

Geoscience and Remote Sensing Society

Frequency Allocations in Remote Sensing Technical Committee

Bill Blackwell, MIT Lincoln Laboratory, Chair Ian Adams, Naval Research Laboratory, Vice-Chair

IGARSS Evening Meeting

Vancouver, July 26, 2011



Agenda

- Overview of FARS technical committee
- Recent/future meetings of interest
 - Committee On Radio Frequencies (CORF) 16-17 May, 2011
 - Space Frequency Coordination Group (SFCG) 7-15 June, 2011
 - World Radiocommunication Conference (WRC) Jan/Feb, 2012
- Current initiatives
 - Promotion, outreach, and recognition
- Future initiatives:
 - NASA request for "RFI Primer for PI's" (terms of reference, players, etc.)
 - Lots of good work at L band, but what about other bands?
 - Build relationship with GEOSS Task AR-06-11
 - FARS article for GRSS Newsletter (grow into TGRS submission?)

FARS website: http://www.grss-ieee.org/community/technical-committees/frequencyallocations-in-remote-sensing/ Wiki coming soon!!





Frequency Allocation for Remote Sensing (FARS) Technical Committee

• Objectives

- ⇒ Interface between GRSS and the frequency regulatory process
 - Help to educate membership on frequency regulatory process
 - Gather and distribute information on current frequency management issues to membership
 - Organize GRSS efforts to impact regulatory process as appropriate
- Coordinate and advocate GRSS technical input to regulatory organizations and working parties
 - □ Standardization of methods applied to analyses
 - □ ITU-R RS 577, 1166, 1028, 1029
 - □ Respond to requests for sensor and user information
 - □ Investigation of RF interference and mitigation





New Chairs

• Bill Blackwell (Chair)

- MIT Lincoln Laboratory
- WJB@LL.MIT.EDU
- 781-981-7973

Ian Adams (Vice-Chair)

- Naval Research Laboratory
- ian.adams@nrl.navy.mil
- 202-767-1937

FARS Officer History

Year	Officers			
2000-01	Ram Narayanan			
2001-02	Ram Narayanan, Chris Ruf			
2002-03	Chris Ruf, Ram Narayanan			
2003-04	David Kunkee, David DeBoer			
2004-05	David Kunkee,David DeBoer			
2005-06	Joel Johnson, David Kunkee			
2006-07	Joel Johnson, David Kunkee			
2007-08	Joel Johnson,-			
2008-09	Joel Johnson, Shannon Brown			
2009-10	Shannon Brown, Joel Johnson			
20010-11	Shannon Brown, Ian Adams			

• Thanks, Shannon (and predecessors)!





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Membership

New members are welcome, you are encouraged to recruit/spread the word! Interested parties (must be GRSS members) contact WJB@LL.MIT.EDU

- June 2011
 - 78 Members; 10 Countries

FARS Membership by Continent

FARS Membership by Organization



Other: Non Profit, FFRDC (LL, JPL, Aero)





Overview

Recent and future meetings

- Committee on Radio Frequencies (CORF), 16-17 May 2011
- Space Frequency Control Group (SFCG-31), 7-15 June 2011
- World Radiocommunication Conference (WRC-12), early 2012

Recent initiatives

- Promotion of FARS causes
- Cross-fertilization with other groups/communities
- Recognition of impactful FARS work

Upcoming events

- Friday morning FARS technical session
- FARS article in GRSS Newsletter





Committee on Radio Frequencies

- CORF represents the interests of U.S. scientists
 who use radio frequencies for research
 - Radio astronomers and remote sensing researchers
- CORF deals with radio-frequency requirements
 and interference protection
 - Primarily through filing comments under the aegis of the National Academy of Sciences in public proceedings of the Federal Communications Commission
- CORF acts as a channel for representing the interests of U.S. scientists:
 - Scientific Committee on Frequency Allocations For Radio Astronomy and Space Science (IUCAF) of the International Council for Science
 - Working groups of the Radiocommunication Sector of the International Telecommunication Union (ITU).





CORF Summary: US Government Policy

- National Broadband Plan: Presidential and congressional initiatives focused on spectrum use
 - Primarily to give wireless industry more bandwidth
 - RAS/EESS community needs to participate
- Wireless industry growing
 - Devices are bandwidth-hungry
- Enhancing Access to the Radio Spectrum (EARS)
 - NSF initiative
 - Funding available for researching spectrum innovation
 - » http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503480
 - Report from workshop
 - » <u>http://www.nsf.gov/mps/ast/nsf ears workshop 2010 final report.</u> <u>pdf</u>





CORF Summary: Community Involvement

RAS/EESS users need to engage Comm community

- NIMBY argument seen as impediment
- Must consider prospects of bandwidth sharing
 - » Negotiate
 - » Secure new bands
 - » Time sharing

Extend FARS relationship with CORF

- Highlight importance of remote sensing
- Work towards a CORF / FARS meeting
- Work with other societies within IEEE
 - Communication Society
 - Electromagnetic Compatibility Society





CORF Summary: Spectrum Use

- Automotive radar
 - 24-29 GHz
 - 76-81 GHz
- Oceanographic radar
 - 4-40 MHz
- LightSquared
 - Possible GPS Interference
- . Cognitive Radio
 - Not location aware
 - Can't detect passive use
- . 60-GHz wireless
 - Should be no interference with O₂ bands





What is the Space Frequency Coordination Group?

