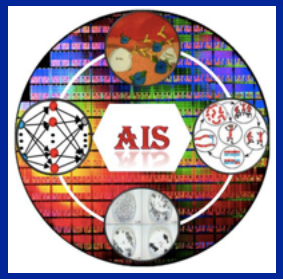
Adaptive Agent-based Self-organization for Robust Hierarchical Topologies



International Conference on Adaptive and Intelligent Systems

TU Delft Delft University of Technology

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

nlnet FOUNDATION

IIDS Intelligent Interactive Distributed Systems

Motivation

Hierarchical topologies → Tree structures

- Aggregation
- Decision-making

- Search
- 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

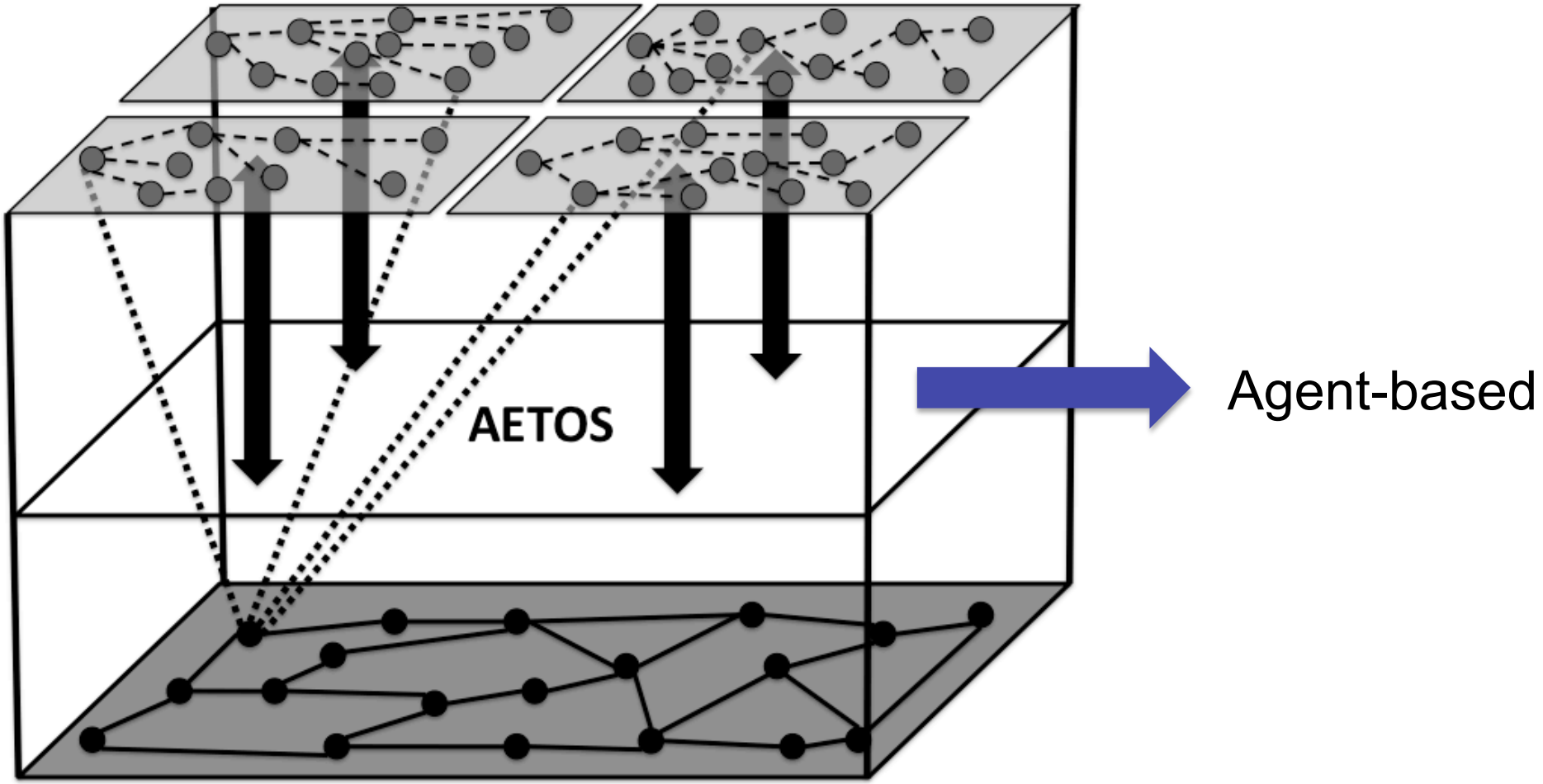
Abstract application to self-organization requirements

