Antennas

Objectives

- Take aways
  - How an antenna works
  - How to read a radiation pattern
  - How to choose the right antenna

What’s an Antenna?

https://www.domyown.com/ant-identification-guide-a-460.html

What’s an Antenna?

http://www.emmeesse.it/en/product.asp?idprod=149&idcat=421

What's An Antenna?

An antenna couples electrical current to radio waves

And it couples radio waves back to electrical current

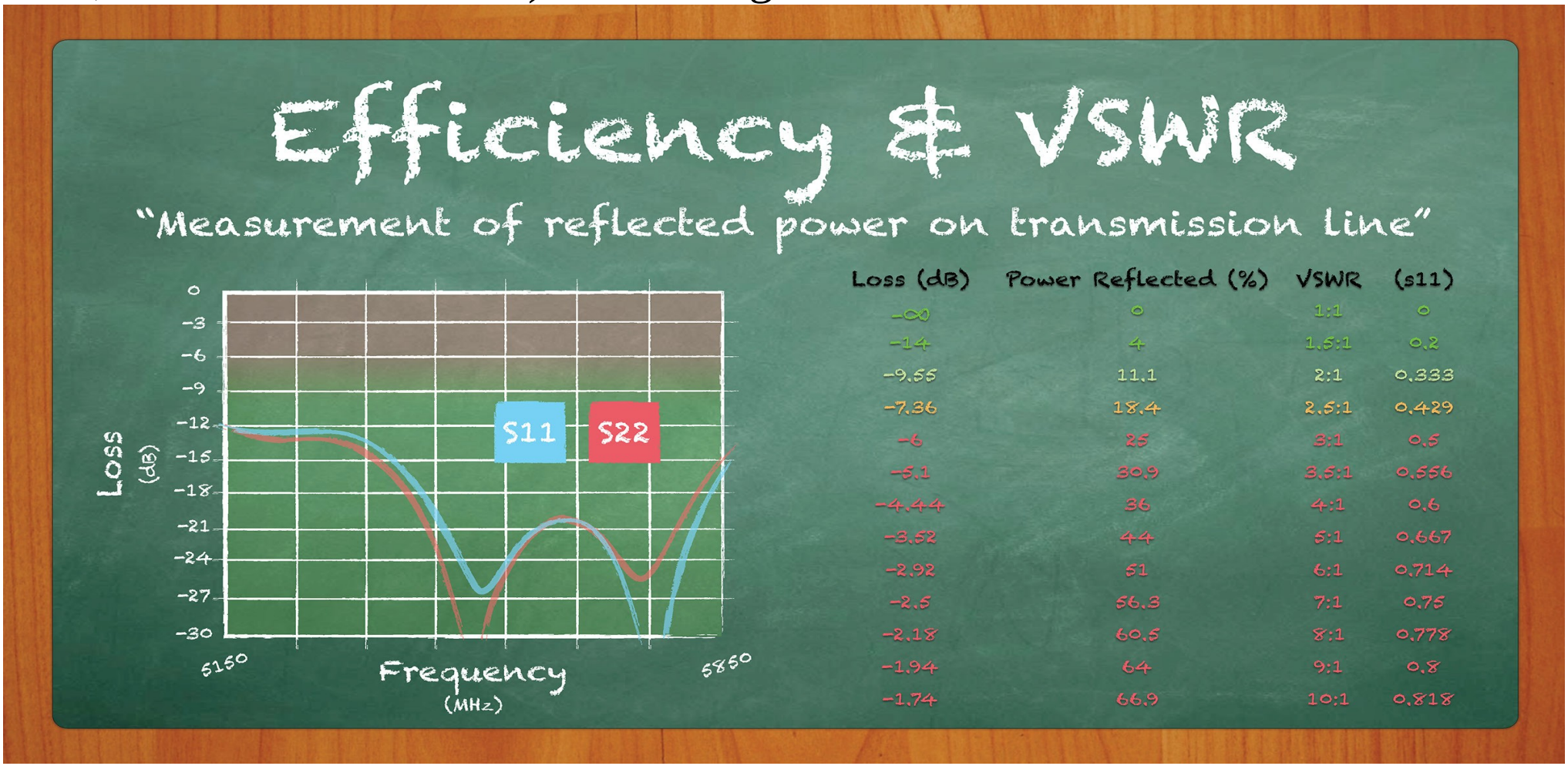
It's the interface between guided waves from a cable and unguided waves in space

When paired with a radio transmitter, the function of the antenna is to convert energy from the generated carrier signal into radio waves. When paired with a receiver radio, the job of the antenna is to convert radio waves back into electrical signals so the radio can decode information from the carrier.

