ERICSSON

In partnership with

Singtel

# Transforming Singapore's future with 5G

## Singtel - the first and most powerful 5G standalone network in Singapore

February 2022

# Unlocking the future with 5G standalone

## Executive summary

Singtel's 5G standalone (SA) network offers blazing fast speeds, hyperconnectivity, and myriad possibilities for both enterprise and consumers. To unlock the benefits of a 5G-enabled reality, Singtel has been ramping up 5G SA deployment across Singapore with Ericsson's cutting-edge technologies.

In May 2021, Singtel became the first operator to launch 5G SA in Singapore. The implementation of 5G New Radio (NR) SA and cloud-native dual-mode 5G Core has brought a wealth of new opportunities and use cases that were previously unachievable with existing 5G non-standalone (NSA) networks.

Singtel and Ericsson worked together to design and implement a highly configurable, high-performance, SA 5G network that delivers ultra-fast speeds and connectivity. In benchmark tests in 2021, Ookla declared Singtel the "fastest 5G mobile operator in Singapore."[1]

"5G SA provides new capabilities, driving new use cases and opportunities. Singtel is committed to continually innovate and maximize the potential of what this developing technology can deliver. Our 5G SA network, powered by Ericsson, will help pave the way for many new applications as we look to drive transformative benefits for consumers and businesses."

**Mark Chong, Group CTO, Singtel**

In May 2021, Singtel – in partnership with Ericsson – became the first operator to launch 5G SA in Singapore, an achievement that aligns with Singtel's ambition to differentiate its 5G offerings beyond connectivity to innovate consumer services and enterprise solutions.

As the largest mobile network operator in Singapore, Singtel is a driving force in developing new opportunities and experiences for both consumers and enterprise across the nation. Singtel provides ISP, IPTV mobile and fixed-line telephony services, it is the largest mobile service provider in Singapore.

Tay Yeow Lian, MD Networks, Singtel explains: **"In 5G, there are many more advanced features slated for the 3GPP release, for example, network slicing, ultra-low latency and mobile edge computing. These are all very exciting and we hope to use this technology to drive a differentiated customer experience and solutions for our customers."**

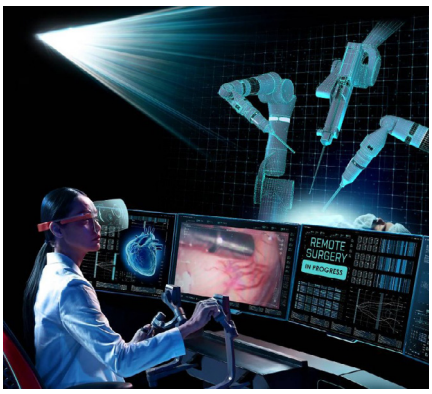
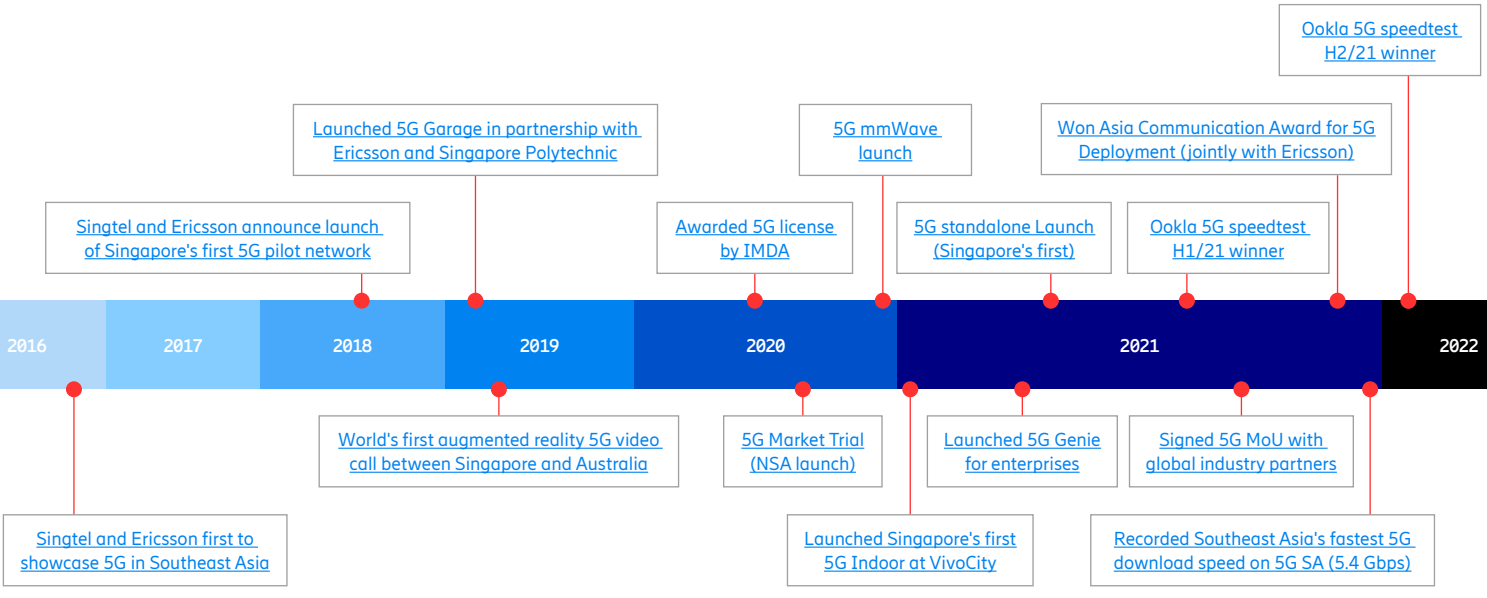



