Practical Federated Learning without a Server

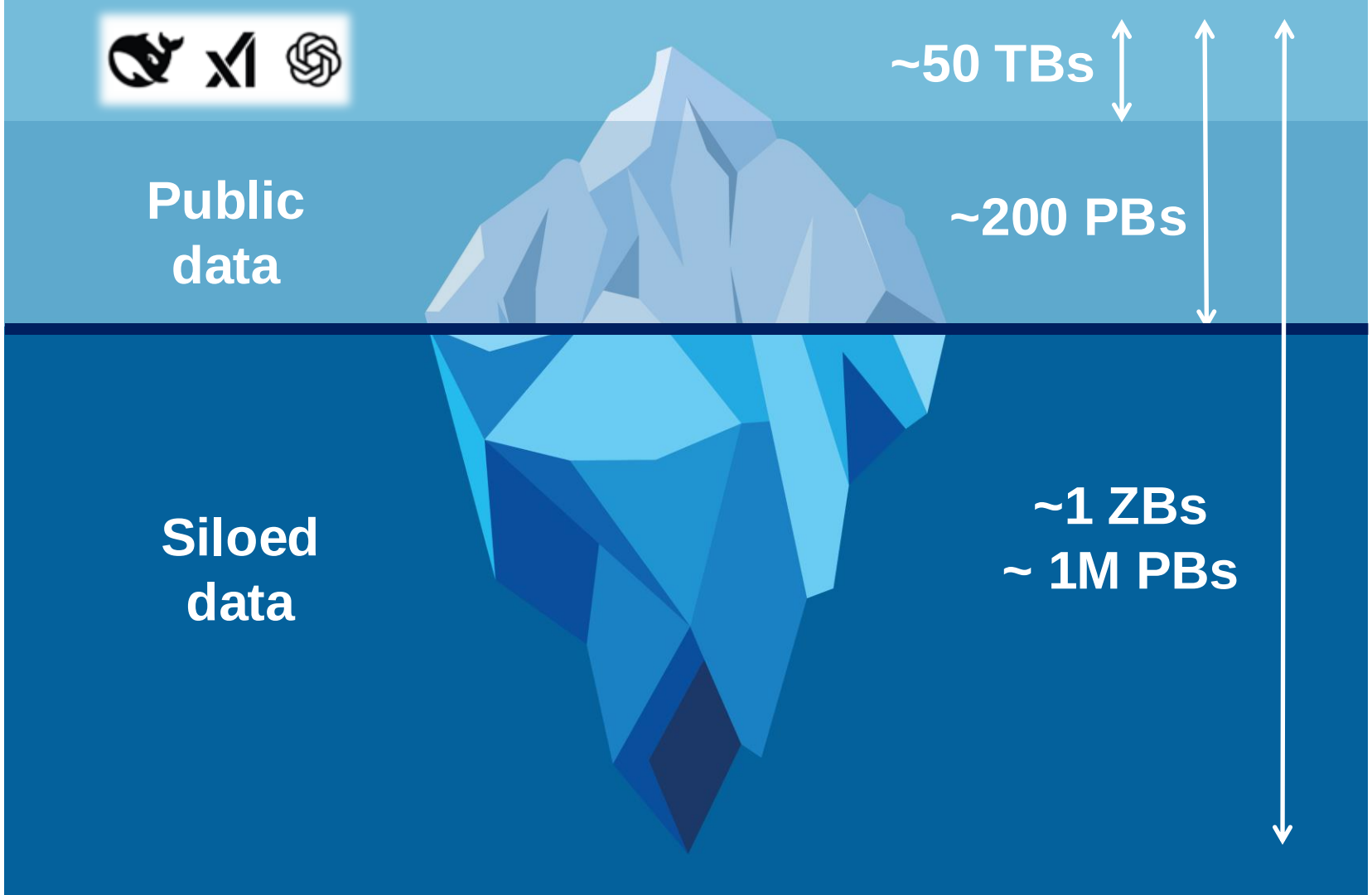
Rishi Sharma

EPFL

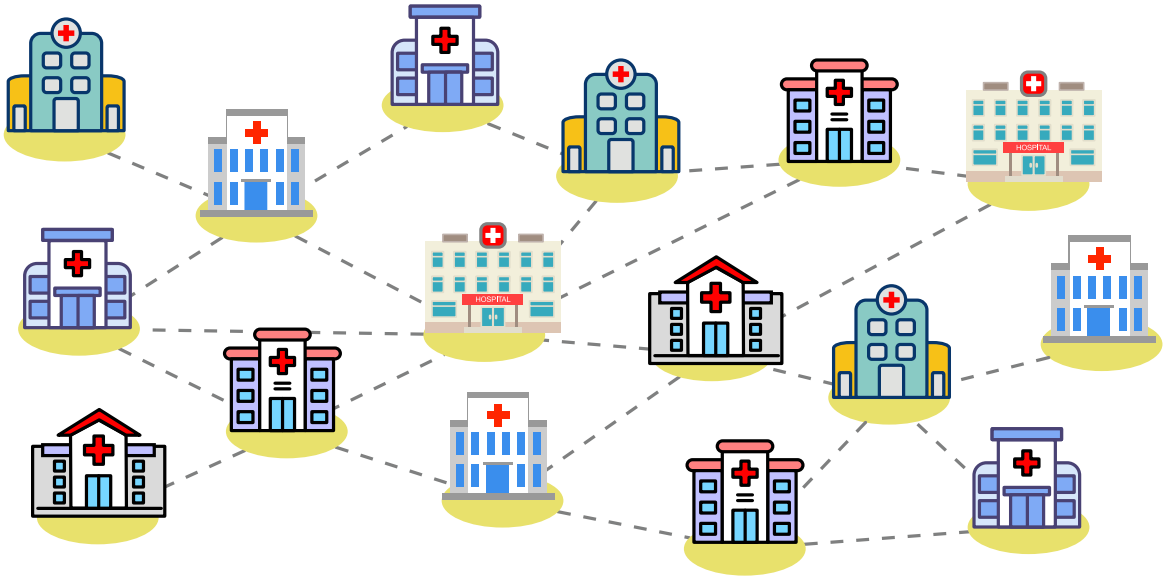
In collaboration with Akash Dhasade, Anne-Marie Kermarrec,
Erick Lavoie, Johan Pouwelse, and Martijn de Vos.

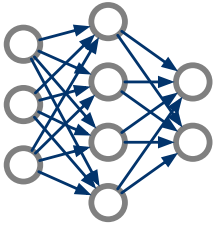
March 31st, 2025

Thinking, Web Search, Deep Research, Agents.

