CryBlock 2019
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SimBlock: A Blockchain Network Simulator

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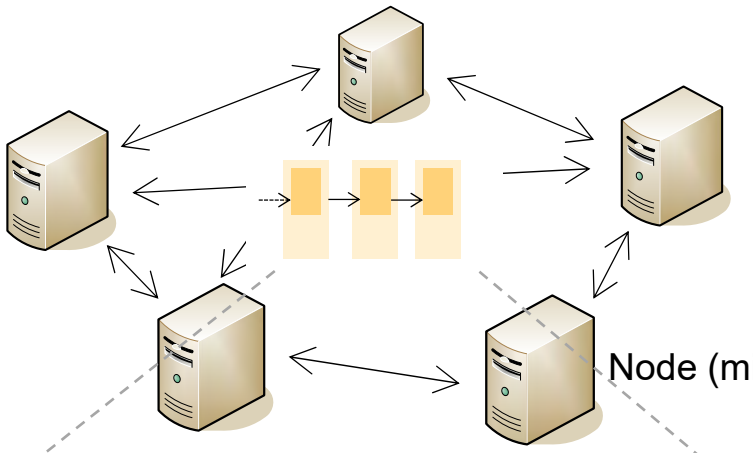
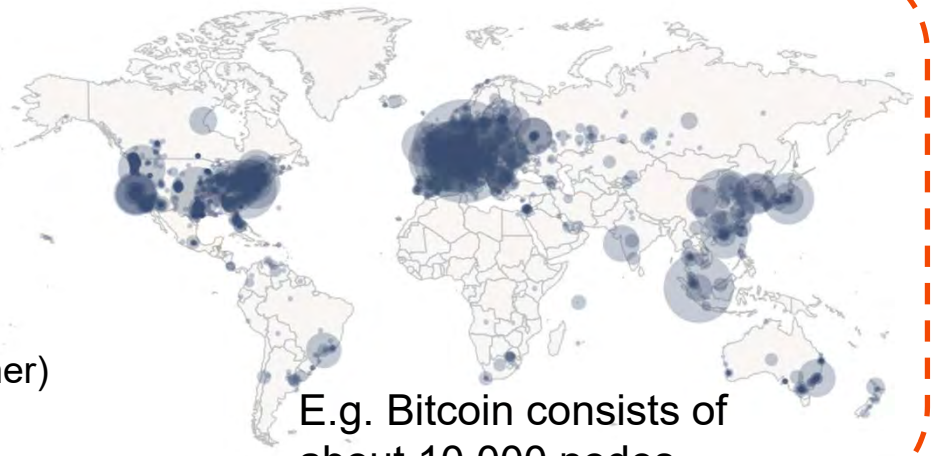
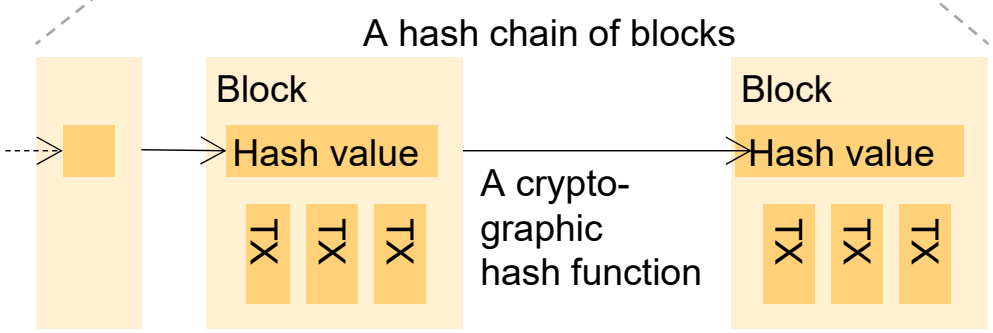
SimBlock

Tokyo Tech

A public blockchain is supported by a Peer-to-peer network







A peer-to-peer (P2P) network of participating nodes

- Transactions (TXs) and blocks are broadcasted to all the nodes.
  - Flooding

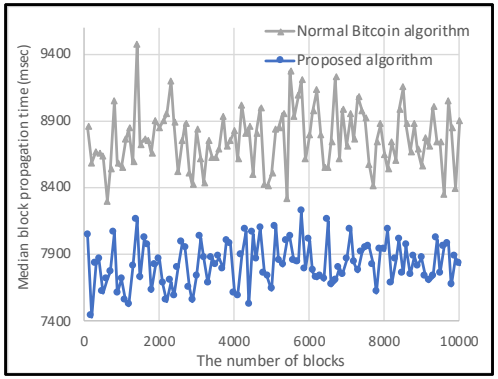
Summary:

SimBlock

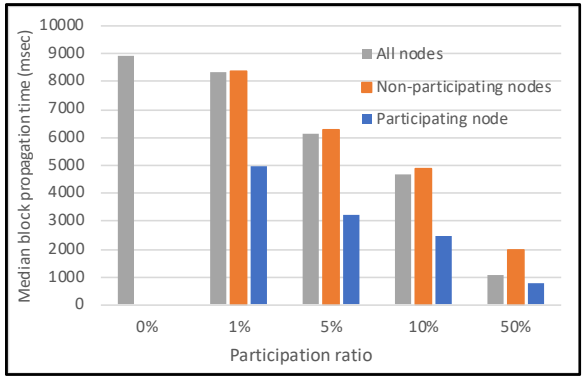
SimBlock

Tokyo Tech

- A public blockchain "network" simulator
  - developed by Distributed Systems group, Tokyo Tech, and
  - will be released in May 2019.
- It simulates transmission of blocks and TXs between nodes over Internet, and PoW mining time
  in an event-driven style. It will provides a visualizer.
- It simulates Bitcoin, Litecoin and Dogecoin.
- Researches :



Neighbor selection



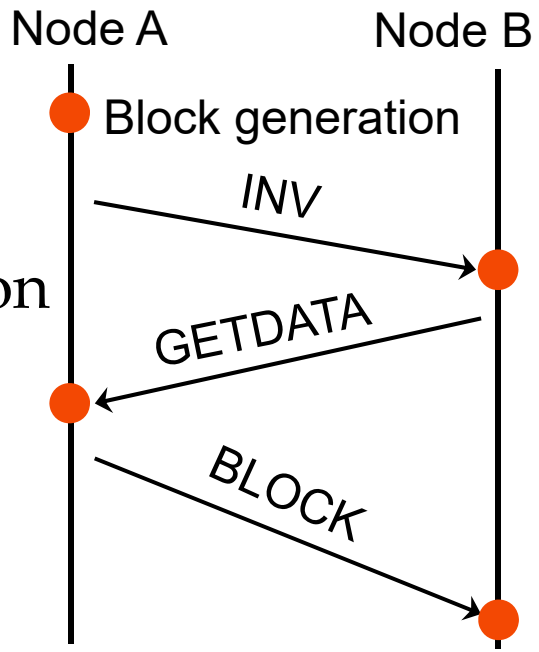
Measurement of relay networks

An event-driven simulator

- It has a (virtually) single event queue.
- The queue sorts events by time.
- It dequeues an event from the queue and processes it repeatedly.

- Events
  - Block generation
  - Message reception: INV, GETDATA, BLOCK

- Timings
  - Block generation time:
    - A random time along the distribution based on node's hash power and generation difficulty.
  - Message reception time:
    - `message_size / bandwidth + latency`



Simulation parameters

- SimBlock adopted parameters in [Gervais 2016].
  - "On the Security and Performance of Proof of Work Blockchains", CCS 2016

Parameter	Bitcoin	Litecoin	Dogecoin
# of nodes	6,000	800	600
Block generation interval	10 min	2 min 30 sec	1 min
Block size	545 KiB	6.11 KiB	8 KiB
# of connections per node	Measured distribution based on [Miller 2015]		
Geographical distribution of nodes	Measured distribution		
Network bandwidth	Measured numbers provided by Verison and testmy.net		
Propagation latency			

  - Nodes are placed in 6 regions: North America, Sourth America, Europe, Australia, Asia Pacific, and Japan

Simulator validation

- Comparison with measured numbers and an existing simulator

Looks good.

Median block propagation time T_{MBP}

	Bitcoin	Litecoin	Dogecoin
Measured T_{MBP}	8.7 s	1.02 s	0.85 s
[Gervais 2016]	9.42 s	0.86 s	0.83 s
SimBlock	**9.52 s**	**0.78 s**	**0.75 s**

