MAINFLUX LABS

Improve processes, detect current problems,
prevent costly downtimes, and produce better products

PITCH DECK

MAINFLUX LABS

Open Source Internet of Things Technology & Consulting Services

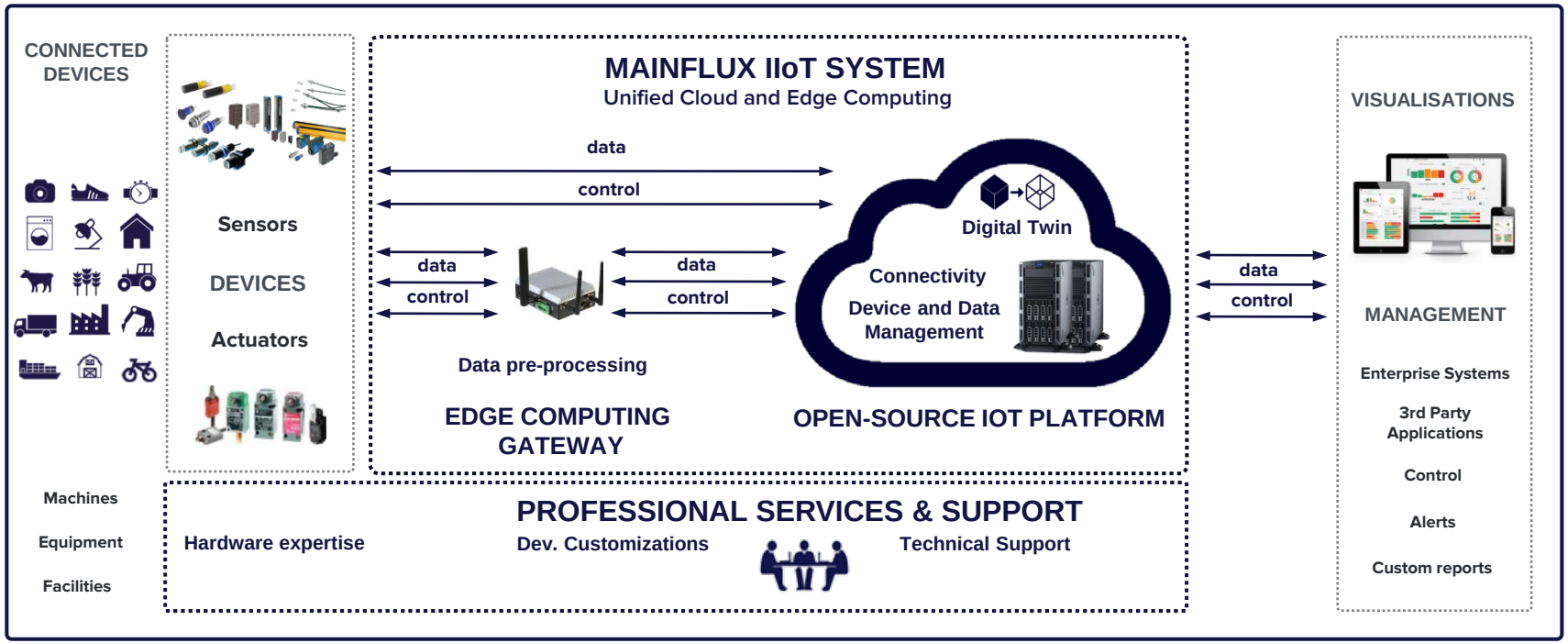
Mainflux Labs
Veljka Dugosevica 54
Belgrade Science Park
11000 Belgrade, Serbia
www.mainflux.com

