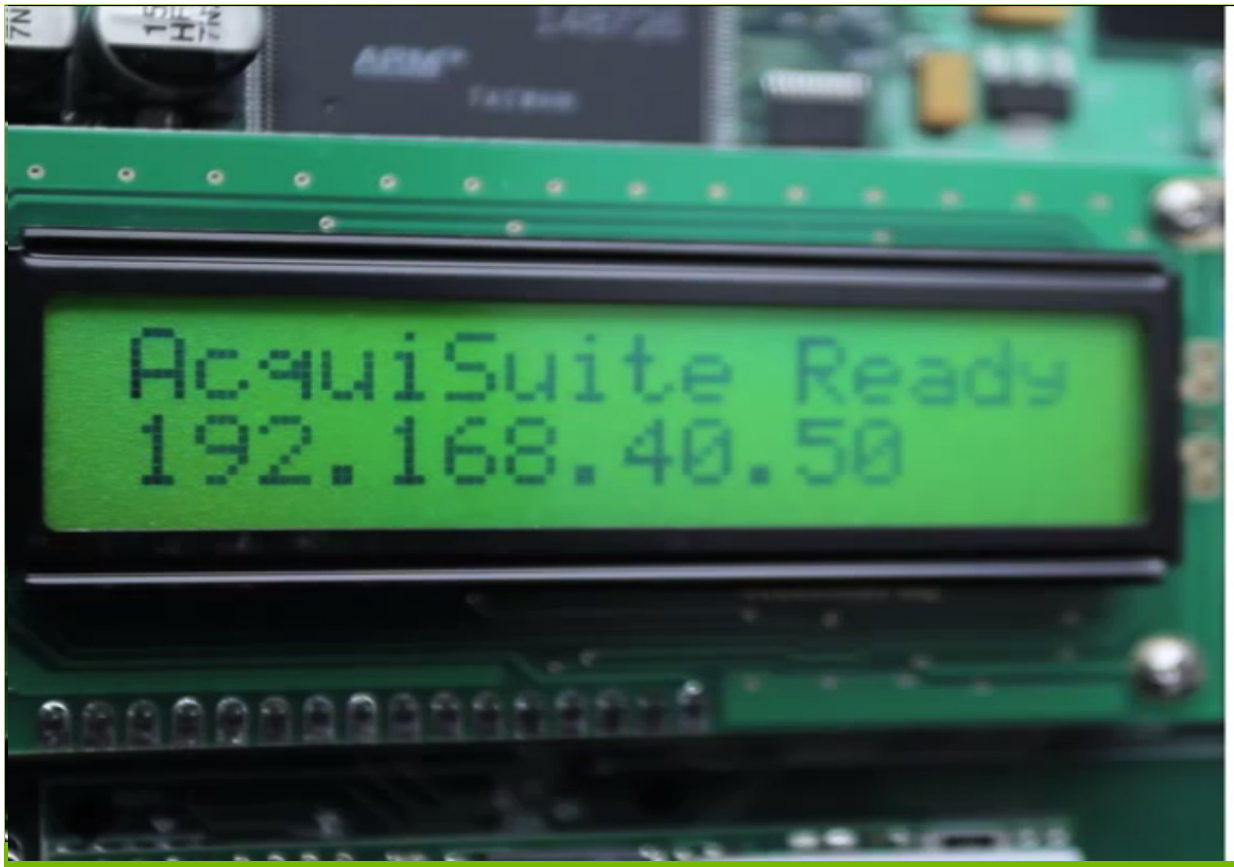


Obvius Training

Advanced ModHopper RF

Revised 4/3/2012

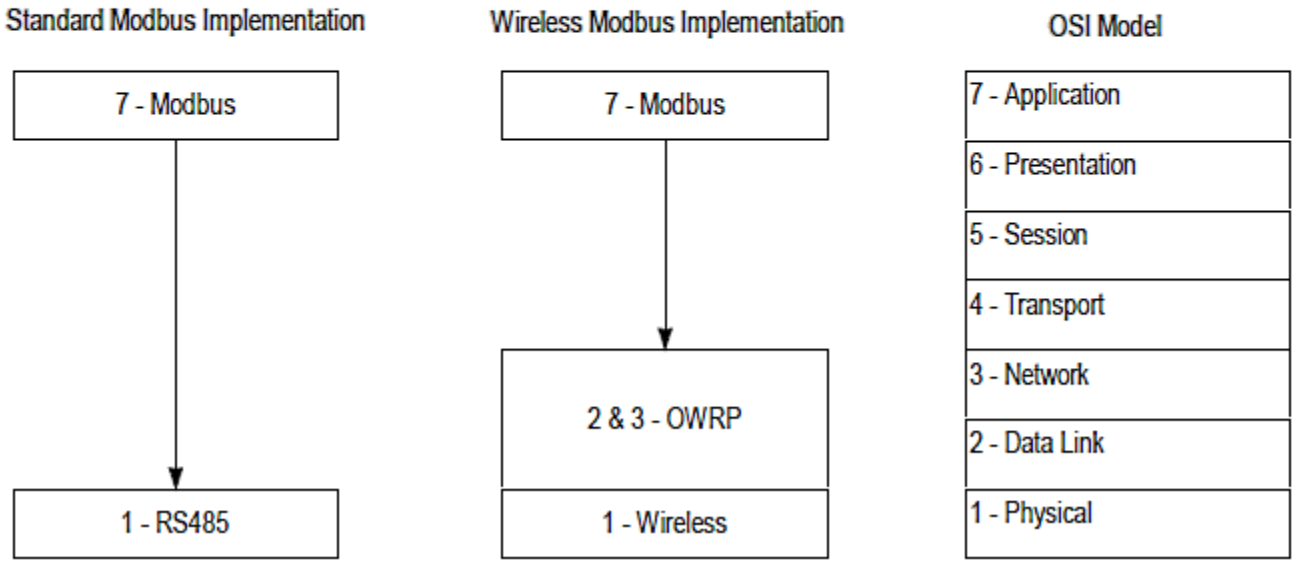
Agenda

- ModHopper features and functions
- Mesh functionality
  - Routing
  - Link quality and budgets
  - Interference
- Modbus addressing and issues
  - RS 485 node detection
  - Data routing
- Miscellaneous

ModHopper operational overview

- **ModHoppers and the OSI model**

Packet Formats: 26 Aug 2004

