

**Supported with interoperable ecosystem  
of plug-and-play components**

## **MFX-1 - Mainflux IoT Edge Gateway**

N6 Industrial Gateway - NXP i.MX6 based Industrial IoT gateway



*Developed to meet the B2B market demand for a high performance with a whole set of features*

# MFX-1 - Mainflux IoT Edge Gateway

IoT gateway developed on the optimized hardware platform for edge computing solutions

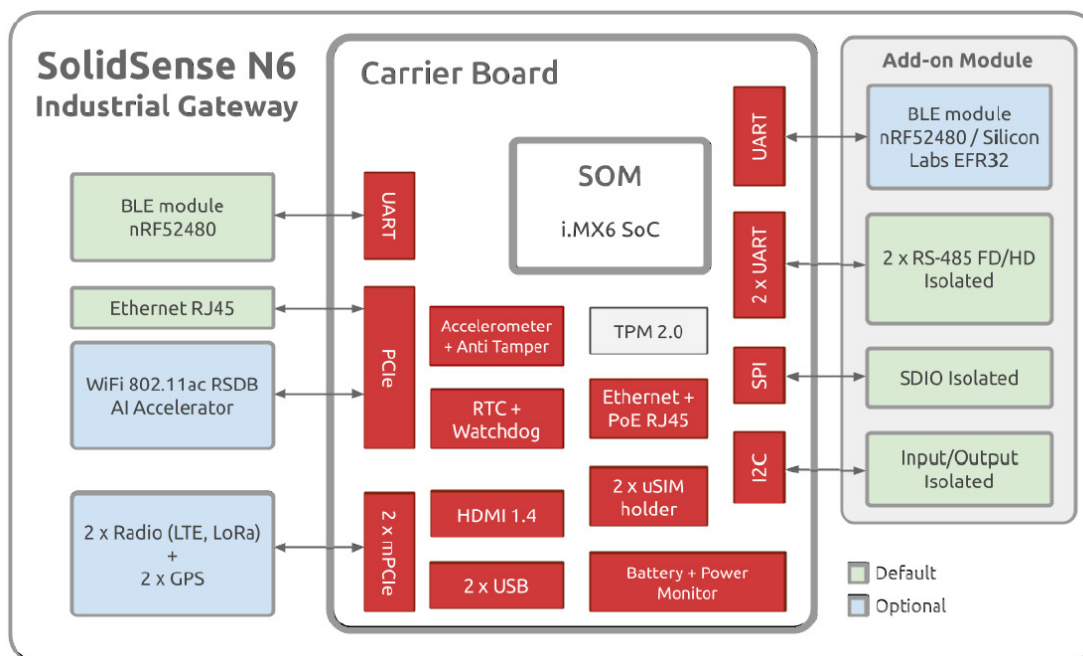
## Introduction

MFX-1 IoT Edge Gateway is developed on the optimized hardware, the SolidSense N6 IndustrialInternet of Things gateway designed for servicing a local network of IoT devices with a range of solutions and business applications. SolidSense has been designed for the unique requirements of industrial M2M IoT solutions, offering a modular mix-and-match platform with a highly customizable add-on module with a whole set of features presented in the table below:

### MFX-1 N6 Industrial Gateway Highlighted Features

Low memory footprint (RAM)	Based on the modular i.MX6 Arm Cortex A9 SOMs
Small size binaries	Ethernet, WiFi, Bluetooth, GPS and LTE options
Low Latency	Industrial Temp. (-25° to 65° C)
Hi Performance	Modular add-on card with a variety of features
Deploy only microservices you need for the project	Up to two LTE modems (Dual-SIM or Dual Modem)
	NINA B3 module supporting Wirepas and BT5.0
	Optional AI accelerator, and TPM 2.0 security chip
	Versatile powering options, including: AC adapter, Battery & Battery charger, PoE PD and PSE, Solar Panel

