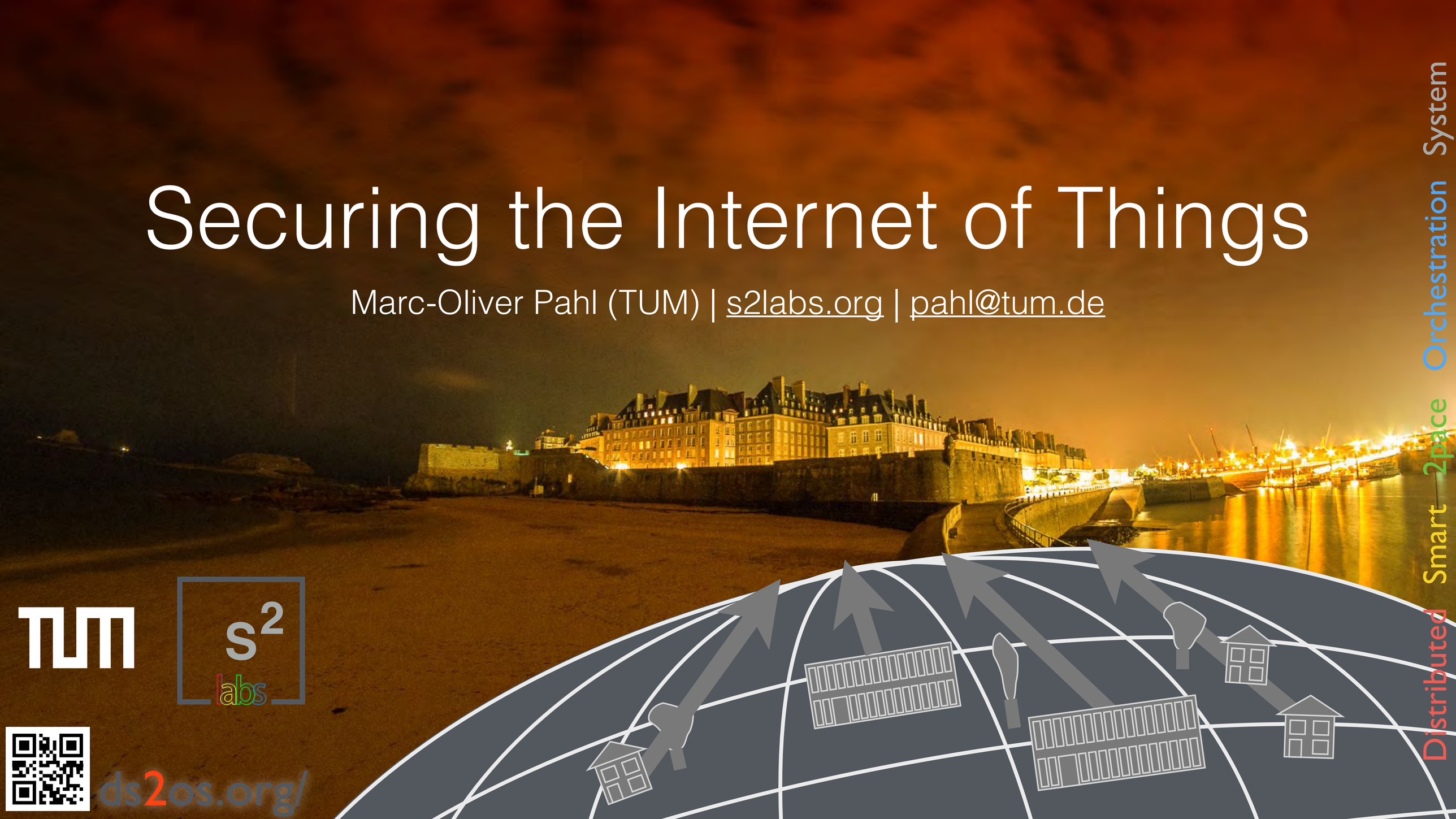
Securing the Internet of Things

Marc-Oliver Pahl (TUM) | s2labs.org | pahl@tum.de



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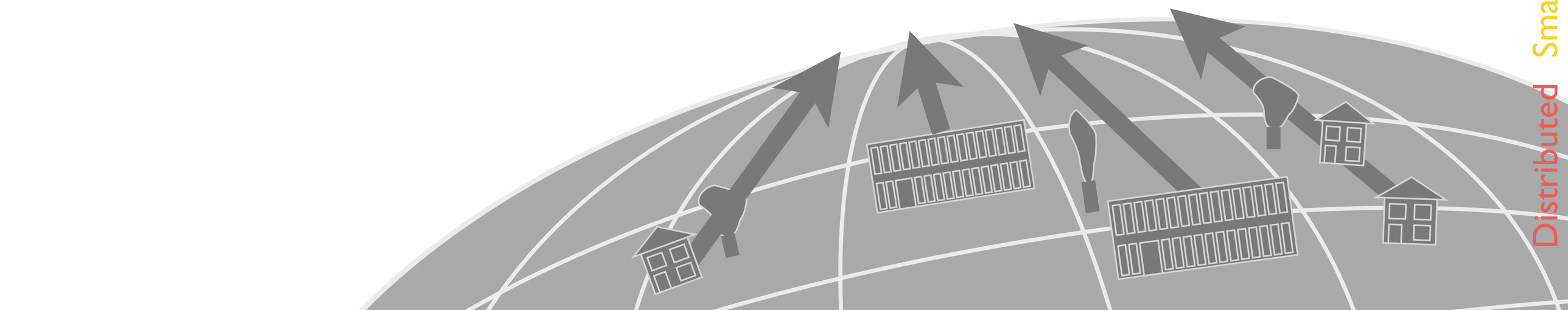
Why do we need a secure IIoT?



Distributed Smart 2pace Orchestration System

User (un)aware monitoring

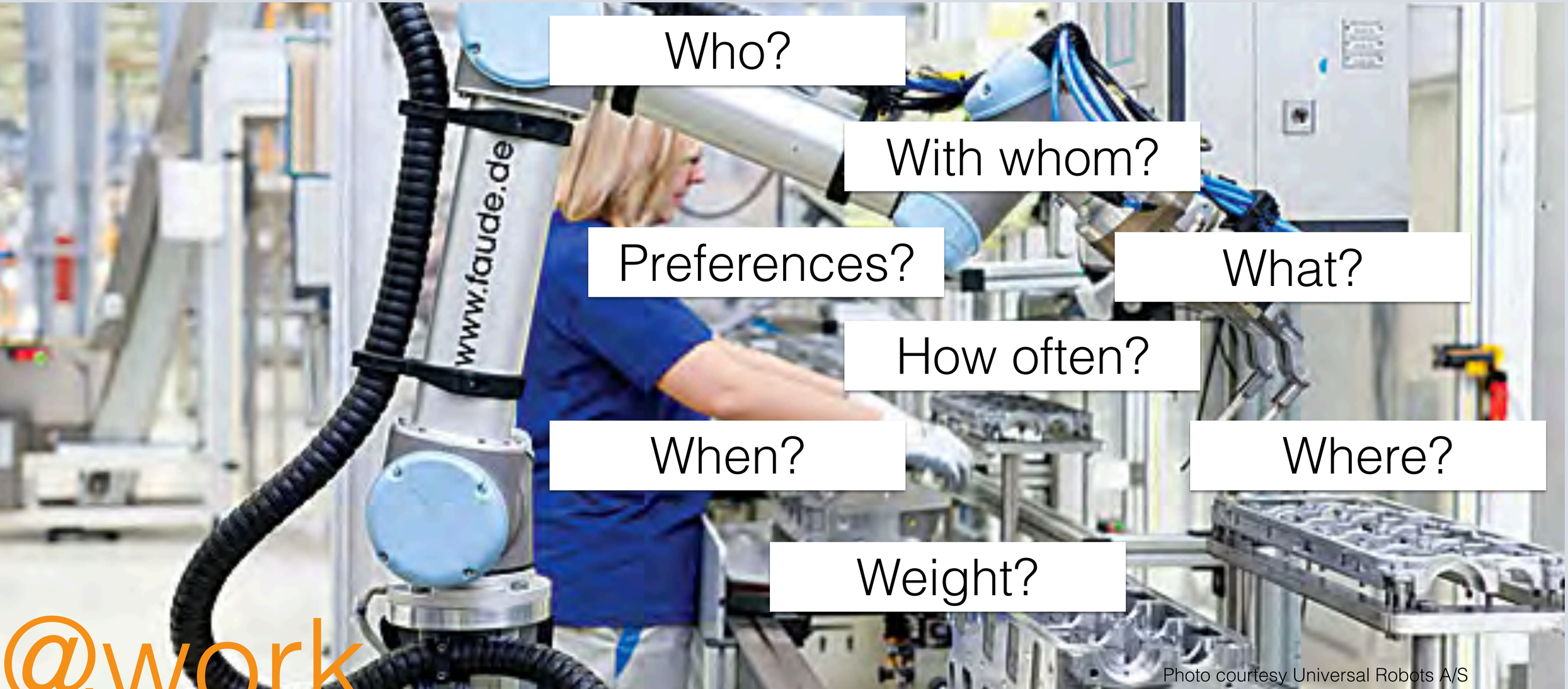


Photo courtesy Universal Robots A/S

@work

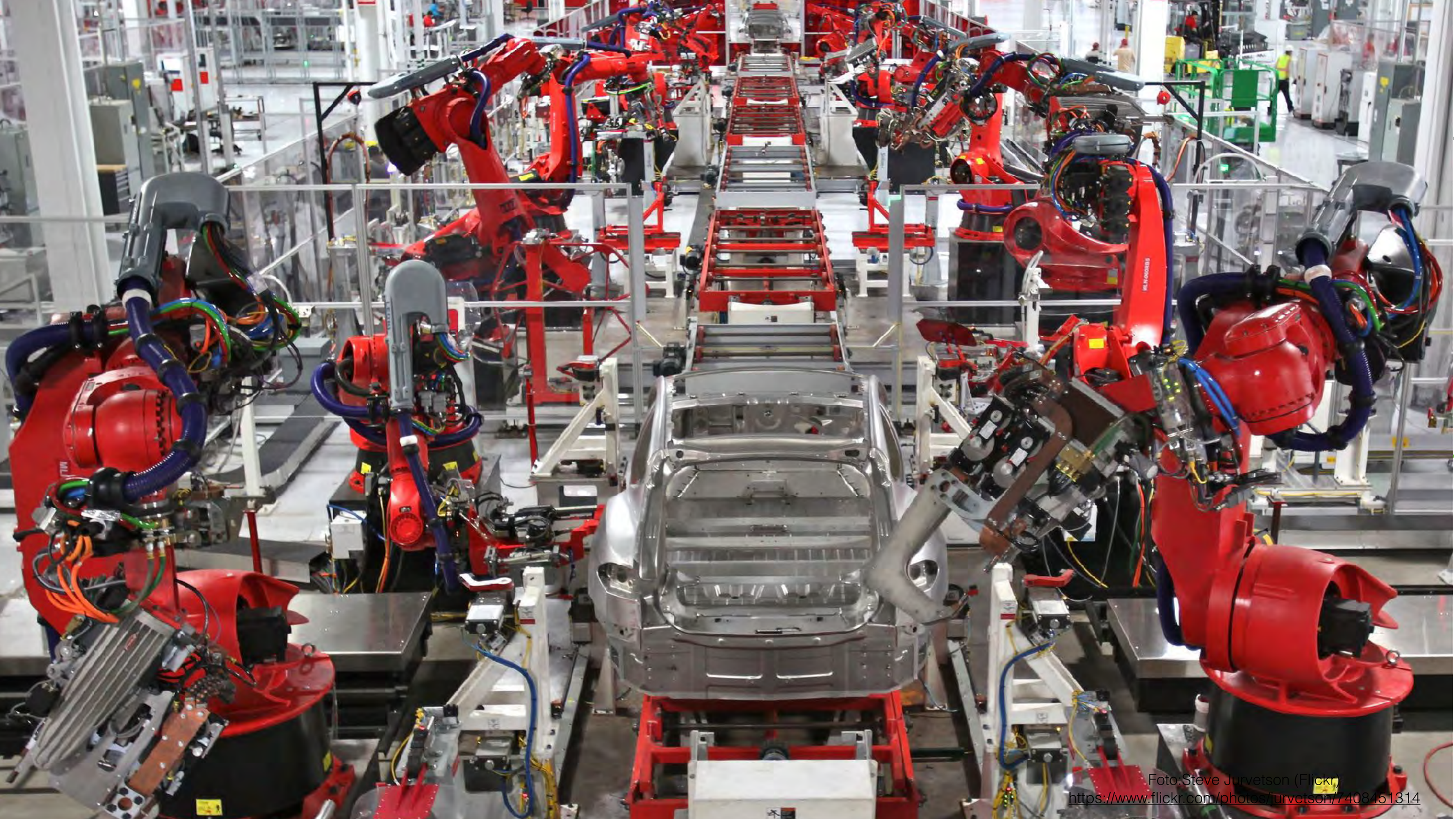


Foto: Steve Jurvetson (Flickr)
https://www.flickr.com/photos/jurvetson/7408451314

