

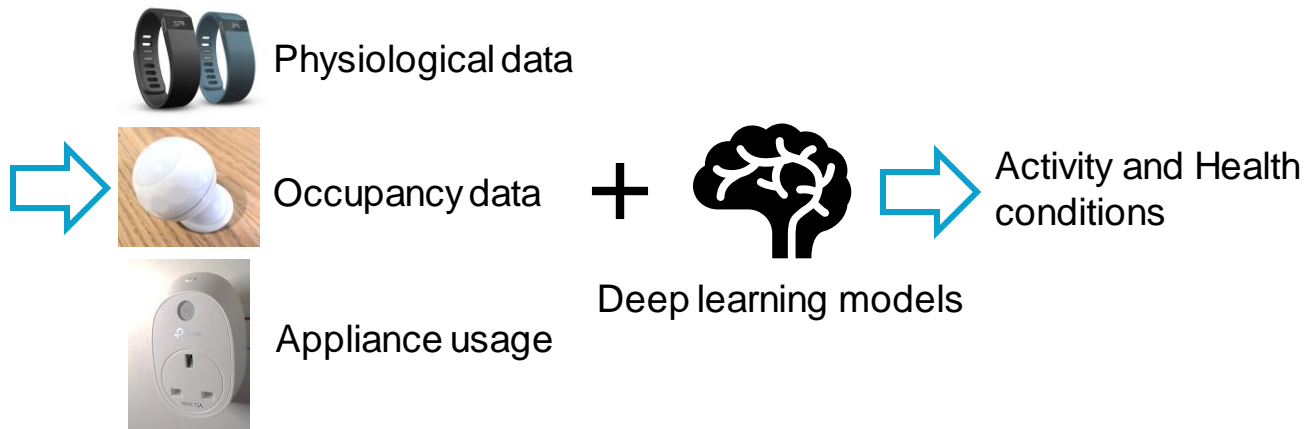
# Privacy-preserving Activity and Health Monitoring on Databox

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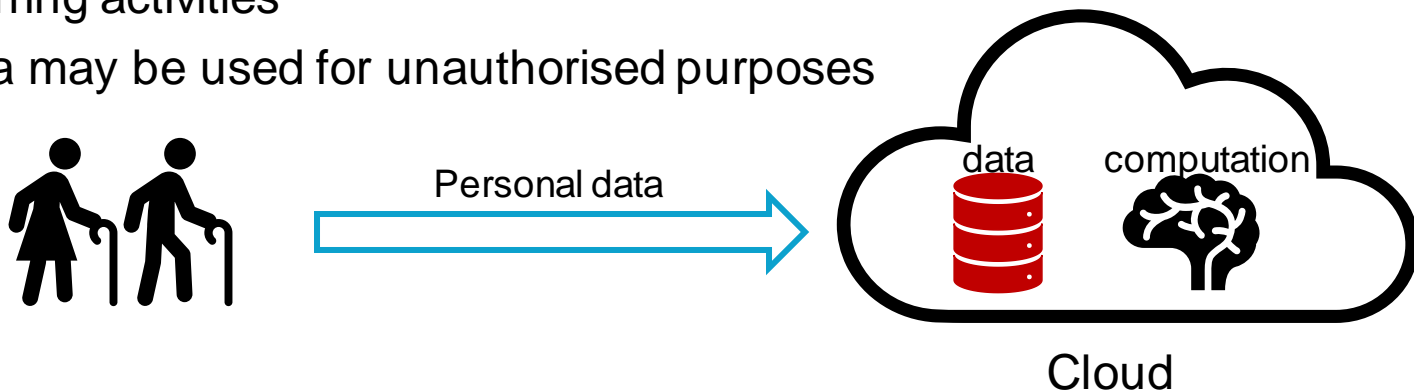
## Activity and health monitoring

