# Two-Bit Reflectarray Elements with Phase and Polarization Reconfiguration

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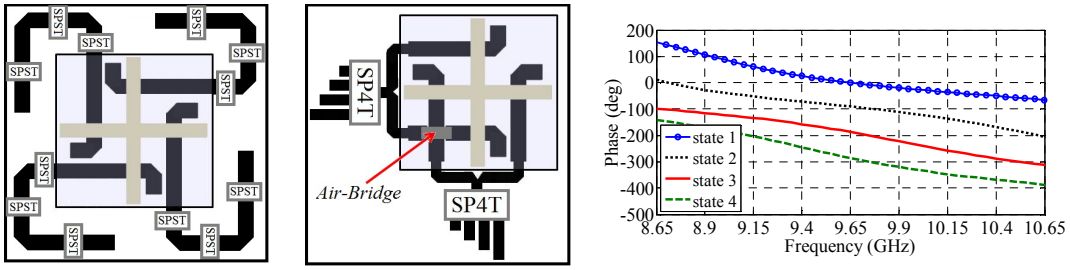
The increasing necessity of reconfigurable-beam antennas for different applications as synthetic aperture radar (SAR), satellite reception in moving vehicles, rescue operations, among others, requires the use of more flexible antennas which can be reused according to environmental or demand conditions. Depending on the application, dual linear polarization (LP) or circular polarization (CP) could be required. In this contribution two reflecting cells for reconfigurable-beam reflectarrays which allow controlling at the same time the polarization of the antenna, regardless of the feed-horn polarization, are proposed. This means that the antenna can be feed using a LP (V, H or both) or a CP (RHCP or LHCP) feed, while reflecting the field with any polarization.

Two topologies for the element are proposed here. In both cases, 2-bit phase-shifter resolution is achieved, which is enough for scanning the beam and introducing the 90° phase difference required between orthogonal polarizations for producing CP. The proposed elements have been designed to operate at the central frequency of 9.65 GHz, with a period of 18.5 mm (0.59λ). The elements are based on an aperture-coupled topology which has been chosen to compensate the effects of the differential spatial phase delay by the introduction of true-time delay (TTD), as can be seen in Fig. 1. The radiating element consist of a square patch which is coupled through a cross slot to four microstrip lines. The cross slot allows to keep the symmetries and therefore to obtain exactly the same behavior in the two linear polarizations, very pure circular polarization, a very linear phase response and low cross-polarization. In the first element, see Fig. 1(a), each micrsotrip line is segmented using three SPST switches in order to obtain 0°, 90°, 180° or 270°, in reflection. All branches must be equally varied (with a 90° difference between linear polarizations if CP wants to be produced). The drawback of using at least two switches for each state can be solved if the two branches which correspond to the same linear polarization are gathered using a matching network connected to a SP4T switch (Fig. 1(b)). In this case, the outputs of the switch are connected to different microstrip line segments that produce the required phase-delay. In this way, each LP polarization can be controlled with a single device. To enable the two microstrip lines crossing over each other, an air-bridge has been accurately designed to cancel any mismatch. The scattering matrix for the different polarizations and switching states has been obtained for each element by full-wave electromagnetic simulations using CST Microwave Studio® and an equivalent circuit modeling the switches. As an example, Fig. 1(c) shows the 2-bit phase response for LP of the first element.




(a) (b) (c)

Fig. 1 (a) SPST configuration. (b) SP4T configuration. (c) 2-bit phase response.