The SFCG is an informal group comprised of the major civil space agencies and related national and international scientific organizations

Its main objectives are:

- To provide working level coordination of international RF spectrum usage among users of the science services
- To adopt agreements that optimise the use of the allocated bands
- To agree common policies and identify long-term targets related to potential changes to the international regulations (ITU-R, WRC, Regional Groups)





History

- 1980 Group jointly chartered by Director-General of European Space Agency (ESA) and NASA Associate Administrator for Space Tracking and Data Systems.
- 1980 First formal meeting held in Toulouse, France.
- Attended by representatives from 10 national space agencies, one scientific organization and ESA.
- English adopted as the official working language.
- SFCG web site: <u>http://sfcgonline.org</u>





Scope

- The radio services covered by the SFCG activity are:
 - » Space Research (data communications and sensors)
 - » Space Operations
 - » Earth Exploration-Satellite (data communications and sensors)
 - » Meteorological-Satellite
 - » Inter-Satellite
- Therefore,
 - Remote sensing is only one (important) element of the SFCG activity
 - Remote sensing other than from satellites is not within the SFCG scope





Members (Space Agencies)

ASA	Austria	INTA	Spain
ASI	Italy	ISRO	India
BNSC	United Kingdom	JAXA	Japan
CAST	China	NASA	USA
CNES	France	NIVR	Netherlands
CONAE	Argentina	NOAA	USA
CSA	Canada	NSA	Malaysia
CSIRO	Australia	NSAU	Ukraine
DLR	Germany	NSPO	Taiwan
ESA	Europe	SBSA/SSC	Sweden
EUMETSAT	Europe	SPPS	Belgium
INPE	Brazil	RAS	Russia
INSA	Spain	RASA	Russia





Observers

- Consultative Committee on Space Data Systems (CCSDS Panel 1)
- Coordination on Geostationary Meteorological Satellites (CGMS)
- Inter-Union Commission on Frequency Allocations for Radio Astronomy and Space Science (IUCAF)
- ITU Radiocommunication Sector (ITU-R)
- Committee on Environmental Observation Systems (CEOS)
- World Meteorological Organization (WMO)
- International TOVS Working Group (ITWG)
- IEEE GRSS Frequency and Allocations for Remote Sensing (FARS)





Working Methods

- Group meets at approximate one year intervals with each meeting hosted by a member agency
- Exec. Sec. is Head of ESA Frequency Management Office, providing continuity, and supporting the meeting.
- Each meeting has an agenda as well as Action Items from the previous meeting and inputs are solicited for any of these topics as well as any topic of interest to members/observers
- Input papers are discussed and output papers prepared:
 - Action Items: to be completed for next SFCG meeting
 - Resolutions: express action for SFCG members
 - Recommendations: express action, to be pursued by SFCG members outside the group, e.g. within member agencies and administrations





SFCG Meeting Summary (7-15 June 2011)

- A total of 62 input documents were received for consideration by SFCG-31
 - ITU Matters and Preparation for WRC-12
 - General Frequency Management
 - Earth environmental satellites and MetSat
 - Coordination Issues and Databases
- Highlights relevant to GRSS/FARS:
 - Request for Database of Passive Sensor Filter Characteristics
 - Fixed Service OOB vs. EESS Passive 86-92 GHz
 - 1400-1427 MHz RFI recent issues (SMOS)
 - LightSquared (next slide)





LightSquared (potential interference to GPS)

- LightSquared is a company that plans to develop a wholesale 4G-LTE (Long Term Evolution) wireless broadband communications network integrated with satellite coverage across the United States
- LightSquared controls 59 MHz of United States spectrum (1525-1559 MHz) and received FCC authorization in 2004 to use this L-Band spectrum to build its nationwide 4G-LTE wireless broadband network integrated with satellite coverage
- LightSquared's SkyTerra 1 launched from the Baikonur Cosmodrome in Kazakhstan on November 14, 2010
 - Largest commercial reflector antenna ever put into space (23M)





GPS sensitive to MSS band



MSS = mobile satellite service ATC = ancillary terrestrial component



IEEE



Next Steps

- LightSquared has proposed to use only 10 MHz on the low-frequency side of the band
- The FCC is accepting public comments until July 30 and replies to those comments until August 15, 2011
- After the public comment period is closed, the FCC can render a decision at any time
- NB, strong influence of U.S. National Broadband Plan, which includes improving Americans' accessibility to high-speed wireless connectivity to the Internet





Watch Item: LTE Spectrum Near 700 MHz

- 698-806 MHz recently auctioned for LTE services
- Note that 2nd harmonics cover the entire 1400-1427 MHz band







World Radiocommunication Conference

- The World Radiocommunication Conference (WRC) is a gathering of official delegations from over 140 nations and organized by the International Telecommunication Union (ITU)
- National government officials come together every few years to negotiate proposals to changes in international spectrum regulations
- If approved, these changes would then be in-force internationally through the auspices of the ITU





