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Orienteering in the Fog: an Information Systems perspective

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1st Workshop on
Flexible Advanced Information Systems
FAiSE @ CAiSE '18 - Tallin, Estonia
June, 12th, 2018

Agenda

- Why orienteering in Fog Computing is important
- What is Fog Computing?
- Fog computing in Information Systems
- DITAS: a data-centric perspective in Fog Computing

Why orienteering in Fog Computing is

Orienteering in Fog Computing

An Information Systems perspective

Motivation

Fog computing is a recent (?) hot topic

There are several definitions around!

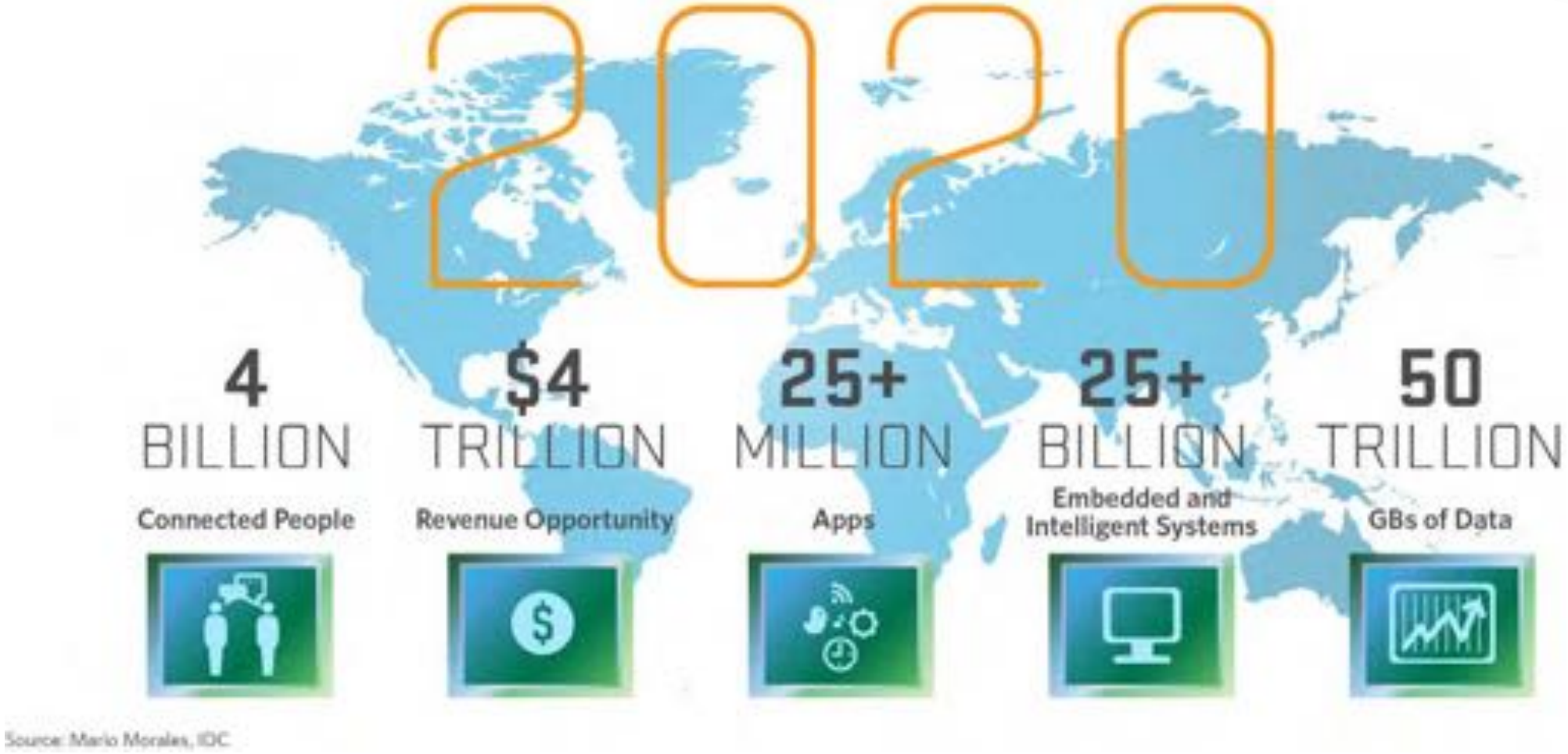
Application of Fog Computing is relevant in several domains

- Embedded systems
- Data analytics
- Software engineering

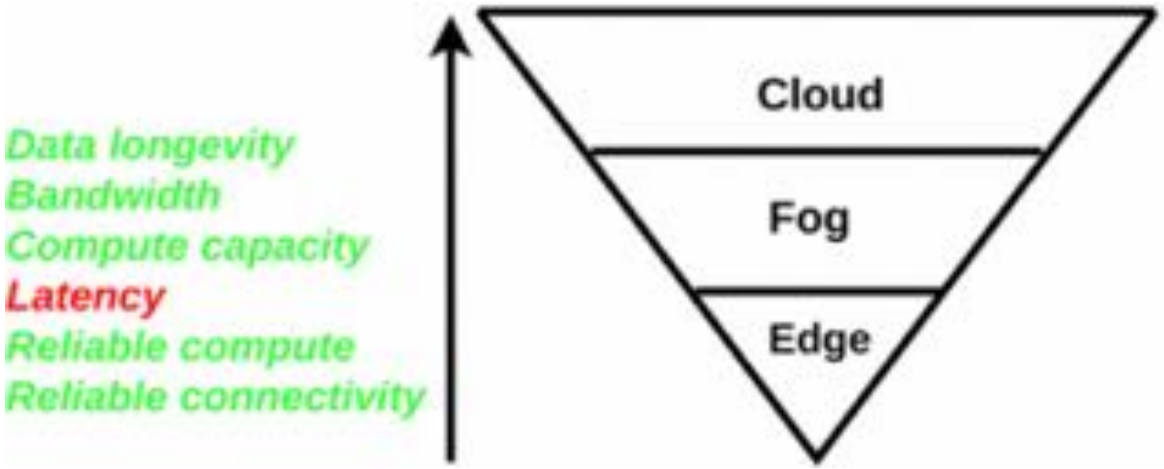
What about Information Systems?

