It's analog … and it's digital … and it's better than digital!

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In 2015, at the previous FTM workshop on Mallorca, we presented our high-definition active antenna system (HDAAS™) concept and showed very promising first experimental data in the lab and in outdoor over-the-air tests. On September 27, 2016, an HDAAS™ prototype mounted on a 100 meter tower in Woodstock, VA was placed into full 4G LTE service provided by Shentel, a Sprint affiliate (Fig. 1). This was the world's first massive-MIMO system in commercial service operating in frequency division duplex (FDD) bands (transmit and receive on different frequencies), which account for 85% of all cellular spectrum in the world. For the next 11 months, this prototype ran in the PCS band, servicing an average of 500,000 LTE data connections every day. Eventually, it was replaced with a production unit marketed under the Blue Danube product name BeamCraft 500. During the same period, additional successful HDAAS™ field trials were done with AT&T and Telstra.

In parallel with the Blue Danube progress, the major OEMs of cellular infrastructure have focused on developing massive-MIMO systems with many more digitizers and much more signal processing than in HDAAS™. These brute force "more digital" systems, also known as "digital sub-arrays", are very costly, heavy and consume large power. The usual justification for these shortcomings is a (blind) trust in future relief from the (fading) Moore's Law. Currently developed for time division duplex or TDD bands (transmit and receive on same frequencies), their application to FDD is significantly more challenging for fundamental reasons.

Not only does HDAAS™ technology operate equally well in FDD and TDD and has significantly lower cost, lower weight and lower power dissipation than the OEM digital sub-array systems, but HDAAS™ can match them or beat them in all practical performance aspects. Same holds for the academic full-digital approach. Only in an ideal world with *a priori* perfect knowledge of the communication channels and for extreme scattering environments can the academic full-digital and OEM sub-array systems outperform HDAAS™.

This presentation consists of three parts. First, we review the HDAAS™ technology in comparison with the academic full-digital and the OEM digital sub-array approaches. Then, we show the HDAAS™ field trial results. Third, we present fundamental arguments and simulations showing why HDAAS™ is superior in practice to the other massive-MIMO systems.

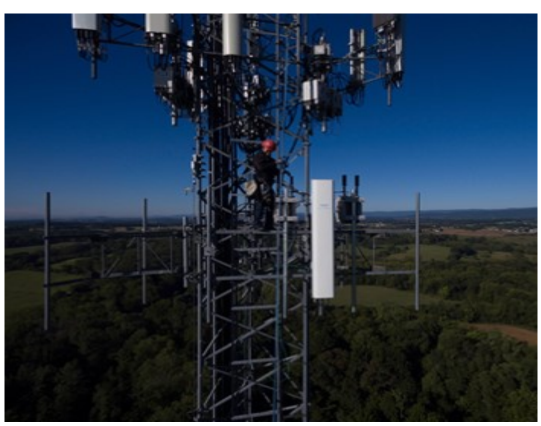

FIG. 1. Photograph of HDAAS™ system on a cell tower.