9.1 SOFTWARE OVERVIEW

9.1.1 Scope

The software system functional interfaces between the Orbiter and the payloads shall be as shown in Figure 9.1.1-1. The interfaces associated with software are the Payload-Orbiter Payload Data Interleaver (PDI) interface and the Orbiter Payload Signal Processor (PSP) interface. The detailed hardware requirements and characteristics of these interfaces are described in Section 8.0. The constraints, formats, and data content that are software dependent for each of these interfaces shall be as defined in the following paragraphs.

9.1.2 Hardware/Software Correlation

Cargo Harness hardware/software correlation is specified in Table 13.5.1.1-1 for the PSP and PDI interfaces. In order to insure hardware/software compatiblity when using Orbiter cargo harness capability, the signal function of the PDI and the PSP should be included as part of the specific command/measurement data in Annex 4 (Command and Data Annex).

9.2 ORBITER GPC SOFTWARE INTERFACE

The Orbiter provides the following software interfaces for use by the payload.

9.2.1 Payload Data Interleaver/PCMMU

Payload data interleaver/PCMMU for data acquisition and monitor for attached payloads.

9.2.2 Payload Signal Processor

Payload Signal Processor for attached payload commands.

9.2.3 (Reserved)

9.2.4 (Reserved)

9.3 FLIGHT PHASE APPLICABILITY

The ability of the GPC software to support the payloads is both flight and flight time (event) dependent.

Timeline. Normally, other than supporting PDI data throughput to the ground, the only GPC software that supports payloads is an on-orbit memory configuration, Systems Management (SM). For a nominal mission SM is available from approximately 77 minutes after lift-off until approximately three hours prior to entry. SM software is also briefly installed during ground processing after payload installation into the Orbiter and before payload bay door closure in order to support agreed-to payload testing.

9.3.1 (Reserved)

9.3.2 (Reserved)

9.3.3 On-Orbit (SM)

The Orbiter software processes acquired payload data and displays to the crew, the health, performance and configuration of payload subsystems. Processing capability includes limit sensing, fault detection and annunciation, display, payload sequencing, payload unique computations and data transferring (downlist) to the Orbiter PCMMU for downlinking. The GPC cannot process subcommutated data. That is, each time a data element is acquired, it will be processed as a different sample of the same payload measurement. The Orbiter software also provides the capability to send commands, either crew initiated or via Orbiter uplink. The constraints, format, and data content that are software dependent for each of these interfaces shall be as defined in Paragraph 9.4.

9.4 SOFTWARE CONSTRAINTS/COMMUNICATION CONVENTIONS

9.4.1 Payload - PDI Interface

Selection of up to four payload asynchronous Pulse Code Modulation (PCM) streams and the required decommutation program (stored in mass memory unit) is provided to the PDI under GPC control. The Orbiter PDI provides two modes of decommutation; format synchronization mode and block mode.

9.4.1.1 Format Synchronization Mode

In the format synchronization mode, the PDI decommutates payload telemetry data into two different data groups for transfer to the PCM master unit. The constraints and format types associated with the two data groups are as defined in Paragragh 8.2.1.1.

9.4.1.1.1 Data Group 1

Data Group 1 includes payload data selected on a telemetry frame basis and transferred via the PDI Toggle Buffer (TB) to the PCMMU solely for interleaving (by the PCMMU) into the operational downlink.

9.4.1.1.2 (Reserved)

9.4.1.2 Block Mode NOT APPLICABLE

9.4.2 PSP/Payload Interface

Hardware characteristics of the PSP/payload interface are as defined in Paragraph 8.2.5. The Orbiter GPC software provides the capability to process command data loads to an attached payload via this link.

9.4.2.1 Data Formats

Each load transferred to the payload via the PSP shall be structured as follows:

9.4.2.1.1 Payload Communications (One or More Commands)

The Orbiter vehicle software limits the maximum message length to the equivalent of 64 x 16 bits (1024) transmitted to the payload without a break in transmission. Each command/data word format shall be preflight-defined.

