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A Performance and Cost Evaluation of Combining OPC-UA and Microsoft Azure IoT Hub into an Industrial Internet-of-Things System

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Overview

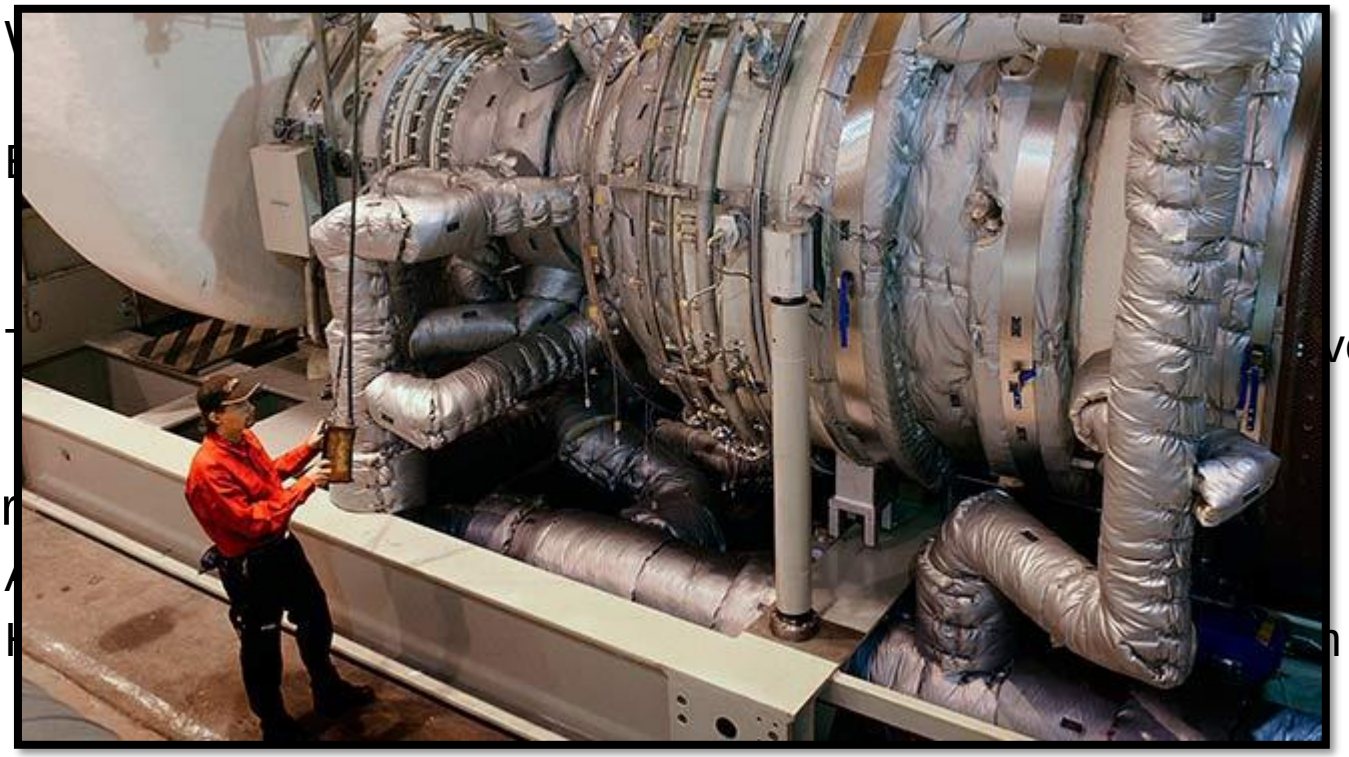
- Background
- Scenario
- Approach & Implementation
- Results
- Conclusion & Future Work

