WHITEPAPER

Standalone 5G Now Ready for Prime Time

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Part 1: 5G progress update

The move to 5G continues to accelerate as mobile operators around the world add much-needed capacity, improve network efficiency as data consumption soars and look to drive growth by tapping new revenue streams.

Despite some 5G network construction delays caused by Covid-19 (coronavirus) lockdown measures, most operators have forged ahead with 5G rollouts or standalone (SA) upgrades this year. The number of 5G operators worldwide rose to 107 in 47 markets after 18 networks were launched in Q3, data from GSMA Intelligence showed.

A total of 217 operators across 100 markets have conducted 561 5G trials.

By 2025, global 5G connections are projected to reach 1.8 billion, with Asia Pacific accounting for 67 per cent of the total.

China, home to the world's largest LTE network, moved rapidly to deploy 5G infrastructure in late

5G commercialisation

Source: GSMA Intelligence

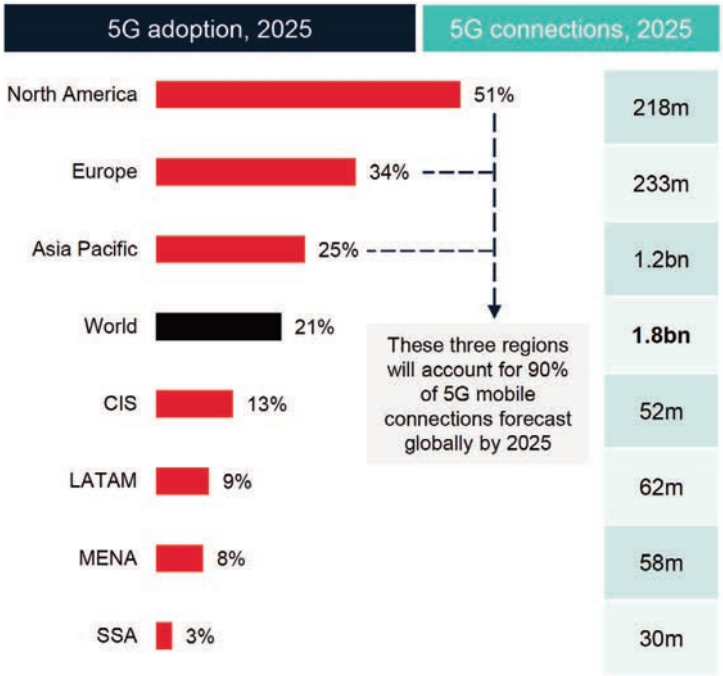
2019 after the government awarded spectrum licences at mid-year. Just two months after services were launched at end-October, the country's three major mobile operators had built 140,000 5G base stations, representing a quarter of the global total.

The three companies set the target of closing 2020 with about 700,000 5G sites and a combined 200 million subscribers. At the end of September, China Mobile had 114 million 5G subs and China Telecom had 64.8 million (China Unicom has not disclosed its numbers).

Handset prices are plummeting worldwide, particularly in China but also in Japan, where NTT Docomo recently said it will cut the prices of 5G models by nearly half from the current JPY100,000 level ($935) later this year. The declines will no doubt spur adoption in all markets with 5G services.

With the focus on enhanced Mobile BroadBand (eMBB) in new 5G markets, all eyes have been on consumer ARPU, which appears to be trending up in South Korea for all three major players. China Telecom reported 5G ARPU of CNY80.60 ($14.50) at end-June, nearly double that of overall mobile ARPU.

5G commercialisation



5G certainly has driven mobile data usage, with China Unicom and China Mobile registering 40 per cent and 27 per cent year-on-year growth respectively in H1 to about 9GB a month per user.

Shift to SA

With SA architecture maturing, the transition from non-standalone (NSA) to SA deployments is gaining momentum. A second wave of what many are calling 'real 5G' is happening in China, the US, South Korea and Pacific-Asia region. In these markets there is increased attention on the promise of the enterprise and industrial sectors.

