FOREWORD

I found this document very hard to read. One problem is surely the fact that stressing genericity (oriented to non CCSDS compliant users) confuses the target of the *normal* use cases and hides reality.

Despite all my efforts, the analysis that follows is clearly partial but sufficient to declare a strong need for improvement.

1. **Section 1.1**
   Change From: The SL-PDUs can be in the form of CCSDS Transfer Frames, partially encoded Transfer Frames, CCSDS Channel Access Data Units (CADUs), or Mission-unique CADUs.

   TO: The SL-PDUs can be in the form of CCSDS Transfer Frames **or**, partially encoded Transfer Frames, CCSDS Channel Access Data Units (CADUs), or Mission-unique CADUs.

   The **partially encoded frames** are vaguely (and confusing) addressed in this document (see also comment on section 1.4). Even if we want to show that FF could be able to digest data not properly produced according to CCSDS rules, this should not be addressed as a main feature of the service. I understand that a partially encoded frame can only be delivered with the "data" parameter defined in 5.6.6.1.1 where a NOTE already says that "Nominally, the data parameter contains a CADU or a transfer frame for any CCSDS space data link protocol." The accent here shall be on what is legally expected while tricks should be addressed within the document or e.g. in a dedicated section on how to cheat the Forward Frame Service ☺ .

   The same applies to "Mission-unique CADUs", term that is used only in 1.1.

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2. "Unified transfer frames" do not exist, USLP Transfer Frames do exist.
   I find also very ambitious to state that Forward Frame service is intended to transfer any future space data link protocol Transfer Frame format. This can be an aim but cannot be assured nowadays. The same can be said for CADUs. Moreover I haven't seen any complete check on frame formats. Use of the verb transmit instead of transfer is recommended as the second verb is often used to mean the confirmed arrival onboard.
   Question 1: Is it stated somewhere which of those 3 protocol can be supported concurrently?
   Question 2: Is USLP cited consistently? I have the impression that USLP is mentioned often but not for sall the cases where it could be appropriate.

   Change FROM: The Forward Frame service is intended to transfer Transfer Frames formatted in accordance with the telecommand (TC), Advanced Orbiting System (AOS), and Unified transfer frames defined in references [J12], [J13], and [J14], respectively, and any future space data link protocol Transfer Frame formats. The Forward Frame service is intended to transfer CADUs formatted in accordance with reference [J15] and

any future CCSDS CADU formats.

TO: The Forward Frame service is intended to <mark>tranmit</mark> Transfer Frames <mark>produced by the following Space Data Link protocols:</mark>
- <mark>Telecommand (TC),</mark>
- <mark>Advanced Orbiting System (AOS), and</mark>
- <mark>Unified Space Data Link Protocol (USLP)</mark>

defined in references [J12], [J13], and [J14], respectively.
The Forward Frame service is <mark>also</mark> intended to transfer CADUs formatted in accordance with reference [J15<mark>]</mark>.
<mark>Because of highly flexible definition of the service, Forward Frames is expected to be able to accommodate with limited or no effort future space data link protocol Transfer Frame formats and future CCSDS CADU formats.</mark>

3. General on the "Mission-unique" terminology
I found the following use for this terminology:
- Mission-unique CADUs
- Mission-unique encoding functions & Mission-unique block coding scheme
- mission-unique link protocol data units
- Mission-unique frames

I think it shall be replaced by "non CCSDS compliant". Again, The accent here shall be on what is legally expected while tricks should be addressed within the document or e.g. in a dedicated section on how to cheat the Forward Frame Service ☺ .
The same apply to the terminology "proprietary space link protocols" that should actually read "non-CCSDS space link protocols"

4. Section 1.1 NOTE 1

It is false that "However, both the AOS protocol (reference [J13]) and Unified Space Data Link Protocol (USLP) (in synchronous mode—see reference [J14]) use the CADU structure on both forward and return links.".
USLP https://public.ccsds.org/polls/Attachments/CESG-P-2018-09-001/732x1b0_CESG_Approval.pdf never mention the term CADU and never mentions the term synchronous mode.
AOS https://public.ccsds.org/Pubs/732x0b3e1.pdf never mention the term CADU.
The CADU is formally defined in https://public.ccsds.org/Pubs/131x0b3e1.pdf section 9.1.2 CHANNEL ACCESS DATA UNIT.
Delete this sentence.

