Antenna Types and Optimal Frequency Ranges for 500kHz to 1.7GHz Spectrum

This comprehensive technical reference catalogs antenna technologies across the 500kHz to 1.7GHz frequency spectrum, providing optimal operating ranges, performance characteristics, and application guidelines for each antenna type.

The research reveals that antenna selection fundamentally depends on three primary factors: operating frequency, required radiation pattern, and physical constraints. Lower frequencies demand larger antenna structures due to wavelength scaling, while higher frequencies enable more compact designs with higher gain potential. Wikipedia Each antenna technology represents an engineering compromise between size, gain, bandwidth, and cost.

Comprehensive Antenna Technology Matrix

Low Frequency Antennas (500kHz - 30MHz)

Antenna Type	Optimal Frequency Range	Gain	Radiation Pattern	Typical Applications	Advantag
Vertical Monopole (Mast Radiator)	535kHz - 1.7MHz	5.19 dBi (λ/4) 8 dBi (5/8λ)	Omnidirectional azimuth Maximum radiation horizontal Null at zenith	AM broadcast stations Navigation beacons	**Advantag** construct coverage, wave propagati Requires ground sy height lim vulnerabil
T-Antenna	500kHz - 1.5MHz	3-6 dB over equivalent vertical	Omnidirectional Vertically polarized	Early AM broadcast Amateur radio Longwave transmission	**Advantag** than shor efficient f antennas Requires structures (<100Hz), matching
Umbrella Antenna	10kHz - 1.7MHz (VLF/LF/MF) HandWiki	~3.52 dBi HandWiki	Omnidirectional Excellent ground wave HandWiki	VLF military communications LF/MF broadcasting Submarine communications HandWiki	**Advantag** electricall single ma power ca **Disad** narrow ba at wire en
HF Dipoles	3-30MHz	2.15 dBi (λ/2) Wikipedia 5 dBd (λ)	Broadside maximum Figure-8 pattern Wikipedia Omnidirectional if vertical	Amateur radio Shortwave broadcasting Point-to-point HF	**Advantag** construct pattern, e matching Fixed freq significan dependen
HF Verticals	3-30MHz	5.19 dBi (λ/4) 8 dBi	Omnidirectional azimuth Low angle	Amateur radio DX Mobile	**Advantag** coverage,

Antenna Type	Optimal Frequency Range	Gain	Radiation Pattern	Typical Applications	Advantag
		(5/8λ)	radiation Null overhead	HF Maritime communications	compact footprint< Extensive required, r nearby ob
Long Wire/End-Fed	1.8-30MHz	-3 to +6 dBi Varies with frequency	Non-resonant: Variable Multiple lobes at higher frequencies	Amateur radio SWL/emergency comms Portable operations	**Advantag** installatio operation efficient<l Pattern ur impedanc tuner
Rhombic	3-30MHz	6-8 dBd typical	Highly directional Fixed direction Narrow beamwidth	Point-to-point HF International broadcasting Military communications	**Advantag** non-critic power capability Enormous fixed dire efficiency

VHF Antennas (30-300MHz)

Antenna Type	Optimal Frequency Range	Gain	Radiation Pattern	Typical Applications
Circularly Polarized FM	87.5-108MHz Antennas +2	7-13 dBi	Circular polarization Omnidirectional or directional	FM broadcast stations<br FM
FM Broadcast Bays	88-108MHz Antennas +2	1-3 dBi/bay 5-15 dBi arrays	60-120° horizontal 30-60° vertical	Commercial FM broadcas
VHF Yagi	30-300MHz 144-148MHz typical Bander Amazon	6-13 dBi (3-11 elements)	Directional 30-60° beamwidth F/B: 15-25dB	Amateur radio Public safety Point-to-point
Collinear Arrays	30-300MHz	3-10 dBd 3dB/doubling Wikipedia Wikipedia	Omnidirectional horizontal Compressed vertical Wikipedia Wikipedia	Repeater sites Base stations Public safety Repeater Builder L3Harris
Ground Plane	30-300MHz	0 dBd (unity) 2-3 dBi RadioReference.com TIARA	Omnidirectional Low angle radiation	Mobile/base stations RFI Americas Marine
J-Pole	30-300MHz	2.1-2.6 dBi	Omnidirectional Slight asymmetry	Amateur radio Simple stations

Antenna Type	Optimal Frequency Range	Gain	Radiation Pattern	Typical Applications
Discone	25-300MHz typical Wikipedia +2	~2 dBi unity gain Wikipedia	Omnidirectional Low angle radiation	Scanner antennas Wid monitoring Electronics Not
Log-Periodic	3:1 to 10:1 bandwidth	6-10 dBi	Directional 60-90° beamwidth F/B: 15-25dB Wikipedia	EMC testing Surveillance<b comms The EMC Shop V

UHF Antennas (300MHz - 1.7GHz)

