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GW-101: Gateways Insights on SW/HW for Connecting IoT Products to the Cloud

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Meet Your Presenters

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Rationale for a Gateway device

- **Provides a connection to the *Internet!***
  - *…Or* connects to private network infrastructure
  - *…Or* just to act as a "Hub" device…
- **Facilitates limitations of reduced-function devices**
  - CPU
  - Memory
  - Storage
  - Connectivity

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Connecting. Every. Thing.

- **For the past 10 years, IoT has been the *Wild West* of wireless protocols!**

- **From the Matter / CHIP charter:**

    "The goal of the first specification release will be Wi-Fi […], Thread […], and IP implementations for BLE […] for the network and physical wireless protocols."

    ❄ matter

- **But also…**

    "The [Matter / CHIP] Working Group will likely also embrace other IP-bearing technologies like Ethernet, Cellular, Broadband, and others."

Gateways in the Wild – SmartHome Hubs

Don't mind me, I'm just a speaker ;-)

- **Remember the "Bad Old Days?"**
  - Necessary Evil
  - Subject of consumer frustration
  - Obsolescence trap
- **Nowadays they *Hide* behind other features**
  - Smart Speakers (Alexa, Siri, g-Assistant)
  - Above, as licensed technologies and services…
  - The future of residential gateways?

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Gateways in the Wild – WiFi APs and Routers

- **But is this *really* a Gateway?**
- **Workhorse at the Edge**
- **Sets design expectation baseline**

- **For embedded Wi-Fi products, this may be all the Gateway you need…**
  - Unless you need aggregation, low-latency, offline spooling, etc!

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Gateways in the Wild – Industrial

- **Diverse requirements**
  - Rugged environmentals
  - Long operational lifetime
- **Wireless protocol diversity**
  - Same protocols as consumer…
  - But also WirelessHART, ISA-100.
  - And *proprietary* protocols

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Purpose-Built Gateway: Case Study 1

DARK ENERGY

- **Gateway for inventory tracking.**
  - 500,000+ assets in a single warehouse, reporting to the Cloud or local site server.

- **Power over Ethernet (PoE) Port for power and communication**

- **Raspberry Pi Compute Module CM3+**

- **2x 2.4 GHz EFR32 BG1 transceivers, proprietary long-range radio protocol, dual internal high-gain patch antennas**

- **MQTT protocol over TCP to backend / cloud**

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Purpose-Built Gateway: Case Study 2
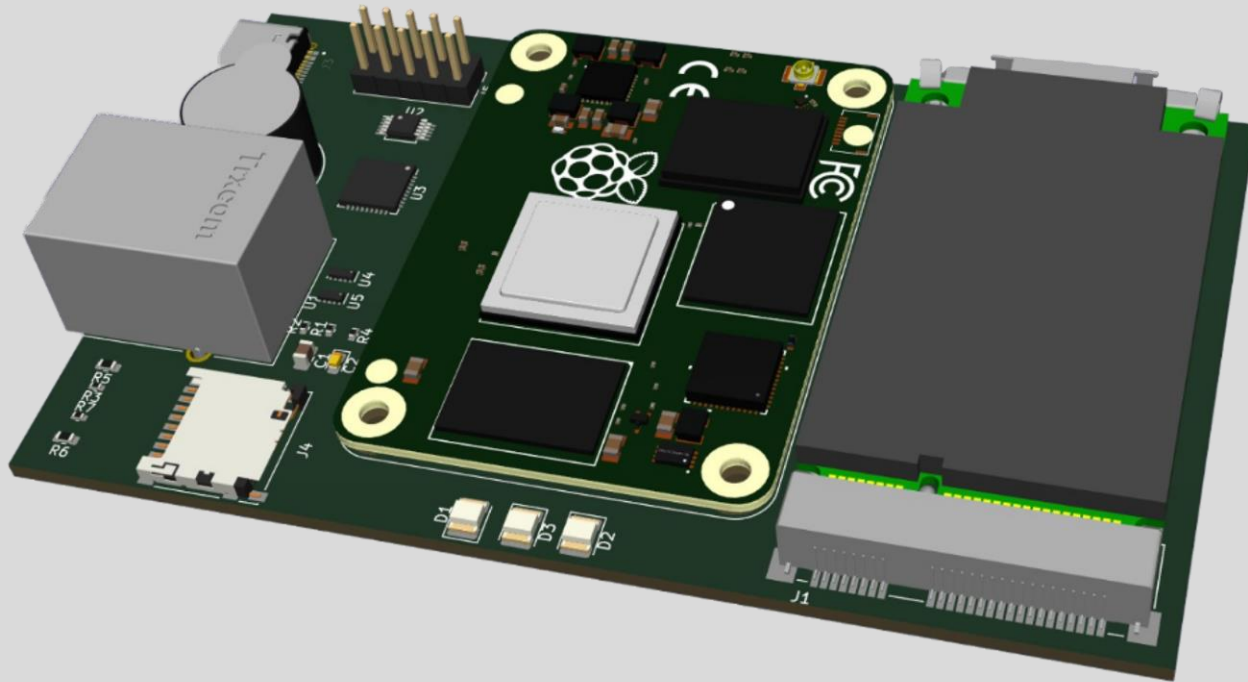
**IoT gateway for a Healthcare sensor manufacturer**

