



5G

TECHNOLOGY & CONCEALMENT ON THE HORIZON

WHITE PAPER - OCTOBER 2017



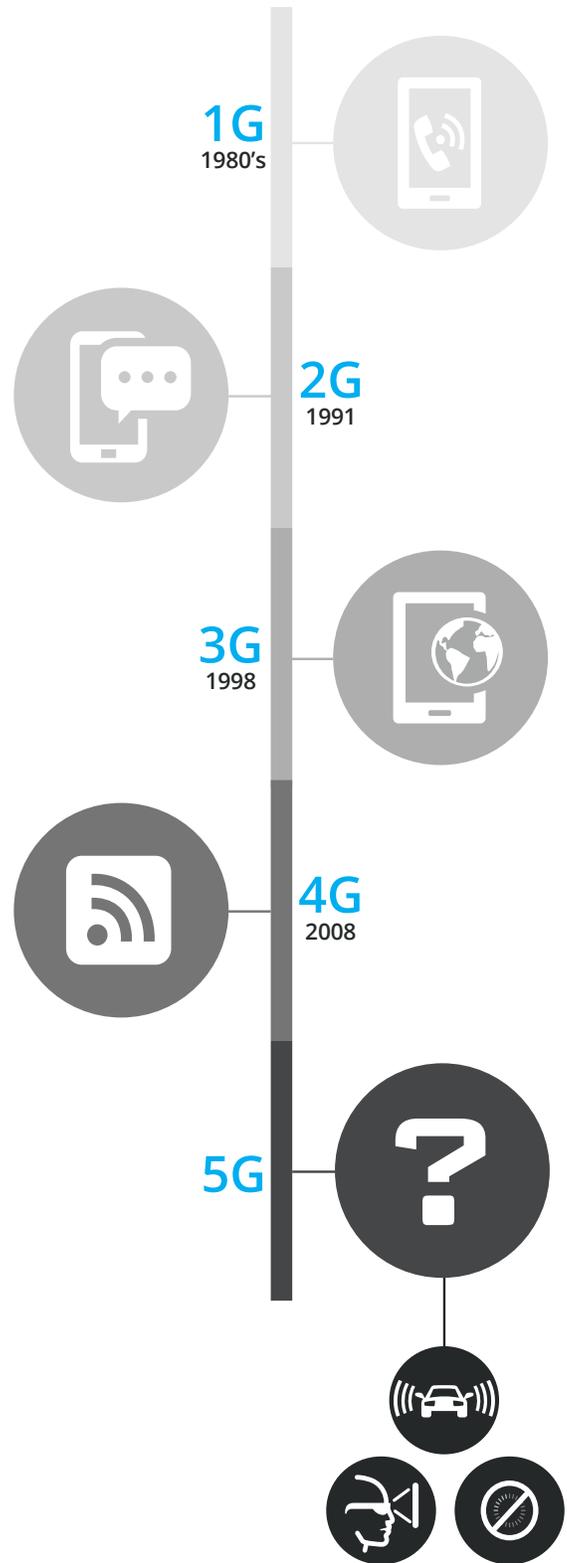
STEALTH[®]
GO UNNOTICED™

WHAT'S THE WORD ON 5G?

What is a 5G network? The short answer, nobody really knows... yet! This is still a work in progress and there are many unknowns, including solutions for spectrum sharing, potential service rules for 5G bands, which bands are going to be useful, ownership of these frequencies, band sharing/coexistence with current services and so on³. These are all obstacles that specialists are working through, which explains the approximate five year expectancy of 5G's arrival².

That said, we're ready to debunk the concealment rumors right now. Concealment will be critical in 5G deployment - and in our opinion should be considered sooner rather than later.

