CCSDS SLS-SLP WG Meeting Minutes

Draft Spring 2021 Virtual Meeting

May 17-18, 2021

7 AM – 9 AM PDT

1. Attendees: Gian Paolo Calzolari (ESA), Greg Kazz (NASA), Marco Rovatti (ESA), Matt Cosby (UKSA), Christian Stangle (DLR), Amanuel Geda (DLR), Victor Sank (NASA), Gilles Moury (CNES), Brent Andres (NASA), John Pietrus (NASA), Lee Pitts (NASA)
2. The SLP WG meet over these two days focused exclusively to disposition agency RIDs against the pink sheet review of AOS, TM, TC, and USLP SDLPs. The detailed disposition of these RIDs are to be found on the SLP WG CWE site at: <https://cwe.ccsds.org/sls/docs/Forms/AllItems.aspx?RootFolder=%2Fsls%2Fdocs%2FSLS%2DSLP%2FMeeting%20Materials%2F2021%2FSpring&View=%7BAE8FB44C%2DE80A%2D42CF%2D8558%2DFB495ABB675F%7D&>
3. All RIDs were resolved at the meeting. Specifically, those RIDs submitted by agency are:

**USLP RIDs (21 Total)**

* 1. 20from NASA
     1. 15 John Pietrus concerning USLP Blue Book
     2. 1 Ken Andrews (identical in AOS, TM) for OID Frame Randomization procedure
     3. 3 David Ni – USLP Blue Book
     4. 1 Craig Biggerstaff – truncated transfer frames using SDLS Security Association
  2. 1 from ESA – Holgar Dreihahn – USLP’s use of Variable Length frames on the downlink affecting Cross Support Services.

**TC RIDs (1)**

NASA RID in Word file concerning Update to Figure 6-3 (collaboration between SLP & SDLS WGs) in TC (232.0-B), addition of send and receive side tables describing figure 6-3 as well as inclusion of Frame Initialization and Finalization Procedures with respect to Figure 6-3.

Note: SLP WG consensus was achieved that the nature of these changes to 232.0-B do not require a separate agency review of this material, since they are clarifications of these existing sections in the blue book. Indeed, these clarifications provide a finer level of detail such as e.g., the fact that the COP passes the modified Frame Sequence Count to the TC SDLP in the Frame Finalization Procedure. An updated draft of the TC Space Data Link protocol blue book containing all of the above listed changes will be produced and provided to both the SLP and SDLP WGs for final review before publication.

During the meeting, it was also confirmed that both the Frame Status Report (FSR) provided by SDLS protocol as well as the CLCW generated by the COP-1 are optional features which is correctly captured by the new end-to-end figure replacing figure 6-3 in 232.0. However, it is also true that it is better to utilize these reporting mechanisms than to have missions generate their own ad-hoc reporting mechanisms.

**AOS RIDs (1)**

* 1. 1 from NASA – (Ken Andrews) – same as above

**TM RIDs (3)**

* 1. 1 from NASA (Ken Andrews) – same as above
  2. 2 from ESA (Felix Flange) – remove some ambiguity in the text concerning TFVN

1. Discussion and follow up associated with OID Frame Randomization pattern generated by newly proposed LFSR procedure.

The SLP WG concluded to include both the Fibonacci as well as the Galois versions of the LFSR figures provided by the C&S WG. A follow up with Ken Andrews of the C&S WG occurred after the meeting, who answered our SLP WG questions after the meeting, since he couldn’t attend. That discussion follows :

[Greg]The SLP WG decided to put both of your diagrams into a new non-normative annex in USLP, TM, and AOS.  
The text in the normative part of the link layer books will state:  
   
The TFDZ of an OID Transfer Frame shall be generated by use of a 32-cell Linear Feedback Shift Register (LFSR) with polynomial 1 + D + D2 + D22 +D32, see Annex X.

[Ken]There should be some normative statement about the initialization sequence somewhere.  One option would be to keep the normative statement from the pink sheets that says, “The LFSR shall be initialized at device start-up with an all-one seed and shall not be restarted”, even though it’s ambiguous, and then hope that readers look at Annex X to see what it means.  Another option would be to put the first figure in the normative text (even though CCSDS doesn’t standardize implementations), and then include a note that readers could look at Annex X for an alternative implementation.

[Greg] I’ve added the following normative statement to AOS, TM, and USLP draft blue books in response to Ken’s concern as follows:

4.1.4.1.10 The TFDZ of an OID Transfer Frame shall be generated by use of a 32-cell Linear Feedback Shift Register (LFSR) with polynomial 1 + D + D2 + D22 +D32.

NOTE – See Annex H which contain diagrams describing the LFSR.

4.1.4.1.11 The LFSR shall be initialized at device start-up with an all-one seed and shall not be restarted. This requirement pertains exclusively to figure H-1 in Annex H.

NOTE – The first 10 bytes of the OID data pattern, in hexadecimal, are: FF FF FF FF 6D B6 D8 61 45 1F ....

[Gian Paolo] Why does the initialization data differ from one figure to the other one?

[Ken] That was the whole point in showing both figures.  The two different implementations simply have different mappings between the initialization data and the output sequence.  If you give them the same initial random number seed, they’ll generate different outputs.  That’s why the normative text in the Pink Sheets is inadequate.  It turns out that if you give these two circuits the different initial values that I showed, they’ll generate the same output.  You could convince yourself of that by computing the first few output values by hand with pencil and paper.

[Greg] The ‘1’ in the figures are misleading to some WG members, please replace ‘1’ with D sub zero i.e., D0 in the figures.