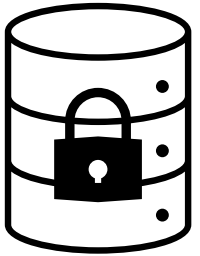

~50 TBs
~200 PBs
Public data
Siloed data
~1 ZBs
~ 1M PBs

Collaborative Machine Learning



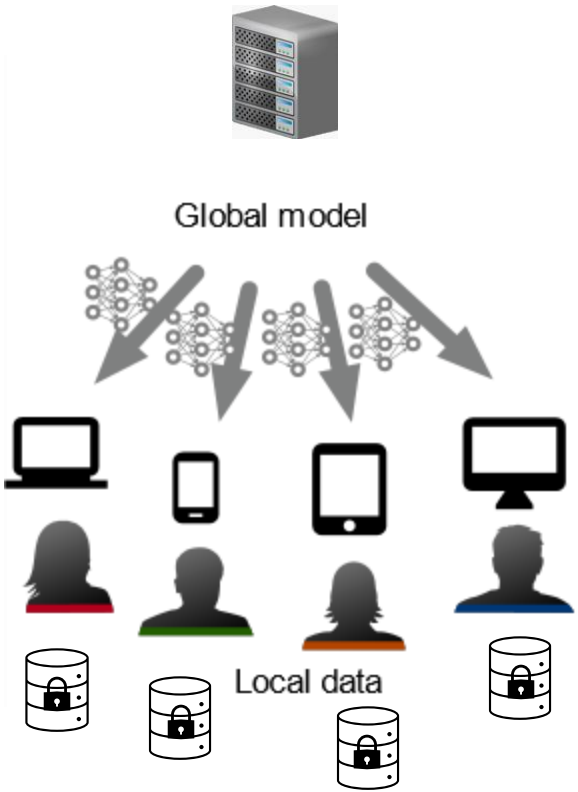


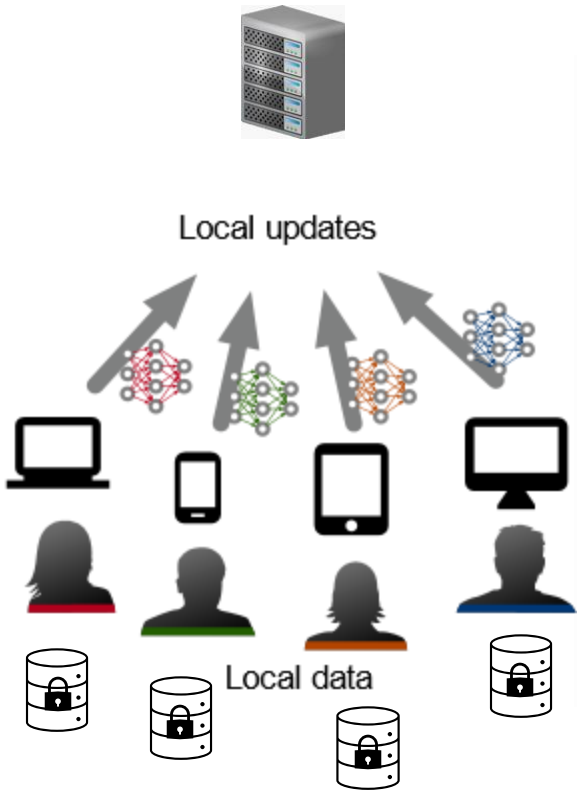
Shared model architecture



Private data

Federated Learning



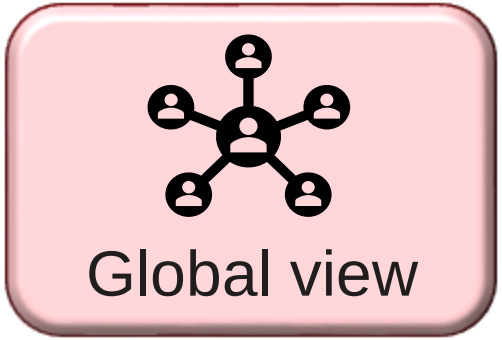


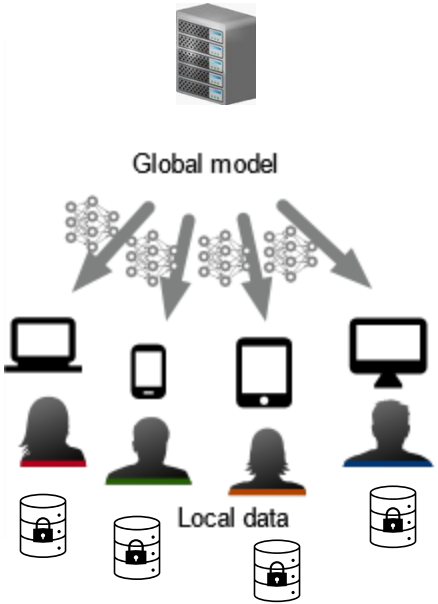
Train locally

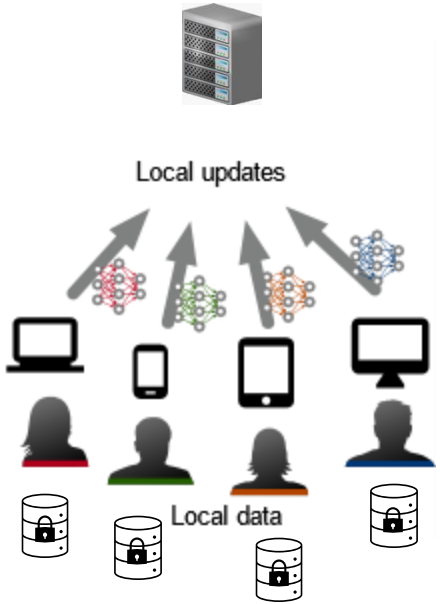