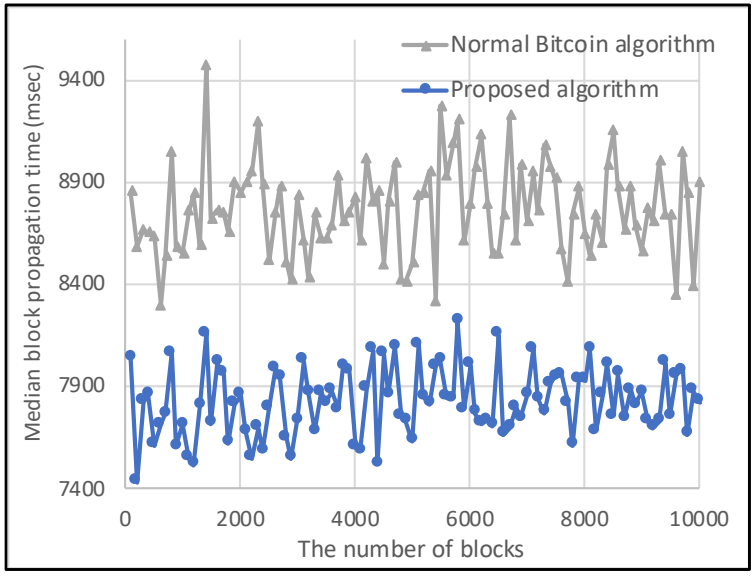
Stale block rate = Orphan (forked) block rate r_f

	Bitcoin	Litecoin	Dogecoin
Measured r_f	0.41%	0.273%	0.619%
[Gervais 2016]	0.14%~ 1.85%	0.24%	0.79%
SimBlock	**1.42%**	**0.25%**	**0.72%**

Researches utilizing SimBlock

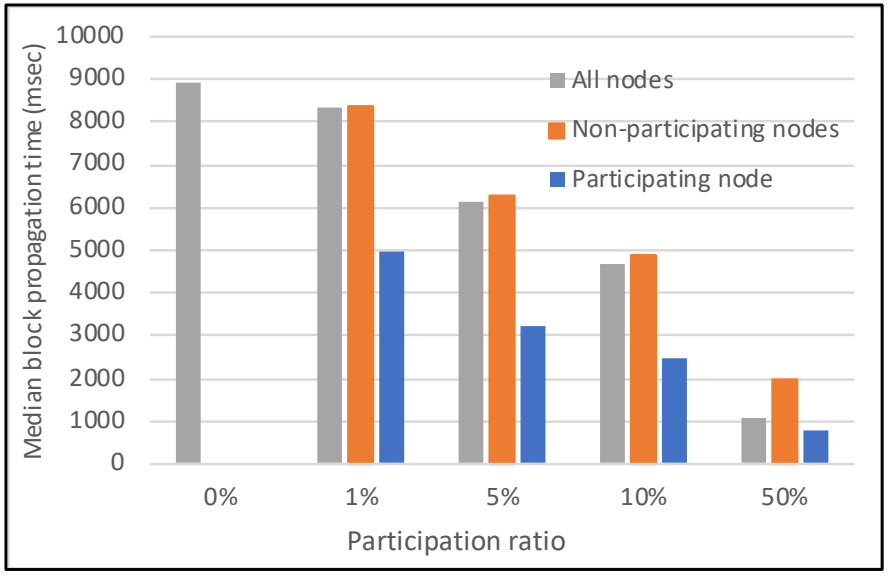
Under review

- Proximity neighbor selection (Aoki et al.)



  - A major technique in P2P field
  - We measured its effects quantitatively.

- Measurement of relay networks (Otsuki et al.)



  - Relay networks: bloXroute, Falcon, ...
  - Oh, my god, they do not improve mining success rate. But …

Summary

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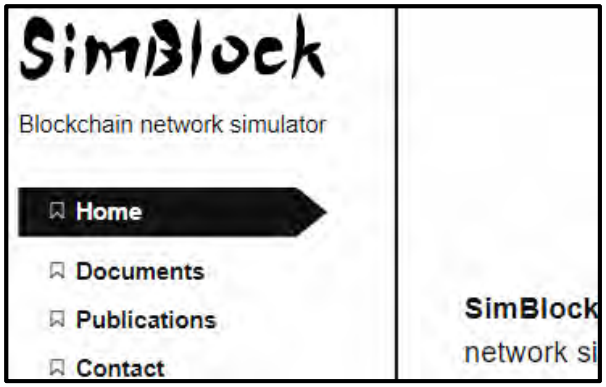
- A public blockchain “network” simulator SimBlock



Web site

- Future events
  - Release in May 2019
    - accompanied by a visualizer
  - Demo in IEEE ICBC 2019 in May 2019 in Seoul
- Future development
  - Support for newer protocols: Compact Block Relay, DAG, PoS, …
  - Update of blockchain and network parameters
    cf. Till Neudecker, “Security and Anonymity Aspects of the Network Layer of Permissionless Blockchains”, Ph.D. thesis, Nov 2018