PENGANTAR SISTEM TRANSMISI TELEKOMUNIKASI

DASAR TEKNIK TELEKOMUNIKASI
Program Studi D3 TT

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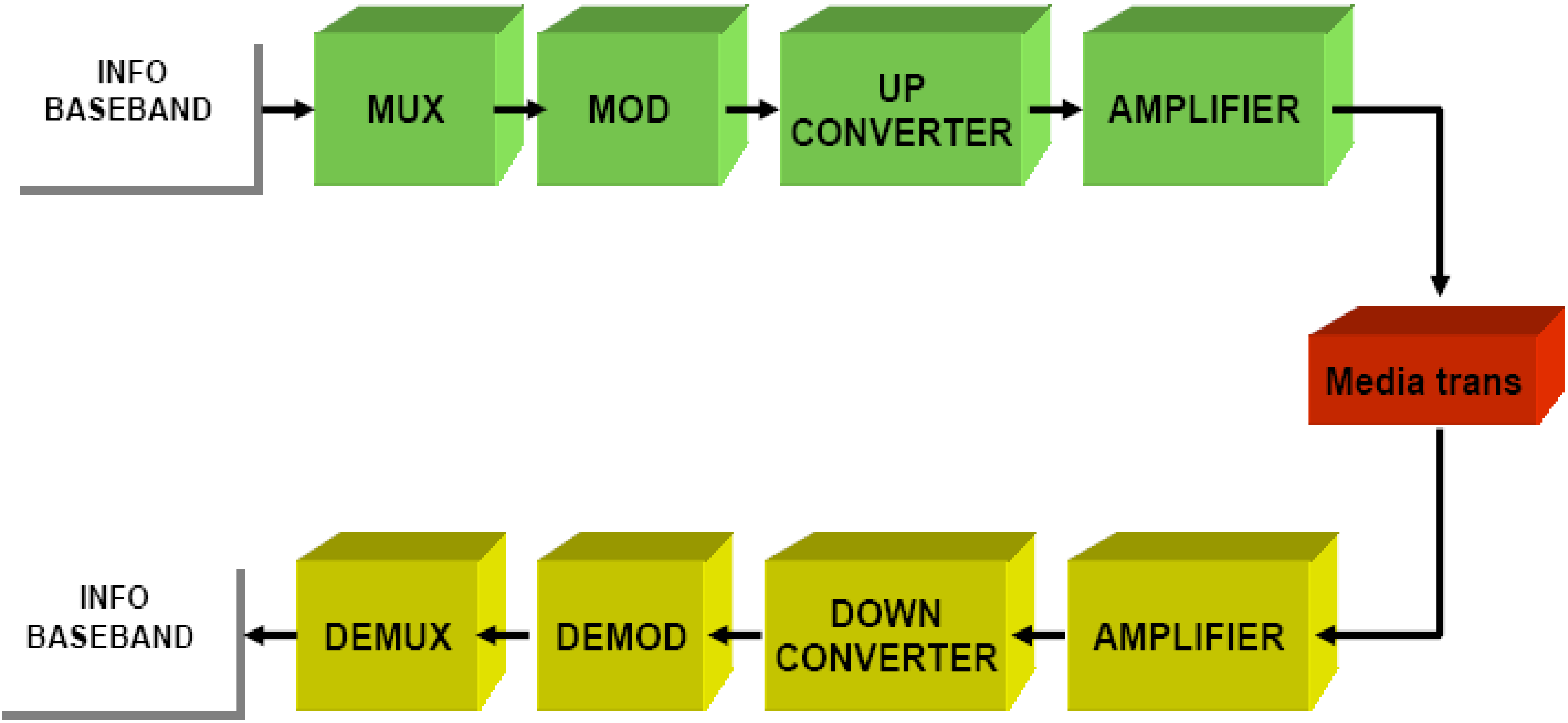
Guided Media

- Guided media
  - Twisted pair (10 Hz - 100 MHz)
  - Kabel koaksial (1 kHz – 1 GHz)
  - Serat optik (100 – 1000 THz)
- Unguided media
  - Radio
  - Gelombang mikro
- Twisted pair
  - Paling murah dan paling banyak digunakan
  - Panjang pilinan 5-15 cm, ketebalan 0,4-0,9 mm
  - Laju data 64 kbps untuk PBX digital, 4 Mbps untuk aplikasi jarak jauh, 10 Mbps untuk LAN (jarak 1 km), 100 Mbps-1 Gbps untuk jumlah terminal terbatas (jarak puluhan meter)
  - Jarak amplifier 5-6 km untuk sinyal analog, jarak repeater 2-3 km untuk transmisi digital
  - Redaman sangat sensitif terhadap kenaikan frekuensi

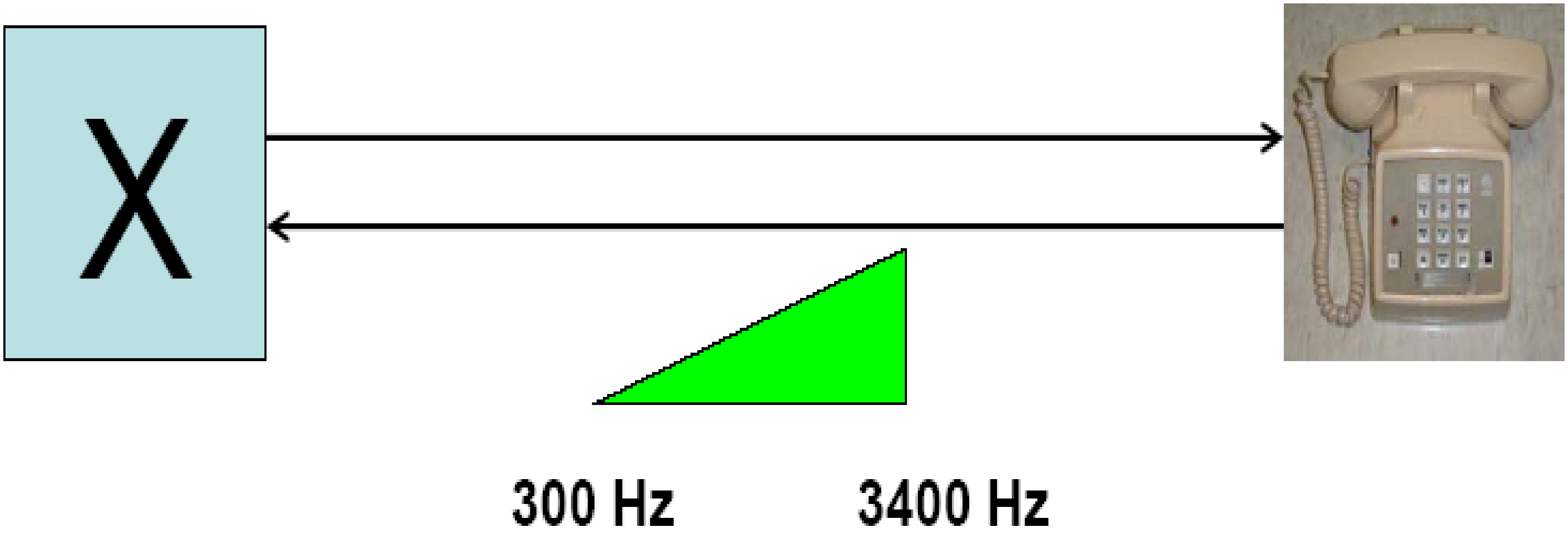
Transmisi


INFO BASEBAND
MUX
MOD
UP CONVERTER
AMPLIFIER
Media trans
AMPLIFIER
DOWN CONVERTER
DEMOD
DEMUX
INFO BASEBAND

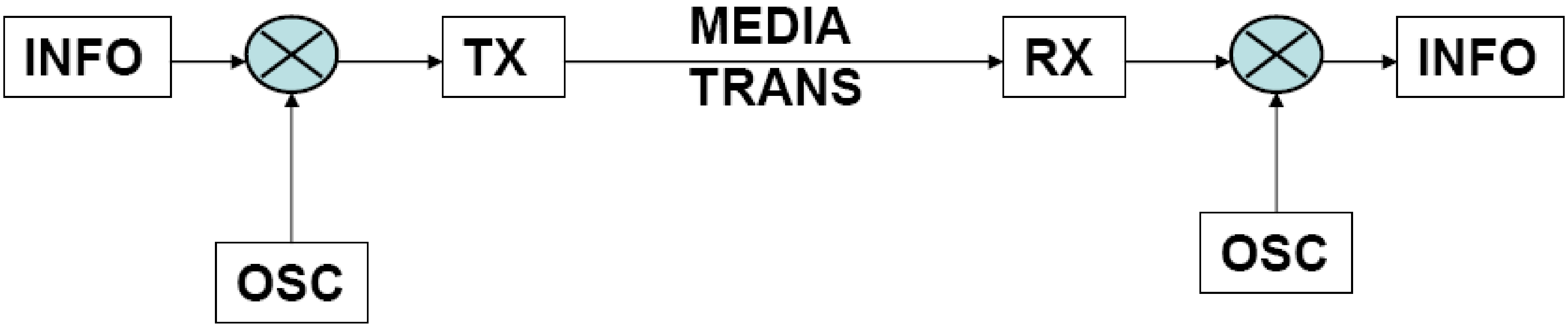
Gel Pembawa

- Tanpa gel pembawa :
  - **Sinyal info ditransmisikan pd frek baseband (pita frek dasar)**
  - **Mis : transmisi suara antara pelanggan dan sentral**
  - **Menggunakan media kawat : OWC, kabel urat jamak**
- Dgn gel pembawa :
  - **Sinyal info ditrasmisikan tidak pd frek baseband**
  - **Sinyal ditumpangkan pd frek gel pembawa**
  - **Hampir semua trans menggunakan gel pembawa**

Tanpa gel pembawa



Dgn Gel Pembawa



Ada translasi frekuensi dr frek baseband ke frek transmisi.

Info :