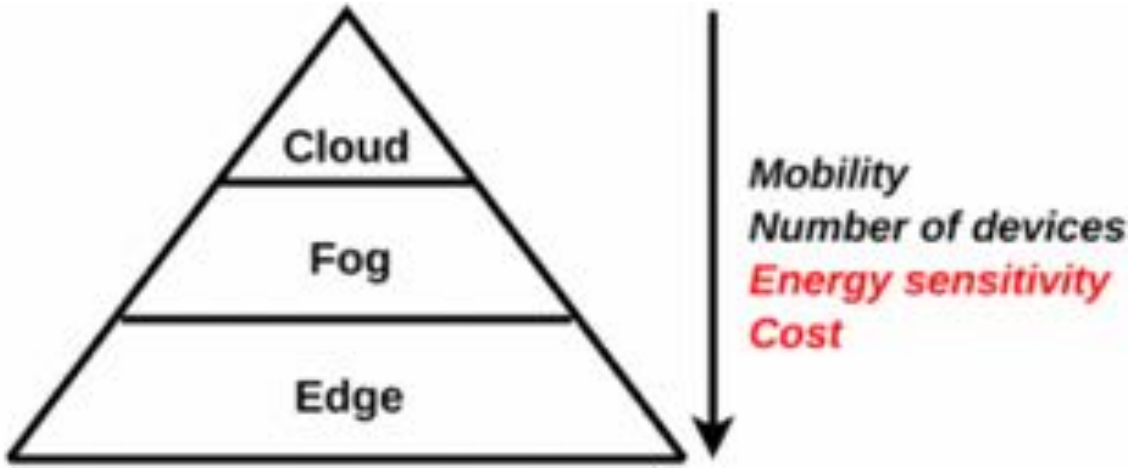
Why all this interest?

IMPORTANT



Why all this interest?





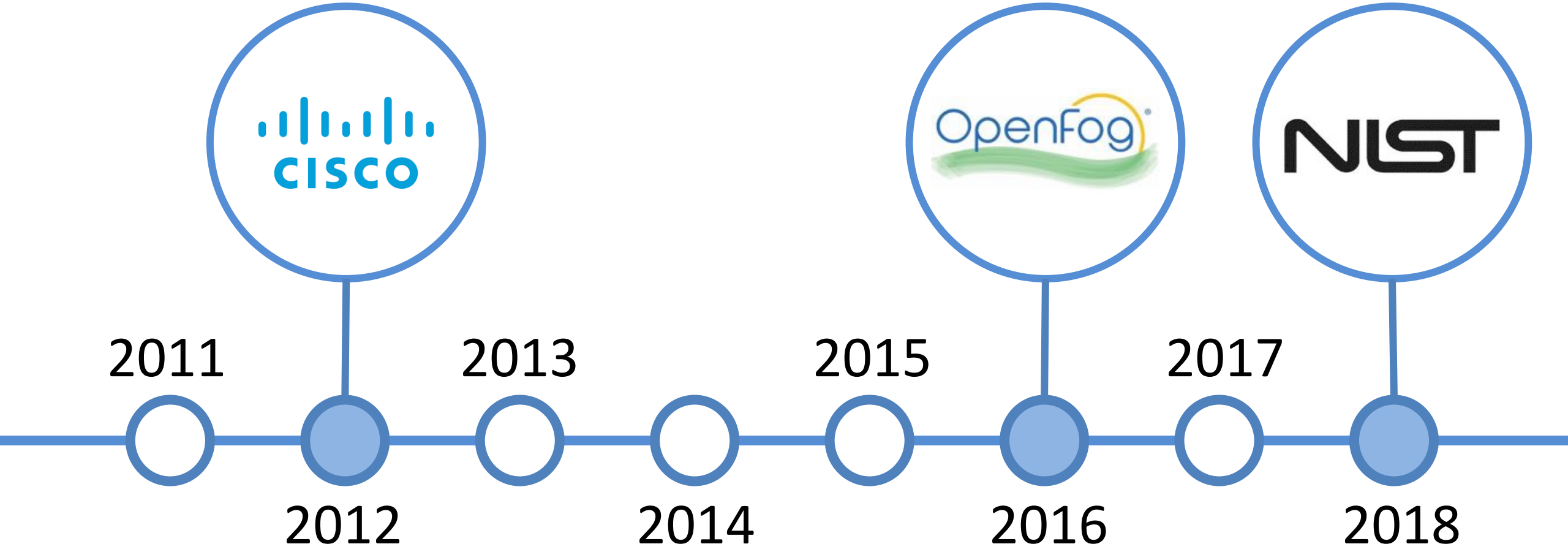
P. Varshney and Y. Simmhan , Demystifying Fog Computing: Characterizing Architectures, Applications and Abstractions , IEEE 1st International Conference on Fog and Edge Computing (ICFEC), 2017

