Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
Comprehensive Review of Licensing and Operating Rules for Satellite Services	)	IB Docket No. 12-267
	)	
	)	

REPLY COMMENTS OF COMTECH EF DATA CORPORATION

Comtech EF Data Corporation ("Comtech EF Data"), by its attorneys, hereby submits its reply to certain comments filed in response to the Commission's Notice of Proposed Rulemaking in the above-referenced docket.[1] In its initial comments, Comtech EF Data urged the Commission to adopt an Automatic Transmitter Identification System ("ATIS") for satellite uplink transmissions to allow efficient and expedited resolution of interference events. Building on the proposed rule revisions to Section 25.281 set forth in the NPRM, Comtech EF Data offered certain modifications to the Commission's proposal to make the ATIS rule more generally applicable to digital transmissions in light of the breadth of interference concerns today and developments in carrier identification ("Carrier ID") technologies and to conform more closely to the broadly supported standardization process which is rapidly nearing completion.[2]

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1 *Comprehensive Review of Licensing and Operating Rules for Satellite Services,* Notice of Proposed Rulemaking, IB Docket No. 12-267, 27 FCC Rcd 11619 (rel. Sep. 28, 2012) ("NPRM"). On December 19, 2012, the International Bureau issued an Order extending the deadline for reply comments to February 13, 2013. *Comprehensive Review of Licensing and Operating Rules for Satellite Services,* Notice of Proposed Rulemaking, IB Docket No. 12-267, DA 12-2046 (rel. Dec. 19, 2012).

2 *See* Comments of Comtech EF Data Corporation, IB Docket No. 12-267 (filed January 14, 2013) ("Comtech EF Data Comments"), Rules Exhibit (containing Comtech EF Data's requested modifications to the proposed rule).

1. The Time to Adopt an ATIS Rule Is Now: the DVB Standardization Process Is Almost Complete

As an initial matter, Comtech EF Data would like to update the Commission on the standard-setting process for spread spectrum Carrier ID. Comtech EF Data noted in its initial comments that the Technical Module of the Digital Video Broadcasting Project ("DVB") was shortly to review the final draft standard.[3] Review of the proposed spread spectrum carrier ID standard was on the agenda for the meeting of the Technical Module of the DVB Project scheduled for January 16, 2013, in Geneva.[4] Comtech EF Data understands that the standard was adopted by the Technical Module unanimously, at which point the standard was forwarded to the Commercial Module of the DVB Project for review. Endorsement of the standard was on the agenda of the Commercial Module, meeting in London, on February 7, 2013.[5] Comtech EF Data understands that the standard cleared Commercial Module review. The final step in the standardization process is review by the DVB Project Steering Board, which Comtech EF Data understands is scheduled for February 28, 2013.

With the attainment of these milestones, Comtech EF Data anticipates that spread spectrum Carrier ID units will become commercially available within a matter of months, certainly early in the second half of 2013, assuming final adoption by the steering board. Accordingly, there is no need to defer adoption of an expanded ATIS rule, even for a short

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3 Comtech EF Data Comments at 6.

4 *See* Attachment A, appended hereto, Draft Agenda of the 93rd meeting of the Technical Module of the DVB Project, Geneva, January 16-17, 2013 (dated January 14, 2013), item 8.2 (Approval of Carried ID Specification).

5 *See* Attachment B, appended hereto, Draft Agenda of the 65th meeting of the Commercial Module of the DVB Project, London, February 7, 2013 (dated February 5, 2013), item 4.2 (Technical Module Related Matter concerning Carrier ID standard, referenced as document 1352).

period, because of the timing of the DVB standardization process.[6] That process will be complete well before new ATIS rules are adopted and spread spectrum carrier ID will likely already have been introduced to the marketplace consistent with the standard. By the date that Comtech EF Data proposes that earth stations should have the technology embedded in earth station transmitting equipment for all new deployments – January 1, 2015, or eighteen months after an order is issued modifying Section 25.281 – the technologies should be well-tested.[7]

2. An ATIS Rule Incorporating the DVB Standard Should Be Adapted for All Fixed Frequency, Non-Bursting Transmissions

Notably, the DVB standard does not draw a line between broadcast video applications and application to other fixed frequency, non-bursting carriers. As noted in the draft standard document, "The [Carrier ID] system has been optimized for satellite applications including DVB-S, DVB-DSNG and DVB-S2, but can be applied to any continous [sic] transmission transmission [sic] by satellite."[8] For this reason, Comtech EF Data, in its initial comments proposed that a Carrier ID requirement be adopted for all digital satellite uplinks using non-bursting fixed frequency transmissions with a symbol rate of 128,000 sps, or greater.[9] In other words, Comtech EF Data urged the Commission to adopt an ATIS requirement for all non-Time Division Multiplexing Access ("non-TDMA") digital transmissions, which would extend to the rule beyond digital video broadcast, as proposed, to other non-bursting fixed frequency transmissions. Through this suggested modification, Single Carrier Per Channel ("SCPC") and

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6 *See, e.g.*, Comments of the National Cable & Telecommunications Association ("NCTA"), IB Docket No. 12-267 (filed January 14, 2013) at 4.

7 *See* Comtech EF Data Comments at 13.

8 Attachment C, appended hereto, Draft ETSI TS 103 129, "Framing Structure, Channel Coding and Modulation of a Carrier Identification System (DVB-CID) for Satellite Transmission," V. 1.1.1 (dated January 2013), Section 1 (Scope) p. 6, printed from the www.dvb.org reflector site.

9 Comtech EF Data Comments at 11.

Multiple Channel Per Carrier ("MCPC") operations, which are recognized in the industry as significant sources of radiofrequency interference ("RFI"), would both be included.

The parties filing comments in response to the NPRM that addressed Section 25.281 recognize the serious problem faced by satellite operators as a result of RFI from uplink carriers and the benefit of ATIS solutions, some specifically calling out Satellite News Gathering ("SNG") stations as particularly problematic.[10] Echostar, in discussing the possible adoption of an ATIS requirement for SNG operations, notes that, in that case, "the equipment is largely standardized among the SNG user community, high power levels are involved, there is frequent antenna re-pointing, and polarization and transponder assignment changes typical of SNG use can result in interference causing mistakes."[11] While Echostar's statement is true, the incidence of interference plaguing the industry for reasons such as these, among others, is by no means limited to SNG use. Apart from the DVB standardization process and the development of spread spectrum Carrier ID technologies, numerous companies, including Siemens A.G. Austria, Glowlink Communications Technology, Kratos SAT Corporation, and Zodiac Data Systems, offer measures to monitor satellite signals, to detect interference, and to help ensure high quality standards in uplink procedures and satellite transmission links. The presence of these solutions

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10 Comments of NCTA at 4 ("as the number and types of satellite uplink facilities and systems have multiplied, radio frequency interference events have become increasingly prevalent"); Comments of Echostar Corporation ("Echostar"), IB Docket No. 12-267 (filed January 14, 2013) at 17 ("[a]pplying ATIS requirements to digital SNG video carriers makes sense from a technology perspective"); Comments of the Satellite Industry Association ("SIA") (supports expansion of ATIS to digital video transmissions from "SNG vehicles and other similar temporary fixed installations," recognizing that "SNG transmission are a well-known source of interference"), IB Docket No. 12-267 (filed January 14, 2013) at 63; Comments of National Public Radio, Inc. ("NPR"), IB Docket No. 12-267 (filed January 14, 2013) (supporting adoption of an ATIS requirement for digital modulation techniques); *see also* Comments of the Global VSAT Forum, IB Docket No. 12-267 (filed January 14, 2013) at 2 ("recognizes the need for rapid and reliable identification of signals to facilitate the resolution on [sic] problems.").

11 Comments of Echostar at 17.

attests to the widespread and serious nature of interference to satellite operations. While these measures have been helpful, spread spectrum Carrier ID solutions offer a much more efficient means to identify the sources of and resolve satellite interference.

At the November 2012 Satellite Interference Reduction Group ("sIRG") conference in Dubai, SES made a presentation entitled "SES RFI Experience," in which SES detailed the types of interference its satellites have been receiving.[12] SES notes that while the clear majority of their service was free from interference, RFI nonetheless represented "a significant cost for SES" due to degraded customer services or unusable capacity and the commitment of personnel and resources to investigate, analyze, and resolve interference events.[13] SES provided data regarding different types of interference it is suffering, and the relative shares represented by different sources.[14] What is telling about that data is that satellite interference from SNG and broadcast operations is far outweighed by interference events caused by SCPC and MCPC sources, as well as other sources, which is not surprising given that there are many more SCPC stations as there are SNG stations. For example, in terms of adjacent satellite interference ("ASI"), SES reported SCPC/MCPC-related interference to be more than 50% more prevalent than SNG- and broadcast-related interference combined. The differential is considerably greater in the case of "cross-pol" and "co-pol" interference events.[15]

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12 *See* Attachment D, appended hereto, "SES RFI Experience," presented by Steve Smith, SES, sIRG Conference, Dubai, Nov. 2012. These slides can be found at http://satirg.org/downloads/2012presentations/RFI%20Experience%20-%20SES%20-%20Rev2.pdf .

13 *Id.*, slide 2.

14 *Id.*, slide 3. Comtech EF Data believes this data was collected over a six-month period, which is typical in such presentations.

15 "Cross-pol" interference is caused by other operators using the same satellite due to misaligned polarization. SES indicates that, for it, SCPC/MCPC-related interference events are more than five times as common as broadcast and SNG events combined. *Id.* "Co-pol" interference is caused by other misalignments and failures. SES reported that

Intelsat also presented data at the November 2012 sIRG conference.[16] While presented differently from the data from SES, Intelsat's six-month data indicate that ASI and cross-pol and co-pol interference, taken together, represent a significant amount of total interference events (approximately 40%). The Intelsat data also reveal that cross-pol and co-pol interference Intelsat receives is predominantly caused by earth station operators. Moreover the data indicate that, while SNG causes a significant amount of such interference (8%), other full time (*i.e.*, non-TDMA) carriers are five times more frequently sources of interference as SNG operations.[17]

As the foregoing demonstrates, the experience of major satellite operators confirms that the sources of interference today are not limited to or even predominantly represented by SNG users.[18] NCTA noted that "the number and types of satellite uplink facilities and systems have

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such interference involving SCPC/MCPC-related sources occurs more than seven times as often as from broadcast and SNG sources combined. *Id*

16 *See* Attachment E, appended hereto, consisting of three slides presented by Jeff Kimble of Intelsat, during a conference call of the Global VSAT Forum on November 10, 2010. Fred Morris, Vice President of Sales Engineering, Comtech EF Data, who was present on that conference call, supplied copies of the slides for this filing.

17 *Id.*

18 In its initial comments, Comtech EF Data indicated that it had no objection to excluding DBS and 17/24 GHz BSS feeder-link transmissions from any ATIS requirement for digital transmissions. Comtech EF Data Comments at 9, n. 15. Upon further review of this question, Comtech EF Data wishes to modify its earlier position. Certain DBS and 17/24 GHz operators, such as Direct TV and Echostar, staff monitoring of their operations on a 24/7 basis. Consequently, these operators can determine rapidly when a transmission is misdirected or otherwise creating a potential for RFI and respond quickly in such circumstances to correct any problem. However, many operations falling into the DBS and 17/24 GHz categories are *not* staffed around the clock. Comtech EF Data submits that these installations tend to be of a lower quality overall than those manned around the clock, and are more prone to malfunctions or other events which cause RFI. Because the stations are not staffed for large portions of the day, the response time in such an interference event can be unacceptable. Therefore, Comtech EF Data supports a qualification that DBS and 17/24 GHz feeder-link operations need not employ an ATIS solution pursuant to the new rule *provided they are monitored on a 24/7 basis*. Otherwise, digital transmissions from DBS and 17/24 GHz stations should be required to adhere to the ATIS rule in the same manner as other non-TDMA operations, as proposed by Comtech EF Data.

multiplied, [and] radio frequency interference events have become increasingly prevalent."[19] In fact, in addition to SNG and video broadcast operations, other non-bursting fixed frequency sources of interference abound, such as transmissions from SCPC and MCPC operations. As Comtech EF Data noted in its initial comments, SCPC and MCPC operations are conducted by cellular service providers, maritime and offshore oil and gas enterprises, government agencies, educational institutions, and emergency and disaster relief agencies. These types of installations, many of which are temporary installations, can be sources of interference. The rapid resolution of interference events from such sources would be – and should be –promoted by the adoption of an expanded ATIS rule for digital earth station transmissions that allows spread spectrum Carrier ID technology to be used as a solution.[20]

As noted above, the standard being finalized by the DVB is not limited to broadcast transmissions but can be applied equally to all non-TDMA transmissions. Indeed, the spread spectrum Carrier ID solution can as easily be utilized by SCPC/MCPC and all other non-bursting, fixed frequency transmissions. Equipment and firmware will be commercially available for these other types of earth station facilities and equipment at the same time as it becomes available for SNG applications. For this reason, the new rule should apply to all such uplink transmissions. Concerns raised in some initial comments about the lesser degree of "standardization" in industry segments other than SNG appear to misunderstand the general

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19 Comments of NCTA at 4.

