NXP EV Charging Solutions
恩智浦电动车充电桩解决方案

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电力与能源市场经理

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NXP Technology optimizes End-to-end Energy Systems from Grid to EV and Building

Best-in-class resilient security technology for authentication, payment and IP protection

Robust Wi-Fi, BLE, Thread, Zigbee, UWB and sub-GHz radio integration

Leadership in the Matter standard for universal communications between IP-connected devices

Scalable analog, processing and machine learning technology for software reuse

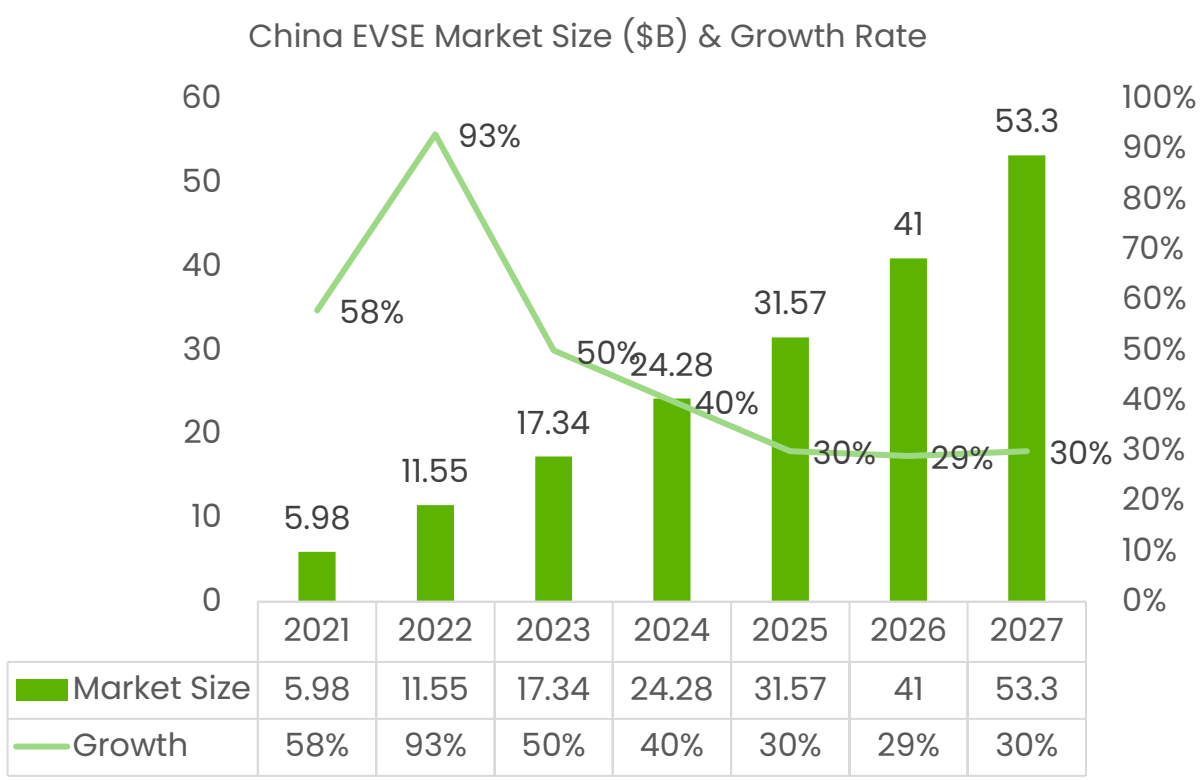
Time-saving, pre-certified enablement for sustainable, reliable & safe energy solutions

NXP 15-year Product Longevity Program

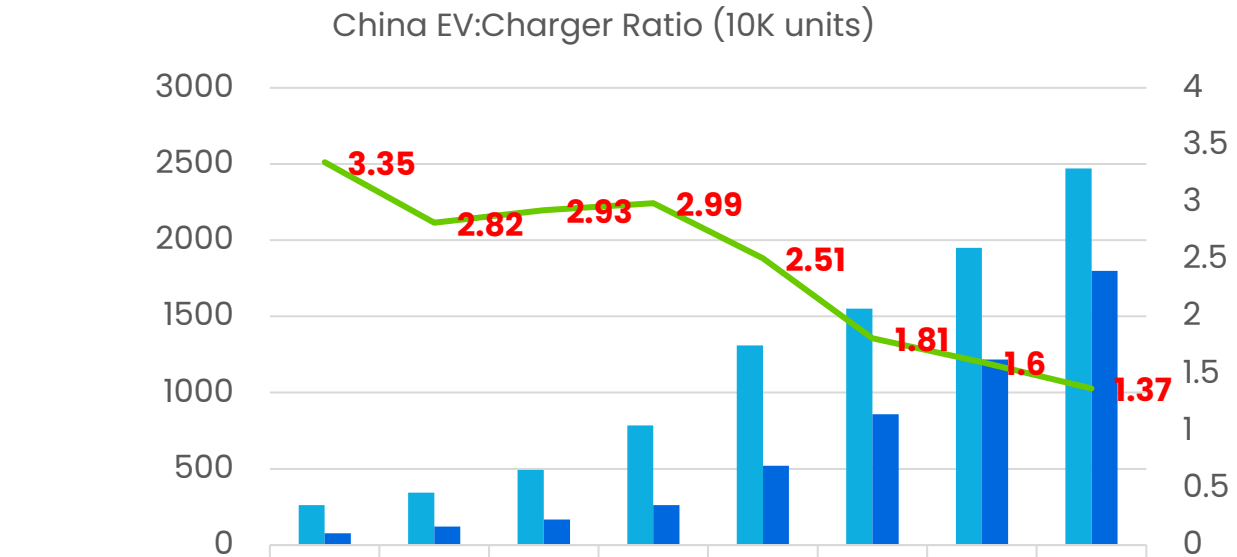
Focus Applications for Enabling the Mission to Net Zero

Energy Management	
EV Supply Equipment	
Energy Storage	
Power Conversion	
Metrology (Flow, Electric)	

Sizable GC EV Charging Market With Continuous Growth



	2021	2022	2023	2024	2025	2026	2027
Market Size	5.98	11.55	17.34	24.28	31.57	41	53.3
Growth	58%	93%	50%	40%	30%	29%	30%



	2018	2019	2020	2021	2022	2023	2024E	2025E
EV	261	344	492	784	1310	1552	1950	2472
Charing Pile	77.7	121.9	168.1	261.7	521	859	1217	1800
Ratio	3.35	2.82	2.93	2.99	2.51	1.81	1.6	1.37

*Data Source: EVCIPA - China Electric Vehicle Charging infrastructure Promotion Alliance

EV CHARGING DESIGN CHALLENGES

- **Efficient and Sustainable**

  Charge faster with less energy conversion loss

- **Reliable and Safe**

  21% charging attempts failed in Q3 2021*

- **Securely Connected**

  83% infrastructure companies breached (2021)

