GSMA
Foundry

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CASE STUDY

Reallocating
RAN Capacity in Real-Time

ZTE's RAN Composer is designed to enhance network performance, sustainability and customer experiences

Highlights

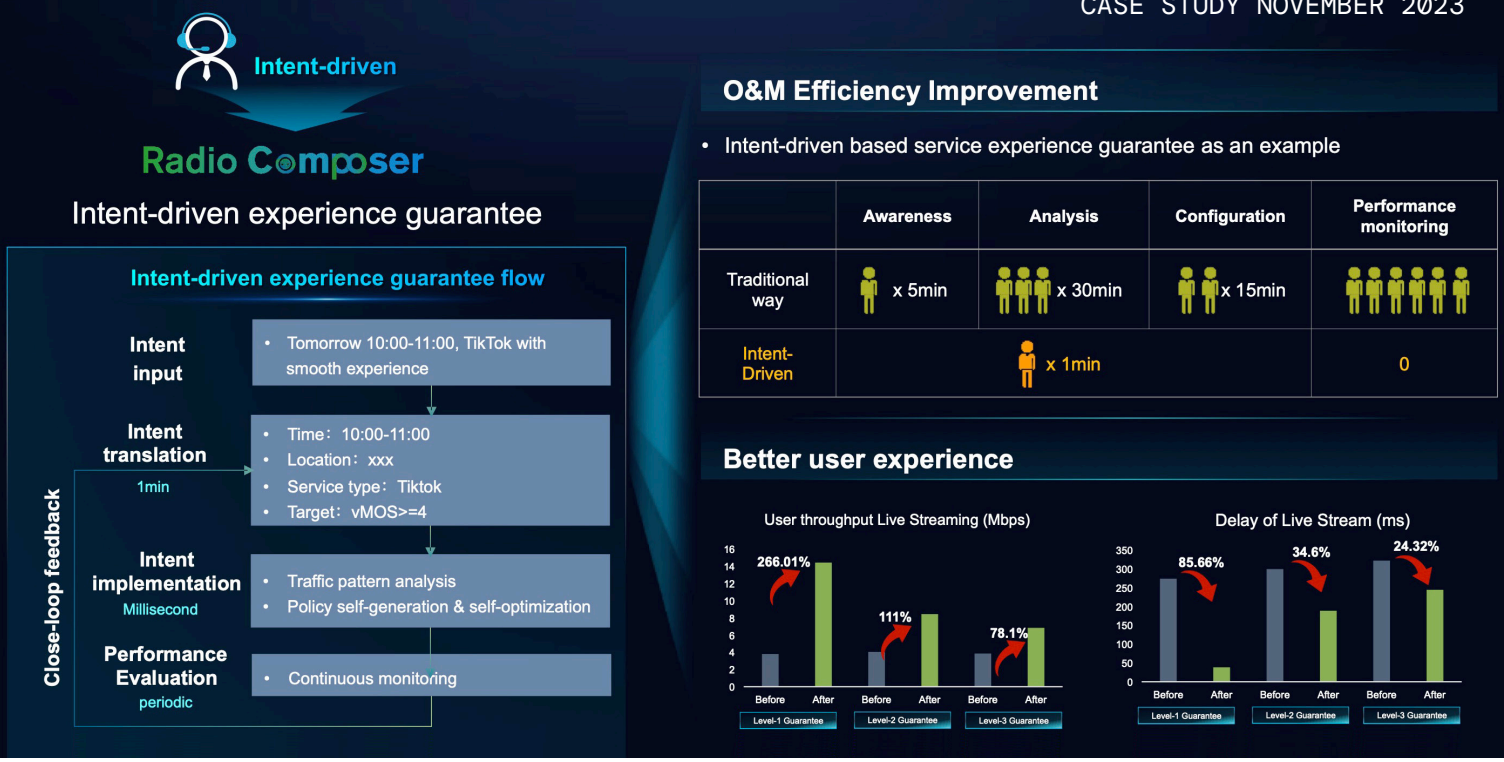
- RAN Composer uses artificial intelligence to orchestrate network resources on the fly.
- The system dynamically allocates network resources in near real-time
- Clusters of base stations work together to optimise connectivity at the user's point of presence
- The goal is to enhance the user experience and make networks more efficient
- In tests, the system reduced the radio network's energy use by 35%
- ZTE and partner operators are preparing for a full-scale commercial rollout in 2024

Unlike its predecessors, 5G is designed to support a very wide variety of business and consumer use cases and applications. That means different users can have very different requirements in terms of throughput, responsiveness and reliability.

