



International Space Station (ISS) Payload Software Integration Overview

NASA ISS Research Academy and Pre-Application Meeting

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International Space Station – Payload Integration

August 5, 2010



ISS Payload Software Integration Overview



- **The purpose of this presentation is to provide familiarity with the range of payload software that can be integrated to conduct ISS research**
- **Payload Software Integration processes are dependent on the type(s) of payload software implemented**
 - Software which runs on a laptop and is operated by the Crew
 - Software within an onboard payload computer to be operated from the ground
 - Variations . . .



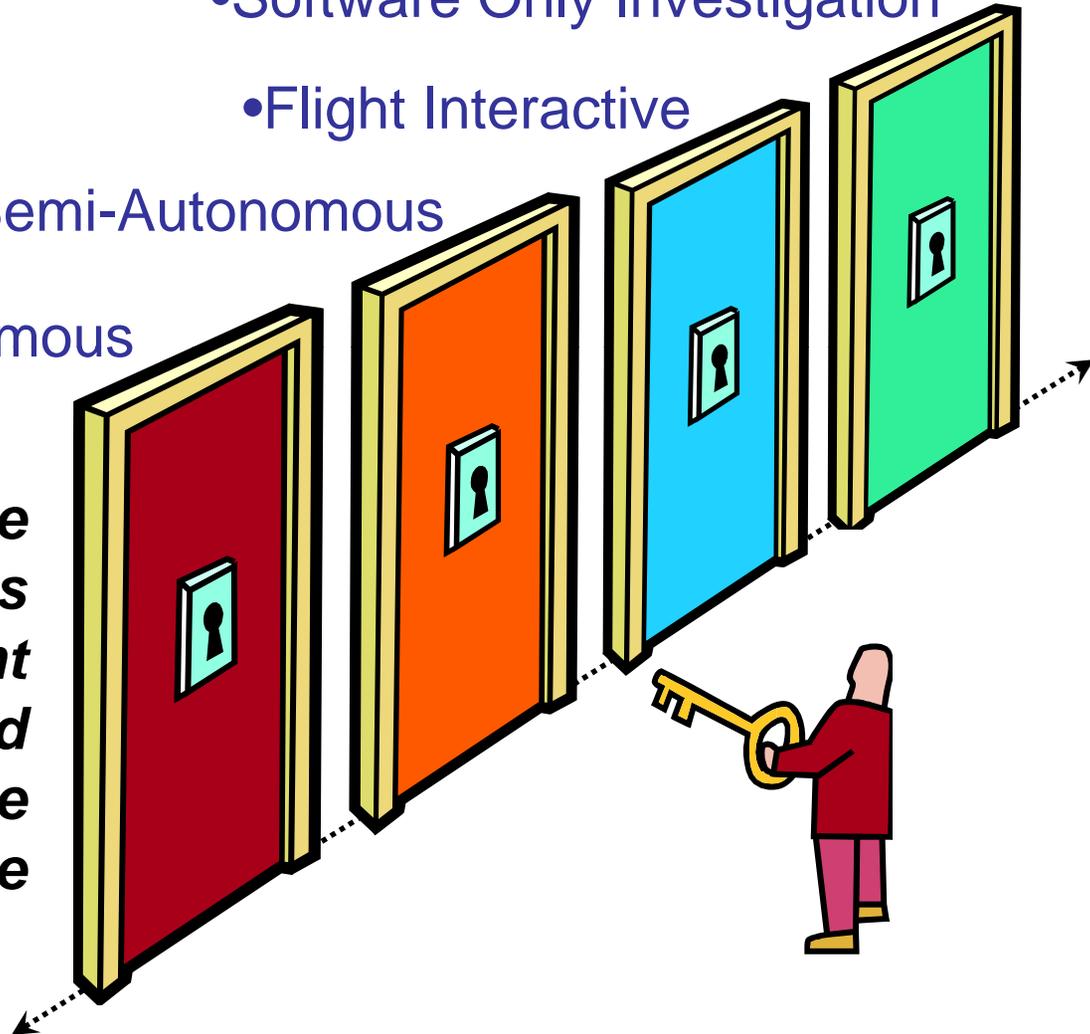
ISS Payload Software Integration Overview



- Software Only Investigation
- Flight Interactive
- Semi-Autonomous
- Highly Autonomous

***Payload Software
Integration tasks
are dependent
upon Payload
Software
Architecture***

**Payload Software
Architecture Options**





Highly Autonomous Payload Software



Payload Software High Level Architecture Overview	Key Payload Software Integration Information
<p>Highly Autonomous Software resides on payload processor with no interactive capability</p> <ul style="list-style-type: none">▪Payload software may self initiate when the payload is powered to collect data on the payload processor▪Data collection results (files) are returned when the payload is returned to earth	<ul style="list-style-type: none">•Although this architecture sounds completely independent, a software interface to ISS may still be required. <p><u>Health and Status Payload Data Interface</u></p> <ul style="list-style-type: none">•Powered payloads may be required to provide Health and Status information for insight to the Payload Operations and Integration Center (POIC) real-time operators that the payload is operating safely and as expected. (Health and Status data typically includes voltage and/or current measurements, temperature measurements, etc.)•If the payload is hosted in a facility, the Payload Developer (PD) may provide these measurements to the host via the host facility interface requirements.•To define the PD payload Health and Status definitions, the ISS Payloads Office has built a database system, the Payload Data Library (PDL)•PDL is used to build two other important sets of integration products:<ul style="list-style-type: none">▪Command and Data Handling (C&DH) Dataset, which configures the ground data systems to capture, route and convert the Health and Status Data to meaningful values to be displayed at the POIC for ground operators.▪Special files are built for onboard equipment to route Health and Status data



