HCTL Open International Journal of Technology Innovations and Research (IJTIR)
http://ijtir.hctl.org
Volume 24, Issue 2, April 2017, e-ISSN: 2321-1814

A Review of Futuristic Technology: Cloud RAN (C-RAN) Technologies

Vimal Upadhyay[1], Dr. Manoj Gupta[2]

vimalupadhyay2002@gmail.com

Motivation

According to the report of CISCO study, traffic on the net due to mobile data increased rapidly and it will be nearly 11 times between 2013 and 2018. This rapidly increased traffic demands a high bandwidth carrier to increase the network capacity. The demand of increased network capacity rises when the world moves to 4G and onward generations. Limited amount of spectrum efficiency improved by using Wi-Fi offloads, 4G and so on. Frequency reuse play important role to improve the network capacity. The frequency reuse with the help of small cells improves capacity up to 1600x. The use of small cells makes important benefits to macro network. Suppose if we place four small cells within one macro, it delivers data 50 percentage of offload and also improves macro network performance by 315 percentages. Now to keep in mind C-RAN play important role to increases the network capacity, I write this article that will beneficiary for those who want to make research area in this field, to spread awareness among youth related to futuristic technologies.

Keywords: Cloud RAN, IoT, 5G

Introduction

In this article authors are going to describe basic definitions, supportive technologies, key components of it, major upcoming issues, growth, requirements, challenges, companies working on it and its application. C-RAN defines as the proposed architecture for futuristic technologies for cellular networks. In some cases C-RAN also referred as centralized-RAN. The term C-RAN was first introduced by china mobile research institute in 2010, after disclosed first patent filed by US companies. The four main characteristic of C-RAN that makes it differ from others are (1) clean (2) centralized processing (3) collaborative radio, and (4) cloud radio access network. C-RAN is define as a centralized, cloud computing-based simple architecture design for radio access networks, that fully support 2G onward to future wireless communication standards.

In traditional wireless communication architectures, each physical base station has a responsibility to combine baseband processing and radio functions. Baseband processing is used to centralized many cell to improve the performance of C-RAN. In C-RAN coordination ability between cells is very

good, it improve the performance of C-RAN. The C-RAN concept generally applied for outdoor as well as indoor to cover the distributed area of large space, such as office building, indoor space of campus, large venue. C-RAN working based on two telnets: (1) Centralization based working of base station baseband processing (2) Virtualization based working of base station baseband processing. Centralization is used to increase the performance; the drivers of network are centralized in pragmatic to reduce the operational cost. At least two third cost of network establishment ownership based on site rental, required energy, supportive hardware and software, and maintenance expenses of network. Operators in many countries specially Korea, Japan, China gave a many demonstration to reduce the Opex reduction in the range of 30%-50%. This reduction motivate for centralizing the RAN. The main aim of virtualization is to reduce total expenditures capital with the help of network function virtualization (NFV) to the radio access network. From figure-1&2 it is clear all base stations (BS) computational resources are lying under same central pool. Remote radio heads (RRH) and remote radio unit (RRU) are used to collect frequency signals from geographical distributed antennas and also transmitted that collected signals to cloud platform with the help of optical transmission network (OTN).

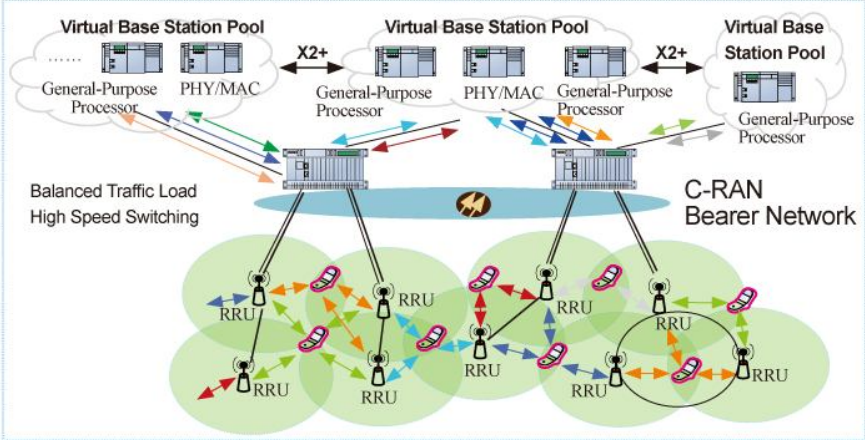

Figure 1. C-RAN architecture.