Propose

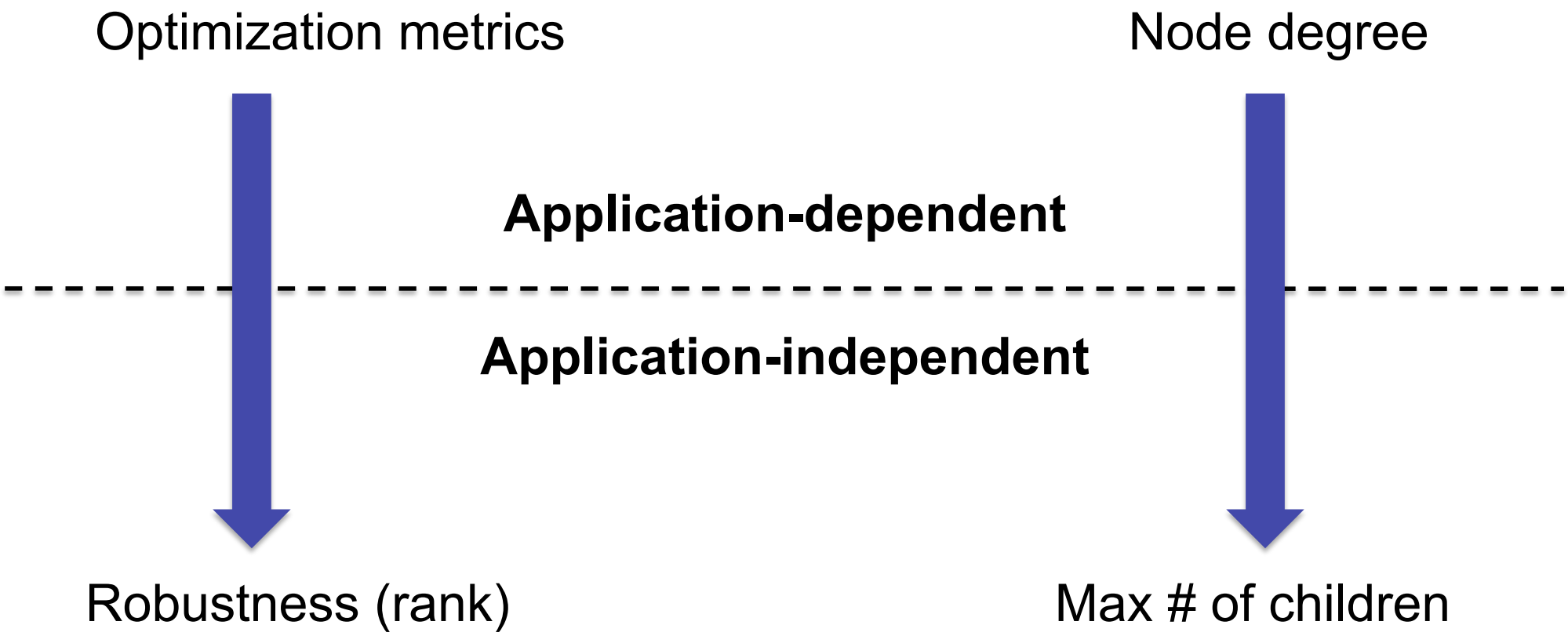
AETOS

The Adaptive Epidemic Tree Overlay Service

