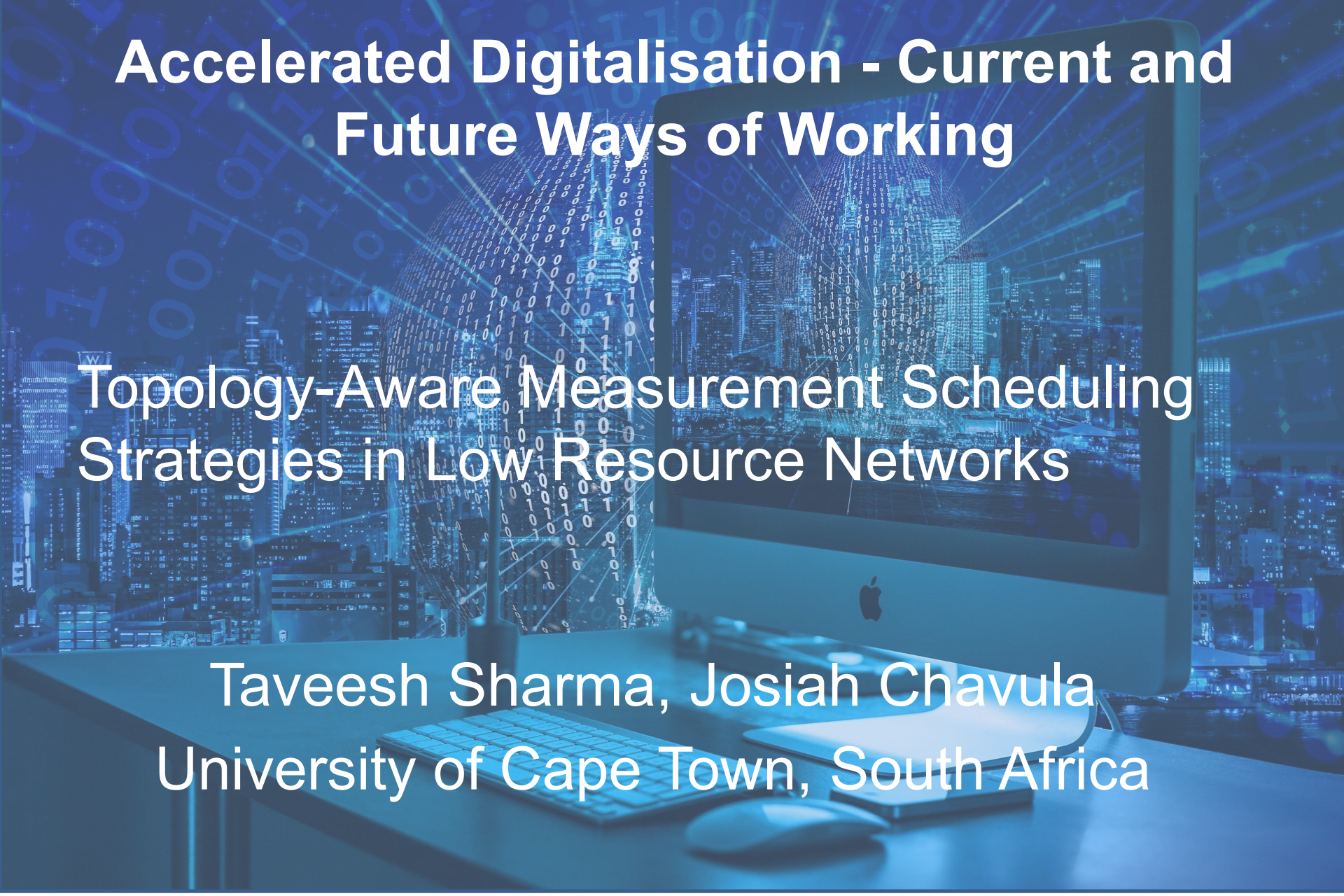

Accelerated Digitalisation - Current and Future Ways of Working

Topology-Aware Measurement Scheduling Strategies in Low Resource Networks

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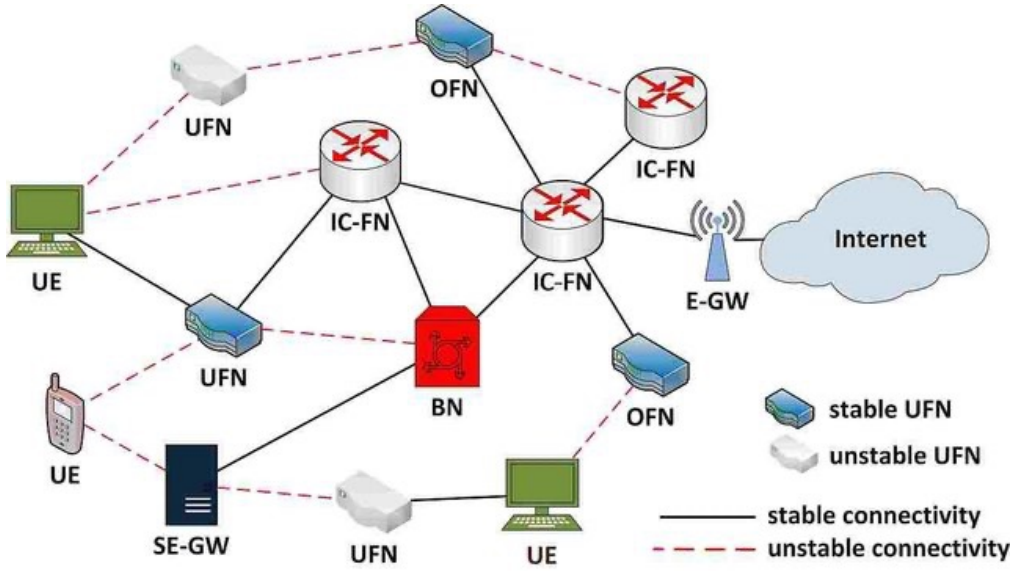
SATNAC 2021
Hosted by Telkom

