

Regulation and Policy in the Telecommunications Industry TM 612-WS

By Dr. Raziq Yaqub
dr.raziq@gmail.com

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Lecture—07 Laws and Regulations for Wireless Systems

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Contents

- **Regulations**
 - Types
 - Approaches
- **Regulation for Unlicensed Wireless Systems**
 - FCC Title 47CFR, Part 15
- **Regulation for Licensed Public Mobile Service**
 - FCC Title 47CFR, Part 22

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Regulations

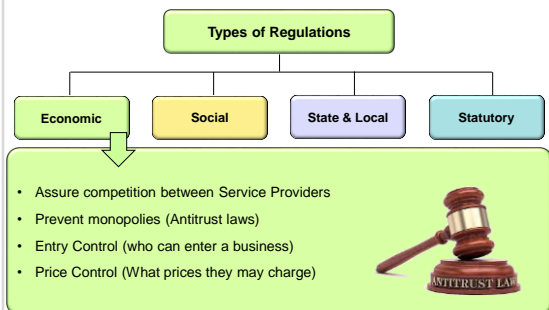
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Regulations

- **Who Gives Congress the regulatory powers?**
 - Constitution of 1789
- **What are the Goals of Regulations?**
 - Goal-1:
 - To change the behavior when pursuit of self-interest could harm others
 - Goal-2:
 - To control employees about their administrative tasks

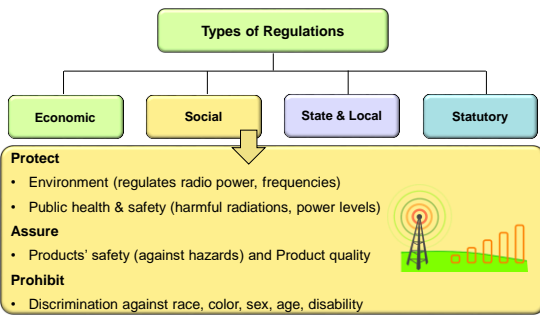
Regulations are costly

Types of Regulations



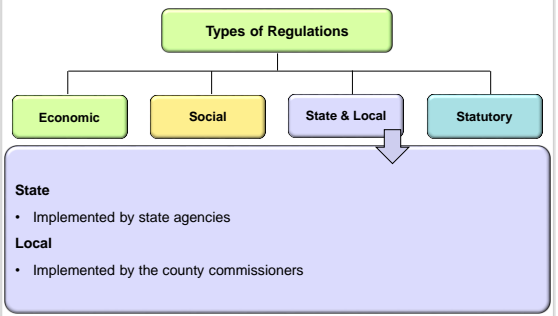
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Types of Regulations



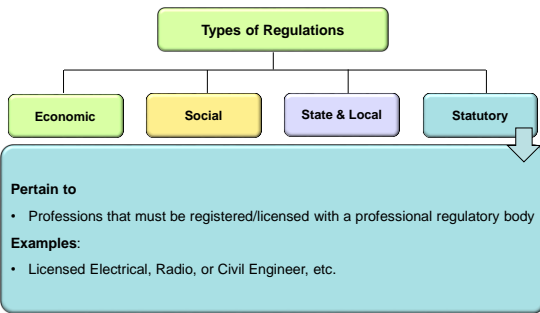
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Types of Regulations



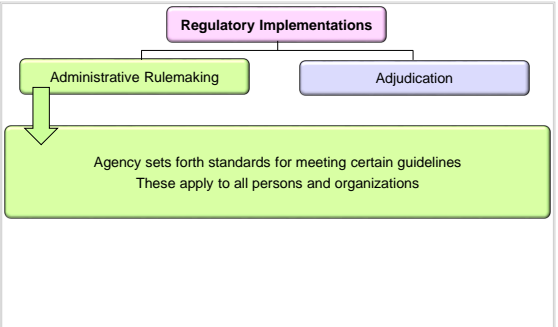
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Types of Regulations



