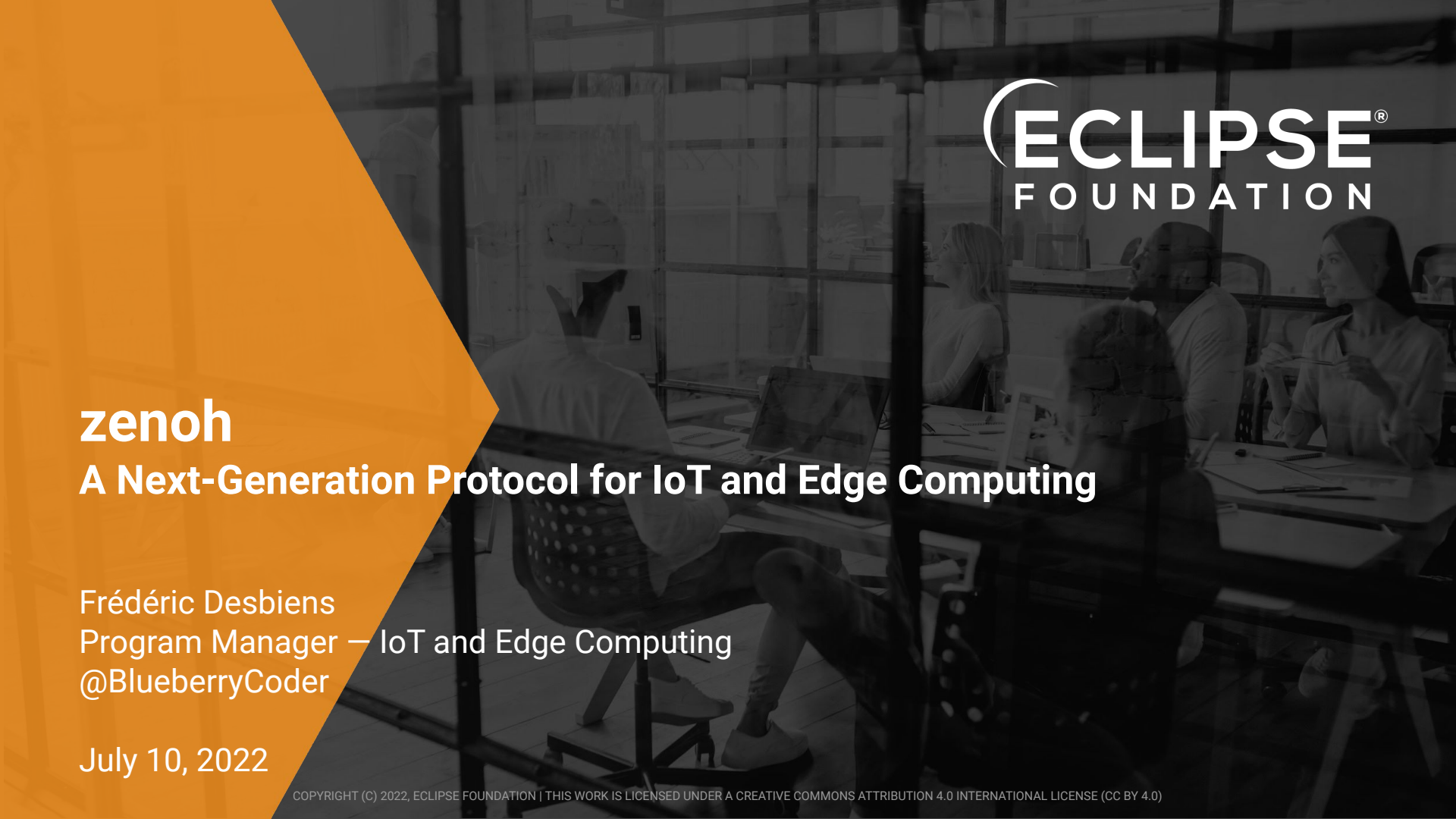

zenoh

A Next-Generation Protocol for IoT and Edge Computing

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Common Protocols at the Edge

