

# Spectrum Management 101

Remarks by

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Spearfish

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# Introduction

- Purpose
- Outline
  - Introduction
  - Background
    - What is Spectrum?
    - Basic Radio Communications System
    - Nature of the Spectrum Resource
    - Spectrum Diagrams
    - Definition of Spectrum Management
    - Importance of Spectrum Management
    - Major Steps in Spectrum Management
    - Agencies Responsible for Spectrum Management
  - Challenges to the Current System
  - Advances in Wireless Technology
  - Competing Approaches/Models for Spectrum Management Reform

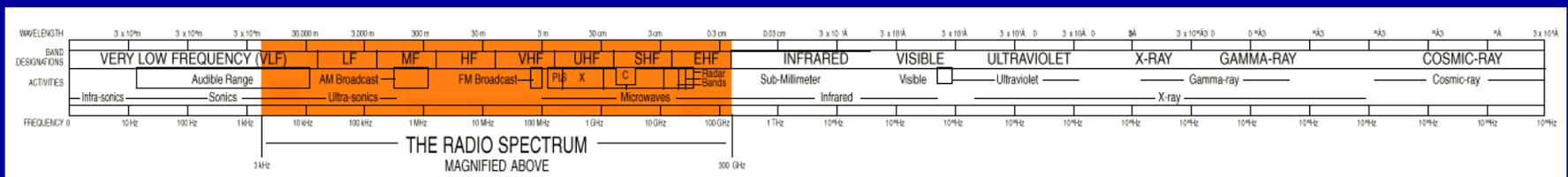
# Background

- What Is Spectrum?
  - “Spectrum” is a conceptual tool used to organize and map a set of physical phenomena
  - Electric and magnetic fields produce (electromagnetic) waves that move through space at different frequencies
  - The set of all possible frequencies is called the “electromagnetic spectrum”

# Background

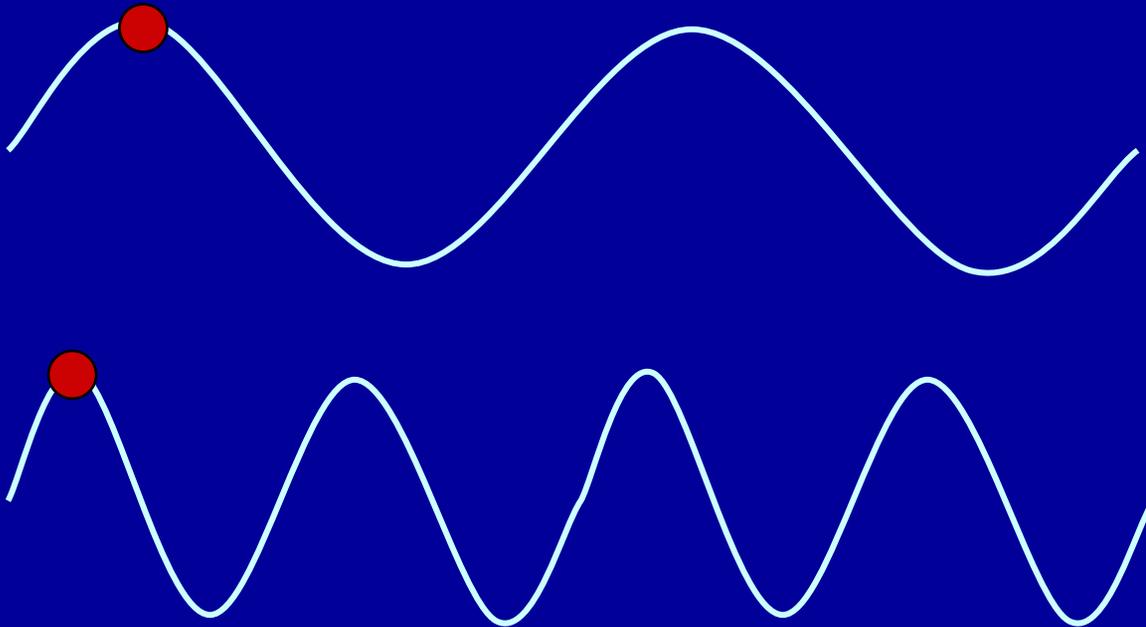
- What Is Spectrum?
  - The subset of frequencies between 3,000 Hz and 300 GHz is known as the “radio spectrum”
  - Note that radio waves do not require a medium *per se*, that is, radio waves can travel through a vacuum (e.g., outer space)