- **Cost-Optimized**

  Products are maintained > 15 years

- **Faster Product Ramp**

  Requirements are rapidly evolving

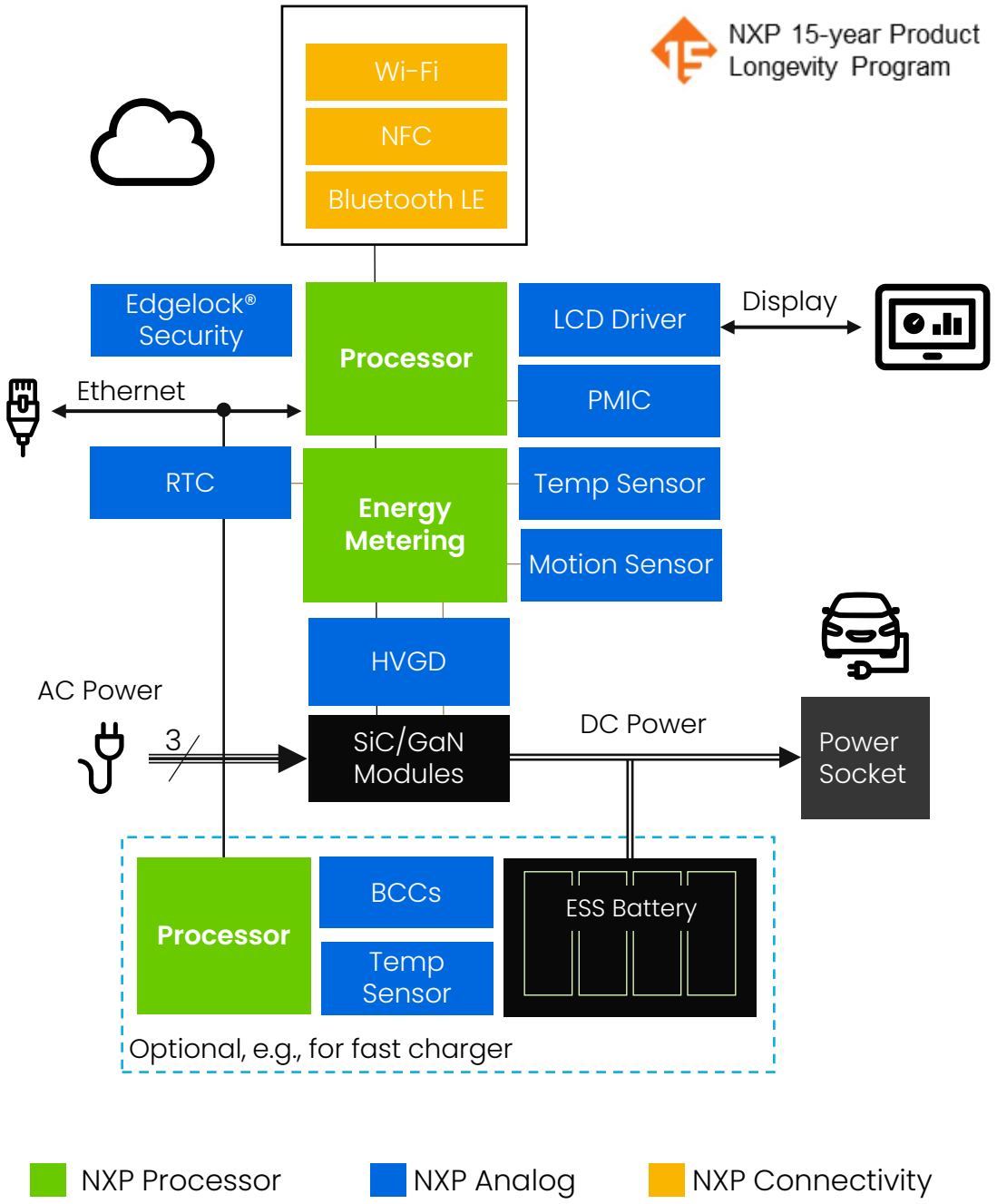
NXP Solutions (2024)

• Accurate AFE & pre-certified metrology libraries for Cortex-M cores • Efficient AC/DC conversion	• Metrology reference designs • DSC reference designs
• ISO 15118-20 for bi-directional charging • Functional safety	• SEVENSTAX ISO 15118 SW on i.MX 93 and RT1064 • EVSE-SIG-BRD1X with Lumissil PLC + LPC55S36
• Robust connectivity solutions • Resilient EdgeLock Security	• Pre-integrated SW for NXP Wi-Fi, Bluetooth LE, NFC • Proven security for ISO 15118 standard
• Scalable roadmap • Product longevity program	• Solutions include MPU, MCU, PMIC, connectivity, analog, software • >15-year product longevity
• Charging reference designs • Pre-certified safety, security, metrology, connectivity, Matter	• EasyEVSE development platforms (i.MX 93, RT1064) • Support for a range of global standards

Why NXP for EV Charging Equipment?

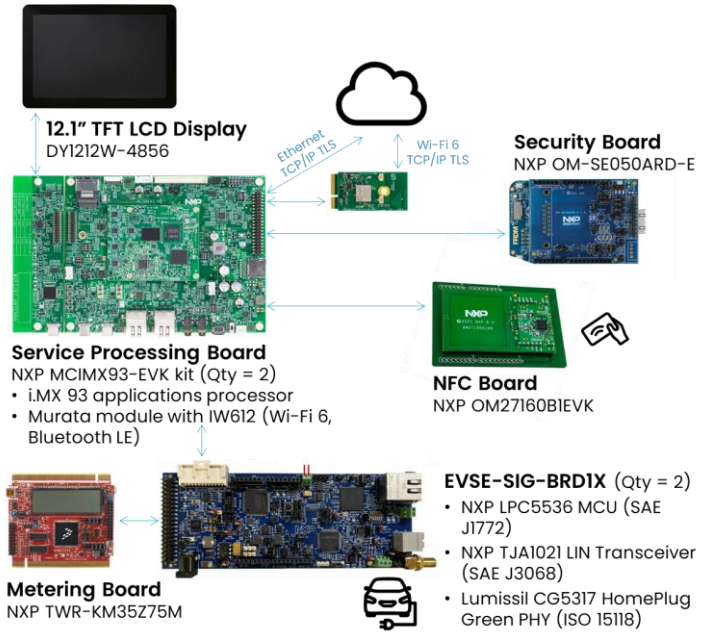
We accelerate development of efficient, scalable and sustainable EV charging solutions

