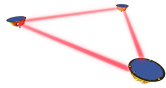


LISA Consortium Management Plan

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Abstract	LISA Consortium Management plan.

	Name	Date	Signature
Prepared by	Martin Hewitson	2019/04/05	
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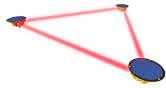
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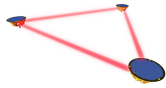
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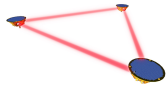
Contents

Purpose and Scope	5
1 Consortium Organisation	5
1.1 Consortium Lead	8
1.2 Board and Executive Board	8
1.3 Consortium Coordination Group	8
1.4 LISA Instrument Group (LIG)	8
1.4.1 Responsibilities	8
1.4.2 Roles	9
1.5 LISA Data Processing Group (LDPG)	9
1.5.1 Responsibilities	9
1.5.2 Roles	10
1.6 LISA Science Group (LSG)	10
1.6.1 Responsibilities	10
1.6.2 Roles	10
1.7 Associate Working Groups	11
1.8 Consortium National Project Manager Board (NPMB)	12
1.8.1 Roles	12
1.9 Publication Committee	12
1.9.1 Roles	13
1.10 Application Review Board	13
1.10.1 Roles	13
1.11 Inclusion and Diversity Committee	13
1.11.1 Roles	13
1.12 Science Working Groups and Consortium Research	14
1.13 The LISA Scientific Community	14
1.14 Roles and Assignments	14
2 Consortium Membership and Policy	14
2.1 Types of membership	14
2.2 Consortium Groups and Members	15
2.3 Consortium Associate	15
2.4 Consortium Membership Rights & Duties	16
2.4.1 Rights	16
2.4.2 Duties	17
2.5 Application and Approval Process	18
2.5.1 New Groups/Members	19
2.5.2 Continuing members	19
2.6 Working Group Members	19



Ref : LISA-LCST-MIS-PL-001	
Issue : 1	Revision : 7
Date : 2019/04/05	Page : 4/ 26

3 Consortium Deliverables	21
3.1 Hardware Deliverables	21
3.2 Nomenclature	21
3.2.1 Support to SEO	21
3.2.2 Consortium Hardware	21
3.3 Ground Segment Deliverables	24
3.3.1 Data Processing Centre	24
3.3.2 Consortium Software Deliverables	24
3.3.3 Consortium Service Deliverables	24
3.4 Science Deliverables	24
3.4.1 Role of the Science Working Groups	24
3.4.2 Consortium Science Goals	25
3.5 Consortium Publication Policy	25
Acronyms and Glossary	26
Acronyms	26
Glossary	26



Purpose and Scope

The scope of this document is to define the roles and responsibilities of the LISA Consortium as part of ESA'S L3 LISA mission. The document lays out the proposed organisational structure of the Consortium and policies for managing membership. The structures described are relevant for Phase A, but may need to be reviewed and possibly modified for later phases of the mission.

Interfaces and interactions are described in [2] while current appointments are listed in [1].

The document is split into three parts: the top level consortium organisation and the different working entities within the consortium; consortium membership policy and the membership approval process; the deliverables of the consortium including the organisation of data processing and science interpretation.

1 Consortium Organisation

The LISA Consortium builds upon the proto-consortium that proposed a Gravitational Wave observatory for the L1 flight opportunity, but has been growing considerably ever since. It is augmented by additional member states and the US as an international partner. The LISA Consortium also proposed *The Gravitational Universe* as a science theme for the selection of the L2 and L3 launch opportunity and submitted the pertinent white paper. In addition, the LISA Consortium includes all the main investigators who were involved in the highly successful LISA Pathfinder mission, a number of scientists who worked on the ground-based LIGO, Virgo, and GEO projects, and a number who worked on the Laser Ranging Interferometer on the GRACE Follow-On mission, thus making full use of all the expertise that has accumulated thus far. This approach optimises the utilisation of the remaining time for mission preparation and technology development.

The Consortium commits to support, as per the Terms of Reference [5], the ESA System Engineering Office with key personnel, providing expert knowledge on the critical aspects of the observatory, including that gathered from LISA Pathfinder. The Consortium also commits to deliver to ESA the integrated and tested science instrument at the heart of the payload, plus several spacecraft-mounted parts of the instrument. It is expected that the remaining parts of the payload, in particular lasers and telescopes, will be procured by ESA or provided by NASA. Consortium deliverables are discussed further in Section 3.

The primary bodies within the consortium are described below, and are shown together in the organogram of Figure 1. Table 1 lists the management roles present in the Consortium.