**Figure 1: Singtel and Ericsson partnership milestones**




[1]Ookla Speedtest Awards 2021, Fastest 5G Mobile Network

## Enhancing Singapore's digital infrastructure

Singapore is a regional business, economic and technology hub in Asia Pacific, and was ranked as one of the world's most competitive nations for two years running by the annual Institute for Management Development (IMD) World Competitiveness Ranking.

5G introduces new innovation possibilities that go beyond today's enterprise limitations, enabling new ways to work, think and solve business challenges. Singtel wanted its customers to experience applications such as lag-free online gaming, augmented reality (AR) and virtual reality (VR), and for enterprises, fully automated seaports, industrial robots as well as remotely operated drone fleets, which are only possible with 5G SA.

Singtel has already launched 5G SA to consumers – with over 300,000 customers currently using 5G – and are doing significant tests and trials with key enterprise customers. Singtel believes it is extremely important for customers, and the partners they work with, to validate the opportunities of 5G SA in real-life scenarios and establish a space for developers to innovate with this new technology.

Mark Chong, Group CTO of Singtel says flexibility, affordability and ease of integration are the key business drivers throughout the deployment process. He says: **"From a network perspective, we are talking about harnessing the different parts of the network, making it programmable, exposing the network functions and enabling an easy and standardized way to integrate with customers' applications to deliver controls."**

Being the first to market was also important for Singtel. The ability to develop new 5G SA use cases in collaboration with its customers will increase efficiency and enable them to capture new business opportunities early. In addition, being a global leader in the 5G race was important for Singapore's successful future with 5G. **"It's an honor that Singtel is one of the first telcos in the world to launch the 5G SA network and the government has been heavily supportive of the launch. Singapore's Minister for Communications and Information has encouraged industry to leverage Singtel's 5G technology and to drive use cases in Singapore that can grow the economy,"** says Tay Yeow Lian, MD Networks, Singtel.

