Zain KSA deploys 600MHz NR network

- Building first MobileAI City in Middle East
- Enabling smart tourism and supporting Saudi Vision 2030
- Saving 30% in energy costs

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CASE STUDY LEAD: ZAIN KSA, HUAWEI

As Saudi Arabia expects to welcome more than 127 million tourists in 2025, tourism grows closer to becoming the second-largest contributor to the country's economy, supporting the realization of Saudi Vision 2030. In line with its goal to support the national vision and enable digital transformation across key sectors, including tourism, Zain KSA embarked on an innovative project to enhance the visitor experience.

CHALLENGES

The company needed to solve two key challenges. For international tourists, who often have limited knowledge of the region's history, language barriers were negatively impacting the travel experience. At the same time, Saudi Arabia's unique architectural styles, (e.g. thick walls and modern glass buildings) create significant mobile coverage gaps and signal penetration losses making it difficult for existing 5G networks to support advanced services, including seamless AI applications. On the technical front, the Time Division Duplexing (TDD) mid-band 5G network falls short in coverage, uplink performance, and latency, failing to meet the 20Mbps uplink demand across all areas and preventing multimodal AI interactions anytime, anywhere.

SOLUTION

To address these pain points, Zain KSA is transforming Riyadh into the first Mobile AI City in the Middle East, with plans to expand this initiative nationwide within three years. On the network side, the first Frequency Division Duplexing (FDD) 600MHz low-frequency NR network in the Middle East has been deployed, which synergizes with the existing TDD 5G network via FDD and TDD Carrier Aggregation (F+T CA technology). In collaboration with Huawei, Zain KSA co-developed intelligent algorithms such as wide area JIRC (Joint Interference Rejection Combining) and an AI advanced receiver, significantly enhancing coverage and uplink capabilities. Meanwhile, leveraging the intelligent core network, the Mobile Home solution establishes an intelligent network channel that enables multi-device connectivity across long distances. On the application side, to create a personal tour guide, Zain KSA introduced AI-powered Augmented Reality (AR) glasses from Rokid, providing real-time translation, object recognition, and navigation.
The AI system was trained using local data and Arabic language corpora to understand and explain Saudi Arabia's unique cultural context. Every visitor can now have a 'Personal AI Tour Guide' at their fingertips, transforming the travel experience. Additionally, Zain KSA has launched its Private Cloud Gaming service, enabling domestic travelers to directly connect their mobile gaming devices to home PlayStation consoles during trips for uninterrupted gaming.

RESULTS:

The new network transformed the user experience, improving coverage by up to 30dB, increasing uplink capacity by up to 10x, and reducing latency by up to 50%, creating a strong foundation for innovative tourism services.

In addition, in line with its ESG commitment, Zain KSA implemented the industry-leading GigaGreen 4T4R solution, delivering significant advantages: 20% better performance, a 30% smaller size, and a 30% reduction in energy use. Its simplified, efficient design also accelerated deployment timelines.

Project Background

Saudi Vision 2030 is a national strategic framework launched in 2016 to transform the country from an oil-dependent economy into a globally leading modern hub through economic diversification, social development, and technological innovation. Saudi Arabia is shaping a diversified economy, encouraging AI innovation, championing a 10 Gbps-society, while expanding its tourism, cultural, and entertainment offerings to attract global audiences and unlock new sectors.

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Tourists are discovering Saudi Arabia's unique blend of ancient history and futuristic cities. Flagship destinations across the Kingdom include the Rub'Al Khali (Empty Quarter) Desert, Al Rahma Mosque (the "Floating Mosque") in Jeddah, Royal Palace Museum in Riyadh, the Red Sea destinations, Qiddiya and other attractions. Visitors can explore centuries-old desert trade routes and Islamic art, and a $100-billion future urban and entertainment complex. They can experience regenerative luxury at The Red Sea and connect with the Nabataean civilization in AlUla. As flagship national projects reach new milestones in 2025, Saudi Arabia continues its transition toward a diversified economy built around culture, tourism, and immersive visitor experiences.

Challenge

Business Challenge

As Saudi Arabia rapidly grows its tourism sector, many international visitors arrive with little knowledge of the nation's rich history. Combined with a low prevalence of English language, this creates communication barriers that can limit the visitor experience. In parallel, Saudi Arabia is advancing digital transformation to foster a vibrant, knowledge-based society and enhance the service industry, with a focus on delivering world-class tourism experiences.