20 The spread spectrum Carrier ID technology from Comtech EF Data can be applied to any fixed frequency, non-bursting carrier, no matter the traffic payload of the carrier, or the waveform standard, whether it is DVB-S, DVB-S2, analog, or other formats and can be implemented by a firmware upgrade in the modulator. It was designed to be a universal solution for such carriers, but cannot be adapted in its present form for TDMA carriers, such as those commonly used on VSATs, where the burst may not be long enough for transmission of the Carrier ID. As noted in Comtech EF Data's initial comments, the spread spectrum Carrier ID technology has been tested in the field, with multiple satellite operators, and has been found to be stable, reliable, and easy to use on a variety of platforms. *See* Comtech EF Data Comments at 5; *see also* Comments of NCTA at 3.

adaptability of the DVB standard. In short, standardization of non-TDMA earth station equipment within specific earth station types (*e.g.*, SNG) is a "red herring" and not a prerequisite to applying spread spectrum Carrier ID solutions that meet the DVB standard to other non-TDMA platforms.[21]

3. The Commission Should Specify the Acceptable ATIS Solutions in the Rule

In its initial comments, Comtech EF Data supported the Commission's proposal to require operators using digital techniques to choose from a limited number of techniques to meet ATIS obligations.[22] For any solution to be effective, satellite operators will have to be equipped to detect the content regardless of which method is utilized. Some commenters believe that the Commission need not specify which methods can be used.[23] If the methods that can be used are not specified, the ATIS rule will not provide certainty to the industry and would create a burden on satellite operators to maintain potentially indeterminate number of systems in order to benefit from the rule. Because, today, there are essentially only two methods available by which ATIS

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21 The slides in Attachments D and E indicate clearly that the experience of satellite operators is that one of the significant sources of interference is VSAT networks. VSATs often cause RFI when the remote VSAT radiofrequency equipment local oscillator fails, resulting in the carrier sweeping the victim satellite's transponders. *See also generally* Attachment D. A spread spectrum Carrier ID solution complaint with the DVB standard cannot be used with VSAT carriers, but carrier identification solutions that would apply to VSATs and other TDMA carriers are in advanced stages of development. Indeed, Comtech has several patents pending related to carrier identification solutions for VSATs and other TDMA carriers that would allow for backward compatibility to accommodate the initial DVB standard. The Commission should monitor the extent to which VSAT operations continue to be a source of interference to satellite operations, and it may very well consider expanding the ATIS rule to earth stations using TDMA transmissions at such time as solutions have been proven or standards are developed that cover VSATs and other TDMA carriers.

22 Comtech EF Data Comments at 7; *see NPRM*, ¶151.

23 *See* Comments of SIA at 64; Comments of Global VSAT Forum at 2.

information can be included in such digitally modulated video uplinks, it is reasonable for the Commission to state them specifically in the rules.[24]

SIA suggests that, instead of setting forth the specific parameters of the DVB standard in the rules, the Commission reference the standard in the rule and require adherence to the "latest version" of that standard.[25] Comtech EF Data has no objection to this suggestion in principle. The DVB standard very well may undergo evolution. Provided that the rule contains a reasonable and equitable ability of affected earth station operators to transition to equipment and/or software using the previous version of the standard to come into compliance, incorporation of "latest version of the standard" language into the rule should be permissible.

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24 *Accord* Comments of NPR at 2-3 (supporting specifying the means that operators may use to satisfy the ATIS rule applicable to digital transmissions).

25 Comments of SIA at 64.

Conclusion

For the foregoing reasons and for those set forth in Comtech EF Data's initial comments, the Commission should modify Section 25.281 to obligate operators of earth station facilities employing digital techniques for frequency fixed non-bursting transmissions in the manner set forth in the Rules Exhibit appended to Comtech EF Data's initial comments, as further qualified herein. Comtech EF Data also urges the Commission to adopt the implementation timetable for compliance with a modified Section 25.281 set forth in its initial comments.

Respectfully submitted,

COMTECH EF DATA CORPORATION

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February 13, 2013

ATTACHMENT A

TM4778r1

To: **Members of the Technical Module (TM) of the DVB Project**

Source: **Nick Wells (BBC) Email: nick.wells@rd.bbc.co.uk**

Subject: **Draft Agenda of the 93rd meeting of the TM**

Date: 14th January 2013

Agenda

13.00			Lunch	
14.00	1		Approval of the agenda	4778r1
14.10	2		Approval of the report on the 92th meeting, the chairman's report on the 92th meeting	4775 4776r1
14.20	3		Report about the 72nd meeting of the DVB Steering Board	4777, 4780, 4785, 4804
14.30	4		Report on the progress in other modules and on developments in the DVB Project Office	
		4.1	News from the DVB Project Office	3985r2, 4550r1
		4.2	Commercial Module (CM), among other things:	
		4.3	- Commercial Requirements S2 extensions	4784,
		4.4	IPR Module (IPRM)	
		4.5	Promotions and Communications Module (PCM)	4816
14:50	5		Report on activities elsewhere and liaison with other organisations:	
		5.1	ETSI (including introduction of TC Cable)	4788
		5.2	MPEG	4781, 4782
		5.3	ITU	4783
		5.4	OMA BCAST	4789, 4799
		5.5	FOBTV	4819, 4724r2
		5.6	SMPTE	4823
15.10	6		Status report on the activities in ETSI and CENELEC	
		6.1	Status of documents in ETSI, schedule of future activities	3097r93, 4818

15.20	7	7.1	**TM-RCS** Status report including final review of RCS specifications	4812, 4718r1, 4719r1, 4498r5, 4499r3
15.30	8	8.1 8.2 8.3	**TM-S2** Progress report on S2 extensions including ➢ Work plan and CfT ➢ Discussion on proposals Approval of Carrier ID specification Future work	 4790r1, 4797, 4798 4763r1, 4817
16.10			Coffee break	
16:30	9	9.1 9.2	**TM-C2** Progress report including presentation of C2 IG Future work	4820, 4355r4
16:50	10	10.1 10.2	**TM-H** Progress report including ➢ MIMO Study Mission report Future work	4786, 4801
17:50	11		**Presentation on "Approaches to co-primary use of spectrum" (TUBS)** Discussion on way forward	4809
18.30			**End of day one**	

			Second day: 17th January 2013	
09:00	12		Discussion on future work areas for the TM	4787, 4779, 4821, 4822
10.00	13	13.1 13.2	**TM-GBS** Progress report, ➢ including proposal for a GSE-Lite profile ➢ Liaison DVB/OMA re GSE-LLC ➢ Presentation on MPEG-MMT Future work	 4800r1 4799 4794
10.20	14	14.1 14.2 14.3	**TM-IPI** Progress report including: ➢ IPv6 progress updates Presentation of the DSM specification and provisional approval Future work ➢ Presentation of scope and timeline of Hybrid IPTV/Internet TV Task force ➢ Align TM-MIS specification TS 102 809 to version 1.5 of the IPTV specification	 4810 4811 4807, 4808 4802
11:20			Coffee	
11:45	15	15.1 15.2	**TM-MG** Progress Report including approval of "MG Guidelines: Amendment for the DVB-C2 System" Future Work	4813, 4814
12:20	16	16.1 16.2	**TM-MUG** Progress report including Future work	4805
13:00			**Lunch**	
14.00	17	17.1 17.2	**TM-CI Plus** Progress report Future work & timeline	4806
14:20	18	18.1 18,2	**TM-CPT** Progress report including discussion of new issue of scrambling at PES level Future work	4815, 4749r1
14:40	19	19.1 19.2	**TM Study Mission on Companion Screens and Streams** Progress Report Future Scope of work and timeline	4803
15.00	20	20.1 20.2	**TM-AVC** Progress report including Future work	4795, 4796
15:20	21	21.1 21.2	**TM-SUB** Status report Future work	4791, 4792, 4793
15:40	22		Report of the members representing the industry on commercial implications of existing standards, specifications and guidelines	

	23		Meeting schedule for the following meetings: 94th TM: 4 and 5 June 2013 (**Tuesday and Wednesday**!) 95th TM: 23 and 24 October 2013	
	24		Any other business	
16.00			End of meeting	

ATTACHMENT B

To: The members of the Commercial Module (CM) of the DVB Project

Subject: Draft Agenda of the 65th meeting of the CM (London, 7th February 2013)

Source: Graham Mills (BT)

Date: 05 February 2013

Dear Colleagues,

The following is the draft agenda of our 65th meeting on 7th February 2013. I look forward to see you all in London.

Time	Item		Subject	Doc number
9.30	**1.0**		**Welcome and administrative matters**	
		1.1	Approval of the Agenda	CM1353r1
9.40	**2.0**		**Report of CM63 Meeting**	
		2.1	Actions and matters arising	CM1343
		2.2	Approval of Reports	CM1342, 1345, 1343,1346,1347
10.00	**3.0**		**Report of the 72th SB meeting**	
		3.1	CM Chairman's Informal Report	CM1348
		3.2	Primer for DVB working groups;	CM1349
		3.3	Update on DVB R&P	CM1354
		3.4	SB Filter Report	CM1354
10.15	**4.0**		**Technical Module relates matters**	
		4.1	Report from the 93nd TM meeting • TM SMG on co-primary spectrum use (CPU) • TM SMG on MIMO • GSE-"Lite"	CM1365 CM1359
		4.2	Documents submitted for endorsement or information • Carrier ID • MG for C2 • 3D Subtitle amendments • DSM for IPTV Handbook	1352 1355, 1356, 1357 1358

			• C2 IG	1098r1
10.30	**5.0**		**CM-COS (Companion Screen)**	
		5.1	Reports of meetings and other activities	1364
		5.2	Discussion and further actions	
10.50	**6.0**		**CM-UHDTV (Ultra High Definition TV) and 3DTV**	
		6.1	Reports of meetings and other activities	1350, 1363
		6.2	Discussion and further actions	
11.20			**Coffee break**	
11.40	**7.0**		**CM-CI-Plus**	
		7.1	Reports of meetings and other activities	1362
		7.2	Discussion and further actions	
12.00	**8.0**		**CM-IPTV**	
		8.1	Reports of meetings and other activities	
		8.2	Discussion and further actions	
12.20	**9.0**		**Discussion on Strategy Paper**	1361
13.00			**Lunch**	
14.00	**10.0**		**CM-BSS**	
		10.1	Reports of meetings and other activities	1344, 1360
		10.2	Discussion and further actions	
14.30	**11.0**		**CM-GEM**	
		11.1	Reports of meetings and other activities	
		11.2	Discussion and further actions	
15.00	**12.0**		**CM-AVC**	
		12.1	Reports of meetings and other activities	1368
		12.2	Discussion and further actions	
15.20	**13.0**		**CM-SEG**	
		13.1	Reports of meetings and other activities	1369
		13.2	Discussion and further actions	
15.40	**14.0**		**Dates and places of next meetings**	
15.50	**15.**		**Any other business**	
		15.1	FOBTV	1366, 1292r2

		15.2	PCM Report	1367
16.30			End of meeting	

List of documents

CM1098r1	TM4355r4: TM-C2 0292 draft : DVB-C2 Implementation Guidelines draft TS 102 911 v1.2.1 (Christoph Schaaf (Kabel Deutschland), 14/01/13, 184 pages)
CM1180r2	TM4499r3: Draft specification of DVB RCS2 LLS (dr EN 301 545-2 v.1.2.1) (Harald Skinnemoen (AnsuR) 13/12/12, 227 pages)
CM1214r3	DVB-RCS2 Part3: Specification of Higher Layers for Satellite Standard (HLS) (dr TS 101 545-3 v1.2.1) (Harald Skinnemoen (AnsuR), 13/12/12, 148 pages)
CM1292r2	FOBTV Use Case Collection (Amaia Arrinda (University of Basque Country) 14/01/13, 103 pages)
CM1294r1	TM4718r1: DVB-RCS2: Lower Layer Satellite Implementation Guidelines (Harald Skinnemoen (AnsuR) 13/12/12, 256 pages)
CM1295r1	TM4719r1: DVB-RCS2: Guidelines for the Implementation and Use of TS 101 545-3 (HLS) (Harald Skinnemoen (AnsuR), 13/12/12, 166 pages)
CM1342	CM64 Report (Peter Siebert (DVB), 22/10/12, 11 pages)
CM1343	CM64 AI List (Graham Mills (BT)16/11/12, 1 page)
CM1344	Naming and market positioning of DVB-S2 extensions (Graham Mills (BT) 24/10/12) 1 page)
CM1345	CM64 report to SB72 (Graham Mills (BT), 24/10/12, 2 pages)
CM1346	Overview of Commercial Module Sub-Groups (Graham Mills (BT) , 24/10/12, 2 pages)
CM1347	CM report to GA22 (Graham Mills (BT), 28/10/12, 5 pages)
CM1348	CM Chairman's notes on SB72 for CM65 (Graham Mills (BT), 1/11/12, 3 pages)
CM1349	SB1987r1: Primer for DVB subgroups on antitrust, licensing and consensus (Carter Eltzroth (DVB), 05/11/12)
CM1350	Conclusions concerning the DVB-3DTV Phase 2a specification (David Wood (EBU), 10/12/12, 3 pages)
CM1351	SB2122: Study on specification and use of in-line filters to reduce interference in broadcast bands from mobile base stations (Nick Wells (BBC), 29/11/12, 48 pages)

CM1352	TM4763r1: Framing structure, channel coding and modulation system of carrier identification (DVB-CID) for use with a satellite carrier draft specification (Draft ETSI TS 103 129 V1.1.1) (Vittoria Mignone, Alberto Morello (RAI), 14/01/13, 25 pages)
CM1353	CM65 Agenda (Graham Mills (BT), 25/01/13, 4 pages)
CM1354	sb1699r7:R&P: Revised DVB Rules and Procedures (Carter Eltzroth, 14/01/13, 29 Pages)
CM1355	TM4814: TM-MG0419: Measurement guidelines for DVB systems; Amendment for the DVB-C2 system (Juergen Lauterjung (Rohde & Schwarz) 12/01/13, 15 pages)
CM1356	TM4792:TM-SUB0027: Proposed corrigendum to EN 300 743 (Nick Tanton (BBC), 17/12/12, 2 pages)
CM1357	TM4793:TM-SUB0028: Guidelines on the use of EN 300 743 v1.4.1 for 3D content (Nick Tanton (BBC), 17/12/12, 8 pages)
CM1358	TM4807: DSM specification to be integrated in DVB-IPTV 1.6 (Anton Havekes) 31/01/13, 59 pages)
CM1359	TM4809r1: Approaches to Co-primary Use of Spectrum (Jan Zoellner/Ulrich Reimers (TUBS), 11/01/13, 28 slides)
CM1360	Results of Newtec's S2 Query (Thomas van den Driessche (Newtec) 01/02/13, 13 slides)
CM1361	TM4821:Strategy Implementation Plan (Nick Wells (BBC)/Graham Mills (BT) 04/02/13, 8 pages)
CM1362	CM-CIplus0082: Liaison letter to CI Plus LLP on trick mode control (Martin Gold (Cisco) 04/02/13, 2 pages
CM1363	CM-3DTV and CM-UHDTV presentation to CM65 (David Wood (EBU), 04/02/13, 21 slides)
CM1364	CM-COS Report to CM65 (Ralf Schaefer (Technicolor), xx/02/12, x slides)
CM1365	TM4826: TM93 Report to SB73 (Nick Wells (BBC) 28/01/13, 9 pages)
CM1366	TM4819: FOBTV report to CM65 (Peter Siebert (DVB), 05/02/13, 3 slides)
CM1367	TM4816: PCM Report to CM65 (Feyo Kolff (DVB Project Office) 14/01/13, 23 slides)
CM1368	CM-AVC Report to CM65 (Tim Sheppard (Cisco), 05/02/13, 9 slides)
CM1369	CM-SEG Report to CM65 (Lindsay Holman (Panasonic), 05/02/13, 6 slides)

ATTACHMENT C

Draft ETSI TS 103 129V<m.t.e> (yyyy-mm)

Technical Specification

TM4763r1

Framing structure, channel coding and modulation of a carrier identification system (DVB-CID) for satellite transmission

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Foreword

This Technical Specification (TS) has been produced by Joint Technical Committee (JTC) Broadcast of the European Broadcasting Union (EBU), Comité Européen de Normalisation ELECtrotechnique (CENELEC) and the European Telecommunications Standards Institute (ETSI).