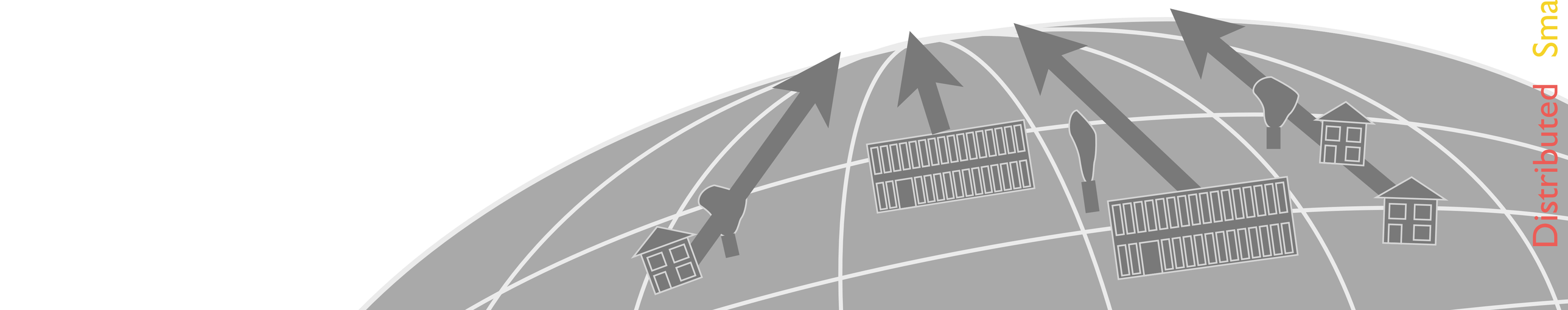
Security Challenges include

Privacy

Reliability

Distributed Smart 2pace Orchestration System

How can we achieve a secure IIoT?



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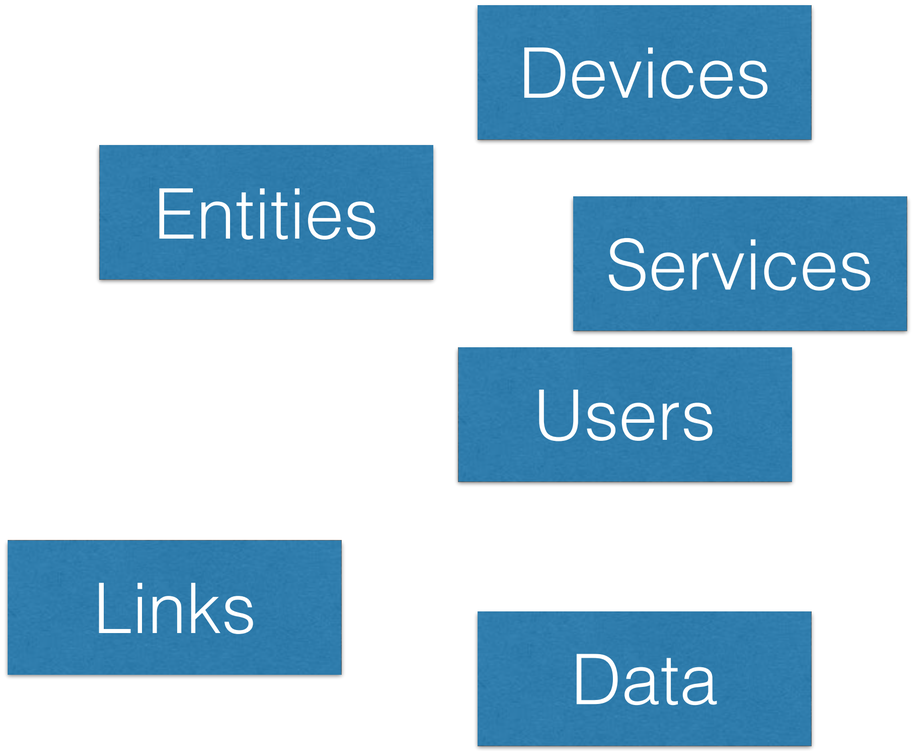
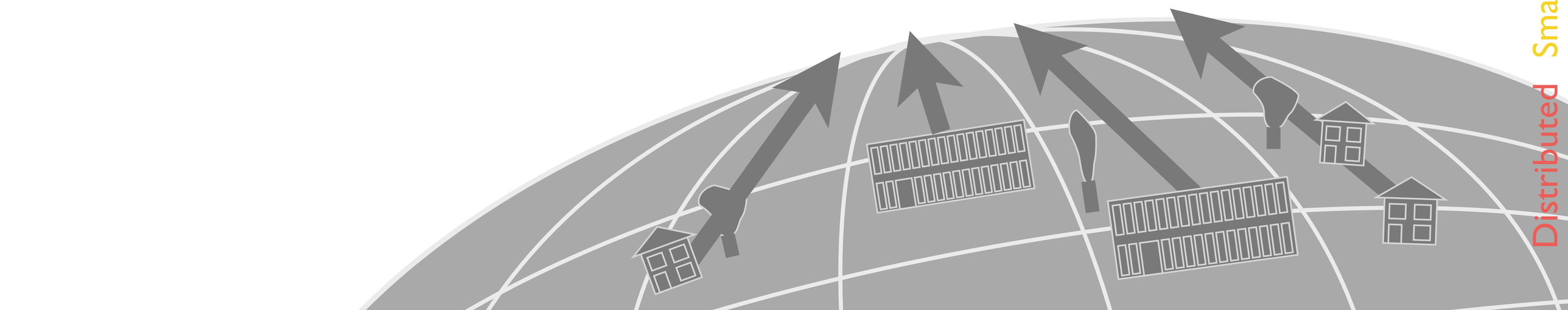
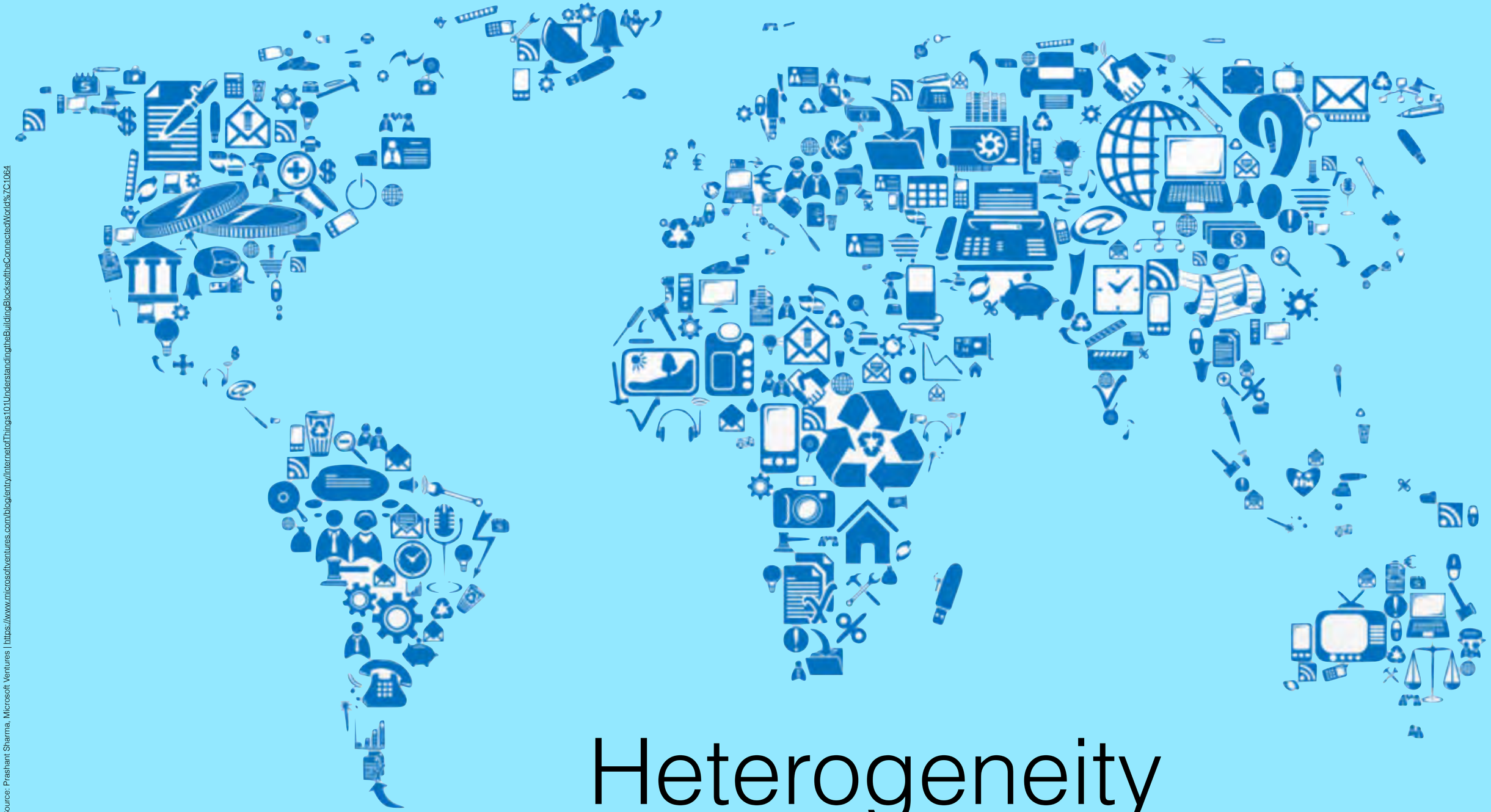
The usual suspects

- Authentication
- Authorization
- Confidentiality



Why is it challenging?

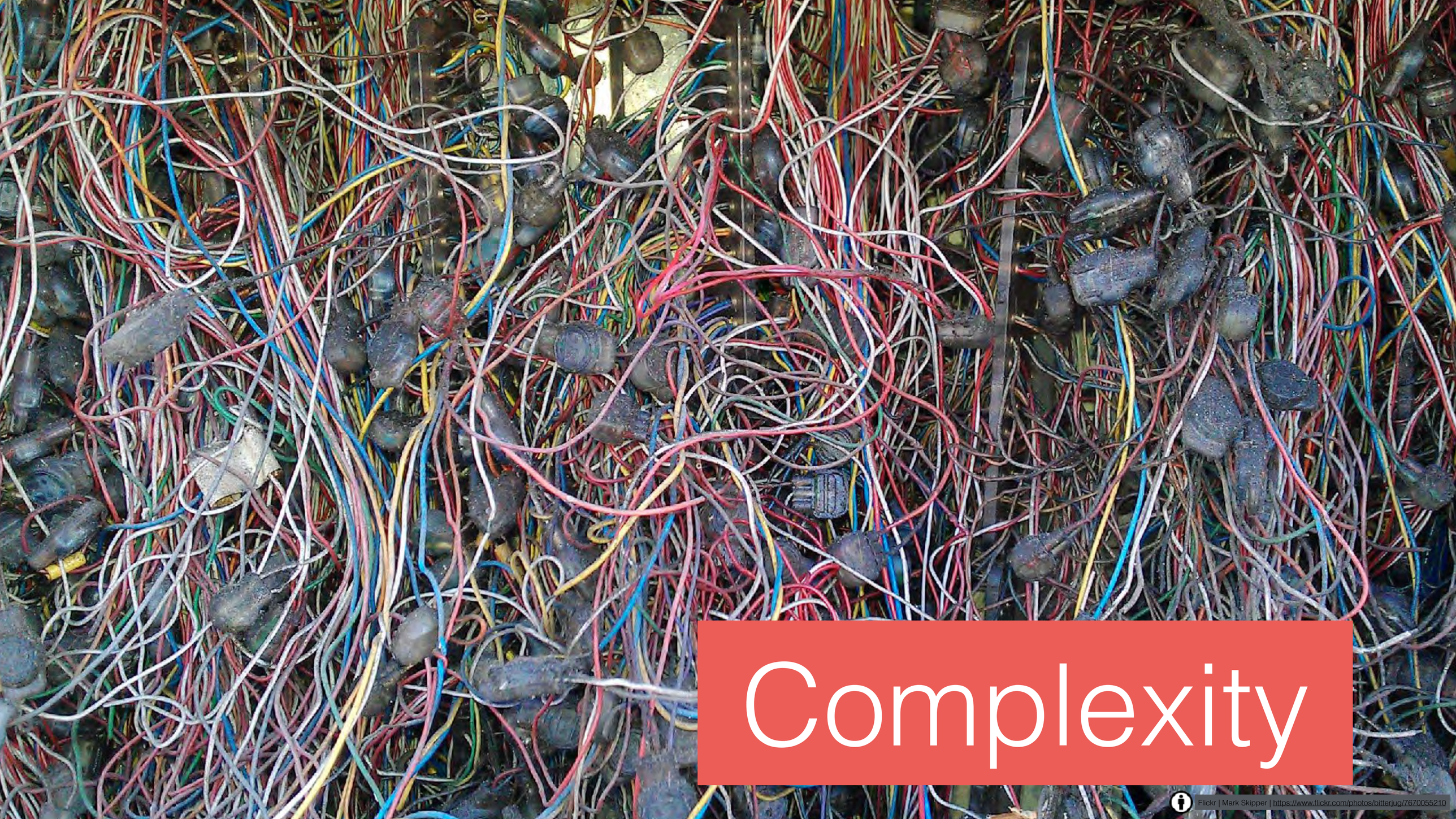




Heterogeneity

Distributed Smart 2pace Orchestration System

Image Source: Prashant Sharma, Microsoft Ventures | https://www.microsoftventures.com/blog/entry/InternetofThings101UnderstandingtheBuildingBlocksoftheConnectedWorld%7C01064

