Tech Lunch

Federated Learning for Loadcurve Prediction

CC Digital Energy and Electric Power

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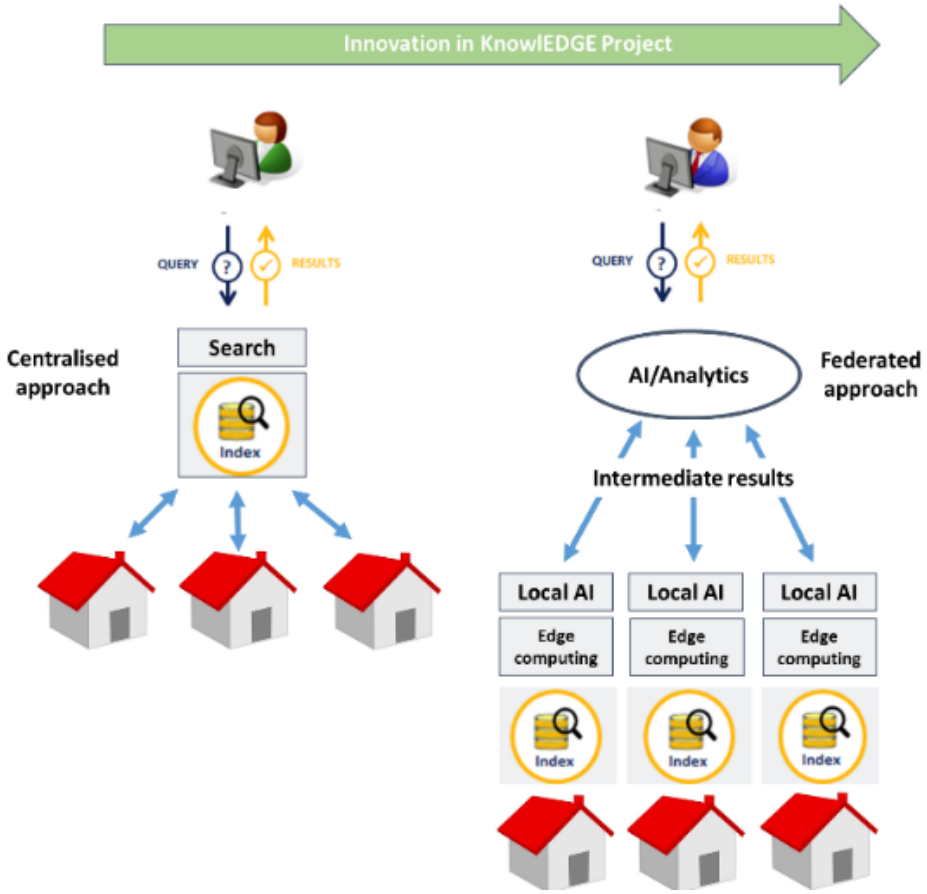

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ROMANDE ENERGIE

Landis+Gyr

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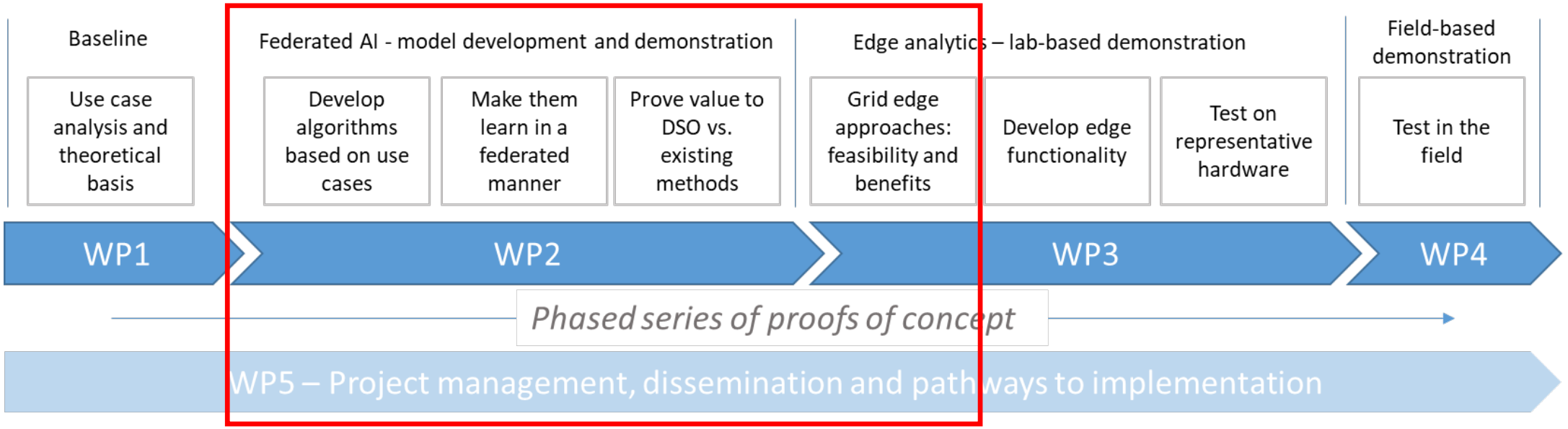
KnowlEDGE Project