Fig.1: C-RAN Architecture for balancing traffic load [3]

Nowadays numbers of new air interfaces standards are coming in market rapidly and also a plenty of smart devices based on latest technologies forced the operators to be work on increase capital expenditure (CAPEX) and operating expenses (OPEX) in order to meet user's requirements. After comparing expenses and expenditure we can say that average revenue per user (ARPU) cannot catch up/ match up with the increasing expenses. After survey of many research papers and reports author predicted that the traffic load on the net will double every year in the present decade from 2011 to 2020 [1]. This amount of rise up in traffic load will require larger amount of coast in operates, build and up gradation of network infrastructure.

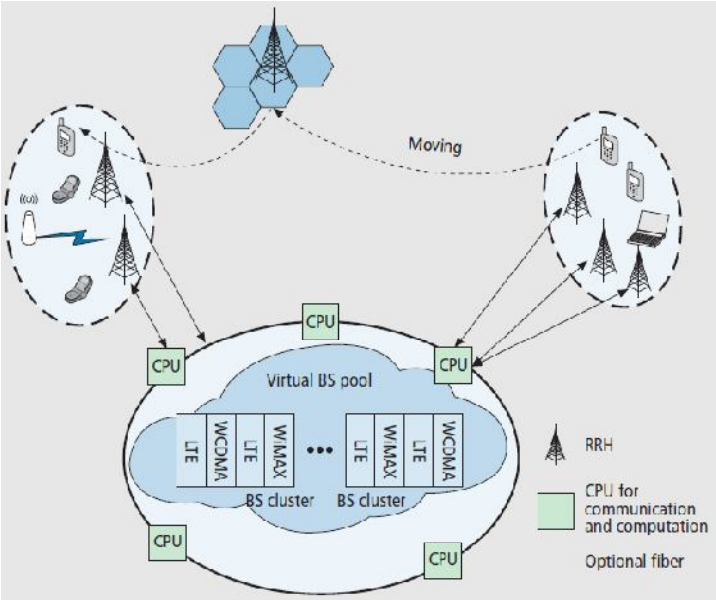

Fig. 2: C-RAN Architecture for OTN [2]

There are three main methods used to increase the network efficiency on which research is still going on.

(1) To enhance spectrum efficiency with the help of MIMO and beam forming, this method has a theoretical limit.

(2) To exploit spectrum holes through dynamic spectrum access technologies such as cognitive radio, but it cannot ensure consistent and reliable services, and the growth of data capacity is also limited [2].

(3) To deploy large number of small cells for frequency band reuse.

Issues in C-RAN

There are two main issues in C-RAN (1) Fronthaul (2) Virtualization of physical layer (PHY). Fronthaul is used to provide the link between baseband unit and remote radios. Fronthaul defined in terms of capacity, delay and synchronization of requirements. The second challenge centers on virtualization of the physical layer (PHY) which involves real-time processes and high computational load functions. General purpose processors are less efficient in running these functions for commercially scalable networks than dedicated processors resulting in high power consumption. Flow between fronthaul and backhaul clearly shown in figure3.