Antenna Type	Optimal Frequency Range	Gain	Radiation Pattern	Typical Applications
UHF Yagi	300-500MHz 400-470MHz 470-860MHz ResearchGate +2	9-20 dBi ResearchGate Wikipedia	Directional 75° beamwidth F/B: 20dB Antennaskit	Point-to-point TV reception Amateur UHF ResearchGate Tesswave
Panel/Sector	698-960MHz 470-700MHz antennas +2	8.7-17.8 dBd antennas +2	60°, 90°, 120° sectors Adjustable tilt antennas +2	Cellular base stations Public safety FirstNet antennas Antennas
Patch Antennas	617MHz-2.7GHz POYNTING	6-10 dBi	Hemispherical Broad pattern MobileMark	Mobile devices WiFi/cellular IoT devices ResearchGate MobileMark
Helical	300-520MHz 400-900MHz TACO Antenna +3	9-13.5 dBic tacoantenna Wikipedia	Circular polarization 35-37° beamwidth TutorialsPoint Wikipedia	Satellite comms GPS systems Wireless audio TutorialsPoint Wikipedia
Slot Antennas	300MHz-24GHz Wikipedia +2	3dB/doubling	Omnidirectional Similar to dipole Wikipedia Wikipedia	TV broadcasting Radar systems Base stations Wikipedia Wikipedia
Corner Reflector	335-512MHz UHF bands Wikipedia +2	10-15 dB Wikipedia Wikipedia	Directional Moderate beamwidth F/B: 20-30dB Wikipedia	Point-to-point TV reception Public safety Wikipedia Wikipedia
Parabolic Dish	1-1.7GHz typical Wikipedia	15+ dBd TutorialsPoint Wikipedia	Very narrow beam Proportional to D/λ Wikipedia	Microwave links Satellite Radio astronomy Wikipedia Wikipedia

Antenna Type	Optimal Frequency Range	Gain	Radiation Pattern	Typical Applications
Collinear UHF	380-806MHz TutorialsPoint +2	3-15 dBd TutorialsPoint +2	360° horizontal 38° vertical typical Protel Antennas +2	Repeater sites Cellular towers Public safety L3Harris +2

Specialized and Wideband Antennas

Antenna Type	Optimal Frequency Range	Gain	Radiation Pattern	Typical Applications	Advant
Magnetic Loop	500kHz-14MHz	Low (negative dBi)	Bidirectional nulls Figure-8 pattern	AM reception Direction finding Low noise RX	**Advant** nulls, lo compa Very na efficier
Ferrite Loop	500kHz-1.7MHz Electronics Notes Cosmoferrites	Low but enhanced by μ	Bidirectional Sharp nulls Electronics Notes	AM radios Portable receivers Wikipedia Electronics Notes	**Advant** compa Wikipe **Di** frequer temper Electro
LPDA	10:1+ bandwidth	5.9-14.97 dBi Antennaexperts Wikipedia	Directional Consistent pattern Wikipedia	TV reception EMI testing Broadband comms Wikipedia	**Advant** wideba perforr **Di** for give
Spiral	30:1 bandwidth 1-18GHz typical	-8 to 0 dBiL	Circular polarization Broad pattern	Military aircraft GPS Direction finding	**Advant** circula Wikipe **Di** gain w
Beverage	500kHz-30MHz	-20 to -10 dBi	Unidirectional Very low angle	Longwave DX Shortwave listening	**Advant** signal Wikipe **Di** Requir negativ Wikipe
Rubber Duck	100-500MHz Wikipedia	Less than λ/4 whip Wikipedia	Omnidirectional High angle radiation Wikipedia	Handheld radios Portable devices Wikipedia	**Advant** damag Wikipe **Di**

Antenna Type	Optimal Frequency Range	Gain	Radiation Pattern	Typical Applications	Advan efficier Wikipe
Fractal	Multiband inherent	Varies with design	Application dependent	Cellular/5G IoT devices Multiband systems	**Advan** single Wikipe **Di** Compl benefit

Key Technical Specifications Summary

Impedance characteristics across the spectrum show standard values of 50Ω for most commercial/amateur applications and 75Ω for broadcast systems. Wikipedia Matching networks are critical for narrowband antennas, especially at lower frequencies where radiation resistance can be less than 1Ω. Kg3v Ham Radio Blog Practical Antennas

Polarization selection depends heavily on application: vertical polarization dominates mobile communications due to vehicle mounting constraints, while horizontal polarization is preferred for weak signal work due to lower noise. Tesswave Circular polarization serves satellite communications and applications requiring orientation independence. Wikipedia +3

Physical scaling with wavelength creates fundamental constraints: a quarter-wave vertical at 1MHz stands 234 feet tall, while the same electrical length at 1GHz measures just 3 inches. KB9VBR Antennas This 1000:1 size ratio drives dramatically different construction techniques and deployment strategies across the spectrum. Wikipedia

Efficiency factors vary significantly: AM broadcast verticals achieve 60-95% efficiency with proper ground systems, while electrically small antennas may operate below 10% efficiency. However, at lower frequencies where atmospheric noise dominates, antenna efficiency becomes less critical than pattern control and noise rejection. Wikipedia Wikipedia

Bandwidth characteristics range from the extremely narrow (umbrella antennas with <100Hz bandwidth) to ultra-wideband (spiral and discone antennas exceeding 10:1 frequency ratios). Wikipedia +3 Narrowband antennas generally offer higher gain and efficiency, while wideband designs sacrifice peak performance for frequency agility. Wikipedia

Environmental deployment considerations show urban environments favor lower-gain antennas with MIMO capability to combat multipath, while rural deployments benefit from high-gain directional antennas for extended coverage. (ResearchGate) Ground effects critically impact performance below 30MHz, (Wikipedia) (Wikipedia) while pattern distortion from nearby structures becomes dominant at VHF/UHF. (Wikipedia)

Conclusion

This comprehensive matrix reveals that optimal antenna selection requires balancing multiple competing factors: frequency coverage, gain requirements, physical constraints, and deployment environment. While no single antenna technology excels across all parameters, understanding each type's strengths enables informed selection for specific applications. The data demonstrates that antenna engineering remains fundamentally about managing trade-offs - there is no universal "best" antenna, only the most appropriate choice for each unique combination of requirements. (A.H. Systems +5)