CLOUD RAN

Aricent®

INTRODUCTION

In today's world, the usage of wireless data has been growing exponentially making it necessary for mobile operators to scale the wireless networks. This is a result of proliferation of new apps, devices, BYOD, usage of wireless broadband for home surveillance, public safety etc. Meeting this unabated growth in demand requires cellular operators to scale their wireless networks and use of advanced wireless technologies. As mobility and the level of bandwidth content increases, mobile operators are finding it difficult to convert the increased demand for broadband into an increased profit. On the other hand, introduction of new technologies, expansion of existing network put Capex and Opex pressure on operators. In our opinion, virtualization helps operators in overcoming these opposite

MOTIVATIONS AND BENEFITS OF CLOUD RAN

Mobile operators also face the challenge for supporting networks with a spurt of increase or decrease of traffic. For e.g., if there is some rugby or football event, then the need for bandwidth increases. So the area near the stadium needs to support much higher capacity for a single day. Another use case is that in order to optimize the capex, operators are looking for option to dynamically use the compute resources such they can be used in business districts during day (where there is high demand during day) and same resources used in residential area in night. Cloud based deployments of access network helps operator meet these challenges.

Cloud RAN (C-RAN) architecture reduces the antenna site hardware including computing resources without impacting Air or Core network interface. This is achieved by moving most of the base station processing to a central location or cloud, handling multiple cell sites at the same time. C-RAN architecture can support virtualization of Access Network across multiple Radio Access Technologies. Hosting multiple RAT in virtualized environment not only assist in launching new RAT but also upgrading or extending the installed base. This leads to a significant reduction in leasing, maintenance, energy and back up cost for cell sites.

With increase in mobile traffic, operators need to deploy dense and sometimes more dense network. This increase in number of base stations in turn causes interference to each other and thus slows the network. The network develops lot of cell edges that act as speed bumps for broadband traffic. Apart from the cell site and hardware cost, C-RAN architecture can provide a virtually edge free network by enablement of spectral efficiency improvement features.

C-RAN architecture increases the spectral efficiency of the access network. The cell edge performance can be improved by a large scale deployment of technologies like eICICI and CoMP. These technologies require a low latency communication among participating cells. Decision on scheduling needs to be made in a very short interval so as to meet LTE air interface requirement as well as coordination need across cells. High bandwidth communication among centrally hosted participating cells is a key element required for the realization of such spectral efficiency methods.

As the computing moves to cloud, resources can be dynamically allocated / de-allocated as per the network traffic demand. In traditional networks, operator need to provision the proprietary hardware at a cell site according to peak traffic in each and every cell even though the subscriber base moves within the network based on time of day. Movement of subscribers, specialized applications, events, IoT linked devices put variable bandwidth demand on the network.

Average load on a cell is much lower in comparison to peak load in a cell. Load on the entire network is close to average but different cells experience peak load at different points in time. Virtualization aided elasticity in resource utilization brings multi-fold benefits. It could mean more bandwidth in a specific area, more device support for networks like IoT, scalable access and core networks, or even could be a combination. Major features need not wait for a major upgrade - a key decision factor in traditional networks. Highly competitive market demands agile mode for introductions of new features. Virtualized networks aid in adding new features or roll them back based on need.

Virtualization aids in deploying the access network solution for multiple operators as resources can be easily shared. Operator can install services for specific geography as per need and even roll it back. The resources can be scaled and shared by multiple operators.

The base station also uses proprietary hardware slowing the R&D cycle. Cloud architecture is supported on standard IT servers, switches and storage. Use of standard pieces of hardware goes soft on Capex. Solutions for operators are no longer tied to specialized hardware boxes. The same hardware can be used to host different technologies or mix of technologies based on the field requirements. The solution becomes more software centric. With specialized hardware boxes out of the way, operators get more choices for the software. It not only speeds up the R&D innovation, it reduces the overall cost to the solution.