Presentation Outline

- Introduction
- Motivation
- Challenges
- Related Work
- Proposed Monitoring Solution
- Performance Evaluation
- Results
- Conclusions & Future Work

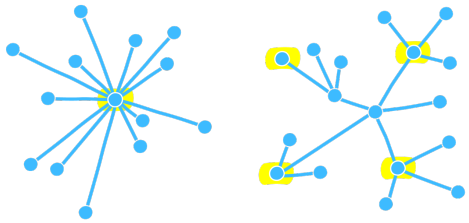
Introduction



- As of 2019 [2],
  - 165.6 mobile-cellular subscriptions per 100 inhabitants in South Africa
  - 102.2 out of these were mobile-broadband subscriptions
- As of 2021 [3],
  - 94.7% of internet users accessed the internet through smartphones

Motivation

- Mobile Crowdsourcing [4] for building network monitoring applications
- Centralized vs Decentralized Designs
  - Cost effectiveness
  - Accessibility
- Active vs Passive monitoring

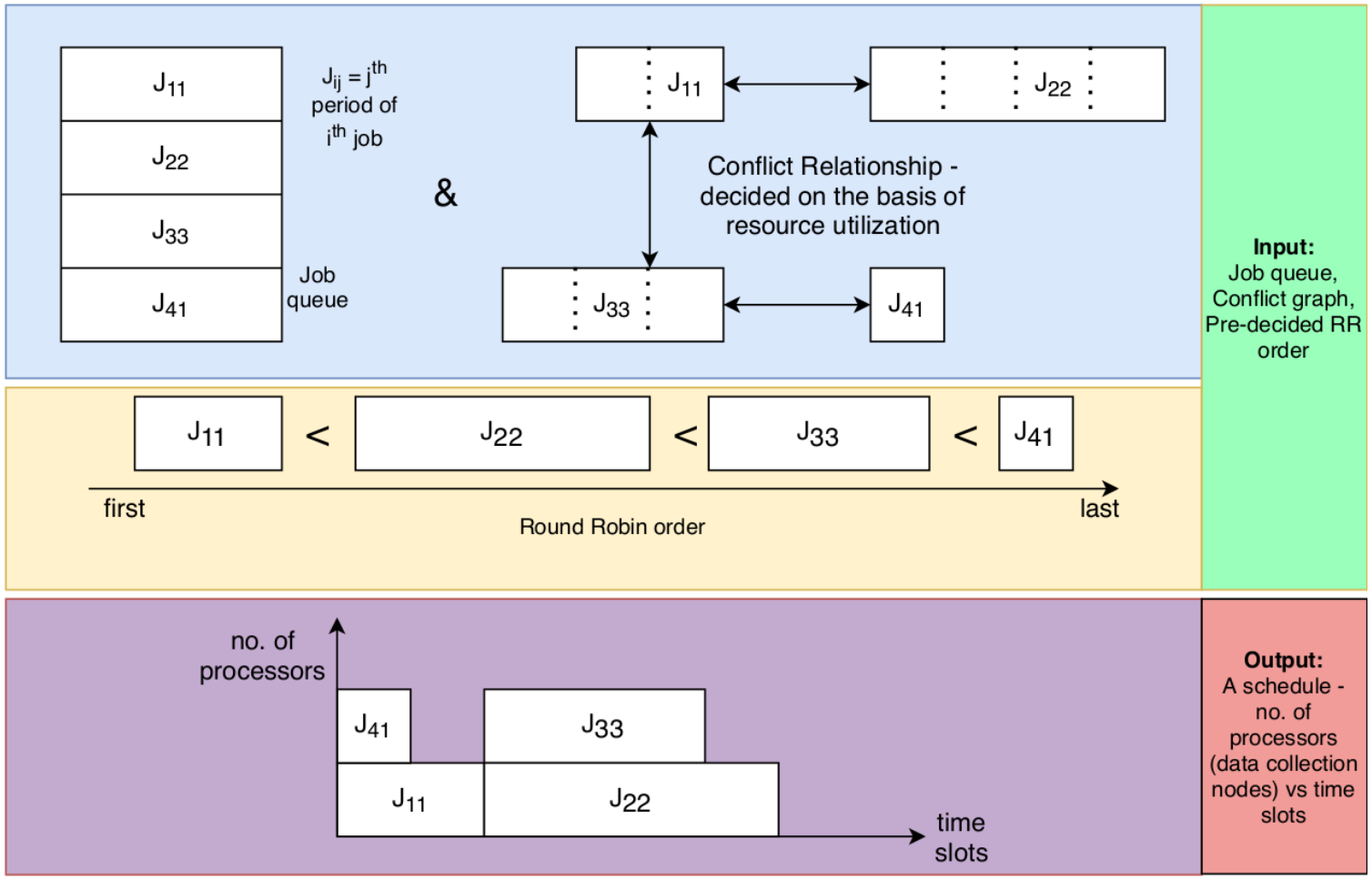


Challenges

- Limited Resources
  - CPU
  - Battery
  - Bandwidth
- Error in measurements due to the infrastructure itself – the observer effect
  - Need for appropriate measurement scheduling

