

DIGITAL RADIOCOMMUNICATION (WHERE ARE WE GOING?)



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TOPICS FOR DISCUSSION

- **POLICY OBJECTIVES**
- **ITU MULTIMEDIA STUDIES**
- **ADVANCED WIRELESS SYSTEMS**
- **DIGITAL RADIO BROADCAST**
- **DIGITAL TELEVISION BROADCAST**
- **12 GHz TERRESTRIAL SHARING WITH GSO SATELLITE DBS**
- **BROADBAND SATELLITE**
- **ABOVE 50 GHz**
- **FUTURE (SOFTWARE) RADIOS**
- **ULTRA-WIDEBAND SYSTEMS**

POLICY OBJECTIVES

- **FOSTER COMPETITIVE AND INNOVATIVE COMMUNICATIONS INDUSTRIES**
- **MINIMIZE REGULATION AND ENACT FLEXIBLE REGULATORY POLICIES**
- **PROMOTE MARKET ACCESS AND ENCOURAGE GOVERNMENTS TO ADOPT OPEN, NON-DISCRIMINATORY, TRANSPARENT POLICIES**

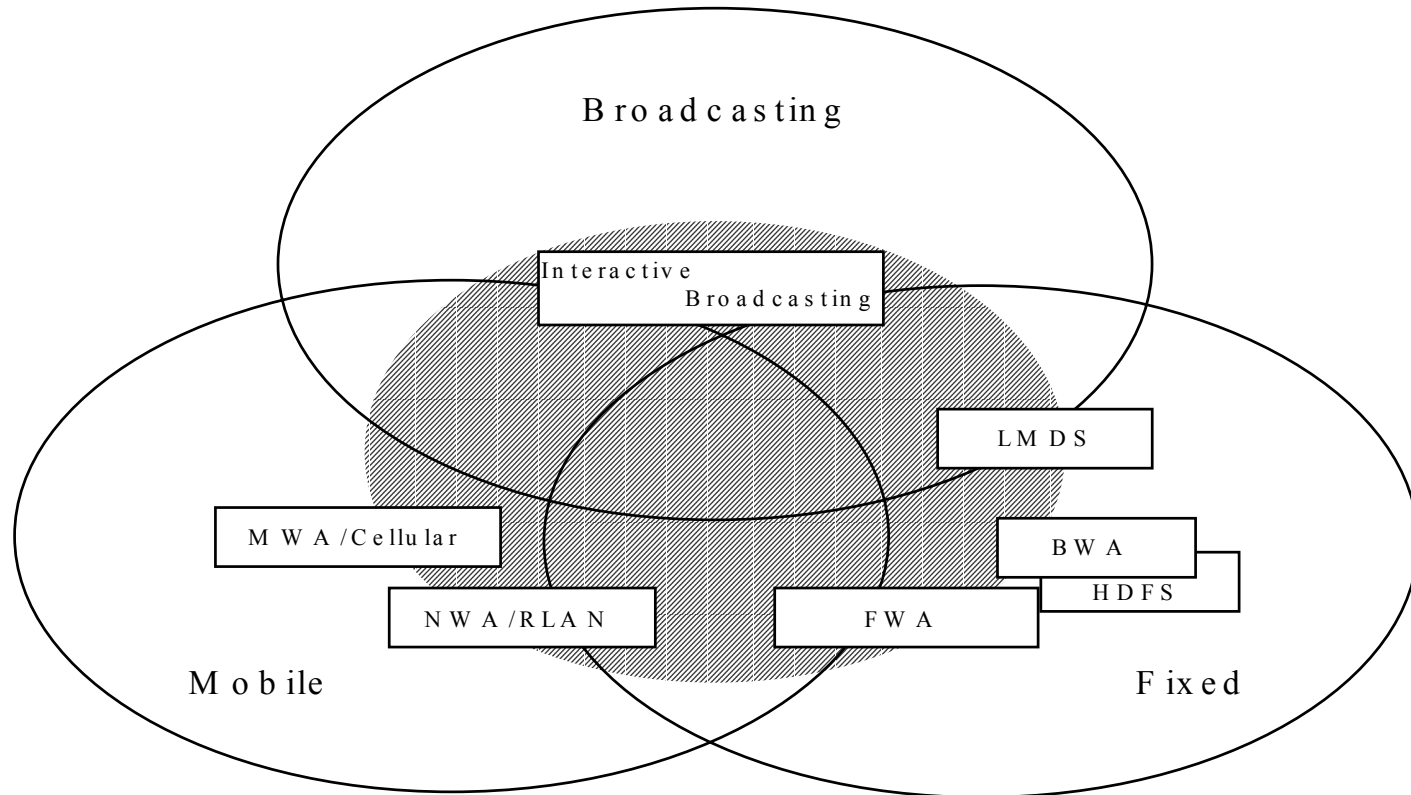
ITU-R JOINT TASK GROUP 1-6-8-9 TERRESTRIAL WIRELESS INTERACTIVE MULTIMEDIA

- **WRC-2003 AGENDA ITEM 1.21**
 - **TO CONSIDER STUDIES CONCERNING
TECHNICAL AND REGULATORY
REQUIREMENTS OF TERRESTRIAL
WIRELESS INTERACTIVE MULTIMEDIA
APPLICATIONS, IN ACCORDANCE WITH
RESOLUTION 737 (WRC-2000), WITH A VIEW
TO FACILITATING GLOBAL
HARMONIZATION**

RESOLUTION 737 (WRC-2000)

- 1. FACILITATE DEVELOPMENT OF COMMON, WORLDWIDE ALLOCATIONS OR IDENTIFICATION OF SPECTRUM**
- 2. REVIEW REGULATORY METHODS AND MEANS OF WORLDWIDE SPECTRUM IDENTIFICATION TO FACILITATE HARMONIZATION OF EMERGING TERRESTRIAL WIRELESS INTERACTIVE MULTIMEDIA SYSTEMS FOR UNIVERSAL PERSONAL SERVICES**