Background

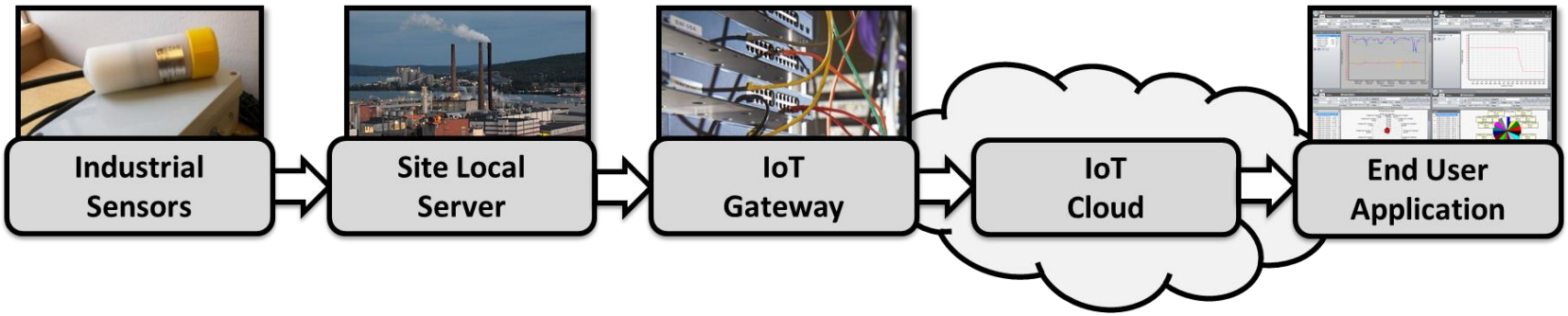
- Post doc project
  - 50 billion devices, 10 times per second updates, 100ms response times
  - This work and scenario originates from one of our partner companies
- This paper aims to find and evaluate potential solutions for creating efficient and flexible Industrial IoT systems. In particular, evaluating the two prominent technologies OPC-UA and Microsoft Azure IoT
- This work seeks to answer the following two research questions:
  - 1) What is the expected response times and performance of an IIoT system that uses UPC-UA and Microsoft Azure IoT Hub?
  - 2) What is the estimated operational costs for the cloud system and will this be feasible for a typical IIoT scenario?

Scenario

- Based on a real world industrial turbine system
  - V
  - E
  - T ver
- Ther
  - A
  - H n

