



SOLUTIONS FOR ELECTRIC VEHICLE CHARGING

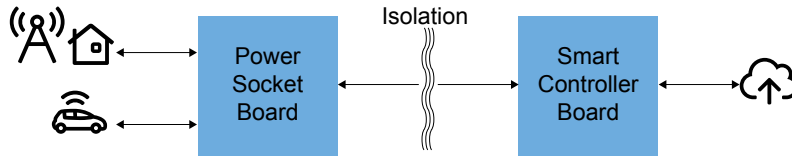
TECHNICAL SOLUTIONS ADDRESSING
THE KEY MAJOR APPLICATIONS OF

- AC 3 KW TO 22 KW
- DC FAST CHARGE
- LOCAL BATTERY STORAGE

EV CHARGING SYSTEM (FIGURE 1)

Electric vehicle sourcing equipment (EVSE), also called the charging system, supplies power for recharging electric vehicles of many types.

EV chargers are made up of at least one smart controller function and a power socket function — either combined or as standalone boards.



In order to support the developing world of EV types, we need a flexible and scalable approach not only in the choice of AC or DC, but also in the following key areas:

Accurate power delivery measurement

- Legislation mandating higher accuracy levels for fair payment
- Government fuel tax recovery
- Power grid load balancing and mains quality analysis

Increasing security and safety at the edge

- Supporting main EV security standards, e.g., OCPP2.x, ISO 15118 and PKI
- GDPR, Calibration Law “Eichrecht” and confidentiality
- Safety standards, e.g., IEC60730 Class B, IEC61508 SIL2

Cloud onboarding

- Simplify the provisioning and ownership process, while maintaining high security and confidence about connection to an authentic device using zero-touch onboarding

Mass deployment readiness

- Integrated and cost optimized

Artificial intelligence (AI) and machine learning (ML)

- Consumption profiling
- Anomaly detection

Availability and reliability

- Product longevity greater than 10 or 15 years
- Operating life ranging 10 to 20 years
- Ruggedized for harsh environments



KEY BUILDING BLOCKS

Metrology

- Accurately measure energy flow between charger and vehicle
- Calculate energy billing consumption
- Manage the safety switching and low-level communications to EV
- Monitor temperature
 - Highly accurate temperature sensor enables safety and anomaly detection
- NFC bridge
 - Acts as an AC-isolated communication channel to metrology MCU
 - Also used during manufacture, commissioning and updates

Controller Board

- Manage the main functions and services of the EVSE including any high-level communications and protocol stacks, e.g., ISO 15118, OCPP and connection to backend
- Options include bare metal and RTOS; for solutions running Linux® OS, may add greater value to on-screen advertising

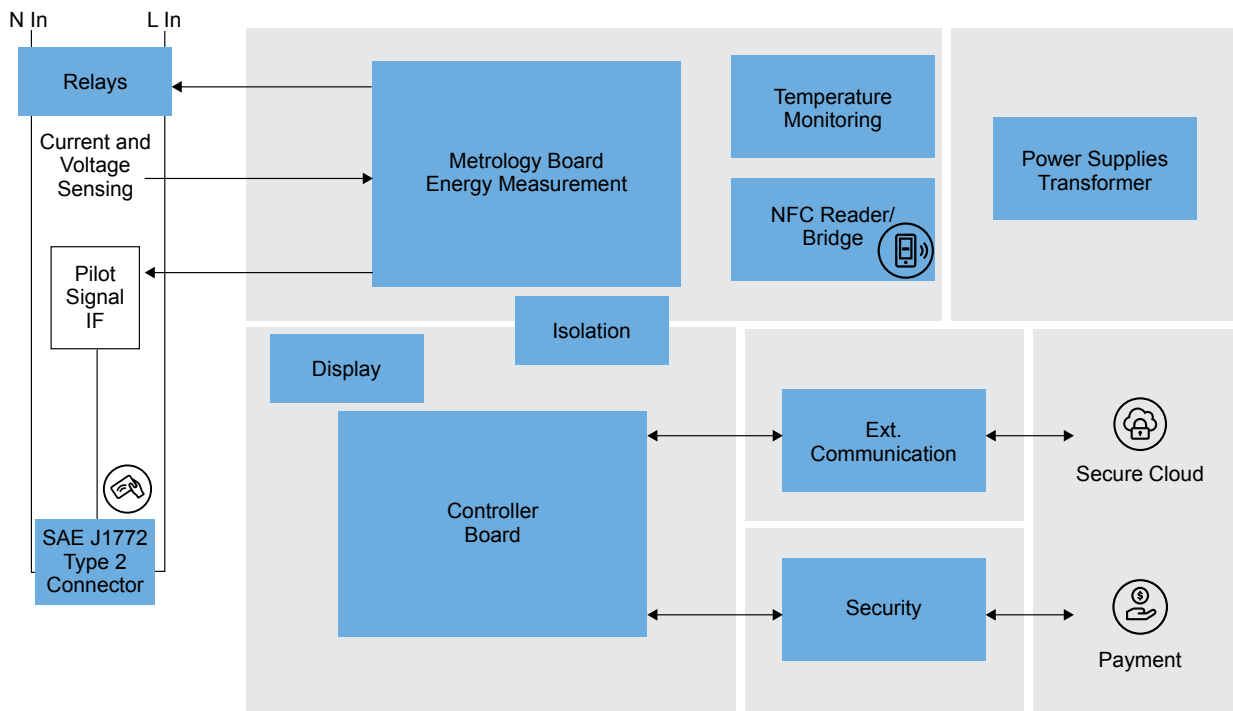
Security

- Authenticate and protect energy usage and billing data end to end with cryptographic keys
- Securely and seamlessly onboard EV chargers to back-end servers and cloud services for remote management
- Configure, update and attest the software and firmware

External Communication

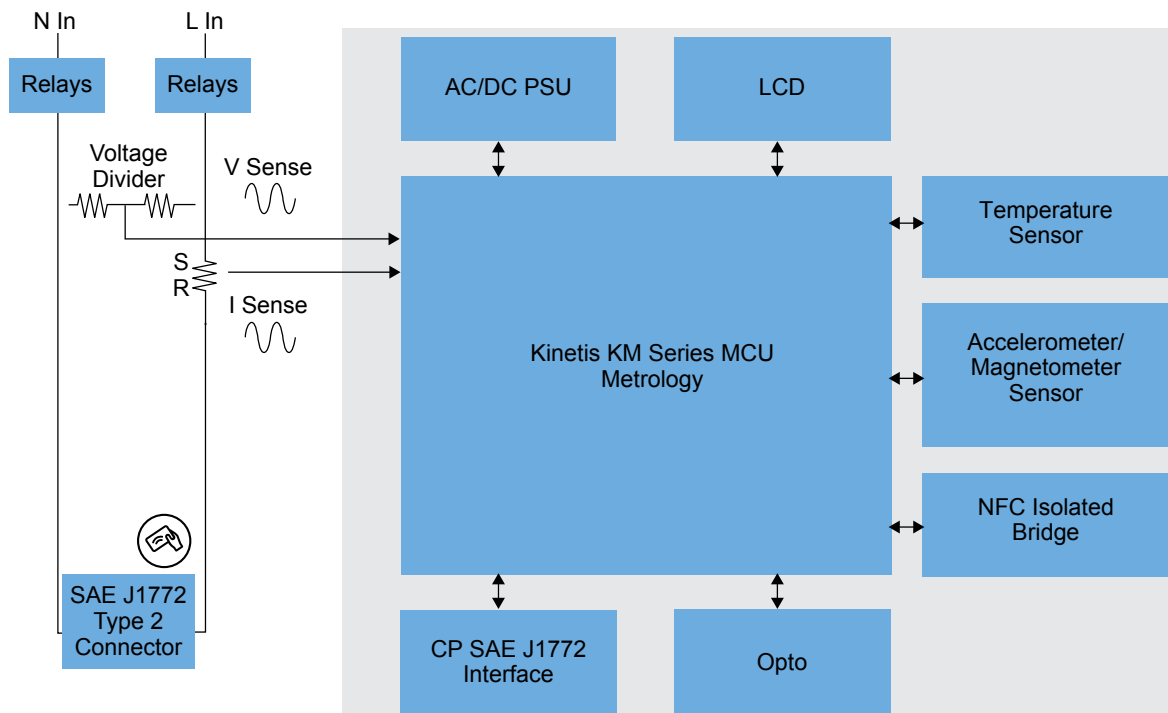
- Support a flexible mix of communication capability depending on location, region EVSE type
- Support region-specific communications solutions, including Wi-Fi®, PLC, NB-IoT Sigfox and many more

