# A Beam Steering Linear Antenna Array with Novel Simultaneous Frequency Agility and Polarization Reconfigurablity

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In this abstract, a beam steering linear (1×4) antenna array with novel simultaneous frequency agility and polarization reconfigurablity is presented. This includes development of a (i) Wideband frequency agile antenna, (ii) Polarization reconfiguration control circuit and (iii) Beam forming network with digital phase shifters and low noise amplifiers (LNAs). The array radiating elements consist of a circular microstrip patch and a concentric annular ring patch around it. Four varactor diodes have been placed between the central patch and the ring patch. By varying the varactor capacitance values, the coupling between the patch and ring is varied. When the varactors are biased such a way to provide low capacitance value, the antenna shows high impedance, and therefore, the patch and the ring become decoupled. In this case, only the central patch radiates in the dominant TM11 mode giving the higher frequency coverage. However, when the varactors are biased such a way that they provide high capacitance value, the antenna shows low impedance, and therefore, the patch and the ring become fully coupled. In this case, both central patch and outer ring patch participate in the radiation mechanism operating in the dominant TM11 mode and provide lower frequency coverage. Therefore, by varying the capacitance of the varactor, the resonant frequency can be varied between 1.5GHz and 2.4GHz. The overall frequency agility range of around 46% has been achieved. This antenna has been fabricated on a Rogers RT/Duroid 5880 ($\varepsilon_r$ = 2.2, tanδ = 0.0009, 3mm thick) and tested for impedance matching and radiation patterns.

For polarization reconfiguration, each of the circular patches is excited using two feed points which are 90° apart from each other. By exciting only one of the ports at a time, the polarization is either linear vertical or linear horizontal. By exciting both ports with equal amplitude and ±90° phase difference between them, the polarization is either right-handed circular (RHCP) or left-handed circular polarization (LHCP). Therefore, by controlling the port excitations, the polarization response can be set as linear horizontal, linear vertical, RHCP or LHCP. An active feed network consisting of RF switches and a compact wideband branch line coupler has been designed and fabricated for realizing the polarization reconfiguration. Four polarization control feed networks have been fabricated and characterized to connect with each of the array elements.

Finally, for beam steering capability, the variable progressive phase shifts between the radiating elements is applied through a beam forming network (BFN). The beam forming network (BFN) consists of LNAs, digital attenuators and digital phase shifters (one for each element). The state of the phase shifters and attenuators is set using a microcontroller. This microcontroller is driven using a Matlab code which calculates the excitation of each element as a complex number (phase and amplitude). The measured beam steering performance results for the fabricated antenna array consisting of frequency agile radiating elements, polarization reconfiguration control circuit and the beam forming network will be presented during the symposium.