



# **Wireless Broadband: Licensed and License-Exempt Spectrum Access**

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# Spectrum Management

- One of the key roles of the FCC in facilitating the deployment of broadband wireless technologies is to make additional spectrum available for these services and technologies
- Mechanisms to make spectrum available
  - Allocate Spectrum to various radio services
  - Develop Service Rules to provide administrative procedures, technical standards, and other operational requirements for shared intra- and inter-service use of the spectrum
  - Assign Frequencies to individual systems or authorize specific equipment use



# Frequency Allocations

- Frequency allocations determine the type of use allowed in the block or band of frequencies
  - Services: Satellite (FSS, MSS...), Fixed, Mobile, Broadcast, Radiolocation, etc.
  - License Exempt: permitted in non-restricted frequency bands
  - Status: Primary, Secondary, Non-Interference Basis
- Spectrum Use Models
  - Exclusive Use
  - Shared Use
  - Commons



# Choosing Spectrum

- Many factors considered when deploying wireless broadband systems
  - Type of service
  - Range of operation
  - End users
  - Interference protection
  - Spectrum availability
  - Equipment availability, reliability, affordability



# Choosing Spectrum

- Broadband systems may consist of a combination of different technologies in different frequency bands and regulatory structures
  - Backhaul may be provided by wireline, satellite, licensed fixed point-to-point, or license-exempt devices
  - Local access may use licensed or license-exempt devices depending on the range that is needed, spectrum and equipment availability





# Frequency Assignments, Authorizations

- First-come, First-served (coordinated site based services)
- Market oriented approach to licensing
  - Exclusive licensees receive specific geographic and spectrum blocks
  - Equipment must meet basic technical requirements
  - Have flexibility to offer new applications
- Licensed-exempt use in non-restricted bands
  - No protection from interference
  - Low cost barrier to entry
- Hybrid licenses
  - Capitalize on benefits non-exclusive, nationwide licenses
  - Licensees register sites to help avoid mutual interference



# Rules that Assist Rural Deployment

- Diverse spectrum offerings.
  - Spectrum auctions offer various spectrum block sizes and geographic block sizes
- Secondary Markets
- Construction requirements (Substantial Service filings)
- Tribal Lands bidding Credits
- Small Business Bidding Credits

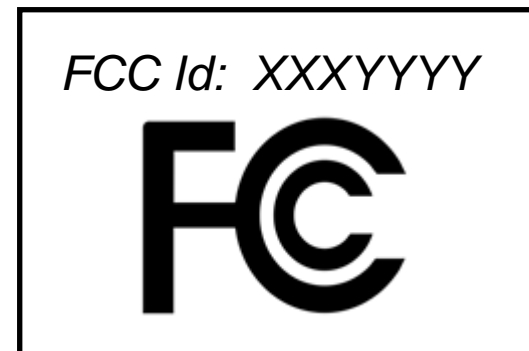


# Auction of Licenses

- The FCC auction homepage has much information on spectrum that has been made available, geographic license areas, spectrum block sizes and other information



- One can then search for specific licensee information using the Universal Licensing System (ULS) and equipment information using the Equipment Authorization System (EAS)







