



***Solar Terrestrial Relations Observatory (STEREO)
Pre-Phase-A Requirements Review***



Command and Data Handling

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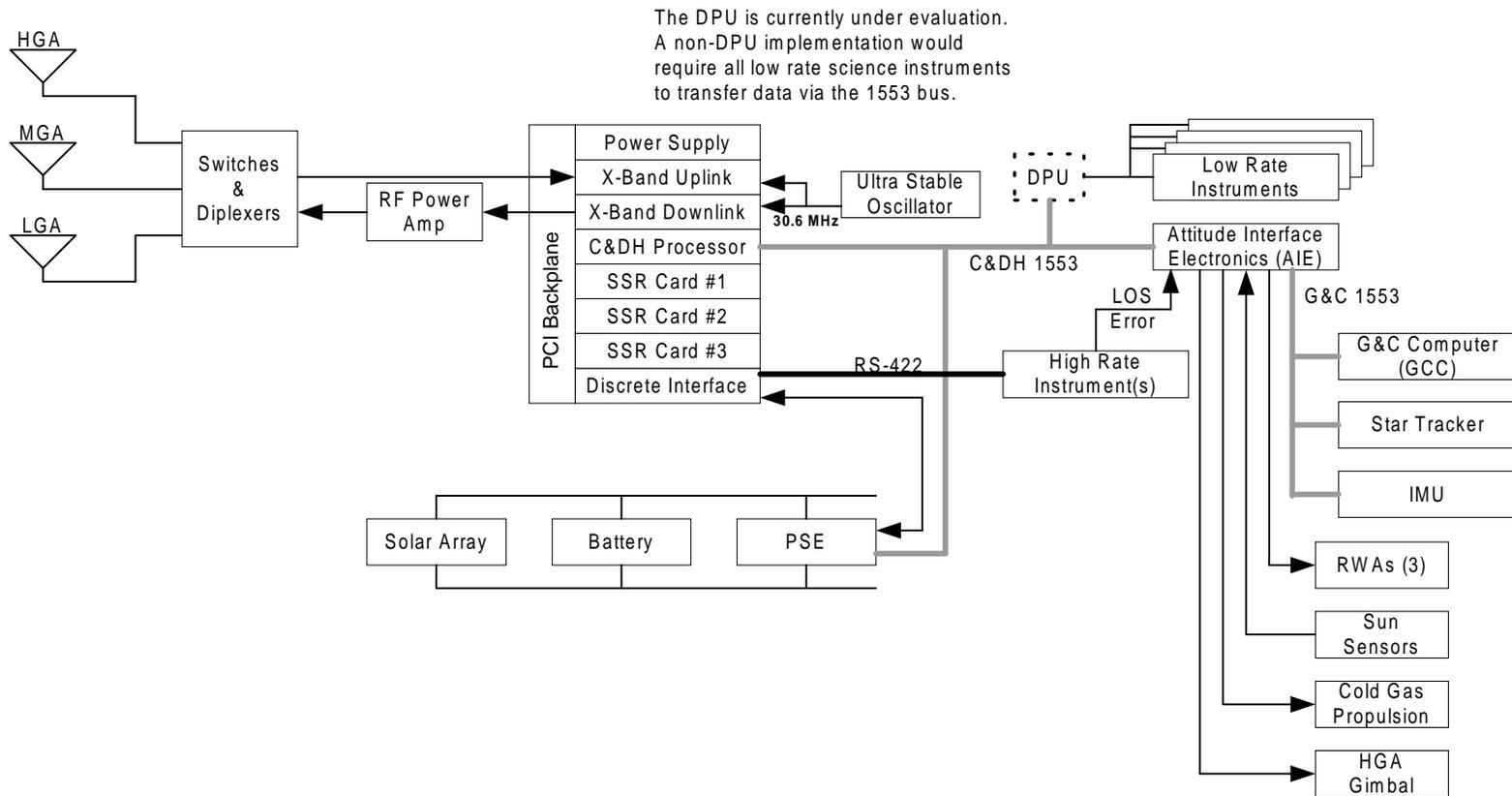
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Spacecraft Block Diagram





