Optimizing Endorsements in the Blockchains
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Research context and motivation

- ❑ Blockchains provide an authoritative log of validated transactions without a trusted intermediary
- ❑ Blockchain-as-a-Service (BaaS) is offered by big cloud service providers
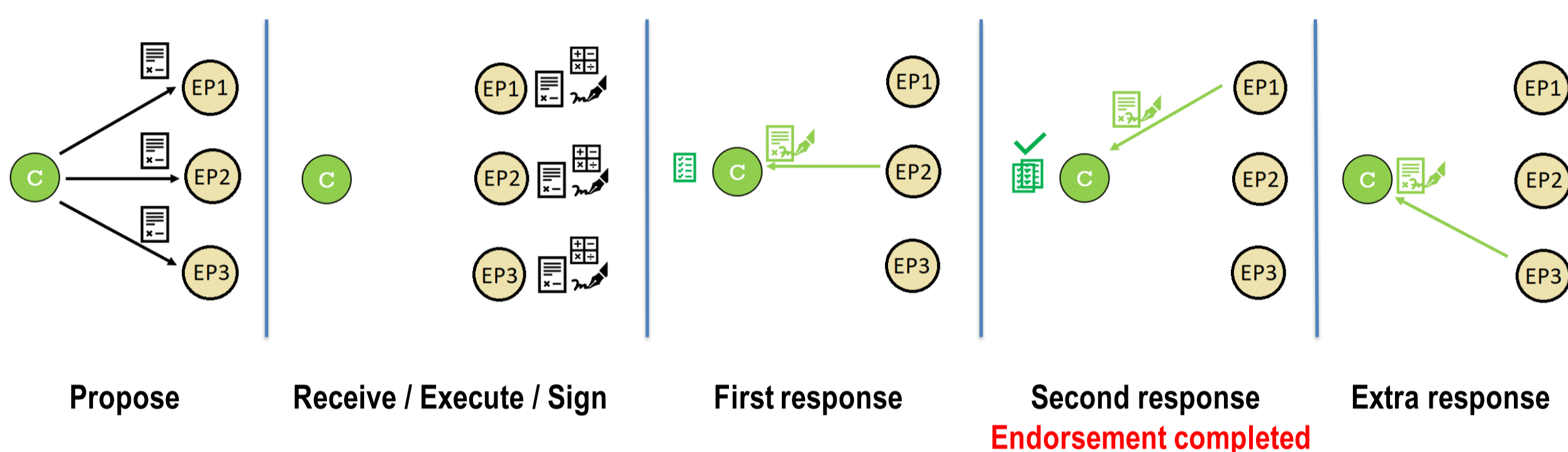- ❑ Latency is very important for real-time applications

  ➢ **Endorsements**
 - ✓ simulation of the transaction without recording the results in the Blockchain by Endorser Peers (EPs)

- ❑ An endorsement policy example:

  2-OutOf-3 EPs ⇔ OR((EP1 AND EP2), (EP1 AND EP3), (EP2 AND EP3))

| Propose | Receive / Execute / Sign | First response | Second response **Endorsement completed** | Extra response |

Addressed research questions/problems

- ❑ How to achieve lower latency in network-wide distributed Blockchains?

- ❑ Is it possible to achieve lower endorsement latency?

