
# Using Directional Antennas in Large Spaces

7SIGNAL

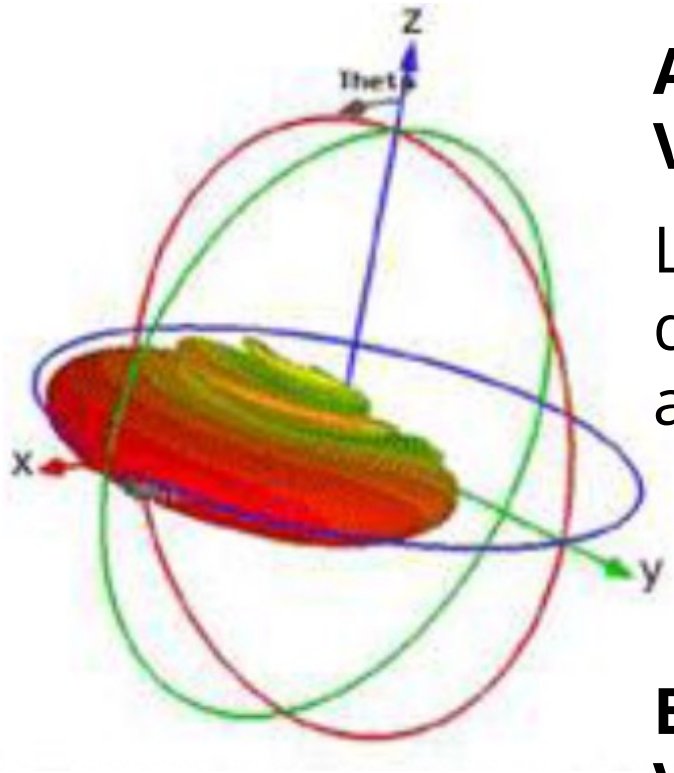
# ABOUT ME

- Senior Systems Engineer with 7signal for 7 years
- Designing, installing, and troubleshooting wireless LANs since 1994.

# TODAY'S AGENDA

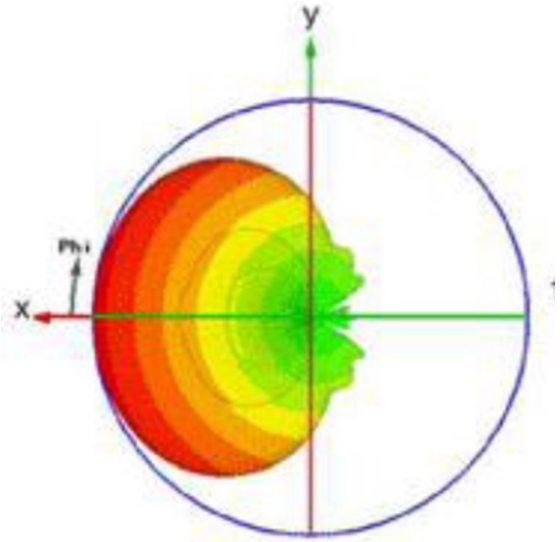
- Understanding Antenna Pattern Charts
- Antenna Gain
- Directional Antenna Types
- Dual Band Antennas and APs
- MIMO Antennas
- Use Case: Parking Lot
- Use Case: Warehouse

