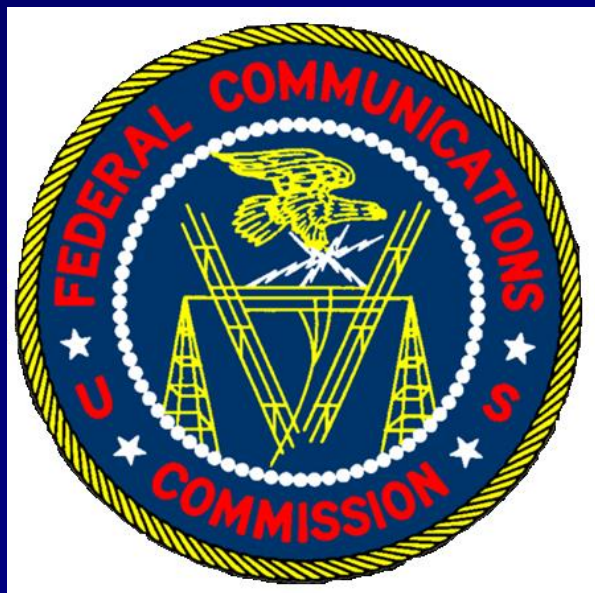


Federal Communications Commission

Spectrum Management Overview



Office of Engineering and Technology
September 2019

Legal Framework

COMMUNICATIONS ACT OF 1934



The President



The Judiciary



The Congress



National Telecommunications
And
Information Administration

Coordination

Federal
Communications
Commission



**FEDERAL
USERS**

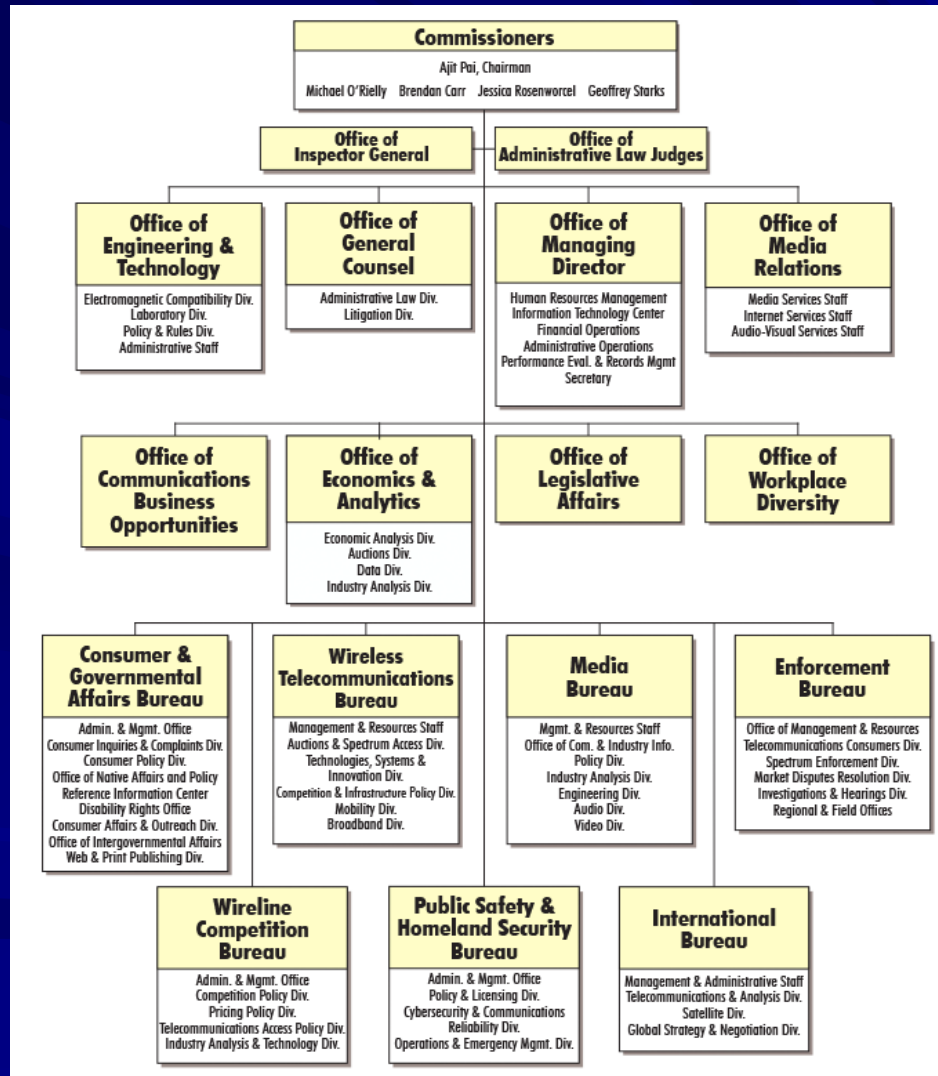
**NON-FEDERAL
USERS**

FCC Background

(www.fcc.gov)

- The FCC is an independent United States government agency, directly responsible to Congress
 - Jurisdiction covers the 50 states, District of Columbia Chairman and four Commissioners
 - Appointed by President
 - Confirmed by Senate
 - Staggered five-year terms

FCC Organizational Chart



FCC Background

(www.fcc.gov)

- Charged with regulating interstate and international communications by radio, television, wire, satellite and cable
- Spectrum management promotes
 - efficient use of the spectrum
 - interference protection among licensed stations
 - new technologies and services
 - harmonized spectrum use

FCC Background

(www.fcc.gov)

■ Communications Act Provisions Relating to Radio

- Section 301 - “...No person shall use or operate any apparatus for the transmission of energy or communications or signals by radio...except under and in accordance with this Act and with a license in that behalf granted under the provision of this Act.”
- Section 303 contains the General Powers of the Commission

■ FCC Rules contained in Title 47 of the Code of Federal Regulations (47 CFR)