5. Section 1.1 NOTE 1

Change from:
At the time of publication of this Recommended Standard, CCSDS is in the process of specifying the synchronization and channel encoding functions to be used on synchronous forward links, which will include the CADU format. Future versions of this Recommended Standard will reference that CCSDS Recommended Standard as the specification of the CADU, as appropriate.
TO:

At the time of publication of this ~~draft~~ Recommended Standard, CCSDS is in the process of specifying the coding scheme allowed for uplink with TM Coding Schemes ~~synchronization and channel encoding functions to be used on synchronous forward links, which will include the CADU format.~~ ~~Future versions~~ The approved version of this Recommended Standard will reference the appropriate CCSDS Recommended Standard ~~as the specification of the CADU, as appropriate~~.

Please keep in mind that a CADU is a structure that formally ignores which kind of transfer frame is contained. The expectation is that AOS and USLP will be allowed to uplink using TM Coding Schemes but nobody can guarantee the real contents of a CADU (unless tjis is decoded etc. etc.)

6. Section 1.1 NOTE 2

Delete NOTE. Actually the text of this note might be used to enhance the propose addition to section 1.1. A possible formulation is here below.
Because of highly flexible definition of the service, Forward Frames is expected to be able to accommodate with limited or no effort future space data link protocol Transfer Frame formats and future CCSDS CADU formats, however the possible use of the Forward Frame service to handle other transfer frame and CADU formats than those specifically referenced may require the implementation of new or different synchronization and coding schemes in the production functions that underlie the Forward Frame service.

7. Section 1.1 NOTE 3 forward space data link protocol

Nobody has defined any "forward space data link protocol". Delete the word forward in the first sentence of Note 3. Otherwise add the term as appropriate to section 1.6.

8. Section 1.1 NOTE 3 GVCID

Replace "global Virtual Channel (VC) identification information" with the correct referring to GVCID.

9. Section 1.1 paragraph after NOTES

I found this paragraph confusing. Actually, I would only use the starting part of this paragraph together with the next paragraph to state:

When used to carry Transfer Frames, several instances of the Forward Frame service can exist and each service instance carries the frames from one Virtual Channel (VC) (see references [J12]–[J14]). Conversely when used to carry CADUs, the forward space link physical channel is dedicated to a single instance of the Forward Frame service.

Question: Do you want to remark that there could be also VC sources that concurrently with the Forward Frame service instances can fed the Forward TC VC Multiplexing FR or the Forward AOS VC Multiplexing FR?

I also find irrelevant (and confusing) talking about the possible contents of the transfer frames. The reader of this book does not care about those contents and the 'multiplexed into a single forward space link physical channel' is a feature of Space Data Link protocols. The second paragraph in section 1.3 is more than enough.

It is stated that each FF provider can receive only one VC from the MUE but actually the bit masking mechanism may allow a MUE providing several VCs. I think this should be remarked somewhere in the document.

10. Section 1.3 sequence controlled data processing mode vs. sequence controlled service

Note that TC provides a Sequence-Controlled Service (AD Service) and also USLP - in association with the COP-1 or COP-P - provides a sequence-controlled service. Since Forward Frame also support TC and USLP I think it would be important to remark somewhere that the **sequence controlled data processing mode shall not be confused with the sequence controlled service provided by TC and USLP.** The definition in 1.6.1.5.1.1 could be a good place for such a note.

Moreover, to remark that this mode applies to the data exchange between the Mission User Entity (MUE) and the FF-CSTS Provider I do recommend to change this definition to:

The sequence-controlled data processing mode of the Forward Frame service is applicable to Missions in which the service user needs to put constraints on each SL-PDU regarding (1) the sequence in which the SL-PDU must be received (with respect to the previous SL-PDU) by the service provider and (2) the time window in which the SL-PDU must be submitted to production processing.

11. Section 1.3 last paragraph

The Forward Frame CSTS also enables the use of forward error correction encoding, randomization and automatic insertion of Only Idle Data (OID) frames in the service production process. These features improve the performance of the communications link, creating a more robust forward service to users.