**Using 5G SA to increase network capabilities and monetization opportunities**

Singtel's evolution to 5G SA provided a major opportunity for the company to achieve three important, transformational, technical changes that would improve operational efficiency and enable new revenue streams. These were:

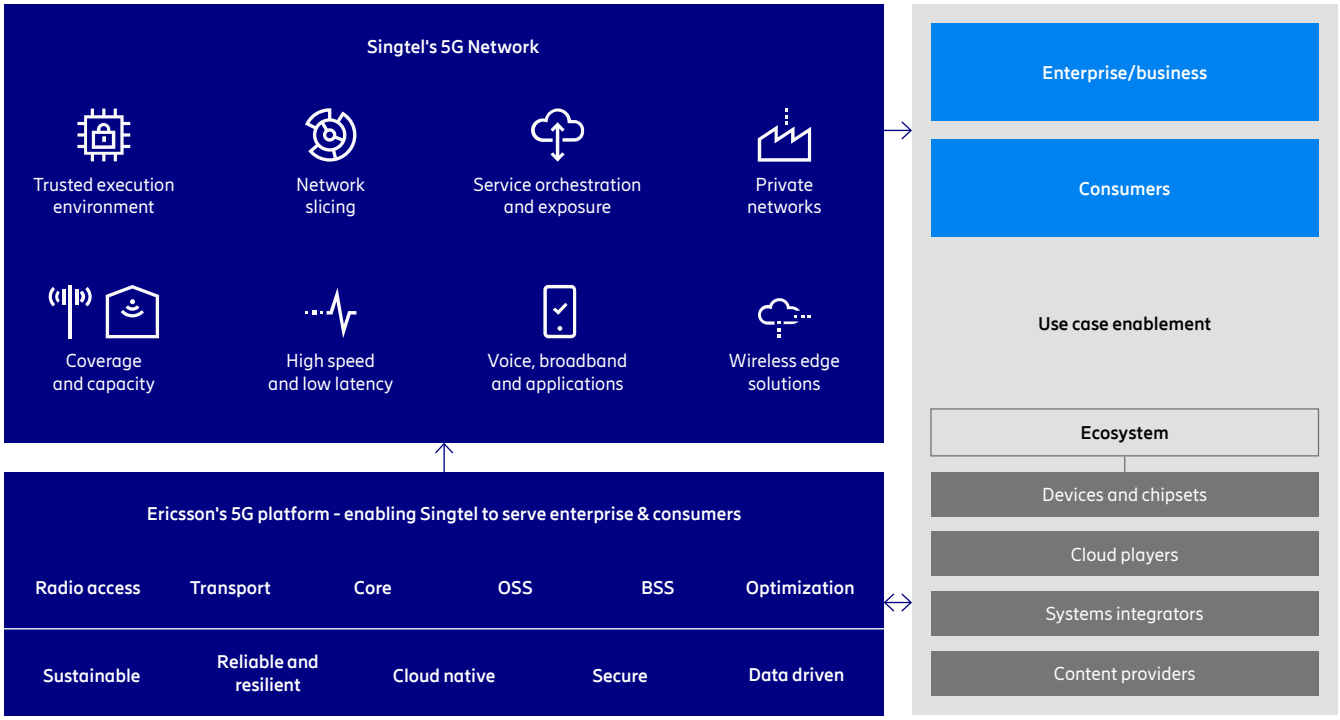
1. create a flexible and programmable network for the future (network programmability)
2. enable rapid and easy integration between the network and customer applications (network exposure)
3. enable a mobile edge to support new industry and enterprise services (enterprise service enablement)

In addition, the move to 5G SA is also needed to address the following wider commercial challenges:

1. enable 5G monetization
2. reduce operational complexity
3. improve sustainability

Singtel recognized the need to overcome the technical challenges posed by the evolution to 5G SA, in order to build a network that meets its long-term strategic vision and drives lasting commercial benefits.

**Figure 2: Singtel's end-to-end network and IT overview**



## Singtel's architecture evolution to 5G SA

Being one of the first telcos in the world to deploy 5G SA was challenging. Singtel devised a comprehensive 5G plan to implement the SA architecture that transformed all network domains including radio, transport and core, along with Operations Support Systems (OSS) and Business Support Systems (BSS). This enabled Singtel to address existing customer needs and use cases as well as attract new customers and drive new use cases as part of the continuing digitalization of Singapore.

