

Analytics Everywhere for streaming IoT data

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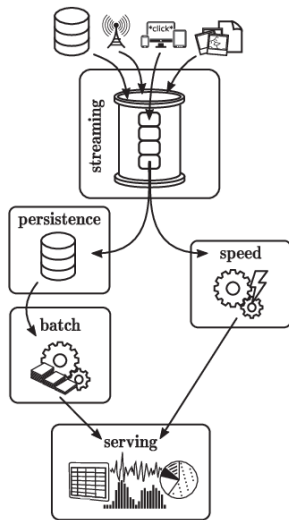
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Outline

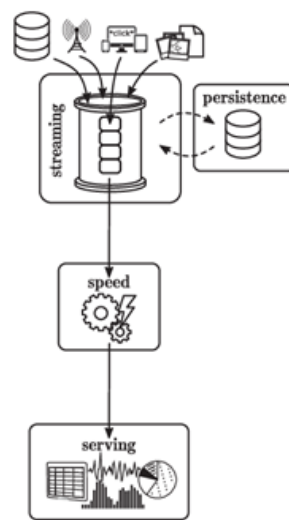
- Introduction
- Related work
- Contributions & Objectives
- The IoT streaming architecture
- Analytical capabilities in relation to resource capabilities
- Architecture implementation
- Implementation and results
- Conclusions

Introduction

Lambda Architecture



Kappa Architecture

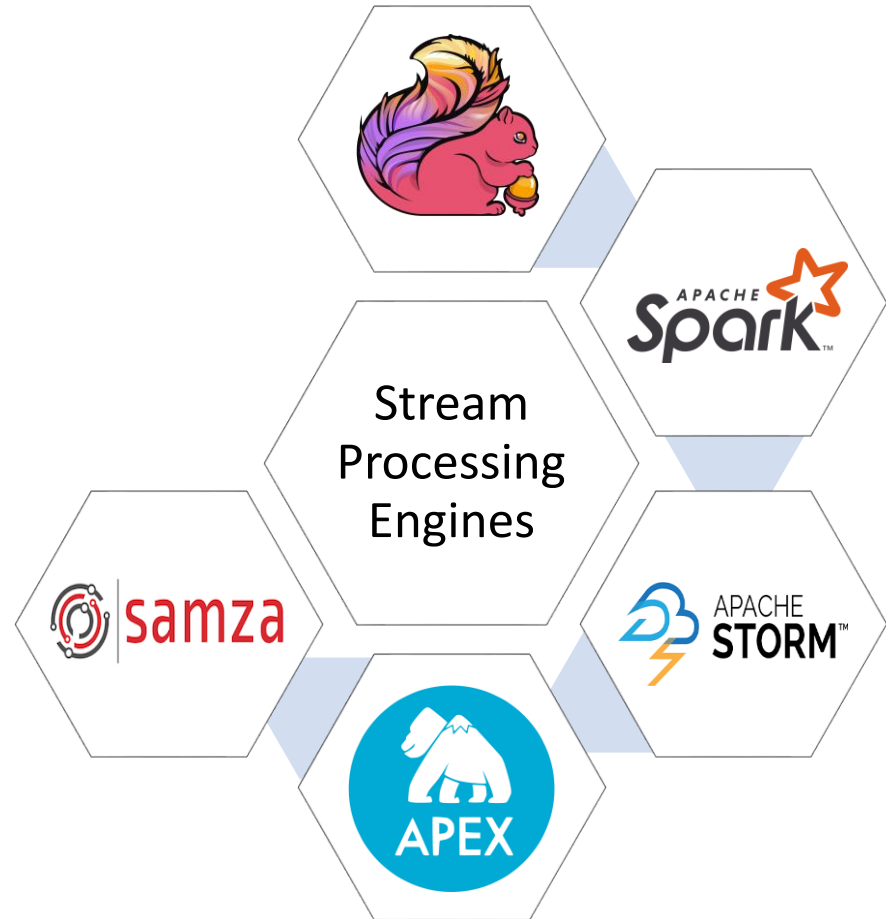
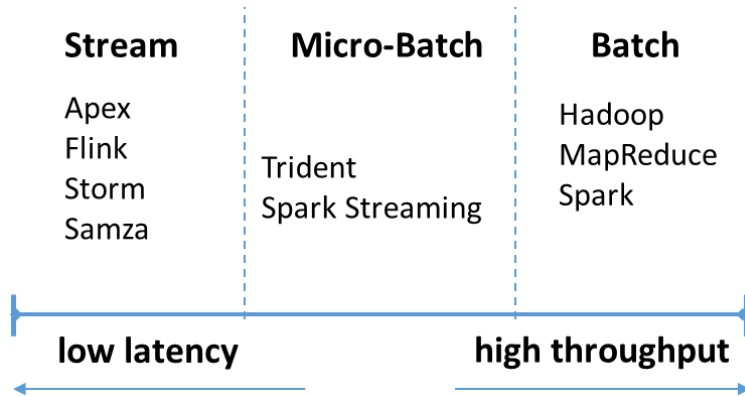


