Automated Procedure Generator for Payload Testing

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Abstract

In this paper we describe our new automated procedure generator, implemented in JAVA [1] which generates Automated Checkout Software System (ACSS) compatible test procedures for Aditya-L1 Payload Testing from input csv files. The csv files contain payload configuration details for which the procedure is to be generated. We start with an introduction to the payloads and requirement for payload testing in Aditya-L1. Then we focus upon the All-Payload Procedure Generator which generates a combined test procedure for all payloads to be operated together. Further we move on to VELC Procedure Generator which generates procedures for Visible Emission Line Coronagraph (VELC) payload testing which is in turn based on a chain of mathematical computations. Finally, we touch upon Solar Ultraviolet Imaging Telescope (SUIT) procedure generator which converts program execution format for SUIT from subsystem format to ACSS compatible format.

Keywords:
Payloads, Procedure, csv, XBS, DH

1. Introduction

The Aditya-L1 spacecraft is dedicated to in-detail study of the Sun from L1 point and has been successfully carrying out its mission objectives [2]. The payloads in Aditya-L1 include an Imaging Camera, Aditya Solar wind Particle Experiment (ASPEX) [3], High Energy L1 Orbiting X-ray Spectrometer (HEL1OS) [4], SUIT [5], VELC [6], Plasma Analyser Package for Aditya (PAPA) [7], Magnetometer [8] and Solar Low Energy X-ray Spectrometer (SoLEXS). ASPEX has Solar Wind Ion Spectrometer (SWIS) and Supra-Thermal & Energetic Particle Spectrometer (STEPS) as sub-payloads while VELC has Continuum, Spectroscopy 1, Spectroscopy 2, and Infrared Imaging Channels/Sub-payloads. Out of these payloads, the procedure generation for VELC was very tricky since there were around 80 commands to Data Handling System (DH) for full configuration for VELC operations which in turn is based on a chain of mathematical computations. The conventional procedure preparation approach for VELC seemed to be voluminous and prone to human errors. In addition to DH configuration, VELC sub-payload configuration commands had to be derived from *csv* files, shared by payload team. Hence, we decided to build our VELC procedure generator for auto generation of VELC procedures. SUIT had around 50 program sequences to be uplinked to the payload to cover all the test cases. The program sequences in subsystem format were shared with us which we had to convert to ACSS compatible format for carrying out Ground Checkout IST (Integrated Spacecraft Testing) activities. Finally, we had test cases wherein we had to operate different combinations of payloads and other sub-systems in the loop which demanded an All-payloads Procedure Generator. Hence, we have built a combined software for the above requirement which could generate VELC procedures, SUIT procedures and All-Payloads combined procedures with ease. In this paper we shall describe our procedure generation methodology with the automated procedure generator, with corresponding procedure structure, computations and input and output formats for the software.

2. All-Payloads Procedure Generator

As discussed earlier, there were 7 Payloads to be tested in Aditya-L1, for each Payload one BDH Configuration must be performed followed by Payload Configuration. Before Payload data starts, SSR Recording to be started and after the Payload data has stopped, SSR Recording to be stopped. Once all the payloads to be

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switched Off, the same file which has been recorded in has to be Played back, and the Data Formatting Unit (DFU) must be configured with the modulation and data rate required as per the configuration decided. There were more than 55 Payload Configuration procedure to be generated, each of the procedures having approximately 170 to 200 commands and similar number of Telemetry checks. The automated Procedure generator was used to generate all the procedures by using the CSV file generated by Checkout team for deciding the Payload Configurations.

