**CCSDS Spacecraft Monitor and Control (SM&C) Working Group**

**Spring 2017 Workshop - San Antonio, Texas, USA**

**May 8-11, 2-17**

**Minutes**

# Agenda



# Attendance

Typically had 15 attendees.

Anita Violet from Scisys (for UKSA) was the only attendee that did not attend any past meetings. She did a great job participating in the meetings.

Towards the end of the week the group size was smaller as several SM&C members left to attend the MOIMS Planning and Scheduling meetings. Work will be needed in future meetings to develop approaches for the joint meetings such that SM&C can still have a full productive week if needed.

# Day 1. Monday May 8, 2017

* Document Notes
  + No projects are currently behind schedule. CWE was reviewed and some updates were made based on the expected review and processing time required.
  + HTTP document - Sam met with Peter Shames on Thursday and resolved the remaining comments.
  + C++ API. Agency review closed last week. Comments received: DRL (4), ESA (14), NASA (23), INPE (0), CNES (0), JAXA (0). NASA has just started to review the RIDS, most are editorial. NASA is working to release the C++ API software as open source, but no date is available. Not clear which open source license will be used.
* Document Status  
  GB: MO Concept: 5y revision             Discussed in WG

BB: Monitor & Control Services (ESA, DLR)          4th AR   
BB: Common Services (ESA, CNES)          Submitted for AR   
BB: Mission Product Data Distribution Services (ESA, CNES)            Submitted for AR   
BB: TCP/IP Transport Binding / Split Binary Encoding (ESA, CNES)      Submitted for publication   
BB: HTTP Transport Binding and XML Encoding (ESA, NASA/JPL)          Submitted for AR   
BB: ZeroMQ Transport Binding (CNES, ESA)          Submitted for AR   
MB: C++ MAL API (NASA)            RIDs Received   
BB: XML Telemetric & Command Exchange (XTCE) (NASA, no prototype assumed)          Awaiting OMG Approval

* Working Group Mailing List

The WG discussed the current SM&C mailing list. It contains 134 entries. Should we have a core team list and a public list? What criteria should we use? Decided to scrub current list by asking each person on the list to confirm their continued desire to be on the list. [The email was then sent out and about 45 confirmations were received during the week]. Feel it is important that rules for being on a list and whether there should be multiple lists should be consistent across all WG’s and we therefore defer to the CCSDS management to decide.

* OMG Report

Mario Merri is the official CCSDS liaison to the OMG and is the only one designated to communicate with the OMG on behalf of the CCSDS. Others can always have general discussions with the OMG and even discuss and advocate for CCSDS, but we can not talk on behalf of CCSDS.

XTCE 1.2 is in the final steps of RID resolution and then will go to final sign off and publication.

Recent activities regarding a potential new planning/scheduling standard worked very well. OMG put together a DRAFT requirements document for a new standard and distributed within their working group for comment. NASA (and possibly others) identified CCSDS standards now in development that should be looked at. The OMG member that had written the draft document then looked at the CCSDS docs, decided they looked very good and had a team even run several of their use cases against the new CCSDS standards. The result is now that the OMG has decided NOT to initiate a planning and scheduling standards development effort. The OMG RFP was never released.

OMG is considering whether to work on space domain glossary of terms or ontology. They looked at the CCSDS SANA glossary and found that it is not a good reference to simply point to. There are many duplicate definitions, a mix of technical detail levels, etc. One idea is to have their own glossary and identify the source of various definitions (ISO, Wikipedia, CCSDS, etc.) with each definition. Not clear whether they will follow up with their glossary effort – it is a lot of work, especially if they move towards and actual ontology.

* Cool MO Services Demos

Stefan Gaertner provided a demo and presentation about the use of MO at GSOC/DLR. They are using MQTT for the transport layer. They did not want to use the ZeroMP brokerless services. They are using standard binary encoding now, but could change later. He also provided a list of approaches he used to “sell” the MO services concept at his agency. Some of these ideas will be used in the Green Book. Great demo using a small “phone sat” and MO services to take selfies. It has been used for public outreach and was very well received by the students that were able to make it work.

Mehran Sarkarati showed how they are creating a lightweight control center for use by 100+ experimenters. They are on sprint 2 of 12, but everything looks very positive.

Ian Harrison reported on ESA’s Lisa Pathfinder MO Services In-Flight demonstration study. It was a very valuable effort to show the ability of MO services to be used on board and on the ground in place of the traditional approaches. Many lessons learned and valuable conclusions are included in the presentation package to be posted. Valuable inputs for the Green Book.

* Start of Green Book Discussion. Discussion was started, see minutes for day 2.

