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CONNECT Centre for Future Networks

FederationS: Federated Learning for Spatial Reuse in a multi-BSS scenario

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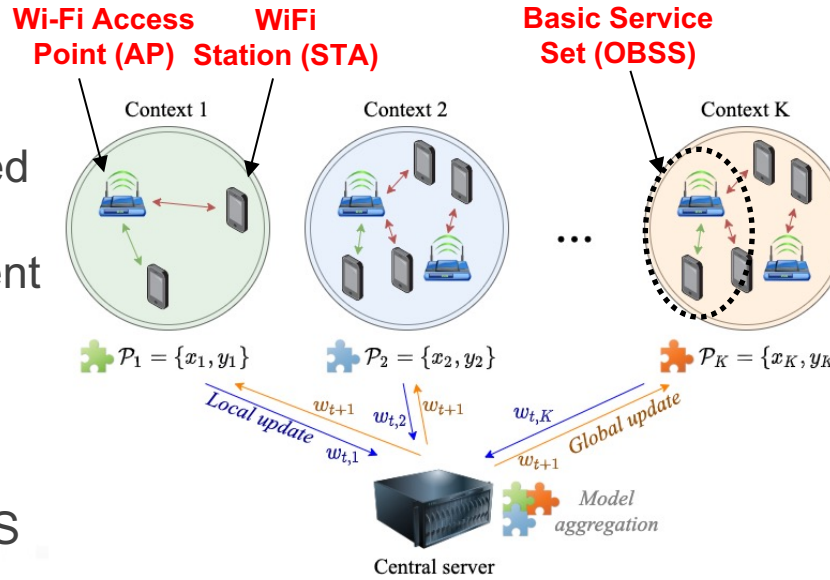
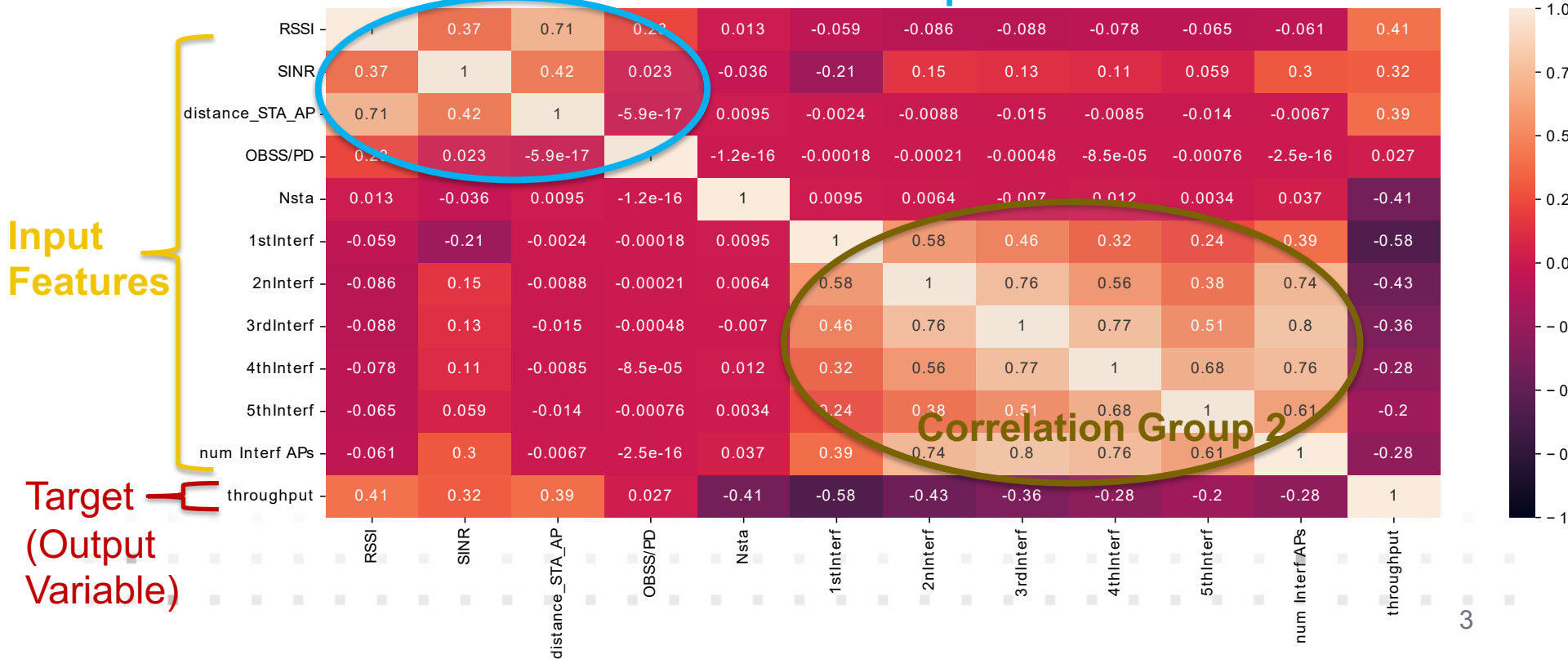
Overview of the Challenge