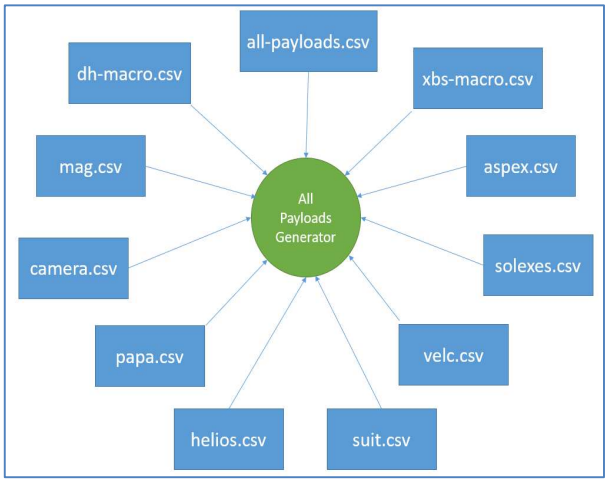

Figure 1 All-Payloads Procedure Generator

2.1. *CSV File as Input*

We used a main *csv* file as input to our All-Payloads Procedure Generator, parsed with opencsv [9] library in java. The columns in csv includes serial number, configuration name, one column for each payload, main/redundant selection for Baseband Data Handling System (BDH), X-Band System (XBS) and TWTA (Twisted Wave Tube Amplifier), modulation, data rate, Trellis Coded Modulation (TCM) Selection, Onboard Computer (OBC) Selection, bus selection and wait time as in Fig. 2. Each test procedure used in Aditya-L1 has a corresponding configuration number based on the payload chain configuration, which

Config Nar	Camera	VELC	Magnetometer	BDH	XBS	TWTA	Modulation
PL-Cfg-13		VELC -17	MAG - 1	M	M	M	8-PSK
PL-Cfg-14		VELC -11	MAG - 1	M	M	M	8-PSK
PL-Cfg-15		VELC -12	MAG - 1	M	M	M	Q-PSK
PL-Cfg-16		VELC -13	MAG - 1	M	M	M	Q-PSK
PL-Cfg-17		VELC -14	MAG - 1	M	M	M	8-PSK
PL-Cfg-18		VELC -15	MAG - 1	M	M	M	8-PSK
PL-Cfg-19		VELC -16	MAG - 1	M	M	M	8-PSK
PL-Cfg-20		VELC -10	NA	M	M	M	8-PSK
PL-Cfg-21		VELC -20	NA	M	M	M	8-PSK
PL-Cfg-22		VELC -21	NA	M	M	M	8-PSK
PL-Cfg-23		VELC -22	NA	M	M	M	8-PSK
PL-Cfg-24		VELC -23	NA	M	M	M	8-PSK
PL-Cfg-25		VELC -24	NA	M	M	M	8-PSK
PL-Cfg-26		VELC -24	NA	M	M	M	8-PSK
PL-Cfg-27		VELC -24	NA	M	M	M	8-PSK
PL-Cfg-28		VELC -24	NA	M	M	M	8-PSK
PL-Cfg-29		VELC -24	NA	M	M	M	8-PSK
PL-Cfg-30		VELC -24	NA	M	M	M	8-PSK
PL-Cfg-31		VELC -24	NA	M	M	M	8-PSK
PL-Cfg-32		VELC -24	NA	M	M	M	8-PSK
PL-Cfg-33		VELC -30	NA	R	R	M	8-PSK

Figure 2 CSV Input to All-Payloads Generator

corresponds to one row in the csv file. Individual columns for each payload contains the corresponding payload sub-configuration, to be used for the given configuration. BDH, XBS, TWTA selections denote main/redundant selections for these subsystems.

Based on these entries, corresponding subsystem configuration macro shall be called in the procedure. 8PSK and QPSK modulation schemes are supported in Aditya-L1. Supported Data Rates are 4Mbps, 6Mbps, 8Mbps, 12Mbps and 24 Mbps. Possible OBC and Bus Selections are OBC1/OBC2 and Bus-A/Bus-B respectively. Wait time represents the number of seconds data is to be recorded in SSR. The column *vdmwait* denotes the number of seconds to be waited for VDM (VELC Drive Mechanism) movements.

