Andrea Bracciali

UNIVERSITY of STIRLING

Ronald de Haan

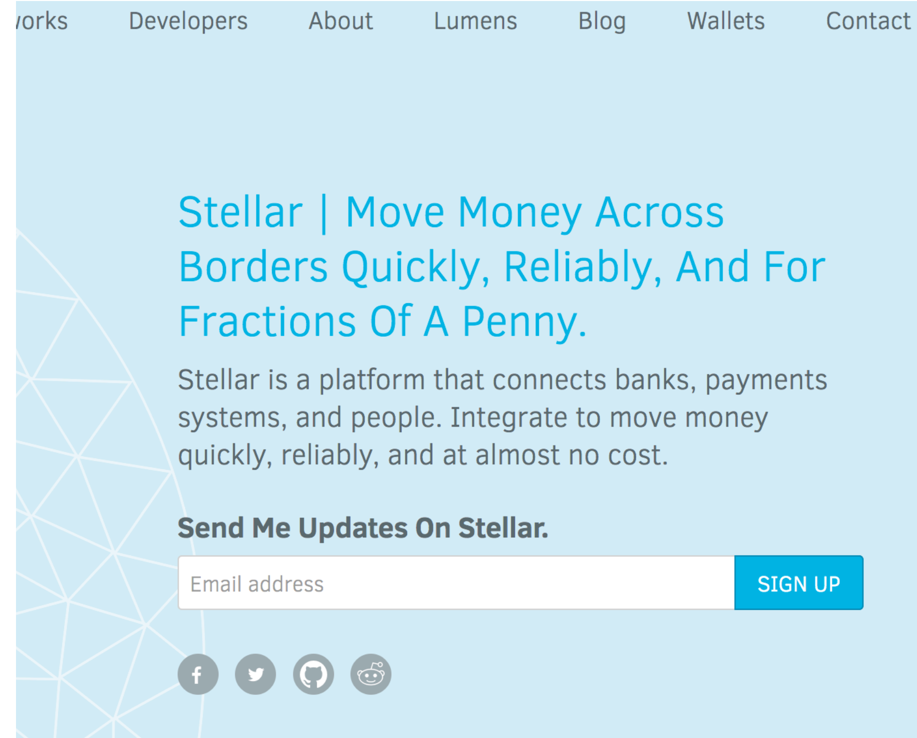
Decentralization in Open Quorum Systems

Davide Grossi

university of groningen

UNIVERSITY OF AMSTERDAM


ripple
RippleNet
Join RippleNet
One frictionless experience to send money globally
How RippleNet Works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Stellar | Move Money Across Borders Quickly, Reliably, And For Fractions Of A Penny.
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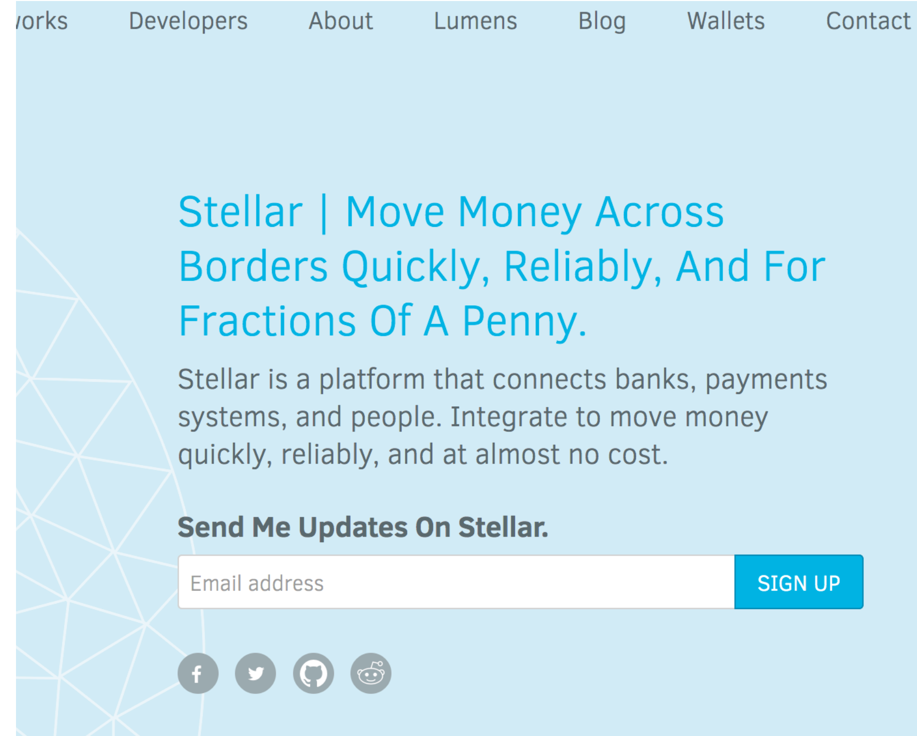

