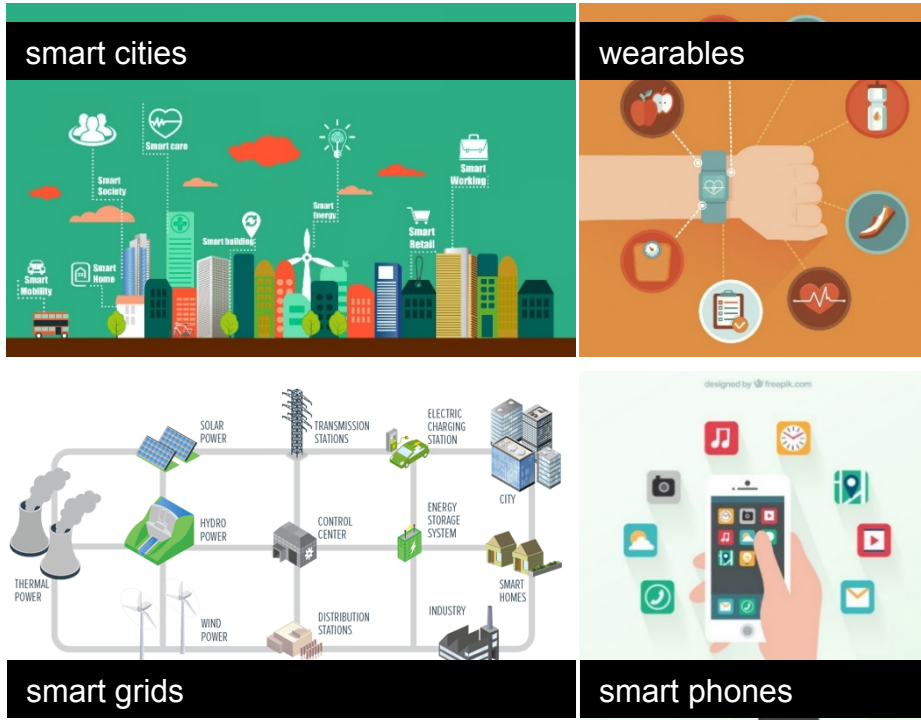




On-demand Self-adaptive Data Analytics in Large-scale Decentralized Networks

Evangelos Pournaras, Jovan Nikolic

Motivation



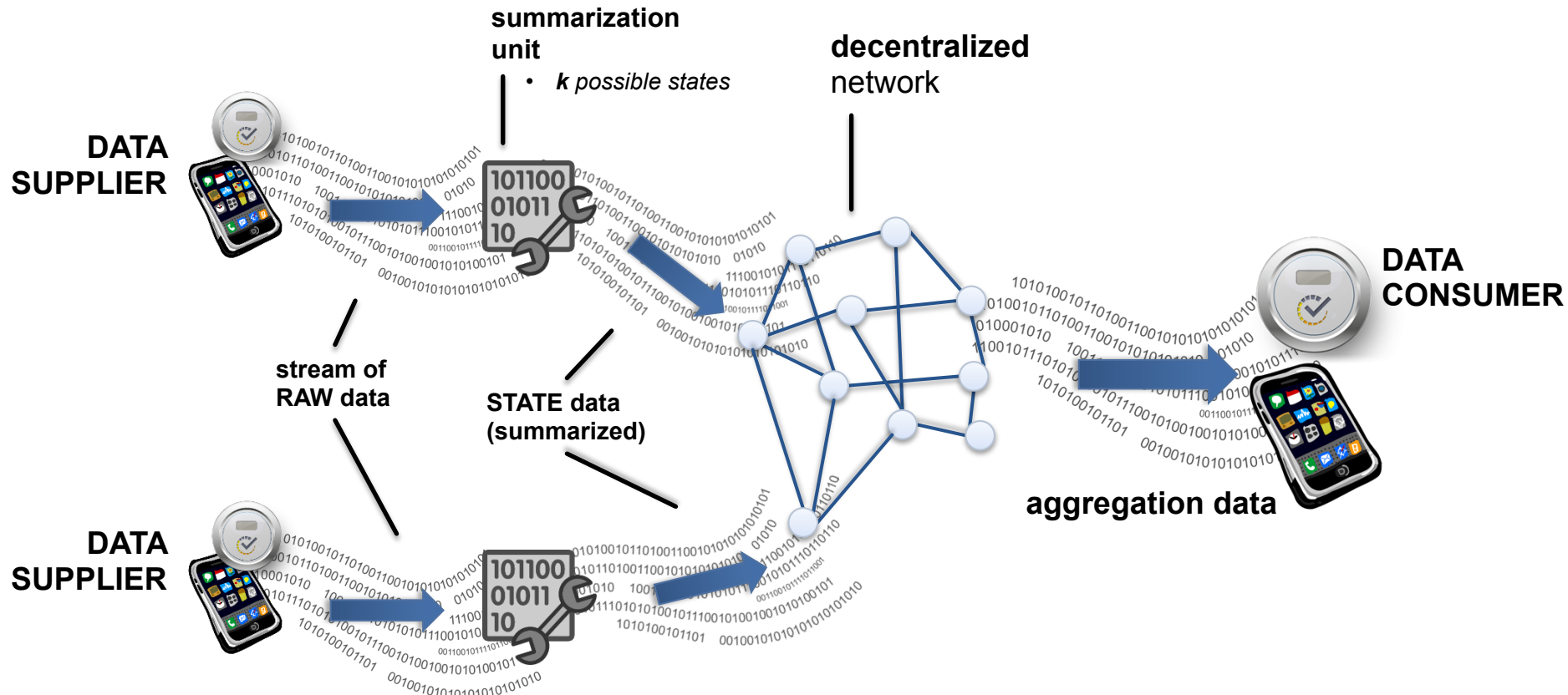
Decentralized networks:

