Case Study: Spectrum Approaches for Community Networks

CYBR 4400/5400: Principles of Internet Policy, Lecture 4-4

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Today's Lecture

- Course Feedback
- Case Study: Spectrum Approaches for Community Networks
- Finish Spectrum Management Lecture
- Economics of Spectrum Management Lecture

Course Feedback — Suggestions

- Identifying key points which need to be read/understood in each Reading Assignment

- Homework problems always seem incredibly large, so could they be split into two Homeworks per unit?

- Readings are very long and dense, a clear outline of what is most important to read would be useful for those that don't have a lot of time to read each sentence

- Course requires lots of reading and writing assignments, which is not something I am used to. It would be helpful if the readings were shorter

Course Feedback — What You Like

- Review of homework assignments in class is very helpful

- Overall, instructor does very good job in keeping the class interesting and explaining topics in a way it is easy to understand

- This is the heaviest workload of any of the classes that I am taking, but I am learning a lot and enjoy the detail we get through the readings

Unleashing Community Networks: Innovative Licensing Approaches

Discussion Questions

- What is a community network?
- Why are community networks important?
- Why is access to spectrum a challenge for community networks?

- Spectrum scarcity
- Inefficient use of spectrum
- Expense of spectrum access

> "Governments should focus on putting spectrum to its highest and best use, and to consider setting aside spectrum for community and/or local access networks at a reduced cost. Doing so ensures long-term benefits for end users and serves the public interest."

Discussion Questions

- Discuss the Innovative Licensing approaches

1. Social purpose licensing (set-asides for non-traditional operators)
2. Experimental licensing
3. Spectrum auction credits
4. License exemptions and unlicensed use
5. Secondary use and dynamic spectrum sharing
6. Secondary market transactions

Policy Brief: Spectrum Approaches for Community Networks

Policy Brief Discussion

- Problem?
  - Connectivity gap in remote unserved/underserved areas
  - Current policies: spectrum scarce, inefficient use of exclusive licenses (broad coverage and expensive)
- Objective
  - Encourage community networks to close gap
- Role of Technology
  - Wireless (Wi-Fi) and fiber networks
  - Bottom-up approach using distributed architectures

Policy Brief Discussion

- Policy Options for Community Broadband services
- Utilizing and offering unlicensed spectrum (e.g. using Wi-Fi)
- Spectrum sharing (e.g., TVWS or CBRS)
- Innovative licensing (“social purpose” licensing)

Assignment

- Use Steps 4 and 5 of Policy Framework to analyze one of the approaches described in this policy brief

- Choose an “example” as your policy option, use a set of attributes to more clearly define it, and describe analytical factors that you will use to evaluate the option

- Real world examples that are not well-defined, so key part of your assignment will be to clearly define your interpretation of their policy proposal

Finishing Spectrum Management Lecture

Developing the Commons by Exploiting "White Space"

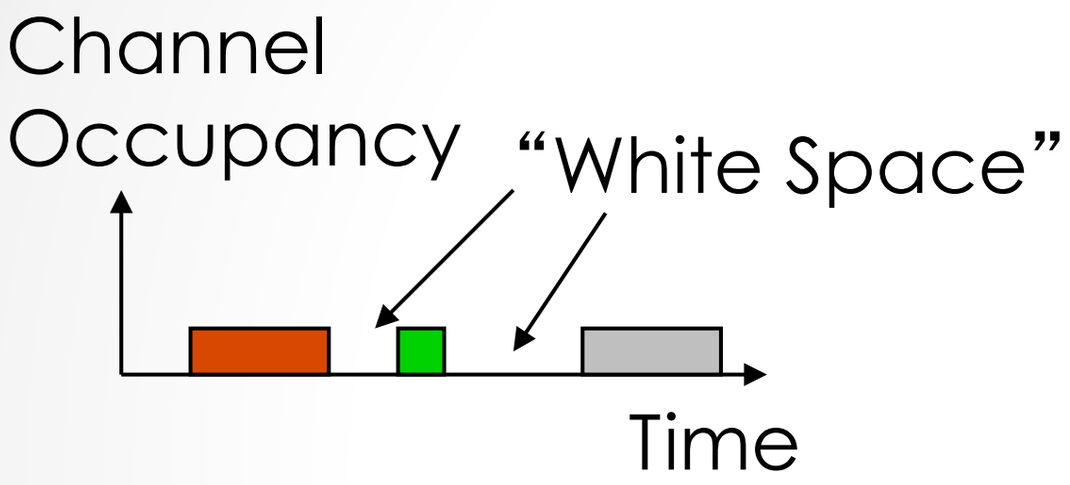
White spaces: unused portions of spectrum in terms of frequency, time, and space