Efficient retrieval and analysis of IoT data streams require generating **useful intelligence** in a **timely manner** before the insights become **outdated**.

New architecture:
handling the arrival data tuples
+
confidentiality, integrity, and availability

Figure from: Wingerath, W., Gessert, F., Friedrich, S., & Ritter, N. (2016). Real-time stream processing for Big Data. *it-Information Technology*, 58(4), 186-194.

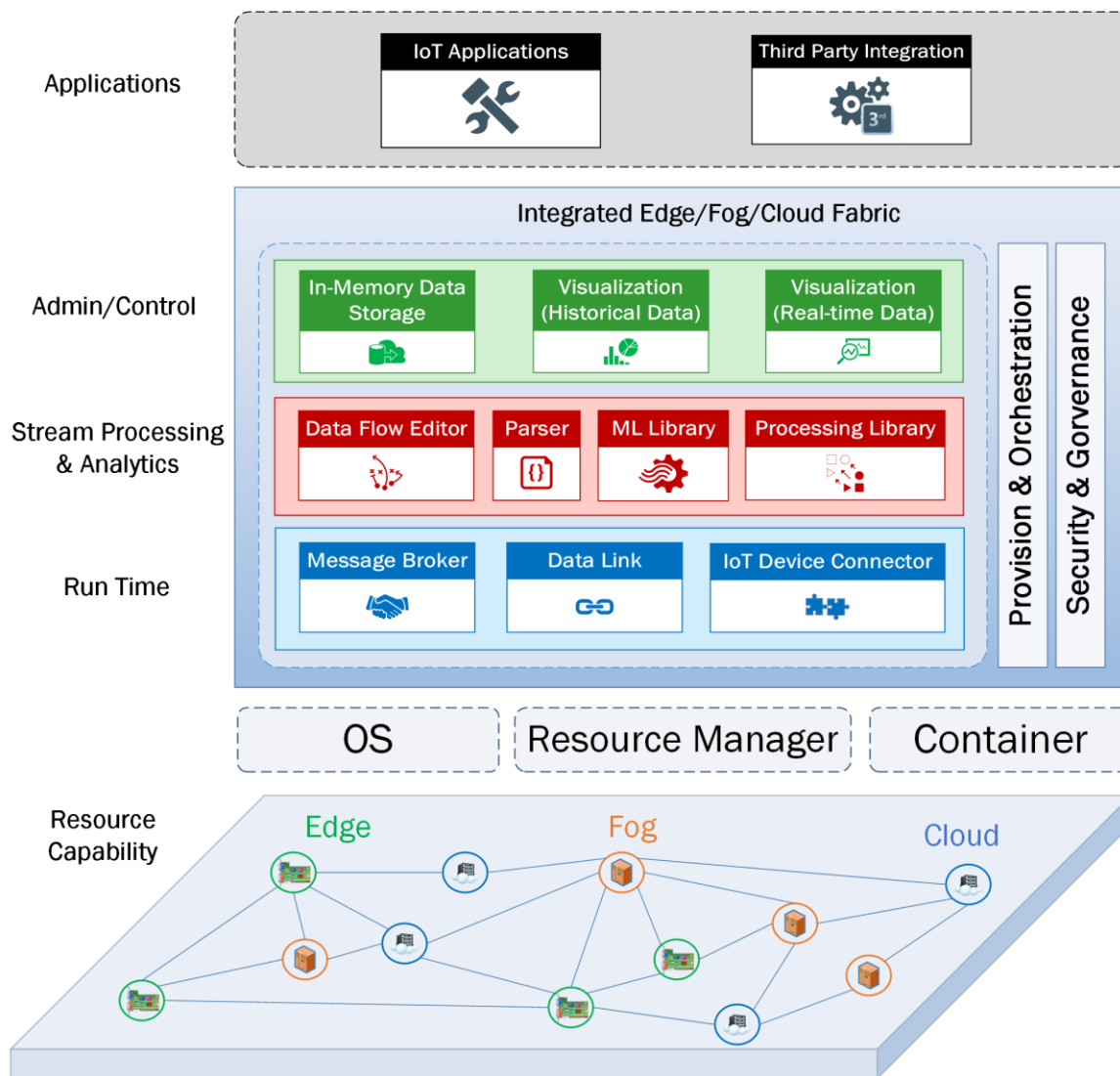
Related work



Contributions and Objectives

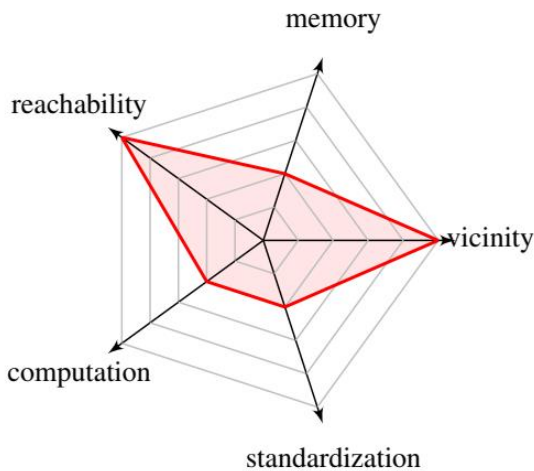
- A new architecture based on an integrated fabric of compute nodes.
 - Perform a network of tasks
 - Data life-cycle generated by IoT devices
 - Responsive to an edge/fog/cloud continuum.
- Developing an analytical everywhere architecture using a real-world scenario
 - real-time at the edge
 - near real-time at the fog and finally
 - time sensitive at the cloud.

