



INTERAGENCY OPERATIONS ADVISORY GROUP

IOAG-19 Meeting

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IOAG-19 Meeting Minutes
Daejeon, South Korea (KARI)
11 May 2015 – Day 1
08:00 – 17:00 KST

Attendance:

Chair: Michael Schmidt

Secretariat: Stephanie Wan

Members:

ASI: Fabio D'Amico

CNES: Jean-Marc Soula

CSA: Ken Lord

DLR: Martin Pilgram, Rolf Kozlowski

ESA: Nestor Peccia (CCSDS Liaison), Enrico Vassallo (SFCG Liaison)

JAXA: Tsutomu Shigeta (C. Harada and S. Nakamura: Wednesday only)

NASA: Phil Liebrecht, Les Deutsch, Dave Israel, Wallace Tai

Observers:

KARI: Sang-II Ahn, D.J. Park

CNSA/CAS: He Shanbao (Tuesday and Wednesday only)

SANSA: Eugene Avenant (Agency Report only)

Teleconference:

NASA: Barbara Adde (Monday), JJ Miller (IOAG Liaison; Monday), AJ Oria (Monday), Dan Smith (Monday)

SANA: Marc Audric

1) Opening/ Opening Remarks, Logistics, Introduction of IOAG Delegates

The Chair welcomed everyone to South Korea, and thanked KARI for hosting. He noted that the first two days of the meeting will be held at KARI, and the third day will be at the Daejeon Convention Center to conduct the joint Agency Reports with SpaceOps.

Dr. Ahn welcomed everyone to Daejeon. The IOAG delegates introduced themselves and their affiliation.

2) Agenda Review

The Chair provided an overview of the agenda, which was approved by the IOAG delegates.

3) Chairman's Report

The Chair noted that there are new participants in IOAG, including ASI's new representative, Mr. Fabio D'Amico. He noted that CSA has participated since IOP, and more recently CNSA has shown more interest. The South African National Space Agency (SANSa), currently an observer, has shown interest in participating. Unfortunately, Russia and India continue to have no or limited participation. There has been no contact with the ISRO representative for the past two years (since IOP) and RFSA continues to show interest but there has not been any feedback on representation due to the agency's reorganization.

The Chair provided a general update on the active working groups, MOSSG and SECSWG. He noted that the SECSWG activities have evolved and will require discussions on how to further proceed at the meeting. The IOAG should review the LEO 26GHz report to see what has evolved. While OLSG has not been active lately, there are different optical communication activities within several agencies.

The Chair commented that one new area of work has been on exploration, specifically with the International Space Exploration Coordination Group (ISECG). With the possible goal for a habitat on the backside of the moon, relay communications would be needed; there is also strong interest in optical communications. The IOAG SISG reports have been forwarded to ESTEC for information on discussions regarding space communication. Regarding the Consultative Committee for Space Data Systems (CCSDS), there are currently good synergies; the Chairman will attend the CCSDS meeting in Nagano next week and present an IOAG report. Regarding the International Committee on Global Navigation Satellite Systems (ICG), there has not been too much evolution of ICG/GNSS. The ICG Liaison, Mr. JJ Miller, will represent the IOAG at this meeting; the IOAG will consider how best to maintain the navigation database.

JAXA addressed the agencies' optical and Ka-band communications activities; their optical data relay satellite planned to be launched in 2019 will be used for the advanced earth observation satellite which also has a direct 26GHz downlink. The JAXA Space Tracking and Communications Center is engaged in developing ground segments for the 26GHz antenna. This information is included in JAXA's agency report, but since the Wednesday presentation is limited, he suggested presenting this in relevant agenda items.

4) Secretariat's Report

The Secretariat requested member approval of the IOAG-18d teleconference minutes. CNES requested confirmation that all comments had been incorporated in this version. A new version will be circulated for review and approval. The Secretariat then noted that all the IOAG action items were up to date, or were on the agenda for discussion. She then displayed the IOAG member agency attendance, noting the growth in memberships and increased participation. The

Secretariat then provided the reference table status, noting that most agencies have contributed to updating their top priorities, communication assets, and mission models prior to the meeting.

5) CCSDS Report

The CCSDS Liaison, Mr. Nestor Peccia, provided an update of activities, noting that the next CCSDS meeting will be held the following week in Japan. There are now 20 working groups, since the Cross-Support Space Communications Architecture working group has now published its report and has been disbanded. There was renewed health of CESG after reorganization. For example, two positions in SOIS had to be replaced. As a result, the organization needed to find the necessary experienced staff to continue consistent work.

There are 141 current active publications, with blue and magenta having 86 and green having 55. He then provided statistics of polls, highlighting that the most important are the magenta books, MOIMs 5 year review, and SOIS RFID encoding. CCSDS has retired two projects to the IOAG-CCSDS Priority Agreement (ICPA) database for discussion. According to the poll statistics, there are many position changes in the last six months, with about two books produced per month.

The past CCSDS meeting in Pasadena was well attended. There were many invitation letters for personnel from Russia and China. JAXA commented that JAXA, like most major agencies, could not dispatch more than 15 participants to the last two meetings since they were held in late March and conflicted with the Japanese end of fiscal year. Mr. Peccia responded that next year's meeting will be held in the beginning of April. In terms of agency participation, NASA's participation increased. It was noted that based upon the priorities of the space agencies, there is an imbalance in attendance; ESA noted that they attend mainly when there is an agency priority.

Mr. Peccia then provided a summary of the Area Summary Report and noted that there will be three new updated SIS green books and one blue book ready at the end of 2016. He planned to discuss the ICPA the following day. For the System Engineering area, they are using the Cloud to test protocol to avoid having a firewall. CESG decided to use a prototype for testing data link security. They will need to see how to put all things together in the working group; the area director is also looking for resources. He also noted that the SANA Steering Group decreased.

As the Cross Support Area is of most interest to IOAG, the Chair asked if CSTS will be consolidated. Mr. Peccia noted that they are working on the next project, but again the problem is on resources. One of the basic books IOAG is asking for is the File Transfer, and CCSDS does not have resources. One of the members is producing the Blue Book but there are no prototypes.