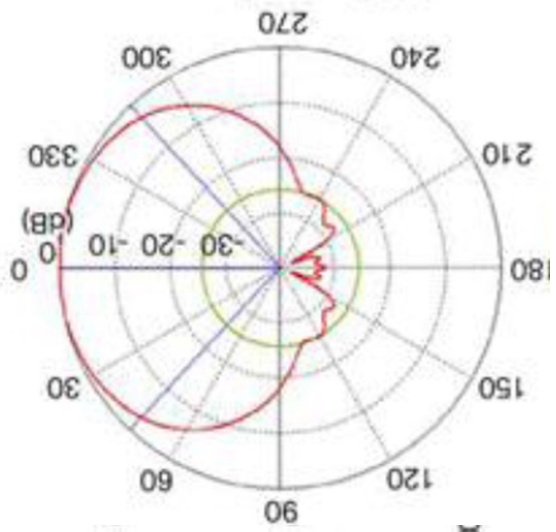
# UNDERSTANDING ANTENNA PATTERN CHARTS




**Azimuth View**

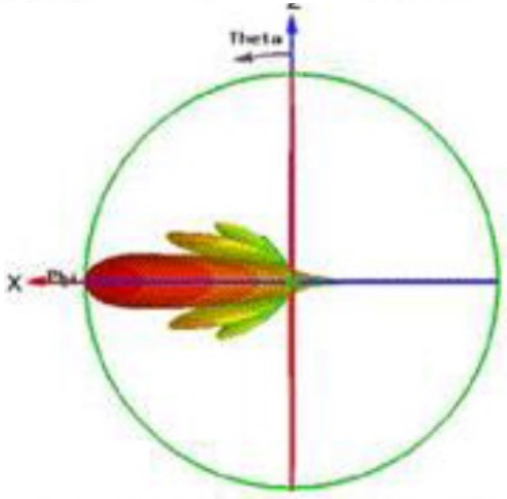
Looking down from above

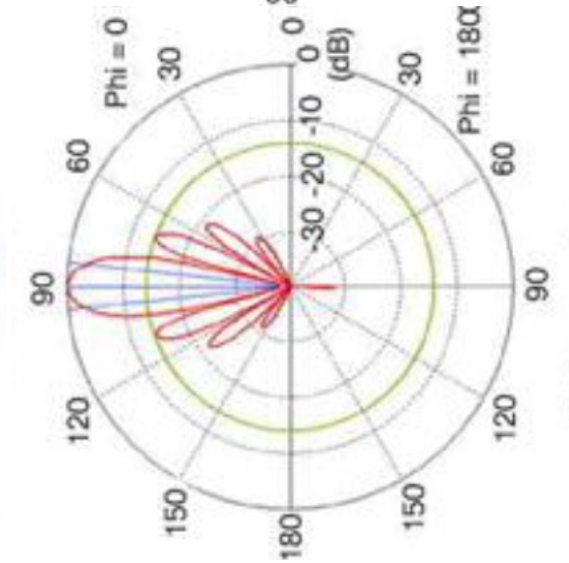



**Elevation View**

Looking from the side



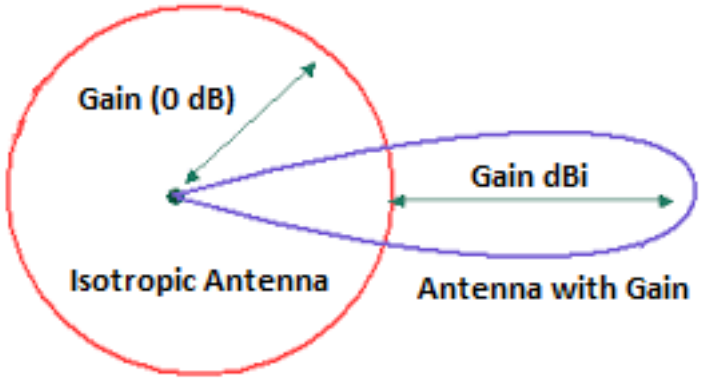
# ANTENNA GAIN

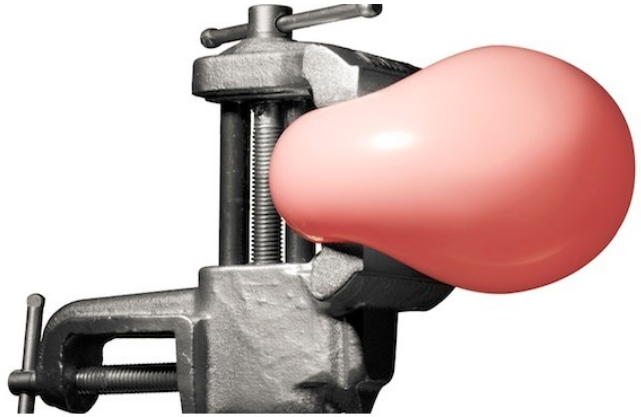
**What is Gain?**

Gain is a measure of an antenna's ability to direct RF energy.

