



[ericsson.com/
mobility-report](https://ericsson.com/mobility-report)

A multi-NR carrier strategy for best performance

Extract from the Ericsson Mobility Report

November 2024

A multi-NR carrier strategy for best performance

stc Group is placing a strong emphasis on expanding its 5G mobile network coverage and capacity, bolstered by various enhancement techniques such as multi-New Radio (NR) carrier aggregation.

Key insights

- A cornerstone of stc’s strategy is to deliver superior network experiences to customers by maintaining national leadership in 5G coverage and speed.
- Adding frequency division duplex (FDD) and time division duplex (TDD) bands with a multi-carrier mobility strategy resulted in a 245 percent 5G traffic volume growth in one year in stc’s network.
- Going forward, stc aims to deploy 5G standalone (SA) and transition it into a high performing and programmable network powered by 5G Advanced.

The Saudi Vision 2030 initiative, introduced in 2016, encompasses several digital programs. Among these are collaborations between service providers and the Government to build a solid telecommunications infrastructure as part of the National Transformation Program. Enhancing both the fixed and mobile network infrastructure is a priority, to attain median speeds in the Kingdom of Saudi Arabia (KSA) that will place it among the top 10 fastest countries in the world. To support this objective, stc is prioritizing expanding its 5G mobile network coverage and capacity, bolstered by various enhancement techniques such as multi-NR carrier aggregation.

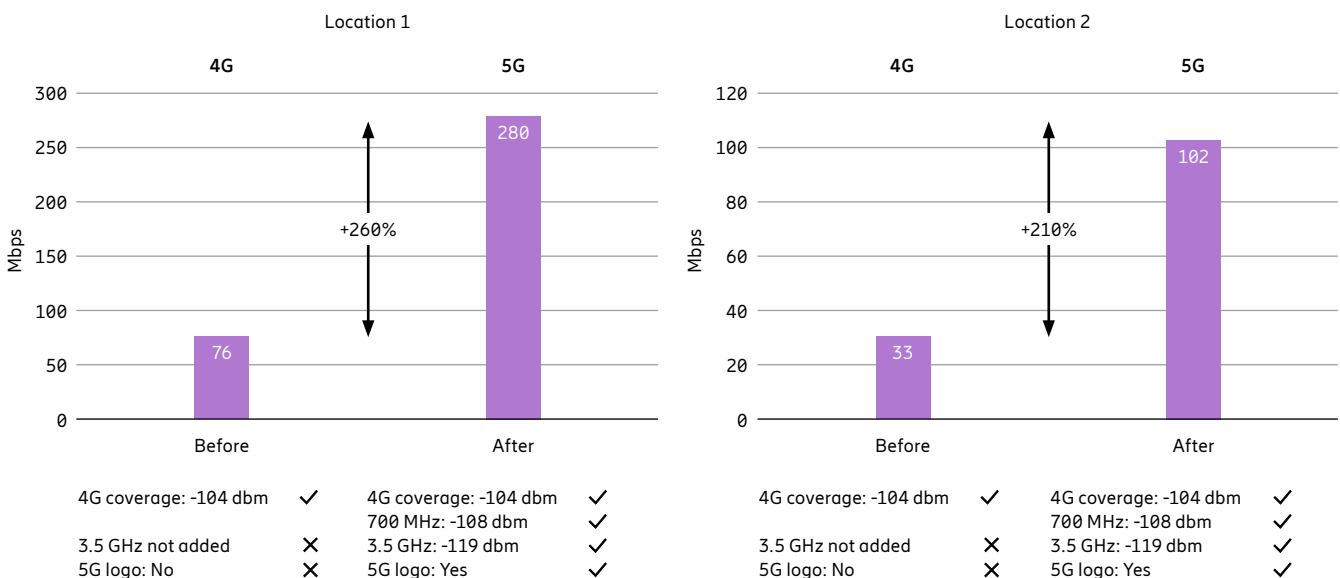
Leveraging carrier aggregation for improved 5G coverage and performance
 Selecting a well-defined business strategy that considers assets, market conditions, the competitive landscape and desired positioning is crucial for success in any business. A cornerstone of stc’s strategy



This article was written in collaboration with stc, a market-leading digital enabler in the KSA, providing innovative digital services and platforms to customers in the Middle East and North Africa region.

is to deliver superior network experiences to customers by maintaining national leadership in 5G coverage and speed. Aligned with the aims of the ambitious Saudi Vision 2030, stc is expanding 5G coverage and proactively increasing capacity to maintain performance leadership and accommodate the continuous traffic growth driven by enhanced mobile broadband (eMBB) and Fixed Wireless Access (FWA).