The current statement give the impression that such usage is set and provided by Forward Frame CSTS. Conversely the Service is completely passive with respect to these feature as they are configured by management. Reword the paragraph to (shortly) make clear FF uses those features as set by management. Note that I consider this a very important element that should be better highlighted also in this initial part of the document.

12. Section 1.4 RATIONALE "c"

I am not convinced by the current rationale listed und bullet c. Following the discussion on partially encoded frames this shall be changed to

c) to permit sources ~~of partially encoded transfer frames and~~ CADUs to ~~bypass some or all synchronization and coding transformations and to~~ be transmitted on a forward space link physical channel.

As mentioned the fact that this access can be used to "cheat" the Forward Frame Service for non CCSDS data should be confined to a dedicated section/note.

13. Section 1.4 NOTE on partially encoded transfer frame

The last sentence of the NOTE states: (See I2.4 and I3.4 for discussion of partially encoded Telecommand transfer frames and AOS transfer frames, respectively.)
However, those two sections do not mention partially encoded frames: I2.4 describes the Functional resource named "Forward TC PLOP, Synchronization and Channel Encoding FR" while I3.4 describes the Functional resource named 'Forward AOS Synchronization, Channel Encoding and OID Generation".
Actually searching the word "partially" (with adobe pdf reader) this is only found (5 times) in section 1 and nowhere else in the document.
Considering also my other comments on the partially encoded frames, I suggest to remove this NOTE.

14. AOS CADU - Section 1.5.1 and more

Section 1.5.1 states: Annex I provides examples of the use of the Forward Frame service and the associated production functions to support the transmission of Telecommand frames, AOS frames, and AOS CADUs.
The AOS CADU does not exist. CADUs do exist as defined in 131.0-B.
If you mean a "CADU generated from an AOS Transfer Frame", say this in this way and keep in mind that
- TM Transfer Frames (and eventually by USLP Transfer Frames) can generate CADUs, and also that
- Contents of CADUs do depend on the applied coding scheme.

Some other occurrences of the term AOS CADU are listed below:
2.5 OPERATIONAL SCENARIOS
2.5.3 AOS CADUs
2.5.3.3
G3.1
I4 CADU CONFIGURATION FOR AOS CADUS

15. Basic remark for AOS CADU

The beginning of Section 2.5.3 seems to limit the uplink of CADUs to the case those CADUs are generated from AOS Transfer frames. Does it make sense considering that the rest of the document generalized and highlight that FF can digest almost everything?
Eventually USLP (close to publication) will also generate CADUs for uplink.
It looks better using the term CADU alone and describe somewhere else in the document that CADUs are expected to be generated only by AOS Transfer Frames (and eventually also by USLP Transfer Frames). In fact, the TM Coding book states what type of frames are expected but that book (as the FF book) is not able to distinguish the type of the provided Transfer Frame since the contents are not checked.
This is another reason for having a simpler definition for CADU with remarks about CADUs contents somewhere in the document.

16. New section before 1.6.1.5 for Terms defined in 131.0-B

Add the definition of CADU referring to 131.0-B.
You may also state that CADUs are generated from TM, AOS [, and USLP] Transfer Frames. For USLP the pending work holds.
Add also
- **ASM** = Attached Sync Marker
- **CSM** = Code Sync Marker   (note that a Code Sync Markers function is mentioned in I3.4, but Sync Code Marker is mentioned twice and it shall be corrected to CSM)

17.   1.6.1.5 Additional Definitions

Additional in which sense? Should this section refer to terms defined in this document and move any other terms defined elsewhere to dedicated subsections?

18.   1.6.1.5.1.1 sequence controlled data processing mode vs. sequence controlled mode

In 1.3 the longer term "sequence controlled data processing mode" is used. Be consistent.

