ETH zürich

Self-corrective Dynamic Networks via Decentralized Reverse Computations

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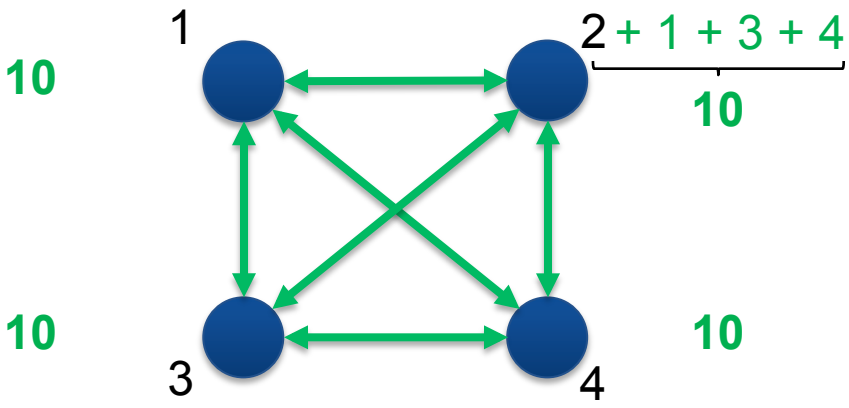
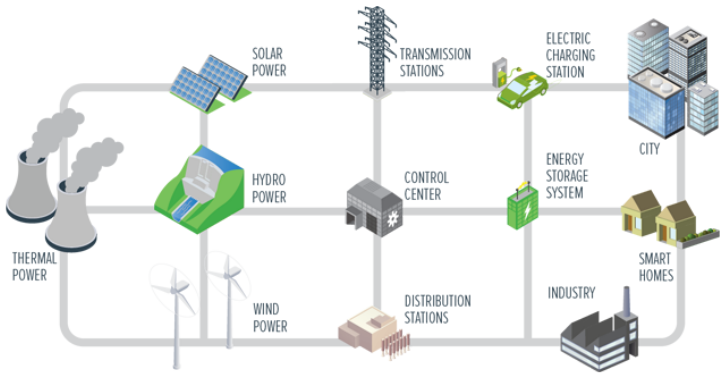
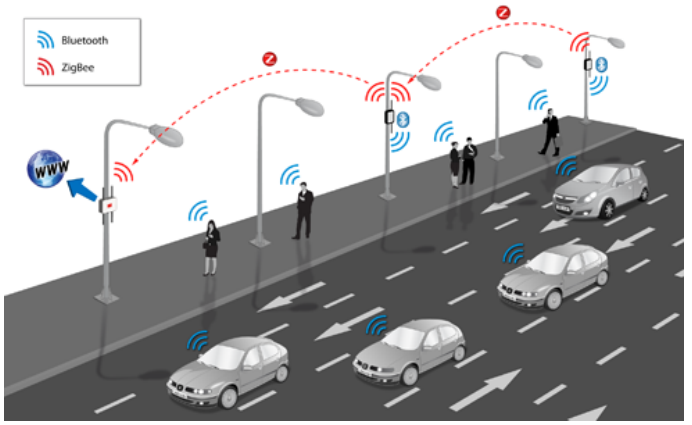
Motivation