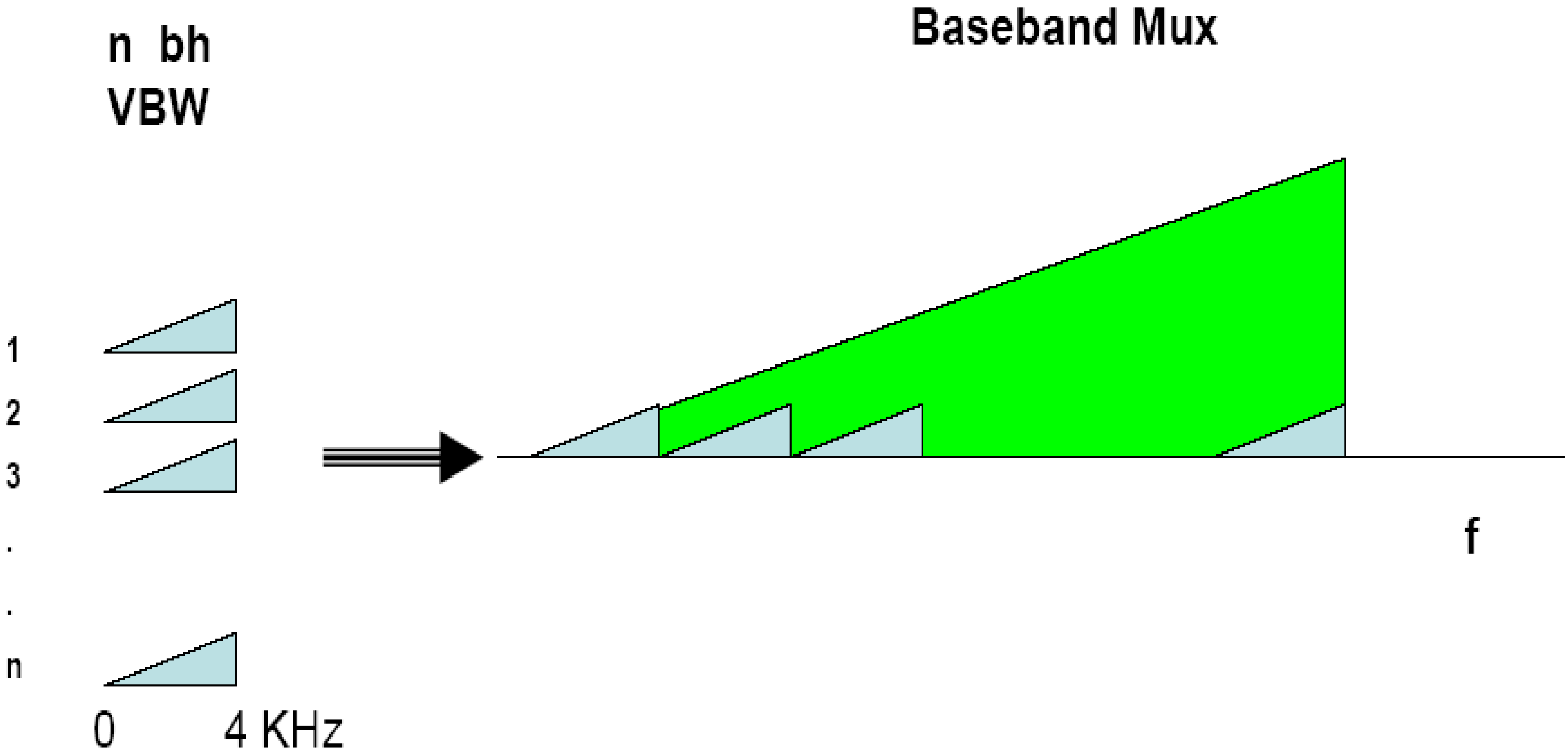
- Tunggal

- Jamak (perlu multipleks)

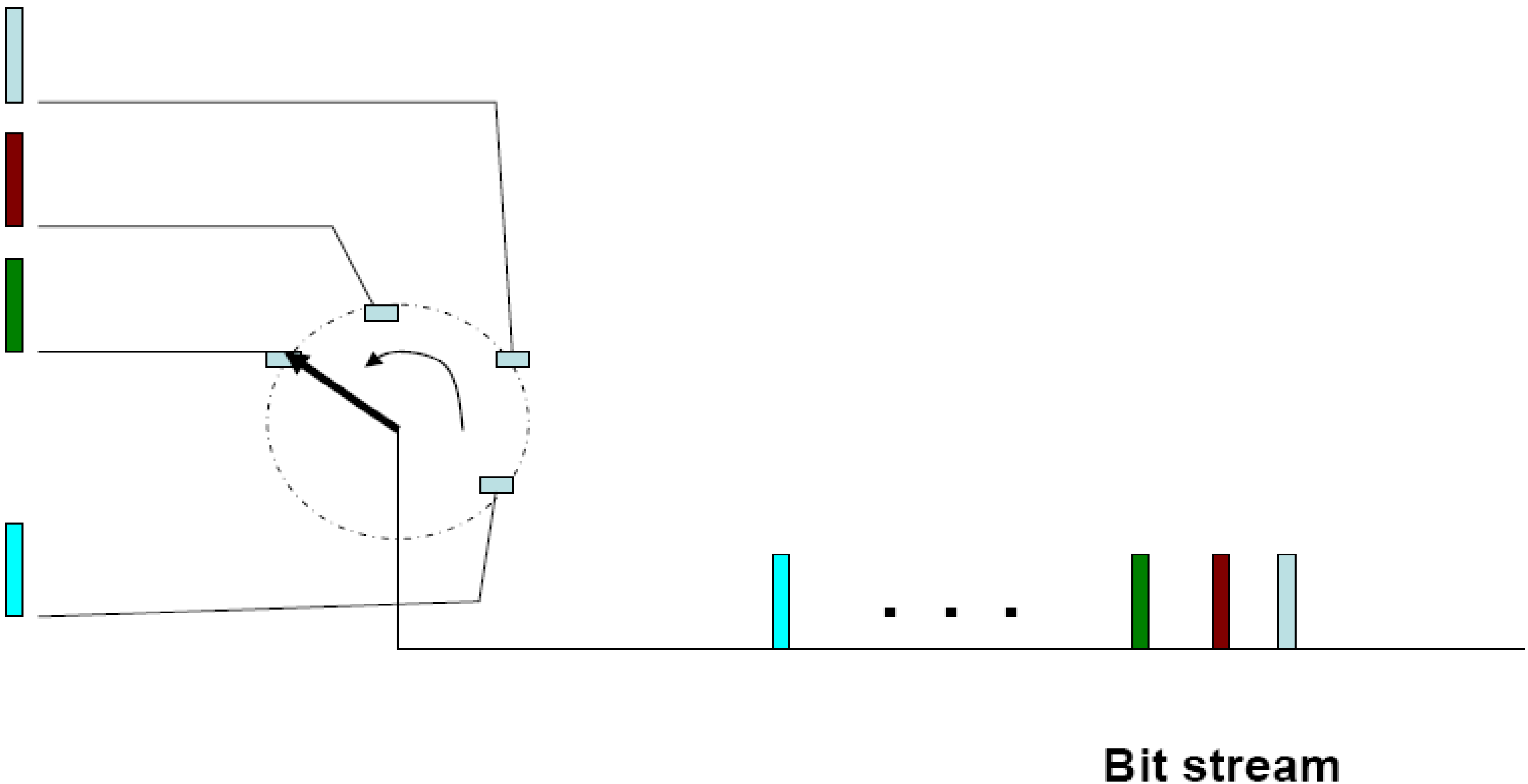
Multipleks

- Fungsi menggabung beberapa VBW agar dpt ditransmisikan secara bersama tanpa saling mengganggu satu dgn yg lain
- Jenis :
  - FDM (Frekuensi Division Multiplex), penggabungan berdasarkan frekuensi
  - TDM (Time Division Multiplex), penggabungan berdasarkan waktu (time slot)