What is Fog Computing

Orienteering in Fog Computing

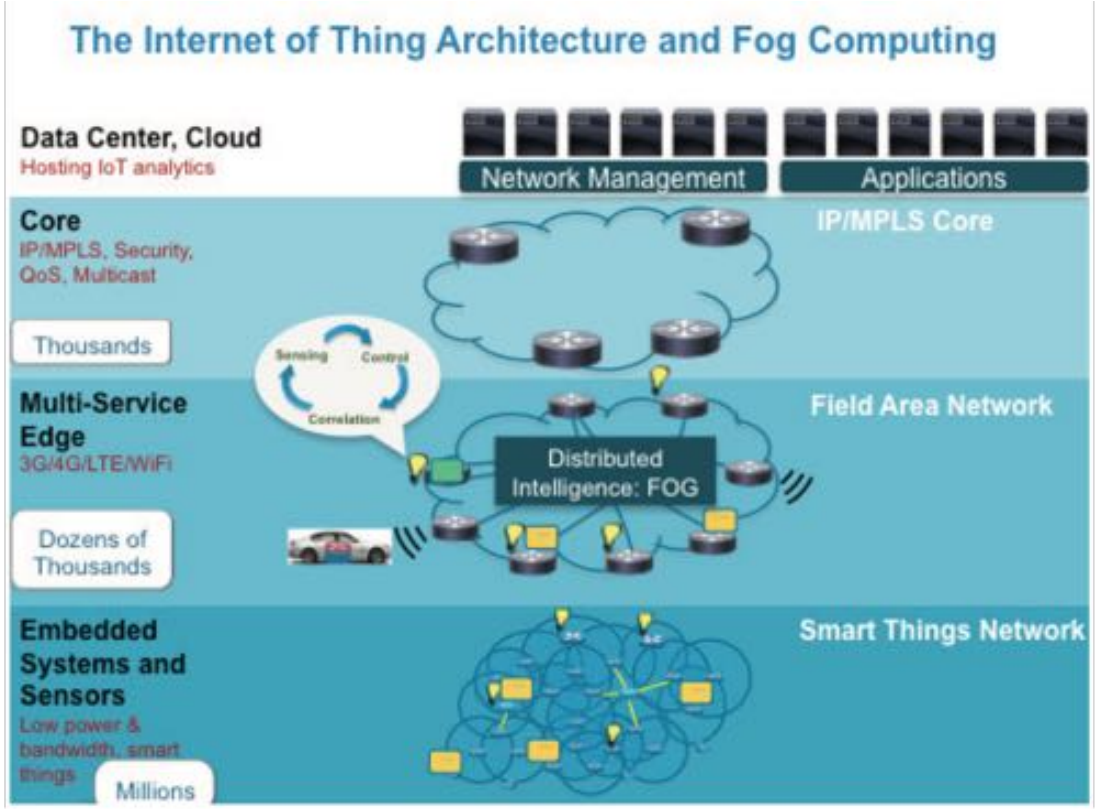
An Information Systems perspective

Timeline



The CISCO definition

"Fog Computing is a **highly virtualized** platform that provides **compute, storage, and networking services** between end devices and traditional Cloud Computing Data Centers, typically, but not exclusively located at the edge of network."



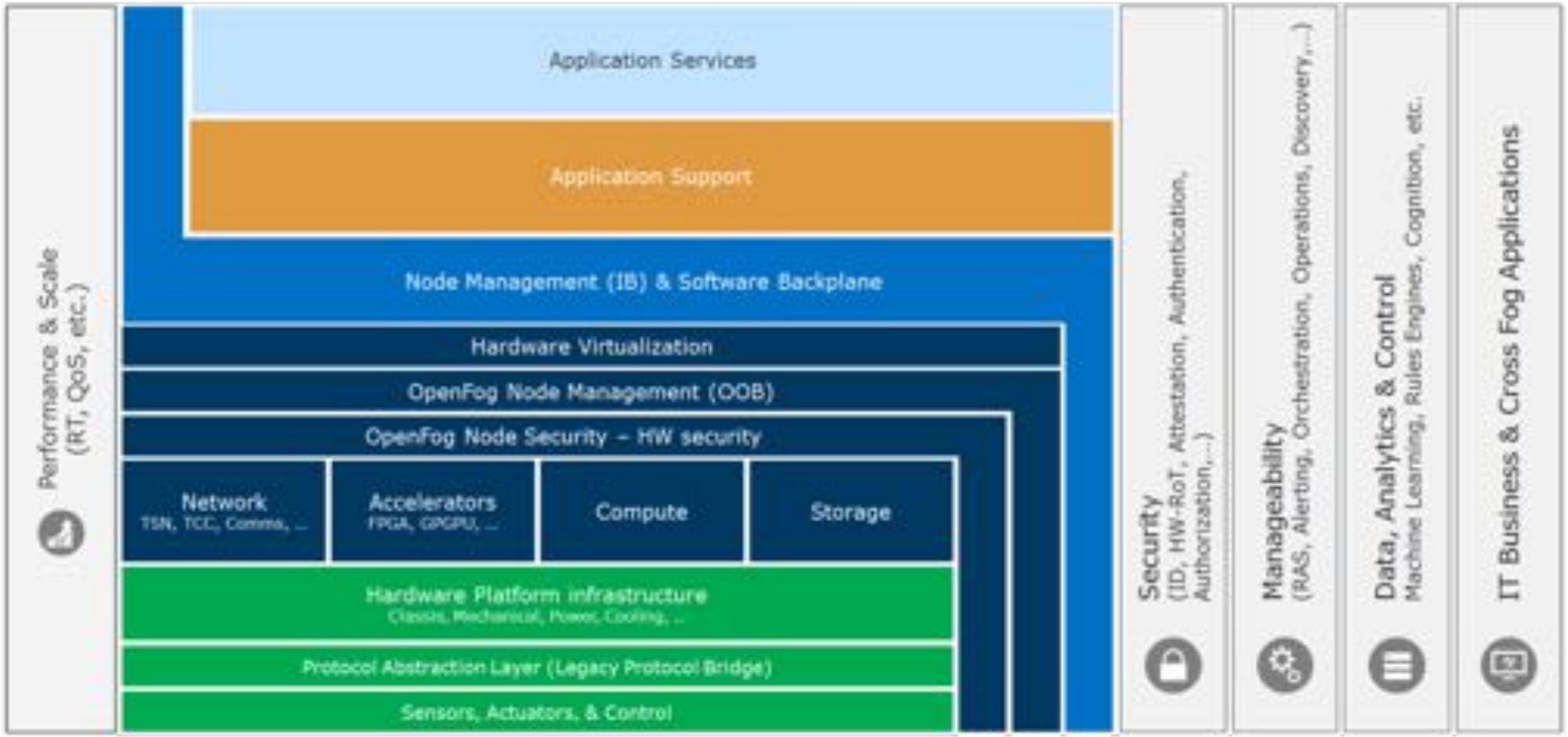
Bonomi, F., Milito, R., Zhu, J., Addepalli, S.: Fog computing and its role in the internet of things. In: Proceedings of the First Edition of the MCC Workshop on Mobile Cloud Computing. pp. 13–16. MCC '12 (2012)

