

CTC and D2D Communication based Network Architecture for Public Safety Communication

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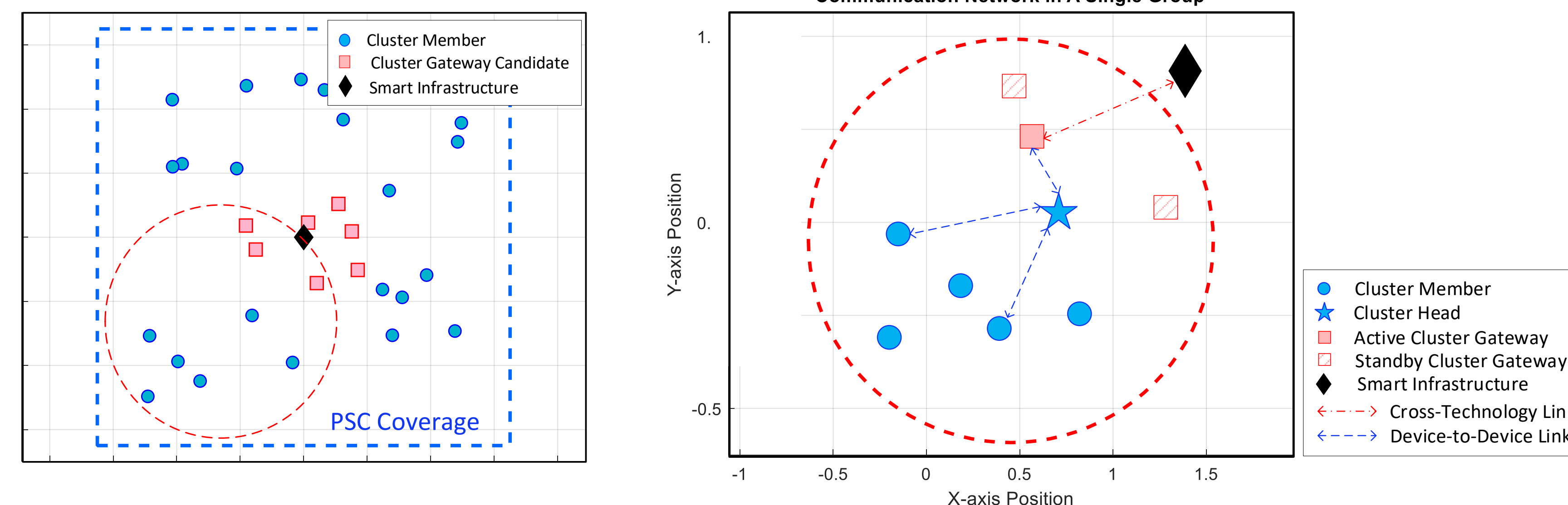
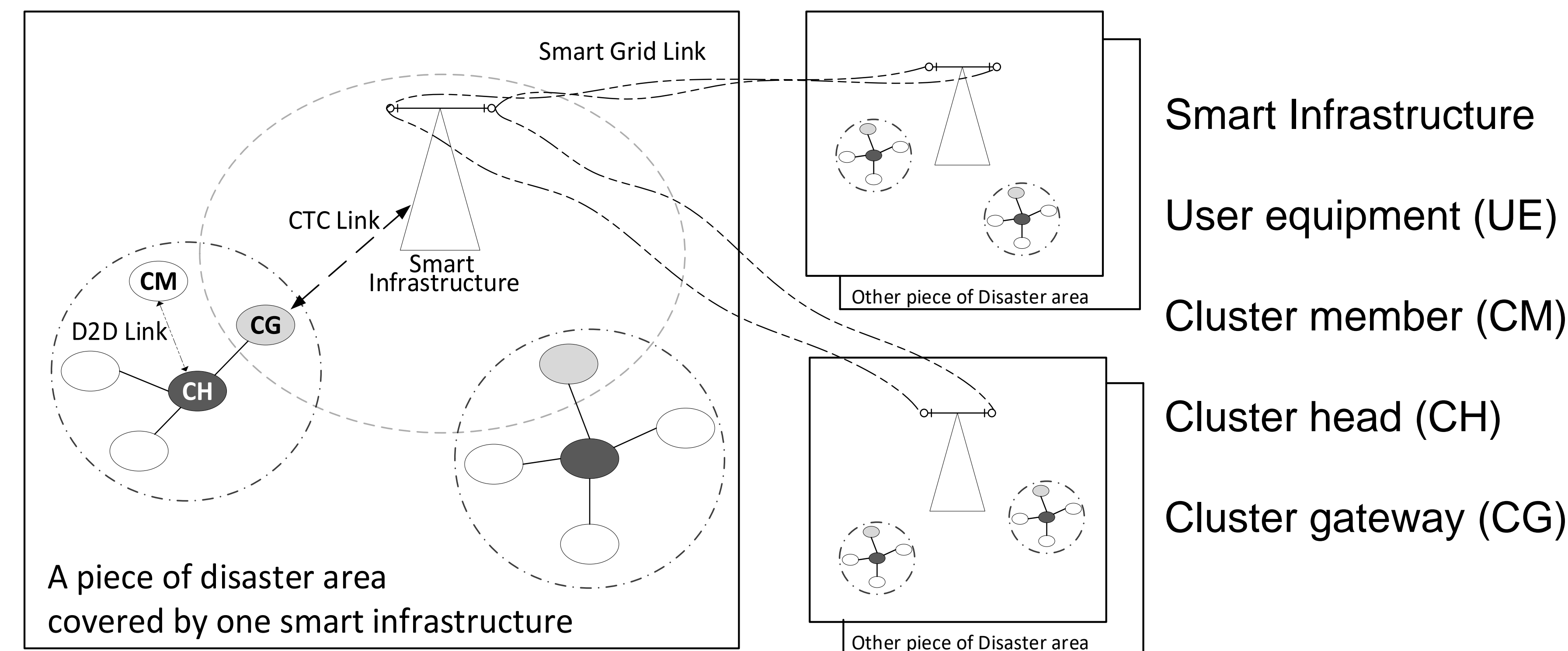
Background

