Licensed vs Unlicensed Microwave Technology

Wireless Topics

- Common licensed and unlicensed frequencies
- Frequencies and Ranges
- Indoor Wireless Technologies
- Licensed vs. Unlicensed Frequencies
- Mobile Applications
- Hot Spot Applications
- Overview of Wireless Security
- Installation and Equipment
- Future of Wireless

Unlicensed Myths

- You can have more than one antenna in a given area
- There is a high occurrence of interference with unlicensed links
- Unlicensed links are less reliable than licensed links
- Interference will cause an outage 100% of the time
- Unlicensed links are not carrier class equipment
- Unlicensed is less secure than licensed

Licensed Myths

- Licensed technology is more expensive than unlicensed
- FCC licensing is very expensive and time consuming
- There are not many manufacturers of licensed microwave equipment
- Licensed technology is more difficult to install
- FCC licenses are hard to get

Licensed vs. Unlicensed

- Distance limitations
- Power Output
- Interference
- License Process and Costs - $2500 per link or more
- Licensed Multipoint
- Frequency Planning and Neighbor Coordination
- Environmental Factors – Rain Zones
- Fade Margin and Rain Fade
- Antenna Size

How to Choose

- Step 1 – Determine your required bandwidth
- Step 2 – Determine your coverage area
- Step 3 – Have a spectrum analysis completed for the area
- Step 4 – Ask the tower or structure owner about their interference policy
- Step 5 – Determine your risk tolerance for interference
- Step 6 – Determine your budget
- Step 7 – Can you use large antenna?
- Step 8 – Pick your frequency

Frequencies and Applications

- Common Unlicensed Frequencies
  - 900Mhz – Multipoint indoor and outdoor
  - 2.4Ghz – Point to Point, multipoint indoor and outdoor
  - 5.3/8Ghz – Point to Point, multipoint indoor and outdoor
  - 60Ghz – Point to Point outdoor
- Common Licensed Frequencies
  - 800 MHz – Multipoint outdoor government and EMS
  - 900 MHz – Multipoint outdoor government and SCADA
  - 2.1/7Ghz – Point to Point and Multipoint outdoor
  - 6/38Ghz – Point to Point outdoor

900 MHz Unlicensed

- Indoor wireless phones and low speed data
- Outdoor multipoint with low speed data
- Bandwidth speeds of up to 1MB
- Penetrates obstructions, walls and foliage very well
- Outdoor ranges to 20 miles with line of sight
- Outdoor ranges to 3 miles with no line of sight
- Not affected by weather or environmental factors
- Used by Wireless ISPs, Water Quality Control, Government and mobile
- Manufacturers include Motorola, Alvarion, WaveRider, etc
- Overall low cost, high penetration and low bandwidth

2.4 Ghz Unlicensed

- Indoor wireless data devices and phones with average speed data
- Outdoor multipoint and point to point with average speed data
- Bandwidth speeds of up to 11MB
- Average ability to penetrate obstructions, walls and foliage
- Outdoor ranges to 40 miles with line of sight
- Outdoor ranges to 1 miles with no line of sight
- Not affected by weather or environmental factors
- Used by Wireless ISPs, Education, Commercial and home users
- Manufacturers include Cisco, Proxim, Alvarion, etc
- Overall low cost, average penetration and average bandwidth

2.4 Ghz Technologies

- 802.11B Direct Sequence Radios
  - Indoor radio equipment with ranges to 500 ft
  - Outdoor radio equipment with ranges to 20 miles
  - Low cost indoor access points and CPE devices
  - Speeds of 11MB
  - Industry standard with many manufacturers
  - Primarily indoor multipoint and outdoor point to point
  - Prone to security problems if not implemented correctly

2.4 Ghz Technologies

- Frequency Hopping Radios
  - Primarily for outdoor multipoint
  - Outdoor radio equipment with ranges to 12 miles
  - Average cost outdoor access points and CPE devices
  - Speeds of 3MB
  - Excellent ability to avoid interference
  - Mobility capable
  - Not Prone to security problems due to proprietary designs

