的距离测试工具
- 集成串口调试终端
- 各种Xbee固件浏览和学习
- 带宽测试工具
- 频谱分析功能
- 设备云集成

XBee Mobile是手机版的XCTU，通过蓝牙来配置，调试模块

XBee Studio 是下一代XBee桌面工具，支持从云端远程配置XBee

Download on the App Store

GET IT ON Google Play

XBee3 可编程能力和蓝牙加持，创造新的机遇

原生的可编程能力

- 简单应用场景无需MCU，用更省的成本打造简单的连网设备
- 可作为智能节点和低端的网关
  - OEM厂商可以利用Xbee3创建自己的特性和功能。
  - 更大的flash和RAM支持本地python程序
- 本地有线，无线传感器连接
  - 可通过串口,SPI,蓝牙等不同方式控制本地传感 网络

蓝牙不仅仅是配置通道

GAP Roles

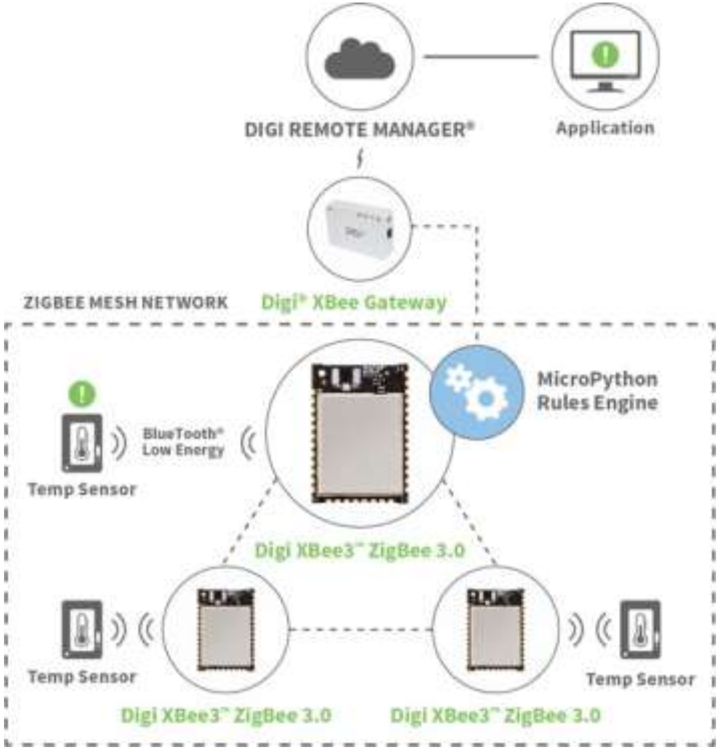
- Advertising (Peripheral)
- Scanning (Central)

GATT Service for Configuration and Data

- Secure Remote Password Protocol - authentication and encryption
- XBee Configuration - API frames over BLE
- Configuration and Data transfer using Data Relay Frames

GATT Client Connections

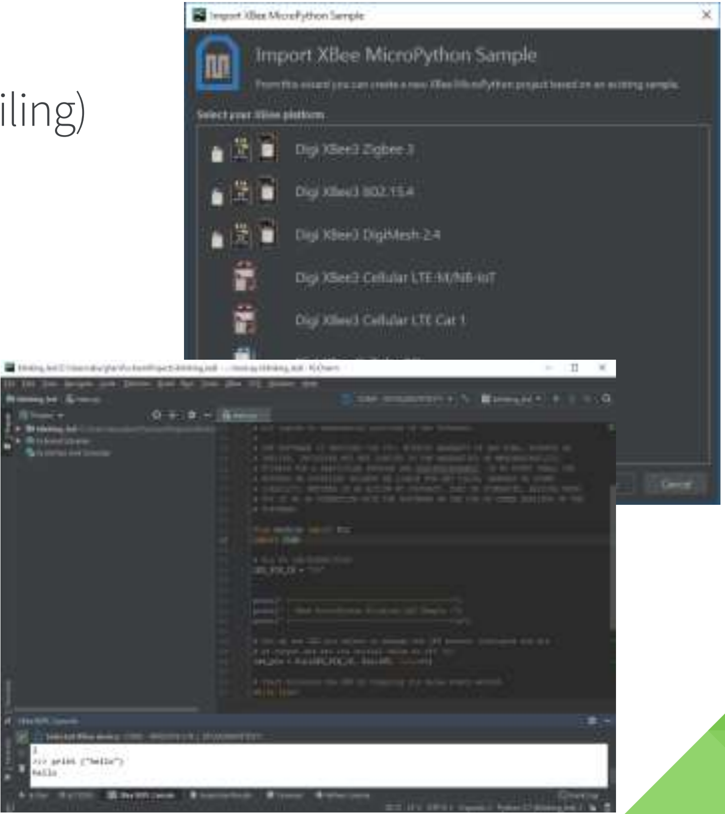
- Read Sensors and Control actuators



XBee MicroPython PyCharm Plugin
MicroPython development

DEVELOP

- Intelligent Coding Assistance
- Built-in Developer Tools (Debugging, Testing and Profiling)
- Graphical debugger and test runner
- Customizable and Cross-platform IDE
- MicroPython samples
- Compile and flash projects into XBee with one click



Import XBee MicroPython Sample

From this wizard you can create a new XBee MicroPython project based on an existing sample.

Select your XBee platform:

- Digi XBee3 Zigbee 3
- Digi XBee3 802.15.4
- Digi XBee3 DigiMesh 2.4
- Digi XBee3 Cellular LTE-M/NB-IoT
- Digi XBee3 Cellular LTE Cat 1

```
>>> print ("hello")
hello
```

Digi XBee® Module Roadmap

	Available Now	2022 Q4	2023 Q1	2023 Q2	2023 Q3
Short Range 2.4 GHz	XBee 3 Zigbee/DigiMesh/802.15.4 XBee S2C PRO SMT XBee RR MMT (specific customers)	XBee RR MMT General Availability	XBee RR SMT & TH General Availability		
Long Range 868/900 MHz	XBee SX		XBee XR Micro SMT & TH in March		CONCEPT XBee 3 XR PRO Early Customer Samples
Cellular	XBee 3 Cellular LTE-M/NB-IoT (NB1) Pre-Inserted SIM Option	XBee 3 North America LTE Cat 1 (3G + GNSS) XBee 3 Global LTE Cat 1 (2G+3G+GNSS)	XBee 3 Global LTE-M / NB-IoT (NB2 + 2G + GNSS) (NB2 + GNSS) (Two SKUs)		CONCEPT XBee 3 Global Cat 4 w/eSIM

THANK YOU

ROBIN.TU@DIGI.COM