The OpenFog definition

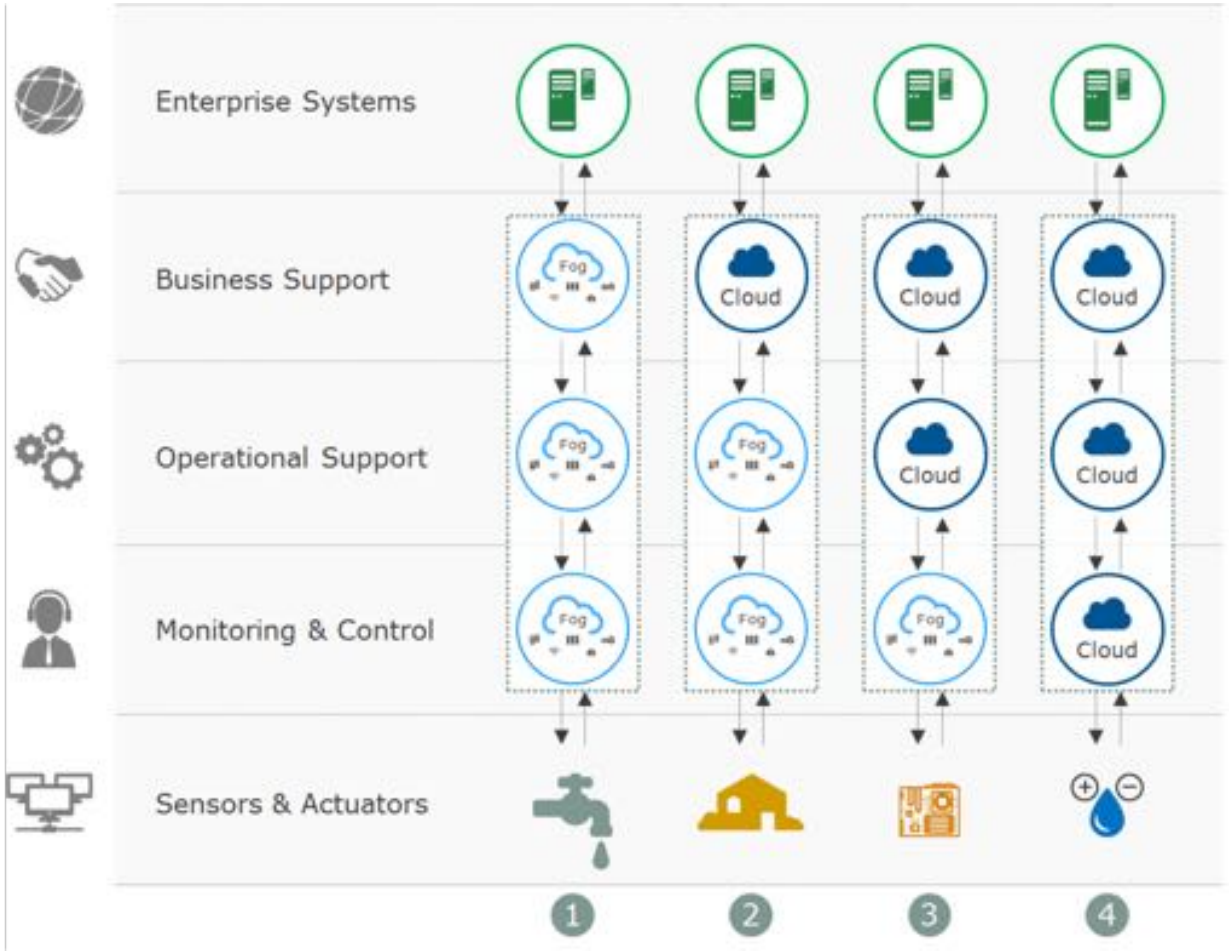
A **horizontal, system-level architecture** that distributes computing, storage, control and networking functions closer to the users along a **cloud-to-thing continuum**

OpenFog Consortium, OpenFog Reference Architecture for Fog Computing, February 2017
https://www.openfogconsortium.org/ra

