Fast vs. Slow Fading

- Combining multipath with doppler, we have a signal that changes with time
- How quickly does the signal change?
- Best to consider this from the perspective of a packet

(Fig. 1)

- If the signal changes much more quickly than the packet length, this is called "fast fading"
- If the packet length is much longer than signal changes, this is called "slow fading"
- Generally, fast fading is better – getting stuck with a low signal strength is bad, but in fast fading you will probably get a good signal on average
- Unfortunately most of the fading in the world is slow

Link Budgeting

- How much power do you need to be reasonably assured of good communication? – make a link budget.
- Aside: Decibels
- Gains and losses in wireless communication are multiplicative, e.g. amplifier gain, fading
- Multiplicative gains are hard to deal with intuitively … but … if the gains are ABCD, they can be made additive by taking the log: log(ABCD) = log A + log B + log C + log D
- You can express a quantity x in decibels by taking $10\log_{10}x$

- Examples: x=1=0dB; x=10=10dB; x=100=20dB; x=1000=30dB; ...
- Other fun stuff to know: x=2≈3dB
- Adding in dB is equivalent to multiplying in normal domain; subtracting in dB is equivalent to dividing in normal domain
- E.g. 20=2x10=3dB+10dB=13dB; 500=1000/2=30dB-3dB=27dB
- dBm = dB referenced to 1 mW : e.g., 30 dBm = 1000 mW = 1 W.
- Link budgets are usually expressed as POWER (not amplitude) and in terms of dB.
- Take the starting power (at the transmitter), add all the gains, and subtract all the losses

(Eq. 1)

- P_T: Transmitter power; G_T: Transmitter antenna gain; G_R: Receiver antenna gain; L_P: Path loss; L_F: Fading margin; L_O:Other losses; P_R:Receiver power (all in dB)