

OUTLINE: Base station antennas for mobile communications

System aspects

Fundamental parameters

Beamwidths

Gain

Typical aperture efficiency

Gain and antenna length

Pattern requirements

Electrical down tilt

Variable tilt

Sidelobe suppression, null-fill

Front-to-back ratio

Squint and tracking

Polarization and cross-polar discrimination

Power handling

r.m.s. rather than peak

Broad-band and multi-band

Passive intermodulation

Sources of intermodulation

Frequency band considerations

Radio networks

Multi-user communication

Noise and link budget

Noise contributions in mobile communications

Diversity

Propagation

Simple theoretical models

Okumura-Hata empirical model

Example of propagation at 900 and 1800 MHz

Cellular systems

Cell planning

Horizontal and vertical beam-shaping

Electrical vs. mechanical tilt

Base station antenna design

Radiating elements

Selection criteria

Size

Polarization

VSWR bandwidth

Inherent beamwidth

Power handling

Dual band capability

Cost!

Examples

Dipoles, folded dipoles, log-periodic elements

Patch elements

Slots

Helices

Reflector design

Azimuth shaping using the radiators or reflector shape

Ex: drooping dipoles, boxed dipoles

Ex: corner reflector, reflector width

Artificial surfaces:

Hard and soft surfaces: Corrugations

Photonic bandgap chokes

Feed networks

Flexibility vs. low cost vs. losses

Corporate feed vs. series feed

Transmission line types

Coaxial lines

PCB

Air microstrip/stripline/coax

Phase shifters

Moving junction

Windshield wiper

Varying phase velocity

Array synthesis for base station antennas

Optimal spacing vs. directivity

Amplitude tapering: side-lobe level vs. directivity

Gain vs. length

Cosecant patterns and null-fill vs. directivity

Diversity and MIMO

Diversity

Diversity gain

Derivation of antenna correlation

Space diversity

Polarization diversity

Symmetrical radiation patterns: the Huygen source

Basic MIMO theory

Shannon capacity from Singular Value Decomposition

MIMO possibility in cellular systems?

2 x 2 or 4 x 2 MIMO?

Adaptive antennas vs. MIMO: where is the difference?

No information of interfering signal (training sequence)

No communication between separate users