AC EVSE BLOCK DIAGRAM (FIGURE 2)



Technology Building Blocks

METROLOGY BLOCK DIAGRAM (FIGURE 3)



PRE-CERTIFIED METROLOGY FRONT END SOLUTION WITH HIGHLY ACCURATE ENERGY MEASUREMENT

New legislation is defining higher levels of accuracy for power delivery measurement e.g., German Eichrecht

11 MWh of potential energy savings per year plus CO2 savings (0.25% versus 3% accuracy and 20.000 charge points)

Math for potential energy savings: For one station, an average day takes $40 \text{ kW} \times 2 \text{ charges per day} \times 5 \text{ days per week} \times 50 \text{ weeks} = 20.000 \text{ kWh} \Rightarrow 0.25\% \times 20.000 \text{ kWh} = 50 \text{ kWh}$ versus $3\% \times 20.000 \text{ kWh} = 600 \text{ kWh}$. Savings for one station = 550 kWh \Rightarrow Total station = 20.000 \Rightarrow Total savings = $20.000 \times 550 \text{ kWh} = 11 \text{ MWh}$ per year.

Measure

- Electricity meters measure phase voltages and phase currents consumed by the connected load
- Measurement linearity of 0.1% over 2000:1 dynamic range
- Shunt resistors, current transformers or Rogowski coils can be connected

Process

- Accurate calculation of the active and reactive energies
- Time keeping accuracy better than $\pm 0.5 \text{ s/day}$ for billing purposes
- Tamper resistance enhances security
- Load profiles and parameters storage

Display

- LCD display allows visual inspection
- HMI (control button) allows system configuration
- IR/RF communication allows data download for utility companies and automatic meter reading

KINETIS KM SERIES MCU DESIGN ENABLEMENT

Leverage metrology libraries from pre-certified reference designs:

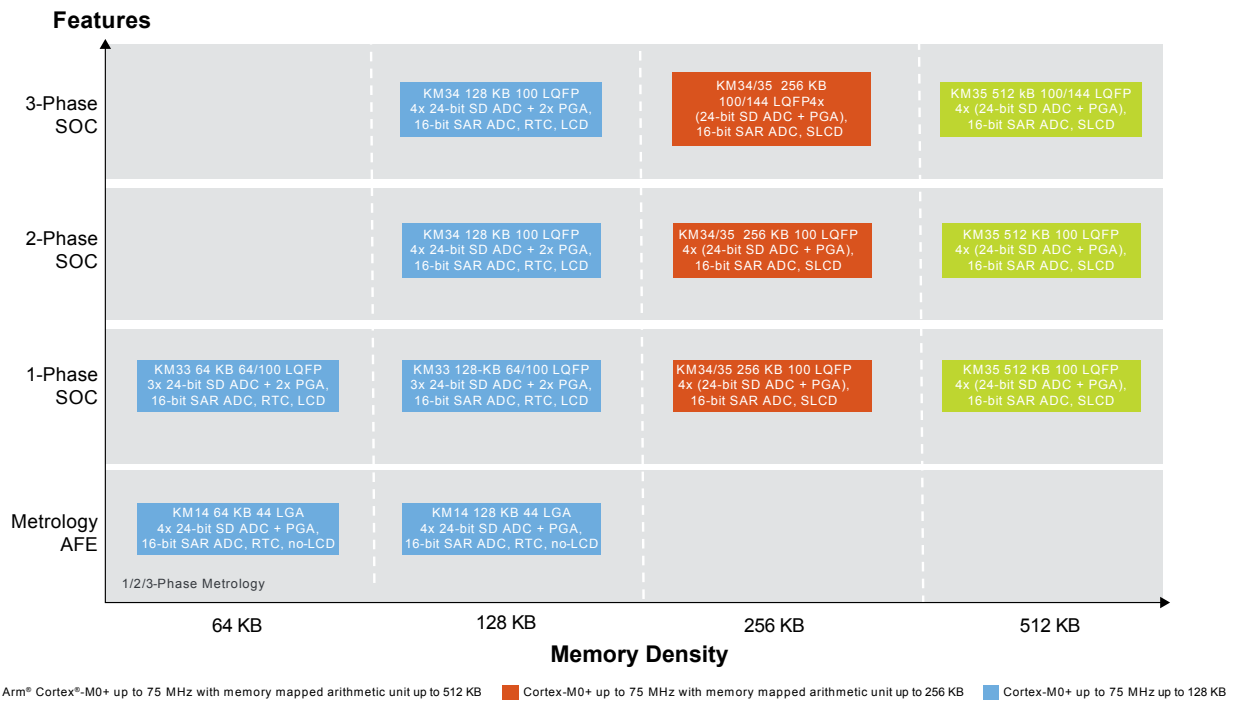
- 1-phase meter reference certified to Accuracy Class B or C (active energy EN50470-3) and 3% or 2% (reactive energy EN62053-23)
- 2- and 3-phase meter reference certified to Accuracy Class ANSI C12.20, Class 0.2
- 3-phase meter reference Active and Reactive energy accuracy IEC50470-3 Class C, 0.2%

Enablement:

- Reference design kits for single/poly and three phase
- Evaluation kits
- Schematics and Gerber files
- Test reports
- NXP Metrology Library



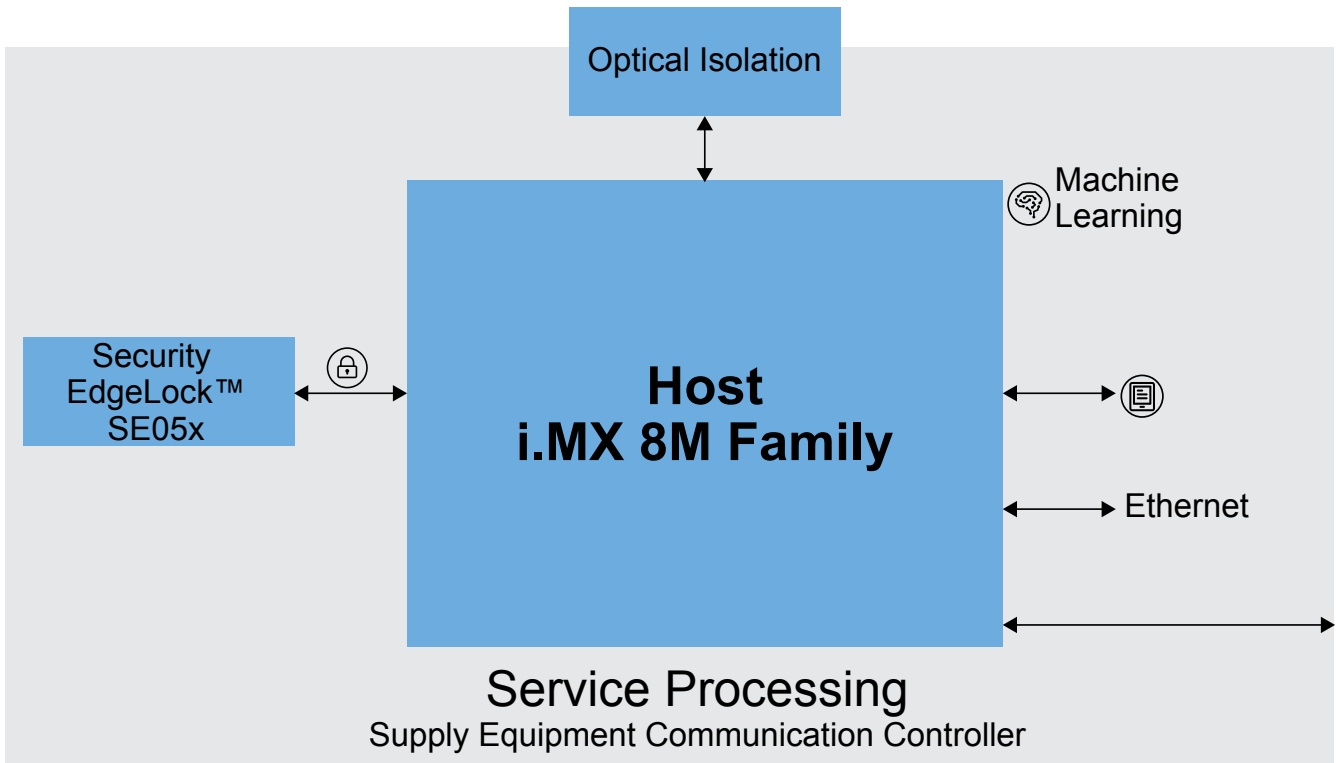
KINETIS KM SERIES MCU SUMMARY (FIGURE 4)