Upload

Aggregate & Send back

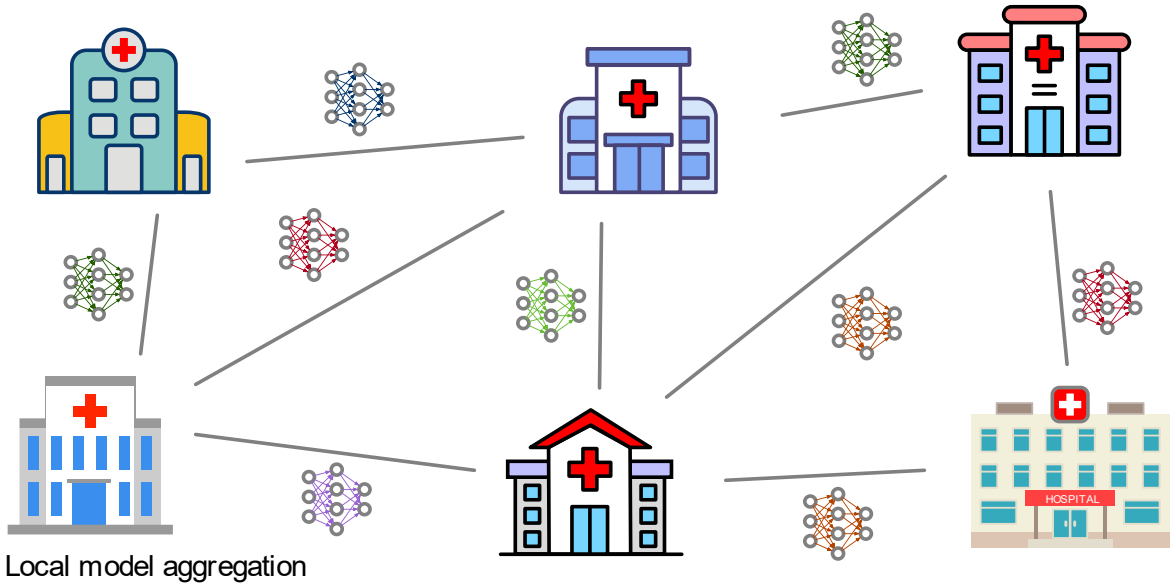
Federated Learning







Decentralized Learning



Local model aggregation

Train locally

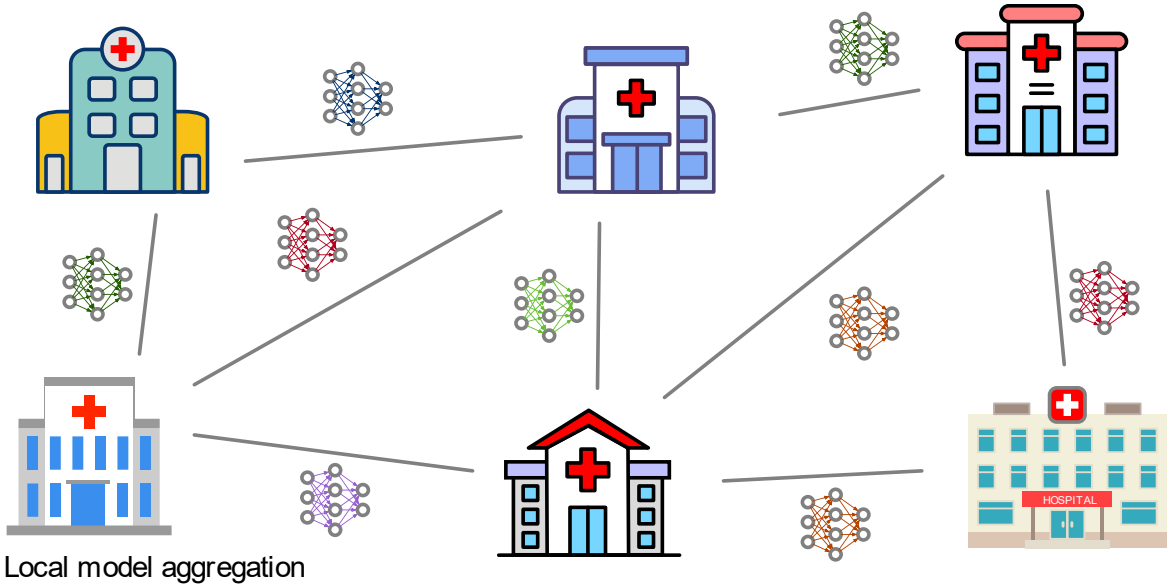
Multicast

Receive & Aggregate

Decentralized Learning

Scalable

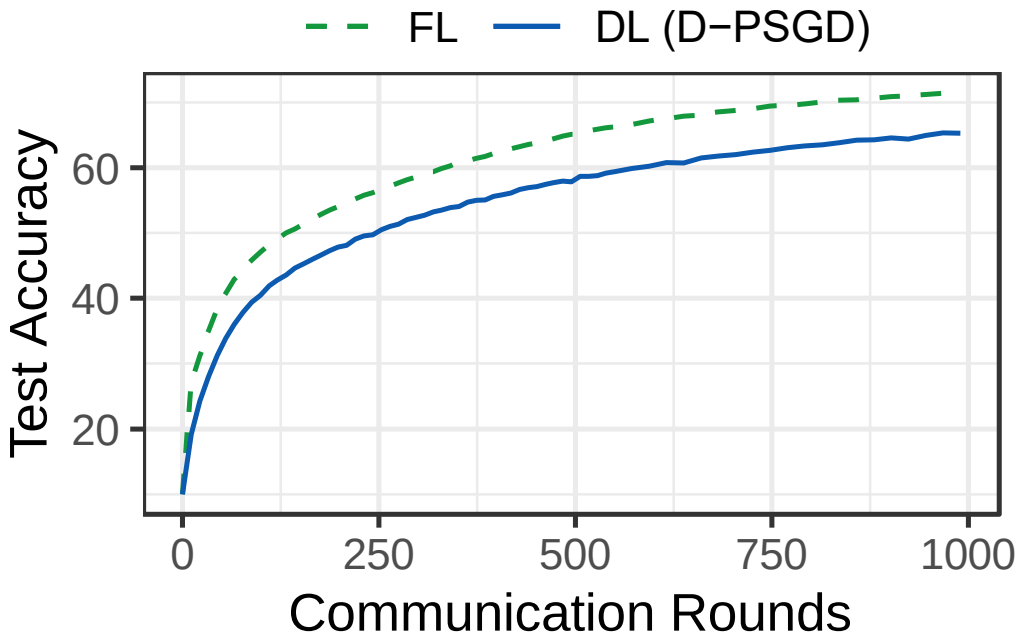
Low Infra. Cost



Local model aggregation

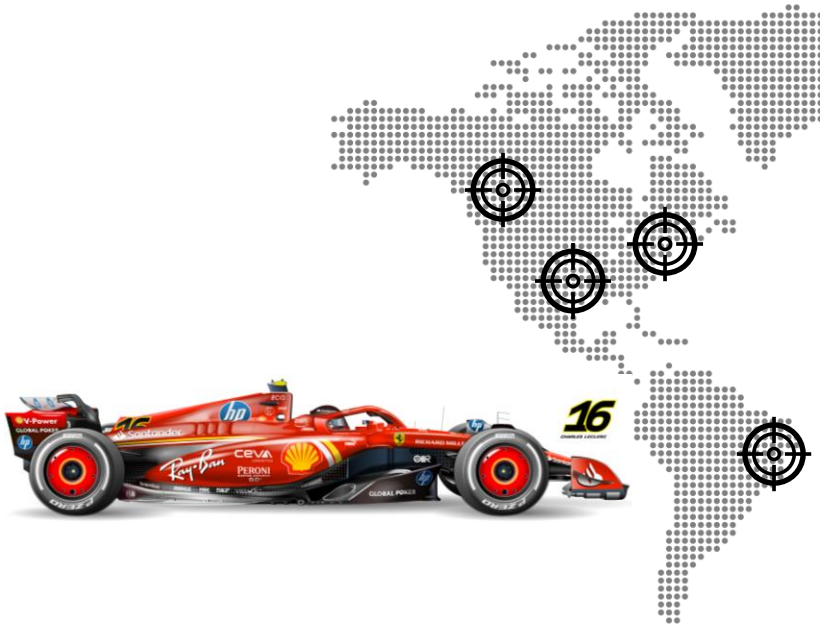
What FL Brings?

