Extracted version

Fixed Wireless Access handbook

Insights

2024

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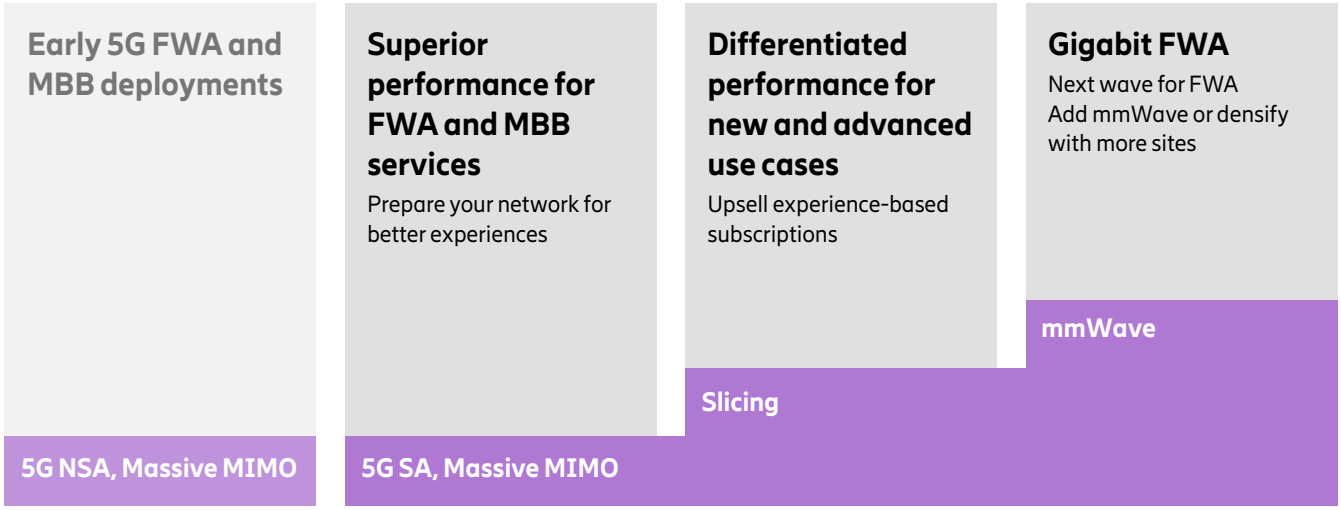
Insight 6 of 6

5G offers a future-proof platform for FWA growth

Typical steps of network evolution

To maximize 5G potential, service providers are now embracing 5G Standalone (5G SA) with dedicated core and advanced air interface, paving the way for differentiated services for new and advanced use cases into premium gigabit FWA



The initial commercial 5G networks relied on the LTE infrastructure in radio access and the core network to accelerate rollout, referred to as 5G non-Standalone (5G NSA). 5G NSA allowed service providers to increase the bandwidth available to end users by bundling 4G and 5G carriers through 4G-5G dual connectivity.

To unlock the full capability and performance of 5G, service providers introduce 5G Standalone (5G SA) with a dedicated 5G Core and highly efficient 5G air interface, without dependency on existing LTE networks. The superior performance network is also prepared for better experiences and the next monetization step.

Leading service providers are now introducing Network and RAN Slicing to enable 5G monetization opportunities with differentiated performance for new experience-based connectivity services with high throughput, reliability, and latency requirements. With premium FWA as an example, the next wave is emerging, adding mmWave to further enhance the gigabit FWA network performance and user experiences.

The 5G FWA toolbox

The superior 5G performance is the foundation for the success of FWA and the opportunity to provide fiber-like services at a large scale.

NR Standalone (SA) unlocks the full potential of 5G. The 5G NR Standalone software upgrade provides enhanced user experience, increased coverage, improved network efficiency, and less complexity and enables new business opportunities.