Mainflux Labs Offering

Mainflux Labs is providing

A **Mainflux IIoT System**

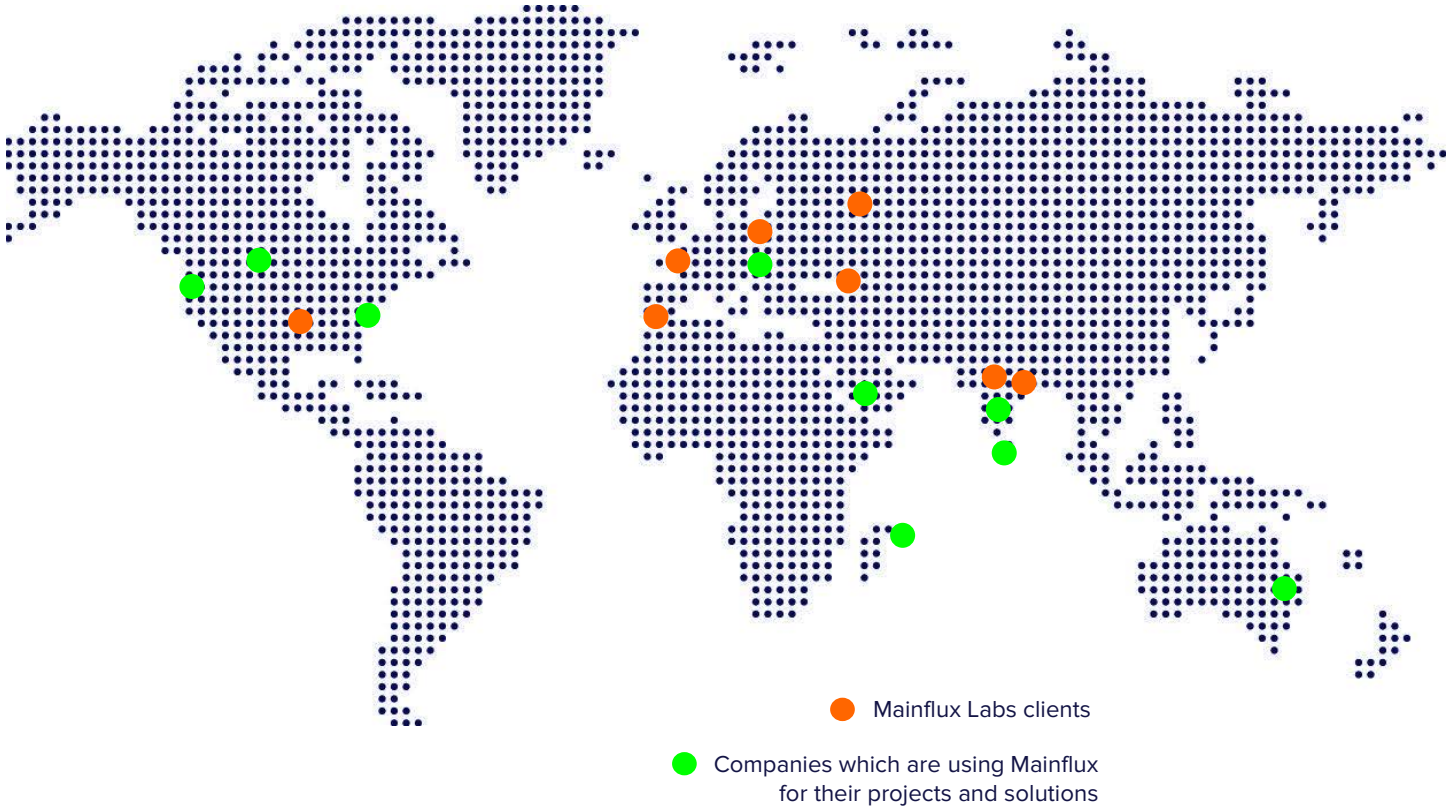
B **Professional Services & Support**



Mainflux Technology – Deployed Globally

Countries in which Mainflux is deployed

- USA
- India
- Sri Lanka
- Mauritius
- Australia
- United Arab Emirates
- Russia
- Georgia
- Switzerland
- France
- Spain
- Germany



Mainflux Technology Adoption

Target USA - 1800 Stores
Non-contractual Partnership

Implementation of Mainflux IoT Platform as Core IoT platform in Smart Retail Store project. Extending LoRa support in Mainflux. Using Mainflux IoT Platform for management of remote gateways. Mainflux IoT platform deployed in 50 stores, preparing for launch the remaining 1800 stores. Video: Principal Engineer of Target's IoT platform Dan Cundiff: Building an IoT Platform at Target.