- 3. REVIEW, IF NECESSARY, SERVICE DEFINITIONS IN LIGHT OF CONVERGENCE**
- 4. REPORT TO A FUTURE CONFERENCE**

TERRESTRIAL WIRELESS INTERACTIVE MULTIMEDIA



LMDS: Local multipoint distribution system
 FWA: Fixed wireless access
 BWA: Broadband fixed wireless access
 HDFS: High density applications in the fixed service

RLAN: Radio local area network
 NWA: Nomadic wireless access
 MWA: Mobile wireless access

SPECTRUM MANAGEMENT (ITU-R SG 1) STUDIES

- **HOW ARE INTERACTIVE MULTIMEDIA APPLICATIONS OF TERRESTRIAL FIXED, MOBILE, AND BROADCASTING SERVICES CONVERGING TECHNICALLY?**
- **HOW DOES TECHNICAL CONVERGENCE IMPACT ON THE NATIONAL AND INTERNATIONAL RADIO REGULATORY ENVIRONMENT?**
- **IF TECHNICAL CONVERGENCE IMPACTS THE SERVICE DEFINITIONS OF THE RADIO REGULATIONS, HOW SHOULD THE DEFINITIONS BE REVISED?**

SPECTRUM MANAGEMENT (ITU-R SG 1) QUESTIONS

- **WHAT CHARACTERISTICS DOES A TERRESTRIAL WIRELESS INTERACTIVE MULTIMEDIA SYSTEM HAVE?**
- **WHAT ARE THE APPLICATIONS AND TECHNOLOGIES THAT FALL INTO THIS CATEGORY?**
- **HOW DO THESE APPLICATIONS AND TECHNOLOGIES RELATE TO THE SPECTRUM?**
- **WHAT ARE THE SHARING SCENARIOS?**
- **WHAT ARE REGULATORY IMPEDIMENTS?**
- **WHAT ARE TRENDS (CURRENT AND FORESEEN) THAT WILL IMPACT THE RESPONSES TO THESE QUESTIONS?**