2.2. *Procedure Generation from CSV*

a. Procedure title shall be derived from the configuration name.
b. OBC selection call as in step 9010.20 of Fig. 3.
c. Appropriate Telemetry checks shall be added based on subsystem selections and available payloads in the configuration, as in step 9010.40 of Fig. 3.
d. For each payload column indicating the payload configuration, a corresponding *csv* file shall be prepared which provides additional information,

including the corresponding payload sub-procedure name to be called. For instance, corresponding to *VELC* column in Fig. 2, *velc.csv* too shall be created with configuration name and sub-procedure name mapping. Our software shall look for the appropriate sub-procedure name and shall insert the corresponding sub-procedure call. A sub-procedure call for PAPA payload configuration 2 is shown in step 9010.120 of Fig. 3.

e. Based on BDH selection, Data Rate and TCM coding scheme, corresponding macro mapping shall be matched and a *SEND* command with macro name shall be inserted into the procedure.
f. Based on XBS and TWTA selection, corresponding xbs macro *SEND* command shall be inserted into the procedure.
g. SSR (Solid State Recorder) record start shall be added immediately after pre-requisite checks and record stop shall be added, post payload and DH configuration, after waiting for the specified wait period.
h. Remarks shall be added wherever necessary.

2.3. *Procedure Structure*

The procedure structure is based on the subsystem switch ON/OFF and operation sequences, as agreed upon by the designers and review committee. The procedure operation sequence for Aditya-L1 is as follows:

```
!*************************************************************!
!                  PROJECT: Aditya-L1                         !
!*************************************************************!
!                FILE NAME: PL-Cfg-10.tst                     !
!    Payload Configuration: PL-Cfg-10                         !
!*************************************************************!
9010.10     TESTNAME      PL-Cfg-10.tst


9010.20     CALL          obc1-sel.tst

9010.30     REMARK        Prerequisite Checks

9010.40     CHECK         ODHM-CTRL5V-MON;
                          BDH-Msg-Tr-Sts = Ena;
                          SR-B0-PWR-STS=ON;
                          SR-B1-PWR-STS=ON;
                          DH-L-RFU-Mod=REC_PB;
                          DH-SUT-RFU-Mod=REC_PB;
                          DH-VL1-Mode=REC_PB;
                          DH-VL2-Mode=REC_PB;
                          DH-VL-AuxEna=ENA;
                          DH-SUT-Aux-Ena=ENA;
                          VDM-M-Elx-Sts=On;
                          PAP-DC-DC1-Sts = ON;
                          PAP-DC-DC2-Sts=OFF;
                          PAP-DC1-15V-Mon;
                          PAP-5V-Mon;
                          PAP-PPU-5V = ON;
                          PAP-HVPPS-5V =ON

9010.50     REMARK        SSR Record Start

9010.60     SENDLIST      SSR0-Rec-L0-FID XXXX;
                          SSR1-Rec-L0-FID XXXX;
                          SSR1-Rec-L1-FID XXXX

9010.70     REMARK        DFU Configuration for each Payload

9010.80     SEND          dh-pap-cnfg

9010.90     WAIT          5 sec

9010.100    SENDLIST      DH-PAPA-AcqEna

9010.110    REMARK        Payload Configurations

9010.120    CALL          pap-cfg2.pl

9010.130    WAIT          500 sec

9010.140    SENDLIST      PAP-SenOprItrlk;
                          PAP-DataAcqStop

9010.150    WAITTILL      960 sec PAP-DataAcq-On=OFF

9010.160    REMARK        DFU Acquisition Disable

9010.170    SENDLIST      DH-StHELAqDis;
                          DH-StAcqDis;
                          DH-SW-AcqDis;
                          DH-STP-AcqDis;
                          DH-SLX-AcqDis;
                          DH-PAPMagAcqDis;
                          DH-HEL-AcqDis;
                          DH-M1-AllAcqDis;
                          DH-M2-AllAcqDis

9010.180    REMARK        SSR Record Stop

9010.190    SENDLIST      SSR0-Rec-Stp-L0;
```