- Greatly improves living conditions of people who need assistance

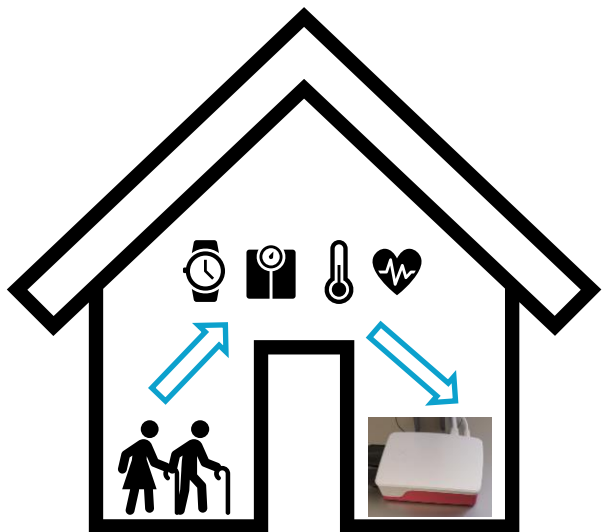


## Privacy issues

- Personal data are sent to the cloud for training deep learning models and inferring activities
- Data may be used for unauthorised purposes



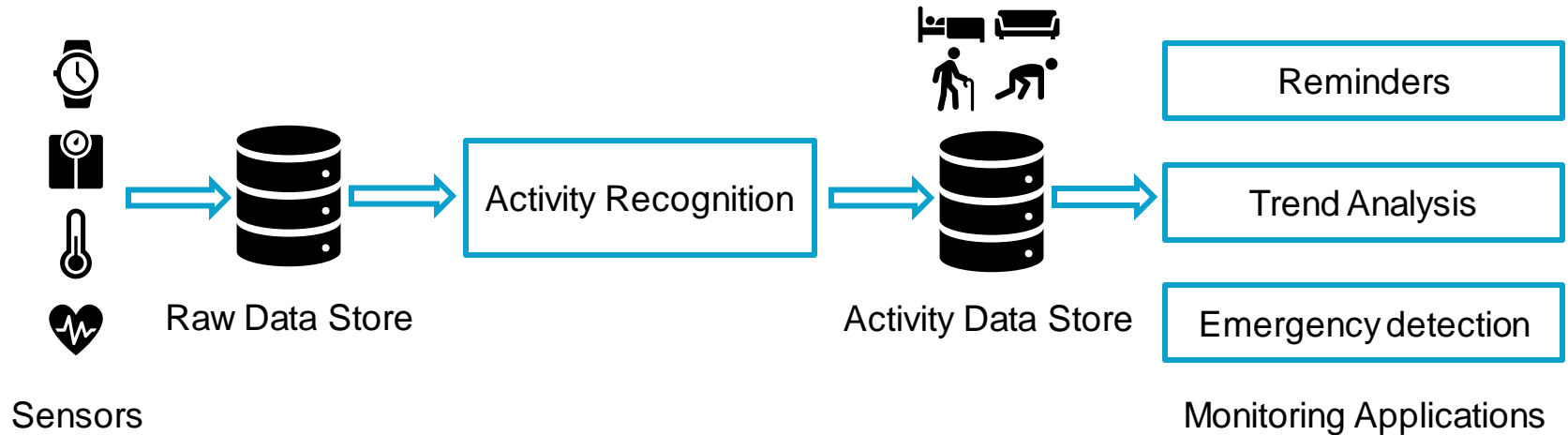
## Monitoring at the edge – brings computation to data



