alcan systems

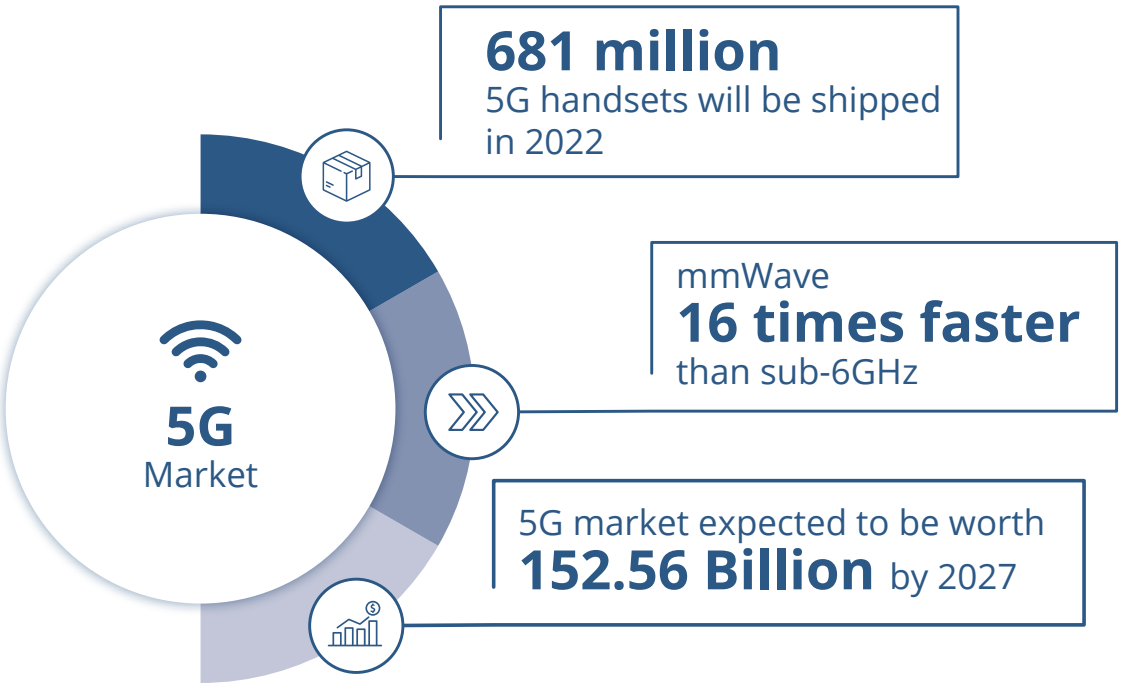
REAL-WORLD READY

Demonstrating the potential of Liquid Crystal Phased-Array Antennas

Executive Summary

ABI Research has predicted that 681 million 5G handsets will be shipped in 2022, highlighting the speed at which 5G is set to become ubiquitous. With more and more supporting mmWave frequencies, service providers face the challenge of rolling out the infrastructure to realise the market potential and deliver the connectivity customers are demanding.

The benefits of mmWave in particular are well documented; it is capable of delivering faster data in greater volumes than ever before, however, delivering this in real-world environments poses a real challenge for service providers. In this whitepaper, we look at the potential for Liquid Crystal Phased Array Antennas to form the cornerstone of the ecosystem that will allow operators to overcome this challenge, showcasing their capabilities as demonstrated in recent tests with Rohde & Schwarz, and highlighting the real-world potential of the technology.



Intro to ALCAN Systems 5G Solutions

ALCAN's 5G solutions are based on unique Liquid Crystal Phased Array Antenna technology and specifically designed to address the challenges associated with the roll out of mmWave 5G.

