Orienteering in the Fog: an Information Systems perspective

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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 important

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?

2020

4 BILLION
Connected People

$4 TRILLION
Revenue Opportunity

25+ MILLION
Apps

25+ BILLION
Embedded and Intelligent Systems

50 TRILLION
GBs of Data

Source: Mario Morales, IDC

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

- 2011: Cisco
- 2013: OpenFog
- 2015: NIST
- 2017:

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“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.”

A horizontal, system-level architecture that distributes computing, storage, control and networking functions closer to the users along a cloud-to-thing continuum.
The definition
The 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
Fog Computing in Information Systems

Orienteering in Fog Computing
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Relevance of Fog Computing

• 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

When things matter: A survey on data-centric internet of things
Yongrui Qin1, Quan Z. Sheng1, Nickolos J.G. Falkner1, Schahram Dustdar2, Hue Wang1, Athanasios V. Vasilakos1

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
A data-centric perspective in Fog Computing

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An Information Systems perspective
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
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?
Additional references