### Block diagram



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## System Specifications

### SolidSense N6 Industrial Common Features

<b>SOM Model</b>	NXP i.MX6 based Solo to Quad Core SOM
<b>Processor</b>	i.MX6 single to quad core Arm® Cortex® A9 (800 MHz)
<b>Memory and Storage</b>	Up to 2GB DDR3 eMMC (8GB by default)*
<b>Network</b>	2 x Ethernet RJ45 10/100/1000 WiFi (2.4 GHz) Bluetooth Low Energy 5.0 (nRF52840 - software defined radio based on Nordic Semiconductor) LTE Cat 4 EU + GPS (with fallback on 3G/2G) LTE Cat M1 EU/US + GPS (with fallback on 3G) Additional mPCIe slot available for networking options
<b>Connectivity</b>	2 x USB 2.0 type A HDMI MicroSD 2 x Physical uSIM
<b>Power</b>	7V to 36V with reverse polarity protection (battery backup) PoE 802.3at PD for external peripheral
<b>Development &amp; Debug Interfaces</b>	Console port (UART)
<b>Certifications</b>	CE, FCC/CSA
<b>Environment</b>	Ambient temperature: -25°C to 65°C Max CPU die temperature: 105°C Humidity (non-condensing): 10% - 90%
<b>Dimensions (WxL)</b>	132.5 x 144 x 40.5mm
<b>Enclosure</b>	Extruded Aluminum (IP32), 8 x SMA Optional DIN rail mounting



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## Add-on Modules

### Industrial Control Add-on module

<b>4 Channels Software Defined IO (SDIO)</b>	Voltage (0 – 11V) and Current (0 – 25mA) Output Voltage, Current and Resistance Measurement Digital Input Thermocouple measurement HART modem compatibility
<b>2 Channels Isolated RS-485</b>	5.7 kV rms Isolated Half/Full Duplex RS-485/RS-422 High speed 25Mbps IsoPower integrated isolated dc-to-dc converter IEC 61000-4-2 ESD protection on bus pins: $\pm 12$ kV Contact, $\pm 15$ kV Air Cable Invert Smart Feature
<b>Isolated CAN</b>	5 kV rms signal and power isolated CAN transceivers ISO 11898-2:2016 compliant (CAN FD) Data rates up to 12 Mbps for CAN FD isoPower integrated isolated dc-to-dc converter
<b>Isolated 4 x IN/4 x OUT</b>	Optocoupler Inputs up to 24V Solid State Relay output (Dry contact) up to 75 mA

### Smart Edge Add-on module

<b>Isolated RS-485 channel</b>	5.7 kV rms Isolated Half/Full Duplex RS-485/RS-422 High speed 25Mbps isoPower integrated isolated dc-to-dc converter IEC 61000-4-2 ESD protection on bus pins: $\pm 12$ kV Contact, $\pm 15$ kV Air Cable Invert Smart Feature
<b>Isolated 4 x IN/4 x OUT</b>	Optocoupler Inputs up to 24V Solid State Relay output (Dry contact) up to 75 mA
<b>NINA B3</b>	5 kV rms signal and power isolated CAN transceivers NINA B3 module supporting Wirepas and BT5.0

### Sharp Edge Add-on Module

<b>Isolated RS-485 channel</b>	5.7 kV rms Isolated Half/Full Duplex RS-485/RS-422 High speed 25Mbps IsoPower integrated isolated dc-to-dc converter IEC 61000-4-2 ESD protection on bus pins: $\pm 12$ kV Contact, $\pm 15$ kV Air Cable Invert Smart Feature
<b>Isolated 4 x IN/4 x OUT</b>	Optocoupler Inputs up to 24V Solid State Relay output (Dry contact) up to 75 mA
<b>Silicon Labs</b>	Silicon Labs EFR32 module supporting high power Wirepas and BT5.0

## Available SKUs for SolidSense N6 Industrial

SKU	Description
SRG0202.01SD	SolidSense N6 Industrial - Dual Core - WiFi-LTE C4 EU   Industrial Control Add-on card

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## How It Works

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Mainflux IoT Edge Gateways works within system which consist of following components:

- 1) Devices - Sensors and actuators
- 2) IoT Edge Computing Gateway - MFX-1 with based on Mainflux IoT Platform
- 3) Mainflux IoT Core Platform – Open-source patent – free IoT Platform
- 4) Mainflux UI - A system for remote device and gateways management

## Mainflux IoT Core Platform and UI – Remote Gateway Management

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Mainflux IoT Core Platform accepts connections from the gateways on the south side. Each gateway has 2 dedicated channels (at least).

