Technische Universität Braunschweig

RailCloud: A Reliable PaaS Cloud for Railway Applications

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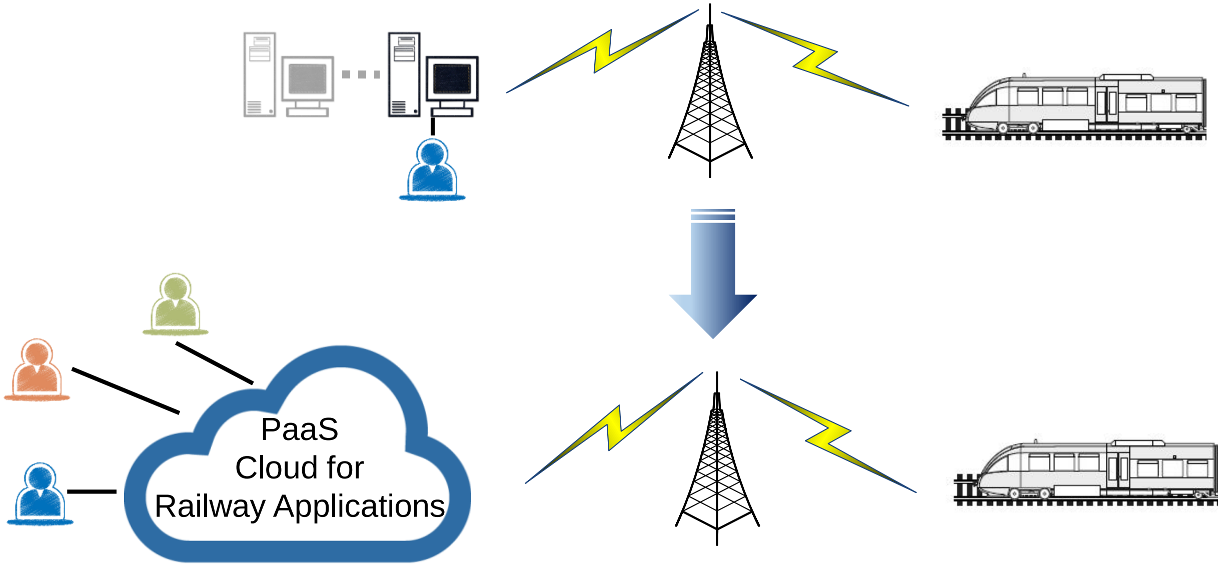
RailCloud



- A PaaS cloud for railway applications
- Shared by small and medium-sized transportation companies
- Reliability and safety guarantee

