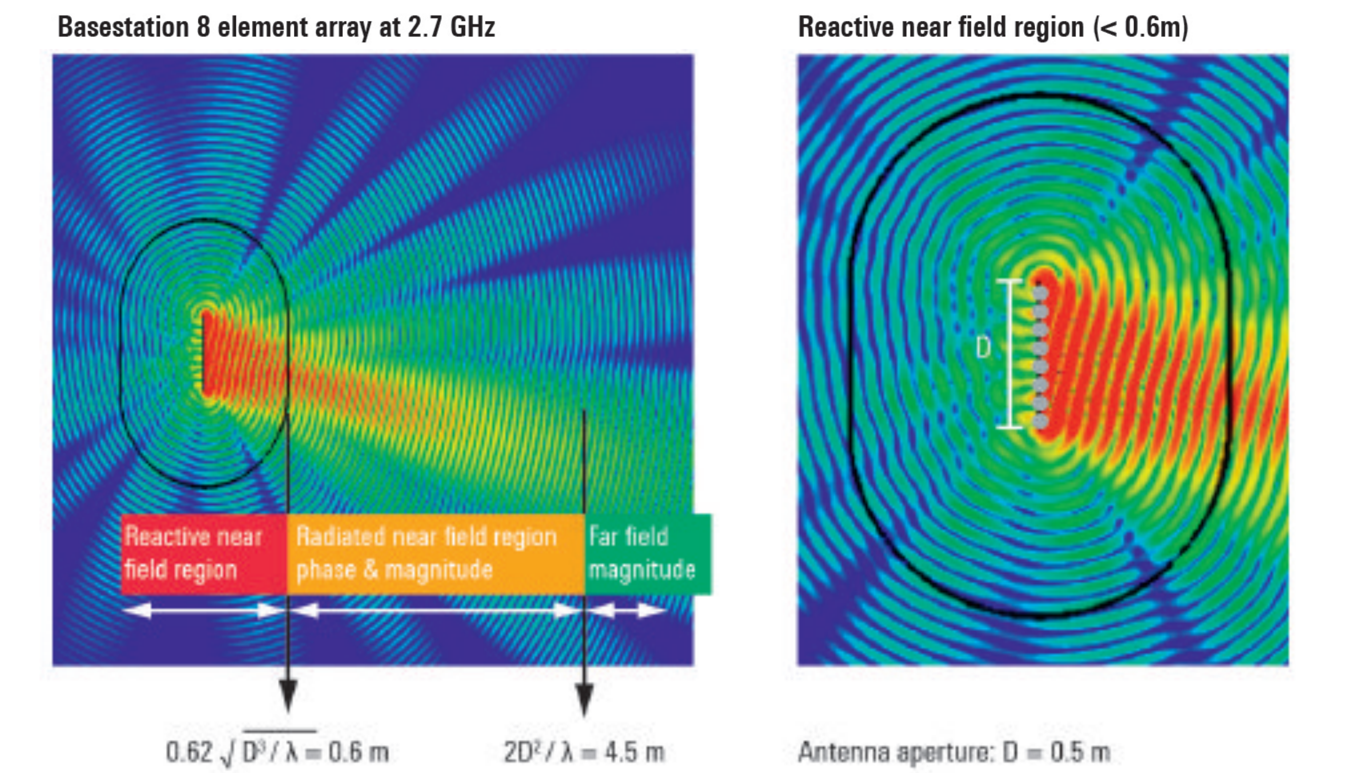

Figure 4. Electromagnetic fields from a basestation antenna array

plane waves: such chambers are generally quite large, where the length is set by a combination of the DUT size and the measurement frequencies.

Although the far field is generally measured at a suitable distance from the DUT, it is possible to manipulate the electromagnetic fields, such that a near-field chamber can be used to directly measure the plane wave magnitudes. There are two techniques:

- Compact range chambers, which are most often used for large DUTs, such as aircraft and satellites; and,
- Plane wave converter (PWC): a planar wave is created at the DUT by replacing the measurement antenna with an antenna array. Similar to using lenses in an optics system, the antenna array can generate a planar far field at a targeted zone in the region of the DUT.

Near-field measurements

Measurements in the near-field region require both the field phase and magnitude sampled over an enclosed surface (spherical, linear or cylindrical) in order to calculate the far-field magnitude using Fourier spectral transforms.

This measurement is usually performed using a vector network analyser, such as the R&S ZNBT20, with one port at the DUT and the other port at the measurement antenna. For active antennas or massive MIMO, there are often no dedicated antenna or RF ports; therefore, the OTA measurement system must be able to retrieve the phase in order to complete the transformation into far field. There are two methods of performing phase-retrieval for active antenna systems:

- **Interferometric –** A second antenna with a known phase is used as a reference. The reference signal is mixed with the DUT signal with unknown phase. Using post-processing, the phase of the DUT signal can be extracted and used for the near-field to far-field transformation.
- **Multiple surfaces or probes –** A second surface volume is used as the phase reference with at least one wavelength separation between the two measurement radii. Instead of multiple surfaces, two probes with different antenna field characteristics can be used. The two probes need to be separated by at least a half-wavelength to minimise mutual coupling.

When selecting a vector network analyser (VNA), true multiport VNAs such as the R&S ZNBT20 have an additional advantage for measuring coupling between antenna elements. Having multiple receivers – instead of using switches – to perform tests simultaneously reduces test duration, and does a better job of performing complete mutual coupling measurements.

Conclusion

Antenna arrays will play an essential role in future wireless communication. But challenges in their development, design and production make thorough testing essential to achieving optimal performance. The elimination of RF test ports and the use of frequencies in the centimetre and millimetre wavelength region make OTA a vital tool for characterising the performance of – not just massive MIMO arrays – but the internal transceivers as well. This will drive a high demand for OTA chambers and measurement equipment to measure the strict radiative properties of antennas and transceiver measurements. Rohde & Schwarz, with its wide range of anechoic chambers and measurement equipment expertise, is well situated to deliver solutions – even for future customer requirements.

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