

C2MON

A highly scalable monitoring platform
for Big Data and IoT scenarios



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A lot of systems to control

Controls
Computers



Electricity



Cryogenics



Magnets



85'000 Devices
> 2 Million I/O
Endpoints

***Much more** when
including subsystems!*

Safety



Cooling



Ventilation



Vacuum

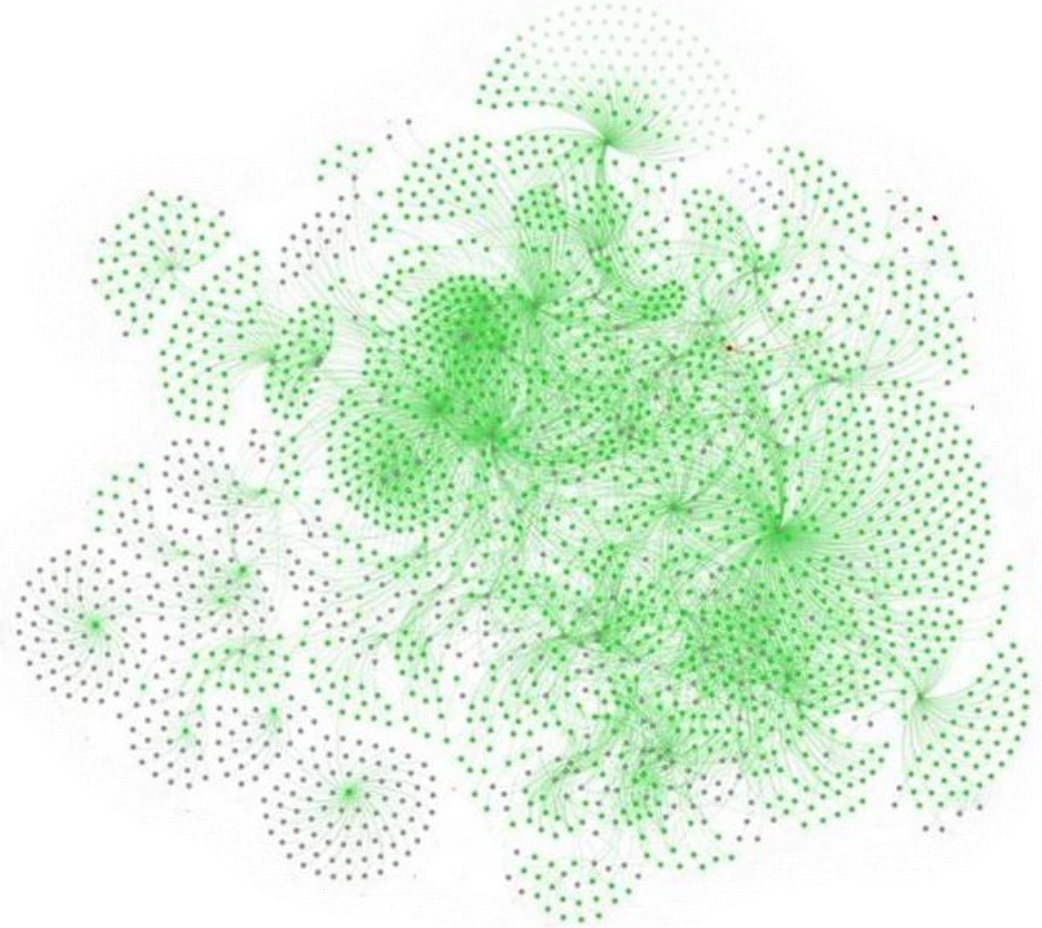


Main systems controlled from one central point: The CERN Control Centre



A complex controls infrastructure...