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C&DH System Requirements

- Implementation requirement
 - Re-use TIMED architecture
- Functional requirements
 - Uplink command and stored command management
 - CCSDS compatible uplink
 - Provide for two data rates: 100 bits/sec and 7 bits/sec
 - Telemetry data processing
 - CCSDS compatible downlink
 - Provide for maximum data rate of 800 Kbits/sec (allows for transmission of 8 Gbits/3 hr DSN downlink time)



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C&DH System Requirements (con't)

- Functional requirements
 - Mass storage of science and engineering data
 - 5 Gbit science volume + housekeeping + overhead and margin
 - Simultaneous and random read/write capability
 - Error management and graceful degradation
 - Interleave real-time data with recorder playback data, but optimized for science (e.g., 97% science data, 3% real-time products)
 - Support science data collection
 - Provide real-time downlink mode for instruments (one at a time)
 - Provide variable telemetry bandwidth allocation for instrument data, selectable by the science team
 - Provide “Broadcast Mode” data collection and transmission at 500 bits/sec when not transmitting high rate data
 - Support instrument combined maximum data generation rate (~410 Kbits/sec) for storage and real-time downlink



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C&DH System Requirements (con't)

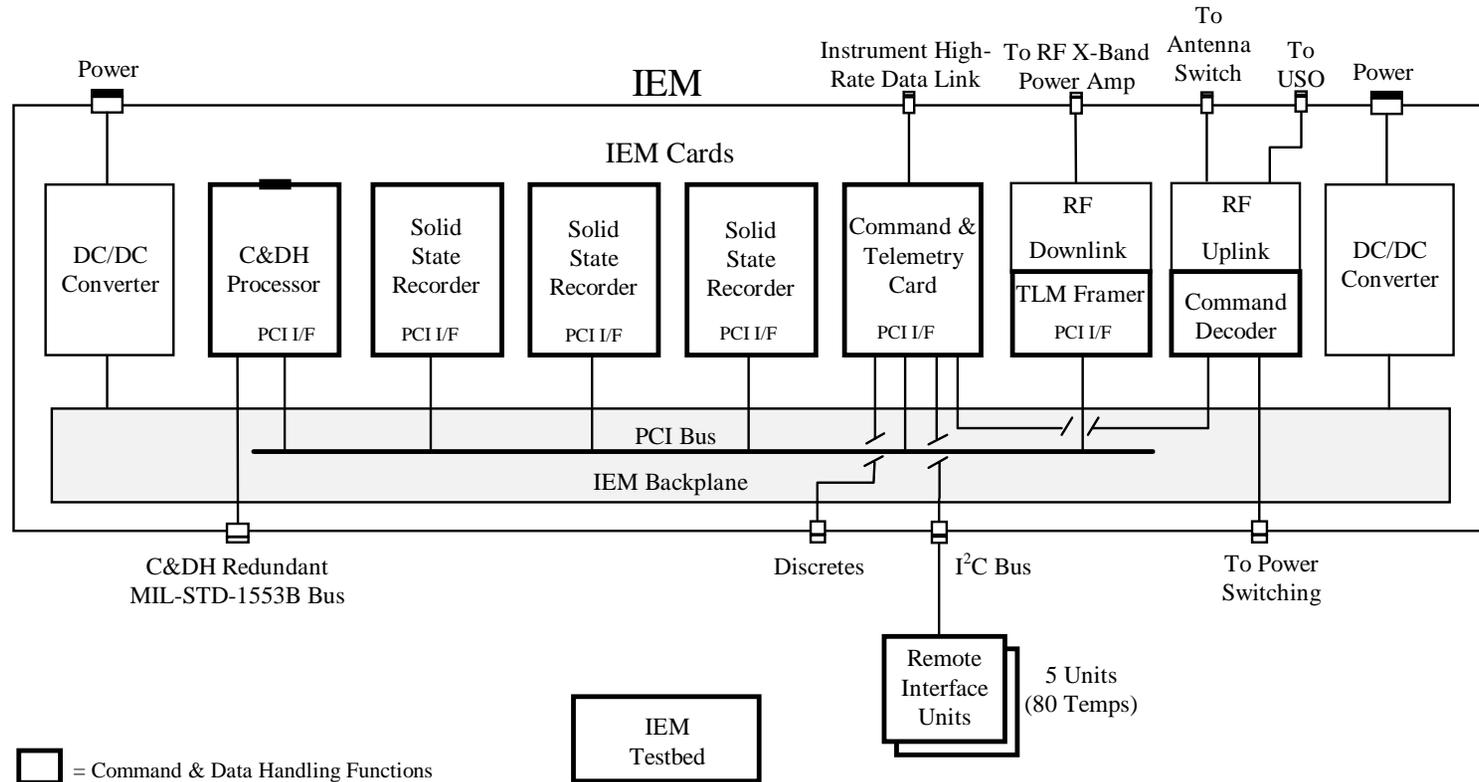
- Functional requirements (con't.)
 - Support engineering data collection
 - S/C temperatures, voltages currents and telldatales
 - Non-coherent navigation data
 - Instrument status information
 - UT maintenance and distribution
 - 0.1 second accuracy
 - Autonomous fault protection
 - Manage subsystem intercommunication
 - C&DH MIL-STD-1553B bus controller



