Analyzing the Performance of the Inter-Blockchain Communication Protocol

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BLOCKCHAIN PROJECT ECOSYSTEM

compound

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Cross-chain communication

- **Communication between different blockchains enables:**
  - Cross-chain payments
  - Cross-chain contracts
  - External data queries and price feeds
  - Off-chain computation

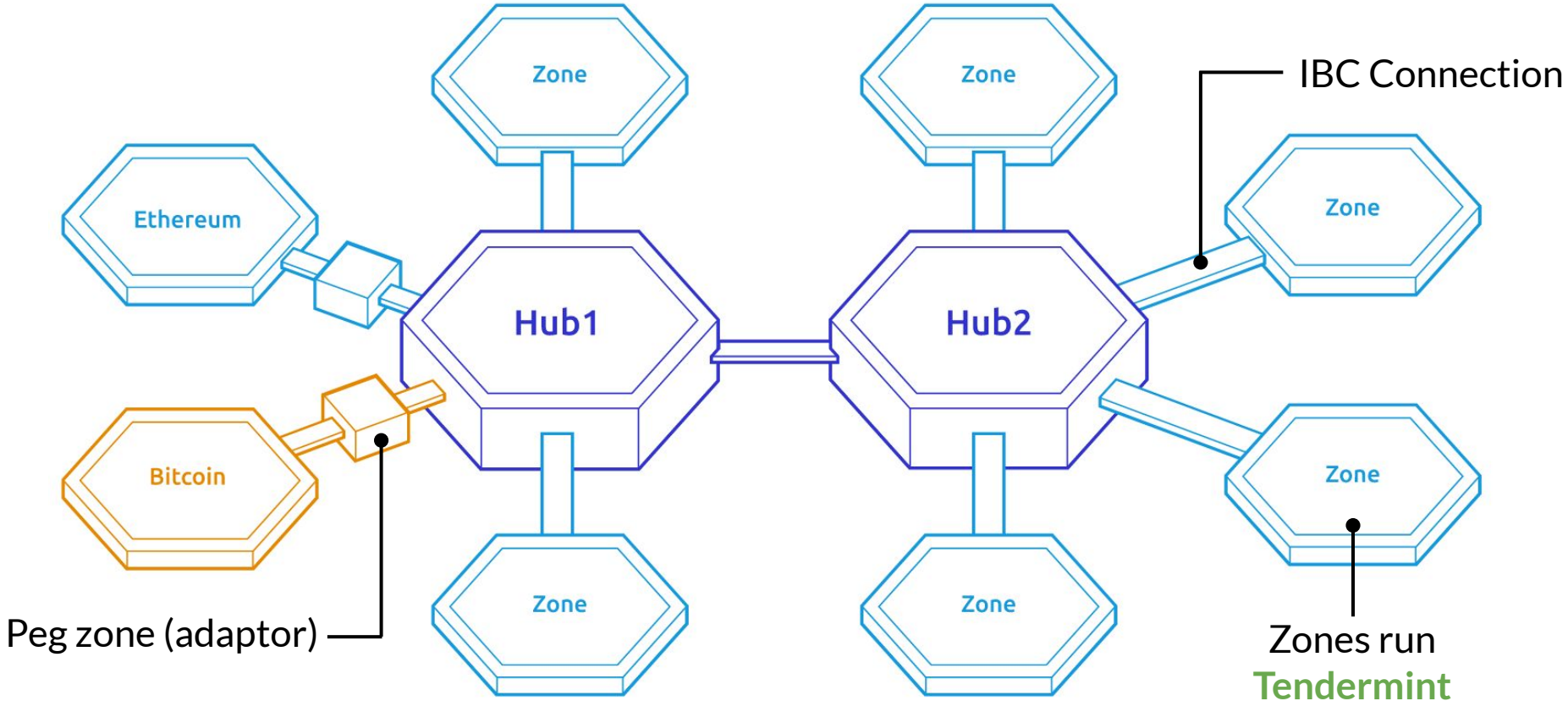
How to achieve cross-chain communication?

COSMOS

Polkadot

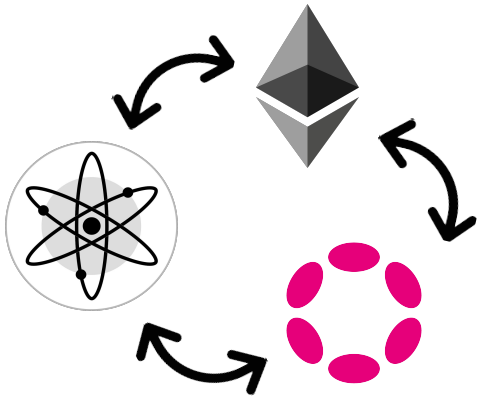
Interledger

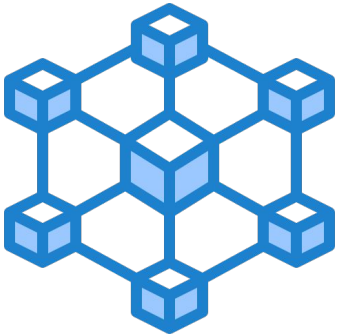
The Cosmos Network



Why Cosmos IBC?

$30.3 Billion (2022)





59 connected blockchains

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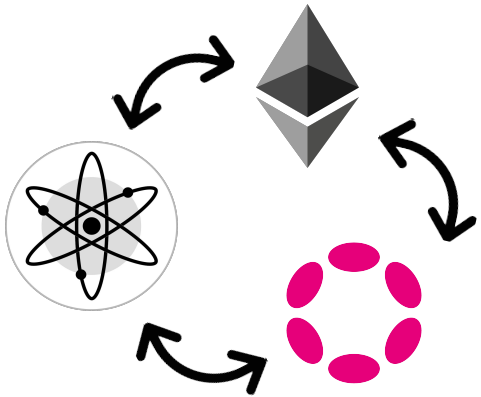

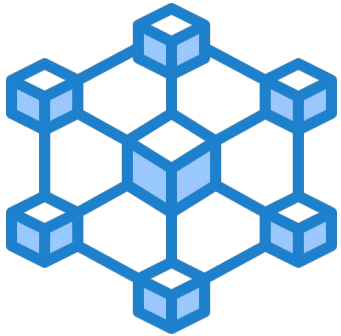

59 connected blockchains

But there's still a lack of studies on IBC and cross-chain protocols

Our work and contributions

- Proposed a **novel framework** to guide the evaluation of cross-chain protocol performance

- Conducted a **comprehensive analysis** of the performance of IBC:

  - Using two relayers **reduces cross-chain throughput by 33%**
  - Identified bottlenecks that can **hinder the performance by 70%**
  - Identified **strategies to reduce** cross-chain transfer latency

- **Identified challenges** associated to deploying the IBC protocol

- Provided a **158GB dataset** and **analysis tool** to aid future research

A brief introduction to IBC

The Inter-Blockchain Communication Protocol (IBC)

IBC handles ***authentication***, ***transport*** *and* ***ordering*** of opaque data packets