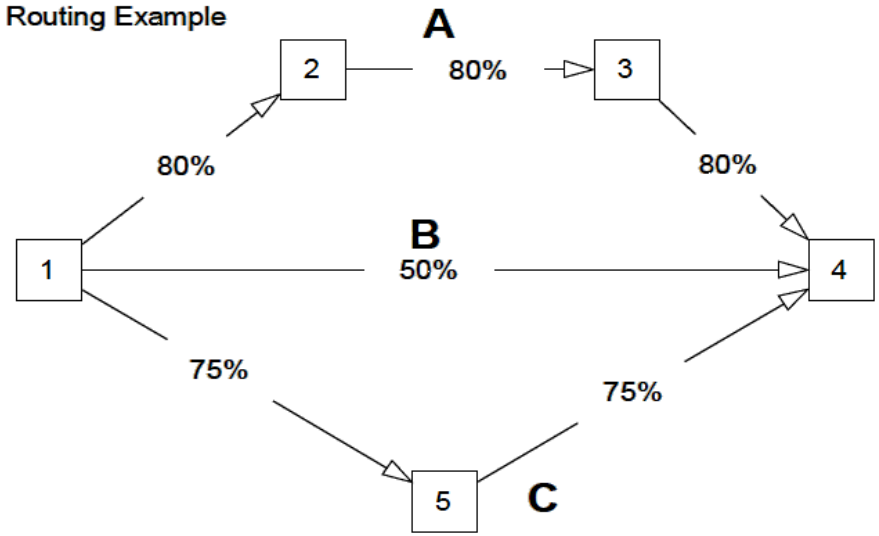


ModHopper Modbus functions

- MH routes modbus wirelessly
- Provides direct pass through for Modbus queries from Master to Slave
- Inspects CRC at end nodes
- Uses modbus registers for remote diagnostics

ModHopper mesh functions

- Organization of routes
  - Locate all peers on network
  - Evaluate each link for best delivery (hops and retry counts)
  - Find best known target for delivery
  - Minimize hops where possible:



