Edge clouds
Challenges and Solutions

Volker Hilt
Nokia Bell Labs
volker.hilt@nokia-bell-labs.com

Edge cloud computing

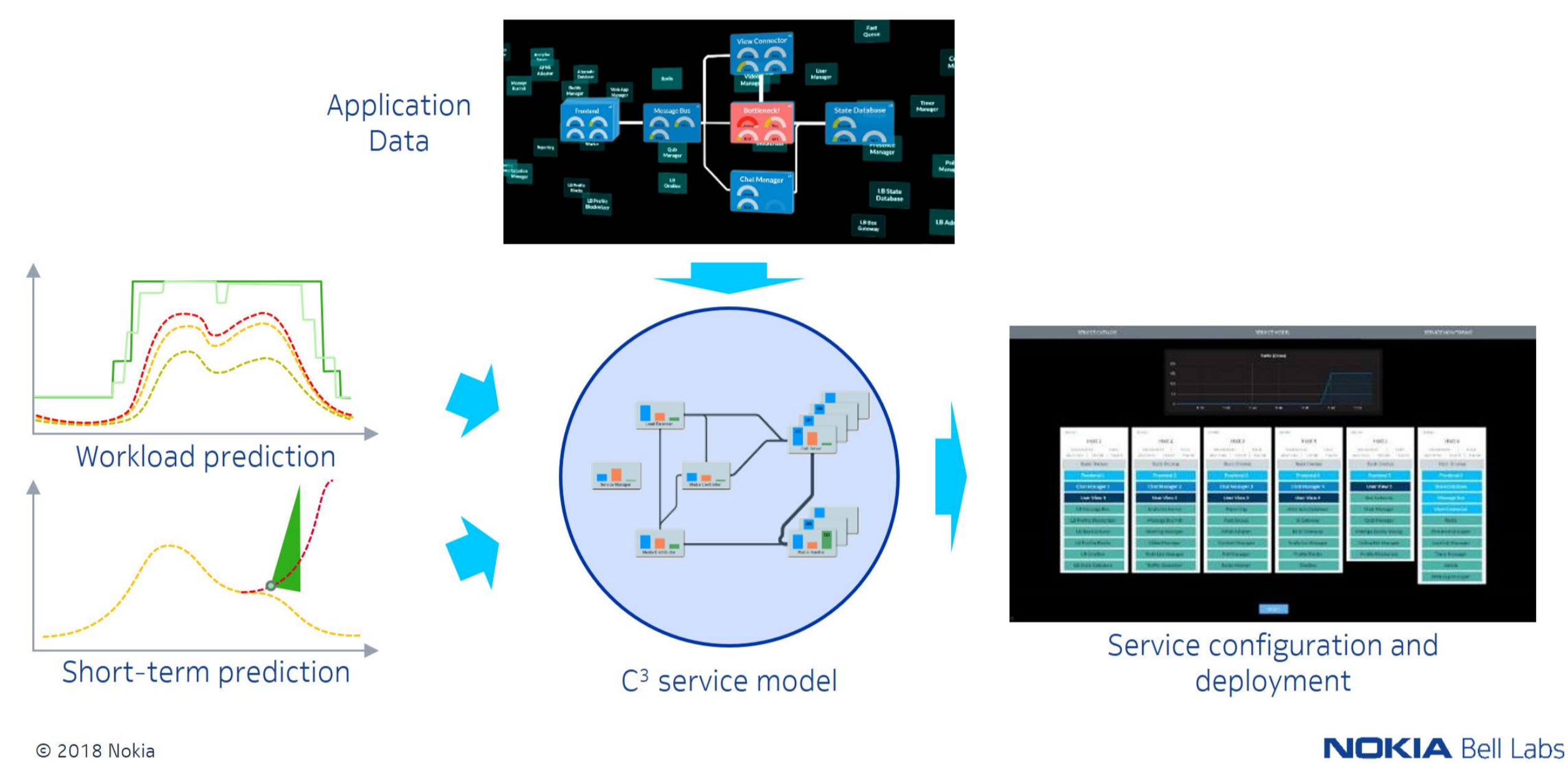Highly **distributed** applications and users