- **Raspberry Pi Compute Module CM4**
  - Integrated Wi-Fi and basic BLE support
- **Expansion via mPCIe card interface**
  - Cellular modem options
- **Gigabit Ethernet**
- **USB Type-C power**
- **MicroSD Card slot**
- **LEDs and speaker UI**

Firia XG1 "Open Gateway" - *Requirements*

- **Edge Compute resources for non-trivial applications**
  - Local in-memory aggregation
  - Data compression, de-duplication (e.g. asset tracking)
- **Software development environment**
  - Software is the biggest long-term expense
  - Open platform, availability of libraries for everything
- **Wireless multi-radio options**
  - Wi-Fi, BLE, 802.15.4, subGHz, Cellular,… expansion!
- **Rugged, fanless operation**
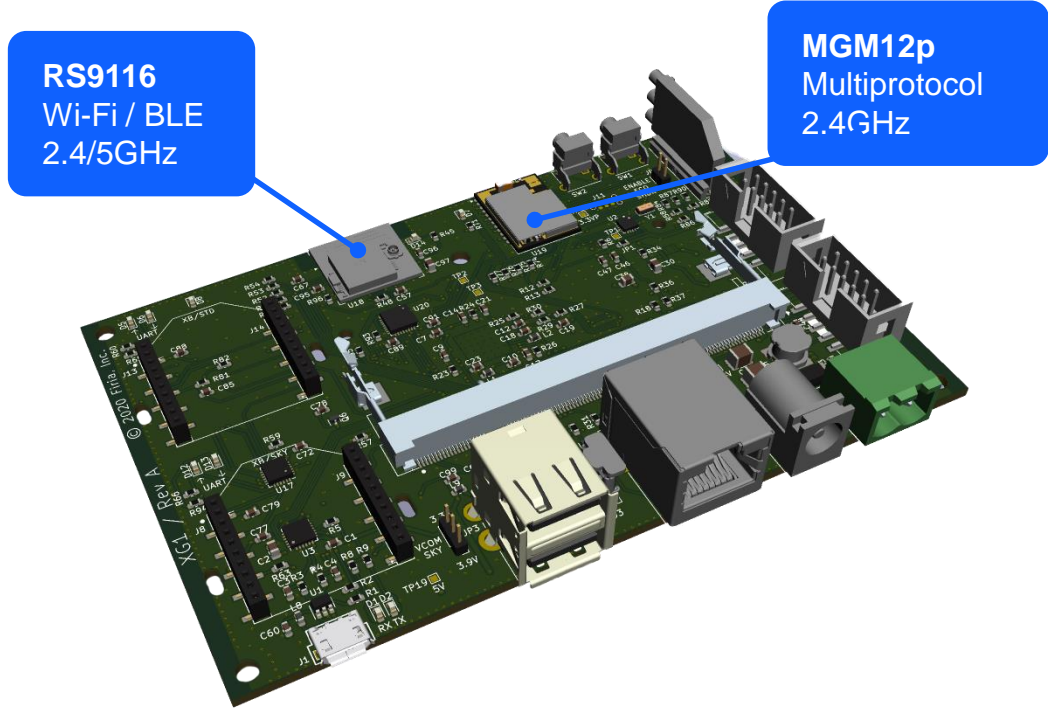
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Open Platform
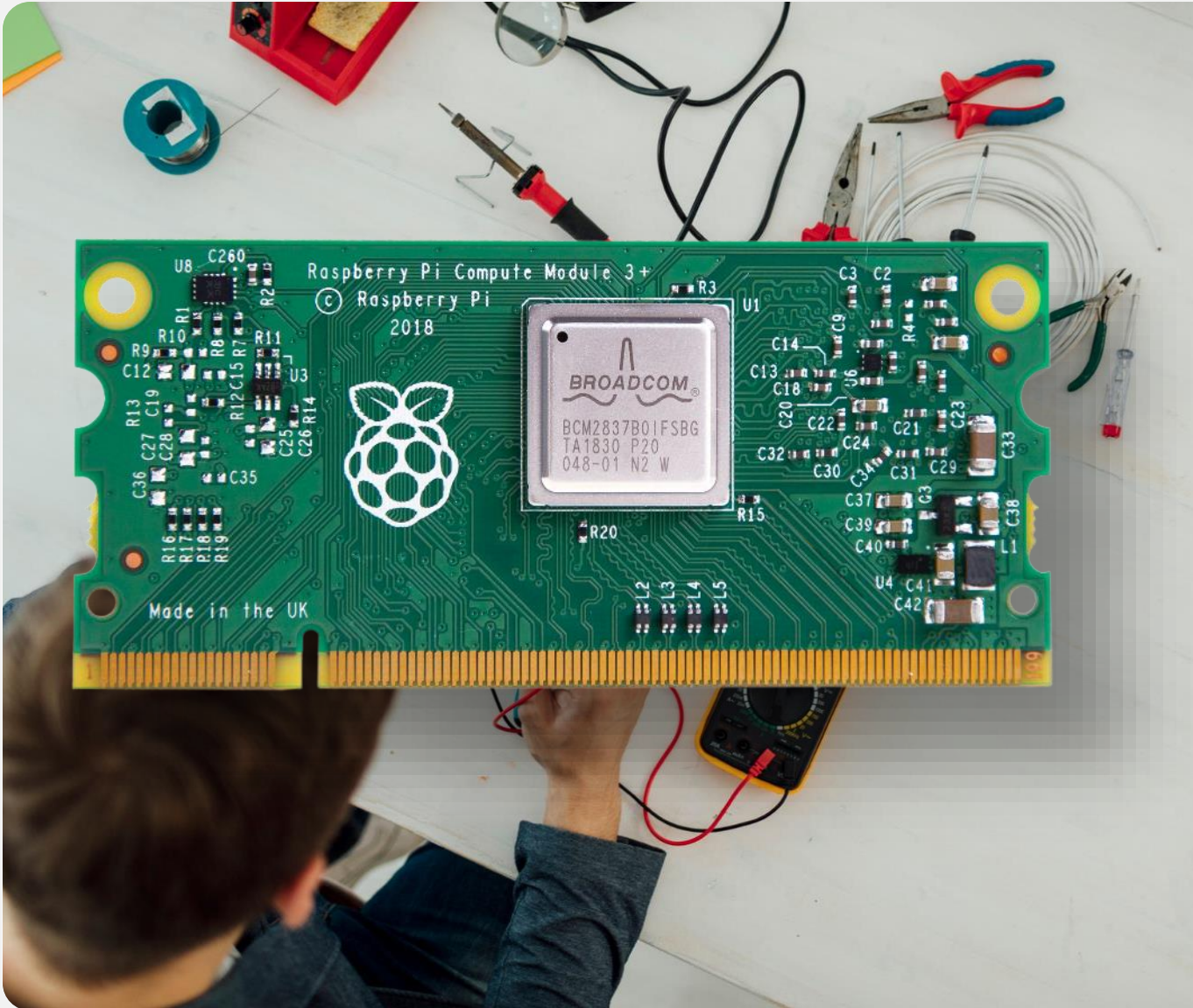
- **Raspberry Pi Compute Module CM3+**
  - Extended temperature range -25° to +75°C
  - Broadcom BCM2837B0, Cortex-A53 64-bit SoC @ 1.2GHz
  - 1GB LPDDR2 SDRAM
  - 32GB eMMC Flash
  - Availability commitment through 1/2026
  - Unmatched design runtime and software stability