- formed by citizens
- tolerate high network dynamics

But **challenging to control and manage**

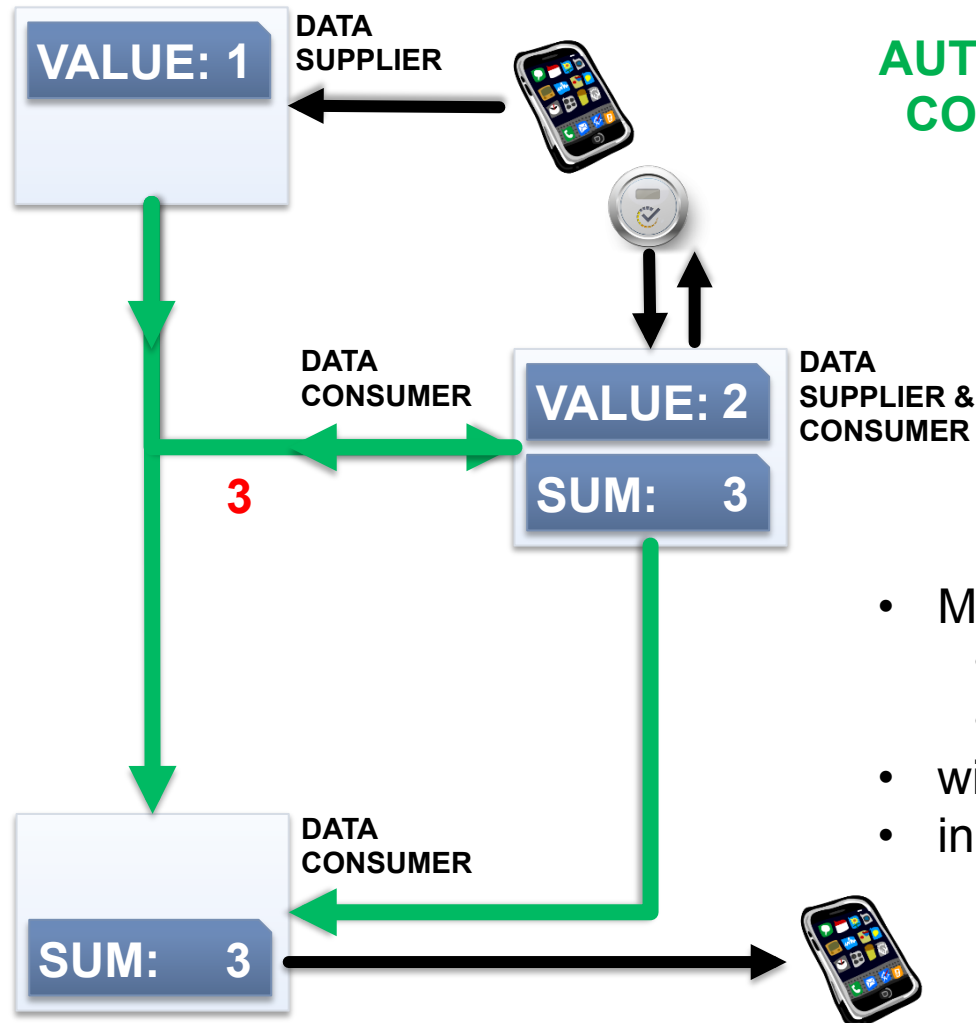
under varying demand: when number of participants **scales up or down**