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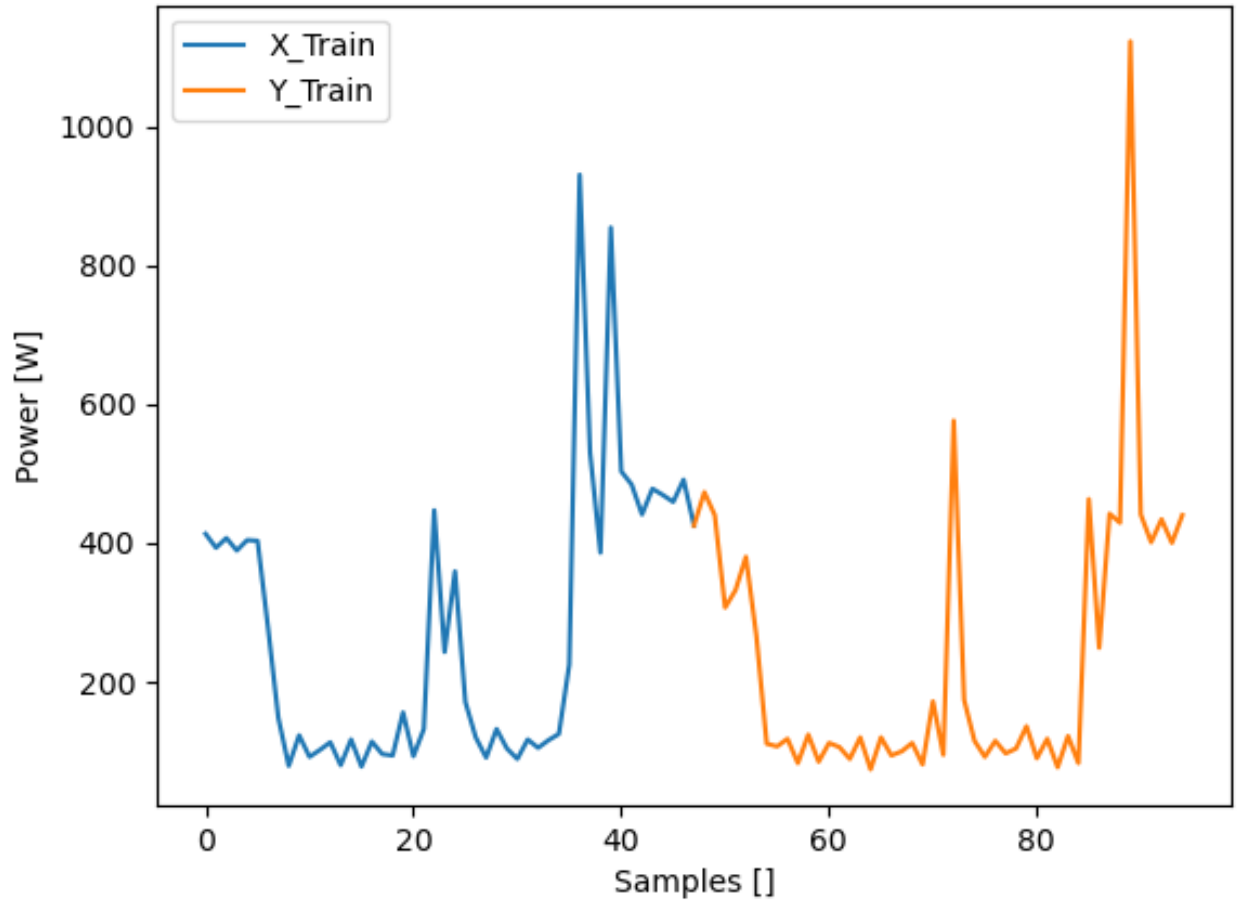
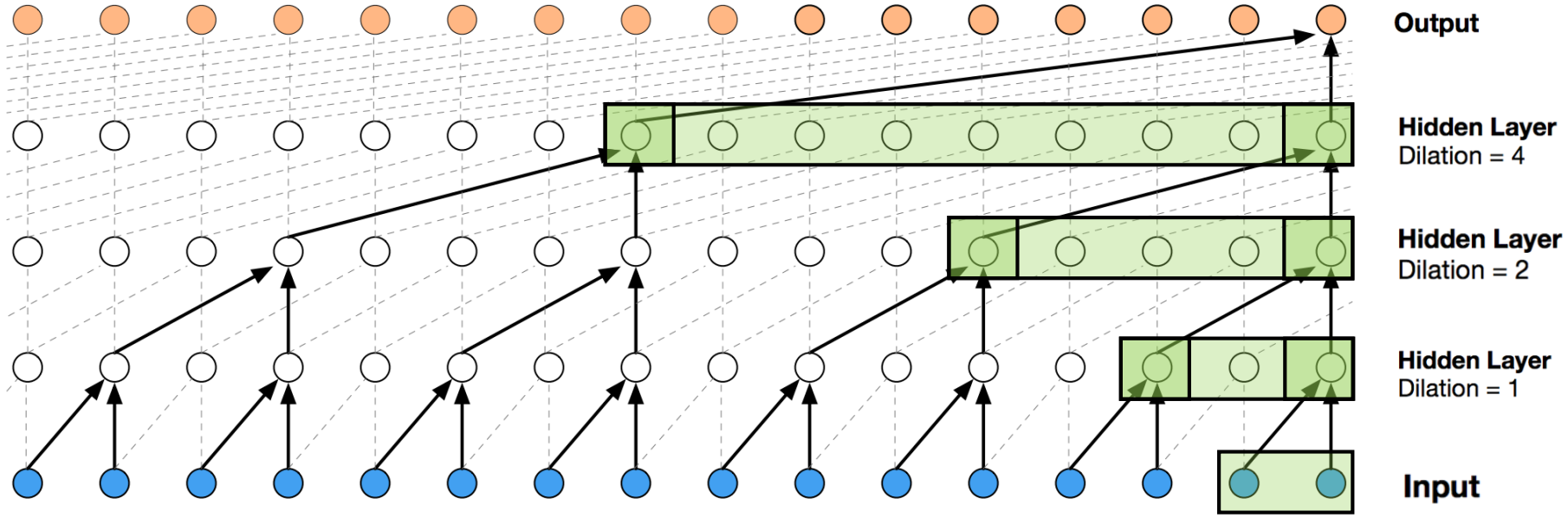
Recap VM02 – Loadcurve Prediction



The Temporal Convolutional Network



(P. Remy, 2020)