- Each **dot** is a process
- Each **line** is a network connections



The configuration hell

- Many different types of data sources and protocols
- Complex data structure
- Different data rates
- Data lifecycle management

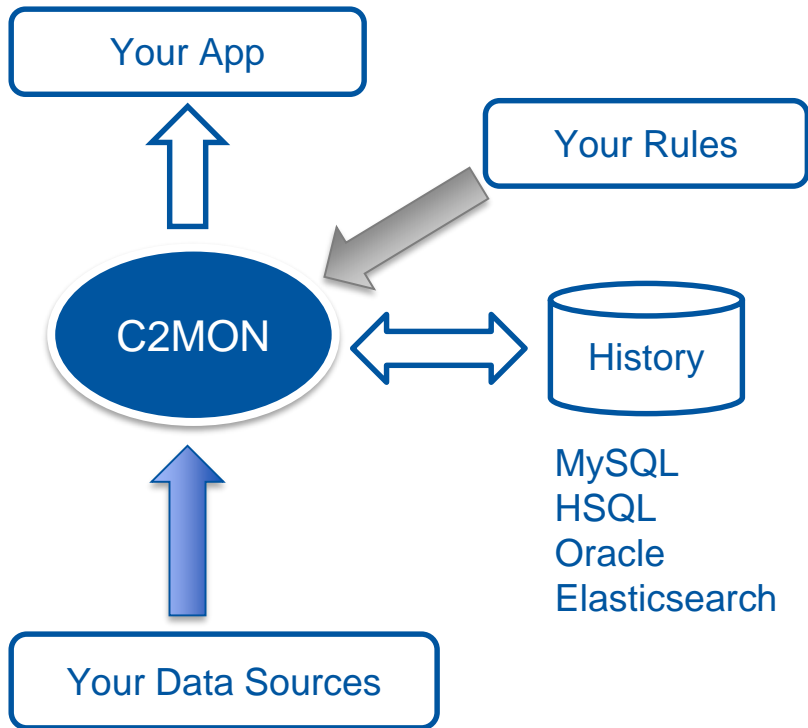


How to subscribe to my data?

