

Reconfigurable Antennas

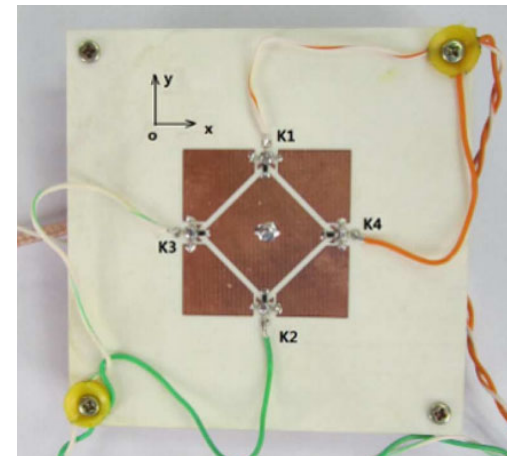
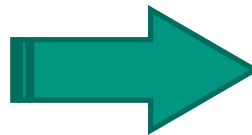
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Why Reconfigurable Antennas?

Reconfigurable antennas can be adapted to varying channel conditions. In some cases they can replace multiple antenna when using a dynamically variable and adaptable single-antenna geometry without increasing the real estate required to accommodate multiple antennas.



Reconfigurable Antennas

■ Reconfiguration

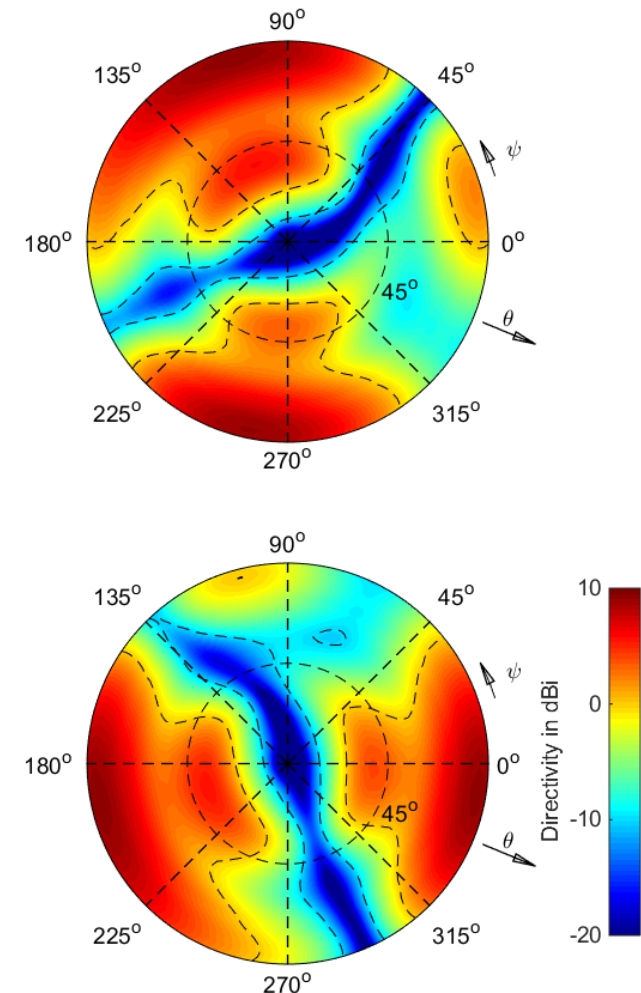
- Radiation pattern
- Polarization
- Frequency

■ Advantages

- No mechanical parts needed
- Adjustment to changing environment
- Interference reduction
- Better SNR
- Compact construction