In our opinion, software centric solution, provided through Radio Network virtualization, aids in dynamic scaling, faster introduction of features and services and reduction of cell site equipment and hence saves Capex and Opex for operators. As per our analysis, this will lead to many new vendors providing solutions and operators can thus roll out new services with very less lead time.

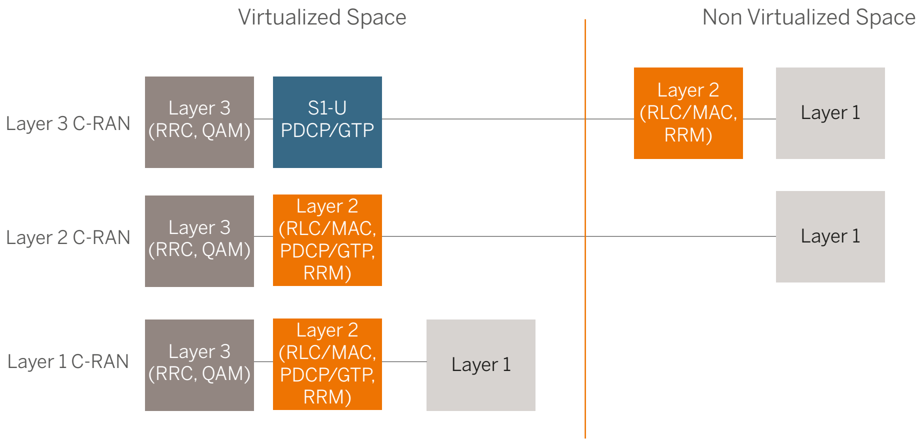
Aricent is working on different solutions in C-RAN space. Aricent Cloud RAN offering is a mix of cloud RAN enabling software and product engineering services. This offering can be leveraged to develop and deploy next-generation virtualized wireless network.

DIFFERENT C-RAN ARCHITECTURES FOR DIFFERENT DEPLOYMENT NEEDS

C-RAN is an architecture choice and allows Node B or Base station to be developed in multiple ways. Different architectures cater to different deployment needs and have different implementation complexity.

LTE eNodeB is a layer 3 OSI device. Virtualization of different layers offer different solution as shown in the Figure below.

C-RAN : Architecture Options



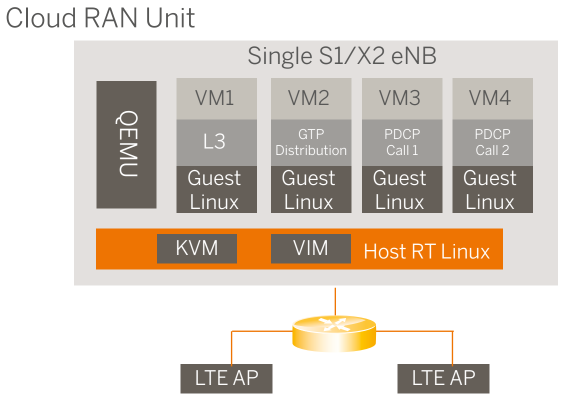
Layer 3 Cloud RAN

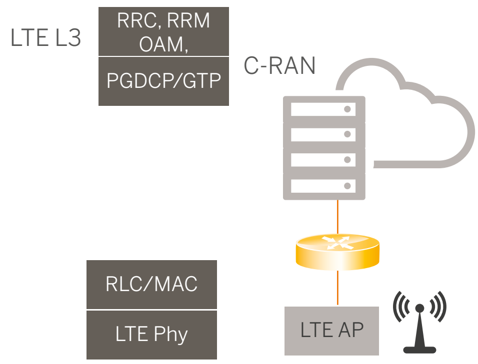
It is possible to virtualize eNodeB Layer 3 consisting of Radio Resource Control, OAM, X2 interface. PDCP/GTP layer are considered as Layer 2 in LTE eNodeB architecture. These layers are non-real time in nature and can also be virtualized.