## Electromagnetic Spectrum



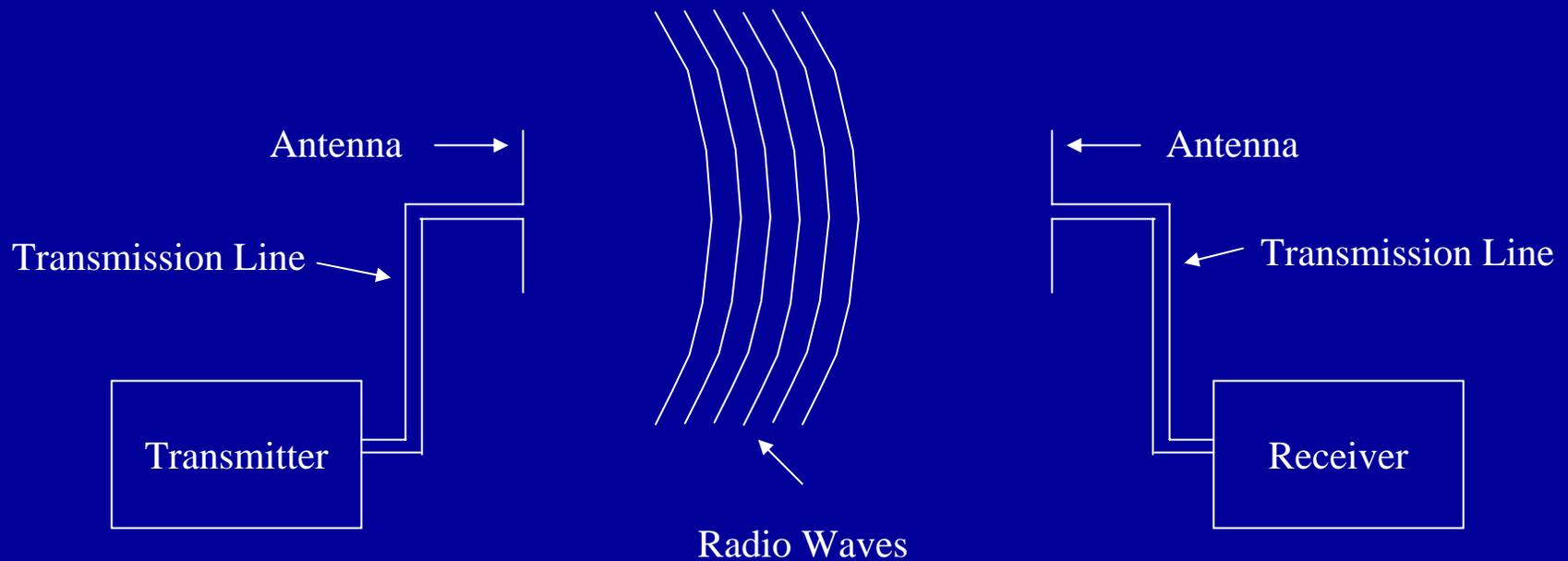
# Background

- Relationship Between Frequency and Wavelength



# Background

- Basic Radio Communication System

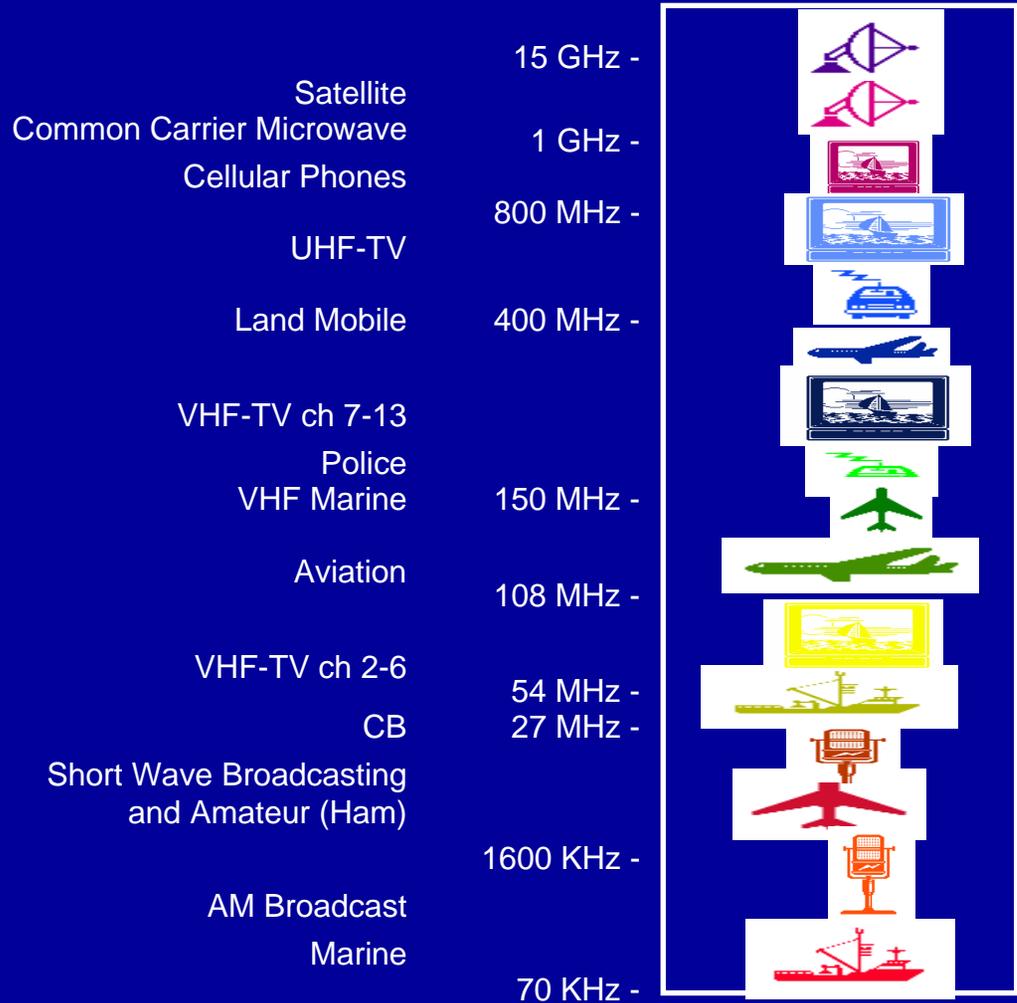


# Background

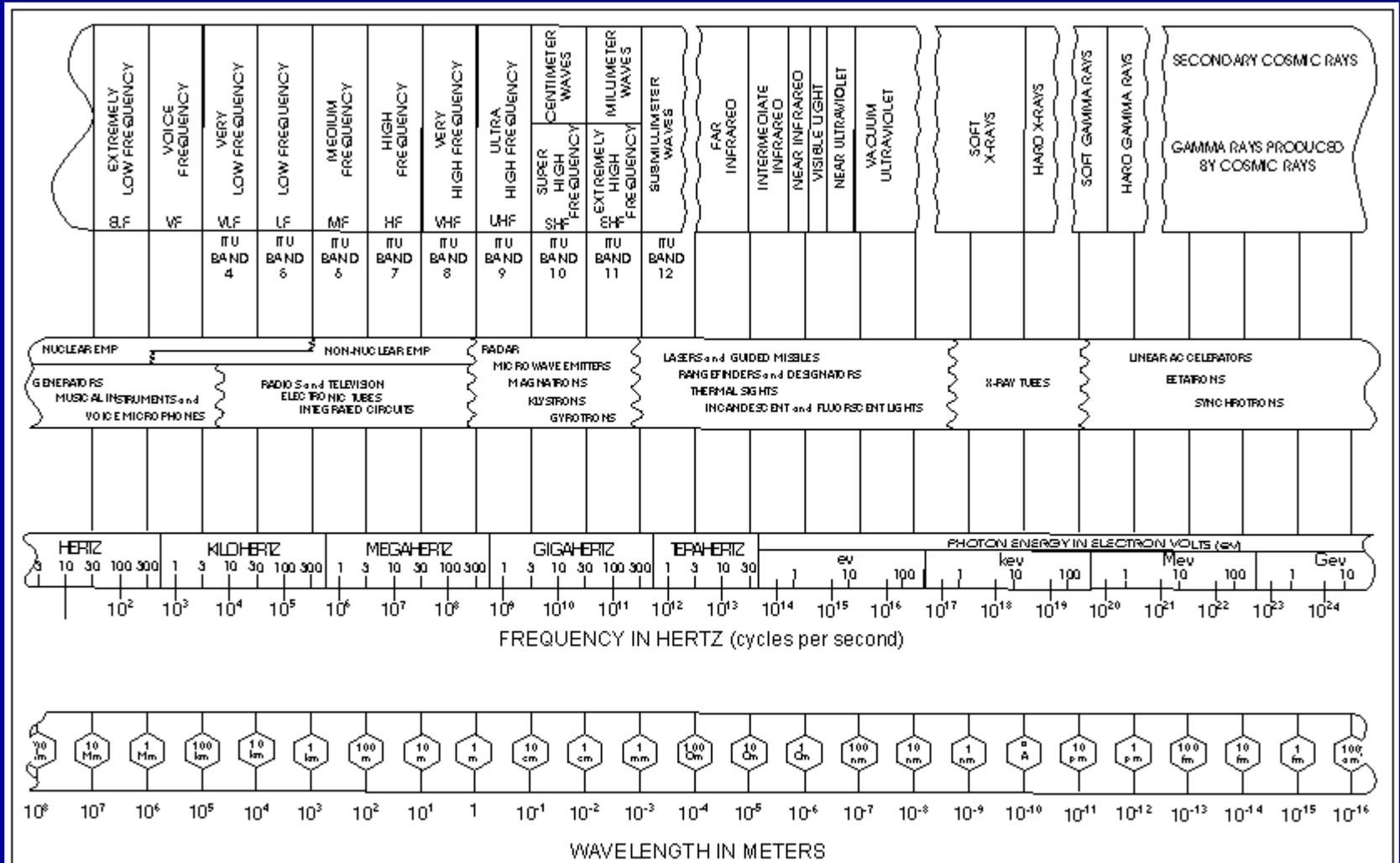
- Nature of the Spectrum Resource
  - A unique natural resource
  - A national and international resource
