Reaching Consensus in Opportunistic Networks

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Consensus Problem

- proposers
- acceptor
- listener
- finally $\rightarrow$ agreement

Related Work

- great importance in distributed systems
- fault tolerance
- only node failures
- apriori knowledge regarding the topology
- not suited for Opportunistic Networks

Related Work(2)

- the **Heard Of** model
- both node and link failures

Last Voting

- 1 coordinator
- 4 rounds
- most frequently received value

One Third Rule

- no coordinator
- 2*n/3 contributions $\rightarrow$ next round

Leader Election

- Direct Leader Election
  - nodes advertise their centrality
  - highest score $\rightarrow$ leader
- Community based Leader Election
  - communities are formed at first
  - all nodes inside a community have to agree upon a single leader

$$score = w_t * v_t + w_c * v_c + w_p * v_p + w_l * v_l$$

Consensus

- node contributions sent to the leader
- the leader decides
- disseminates the decision
- nodes keep only the latest decision
- malicious nodes
- leader changed $\rightarrow$ resend unvalidated contributions

Decision Algorithm

- minimum number of contributions
- for each proposal, compute score (trust)
- highest score $\rightarrow$ correct value
- multiple values with the same score $\rightarrow$ no decision
- confidence level = max trust $\div$ total trust
- nodes proposing values $\rightarrow$ new trust score
- minim level of confidence

Results

- MobEmu simulator
- decision accuracy
- decision latency
- malicious nodes detection

HCMM:

- 2 hours
- 40 nodes
- over 2 700 contacts

Sigcomm:

- 4 days
- 76 nodes
- over 16 000 contacts

Decision Accuracy (HCMM trace)

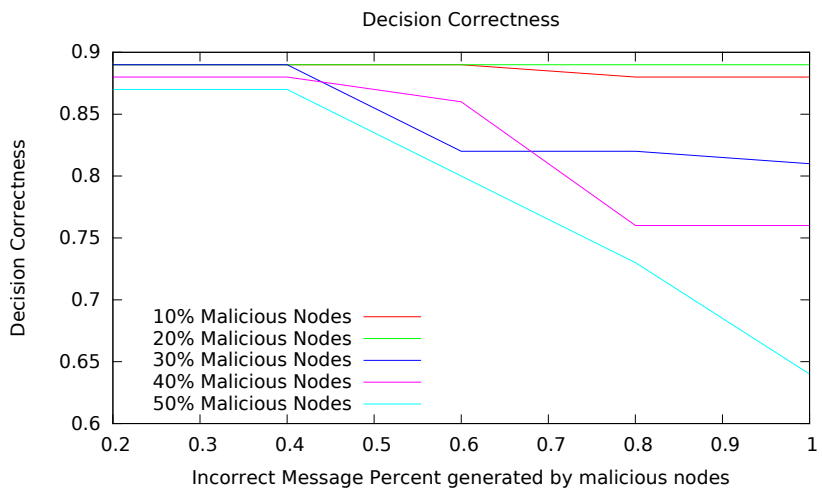

Figure: Correctness Percentage Direct

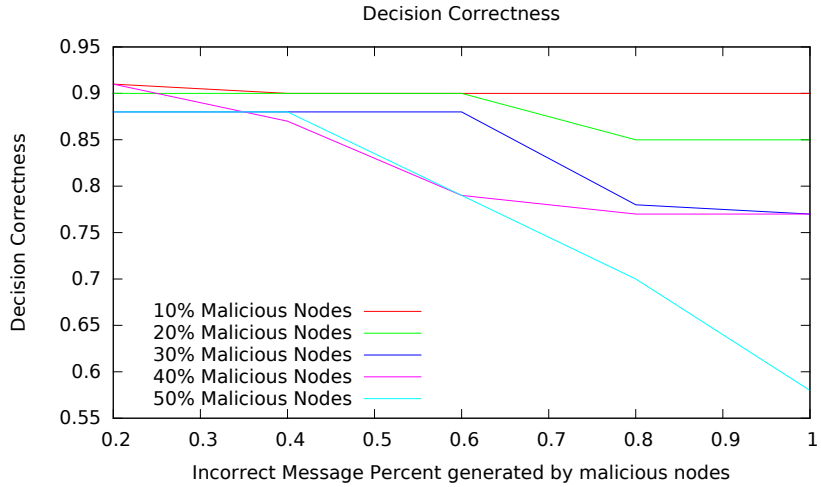

Figure: Correctness Percentage Community

Decision Accuracy (Sigcomm trace)