19.   1.6.1.5.1.1 sequence-controlled mode

The sequence-controlled mode allows the service user to place constraints on each SL-PDU regarding (1) the sequence in which the SL-PDU must be received (with respect to the previous SL-PDU) and (2) the time window in which the SL-PDU must be submitted to production processing (e.g., multiplexing with SL-PDUs from other sources of virtual channel frames (such as other FF service instances), encoding, and modulation onto a forward space link carrier signal). The sequence-controlled mode reports back to the service user the provision and processing status of every SL-PDU

I guess you mean the sequence in which the SL-PDU must be received **by the FF Provider**? Multiplexing with SL-PDUs from other sources of virtual channel frames is ruled by the multiplexing scheme and from the statement in brackets it looks as the time window may override the multiplexing scheme. The "e.g." part in brackets is therefore confusing and to be removed. The last sentence looks also irrelevant for the definition of terms section; i.e. change this definition to match the shorter one in 1.3 as follows

The sequence-controlled data processing mode of the Forward Frame service is applicable to Missions in which the service user needs to put constraints on each SL-PDU regarding (1) the sequence in which the SL-PDU must be received (with respect to the previous SL-PDU) by the service provider and (2) the time window in which the SL-PDU must be submitted to production processing.

NOTE – The sequence controlled data processing mode shall not be confused with the sequence controlled service provided by TC and USLP.

20.   1.6.1.5.2 global virtual channel identifier, GVCID

It should be stated that this term is defined in Space Data Link Protocols.
Note that actually this term is not present in the SANA Glossary as it never defined in the appropriate section 1.6 of SDLP's books. However the matter is going to be discussed at the SLP Meeting in Berlin and some TBD referencing should then be included in FF. This would allow moving the term to a section for Terms defined in TM SDLP Book (TBC). I guess we can fix this according to the SLP Meeting in Berlin that will be completed before CMC Poll starts.

21. **Add Transfer Frame to 1.6.1.5**

Add the term Transfer Frame to state that in this document the term Transfer Frame is (generically) used to mean either a TC Transfer Frame or an AOS Transfer or a USLP Transfer Frame.

22. **Add SL-PDU to 1.6.1.5**

Add the term SL-PDU to state that in this document to term SL-PDU may contain either a TC Transfer Frame or a AOS Transfer or a USLP Transfer Frame or a CADU.

23. **Add OID-CADU to 1.6.1.5**

Add this as term locally defined for CADUs that would be generated by an AOS or USL OID Frame according to the encoding scheme currently applied. Section 2.5.3.1 says that "The OID CADU is a CADU formed by applying the same sync and coding transformations to an OID Frame as the user of the Forward Frame service applies before transferring the CADUs" however this is only correct for a uses providing CADUs and not for a user providing frames.

Remark: I think it is clear that generation of OID-CADUs is useless when LDPC with slicing is applied.

24. **Add OID-SMTF to 1.6.1.5**

Add this as term locally defined.

25. **Section 2.1 Nominal Use Cases**

Why AOS Frames are excluded by the sequence-controlled mode (bullet a)? The presence of the VC Counter may require this mode as well.

Why TC Frames are excluded by the buffered mode (bullet a)? A user could be providing type BD frames where the frame sequence number is not used.

I could not find the rationale for the choices expressed in bullets a and b.

26. **2.2.1.1: non-CCSDS standards?**

It is stated: "there are multiple CCSDS Recommended Standards (and in some cases non-CCSDS standards) that specify functions that can be combined to support Forward Frame services to user Missions."

Can you make an example of non-CCSDS standards in this context? If not, remove this part in brackets.

27. **2.2.1.2 Service Production in the CADU Configuration**

Change to: Provider sends its CADUs directly to the Forward Synchronization and Channel Encoding functions that have been set by management appropriately for that space link

The fact that FR's are configured by management should be highlighted whenever possible.

28. **Bit-masking in sections 2.2.2.1.1.1 and 2.2.2.1.2.1**

The concept of bit masking is not formally defined in section 2. In principle it could be either the OR of the data with a mask, or the AND of the data with a mask.

A formal specification of the steps (including bit masking as AND) is present in **4.5.3.1**.

Either add this term to section 1.6.1 (as appropriate) or include forward reference in section 2

29. **2.2.2.1.1.1 NOTE 2**

Please integrate the note to remark that the bit-mask-and-compare approach does not only allow the Forward Frame service to support future CCSDS space data link protocols but can also allow non ccsds protocols or tricks. In other words make clear (not only here) that FF is a quiet "ingenuous" provider and the responsibility of proper settings in on management.