5.3 , 5.7 and 5.8 Ghz Unlicensed

- Indoor wireless data devices with high bandwidth
- Outdoor multipoint and point to point with high speed data
- Bandwidth speeds of up to 480MB
- Average ability to penetrate obstructions, walls and foliage
- Outdoor ranges to 30 miles with line of sight
- Outdoor ranges to 3 miles with no line of sight
- Somewhat affected by weather or environmental factors
- Used by Wireless ISPs, Education, Government and Commercial
- Manufacturers include Cisco, Proxim, Alvarion, Motorola,etc
- Overall average cost, low penetration and high bandwidth

60 Ghz Unlicensed

- Outdoor wireless data devices with high bandwidth
- Outdoor point to point with high speed data
- Bandwidth speeds of up to 1GB
- No ability to penetrate obstructions, walls and foliage
- Outdoor ranges to 2 miles with line of sight
- Very affected by weather or environmental factors
- Used by Education, Government and Commercial
- Manufacturers include Terrabeam, YDI, AirFiber,etc
- Overall high cost, no penetration and very high bandwidth

800-900 MHz Licensed

- Outdoor wireless phones and low speed data
- Outdoor multipoint with low speed data
- Bandwidth speeds of up to 1MB
- Penetrates obstructions, walls and foliage very well
- Outdoor ranges to 20 miles with line of sight
- Outdoor ranges to 10 miles with no line of sight
- Not affected by weather or environmental factors
- Used by Water Quality Control, Government and mobile
- Manufacturers include Motorola, Alcatel, Harris, etc
- Overall high cost, high penetration and low bandwidth