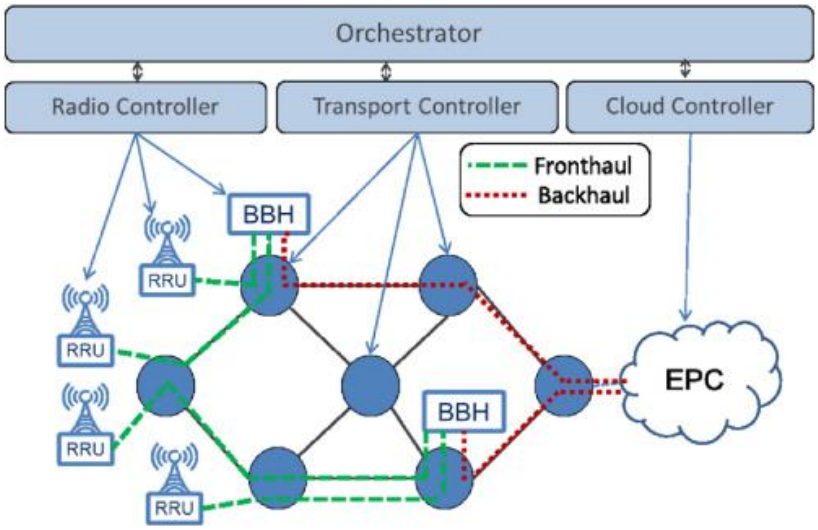

Fig. 3: Fronthaul and Backhaul

C-RAN, Working architecture based on baseband centralization of small cells. However, OneCell goes beyond ordinary C-RAN solutions in four important respects:

1. To creates a single cell
2. To coordinates the functions for assigning multiple radio endpoints
3. To provide standard IP Ethernet LANs for fronthaul
4. It leverages many other small cell benefits

Technical terms and components used in C-RAN:

A radio access network (RAN) is defined as a main part of a wireless and mobile telecommunication system. RAN is used to implement a radio access technology (RAT). The RAN term conceptually reside inside the device such as smart phone, mobile phone, remote panel, machine, or any remotely operable controller and provide connection with its main network or core network (CN).

Radio Access Technology (RAT) is defined as the physical connection method for a radio based communication channel and communication network. As of 2013, many modern phones such A the Nexus 4 or iPhone5 support several RATs in one device such as Bluetooth, Wi-Fi, and 3G, 4G or Long Term Evolution (LTE) as.

Small cells of C-RAN: Small cell is a low powered consuming radio access node, working on licensed and unlicensed spectrum of carrier. Covering rage of typically small cells are lying in the range of 140 meters to several hundred meters. Generally small cells are categorize into three types: (1) femtocells (the smallest in size) (2) picocells (medium in size) (3) microcells (the largest in size)

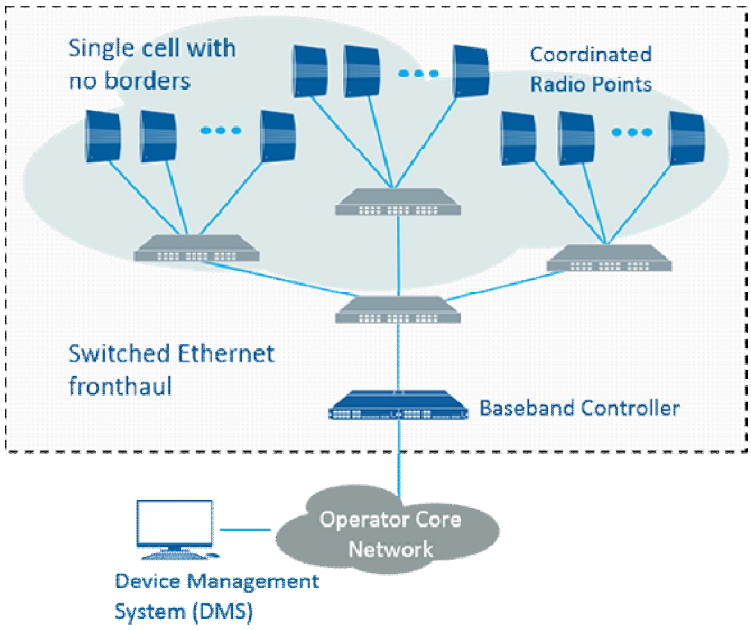

Fig. 4: In OneCell's C-RAN architecture, baseband processing is centralized in the Baseband Controller to create a single cell without border interference or handovers [Source: Wikipedia]

Growth in Traffic

According to Ericsson mobility report declared in Nov 2016, in this report Ericsson predicts an increase of 10x (tenth times) the mobile data traffic by 2022 shown in figure5. This is nearly equal to annual growth rate data traffic of 45%.