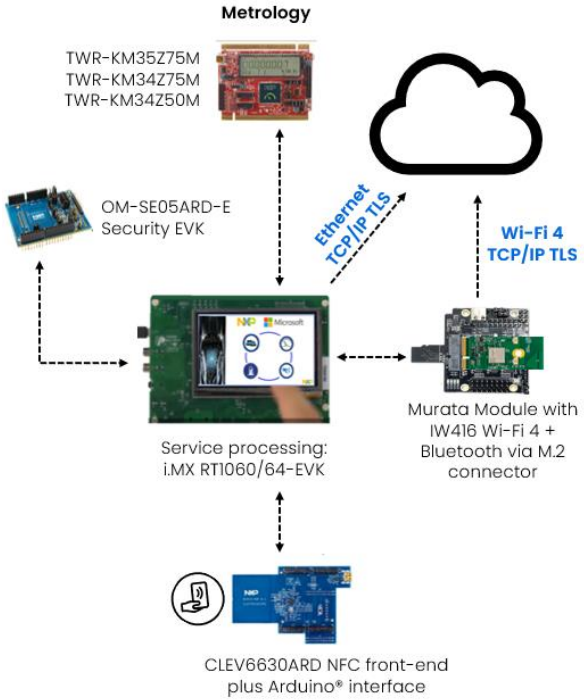
- Efficient and sustainable power analysis with accurate AFE and pre-certified metrology libraries
- Reliable and safe charging control with proven cloud authentication
- Pre-integrated Wi-Fi, Bluetooth LE, near-field communications and resilient EdgeLock® security software, proven for authenticating ISO 15118
- Scalable processor, connectivity & analog platforms with 15-year product longevity
- Faster product ramp with standards-based EasyEVSE development platforms

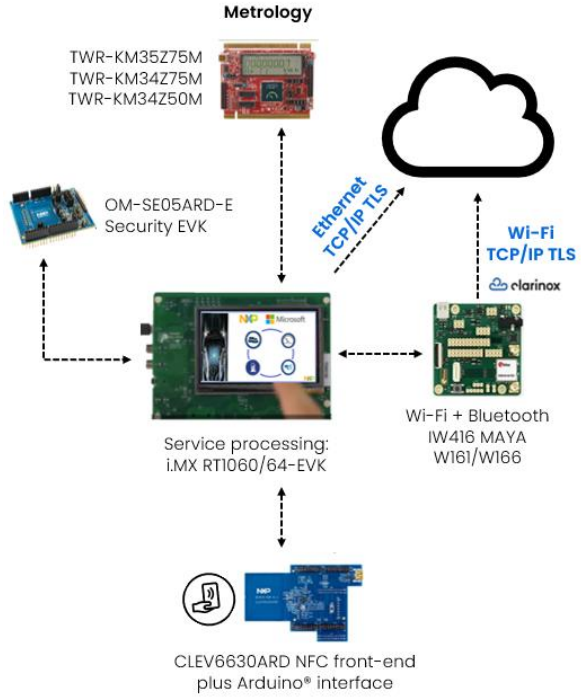


EasyEVSE Development Platforms

Launched in June 2024	Launched in 2023	Old – In stable shipment to Market
Control MPU (Linux OS) **Power MCU (no OS)** ISO 15118 communications	**Control MCU (FreeRTOS)** Secure Cloud Connectivity	**Control MCU (Azure RTOS)** Secure Cloud Connectivity







ISO 15118 Partners: SEVENSTAX (stack software) and Lumissil/ISSI (PLC transceiver)
Wireless Module Partners: Murata (IW612 Wi-Fi 6, Bluetooth LE) and u-blox (IW416 Wi-Fi 4)

EasyEVSE Development Platform (Linux OS, Wi-Fi 6) – Launch June 19th

Develop differentiated EVSE systems that:

- Integrate standard ISO 15118-2 (and coming in a later release, ISO 15118-20 bi-directional) charging communications between the EV and EVSE
- Connect EVSE to cloud over Ethernet, or Wi-Fi via Murata module built with NXP IW612 Wi-Fi 6 + Bluetooth LE SoC
- Leverage resilient EdgeLock SE050 secure element and validated software to authenticate cloud services such as Microsoft Azure IoT Central service
- Use modifiable pre-certified metrology software for accurate billing, and monitor/respond to power line faults
- Tap to authenticate with the NFC PN7160 Plug and Play controller

nxp.com/EasyEVSE

Live on nxp.com on June 19/24
Demo at Smarter E Europe (Munich) June 19-21

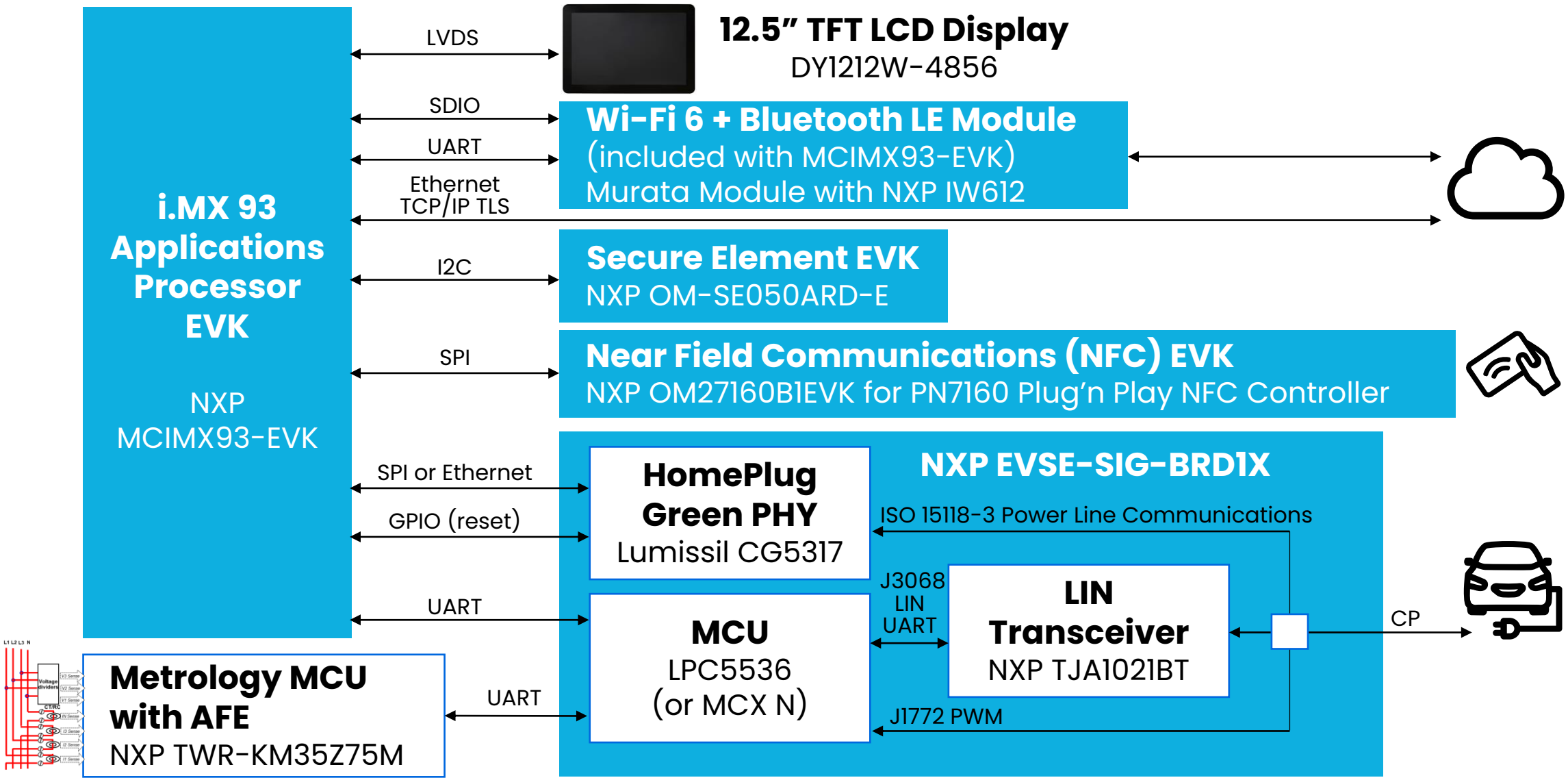
Order full kit by **EVSE-iMX93** (US$3900)
Software, boards, cables, design files, documentation