Figure 3 Procedure Generated by All-Payloads Generator

a. Procedure Title and Description.
b. Procedure call for OBC Selection.
c. Pre-Requisite Telemetry checks.
d. SSR Record commands.
e. ODHS (On Board Data Handling and Storage System) configuration macros for payloads to be operated.
f. **Payload** configuration sub-procedure calls.
g. Wait for data recording in SSR.
h. Payload acquisition disable commands.
i. Stop SSR Recording.
j. Switch ON and configure XBS and TWTA.
k. Configure DH for data downlink.
l. Playback recorded data from SSR.
m. Switch off XBS.
n. Procedure footer.

3. VELC Procedure Generator

Each of the 4 sub-payloads of VELC have 32 command words to be uplinked for its configuration and BDH configuration requires 70 commands, to acquire VELC data. The BDH command formation is based on mathematical computations, depending on the data rates of the sub-payloads. The 32 words in VELC configuration are decided based on the programmable parameters in the VELC payload. The automated procedure generator is used to generate the VELC procedures taking all the above requirements into account.

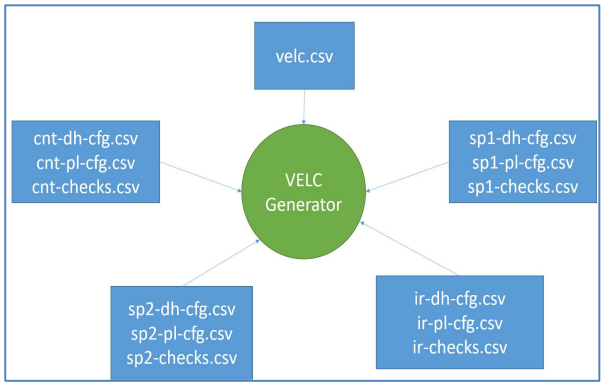

Figure 4 VELC Procedure Generator

3.1. *CSV Files as Input*

Sl. No	ConfigName	CONT	SPEC1	SEPC2	IR	CI/CB	BDH
10	VELC -10	1	1	1	1	Include	M
11	VELC -11	2	2	2	2	Include	M
12	VELC -12	3	3	3	3	Include	M
13	VELC -13	4	4	4	4	Include	M
14	VELC -14	6	6	6	6	Include	M
15	VELC -15	7	7	7	7	Include	M
16	VELC -16	12	9	9	9	Bypass	M
17	VELC -17	12	10	10	9	Bypass	M
18	VELC -18	11	8	8	11	Bypass	M
19	VELC -19	12	8	8	12	Bypass	M
20	VELC -20	A	A	A	A	Bypass	M
21	VELC -21	B	B	B	B	Bypass	M
22	VELC -22	C	C	C	C	Bypass	M
23	VELC -23	D	D	D	D	Bypass	M
24	VELC -24	E	E	E	E	Bypass	M

Figure 5 Input to VELC Procedure Generator: velc.csv

The input csv files to be used are *velc.csv* and 3 csv files each for sub-payloads as in Fig. 5. *velc.csv* shall contain the main VELC configuration names, corresponding sub-payload configuration names for Continuum, SP1, SP2, IR, and compression status. *dh-cfg.csv, pl-cfg.csv, checks.csv* for each sub-payload shall contain details for DH configuration, sub-payload configuration and telemetry checks corresponding to configuration name specified in *velc.csv*.

Each row in *velc.csv* corresponds to a given VELC configuration. These csv files shall be prepared from the configuration details provided by payload and DH subsystem teams.