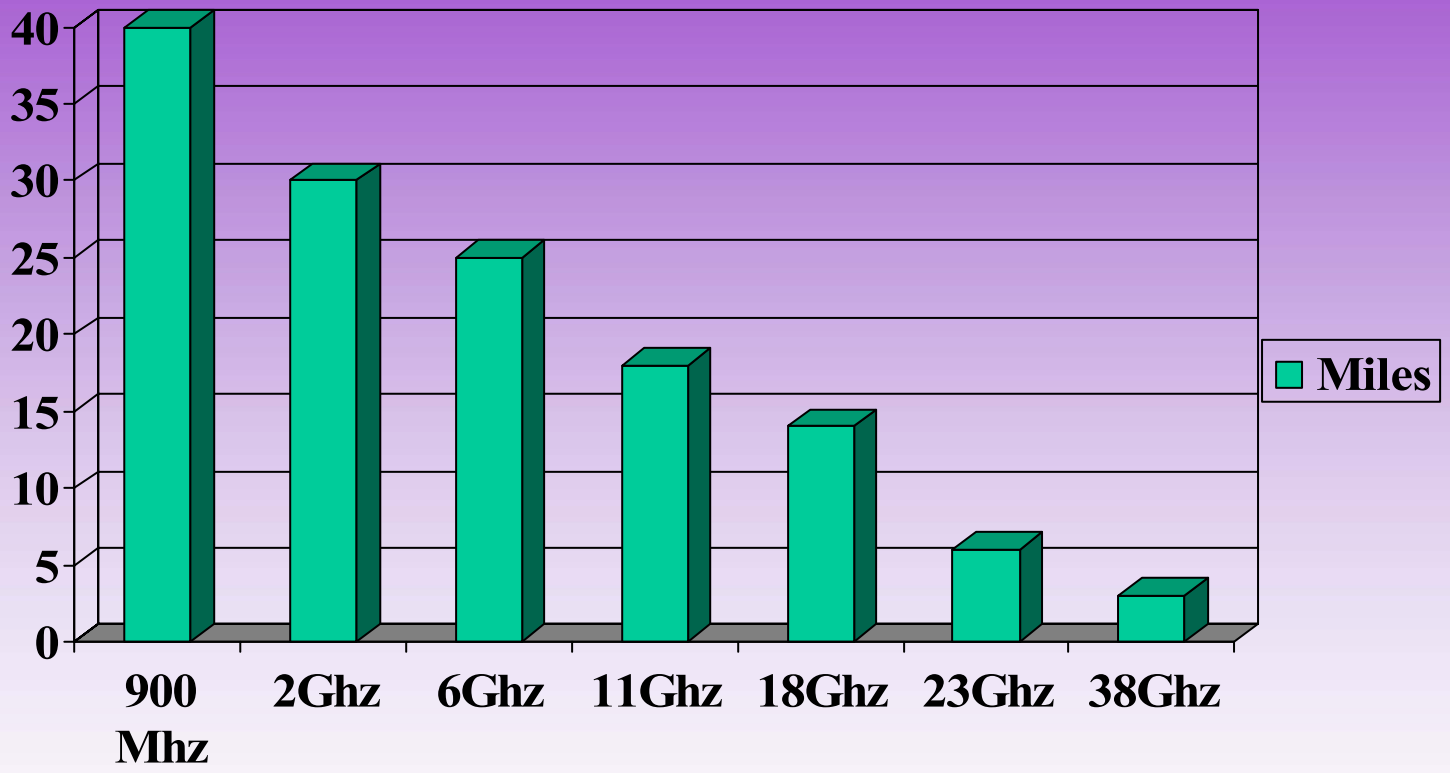
2.1 to 2.7 Ghz Licensed

- MDS, MMDS and ITFS
- Outdoor multipoint with average data speeds
- Bandwidth speeds of up to 30MB
- Average penetration of obstructions, walls and foliage very well
- Outdoor ranges to 30 miles with line of sight
- Outdoor ranges to 10 miles with no line of sight
- Not affected by weather or environmental factors
- Used by Carriers, Government and mobile
- Manufacturers include Motorola, Alcatel, Harris, etc
- Overall high cost, average penetration and average bandwidth

