Adaptive Agent-based Self-organization for Robust Hierarchical Topologies

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Evangelos Pournaras, Martijn Warnier, Frances M.T. Brazier

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Motivation

Hierarchical topologies → Tree structures

- Aggregation
- Search

- Decision-making
- Information dissemination

Simple in principle

Motivation (cont.)

Distributed systems and tree overlays

- Node / link failures
- Congestions

- Attacks
- Heterogeneity

Sensitive in principle

Problem

Robustness

Minimization of the impact of failures in the topology

Self-organization

Nodes with local knowledge in dynamic environments

Application-dependence

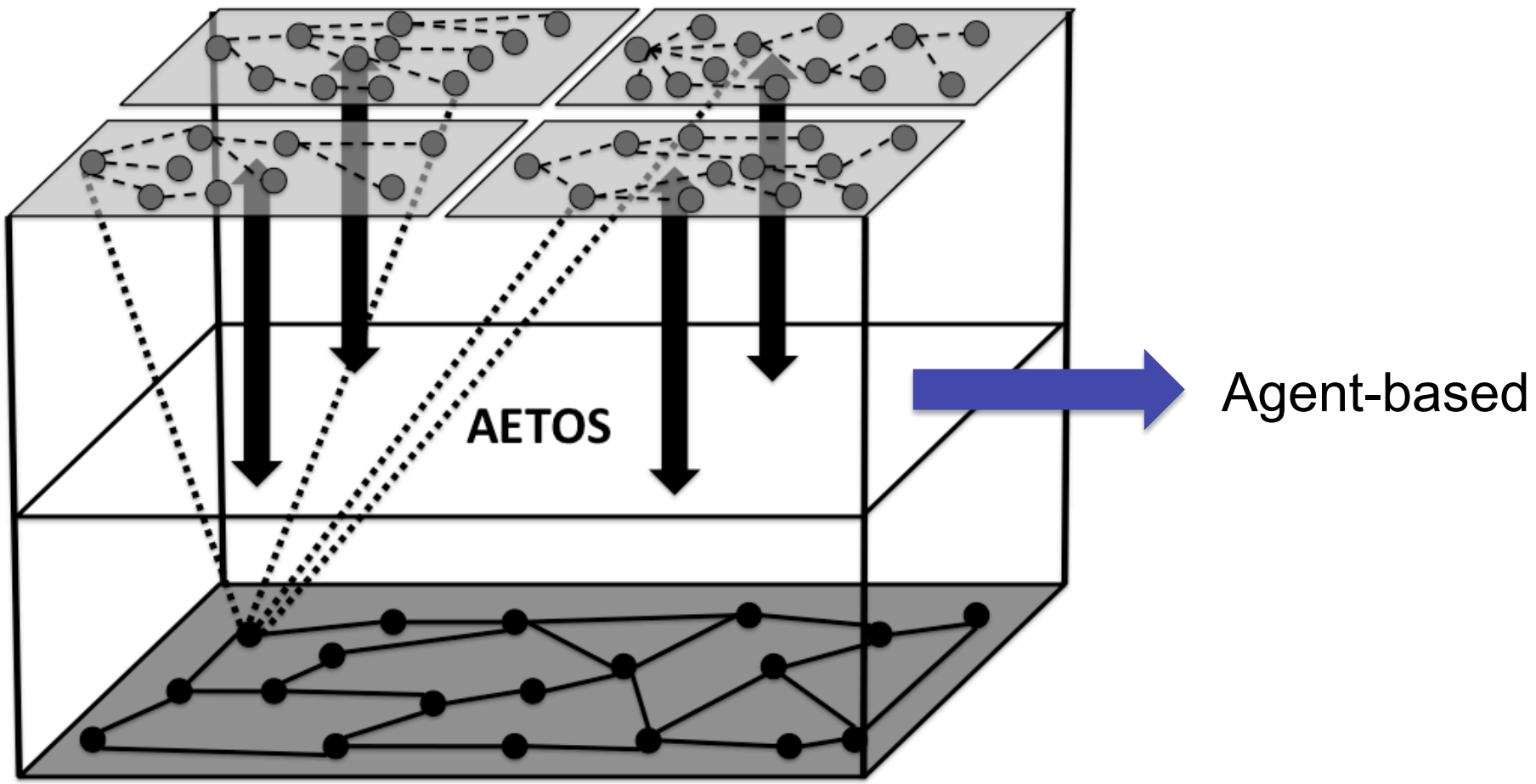
Abstract application to self-organization requirements

