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DPNCT:

A Differential Private Noise Cancellation Schemefor Load Monitoring and Billing for Smart Meters

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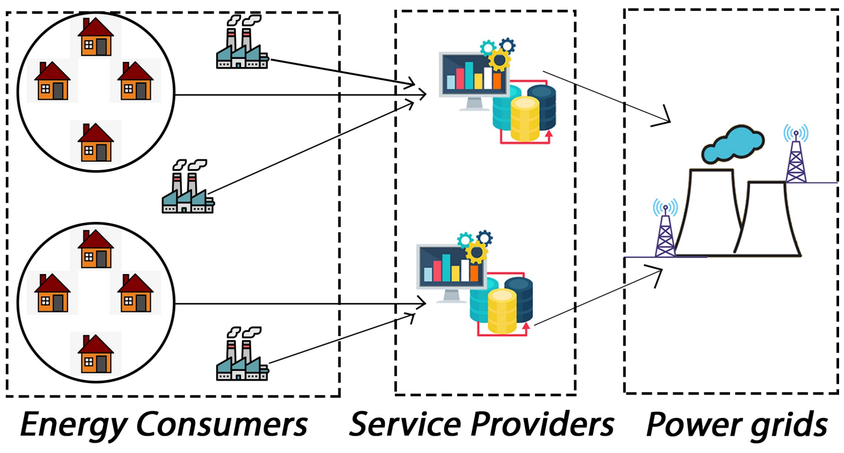
What is smart grid?

- Consumers send energy consumption data to service providersvia smart meters
- Service providers do analysis of data to provide services like billing, load monitering and demand response schemes
- Power grid take critical decisions on the basis of these analytics and devise policies



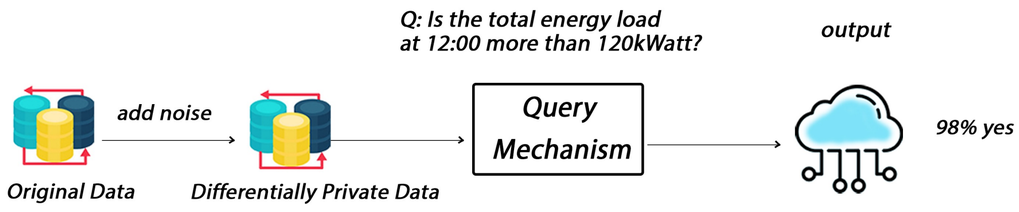
Entities in Smart Grid

Motivation:

- Smart grid data accuracy is required to:
  - Calculate Bills of individual
  - Load Monitoring of Areas
- Smart grid data leaks sensitive information regarding:
  - Consumers' life style
  - *Survellience of consumers*
- This information can be used for:
  1) Targeted marketing 2) *Serious security threats.*

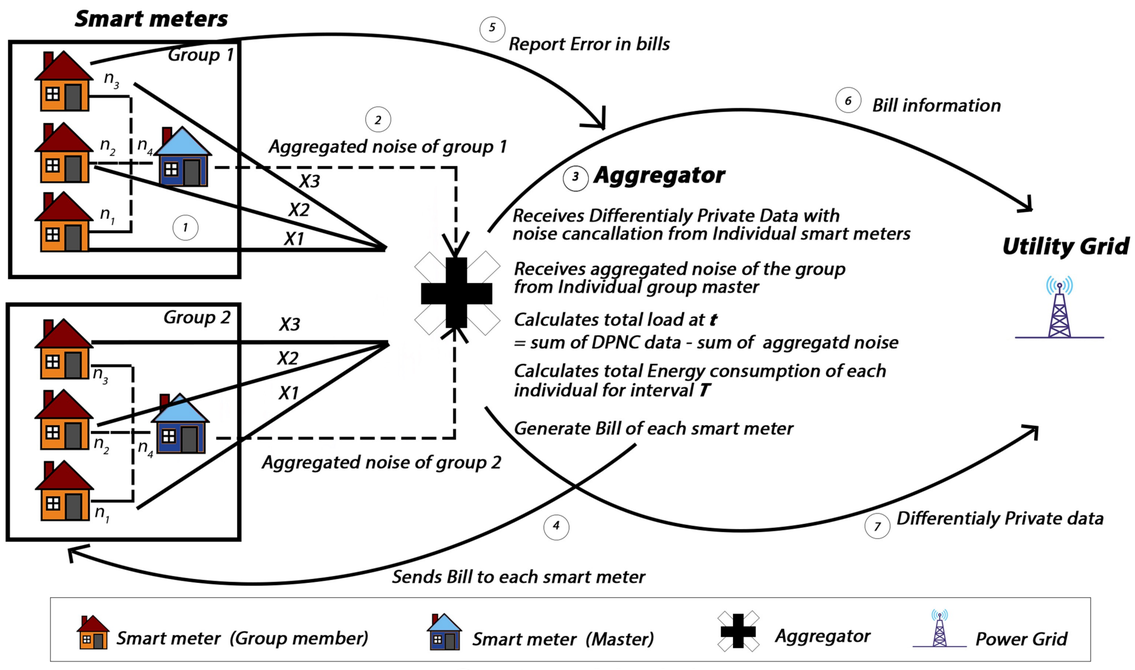
Existing Solution:

Existing works use Differential Privacy (DP) i.e. adding random noise to the data in way that does not significanlty disrupt the outcome of the mechnism.