The OpenFog definition

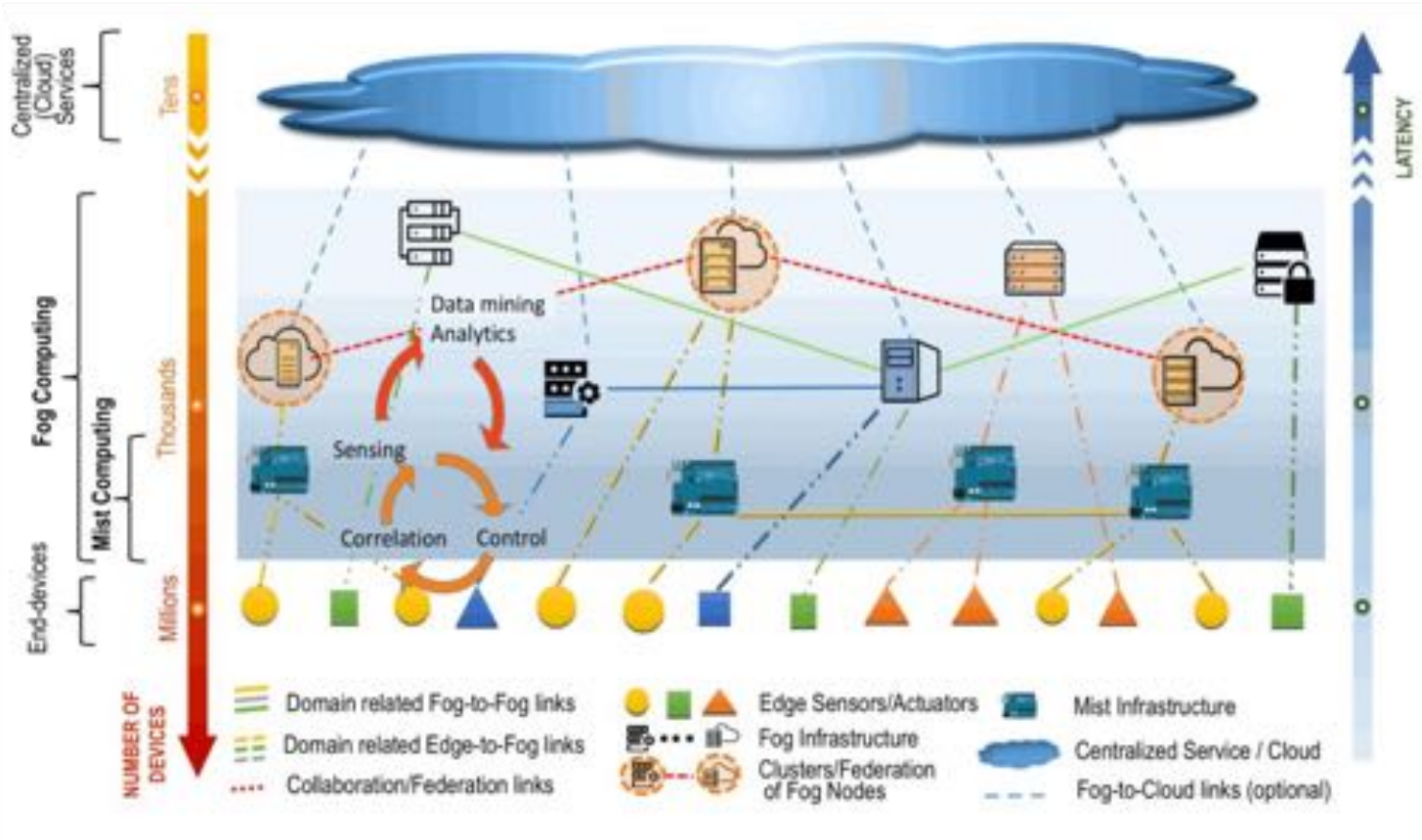


The OpenFog definition



The NIST definition

Layered model for enabling ubiquitous access to a shared continuum of **scalable computing resources** to minimize the request-response time from/to supported applications, and provides, for the end-devices, local computing resources and, **when needed, network connectivity to centralized services**



Summarizing

- Fog is **not** Edge
- Fog works **with** the cloud
- Fog **extends the cloud** and the cloud technologies can be adopted (virtualization, containerization, orchestration)
- **Fog node** is the elementary computational/storage/communication node

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Fog Computing in Information Systems

Orienteering in Fog Computing

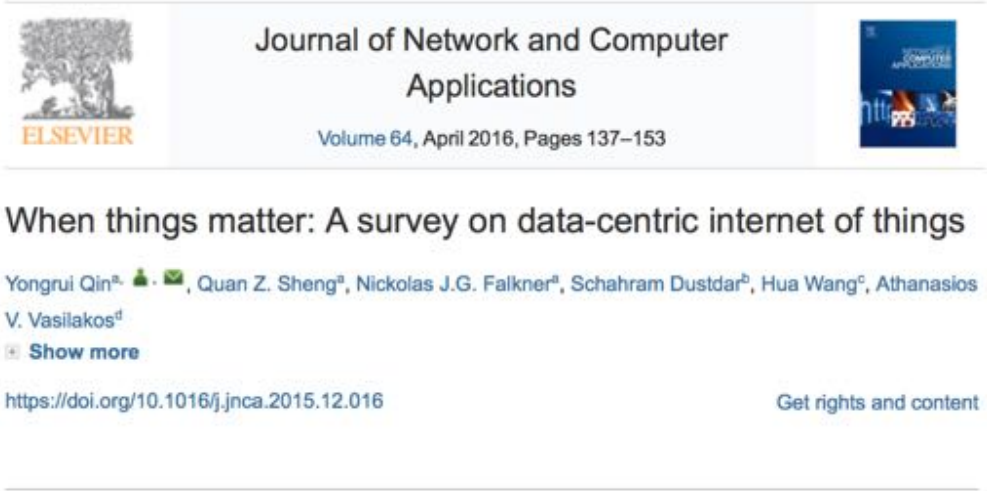
An Information Systems perspective

Relevance of Fog Compuring

- When data are managed by
  - IoT
  - Mobile
  - Wearables (IoT+mobile)
  - Prosumers

- When applications need to be integrated with
  - Data produced by (see above)
  - Processes drives the integration

Data perspective of IoT



- Service viewpoint provided by things, IoT means:
  - "a world where things can automatically communicate to computers and each other providing services to the benefit of the human kind" (CASAGRAS, 2000)
- Connectivity viewpoint:
  - "from anytime, anyplace connectivity for anyone, we will now have connectivity for anything" (ITU, 2005).
- Communication viewpoint:
  - "a world-wide network of interconnected objects uniquely addressable, based on standard communication protocols" (INFSO, 2008).
- Networking viewpoint:
  - Internet evolved "from a network of interconnected computers to a network of interconnected objects" (European Commission, 2009)