The IoT streaming architecture

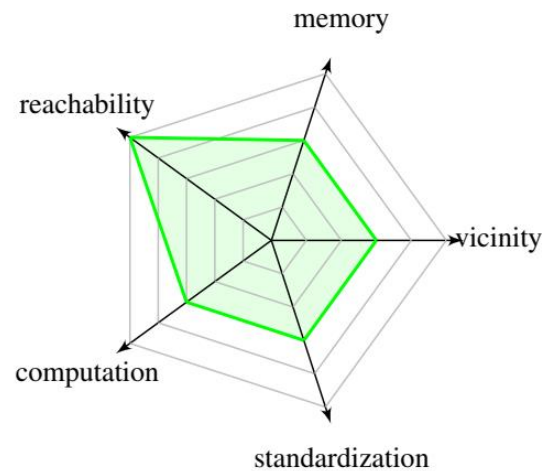


The IoT streaming architecture

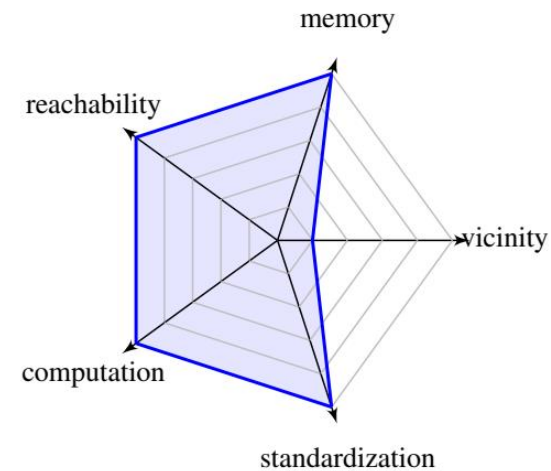
