Balancing Gossip Exchanges in Networks with Firewalls

J. Leitão, R. van Renesse and L. Rodrigues

IPTPS 2010
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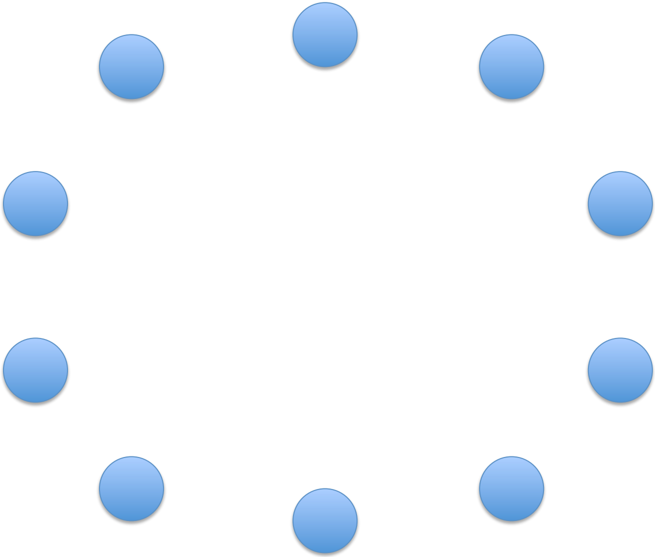
Outline

Introduction

Scope

- Gossip protocols:
    - Very flexible.
    - Easy to implement.
    - Scalable.

Introduction
Gossip protocols



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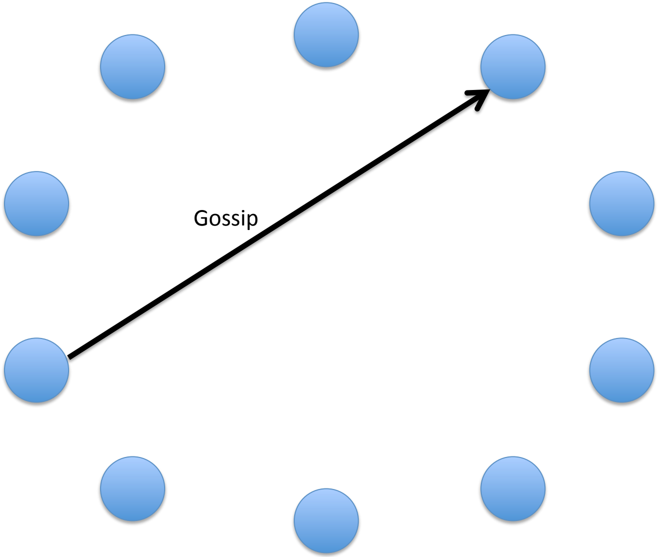

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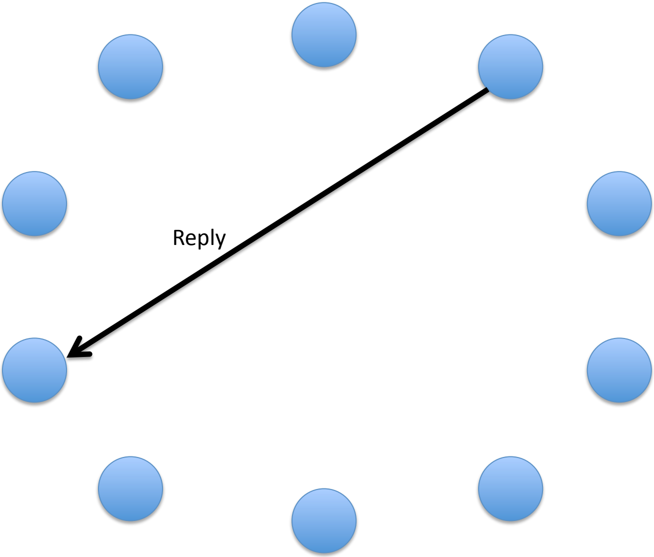

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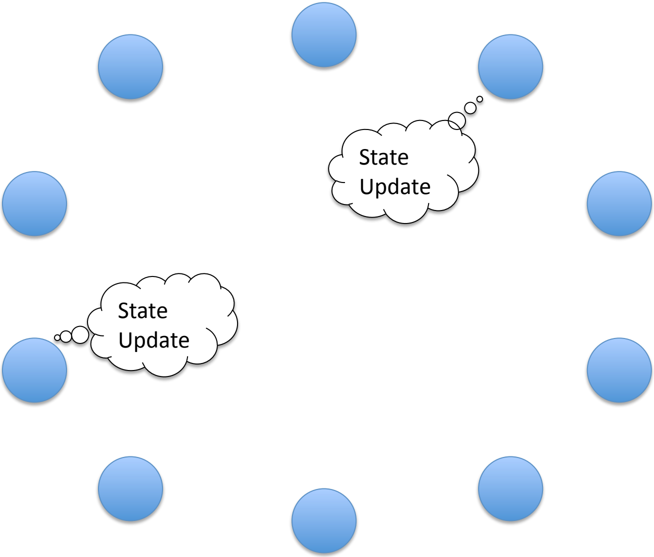

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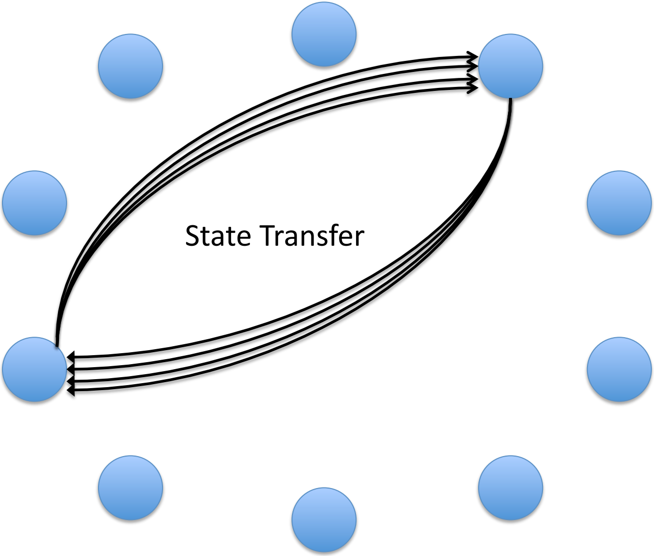