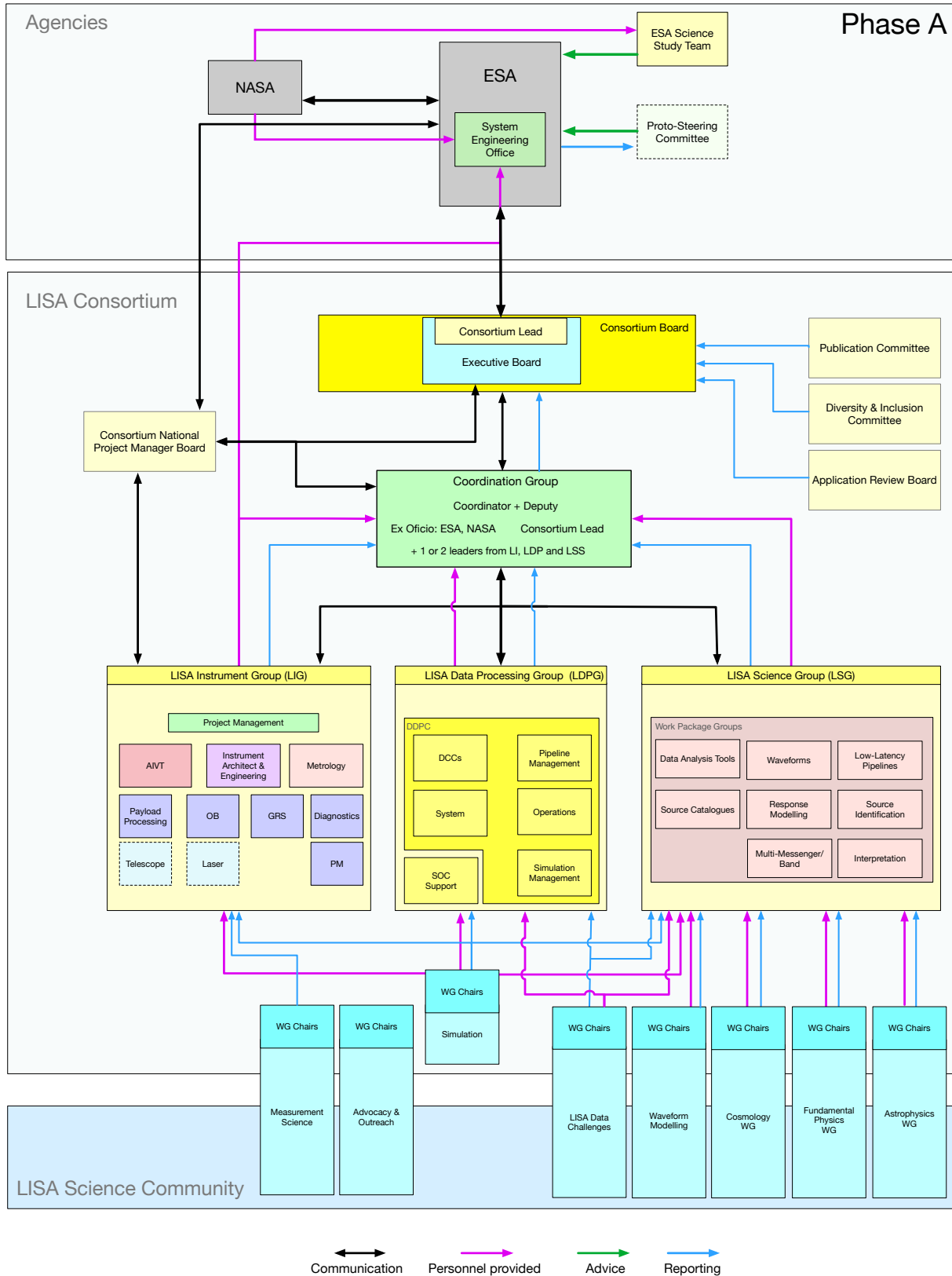


Figure 1: Organogram of the internal top-level organisation of the LISA Consortium, with some links to external entities.



LISA Management	
Role	No.
Consortium Lead	DE
Executive Board	
Science	1
LISA Pathfinder	1
Optical Metrology	1
Member States Liaison	1
US Liaison	1
Consortium Board	
Member State Representatives	
Germany	2
Italy	2
France	2
UK	2
Switzerland	2
Spain	1
Denmark	1
The Netherlands	1
Belgium	1
Portugal	1
Sweden	1
Hungary	1
Romania	1
USA	5
Consortium Coordination Group	
Coordinator	1
Deputy Coordinator	1
LIG Lead	1
LIG Deputy	1
LDPG Lead	1
LDPG Deputies	2
LSG Lead	1
LSG Deputies	2

Table 1: Roles of the LISA Management structure.



1.1 Consortium Lead

The LISA Consortium is led by the LISA Consortium Lead (LCL), supported in its top management function by the Executive Board consisting of the Consortium Lead and five Co-Leads, one for Science, one for LISA Pathfinder, one for the optical metrology, one as liaison to the other member states, and one as liaison to the US community. The composition of the Executive Board will be adapted to the changing project needs. The LISA Consortium Lead is the single formal interface of the Consortium with ESA.

1.2 Board and Executive Board

The role of the LISA Consortium Board is to define the Consortium policy with respect to the Consortium management and the scientific objectives. The Consortium Board steers the activities of the Consortium in the involved countries, it confirms the members of the Executive Board in agreement with ESA and, eventually, the Steering Committee, and delegates the management and the coordination of the Consortium and the top-level operative decisions to the LISA Consortium Lead and the Executive Board.

The Consortium Board comprises Co-Investigators as representatives per participating country and is chaired by the Consortium Lead. Board members should be approved by their national agency or other relevant body. The current members of the Consortium Board are listed in [1]. The membership may be changed to adapt to the evolving project needs.