Figure 24: Coverage and downlink median speed improvements with 5G carrier aggregation



To provide a good 5G user experience, stc's strategy includes leveraging carrier aggregation as a cornerstone for improved 5G coverage and performance. This involves the addition of second, third and fourth¹ NR carriers throughout the network.

This strategy was initiated in 2020, as stc evaluated the impact of FDD/TDD carrier aggregation and its ability to expand 5G coverage and increase network capacity, while supporting higher peak rates. Improvements in coverage and median downlink speed due to 5G carrier aggregation are illustrated in Figure 24, which shows test measurements from two areas in Riyadh before and after the low-band (700 MHz) deployment and addition of carrier aggregation in Q4 2023. These areas had no 5G coverage before low-band was deployed and aggregated with mid-band (3,500 MHz). The deployment resulted in significantly improved median downlink speeds in both areas. Currently, the peak rate throughput is over 2 Gbps for an evolved non-standalone (NSA) dual connectivity (EN-DC)² user. The monthly 90 percentile of NR throughput measured is 750 Mbps in live network across the KSA and over 800 Mbps in the capital, Riyadh.

The need for additional mid-band spectrum to meet service demand
Additional TDD spectrum was recognized by stc as being essential for further increasing the capacity of the mobile network in order to meet the rising demands of digital services, while enhancing the network experience and global speed ranking.

Testing commenced with an additional TDD-mid band carrier to enable third and fourth carrier aggregation as needed. Spectrum testing at 2,300 MHz was initiated, to evaluate the coverage gain on top of the 3,500 MHz (C-band) and throughput gains in TDD-TDD carrier aggregation. This was implemented across stc's network in 2022–2023.

stc's RAN mobility strategy

The use of spectrum components, including 700 MHz (FDD), 3,500 MHz (TDD) and 2,300 MHz (TDD), were defined and a target of median 5G speed of 300 Mbps in deployed areas was set. The next step involved devising a Radio Access Network (RAN) mobility strategy to maximize the investment and optimize performance in both mobile and stationary (that is, FWA) modes. A clear strategy was essential to address these various challenges:

- stc has a high-performing 4G network, and did not want to utilize only the 700 MHz carrier (single layer) for 5G access, as the user experience might be perceived as worse than when connected to the 4G network (85 MHz FDD available).
- The 2,300 MHz device ecosystem is expanding but is not as extensive as the 700 MHz and 3,500 MHz ecosystems.
- Multiple devices in the network didn't support FDD/TDD carrier aggregation, which ensures they are served by TDD layers only.

Numerous scenarios were evaluated both theoretically and in practical field tests to determine the most effective strategy for achieving the objectives.