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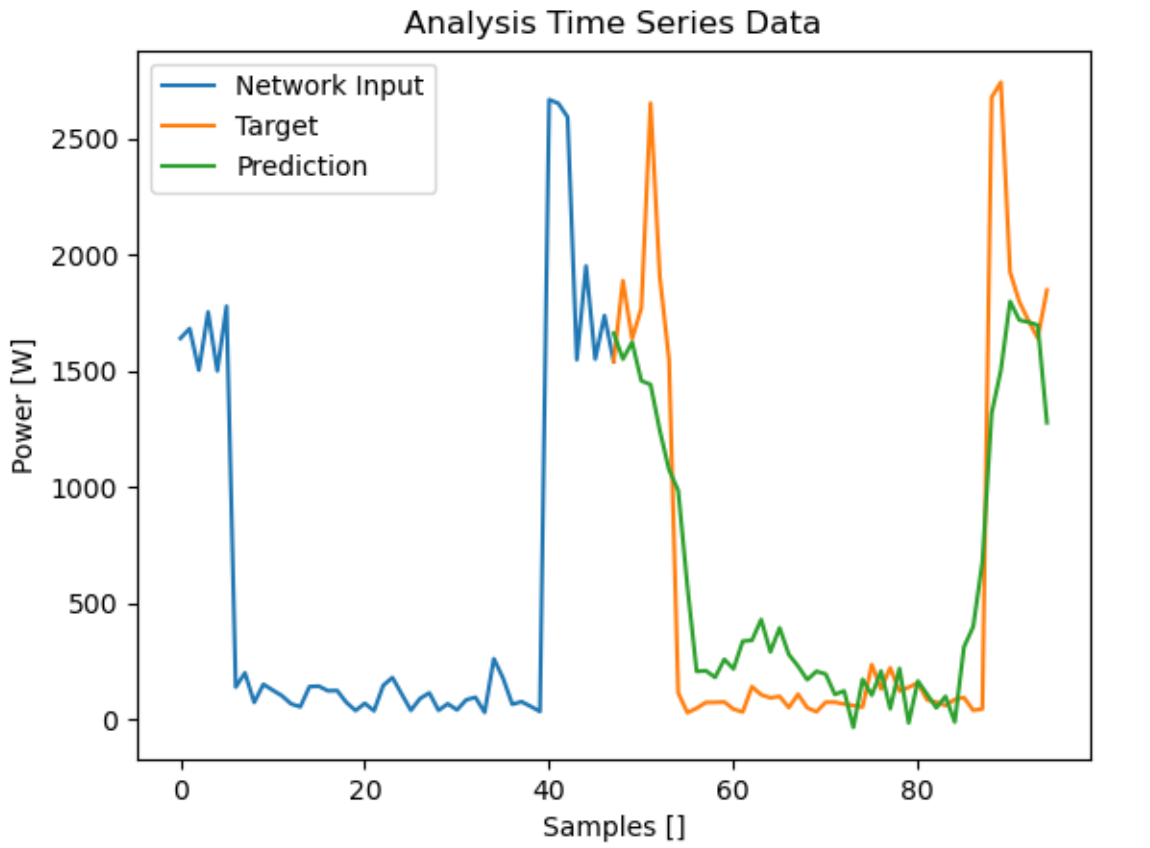
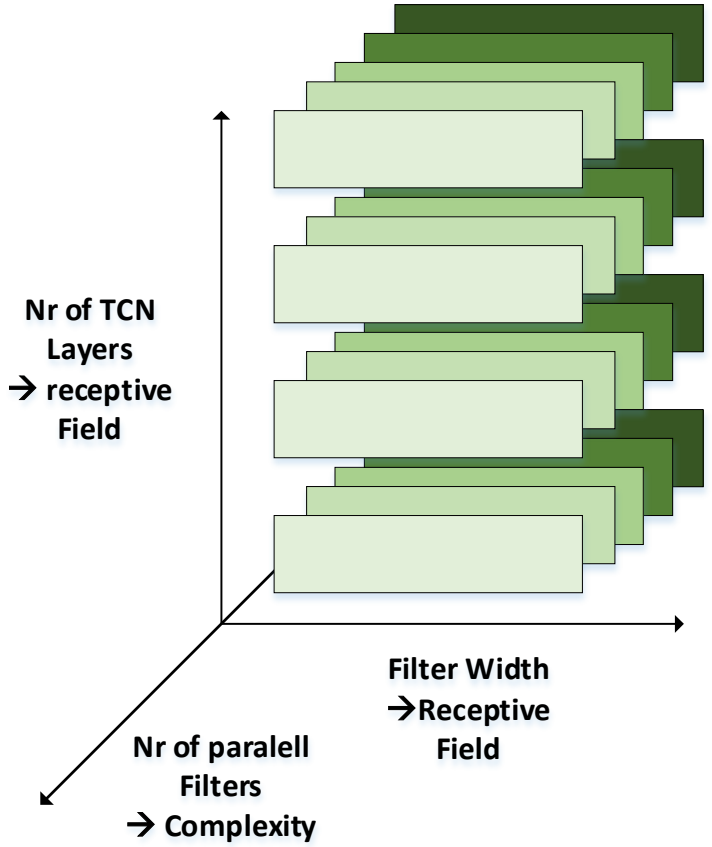
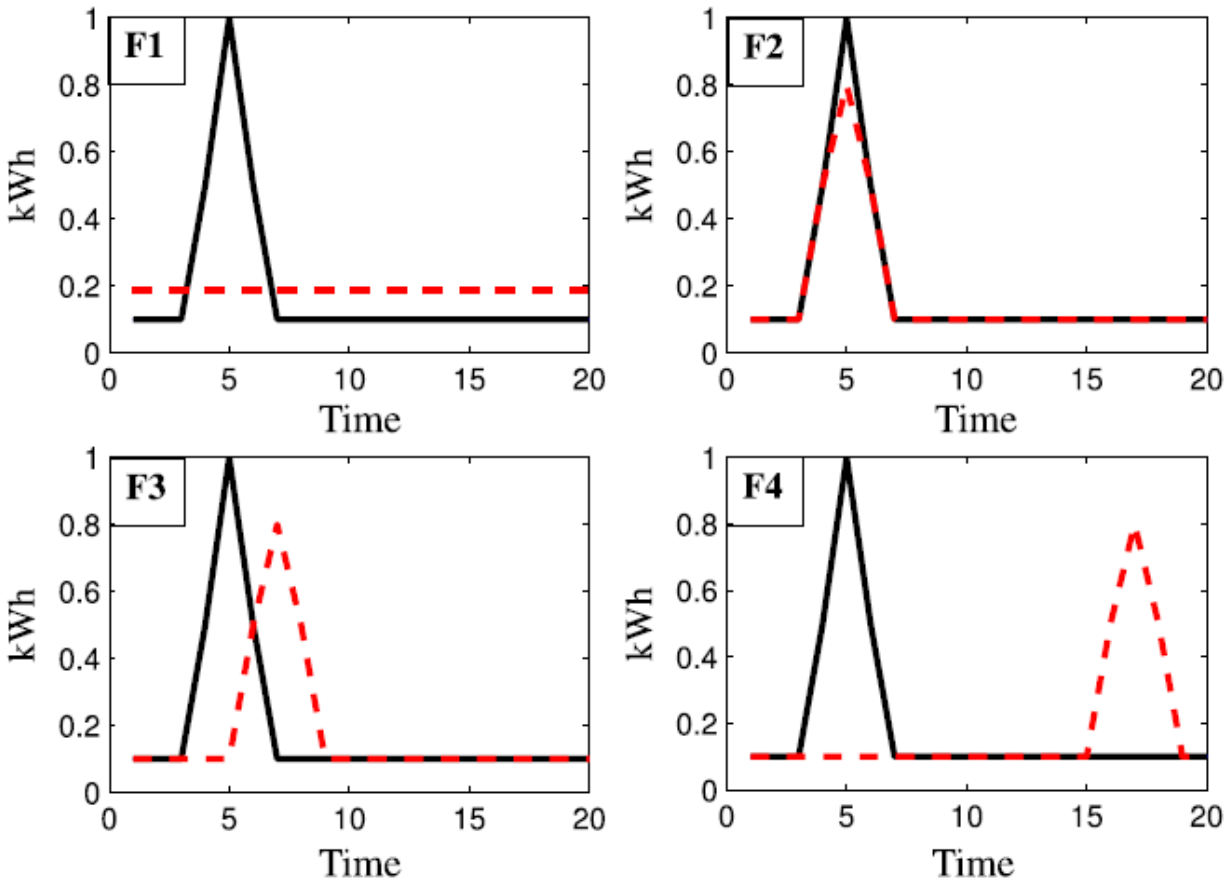
Goal Loadcurve Prediction