CoAP	DDS	LwM2M	OPC UA	MQTT
Request / Response	Publish / Subscribe	Request / Response	It's complicated	Publish / Subscribe
Client / Server	Peer-to-Peer	Client / Server		Brokered

Common Edge Protocol Implementations

CoAP

Eclipse Californium

DDS

Eclipse Cyclone DDS

LwM2M

Eclipse Leshan
Eclipse Wakaama

OPC UA

Eclipse Milo

MQTT

Eclipse Amlen
Eclipse Mosquitto
Eclipse Paho

Common Edge Protocols: Criticisms

CoAP
RFC 7252

CoAP	DDS	LwM2M	OPC UA	MQTT
Longer transmission times	Implementations often incompatible	Tied to CoAP and UDP	Complex; spec is several thousand pages long	Tied to TCP
DTLS has limitations	Routing over the public Internet is tricky		Six transports; 200+ facets. Interoperability is a challenge	MQTT-SN is a different protocol

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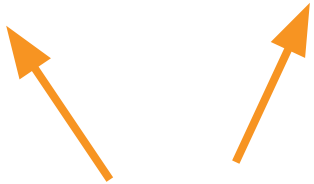
The Journey of Data

1. Capture	2. Transmission	3. Computation and storage	4. Retrieval
Sensors capture data at the edge	Data is transmitted from the edge to its destination	Data is stored as is or after computation	Data is retrieved, often for further processing

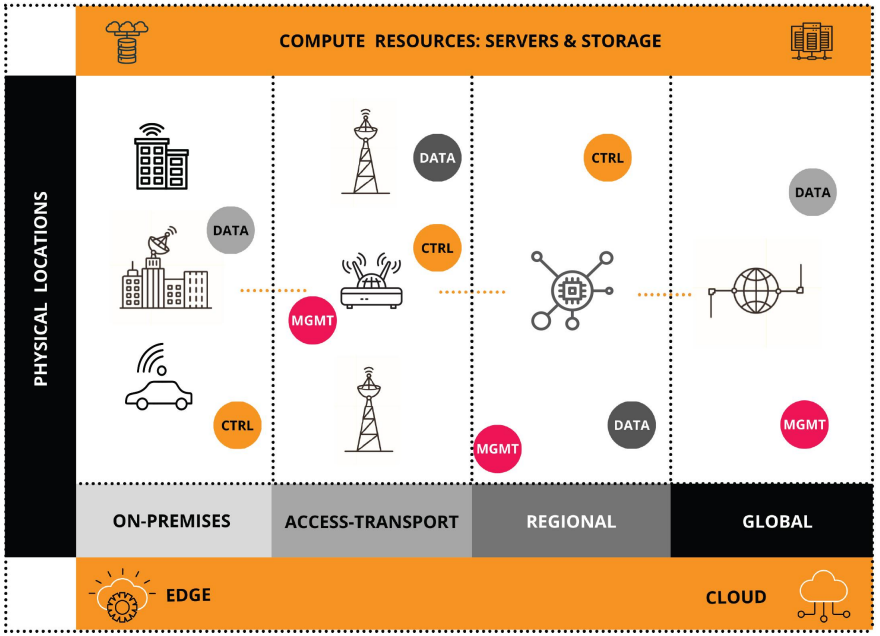


Opportunity

Existing protocols do not care about computation, storage and retrieval

The Edge-To-Cloud Continuum

IoT solutions, whether they leverage edge computing or not, leverage a continuum of compute, storage and communication ressources spanning from the microcontroller to the Cloud



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- Unifies data in motion, data in-use, data at rest and computations
- Blends traditional pub/sub with distributed queries
- Built-in support for geo-distributed storage and distributed computations

96Boards AutoCore ADLINK Leading EDGE COMPUTING AMPERE. BOSCH Invented for life CentraleSupélec F1 TENTH FARobot FOXCONN