1.3 Consortium Coordination Group

The primary function of this group is to coordinate and manage the day-to-day activities of the Consortium to ensure good information flow and good communication between the three coordination sub-groups (LIG, LDPG and LSG). By comprising representatives (leads) of each of those groups, together with a coordinator and the Consortium lead (where possible) the Consortium Coordination group can ensure regular contact between all the main activities of the consortium, ensuring a lean and reactive system to help guide the daily work. The members of this group will have LISA as their focus and will be available for daily interactions and problem solving. They will monitor and help coordinate the set of work packages that each top-level group manages, ensuring that all the work of the consortium is covered, and that duplication is minimised.

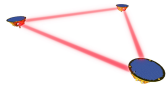
1.4 LISA Instrument Group (LIG)

The LISA Instrument Group is responsible to manage the consortium work in the area of hardware deliverables. This group would eventually host (or morph into) a project management office responsible for the development of the hardware.

1.4.1 Responsibilities

The charge of this group is to

- maintain scientific oversight of payload items;
- coordinate the Phase 0 and Phase A work of the consortium's hardware deliverables;
- aid in interface definition of all payload items;
- maintain scientific oversight of technology development of consortium deliverable hardware items;
- follow progress of other technology developments (e.g., laser, telescope);
- provide support to ESA's Phase A industrial studies through ESA's System Engineering Office.



1.4.2 Roles

Role
Team Leader
Project Manager(s)
Metrology System Leads
Instrument Engineering & PA
Instrument AIVT Engineering
Instrument Experts
Phasemeter
Optical Bench
GRS
Diagnostics & Payload Processing
Observers
Laser Assembly
Telescope
Agency Liaisons
Industry Liaisons
Board Observer

Table 2: Identified roles for the LISA Instrument Group

1.5 LISA Data Processing Group (LDPG)

The LISA Data Processing Group is responsible for coordinating the consortium activities associated with data processing during operations. In particular, the LDP coordinates the implementation of the analysis pipelines, the data processing infrastructure, the data processing centres, the support to operations, and the management of science products.

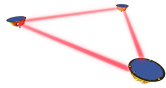
1.5.1 Responsibilities

The charge of the group is to:

- Develop and coordinate the unique Distributed Data Processing Centre (DDPC) for LISA;
- Prepare and execute the pipelines to produce L2 (identified source waveforms and TDI residuals with all identified signals subtracted) and L3 (Source Catalogues) products as well as other defined scientific products and deliver them to the SOC;
- manage the interfaces between pipeline design and pipeline implementation;
- Aid in the management and execution of large-scale simulations and provide structures for data management;
- coordinate the definition and development of LISA Data Computing Centres (DCCs);
- Aid in the definition of Consortium support to ESA's ground-segment (operations support);
- Coordinate the definition and implementation of the data analysis frameworks and operations environment;
- Coordinate the development and management of data analysis pipelines;
- Provide structures and support for the management of Consortium data products.

The development of the DDPC includes:

- definition and maintenance of the pipeline and data analysis development environment;
- design and implementation of the pipeline and analysis operations environment;



- design and implementation of data storage facilities and databases;
- implementation and operation of consortium IT services;
- management and implementation of pipelines for simulation and data analysis.

1.5.2 Roles

Role
Team Leader
Deputy Team Leader
System Leads
Pipeline Management Leads
Simulation Management Leads
Operations Leads
DCC Management Leads
SOC Support
Observers
LISA Instrument Lead
LISA Science Lead
ESA
NASA

Table 3: Identified roles for the LISA Data Processing Group

1.6 LISA Science Group (LSG)

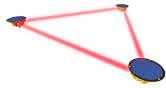
The LISA Science Group is the body tasked with implementing the scientific vision of the consortium. In particular, the group will ensure the development needed to allow the consortium to deliver on its promised science goals and products. The group will provide the forum where the work and ideas of the science working groups (Astrophysics, Fundamental Physics and Cosmology) is brought together and implemented and tracked as projects.

1.6.1 Responsibilities

The charge of the LSG is to:

- aid in the definition of the Consortium’s key science questions;
- ensure key science questions will be answered;
- manage the work packages needed to deliver the science of the Consortium;
- manage the high-priority, urgent science questions arising from the daily development of the project;
- manage the interface between the pipeline design and pipeline implementation;
- Initiate and coordinate preparation of follow-up observations of GW events;
- develop validation protocols for the consortium science deliverables.

1.6.2 Roles



Role
Team Leader
Deputy Team Leader
Work Package Group Managers
Waveforms
Data Analysis Tools
Instrument Response Modelling
Low-latency Pipelines
Individual and global source identification codes
Source Catalogues
Multi-messenger/band astronomy
Interpretation, key science projects
Science Working Group Chairs
Astrophysics
Fundamental Physics
Cosmology
Waveform
Observers
LISA Instrument Lead
LISA Data Processing Lead
ESA
NASA

Table 4: Identified roles for the LISA Science Group

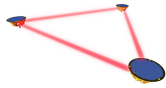
1.7 Associate Working Groups

A number of working groups are set up to provide fora for continuing research and development on LISA related topics. These working groups also provide an entry point to the consortium for associate members, and thus provide a strong link to the scientific community. Table 5 lists the different working groups. In addition to these associate working groups, each of the three primary coordination groups listed above is expected to form sub-working groups as and when necessary.