Propose

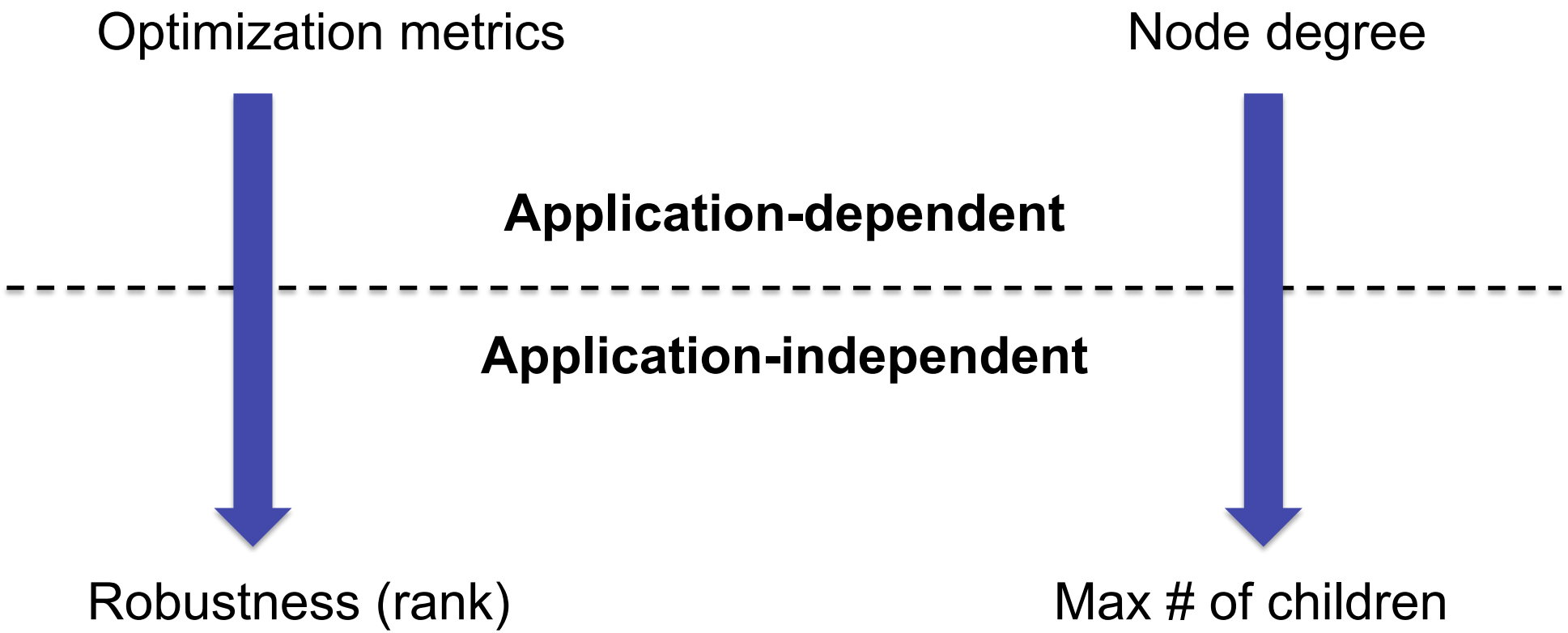
AETOS

The Adaptive Epidemic Tree Overlay Service

Approach



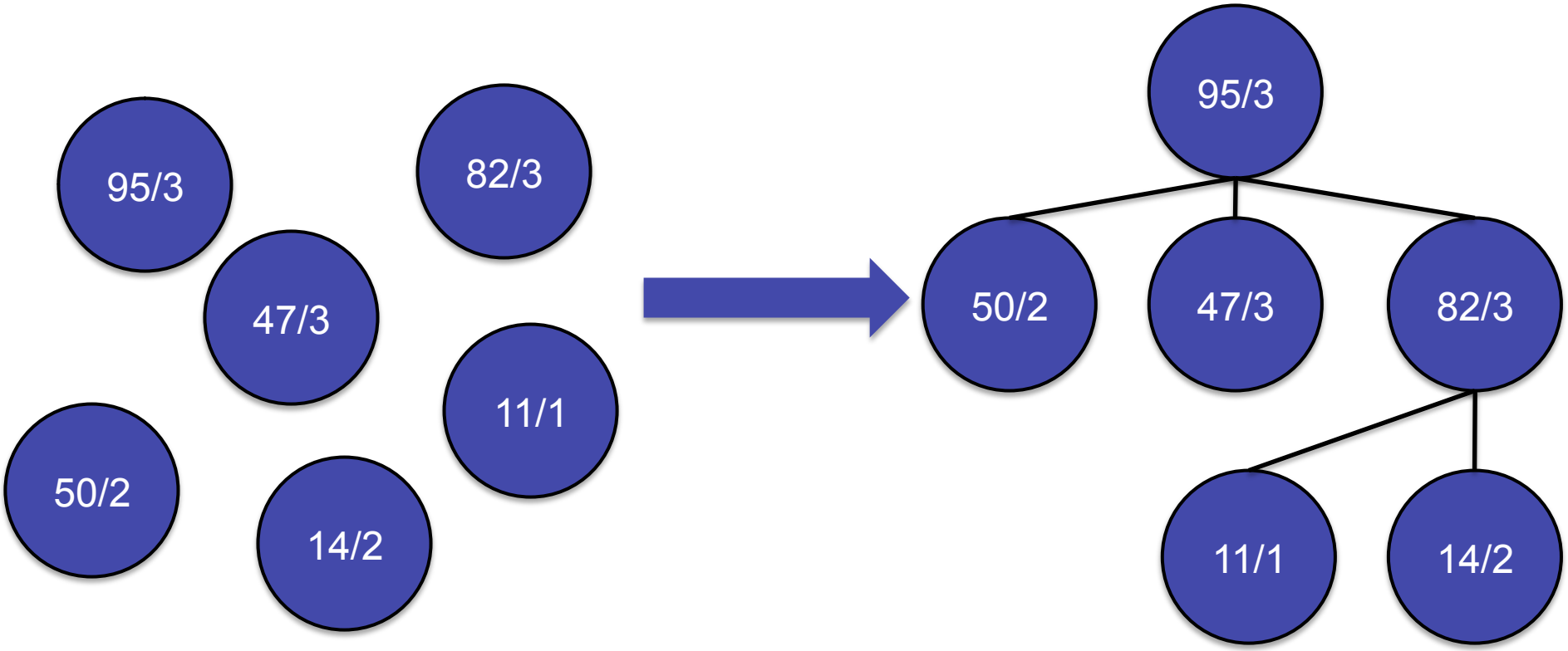
