Antennas

Håvard Austad

Agenda

- About me
- What is an antenna?
- How does it work?
- Different kinds of antennas
- Antenna gain

About me

- Håvard Austad
- Bachelor of engineering; Communications systems
- Bergen University Collage
- Not an antenna expert
- But learning…¨
- Works at ATEA as network consultant/trainee

What is an antenna?

- Electrical conductor for radiating or collecting electromagnetic energy
- Same characteristics while sending or reciving
- Gains the signal due to frequency and area

How does it work

- Antenna puts up an electric field based on a current/signal

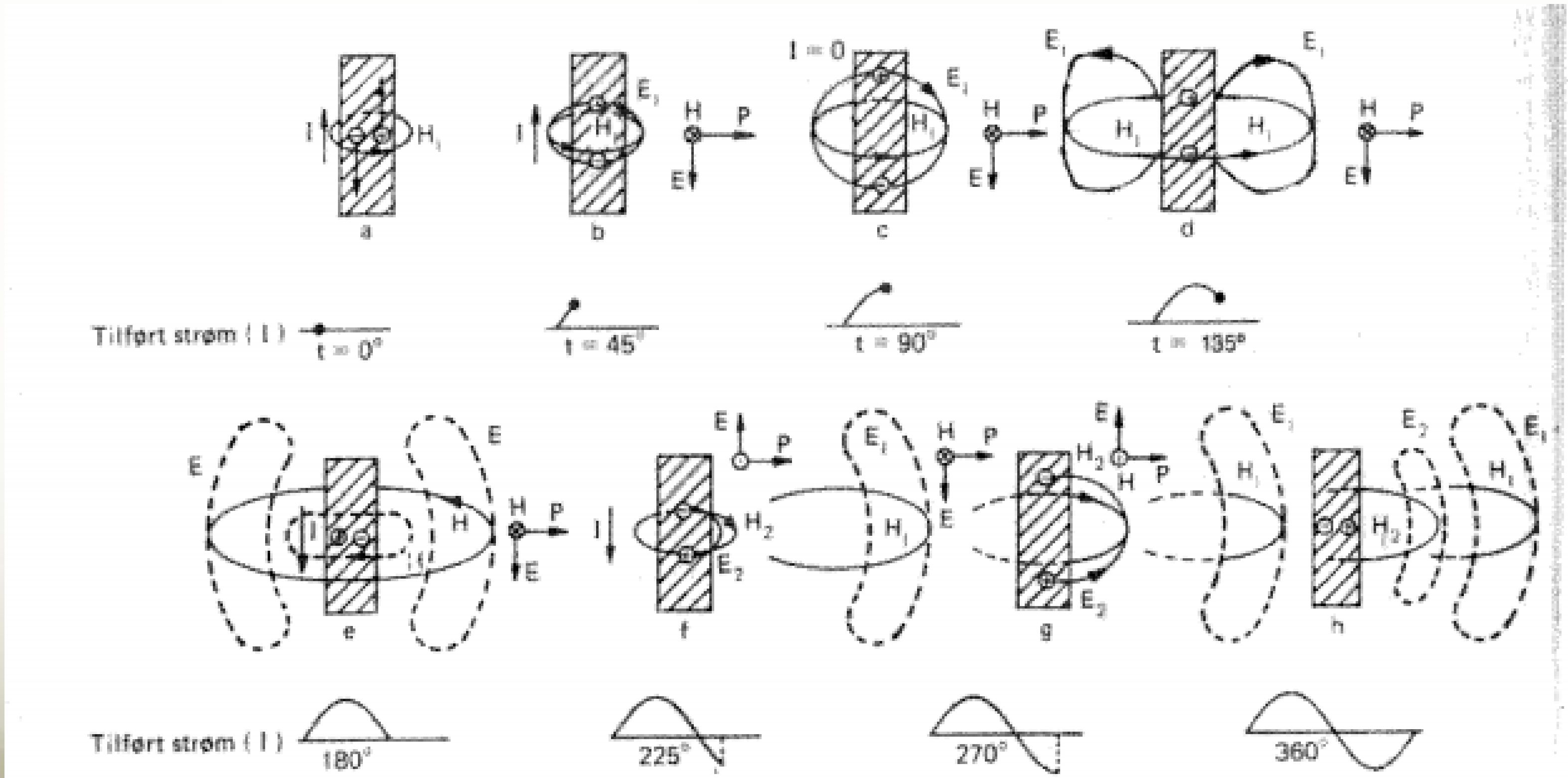
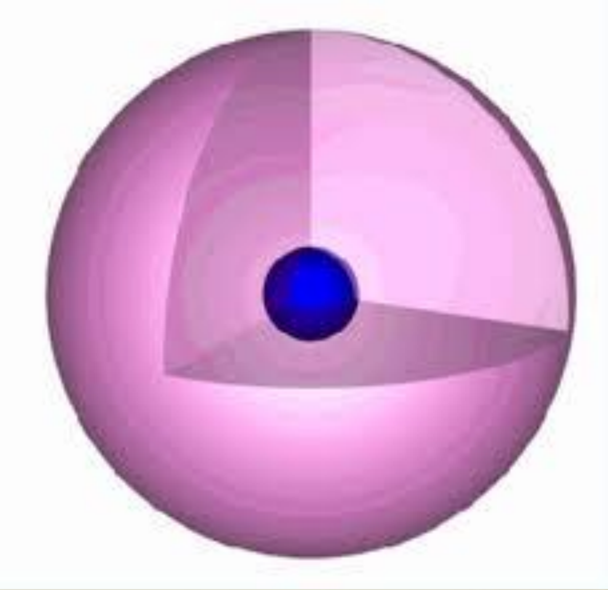