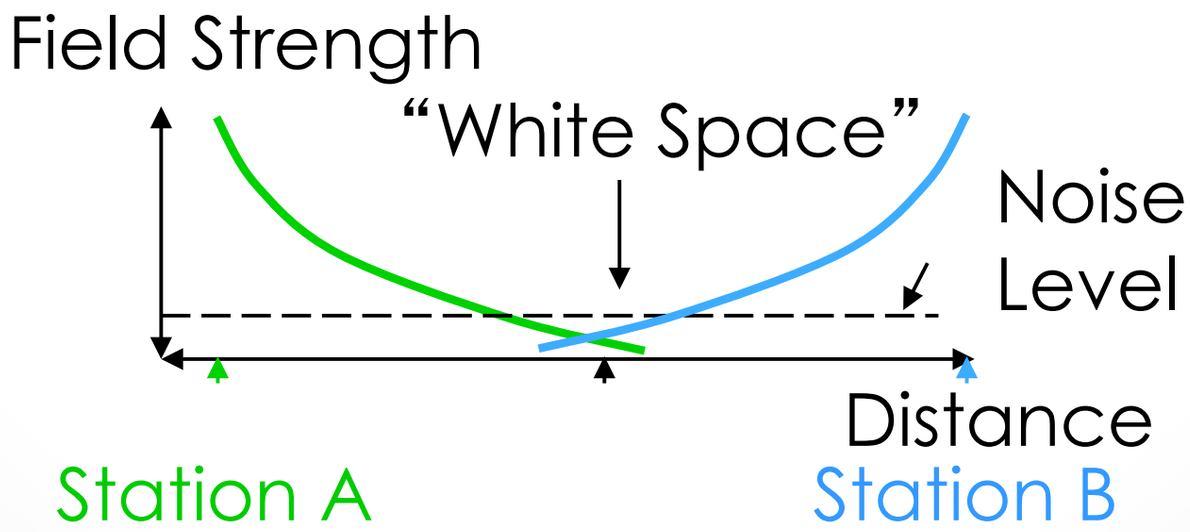
- Underlay technologies transmit at power levels below the electromagnetic noise floor (e.g., Ultrawideband)

- Overlay technologies detect and utilize unused spectrum

  - Dynamic Frequency Selection capability based on technologies such as GPS for location, beacons, and "listen-before-talk" protocols.

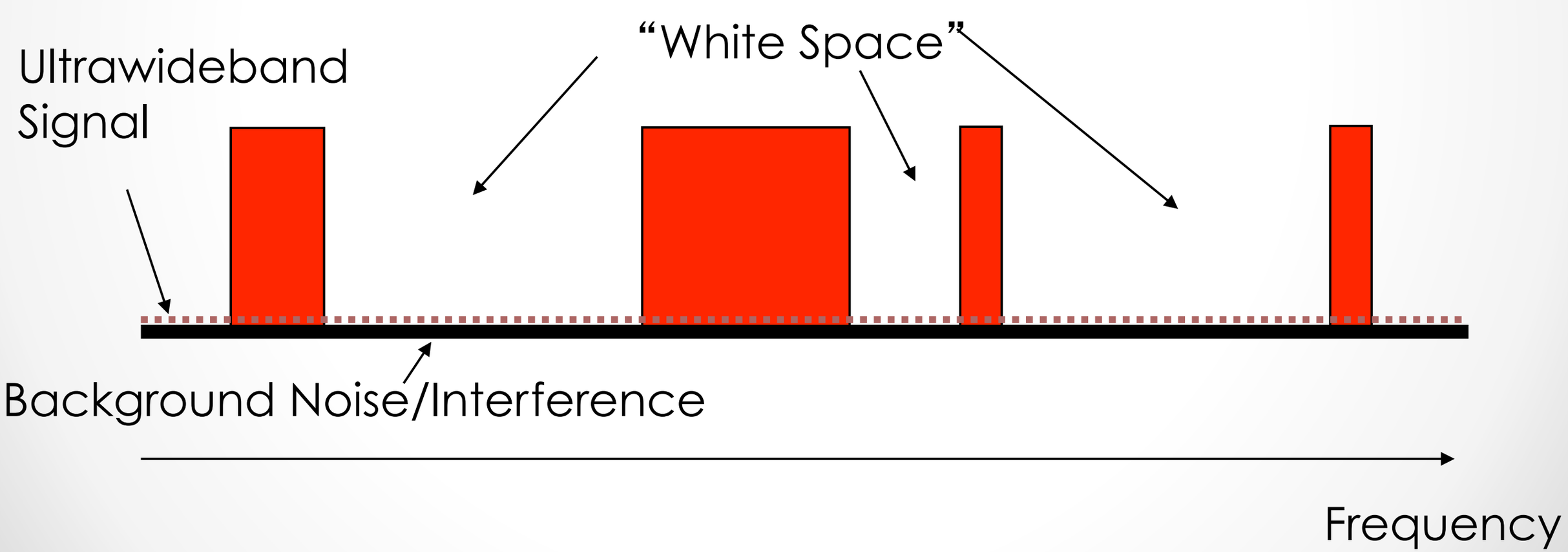
Exploiting "White Space"