Working Group
Astrophysics
Fundamental Physics
Cosmology
Waveform Modelling
Measurement Science
Advocacy & Outreach
LISA Data Challenges
Simulation

Table 5: LISA Consortium Associate Working Groups

Note: Due to the nature of the Simulation working group and the products it produces, it is run somewhat differently to the others in that it contains only full members of the Consortium, and does not have the link to the community.



1.8 Consortium National Project Manager Board (NPMB)

A group of representatives from the National Agencies charged with monitoring the work of the Consortium, in particular, the technology development, and ensuring that the commitments of the Consortium are being met, and that they are aligned with the funding available from the member states.

The charge of the NPMB is to:

- act as the interface between the National Agencies and the LISA Consortium and its Coordination Group;
- Advise the Consortium Board on all issues that have (or may have) an impact on the project/CPI funding , e.g., those caused by technical problems, necessary descopes and/or changes to the hard- and software (requirements), and schedule delays;
- Advise the National Agencies and (Proto-)Steering Committee (members);
- Coordinate the national contributions in each member state; and
- take care of risk mitigation concerning the national CPIs.

1.8.1 Roles

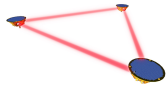
Consortium National Project Manager Board	
Role	
	Germany
	Italy
	France
	UK
	Switzerland
	Spain
	Denmark
	The Netherlands
	Belgium
	Portugal
	Japan
	Sweden
	Hungary
	Romania
	Czech Republic
	Observers
	ESA
	NASA

Table 6: Role assignments for the Consortium National Project Manager Board for the Member States currently foreseen to provide flight hardware for Consortium Provided Items.

1.9 Publication Committee

A group of Consortium members responsible to

- organise reviews of consortium papers and conference proceedings;
- maintain oversight of consortium presentations (lectures, public talks, conference talks, posters, etc);
- Promote career development of consortium young researchers by distributing talks.



1.9.1 Roles

LISA Publication and Presentation Committee
Role
Lead
Deputy

Table 7: Roles for the LISA Publication and Presentation Committee

1.10 Application Review Board

A group of Consortium members responsible for the reviewing and processing of membership applications to the Consortium. The group should consist of a mix of expertise to allow for efficient assessment of applications.

1.10.1 Roles

LISA Application Review Board
Role
Lead
Deputy
LIG Representatives
LDPG Representatives
LSG Representatives

Table 8: Roles for the LISA Application Review Board.

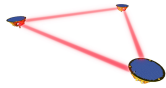
1.11 Inclusion and Diversity Committee

A group of consortium members responsible for all matters pertaining to the Consortium mission and core values as stated in the LISA Code of Conduct [6]. In particular, it is in charge of developing and administrating the infrastructure and actions needed to realise a fully inclusive, safe and stimulating working environment.

1.11.1 Roles

LISA Diversity and Inclusion Committee
Role
Lead
Deputy
Board Contact
Members

Table 9: Roles for the LISA Diversity and Inclusion Committee.



1.12 Science Working Groups and Consortium Research

The Consortium scientific research will be organised in a number of working groups to serve as fora for fostering the development of science associated with different themes. Each Working Group is to be chaired by at least two members of the consortium. Working Groups can accept members either from within the consortium or from the broader scientific community.

The following working groups are identified at the current time:

- Astrophysics;
- Cosmology;
- Fundamental Physics;
- Waveform modelling;
- LISA Data Challenges;
- Simulation;
- Measurement Science;
- Advocacy and Outreach.

Some of these working groups also form a link between the Consortium and the wider scientific community.

1.13 The LISA Scientific Community

Composed of all world-wide scientists interested in the science of LISA, this group has a direct interface to the LISA Consortium and an easy entry point through the various science working groups. By such means, those members of the community interested in LISA science, but not in a position to commit to the dedicated work of the Consortium, can benefit from interactions with Consortium members. This interaction will go both ways: members of the community will get information on the state of the LISA project and on the active developments and working structures within the Consortium, and will have an interface (through the working group chairs) to input their thoughts and/or concerns to the Consortium, while members of the consortium are expected to gather input from the community (via the Working Groups) to update, for example, the science goals for LISA.

1.14 Roles and Assignments

Except for the Consortium Board, appointments to the other various functions outlined above will be detailed and maintained in [1]. Appointments are expected to be reviewed every two years, with a possibility of reappointment, or new appointment. Appointments will be made by the Consortium Board, which remains the core of the Consortium appointed by the national agencies.

2 Consortium Membership and Policy

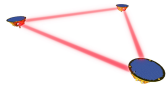
2.1 Types of membership

Membership to the LISA Consortium comes in three flavours:

Consortium member commits to contribute directly to the work of the consortium.

Consortium Associate interested in the science of LISA, working group members expressing willingness to participate, on request, to short- or long-term tasks of the consortium, as organised by the working group chairs.

Ex-Officio members, appointed directly by the Consortium board on suggestion by Consortium members, by ESA, by NASA or by any of the National Agencies involved in LISA.