C2MON – a best-of-breed open-source data architecture



C2MON – Features

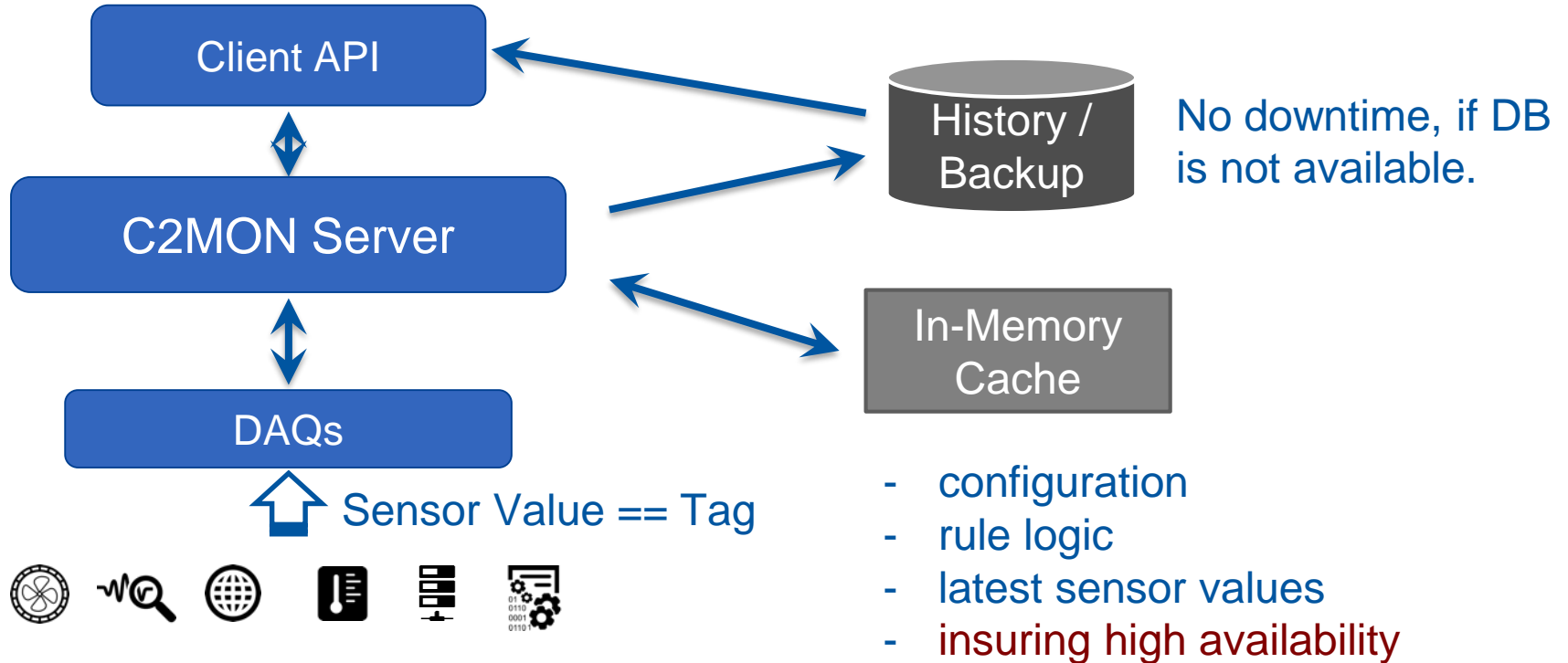


C2MON handles the following aspects :

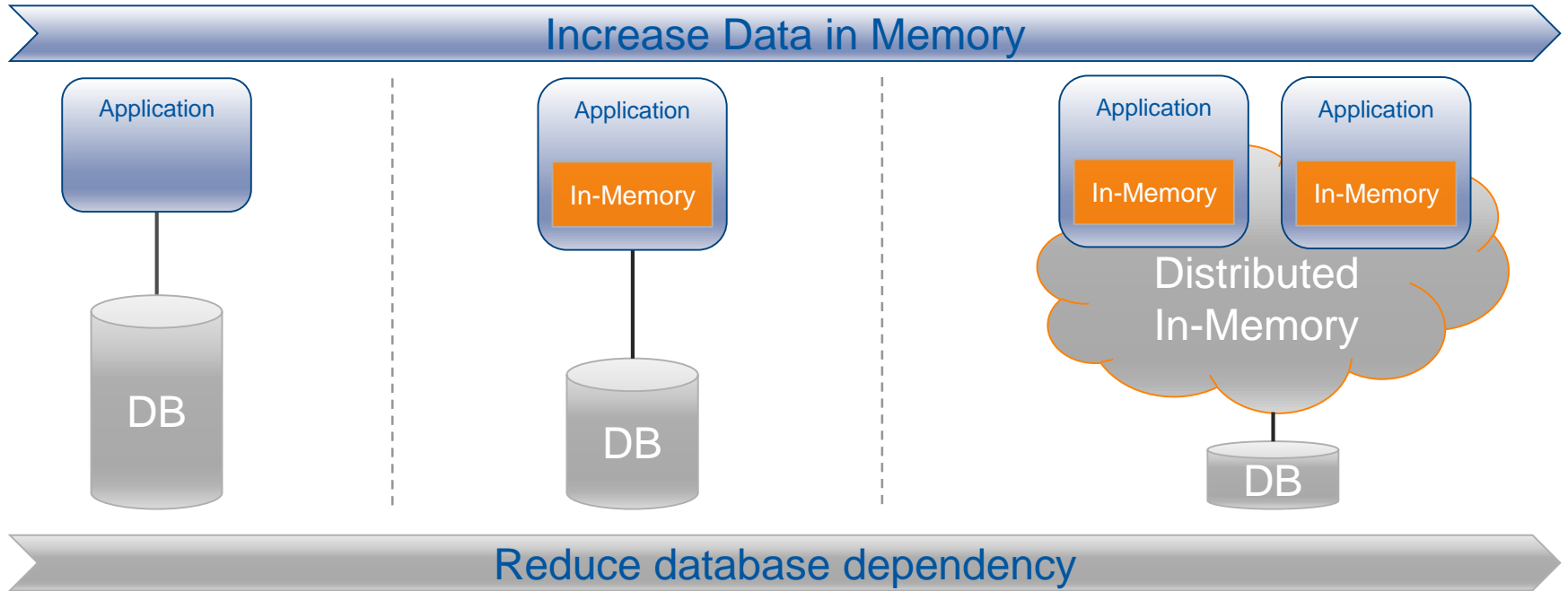
- Ensures the data keeps coming
- Add new data sources on the fly
- Regulates the information flow
- Caches latest values
- Makes sure no message gets lost

C2MON is open-source(LGPLv3) supported by CERN!