Resource Capability



(a) Edge

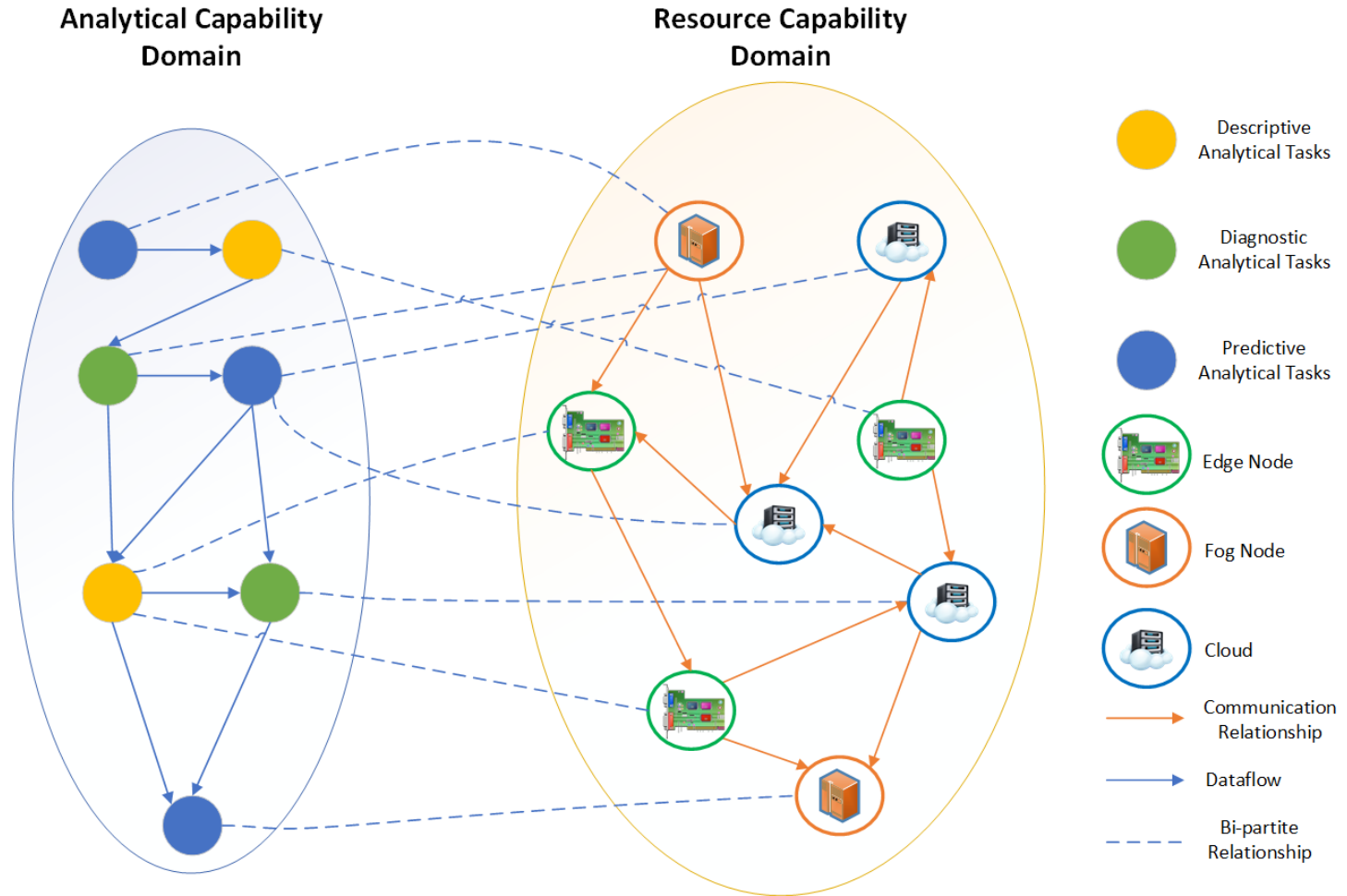


(b) Fog

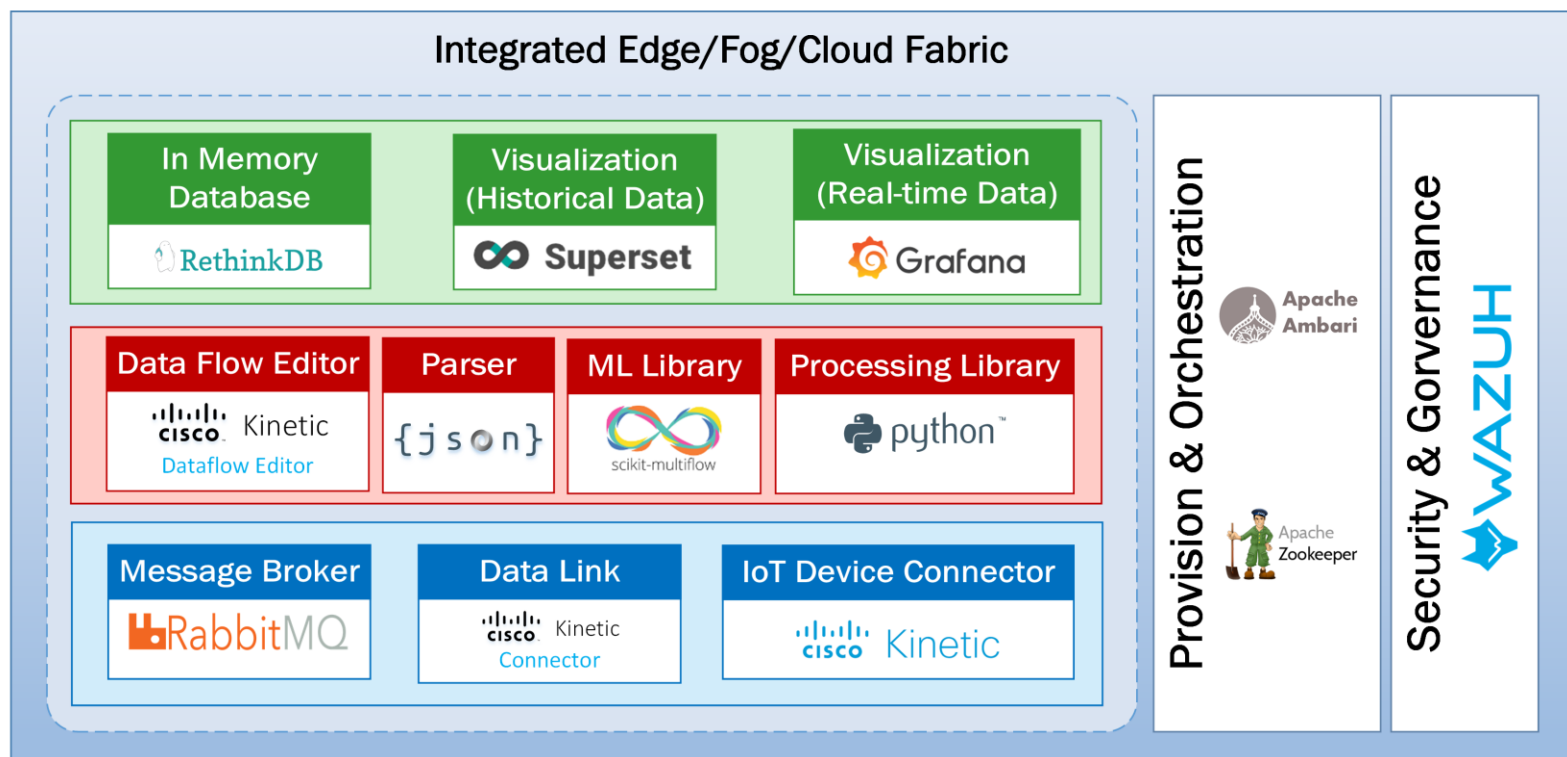