Fig. 4.3. Modell for elektromagnetisk bølgeutbredelse

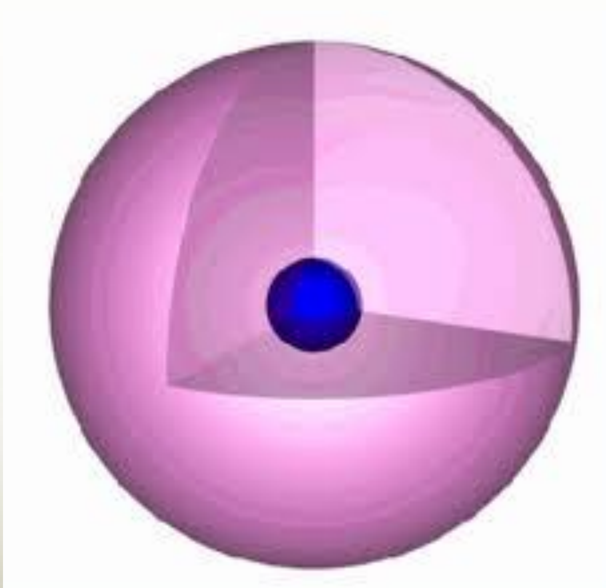
Isotropic antenna

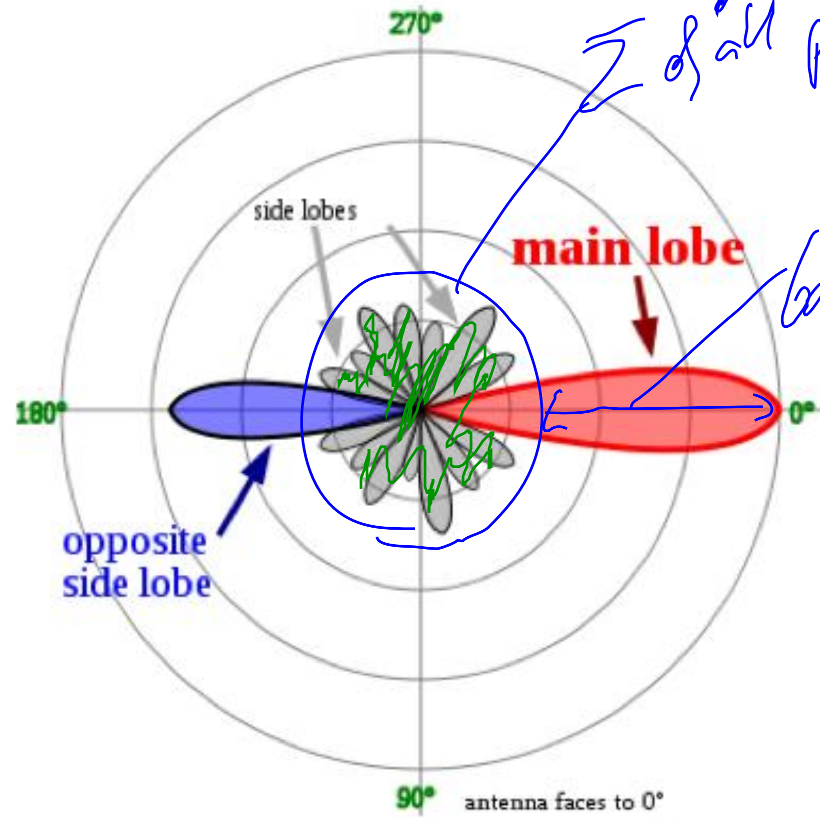
- Theoretical reference antenna (ideal)
- Uniform radiation
- 0db Gain