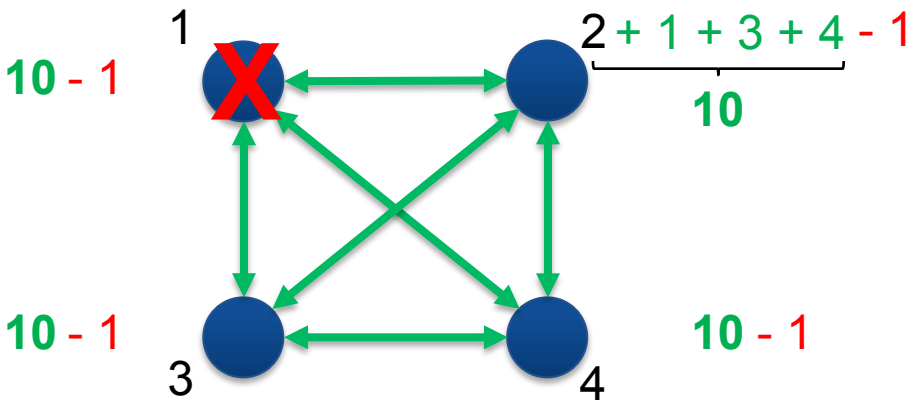
DECENTRALIZED IN-NETWORK
AGGREGATION







Reverse Computation



- Node presence determines operations

- ***Constructive operation***:
  any operation that can be undone

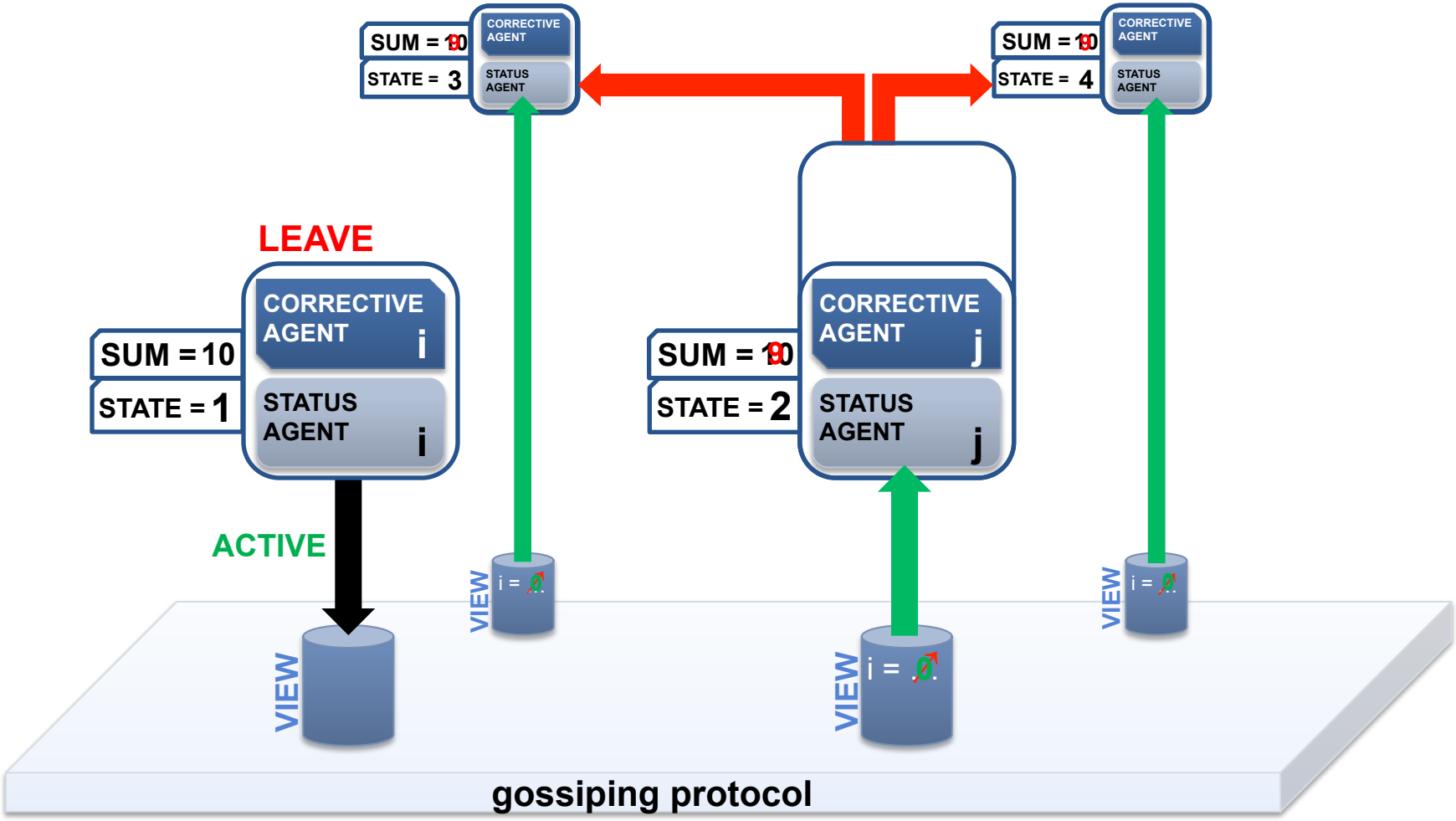
++ --
+= -=
*= /=

REVERSE COMPUTATION

SELF-CORRECTIVE PROPERTY

no redundancy
no heavy analytics
autonomous

Self-Corrective Agent-Based Model



Model applicability

Dynamic Intelligent Aggregation Service – **DIAS**:

- accurate in-network aggregation
- Peer Sampling Service reused
- nodes inherit model functionality

SUMMATION AVERAGE MIN MAX

NO ADDITIONAL MEMORY OVERHEAD

NO MAJOR CHANGES IN MAIN DESIGN

Experimental Evaluation

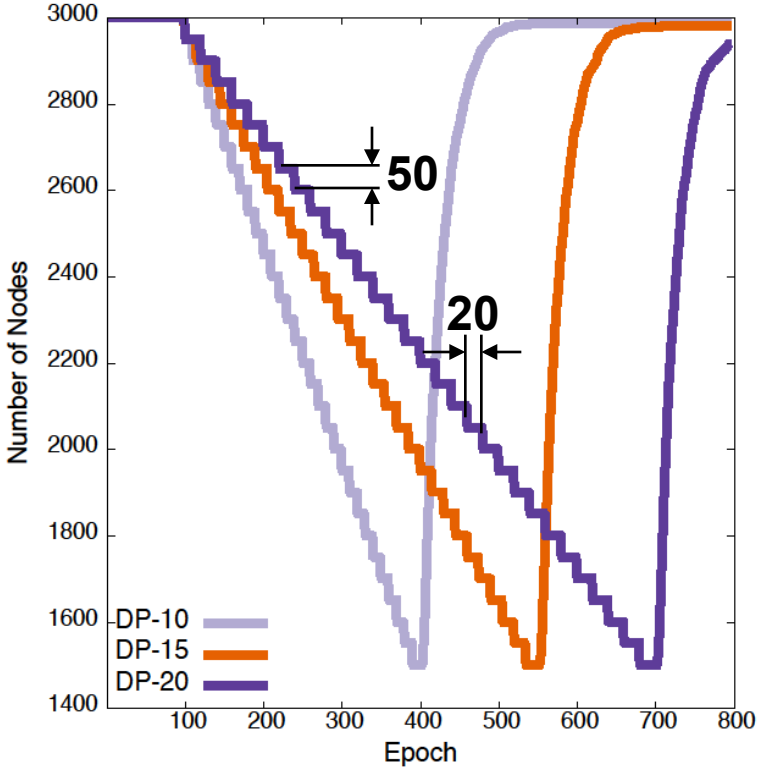
1. **Aggregation accuracy**
2. **Migration cost**
3. **Migration success**

- **ECBT** (Electricity Customer Behaviour Trial):
  - power consumption data
  - 3000 users
  - 1-day data
  - records for every 30 min

