CASE STUDY

A leading European operator enhances 5G uplink data rates with SRS-based Beamforming

- 40% increase in median uplink data rates
- 25% more users experiencing uplink data rates of 50Mbps

NOKIA

As operators roll out and expand their 5G networks, subscribers have come to expect superior data rates for a true 5G experience.

In typical 5G deployments built on a multi-band 4G foundation, the 3.5GHz frequency band is key to higher data rates.

Maximizing network capacity per site is essential for operators to sustainably serve the continued traffic growth and meet their targets for network energy efficiency.

This case study describes how a leading operator in Europe enhanced the performance of its 5G Massive MIMO cells on the 3.5GHz band with Sounding Reference Signal (SRS) based Beamforming software.

Nokia is a long-term partner and Radio Access Network (RAN) supplier for this customer.

In this case study, we examine the results from a city of close to one million inhabitants, where the operator achieved high uplink throughput gains.

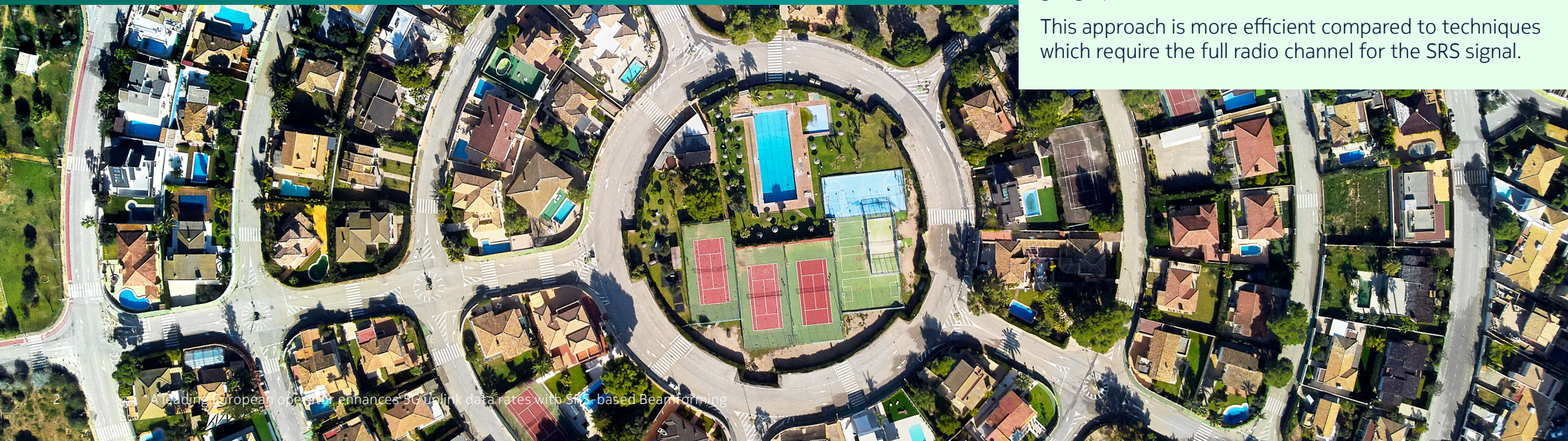
SRS-based Beamforming

To estimate the radio channel conditions, a 5G base station listens to a sounding reference signal it receives from a mobile device, and then adapts beamforming weights for both uplink and downlink data transmission for that mobile device accordingly.

Nokia's implementation of SRS-based Beamforming leverages sub-band channel sounding, which means that the SRS signal from the mobile device uses only a small portion of the radio channel. This results in higher received power, or in other words, higher spectral density levels at the 5G base station.

Nokia's SRS-based Beamforming technique uses channel reciprocity for better radio channel estimation. It helps extend a radio cell's coverage and capacity, supporting hundreds of simultaneous mobile users over a larger geographical area.

This approach is more efficient compared to techniques which require the full radio channel for the SRS signal.



OBJECTIVE

Enhancing uplink data rates at existing 5G Massive MIMO sites

The European operator launched its 5G network in 2020. It prioritized the quality of service and placed the 3.5GHz frequency band at the center of the rollout to deliver a true 5G experience for subscribers.

In response to anticipated 5G data traffic growth, the operator wanted to further enhance the typical uplink data rates of its existing 5G radio sites.

The European city where the uplink performance was measured has a high geographic population density. In its historic city center, buildings are relatively tall and many streets are very narrow, which is a special flavor of a dense urban environment.