Decentralized Aggregation



- ✓ Decentralized data management
- ✓ Data Suppliers leave & rejoin
- Data Consumers leave & rejoin

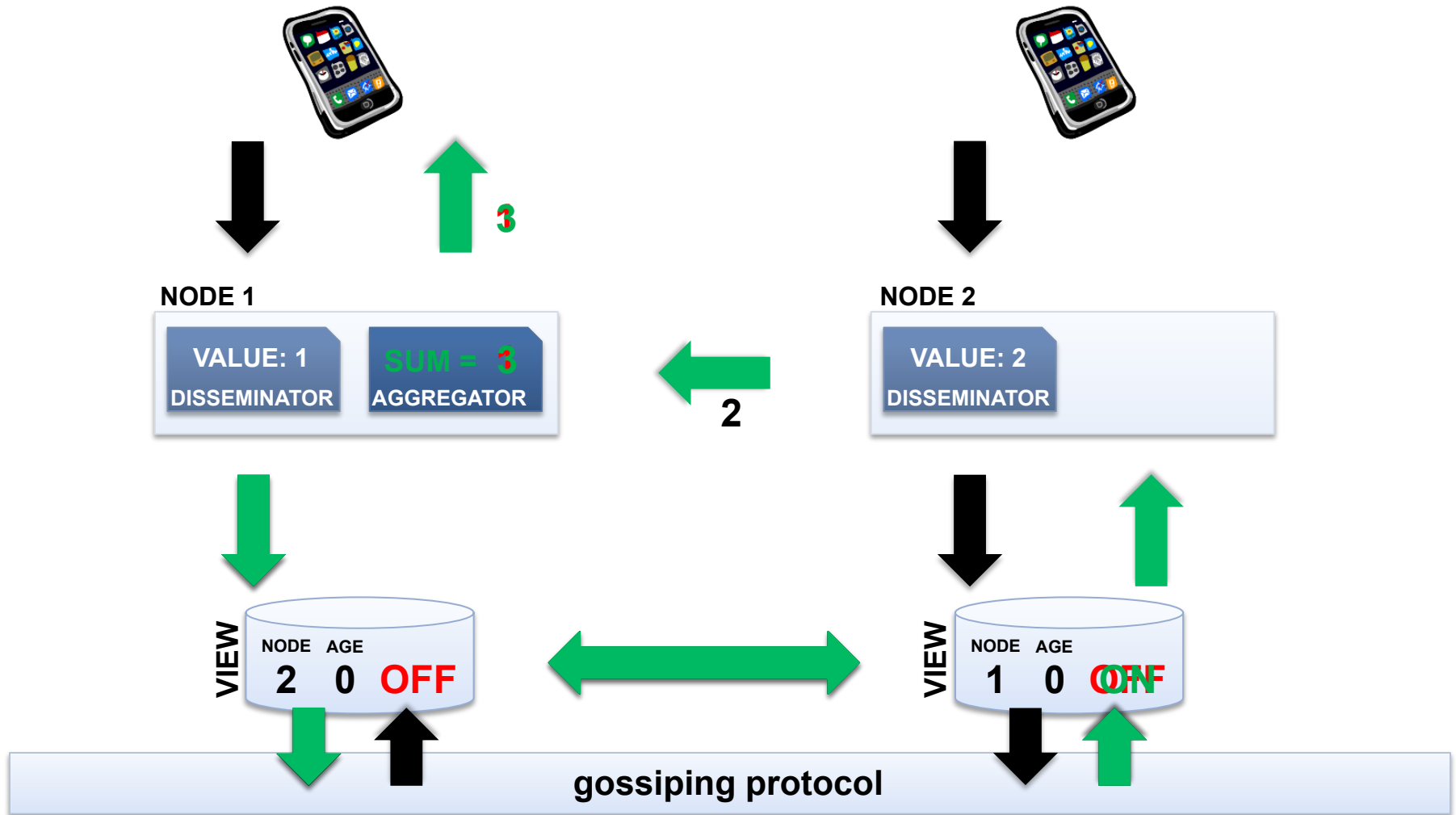
Research Challenge



AUTOMATED ORCHESTRATION OF COMMUNICATION TO DISCOVER NEW DATA CONSUMERS

- Maintain **high quality of service**:
 - accuracy
 - low communication cost
- with **dynamic computational demand**
- in **self-adaptive fashion**