Carrier aggregation (CA) is essential to deploy better 5G. It maximizes the use of scattered spectrum and enhances the user experience. It is also a powerful tool to extend the coverage.

Massive MIMO (M-MIMO) is a key component to accelerate 5G. The beamforming, single-user, and multi-user MIMO solutions enhance the radio access network's user experience, capacity, and coverage.

New and more spectrum is becoming available in mid-band TDD and mmWave, with wide bandwidths that can carry large amounts of data traffic.

Service differentiation enables 5G monetization opportunities for new experience-based connectivity services with high throughput, reliability, and latency requirements.

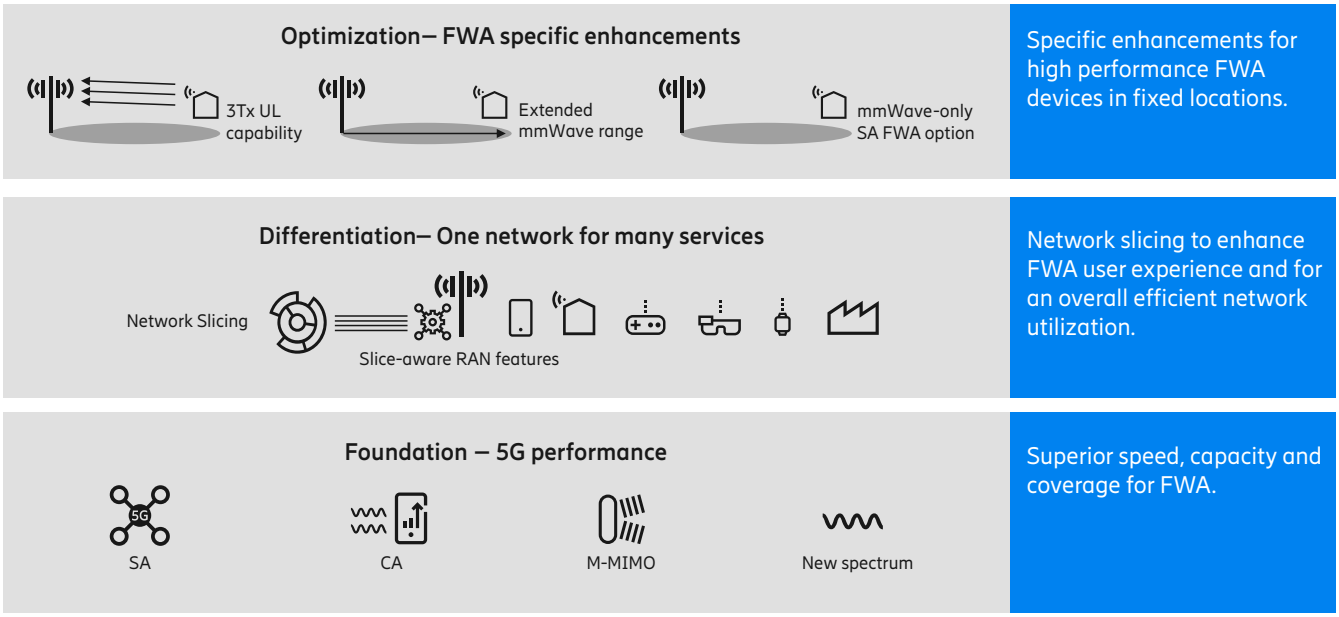
5G RAN slicing is key enabler for the 5G monetization opportunities. This software solution offers service differentiation and guaranteed performance for many new services, with an overall efficient utilization of the common 5G RAN. It supports dynamic optimization of radio resource allocation and prioritization across different slices for guaranteed service-level agreements fulfillment.

Many RAN features are slice-aware for differentiating services, functions, and feature behavior in terms of configuration and observability. It can, as an example, optimize parameter settings for best FWA performance, steer FWA subscribers to a specific frequency band, and provide observability for the FWA UE group. A characteristic of FWA is the use of high-performance devices in fixed locations with typically good RF conditions. Specific enhancements can be applied for optimization in these FWA-unique scenarios.