Edge devices

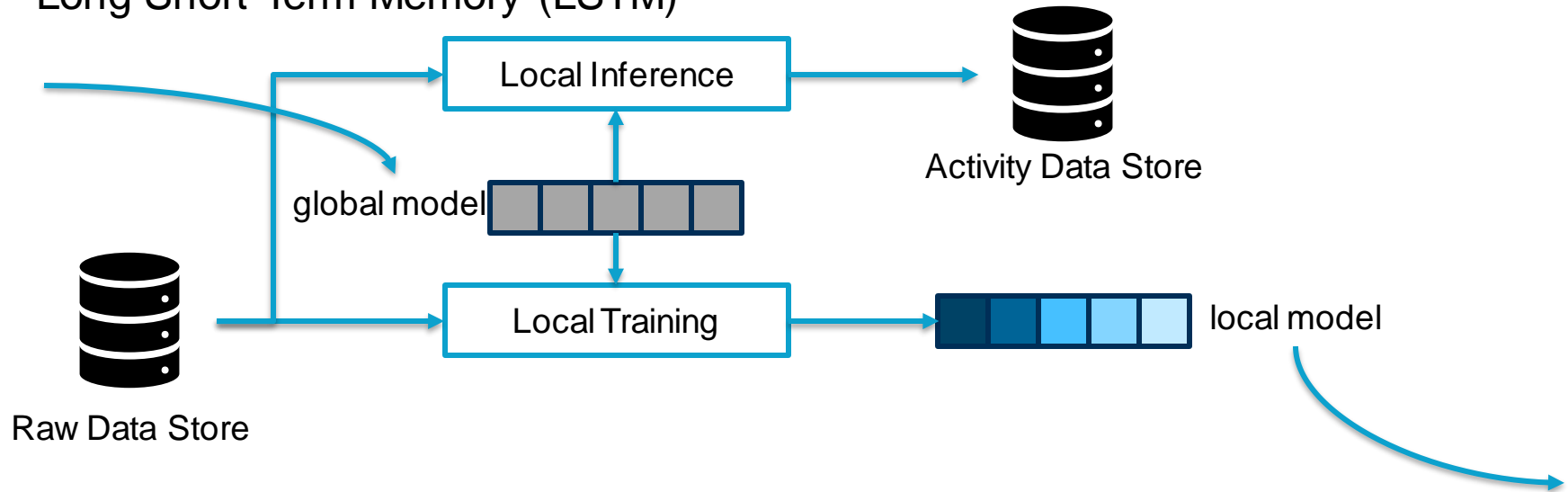
- Using edge devices to
  - Aggregate and manage data
  - Infer activities locally
  - Jointly train deep learning models

## Design consideration 1 – Databox as an edge gateway

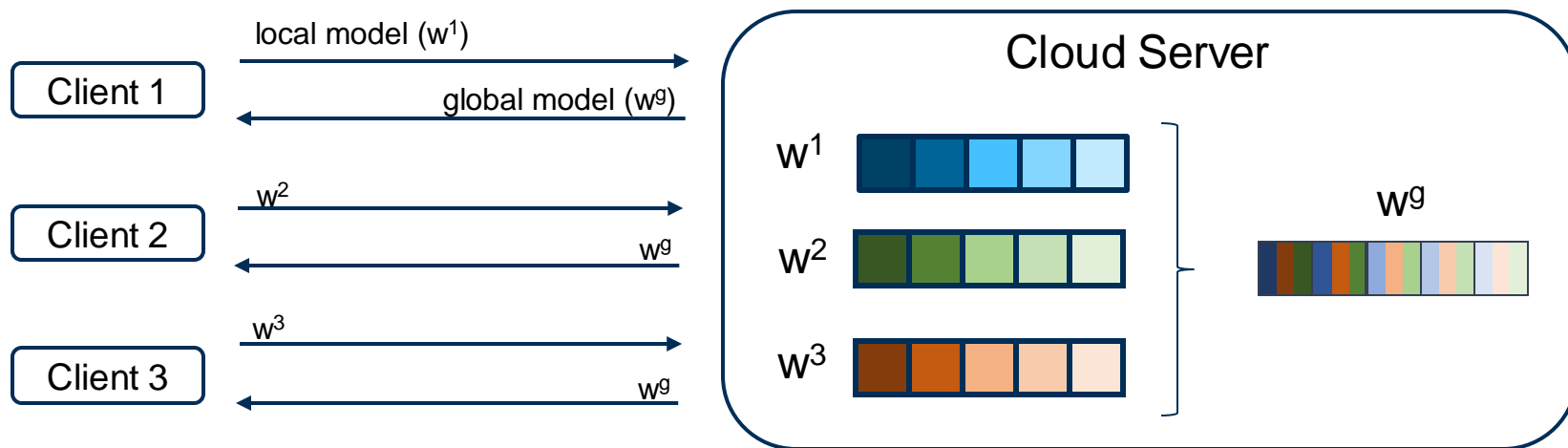


## Design consideration 2 – Activity recognition at the edge

- Long Short-Term Memory (LSTM)



