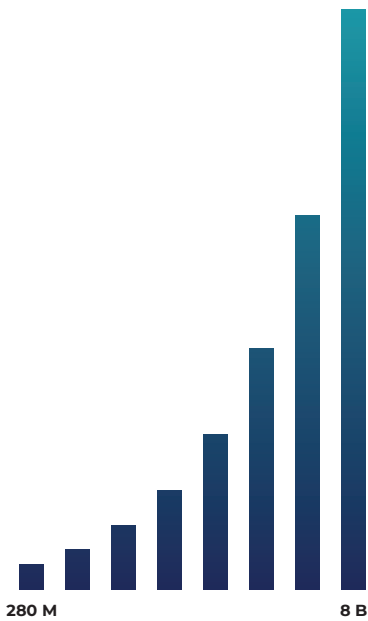




AgeNT™

Flexible Transparent Antennas for a Safer & More Connected world

**Global 5G Antenna Market**

A compound annual growth rate of 54.7% is expected between 2020 and 2027.

Antennas are the cogs in the massive 5G networks — and the growth figures prove it. The global 5G antenna market is estimated to grow at a compound annual growth rate (CAGR) of 54.7% during the forecast 2020-2027 period, reaching \$8 billion by 2027, compared to \$280 million just two years ago.

This massive 5G universal adoption brings new design challenges not perceived in the past years with the promulgation of 4G. For example, with 4G communication, the comparatively low-frequency radio waves, LTE, have a low attenuation during the propagation process, enabling them to pass through objects, walls, or buildings well. This principle becomes more complicated in 5G.

High Attenuation of 5G:

5G millimeter waves can receive and transmit large amounts of data at high speeds. Still, the highly linear radio waves are more attenuated in the transmission process and, thus, pass through objects less easily and are hard to reach indoor areas or inside vehicles. Therefore, 5G waves must be concentrated and transmitted with precision. Advanced antennas are used to bring radio waves together and transmit them in the form of pencil beams. While increased usage of these antennas can solve the 5G attenuation problem,

this presents additional design challenges, and antenna placement considerations are more critical. Engineers are thus being taxed with thinking outside of the box to find new antenna designs that are both unobtrusive and not unsightly. This may have been impossible with traditional antenna materials, but these prior boundaries are changing and it is clear why... antenna material transparency!

Transparent 5G Antennas Break Innovation Barriers

Conventional antenna designs use advanced ceramics-based raw materials such as barium carbonate and silicon dioxide. Unfortunately, this traditional design, while adequate from a performance standpoint, serves little help from a design standpoint in making the antenna subtle, or even better, “hidden in plain sight.”

While antennas made of visible materials can only be placed in specific locations that do not obstruct views or cause visual blight, transparent antennas come with no such constraints. Flexible transparent antennas further expand opportunities for placement and design, allowing product designers to easily shape antennas in accordance with the demands of the surrounding environment.

CHASM Transparent Antenna Technology

Transparent antennas made using AgeNT films offer performance equal or better to traditional antennas.



Transparent Antenna Applications



Each of a building's windows can become a potential antenna.



Transparent FWA Indoor Antennas can be installed on or near a window.



Transparent antennas can be invisibly incorporated into a vehicle's glass surfaces.



A transparent NFC antenna turns any display into a payment interface.

With transparent beamforming phased array antennas, every window surface in a building becomes a potential hosting ground for an advanced antenna. This enables these windows to act as high-performing antennae while maintaining transparency and visibility as a functioning window. While traditional antennas can typically be implemented only on roofs or fixed material surfaces, transparency implementation options increase substantially as all windows and clear surfaces are now brought into play.

The transparent antenna can also be used for MIMO fixed wireless applications (FWA). Because 5G provides border bandwidth and use MIMO technology, cellular providers can now offer broadband access without significant investment in optical installations, leverage the existing cellular infrastructure, and sell unused capacities. Transparent FWA Indoor Antenna, installed on the window or near the window, requires no bulky waterproof equipment, no technician visit, and significantly reduces the cost and increases user-friendliness. Connect the disconnected!