30. **2.2.2.1.1.1 Bullet b**

Replace allowed size range with "allowed size, or size range" OR remark that in some cases the transfer frame shall have fixed length. NOTE that the suggested formulation is already used in bullet c of 2.3.2.

31. **2.3.2 CONFIGURATION CONSISTENCY**

I think that the first statement of this section (Service Management ensures that the configuration of Forward Frame service instances and underlying production are mutually consistent.) is a key feature of

this service and it should be highlighted earlier in the document as it represent a pre requisite to correctly understanding the FF approach etc..

32. 2.3.2 Bullet "a" GVCID
This bullet talks about GVCID but in other places the term virtual channel is used

33. 2.3.2 Bullet "a" domain
This bullet includes a statement about the "domain of the forward space link" but there is no explanation about what this domain is. This terminology should then be explained somewhere but considering that this is the only occurrence of the word "domain" it may be simpler to reword the sentence.
BTW, I guess that the "domain of the forward space link" means a GVCID from either TC or AOS or USLP. Correct?

34. 2.3.2 Second occurrence of Bullet "a" SL-PDU
Change to: "… ignore the header of the SL-PDUs as this will contain CADU"

35. 2.3.2 Second occurrence of Bullet "c" SL-PDU
As the CADU has fixed size, change to: "the Forward Frame Service Provider instance is configured to accept SL-PDUs in the size, or range of sizes, that is appropriate to the forward space link to which that provider instance will provide its SL-PDUs; and"

36. CLCW in Figure 2-5
Somebody wanting to compare this figure with Figure I-2 (fool=wing the indication in the note above the figure to section I2) would notice that the CLCW shown in this figure is not shown in the other one. Should some remarks be added e.g. in Annex I?
Should somewhere be remarked that checks on the (two flags in the) CLCW can be disregarded (e.g. bullet I on page 2-17)?

37. 2.5.2.1 bullet g (Concatenated Code for AOS uplink)
g)   The Forward AOS Synchronization, Channel Encoding, and OID Generation function is configured to perform Reed-Solomon encoding, frame randomization, ASM attachment, OID CADU generation, and convolutional encoding.
WARNING: Note that in the proposal to be discussed in Berlin NASA propose not to include this option (despite currently used for ISS). You may want to add a TBC…..

38. 2.5.2.1 bullet g (Correction for the Note on OID Frames)

NOTE – OID Frame generation is formally defined in the AOS SDLP Recommended Standard (reference [J13]) and the USLP Recommended Standard (reference [J14]) to be a subfunction of the MC Multiplexing function. However, for configurations in which the SDLP functions are bypassed (as in the case of the CADU configuration—see 2.5.3 and I4), OID data units must be generated as part of channel synchronization. For consistency across the various types of AOS configurations and simplification of the Service Management configuration of those configurations, all OID data are generated and interleaved into the forward link in the form of OID data units (e.g., OID CADUs) even when an MC Multiplexing function is present in the configuration. It should be noted that the net effect on the space link is the same as if the OID data had been inserted at the frame level, interoperability in accordance with CCSDS SDLP and Synchronization and Chanel Coding standards is maintained.

The note contains a number of wrong and/or arguable statements:

1. AOS SDLP mandates generation of OID Frames also within Virtual Channel Multiplexing Function (see 4.2.5) when there is only one Master Channel on the Physical Channel. Otherwise, generation of OID Frames is assigned to the Master Channel Multiplexing Function.
2. USLP SDLP conversely always mandates generation of OID Frames to the Master Channel Multiplexing Function.
3. The statement "for configurations in which the SDLP functions are bypassed (as in the case of the CADU configuration—see 2.5.3 and I4), OID data units must be generated as part of channel synchronization" leaves room to ambiguity as this is basically a **design choice** to avoid needing the User to continuously feed the provider. Of course such a design choice can be pursued as the global behavior of the stack produces an output compliant with requirements (as stated by the last sentence in the note).
4. Define formally what a OID-CADU is (see also previous comment on terms in section 1.6).
5. If AOS or USLP fixed length frames are uplinked using LDPC with slicing the generation of OID-CADUs is not possible and OID SMTFs shall be generated (as correctly stated in I3.4) but if the user provides CADUs neither OID-SMTFs not OID-CADUs can be generated and responsibility remains on the user to feed continuously the FF provider.
6. Apply same consideration the (almost?) identical NOTEs in I3.2 and I3.4.

