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CloudRAN
Running with the clouds

Based on cloud architecture and SingleRAN, CloudRAN features a re-segmented wireless management framework, multiple connectivity capabilities, and elastic deployment architecture. The solution provides a powerful radio access network (RAN) development strategy to help operators achieve a better connected future.

The rise of mobile Internet has unleashed new types of services carried on public mobile networks that would have once been regarded as impossible. These include HD video, virtual reality (VR), augmented reality (AR), driverless vehicles, real-time industrial control, ubiquitous access to high-speed cloud content anytime, Internet of Things services, and public safety services – all are confirmed as key future wireless network applications. As network capabilities are opened and mobile edge computing (MEC) goes mainstream, the number of innovative mobile Internet business models will increase.

Over the next two to three years, mobile network operators' most pressing issues will be maximizing the value of mobile networks, constructing future-facing mobile access networks, and future service innovation. New wireless architecture will need to connect everything and adapt to an uncertain future.

Evolve to adapt

RAN architecture has evolved over two stages. In the era of traditional RANs – the first stage – operators built networks using different technologies based on independent designs, hardware components, and operating teams. They were expensive and flexibility was poor. Huawei's SingleRAN solution in 2007 marked the start of the second stage: SingleRAN enabled the integrated deployment of the following standards: GSM, WCDMA, CDMA2000, and LTE. This was completed on a single access platform that used the same hardware components, spectrum, transmission, network management, basebands, and master control. The SingleRAN solution significantly reduced RAN investment and maintenance costs, becoming the wireless industry's de facto standard architecture.

SingleRAN is one of Huawei Wireless' most impressive achievements in the past ten years. But, for the future, how will Huawei Wireless meet the challenges to come?

The next decade will see great changes in wireless communications. 4.5G, 5G and new forms of network construction and mobile applications will revolutionize mobile connectivity. But, evolution from 4G to 5G alone will not prompt transformation. Far from it.

Reconstructing basic interconnectivity capabilities as part of carriers' digital transformation will increase in prominence, because it will kick off a new stage of service interconnections and open reconstruction. In the future, new network architecture will be needed to meet a multitude of new requirements like network flexibility. These requirements will come from diverse services, new business models, and the need for faster connections and anytime, ubiquitous, and consistent experiences on complex multi-band, multi-standard heterogeneous networks.

With this uncertainty, Huawei Wireless has upped its game since SingleRAN with CloudRAN, its latest breakthrough in wireless communications networking.

Cloud tech on mobile architecture

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Six distinctive features of CloudRAN architecture

1 Cloud-based architecture

Adopting a cloud-based hardware and software system, CloudRAN includes a series of systematic cloudi capabilities like functions virtualization, resource cloudification, distributed architecture, layered capabilities , and flexible coordination.

2 Multi-standard connectivity

CloudRAN integrates all access technologies on to a single platform, including 4G, 4.5G, and future 5G technology, and various non-licensed spectrum access technologies such as Wi-Fi.

3 Elastic networks

CloudRAN's new network layering standard means the system is oriented to functions rather than network elements. This allows flexible, fast, and elastic functions deployment based on service development requirements.

CloudRAN is designed to help operators deal with the complexity of tomorrow's tech integration, service diversification, and business model fragmentation. Featuring redesigned wireless management architecture and capabilities like resource management, multi-tech connectivity, and elastic architecture, carriers can better cope with future uncertainties.

Cloud-based architecture

With cloud-based hardware and software systems, CloudRAN enables operators to build a service-driven and user-centric elastic network that supports 4G and 5G connectivity and embraces the diversity of future MBB and services for verticals.

Cloud architecture is the basis of future networking. Huawei's All Cloud strategy sets out a blueprint for full E2E network cloudification. Huawei's CloudRAN fully integrates cloud concepts into the RAN, the most difficult part to cloudify, putting the last piece of the puzzle in place for full cloudification – an unprecedented innovation in wireless infrastructure.

CloudRAN transforms the RAN and delivers cloud capabilities like functions virtualization, resource cloudification, architecture distribution, capabilities layerization, and flexible coordination. The solution enables hardware resource pooling to maximize resource sharing. With fully distributed software architecture resembling those of Internet companies, CloudRAN gives elastic capabilities such as flexible fault handling and resource scheduling, and fully automates service deployment, resource scheduling, and troubleshooting.