FDM

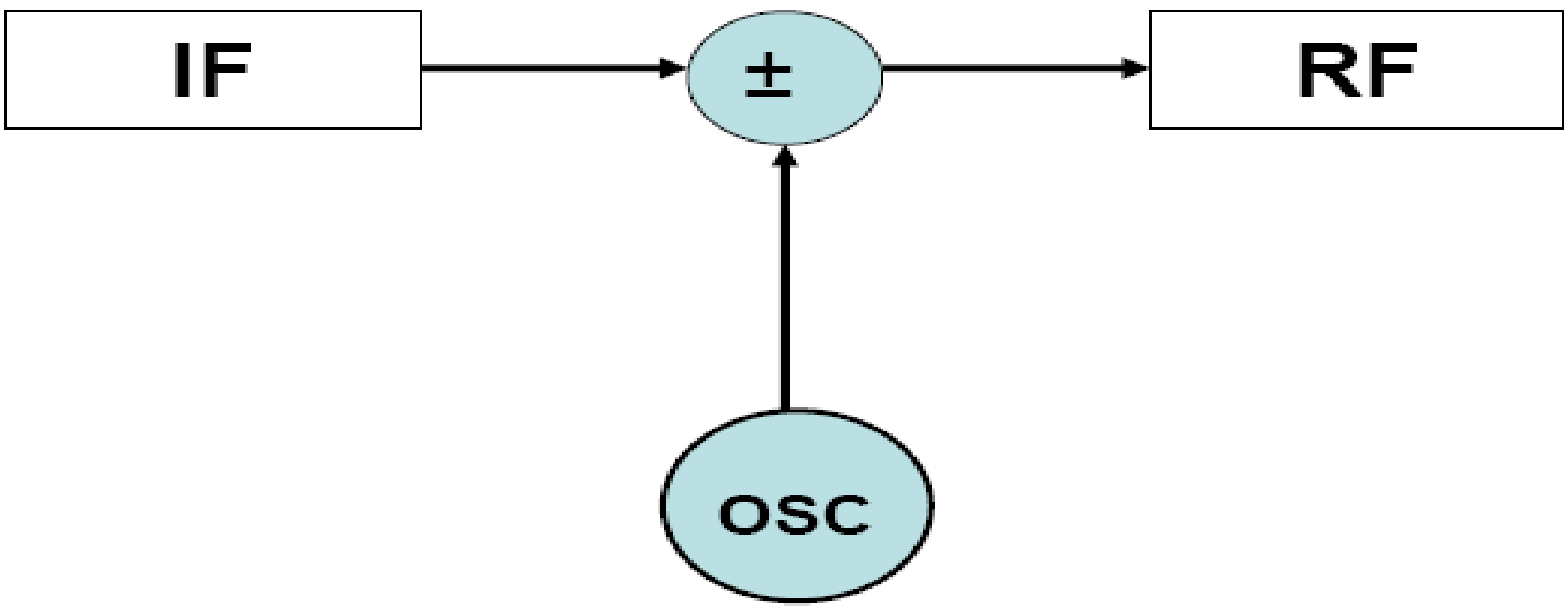


TDM



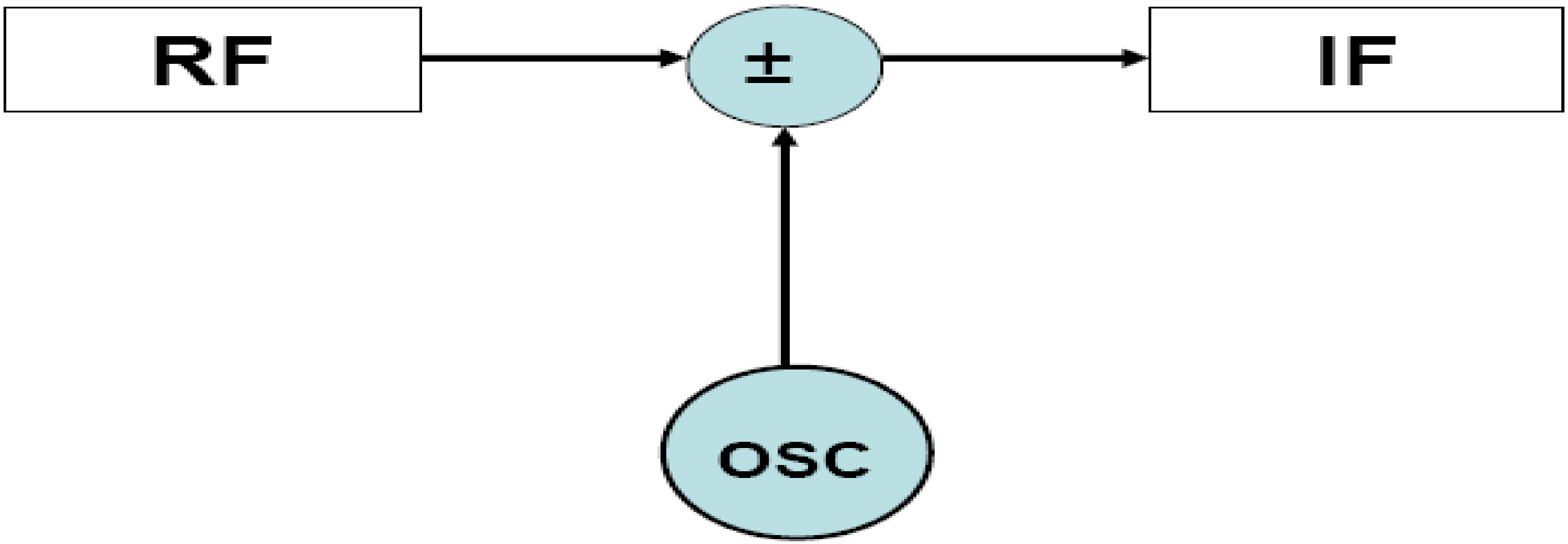
UP CONVERTER

Fungsi : mentranslasikan dr frek IF ke frek RF agar dpt ditransmisikan



DOWN CONVERTER

Fungsi : mentranslasikan dr frek RF ke frek IF utk didemodulasi



AMPLIFIER

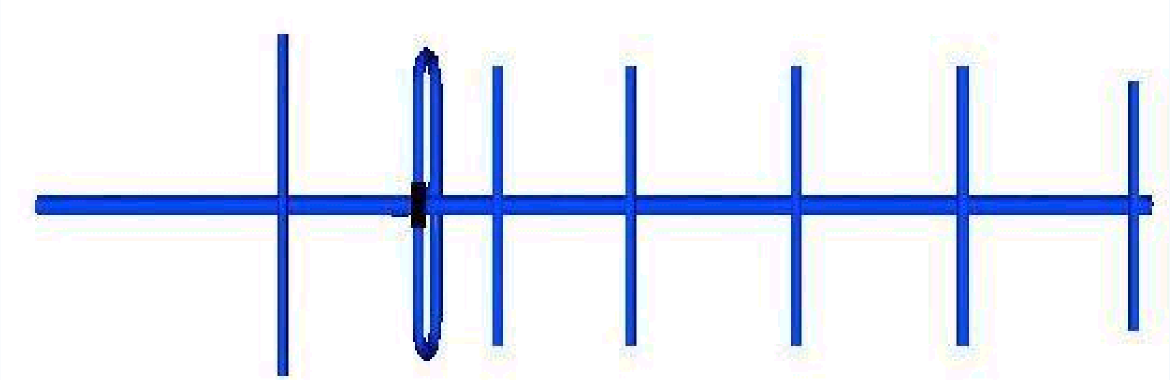
- Fungsi : menguatkan sinyal RF agar memiliki daya yang sesuai dengan kebutuhan yg diperlukan shg dpt menghasilkan kualitas yg distandarkan.
- TX : Daya relatif besar, noise figure tidak perlu rendah.
- RX : Daya tidak perlu besar, noise figure harus rendah.

Antenna - How it Works

The antenna converts radio frequency electrical energy fed to it (via the transmission line) to an electromagnetic wave propagated into space.

The physical size of the radiating element is proportional to the wavelength. The higher the frequency, the smaller the antenna size.

Assuming that the operating frequency in both cases is the same, the antenna will perform identically in Transmit or Receive mode



The type of system you are installing will help determine the type of antenna used.

Generally speaking, there are two ‘types’ of antennae:

1. ***Directional***

   - This type of antenna has a narrow beamwidth; with the power being more directional, greater distances are usually achieved but area coverage is sacrificed

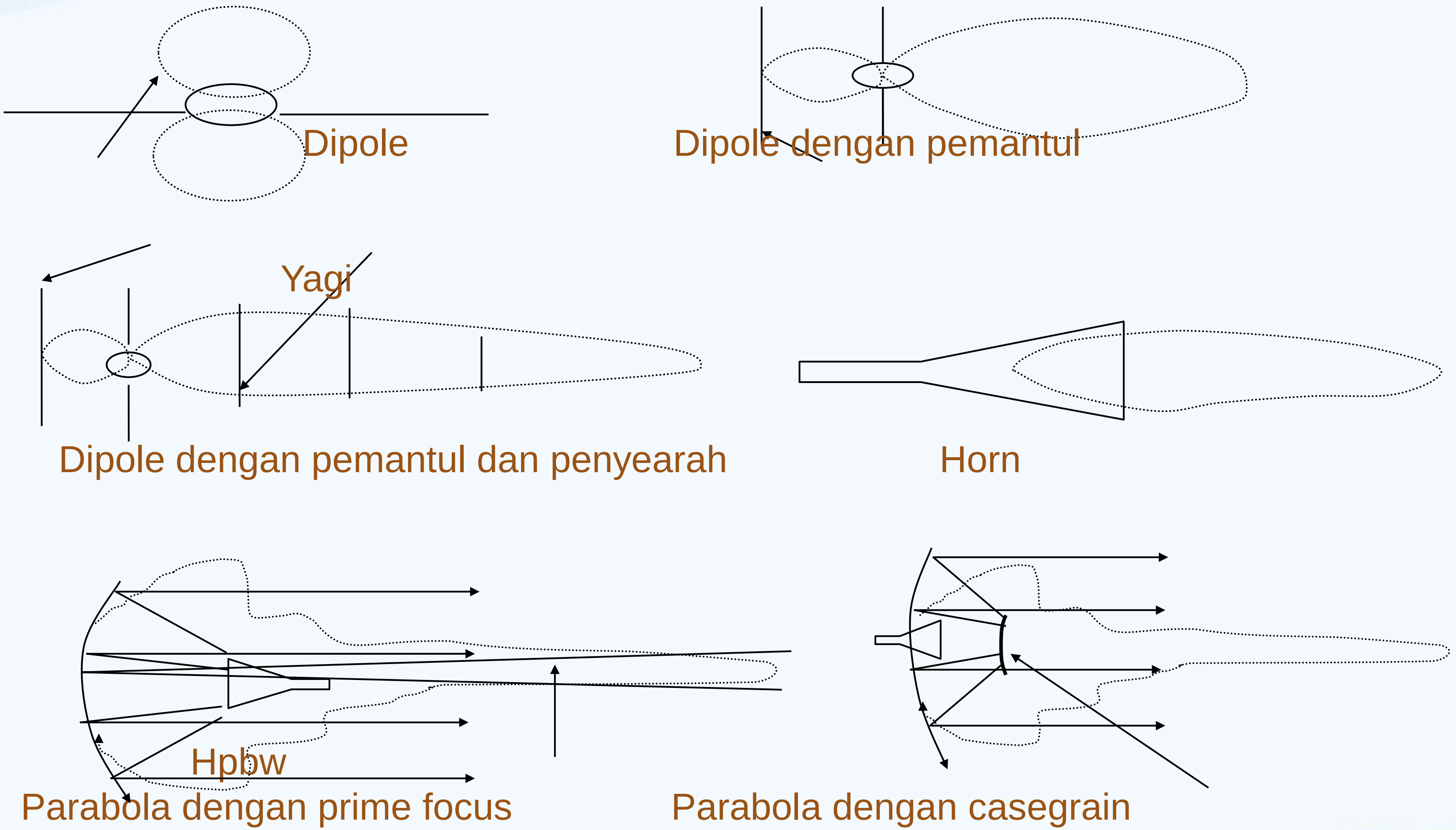
   - Yagi, Panel, Sector and Parabolic antennae

   - An EUM, NCL Station/Master will use this type of antenna in both Point to Point and Point to Multipoint

2. ***Omni-Directional***

- This type of antenna has a wide beamwidth and radiates 3600; with the power being more spread out, shorter distances are achieved but greater coverage attained
- Omni antenna

Macam – macam konfigurasi antena

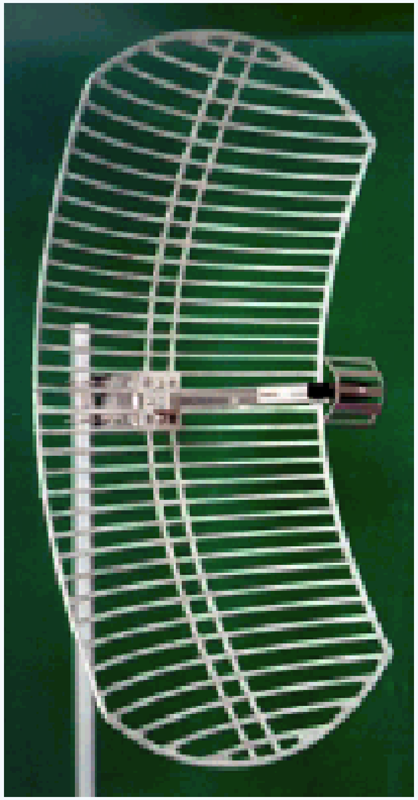


Yagi

- better suited for shorter links
- lower dBi gain; usually between 7 and 15 dBi

Parabolic

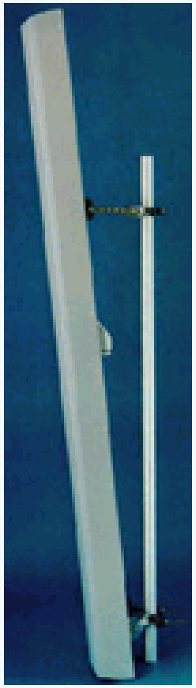
- used in medium to long links
- gains of 18 to 28 dBi
- most common



Sectoral

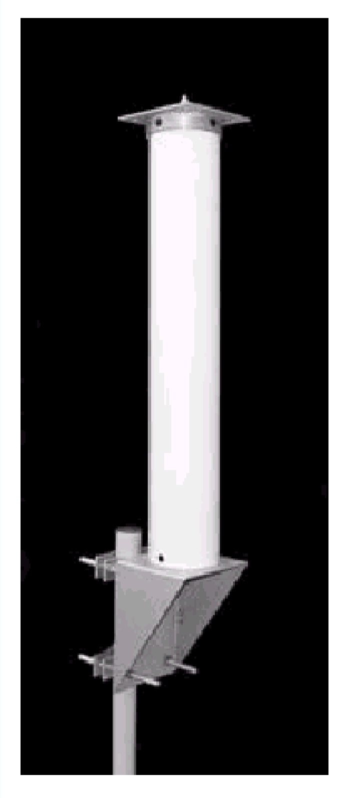
- directional in nature, but can be adjusted anywhere from 45^0 to 180^0

- typical gains vary from 10 to 19 dBi



Omni

- used at the CCU or Master NCL for wide coverage
- typical gains of 3 to 10 dBi



Polarization

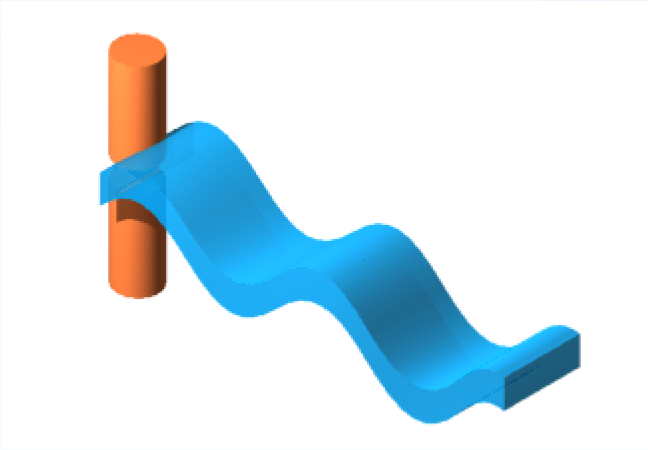
An antennas polarization is relative to the E-field of antenna.

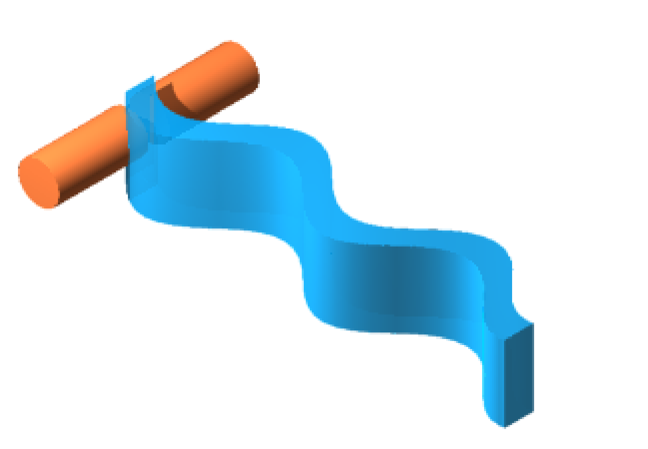
– If the E-field is horizontal, than the antenna is Horizontally Polarized.

