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Post Conference Presentation

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Introduction

Paper

Traffic-Aware Heuristic BBU-RRH Switching Scheme to Enhance QoS and Reduce Complexity

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***Abstract*—Cloud Radio Access Network (C-RAN) is a new architecture that has been proposed to enable the current hardware to meet the ever-increasing traffic demand, as well as reducing the energy consumption of mobile base stations. This paper mainly focuses on two components of C-RAN, namely Remote Radio Heads (RRH) and Baseband Processing Unit (BBU) pool. The method of association of these two components could potentially affect the Quality of Service (QoS) and energy consumption level of the system. The connection between RRH(s) and BBU(s) is logical in C-RAN, which means that the association of RRH(s) to BBU(s) can be dynamically adjusted. Thus, a BBU-RRH switching scheme is required to manage the computational resource that the BBU pool possesses. This paper proposes a switching algorithm that works in conjunction with the knowledge of the traffic pattern of an area. This algorithm not only reduces the number of BBUs used in comparison with the traditional approach, but also decreases the number of switches required while maintaining a satisfactory level of service. In order to achieve this, the proposed algorithm reduces or limits the load of BBUs when the overall traffic of a BBU is on the rise, and vice versa. Finally, the simulation results illustrate that the proposed algorithm reduces the switching complexity and improves QoS while achieving significant reduction of BBU usage in comparison to traditional RAN.**

I. Introduction

3) Fronthaul link: The fiber optical link that physically connects the BBU pool and RRHs.

The C-RAN components are illustrated in Figure 1. It is observed that the traffic pattern of a cell is strongly influenced by its geographical location [3]. This behaviour, named tidal effect, is shown in Figure 2. It can be observed that the base station load of an office area rises at a much faster rate than that of the residential area in the beginning of working hours, but the base station load in a residential area outgrows the ones in office areas after working hours. It is noticeable that the utilisation of base station resource is extremely poor in both peak and off-peak hours because the base stations are designed with capacity much higher than needed to ensure ubiquitous connection of subscribers. Such approach inevitably leads to a significant wastage of resource and energy. In C-RAN, numerous RRHs can be associated with one common BBU in the BBU pool, so that all un-utilised BBUs in the pool can be shut down in order to reduce power consumption and improve resource utilisation.

This paper focuses on the development of a BBU-RRH mapping or switching algorithm that will achieve the following objectives:

King's Colleage Prototype

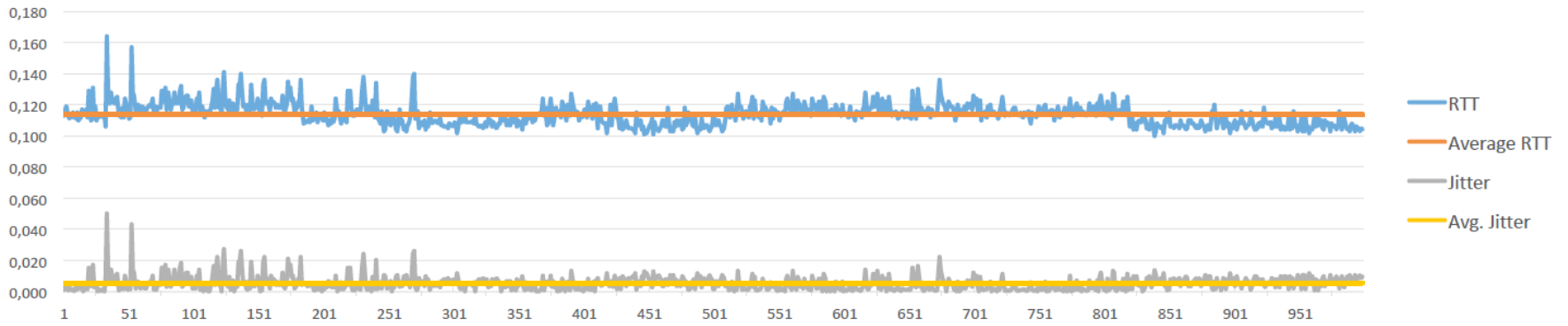
5G VM to 5G VM (i.e. service-to-service) RTT performance:

Pinging between VMs residing on different wireless hosts returns results equivalent to almost bare metal performance:

- **Avg. RTT is 114us + 2x18us = 0.15ms**
- Avg/Max Jitter is 0.005/0.050 (ms)
- iPerf TCP throughput 9.81Gbps sustained
- iPerf UDP throughput 9.60Gbps sustained

	Sub-carrier spacing	Symbol duration	Cyclic Prefix	Slot (14 symbols)	Mini-slot (7 symbols)	(4 symbols)	(2 symbols)
NR and LTE	15 kHz	66.67 µs	4.76 µs	1000 µs	500 µs	286 µs	143 µs
NR	30 kHz	33.33 µs	2.38 µs	500 µs	250 µs	143 µs	71 µs
NR	60 kHz	16.67 µs	1.19 µs	250 µs	125 µs	71 µs	36 µs
NR	120 kHz	8.33 µs	0.59 µs	125 µs	63 µs	36 µs	18 µs