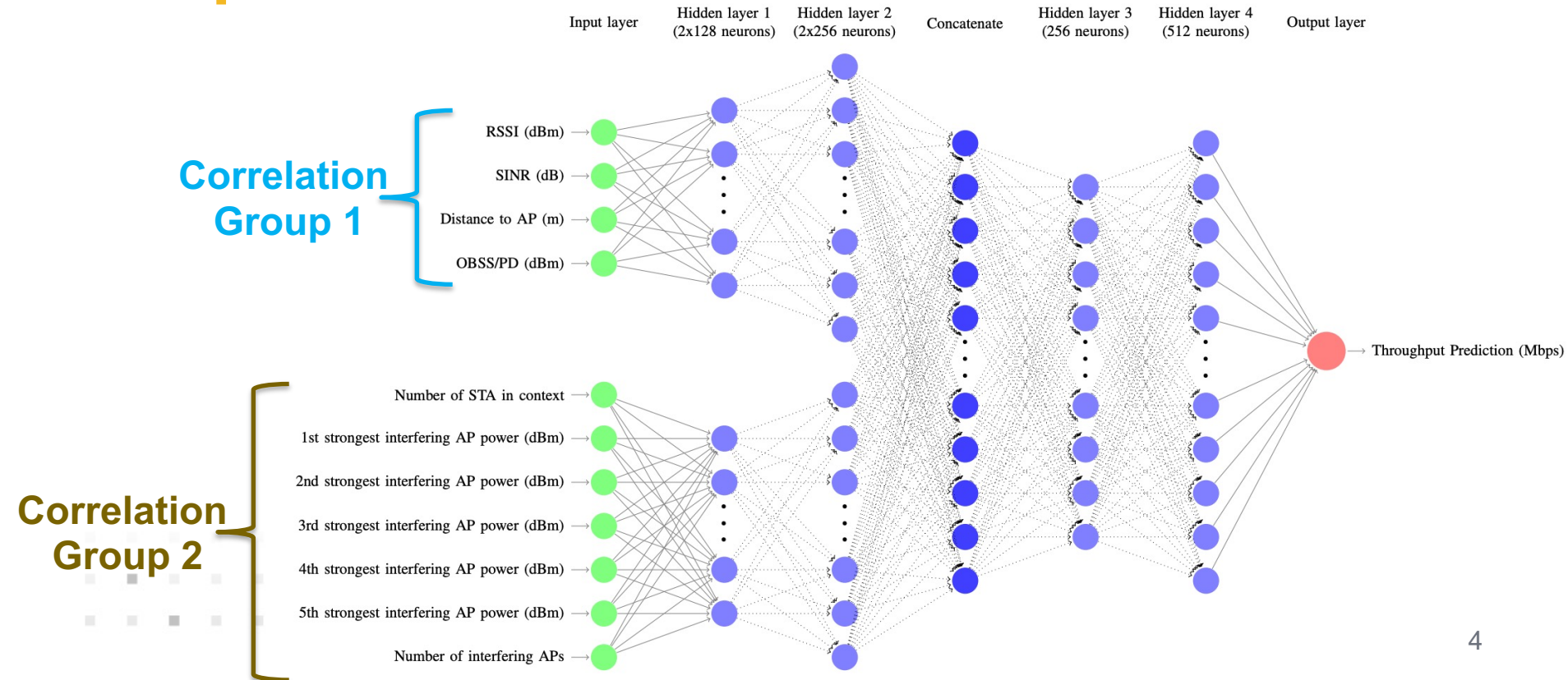
- Wi-Fi system relies on distributed channel access + usage of unlicensed frequency bands
  - Performance tends to degrade in crowded scenarios
- To increase simultaneous transmissions recent IEEE 802.11ax amendment added **Spatial Reuse** (SR)
- We use Federated Learning (FL) **to predict the STA throughput** based on **Preamble Detection (PD)** threshold in Overlapping BSS