Singtel envisages three phases of use cases supported by 5G SA:
1. existing mobile data use cases
2. evolved or "hybrid" use cases – existing use cases leveraging the improved data capability
3. new use cases leveraging the full capabilities of 5G SA including ultra-low latency, improved reliability and enhanced security

**Evolved Packet Core (EPC) evolution**
Singtel rolled out its 5G NSA network in September 2020. This was achieved with a software upgrade of its existing EPC solution from Ericsson to 5G EPC.

**5G Radio and Ericsson Spectrum Sharing**
For a quick introduction of 5G over a wide area and to leverage the 4G spectrum and existing Ericsson Radio System, Singtel and Ericsson implemented Ericsson Spectrum Sharing (ESS) on 2100MHz.

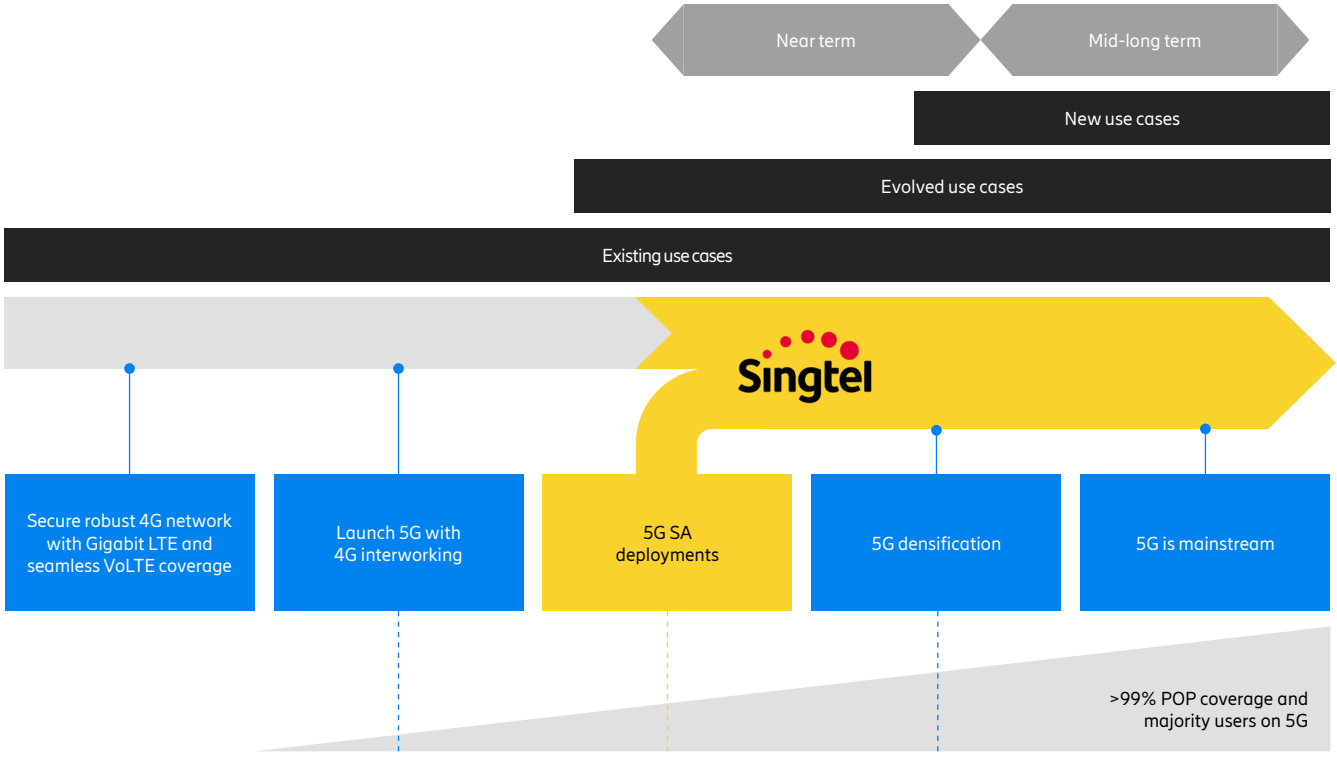
Time-to-market is always a challenge when introducing new services. Singtel overcame this with a rapid deployment plan leveraging Ericsson's state-of-the-art 5G SA software, which can run on existing NSA radio access network hardware.