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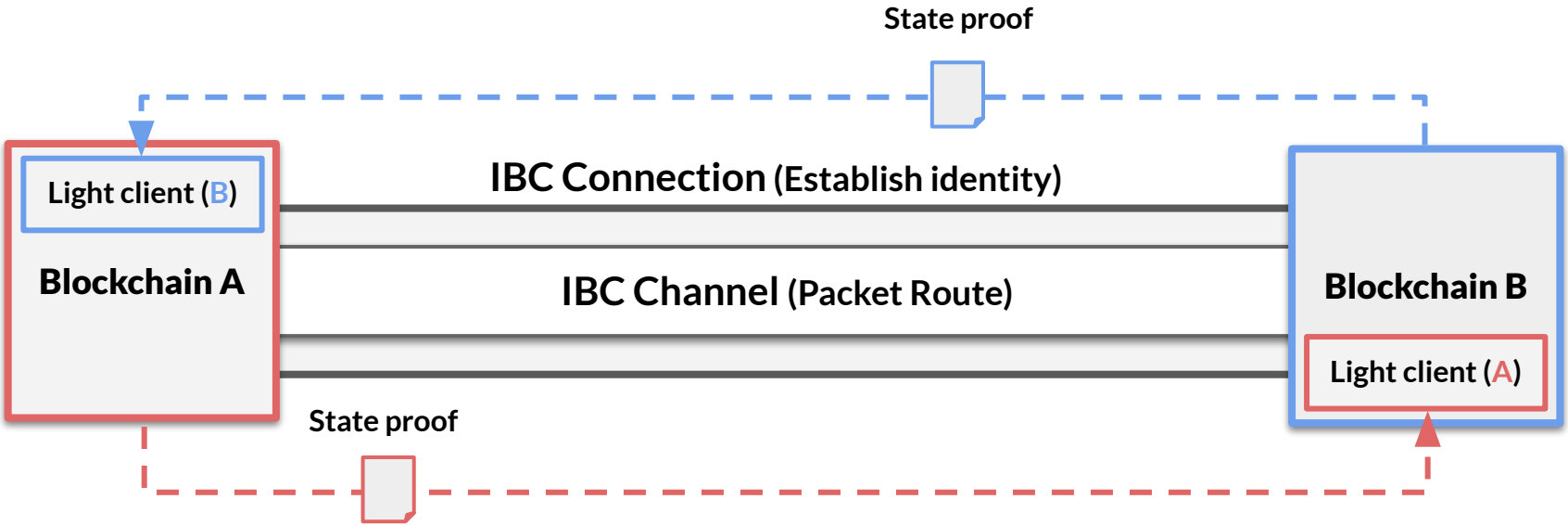
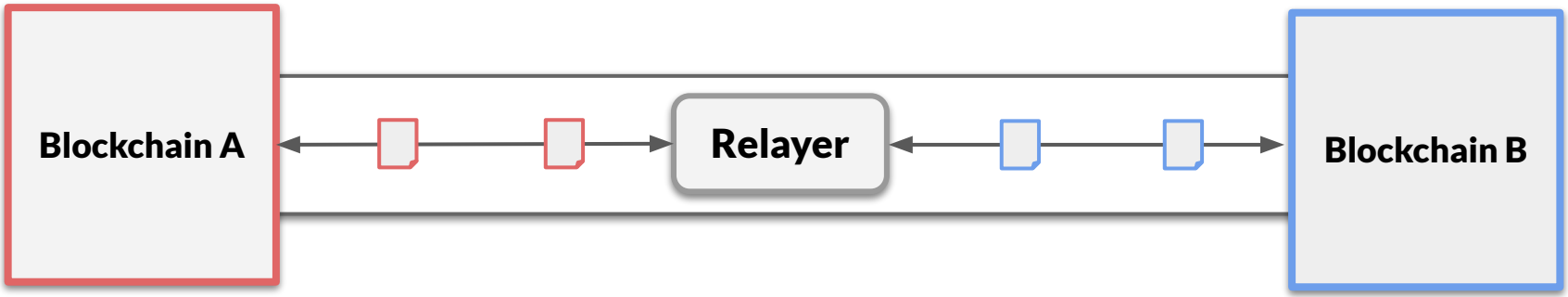


IBC messages are sent through IBC Channels

The Inter-Blockchain Communication Protocol (IBC)



The relayer monitors chains and delivers IBC packets

Cross-chain performance evaluation framework

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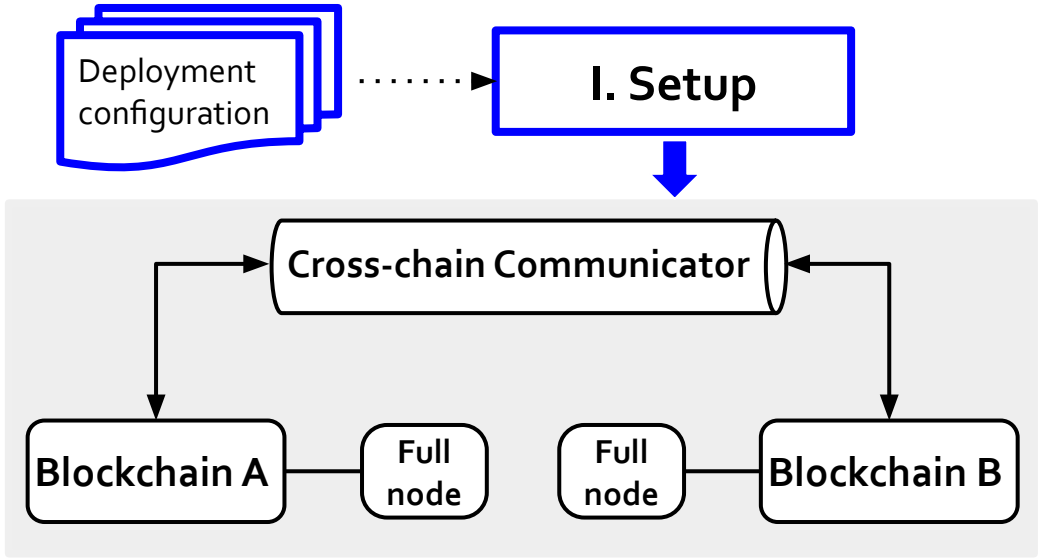