1000 nodes; CIFAR-10; non-IID;

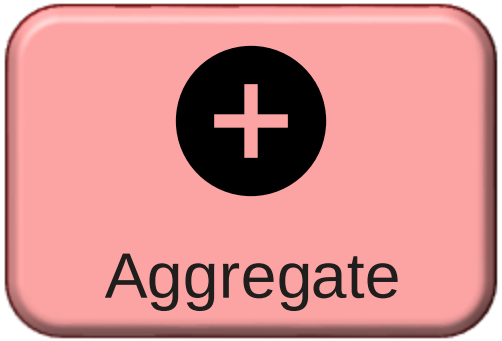


Global aggregation = Better convergence

Best of Both Worlds?



Plexus: FL Without a Server



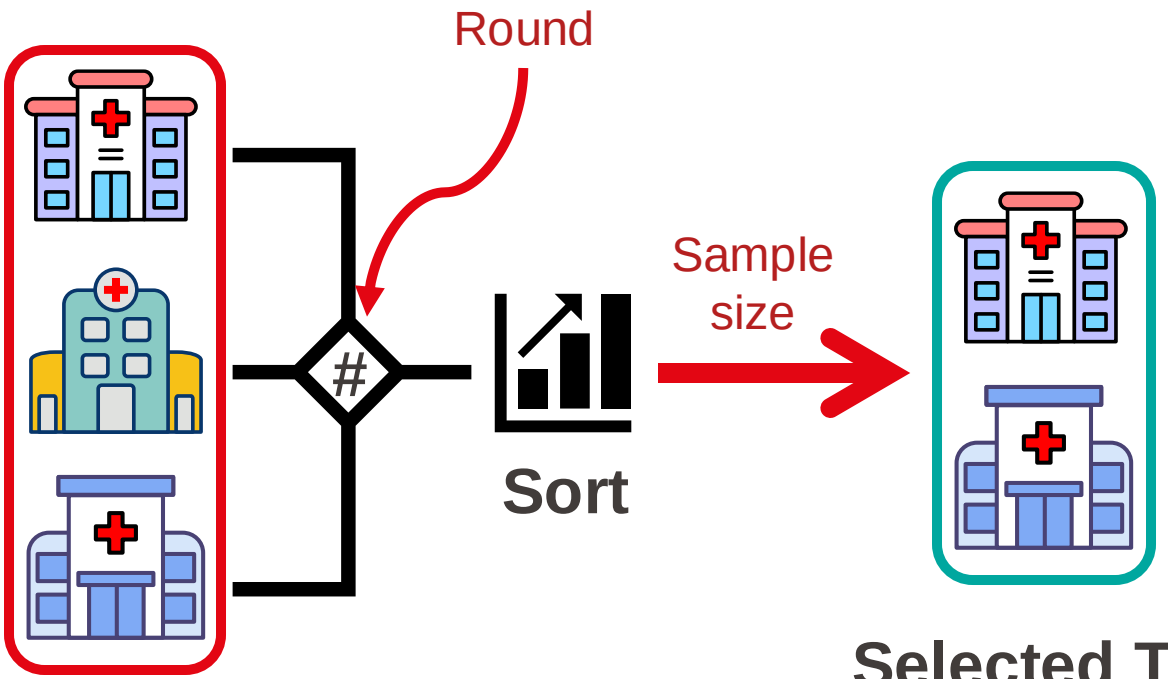
Decentralized peer sampling

Aggregator selection

Aggregate & Push

Decentralized Peer Sampling