Transactional Architecture



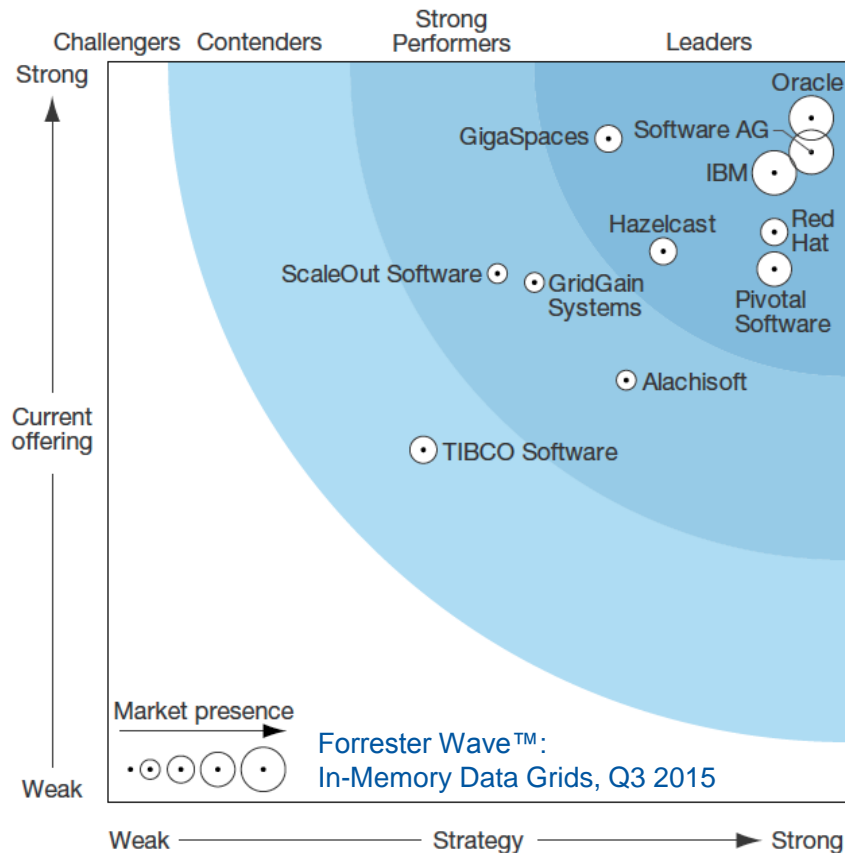
In-Memory approach: Scale with data and processing needs