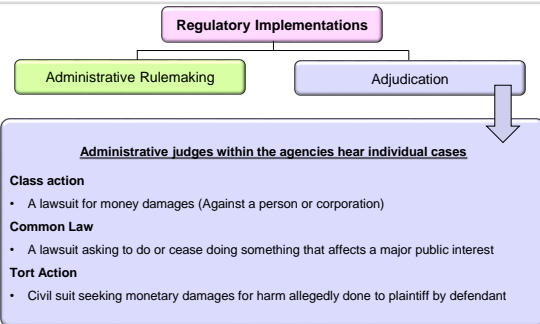
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Regulatory Implementations



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Types of Regulatory Approaches



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Regulation for Wireless Systems

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Contents of FCC CFR Title 47 Regulations

- **Title 47 CFR**
 - Laws pertaining to telecommunications and broadcasting
- **Parts of 47 CFR**
 - Part 2 General Requirements
 - Part 5 Experimental Radio Service
 - **Part 15 Subpart C, D, and E Unlicensed Low Power Transmitters**
 - Part 20 Common Carrier
 - Part 21 Domestic Public Service
 - Part 22 Public Mobile Service
 - Part 24 Licensed PCS
 - Part 25 Satellite Communication Services
 - Part 26 General Wireless services
 - Part 27 Miscellaneous Wireless Services



FCC CFR 47 Regulations (Contd.)

- **Parts of 47 CFR (Contd.)**
 - Part 68 Telecom Services
 - Part 73 Education Services
 - Part 74 Television Broadcast
 - Part 80 Maritime Service
 - Part 87 Aviation
 - Part 90 Private Land Mobile
 - Part 95 Personal Radio Service
 - Part 97 Amateur Radio
 - Part 100 Digital Satellite Broadcast
 - (It is eliminated, and now requirements are in Part 25)
 - Part 101 Fixed Microwave



Regulations for Unlicensed Wireless Systems

Part 15 Subpart C, D, and E Unlicensed Low Power Transmitters

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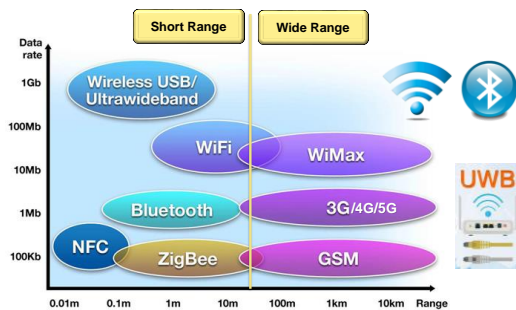
FCC Part 15.1: Scope



- **This part sets out the**
 - Regulations for wireless devices operated without a license
 - Technical specifications
 - Administrative requirements
 - Conditions relating to the marketing of part 15 devices

Unlicensed is Basically for
Short Range Communications

FCC Part 15.15: Short-range, wireless communication



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FCC Part 15.15: General Technical Requirements

- **This part states**
 - No adjustments by user
 - User must cease operation if interference is caused to the authorized users
 - That devices must be **CERTIFIED**
 - e.g. 802.11, WLAN, UWB, and other Low Power Devices



Certified by Wireless
Power Consortium



Wi-Fi
CERTIFIED

Certification= Certifies that a device meets a certain standard of competence

FCC Part 15.15: General Technical Requirements

• Measurement Standards

- ANSI C63.4–2003 contains
 - "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz"



- ANSI C63.17–1998

- "Methods of Measurement of the Electromagnetic and Operational Compatibility of UPCS Devices"



ANSI = American National Standards Institute

UPCS = Unlicensed Personal Communications Services (UPCS)

FCC Part 15.15: Test Report Requirements

• Designed to show transmitter is "well-behaved"

- 2.1046 – Output Power
- 2.1047 – Modulation Requirements
- 2.1049 – Occupied Bandwidth
- 2.1051 – Antenna Conducted Spurs (any unwanted signal)
- 2.1053 – Transmitter Radiated Spurs
- 2.1055 – Frequency Stability