- ❑ An option ➡ Selecting proper/faster EPs for endorsement to achieve lower latency.
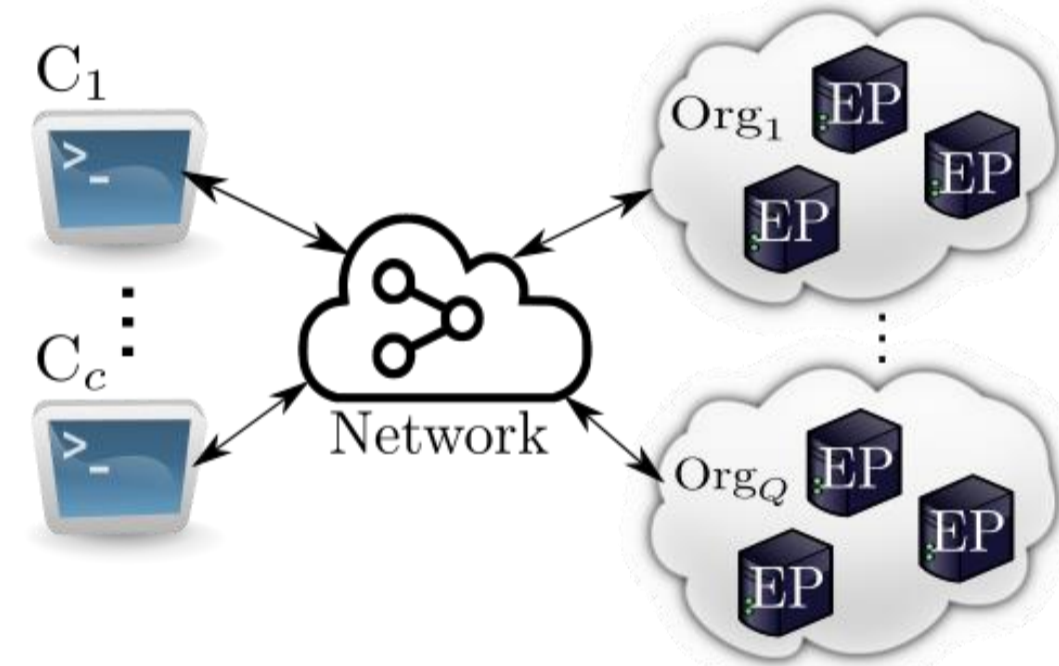
- ❑ State of the art ➡ Select the least loaded EP (DSLM)
- ✅ ➢ Reduce the endorsement processing time
- ❌ ➢ Double communication delay due to check EPs' load
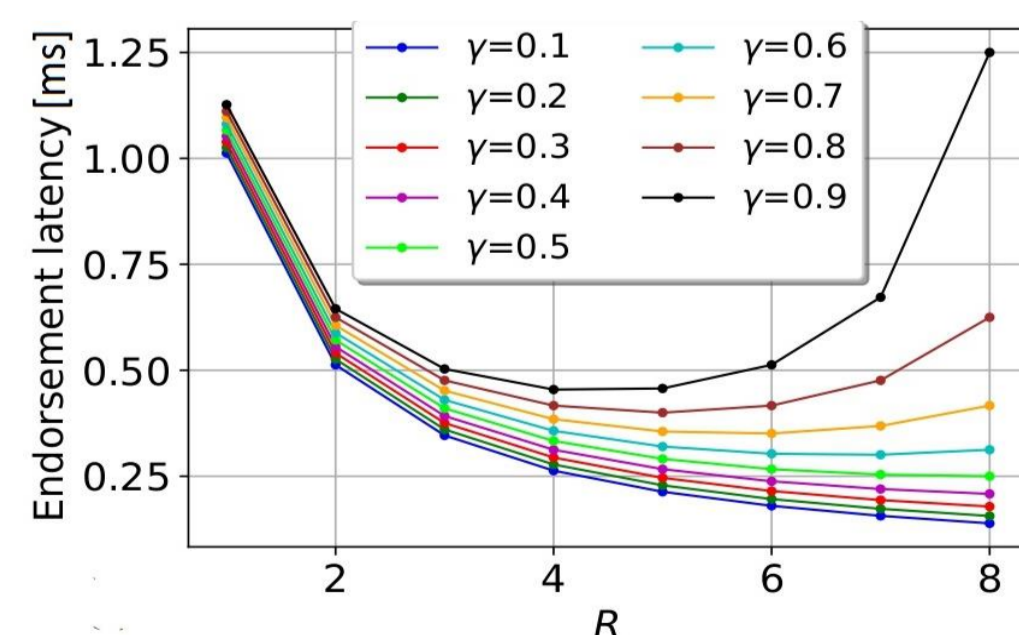- ❌ ➢ Not considering the network delays

- ❑ Is there a simpler yet more effective way?

