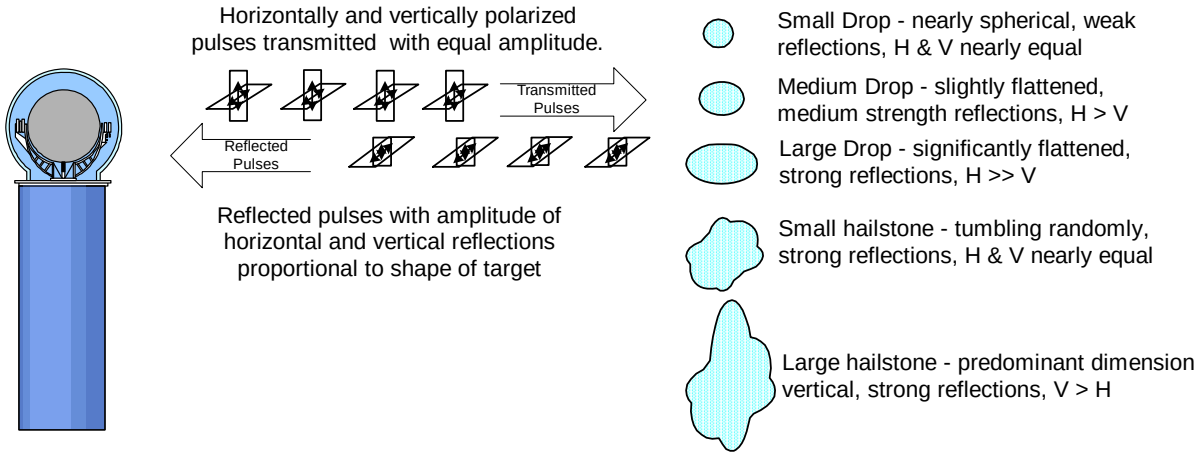
Dual Polarity Weather Radar Overview

Weather radar systems typically transmit and receive horizontally polarized signals. This improves the radar's sensitivity to rain.

Dual polarity weather radar systems transmit and receive both horizontally and vertically polarized signals. With the proper signal processing hardware and associated software, this provides significantly improved accuracy of radar based rainfall measurements, and the ability to classify precipitation as rain, snow, hail, etc..

The basic principle of operation is that the dual polarity data provides information about the shape of the rain drops in addition to the reflectivity. The relationship between the size and shape of rain drops is well known, thus the actual water content of the drops can be calculated more accurately. The shape factor also provides classification information.



Research to date indicates that dual polarity radars can routinely provide rainfall measurements that are within ±10% to ±15% of the "ground truth" from rain gauges.

The advantage of a radar is that it can provide essentially continuous coverage within a circle of approximately 100 miles radius around the radar antenna. A system of rain gauges to cover the same area with 1 km resolution would require over 80,000 gauges; clearly an impractical, if not impossible, system.

Thus, a dual polarity weather radar system is a practical way to provide a high probability of detecting, locating and accurately measuring a small, high intensity rain cell of the type that can cause localized flash flooding, as well as providing general rain and classification data. Because the precise location and amount of rain can be determined in real time, flash flood alerts can be issued quickly for the specific watershed/creek/river involved, and provide advance warning of potentially life threatening conditions in a specific area.

There are two ways of implementing dual polarity radar; transmitting alternate pulses with a polarity switch between pulses, or transmitting and receiving horizontal and vertical pulses simultaneously (STAR- Simultaneous Transmit And Receive).

Radtec uses the STAR method. It is more reliable, and works with either a magnetron or Klystron radar. The STAR method was developed and patented by Dr. Dusan Zrnic of the US National Weather Service. To the best of our knowledge, Radtec is the only manufacturer of complete weather radar systems that is currently licensed under this patent.

The following table summarizes the differences between alternate pulse and STAR dual polarity technology:

Item	STAR	Alternate Pulse	Comments
Antenna	**H & V polarity feed required**	**H & V polarity feed required**	**Similar antennas**
Switch	**None required**	**Electromechanical or ferrite**	**Electromechanical switches have limited life and impose severe limitations on radar operating modes. Ferrite has stability issues.**
Receiver	**2 required**	**1 required**	**With digital receivers, typically the STAR method requires only the digitizers to be duplicated.**
Transmitter	**Magnetron or Klystron**	**Klystron**	**An alternate pulse system must be fully coherent**
Signal Processor	**1**	**1**	**Similar signal processing requirements**
Compatible With Future NEXRAD Development	**Yes**	**No**	
Upgrade of existing radar to dual polarity	**Yes**	**Very difficult and expensive**	**May be easier/cheaper to get new radar than to upgrade to an alternate pulse radar.**