**Tishk International University**
**Science Faculty**
**IT Department**


# Wireless Networking

## Lecture 2: Antennas

4th Grade -Fall Semester

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# Lecture 3
# Antennas

# Topics

1. Introduction to Antennas
2. Antenna Features
3. Antenna Alignment
4. Antenna Types

# 1. Introduction to Antennas

**An antenna** is a specialized transducer that converts radio-frequency (RF) fields into alternating current (AC) or vice-versa

An **isotropic antenna** radiates the energy fed into it equally in every direction in space. It is only an ideal model and cannot be built.
Real-world antennas are characterized by their ability to radiate more strongly in some directions than in others; this is called **directivity**.

Radios

Coaxial Cable

Antenna

# 2. Antenna Features

**Antenna Gain**: is a relative measure of an antenna's ability to direct or concentrate radio frequency energy in a particular direction or pattern. The measurement is typically measured in dBi (Decibels relative to an isotropic radiator).

**The Antenna bandwidth** refers to the range of frequencies over which the antenna can operate correctly.

You must choose an antenna that works well for the frequencies you intend to use (for example, use a 2.4 GHz antenna for 802.11 b/g, and a 5 GHz antenna for 802.11a).

**The Antenna Beam Width** of an antenna is the angular measure of that part of the space where the radiated power is greater than or equal to the half of its maximum value.

## Antenna Polarization

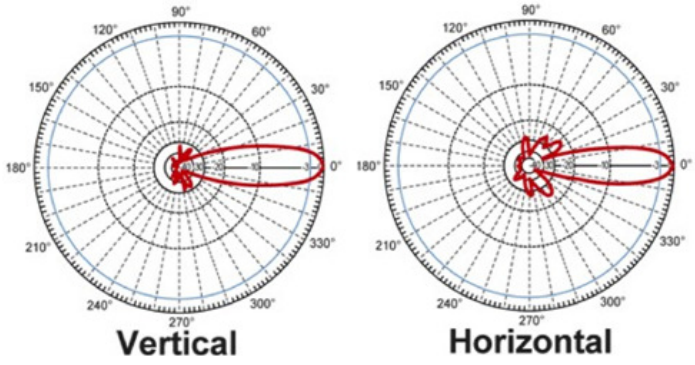
Electromagnetic waves have electrical and magnetic components. The electric field or "E" plane determines the polarization or orientation of the radio wave

The polarization of transmitting and receiving antennas MUST MATCH for optimum communications

**Reciprocity** means that antenna characteristics are same in transmitting or receiving.

**The Radiation Pattern** of an antenna is a pictorial representation of the distribution of the power radiated from, or received by, the antenna.

This is presented as a function of direction angles centered on the antenna. Radiation patterns usually use a polar projection.



# Antenna polarization - Examples



# 3. Antenna Alignment

**Antenna Alignment :** is  positioning the antennas at the same height and point them toward each other.
Some basic tools for antenna alignment: a compass, a binoculars, and means of communication, such as a walkie-talkie.
If the distance is reasonably short, a light source, such as a flashlight or laser pointer can be used.

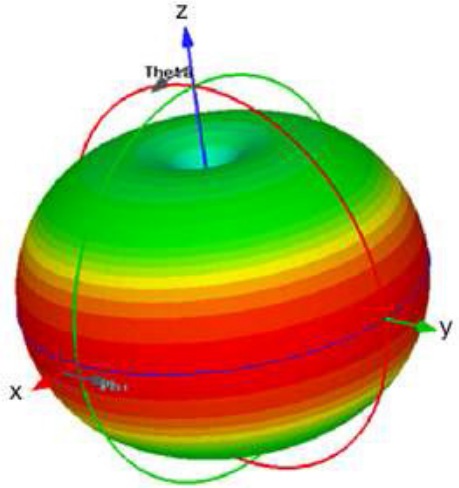
Use the Signal Level of the management tools that comes with the radio unit to analyze the radio link quality.
This option displays the radio signal strength in relation to the noise in the signal path.
If required, you can interactively optimize the antenna alignment with the Signal Level , by making small modifications in the antenna orientation

