How to Simplify Industrial IoT Development

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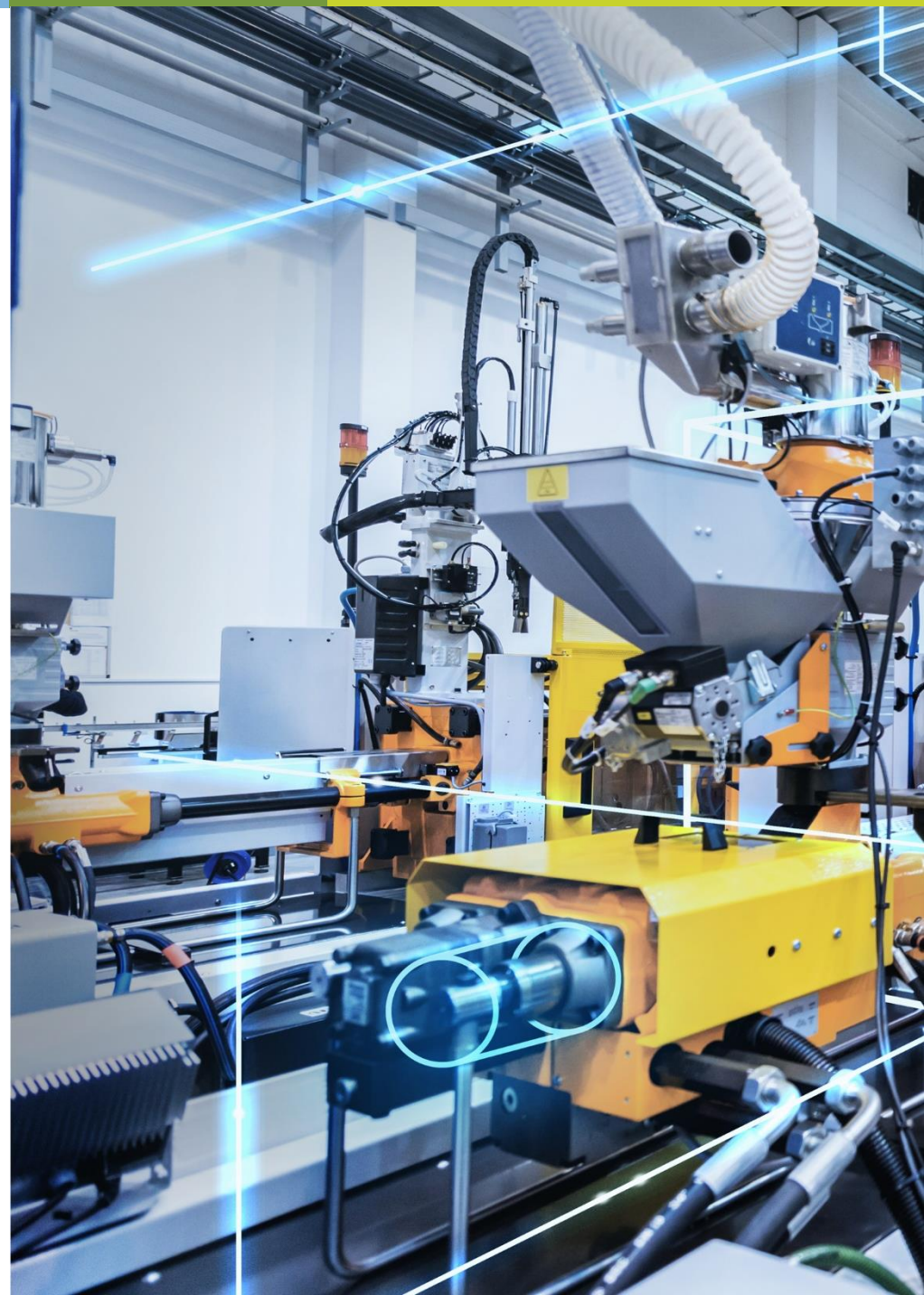
SECURE CONNECTIONS FOR A SMARTER WORLD




BIG OPPORTUNITIES
CAN COME WITH
BIG COMPLEXITY
How do you cut out complexity and smooth the development cycle?

AGENDA

- Introducing i.MX RT Industrial Drive Development Platform
- Block Diagram and Boards
- Use Cases and Enablement
- Applications
- Support Package
- Q&A

Introduction

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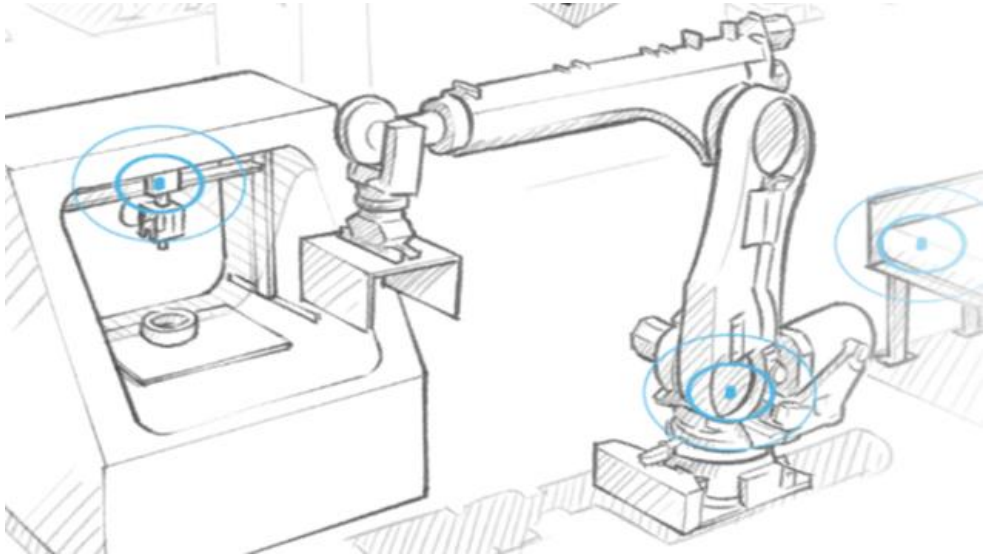
i.MX RT INDUSTRIAL DRIVE DEVELOPMENT PLATFORM