O'REILLY GoLab ONS
OPEN SOURCE SUMMIT EUROPE
IOT SOLUTIONS {codemotion} FOSDEM

Conferences
Speaking Engagements

Presented on 16 world conferences in Europe, USA and China

Open Networking Summit - Santa Clara
O'Reilly Software Architecture - London
ITNext Summit & Codemotion - Amsterdam
Embedded Linux Conference - Portland
IoT Solutions World Congress - Barcelona
Redis Lab - San Francisco
ONS - Shanghai

intel Software DEVELOPER ZONE

Intel USA - Non-contractual Cooperation

Intel demonstrates Mainflux IoT Plarform or metering on the edge, with article " View Metering In Action On Edge Middleware Platforms"

THE LINUX FOUNDATION COLLABORATIVE PROJECTS
EDGE X FOUNDRY LF EDGE
CONTRIBUTION INNOVATION

Linux Foundation
Membership & Awards

Two awards from the community of 80 companies and EdgeX Governing board:

1. Community Contribution Award for Exemplary Leadership

2. Innovation Award for Extensive Technical Contribution.

300,000 DOWNLOADS
of Mainflux SW Repositories

512,743 DL
MQTT adapter service

282,537 DL
Normalizer service

347,206 DL
Users service

300,691 DL
HTTP adapter service

370,174 DL
Things service

Mainflux Technology Adoption – EU H2020

Participation in projects funded by EU H2020 Research and Innovation program

Horizon 2020 European Union Funding for Research & Innovation

Technische Universität Berlin · sbp schlaich bergermann partner · NCC

Ashvin EU H2020- €5mil Digital Building Twins

Member of the consortium funded by EU H2020 Research and Innovation program for development of assistants for Safe, and Productive Virtual Construction Design, Operation & Maintenance using a Digital Twin. Mainflux was invited by TU Berlin, other members include Erasmus Universiteit Rotterdam, German and Scandinavian construction structural engineering companies.

Horizon 2020 European Union Funding for Research & Innovation

TU Delft Delft University of Technology · Fraunhofer FOKUS · Telefonica · NEC

Spatial - EU H2020- €5mil Trustworthy AI

Member of the consortium funded by EU H2020 Research and Innovation program for development developing resilient accountable metrics, privacy-preserving methods, verification tools and system framework that will serve as critical building blocks to achieve trustworthy AI in security solutions. Member of consortium Includes Fraunhofer, Delft University of Technoogy, Telefonica, NEC, among the others.

NEW!

Jun 2022

Horizon 2020 European Union Funding for Research & Innovation

Technische Universität Berlin · TU Delft Delft University of Technology · BAM Bundesanstalt für Materialforschung und -prüfung · CEMEX

Reincarnate Innovative solutions for a greener construction industry

Advancing circular economy practices within the European construction industry

NEW!

Feb 2023

Horizon 2020 European Union Funding for Research & Innovation

VTT · EDF · technische universität dortmund

GlocalGFlex Flexibile Automatic Energy Trading

A global &local flexibility marketplace to demonstrate grid balancing mechanisms through Cross-sectoral interconnected and integrated energy ecosystems enabling automatic flexibility trading

NEW!

Apr 2023

Horizon 2020 European Union Funding for Research & Innovation

UCD Dublin · Université Gustave Eiffel · SPW Service public de Wallonie · ZF Transics

Seto - Smart Enforcement of Transport Operations

A framework for existing and future-proof smart transport enforcement in multimodal and cross-border contexts.

