Purpose – For Lunar, the CCSDS plans on defining Prox-1 directives for S-band and maybe K-band. I would like to get your thoughts on my ideas below for expanding these Prox-1 directives. I don’t know all the values for all the parameters yet, but I do know that Lunar operations plans to add the rate 2/3 LDPC k=4096 code and OQPSK and GMSK modulations.

Principles to adhere to for this change:

1. Make the directive set useable for more than just S-band (Lunar) i.e., make it multi-frequency compatible, and backward compatible with the original UHF directives in Prox-1.
2. Use Tables for frequencies and data rates (allows missions more flexibility)
3. Define a channel number index into the frequency tables … same for data rate tables
4. Front load the directive type as bit 0 instead of the last bit in the directive. (Note: we were forced to do it the wrong way by CE Mars 98 design)
5. Use one directive for SET TRANSMITTER PARAMETERS, SET RECEIVER PARAMETERS like Electra does (SET PL\_EXT) but rename it: SET TRANSCEIVER PARAMETERS.
6. Replace SET PL\_Extensions directive with the more generic SET TRANSCEIVER EXTENSIONS for the use case where an agency has orange book parameters that they would like to experiment with before they perhaps are standardized.

These directives are variable length and can accommodate up to 16 octets of directive size. They are to be defined as the new Type 4 Variable length SPDUs in Table 3-6 (p. 3-15) in CCSDS 211.0-B-6.

1. New SET TRANSCEIVER PARAMETERS directive (32 bits):

* Bit 0-3: Directive Type (4 bits) – Provides maximum of 16 directives; value= ‘0000’
* Bit 4: Transceiver Side (1 bit) – Set up the Receiver or the Transmitter
* Bit 5: Frequency Table – 0 = Default; 1 = Extended
* Bit 6-10: Frequency Channel Number – Up to 32 frequency assignments are available per table
* Bit 11: Data Rate Table - 0 = Default; 1 = Extended
* Bit 12-16: Data Rate - Up to 32 data rate assignments are available per table
* Bit 17-19: ModCod – Up to 8 modulation/coding assignments per ModCod table

Coding (accommodates new LDPC rate 2/3 code k=4096, reserved bits)

Carrier Modulation – (accommodates new OQPSK and GMSK)

* Bit 20-21: Bit Data Format – NRZ-L, Bi-Phase-L, …
* Bit 22: Protocol Mode – 0 = Prox-1; 1= No Protocol (Raw mode)
* Bit 23-24: Carrier Suppression – 0 = Suppressed Carrier; 1 = Residual Carrier, reserved bits
* Bit 25: Transceiver Coherency – 0 = Coherent; 1 = Non-coherent
* Bit 26-31: Spares

1. SET CONTROL PARAMETERS directive (16 bits)

* Bit 0-3: Directive Type (4 bits) – Provides maximum of 16 directives; value=’0001’
* Bit 4-9: Time Sample (6 bits) –
* Bit 10-12: Duplex (3 bits) –
* Bit 13: Remote No More Data (1 bit) –
* Bit 14: Token (1 bit) –
* Bit 15: Reserved

1. SET V(R) (COP command) (16 bits)

* Bit 0-3: Directive Type (4 bits) – Provides maximum of 16 directives; value=’0010’
* Bit 4-11: Receiver Frame Sequence Number (8 bits)
* Bit 12-15: Reserved

1. REPORT REQUEST directive (16 bits)

* Bit 0-3: Directive Type (4 bits) – Provides maximum of 16 directives; value=’0011’
* Bit 4-8: Status Report Request Type (5 bits)
* Bit 9-11: Time Tag Report Request Type (3 bits)
* Bit 12: PCID 0: PLCW Request (1 bit)
* Bit 13: PCID 1: PLCW Request (1 bit)
* Bit 14-15: Reserved

1. REPORT SOURCE SPACECRAFT ID directive (32 bits)

* Bit 0-3: Directive Type (4 bits) – Provides maximum of 16 directives; value=’0100’
* Bit 4-19: Source Spacecraft ID – Provides for Version 3 & Version 4 SCID values
* Bit 20-31: Reserved

Directive Types ‘0101’ through ‘1110’ are CCSDS reserved

1. SET TRANSCEIVER EXTENSIONS directive (32 bits)

* Bit 0-3: Directive Type (4 bits) – Provides maximum of 16 directives; value=’1111’
* Bit 4-6: Transceiver ID – Identifies how to parse the rest of the directive bits, by the ID of the first transceiver to define them. Allows for up to 8 distinct transceiver product lines.
* Bit 7-31: Transceiver-specific definition (for future Agency product lines and later compatible spacecraft).

Question (1): Do we need to keep and maintain the specific and unique parameters in the SET PL\_EXTENSIONS Directive for Lunar operations and beyond ?

Question (2): What do you think about the names of these parameters ? Descriptive enough ?

Your thoughts ?

Question (3): Can we simplify the SET TRANSCEIVER PARAMETERS directive? In DVBS2, they use “modcod” as a combination of modulation and coding into a single unique identifier. Thus, a link can be established with three parameters. Do we need the other parameters or not ?

1. Carrier Frequency
2. Symbol Rate
3. ModCod value