**What about Transmit vs Receive antennas?**

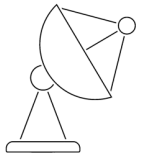
The principle of *Reciprocity* states that the receive and transmit properties of an antenna are identical**.**



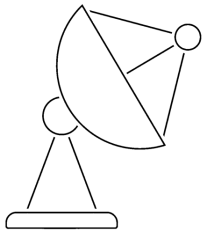



# ANTENNA GAIN AND RANGE

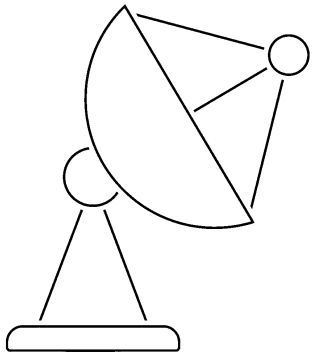
**6 dB Rule:** Adding 6 dB of gain doubles the range, subtracting 6 dB of gain halves the rage.



X **–** 6 dBi → Range **/** 2



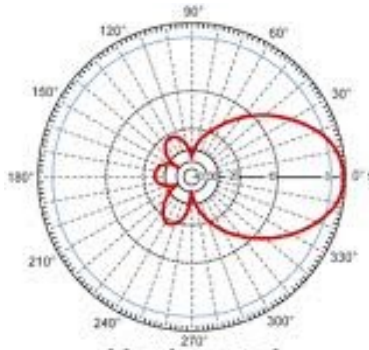
X dBi → Range

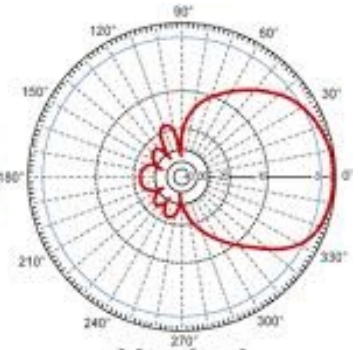


X **+** 6 dBi → Range ***** 2

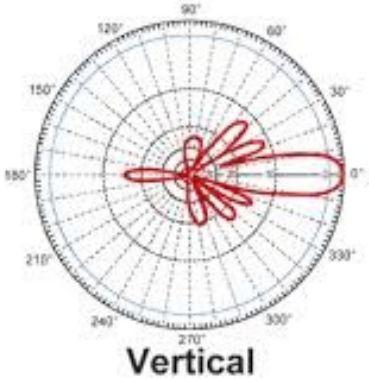
# DIRECTIONAL ANTENNA TYPES

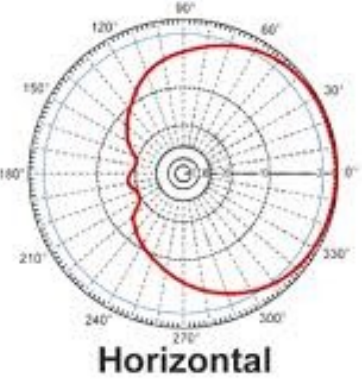
**Patch Antenna**
Approx. 3-15 dBi



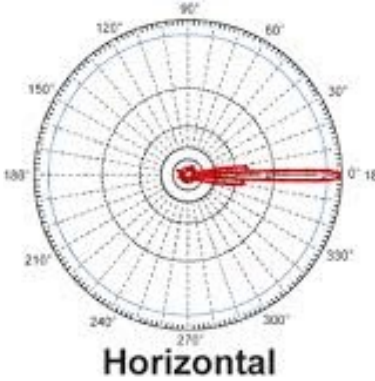



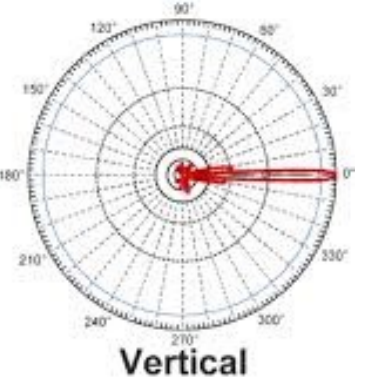

**Sector Antenna**
Wide horizontal pattern
Narrow vertical pattern
Approx. 8-18 dBi




**Highly directional “Beam”**
Narrow pattern
Mostly used for PtP links
10-30 dBi



# DUAL BAND ANTENNAS AND APS

**Dual Band Antennas** have
Connectors which are both 2.4 & 5 GHz
-or-
Connectors for 2.4 GHz & Connectors for 5 GHz

**Dual Band Access Points** have
Connectors which are both 2.4 & 5 GHz
-or-
Connectors which are 2.4 GHz & Connectors which are 5 GHz
-or-
Connectors which are under software control