- Flexible modular-board kit (daughter card, digital board, power stage board) to evaluate motor control, deterministic communication and industrial cyber-security
- Comprehensive solution to dramatically shorten the development time of secure industrial field devices
- Primary target applications: servo drives, robotics, 3D printing, multi-axis machinery

Target: 2023

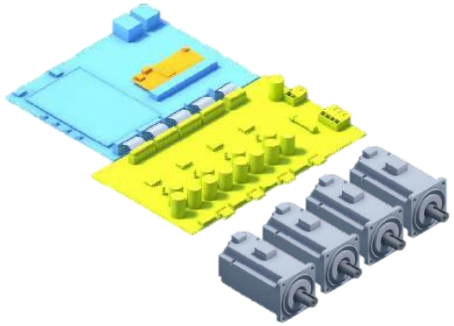
Target Launch: Sep/Oct 2022

Q2 2020

Next Generation Development Platform

i.MX RT Industrial Drive Development Platform

Quad Motor Control Development Platform
Link



- *Multi-axis motor control*
- *Secure cloud-based monitoring*
- *i.MX RT1050 based*

- *Multi-axis motor control*
- *TSN Ethernet*
- *ISA/IEC 62443-4-2 compliant*
- *Analog Front End*
- *i.MX RT1170 based*

- *Additional industrial innovative use cases*
- *Integration of latest NXP products*
- *i.MX RT1180 based*

1st Generation **2nd Generation** **3rd Generation**

**Daughter card connector compatibility across generations*

*HW compatibility, daughter card edge connector for both 1st Generation and 2nd Generation is SO-DIMM 200 pos.

✓Standardized Industrial Cybersecurity

Provides guidance and collateral to ease IEC 62443-4-2 certification journey – we are undergoing certification

Note: this platform only serves as a reference, it does not grant automatic IEC62443-4-1/2 certification to your products

✓Real time deterministic communication

Demonstrates and guides how to enable a field device as TSN end point in a TSN enabled network.

✓Multi-axis servo control

Demonstrates and guides how to leverage NXP MCU peripherals and gate drivers for single to multiple motor control.

✓Fault detection

Demonstrates and guides how to leverage NXP analog and digital technology for instantaneous fault detection

i.MX RT Industrial Drive Development Platform

Modular approach enables better flexibility

Daughter card (ISI-QMC-DGC-02)

Control board, which integrates MCU chip, debugging interface and Ethernet TSN port.

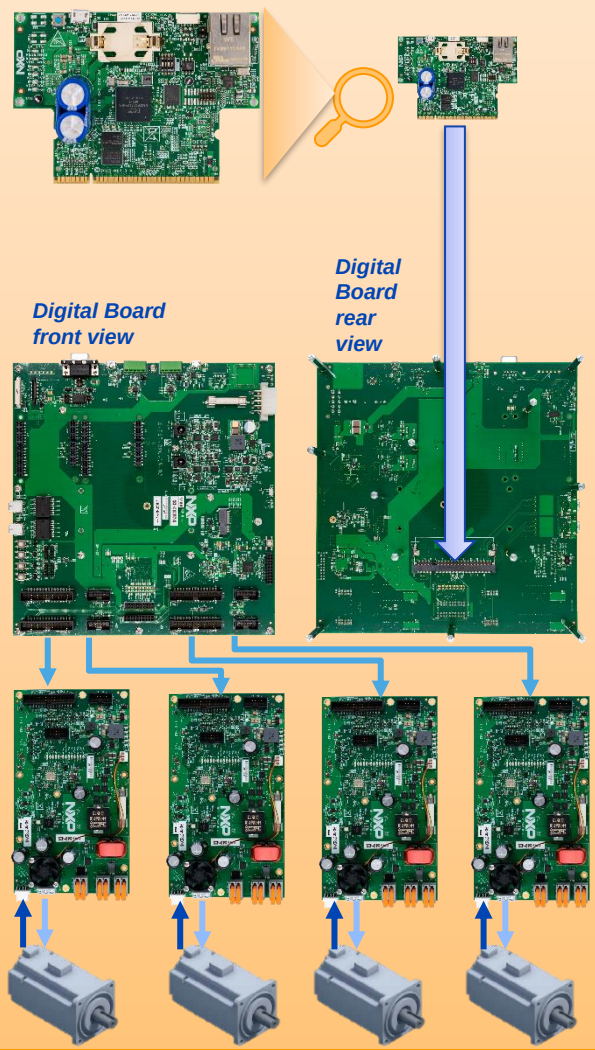
Digital Board (ISI-QMC-DB-02)

Expansion board for Daughter Card, integrates multiple peripherals for communication, security and display.

