Intelligent Surfaces for 5G and Beyond Wireless Communications

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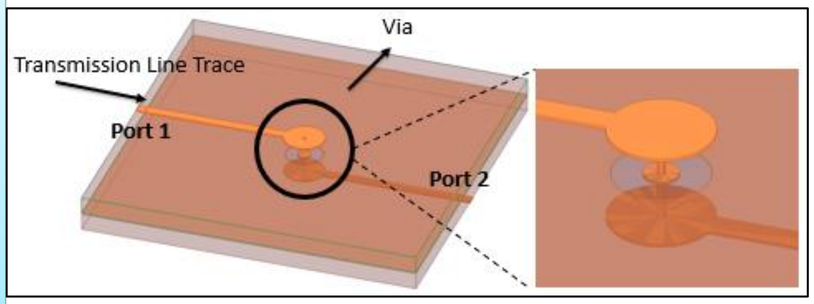
Designing Efficient Reflective Surfaces Wireless Communication

This work presents a novel design for efficient reconfigurable reflective surfaces which can improve radiation efficiency

What is an intelligent surface?

Such a surface is comprised of hundreds or thousands of antennas capable of collecting the waves that impinge on their surface and redirect to desirable directions. The surface can sense the direction of incoming signals, identify the position of the mobile user and focus the wireless signal appropriately.



Design of via for 27 GHz

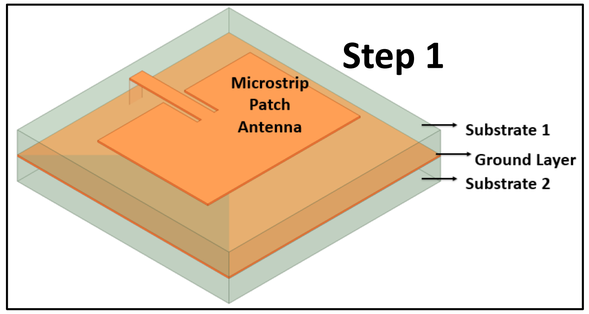
In our approach, we are designing a multilayer stacked structure, which requires ***via*** as an interconnect between the top layer and the bottom layer wherein the biasing lines for the PIN diodes will be placed.

Why do we care about interconnects?

- Vias produce discontinuity from the signal transition and significantly affect signal performance.
- Parasitic capacitance of via can further shift the frequency of resonance.
- A good impedance transition must be made from the transmission line trace to the via.

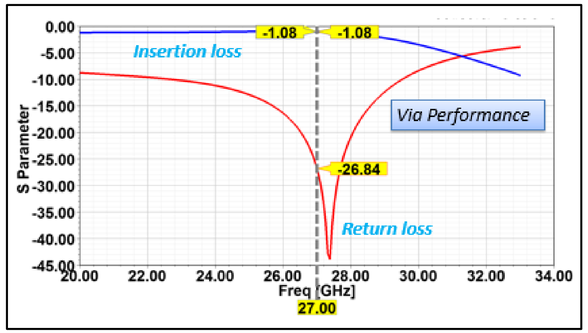
Design Process:

I) Step I :1-bit Reflect array unit cell.
II) Step II: Integration of Via with Unit Cell

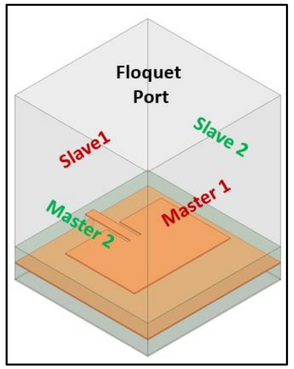


Concept for the novel design

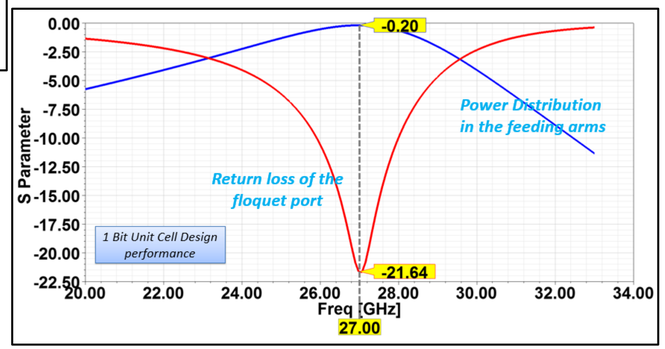
- When an electromagnetic wave is incident on the reflectarray, the surface modulates the phase of the incident wave (by using RF switches) and using beamforming it redirects the beam to the desired direction.
- As a comparison with the conventional phased arrays, continuous phases to each element is provided by using analog/digital phase shifters which can be cumbersome because of the real state involved and it adds to complexity, losses.
- In our approach, phase modulation is achieved by PIN diodes as RF switches.
- Further by randomization of these phases would help to lower the side lobe level and thus improving efficiency.



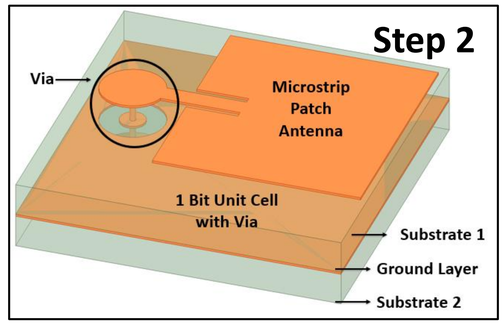
Plot showing S parameters of the via at 27 GHz



Simulation Setup in ANSYS HFSS Full wave simulation



Plot showing S parameters of the unit cell at 27 GHz



References:

[1] J. Huang and J. A. Encinar, Reflectarray Antennas, 1st ed. Hoboken, NJ, USA: Wiley, 2008.
[2]IEEE Standard for Definitions of Terms for Antennas. IEEE Std 145-2013 (Revision of IEEE Std 145-1993). 2014.

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