The following fixed text elements for the foreword are identified for ***Broadcast****.*

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NOTE: The EBU/ETSI JTC Broadcast was established in 1990 to co-ordinate the drafting of standards in the specific field of broadcasting and related fields. Since 1995 the JTC Broadcast became a tripartite body by including in the Memorandum of Understanding also CENELEC, which is responsible for the standardization of radio and television receivers. The EBU is a professional association of broadcasting organizations whose work includes the co-ordination of its members' activities in the technical, legal, programme-making and programme-exchange domains. The EBU has active members in about 60 countries in the European broadcasting area; its headquarters is in Geneva.

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The Digital Video Broadcasting Project (DVB) is an industry-led consortium of broadcasters, manufacturers, network operators, software developers, regulatory bodies, content owners and others committed to designing global standards for the delivery of digital television and data services. DVB fosters market driven solutions that meet the needs and economic circumstances of broadcast industry stakeholders and consumers. DVB standards cover all aspects of digital television from transmission through interfacing, conditional access and interactivity for digital video, audio and data. The consortium came together in 1993 to provide global standardisation, interoperability and future proof specifications.

Introduction

Radio Frequency Interference (RFI) is the largest single issue that impacts Quality of Service for satellite operators and their customers. This in particular applies to occasional use satellite transmissions and temporary feeder links, rather

than to full time DTH services where the owners and locations of the uplinks are well known and identified by the respective DVB-SI data.

Whilst RFI can come from many sources, various satellite operators have confirmed that a significant amount of interference comes from so-called “rogue carriers”. These are often caused by failed equipment or by a system improperly configured due to human error.

Various actions are being taken by operators, customers, vendors and industry groups to tackle interference, including: training for installers and operators; data sharing to improve operational processes; and new innovations such as Carrier Identification (CID).

Carrier ID is not expected to be a perfect solution to solve all RFI, but it will be a key technology in contributing to the rapid identification of RFI and reducing its negative impact on operators, customers, and the satellite industry as a whole.

Carrier ID will enable the operators and users to:

- Quickly identify interfering carriers and respond to RFI, reducing the duration of each event;
- Improve Quality of Service and reduce operating costs;
- In the longer term, lower the number of RFI events andrelease bandwidth being used to overcome current and ongoing RFI events.

1 Scope

The present document describes the modulation, channel coding and signalling protocol system (denoted the "System", "DVB Carrier Identification" or "DVB-CID" for the purposes of the present document) intended for the identification of the host carrier it belongs to.

The system uses Binary Phase Shift Keying (BPSK) spread spectrum modulation, differential encoding, scrambling and a concatenated error protection strategy based on repetition, cyclic redundancy check (CRC) and Bose and Ray-Chaudhuri (BCH) codes.

The present document:

- gives a general description of the system for the transmission of the identification information of a host carrier.
- specifies the digitally modulated signal in order to allow compatibility between pieces of equipment developed by different manufacturers. This is achieved by describing in detail the signal processing principles at the modulator side, while the processing at the receive side is left open to different implementation solutions.
- identifies the global performance requirements and features of the System, in order to meet the quality targets for identification of the host carrier.

The system has been optimized for satellite applications including DVB-S, DVB-DSNG and DVB-S2, but can be applied to any continous transmission transmission by satellite. The system is to be used when no other suitable means of identifying the transmitter are available; such means include but are not limited to remote-control facilities that can switch the transmitter on and off.

2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references,only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at http://docbox.etsi.org/Reference.

NOTE: While any hyperlinks included in this clause were valid at the time of publication ETSI cannot guarantee their long term validity.

2.1 Normative references

The following referenced documents are necessary for the application of the present document.

[1] IEEE standards association, EUI-64 Guidelines, Guidelines for 64-bit Global Identifier (EUI-64™) Registration Authority, http://standards.ieee.org/develop/regauth/tut/eui64.pdf

[2] ITU-T , E.123, "Notation for national and international telephone numbers, e-mail addresses and Web addresses" , February 2001

[3] Intelsat Earth Station Standard IESS-308 (Rev 10), Performance Characteristics for Intermediate Data Rate Digital Carriers using Convolutional Encoding/Viterbi Encoding and QPSK Modulation

2.2 Informative references

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] RFC 2373, "IP Version 6 Addressing Architecture", July 1998

[i.2] National Marine Electronic Association, NMEA 0183

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

CID carrier: The transmission signal that transports the Content ID.

Content ID: A possible content of the Information field carried by CID, as described in Section 4.2.

DVB CID Global Unique Identifier: An unique identifier for the modulator that transmits the host carrier

Hexadecimal representation: The representation of a sequence of octet values in which the values of the individual octets are displayed in order from left to right, with each octet value represented as a two-digit hexadecimal numeral, and with the resulting pairs of hexadecimal digits separated by colons. The order of the hexadecimal digits in each pair, and the mapping between the hexadecimal digits and the bits of the octet value, are derived by interpreting the bits of the octet value as a binary numeral using the normal mathematical rules for digit significance.

Host carrier: The transmission signal that is identified by the DVB CID.

3.2 Symbols

For the purposes of the present document, the [following] symbols [given in ... and the following] apply:

α	Roll-off factor
c_i	chip
D(x)	BCH FEC code message polynomial
f_0	Carrier frequency
f_N	Nyquist frequency
$G_{BCH}(x)$	BCH FEC code generator polynomial
$G_{CRC8}(x)$	CRC-8 generator polynomial
$g_1(x),g_2(x),...,g_6(x)$	polynomials to obtain BCH FEC code generator polynomial
GF	Galois Field
I, Q	In-phase, Quadrature phase components of the modulated signal
P(x)	BCH FEC code parity polynomial
R_C	chip rate
T_s	symbol period
y_i	modulation symbol

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

ASCII	American Standard Code for Information Interchange
BCD	Binary Coded Decimal
BCH	Bose, Ray-Chaudhuri, Hocquenghem code
BPSK	Binary Phase Shift Keying
CID	Carrier Identification
CRC	Cyclic Redundancy Check
CRC8	Cyclic Redundancy Check with 8 bits
DTH	Direct To Home
DVB	Digital Video Broadcasting Project
DVB-CID	DVB Carrier Identification
DVB-DSNG	DVB System for Digital Satellite News Gathering

DVB-S	DVB System for satellite broadcasting
DVB-S2	second generation DVB System for satellite broadcasting and unicasting
DVB-SI	DVB Service Information
EBU	European Broadcasting Union
EUI	Extended Unique Identifier
FEC	Forward Error Correction
GF	Galois Field
ID	IDentifier
IEEE	Institute of Electrical and Electronics Engineers
LFSR	Linear Feedback Shift Register
LSB	Least significant bit
MAC	Media Access Control
MSB	Most significant bit
OUI	Organizationally Unique Identifier
RFI	Radio Frequency Interference
SSB	Single Side Band

4 Host Carrier identification information

The following specifies the host carrier identification information that is transported by the CID carrier.

The information that identifies the host carrier contains mandatory the DVB CID Global Unique Identifier, fixed by the equipment manufacturer, that shall not be editable by the user, and the CID format revision code (Content ID 0). Additionally it may contain other information that is configurable by the user, identified by different Content ID fields.

4.1 DVB CID Global Unique Identifier

The 64-bit DVB CID Global Unique Identifier is based on the IEEE-defined 64-bit extended unique identifier (EUI-64) [1] and is sent in two parts of 32 bits. It can be derived from a 48 bit MAC address or a 48 bit Space Data Association modulator identifier as described below.

A 48 bit MAC address assigned to a modulator can be unambiguously sent in the same 64 bit field that specifies an IEEE EUI-64. The process is also described in Appendix A of RFC 2373 [i.1]. The process is illustrated as follows.

An EUI-48 MAC is composed of 2 sections, a 24 bit manufacturer's IEEE-assigned company ID (for OUI-24) followed by the 24 bit extension identifier.

EXAMPLE 1: 00:06:B0:01:AC:07

Manufacturer ID 00:06:B0

Extension 01:AC:07

An equivalent EUI-64 starts with the same manufacturer ID, but adds 2 additional bytes of extension identifier. EUI-64 can also accommodate an OUI-36 manufacturer ID with a 28 bit extension identifier.

In either case, there is a restriction on bytes 4 and 5, that shall never be set to either 0x"FFFF" or 0x"FFFE". This is used in the standard as a means of encapsulating a 48 bit MAC into the 64 bit field.

EXAMPLE 2: 00:06:B0:FF:FF:01:AC:07 is parsed as:

Manufacturer ID 00:06:B0

Added Bytes FF:FE Code identifies a 48 bit MAC (EUI-48)

Or

Added Bytes FF:FF Code identifies a 48 bit MAC (MAC-48)

Extension 01:AC:07

NOTE: the two least significant bits of the most significant byte of the 48 bit MAC address shall always be equal to 0: multicast off and globally unique (OUI enforced)

Alternatively, instead of a 48 bit MAC address, a 48 bit Space Data Association assigned modulator identifier can be encoded as a MAC-48, but the the least significant bit of the most significant byte shall be set to zero (=unicast) and the second-least-significant bit of the most significant byte shall be set to one (=locally administered)).

NOTE: To make sure that the DVB CID Global Unique Identifier is unique, the 'locally administered' are to be assigned by Space Data Association.

Where the DVB CID Global Unique Identifier is shown on the device (printed on a label, displayed on a command line interface, displayed on a graphical user interface) the representation shall be a string of 9 octects starting with a check_digits_octet followed by the octets of the DVB CID Global Unique Identifier starting with the most significant octet, using the hexadecimal representation. The check_digits_octet is a CRC8 covering the bits of the DVB CID Global Unique Identifier with the most significant bit first.

EXAMPLE 3: The format of the displayed DVB CID Global Unique Identifier is then

CC:XX:XX:XX:XX:XX:XX:XX:XX

Where C are the hexadecimal digits of check_digits_octet and X 16 hexadecimal digits of the octets of the DVB CID Global Unique Identifier.

EXAMPLE 4: the DVB CID Global Unique Identifier 00:06:B0:FF:FF:01:AC:07 will then be shown as:

75:00:06:B0:FF:FF:01:AC:07

When the DVB CID Global Unique Identifier is entered by a human (for example for adding an entry to the CID database), it shall be prepended by this check_digits_octet and the human shall be notified if the check_digits_octet does not match with the following octets of the DVB CID Global Unique Identifier.

4.2 Content ID table

The Content ID table (Table 1) lists the possible content of the Information field carried by CID. The CID format revision code (Content ID 0) shall be transmitted; other information is optional, and the Content ID value indicates the corresponding Information field content. If the telephone is sent, all 3 Telephone content ID fields shall be sent. If the User Data is sent, all 7 User Data fields shall be sent.

Content ID table	
Content ID Value	**Information field content**
0	Carrier ID Format (23:0) CID Format is a revision code anticipating possible changes in the number and possible content of the Fields. This shall be set to 0x000001. All other values are reserved.
1	Latitude(23:4) and (0) Latitude(3:1) are unused and set to '000' Interpreted based on NMEA 0183 protocol of degrees and decimal minutes[i.2]. The field is interpreted as 6 numerical digits in binary form, plus a single bit assigned as “0” = N and “1” = South latitude. For example: 8959.99 N or 89°59'59.4“ N would be coded in 24 bits as 110110101011111111110000 and 1245.9 S or 12°45'54“ S would be coded in 24 bits as 000111100110101011100001. Resolution is equivalent to 20 meters.
2	Longitude(23:3) and (0) Longitude(2:1) is unused and set to '00' Interpreted based on NMEA 0183 protocol of degrees and decimal minutes[i.2]. The field is interpreted as 7 numerical digits in binary form, plus a single bit assigned as “0” = E and “1” = W longitude. For example: 17959.99 W or 179°59'59.4“ W would be coded in 24 bits as 110110110011110011111001 and 2334.45 E or 23°34'27“ E would be coded in 24 bits as 000111000111111100101000. Resolution is equivalent to 20 meters.
3	Telephone 1 of 3: (23:0): field is 72 bits made up of 18 x 4 bit BCD coded characters. This field is user entered. Telephone 1 (23) is the MSB of the BCD code of the first digit of the telephone number while Telephone 3 (0) is the LSB of the BCD code of the last digit of an 18 digit telephone number. The telephone number is in international format according to ITU E.123[2] with three modifications: ‘+’, “ ext. ” and padding. The ‘+’ sign is not transmitted. In case of an extension, “ ext. ” will be transmitted as binary code “1101”. Telephone numbers that do not completely fill the 72 bits are appended with the appropriate number of bits to fulfil the 72 bit filed with the invalid BCD code '1111' (padding). The full table with used BCD codes is in table 2. Example: +1 480 333 2200 ext. 1835 would be coded as 000101001000000000110011001100100010000000001101000110000011010111111111
4	Telephone 2 of 3: (23:0)
5	Telephone 3 of 3: (23:0)
6	User Data 1 of 7 (23:0) This field is 168 bits made up of 24 x 7 bit ASCII characters. It allows the operator to enter a user message. This field is user entered. User Data 1 (23) is the MSB of the ASCII code of the 1st character. User Data 7 (0) is the LSB of the ASCII code of the last (24th) character. Used Data that does not completely fill the 168 bits are appended with the appropriate number of bits to fulfil the 168 bit filed with binary ‘0’s (padding).
7	User Data 2 of 7 (23:0)
8	User Data 3 of 7 (23:0)
9	User Data 4 of 7 (23:0)
10	User Data 5 of 7 (23:0)
11	User Data 6 of 7 (23:0)
12	User Data 7 of 7 (23:0)
13 – 31	Undefined

Table 1 – Content ID

Phone number symbol or padding	BCD **8 4 2 1**
‘0’	0 0 0 0
‘1’	0 0 0 1
‘2’	0 0 1 0
‘3’	0 0 1 1
‘4’	0 1 0 0
‘5’	0 1 0 1
‘6’	0 1 1 0
‘7’	0 1 1 1
‘8’	1 0 0 0
‘9’	1 0 0 1
‘ ext. ‘	1 1 0 1
Padding	1 1 1 1

Table 2 – Coding of the telephone number

The content ID shall be sent in a repetitive sequential manner (starting from the lowest Content ID value and ending with the highest Content ID value) for any Content ID fields that are populated with data. If the total number of populated content ID fields is odd, another Content ID field “0” shall be appended at the end of sequence, to make the number even. Each frame contains two content ID fields. Note: Content ID 0 is a mandatory filed that must be sent per the sequence rules below.