- In comparison, lab PCs on standard linux kernel, average RTT is 0.250ms with average jitter 0.100ms
- Dedicated hosts in Openstack provide low latency performance for function splits and other low-latency applications
- Dedicated network interfaces for VMs are also available for high-throughput ultra low latency applications



5G applications

- **World's first 5G-drone trial where control goes over the Atlantic (22 Feb 2018)**
- **Trial between BT, Ericsson, Verizon and King's College London**
- **http://www.bbc.co.uk/news/business-43906846**

Transport: 1st 5G Drone

- **Guildhall, London – Brandenburger Tor, Berlin**
- **World's first distributed concert using ultra-low latency 5G, with an end-to-end delay of 20ms (!)**
- **Ambition is to make commercial applications with major music brands**
- **Video available under: https://bit.ly/2yXcHXd**

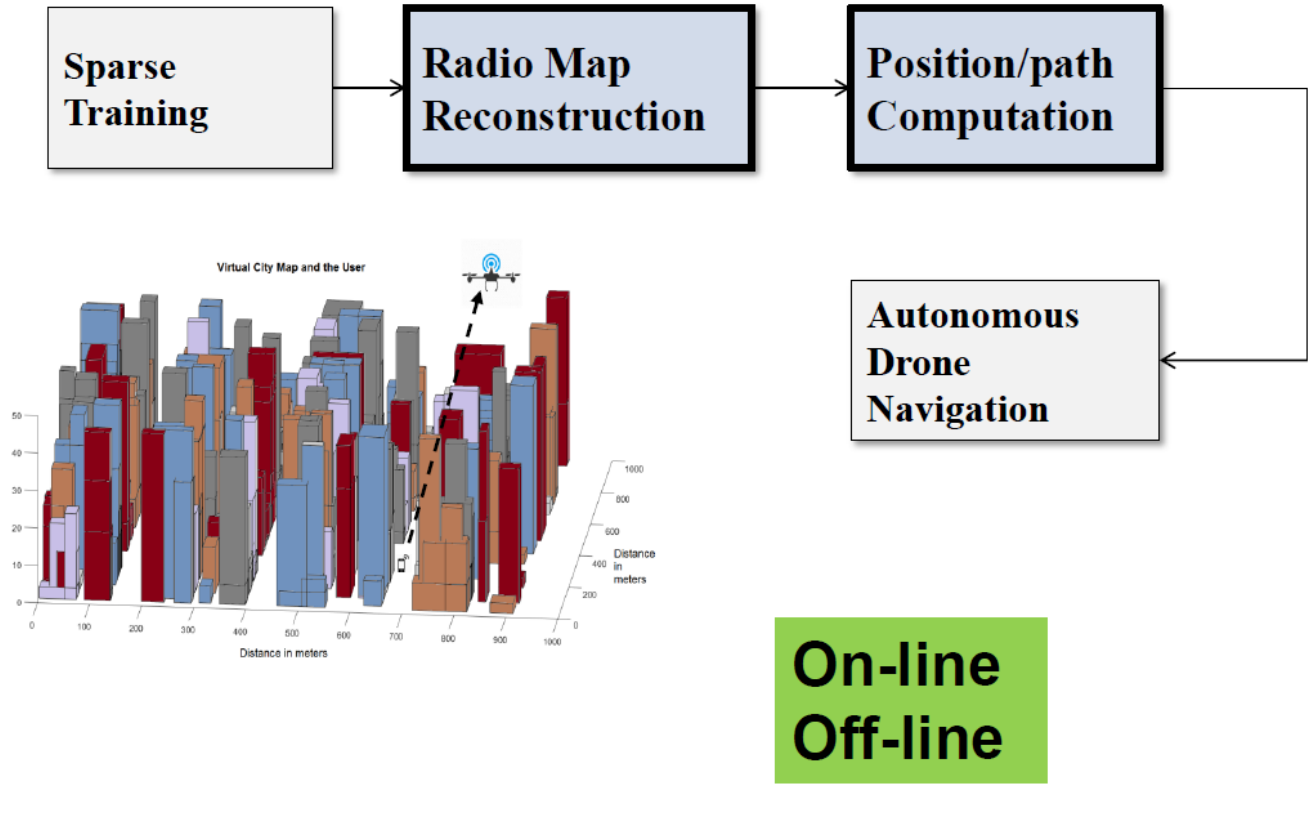
Arts: 5G Distributed Concert

- **pioneering the next generation Internet, the Internet of Skills, which is underpinned by 5G**
- **will be an enabler for remote skillset delivery and thereby democratize labour globally the same way as the Internet has democratised knowledge**
- **http://money.cnn.com/2018/02/05/technology/business/5g-internet-of-skills/index.html**

Overall Vision: Internet of Skills

Drone as a base station

Learning-based placement



Huawei Trial