

Wireless Communications

ITL

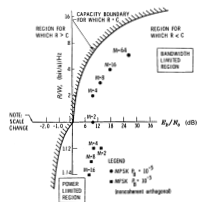
The Basics

- Wireless digital communications
 - Select a frequency for the "carrier"
 - Encode bits or multi-bit symbols onto the carrier
 - e.g. Amplitude or Phase Shift Keying
 - Signal to Noise ratio at the receiver key
 - Measured as E_b/N_0 -- Energy per bit relative to noise density
 - Spectral efficiency measured in bits/sec per Hz
 - Shannon's Law limits the theoretically possible efficiency

More Terminology

- What is dB?
 - Logarithmic scale for measuring ratios
 - $\text{dB} = 10 \log_{10}(\text{ratio})$
 - A factor of 1,000 = 30dB
 - A factor of 1,000,000 = 60dB
 - A factor of 2 is 3dB
- What is dBm
 - Power measured in dB relative to 1mW
 - $100\text{mW} = 20\text{dBm}$

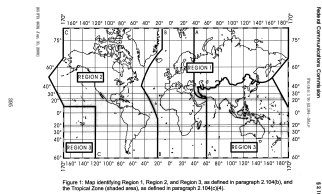
Allowed Operating Regions



About those Carrier Frequencies

- Spectrum has to be shared within the coverage area of a transmitter
- Globally, the ITU-R provides "recommendations"
- In the US, every transmitter must have either
 - an FCC License, or
 - an NTIA authorization

ITU Regions



About those Carrier Frequencies

- FCC rules provide for a "blanket license" for a few frequency bands
 - Called "unlicensed spectrum"
 - Restrictions on power levels and encoding apply
 - Most common examples:
 - 2.5Ghz and 5Ghz

About that Power Thing

- Unless we can control noise, power is everything
- Raw power is limited by
 - Battery life
 - Regulation
- We can improve performance with directional antennas
- Power fades away.....
 - With the square of the distance from the transmitter
 - Higher frequencies fade sooner (square law)
 - Stuff (walls, people, shrubs) absorbs power