WHITEPAPER

Commercial mmW 5G Made Easy with Scalable Active Antennas

PRESENTED BY:

Anokiwave
mmW Solutions. Enabling a new world

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INTRODUCTION: THE 5G LANDSCAPE

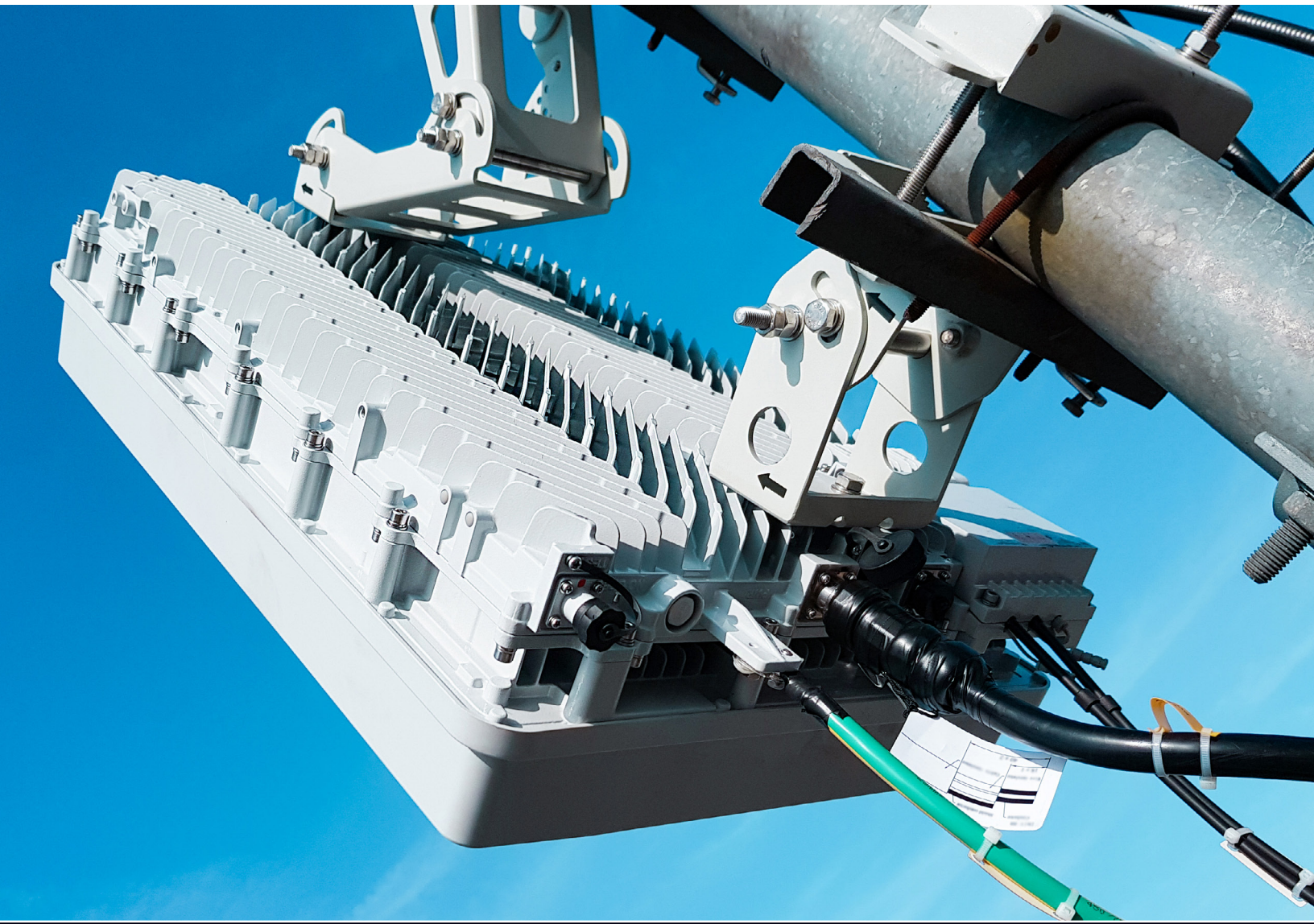
As economies begin to emerge from the coronavirus pandemic, we are navigating through a tipping-point year for 5G.

