



A Dual-Band Answer to the Challenges of 5G Backhaul



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EXECUTIVE SUMMARY

\$2.2 trillion. That is the anticipated value of the 5G market by 2034 according to [research from the GSMA](#). It is a huge opportunity to make significant headway on the economic recovery that is essential in a post-Covid world. However, the vision and market value of 5G is absolutely contingent on having the right infrastructure in place to support it.

Take a state of the art F1 car. A feat of precision engineering with top speeds of 246mph and recognized as the fastest cars in the world. Put it on a dirt track and that 246mph is nothing but theory. 5G faces the same conundrum, without a solid infrastructure, the theoretical vision and the associated benefits remain completely hypothetical.

Reliable backhaul is an absolutely critical part of that solid infrastructure and so one of the big challenges that operators face is how to deliver robust backhaul that marries the capacity, coverage and reliability to let 5G reach its promised potential.

SECTION 1: THE CHALLENGE

Backhaul of the future

Backhaul is the backbone of 5G. Many of the 5G applications that hold the most promise not only need the enhanced speeds associated with the next generation of mobile connectivity, but increased reliability. Take the classic example of connected cars, to be able to truly support this application and reap potential returns, there can be no risk of a delayed or interrupted connection. It makes the technology unsafe and so commercially unviable.

This is why the backhaul solutions that operators put in place must not only maintain a strong consistent backhaul connection, but they must be robust and reliable, with a fail-safe to stop any problems impacting the end user.

This is what sets the 5G backhaul challenge apart from previous generations. It must not only deliver higher speeds and greater capacity, but also incorporate enhanced reliability, at a viable price point for mass roll out, without hugely increasing the site footprint. Not much to ask.

Not all backhaul challenges are created equal.

So far, we have looked at the universal challenges of 5G backhaul, but depending on the environment, the requirements differ slightly, and this changes the backhauling needs:

ENVIRONMENT	THE CHALLENGES		
URBAN	Small but dense coverage	Highest concentration of users	Navigating physical obstacles such as buildings
SUBURBAN	Longer range coverage	Larger area to cover without skyrocketing equipment costs	Variable capacity needs
RURAL	Longest range coverage	Largest area to user ratio makes balancing coverage with investment a challenge	Fiber is difficult to roll out and prohibitively expensive

There is not a one size fits all solution to the challenges of 5G backhaul, so the question for operators is how do they design infrastructure that meets the variety of needs in a way that is reliable and delivers a 5G network that is fit for purpose?

Fiber vs Microwave

The two options operators have for backhaul are Fiber and Microwave and they must weigh up the pros and cons of each solution to work out which is the most suitable for 5G networks.

Traditionally, fiber would be the go-to option for backhaul, however it is not without its drawbacks. It requires a high CAPEX; it is an expensive solution that is slow to roll out and requires a significant amount of labor to deploy.

Microwave has always had a question mark over its suitability for backhaul due to concerns over coverage range and reliability. However, developments in microwave technology are rapidly overcoming its traditional drawbacks, particularly given the advent of dual band solutions.