- Public Safety Communication (PSC) is responsible for making direct response to the emergency situations. [1]
- Device-to-Device communication (D2D) is defined as the direct communication between two mobile users without the base station or core network.
- Cross-Technology Communication (CTC) [2] enables the communication between two communication devices with different communication protocols, e.g., Wi-Fi, Bluetooth, Zigbee, etc.

Objectives

- Design a framework with the help of CTC and D2D communication technologies.
- To provide reliable network connectivity for emergency response.
- The energy efficiency is considered in such a PSC network.

Framework Design



Methodology

UE Clustering

- Find CG candidates which are close to the infrastructure.
- Use K-means algorithm to cluster UE so that summation of the residual energy in each cluster is balanced.

$$\min \left| \sum_{i \in c_a} e_i - \sum_{j \in c_b} e_j \right|$$

CG and CH Scheduling

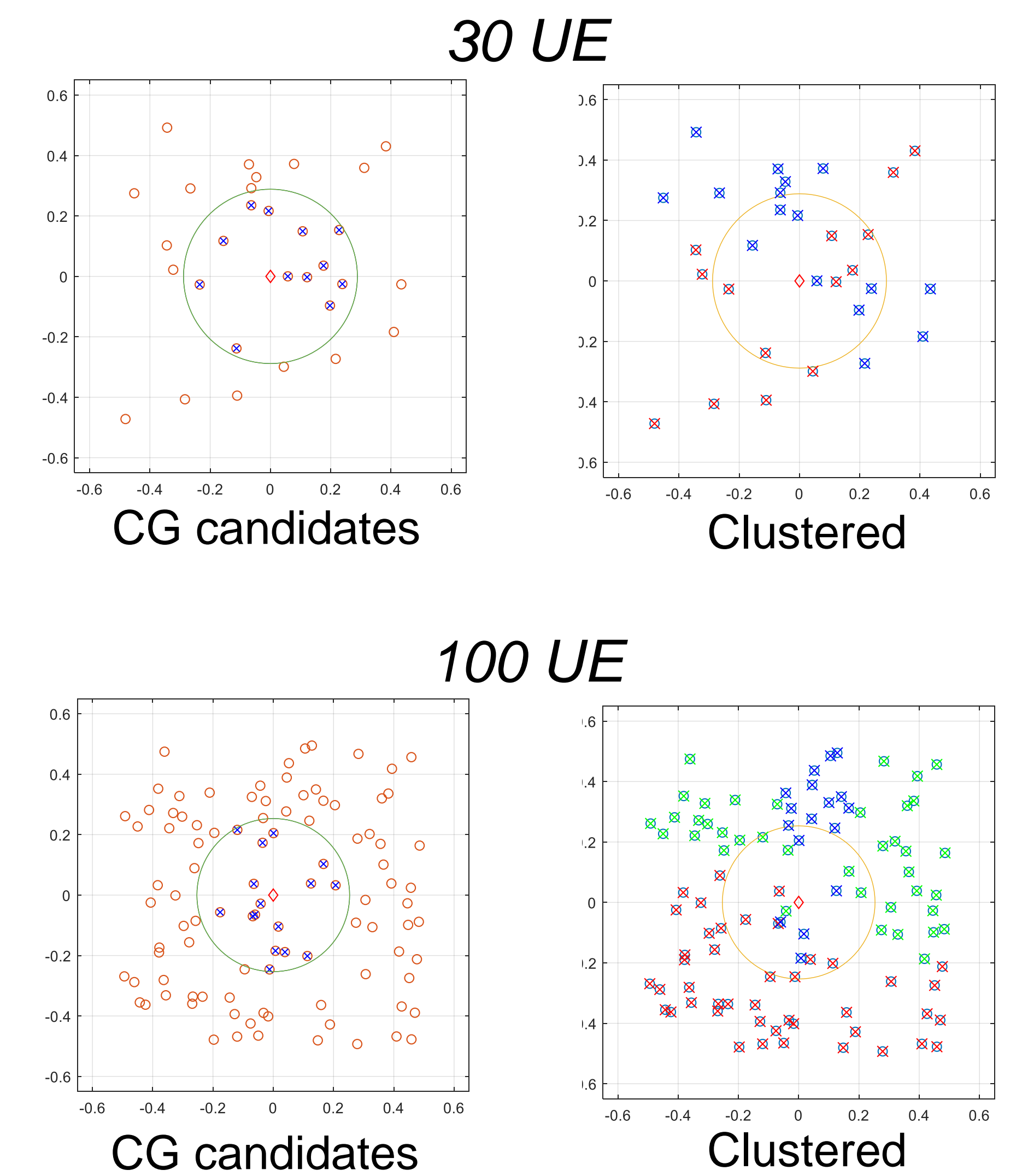
- Use linear programming to schedule CM and CH
- To maximize the time for a UE to work as CG/CH while keep it alive for the expected duration