Radiation pattern

- Isotropic antenna = uniform
- Directional antennas

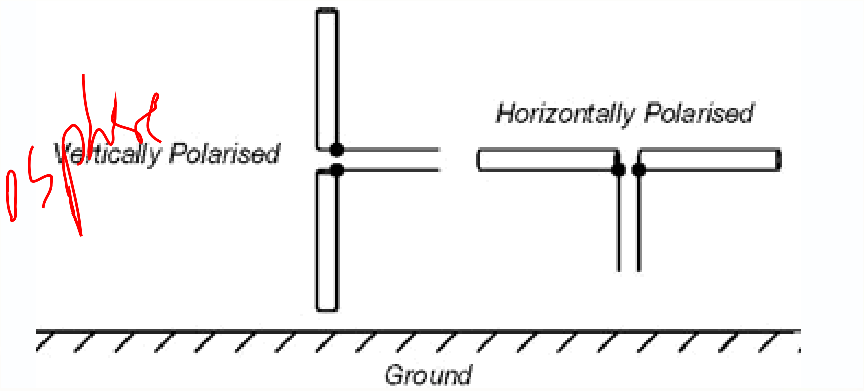


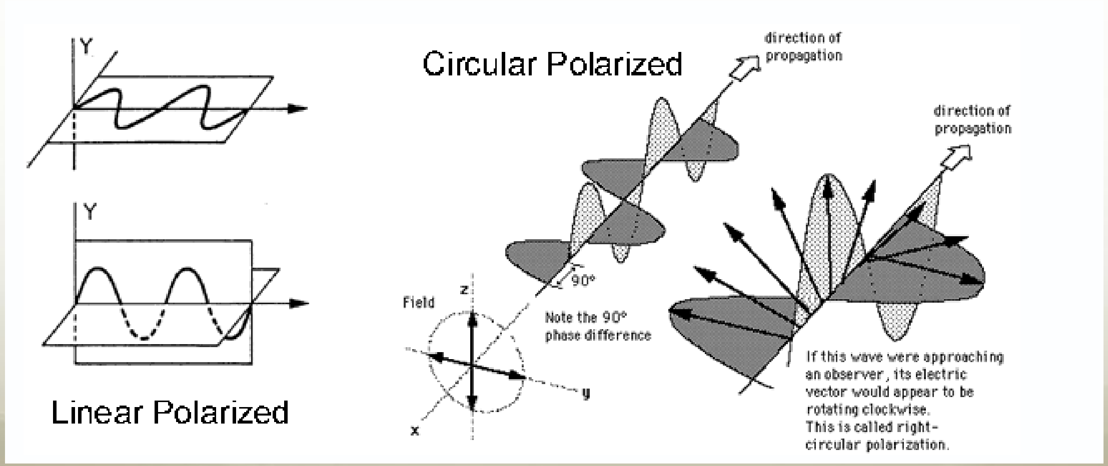


Polarization

- The antenna can transmit in different polarizations
- Horizontally
- Vertically
- Circular — Space