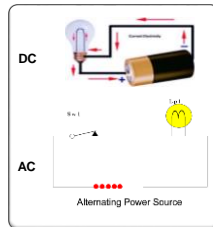
15.203-15.207 Antenna Requirements

• An intentional radiator

- Shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device
- Must meet 15.207 limits anywhere outside of their allotted frequency band

• Conducted Emissions

- Not required for battery powered devices
- Required for AC Powered devices (60Hz)



• Measurement Standards

- ANSI C63.4-2001- per Part 15.31 (a) (3)

15.225: 13.110 – 14.010MHz

• RFID devices

- Allow the RF tag to be certified with the interrogator device

• Field strength limits:

- Average above 1GHz
- 20dB Bandwidth limited to 0.25% of operating frequency

• Common devices:

- Garage door remotes
- Car entry systems/keyfobs
- Alarm systems
- Voice, video and radio controlled toys



15.247 Spread Spectrum

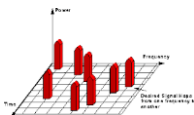
• ISM Band

ISM = Industrial Scientific and Medicines

- 902 – 928 MHz
- 2400 – 2483.5MHz
- 5725 – 5850MHz

• Spread Spectrum Types

- Direct Sequence Spread Spectrum (DSSS)
- Frequency Hopping Spread Spectrum (FHSS)
 - Examples: 802.11 a/b/g systems



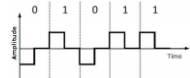
• Hybrid System (Combination of both DSSS and FHSS)

- Examples: Bluetooth

FCC Requirements for Spread Spectrum Devices

• FCC allows four types of transmitter modulation

- Frequency Hopping
- Direct Sequence
- Hybrid
- Digital Transmission Systems



15.247 Spread Spectrum FCC Requirements

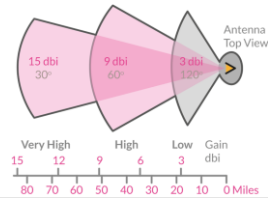
- **Power**

- Tx Output Power 1 Watt
- Effective Isotropic Radiated Power 4 Watts (36dBm)



- **Antenna Gain**

- Limited to 6dBi



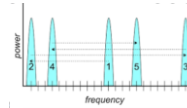
15.247 Spread Spectrum FCC Requirements FHSS

- **Minimum number of hopping frequencies**

- 50 hopping frequencies for 902-928 MHz
- 15 hopping frequencies for 2400-2483.5 MHz
- 75 hopping frequencies for 5725-5850 MHz

- **Average occupancy less then 0.4 seconds in a 30 second period**

- **Random non-sequential hop pattern**



Unlicensed Transmitters Millimeter Wave Devices

- **FCC Part 15.253**

- Frequencies of operation
 - 46.7-46.9 GHz, 76-77 GHz
 - Limited to vehicle mounted field-disturbance systems (Police cars, etc.)

- **FCC Part 15.255**

- Frequencies of operation
 - 57 - 64 GHz
 - Can not be used on aircraft or satellites

Part 15 Subpart D - Unlicensed PCS Bands

- **Unlicensed PCS Bands**

- 1910 -1930 MHz
- 2390-2400 MHz
- Unique Antenna Connector Required
- 3dBi Max (1 to 1 Power Reductions vs. antenna gain)



PCS = Personal Communication System

UNII Part 15.401

- **FCC designated 3 bands for UNNI in 1997**

- 5.15 -5.25 GHz
- 5.25 -5.35 GHz
- 5.725 -5.825 GHz
 - Each band has a specific power and usage limitations
 - Indoor use only with integral antennas in the 5.25-5.35 GHz band

UNII = Unlicensed National Information Infrastructure

UNII Part 15.401 (Contd.)