Application requirements abstraction



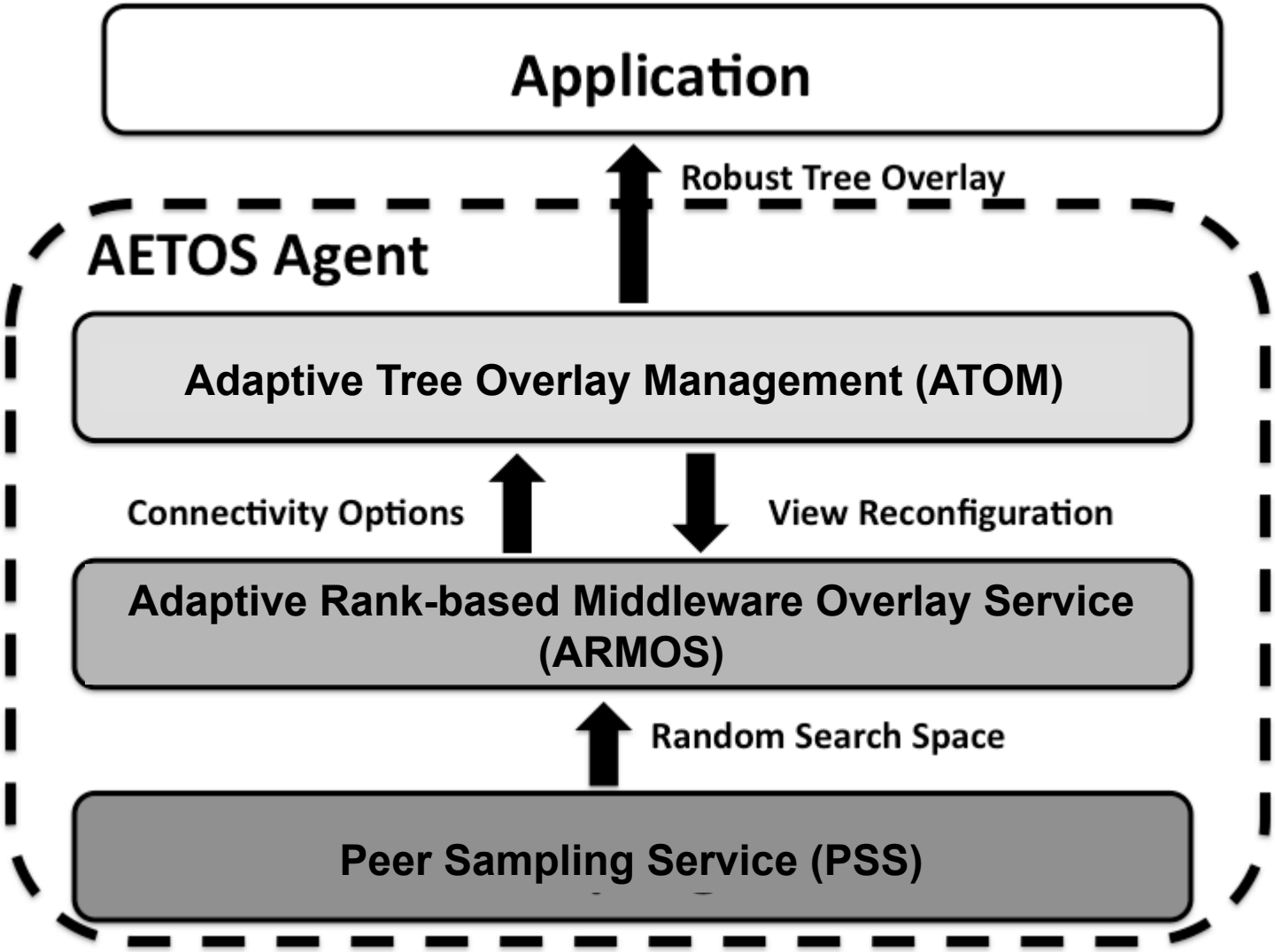
Target topology

Optimization problem:

Sort nodes according to their robustness and max # of children



Architecture



AETOS Agent

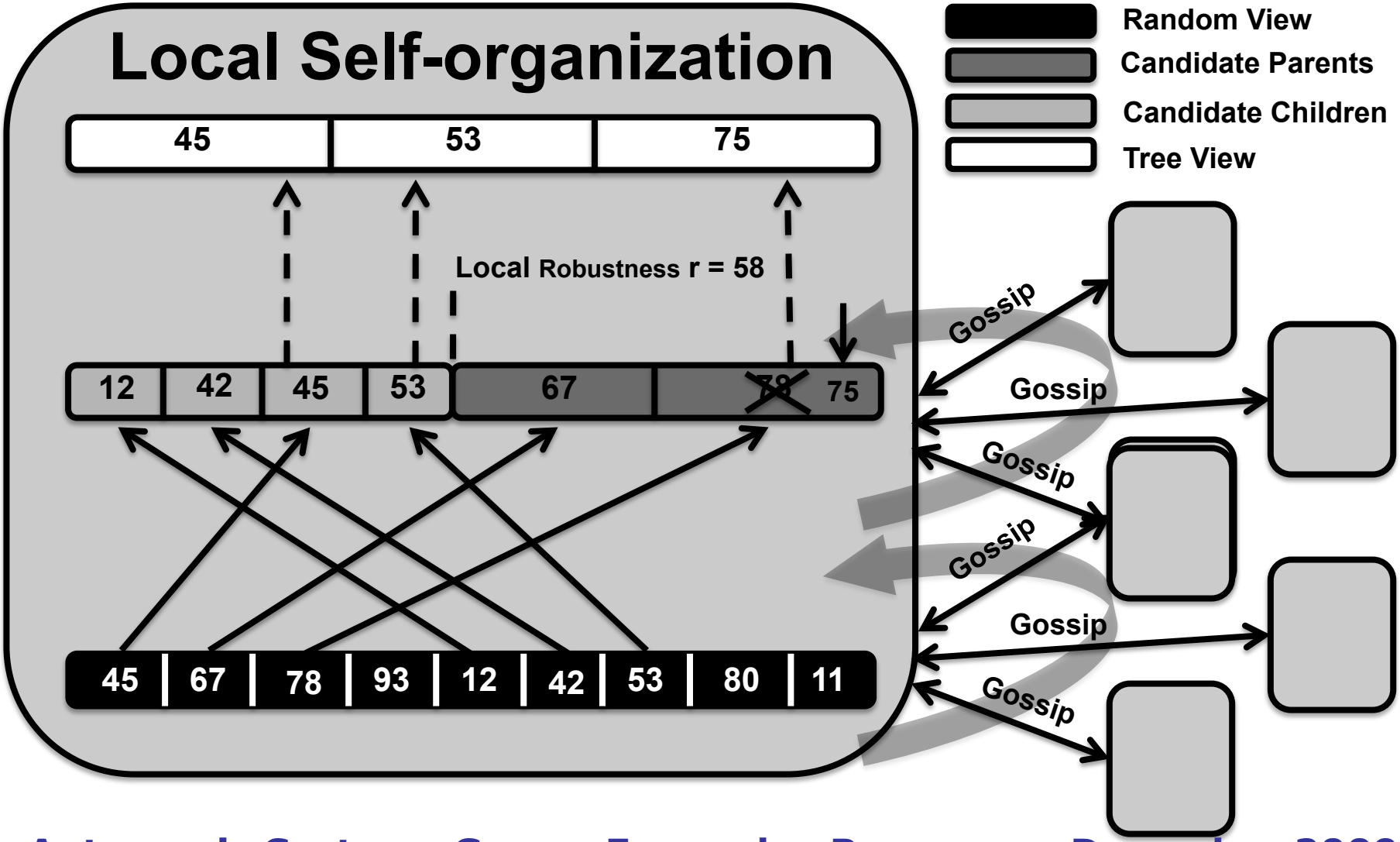