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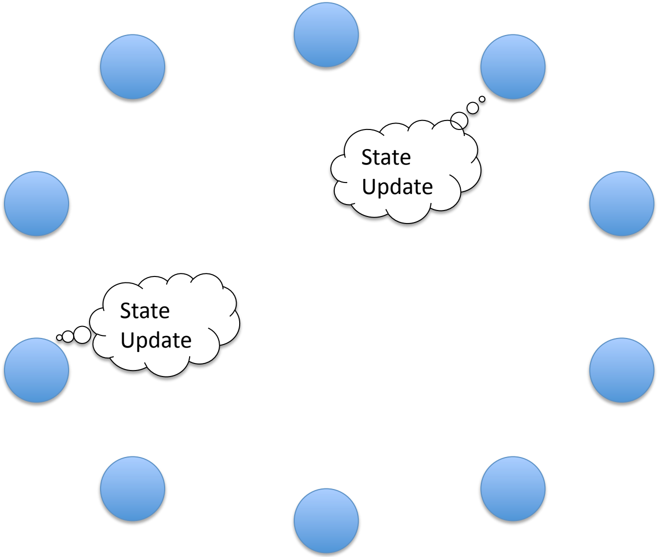

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Inherent load-balancing properties

Every participant will engage in a similar number of gossip exchanges.

Load Balancing...

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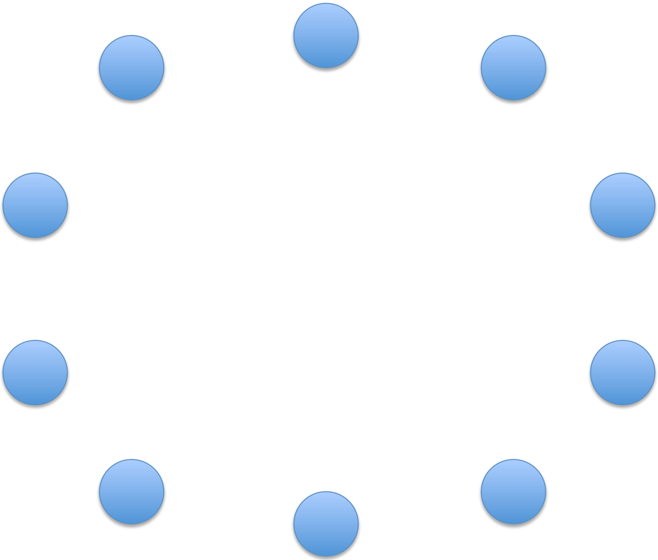

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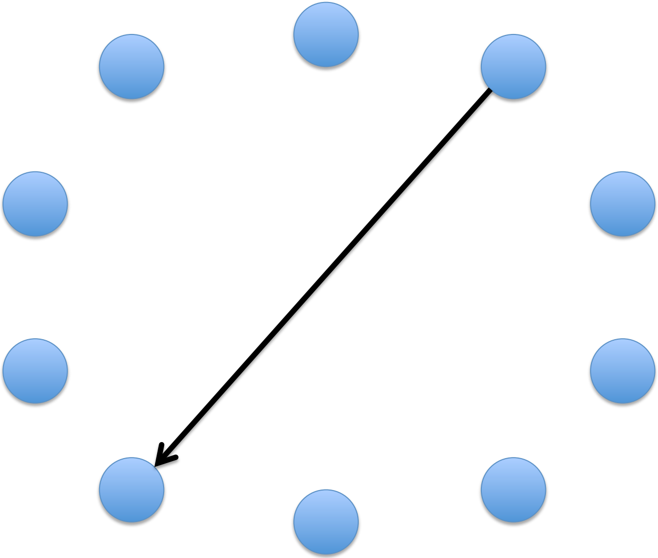

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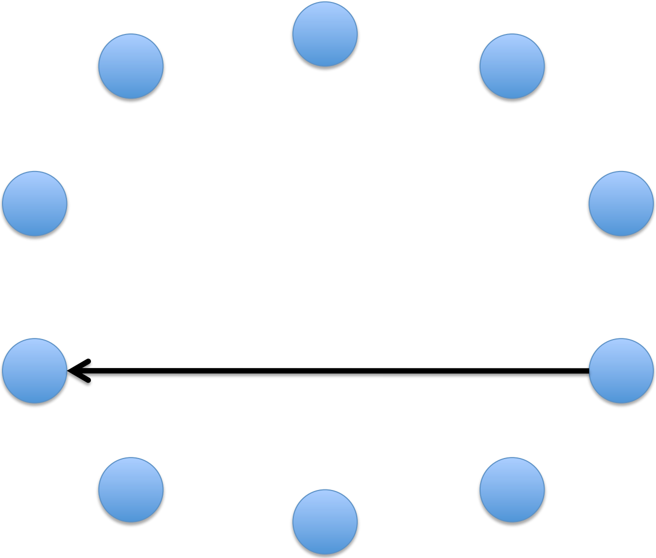

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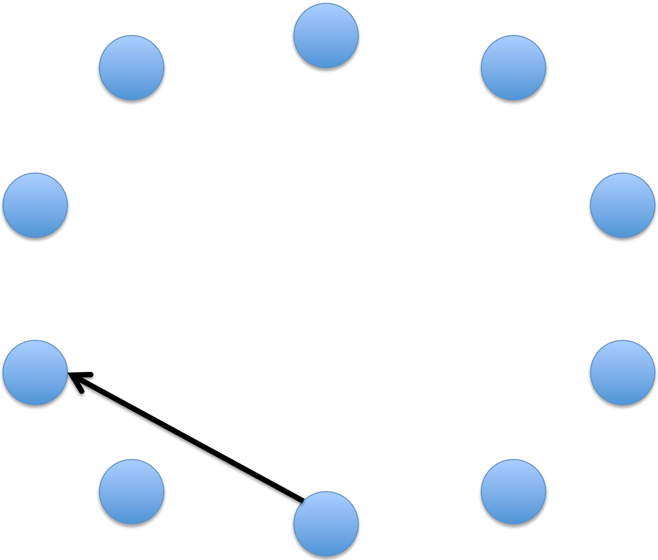