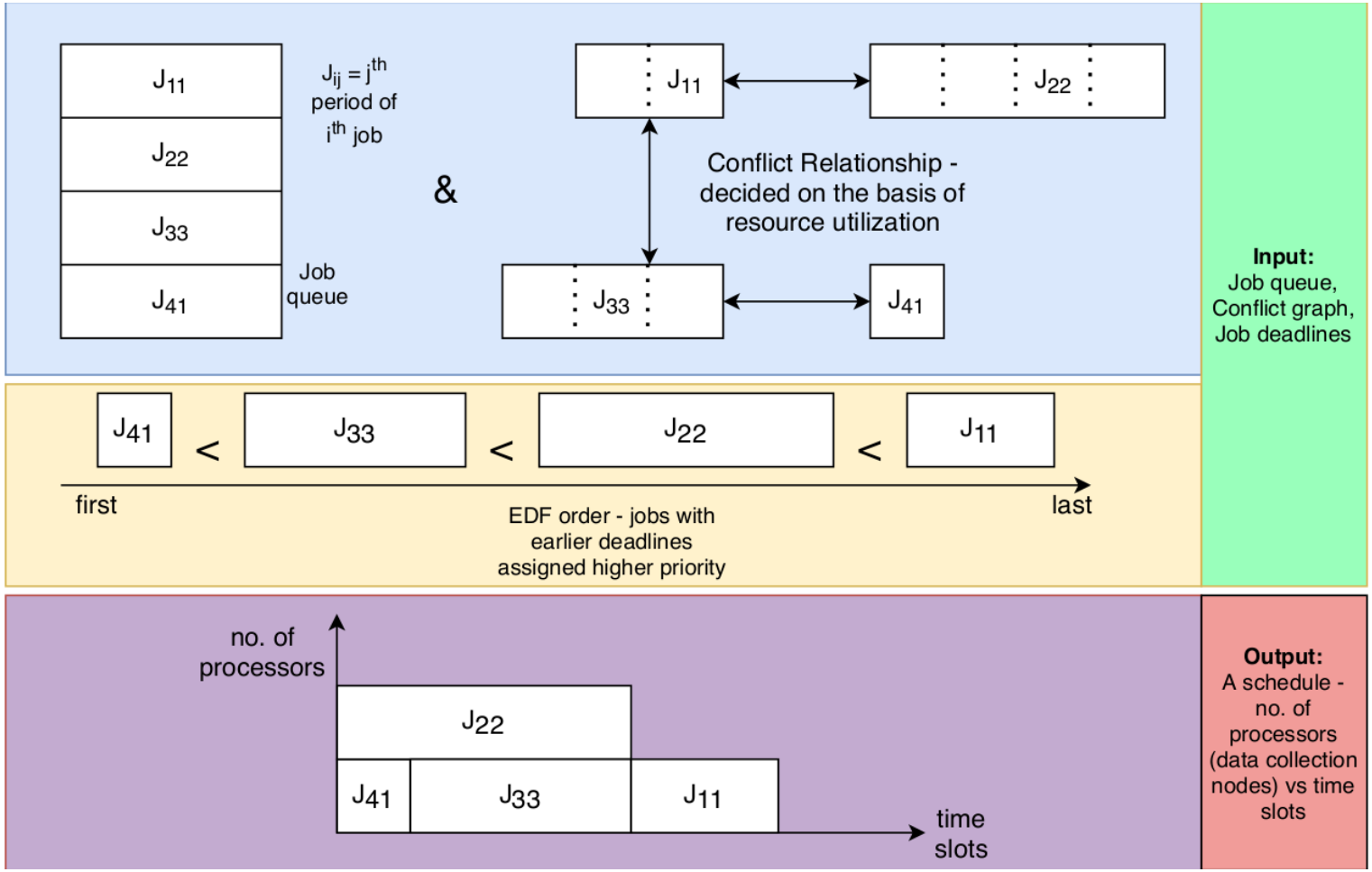
Related Work

- Round Robin Algorithm [5]