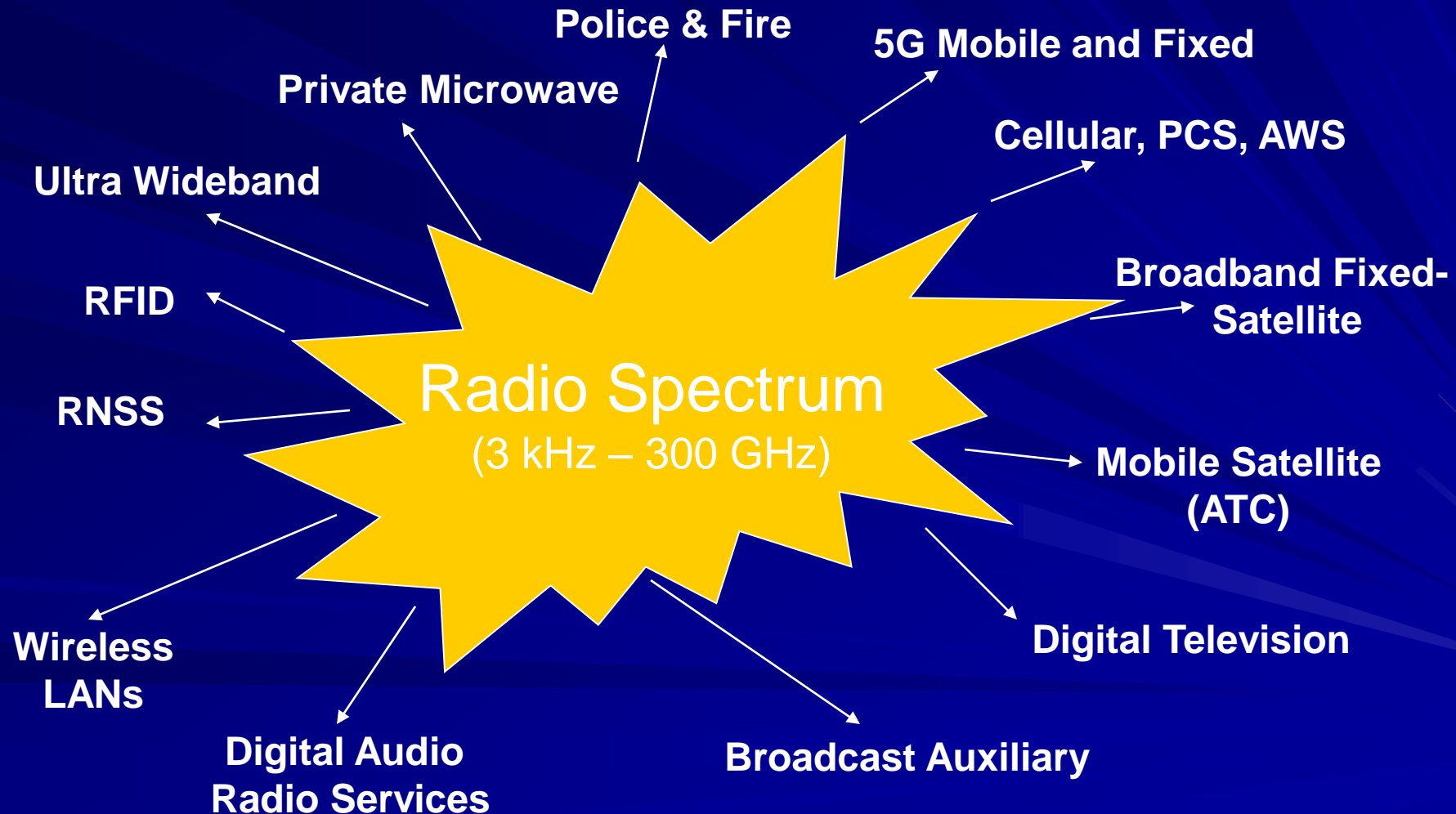


NTIA Background

(www.ntia.doc.gov)

- NTIA Performs spectrum management and assignment for all Federal spectrum use
- Section 305 of the Act – Government Owned Stations
 - “Radio Stations belonging to and operated by the United States shall not be subject to the provision of sections 301 and 303 of this Act. All such Government stations shall use such frequencies as shall be assigned to each or to each class by the President.”

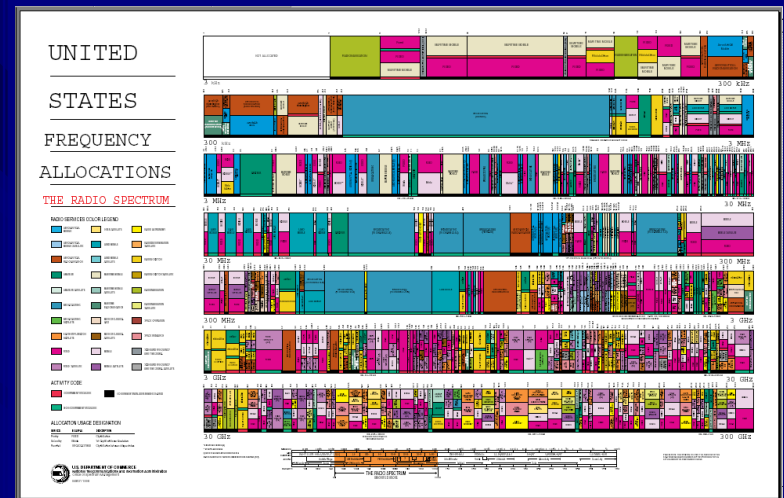
Spectrum is a Shared Resource



Spectrum Management

■ Four major functions in radio services

- 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 authorizes specific equipment use, assignments coordinated domestically and internationally
- Enforce Rules to ensure compliance of radio equipment and systems



Principal Spectrum Management Models

- Dedicated Use Model (sometimes called command-and-control)
 - Spectrum uses are limited and conform to detailed service rules (AM and FM Radio, TV broadcasting, public safety)
- Exclusive Use Model
 - Flexible use rights for specified spectrum within defined geographic area (Cellular, PCS , AWS, BRS, UMFUS)
 - Rights governed by technical rules to protect against interference

Principal Spectrum Management Models

■ Opportunistic Use Model

- Spectrum is shared with multiple licensed exempt users
 - (eg. Wi-Fi, UNII, UWB)
- Technical and operational rules to protect licensed services
- No right to interference protection

