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Subject:	<b>RVTEC – RF Survey – Results for 2006</b>
Project:	RVTEC RF Survey
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The RF Survey Committee was created by RVTEC in November of 2005. The committee was charged with surveying the UNOLS fleet as well as other RVTEC members who operated research vessels, to discern what portions of the RF spectrum this community was using.

The committee identified areas of RF spectrum use, which might be encountered while providing shipboard support for science operations. The major usage areas identified were; navigational aids, ship to shore communications, onboard communications as well as ship / support aircraft communications.

Additionally we identified several areas of scientific instrument use which were potential users of RF Spectrum

We developed a survey questionnaire which sought to gather data on spectrum usage within identifiable portions of the spectrum as well as areas of the spectrum was not readily apparent not readily apparent.

This survey was made available online at  
<http://www.shipops.oregonstate.edu/martech/rvtec/2005/rf.survey/>

We requested response from RVTEC members (full mailing list) either as individuals or institutions.

As of November 2006 we had heard from ten respondents. These respondents identified 24 areas of current RF spectrum use as well as five areas that were viewed as emerging technologies having potential for future use.

Results of the Survey were reported at the RVTEC annual meeting held at WHOI in November of 2006. See below.

At this time RVTEC voted to have the RF Spectrum Committee continue its efforts and to possibly expand the scope of its survey efforts. We are presently in the process of revising the survey questionnaire, based on previous responses and plan the inclusion of some emerging technologies, which may be of interest to the community.

However, we have identified several problems with the current approach to gathering spectrum data.

- Ship operators may or may not be knowledgeable about what type of RF sources (TX) or passive RF (RX) equipment any particular PI might bring aboard.
- Our community is generally knowledgeable about active sources that are likely to share spectrum with existing shipboard equipment, but less knowledgeable about spectrum usage in other areas where interference with existing ship equipment is not likely.
- . We are relying on the memory or record keeping of the ship operators for this information, as we are asking them for one response per year. – As one would expect, the quality of resultant data will be variable

To improve this situation we are considering the establishment a Ships Standard RF spectrum use sheet that lists all of the ‘standard’ services in use, even though not every device might be on every ship. In addition in order to gather data from more users we may endeavor to simply update survey information by handing out copies of this standard survey for updating or modification at the annual RVTEC meeting. We would then collect and analyze the data over the course of the RVTEC meeting.

As for the science or PI furnished equipment, there are 3 possible approaches, which are under consideration.

1. Include a survey questionnaire (which we provide) as part of the pre-cruise planning carried on by each institution. The advantage of this approach is access to the data, the disadvantage is that pre cruise planning effort varies from ship to ship.
2. Explore with Sandy Shor whether or not there is an appropriate juncture in the ship requirements / scheduling process for us to insert and require the filling out of a questionnaire.

This approach offers the substantial advantage in that we receive the information directly from PI. Naturally the ship operator would also receive a copy to assist in cruise planning. This would also help to insure that proper licensing is in place.

3. We might also formally approach the user communities - Buoy Workshop, Coastal studies groups others in order to ascertain both current and future spectrum usage.

Spectrum usage as compiled as of November 2006

## **High Seas Net**

<b>Satellite</b>		<b>Ship</b>	<b>uplink(Tx) Mhz</b>	<b>downlink(Rx) Mhz</b>
Intelsat 701 (POR, / frequencies in MHz)	Shore-to-Ship: C-band		6354.8000	4129.8000
	Ship Slot 1: C-band	Revelle	6354.3250	4129.3250
	Ship Slot 2: C-band	Melville	6369.4600	4144.4600
	Ship Slot 3: C-band	Atlantis	6369.5725	4144.5725
	Ship Slot 4: C-band	Thompson	6369.6850	4144.6850
	Ship Slot 5: C-band	Kilo Moana	6369.7975	4144.7975
S-707 (AOR, uplink(Tx)/downlink(Rx) frequencies in MHz)	Shore-to-Ship: C-band		6315.8525	4090.8525
	Ship Slot 1: C-band	Knorr	6315.5450	4090.5450
	Ship Slot 2: C-band	Not assigned	6315.6350	4090.6350
	Ship Slot 3: C-band	Seward Johnson	6315.7250	4090.7250
atmex 5 (Ku-band, uplink(Tx)/downlink(Rx) in MHz)	Shore-to-Ship: Ku-Band		14436.0900	12136.0900
	Ship Slot 1: Ku-Band	Endeavor	14436.2150	12136.2150
	Ship Slot 2: Ku-Band	New Horizon	14436.2750	12136.2750
	Ship Slot 3: Ku-Band	Pelican	14435.9700	12135.9700