atmosphere





Radiation Diagram

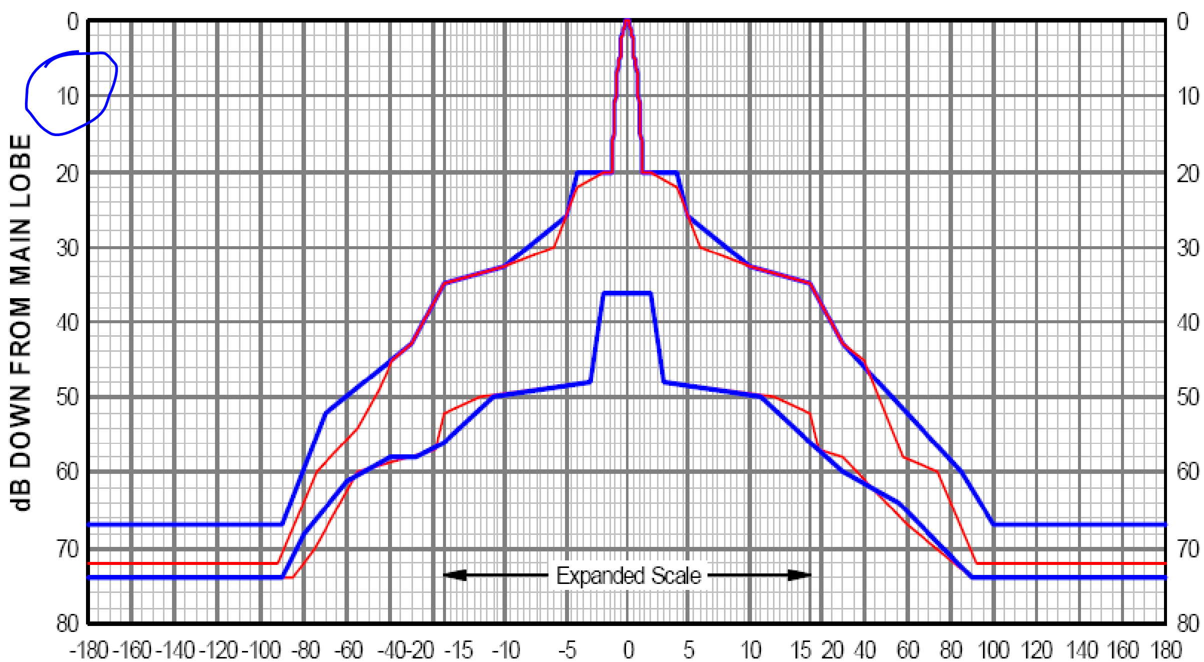
$G \sim \left(\frac{l}{\lambda}\right)^2$

Antenna Type:	High XPD antennas		
Frequency:	17.00 to 19.700 GHz	Gain at mid band:	44.4 dBi
Diameter:	1.2 m (4 ft)	3 dB beamwidth:	1.0 degrees
Antenna Code:	AN-HSX4-180	VSWR:	≤ 1.14
Polarisation:	Dual		