(c) Cloud

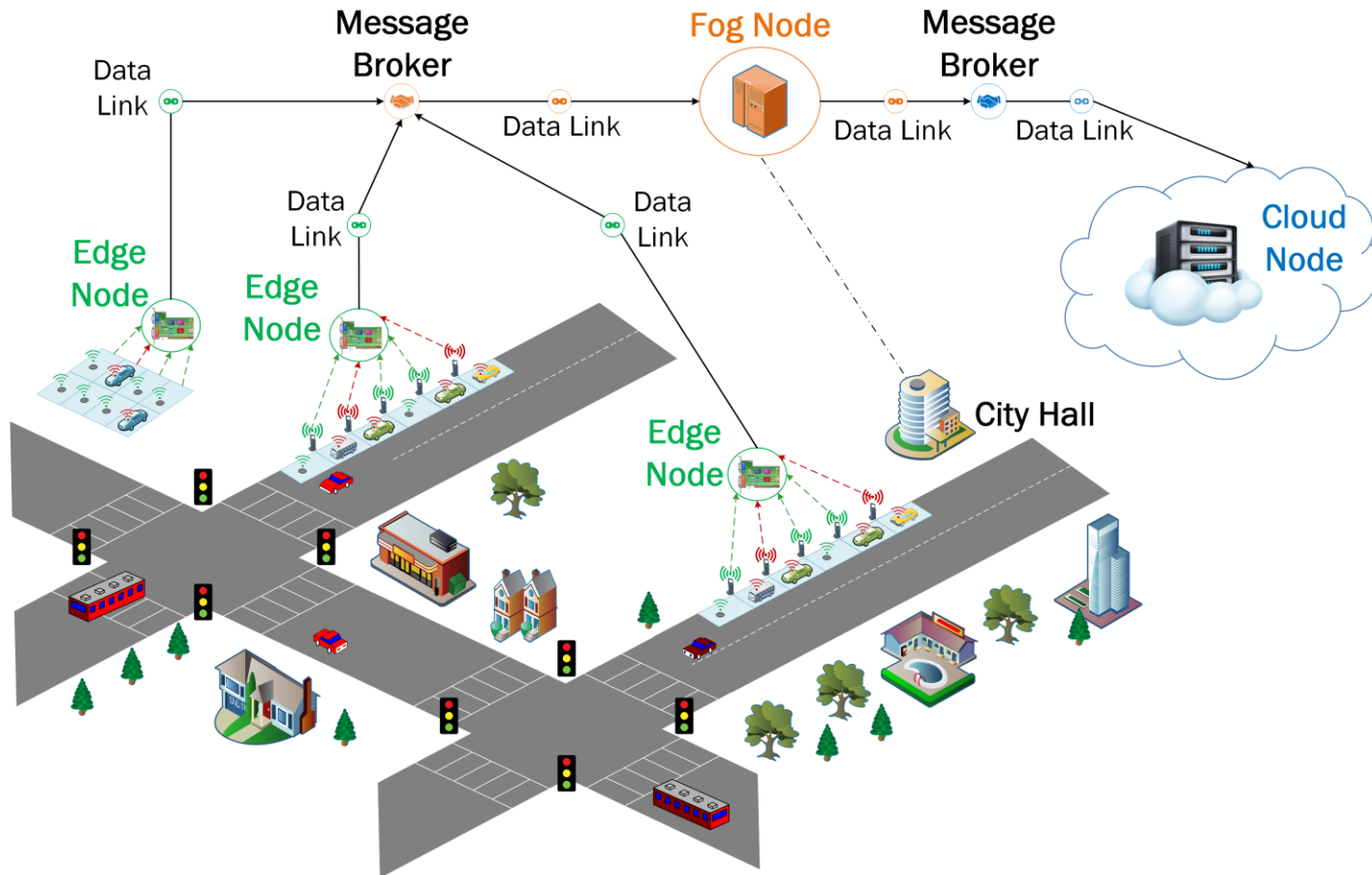
Analytical capabilities in relation to Resource capabilities