FWA users can benefit from much higher upload speeds and capacity combined with uplink single-user MIMO and uplink carrier aggregation. This requires devices with three transmit antennas (3Tx), which is especially appealing for FWA service providers given that device output power constraints and the placement of additional radio frequency components are simplified for FWA devices with larger form factors in contrast to smartphones.

FWA deployments with good line-of-sight propagation conditions between high tower radio sites and outdoor roof-top mounted CPEs can deliver much longer mmWave cell ranges – up to several kilometers – in contrast to smartphones. This requires high-power radios, high-power CPEs, and mmWave extended-range software to accommodate the increased propagation time at longer distances.

mmWave-only SA is a new network option that unlocks the FWA opportunity also for service providers that only has mmWave spectrum.



Multiple 5G SA benefits for FWA

In the context of Fixed Wireless Access, the introduction of 5G Standalone marks a significant event, enhancing efficiency, performance, and differentiation for FWA.

The freedom from 4G infrastructure empowers service providers to shape 5G networks, unlocking the full potential of spectrum resources. This strategic autonomy, immediate NR access, and reduced latency result in a streamlined FWA ecosystem. It signifies a fundamental shift towards efficiency, where the reduced $/GB for 5G FWA becomes a reality, underscoring the financial soundness of 5G SA.

Performance is a key focus as 5G SA maximizes NR spectrum utilization. Instant access simplifies the Radio Access Network and CPE devices drastically. Unlike 5G NSA, SA operates without an LTE anchor, resulting in ultra-fast connections and enhancing the end-user experience. The SA approach, avoiding power-sharing with LTE, allows full power utilization for NR, resulting in superior uplink coverage and throughput. Together with superior Massive MIMO performance, these enhancements have a strong positive impact on throughput, contributing to an overall improvement in network capacity available for FWA.

5G SA empowers service providers to stand out in a competitive landscape, enabling them to differentiate their FWA offerings. By leveraging 5G SA's capabilities, service providers implement sophisticated monetization strategies, taking advantage of network slicing and speed differentiation. This optimizes FWA revenue and establishes a framework for offering tailored services with specific commitments. Whether serving residential users, businesses, or online gaming, service providers can customize FWA services for optimal performance, enhancing the overall customer experience.

In summary, 5G SA transforms the FWA scenario, emphasizing efficiency, performance, and differentiation. By maximizing spectrum use, optimizing service performance, and providing unique services, 5G SA becomes a strategic enabler for service providers to develop new revenue streams for premium FWA connectivity.

Offload 4G to 5G FWA

Lower $/GB for 5G FWA.
Easy to migrate (data-only, stationary).

Coverage extension

FDD and TDD CA increases mid-band coverage and system capacity.

QoS and Slicing

Monetize with SLAs for FWA.
Tailored offerings for new business.

Efficiency

Spectrum management

Maximize utilization of NR spectrum.
Instant access to NR and lower latency.