With sustainability in mind, Singtel has been deploying 5G with precision to maximize performance. The next plan is to activate energy-saving software features and use AI/ML to reduce energy costs, with no negative impact to user experience or network performance. A combination of these efforts will result in a more energy-efficient network and a lower carbon footprint.

**Importance of indoor coverage**
In Singapore, indoor mobile traffic makes up around 80 percent of all network traffic. This means that indoor coverage and capacity planning are critical to customer experience. Singtel was the first operator to deploy indoor 5G, starting with the largest mall in Singapore, Vivocity, which required more than 50 antennas to maximize coverage. The 5G deployment was swiftly extended to several hundreds of malls and buildings in Singapore using 3.5GHz radio dots and 2.1GHz using distributed antenna systems (DAS) solutions.

**High-performance transport networks**
A high-performance transport network is required to connect the radio to the core to support the diverse set of services and deployment models expected in 5G SA. To achieve this, Singtel deployed the Ericsson Router 6000 Cell Site Router.

**Figure 3: Singtel end-user use case evolution**



**Leveraging the power of dual-mode 5G Core**

Singtel moved from EPC to 5G EPC to support NSA and deployed a parallel cloud-native 5G Core (5GC) using Ericsson's dual-mode 5G Core to support the SA launch (See Figure 4). It offers full 5GC and EPC functionality in a common cloud-native platform and provides a flexible and smooth migration strategy. The dual-mode core deployment was important for Singtel, as EPC functionality will be needed long term to support legacy (non-5G capable) devices and roaming devices that are EPC-only capable. With the dual-mode 5G Core, Singtel benefits from high levels of network programmability, operational efficiency and resource optimization. It allows Singtel to gradually retire its legacy EPC network and move into cloud-native EPC further reducing operational costs and network complexity.

The new cloud-native 5GC environment included new interfaces and new network functions, which required thorough and vigorous testing. Ericsson Automated Acceptance Tests (AAT) was used to accelerate the deployment and achieve an early launch with 5G SA. AAT saved a substantial amount of time in regression testing, free up Singtel's team to focus on Singtel specific testing and increase the speed of delivery.