- **Complete MIT licensed source code and examples at: firia.com/xg1**

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Onboard Radio Modules

firia
XG1

RS9116
Wi-Fi / BLE
2.4/5GHz

MGM12p
Multiprotocol
2.4GHz

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ECO-Processor

Running on solar panels, or a small battery pack?
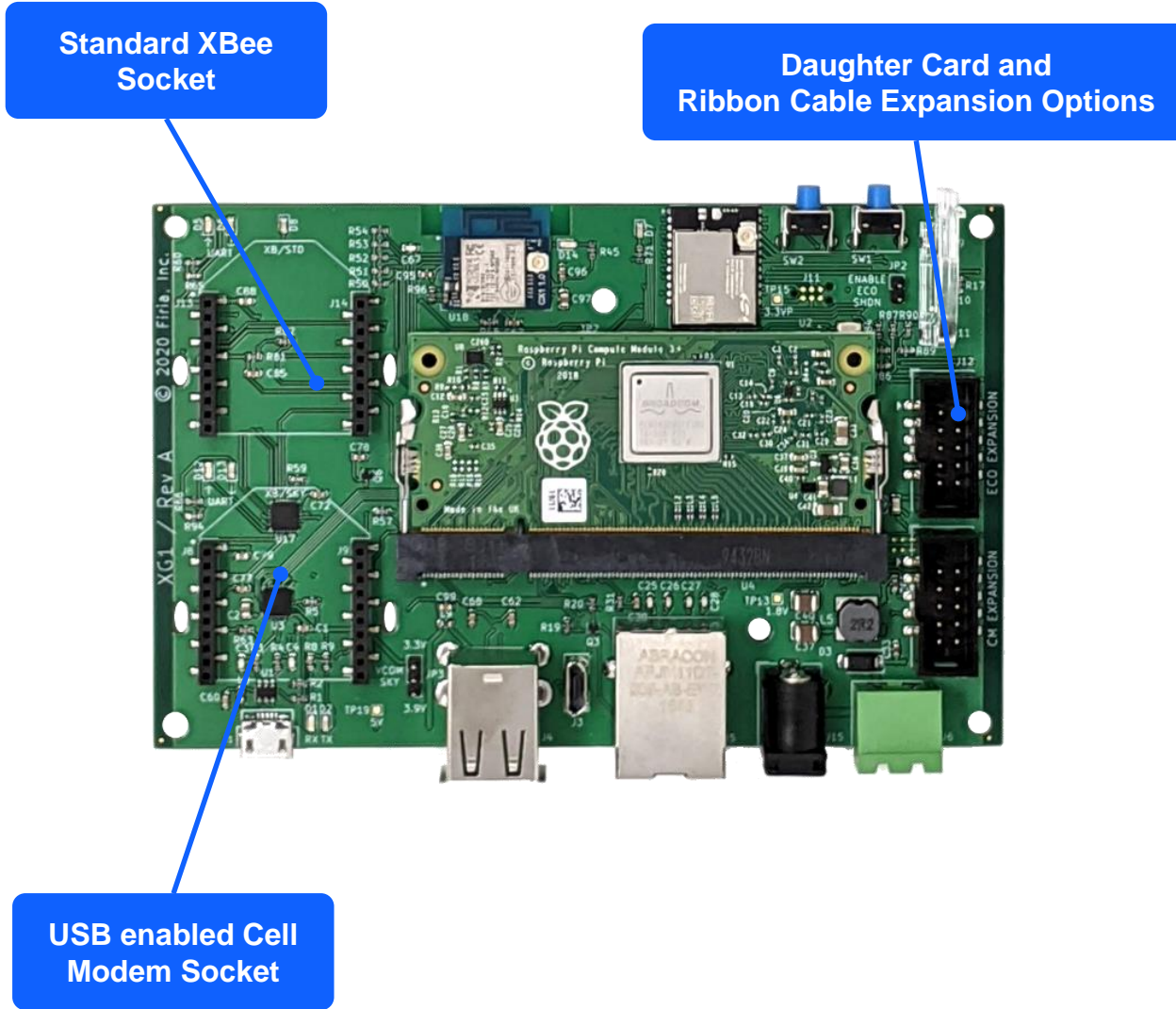*No problem!*

- **MGM12P runs on an independent "ECO" power rail**
  - Can fully control main system power (jumper enabled)
  - System sleep modes down to 250uA
  - I2C access to system RTC (Linux clock) with interrupt capability
  - Dedicated expansion port – wakeup on external sensors
  - Remote Debug / Packet Trace Interface (PTI)