Power Stage Board (ISI-QMC-PSB-02)

Transforms the control commands into power signals to drive servo motor (200W up to 450W)

Motors are not included



Block Diagram and Boards

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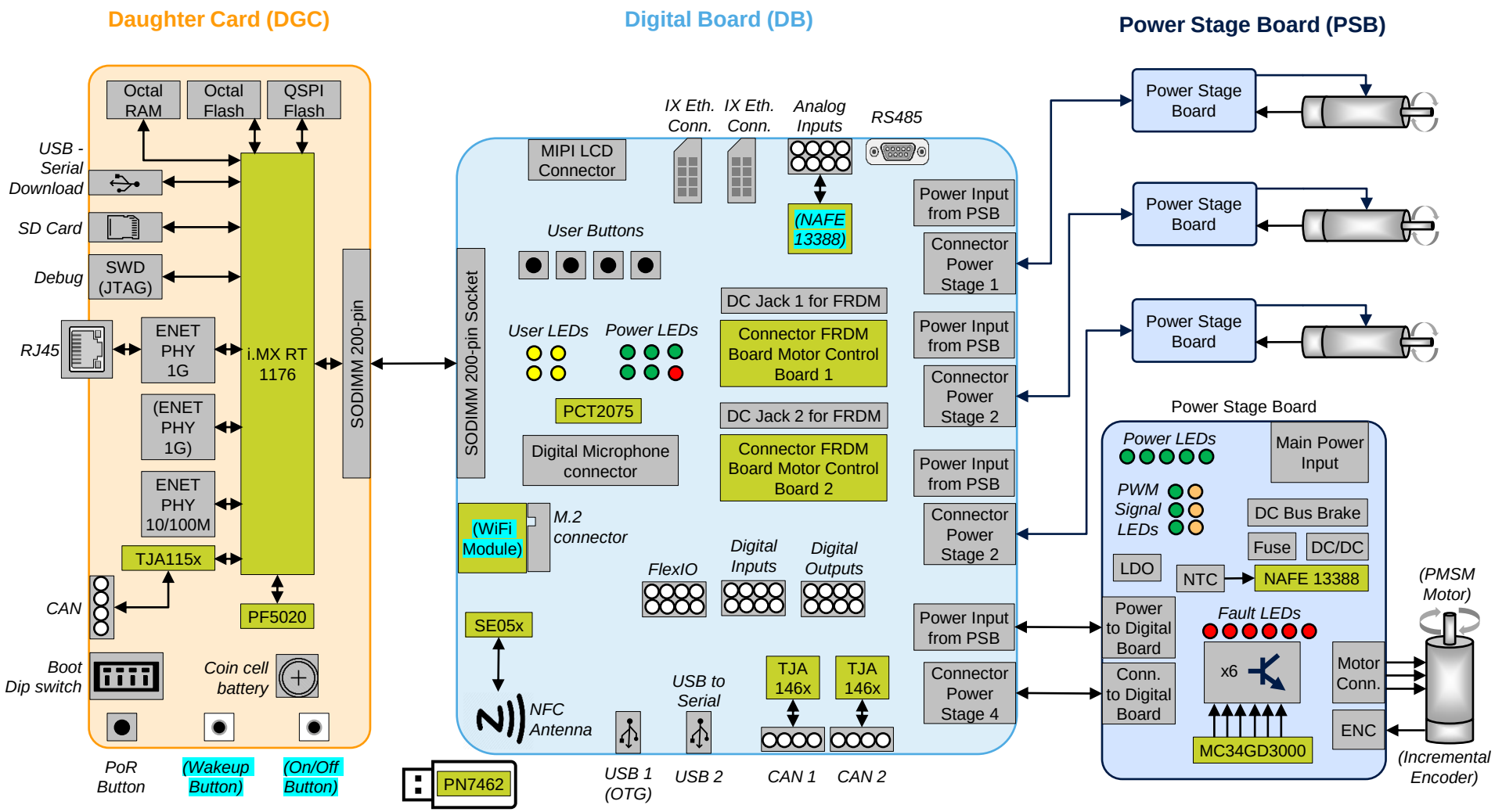
i.MX RT DEVELOPMENT DRIVE PLATFORM



Crossover MCU
i.MX RT1176

Secure Element
SE05x

(WiFi Module)
M.2 connector for NXP WiFi module*

PMIC
PF5020

NFC Reader
PN7462

CAN Transceiver
TJA1462A
TJA1152A

Analog Front End
NAFE13388

Gate Driver
MC34GD3000

(FRDM Board)
Connector for FRDM-MC-LVPMSM

Digital Temp. sensor
PCT2075

**search for WiFi module supported by i.MX RT117x SDK.*

Note: components within parenthesis ( ) are not included or not populated

i.MX RT DEVELOPMENT DRIVE PLATFORM **DAUGHTER CARD**

Part Number: ISI-QMC-DGC-02, 12NC: TBD, Selling price: TBD (estimated price: ~$250)

Features:

- 200 pos SODIMM edge connector
- 1x i.MX RT 1176 (controller)
- 1x PF5020 for power management
- 1x Ethernet RJ45 terminal (interface for 1Gb TSN port)
- 1x TJA1152A secure CAN transceiver
- 1x SWD interface (JTAG not populated)
- 1x µUSB interface (serial download)
- 1x µSD card socket
- 1x Coin cell socket
- 1x on board PoR (Power-on reset) button
- 1x Dip Switch for Boot mode and configuration
- 1x 512Mb Octal Flash
- 1x 256Mb Octal RAM
- 1x 256Mb QSPI Flash