Approach



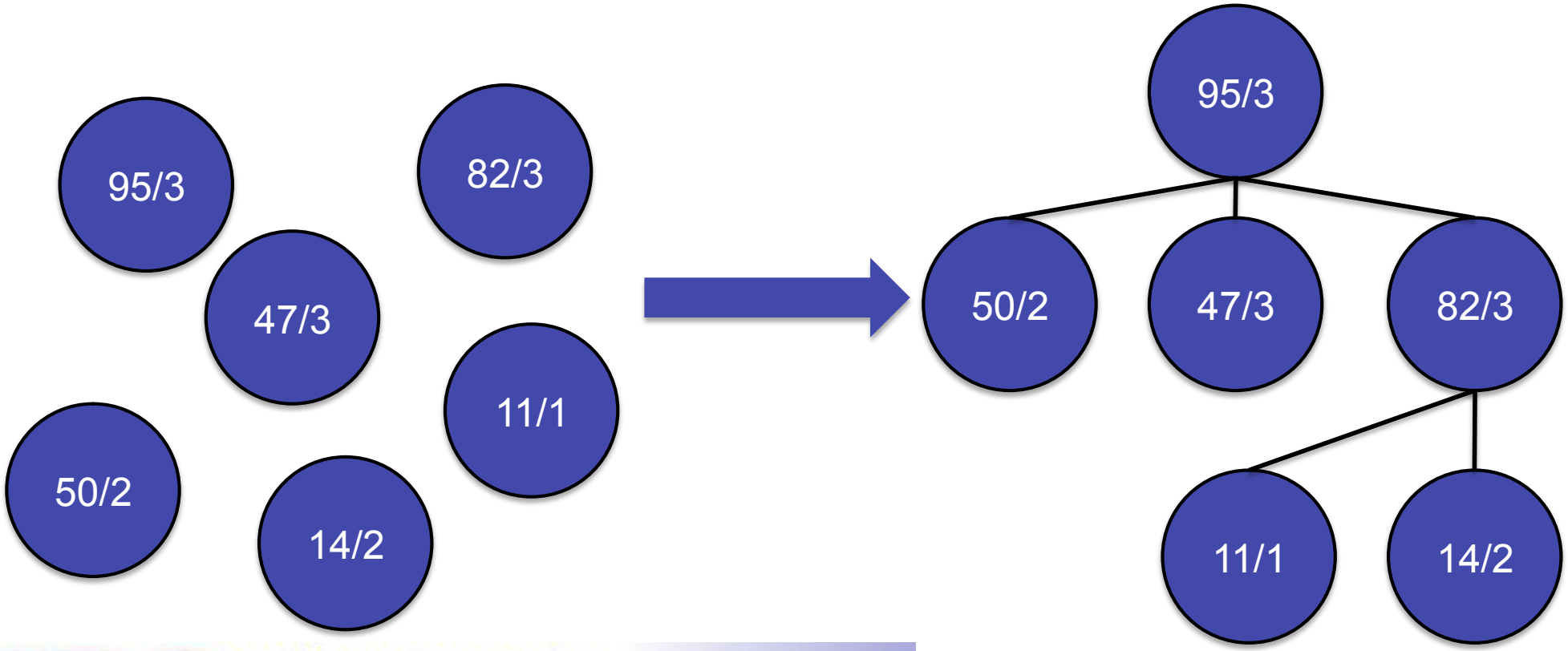
Application requirements abstraction