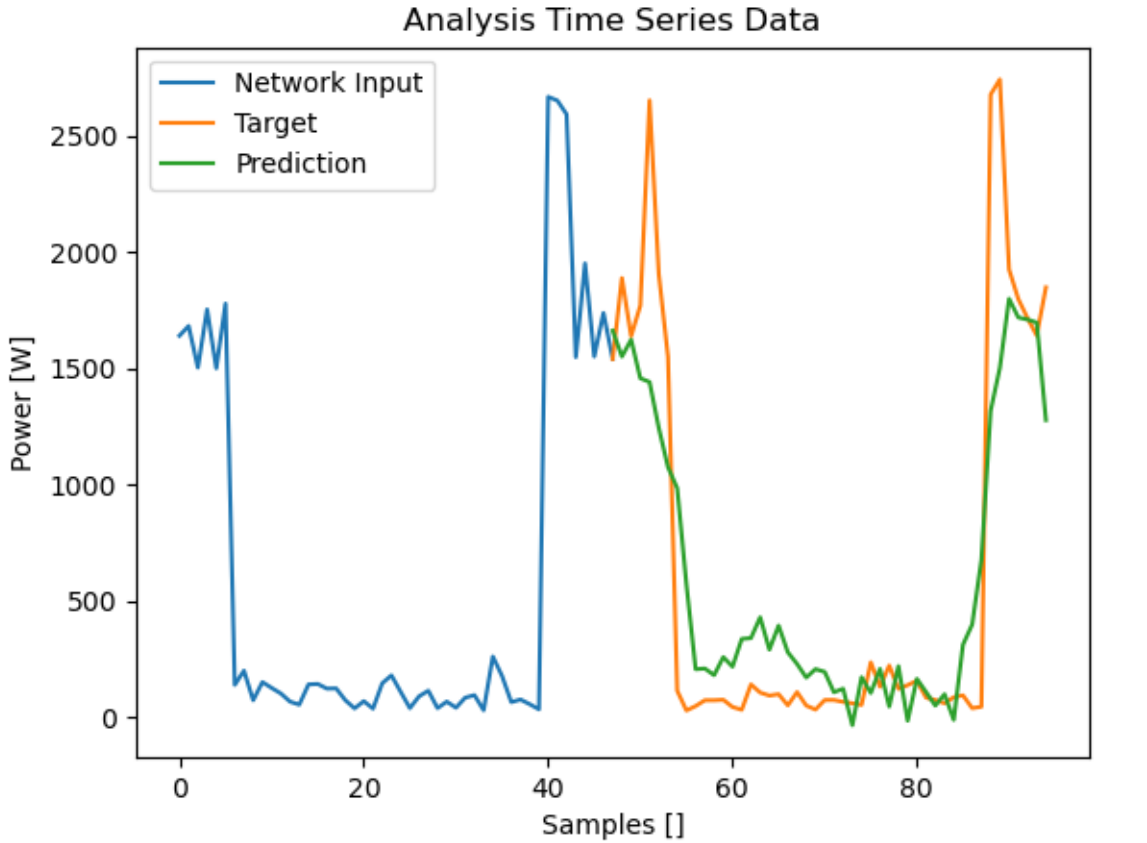
Design of TCN Network



The Adjusted Loss



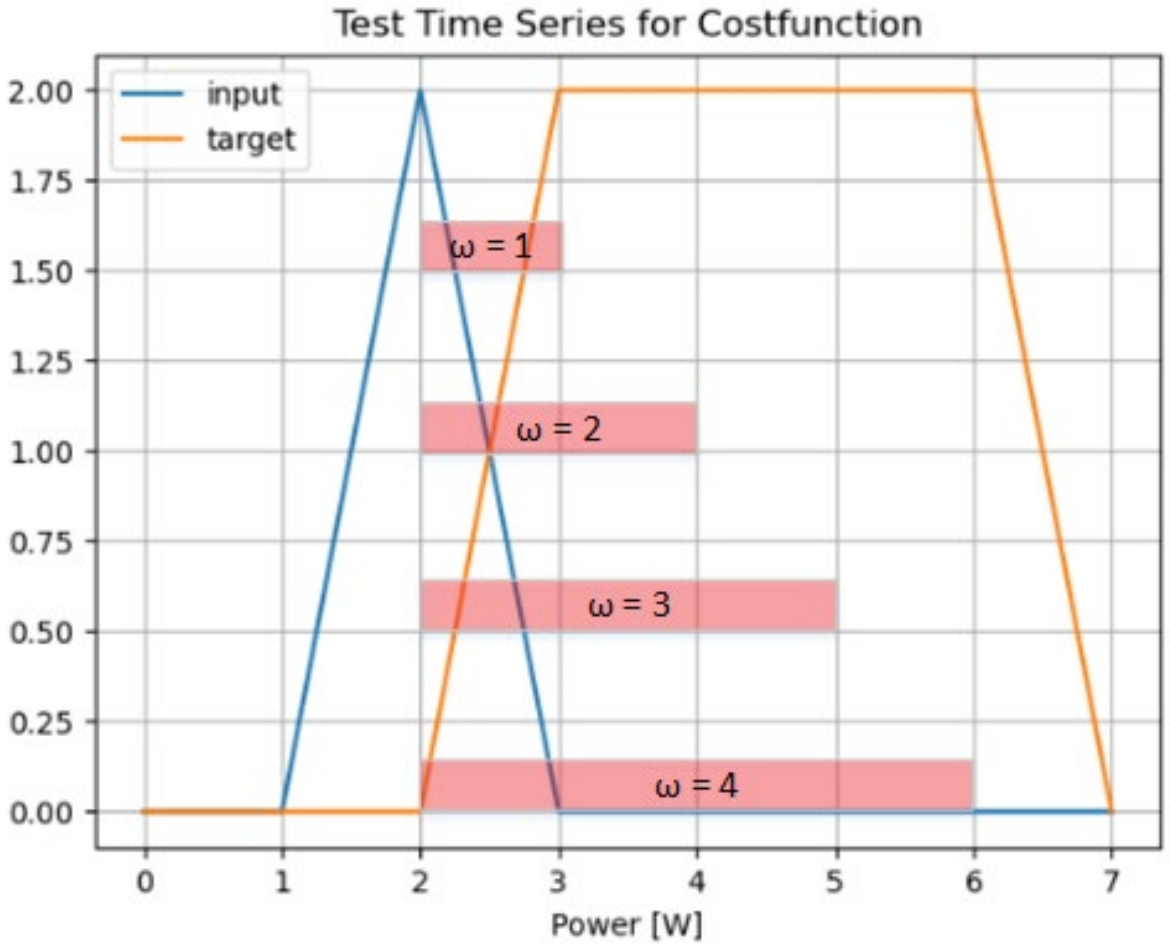
(S. Haben et al, 2014)



