## Insertion of Modified MessageID#3 and SDN500 Messages in Line 1 of Frame

### First Line Mapping from the FPIE

Section 4 of reference [1] (JPLAVIRISNG\_SerialFlightTest\_TaskPlan\_full\_130121.docx) describes the FPIE AVIRISng image format from the Camera Link interface.

The first line of each frame coming from the Camera Link includes (Alan Mazer, Software User Manual):

|  |  |  |  |
| --- | --- | --- | --- |
| **Byte offset** | **Width (Bytes)** | **Field** | **Description** |
| 0 | 2 | FPIE timestamp | Number of 100us intervals since the falling edge of the last GPS 1 second time pulse (14 bits) |
| 2 | 318 | Redundant FPIE timestamps |  |
| 320 | 2 | Frame Count | Increments by 1 each frame, 14 bits |
| 322 | 318 | Redundant frame counts |  |
| 640 | 1 | OBC position (ASCII) | Last character sent to the FPIE, low byte has the full character; high byte has the character with the upper 2 bits missing.  ‘B’ = first dark frame  ‘C’=science  ‘D’=second dark frame  ‘E’=medium brightness  ‘F’=high brightness  ‘G’=laser  (see NGIS Software User Manual v5) |
| 641 | 1 | OBC position (BINARY) | ‘2’ = first dark frame  ‘3’=science  ‘4’=second dark frame  ‘5’=medium brightness  ‘6’=high brightness  ‘7’=laser  (see NGIS Software User Manual v5) |
| 642 | 638 | Redundant OBC positions |  |

### First Line Mapping after FPGA processing

After the integration with

1. the free-running counter captured at each frame valid: 4 Bytes (see section 4.1 of reference [1])
2. the modified MessageID#3: 24 Bytes (see section 4.2.3 of reference [1])
3. GPS Navigation Messages: 5414Bytes (see section of this document) will be decomposed into around 9 Frames which will carry a maximum of 592 bytes of GPS data.

the first line of each frame has 640\*2 = 1280 Bytes will be:

Address of frame:

1frame: hx000

2 frame: (after 640\*481\*2 Bytes = 615680): hx96500

3frame: hx12CA00

This table describes what is written in the frame inside the cust\_apps of alpha\_data SDK software. It does not describe what is in the DDR memory to be transferred to the host. The alpha-data SDK firmware may reverse the Bytes order from big endian (MSB) to little endian (LSB).