Get Started
User Guide, Manual, Get Started video

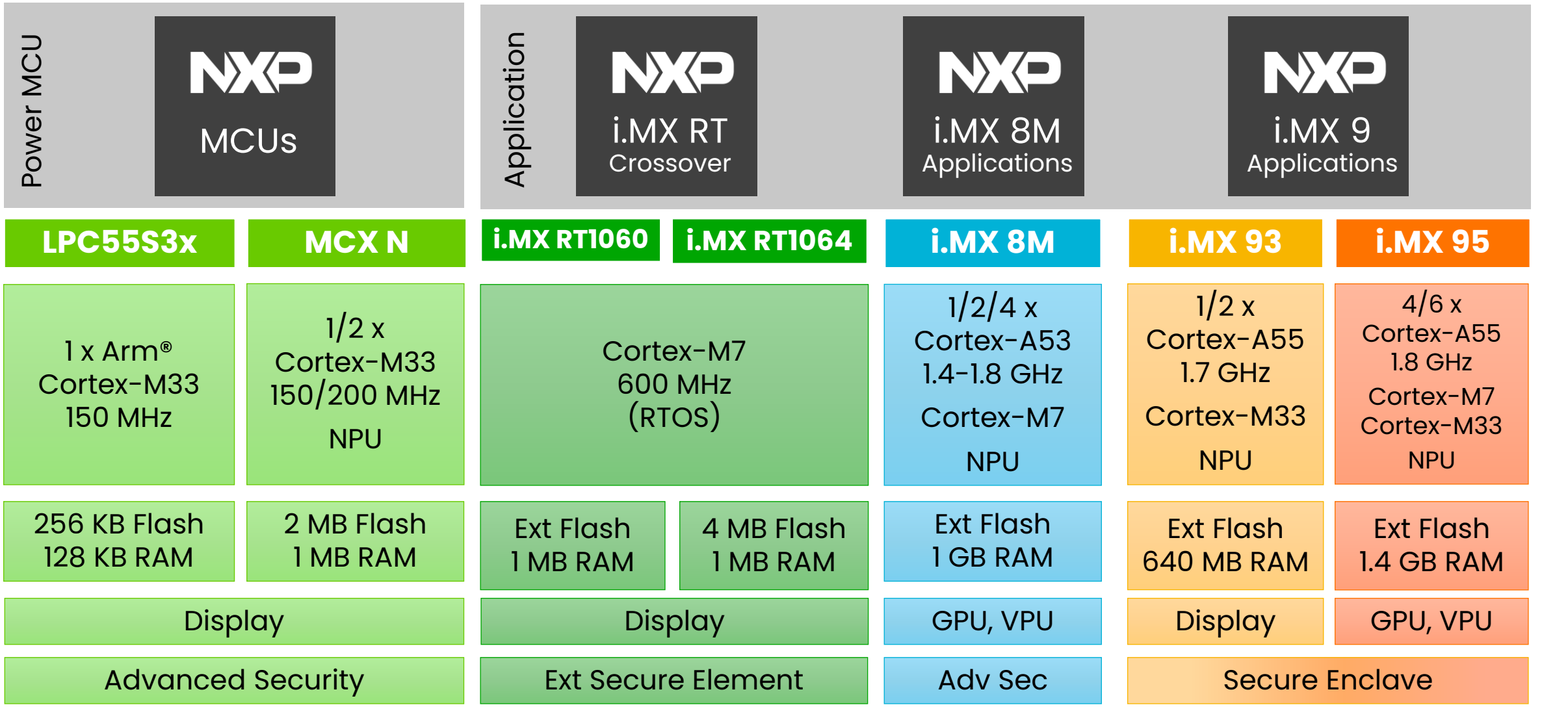
Development Hardware
Order from nxp.com/EasyEVSE

Complementary Development Software
Download from github.com/NXP

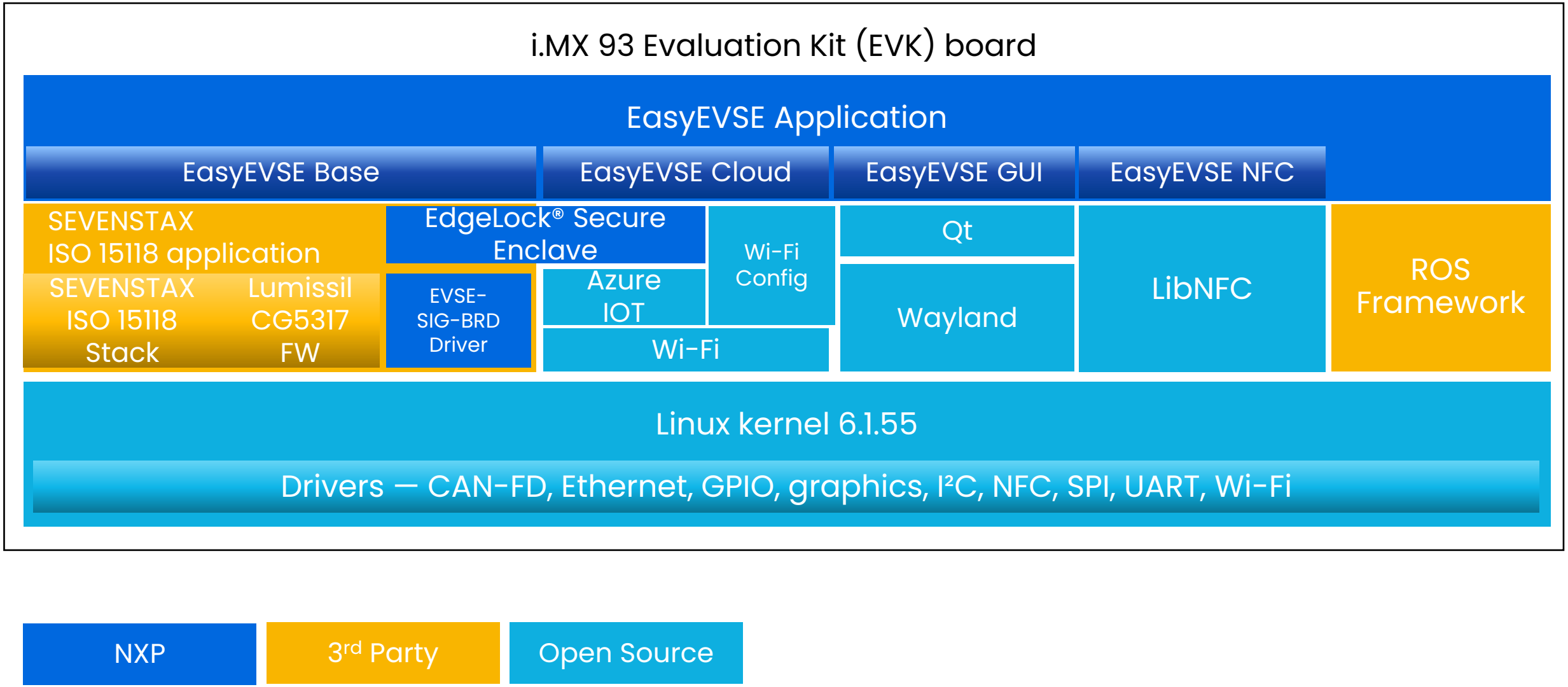
EasyEVSE Development Platform (Linux OS, Wi-Fi 6)