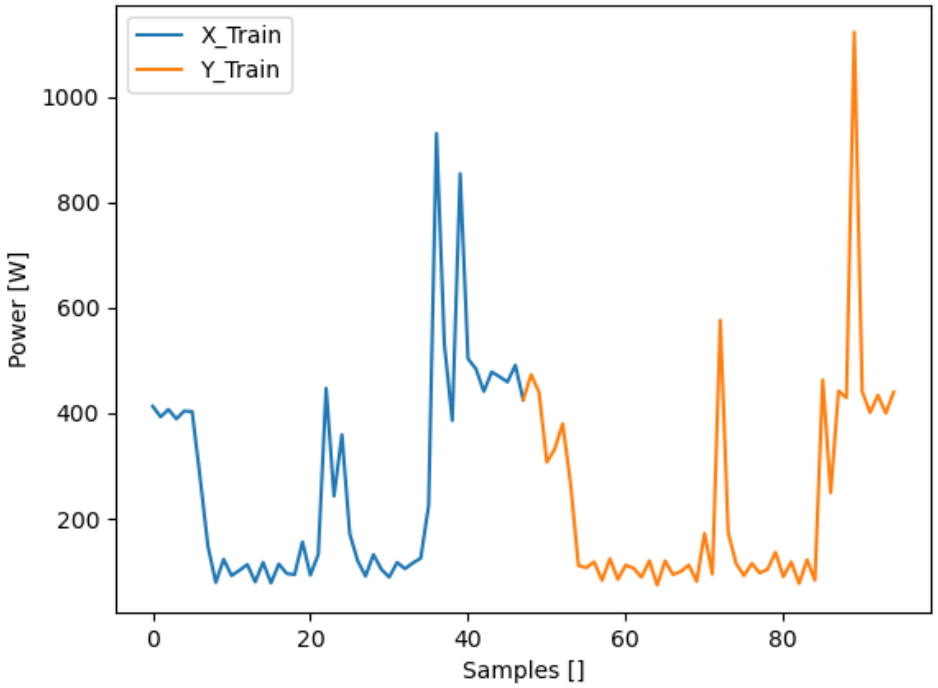
The Adjusted Loss

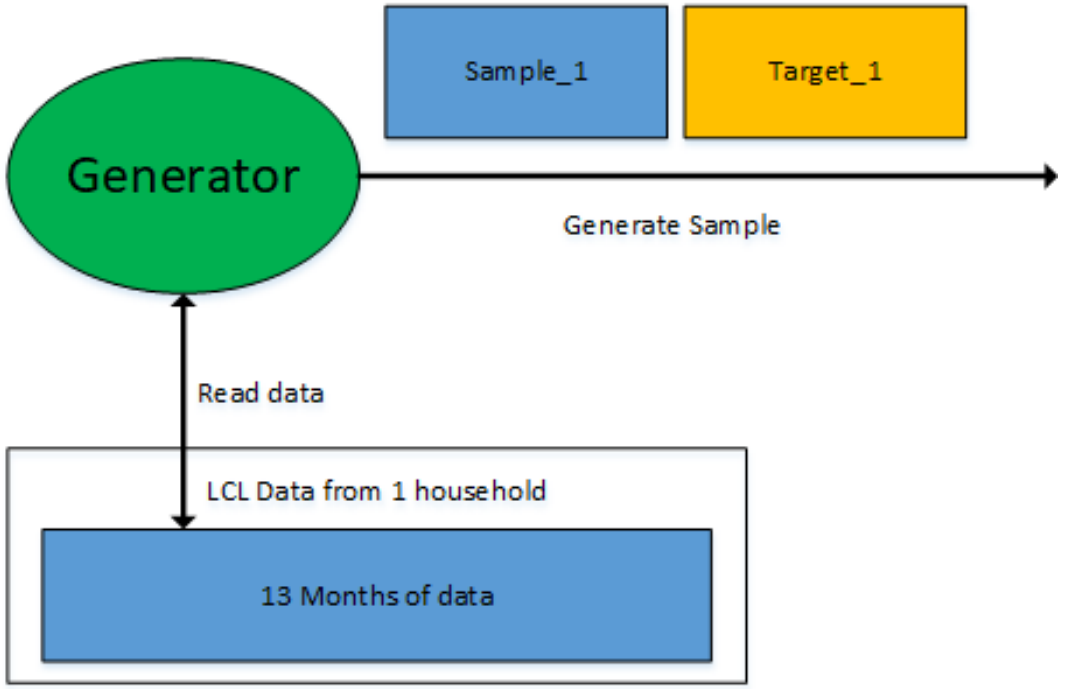
Hyperparameters:

- Omega ω
- Power P

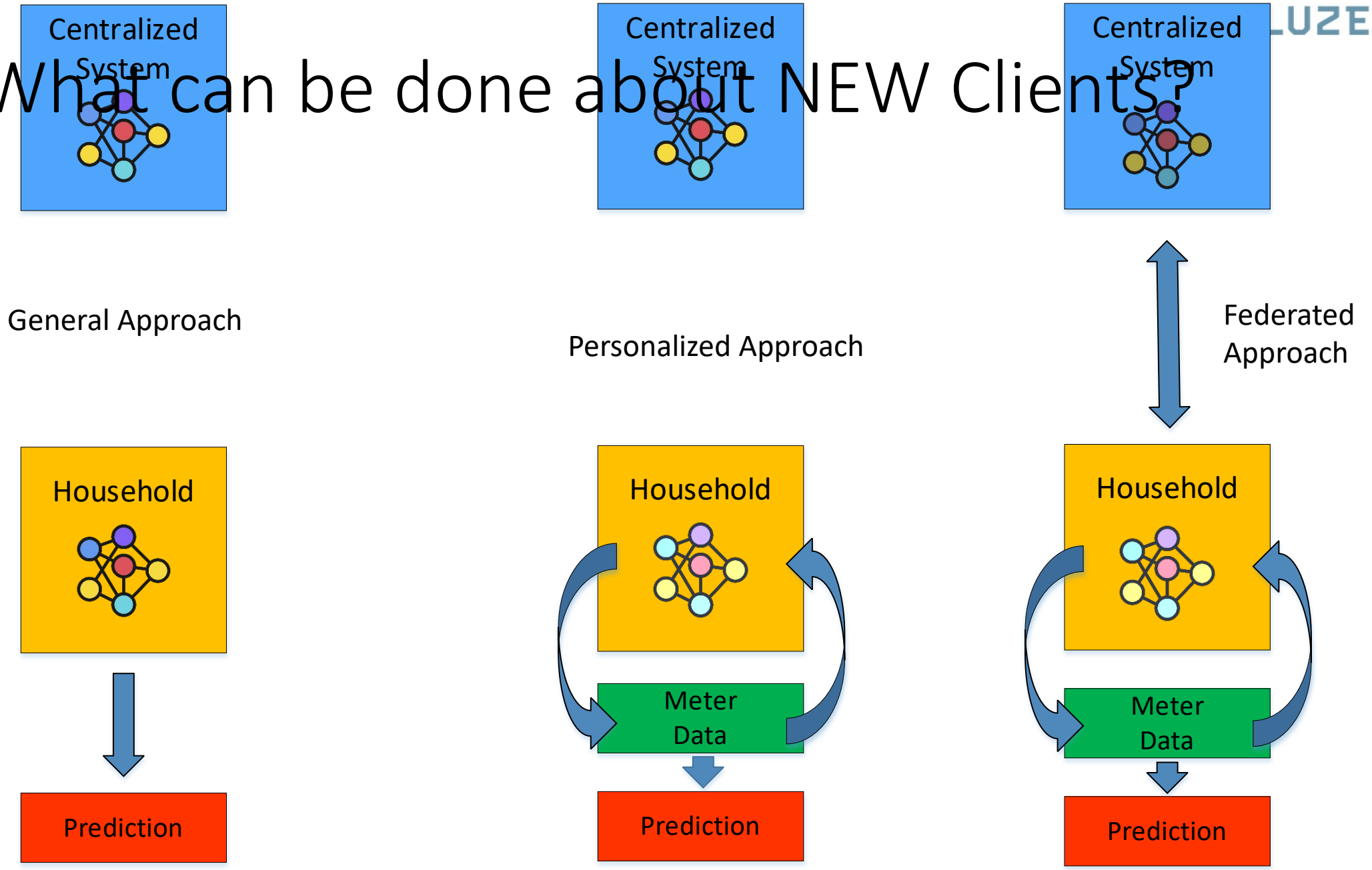


Recap VM02 – Time Series Generator





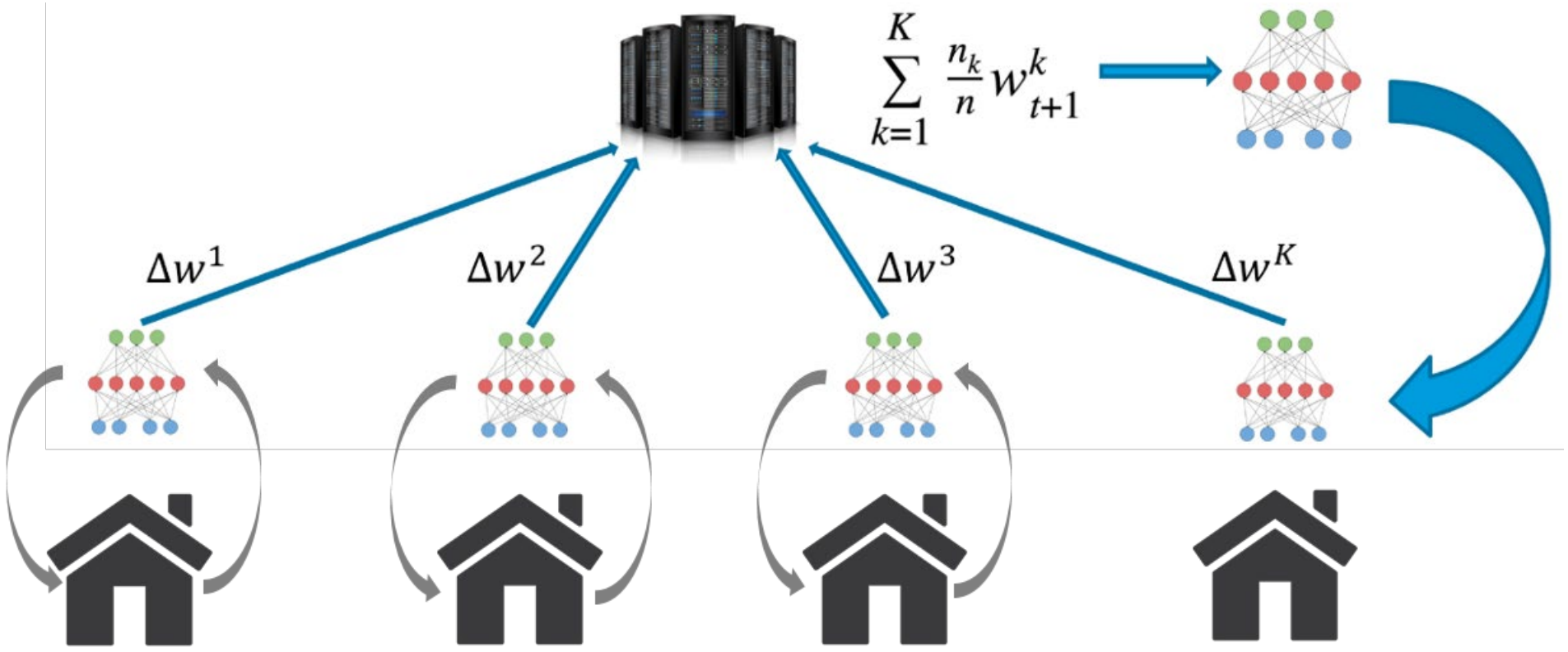
What can be done about NEW Clients?