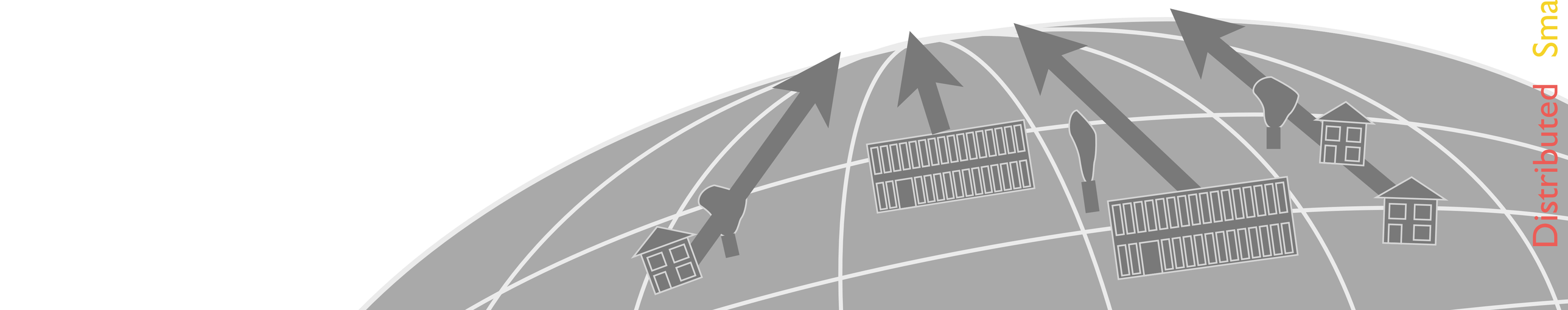


Complexity

Whom to trust?

- Hardware?
- Software Services?
- My answer: no-one but the components you design as enabler for the IoT: **MIDDLEWARE**.

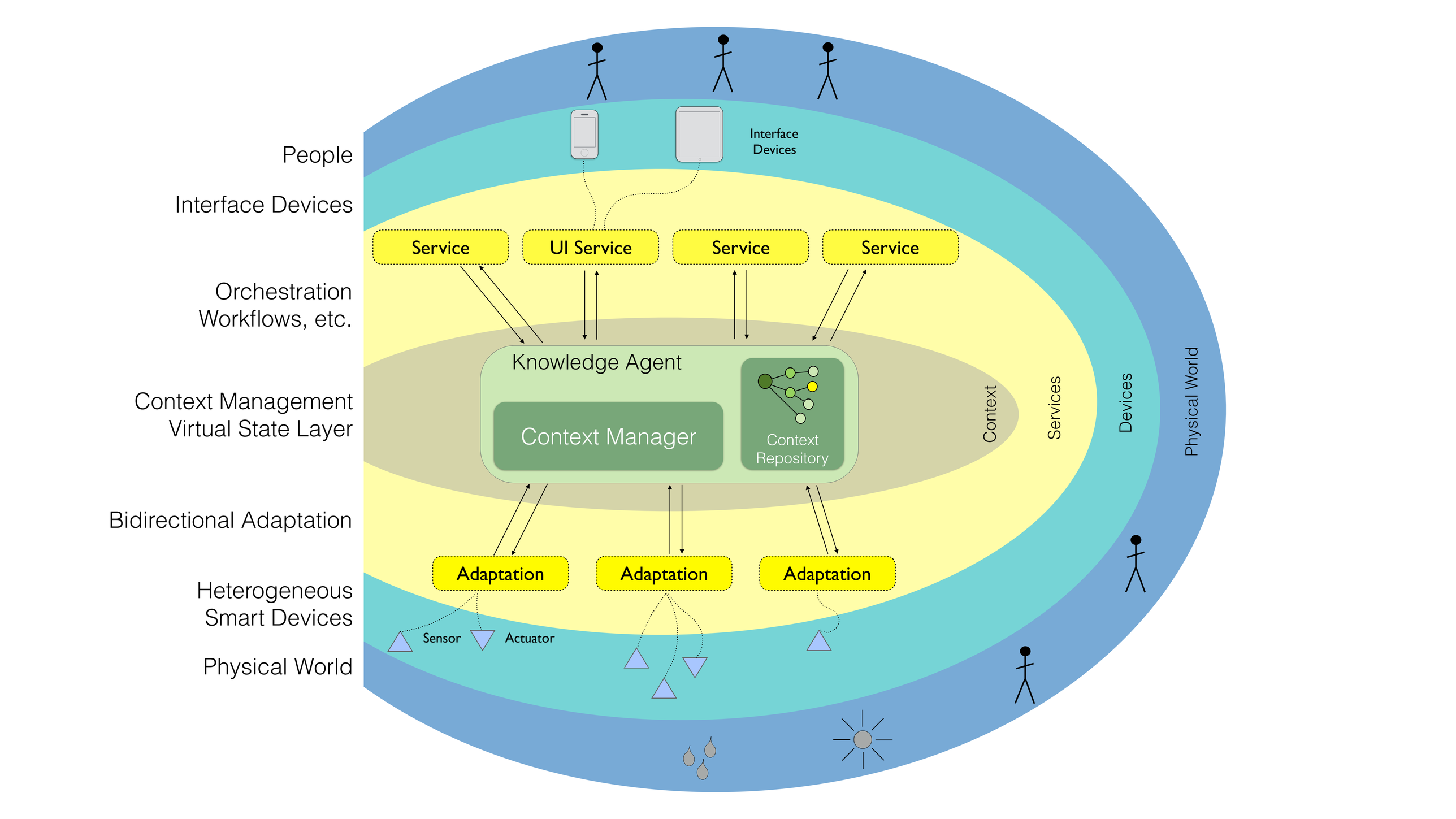
Security **by-design**



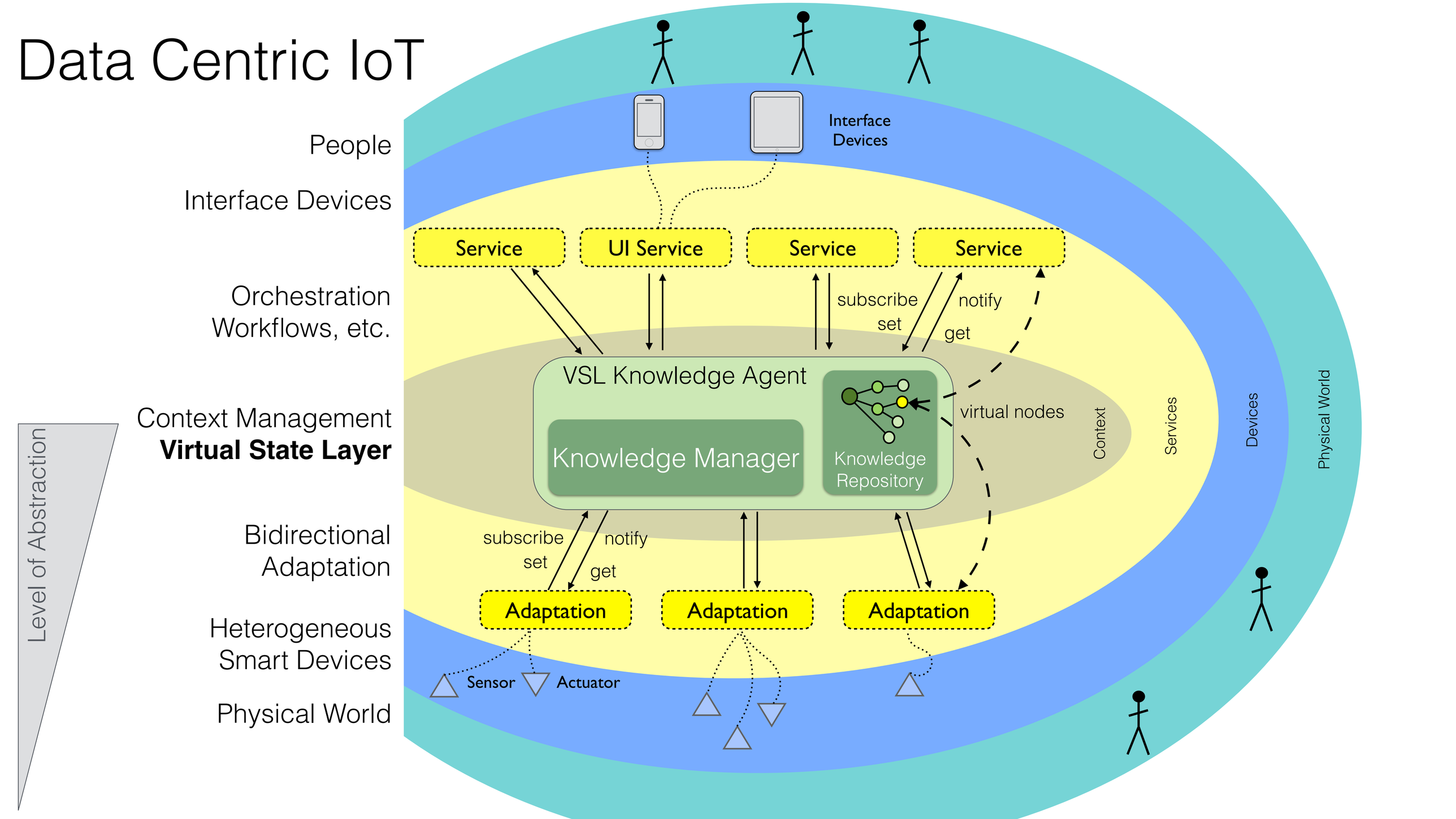
Distributed Smart 2pace Orchestration System

Data Centric IoT

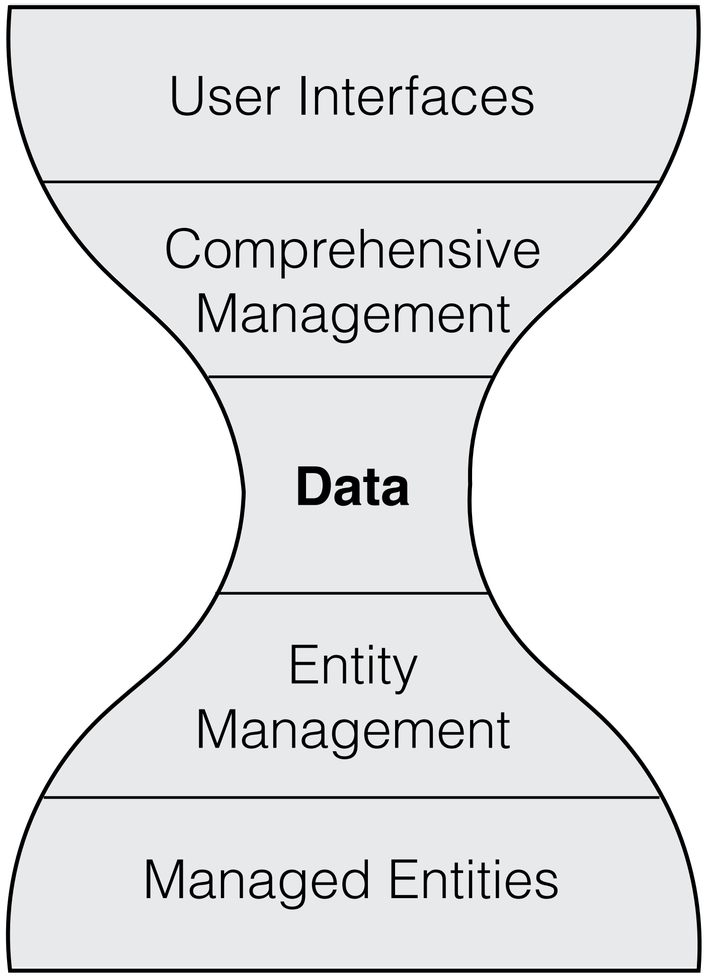
Distributed Smart 2pace Orchestration System