## Design consideration 3 – Federated learning for training



## Evaluation

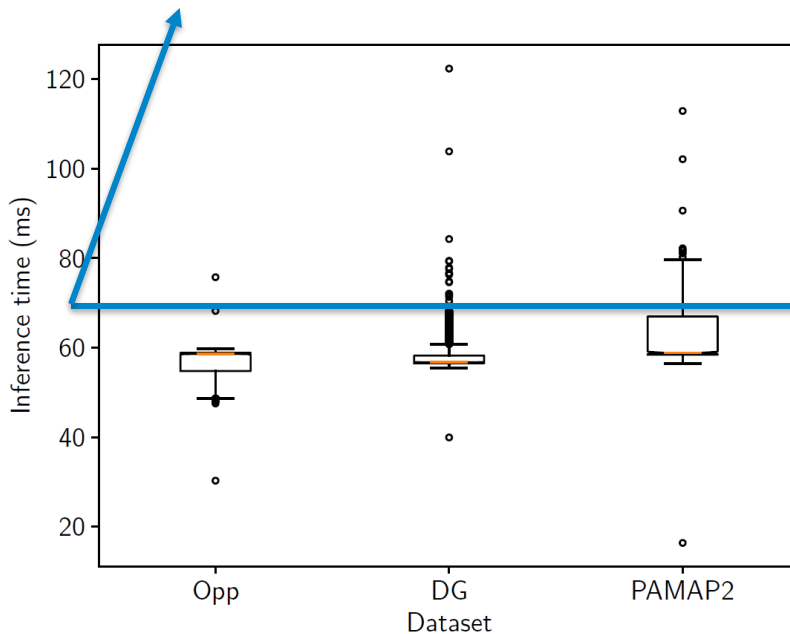
- Q1: How fast is the local inference?
- Q2: How accurate is the model trained through federated learning (FL)?
- Datasets: Opportunity (Opp), Daphnet Freezing of Gait (DG), PAMAP2
- Deep learning model: LSTM with bagging (bootstrap aggregating) by randomising batch sizes and sequence lengths
- Deep learning library: Pytorch



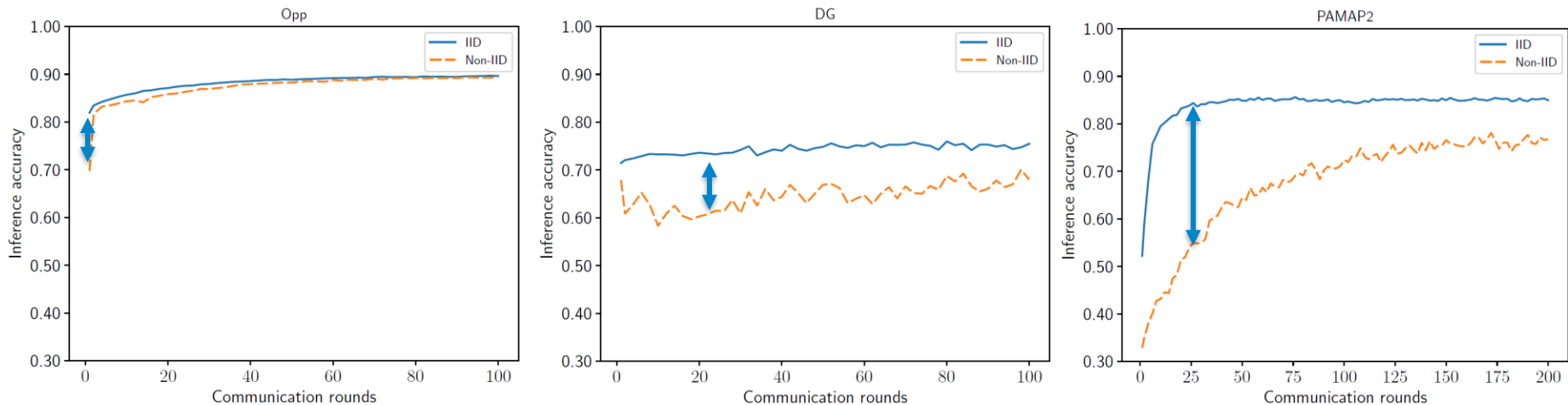
## Processing time is acceptable

- Raspberry Pi 4 Model B
  - CPU: Quad core Cortex-A72 (1.5GHz)
  - RAM: 4GB
  - Storage: 32GB microSD card
  - OS: Ubuntu Server 19.10
- Each data point = processing time of inferring 33 samples

Ave + SD < 70ms for all



## Accuracy converges fast (100 clients, 10% selected)



Accuracy with IID data is higher than with Non-IID data

## Summary

- Without releasing raw data to the cloud, our proposed system can provide **fast and accurate** activity and health monitoring at the edge.
- Future research
  - More advanced privacy guarantee (e.g., differentially private FL).
  - Personalising global models for different users.
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