Goals of my Master's Thesis

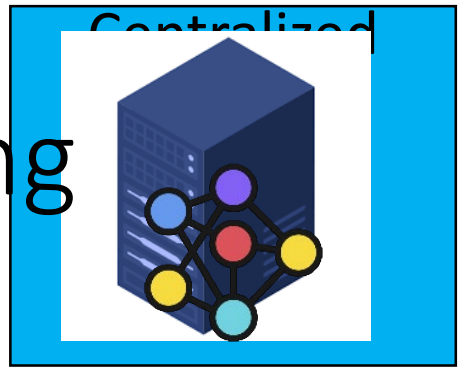
- Analyze the benefits / disadvantages of the model personalization in the context of load curve prediction
- Theory research for the Federated Learning strategy
- Implement a Federated Learning algorithm
- Analyze the performance of the Federated model compared to a base line model
- Stretch Goal: Implement Federated Learning on an Edge Device

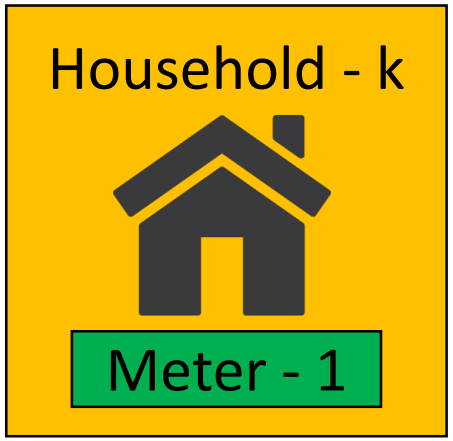
Federated Learning

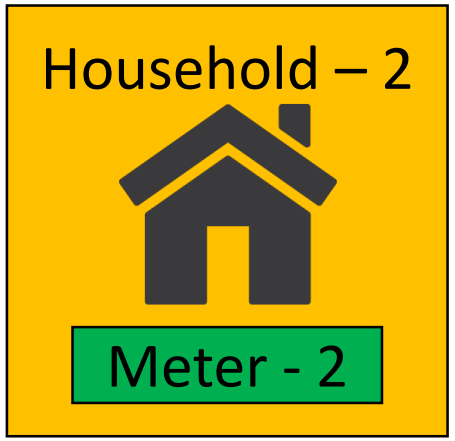


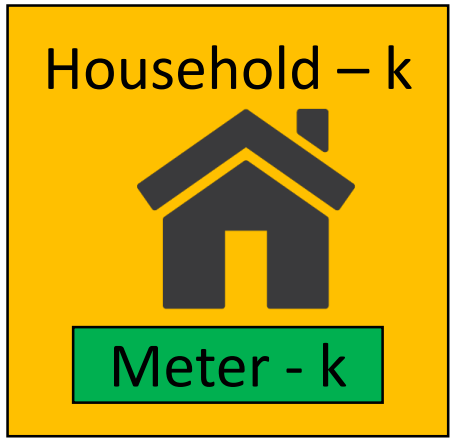
(J. Corbacho, 2018)

Federated Learning









Centralized System

$$\sum_{k=1}^{K} \frac{n_k}{n} w_{t+1}^{k}$$

Δw^1

Household – 1

Meter - 1

Δw^2

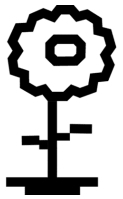
Household – 2

Meter - 2

Δw^K

Household – k

Meter - k



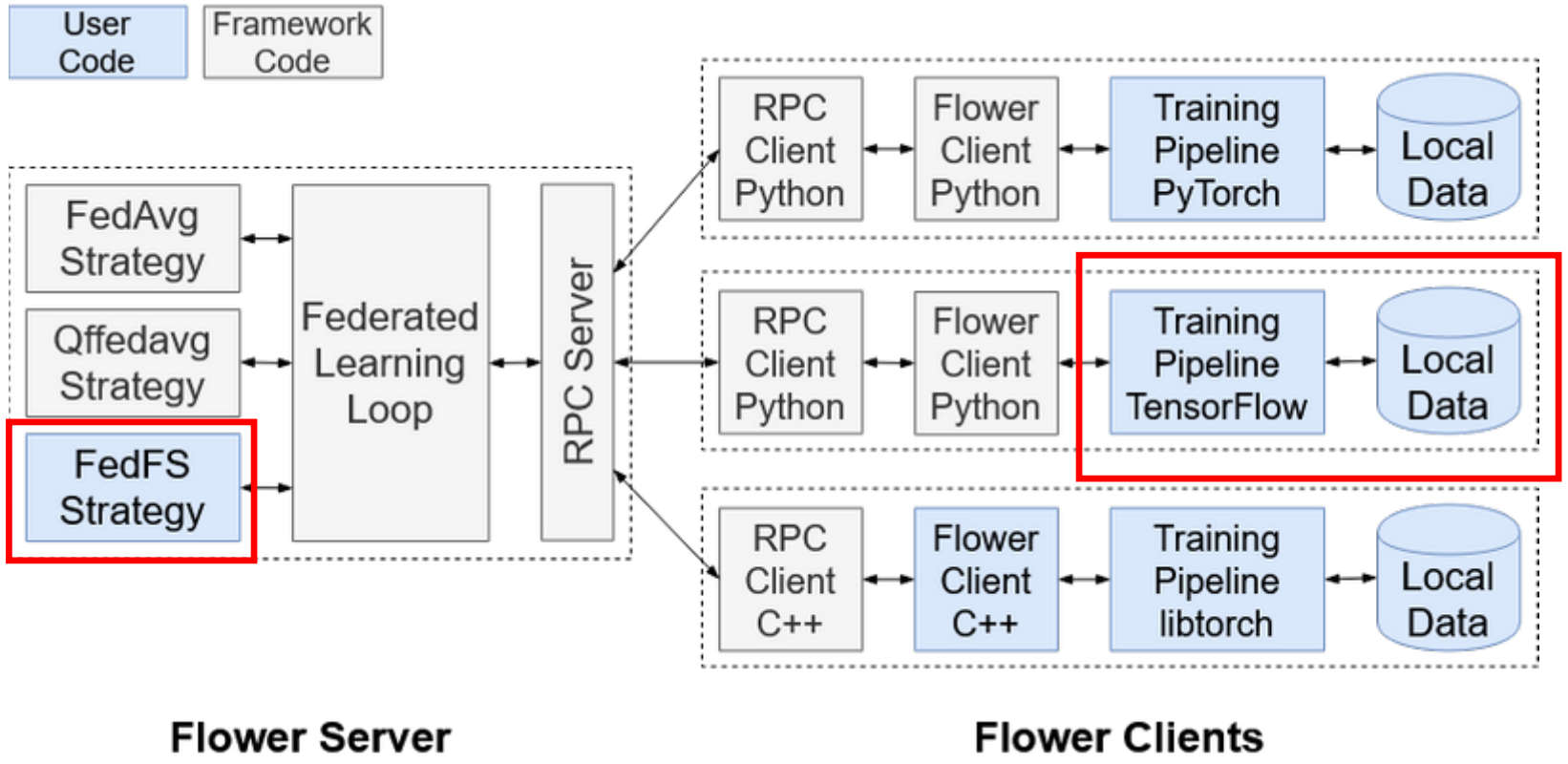
The Flower Framework

	TFF	PySyft	LEAF	Flower
Heterogeneous clients				√
Scalability	*	(√)**		√
Server-side definitions	√	√		
ML framework-agnostic		***		√
Language-agnostic				√
Baselines			√	√