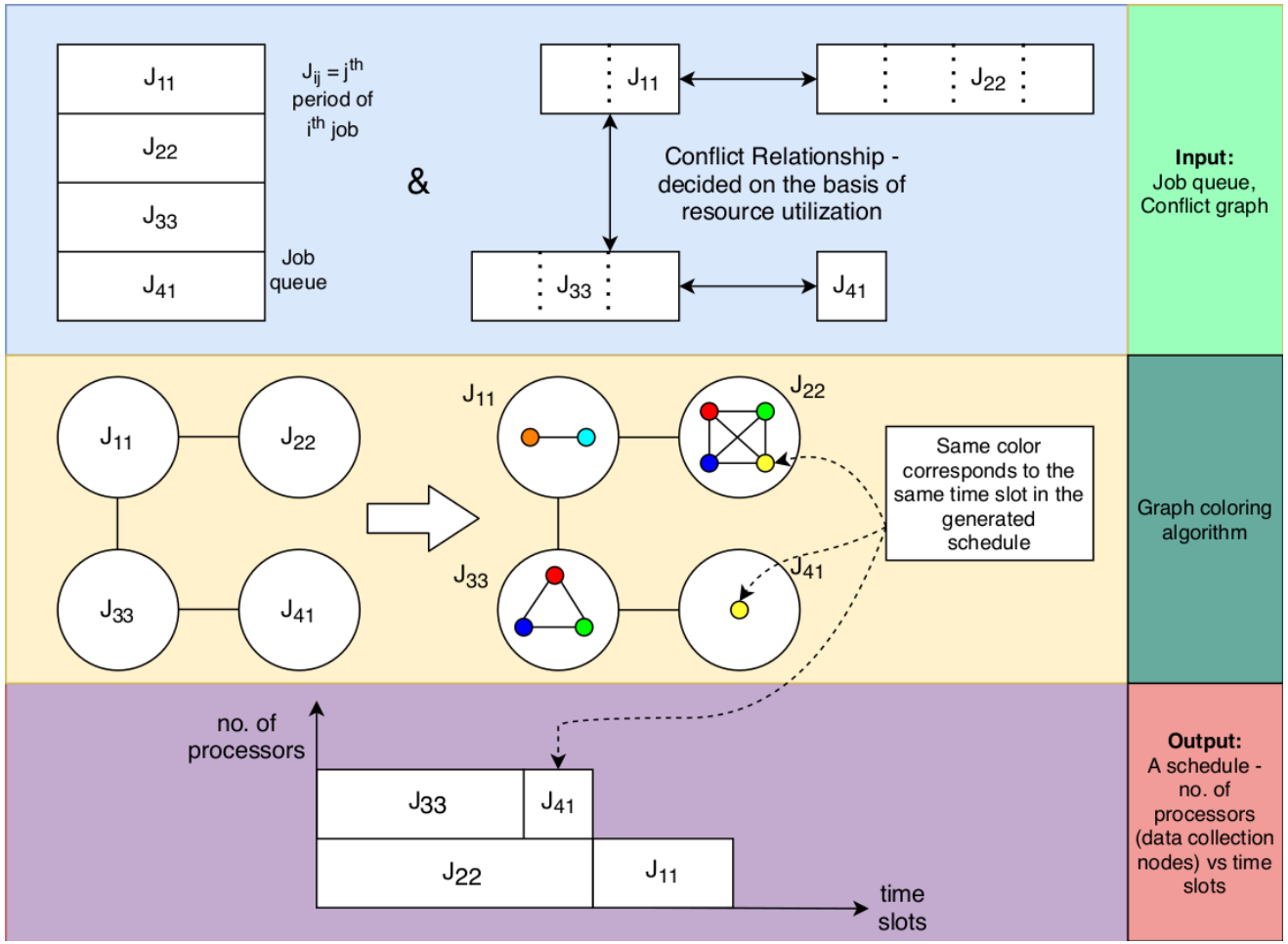
Related Work (Cont.)

- Earliest Deadline First Algorithm [6]



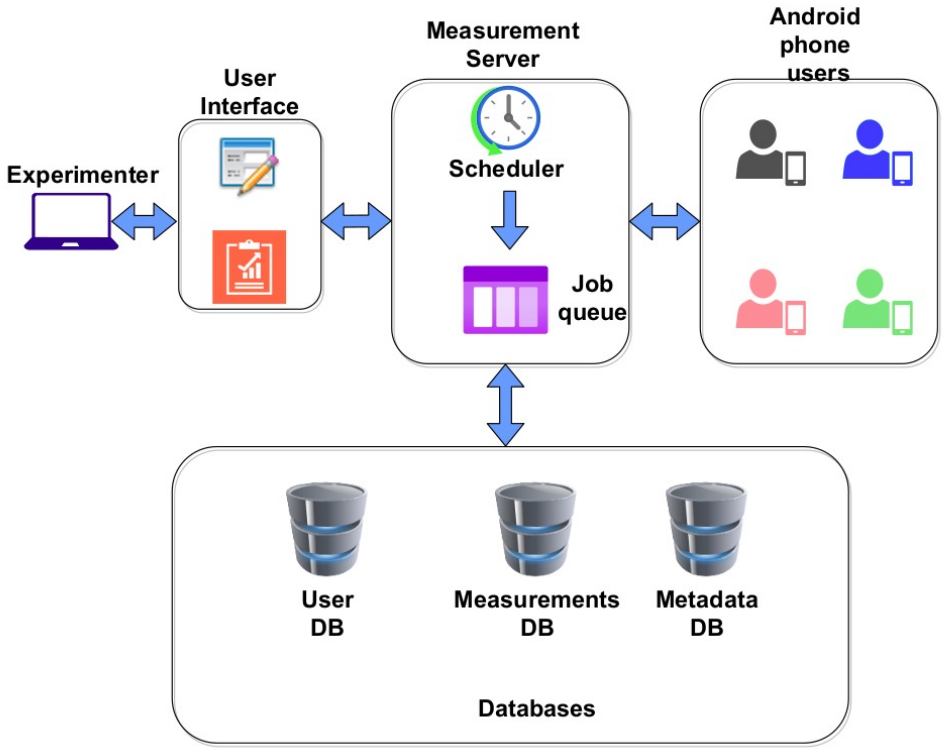
Related Work (Cont.)

- DOSD Algorithm [5]