EV Supply Equipment: ISO 15118 Processor Options



EasyEVSE Software Architecture for i.MX 93 EVK (Linux OS, Wi-Fi 6)



NXP | 3rd Party | Open Source

i.MX 9 Applications Processors Series

Adding to EVSE portfolio

Software Compatible

Pin-to-pin Compatible

- i.MX 6QuadPlus
- i.MX 6Quad
- i.MX 6DualPlus
- i.MX 6Dual
- i.MX 6DualLite
- i.MX 6Solo
- i.MX 6SoloX
- i.MX 6SoloLite
- i.MX 6SLL
- i.MX 6UltraLite
- i.MX 6ULL
- i.MX 6ULZ

Arm® v7-A

A9

A9 M4

A7

i.MX 8 Family
Advanced graphics, vision & performance
A72 A53 M4

i.MX 8M Family
General purpose Edge processing
A53 M4/M7 NPU

i.MX 8ULP Family
Ultra low power with graphics
A35 M33

i.MX 8X Family
Safety certifiable & efficient performance
Arm ® v8-A (32-bit/64-bit)
A35 M4

i.MX 7 Family
Flexible efficient connectivity
A7 M4

i.MX 7ULP Family
Ultra Low Power with Graphics
Arm® v7-A (32-bit)
A7 M4

i.MX 95 Family
ML Vision, Safety Enabled Platforms, HMI, Powerful Android/Linux Platforms
FuSa A55 M33 M7 NPU ISP GPU

i.MX 93 Family
Vision, Industrial HMI, Smart Appliances, Industrial & IoT Gateway, Linux Platforms
A55 M33 NPU

i.MX 91 Family
IoT & Industrial Gateway, Connected Appliances, Linux Platforms
A55

...and Future i.MX 9

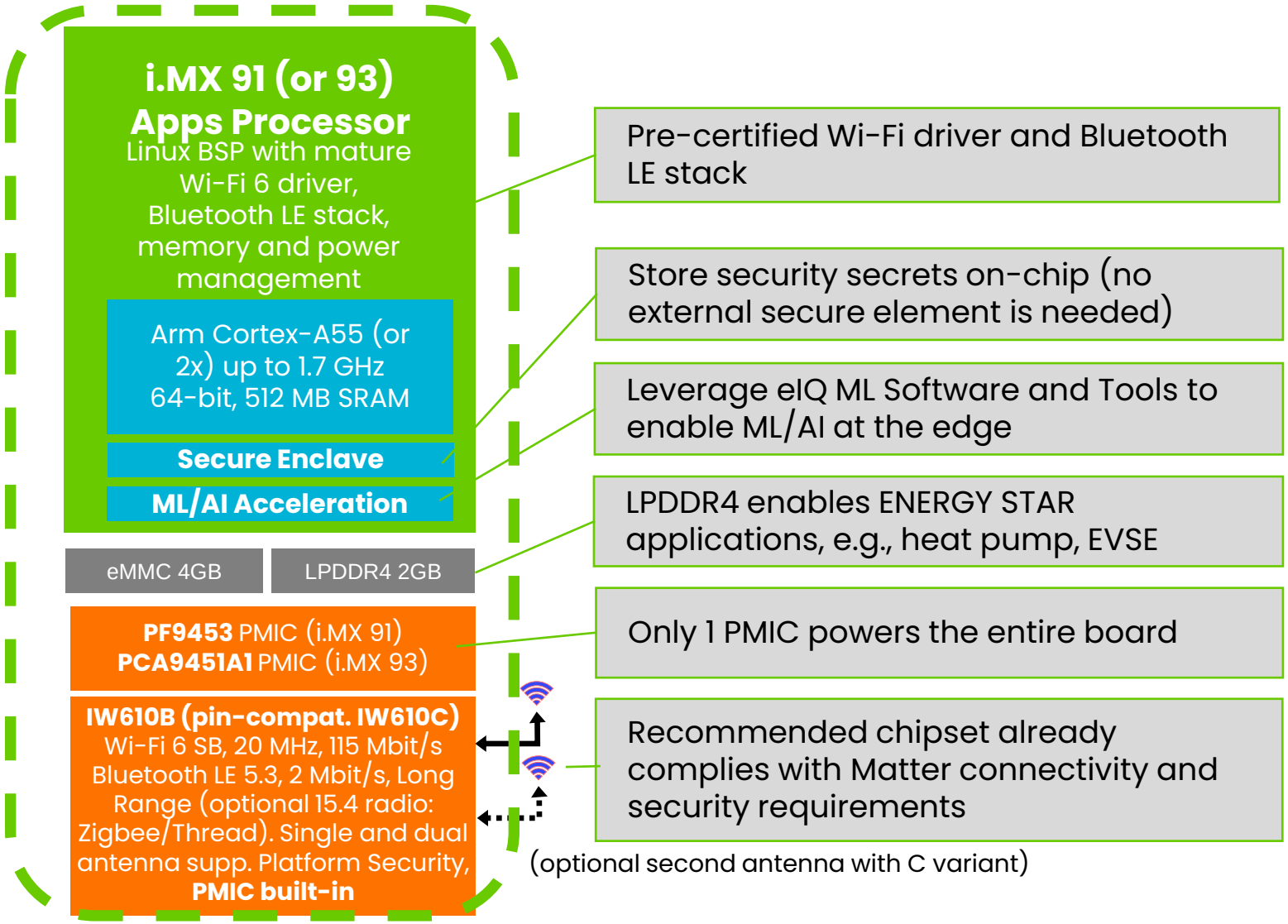
Scalable Platform

Arm® v8.2-A (32-bit/64-bit)

