5G-Advanced: The Future of Wireless Communications in the UAE

1. Introduction

The development of 5G networks is progressing rapidly, representing the next frontier in wireless communication technology.

This white paper presents a comprehensive evaluation of 5G-Advanced, which is set to evolve the 5G system to its fullest capabilities, and highlights etisalat by e&'s crucial role in the United Arab Emirates' (UAE) transition to 5G-Advanced and its commitment to global standards

5G-Advanced is the next big step in 5G technology. It will bring more advanced capabilities and support new use cases for different industries. It will make advanced applications faster and more reliable, and it will also improve network performance using AI and machine learning. Moreover, 5G-Advanced will make the network more energy-efficient and use less resources.

I am honoured to lead a team in the UAE committed to redefining the possibilities of connectivity, realising the full potential of 5G for a smarter, more connected tomorrow.

Our focus on pioneering technologies and achieving global benchmarks reflects our dedication to providing enhanced experiences for consumers and businesses.

etisalat by e&'s 5G journey aims to empower societies and industries to thrive in the digital age as part of our techco transformation.

The company's commitment to excellence and the UAE's forward-thinking approach have led to a telecommmunications sector that not only meets but exceeds global standards. From having the fastest mobile broadband network to leading the world in FTTH penetration, etisalat by e& and the UAE continue to demonstrate the transformative power of state-of-the-art technology in connecting people and promoting innovation.

Beyond speed and connectivity, etisalat by e&'s emphasis on sustainability is clear in its strategic initiatives. The focus on energy efficiency to accommodate the anticipated 10x traffic growth aligns with global sustainability initiatives, demonstrating a forward-looking and responsible approach to technology deployment.

We are at the forefront of innovation, constantly pushing the boundaries of what is possible in connectivity.

Khalid Murshed

Chief Technology and Information Officer (CTIO), etisalat by e&

- First Operator in MENA to Launch 5G NSA (May 2019):

  In May 2019, etisalat by e& made history as the first operator in the Middle East and North Africa (MENA) region to introduce 5G Non-Standalone (NSA) technology to consumers. This significant milestone marked the beginning of a transformative journey, laying the groundwork for future advancements in 5G technology.

- First UAE Operator to Announce 5G SA Readiness (2021):

  etisalat by e& has continued its leadership by declaring readiness for 5G Standalone (SA) deployment in 2021, signalling a commitment to unlocking the full potential of 5G networks and their capability to support numerous advanced applications.

- VONR and Network Slicing Readiness (2022):

  Enhancing its 5G capabilities, etisalat by e& announced Voice over New Radio (VONR) and network slicing readiness in 2022, reaffirming its commitment to improving voice communication and network customisation for an optimised user experience.

- Commercial Deployment of 5G Private Networks (2023):

  In 2023, etisalat by e& achieved another milestone by becoming the first UAE operator to announce the commercial deployment of 5G private networks. This move indicates a significant transition towards tailored, high-performance 5G solutions for businesses, marking a new phase of dedicated connectivity.

- Commercial Launch of 5G SA for FWA and Smartphones (2023):

  etisalat by e& continued its track record of pioneering achievements by commercially launching 5G SA for Fixed Wireless Access (FWA) and smartphones in 2023. These launches expanded the accessibility of high-speed 5G connectivity, enriching user experiences in both household and mobile settings.

- Demonstrating 10Gbps in 6GHz with 400MHz Spectrum:

  etisalat by e& has set a precedent in the race towards 5G-Advanced by becoming the first to showcase 10Gbps in the 6GHz spectrum, utilising 400MHz as the initial stride into the future. This remarkable achievement underscores etisalat by e&'s commitment to driving the progress of wireless technology, laying the groundwork for the advanced capabilities that will define the next phase of connectivity.

- World's Fastest 5G SA Speed of 13.2 Gbps (GITEX 2023):

  At GITEX Global 2023, etisalat by e& marked a historic moment by showcasing the world's fastest 5G SA speed, achieving an extraordinary 13.2 Gbps. This feat was made possible by etisalat by e&'s commercial 5G SA Access Network solutions, leveraging New Radio Dual Connectivity (NR-DC) and Carrier Aggregation (CA) software features to aggregate nine carriers' components across mid-band and millimetre-wave spectrums, boasting a total bandwidth of 900MHz. In addition to setting a global benchmark, this achievement positions etisalat by e& as a leader in 5G technology, paving the way for transformative applications and reinforcing its commitment to delivering unparalleled connectivity experiences.

In this white paper, we explore these milestones, evaluating their impact on the journey towards 5G-Advanced and the transformative potential they hold for industries and consumers. etisalat by e&'s continuous innovation positions it as a leading force in shaping the future landscape of wireless communication, as demonstrated in **Figure 1**.

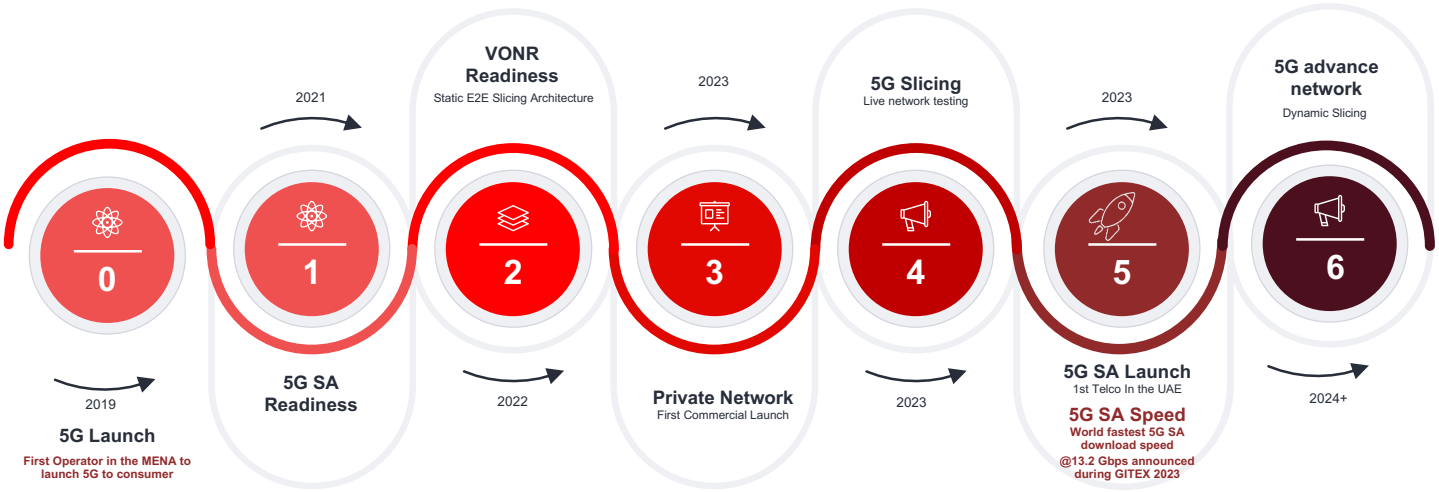

Figure 1 – etisalat by e& 5G Journey

2. etisalat by e& and UAE: Setting global benchmarks in telecommunications

In the ever-changing world of telecommunications, etisalat by e& and the UAE stand out as leaders, continuously setting and exceeding benchmarks for mobile and fixed broadband performance. This is evident through a series of achievements that demonstrate not only the advanced infrastructure deployed by etisalat by e& but also the UAE's commitment to providing its citizens with exceptional connectivity.

