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