Antenna Characteristics

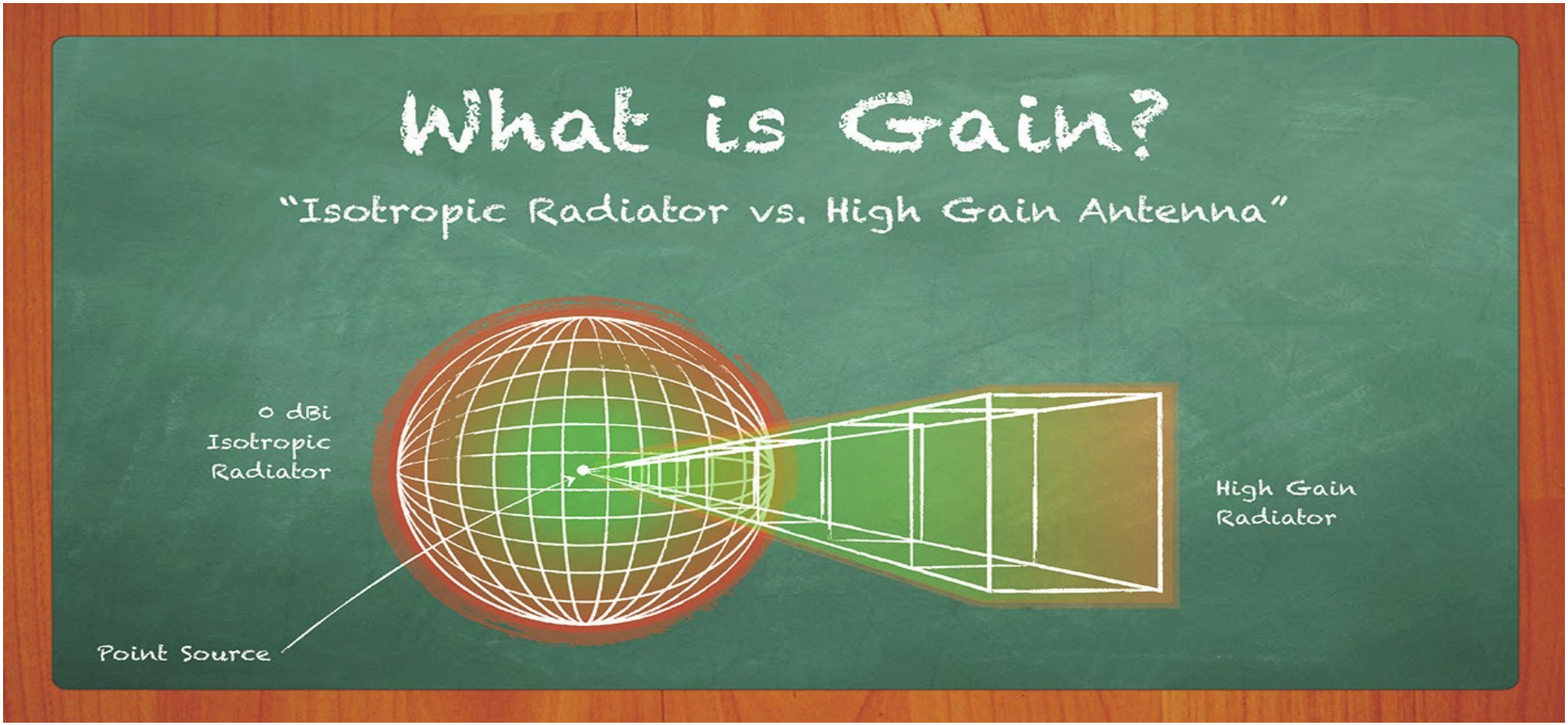
Efficiency

One of the most important characteristics of the antenna is the efficiency with which it converts energy passing back and forth to the radio. Voltage Standing Wave Ratio (VSWR), otherwise known as return loss, measures the amount of energy that is reflected back and wasted on a transmission line (e.g., antenna feed, RP-SMA connectors) connecting the radio chain and antenna.