Experimental setting

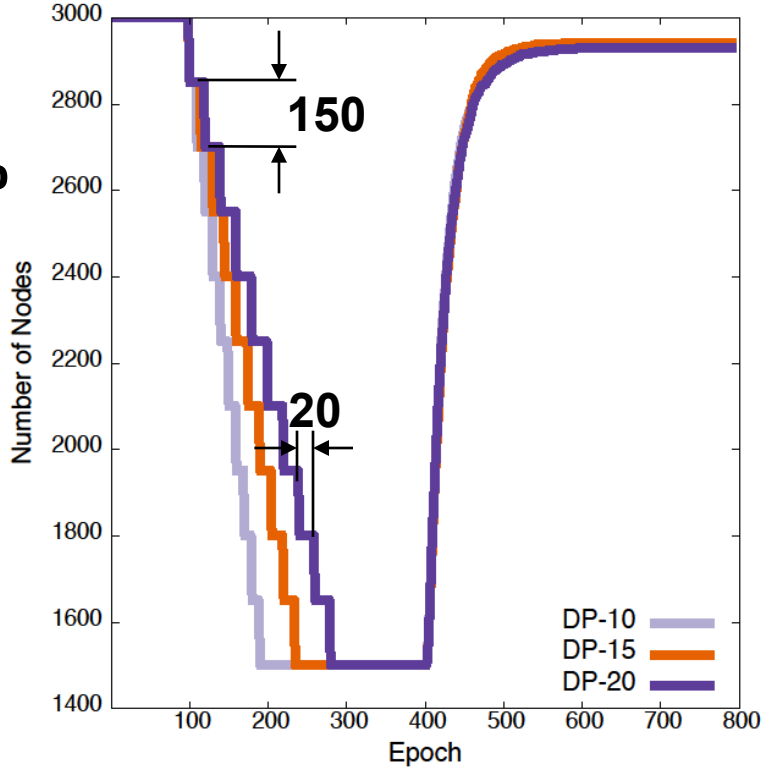
HEAVYWEIGHT

Departure Step (DS) 50



50%

Departure Step (DS) 150



Improvement Potential of Accuracy

HEAVYWEIGHT

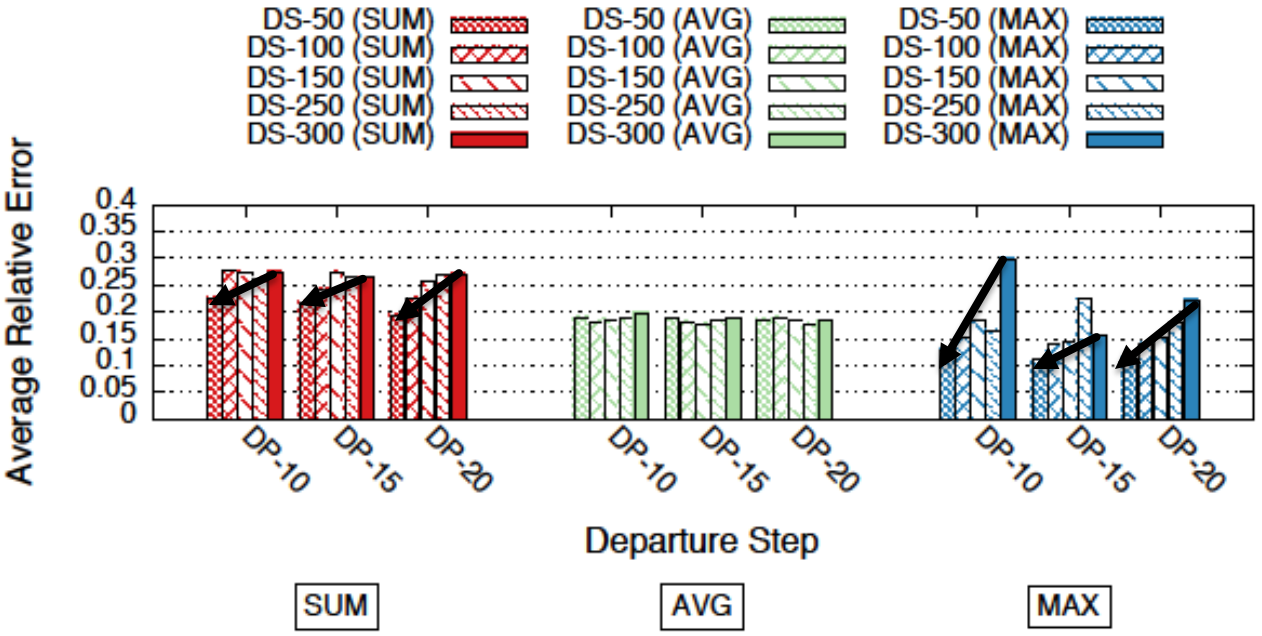
NON-CORRECTIVE NETWORK

+55%

SELF-CORRECTIVE NETWORK

Accuracy

HEAVYWEIGHT



- Varying departure *period* doesn't change the main trend
- By increasing departure *step*, accuracy **decreases**