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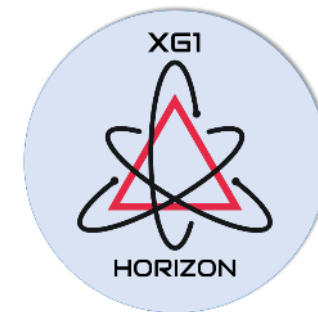
Power and Security

- **Robust and Efficient Power Section**
  - Industrial grade ESD and surge protection
  - Wide power input range (6-30VDC), with EMI filtering and reverse-voltage protection
- **Advanced Security Controller Hardware (EAL4+ Certified)**
  - Trusted Platform Module (TPM)
  - Tamper-resistant crypto key storage
  - FIPS 140-2 level 2 (Physical Security Level 3)

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Connectivity and Expansion

Standard XBee Socket

Daughter Card and Ribbon Cable Expansion Options

USB enabled Cell Modem Socket

- **Multi-carrier end-device certified Skywire modem options: LTE-M, NB-IoT, and LTE CAT4**

- **Expansion connectors provide power, analog/digital IO, serial ports**

XG1
HORIZON

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Local Application Services - *Edge Computing*

- **Network management and commissioning applications require software running on the Gateway.**

- **Wireless stacks must be initialized and maintained**
  - Node provisioning and security
  - Failover when peer-gateways become unavailable

- **Spooling data when backend connection is unavailable**

- **On-premises Cloud Functions**
  - Containerized Edge Computing
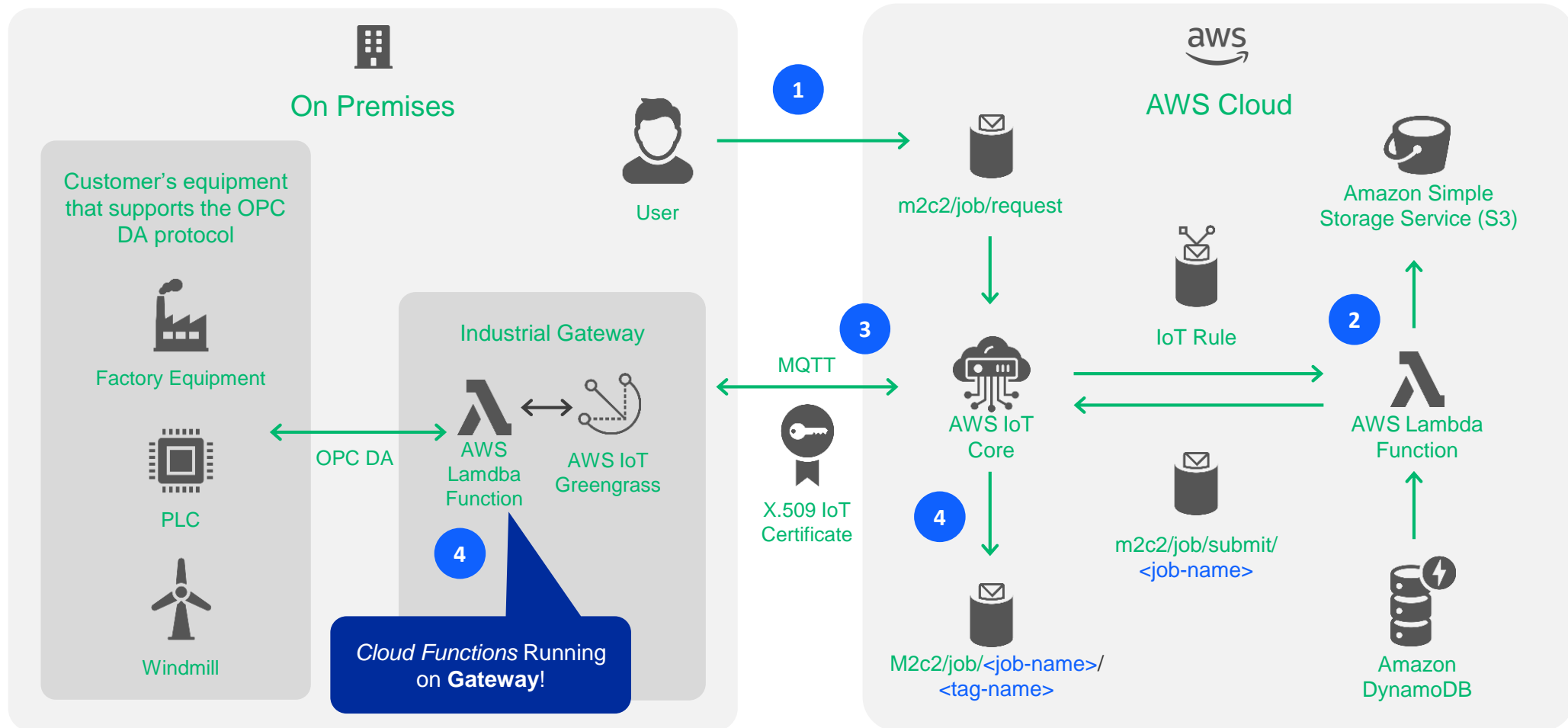 - Amazon Greengrass
  - Azure IoT Edge

