So, You Want to Get On the Microwave Bands?

- What Antenna?
- How do I Decide?
- Build or Buy?
- Cost?
- How Hard to Install?
- How Good?
- How Reliable?
Assumptions

- Basic Fixed Tropo Station
- Up to 10 GHz
- Not Considered:
  - Preamps, RF Switching
  - Feedlines
  - Mounting, Rotating
  - Omnis
Decide on a Band

- This Determines Many Tradeoff Choices
- Start Low (say 2304)
- Start Simple
- Principles:
  - KISS (simple), KICK, KIDD (doable)
  - Low Cost
  - Easy
Basic Microwave Antenna Types

- Yagis
  - Standard Linear
  - Loop/Quad
- Parabolic Reflectors (Dishes)
- Phased Arrays
- Horns
Basic Tradeoffs

- Antenna Type
- Gain, Beamwidth, Size
- Cost, Complexity
- Buy or Build
Implementation Trades

- Dish Feeds (Many Choices)
- Single vs Multiple Bands
- Height vs Wind Load
- Personal Confidence
902, 1296 Bands

- Dominated by Loop Yagis
- Some Dishes (but need to be large)
- Similar to Other UHF Systems
2304, 3456 Bands

- Both Dishes and Yagis
- Directive System Kits
- WiFi Dishes can be cheaper
- Coax Feedlines
5, 10 GHz Bands

- Mostly Dishes
- Horns for Portability (and Feeds)
- Some WiFi Antennas on 5 GHz (not 10)
- More Antenna Gain Mitigates Low Power
- Smaller Beamwidths Require Good Pointing Accuracy
- Potential dB Losses Increased (Gotchas)
Loop Yagis

- Originally the Loop-Quad Design
- By G3VJL in 1974
- Now Optimized Designs
- Low Wind Loading
- Easy Mounting, Feeding
- Higher Cost
- Kits Avail from Directive Systems
21 Element Loop Yagi Example

Frequency range: 2.25 to 2.35 GHz
Gain: 17.5 dBi
Number of elements: 21
3 dB Beamwidth: 24º
Boom length: 36 inches
Boom diameter: 0.5 inches
F/B ratio: >20 dB
Maximum Power: 400 W average
Weight: (assembled) 2 pounds assembled
## Loop Yagi Cost/Perf Comparison (Directive Systems)

### 13cm (2300 – 2350 MHz)

Click on any bold model number below to view or download a PDF manual.

<table>
<thead>
<tr>
<th>Model</th>
<th>Elements</th>
<th>Boom Length (IN)</th>
<th>GHz Range</th>
<th>Gain (dBI)</th>
<th>Mount Position</th>
<th>Polariz.</th>
<th>Description</th>
<th>Price</th>
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<td>36</td>
<td>2.25-2.35</td>
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<td>144</td>
<td>2.28-2.35</td>
<td>23.4</td>
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<td>DSE13MOD</td>
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<td>1345/1352LY Mod kit for pre 1995 versions - improved performance</td>
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Parabolic Dish Reflectors

- Types:
  - Prime Focus (0.3 – 0.5 f/D)
  - Offset Fed (TV Dish) (0.5 – 0.8+ f/D)
  - Wire Grid
  - Mesh

- Design Geometry
  - Graphic
  - F/D IMPORTANT!
  - Gain vs Diameter
  - Gain vs Frequency
Dish Efficiency Factors

- Illumination Loss
- Surface Error
- Phase Errors
- Spillover
- Feed Mismatch/VSWR
- Feed Blockage
- Pointing Error
- Feed Mechanical
W1GHz Example Analysis
Dish Geometry

Fig 136. Basic geometry of a paraboloid

\[ y^2 = 4fx \]

\[ y^2 = 4Dx\left(\frac{f}{D}\right) \]

where \[ f = \frac{D^2}{16c} \]
Dish Illumination Issues

Figure 4-5. Typical vs. Desired Dish Illumination
NIBWT 1994
Not So Good Example
Great Feed Example

Large W2IMU dual-mode feed, 1.88λ diameter, by NEC2

Figure 6.5-2

Feed Radiation Pattern

Dish diameter = 19 λ  Feed diameter = 1.88 λ

Rotation Angle around specified
Phase Center at 0 λ beyond aperture

MAX Possible Efficiency with Phase error
MAX Efficiency without phase error
MAX Efficiency - published data
REAL WORLD at least 15% lower
AFTER LOSSES:
Illumination
Spillover