For the Optical Working Group, DLR noted that there was a proposal from NASA at the CCSDS meeting. DLR asked how the proposal was moving forward. CCSDS responded that they are starting to go through the issues and it is still under discussions. Consensus requires time for people to discuss. The Chair asked if there is an issue with the wavelength, and asked if there is a

forum to discuss this since the issue is arising elsewhere. NASA asked CCSDS technical experts to deal with this as they want interoperable standards, and DLR agreed. CCSDS responded that if there is no agreement by November, then it will be elevated. The Chair asked about the method for coming to a solution; CCSDS is looking for a common coordination, and DLR responded they will check with their agency. Mr. Peccia noted that the potential for incompatible standard is a suboptimal approach and not the best way forward, as the Optical area is currently a “hot potato.” IOAG noted that ISECG is also looking at an optical solution and had asked CCSDS so IOAG would like to report back. There are a couple items for consideration, as the Lunar-Earth is close to deep space and is a lot harder than GEO to Earth link. NASA noted that they accept to use the evolving deep space optical standard for lunar missions. Also, projects are heading towards Mars.

Next, the IOAG priority level was shown in ICPA. ICPA has 17 approved projects; CCSDS is compliant with the IOAG need dates, but they may get past IOAG potential dates. There will be further discussions tomorrow. NASA noted that ICPA has served IOAG well as a tool.

6) ICG Liaison Report

ICG Liaison, Mr. JJ Miller, provided an update on the activities within the ICG. The key now is to continue sharing IOAG and ICG’s assets with each other, as compatibility and interoperability is key. The next ICG meeting will be hosted by the United States from 2-6 November 2015, in Boulder, Colorado.

He then noted that the Space Service Volume (SSV) activity is being discussed in Working Group B, but there are other topics focused on reference frames, satellite laser ranging, and geodesy. He pointed out that the National Space-Based Positioning, Navigations, and Timing (PNT) Advisory Board’s Vice-Chair, Dr. Parkinson, made a presentation emphasizing the need to protect, toughen and augment PNT assets. He further noted that Dr. Parkinson suggested other GNSS providers charter similar Advisory Boards so the user groups can provide input to the provider on its services.

Mr. Miller discussed expanding SSV as there is interest in the system performance out to GEO. In the late 1990s, GEO was selected as an option but there was an availability problem: due to the geometry in MEO, there are only one or two GPS satellites in view.

With Triple GNSS to process GPS, Galileo and GLONASS signals, the market is heading towards multi-GNSS and we are getting more experience. Mr. Miller provided a graphical depiction that illustrated the many ways that the US is starting to use GPS in the space domain. Since NASA’s Space Communications and Navigation Program manages tracking networks, it also provides a better position fix.

Mr. Miller summarized the Working Group B activities, and noted the IOAG Chair’s participation. One of the primary goals for IOAG has been to educate other providers on

adoption of SSV. For example, there were two Galileo satellites in the wrong orbit and the ESA representatives wanted to use their signals for alternative use. Therefore, it is important to stay proactive and educate the group on signals in space domain.

Mr. Liebrecht noted a schedule conflict with ESA and NASA participation for the next ICG meeting in Boulder due to SpaceOps obligations. However, it would be good to have someone representing IOAG to attend. The Chair asked Mr. Miller if he can continue to participate on IOAG's behalf, and Mr. Miller agreed.

Concerning the GNSS model, the Chair noted that it had been updated in the last six months, but perhaps it can be updated for the upcoming ICG to see what else is available. The Chair asked the agencies to please provide their input to Mr. Miller. The database is maintained for the IOAG and shared with ICG.

AI 19-01: IOAG members to update table for missions that plan to work with multi-GNSS in order to provide inputs by ICG-10 to Mr. Miller. [Due Date: 1 Oct 2015]

7) Space Frequency Coordination Group (SFCG) Liaison Report

The SFCG liaison, Mr. Enrico Vassallo, focused on the schedule of World Radiocommunication Conference (WRC)-15 and the status after the Conference Preparatory Meeting (CPM.) He presented the WRC Agenda Items (AI) that are of interest to IOAG:

- *AI 1.1:* Additional spectrum for international mobile cannot be compatible and share the bands with space science services. The 2 GHz bands are no longer candidate bands in the CPM report.
- *AI 1.9.1:* The CPM report indicates that sharing between fixed-service satellites and space research missions is feasible under a number of regulatory constraints and in worst case conditions with operational coordination for deep space missions. Space agencies have to determine when the operational coordination is needed and this is a burden for space agencies. SFCG agencies are against the possible allocations.
- *AI 1.10:* With regard to MSS allocation, many sharing studies have not been done and the ones done indicate interference to space research and inter-satellite missions.. Active participation is required at the WRC-15 to fight against this allocation.
- *AI 1.12:* There is a transmission constraint to avoid the possibility of damaging the space research station receiver in an ITU-R recommendation that will be incorporated by reference in the Radio Regulations. No issues for SFCG.
- *AI 1.11:* This was proposed by SFCG to offload the densely populated band. It is adjacent to the deep space band. The CPM report Method A is aligned with the position of SFCG and China. The only agency opposing is Russia because there is a different service in Russian territory. France/CNES is abstaining.

- *AI 1.13*: This was to remove a 5 kilometer distance limitation to space-to-space links, and there is currently no objection.

Mr. Vassallo noted that here is also a new item relevant to IOAG that is listed on the WRC-15 draft agenda for WRC-19, which is potentially critical for space research services. Within the 6GHz to 100GHz for IMT, there are potentially many bands under threat from the International Mobile Telecommunications (IMT). The goal is to limit the number of frequency bands affected.

Mr. Vassallo concluded that a number of IOAG agencies are already cooperating at the International Telecommunications Union (ITU) level. It is recommended to continue active contribution at the ITU and regional preparatory meetings in accordance with the SFCG strategic goals and to express the concerns to respective space agencies so that a balanced national/regional position can be taken. Furthermore, he recommended that IOAG members focus additional efforts on **AI 1.9.1** and **AI 1.10**, where new allocations are deemed problematic for IOAG interests. Additionally, he asked all agencies to support the SFCG effort to limit the scope of a new WRC-19 AI on broadband mobile (6-100 GHz).

A question was raised regarding the possibility of holding off the 2-GHz IMT threat indefinitely. Mr. Vassallo said it is more difficult in Europe to obtain a license at 2 GHz. Military mobile systems have priority over half of the band in Spain as of January 2015. ESA and JAXA have to stop 2GHz use in Perth from 1 January 2016. It is hopeful that it can be kept for Data Relay Satellites (TDRSS, DRTS, etc.).