To avoid providing too many resources to one user, and too few resources to another, mobile operators need a way to intelligently allocate radio capacity in real-time. To that end, ZTE is harnessing artificial intelligence (AI).

It has developed a solution, called RAN Composer, which uses intelligent traffic pattern analysis and learning to help orchestrate network resources on the fly.

The AI analyses in real time the loads on each frequency layer in each cell of the network, together with the capabilities of the local network, the connected devices in the cell and what they are being used for: Is the device downloading content, browsing the web or making a video call?



Source: ZTE

Based on its analysis of these variables, the RAN Composer then dynamically allocates network resources in near real-time. It can, for example, prompt devices to switch to a different frequency band or connect to a different base station. It can also dynamically pool the compute resources of local base stations to meet the requirements of demanding services. The goal is to ensure that each user has the right network resources at the right time to meet his or her needs to the best extent possible, within the bounds of what they are paying for.

By precisely mapping differentiated service requirements and network resources, the system aims to significantly enhance the user experience and in turn generate more revenue for operators without extra investment in hardware. “The main idea is flexible production…you have the possibility with this to really deliver what the customer needs in real time, even when the customer changes what he needs,” says Hans Neff, Senior Director, CTO Group at ZTE.

As it tailors the network performance to individual customer requirements, the RAN Composer aims to prioritise applications that matter most to users and guarantee smooth, lag-free experiences for real-time services, such as video conferencing and gaming. In so doing, operators should increase customer satisfaction and loyalty, while gaining a competitive advantage.

As well as boosting revenue, RAN Composer is designed to lower the mobile operator’s operating costs. “It increases the network efficiency, it increases the energy efficiency of the whole environment,” adds Hans Neff. In tests, the system has reduced the radio network’s energy use by 35%, according to ZTE, while making 14% more computing resources available to users during busy periods.

The RAN Composer increases network and energy efficiency by dynamically allocating frequencies, resource blocks, and slices to eliminate congestion and maximise network capacity. The goal is to ensure consistently high-quality service even during peak network usage. By optimising energy consumption, operators will reduce operational costs, while running a more sustainable, eco-friendly network with a lower carbon footprint.

Operators can also leverage the data analytics and AI supported by RAN Composer to make informed decisions about resource allocation and gain valuable insights into customer behaviour and network performance, according to ZTE. That could enable them to continuously improve network operations and customer experiences through data-driven optimizations.

ZTE believes RAN Composer will play a key role in ensuring that 5G can deliver on the promise of network slicing – the concept of providing dedicated slices of connectivity to specific users under a service level agreement (SLA).

It also promises to boost network reliability, while reducing operational and maintenance costs by a 500%, according to ZTE. The size of that figure reflects the fact that the RAN Composer is highly automated – the operator simply needs to state intent and the system configures the network and devices accordingly (see graphic). It also monitors the resulting performance and then makes adjustments, as necessary.

ZTE says RAN Composer’s robust protocols and intelligent resource allocation also ensure data privacy and network security, thereby building customer trust.

Following extensive testing across thousands of base stations over the past two years, ZTE says RAN Composer will be running on commercial sites in Asia and Europe in 2024. China Mobile, China Unicom,

China Telecom and AIS in Thailand and a tier 1 operator in Europe have all tested RAN Composer, helping ZTE to optimise the system. As it is AI-based, its algorithms should improve as the system acquires more network usage data.

Optimising performance by service application, rather than by site

Historically, mobile operators have optimised the performance of each cell by adding new functionalities, upgrading the antenna, or using dynamic spectrum sharing (DSS) systems to optimise the cell's usage of the available frequencies.

By contrast, ZTE's RAN Composer uses AI to optimise radio resources across multiple cells so that each end-user experiences the network performance necessary to support the application they are using. In practice, that means the end user may not connect to the cell with the strongest signal strength, particularly if that cell is heavily loaded or has other resource issues.

