Byzantine Reliable Broadcast with signatures

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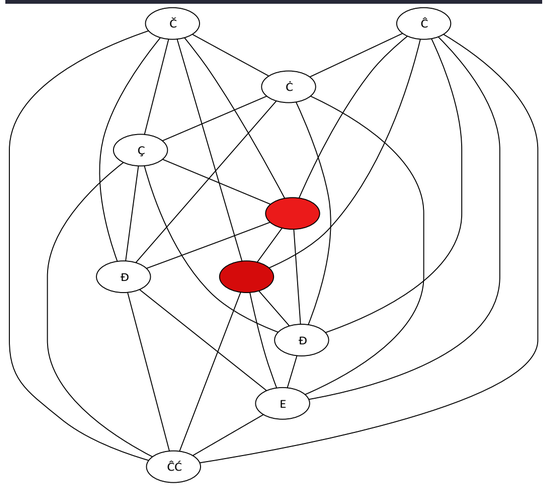
(1) Background

- **BRB –** Broadcast to entire network in the presence of Byzantine nodes, where the broadcaster can also be Byzantine
- **Reliable Communication -** Broadcast to entire network in the presence of Byzantine nodes, where the broadcaster cannot be Byzantine.
- **Bracha's algorithm –** BRB in fully connected networks
- **Dolev's algorithm –** RC in 2f+1- connected networks
- **Bracha-Dolev –** BRB in 2f+1 connected networks

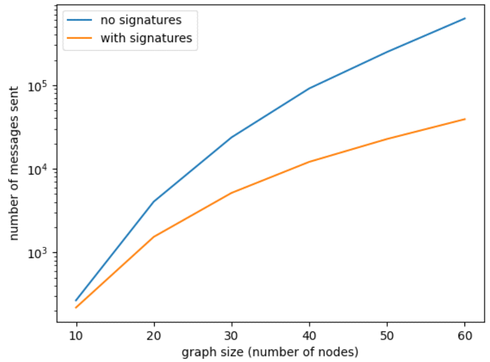


Example network. Red nodes are Byzantine.

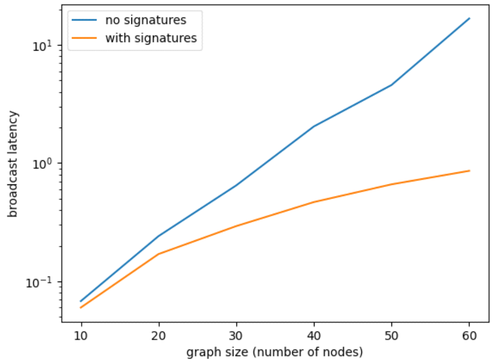
(2) Objective

Use Digital Signatures to reduce the number of messages sent by Bracha-Dolev

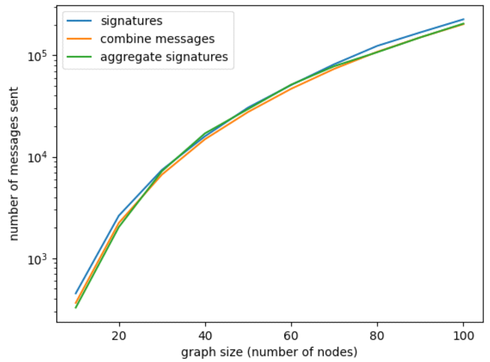
(5) Results



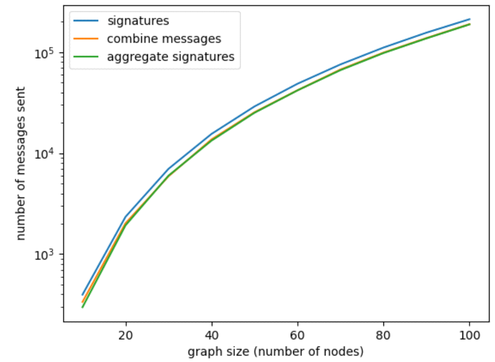
Comparison of **message complexity** between Bracha-Dolev with signatures and without.



Comparison of **broadcast latency** between Bracha-Dolev with signatures and without.



Comparison of **message complexity** between the different modifications, **without** the "stop after Bracha-deliver modification".



Comparison of **message complexity** between the different modifications, **with** the "stop after Bracha-deliver modification".

(3) Improvements made

- **Signatures** – Use signatures instead of paths to validate messages.
- **Combining messages** - When needing to broadcast one message and forwarding another in the Dolev layer, create a message with multiple signatures, each representing one message.
- **Aggregate or Multi- signatures** – Combine messages, but use aggregate or multi signatures to have 1 or 2 signatures instead of n. Where n is the number of messages combined.
- **Stop participating after Bracha-Deliver –** After a node has Bracha-Delivered, it can stop participating in the protocol.

(4) Evaluation setup

- The modifications were implemented in Kotlin.
- Each node has multiple message handlers running concurrently to handle messages.
- When testing, multipole nodes are launched on the same computer.
- The different nodes communicate through queues.

(6) Future Work

Combine signatures, trusted execution environments and sharding to further increase performance.

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