# Day 2. Tuesday May 9, 2017

* Green Book Discussion

Sam Cooper led the discussion of the Green Book refresh effort. It is being completely restructures to address the needs of the many different user types that will try reading it (managers, developers, etc.). Although Sam is coordinating the effort, the update is being developed by someone else as a way to ensure that it is not simply written assuming one already knows everything about MO services. An agile documentation approach is being used with partial updates to be sent around for review on a fairly regular basis. It is important that the entire WG help in this process.

* Operations Scenario Exercise

The working group split up into team to create scenarios to demonstrate the use and benefit of MO services. Each group then reported out. The intended value was to get the whole team involved and to share ideas as we show the breadth of benefits possible with MO services. It was felt that these objectives were met and also that important inputs for the Green Book were developed.

1. Simple multi-agency tlm data exchange. We know we have instrument tlm and the downlink bits. Use mission data product service to alert that data is there and then they could retrieve it. OR, could use action service to send known commands and reply with error message if execution is not allowed then (conflict). For the 4 agencies on the scenario team, they exchange software now. For green book, a simple use case like this is good. Could drop the commanding part and focus on the telemetry.

2. Inter-Agency Gateway. Assume that the many agencies have many missions involving collaborations. Instead of thinking of the single-mission scenarios, why not have Agency-level gateways that could communicate using MO services for many missions? One side of the gateway could interface via MO and the other side would communicate with whatever the agency ground systems require (may or may not be MO). The group was concerned that this approach will only work if the entire world for all collaborative missions agreed on a single encoding and transport. However, Sam pointed out that some of the MAL implementations already support multiple encodings or transport and it would be better to have the gateways support multiple options. It was felt that the Green Book should include this scenario.

3. Complex moon or mars mission with surface assets. System of systems, with a diverse set of assets with different governance models. But need broad situational awareness. Comm needs to become a utility. Automation, scheduling, etc. would benefit from MO services. Lots of players. Too many services used in too many places may tend to suggest a very complex system. It is important now to overwhelm people with complexity when detailing such a scenario. Mehran pointed out that some of the scenario ideas go beyond today’s standard payload missions, but that MO still works – it is basically like flying a Mission Ops Center.

4. Radio Science Experiments (involving space and ground elements). PI has a Radio Science Experiment on a spacecraft of two different space agencies. PI uses ground antennas of multiple agencies (potentially also including the agencies hosting their space elements).   
  
Traditionally the PI schedules Radio Science experiments long in advance by booking time on ground antenna and also booking time on the spacecraft when a common spacecraft antenna is Earth Pointing. The experiment is then preplanned and space and ground elements preconfigured for the science to be conducted. The data is then recorded on the spacecraft and at the various ground antenna and sent off-line to the PIs for processing and analysis.   
  
Radio science could be improved by allowing real-time access and processing of the space-element and ground-element science-data and then updating the configuration of both space and ground elements in pseudo-real-time (OWLT can be 20+min) during the experiment.   
  
MO\_Services can support this improved science experiment concept by providing a common basic M&C interface to the Agencies flying the Space-Element and to the Agencies providing the Ground-Antenna-Element. This MO\_services would be provided as a secure MO-Service Gateway/Bridge outside of any Agency Operational LAN to the Control-System of the Spacecraft and/or Ground Antenna, and would allow real-time (and offline) streaming of a limited subset of parameter values from the control-system to the PI, and allow specific configuration update requests to be sent to the control-system which would then be commanded onwards to the Space and Ground Elements.   
  
MO\_Services would be a common interface provided by all the Agencies supporting the PI experiments, the interface would be common whether the commanded element is a space or ground asset. Such MO Gateways are easily adapted to new control-systems or security updates and can easily support the addition of new space and ground elements to an agency.

* COM RID Review

Reviewed several RIDs from CNES, no issues.

* HTTP Prototype. Brian Giovannoni described the JPL plans for completing the HTTP prototype of the next several months. The effort is greatly simplified through the use of the ESA JAVA MAL. JPL plans to make the software available as open source with the Apache License. ESA will develop the yellow book. It was suggested that Brian’s team document lessons learned and issues encountered during the development effort.
* Advocating for MO. Mario encouraged the team to focus on something achievable. Start on ground, keep it simple. Work on ground-ground. Could show progression to space systems. He thinks that product distribution may be the winner app.