The city has close to one million inhabitants, and its urban area extends from the sea to the surrounding hills.

The geographic landscape can cause coverage challenges.

The combination of these characteristics made this city an ideal candidate for verifying the performance gains of SRS-based Beamforming software on 5G Massive MIMO radios.

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SOLUTION

Nokia's SRS-based Beamforming in uplink with AirScale Massive MIMO radios

The operator uses the 3.5GHz band for 5G and multiple lower frequency bands for 4G, an excellent foundation for a superior 5G user experience through 4G-5G dual connectivity.

In the urban area of the city we chose for this case study, the operator has deployed Nokia's AirScale Massive MIMO radios to serve the 3.5GHz band.

Depending on topology and traffic load, the inter-site distances can reach several hundred meters. To reflect each site's specific requirements, the operator has chosen 32 TRX and 64 TRX Massive MIMO radios for the deployment.

Many of the Massive MIMO radios are located on rooftop sites.

Nokia helped the operator upgrade its 5G network with SRS-based Beamforming software to further enhance performance.

The sounding reference signal steers the Massive MIMO beams more precisely to where the 5G signal is required: horizontally and vertically, directly in line-of-sight or via reflections on building fronts.

The vertical dimension of beamforming has proven essential for the performance of the 3.5GHz band. It can serve users in any street running alongside a rooftop site and those several hundred meters away.

Likewise, it enables the 5G service to work effectively from the existing sites across the urban area from the sea to the hills.

RESULTS

Enhanced 5G uplink throughput and more consistent user experience

Nokia worked together with the operator to validate the impact of SRS-based Beamforming software in uplink.

The tests confirmed that SRS-based Beamforming extends the reach of existing sites, thus increasing the share of locations where mobile users feel well connected.

The testing took place during an average workday with ongoing commercial traffic running on the operator's 5G network.

The following results were observed:

- In drive tests, more than 90% of all uplink throughput measurements exceeded 5Mbps.
- At a 200-500 m distance from the 64 TRX Massive MIMO radio sites, the median uplink data rate more than doubled.
- Overall, the median measured uplink data rates increased by 40%.

A closer look at data measurements at specific sites confirmed further the benefits of SRS-based Beamforming:

- In direct proximity to a rooftop site on an 11-storey building, the measured uplink data rates at street level increased by over 35Mbps.
- Towards the cell edge, more than a kilometer down a long avenue from another rooftop site, the measured uplink data rates more than doubled.
- The likelihood of users experiencing uplink data rates of over 50Mbps increased by more than 25%.

In general, very high gains could be observed at sites with relatively high vertical elevation, for example in streets meandering up a hill.

Enhanced uplink performance has a significant impact on how people perceive the 5G network experience.

Considering the rapid evolution of smartphone video quality and the subsequent increase in the size of video files, consistently high uplink throughput is essential for mobile users who want to share their videos with friends and family without delay.

Increase in median uplink data rates

40%

25% more users with uplink data rates of

50Mbps

SRS-based Beamforming unlocks the potential of 5G Massive MIMO cells

Mobile network operators are continuously optimizing their networks to enhance both network efficiency and subscriber experience.

As described in this case study, the introduction of Nokia's SRS-based Beamforming software helped a leading European operator efficiently enhance the 5G uplink user experience.

SRS-based Beamforming enhances data rates in both downlink and uplink. It helps maximize the efficiency of Massive MIMO radios, cell sites and mid-band spectrum assets.

While most attention is still on downlink data rates, uplink will grow more relevant as consumer services become more immersive and enterprises adopt 5G on a greater scale.

Beyond capacity considerations, horizontal and vertical beamforming delivers the immediate benefit of increasing the consistency of subscriber experience across a larger geographic area by utilizing an existing cell grid.

The city selected for this case study is representative of many urban areas, which have a high population density but are not massive in size. It showcases the efficiency of SRS-based Beamforming, which can be applied to similar cities elsewhere.

Using Massive MIMO radios in combination with SRS-based Beamforming has the potential to support 5G mid-band rollouts in less densely populated cities with high elevation differences.

Nokia's extended suite of beamforming algorithms, including the SRS-based Beamforming solution, is globally available for customers.

Visit the Nokia AirScale Massive MIMO radios webpage.

Nokia OYJ
Karakaari 7
02610 Espoo
Finland

Tel. +358 (0) 10 44 88 000

CID: 214443

nokia.com

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