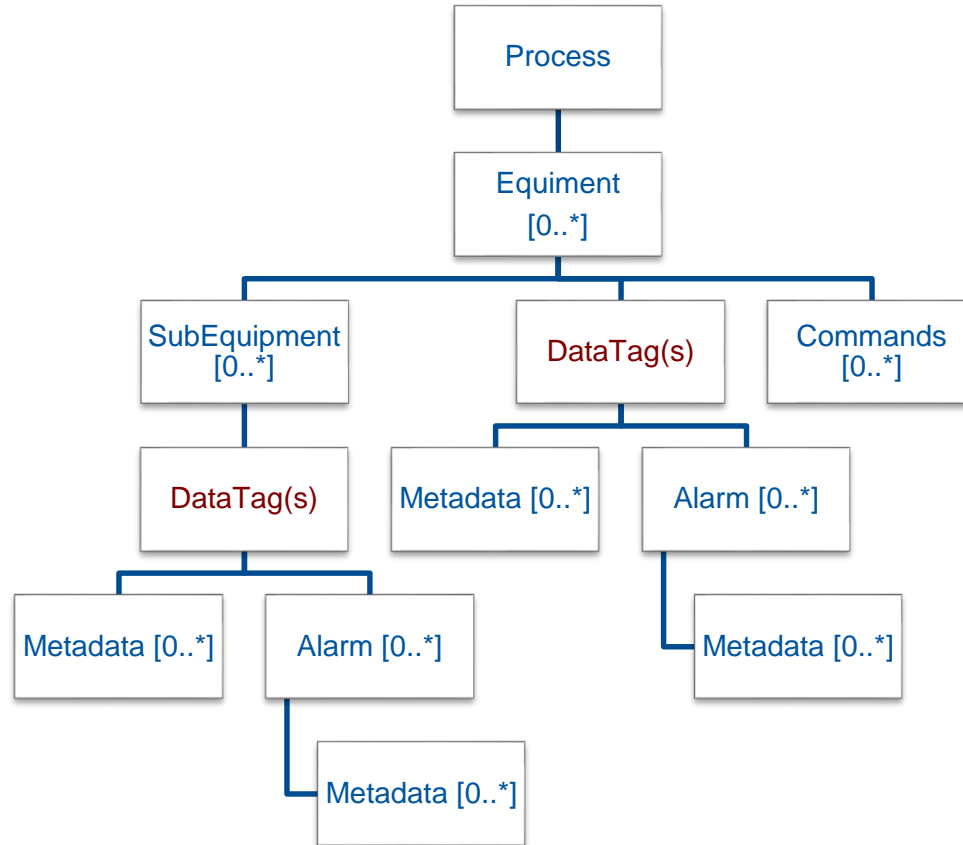
In-Memory Data Grid solutions



redis

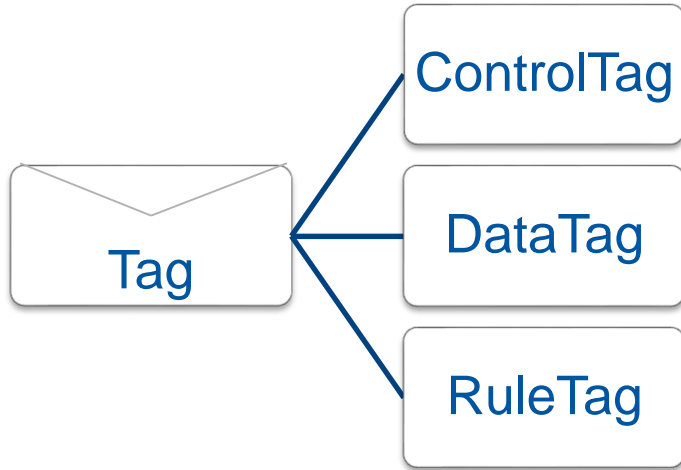


Basic configuration structure



The Tag family

- Id
- **Name**
- Value
- Quality
- Timestamp



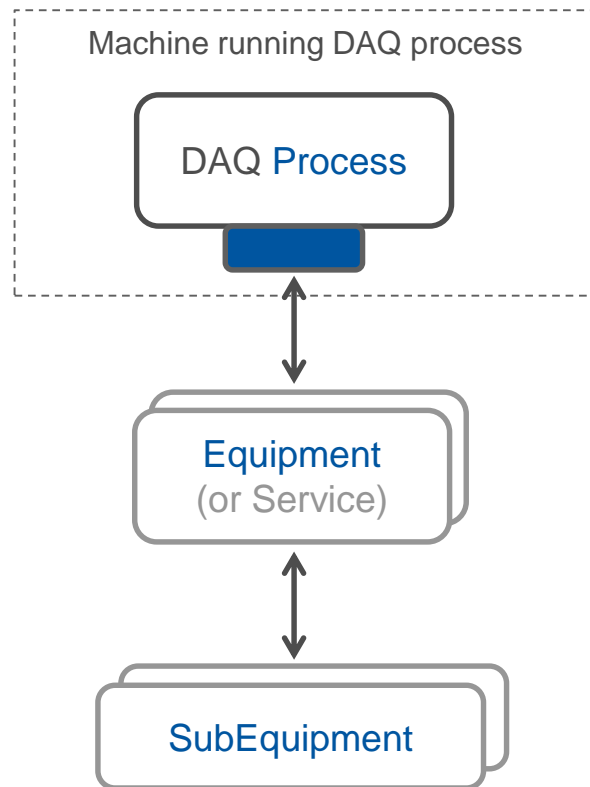
- Internally used for Process and Equipment surveillance
- Used for data acquisition *
- $(\#123 + \#234) > 2$ [ERROR], true [OK]