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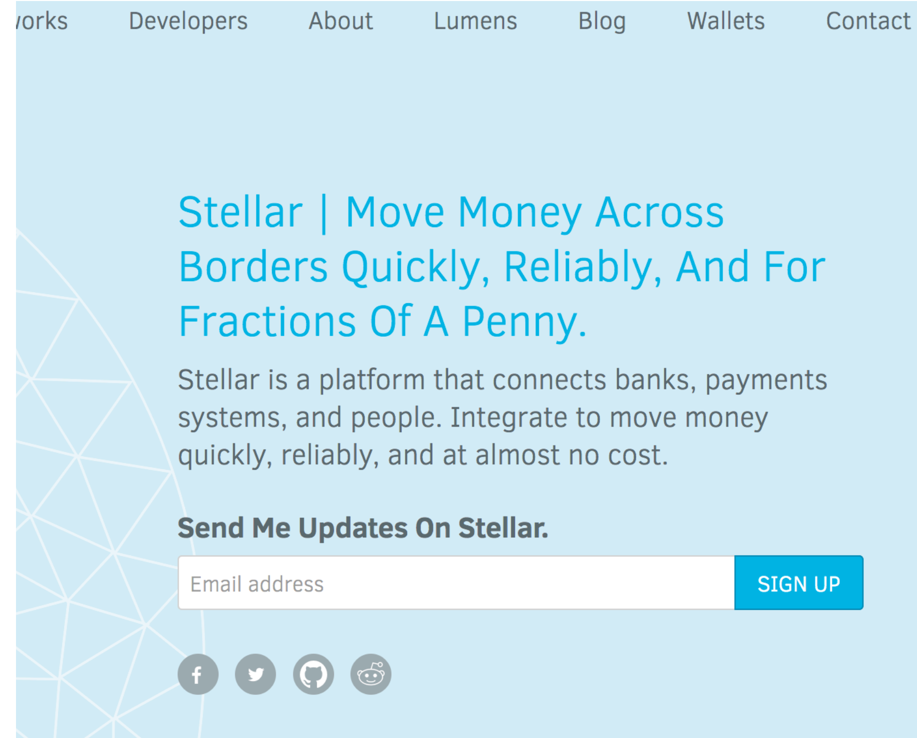

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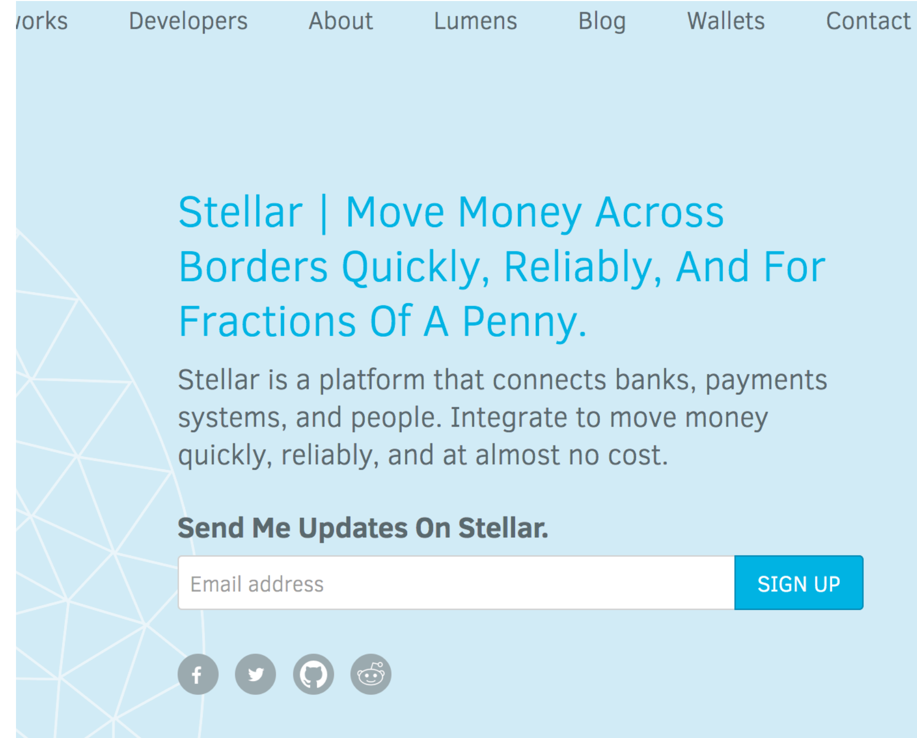

