IMPACT Comments on the Draft STEREO Spacecraft/Investigation ICD
Dave Curtis 2000-3-23

Section 1.1:

How will the PLASTIC and IMPACT ICDs divide up the interfaces? Most if not all of PLASTIC's electrical interfaces will come via the IMPACT IDPU. The IMPACT IDPU mechanical and thermal interface will probably be to PLASTIC. Meanwhile there are plenty of PLASTIC interface issues that IMPACT has no part in and vice-versa. I suggest we keep 2 ICDs (PLASTIC and IMPACT). We keep the mechanical and thermal issues of the combined PLASTIC/IDPU interface in the PLASTIC ICD, but put most of the electrical interface issues in the IMPACT ICD. How does this sound?

Section 1.3:

I would replace the IMPACT suite description with something more like the following:
The IMPACT suite consists of the Solar Energetic Particle (SEP) instrument package (SEPT, SIT, HET, and LET), the plasma electron instruments (SWEA and STE), and a magnetometer sensor (MAG). In addition there is a common instrument data processing unit (IDPU), which is also shared with the PLASTIC instrument. SWEA, STE, and MAG are located on an instrument-provided fixed 1.5m long boom that in turn is mounted to a spacecraft-provided extendable 3-6m long boom.

Figure 2:

Shows a common IDPU with SWAVES, which is not the case.

Section 2.2

Manning's EMC recommendations request that chassis ground be electrically tied to secondary ground, which is fine with us. What is the spacecraft policy on that? We will not be able to provide instrument unique requirements until you give us the system grounding policy.

Section 2.3

Our power distribution plan is not firm yet, but our current plan calls for 3 or 4 separate power services: one for SEP, one for SWEA/STE, one for IDPU/MAG, (plus one for PLASTIC). Multiply this times two, assuming we also have separate survival hater services.

What are the characteristics of the 28V bus? What range of voltages, what ripple, what transients?

Section 2.3.1

Figure 2.3.1-1 is missing.

Are the fuses accessible? Can you tell if you have fired one? (these are design questions, probably not ICD issues).

Table 2.3.11-1. (Shouldn't this be table 2.3.10-1?)

This power does not include the 1553 interface power, which I believe Haydee is currently holding. At some point when that number is known, we should transfer it to the ICD.

There is also an issue of the PLASTIC classification electronics. This used to reside in the PLASTIC IDPU, which was descoped. It will now reside in the IMPACT/PLASTIC IDPU, but there is currently no power budget for it. This is an issue for you to work with Project and PLASTIC; I bring it up because it is not part of the existing IDPU power budget.

Section 2.4

Please tailor the EMC requirements to what is really required for STEREO. Bear in mind that these are custom instruments and arbitrary requirements can have real costs.

Section 3.2.1

What does SEAFAC testing buy you? I am looking for a suitable 1553 interface for my little processor and the newer more integrated systems (such as the UTMC Summit line) are not SEAFAC tested.

Section 3.2.1.6

The telemetry packet size is fairly small. This is good for testing (packets come more often), but bad for overhead (higher fraction of packet header data). Who pays the packet header overhead? Does that come out of our telemetry allocation? Since we are not in control of the packet size, it seems like we should not have to pay the penalty for the small packets…

The timing scheme (no hardware timing tic) forces me to time my data with an internal clock. Packets will need to be marked with this clock, in addition to the normal packet time in the CCSDS header (which will contain the spacecraft clock time of packet collection). This is another small hit on my telemetry allocation (around 10bps). Small potatoes to you, but significant to me. We would still prefer a hardware time tick, but if that is not an option, can we at least have a little bitrate relief for the work-around solution?

The question of having a spacecraft telemetry bitrate enforcement scheme came up in the 1553 meeting the other day. I am not so sure this is a good idea. The instruments can certainly keep track of their own average telemetry rate, so the only concern is that they do not hang up the bus with excessive telemetry requests, either to get out a large block of data (such as a memory dump), or because the instrument is broken. In any case the 1553 telemetry will not account for a large fraction of the total spacecraft telemetry, so I don't think we need to

worry about filling up the SSR through this channel, even if instruments take many times their allocation. The instrument polling scheme can be tailored to avoid saturating the 1553 bus. Ground software can monitor average bitrates and alert the appropriate people if some threshold is crossed. So I don't see the need for an on-board bitrate enforcer to protect the spacecraft. The advantage of loose allocations is that it allows me to make use of the SSR to store my high rate data that is collected periodically. This avoids having to allocate twice the memory in my system and read it out slowly with the rest of my telemetry while collecting the next snapshot. It also allows me to send data at a higher real-time rate during testing and diagnostics both on the ground and in space (with the permission of some authority on the ground). So I would prefer no bitrate enforcement beyond a maximum rate set by how often you poll my instrument for data, which I would prefer to be fairly large (maybe something like 8 times a second).

Section 3.2.2

Does instrument housekeeping (current, temperatures) come out of our telemetry allocation?

Section 3.2.3

There is a reference to section 3.2.4 which does not exist.

Section 4.2

UNSOLICITED ADVICE: Thermally isolated design is easier for the thermal engineer but does not make use of the large thermal mass of the spacecraft to mitigate thermal issues in the instruments. A small error in an instrument thermal model, or blanket degradation effects, will have much bigger effects if the instrument is isolated.

We need to decide who does the PLASTIC/IDPU thermal design. I vote that PLASTIC does this, with a simple one or two node thermal model of the IDPU from us.

The SWEA/STE/MAG boom thermal interface is a little different. Is the end-plate of the extendible boom part of our thermal design or yours?