– If the E-field is vertical, than the antenna is Vertically Polarized.

No matter what polarity you choose, all antennas in the same RF network must be polarized identically regardless of the antenna type.

Polarization





Vertical | Horizontal

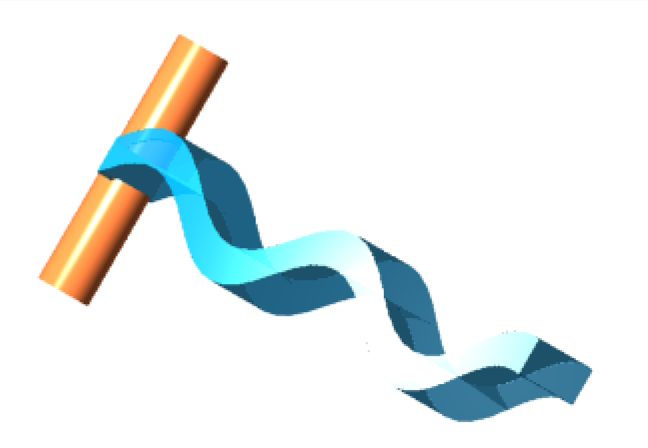
Vertical Polarization:

The electric field is vertical to the ground (In the maximum gain direction)

Horizontal Polarization:

The electric field is parallel to the ground (In the maximum gain direction)

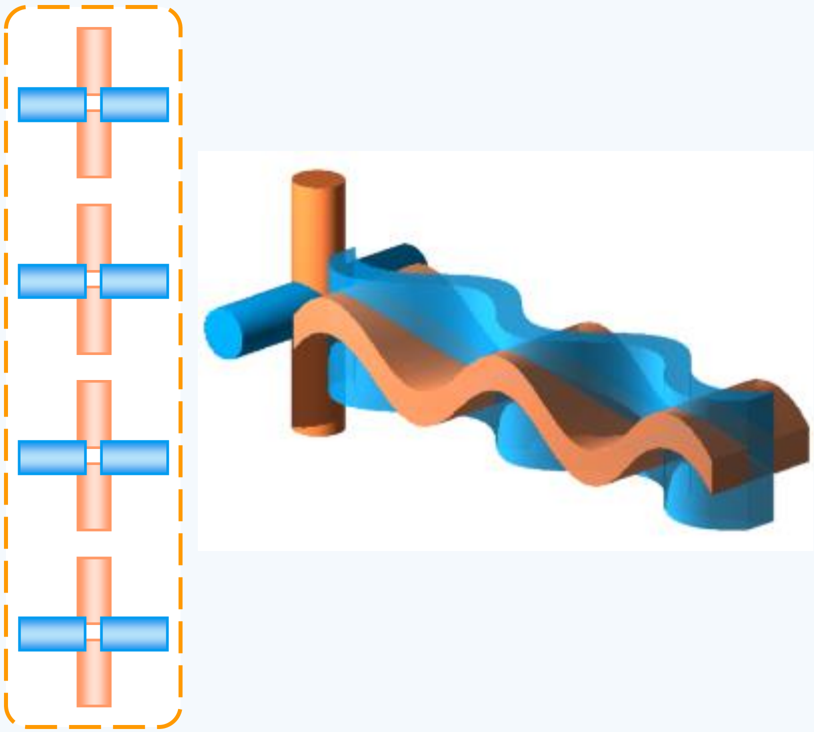
Polarization



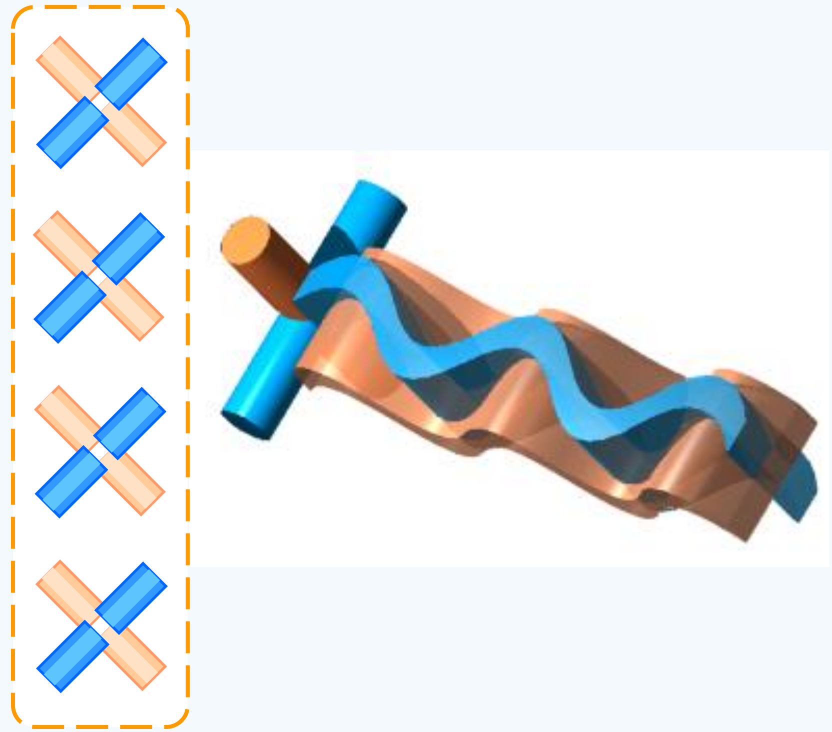
+ 45degree slant

- 45degree slant

Polarization



V/H (Vertical/Horizontal)



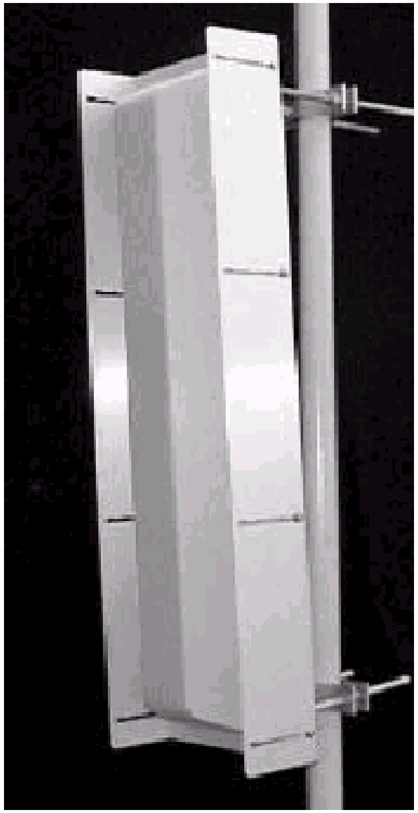
Slant (+/- 45°)

Polarization may deliberately be used to:

- Increase isolation from unwanted signal sources (Cross Polarization Discrimination (x-pol) typically 25 dB)
- Reduce interference
- Help define a specific coverage area

Horizontal

Vertical

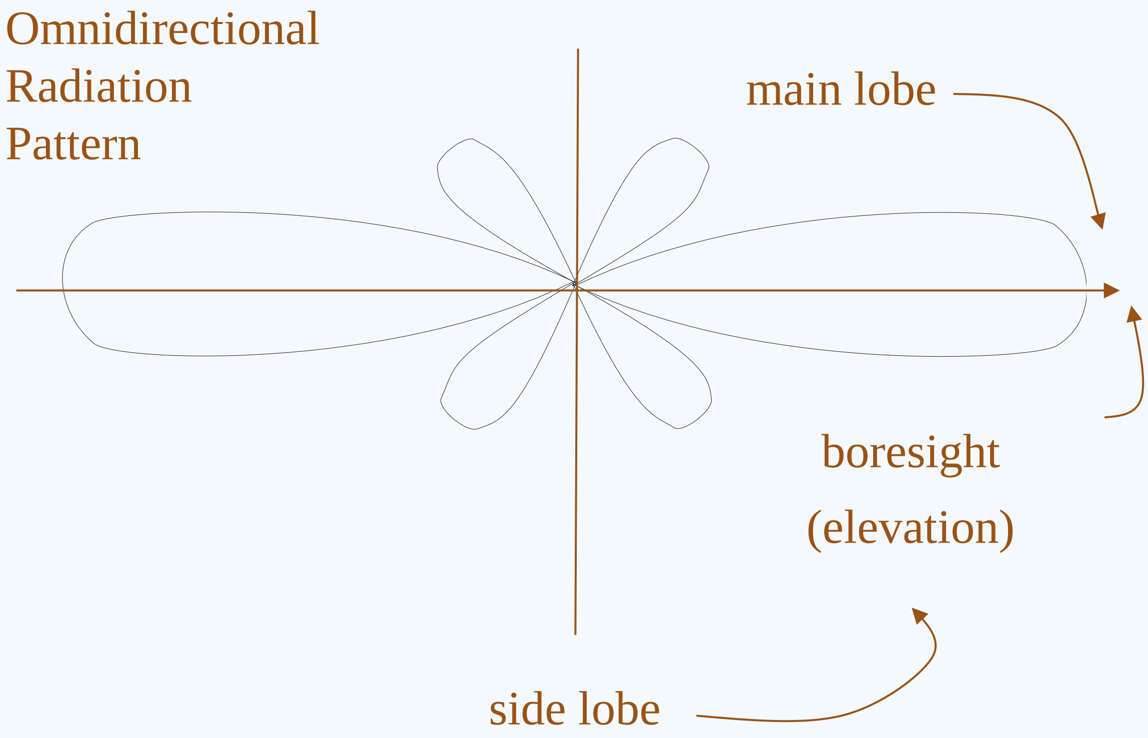


Antenna Radiation Pattern

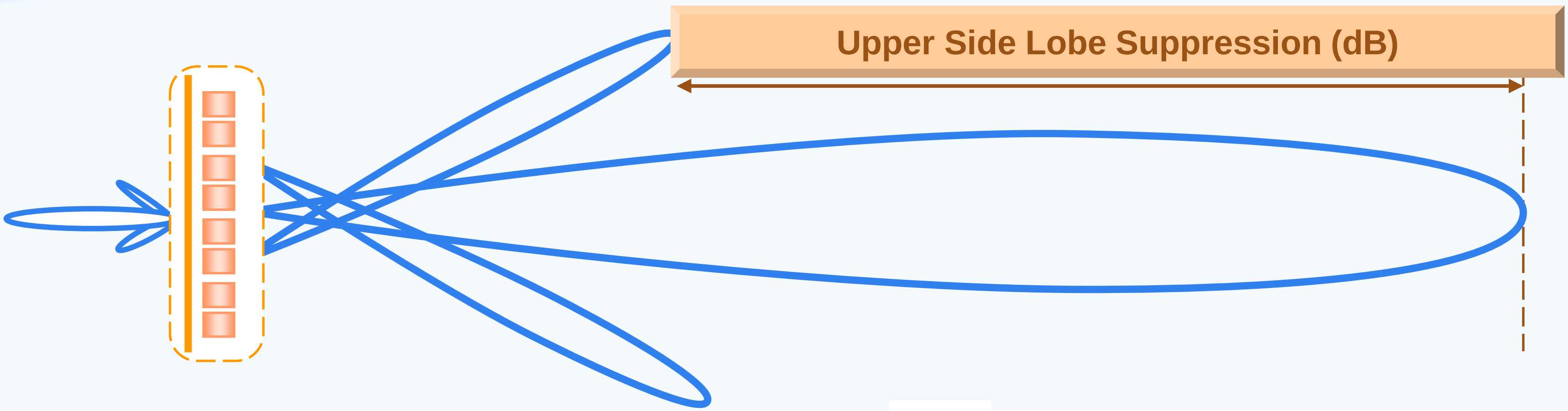
Radiation Pattern

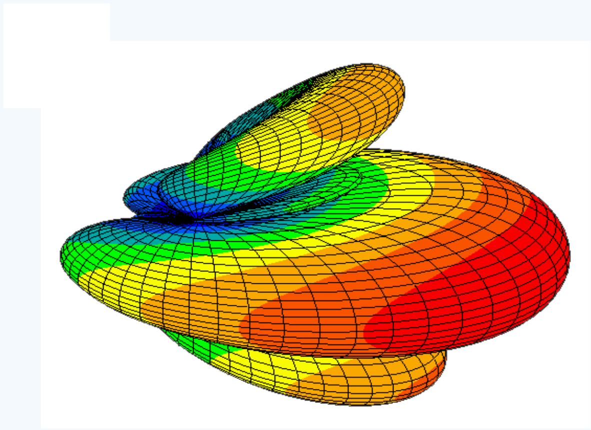
- A graphical representation of the intensity of the radiation vs. the angle from the perpendicular.
- The graph is usually circular, the intensity indicated by the distance from the centre based in the corresponding angle.