1. World's Fastest Mobile Broadband Network

According to Ookla, etisalat by e& in the UAE has been named the fastest mobile broadband network globally. This recognition highlights the result of continuous investment and innovation by etisalat by e& in its mobile infrastructure, aiming to provide users experience with outstanding speed and reliability.

2. UAE: The Fastest Mobile Broadband Nation

Ookla's Speedtest Global Index reaffirms the UAE's position as the fastest mobile broadband nation in the world. This achievement underscores the comprehensive approach taken by the UAE in fostering an environment where mobile data connectivity not only meets but exceeds global standards.

3. Fourth Nation Worldwide in Fixed Broadband Speed

The UAE ranks fourth nation globally in terms of fixed broadband speed, demonstrating a commitment to providing high-speed and reliable internet access to homes and businesses. This achievement reflects the strategic infrastructure planning and investment in advanced technologies.

4. Number One in the World for FTTH Penetration Rate

The UAE has reached the top position globally for fibre-to-the-home (FTTH) penetration rate, achieving an impressive 99 per cent largely due to etisalat by e&'s fixed FTTH network. This success reflects etisalat by e&'s commitment to providing ultra-fast internet connections, with peak speeds reaching 10Gbps.

5. Dubai and Abu Dhabi: Leading the Global Charts

Dubai, supported by etisalat by e&'s 5G infrastructure, is recognised as the 'Fastest Mobile Broadband City' in the world. At the same time, Abu Dhabi leads as the 'Fastest Fixed Broadband City' globally. These achievements highlight the significant role of etisalat by e&'s advanced networks in shaping the digital landscape of these cities and the nation as a whole.

etisalat by e&'s commitment to excellence and the UAE's forward-thinking approach have led to a telecommunications sector that not only meets but exceeds global standards. From having the fastest mobile broadband network to leading the world in FTTH penetration, etisalat by e& and the UAE continue to demonstrate the transformative power of state-of-the-art technology in connecting people and promoting innovation.

In **Figure 2**, we present a visual representation of the Ookla Speedtest global index results, highlighting the prominent leadership of the UAE in the domain of global broadband speed thanks to etisalat by e&. The graph illustrates the notable performance metrics that have positioned the UAE at the forefront of mobile and fixed broadband connectivity.

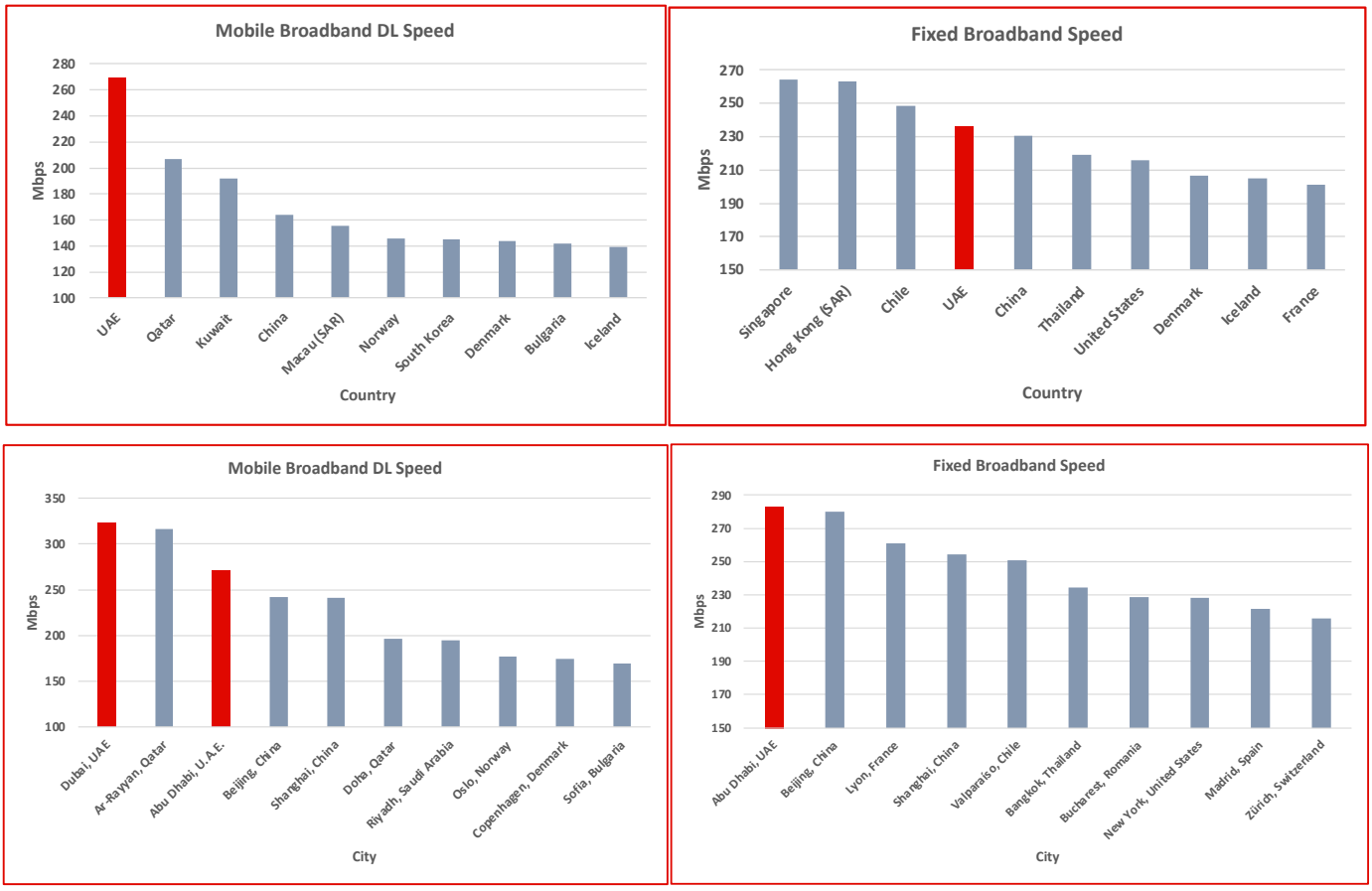

Figure 2: Global Benchmarking Ranking

3. etisalat by e&'s advanced 5G commercial products and services for consumers

etisalat by e& has established itself as a leader in the deployment of 5G technology, offering a variety of commercial products and services that redefine the connectivity experience for consumers in the UAE. This commitment to innovation is evident not only in the deployment of advanced infrastructure but also in the introduction of products designed for the modern digital lifestyle.

1. Launching the First 5G Smartphone in the GCC (May 2019)

etisalat by e& marked a significant milestone in introducing the first 5G smartphone in the Gulf Cooperation Council (GCC) region in May 2019. This move signalled the beginning of a new era in mobile connectivity, providing users with access to the transformative speeds and low-latency capabilities of 5G technology.

2. Serving 4 Million 5G Subscribers in the UAE

The adoption of 5G technology has been notable, with etisalat by e& currently catering to the connectivity needs of four million 5G subscribers in the UAE. This widespread adoption reflects the trust and confidence that consumers place in etisalat by e&'s advanced offerings.