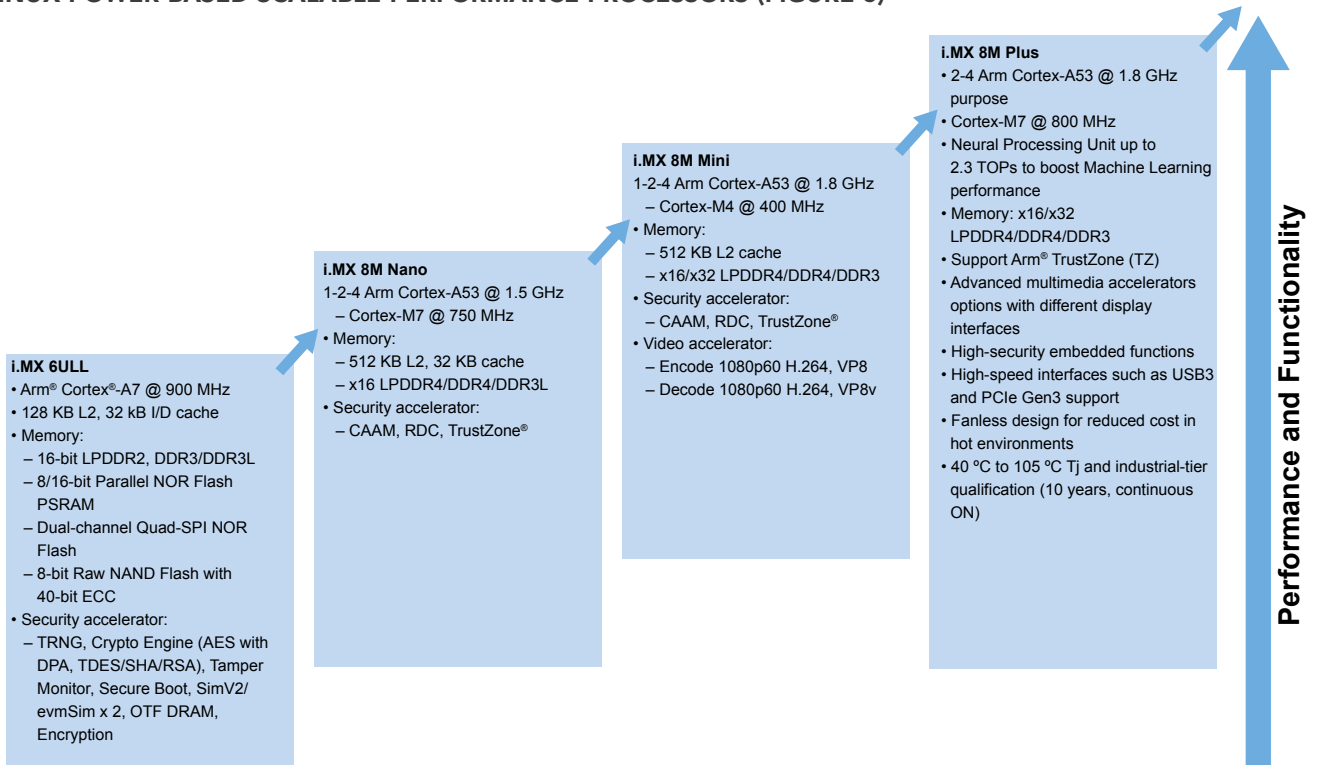
KINETIS® KM SERIES MCU COMPARISON

Configuration/Module	Pin-to-pin Compatible		
	MKM1xxZxxACxx5	MKM3xZ256VLxx7	MKM3xZ512VLxx7
Maximum CPU frequency (MHz)	50 MHz	75 MHz	75 MHz
Flash memory (KB)	64–128	256	512 (dual bank)
RAM (KB)	16	32	64
Memory Mapped Arithmetic Unit (MMAU)	No	Yes	Yes
Memory Mapped Cryptographic Unit (MMCAU)	No	Yes	Yes
Programmable Delay Blocks (PDB)	No	Yes	Yes
24-bit Analog Front End (PGA)	4-ch. (2)	4-ch. (4)	4-ch. (4) with improved settling time
UART (LPUART)	4	4 (1)	4 (1 with FIFO)
SPI	2	2	3
LP Timer	1	1	2
Peripheral XBAR (I/O supported)	33 x 33	52 x 44	52 x 44
Comparators	2	3	3
Segmented LCD	288 (8 x 36)	448 (8 x 56)	448 (8 x 56)
Total GPIO pins	Up to 68	Up to 99	Up to 99
Low Leakage Wake-up pin filter	2	2	4
Ambient Temperature Range	-40 °C–85 °C	-40 °C–105 °C	-40 °C–105 °C
Packages	144 LQFP 64 LQFP 44 LGA	144 LQFP 100 LQFP	144 LQFP 100 LQFP

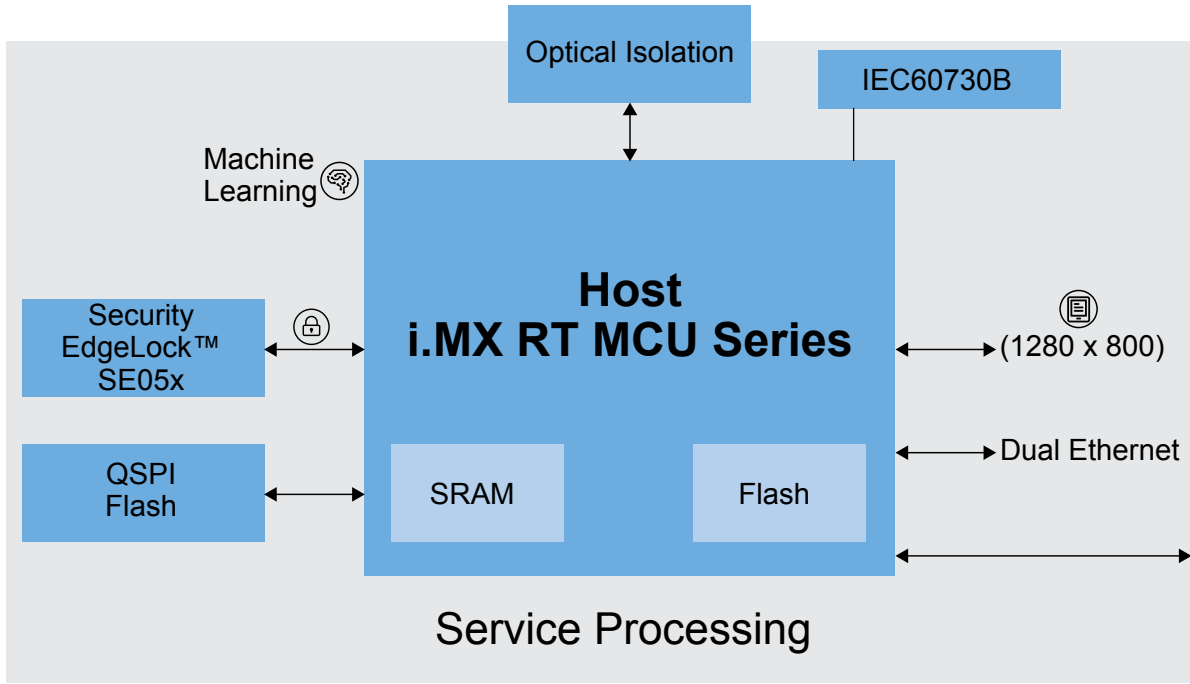
CONTROLLER BOARD, LINUX® OS-BASED (OR RTOS-BASED) SCALABLE PERFORMANCE (FIGURE 5)