BETTER IF NODES LEAVE IN SMALLER BATCHES

Consecutive Migrations

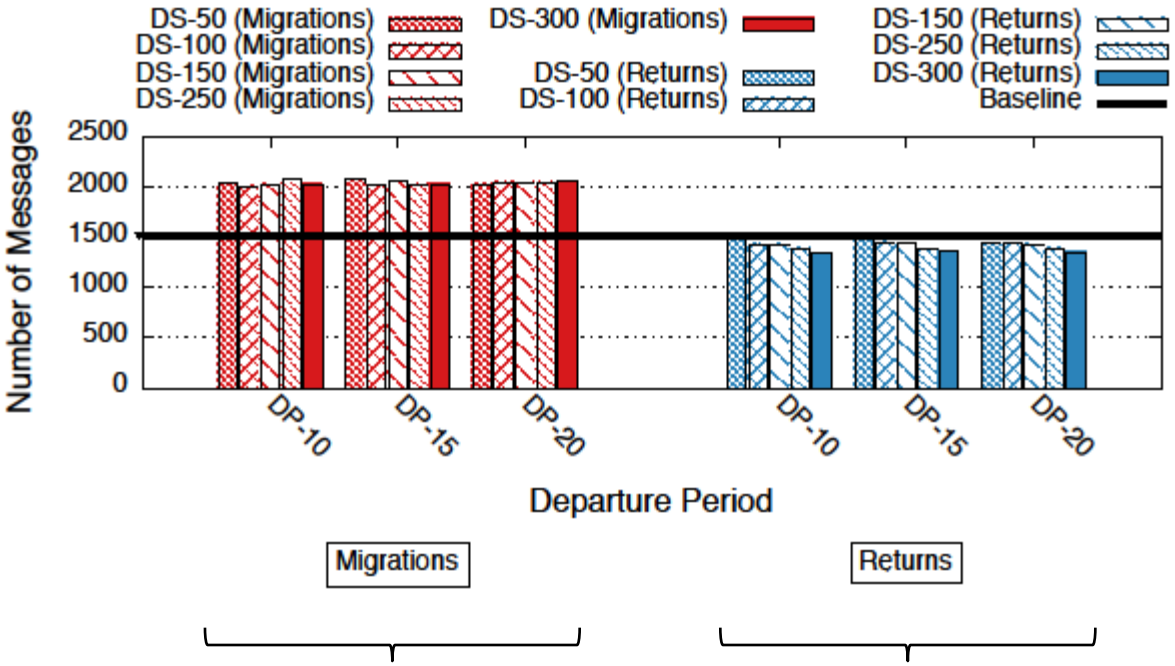
HEAVYWEIGHT

Unsuccessful Migrations

HEAVYWEIGHT

Migration Costs

HEAVYWEIGHT

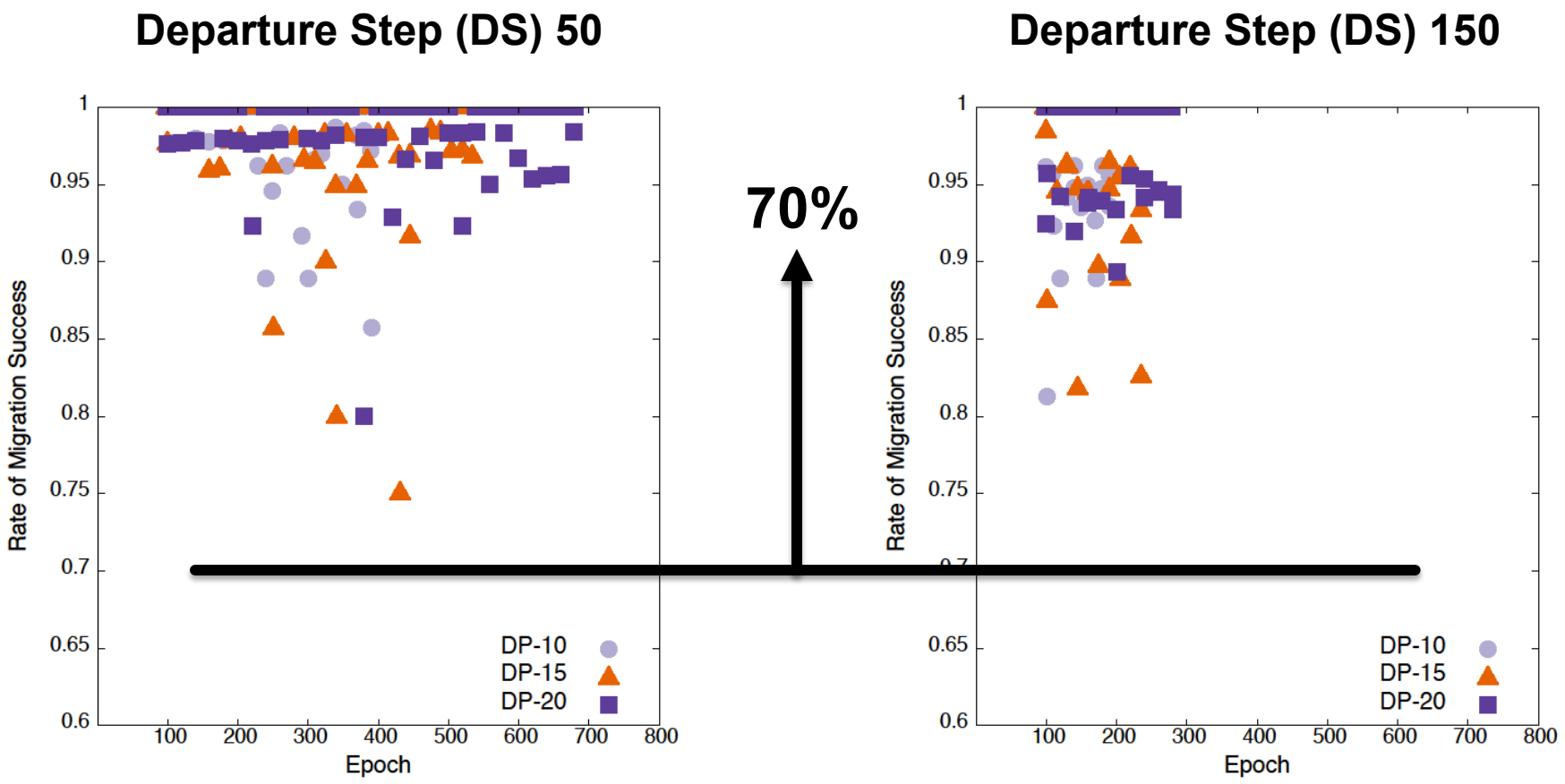


host to host migrations required

self-corrective actions more effective in **smaller batches**

Migration Success

HEAVYWEIGHT



Conclusion

- **large-scale**
- **dynamic**
- **decentralized**
- **computation network**

- **self-corrective**:
  - generic
  - dynamic
  - autonomous

FEASIBLE

+ no redundancy

+ no major changes in main design

+ under extreme network adjustments

Future Work

- Experimental evaluation under node failures
  - network-availability profiles data
- Expanding to other scopes:
  - malicious nodes

Questions?

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