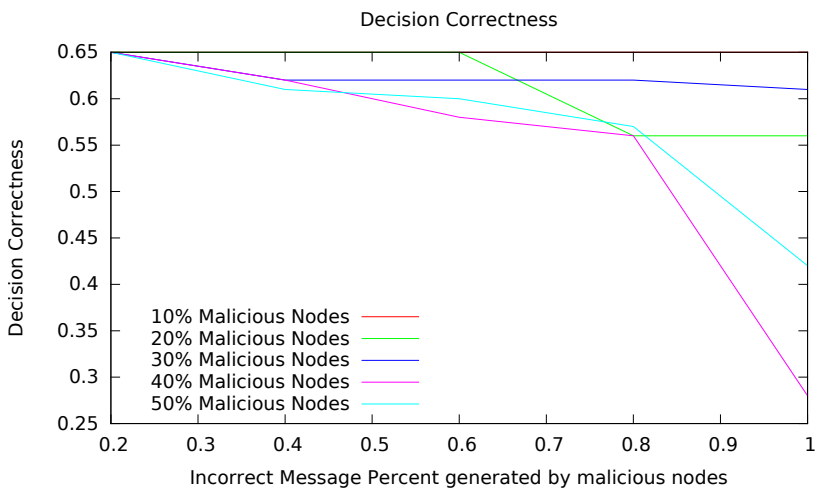

Figure: Correctness Percentage Direct

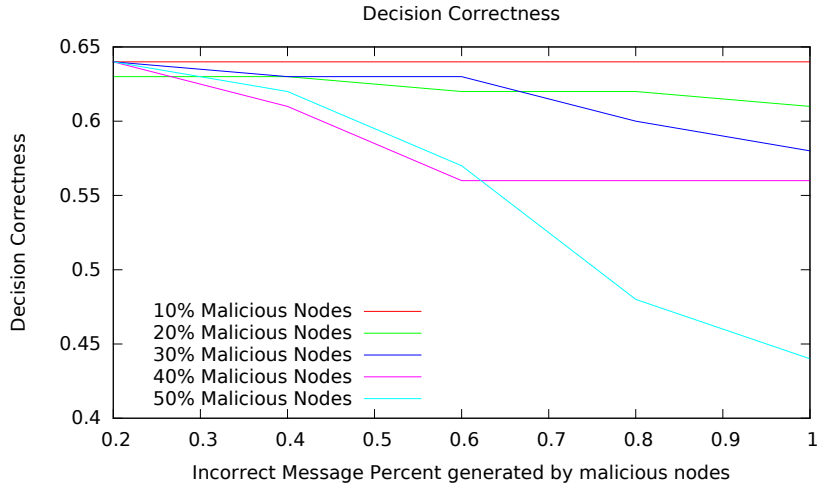

Figure: Correctness Percentage Community

Decision Latency

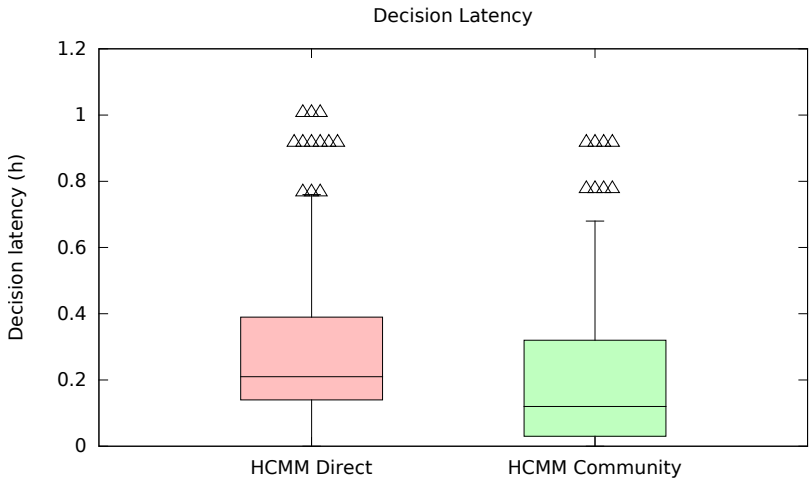

Figure: Decision Latency HCMM

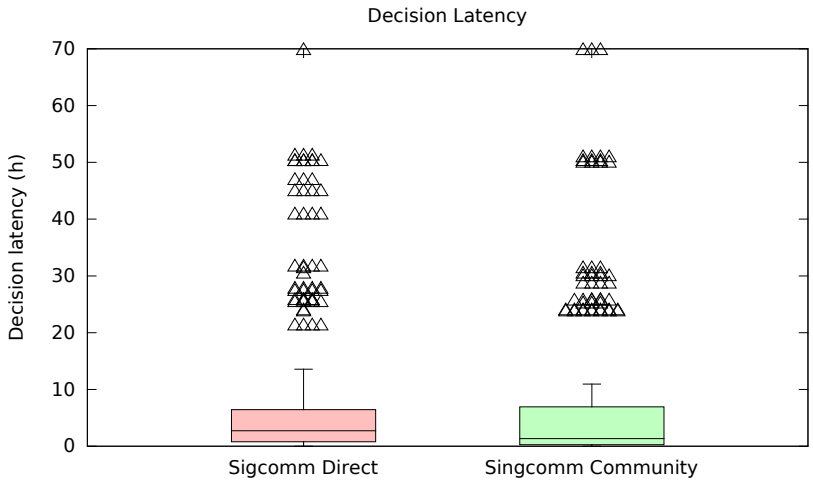

Figure: Decision Latency Sigcomm

Future Work

- further refinements of the algorithm
- compare against other similar algorithms
- engage in a real ON scenario
- design specific applications that employ the algorithm

Conclusions

- consensus algorithm for Opportunistic Networks
- high decision accuracy
- decisions received in a timely manner
- high applicability