39.   2.5.3 AOS CADUs
1) Rename section title to "CADU".
2) This is another example of the "selective" mentioning of USLP. Add a statement to e.g. say that CADUs can be generated by AOS or USLP Frames but the type of original transfer frame will be invisible to the FF Service Provider.

40.   Figure 2-7: Forward Frame Service Scenario—CADU Configuration—AOS CADUs
Of course, AOS CADU shall be removed by the caption.
I think that the processing applied to CADUs generated by fixed length AOS Frames is identical to the processing applied to CADUs generated by fixed length USLP Frames. However the Functional Resource name is "Forward **AOS** Synchronization, Channel Encoding, and OID Generation FR" with explicit reference to AOS. If you are not planning to create a "Forward **USLP** Synchronization, Channel Encoding, and OID Generation FR", the best would be renaming the FR appropriately and make clear that it can digest the uplink of CADUs generated by both AOS and USLP fixed length Frames. If renaming the FR is awkward , this could be highlighted in the text of the section.

41.   2.5.3.1 bullet g (Concatenated Code for AOS uplink)

WARNING: Note that in the proposal to be discussed in Berlin NASA propose not to include the CONCATENATED option (despite currently used for ISS). You may want to add a TBC.....

42.   4.1 operational philosophy of the sequence controlled mode

It is stated that: The principal operational philosophy of the SCFDP procedure is that the sequencing and timing of the transmission of each frame is of critical importance, and that if each frame cannot be transmitted in-sequence and within its permitted time window then the transmission of frames must be suspended until proper sequencing and timing can be restored.
This means that if a user if queueing AD and BD Frames also the BD Frames would be discarded.
This means that FF would not really support a user mixing AD and BD frames (or that the user in such cases shall act with very precise timing). The document completely ignores that in the uplink that could be sequence controlled service (not mode) and expedited service (for TC but also for USLP). I think this concept shall be clarified and addressed in the document.

43.   4.1.2 for one GCVID

It is stated: The SCFDP procedure is configured to accept the frames for one GVCID.
Should't be more correct to say "frames with one GVCID"?

44.   4.7.4 and 4.7.5

It may be worth to remark (in a NOTE?) that in some cases (e.g. AOS Frame) the two value shall be identical.
The NOTE after 4.7.5 is marked NOTE 2 but there is only that note.

45.   5.7.5 and 5.7.6

It may be worth to remark (in a NOTE?) that in some cases (e.g. AOS Frame) the two value shall be identical.

46.   NOTE to 5.6.6.1.1 data Parameter Refinement

I find quite odd (and confusing) the usage of the terms *Nominally* and *Nominally* in this note.
I think that the note should make clear that "the data parameter is expected to contain either a CADU or a transfer frame **for the supported** CCSDS space data link protocol". In addition, the note should make clear that, due to the very limited checks performed on this parameter it is possible for a user to provide other type of data that would be supported by Forward Frame. A partially encoded frame might be mentioned here clarifying that it would be supported if management sets properly the Functional resources providing Synchronization and Channel Encoding.

47.   G1 GENERAL

This section should highlight (e.g. after second paragraph) the fact that configuration of coding options etc. is performed by service management.

48.   G2.2.1.1

Statement "The Virtual Channel Multiplexing function for each space data link protocol is represented by a corresponding Forward Virtual Channel Multiplexing Functional Resource (FR)." Should be converted to a NOTE.
The note after this clause should reference also USLP (to be published soon)

49.   G2.2.1.2   priority, polling, and First-In-First-Out (FIFO)

There is no formal definition for the three Virtual Channel multiplexing schemes: priority, polling, and First-In-First-Out (FIFO). This shall be added (explicitly or by referencing).