IoT Data Taxonomy

Journal of Network and Computer Applications
Volume 64, April 2016, Pages 137–153

When things matter: A survey on data-centric internet of things

Yongrui Qin[a], Quan Z. Sheng[a], Nickolas J.G. Falkner[a], Schahram Dustdar[b], Hua Wang[c], Athanasios V. Vasilakos[d]

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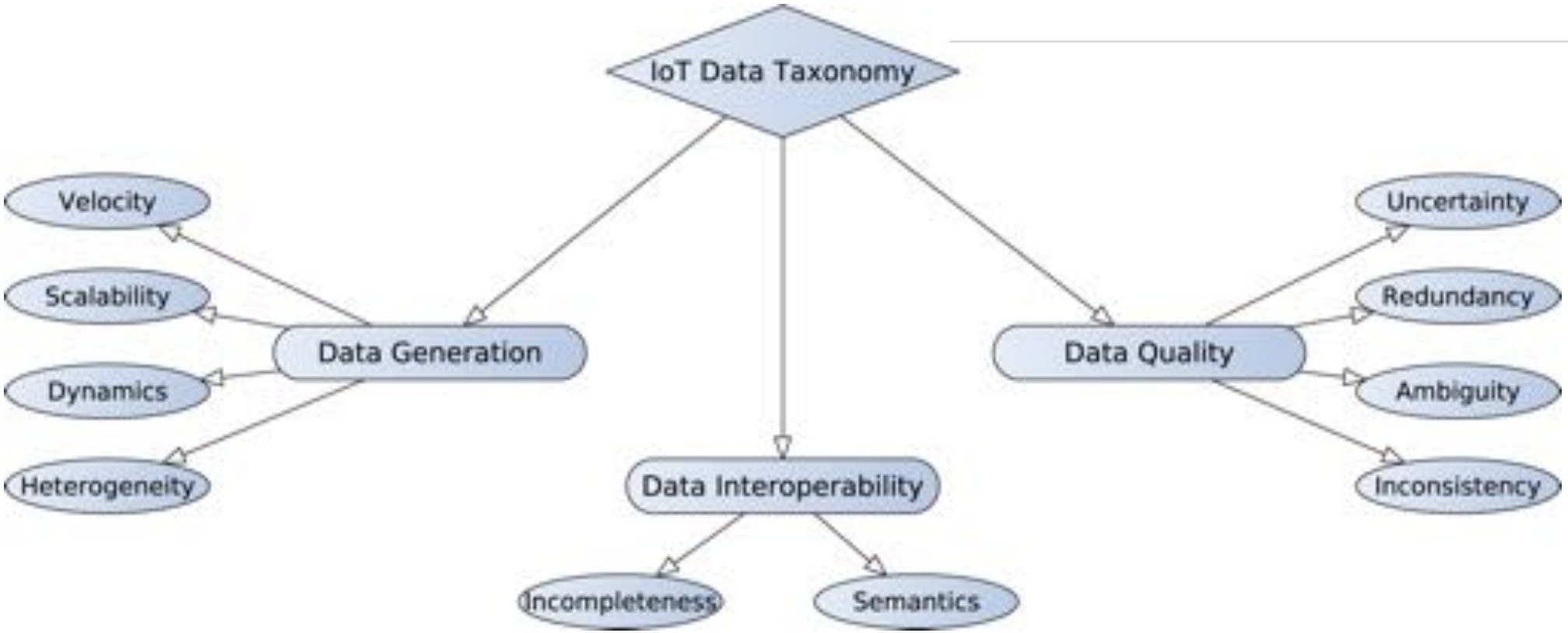
https://doi.org/10.1016/j.jnca.2015.12.016



Industry 4.0

Issues:

- Heterogeneity
- Real time
- Management
- Security/privacy

Mobile

- Mobile Cloud Computing
  - Extension of the Cloud
  - Cloudlets
- Mobile Edge Computing
  - Extension of the Edge
  - Edge servers and network based stations to operate together

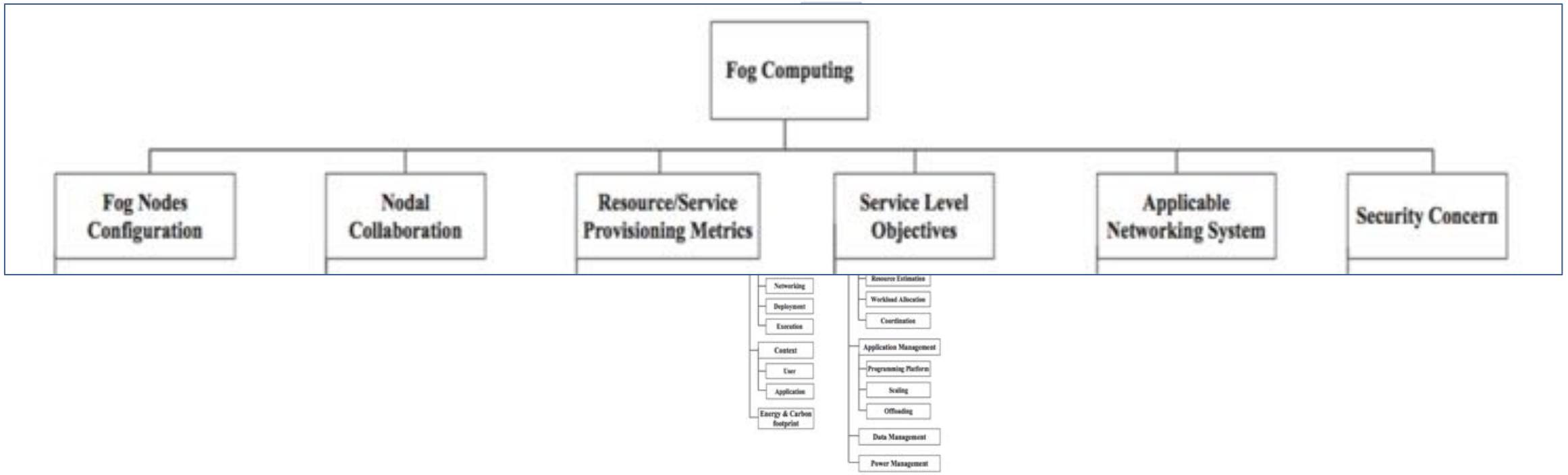
Taxonomy of the literature on Fog Computing