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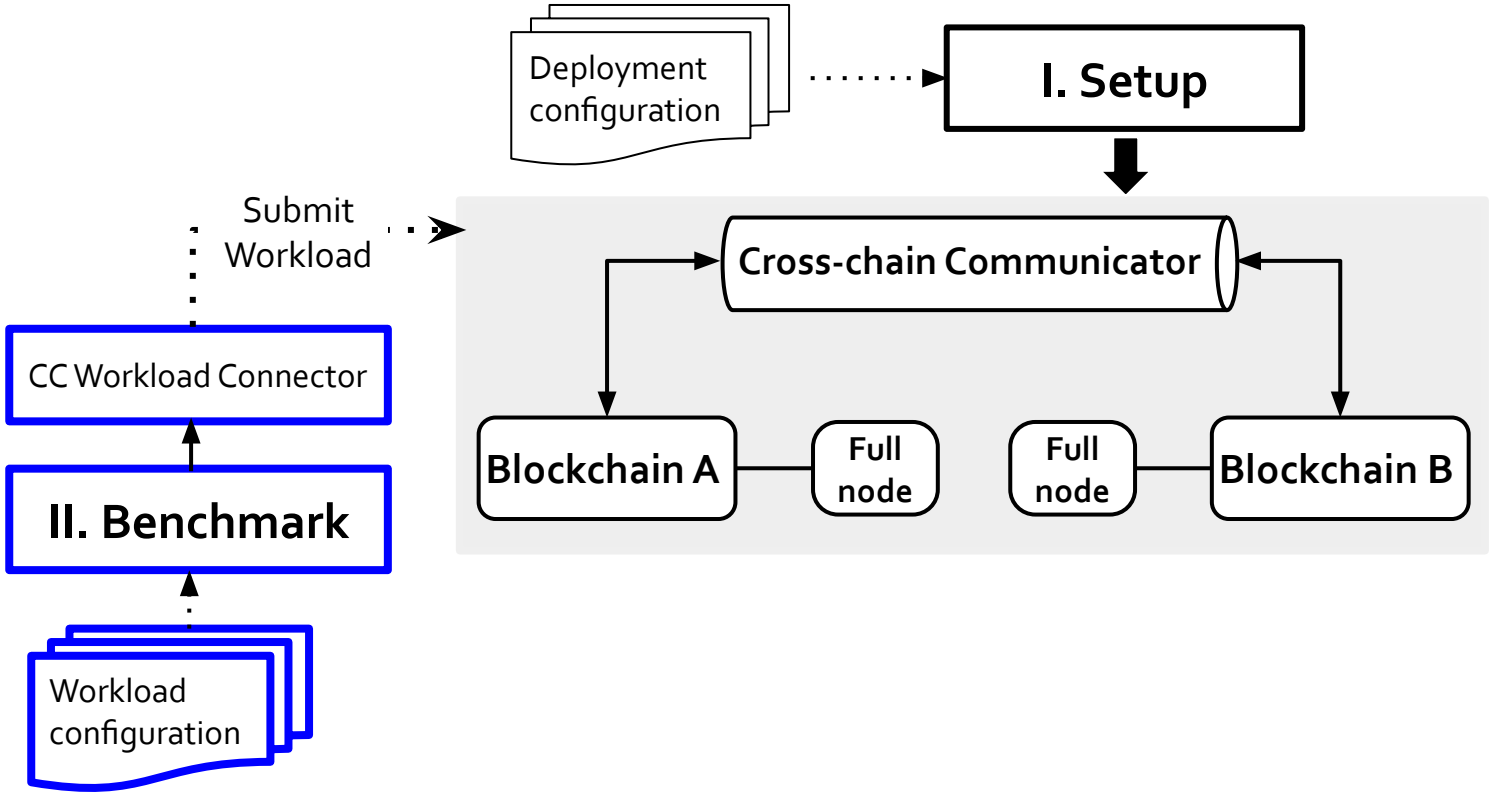

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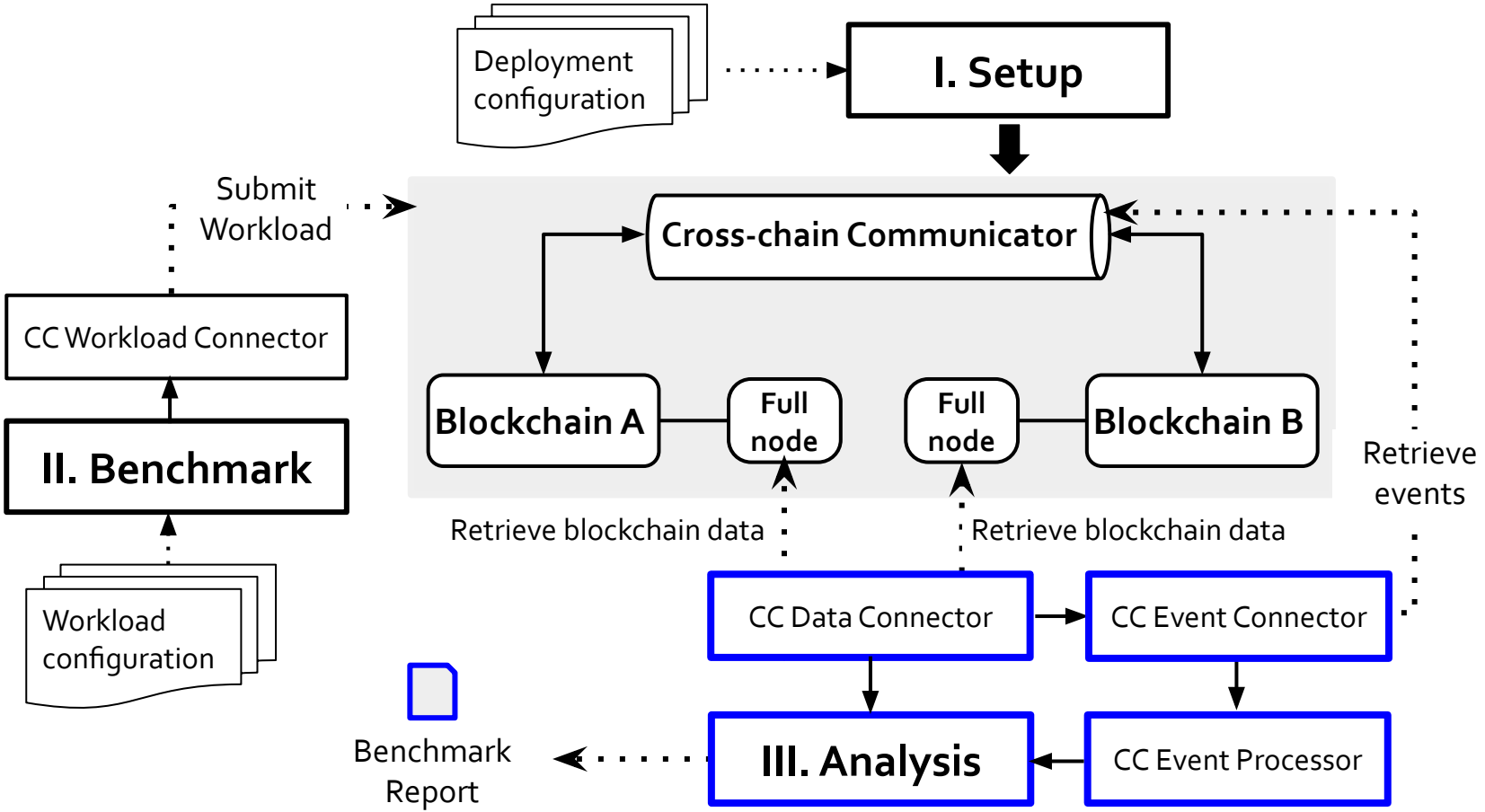
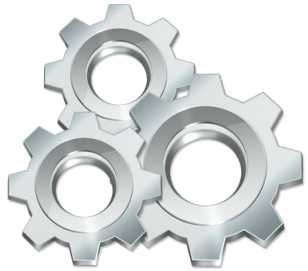