Architecture implementation



Smart parking scenario

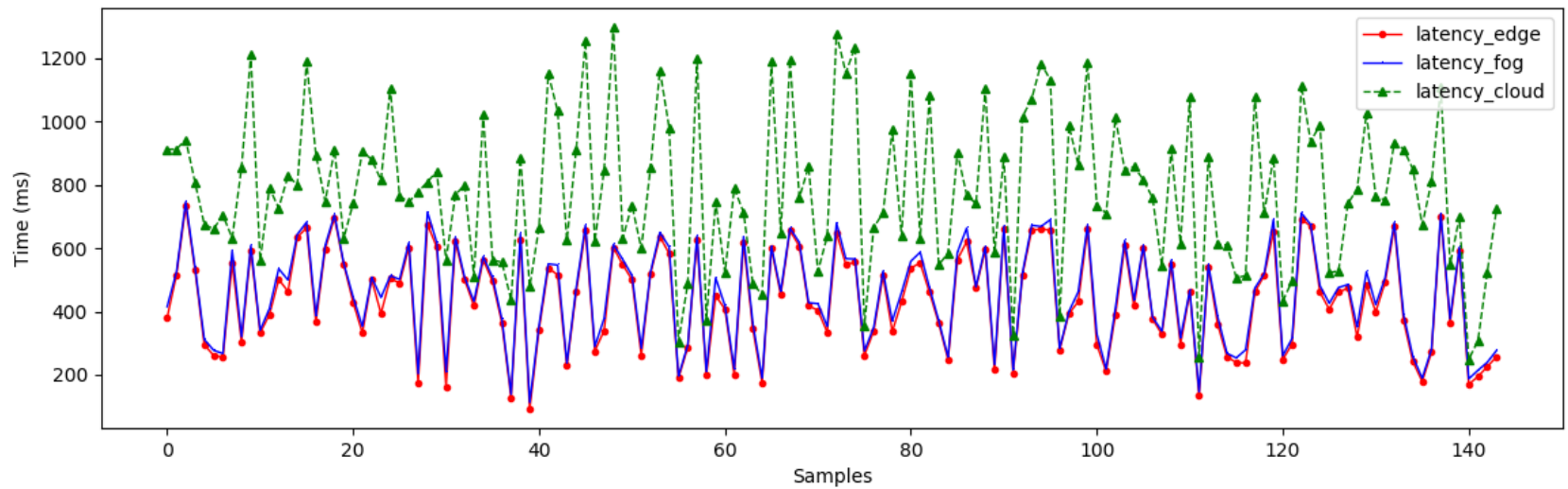


