

UTC	Korean Standard Time UTC+9	Monday 10 (day 1)	Tuesday 11 (day 2)	Wednesday 12 (day 3)	Thursday 13 (day 4)
00:00~01:20	09:00~10:20		WG1 session 2.1 Agencies status report (2/2)	WG1 session 3.1 WG1/WG2 joint session (in WG1 room)	WG1 session 4.1 Preparation of new AI/IT
01:00~01:30	10:20~10:40		Coffee Break (Lobby, 2F)	Coffee Break (Lobby, 2F)	Coffee Break (Lobby, 2F)
01:40~03:00	10:40~12:00		WG1 session 2.2 AI and IT review 1/2	WG1 session 3.2 Presentations on research efforts	Preparation of WG1 report for closing plenary
03:00~04:00	12:00~13:00	Registration	Lunch (Sorang, 1F)	Lunch (Sorang, 1F)	Lunch (Sorang, 1F)
04:00~04:30	13:00~13:30	Opening Ceremony			Closing ceremony
04:30~05:00	13:30~14:00		WG1 session 2.3 AI and IT review 2/2	WG1 session 3.3 Presentations AI/IT discussions	
05:00 06:00	14:00~15:00				
06:00~06:30	15:00~15:30		Coffee Break (Lobby, 2F)	Coffee Break (Lobby, 2F)	
06:30~07:30	15:30~16:00 16:00~16:30	WG1 session 1.1 Agencies status report 1/2	WG1 session 2.4 Preparation of WG1/WG2 joint session	WG1 session 3.4 AI/IT discussions	
07:30~08:00	16:30~17:00			WGs report to SG	
08:00~08:30	17:00~17:30	Welcome Reception	WGs report to SG		
08:30~09:00	17:30~18:00			Gala Dinner	
	18:00~20:00				

### Day 1: Monday 10<sup>th</sup> October 2022

#### 15:30~17:00 : WG1 session 1.1 – agencies status report 1/2

Meeting overview (P. Richard, T. Flohrer, 10 minutes)

Chair and deputy chair opened the meeting and asked for atour-de-table of participants

Participants hybrid:

CNSA: Zhao Changyin, Jiang Hai, Sun Rongyu, Chen Zhang, Wei Dong

SSAU: Kozhukov Oleksandr

Participants on-site:

ASI: Pierluigi di Lizia, Germano Bianchi, Mauro Massari, Lorenzo Mariani

CNES: Pascal Richard

DLR: Hauke Fiedler

ESA: Tim Flohrer, Thomas Schildknecht, Jan Siminski

ISRO: Pradeep Kumar

KARI: Sae-Ha Song

JAXA: Toshifumi Yanagisawa

UKSA: Laurence Blacketer

Update and approval of agenda (P. Richard, T. Flohrer, 5 minutes)

Chair introduces outline agenda (previously distributed version 5 Oct)

3. Agency status reports 1/2

Presenting agencies

Remote	SSAU
Remote	CNSA
On-site	CNES
On-site	ESA
On-site	ASI
On-site	KARI
On-site	JAXA

## **DAY 2: TUESDAY 11<sup>th</sup> OCTOBER 2022**

Participants hybrid:

ASI: Fabrizio Piergentili, Paolo Marzioli

CNSA: Jiang Hai, Gongqiang Li, Chen Zhang

DLR: Jan Grosser

ESA: Delphine Cerutti-Maori

NASA: Heather Cowardin, Tim Payne

SSAU: Oleksandr Kozhukhov

Participants on-site:

ASI: Pierluigi di Lizia, Germano Bianchi, Mauro Massari, Lorenzo Mariani

CNES: Pascal Richard

CSA: Viqar Abbasi

DLR: Hauke Fiedler

ESA: Tim Flohrer, Thomas Schildknecht, Jan Siminski

ISRO: Pradeep Kumar

JAXA: Toshifumi Yanagisawa

KARI: Sae-Han Song

UKSA: Laurence Blacketer

**09:00 – 10:20: WG1 SESSION 2.1 – Agencies status report 2/2**

4. Agency status reports 2/2  
Presenting agencies

On-site	DLR (no slides)
On-site	CSA
On-site	NASA
On-site	ISRO

Presentation of AI and IT status by leaders and participants of AI and Its  
*IT37.1 Preparation of next beampark campaigns (NASA/Tim Payne)*