SECTION 2: THE BENEFITS OF A DUAL BAND APPROACH

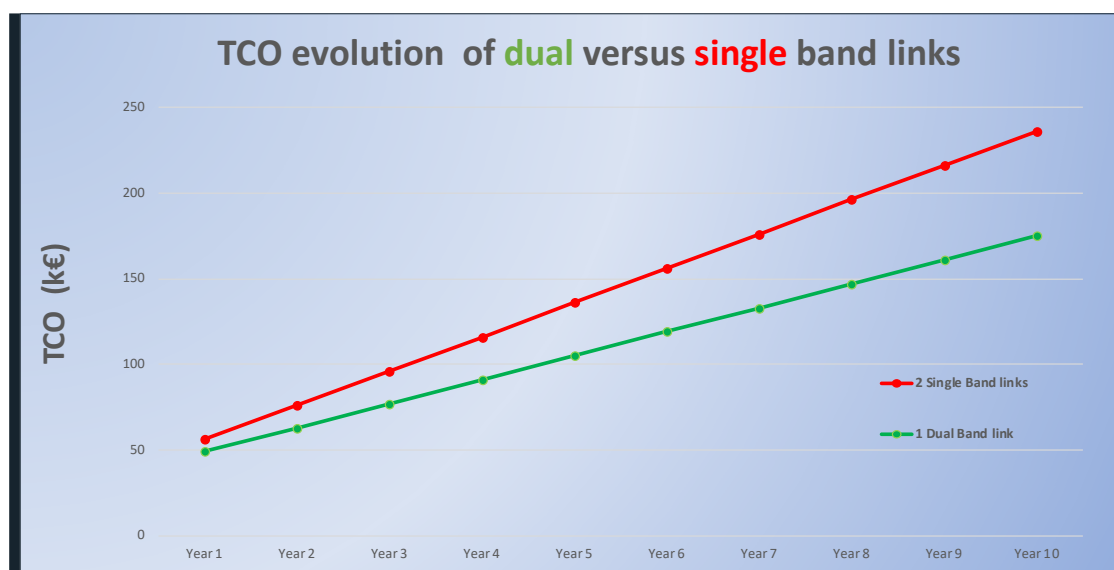
Dual-band microwave systems make microwave a real-world, viable option when it comes to 5G backhaul. They incorporate the latest antenna technologies that combine multiple bands in a single antenna to offer ultra-high capacity that is now comparable to traditional fiber options. The result is mobile operators can backhaul higher volumes of 5G traffic much further than previously possible with a number of additional benefits.

Site footprint

One of the biggest challenges facing operators as they look to 5G rollouts is site footprint. They must deliver significantly greater capacity, for an entirely new network generation, without significantly increasing their site footprint.

By consolidating multiple bands into a single antenna, operators can deliver the network capabilities that 5G requires without having to incur the additional costs and potential problems associated with expanding their site.

The financial benefits for operators are twofold. They lower their CAPEX costs, as less equipment is required as each antenna is working harder. Additionally, they can avoid significantly increasing the OPEX costs associated with expanding their site footprint. The graph below demonstrates the cost saving operators can see over a 10-year period by choosing a dual band link over two single band links. **The TCO is reduced by 13% in year one and 25% by year five.**



Greater capacity

The dual band approach means a single antenna can deliver higher capacity than in single band. The new dual microwave band antennas double or quadruple the capacity, depending on its polarization. This is a critical advantage for 5G where capacity is king.

By investing in equipment that works harder, operators are able to deliver a 5G service that is able to deliver on the vision for technology that has been promised over the past 5 years.

For operators making huge investments in 5G, they must be able to see that the 5G service they offer meets the needs of potential applications. It is only by doing this that they will be able to ensure that they see a real return on investment for 5G.

Reliability

Alongside the benefit of increased capacity, by integrating two bands into a single solution, Dual Band offers its customers a higher level of reliability as it has an inbuilt fail-safe. If there is a temporary problem with one band, there is no down time as the other band continues to function. This is a crucial benefit for operators as they look to convince customers that their 5G networks can support connectivity critical applications such as connected cars or Healthcare IoT.

SECTION 3: TECHNICAL DEEP DIVE

Taking a dual band approach offers clear benefits to operators looking for a backhaul solution that is suitable for 5G deployments. However, not all environments have the same requirements when it comes to backhaul. This is why RFS has developed an extensive portfolio of dual band antenna solutions to suit every environment.

Urban areas: E-band +

To suit urban environments with a high concentration of users, RFS offers a dual band option that incorporates ultra high capacity E band with an additional medium band such as 15 GHz, 18 GHz or 23 GHz.

By combining the high throughput of E-band frequencies with the broader coverage of microwave frequency bands RFS antennas can create a wireless backhaul offering suitable for 5G networks. The E-Band + solution can be used to replace existing 2 ft single band links giving significantly enhanced backhaul performance without impacting site costs.

