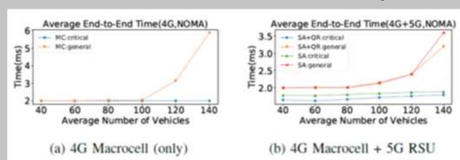
電機系 DEPARTMENT OF ELECTRICAL ENGINEERING

網路協定與資源最佳化設計實驗室

Network Protocol and Resource Optimization Design (NETPROD) Lab

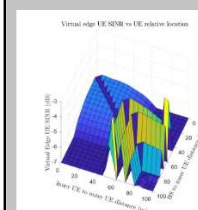
Socially-Aware V2X Dual-Connectivity



(a) 4G Macrocell (only) (b) 4G Macrocell + 5G RSU

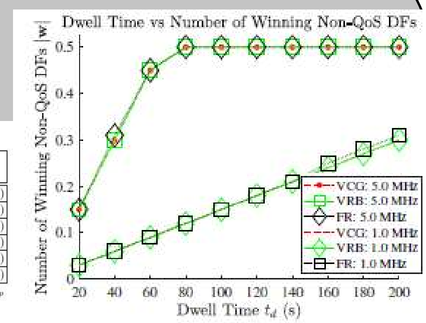
Vehicle-to-everything (V2X) is a core 5G technology. While V2X enables ubiquitous vehicular connectivity, the impact of bursty data on the network's Quality of Service (QoS), such as that encountered when a vehicle accident occurs, is often ignored. In this work, we study both 4G and 5G V2X utilizing Evolved Universal Terrestrial Radio Access New Radio (E-UTRA-NR) and propose the use of socially-aware Dual Connectivity (en-DC) to enable traffic differentiation and localized QoS settings. Compared to static QoS settings, we utilize social networks to dynamically set each data flow's QoS. By re-purposing 5G Road Side Units (RSUs) as secondary base stations we minimize the impact of localized bursty traffic events on the network's overall QoS, while at the same time enabling regional awareness of localized road traffic conditions via a socially-aware Road Condition Warning Systems (RCWS).

Stochastic Whitespace M2M



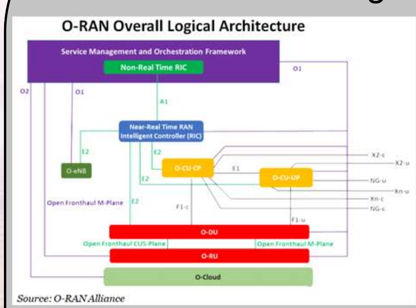
MCS index	SINR Range (dB)
1	[−6.90, −5.10)
2	[−5.10, −3.10)
3	[−3.10, −1.40)
4	[−1.40, +0.80)
5	[+0.80, +2.60)
6	[+2.60, +4.70)

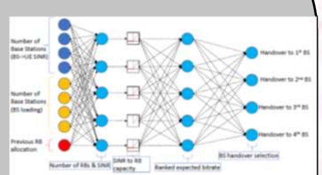
MCS index $\propto \overline{RB}_{cap}$

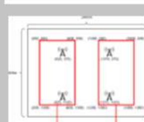


Everyday more and more Internet of Things (IoT) devices are deployed. While next generation networks and technologies offer more efficient spectrum use, they cannot entirely address the influx of devices connecting to the network. In this work, we proposed use of the spectrum sharing technology, Non-Orthogonal Multiple Access (NOMA), and repurpose spare spectrum for delay tolerate network purposes. Our proposed solution offers IoT equipment a means of obtaining network connectivity, while not adversely impacting primary QoS guaranteed users services. We repurpose cell edge spectrum as cell-wide location independent resources, as the average user's cell dwell time increases, the reusable resources increases.

Federated Deep Q-Learning and 5G load balancing



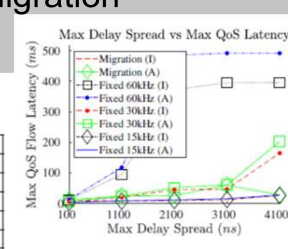




Next Generation wireless networks, such as 5G and 6G, will rely on Artificial Intelligence (AI) to enhance network operation and enable real-time dynamic network configuration. This research actively studies how AI-enabled next-gen networks, such as Open-RAN, can be enabled to provide more efficient resource allocation and enable distributed decision making. In this work we use federated learning to perform distributed load balancing (each User Equipment (UE) determines which Base Station (BS) to connect to, based on local observations and feedback from the global model.

5G Multicast Flow Migration

RB Latency	CP (us)	Capacity (bits / RB)			Capacity (bits / RB)		
		DS=2.1 us	DS=1.1 us	DS=0.1 us	DS=2.1 us	DS=1.1 us	DS=0.1 us
NL	4.69	248.1	321.6	933.2	248.1	321.6	933.2
LL	2.34	101.1	248.1	933.2	101.1	248.1	933.2
VL	1.17	25.6	101.1	933.2	25.6	101.1	933.2
		OMA / Inner NOMA			Outer NOMA		



In 5G, QoS flow priority and Resource Block geometry are intrinsically linked. Higher latency Resource Blocks (RB) have lower sub-carrier space (SCS) , i.e. a normal latency resource block has a SCS of 15kHz, while the lowest latency RB has a SCS of 60 kHz. Yet as delay spread increases the capacity of low latency resource blocks decrease and they in effect become high latency resource blocks. In this work, we propose use of feedback from each UE as to the delay spread of the received downlink signal. We find that the QoS flow latency can be reduced in high-delay spread scenarios, when the Resource Block geometry can be decoupled from the QoS priority and dynamically modified.

國立中山大學
NATIONAL SUN YAT-SEN UNIVERSITY