The telecoms industry more widely took less of a hit than other sectors, its multifaceted business models shielding it from the levels of damage from which it could take industries such as oil & gas, travel and hospitality many years to recover.

In fact, it's poised to emerge stronger than ever. The 5G market is set for an explosive period of expansion of the next seven years:

"The value of 5G services in 2020 was measured at $41.48 billion, a figure which is forecast to grow at a compound annual growth rate of 46.2% between 2021 and 2028."

— Grand View Research[1]



Despite the global pandemic and associated economic constraints, new 5G networks continue to be launched in significant quantities. Since March 2020, when the pandemic started to take hold around the world, expansion has held steady at eight new networks per month, up from less than six during most of 2019.[2]

According to the GSMA's 2021 Mobile Trends report, there are currently 113 5G operators across 48 countries which collectively account for 40% of the global mobile subscriber base.[3] Much of this is concentrated in mature markets, although 5G network launches (albeit small ones) in developing markets such as South Africa and Brazil are important steps.

Furthermore, global population coverage of 5G is expected to surpass 45% over the next five years, thanks to expected operator capex of around $890 billion.[4]

What these figures show is that operators are realizing the enormous benefits offered by 5G in terms of capacity, coverage, speed and latency. Meanwhile, new use cases are being uncovered at regular intervals.

This is especially apparent in B2B and industrial circles. Here, 5G is viewed as a key enabler to executing digital transformation projects, and many connectivity giants are jostling for position in what has quickly become a highly competitive arena.

Indeed, manufacturing, financial services, retail, healthcare, energy, agriculture and mining are all key sectors which telecoms operators see as drivers for revenue growth in the coming years.

The B2B and industrial focus highlights in part how the dial has shifted. Where its predecessors were predominantly focused on building up higher connectivity speeds for end users, 5G is unlocking a far greater range of benefits, especially for telcos.

"My view of 5G is not that it's about speed – people often talk about the need for speed, but in fact there are few applications that actually need to use the kind of speeds 5G can reach. The reality is that 5G is more about bringing down costs and providing capacity for the operators. Unlike the journeys through 2G, 3G and 4G, the main benefit from 5G is for the telco, not necessarily the end user."

— Joe Madden, Chief Analyst, Mobile Experts

mmW WITHIN THE 5G MIX

In order to leverage the full socioeconomic potential of 5G, access to a variety of spectrum resources and technologies is paramount.

There are several types of 5G network currently in use, one of which is millimeter wave (mmW).

A short-range, high-frequency network technology, millimeter wave is viewed as a critical step toward delivering on 5G's potential. The mmW spectrum allows for significant increases in bandwidth and capacity that numerous 5G applications need.

The major advantage it brings is massive spectral bandwidth, making mmW bands key to meeting high traffic demand while at the same time maintaining the performance and quality required of 5G services.

Several applications and use cases have been identified, including:

- Crowded arenas and stadiums
- Subway stations
- Smart factories and industrial automation
- Next generation connectivity for vehicles
- Busy urban settings

Commercial mmW 5G networks have already been launched in a handful of countries, including the U.S., Japan and South Korea. Other nations such as Italy, Finland and Australia are releasing mmW spectrum for 5G or are about to follow suit.

The launch of the millimeter wave-enabled iPhone 12 series has also given a timely boost to the adoption of this technology.

Over the next ten years, it is estimated that the mmW spectrum will underpin a contribution of $565 billion to global GDP and $152 billion in taxation revenue, making it accountable for 25% of the value created by 5G.[5]

"Operators that underestimate the role of mmWave in the short term run the risk of finding themselves at a disadvantage to competitors when offering 5G services."