Semi Autonomous Payload Software



Payload Software High Level Architecture Overview	Key Integration Information
<p>Semi-Autonomous Software resides on payload processor and interactive capability exists from the ground</p>	<ul style="list-style-type: none">•The PD typically needs to define Health and Status data parameters in PDL. <p><u>Command and Telemetry Data Interfaces</u></p> <ul style="list-style-type: none">•The PD also needs to define commands to be sent to their payload, as well as near real-time telemetry data to be routed to the PD's operations location. Adding the PD's command and telemetry definitions to PDL will ensure that the C&DH Dataset is configured to properly route this data from/to the PD's ground operations location. <p><u>Ground Operations Location Interfaces</u></p> <ul style="list-style-type: none">•The PIM will help the PD coordinates with the Ground Systems Requirements Team to plan and establish the PD's ground operations location(s) to interact with their payload. This team works with the PD to establish secure accounts and data routing between the PD's operations location and the Huntsville Operations Support Center (HOSC) location, which is the PD interface for uplink and downlink routing. <p><u>Ground Interface Software</u></p> <ul style="list-style-type: none">•Additionally, NASA has also developed Telescience Resource Kit (TReK) software that the PD can use to interact with their payload from the PD's ground operations location. The TReK is also a useful tool for software development testing.



Flight Interactive Payload Software



Payload Software High Level Architecture Overview	Key Payload Software Integration Information
<p>Flight Interactive Software resides on a payload processor and a display is available for crew interaction with the payload</p> <ul style="list-style-type: none">▪ Display may be integral to the payload and easily accessible by the crew▪ Laptops are available onboard to host the PD's payload application (host facility may provide a laptop; common use laptops are also available)	<p><u>Displays and Procedures</u> Development of the displays and crew procedures to interact with the PD's displays is a PD responsibility.</p> <ul style="list-style-type: none">• Usability Assurance of the PD developed displays is the responsibility of the Payload Display Review Team (PDRT). The PDRT provides design support throughout the displays and crew procedures development process to ensure payload on-orbit Crew interfaces are standards compliant, and certified flight ready.• Payload displays must be compliant with the Integrated Displays and Graphics Standards (IDAGS) <p><u>Onboard Laptops and Compatibility</u></p> <ul style="list-style-type: none">• Onboard laptops may be available for PD use.• PDs need to be aware of the operating system and capabilities of the onboard laptops if the PD chooses to use an existing, common use, onboard laptop.• PDs are responsible for testing their laptop applications and to system-test their device with the common use laptops.• If the PDs' laptop applications will operate on a host facility or on onboard laptops, compatibility testing will be performed by the integration team. <p><u>Software Media</u> If the PDs payload software implementation requires that media be launched to the ISS, the ISS Payloads Office will develop the flight copy of the software media that is manifested for launch.</p>



Software Only Investigation



Payload Software High Level Architecture Overview	Key Payload Software Integration Information
<p>Software Only Investigation - research is conducted with software</p> <ul style="list-style-type: none">▪No unique payload hardware exists▪May be loaded on an existing computer and operate autonomously, semi-autonomously, or with crew interaction▪Ground operators can downlink files from some onboard laptops to the ground	<ul style="list-style-type: none">•Typically, no health and status data are required for onboard laptop hardware; other methods are used by ground controllers to monitor laptop operations.•Some host facility laptops provide hard drive space for payloads and the functionality for ground controllers to downlink stored payload files.•Depending on the level of interaction desired (ranging from near autonomous to crew operated), key integration factors discussed previously also apply for a Software Only investigation:<ul style="list-style-type: none">•The PDL definition of C&DH Dataset for command and telemetry routing•Ground Systems Requirements for a remote payload ground operations location•TReK software to implement at a remote payload ground operations location•Crew Displays and Crew Procedures for interacting with payload software•Onboard Laptops and Compatibility to host payload software•Software Media for payload applications



Payload Software Integration Schedule



- Your PIM will coordinate with you regarding your Payload Software Architecture, and will develop appropriate Payload Software Integration Schedule milestones for your integration, based on more detailed information found in SSP 57057, Payload Integration Template (PIT)



Payload Software Integration Reference Links



Item	URL
Payload Data Library (PDL)	http://pdlprod.hosc.msfc.nasa.gov/
Telescience Resource Kit (TReK)	http://trek.msfc.nasa.gov/
Integrated Displays and Graphics Standards (IDAGS)	http://mod.jsc.nasa.gov/da8/idags/
Payload Display Review Team (PDRT)	https://payloads1.msfc.nasa.gov/station/EO20/Displays%20Team.asp (from the POIF web site (account required))
Onboard Laptop Specifications	http://iss-www.jsc.nasa.gov/nwo/avionics/cr/T61p_Laptop/web/index.shtml