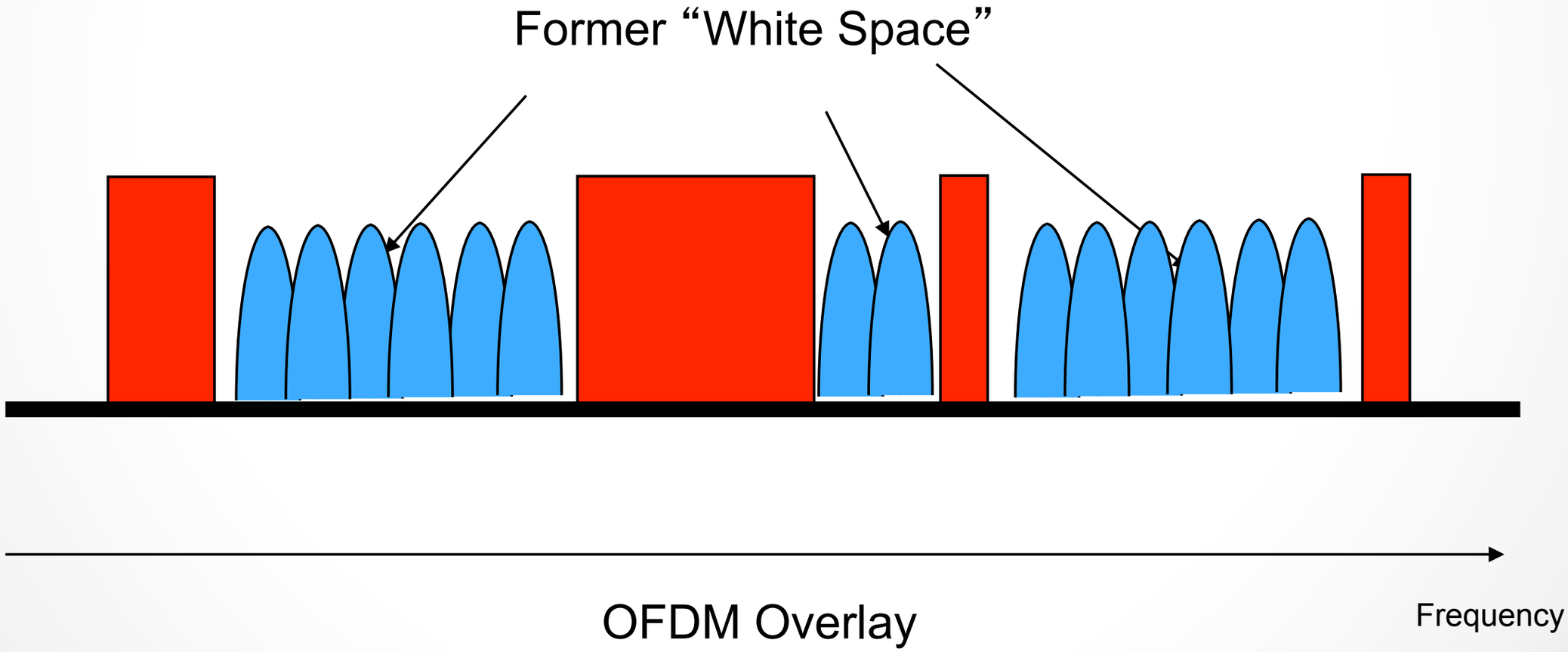
Exploiting "White Space"