The architecture allows an option whereby multiple cells in a dense deployment can be aggregated and provided a single S1 view towards core network. Such architecture option can be used in enterprise or dense deployment cases whereby there is a need to improve Core network connection behavior in dense deployed case as well as control the visibility of handovers in core network.

S1-U hosted on cloud architecture enables Dual cell connectivity whereby mobile can be reached from two cells. The architecture also enables LWA (LTE – Wi Fi Aggregation) whereby Wi-Fi hot spots can be integrated with LTE Cloud RAN solution increasing the deployment capacity by using unlicensed spectrum.

In the architecture Layer 3 and S1-U layers are hosted on centralized IT servers. The servers are connected with antenna site over Ethernet. Antenna sites have LTE Layer 2 (RLC/MAC, Scheduler) and Layer 1 implemented.





Layer 3 C-RAN

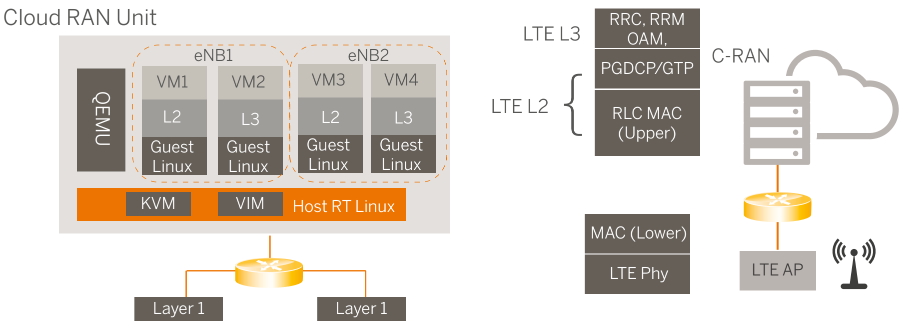
Layer 2 C-RAN

In Layer 2 C-RAN architecture, LTE layer 2 and above software is hosted at a central location on standard IT servers. These servers connect with the antenna site through IP links such as using Ethernet. The architectures can be leveraged across various deployment scenarios. Layer 2 C-RAN can be further implemented in following different ways.

MAC – Split Architecture

In the LTE MAC Split architecture, the one-way latency between cloud and antenna site is more than a millisecond. In order to meet LTE Air interface requirement, HARQ portion of MAC is kept at antenna site whereas MAC scheduler and Layer 3 resides at central location. The architecture is well-suited for wide-area continuous deployment. The distance between cloud and cell site can be further extended using CPRI/OBSAI links from antenna sites.

All the benefits of Layer 3 C-RAN, viz S1/X2 Aggregation, Dual Cell Connectivity, LWA Enablement, are also present in this architecture. In addition, the architecture option further moves processing needs at antenna site to centralized IT servers.



Layer 2 MAC Split C-RAN

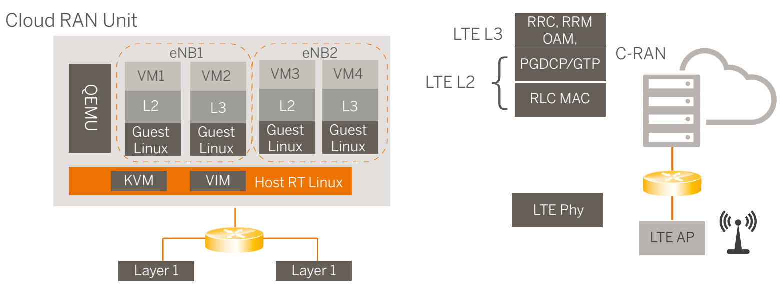
L2+ IN CLOUD ARCHITECTURE

In case of the L2+ in Cloud Architecture solution, complete L2+ resides in cloud. The architecture necessitate that the one way latency between antenna and central site is of the order of 100 – 150 microsecond. In the architecture centralized IT servers host Layer 3, S1-U, RLC/MAC, Scheduler in the virtualized environment. Servers are connected to antenna sites that implement only Layer 1.