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Integrated Electronics Module (IEM) Configuration Baseline





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TIMED: Processor and SSR Requirements and Capabilities

TIMED	REQUIREMENTS	CAPABILITIES
C&DH Processor	32-Bit architecture 2MBytes SRAM 4MBytes EEPROM MIL-STD-1553B redundant bus PCI local bus	Mongoose V CPU clocked at 12 MHz 9.6 RISC MIPS throughput
Solid-State Recorder	1.9 Gbit Capacity 4Mb/s Pk Read Rate 30Kb/s Pk Write Rate Random read/write capability Map around bad memory blocks Error management Simultaneous read/write	2.5Gbits Capacity 8Mb/s Pk Read Rate, 8Mb/s Pk Write Rate Simultaneous R/W, 8Mb/s combined rate Random access at code block level Settable, auto-incrementing R/W pointers Error management: <ul style="list-style-type: none"> Reed Solomon encoding with correction of up to 5 bytes with errors per block (245 bytes/block). Probability of >5 bytes in error per block is: <ul style="list-style-type: none"> <math>10^{-21}</math>, 24-hour scrub rate <math>10^{-25}</math>, 4-hour scrub rate memory error rate: <math>10^{-12}</math> err/bit/sec



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STEREO: Processor and SSR Requirements and Capabilities

STEREO	REQUIREMENTS	CAPABILITIES
C&DH Processor	Same as TIMED	Same as TIMED
Solid-State Recorder	5 Gbit + housekeeping + OH + Margin 750Kb/s Pk read rate 450Kb/s Pk write rate Random read/write capability Map around bad memory Error management: Max error rate $<10^{-9}$ bit errors/3-days	7.5Gbits capacity 8Mb/s Pk read rate, 8Mb/s Pk write rate Simultaneous R/W, 8Mb/s combined rate Random access at code block level Settable, auto-incrementing R/W pointers Error management: Reed Solomon encoding with correction of up to 5 bytes with errors per block (245 bytes/block). Probability of >5 Bytes in error per block is: $<10^{-TBD}$ w/scrub rate of every TBD-hrs memory error rate: $<10^{-TBD}$ err/bit/sec



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Other IEM Internal Subsystem Functional Requirements

Command & Telemetry Card	Route uplink commands from the command decoder to the C&DH processor and C&DH processor relay commands to the command decoder Collect S/C temperature data and IEM temp and voltage telemetry data Provide interface for high rate instrument science data (RS-422)
Downlink Framing	Builds CCSDS compatible realtime, recorder, and null telemetry frames from data collected from the C&DH processor and the SSR and produces a serial data stream to the RF modulator. Timing chain and counter to provide 1 Hz time marking and MET, respectively (clocked by S/C ultra-stable oscillator)
Uplink Command Decoder	Receive CCSDS compatible commands from the Uplink Receiver command detector (or from the GSE). Route all commands to the C&DH processor, via the C&T subsystem. Route all relay commands, either uplinked or generated by the C&DH processor, to the power switching subsystem. Perform autonomous load reduction upon receipt of a low bus voltage indication from the power subsystem (execute a stored set of relay commands).