BROADCAST (ITU-R SG 6) STUDIES

STUDY GROUP 6 STUDIES TERRESTRIAL AND SATELLITE BROADCASTING FROM END-TO-END, INCLUDING VISION, SOUND, MULTIMEDIA AND DATA SERVICES INTENDED FOR THE GENERAL PUBLIC. USE IS MADE OF POINT-TO-EVERYWHERE INFORMATION DELIVERY. WHEN RETURN CHANNELS ARE REQUIRED FOR ACCESS CONTROL, INTERACTIVITY, ETC., AN ASYMMETRICAL INFRASTRUCTURE IS USED.

MOBILE SERVICE STUDIES ITU-R WORKING PARTY 8F (IMT-2000 AND BEYOND)

- **FUTURE SYSTEMS WITH DATA RATES > 2 Mbit/s**
- **INCLUDE FREQUENCY BANDS ABOVE 3 GHz**
- **SERVICE APPLICATIONS, OBJECTIVES AND USER NEEDS**
- **INCLUDE ENHANCED INTERNET PROTOCOL**
- **TECHNICAL AND OPERATIONAL ISSUES, AND CHARACTERISTICS**
- **HARMONIZE SPECTRUM**
- **MIGRATION STRATEGY**
- **GLOBAL CIRCULATION AND MUTUAL RECOGNITION AGREEMENTS**

ADVANCED WIRELESS SERVICES BELOW 3 GHz

- **STUDIES HAVE JUST BEGUN OF TYPES OF ADVANCED, FUTURE MOBILE AND FIXED COMMUNICATIONS SERVICES, INCLUDING 3G**
- **STUDIES**
 - **TECHNICAL CHARACTERISTICS**
 - **SPECTRUM REQUIREMENTS**
 - **AMOUNT OF SPECTRUM**
 - **FREQUENCY BANDS**
- **STUDIES INCLUDE OF BANDS CURRENTLY USED FOR ANALOG CELLULAR, PERSONAL COMMUNICATIONS SERVICE, SPECIALIZED MOBILE RADIO AND THE FIVE BANDS JUST ALLOCATED BY WRC-2000 (ISTANBUL)**

THIRD GENERATION (IMT-2000 AND BEYOND)

1710 - 1755 MHz - FIXED & MOBILE

1755 - 1850 MHz - DEFENSE USES

2110 - 2150 MHz - FIXED & MOBILE

2160 - 2165 MHz - FIXED & MOBILE

2500 - 2690 MHz - MMDS and ITFS

DIGITAL FM BROADCAST

- **88 - 108 MHz BAND**
- **EXISTING FM RADIO STATIONS IN THE U.S. ARE USING +/- 75 kHz DEVIATION AT 200 kHz CHANNEL SEPARATION**
- **OTHER COUNTRIES, E.G., IN EUROPE, ARE USING +/- 50 kHz DEVIATION AT 100 kHz CHANNEL SEPARATION**
- **IN-BAND ON CHANNEL (IBOC) DIGITAL OVERLAY EXPERIMENTS**
- **IBOC DIGITAL SIGNAL INSERTED ~25 dB BELOW THE ANALOG FM SIGNAL**
- **OTHER STANDARDS BEING DISCUSSED INTERNATIONALLY WITH THE HOPE OF FINDING A COMMON GLOBAL STANDARD**

DIGITAL SOUND BROADCASTING BELOW 30 MHz

THE WORLD BROADCASTING UNION AND THE ITU HAVE BEEN COOPERATING IN SUPPORT OF STUDIES LEADING TO THE ADOPTION OF SINGLE WORLDWIDE BROADCASTING STANDARDS, PARTICULARLY:

- SINGLE COMMON DIGITAL SOUND BROADCAST SYSTEM IN LF, MF, AND HF**
- DIGITAL CODING AND MODULATION COMPATIBLE WITH EXISTING STATION PLANNING**
- WHAT ARE ADVANTAGES OVER ANALOG**
- WHAT ARE NEW SERVICES**
- COMPLEXITY OF DUAL STANDARD (ANALOG AND DIGITAL) BROADCAST RECEIVERS**

SATELLITE RADIO SYSTEMS

U.S. Services

International

	Sirius	XM satellite radio	Worldspace
Market	auto	auto/home	home/portable
Orbit	inclined	GEO	GEO
Size	3 satellites	2 satellites	3 satellites
Manuf.	Loral	Hughes	Alcatel
Channels	100	100	NA
OEM	Ford	GM	NA

DIGITAL TELEVISION

- **THERE ARE TWO COMMON GLOBAL STANDARD (ANALOG) TELEVISION BROADCAST CHANNEL BANDWIDTHS, 6 MHz AND 8 MHz**
- **THERE IS A COMMON DIGITAL TELEVISION DISPLAY FORMAT BUT DIFFERENT RF MODULATION SCHEMES, COFDM AND 8VSB**
- **VERY POLITICAL**
- **RECALL THE DIGITAL LAG IN TRANSITION FROM ANALOG TO DIGITAL (HIGH DEFINITION DEFINED AS EQUIVALENT TO A 35 mm CINEMA PICTURE**

INTERACTIVE TELEVISION

- **THE FCC BEGAN (JANUARY 2001) THE STUDY OF THE DEFINITION OF *INTERACTIVE TELEVISION SERVICES* SO AS TO FACILITATE APPROPRIATE LICENSING:**
 - **VIDEO PIPELINE (MPEG VIDEO)?**
 - **HIGH SPEED INTERNET PROTOCOL?**
 - **CUSTOMER PREMISES EQUIPMENT?**
 - **ANTI-COMPETITIVE BEHAVIOR?**

BSS SHARING (NORTHPOINT)

- **SHARING WITH GEOSTATIONARY SATELLITE, BROADCAST SATELLITE SERVICE (BSS), IS FEASIBLE**
- **UNIQUE TECHNICAL PROPOSAL**
- **MANDATORY INTERFERENCE TESTING REQUIRED (BY U.S. CONGRESS)**
- **POLITICALLY SENSITIVE**

Ka/Ku-BAND U.S. BROADBAND SATELLITE SYSTEMS

CAI Satcom

GE StarPlus

EchoStar

GE Star

Hughes Spaceway

iSky

Astrolink

Loral Cyberstar

Morning Star

CyberStar

NetSat 28

PanAmSat

SkyBridge (LEO in Ku)

Teledesic (LEO)

VisionStar

Orion Ka

Vinasat

Celstar*

DirecTV Expansion

* Also plans to operate in C-band

ADDITIONAL Ka/Ku-BAND BROADBAND SATELLITE SYSTEMS

Medsat (Aerospatiale)

Videosat (France Telecom)

WEST (Matra Marconi Space)

Genesis (Deutsche Telekom)

Euroskyway (Alenia Spazio)

**Astra (Societe Europeenne des
Satellites)**

Megasat (Mexico)

Gelikon (Informkosmos)

South Africa-sat (South Africa)

Diamondsat (South Africa)

PC DataStar* (PCG)

Afrisat (United Kingdom)

V-BAND U.S. BROADBAND SATELLITE SYSTEMS

Globalstar (GS-40)

Hughes Expressway

Hughes SpaceCast

Hughes StarLynx

PanAmSat V-Stream

VisionStar

Loral CyberPath

Motorola M-Star

OSC (OrbLink)

PanAmSat (V-Stream)

Spectrum Astro

Teledesic

TRW (GESN/GEO)

