Federated Learning for BSS throughput prediction

Federated Learning for Spatial Reuse in a multi-BSS (Basic Service Set) scenario
ITU-ML5G-PS-004

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Problem Description

➢ Scenario

- Spatial Reuse
  - ➢ Massively crowded scenarios
  - ➢ High variability
- Deep Learning Solution
- Federated Learning Solution

➢ Goal

- Predict the downlink throughput of a particular Access Point (AP) with a specific OBSS/PD parameter value in typical dense environments.

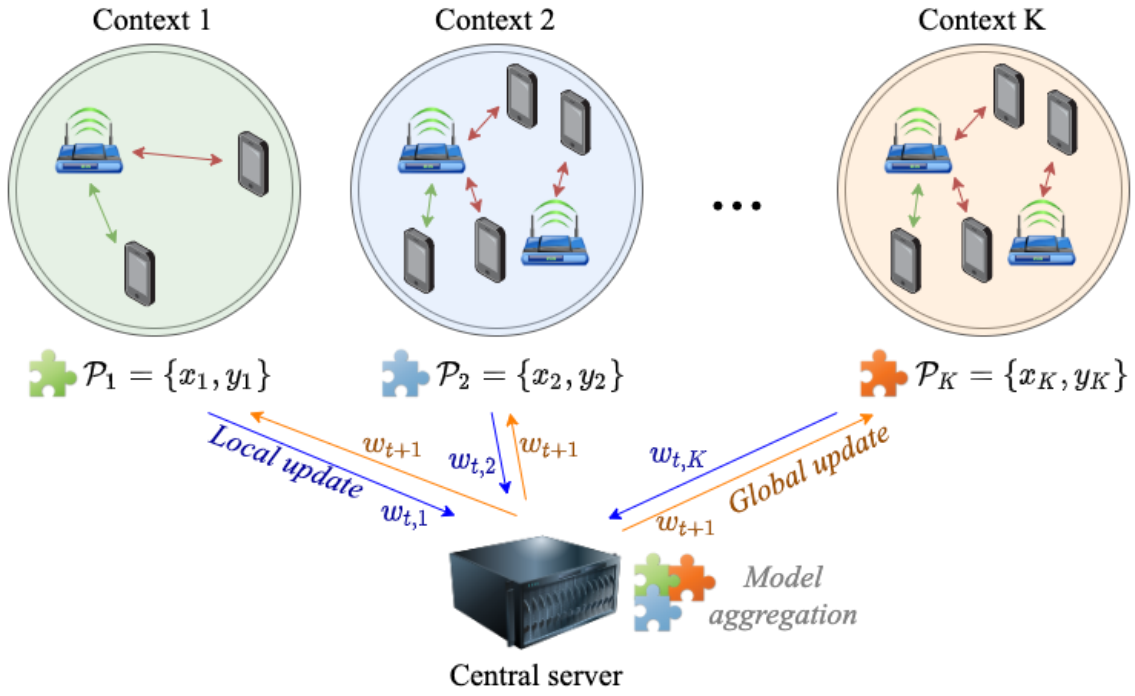
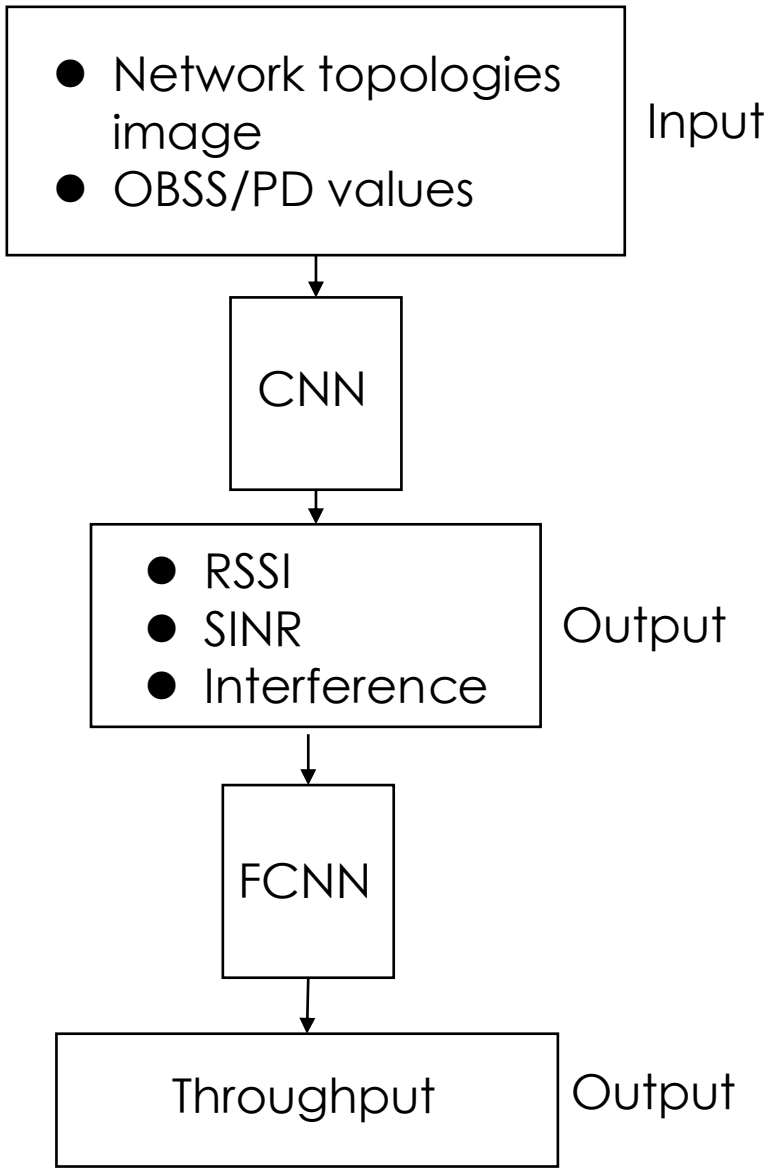