— GSMA, The economics of mmWave 5G: An assessment of total cost of ownership in the period to 2025

PHASED ARRAY ACTIVE ANTENNAS ESSENTIAL FOR mmW 5G ROLLOUT

To maintain the momentum of the 5G rollout, there is an urgent need for cost-effective infrastructure development and deployment en masse. It is essential if 5G connectivity is going to reach a greater volume, density and variety of end users in consumer and commercial spheres.

In the mmW segment, phased array active antennas are essential pieces of equipment that underpin its deployment.

As mobile data traffic grows in busy areas, higher data rates are needed to serve new applications and relieve network congestion – a need that mmW is perfectly suited to meet through its ability to accommodate greater capacity than any other band.

While 2G, 3G, 4G and commonly used 5G have all been rolled out on low- and mid-frequency bands of under 6GHz, mmW is built on higher frequency bands typically ranging from 24GHz to 40GHz.

There are some technical hurdles with mmW 5G. Millimeter wave signals travel relatively short distances compared with those of lower frequency bands, and can therefore be susceptible to attenuation from trees and other obstacles. Equally, they often suffer difficulties in penetrating through material such as concrete, glass and wood. As result, standalone mmW is not an optimal solution for reaching indoors areas or dealing with other physical obstacles.

In overcoming these challenges, phased array active antennas are vital – without them, mmW couldn't be deployed in these bands at all.

How do they work? In essence, by taking the radiation patterns of multiple antennas and combining their individual signals to concentrate overall energy into a narrow beam that generates a stronger composite signal.

"Semiconductors in the mmW range are inefficient. While semiconductors in the lower 1-2GHz offer 50% efficiency, this can drop to between 5-8% in the mmW range. It's a big difference, but by using phased array active antennas, a higher power signal can be provided over a longer distance."

— Joe Madden, Chief Analyst, Mobile Experts

This is easier said than done, however. Much like mmW, phased array active antennas pose their own set of hurdles:

- **Novel:** Other niche, non-mobile markets have used this technology in the past, such as the defense industry in the development of radar systems, but at very low volumes of perhaps 100 units. Yet, in 2021 alone, tens of millions of mobile phones will require phased array active antenna technology.
- **Different:** It also operates quite differently to previous cellular systems that many major manufacturers have built in the past. Where 2G, 3G and 4G base stations have been built over the past 40 years and manufacturing key equipment in low frequency bands has become routine, phased array active antennas are a whole new ball game.
- **Technical:** OEMs, system integrators and radio manufacturers struggle to develop working arrays capable of standing up to the needs of the fast-evolving 5G market. As a result, they can be laborious and costly to make, let alone commercialize.

These antennas are renowned as being difficult to commercialize. Yet smaller manufacturers that are not tied up in old technology, and better able to react to the needs of the market more quickly, are perfectly placed to take the phased array 5G reins.

With more agile and flexible models, such organizations can effectively combine the experience of those that previously rolled out 3G and 4G networks with the technical expertise of individuals familiar with phased array technology in defense segments to make the commercialization of phased array active antennas (and in turn mmW 5G) a reality.

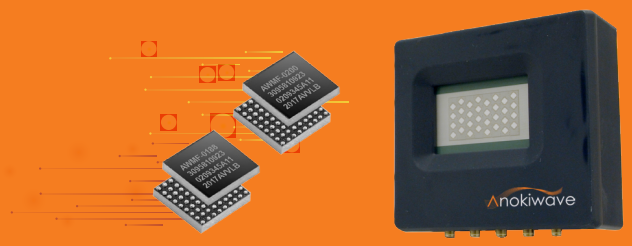
ENABLING 5G OEMs

Anokiwave recognizes that it is these manufacturers that are going to be central to the success of millimeter wave 5G. The company's solutions are dedicated to supporting them through the provision of the world's best integrated circuit solutions for next generation mmW applications.