Performance

Speed and Capacity

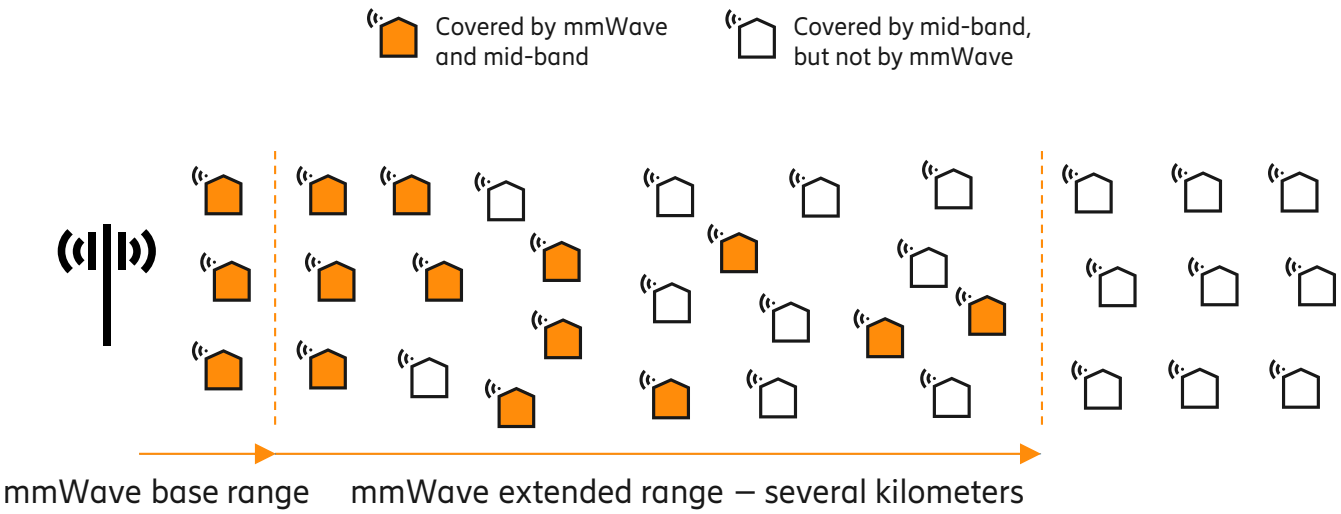
Capacity and speeds enhancements.
Optimized for service performance.

Differentiation

Intelligent traffic management

Differentiated mobility and CA behavior for different user groups.

Add extended range mmWave to offer wireless fiber in rural areas



A large amount of mmWave spectrum can provide exceptionally high peak rates, low latency, and high capacity. However, the unfavorable propagation characteristics of the mmWave spectrum produce a much shorter cell range than for lower frequencies. Currently, mmWave cells are typically configured to support cell ranges of up to about 600 m, corresponding to an inter-site distance (ISD) of around 1 km.

FWA deployments with good line-of-sight propagation conditions between high tower radio sites and outdoor roof-top mounted CPEs could deliver much longer mmWave cell ranges – up to several kilometers. This requires high-power radios, high-power CPEs, and a new software innovation – mmWave extended range – to accommodate the increased propagation time at longer distances. Field trials across four continents have demonstrated good performance over several kilometers and enhanced the value of 5G mmWave spectrum (TIM, 2020*) (NBN, 2021*) (USCC, 2021*) (DNB, 2022**).

The 3GPP NR specification allows for large cell ranges on mmWave. The guard period – the gap between the downlink and uplink in the TDD format – allows the transmission roundtrip time and the time needed for the equipment to switch from reception to transmission. An extended cell range is enabled using a larger gap, but with the trade-off that it slightly reduces the downlink peak rates for all users in the cell. By combining these measures, mmWave FWA can be used to serve selected households in good signal conditions at several kilometers distance.

The larger the distance from a household to the radio site, the more challenging it is to achieve good line-of-sight conditions. The combined use of mmWave and mid-band is the winning recipe, where mmWave serves households in good conditions and mid-band households in less favorable conditions. With the capacity offload enabled by mmWave, the mid-band can serve even more households at more distant, challenging locations. This provides an opportunity to offer high-end wireless fiber services even in more rural areas, serve more households per radio site, and support higher data consumption. This unlocks the full business and technology potential of mmWave FWA and is an attractive opportunity for profitable use of mmWave spectrum combined with mid-band.