**OSS evolution and AI/ML-driven network intelligence solutions**

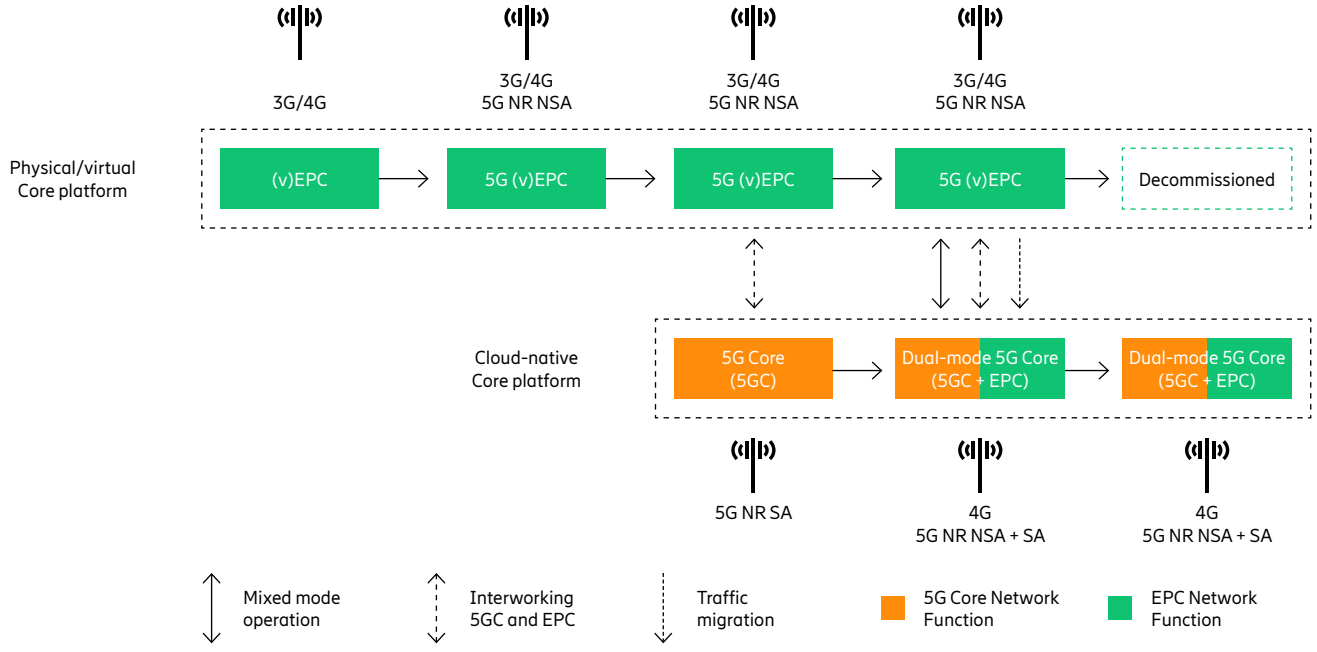
As part of Singtel's transition to a 5G SA network, OSS was enhanced to include:

- Ericsson Network Manager (ENM) to support operation and maintenance of the 5G radio, transport, and core networks
- improved network function and service orchestration to support the newly installed cloud native containerized dual-mode 5G Core
- future deployment of AI/ML-driven Ericsson Network Intelligence (ENI) to examine RAN, core and IP Multimedia Subsystem (IMS) KPIs for troubleshooting, predicting problems and recommending fixes.

**BSS evolution to support new services and price plans**

In tandem with the network evolution, capabilities such as mediation and charging are needed to gather and process network information for monetizing 5G's service packaging and rich bundling for services such as AR, music and gaming, on top of new 5G price plans.

**Figure 4: Singtel's path to cloud-native dual-mode 5G Core**



## 5G SA – enabling new enterprise services and consumer experiences

With a vision to drive 5G-powered industry digitalization, Singtel launched Singapore's first 5G SA trial network for enterprises in October 2020 – deployed at its 5G Garage testing facility. In addition, Singtel is working with Singapore's Advanced Remanufacturing and Technology Centre (ARTC) and the JTC Corporation to develop and test advanced 5G-powered manufacturing solutions. Singtel was also selected by Govtech, the technology arm of the Singapore government, to provide a 5G test bed on the island of Sentosa for government agencies to test 5G use cases. In 2021, a total of 10 trials have started.

To support rapid trial of use cases, Singtel and Ericsson launched the world's first portable 5G platform, GENIE. Installed in under an hour, GENIE enables enterprises to experience 5G's capabilities and trial use cases in their own premises. Singtel and Ericsson and have also partnered with nine global industry partners to accelerate 5G adoption across multiple industries, as well as to develop and deploy advanced 5G solutions in Singapore.[2]

Going beyond connectivity, Singtel co-creates new 5G services and business models with global enterprises through its multi-access edge computing platform. The first telco in Asia-Pacific to demonstrate cross-region, multi-access edge computing (between SKT and Singtel through Bridge Alliance),[3] Singtel today offers the most comprehensive 5G stack including infrastructure/network/platform-as-a-service with self-service and application programming interface (API) integration capabilities.