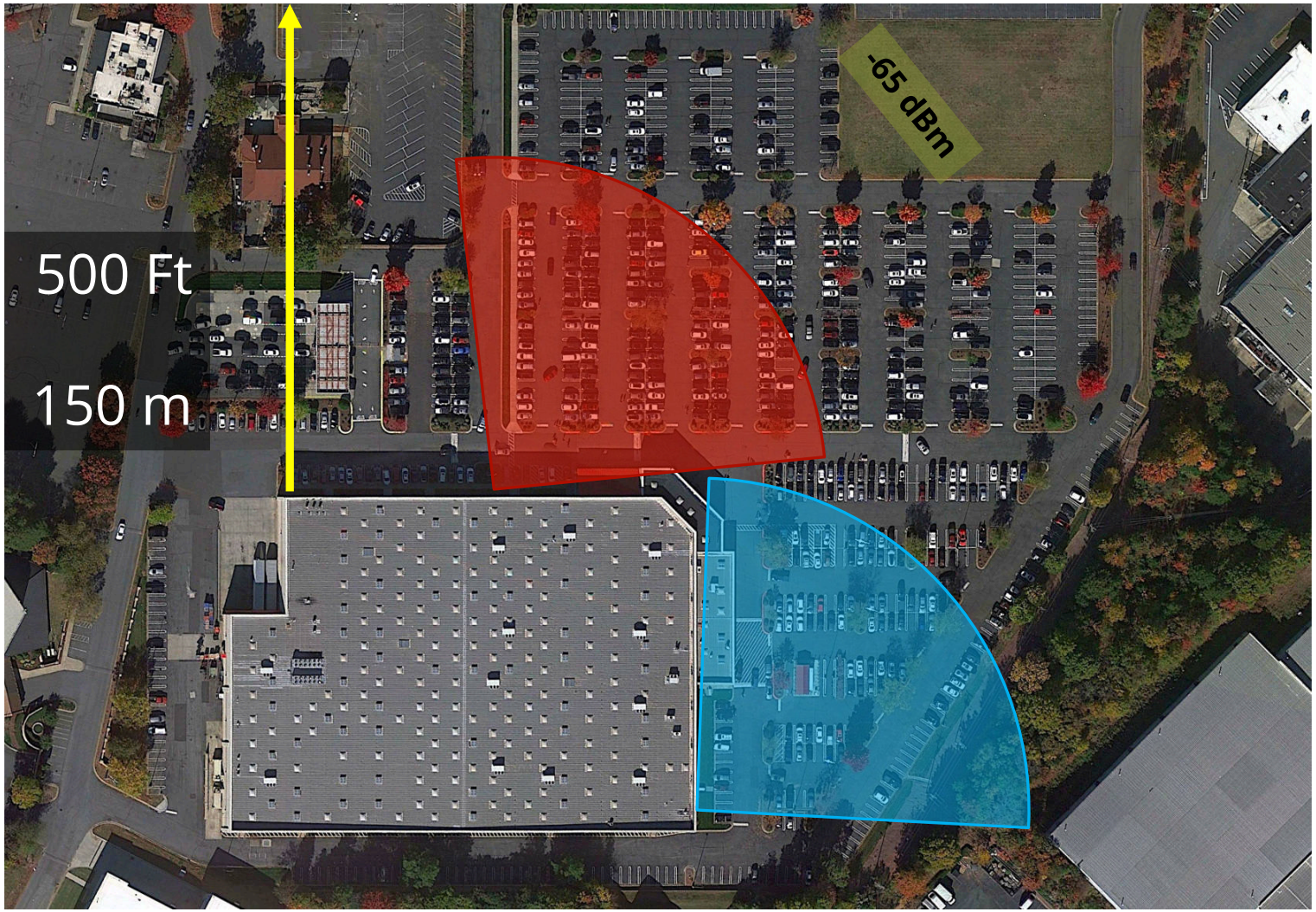
# MIMO ANTENNAS

What if I have a multiple spatial stream AP, but the antenna with the pattern I need only has a single element?

