Tech Bite #12: Antennas -- Gain, Polarization, and Types

The final Bite -- the antenna, where your signal leaves the radio for the world. The main types, and the words for how they perform.

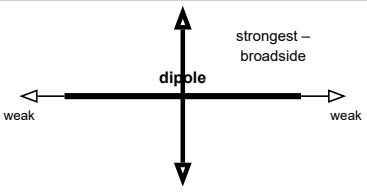
Group T9A · 11 pool questions · 5-10 minute presentation · Practice exams at eham.net/exams

The Big Picture

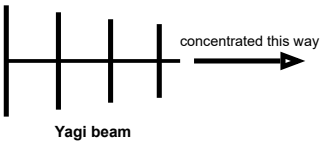
The last Bite, and a fitting one to end on: **antennas**. The antenna is where your signal actually leaves the radio for the world – and a good antenna does more for you than almost any other upgrade. This Bite covers the main antenna types and the words for how they perform.

How Antennas Radiate

The simplest real antenna is the **half-wave dipole**. It does **not** radiate equally in all directions – it sends its strongest signal **broadside**, out to the sides, at right angles to the wire. (T9A10) An antenna's **polarization** – which way the signal is oriented – is set by the **orientation of its electric field**. (T9A03)



A dipole radiates strongest broadside – out to the sides – and weakly off its ends.



A Yagi beam concentrates the signal in one direction, giving gain that way.

A **beam** antenna does the opposite of "everywhere": it **concentrates the signal in one direction**. (T9A01) The **Yagi** is the most common beam, and of the common antenna types it offers the **greatest gain**. (T9A06) **Gain** is the increase in signal strength in a chosen direction, compared to a reference antenna (T9A11) – a beam "gains" one direction by giving up the others.

Sizing an Antenna

An antenna's resonant frequency depends on its **length**. **Shorten** a dipole and its resonant frequency **goes up**. (T9A05) On 2 meters, a **19-inch vertical** is popular because it is a **resonant quarter-wave**. (T9A08) When an antenna must be physically short, **loading** electrically lengthens it – **inserting inductors** (coils) into the radiating elements. (T9A02)

Vertical and Mobile Antennas

A **5/8-wavelength whip** has **more gain** than a quarter-wave whip for VHF/UHF mobile work. (T9A09) Two cautions about handhelds: the short "rubber duck" antenna has **low efficiency** compared to a full quarter-wave (T9A04), and using a handheld **inside a vehicle** without an external antenna gives **reduced signal** – the vehicle's metal body shields it. (T9A07)

Mental Cheat Sheet

- A **dipole** radiates strongest **broadside**, weak off the ends.
- **Polarization** = the orientation of the antenna's **electric field**.
- A **beam** concentrates the signal one way; the **Yagi** has the most gain.
- **Gain** = stronger signal in a chosen direction vs a reference antenna.
- **Shortening** a dipole **raises** its resonant frequency.
- A **19-inch** 2 m vertical is a resonant **quarter-wave**.
- **Loading** = adding inductors to electrically lengthen a short antenna.
- A handheld's "rubber duck" has **low efficiency**.

Common Traps

- A dipole is strongest **broadside** – not off the ends, not all directions.
- Polarization is set by the **electric** field's orientation.
- **Shortening** raises resonant frequency; lengthening lowers it.
- The **Yagi** has the greatest gain of the listed antennas.
- **Loading** uses **inductors** – not resistors – to lengthen electrically.
- A handheld in a car (no outside antenna) is weak from **vehicle shielding**.

Takeaway: The antenna is where it all happens. A **dipole** radiates strongest **broadside**; a **beam** (the **Yagi**) concentrates the signal one way for **gain**. **Polarization** follows the electric field. **Shorter** means a **higher** resonant frequency, and **loading coils** electrically lengthen a short antenna. That is the twelfth and final Bite – with the Desserts, you have now seen the whole exam.

Bite 12 Question Bank (T9A)

T9A01. What is a beam antenna?
A. An antenna built from square aluminum beams
B. An omnidirectional antenna invented by Clarence Beam
C. An antenna that concentrates signals in one direction
D. An antenna that focuses the signal into two intense rays

T9A02. Which of the following describes a type of antenna loading?
A. Electrically lengthening by inserting inductors in radiating elements
B. Inserting a resistor in the radiating portion of the antenna to make it resonant
C. Inserting a supplementary element into the vertical antenna to better resist wind damage
D. Installing a spring in the base of a mobile vertical antenna to better resist wind damage

T9A03. How is the polarization of an antenna described?
A. By the shape of the driven element
B. By the orientation of the electric field
C. By the orientation of the magnetic field
D. By the direction of radiation

T9A04. What is a disadvantage of a handheld radio transceiver's short flexible antenna compared to a full-sized quarter-wave antenna?
A. It has low efficiency
B. It transmits only circularly polarized signals
C. It is more susceptible to receiver desensitization
D. It only works on analog signals, not digital ones

T9A05. Which of the following increases the resonant frequency of a dipole antenna?
A. Lengthening it
B. Inserting coils in series with radiating wires
C. Shortening it
D. Adding capacitive loading to the ends of the radiating wires

T9A06. Which of the following types of antennas offers the greatest gain?
A. 5/8 wave vertical
B. Isotropic
C. J pole
D. Yagi

T9A07. What is a potential drawback of using a handheld VHF transceiver inside a vehicle that lacks an externally mounted antenna?
A. Signal strength is reduced due to the shielding effect of the vehicle
B. The bandwidth of the antenna will decrease, increasing SWR
C. The SWR might decrease, decreasing the signal strength
D. The handheld will overheat due to reflected power in the vehicle

T9A08. Why is a 19-inch-long vertical antenna often used on 2 meters?
A. It has high gain
B. It is a resonant half-wave
C. It is a resonant quarter-wave
D. It has low RF radiation exposure

T9A09. What is an advantage of a 5/8-wavelength whip antenna for VHF or UHF mobile service compared to a 1/4-wave antenna?
A. It has more gain
B. It radiates at a higher angle
C. It has lower SWR
D. It has lower impedance

T9A10. In which direction does a half-wave dipole antenna radiate the strongest signal?
A. Equally in all directions
B. Off the ends of the antenna
C. In the direction of the feed line
D. Broadside to the antenna

T9A11. What is antenna gain?
A. The additional power that is added to the transmitter power
B. The additional power that is required in the antenna when transmitting on a higher frequency
C. The increase in signal strength in a specified direction compared to a reference antenna
D. The increase in impedance on receive or transmit compared to a reference antenna

Answer Key

T9A01: C	T9A02: A	T9A03: B	T9A04: A
T9A05: C	T9A06: D	T9A07: A	T9A08: C
T9A09: A	T9A10: D	T9A11: C	