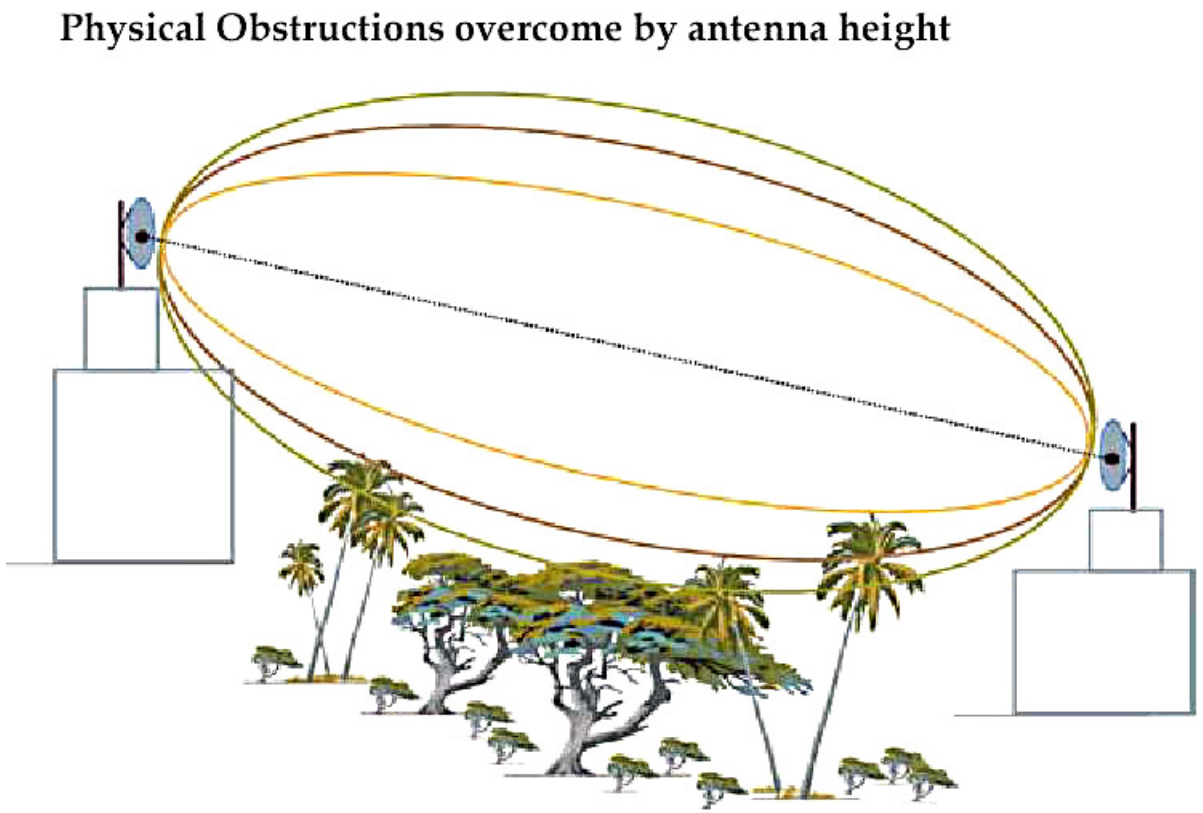
Link quality issues

- RSSI
- Loud vs Good
- dB is a log scale (+3 dB = 2x power)
  - 1 mW = 0 dBm
  - 10 mW = 10 dBm
  - 100 mW = 20 dBm
  - 1 W = 30 dBm

Link budget estimation

Fresnel zone

(Example: 1000 ft between radios requires 16 ft diameter wide path at center)



Link budget estimation (2)

- **Indoor signal loss:**
  - **– Link budget:**
    - Transmit: 20 dB and Receive -107 dB; total 127 dB
    - Less receiver sensitivity is allowed if there are other sources of RF
    - 100 dB to 120 dB is generally a good working value
- **– Free space signal loss (indoors):**

Distance	900 Mhz free space loss
10 meters	72.5 dB
100 meters	92.5 dB
1000 meters	112.5 dB

Link budget estimation (3)

