

Edge Clouds Control Plane and Management Data Consistency Challenges: Position Paper for IEEE International Conference on Cloud Engineering, 2019

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Abstract—Fog computing is emerging Cloud of (Edge) Clouds technology. Its control plane and deployments data synchronization is a major challenge. Autonomy requirements expect even the most distant edge sites always manageable, available for monitoring and alerting, scaling up/down, upgrading and applying security fixes. Whenever temporary disconnected sites are managed locally or centrally, some changes and data need to be eventually synchronized back to the central site(s) with having its merge-conflicts resolved for the central data hub(s). While some data needs to be pushed from the central site(s) to the Edge, which might require resolving data collisions at the remote sites as well. In this paper, we position the outstanding data synchronization problems for OpenStack platform becoming a cloud solution number one for fog computing. We define the inter-cloud operational invariants based on that Always Available autonomy requirement. We show that a causally consistent key value storage is the best match for the outlined operational invariants and there is a great opportunity for designing such a solution for Edge clouds. Finally, the paper brings the vision of unified tooling to solve the data synchronization problems the same way for infrastructure owners, IaaS cloud operators and tenants running workloads for PaaS, like OpenShift or Kubernetes deployed on top of Edge clouds.

Index Terms—Open source software, Edge computing, Distributed computing, System availability, Design

I. GLOSSARY

Aside of the established terms [3], we define a few more for the data processing and operational points of view:

A. Deployment Data

Data that represents the configuration of cloudlets [3], like API endpoints URI, or numbers of deployed edge nodes [3] in edge clouds [3]. That data represents the most recent state of a deployment.

B. Cloud Data

Represents the most recent internal and publicly visible state of cloudlets, like cloud users or virtual routers. Cloud data also includes logs, performance and usage statistics, state of message queues and the contents of databases. When we refer to just data, we do not differentiate either that is deployment or

control data. When there is unresolved data merging conflicts, the most recent state becomes the best known state.

C. Control Plane (CP)

Corresponds to any operations performed via cloudlets API endpoints or CLI tooling. For example, starting a virtual machine instance, or creating a cloud user. Such operations are typically initiated by cloud applications, tenants or operators.

D. Management Plane

Corresponds to administrative actions performed via configuration and lifecycle management systems. Such operations are typically targeted for cloudlets, like edge nodes, edge datacenters [3], or edge clouds. For example, upgrading or reconfiguring the centralized data center [3], or scaling up edge nodes. And typically initiated by cloud infrastructure owners. For some extended cases, like Baremetal-as-a-Service, tenants may as well initiate actions executed via the management plane. Collecting logs, performance and usage statistics for monitoring and alerting systems also represents the management plane operations, although it operates with the cloud data.

E. Always Available (AA)

The operational mode of the control and management planes that corresponds to the best for today choices for the sticky available consistency models [4], which is like Real-Time Causal [2], or causal+ [1]. The

II. INTRODUCTION

III. ANALYSIS AND DISCUSSION

A. Autonomy Requirements

We define autonomy requirements for Edge sites as the following:

- Foo

B. Operational Invariants

Always available control and management planes require the following operational capabilities:

- Foo

C. Data Consistency Requirements

Foo [2].

IV. CONCLUSION

A. Figures and Tables

a) Positioning Figures and Tables: Place figures and tables at the top and bottom of columns. Avoid placing them in the middle of columns. Large figures and tables may span across both columns. Figure captions should be below the figures; table heads should appear above the tables. Insert figures and tables after they are cited in the text. Use the abbreviation “Fig. 1”, even at the beginning of a sentence.

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TABLE TYPE STYLES

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^aSample of a Table footnote.

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Fig. 1. Example of a figure caption.

REFERENCES

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