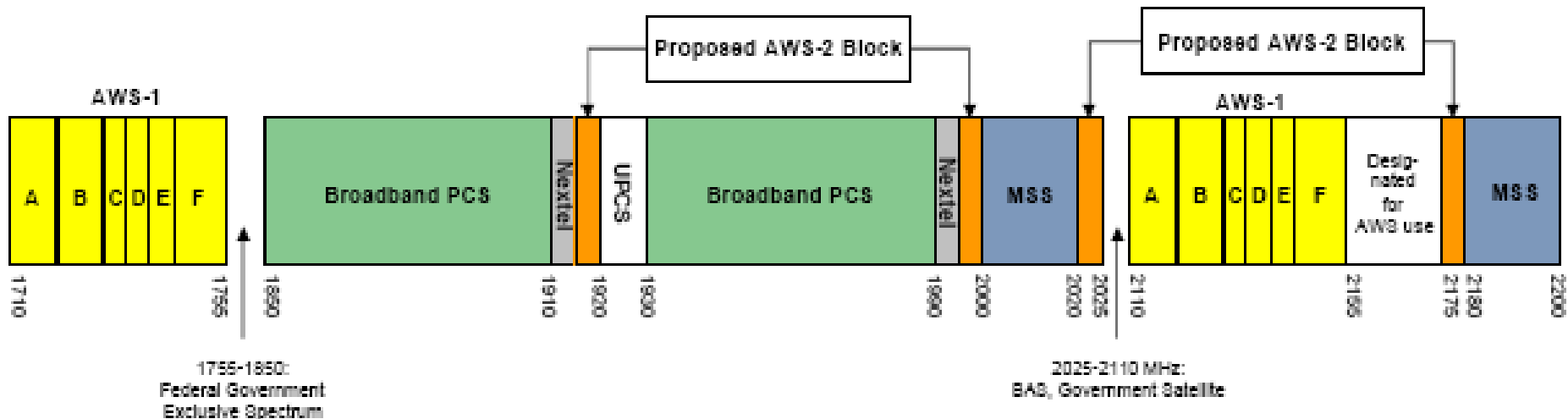
# Frequency Allocations

- Frequency bands recently available for licensed wireless broadband services
  - 1710-1755 MHz / 2110-2155 MHz (AWS-1); (Auctioned September, 2006)
  - 3650-3700 MHz (Hybrid Licensing since May, 2007)
  - 700 MHz Band; (Auctioned January, 2008)
  - 2496-2690 MHz (BRS/EBS); (Auction scheduled for October 2009)

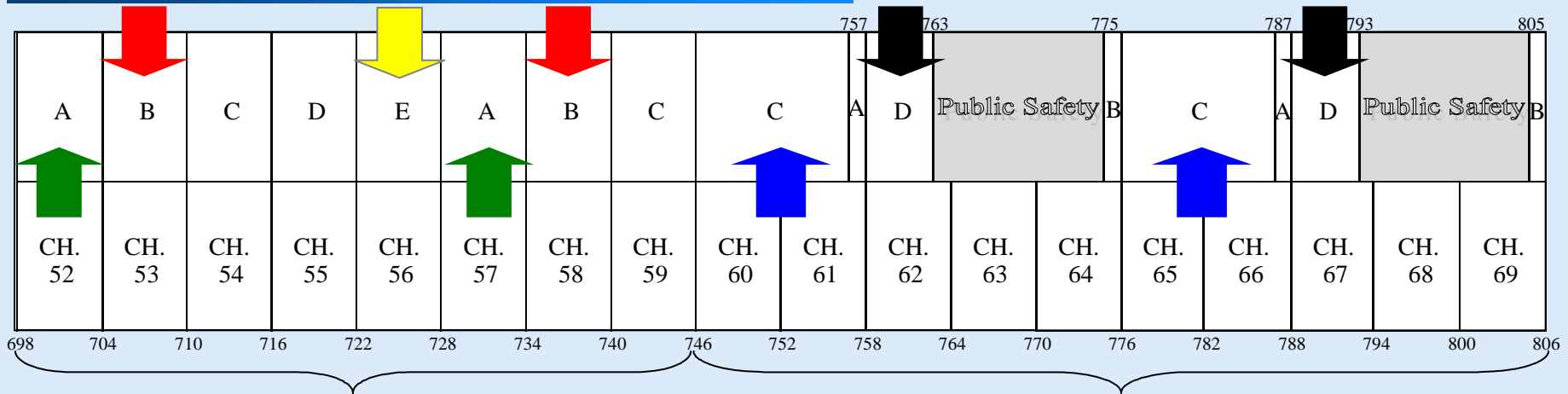


# AWS -1

## Advanced Wireless Services (AWS) Band Plan



# Revised 700 MHz Band Plan



LOWER 700 MHz BAND (CH. 52-59)

UPPER 700 MHz BAND (CH. 60-69)

