IoT Edge Computing Discussion @ IETF-98

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IoT Edge Computing Discussion

- Motivation for Edge Computing
- Terminology
- Research Questions
- Discussion

https://github.com/t2trg/2017-ietf98/blob/master/slides/T2TRGEdgeComputing.pdf

Motivation for IoT Edge Computing

When the IoT Data generated is:

- Delay-sensitive
- High-volume
- Trust-sensitive
- (Intermittently) disconnected
- Energy-challenged
- Costly to transmit

Terminology

- **What is the edge**?
  - What is the edge a boundary between?
  - Edge is 1st step to Fog computing (a multi-tiered cloud of clouds) creating multiple edges
- **Edge computing a step toward the DC re-imagined**
  - Moves data center out of confines of back-end cloud
  - Moves cloud functionality closer to network Edge & Things
  - Distributes compute, storage, networking, control, actuation etc.
- **Edge dynamics supports (mobile) edge computing**
  - How dynamically can edges be created?
  - How dynamically do we need to distribute computation, storage, etc.?
- **Edge computing is more than computation on a gateway**
  - Often equated with first-hop gateway in the direction from Things to Cloud
  - An ensemble of resources willing to logically form an“edge cloud”
  - Not limited to specific platforms and execution environments

Research Questions (1/2)

- **Programming models**
  - How would people develop applications that can leverage edge computing?
  - What distributed constructs require support?
  - How to steward, curate, route, cache, process, migrate, archive the edge device data?

- **Networking and operations**
  - Compute function description & discovery
  - Assembly of individual functions into larger blocks, applications & services
  - Orchestration of edge computing systems
  - Managed vs. unmanaged edge computing

Research Questions (2/2)

- **Isolation**
  - How would individual tenants and compute functions be isolated in a decentralized cloud environment?

- **What would be granularity levels for edge compute functions?**
  - Containers
  - Step functions
  - Stateless functions
  - Named Function Networking as in ICN

- **Multi-X**
  - Multi-application, multi-user, multi-tenancy
  - Edge Computing in multi domain networks

Discussion (1/2)

- **Difference between Edge Computing and Data Center Computing**
  - New abstractions and mechanisms for edge computing?
  - Re-use existing cloud service provider APIs?

- **Usability of Edge Computing**
  - How to extend existing eco-system components (e.g., data/meta-data registries) to support?
    - due to increased levels of dynamics, scalability, and group data sharing
  - How to make distributed system interfaces intuitive and consistent?

- **From “Pet” to “Cattle model”**
  - In the presence of ubiquitous, cheap IoT deployments, how carefully should/can Edge Computing deployments be crafted?
  - What are the security and availability implications?

Discussion (2/2)

- **“Rackscale for Edge Computing”**
  - Will there be established models for disaggregating network, storage, compute?
  - Rely on similar automation and operations support functions (infrastructure management, telemetry)?
  - Rely on SDN standards to dynamically configure and reconfigure resource pools?

- **Networking Edge Computing**
  - What comms models best support Edge Computing?
  - How will Edge Computing affect existing protocols?
  - If edge and cloud represent two ends of the spectrum, how to seamlessly evolve toward fog computing?
  - Do/should intra-cloud and inter-cloud communication differ in Edge/Fog computing?
  - Are different technologies needed to support upstream vs downstream data flows?

Other Activities in the Meantime

- IRTF Distributed Internet Infrastructure
  - Decentralizing Internet infrastructure (for IoT, edge computing and other use cases)
  - https://trac.ietf.org/trac/irtf/wiki/blockchain-federation

- Information-Centric Fog Computing Workshop (next slide)
  - Might Information-Centric concepts be helpful (cf. Named Function Networking)?
  - Since ICNs already combine routing with native caching in the network, could they be extended to support processing for data in-flight as well (e.g., at the aggregation points in the reverse data flow paths)?

1st workshop on

Information-Centric Fog Computing

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12 June 2017

http://networking.ifip.org/2017/index.php/workshops/workshop-on-information-centric-fog-computing-icfc/icfc-technical-program

Schedule Overview

Keynote: ***"Information-Centric Networking in Wireless Edge Networks and Beyond"*** **--** Eve Schooler

Session 1: Information Centric Networking and IoT

- *"Edge-ICN and its application to the Internet of Things"*, Nikos Fotiou, Vasilios A. Siris, George Xylomenos, George C. Polyzos, George Petropoulos, Konstantinos V. Katsaros
- *"Observing Resources over ICN*", H. Islam, Dmitrij Lagutin, Nikos Fotiou

Session 2: Computing and Caching at the Edge

- *"Execution State Management in Named Function Networking*", Christopher Scherb, Balázs Faludi, Christian F Tschudin
- *"In-Network Live Stream Processing with Named Functions*", Christopher Scherb, Claudio Marxer, Urs Schnurrenberger, Christian F Tschudin
- *"A Content-based Centrality Metric for Collaborative Caching in Information-Centric Fogs",* Junaid A Khan, Cedric Westphal, Yacine Ghamri-Doudane

Industry Panel: Adoption Challenges and Prospects of Information-Centric Fog Computing

Session 3: Computing Networks

- **Invited Talk:** *"Tools, reliability and pricing for cloud-based compute instances";* Ioannis Andreopoulos
- *"Benchmarking and Simulating the Fundamental Scaling Behaviors of a MapReduce Engine"*, Brenton Walker
- *"Session Support for SCN"*, Mikael Gasparyan; Guillaume Corsini; Torsten Braun; Eryk Jerzy Schiller; Jonnahtan Eduardo Saltarin de Arco

Suggested Next Steps

- Opportunity to rethink IoT edge computing to support local, decentralized operation better
  - Removing dependency on cloud, edge gateways etc.
  - Light-weight function execution, enabling formation of local edge computing clouds

- This could be documented in a draft
  - Shortcomings with legacy edge computing approaches
  - Concepts for Thing-to-Thing edge computing
  - Research challenges