50.   G2.2.2.1

Statement "The Master Channel Multiplexing function for each space data link protocol is represented by a corresponding Forward Master Channel Multiplexing Functional Resource (FR)" should be converted to a NOTE.
The note after this clause should reference also USLP (to be published soon)

51.   G2.2.2.2   priority, polling, and First-In-First-Out (FIFO)

There is no formal definition for the three Virtual Channel multiplexing schemes: priority, polling, and First-In-First-Out (FIFO). This shall be added (explicitly or by referencing).

52.   G2.3.1

Statement "The combined set of (optional) randomization, (optional) encoding, and synchronization functions performed on the forward link physical channel data unit stream to create a physical channel symbol stream in accordance with a particular forward link synchronization and channel coding standard is represented by a corresponding Forward Synchronization and Channel Encoding FR" should be converted to a NOTE.

53.   G2.3.7

States: For each Forward Synchronization and Channel Encoding FR that processes synchronous, fixed-length frames or CADUs, the FR shall generate OID data units when no user-data-bearing frame or CADU is available for radiation.
The terminology of "synchronous frames" is rarely used in other SLS documents and I would avoid it.
It shall also be kept in mind that OID-CADUs for LDPC with slicing (if this coding scheme will be approved for uplink) is not possible.

54.   G2.4.1

Statement "The set of functions performed to modulate the forward link physical channel symbol stream onto the carrier signal in accordance with a single forward link carrier modulation standard is represented by a corresponding Forward Space Link Carrier Transmission FR" should be converted to a NOTE.

55.   G3 is a duplication

Since all the subsection of G3 refer to subsections of G2 *and the document is not short…), would.t be better to have a concise statement and not verbose subsections

56.   I1

Change from AOS CADU to CADU

57.   I2.2   priority, polling, and First-In-First-Out (FIFO)

There is no formal definition for the three multiplexing schemes: priority, polling, and First-In-First-Out (FIFO). This shall be added (explicitly or by referencing).

58.   I2.3 (and general) referring to SDLP Functions

I would change the referring to SDLPs functions to be more evident. The example here below shows bullet a of I2.3:

a) The MC Multiplexing function of the TC Space Data Link Protocol Recommended Standard (reference [J12]), which multiplexes the Transfer Frames from one or more MCs into a single stream of Transfer Frames. This function also implements the three multiplexing schemes required by this Recommended Standard (see G2.2.2): priority, polling, and FIFO.

That I propose to change TO:

a) The "MC Multiplexing function" of [J12]), which multiplexes ….
OR TO

b) The **MC Multiplexing function** of [J12]), which multiplexes ….

59.   I2.3 bullet a

The second sentence states: This function also implements the three multiplexing schemes required by this Recommended Standard. I think there I basic mistake in this sentence as the MC Multiplexing function defined in section 4.3.7 of https://public.ccsds.org/Pubs/232x0b3.pdf does perform multiplexing but no multiplexing scheme is defined and the managed parameter Multiplexing Scheme defined in Table 5-1 is defined to be Mission Specific. Therefore, that sentence (and similar ones) shall be changed to: The Forward TC MC Multiplexing FR supports the three multiplexing schemes required by G2.2.2: priority, polling, and FIFO.

60.   I2.3 bullet b - Repetition Parameter

The definition of the service interface from TC SDLP to the Synchronization and Channel Coding Sublayer includes the ChannelAccess.request service primitive, which has an optional Repetitions parameter. Note that this reflected by the following clause in TC SDLP section 4.3.8 ALL FRAMES GENERATION FUNCTION:

4.3.8.5 In accordance with parameters set by management, the All Frames Generation Function may request the Synchronization and Channel Coding Sublayer to perform systematic retransmissions of a data unit as described in 2.4.2, unless the data unit contains one or more frames carrying service data on the Type-B Service.

How is this Repetition Parameter considered by Forward Frame and related FR's? Should some remarks be added in bullet b?

61.   I2.4 bullet d

Keeping in mind that PLOP-1 is left for legacy missions, should a NOTE mention that/if both PLOPs are supported?

62.   Discrepancy labelling in figures in Annex I

Figures I-1, I-2, and I-3 show boxes labelled "Forward Frame CSTS Provider", Conversely Figures 2-1, 2-2, 2-3, and 2-4 shorten the labeling to "FF-CSTS Provider (X)" and include in bracket the exchanged data (either frame or CADUs. Though not essential, it would be good keeping consistency.