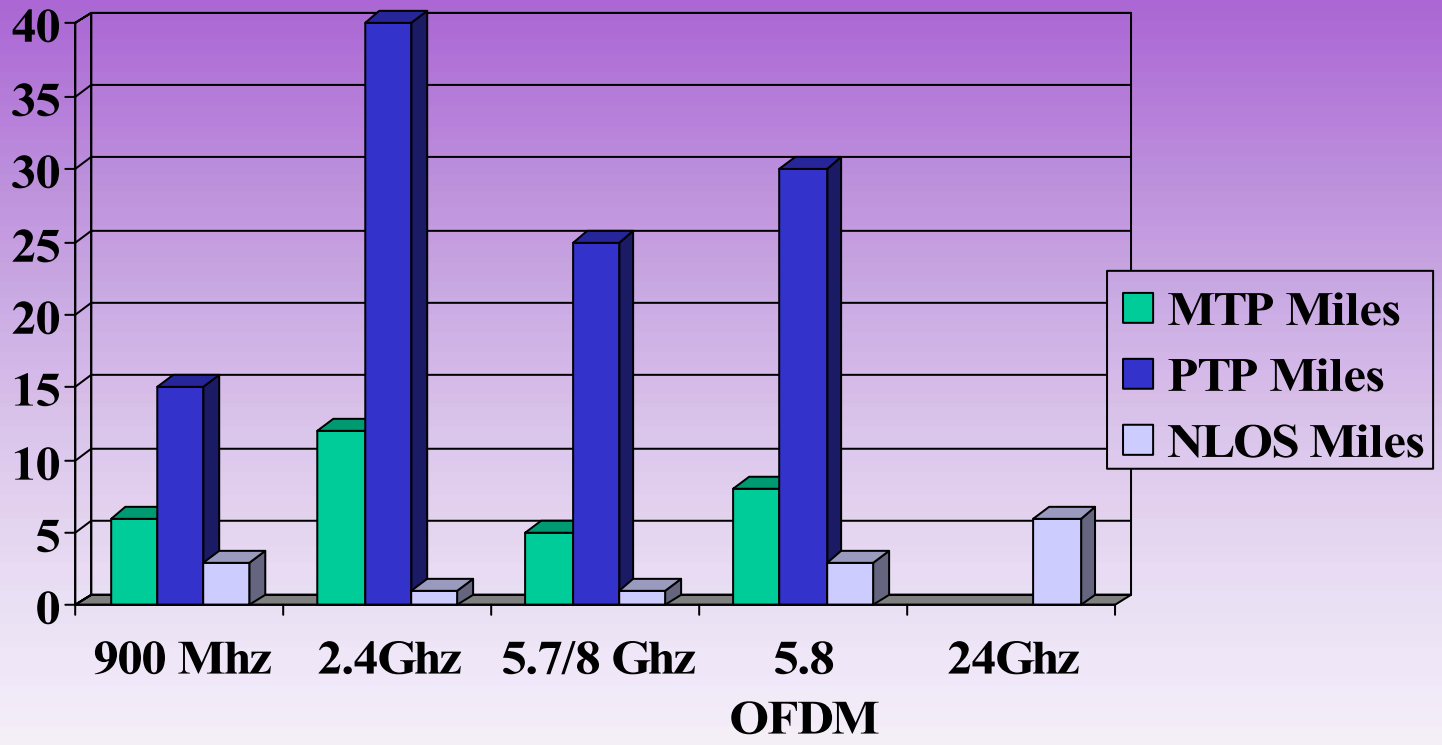
6Ghz to 38Ghz Licensed

- Outdoor point to point with high data rates
- Bandwidth speeds of up to 1GB
- No penetration of obstructions, walls and foliage very well
- Outdoor ranges to 30 miles with line of sight
- affected by weather or environmental factors as frequency goes up
- Used by Radio Stations, Education, Carriers, Government and Commercial
- Manufacturers include Motorola, Alcatel, Harris, Ceragon, Proxim,etc
- Overall high cost and high bandwidth