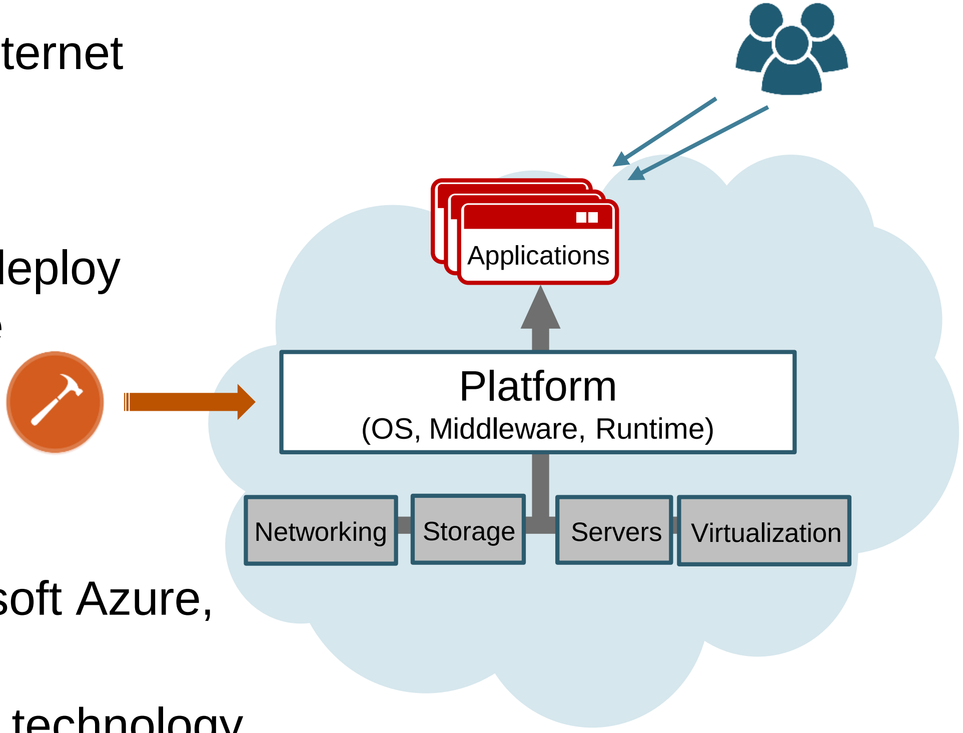
PaaS Cloud in a Nutshell

What is a PaaS Cloud?

- A computing platform for software development delivered over the Internet

How to use it?

- Software developers can quickly deploy applications, without infrastructure management tasks



Existing PaaS Clouds?

- Google App Engine (GAE), Microsoft Azure, OpenShift, Cloud Foundry etc.
- Recent evolvement with container technology

Existing PaaS Clouds?

Reliability?