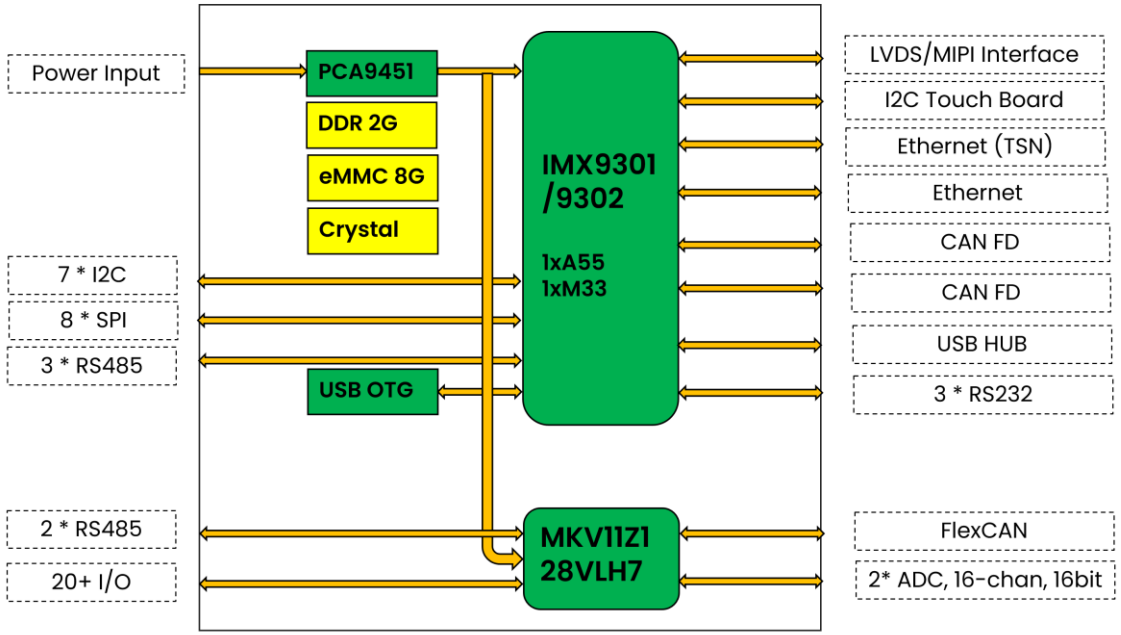
Scalable Software

PRODUCTION NOW

i.MX 93/91 + IW61x for Entry-level Linux (or RTOS) Platform



EVSE – GC Initiated i.MX93 Bundle Solution - extending to SAPAC



Features

- Supports one SPI-to-CAN interface, compliant with the CAN 2.0B standard, with baud rates from 50K to 1Mbps. Supports both standard and extended frames.
- Support SPI clock up to 6MHz
- Performance: TX: 6075 fps @ 1MHz CAN bitrate; RX: 7000 fps @ 1MHz CAN bitrate
- Git: https://nxa23078@bitbucket.sw.nxp.com/scm/nxp-appcodehub/dm-kv11-spi-can-bridge.git

Customer Needs:

- Unique platform to support both CCS and GB/T.
- 3 x CAN FD to support GB/T dual gun charger scenario.
- PWM and 16-channel ADC(high accuracy) to support CCS.

Our Advantages:

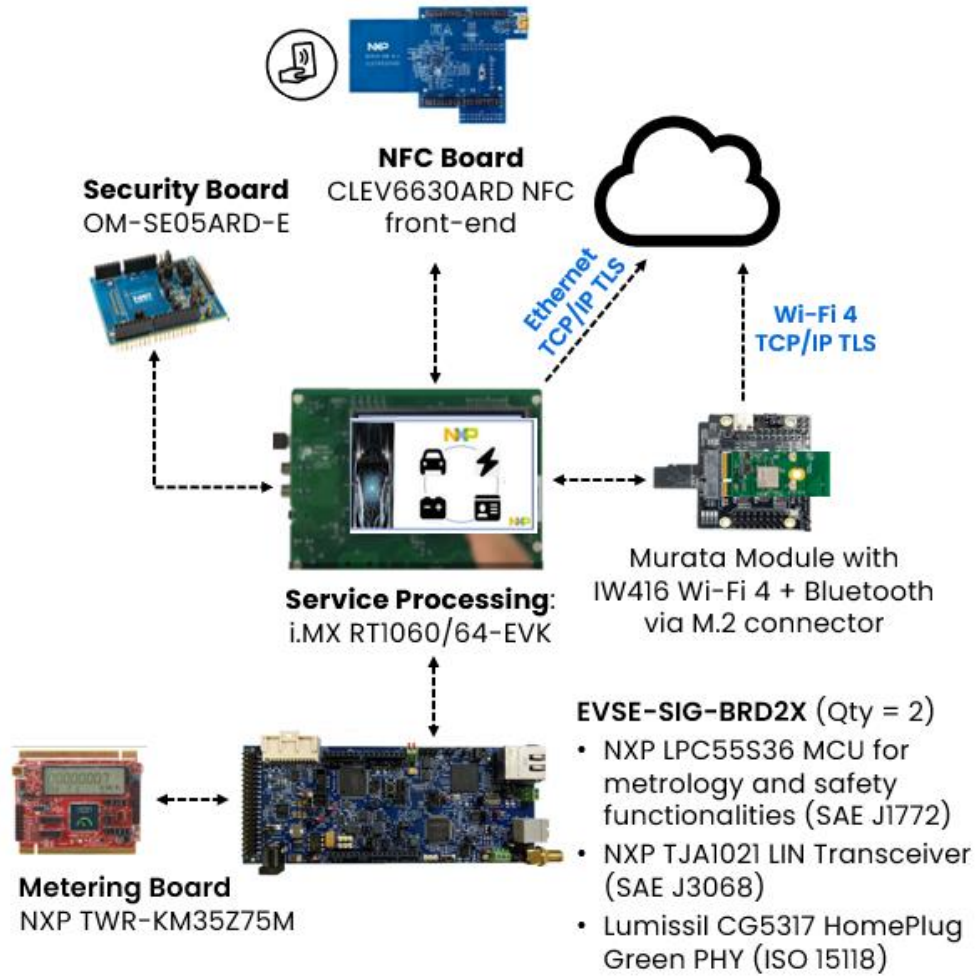
- Lower power consumption. LPDDR to support Energy Star Rating for oversea market.
- Security: Embedded Edgelock® secure enclave enabling EdgeLock2Go services
- Support extended Industrial qualification grade
- Stress tests: bidirectional 100W frames without frame loss.
- Provides comprehensive Linux driver based on the I.MX93 platform.