Passive Microwave RFI Observation Updates

SMOS ocean observations of RFI

- See postcard

WindSat / AMSR-E ocean RFI at 10 GHz continues to expand

- Europe
- Middle East
- Canary Islands and Azores
- South America





WindSat Observations of Ocean-Reflected RFI

- Three month average retrieval $P(\chi^2)$
 - Highly correlated with RFI







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Satellite TV Services

Identifier	Operator	Region	(degrees)	(GHZ)	Comments
1KR	SES-Astra	Europe	19.2 E	10.7-10.95	
1M	SES-Astra	Europe	19.2 E	10.7-12.5	
2C	SES-Astra	Europe	19.2 E	10.7-10.95	
2D	SES-Astra	Europe	28.2 E	10.7-10.95	
1E	Hispasat	Europe / North Africa	30 W	10.7-10.95	Has Americas beam, not active and unknown band
Atlantic Bird 4A	Eutelsat	Mid East / North Africa	7 W	10.7-12.75	To be moved to 13 E, where it will also serve Europe
W2A	Eutelsat	Europe / Africa	10 E	10.7-11.2	
W2M	Eutelsat	Europe / Africa	16 E	10.7-11.2	
W3A	Eutelsat	Europe / ME / NA	7 E	10.7-11.7	
Hot Bird 6	Eutelsat	Europe / ME / NA	13 E	10.7-11.2	
Hot Bird 8	Eutelsat	Europe / ME / NA	13 E	10.7-12.75	
Hot Bird 9	Eutelsat	Europe / ME / NA	13 E	10.7-12.75	
Hot Bird 10	Eutelsat	Europe / ME / NA			Not yet in position See Atlantic Bird 4A
DTV 10	DirecTV	USA	103 W	18.3-18.8	
DTV 11	DirecTV	USA	99 W	18.3-18.8	
DTV 12	DirecTV	USA	103 W	18.3-18.8	Also equipped to broadcast 19.7-20.2 GHz
IS-11	Intelsat	South America	43 W	10.7-10.95	
IS-16	Intelsat	South America	58 W	10.7-10.95	Listed "customer proprietary"

Longitude

Band





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FARS Promotion



Frequency Allocations in Remote Sensing (FARS) Technical Committee

- Purpose: Provides technical assessments, guidance and recommendations regarding matters of frequency sharing and interference between remote sensing and other uses of the radiowave spectrum.
- Objectives: Maintain up-to-date database of a) present and projected future user requirements for frequencies, bandwidths, and noise floors; b) Scientific rationale for all elements of item a; c) present and projected future sensor specifications (spaceborne, airborne and ground based) regarding frequencies, bandwidths and noise floors.

Provide a standardized methodology for computing the appropriate link budgets to assess RFI between the most common types of remote sensing instruments and sources of interference.

Respond reactively to a) requests for instrument and user requirements information; and b) technical interference assessments from outside organizations and individuals.

Proactively investigate potential interference problems. Promote the development, analysis and dissemination to interested parties of interference mitigation techniques.

Information:

http://www.grss-ieee.org/community/technical-committees/ frequency-allocations-in-remote-sensing/

Bill Blackwell, MIT Lincoln Laboratory, and Ian Adams, Naval Research Laboratory, Co-Chairs

Image provided courtesy of CESBIO and ESA (R. Oliva).





FARS Outreach

- Communicating with "under-represented" groups in user community
 - AMS
 - AGU remote sensing working groups
- Collaborating with related groups
 - CORF
 - SFCG





FARS Recognition

- Very prolific group
- Outstanding/impactful work, often unheralded
- We propose annual best paper/presentation award
 - Start with certificate of recognition
 - MicroRad and IGARSS
 - Brief article in GRSS Newsletter





FARS session Friday 10:20am (Room 19)

- INVESTIGATION OF THE INFLUENCE OF L-BAND RFI ON SMOS – A VIEW FROM THE FINNISH VALIDATION SITES, Martti Hallikainen, et al., Aalto University
- DOMAIN ANALYSIS OF RADIO FREQUENCY INTERFERENCE DETECTION TECHNIQUES FOR SMOS, Sidharth Misra and C. Ruf; University of Michigan
- STUDIES OF RADIO FREQUENCY INTERFERENCE IN SMOS OBSERVATIONS, Joel Johnson and M. Aksey, OSU
- EXPERIMENTAL STUDY OF RADIO-FREQUENCY INTERFERENCE DETECTION ALGORITHMS IN MICROWAVE RADIOMETRY, Jose Miguel Tarongi, G. Forte, A. Camps; Universitat Politècnica de Catalunya
- PROTECTION OF 6-7 GHZ BAND SPACEBORNE MICROWAVE RADIOMETER FROM INTERFERENCES TO DERIVE SEA SURFACE TEMPERATURE AND OTHERS, Korehiro Maeda; University of Tokyo, A. Shibata and K. Imaoka JAXA





Future Initiatives

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- Others?