In the future, we may be assigned anything in C-band or Ku-band. Those bands include the following frequencies:

C-band:

Downlink: 3.7 to 4.2 GHz

Uplink: 4.975 to 6.475 GHz

Ku-band:

Downlink: 11.7 to 12.2 GHz

Uplink: 14.0 to 14.5 GHz

# VHF

we assume that any and all channels may be used

Channel Number	Ship Transmit MHz	Ship Receive MHz	Use
01A	156.050	156.050	Port Operations and Commercial, VTS. Available only in New Orleans/Lower Mississippi area.
05A	156.250	156.250	Port Operations or VTS in the Houston, New Orleans and Seattle areas.
6	156.300	156.300	Intership Safety
07A	156.350	156.350	Commercial
8	156.400	156.400	Commercial (Intership only)
9	156.450	156.450	Boater Calling. Commercial and Non-Commercial.
10	156.500	156.500	Commercial
11	156.550	156.550	Commercial. VTS in selected areas.
12	156.600	156.600	Port Operations. VTS in selected areas.
13	156.650	156.650	Intership Navigation Safety (Bridge-to-bridge). Ships >20m length maintain a listening watch on this channel in US waters.
14	156.700	156.700	Port Operations. VTS in selected areas.
15	--	156.750	Environmental (Receive only). Used by Class C EPIRBs.
16	156.800	156.800	International Distress, Safety and Calling. Ships required to carry radio, USCG, and most coast stations maintain a listening watch on this channel.
17	156.850	156.850	State Control
18A	156.900	156.900	Commercial
19A	156.950	156.950	Commercial
20	157.000	161.600	Port Operations (duplex)
20A	157.000	157.000	Port Operations
21A	157.050	157.050	U.S. Coast Guard only
22A	157.100	157.100	Coast Guard Liaison and Maritime Safety Information Broadcasts. Broadcasts announced on channel 16.
23A	157.150	157.150	U.S. Coast Guard only
24	157.200	161.800	Public Correspondence (Marine Operator)
25	157.250	161.850	Public Correspondence (Marine Operator)
26	157.300	161.900	Public Correspondence (Marine Operator)
27	157.350	161.950	Public Correspondence (Marine Operator)
28	157.400	162.000	Public Correspondence (Marine Operator)
63A	156.175	156.175	Port Operations and Commercial, VTS. Available only in New Orleans/Lower Mississippi area.
65A	156.275	156.275	Port Operations
66A	156.325	156.325	Port Operations
67	156.375	156.375	Commercial. Used for Bridge-to-bridge communications in lower Mississippi River. Intership only.
68	156.425	156.425	Non-Commercial
69	156.475	156.475	Non-Commercial
70	156.525	156.525	Digital Selective Calling (voice communications not allowed)
71	156.575	156.575	Non-Commercial
72	156.625	156.625	Non-Commercial (Intership only)
73	156.675	156.675	Port Operations
74	156.725	156.725	Port Operations
77	156.875	156.875	Port Operations (Intership only)
78A	156.925	156.925	Non-Commercial
79A	156.975	156.975	Commercial. Non-Commercial in Great Lakes only

80A	157.025	157.025	Commercial. Non-Commercial in Great Lakes only
81A	157.075	157.075	U.S. Government only - Environmental protection operations.
82A	157.125	157.125	U.S. Government only
83A	157.175	157.175	U.S. Coast Guard only
84	157.225	161.825	Public Correspondence (Marine Operator)
85	157.275	161.875	Public Correspondence (Marine Operator)
86	157.325	161.925	Public Correspondence (Marine Operator)
AIS 1	161.975	161.975	Automatic Identification System (AIS)
AIS 2	162.025	162.025	Automatic Identification System (AIS)
88A	157.425	157.425	Commercial, Intership only.

## ***New and Future use services***

4G (fourth generation wireless) 59 to 64 GHz (U.S. general wireless)  
59 to 62 GHz (Europe, WLAN)  
62 to 63 GHz (Europe, mobile broadband)  
65 to 66 GHz (Europe, mobile broadband)

E-band (new FCC-approved ultra-high speed data communications band) 76 GHz, 81 to 86 GHz  
and 92 to 95 GHz

Industrial, Scientific and Medical (ISM) band 2400 to 2483.5 MHz ???