IBC protocol performance analysis

Experimental settings

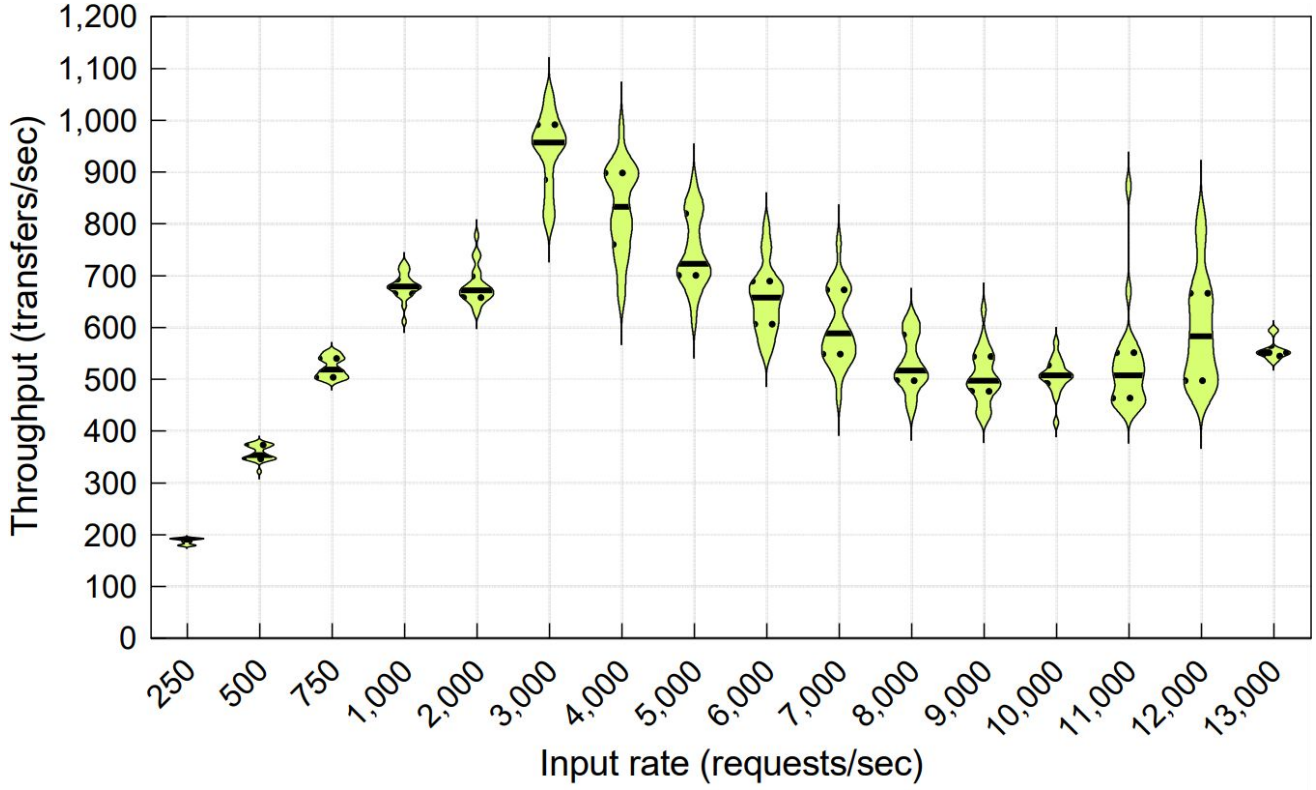
- **Setup:**
  - Two *Cosmos Gaia* blockchains (Tendermint consensus, 5 validators each)
  - 5 seconds block interval (similar to Cosmos Hub, Osmosis)
  - *Hermes Relayer* v1.0 (Rust-based IBC Relayer)
  - 200ms simulated round-trip simulated latency
- **Workload:**
  - Fungible token transfers (***transfer, receive, acknowledge***)
  - 1 blockchain transaction contains 100 IBC messages



