

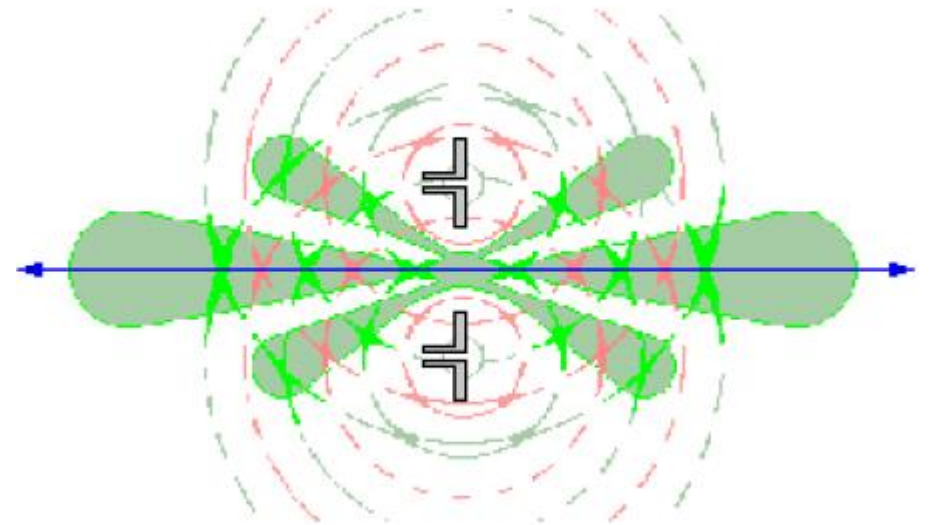
PHASED ARRAY ANTENNAS

ECE 516E –SATELLITE ENGINEERING

Monday, 12 January 2026

WHAT IS PHASED ARRAY ANTENNA

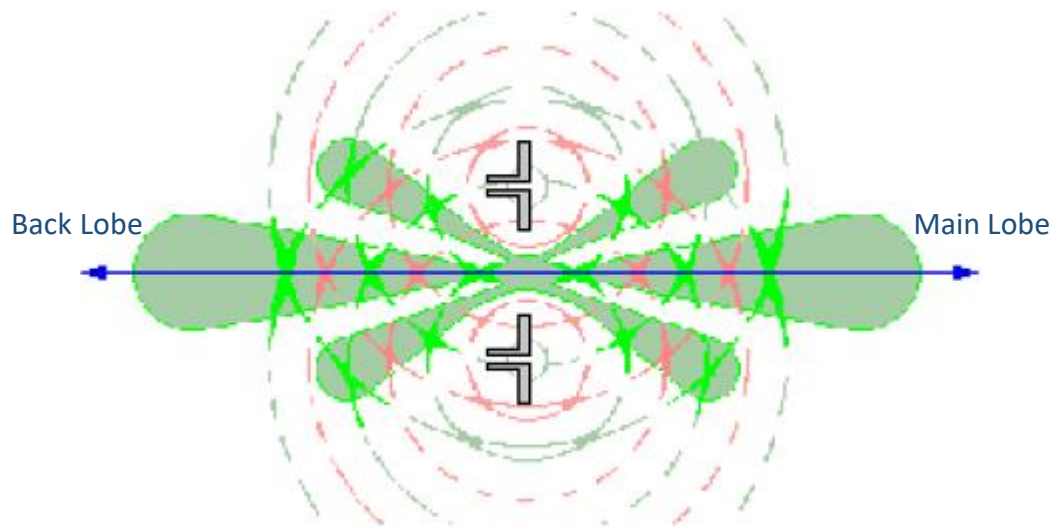
1. A **phased array antenna** is composed of lots of radiating elements each with a phase-shifter.
2. Beams are formed by shifting the phase of the signal emitted from each radiating elements, to provide constructive/destructive interference so as to steer the beams in the desired direction.



1. Two radiating elements are fed with the same phase.
2. The signal is amplified by constructive interference in the main direction.
3. The beam sharpness is improved by the destructive interference.