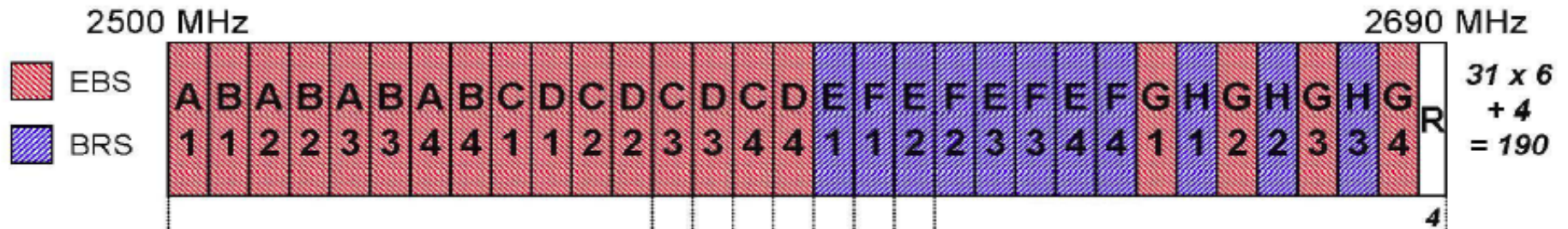
Block	Frequencies	Bandwidth	Pairing	Area Type	Licenses
A	698-704, 728-734	12 MHz	2 x 6 MHz	EA	176
B	704-710, 734-740	12 MHz	2 x 6 MHz	CMA	734
C	710-716, 740-746	12 MHz	2 x 6 MHz	CMA	734
D	716-722	6 MHz	unpaired	EAG	6
E	722-728	6 MHz	unpaired	EA	176
C	746-757, 776-787	22 MHz	2 x 11 MHz	REAG	12
D	758-763, 788-793	10 MHz	2 x 5 MHz	Nationwide	1
A	757-758, 787-788	2 MHz	2 x 1 MHz	MEA	52**
B	775-776, 805-806	2 MHz	2 x 1 MHz	MEA	52**

\*\* These Guard Band Blocks have been auctioned, but are being relocated.

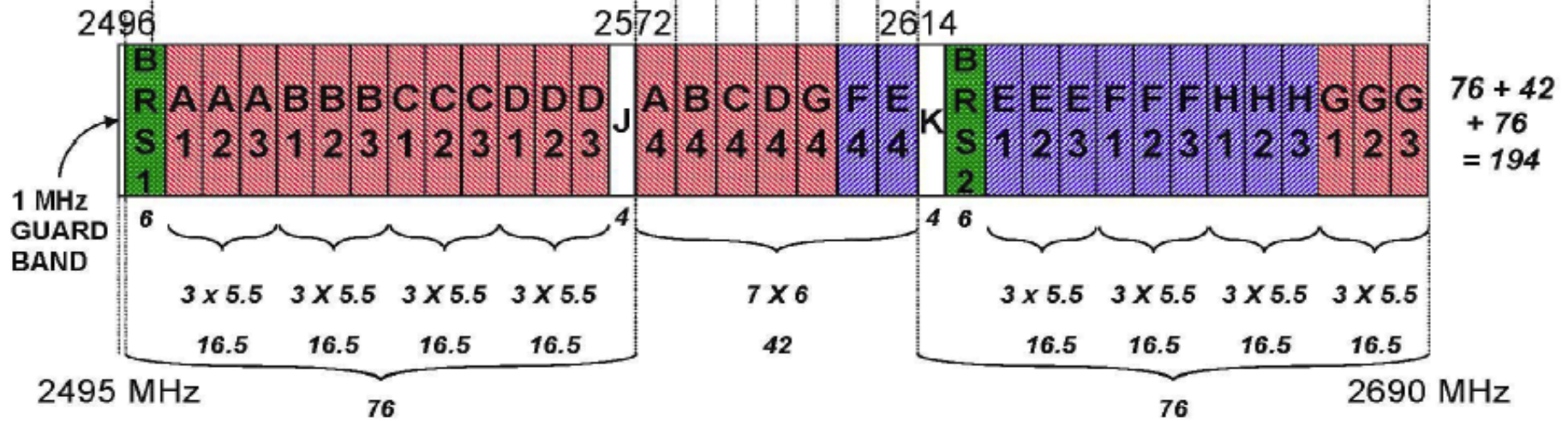


# BRS/EBS

## PRE-TRANSITION



## POST-TRANSITION











# Service Rules

- Promote Intra-service and inter-service spectrum sharing and ensures use of the spectrum
  - Technical rules (power limits, frequency and emissions) to control interference
  - Coordination processes, coordination thresholds
  - Construction requirements
  - Discontinuance prohibitions



# Secondary Markets

- Generally refers to a means of accessing spectrum after it has been assigned to an entity.
- Spectrum lease (Sections 1.9020, 1.9030)
- License assignment (Section 1.948)
- Partitioning (breaking up the geographic area)
- Disaggregation (dividing the spectrum)
- **WARNING:** Note the regulatory requirements on a license before entering an agreement.