- **Anokiwave's mission:** To enable radio and antenna manufacturers to build their products more successfully, more efficiently, quicker, in a more cost-effective way, and at a mass scale.
- **Anokiwave's goal:** To provide enabling ICs that make mmW active antennas a commercial reality – be it for 5G purposes, SATCOM purposes, or defence purposes.

The company's Silicon-based (Si) transceiver and beamformer ICs are capable of providing the lowest cost and high performance available to meet commercial market demand. These products that have been optimized through multiple generations since their initial release leverage state-of-the-art, unique architecture allowing manufacturers to build scalable arrays with effective radiated power (EIRP) from 30 dBmi to 70 dBmi.

The components themselves, however, are just one part of enabling commercial arrays. In respect of the manufacturing challenges, the Anokiwave Innovator Kit has been built with the specific purpose of bridging the gap.



"By leveraging the uniform quad architecture of Anokiwave core ICs, the kit is a plug-and-play solution manufacturers can use to rapidly build and deploy a 5G radio or 5G system, with most of the heavy lifting on the array portion already completed. Anokiwave designed, developed, and tested these Active Antennas 100% in-house, in a third of the time of a typical commercial active antenna development, and achieved near ideal performance in the first pass design. This speaks to the decades of mmW active antenna expertise the company has developed."

Through the Anokiwave Innovator Kit, manufacturers are directly supported in overcoming the technical challenges associated with phased array active antennas.

It is a low-cost solution, built with ease of integration and the end user in mind. It provides complete antenna front ends spanning mmW to IF. It can easily be used to prototype and develop proof of concept for a quick 5G radio or antenna design. And it can easily be scaled up or down depending on requirements.

The Innovator Kit equally features Anokiwave's patented ZERO-CAL® technology that removes and compensates for any electronic amplitude and phase mismatch across the array. As a result, manufacturers are able to generate ideal patterns that can be trialled and tested straight out of the box to achieve near ideal performance.

"Anokiwave's 5G Innovator Kit active antenna shortened the time to market to one third of a typical commercial development."

Anokiwave is an IC company. Its goal is not to deliver arrays into the marketplace – rather, it strives to provide customers with a tool that they can use and adopt to learn more about active antennas, become familiar with the technology, and accelerate their go-to-market strategies. The Anokiwave Innovator Kit is that tool.

More broadly, Anokiwave products deliver the maximum number of options for performance, cost, and functionality for mmW 5G.

By harnessing the appropriate level of integration, multiple generations of active antenna IC learning, and cost structures only available on 300 mm silicon processes, we have enabled the total cost of ownership for mmW 5G systems to resemble Wi-Fi access points or "handset technology for infrastructure".

Anokiwave continues to lay a path for the industry to adopt mmW active antennas at a commercial scale, helping to make mmW 5G a reality for all.

Endnotes

1. https://www.grandviewresearch.com/industry-analysis/5g-services-market
2. GSMA, Global Mobile Trends 2021, p15.
3. GSMA, Global Mobile Trends 2021, p15.
4. GSMA, Global Mobile Trends 2021, p16.
5. GSMA, Study on Socio-Economic Benefits of 5G Services Provided in mmWave Bands, p3

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About Anokiwave

Anokiwave is a fabless semiconductor company providing highly integrated millimeter-wave silicon ICs to enable large scale commercialization of phased array active antennas for 5G, SATCOM, and RADAR markets. Anokiwave brings unique, industry-leading, Silicon IC technology and system level support to help companies develop high performance and cost-effective phased arrays with first pass-success. Anokiwave is innovative, reliable and committed to superior quality with ISO 9001:2015 certification. Customer satisfaction is our number one priority.

- mmW Silicon ICs
- Intelligent Array IC Solutions™
- mmW Algorithms to Antennas™

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