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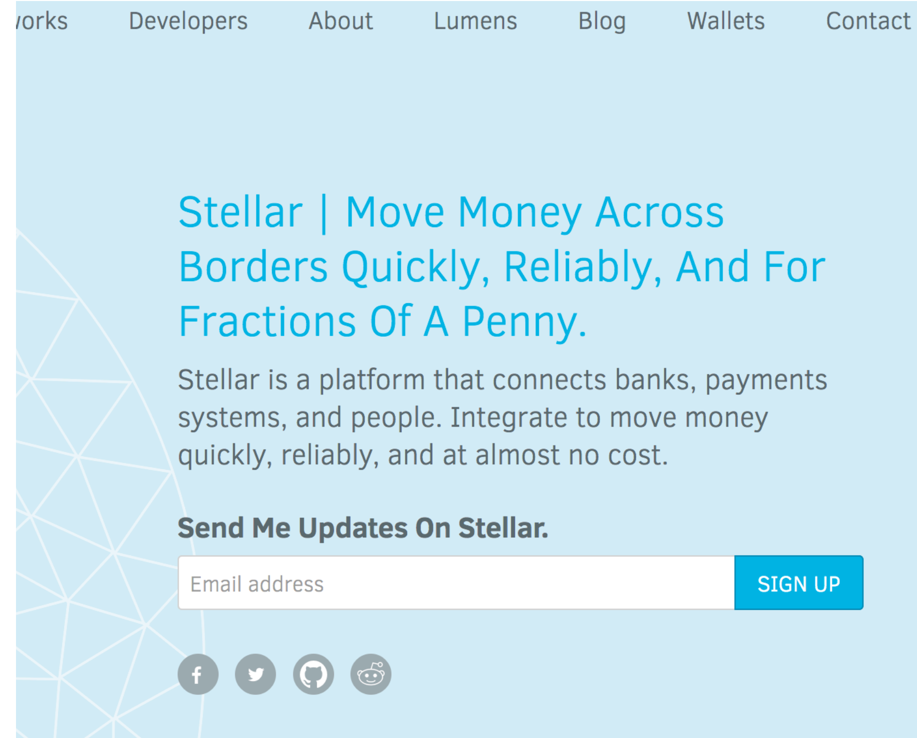

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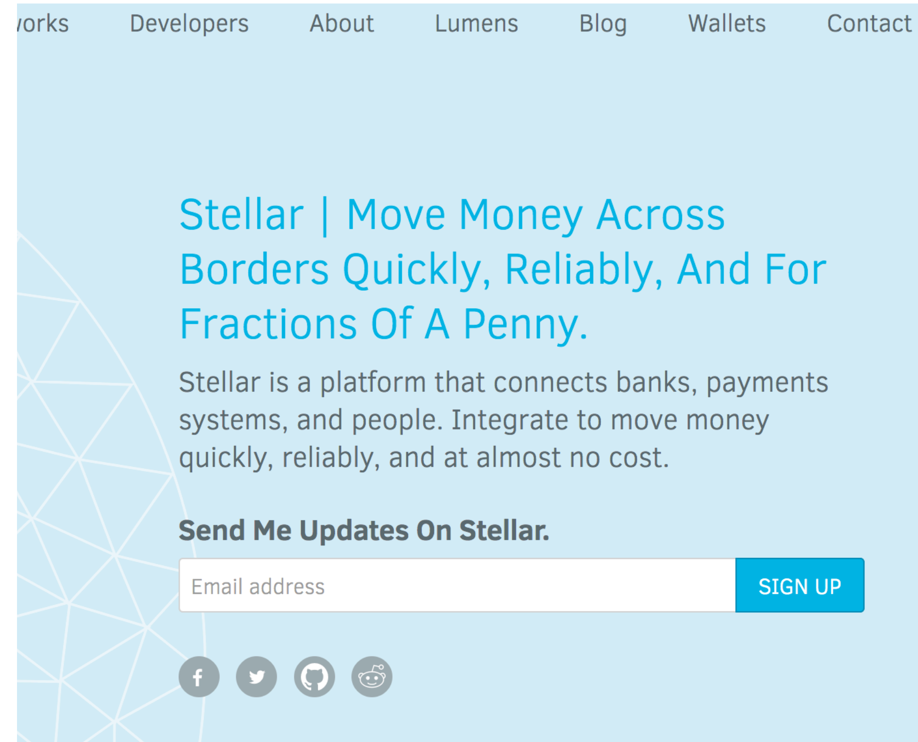