Tackle in-building penetration

Minimize OPEX

Enable densification

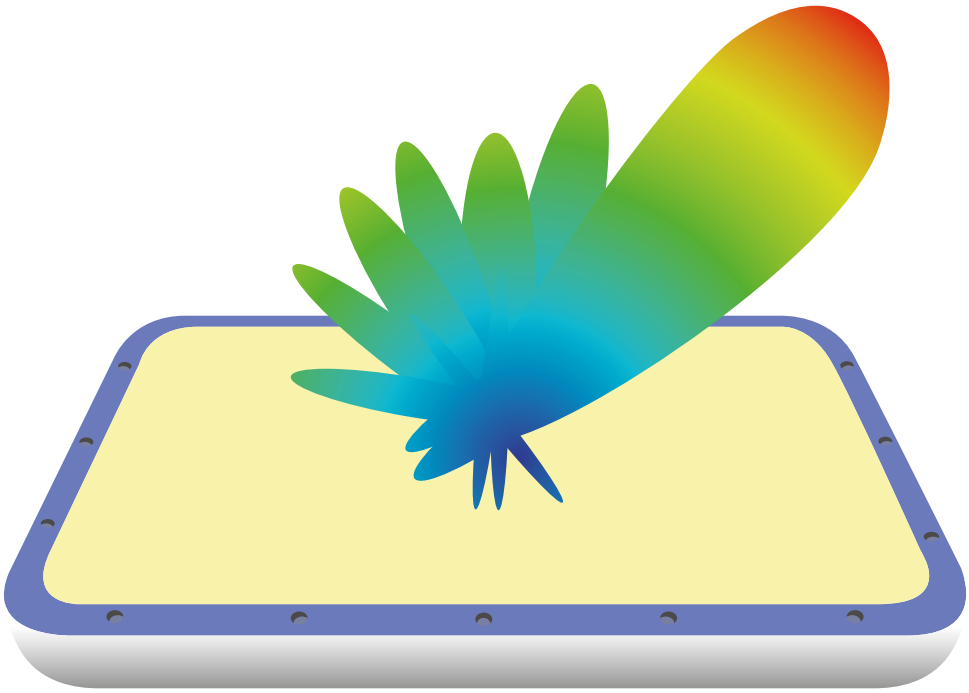
Overcome pathloss

Lower CAPEX

Liquid Crystal based phased array antenna solutions

Designed to minimize losses by directing signal at a specific target, beam steering equipment will be a core component of mmWave 5G infrastructure. The difficulty Service Providers face when deploying this technology is the high upfront costs and ongoing maintenance of the equipment. Delivering this in a cost-effective way will be vital to ensuring the ROI for Service Providers that will ensure 5G is seen to be a success.

However, using liquid crystal based phase shifters, allows beam steering at a fraction of the cost of traditional approaches compared to this advanced technology. The solution can change the direction of the received or transmitted beam without needing to physically turn the antenna. No moving parts means lower energy costs and an antenna which requires minimal maintenance.



Low cost **Low power** **Low profile**

By taking this approach, the Liquid Crystal Phased Array solves a triad of challenges for operators.

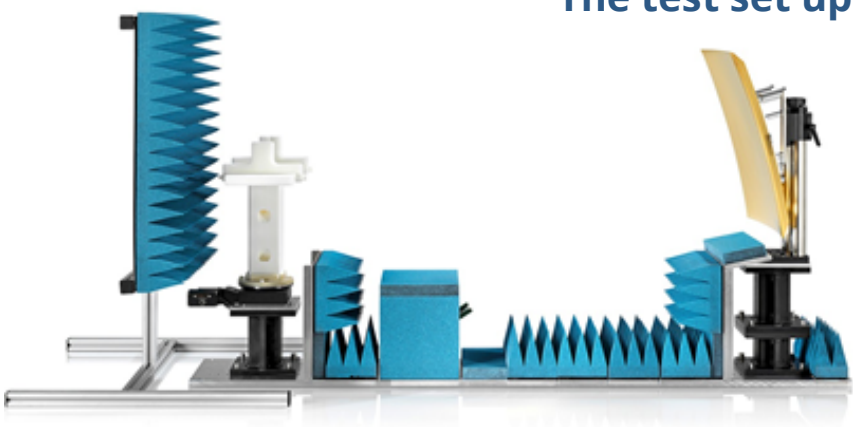
- Cost-effective materials and efficient manufacturing offers a low cost phased array antenna solution
- Using Liquid Crystal (based phase shifters), rather than typical silicon beamforming solutions, offers a low power yet high performance phased array antenna using only a few watts, minimising OPEX costs
- The liquid crystal make-up allows a completely flat, discrete form factor

The solutions have been designed from the ground up with the real-world challenges of 5G in mind, however, the real question is; does the theory translate into a solution capable of delivering in practice.

Testing for Real-World Performance

The ALCAN technology is designed to overcome some of the biggest challenges facing Service Providers as they look to expand mmWave 5G coverage. However, in order to overcome the hurdles, the technology must stand up to rigorous testing and demonstrate its potential as a real-world solution. In November 2020, the solution was tested with Rohde & Schwarz, looking to demonstrate that the solution would facilitate 5G beam steering, without impacting performance.

The test set up



ROHDE&SCHWARZ

Rohde & Schwarz has identified that beamforming has a significant role to play in mmWave 5G role outs and developed dedicated testing equipment to allow exact evaluation of beamforming capabilities.

The testing of ALCAN's technology was conducted using the R&SATS800B. This very compact benchtop CATR set up enables mmWave testing to be conducted in the lab. The set up enables far-field over-the-air RF measurements to give a true idea of how equipment will perform in the field. The ALCAN antenna was connected to a base station emulator (R&S CMX500), sending signal to a commercial mobile phone with 5G NR FR2 capabilities. This was then tested using 5G NR band n261 with LTE band 2 as anchor. The test looked to measure two main metrics:

- Throughput
- Error Vector Magnitude (EVM)

The results

Using the Rohde & Schwarz set up, the Liquid Crystal Phased Array Antenna for 5G demonstrated the following.