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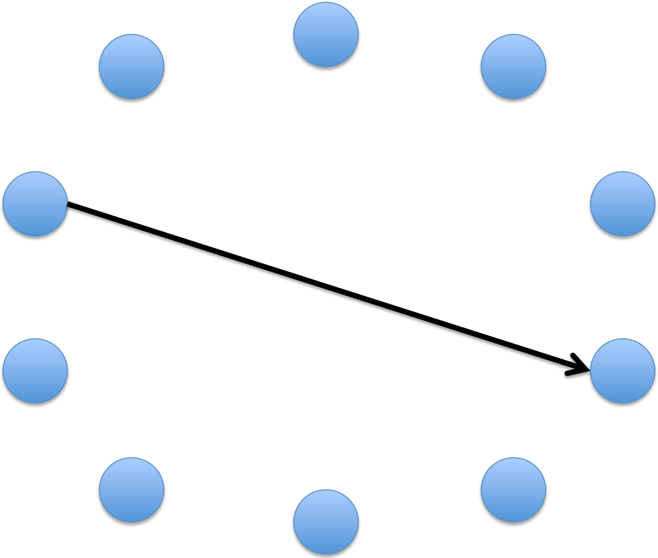

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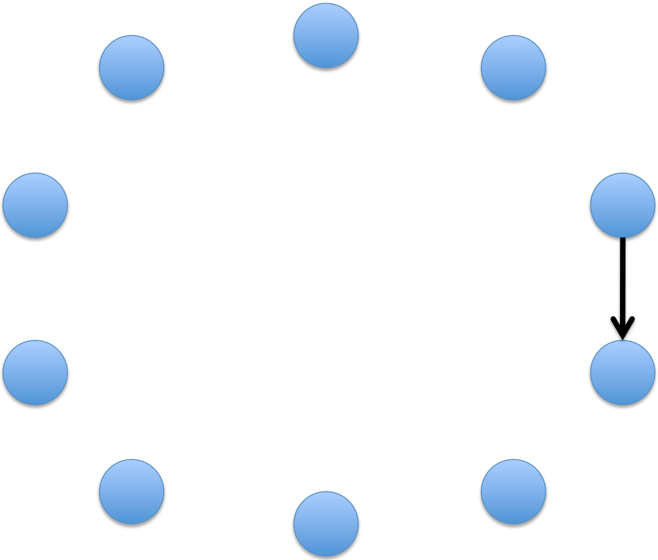

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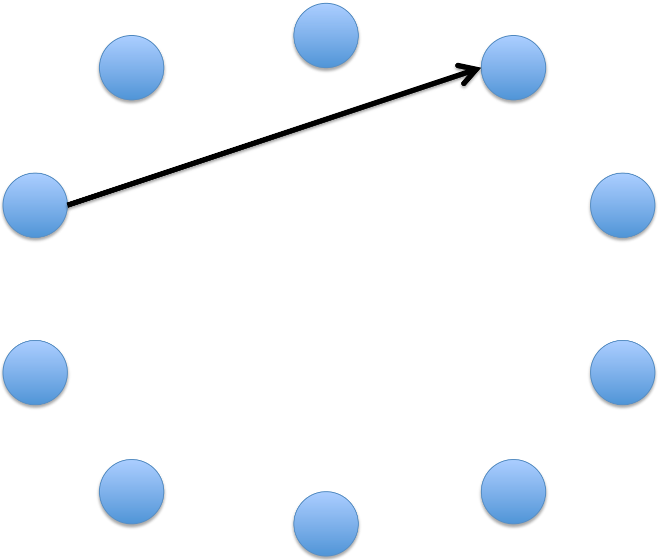

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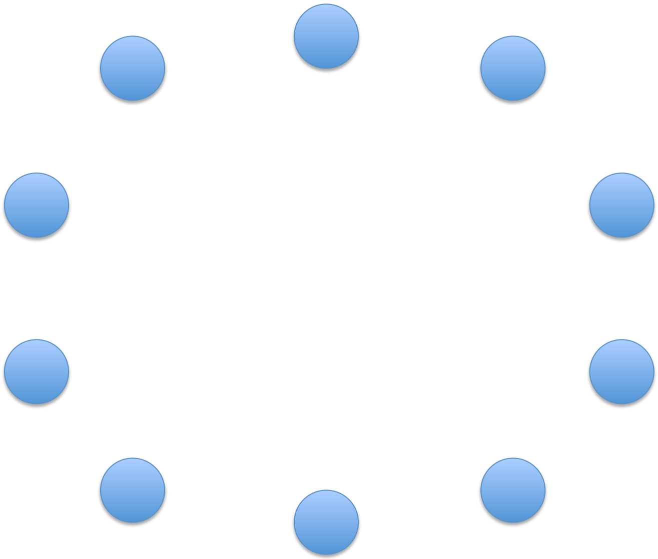