# Help with Secondary Markets

- FCC hotline can walk parties through the filing process
  - (877) 480-3201 (M – F 8:00 am – 6:00 pm ET)
- <http://wireless.fcc.gov/uls>
  1. License Assignment
    - File FCC Form 603
  2. Spectrum Lease/Sublease
    - File FCC Form 608



# Tower Information

- Towers over 200 feet or within the glide-slope of an airport must obtain FAA clearance and register with the FCC.
- Tower information URL:  
[http://wireless.fcc.gov/index.htm?job=towers\\_antennas](http://wireless.fcc.gov/index.htm?job=towers_antennas)
- This URL can be used to find a tower for your antenna or to learn of regulations.
  - National Environmental Policy Act
  - National Historic Preservation Act



# For More Information

- FCC Online Table

<http://www.fcc.gov/oet/spectrum/table/fcctable.pdf>

- Wireless Broadband Technologies

<http://wireless.fcc.gov/outreach/index.htm?job=wireless>

- How to find a Licensee

<http://wireless.fcc.gov/outreach/index.htm?job=wireless3>

- Universal Licensing System

<http://wireless.fcc.gov/uls>





# For More Information

- Main FCC Website
  - <http://www.fcc.gov/>
- Broadband Beta site
  - <http://www.broadband.gov/>
- Auctions:
  - [http://wireless.fcc.gov/auctions/default.htm?job=auctions\\_home](http://wireless.fcc.gov/auctions/default.htm?job=auctions_home)
- Equipment Authorization System Search
  - <https://fjallfoss.fcc.gov/oetcf/eas/reports/Generi cSearch.cfm>



# Licensed Exempt Devices

- Part 15 provides for operation of low power radio transmitters without a license
  
- Operating conditions:
  - **May not cause harmful interference**
  - **Must accept any interference received**
  
- Part 15 minimizes likelihood of interference by:
  - **Limiting operation to certain non-restricted frequency bands (Ref. Section 15.205)**
  - **Limiting power to relatively very low levels**
  - **Requiring equipment approval to ensure compliance**