$$\max \sum_{i=0}^K \theta_i \cdot \tau_{gi}$$

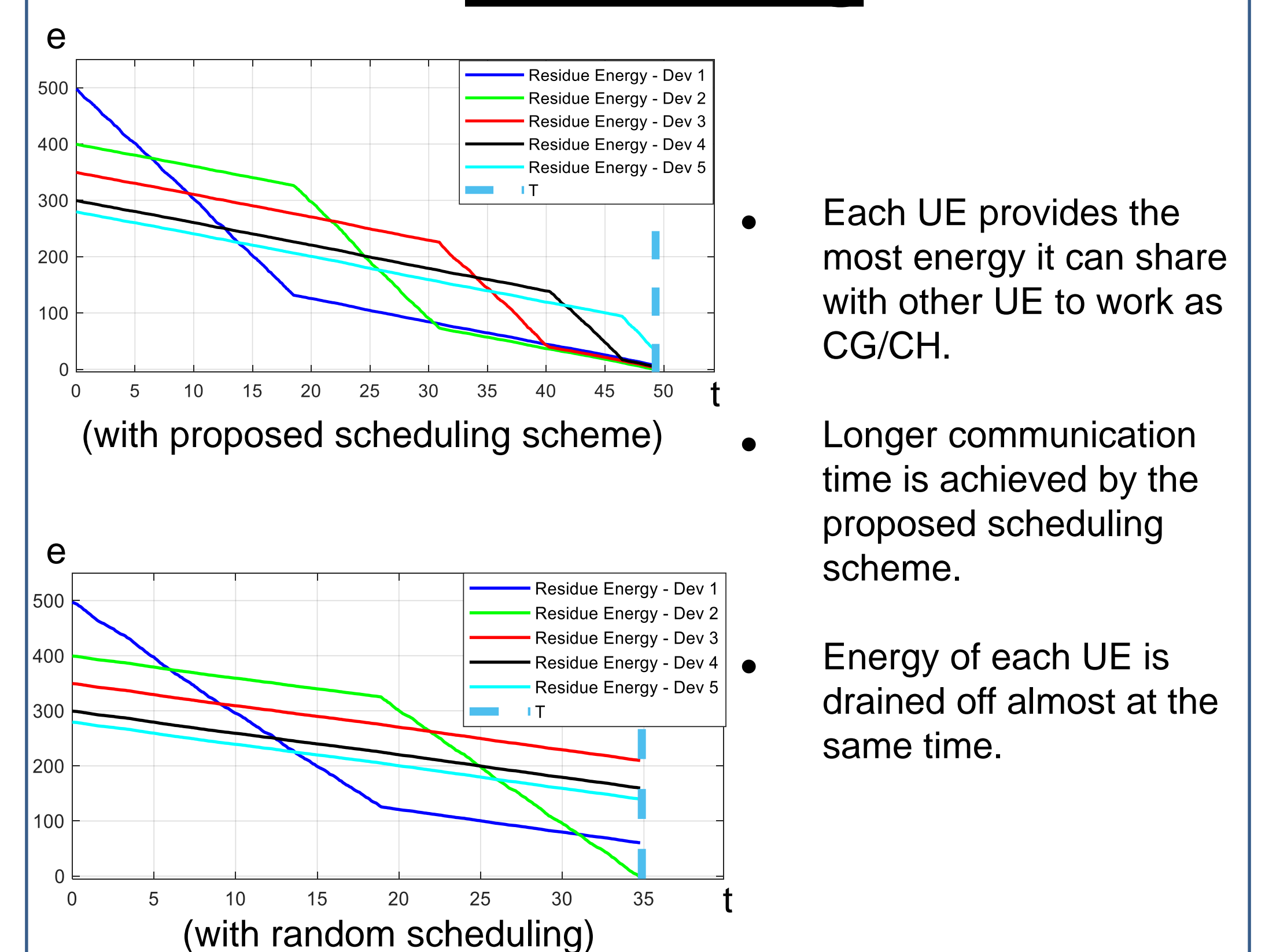
$$s. t. P_g \theta_i \tau_{gi} + P_m (T - \theta_i \tau_{gi}) < e_i$$

Simulation

Clustering



Scheduling



- Each UE provides the most energy it can share with other UE to work as CG/CH.
- Longer communication time is achieved by the proposed scheduling scheme.
- Energy of each UE is drained off almost at the same time.

Jielun Zhang received the B.S. degree in electrical engineering from Shanghai Normal University, Shanghai, China; the B.S. degree in electronic and computer engineering technology and the M.S. degree in electrical engineering from the University of Dayton, Dayton, OH, USA. He is currently pursuing the Ph.D. degree from the Department of Electrical and Computer Engineering, University of Dayton, Dayton, OH, USA. His current research interests include deep learning in networking, wireless communications and smart city.

[1] Public Safety Communications Research Division www.nist.gov/ctf/pscr/about-pscr

[2] W. Wang, S. He, L. Sun, T. Jiang and Q. Zhang, "Cross-Technology Communications for Heterogeneous IoT Devices Through Artificial Doppler Shifts," in *IEEE Transactions on Wireless Communications*, vol. 18, no. 2, pp. 796-806, Feb. 2019.