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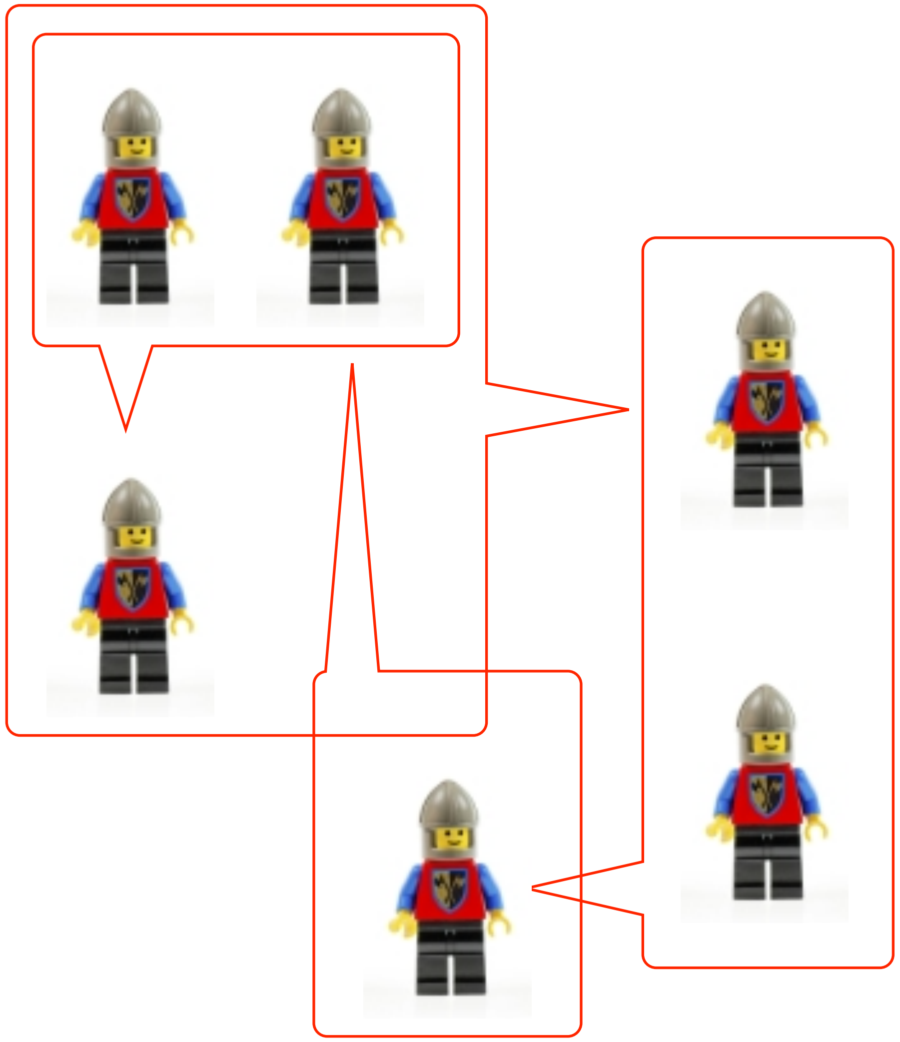
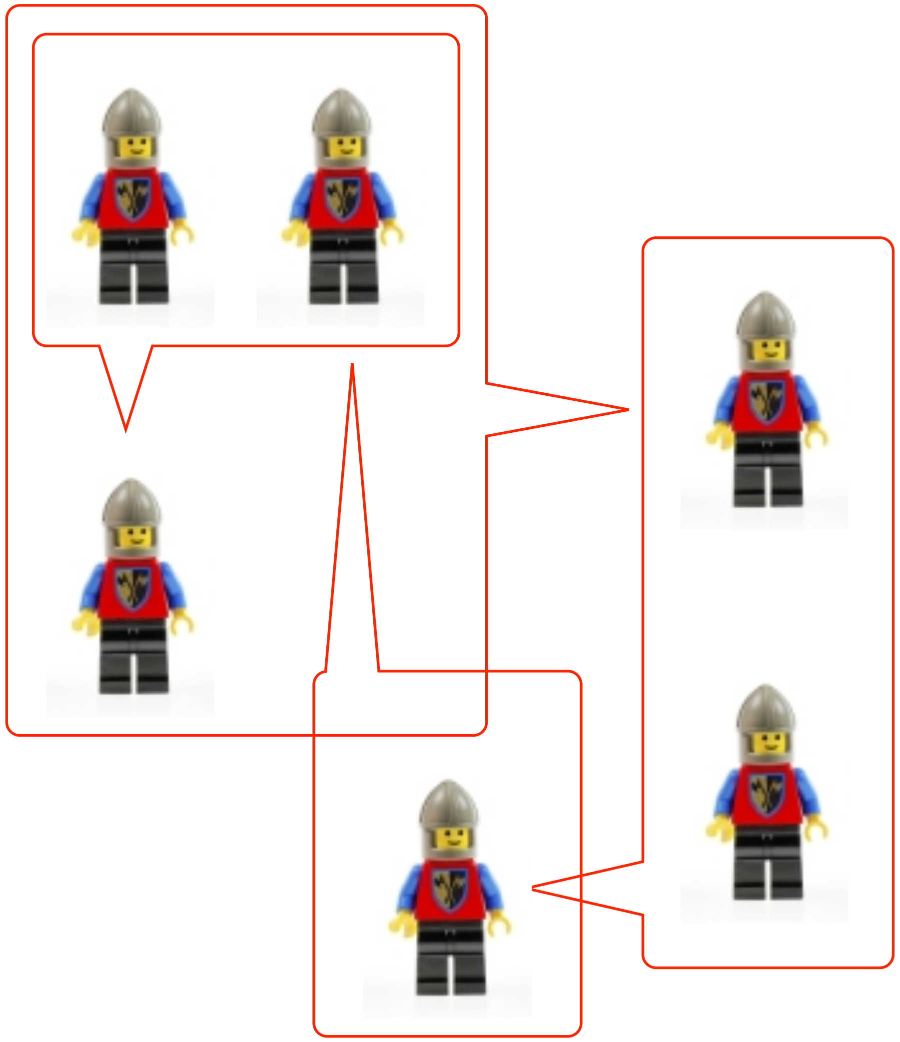
Are there inherent limitations to decentralisation in this form of consensus?