■ Possible switches

- PIN diodes
- MEMS
-



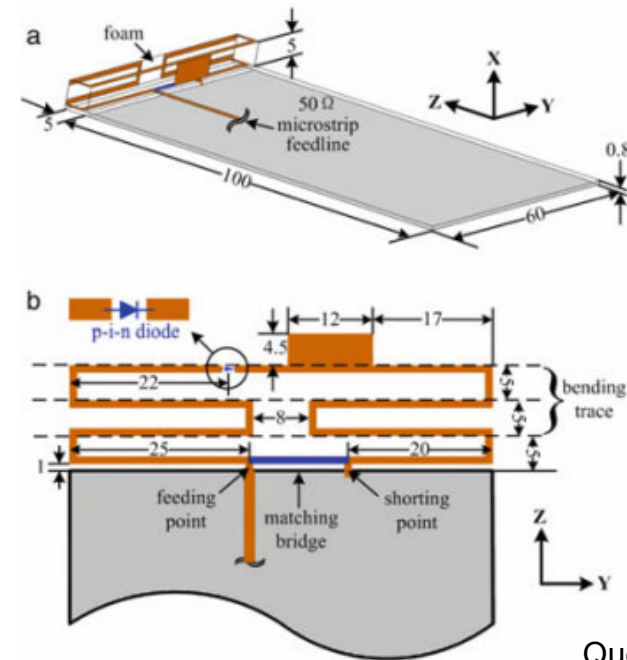
Frequency Reconfiguration

■ Application

- Switching of frequency band on user's demand
- Multiple frequency bands
- Used in cognitive radio

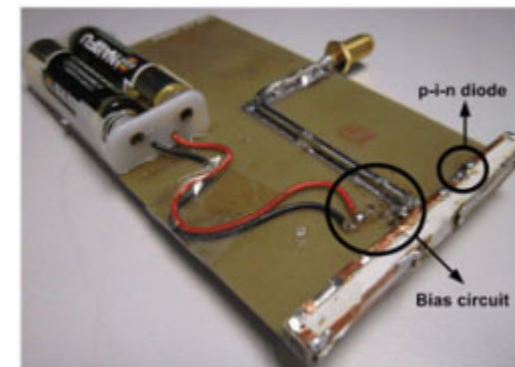
■ Mechanism

- Frequency shifting by use of varactor
- Change in antenna's resonant length by connecting additional elements



Quelle: [1]

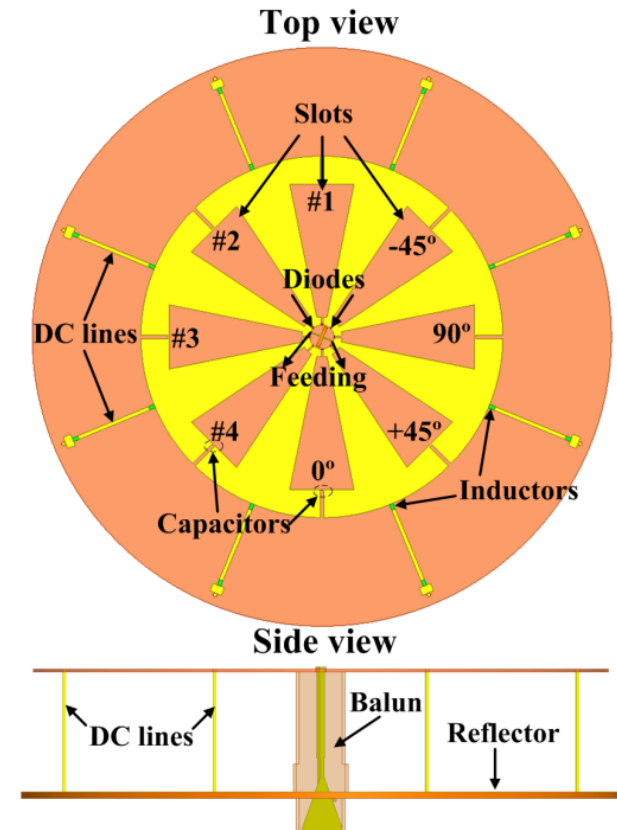
[1] Li Y., Zhang Z., Zheng J., Feng Z., Iskander M.F., „A compact hepta-band loop inverted F reconfigurable antenna for mobile phone“. in *IEEE Transactions on Antennas and Propagation*, vol. 60, no. 1, Jan. 2012, pp. 389–392



Polarization Reconfiguration

- Switching of polarization on user's demand
 - Compensation for polarization mismatch
 - Reduction of multipath interference
 - Polarization coding
- Mechanism
 - Modification of microstrip patch
 - Switching between radiating elements
 - Reconfigurable multi-slot [2]