Parabolic Dish Efficiency %

Parabolic Dish f/D

W1GHZ 1998
Gain vs Diameter

**Figure 8.** Gain of a Typical Dish at 9 GHz (With Losses)
Dish Gain vs Frequency

Figure 7. Gain of a Typical 6 Foot Dish Antenna (With Losses)
Fig 4.24. Relationship between the size of a dish, its gain and bandwidth as a function of frequency. An overall efficiency of 50 per cent is assumed. As an example, a dish 2.5ft in diameter at 2,305MHz will have a gain of 22dB and a beamwidth of about 22°.
Dish Recommendations, Common Usage

- Long Loopers for 902, 1296
  - Big Dishes have BIG Wind Loads
- Loop Yagi or 2 – 4 ft Dishes for 2304, 3456
  - Big Dish Wind Loading
  - Pointing Becoming Difficult
- 18 in to 36 in Dishes for 5.7, 10 GHz
  - Wind Loading
  - Big Dish Pointing Muy Difficile!
Offset Fed (TV) Dishes

- Better Efficiency for Small Dish –
- No Feed Blockage
- Higher G/T due to Feed Position
- Typical Subtended f/D approx 0.7
- Free
Offset Dish Geometry

Geometry of Offset Parabolic Dish Antenna
Figure 5-1

Aperture projected on boresight

Focus

Reflector outline
Find the Focal Point
Horn Feed Template for TV Dish

Template for 11.49 dBi horn for 10368 MHz

Figure 5-6. Feedhorn Template for RCA DSS Offset Dish (WR-90 Waveguide)
Dish Feeds

- Basic Types:
  - Horn
  - Dipole with Splash Reflector
  - Loop plus Splash
  - Reverse Feed (Shepherd's Crook)
Horn Antennas

- Often Used as Feeds (5+ GHz)
- Simple Design
- Can Be Fabricated
- Precision Gain, Pattern
- Efficient
- See W1GHz Dish Feed Pages
Pyramidal Horn Design
Circular Horns

- Similar Design Approaches
- Simple Horn 5 GHz
- W5LUA Dual Band 5G, 10G Feed
- Coffee Can Feeds for Lower Bands
- More Exotic Feeds for EME (CP)
Wire Feeds

23 & 13cm Dish feed
Phased Arrays

- Types
  - Log Periodic
  - Stacked Yagis
  - Slot Arrays
  - Others

- Beginners: Purchase LP from WA5VJB
- Don't Stack; Use Longer Yagi
- Slots often for Omnis
Book References

- RSGB Microwave Handbook (Loop Yagi, Dish, Horn Design)
- ARRL Antenna Manual Ch. 18 (1296 LY)
- W1GHz Online Microwave Antenna Book (w1ghz.org)
- Antennas, J. D. Kraus
- Conference Proceedings
Vendors

- Directive Systems
- RF Hamdesign (Holland)
- ProCom (SSB Electronic 10 GHz)
- Ebay (who knows)
- Kent Britain WA5VJB
- Various WiFi Antenna Vendors, ex:
  - L-com
  - Rowe Wireless
Summary

- Many Antenna Choices (What Fun!)
- Mainly Dishes vs Loop Yagis for Basic Station
- Can Be Cheap and Can Be Easy
- Fun to Tinker, Experiment —
  - Still Room for Creativity!
  - Or Climb the Highest Mountain
Recommendations

- Try Not to Do Too Much
- Add a Band at a Time
- Then Increase Antenna Size, Complexity
- There is NO PERFECT ANTENNA !!
More Examples

Septum Dish Feed 2304 MHz

DUAL NODE CIRCULAR DISH FEED 1296 MHz (Septum Dish Feed)
Example: Wire Grid, 3456 MHz

3.5 GHz 27 dBi Lightweight Die-cast Grid Antenna - N-Female Connector

L-com Item # HG3527EG

- List Price: $103.95
- Your Price 1-9: $103.95
- Quantity 10-24: $99.79
- Quantity 25-99: $95.63
- Quantity 100+: Call Us

Availability: In Stock
Available for Same Day Shipping

Quantity 1
ADD TO CART
Email This Page
Example: 36 inch Dish Radome

900mm Diameter Radome Cover for Parabolic Dish Antennas

L-com Item # HGR-09

List Price $74.95
Your Price 1-9 $74.95
10-24 $73.45
25-99 $71.95
100+ Call Us

Availability: In Stock
Available for Same Day Shipping

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