On the consumer front, Singtel continues to create and deliver new entertainment experiences for customers including Singapore's first underwater 5G livestream of the S.E.A. Aquarium to UNBOXED and collaborations with the National Gallery Singapore and Esplanade – Theatres on the Bay to deliver cultural and art experiences over 5G, from the Singtel Special Exhibition Gallery and the Singtel Waterfront Theatre when it opens officially this year.

Moveable unmanned 5G pop-up store – UNBOXED – powered by Singtel's 5G (mid-band and mmWave)

## Ericsson solutions deployed by Singtel:

- **Ericsson Cloud Packet Core:** Existing physical/virtual Evolved Packet Core (EPC) network upgraded to support 5G NSA and 4G services.
- **Ericsson's dual-mode 5G Core:** Container-based, cloud-native platform including packet core, unified and data management, policy, signaling controller and exposure network functions.
- **Ericsson NFVI:** Cloud infrastructure including Ericsson Cloud Container Distribution (CCD) based on Kubernetes opensource container orchestration system.
- **Ericsson Cloud IP Multimedia Subsystem (IMS):** Supporting voice services, initially with EPS fallback and later voiceover NR (VoNR).
- **Ericsson 5G RAN:** Antennas, radios, baseband (RAN Compute), and RAN software to enable incredible speeds and mobility.
- **Ericsson Spectrum Sharing:** Software solution for quick introduction of 5G over a wide area, leveraging 4G spectrum and existing Ericsson Radio System Infrastructure.
- **Ericsson's mmWave:** To enhance the 5G experience and performance, Singtel will also deploy Ericsson 5G in the mmWave band (28GHz) in the near future.
- **Ericsson Router 6000:** IP transport portfolio, delivering high-performance connectivity for LTE, LTE-advanced and 5G applications.
- **Ericsson Dynamic Orchestration:** Including Ericsson Network Manager (ENM), AI/ML driven Network Intelligence (ENI), and Ericsson Orchestration – cloud-manager and service orchestration.
- **Ericsson Digital BSS/5G charging:** To capture 5G network data and monetize 5G services.

[2]Ericsson press release, 'Ericsson and Singtel power up Singapore's 5G enterprise ecosystem with global industry partners', Oct 2021
[3]https://www.bridgealliance.com/2021/03/16/bridge-alliance-singtel-sk-telecom-trial-interconnected-multi-access-edge-computing-across-singapore-and-south-korea/

## Unparalleled flexibility and speed with 5G SA

With 5G SA, Singtel and Ericsson have delivered up to 10 times greater data speeds than LTE, halved latency, and enhanced network capacity. This supercharged connectivity has seen Singtel recognized internationally and nationally with a number of awards. Ericsson and Singtel also jointly won 2021's Asia Communication Award in the 5G deployment category for delivering Singapore's first and fastest 5G SA network.

Singtel and Ericsson also made a technology breakthrough in 5G SA New Radio-Dual Connectivity (NR-DC), becoming the first in Southeast Asia to reach download speeds of 5.4Gbps.[4] This was achieved in a demo with Ericsson's 5G RAN and dual-mode 5G Core network solutions.

**Inspiring consumers, enterprises and government**
Singtel has partnered with enterprises and the government to leverage the opportunities that the new 5G SA network offers to consumers and enterprises in Singapore. This includes developing use cases in collaboration with start-ups and enterprises in areas such as robotics, VR, AI and drones, and trialling maritime 5G use cases to optimize port operations at the future Tuas Port. They have also collaborated with GovTech Singapore and Sentosa Development Corp to support large-scale adoption of 5G by government agencies and develop Singapore's 5G ecosystem.

**Future innovation: Supporting the next generation of industry talent**
Ericsson and Singtel's collaboration with global industry partners to develop advanced 5G enterprise solutions in Singapore, which can be scaled for global deployment, will create exciting new industries and job opportunities.