■ Managed Access Model

- Data Base used to assign spectrum that is shared among multiple licensed and general authorized access users
 - (eg. TV White Space Devices and Broadcast TV)
- Technical and operational rules to protect licensed services
- General Authorized Access users have no protection from interference

Allocations

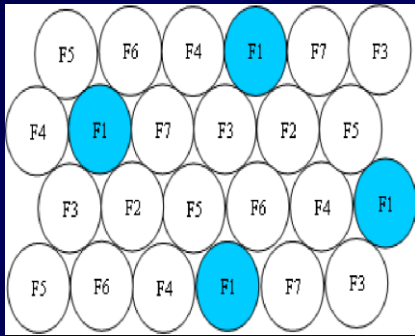
International Allocations

Federal Allocations

Non-Federal Allocations

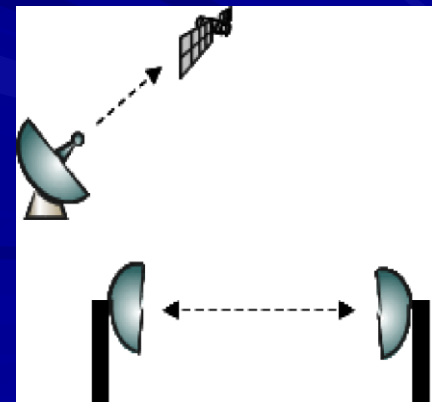
941-1430 MHz (UHF)					Page 41
International Table			United States Table		FCC Rule Part(s)
Region 1	Region 2	Region 3	Federal Government	Non-Federal Government	
See previous page for 890-942 MHz			941-944 FIXED US268 US301 US302 G2	941-944 FIXED US268 US301 US302 NG120	Public Mobile (22) Fixed Microwave (101)
942-960 FIXED MOBILE except aeronautical mobile 5.317A BROADCASTING 5.322 5.323	942-960 FIXED MOBILE 5.317A	942-960 FIXED MOBILE 5.317A BROADCASTING 5.320	944-960	944-960 FIXED NG120	Public Mobile (22) Auxiliary Broadcast (74) Fixed Microwave (101)
960-1215 AERONAUTICAL RADIONAVIGATION 5.328 5.328A			960-1215 AERONAUTICAL RADIONAVIGATION 5.328 US224		Aviation (87)
1215-1240 EARTH EXPLORATION-SATELLITE (active) RADIOLOCATION RADIONAVIGATION-SATELLITE (space-to-Earth) (space-to-space) 5.329 5.329A SPACE RESEARCH (active) 5.330 5.331 5.332			1215-1240 RADIOLOCATION 5.333 G56 RADIONAVIGATION-SATELLITE (space-to-Earth)	1215-1240 5.333	Rule References
1300-1350 AERONAUTICAL RADIONAVIGATION 5.337 RADIOLOCATION RADIONAVIGATION-SATELLITE (Earth-to-space) 5.149 5.337A			1300-1350 AERONAUTICAL RADIO- NAVIGATION 5.337 Radiolocation G2 5.149	1300-1350 AERONAUTICAL RADIO- NAVIGATION 5.337 5.149	

Table of Frequency Allocations, 47 C.F.R. §2.106, Sample, ref.: <http://www.fcc.gov/oet/spectrum/table/fcctable.pdf>



Service Rules

- Promote spectrum efficiency
- Promote Intra-service and inter-service spectrum sharing
 - where risk of interference is minimal or uses are compatible and can be coordinated
 - where system complexity and cost do not outweigh benefits of spectrum sharing
 - Frequency separation and emission limits
 - Geographic separation and coordination
 - Power deltas – also in non-restricted bands
 - Time separation – manage authorized emitters



Frequency Assignments, Authorizations

■ First-received, First-licensed

- Dedicated uses for particular location and frequency receive interference protection

■ Flexible Use Licenses

- Exclusive uses receive interference protection and flexibility to offer new applications