3. Home Wireless Advance

etisalat by e&'s Home Wireless Advance package redefines in-home connectivity. Offering unlimited data paired with a 5G router, this product ensures a reliable internet experience for users. Whether for work, entertainment, or staying connected with loved ones, Home Wireless Advance provides the speed and reliability needed for today's dynamic lifestyles.

4. Home Wireless Premium

Enhancing the connectivity experience, Home Wireless Premium goes beyond basic internet access. With unlimited data and a 5G router, this premium offering includes additional features. Users can access STARZPLAY, a subscription video-on-demand service offering a diverse range of Hollywood movies, series, documentaries, kids' entertainment, and same-time-as-the-US series. Additionally, users benefit from GoChat premium, a high-quality communication platform that includes video calls, voice calls, and chats worldwide.

etisalat by e&'s 5G commercial products and services for consumers show the company's commitment to staying at the forefront of technological advancements and a customer-centric approach by offering tailored solutions that cater to the diverse needs of today's connected households.

Figure 3 highlights the advantages of etisalat by e&'s home wireless products, showcasing the range of benefits these innovative solutions bring to users. In Figure 4, we explore the unique benefits of etisalat by e&'s 5G technology, illustrating its transformative features and capabilities that position it at the forefront of next-generation connectivity.

Figure 3: 5G Home Wireless

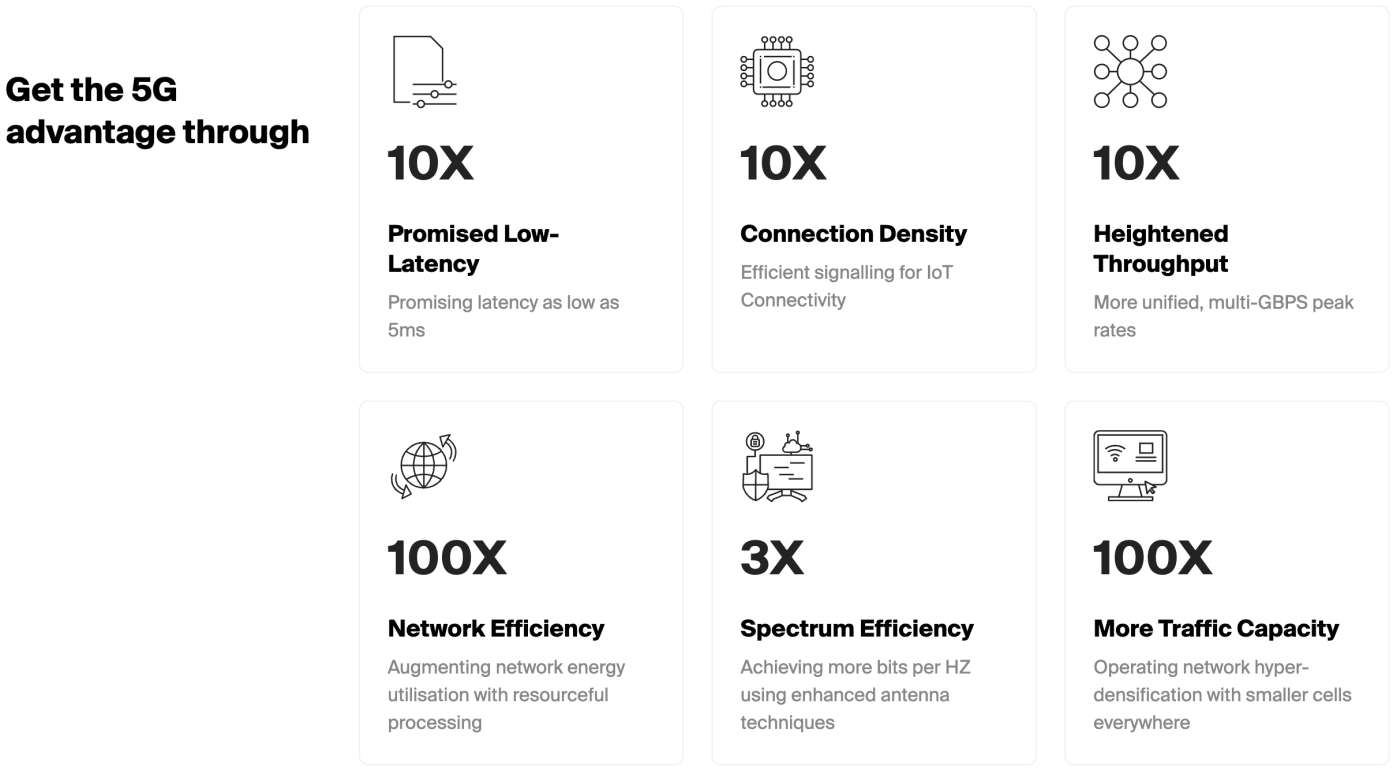

Figure 4: etisalat by e&'s 5G advantage

4. etisalat by e&'s advanced 5G solutions for businesses: Advancing connectivity for the future

To meet the changing needs of businesses, etisalat by e& has curated a suite of 5G products tailored to empower enterprises across different industries. These solutions not only utilise the power of 5G technology but also address the specific requirements of various sectors, unlocking new possibilities for innovation and efficiency.

1. 5G Private Mobile Edge

etisalat by e& offers businesses the flexibility to choose between public or private mobile edge computing, tailoring solutions to meet the unique requirements of advanced use cases. Whether achieving lower latency, reducing backhaul, or localising data, the 5G Private Mobile Edge is a dynamic solution that supports a variety of applications.

2. 5G Wireless Lines

Businesses can leverage etisalat by e&'s turnkey 5G portfolio, which includes high-performance 5G connectivity and advanced 5G routers. Supported by managed service expertise, this comprehensive offering ensures that businesses have the tools needed to thrive in the era of 5G, promoting seamless connectivity and operational efficiency. Our clientele spans across diverse sectors, including the oil and gas industry, public safety entities, the construction segment, and the services industry, among others. The 5G Wireless portfolio undergoes continuous refinement, offering a variety of products and tailored solutions to address specific needs within various industry verticals. This encompasses the development of products for public safety and surveillance, the integration of 5G-enabled WiFi connectivity in public transport vehicles, seamless connectivity solutions for construction projects, comprehensive packages designed for safe city initiatives, and bandwidth-oriented offerings for surveillance on roads and highways. Our commitment to innovation ensures that our 5G Wireless portfolio remains at the forefront of technological advancements, meeting the evolving requirements of our diverse client base.

3. 5G Private Campus

etisalat by e&'s 5G Private Campus solution is tailored to adapt to the evolving connectivity needs of businesses, particularly those with multiple campus locations. This offering addresses the demand for range, mobility, and performance, enhancing the reliability and flexibility of connectivity within campus environments.

4. 5G Network on wheels

In first of its kind endeavour in the region, etisalat by e& can offer a nomadic 5G private network connectivity to cover events and critical locations. A customized 5G network is integrated with a vehicle so it can be driven up to the target location enabling various scenarios by providing customized coverage and throughput.

Figure 5: etisalat by e&'s 5G Solutions for Business

Key Verticals and Use Cases

- **Government and Security**

  etisalat by e&'s 5G solutions empower government entities and security agencies with enhanced connectivity for mission-critical operations. The low latency and high data speeds of 5G contribute to real-time response capabilities, facilitating improved public safety and security measures.