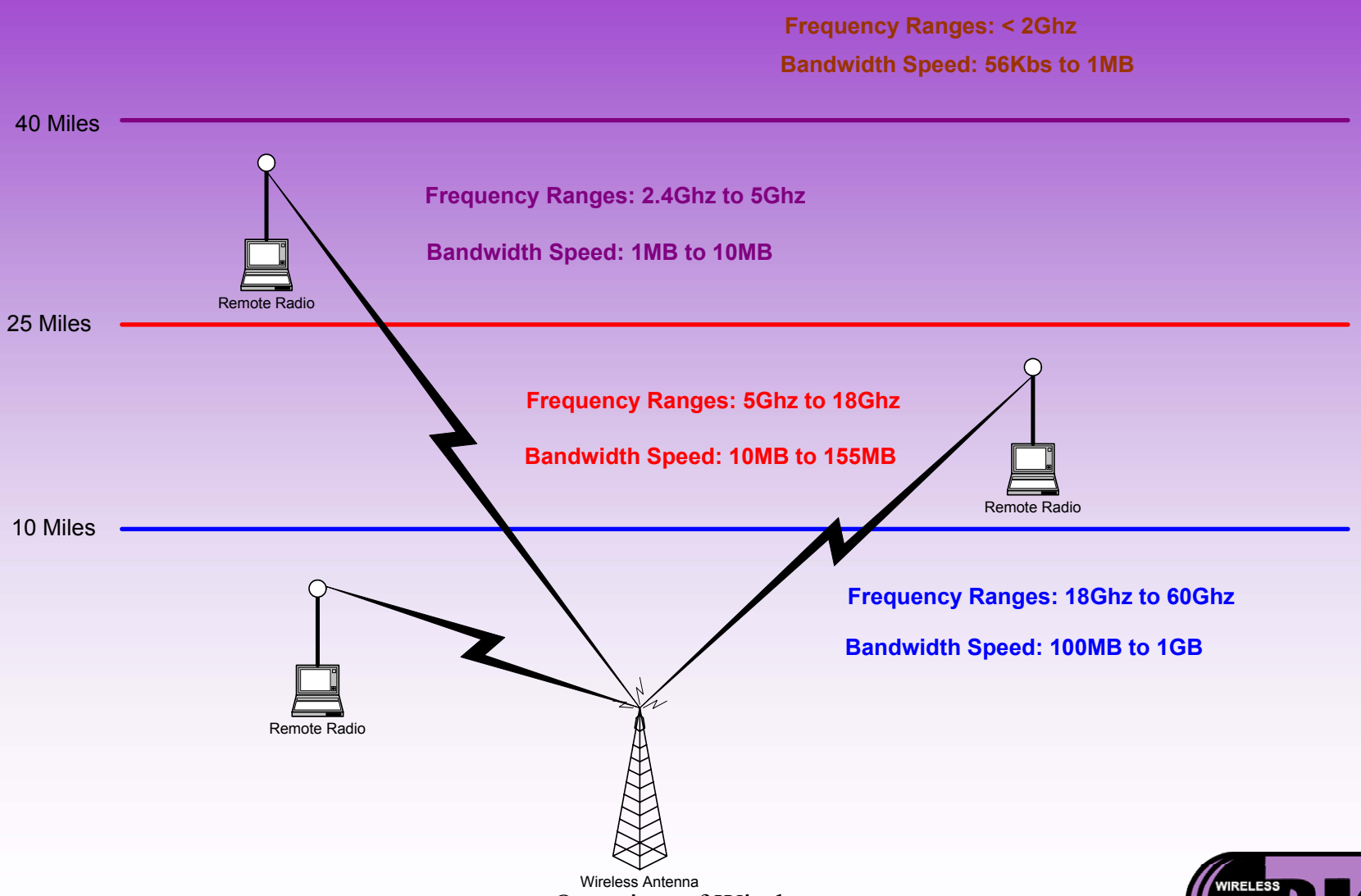
Licensed Frequency Ranges Point to Point