Includes:

- 1x board ISI-QMC-DGC-02
- 1x USB A to µUSB B cable
- 1x Mini flyer
- 1x Inventory sheet

Does not include:

- Coin cell battery (CR 2032)
- µSD Card (recommended SDHC or SDXC card with UHS-I interface bus)

  Needed for FW storage and data log file
- Power supply

  As standalone it can be powered up via USB interface. If attached to digital board, then this board powers the daughter card
- Ethernet cable

Top View

Bottom View

i.MX RT DEVELOPMENT DRIVE PLATFORM **DIGITAL BOARD**

Part Number: ISI-QMC-DB-02, 12NC: TBD, Selling price: TBD (estimated price: ~$800)

Features:

- 1x 200pos SODIMM connector for Daughter Card
- 4x Connectors to power stage boards: 30pin block (control) and 10pin block (power)
- 1x SE05x connected to NFC antenna
- 1x MIPI® LCD connector, 1x M.2 connector
- 2x TJA1462AT CAN transceivers
- 2x IX Ethernet interfaces (reserved for future)
- 1x RS485 interface
- 4x Digital Input, 4x Digital Input (low speed)
- 4x Digital Output, 4x Digital Output (low speed)
- 1x µUSB (USB-to-Serial), 1x µUSB (OTG)
- 4x User buttons
- 1x PCT2075 digital temperature sensor
- Optional: 8x Analog Inputs (NAFE13388 not populated), FlexIO (not populated)

Only use if power stage boards are not connected:

- *2x NXP´s FRDM board interface*
- *1x alternative power input (max 48Vdc)*

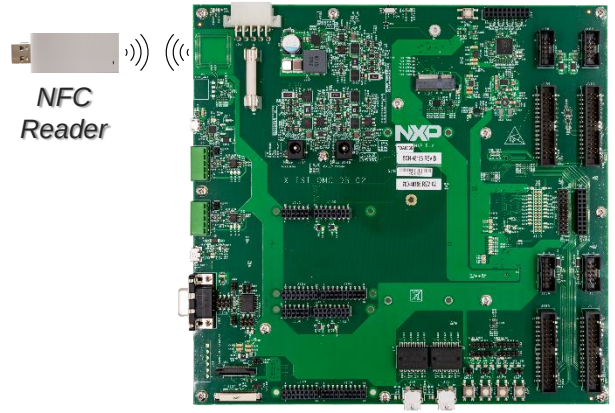
Includes:

- 1x board ISI-QMC-DB-02
- 2x IX Industrial Ethernet to RJ45 cable
- 2x Male to Male DC barrel jack cable
- 1x USB A Male to USB A Female cable
- 1x *GMMC NFC Pocket Reader. It integrates 1x PN7462
  **GMMC GmbH is an NXP's Gold Partner*
- 8x standoffs & 16x screws to fix FRDM boards
- 1x Mini flyer
- 1x Inventory sheet

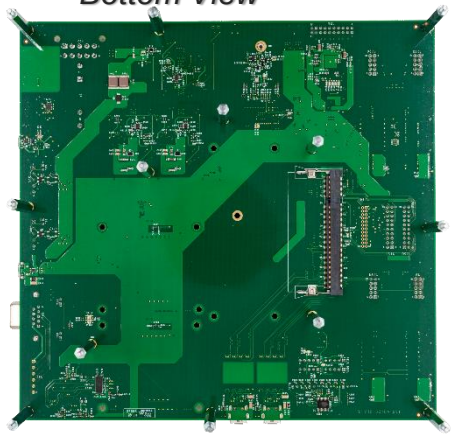
Does not include:

- Power supply
- LCD panel
- WiFi-Module
- Freedom Board

Top View



Bottom View



i.MX RT DEVELOPMENT DRIVE PLATFORM **POWER STAGE BOARD**

VARIANT B: ANALOG FRONT END IS NOT POPULATED

Part Number: ISI-QMC-PSB-02B, 12NC: TBD, Selling price: TBD (estimated price: ~$360)

Features

- 1x Connector to Digital Board: 30pin block (control) and 10pin block (power)
- 1x 3pin block for 3 phase motor
- 1x 5pin connector for incremental encoder
- 1x 2pin block for braking resistor
- Power input 48Vdc max. 1x 2pin block for +V and 1x 2pin block for –V
- 1x MC34GD3000 Gate driver
- 1x 5 Vdc axial fan, 25x10 mm (to cool down mosfets)
- 1x 10pin connector (reserved for future)

Includes:

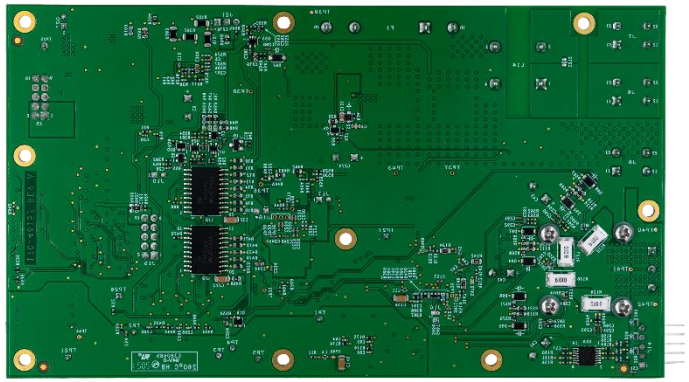
- 1x ISI-QMC-PSB-02
- 1x 10-Pin flat cable to deliver power to digital board
- 1x 30-Pin flat cable. Control signals between Digital Board and Power Stage Board
- 18x standoffs & 9x screws to stack additional Power Stage Board on top
- 1x Mini flyer
- 1x Inventory sheet