Test Name	Exp Time (ms)	line time no (0.1 ms)	Frame time no (74 ms)	Frame binning Count	No Of Frames
FT1	10	77	0	10	16
FT2	50	382	0	10	16
FT3	4.978	38	0	10	64
FT4	296.512	0	4	5	16
FT5	518.896	0	7	5	16
FT6	1037.792	0	14	1	16
FT7	2001.456	0	27	1	16
FT8	3039.248	0	41	4	16
FT9	5040.704	0	68	1	16
FT10	10081.408	0	136	1	16
FT11	50110.528	0	676	1	8
FT12	100221.056	0	1352	2	8
FT13	10	382	0	10	16
FT14	50	382	0	7	16
FTA	222.384	0	3	10	8
FTB	2000.7	0	27	1	279
FTC	2000.7	0	27	1	438
FTD	2000.7	0	27	1	48
FTE	100221.056	0	1352	1	16
FTF	100221.056	0	1352	1	16
FTG	4.978	38	0	32	16
FTH	148.256	0	2	2	16

Figure 6 Input to VELC Procedure Generator: cnt-dh-cfg.csv

3.2. *Procedure Generation Methodology*

For each row in *velc.csv*, our software checks for the corresponding sub-payload configuration name for Continuum, SP1, SP2 and IR and compression selection status. For each sub-payload configuration name identified, the software shall look for mapping in corresponding sub-payload csv file. For instance, consider *VELC-10* configuration in Fig. 5 with Continuum configuration=*1*. Our procedure generator shall look for *FT-1* in *cnt-dfu-cfg.csv* for corresponding DH configuration and *cnt-pl-cfg.csv* for payload configuration, shown in Fig. 6 and Fig. 7. DH configuration details includes Exposure Time, Line Time No, Frame Time No, Frame Binning Count, No of Frames and few more parameters not shown in figure due to space constraints. Based on these parameters, corresponding DH configuration commands shall be inserted into the procedure. Similarly, commands shall be inserted for SP1, Sp2 and IR as well. Payload configuration includes 32 words to be uplinked for a selected configuration which shall be inserted by the software.

3.2.1. *DH Configuration Commands for Visible Chains*

A batch of 8 configuration commands are to be sent to DH, for chain1 and chain2 configuration of Continuum, SP1 and SP2. Details of these configuration commands to be sent for Continuum are enumerated below for chain1. A similar set of commands are to be sent for chain1 and chain2

```
frameTimeNo : from csv

totalPixels : from csv

pixelsPerRow : from csv

if (frameTimeNo == 0){
        timePeriod = frameBinningCount *
146.4192 * 50;
} else {
        timePeriod = frameBinningCount *
        ((frameTimeNo* 74.128) + 72.2912) *
        50;
}

dataRate = (totalPixels * 16.0 *
1000/timePeriod);
ratioComponent = dataRate * (2592.0 /
```

Algorithm 1 : Additional Computation for each Visible Chain

	word1	word2	word3	word4	word5	word6	word7
FT1	AAAA	EC20	1000	0	004D	000A	0
FT2	AAAA	D820	1000	0	017E	000A	0
FT3	AAAA	CC00	1000	0	26	000A	0
FT4	AAAA	8560	1000	4	0	5	0
FT5	AAAA	8A80	1000	7	0	5	0
FT6	AAAA	E400	1000	000E	0	1	0
FT7	AAAA	EC20	1000	001B	0	1	0
FT8	AAAA	8160	1000	29	0	4	0
FT9	AAAA	D400	1000	44	0	1	0
FT10	AAAA	C3C0	1000	88	0	1	0
FT11	AAAA	C680	1000	02A4	0	1	0
FT12	AAAA	A000	1000	548	0	2	0
FT13	AAAA	8C00	1000	0	017E	000A	0
FT14	AAAA	8C00	1000	0	017E	7	0
FTA	AAAA	8020	1000	3	0	000A	0
FTB	AAAA	CE80	1000	001B	0	1	0
FTC	AAAA	CFE0	1000	001B	0	1	0