AI 19-02: SFCG asks member agencies to strongly relay the concerns pertaining IOAG interests to their national and regional spectrum delegation, as soon as possible, in time for related WRC meetings. [Due Date: 13 July 2015]

8) Mission Operations Space Study Group (MOSSG) Report

Mr. Dan Smith introduced himself as the new US MOSSG co-chair. He stated that CCSDS has been developing standards on Mission Ops Services for over ten years. The IOP chartered IOAG to consider mission operations (MO) services as a higher level agreement between agency and missions. The MOSSG has been holding biweekly teleconferences. Some expected products include a study report, Priority Service Catalogue on MO services, and prototyping simulation or demonstration, but there is a lack of resources.

The team's work is not expected to include development and prototype work. Since the last meeting, there were some personnel changes. The technical presentation Mr. Kearney provided last year to spacecraft monitor and control group noted development has been slow and ICD documentation is still needed. Mr. Kearney had challenged the CCSDS group to work on configuration service for automation. The MOSSG group would work with the CCSDS group to present initial thoughts and services.

MOSSG is currently working on the document but the trouble is that it keeps on increasing after finding more things to add. There is concern about not having all the valuable content conveyed to the CCSDS working group, and it has grown to about 70 pages. The book emphasizes complex missions; they would like to see if interoperability issues can be worked into them. Then they decided to step back and try to understand the simplest mission first, so it is easier to talk about. The group discussed the underlying basis on gaps and processes.

Due to the lack of resources, a short report will be created for IOAG, highlighting items that the group found to share with CCSDS. CCSDS needs to receive something from IOAG; the working group will continue with the work that is planned, but if they cannot deliver the whole document, then they hope IOAG can use the shorter document.

The content in the short report will answer key questions on scope. A number of agencies and Centers have expressed the need for interoperability services and a definition of interoperability, as it is very diverse. The report will look into what is an appropriate scope and definition of interoperability. The group developed an assessment criteria and approval process.

There are some key questions in terms of suitability assessment and how to meet interoperability objectives, and how well the MO services standards can be adopted. The common core agreed to MO services, and this will be the prime use for all future missions in 2017/2018. Another key question is if missions really apply the functionality or use the services already available.

A question was asked whether there would be any activities from NASA required, and the response was that there are prototyping efforts only but no missions where the agency would want to use it yet.

In terms of service quality, a key question is how well integrated the SMC and other MOIMs have compatibility with lower level standards. MOSSG tries to use the missions today for analysis of tomorrow's missions to develop more concrete examples and various programs.

Therefore, a strategy must be carefully chosen for MOSSG when reviewing all the services and where to add it to the standards. When there is a service, there are many functions; the question is whether the agency wants to meet basic interoperability needs and add capability, or survey a mission in order to develop a fully implemented standard? The general thought is for an operational use for the lower end and basics to be done, and a growth path and outside formal standards. The suggestion is to see what happens on level 1 basics and level 2 enhancements. It would be valuable to clearly document the challenge of super set versus subset, and grow additional services over time.

Looking at Catalogue 3, it is designed as a set of generic MO Services that could be the baseline set of exchangeable service for interagency operations for nominal scenarios and contingency cases. The question is how to assign priorities to Catalogue 3.

DLR asked about the preliminary list and which services are covered by MO services. Mr. Smith noted it is the plan for the preliminary assessment of the list. There are different ways to think about telemetry services.

NASA noted there was a survey conducted and asked if the survey results were used in consideration with the priority. Mr. Smith stated that it has not been consolidated for MOSSG, but there have been some ideas to use it in the MOSSG catalogue. They are taking into account the importance of different services and planned missions; there is still a need to consolidate the priorities. It has not been discussed in the working group yet.

MOSSG then provided examples of Catalogue 3 operations services, noting that the next plans are to continue bi-weekly telecons, and hold a MOSSG meeting in Darmstadt in November. He reported that on the whole, he was impressed that people were active and comment on each other's work despite the low level of resources. The team has milestones; if there was more resources then a full report can be completed in 2016. The Chair asked for clarification on the meaning of more resources. Mr. Smith noted that if participants had more time in the group. Each person only has a small fraction of the time allocated. He noted that by the end of summer, they would be prepared for the November meeting.

9) ISECG Liaison Report

Mr. Liebrecht noted that he had a conversation with the US ISECG co-chair, Ms. Kathy Laurini, and that there had not been any recent activities related to space communication within ISECG. He noted ISECG recently had a meeting in Pasadena.

The ISECG Docking Standard activity group is only beginning to meet, so Mr. Liebrecht told Ms. Laurini that it is within the scope of IOAG and CCSDS to use those groups for consistency. The Chair asked if the docking standard would be the baseline; are JAXA and NASA driving the standard? NASA said they did not know, as the ISECG docking group is only focused on CIS-lunar operations and were not at that point yet. ESA expressed concern about the lack of re-utilization of related technology; for example, the Multi-Purpose Crewed Vehicle (MPCV) does not allow reutilization of docking technology, which was developed in the past.

The Chair noted ESTEC robotics and exploration and identified five areas: docking robotics, standardization of sample return to habitat, re-usable cis-lunar habitat, and operations scenarios, and suggested looking into it for IOAG in the near future.

CCSDS noted that tele-landers, crew training, refilling of used vehicles in propellant types and conditioning are outside the scope of CCSDS. CCSDS raised the issue of the case of a mission requesting these standards, and currently does not have the expertise. NASA agreed with this concern. The Chair noted there is no concrete work expected from IOAG and he will keep an eye on the exploration roadmap, as it is too early to develop anything but the group should be prepared to jump in.

The Chair asked if any agencies would be interested in further analysis on these types of operational interfaces with scenarios. ESA and NASA noted their interest. JAXA responded that JAXA's concern is the JAXA Space Tracking and Communications Center is not engaged in this type of activity. CNES noted there may be interest in the agency, but for ISECG, they refer to IOAG for communication not operations. NASA said they will wait to see what ISECG would come up with and see which ones will align well with IOAG and CCSDS, since it would not be good to reinvent a new group when there is an existing process. The Chair responded that for SISG, it is good to make resources available and add experience.

CSA commented that they are in ISECG and would be interested in tele-robotics and docking. KARI noted the agency's plan for lunar explorations, but resources may be limited and he may need to ask his department. ASI noted that two agency representatives already participate in ISECG despite no lunar program, and he would need to check with his colleagues before providing his response to IOAG. DLR noted the agency was in the robotics working group in CCSDS and some of the issues can be covered there.