|  |  |  |  |
| --- | --- | --- | --- |
| **Byte offset** | **Width (Bytes)** | **Field** | **Description** |
| 0  (hx000) | 2 | 100kHz Free-running counter timestamp (MSW) | Value of the 100kHz free-running counter at leading edge of Frame Valid used to synchronize Frame Valid (and INT) with pps @ 1Hz(16bits, MSW ) (16bits are in little endian, LSB first) |
| 2  (hx002) | 2 | 100kHz Free-running counter timestamp (LSW) | Value of the 100kHz free-running counter at leading edge of Frame Valid used to synchronize Frame Valid (and INT) with pps @ 1Hz(16bits, LSW ) (16bits are in little endian, LSB first) |
| 4  (hx004) | 2 | FPIE timestamp | Number of 100us intervals since the falling edge of the last GPS 1 second time pulse (14 bits) (16bits are in little endian, LSB first) |
| 6  (hx006) | 314 | Redundant FPIE timestamps |  |
| 320  (hx140) | 2 | Frame Count | Increments by 1 each frame, 14 bits (16bits are in little endian, LSB first) |
| 322  (hx142) | 318 | Redundant Frame Counts |  |
| 640  (hx280) | 1 | OBC position (ASCII) | Last character sent to the FPIE, low byte has the full character; high byte has the character with the upper 2 bits missing.  ‘B’ = first dark frame  ‘C’=science  ‘D’=second dark frame  ‘E’=medium brightness  ‘F’=high brightness  ‘G’=laser  (see NGIS Software User Manual v5) |
| 641  (hx281) | 1 | OBC position (BINARY) | ‘2’ = first dark frame  ‘3’=science  ‘4’=second dark frame  ‘5’=medium brightness  ‘6’=high brightness  ‘7’=laser  (see NGIS Software User Manual v5) |
| 642  (hx282) | 2 | Redundant OBC positions |  |
| 644  (hx284) | 2 | Modified MessageID#3 Status Flag | “hxBABE”: Valid Flag  “hxDEAD”: Not Valid (keep original data “ Redundant OBC position” from camera link in Modified MessageID#3 field)  “hx0BAD”: Modified MessageID#3 with no PPS  (16bits are in little endian, LSB first) |
| 646  (hx286) | 2 | Modified MessageID#3 Word Count | [Bit 0, Bit15]: Word Counts (number of 16-bit words in Modified Message ID#3 Data (16bits are in little endian, LSB first) . The Modified MessageID#3 Word Count is set to 13 except in the case of “DEAD” with no Modified MessageID#3 information which the word count is 0. |
| 648  (hx288) | 26 | Modified MessageID#3 Data  Currently Modified MessageID#3 is 26 Bytes long and the last 2 bytes are filler “0xBEEF” | Header of MessageID#3 from SDN500 obtained at the last GPS 1 seconds time pulse. It includes:  (1) MessageID#3 header,  (2) GPS Time from MessageID#3,  (3) Frame count of the frame at the last PPS  (4) 100kHz free running counter time stamp of the PPS  (5) Filler “BEEF”  (16bits are in little endian, LSB first). The “Modified Message ID#3 Data” fit in this space. It is generated every second. |
| 674  (hx2A2) | 2 | Modified Message ID#3 Filler | Filler “C0DE” (16bits are in little endian, LSB first) is used to re-align Modified MessageID#3 to double word aligned |
| 676  (hx2A4) | 2 | Modified MessageID#3 Header Checksum (Status Flag and Word Count) | (16bits are in little endian, LSB first) |
| 678  (hx2A6) | 2 | Modified MessageID#3 Data Checksum | (16bits are in little endian, LSB first) |
| 680  (hx2A8) | 2 | GPS Status Flag | “hxBABE”: Valid Flag  “hxDEAD”: Not Valid (keep original data “Redundant OBC position” from camera link in GPS field)  “hx0BAD”: GPS data with no PPS  (16bits are in little endian, LSB first) |
| 682  (hx2AA) | 2 | GPS Word Count | [Bit 0, Bit15]: Word Counts (number of 16-bit words in GPS Serial Data ) (16bits are in little endian, LSB first) (MAX: hx118 = dx280)  Normal GPS data has 5414 bytes of data in one second. This GPS data will be sent out in 10 consecutive frames with the 1st 9 frames in 280 words and the 10th frame in 187 words |
| 684  (hx2AC) | 560 (MAX; hx118 16-bit words) or less(TBD) | GPS Serial Data | All messages from NavigationGPS data from SDN500 (16bits) including last raw message ID#3 (16bits are in little endian, LSB first). The “GPS Serial Data” between two messages ID#3 is spread over multiple frames. In normal configuration, there are a total of 5414 bytes of GPS data in between 2 messages ID#3. This data will spread over 10 consecutive frames with the 1st 9 frames in 280 words and the 10th frame in 187 words. For the last frame with odd number of word count (187), an extra filler “81FF” is included but it does not count in the GPS word count and is not part of the GPS Serial Data Checksum. |
| 1244 (hx4DC) (MAX) or less (TBD) | 2 | GPS Header Checksum (GPS Header: Status Flag and Word Count) | (16bits are in little endian, LSB first) |
| 1246 (hx4DE) (MAX) or less (TBD) | 2 | GPS Serial Data checksum | In case of odd word count, the Serial Data Checksum does not include the extra filler “81FF”(16bits are in little endian, LSB first) |
| 1248  (hx4E0) | 32 | Reserved | Reserved for monitoring hardware information.   * + 1. The local frame count is located at bytes hx4E0 to hx4E2 as followed,   hx4E1-hx4E0: MSW of the local frame count  hx4E3-hx4E2: LSW of the local frame count   * + 1. The current extracted FPIE Frame Number is located at bytes hx4E4 to hx4E5     2. The current serial RX port Error Count is located at bytes hx4E6 to hx4E7     3. The timestamp of the corresponding Message ID#3 is located at bytes hx4F0 to hx4F2 as followed,   hx4F1-hx4F0: MSW of the Message ID#3 timestamp  hx4F3-hx4F2: LSW of the Message ID#3 timestamp  (each word is 16 bits and in little endian, LSB first) |