EXAMPLE 1: Using the Content ID table above if a user only entered their telephone number into the modulator and did not enter any other information, the sequence becomes 0-3-4-5. The frames sent would be as follows:

- Frame N => Content ID “0” and Content ID “3”
- Frame N+1 => Content ID “4” and Content ID “5”
- Frame N+2 => Content ID “0” and Content ID “3” (restart from the beginning)
- Frame N+3 => Content ID “4” and Content ID “5”
- Frame N+4 => Content ID “0” and Content ID “3” (restart from the beginning)

EXAMPLE 2: Using the Content ID table above if a user did not enter any optional information, the sequence becomes 0-0 (another Content ID field “0” was added to make the total number even). The frames sent would be as follows:

- Frame N => Content ID “0” and Content ID “0”
- Frame N+1 => Content ID “0” and Content ID “0” (restart from the beginning)
- Frame N+2 => Content ID “0” and Content ID “0” (restart from the beginning)

EXAMPLE 3: Using the Content ID table above if a user only entered Latitude and longitude information and did not enter any other information, the sequence becomes 0-1-2-0 (another Content ID field “0” was added to make the total number even). The frames sent would be as follows:

- Frame N => Content ID “0” and Content ID “1”
- Frame N+1 => Content ID “2” and Content ID “0”
- Frame N+2 => Content ID “0” and Content ID “1” (restart from the beginning)
- Frame N+3 => Content ID “2” and Content ID “0”
- Frame N+4 => Content ID “0” and Content ID “1” (restart from the beginning)

5 DVB CID construction

The Carrier ID Transmitter Block diagram is shown in Figure 1. It shall be possible to disable the CID in an equipment by hardware or software.

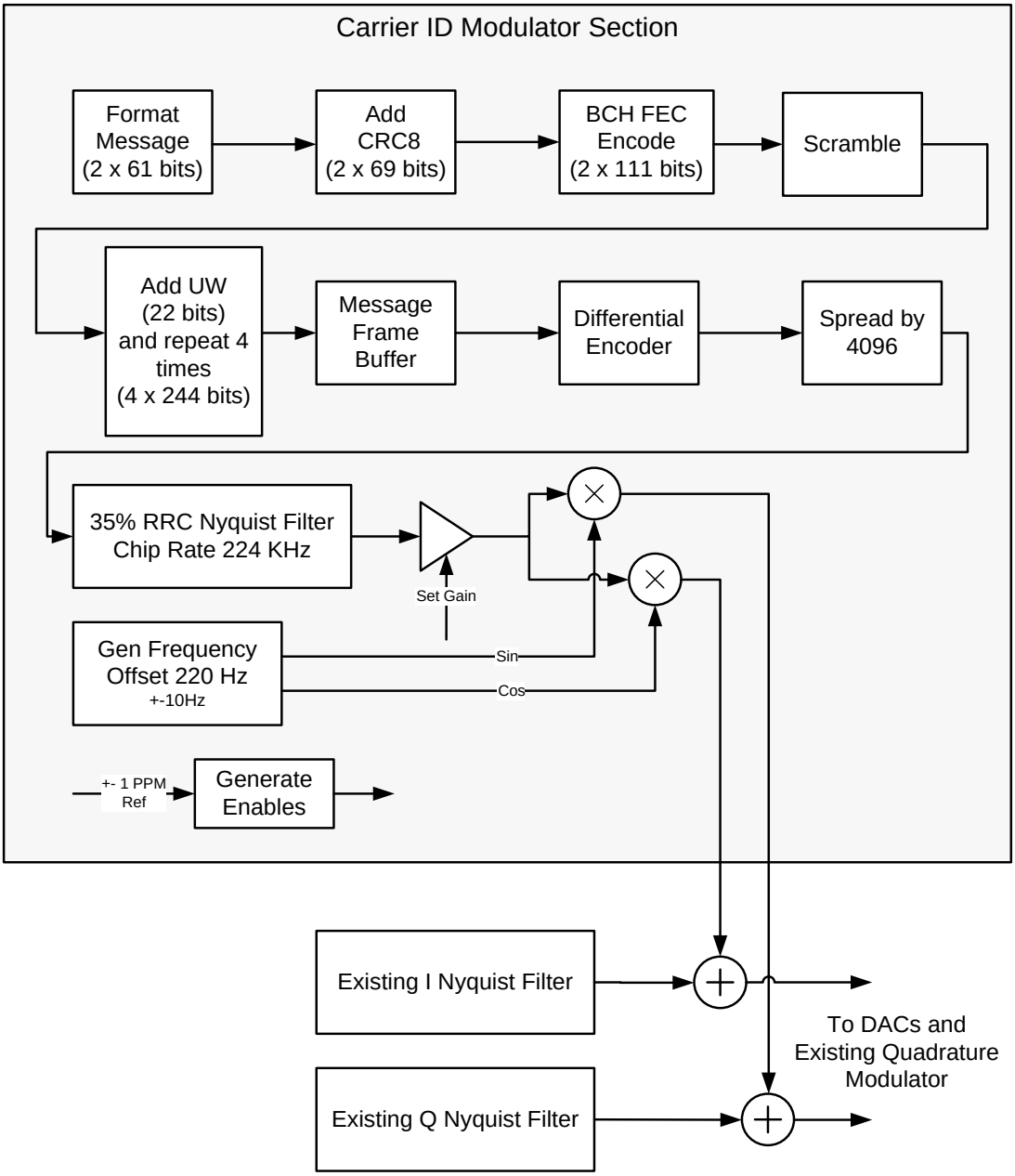


Figure 1: An example Carrier ID transmission block diagram

5.1 DVB CID frame construction

5.1.1 DVB CID Frame format

The syntax and semantics of the CID_Frame are defined in Table 3. This CID_Frame will contain the DVB CID Global Unique Identifier and 2 content ID's.

Syntax	No. of bits	Mnemonic
CID_Frame () {		
unique_word	22	bslbf
id_high	32	uimsbf
content_id_1	5	uimsbf
content_id_information_1	24	uimsbf
crc_1	8	rpchof
fec_1	42	bslbf
id_low	32	uimsbf
content_id_2	5	uimsbf
content_id_information_2	24	uimsbf
crc_2	8	rpchof
fec_2	42	bslbf
}		
NOTE: id_high and id_low are transmitted in most significant bit first order here, on Ethernet the least significant bit of the most significant byte is transmitted first !		

Table 3: Syntax and semantics

The semantics of CID_Frame are as follows (Table 3):

unique_word: The unique word (UW) is a 22-bit unique word set alternatingly to (MSB first) 0x147147 and 0x2b8eb8.

id_high: The 32 most significant bits of the DVB CID Global Unique Identifier.

content_id_1: Contains the content ID value that indicates what the content_id_information_1 field content will be. (see table 2)

content_id_information_1: Contains the Information field content for the Content ID value specified in content_id_1.(see table 2)

crc_1: The CRC8 covers the bits in the id_high, content_id_1, and content_id_information_1 fields in that sequence. See section 5.1.2 for the details for CRC8 calculation.

fec_1: The BCH FEC covers the id_high,content_id_1,content_id_information_1 and crc_1. See section 5.1.3 for the details on BCH FEC calculation.

id_low: The 32 least significant bits of the DVB CID Global Unique Identifier.

content_id_2: Contains the content ID value that indicates what the content_id_information_2 field content will be. (see table 2)

content_id_information_2: Contains the Information field content for the Content ID value specified in content_id_2.(see table 2)

crc_2: The CRC8 covers the bits in the id_low, content_id_2, and content_id_information_2 fields in that sequence. See section 5.1.2 for the details for CRC8 calculation.

fec_2: The BCH FEC covers the id_low,content_id_2,content_id_information_2 and crc_2. See section 5.1.3 for the details on BCH FEC calculation.

5.1.2 CRC8

The calculation below for CRC-8 shall be used for crc_1 and crc_2 in CID_Frame (section 5.1.1 and Table 3), and for the creation of the check_digits_octet when displaying a DVB CID Global Unique Identifier (section 4.1). The CRC8 is a systematic 8-bit CRC encoder. The generator polynomial shall be:

$$G_{CRC8}(X) = (X^5+X^4+X^3+X^2+1)(X^2+X+1)(X+1) = X^8+X^7+X^6+X^4+X^2+1$$

The CRC encoder output shall be computed as:

$$CRC = \text{remainder } [X^8\, u(X) : G_{CRC8}(X)]$$

Where u(X) is the input sequence to be systematically encoded. Figure 2 gives a possible implementation of the CRC generator by means of a shift register.

The register shall be initialized to all ones (0xFF) before the first bit of each sequence enters the circuit.

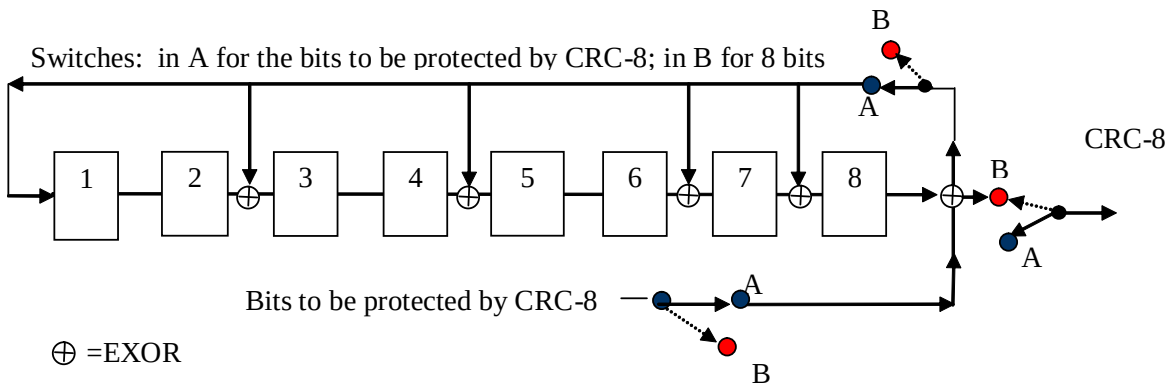


Figure 2: Implementation of the CRC-8 encoder

The MSB of the CRC shift register is MSB of the CRC byte. This CRC is "0xD5" in MSB first notation, and is equivalent to the CRC-8 with Polynomial "0xEA" in Koopman notation .

NOTE: The CRC does not cover the unique word

5.1.3 BCH FEC

The FEC is a (127, 85) 6-error correcting systematic BCH code, shortened by 16 bits to (111, 69). The encoding operation is defined as an operation involving polynomials over GF(2). The first data bit sent is the coefficient of the highest degree term in the degree 68 data polynomial D(x). The first parity bit sent is the coefficient of the highest degree term in the degree 41 parity polynomial P(x). The parity polynomial P(x) is the remainder after dividing $D(x)\cdot x^{42}$ by the degree-42 generator polynomial $G_{BCH}(x)$. The generator polynomial is the product of the following degree-7 polynomials over GF(2) (Table). The parity bits are sent after the data bits.

$g_1(x)$	$1+x^4+x^7$
$g_2(x)$	$1+x^2+x^3+x^4+x^7$
$g_3(x)$	$1+x+x^2+x^3+x^4+x^5+x^7$
$g_4(x)$	$1+x^6+x^7$
$g_5(x)$	$1+x^2+x^4+x^6+x^7$
$g_6(x)$	$1+x^4+x^5+x^6+x^7$

Table 4: BCH polynomials

NOTE: The BCH FEC does not cover the unique word

5.2 Scrambling

All bits in a CID_Frame except the unique word bits are scrambled. The scrambling polynomial is: x^9 + x^5 + 1. The initial state is 0x41. The feedback value x^9 + x^5 is the output. The scrambler does not advance over the unique words. The scrambler is reset to the initial state at the start of each CID_Frame.

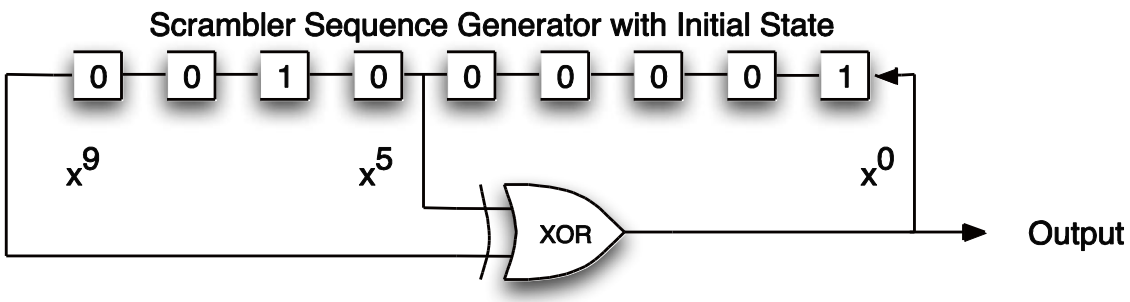


Figure 2: Message Frame Scrambler

NOTE: The scrambler does not cover the unique word

5.3 Repetition

The scrambled CID bits (unique word and scrambled bits) are repeated 4 times.