3 type of **views**

Random View → Proximity View → Tree View

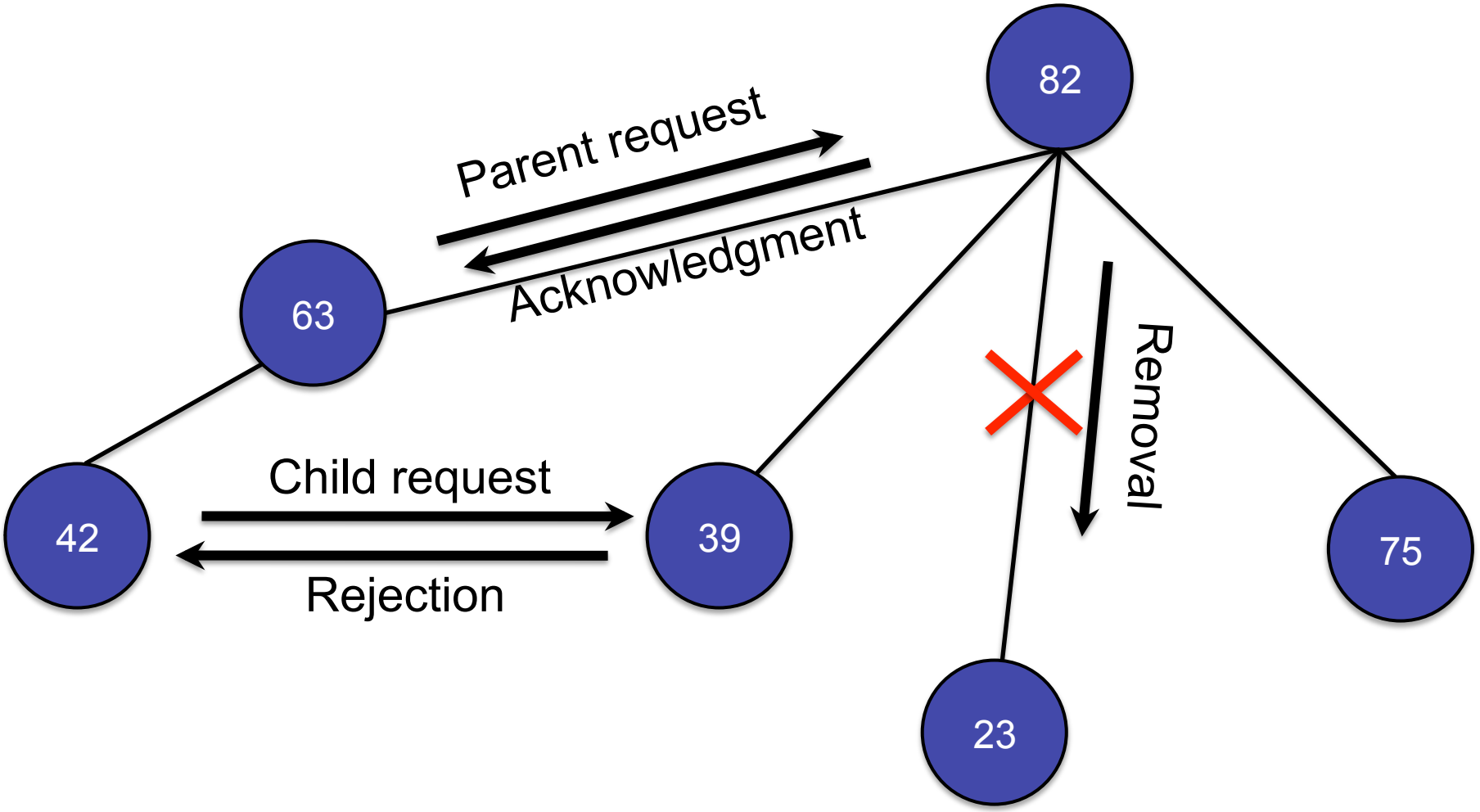