Full Consortium Members help shape the mission. They have full access to all Consortium information and may be involved in all mission-critical decisions that the Consortium is allowed to take. Associate Members will work in the context of the mission but have no obligations and no decision making power.

2.2 Consortium Groups and Members

Persons applying for LISA Consortium membership can be part of, and organised in, an external group. Such an applying group is an association of one or more scientists led by a Lead Scientist, which makes a firm commitment to the work of the Consortium. The members of the group are chosen by the Lead Scientist but all members must be named and put forward to the Consortium Application Review Board for approval. This last step is a formality to ensure that the group members are properly recorded in the Consortium and that their credentials for Consortium IT services can be managed properly. Becoming a member of the LISA Consortium is a formal process that is based upon a commitment to contribute directly to the goals and work of the consortium.

Examples of commitment would be:

- contribution of flight hardware for Consortium deliverables;
- performing laboratory tests of parts of the LISA instrument;
- development of data analysis pipelines, or parts of one;
- management of, or commitment to, one or more work packages;
- performing a coordination role.

Full members will benefit in the following ways:

- helping to shape the mission in the early phases of the project;
- helping to shape the goals and structure of the Consortium;
- having access to Consortium information about the project, as appropriate;
- having access to Consortium services, such as documentation (as appropriate), IT services like git, wiki, document management, mailing lists, etc, and direct access to all (as appropriate) data the Consortium produces, both during development and operations.

2.3 Consortium Associate

A Consortium Associate is a member of one or more of the Consortium working groups. An associate does not make any firm commitment as to the amount of their time that is available for consortium work, but is expected to regularly attend meetings of the relevant working groups, and to participate actively to the discussions, interactions and work of the group.

Consortium Associates benefit in the following ways:

- By giving input to the Consortium via the working groups, raising awareness of concerns or scientific advancements;
- Learn about all aspects of LISA science by taking part in Working Group projects and interacting with other members of the Consortium;
- Having an easy route to transition to full membership, by first demonstrating or developing an appropriate level of commitment over time.

While it is expected that associates join one or more working groups, there may be cases where that is not appropriate.

All associates

- will be invited to full Consortium meetings;
- will receive reports on Consortium activities (possibly in the form of a news letter every month or two TBD);
- may be called upon to give input to the Consortium in their area of expertise.



Applications for Consortium Associate are made by individuals, or as part of a group application (see above). The application should include a description of the areas of interest/expertise of LISA Science. The application should also indicate which (if any) of the Consortium science working groups the applicant wishes to join.

Each applicant should supply:

- Name;
- Affiliation;
- Nationality;
- Contact information (email, work address, phone number).

2.4 Consortium Membership Rights & Duties

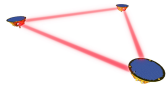
2.4.1 Rights

All LISA Consortium Full members:

1. Will have access to the LISA Consortium IT services like mailing lists, git, wiki, document management and communication channels;
2. Will have access to documents from the LISA Consortium Document Management System according to the groups to which they belong;
3. Will have access to detailed information of the LISA Consortium and relevant information about the project;
4. Will have direct access to all (as appropriate) LISA data the consortium produces, both during development and operations;
5. Will have access to LISA simulated data and other LISA materials produced by the Consortium during the implementation and the operation phases;
6. Will be authorized to write papers, technical notes, make presentations using LISA Consortium materials, provided it follows the LISA Consortium Publication & Presentation rules (TBW);
7. Will help to shape the Consortium deliverables in the early phases of the project;
8. Will help to shape the goals and structure of the Consortium;
9. Can propose new Work Package that can be included in the list of Work Packages after review.

All LISA Consortium Associate members:

1. Will have appropriate access to the LISA Consortium IT services like mailing lists, git, wiki, document management and communication channels, according to the groups to which they belong (see list below);
2. Will have appropriate access to documents from the LISA Consortium Document Management System according to the groups to which they belong (see list below);
3. Will have access to LISA simulated data produced within their working group(s) (see list below);
4. Will be authorized to write papers, technical notes, make presentations using LISA Consortium materials, provided it follows the LISA Consortium Publication & Presentation rules (TBW);



2.4.2 Duties

All LISA Consortium Full members:

1. Have to declare a primary affiliation (and any change of this affiliation);
2. Must clearly define their contribution to LISA and report in due time the LISA activities they are involved in. The objectives, deliverables, fraction of time spent Consortium activities, and schedule should be clearly spelled out;
3. Have to belong to at least one approved Consortium working or coordination group;
4. Agree that any Consortium information or LISA materials they have access to, or are aware of, will not be used for other purposes, or in another context than the LISA mission, without permission of the relevant LISA Consortium persons (LISA Consortium Board or person assigned by the LISA Consortium Board);
5. Agree to inform, far in advance, the relevant LISA Group and the LISA Publication and Presentation Committee of any scientific papers in preparation that uses LISA Consortium materials or work performed in the framework of the LISA Consortium and comply with the LISA Publication & Presentation policy (TBW);
6. Agree that scientific papers, technical notes and presentations using LISA Consortium material should acknowledge the LISA Consortium;
7. Should comply with the LISA Consortium internal confidentiality policy (TBW);
8. Agree that non-publicly available LISA Consortium data will not be used in collaboration with non-LISA Consortium members without agreement of the LISA Consortium Board (TBC);
9. Understand that, as part of the LISA Consortium, any scientific projects that may use LISA Consortium data with restricted access (during any proprietary period or specific simulations) will be done in collaboration with all scientists of the LISA Consortium;
10. Agree, in good faith, that in case of resignation, if they have a responsibility to any Work Packages of the LISA Consortium, they will inform the LISA Consortium Board at least 2 months before leaving and will guarantee a two-month hand over period to transfer information, starting at the date of the official resignation;
11. Agree that in case of resignation, none of the LISA Consortium internal information or materials they may have in hand, or are aware of, will be used or circulated further.