## 4. Antenna Types

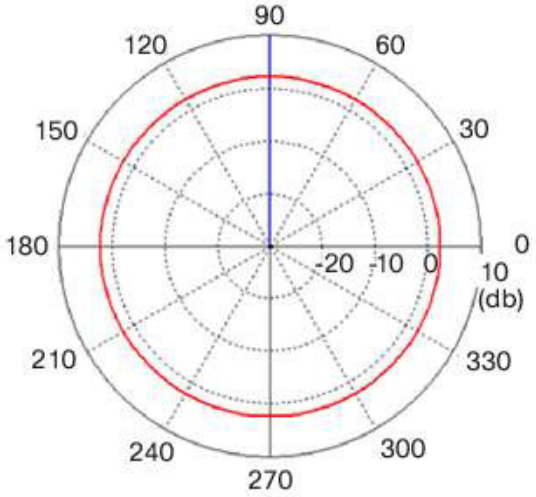
# Dipole Antenna

A dipole antenna most commonly refers to a half-wavelength (λ/2) dipole. The physical antenna (not the package that it is in) is constructed of conductive elements whose combined length is about half of a wavelength at its intended frequency of operation. This is a simple antenna that radiates its energy out toward the horizon (perpendicular to the antenna). The patterns shown in the next Figure are those resulting from a perfect dipole formed with two thin wires oriented vertically along the z-axis.

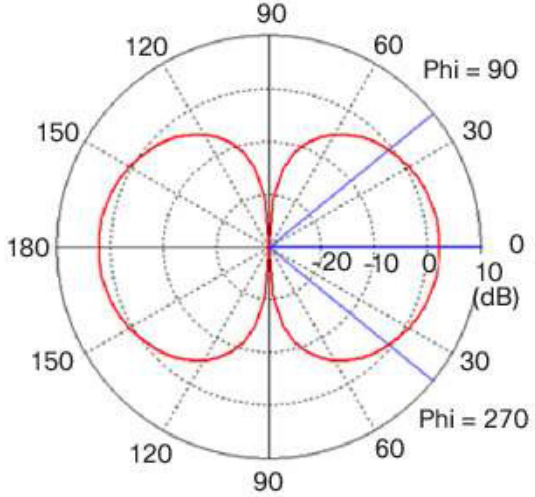
(a) Dipole Antenna Model




(b) Dipole 3D Radiation Pattern




(c) Dipole Azimuth Plane Pattern



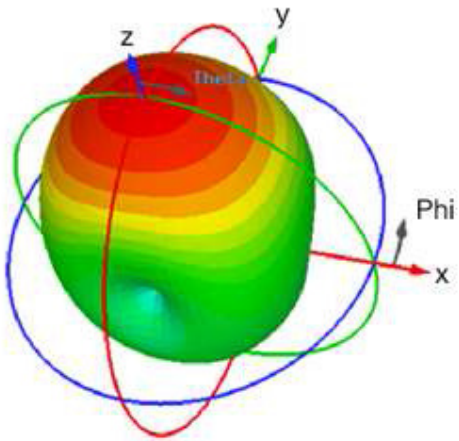

(d) Dipole Elevation Plane Pattern

# Patch Antenna

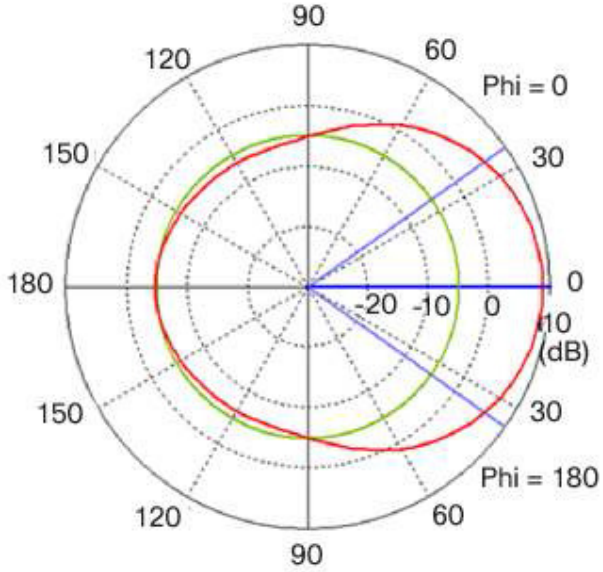
A patch antenna, is just a single rectangular (or circular) conductive plate that is spaced above a ground plane. Patch antennas are attractive due to their low profile and ease of fabrication.
The radiation pattern of a single patch is characterized by a single main lobe of moderate beam width. Frequently, the beam widths in the azimuth and elevation planes are similar,  resulting in a fairly circular beam.