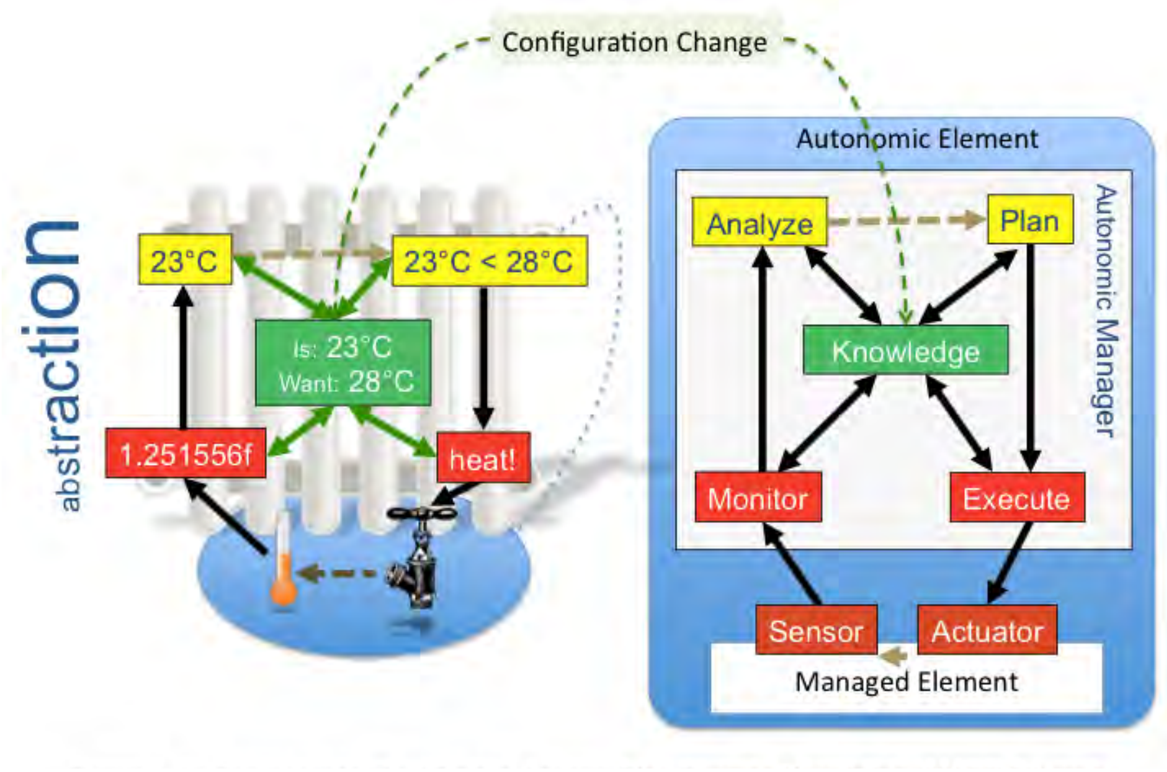

People
Interface Devices
Orchestration
Workflows, etc.
Context Management
Virtual State Layer
Bidirectional Adaptation
Heterogeneous
Smart Devices
Physical World
Interface
Devices
Service
UI Service
Service
Service
Knowledge Agent
Context Manager
Context
Repository
Context
Services
Devices
Physical World
Adaptation
Adaptation
Adaptation
Sensor
Actuator

Data Centric IoT



A Data Centric IoT

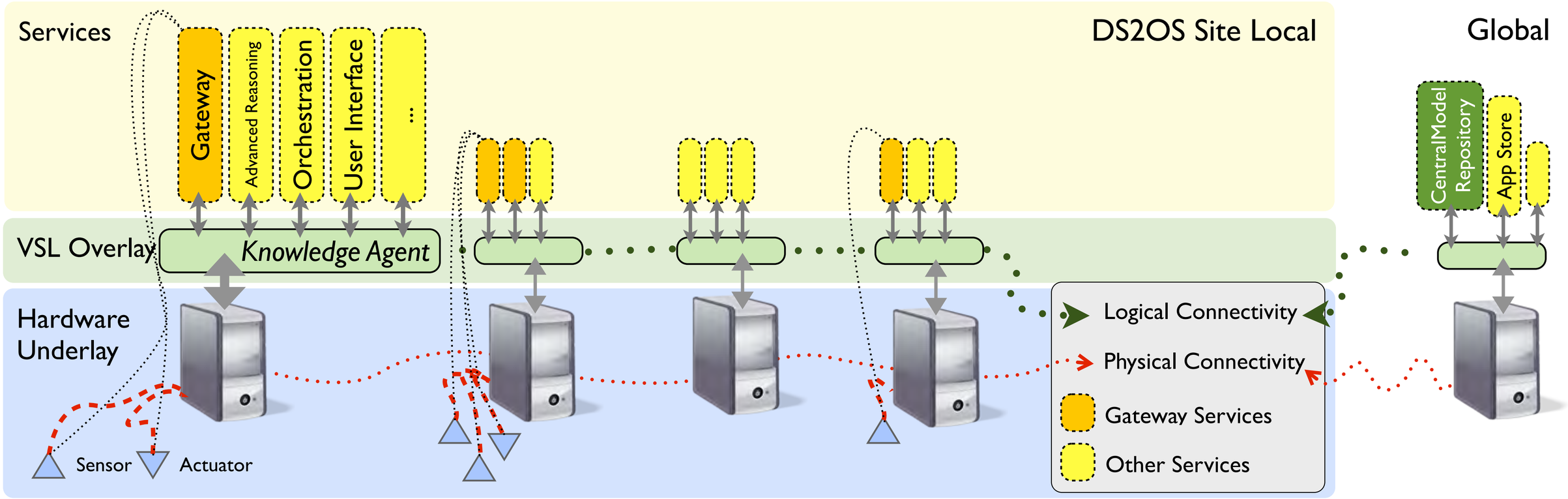


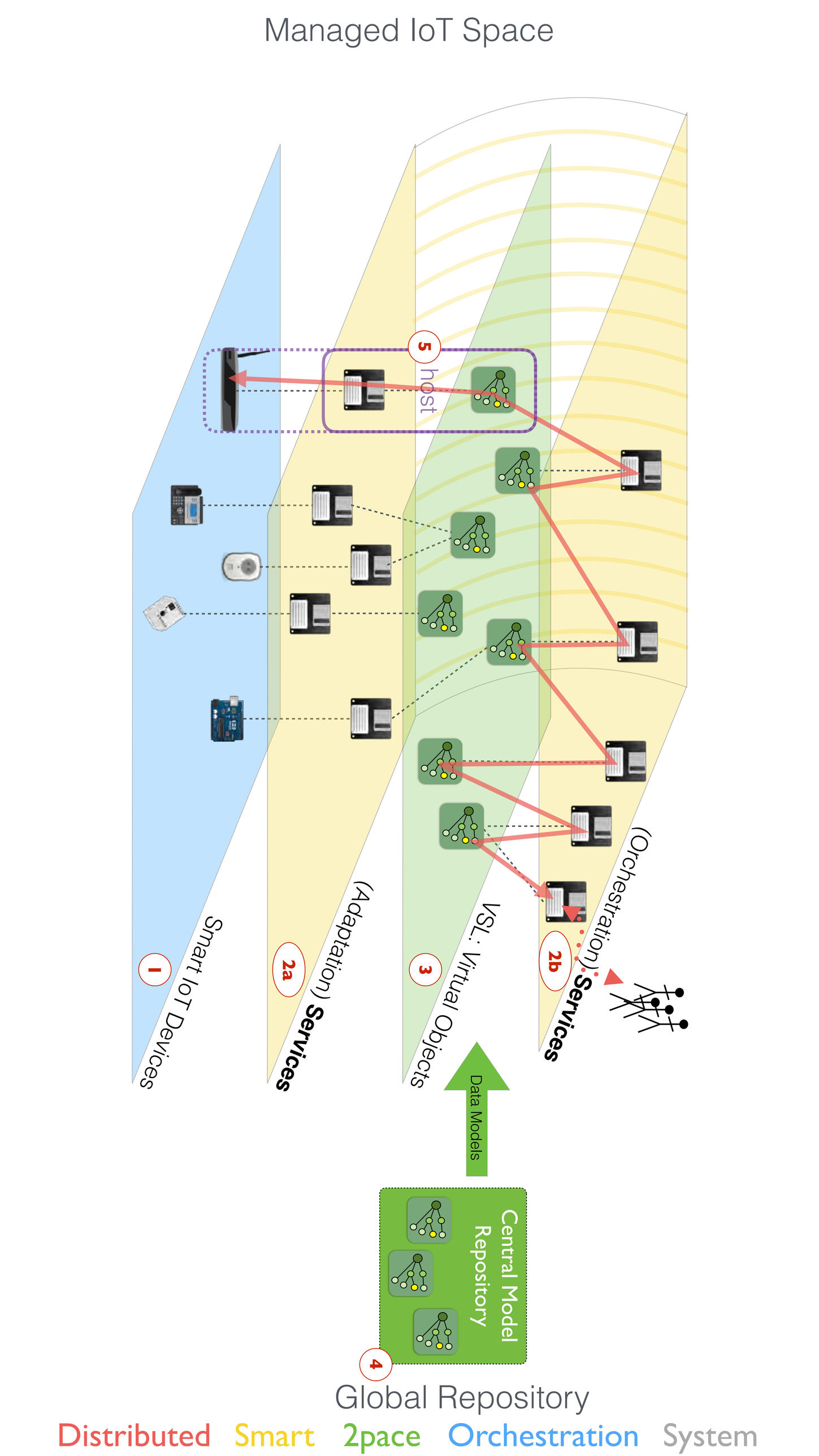


Needs **autonomous management!**

Distributed Smart 2pace Orchestration System

The Virtual State Layer




Managed IoT Space
5
host
1
Smart IoT Devices
2a
(Adaptation) Services
3
VSL: Virtual Objects
2b
(Orchestration) Services
Data Models
Central Model Repository
4
Global Repository
Distributed
Smart
2pace
Orchestration
System

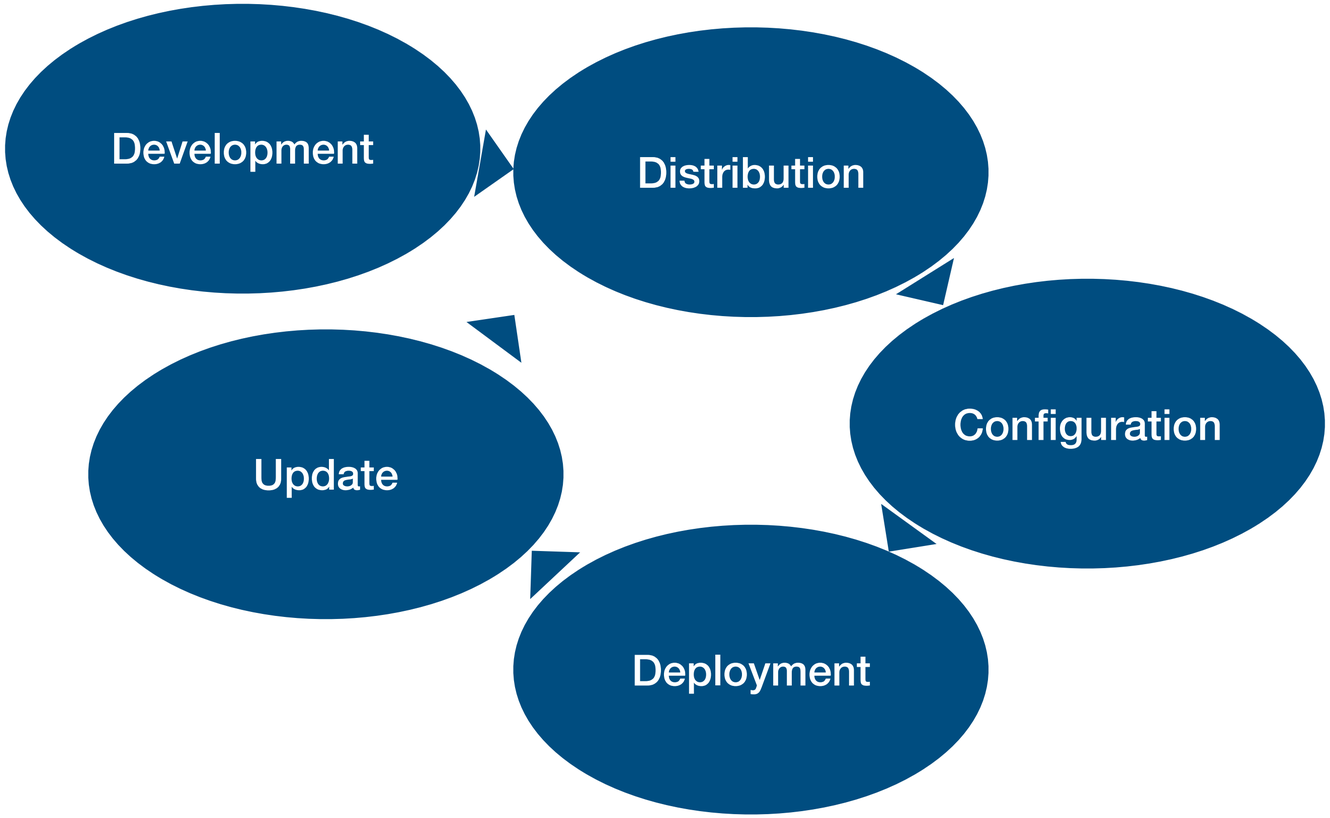
How to achieve Security-by-Design?