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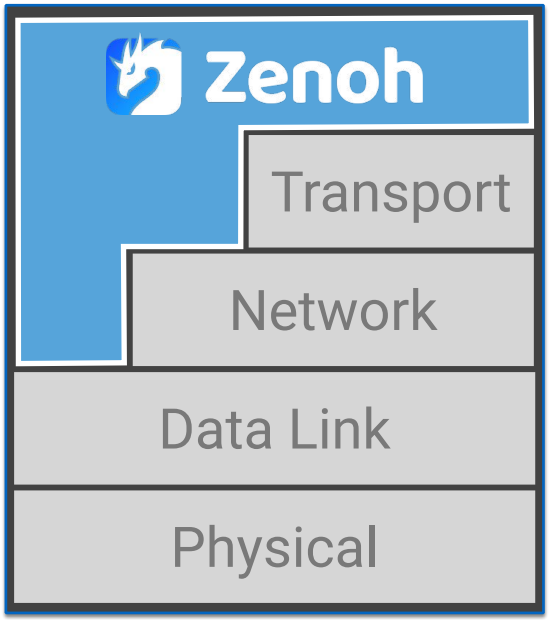
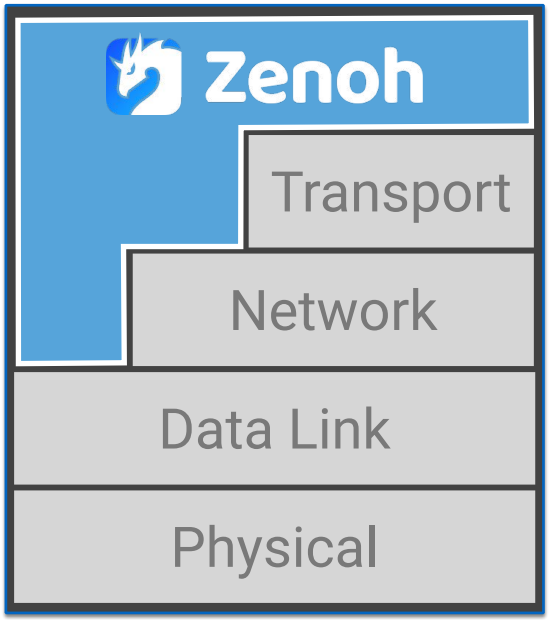
What Is zenoh?