As shown in **Figure 1**, E-band alone typically supports around 5 Gbps over 4 kilometers. It is perfect from a capacity perspective, but lacks the distance required to make this a commercially viable solution. By integrating a second, medium frequency band, a dual-band antenna can support larger volumes of 5G traffic over longer distances with lower latency than fiber-based backhaul solutions. This RFS solution delivers 10Gbps over longer distances making it perfect to support 5G deployments in dense urban environments.

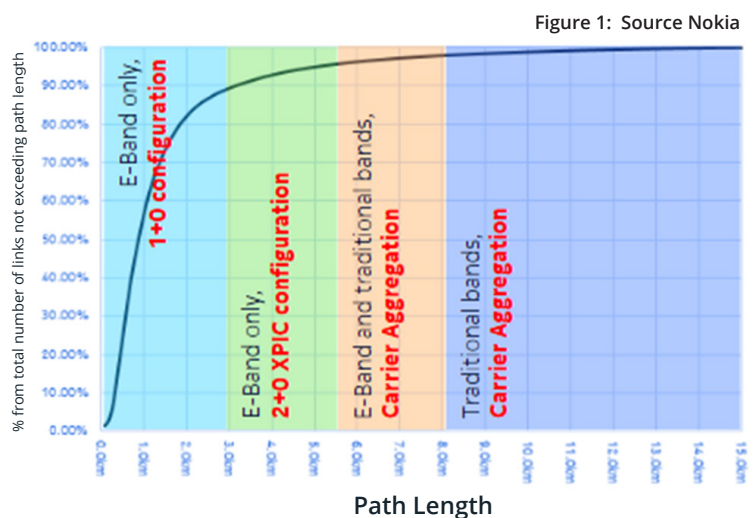


Figure 1: Source Nokia

Rural and suburban: 6 + 11 GHz

The E-band solution, although perfect in city deployments, is not able to deliver the range of coverage needed to suit suburban and rural deployments. Operators would need to install greater volumes of equipment to cover vast areas which is not economically viable. To address this RFS has developed a second offering that delivers the same benefits of a dual-band solution, but using frequencies better suited to non-urban environments.

The new TowerBooster solution is ideal for new long-haul microwave installations and as replacements for single-band antennas. It takes the same form factor as existing 6-12ft microwave antennas so again is able to replace existing infrastructure without escalating site costs.

It supports both horizontal and vertical polarization in each band allowing the capacity to be doubled compared to single-band, dual polarized microwave antennas or quadrupled in comparison to single-band, single-polarized equipment.

Beyond the increased capacity, by using multiple bands, operators benefit from an increasingly reliable and robust microwave backhaul solution that serves the rural and suburban environments.

Technical specification including

- Provides ETSI Class 3 ultra-high performance
- Meet FCC Part 101 Cat A standards in the 6 and 11 GHz bands
- Feature high cross-polarization discrimination (XPD) between the two bands to support high-capacity cross-polarization interference cancellation (XPIC) and Co-Channel Dual Polarization (CCDP) applications
- Maximize the effects of link diversity in a single antenna to mitigate multipath fading on long-distance links and to increase link quality and availability
- Incorporate RFS structural design features to achieve outstanding mechanical reliability

All solutions are available in both standard and high wind, high ice configurations for reliable operation in severe environment and climate conditions making microwave backhaul for 5G viable everywhere.

SECTION 4: 5G EVERYWHERE - USE CASES

By having multiple dual-band solutions to suit different environments, RFS is able to deliver reliable, robust 5G backhaul solutions in virtually any environment, for a wide range of use cases.



SMART CITIES

Technology | E-band + Solution

One of the huge selling points of 5G is the enablement of Smart Cities. The promise of a wide range of real-time safety applications, better management of utilities and smart transportation make it a hugely appealing proposition for operators looking to drive new revenue streams. However, the vast number of sensors and connected devices needed to make this a reality, need a backhaul system that can support a huge surge in demand for high-speed connections. The E-band + solution can help operators meet this need and deliver enhanced, reliable connectivity in a city environment.