* See Ericsson FWA Handbook 2023 edition: ericsson.com/fwa

** https://www.ericsson.com/en/press-releases/2/2022/12/ericsson-and-dnb-achieve-new-world-record-with-mmwave

A profitable use of mmWave spectrum

- Offer wireless fiber services
- Connect more households
- Support higher data consumption
- Benefit from combined mmWave + mid-band FWA

mmWave FWA enables 3x capacity with gigabit speeds

A study from Ericsson shows that with the addition of mmWave, all homes will encounter higher data rates, with selected homes experiencing gigabit speeds. Simultaneously, the total capacity will increase threefold.

In this scenario, which models the performance achieved in field trials, we illustrate how mmWave extended range increases capacity and boosts user experience. The existing MBB deployment has a macro inter-site distance of 3 km, and lower FDD bands are used to serve current traffic. For FWA, there will be excess spectrum that can be used: 100 MHz TDD at 3.5 GHz and 400 MHz in the 28 GHz band.

Combining available spectrum, including lower FDD bands, mid bands, and mmWave using TDD, the service provider can obtain a combined network deployment catering to both MBB and FWA. In this analysis, we focus on the mid-band and mmWave, and we leave out the details on lower bands as well as the performance of the MBB users. Furthermore, as the case is limited by the DL capacity, we leave out the analysis of the UL. To maximize link performance in the case, it uses rooftop-placed, high-power CPE that supports mmWave and lower bands.

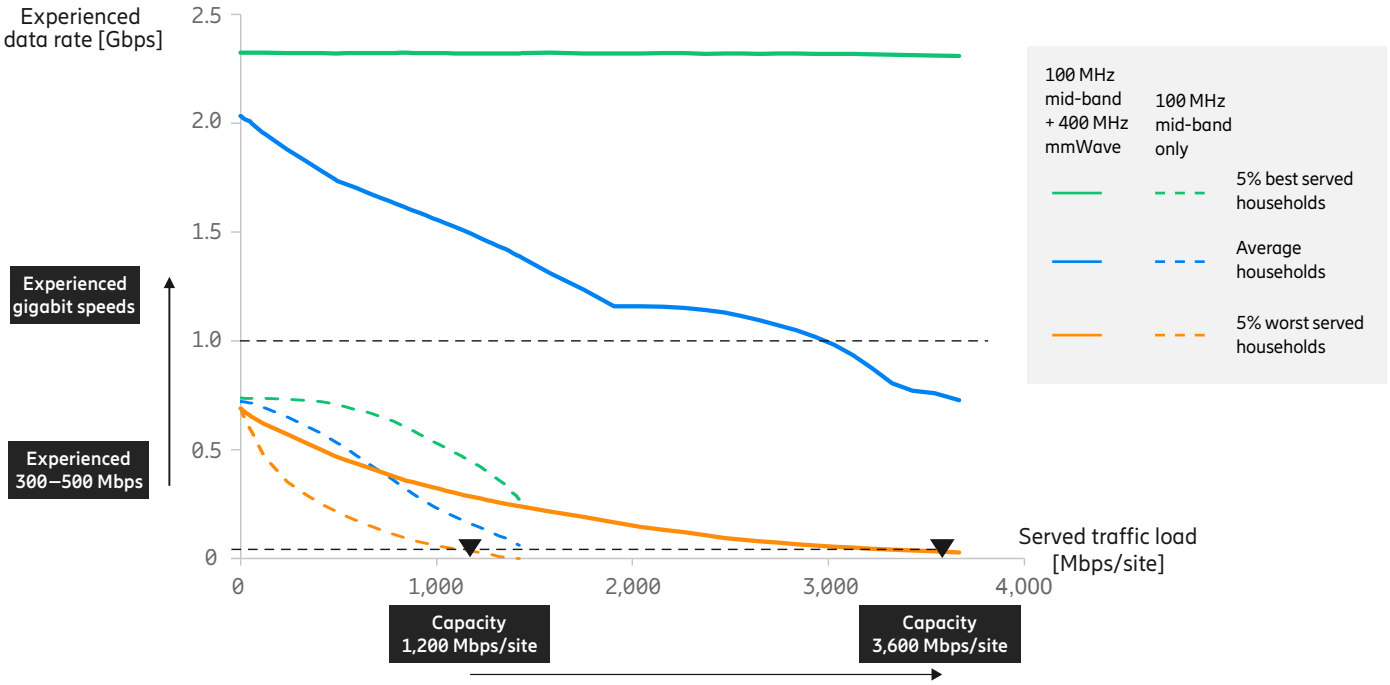
The system is dimensioned to target a minimum DL data rate of 30 Mbps for the 5 percent worst-located homes at peak traffic hours to sustain a fiber-like experience, including multiple HDTV streams per home, also in those worst cases.