63. Figure I-1 Other VC/MC

This figure shows other VC frames sources and other master channels. I guess these other sources are internal to the location of the FF provider and they do not interface via CSST service. Correct? Worth remarking?

Valid also for similar figures.

### 64. Figure I-1 Random Sequence Generation

I would rename the box from "Random Sequence Generation" to "Randomization" or "Transfer Frame Randomization" this would avoid the strange xor beneath the box and would make more sense for the output being "(Randomized) Transfer Frames" (as shown in figure)

65.　I3 TRANSFER FRAME CONFIGURATION FOR AOS FRAMES

Another selective (missing) citation of USLP.

Considering that the functions shown in USLP Figure 4-6 (attached here below) differ from the functions shown in AOS Figure 4-7 (see https://public.ccsds.org/Pubs/732x0b3e1.pdf) - despite the global behaviour is almost identical - it is possible that the FR's for USLP differ from those for AOS.

If the FR's are different please introduce a section (that could even be just TBD for RED-1 review) for **TRANSFER FRAME CONFIGURATION USLP FRAMES**, otherwise explain in this section how the FR's can handle both AOS and USLP (fixed-length) frames.
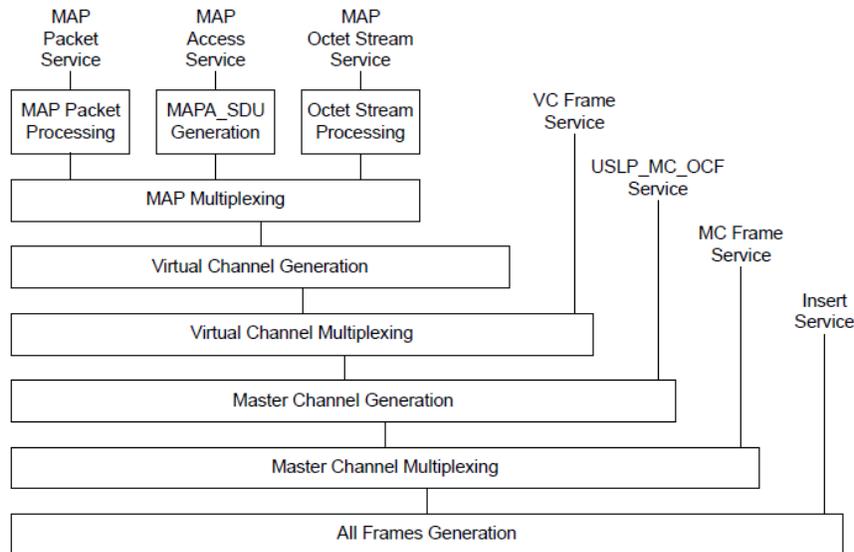
66. NOTE in I3.2 on OID Frames generation

See my comment on **2.5.2.1 bullet g (Correction for the Note on OID Frames)**

AOS mandates OID frames generation to be in a single place. It is your decide choice to put is always at MC level.

67. Figure I-2 Encoding FR

Pending the SLS discussion, the box corresponding to the Encoding FR should be cover by a big TBD to avoid misleading information.

68. Figure I-2 Partially encoded Transfer Frames

The Partially encoded Transfer Frames should be removed from the connection label in this figure.

69. NOTE 2 in I3.3

Change last sentence to: "However, at the time of this writing, there are no plans to implement a cross-supported Insert service provided by Forward Frame."

70. NOTE in I3.4

The note should be reworded to consider the possible uplink of USLP frames.
Moreover the fact that this section is all TBD/TBC should be highlighted better.
The matter of OID-CADUs for Sliced LDPC should also be checked.
[Sorry but I could not analyze this section in detail]

71. I4 CADU CONFIGURATION FOR AOS CADUS

Rename to **I4 CADU CONFIGURATION**

Possibly address also USLP.
[Sorry but I could not analyze this section in detail]

72. Figure I-3 Encoding FR

Pending the SLS discussion, the box corresponding to the Encoding FR should be cover by a big TBD to avoid misleading information.

END COMMENTS