Horizontal Scalability

- Usuall
- Tolera
- Mostl

Issues

- Lack
- Canno
- Complex deployment and coordination for cloud customers

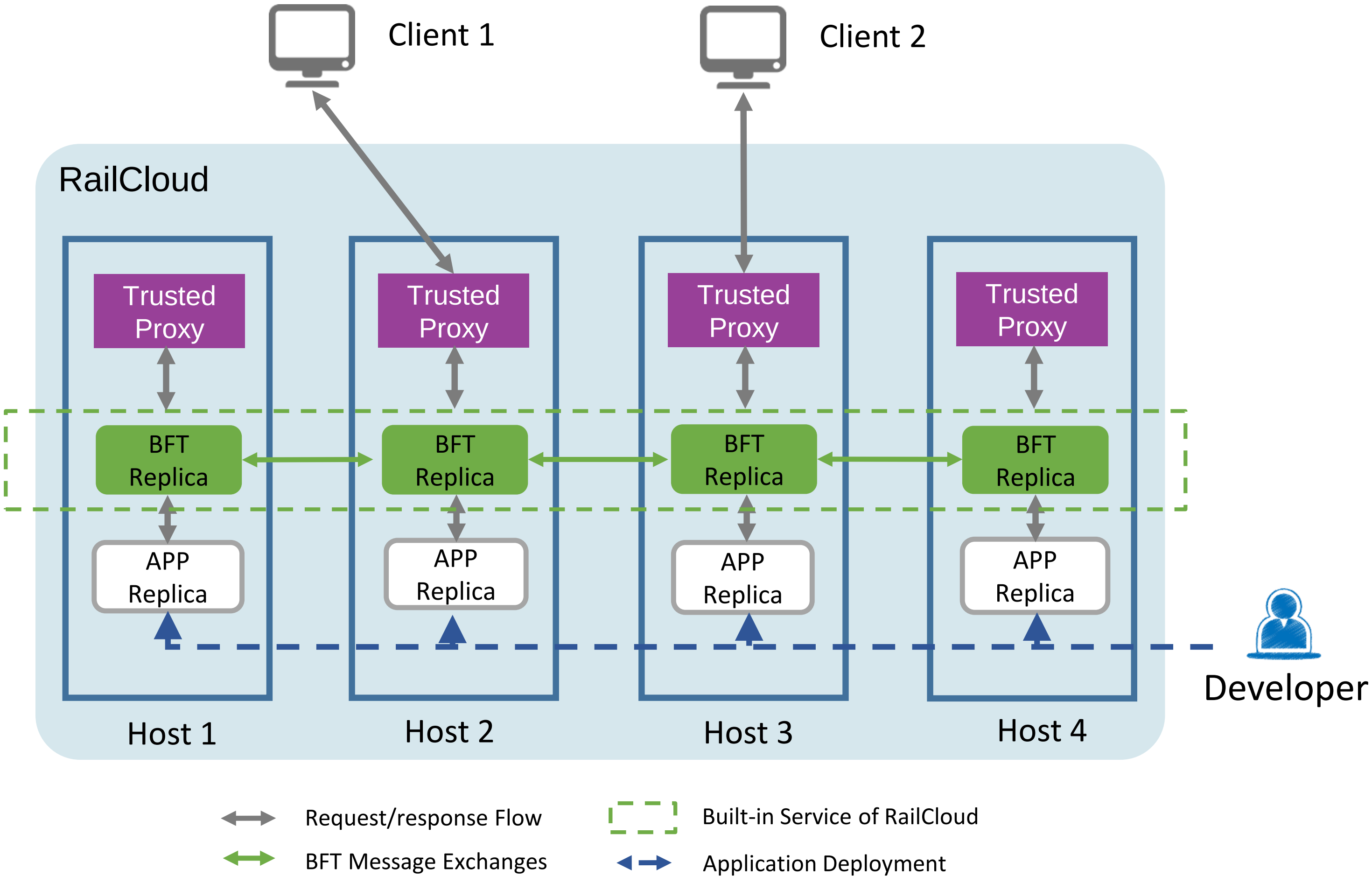
Goal of RailCloud

- Easy deployment of replicated stateful applications with automatic coordination to guarantee reliability
- Easy deployment of legacy railway applications

Outline

- Reliability in PaaS Clouds
- RailCloud Design
    - Byzantine Fault-Tolerant Applications in the Cloud
    - Trusted Proxy: Making Replicated Systems Transparent
- Conclusion and Future Work

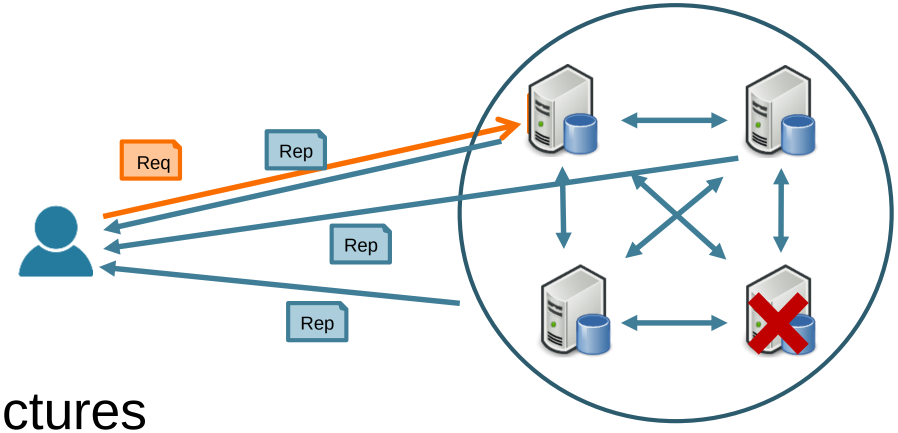
RailCloud Architecture



Byzantine Fault Tolerance in the Cloud

Byzantine Fault-Tolerance (BFT) Protocols

- Tolerate crash-stop failures and arbitrary and malicious behaviors
- *3f* +1 replicas to tolerate *f* faults
- Message exchanges for agreement