  - Infinitely renewable
  - Like air or water it can be polluted
  - Scarcity of the resource – economic value

# Background

- Spectrum Diagrams



# Background



electromagnetic spectrum

# Background

- Definition of Spectrum Management
  - All activities associated with regulating the use of the radio spectrum; it includes the structure and processes for allocating, allotting, assigning, and licensing the scarce resource as well as enforcing the associated rules and regulations

# Background

- Importance of Spectrum Management in the Face of Increasing Demand

# Background

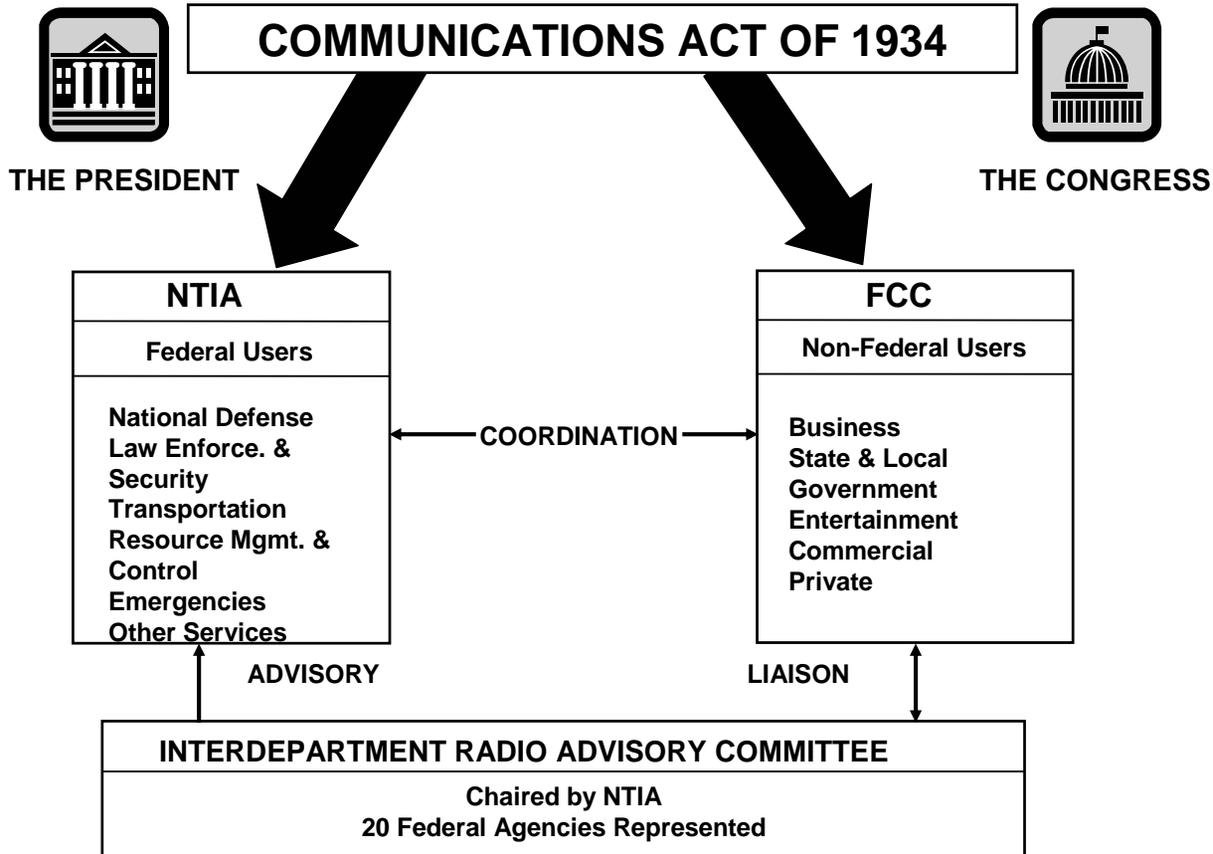
- Basic Steps in Spectrum Management
  - Allocation
  - Service Rules
  - Assignment
  - Enforcement