The graph shows the experienced DL user data rate as a function of varying system load for the worst, median, and best-located homes. The dashed curves represent a mid-band-only deployment, while the solid lines represent the combined mid-band and mmWave case.

We define the DL capacity as the system load at which the fifth percentile worst-located homes experience a data rate of 30 Mbps (the lower dotted black line) according to the dimensioning criterion described above. With 100 MHz of the mid-band, the capacity is 1,200 Mbps per site, while it is three times higher, 3,600 Mbps per site, when adding the mmWave spectrum.

The graph shows that, already with a mid-band-only deployment, average homes experience DL rates of 300–500 Mbps or higher at moderate system load, that is, most of the time. After adding 400 MHz of mmWave spectrum, the rates of average homes increase drastically, with most of the time being above 1 Gbps (the upper dotted black line). We also see a significant variation in this range of the peak rates, which reach up to 2,300 Mbps depending on whether or not the home can be served by mmWave.

As mmWave can serve many users close to the base station, it is possible to offload lower bands and use these for homes in less favorable locations instead. The further the reach of mmWave, the larger the offload. Consequently, even though many homes may be unable to use the mmWave spectrum, they will all benefit from the offload from mid-band and experience higher data rates. →



Source: Digital Village, Ericsson Technology Review

In addition, homes that can use mmWave can have significantly higher speeds, which opens for differentiating service offerings concerning data rates. Homes in favorable locations could be offered higher service levels with subscriptions of 1 Gbps or higher to selected homes, using CPE with mmWave capability. Meanwhile, subscribers in less favorable locations, where the mmWave signal is insufficient, could be offered less expensive mid-band CPE and lower speeds. A dedicated prequalification method would be needed to achieve this.

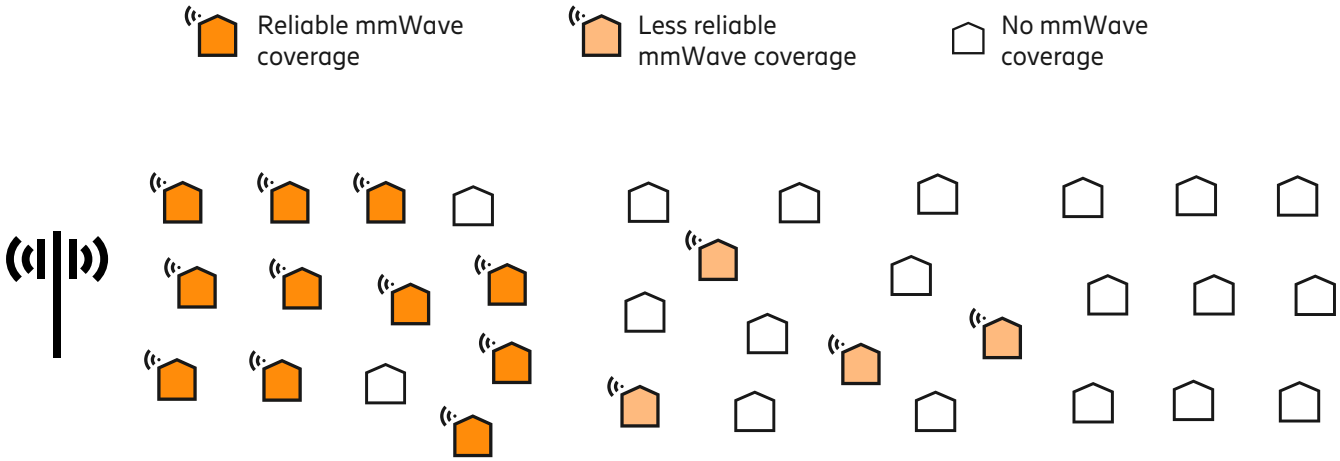
To summarize the case study, the deployment of mmWave radios on the macro sites in addition to mid-band radios results in three times higher capacity compared to mid-band-only deployment. The network will be able to serve more than 400 homes per site with an average consumption of 4 GB per busy hour, corresponding to a monthly DL consumption of 1.2 TB. In addition, mmWave spectrum opens up for differentiated speed offerings with 1 Gbps+ subscriptions to prequalified homes.