- *Strong support from WG2*
- *Question for joint session identified:*
  - *Data format usable for WG2*
  - *Target regime 700-800km, 400-450km, 475-525km (ASAT)*
- *NASA: HUSIR and Goldstone proposed*
- *ESA mentioned TIRA possibility (not for 24h?)*
- *Which delegations can join?*
  - *ISRO new radar (confirmed - will check whether 24h is feasible)*
  - *CNSA new radar (will check with operator)*

AI38.2 : “Attitude motion characterization of LEO upper stages using different observation techniques” (leaders Toshifumi Yanagisawa and Fabrizio Piergentili)

- CNES, ESA, JAXA, SSAU completed observations (optical)
- Lead want to complete report ASAP for review in the WG1
- Proposal to exchange lightcurve only in reporting to SG (reason: data volume from CMOS) - allows for qualitative comparison
- KARI will check <10GB exchange option via IADC webpage for authorised users
- AI leads need to check consent of participating agencies to share data via certain disclaimer
- ASI: radar input to the campaign possible

**10:40 – 12:00 WG1 SESSION 2.2 – AI and IT review 1/2**

- Progress in Tumbling Motion assessments (20 minutes), (ESA, Jan Siminski)

- Discussion addressed tumbling motion assessment and new activities on hyperspectral classification and semianalytical attitude propagator
- Attitude motion characterization of LEO objects, Lorenzo Mariani, ASI
  - Discussion addressed best ways to present results in AI report, best observation approaches, use of specular reflections to identify features, needs to have sc models in digital format, and observed unexplained behaviour in larger spacecraft (Topex, Envisat)

#### IT39.1 “Astrometrics and photometrics data exchange format” (leader Oleksandr Kozhukhov)

- Minimal changes to TDM to exchange photometric observations
- Discussion on few remaining questions - closed all open questions
- ICD shall be preferred for specific information; TDM update for generic/generalised points
- The responsibility for setting up and maintaining the ICD shall be with AI lead and/or campaign organiser
- Aim to close-out work with a first MS release for presentation to CCSDS (who may adopt or reject)

### 13:30 – 15:00 WG1 session 2.3

#### ***Radar topics + BEAMPARK IT***

##### IT 39.2: “Permanent IT on fragmentations” (leader Fabrizio Piergentili)

- EISCAT beam-park capabilities (20 minutes), ESA
  - Discussion on a new method for deriving RCS that can also be applied to historical data; and also supporting RCS to physical size mapping; a related scientific paper by Kastinainen et al. will be published in AA very soon
- New architecture of BIRALES radar (10 minutes) Germano Bianchi, ASI
- New data processing pipeline of BIRALES (10 minutes) Pierluigi Di Lizia, ASI

##### IT37.1 “Preparation for a future beampark campaign”

- See session 2.1

#### ***Data exchanges ITs***

##### IT36.1 “Compilation and maintenance of sensor list, both optical and radar facilities” (to be replaced by a new IT on technical needs for exchange of data)

- ESA mentioned that AI38.2 starts data exchange and we will learn from this
- Consensus to approach SG with idea to have permanent open task on technical needs for exchange of data

##### Reorganisation of WG1 space in iadc-home.

- Collection of points completed; chair will send list to KARI for consideration

### 15:30 – 17:00 WG1 SESSION 2.4 - Preparation of WG1-WG2 joint session

##### IT 39.2: “Permanent IT on fragmentations” (leader Fabrizio Piergentili)

- Presented by Lorenzo Mariani, ASI
- WG1 opinion to keep the IT aiming to share information efficiently, WG1 recalled the quick actions allowing information and data exchange for COSMOS-1408, WG expressed need to have procedures in order to be fast --> possibility to conduct a **lessons learnt** exercise (shared document open for all to collect points from 1408 case) will be followed by ESA
- WG reconfirmed that this IT is not about data sharing