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Candidate Studies

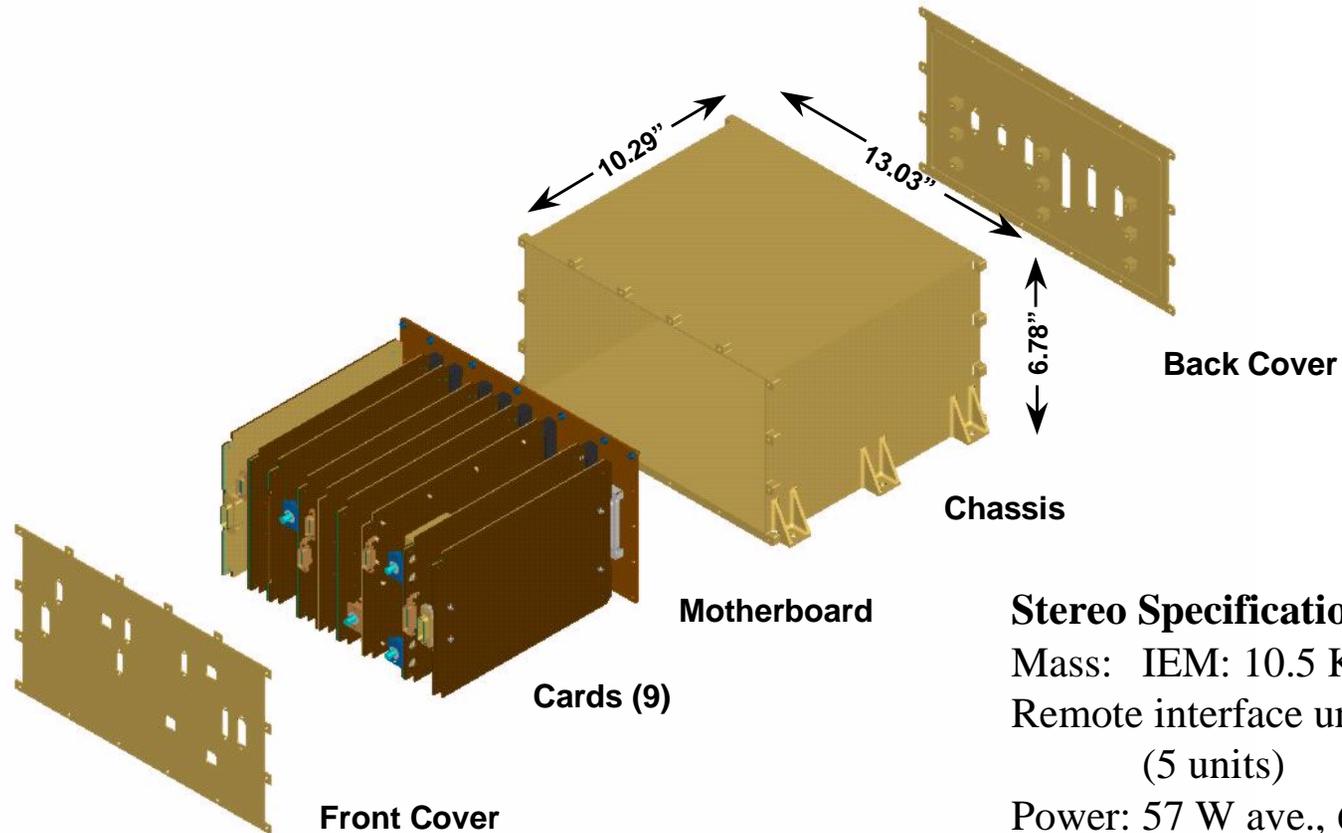
- **Solid-State Recorder–Make versus Buy**
 - “Buy” considerations:
 - Acquire a unit that can be either interfaced to or inserted into the IEM.
 - “Make” considerations:
 - Modified baseline–Upgrade the SSR using denser memory technology and/or packaging reducing it to a single card but with a 10 Gbit capacity.
- **Temperature Remote I/O (TRIO) Chip–Technology Insertion**
 - Compatible with existing IEM I²C bus system
 - Part packaging and qualification needs to be completed. Same part sought by JPL for use in X2000 program.



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TIMED IEM Chassis



Stereo Specifications

Mass: IEM: 10.5 Kg

Remote interface unit (RIU): 1.2 Kg
(5 units)

Power: 57 W ave., 62 W peak
(9-cards, 5 RIUs)