As they are served by a cell that can meet their needs, the user ultimately gets a better experience. For the mobile operator, the overall efficiency of the network is improved, as it can make full use of the network resources available in a specific point of presence, rather than overloading some cells and under-utilising others.

To keep the latency low, the RAN Composer software runs in each individual base station, overseen by a centralised coordination layer, or multiple coordination layers as required by the operator. Hans Neff explains that the software will tailor the frequency band allocated to each device, according to its precise location and how it is being used. An indoor device, for example, would benefit from using a low-frequency band, in which signals are better at penetrating walls.

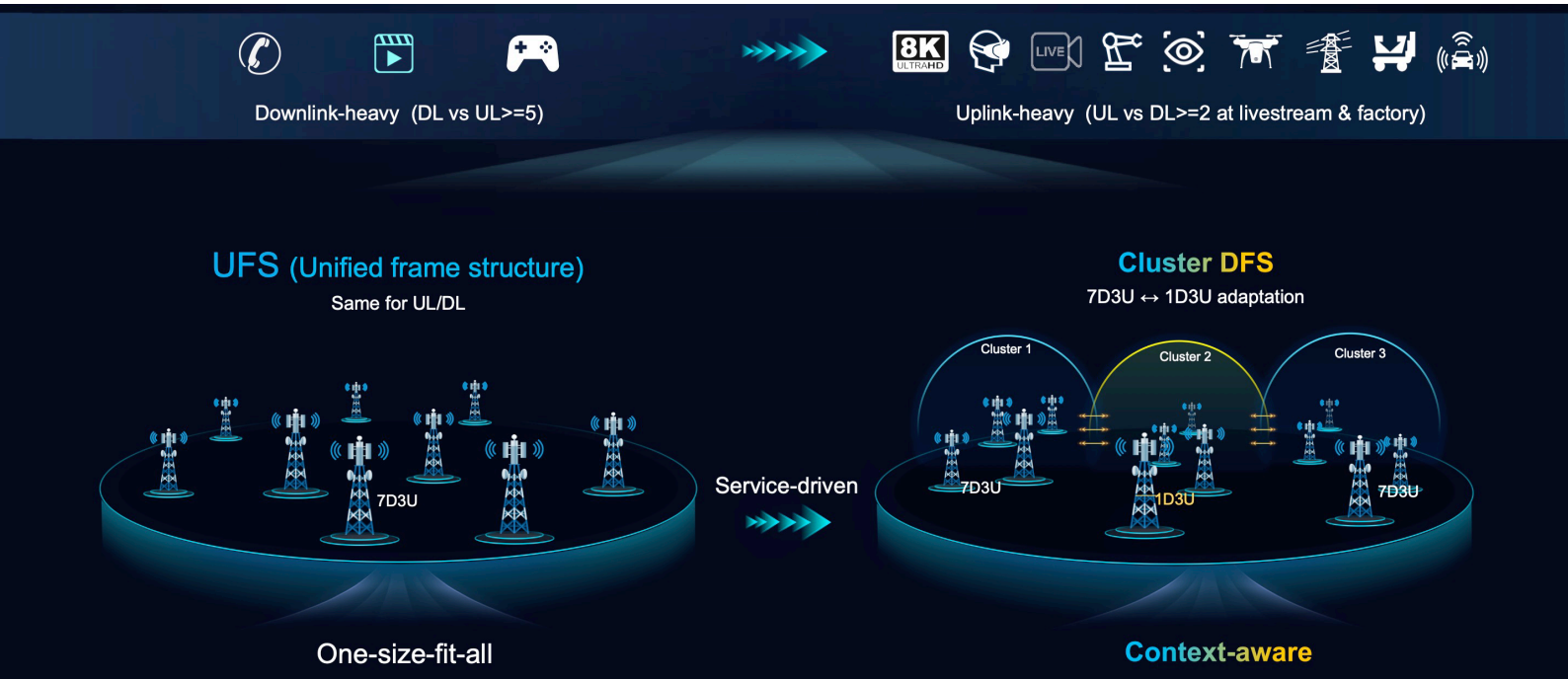
As well as adjusting the frequency bands being employed, the RAN Composer can adapt the carrier, beam, and frame structure to maximise the traffic handled by the local network. For each cluster of base stations, the system learns the network service capabilities under different resource combinations (spectrum, carrier, beam and frame structures) to generate a cluster knowledge library.