China's operators' earmarked CNY180 billion ($23.1 billion) for phase two of the country's SA 5G projects.

Korea-based LG Uplus, which in June completed tests of core technologies supporting high-quality voice running on a SA network, SK Telecom and KT are expected to switch on SA 5G networks by the end of the year or in early 2021.

In the US, AT&T said in August work on its SA core was progressing as planned despite the Covid-19 pandemic and it is on track to begin initial commercial deployments in the coming months. That announcement came shortly after T-Mobile US launched SA 5G, boldly claiming a world first in terms of providing nationwide coverage. Meanwhile, Verizon continues to prepare to move traffic to a SA core later this year, announcing the completion of its first successful end-to-end data session using the infrastructure.

In Singapore, SA launches aren't coming until 2021, with StarHub, M1 and Singtel recently announcing limited NSA tests using the 2.1GHz and 3.5GHz bands.

In Australia and New Zealand, operators (Telstra and Vodafone NZ) are talking up industrial and agriculture use-cases. Telstra in May said it upgraded its entire 5G RAN to SA but is testing compatible devices, with commercial availability not expected until later in the year. The market leader highlighted SA would improve network efficiency and drive new use cases.

With SA deployment plans currently limited to about a dozen countries, the question is when will it take off?

A GSMA Intelligence survey found that just under half of respondents expect to rollout SA within the next two years, with 18 per cent planning to do so within the next year. Another 31 per cent of operators target SA launches in two to three years.

The key reasons behind the move to SA are simplifying network architectures and reducing costs, the survey results showed. While a focus on operational efficiencies ranked high, the top driver is the broad category of new service and revenue generation, which is part of operators' longer-term network transformation strategy.

China leads SA

China Mobile, the world's largest operator by subscribers with 188,000 5G sites in more than 50 cites by the end of Q2, began deploying SA in early 2020. It aims to take its total base station count to nearly 400,000 by end-2020. It uses spectrum in the 2.6GHz and 4.9GHz bands, with plans to use 700MHz and mmWave airways in the future.

The market leader is taking a different path from NSA to SA than the joint deployment of China Telecom and China Unicom, which in September 2019 agreed to build and operate a single nationwide SA RAN.

All new China Mobile sites being rolled out are now the SA version, and the existing sites have been upgraded to dual-mode (NSA and SA).

China Telecom and China Unicom plan to share 250,000 RAN sites (each built about 40,000 in some 40 cities by end-2019). The joint phase 2 project uses 3.5GHz and 2.1GHz spectrum.

On 7 November, China Telecom officially announced its SA commercial network in more than 300 cities in China.

Meanwhile, China Broadcast Network (CBN), the fourth player which also was granted a licence in June 2019, targets reaching 95 per cent population coverage by end-2021.

Part 2: Challenges and solutions of SA deployment

SA networks have been commercially deployed in a number of countries, including China, the US and South Korea, indicating the new architecture is now mature.

Major equipment makers Huawei, ZTE, Ericsson and Nokia completed SA base station and core network commercial tests in early 2019.

Huawei and ZTE, end-to-end suppliers of SA products, were awarded the majority of a large-scale SA network contracts in China in early 2020.

Meanwhile, semiconductor suppliers around the world have released SA chipsets, including Qualcomm (Snapdragon X60), Samsung (Exynos 990), HiSilicon (Kirin 990) and MediaTek (Dimensity 700). And leading handset vendors Samsung, Huawei, ZTE, Xiaomi and Oppo have introduced smartphones supporting SA.