Distributed Smart 2pace Orchestration System

Two approaches

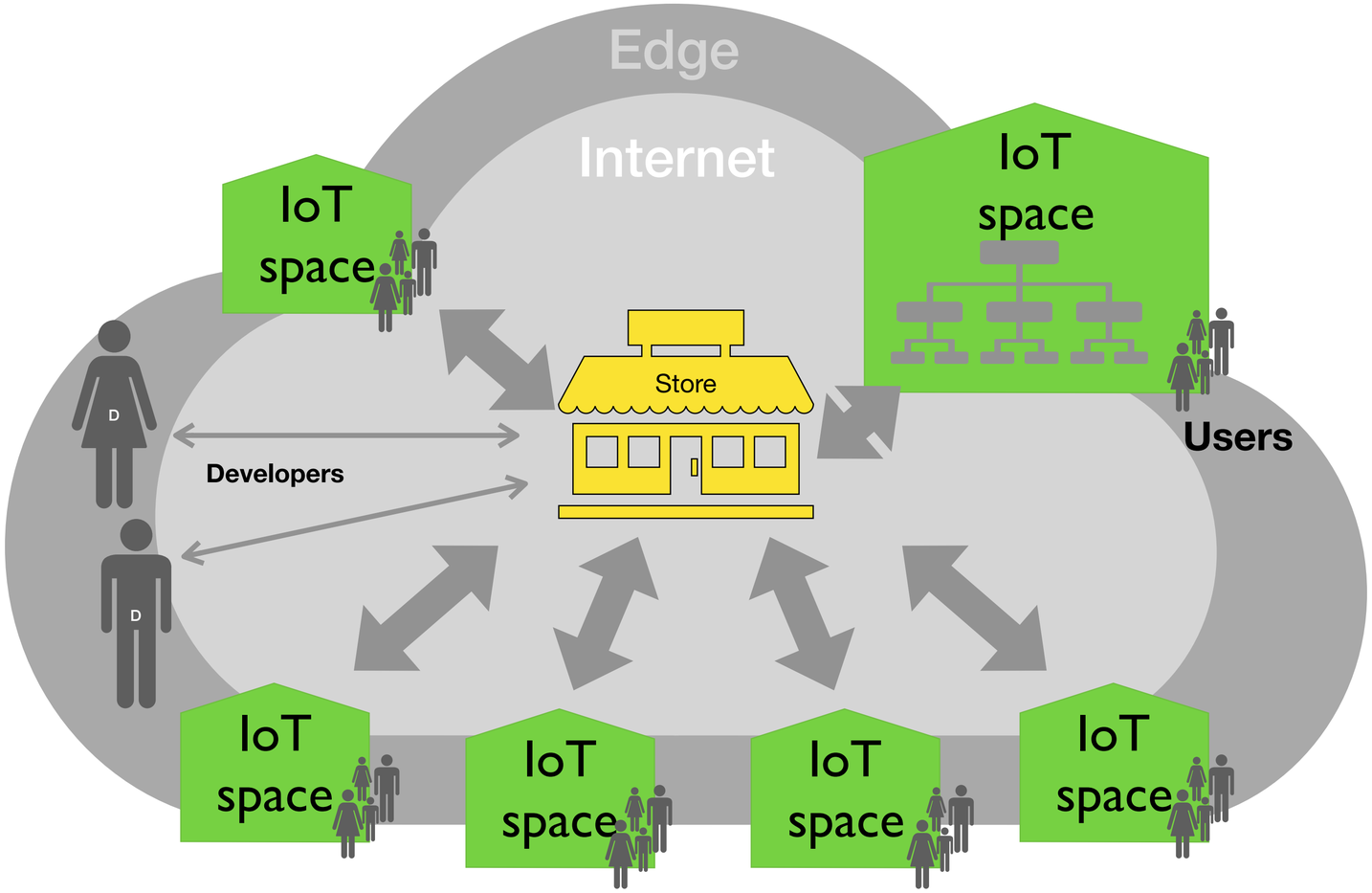
1. Handling security in the middle in a non-circumventable way
2. Retrofitting Security

For me everything is a service



Distributed Smart 2pace Orchestration System

“Crowdsourced” Development

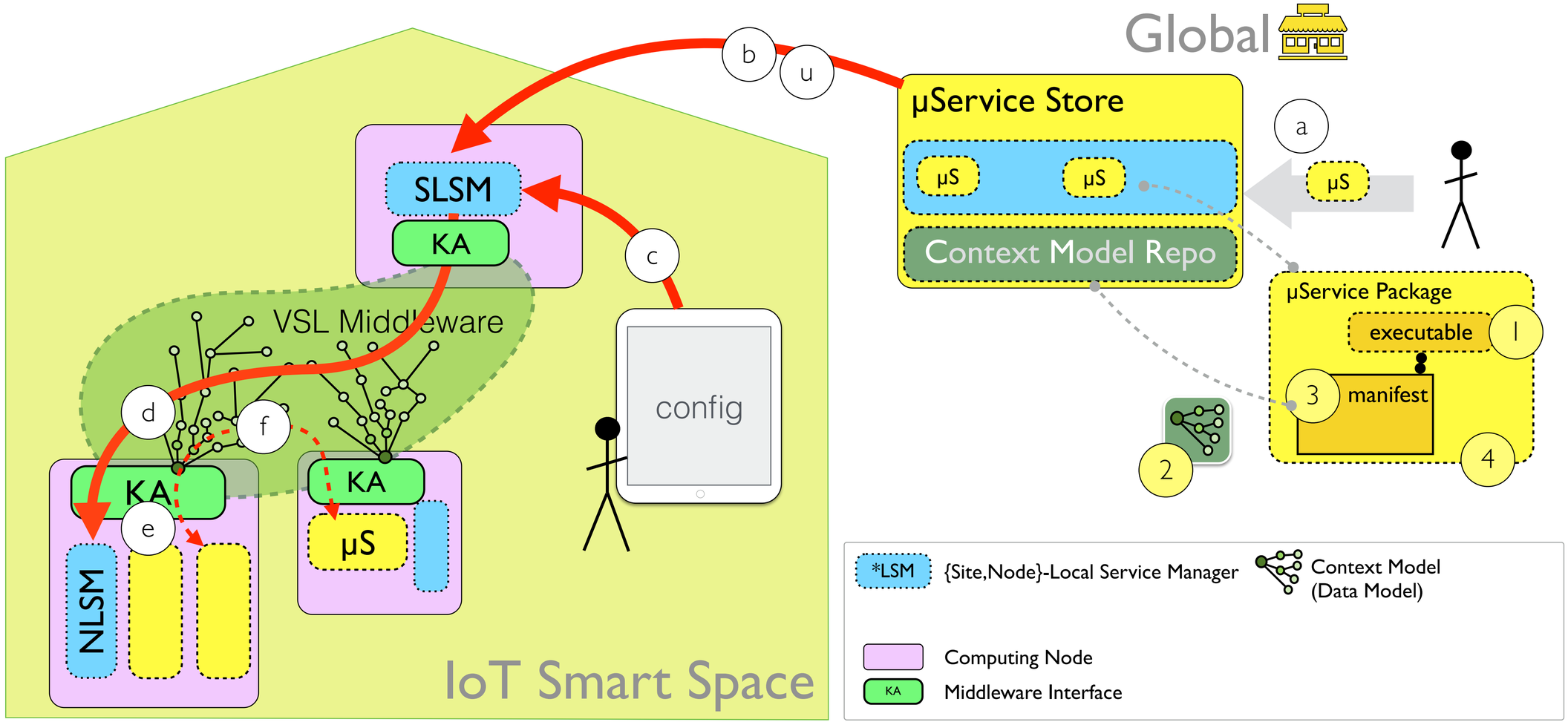


Distributed Smart 2pace Orchestration System

1. Handling security in the middle in a non-circumventable way

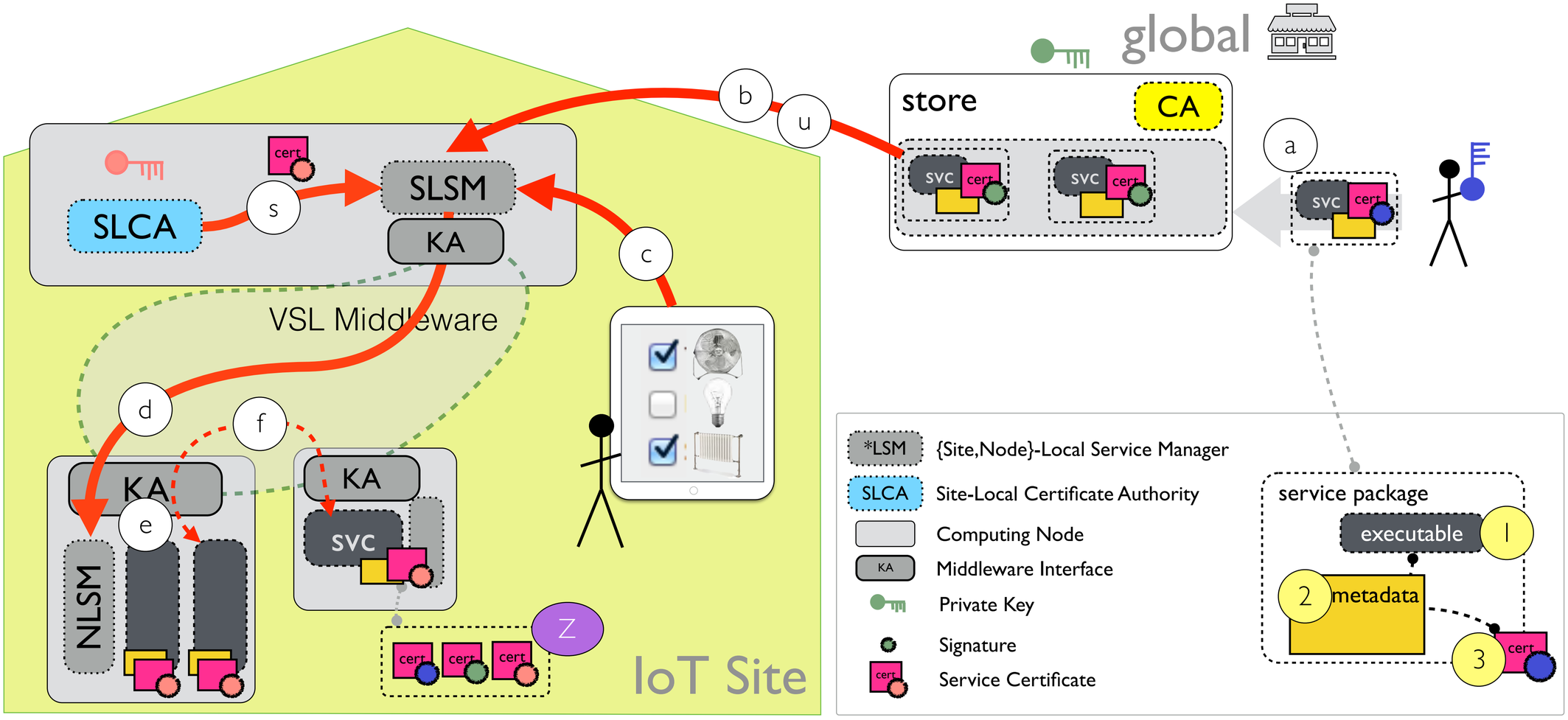
Distributed Smart 2pace Orchestration System