Internet of Everything pp 103-130 | Cite as

Fog Computing: A Taxonomy, Survey and Future Directions

Authors | Authors and affiliations

Redowan Mahmud ✉, Ramamohanarao Kotagiri, Rajkumar Buyya



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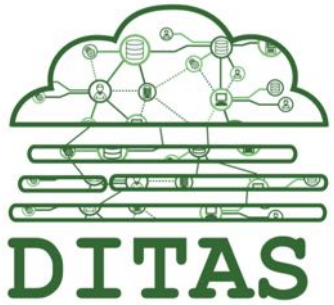


A data-centric perspective in Fog Computing

Orienteering in Fog Computing

An Information Systems perspective

Horizon 2020 research and innovation programme
under grant agreement RIA 687584

www.ditas-project.eu

@DITASproject

DITAS

Data-intensive applications Improvement by moving daTA and computation in mixed cloud/fog environmentS

ATOS (SPAIN)

IK4-IDEKO (SPAIN)

POLIMI (ITALY)

TECHNISCHE UNIVERSITAET BERLIN (GERMANY)

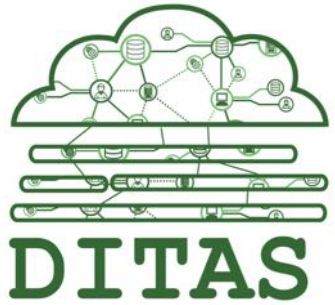
CLOUDSIGMA (SWITZERLAND)

ICCS (GREECE)

IBM (ISRAEL)

OSPEDALE SAN RAFFAELE (ITALY)

Goal of DITAS

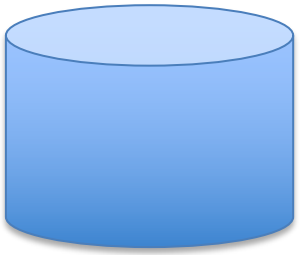


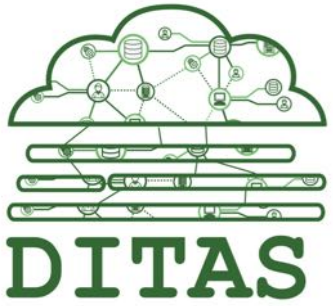
To simplify with an SDK the development of **data-intensive applications…**

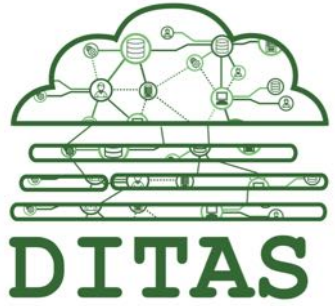
… proposing the concept of **Virtual Data Containers …**

… that take care of data and computation movement in a Fog Computing **execution environment**

Virtual Data Container







For data providers

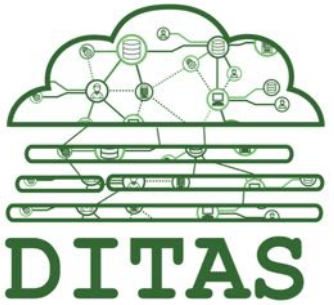
Virtual Data Container offers to solve problems about scalability and movement to achieve a certain QoS level

Virtual Data Container embeds the logic to move data and computation in the Fog architecture

For data consumers

Virtual Data Container offers an abstraction layer hiding the complexity of the edge