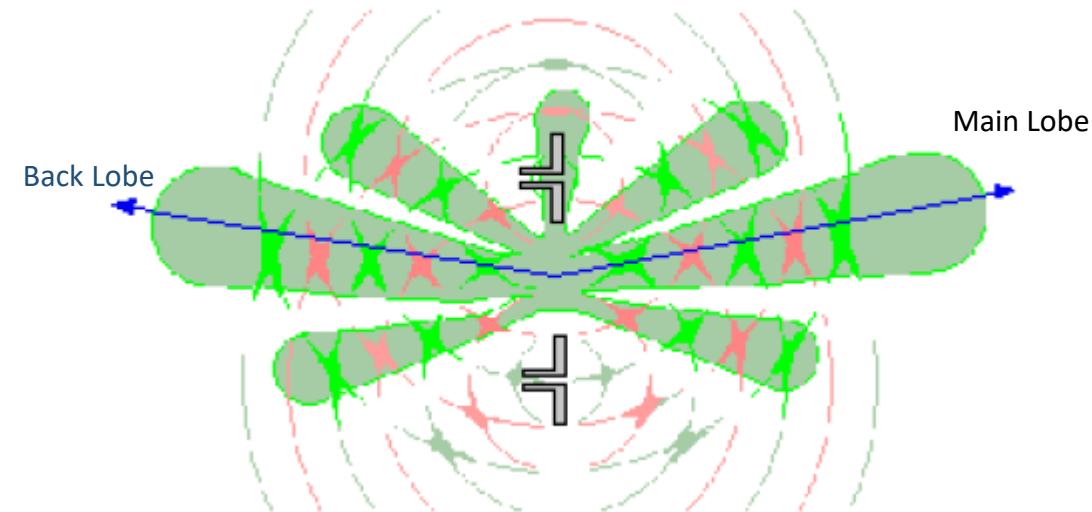
PRINCIPLE OF PHASED ARRAY ANTENNAS

NO PHASE SHIFT



1. Two radiating elements are fed with the same phase.
2. The signal is amplified by constructive interference in the main direction.
3. The beam sharpness is improved by the destructive interference.

