Aspects of Radio Frequency Telemetry in Medical Devices and Medical Research

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Four Aspects of RF in Biomedicine

• Medical Telemetry
• RF Exposure and Safety
• RFID Tag Applications in Medicine
• Research Applications
Medical Telemetry

- Medical telemetry devices monitor patients' vital signs and other parameters -
- Example: wireless cardiac monitors
- Use: in hospitals, health care facilities, home
- FCC 00-211 Established a new Wireless Medical Telemetry Service on 12 June 2000.
Wireless Medical Telemetry

• FCC 00-211 sets aside the frequencies of: 608 to 614 MHz, 1395 to 1400 MHz, and 1429 to 1432 MHz
  • For: “primary or co-primary use by eligible wireless medical telemetry users”
  • For: "the measurement and recording of physiological parameters and other patient-related information via radiated bi- or unidirectional electromagnetic signals"
Medical Telemetry: Authorized Users

• WMTS use is limited to authorized health care providers, and includes:
  • Healthcare facilities,
  • Licensed physicians,
  • Certain trained and supervised technicians.

• Eligible WMTS facilities include hospitals, medical providers that offer services for use beyond 24 hours
  • Ambulances and other moving vehicles are not included
Medical Telemetry: Reasons for New Service

• Parts 15 and 90 of Title 47 of the Code of Federal Regulations allow wireless medical telemetry devices to operate on a secondary user basis in either:
  • the Private Land Mobile Radio Service (PLMRS)
    • between 450 MHz and 470 MHz,
  • or in vacant television channels 7 to 36 and 38 to 46:
    • 7 to 13 = (174-216 MHz)
    • 14 to 46 (470-668 MHz, except in channel 37).
Medical Telemetry:
Reasons for New Service

• Emergence of digital television (DTV) and an increase in land mobile radio services, (crowding of these bands increases the potential for medical devices to be interfered with by licensed primary users)

• Incidents: DTV broadcasting interfered with wireless telemetry cardiac monitors at two Dallas hospitals.
Medical Telemetry:
Reasons for New Service

• Digital TV Interference with Medical Devices:
  Certain medical telemetry devices, such as cardiac monitors, are allowed to use TV broadcast channels that are unoccupied in their geographic area.

• Many medical telemetry devices operated under 47 CFR Part 15 of the FCC regulations
  1. These devices are secondary users of the RF spectrum
  2. Licensed users such as television stations are the primary users.
Sharing of TV Spectrum by Medical Devices

• Medical telemetry devices operated on a secondary basis: must avoid interference from TV broadcasting -
  • TV stations begin transition to digital transmission FY2002
  • That is, they must tolerate any interference that may be caused by local television stations' broadcast signals
  • Medical use had generally been able to avoid interference by using TV channels that were vacant locally
Sharing of Spectrum:
Introduction of digital television (DTV) stations

- “FCC has provided each local TV station with an additional channel that will be used to broadcast digital TV during the transition. This means there are fewer vacant channels in every market”

- “In those areas where DTV will use frequencies now occupied by medical devices, users should adjust their devices so that they continue to operate on those TV channels that are vacant in their area. Once the DTV transition is complete, no further changes should be necessary.”

Sharing of Spectrum:
Introduction of digital television (DTV) stations

- Texas Digital Television stations on channels 7 - 13:
  - KFDA TX AMARILLO 09 On the air
  - WFAA TX DALLAS 09 On the air
  - KUHT TX HOUSTON 09 On the air
  - KAKW TX KILLEEN 13 Authorized to construct and program test
  - TX KILLEEN 13 DR GRANT
  - KLST TX SAN ANGELO 11 Authorized to construct and program test
  - KPCB TX SNYDER 10 Authorized to construct and program test
  - KRGV TX WESLACO 13 On the air
Sharing of Spectrum:
Introduction of digital television (DTV) stations

- **Dallas - Digital Television stations on all channels:**
  - KDAF TX DALLAS 32 Authorized to construct and program test
  - KDFI TX DALLAS 36 Authorized to construct and program test
  - KDFW TX DALLAS 35 On the air
  - KDTX TX DALLAS 45 Authorized to construct and program test
  - KERA TX DALLAS 14 Authorized to construct and program test
  - KXTX TX DALLAS 40 Authorized to construct and program test
  - WFAA TX DALLAS 09 On the air
  - (January 2003)
Sharing of Spectrum:
Introduction of digital television (DTV) stations