Small Patch Antennas are used for indoor applications
Large Patch Antennas are  used of outdoor point to point links

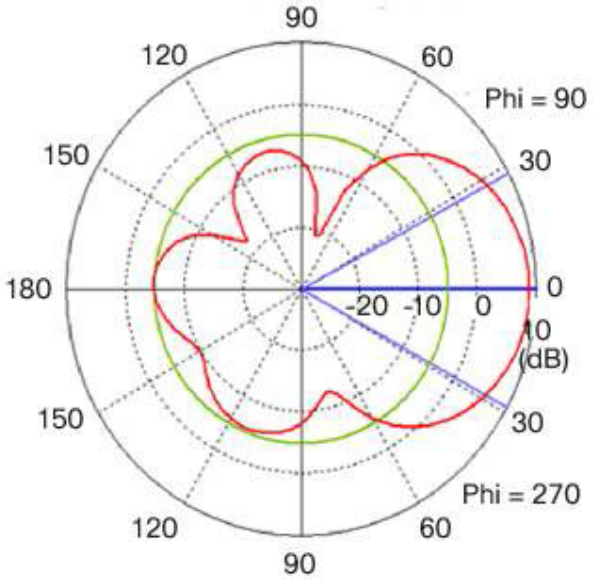
(a) Patch Antenna Model




(b) Patch Antenna 3D Radiation Pattern




(c) Patch Antenna Azimuth Plane Pattern

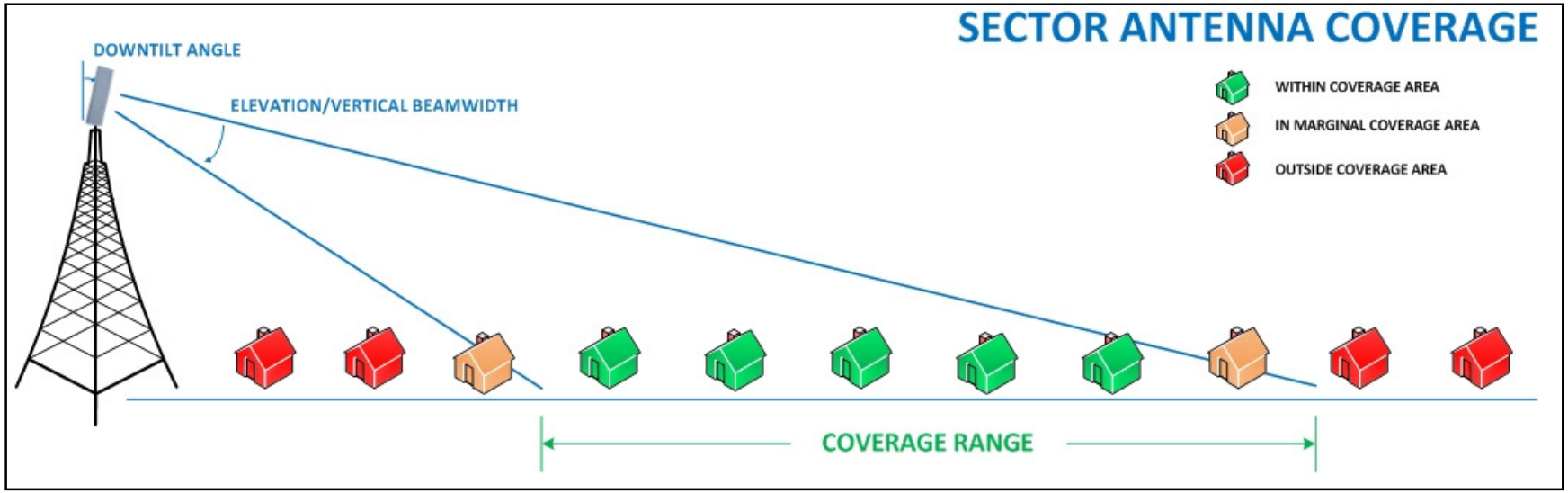


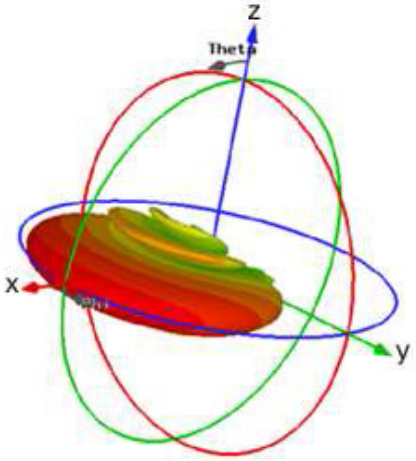

(d) Patch Antenna Elevation Plane Pattern

# Sector Antenna

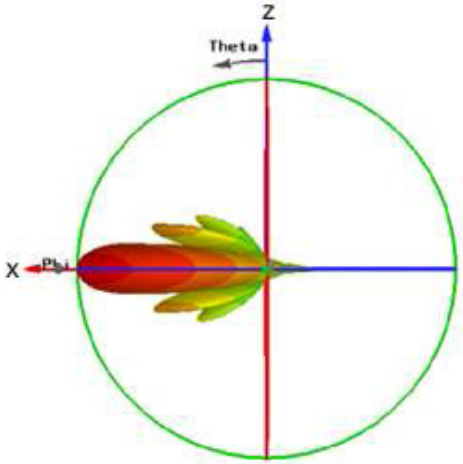
A sector antenna or “sector panel” is a somewhat specialized antenna frequently encountered in outdoor systems where wide coverage areas are desired. Very often they are built from an array of dipoles placed in front of a shaped reflector. The size and shape of the reflector determines the performance of these antennas to a large extent

Used mainly in GSM towers, and wireless ISP towers.

