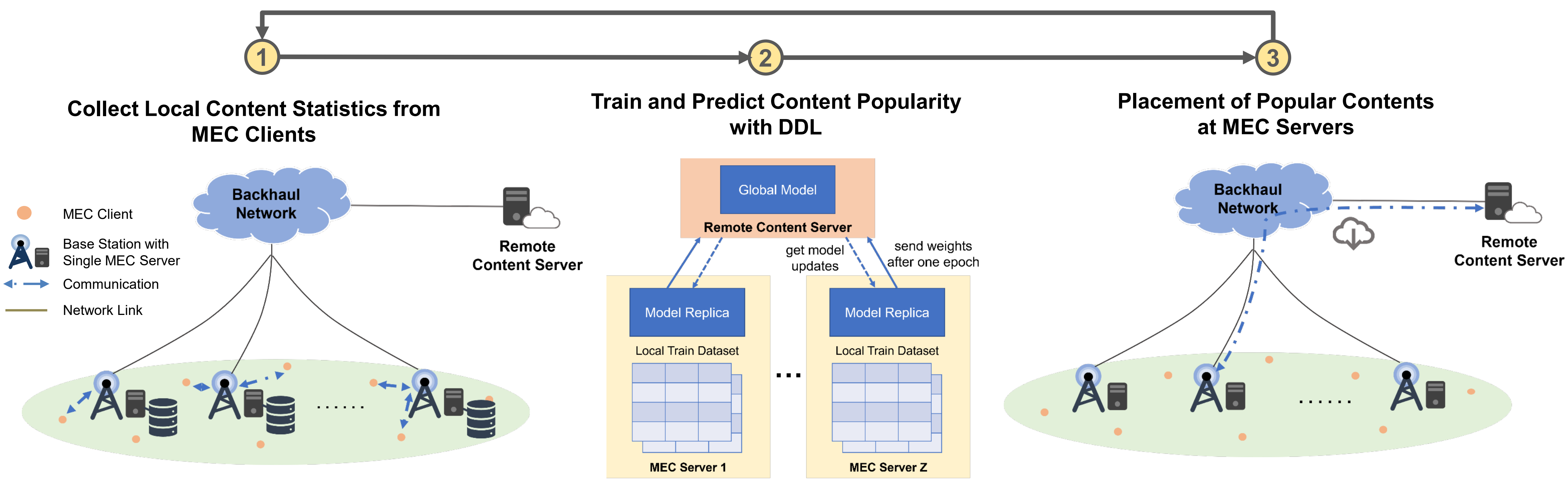
NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE

School of Computer Science and Engineering
College of Engineering

A Distributed Deep Learning-driven Edge Caching Strategy

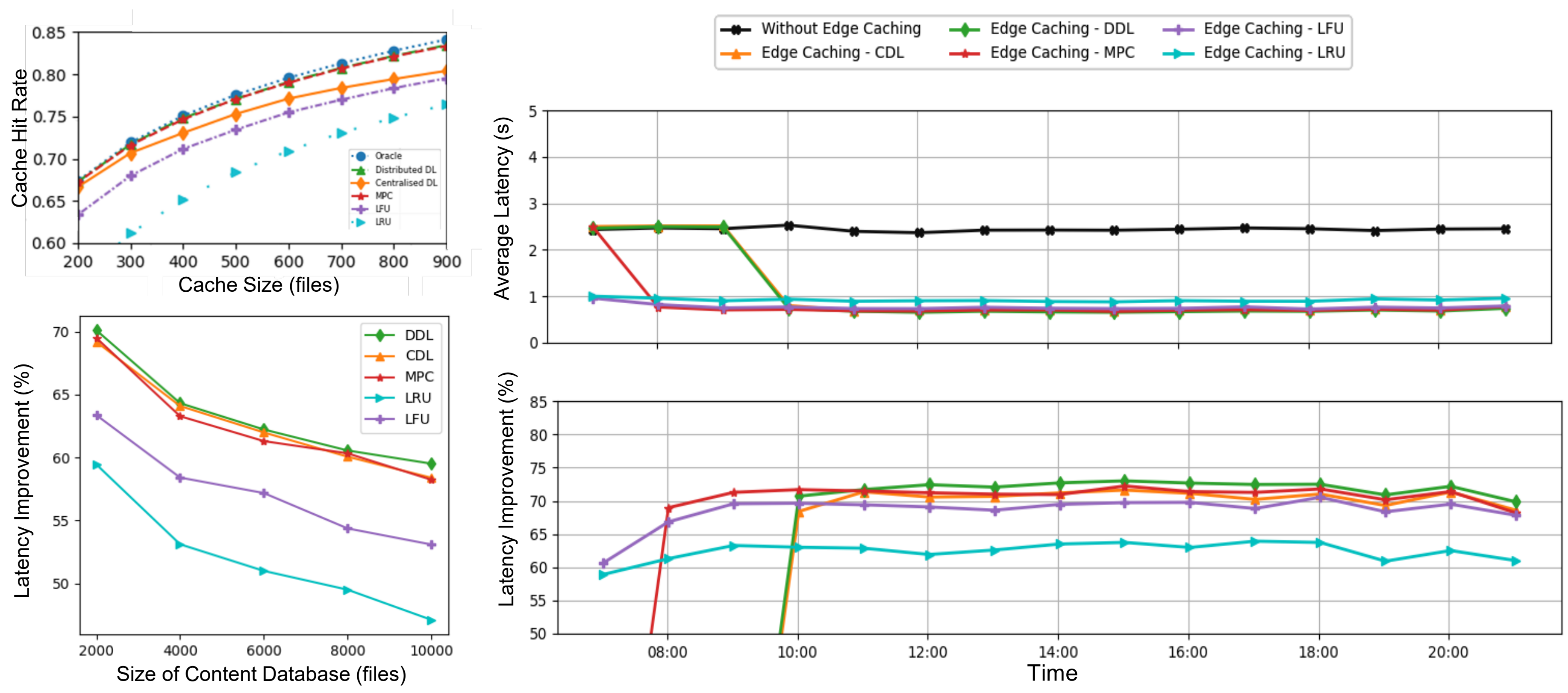
for Industrial IoT Networks

Student: Shen Li Qin Supervisor: Assoc. Prof A S Madhukumar



Project Objective

This project investigates the use of an edge computing model, Multi-access Edge Computing (MEC) and a Distributed Deep Learning (DDL) edge caching strategy to jointly support ultra-reliable low-latency content access in IIoT networks. The proposed DDL training scheme aims to harness the computing power of edge servers to concurrently run deep learning models and promote efficient information exchange between edge servers.



	Distributed Deep Learning (DDL)	Centralized Deep Learning (CDL)	Most Popular Content (MPC)	Least Frequently Used (LFU)	Least Recently Used (LRU)
Simulation Study					
Estimated Cache Hit Rate*	**0.748**	0.731	**0.748**	0.712	0.652
Real-time Analysis					
Average Latency (s)*	**0.651**	0.687	0.673	0.73	0.88
Cache Hit Rate*	**0.75**	0.736	0.742	0.717	0.652

*Results taken when cache ratio=0.1

METHOD

Using simulated network data, the proposed strategy was evaluated against benchmarks, including traditional approaches such as LRU and LFU, in terms of two key indicators, cache hit rate and latency. Real-time analysis was performed on an edge caching test bed designed for industrial use cases, provided by Advanced Remanufacturing Technology Centre (ARTC).

KEY FINDINGS*

- Near-optimal cache hit rates, 5%-15% higher cache hit rates as compared to traditional approaches as observed in simulation study.
- Highest cache hit rate and lowest real-time average latency among strategies evaluated with edge caching system prototype.
- ~73% reduction in real-time latency as compared to without edge caching.