2 agent **behaviors**

Greedy Myopic

Information flow



Tree Management

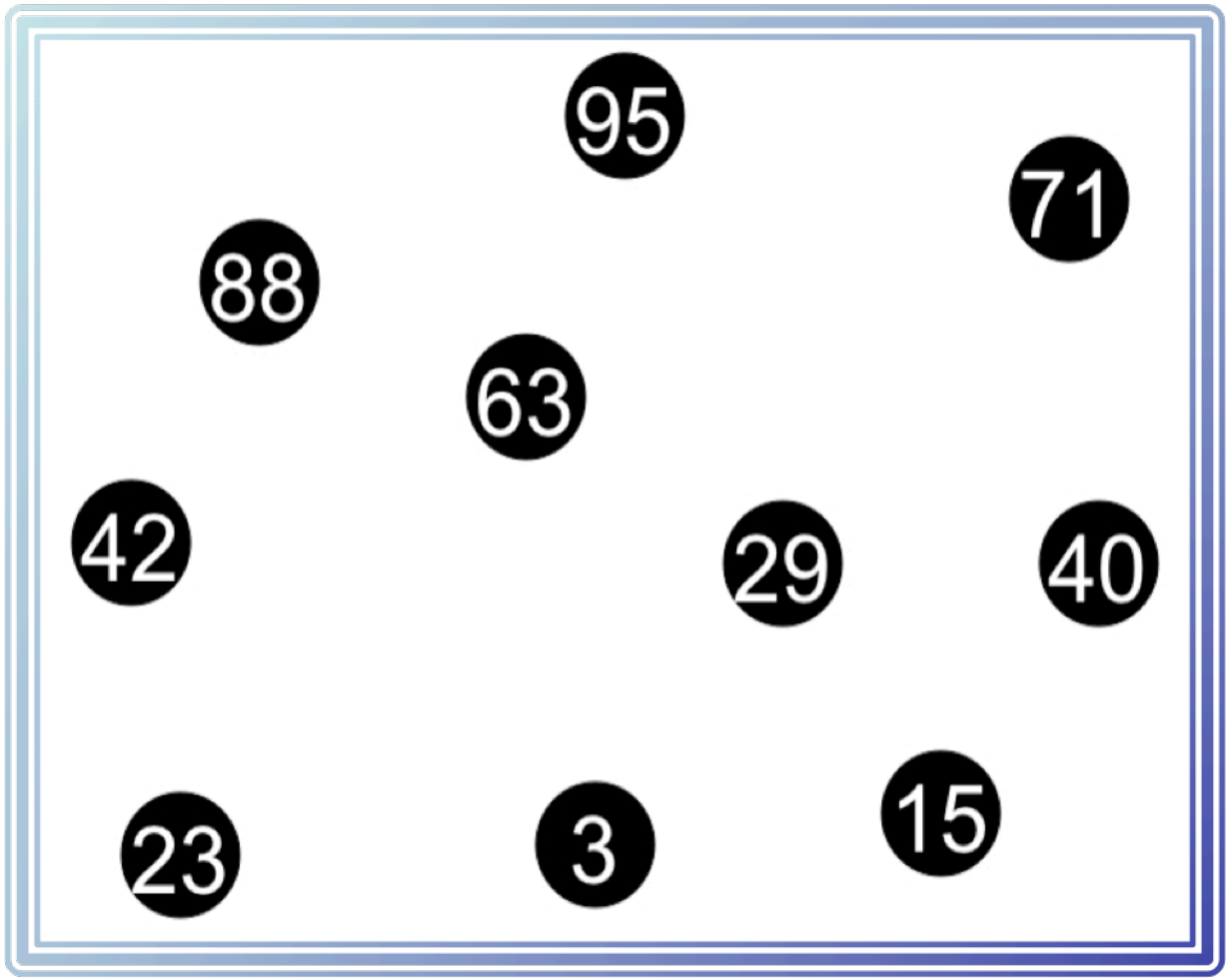