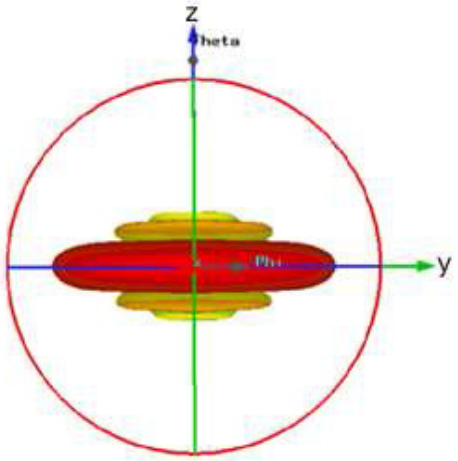




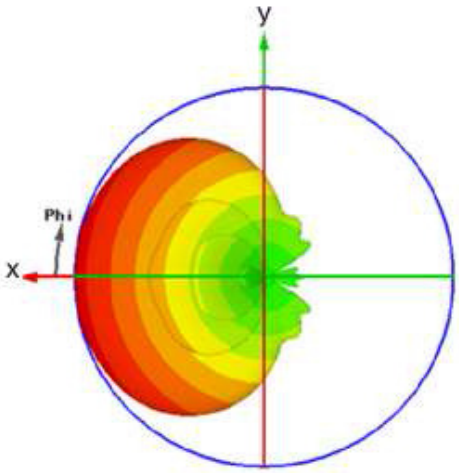

(a) Sector Antenna 3D Pattern



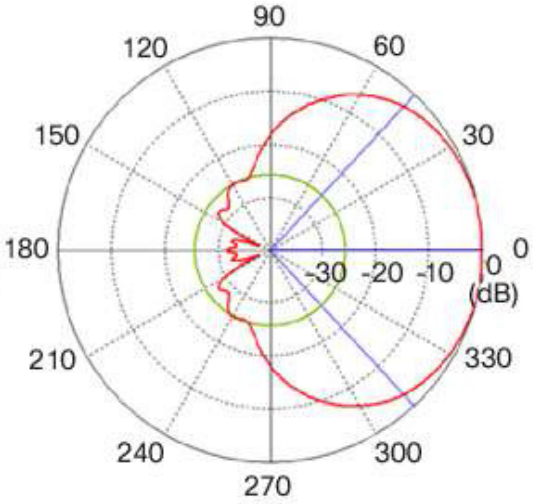

(b) Sector Antenna 3D Pattern Side View



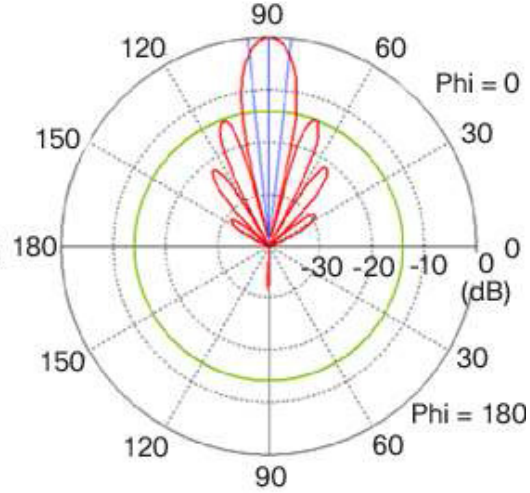

(c) Sector Antenna 3D Pattern Front View




(d) Sector Antenna 3D Pattern Top View




(e) Sector Antenna Azimuth Plane Pattern




(f) Sector Antenna Elevation Plane Pattern

# Dish Antenna

As shown in Figure below , use a parabolic dish to focus received signals onto an antenna mounted at the center. The parabolic shape is important because any waves arriving from the line of sight will be reflected onto the center antenna element that faces the dish. Transmitted waves are just the reverse; they are aimed at the dish and reflected such that they are propagated away from the dish along the line of sight.
Used in long distance Point to Point outdoor connections