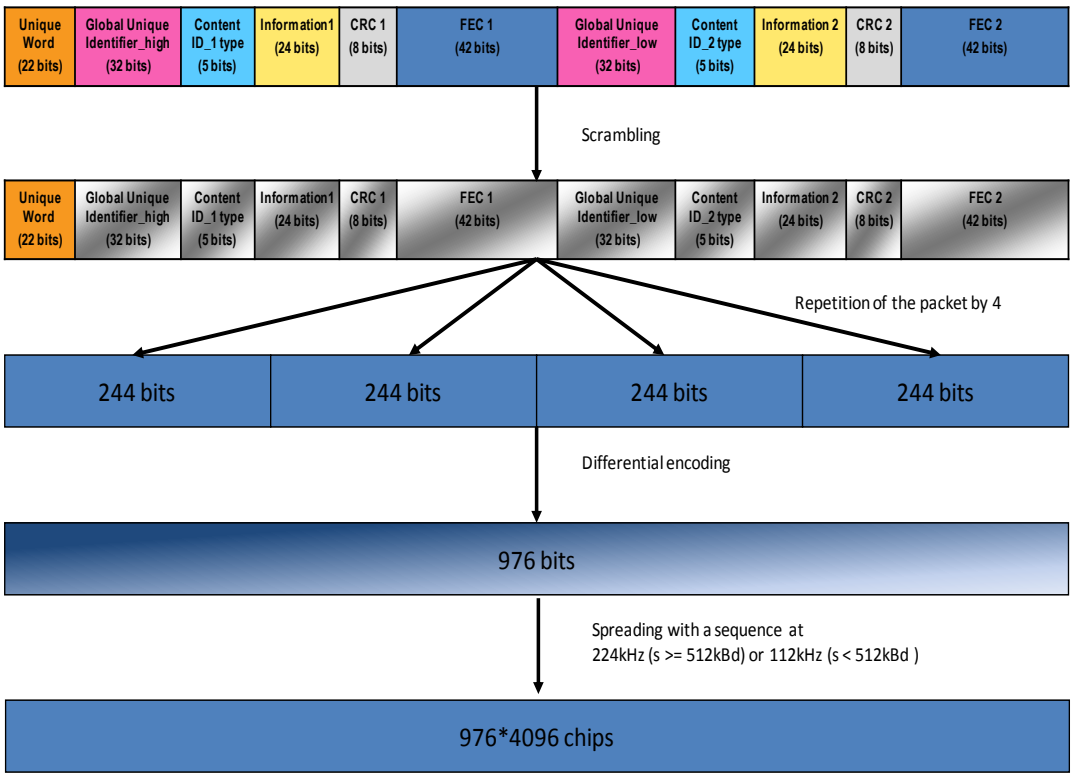


Figure 3: Scheme of the CID Frame

5.4 Differential encoder

All repeated CID bits are differentially encoded.

NOTE: Unique word bits are also differentially encoded.

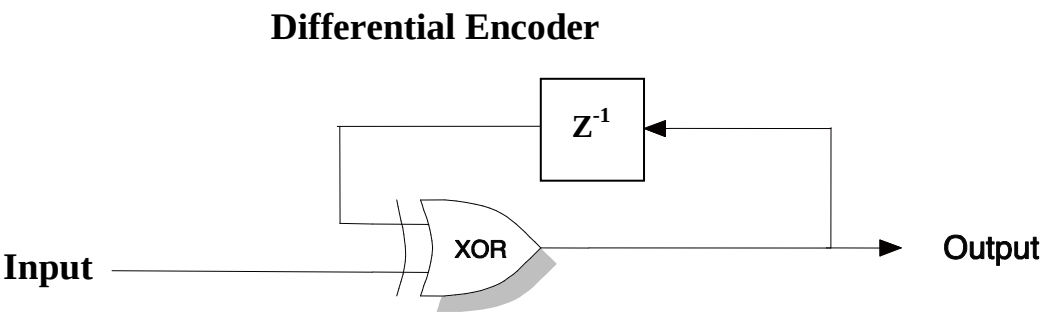


Figure 4: Symbol Differential Encoder

5.5 Chipping

Chipping is applied on every bit after differential encoding. The chipping ratio (spreading) is 4096 chips / bit at all supported symbol rates. Each bit is chipped using the same 4096 bit pattern.

The chipping pattern is created using a LFSR polynomial of $x^{15} + x^{14} + 1$ with an initial state of [0 1 0 1 0 0 0 0 1 0 0 1 0 0 0]. The first 32 chips generated by the LFSR are (MSB first) 0x5091E364. The pattern is forced to repeat every 4096 chips.

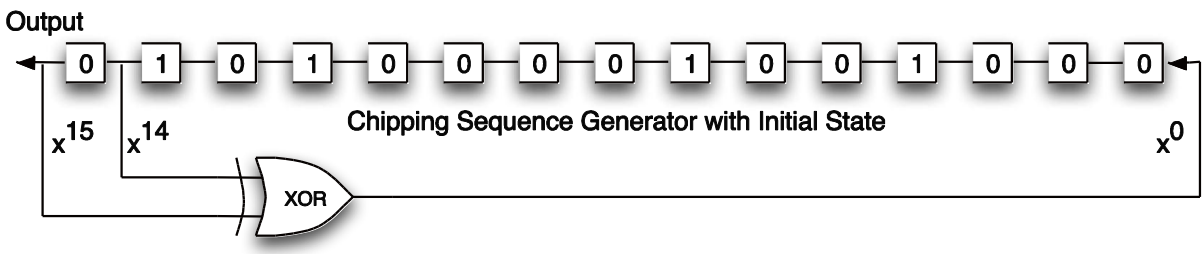


Figure 5: Chipping Sequence Generator

For host carrier symbol rate (see note 1) >= 512kBd a chip rate of 224kHz shall be used. For host carrier symbol rate < 512kBd a chip rate of 112kHz shall be used.

NOTE 1: The -3 dB Bandwidth shall be considered when the Symbol rate concept is not applicable

5.6 Chip mapping into BPSK constellation

After chipping, each chip c_i of the sequence of CID_frames shall be mapped into BPSK constellation, generating a modulation symbol y_i as a complex vector in the format (I,Q) (I being the in-phase component and Q the quadrature component).

Chip mapping into the BPSK constellation shall follow figure 6. The normalized average energy per symbol shall be equal to 1.

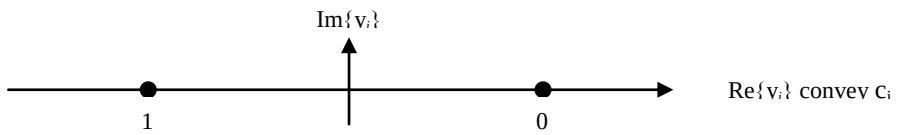


Figure 6: Bit mapping into BPSK constellation

The exact values of the real and imaginary components Re(y_i) and Im(y_i) for each combination of the relevant input bits c_i are given in table 4.

c_i	1	0
Re(y_i)	-1	1
Im(y_i)	0	0

Table 5: Constellation mapping for BPSK

5.7 Nyquist filter

After mapping into constellation, the signal shall be square root raised cosine filtered. The roll-off factor shall be α = 0,35.

The baseband square root raised cosine filter shall have a theoretical function defined by the following expression:

$$H(f) = 1 \qquad \text{for } |f| < f_N(1-\alpha)$$

$$H(f) = \left\{ \frac{1}{2} + \frac{1}{2}\sin\frac{\pi}{2f_N}\left[\frac{f_N - |f|}{\alpha}\right] \right\}^{1/2} \qquad \text{for } f_N(1-\alpha) \le |f| \le f_N(1+\alpha)$$

$$H(f) = 0 \qquad \text{for } |f| > f_N(1+\alpha),$$

where: $f_N = \frac{1}{2T_s} = \frac{R_C}{2}$ is the Nyquist frequency, α is the roll-off factor and R_C is the chip rate.

A template for the signal spectrum at the modulator output is given in annex A.

Modulation shall be performed by multiplying the samples (after baseband filtering) by sin ($2\pi f_0 t$) (where f_0 is the carrier frequency). The resulting signal shall be added to obtain the modulator output signal.

5.8 Gain adjust

A gain adjust has to be performed in order to produce a constant power spectral density of the DVB CID signal relative to the power spectral density of the center of the host carrier at the level as detailed in table 6. The power spectral density accuracy shall be within +- 0.5 dB.

Host carrier Symbol rate (s) range (1)	DVB CID signal PSD level relative to host carrier center PSD
128kBd≤s<256kBd	-27.5
256kBd≤s<512kBd	-27.5
512kBd≤s<1024kBd	-27.5
1024kBd≤s<2048kBd	-27.5
2048kBd≤s<4096kBd	-24.5
4096kBd≤s<8192kBd	-21.5
8192Bd≤s<16384kBd	-18.5
16384kBd≤s	-17.5

Table 6: relative PSD levels for the DVB CID signal

NOTE 1: The -3 dB Bandwidth shall be considered when the Symbol rate concept is not applicable

5.9 Complex Mix

At the output of the modulator the carrier ID signal is sent at +220Hz offset when the modulator is configured not to introduce a spectrum inversion in the host carrier signal.
At the output of the modulator the carrier ID signal is sent at -220Hz offset when the modulator is configured to introduce a spectrum inversion in the host carrier signal.

6 DVB CID carrier phase noise specification

For chip rate 224kHz (host carrier symbol rate ≥ 512kBd) the close-in TX phase noise for the DVB CID signal shall be as specified in Table 5, which extends the mask in [3] below 10Hz maintaining $1/f^3$ slope downto 1Hz.

For chip rate 112kHz (host carrier symbol rate < 512kBd) the close-in TX phase noise for the DVB CID signal shall be as specified in Table 6.

NOTE 1: The -3 dB Bandwidth shall be considered when the Symbol rate concept is not applicable

For both chip rates, the accuracy shall be 5ppm/year.

Frequency Offset [Hz]	SSB phase noise [dBc/Hz]	SSB phase noise [dBc/Hz] after xD frequency divider D≥20	Source
1	0	$-20 \cdot \log_{10}(D)$	[3] extended
10	-30		[3]
100	-60		[3]

Table 7: close-in TX phase noise mask for the Carrier-ID signal for chip rate 224kHz (host carrier symbol rate ≥512kBd).

NOTE: To avoid confusion about the interpretation of 0dBc/Hz phase noise: The the 3rd column corresponds to -26dBc/Hz measured with an ideal spectrum analyzer after a x20 frequency divider.

Frequency Offset [Hz]	SSB phase noise [dBc/Hz]	SSB phase noise [dBc/Hz] after xD frequency divider D≥20	Source
1	-6	$-6-20 \cdot \log_{10}(D)$	[3] extended – 6dB [5] extended + 6dB
10	-36		[3] – 6dB [5] + 6dB
100	-66		

Table 8: close-in TX phase noise mask for the Carrier-ID signal for chip rate 112kHz (host carrier symbol rate <512kBd).

Annex A (normative): Transmit filter response

Figure A.1 gives the template for the amplitude response of the CID modulator equivalent baseband Nyquist filter.

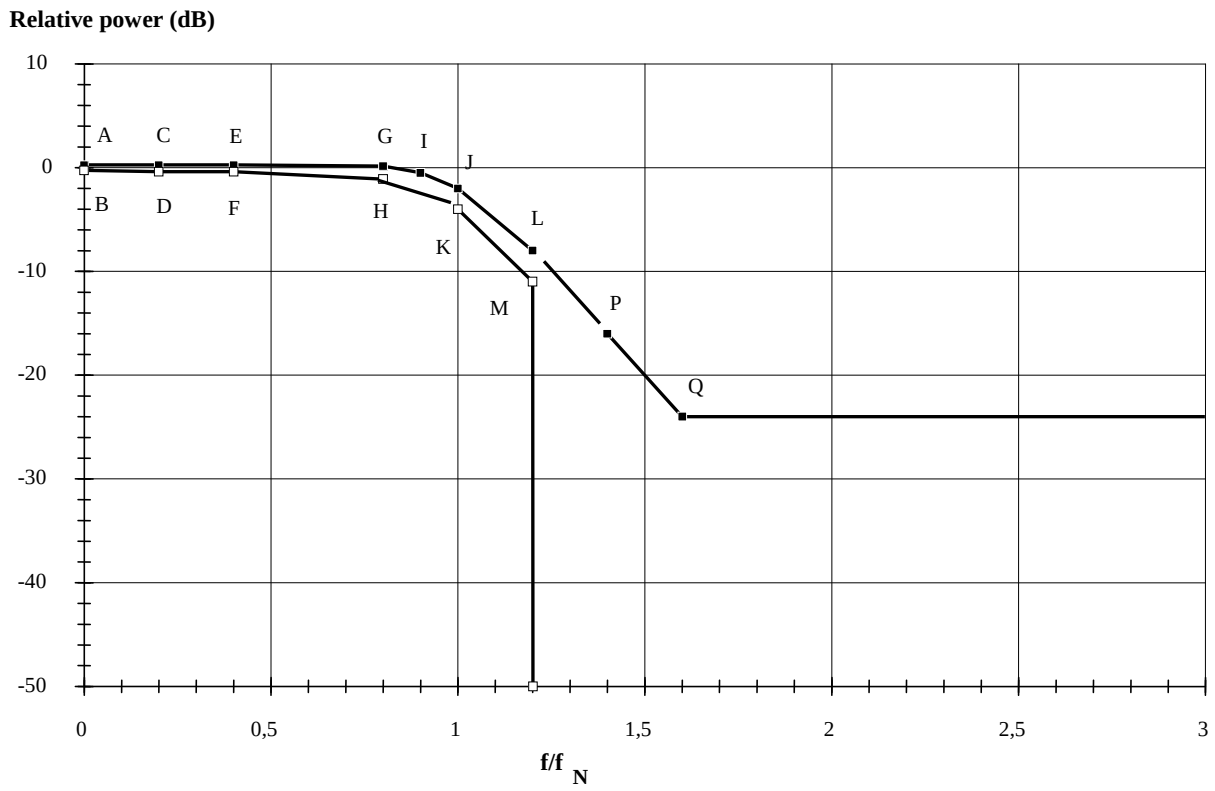


Figure A.1: Template for the amplitude response of the CID modulator equivalent baseband Nyquist filter

Figure A.2 gives the template for the group delay response of the CID modulator equivalent baseband Nyquist filter.