Proximity View Reconfigurations

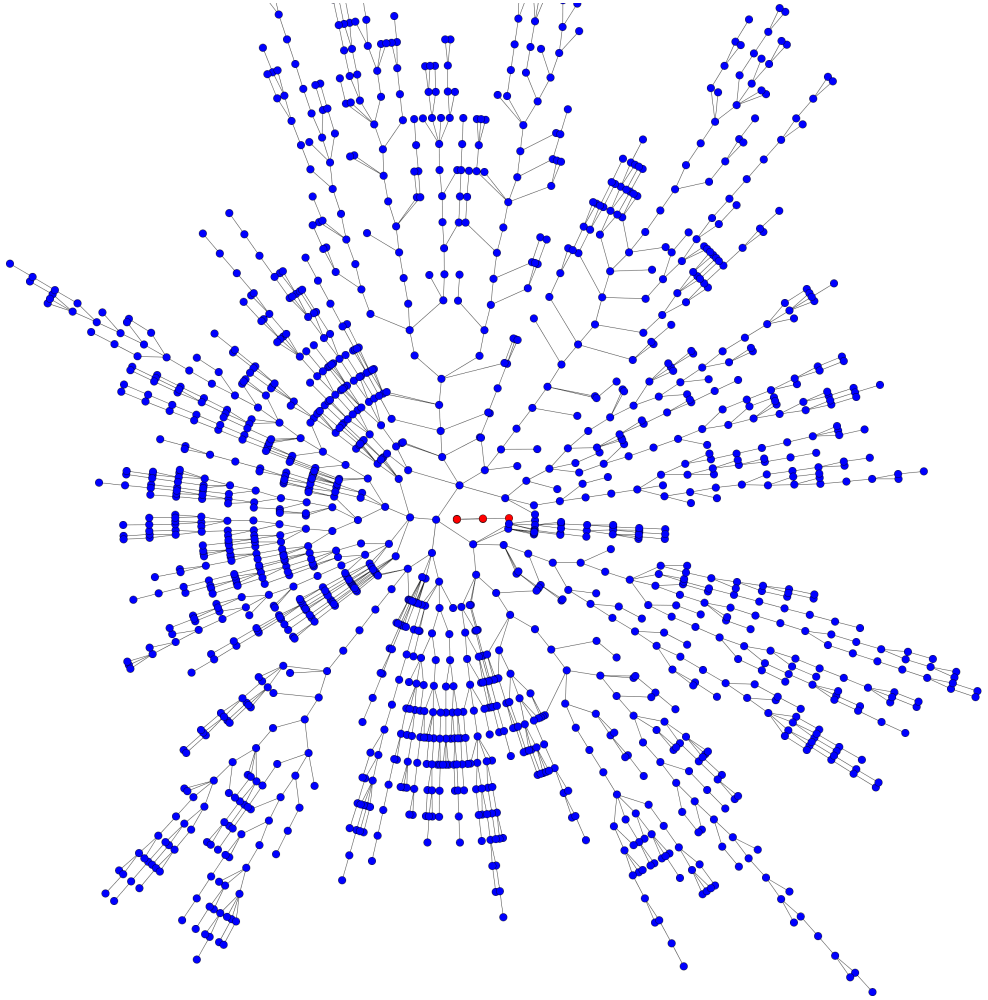
Downgrade reconfiguration (rejection, removal)