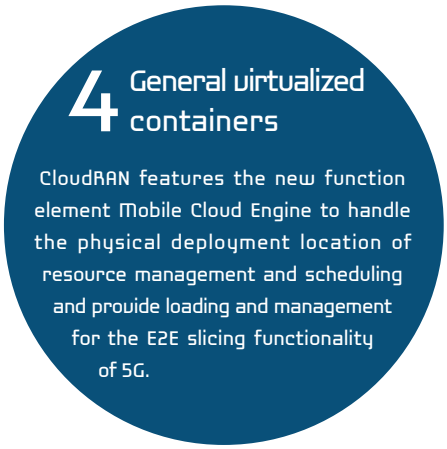
Multi-standard connectivity

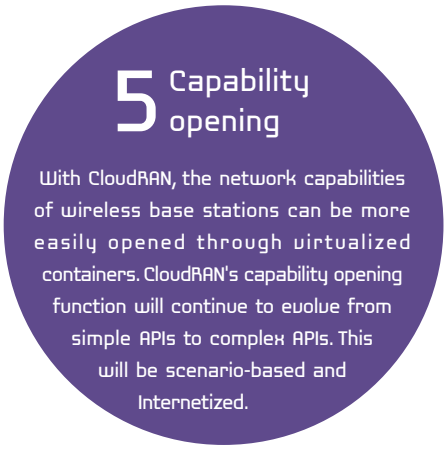
CloudRAN architecture adopts multi-connectivity technology to overcome the complexity of a multi-standard, multi-band, and multi-layer integration environment. It can also be applied to terminals for the optimum user experience.

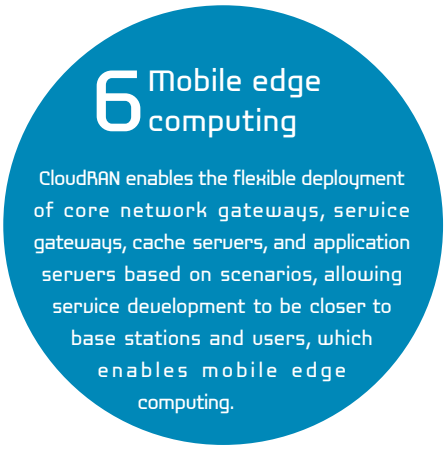
The industry agrees that 5G and LTE multiple connectivity are the future. Mainstream mobile terminals are capable of multi-standards access, but only in a single connectivity state. But, spurred by the industry, multiple-connectivity will happen. CloudRAN consolidates all access technologies on a single platform; the completed standards include TDD and FDD LTE dual connectivity and LTE Wi-Fi aggregation.

The new architecture will be able to connect to multiple types of access technologies, including traditional 4G, 4.5G, and future 5G technology, and various non-licensed spectrum access technologies such as Wi-Fi.

CloudRAN architecture overcomes anchor point selection with multiple-connectivity technology. The anchor point enables service distribution, carries out unified management, and







allocates high-level data, which is restored on the terminal via different air interface technology pipes. This enables operators to maximize the use of technology, spectrum, and hardware resources to increase overall resource efficiency.

Elastic networks

Like the early distributed base station design, CloudRAN balances distribution and centralization through a new, layered framework. All network functions can be configured and managed on-demand to deal with business model fragmentation and service growth in verticals.

CloudRAN's new network-layering standard means the system is function-oriented rather than based on network elements. Resource management adds more detailed functions to the traditional vertically managed wireless architecture systems. These capabilities can be configured on-demand and network functions atomization for optimal collaboration efficiency and fast and elastic function deployment to reflect service growth requirements.

Base station atomization considers the benefits as well as the technical costs. Dividing the horizontal layer of base stations into real-time and non-real-time sections will enable the system to better adapt to diverse network environments and implement multiple connectivity, multi-carrier, and multi-streaming technologies. In principle, real-time components are closer to base stations, enabling super-low latency and accelerating post-processing on complex data calculations at the front end.

Centralizing non-real-time components can support multi-dimensional wireless standard management and service distribution unification. With elastic architecture, real-time and non-real-time scheduling on different layers enables transition from network-

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CloudRAN architecture can be used in different wireless network environments and scenarios to deal with different uncertainties.

centric to service-centric deployment.

General virtualized container design

CloudRAN will open management capabilities to better serve verticals. Huawei has included its Mobile Cloud Engine into the new architecture to configure where resource management and scheduling are physically located and to provide loading and management on E2E slicing for 5G by opening capabilities and resource management.