  The value of diversity!

- ❑ Send a request randomly to R EPs (RND-R) to use the first response
  - Generally, higher R ➡ Higher chance of lower latency
  - Higher loads ➡ Reduces the latency reduction gain as queueing occurs/increases in EPs

- ❑ Variation of R for 1-OutOf-8 policy under load change where the load is normalized with respect to the maximum sustainable income rate: $\lambda = \gamma \mu$

Submitted and published works

- I. Lotfimahyari, G. Sviridov, P. Giaccone and A. Bianco, *"Data-Plane-Assisted State Replication With Network Function Virtualization"*, IEEE Systems Journal, vol. 16, no. 2, 2022, pp. 2934-2945
- I. Lotfimahyari, P. Giaccone, *"Optimal endorsement for network-wide distributed blockchains"*, Submitted to IEEE Systems Journal

Novel contributions

- ❑ OPEN (Optimized Endorsement)

  " *Latency as a Simple reputation metric* "

- ✓ Endorsement response latencies from each EP are correlated
- ✓ Age of information ➡ more recent measurements are more reliable (last response)
- ✓ No need to separate the Path-delay, EP service-time and the queueing time
- ✓ Late response from an EP ➡ The EP is busy enough to not be selected now

  " *A standard form for Endorsement policies* "

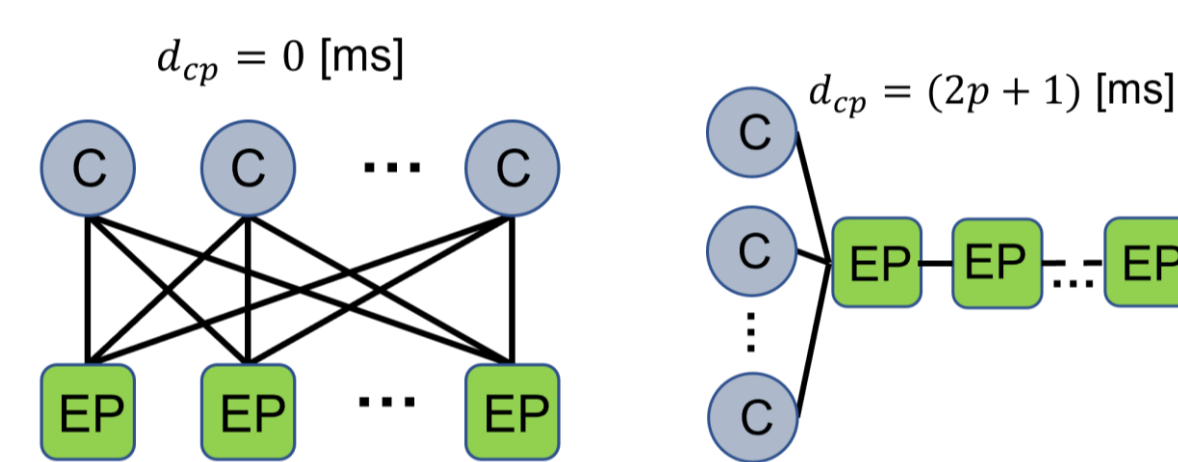- ✓ All policies made of "AND", "OR", and "-OutOF-" can be transformed to 1-OutOf-N

  " *A simple trade-off between exploration and exploitation* "

- ✓ Send to the half of the EPs with best delay estimation

Adopted methodologies

- ❑ Simultion with OMNet++, 8 Eps
- ❑ Three scenarios ➡ Two synthetic topologies and one realistic (Highwinds network)