PART I

P2P Trust Networks





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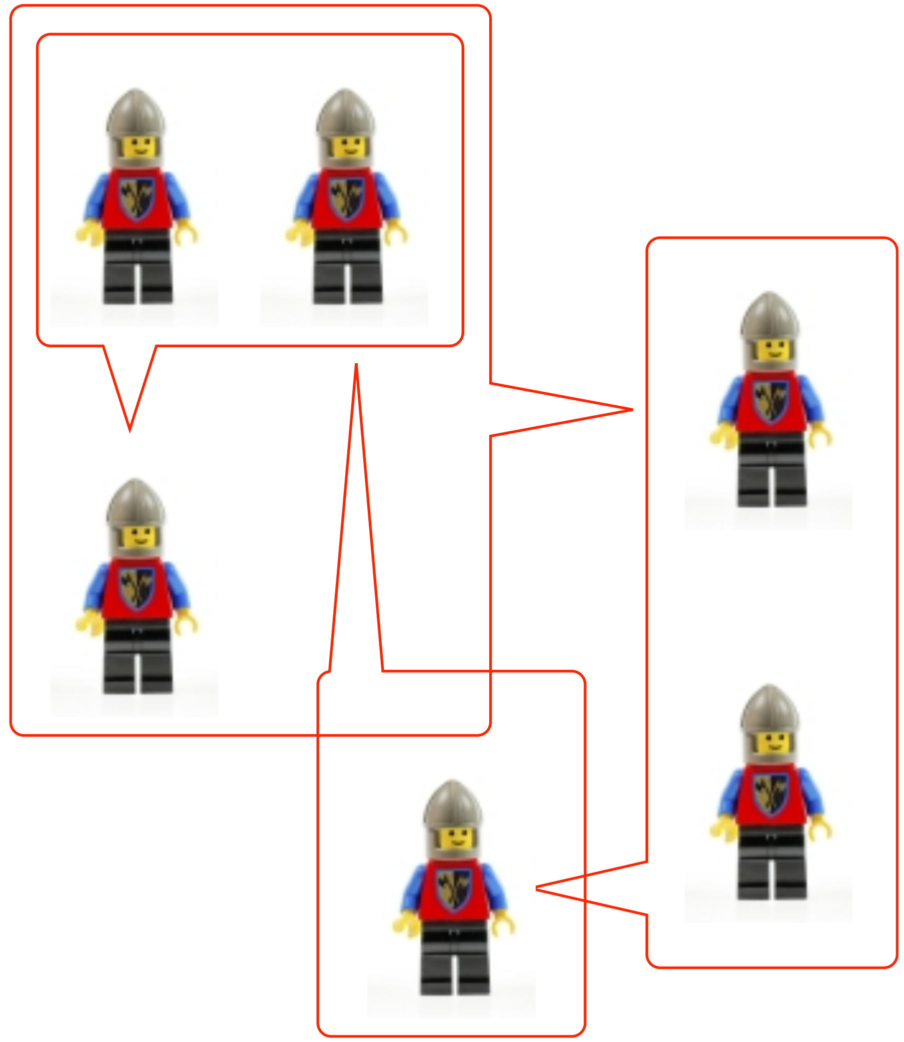