Implementation and results

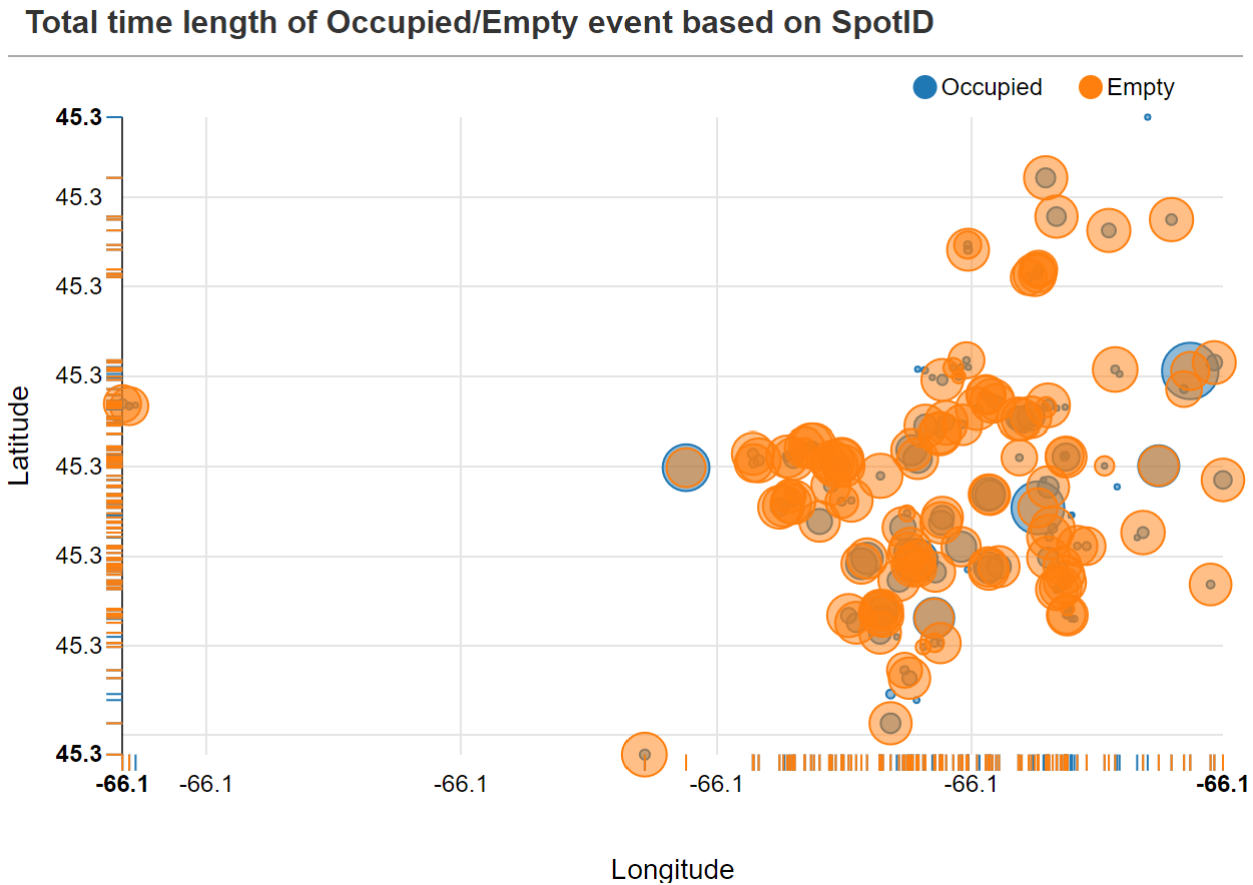
THE OVERVIEW OF THE COMPUTE NODES.