Does not include:

- Power supply (recommended not to exceed 48 Vdc)
- Motor
- Braking resistor

Top View

Bottom View



i.MX RT DEVELOPMENT DRIVE PLATFORM **POWER STAGE BOARD**

VARIANT WITH ANALOG FRONT END – THIS VARIANT WILL BE UNDER RESTRICTED SELL

Part Number: ISI-QMC-PSB-02, 12NC: TBD, Selling price: TBD (estimated price: ~$360)

Features:

- 1x Connector to Digital Board: 30pin block (control) and 10pin block (power)
- 1x 3pin block for 3 phase motor
- 1x 5pin connector for incremental encoder
- 1x 2pin block for braking resistor
- Power input 48Vdc max. 1x 2pin block for +V and 1x 2pin block for –V
- 1x MC34GD3000 Gate driver
- 1x 5 Vdc axial fan, 25x10 mm (to cool down mosfets)
- 1x 10pin connector (reserved for future)
- 1x NAFE13388 Analog Front End – Analog Input (connected to NTC)

Includes:

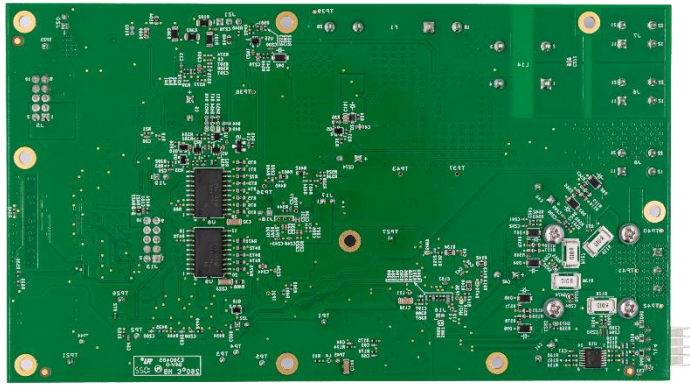
- 1x ISI-QMC-PSB-02
- 1x 10-Pin flat cable to deliver power to digital board
- 1x 30-Pin flat cable. Control signals between Digital Board and Power Stage Board
- 18x standoffs & 9x screws to stack additional Power Stage Board on top
- 1x Mini flyer
- 1x Inventory sheet

Does not include:

- Power supply (recommended not to exceed 48 Vdc)
- Motor
- Braking resistor

Top View

Bottom View



Use Cases and Enablement

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SPEED DEVELOPMENT ACROSS INDUSTRIAL USE CASES

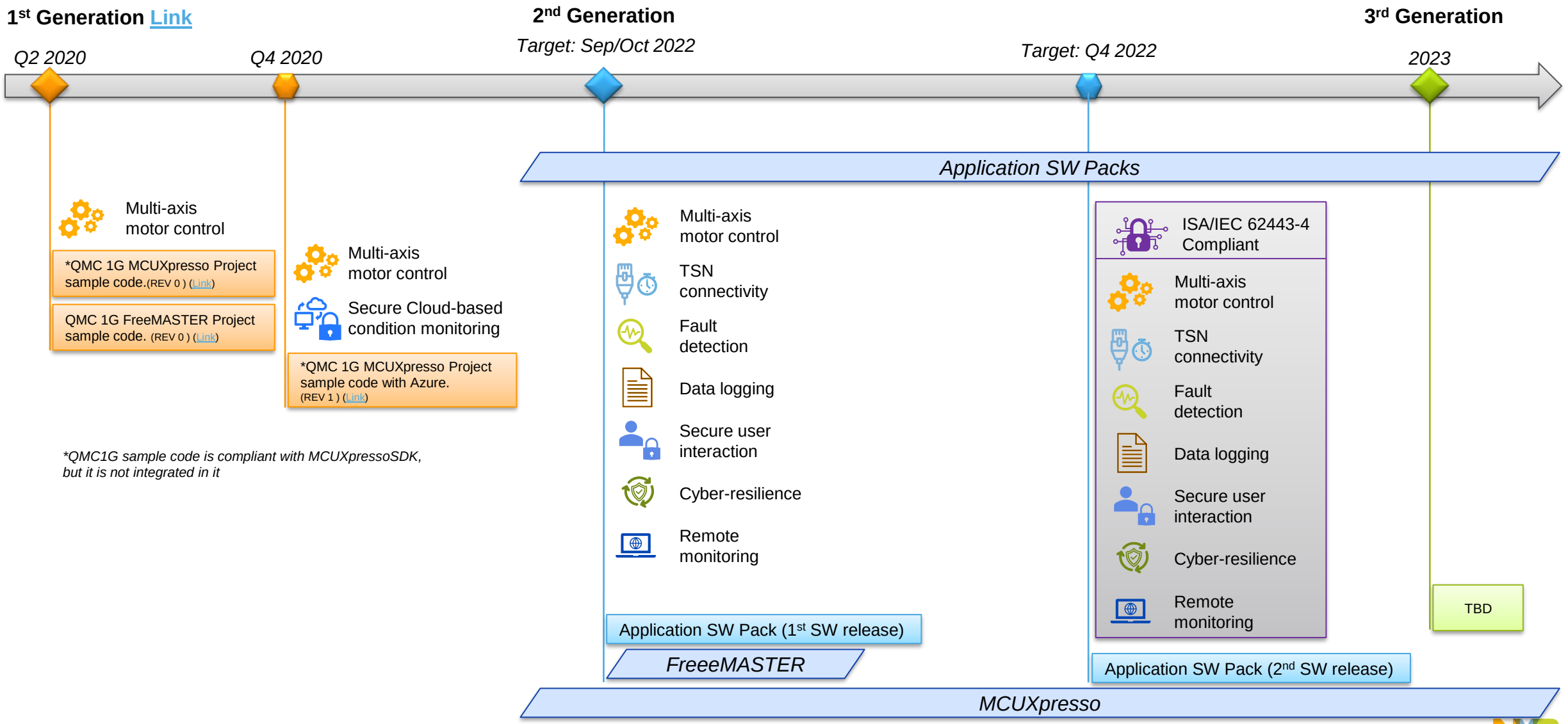
Multi-axis motor control	Single, Dual, Triple or Quad motor control using Field oriented control (FOC) algorithm to command servo motors (PMSM motor with incremental encoder).
TSN connectivity	Deterministic Ethernet communication, implementing IEEE 802.1AS and IEEE 802.1Qbv standards. It supports Real-time and Best-effort traffic over the same wire.
Fault detection	Detection of abnormal behavior of the development platform, covering events of motor control, power management and board temperature.
Data logging	Encrypted and time stamped registration of user interactions, faults, operation and communication events.
Secure user interaction	User access policy enforcement. It protects local interaction of platform in maintenance activities (e.g. local start/stop motors, SD card access, among others).
Cyber-resilience	Approach that allows to always recover to a trusted state without human intervention after a remote attack (key elements: Authenticated Watchdog Timer (AWDT), Secure Boot Loader and Recovery service).
Remote monitoring	Remote access (local network or cloud) for trusted users allowing the monitoring of internal data over a secure communication channel.