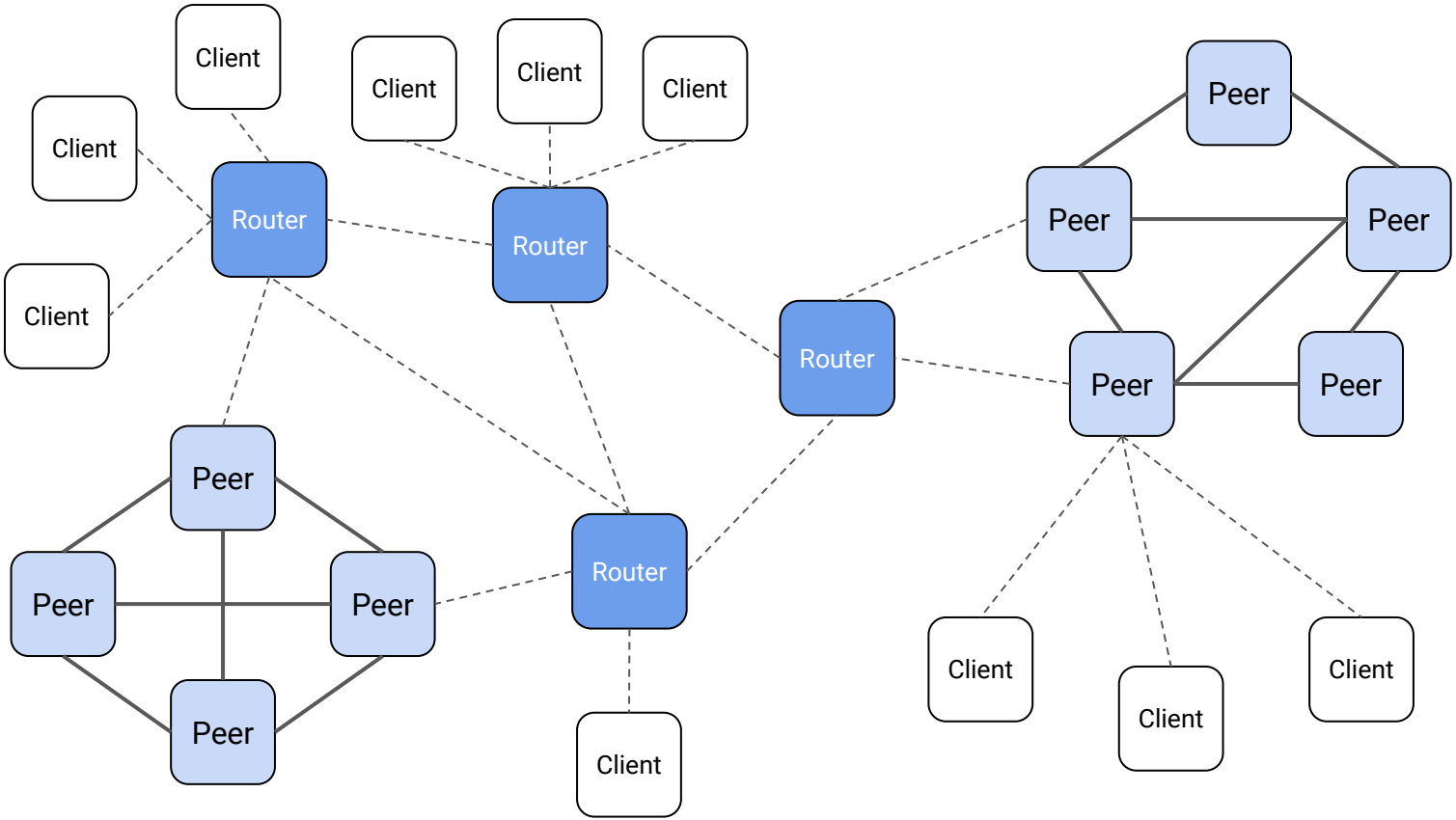
- Unifies data in motion, data in-use, data at rest and computations
- Provides a location-transparent API for high performance pub/sub and distributed queries
- Facilitates data representation transcoding, geo-distributed storage and distributed computed values

Zenoh Technical Highlights



- Efficient protocol (bandwidth, power consumption, memory usage) with support for extremely constrained targets
- Supports push and pull pub/sub along with distributed queries
- Resource keys are represented as integers on the wire (these integers are local to a session)
- Support for peer-to-peer and routed communication
- Support for zero-copy
- Ordered reliable data delivery and fragmentation
- Minimal wire overhead for user data is 5 bytes

Node Types and Topology



Naming Data

Following the tradition of Named Data Networking protocols, data is identified by a **key** (sequence of byte arrays)

```
/fleet/CA/robot/1/pointcloud
/home/kitchen/sensors/C202
```

Data interest and intents are expressed by means of **keys regular expressions**, such as:

```
/fleet/FR/robot/**
/camera/FR/*/image
```

Selecting Data

Uses selector to defines data sets. A selector is composed by a key expression, and optionally a predicate, a projection and a set of properties

```
/fleet/*/robot/*/sensor/temp?value>25

/mycar/dynamics?speed>25#acceleration
```

The key-expression is used to route the query, while predicate, properties, projection, etc., are interpreted only by the entity that executes the query. It also provide different policies to control query consolidation and completeness and potentially quorums

Primitives: Entities

Resource

Named data item (key,value)

```
/fleet/CA/robot/1867/sensor/temp, 21.5
/fleet/FR/robot/1789/sensor/hum, 0.67
```

Publisher

Spring of values for a key expression

```
/fleet/CA/robot/1867/sensor/temp
/fleet/*/robot/*/halt
```

Subscriber

Sink of values for a key expression

```
/fleet/CA/robot/1867/sensor/temp
/fleet/FR/robot/1789/sensor/*
```

Queryable

Well of values for a key expression

```
/fleet/CA/**
```

Primitives: Operations

scout	Looks for zenoh entities on the network. The type of node (peers, router, etc.) is specified through a bitmask
open/close	Open/Close a zenoh.net session
declare/undeclare	Declare/Undeclare resources, publishers, subscribers and queryables. For subscribers the declare primitive registers a user provided callback that will be triggered when data is available. For queryable, the declare primitive register a user provided callback triggered whenever a query needs to be answered.