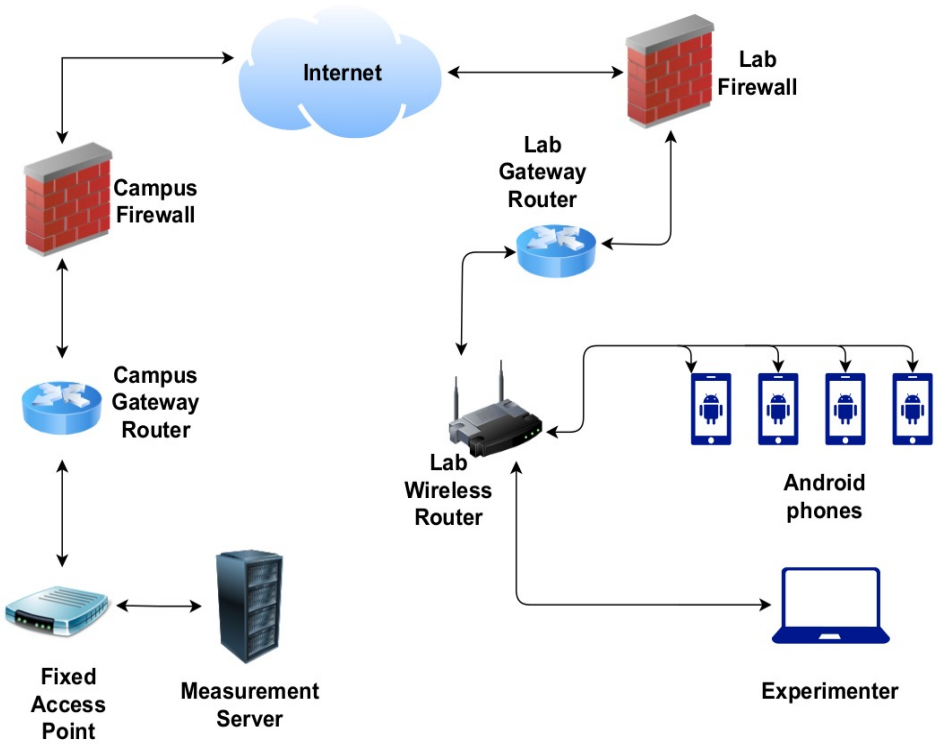
Proposed Monitoring Solution

- Users : Researchers and Network Managers
- Supported Measurements:
  - Ping
  - DNS Lookup
  - Traceroute
  - HTTP Download
  - TCP Throughput
- Supported Algorithms:
  - RR
  - EDF
  - AOSD
  - DOSD
- Databases : MongoDB & InfluxDB



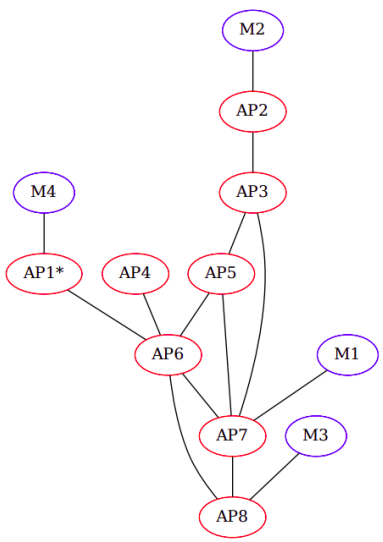
Proposed Monitoring Solution (Cont.)

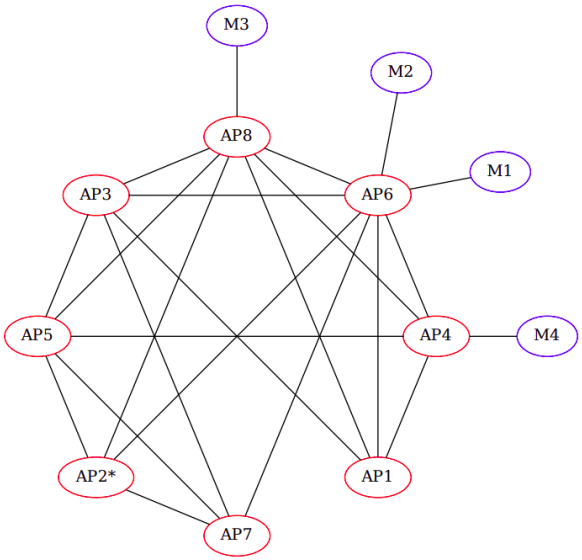
- Measurement Server:
  - Intel Xeon CPU E3-1225 v
  - 8 GB RAM
  - 1 TB HDD
- Phones:
  - Android 8.1
  - Quad-core 2.0 GHz CPU
  - 2 GB RAM
  - 16 GB Storage

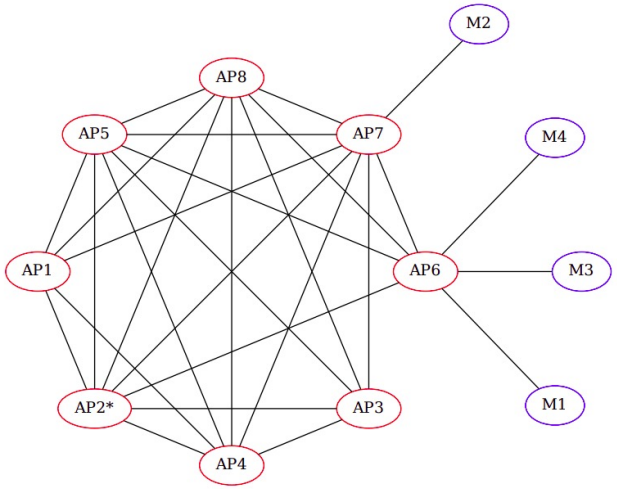


Performance Evaluation

- Choice of topologies:
  - **Sparse (p = 0.1)**
  - **Moderate (p = 0.5)**
  - **Dense (p = 0.9)**
- Number of periodic jobs: **20**
- Period of each job: **5 to 10 minutes**
- Duration per algorithm: **2 hours**
- Target servers: **Alexa top 8 global websites [7]**



