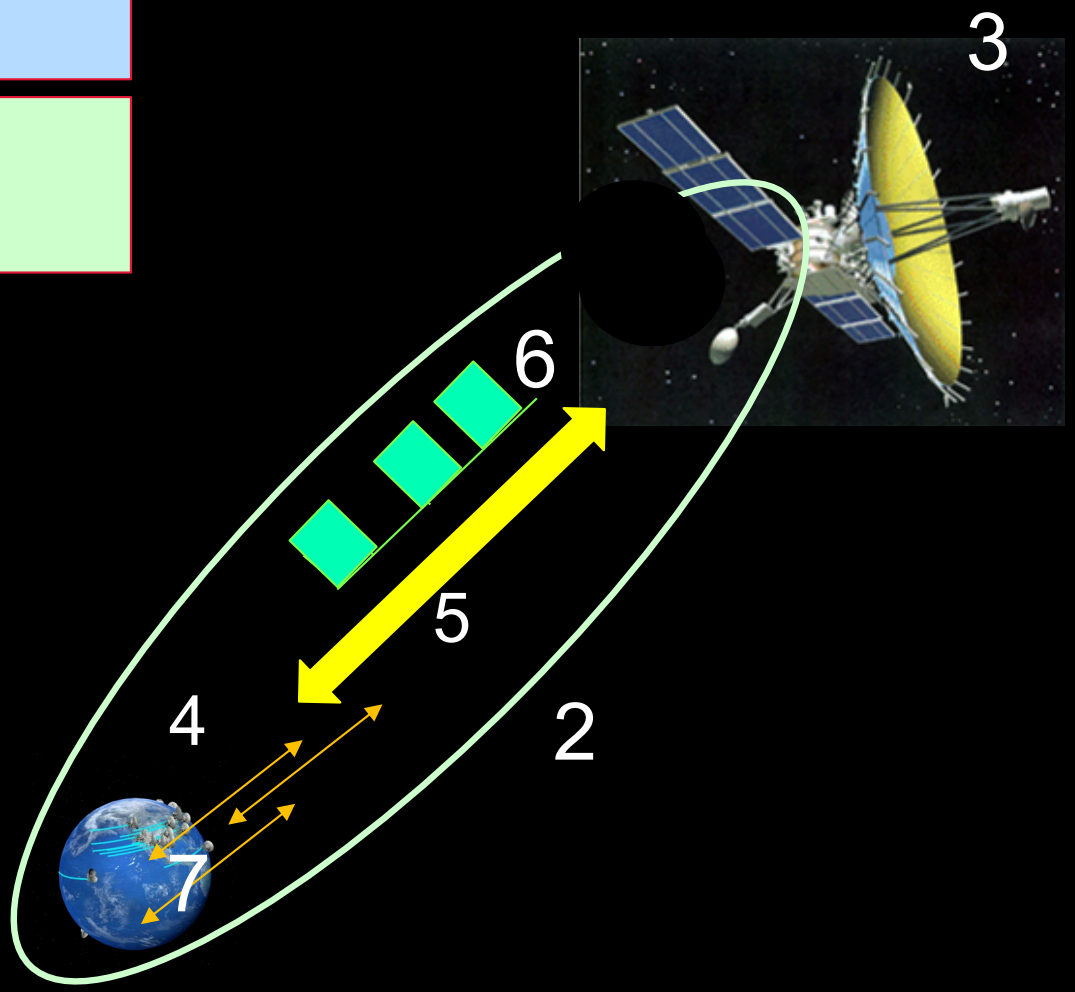
PHYS 3250
Introduction to space communications

Professor N Bartel

Sketch of the 7 chapters

2 Orbital aspects
3 Spacecraft
4 Earth station
5 Communications link
6 Modulation and multiplexing techniques
7 Multiple access to a satellite



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4. Earth station

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4. Earth station

Here we want to focus on the earth stations. These are transmit and receive stations, not TT&C stations. For antennas, there are different design aspects to consider for building an antenna for a satellite or for an earth station.

Satellite antenna	Earth station antenna
Low mass	Not importnat
Survival in space	Not important
Coverage over landmass	No coverage
Constraints due to launch vehicle	Not applicable
Concern of side lobes with respect to spot beam technology	Concern of sidelobes wit respect to interference from adjacent satellites
Offset feed paraboloid (no feed blockage, no subreflector)	Symmetrical Cassegrain or Gregorian