Total experiment time: 460 hours

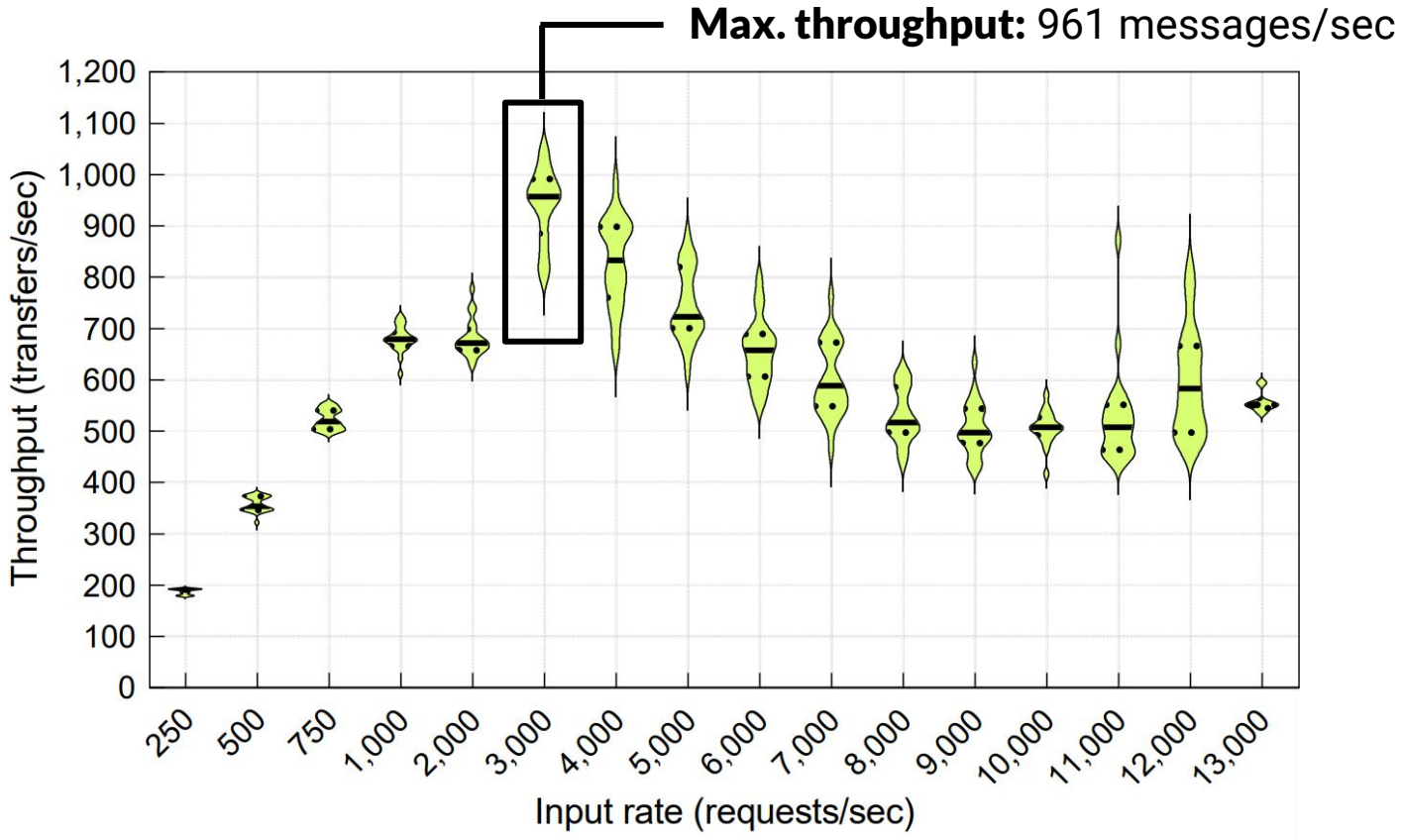
Data analysed: 158 GB

Tendermint blockchain throughput



20 executions per data point

Tendermint blockchain throughput



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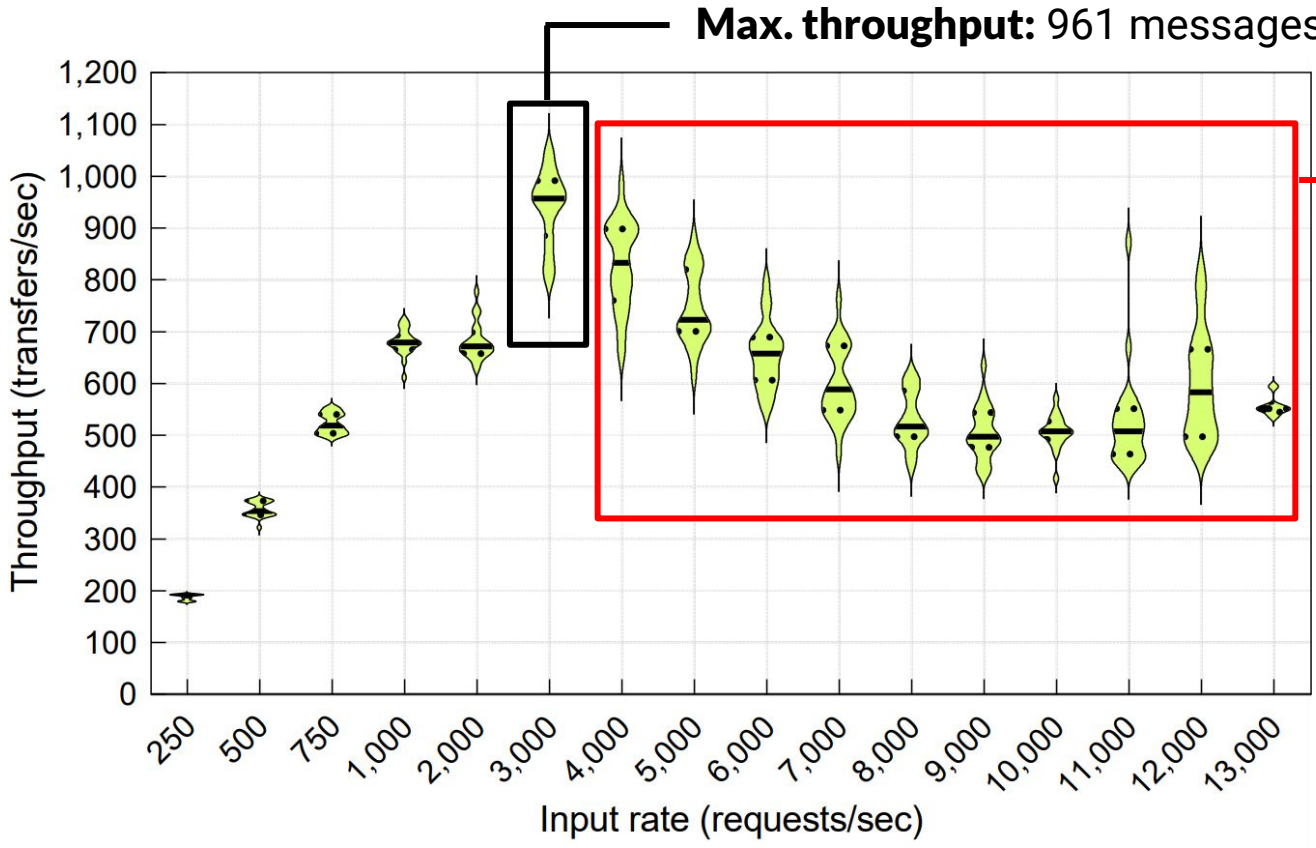


Inconsistent performance:

"failed tx: no confirmation"

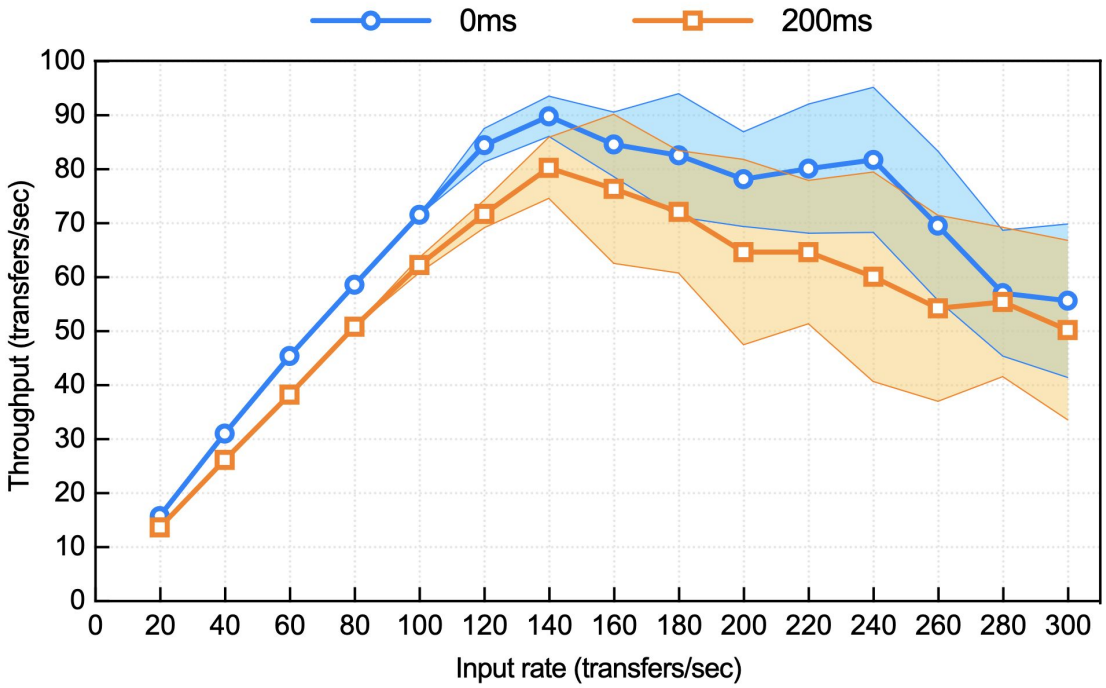
"account sequence mismatch"

20 executions per data point

Cross-chain transfer throughput

One packet relayer

- Executions span **50** consecutive blocks
- 20 executions for each data point
- **Max. throughput:** 80 transfers/s with 200ms latency
- Tendermint can process 961 messages/s