■ Licensed-exempt in non-restricted bands

- Authorized but no interference protection; Low cost barrier to entry

■ Multi-Tiered Licenses

- Geographic Area Licenses and General Authorized Access;
- Coordination to avoid mutual interference; database managed access

Frequency Assignments, Authorizations

- Special Temporary Authority (STAs)
 - Case-by-case, extraordinary circumstances, limited time duration
- Waivers
 - Case-by-case, rules may not yet be established, demonstrate low risk for interference
- Equipment Authorizations
 - Including License-exempt devices
- Experimental Authorizations, Part 5
 - Non-interference basis only (Section 5.85(c))
 - to test and demonstrate equipment and applications

Decision Making Process

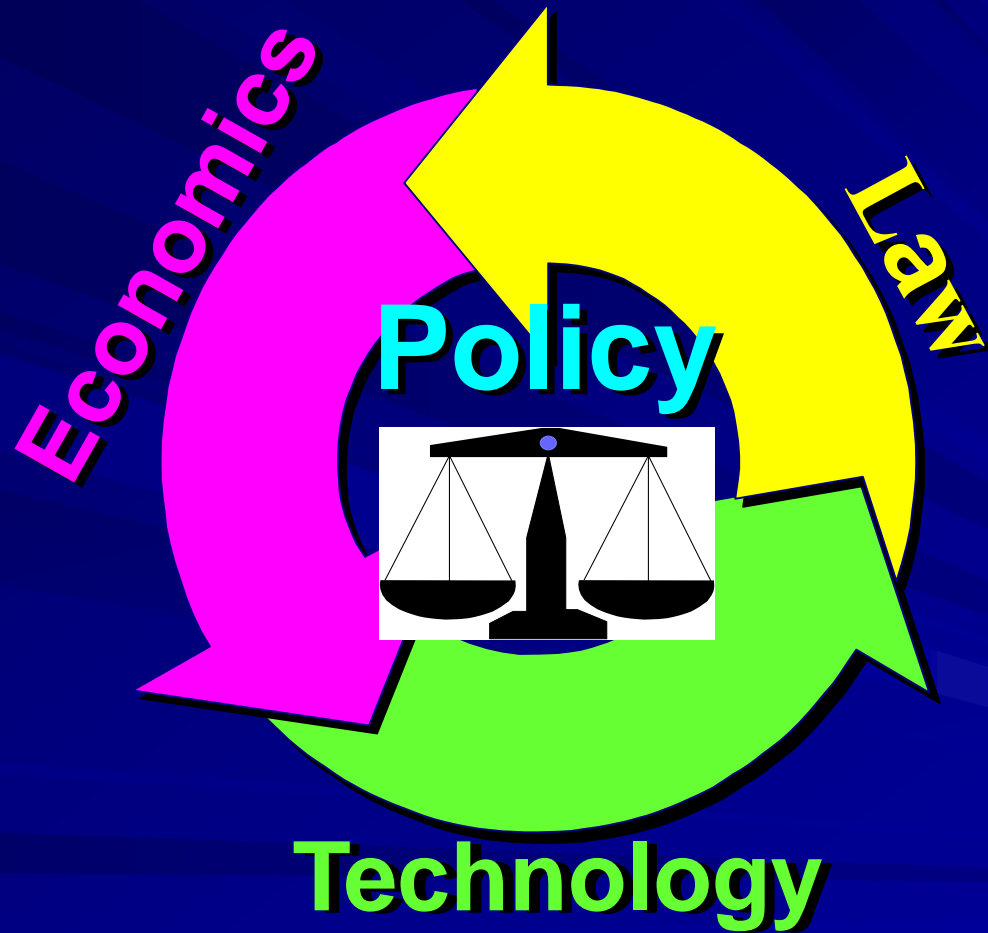
- Laws such as the Communications Act and Administrative Procedures Act govern FCC's interactions with the public and the management of public resources (e.g. Spectrum)
- Notice to Public
 - Public Notices (PN), Notice of Inquiry (NOI), Notice of Proposed Rulemaking (NPRM or Further NPRM), Federal Register Publication
- Decision based on Public Comment
 - Report and Order (R&O), Memorandum Opinion and Order (MO&O)
- Authorization Orders issued with operating conditions