- **Material attenuation examples:**

Glass 0.25” (6mm)	0.8 dB
Glass 0.5” (13mm)	2 dB
Lumber 3” (76mm)	2.8 dB
Brick 3.5” (89mm)	3.5 dB
Brick 7” (178mm)	5 dB
Brick 10.5” (267mm)	7 dB
Concrete 4” (102mm)	12 dB
Masonry Block 8” (203mm)	12 dB
Brick faced concrete 7.5 “ (192mm)	14dB
Masonry Block 16” (406mm)	17dB
Concrete 8” (203mm)	23dB
Reinforced Concrete 3.5” (203mm)	27dB
Masonry Block 24” (610mm)	28dB
Concrete 12” (305mm)	35dB

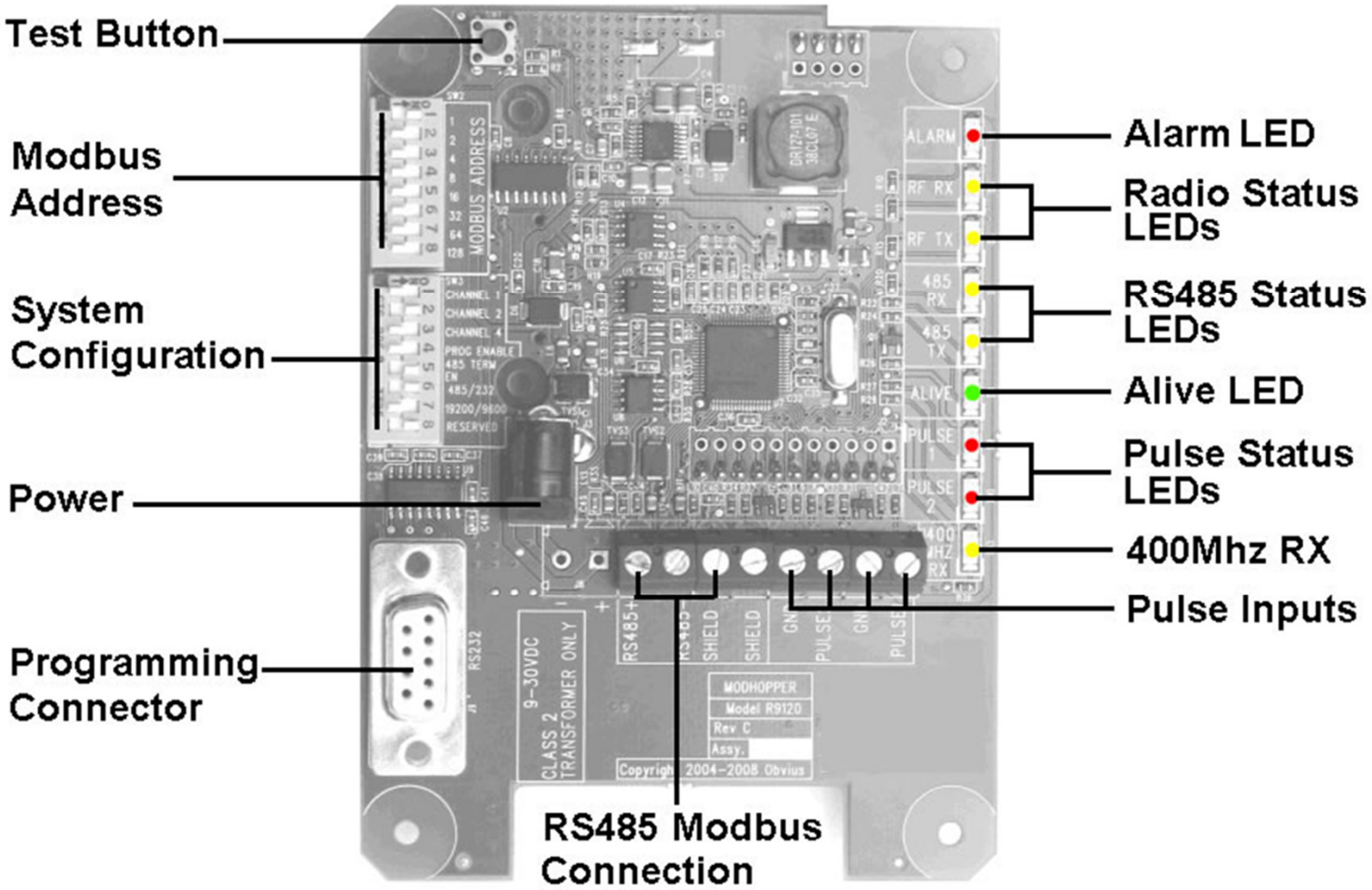
Other mesh issues

- Sustained signal quality over time
- Options for dealing with interference
- Acknowledge/resend per hop