* Support of primitive arrays and arbitrary Objects

Acquisition layer

DAQ Process takes care of:

- Equipment/Service monitoring
- Data acquisition for configured Tags
- Raw data validation & filtering
- Sending data to server tier



Raw data validation & filtering on DAQ layer

Dynamic Filtering

- Dynamic Time dead-band filtering for Protecting against data bursts

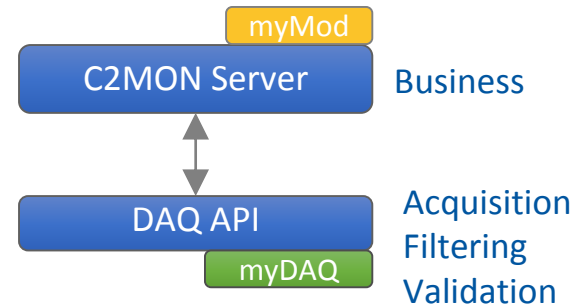
Static Filtering

- Static time dead-band filtering
- Value redundancy
- Value dead-band filtering

Data Validation

- Value in defined range?
- Correct value data type?
- Source timestamp in the future?
- Outdated information?

Configurable
by Tag

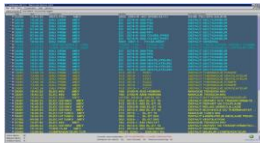


C2MON at CERN

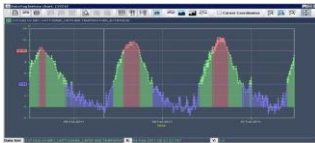
- CERN uses C2MON since January 2012 as backbone for the **Technical Infrastructure Monitoring (TIM)** service :
 - Electrical Network alarm monitoring
 - Technical Infrastructure surveillance (fire alarms, access doors ...)
 - Computing Center cooling and ventilation monitoring
 - Radiation zones monitoring

TIM Service

Client Tier



Alarm Console



Data Analysis



TIM Viewer



Web Apps

> 91k data sensors
> 60k alarms

TIM Server C2MON

> 1200 commands
> 1300 rules

Data Acquisition & Filtering



Cooling



Safety Systems



Electricity



Access



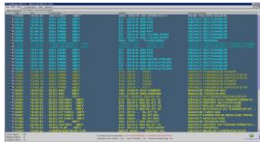
Network and
Hardware Controls



Cryogenics

TIM Service

Client Tier



Alarm Console



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TIM Server
C2MON

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Data Acquisition & Filtering

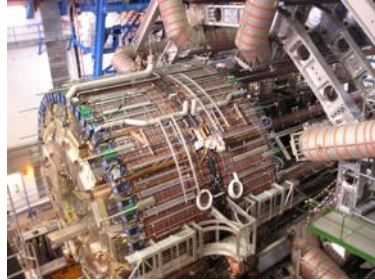
~ 400 million
raw values per day



~3 million updates

Real-world C2MON use cases

- Geneva-based **Securaxis** is researching road traffic monitoring.
- **Bologna University students** implemented a Fruit and Vegetable RFID-based tracking system for one of the top 3 Italian grocer logistics company.
- **Tanzanian students** implemented a medical field-device for data collection using C2MON as a data back-end.



Questions?
Thank you for your attention!