- **Transport**

  The transport sector benefits from etisalat by e&'s 5G solutions by enabling connected and autonomous vehicles, smart traffic management systems, and efficient logistics operations. The high-speed, low-latency connectivity of 5G enhances overall transportation efficiency and safety.

- **Healthcare**

  In the healthcare sector, etisalat by e&'s 5G solutions support telemedicine, remote patient monitoring, and augmented reality applications for surgical procedures. These advancements contribute to improved patient care and operational efficiency in healthcare facilities.

- **Airline and Logistics**

  etisalat by e&'s 5G offerings play a crucial role in optimising airline and logistics operations. From smart warehouses to real-time tracking of shipments, 5G connectivity enhances the speed and accuracy of operations, contributing to a more streamlined and efficient supply chain.

- **Oil and Gas**

  In oil and gas industry, 5G solutions facilitate control of critical infrastructure along with HSE (Health, Safety and Environment) compliance, contributing to operational safety and efficiency. 5G connectivity supports advanced scenarios such as realtime IoT sensors and drones for asset monitoring in challenging environments.

- **Retail**

  Retail businesses benefit from etisalat by e&'s 5G solutions by enabling immersive shopping experiences, smart inventory management, and efficient point-of-sale systems. The enhanced connectivity contributes to a reliable business critical corporate and chain interconnectivity.

- **Media**

  etisalat by e&'s 5G solutions in the media sector support high-quality content delivery through integration of portable encoders with the broadcast cameras, enabling direct uplink from events thus reducing the need for OB (Outside Broadcasting) Vans. 5G also enables resource intensive virtual and augmented reality experiences.

etisalat by e&'s 5G solutions for businesses go beyond providing connectivity. They serve as enablers for advanced use cases across a spectrum of verticals, empowering businesses to realise the full potential of 5G technology in the age of digital transformation.

5. etisalat by e&'s 5G evolution towards 5G-Advanced: A look ahead

etisalat by e&'s journey towards 5G-Advanced is marked by a commitment to industry standards, forward-looking demonstrations of capabilities at major events, and a strategic roadmap that positions the network as a leader in the development of 5G technology. The planned upgrades and demonstrations not only showcase etisalat by e&'s technical skills but also underscore its commitment to delivering an exceptional and future-ready 5G experience for its customers.

Figure 6: 5G Vertical Industries

Figure 7 illustrates the alignment between the 3rd Generation Partnership Project (3GPP) 5G roadmap and etisalat by e&'s 5G journey. The graphic highlights key milestones from both perspectives, emphasising the seamless synergy that drives etisalat by e& towards the forefront of 5G technology.

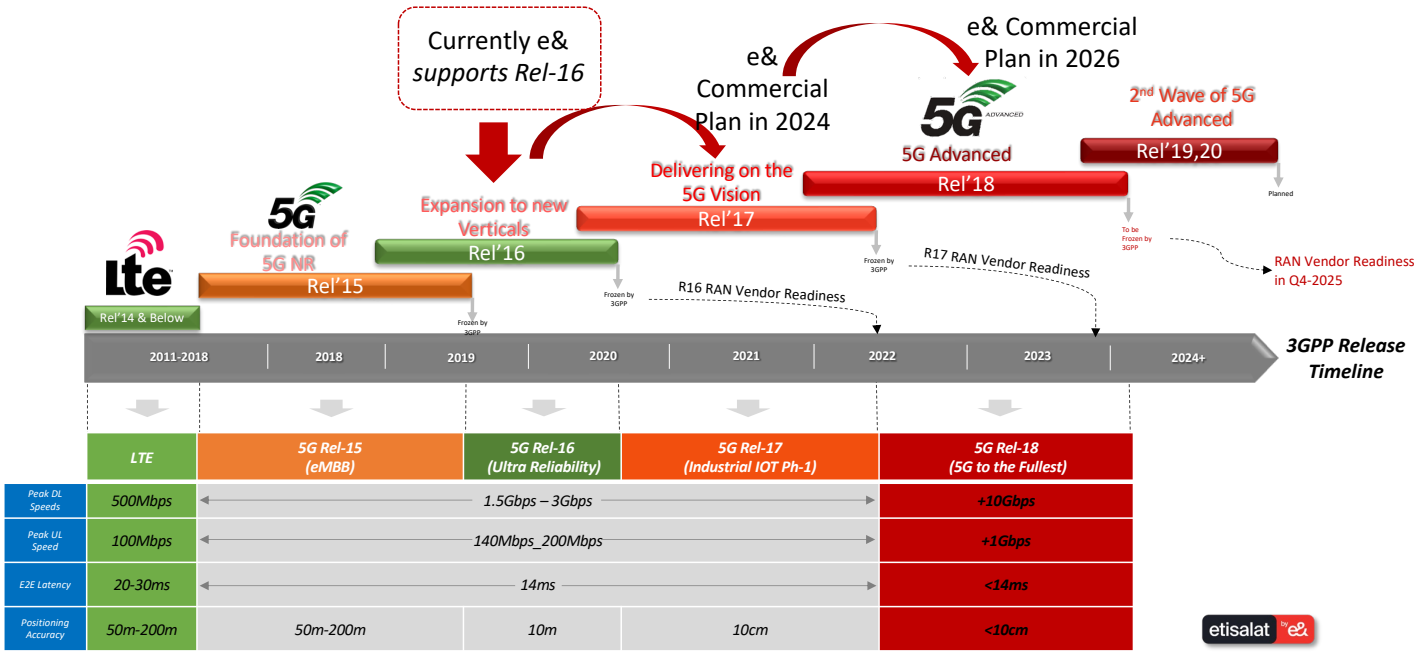

Figure 7: The intersection of 3GPP 5G roadmap and etisalat by e&'s 5G journey

1. Adherence to 3GPP Standards and Rel 16 Implementation

In striving for technological excellence, etisalat by e& adheres to the 3GPP standards, underscoring a commitment to global best practices. Currently, the network supports 3GPP Release 16, representing a foundational step in the advancement towards 5G-Advanced.

2. Demonstrating 3GPP Rel 17 with RedCap Capability at GITEX 2023

etisalat by e& demonstrated 3GPP Release 17, incorporating RedCap (Reduced Capability) at GITEX 2023. This capability is strategically positioned to strengthen support for massive Internet of Things (IoT) use cases, laying the groundwork for a network that can accommodate diverse and resource-efficient IoT applications.

3. 2024 Network Upgrade for 3GPP Rel 17 through Software Upgrades

etisalat by e& is ready to take a significant step in 2024 by upgrading its network to seamlessly support 3GPP Release 17 through software upgrades. This forward-thinking approach ensures a swift and efficient transition, empowering the network to meet the evolving demands of the digital landscape without the need for extensive hardware overhauls.

4. Demonstrating 5G-Advanced Capabilities at GITEX 2023

At GITEX 2023, etisalat by e& showcased its 5G-Advanced capabilities with remarkable peak throughput (TP) achievements. Notably, reaching peaks of 10Gbps and 13.2Gbps, etisalat by e& demonstrated the network's readiness to cater to high-bandwidth applications, especially in extended reality (XR) applications. These milestones underscore etisalat by e&'s commitment to providing an ultra-responsive and high-performance 5G experience.