Mainflux Technology Adoption – EU H2020

Demo-sites and Implementation of Mainflux IoT Technology in 2022

Horizon 2020
European Union Funding
for Research & Innovation

Technische Universität Berlin

sbp
schlaich bergermann partner

NCC

Ashvin EU H2020
Digital Building Twins

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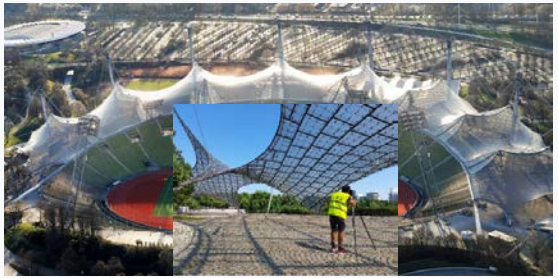
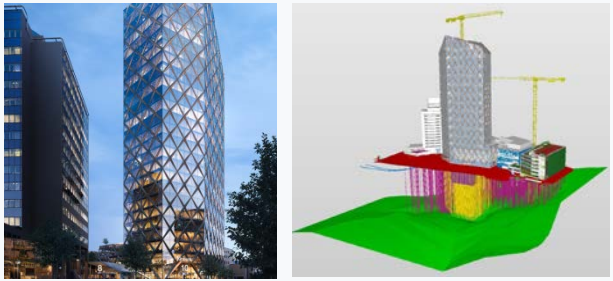


Munich
Olympic Stadium



Gothenburg
110 meters office building

Bridges in highway network
in Spain

Highspeed Railway structures
in Spain

Port of Rotterdam
Euromax, Yangstehaven, Maasvlakte II

Mainflux Technology Adoption – EU H2020

Demo-sites and Implementation of Mainflux IoT Technology in 2023 and 2024

Horizon 2020
European Union Funding
for Research & Innovation

Reincarnate
Innovative solutions
for a greener
construction industry

Member of the consortium funded by EU Horizon Research and Innovation program for enabling the European construction industry to significantly reduce construction and demolition waste (CDW) by providing a circular potential assessment information model platform (CP-IM) and a set of innovations to make use of the CP-IM. The CP-IM will provide a digital representation of building materials and products with life-cycle information and prediction methods for tracing and predicting the lifetime of a products / material

Redevelopment of the Tempelhof airfield (Berlin, Germany)

Hospital building (Arnhem, Netherlands)

Infrastructure Replication, Waste Water Treatment Plant (Spain)

Hotel building (Hong Kong, China)

Circular housing asset management (Paris, France)

Refurbishment value chain at B-Right (Amersfoort, Netherlands)

Researches which used Mainflux IoT Platform

Publications	Authors	Description
Enabling the Orchestration of IoT Slices through Edge and Cloud Microservice Platforms	MDPI Sensors; uc3m Universidad Carlos III de Madrid; Ericsson	This article addresses one of the main challenges related to the practical deployment of Internet of Things (IoT) solutions: the coordinated operation of entities at different infrastructures to support the automated orchestration of end-to-end Internet of Things services. This idea is referred to as “Internet of Things slicing” and is based on the network slicing concept already defined for the Fifth Generation (5G) of mobile network. Link
A Multi-Site NFV Testbed for Experimentation With SUAV-Based 5G Vertical Services	IEEE Access; IMDEA Networks; uc3m Universidad Carlos III de Madrid; UPC Universitat Politècnica de Catalunya BarcelonaTech; University of the Basque Country	The goal of this testbed is to explore synergies among NFV, SUAVs, and vertical services, following a practical approach primarily governed by experimentation. To verify our testbed design, we realized a reference use case where a number of SUAVs, cloud infrastructures, and communication protocols are used to provide a multi-site vertical service. Link
ETSI - TECHNICAL REPORT SmartM2M; Guidelines for using semantic interoperability in the industry	ETSI TECHNICAL REPORT	The main objective of the present document is to push semantic interoperability in IoT forward in raising awareness about its importance in industry in order to unlock the potential economic value of IoT. A major focus is on thedevelopment of guidelines on how to use semantic interoperability in the industry. 5.2.5 Open source - 5.2.5.1 Mainflux / Link