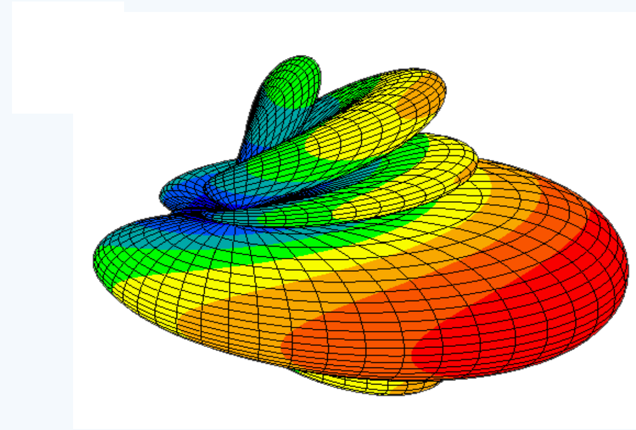
Radiation Patern



Side lobes

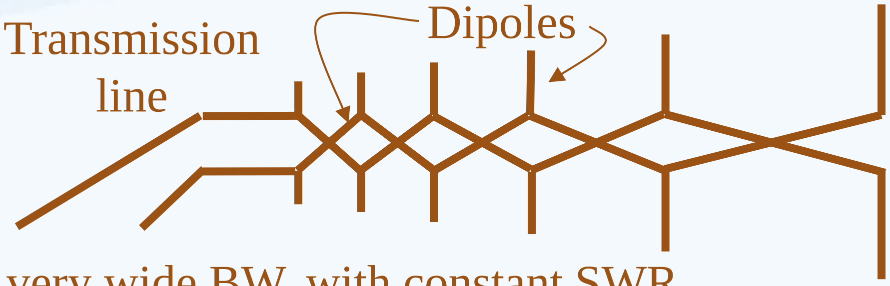


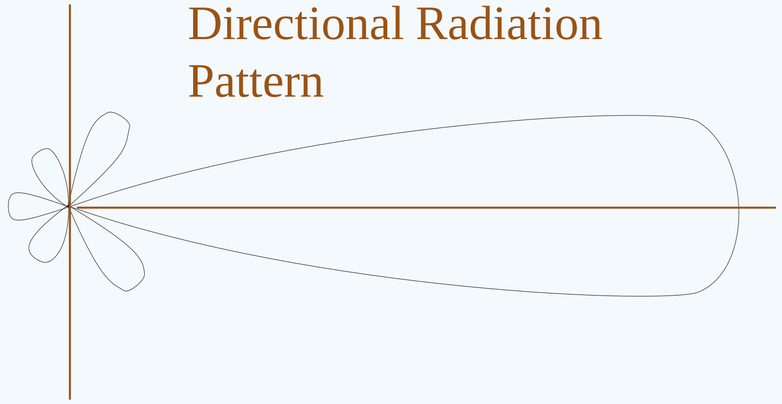




Contoh Radiation Patern

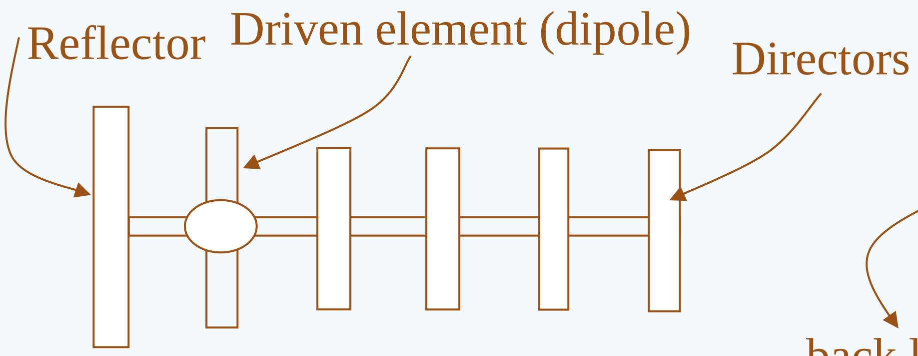
- *Log periodic dipole array (LPDA)*

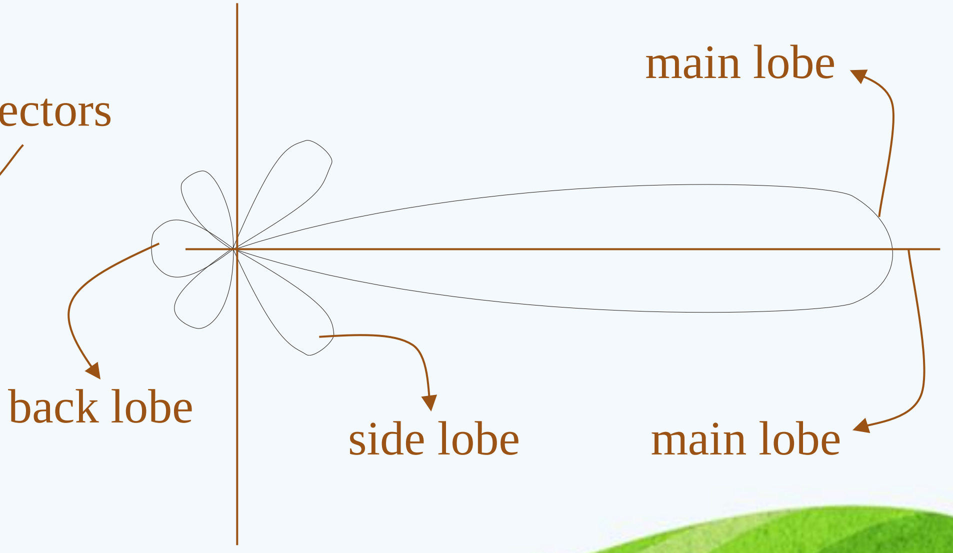




- very wide BW, with constant SWR
- typical gain 10 dBi

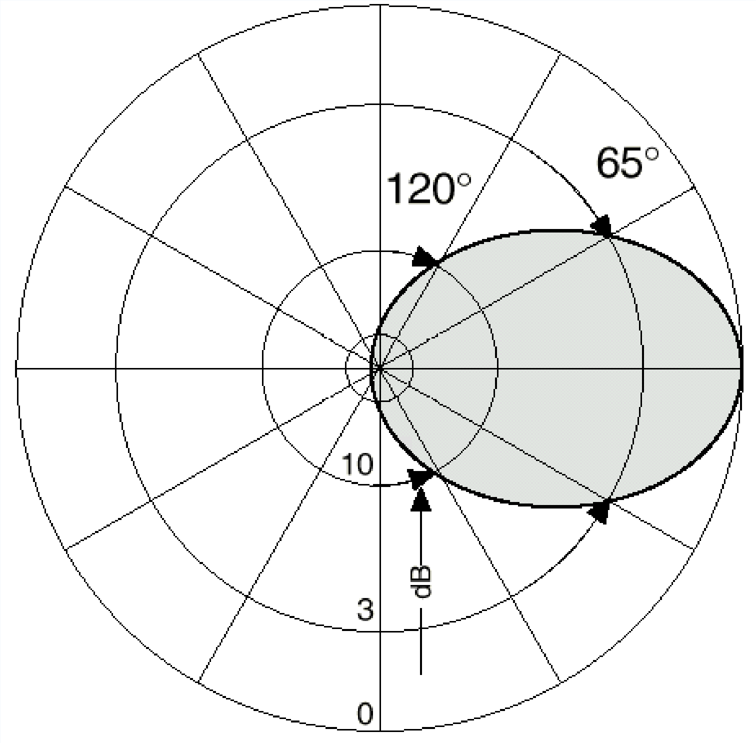
Yagi antenna

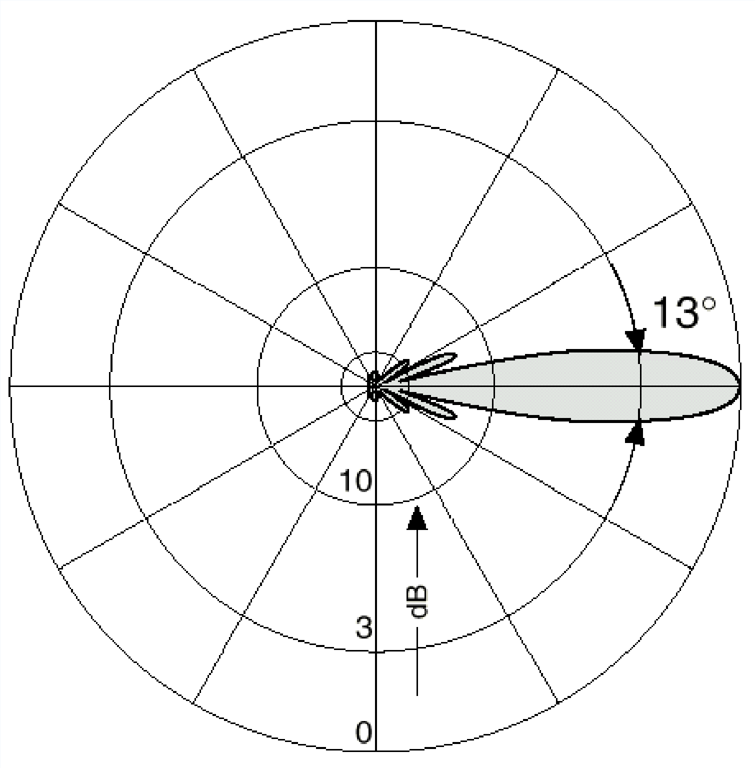




- BW is smaller than LPDA
- typical gain 12 – 14 dB

Antenna Radiation pattern