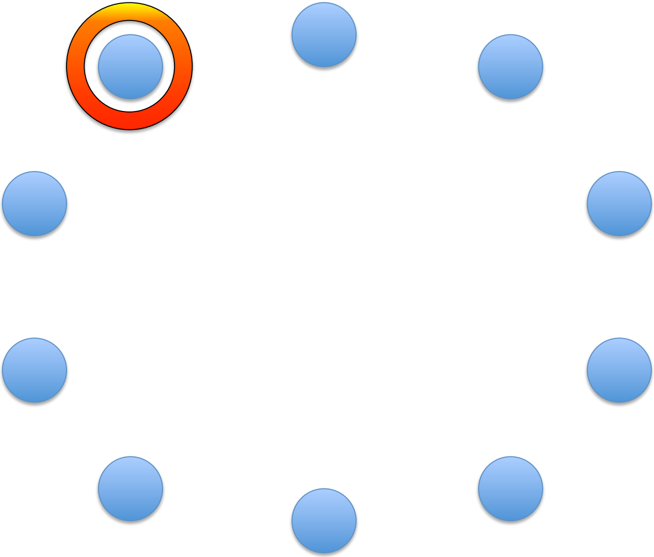

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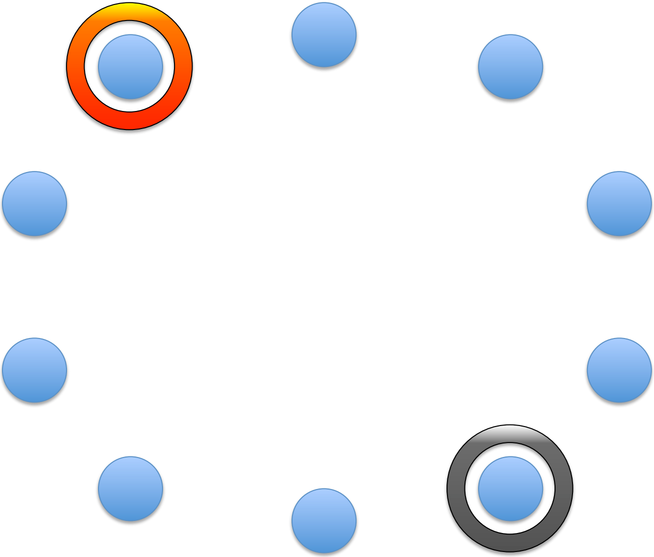

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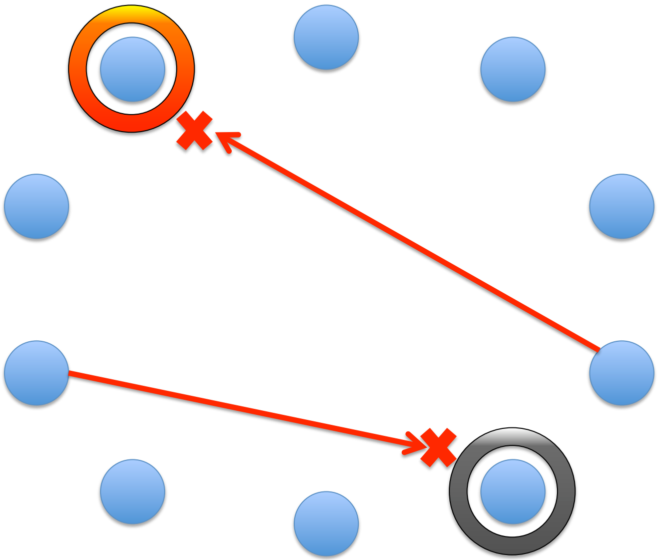

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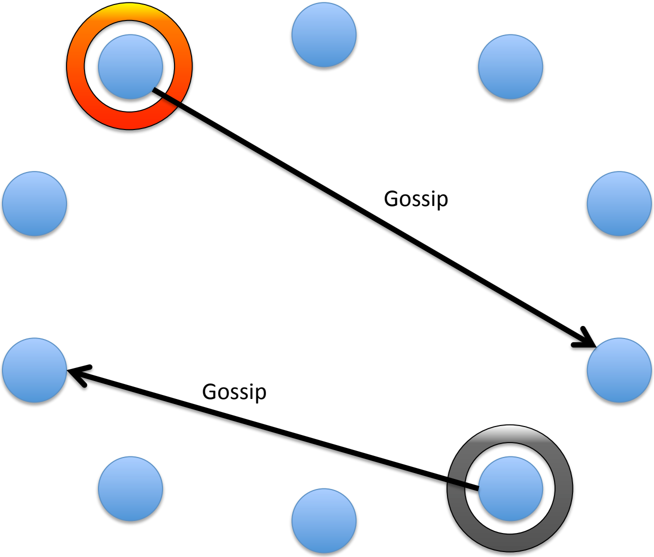

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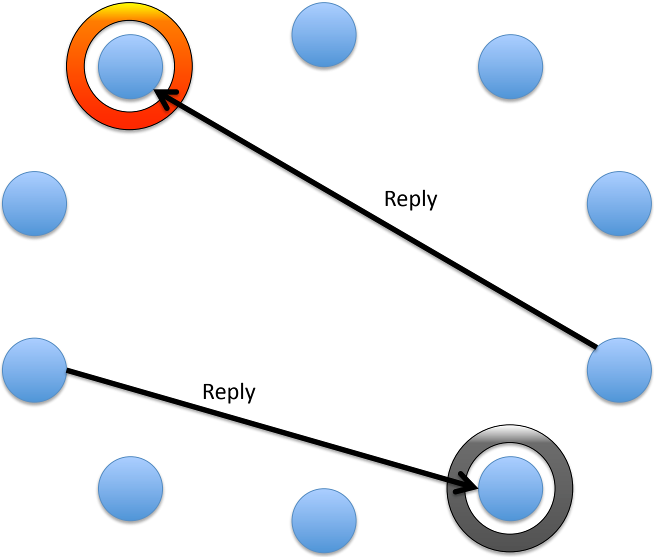