10) Space Emergency Cross Support Working Group (SECSWG) Report

Mr. Tai provided highlights of the SECSWG's goals and the working group's meetings. He provided some issues and recommendations. He noted that providing emergency support is a current relationship between agencies with bilateral agreements. However, it deserves to have an explicit definition for emergency mode. NASA asked if it can already be annotated; Mr. Tai responded yes, and the explicit definition is in the SECSWG report.

The question is how to provide emergency support to agencies with no cross support agreement; can there be an umbrella agreement so there is no need for a bilateral agreement? Then emergency cross support can be achieved with or without bilateral support.

There are also legal and liability issues: language must be developed in such a way that in order to encourage cross support, the supporting agency shall not be held liable for consequential damages. In terms of radiofrequency operating license, it is hard to have one global solution for all agencies. Mr. Vassallo noted that in Australia, a license is needed to receive even under no protection clauses. NASA asked whether most countries can come up with rapid authority to radiate/receive. In Europe, there is a three month waiting period. Instead of emergency, perhaps the term "safety of life mission" should be used. Mr. Tai noted it may be easier for some countries; but others may find it more difficult. CNES commented that when there is planned cooperation, it requests licensing for bands. This is something that can be done in IOAG. Mr. Tai noted the multilateral guideline can be useful for legal and liability issues. ASI noted another legal issue to check into is the feasibility for cross support and systems for emergency support. Japan noted Australia is similar and it is a challenge to receive authority. CSA asked if there is a consequence for "inaction" - by inaction, you cannot be held responsible. Mr. Tai agreed.

Mr. Tai then noted that the asset and mission databases will help identify emergency cross support. He noted emergency cross support is very local, national, and region-dependent. If we want to make IOAG value-added, this is an area that IOAG can help. This can be leverage when negotiating with the license authority. NASA suggested using language such as “expedited” to avoid misinterpretation.

Regarding interoperability cross support, development of a multilateral guideline help reduce response time. However SECSWG found out it may not be meaningful because each emergency case takes different types of effort. Reducing response time requires mechanism and readiness to support. At a minimum, each agency can have a contact point for Spacecraft Emergency Cross Support. The Chair noted the two possibilities: one can be the shift personnel in the control room (but they can only have predefined procedures but no real background). The other is defining a person as the main contact point. Mr. Tai suggested the former; this will be at a higher level multilateral guideline and each agency will have internal processes. The common points of contact can exchange information as necessary on procedures.

In terms of Support Priority, IOAG member agencies would adopt the priorities as proposed by the SECSWG. In the unlikely scenario where multiple spacecraft requesting the SECS support simultaneously and are at the same high priority level, then a mechanism of adjudication may be needed. Mr. Tai recommended that this be addressed for consideration. The IOAG may have to define a common database. Mr. Tai said ground-to-ground capabilities are buried in the services catalogue and should be more explicit, such as how to quickly acquire ground-to-ground communication. NASA asked if the group proposed to pre-populate so they can do emergency cross support in advance, or to exchange information quickly when necessary. CNES commented on the potential to just use prepared services since if a satellite is lost, it usually occurs on the first day. Mr. Tai noted the problem domain is the additional work that needs to be taken. If two satellites are lost, then the guideline would be to only resolve the conflict with priority.

For these recommendations, Mr. Tai also noted that he does not recommend an absolute duration for the readiness of SECS. A pre-defined time duration may not be very meaningful while some agencies may have their own restrictions.

In terms of services provided:

- 1) Safeguarding emergency support capabilities: IOAG should keep a record of the cross-support capabilities and utilization, and agencies should make a commitment to safeguard these capabilities.
- 2) IOAG charge for the support: maybe a ‘credit based system’ to provide and receive reciprocal arrangements. ASI noted attention should be put on reporting humans/astronauts in emergency.

The working group will work on a definition for emergency contact points. The group definitions will be completed by September 2015 and have time to finalize the entire report. NASA noted

this is a good report by the group and something IOAG can tackle and add value. A multinational agreement may be difficult to do, but a multi-agency guideline or approach can be a bit more feasible for agencies.

CNES said that would be a resources issue: a station-satellite compatibility matrix needs to be established and be available very quickly. NASA suggested providing a minimal subset. A few questions were raised. NASA recommended that IOAG prepare a standard set of parameters to support; ASI suggested the umbrella interface. CSA asked how long a satellite would be in an emergency state. Mr. Tai said it is in the guideline and determined by the agencies. CSA suggested that it is the same as the “rule of the high seas,” as long as it doesn’t hurt the supporting party. The Chair would like to get SECSWG input on the guideline’s position of topics.

JAXA noted that the operations team and management are aware of SECSWG activities with not much concern, while, in the course of finalizing multilateral guideline, they may have comments. DLR suggested developing an emergency charter. Mr. Tai compared it to an insurance policy: hope that you don’t use it even if you buy it.

Issue	Discussion Results
1. Context of emergency support	IOAG members agree
2. Providing emergency support under a cross-support agreement	IOAG members agree
3. Providing emergency support with no cross-support agreement	If there was a multilateral agreement, it may be too hard to obtain authorization from some agencies. The Chair would like to come back to this point and ask the other IOAG members.
4. Legal and liability issues	Suggested wording of “IOAG member agencies will apply, if applicable and if agreed” for relevant RF license. This should not be discussed on agency level, but on using terms such as, “try to negotiate,” “should negotiate arrangements if appropriate and if possible.”
5. Response time	IOAG members agree
6. Support priority	Item to add: IOAG will agree on priorities used. This would be the guideline.
7. Services provided	“Simple schedule interface”- would include enough information so it would be in the database. Tai- have to check with the team on whether there is a template. ASI proposed defining mission databases, which agency could simplify the matter to reduce the number of missions.
8. Safeguarding emergency support capabilities	The issue is open ended on whether there would be a point of contact. For rudimentary configuration it will be under a

	configuration management. They want to update the service catalogue, they would maintain core services. Suggested language was proposed: “if there are changes, you inform the other agencies” and agencies “should keep record of cross support and to safeguard” minimum approach for configuration management of the service catalogue.
9. Charge for the support	A question was raised on who would keep the ledger. CCSDS asked if 1-2 pages for information is feasible for non-IOAG members. Mr. Tai said currently it should be for the IOAG members. It was suggested that the UN could be a platform. A question has been raised about how cubesats may be factored in, as it has not been addressed at the university level.