Useful Websites and Addresses

- Main FCC Website
 - www.fcc.gov
- FCC Online Table and History File
 - <https://www.fcc.gov/engineering-technology/policy-and-rules-division/general/radio-spectrum-allocation>
- Electronic Documents Management Site For finding Rulemakings, public notices and news release information
 - https://apps.fcc.gov/edocs_public/
- Title 47 of the Code of Federal Regulations (CFR) –
 - <https://www.fcc.gov/general/rules-regulations-title-47>

Spectrum Management



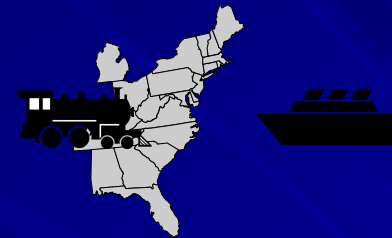
Competition
Transparency
Flexibility

“The Dynamic Spectrum Environment”

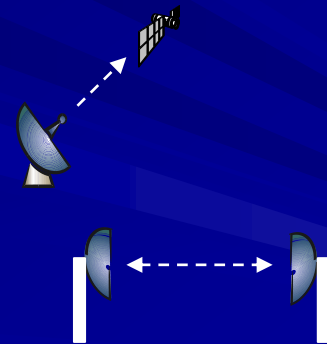
BACKUP SLIDES

Traditional Sharing Techniques

- Much of the Spectrum Is Shared
- Most Sharing is Static Based On
 - Geographic separation
 - Frequency separation
 - Power deltas
- Efficiency: Better, not Best
 - Leaves “White Space” – Unused bandwidth in terms of Geography and Time

