**Green Book R5 Feb 2019 Comments**

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Intro. Mention that MO is designed with a set of well-defined service specifications, but also with enabling concepts for users to add their own supplemental services as needed.

General. Glad we did not say we have standardized an architecture or a system design. May even want to explicitly point this out.

1.1 Definition of “Managers”. Don’t say “We use . . .”. Change to “Manager stakeholder refers broadly to anyone . . .”. Check for other cases of “We” throughout document.

1.1 May want to add a mission designer stakeholder who considers the allocation of functions between space and ground systems and the applicability of new technology or operations concepts for missions in the early design stages.

General. “Agency” or “agency”. Let’s use “agency” unless it is a name like “Agency A.

2.1.1 Radio Astronomy. Are we suggesting that the radio telescope facilities also implement MO?

2.1.4 Small Satellite Earth Observation Constellation. Point out that this is all under a single agency. That they are small sats or a constellation is not really the point. The point is the value of having a common internal approach to building systems for different missions within an agency.

2.2 Intra-Operability. There are a lot of MO service specifications that are designed for intra-operability and not for inter-operability. Should be more clear that we are not just talking about using the inter-operability interfaces internally.

2.3 MO Vision. Let’s expand the thought a little. “Heritage control centers, for example, may find very limited but crucial uses for MO standards when interfacing with other agencies for specific purposes.”

3.2 We need to decide what to do about services not yet written. This section makes it sound like we already have Planning Services and Automation Services and there is no mention of Navigation Services. I am not sure of the best approach. OK to list them all as a “vision of the mature MO”.

3.3 Service interactions. “MO calls each bit of information sent between the consumer and provider a message.” Please don’t use the word “bit”. A 16-bit parameter does not require 16 messages.

3.4 Communications mappings. It is implied, but we should make clear that cooperating systems must match each other on communications mapping and encoding technologies. This becomes a big deal when adding in the desire for reuseability and general common approaches between agencies.

3.5 Data Formats. The statement is made that “The data format approach does not define how that data is to be used, or how it is transferred, this is left to some agreement between the two organisations: “. Change to “The data format approach does not define how that data is to be used. As with the service specification approach, there must be agreement on the communications approaches to be used to transfer the data.”

Figure 3-6. Change “Undefined” to “Agreed between organizations”

3.5 Data Formats. The Green book is not where to state someone’s position on things that are “not actually true”, perceptions, etc. Please leave those thoughts in an ESA internal whitepaper.

 3.6.2 Radio Astronomy Example. Should point out that this is an ideal place to use formats instead of services when getting data from the radio astronomy sites since they may have many other interfaces and are not created as mission operations centers. Then use MO between agencies.

3.6.3 Lunar Exploration Mission. Very good to point out that the more there are systems using the same standards, the easier the communications and management become. In reality, one needs to expect a mix of commercial and agency systems with a mix of protocols and communications technologies and that MO can be a key uniting factor in a hybrid system. Do not expect everyone to jump to MO. Also it is not clear whether MO is being suggested for the space elements – if so be very clear that new ops concepts like this are enabled by MO.

3.6.4 Small Sats. We say MO scales well to large constellations – please explain how. Can a single app support any number of satellites? With satellites coming in and out of view, can they be managed without satellite-specific sessions and setup? IN the diagram there are no MOcommunications between manufacturers and the agency, not clear what the diagram is trying to show.

4.3.3.1 Archive Service. We need to repeat the note that many of these services may not pertain to all systems. For example, interagency interactions may never include archive storage requests since archives are controlled by a local agency internally.

4.4 Common Services. For inter-agency interoperability do we require these services? The goal often is to create the simplest interface possible. This sounds like we are creating a sophisticated service framework. Most missions I know would therefore go back to the formats approach with all of its benefits.

5.3 Standard vs applications-specific services. The discussion of the Action service is the first time in the document I have seen that MO services go down to the functional level of device on/off management, etc. and including the control of remote or space-based elements. This is a big deal and a major change that NASA has not moved to. Somewhere we need to highlight that MO is enabling this new concept that may bring benefits to many future missions (or, more probably, NASA will continue with easier approaches).

5.4 Development Tools. Should probably state that the list is as of early 2019 and be clear that these are agency-developed with no CCSDS claim of validity or operational worthiness. Also, the list of tools should fall under 5.4 instead of being their own sections.

Figure 6-1. Not clear what the colors mean so not clear what the diagram shows. Maybe label the tan boxes as “Non-MO . . .”

6.3 Integration. “The use of standard CCSDS specifications removes the need for this, the only aspect required is the mapping and selection from the standard MO services.” We already have a standard approach of using CCSDS standards – AOS telemetry packets plus XTCE files to our partners – much easier than jumping to MO and adding a parameter services suite.

7.4 Longevity. A concern with such a large specification is longevity and handling changes to the MO spec itself. We should state that service names and ops codes should never change, but new features and opcodes will be added and are expected. Need to explain that MO can grow with time.

8.1 Communications Architecture. There are many COTS packages available for moving messages that include some aspects of security, validation, etc. We should discuss how two systems that use IBM Message Que or some other product can still use MO. We don’t need to know the on-the-wire format when using these products.

8.2 Overview. “For a mapping to a programming language, the specification will define how to transform from a service specification to a high-level API in that language . . “ Does this mean that the language bindings must be updated each time MO adds a new service and that users should develop an internal supplement if they add their own services? Seems like an important item to discuss.

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