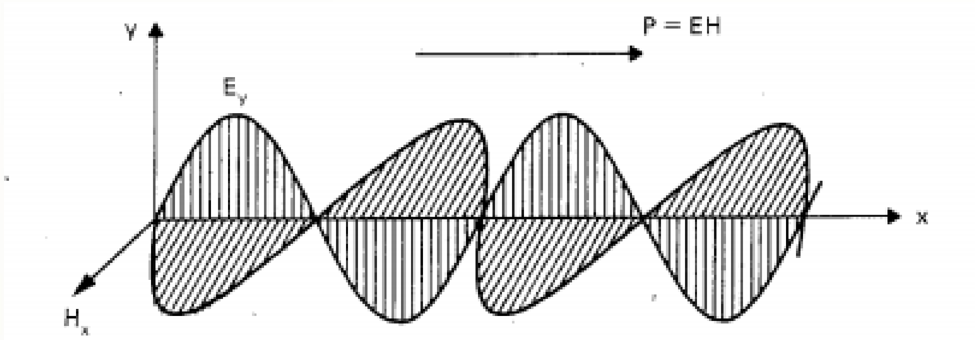
$\theta_{3dB} \sim \frac{\lambda}{l}$

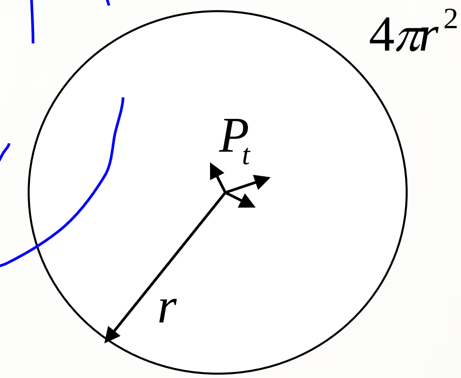
Regulatory Compliances

FCC Part 101	ETSI Class	Horisontal polarised antenna	**HH, HV**
Cat A	R2 C2	Vertical polarised antenna	VV, VH



Electric field





$$E = \frac{\sqrt{30 P_t}}{r}$$

$$P_t = EH = E \times \frac{E}{Z_0} = \frac{E^2}{120\pi}$$

$$P_m = \frac{P}{A} = \frac{P_t}{4\pi r^2}$$

Free Space Impedance

$$Z_0 = \sqrt{\frac{\mu_0}{\varepsilon_0}} = 120\pi = 377\Omega$$

$$\mu_0 = 4\pi \cdot 10^{-7} \,(\textit{magnetic const.})$$

$$\varepsilon_0 = 8.854187.... \cdot 10^{-12} \,(\textit{electric const.})$$

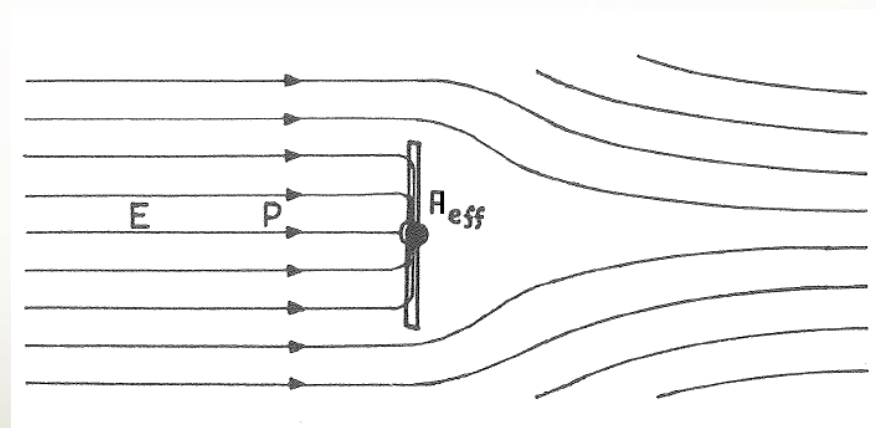
Effective area

- Isotropic antenna

$$A_{effiso} = \frac{l^2}{4p}$$

- Received power

$$P_r = \frac{P_S G_S}{4pr^2} A_{eff}$$



Area and gain

$$G = \frac{4\pi}{\lambda^2} A_{eff}$$

- Microwave antennas

$$A = \pi \left(\frac{D}{2}\right)^2 \quad \textit{aperture efficiency} \quad \eta = 0.55 \quad A_{eff} = \eta A$$

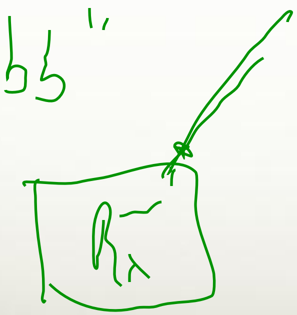
$$G = \frac{4\pi}{\lambda^2} A_{eff} = 0.55 \left(\frac{\pi D}{\lambda}\right)^2 \qquad G \approx 10\log\left(\eta \times A \times \frac{4\pi}{\lambda^2}\right)[dBi]$$

$$G \approx 17.8 + 20\log\left(D \times f\right) dBi \qquad ASSUMING\ \eta = 0.55$$