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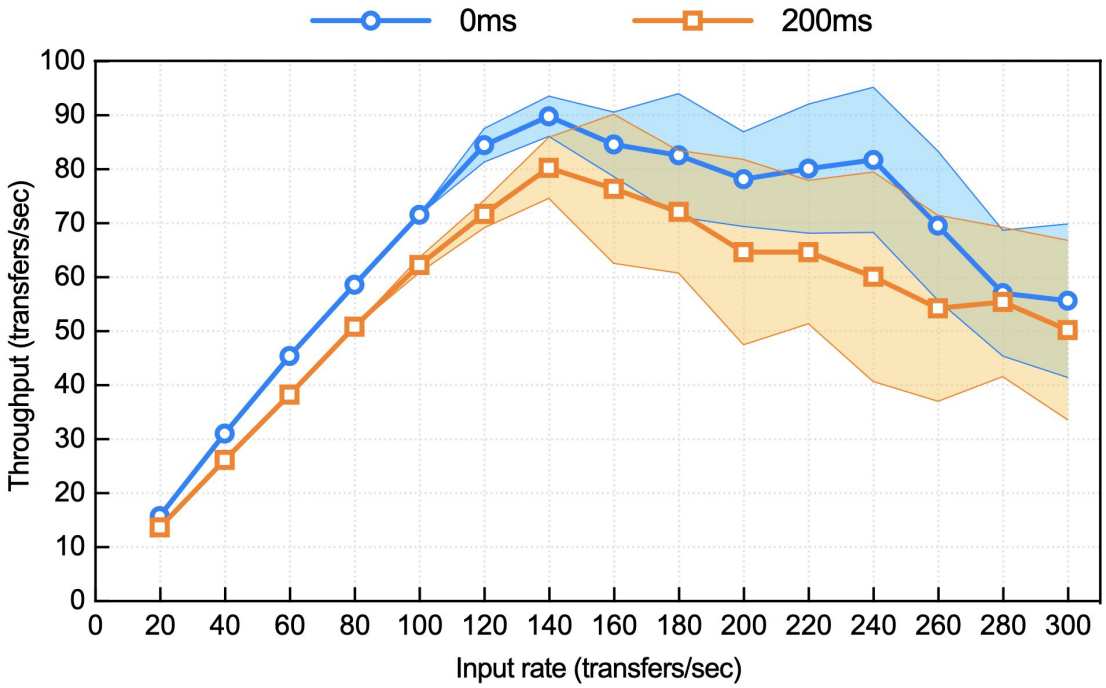

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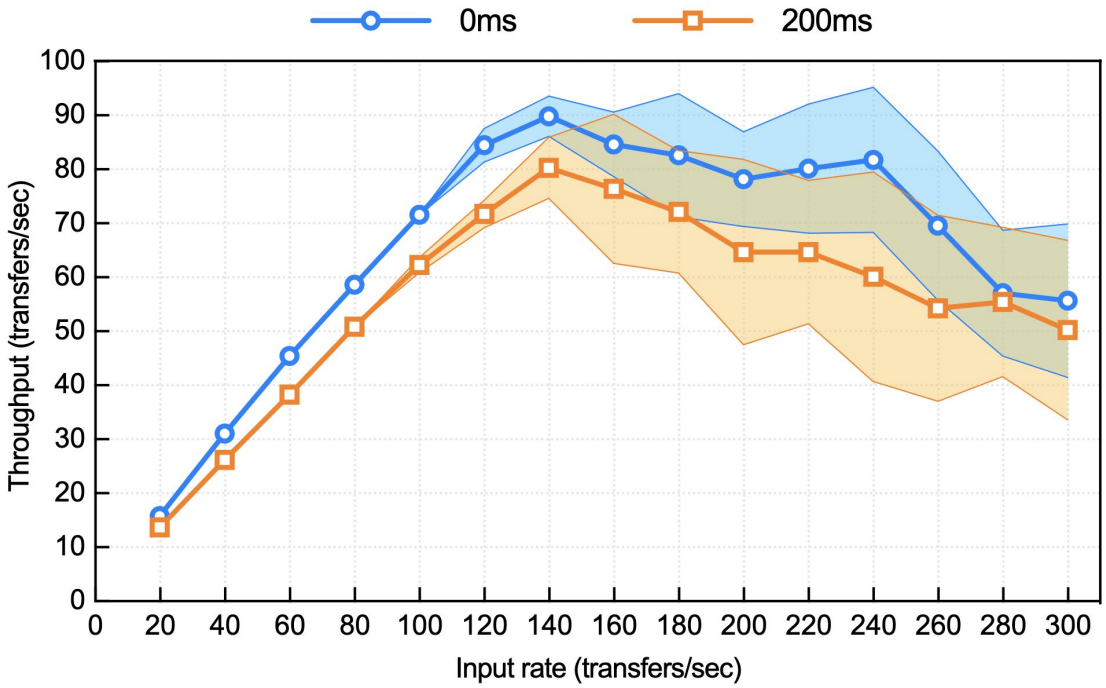

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✗ **Different channels lead to different, non-fungible token representations**

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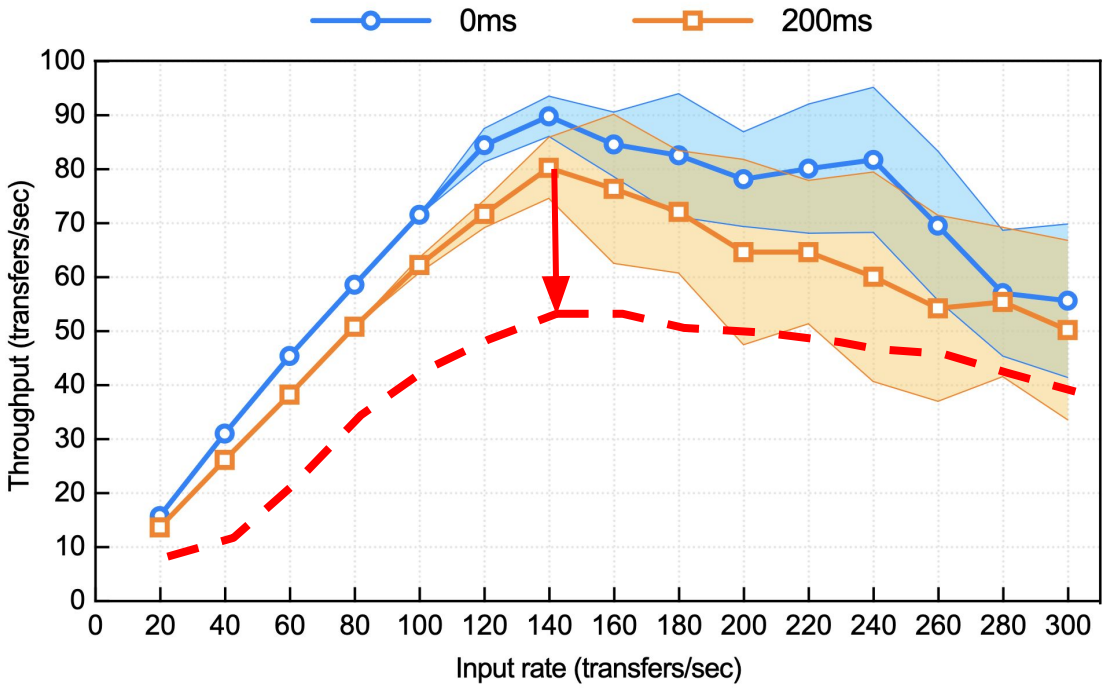
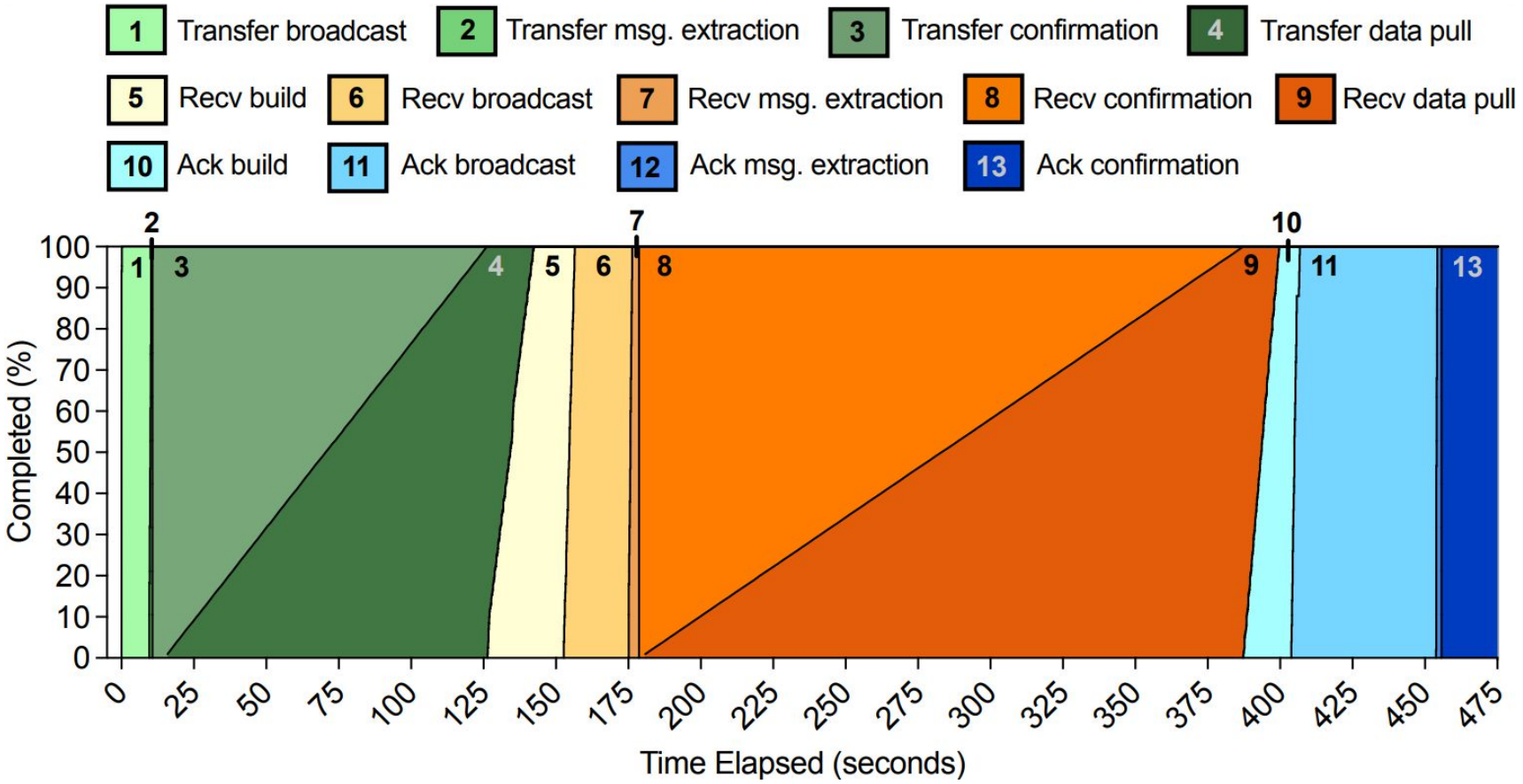