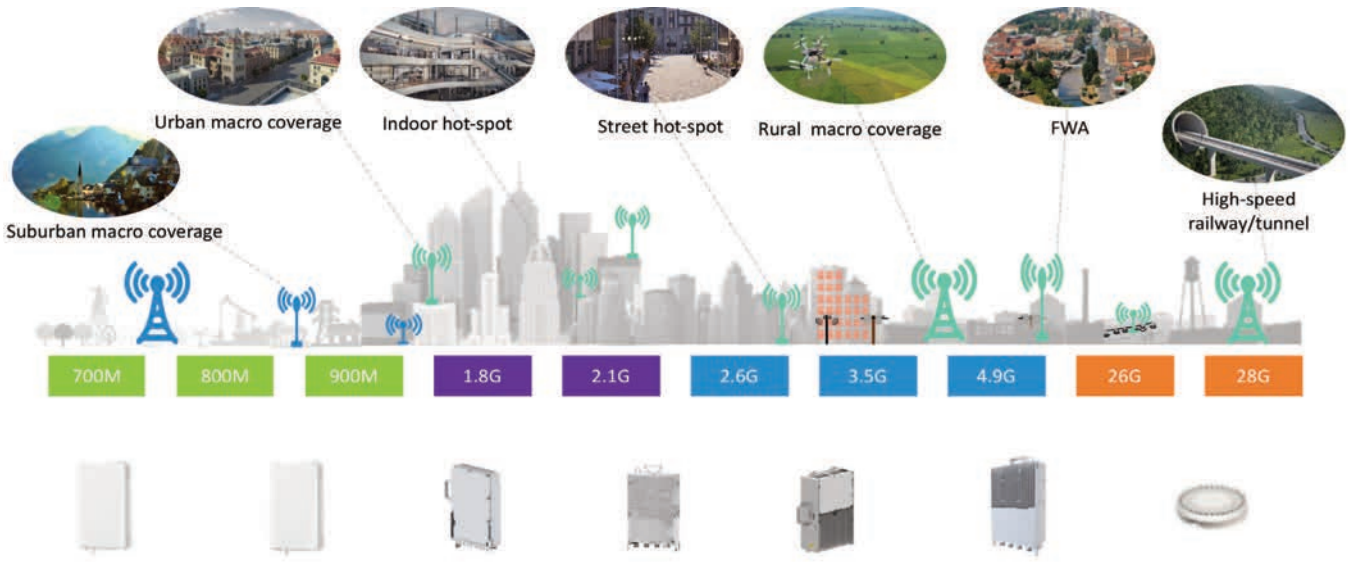
While SA commercial deployments are still in the initial stage, operators are facing a number of challenges, such as how to achieve seamless coverage; co-existence with existing 4G and NSA networks; end-to-end network slicing; and private networks for various industry verticals.

Seamless coverage

Seamless coverage is a basic network requirement for both NSA and SA networks. For NSA networks, it can be implemented through LTE networks, while for SA networks, seamless coverage can only be achieved by rolling out SA base stations, prompting some in the industry to consider SA deployments the only 'real' 5G networks.

Facing complicated coverage scenarios, such as dense urban and rural areas, wireless equipment suppliers are required to provide a range of SA base station products, including macro, micro, pico and indoor small cell sites. These support the full range of 5G spectrum across low bands (700MHz, 800MHz and 900MHz), medium bands (1.8GHz, 2.1GHz, 2.6GHz, 3.5GHz and 4.9GHz) and high bands (26GHz and 28GHz).

Full scenarios coverage with diversified products



Generally, SA base stations will share the same sites with 4G base stations. The coverage capability of 5G using the 2.6GHz and 3.5GHz bands is more limited than when using 4G's 1.8GHz and 2.1GHz bands.

According to field verification tests, the downlink coverage of 5G is equivalent to that of 4G, while the main gap lies in uplink edge coverage, which can be overcome using uplink coverage enhancement solutions, such as MR-DC (Multi-RAT Dual Connection) and FAST (FDD Assisted Super TDD). FAST, an innovative UL TDM carrier aggregation-based option, not only increases uplink coverage but also enhances uplink and downlink capacity.