Primitives: Operations (2)

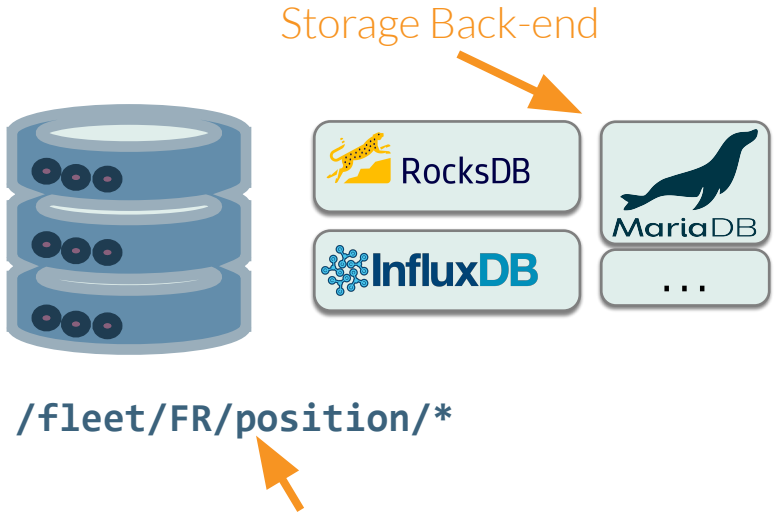
write	Writes data for a key expression.
pull	Pulls data for a pull subscriber.
query	Issues a distributed query and returns a stream of results. The query target, coverage and consolidation depends on policies

Storage

A storage is defined by:

- **Selector**
  Defines the set of resources keys hosted by this storage
- **Backend**
  Defines the storage technology used. Available choices include: filesystem, InfluxDB, in-memory (hashmap), RocksDB and SQL (SQLITE3, MariaDB, PostgreSQL)

zenoh storages can be created via the administration API **anywhere on the network** and back-ends are dynamically loaded plugins.



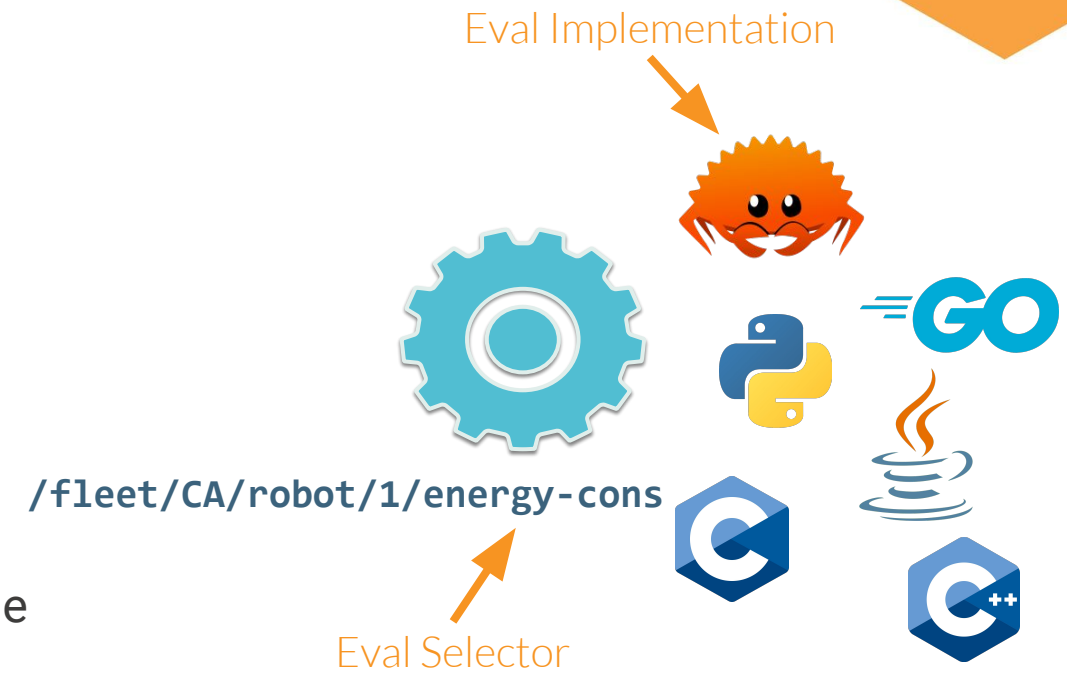
zenoh storages can be standalone or bound to existing databases