AI 19-03: IOAG delegates are recommended to consult with their respective legal experts on how UN Treaty on the Outer Space (Part I, Article V) is applicable to SECSWG. (Recommended but not binding.) [Due Date: 9 September 2015]

AI 19-04: SECSWG to develop a position statement on small satellite (ie. Cubesat) support in spaceflight emergency. [Due Date: 9 September 2015]

11) LEO 26GHz Working Group Update

Dr. Les Deutsch reported that the group was not active at the moment, and provided a brief history of the work. He pointed out the status of ESA and NASA who have plans to use 26GHz.

There are very few new missions on the list, such as TESS. In the technology area, NASA has been working on Software Defined Radio, and Adaptive Coding and Modulation (ACM) was demonstrated.

He noted that for the next report, there are considerations on whether to go to a higher bit rate.

12) Coding & Modulation

Dr. Deutsch also reported on the Coding and Modulation working group activities. He commented that the number of coding and modulation standards is quite high, and the expectation is that all core standards in the IOAG service catalogue should be implemented as applicable in participating ground stations. Because older standards are not retired, there is not enough incentive for missions to opt for the newer, better-performing standards.

He noted the group surveyed member agencies. Based on the results, the group has suggested a list of core standards. He highlighted the survey timeline:

- A survey template was created that includes all current CCSDS coding and modulation standards

- Four agencies on the team (CNES, DLR, ESA, and NASA) completed the survey first
- The group then solicited inputs from all IOAG member agencies (September 2014)
- A face-to-face meeting was held at ESOC in January 2015
- ASI, CNES, CSA, ESA, DLR, JAXA, and NASA provided input responses
- A recommended list based on inputs was developed

Dr. Deutsch recommended to retire old standards and work with plans that can help reduce the burden on the core services. The group did not agree. The next steps will be receiving feedback from today's discussion and update the service catalogue with the preferred list. This will need to be officially shared from IOAG to CCSDS. Dr. Deutsch noted that a report will be sent through a cover letter.

13) Other Working Groups: Discussion on Service Catalogues

Mr. Soula presented a discussion on the creation of a Service Catalogue Working Group, and highlighted this was from an IOAG-18c action item. The IOAG members approved the establishment of this working group, and members were designated; the activities can start after the summer. There are some pending items, such as to draft a charter and define a schedule for the Working Group. Mr. Soula noted that the working group should align their terms to CCSDS and the services remain the same. The group would update the existing Service Catalogue and have it approved by IOAG. JAXA noted an additional person from JAXA will participate. CNES noted that if agreeable, a chairman should be nominated, and start with the drafting of the charter. Mr. Soula and Mr. Calzolari were approved as co-Chairs.

AI 19-05: Service Catalogue Working Group co-chairs to draft charter and report out at next IOAG-19a meeting. [Due Date: 9 September 2015]

14) Summary of the Day

The Chair thanked the IOAG delegates for a successful first day of IOAG-19 meetings.

15) Opening/ Review

Due to the limited time for optical communications, the CNSA presentation was moved to Wednesday. Instead, IOAG membership would be discussed today.

16) Top Priorities/ICPA

Mr. Soula noted the Top Priorities would be presented first, and then ICPA will be discussed as a separate topic. He commented that there was an action assigned in IOAG to develop documentation on the priority process on what we are supposed to do on top priorities and in managing the ICPA. The presentation made in IOAG-18 consists of a revision cycle of top priorities managed in IOAG. A procedure on Top Priorities was created in April 2014, but there has been no review nor approval for publication. It should be reviewed by all delegates and validated to keep track.

Mr. Soula asked if IOAG needed to update the top priorities process while the IOP cycle is every three to four years and the current list of Top Priorities was established in February 2014; new subjects may emerge and be added that may be good to consider. He proposed a procedure to evaluate priorities for each cycle, then creating a new list of top priorities that IOAG can bring to management on what the group can share with other agencies, along with implications and objectives. The new list may also be used to create study groups in preparation of the next IOP. Therefore Mr. Soula proposed that the cycle is aligned to the cycle of the IOP meetings.

CCSDS commented that it is a good proposal based upon the experience of rotation of personnel; if there is a book there is a reference to go to read/learn. CNES noted there is currently a reference document for newcomers they can refer to. NASA asked if this should be voted on; CNES noted there is no action open to review the document; NASA suggested this should have delegate concurrence.

AI 19-06: IOAG delegates to review Top Priorities Process Documentation for approval at the next IOAG-19a meeting. [Due Date: 9 September 2015]

The Chair asked if the Top Priorities should be linked to IOP. NASA asked if they are strategic priorities. Mr. Soula confirmed and commented that consistency on level of items should be the same as strategy. The Chair agreed with Mr. Soula's proposal update in step with the IOP meetings. The IOAG can decide for top priority selection. If there is no other opinion, this can be reviewed during the next face to face meeting.

The Chair then asked if members want to replace 'old' priorities. If there is a list that is getting old, it needs to be updated by removing the old priorities that have been addressed, if the IOAG adds new one. Mr. Soula agreed but reminded that the current list is just one year old. The list may be managed as IOAG wants; when a new list is established, then there may be an action to

rephrase the top priority list to have a small description of the objective. IOAG probably has more content to put behind this item, and suggested this could be an action for Mr. Calzolari.

NASA suggested putting strategic priorities in there versus priorities shown in the ICPA. Mr. Soula noted that this different level is already well addressed between the two types of priorities which are de-correlated in the IOAG report produced every year, the Top Priorities (strategic level) can be distributed to the agency management to show IOAG's efforts. He then showed the current IOAG Top Priority list from IOAG-18.

The Chair reviewed and commented on the following from Mr. Soula's presentation:

- *Protection of the S-band for TT&C operation of S/C*: Is this currently done by SFCG? SFCG responded that it is AI 1.1., and has been taken care of now.
- *Common choices for RFM and Coding*: it is now also completed in IOAG.
- *EWG*: the topic is fine.
- *SM&C*: it is covered by MOSSG.
- *Data Link Security Layer*: this was one of the items with a clear connection to CCSDS and ICPA being developed. One of them is close to being available and the other is a bit delayed. He noted this as an interface for CCSDS.
- *Harmonized practices for 26GHz*: Dr. Deutsch commented that it is not current as no work is being done in the working group; it may be possible for new work to be given. It was noted that feedback from CCSDS is needed on how to address these items. It may be a good idea for an extension of the group to coordinate with SFCG and CCSDS. The Chair asked if new members may be needed. Dr. Deutsch responded that it has to be addressed and it may be good to have people suggest ideas to be considered.
- *DTN*: it is already covered by CCSDS.