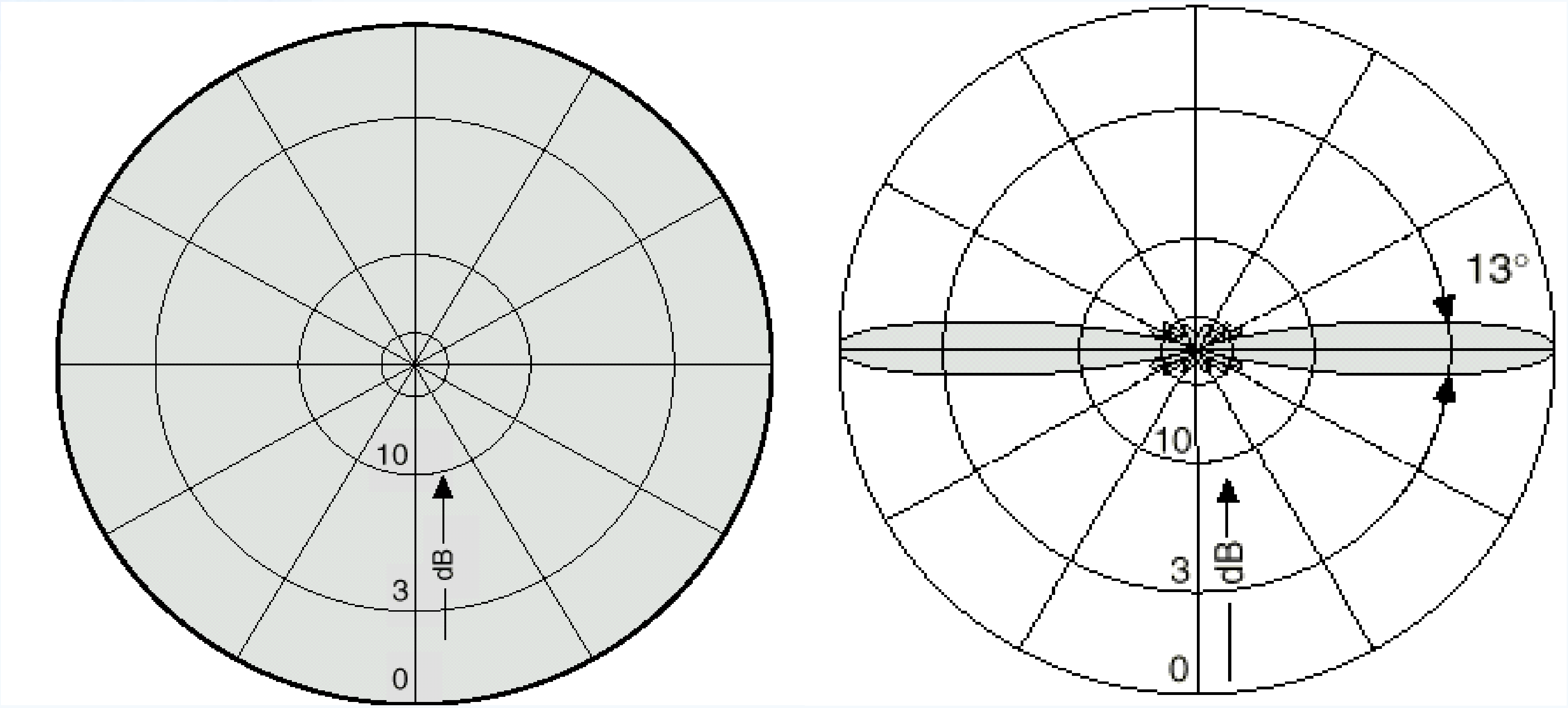




Horizontal plane Vertical plane

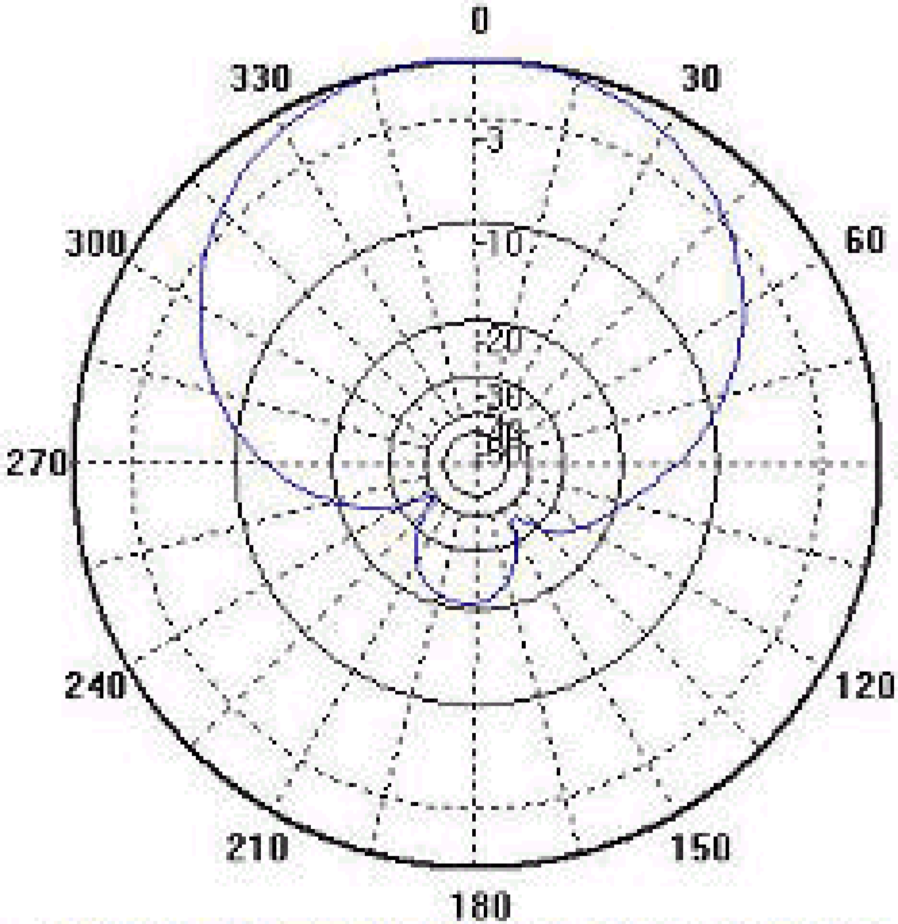
Directional Antenna Radiation Pattern

Antenna Radiation pattern

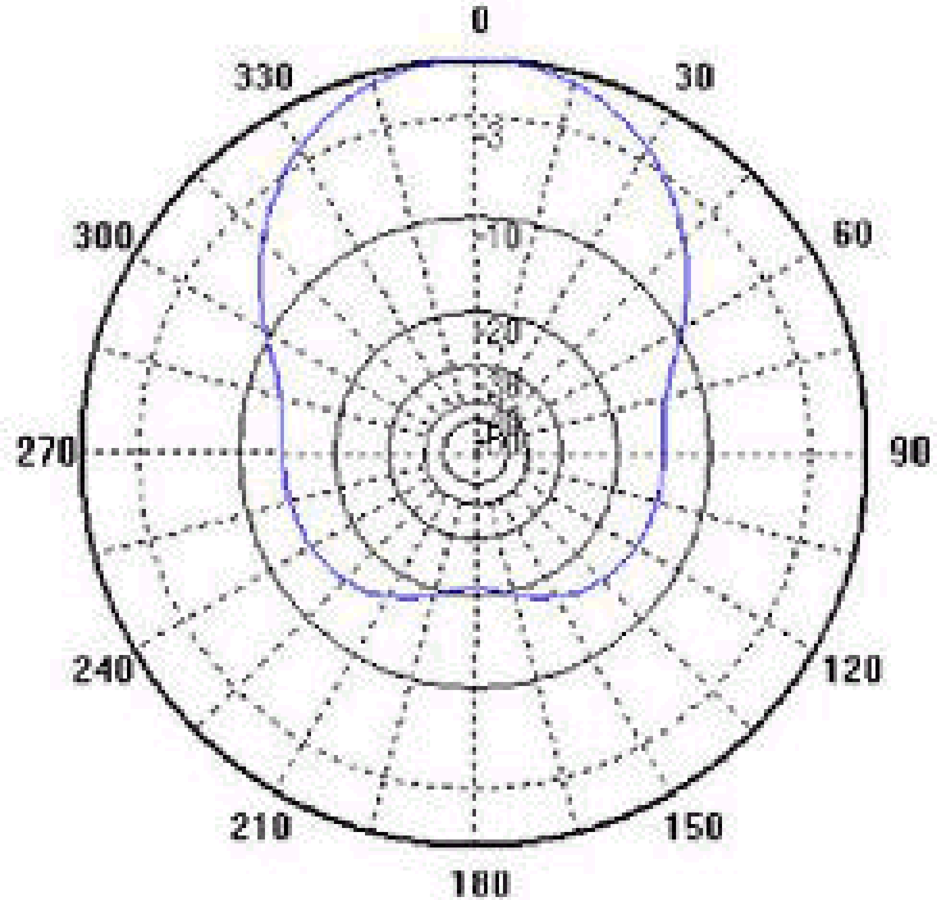


Horizontal plane Vertical plane

Omni-directional Antenna Radiation Pattern

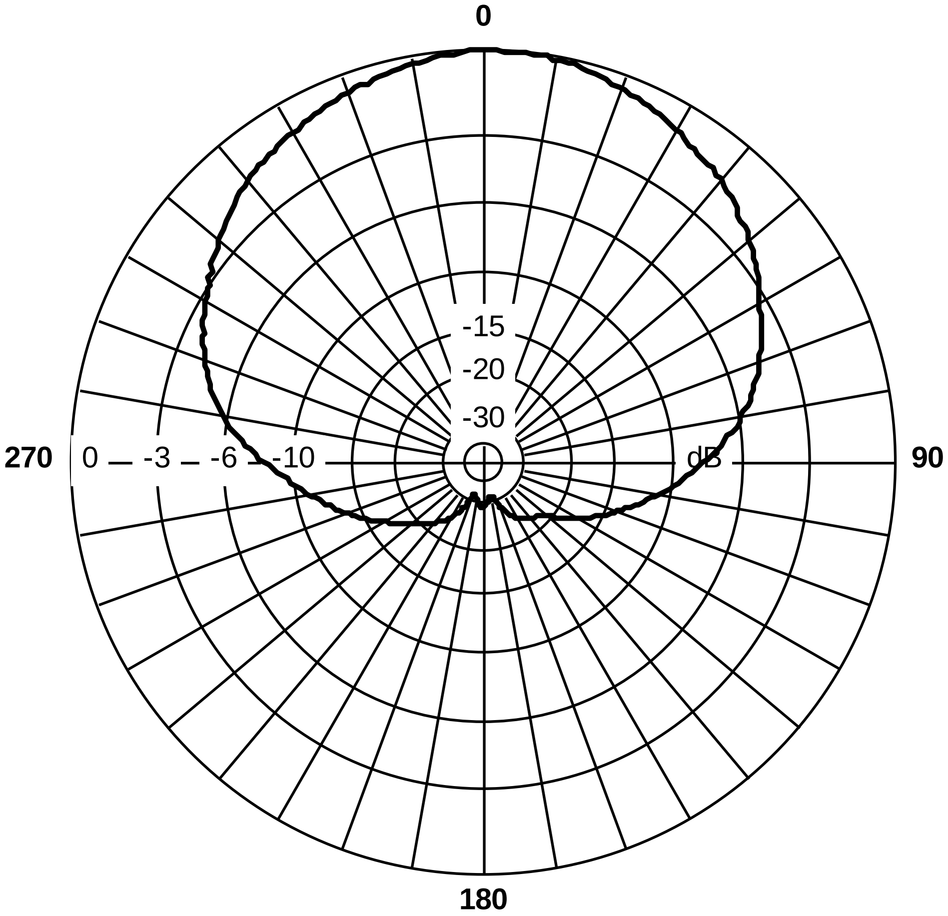


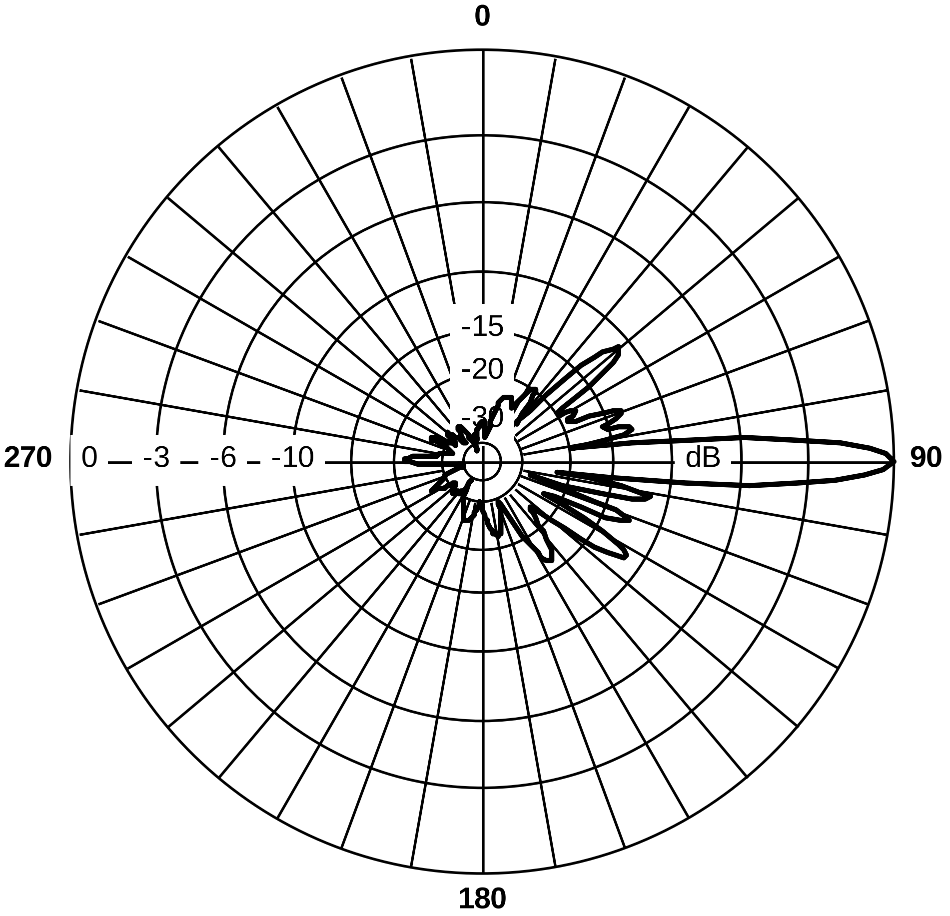
HORIZONTAL PATTERN FOR VERTICAL POLARIZATION



HORIZONTAL PATTERN FOR HORIZONTAL POLARIZATION

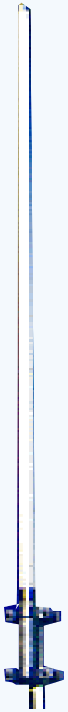
Typical Radiation Pattern for a Yagi