Scarce and **heterogeneous** resources

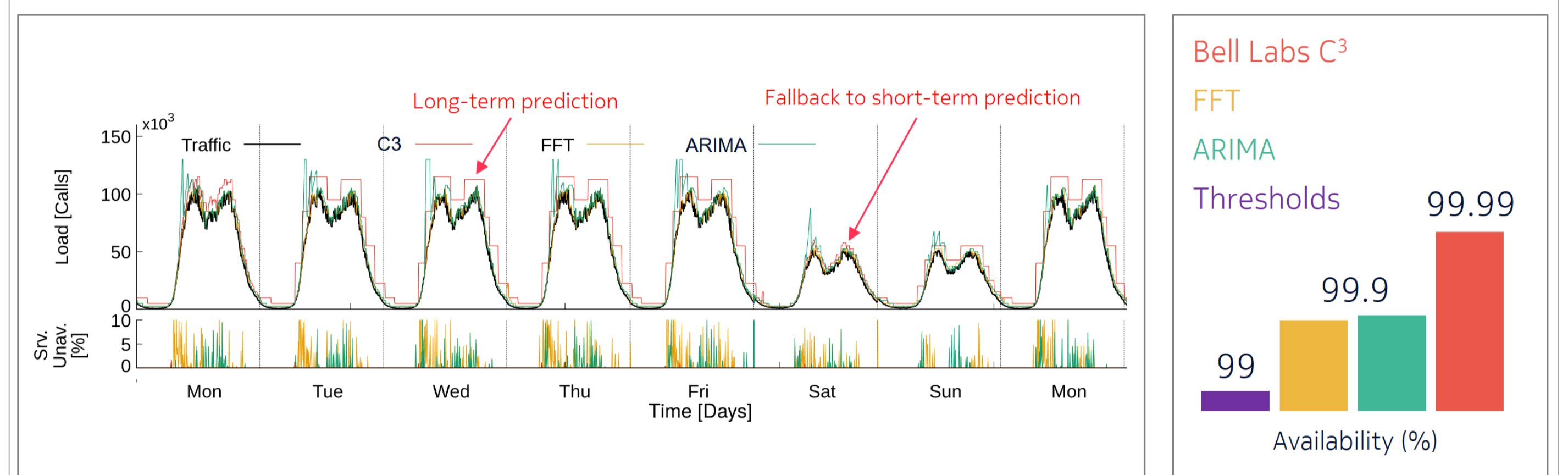Cost efficient **management** and **operation** is critical

---

Cognitive Cloud Control (C³)
Automating the operation of edge services

Application Data

Workload prediction

Short-term prediction

C³ service model

Service configuration and deployment

Cognitive Cloud Control
Service availability

1-year data trace from large European city

Bell Labs C³
FFT
ARIMA
Thresholds

99   99.9   99.99

Availability (%)