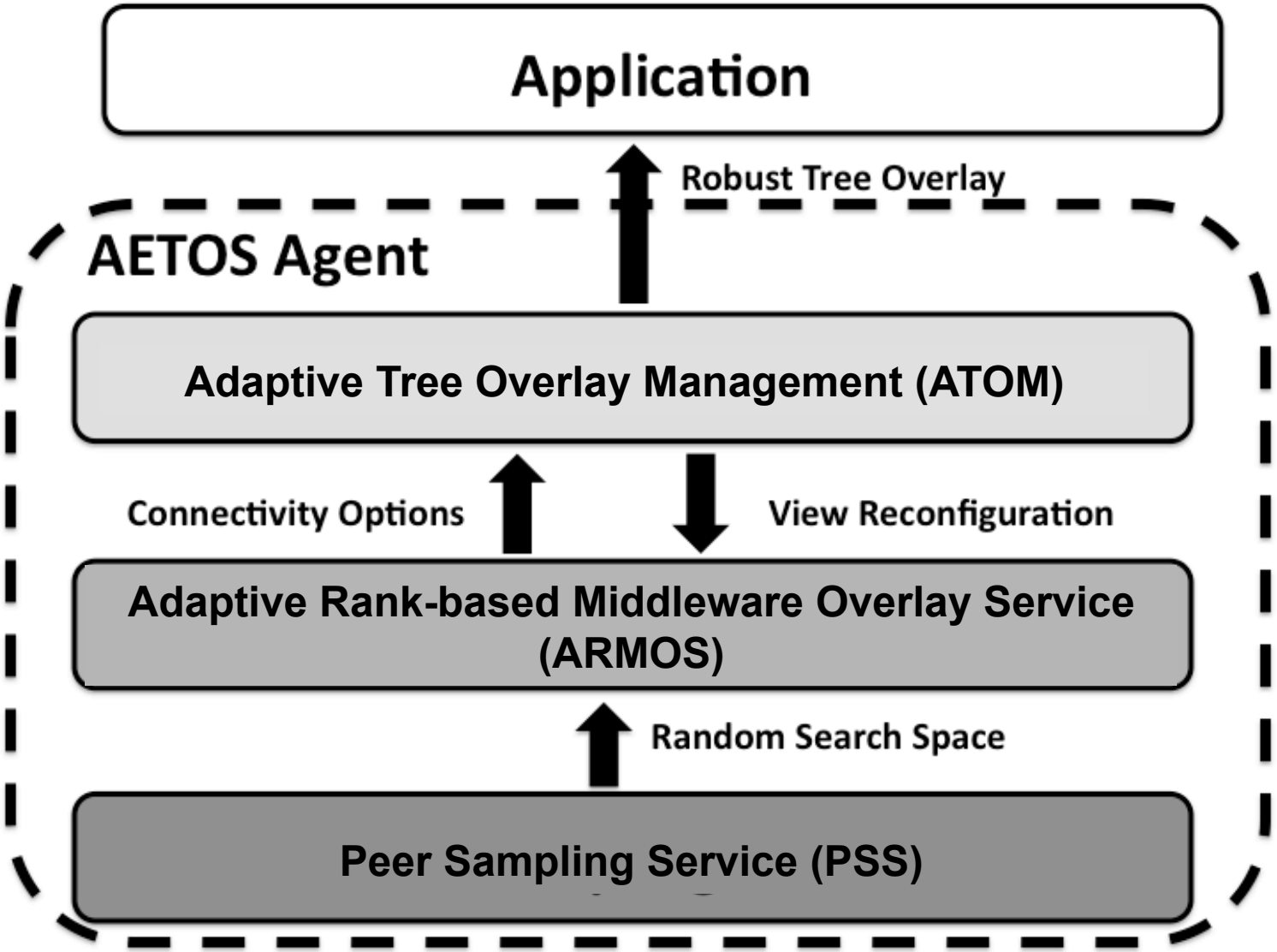
Target topology

Optimization problem:

Sort nodes according to their robustness and max # of children



Architecture

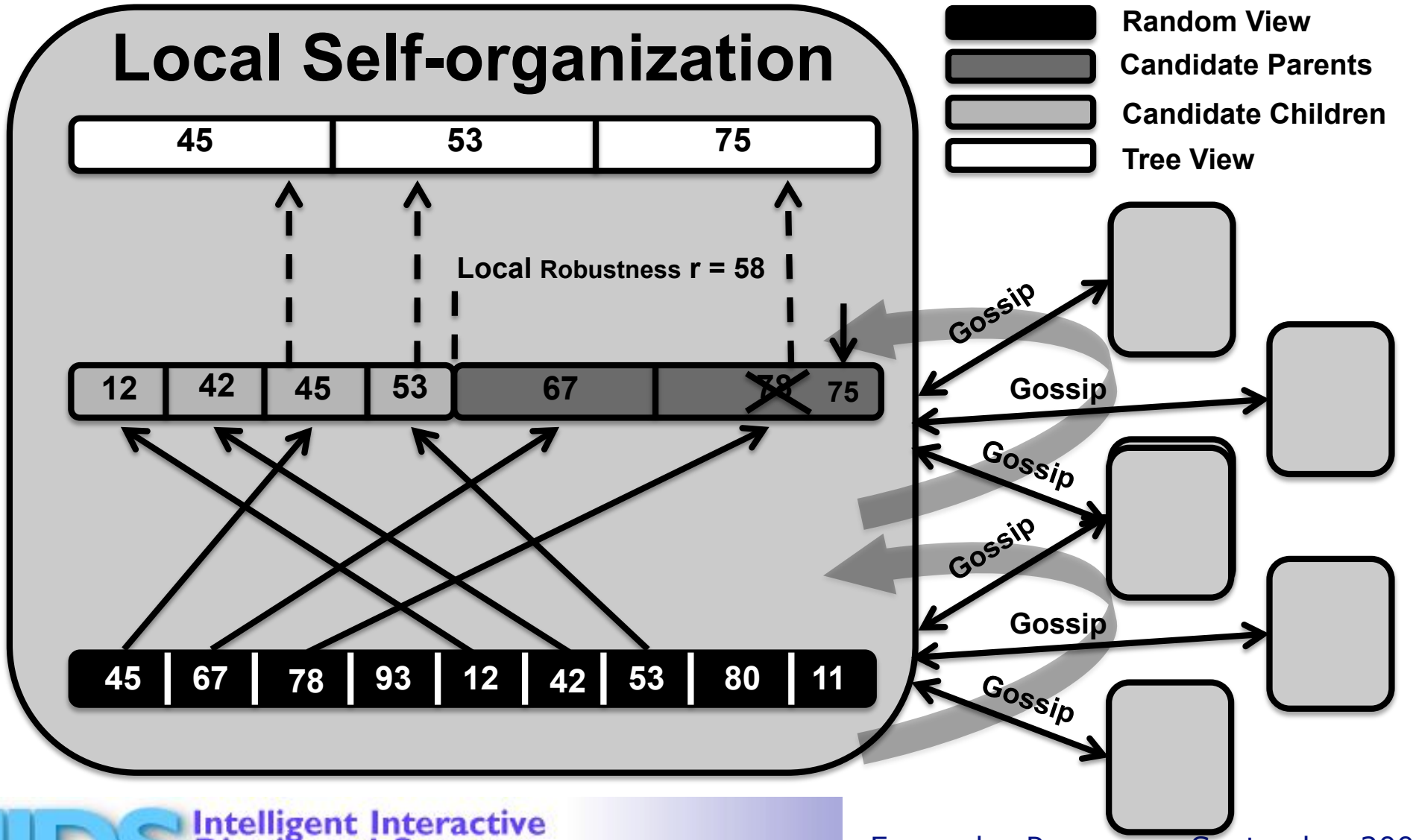


Agent knowledge