5. Planned Upgrade to 3GPP Rel 18 for 5G-Advanced by 2025/2026

etisalat by e&'s roadmap plans for a future upgrade to 3GPP Release 18, the next phase in the evolution towards 5G-Advanced. With plans set to be completed by 2025/2026, etisalat by e& is aligned with the advancements at 3GPP, ensuring that its network remains at the forefront of global standards and capabilities.

6. The Four-Fold Enhancement: Elevating 5G networks and societies through 5G-Advanced

Essentially, 5G-Advanced goes beyond traditional connectivity, becoming a powerful force that enriches experiences, expands possibilities, extends connectivity, and operates with unmatched excellence. This four-fold enhancement ensures that 5G-Advanced becomes a key factor in shaping the future of connected societies and technological advancements.

In **Figure 8**, we illustrate the detailed transition of 5G-Advanced as a step-by-step progression rather than a complete overhaul. The graphic highlights key facets of this evolution, emphasising the introduction of new usage areas, innovative services, and the enhanced resiliency and operability that define the evolution of 5G-Advanced.

1. Enriched Experience: 5G-Advanced marks a new phase in connectivity by delivering an enhanced experience for both individuals and machines. The focus on boosting throughput in both the Downlink and Uplink, reducing service interruption times, and facilitating superior digital experiences transforms the way we interact with technology. The integration of Extended Reality (XR), Virtual Reality (VR), and Augmented Reality (AR) creates immersive environments, seamlessly blending the physical and virtual spaces.

2. Expanded Horizons: 5G-Advanced expands horizons beyond traditional communication, offering enhanced positioning with sub-10cm accuracy indoors and outdoors, along with time synchronisation as a service. This opens avenues for diverse applications, from smart power grid control and industrial automation to real-time financial transactions, enhancing navigation precision and optimising logistics systems.

3. Extended Connectivity: 5G-Advanced acts as a catalyst for extending connectivity to new frontiers. Innovations in improved coverage, cost-effective massive Internet of Things (IoT), and support for non-terrestrial networks (NTN) and drones mark a significant extension of reach. This expansion ensures that connectivity becomes more accessible, reaching untapped market segments and promoting innovation in various domains.

4. Operational Excellence: Powered by operational excellence, 5G-Advanced aims to optimise the 5G platform and its operations. Gradual integration of Artificial Intelligence (AI) and Machine Learning (ML) enablers, wireline and wireless convergence, improved resiliency, and energy efficiency enhancements are the foundation of this excellence. These operational enhancements not only improve network performance but also ensure cost-effective and sustainable network operations.

Figure 8: The Four-Fold Enhancement: Elevating 5G networks and societies through 5G-Advanced

7. 5G-Advanced: Transforming connectivity and society

5G-Advanced is a significant technological advancement, transforming connectivity with a wide range of features that improve user experiences, empower businesses, and enhance network operations. The impact of 5G-Advanced goes beyond traditional boundaries, creating a future where connectivity is seamless, reliable, and transformative.

In **Figure 9**, we illustrate the detailed features of 5G-Advanced, highlighting the technological advancements that redefine connectivity in terms of speed, reliability, precision, and societal impact.

1. Features

Higher Speeds (10Gbps DL / 1Gbps UL): 5G-Advanced drives connectivity to new heights with swift download speeds of 10Gbps and upload speeds of 1Gbps, ensuring seamless data transfer for the most demanding applications.

Lower Latency and Ultra Reliability (99.9%): 5G-Advanced introduces lower latency and ultra-reliability, with a 99.9 per cent reliability rate. This enables real-time interactions and applications requiring reliability.

Better Device Positioning (<10cm): Precision becomes crucial as 5G-Advanced enhances device positioning to sub-10cm accuracy, unlocking applications that demand precise location accuracy.

Synchronisation as a Service (Time Sensitive Network): Time-sensitive applications benefit from 5G-Advanced's synchronisation as a service, ensuring that critical time-sensitive networks operate seamlessly.

Enhanced Reduced Capacity (RedCap 5MHz to 20MHz): 5G-Advanced introduces RedCap, expanding reduced capacity options from 5MHz to 20MHz, offering greater flexibility in adapting to diverse network demands.

Passive-IoT (Sensors without Batteries): Introducing a new phase of IoT, 5G-Advanced introduces passive-IoT, enabling sensors without batteries to operate efficiently and sustainably.

AI and ML Based Radio Access Optimisation (New Set of KPIs): The integration of Artificial Intelligence (AI) and Machine Learning (ML) introduces a new phase of radio access optimisation, introducing a new range of Key Performance Indicators (KPIs) for enhanced network performance.

2. Societal Impact

- Consumer

Extended Reality (XR): 5G-Advanced transforms consumer experiences with extended reality applications, bridging the gap between the physical and digital worlds.

Cloud Gaming: Gamers brings 5G-Advanced brings cloud gaming to the forefront, offering high-quality, lag-free gaming experiences.

Live High-Quality Video Streaming: Consumers enjoy high-quality video streaming in real-time, courtesy of 5G-Advanced's enhanced capabilities.

5G Based Wearables: Wearable technology reaches new heights with 5G-Advanced, providing seamless connectivity for smartwatches, fitness trackers, and more.

Video Surveillance with Built-in 5G Modem: Enhanced security is achieved with video surveillance systems featuring built-in 5G modems, ensuring reliable and high-speed data transmission.

- Business

Full Autonomous Vehicles: Businesses enter the era of full autonomous vehicles, powered by the low latency and reliability of 5G-Advanced.

Industrial Automation: Industrial processes are optimised with advanced automation solutions enabled by the capabilities of 5G-Advanced.

Asset Tracking: Precise asset tracking enhances efficiency in logistics and supply chain operations.

Positioning for Public Safety: Public safety is strengthened with precise positioning, ensuring rapid and accurate response in emergencies.

Industrial IoT: The Industrial IoT (IIoT) thrives with 5G-Advanced, enabling smart and connected industrial ecosystems.

3. Network: New Set of Capabilities

Energy Efficient RAN Network: 5G-Advanced introduces a more energy-efficient Radio Access Network (RAN), aligning with sustainability goals while maintaining high-performance connectivity.

Advanced Self-Healing: Network resilience is enhanced with advanced self-healing capabilities, minimising downtime and ensuring continuous service availability.

Predictive Maintenance: Proactive network management is achieved through predictive maintenance, anticipating and addressing issues before they impact performance.