- **Fort Worth - Digital Television stations on all channels:**
  - KFWD TX FORT WORTH 51 On the air
  - KTVT TX FORT WORTH 19 Authorized to construct and program test
  - KTXA TX FORT WORTH 18 On the air
  - KXAS TX FORT WORTH 41 On the air

- http://www.fcc.gov/healthnet/dtv.html
- (January 2003)
Sharing of Spectrum:
Introduction of digital television (DTV) stations

- **DFW Region - Digital Television stations on all channels:**
  - KPXD TX ARLINGTON 42 On the air
  - KMPX TX DECATUR 30 Authorized to construct and program test
  - KDTN TX DENTON 43 Authorized to construct and program test
  - KUVN TX GARLAND 24 Authorized to construct and program test
  - KTAQ TX GREENVILLE 46 Authorized to construct and program test
  - KSTR TX IRVING 48 On the air
  - KLDT TX LAKE DALLAS 54 Authorized to construct and program test
  - KXII TX SHERMAN 20 On the air
Sharing of Spectrum:

- **FCC Digital Television channels: frequency allocations**

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<th>TV Channel</th>
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<td>800-806</td>
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Last Updated/Reviewed on: Tuesday, October 02, 2001

http://www.fcc.gov/oet/dtv/tvchfreq.html

(47 CFR § 73.603 Numerical designation of television channels)
RF Exposure and Safety: Potential for RF Interaction with Biological Systems

- Most radio frequency energies pass through the body without any harmful or residual effects
- Newer devices operate at higher frequency levels
- Higher frequencies and shorter wavelengths have the potential for greater interaction with tissue.
- Increased frequencies have greater potential for interference with medical life support devices
RF Exposure and Safety: Standards for Safe Usage of RF Energy

- Developed by Institute of Electrical and Electronic Engineers (IEEE)
- Guide for safe usage to prevent harmful effects of RF energy
- Covers non-ionizing RF energy
RF Exposure and Safety: Standards for Safe Usage of RF Energy

• Since January 1, 1997, RF devices from:
  Amateur Radio Stations,
  Cellular Phones,
  Spread Spectrum data radios,
  Other RF devices
• Are Required to meet the RF safety limits set forth by the FCC
• OET (FCC Office of Engineering Technology) Bulletin number 65
• Docket 96-362 (NPRM 93-62)
RFID Tags in Biomedicine: Many New Applications - Lots of Potential

- Inventory Tracking for Medical Supplies, Devices, and Pharmaceuticals
- Quality Assurance in Patient Care
- Labeling of Organisms
- Implantable Tags and Devices
  - (http://www.ti.com/tiris/docs/docntr.htm#notes)
RFID Tags in Biomedicine: Frequency Allocation Issues

- RFID tags originally operated at 125kHz
  - In the USA from 902 to 928 MHz was also allocated.

- Recent 13.56MHz allocation for RFID systems:
  - Adopted in Europe - ranges are in the 30cm region.
  - US FCC has allowed, but with lower power (shorter ranges)

- Potential for conflict between RFID and Bluetooth IEEE 802.11 in the 2.4 GHz ISM bands
  - (http://www.ing.unipi.it/ew2002/proceedings/001.pdf)

- Summary: Many RFID FQ allocation issues
RF in Biomedical Research

- Electromagnetic Field Simulation
Acknowledgements: sources and references

- **U.S. Department of Health and Human Services:**
  - Food and Drug Administration
  - Center for Devices and Radiological Health
  - Office of Device Evaluation
  - RF Exposure and Safety
  - [http://www.fda.gov/cdrh/emc/wmt2.html](http://www.fda.gov/cdrh/emc/wmt2.html)
  - [http://www.fda.gov/bbs/topics/NEWS/NEW00630.html](http://www.fda.gov/bbs/topics/NEWS/NEW00630.html)

- **U.S. Federal Communications Commission:**
  - Digital TV and Medical Telemetry Devices:
  - OET (FCC Office of Engineering Technology) Bulletin number 65:
    - “Evaluating Compliance with the FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields”
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