Distributed Smart Space Orchestration System



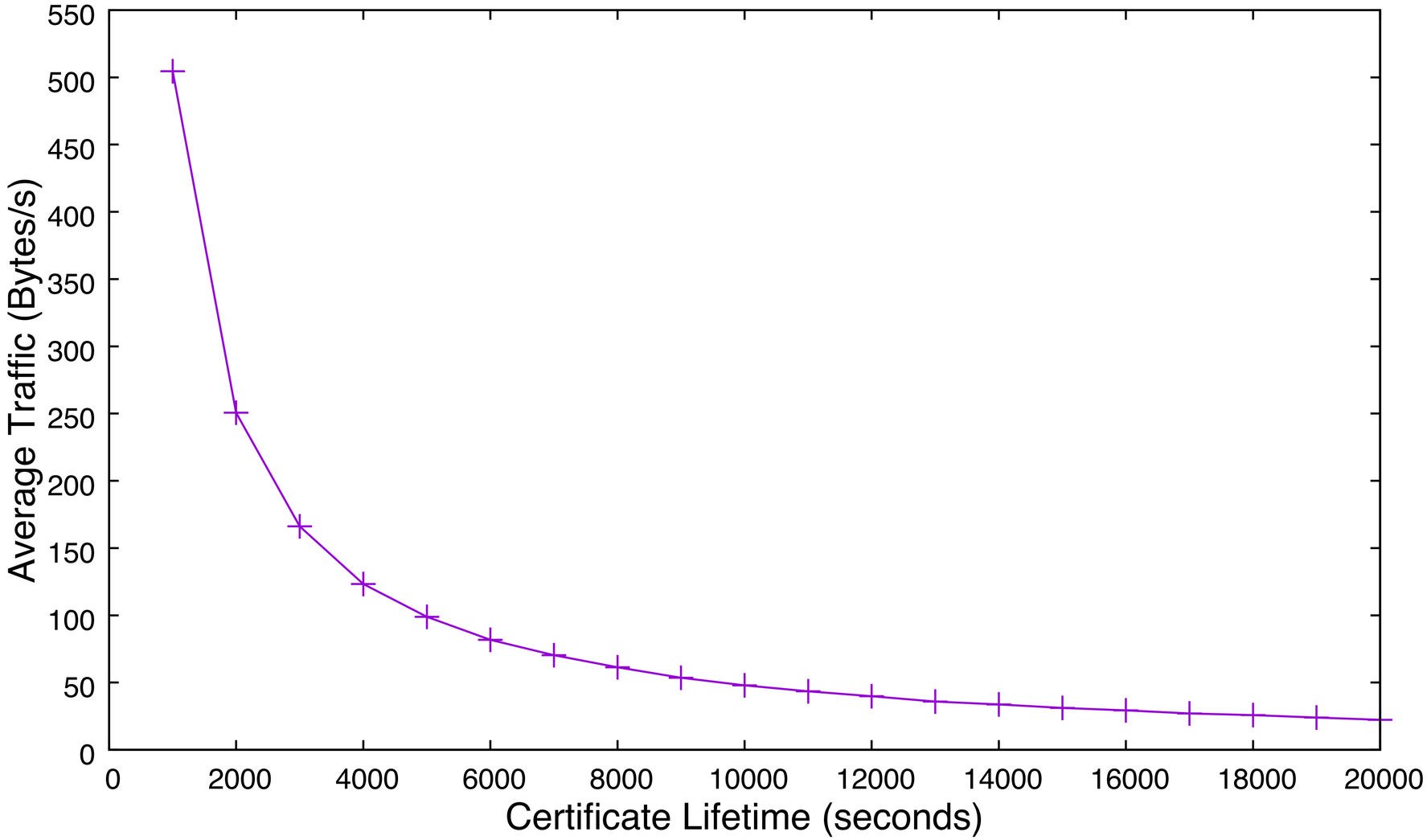
Distributed Smart 2pace Orchestration System

Distributed Smart Space Orchestration System

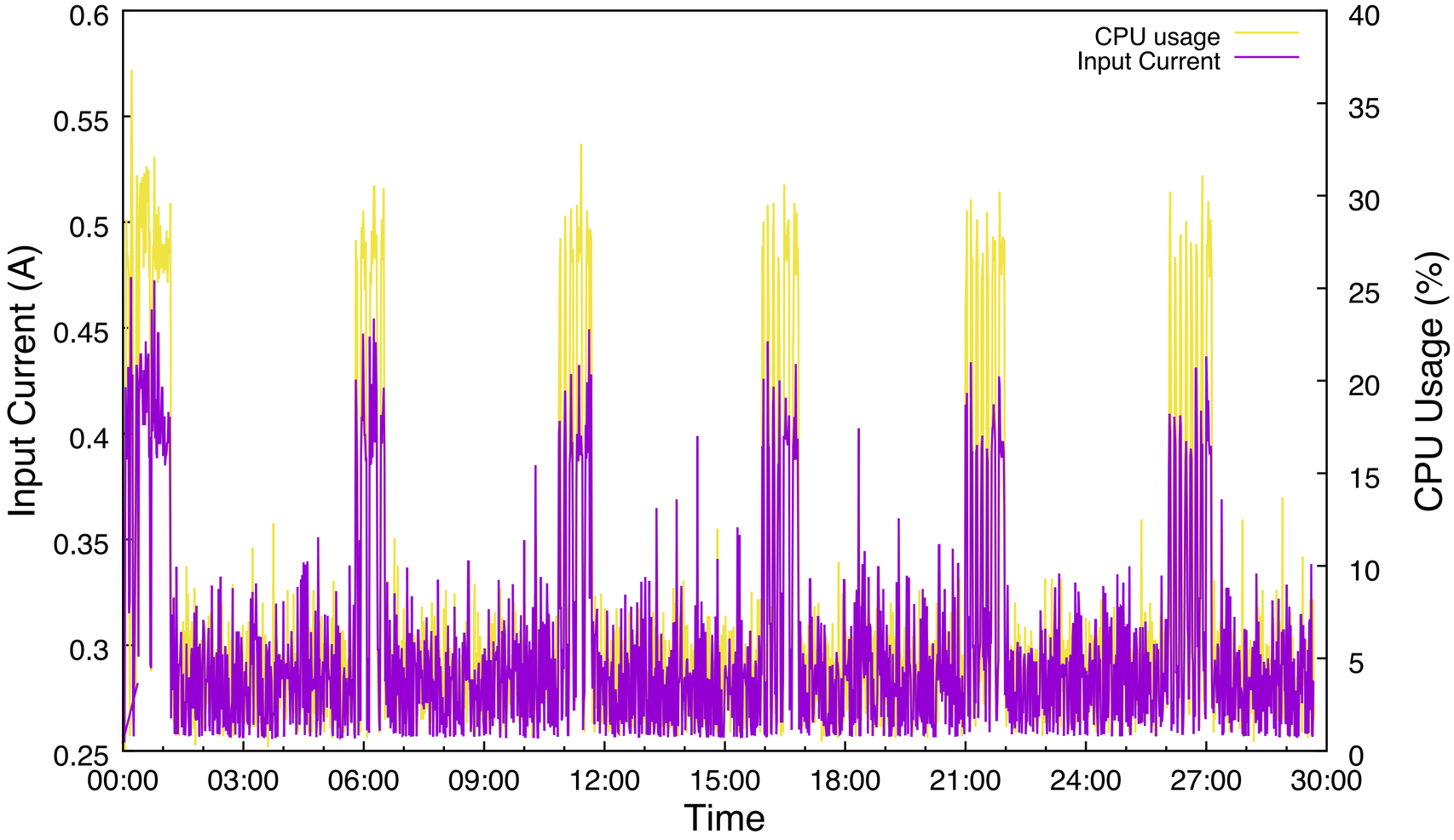


Distributed Smart 2pace Orchestration System

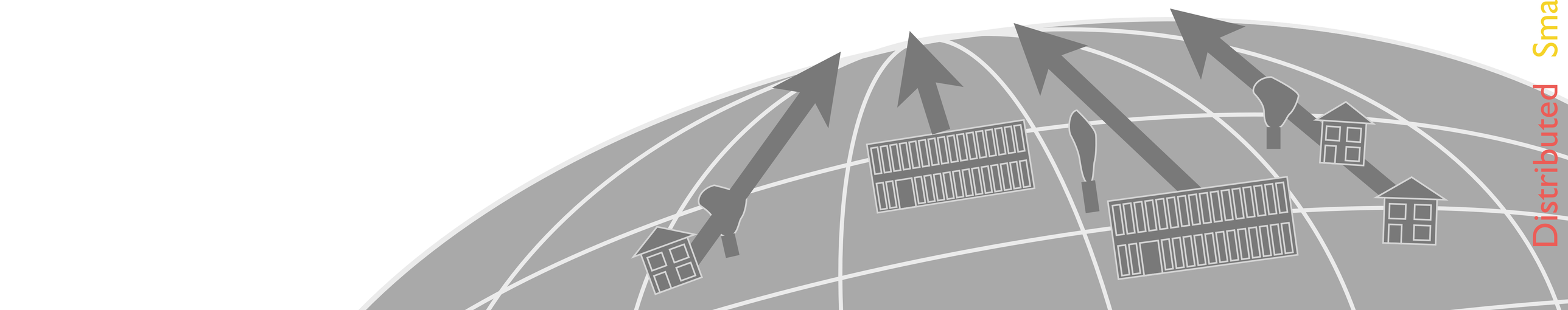
Distributed Revocation via Short Lifetime Certificates and fully automated Renewal