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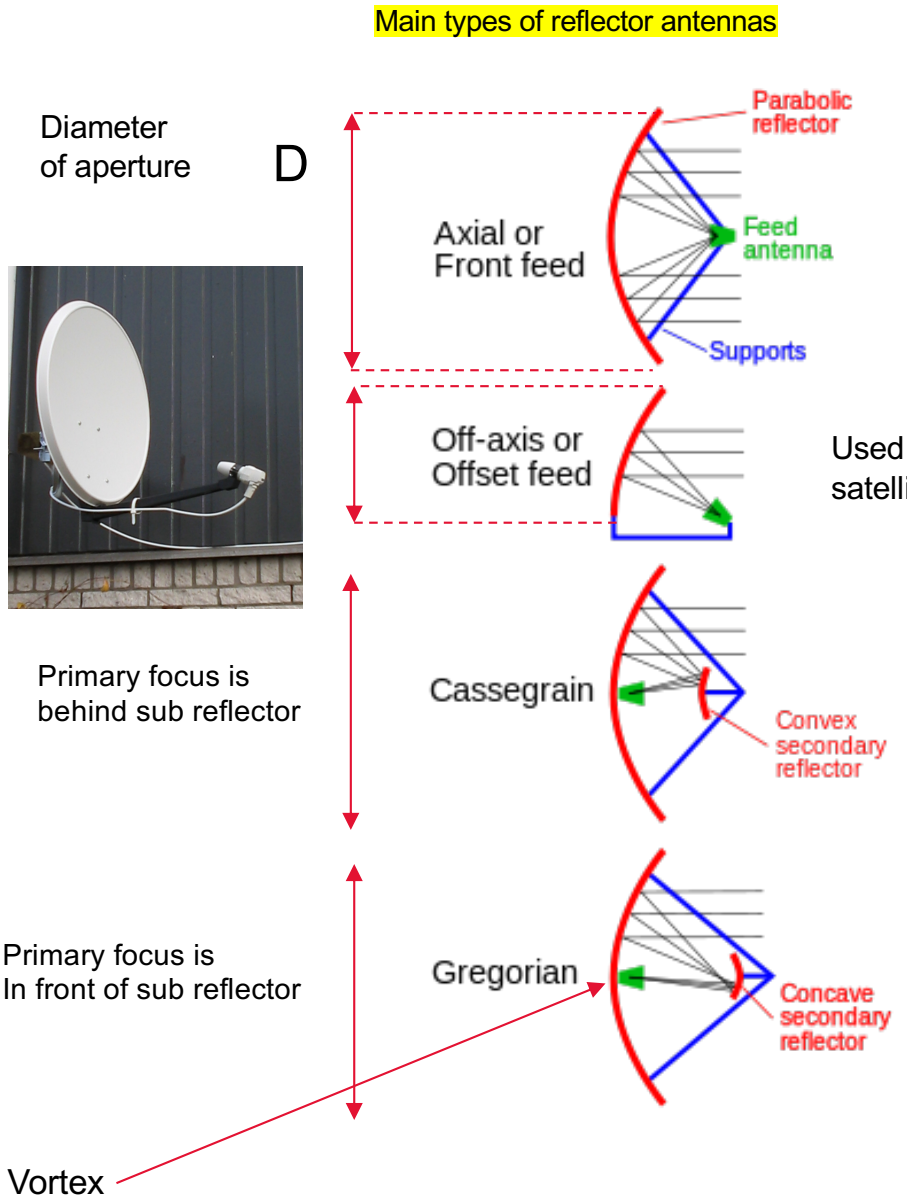
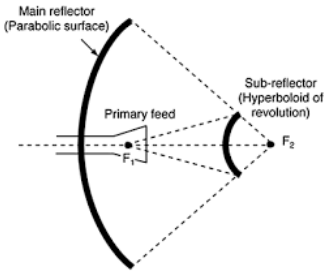
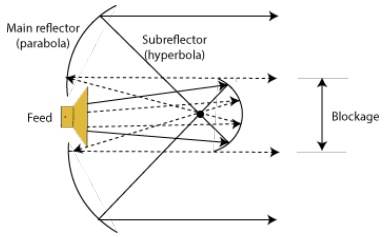
Main types of reflector antennas



Reflector antennas have (mostly) a parabolidal surface, large aperture

Used for small home antennas , satellites and radar





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Arecibo antenna – diameter 305 m

Unusual design

Spherical dish with movable line feeds

Wikipedia

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NASA Deep Space Communications Antennas

Tidbinbilla, Australia

Nasa/JPL Caltech

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The simplest earth stations are the home TV receive-only antennas