All LISA Consortium Associate members:

1. Have to declare a primary affiliation (and any change of this affiliation);
2. Have to belong to at least one approved Consortium working group (see list below);
3. Agree that any Consortium information or LISA materials they have access to, or are aware of, will not be used for other purposes, or in another context than the LISA mission, without permission of the relevant LISA Consortium persons (LISA Consortium Board or person assigned by the LISA Consortium Board);
4. Agree to inform, far in advance, the relevant working group chairs, and the LISA Publication and Presentation Committee, of any scientific papers in preparation that uses LISA Consortium materials or work performed in the framework of the LISA Consortium and comply with the LISA Publication Presentation policy (TBW);



5. Agree that scientific papers, technical notes and presentations using LISA Consortium material should acknowledge the LISA Consortium;
6. Should comply with the LISA Consortium internal confidentiality policy (TBW);
7. Agree that non-publicly available LISA Consortium data will not be used in collaboration with non-LISA Consortium members without agreement of the LISA Consortium Board (TBC);
8. Understand that, as part of the LISA Consortium, any scientific projects that may use LISA Consortium data with restricted access (during any proprietary period or specific simulations) will be done in collaboration with all scientists of the LISA Consortium;
9. Agree that in case of resignation, none of the LISA Consortium internal information or materials they may have in hand, or are aware of, will be used or circulated further.

For associate members, relevant working groups are:

- Measurement Science WG,
- Waveform Modelling WG,
- Fundamental Physics WG,
- Cosmology WG,
- Astrophysics WG,
- Advocacy and Outreach WG, and
- LISA Data Challenges WG.

2.5 Application and Approval Process

Consortium applications can be either individual or group applications, depending on the type of application. However, in all cases, individuals will need to be named and submit the appropriate paperwork to allow for their Consortium Credentials to be created, and to allow for proper management of their access rights to different areas of the project.

In summary:

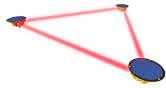
- All applications to the consortium can be considered as 'group' applications.
- A group is defined as one or more individuals.
- Each group will be led by a Lead Scientist/Engineer.
- The Lead Scientist is responsible for managing the members of the group.
- The Lead Scientist is responsible for informing the consortium when members of the group change.

A group should indicate in their application:

- the number of FTE available for consortium work;
- any consortium coordination or management roles held within the group, including WG chairs;
- any work package leadership roles;
- interest in contributing to particular work packages;
- areas of interest;
- other deliverables to the consortium.

For each member of the group, the following information should be provided to the Consortium:

- Name
- Affiliation
- Nationality
- FTE commitment
- areas of expertise / interest
- Contact information



- email address
- work address
- work phone number

If a group has un-appointed members who will be active on LISA in the future, and are therefore part of the application, placeholder details (i.e., Name = Not-Known) should be submitted.

2.5.1 New Groups/Members

To register a new external group for Consortium membership, the Group Lead Scientist must submit an application to the Consortium. This application will be reviewed internally by the Application Review Board (ARB) and either accepted or not. The applicant will be notified in either case, with reasons given if the application is rejected. A negotiation could then take place to possibly steer or adjust the scope of the application, as appropriate. Applications can come from entirely outside the Consortium, or from within the working groups.

Internally, the review process would follow the steps indicated in Figure 2. The ARB should assess the application taking into account:

- the proposed level of commitment;
- the appropriateness of the proposed work and areas of interest;
- any proposed role(s) in the coordination and management of the Consortium;
- any other extenuating circumstances appropriate to the application under review.

2.5.2 Continuing members

The Consortium will ask existing members/groups to critically self-review their membership on a yearly basis to ensure the current statement of commitment is appropriate. An updated statement of commitment would then be submitted for the records. Only in exceptional circumstances (e.g., clear conflict of duties leading to significant problems in delivering the proposed level of commitment) would the Consortium board organise a more formal review of an individual member. The aim is to keep the review process light.

2.6 Working Group Members

Working Group members should submit an application for Consortium Associate, which will then be assessed by the ARB and ultimately the WG chairs. Working Group members can, at any time, apply for membership to the Consortium, should it become clear that their level of commitment has increased to the appropriate level. Equally well, a Consortium member can relinquish membership if their level of commitment is no longer feasible, but maintain membership of any Working Groups they are already part of.