EasyEVSE Development Platform with ISO 15118 implementation (FreeRTOS, Wi-Fi 4) – Coming Soon

Develop differentiated EVSE systems that:

- Integrate standard ISO 15118-2 charging communications between the EV and EVSE
- Connect EVSE to cloud over Ethernet, or Wi-Fi via Murata module built with NXP IW416 Wi-Fi 4 + Bluetooth LE SoC
- Leverage resilient EdgeLock™ SE050 secure element and validated software to authenticate cloud services such as Microsoft Azure IoT Central service
- Use modifiable pre-certified metrology software for accurate billing, and monitor/respond to power line faults
- Authenticate with one tap using the CLRC663 high-performance NFC front-end

Use case: private/residential



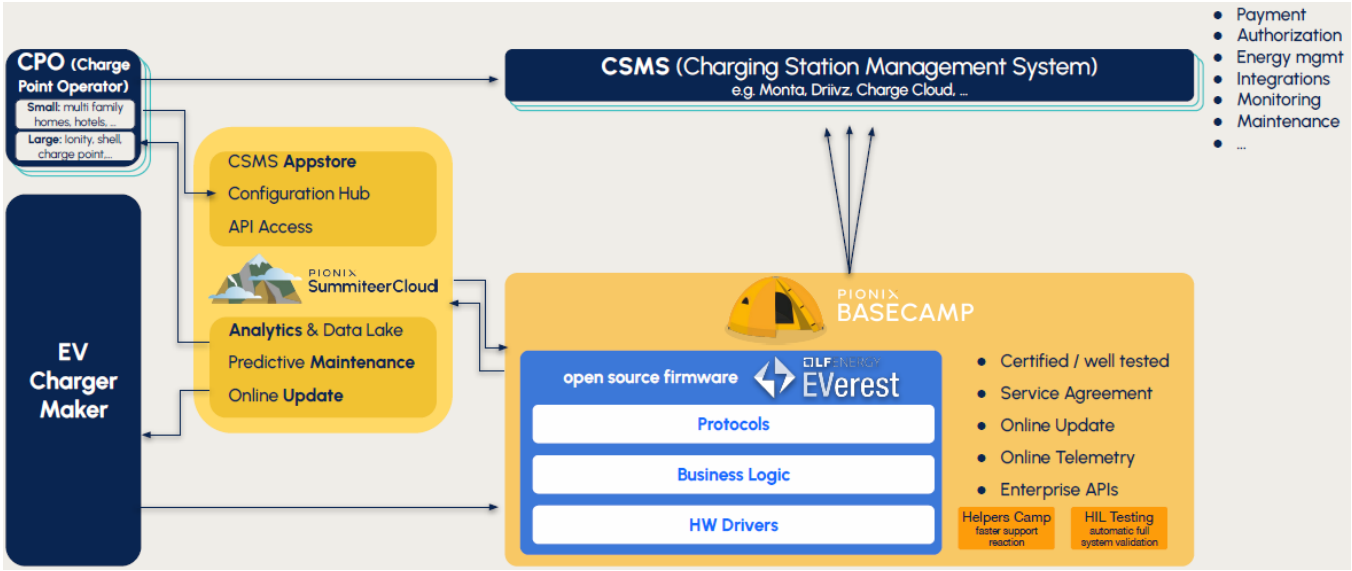
Get Started
User Guide, Manual, Getting Started Instructions

Development Hardware
Order from nxp.com

Complementary Development Software
Download from nxp.com

EVSE - Enabling Mass Market with Partners

- **ISSI / Lumissil** provides HomePlug Green PHY for ISO15118 PLC communication
- **SevenStax** provides ISO15118-2 and -20 communication Software Stack
- **PIONIX** (Open Source) provides solution BaseCamp to build charging software, provide CPOs + CSMS a middleware
- **Enrich Local HW and SW partners** for all-rounded ecosystem offering to customers
- **Wifi Module partner** (U-blox and Murata – IW416 and IW612)



NXP Components in Electricity Meters

Metrology and Metering

- KM35 or KM34 MCU with sensitive energy AFE
- MCX N MCU for metering application
- Mature pre-certified metrology libraries
- Metering reference designs

Utility and In-home Communications

- IW61x for Wi-Fi 6, 2.4 GHz and Bluetooth LE
- Sub-GHz transceivers
- Enablement for Matter protocol

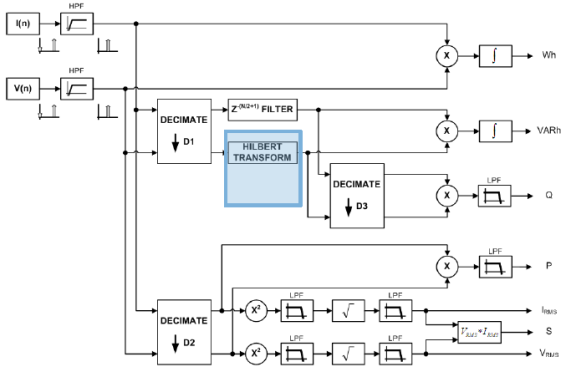
Data Compute and Energy Management

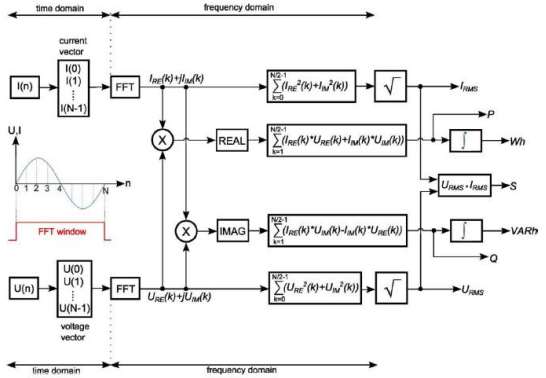
- MCX or i.MX RT MCUs, i.MX 93/91 MPUs
- On-chip secure enclave, ML acceleration

Peripheral Components

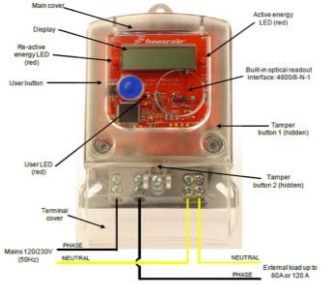
- PCF2131 (RTC), TEA1723 (PSU), PCA9421 (PMIC), NMH1000 (Tamper switch), FXLS8FXLS8974 (accelerometer), NT3H2111 (NFC), sensors, analog

Metering algorithms:
Filter and FFT-based metrology libraries





Single-phase Meter



2-phase Current Transformer (CT)