Industrial, medical & scientific (ISM) band 2400 to 2483.5 MHz ???

Industrial, medical & scientific (ISM) band 5.725 to 5.85 GHz

<b>Aircraft Operation Support</b>			
None reported	Voice -	Marine VHF	
		Civil AC freqs	
		Military AC freqs	
		Other	
		HF	
	Navigation	Omni	
		TACAN	
		DME	
		Becaon	
		Radar Altimiter	
		Weather Radar	
		Trasponder	
		IFF	
		Fuel Cache Beacon	
	Data		

### Ship Operations

Deck & Lab Operations			Freq	Transmit?	Receive?
Voice -		Marine VHF	See Worksheet		
		Family Radio Band			
		Cell	See Below		
		Other			
Data-		Met sensors			
		Winch Sensors			
	802.11 b & Bluetooth	Other		2402 to 2495 MHz 5.15 to 5.25 GHz (lower band) 5.25 to 5.35 GHz (middle band) 5.725 to 5.825 (upper band)  902-928 Mhz	
	802.11a				
	Wireless radio modem				
Instruments-	AXCTD			88-108 Mhz	
	AXCP			88-108 Mhz	
	lotek WHS_1000 wireless hydrophones			140.000 - 175.000 MHz (factory set)	
	lotek Nano tags				
	Orbcomm Transmit Frequency			148 - 150.05 MHz	137 - 138 MHz
	Argos tracking collars			430-460 MHz	
				148-174 MHz	
<b>Navigation</b>					
Radar		Bands			
	Weather	S		2 - 4 GHz	
	SAR	SART		9 Ghz	
	Navigation	X		8 - 12 Ghz	
GPS					1559-1610 Mhz
GPS enhancement services	WAAS				L1/1575.42 MHz
					L2/1227.6 MHz

					L5/1176.45 MHz
	DGPS				283.5 to 325.0 kHz
	RTK				450-470 MHz
Loran C					90-110 kHz
Sattelite services					
		Ice Reports			
		Other			
	Beacon receivers/ADF			200-285 kHz	
	LF Ranges				
<b>Comms</b>		Inmarsat L band		1626.5 to 1660.5 MHz	1525.0 to 1559.0
		VHF	See workheet		
		SSB			
		HighSeasNet	See worksheet		
		SeaNet	See Inmarsat entry		
	Iridium	Iridium Phone-Satellite		1616-1626.5MHz	
		Satellite-Iridium Phone/Pager		1616-1626.5MHz	
		Satellite-Satellite		23.18-23.38GHz	
		Satellite-Gateway		19.4-19.6GHz	
		Gateway-Satellite		29.1-29.3GHz	
	Globalstar sat phone	Globalstar satellite phone downlink		1610.73 to 1625.49 MHz	
		Globalstar satellite phone uplink		2484.39 to 2490.15 MHz	
		Globalstar satellite gateway		6875-7055 MHz	
	Cell Phone	GSM		824-960 Mhz	

## **Buoy Operations**

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### **Science Operations**

<b>Deck Operations</b>			<b>Freq</b>	<b>Power If Known</b>	<b>Send and or RCV</b>	<b>Make</b>	<b>Model</b>	<b>% of Sea Days Used</b>
	Voice -	Marine VHF	Ch 71,67	1 W	Send and or RCV	Icom	various	75%
		FR						
		Cell						
		Other						
	Data-	Met sensors						
		Winch Sensors						
		Other						
<b>Infrastructure</b>								
	wireless networks							
	Other RF data Links							



<b>Over the Side Operations</b>								
<b>Buoys</b>								
Datawell waverider		Buoy Type	27-40 MHz	75 mW	send and or RCV	Datawell		25 streaming data
		SonoBuoy						
		Met Buoy						
		Tail Buoy						
		Other						
<b>Work/ Dive Boat</b>								
	Voice	Marine VHF	Ch71, 77, 67	25 or 1 W	send and or RCV	Various	Various	100%
		FR						
		Cell						
		Other						
	Data							
<b>Ship To Ship</b>								
	Voice	same as work boat						

	Data	SWAP						
		Inmarsat						
		Road NET						