AI 19-07: All IOAG members to consider ideas on how to establish harmonized practices for 26GHz. [Due Date: 1 August 2015]

AI 19-08: 26GHz Working Group/L. Deutsch and SFCG/E. Vassallo to develop charter and status report for harmonized practices for 26GHz band cross support. [Due Date: 9 September 2015]

AI 19-09: CNES/Soula and ESA/Calzolari to write a one-to-two page summary of the various IOAG Top Priorities on the list. [Due Date: 9 September 2015]

NASA asked about why optical was dropped; Mr. Soula responded that the priority was not high enough on all agencies' lists. It was a special situation and the actions have been referred to CCSDS. IOAG does not need a renewed list to the management since it is discussed at the technical ICPA level. The Chair noted two years ago there was no utilization on missions until now.

With regards to the next IOP, Mr. Soula asked if there is a need to update the IOAG top priority list at this time. Everything is on schedule, except for a delay in MOSSG. NASA noted the IOP meets every 5 years; it was 2 years ago in 2013, so in about two-to-three years from now would be a good time frame and alignment of the work. CNES suggested 2017-2018 for the next IOP. The Chair suggested in the 2016 IOAG meeting to start thinking about next IOP meeting. The group may need to consider the next challenges after IOP and present new activities for IOP-4. SFCG noted that after the November WRC-15, new issues will arise that need to be defended. Mr. Vassallo commented that he will have a report after November to see where we are at the time. CNES noted to perhaps prepare a document on what we have achieved and what are the next challenges for space operations. Chair responded that there is no immediate need of update, and in 2016 to prepare for IOP-4 and the frequency band.

ASI also noted they were impressed by the interoperability of GNSS, in consideration from the operation and communications point of view; if we are to cooperate with Galileo, GPS and Beidou, then a lot of work should be done with spacecraft coordination. This area should be partly worked on by ICG and by IOAG. The Chair noted that Mr. Miller has suggested in the past two meetings that there is not a feeling IOAG needs to be involved, but it should be discussed. CNES noted that the proposed list is not the only list, and some areas may not be mature enough. ASI responded that the common area with ICG is the role of pushing communication standards in CCSDS environment. NASA noted didn't know what ICG/SSV is coordinating with CCSDS, and if CCSDS would adopt that standard. The Chair suggested asking Mr. Miller; at this point he does not see whether the activity is needed. That would mean embarking more in the interoperability working group. NASA noted it is advocacy and that GNSS status is presented in the IOAG because of the importance of GNSS in spacecraft to global spacecraft operations.

AI 19-10: ICG/JJ Miller to determine whether further activity from IOAG to ICG is needed to help with interoperability of GNSS standards. [Due Date: 30 June, 2015]

ICPA

Mr. Soula provided an update on progress on the ICPA made between IOAG-18c and IOAG-18d. RUFT, Validated Radiometric Data, Optical Links, and Space Data Link Security Protocol Extended Procedure were highlighted. He showed the current ICPA Process on IOAG side and noted that there may be new items that should be added to the ICPA. IOAG may need to address new priorities. He suggested the ICPA process should be documented.

AI 19-11: CNES/Soula and ESA/Calzolari to create a draft IOAG internal reference document for ICPA Documentation. [Due Date: 9 September 2015]

The Chair asked if there will be any issues for IOAG at this stage. Mr. Soula commented that there are short term issues with Priority 1, Medium term for Priority 2, and Long term issues for priority 3. CCSDS noted it is important IOAG touches on the area of SIS. CCSDS noted if it is important, to please think about the priority and give resources to CCSDS to do the work. Mr. Tai noted that KARI and ETRI are working heavily with NASA, and suggested it may be good to bring KARI resources.

The Chair asked what are the consequences if they relax the deadline or is there a driver for requirement. CNES noted the driver is the evaluation consensus of agencies that is required and the resulting priorities. It was agreed to revisit the new date for bundle security and network management protocols and IOAG can examine the discrepancies.

AI 19-12: All IOAG members to revisit their priorities and need dates and inform the IOAG concerning the two standards discussed: Bundle Security Protocol and Bundle Protocol Network Management. [Due Date: 9 September 2015]

17) Discussion on CSTS Offline Radiometric Service

In Priority 1 for CSTS Transfer File Service and Offline Radiometric service, the need date is at the end of next year and Mr. Soula commented that CCSDS said the project did not start. CCSDS noted that because of the lack of prototype resources it has not been approved. CCSDS emphasized that it is an IOAG high priority. CCSDS has a problem with resources and ESA continues to reduce; and therefore he is stressing more resources are deployed.

CCSDS commented that many participants are monitoring the information but only 50-60 percent are doing the technical work.

The discussion led to the CSTS Offline Radiometric Service and if TDM is enough. NASA recommended that IOAG does not need two more services. IOAG response was that an answer should come from CCSDS and input from CCSDS would be appreciated.

With regards to the Generic File Transfer Service Defined, NASA commented that their position on priority has changed to accommodate what is in CCSDS. IOAG response was that an answer should come from CCSDS and input from CCSDS would be appreciated. IOAG will report and make a presentation of these issues to summarize the outcomes in preparation for the CCSDS meeting the following week.

Mr. Soula then provided a view of the aggregate IOAG priorities from last year highlighting the main interest is offline radiometric service and file transfer service. The need date is as soon as possible, but will now be postponed to 2016.

18) Optical Communications Status Update

JAXA Optical Update:

Mr. Shigeta provided a presentation highlighting their optical communications activities. It has been nearly 10 years since the agency launched the Optical Inter-Orbit Communications test satellite. It was a successful mission, demonstrating both space-to-space and space-to-ground communications. Now, 10 years later, JAXA plans to launch an Optical Data Relay Satellite. The budget is secured and the target launch is for the 2019 fiscal year, which is from April 2019-March 2020.

An advanced earth observation satellite will be launched as well. The current relay is DRTS, which is Ka-band, but the new one is only optical. (Feeder link of the Optical Data Relay Satellite is Ka-Band). The advanced earth observation satellite uses not only an inter-satellite link, but also a space-to-ground link.

As to the Optical Data Relay Satellite, there are two communication partners: the advanced earth observation satellite, and a terminal to be installed on ISS. The details have yet to be decided. JAXA will keep IOAG informed of the progress.

Mr. Tai asked if there is currently any users with DRTS. JAXA responded that only ISS and ALOS-2 are using DRTS.