9.4.2.2 Data Content

The data content of the message transmission shall consist of Orbiter computed data, uplink throughput, or data prestored in the GPC for transmission under crew control. The time interval between command messages could be as long as

the time required by the PSP to output the command data from the command output buffers plus 1.5 seconds:

$$\text{Example:} \quad tm = \frac{\text{Command Message Length in Bits}}{\text{PSP Command Bit Rate in BPS}} + 1.5 \text{ seconds}$$

Where: tm = Time Minimum
BPS = Bits per Second

9.4.2.2.1 (Reserved)

9.4.2.2.2 (Reserved)

9.4.2.2.3 Uplink Throughput Data Loads
The uplink throughput data load provides the capability to uplink data and/or commands to payloads. The Orbiter GPC software shall not be required to be aware of the data content/format internal to these 16-bit words. Any command sent before transfer completion of the previous command will cause a rejection of the later command. The Orbiter will support the uplink throughput data loads as defined below.

9.4.2.2.3.1 Throughput Command Data Load
The capability is provided to throughput up to 64 sixteen-bit (1024 bits) payload command words per transmission. These words will be downlisted for ground validation/correction before being transferred to the PSP. These words will normally be transferred to the designated PSP channel within two seconds after receipt of a cooperative command to execute the uplink load.

9.4.2.2.3.2 Throughput Command Data Load-Single Stage Processing
The capability is provided to throughput up to 64 sixteen-bit (1024 bits) payload command words per transmission. These words will normally be transferred to the designated PSP channel within two seconds after receipt of the last command word in the uplink load. The Orbiter does not provide validation of these commands and therefore, for critical commands, the payload must provide two-stage execution or other comparable validation systems.

9.4.2.2.3.3 (Reserved)

9.4.2.2.4 PSP Idle Pattern
The capability is provided for the PSP to generate an idle pattern consisting of alternating ones and zeros. The idle pattern is selectable by the Orbiter GPC and shall be generated at a preselected command data rate in NRZ-L, M, or S format as specified.

9.4.2.2.4.1 Payload Commands
Each command message transferred to the payload via the PSP link shall consist of an idle pattern, followed by command word(s). The interval between consecutive command transmissions with no transmission interruption shall be filled by the PSP idle pattern. There shall be no idle pattern between consecutive command words of the same command transmission.

Upon receipt of command data, the idle pattern will terminate with a logic zero and command data will be transmitted. At the completion of command transmission, the idle pattern will again be generated and start with a logic

one. If the payload requires a minimum idle pattern, it shall be provided through procedural control.

The idle pattern between consecutive command transmissions, and following the last command to a particular payload, shall begin with a logic one and end with a logic zero. The PSP shall always output command data words in multiples of 16-bits. Command data words less than multiples of 16-bits shall contain fill data. The command data will be transmitted Most Significant Bit (MSB), Most Significant Syllable (MSS) first.

9.4.2.2.4.2 (DELETED)