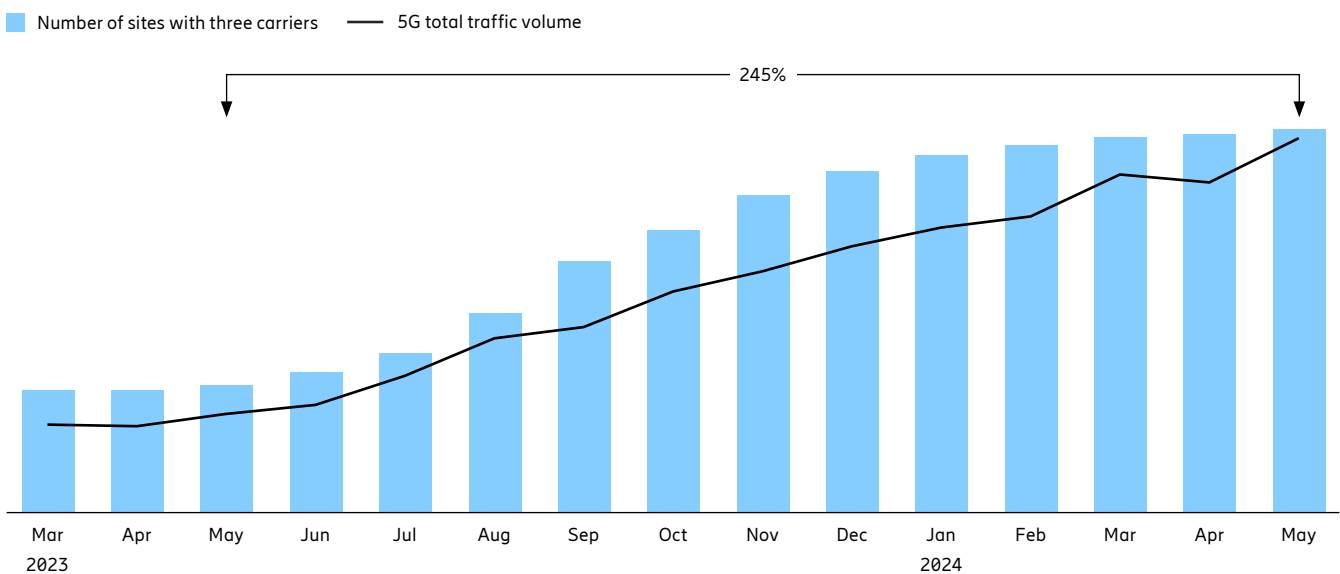
First was priority-based assignment, with 3,500 MHz having the highest priority, followed by 2,300 MHz and then 700 MHz. One major issue with priority-based assignment, despite having carrier aggregation available under all scenarios, was that utilization levels on 2,300 MHz were low due to low device penetration on that band. In addition, stc did not want users to be served only by low-band (700 MHz), but always served by low-band and mid-band carrier components aggregated for all service scenarios. Therefore, priority-based assignment alone was not optimal, prompting the need for a more effective approach. After conducting iterative field testing, the mobility strategy was finalized, incorporating advanced RAN and core network features such as capability-aware idle mode control, user and service-specific mobility and EN-DC-triggered handover during connected mode mobility.

Separating FWA and mobile broadband layers

The mobility strategy involves separating FWA and mobile broadband layers, directing services toward specific layers to improve mobile experience and FWA coverage.

FWA: Within 5G mid-band coverage (2,300 MHz and 3,500 MHz) an FWA user will be served by 2,300 MHz as primary secondary cell (PSCell), as the coverage of 2,300 MHz is better indoors. When the router is outside of such coverage it will be served by low-band (700 MHz) as PSCell. The threshold is set for 700 MHz coverage to ensure 3,500 MHz as secondary cell (SCell) and avoid 700 MHz being the only NR layer.

Figure 25: Multi-carrier aggregation strategy drives traffic growth



¹ Fourth carrier dependent on coming Saudi Communications Authority (CST) auction results.
² EN-DC is a 5G feature that allows for simultaneous 4G LTE and 5G NR connectivity in a 5G NSA network. This enables 5G devices to connect to both 4G and 5G at the same time, improving coverage, speed and reliability.

eMBB: Within 5G mid-band coverage (2,300 MHz and 3,500 MHz) an eMBB user will be served by 3,500 MHz as PSCell. When the device is outside of such coverage it will be served by low-band (700 MHz) as PSCell. The threshold is set for 700 MHz coverage to ensure 3,500 MHz as SCell and avoid 700 MHz being the only NR layer.

In summary, stc only uses the NR 700 MHz layer as a coverage extension for 5G NR carrier aggregation with NR 2,300/3,500 MHz, and not full NR 700 MHz coverage, reducing the actual NR 700 MHz layer coverage to achieve that objective. This is to ensure that when the "5G icon" is visible on device screens, the subscriber has a better EN-DC performance than with LTE-only performance.

The new configuration of adding FDD and TDD bands with a multi-carrier mobility strategy has resulted in a 245 percent 5G traffic volume growth in one year in stc's network. This is about three times more traffic than would have been expected without three carrier deployments. This growth has mainly been driven by extended FWA coverage due to deployed 700 MHz and 2,300 MHz.

Alongside continued coverage extension of the terrestrial mobile network, stc is building an air-to-ground (A2G) network covering the main national air routes, providing airlines with reliable high-performance connectivity.

It has also acquired spectrum license (2,100 MHz) for non-terrestrial networks (NTN) to provide nationwide mobile communications via mobile satellite services (MSS).