Co-existence

An SA network cannot be deployed without a 5G core network. Since the 4G era, core networks have been virtualised. With the move to 5G, cloud native and micro services have become basic capabilities of core networks. By deploying different components, the full range of network modes, such as 2G, 3G, 4G, 5G and even fixed-line networks, can be realised and converged in the same hardware.

The first virtualised and converged core network (ZTE's Common Core) has been widely used in 4G deployments as well as 5G rollouts by the three major operators in China, Hutchison Drei Austria and WindTre in Italy.

Although 5G is developing rapidly, 4G will continue to carry the majority of mobile services for a very long time. In the early stage of 5G, NSA has been commercialised, and over the next several years, SA will be introduced and will co-exist with 4G and NSA networks. Over time, 4G and NSA will gradually evolve towards SA.

Operators' main concern is SA deployments could have a negative impact on their 4G and NSA networks. Many seek to roll out SA networks quickly without significant changes to their existing equipment, with the aim to share sites, power supplies and transmission resources to reduce costs. They also are prepared to re-farm spectrum to simplify the path to SA in the future.

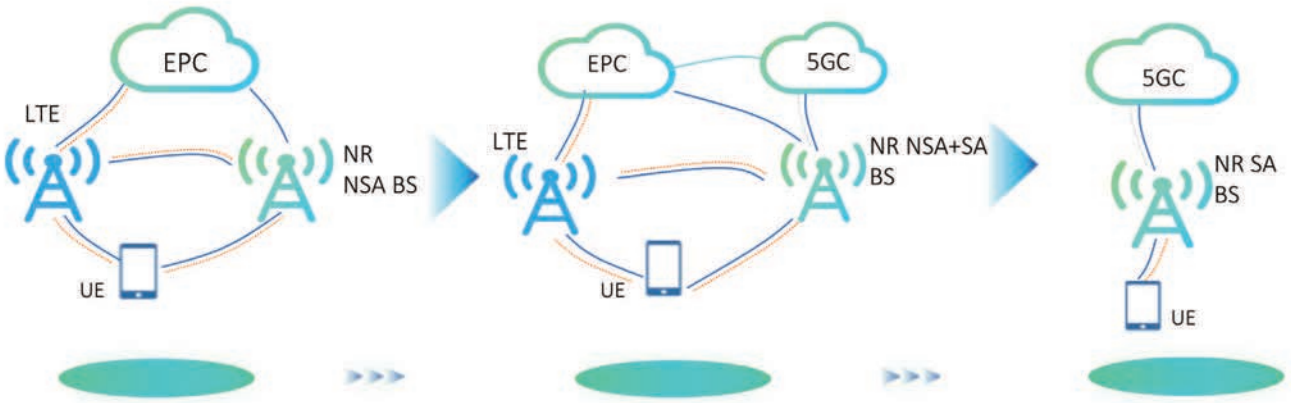
In general, there are two options for moving to SA: overlay and multi-mode.

For SA overlay, the new network is superimposed directly without any change to the 4G and NSA network. The SA interconnects with the 4G via the 3GPP standard interface of the core network. The main benefit of this is the rapid introduction of 5G. Another advantage is that new equipment vendors can be introduced.

This approach requires sufficient space for the installation of additional equipment. If space in the equipment room or resources are limited, the existing 4G or NSA equipment will need to be upgraded or replaced with dual-mode or multi-mode equipment.

When deploying new sites, the dual-mode or multi-mode option is the most cost-effective. By deploying a single set of equipment, an operator can deliver both NSA and SA services, or implement 2G, 3G, 4G and 5G. The key advantage is low-cost co-location and a smooth evolution path.