On the north side, Mainflux is connected to UI, and serves as a middleware (messaging bridge) between gateway management and data acquisition apps in the cloud and thousands of remote gateways in the field.

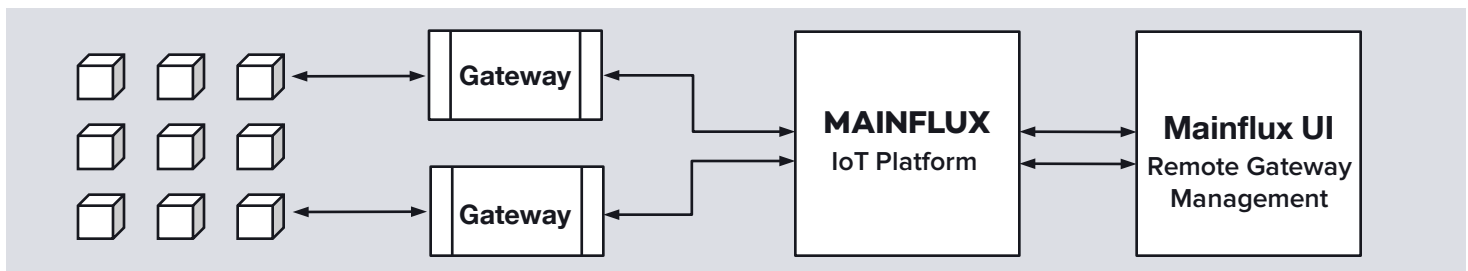
Mainflux has several important roles:

- Control plane communication - commands for gateway management
- Data plane communication - data acquisition and storage
- Bootstrapping - initial gateway config, plug-and-play for factory devices

Mainflux UI gives visualisation and monitoring of the gateways:

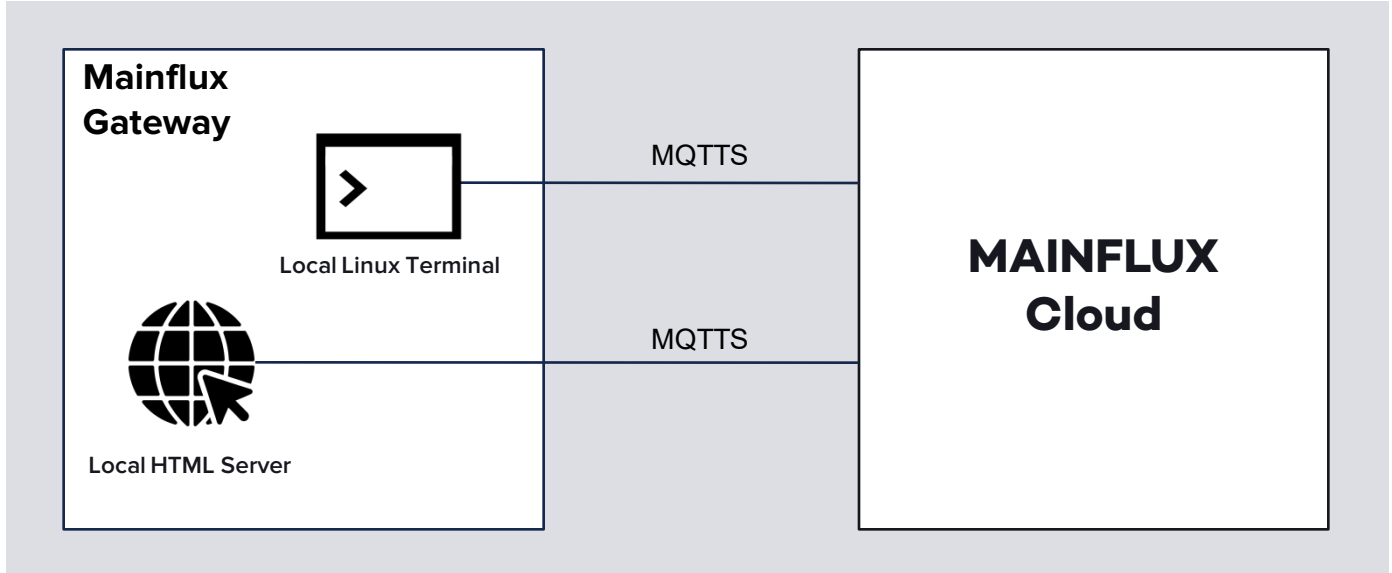
- Metrics from each of the gateway (CPU, memory, networking)
- Map geopositioning
- Various logs
- And so on