Cognitive Cloud Control
Responsiveness

#VMs

— Demand
■ C³-driven capacity
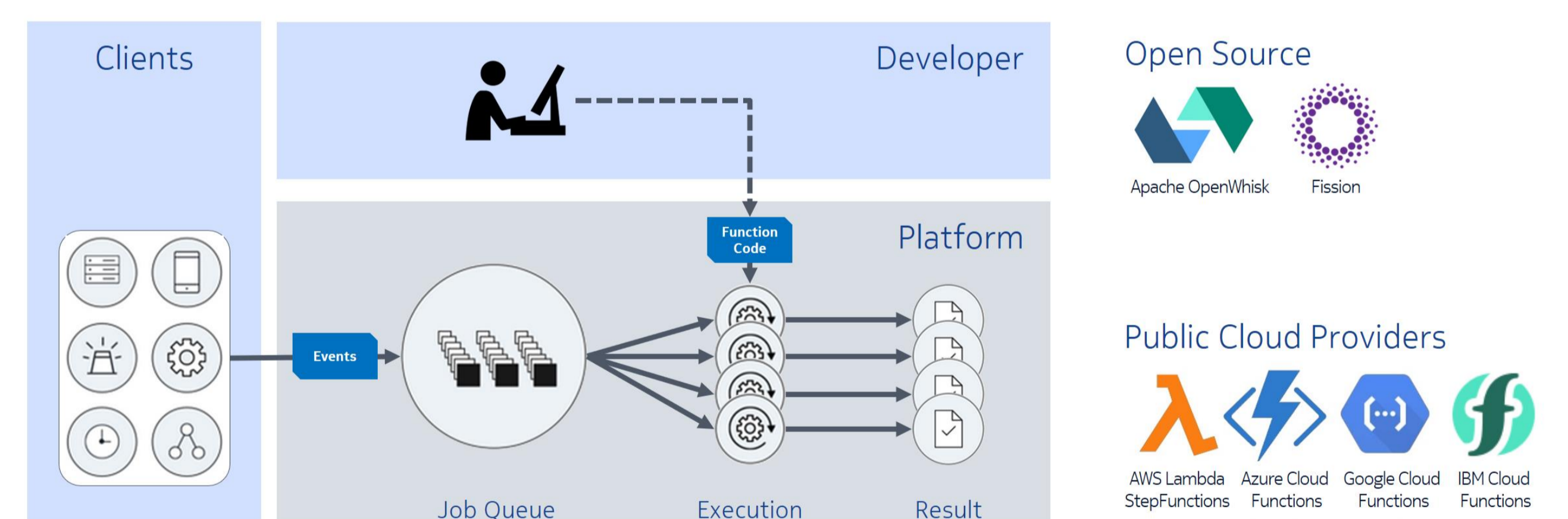■ Threshold-driven capacity
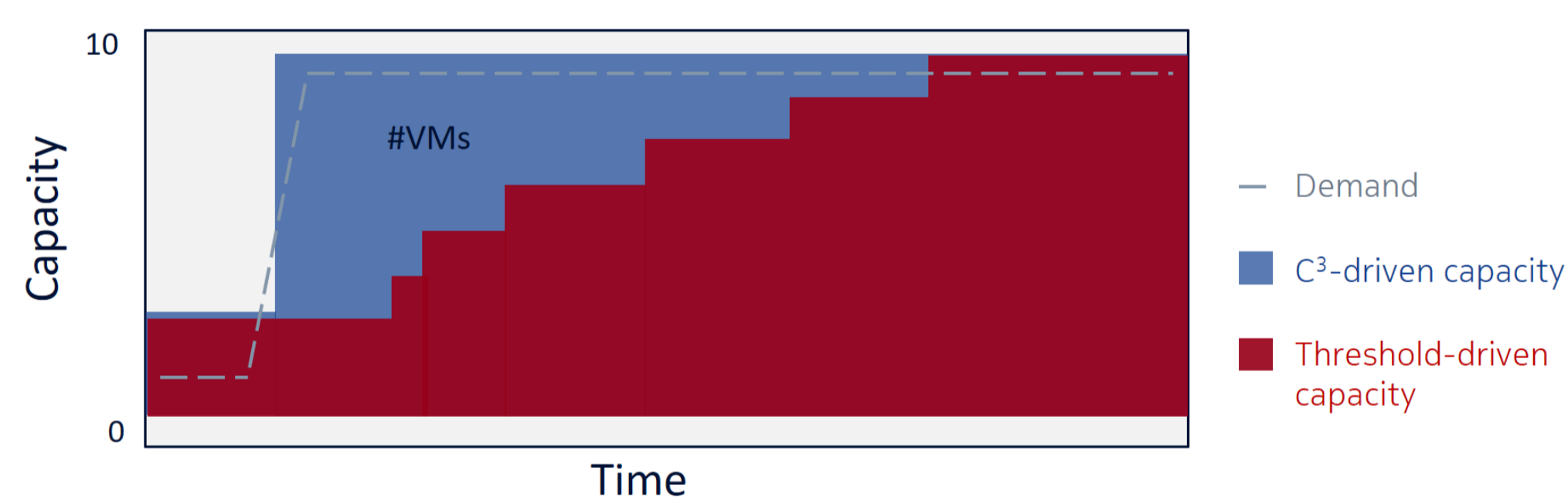
References:
- Jesus Omana Iglesias, Jordi Arjona Aroca, Volker Hilt, and Diego Lugones, ORCA: an ORChestration Automata for Configuring VNFs, ACM/IFIP/USENIX Middleware 2017, Dec 2017.
- Diego Lugones, Jordi Arjona Aroca, Yue Jin, Alessandra Sala, Volker Hilt, AidOps: A Data-Driven Provisioning of High-Availability Services in Cloud, ACM Symposium on Cloud Computing (SoCC), Sept 2017.