3 Consortium Deliverables

The Consortium commits to a core set of deliverables covering flight hardware, software, services and core science. The Consortium will put in place structures (and funding) to ensure these deliverables. The primary route to ensuring the work is executed, is via the definition of Consortium defined Work Packages (WPs), which are then organised into Work Package Groups (WPGs) and managed by the three coordination sub-groups, LIG, LDPG and LSG.

3.1 Hardware Deliverables

A primary concern in any approach to the hardware provision by the Consortium is to ensure there is a single system engineering entity in the mission, which is currently expected to be the System Engineering Office at ESA. As such, the Consortium has two responsibilities when it comes to the space segment: to support the SEO, and to deliver the promised hardware.

What follows is an agreed upon view for the purposes of Phase A work, during which we need to review the details of scheme and arrive at a management plan that meets all the boundary conditions: technical, financial and political.

3.2 Nomenclature

In the discussions that follow, the following definitions are adopted, following the ESA conventions:

MOSA Moving Optical Sub-Assembly: composite of Telescope (provided by ESA), Optical Bench, and GRS, including harness and internal structure, thermal management etc.

LISA Instrument All Consortium Provided Items (see Table 10) associated, and including, the integrated MOSA.

Payload (a.k.a LCA) The assembly of two MOSAs, the mounting and articulation structure, and the articulation actuator, together with associated Consortium Provided Items (CPIs). This also includes other payload items provided by ESA, such as the stabilised laser subsystems.

Platform S/C without Payload.

S/C Platform and Payload.

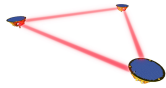
3.2.1 Support to SEO

The Consortium responsibilities with regards ESA's SEO are:

- to follow the terms of reference of the SEO as listed in [5];
- to support ESA's SEO in its day-to-day work;
- to provide expertise on LISA measurement principle and detailed inner workings of the instrument, based on experience in LPF, ground based GW observatories and GRACE-FO;
- to support ESA in defining requirement specifications of the whole mission;
- to support ESA in defining verification requirements of the whole mission,

3.2.2 Consortium Hardware

In the scheme described here, the Consortium (via the lead) has the responsibility to deliver an integrated and tested Moving Optical Sub-Assembly (MOSA), as well as supporting platform mounted equipment (e.g., phasemeter and diagnostics). The exact split of responsibilities, and the scope of the testing, are to be defined in Phase A.



It is anticipated that the Consortium (via the lead) will carry out the engineering tasks associated with the design and building of a MOSA, as well as aiding in the definition of interfaces of the various subsystems delivered by the consortium.

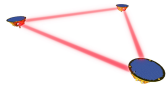
The following activities are identified:

- Manage and implement the engineering activities associated with the internal interfaces of the MOSA.

One critical aspect of this is to support the definition of interface requirements and high-level designs with ESA/Prime, for example, the scheme for mounting GRS to OB. Following the primary assumption, this is expected to be managed at ESA's SEO.

- The Consortium is to carry out the detailed implementation of the agreed upon designs.
An example of this would be the design and fabrication of support structure to allow the GRS to be mounted to the OB, with associated thermal and mechanical modelling and analysis.
- The Consortium will support the definition of the requirement specifications of the MOSA.
- The Consortium will support ESA in designing verification requirements for MOSA level interfaces.
- The Consortium will write a MOSA test plan to comply with those requirements. This has to be accepted by ESA.
This should cover, at least, MOSA optical performance, internal alignments, and functional verification.
- The Consortium will support ESA in the definition of requirements for Consortium provided payload items.
For each Consortium provided item, the test and verification plan will be written by the provider, for the Consortium, and accepted by ESA.
- The Consortium will perform verification and performance tests defined at MOSA level.
For example, functional tests to be done when OB and Telescope are integrated, or opto-electrical performance tests of the measurement chain (including PM and LA).
- The Consortium will oversee the delivery of all payload units to be provided by the Consortium to ESA/Prime.
- The Consortium will maintain a body of scientific expertise on the entire mission to allow proper exploitation of data.

The current list of hardware subsystems to be delivered by the Consortium is listed in Table 10.



System	Sub-system	National Provider
System Engineering and AIV/T		
	MOSA System Engineering	DE
	Instrument AIV/T	FR
MOSA		
	MOSA Structure	DE
	Harness	?
	Actuator	ESA
Phase Measurement System		
	Frequency Distribution System	DE/DK
	PM Core	DE/DK
	Signal Conditioning Box	DE/DK
	PDs + Front End	US / BE / NL
	Harnessing	?
	OGSE, GSE	DE?
Optical Bench		
	OB	UK
	PAAM	NL?
	Fibre Selectors	NL?
	Constellation Acquisition Sensor	ESA, RO?, BE?
	Backlink	UK
	Fibres	UK
	OGSE	UK
GRS		
	GRS Head	IT
	CVM	CH
	GPRM	CH
	FEE	CH
	Charge Management	IT / NASA
	GSE	IT
	Testmass Simulator	DE / IT
Payload Processing		ES
Diagnostics		
	Radiation Monitor	ES
	Thermistors	ES
	Magnetometers	ES
	Heaters	ES
	Control Electronics	ES
Payload Electronics Unit		?

Table 10: Table of consortium deliverable hardware items with associated providers, where known.