Integration of BFT into Cloud Infrastructures

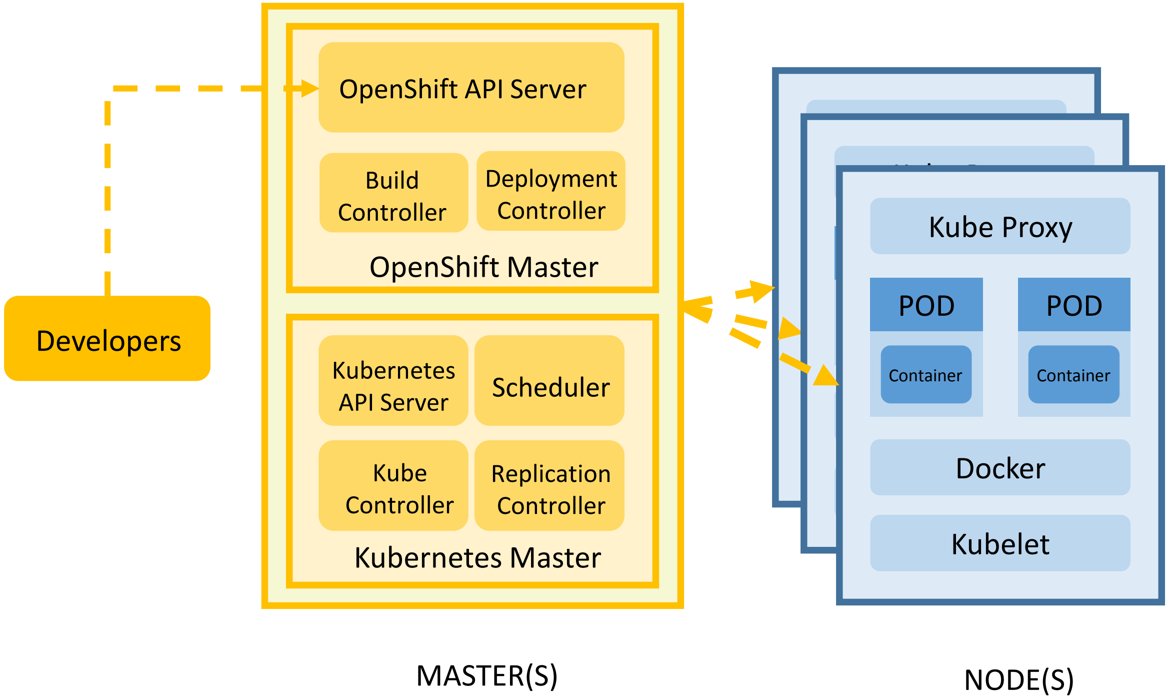
- Infrastructure level: Depsky, Fitch, TClouds etc.
- Middleware level: Thema etc.

RailCloud: PaaS Level + Automatic Deployment Extension

Base of RailCloud

OpenShift Origin v3

- Docker container packaging
- Kubernetes container cluster management
- Application lifecycle management