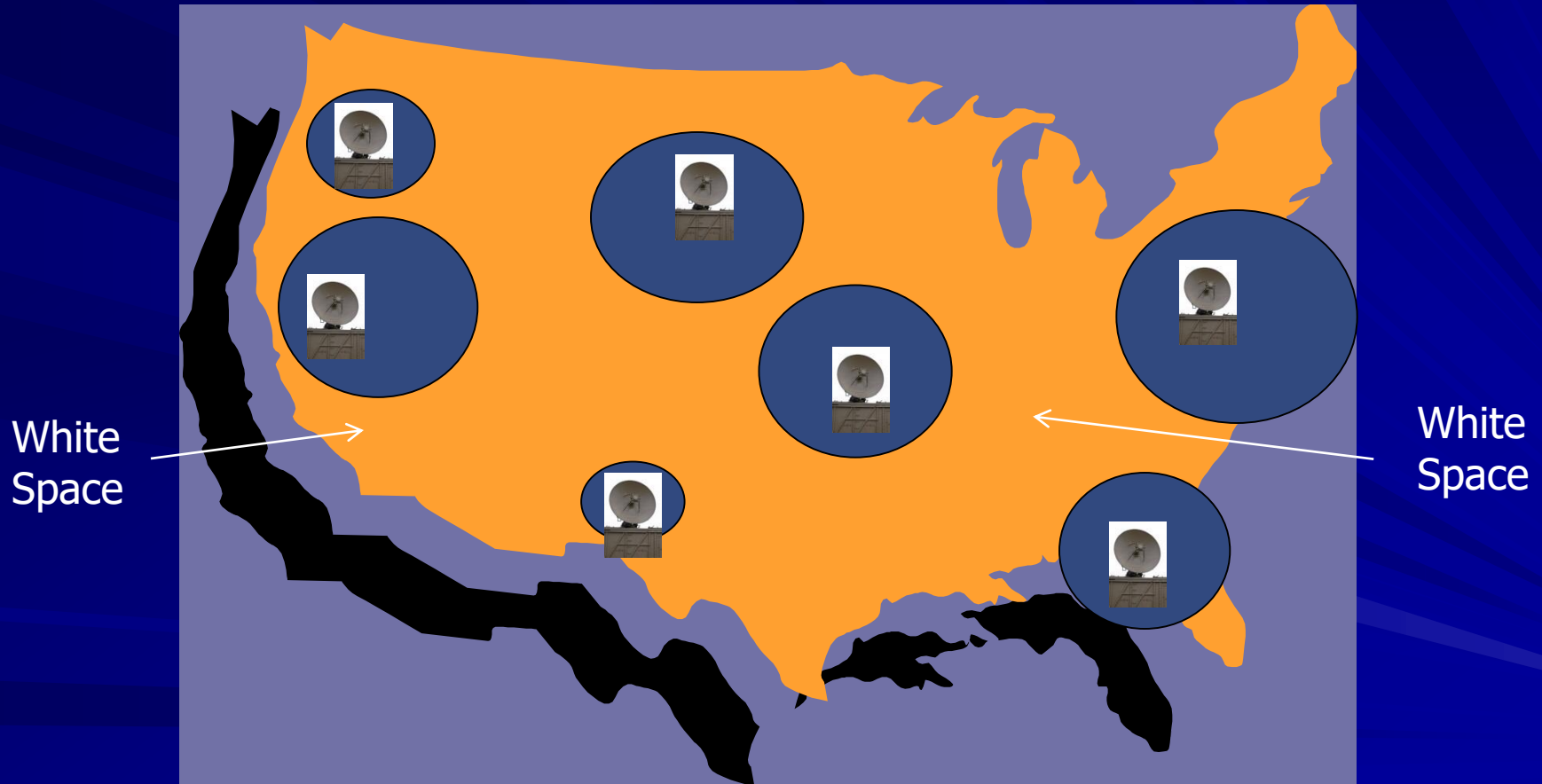


Re-use Frequencies Through Geographic Separation



Earth Stations (Uplinks) and Fixed Microwave Links Use the Same Frequencies Through Antenna Discrimination