Figure 7 Input to VELC Procedure Generator: cnt-pl-cfg.csv

configuration of all three visible channels. It is to be specifically noted that value is a Hexadecimal number. Few variables used are directly available in the input csv files while few are derived based on Algorithm. 1:

- Mnemonic: DH-VLCntCh1Cfg1
  Value: First 2 nibbles of (*totalPixels*+32)
- Mnemonic: DH-VLCntCh1Cfg2

Value: Last 4 nibbles of (*totalPixels*+32)

- Mnemonic: DH-VLCntCh1Cfg3
  Value: 4 nibbles of (*pixelsPerRow*)
- Mnemonic: DH-VLCntCh1Cfg4
  Value if *alternate gain=true*:
  4 nibbles of (*rowsPerFrame*)
  Value if *alternate gain=false*:
  (rowsPerFrame/2) + 4096
- Mnemonic: DH-VLCntCh1Cfg5/6
  Value: Fixed to 0
- Mnemonic: DH-VLCntCh1Cfg7
  Value: First 4 nibbles of *subpayloadRatio* for Continuum as per computations shown in Algorithm. 1.
- Mnemonic: DH-VLCntCh1Cfg8
  Value: Last 4 nibbles of *subpayloadRatio* for Continuum as per computations shown in Algorithm. 1.

Refer Alogorithm.1 for additional computations done for visible channels including CNT, SP1 and SP2. These computations shall be done for each of the visible chain sub-payloads, separately for chain 1 and chain 2.

3.2.2.DFU Configuration Commands for IR Chain

A batch of 6 configuration commands are to be sent to DH, for IR configuration. Details of these configuration commands are enumerated below.

- Mnemonic: DH-VL-IR-Cfg1
  Value if *compression=true*:
  rowsPerFrame + 4096 + 16
  Value if *compression=false*:
  rowsPerFrame + 16
- Mnemonic: DH-VL-IR-Cfg2
  Value: 4 nibbles of (*rowsPerFrame* + 32768)
- Mnemonic: DH-VL-IR-Cfg3
  Value: 4 nibbles of (*pixelsPerRow*)
- Mnemonic: DH-VLCntCh1Cfg [4/5/6]
  Value: Fixed to 0
- SDRAM Read Window Command
  Mnemonic: DH-M1BWcfgChCmp
  Value: 4 nibbles of *sramReadCmdVal* as per additional computation in Algorithm. 2.

3.3. *Procedure Structure for DH Configuration*

```
totalPixels : from csv

frameTime : from csv

e = (((frameTime - 53) / 50) + 1);

period = derived from e based on lookup table

dataRate = (totalPixels * 12 / period) *
1000;

if (visibleCompression.equals("Include"))
{
  sramReadCmdVal =
       0x8000 + 4096 +
      (int) Math.floor((256 - dataRate) *
      (312.0 /256));
}else{
  sramReadCmdVal =
      0x8000 + (int) Math.floor((256 -
      dataRate) * (312.0/256));
}
```

Algorithm 2 : Addition Computation for IR Chain

The procedure operation sequence for Aditya-L1 VELC DH Configuration is as follows and a part of the same is shown in Fig. 8:

a. Procedure Title and Description.
b. Acquisition Disable for VELC.
c. DESER Disable.
d. DH-VELC Reset Commands.
e. VELC Bandwidth configuration 1.
f. VELC DESER Enable.
g. Strip ID selection.
h. Specific Bandwidth Configuration settings.
i. CNT, SP1, SP2 configuration 1 to 8 for chain 1 and chain 2 if applicable, followed by IR configuration 1 to 6, if applicable.
j. DH Operation enable for VELC.