##### IT 34.1 “Feasible options to study Molniya population of space debris”

##### Presentation of the current status of the IT

- Co-leaders not participating in WG1 anymore (ASI/UKSA)
- Problem is lack of leadership and problems in organising coordinated campaigns
- DLR and ASI plus CNES plus SSAU plus CNSA ready with supporting observation of the regime - but all optical; ESA points out that radar observations are needed to capture the (unlocked) perigee

Topics and interrogations to be prepared for presentation to WG2:

- Preparation for a future beampark campaign” (IT 37.1)
  - *Data format usable for WG2*
  - *Target regime 700-800km, 400-450km, 475-525km (ASAT)*
- Feasible options to study Molniya population of space debris (IT 34.1)
  - --> A/m characterisation possible for higher values?
- Participation of WG1 in re-entry campaigns
  - Open this for interest of WG2 (front-end can use data, such as attitude, observations etc.)
- Information exchange from fresh fragmentation
  - For info to WG2

### **DAY 3: Wednesday 12th October 2022**

Participants hybrid:

CNSA: Jiang Hai, Gongqiang Li, Chen Zhang

ESA: Delphine Cerutti-Maori

NASA: Heather Cowardin, Tim Payne

SSAU: Oleksandr Kozhukhov

Participants on-site:

ASI: Pierluigi di Lizia, Germano Bianchi, Mauro Massari, Lorenzo Mariani

CNES: Pascal Richard

CSA: Viqar Abbasi

DLR: Hauke Fiedler

ESA: Tim Flohrer, Thomas Schildknecht, Jan Siminski

ISRO: Pradeep Kumar

JAXA: Toshifumi Yanagisawa

KARI: Sae-Han Song

UKSA: Laurence Blacketer

### **9:00 – 10:20 WG1 SESSION 3.1 WG1-WG2 joint session**

- Preparation for a future beampark campaign (IT 37.1)
  - Data format suitability confirmed, but should be re-confirmed for next campaigns
  - Interest in BPE confirmed
  - Focus should not be only on altitude, but rather on low inclination orbits (if possible) for larger diversity, high uncertainty is on slag (sizes up to 6cm can be reached)
  - Higher altitude is preferred (because of long-term consequences and because instability of population would start there)
  - Second priority is also on 300-400km

- Feasible options to study Molniya population of space debris (IT 34.1)
  - Question introduced by WG1 - focus on surveying for unknown objects, or on catalogue characterisation of known objects
  - WG2 has larger interest also in understanding dynamics in Molniya
  - WG2 has also large interest (in whatever data) to understand the catalogue completeness for model validation
  - Data to support breakup forensics/analytics in Molniya is also very welcome to WG2

Propositions of other topics :

- Participation of WG1 in re-entry campaigns ?
  - WG2 wants to raise awareness in WG1 (and to motivate) to observe and to share information via their delegation for sharing in re-entry test campaign, e.g. measurements, derived state vectors, A/m estimates, etc.
  - WG2 informed that campaign 2022/1 opening now (Starlink test object)
  - WG1 interested in contributing and requests more information
  - Further discussion addressed the object selection process
- IT on fragmentations in WG1 (Cosmos-1408 case)
  - WG1 shared intentions to further develop means for quick information exchange (not necessarily data sharing)
  - WG2 supports WG1 efforts, modelling needs are twofold: quick feedback to operational missions, updates of environment models on the longer run

### **10:40 – 12:00 WG1 SESSION 3.2 WG1 members presentations/ Exchanges 1/2**

De-brief SG yesterday

- No concerns raised by SG

Presentations about research efforts in the area of measurement technics.

Exchange of information and plans concerning research activities in the area of measurements of orbital debris.

- 11:05 ESA Optical Surveys to Characterize the Space Debris Environment in GEO and HEO, (20 minutes) ESA
- 11:25 European Expert Centre for Space Safety (20 minutes), ESA
- Wrap-up joint session
  - IT37.1

Goals of WG2 are very demanding and might not be met all

Low latitude gets improvements from ISRO participation

NASA/ESA see sun-synchronous orbits and 800km band in better geometry

BPE-interested delegations need to check limits of considered sensor infrastructure

- IT34.1

Dynamics characterisation through following-up catalogued objects is possible through optical means

Catalogue completeness question is hard to address without radar means

Event characterisation/forensics support is very interesting and needs to be discussed further in WG1, especially on how fragmentation surveys in LEO could help here