The architecture further moves the antenna processing to centralized server thus reducing the cost of antenna site. The distance between cloud and cell site can be further extended using CPRI/OBSAI links from antenna sites.

All the benefits of Layer 3 C-RAN, viz S1/X2 Aggregation, Dual Cell Connectivity, LWA Enablement, are also present in this architecture. In addition, the architecture option further moves processing needs at antenna site to centralized IT servers. The architecture moves antenna processing needs on and above what MAC-Split Architecture needs.

The architecture is well-suited for in campus dense deployment, e.g., stadium, mall, airport etc.



Layer 2+ in Cloud C-RAN

CONCLUSION

Different C-RAN software centric solutions are possible to meet different deployment needs to operator. The centralized solution opens the options to include Centralized SON function in the cloud and thus further assisting operator in controlling network operations cost. C-RAN architecture has the ability to handle non-uniform data traffic because of the load balancing capability it has in the baseband unit.

Implementation of a cloud RAN solution can save CAPEX up to 15 percent and OPEX up to 50 percent over five to seven compared with traditional RAN deployment, per the China Mobile report [1]. According to the Alcatel-Lucent Light Radio Economics analysis [2], these disruptive RAN architecture designs and innovative features can reduce overall TCO by at least 20 percent over five years for an existing high-capacity site in an urban area — with at least 28 percent reduction for new sites

When adopted, C-RAN provides the possibility to implement RAN as a service.

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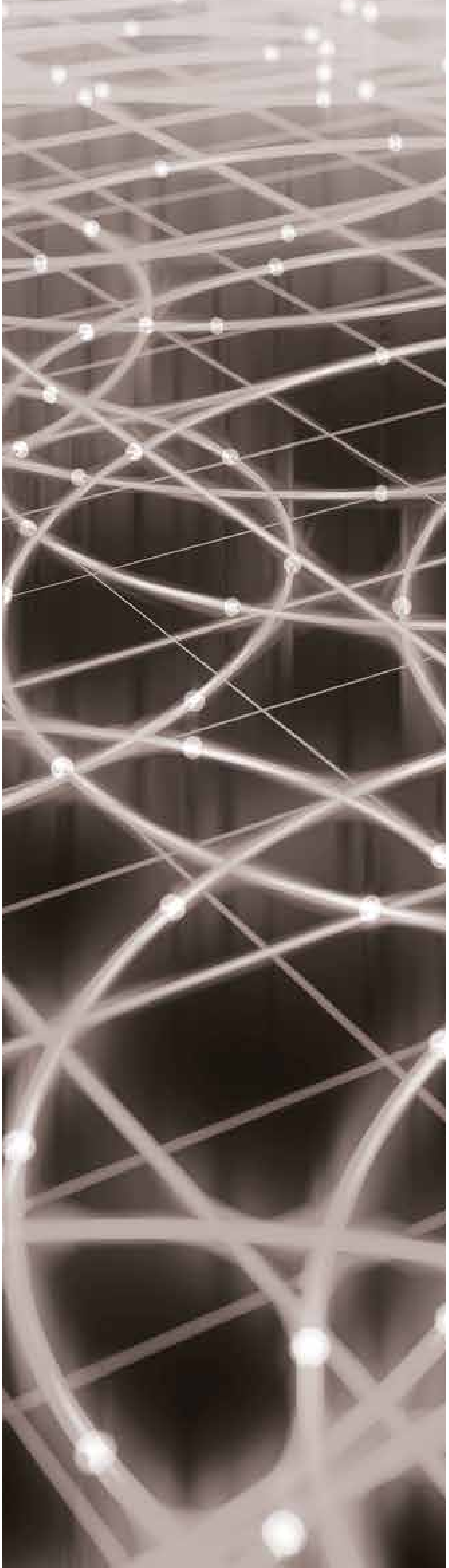

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The company's key investors are KKR & Co. and Sequoia Capital.

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