Can throughput be increased with more relayers or channels?

Two relayers reduce performance by 33% due to redundant packet delivery

Cross-chain operations breakdown (5,000 transfers)



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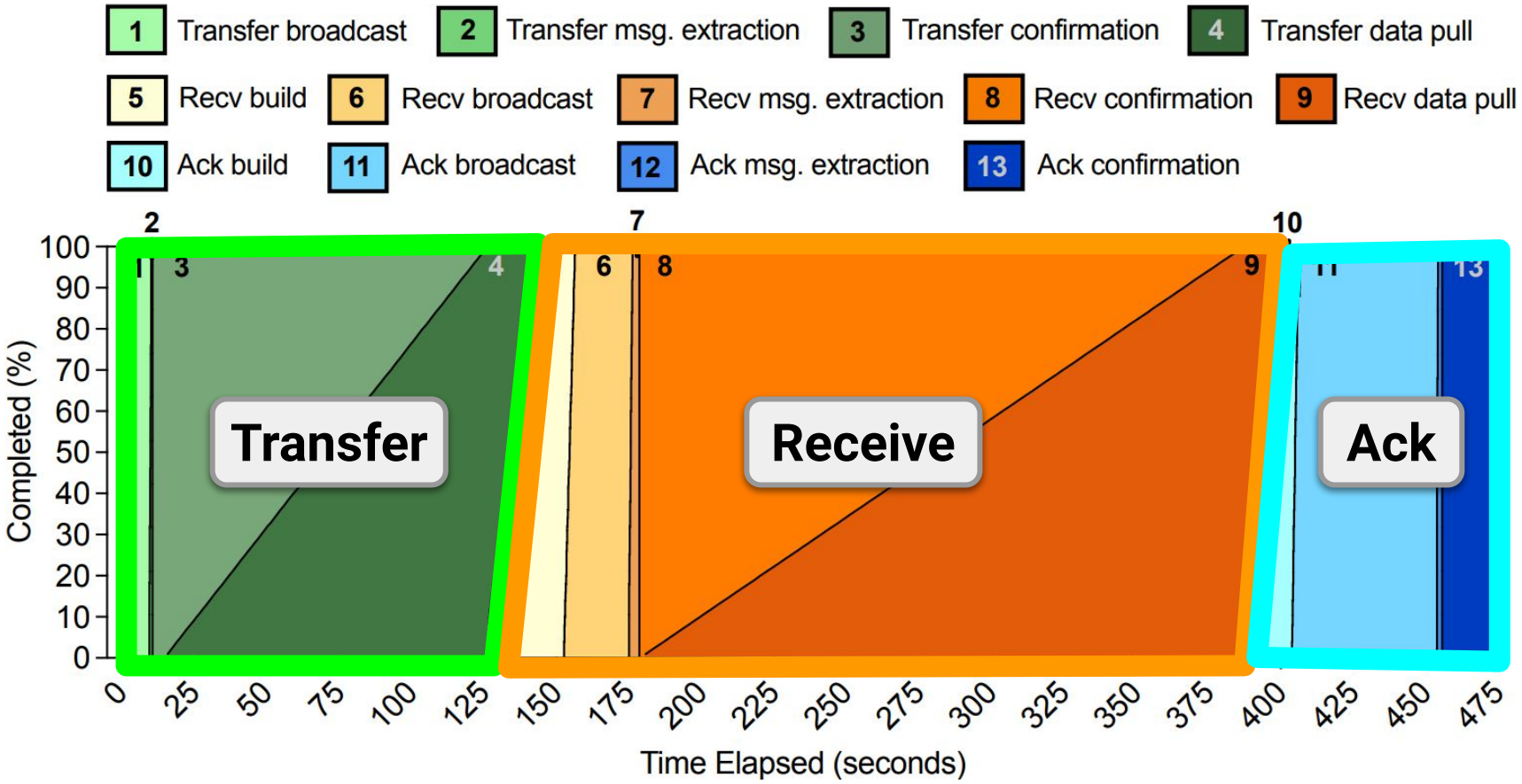