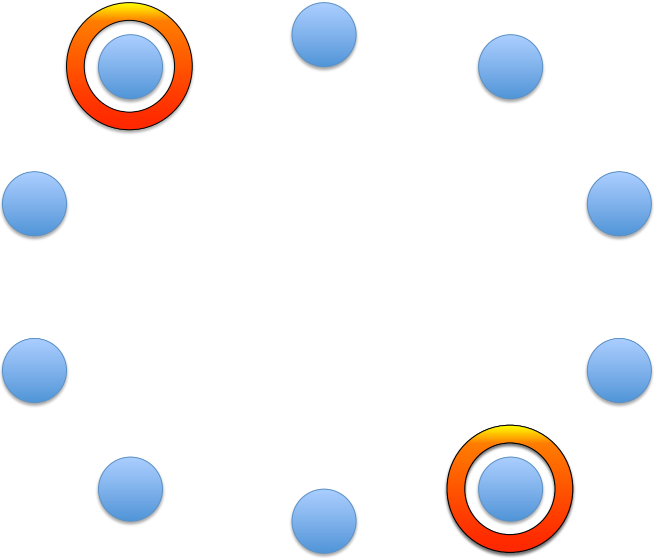

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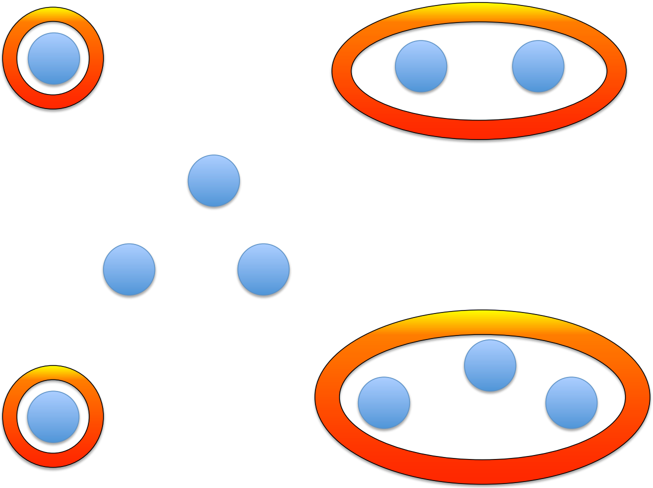

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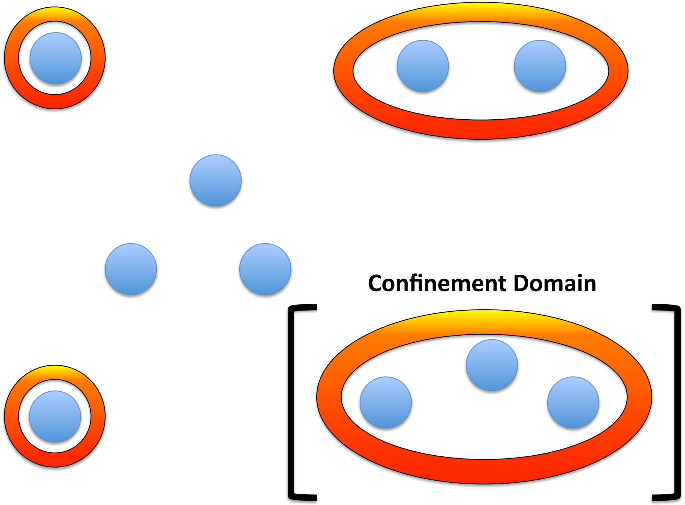

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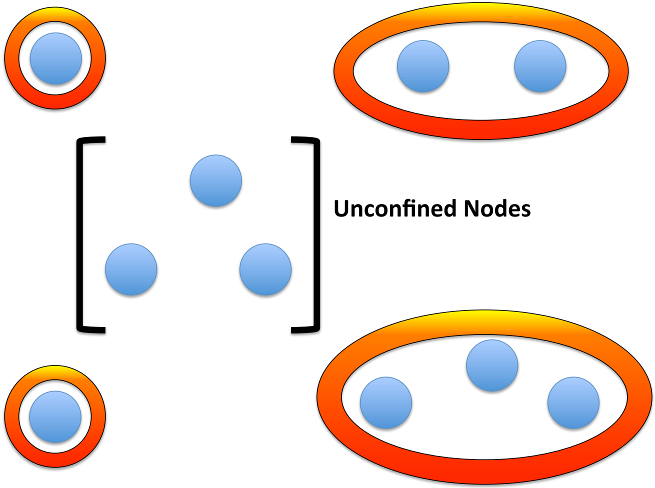

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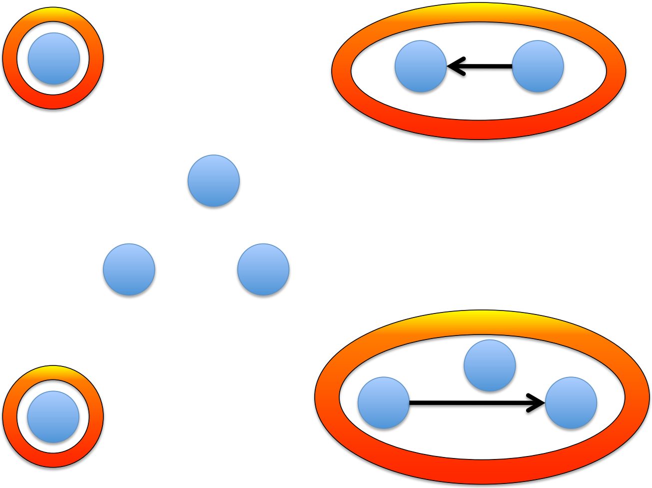

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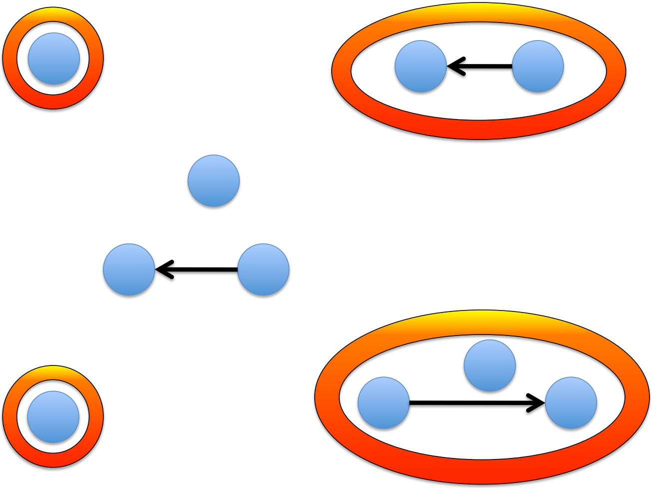