One of the most important features of remote gateway management are Secure Remote Terminal and Secure Remote Browser.



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## Secure Remote Terminal

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Secure Remote Terminal is basically Linux terminal - to - MQTT(S) proxy, that lets apps in the cloud open remote and secure SSH-like sessions, but without a need for heavy VPN infrastructure to be maintained (these infrastructures in the cloud present heavy burden for operators, as they are complex and expensive. Moreover, gateways act as SSH servers and need to keep ports open to accept connections).

Gateway MQTT connections are client initiated (no need to open extra ports on gateway), secured with PKI X.509 certificates and encrypted via mTLS.

This innovation allows very lightweight, simple and secure logging into each of remote gateways, executing commands interactively, opening and editing files, debugging and so on.

## Secure Remote Browser

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Similar to Secure Remote Terminal, Secure Remote Browser is HTTP-to-MQTT proxy, that bundles HTTP requests and responses into MQTT messages. These HTTP req/resp are executed on a gateway itself, as often on the gateway there is a local web browser that serves configuration or other web pages. Typically these web servers on gateways are accessed via VPN, which again means that gateway needs to keep port 80 open as well.

Mainflux Edge avoids heavy VPN infrastructure, and uses lightweight technology to wrap HTML content into secure MQTT messages and send them to the cloud, where this content is examined in the browser and acts like the browser actually accessed the server on the gateway itself.

Again - benefits are simplified infrastructure and higher security, as MQTT connections are client-initiated, so gateways can close port 80 (and all other ports) for external access