Monopole

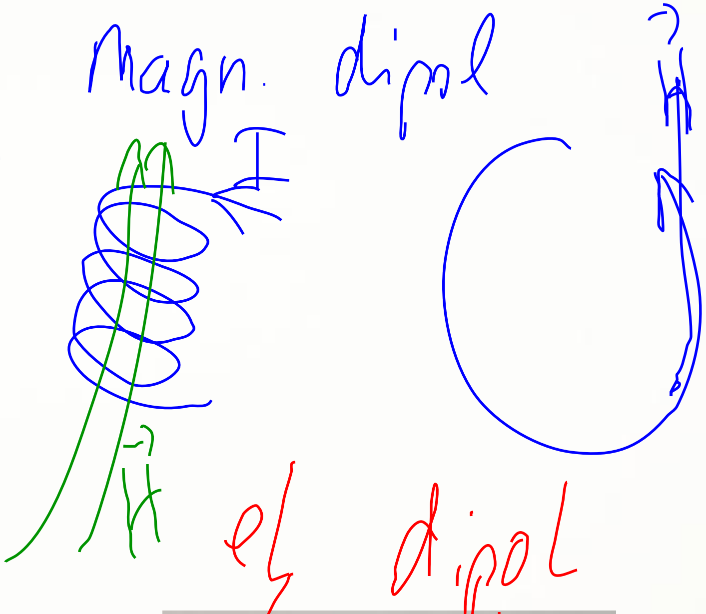
- One pole
- Need a horizontally ground-plane
- Quarter-wave
- Half-wave

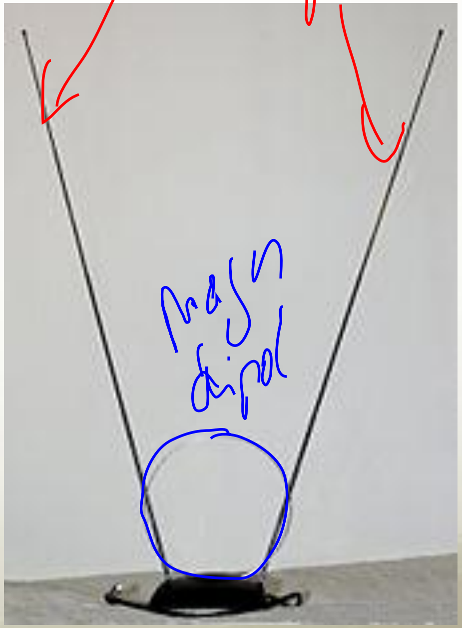
- $Q \sim \left(\frac{\ell}{\lambda}\right)^2$
- input impedance
- "stubb"