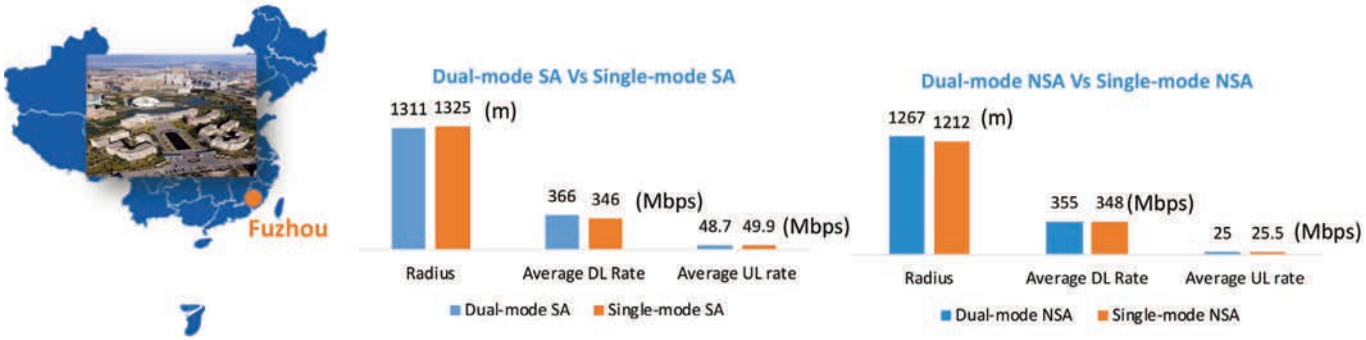
NSA+SA dual-mode site evolving to SA smoothly



Most major equipment providers have released dual-mode or multi-mode equipment. For example, ZTE's base stations support multiple combinations of NSA, SA and NSA+SA, or multiple combinations of 2G, 3G, 4G and 5G, as well as a smooth evolution to 5G. In addition, its Super DSS technology supports a maximum of three modes of dynamic spectrum using 2G, 4G and 5G or 3G, 4G and 5G.

In Fuzhou city, the industry's first commercial NSA+SA dual-mode network was deployed by China Mobile in cooperation with ZTE. Based on the test results, the performance of dual-mode 5G base stations is similar to that of a single-mode 5G base stations.

First large-scale dual-mode 5G network



End-to-end slicing

Network slicing provides a way for operators to change the business model from traffic management to differentiated services for vertical industries, creating virtual network slices to serve different customers and offer specific service level agreements (SLAs).

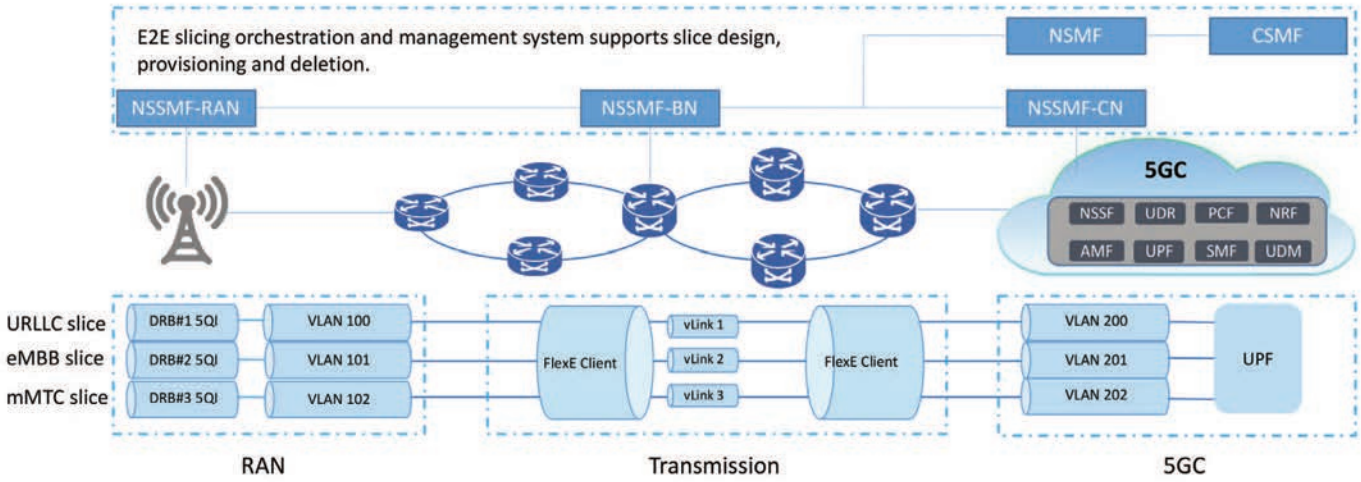
The core network is considered the most critical element for network slicing, providing the network services for tenants and their end-users. To meet the diversified demands of vertical industries, network service customisation and on-demand deployment are the key concepts that need to be built-in. To guarantee SLAs at a precise level, the core network must be cloud native and adopt a service-based architecture, with a modular design, and support on-demand customisation and dynamic service orchestration.

