Radios – The Wireless Interface

Part 1
Objectives

• Understand the performance requirements of each component in the RF block diagram. *Links to communications systems analysis*

• Understand the design and technology challenges for each component in the RF block diagram

• Describe implications on the radio hardware design due to various types of scaling, e.g. size, frequency, cost, power, data rate. *Links to wireless network design*
Outline

- Overview and RF Block Diagram
- Filters
- Amplifiers
- Up/Down Conversion
- Oscillators and Synthesizers
- Modulation Basics
- Antennas
- Chip-Level Radios
- Integration and Packaging
Overview & RF Block Diagram
Overview and RF Block Diagram

• Functional View of the Radio
• The Role of Analog RF Hardware in Today’s Radios: RF Sub-system Block Diagrams & Requirements
• Some Design and Technology Issues
• Future Front-End Technology
Functional View of the Radio

• Analog RF hardware – the link between the information (data) and the channel

• Multiple perspectives
  – High Level → how information is processed
  – Mid Level → components needed for each processing step
  – Low Level → design of each component
RF Analog Block Diagram

Information Processing

Baseband → Modulator → Demodulator → Baseband

Noise + Channel

RF Carrier

RF Carrier

Courtesy of Brit Kane, ITT Technologies
RF Analog Block Diagram - Receiver

Courtesy of Britt Kane
RF Analog Block Diagram - Receiver

- Band select Filter
- Image Reject Filter
- Channel select Filter
- IF Amp

Courtesy of Brit Kane, ITT Technologies
RF Analog Block Diagram

Courtesy of Britt Kane
Some Design & Technology Issues

• Form: Board Level vs. Chip Level

• Architecture:
  – Down-conversion: Single vs. Dual vs. Zero
  – Dual-band, multi-band
  – Multi-channel, redundancy
Future Front-End Technology

RF IN

A/D

DIGITAL
I/O

D/A

RF OUT

Courtesy of Britt Kane
Overview – Conclusions

• RF analog hardware is the pathway between the data and the propagation channel
• Functional and then component-level block diagrams are the starting points for radio design
• The radio architecture defines how functional requirements flow down to the component / device level