In past years the advancements in technology from 1G to 3G brought us massive changes. First, with 1G, we learned about and acquired cell phones, with 2G texting became available and slowly but surely our lives were taken over with the ability to access the Internet from anywhere with 3G¹. Okay, maybe that's a bit dramatic, but ultimately, our lives have changed considerably. When 4G came about, the technology from the consumer perspective was generally the same, just significantly faster. Speeds and functionalities have increased with each technology, but with 5G, we're going to experience advancements with capabilities like we've never seen before. Incredible functionality including 4K/8K video, augmented/virtual reality, and autonomous vehicle support are all among the advances possible with 5G!



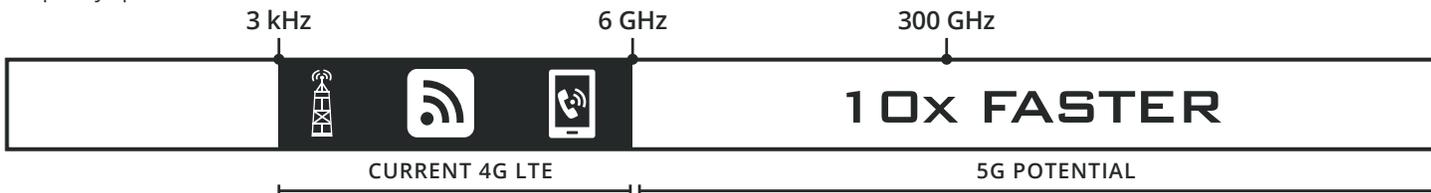
THINK OF HOW FAR WE'VE COME IN THE LAST 15 YEARS AND THEN LET YOUR IMAGINATION GO WILD ON WHAT THE NEXT 15 YEARS MAY LOOK LIKE. •

WHY WILL CONCEALING 5G BE DIFFERENT?

4G systems today are using frequencies that top out around 2.5GHz, with higher frequencies being used only on a small percentage of sites for backhaul purposes. 5G technologies, however, are expected to rely heavily on higher frequency signals, which are desirable because of their ability to accommodate immense amounts of data to support the breathtaking new functionality described above. In fact, as shown in Figure 1, the use of higher frequency signals (commonly referred to as millimeter waves) will provide more room to grow, potentially allowing 1,000 times more traffic that is 10x faster than our current 4G LTE¹. These same higher frequencies that will enable the 5G revolution will also create substantial new concealment challenges for antennas and equipment. Testing is currently in progress in the frequency ranges of 28GHz, 37GHz, 39GHz and 64-71GHz bands for use in the U.S. market². In general, these higher frequency applications are much more sensitive to concealment materials being placed in the antenna path. The good news? There are concealment materials and material combinations that work well at the frequencies being considered, however there is not one “silver bullet” concealment panel; the correct concealment panel(s) has to be selected based on the concealment application and frequenc(ies) being used for the site.

One example is shown in Figure 2. This data represents the volatility in concealment panel performance at different

FIGURE 1
Frequency Spectrum

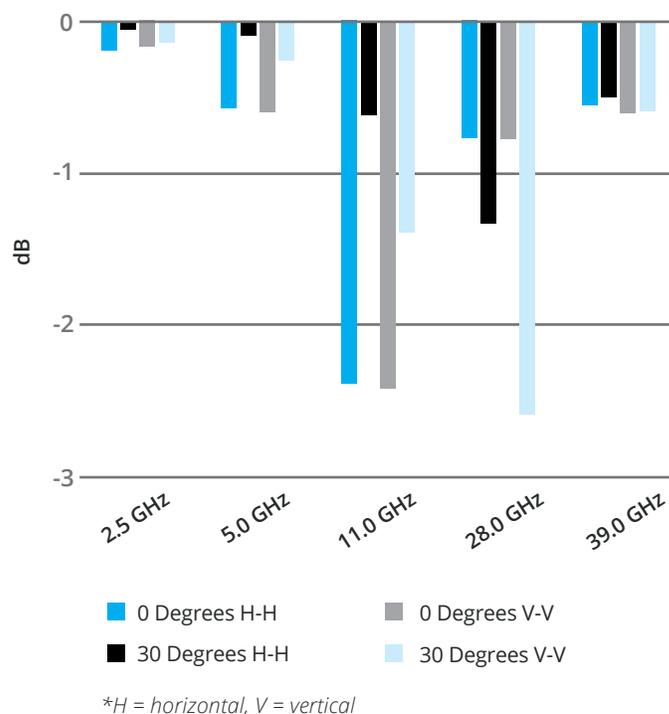


CHECK OUT THIS VIDEO, “*EVERYTHING YOU NEED TO KNOW ABOUT 5G*” FROM IEEE SPECTRUM!



