The $\frac{1}{2}$ Dipole

* The dipole with length $l = \frac{\lambda}{2}$ is very popular because $2l \approx 75 \; \Omega$ (specifically 73 $\Omega$).

* The directivity $D_0$ of a $\frac{1}{2}$ dipole is $D_0 = 1.643$

$\Rightarrow$ Not very large! Note the directivity of an isotropic radiator is 1.0!

* The effective Aperture of a $\frac{1}{2}$ dipole is:

$$A_{em} = \frac{\lambda^2}{4\pi} \quad D_0 = \frac{\lambda^2}{4\pi} \left( 1.643 \right)$$

$$= 0.13 \; \lambda^2$$

Note as $\lambda$ gets bigger (if is smaller) the length $l$ of a $\frac{1}{2}$ dipole increases ($l = \frac{\lambda}{2}$).
and the effective aperture $A_{em}$ gets bigger!

$\Rightarrow$ A physically larger antenna typically results in larger $A_{em}$.

**Q:** What other reasons are there for selecting a dipole??

**A:** It's lightweight and has low wind load.

**Q:** So a dipole has no problems??

**A:** No! The main problem with a $\frac{\lambda}{2}$ dipole is that an antenna length $l$ will be a half wavelength at one frequency only $f$

For example, a dipole with length $l=1m$ is a half wavelength at frequency:

$$l = \frac{\lambda}{2} = \frac{c}{2f} \Rightarrow f = \frac{c}{2l} = 150 MHZ$$
In other words the dipole length \( l = 1 \) m is a half-wave \( (\lambda_e = l) \) dipole for a signal at \( f = 150 \text{ MHz} \) ONLY!

\[\Rightarrow\] Thus, the impedance of the dipole is \( Z_0 = 75 + 70 \ j \ \Omega \) only at one frequency.

As we move from the "resonant" frequency, the antenna impedance will become more reactive - the antenna will no longer be matched.

A dipole is a narrow-band antenna!