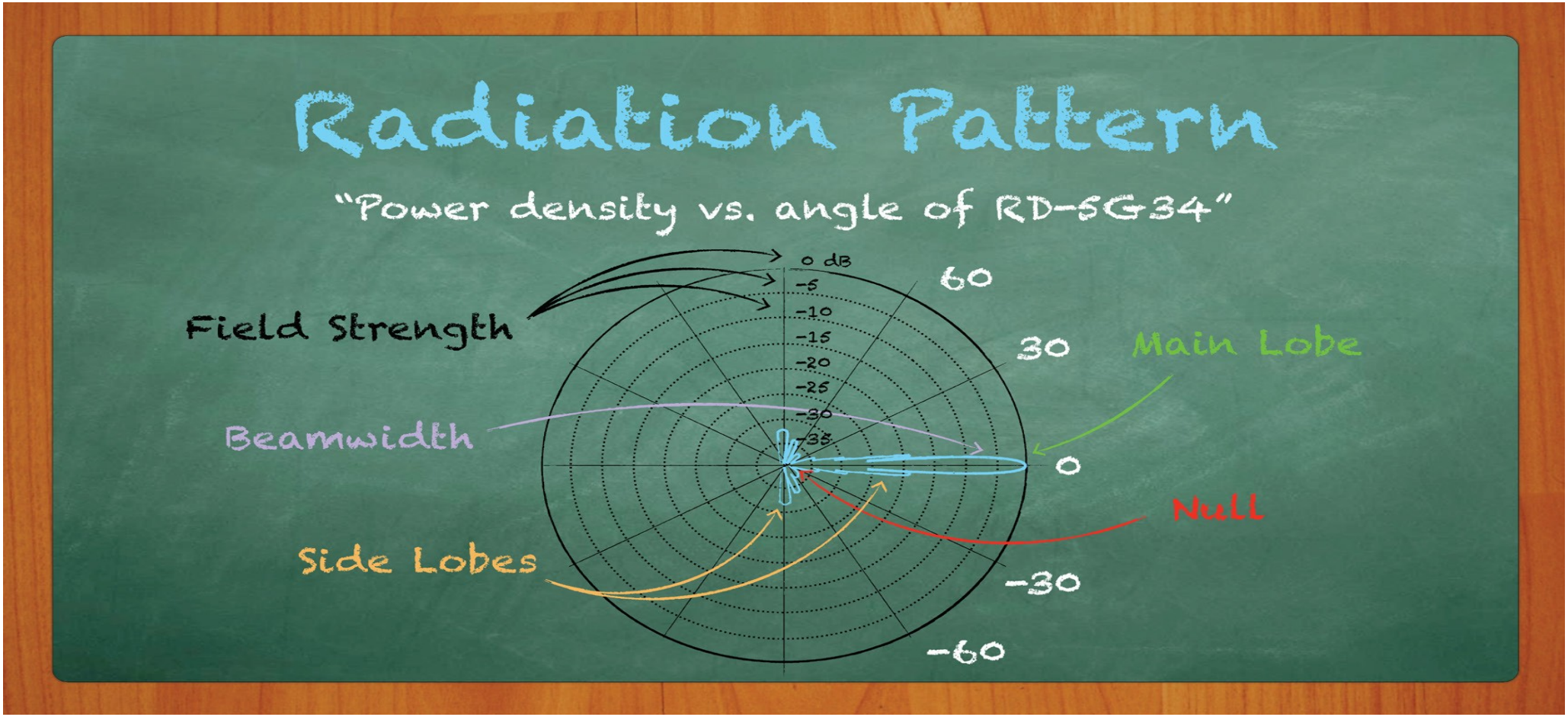
Gain and Directivity

Antenna gain measures the efficiency and directivity of an antenna. Directivity describes the direction and power density of the energy radiated by an antenna. Gain and directivity are often used interchangeably.
Measured using logarithmic units:
Decibels relative to Isotropic Radiator (dBi).