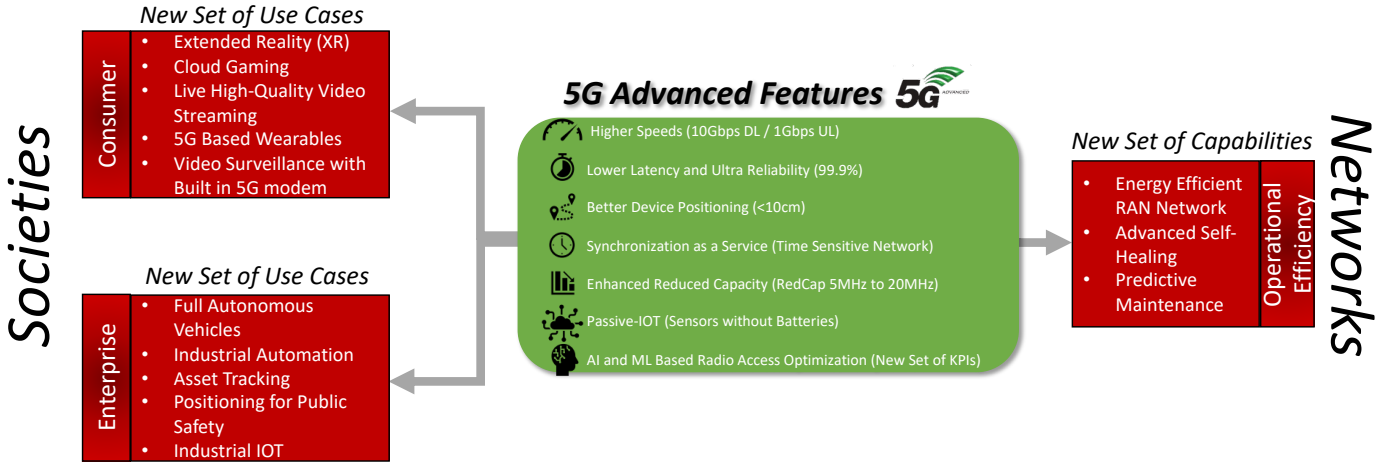

Figure 9: Deep Dive into 5G – Advanced Features

8. etisalat by e&'s Advancements Towards 5G-Advanced

etisalat by e&'s journey towards 5G-Advanced is characterised by the activation of foundational technologies, strategic alignment with industrial transformations, initiatives in spectrum utilisation, and a roadmap for the future launch of 5G-Advanced. etisalat by e& has achieved milestones that make it a pioneer in the evolution of connectivity, marking the beginning of enhanced services and transformative capabilities.

In **Figure 10**, we illustrate the strategic steps taken by etisalat by e& to advance towards 5G-Advanced. The graphic shows the activation of underlying technologies that form the foundation for the seamless transition to 5G-Advanced, using 5G SA, 5G for enterprise, and field trials of high speeds.

1. 5G Standalone (5G SA)

Commercial Launch in 2023: etisalat by e& makes a significant move into the future by commercially launching 5G Standalone (5G SA) in the UAE in 2023. This deployment marks a milestone, providing users with a fully independent and robust 5G infrastructure.

New Service Based Architecture (SBA): The deployment a New Service Based Architecture (SBA) in the 5G Core demonstrates etisalat by e&'s commitment to the state-of-the-art technology. This architectural advancement ensures a more dynamic and flexible 5G network core, laying the foundation for enhanced services and capabilities.

2. On Track Towards Industrial 4.0

- **Digital Transformation of IIOT:** etisalat by e& actively drives the digital transformation of Industrial IoT through the deployment of 5G networks, adopting private and hybrid models to cater to specific use cases within the Industrial 4.0 landscape.
- **Monetised Use Cases:** The strategic alignment of 5G with Industry 4.0 results in monetised use cases, including video surveillance and 5G leased line services. etisalat by e&'s innovative approach ensures that these use cases are technically strong and also economically feasible.

3. 5G-Advanced Initiatives

- **New Spectrum Initiatives:** etisalat by e& diversifies its spectrum portfolio with 5G New Spectrum Initiatives, including the deployment of frequencies in the 600MHz and 6GHz bands. This strategic move expands the network's capabilities, enabling it to cater to a broader range of services and applications.
- **High Throughput Field Trials:** The high speeds achieved in etisalat by e&'s High Throughput Field Trials, reaching 13Gbps and 10Gbps, demonstrate a significant advancement. These trials play a crucial role in testing 5G performance and validating the network's readiness for advanced applications.
- **AI/ML Management Platform:** By harnessing the potential of AI and ML, etisalat by e& is introducing a specialised AI/ML Management Platform for 5G. This platform enhances network intelligence, optimising performance and paving the way for adaptive and self-learning network management.

4. Plan to Launch 5G-Advanced in 2025/2026

- **Aligned with 3GPP Progress:** etisalat by e& strategically prepares for the future by outlining plans to launch 5G-Advanced in 2025/2026. This approach is aligned with the progress of the 3GPP, ensuring that etisalat by e&'s 5G-Advanced network adheres to global standards and capabilities.

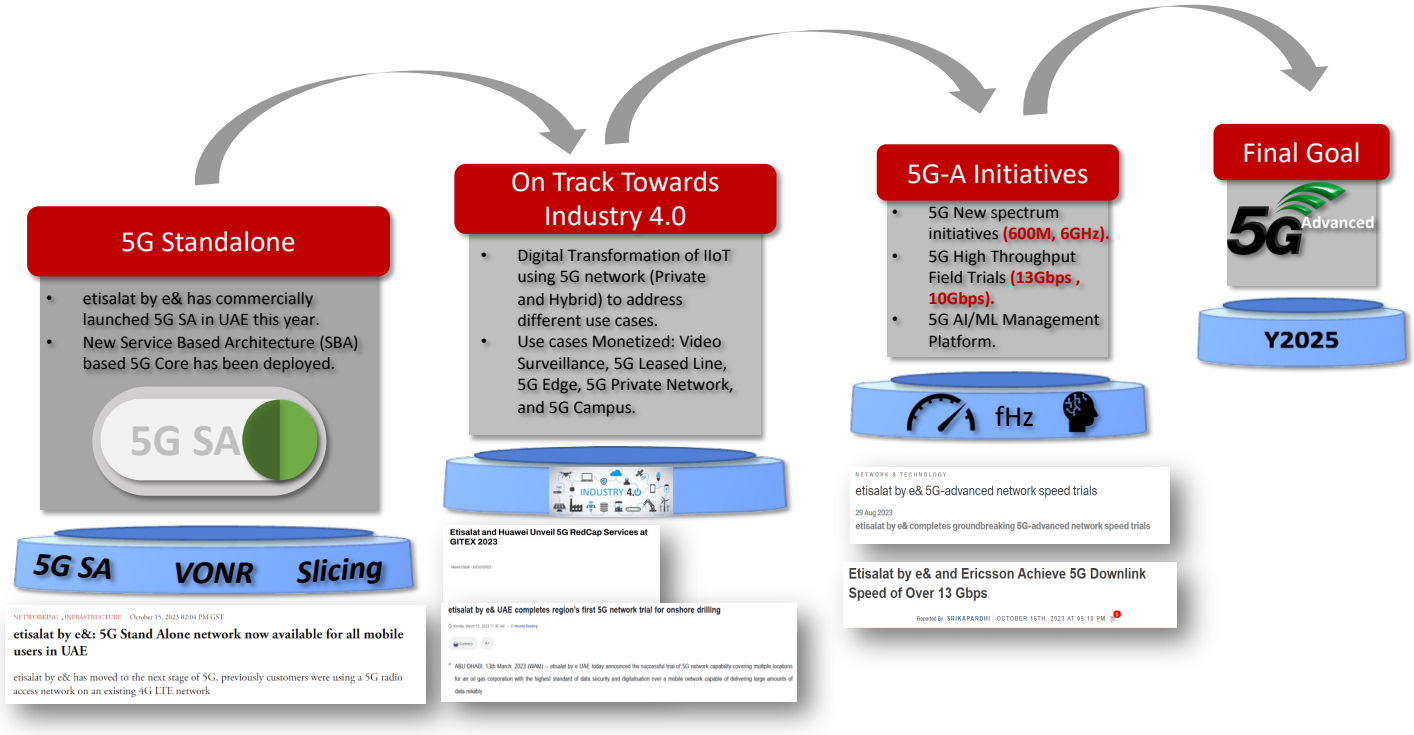

Figure 10: etisalat by e&'s strategic steps to advance towards 5G-Advanced

9. Spectrum evolution for 5G-Advanced and the vision for 6G

The evolution of spectrum from 2022 to beyond 2030 illustrates a dynamic landscape adapting to the requirements of advancing wireless technologies. The strategic allocation and utilisation of spectrum bands align with the trajectory of 5G-Advanced and lay the groundwork for the anticipated demands of 6G.