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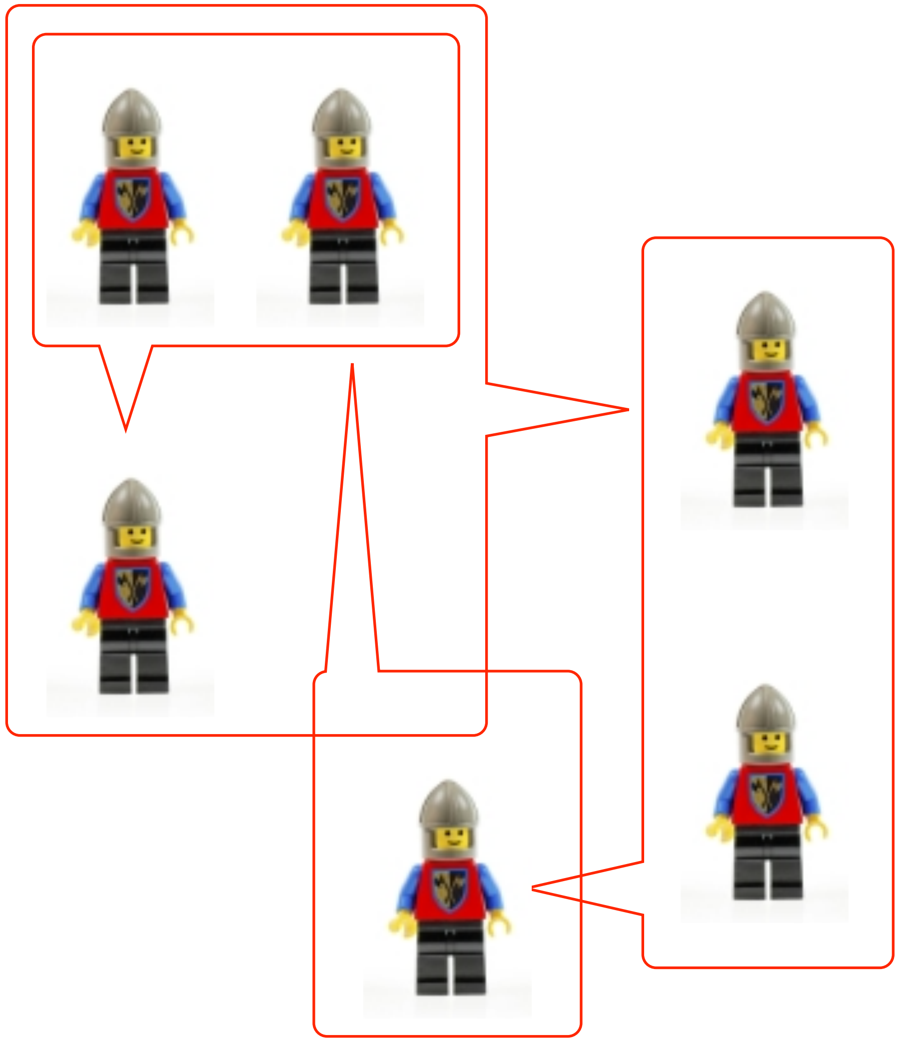

