GR-314

MP-DDPG: Optimal Latency-Energy Dynamic Offloading Scheme in Collaborative Cloud Networks

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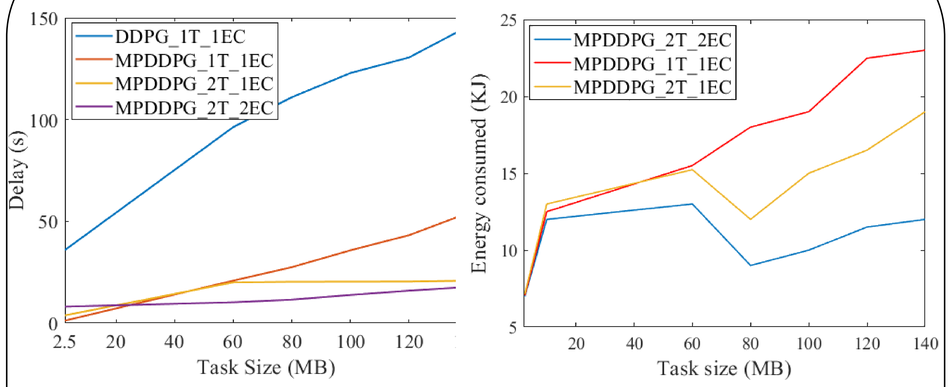
Introduction

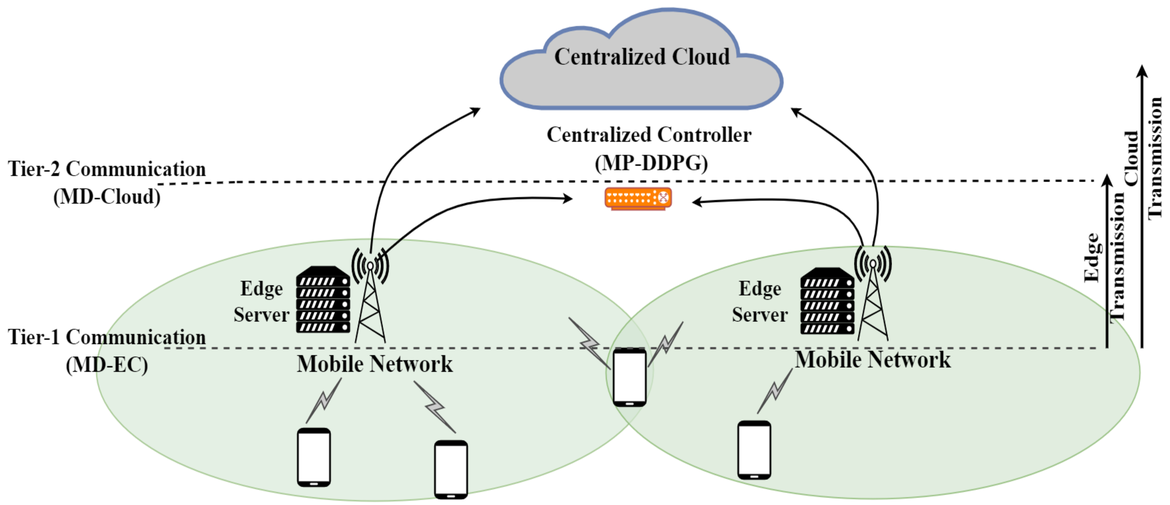
Growing technologies like virtualization and artificial intelligence have become more popular on mobile devices. But lack of resources faced for processing these applications is still major hurdle. Collaborative edge and cloud computing are one of the solutions to this problem. We have proposed a multi-period deep deterministic policy gradient (MP-DDPG) algorithm to find an optimal offloading policy by partitioning the task and offloading it to the collaborative cloud and edge network to reduce energy consumption. Our results show that MP-DDPG achieves the minimum latency and energy consumption in the collaborative cloud network.

Result Analysis



Improvement in Latency by using MPDDPG
Improvement in Latency and energy using 2 Tier architecture

Model	Description
DDPG_1T_1EC	DDPG Algorithm used in 1Tier having MD communicating with Edge server
MPDDPG_1T_1EC	MPDDPG Algorithm used in 1Tier having MD communicating with Edge server
MPDDPG_2T_1EC	MPDDPG Algorithm used in 2Tier having MD communicating with Edge n Cloud
MPDDPG_2T_2EC	MPDDPG Algorithm used in 2Tier having MD communicating with 2 Edge server and a cloud server



Contributions

1. We formulate our offloading strategy based on communication and computation time and energy consumption by mobile devices, edge and cloud servers.
2. We propose "Multi-Period Deep Deterministic Policy Gradient" (MP-DDPG)based on the reinforcement learning method for finding optimal offloading strategy by scheduling at each time slot

Problem Formulation

Min (Computation Time + Computation Energy + Transmission Time + Transmission Energy)
Such that:

1. All tasks from all devices are computed
2. Battery of devices is not exhausted
3. Battery of Edge servers is not exhausted
4. Offloading decisions at each time slot are optimal

Conclusion and Future Work

.We observe that larger task sizes offload their major share to cloud and conserve energy of mobile device. This makes MPDDPG suitable for real-time environment and high-speed next generation collaborative networks.
As part of future work, we aim to design algorithms to support mobile of devices and improve the offloading ratio prediction dynamically

References

[1] Yunpeng Wang, Weiwei Fang, Yi Ding, and Naixue Xiong. 2021. Computation offloading optimization for UAV-assisted mobile edge computing: a deep deterministic policy gradient approach. Wireless Networks 27, 4 (2021), 2991–3006.
[2]William L Cooper and Bharath Rangarajan. 2012. Performance guarantees for empirical markov decision processes with applications to multiperiod inventory models. Operations Research 60, 5 (2012), 1267–1281.
[3] Xutao Chen, Haibo Ge, Linhuan Liu, Shun Li, Jiapeng Han, and Haiwen Gong.2021. Computing Offloading Decision Based on DDPG Algorithm in Mobile Edge Computing. In 2021 IEEE 6th International Conference on Cloud Computing and Big Data Analytics (ICCCBDA). IEEE, 391–399

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