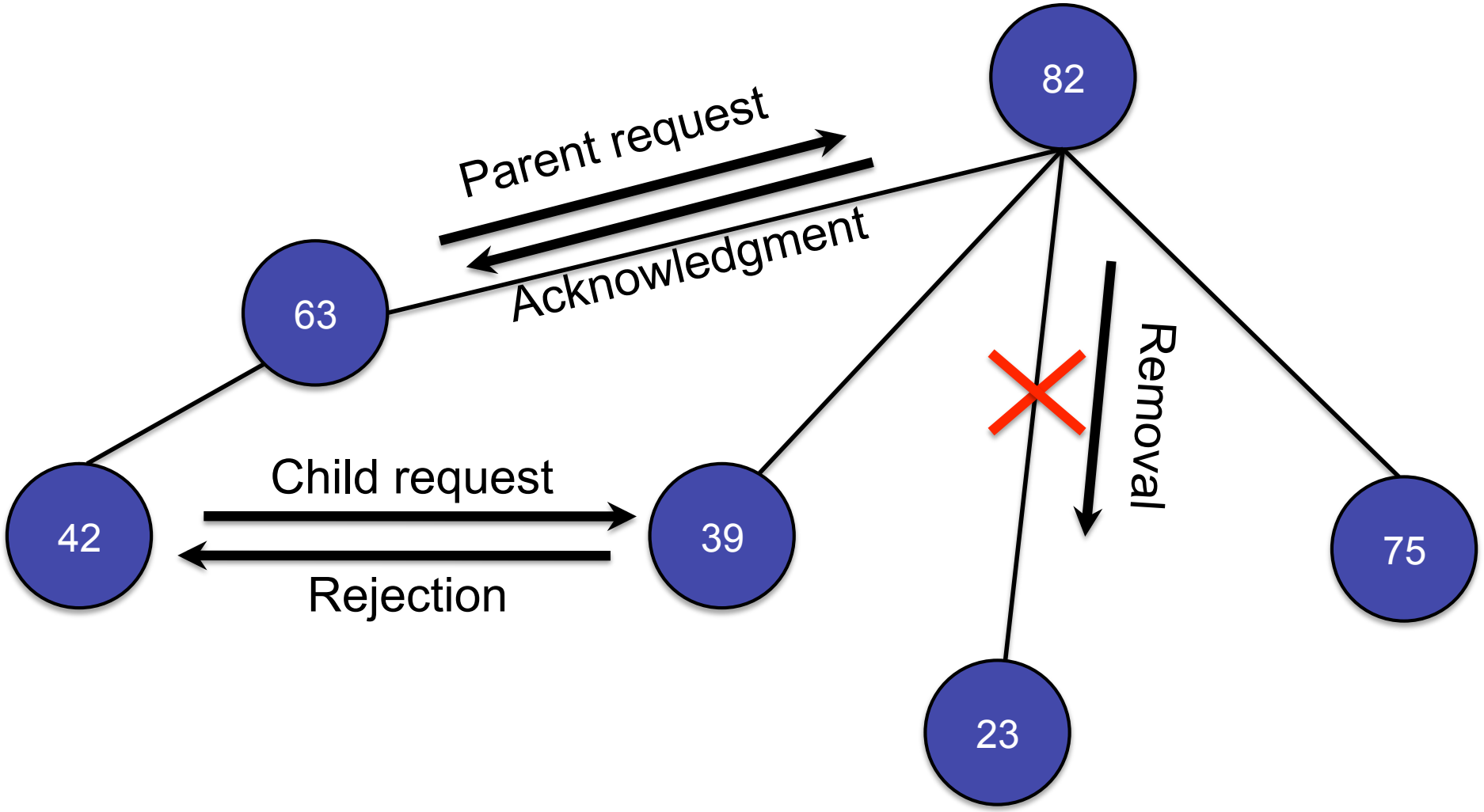
3 type of **views**

Random View  Myopic View  Tree View

Information flow



Tree Management