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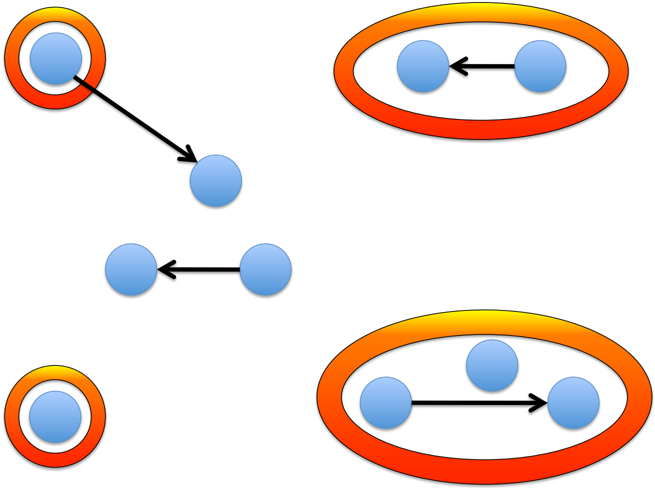

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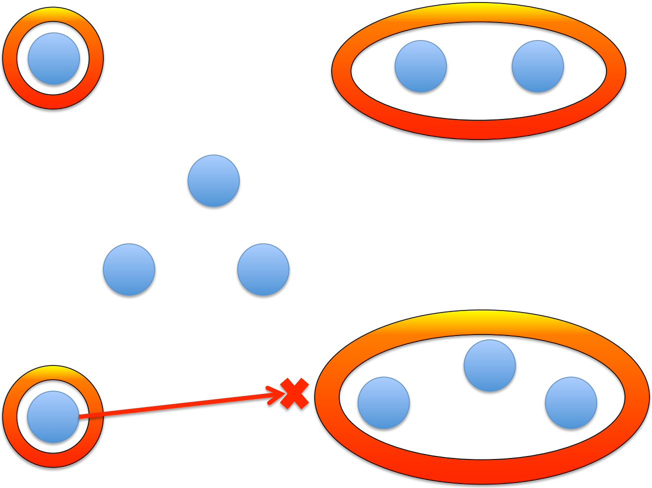

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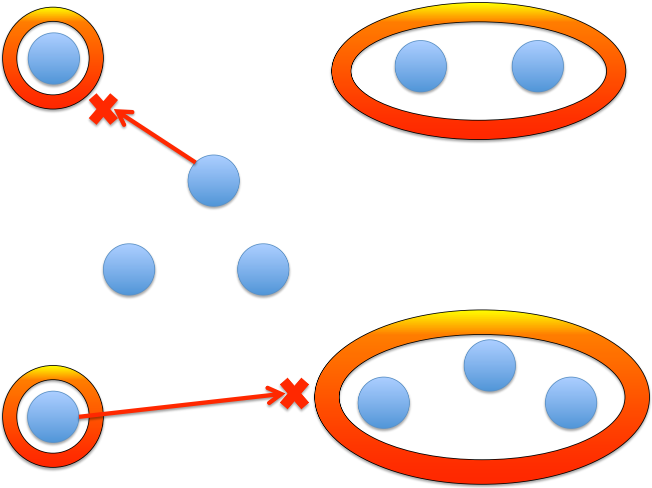

This can unbalance the system behavior:

- Unconfined nodes can participate in a much higher number of gossip exchanges.
- Specially when only a small fraction of nodes are unconfined.

This unbalance is undesirable:

- State reconciliation can require significant CPU Resources:
  - Techniques to reduce the use of bandwidth.
  - Encryption/decryption and signature/verification of messages.
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  - only requires local information.
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We follow 2 observations.

Observation 1:

Two nodes in distinct confinement domains can only exchange information through an unconfined node.

Observation 2:

In a balanced system on average:
For each gossip exchange initiated by a node (on average) that node participates in a gossip exchange initiated by another peer.

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Intuition

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- The quota limits the number of gossip exchanges initiated by other peers that a node can accept.
- Nodes increase their quota when they initiate a gossip exchange.
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- When a node receives a gossip request and does not have a quota value above zero it forwards the request through the cached connection.

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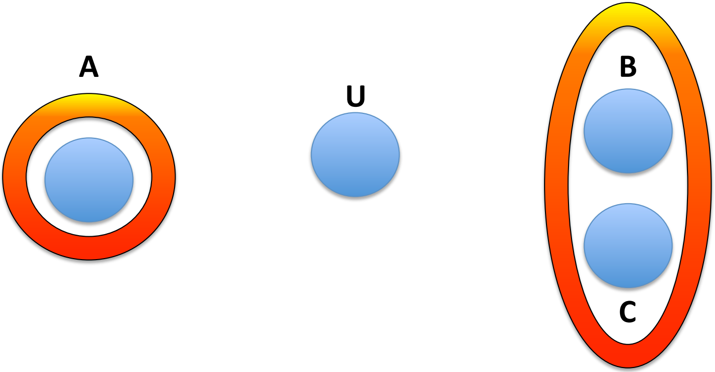

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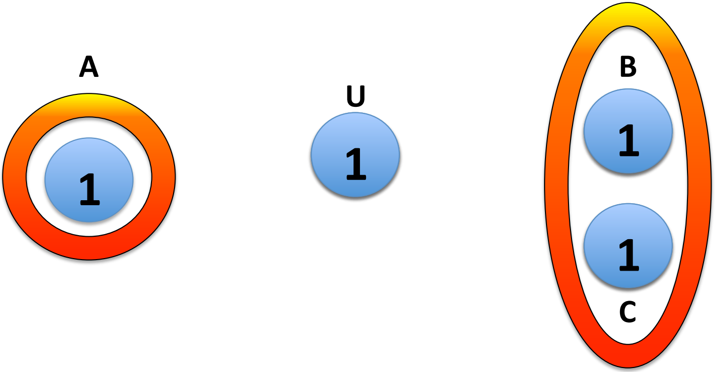