Active Nodes
Gossip

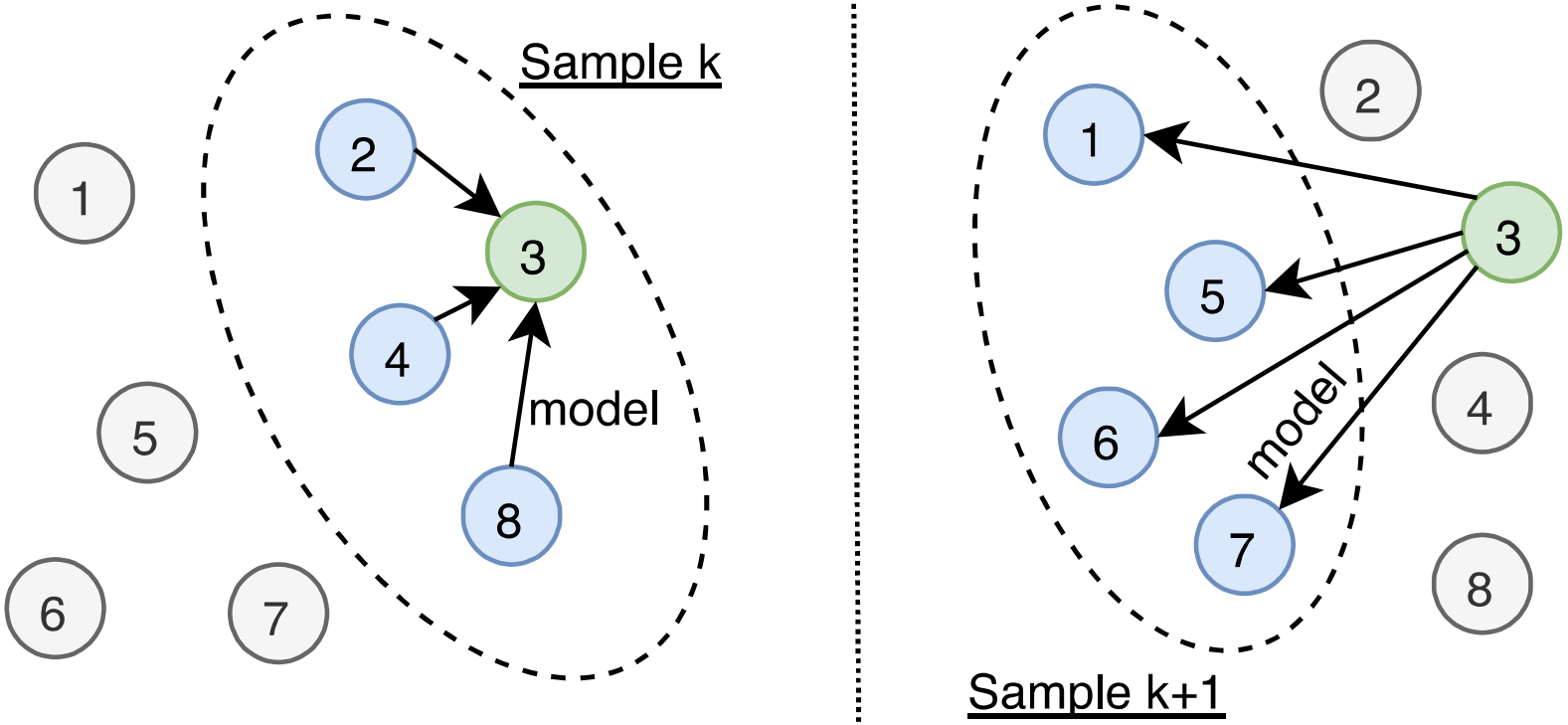


Selected Team
(Current Sample)

Aggregator Selection

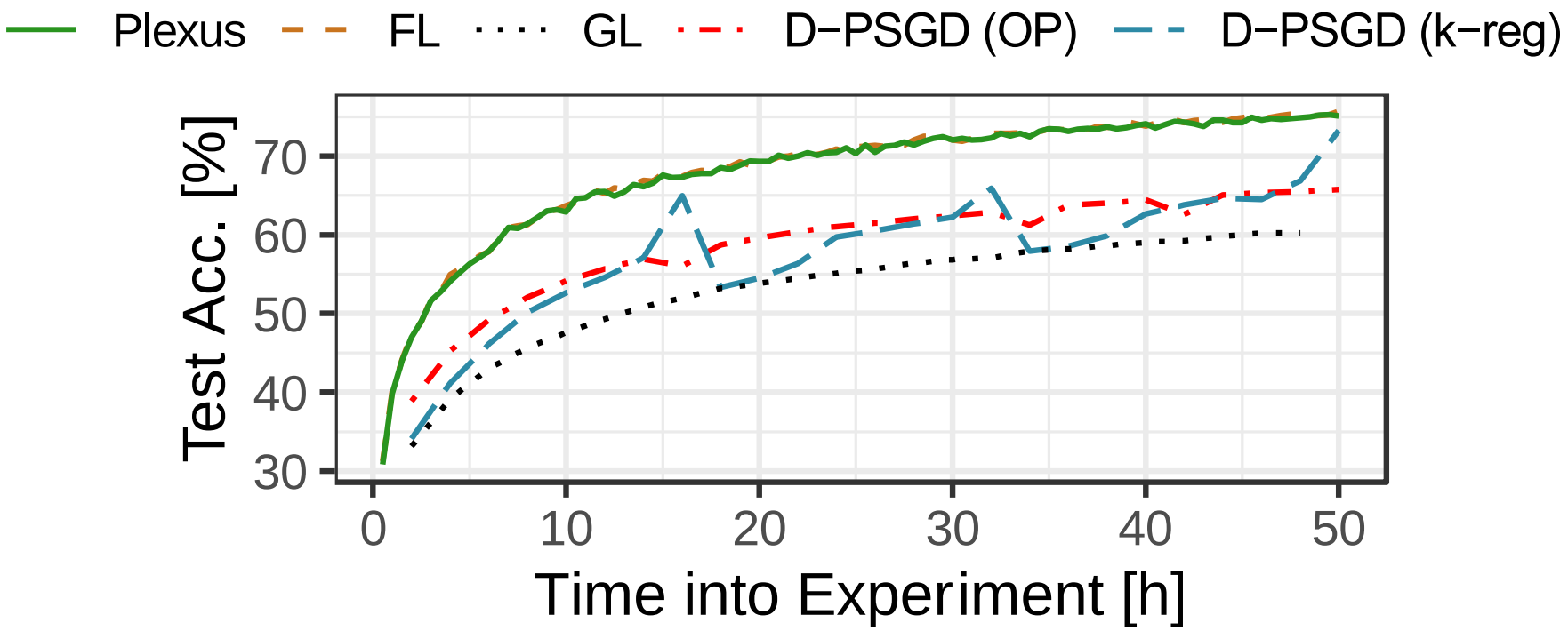
Highest bandwidth in the sample

Aggregate & Push



Results: Convergence

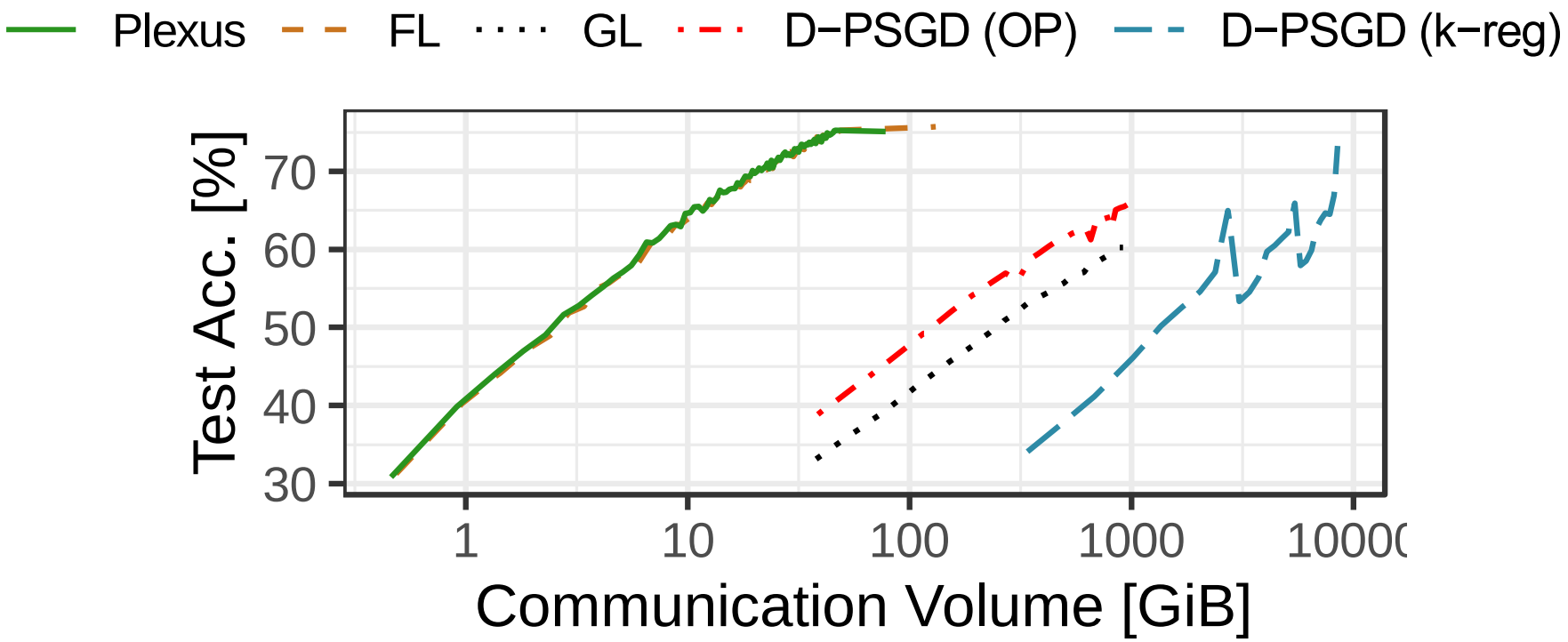
1000 nodes; CIFAR-10; IID;