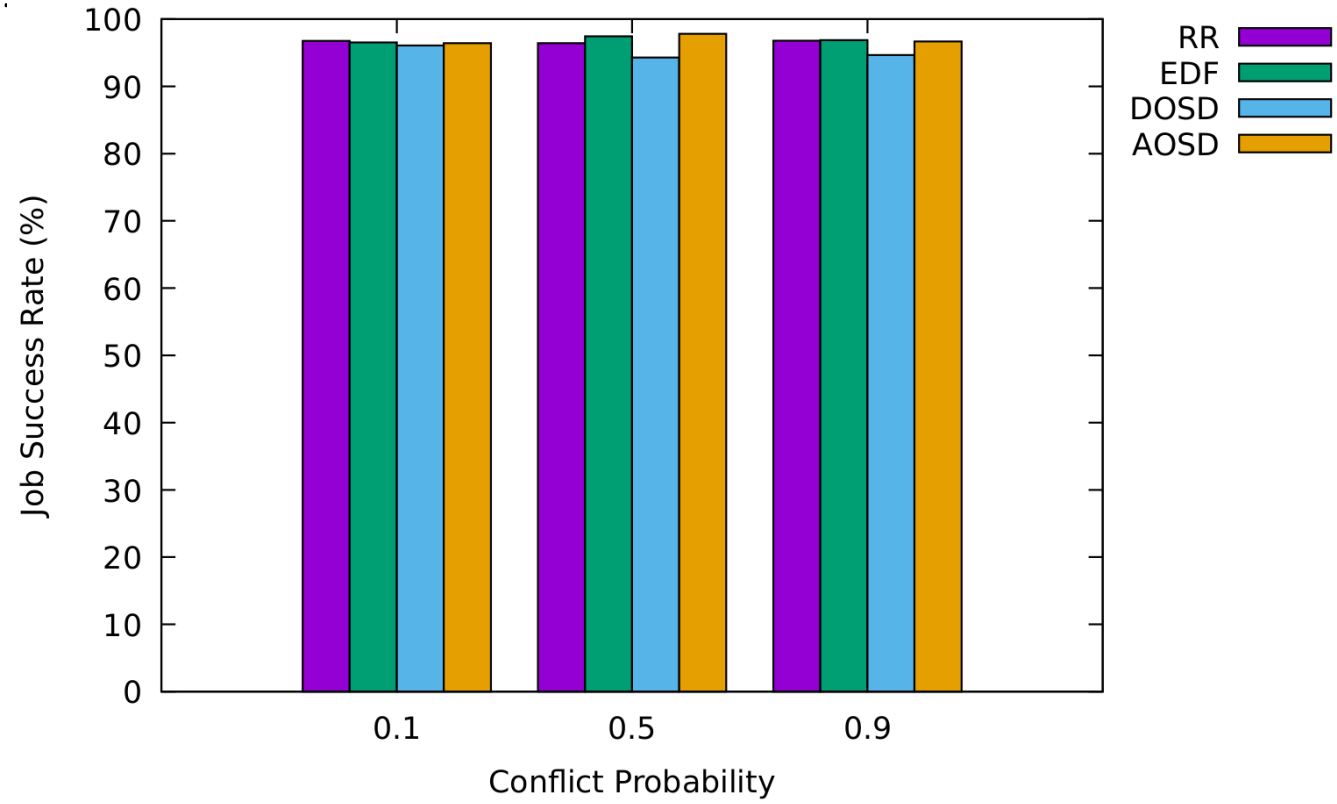




Results

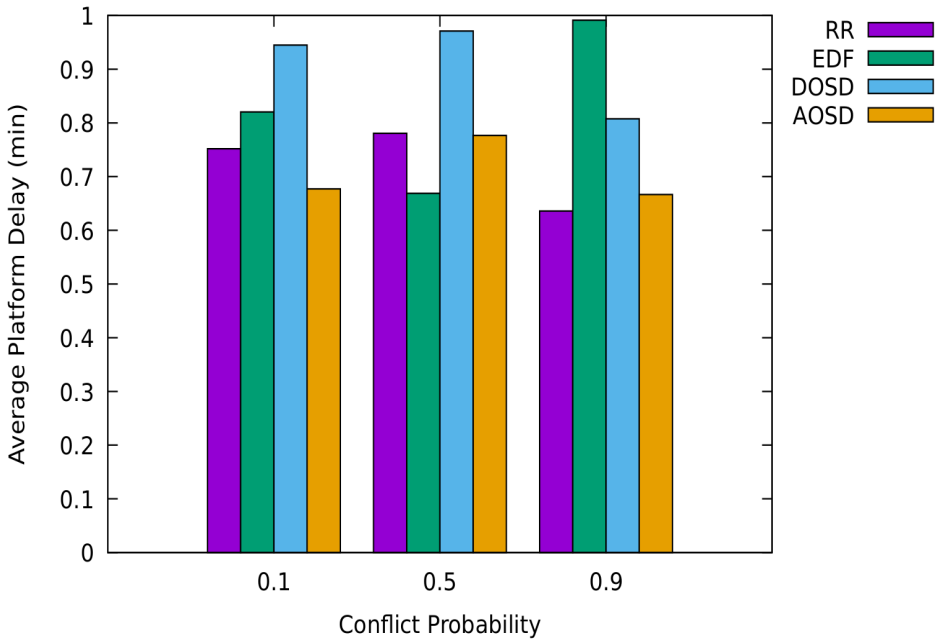
- **Job Success Rate**: Number of successful instances per 100 runs of the job