DLR Optical Update:

Mr. Pilgram provided an optical update, highlighting the agency's Laser Communication Terminal (LCT) Technology. It has successfully communicated with NFIRE, and has been successfully tested with high bit rates. He noted that DLR is currently in development and pre-operation of the GEO test platform; the Alpha-sat has the LCT on board. The performance is better than specified. The System is operating with a 1064-nm wavelength.

Results of the first test are now published in the press. The link performance was successful, from 2w-5w. The LCT on board aircraft links will have EDRS compatible UAV to communicate. The higher rate laser communications for military area for navigation and communication successfully demonstrated on the platform with high rate optical downlink. The LCT is also on the application of EDRS. It should be launched soon on a commercial platform. DLR noted that optical communication is only space-to-space.

DLR concluded that Germany is open to proposals for international cooperation on developing a dual wavelength option.

CNSA Optical Update (presented on Wednesday, 12 May, 2015):

Mr. He Shanbao noted that it was the first time he has taken part in a face-to-face IOAG meeting. He reported that from October 2011 to May 2012, the first in-orbit satellite, HY-2 satellite, performed a ground laser communication experiment. In two years, there will be two future experiments planned from GEO-Ground and Moon-Ground.

He noted that CNSA is currently developing technology on PSK Modulation and Low Complexity small terminal. He asked a few questions to the delegates regarding optical communications. The Chair asked if anyone had information and if they have answers to those questions, which DLR offered to look into and provide a response.

Mr. Shanbao posed questions about the advantages of a transportable optical ground and differences in using a transportable station and fixed station. DLR and CNSA engaged in a dialogue regarding the station location and whether it should be fixed versus mobile. DLR commented it is easier to go overseas to station, and there may be some disadvantages but not enough to move away from a transport station. The disadvantage is that network data is needed (perhaps through a university or ground station complex) and a strong power supply.

CCSDS asked about the reliability of a university network, as compared to how agencies provide cross support to one another to transport to the other agency. These lines are costly for remote stations and IOAG will need to take a look at this in cross support due to the limitation. At universities, this is fine but a delay in data with agencies may cause an issue.

NASA asked how many optical ground stations they have in China right now; CNSA responded there are three optical ground stations.

In addition, CNSA also performed experiments from ship-to-ship airborne communication and air-to-ship laser communication, and airplane-to-airplane communication. As IOAG observer, CNSA will take part in more activities and consult with international candidates not in space communication for space activities, including space exploration. The Chair thanked CNSA for the presentation and noted optical communication cooperation may be useful due to the conditions it is being used.

CNES noted it is part of the OLSG report and highlighted they need many terminals to cope with the weather conditions. He suggested worldwide cooperation is necessary for communications. The Chair commented on the need for a number of ground stations versus compatibility and the need for cooperation in planning. CNES responded it is too early considering standards are still under discussion, but it may be good to provide guidance for other agencies as it would be a pity if five terminals from five different agencies cause limitations to service projects.

DLR emphasized the need to support multiple stations and to take care of the network's high capacity in a cost efficient manner. CCSDS noted this has not been discussed to the CSG. The Chair asked if IOAG should consider creating another working group to analyze this issue or

leave it to the agencies. DLR responded that it depends on the outcome of CCSDS and then decide on the best path forward.

DLR further noted that they were not on the same path as NASA with regard to the wavelength of 1064 to go to the moon; for cis-lunar missions/deep space missions, the two agencies are currently not on the same track and suggested that can be left to the working group. Mr. Tai replied that IOAG can look into this at IOAG-20 and consider it as an action to re-evaluate the roadmap and plan of the various agencies and their optical communications roadmap development. IOAG can review all agency plans to see if synchronization is possible and facilitated, especially since agency budgets are tight. Mr. Tai further noted that with a human landing to Mars, optical communication is a key to success.

The Chair suggested the topic continue at the next teleconference and CNES reported that the topic will be discussed in CCSDS at the end of this year. A roadmap is only useful if domains are defined and there are other issues that need to be resolved since CCSDS noted they need to make updates to ground stations (most of the ground stations are experimental). Mr. Tai commented that these are areas that IOAG can deploy a development strategy for cross support benefits. The Chair responded that IOAG will need to wait for comments from CCSDS after the November meeting, and prepare for the Fall 2016 meeting.

AI 19-19: All IOAG members with expertise in optical communications to consider the questions raised in CNSA's optical communications presentation and provide a response to CNSA if possible. [Due Date: 15 June 2015]

19) Communications Assets Database

SANA provided a presentation on the status of the communications assets database. He reminded the delegates that the first registry version was based on an Excel spreadsheet. They are currently working with IOAG for data normalization; it is now published as a new registry and being updated periodically.

Since the last report, the new registry was published with capabilities to create/modify the web form. Over the past couple of weeks, there have been updates from different organizations via Excel spreadsheets, and SANA will be updating the registry in the next weeks.

The Chair asked how many inputs came from agencies. SANA noted there were only changes in one or two assets in inputs received until now. They noted that is a two-step process to make changes: when a change is made, a note for integration will be provided with a tracker; and after the request is done, it will be confirmed. A question was asked as to what is update schedule. SANA responded that it would need two to three weeks to get it updated; therefore, all delegates should provide inputs within a month.

AI 19-16: All delegates check SANA Communications Database to make sure it is up to date.
[Due Date: 30 June 2015]

There have been difficulties with fully validated data; it was suggested that perhaps it can be listed by agency with a certain date. IOAG asked if SANA can provide a list of who has updated or validated by a certain date. SANA responded that they could.

SANA noted that with regard to the commercial assets, the seven organizations that provided inputs were sent emails, with only two responding. The Chair asked SANA to provide a list of the non-responsive assets so the Secretariat can contact them.

AI 19-17: SANA should inform IOAG on which five non-IOAG assets registries are nonresponsive so Secretariat can contact them. [Due Date: 30 June 2015]

20) KARI Tour

IOAG members participated in a tour around KARI facilities.

21) IOAG Membership

The Chair noted the following agencies and how to best approach their membership and point of contact:

- *SANSA*: Determine if SANSA seeks IOAG membership
- *ISRO*: IOAG is not sure whether to keep ISRO as an observer or to remove their IOAG membership, as they have not provided any feedback despite being contacted multiple times from various IOAG representatives with no feedback and emails from the ISRO IOAG point of contact has bounced.
- *RFSA*: The Chair noted that the RFSA point of contact has stopped responding and hopes it is a temporary interruption. Also, according to procedures, after not attending two meetings they would be observer. Chair will also contact Moscow/ESA office.
- *CNSA*: The Chair will ask Mr. He Shanbao tomorrow about CNSA participation in IOAG and optical communications activities.