Ultrawideband Underlay



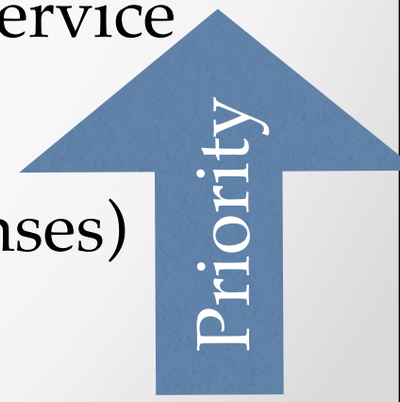
Exploiting “White Space”

Orthogonal Frequency Division Multiplexing Overlay



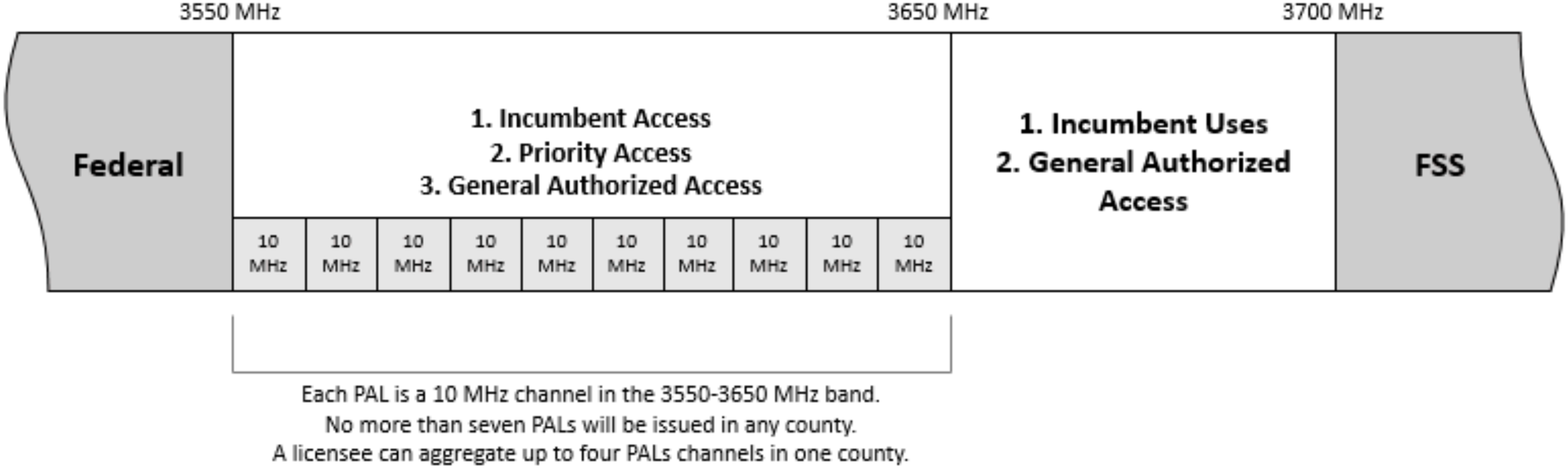
New Sharing Model: Citizens Broadband Radio Service (3550-3700 MHz)

- Tiered access and authorization framework to share federal/commercial use of 3.5 GHz band
- Spectrum Access System (SAS) manages access and operations (i.e., automated frequency coordinator based on actual transmissions in band)
  - Uses Environmental Sensing Capability (ESC) sensor network to detect transmissions from Dept. of Defense radar systems
  - SASs coordinate operations between and among users in three tiers
    - Incumbent Access (authorized federal users, Fixed Satellite Service (space-to-Earth) earth stations in 3600-3650 MHz band)
    - Priority Access (auction 10 MHz county Priority Access Licenses)
    - General Authorized Access (unlicensed)



New Sharing Model: Citizens Broadband Radio Service (3550-3700 MHz)

- Bandplan



Each PAL is a 10 MHz channel in the 3550-3650 MHz band.
No more than seven PALs will be issued in any county.
A licensee can aggregate up to four PALs channels in one county.