Throughput

The equipment set up was designed to test the capabilities of the Liquid Crystal Phased Array as a beam steering solution and assess whether the solution would hamper performance. Looking specifically at throughput, the testing looked to ascertain the percentage difference between the theoretical maximum throughput and the average actual throughput. By doing this it would be possible to say with confidence the throughput capabilities of the phased array antenna with alternative configurations.

Based on the configuration used in the test environment the maximum theoretical achievable throughput would have been 230Mbps. The testing yielded an average throughput of 224Mbps. The results demonstrated a throughput of 97.39% of the theoretical maximum in a 5G set up. Using this it is therefore possible to see that the ALCAN solution can fit into the 5G ecosystem and enhance coverage capabilities without compromising throughput.

Test configuration

Configuration	Test	4CC	8CC
QAM	64	64	64
SCS	120KHz	120KHz	120KHz
MCS	27	27	27
Code rate	910/1024	910/1024	910/1024
Bandwidth	100MHz	100MHz	100MHz
Number of resource blocks	66	66	66
DL:UL	7:2	8:2	8:2
MIMO layers	1	2	2
Number of aggregated components carriers	1	4	8
Average Down Link Throughput	224Mbps	2.4 Gbps	4.8 Gbps

EVM

Error vector magnitude (EVM) is a measure of modulation quality and error performance in complex wireless systems and is a key indicator of what can be expected when it comes to the reliability of a solution.

The reference for testing showed an EVM of 1.5% when the signal generator and receiver were connected directly to each other. When the signal was sent over the air and used the Liquid Crystal Phased Array Antenna as part of the configuration, the results demonstrated minimal deviation with an EVM of 2% - only 0.5% greater than a direct RF cable connection.

Actual test figures

The findings

The throughput and EVM results demonstrate that the introduction of ALCAN's equipment to enable beam steering has a minimal impact on the theoretical maximum performance that can be achieved in a 5G configuration. By showcasing the capabilities in the sophisticated test environment, Service Providers can confidently see the potential of using a solution that addresses real-world problems, without creating further challenges.

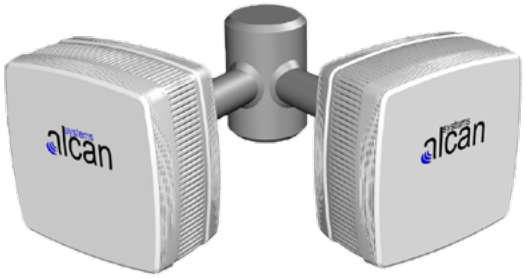
Application Potential

The technology that is at the core of ALCAN's 5G solutions has been designed with versatility in mind so that it can be deployed in a variety of situations to deliver next generation connectivity without spiraling costs.

CPE

CPE solutions look to address the challenges of delivering 5G in-building. With countless 5G use cases dependent not only on the high capacity, high speed that 5G offers, but also consistency of coverage, overcoming the in-building problem is crucial. The Liquid Crystal Phased Array can therefore be modelled into mmWave 5G Fixed Wireless Access solutions. They allow coverage everywhere and offer a cost-effective, fast alternative to optical fiber deployments, bringing full 5G coverage inside.

Repeater



The repeater solution takes the same Liquid Crystal Phased Array Antenna to deliver a cost-effective repeater which helps operators overcome the shorter-range issues associated with mmWave. By enabling discrete additional sites to be deployed across cities, service providers can deliver 5G coverage without the cost or complexity of adding a gNB site.

In practice

Streetlight integration – The ALCAN solution is designed to be easy to deploy and easy to run. The low electrical requirements associated with this solution make it simple to attach to existing street furniture, such as streetlights, delivering connectivity without the need for a large volume of additional infrastructure.

Conclusion

Consistent and reliable performance is a key component of any solution that is selected as part of 5G infrastructure. By demonstrating that beam steering is not only achievable using a liquid crystal-based solution but offers performance on par with alternatives, with the additional benefits laid out, we can see the potential for this technology in real world deployments. On a worldwide stage although mmWave 5G is not a priority in multiple regions, it is an inevitability. The superior performance that is a real step up from the capabilities of 4G mean that to truly deliver on the promises of 5G, mmWave will at some point form a key part of every Service Provider's 5G strategy. Therefore, technology that brings down CAPEX and OPEX costs while still delivering everything that will be required for mmWave 5G rollouts is critical and the high throughput and low EVM demonstrated in testing offers operators a simple and effective solution to some of the biggest challenges on their horizon.

If you would be interested to hear more about ALCAN's Liquid Crystal Phased Array Antenna technology, please get in touch:

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