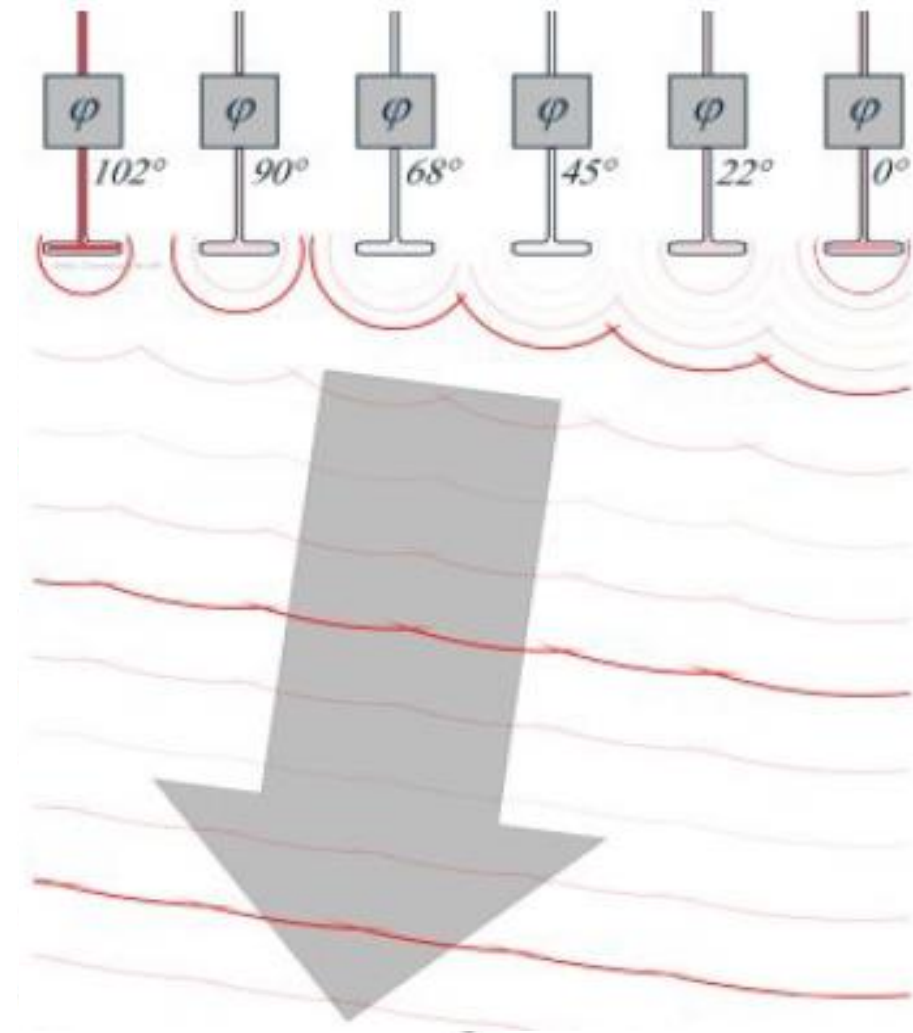
10° PHASE SHIFT



1. The signal is emitted by the lower radiating element with a phase shift of 10 degrees earlier than of the upper radiating element.
2. As a result, the main direction of the emitted sum-signal is moved upwards.

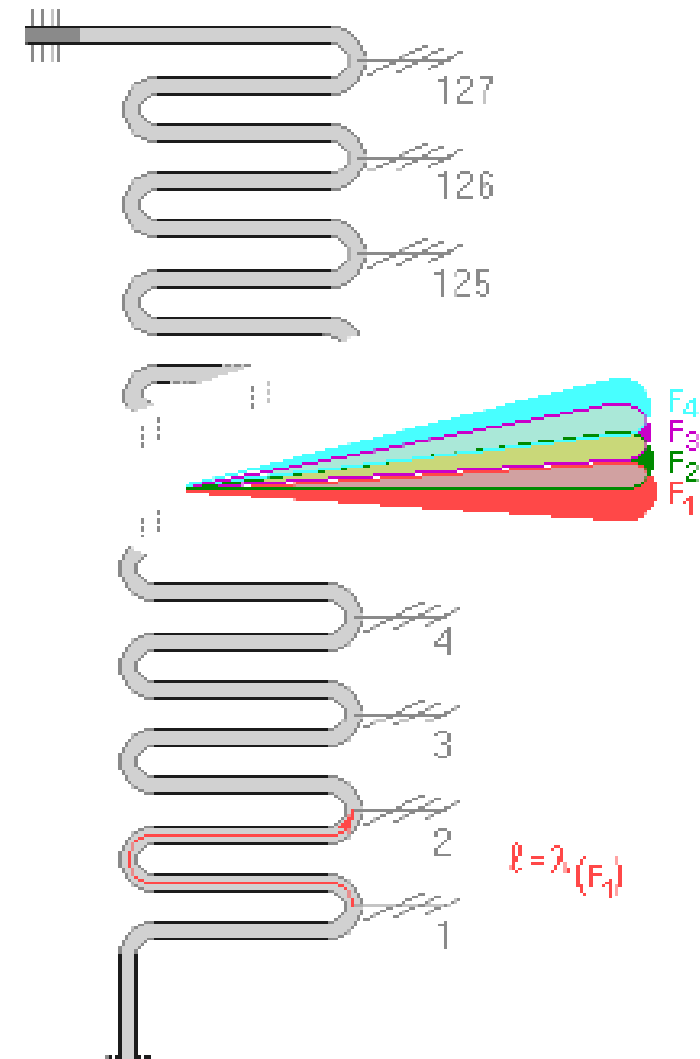
ELECTRONIC CONTROL OF BEAM DIRECTION

1. The main beam always points in the direction of the increasing phase shift.
2. Therefore, if the signal to be radiated is delivered through an electronic phase shifter giving a continuous phase shift, the beam direction will be electronically adjustable.