Agent picks candidates with **lower robustness than the ones it tried before**

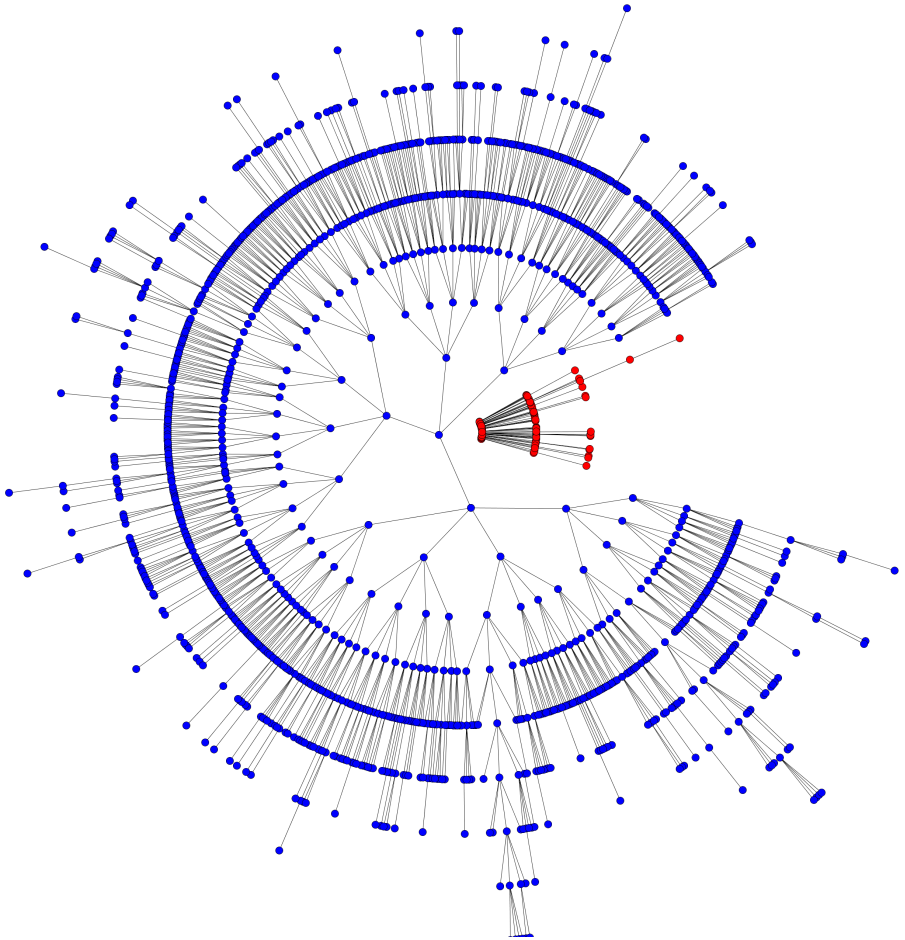
Example



Example: Myopic Agents



Example: Greedy Agents



Conclusions & Future Work

- **Building & maintaining** hierarchical structures in distributed environments **is challenging**
- Importance: **Robustness, self-organization, application-independence**
- 3-layer architecture:
  - Bottom: randomness->**proactive robustness**
  - Middle: proximity->**reconfigurable knowledge**
  - Top: connectivity->**reactivity**

- Further large-scale experimentation in dynamic settings, e.g. changing rank values
- Test in different applications, e.g. energy management, application-level multicast

Questions?