Self-Adaptive Model



Model Applicability

Dynamic Intelligent Aggregation Service – **DIAS**:

- **accurate** in-network aggregation under dynamic streams of data
- Peer Sampling Service as gossiping protocol
- **supports join & leave of data suppliers**

SUMMATION
AVERAGE
MIN
MAX

NO CHANGES IN DIAS DESIGN

Experimental Evaluation

1. Accuracy

2. Communication Costs

2 operational modes:

- **SIMULATION**
- **LIVE**

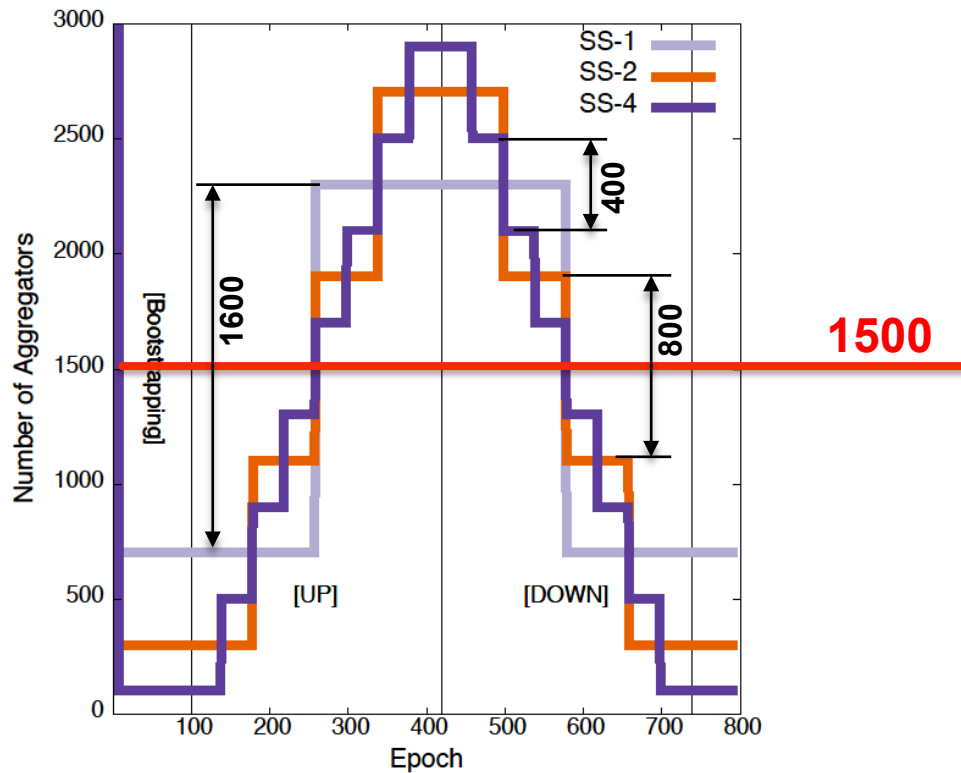
ECBT – Electricity Customer Behaviour Trial