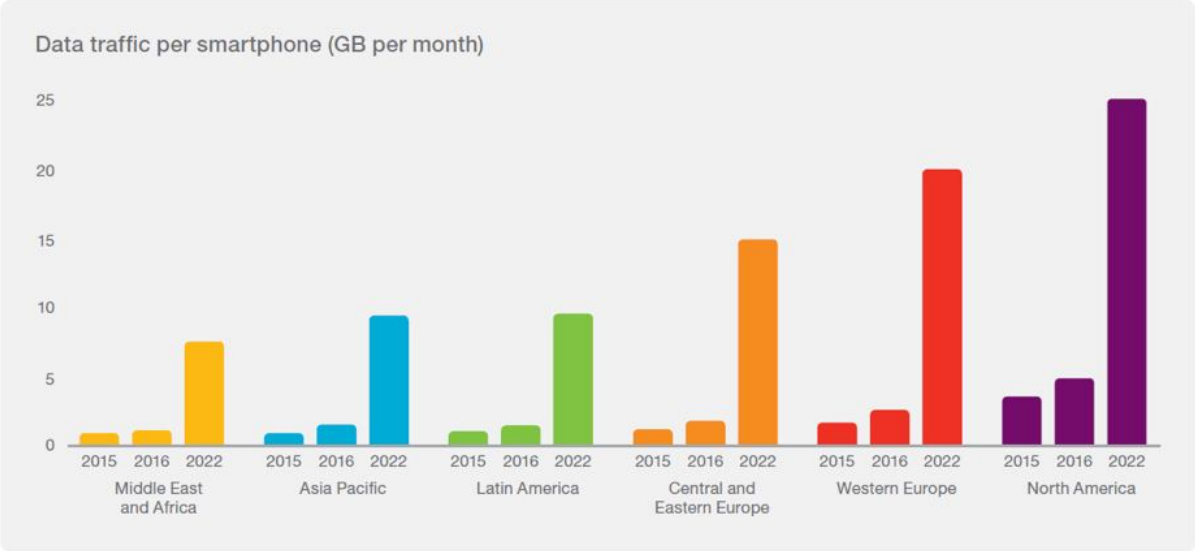

Fig. 5: Data traffic growth chart [5]

Audio, video, images and text information are the main driver that increases the traffic over internet. According to Ericsson report 75% of the traffic in 2020 will be due to videos. C-RAN, RRH and fronthaul are needed for mobile networks to support growth.

C-RAN and advanced innovation in it should meet the following requirements:

(1) It will be able to support air interfaces standards as well as flexible software up gradation.
(2) It will provide reliable services in cost effective manner while maintaining good revenue.
(3) It will be based on optimization in terms of capacity, mobility, and coverage.

Advantages of C-RAN or topics for further research

1. Improves wireless user experience
2. Adds capacity without interference via cell virtualization
3. Simplifies capacity planning and upgrades
4. Reduces macro network interference
5. Reduces deployment costs
6. Provides a future-ready solution

Companies working on C-RAN:

Most of the well established companies around the world are working on C-RAN project and upcoming innovations in this field are IBM, Intel, Huawei and ZTE etc. most of the project in C-RAN are based on optimization of OPEX and CAPEX, optimization of channel bandwidth in terms of small cells and optimization of service layer in terms of cognition services.

Conclusion

The purpose of writing this article to update researchers and students related to upcoming technologies and spread awareness among them. In the pre campus placement talk by Human resource manager of big companies also focused on lots of vacancies in C-RAN.

References:

[1]. H. Taoka, “Views on 5G,” DoCoMo, WWRF21, Dusseldorf, Germany,Tech. Rep., Oct 2011.

[2]. Jun Wu, Zhifeng Zhang, Yu Hong, and Yonggang Wen,” Cloud Radio Access Network (C-RAN): A Primer”, IEEE Network • January/February 2015, pp35-41.

[3]. https://www.ericsson.com/assets/local/mobility-report/documents/2016/ericsson-mobility-report-november-2016.pdf

[4]. https://www.aktietorget.se/NewsItem.aspx?ID=78999

[5]. https://siversima.com/news/will-mm-wave-used-fronthaul/