BROADBAND CAPACITY QUESTION

- **EXPECTED GROWTH IN SATELLITE AS DELIVERY MECHANISM FOR BROADBAND DATA COULD STRAIN SATELLITE CAPACITY**
- **25 MILLION PEOPLE IN RURAL AREAS (U.S. ALONE) WILL NEED BROADBAND VIA SATELLITE**
- **CURRENT ESTIMATE: 20,000 BROADBAND SUBSCRIBERS/TRANSPONDER OR 480,000 BROADBAND CONSUMERS/SATELLITE (24 TRANSPONDERS/SATELLITE)**

PROMOTING COMMERCIAL MILLIMETER WAVE USE (ABOVE 50 GHz)

- **51.4 - 52.6 GHz AND 58.2 - 59 GHz BANDS IN THE U.S. ALLOCATED TO FIXED AND MOBILE SERVICES (INTERCONNECT MOBILE SERVICE BASE STATIONS AND INTERCONNECT DIFFERENT SYSTEMS)**
- **57 - 59 GHz ALLOCATED TO UNLICENSED USES (FCC PART 15) SO AS TO ENLARGE THE CURRENTLY UNLICENSED 59 - 64 GHz BAND TO 8 GHz (VERY HIGH SPEED AND/OR HIGH BANDWIDTH COMMUNICATION OVER SHORT DISTANCES AND FOR NETWORKING BACKBONE PURPOSES IN CONGESTED AREAS)**

PROMOTING COMMERCIAL MILLIMETER WAVE USE (ABOVE 50 GHz)

- **64 - 66 GHz ALLOCATED TO FIXED AND MOBILE SERVICES, EXCEPT FOR AERONAUTICAL MOBILE SERVICE (AGAIN, INTERCONNECT MOBILE SERVICE BASE STATIONS AND INTERCONNECT DIFFERENT SYSTEMS)**
- **65 - 71 GHz ALLOCATED TO INTERSATELLITE SERVICE (ISS) TO MAKE SATELLITE NETWORK INTERCONNECTIONS MORE EFFICIENT (WILL PROMOTE VIDEO TELEPHONY, MEDICAL AND TECHNICAL TELE-IMAGING, HIGH SPEED DATA NETWORKS, AND BANDWIDTH-ON-DEMAND FOR CONSUMERS)**

U.S. UNLICENSED OPERATION

57 - 64 GHz

- **LICENSING THIS BAND IS UNNECESSARY BECAUSE OF THE VERY LIMITED POTENTIAL FOR INTERFERENCE DUE TO THE LOW POWER LIMITS, THE DRAMATIC OXYGEN ABSORPTION OF RF ENERGY AT FREQUENCIES AROUND 60 GHz, AND THE NARROW BEAMWIDTH OF POINT-TO-POINT ANTENNAS USED OUTSIDE**
- **MAXIMUM PFD PERMITTED IN THIS 7 GHz BAND IS 9 $\mu\text{W}/\text{cm}^2$ AVERAGE, AND 18 $\mu\text{W}/\text{cm}^2$ PEAK AT 3 METERS**
- **NOKIA HAS ALREADY BEGUN DEPLOYING UNLICENSED MICRO-CELLULAR EQUIPMENT IN THE BAND 57 - 59 GHz IN EUROPE**

SOFTWARE DEFINED RADIO

- **NEW TECHNOLOGY USING SOFTWARE (COMPUTERS), RATHER THAN HARDWARE FOR TRANSMITTERS AND RECEIVERS TO CHANGE OPERATING PARAMETERS, INCLUDING FREQUENCY, MODULATION, AND POWER**
- **RADIOS QUICKLY CHANGE TRANSMIT FREQUENCIES AND FORMAT**
- **DESIGNED TO ALLEVIATE POTENTIAL SPECTRUM SHORTAGE AND SPUR MORE EFFICIENT USE OF BANDWIDTH**
- **WILL ASSIST INTEROPERABILITY, PARTICULARLY FOR PUBLIC SAFETY AND BETWEEN FEDERAL AND LOCAL OFFICIALS**
- **ITU-R SG 8 STUDYING APPROPRIATE TECHNICAL CHARACTERISTICS, FREQUENCY BANDS, INTERFERENCE CONSIDERATIONS, OPERATIONAL ISSUES, AND DEFINITIONS**