WHAT TO EXPECT FROM THE SECOND SOFTWARE RELEASE

Hardened version of first SW release, in order to be compliant with ISA/IEC 62443-4 standards

Multi-axis motor control	Single, Dual, Triple or Quad motor control using Field oriented control (FOC) algorithm to command servo motors (PMSM motor with incremental encoder).
TSN connectivity	Deterministic Ethernet communication, implementing IEEE 802.1AS and IEEE 802.1Qbv standards. It supports Real-time and Best-effort traffic over the same wire.
Fault detection	Detection and registration of abnormal behavior of the development platform, covering events of motor control, security and board's temperature.
DatalLogging	Encrypted and time stamped registration of user interactions, faults, operation and communication events.
Secure user interaction	User access policy enforcement. It protects local interaction of platform in maintenance activities (e.g. local start/stop motors, SD card access, among others).
Cyber-resilience	Approach that allows to always recover to a trusted state without human intervention after a remote attack (key elements: Authenticated Watchdog Timer (AWDT), Secure Boot Loader and Recovery service).
Remote monitoring	Remote access (local network or cloud) for trusted users allowing the monitoring of internal data over a secure communication channel.
ISA/IEC 62443-4 Compliant	The development platform, together with a physical enclosure concept and its 2nd SW release are developed to be compliant with ISA/IEC 62443-4 part 1 and part 2 (industrial cybersecurity standards).

APPLICATION CODE EXAMPLES AND TARGETS AHEAD



Applications

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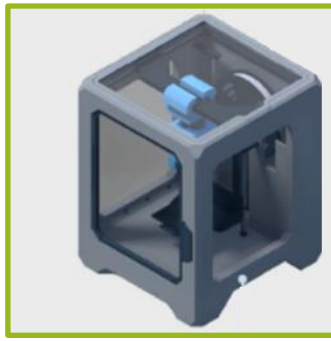
MADE FOR ADVANCED AUTOMATION DEVELOPMENT

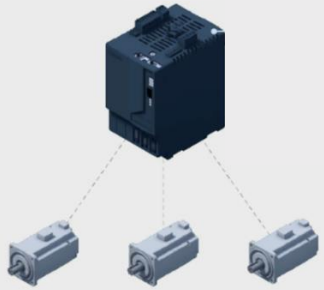
Motor control module for
Industrial robots

- Delta robots
- SCARA robots
- Robot arms (up to 4 DOF)



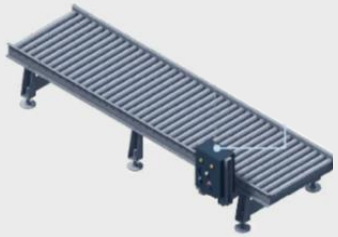
Motor control module for
Digital manufacturing

- Industrial 3D printers
- CNC Machines
- Automatic embossing machines



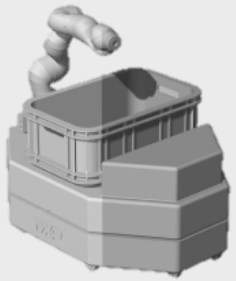
Motor drives

- Servo drives
- AC Drives
- Multi-axis servo drives



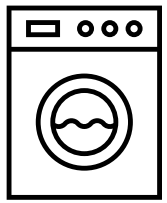
Motor control module for
Multi-axis machinery

- Conveyor belts
- Vertical transport devices
- Laboratory equipment



Motor control module for
Mobile robotics

- Automated Guided Vehicle (AGV)
- Autonomous delivery robots
- Industrial cleaning robots