Di-pole

- Two poles
- Makes filed between the poles



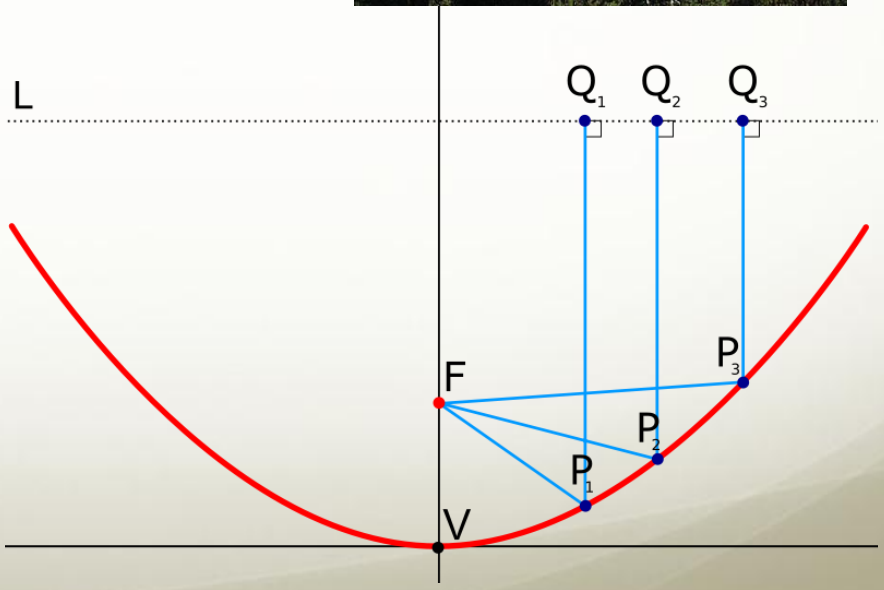


$\theta \sim \frac{\lambda}{\ell}$

Parabolic

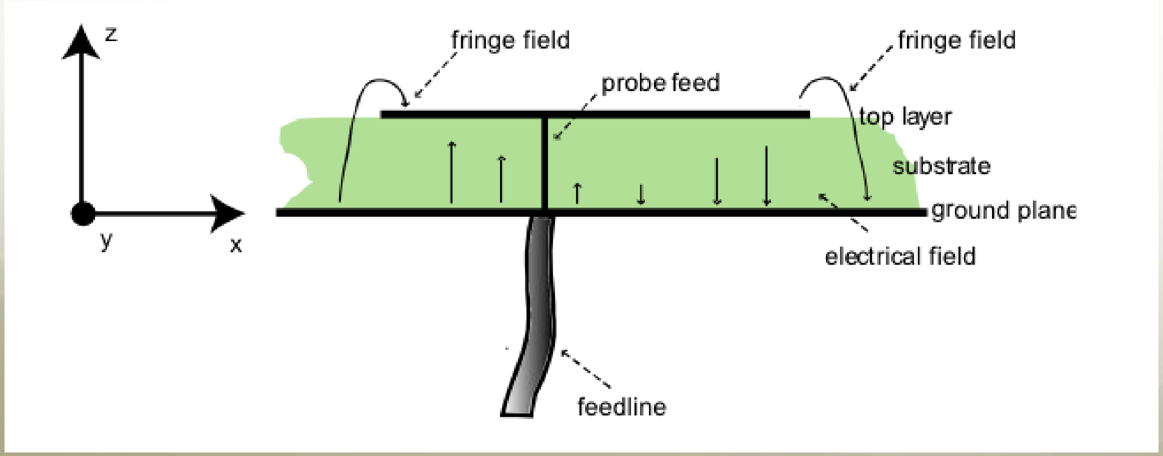
Radar

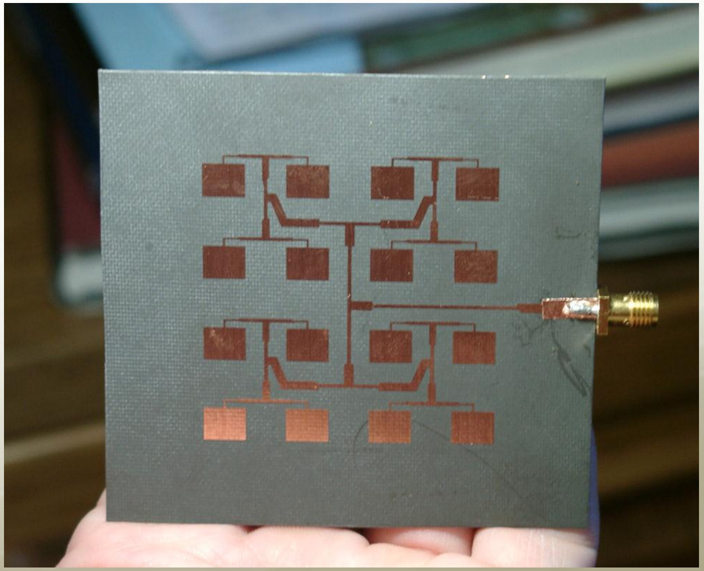
- Parabolic reflector
- Feed antenna
- Disc-shaped or non-disc-shaped



Patch antennas

- Also known as microstrip antenna
- Metal “sheet” (patch) placed over a ground-plane
- Isolated by a dielectric materia (PCB)
- Inexpensive to produce/design





Wireless is the new wire!

- Want to transmit? You need a antenna!

- Thank you!