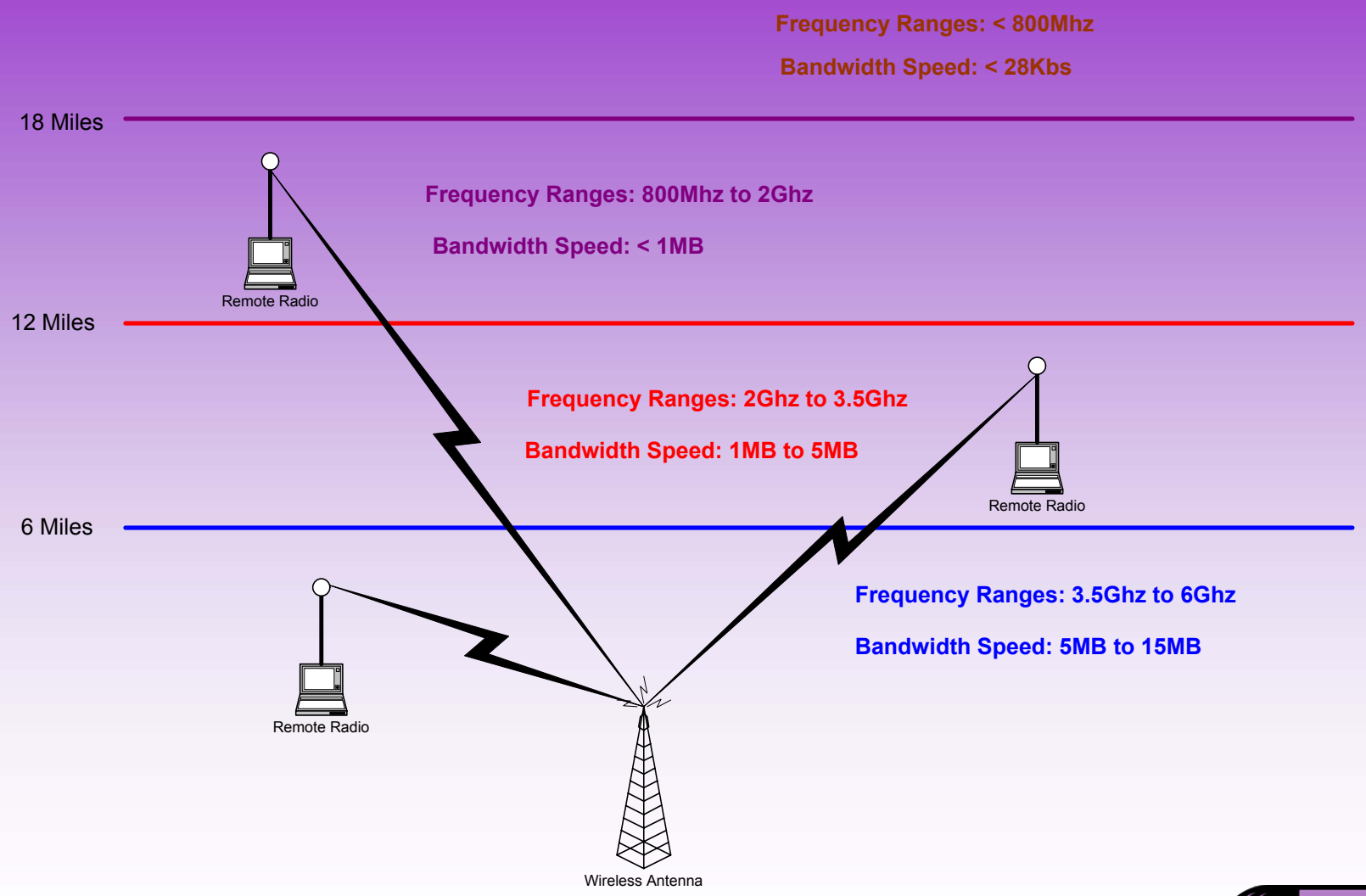
Unlicensed Frequency Ranges



Outdoor Wireless Technology
Typical Point-to-Point Range Chart



Outdoor Wireless Technology
Typical Multipoint Range Chart



Outdoor Wireless Technologies

- Point to Point
  - 802.11B, G and A – Low cost links to 54MB, not a true outdoor technology yet
  - 2.4Ghz Frequency Hopping – Average cost to 3MB, proven outdoors
  - 5.3 and 5.7Ghz – Average cost to 45MB and 7 miles
  - 5.8 Ghz – Average cost to 480MB and 10 miles
  - 5.8Ghz OFDM – Average cost to 50MB and 30 miles, NLOS capable
  - 6Ghz – Higher Cost to 1GB and 25 miles
  - 11Ghz – Higher Cost to 400MB and 20 miles
  - 18Ghz – Higher cost to 200MB and 14 miles
  - 23Ghz – Higher cost to 45MB and 5 miles
  - 60Ghz – Average cost to 1GB and 2 miles

Outdoor Wireless Technologies

- Multipoint
  - 900Mhz – Low cost to 1MB and 6 miles, NLOS to 3 miles
  - 802.11B, G and A – Low cost links to 54MB, not a true outdoor technology yet, 1 mile range
  - 2.4Ghz Frequency Hopping – Average cost to 3MB and 12 miles
  - 2.1/7Ghz MMDS – High cost to 30MB and 10 miles
  - 5.3 and 5.7Ghz – Average cost to 20MB and 5 miles
  - 5.8 Ghz – Average cost to 60MB and 5 miles
  - 5.8Ghz OFDM – Average cost to 15MB and 8 miles, NLOS capable

