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| **Phased Array Antenna** |

using the **Spirent Vertex RF Channel Emulator** withits **AMT software** option

  
**64 element Phased Array Antenna**

**Executive Summary**

Antennas come in all shapes, sizes, and capabilities. From the four miniaturized antennas inside our cellphone, to the humongous monstrosities that stand 2000 feet tall, and various custom antennas in between – all sharing the same primary function of any antenna – which is to receive and transmit electromagnetic waves (also known as RF).

A specific type of antenna has emerged to be the foundation 5G cellular systems and other advanced wireless-based systems going forward (like 6G by 2030) – the Phased Array Antenna.

A phased array is a cluster of antennas that work together to achieve significantly higher capabilities that simple antennas cannot – like to steer and change the shape and direction of the transmitted electromagnetic waves.

However, the technology is not new, the military has been using phased array for years, specifically in long-range detection radars.

With all its promise, the Phased Array Antenna does have a significant downside – its cost.

Which is the purpose of this Whitepaper, to provide a means to model Phased Array Antennas in the lab, where the RF environment can be simulated, measurements can be controlled and repeated, and costs can be managed.

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| **Phased Array Antenna**  **technology** | Best Phased Array GIFs | Gfycat |

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| **Beam forming** Beam forming is the application of multiple radiating elements transmitting the same signal at an identical wavelength and phase, which combine to create a single antenna with a longer, more targeted stream which is formed by reinforcing the waves in a specific direction. The more radiating elements that make up the antenna, the narrower the beam. | **Diagram  Description automatically generated** |
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| **Beam steering** Beam steering is achieved by changing the phase of the input signal on all radiating elements. |  |
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| **Phase Shifting** Phase shifting allows the signal to be targeted at a specific receiver. |  |

**Vertex RF Channel Emulator**

Spirent Vertex RF Channel Emulator along with the Array Modeling Tool (AMT) software enables you to model Phased Array Antenna technology in the lab.

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| **Vertex is a fully modular and scalable platform**   * Operating Freq: 30MHz to 6.0GHz * Channel BW: 40MHz up to 1.20GHz * Number of RF Ports: 2x2 up to 16x16   **Extend Operating Freq by adding:**   * HF-band Upconverter for 3MHz to 30MHz * mmWave High Freq Converter (HFC) for 28GHz and 40GHz | Diagram  Description automatically generated |

**Concatenate Vertex units for large scale Phased Array Antenna modeling**

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| **1 – Vertex unit** | **16 – elements** |
| **2 – Vertex units** | **32 – elements** |
| **4 – Vertex units** | **64 – elements** |

**Array Modeling Tool (AMT) software**

AMT enables you to plot and view a graphical representation of how your antenna array will perform and see how spatial filtering will occur. With AMT, you can implement tapering, select the beam angle in either *elevation* or *azimuth*, and enter the *phase progression* of the individual elements.

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| **AMT – tab**   * DL Frequency (MHz) * UL Frequency (MHz) * Units * Y Element Distance (meters) * Z Element Distance (meters) * Number of Element Rows * Number of Element Columns * Add Second Slant * Polarization Vector (o degrees) * Row Elevation Beam Pointing Angle  (o degrees) * Column (Azimuth) Beam Pointing Angle (o degrees) * Tapering Vector Rows * Tapering Vector Columns * Row (Theta) Phase Offsets (o degrees) * Columns (Phi) Phase Offsets (o degrees) * Antenna Settings Dialog Box   + Load   + Save   + Plot |  |

**AMT – Parameters and Settings**

* DL Frequency (MHz)  
  Specify the Downlink carrier frequency. Range is 30.0 to 5925.0MHz
* UL Frequency (MHz)  
  Specify the Uplink carrier frequency. Range is 30.0 to 5925.0MHz
* Units  
  Selectable – either Meters or Lambda
* Y Element Distance (meters)  
  Specify the horizontal distance between adjacent antenna array elements that are in the same row of the antenna array.
* Z Element Distance (meters)  
  Specify the vertical distance between adjacent antenna array elements that are in the same column of the antenna array.
* Number of Element Rows  
  Specify the number of rows in the antenna array.
* Number of Element Columns  
  Specify the number of columns in the antenna array.
* Add Second Slant  
  Selectable – whether each antenna array location contains 2 slants. Choices are Yes and No.
* Polarization Vector (o degrees)  
  Specify the polarization vector for the antenna array slant. The left box sets the polarization vector for the first antenna array slant. The right box sets the polarization vector for the second antenna array slant. The right box is enabled if Add Second Slant is set to Yes.  
  Range is -180 to 180 degrees.
* Row Elevation Beam Pointing Angle (o degrees)
* Column (Azimuth) Beam Pointing Angle (o degrees)
* Tapering Rows and Columns – is the manipulation of the amplitude contribution of an individual element to the overall antenna response.
* Row (Theta) Phase Offsets (o degrees)
* Columns (Phi) Phase Offsets (o degrees)
* Antenna Settings Dialog Box
  + Load – tab   
    If you want to load the settings from an existing antenna settings file, click the **Load** button, select the appropriate file, and then click the Open button.
  + Save – tab  
    If you want to save the antenna settings to a file, click the **Save** button, enter the file name, and then click the **Save** button.  
    **NOTE**: If you modify any of the Beam Pointing Angles, be sure to click the Apply button next to the corresponding box so that your setting is saved.
  + Plot – tab (*see next page*)

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| **Plot – tab**  When you are finished configuring the Array settings, click the **Plot** button.  **2D plots** of the downlink (DL), uplink (UL), and **Polarization** will be displayed.  If you specified more than 1 row of elements, **3D plots** of the downlink (DL) and uplink (UL) are also displayed.  Use the **Rotate 3D button** located at the top of the plot window to rotate the selected **3D plot**.  For **3D plots**, blue indicates low amplitude, and red indicates high amplitude. | Example: 2D Plot    Example: Polarization Plot    Example: 3D Plot |

**Vertex other Use Cases**

Outlined in this whitepaper is how Vertex and our AMT software can emulate and model the complexities of Phased Array Antennas. Vertex along with other software packages has been used to emulate and model other complex RF environments:

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| \*Dynamic Spectrum Sharing (DSS) | \*Electronic Warfare (EW) & Signal Intelligence (SIGINT) |
| \*Maritime Ship to Shore (LOS/NLOS) | \*MANET and other MESH topologies |
| \*SATCOM | \*5G FR1 & FR2, 4G-LTE, 3G |

*Want to learn more and schedule a Demo…*

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| A close-up of a person smiling  AI-generated content may be incorrect. | **Claude Sweeton**, Director of Test & Measurement Solutions  [claude.sweeton@dualos.com](mailto:claude.sweeton@dualos.com)  630.881.2288 Cell   * [**linkedin.com/in/claudesweeton**](https://www.linkedin.com/in/claudesweeton?lipi=urn%3Ali%3Apage%3Ad_flagship3_profile_view_base_contact_details%3BF6vcFGVLQqCb1Gi%2BaLHjrA%3D%3D) * +45yrs in the Test & Measurement industry * US Navy Veteran 1978-86 |

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Dualos applies our expertise and products, along with industry-leading partner solutions, to serve the Aerospace and Defense industry. We provide tailored solutions designed to address the complex testing challenges our customers encounter.

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