All filter effects up to the output of the CID modulator are understood to be included.

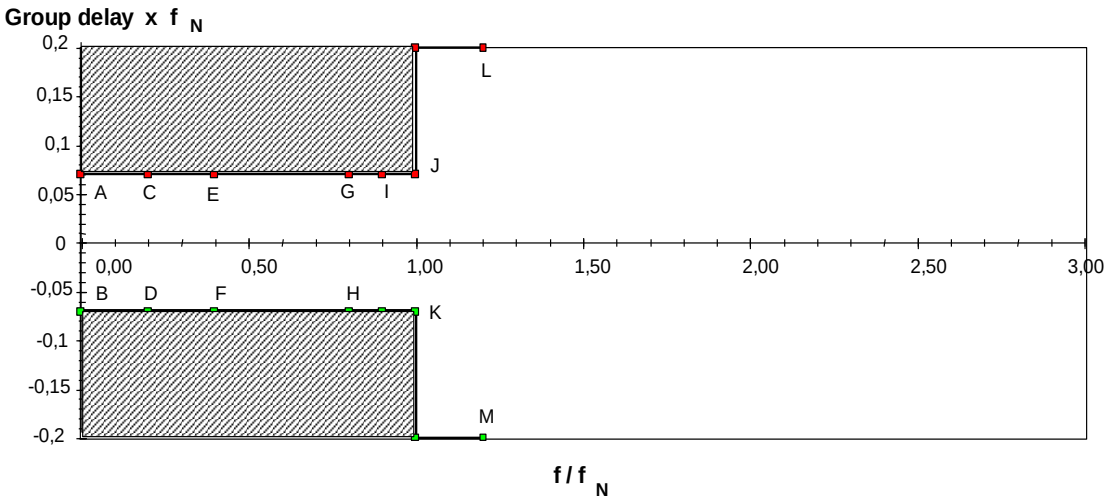


Figure A.2: Template for the group delay response response of the CID modulator equivalent baseband Nyquist filter

Table A.1: definition of points given in figures A.1 and A.2

Point	Frequency	Relative power (dB)	Group delay
A	0,0 f_N	+0,25	+0,07 / f_N
B	0,0 f_N	-0,25	-0,07 / f_N
C	0,2 f_N	+0,25	+0,07 / f_N
D	0,2 f_N	-0,40	-0,07 / f_N
E	0,4 f_N	+0,25	+0,07 / f_N
F	0,4 f_N	-0,40	-0,07 / f_N
G	0,8 f_N	+0,15	+0,07 / f_N
H	0,8 f_N	-1,10	-0,07 / f_N
I	0,9 f_N	-0,50	+0,07 / f_N
J	1,0 f_N	-2,00	+0,07 / f_N
K	1,0 f_N	-4,00	-0,07 / f_N
L	1,2 f_N	-8,00	-
M	1,2 f_N	-11,00	-
N	1,8 f_N	-35,00	-
P	1,4 f_N	-16,00	-
Q	1,6 f_N	-24,00	-

Annex B (informative): Computation of the Degradation of the host carrier and Detectability computation

B.1 Notation

A		the signal identified by the CID
B		the signal being interfered
R_A	[ksps]	the symbol rate of signal A
$SNIR_A$	[dB]	the Es/(No+Io) threshold for the coding and modulation scheme used by signal A (in the absence of a carrier-ID nuisance signal)
$SNIR_{A+CID}$	[dB]	Overall link budget result as signal to noise and interference ratio with all noise and interference degradations and impact
R_B	[ksps]	the symbol rate of signal B
Rc	[ksps]	the chip rate of the CID signal that identifies A
PSD_{CID}	[dB]	the power density level of the CID signal relative to the power density of A
SF	[]	the spreading factor for the CID signal
SNR_{CID}	[dB]	the Es/(No+Io) threshold for the coding and modulation scheme used by for the carrier-ID signal, after despreading and assuming diff. coherent detection
$C^*_{0,B}$	[W/Hz]	signal B power spectral density, at the E/S where the CID is decoded
N^*_0	[W/Hz]	noise power spectral density, at the E/S where CID is decoded
$comp_factor_CID_A$	[dB]	Compensation factor to be added to the link budget target SNIR in order to reach a target SNIRA+CID total level equal to the SNIRA when no CID would have been present
Deg_A	[dB]	Degradation of the link budget when a CID is added to an existing link

B.2 Degradation of the host carrier

Degradation of signal A. There are two effects from the CID signal that cause degradation.

1) To maintain a fixed transmit power, the signal A carrier power must be decreased by the CID signal power.

2) The CID signal power acts as an interferer to the signal A carrier.

Degradation due to the first effect can be shown to be an order of magnitude smaller than the second effect, so the first effect often can be ignored.

The second effect can be calculated as described here. For a given link with symbol rate R_A 256 kBaud and with an overall link signal to noise and interference ratio of $SNIR_A$ of for example 19dB, a carrier ID (CID) signal is added at a power spectral density level of -27.5dB compared to signal power and with a chip rate R_C 112 kHz.

The resulting link degradation can be computed as follows:

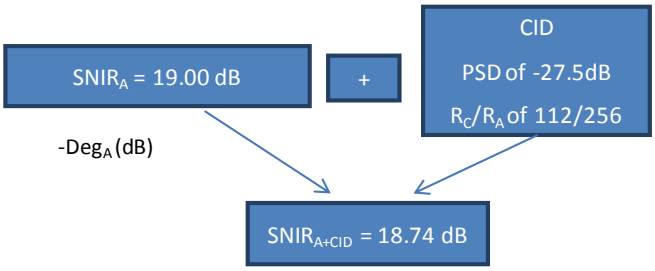
$$Deg_A(\text{dB}) = 10\log_{10}\left(1 + 10^{\frac{SNIR_A + PSD_{CID} + 10\log_{10}\left(\frac{R_c}{R_A}\right)}{10}}\right) = 0.26dB$$

Hence factors leading to high degradation in service A are:

- high level of the CID signal PSD_{CID}
- high operational $SNIR_A$ for signal A

- low symbol rate R_A of the main signal compared to the CID chip rate R_c

$Deg_A(\text{dB})$ is the link degradation at receiver after the carrier CID has been added. The receiver will see the CID as additional interference contribution and the overall link $SNIR_{A+CID}$ becomes 18.74dB.

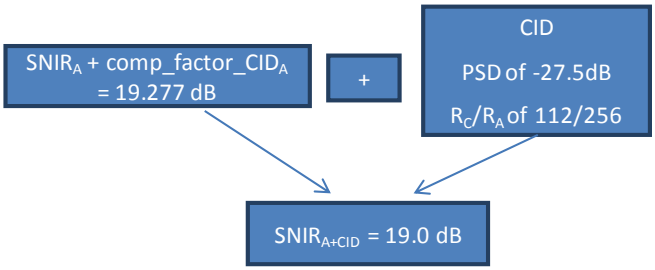


The operator of the link may dispose of means to compensate for the link degradation with small changes in link parameters like the uplink power for example. In this case the overall link $SNIR_A$ needs to be changed to take into account the additional carrier ID interference contribution to the overall link budget.

The initial $SNIR_A$ of 19dB needs to be adapted to take into account the CID contribution by the additional factor of:

$$comp_factor_CID_A(\text{dB}) = -10\log_{10}\left(1-10^{\frac{SNIR_A+PSD_{CID}+10\log_{10}\left(\frac{R_c}{R_A}\right)}{10}}\right) = 0.277dB$$

The compensated $SNIR_A$+comp_factor_CID_A is then 19.277dB. This represents the target overall link budget without CID. This assuming a CID of PSD -27.5dB and at a rate of R_C/R_A = 112/256 to this link will yield an overall link budget at reception of $SNIR_{A+CID}$ of 19.0dB.



B.3 Detectability computation

It is preferred to detect the identity of interferer A without interrupting the service of the interfered signal B. This requires spare margin for the interfered signal B. As a figure of merit for detectability we will computed the extra C/I to be considered in the link budget of signal B to allow identifying interferer A without switching off B. This value is well approximated[1] by

[1] A small correction is needed when service A and B have very similar symbol rates. Providing the exact formula would blur the main trends.

$$C/I = PSD_{CID} - SNR_{CID} + 10\log_{10}\left[SF\,\frac{\max(R_A, R_B)}{R_A}\right] - 10\log_{10}\left(1 + \frac{N_0^*}{C_{0,B}^*}\right)$$

Hence factors improving detectability are:

- high level of the CID signal PSD_{CID}
- low detection threshold
- high spreading factor SF
- high symbol rate R_B of the interfered signal compared to the interfering signal R_A

The last term

$$10\log_{10}\left(1 + \frac{N_0^*}{C_{0,B}^*}\right)$$

is often negligible, in particular when the interfered signal B is a broadcast service[2].

It will be noticed from the factor analysis above that the requirement for low degradation to signal A and good detectability of interference to signal B are in part opposing requirements. A better marriage of the opposing requirements is possible by selecting the value of PSD_{CID} as a function of the TX symbol rate R_A.

[2] since service B is then typically downlink limited and the E/S where carrier-ID is decoded can be expected to have much better G/T than service B terminals

Annex <y> (informative): Bibliography

- Robert Clyde Dixon, “Spread spectrum systems”, J. Wiley

History

Document history		
<Version>	<Date>	<Milestone>
V1.1.1	January 2013	Draft specification for DVB-TM