Radiation Pattern

Antennas radiate and receive signals across three-dimensional space, as represented by radiation patterns. Also known as polar plots, these patterns describe the power density and angle at which signals propagate from or are received by the antenna. Polar plots exist in two planes: Azimuth and Elevation.

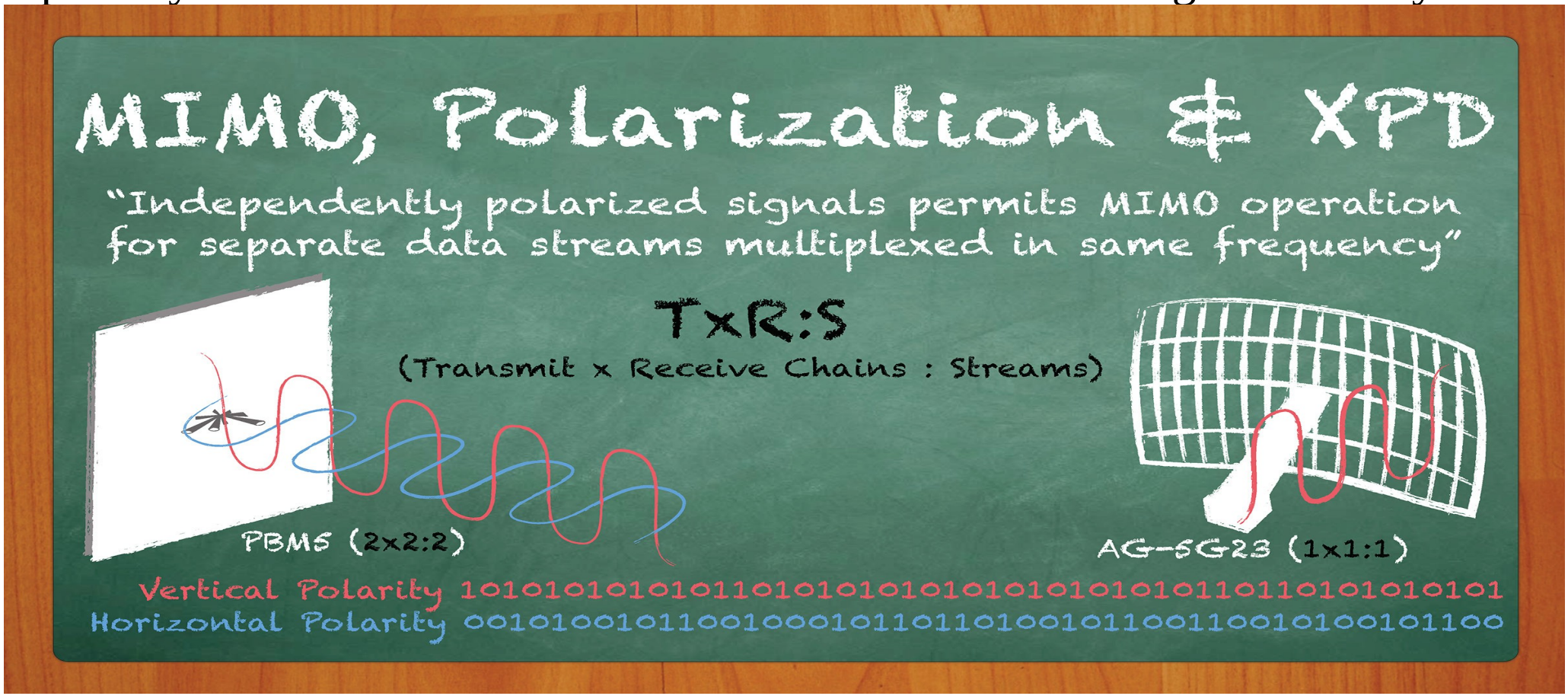


In RF system, antennas require precise alignment along the angle at which peak power density is radiated, otherwise known as the **main lobe**. When properly aligned, the antenna improves the receive signal by a factor equal to the gain level. If improperly aligned however, the receive signal will drop by a factor equal to the density and angle of the lobe (known as side lobes) on which the antenna is aligned.