Serverless
A new paradigm for resource-efficient computing

Clients

Developer

Function Code

Platform

Events

Job Queue   Execution   Result

Open Source
Apache OpenWhisk   Fission

Public Cloud Providers
AWS Lambda StepFunctions   Azure Cloud Functions   Google Cloud Functions   IBM Cloud Functions
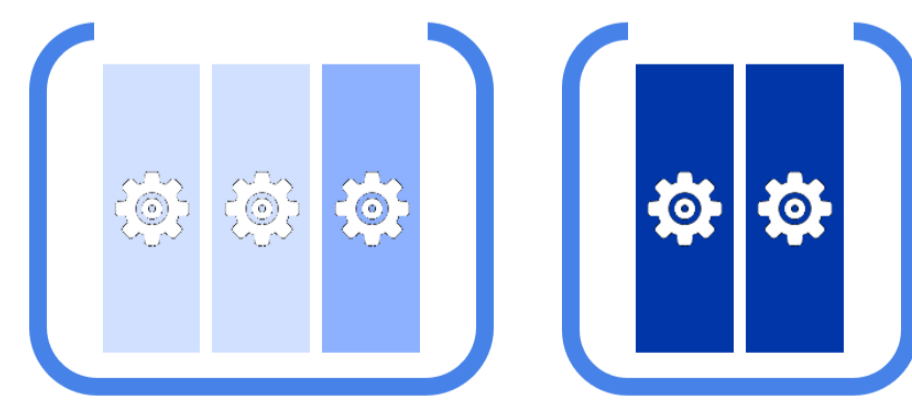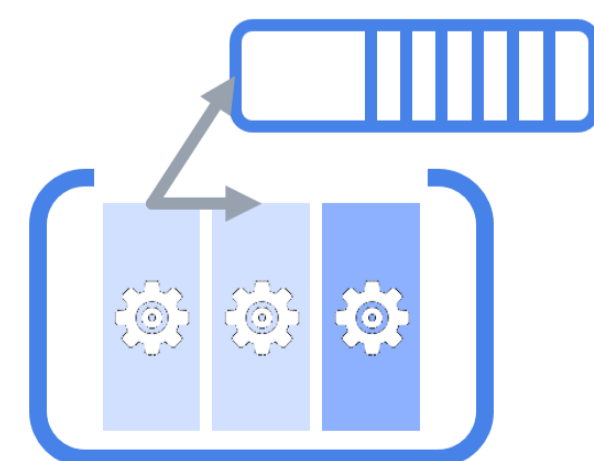

SAND: high-performance Serverless

Service sandboxing: joint execution of functions
- Light-weight execution model based on processes and not containers
- Low latency & resource-efficiency by fast grain allocation/de-allocation