Illustration of using FL to predict the throughput of a particular AP
https://www.upf.edu/web/wnrg/ai_challlenge

Proposed Solution



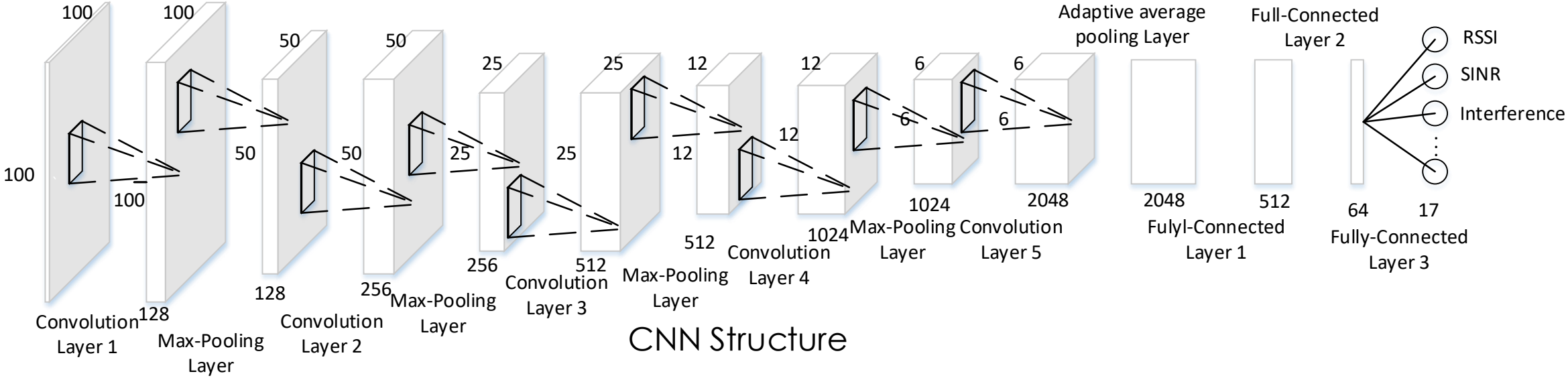
0	0	62	0	0	0	1	0	0	0
0	0	0	0	0	1	0	0	0	0
3	0	0	0	3	0	0	0	0	0
0	0	0	1	0	0	0	0	0	0
0	0	0	0	0	0	0	2	0	0
0	3	0	0	2	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	1
0	1	0	0	0	2	0	0	0	0
0	0	0	1	0	0	0	0	0	0