- Re-entry support

WG1 took note of increased capabilities and possibility to support with various data

- IT on Fragmentation

WG1 took note that actually two modelling needs exist: short-term for supporting missions, long-term to support development and update of space debris environment models

### **13:30 – 15:00 WG1 SESSION 3.3 WG1 members presentations / Exchanges 2/2**

- Use of low cost CMOS cameras with built-in GPS receivers for the observation of LEO objects (10 minutes, remote) , Olexandr Kozhukhov, SSAU
  - Delegations exchanged on plans for updating existing larger aperture (or FPA) systems with CMOS or APS detectors - ANDOR and Teledyne are manufacturers that NASA is in contact with, JAXA reports on large camera under development with UniTokyo
- New Two-Tubes Telescope for Observation of Near-Earth Space" (10 minutes, remote), Olexandr Kozhukhov, SSAU.

- Delegations discussed the status and outlook of the new systems that are very promising systems producing high-quality results

### **15:30 – 16:30 WG1 SESSION 3.4 AI and IT discussion**

- Revisit IT34.1 description and leaders - new test with Pascal; update on task leads to ASI(Lorenzo Mariani), and UKSA replaced by CNES (Pascal Richard)
- ASI presentation on potential need for AI on brightness of large constellations
  - WG decided to consider the IAU center for dark and quiet skies, and to check IADC approach towards this question via contacting WG4 and SG
  - WG4 chair and co-chair confirmed that there has been no request or related interaction with the IAU

AI38.2 “Attitude motion characterization of LEO upper stages using different observation techniques” (leaders JAXA/Toshifumi Yanagisawa and ASI/Fabrizio Piergentili)

- ~~January 2022-March 2022—Draft Report preparation~~
- ~~March 2022—draft report is to be presented to SG at 40th IADC meeting~~

October 2022 - March 2023 – Draft Report preparation and WG-internal review

June 2023 – draft report is to be presented to SG at 41th IADC meeting

IT 34.1 “Feasible options to study Molniya population of space debris”

- See above

IT 39.2 “Permanent IT on fragmentations” (leader ASI/Fabrizio Piergentili)

- Lead calls for more support

IT37.1 "Preparation for a future beampark campaign”

- Needs text and discussion tomorrow morning

IT 39.1 Data exchange format for AI 38.2

- Text prepared, updates of final draft being prepared for WG1 review in 2022

IT36.1 IT re-shaped towards permanently open IT on technical means for WG1-internal data exchange

- Needs text and discussion tomorrow morning

### **DAY 4: THURSDAY 13th OCTOBER 2022**

Participants hybrid:

CNSA: Jiang Hai, Sun Rongyu, Chen Zhang

Participants on-site:

ASI: Pierluigi di Lizia, Germano Bianchi, Mauro Massari, Lorenzo Mariani

CNES: Pascal Richard

DLR: Hauke Fiedler

ESA: Tim Flohrer, Thomas Schildknecht, Jan Siminski

ISRO: Pradeep Kumar

KARI: Sae-Ha Song

JAXA: Toshifumi Yanagisawa

UKSA: Laurence Blacketer

### **09:00 – 10:20 WG1 SESSION 4.1 preparation of new AI / ITs ?**

De-brief SG yesterday

- No concerns raised by SG

WG1 co-chair will be Hauke Fiedler (DLR)

IT37.1 "Preparation for a future beampark campaign"

- Discussed and formulated (see details in new IT form)
- Leads by ESA (Jan Siminski) and NASA (Tim Payne)

IT36.1 IT re-shaped towards permanently open IT on technical means for WG1-internal data exchange

- Following tour-de-table, WG agreed not to proceed in this direction and to end IT
- If new needs (such as unavailability of IADC webpage to host AI38.2 results, check pending by KARI) arise, the WG will look into technical means again through a new IT

#### **10:40 – 12:00 WG1 SESSION 4.2 Preparation of final report for closing plenary**

- **WG reviewed the drafted closing plenary presentation, gathered for a group photo, and thanked to outgoing chair (Pascal Richard) for his work and dedication to lead WG1 in especially challenging years. The incoming chair and deputy chair expressed that they look forward to working within the WG in the next years to come.**