Cloud Based Architectures

Introduction

The Cloud Computing Architecture is a broad and comprehensive modern concept, which includes the possibility to use the cloud to store large amounts of various data and applications, and providing them on demand, it is also the use of storage internet applications, as for example e-mails, it is the seamless access to powerful hardware, servers, storage and software technologies offered by datacenters without embedding significant investment to own infrastructure, software and hardware. In this section, we will discuss cloud-based architectures or cloud based radio access networks(C-RANS) for 5G networks. A detailed review of C-RANS is given below:

C-RAN

C-RAN (Cloud-RAN), sometimes referred to as Centralized-RAN, is a proposed architecture for future cellular networks. It was first introduced by China Mobile Research Institute in April 2010 in Beijing, China, 9 years after it was disclosed in patent applications filed by U.S. companies. Simply speaking, C-RAN is a centralized, cloud computing based architecture for radio access networks that supports 2G, 3G, 4G and future wireless communication standards. Its name comes from the four 'C's in the main characteristics of C-RAN system, "Clean, Centralized processing, Collaborative radio, and a real-time Cloud Radio Access Network".

Evolving the radio access network architecture

Mobile broadband is approaching a point where cellular infrastructure –originally designed for mobile telephony.

This evolution is being driven by both the evolution of 4G and the coming introduction of 5 G.

In essence, the main challenges for mobile network infrastructure to meet this need over the next three to five years will be to:

1. Manage large amounts of new spectrum.

2. Deploy new sites to support new use cases.

3. Develop efficient hardware and software solutions which are both an energy and cost perspective.

For this purpose the authors analyze on the RAN architecture associated to current Radio Access Technologies (mainly LTE) and envisaged future 5G technology.

Architecture of a C-RAN for 5G networks

There are 2 architectures of C-RAN proposed by the authors. They are:

1. Two-layered architecture

2. Three layered architecture.

We are going to describe about these architecture below:

2-layered C-RAN architectures

The authors provided two C-RAN architectures based on the division of functionalities of a Mobile Broadband System (MBS).

Full Centralized C-RAN: Where a Baseband Unit (BBU) and all other higher level functionalities of a MBS are located in the cloud while a Remote Radio Head (RRH) is only located in the MBS.

Partially centralized C-RAN: Where a RRH and some of the functionalities of a BBU are located in the MBS while all the remaining functions of the BBU and higher level functionalities of the MBS are located in the cloud. Thus the authors proposed the use of only two layers, namely a control layer and a data layer.

Data Layer-It contains heterogeneous physical resources (e.g., radio interface equipment) and perform signal processing tasks (e.g., channel decoding, de-multiplexing and fast fourier transformation).

Control Layer- It performs baseband processing and resource management (application delivery, QoS, real-time communication, seamless mobility, network management, regulation and power control).

3-layered C-RAN architectures

The full centralized C-RAN architecture has some disadvantages, as: continuous exchange of raw baseband samples between the data and the control layers. In order to remove this disadvantages, ‘Liu’ proposed convergence of cloud and cellular systems (CONCERT). In this architecture, one more layer, called a software defined service layer, is introduced at the top of the control layer. The functioning of the layers in CONCERT is as follows:

1. Data layer: is identical to the full centralized C-RAN’s data layer, having RRH’s with less powerful computational resources for application level computations.

2. Control layer: The control layer coordinates with the data layer resources and present the, as virtual resources to the software defined service layer. The control layer provides a few services as: radio interfacing management, wired networking management and location aware computing management to the data layer.

3. Software-defined services layer: works as a virtual BS and provides services (e.g., application delivery, QoS, real time communication, seamless mobility, security, network management, regulation and power control) to the data layer.

Advantages of C-RANs in 5G networks

• An easy network management: C-RANs facilitate on-demand installation of virtual resources and execute cloud based resources that dynamically manage interference traffic, load balance, mobility and do coordinated signal processing.

• Reduce cost: The deployment of C-RANs involves less cost.

• Save energy of UEs and MBS: C-RANs allow UEs and MBSs to offload their energy consuming tasks to a nearby cloud, which saves energy of UEs and MBSs.

• Improved spectrum equipment: A C-RAN enables sharing of Channel State Information (CSI), traffic data, and control information.

Open issues

Transferring data from data layer to the control layer is a crucial step based on the functions of a MBS that has to send to a cloud, resulting in the minimal data movement in the network. The security and privacy issues involved in the cloud computing effect C-RANs, and hence, the development of a C-RANs has to deal with inherent challenges associated with the cloud and the wireless cellular communication simultaneously.