Applicable to other segments

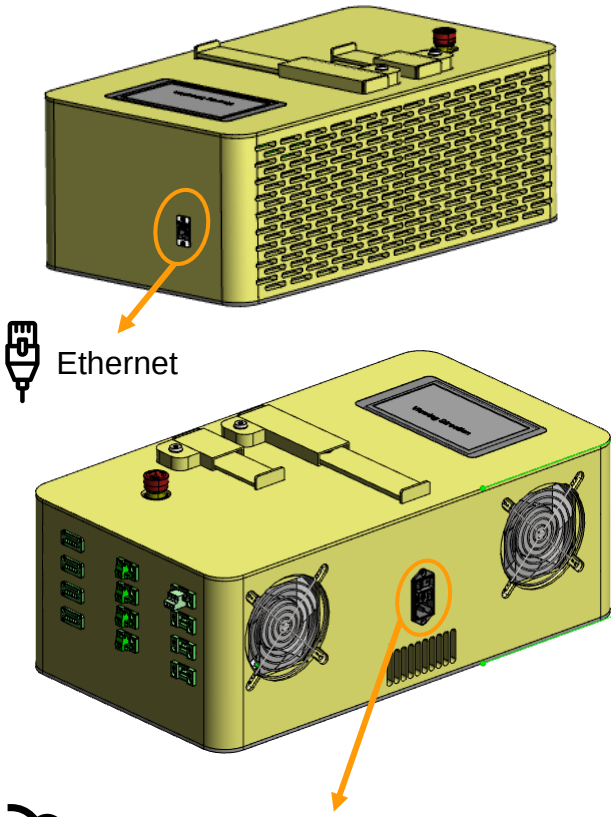
- The development platform is originally designed for industrial market, but it can be used consumer applications as well

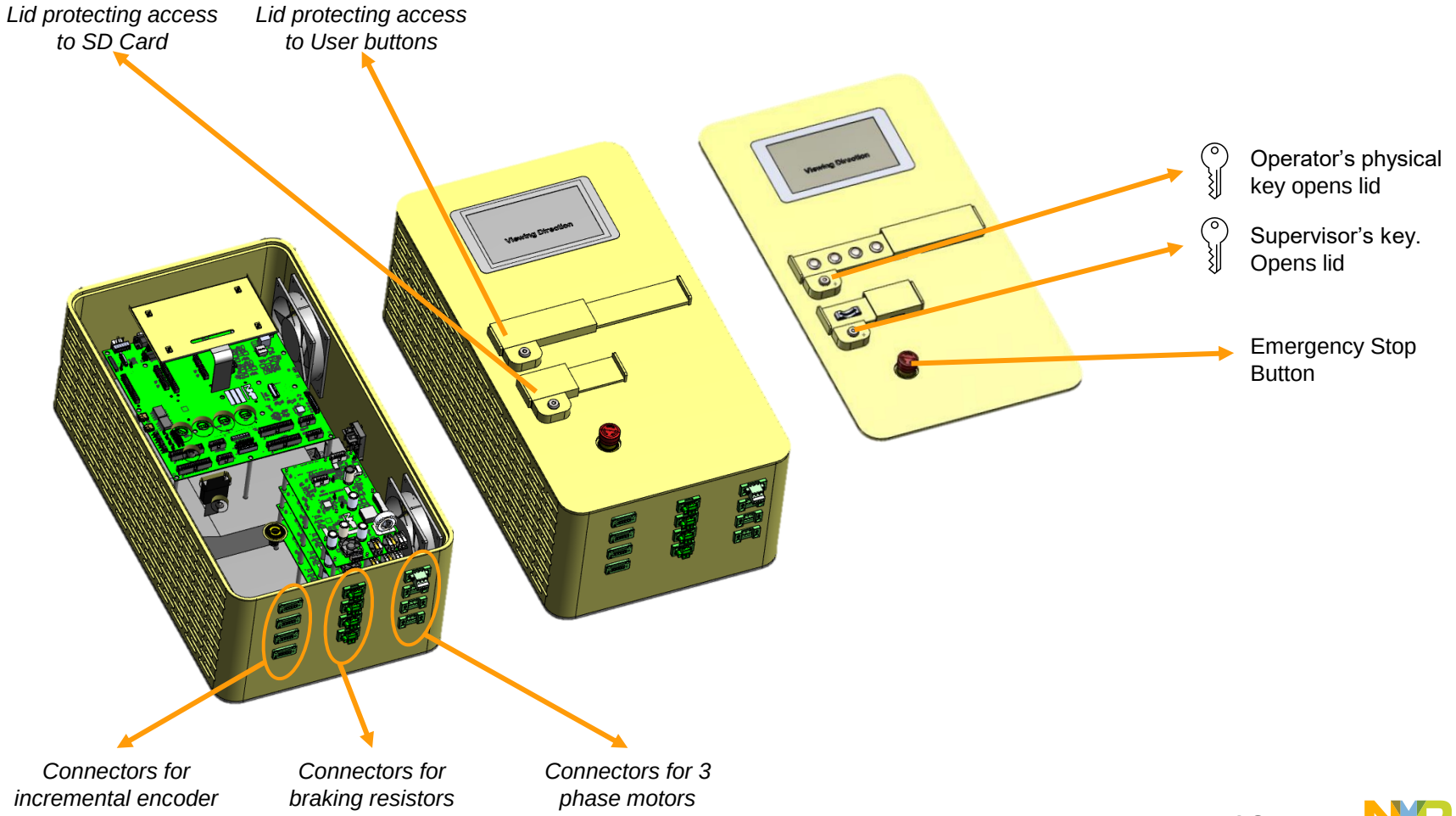
DOF: Degrees of Freedom *CNC: Computer Numerical Control*