LINUX POWER BASED SCALABLE PERFORMANCE PROCESSORS (FIGURE 6)

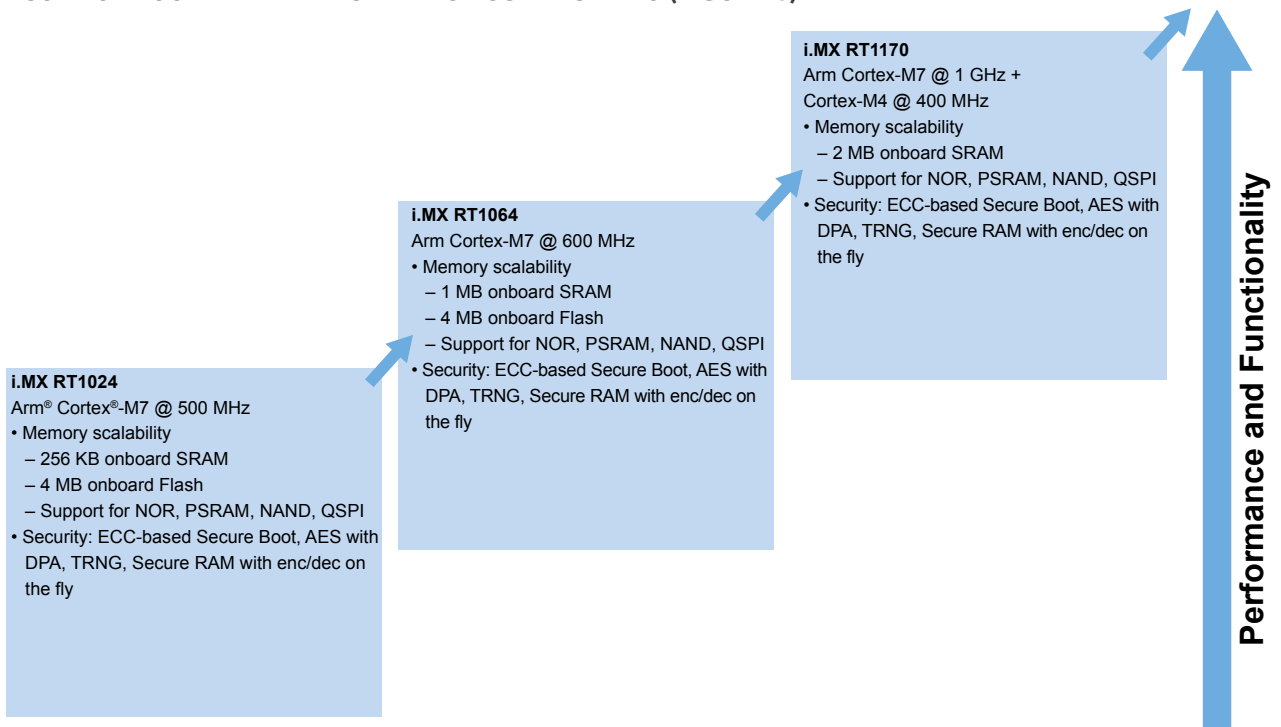


CONTROLLER BOARD, RTOS-BASED SCALABLE MCU PERFORMANCE (FIGURE 7)

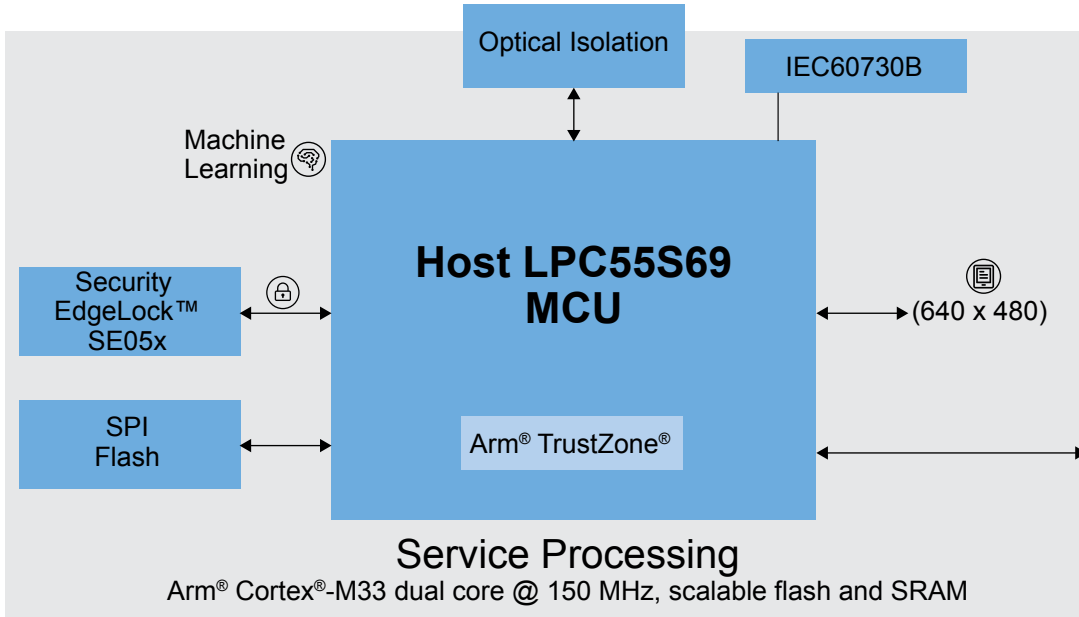


Flexible options across a family of devices
 Scalable performance, memory, features and package

RTOS BASED SCALABLE PERFORMANCE CONTROLLERS (FIGURE 8)



CONTROLLER BOARD, ENTRY LEVEL (FIGURE 9)



Separation and access control isolate trusted software and resources

- Assured and managed isolation between legally and non-legally relevant code
- Reduce attack surface of key hardware and software components
- Reduce recertification on FW change

Trusted software

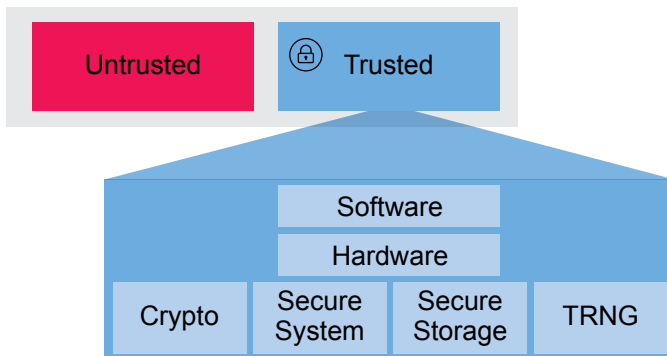
- Provision of security services
- Small, well-reviewed code

Trusted hardware

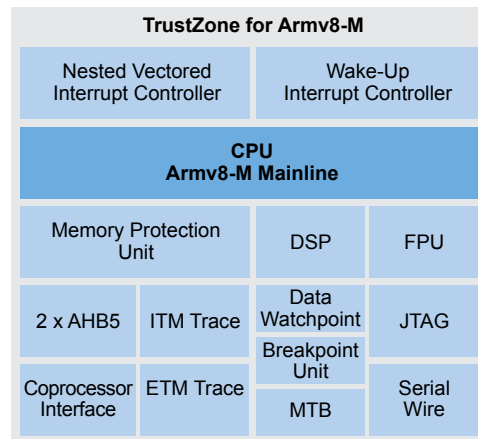
- Hardware assist for cryptography
- Secure-access validation built into SoC

TRUSTZONE® IMPLEMENTATION AVAILABLE IN THE LPC5500 MCU SERIES (FIGURE 10)

Arm® TrustZone®



Arm® Cortex®-M33



SECURITY

Embedded security modules are commonplace in several critical national infrastructure projects, e.g., passport, e-ID, Linky French smart meters, BSI German Smart Metering program, UK Comms Hub.

The security functionality is defined, fixed, assured and not open to interpretation.

