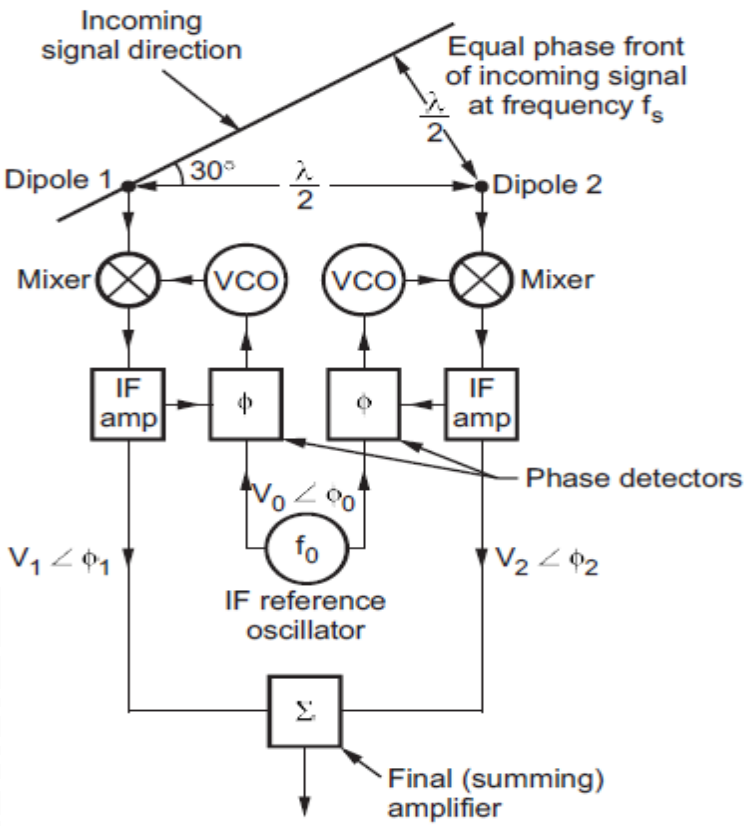
3.1 Smart Antennas

The antenna elements and their transmission-line interconnection produce a beam (or) beams in predetermined directions.

- By processing the signals from the individual elements, an array can become active and react intelligently to /-s environment, steering I-s beam towards a desired signal while simultaneously steering a null toward an undesired, interfering signal and thereby maximizing the signal-to-noise ratio of the desired signal. The term adaptive array is applied to this kind of antenna.
- By suitable signal processing, performance may be further enhanced giving simulated patterns of higher resolution and lower side lobes.
- In addition, by appropriate sampling and digitizing the signals at the terminals of each element and processing them with a computer a very intelligent small antenna be built. Multiple beams may be simultaneously directed toward many signals among from different directions within the field of view of the antenna These antennas are sometimes called Digital Beam Forming (DBF) antennas.
- the patterns of the elements are uniform in the plane of the page. With elements operating in phase, the beam is broadside.



The phase of the signal of 90° at element 2. Each element is equipped with its own mixer, Voltage Controlled Oscillator (VCO), intermediate frequency amplifier and phase detector. An oscillator at the intermediate frequency is connected to each phase detector as reference. The phase detector compares the phase of the downshifted signal with phase of the reference oscillator and produces a voltage proportional to the phase difference. This voltage, in turn, advances (or) retards the phase of the VCO output so as to reduce the phase difference to zero (phase locking). The voltage for the VCO of element 1 would ideally be equal in magnitude but of opposite sign to the voltage for the VCO of element 2, So that the downshifted signals from both elements are locked in phase, making

$$\phi_1 = \phi_2 = \phi_o$$

ϕ_1 = Phase of the downshifted signal from element 1

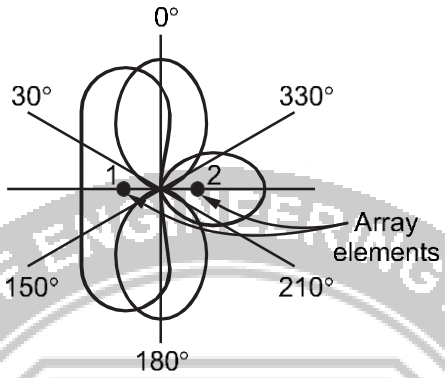
ϕ_2 = Phase of the downshifted signal from element 2

ϕ_o = Phase of reference oscillator

With equal gain from both If amplifiers the voltage V2 from both the elements should be equal so that

$$V_1 \angle \phi_1 = V_2 \angle \phi_2$$

In this 2 element example, the beam will be in the 0° direction for a signal from the 0° direction and at 38 for a signal from that direction



- If interfering signals are arriving from the 210 and 330° directions when the main signal is at 30°, the nulls at 210 and 330° will suppress the interference.
- However, an interfering signal at 150° would be at a pattern maximum, the same as the desired signal at 30°.
- To provide more effective adaption to its environment, an array with more elements and more sophisticated signal processing is required.