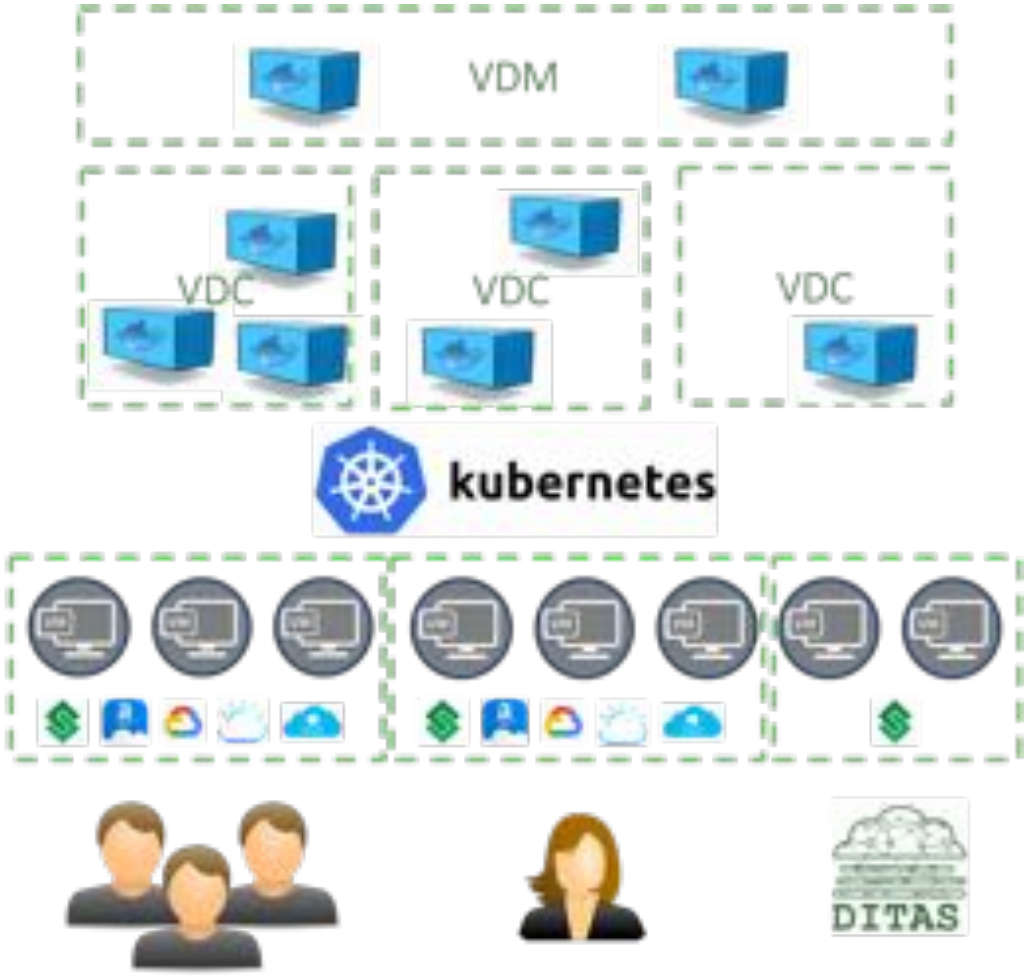
DITAS has been conceived for



- Who has some data and want to make them available **efficiently and efficaciously**
  - Data providers leave to DITAS the burden of make their data available to the consumers
  - Data can be generated on the edge
- Who is looking for some data sources **suitable for their applications**
  - Data consumers can find the most interesting data sources
  - Only needed data are moved to the consumer
  - Privacy is enforced
- Who is looking for a platform that **analyses** data in an efficient way
  - In case the same actor holds both the roles of provider and consumer

DITAS SDK

DITAS Execution Environment



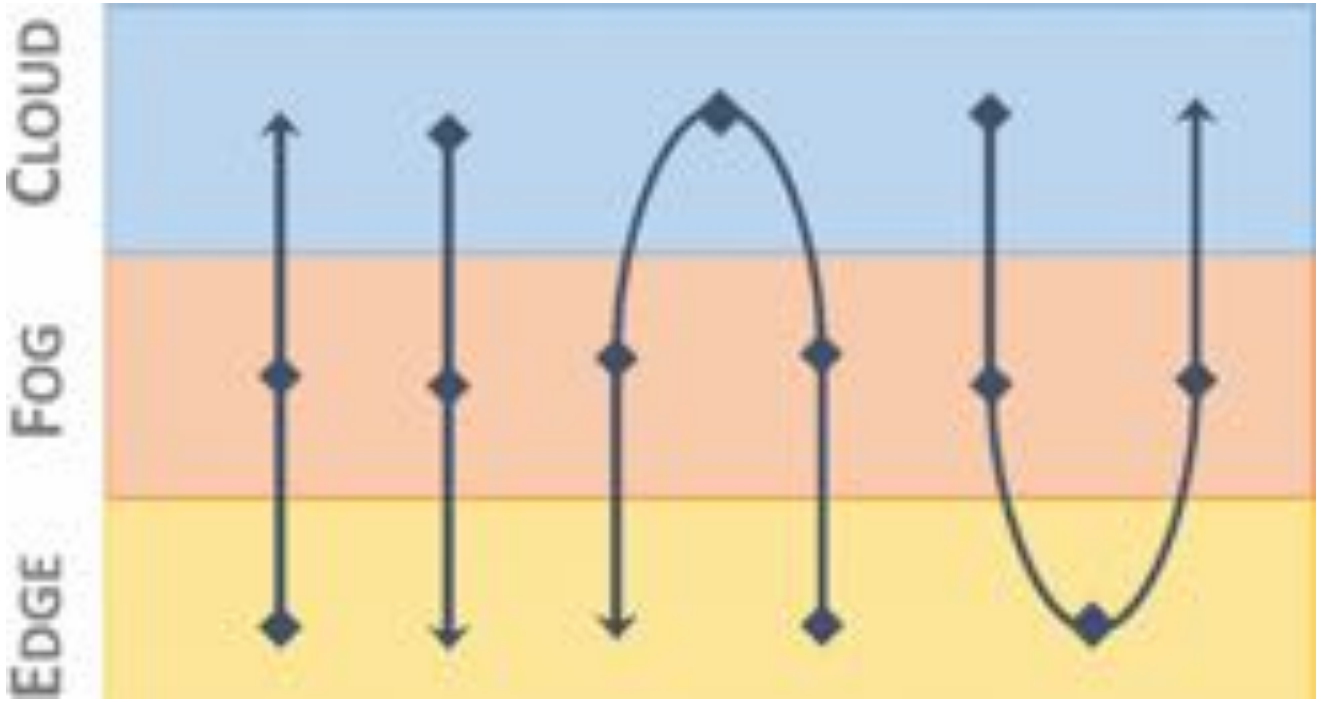
Issues

Browse Conferences > Fog and Edge Computing (ICFEC...

Demystifying Fog Computing: Characterizing Architectures, Applications and Abstractions

View Document | 4 Paper Citations | 474 Full Text Views

2 Author(s) — Prateeksha Varshney ; Yogesh Simmhan



Concluding remarks

- Fog Computing has been investigated in close environments
- Especially in Information Systems, Fog Computing must be considered in a more open environment
- Research challenges are clear
  - From data perspective
  - From service orientation perspective
- Solutions to those challenges are coming (?)
- What about business processes?

Acknowledgments

Additional references

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