

Polarization Reconfigurable Patch Antenna for 5.8 GHz ISM Applications

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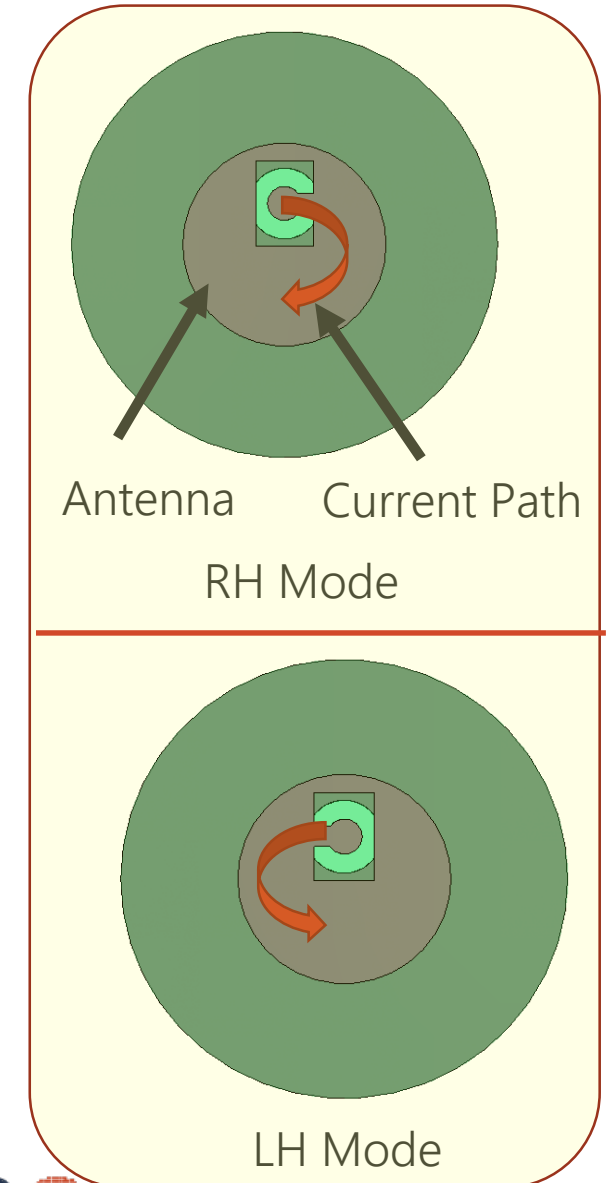


Polarization Reconfigurable Antennas

- Modern communication systems are increasingly sophisticated, and demand high performance electronics
- Similarly, consumer electronics and other modern advances increasingly drive small footprint of electronic devices
- As a result, Radio-frequency (RF) devices that can be electronically adjusted to meet dynamic demands are gaining increased attention
- These include many frequency reconfigurable structures, and for antennas, frequency and pattern reconfigurable antennas
- In this presentation, we will present results on the design and analysis of a polarization reconfigurable antenna for the 5.8GHz ISM band. The evolution of the antenna is presented.

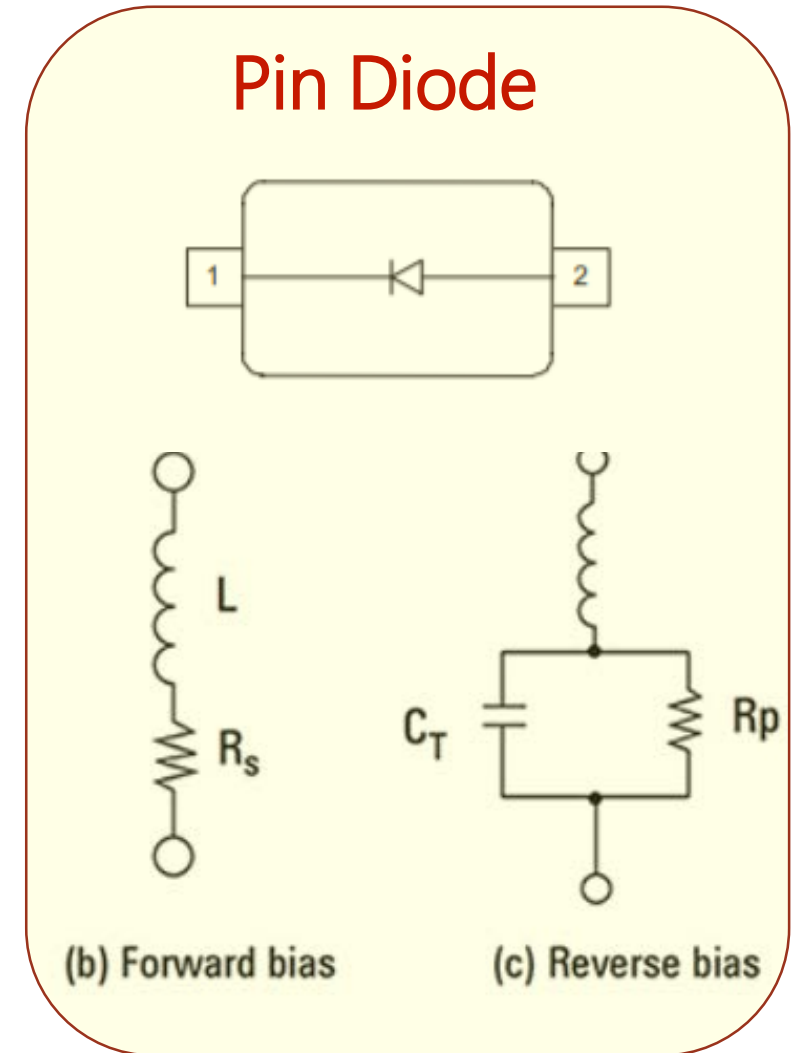
Basis of Reconfigurable Antenna Topology