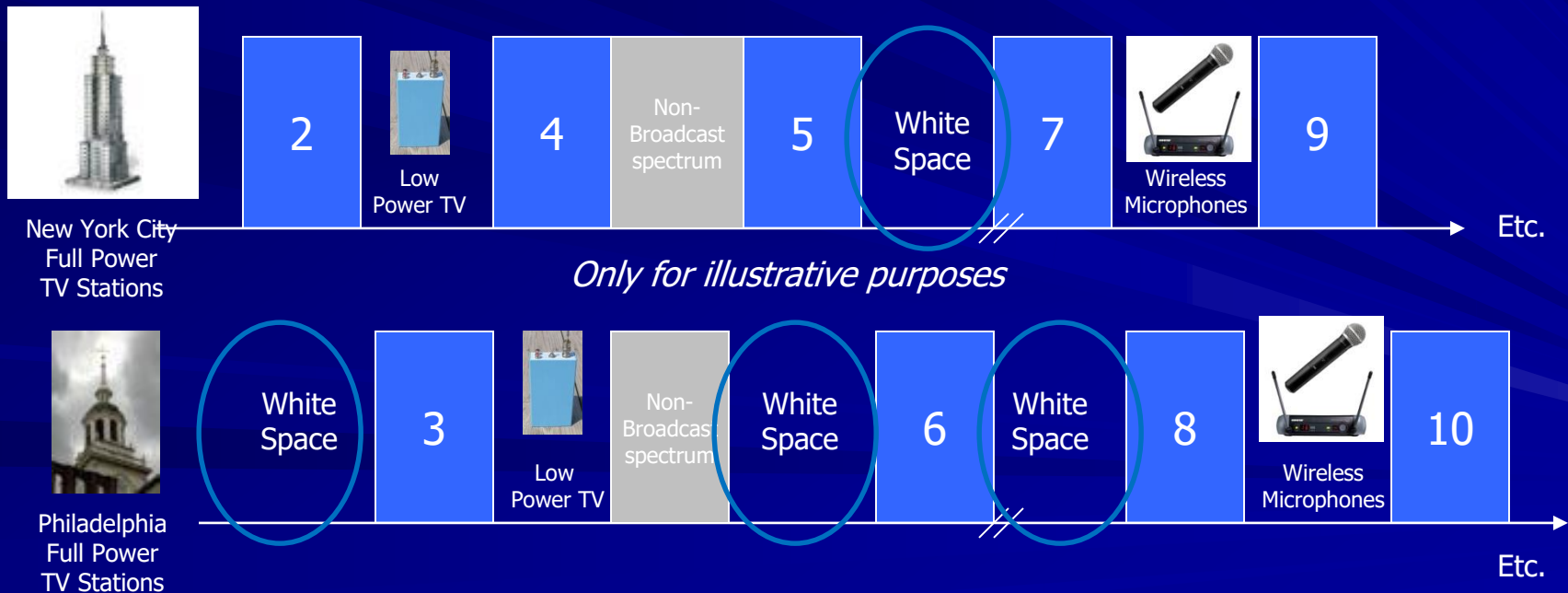
New Sharing Concept: White Space



Circles represent existing service areas
- - remaining areas may be used for introduction of new services

White Space Concept

- Originated in TV channels “allotted” to cities to serve local areas
- Other licensed and unlicensed services are also in TV bands
- “White Spaces” are the channels that are “unused” in terms of time at any given location by licensees

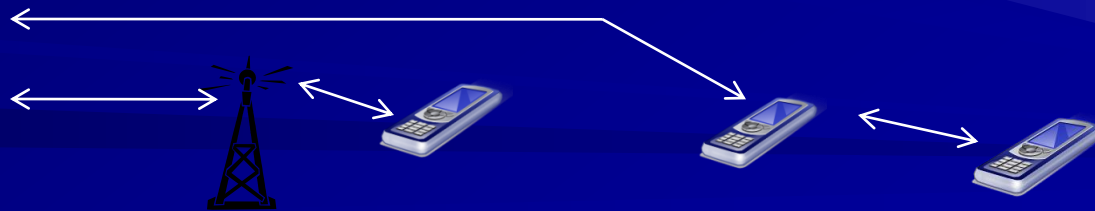


Managed Access Database

- TV white space rules introduced new spectrum sharing technique based on geolocation & data base of protected services:
 - A number of TV channels are vacant at any given location
 - Device determines its location
 - Communicates with data base of protected services
 - Data base replies with permissible frequencies at that location
 - Device automatically adjusts to operate on permissible frequencies



Data Base



Mode 1: Portable device obtains location/channels from fixed device

Mode 2: Portable device uses its own geolocation/data base access capability

Managed Access to Other Spectrum

Coexistence Overlay

- Commercial wireless is using LTE - - designed to tolerate some interference

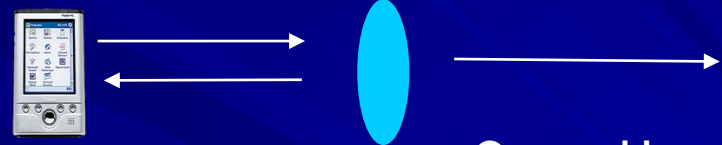


In LTE data is divided among multiple “carriers” – OK if some lost

- Implementing dynamic sharing with federal systems @ 3550-3650 MHz

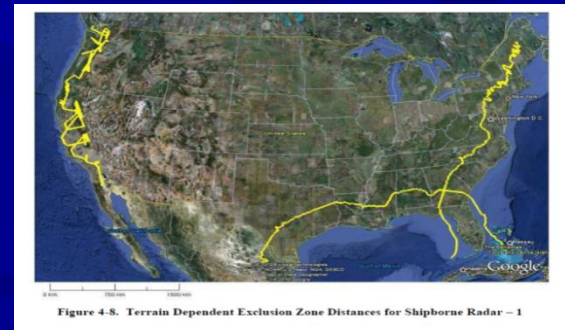
Small cells

Small cells are being used to off-load traffic



Connect via Wi-Fi or alternate spectrum

Connect to Network over the Internet



- Protecting federal systems operating @ 3550 – 3650 MHz
- Candidate for small cells

Opportunistic Use

- In various geographic locations, spectrum is “unused” for periods of time
- Dynamic spectrum access: radio system would identify “unused” spectrum at particular geographic locations and devices operate for time interval without causing harmful interference to others