- **New 255 MHz of spectrum**

- 5.47 – 5.725GHz
 - DFS for devices in the 5.25–5.35GHz & 5.47–5.725GHz bands
 - DFS Interim Test Procedures in rules
 - Transmit Power Control (TPC) 5.47 – 5.725GHz band
- Requires submission of application to FCC

DFS is legally required
It allows Wi-Fi router to find and avert interference with
5GHz radar signals

DFS = Dynamic Frequency Range Selection (DFS)

Part 15 Subpart F: UWB

- **UWB = Ultra-Wide Band**

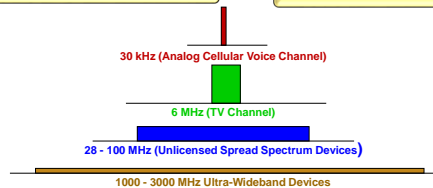
- Operates over wide area of band (1 to 6 GHz wide signals)

Radio Communication Technology that

- Uses a very low energy level
- Used for short-range
- Has high-bandwidth

Applications

- Radar imaging
- Sensor data collection
- Precision locating and tracking



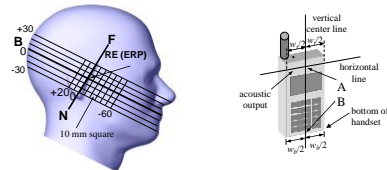
RF Safety Issues OET 65 (FCC)

- **MPE: Maximum Permissible Exposure**

- Calculation to determine separation distances

- **SAR: Specific Absorption Rate**

- Test for body-worn devices



RF Safety Issues Human Exposure Rules and Regulations

- **ANSI (American National Standards Institute)**

- ANSI C95.1

- **OET (Office of Engineering Technology)**

- OET 65
- OET 65-C

- **FCC (Federal Communication Commission)**

- FCC Part 1.1037
- FCC Part 2.1091 Mobile Devices
- FCC Part 2.1093 Portable Devices
- FCC Part 15.247 (b) (4)

Part 15 and RF Exposure

- **RF Exposure for Uncontrolled Environment**

- FCC requires a MPE study for both Mobile and Fixed devices that use high gain antennas

- **Controlled Environment**

- People are aware of potential hazards (posted warnings/training)
 - Radio Facilities
 - Test Environments
 - Manufacturing Environments
- Limits:
 - 5mW/cm² over a 5 minute period

MPE: Maximum Permissible Exposure

Categories of Devices

- **Fixed**

- Permanent mounted device
- Antenna 2 meters away from all users and bystanders
- Antenna usually roof mounted or pole mounted

- **Mobile**

- Designed to operate at 20cm or more from any bystander
- Subject to MPE study
- MPE Example Calculation
- Desktop devices

- **Portable**

- Operate less than 20cm from any user or bystander
- Usually involves body worn devices
- SAR Testing may be required

SAR: Specific Absorption Rate

Regulation for Public Mobile Service

Part 22 Licensed Transmitters

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Title 47 Telecommunication

- **Chapter I Federal Communications Commission**
 - Subchapter B Common Carrier Services 20 – 69
 - Part 22 Public Mobile Services 22.1 – 22.1037
 - Subpart A Scope and Authority 22.1 – 22.99
 - » § 22.1 Basis and purpose.
 - » § 22.5 Citizenship.
 - » § 22.7 General eligibility.
 - » § 22.9 Operation of certificated signal boosters.
 - » § 22.99 Definitions
 - Subpart B Licensing Requirements and Procedures
 - Subpart C Operational and Technical Requirements
 - Subpart D [Reserved]
 - Subpart E Paging and Radiotelephone Service
 - Subpart F Rural Radiotelephone Service
 - Subpart G Air-Ground Radiotelephone Service
 - Subpart H Cellular Radiotelephone Service
 - Subpart I Offshore Radiotelephone Service

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BAD Wireless Regulations

- **Bad regulations or bad implementation approaches may result**
 - Artificial barriers to technology
 - Higher costs
 - Fewer services
 - Less reliability
 - Lower quality of service
 - Unequal distribution of access and services