### pps.bin File format extracted from Message ID#3 data field.

The gps data is written in little-endian with LSB and then the MSB

|  |  |  |  |
| --- | --- | --- | --- |
| **Byte offset** | **Width (Bytes)** | **Field** | **Description** |
| 0 | 2 | Header Word#1 | Synchronization word (***hx81FF***) (16bits) |
| 2 | 2 | Header Word#2 | Message ID3 number (***hx0003***)(16bits) |
| 4 | 2 | Header Word#3 | Word Count (number of 16-bit words in data portion of message, excluding data checksum): 52 + (2 X Number of GPS Channels) (**e.g.: *hx004C***) (16bits) |
| 6 | 2 | Header Word#4 | Flags word (see table 7-2 of SDN500 user’s guide) (**e.g.: *hx8000***) (16bits) |
| 8 | 2 | Header checksum | 2’s complement of 16-bit sum of header words 1-4 (**e.g.: *hxFDB2***) (16bits) |
| 10 | 8 | GPS Time | GPS Sensor time (time of week (TOW) in seconds starting at Saturday 2400hours/ Sunday 0000 hours). Data words are in the order 2,1 (MSW), 4(LSW), 3 (16bits per word) (***e.g.: hx49D9, hx00F6, hx7BAD, hx9950***) |
| 18 | 2 | Frame Count | Frame count (Pixel 318 at Bytes offset 634 on the first line of each frame) of the last frames acquired at the leading edge of pps (***e.g.:hx1FE0***) (14 bits) |
| 20 | 2 | 100kHz free-running counter timestamp of PPS (MSB) | Value of the 100kHz free-running counter at leading edge of the pps used to synchronize Frame Valid (and INT) with pps @ 1Hz (***e.g.: hx001F***) (16bits, MSB ) |
| 22 | 2 | 100kHz free-running counter timestamp of PPS (LSB) | Value of the 100kHz free-running counter at leading edge of the pps used to synchronize Frame Valid (and INT) with pps @ 1Hz(***e.g.: hx2B9B***) (16bits, LSB ) |
| 24 | 2 | Filler | Constant filler (***hxBEEF****)* (16 bits) |

Suggested New pps.bin including Message ID#3 Time stamp:

The gps data is written in little-endian with LSB and then the MSB

|  |  |  |  |
| --- | --- | --- | --- |
| **Byte offset** | **Width (Bytes)** | **Field** | **Description** |
| 0 | 2 | Header Word#1 | Synchronization word (***hx81FF***) (16bits) |
| 2 | 2 | Header Word#2 | Message ID3 number (***hx0003***)(16bits) |
| 4 | 2 | Header Word#3 | Word Count (number of 16-bit words in data portion of message, excluding data checksum): 52 + (2 X Number of GPS Channels) (**e.g.: *hx004C***) (16bits) |
| 6 | 2 | Header Word#4 | Flags word (see table 7-2 of SDN500 user’s guide) (**e.g.: *hx8000***) (16bits) |
| 8 | 2 | Header checksum | 2’s complement of 16-bit sum of header words 1-4 (**e.g.: *hxFDB2***) (16bits) |
| 10 | 8 | GPS Time | GPS Sensor time (time of week (TOW) in seconds starting at Saturday 2400hours/ Sunday 0000 hours). Data words are in the order 2,1 (MSW), 4(LSW), 3 (16bits per word) (***e.g.: hx49D9, hx00F6, hx7BAD, hx9950***) |
| 18 | 2 | Frame Count | Frame count (Pixel 318 at Bytes offset 634 on the first line of each frame) of the last frames acquired at the leading edge of pps (***e.g.:hx1FE0***) (14 bits) |
| 20 | 2 | 100kHz free-running counter timestamp of PPS (MSB) | Value of the 100kHz free-running counter at leading edge of the pps used to synchronize Frame Valid (and INT) with pps @ 1Hz (***e.g.: hx001F***) (16bits, MSB ) |
| 22 | 2 | 100kHz free-running counter timestamp of PPS (LSB) | Value of the 100kHz free-running counter at leading edge of the pps used to synchronize Frame Valid (and INT) with pps @ 1Hz(***e.g.: hx2B9B***) (16bits, LSB ) |
| 24 | 2 | 100kHz free-running counter timestamp of messageID#3 (MSB) | Value of the 100kHz free-running counter when a correct header checksum of the messageID#3 is detected. It is used to synchronize Frame Valid (and INT), pps @ 1Hz and Message ID#3 (***e.g.: hx001F***) (16bits, MSB ) |
| 26 | 2 | 100kHz free-running counter timestamp of messageID#3 (LSB) | Value of the 100kHz free-running counter when a correct header checksum of the messageID#3 is detected. It is used to synchronize Frame Valid (and INT), pps @ 1Hz and Message ID#3 (***e.g.: hx2B9B***) (16bits, LSB ) |