USC Viterbi School of Engineering
Center for Cyber-Physical Systems and the Internet of Things

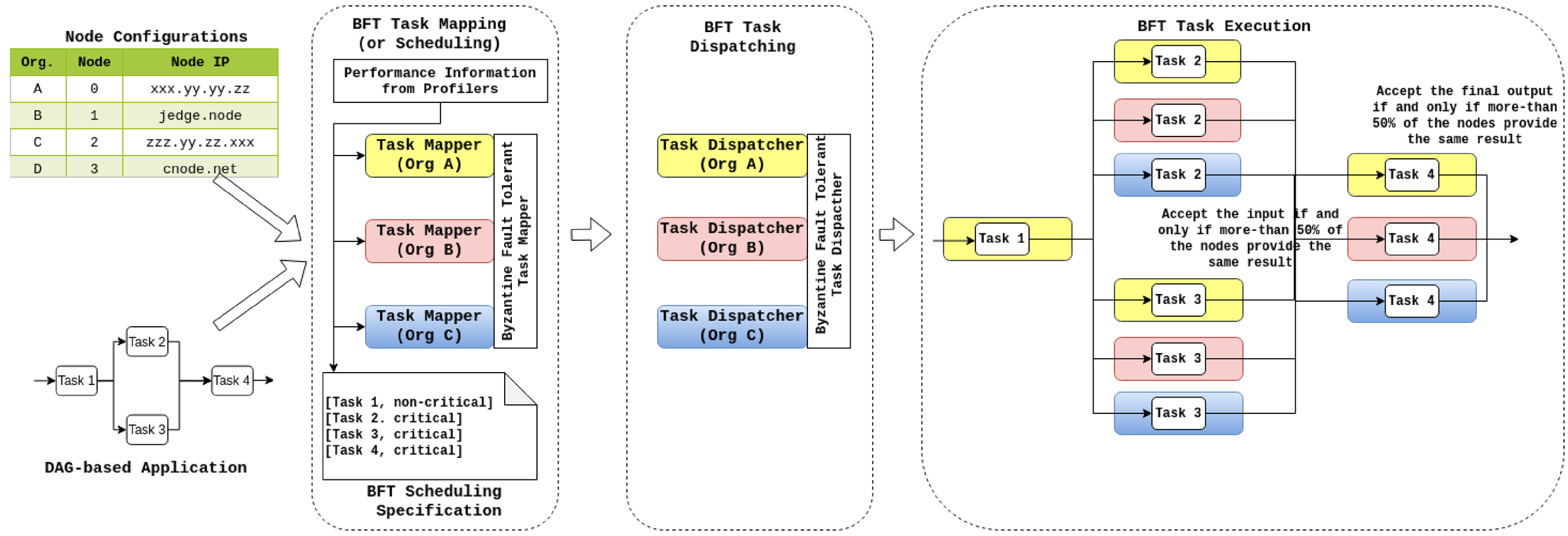
ANRG

Towards a Distributed and Byzantine Fault Tolerant Edge Computing using Jupiter+

Gowri Ramachandran, Quynh Nguyen, and Bhaskar Krishnamachari
University of Southern California

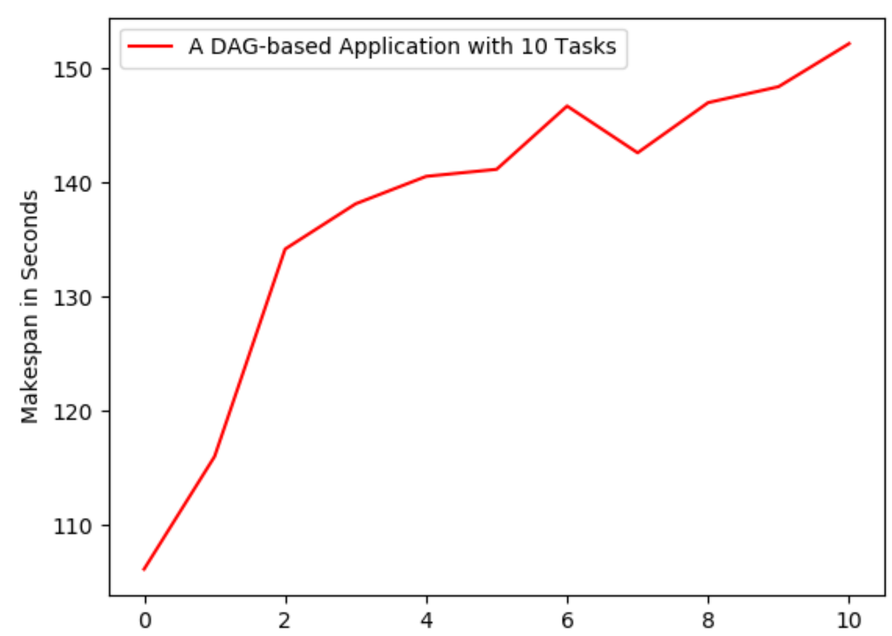
Motivation & Introduction

- Edge-computing-as-a-service (ECaaS) model involving multi-stakeholders is on the rise in emerging networking standards such as 5G and 6G
- Complex and computationally-intensive applications require significant computation power at the edge
- A distributed edge computing platform involving multiple organizations at the edge allows the end-devices to execute complex computation tasks at the edge
- Distributed computing frameworks such as Jupiter[1] do not consider *multi-stakeholder ownership model*, which is susceptible to *byzantine failures*



Highlights

- Orchestration for distributed computing involves scheduling (mapping), dispatching, and execution phases
- The functional modules that belong to each phase must be capable of handling byzantine faults
- A Byzantine fault-tolerant (BFT) edge computing requires replication of functional modules among multiple (N) compute nodes
- Our framework progresses when (N / 2) nodes recommends the output, and it can tolerate up to (N-1) / 2 byzantine failures
- Application functionalities are specified in the form of Directed Acyclic Graph (DAG) for distributed scheduling and execution
- Replication of tasks among multiple compute nodes increases the makespan, but it outweighs the safety and trust benefits



Summary

A byzantine fault-tolerant distributed edge computing framework offers a reliable and trustworthy solution for orchestrating large-scale edge computing computations.

1. Pradipta Ghosh, Quynh Nguyen, and Bhaskar Krishnamachari. "Container Orchestration for Dispersed Computing." In Proceedings of the 5th International Workshop on Container Technologies and Container Clouds, pp. 19-24. 2019.

+This material is based upon work supported by Defense Advanced Research Projects Agency (DARPA) under Contract No. HR001117C0053. Any views, opinions, and/or findings expressed are those of the author(s) and should not be interpreted as representing the official views or policies of the Department of Defense or the U.S. Government.

Contact Information
{gsramach, quynhngu, bkrishna}@usc.edu