Implementation and Deployment

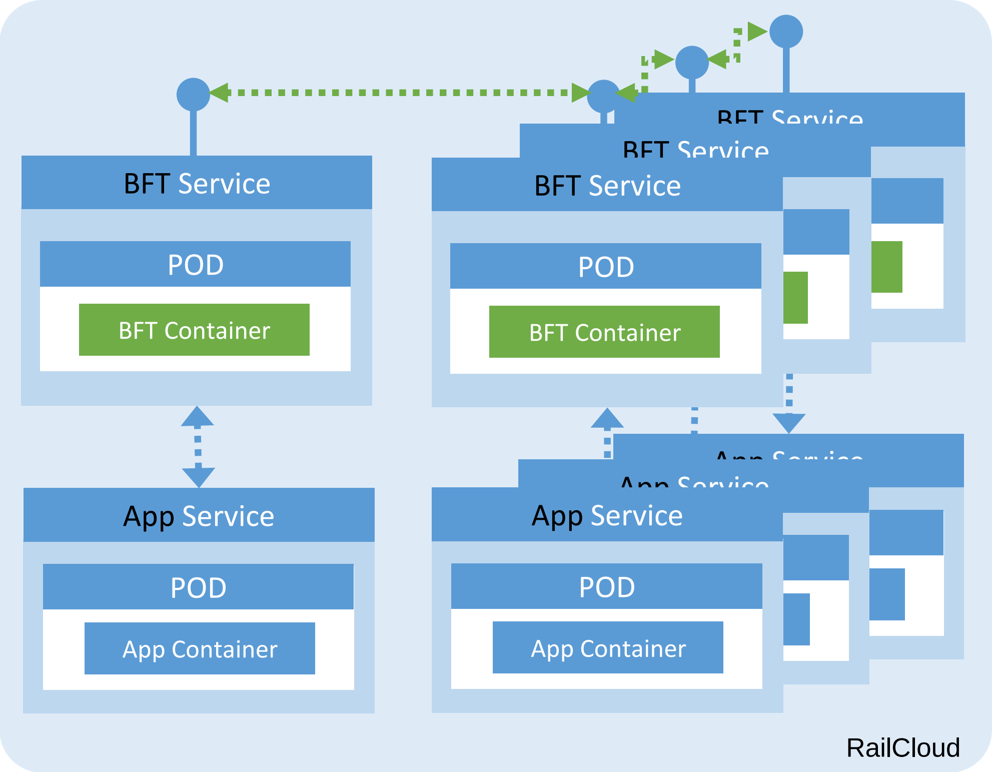
BFT Service Layer

- BFT image (BFT-SMaRt)
- BFT pods
- BFT services

Application Deployment

Networking

- Connect each BFT service to application service
- Expose BFT services



Trusted Proxy: Making Replicated Systems Transparent

Why transparent?

Minimum modifications to clients

- HTTPS connections
- Web-based railway applications
- Implements client-side BFT library