3-phase CT

Bidirectional AC/DC converter

Power Spec

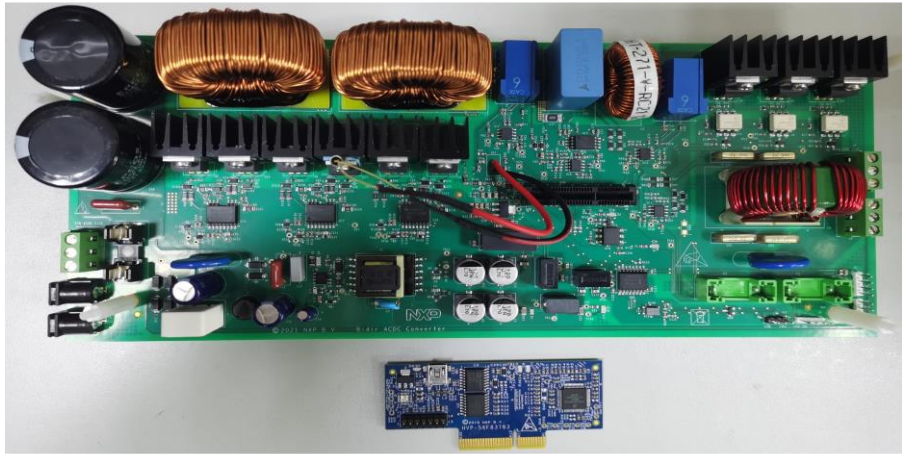
Power: 800W@220Vac, 400W@110Vac

AC-to-DC

- Wide input range: 85-265 Vac, 50/60Hz
- Output: 380V DC
- Peak efficiency: >95% @ 110Vac and >97% @220Vac
- Power factor: > 0.99

DC-to-AC

- Input: 380V rated
- Output: 220V/50Hz, 110V/60Hz
- Peak Efficiency: >95.5% considering auxiliary power



Features

- Bidirectional AC/DC converter controlled by MC56F83783
- Smooth transition between AC-to-DC and DC-to-AC mode by SW
- Smooth transition between islanded and grid-connected mode in DC-to-AC mode without surge
- PR controllers to zero the error at the fundamental AC frequency and harmonic frequencies in DC-to-AC mode, steady-state error below 1% for output voltage RMS and THD below 1.5% under linear load condition
- Capacitor current feedback to suppress LCL resonant
- Fast and stable DC bus pre-charging with Triac and soft starting for AC-to-DC mode
- Light-load mode to enable higher efficiency and power factor in AC-to-DC mode
- Cycle by cycle current limitation is realized with flexible DSC peripherals
- Protections: OCP, OVP, UVP, OFP, UFP, OTP
- FreeMaster support enables easy debugging of the system
- Highly optimized libraries, RTCESL, help speed development and improve code execution efficiency

Security in EV Charging

EV Chargers Cyber Security Risks & ISO 15118

Smart charging is creating huge opportunities **but** also adds security risks to the equation; cars, home solar panels, wind turbines and power grid, all these need to be securely connected for the charging process to run smoothly.

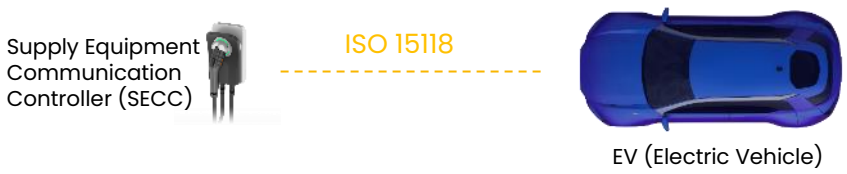
ISO 15118 offers EV charging ecosystem interoperability, but the security considerations of ISO 15118 are mostly bounded by the scope of the communication protocol between EV and charging stations

System Security gaps in ISO 15118 could be used by an adversary to gain unfair advantage over the charging process and use it for own self-interest, mostly harming legitimate users and other participants

NXP has a Security portfolio EdgeLock®
that helps in the implementation of ISO 15118, whilst enhancing the system with security mechanisms and certification aligned with industrial and local National security certification e.g. Common Criteria, FIPS

Meeting ISO 15118 security requirements and goes beyond

EV Charger Security concern	Nr	Business Drivers	Covered in ISO 15118	EdgeLock SE offering
EV to Supply Equipment Communication Controller	**1**	Prevent unauthorized charging session, preserve users privacy	Yes, TLS 1.2, ECDH & ECDSA	SE05x provides a certified HW implementation of all the crypto protocols required for ISO15118-2
Secure Storage of Leaf Certificate and private key into the Supply Equipment	**2**	Preserve Brand and business model (protect access to services and against device cloning)	Yes, x.509 ECC 256	SE05x with its dynamic secure key storage and high flexibility allows customization of x.509 certificates.
Secure management of EV and Charger certificate / key OTA	**3**	Keep security up to date, protect EV Charger identities against clone, over production control	Yes, multiple certificate authorities (CA)	NXP Trust provisioning and EdgeLock 2GO Managed options allows customers to deploy NXP PKI infrastructure without the need for customers to set in place a complex and costly PKI Infra.
EV Supply Equipment Controller FW Integrity	**4**	Protect business model, avoid mal functions of EVSE, and protect users charging session from theft	No, out of scope	SE05x can be bound to a host MCU/MPU and enhance the security of the system by storing the mission critical credentials to validate a FW
Compliance with Countries EV Chargers security policies	**5**	Preserve access to a market, liability control	No. most of countries has their own regulation for EVSE	High level certification (same as Passport and Smart Cards) of SE05x can be leveraged to meet country specific security policies (e.g. Eichrecht)
OTA Update capabilities of FW of Supply Equipment Controller	**6**	Need to keep control on EVSE SW OTA to prevent and recover from DDos Attacks, deploy new features, fix bug	No. out of scope	SE05x makes the OTA update more secure by storing the mission critical credentials used to verify the FW
Zero trust on 3rd party manufacturing and supply chain	**7**	Anti counterfeiting, Preserve availability, Protect users charging sessions, Preserve Reputation	No. out of scope	Customers can leverage the secure PKI infrastructure of NXP and the SE05x root of trust solution



NXP offering on EdgeLock SE and services for EV Charging

EdgeLock® Secure Elements & Authenticators Plug & Trust family
HW root of trust, CC EAL6+ AVA_VAN.5 and FIPS certified
Pre-installed IoT applet (updatable for SE051 variants)
Full MW package

EdgeLock 2GO
Secure and flexible IoT service platform
Secure provisioning
Secure Identity management

EV Charging
Authenticate measurement data & communicate securely within the IoT infrastructure (gateway, data concentrator, backend, cloud)
ISO15118, NXP Plug & Trust for Plug & Charge

Summary

Thank You!

NXP supports the range of EV Supply Equipment to enable accurate energy measurement, secure remote management and intuitively safe operation

Identify best-fit devices for AC and DC charging stations at EVSE充电桩方案-恩智浦半导体 (nxp.com.cn)

Get started with a range of EasyEVSE Development Platforms and training at www.nxp.com/EasyEVSE

nxp.com