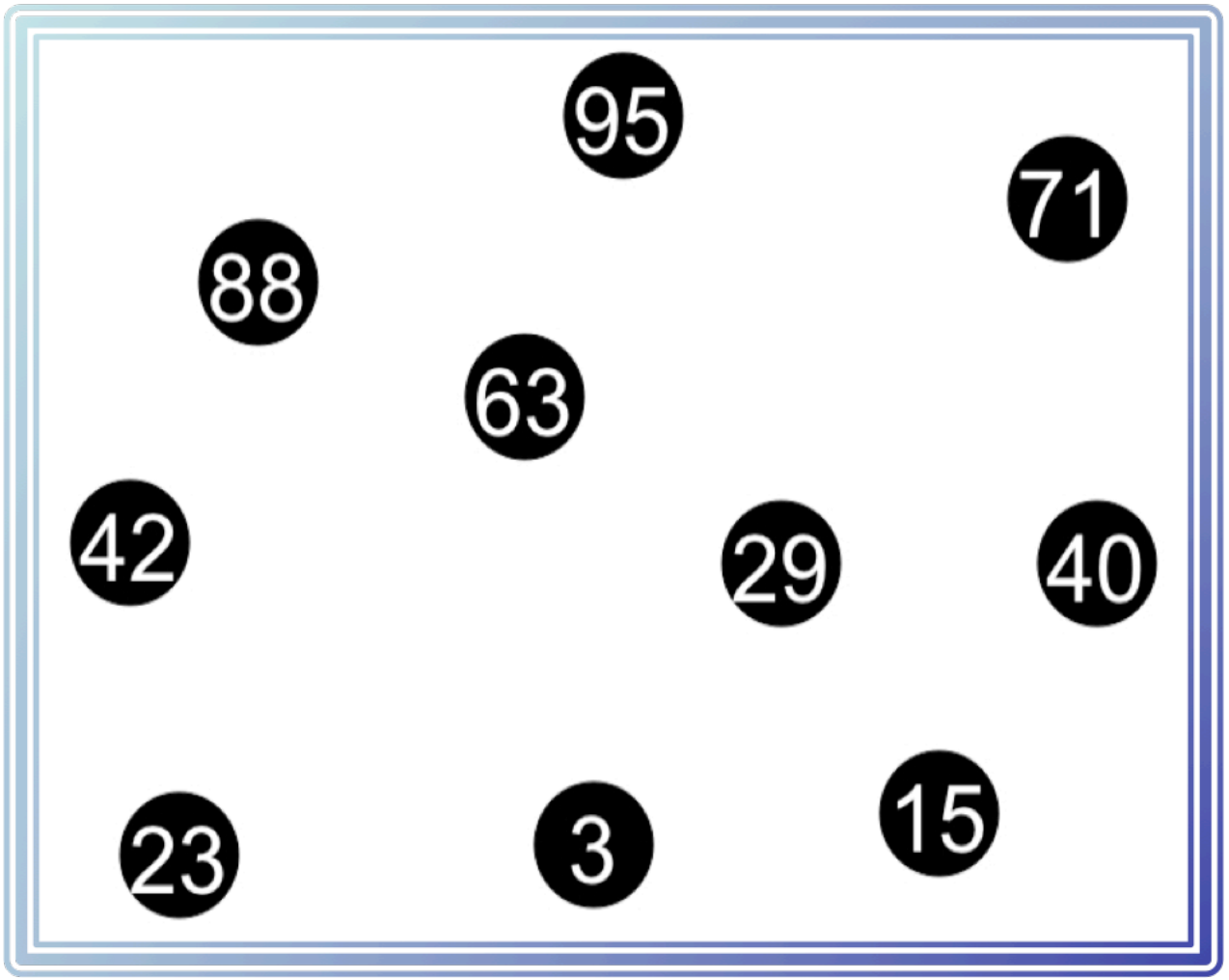


Myopic View Reconfigurations

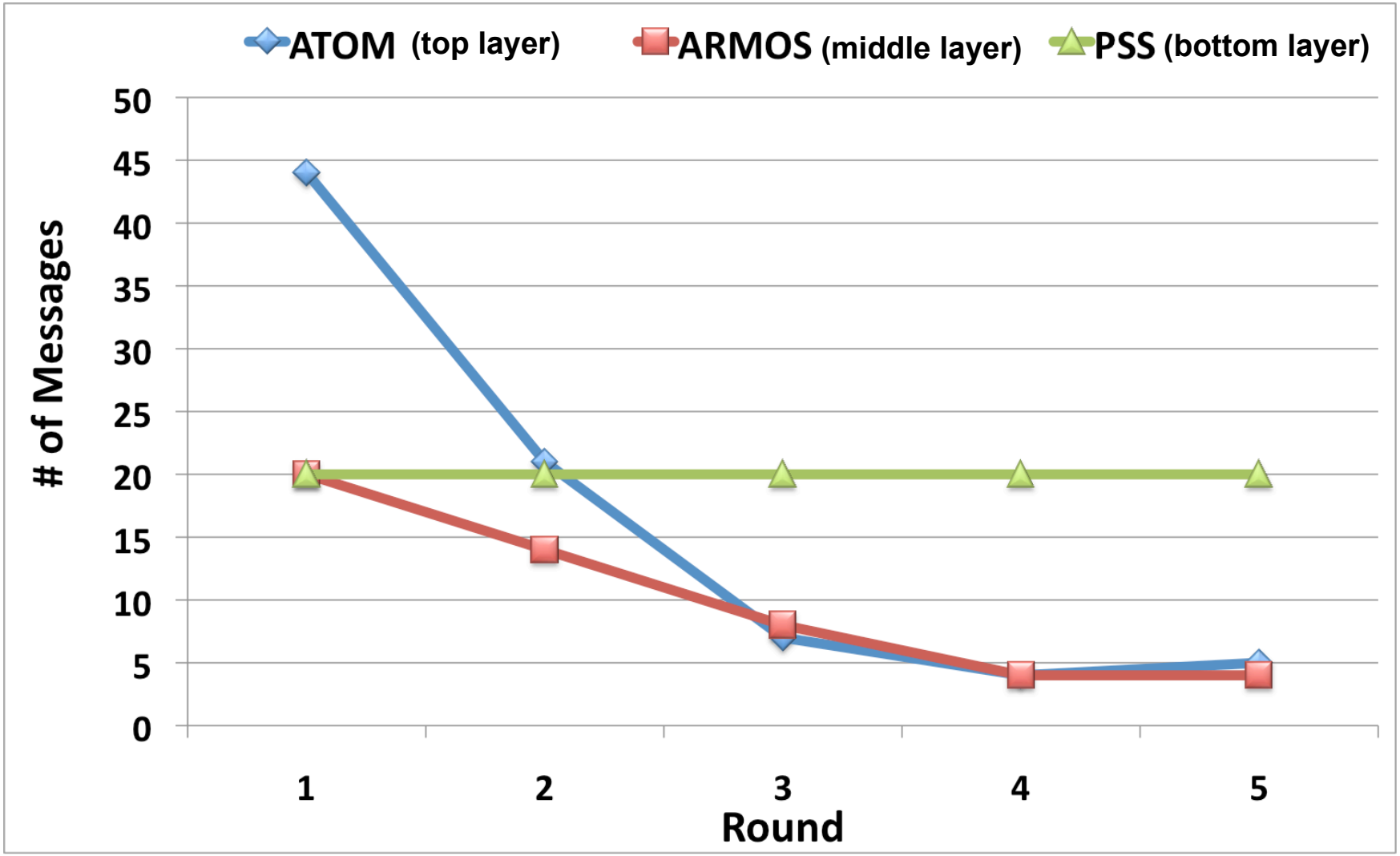
Downgrade reconfiguration (rejection, removal)

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

Example



Message Overhead



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?