OTF CCSDS Mission Operations
Prototype
Parameter Service

Phase I
Exit Presentation

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Project Goals

• Demonstrate the use of Mission Operations standards to implement the Parameter Service
• Demonstrate interoperability between Houston MCC and a CCSDS Mission Operations compliant mission operations center
• Utilize Mission Operations Common Architecture
Project Goals

Utilize Common Architecture

• Service Provider (Center A)
• Service Consumer (Center B)
• SM&C Standards (blue boxes)
  – MAL provides
    • Standard Patterns of Interaction
    • Fundamental definitions
  – Common Services provides
    • Standard Model for Services to Extend
    • Infrastructure Services
  – Mission Operations
    • Core Monitoring and Control, Planning, …
• Messaging Technology (e.g. AMS, SOAP, …)
Project Benefits

• Demonstration
  - Prototype CCSDS Blue Book service specifications
  - Pathfinder for inter-center communications

• Use of CCSDS Standards
  - International agreement
  - Reduce Cost

• Investigation of new technologies
  - Service Oriented Architecture (SOA) concepts
Project Definition

- Demonstrate Mission Operations Protocols
  - **Scope**
    - Implement the Core Services Parameter Service
    - Implement the Common Services Common Model Service monitorStatus Operation
    - Implement the Message Abstraction Layer (MAL)
    - Implement Information Sharing Protocol (ISP) for the transport layer
    - Interface with a Common Services Directory Service
Project Definition

- Out of scope (Related Services)
  - Core Services Check Service
  - Common Services Common Model Service Operations
    - request, list Status
    - request, list, monitor, add, modify, delete, and delete all Definitions
  - Core Service Parameter Service
    - set/get Filtered
    - set/get Timeouts
  - Common Services Configuration Management Service
    - Dependencies
  - OTF MO Common Services Directory Services Interface
Parameter Service Design

- Parameter Service Provider and Consumer Integrated Products
  - ANSI C
  - Based on the MCC Information Sharing Protocol (ISP) Client Toolkit
  - ANSI C GSOAP-XML Directory Service API
- Parameter Service Broker Integrated Products
  - ANSI C
  - Based on the MCC Information Sharing Protocol (ISP) Server Toolkit
  - ANSI C GSOAP-XML Directory Service API
ISP’ is a revised version of the ISP protocol for SM&C compliant messages.
Parameter Service - Interfaces

1 SM&C ANSI C Implementation (MAL, Common Services, and Core Services).
Parameter Service - Interfaces

2 SM&C ANSI C GSOAP-XML Implementation (MAL, Common Services).
3 SM&C Java JAXB-XML Implementation (MAL, Common Services).
Parameter Service - Structures

- Parameter Service
- Containers
- MAL
- Domain
- EntityKeyList
- EntityRequest
- InteractionType
- IdentifierList
- MessageHeader
- StandardError
- Subscription
- SubscriptionList
- SubscriptionUpdate
- SubscriptionUpdateList
- Update
- UpdateList

Common Services
(Common Model)
- CompleteStatusUpdate
- Status
- StatusIdentifier
- StatusUpdate

Parameter Service
ParameterStatus

Attributes
- MAL
- Boolean
- Blob
- Double
- Duration
- FineTime
- Float
- Identifier
- Integer
- Long
- Octet
- Short
- String
- Time
- URI

Enumerators
- Parameter Service
- MAL
- InteractionType
- QoSLevel
- SessionType
- UpdateType

Containers
- NULL
- Element
- Attribute
- Enumerator
- Container
- NULL

Or
ANSI C Parameter Service

• ANSI C API Layer
  - Monitor Status operations support the Consumer-Broker-Provider interaction
    • SmcInitialize
    • CP_registerMonitorStatus
    • CP_deregisterMonitorStatus
    • CP_publishMonitorStatus
    • CP_notifyMonitorStatus
• MAL, Common Services, and Parameter Service Layers
  - Constructors, Destructors, Accessors
• Transport/Encoding Mappings
  - MCC ISP transport modified to support MAL PUBLISH SUBSCRIBE Pattern of Interaction
  - Binary Encoding of MO Structures
Results

• Four (4) RIDS against MAL Book
• Two (2) RIDS against Common Services Book
• Two (2) RIDS against Core Services Book
• Three (3) generalized RIDS across the MAL, Common Services, and Core Services Books
Lessons Learned

- Significant amount of effort to modify legacy applications for SOA
- Message sizes significantly larger for Mission Operations than for legacy telemetry distribution
Message Size

![Message Size Chart]

- **Publish**: Legacy 100, MO 300
- **Subscribe**: Legacy 300, MO 300
- **Notify**: Legacy 100, MO 400
Conclusions

• Findings
  - To verify the CCSDS MO Standards meets manned spaceflight telemetry requirements, at a minimum the Parameter Service must be evaluated with the Check Service
  - Large amount of effort to modify legacy applications for SOA
  - Message sizes are significantly larger for Mission Operations
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Thank You

• Questions
CCSDS Mission Operations
Parameter Service Demonstration

Screen Shots
1. Parameter Service Provider Log File
2. Parameter Service Broker Log File

```
<table>
<thead>
<tr>
<th>Time</th>
<th>Data</th>
<th>Value</th>
<th>Additional Info</th>
</tr>
</thead>
<tbody>
<tr>
<td>00000</td>
<td>C011</td>
<td>4200</td>
<td></td>
</tr>
<tr>
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<td>C011</td>
<td>4200</td>
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<tr>
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</tr>
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<td>00000</td>
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<td></td>
</tr>
<tr>
<td>...</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
```

```yaml
[msgHeader = {dataType = "x", endianism = 03, URIfrom = "lance", authenticationId = {19 bytes @ addr 349c400}:
  00000: 61EE 6FEE 7300 6F73 73 }}, URIto = "THERE", timestamp = 054/13:52:57.061, QoSlevel = 2, priority = 1, doMain = "otf", "parmnc", "sin"], networkZone = ", session = 2, sessionName = "ISP-InControl SIM", interactionType = 6, interactionStage = 3, transactionId = "parm_publisher(4)"], area = "1", service = "1", operation = "8", version = 1, isError = 0]
```
3. Parameter Service Subscriber Log File
4. Parameter Service Test Display

Quick Example msk Display of SMC Data

- ISP_SERVER_TIME: 054/20:05:31
- MET_sec: 773.001
- inertial_vel_mag: 773.002
- nonconserv_accel_mag: 773.003
- mach_number: 773.004
- geodetic_altitude: 773.005
- MISSING_PARM: M
- SIN0000: 45.399
- RAND0000: 48.725

Plot of SIN0000

History Tab of RAND000

0.508 054/14:05:30.839
2.386 054/14:05:29.873
4.392 054/14:05:28.849
35.994 054/14:05:27.850
34.396 054/14:05:26.864
73.675 054/14:05:25.850
95.896 054/14:05:24.833
82.133 054/14:05:23.860
53.103 054/14:05:22.850

/ Resized 626 x 477 (requested 610 x 475)