- NXP offers a broad range of secure elements and services
 - EdgeLock™ SE050 and EdgeLock SE051 are a family of ready-to-use secure elements for IoT devices providing a root of trust at the IC level and delivering real end-to-end security, from edge to cloud.
 - EdgeLock 2GO offers easy, secure deployment and management of IoT devices and services that use an NXP EdgeLock SE050/51 secure element.
- The EdgeLock SE050 product family of Plug & Trust devices offers enhanced Common Criteria EAL 6+ based security, for unprecedented protection against the latest attack scenarios.
- Ready-to-use solution
 - The EdgeLock SE050 configurations are ready to use and ready to integrate security to EV Charging solutions to authenticate energy usage and billing data, and securely and seamlessly onboard to back-end servers and cloud services for remote management.
- Complete Plug & Trust product support package
 - EdgeLock SE050/51 comes with a complete product support package that simplifies design-in and reduces time to market.
 - A middleware package and libraries are available for different MCUs and MPUs.
- Certified EdgeLock Assurance
 - The EdgeLock SE050, part of the Certified EdgeLock Assurance program, is designed to meet industry standards and follows NXP's security-by-design approach. It has been certified by an independent lab.

EdgeLock SE050 platform features

- Common Criteria EAL 6+ certified up to OS level as a safe environment to run pre-installed NXP IoT applets, supporting full encrypted communications and secured lifecycle management
- RSA & ECC functionalities, high key length and future proof curves, for example: Brainpool, Edwards and Montgomery
- AES & 3DES encryption and decryption
- HMAC, CMAC, SHA-1, SHA-224/256/384/512 operations



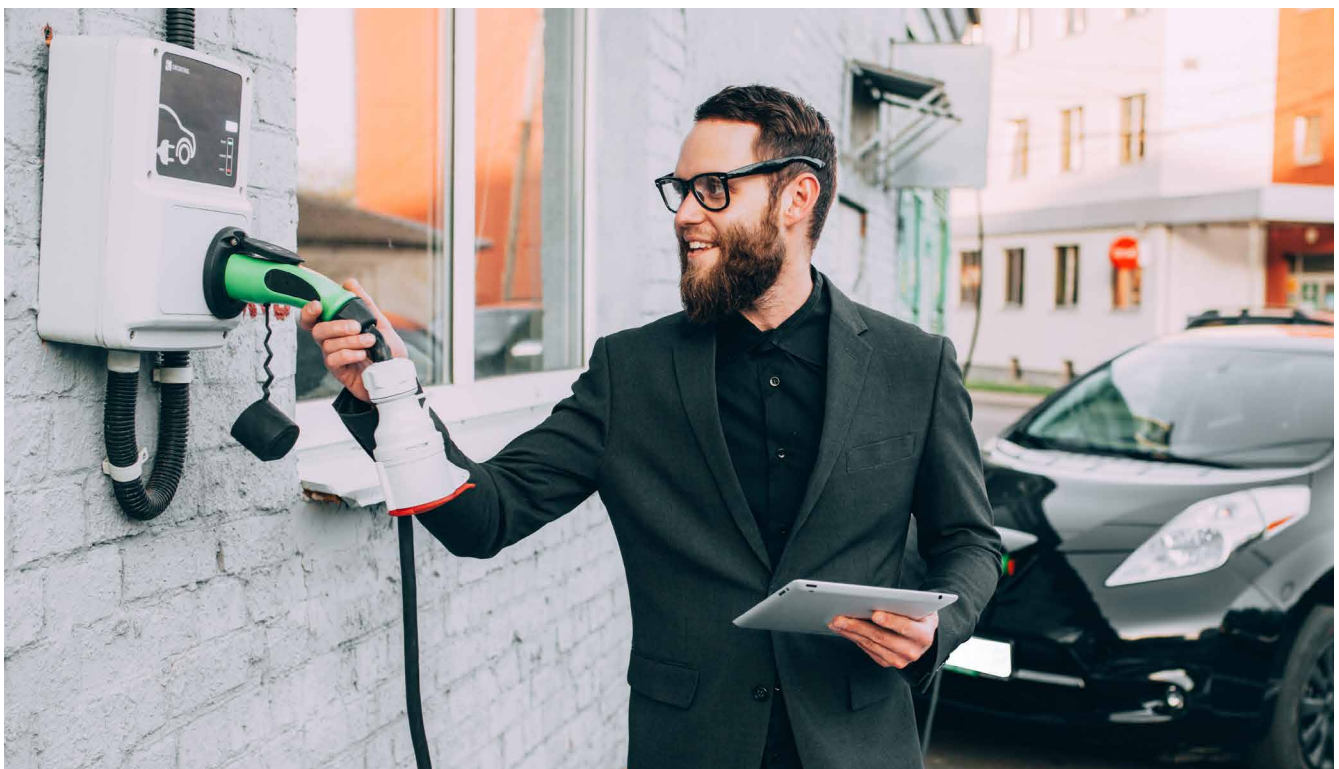
- HKDF, MIFARE® KDF, PRF (TLS-PSK)
 - Support of main TPM functionalities
 - I²C target (High-speed mode, 3.4 Mbit/s), I²C controller (Fast-mode, 400 kbit/s)
 - SCP03 (bus encryption and encrypted credential injection on applet and platform level)
 - Contactless interface for late-stage parameter configuration of unpowered devices
 - Extended temp range for industrial applications (-40 °C to +105 °C)
 - Small footprint HX2QFN20 package (3 x 3 mm)
- EdgeLock SE051 extensions (on top of EdgeLock SE050 platform features)**
- IoT security solutions with updatability for time to market and customization SE051A/C with preinstalled IoT applet and full SW enablement for fast deployment
 - SEMS Lite for convenient IoT applet updatability
 - Expanded crypto agility by AES GCM, GMAC and Montgomery Curve448

EDGELOCK SE050 PRODUCT FAMILY — DETAILS

Features		SE050C1	SE050C2	SE050B1	SE050B2	SE050D2	SE050A1	SE050A2
ECC Crypto Schemes	ECDSA	X	X			X	X	X
	ECDH	X	X			X	X	X
	ECDHE	X	X			X	X	X
	ECDA	X	X					
	EdDSA	X	X					
Supported Elliptic Curves	NIST (192 to 521 bit)	X	X			X	X	X
	Brainpool (160 to 512 bit)	X	X			X	X	X
	Koblitz (160 to 256 bit)	X	X			X	X	X
	Barreto-Naehrig (256 bit)	X	X					
	Twisted Edwards (for Ed25519)	X	X					
	Montgomery (Curve25519)	X	X					
RSA	RSA (up to 4096)	X	X	X	X			
Symmetric Crypto Algorithm	TDES (2K, 3K)	X	X	X	X	X	X	X
	AES (128, 192, 256)	X	X	X	X	X	X	X
	Modes: CBC, CTR, ECB							
MAC	HMAC, CMAC	X	X	X	X	X	X	X
Hash Function	SHA-1, SHA-224, SHA-256, SHA-384, SHA-512	X	X	X	X	X	X	X
Key Derivation (KDF)	TLS KDF, TLS PSK	X	X	X	X	X	X	X
	MIFARE DESFire KDF	X	X			X		
	Wi-Fi KDF (PBKDF2)	X	X	X	X	X	X	X
	OPC-UA KDF	X	X	X	X	X	X	X
TPM Functionalities		X	X					
Pre-Provisioned**	Details	X	X	X	X	X	X	X
Interfaces	ISO 14443	X	X					
	I ² C Target	X	X	X	X	X	X	X
	I ² C Controller	X	X					
Temperature Range		-25 °C– +85 °C	-40 °C– +105 °C	-25 °C– +85 °C	-40 °C– +105 °C	-40 to +105 °C	-25 °C– +85 °C	-40 °C– +105 °C

* FIPS Certified SE050 variant will be launched in H2. For more information on configuration, contact your sales representative.