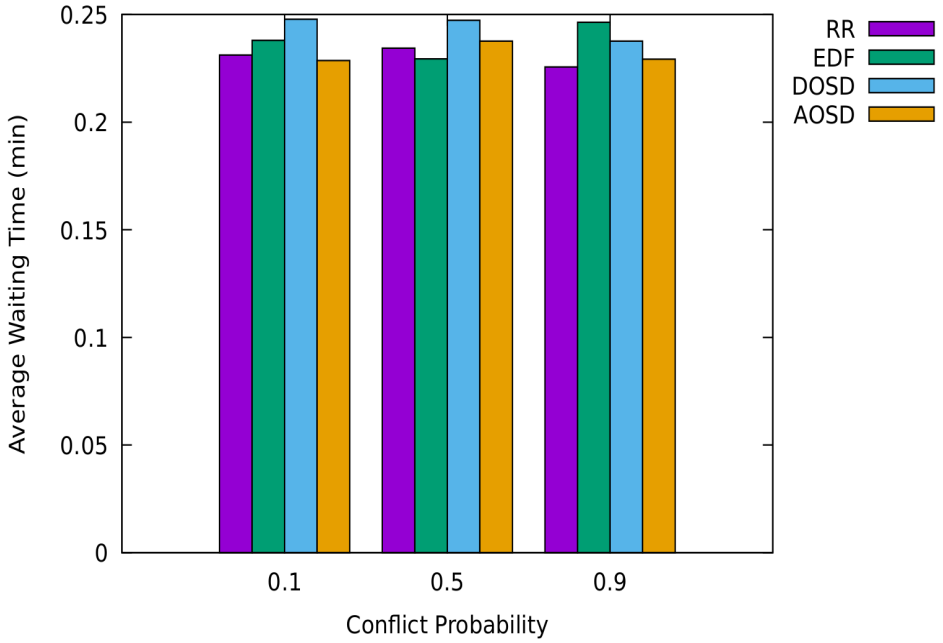
→ A near 100% success rate across all 4 topologies was achieved



Results (Cont.)

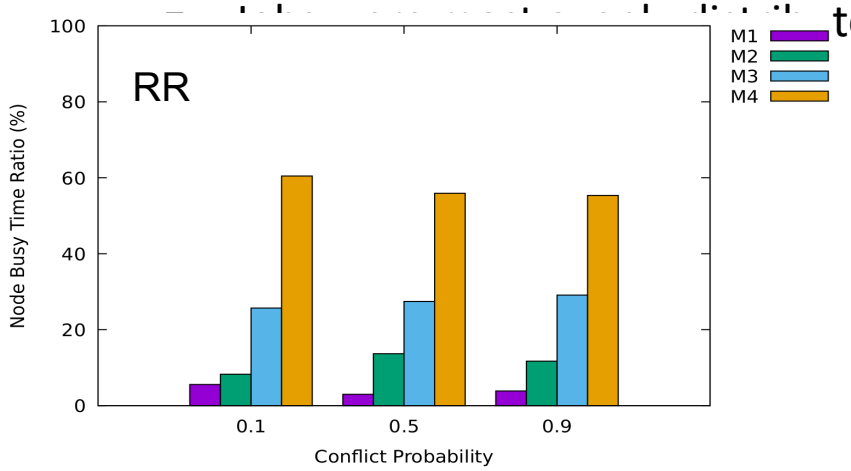
- **Average Platform Delay:** Time difference between job dispatch and result storage
- **Average Waiting Time:** Time spent by a job in waiting queue
  - Majority of the platform delay was a result of external factors

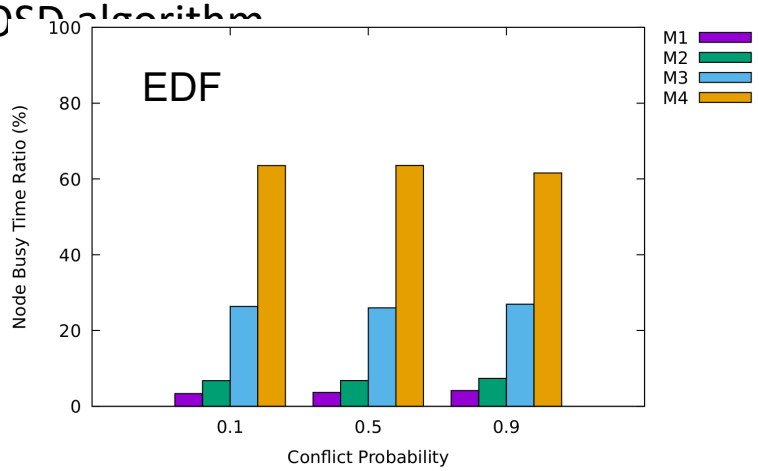


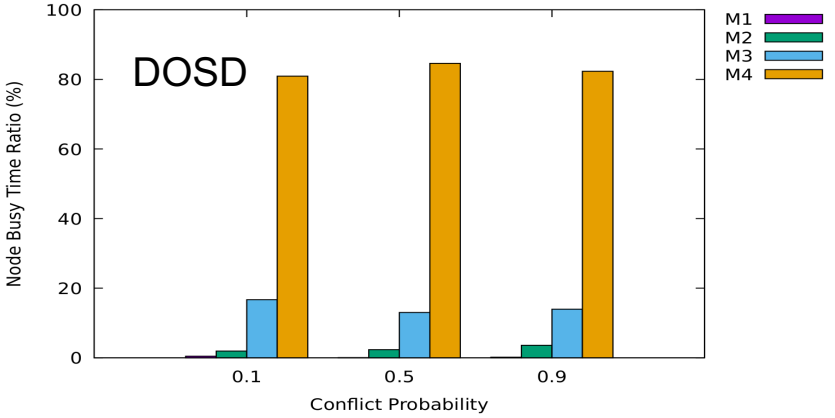


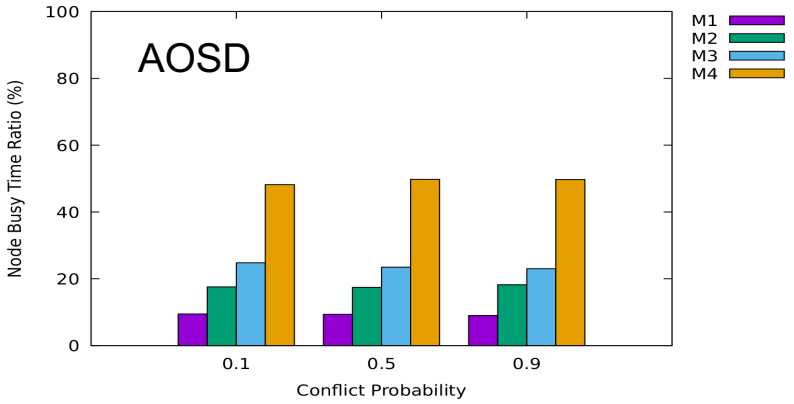
Results (Cont.)