Full case description:
→ ericsson.com/en/reports-and-papers/ericsson-technology-review/articles/closing-the-digital-divide-with-mmwave-extended-range-for-fwa

3x
served homes

1 Gbps
experienced data rate

A new network option – mmWave-only SA



mmWave-only SA

- For service providers with only mmWave spectrum
- An option in areas with reliable mmWave coverage

A new network option is mmWave-only SA, supporting NR standalone deployment and operation on mmWave without any sub-6 GHz anchor band. This option also unlocks the gigabit FWA opportunity for service providers with only a mmWave spectrum.

The coverage and reliability of mmWave-only FWA deployments must be carefully considered compared to the combined mmWave and mid-band FWA solutions. Mid-band adds reliability as it is a fallback solution for FWA at any mmWave outages due to blocking or fading.

Scale of open 3GPP ecosystem delivers FWA with lowest TCO and future-proof evolution

To be competitive, FWA service providers need to be able to offer data at the lowest possible Total Cost of Ownership (TCO) with a future-proof evolution of the network and the entire broad ecosystem. 3GPP offers all this through three main aspects:

1. Network Platform

- MBB anchor use case, main funding for spectrum and site/ coverage
- Multi-service: MBB, FWA and IoT
- Spectrum shared with slicing

3GPP offers a network platform where mobile broadband (MBB) is the anchor use case and has funded large parts of the site infrastructure and spectrum costs. Most incumbent 3GPP service providers are in an advantageous starting position since they can reuse the entire mobile network and much of its business processes to offer multiple services, including MBB, FWA, and IoT. The spectrum can be shared, and network slicing offers a way to manage both network and spectrum across multiple services while meeting or exceeding the emerging requirements of a wide range of use cases (including 5G FWA).

2. Device ecosystem

- Affordable devices leveraging 3GPP chipset ecosystem
- Nearly 100 CPE device vendors
- Broad device ecosystem with +1,000 LTE and +250 5G CPEs*

The 3GPP CPE ecosystem benefits from the sizeable innovative smartphone and device chipset market. Costs are driven down by economies of scale and LTE and 5G FWA CPE availability with attractive form factors and functionality evolution. There are nearly 100 different FWA CPE vendors, with over 1,000 LTE CPEs and over 250 5G CPEs (GSA FWA report, June 2023).

3. Innovation ecosystem

- Open technology and multivendor
- Future proof technologies including evolution to 6G
- Global spectrum allocation

A further advantage of 3GPP is a future-proof ecosystem that ensures innovation, scale, and cost-efficiency. One of the latest innovations benefiting FWA is the mmWave extended range. 3GPP also offers an open technology platform with multiple vendors without lock-in. Furthermore, it ensures global licensed spectrum allocations, further driving economies of scale for network equipment and the entire FWA CPE ecosystem.

* GSA FWA report June 2023

Learn more in six actionable insights on capturing the value of 5G FWA

ericsson.com/fwa-insights

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