Differential Privacy Mechanism

DPNCT [2]:



System Model

Challenges:

Existing approches using Differnetial Privacy had

- Trusted third party aggregators/service provider
- Inaccuracy in billing and load monitoring due to added noise

UN SDG align Goals:

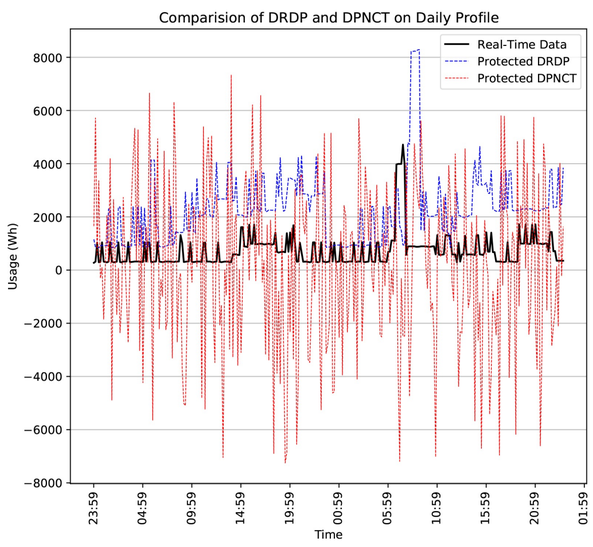
Our goals are align with UN SDG to create **sustainable cities and communies** by providing:

- Privacy of individual user from Untrusted service provider in energy sector
- Increased accuracy in total energy consumption of a single user for billing in sustainable community
- Increased accuracy in aggregated load at an instant for load monitoring sustainable smart grids

Evaluation:

We evaluate results of our solution with existing state of the art solution Differentially Private Dynamic Pricing for Demand Response (DRDP) [1] .

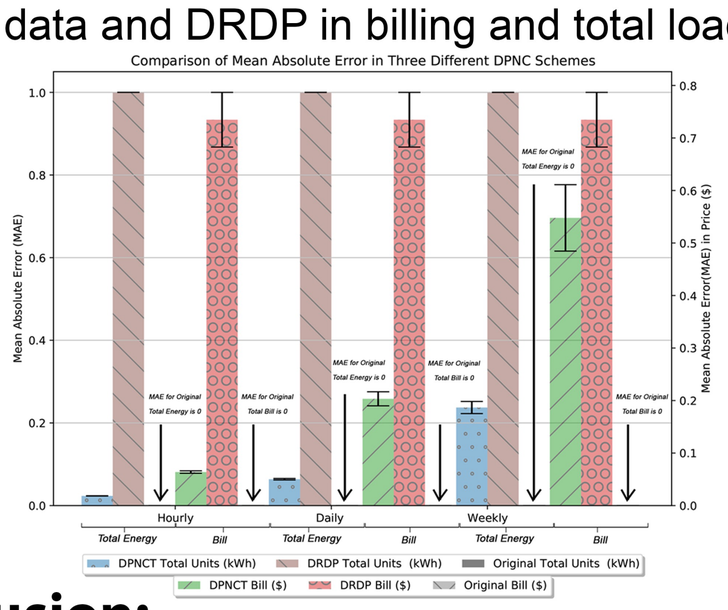
Figure shows no correlation (0.1) between DPNCT protected data profile and original profile.



Billing:
The noise added due to DP is cancelled dynamically either daily,weekly, or monthly

Load monitoring:
The total noise added at an instant gets cancelled at aggregator level from the total masked data of the area.

Comparison between three DPNCT schemes with original data and DRDP in billing and total load



Conclusion:

DPNCT provides privacy with accuracy in billing and load montoring with mean absolute error (MAE) in:

- Total energy consumption of a house (5%)
- Total bill of a single house (6%)

References:

[1] M. U. Hassan, M. H. Rehmani, and J. Chen, "Differentially private dynamic pricing for efficient demand response in smart grid," in IEEE International Conference on Communications (ICC), 2020, pp. 1–6.

[2] A detailed version of this poster is accepted at IEEE ICC 2021 Workshop and it is also available online at arxiv. Khadija Hafeez, Mubashir Husain Rehmani, Donna O'Shea, *DPNCT: A Differential Private Noise Cancellation Scheme for Load Monitoring and Billing for Smart Meters,* CoRR abs/2102.09458, 2021.

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