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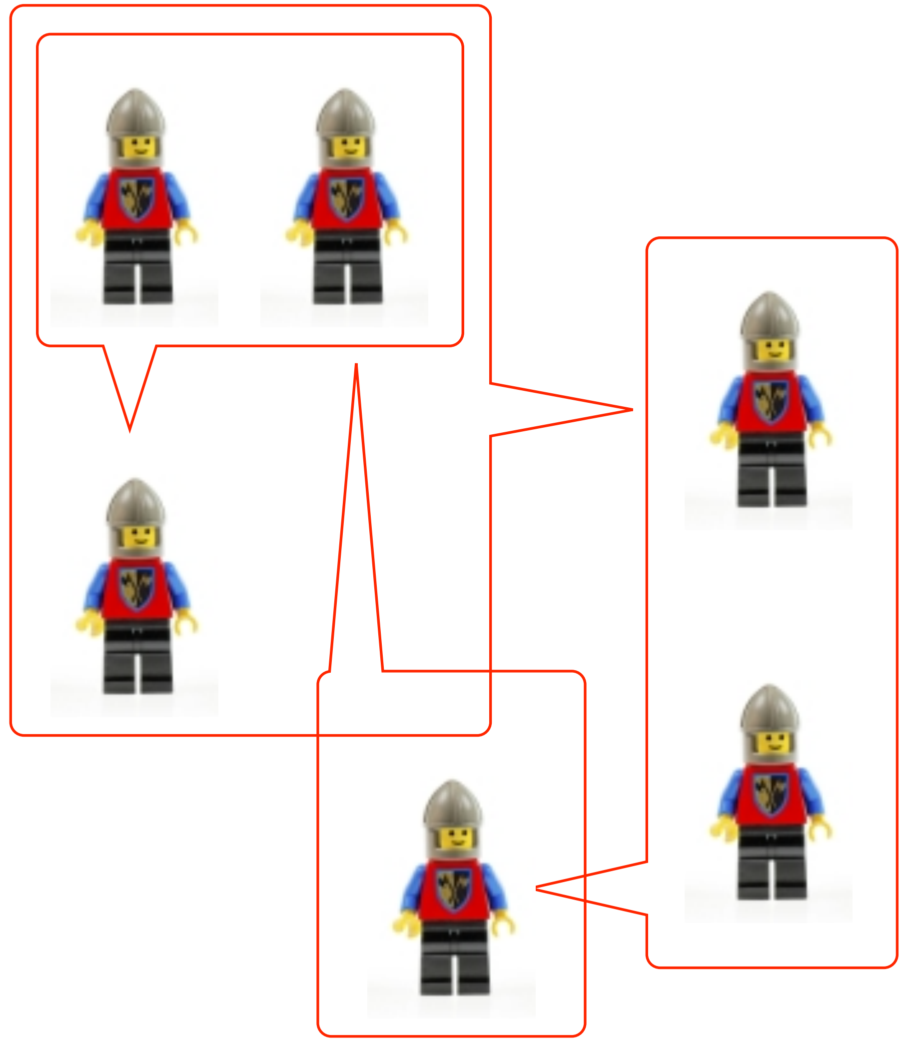

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- ☐ when a quota of trusted nodes agree (on whether to record a transaction or not) the node settles its value on that agreement
- ☐ CONSENSUS = all honest nodes ***agree stably***

Byzantine Trust Networks (BTNs)

$$\mathcal{T} = \langle N, H, L_i, q_i \rangle$$

Byzantine Trust Networks (BTNs)

Nodes

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Honest nodes

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(one for each i in H)

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- ☐ Nodes make binary decisions ("should a transaction be included?")

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- Nodes: N
- Honest nodes: H
- Trust sets (one for each i in H): L_i
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- Byzantine nodes can reveal any opinion to any honest node

Command Games

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FBAS in Stellar

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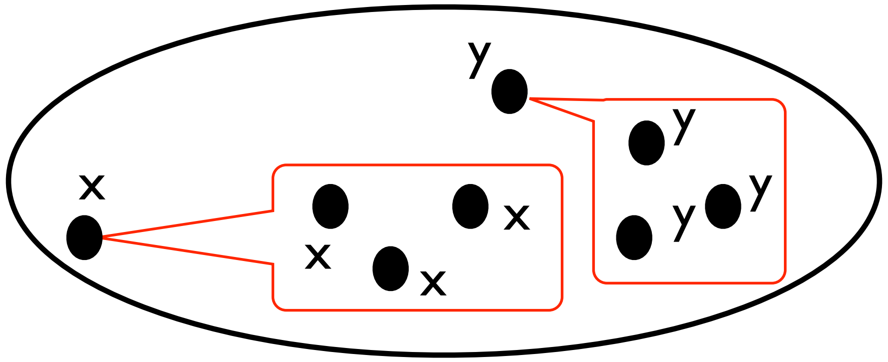