** for ease of use



EDGELOCK SE051 PRODUCT FAMILY — DETAILS

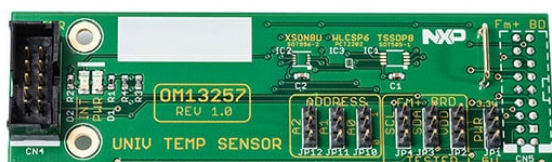
		SE051C2	SE051A2
SEMS Lite	SEMS Lite	X	X
ECC Crypto Schemes	ECDSA	X	X
	ECDH	X	X
	ECDHE	X	X
	DH_MONT	X	
	ECDAA	X	
	EdDSA	X	
Supported Elliptic Curves	NIST (192 to 521 bit)	X	X
	Brainpool (160 to 512 bit)	X	X
	Koblitz (160 to 256 bit)	X	X
	Barreto-Naehrig (256 bit)	X	
	Twisted Edwards (for Ed25519)	X	
	Montgomery (Curve25519)	X	
	Montgomery (Curve448)	X	
RSA	RSA (up to 4096)	X	
Symmetric Crypto Algorithm	3DES (2K, 3K)	X	X
AES Modes	AES (128, 192, 256)	X	X
	AES CBC, ECB, CTR	X	X
	AES CCM, AES GCM	X	X
MAC	HMAC, CMAC, GMAC	X	X
Hash Function	SHA-1, SHA-224, SHA-256, SHA-384, SHA-512	X	X
Key Derivation (KDF)	TLS (KDF, PSK)	X	X
	MIFARE DESFire KDF	X	X
	PBKDF2 (Wi-Fi EAP)	X	X
	HKDF	X	X
Secure Channel	Secure Channel Host-SE (Platform SCP)	X	X
TRNG		NIST IG7.15, AIS31	NIST IG7.15, AIS31
DRBG		NIST SP800-90A, AIS20	NIST SP800-90A, AIS20
User Memory: Full Feature—NV		46 kB	46 kB
User Memory: Maximum—NV		104 kB	104 kB
User Memory: RAM		608 bytes	608 bytes
Pre-Provisioned*		X	X
Interfaces	ISO14443	X	
	I ² C Target	X	X
	I ² C Controller	X	
Temperature range		-40 °C–105 °C	-40 °C–105 °C

TEMPERATURE SENSORS

The PCT2075 is a temperature-to-digital converter featuring ± 1 °C accuracy over -25 °C to +100 °C range. It uses an on-chip band gap temperature sensor and Sigma-Delta A-to-D conversion technique with an overtemperature detection output that is a drop-in replacement for other LM75 series thermal sensors.

The PCT2075 converter also includes an open-drain output (OS) which becomes active when the temperature exceeds the programmed limits. The OS output operates in either of two selectable modes: OS comparator mode or OS interrupt mode. Its active state can be selected as either HIGH or LOW. The fault queue that defines the number of consecutive faults in order to activate the OS output is programmable as well as the set-point limits.

OM13257: UNIVERSAL TEMPERATURE SENSOR DAUGHTER CARD



CONNECTED NFC TAGS

Besides standalone passive NFC tags, as they would be found in NFC stickers, NXP also offers NFC tags with an additional electrical interface. A connected NFC tag is a fast, cost-effective way to add tap-and-go connectivity to just about any electronic device. On the NFC side, these connected tags communicate with an NFC smartphone or with a dedicated reader device. Towards their electrical system side, they typically communicate over I²C — often to a microcontroller. They act as a communication modem between the microcontroller and any NFC-enabled devices.

When a connected tag is embedded in a system, it helps expand the user interface. An NFC smartphone can act as an extended GUI to the system. If the smartphone is connected to a network, the connected tag and the phone together allow for creating a direct end-to-end link between the local microcontroller and an internet service. An NFC smartphone can also display maintenance and status data from the system internal microcontroller, thus making a maintenance engineer's job easier.

FEATURED PRODUCTS:

NTAG® I²C

The NTAG I²C *plus* combines a passive NFC interface with a contact I²C interface. A connected NFC tag is a fast, cost effective way to add tap-and-go connectivity to just about any electronic device. The device supports advanced features for password protection, a full memory-access configuration from both interfaces and an originality signature for protection against cloning.

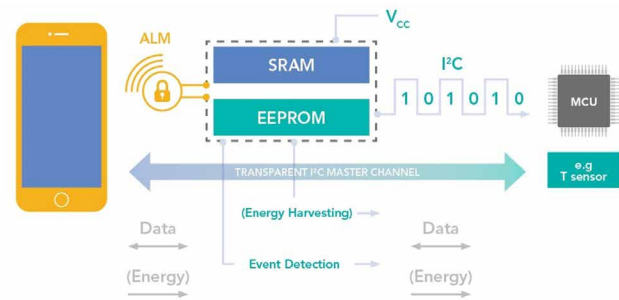
NTAG 5 link and NTAG 5 boost

Compared to NTAG I²C *plus*, NTAG 5 adds a number of powerful features. AES-128 authentication is supported. The device has a far greater configuration range and more flexible interface options for the event detection pin. If the system power is down, NTAG 5 can harvest energy from the NFC field with twice the efficiency as NTAG I²C *plus*. Finally, NTAG 5 boost has the capability to perform NFC communication in an active mode with an antenna size of only 10 x 10 mm that fits nearly everywhere.

Commitment to Longevity

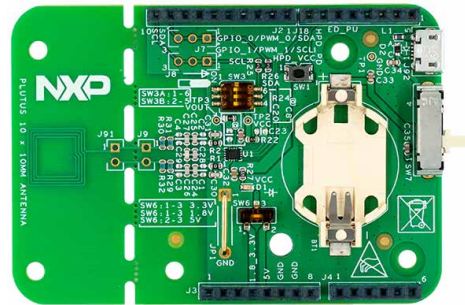
Both NTAG 5 and NTAG I²C are ready to support your development today, tomorrow and beyond through the longevity program. The Product Longevity program ensures a stable supply of products for your embedded designs.

CONTACTLESS AND CONTACT SYSTEM



EVALUATION BOARDS

OM2NTx5332: NTAG® 5 development kits



NTAG I²C *plus* Explorer Kit OM5569NT322E



MIFARE EV CHARGING CARD SOLUTION INTEGRATES SMART CITY SERVICES ON ONE CARD

- Contactless EV charging card solution based on MIFARE allows customers to pay easily, quickly and securely at the charging station.
- Services such as transport ticketing, parking, tolling, car sharing, park & ride, etc., can be integrated onto the EV charging card, bringing convenience to the car owner.
- Leveraging on the wide install bases of MIFARE contactless smartcard platform
- Secure and expandable platform to match all future requirements of EV charging retailers



NXP'S SECURE, CONTACTLESS AND MULTI-APPLICATION IC — MIFARE DESFIRE

- NXP Essential line ICs – MIFARE DESFire EV3
- Flexible file structure for true multi-application operation with 2–8 KB user memory
- Inter-application file sharing enables multiple e-mobility service providers to share on one card
- ISO/IEC 14443 A 1-4 and ISO/IEC 7816-4 compliant
- Common Criteria EAL5+ certified for IC hardware and software
- Based on AES crypto algorithms
- NFC Forum Tag Type 4 certified tap and easy access to e-mobility mobile app
- Proximity Check mitigates risk of fraud caused by relay attack on the card
- Proof of transaction/purchase with card-generated MAC in multi-service provider environment

FACILITATING CASHLESS, CONTACTLESS CONTACTLESS PAYMENTS WITH NFC

Holding cash is gradually becoming a thing of the past, and consumers are increasingly seeking digital transactions. In particular, EV charging customers want to pay easily, quickly and securely. They may be further enticed by access to useful driver information or loyalty points that can be collected by regularly charging at the same operator(s).

Contactless NFC technology can support EV users at their charging session with connected payments.

Firstly, a mobile website can be a good solution. Customers can log on via a custom URL to pay on an ad-hoc basis for the transaction, or can also enter their card details to pre-pay for their EV charges. To facilitate access to the website, customers can tap an NFC tag at the EV station to be connected to the operator's payment site.

Secondly, app-based payments offer extra flexibility. EV charging customers simply download an app — e.g., by way of tapping an NFC signage near at the charging station — and then pay ad-hoc within the app interface, or even pre-pay for future charges using their bank card details. A customer would need to register an account, set up payment details, plug in and charge! To start a charging session, drivers would tap an NFC terminal and identify themselves using their NFC device. Additionally, this type of app could track spending over time and provide useful travel information en route.