[Ken] Done; see that attached figures.  I also replaced D with D^1.  These make the correspondence to the generator polynomial less clear, but I understand the concern expressed by the working group.  

Do you concur with these changes ?

[Ken] Sure; whatever changes you choose are fine by me, so long as the initialization sequence is specified in a reasonably normative way somewhere.

And now for Victor's issues…

[Victor] For implementing I understand that the Galois shift register is sometimes preferred over the Fibonacci form.

[Ken] Personally, I prefer the Fibonacci form when writing in Verilog for an FPGA, and the Galois form when writing C-language software for a microprocessor.  With the Fibonacci form, all the computational logic usually fits in a single 4- or 5-input combinatorial logic gate (or LUT in Xilinx terminology), while the Galois form puts the logic in a single integer exclusive-or command.  Both of those are for bit-serial implementations; since protocols tend to operate on entire bytes at a time, I often choose to implement these using a matrix-multiplication implementation that’s entirely different yet.  In short, there are good reasons why CCSDS isn’t in the business of specifying implementations.

[Victor] However, for understanding and for setting an initial seed, Fibonacci has tremendous advantage because WYSIWYG, if you remember that phrase from the early Apple computers, what you see is what you get.

[Ken] Yea, verily.  To a control-theorist, the Fibonacci choice is known as the “controllable canonical form”, and the Galois choice is known as the “observable canonical form”, but those guys use real numbers instead of binary bits.  Just to keep one on one’s toes, LFSRs work with larger finite fields too, so one can admire the Reed-Solomon encoder in Figure 5-1 of the “TM Coding” Green book, and consider how to redraw that in Fibonacci form!

[Victor] You might also remember that we had a recent go-around in the code and synch WG about how to show these shift registers and we (GSFC) were recommending Fibonacci with particular labeling of the cells so that the polynomial is directly related to the cells that are tapped.  Yes, I realize that this can also be done for the Galois form.  Another value of the Fibonacci with the particular cell numbering is that it is what MatLab uses.  So when people are doing simulations, no conversion is needed.

[Ken] Yeah, I know that Matlab has conventions, but I can never remember which it uses, since I usually end up writing my own encoding and decoding functions.  I’m not at all sure that Matlab is consistent across its various toolboxes.  Matlab also numbers vectors from 1 instead of 0, so there are endless details to watch.

[Victor]              As you might remember there is an ambiguity between the associated polynomial and the shift register labeling.  A particular pattern can be generated in one direction or the reverse.

[Ken] I’m very much aware of this.  In fact, my understanding is that the JPL Electra radio got this backwards, so it’s non-compliant with the CCSDS standards.  A few coding people write their polynomials using the letter D for delay, in which case there’s no ambiguity.  Control people use the letter z, but interestingly, 1/z is a delay, so the polynomials are reversed.  Most coding people use the letter x, and usually x is the same as z (and the opposite of D), but I don’t know if this is always true.  I didn’t dig for the history to see why Greg’s polynomial uses the letter D, but he probably got that from me at one time, for exactly this reason.

[Victor] We had a particular proposal and it turned out that MatLab used the same convention.     Our proposal was discarded since it would be too much editing to get all the books to follow the same convention, and maybe other reasons.

[Ken] I don’t think your proposal was discarded; it’s just that nobody signed up to do all the work required to pursue the project.  Sorry, but I’m not signing up right now either.  It would be a good project.  I hope that these figures capture the best attributes of each of the different drawings, but if not, I’d welcome improvements.

[Victor] But in any case, seems better from an understanding point of view to use Fibonacci.

[Ken ] Agreed.

1. Current Status of Draft SLS Glossary of Terms Magenta book – given the additional work on USLP, this Project’s status is the same. There exists a list of terms distributed to the SLP WG which contains all of the multiple possibilities associated with the key terms for the SLS area. Next step is to narrow the list down to the chosen terms given all the potential alternatives (note – some terms are clear cut and have only one option, others have multiple) and once completed, provide this recommendation to all of SLS area, so that consensus can be achieved at the area level (involving telecoms and joint meetings).
2. Current Status of SPP/EPP Green Book – No further progress has been made here due to the other topics above which have taken priority. A draft SPP GB does exist but there was never an Encapsulation Service GB, so a combined SPP/EPP will take up to two additional meeting cycles to complete.
3. Resolutions agreed at this meeting are:

* Publish Issue 2 of CCSDS 732.1-B USLP
* Publish Issue 4 of CCSDS 232.0-B TC SDLP
* Publish Issue 3 of CCSDS 132.0-B TM SDLP
* Publish Issue 4 for CCSDS 732.0-B AOS SDLP

This meeting will be the last one at which Gian Paolo Calzolari will be our SLS Area director. The SLP WG thanks Gian Paolo for his outstanding support and due diligence to our WG throughout the many years of his leadership in CCSDS. We wish him and his family the best of luck as he transitions to an enhanced form of freedom and decreased entropy. Most likely, Mr. Ignacio Aguilar Sanchez will serve as the next SLS Area Director. Ignacio joined ESA in 1991 in the Directorate of Technology (D/TEC) and has developed a unique expertise in the area of Space Communications and Space Link Protocols.

1. Next meetings – the Fall 2021 meetings are scheduled to be held in Toulouse, FR from Oct. 18 to Oct. 22, 2021. Please see <https://public.ccsds.org/meetings/default.aspx> for more details as they appear. However, due to the COVID-19 pandemic, that may change. Please stay tuned to the CCSDS website for updates.

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