Data Analysis



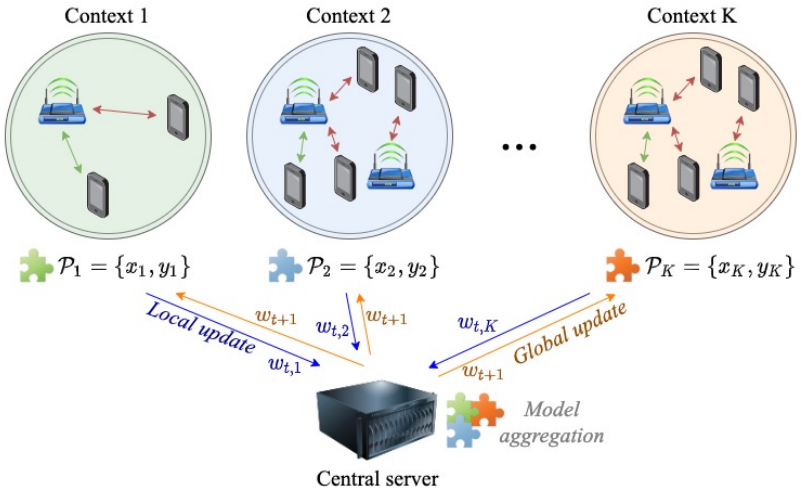
Proposed DNN model



Training the federated solution

1) In each communication epoch we **randomly** select 500 contexts for training
2) Each context sends the local **trained neural network update (w_i^t)** to central server
3) The central server aggregates all the updates and sends back the **global update (w^{t+1})**

Comm. Epoch loop



How to aggregate the trained neural networks from the select contexts?

- First, we obtain the normalisation weight α_i proportional to the number of samples i-th context has :

$$\alpha_i = \frac{n_i}{N_{STA}}$$

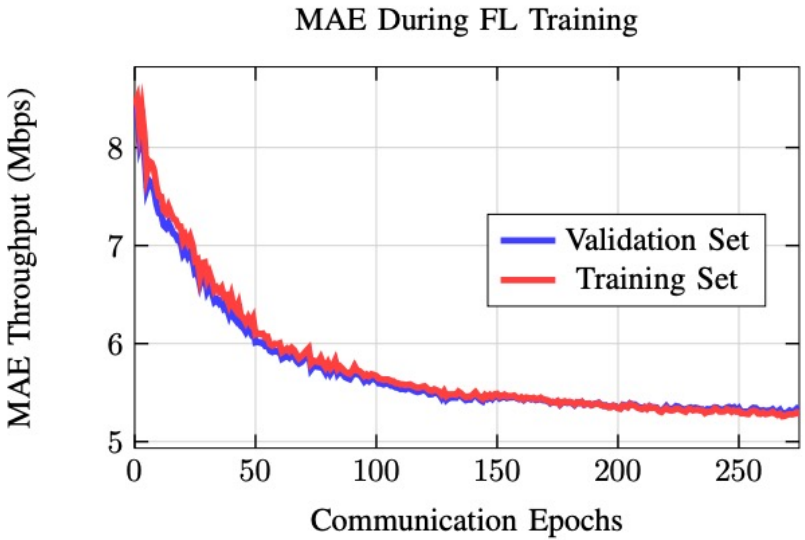
- On the central server, we then determine the sum of all sample used:

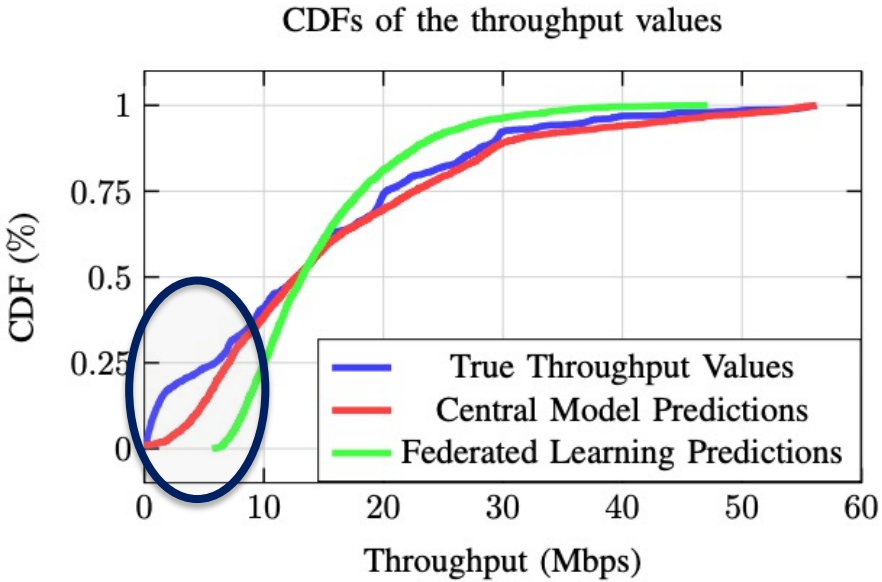
$$\alpha_t = \sum_{i=1}^{N_{tr}} \alpha_i$$

- Then we can update the global model (on the central server):

$$\theta_k^t = \sum_{i=1}^{N_{tr}} \frac{\alpha_i \, \theta_i^t}{\alpha_t}; \quad w_k^t = \sum_{i=1}^{N_{tr}} \frac{\alpha_i \, w_i^t}{\alpha_t}$$

Results & Lessons Learned





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Thank you

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