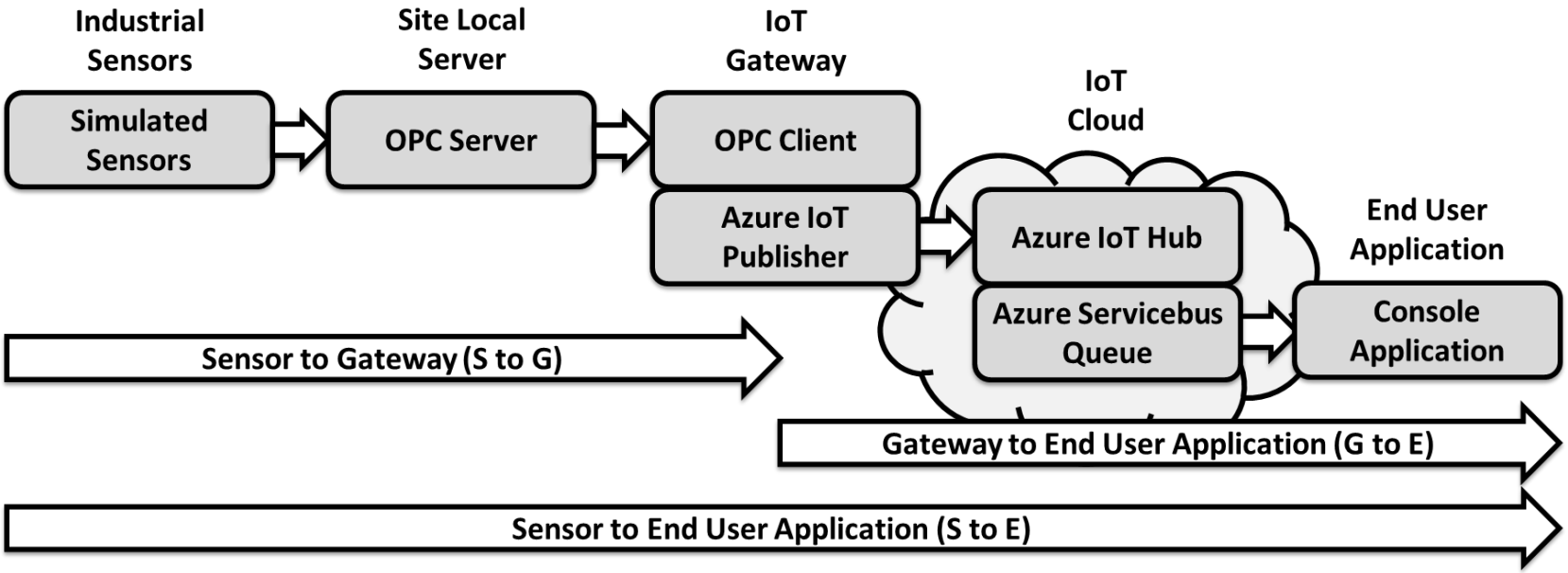


Approach



- Industrial sensors being connected to a site local server
- That is also connected to an IoT gateway
- That can send the data to the IoT cloud
- Which then makes it available to end user applications

Implementation



- Measurements
  - Latencies: S to G, G to E, and S to E
  - Monetary costs: for sending to cloud and to route inside the cloud

Results (Latency)

- Measurements
  - Fiber (SUNET)
  - LTE (Telia)
  - Average (μ)
  - Standard deviation (σ)
- Maximum Response Time
  - Industry often discuss five-nines reliability, etc.
  - So we specified the MRT in our particular scenario to 99.999% of all values.

Table I
RESPONSE TIME MEASUREMENTS WITH WIRED FIBER

Fiber	μ	σ
S to G	1,8 ms	1,6 ms
G to E	760 ms	330 ms
S to E	770 ms	330 ms

Table II
RESPONSE TIME MEASUREMENTS WITH WIRELESS LTE

LTE	μ	σ
S to G	2,8 ms	1,5 ms
G to E	1100 ms	340 ms
S to E	1150 ms	340 ms

Results (Cost)

- Our scenario produces 51 840 000 sensor values per day

Table III
COST PLANS FOR MICROSOFT AZURE IOT HUB

Plan	Price per month	Messages per day	Message size
Free	Free	8 000	0.5 kB
S1	$50	400 000	4 kB
S2	$500	6 000 000	4 kB
S3	$5 000	300 000 000	4 kB

- Sending to cloud
  - $5000 for our scenario
- Routing
  - Costs $0.05 per million operations
  - Resulting in $2.6 for our scenario
- **Total: $5002.6 per month**

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Summary and Conclusions

- OPC-UA and Microsoft Azure IoT hub was used to create an industrial IoT system for a real life industrial scenario
  - A proof-of-concept system was implemented to evaluate its feasibility, performance, and expected monetary costs
- Latency
  - Average response time
    - Fiber: 770 ms, LTE: 1150 ms
  - Expected response time for 99.999% of all values
    - Fiber: 2.2 s, LTE: 2.6 s
  - The major part of the delay was consumed by Microsoft Azure's internal system, not the network or OPC-UA
- Cost
  - The scenario will cost roughly $5000 per month
  - Which can be a significant cost for a small enterprise

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Future Work

- We want to set up a testbed with more of the industrial system
  - Including connecting it with the process information management system as the end user application (Prevas AutArch)
- We aim for a “Secure Industrial Internet of Things” project
  - The value chain, device trust, and cloud trust
- Continue to evaluate cloud systems and fog computing
  - Especially when the scale and demands is pushed even higher
  - Billions of sensors, faster sensor updates, and short response times

Prevas
Innovation for Growth

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