**A 1XN Vector Array of Smart Plasma Antennas that Satisfies Beamforming and MIMO for 5G**.

Dr. Theodore Anderson

Haleakala R&D, Inc.

This presentation will explain novel concepts for the potential use of plasma antennas for cellular systems improvement for 5G and future generations. The targeted application is the use of smart plasma antennas to improve the performance and capacity (i.e. increase the number of users, range, bandwidth) while reducing the equipment required ( number of towers, antennas, transmitters, power levels). The plasma window antenna has attributes that can make it highly desirable for cellular systems. The plasma antenna can have relatively high gain, directivity, and low sidelobes in a compact size, compared to conventional antennas . It can sweep focused beams at extremely high speed, e.g. 10’s of degrees per microsecond, or step from one direction to another in microseconds. It has very low sidelobe levels due to its’ much reduced diffraction effects at plasma boundaries, hence, high isolation and low crosstalk interference. It has very high front to back ratio. The smart plasma antenna has the advantage of simultaneously satisfying beamforming techniques and MIMO techniques. The MIMO techniques will overcome deep fading. This is in regard to OFDM and SFBC. This means that we build a vector or one dimensional array of smart plasma antennas to satisfy both beamforming and MIMO. Another key advantage of smart plasma antennas is that there is built in protection against EMI with the cylindrical annular ring of plasma tubes. Haleakala R&D, Inc has already built a smart plasma antenna which steers and shapes the antenna beam in the phi (horizontal) direction. If we add beam steering and shaping in the theta (vertical) direction we can address beamforming and MIMO in the theta direction which would be useful for audiences in stadiums. The greatest advantage of the plasma window antenna for cellular use is its’ reconfigurability. Not only can the beam be rapidly stepped from one direction to another, without physical movement, but the gain and beamwidth can also be rapidly adjusted. This could be utilized to continuously optimize the system. Hence, the term “smart antenna” is an appropriate description (where the “smart” comes from the computer control system algorithm devised by a very smart engineer). As a simple case, consider a single plasma windowing antenna that is stepped in 22.5 degree steps in a 360 degree circle, on a single frequency transmitting channel. That would be 16 beams available to 16 users on the same channel. But suppose, at one time, there were only 2 users on the channel. The smart antenna could only activate 2 beams, thus directing 8 times more power and/or bandwidth to the 2 users. The beamwidths can be varied, and even multiple beams generated from a single plasma window antenna. This could be very effective especially for remote cellular systems.