- We targeted a tri-polarizable antenna in the ISM Band, covering 5.725- \rightarrow 5.875GHz
- Antenna should be able to have left-handed, right-handed, and linearly polarized radiation patterns
- Each mode of the antenna should be roughly matched in-band, with suitable radiation pattern
- These requirements strongly suggest an antenna with symmetry
 - Each biased mode of the antenna should produce a circularly polarized state, so that the doubly-biased antenna produces a linearly polarized state.



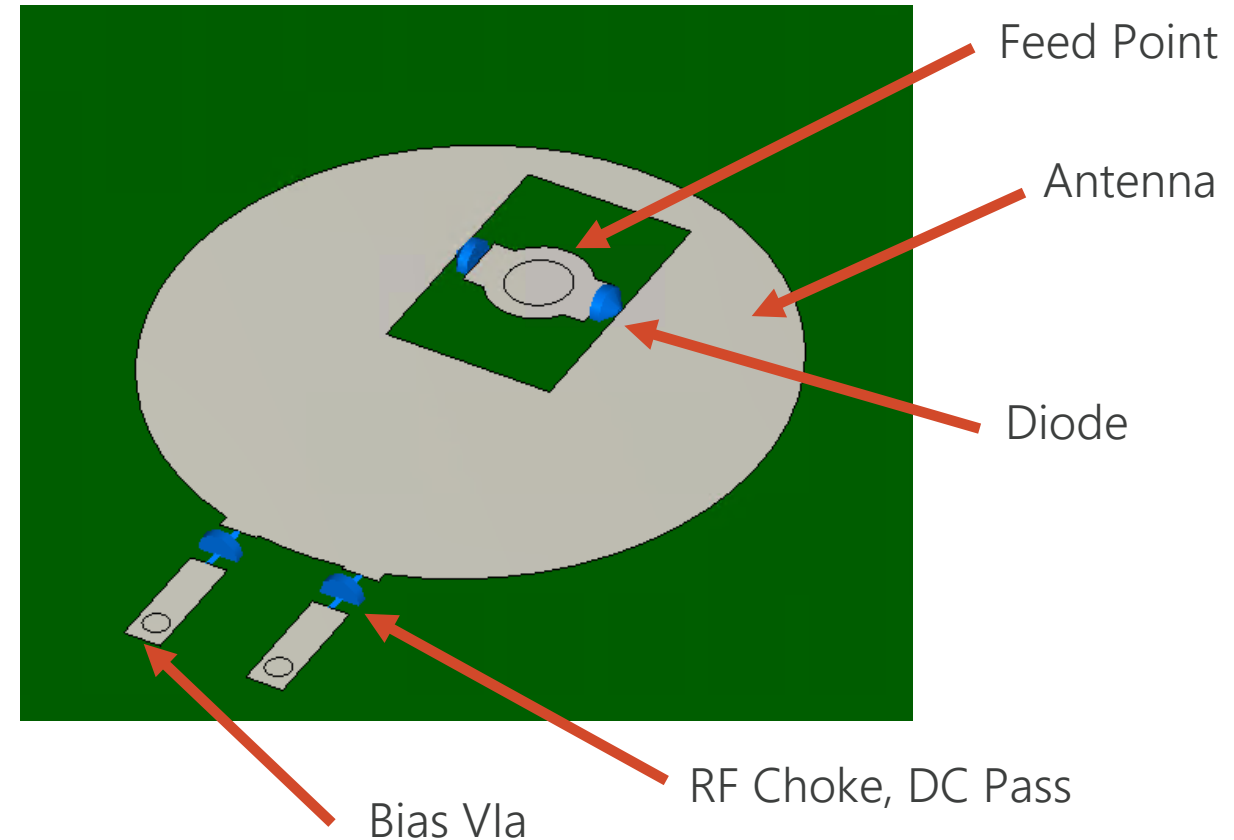
Method of Reconfigurability

- In general, a number of methods exist to allow for antenna reconfigurability
 - For high-speed applications, we target electrically reconfigurable options