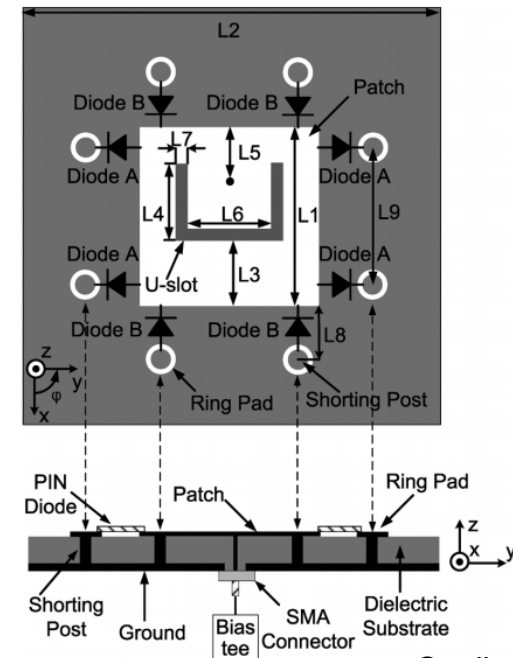
[2] L. Huitema, Hang Wong, Wei Lin and A. Crunteanu, "Reconfigurable multi-slot antenna for bio-medical applications," *2016 10th European Conference on Antennas and Propagation (EuCAP)*, Davos, 2016, pp. 1-4.



Quelle: [2]

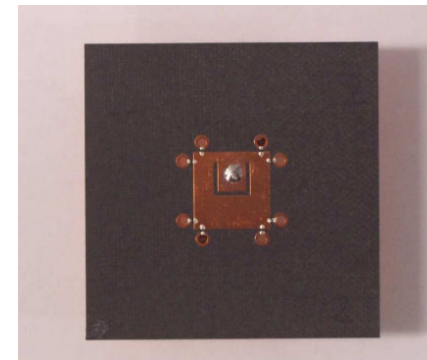
Pattern Reconfiguration

- Switching of radiation pattern
 - SNR improvement
 - Reduction of multipath interference
 - Channel capacity improvement
- Mechanism
 - Modification of microstrip patch [3]
 - Switching between radiating elements
 - Switching phase of signal feeding radiating elements
 - Parasitic elements



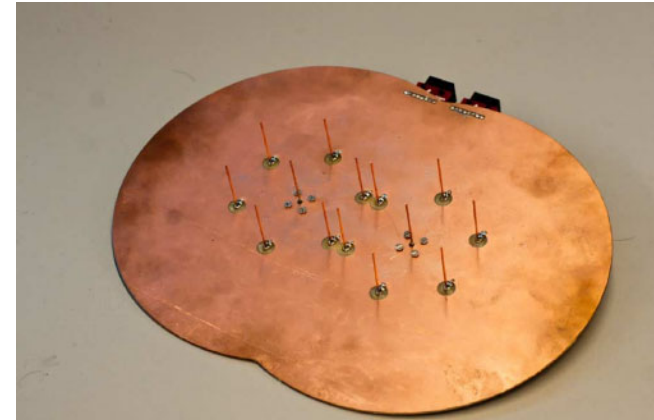
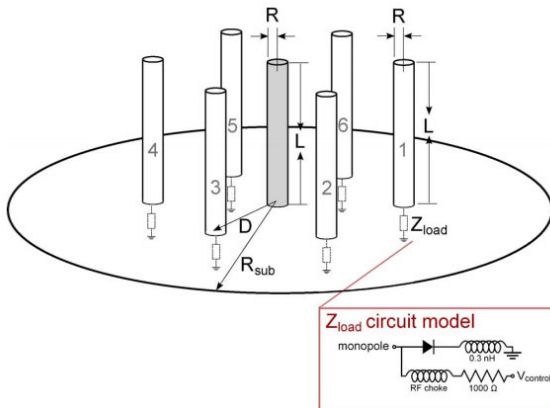
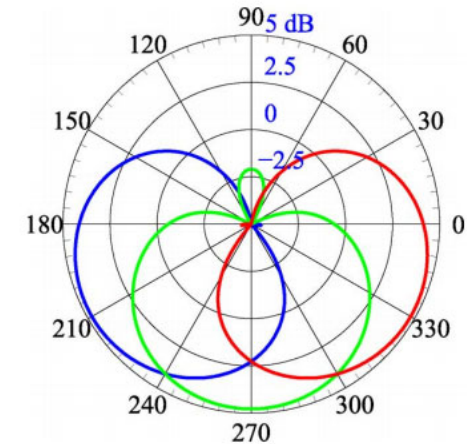
Quelle: [3]

[3] P. Y. Qin, Y. J. Guo, A. R. Weily and C. H. Liang, "A Pattern Reconfigurable U-Slot Antenna and Its Applications in MIMO Systems," in *IEEE Transactions on Antennas and Propagation*, vol. 60, no. 2, pp. 516-528, Feb. 2012.