ATTACHMENT D

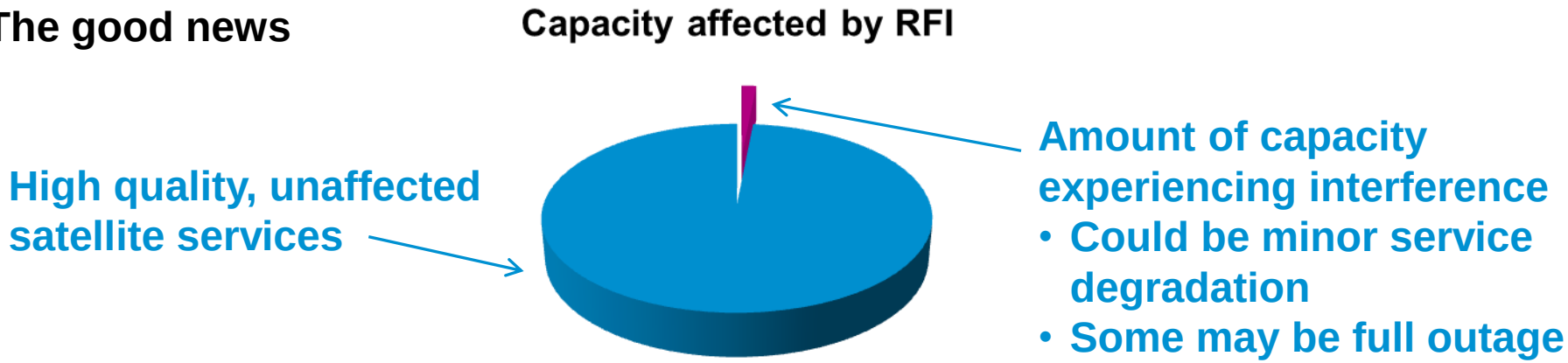
SES RFI Experience

SES
your satellite company

November 2012 – sIRG Conference, Dubai –Steve Smith

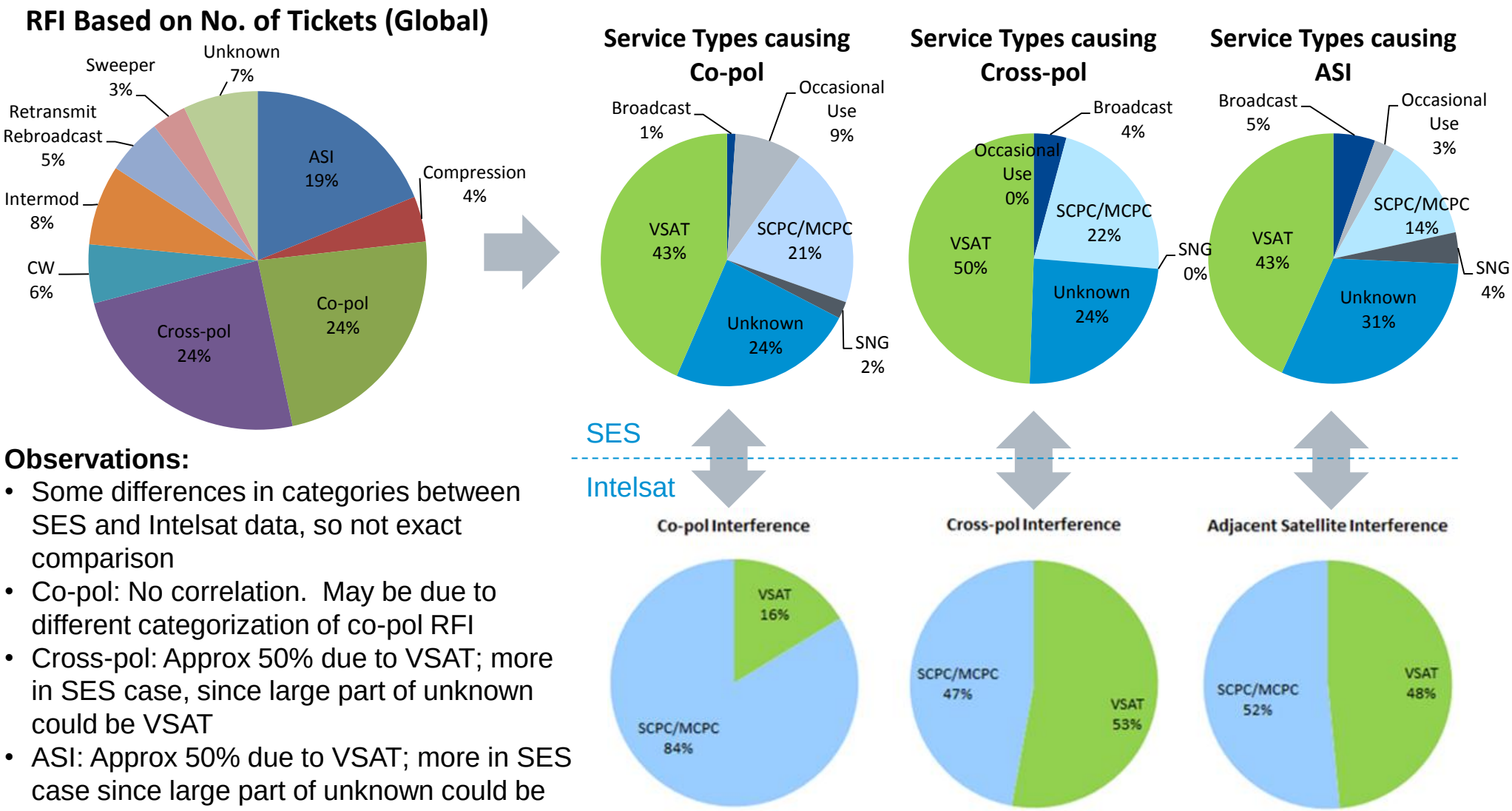
A perspective on interference

- **The good news**



- **The not so good news**
  - Although a very small percentage of our capacity is affected, this could be a problem for the affected customer(s), if they suffer degraded service, or full outage
  - It is a significant cost for SES in terms of:
    - Degraded customer services or unusable capacity
    - Staff to investigate interference
    - Infratructure, monitoring/geolocation systems, and software tools to analyze interference

SES versus Intelsat (by ticket count)

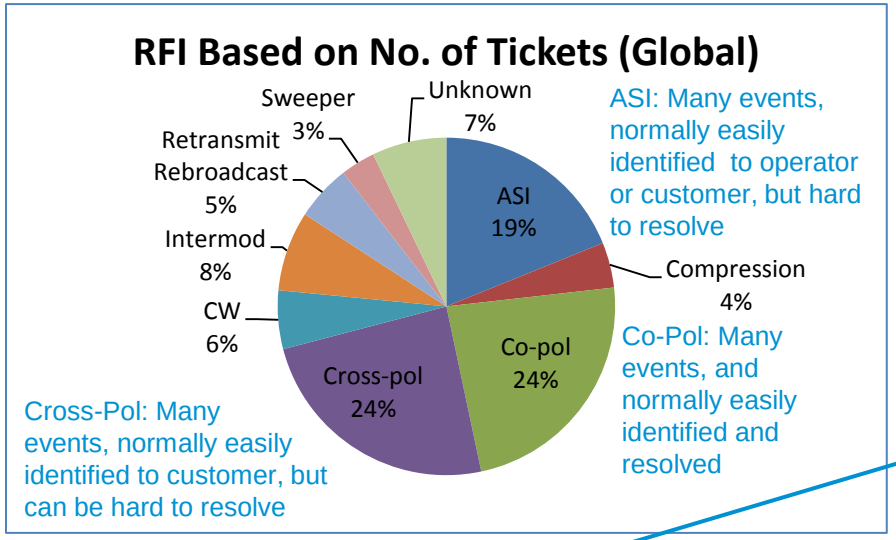


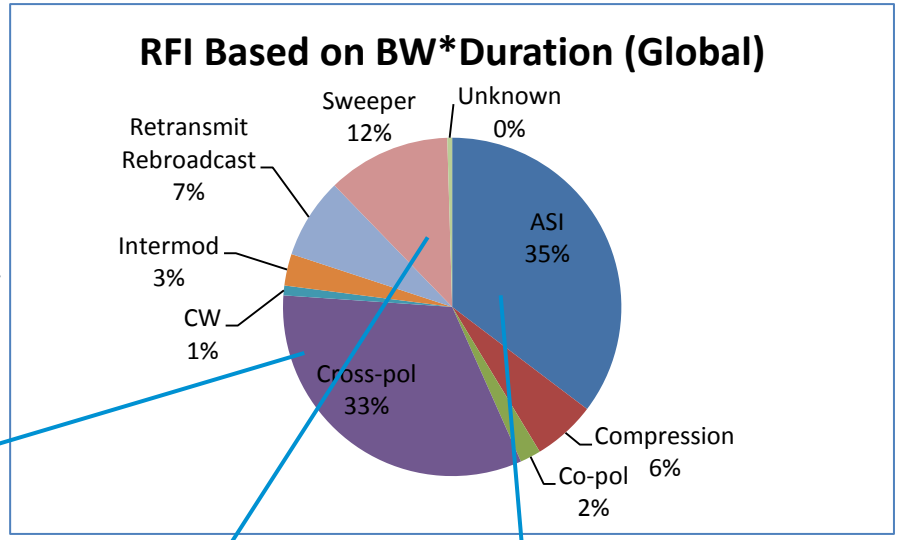
Observations:

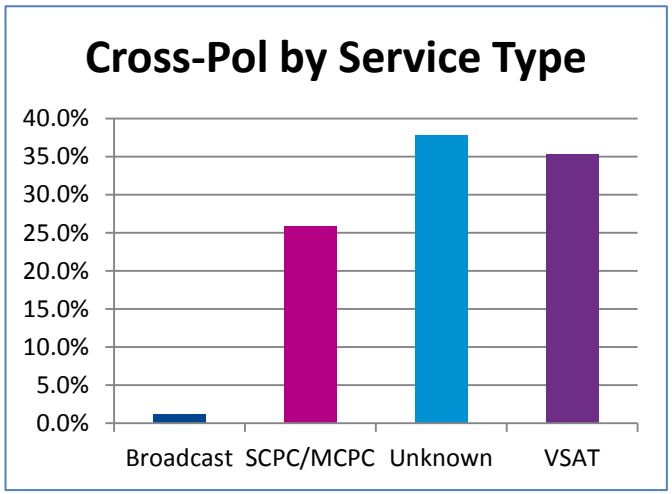
- Some differences in categories between SES and Intelsat data, so not exact comparison
- Co-pol: No correlation. May be due to different categorization of co-pol RFI
- Cross-pol: Approx 50% due to VSAT; more in SES case, since large part of unknown could be VSAT
- ASI: Approx 50% due to VSAT; more in SES case since large part of unknown could be VSAT

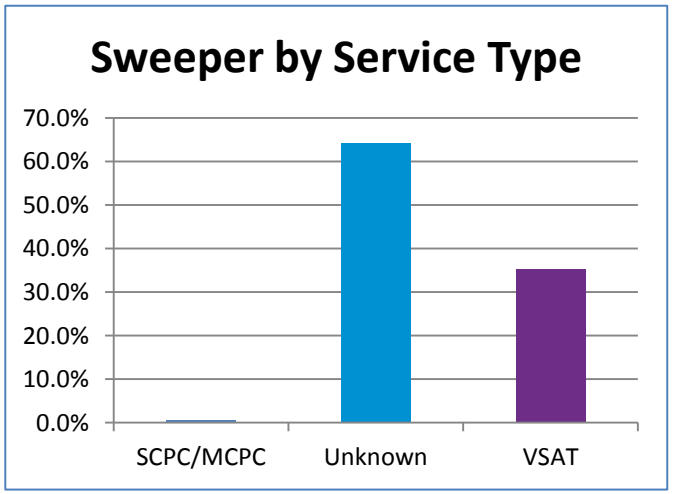
SES Proprietary – Not for Public Release

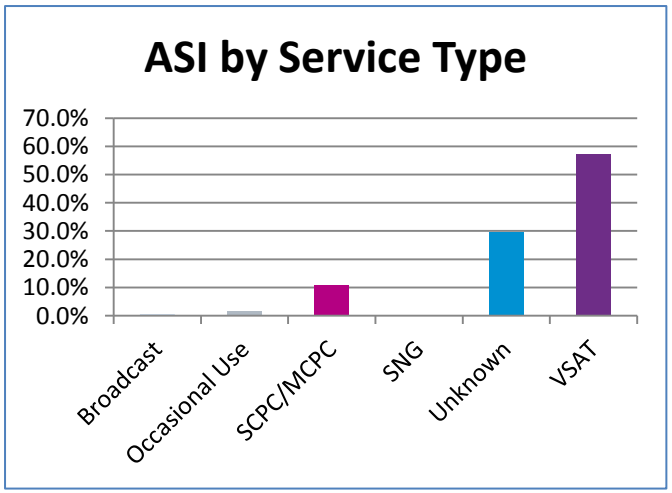
Interference (global) impact: MHz*Days











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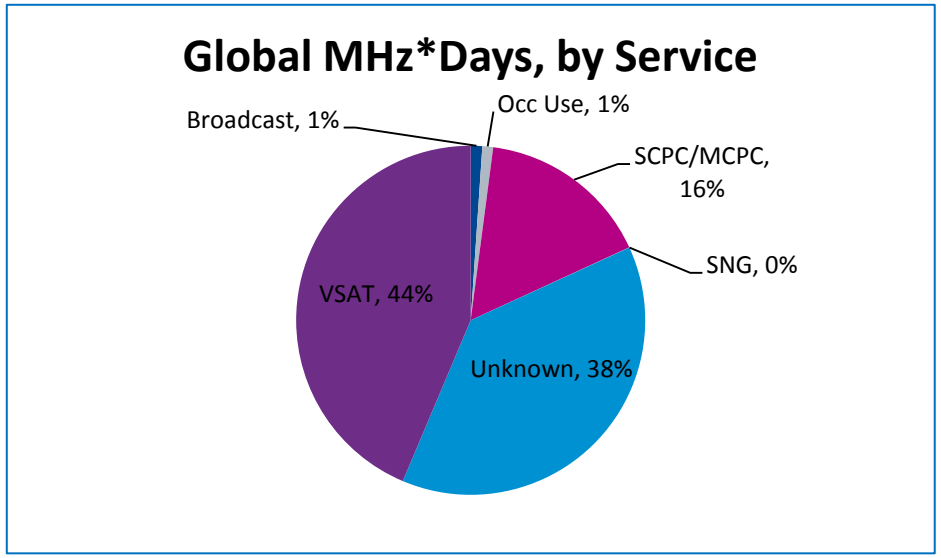
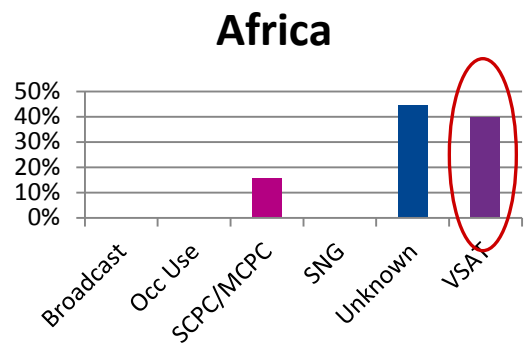
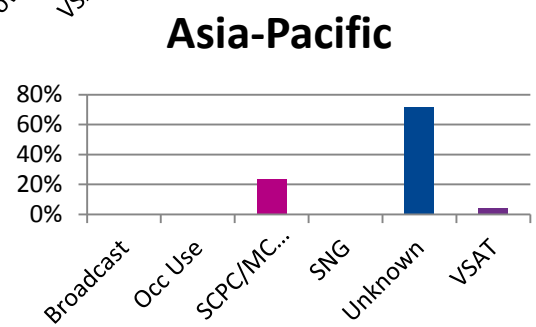
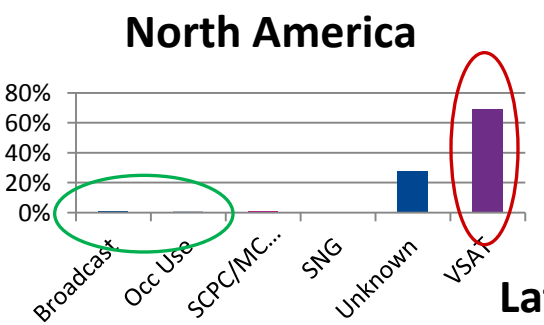
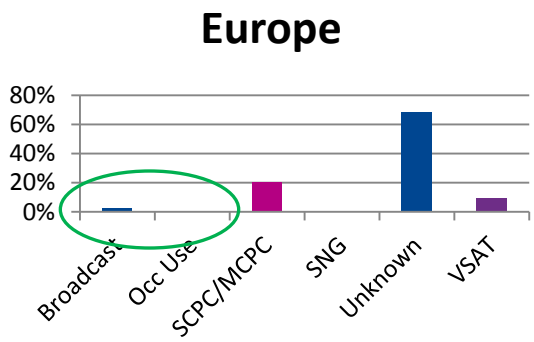
Interference (regional) impact: MHz*Days

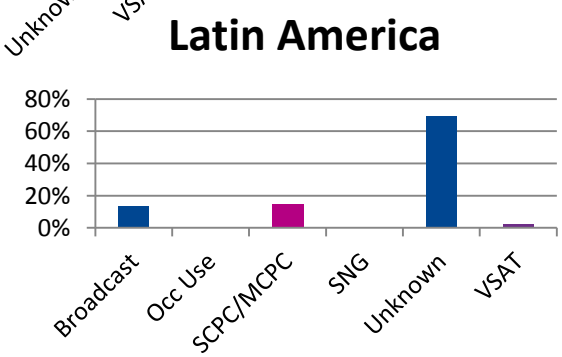


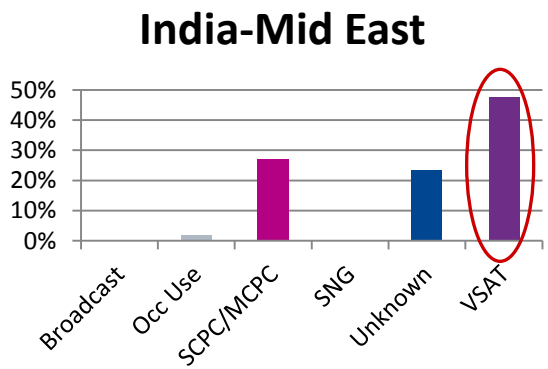












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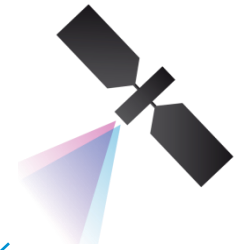
Summary

- **VSATs cause a significant proportion of interference on SES satellites**
  - Majority of interference in some regions
  - Less VSAT RFI in other regions – fewer SES satellites, fewer adjacent beams, less VSAT service?
  - More analysis required, including manufacturer root cause data
- **VSAT RFI takes the longest to investigate**
  - Hard to identify faulty or mis-pointed terminal. Even network operator can‘t find it
  - Network operators don‘t have complete records of their customer antenna locations (even if geolocated, network operator may deny having a terminal there)
- **Unreliable remote terminal installations/products**
  - Uncertain quality of small antennas
  - BUCs that cannot be turned off remotely (unlocked BUCs can create sweepers)
  - Poor installations – not solid mounting – incorrect pointing – moves over time

The big picture: VSAT ideas



Sat ID on beacon?