k. DH VELC Acquisition enable based on sub payloads applicable for the given configuration.
l. DH Telemetry checks for the above settings.

```
9836.20      SENDLIST       DH-VLCntCh1Cfg1 56;
                            DH-VLCntCh1Cfg2 b22a;
                            DH-VLCntCh1Cfg3 0a20;
                            DH-VLCntCh1Cfg4 1448;
                            DH-VLCntCh1Cfg5 0000;
                            DH-VLCntCh1Cfg6 0000;
                            DH-VLCntCh1Cfg7 10;
                            DH-VLCntCh1Cfg8 0002;
                            DH-VLCntCh2Cfg1 56;
                            DH-VLCntCh2Cfg2 b22a;
                            DH-VLCntCh2Cfg3 0a20;
                            DH-VLCntCh2Cfg4 1448;
                            DH-VLCntCh2Cfg5 0000;
                            DH-VLCntCh2Cfg6 0000;
                            DH-VLCntCh2Cfg7 10;
                            DH-VLCntCh2Cfg8 0002;
                            DH-VLSP1Ch1Cfg1 16;
                            DH-VLSP1Ch1Cfg2 7a2a;
                            DH-VLSP1Ch1Cfg3 02a0;
                            DH-VLSP1Ch1Cfg4 1448;
                            DH-VLSP1Ch1Cfg5 0000;
                            DH-VLSP1Ch1Cfg6 0000;
                            DH-VLSP1Ch1Cfg7 20;
                            DH-VLSP1Ch1Cfg8 0001;
                            DH-VLSP1Ch2Cfg1 16;
                            DH-VLSP1Ch2Cfg2 7a2a;
                            DH-VLSP1Ch2Cfg3 02a0;
                            DH-VLSP1Ch2Cfg4 1448;
                            DH-VLSP1Ch2Cfg5 0000;
                            DH-VLSP1Ch2Cfg6 0000;
                            DH-VLSP1Ch2Cfg7 20;
                            DH-VLSP1Ch2Cfg8 0001

9836.30      SENDLIST       DH-VLSP2Ch1Cfg1 16;
                            DH-VLSP2Ch1Cfg2 7a2a;
                            DH-VLSP2Ch1Cfg3 02a0;
                            DH-VLSP2Ch1Cfg4 1448;
                            DH-VLSP2Ch1Cfg5 0000;
                            DH-VLSP2Ch1Cfg6 0000;
                            DH-VLSP2Ch1Cfg7 30;
                            DH-VLSP2Ch1Cfg8 0001;
                            DH-VLSP2Ch2Cfg1 16;
                            DH-VLSP2Ch2Cfg2 7a2a;
                            DH-VLSP2Ch2Cfg3 02a0;
                            DH-VLSP2Ch2Cfg4 1448;
                            DH-VLSP2Ch2Cfg5 0000;
                            DH-VLSP2Ch2Cfg6 0000;
                            DH-VLSP2Ch2Cfg7 30;
                            DH-VLSP2Ch2Cfg8 0001;
                            DH-VL-IR-Cfg1  1014;
                            DH-VL-IR-Cfg2  8200;
                            DH-VL-IR-Cfg3  00a0;
                            DH-VL-IR-Cfg4  0000;
                            DH-VL-IR-Cfg5  0000;
                            DH-VL-IR-Cfg6  0000

9836.40      SEND           DH-VL-M1-OpEna;
                            DH-VL-M2-OpEna
```

Figure 8 Generated DH Configuration Procedure

3.4. *Procedure Structure for Payload Configuration*

The procedure operation sequence for Aditya-L1 VELC Payload Configuration is as follows and is shown in Fig. 9:

a. Procedure Title and Description.
b. Switch to bulk mode of commanding.
c. *SENDLIST* with remote uplink of 32 words.
d. TM checks of all words uplinked above.

3.5. *Procedure Structure for total VELC Configuration*

The procedure structure of total VELC configuration is a combination DH configuration for VELC and sub-payload configuration as follows:

a. Procedure Title and Description.
b. VELC DH configuration as per 3.3.
c. VELC DH configuration as per 3.4.