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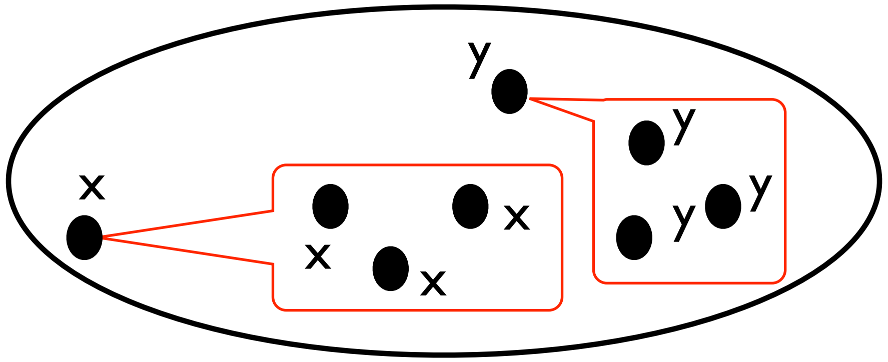

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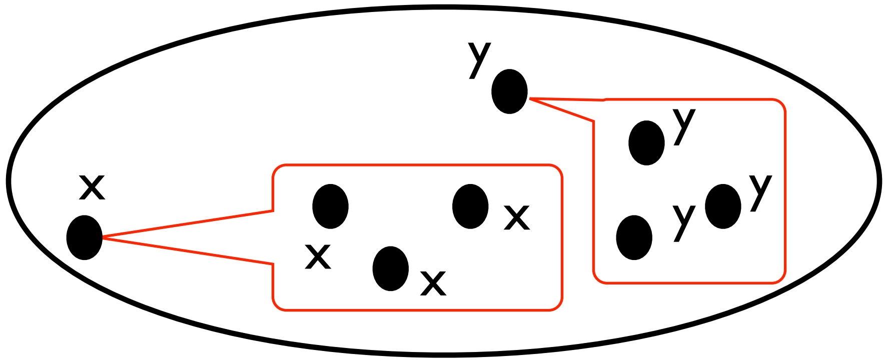

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- **QUESTION**: what are necessary structural conditions for safety?

PART II

Decentralization

Safety & Decentralization in uniform BTNs

Theorem In uniform BTNs with quotas in $[0.75, 0.8]$, safety implies the existence of nodes that are trusted by all honest nodes.

Safety & Decentralization in uniform BTNs

Ripple

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- Safety implies any two trust sets should overlap for at least (1-q)/q of their combined size
- If all pairs of trust sets overlap for at least 0.25 of their combined size, then the intersection of all trust sets is non-empty (i.e., there are nodes trusted by all nodes)
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Fully decentralised consensus is impossible

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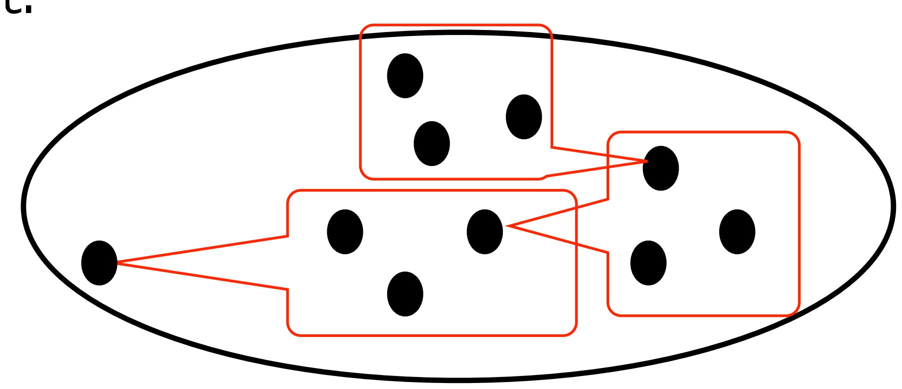

PART III

Influence

Influence in uniform safe BTNs

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- It is trickier for consensus based on trust networks

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Power index
e.g.: Penrose/Banzhaf

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Summary

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A. An analysis of inherent limitations of consensus based on trust networks: decentralisation & influence

B. Relevance of economic methods (game theory and social choice) for the analysis of consensus protocols

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