Antenna Polarity

All electromagnetic waves travel through space consistent with a given plane, or, polarity.

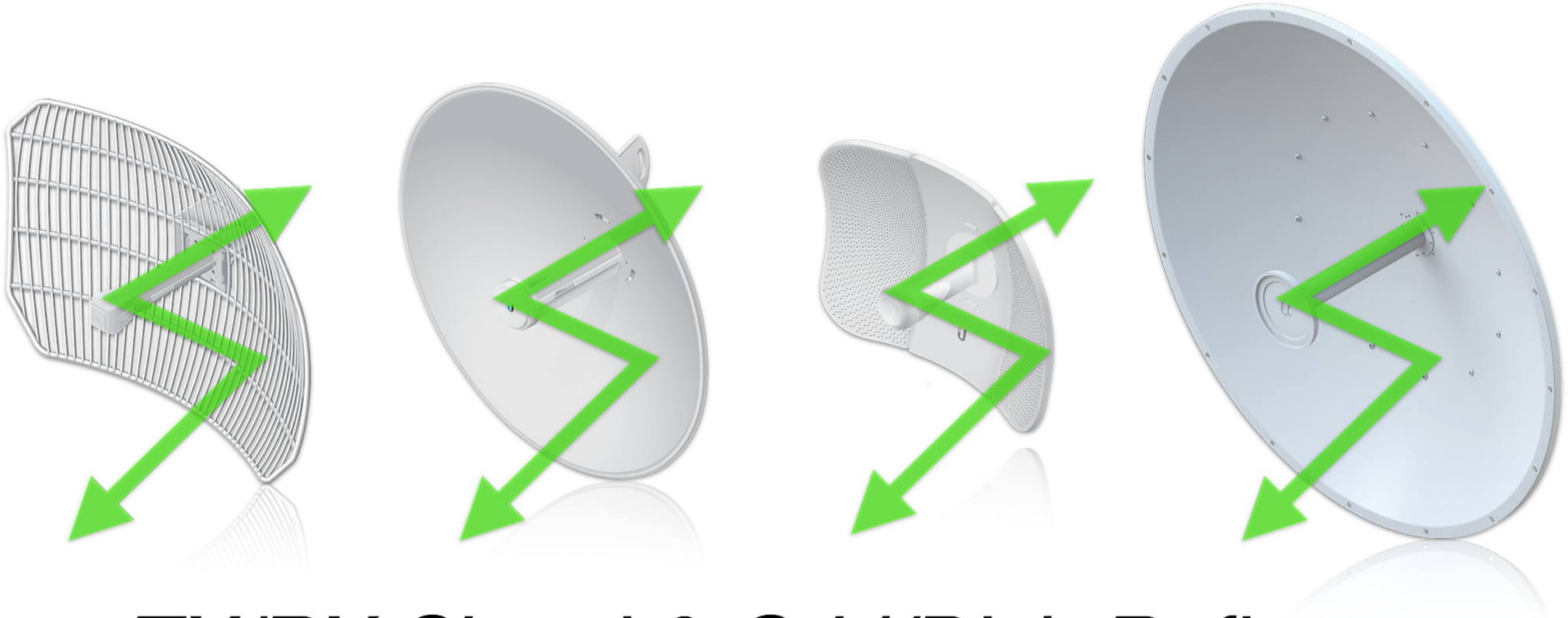
Ubiquiti antennas are linearly-polarized, meaning they radiate waveforms along distinct planes: vertical (V-pol) and horizontal (H-pol). Signal polarization is another reason why antennas must be properly aligned, since a polarity mismatch at either end would result in a loss of signal intensity.



Types of Antennas

Parabolic reflector, or more commonly, ‘dish’ antennas are high gain, high directivity devices. A dish antenna is composed of two pieces: feedhorn and reflector. Both are positioned such that the reflected waves are in-phase and add together to produce gain.