NXP'S PASSIVE NFC TAG ICS BRINGING ADVANCED CONNECTIVITY AND INTERACTIVITY

NXP Essential line ICs — NTAG 213/215/216:

- Full NFC interoperability: NFC Forum compliant Type 2 Tag
- Chip user memory size of 144B/504B/888B, protected by password
- UID mirror for serialization for NDEF message (e.g., URL)
- NFC tap counter and mirror for additional backend plausibility check
- Originality signature to validate tag origin

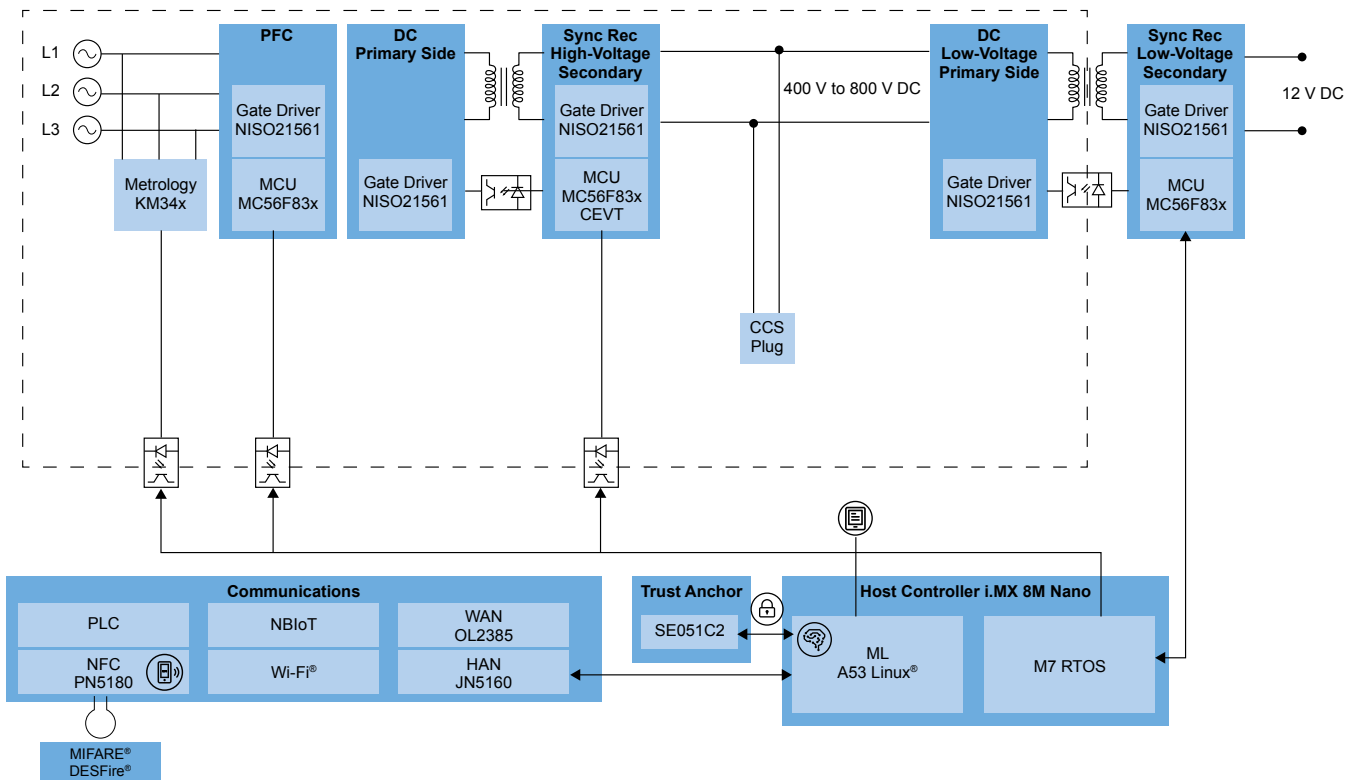
NXP Security IC — NTAG 424 DNA:

- Full NFC interrogability: NFC Forum compliant Type 4 Tag
- Common Criteria EAL 4 certified security IC
- Chip user memory of 416B, including one additional security data file
- Standard AES-128 cryptography
- SUN (Secure Unique NFC) message authentication, making taps unclonable
- 3-pass mutual authentication to access secured data file
- Physical tag presence

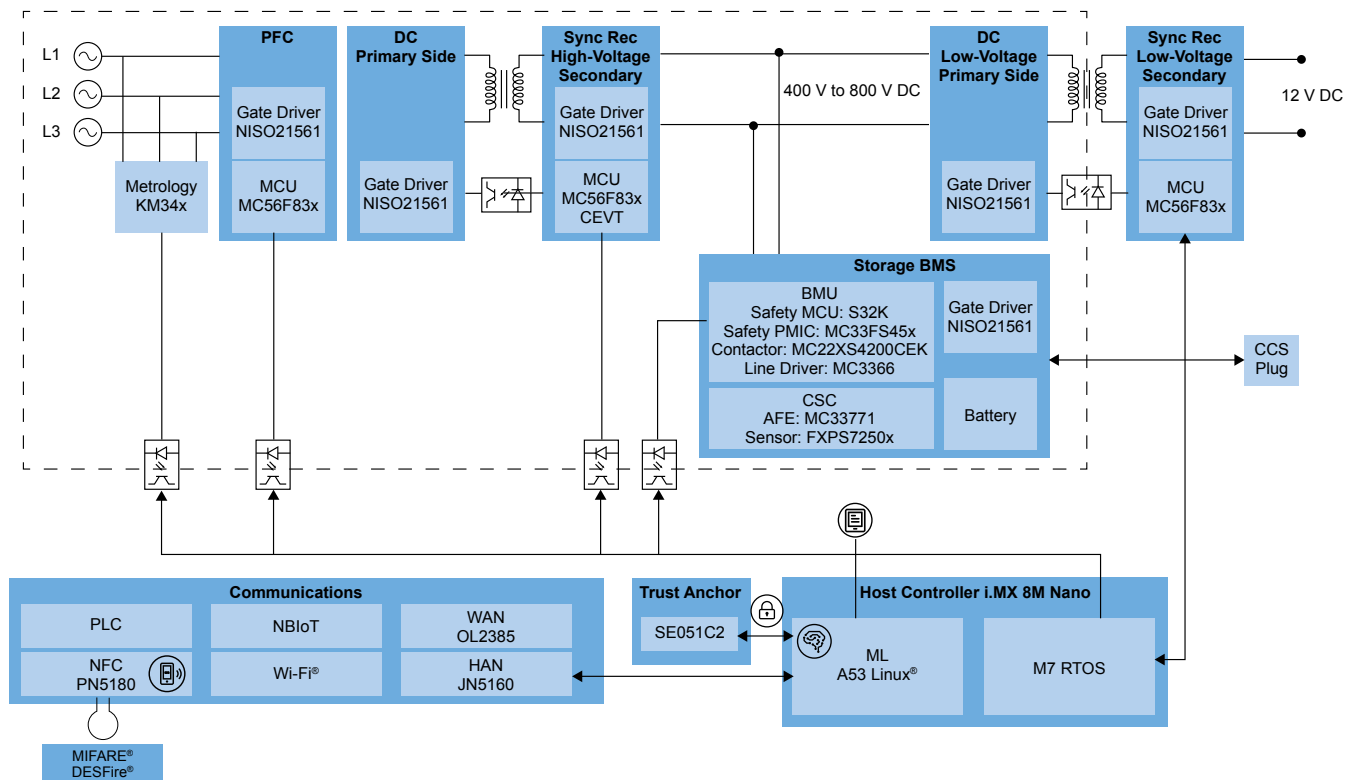


DC EVSE SOLUTION (FIGURE 13)