- These include varactors, PIN diodes, MEMS, tunable materials, etc.
- We focus on PIN diodes to change current distribution on the patch surface
- Using two pin diodes requires two control voltages on the antenna, and yields four antenna bias states.



Notes on Reconfigurability Topologies

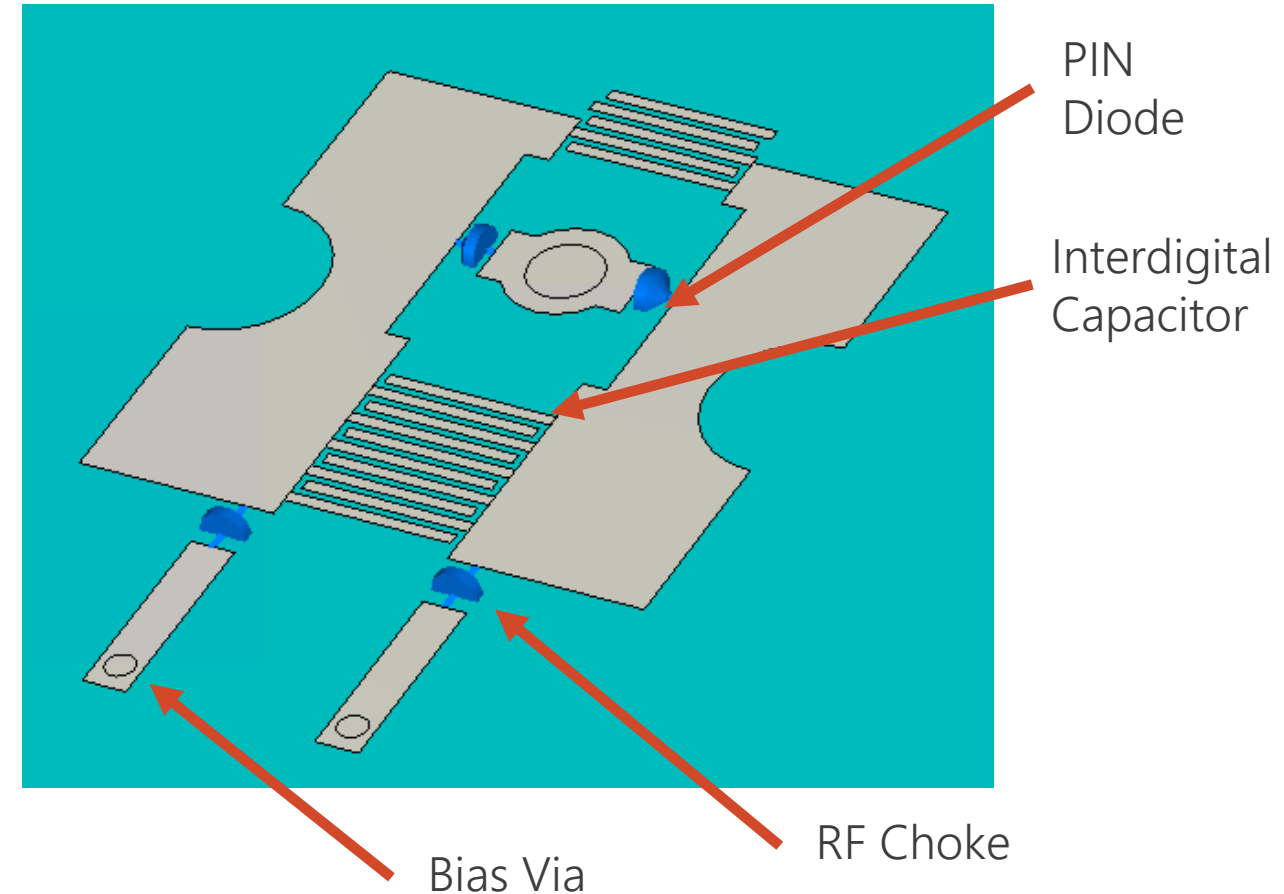
- The difficulty in incorporating reconfigurability into antennas is balancing DC-biasing with RF structure integration
- Conductive structures (DC-carrying wires) will carry RF currents
- Addition of ground path for DC-current return can influence RF currents
- The more bias states the antenna carries, the more complicated these structures must become, in order to allow multiple DC-states to co-exist.