- ❑ Comparison:
  - An online perfect competitor that knows the service times for each new TX in each EP, Optimal Oracle Delay (OOD-4)
  - L random EPs knowing the load (RND-L)
  - Randomly selected half of the EPs (RND-4)
  - Dynamic Stochastic Load Minimization (DSLM)
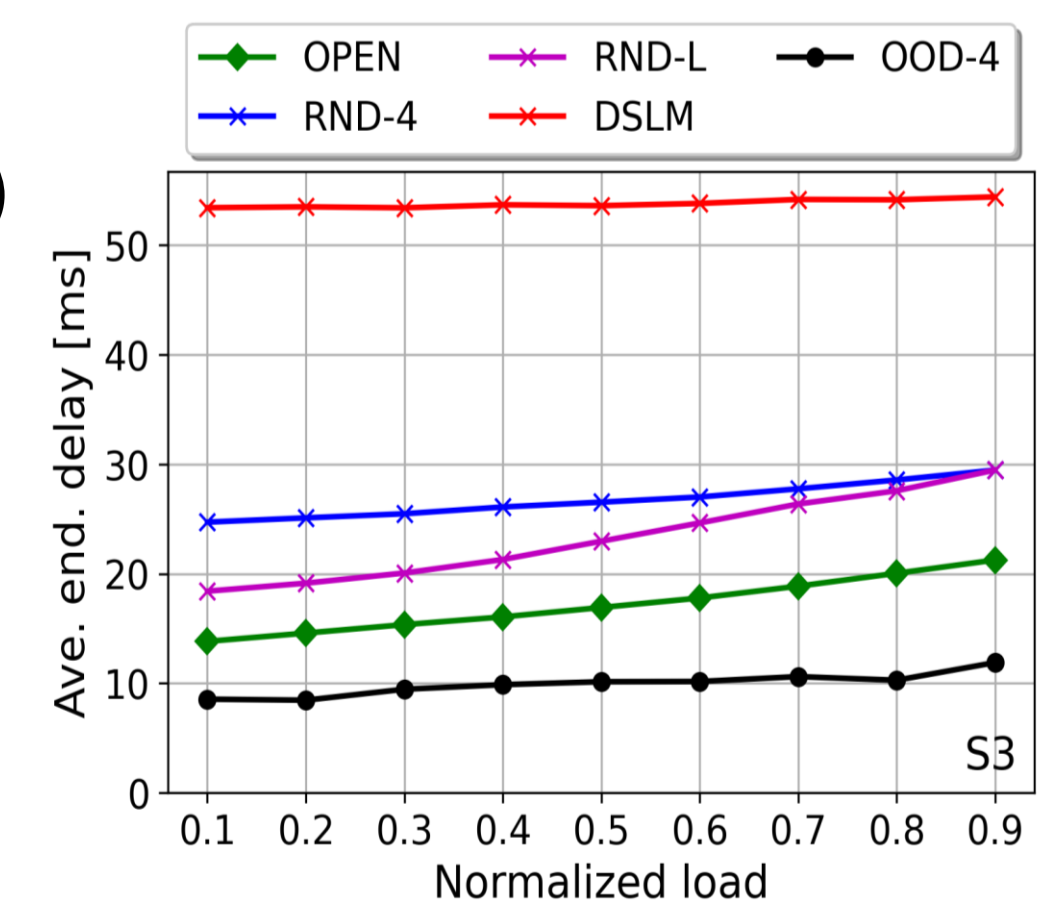
- ❑ OPEN
  - \# is close to OOD and outperforms DSLM and RND-4
  - \# is load oblivious compared to RND-L which is not practically implementable

Future work

- ❑ Selection of the best EPs with a dynamic number of EPs
- ❑ Implementation in Hyperledger Fabric and experimental validation

List of attended classes

- 01QTEIU – Data mining concepts and algorithms (01/02/2021, 4/)
- 02QUBRS – Statistical data processing (04/02/2021, 4/)
- 01TRARV – Big data processing and programming (08/03/2021, 4/)
- 01TSLRO – Innovative solutions for electric and/or hybrid vehicles (19/05/2021, 3/)
- 01UJVRS – IoT platforms for spatial analytics in smart energy systems (12/07/2021, 5/)
- 01TSBRV – Data science applied to complex networks (23/07/2021, 4/)