# Day 3. Wednesday May 10, 2017

* SOIS EDS discussion. Richard Melvin provided a detailed description of the purpose and value of the SOIS Electronic Data Sheet (EDS) concepts. Whereas the EDS has the knowledge for the direct device connectivity and interfacing, MO is more of the abstract user-control service interface. It seemed clear that MO with an EDS device adapter, could be very powerful combination. EDS and MO complement each other.
* Time Service Action Discussion. The WG discussed Time Services as presented in IOAG Catalog #2. We found the Catalog #2 descriptions very confusing. Recognizing that time requirements exist in all aspects of a mission – space, ground station, nav, mission ops center, etc., it is probably best that Systems Engineering take a lead in this area, but that SM&C would like to be involved from the MO Services viewpoint.
* **NASA’s view on standard formats**

Dan Smith presented NASA’s challenge of supporting very small programs and many small-needs users using MO. For example, if all someone needs from a mission are the converted values for 5 telemetry points, they don’t want to bring in a full MO services system. Sam Cooper showed how the underlying data exchange messages associated with MO can be identified for NASA to use in such a case. NASA plans to look at all the functional MO services, identify which functions may be of value for interoperability in small missions, and then look at the underlying simplicity of the data formats. Of particular concern are service data formats which implicitly require other services. For example, to request 5 parameters, you can’t just specify the parameter names, you need to specify the IDs assigned to those names by other parts of MO. NASA will report out the findings this summer.

* **Future Directions and Projects**

With the near completion of all active projects except for the Green Book refresh, it is important that the working group determine what areas to work on next and to gain the agency resources/commitment for the documents and prototypes. We started with a large list and everyone is asked to provide additional ideas. Below are the items, separated into the list of things already in progress, those still up for consideration, and several that the team decided we should not keep on our list of candidate efforts. Dan Smith took an action to distribute the list of potential work areas to the WG members to find out the level of interest and commitment (including allocation of resources) by the agencies. The automation entry (1C below) seemed by many to be the best one to work on next.

**In Progress**

1. Team work on Green Book Update
2. Data exchange formats for interoperability for non-MAL users (NASA)

**To be considered**

1. Anything listed as a DRAFT SM&C Project
   1. Time service
   2. Software management service (load, dump, verify image)
   3. Automation service (ground or on-board procedures).
   4. Remote buffer management
   5. Remote file management
   6. Nav, scheduling, planning request - covered by other WGs
2. Display pages – alphanumeric and/or graphical [some use cases]
3. Spacecraft characteristics (protocol, data rates, etc.) [emergency commanding use case; could use SANA (others already working)]
4. Time Services per IOAG Catalog #2
5. File transfer/management [terrestrial file management effort to cover this?]
6. Services for relay operations (clarification needed, probably not MOIMS)
7. Move MO closer to EDS. Can we have a generic “Control Device” service?
8. Others – ideas yet to be identified by the agencies

**No interest expressed by working group**

1. Parameter/mnemonic naming conventions
2. Multi-mission common services – i.e. GPS service, star tracker service [
3. Mission OPS glossary of terms (using current SANA registry)
4. Cloud-based tools for interoperability and cross-Agency mission ops work and data sharing
5. Formats/templates for documents and technical memos [could be Systems Engineering]

* Joint Meeting with DAI. John Garrett led a very good discussion by the DAI WG on their approach to handling very long-term archives. They start new architecture work over the next few years and would like to base it on SM&C. We will continue to share information with them. They deal with Open archive information system (OAIS). They have well defined terms and concepts.

# Day 4. Thursday May 11, 2017

System Engineering Overall Architecture Discussion. Peter Shames gave a full presentation on the reference architecture and where the SM&C efforts fit in. He is still updating the charts and will provide them to Dan Smith for posting within the next week or two.

**WG Concluded at noon**

# Actions

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| --- | --- | --- | --- | --- |
| **ID** | **ACTION** | **ASSIGNED TO** | **DUE** | **NOTES** |
| 20170511-1 | Scrub email list | Dan Smith | June 15, 2015 |  |
| 20170511-2 | Figure out the SM&C ties to Planning and Scheduling WG and how to handle joint meetings in the future without stopping SM&C early. | Mario Merri, Dan Smith, Mehran Sarkarati | September 1, 2017 |  |
| 20170511-3 | Send out list of potential next work areas and solicit responses back from the agencies | Dan Smith, ALL | June 15, 2017 |  |
| 20170511-4 | NASA to develop the list of potential services (and associated data formats) for agency interoperability for simple missions and look at any implied dependencies on other services. Report back to the WG on findings. | NASA | August 1, 2017 |  |
| 20170511-5 | Document lessons learned and challenges encountered in the development of the HTTP prototype by JPL. | Brian Giovannoni | October 1, 2017 |  |

Note that the CCSDS Secretariat has uploaded Phil Liebrecht’s presentation to the CESG under the CWE > CESG > Meetings. The folder is located here: <https://cwe.ccsds.org/cesg/docs/Forms/AllItems.aspx?RootFolder=%2Fcesg%2Fdocs%2FCWE%20Private%2FMeetings%2F2017%20Spring%20Meeting%2C%20SwRI%2C%20San%20Antonio%2C%20Texas%2FCESG%20Opening%20Plenary%2C%208th%20May%202017>