FAST CHARGE

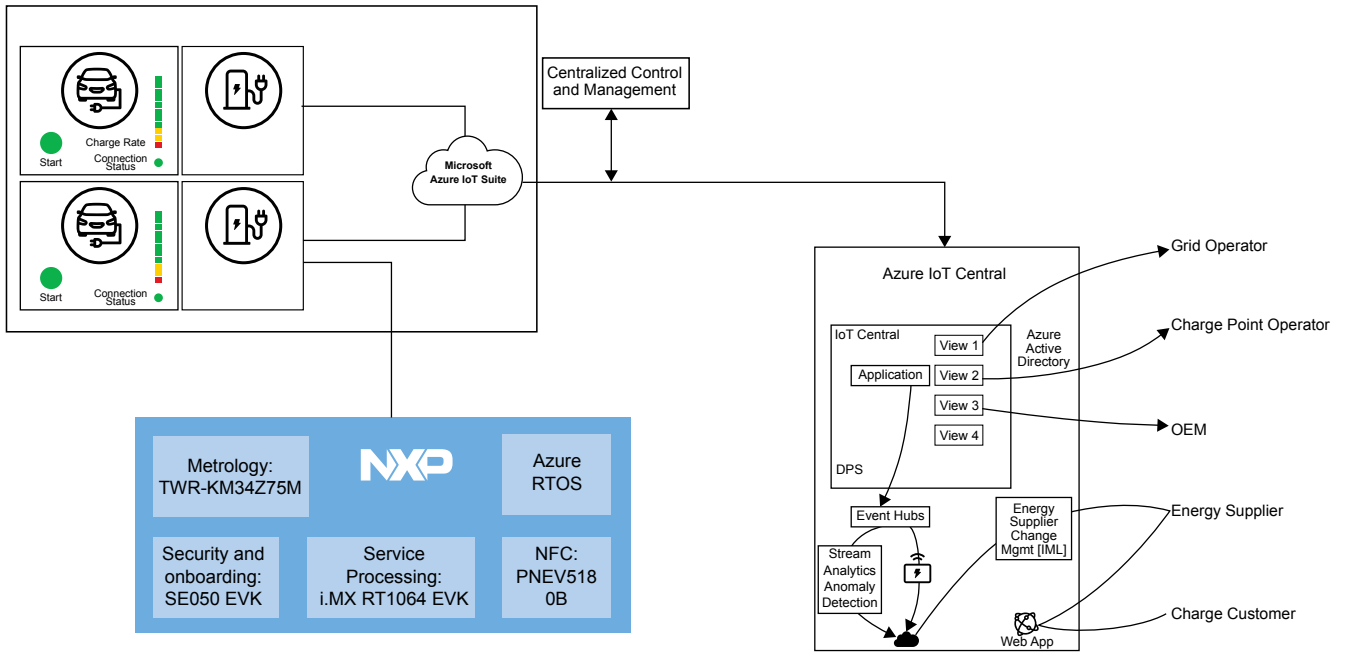


ULTRA FAST CHARGE (FIGURE 14)



DEMO

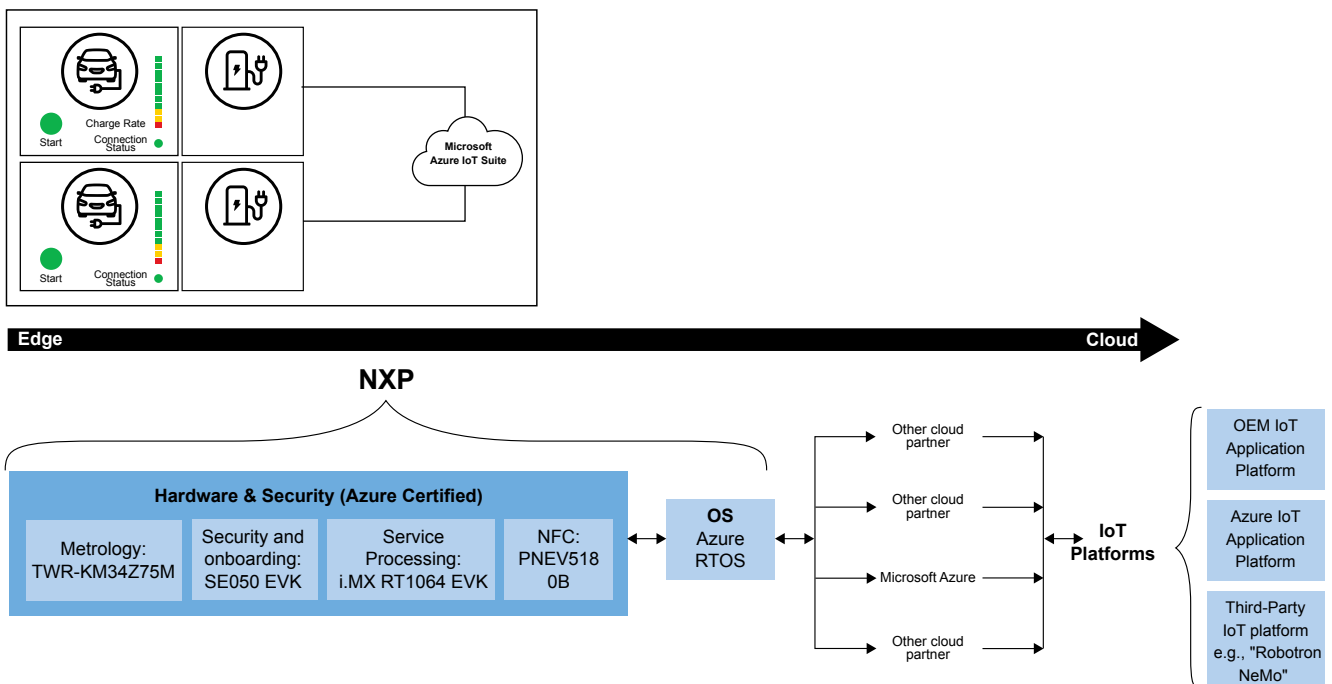
EV BATTERY CHARGING STATION SOLUTION FROM THE EDGE TO THE CLOUD (FIGURE 15)



Reference solution resolves customer challenges

- Energy Savings
- Faster Time-to-market
- Cost Optimization
- Safety and Security
- Project De-risking

NXP CLOUD AND IOT PLATFORM FLEXIBILITY (FIGURE 16)



**VALUE OF NXP — MICROSOFT EV CHARGING
REFERENCE SOLUTION**

Faster TTM, Lower Energy Consumption, Cost
Optimization, Security, Safety and Project de-risking

Offering	Value
Turn-key solution Edge to Cloud	End-to-end solution using Azure IoT Central as a Cloud Application Service. Ready in hours.
Pre-certified Metrology front end solution with highly accurate energy measurement	New legislation is defining higher levels of accuracy for power delivery measurement e.g., German Eichrecht 11 MWh of potential energy savings per year plus CO2 savings (0.25% vs. 3% accuracy and 20.000 charge points)
Shift device architecture from MPU to MCU	Potential for up to \$10 device solution cost savings
Azure RTOS	Significant license cost saving with license agreement between NXP and Microsoft, offering Azure RTOS for free to NXP MCU customers. Industrial grade real-time operating system providing reliability and robustness working seamless with Azure. Pre-certified for functional safety standards ASIL-D and IEC60730. Security certified environment for EAL4+ Common Criteria and FIPS140.
Component's longevity	10 and 15 Longevity Program for NXP components
Zero-Touch Provisioning	Simplify with zero-touch provisioning. Minimize manual connection requirements. Enhance security through Secure Element, addressing needs of complex and untrusted supply chains. Remove manual errors by deploying Microsoft Device Provisioning Service (DPS) to register devices securely.
Microsoft IoT Plug and Play	Microsoft IoT Plug and Play IoT Plug and Play enables solution builders to integrate smart devices with their solutions without any manual configuration. Reduce application development time from 1 day to few hours and reuse functional behavior for subsequent platform developments
Co-sell with Microsoft	Co-selling with Microsoft is defined as any collaborative engagement between Microsoft and their partner ecosystem, including building demand, sales planning, sharing sales leads, accelerating partner-to-partner empowered selling and delivering marketplace-led commerce for customer transformation.

www.nxp.com

NXP, the NXP logo, NTAG and EdgeLock are trademarks of NXP B.V. m, Cortex and TrustZone are trademarks or registered trademarks of Arm Limited (or its subsidiaries) in the US and/or elsewhere. The related technology may be protected by any or all of patents, copyrights, designs and trade secrets. All rights reserved. All other product or service names are the property of their respective owners.
© 2021 NXP B.V.

Document Number: MSFTEVBROCHA4 REV 1