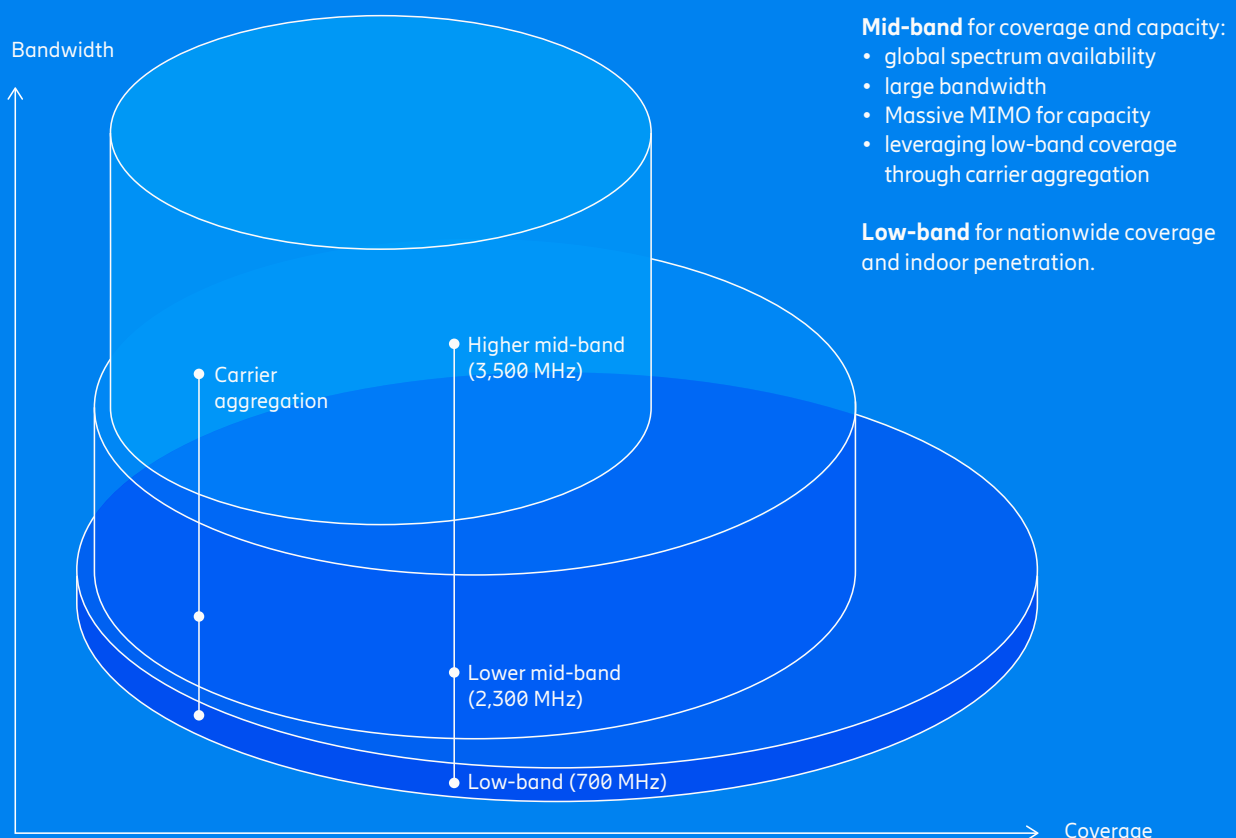
The Communications and Information Technology Commission (CITC) in the KSA has updated the IMT regulatory document in furtherance of its national spectrum strategy, which aims to further unlock the potential of radio spectrum in the KSA by 2025. With additional spectrum expected in low/mid-band, an evolved mobility strategy will continue to play a fundamental role in getting the maximum performance out of precious spectrum assets.

Multi-band NR carrier aggregation for best performance

stc is the largest digital enabler in the KSA, with around 27 million mobile subscriptions and 1.6 million 4G and 5G FWA subscriptions, representing a 55 percent market share. stc launched 5G commercial services in June 2019 and now has over 7.5 million 5G subscribers. Since commercial launch, 5G population coverage has reached 50 percent, with a target to have 5G coverage in all cities

with a population of over 5,000, with a median speed of 100 Mbps, by 2029. The set countrywide median speed target is 300 Mbps by 2030. Going forward, stc aims to deploy 5G SA and transition it into a high-performing and programmable network powered by 5G Advanced. This will enable new service offerings based on SA network capabilities such as network slicing and differentiated connectivity.

Figure 26: A coordinated multi-layer network for best performance



About Ericsson

Ericsson's high-performing networks provide connectivity for billions of people every day. For nearly 150 years, we've been pioneers in creating technology for communication. We offer mobile communication and connectivity solutions for service providers and enterprises. Together with our customers and partners, we make the digital world of tomorrow a reality.

www.ericsson.com