FL in Decentralized!

Results: Communication

1000 nodes; CIFAR-10; IID;



FL in Decentralized!

More results in the paper…

Plexus – Practical Federated Learning without a Server

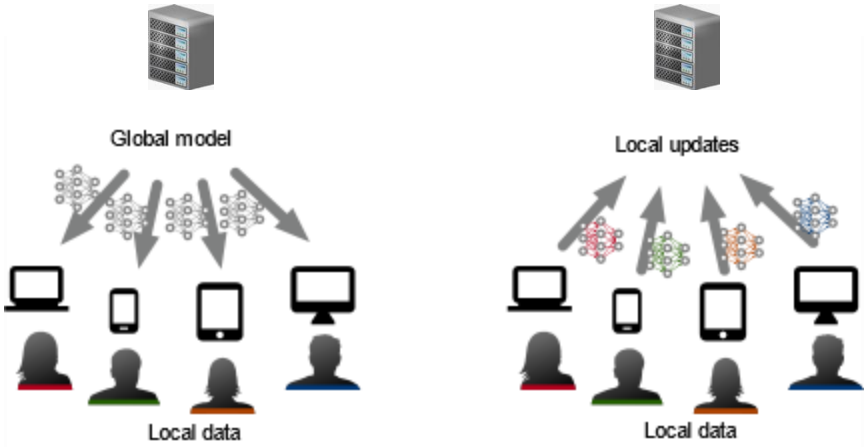
- Best of both worlds
- Contributions:
  - Emulating the server in decentralized settings
- Future work:
  - Nodes leaving and joining
  - Load balancing
  - Asynchronous learning

rishi.sharma@epfl.ch

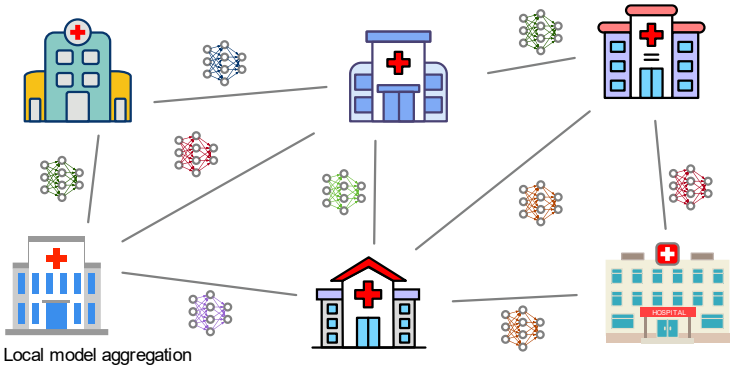
rishi-s8.github.io

Backup Slides

Collaborative Machine Learning



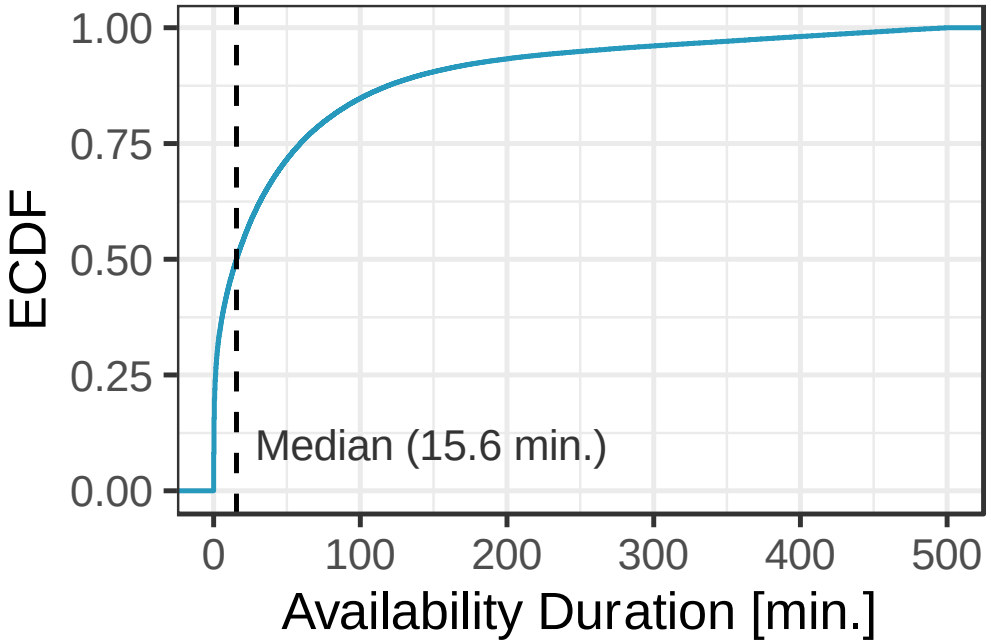
Federated Learning (FL)



Decentralized Learning (DL)

Federated in Decentralized?