Economics of Spectrum Management

Interference Policy

- Historically: poorly defined standard of “harmful interference”
  - Too stringent or lax guidelines: high opportunity costs
- Normative goal: Devise guidelines that maximize spectrum value by allowing diverse technologies to flourish and permit “right” level interference
  - Force incumbents to internalize opportunity costs

Interference Policy (cont'd)

- Coase: "the gain from [allowing additional] interference more than offsets the harm it produces"

- Regulators must balance competing priorities

  - Lightsquared-GPS: need for greater spectrum efficiency vs. need to keep critical infrastructure operable

- FCC yet to establish comprehensive interference policy

Goal of Spectrum Auctions: Competition in Wireless

- Multiple, facilities-based networks supporting improved redundancy and reliability
- Rivalry on coverage, pricing, and service
- Encourages innovative services, terms, and applications
- Assign available spectrum to "highest valued" use
  - Maximize consumer value of wireless services less the cost of production

Using Auctions to Assign Spectrum

- Encouraging new entry for competition
  - Incumbent advantages of economies of scale and scope
  - Incumbent value driven in part by deterring new entry
- Should raising revenues be a goal?
  - Can reduce the amount of spectrum
  - Sell to a monopolist
- Low revenues bad if due to auction design, tacit collusion, or entry deterrence by incumbents

Market Failures to Consider

- Less natural monopoly (market concentration) in wireless — but network effects might be sufficient source of concern to merit some regulation
- Bidders private values may differ from social values (e.g., incumbent includes private value plus value of keeping it away from competitor)
- Policy instruments impact competition both in the auction and downstream market for wireless services

Current Setting

- Spectrum Auctions used to assign and price spectrum since 1994 in U.S.
  - About 90 auctions, raising over $130B
  - Goal of economic efficiency: put the spectrum to highest-valued use

- Policy instruments for competition available to regulators using auctions
  - Set-asides
  - Bidding credits
  - Spectrum caps
  - Band plan design
  - Auction format
  - Antitrust enforcement

Designated Entities and Bidding Credits

- FCC auction authority stems from Omnibus Budget and Reconciliation Act of 1993: Revenue maximization is not to be the goal of auctions!
  - Section 309(j): FCC should ensure opportunity of small businesses, businesses owned by women and minorities, and rural telephone companies ("Designated Entities")
    - Supreme Court *Adarand* decision trimmed list to small businesses
- How do you define "small business"? — Large company entering new market?
- Bidding credits used assuming additional participation can increase revenues
  - Allows government to put a "face value" on some policy goal (e.g., new entrant)
  - FCC auction evidence shows bidding credits typically "bid away" as qualified entities compete for licenses

Important to Enforce Rules

- In 2014, Northstar Wireless and SNR Wireless LicenseCo borrowed from Dish in exchange for Dish's de facto control
  - Also expected to qualify for FCC's bidding credits for small business (revenue below $40M)
  - FCC accepted their $13.3B in bids but denied requests for $3.3B in credits
- "2G Scam" in India in 2008 when Minister of Communications and IT forced "first come, first served" licensing scheme
  - Illegally undercharged major companies ($28B) by tipping off favored companies to conditions required (all happened in matter of hours)
  - In 2011, Time listed scam at #2 of "Top 10 Abuses of Power" list, right behind Watergate!!!!

Sources of Spectrum: Reclaiming Government-Held Bands

- Government agencies do not internalize opportunity costs
- President's Council of Advisors in Science and Technology (PCAST) in July 2012
  - Comprehensive reallocation of federal spectrum not going to happen
  - "Norm for spectrum use…should be sharing, not exclusivity"
- Industry response: "Gold standard…remains cleared spectrum"

5G Supplement

- Some interesting videos
  - Qualcomm's 5G Vision
  - Samsung 5G Future
  - Intel and Nokia 5G Vision
  - 5G and Health Effects
  - 5G and Autonomous Vehicles