Illustration of the network topologies image

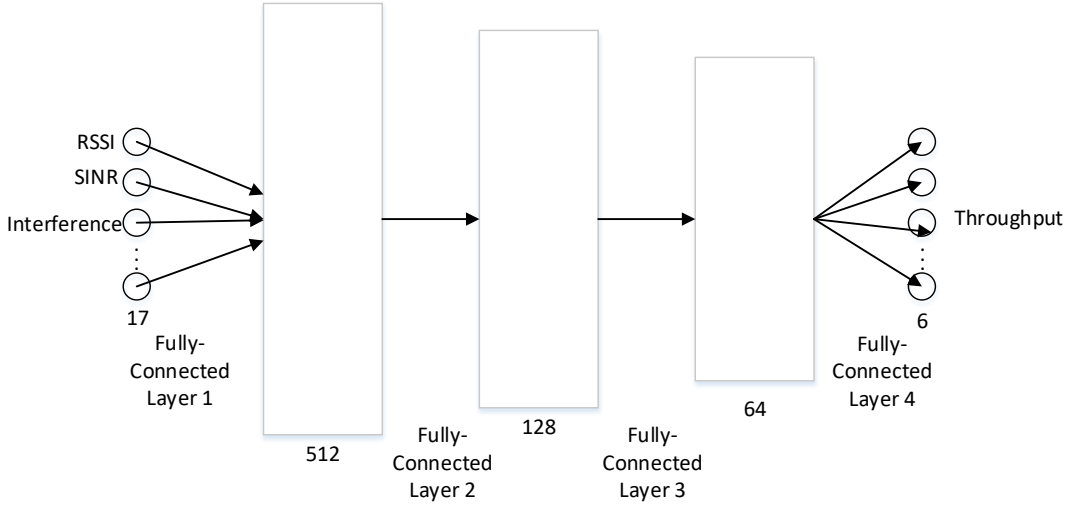
1:AP B,C…; 2:STA B1,B2…; 62:AP A; 3:STA A1,A2…

Proposed Model: CNN&FCNN

Network topologies image



CNN Structure



FCNN Structure

Dataset

- Scenario 1 (2-6 APs and 1-4 STAs per AP)
  - 1,000 different deployments
  - Up to 20 different locations for STAs in BSS A for each context
  - 21 OBSS/PD thresholds from -62 dBm to -82 dBm

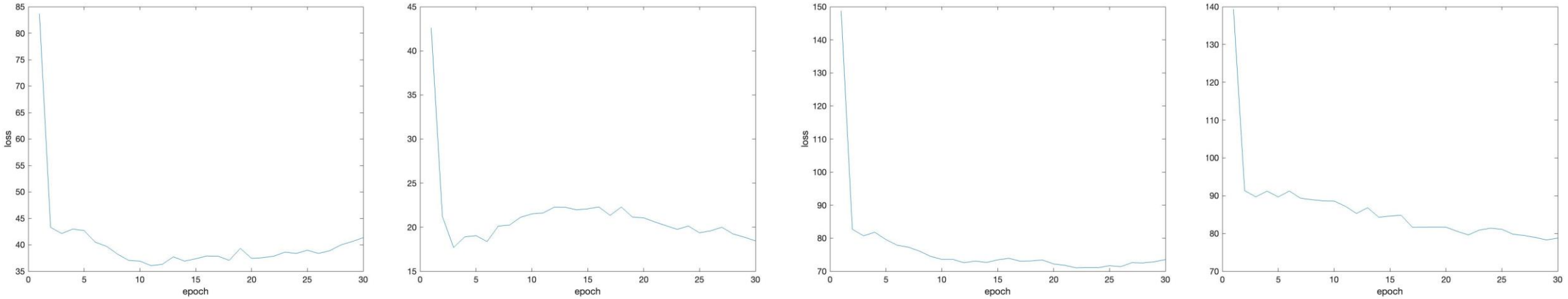
Training and Validation

Criterion:

$$\text{MSE}=\frac{1}{m}\sum_{i=1}^{m}(y_i-\hat{y}_i)^2$$

Optimizer:

Adaptive moment estimation(Adam)



The loss of random contexts

Testing

- Scenario (2-6 APs and 1-4 STAs per AP)
  - 1,000 different deployments
  - A random OBSS/PD threshold for each context
- Test loss:
  - MAE=8.913Mbps

Thank you!

Questions?