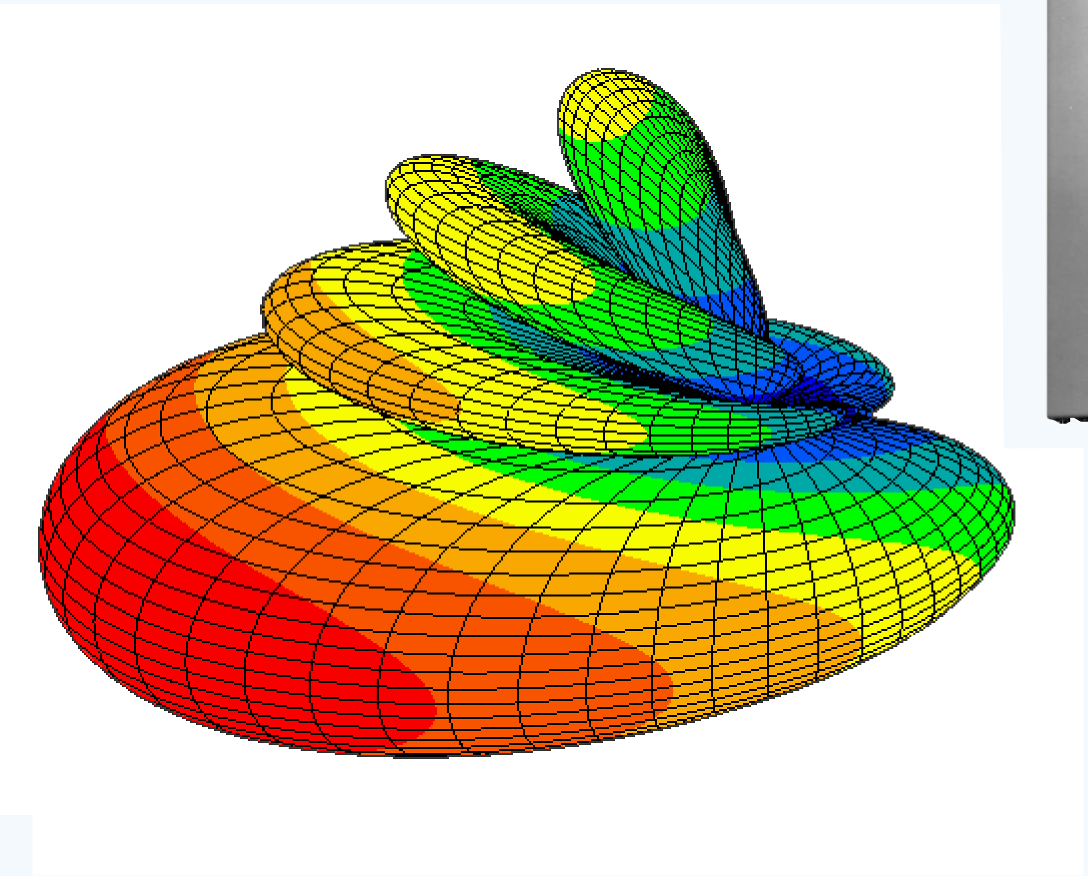




Typical Radiation Pattern for a Sector

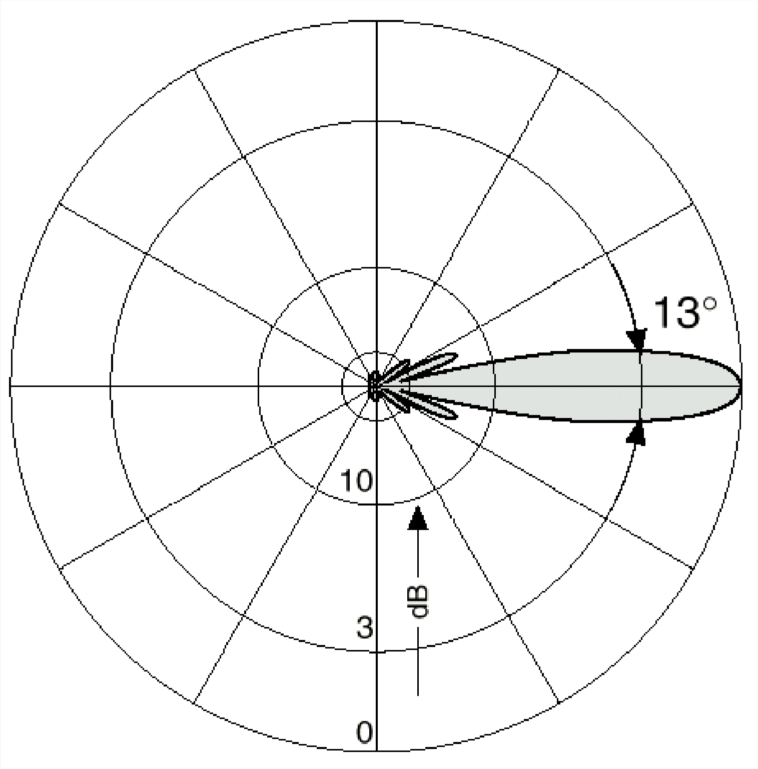
Pattern





Gain

Unless otherwise specified, the gain usually refers to the direction of maximum radiation.



Gain Unit

Antenna gain is usually expressed in dBi or dBd

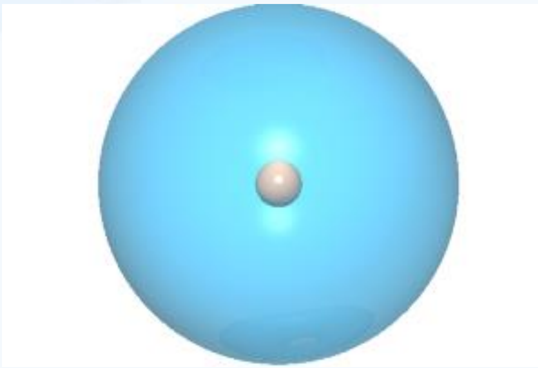
dBi

Gain relative to an isotropic antenna when the reference antenna is an isotropic antenna.

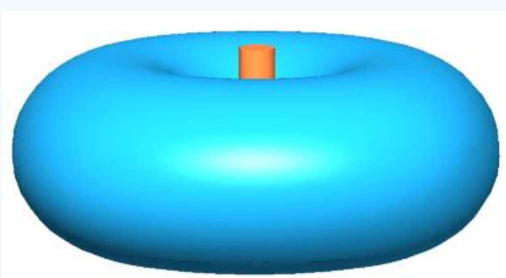
dBd

Gain relative to a half-wave dipole when the reference antenna is a half-wave dipole.