Modbus addressing

- RS 485 node detection
- Importance of unique addressing
- Routing of data to known destination
- No broadcast

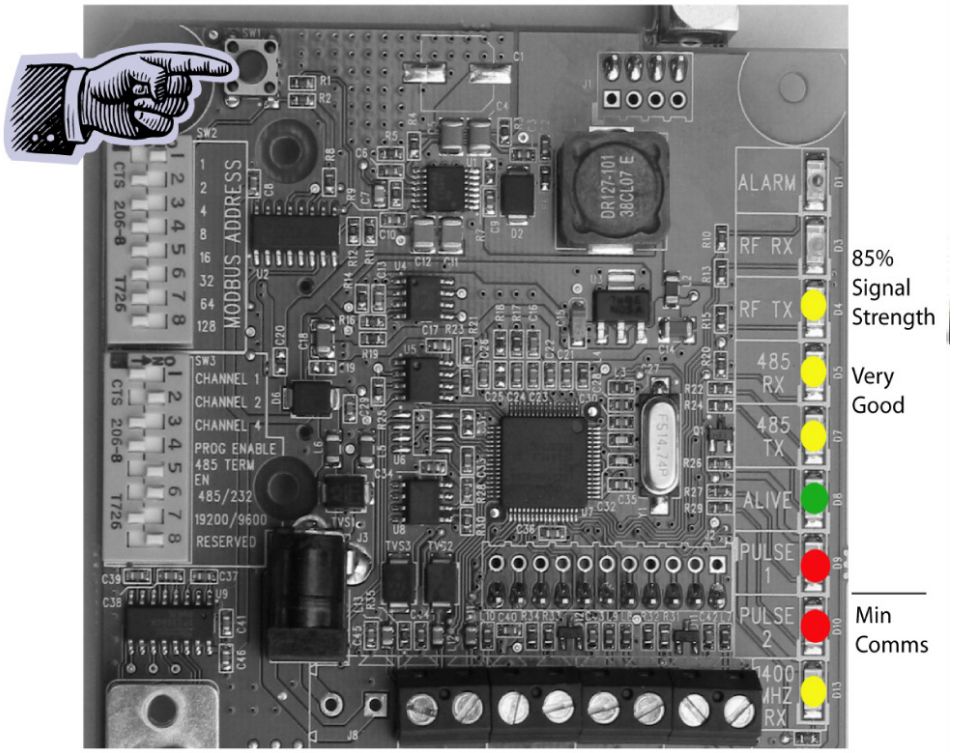
Annotated Internal View



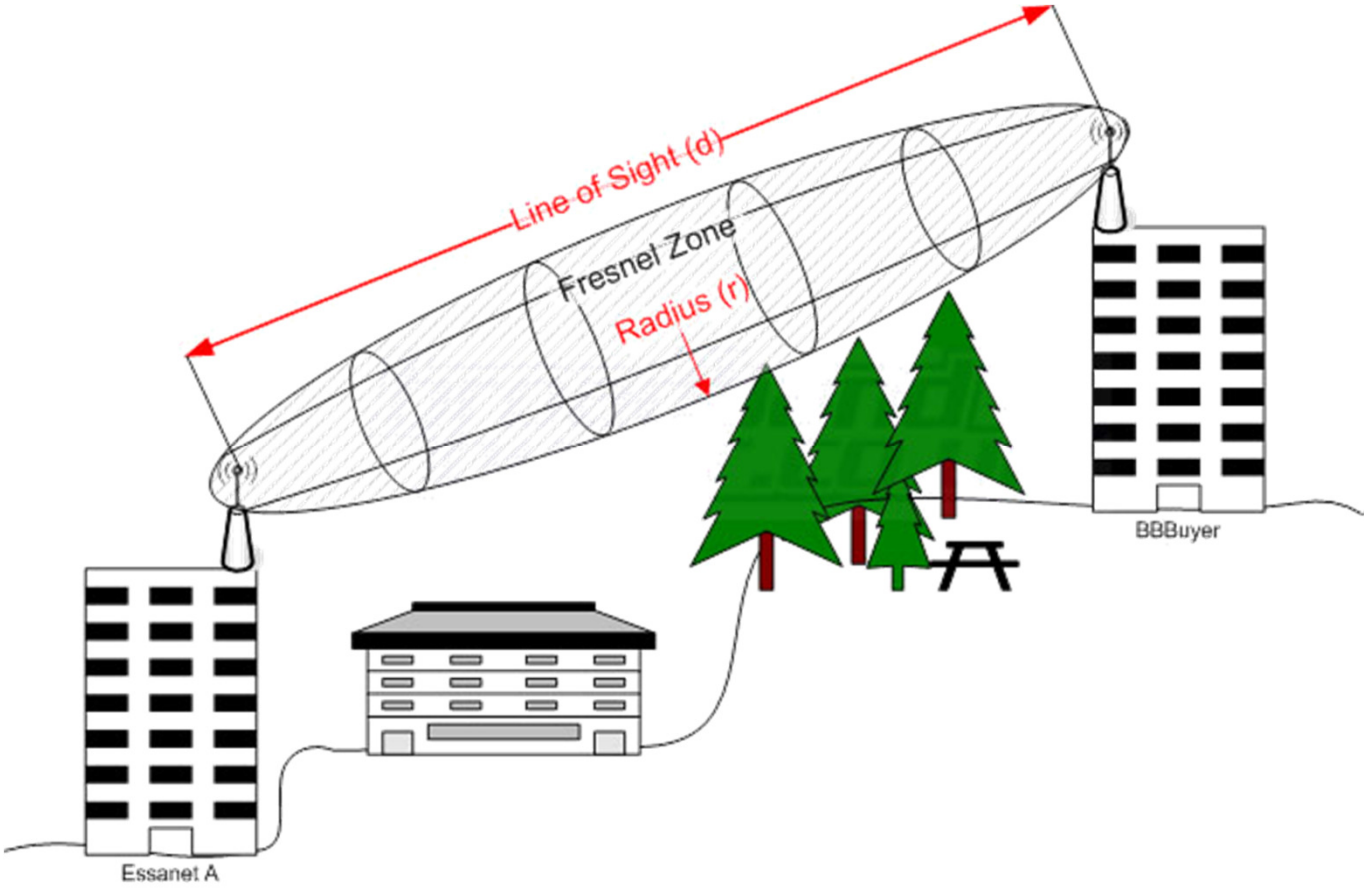
Site Surveys

The onboard rangefinder will show you the signal strength to the closest ModHopper in the network. Only two ModHoppers and power are needed for site surveys.

Onboard RF Signal Testing



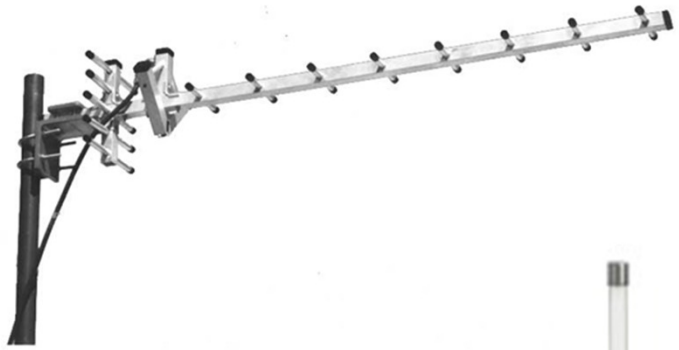
Elevation is Your Friend



Antenna Options & Cable Accessories

Improve ModHopper Signal Strength

- Yagi Base Station Antennas (picture right)
- Dipole Directional Antennas



Used for Outdoor Applications

Cables

- LMR 195 and above cables are used to connect high-gain antennas
- Available in 3ft -20ft lengths.
- Extension cables are also available for placing antennas on the outside of a metal enclosure, although a composite enclosure is generally recommended