- real-world smart-grid pilot project
- 3000 users
- records every 30 minutes

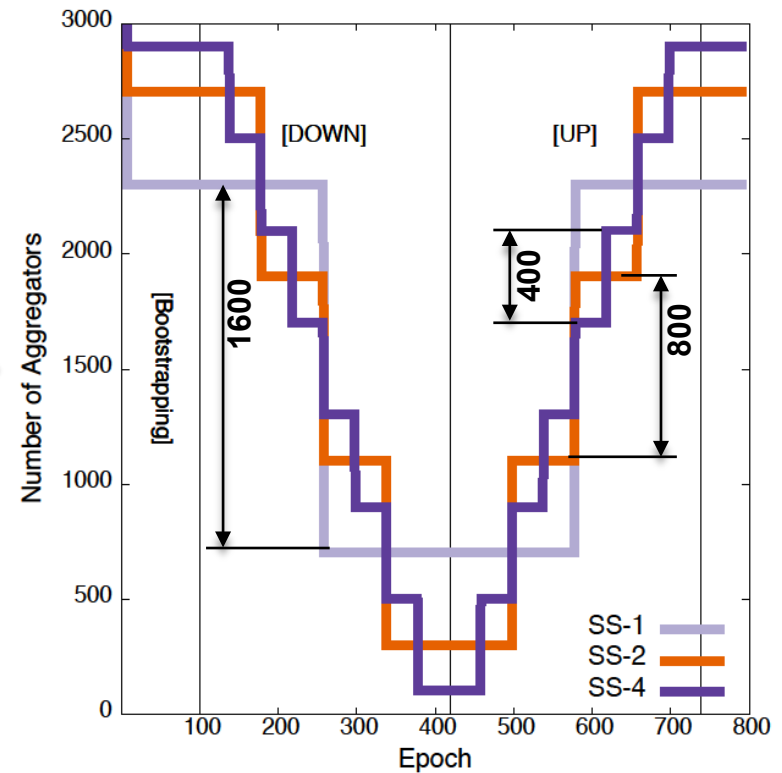
Synthetic Demand Profiles

SIMULATION

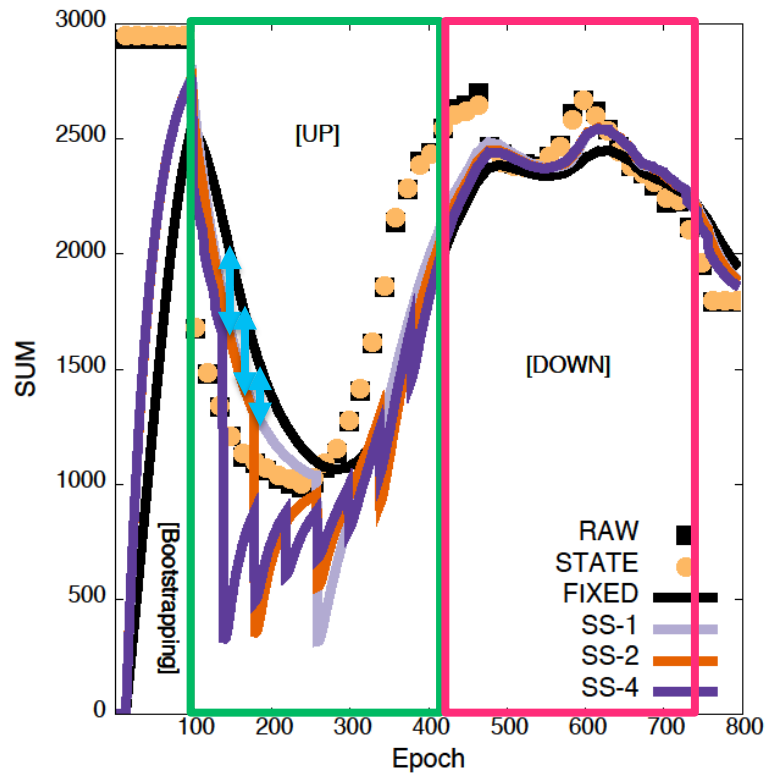
UP-DOWN



DOWN-UP

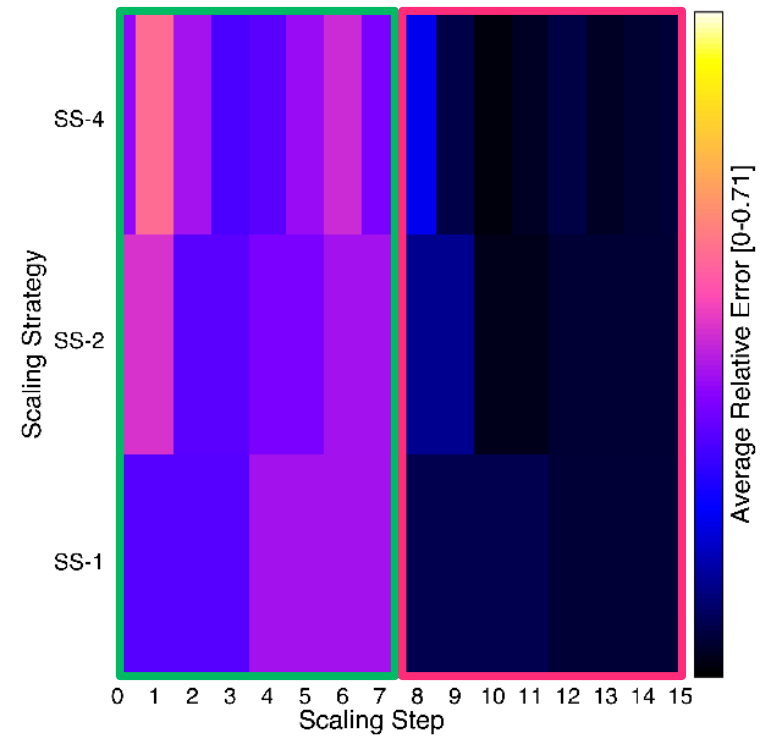


Accuracy



SIMULATION UP-DOWN

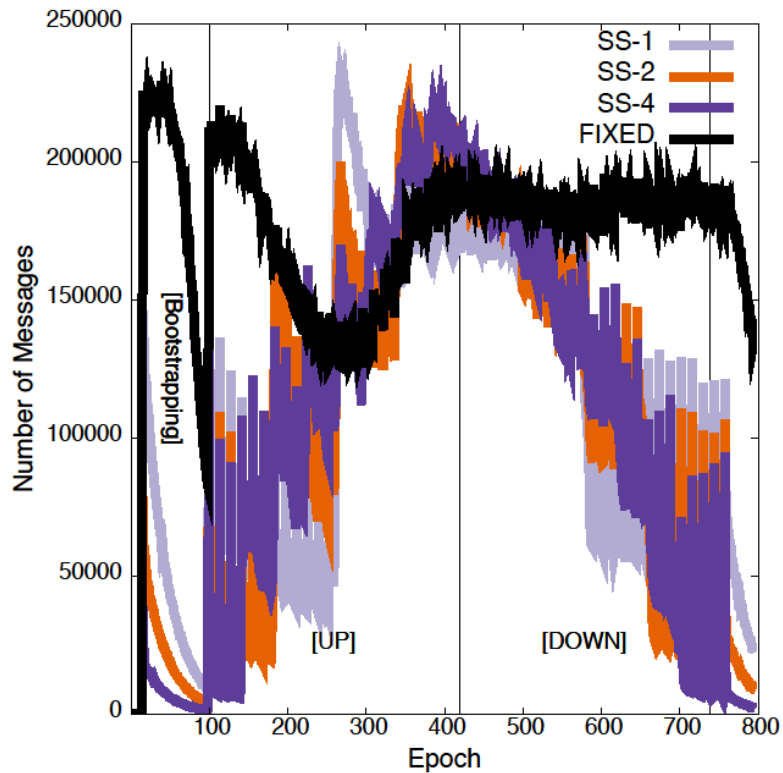
ACCURACY