The size of a cluster is determined by the proximity of the base stations and the time it takes for them to interact – the links between the base stations need to be low latency to enable RAN Composer to coordinate their resources in real-time. Base stations to be part of the same cluster typically within 10km based on frequency and coverage scenario, Hans Neff explains.

As well as building a cluster knowledge library, the system generates a traffic mode knowledge library, which it uses to predict the future traffic requirements of the network. The software builds this library by tracking the uplink and downlink traffic requirements of different technologies, in different spatial directions. RAN Composer then draws on both these libraries to precisely deploy network resources to meet the service requirements in real-time.

Historically, mobile operators have focused their frame structure, which has been fixed across the network, on the downlink. However, the bandwidth available through 5G is stimulating usage of more uplink-intensive services, such as video calls and live streaming. Adjusting the uplink frame structure manually can result in a major maintenance workload and delayed response. But the RAN Composer system can perform this task automatically for a specific cluster of cells (see graphic).

Source: ZTE



Using RAN Composer, an operator could offer a business customer looking to make high quality video calls, for example, a service guarantee in a specific point of presence. That service guarantee could ensure that the network provides both the uplink and downlink capacity and the latency to support a smooth video experience in high resolution. “It’s automatically translated to the terminals, to the service sets, to the point of presence where you want to do it,” Hans Neff explains. “You can update it and modify it as you want to.” The RAN Composer can also check whether any other services will be impacted by adjustments in resource allocation.

China Mobile has piloted RAN Composer to help it manage video traffic, which accounts for more than 70% of its overall traffic, and provides its customers with a better overall experience, boosting loyalty. By using RAN Composer, it has reduced the proportion of low-definition video (less than 720p) from 21% to 16%, while increasing the high-definition (over 720p) proportion by more than 20%. The telco reports the value of vEMI (the video equivalent of a mean opinion score) increased by over 30%, while total cell traffic rose by 10%.

Meanwhile, China Telecom has employed RAN Composer to enable intelligent frame structure adaptation based on traffic patterns at a cluster-level, in order to meet the uplink requirements of B2B and B2C services. The telco reported an average uplink throughput improvement of 70%, giving it the flexibility to offer guaranteed SLAs for both B2C and B2B services, such as live-streaming video from the Asian Games.

China Unicom uses RAN Composer to implement intelligent spectrum adaptation based on traffic patterns to improve DSS NR user experience, the test result shows up to 130% NR user experience improvement when all DSS cells in a cluster can change to NR cells with LTE cells shutdown, greatly enhancing DSS application.

Operators outside China are also piloting RAN Composer. ZTE says a test in Thailand led to a 300% increase in use throughput at cell edge on a 5G network, as RAN Composer dynamically changed the frequency band allocated to a device to better meet its needs (see graphic), both uplink and downlink traffic increased by around 10%.

Although some of the RAN Composer’s capabilities can be applied across 4G networks, as well as 5G, it has the biggest positive impact when employed in conjunction with a 5G core network, which is much more flexible and configurable than its predecessors.

While RAN Composer is a proprietary system, ZTE is looking to open up the underlying technologies so that they can be applied across base stations from multiple vendors. Hans Neff believes this could happen in the 2025 to 2026 timeframe.

If and when the AI-based system is widely deployed, ZTE believes it will have a major impact on both the efficiency and effectiveness of mobile operators’ networks. In short, they could wring much greater capacity out of their existing network resources.

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Hans Neff - Senior Director, CTO Group, ZTE Corporation

Source: ZTE

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The GSMA is a global organisation unifying the mobile ecosystem to discover, develop and deliver innovation foundational to positive business environments and societal change. Our vision is to unlock the full power of connectivity so that people, industry, and society thrive. Representing mobile operators and organisations across the mobile ecosystem and adjacent industries, the GSMA delivers for its members across three broad pillars: Connectivity for Good, Industry Services and Solutions, and Outreach. This activity includes advancing policy, tackling today's biggest societal challenges, underpinning the technology and interoperability that make mobile work, and providing the world's largest platform to convene the mobile ecosystem at the MWC and M360 series of events.

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About ZTE

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