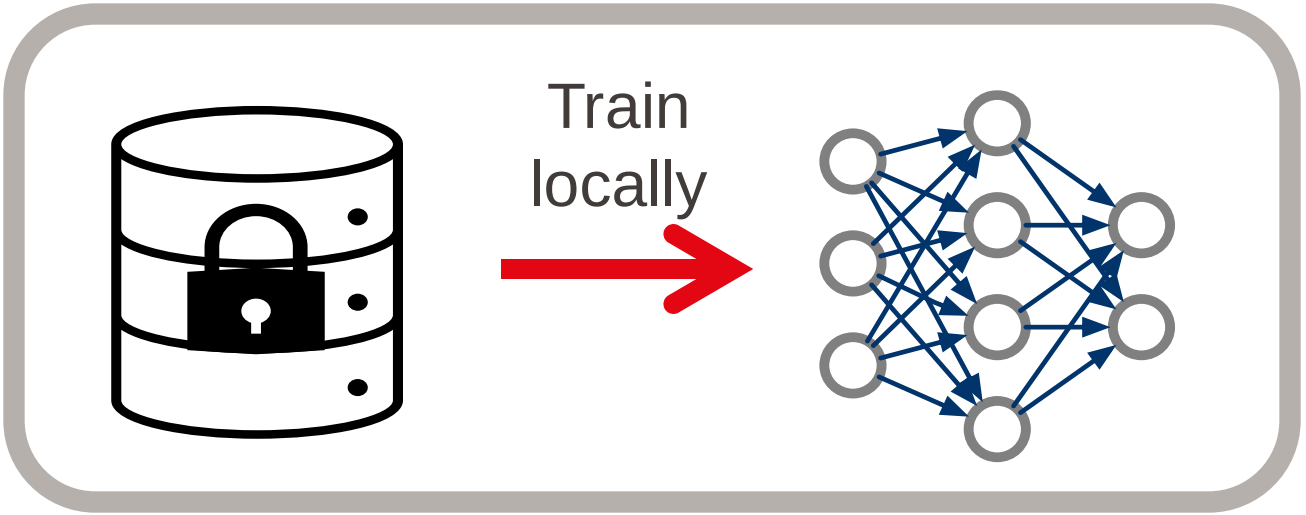
Availability

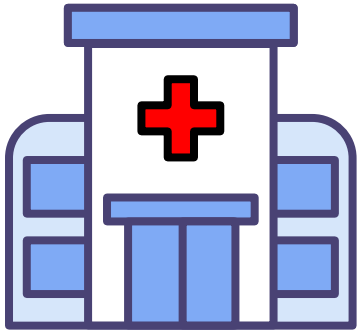


Bandwidth

FedScale Traces

Decentralized Learning





Train locally

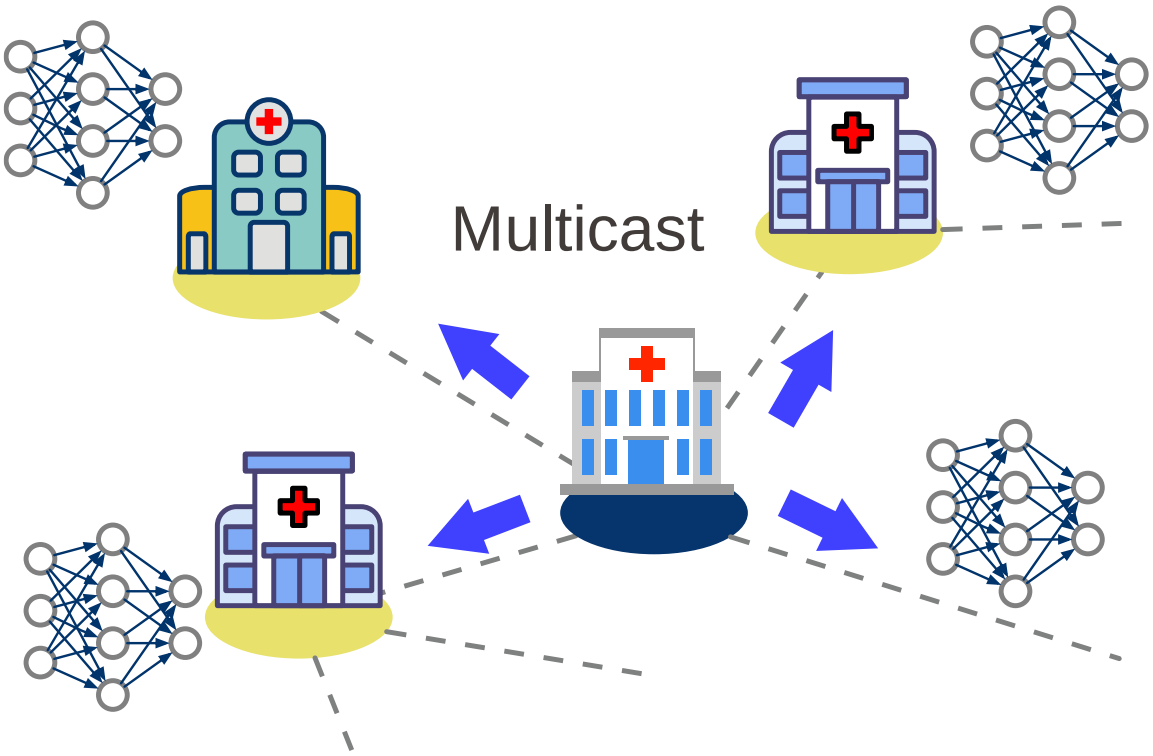
↓

Multicast

↓

Receive & Aggregate

Decentralized Learning

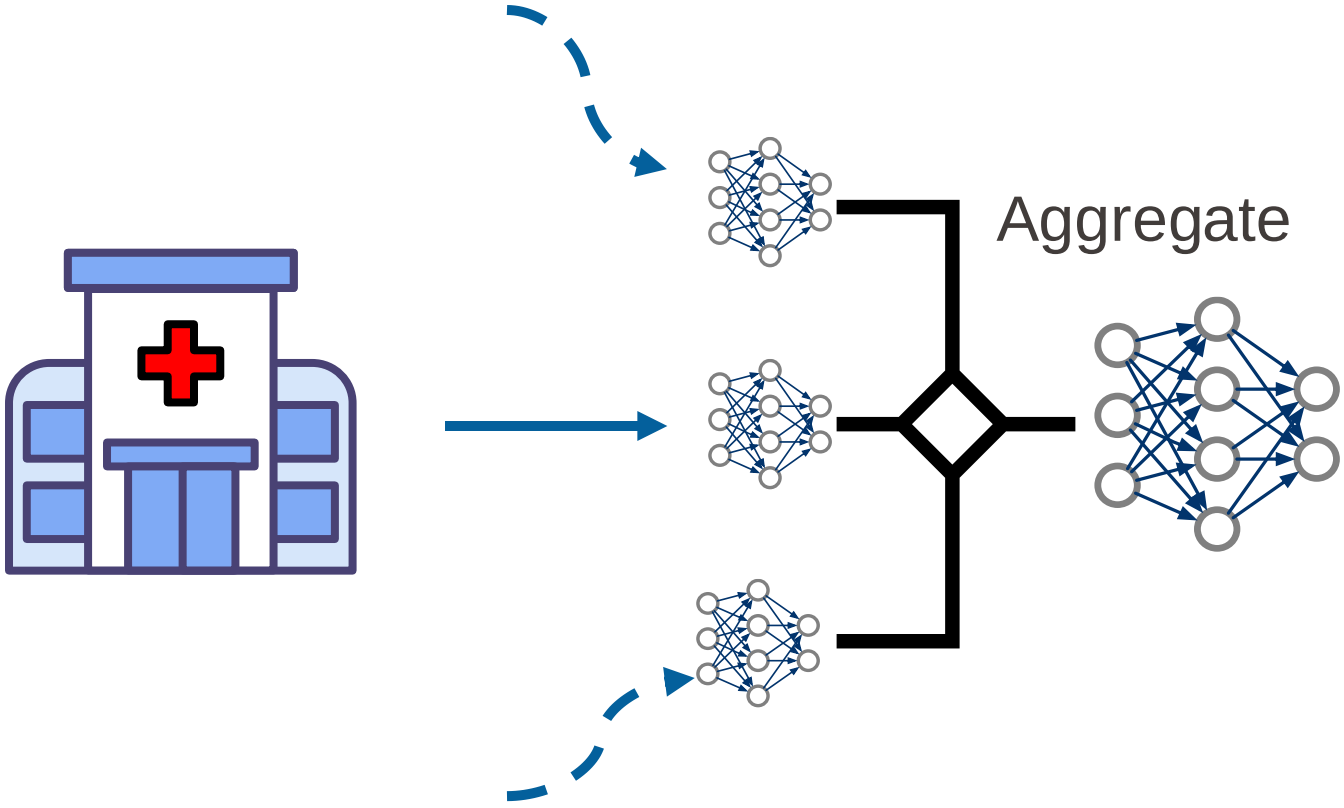


Train locally

Multicast

Receive & Aggregate

Decentralized Learning

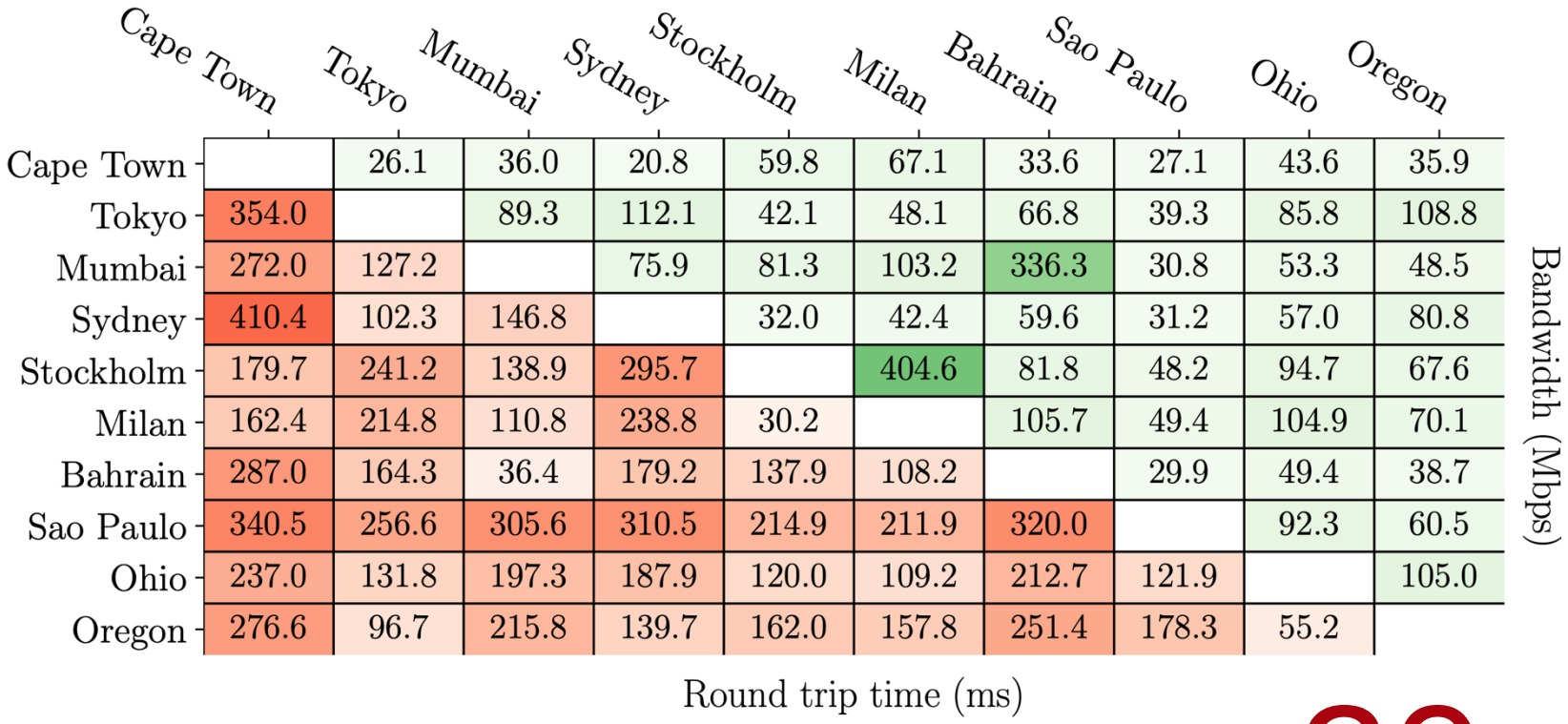


Train locally

Multicast

Receive & Aggregate

Communication Stragglers



	Cape Town	Tokyo	Mumbai	Sydney	Stockholm	Milan	Bahrain	Sao Paulo	Ohio	Oregon
Cape Town		26.1	36.0	20.8	59.8	67.1	33.6	27.1	43.6	35.9
Tokyo	354.0		89.3	112.1	42.1	48.1	66.8	39.3	85.8	108.8
Mumbai	272.0	127.2		75.9	81.3	103.2	336.3	30.8	53.3	48.5
Sydney	410.4	102.3	146.8		32.0	42.4	59.6	31.2	57.0	80.8
Stockholm	179.7	241.2	138.9	295.7		404.6	81.8	48.2	94.7	67.6
Milan	162.4	214.8	110.8	238.8	30.2		105.7	49.4	104.9	70.1
Bahrain	287.0	164.3	36.4	179.2	137.9	108.2		29.9	49.4	38.7
Sao Paulo	340.5	256.6	305.6	310.5	214.9	211.9	320.0		92.3	60.5
Ohio	237.0	131.8	197.3	187.9	120.0	109.2	212.7	121.9		105.0
Oregon	276.6	96.7	215.8	139.7	162.0	157.8	251.4	178.3	55.2	

Round trip time (ms)

Bandwidth (Mbps)

Diablo: A Benchmark Suite for Blockchains

20x