ENCLOSURE CONCEPT

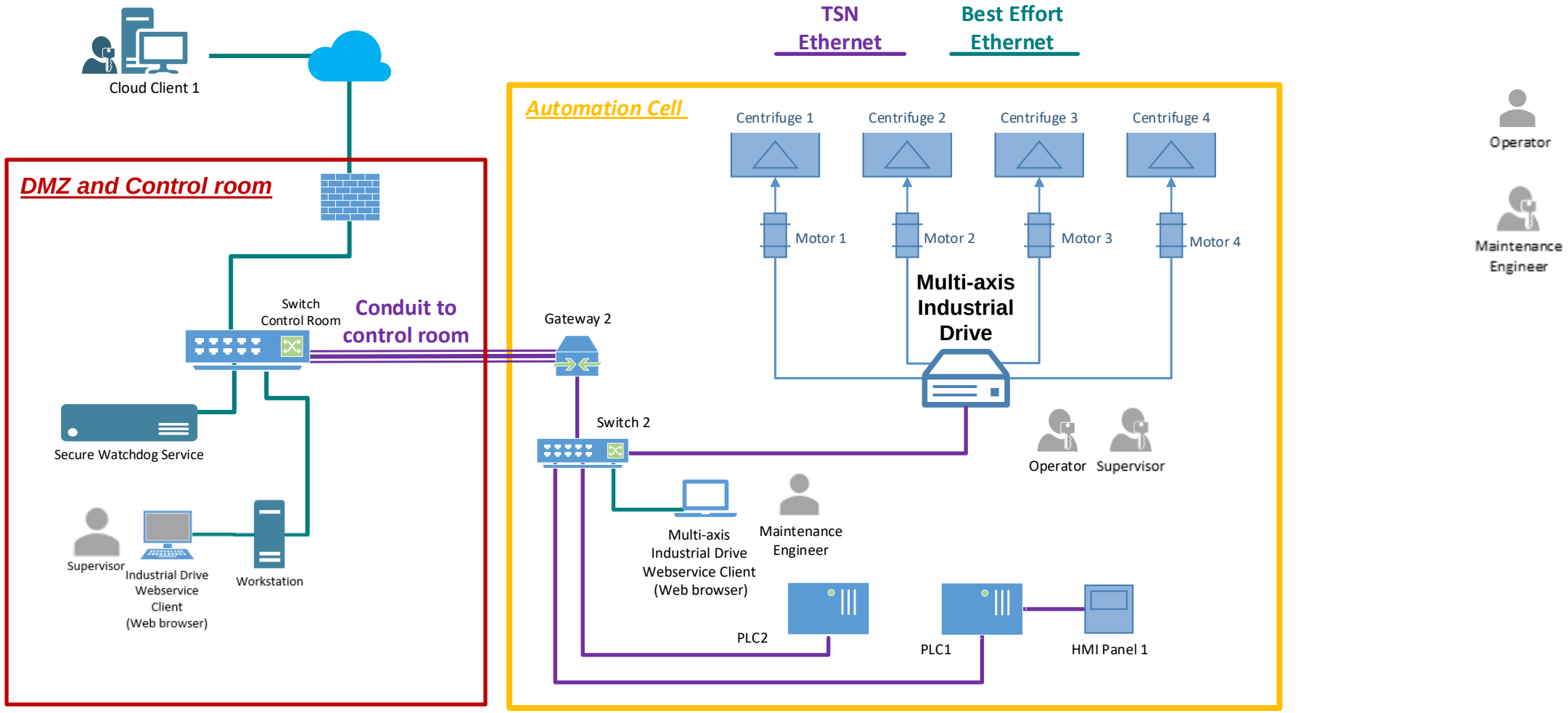
Enclosure is needed to protect boards of direct and unauthorized interaction, which is forbidden by ISA/IEC62443-4-2

*Enclosure will not be included in platform, but will be available as a design





EXAMPLE SCENARIO



Support Package

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PSP (PRODUCT SUPPORT PACKAGE) – PREPARATION UNDERWAY

Target release: Sep/Oct 2022

- Boards for sale at NXP.com and through distribution channels
  - ISI-QMC-DGC-02 (Daughter card)
  - ISI-QMC-DB-02 (Digital Board)
  - ISI-QMC-PSB-02 (Power Stage Board)
- Dedicated webpage for i.MX RT Industrial Drive Development Platform at nxp.com

www.nxp.com/imxrtindustrialdrive

- Getting-started-with section at webpage
- Factsheet
- Quick Start Guide
- 6 Pack presentation
- Video Tutorial
- Technical documentation
  - (AppNote) NXP i.MX RT Industrial Drive Development Platform HW overview
  - (AppNote) NXP i.MX RT Industrial Drive Development Platform SW overview
  - (UserManual) Get started with NXP i.MX RT Industrial Drive Development Platform
  - (UserManual) NXP i.MX RT Industrial Drive Development Platform security manual
    - (Security recommendations and how to leverage NXP portfolio to fulfill ISA/IEC-62443-4-2 compliancy)
- Schematics, BOM, Layout, Gerbers
- Sample code as Application SW Pack
- Support/Training via NXP CAS team to focused accounts and Partner's DFAEs to Mass Market accounts

Q&A

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