Organizations which are using Mainflux IoT Platform

ORGANIZATIONS AND COMPANIES WHICH ARE USING MAINFLUX AS AN OPEN-SOURCE SOLUTION

open source

TARGET – USA
Implementation of Mainflux IoT Platform as Core IoT platform in Smart Retail Store project

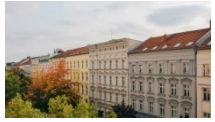
XEROX PARC – USA
Predictive maintenance for manufacturing

OSIRIS SYSTEMS FOR INDIAN COAST GUARD - INDIA
Osiris system used Mainflux IoT platform to develop solution for the centralized monitoring and control of vital metrics of geographically spread multitude of data centers

TALOSLOGY – SRI LANKA
Taloslogy uses Mainflux to create IoT based Building Automation System for the mix-used facility in Sri Lanka that cost significantly less than the traditional BAS solutions

TECHOLUTION FOR MAURITIUS TELECOM – USA/INDIA
Techolution uses Mainflux to monitor hard-to-reach BST Towers and replaces expensive manual maintenance to prevent power outages

TOUCH PANEL CONTROL - AUSTRALIA
School Management System for Australian Universities



DIGITAL TWIN TECHNOLOGY- GERMANY
Mainflux is used for health monitoring solution deployed in 40 buildings in Berlin

Mainflux Labs Clients

CLIENTS

MULTINATIONAL COMPANY'S STARTUP - FRANCE
Development of blockchain powered data marketplace.

WORLDWIDE PROVIDER OF OILFIELD & GAS EQUIPMENT - USA
Implementation of Mainflux IoT Platform for gathering operational data from Oil & Gas equipment.

INDEPENDENT SOFTWARE VENDOR - RUSSIA
PoC - Monitoring of operational indicators of underlying IoT specific IT-infrastructure, remote control of the lifecycle of remote devices.

SYSTEM INTEGRATOR - GERMANY
PoC - Connecting pharma manufacturing machines via enterprise network to Mainflux.

SYSTEM INTEGRATOR - INDIA
PoC - IoT Platform connected with provisioning, monitoring & analysis with mongoDB with full UI. First phase: Oil & Gas use case demo kit.

SYSTEM INTEGRATOR - GEORGIA
Customization of IoT platform for NB-IoT devices for smart metering aimed for Eastern Europe Telecom.

LEADER IN RECYCLING AND WASTE MANAGEMENT VENTURES - EU
Mainflux IoT Platfrom deployment as company-wide general IoT platform
Development of custom components and knowledge transfer and trainings.