Section 4.3.2

Do you really expect the endplate of the boom to get to +/-90C? Can we blanket the endplate to avoid these extremes? I don't know if we care; depends on how we do the thermal isolation.

Section 4.4.1.1

We plan to design the instruments to have no operational heaters, with the possible exception of the MAG sensor (depends on if we can get it into the sun). They will be blanketed sufficiently to stay warm with their internal dissipation.

Section 4.4.2.1

I assume this will be two thermistors per box: IDPU, SWEA, STE, MAG, SEP.

Section 4.5

I assume for thermal and mechanical issues, we have three units to deal with: The SWEA/STE/MAG/Boom unit, the SEP (assuming it stays in one piece), and the PLASTIC/IDPU. Thermal models, mass properties, etc., will be provided for each of these combined units. See comments on section 1.1 about the PLASTIC/IDPU combination.

Why do you care what our junction temperatures are. Probably a good idea, but it seems like an odd thing to have in an ICD.

Section 5.1.1

What about the extendable boom harness? Who provides that? Seems like an integral part of the boom, so perhaps APL should build it.

Who is responsible for the mass of the intra-instrument harnesses? If it is part of the instrument mass, you can't hold us to a mass allocation until you tell us how long the harnesses have to be.

Do you require metric fasteners? How about if we call out standard fasteners in metric units?

Section 5.1.4.2

Flat to 0.0003 meters per foot? What kind of unit is that?

Refers to section 2.2.2.2, which does not exist. (also referred to in 5.1.4.3)

Section 5.1.5.3

See comments on section 1.1 about PLASTIC/IDPU, and section 4.5 about the definition of what level of assembly the data will be provided to.

Section 5.1.5.6

I believe there are no ejectable items in IMPACT.

Section 5.1.6

Good mounting hole tolerance should be adequate for IMPACT alignment; the requirement is +/-0.5 degree knowledge. No alignment cube will be required.

Section 5.1.7

IMPACT will have small moving doors to close off apertures. These are 1-time deployables, and are probably too small a mass and motion to be of interest to you. Do you have some rule of thumb about what level of force/torque you are concerned with? We have no recurring motions.

I assume that the deployable boom torques/forces during deployment is taken care of by APL and is not part of this ICD

Section 5.1.7.2

I assume we will be responsible for developing some kind of caging mechanism for the SWEA end of the fixed boom, and that APL will deal with caging the deployable boom, including the end plate. The ICD will need to include details on how we mount this caging mechanism, and what kind of actuators it has and who fires them. Also, we need an envelope indicating the trajectory of the boom elements during deployment so we don't hit or hang up on some spacecraft element.

Another ICD issue that I don't see a place for is the sunshade; we want the STE and SWEA to be in shadow, while it would be better if the MAG were in the sun (otherwise it will need a little operational heat). MAG could stick out a bit to accomplish this, but not too far out or it will violate the envelope mentioned above and hit the spacecraft during deployment. A sunshade mounted with the boom canister could provide some kind of tailored shadow.

Section 5.1.8.1

We are talking about a harness between the IDPU and SWAVES. Presumably that harness would be provided by SWAVES or us. What ICD would cover that harness?

Who is responsible for the harness that runs up the deployable mast? SWAVES has some requirements on the shielding of that harness (since it runs close to their antennas).

Section 5.1.9

IMPACT will have a TBR number of red-tag covers.

Section 5.2.1.1

IMPACT will have a TBR number of "Green Tag" actuator / high voltage enable plugs to avoid accidental operations that could damage the instruments. These are IMPACT's responsibility, not APL.

The numbering of this section seems odd.

Section 5.3

This seems redundant with section 5.2

Section 6.2.5

The IMPACT attitude knowledge requirement (including jitter and stability) is 0.5 degrees. Obviously we do not drive the spacecraft, so perhaps we do not need this section of the ICD.

Section 6.3.1

The IMPACT attitude knowledge requirement (including jitter and stability) is 0.5 degrees.

Section 7.1.2

What is a "GSE instrument"

Section 7.2.1.1

Refers to section 7.2.1.3, which does not exist. Perhaps you mean 7.2.1.2.1?

Would it be possible to connect remotely to instrument GSE via the network during tests so that personnel not at the test facility could look at data? I understand that there may be firewall issues, but could we punch some holes, perhaps to designated machines outside the firewall?

Section 7.4.4

IMPACT instruments will require purge, including SEP and SWEA. Purge through the bus manifold is desirable, but may be difficult for SWEA due to the deployable boom extension. Purge through some GSE manifold (removed at encapsulation) is an acceptable alternative for SWEA.

Section 7.6.2.1

From the list, IMPACT has high voltage (not exposed), Purge, and ESD issues. What is the EGSE issue - does that only apply to EGSE attached directly to the instrument, or does it cover our EGSE attached to the MOC?

Section 7.6.2.3

Obviously this section does not apply to IMPACT.

Section 7.6.2.4

There will be no Ionizing Radiation sources in the flight hardware. There may be sources used as stimulus at APL, GSFC and the Launch Site (TBR).

Section 7.6.2.5

IMPACT includes no Lasers In the flight hardware or GSE.

Section 7.6.2.7

Most actuators in IMPACT are non-explosive, with the possible exception of the SWEA/STE/MAG boom caging actuator (TBR).

Section 7.6.2.8

IMPACT has no pressurized systems.

Section 7.7.1

If required, IMPACT shall be cleaned by a designated team member, not APL.

Appendix F

A preliminary version of this shall be developed for the SRR.