5G New Radio (NR) is preconfigured with data for each network slice, which enables it to support

differentiated handling of traffic for different slices. This allows the slice-aware and slice-optimised scheduler in the NG-RAN node. 5G NR supports resource isolation between slices using RRM policies and protection mechanisms to manage the shared resources and avoid a problem in one slice impacting SLAs in another slice.

Slicing technology also is introduced in the transmission network. There are two slicing solutions to realise soft isolation and hard isolation, respectively. Soft isolation with QoS and VPN can meet the requirements of medium and low-level services. For critical services like URLLC, FlexE technology should be adopted.

End-to-end network slicing



Business-oriented network

Operators can take four approaches to meet the diversified requirements for their business customers: 5G private line, virtual private network, hybrid private network and physical private network.

A 5G private line uses a dedicated LAN connection to improve end-to-end QoS.

A virtual private network is based on end-to-end network slicing on public NR and core, offering a private network with best-effort SLAs and low cost.

By contrast, a hybrid slicing network usually contains shared public 5G NR and a shared core control plane, as well as user plane function and mobile edge computing (MEC) on premise. This type of deployment provides traffic offloading along with rich MEC applications, guarantees network latency to an ultra-low level, and also saves a large portion of transmission resources. Since user plane function and MEC are deployed on premise, data privacy is highly protected and network SLAs are guaranteed. Pre-integrated hardware is applied, with plug-and-play installation; O&M can be performed remotely and service activation can be achieved in a few hours.

In some cases, 5G NR and a complete 5G core are required to be deployed on premise. With this situation, a flexible and compact 5G core is used to reduce costs, conserve equipment room resources and simplify the network. O&M can also be performed remotely. This type of deployment offers the highest standard of security and isolation, functions can be customised and SLAs can be precisely guaranteed.

With 5G technology expected to accelerate industrial digital transformation, China Mobile and China Unicom opted to deploy a dedicated 5G core for business-oriented services, completely separate from their consumer 5G services.