frequencies. The StealthSkin™ V (SSV) performs very well at 2.5GHz, 5GHz, and 39GHz, but shows substantially more loss at 11GHz and 28GHz. In addition, the “Angle of Incidence” is shown to have a large influence on the amount of expected loss. The data at 28GHz shows less than 1dB of loss for 0 degree angles of incidence, but substantially more when the signal is rotated to 30 degrees relative to the concealment panel.

FIGURE 2
SSV Concealment Panel - Insertion Loss



WHAT OTHER FACTORS SHOULD BE CONSIDERED WHEN DESIGNING CONCEALMENT FOR 5G?

Application of the concealment product, the color, the material and where the site is located all play a large role on whether or not you'll have the best performance possible. For instance, in some cases fiberglass is more thermally stable than a plastic material which makes it a good choice for desert climates, but there may be trade offs in RF performance. Different panel options are not suitable for certain environments, depending on the temperature and the exposure to elements. Some thin plastic materials are excellent performers at a variety of frequencies. But due to their relatively low strength may not be usable for larger screenwall-type concealment applications. So what is the best concealment application for your project? This should be decided on a case by case basis. On each site, a comparison of high frequency applications should be performed to ensure that the best possible application and materials are chosen.

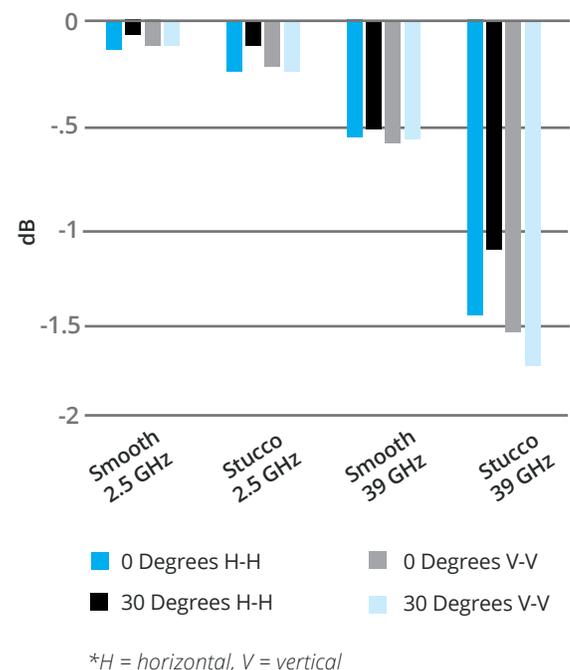
It is also important to consider **geometry of the antenna signal** relative to the concealment material. For most cases, orienting the signal to transmit through the concealment panel in a perpendicular orientation creates the best performance, but not always! It's highly dependent on the actual frequency being used and the material type and thickness. **Signal polarization** also should be accounted for. Vertical and horizontal polarization is a similar issue to angle of orientation. The degree and orientation of the wave can have major effects on loss in higher frequencies as it passes through the concealment panels. We have testing for Horizontal and Vertical polarizations at 0 (perpendicular) and 30 degree angles of incidence for all of the concealment materials we commonly use.

Texture should also be considered as a factor. As shown in the Figure 3 below, a stucco SSV concealment panel and

a smooth SSV panel will both experience minimal dB loss at the lower (2.5GHz) frequency. However, at 39GHz, the additional loss from the stucco panel is substantial.