To the Cloud!

- **Making sure your Gateway can handle ALL the Cloud throws at it!**
- **Software library availability**
  - MQTT, AMQP
  - Protobufs
  - HTTPS / TLS connection
- **Secure certificate management (TPM)**
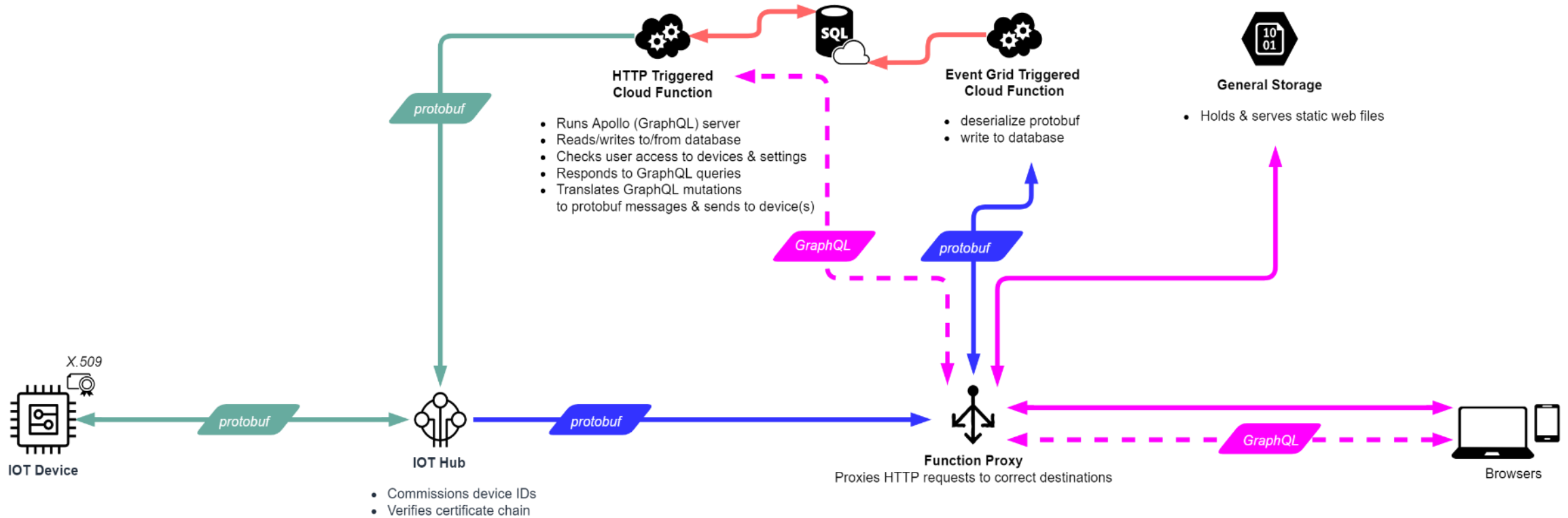- **CPU, RAM and FLASH resources**
  - Edge processing
  - Local services

AWS IoT Core

Greengrass service can run Lambdas on the Gateway

Full Stack: Device – Cloud – User

Understanding the data flow: Azure example

HTTP Triggered Cloud Function
- Runs Apollo (GraphQL) server
- Reads/writes to/from database
- Checks user access to devices & settings
- Responds to GraphQL queries
- Translates GraphQL mutations to protobuf messages & sends to device(s)

Event Grid Triggered Cloud Function
- deserialize protobuf
- write to database

General Storage
- Holds & serves static web files

IOT Device
X.509

IOT Hub
- Commissions device IDs
- Verifies certificate chain

Function Proxy
Proxies HTTP requests to correct destinations

Browsers

protobuf · GraphQL · SQL

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