Part 3: B2B use-cases

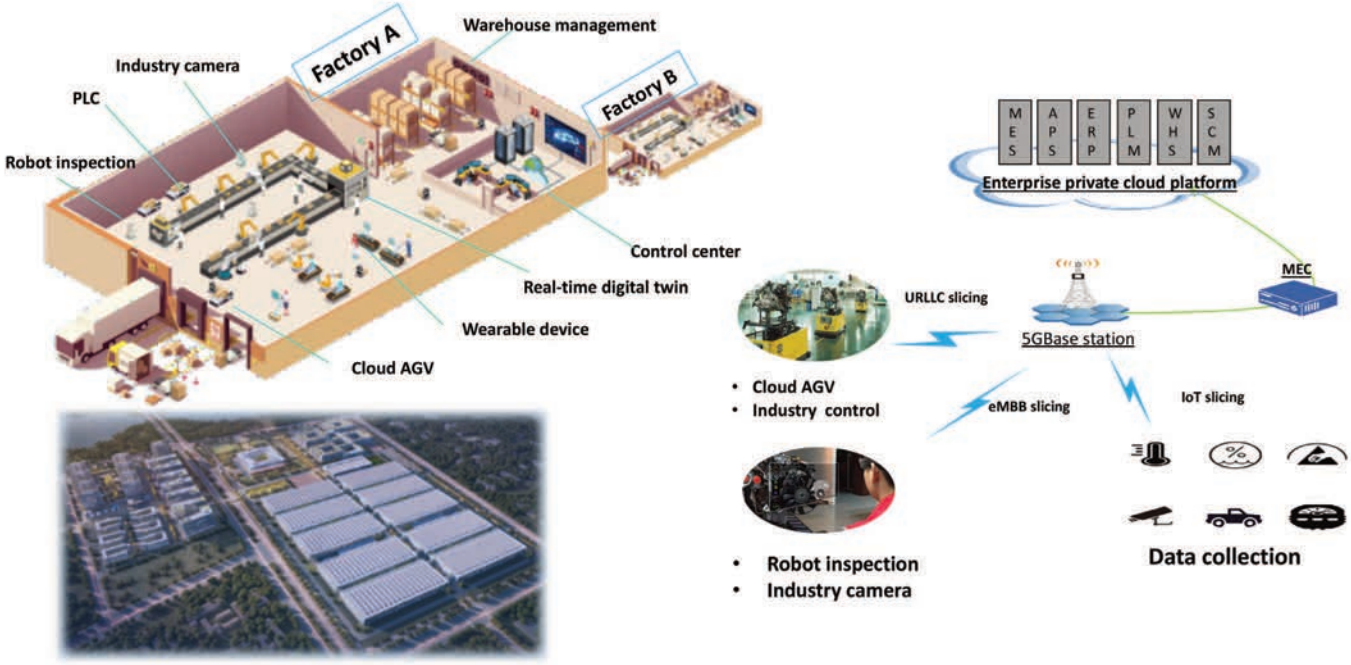
After introducing SA, the biggest benefit for operators is the added flexibility to cater to the vast B2B sector. However, the first challenge is to decide which industries to target.

In China, operators have already opted to work with industry partners in the manufacturing, energy, transportation, entertainment, health and public safety sectors.

China Telecom and ZTE joined hands to explore deploying smart factory applications at the BinJiang Industrial Park in Nanjing city.

The two companies deployed a 5G NR network, with macro and small cells as well mobile edge computing, to enable real-time network slicing. Smart manufacturing services introduced in May 2020 included 360-degree remote production monitoring, automated quality inspection and AR guided repair. In December the industry park will add robots to the production line and start to run autonomous minibuses around the park.