Early antenna model. Circuit states are considered, but not the biasing considerations.

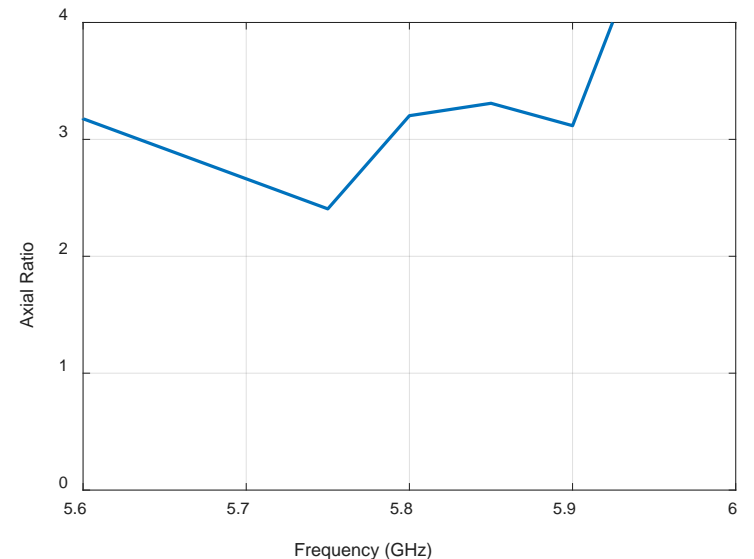
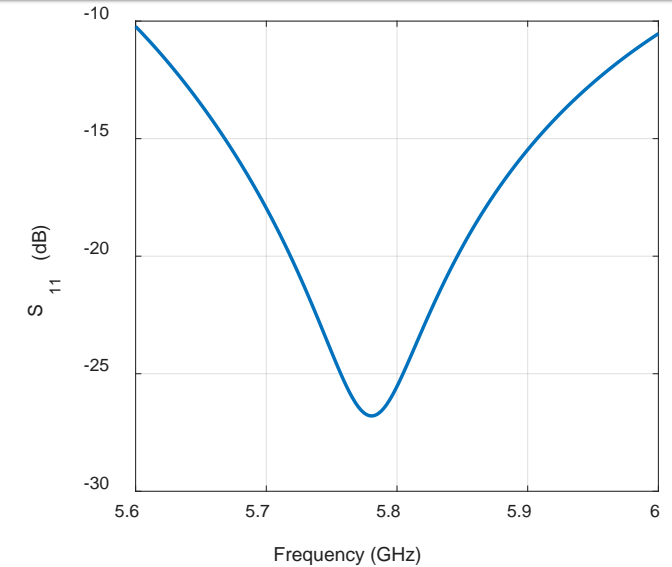
Proposed Reconfigurable Antenna

- Shown is the proposed polarization reconfigurable antenna
- Interdigital capacitor is introduced into the antenna surface to allow for two DC control voltages without interfering with each other
 - Allows for PIN-diodes to be rectified in the same way, without requiring negative voltages, and for all four states to be used
- Stacked patch topology used for bandwidth enhancement.



Key Antenna Characteristics

- Good bandwidth, gain, and axial ratio observed
 - S11, axial ratio for CP modes are shown on right
- Simple tuning circuit (inductor) used to improve antenna match.
- Antenna Truth table shown below for its various modes



Left Diode	Right Diode	Result
Off	Off	Linear Polarization
On	Off	Right Handed Polarization
Off	On	Left Handed Polarization
On	On	Highly Unmatched, Linear Polarization

Conclusions

- A novel tri-polarizable reconfigurable antenna for the 5.8GHz ISM band has been demonstrated
- Relatively simple construction allows for practical system implementation
- Good performance characteristics are demonstrated