CONNECTED WIND FARMS

Technology | TowerBooster

As the world strives for sustainability, wind power has grown exponentially. As this trend continues there is an opportunity for energy providers to improve efficiency by taking advantage of 5G technology for connected turbines. These provide actionable insights to improve efficiency, but to deliver, 5G must extend to the rural areas that are most often home to wind farms. By extending coverage out to rural areas and ensuring 5G infrastructure that is capable of supporting reliable and real-time updates, operators are able to support this rapidly growing industry. The TowerBooster solution, which is available in high wind, high ice configurations, can deliver cost effective, reliable backhaul in rural environments to support this, and many other potential 5G use cases.



MANUFACTURING

Technology | TowerBooster

The 5G Industrial IOT Market is anticipated to be worth \$15.7 billion by 2026 according to recent research from [Markets and Markets](#). However, to achieve this potential, 5G cannot be restricted to cities as many manufacturing facilities are located in more rural environments. This is a huge incentive for operators to expand the reach of 5G to extend to areas where manufacturers can take advantage of 5G to power IIoT applications that deliver tangible benefits for their business. To be able to support these applications operators need to be able to offer businesses high capacity, reliable 5G connections. The TowerBooster solution takes care of the backhaul element of this infrastructure in a way that is efficient, easy to install – delivering the optimum performance needed without compromise.



5G APPLICATION: ENHANCED SPORTS VIEWING

One of the use cases expected to generate a rapid ROI for operators' investments in 5G is sport viewing. Even in a year with minimal live sport, US OTT provider FuboTV saw a monthly ARPU of \$54.79. It is an industry where users have shown time and time again that they are prepared to pay for premium services presenting a great opportunity for operators that can deliver.

In Stadium Deployments | E-band +

It's not news that data consumption in sports venues surges during matches as viewers crave an ever more interactive experience. By offering the infrastructure to support data surges with the E-band + solution, operators can deliver the connectivity that sports fans are demanding.

Enhanced Home Viewing | TowerBooster

OTT providers are already touting AR and VR options to enhance the sports viewing experiences. With great experience comes great data consumption and this is where having a high capacity, reliable 5G network becomes critical. With the TowerBooster solution, RFS can help offer this in all environments, without skyrocketing investment costs that make it impractical.



CONCLUSION

5G does offer significant revenue opportunities for operators, but only if the infrastructure is in place to consistently and reliably support them. Operators need to deliver unequivocal connectivity and dual-band solutions offer a smart solution to this challenge. By diversifying frequencies, they can offer enhanced reliability of connectivity, as well as increased capacity. By using a consolidated form factor they can avoid escalating tower costs, and minimize the visual impact of 5G.

For 5G to see its full potential and start delivering ROI for operators, it cannot be limited in its coverage. Due to the range of dual-band solutions available from RFS, robust and reliable backhaul can now be delivered in any environment. This is a critical step forward to ensure that all promised applications for 5G are capitalized on and in turn that the industry looks back on 5G as a commercial success.

To see how RFS's range of dual-band solutions can help to deliver 5G everywhere get in touch with: paula.mennone@rfsworld.com



ABOUT RFS

Radio Frequency Systems (RFS) delivers the end-to-end RF solutions and expert services needed to evolve wireless and broadcast networks today and tomorrow. Our cables, connectors, antenna systems and RF conditioning products are based on more than 120 years of experience delivering cutting-edge RF solutions and industry firsts. As a result, our solutions are recognized globally for their innovation, superior performance and unmatched quality.

As an ISO-compliant company with global operations, we bring our customers world-class engineering and manufacturing skills backed with comprehensive local support services. Our customers know they can rely on our expertise and commitment to excellence from initial design to final delivery and beyond — whether they're looking to support 5G, deploy small cells, empower smart cities or improve indoor coverage in the most challenging locations.

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