4. SUIT Procedure Generator

The SUIT payload generator generates IST procedures for SUIT payload testing from input program files provided by subsystem team. These program files are not as per the IST procedure format for ground checkout testing. Hence, these files are taken up by the software and converted to *SENDLIST* blocks with *SUIT-DATA-COMMANDS* as supported by ACSS, with data portion extracted from the input program sequence.

```
!************************************************************!
!                 PROJECT: Aditya-L1                         !
!************************************************************!
!                FILE NAME: cnt-ft7.tst                      !
! Configuration: FT7
!************************************************************!
 5046.10      TESTNAME       cnt-ft7.tst


 5046.10      SELECT CMDMODE bulk1553

 5046.20      SENDLIST       Data-Word 0000;
                             Data-Word 0001;
                             Data-Word 0001;
                             Data-Word C880;
                             Data-Word AAAA;
                             Data-Word EC20;
                             Data-Word 1000;
                             Data-Word 001B;
                             Data-Word 0000;
                             Data-Word 0001;
                             Data-Word 0000;
                             Data-Word 0000;
                             Data-Word 0000;
                             Data-Word 0000;
                             Data-Word 0000;
                             Data-Word 0000;
                             Data-Word 0447;
                             Data-Word 0A1F;
                             Data-Word 0001;
                             Data-Word 0000;
                             Data-Word 0011;
                             Data-Word 0000;
                             Data-Word 0000;
                             Data-Word 0000;
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                             Data-Word 0000;
                             Data-Word 0000;
                             Data-Word 0000
```

Figure 9 Generated Payload Configuration Procedure

5. Performance and Generation Time

In the conventional procedure preparation methodology, each procedure would be prepared manually by checking the Payload and DFU configuration details. As per our calculation this process would have taken 2 weeks' time for Aditya-L1 payload IST procedures.

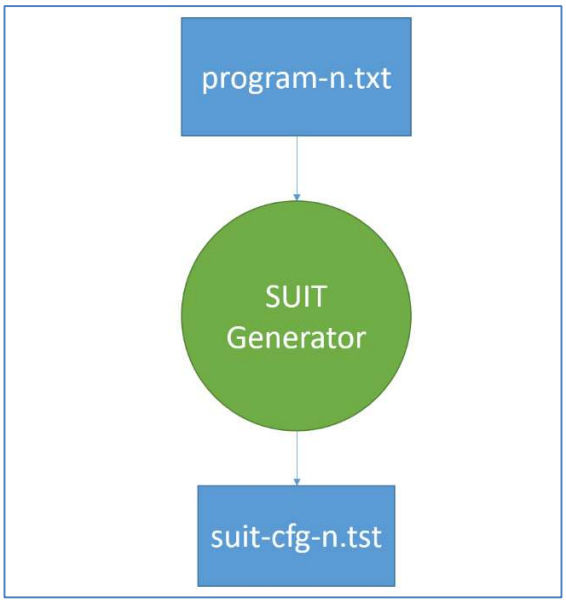

Figure 10 SUIT Procedure Generator

The procedure generation time with the automated procedure generator is the sum of *csv* preparation time from the available payload and DFU configuration details and generation time from the software. The input csv preparation shall be done once at beginning of the project, from details provided by subsystem teams which took around 1 week. Subsequently, the procedures for VELC, SUIT and All-Payloads were generated in less than 10 seconds using the software. As evident the procedure preparation time with automated generator took only half the time as compared to the conventional procedure generation methodology. This essentially means that the procedure preparation delays before and during IST were drastically reduced.

Further, updates in configuration for around 20 plus configurations were carried out throughout the period of Aditya-L1 IST. We could accommodate these changes in *csv* and generated updated procedure within 10 seconds.

6. Conclusion

The automated procedure generator as described above gave 100% improvement in the initial procedure generation time. While any updates in procdure during the course of IST were carried out instantly with the procedure generator which drastically reduced delays during IST and thus reducing spill overs in test schedule. We are further working on generic automated procedure generators which can be used in any spacecraft project with minor modifications.

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