As a general rule, higher frequencies are much more sensitive to concealment, as well as other environmental factors, than lower frequencies. Many of the proposed frequency ranges will struggle to perform through many of the commonly used concealment materials on the market, but we are thinking ahead! Our materials are not only made to stand the test of time, but to perform at the higher frequency ranges that 5G will require. There are a few things to note, however. If 3G or 4G antennas are swapped out with a new 5G antenna behind existing concealment, the results may be very poor. Basically, older and existing concealments may not function with the new 5G frequencies.

FIGURE 3
Smooth vs Stucco SSV Concealment Panel - Insertion Loss



WHAT ARE THE ADVANTAGES OF USING AN EXPERIENCED PARTNER?

Unfortunately, there is no one-size-fits-all concealment product that works optimally for all frequencies; for a site to perform at top level through concealment, the concealment material must be selected for the specific frequenc(ies) being used. It is important to choose a concealment partner who is prepared for this next step.

STEALTH® has a huge advantage when it comes to 5G. All of our RF transparent materials are already proven to stand the test of time, outperform any other in the industry and be of the highest quality. We've got 4G completely under control at this point but we know that 5G will be a whole new ballgame, so we've put ourselves to the test, as should all concealment vendors. We have full testing up to 100GHz on the concealment materials currently in use today. This testing gives us the ability to hand pick the best possible material based on the frequency being used and the concealment application/design required per site. We've completed projects in every market and on every application and guarantee that our custom solutions will continue to support sites into the next generation.



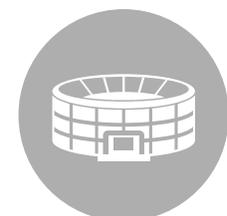
HISTORIC



URBAN



RURAL



STADIUMS



CAMPUSES



PARKS

WE'VE PUT OURSELVES TO THE TEST, AS SHOULD ALL CONCEALMENT VENDORS. WE HAVE FULL TESTING UP TO 100GHZ ON CONCEALMENT MATERIALS USED TODAY! •

WHO ARE WE TO SAY?

STEALTH's story began in 1992 with the country's first RF-transparent antenna concealment system.

Now armed with an arsenal of options, STEALTH covers the entire wireless industry with rooftop, tower, pole, DAS and many custom concealment structures. STEALTH's engineered solid, sound and attractive cell tower concealments accelerate the approval process.

STEALTH knows that beauty only goes so far without the brains to back it up. So every cell tower concealment is engineered using the highest-grade radiofrequency (RF) transparent materials on the market. STEALTH has tirelessly tested and developed proprietary resources like StealthSkin™ panels that outperform any other.

STEALTH set the worldwide standard 25 years ago, and remains the industry leader by designing thousands of sites and fabricating the most innovative cell tower concealments. Period.

20,000
CONCEALMENTS & COUNTING

THE EXTRAS			
25 YRS. IN BUSINESS	100 YRS. EXEC. EXPERIENCE	97% FINANCIAL STRENGTH SCORE	A+ BBB RATING

**As measured by a major U.S. Carrier.*



REPRESENTATIVES AVAILABLE
TO HELP CONCEAL THE
TOUGHEST SPOTS
IN ALL 50 STATES
(& INTERNATIONALLY)

Click to view our
interactive map!



END NOTES

¹ Amy Nordrum, Kristen Clark and IEEE Spectrum Staff, "Everything You Need To Know About 5G." IEEE Spectrum, 27 January 2017.
<http://spectrum.ieee.org/video/telecom/wireless/everything-you-need-to-know-about-5g>

² "5G Spectrum Recommendations", 4G Americas, August 2015.
http://www.5gamericas.org/files/6514/3930/9262/4G_Americas_5G_Spectrum_Recommendations_White_Paper.pdf

³ Stephen Lawson, "FCC looks to higher frequencies for 5G mobile," ComputerWorld, 22 October 2015.
<http://www.computerworld.com/article/2996149/mobile-wireless/fcc-looks-to-higher-frequencies-for-5g-mobile.html>

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