Costs: Energy



2. Retrofitting Security

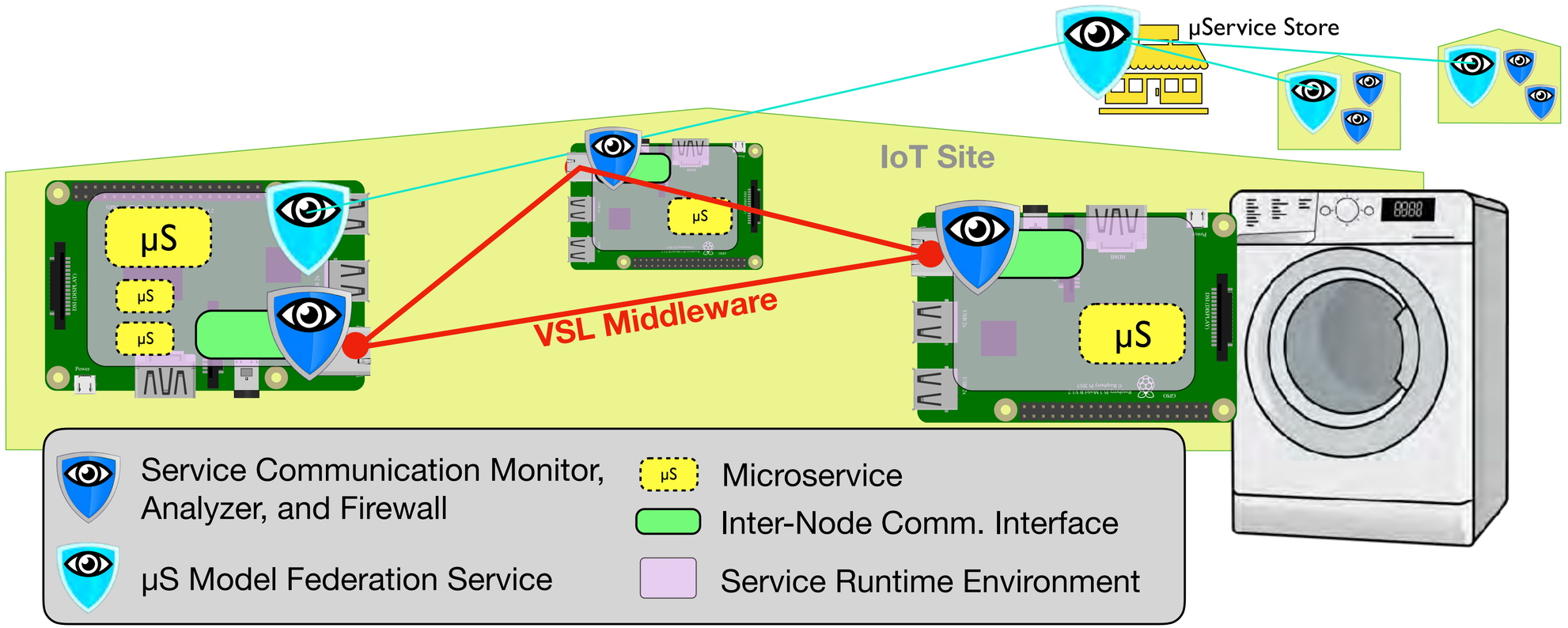


Distributed Smart 2pace Orchestration System

Approach in a 

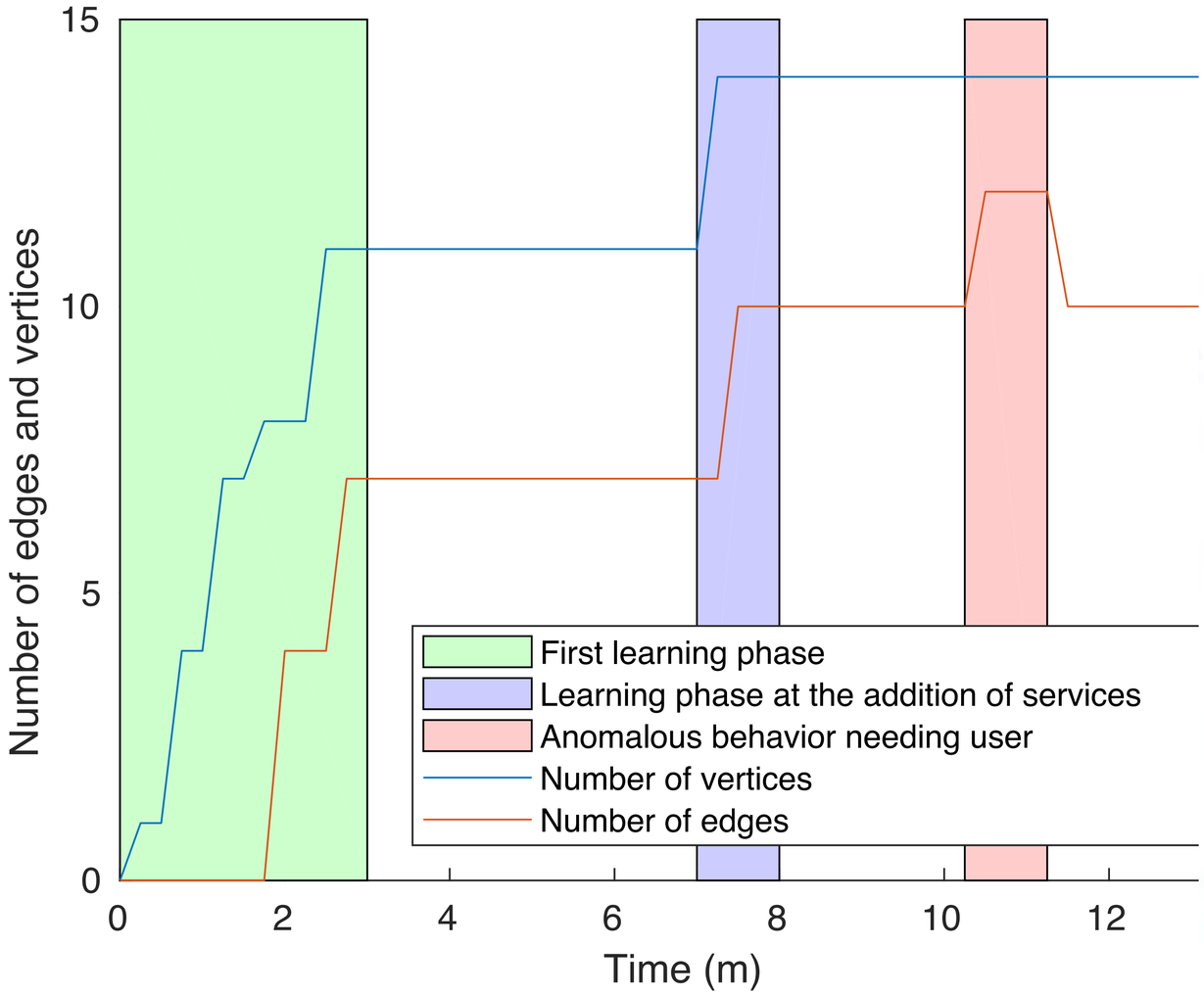
- Blackbox assumption
- Passive traffic monitoring
- Behavior modeling
- Anomaly detection
- Firewalling

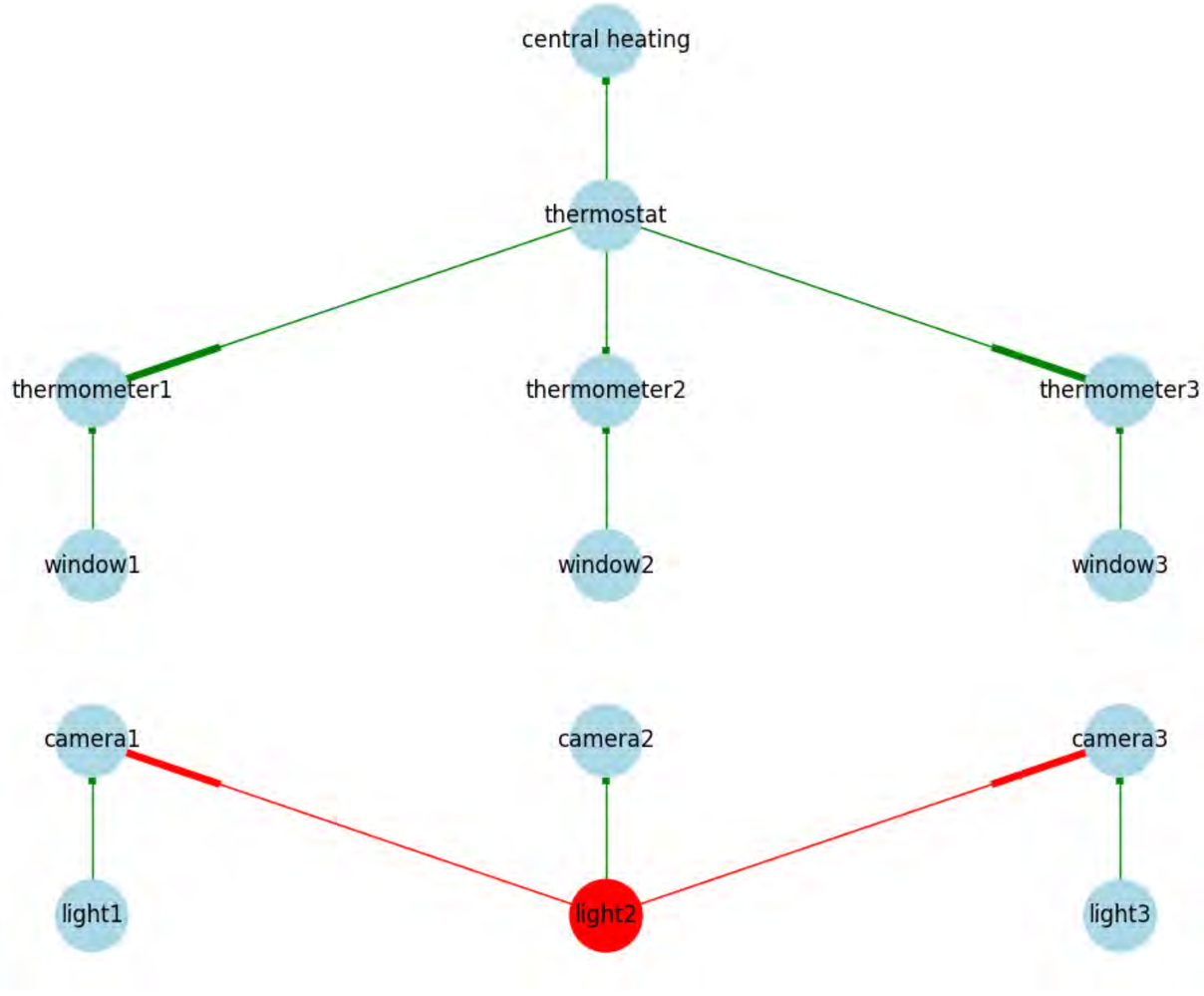
Approach



Distributed Smart 2pace Orchestration System

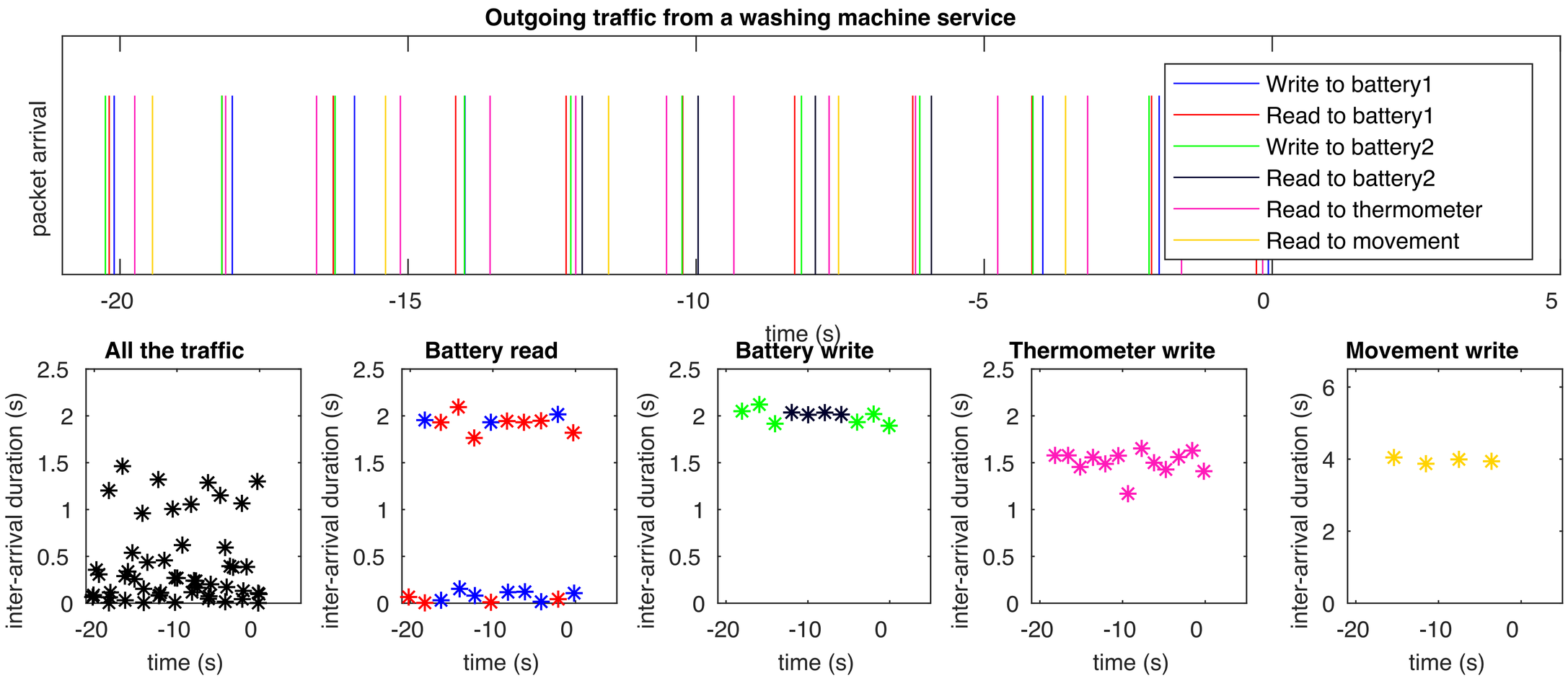
Who talks to whom?