That's fine – *you can gang multiple SISO antennas together into a MIMO antenna*.

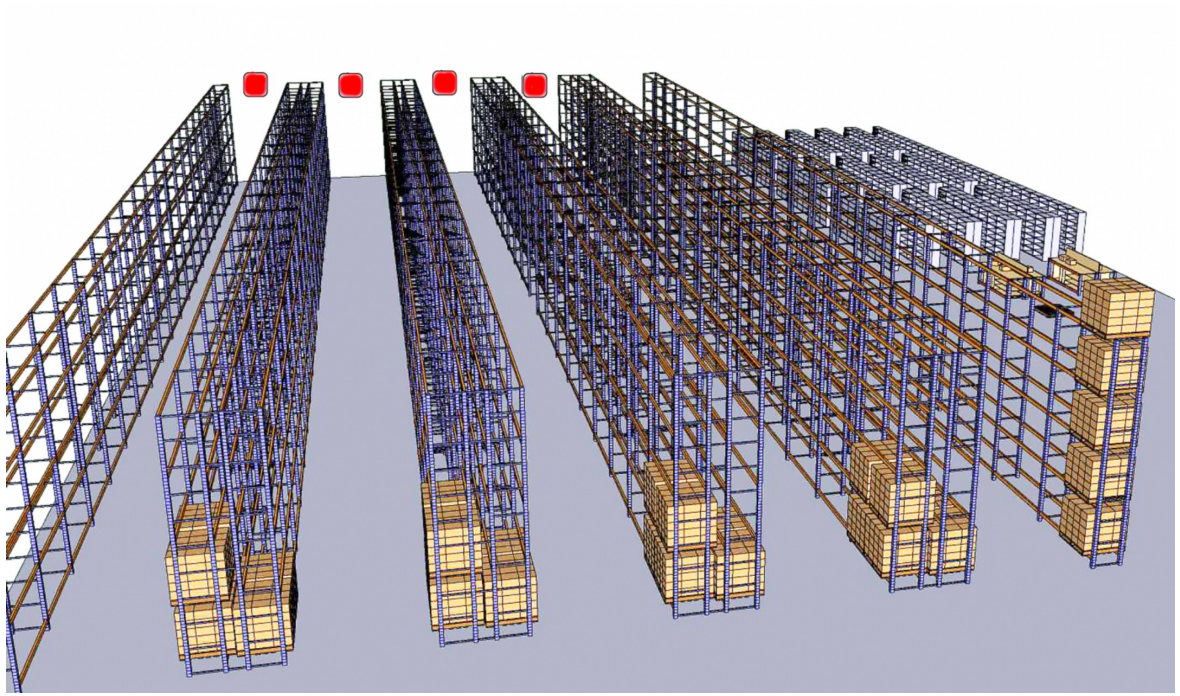
- Use a single type of antenna.
- Aim them all at the same area.
  - MIMO Wi-Fi APs (802.11n and newer) will transmit control and management traffic using a single antenna.
- You may need to experiment with polarization
  - +45, & -45 degrees, Vertical & Horizontal, or all vertical are good starting points.

# USE CASE – PARKING LOT




| | |
|---|---|
| Antenna Type: | 90-degree Sector |
| Antenna1 Gain: | 15 dBi (AP) |
| Cable & Misc Losses: | 4 dBm |
| Antenna1 Length: | 3 ft / 1 m |
| Antenna2 Gain: | 0 dBm (Client) |
| Tx Power: | 15 dBm (32 mW) |
| Frequency: | 5.8 GHz |
| Calculated RSSI @ 500 ft / 150 m: | -65 dBm (5 GHz) |

# USE CASE: WAREHOUSE



Wall Mount APs and use Directional Antennas

# Q&A

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