Energy passes between the feedhorn and the radio, reflecting off the dish to produce a highly directive radiation pattern.



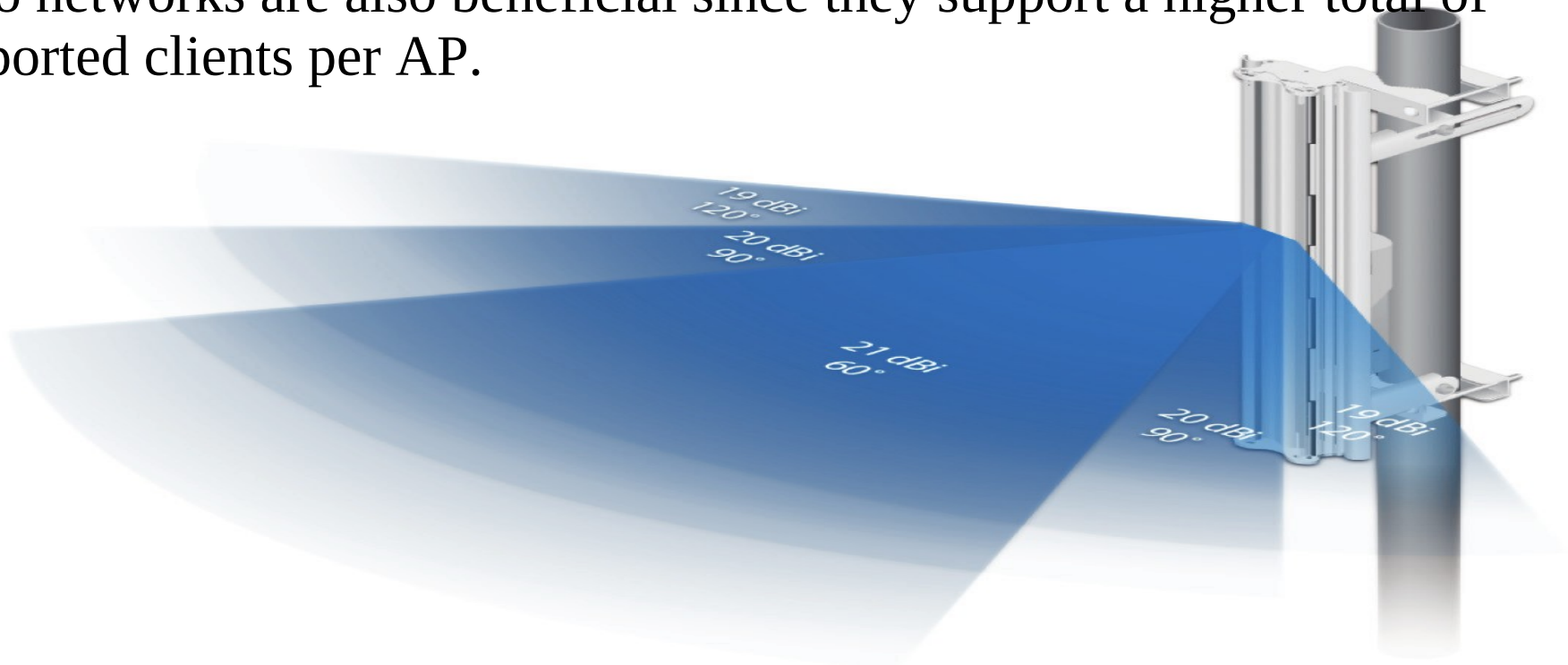
TX/RX Signal & Grid/Dish Reflector

Omnidirectional Antenna

Omnidirectional, or omni antennas, provide 360° of coverage on the azimuth plane.They are typically used in outdoor wireless networks where universal coverage is needed, like APs at base station tower sites. Despite affording ease of deployment, their range is relatively short. Because omni antennas radiate in 360°, they lack adequate spatial filtering needed in environments with increased noise levels.