# MFX-1 - Mainflux IoT Edge Gateway

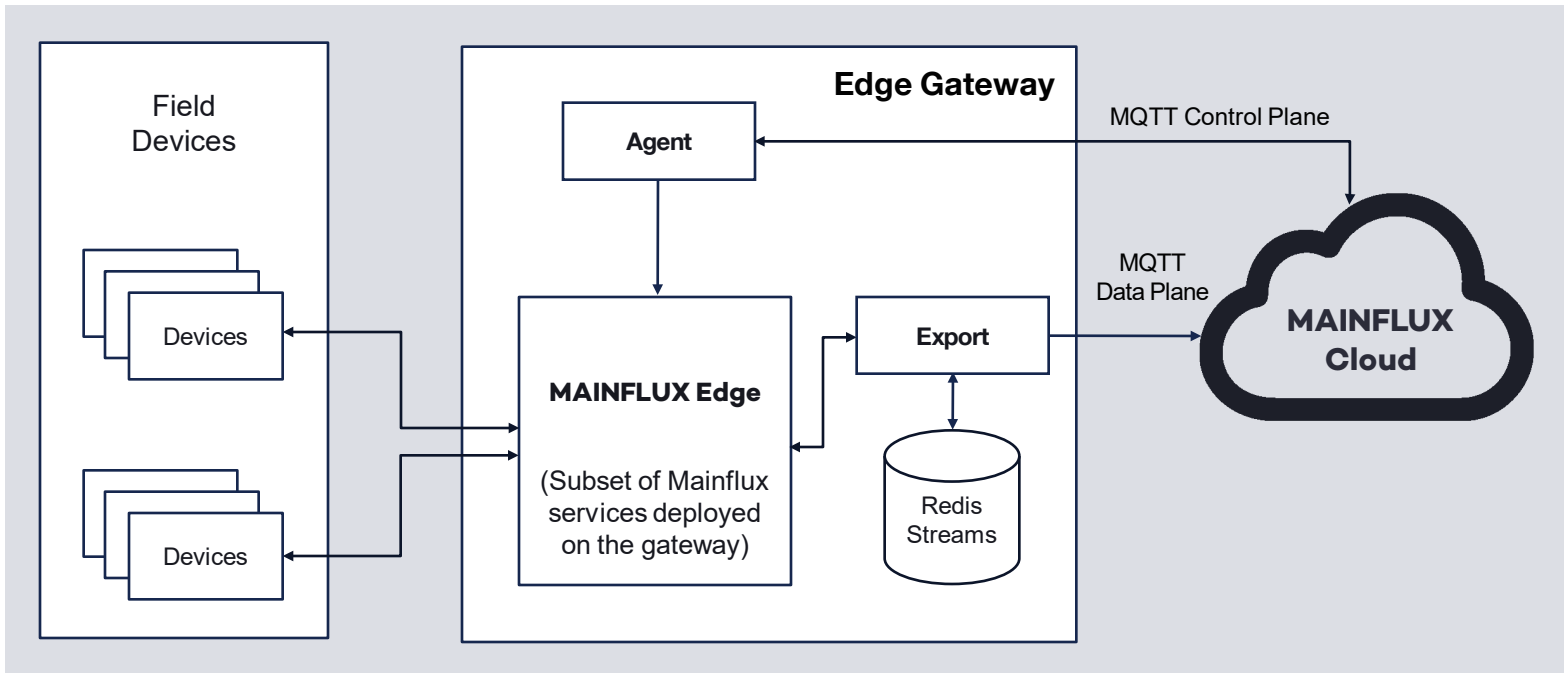
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## Mainflux IoT Agent - Linux Daemon Agent – Gateway Remote Management Enabler

Mainflux IoT Agent is a Linux daemon agent that runs on the remote gateway and connects to Mainflux cloud in order to enable remote management, monitoring and alerting and the Control Plane of the gateway.

It is subscribed via MQTT to Mainflux IoT Core Platform on the CMD channel. It gets commands from Mainflux, executes them on the gateway and returns responses to Mainflux.

It configures and manages all other services on the gateway, as well as aforementioned remote terminal and remote browser.



## Export Service – Gateway Data Acquisition With Buffering

Export service is used to send data from gateway to Mainflux cloud.

One of the common problems with IoT gateways are intermittent connections due poor network reliability (especially with moving objects). Export service is an intelligent service: it constantly monitors the network availability and in the case of disconnection it buffers data locally, so none of the data points are lost. When the network comes back on, Export service sends a buffered data stream to the cloud while preserving order of messages.

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## Mainflux IoT Platform on MFX-1 IoT Edge Gateway

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Mainflux IoT platform acts as a multi-protocol data brokering platform, which can internally bridge different protocols and make applications and devices speaking between themselves. It is capable of distributing and delivering data from the machines to different applications and analytics/ML engines and vice-versa.

Thanks to very lightweight memory footprint, small binary size, high portability (single statically-compiled binary) and great cross-compilation features of Go programming language, it's easy to deploy a subset of Mainflux services, or even whole Mainflux on edge IoT gateways.

When deployed on a gateway, Mainflux system is used to accept various end device connections that talk different protocols (devices connected to a gateway), authenticate and authorize them, encrypt the communication, distribute messages further or even store them locally on the gateway in dedicated lightweight databases.