- **Node Busy Time Ratio (NBTR)** : Fraction of time spent by a measurement node in execution of jobs



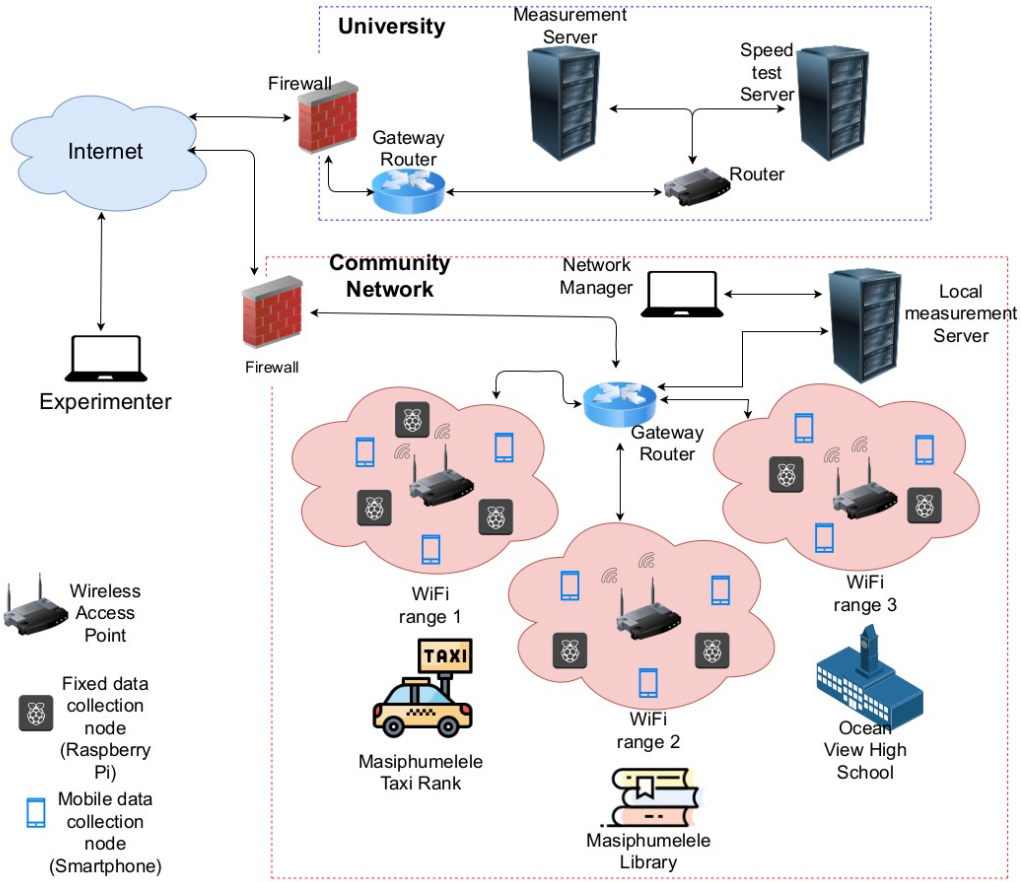






Conclusions & Future Work

- AOSD algorithm performs well with partial virtualization of the network topology
- Future Work:
  - Better network virtualization with SDNs
  - Support for on-demand measurements
  - Integration with existing iNethi [8] services



References

1. A simplified wireless community network with icn and non-icn nodes, https://www.researchgate.net/figure/A-simplified-wireless-community-network-with-ICN-and-non-ICN-nodes-The-Edge-Gateway_fig1_315977963, Accessed September 20, 2021.

2. ITU Statistics, https://www.itu.int/en/ITU-D/Statistics/Documents/statistics/2020/MobileCellularSubscriptions_2000-2019.xlsx, Accessed September 20, 2021.

3. Internet users in the world 2021, https://www.statista.com/statistics/617136/digital-population-worldwide/, Accessed September 20, 2021.

4. A. Faggiani, E. Gregori, L. Lenzini, V. Luconi, and A. Vecchio, “Smartphone-based crowdsourcing for network monitoring: opportunities, challenges, and a case study,” IEEE Communications Magazine, vol. 52, no. 1, pp. 106–113, 2014.

5. Z. Qin, R. Rojas-Cessa, and N. Ansari, “Task-execution scheduling schemes for network measurement and monitoring,” Computer communications, vol. 33, no. 2, pp. 124–135, 2010.

6. P. Calyam, C.-G. Lee, P. K. Arava, and D. Krymskiy, “Enhanced edf scheduling algorithms for orchestrating network-wide active measurements,” in 26th IEEE International Real-Time Systems Symposium (RTSS’05). IEEE, 2005, pp. 10–pp.

7. Alexa Internet, https://www.alexa.com/topsites, Accessed May 26, 2021.

8. Inethi, https://www.inethi.org.za/, Accessed September 21, 2021.

Thank you!

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