	Edge node	Fog node	Cloud node
OS	Ubuntu Mate	Window Server	CentOS 7.0 (x86_64)
CPU	ARM Cortex-A53	Intel Xeon E5-2623 v3	Intel Xeon E5-2650 v2
# of Core	4 (1.4GHz 64-bit)	4 (3.00GHz 64-bit)	8 (2.60GHz 64-bit)
RAM	1GB	30GB	30GB
Disk	32GB	1TB	1TB
Hardware	Raspberry Pi 3 B+	Commodity Server	Virtual Machine

Implementation and results

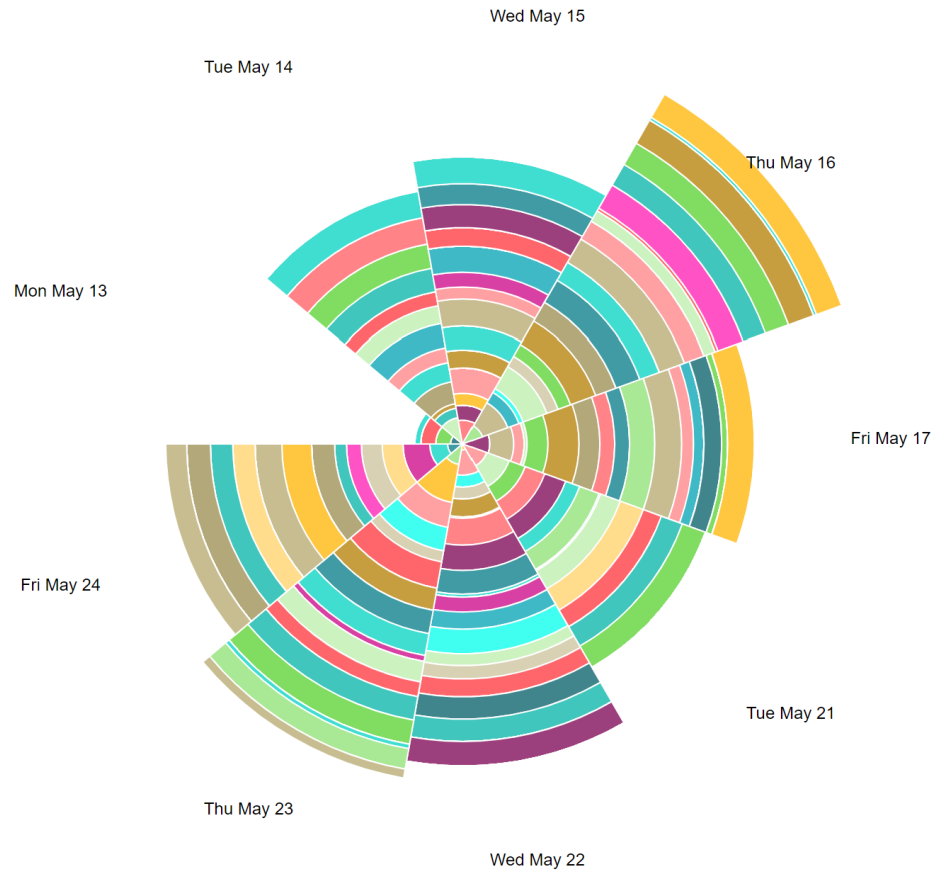
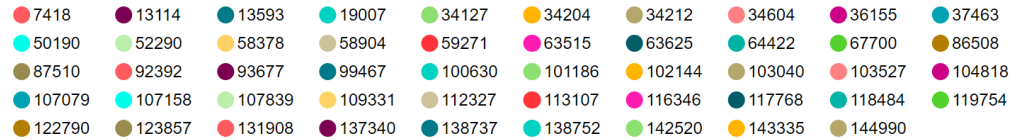


Implementation and results



Implementation and results

Visualization of the most 50 vehicles using the parking service based on the total time length



Conclusions

- An IoT architecture where edge, fog, and cloud resources are used to support streaming IoT analytics.
- Real-world scenario was used to demonstrate the feasibility of IoT architectures for smart parking
- New metrics to evaluate IoT architectures in the future
- We do not expect that one IoT architecture will fit all IoT applications.
- We have extended this work and publish in the Special Issue Edge/Fog/Cloud Computing in the Internet of Things of Sensors Journal.

Cao, H., & Wachowicz, M. (2019). An Edge-Fog-Cloud Architecture of Streaming Analytics for Internet of Things Applications. Sensors, 19(16), 3594.

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