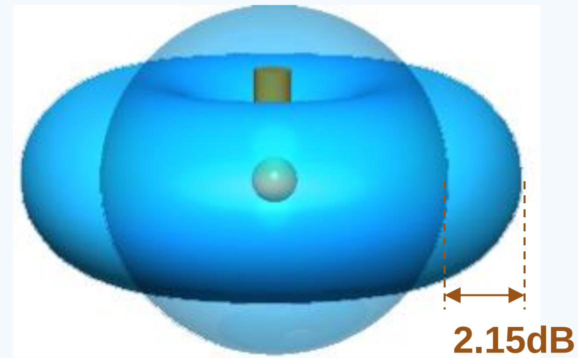
dBd and dBi



isotropic radiator

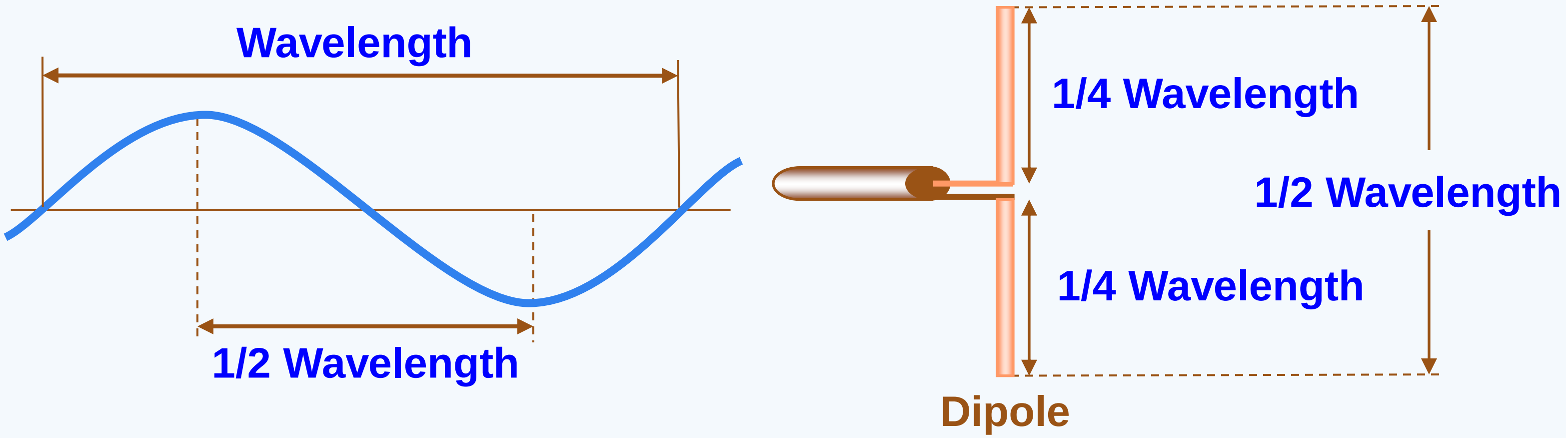


half-wave dipole



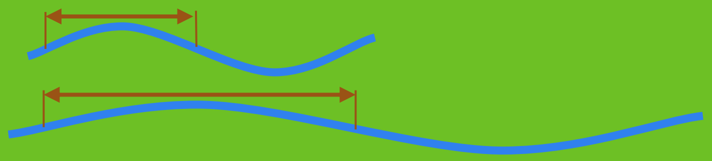
eg: 0dBd = 2.15dBi

Dipoles

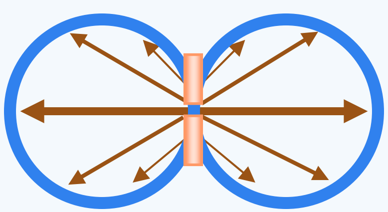


1900MHz : 78.95mm

800MHz : 187.5mm

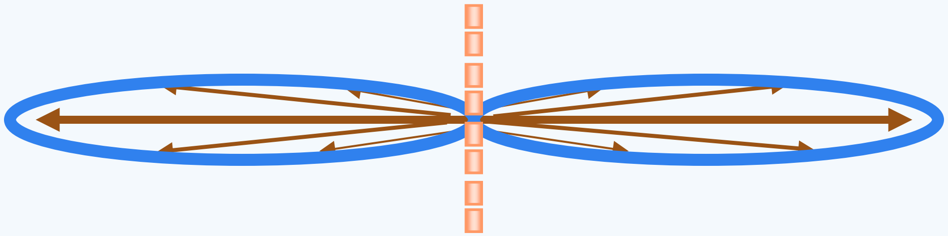


Dipoles



One dipole

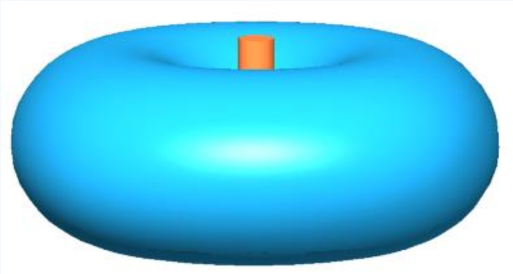
Received Power： **1mW**

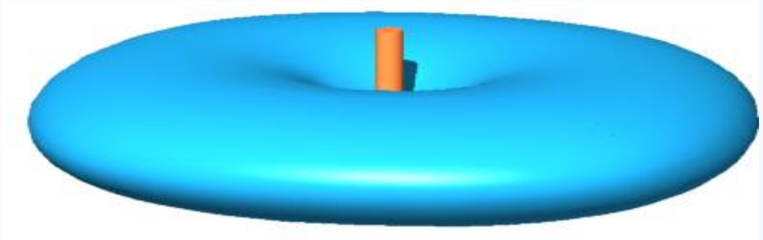


multiple dipoles

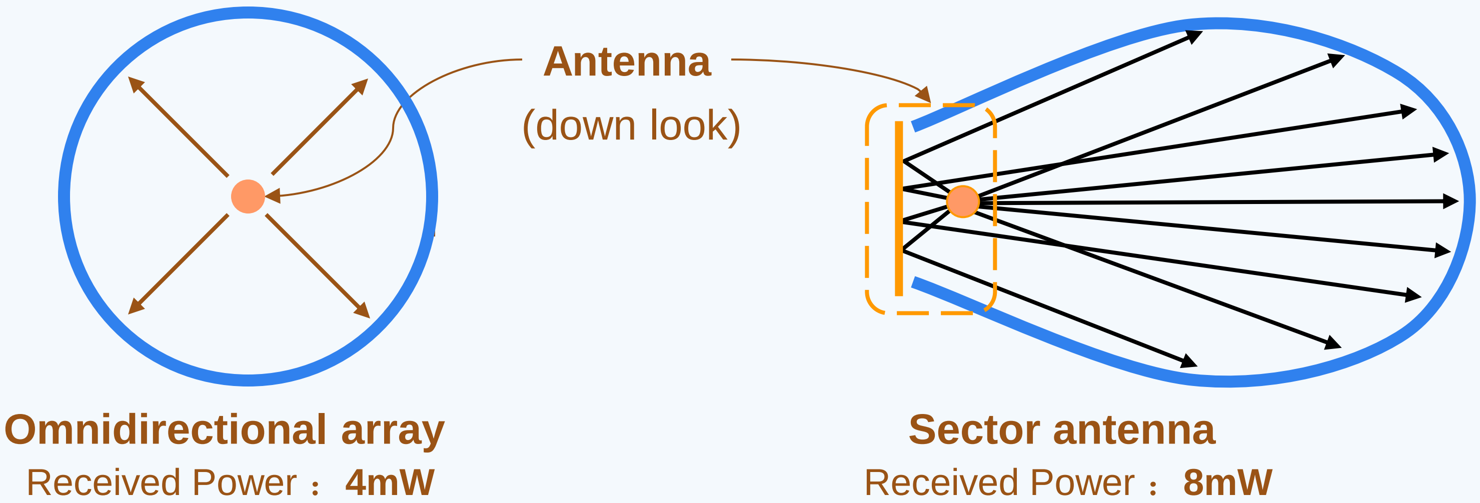
Received Power ： **4 mW**

GAIN**= 10log(4mW/1mW) = 6dBd**



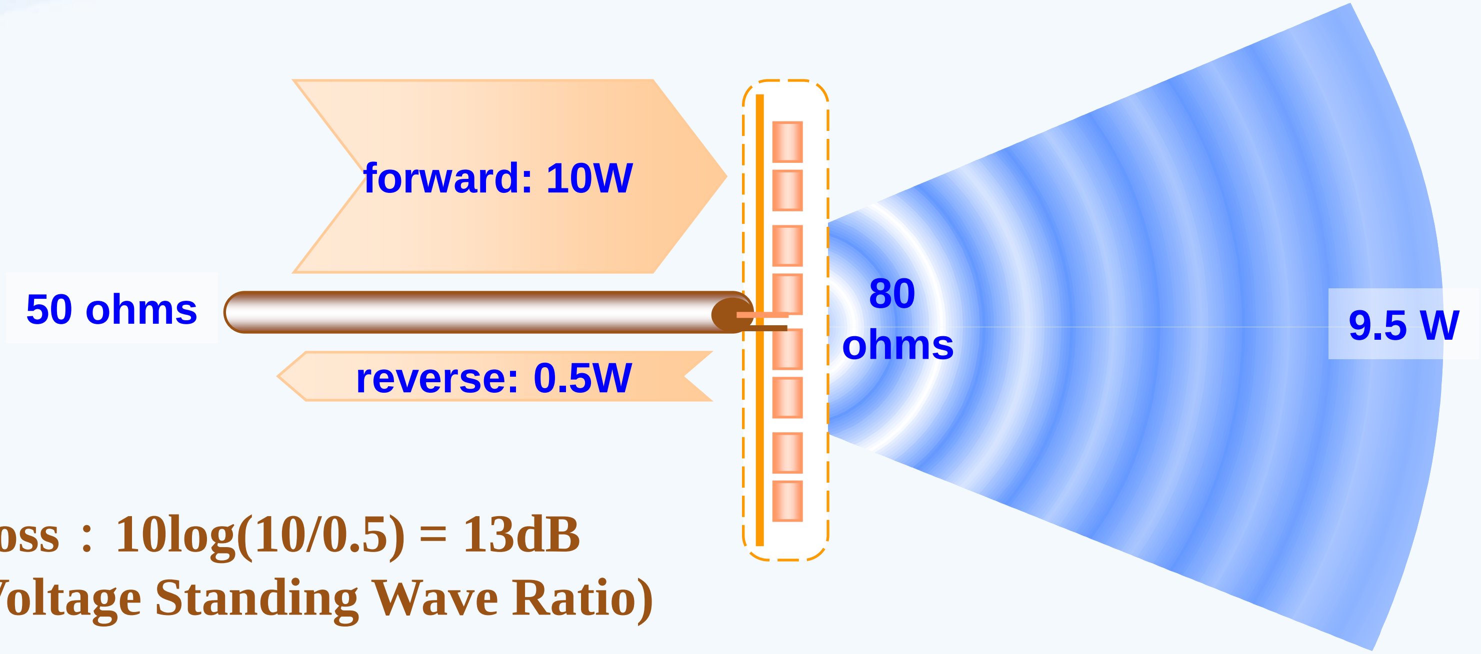


Dipoles



10log(8mW/1mW) = 9dBd

VSWR



Return Loss：10log(10/0.5) = 13dB

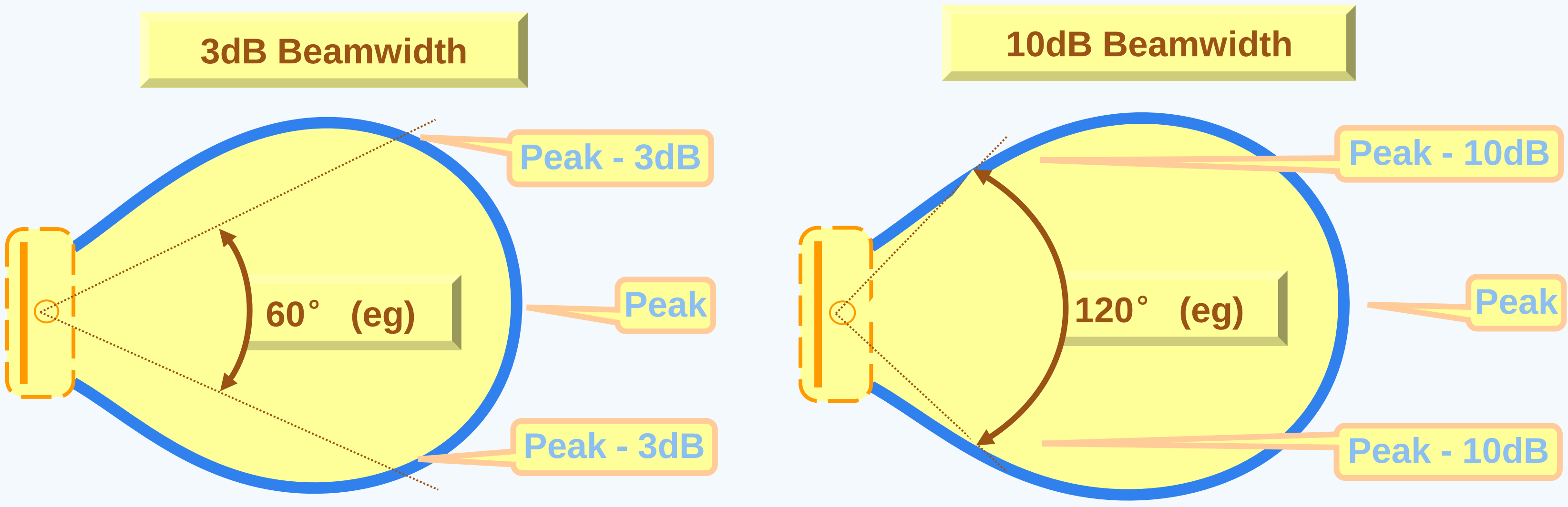
VSWR (Voltage Standing Wave Ratio)

$$\Gamma = \sqrt{\frac{0.5}{10}}$$

$$VSWR = \frac{1+\Gamma}{1-\Gamma} = \frac{1+0.2236}{1-0.2236} = 1.576$$

- **Usual Request：VSWR<1.5**
- **Reflection Coefficient：Γ=(VSWR-1)/(VSWR+1)**
- **Return Loss：RL=-20lg Γ**

Beamwidth


3dB Beamwidth
Peak - 3dB
60° (eg)
Peak
Peak - 3dB
10dB Beamwidth
Peak - 10dB
120° (eg)
Peak
Peak - 10dB

THANK U