In **Figure 11**, we illustrate the progressive transformation of spectrum allocation, capturing the journey from the inception of 5G-Advanced to the anticipated demands of the 6G vision. The graphic highlights key spectrum bands and their evolution across three critical timelines: 2022, 2025-2030, and beyond 2030.

1. Spectrum in 2022:

Legacy 2G/3G/4G Spectrum: The foundation for 5G evolution is laid on existing legacy spectrum bands allocated for 2G, 3G, and 4G technologies. This includes the coexistence of networks, ensuring a smooth transition to more advanced technologies.

Low Bands (e.g., 600 MHz, 700 MHz): In 2022, low-frequency bands such as 600 MHz and 700 MHz continue to play a crucial role, providing expansive coverage and better penetration through barriers, particularly in urban and rural areas.

Mid Bands (e.g., 3.5 GHz, 4.4-4.9 GHz): Spectrum in the mid-range, such as 3.5 GHz, achieves a balance between coverage and data speeds, making it ideal for urban deployments and supporting enhanced mobile broadband services.

High Bands (e.g., 26 GHz, 28 GHz): High-frequency bands, including 26 GHz and 28 GHz, play a key role in delivering ultra-fast data rates, low latency, and massive device connectivity, laying the groundwork for 5G capabilities.

2. Spectrum in 2025-2030:

Legacy 2G/3G/4G/5G Spectrum: As technology advances, the spectrum landscape evolves to incorporate legacy bands from 2G to 5G, ensuring backward compatibility and a seamless user experience across generations of wireless technology.

Low Bands (e.g., 600 MHz): Low-frequency bands, exemplified by 600 MHz, maintain their relevance, providing widespread coverage and serving as a reliable foundation for mobile communication services.

Mid Bands (e.g., 6 GHz): The mid-frequency spectrum, represented by 6 GHz, becomes increasingly essential, balancing coverage and capacity to meet the growing demands of diverse applications and services.

High Bands (e.g., 40 GHz): High-frequency bands, including 40 GHz, continue to be utilised to deliver exceptional data speeds, meeting the demands of ultra-high-speed applications and services.

3. Spectrum Beyond 2030:

Legacy 2G/3G/4G/5G/5G-Advanced Spectrum: The spectrum landscape extends to include legacy bands up to 5G-Advanced, reflecting the continuous integration of newer technologies into the existing framework.

Centimetric Range (7-15 GHz): Focusing on the essential centimetric range between 7-15 GHz becomes crucial and provides a balance between coverage and capacity, which is ideal for a variety of use cases.

Sub-THz Range (92-114 GHz and 130-175 GHz): Exploring the complementary sub-terahertz range from 92-114 GHz and 130-175 GHz becomes essential and offers opportunities for unprecedented data rates and innovative applications.

- 6G Spectrum Requirements:

  Additional Spectrum Needs: In anticipation of the 6G vision, the landscape requires additional spectrum beyond 2025-2030. Approximately 1.5-2.2 GHz of spectrum is projected to be essential for 6G, particularly in the 7-15 GHz centimetric range, ensuring the attainment of performance objectives.

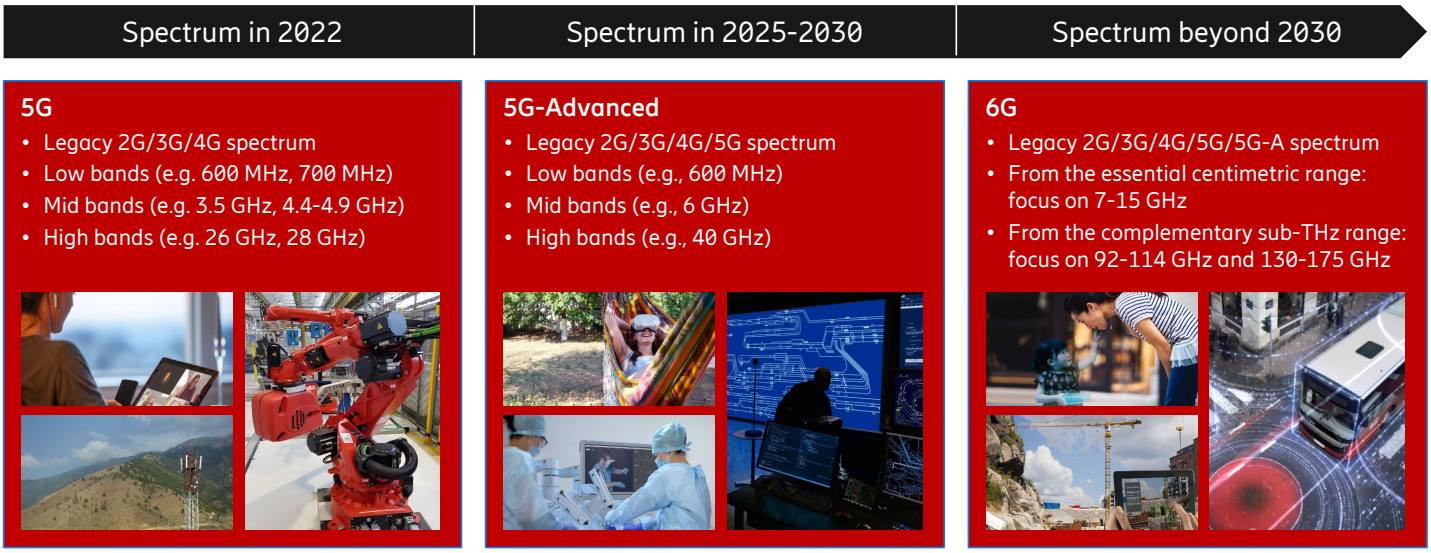

Figure 11: Evolution of Spectrum for 5G-Advanced in anticipation of the 6G Vision

10. 5G-Advanced: Pioneering the Future, Expanding Connectivity, and Redefining Service Boundaries

As 5G-Advanced gains prominence in telecommunications, it extends beyond traditional connectivity boundaries, introducing, an era characterised by expanded services and broader horizons. The evolution is reflected in the shift from the ITU triangle—encompassing enhanced Mobile Broadband (eMBB), Massive Internet of Things (Massive IoT), and Ultra-Reliable Low Latency Communication (URLLC)—to a more comprehensive hexagon. This hexagon retains the original three dimensions and extends its reach to include:

- Real-Time Broadband Communication (RTBC)

  Immediate Interactions: RTBC signifies the capability for real-time communication, enabling immediate interactions between devices and applications. This dimension caters to scenarios where low latency is critical, ensuring swift responsiveness in various applications.

- Uplink Centric Broadband Communication (UCBC)

  Enhanced Uplink Capacities: UCBC highlights a focus on the uplink communication channel, acknowledging the growing importance of efficient data transmission from devices to the network. This dimension is particularly relevant for applications where uplink data is important.