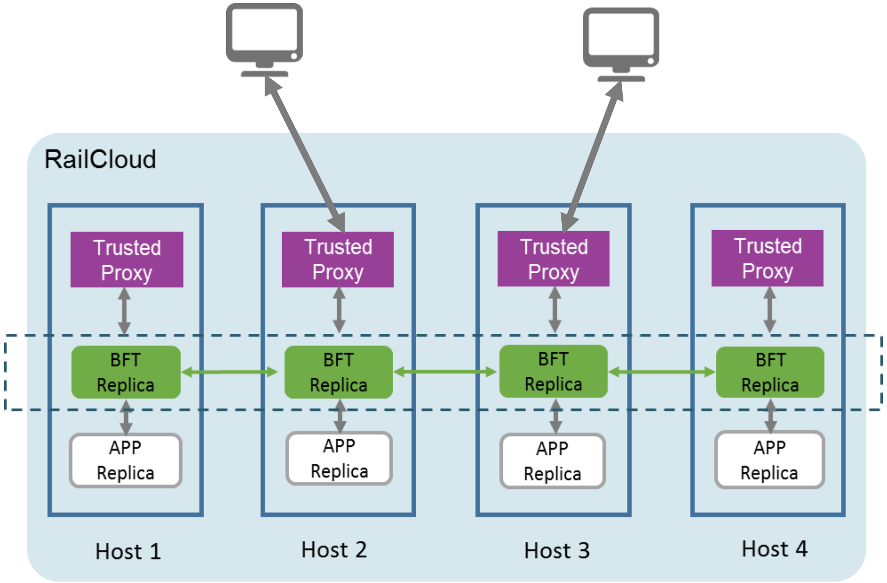
Friendly to low-bandwidth clients

- No redundant requests/replies

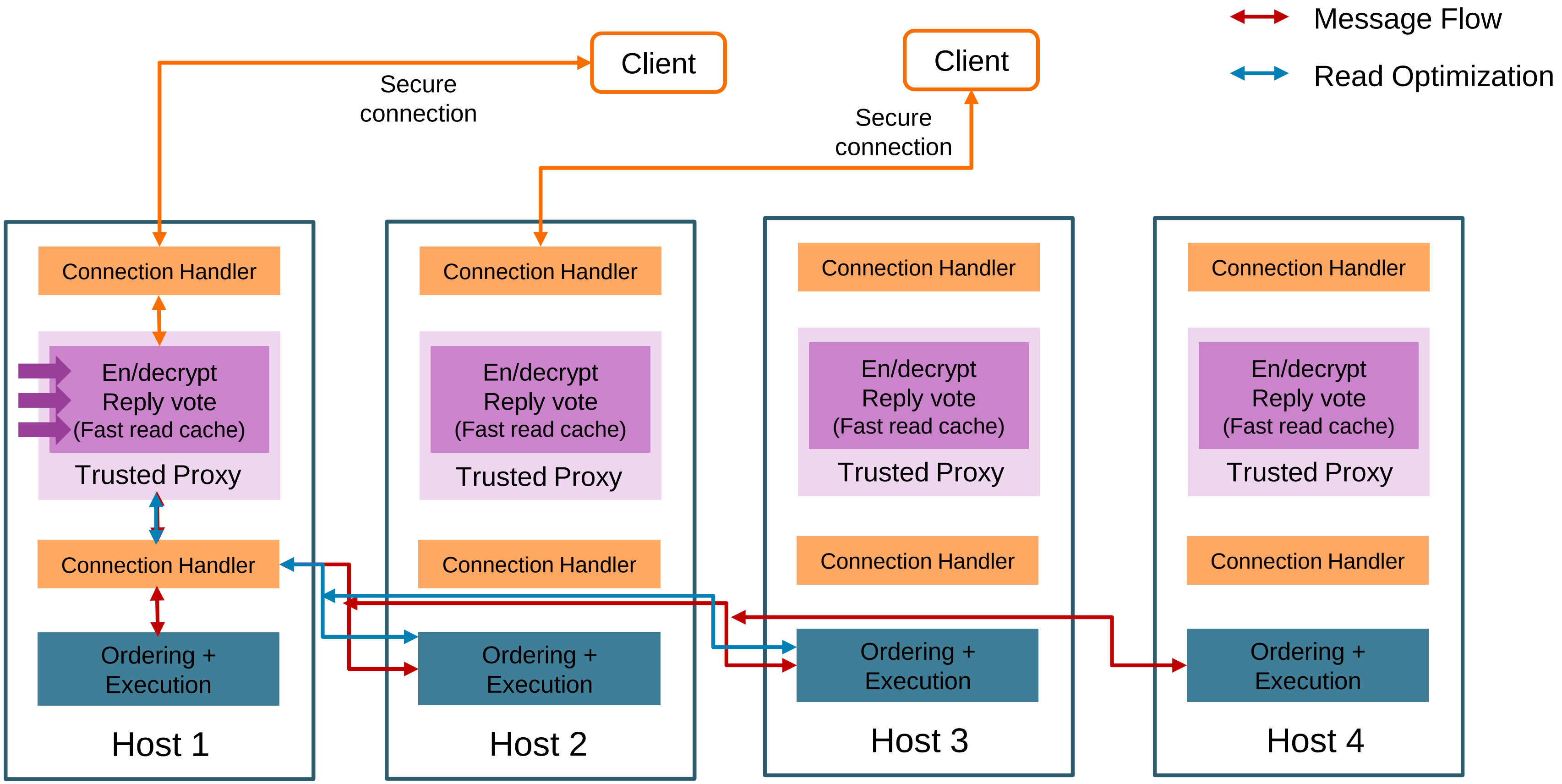
Hide details of replicated system

- Simple and secure interface to clients

Throughput improvement



Trusted Proxy in RailCloud



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Conclusion and Future Work

RailCloud

- Integrate BFT for reliability demands into PaaS Cloud
- Easy deployment of BFT applications
- Automatic coordination among replicated services
- Using trusted proxy to make replicated system transparent

Future Work

- Explore more functions of trusted proxy

Appendix

Related Works

- Bessani, A., Correia, M., Quaresma, B., Andre, F., Sousa, P.: **Depsky: dependable and secure storage in a cloud-of-clouds**. ACM Transactions on Storage (TOS) 9(4), 12 (2013)

- Cogo, V.V., Nogueira, A., Sousa, J., Pasin, M., Reiser, H.P., Bessani, A.: **Fitch: Supporting adaptive replicated services in the cloud**. In: DAIS'13

- Garraghan, P., Townend, P., Xu, J.: **Using byzantine fault-tolerance to improve dependability in federated cloud computing**. International Journal of Software and Informatics 7(2), 221–237 (2013)

- Verissimo, P., Bessani, A., Pasin, M.: **The tclouds architecture: Open and resilient cloud-of-clouds computing**. In: Dependable Systems and Networks Workshops (DSN-W), 2012 IEEE/IFIP 42nd International Conference on. pp. 1–6. IEEE(2012)

- Merideth, M.G., Iyengar, A., Mikalsen, T., Tai, S., Rouvellou, I., Narasimhan, P.: **Thema: Byzantine-fault-tolerant middleware for web-service applications**. In: Reliable Distributed Systems (SRDS), 2005 24th IEEE Symposium on. pp. 131–140. IEEE (2005)