Mobile Cloud Engine is an optimized virtual machine for wireless capabilities that can run on dedicated platforms and general commercial-off-the-shelf (COTS) platforms with Cloud OS under a COTS cloud infrastructure. It offers carrier-class disaster recovery and on-demand deployment, flexible capacity expansion, independent feature upgrades, and other functions of native cloud architecture.

Opening capabilities: A hotbed of service innovation

Communications networks must be able to open network capabilities. Thus, operators need to get involved in the Internet industry chain, and by monetizing network capabilities, transform towards bilateral business models. If RANs are closer to users, network information is more accurate. Opening RAN capabilities can bring more business value for operators. CloudRAN architecture opens wireless base station network capabilities through virtualized containers, including anonymized user locations, network optimization parameters, QoS, billing, users' context network information, and service APIs. These valuable data sources and interfaces can be used by OTT companies and verticals to innovate services.

CloudRAN's capability opening function will keep evolving from simple to complex APIs and into scenario-based and Internetized capabilities, helping operators to further expand individual and household markets, traditional enterprises, vertical industries, and Internet markets. Operators can then expand and succeed in the digital economy.

Enabling mobile edge computing

CloudRAN allows core network gateways, service gateways, cache servers, and application servers to be flexibly deployed based on scenario, allowing service development to be closer to base stations and users. This will also enable MEC, functions like reducing transmission distance and latency, and optimization processing.

Each function component can share computing and storage resources, lowering service development costs and greatly increasing MEC innovation. Running services as close to end users as possible slashes latency, enabling rapid feedback on network status and lessening congestion on the rest of the network. Tighter integration with wireless components enables CloudRAN to acquire information on traffic, wireless, and terminal device location more easily, which in turn allows big data analysis and new business models.

Benefits for verticals

CloudRAN architecture can be used in different wireless network environments and scenarios to deal with different kinds of uncertainty

that will occur in future as wireless networks evolve. This will enable wireless networks to become the core infrastructure and key innovation driver of socioeconomic development.

Sharing network resources

Two issues are that different operators offer a wide variety of network transmission resources and fiber-to-the site rates differ from country to country. Achieving on-demand provisioning of network resources requires resource sharing, including baseband resources and computing and storage. CloudRAN architecture allows maximum adaptation to current network environments, enabling operator networks to flexibly provision baseband, storage, and computing resources and services with maximum efficiency. They can then provide different services and deliver the best experience for different users.

Higher spectral efficiency, higher income

CloudRAN architecture turn interferences into gains by centrally deploying non-real-time management units. This allows multi-dimensional collaboration between different standards, frequency bands, base stations, and layering technology through greater ranges of time, spectrum, space, and different processing functions. It also allows increased system capacity through multi-site and multi-user MIMO collaboration and significantly improves cell edge user rates, thus guaranteeing user experience. CloudRAN also supports the automatic selection of different collaboration levels according to deployment conditions to maximize the value of operator assets.

These functions greatly increase spectral usage efficiency.

Ultimate experiences with ultra-broadband

CloudRAN's multiple concurrent connections capability allows users to receive signals from multiple technologies and simultaneously connect to multiple base stations. In the future, when Wi-Fi operates on unlicensed bands and LTE on licensed bands, multi-connectivity technology will allow simultaneous connections to Wi-Fi and LTE, or enable users to simultaneously connect to LTE and 5G and macro and micro base stations. This multi-connectivity will improve user perception of speeds. CloudRAN will also support functions such as ultra-high bandwidth carrier aggregation, fast collaboration, and balanced scheduling. These functions will enable gigabit+ download speeds, meeting the requirements of applications like video and VR/AR.

Service diversification and service innovation capabilities

CloudRAN architecture allows the flexible deployment of MEC according to service type. For example, video services can be deployed closer to the end user to reduce the transmission resources needed by the system, shortening latency and ensuring an optimal user experience.

CloudRAN architecture also allows developers to fully leverage the value of network capabilities through opening network capabilities. Developing services that match user needs can increase commercial value and service innovation; for example, anonymized user location data can help retailers select sites and push advertising or yield IoT surveillance information on crops to predict crop yields.

CloudRAN architecture also enables the on-demand deployment of real-time/non-real-time resources based on particular service requirements and the distribution of base stations, server rooms, and fiber resources to guarantee service experience and minimize network deployment and OPEX.

Mobile IoT will increase the value brought by CloudRAN. According to industry visionary Kevin Kelly, "We're at the most important stage, the beginning. It's a process. Every new thing we create is in essence still at the beginning stage." With CloudRAN, operators will be ready for the arrival of the better connected mobile era.