AI 19-13: Secretariat to send DLR the ISRO contact to share and discuss possible response from ISRO. [Due Date: 30 May 2015]

AI 19-14: Chair will reach out to IOAG Russian delegates present during IOAG-18 meeting, as well as contact the Moscow/ESA Office to follow up on whether ROSCOSMOS/RFSA has plans to participate in IOAG. [Due Date: 30 June 2015]

22) Agency Participation in Working Groups

The Secretariat provided a list of the current participants in each working group and the Chair asked each agency if it was satisfied with its level of participation or if it would like to contribute to other working groups.

- *NASA, DLR, CNES*: The agencies are fully involved; no change to levels of participation.
- *ESA*: The agency is fully involved; and is also providing CCSDS and SFCG liaisons.
- *JAXA*: The agency is fully involved; and is internally discussing how to provide more members and be engaged in more activities. The Chair recommended participating in the Coding and Modulation group.
- *ASI*: The agency agrees with its level of participation, and would like to participate in MOSSG (Mr. D'Amico as point of contact).
- *CSA*: The agency agrees with its level of participation, and would like to possibly participate in coding and modulation.
- *UKSA*: Will be asked offline.

AI 19-15: Secretariat to ask UKSA to which WGs it may want to be involved. [Due Date: 30 May 2015]

23) Any Other Business

Next meetings (*presented on Monday, 11 May, 2015*)

For 2016, CCSDS's next CMC meeting will be in Brazil. For the October/November, CCSDS may hold a meeting in Rome. CSA offered Canada as the next possible location to host IOAG. It was agreed the next tentative date for the IOAG teleconference will be 9 September 2015.

AI 19-18: CSA consider hosting IOAG-20 (Sept/Oct 2016) after confirming CCSDS schedule provided by CCSDS/N. Peccia. [Due Date: 9 September 2015]

SpaceOps 2016 Paper

The Chair asked if there is any interest in preparing an IOAG paper for SpaceOps 2016. CNES suggested reporting on new activities and working groups that have arisen and material not presented; however, it depends on the maturity of the topics in time for the meeting. It was agreed that SECSWG would be a good topic, and Mr. Tai will draft an abstract for all to review.

AI 19-20: SECSWG/W. Tai to lead and share the draft with the working group and submit an abstract for SpaceOps 2016 on Emergency Cross Support activities in IOAG. [Due Date: 15 July 2015]

24) Closing Summary of the Day

The Chair reviewed the results of meetings from the past two days and reviewed each group's interaction with IOAG, with particular areas for discussion:

- *MOSSG*: The group mainly lacks resources and CNES noted no action was taken. The Chair responded that the extended timeframe is understood. CSA noted that the difficulty will be figuring out missions in the future and what may be required. Since there is a lot of struggle in looking at potential future missions, any additional information from agencies would be useful.
- *ISECG*: The group is mainly focusing on CIS Lunar rendezvous and docking and looking at options regarding the communications infrastructure for upcoming moon missions but is not yet at a stage to involve IOAG.
- *SECSWG*: Mr. Tai noted the group is focused on an updated draft report and summary of recommendations.
- *26GHz*: Dr. Deutsch noted the general progress and that more missions and ground assets are coming along all the time. The Chair asked if it would be valuable to revive the group to discuss harmonization; Dr. Deutsch responded that he will bring it up with the community.
- *Coding & Modulation*: Dr. Deutsch is addressing how to respond to the proliferation of standards. Mr. Tai noted someone needs to communicate to CCSDS about some coding and modulation schemes that could be retired in the future to share with CCSDS. The Coding and Modulation group was asked to provide a preferred list of standards to be used in the future to share with the Chair for communication to CCSDS (which is in the slides presented).
- *Service Catalogue WG*: The group was just created.
- *ICPA*: The Chair noted IOAG agrees on the top priority procedures and that ICPA is successfully working on. CNES replied the rest will be on the CCSDS part.
- *Optical Communications*: The Chair highlighted that IOAG has made progress with a lot of the agencies working on the topic. There is a need for closer cross cooperation.
- *Communication Assets Database*: The Chair noted the database is now established and running so users need to start using it.
- *IOAG membership*: The Chair asked if He Shanbao/CAS is interested in continuing participation in IOAG activities. CAS replied yes, and that he will be the contact on which working groups the agency wishes to be involved in at a later time. The Chair will ask Russia and SANSa about how interested they are in activities. DLR will follow up with ISRO.

25) Drafting Committee

The Chair adjourned the meeting for the day.

IOAG-19 Meeting Minutes
Daejeon, South Korea (Daejeon Convention Center)
13 May 2015 – Day 3
9:00 – 13:00 KST

26) Adjourn

The Chair expressed his appreciation for the participation and dynamic discussion of the working groups and thanked the IOAG host and delegates for a fruitful meeting. He looks forward to hearing everyone in teleconferences and seeing them in Canada for the IOAG-20 meeting in 2016. He then noted that after the break, the joint agency reports will start once SpaceOps members join.

27) IOAG & SpaceOps Joint Agency Reports

The IOAG and SpaceOps Members provided presentations on the latest activities from their respective agencies.

IOAG-19 Action Items

AI 19-01: IOAG members to update table for missions that plan to work with multi-GNSS in order to provide inputs by ICG-10. [Due Date: 1 Oct 2015]

AI 19-02: SFCG asks member agencies to strongly relay the concerns pertaining IOAG interests to their national and regional spectrum delegation, as soon as possible, in time for meetings that will take place. [Due Date: 13 July 2015]

AI 19-03: IOAG delegates are recommended to consult with their respective legal experts on how UN Treaty on the Outer Space (Part I, Article V) is applicable to SECSWG. (Recommended but not binding.) [Due Date: 9 September 2015]

AI 19-04: SECSWG to develop a position statement on small satellite (ie. Cubesat) support in spaceflight emergency. [Due Date: 9 September 2015]

AI 19-05: Service Catalogue Working Group co-chairs to draft charter and report out at next IOAG-19a meeting. [Due Date: 9 September 2015]

AI 19-06: IOAG delegates to review Top Priorities Process Documentation for approval at the next IOAG-19a meeting. [Due Date: 9 September 2015]

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