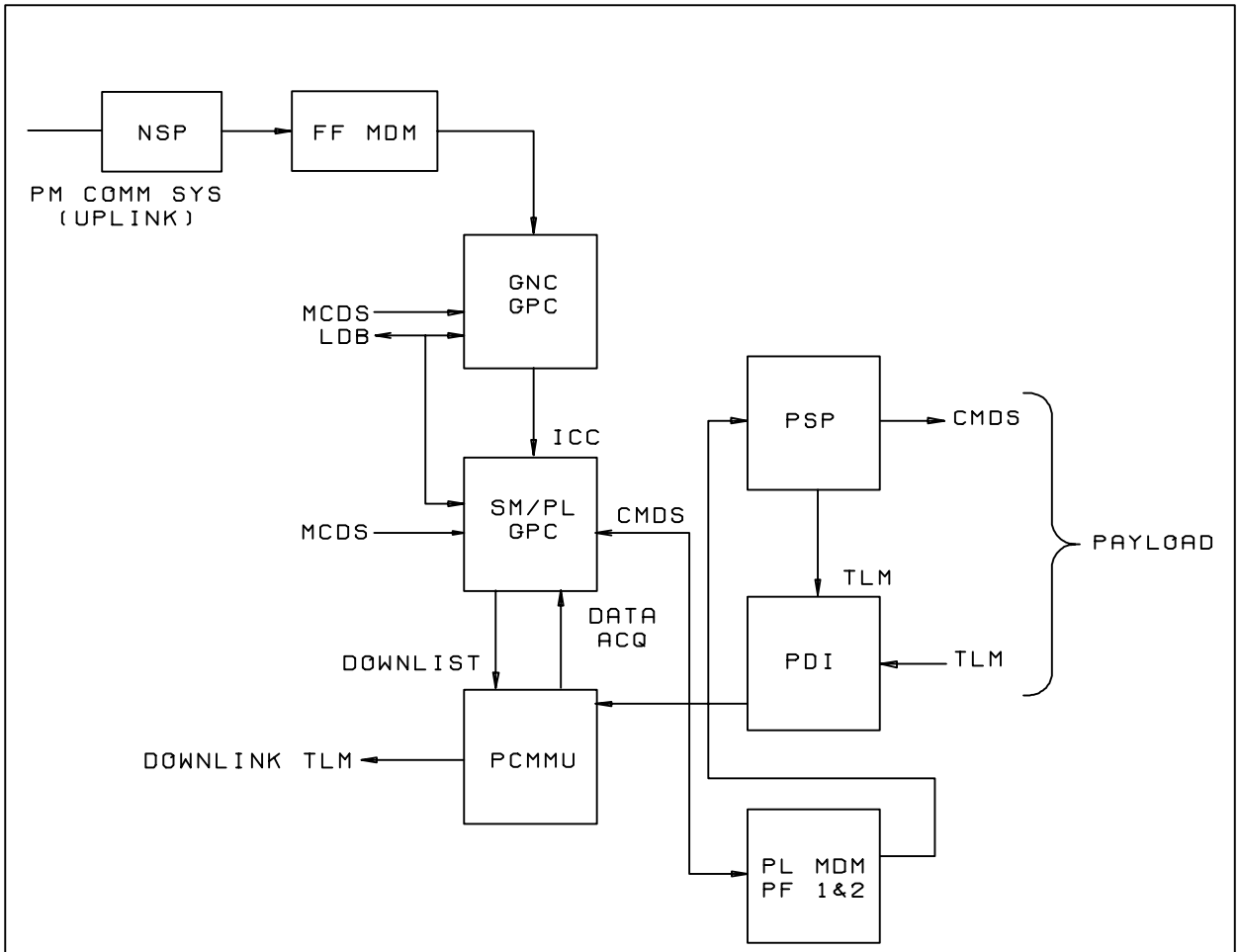
9.4.2.2.5 Non-Standard Idle Pattern NOT APPLICABLE

9.4.2.3 PSP/Payload Telemetry Interface NOT APPLICABLE

9.4.3 (Reserved)

9.4.4 (Reserved)

9.4.5 (Reserved)



LEGEND

PF	PAYLOAD FORWARD
PSP	PAYLOAD SIGNAL PROCESSOR
PDI	PAYLOAD DATA INTERLEAVER
NSP	NETWORK SIGNAL PROCESSOR
PL	PAYLOAD
FF	FLIGHT CRITICAL FORWARD
ICC	INTERCOMPUTER CONTROL
DATA ACQ	DATA ACQUISITION
GPC	GENERAL PURPOSE COMPUTER
GNC	GUIDANCE, NAVIGATION AND CONTROL
SM	SYSTEMS MANAGEMENT
MDM	MULTIPLEXER/DEMULTIPLEXER
PCMMU	PULSE CODE MODULATION MASTER UNIT
MCDS	MULTIFUNCTION CRT DISPLAY SYSTEM
TLM	TELEMETRY
CMDS	COMMANDS
LDB	LAUNCH DATA BUS

FIGURE 9.1.1-1 ORBITER - PAYLOAD SOFTWARE FUNCTIONAL INTERFACE

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