Parasitic Element Switching

- Parasitic elements in vicinity of fed element
 - Parasitic elements switched between director and reflector state
- ESPAR (electronically steerable parasitic array)
 - Configuration as in the picture
 - Switching between radiation sectors

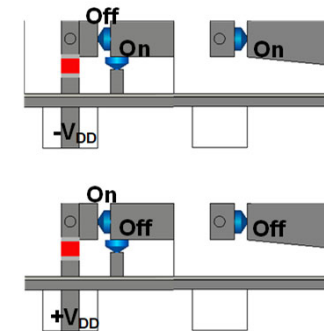
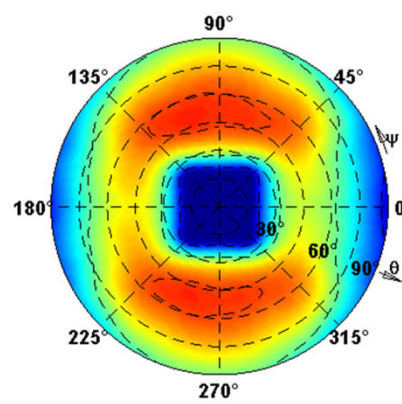
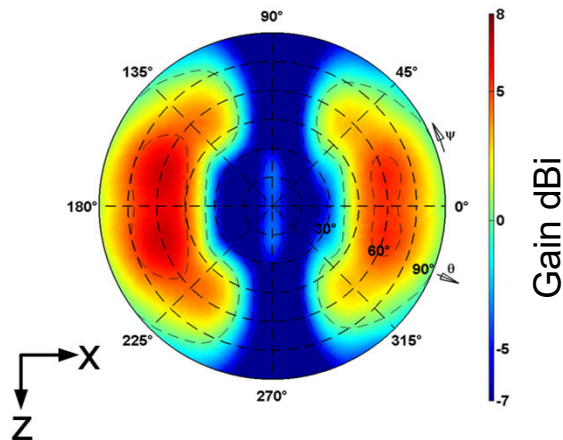
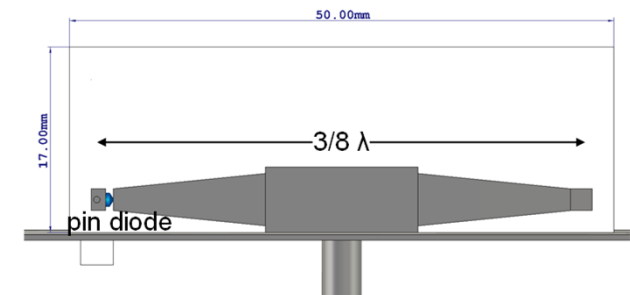
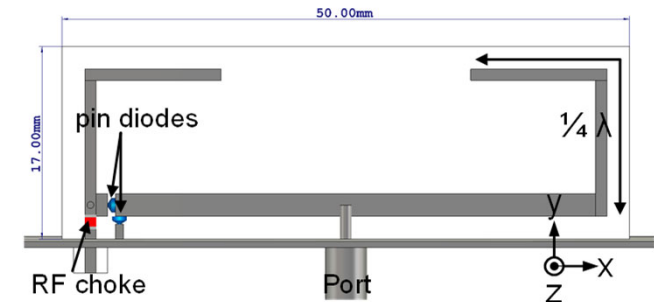


Quelle: [4]

[4] Y. Zhou, R. S. Adve and S. V. Hum, "Design and Evaluation of Pattern Reconfigurable Antennas for MIMO Applications," in *IEEE Transactions on Antennas and Propagation*, vol. 62, no. 3, pp. 1084-1092, March 2014.

Phase Switching

- Two inverted L antennas separated by $\frac{3}{8} \lambda$
- Parallel feeding
 - Horizontal line of $\frac{3}{8} \lambda$ length
 - T junction in the middle
 - Microstrip balun
 - 0° or 180° phase shift depending on switch settings



Switching between radiating elements

- Two elements per antenna part
- Elements switched between reflector state and radiator state with aid of PIN diodes
- Small spacing between reflector and radiator (about 0.01λ)
- Four reconfigurable radiation patterns
- Patterns for each state are shifted by 90° in comparison to adjacent state

