

**Proposal:
Revised USA VDL Mode 2 Spectral Plan**

Prepared for:

**Aeronautical Frequency Committee
Albuquerque , NM
March 1-2, 2016**

Introduction:

- Rockwell-Collins IMS / ARINC proposes a revision to the USA VDL Mode 2 Spectral Plan. Overview:
 - RF analysis indicates 3rd order intermods will occur on upper band (136.450-136.525MHz) & impact both voice & data. Voice channels must move.
 - SITA can continue to operate on 136.850 MHz on their existing (since ~2004) USA ACARS base frequency.
 - No efforts or expense required for SITA USA customers
 - No efforts or expense for RC IMS customers
 - Revised plan does not adversely affect the number of VDLM2 channels planned for AOC and ATC.

Why the New Recommendation?

- Original VDL Spectrum Plan Charter:
 - “Clear out the upper band from all other users; reserve for VDL...”
 - New analysis indicated in-band voice users will cause problems
- SITA originally asked for continued operation on 136.850 MHz
- Rockwell-Collins preferred data link customers expressed serious concerns about managing their USA DSP preferences after the change
 - Many avionics and aircraft systems uses a flat list of VHF frequencies – no geographic functions
 - Prefer to chose DSPs based on region of operation – different frequencies by region gives customers this control.
 - Significant costs and risks at modifying MU & CMUs software
- A single base frequency for one DSP creates a significant competitive advantage that, over the long term, will upset the balance & business environment that airlines currently enjoy.

The Current VDL Frequency Allocation Plan:

- Frequencies in the “Upper Frequency Band” (136.000 to 136.975 MHz):
 - 136.975 MHz - CSC
 - 136.800 MHz - SITA VDL On-Airport ASRI Band
 - 136.650 MHz - ARINC VDL On-Airport ASRI Band
 - 136.525 MHz - ASRI Voice
 - 136.500 MHz - ASRI Voice
 - 136.475 MHz - FAA Voice
 - 136.450 MHz - FAA Voice
 - 136.300 MHz - On Airport VDL Alternate, FAA Band
 - 136.100 MHz - On Airport VDL Alternate, FAA Band

Characteristics of the Present VDL Spectral Plan

- Many airlines must update core software or reconfigure data link avionics
- SITA must vacate their 136.850 POA base frequency
- Provides for 5 VDL frequencies
 - CSC
 - 4 on Airport Frequencies
- Voice users occupy upper band frequencies
- Four Voice Frequencies:
 - Previous analysis did not fully consider 3rd order intermodulation products
 - Previous analysis did not fully consider wideband (AM) emissions

Existing Frequency Plan 3rd Order IM Products Without Considering Voice Users

Creating a channel plan in order to avoid third-order intermodulation interference and the near-far problem. Help

■ Selected channels
 ■ Forbidden channels
 ■ Channels where third-order intermodulation occurs.

<input type="checkbox"/> [1] 135.5	<input type="checkbox"/> [26] 136.125	<input type="checkbox"/> [51] 136.75	<input type="checkbox"/> [76] 137.375	<input type="checkbox"/>	<input type="checkbox"/>
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Starting channels
 Starting frequency MHz
 Forbidden frequency bands kHz = span x times

End channels
 Channel span kHz
 Plan support

Band selection
 Select the channels to use
 Initialize

Existing Frequency Plan 3rd Order IM Products Considering Voice Users

Creating a channel plan in order to avoid third-order intermodulation interference and the near-far problem.

Selected channels
 Forbidden channels
 Channels where third-order intermodulation occurs.

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Starting channels:
 Starting frequency: MHz
 Forbidden frequency bands: kHz = span x times

End channels:
 Channel span: kHz
 Plan support:

Band selection:
 Select the channels to use:
 Initialize

Wideband Emissions from AM Voice Transmitters

- The Specifications:
 - Less than -35 dBm at $F_c \pm 12.5$ kHz
 - -45 dBm maximum elsewhere
- Interference from AM Voice Radio on VDLM2 receiver
 - Limits SNR of VDLM2 Receiver
 - -45 dBm On VDLM2 Channel Power
 - -40 dB Antenna Separation
 - = -85 dBm On Channel Noise
 - 20 dB Required SNR
 - = -65 dBm Best Decodable VDLM2 Signal
 - Interference Limits Reception to ~ 30 NM
- Interference is Long Lasting
 - May be Greater Than Multiple Retransmit Timeouts
 - Causes Retransmissions
 - Increases Latency

Deficiencies of the Present VDL Spectral Plan

- Higher Costs
 - Most airlines must change data link units: Acquire and load new core software or reconfigure frequency tables.
 - SITA POA base moves from 136.850; Ground radio and filter configuration costs
- Voice Channels Remain in Upper VHF Band; their Wideband Emissions Interfere on VDLM2 channels
- Major 3rd Order Intermodulation Products
 - Both VDLM2 and AM Voice Channels are Subject to Effects from Intermodulation Products

Rockwell-Collins Proposal: Modified VDL Frequency Allocation Plan

- List of frequencies:
 - 136.975 MHz – VDL CSC
 - 136.850 MHz - SITA POA Base
 - 136.650 MHz - ARINC VDL On-Airport ASRI Band
 - 136.500 MHz - SITA VDL On-Airport ASRI Band
 - 136.275 MHz - VDL On-Airport Alternate; FAA Band
 - 136.100 MHz – VDL On-Airport Alternate; FAA Band
- Characteristics of plan
 - No CMU configuration or core SW updates needed for airlines
 - No changes to SITA POA base frequency
 - Provides for 5 VDL frequencies
 - CSC
 - 4 On-Airport Frequencies
 - Ref: 3rd Order Intermodulation Analysis
- Voice users must migrate from the band

Proposed Frequency Plan 3rd Order IM Products

Creating a channel plan in order to avoid third-order intermodulation interference and the near-far problem. Help

■ Selected channels
 ■ Forbidden channels
 ■ Channels where third-order intermodulation occurs.

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Starting channels Starting frequency MHz Forbidden frequency bands kHz = span x

End channels Channel span kHz Plan support

Band selection Select the channels to use Initialize

Advantages of Proposed Frequency Plan

- Lower Cost
 - No Configuration or software change costs for the airlines
 - SITA POA base remains on 136.850; no costs for RGS/ground radio and filter changes
- Still provides 5 VDL frequencies
 - CSC
 - 4 On-Airport Frequencies
- No intermodulation products
- Upper VHF Band (136.000 to 136.975) is restricted to Data Link Communications



Discussions:

- Questions and ideas?