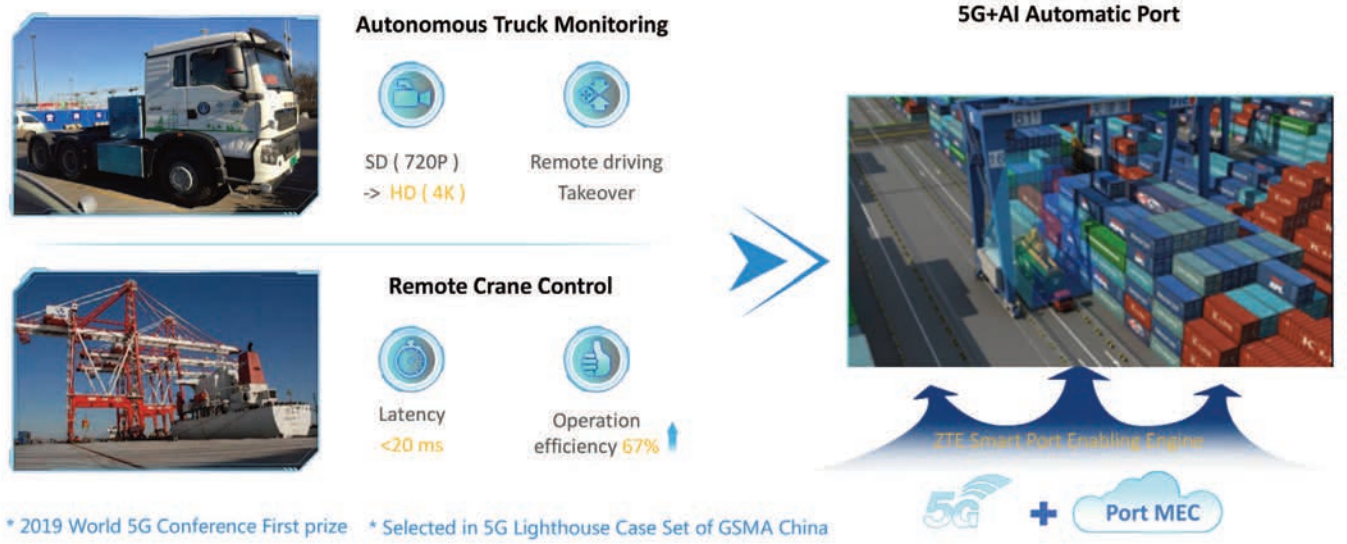
BinJiang smart factory



Tianjin Port Group worked with China Unicom with ZTE in 2018 to demonstrate the world's first 5G and MEC smart port applications. Early services focused on customs inspection and remote real-time monitoring, with video streams uploaded via a 5G network at a speed of more than 80Mb/s and then distributed through the MEC to the port's video cloud.

It also completed pilots in autonomous driving, remote crane control and customs traffic management to support intelligent operation and improve operation efficiency. It won first prize in the 5G World Congress' 5G Application Design Contest.

Tianjin Port leads the way



Outlook

Operators are forecast to invest up to $1 trillion in 5G networks between 2018 and 2025. To recoup these heavy investments, they need to be prepared to introduce a wide range of compelling services for both the consumer and enterprise segments.

5G is expected to have a bigger impact on businesses than consumers but requires far greater network flexibility. This will likely speed up the move to SA in many markets, which will be supported as the broader ecosystem of devices and applications matures to take advantage of the technology's features.

As of end-October 2020, six operators deployed SA 5G networks globally, with another 11 announcing plans to do so.

A recent research note by GSMA Intelligence suggested that with 5G hardware based on Release 16 to be commercially ready by 2022, operators will be able to go to market with a richer set of offerings, giving them a window of opportunity to seek out industrial vendors and systems integrators to capture early movers in Industry 4.0.

Jason Tu, principle scientist of NFV/SDN products at ZTE, believes that to connect everything around us we need SA 5G because one of the key features required to move beyond eMBB is low-latency, which is only supported by SA.

He encouraged regulators and operators to consider deploying SA from the start to avoid a possible painful migration after two to three years. "Rather than take a step-by-step approach to 5G, operators should consider the advantages of going directly: it's more economical and a smarter way to deploy".

He pointed to Singapore, which delayed awarding spectrum until the SA technology was more mature, with the city state's operators now planning to launch SA 5G networks in 2021.

Tu believes 5G is much more than a technology as it has the potential to be the engine of the digital economy, driving the next industrial revolution. "It will encourage a boom in applications beyond consumer communications and entertainment, which we've seen with 4G, into all aspects of life: work, education, health and more."

The technical benefits of 5G are now clear and the standards mature, with the conversation shifting to how the next-generation technology can be used to create value across all sectors of society and be the foundation of growth.

As businesses around the world make the shift to 5G and develop and launch a plethora of new applications, the technology will be well on its way to achieving the target of contributing $2.2 trillion to the global economy between 2024 and 2034 as forecast by GSMA Intelligence in its Mobile Economy 2020 report.

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