- Harmonised Communication and Sensing (HCS)

  Symbiotic Relationship: HCS represents a blend of communication and sensing capabilities. This dimension acknowledges the need for networks transmit data and gather information from the environment, facilitating applications in the domain of the Internet of Everything (IoE) and beyond.

Addressing Multi-dimensional Service Requirements:

Versatility: The hexagonal expansion caters to multi-dimensional service requirements, acknowledging the diverse needs of applications, ranging from high-speed broadband to massive IoT deployments and ultra-reliable low-latency communication. 5G-Advanced's versatility ensures it can adapt to the varied demands of the digital landscape.

Consideration of Varying Capabilities of Different Bands:

Band Diversity: Acknowledging that different frequency bands offer distinct advantages, 5G-Advanced considers the varying capabilities of these bands. Whether it is the extensive coverage of low bands or the high data rates of millimetre-wave bands, the hexagonal framework accommodates and optimises for band diversity.

Energy Saving for 10x Traffic Growth:

Sustainability Initiatives: Recognising the projected 10x traffic growth, 5G-Advanced prioritises efficiency. This commitment aligns with global sustainability initiatives, ensuring that the exponential increase in data demand does not compromise environmental considerations. The evolution aims to achieve this growth while maintaining a minimal ecological footprint.

5G-Advanced broadens the scope of connectivity and redefines the nature of communication and sensing. The hexagonal expansion demonstrated in **Figure 12**, reflects a holistic approach, accommodating a spectrum of services and considerations, from real-time interactions to uplink-centric needs and the interdependence of communication and sensing. This progression shows 5G-Advanced as a powerful force that is leading the way for a future where connectivity integrates with the complexities of our digital and physical worlds.

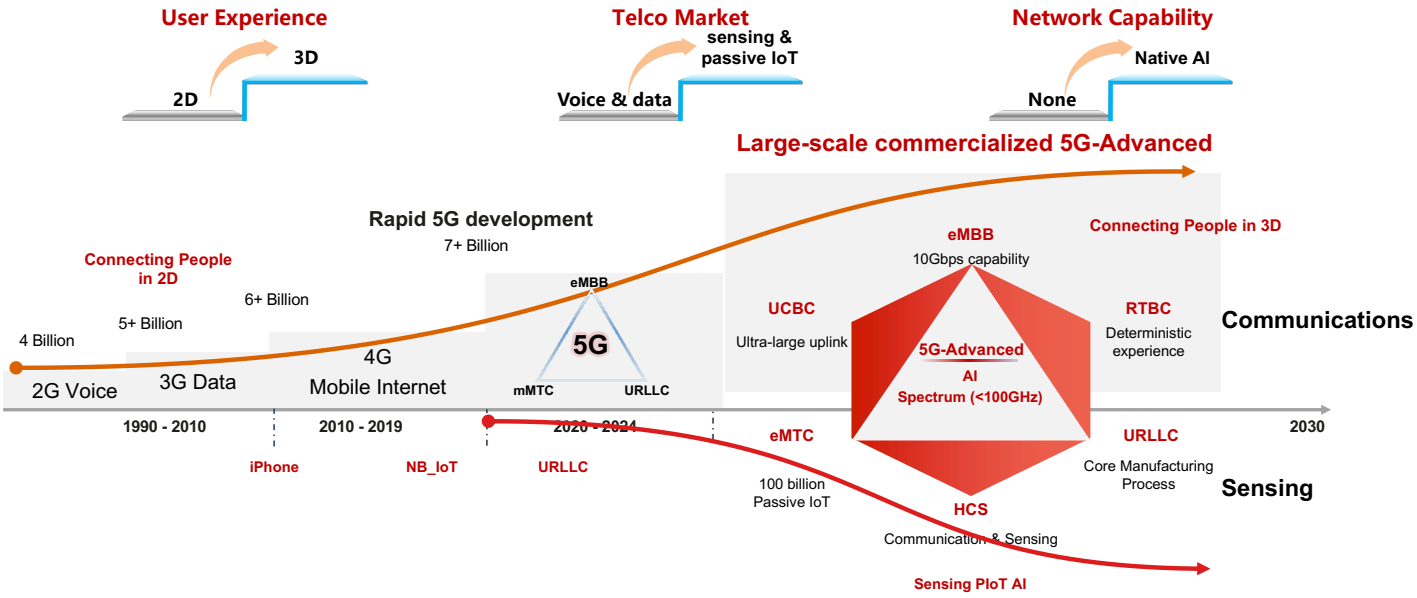

Figure 12: 5G-Advanced Leads to the Future, Strides to Expand Connectivity & Services Boundary

11. Summary

etisalat by e&'s is a leading force in advancing the UAE towards the era of 5G-Advanced. The company's proactive stance, innovation-driven initiatives, and commitment to global standards make it a key contributor to the nation's technological progress.

etisalat by e& has been a driving force in the evolution of the UAE's telecom sector, particularly in the transition to 5G-Advanced. The company's strategic endeavours underscore its commitment to staying at the forefront of technological innovation. Notably, etisalat by e& achieved a series of milestones, positioning itself as a leader in the region. The launch of 5G NSA in 2019 marked a significant step, followed by the announcement of 5G SA readiness in 2021, showcasing the company's proactive approach in adopting cutting-edge technologies.

In 2022, etisalat by e& demonstrated its commitment to advancing connectivity with achievements like VONR (Voice over New Radio) and network slicing, introducing new dimensions to its service offerings. The commercial deployment of 5G private networks in 2023 underscores etisalat by e&'s dedication to tailoring solutions for specific use cases, particularly in the area of industrial applications.

The company's expansion into 5G SA for Fixed Wireless Access (FWA) and smartphones demonstrates its commitment to providing high-quality, reliable, and fast connectivity to consumers and businesses. etisalat by

e&'s demonstration of the fastest 5G SA speed of 13.2 Gbps during GITEX 2023 highlights its technological strength and contributes to positioning the UAE as a global leader in mobile speed.

Beyond speed and connectivity, etisalat by e&'s emphasis on sustainability is clear in its strategic initiatives. The focus on energy efficiency to accommodate the anticipated 10x traffic growth aligns with global sustainability initiatives, demonstrating a forward-looking and responsible approach to technology deployment.

In terms of products and services, etisalat by e&'s diverse offerings provides for both consumers and businesses. The company's commitment to 5G-Advanced deployment, aligned with 3GPP standards, indicates a dedication to evolving with global technology standards and preparing for the next phase of connectivity.

References

[1]- https://www.ookla.com/articles/5g-uae-q2-2023
[2]- https://www.ookla.com/articles/gaming-experience-gulf-countries-q1-q2-2023
[3]- https://www.etisalat.ae/en/c/home/home-wireless.html
[4]- https://www.etisalat.ae/en/enterprise-and-government/enterprise-solutions/5g-for-business.html
[5]- https://www.ericsson.com/en/press-releases/5/2023/ericsson-and-etisalat-by-e-reach-more-than-13-gbps-5g-downlink-speed-for-superior-ran-capacity
[6]- https://www.commsupdate.com/articles/2023/03/01/etisalat-brings-5g-sa-to-uae/
[7]- https://www.commsupdate.com/articles/2023/10/16/etisalat-expands-5g-sa-to-all-customers/
[8]- https://www.3gpp.org/specifications-technologies/releases/release-18