High-performance function interactions:
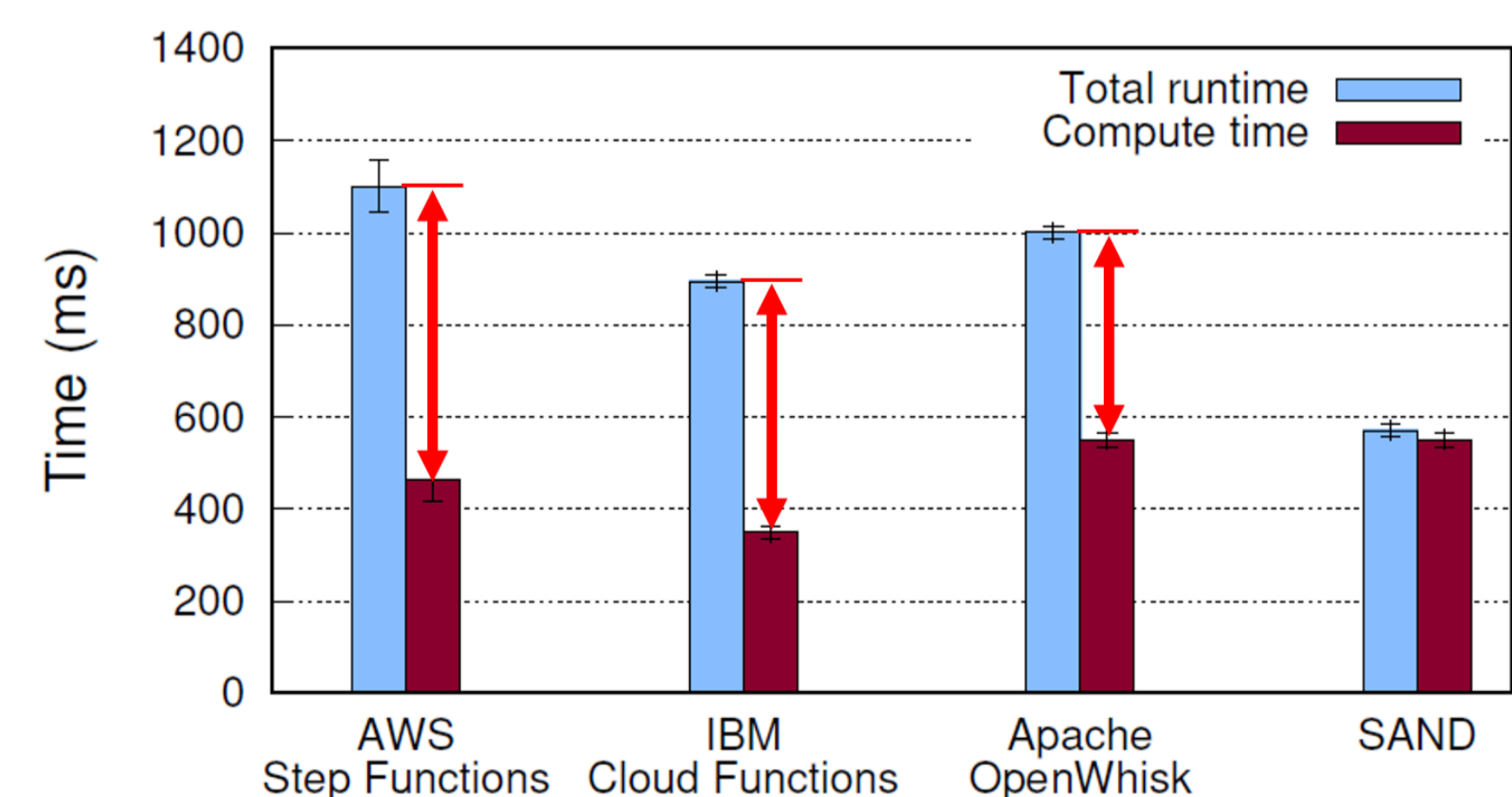hierarchical event queue & data layer
- Invocation and data sharing - done locally
- Parallelism and reliability - done globally

The ugly-truth of Serverless – invocation overhead
SAND reduces overhead by an order of magnitude

Total runtime
Compute time

AWS Step Functions   IBM Cloud Functions   Apache OpenWhisk   SAND

Reference:
- Istemi Ekin Akkus, Ruichuan Chen, Ivica Rimac, Manuel Stein, Klaus Satzke, Andre Beck, Paarijaat Aditya, Volker Hilt, SAND: Towards High-Performance Serverless Computing, USENIX Annual Technical Conference (ATC), Jul 2018.