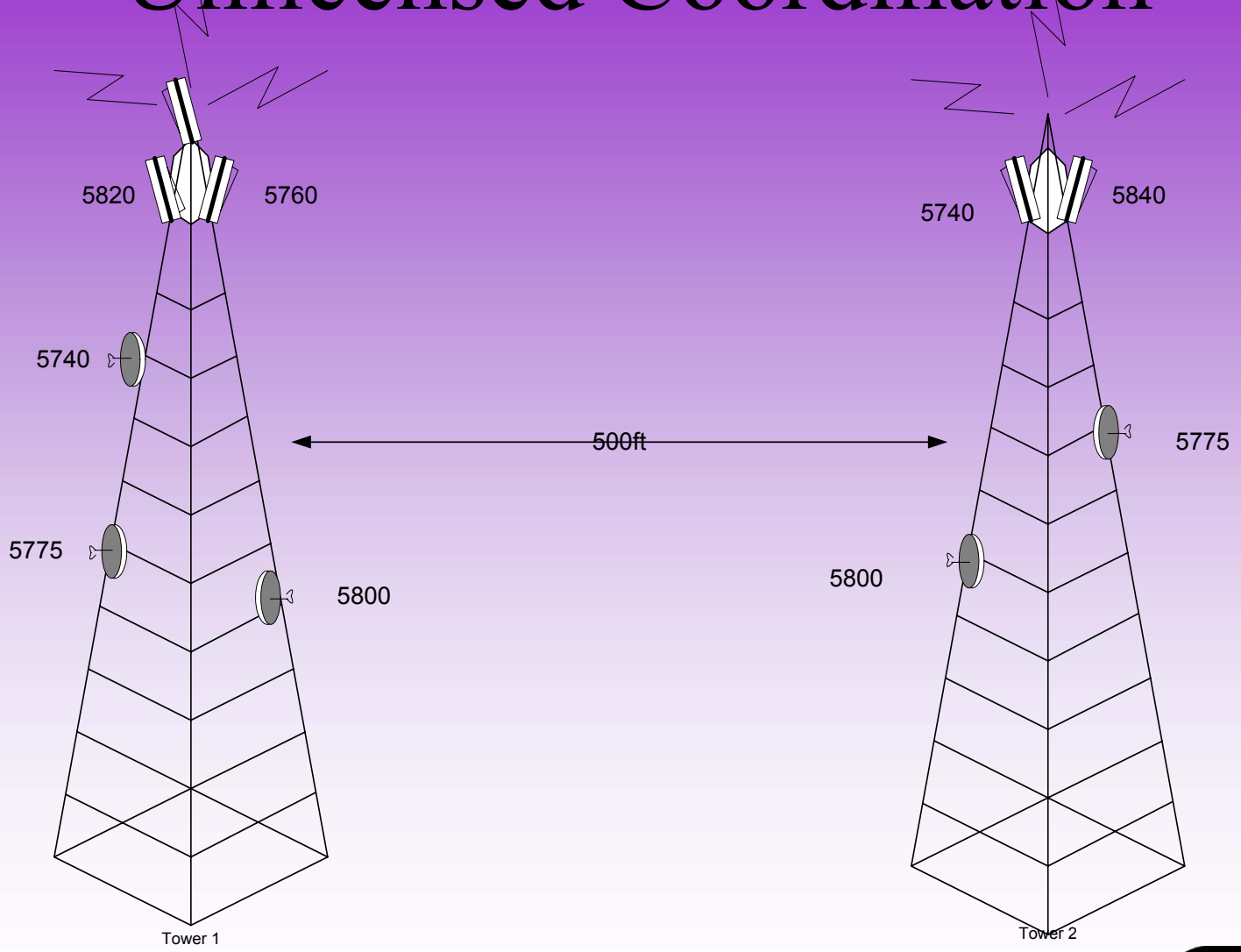
Average Costs for Wireless

- Point to Point
  - 2.4Ghz and 5.8Ghz low speed - $3000.00 per link
  - 5.3-8Ghz 45 MB - $10000.00-$15,000.00 per link
  - 5.8Ghz 100Mb and higher - $25,000.00-$80,000.00 per link
  - 6-18Ghz 100Mb and Higher - $40,000.00-$120,000.00 per link
  - 60Ghz 100MB and higher - $15,000.000-$40,000.00 per link
- Multipoint
  - 2.4Ghz outdoor $1500.00-$3000.00 per base station
  - 2.1/7Ghz MMDS - $20,000.00-$40,000.00 per base station
  - 5.7/8Ghz - $3500.00-$5000.00 per base station

Licensed Considerations

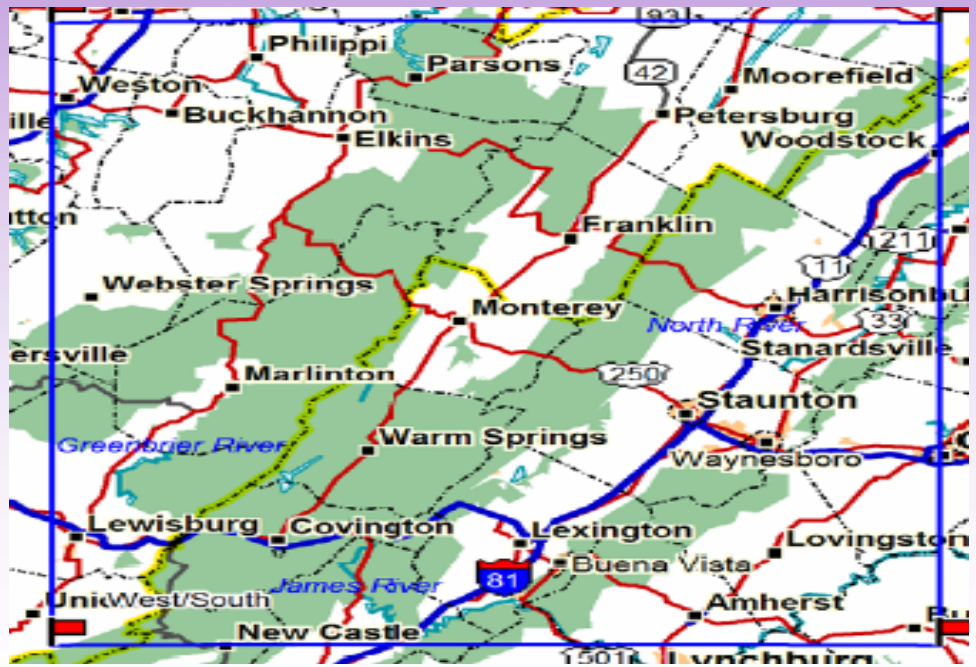
- Point to Point Common Backhaul Frequencies
  - 6Ghz – not affected by rain
    - 6Ft Antenna Minimum
    - In Use by Public Safety
  - 11Ghz – somewhat effected by rain
    - 4Ft Antenna Minimum
    - In Use by Public Safety but more readily available
  - 18Ghz – very effected by rain
    - 2Ft Antenna Minimum
    - FCC restrictions and less channel bands available
  - 23Ghz – extremely effected by rain
    - 2Ft Antenna Minimum

Unlicensed Coordination



Protected Zones

- Protected zones are areas of the country that have been setup for space and weather observation purposes and special consideration must be taken when using certain licensed frequencies in these areas.
- 18Ghz Frequency Effected for Point-to-Point



FCC|Resources

- www.fcc.gov - complete research, license search and application resource site
- Call the FCC at