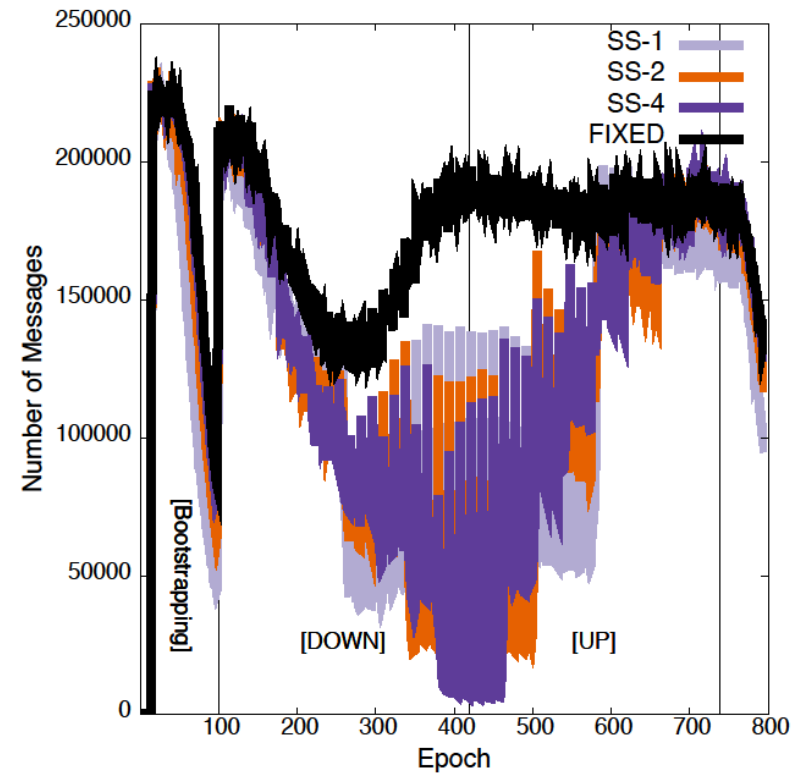
Communication Costs

SIMULATION

UP-DOWN



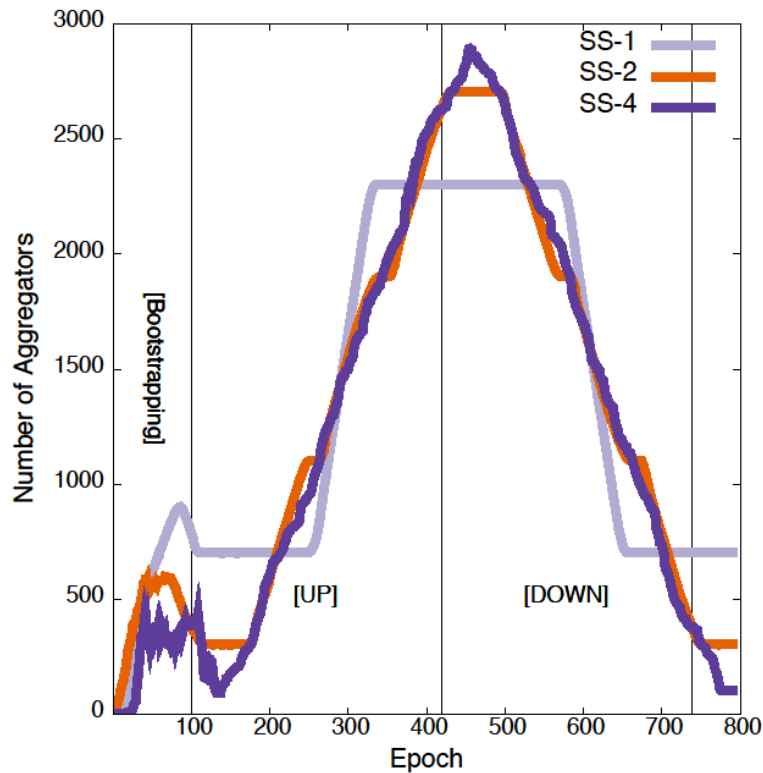
DOWN-UP



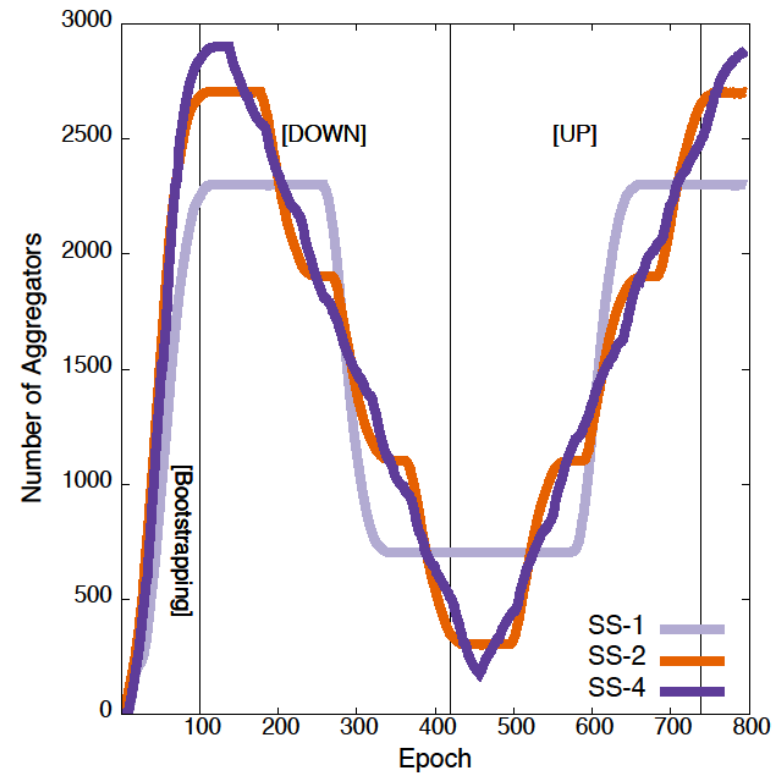
Synthetic Demand Profiles

LIVE

UP-DOWN



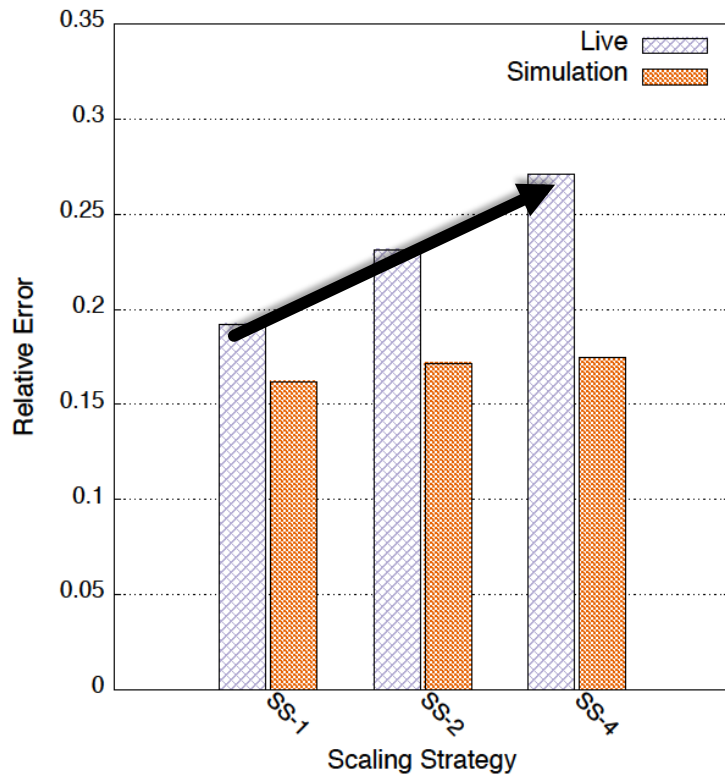
DOWN-UP



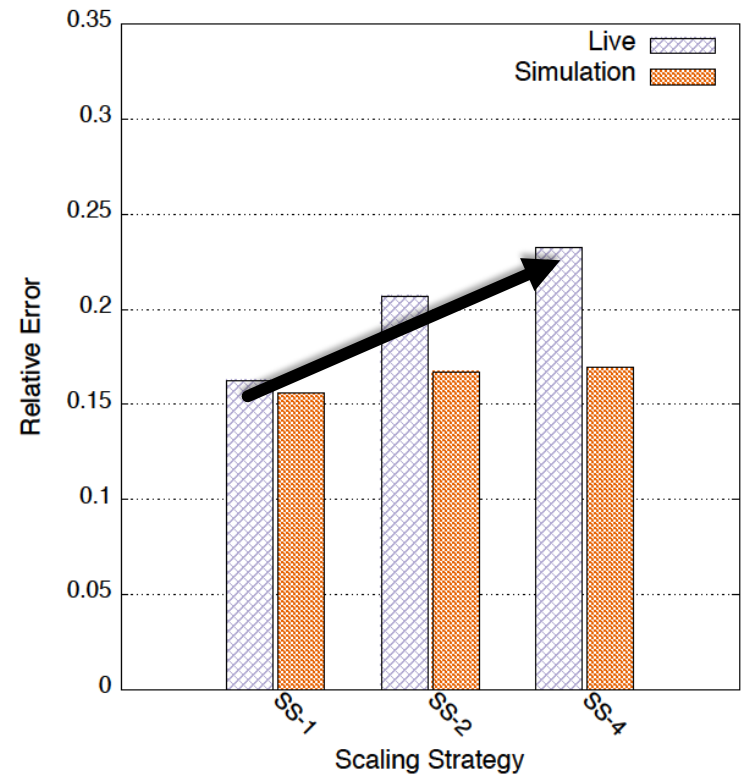
Accuracy

LIVE vs SIMULATION

UP-DOWN



DOWN-UP



Conclusion

- ✓ **self-adaptive** to varying computational demand
 - ✓ provides **high accuracy**
 - ✓ **controlled** communication cost
 - ✓ simple and **modular**
-
- + **no major architectural changes** in DIAS
 - + under **extreme variation** in computational demand
 - + **LIVE & SIMULATION**

Future Work

- **Applicability** to other systems beyond DIAS
 - e.g. cloud resource allocation
- Evaluate the system with **real-world demand** profiles
- Go **beyond aggregation** functions
 - machine learning over decentralized networks?
- Deployment of DIAS system with **nervousnet** – **ONGOING WORK**
 - **nervousnet** is Internet of Things platform for smartphones

Questions?

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