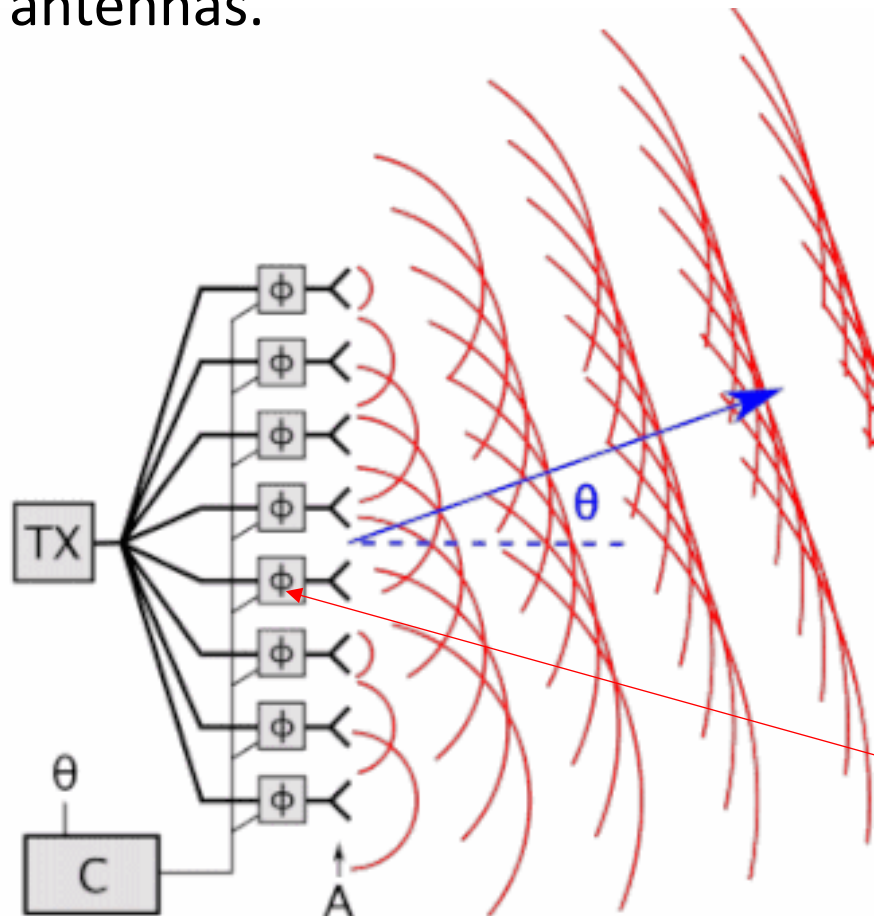
FREQUENCY SCANNING ANTENNA

1. A frequency scanning Antenna is a special type of the phased array antenna where the main beam steering occurs by the frequency scanning of the exciter.
2. As a result, beam steering is a function of the transmitted frequency.
3. The normal arrangement is to feed the different radiating elements from one folded waveguide.
4. Height information is generated using the following philosophy:
 1. If the transmitted frequency rises then the beam travels up the face of the antenna;
 2. If the transmitted frequency falls then the beam travels down the face of the antenna.
5. The radar set is designed so that it keeps track of the frequencies as they are transmitted and then detects and converts the returned frequencies for 2D display data.



DEMONSTRATION OF PHASED-ARRAY ANTENNA

A phased array Antenna is a computer-controlled array of antennas which creates a beam of radio waves that can be electronically steered to point in different directions without moving the antennas.



The feed current for each element passes through a phase shifter (ϕ) controlled by a computer (C).

APPLICATIONS OF PHASED ARRAYS

1. **Phased arrays were originally conceived for use in military radar systems**, to steer a beam of radio waves quickly across the sky to detect planes and missiles.
2. These systems are now widely used and have spread to civilian applications such as **5G MIMO for cell phones using 3D beamforming**.
3. **Low-cost user terminals able to track satellites** which are not in geostationary orbits.
4. Phased arrays of acoustic transducers are used in medical **ultrasound imaging scanners**.