To do so, the government is integrating 5G and AI to deliver intelligent tour-guide services to international visitors. These services are accessible through mobile apps and innovations, including AI Glasses, which use advanced visual recognition and real-time conversation skills. Whether exploring busy streets, historic cities, or museums, visitors can receive detailed explanations of landmarks and artwork instantly.

Crucially, these tools help overcome language barriers. Visitors can use AI-enabled smartphones and glasses for real-time translation, allowing conversations with locals during activities and everyday engagements, including shopping or dining. This also enables them to gain a deeper understanding of local culture and customs.

Technical Challenge

Saudi Arabia's unique construction standards create major challenges for mobile signals. Traditional buildings have walls with a thickness of up to 50cm, causing signal losses up to 20dB higher than normal. Furthermore, modern glass and metal high-rise buildings cause signal reflections, creating indoor coverage holes and interference. Newer commercial buildings often use triple-glazed glass to manage the heat, which further weakens indoor signals by up to 25dB, compared to standard glass. These physical barriers are a hurdle for advanced AI applications, which require reliable high uplink throughput, low latency, and wide indoor coverage.

In practice, a mid-band 5G layer alone may not reliably provide the 20Mbps uplink speed tourists need anywhere, anytime. This can lead Personal AI Tour Guide users to occasionally lose connection while exploring the city or visiting historical sites.

> "We are committed to enhancing travel experiences sustainably through the integration of 5G and AI, leveraging ubiquitous AI-guide services to support Saudi Arabia's tourism industry and contribute to Saudi Vision 2030. To achieve this, we needed solutions to address challenges preventing deep indoor and wide area coverage and meet new demand for high uplink capacity and low latency from multimodal AI interaction applications."

Mohammad AlNujaidi - CTO, Zain KSA

Solution

Network Foundation

To continuously optimize user and visitor experiences, Zain KSA has deployed the world's first FDD 600MHz low-frequency 5G Standalone (SA) network, which synergizes with the existing TDD 5G network. Through FDD+TDD carrier aggregation (F+T CA), this layer significantly enhances network coverage and uplink capacity. To further improve the network's uplink performance for multimodal, AI interactive applications with large uplink capacity, Zain KSA collaborated with Huawei to develop software algorithms such as intelligent cell coordination and intelligent link management.

1. Implementing wide-area Joint Interference Rejection Combining (JIRC) enables large-scale intelligent orchestration from intra-site to multi-site, delivering predictable experiences through distributed uplink Extra-Large Antenna Array (ELAA).

2. Advanced AI receiver technology is introduced to demodulate higher-order MCSs under the same air-interface (SINR). In addition, TTI-level link adaptation is implemented to ensure modulation and coding scheme (MCS) selection tracks over-the-air interface changes in real time, enhancing the uplink user experience. These enhancements support multi-modal AI interactive applications and significantly enhance the travel experience of international tourists.

Application Enablement

To revolutionise the visitor experience, Zain KSA introduced innovative AI terminals, primarily the Rokid AI+AR glasses, to power the 'Personal AI Tour Guide'. These glasses integrate AI visual recognition, real-time language translation, and intuitive visual navigation. This hands-free technology addresses common travel frustrations. Visitors no longer need to look down at a map or struggle with devices; navigation appears directly in their field of view, making the tour safer and more immersive. They can instantly learn about cultural relics simply by looking at them, and use real-time translation to communicate with local residents.

Simultaneously, Zain KSA worked closely with Rokid to optimize the technology, leveraging local internet data and an Arabic language model to tailor content to Saudi history, culture, and service needs. This enhancement turns the AR glasses into a safe-to-use, immersive, personalized guide. In addition, Zain KSA supports Saudi Arabia's growing gaming industry launching the the 'Private Cloud Gaming', a service designed to deliver seamless user experience across devices based on 'Mobile Home' network solution. Local tourists can connect their mobile gaming devices directly to their home PlayStation consoles while traveling and continue enjoying their favorite games on the go. This network solution will integrate additional connected home devices in the future, using wireless technology to deliver low-latency, high-definition service experiences for users and tourists.

In parallel, Zain KSA is pioneering a Mobile AI City in Riyadh, with plans to expand the initiative nationwide over the next three years.

Deployment

Zain KSA initiated the 600MHz low-frequency NR network proof-of-concept (PoC) experimental testing in June 2024, with large-scale contiguous deployment starting in July. To date, the network has achieved coverage of Riyadh's core urban areas, with full city coverage expected by the end of 2025. Deployment will extend to key cities including Madinah and Dammam by 2026, with nationwide coverage across Saudi Arabia projected for 2027-2028.