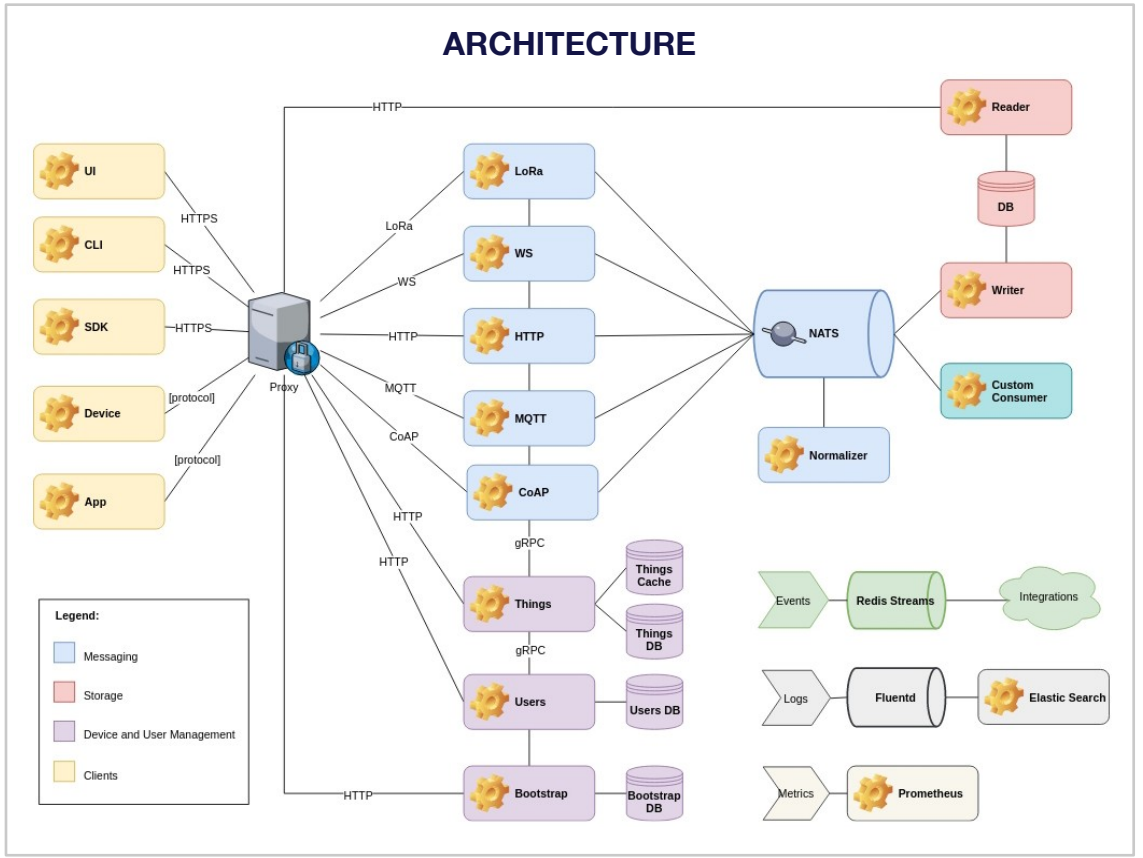
Mainflux IoT Platform

Mainflux IoT Platform

COMPREHENSIVE - FULL-SCALE FUNCTIONALITIES

1. Storage and connectivity management
2. Device and user management
3. Data aggregation and data management
4. Messaging
5. Persistence
6. Rules engines
7. Administration
8. Digital Twin backend
9. User Interface

ARCHITECTURE



Mainflux IoT Platform – Technology Choices

Microservices - modern architecture, complete set of easy-to-maintain services with clear division of responsibility

Golang - modern, highly concurrent, readable, easier to maintain, fast/efficient, highly portable (runs on Windows, Linux, Mac and both Intel and ARM CPUs)

Docker containers - good isolation, fast startup, easy to distribute, small footprint due to Go and multi-stage builds (~5MB per microservice), production deployment using Kubernetes

SQL database for structured data **NoSQL** database for Telemetry

InfluxDB, MongoDB

PUB/SUB multiprotocol messaging bridge (HTTP, MQTT, WebSocket, CoAP) based on **NATS** ultra-performant broker

NGINX Reverse Proxy for security, load-balancing and termination of TLS and DTLS connections

Mutual TLS Authentication with X.509 Certificates

Mainflux IoT Platform – Benchmark

TESTING INFRASTRUCTURE

- Managed Kubernetes cluster on Digitalocean with deployed Mainflux IIoT using helm charts.
- Kubernetes cluster size: 5 Nodes CPU Optimized droplet - 8 vCPU 16 GB RAM
- Estimated monthly costs for this cluster: $500/month