planned * only Python-based instances **
limited to PyTorch and TF/Keras ***

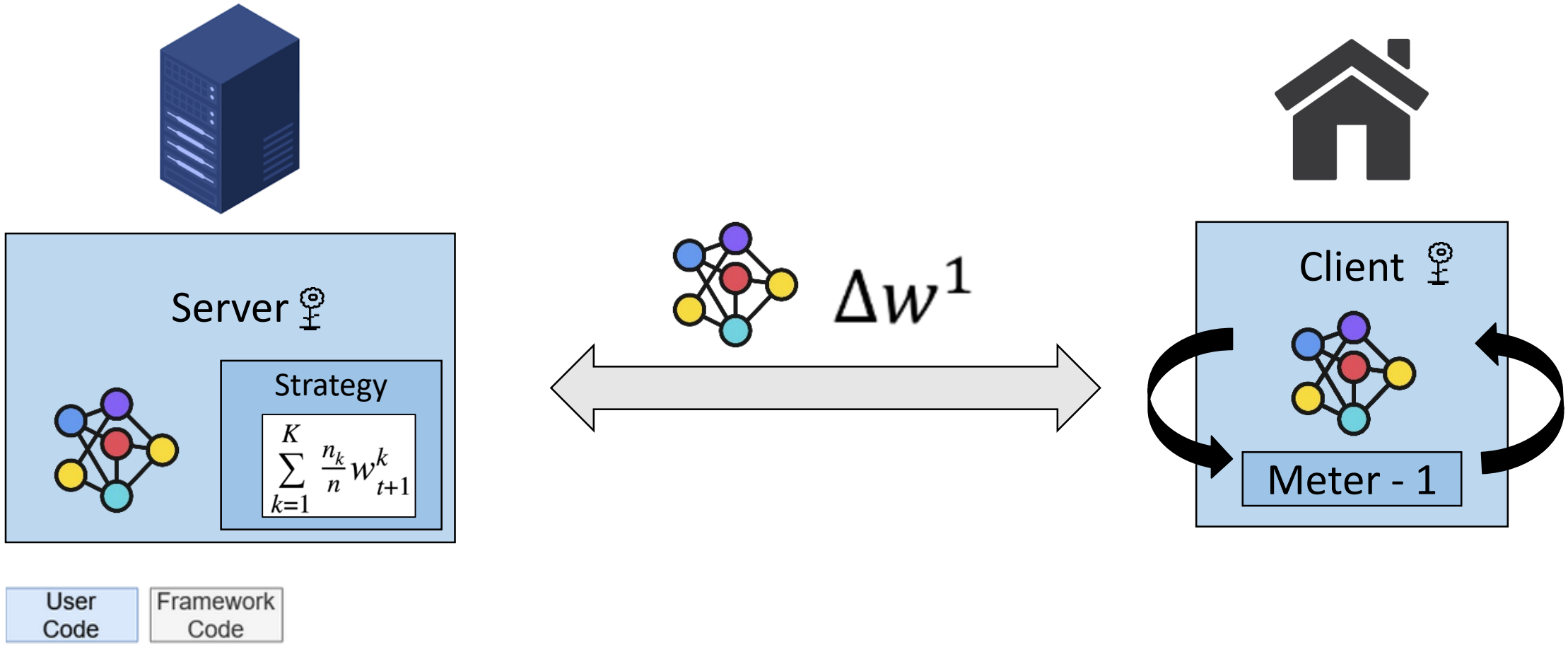
(D. Beutel et al, 2020)

The Flower Framework



(D. Beutel et al, 2020)

The Flower Framework



Simulated Experiments

- Repeatability
- Comparability of logged data
- Statistical relevant Results
- Dynamic Code allows for future Hyperparameter Optimization

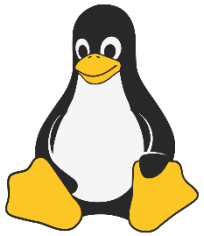
Outlines & Constraints Master Thesis

- Focus on Simulation / Analysis
- Compare Performance of FL vs. Personalization vs. General Models
    - Statistical Analysis
    - Quantitative Comparison (Comparable Numbers)

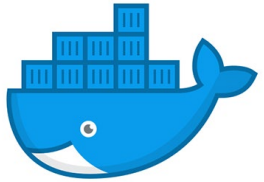
- On Edge Training needed for Personalization & Federated Learning
    - Not yet supported by TFLITE (for regression tasks)

    → Needs full-fledged Tensorflow

    →Use Linux, Python & Docker environment
        - Docker allows for the “porting” of containers



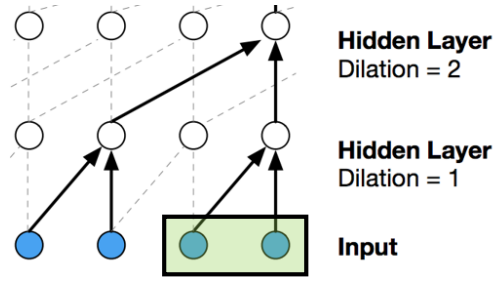
(S. Smith, L. Ewing, 2017)

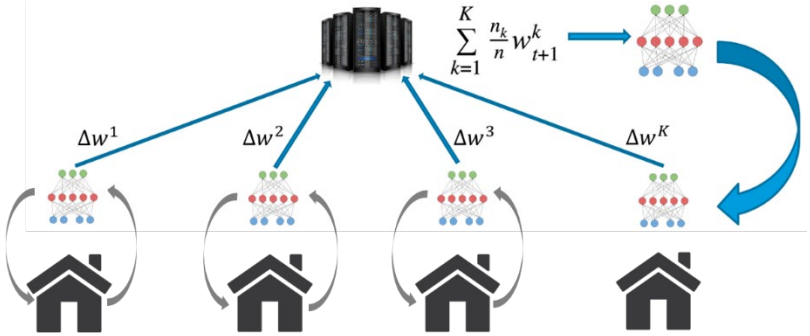


(Dirk Merkel, 2014)

Summary

- Use in VM2 established Structures
  - TCN Architecture
  - Time Series Generator
  - Adjusted Loss
- Federated Learning:
  - “Inverse” decentralized Training
  - Training on Edge
  - Allows for data privacy
- Focus on Simulation Approach
  - Flower Framework
  - Docker containers





(J. Corbacho, 2018)

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Questions?

Bibliography

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