Low-cost coaxial cable

LNA

Mixer

FM RF signal

$\nu \sim 950\ 1450\ \text{MHz}, \Delta\nu = 500\ \text{MHz}$

2x16 TV channels at 24 MHz for two polarizations

Horn + polarizer switchable
between orthogonal polarizations

Antenna

outdoor

indoor

ν_D = 60 -560 MHz
ν_U = 1840 - 2340 MHz

Satellite receiver

60< ν_D<84 MHz

IF block

FM modulator

AM modulator

LO

Channel select

IF: Intermediate frequency
AM: Amplitude modulated
FM: frequency modulated

RF: Radio frequency

ν_{Lo} = 890 MHz
ν_{Lo} = 920 MHz

Channel 1 ➔ RF:950- 974 MHz
Channel 2 ➔ RF:980-1004 MHz

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TV

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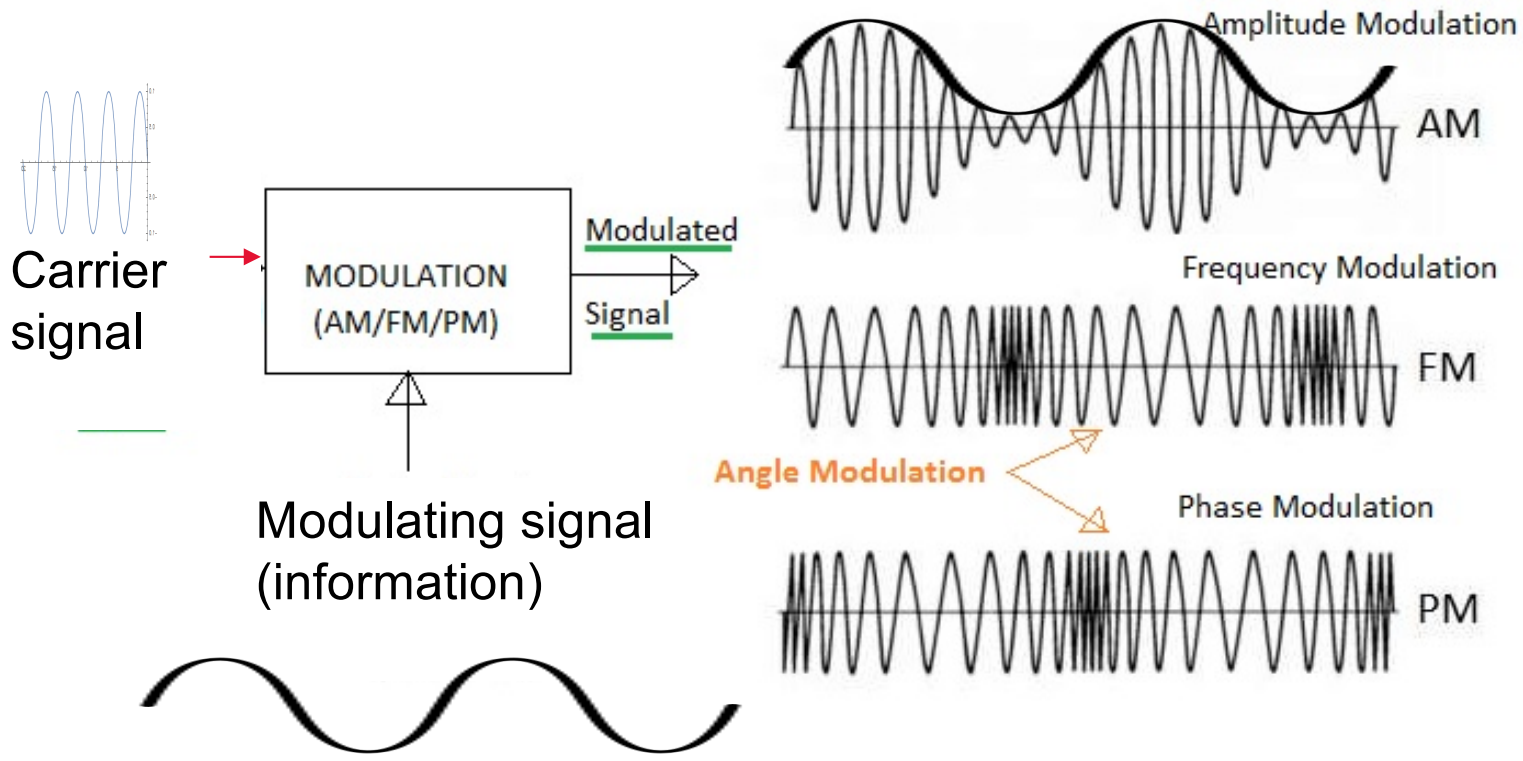
Forms of analogue modulations

AM: $S(t) = A(t)\sin[\omega\,\mathrm{t} + \psi]$
FM: $S(t) = A_0\sin[\omega(\mathrm{t})\mathrm{t} + \psi]$
PM: $S(t) = A_0\sin[\omega\,\mathrm{t} + \psi(t)]$



https://pdfslide.net/documents/frequency-modulation-demodulation-phase-modulation.html