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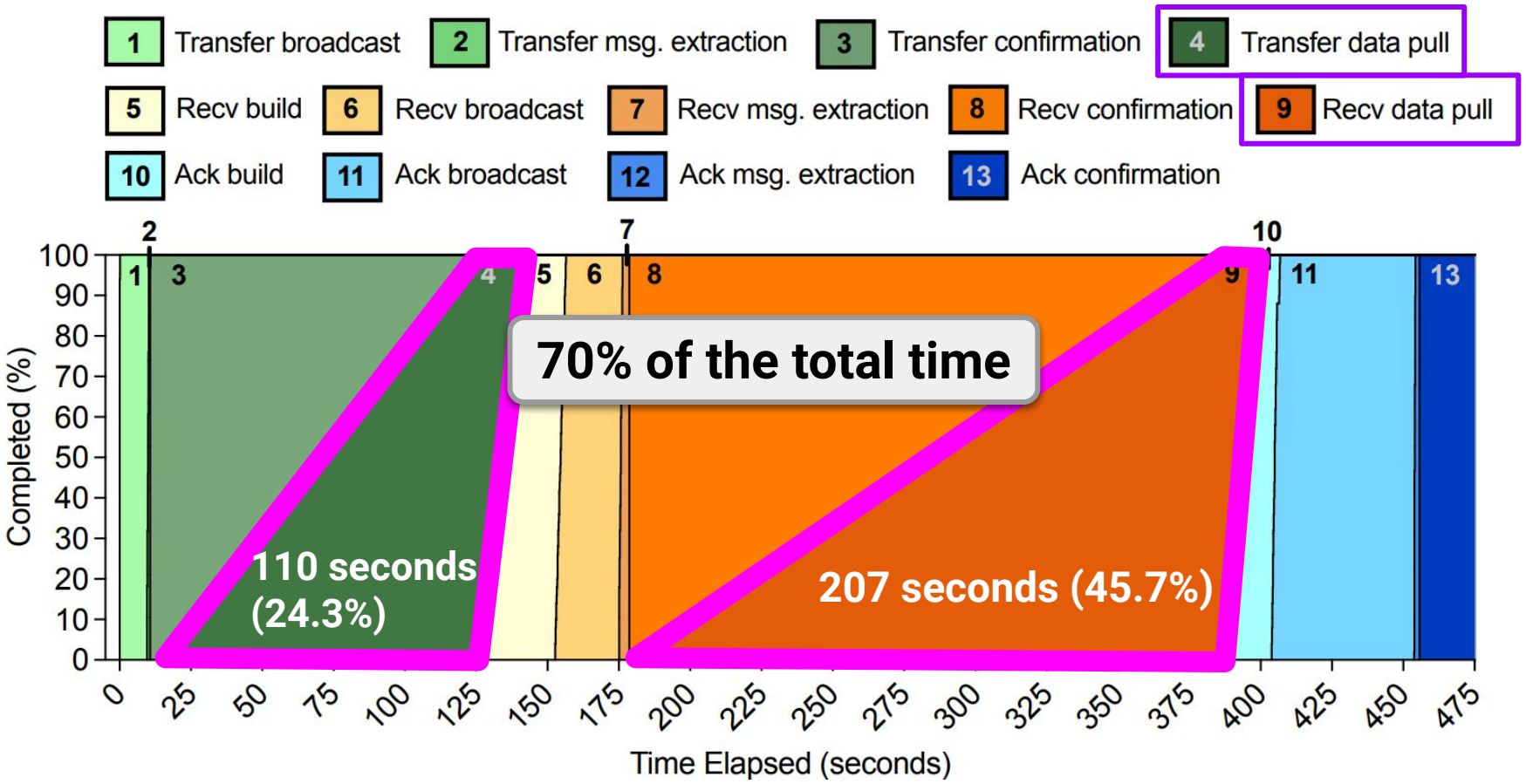


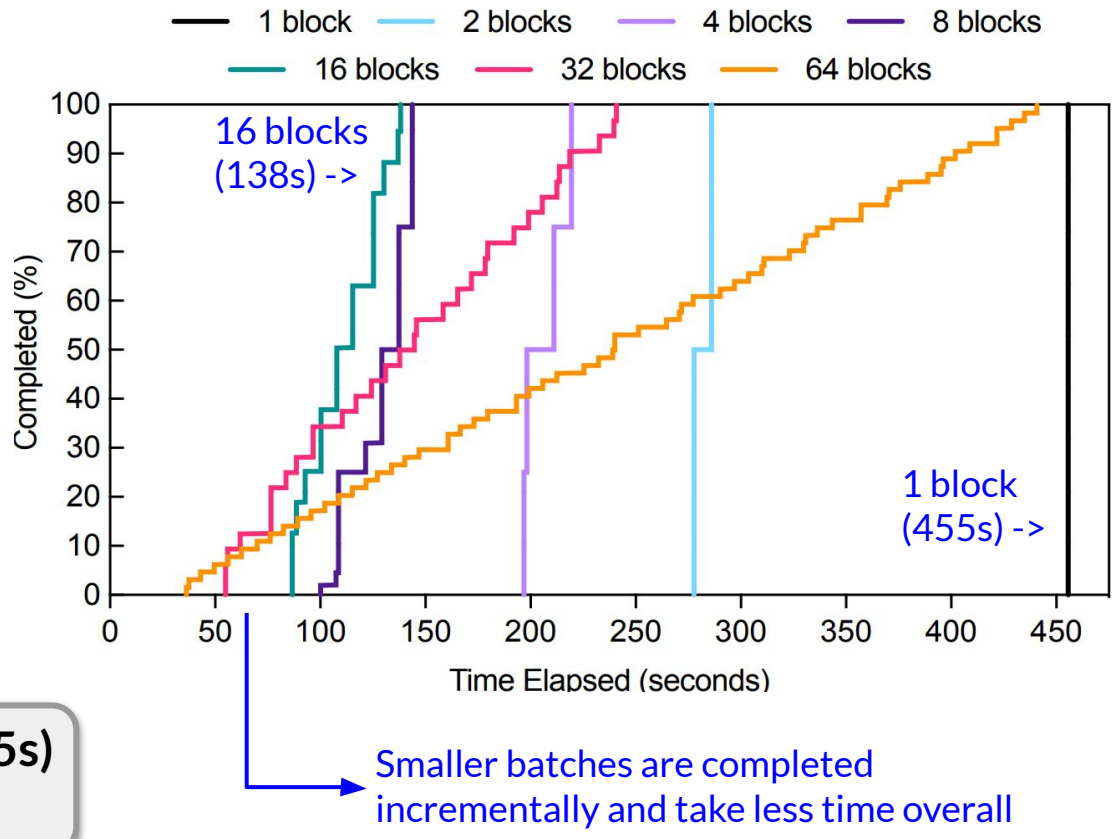
Reducing completion latency (5,000 transfers)

Can we reduce completion latency?

Divide into more blocks:

1 block: 455 sec
↓ **2 blocks:** 286 sec
↓ **4 blocks:** 219 sec
↓ **8 blocks:** 143 sec
↓ **16 blocks:** 138 sec
↑ **32 blocks:** 240 sec
↑ **64 blocks:** 441 sec

70% reduction from 1 block (455s) to 16 blocks (138s)



What can we learn from the results

- **Blockchains are evolving fast, but this should not lead to a compromise on quality when designing systems**

- **Need to leverage existing research and knowledge**
  - Not every problem needs a completely new solution
  - Leverage existing solutions (parallel queries, scalability)

- **Testing is software is crucial to find ways to improve**

That’s all!

I’m looking for jobs!

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