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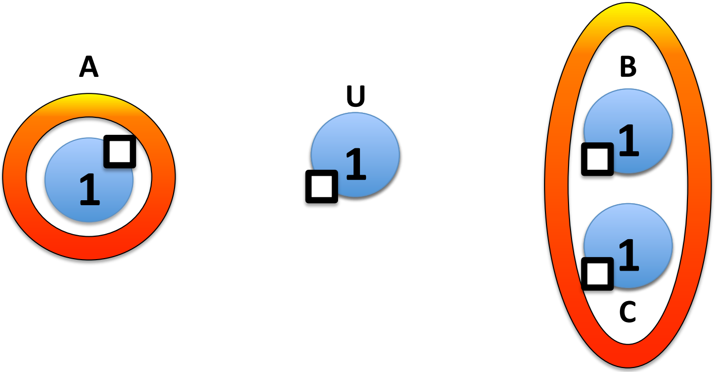

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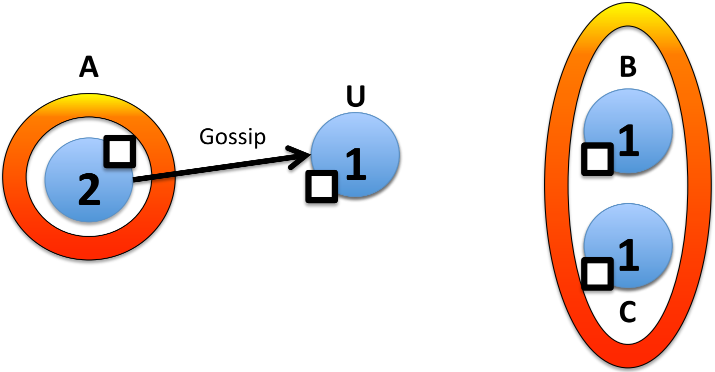

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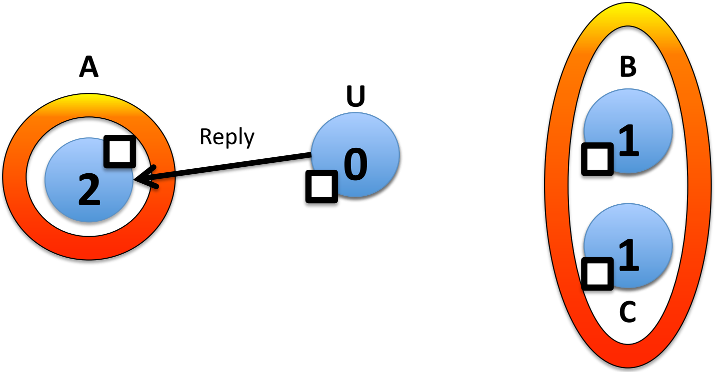

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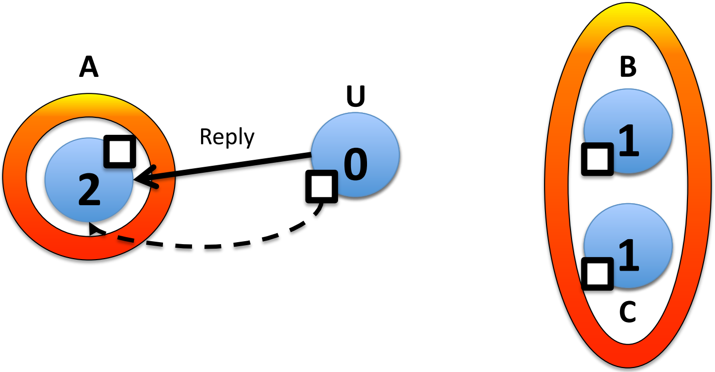

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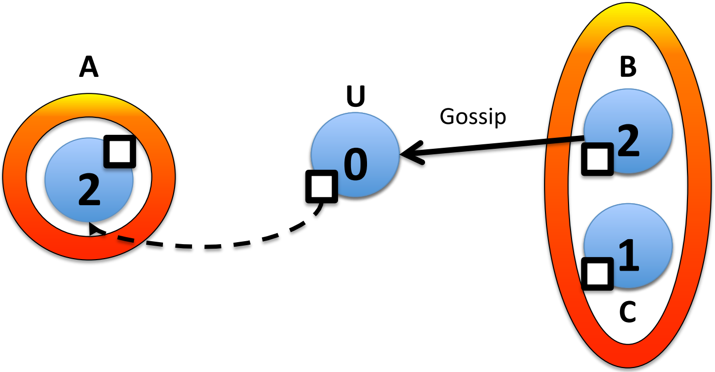

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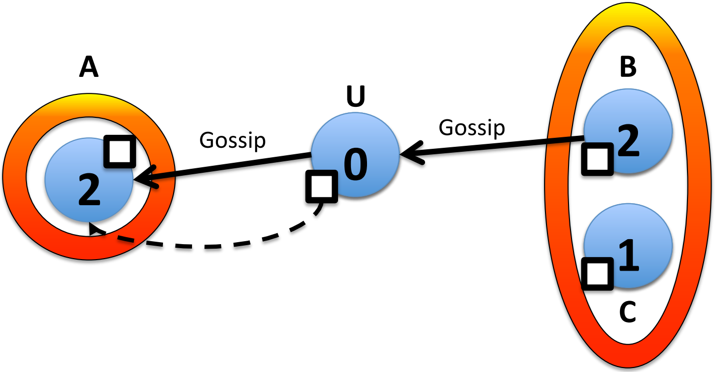

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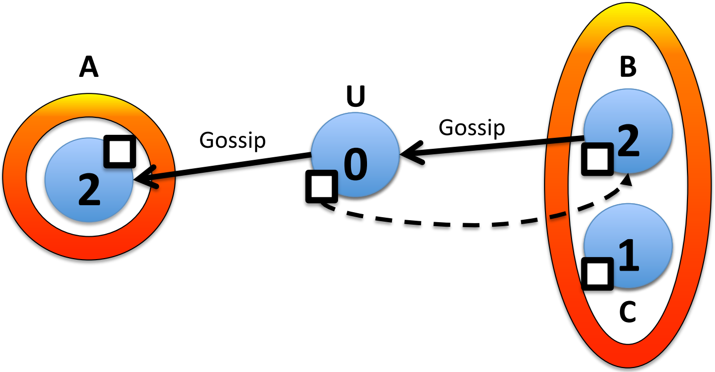