Eval

An eval is defined by:

Selector
Defines the set of resources keys that will trigger this computation

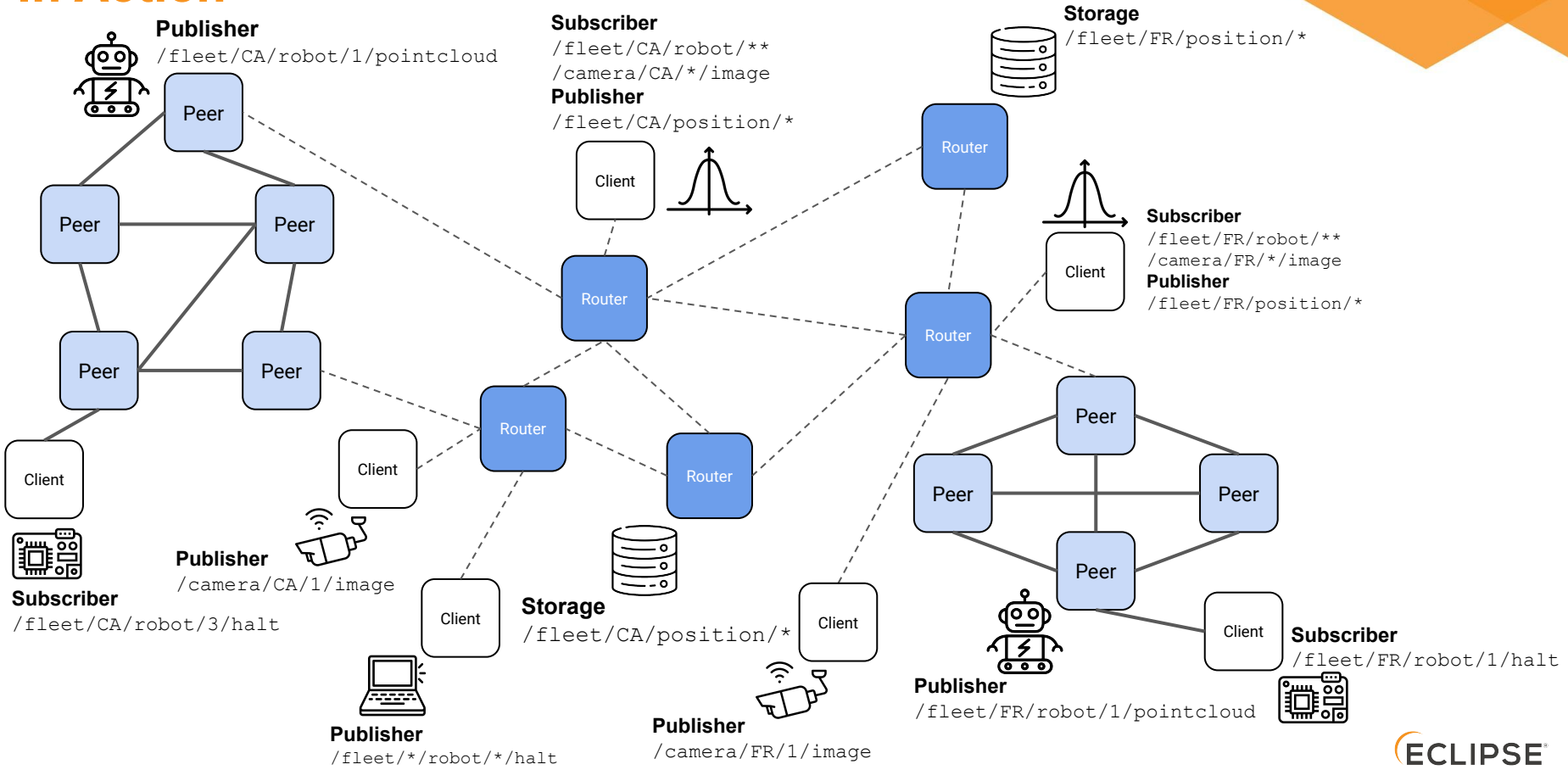
Implementation
The user code implementing the computation