# Background

- Agencies Responsible for Spectrum Management
  - The Communications Act of 1934 grants coequal authority for spectrum management to:
    - The Federal Communications Commission for state and local government and private sector use (47 USC 301 and 303)
    - The President for federal use (47 USC 305)

# Background

Figure 1. National Spectrum Management



# Background

- Agencies Responsible for Spectrum Management
  - Federal Communications Commission
    - Independent regulatory agency
    - Among other responsibilities, manages all non-federal government use of the radio spectrum
    - Allocations and allotments are made in formal rule-making proceedings and the results are incorporated into the agency's rules and regulations
    - Public interest standard

# Background

- Agencies Responsible for Spectrum Management
  - National Telecommunications and Information Administration (NTIA)
    - Unit of the U.S. Department of Commerce
    - Among other responsibilities (including serving as the President's principal advisor on telecommunications policy) manages the federal government's use of the radio spectrum
    - Spectrum use decisions and assignments/authorizations made with the assistance of the Interdepartmental Radio Advisory Committee (IRAC)
    - Consensus driven with provision for dispute resolution

# Background

- Agencies Responsible for Spectrum Management
  - Note that the FCC issues licenses when it assigns spectrum to its users while the NTIA grants authorizations to its users
  - Spectrum is divided among exclusive federal government, exclusive non-federal government, and shared spectrum

# Challenges to the Current System

- Pressures on the Resource
  - More users, more uses, greater bandwidths
  - Traditional solutions to spectrum congestion
    - Reallocation
    - Move higher in frequency
    - Increased sharing
    - Improved technology
      - More spectrally efficient technologies (bits/second/Hertz)
      - More frequency reuse
      - Compression

# Challenges to the Current System

- Difficulties with the Current System in the Face of Increasing Demand
  - Excessive rigidity
  - Administrative scarcity
  - Barriers to sharing
    - Voluntary
    - In-voluntary
  - Barriers to other welfare enhancing transactions
- A Note on Spectrum Auctions

# Advances in Wireless Technology

- Prior Technical Constraints
- Recent Advances
  - Software Defined Radios
  - Adaptive antennas
  - Space-time processing
  - Interference cancellation
  - Space division multiplexing
  - Ad hoc networks
  - “Intelligence at the edge”

# Competing Approaches/Models for Spectrum Management Reform

- Challenges
  - Reducing rigidities in current system
  - Taking advantages of advanced technologies
  - Vision of a more flexible future
- Competing Approaches/Models
  - Property rights model
  - Commons model
  - Command and control/engineering model

# Summary and Conclusions

# Contact Information

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