3.3 Ground Segment Deliverables

3.3.1 Data Processing Centre

The Consortium commits to develop a Distributed Data Processing Centre (DDPC), which is a management structure tasked with developing and executing the data processing activities of the Consortium. In particular, the DDPC is concerned with

- facilities, environment, data management, engineers, systems management;
- Data Computing Centre(s);
- Operational Pipelines;
- Operational preprocessing and TDI software, to be delivered to, and operated by, SOC.

3.3.2 Consortium Software Deliverables

Software, like hardware, is a Consortium deliverable to be managed as an engineering discipline with a structured approach, with well defined style and interface requirements. The exact scope and nature of the software deliverables will develop during Phase A, but it is clear that the Consortium needs to develop all the software and infrastructure necessary to enable its key science questions to be answered. In addition to this, the Consortium promises to deliver the software needed to produce Level 1 data (TDI variables) from Level 0 data. It is envisaged that this software will be delivered to ESA to be operated by the SOC.

3.3.3 Consortium Service Deliverables

A number of Consortium Services are foreseen to ensure the Consortium can do the planned work, and the facilitate interfaces with SOC and the external community.

Within the Consortium, these services will cover

- Outreach and advocacy (coordinated through the Outreach and Advocacy working group);
- IT services (organised primarily through the DDPC);
- Computing services and facilities (organised through the DDPC);
- Management and engineering expertise;
- Support to SOC both in development and during operations, covering:
 - calibration and commissioning of the LISA instrument and the whole observatory;
 - hardware monitoring for an agreed upon duration and at an agreed upon level;
 - data analysis tools and procedures.

3.4 Science Deliverables

The Consortium commits to a core set of deliverable science goals (see Work-package Group 8 of [4]), and puts in place structures (and funding) to ensure these deliverables. There also exists a larger LISA Science Community external to the Consortium who will receive the data products from the mission at the agreed-upon time (following ESA/NASA procedures), allowing the data to be fully exploited.

It is expected that the full list of science WPs evolves with time as some WPs are completed, and new ones are created. As well as a lead for each WP, there will also be a coordinator for each Work Package Group.

3.4.1 Role of the Science Working Groups

The Science Working Groups (SWGs) of the Consortium perform a dual role. They provide a pool of expertise that the Consortium can draw upon when establishing teams to tackle individual work pack-



ages or short-term projects. The SWGs also serve as a link to the larger LISA Science Community, providing a lower level entry point into the Consortium, and expanding the pool of resources which can respond to a variety of short or long term science questions. In essence, the WGs form the scientific research element of the Consortium, ensuring all the latest relevant scientific thinking is well represented in the Consortium. Three Science Working Groups are currently envisaged to cover Astrophysics, Cosmology, and Fundamental Physics, and as such, should provide all the expertise needed to allow the primary science goals of the Consortium to be reached. Two more specialised WGs are foreseen to tackle LISA Simulation and LISA Data Challenges. One further WG will be setup to focus on the Outreach and Advocacy of LISA.

3.4.2 Consortium Science Goals

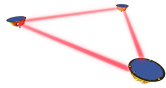
The primary science goals of the Consortium are listed in Table 11. Further details of the scope of each of these is given in [4], together with the current set of WPGs and WPs.

1	Analysis of joint GW+EM observations of GBs (including VBs)
2	Population studies of GW-only GBs
3	Studies of seed black holes and BH formation mechanisms
4	Studies of SMBHBs and connection to galaxy clustering
5	Analysis of joint EM+GW SMBHB events
6	Analysis of the EMRI population
7	Tests of GR and the nature of compact objects
8	Analysis of IMBHBs and IMRIs
9	Studies of SOBH populations
10	Estimation of cosmological parameters
11	Characterisation of backgrounds
12	Analysis of detected unmodelled events
13	Instrument performance analysis

Table 11: Key science topics of the Consortium.

3.5 Consortium Publication Policy

The Consortium will develop a publication policy to ensure fair representation concerning authorship, quality control of publications coming from the Consortium, and to promote the careers of Consortium scientists. The publication policy will be detailed in [3].



Acronyms and Glossary

Acronyms

CPC Consortium Publication Committee

DCC Data Computing Center: physical center with computing and storage facilities

DDPC Distributed Data Processing Center (Consortium)

ESA European Space Agency

GS Ground Segment

LISA Laser Interferometer Space Antenna

LDC LISA Data Challenge

MOC Mission Operation Center

LI LISA Instrument Group

LDP LISA Data Processing Group

LSS LISA Science and Simulation Group

SOC Science Operation Centre (ESA)

WP Work Package

WPG Work Package Group

Glossary

References

- [1] LISA-LCST-MIS-LI-001, *LISA Consortium Role Assignments*.
- [2] LISA-LCST-MIS-AD-001, *LISA Consortium Interfaces and Interactions*.
- [3] LISA-LCST-MIS-POL-001, *LISA Consortium Publication Policy*.
- [4] LISA-LCST-SGS-WPD-001, *LISA Data Analysis Work Packages*.
- [5] ESA-LISA-EST-MIS-TOR-001, *LISA System Engineering Office - Terms of Reference*.
- [6] LISA-LCST-MIS-POL-001, *LISA Consortium Code of Conduct*.