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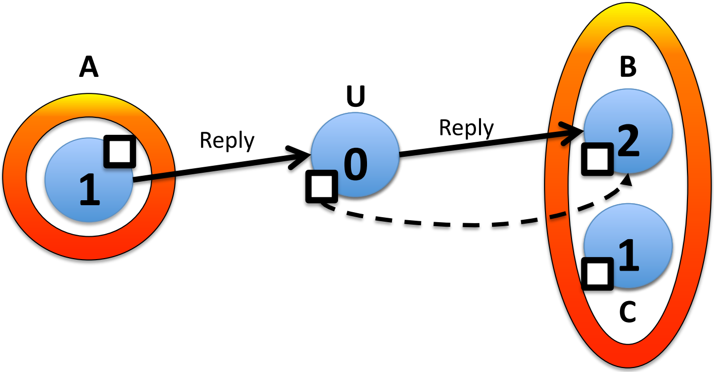

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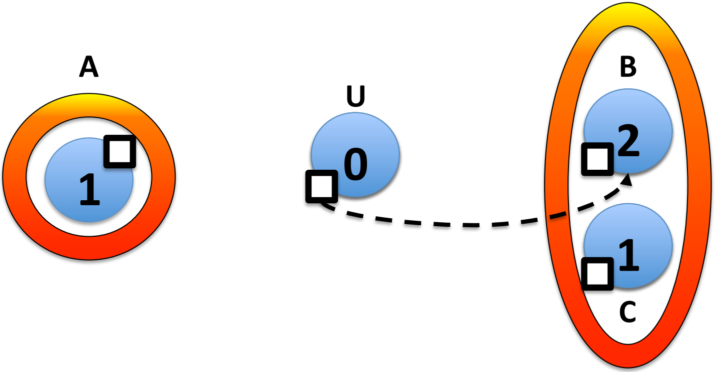

Balancing Gossip

Some additional aspects:

- A gossip requests are forwarded a limited number of times (TTL).
- If a node has an empty connection cache it engages in the gossip exchange.

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Evaluation

Experimental Setting

- We conducted simulations in the Peersim simulator.
- System composed of 12.800 nodes.
- Distributed in a variable number of confinement domains:
- From 1 (flat topology) to 12.100 (star topology).
- Each communication step has a latency selected uniformly at random between 2 and 7.

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  - All nodes have a state values initially set to 0.
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  - Nodes gossip their state value and update theirs with highest value.
- Each node initiates 500 gossip exchanges.
- If the system is balanced each node should participate in 1000 gossip exchanges.

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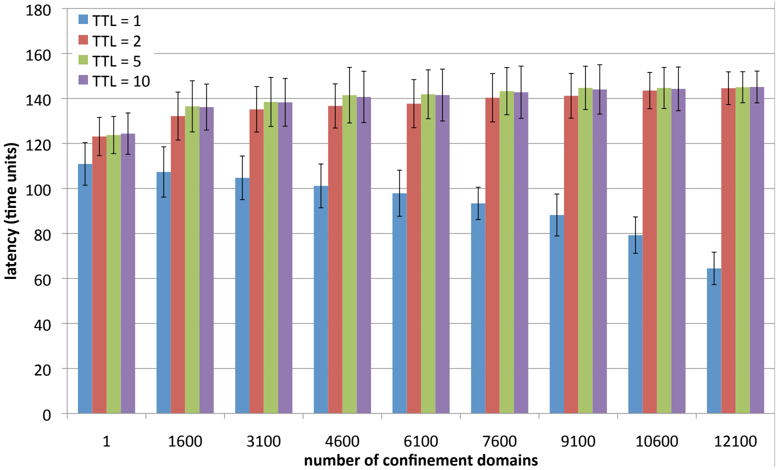

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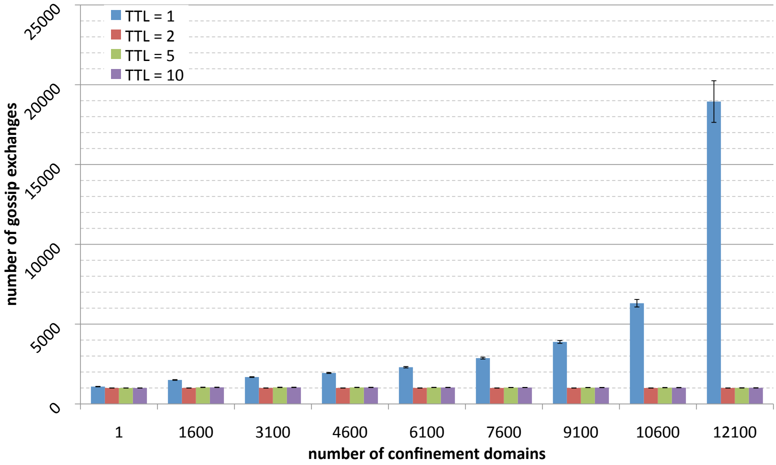

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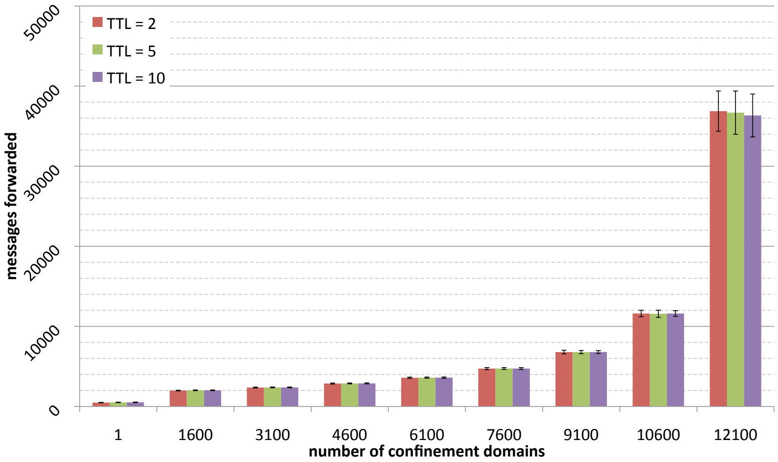

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