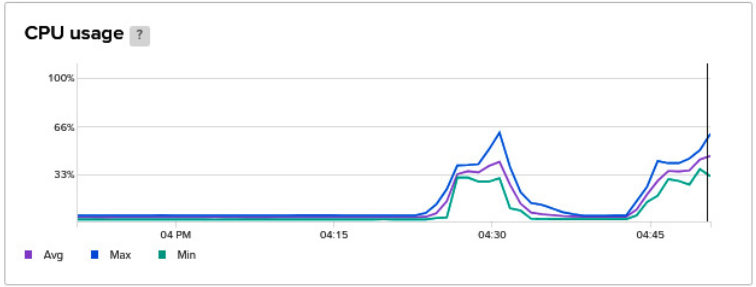
TESTING RESULTS - Messaging Benchmark (MQTT)

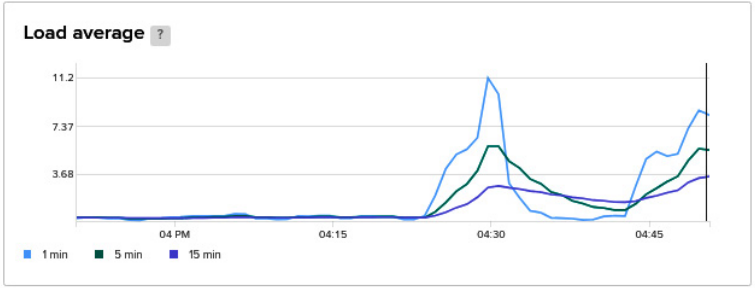
1. With this cluster and allocated compute power from 5 Nodes, we have successfully managed 10 000 concurrent connections, each client sending 1 message every second, **which is 10 000 messages per second.**
2. **Quality of service level 2** is used, which is the highest level of service in MQTT. This level guarantees that each message is received only once by the intended recipients. QoS 2 is the safest and slowest quality of service level.
3. **No message lost** detected.

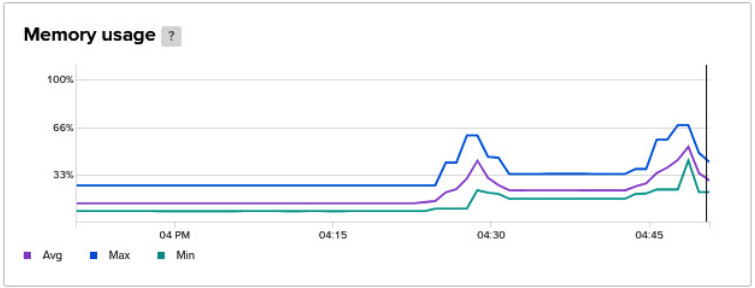
- **Total messages sent in 5 min is 3 000 000**
- **Message published acknowledge latency**
  - Max latency was up to 20 sec
  - 95% of clients had latency from 5 sec up to 15 sec under high load - Average latency was 5 sec without pekas
- **Total message sent per second is 10 000**
- **Message Publish received ACK Latency**
  - Max latency was up to 8 sec
  - 95% Of clients had latency from 0.5sec up to 6sec under high load - Average latency was ~2sec without peaks

Mainflux IoT Platform – Benchmark

Digitalocean Kubernetes cluster node's insights during testing







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CPU USAGE

Avg	45.91 %
Max	61.33 %
Min	31.63 %

LOAD AVERAGE

1 min	8.26
5 min	5.55
15 min	3.50

MEMORY USAGE

Avg	29.13 %
Max	42.11 %
Min	21.05 %

DISK USAGE

Avg	5.53 %
Max	6.07 %
Min	4.86 %

DISK I/O

Read avg	0.00B/s
Write avg	980B/s
Read max	0.00B/s
Write max	1.96kB/s

PUBLIC BANDWIDTH

Incoming avg	206bps
Outgoing avg	49.5kbps
Incoming max	426bps
Outgoing max	85.9kbps

MAINFLUX LABS

THANK YOU!

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