It will also provide a boost to Singtel's partnership with IMDA, the National University of Singapore (NUS), and Singapore Polytechnic (SP) to attract and build a pool of capable talent in 5G and emerging technologies such as the Internet of Things, cloud engineering and data analytics.

"To achieve our goals we followed the three P's. The first 'P' is people. I'm very heartened to see the great partnership between the Singtel engineers and the Ericsson engineers. The second is processes. We engaged the local engineers, and the PDU back in Stockholm, enabling us to fix all the issues without glitches to prepare for the launch. Lastly, the platform – Singtel is very happy to have selected Ericsson as our 5G platform, and now we're reaping the benefits of getting ready for 5G and we hope to grow the 5G business."

**Tay Yeow Lian,**
**MD Networks, Singtel**

## Key learnings and insights

The wider benefit of Singtel's project is that the industry can learn and gain insights from one of the world's first commercial 5G SA deployments, which will accelerate their own adoption of the new 5G technology. The insights can be characterized as people, platform and process.

**People insights**
One of the challenges for new technology is the skills gap that companies face in areas like 5G NR, containerization and network engineering. Singtel recognized that education was a key factor for success. Using its position as a technology leader in Singapore, Singtel trained or retrained over 250 engineers and influenced the technical curriculum for new engineers to ensure that new staff have the right skills for these ground-breaking network technologies. The company also educated its consumer and enterprise customers on the capabilities of the new technologies.

**Process insights**
Too often technical transformations fail, as companies do not recognize that for the technology to succeed, the underlying processes have to evolve as well. Singtel took a holistic approach to its current processes and made changes that allowed it to leverage the new capabilities for automation and the use of AI/ML technologies to reduce operational complexity and costs.

A key to successful enterprise use cases is the ability to support and enable new 5G applications that provide value to industry. This not only requires the ability to access the Singtel network using new APIs and interfaces, known as network exposure, but to also have the right processes to develop and launch these services seamlessly and securely.

**Platform insights**
The evolution to a 5G SA network requires changes to almost every aspect of the network, RAN, transport, core, BSS and OSS systems, which Singtel believes will take three years to complete. The benefits of this change are enormous. For consumers, it allows Singtel to offer new services linked to increased speed, improved reliability, reduced latency and improved security. The 5G SA network is better able to support dedicated private networks and enterprise applications at the mobile edge, making 5G a genuine enabler for new enterprise services with the ability to surpass traditional Wi-Fi and LAN enterprise network capabilities.

**Looking to the future**
Singtel had a vision for the future that has not only delivered Singapore's fastest 5G network, but more importantly has enabled it to work collaboratively to create new use cases and services for consumers and enterprise that leverage the full capabilities of 5G. Ericsson has been proud to support Singtel in executing its 5G SA vision. As long-standing partners over the past 30 years, Singtel and Ericsson are technology front runners in Singapore, and will continue to collaborate closely to build a thriving 5G ecosystem in Singapore.

[4] https://www.singtel.com/about-us/media-centre/news-releases/singtel-and-ericsson-achieve-south-east-asia-first-with-fastest-download

## About Singtel

Singtel is Asia's leading communications technology group, providing a portfolio of services from next-generation communication, 5G and technology services to infotainment to both consumers and businesses. The Group has presence in Asia, Australia and Africa and reaches over 750 million mobile customers in 21 countries. Its infrastructure and technology services for businesses span 21 countries, with more than 428 direct points of presence in 362 cities.

## About Ericsson

Ericsson enables communications service providers to capture the full value of connectivity. The company's portfolio spans Networks, Digital Services, Managed Services, and Emerging Business and is designed to help our customers go digital, increase efficiency and find new revenue streams. Ericsson's investments in innovation have delivered the benefits of telephony and mobile broadband to billions of people around the world. The Ericsson stock is listed on Nasdaq Stockholm and on Nasdaq New York.

www.ericsson.com

Ericsson
SE-164 80 Stockholm, Sweden
Telephone +46 10 719 0000
www.ericsson.com



46/21341-FGB1010909