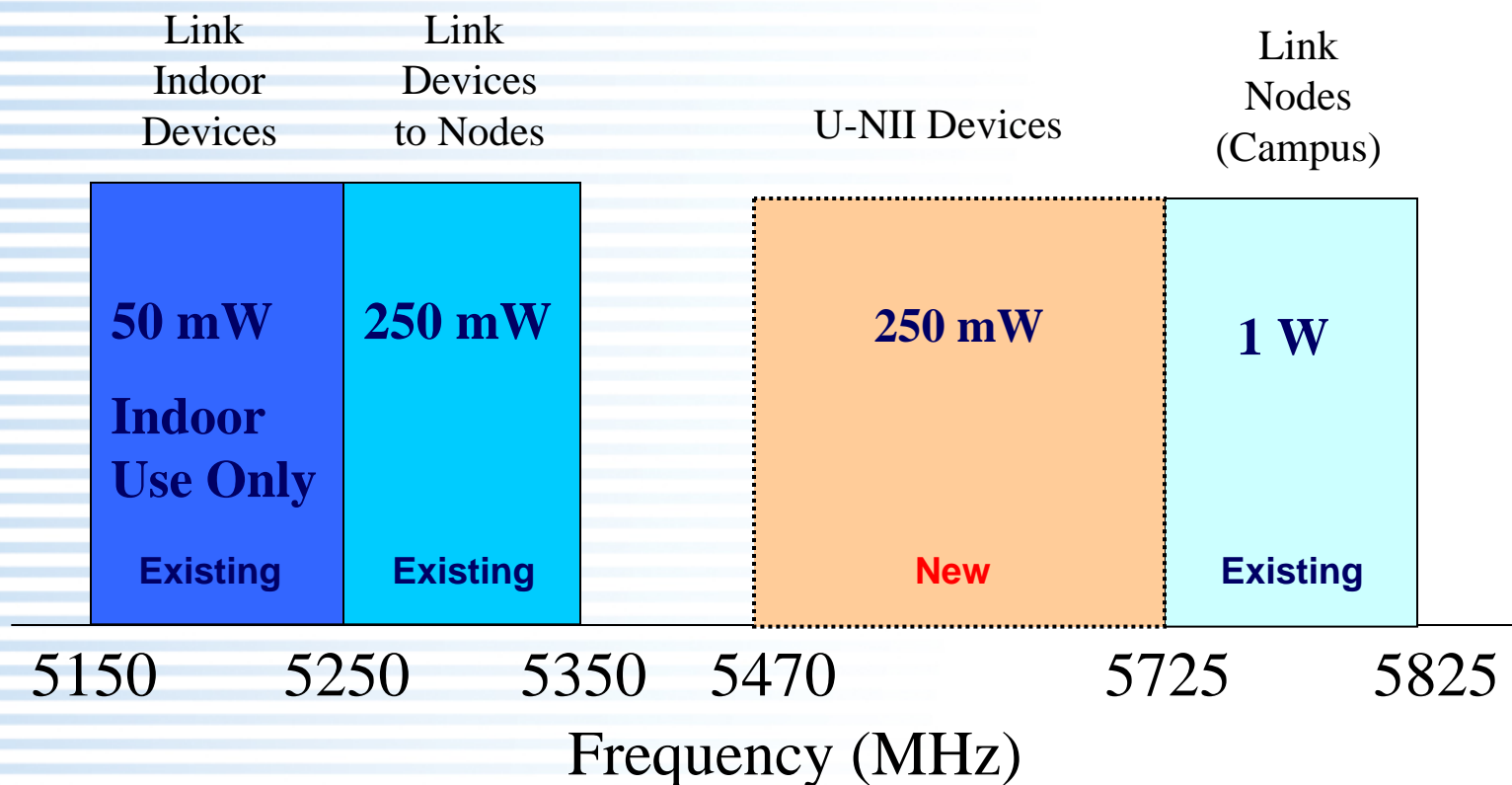
# Licensed Exempt Devices

- On most frequencies, operation is limited to  $< 100$  mW; duty cycle applies in some cases
- Three (ISM) bands allow 1 W transmitter power:
  - 902-928 MHz
  - 2400- 2483 MHz
  - 5725 – 5875 MHz
    - Power reduction for antenna gain  $> 6$  dB



# Licensed Exempt Devices

- **FCC has made available an additional 255 MHz of spectrum for anticipated Wi-Fi growth**
- **Provides A Total of 555 MHz of Spectrum for unlicensed operations**





# Licensed Exempt Devices

- **IEEE Committee 802.11 developed a family of standards for unlicensed WiFi data networks within the framework of the Part 15 rules**

<b><u>Standard</u></b>	<b><u>Frequency Band</u></b>	<b><u>Modulation</u></b>	<b><u>Data Rate</u></b>
<b>802.11(b)</b>	<b>2.4 GHz</b>	<b>DSS</b>	<b>11 Mb/s</b>
<b>802.11(g)</b>	<b>2.4 GHz</b>	<b>OFDM</b>	<b>54 Mb/s</b>
<b>802.11(a)</b>	<b>5.8 GHz</b>	<b>OFDM</b>	<b>54 MB/s</b>





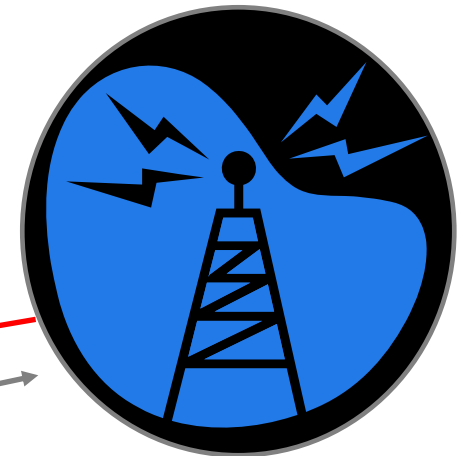
# TV “White Spaces”

- Spectrum below 900 MHz is particularly well suited for penetrating buildings
- Permits fixed and personal portable devices on certain TV channels
  - Power and out-of-band emission limitations
  - Geo-location and databases
  - Registration