ULTRA-WIDEBAND (UWB) (UNLICENSED - NO COORDINATION)

- **EXTREMELY NARROW PULSE MODULATION, SWEPT FM OVER A WIDE BANDWIDTH, OR FREQUENCY HOPPING SYSTEM**
- **TWO OBSTACLES TO IMPLEMENTATION**
 - **WIDE BANDWIDTH EMISSIONS CAN RESULT IN FUNDAMENTAL ENERGY IN RESTRICTED BANDS, E.G., TELEVISION, SAFETY, RADIONAVIGATION**
 - **CURRENT PHILOSOPHY AND REGULATIONS ARE GEARED TO NARROWBAND SYSTEMS AND MAY POSE UNNECESSARY RESTRICTIONS TO UWB TECHNOLOGY**

ULTRA-WIDEBAND (UWB)

PROPOSED USES:

- GROUND PENETRATING RADARS (PUBLIC SAFETY, ARCHEOLOGICAL, CIVIL ENGINEERING, EARTHQUAKE)**
- THROUGH-THE-WALL RADAR FOR PUBLIC SAFETY AND CONSTRUCTION**
- EMERGENCY MOTION AND IMAGING**
- HIGH PERFORMANCE MICROPHONES**
- LOCAL AREA NETWORKS**
- SECURITY DEVICES**
- COLLISION AVOIDANCE SENSORS**
- FLUID-LEVEL DETECTION**
- SHORT RANGE CLANDESTINE COMMUNICATION DEVICES**
- LONG RANGE MILITARY COMMUNICATIONS**

PROPOSED UWB DEFINITION

- ANY EMITTING DEVICE WHERE THE FRACTIONAL BANDWIDTH IS GREATER THAN 0.25 OR OCCUPIES 1.5 GHz* OR MORE OF SPECTRUM**
- THIS DEFINITION IS PROPOSED TO BE BASED ON THE -10 dB BANDWIDTH, MEASURED AFTER THE ANTENNA**, BECAUSE THESE DEVICES OPERATE SO CLOSE TO THE NOISE FLOOR**
- CENTER FREQUENCY IS THE AVERAGE OF THE UPPER AND LOWER -10 dB FREQUENCY POINTS**

***The 1.5 GHz bandwidth floor would only apply where the center frequency is greater than 6 GHz.**

****The antenna acts as a bandpass filter for UWB devices.**

UWB FRACTIONAL BANDWIDTH

$$\text{FRACTIONAL BW} = 2(F_h - F_l)/(F_h + F_l)$$

WHERE

F_h = HIGHEST FREQUENCY LIMIT WITH SIGNAL 10 dB
BELOW PEAK EMISSION

F_l = LOWEST FREQUENCY LIMIT WITH SIGNAL 10 dB
BELOW PEAK EMISSION

UWB

- **STUDIES AND EXPERIMENTS ARE BEING CONDUCTED AND REPORTED TO ENABLE INFORMED REGULATORY DECISIONS, PARTICULARLY WITH REGARD TO POSSIBLE INTERFERENCE TO SATELLITE RADIONAVIGATION AND RADIOLOCATION SYSTEMS, E.G., ILS, MLS, DME, SARSAT, ALTIMETERS, GPS AND GLONASS**
- **PROPOSED PEAK EMISSION LIMIT OVER THE ENTIRE BANDWIDTH, PENDING STUDIES AND EXPERIMENTS, IS:**

$$[20 + 20\text{LOG}_{10}(-10\text{dB BANDWIDTH IN Hz}/50 \text{ MHz})] \text{ dB}$$

ADDITIONALLY, THIS PROPOSED PEAK IS NOT TO EXCEED THE AVERAGE BY MORE THAN 60 dB

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