### Unified IoT Cloud/Edge Computing System

Considering that the same codebase is deployed on the edge gateway and in the cloud, Mainflux Labs unifies the IoT platform implementation over edge-fog-cloud continuum. Deploying, managing and maintaining a unified platform is much easier, than keeping track of several different platforms (one for gateway, one for fog datacenter, one for cloud, and so on) that together make an IoT system. Mainflux wins with simplicity.



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## Mainflux IoT Platform Features

### Open Source & Patent Free

Apache 2.0 license. Transparency, control, community testing, support and bug fixes.  
No vendor lock and client access licenses issues.

### Secure

Mutual TLS Authentication (mTLS) using X.509 certificates, NGINX reverse proxy for security, load-balancing and termination of TLS and DTLS connect.

### Performant

Thanks to Golang language, and microservices

### Scale Down - Deployable

Deployable from multi-datacenter scale to RPi devices.

### Scalable and Responsive

Microservice-based architecture, built using open-source technologies resulting in high-performance, scalability and fault-tolerance.

### Protocol and Device Agnostic

Multi-protocol support and hardware agnostic. Connectivity for any device PUB/SUB multiprotocol messaging bridge (HTTP, MQTT, WebSocket, CoAP)

### Low Opex

Low operating expense (OPEX) due to design and selection of core technologies

### Remote IoT Devices & Gateways Management

Ensures the secure and proper functioning of multiple IoT devices

## Pricing

Item	Hardware	Software	Price per item
<b>MFX-1 - Mainflux IoT Edge Gateway</b>	SolidRun SolidSenseN6 Industrial Gateway - NXP i.MX6 based Industrial IoT gateway	- Mainflux IoT Platform - Mainflux IoT Agent - Mainflux IoT Export	<b>485.00 EUR*</b>

\*Price might vary depending on the Hardware options added

# SolidRun References

Mainflux Labs hardware partner



## About SolidRun

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SolidRun is a global leading developer of embedded computing and network solutions, focused on a wide range of energy-efficient, powerful and flexible off-the-shelf platforms including SOMs (System-on-Module), SBCs (Single Board Computer) and industrial mini PCs.

SolidRun offers a one-stop-shop for developers and OEMs, providing a complete service from hardware customization, to software support, product branding and enclosure design.

- Annual Revenue of over \$10M (2019), 48% CAGR (2016-2019)
- Annual delivery of over 200K units
- Over 50 active customers in U.S.A, Japan and Europe

## IoT Customers Use Cases (Device Edge)

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### SolidSense Edge Gateway Solution (SW/HW)



#### Sensing as a service

Real-time processed and analyzed environmental data and remote monitoring of network assets.



#### Reinventing the Shipping Industry

Remote Container Management (RCM) system that allows its fleet of 300,000 refrigerated containers to be monitored.



#### Fujitsu Healthcare Solution

Tracking and analysing rehabilitation by monitoring patient movements.



# Contact Mainflux Labs

Solving Internet of Things Complexity

Mainflux is a technology company providing full-stack, open-source IoT platform, IoT edge computing gateway and consulting services for all IoT technology stack layers.

Technically diverse our cross-functional team covers hardware expertise, embedded-software development, IT operations and management, software and web application development, distributed systems, data science and blockchain development.

From the initial phase and strategic planning, PoC stage, to data analytics after rollout, we are providing professional services and support to ensure success of your IoT development.

## Edge computing expertise

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Due to the leading edge design of the Mainflux open-source IoT Cloud platform, Linux Foundation invited Mainflux Labs in 2017 to participate as a member of its EdgeX Foundry Project and later LF Edge with companies like AT&T, Dell, Baidu, HP, Ericsson, Huawei, NOKIA, Red Hat, Samsung, Intel and IBM. Considering our contribution to the EdgeX, Mainflux Labs founder Draško Drašković received two awards from the community of 80 companies: Contribution Award for Exemplary Leadership and Innovation Award for Extensive Technical Contribution.



## Mainflux Labs Serbia

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