Transmits in  
vacant channel

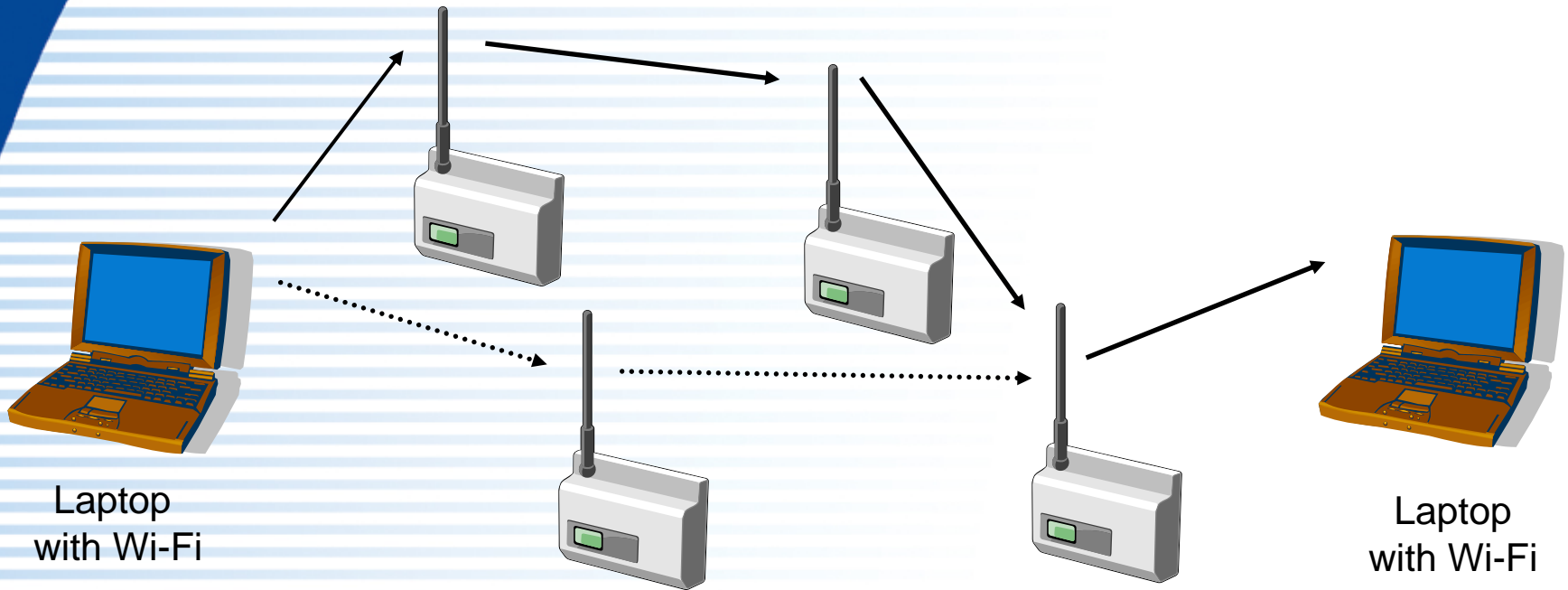
Device identifies  
vacant channels



“White Spaces”  
Are channels left  
vacant in each market



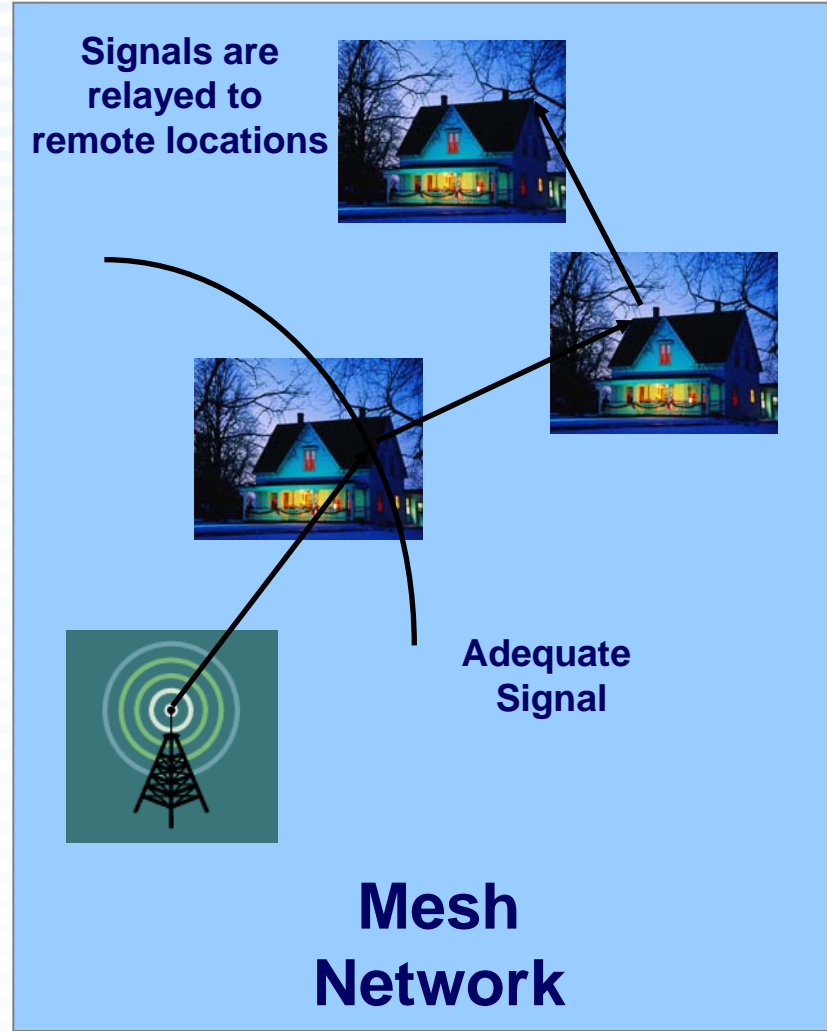
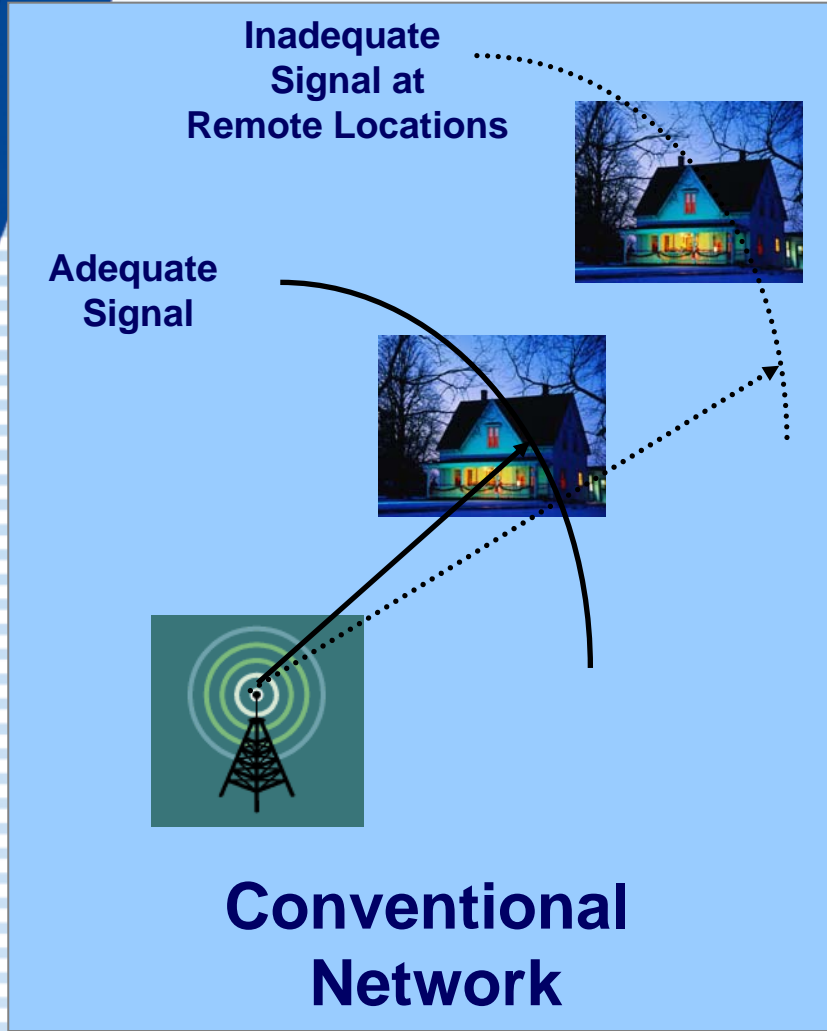
# Wi-Fi Mesh Networks



Mesh networks use each transmitter/receiver as a relay point to provide wide service areas. They are self-forming and provide numerous communication paths- - same principle as the Internet



# Mesh Network Coverage





# Conclusion

Thank you!

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