Vehicle and transportation technology also benefits tremendously from transparent antennas for V2X & high-precision PNT (Position, Navigation & Timing) systems. 5G enables vehicle-to-anything (V2X) solutions that communicate with the network and the vehicle's surroundings. Whether for robot taxis, urban public transportation management, ADAS, or automatic guided vehicles, transparent antenna solutions offer state-of-the-art design possibilities that make incorporating the antennas needed for connective performance a challenge of the past.

The Internet of Things (IoT) and Near Field Communication (NFC) technology have grown side by side in the 5G era. A transparent NFC antenna turns any display into a payment interface. Compared to traditional RFID tags, which require touching or swiping, the NFC antennas with a total transmittance of 80%, incorporated on the display panel, increase the operational distance and reduce the response times to under a second.



CHASM's Agent Product Platform:

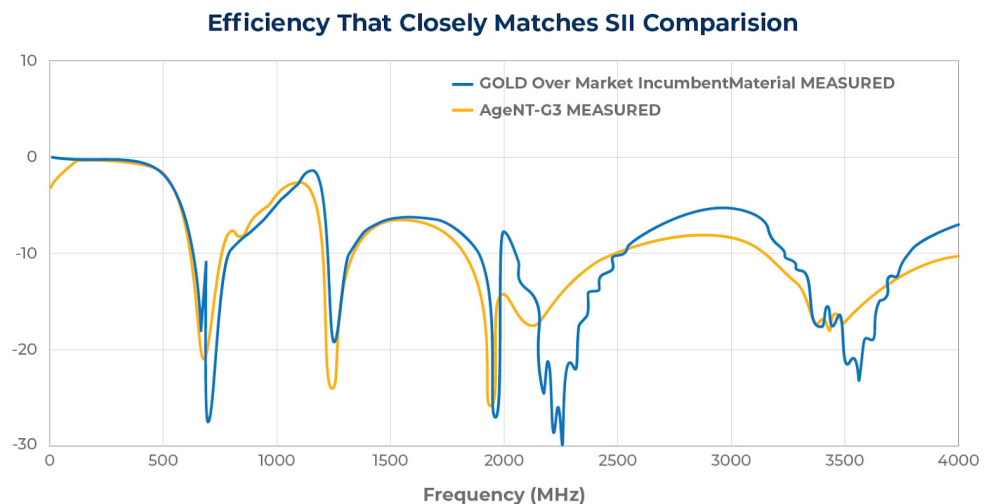
Chasm Agent Antenna Solution is a product family of Nanotube Hybrid Transparent Conductive Films (TCF) made by printing proprietary Agent ink formulated with conductive carbon nanotubes onto a Metal Mesh (MM) film. Delivering comparatively more robust and uniform conductivity at higher transparency, this exclusive category of flexible TCF performs substantially better than TCFs comprised of CNTs or MM alone.

PRODUCT BENEFITS

- **Extremely low sheet resistance with high optical transparency**
- **Low materials and processing costs for creating patterned TCFs**
- **Thin & flexible — can be easily be attached to flat or curved plastic or glass surfaces with OCA film**
- **Resistance, adhesion and optical properties are very stable with environmental aging.**

How Does Chasm Agent Antenna Solution's Antenna Efficiency Compare to Ceramic-based PCB 5G Antennas?

CHASM transparent TCF performance closely matches incumbent ceramic PCB 5G antennas. Please see the chart below showing Agent's strong performance compared to the widely used 5G ceramic-based antenna materials.



Chasm has worked with leading RF innovation centers to develop three antenna reference designs to shorten the design and production cycle:

- **Microstrip patch antenna for phased arrays**
- **Microstrip multiband antenna**
- **Coplanar multiband antenna**

In Conclusion:

This new class of antennas can not only hide in plain sight, on windows and displays, vehicles; they can also be molded to blend into 3D-shapes — without compromising performance.



Do you have questions for us about AgeNT or wonder how our pioneering use of CNTs could benefit your products?

Contact us today. We are here to help:

chasmtek.com

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