zenoh-pico

- Targets constrained devices
- Offers a C API for pure clients
- No support for peer-to-peer communications
- Zephyr support

In Action



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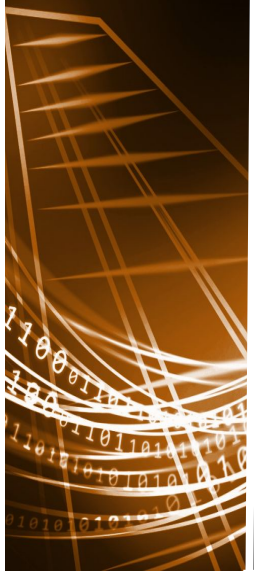
EdgeOps

Adapting DevOps for the Edge



Challenges

- Latency
- Bandwidth
- Resiliency
- Data sovereignty

Characteristics

- Long lifespan
- Heterogeneous
- Constraints
- Connectivity

Deployment

- Workloads
- Artifacts
- Strategies

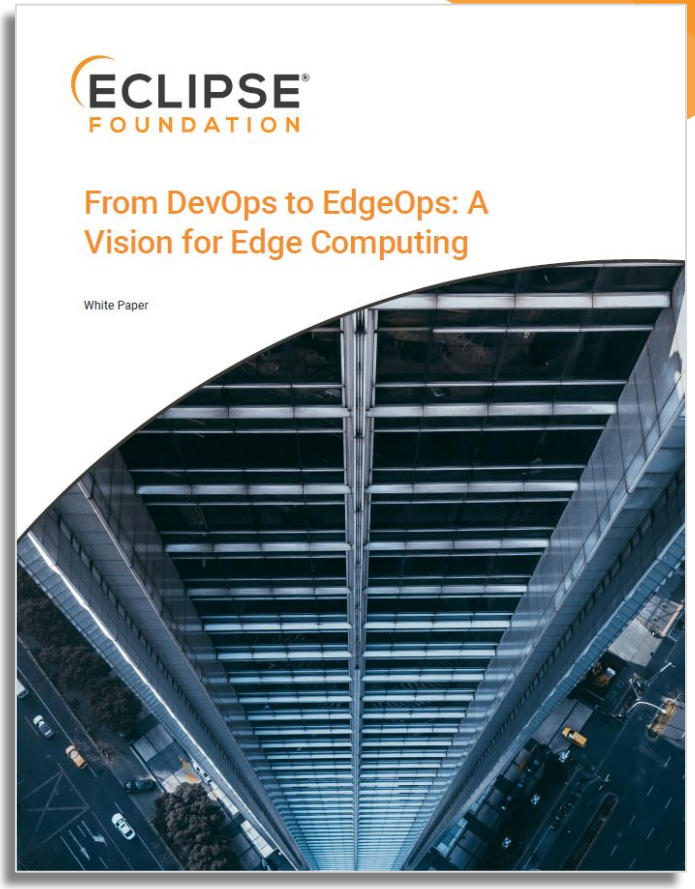
DevOps Principles

Short Lifecycle, Collaboration, Continuous Integration and Delivery (CI/CD), Microservices, Infrastructure as Code

Download the White Paper

SCAN ME

https://hubs.la/H0L379c0



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It Takes a Village to Build the Edge

Color Logos Represent Eclipse Projects

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