During deployment, Zain KSA adopted the industry-leading GigaGreen 4T4R low-tri-band solution. Compared with the industry baseline, this solution offers 20% performance improvement, 30% reduction in size and weight, and 30% decrease in energy consumption. The solution is also highly simplified, efficient, and easy to deploy, significantly shortening project timelines and reducing time to market (TTM). This strongly supports Saudi Arabia's advancement toward building a "zero-carbon society."

Zain KSA adopted the industry-leading GigaGreen 4T4R low-tri-bandsolution, resulting in a 30% reduction in energy consumption, in line with Saudi Arabia's zero-carbon goals.

Result

After the commercial launch of the 600MHz low-frequency NR network, coverage capability improved by 10-30dB, uplink capacity increased 10x, and latency was reduced by up to 50%. This laid a solid foundation for the large-scale adoption of multimodal AI interaction applications. Today, when using multimodal AI services, tourists enjoy smoother and more intelligent interactive experiences. Through the 'Personal AI Tour Guide', they can access expert explanations of historical sites and scenic spots anytime, anywhere, driving the visitor experience and contributing to the realization of national tourism goals.

In 2024, the total number of tourists in Saudi Arabia amounted to 116 million, with international visitors reaching 30 million, a year-on-year increase of 9%. The number of tourists in 2025 is projected to surpass 127 million. This brings the Kingdom closer to its goal of positioning tourism as the second-largest economic contributor after oil by 2030.

"Rokid has accumulated extensive successful practices in smart cultural tourism. This collaboration with Zain KSA, leveraging the world's lightest AI+AR glasses hardware platform, has successfully developed a professional 'Personal AI Tour Guide' through customized Large Language Model (LLM) training. This guide deeply understands Saudi Arabia's historical context, regional culture, and tourism service details, injecting technological momentum into the country's tourism industry. We are honored to contribute to the realization of Saudi Vision 2030."

Future Outlook

By building an experience-driven economy ecosystem, Saudi Arabia is poised to transition from an oil-dependent economy to a global cultural and tourism hub. By 2030, tourism is expected to contribute 10% to GDP and create 1.6 million jobs. To further support Saudi Vision 2030, Zain KSA will accelerate the nationwide deployment of 600MHz low-frequency NR network, developing multi-dimensional network capabilities with extensive coverage, large uplink, and low latency. This will enable a comprehensive Mobile AI network that continually optimizes multimodal AI travel experiences.

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Xi Chen - Vice President, Rokid

About the GSMA

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.

For more information, please visit the GSMA corporate website at gsma.com

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About the GSMA Foundry

The GSMA Foundry is the go-to place for cross-industry collaboration and making positive change happen, supported by leading technology organisations and companies. By bringing together members and key industry players, engaging, and unifying the end-to-end connectivity ecosystem, the GSMA is solving real-world industry challenges.

Our vision is to unlock the full power of connectivity so that people, industry, and society thrive. This enables the mobile industry's mission: to connect everyone and everything to a better future.

Find out more, or submit a new project idea, at gsma.com/Foundry

About this case study

Zain KSA

Zain KSA is a leading telecom provider established in Saudi Arabia on August 2008 as a listed company. In due respect to its highly developed infrastructure, the company was successful in establishing itself as a reliable telecom operator and a digital service provider whose services include telecom services, 5G network, digital payment services, cloud computing, IoT solutions, fiber services, drones, and many others.

In line with its pioneering strategy, Zain KSA was the first operator in the Middle East to commercially launch the 4G/LTE network in September 2011. In addition, in October 2019 it advanced its network through state-of-the-art 5G in its first phase to reach 28 cities across the Kingdom, enabled by 2,600 towers and currently in its second phase covers 53 cities enabled by more than 5000 towers to be ranked as the fourth largest 5G deployment globally.

Zain KSA is committed to the continuous development of its network and services in order to achieve the best customer service experience for individuals, the private sector and government institutions, in line with the goals of Saudi Vision 2030 and the digital transformation in the Kingdom which is to provide the services needed for a smart society and a better quality of life.

For more information, visit: www.sa.zain.com/en

Huawei

Founded in 1987, Huawei is a leading global provider of information and communications technology (ICT) infrastructure and smart devices. We have 207,000 employees and operate in over 170 countries and regions, serving more than three billion people around the world. We are committed to bringing digital to every person, home and organization for a fully connected, intelligent world.

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