Sectorial Antenna

Compared to omnidirectional antennas, sector antennas are more directive devices. Sector antennas provide a set amount of coverage on the azimuth plane as defined by their main lobe beamwidth. airMAX sector antennas have beamwidths commonly divisible by 15° (e.g., 45°, 60°) in order to provide cumulative, 360° coverage at base station tower sites. Compared to omni antennas, a cluster of three or more airMAX sectors can provide complete coverage across greater distances and with much better spatial filtering. Cluster radio networks are also beneficial since they support a higher total of supported clients per AP.



Choosing an Antenna

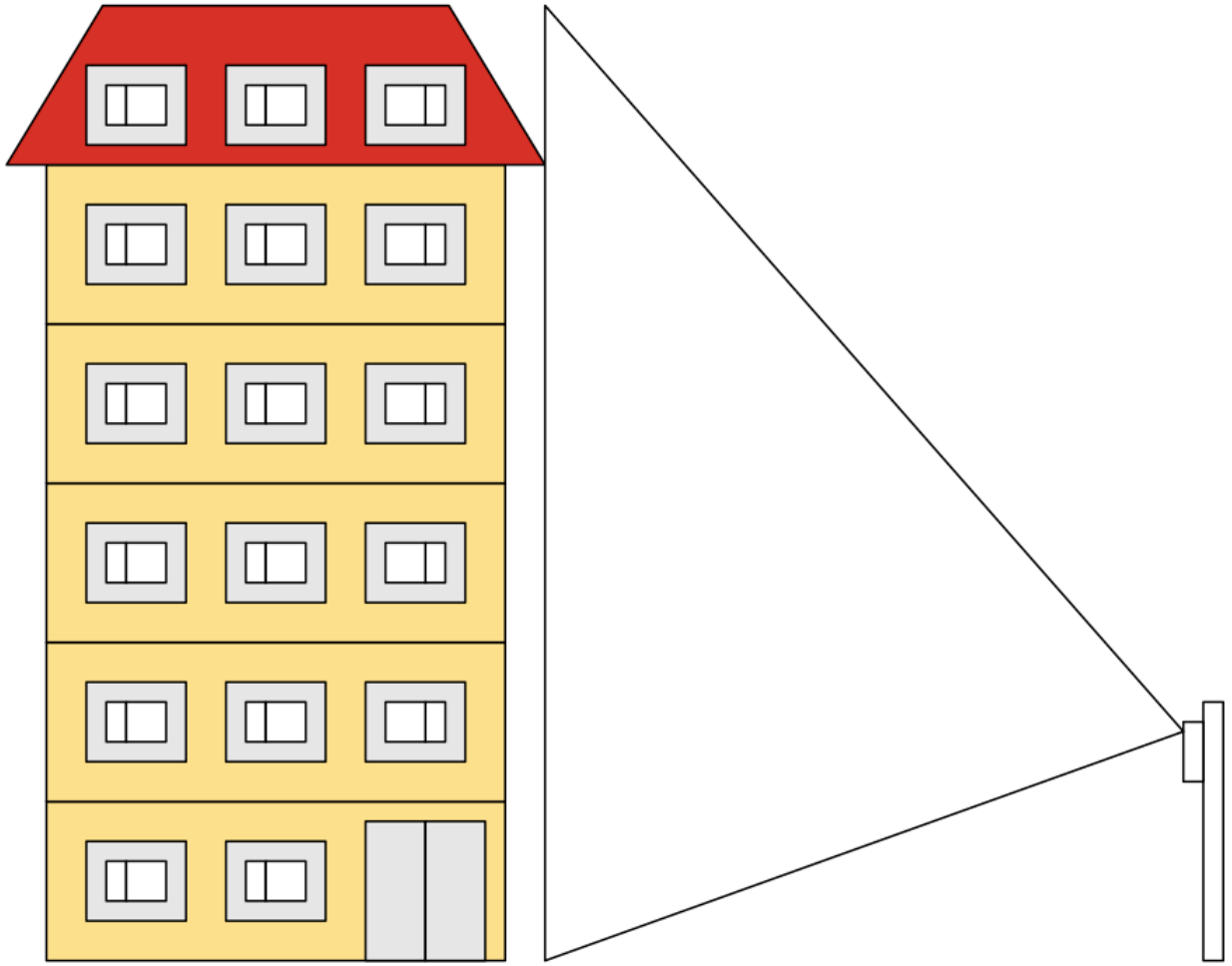
- What frequency and bandwidth?
- What coverage do you need?
- Does physical size matter?
  - Is your mast strong enough for a big antenna?
- Are aesthetics important?
- Is the environment windy?
  - Maybe use a grid antenna with low surface area
- Is there ice?
  - Use a dish with a plastic cover to keep the ice off