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Chapter Review Questions (CRQ)

Chapter-07



Q1

- **Pick the most accurate statement.**
- **Bad regulations or bad implementation approaches may result**
 - A. Artificial barriers to technology
 - B. Lower quality of service
 - C. Unequal distribution of access and services
 - D. All the statements are correct

Q2

- **Pick the most accurate statement**
- Title 47 CFR Part 15 Subpart C, D, and E Consists of:**
 - A. Laws pertaining to monopoly and antitrust
 - B. Laws authorizing and empowering states and county commissioners
 - C. Laws pertaining to unlicensed low power transmitters
 - D. Laws pertaining to licensing requirements for telecommunication personnel

Q3

- **Pick the most accurate statement**
- **ANSI C63.4–2003 Standards relate to the methods of measurement:**
 - A. Of hopping frequency for low range RFID transmitters, such as car key fobs
 - B. Of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
 - C. Of measurement of Effective Isotropic Radiated Power for antenna gain limited to 6dBi
 - D. None of the statements in correct

Q4

- Pick the most accurate statement
- According to FCC CFR Title 47 Part 15, RF Exposure, controlled environment means:
 - A. People are aware of potential hazards
 - B. Reduced distractions so the people can provide their best performance
 - C. Controlled pressure and temperature for optimum equipment performance
 - D. A condition that does not involve exposure to the treatment or intervention

Q5

- Pick the most accurate statement
- FCC designated 3 bands for UNNI in 1997. UNNI stands for?
 - A. Universal Networking Information Infrastructure
 - B. Unlicensed National Information Infrastructure
 - C. University News Network Infrastructure
 - D. Unallocated National Number Interface

Answers to CRQ



Q1

- Pick the most accurate statement.
- Bad regulations or bad implementation approaches may result
 - A. Artificial barriers to technology
 - B. Lower quality of service
 - C. Unequal distribution of access and services
 - D. All the statements are correct

D. All the statements are correct

Q2

- Pick the most accurate statement
- Title 47 CFR Part 15 Subpart C, D, and E Consists of:
 - A. Laws pertaining to monopoly and antitrust
 - B. Laws authorizing and empowering states and county commissioners
 - C. Laws pertaining to unlicensed low power transmitters
 - D. Laws pertaining to licensing requirements for telecommunication personnel

C. Laws pertaining to unlicensed low power transmitters

Q3

- Pick the most accurate statement
- ANSI C63.4–2003 Standards relate to the methods of measurement:
 - A. Of hopping frequency for low range RFID transmitters, such as car key fobs
 - B. Of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
 - C. Of measurement of Effective Isotropic Radiated Power for antenna gain limited to 6dBi
 - D. None of the statements in correct

B. Of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

Q4

- Pick the most accurate statement
- According to FCC CFR Title 47 Part 15, RF Exposure, controlled environment means:
 - A. People are aware of potential hazards
 - B. Reduced distractions so the people can provide their best performance
 - C. Controlled pressure and temperature for optimum equipment performance
 - D. A condition that does not involve exposure to the treatment or intervention

A. People are aware of potential hazards

Q5

- Pick the most accurate statement
- FCC designated 3 bands for UNNI in 1997. UNNI stands for?
 - A. Universal Networking Information Infrastructure
 - B. Unlicensed National Information Infrastructure
 - C. University News Network Infrastructure
 - D. Unallocated National Number Interface

B. Unlicensed National Information Infrastructure

Home Assignment

Chapter-07

- Q1.
 - Explain in maximum 10 lines the economic and social wireless regulations you studied in this chapter
- Q2.
 - According to FCC Title 15.247 Spread Spectrum, What are the ISM bands used in spread spectrum. Also what are the power requirements for those bands.
- Q3.
 - According to RF Safety Issues OET 65 (FCC), what is MPE and SAR?

**No Need to Submit
Test is next week**

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