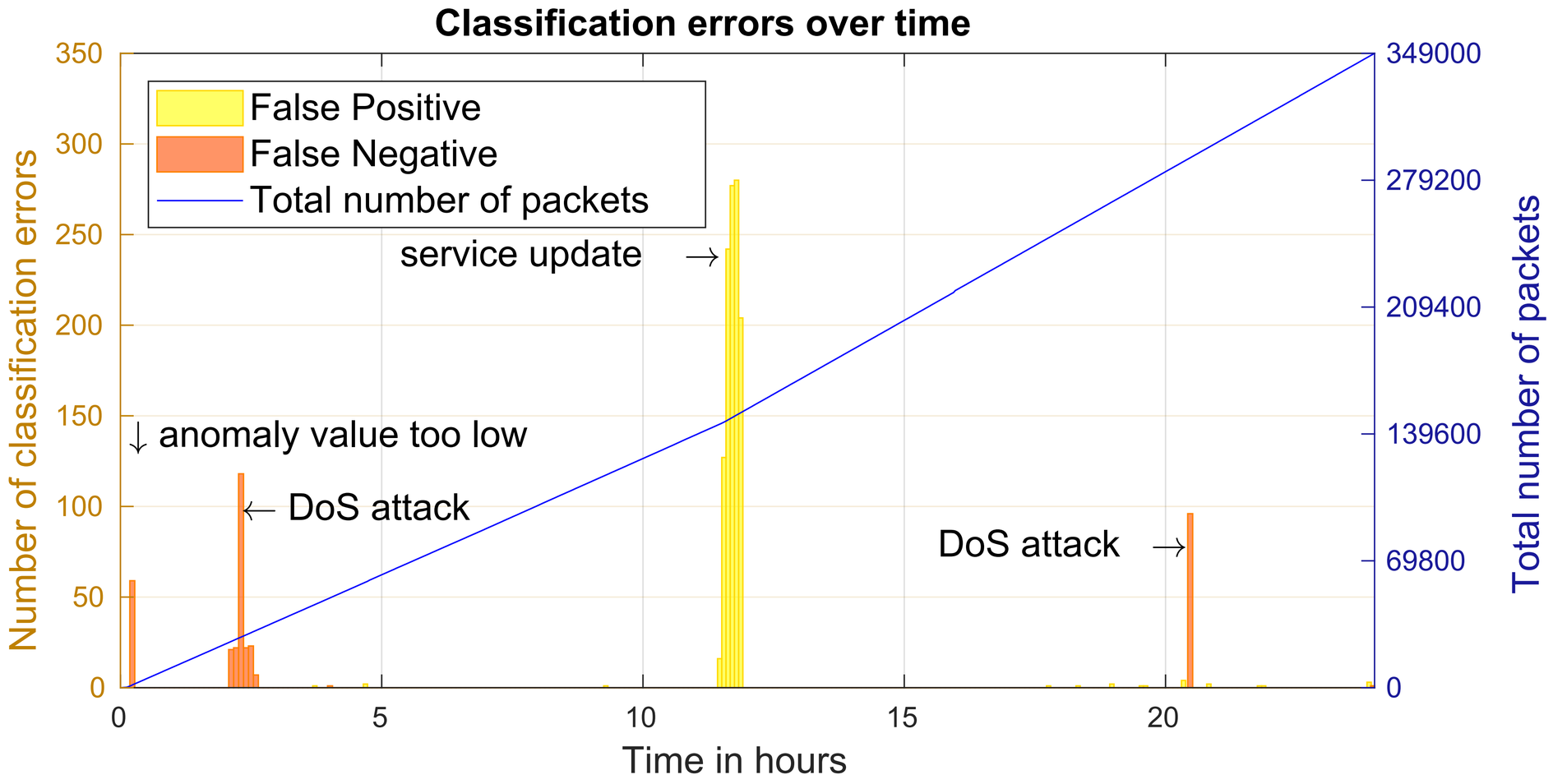


System Orchestration 2pace Smart Distributed

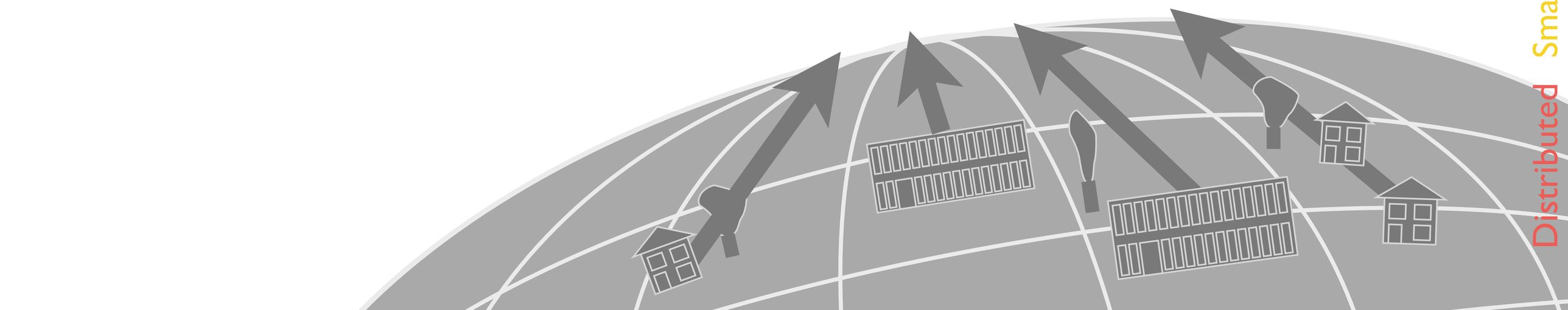
Clustering Periodicities



Quality

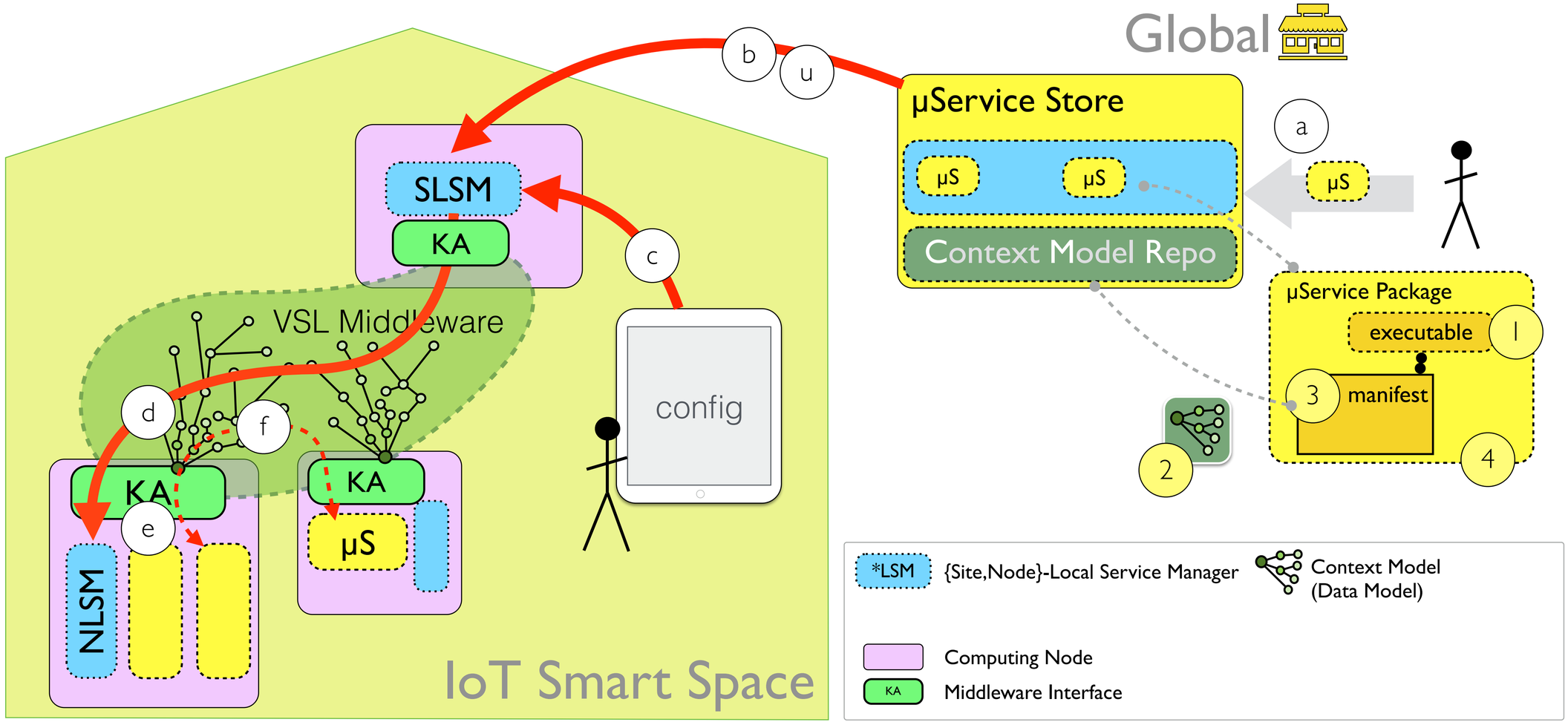


Summary



Distributed Smart 2pace Orchestration System

Distributed Smart Space Orchestration System



Distributed Smart 2pace Orchestration System

[1] M.-O. Pahl and F.-X. Aubet, “All Eyes on You: Distributed Multi-Dimensional IoT Microservice Anomaly Detection,” presented at the 2018 14th International Conference on Network and Service Management (CNSM) (CNSM 2018), Rome, Italy, 2018.

[2] M.-O. Pahl and L. Donini, “Securing IoT Microservices with Certificates,” presented at the Network Operations and Management Symposium (NOMS), 2018.

[3] M.-O. Pahl and M. Loipfinger, “Machine Learning as a Reusable Microservice,” presented at the Network Operations and Management Symposium (NOMS), 2018.

[4] M.-O. Pahl, F.-X. Aubet, and S. Liebald, “Graph-Based IoT Microservice Security,” presented at the Network Operations and Management Symposium (NOMS), 2018.

[5] F.-X. Aubet, M.-O. Pahl, S. Liebald, and M. R. Norouzian, “Graph-based Anomaly Detection for IoT Microservices,” presented at the Passive and Active Measurement Conference (PAM), 2018.

[6] M.-O. Pahl, G. Carle, and G. Klinker, “Distributed Smart Space Orchestration,” presented at the Network Operations and Management Symposium 2016 (NOMS 2016) - Dissertation Digest, 2016.

[7] M.-O. Pahl, “Data-Centric Service-Oriented Management of Things,” presented at the Integrated Network Management (IM), 2015 IFIP/IEEE International Symposium on, Ottawa, Canada, 2015, pp. 484–490.

[8] M.-O. Pahl and G. Carle, “Crowdsourced Context-Modeling as Key to Future Smart Spaces,” presented at the Network Operations and Management Symposium 2014 (NOMS 2014), 2014, pp. 1–8.

[9] M.-O. Pahl and G. Carle, “Taking Smart Space Users into the Development Loop: An Architecture for Community Based Software Development for Smart Spaces,” presented at the Proceedings of the 2013 ACM Conference on Pervasive and Ubiquitous Computing Adjunct Publication, New York, NY, USA, 2013, pp. 793–800.

[10] M.-O. Pahl and G. Carle, “The Missing Layer - Virtualizing Smart Spaces,” presented at the 10th IEEE International Workshop on Managing Ubiquitous Communications and Services 2013 (MUCS 2013, PerCom 2013 adjunct), San Diego, USA, 2013, pp. 139–144.

[11] M.-O. Pahl, H. Niedermayer, H. Kinkelin, and G. Carle, “Enabling Sustainable Smart Neighborhoods,” presented at the 3rd IFIP Conference on Sustainable Internet and ICT for Sustainability 2013 (SustainIT 2013), Palermo, Italy, 2013.

[12] M.-O. Pahl, C. Niedermeier, M. Schuster, A. Müller, and G. Carle, “Knowledge-based middleware for future home networks,” presented at the WD'09: Proceedings of the 2nd IFIP conference on Wireless days, Paris, France, 2009.

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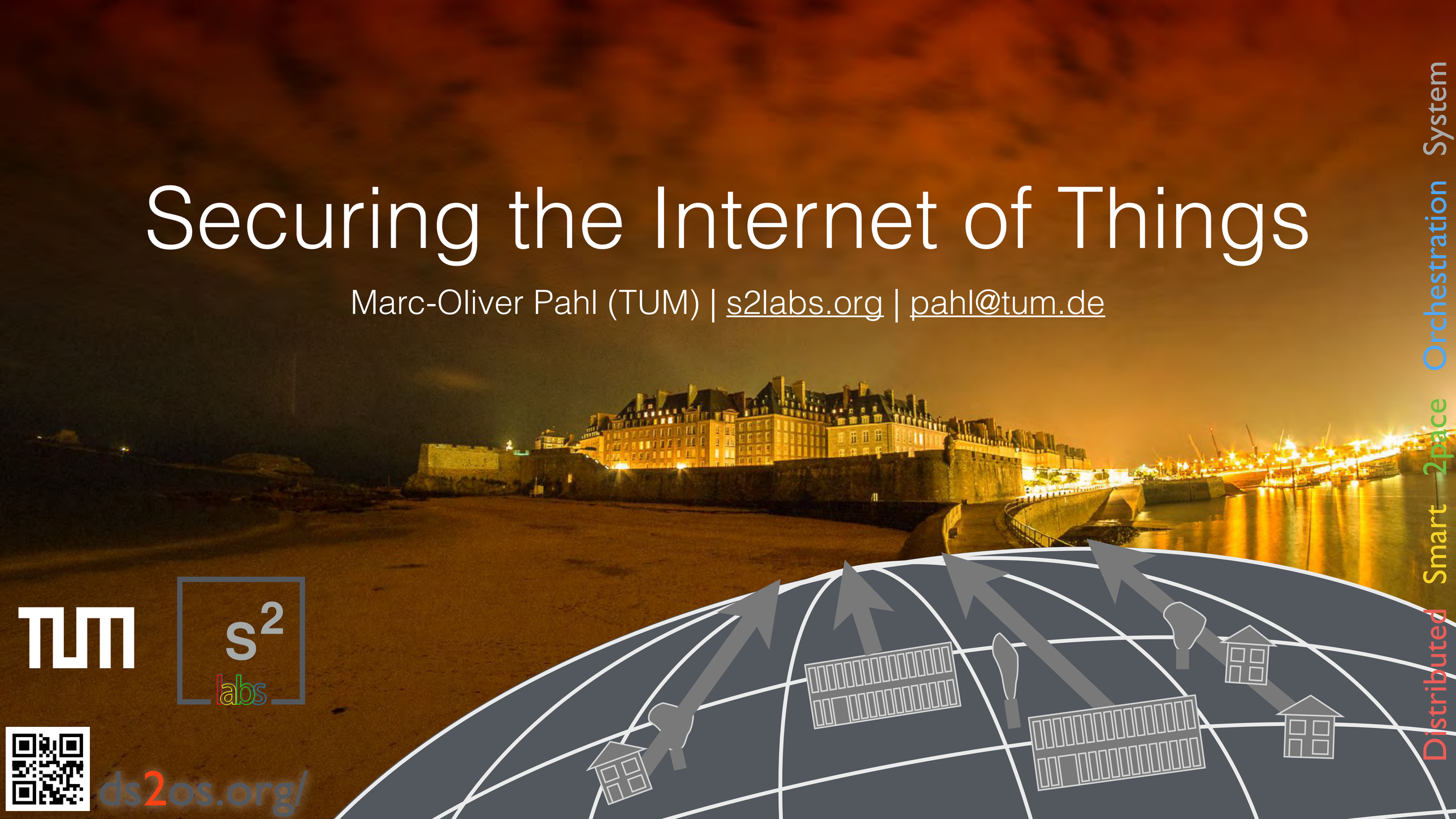

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