A Commercial Sector Antenna

60 degree H, 4 degree E, 10m from a 18m Building

Is this going to work?

A Commercial Sector Antenna

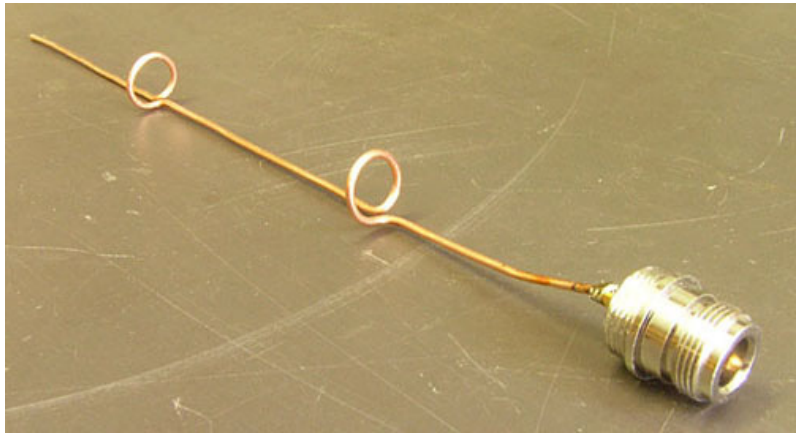


Making Your Own Antennas

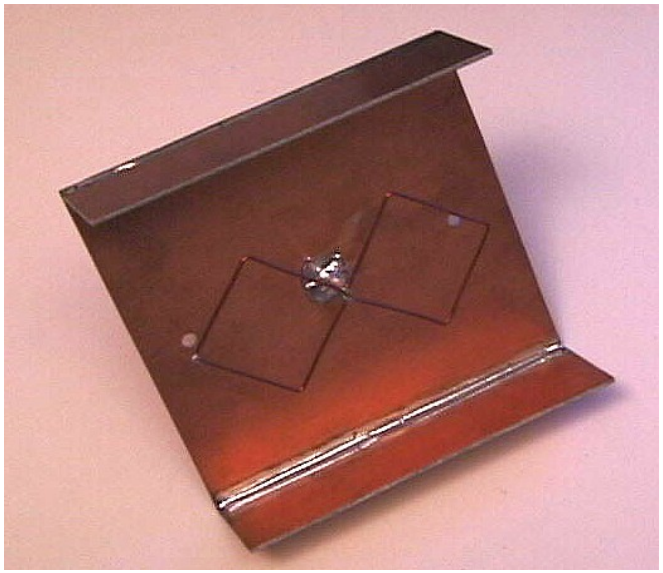
- Free, Open Source Designs Available
- Combine with Reflectors (Satellite Dishes) for high gain
- Learn Collinear & Cantenna with WNDW (multiple languages)
  - http://wndw.net/book.html
- Make a BiQuad with Trevor Marshall (English)
  - http://www.trevormarshall.com/biquad.htm
- Make a Parabolic Reflector & More with M. Erskine (English)
  - http://www.freeantennas.com/projects/template/index.html
- Make a Collinear with Marty Bugs (English)
  - http://martybugs.net/wireless/collinear.cgi

Making Your Own Antennas

http://www.dslreports.com/forum/remark,5605782~root=wlan ~mode =flat



http://martybugs.net/wireless/collinear.cgi



http://www.trevormarshall.com/biquad.htm

Acknowledgement

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UBNT (https://www.ubnt.com/download/trainings)

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UBIQUITI NETWORKS

NSRC Network Startup Resource Center