Technical support: Network Operator or vendor should have capability to test remote terminals for Cross-pol and ASI

Antenna design: need good quality, tested products

Carrier ID on remote transmissions?

RF Inhibit on BUCs

Trained installers: accurately align antennas

Rigid antenna installation: E.g. no loose bricks or supports

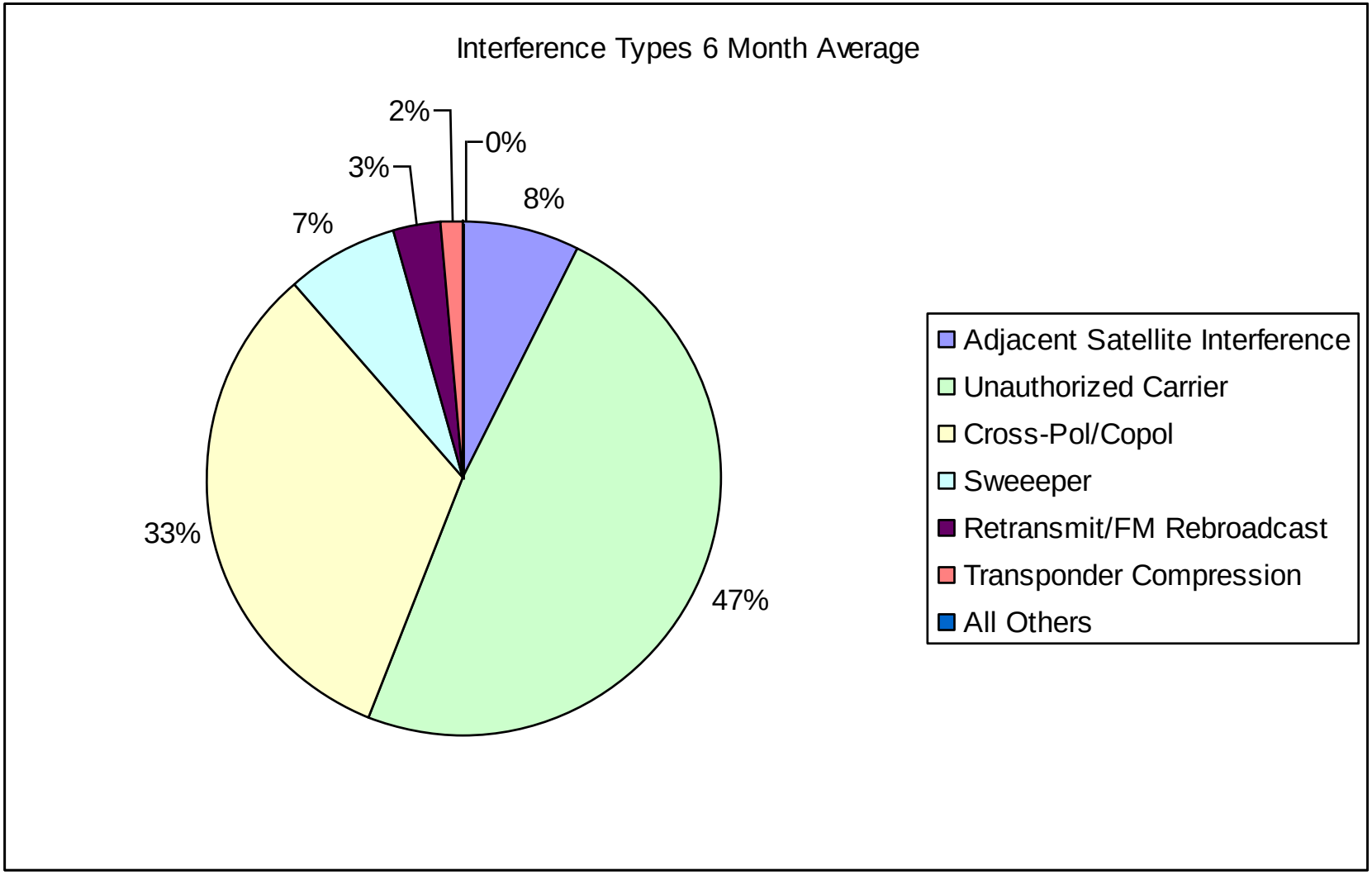
Geographic location: Network Operator should know the location of their customer antennas

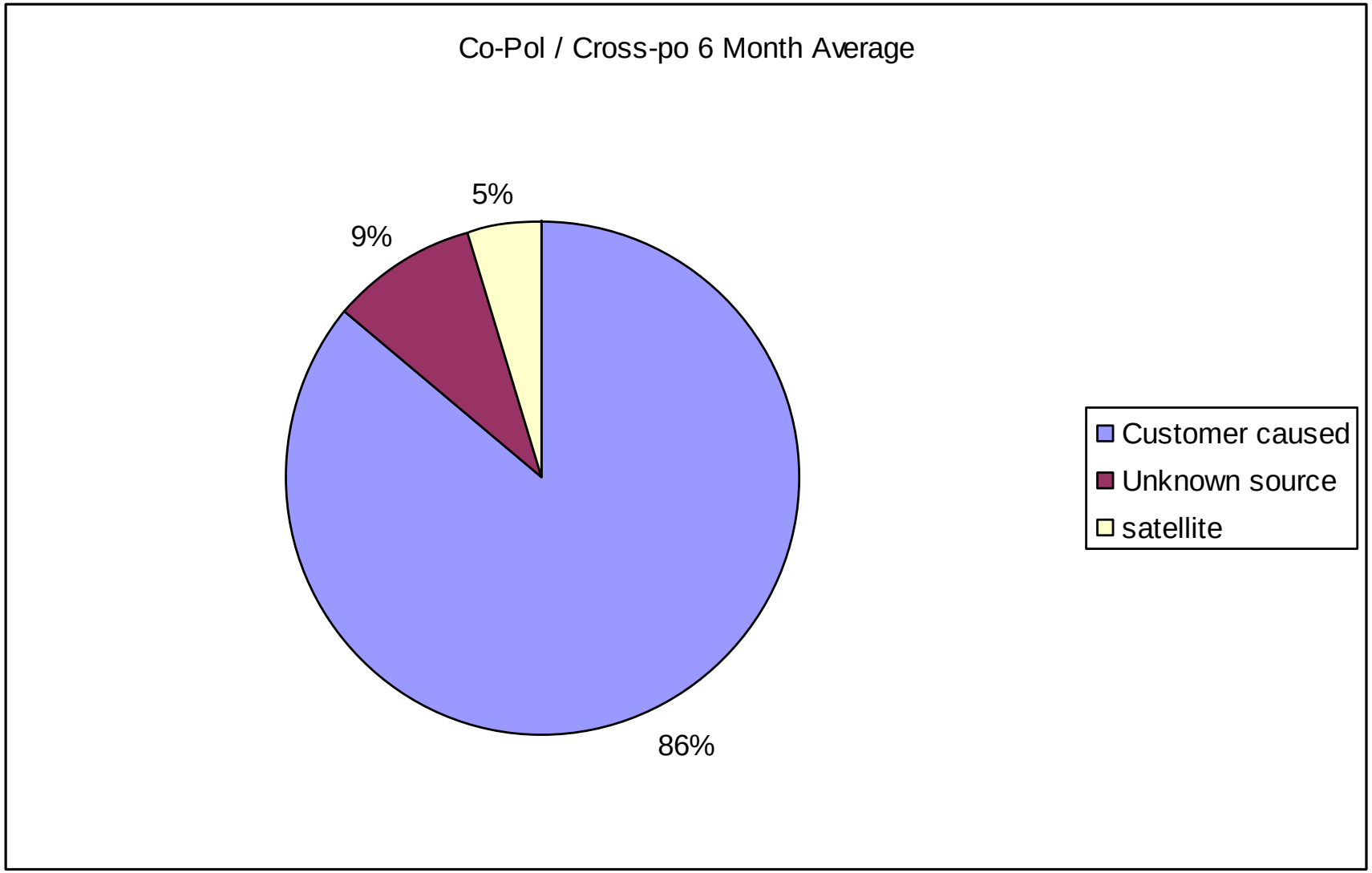
Hub system: better tools for identifying faulty remote transmissions and troubleshooting

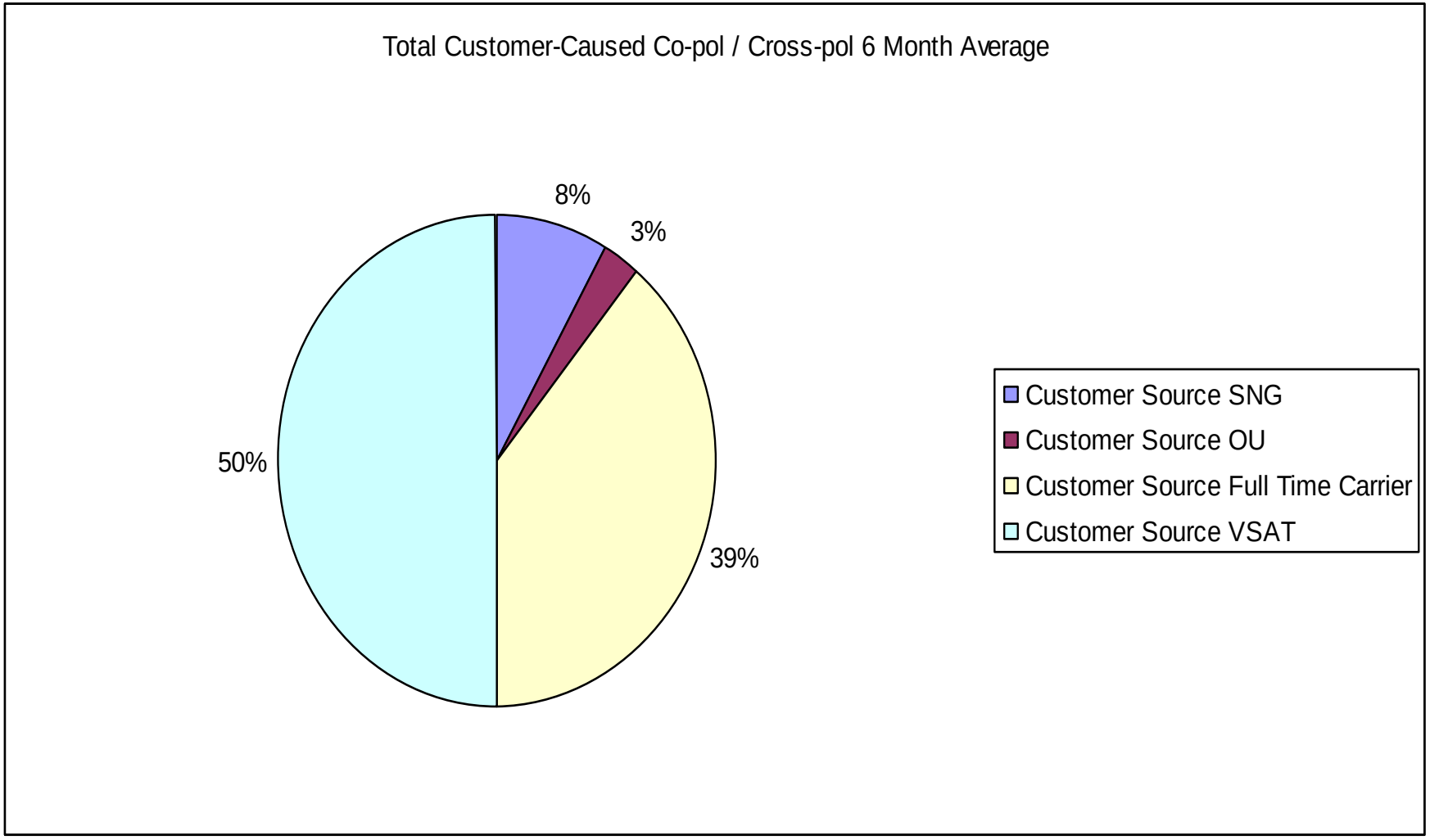
SES
your satellite company

Thank you!

ATTACHMENT E


Interference Types 6 Month Average
2%
0%
3%
8%
7%
33%
47%
Adjacent Satellite Interference
Unauthorized Carrier
Cross-Pol/Copol
Sweeeper
Retransmit/FM Rebroadcast
Transponder Compression
All Others


Co-Pol / Cross-po 6 Month Average
5%
9%
86%
Customer caused
Unknown source
satellite


Total Customer-Caused Co-pol / Cross-pol 6 Month Average
8%
3%
39%
50%
Customer Source SNG
Customer Source OU
Customer Source Full Time Carrier
Customer Source VSAT