

## Proposal for Forming an IAA Study Group

**Title of Study:**

Lunar Laser Reflectors for First Moon-Light timing & Navigation Applications

**Proposer(s):** Dr. Mohamed El-Aoucet Ayari

**Primary IAA Commission Preference:** Commission 6

**Secondary IAA Interests:** Basic Sciences & Social Sciences Sections

### Members of Study Team

**Chair(s):**

Dr. Mohamed El-Aoucet Ayari (Tunisia)

**Secretary:**

Ms. Cindy Fellows, USA

**Other Members:**

Prof. Hedi Ben Ismail Tunisia

Dr. Saleh Gashoot, Libya

Dr. Sergey Lysy Russia

Prof. Mustapha Masmoudi Tunisia

Prof. Valery Menshikov Russia

**Non-IAA Study Members:**

Dr. Haroun Amira, Belgium

Dr. Ahmed Al-Kasabi, Saudi Arabia

Dr. Vladymyr Burachynski, Canada

Mr. Larry Kaylor, USA

Mr. Robert Levenduski, USA

### Short Description of Scope of Study

**Overall Goal:**

To work toward assessment of the technical feasibility and social acceptance of a unified communication and navigation protocol between the moon, earth and space vehicles traveling between the two celestial bodies. Such unified protocol will lay down the foundation for voice and data communication standard that (a) will facilitate cooperation between space agencies in future exploration missions, (b) serve as a carrier for science and technical data, and (c) prepare the ground for future exploitation of the moon. In addition, this study aims to further interest in space exploration in nations with little or no direct contribution to space exploration.

This goal requires a phased approach. The results of the first phase will be provided in two reports, the first report will address top level needs for communication requirements to support future missions, including continuous multiple forms of data relays and transfer. The second report will address the social aspects pertaining to (a) acceptance of a unified system in different nations, (b) readiness for contribution to such protocols, and (c) gains from data usage and exploitation.

**Intermediate Goals:**

In order to jumpstart many nations in the fields of space exploration, we propose to provide a set of intermediate goals with solutions to important needs. We intend to perform a feasibility study of a concept for basic laser navigation and communication system.

In addition to providing basic functions, this system is required to also deliver new moon-light timing at selected locations on the moon surface. This will respond to an old need to establish the timeline for lunar months and festivals in many cultures.

Laser Terminals are proposed for navigation reference for earth-moon space vehicles as well as other scientific applications. These could be the study of gravitational fields, earthquake detections, and beaming science data from separate instruments.

Additionally, the study team will endeavor to determine the social implications of such a project, and the overall willingness to cooperate with or participate in these types of efforts including the previously proposed moon base, and future missions to the moon.

This intermediate study will bring together an interdisciplinary team to provide:

- (a) Assessment surrounding the technical feasibility of such a concept
- (b) Suggested strategies and technical details for such a concept given what is known and can be extrapolated from that knowledge at this point
- (c) Rough order of magnitude estimates of the scope of such a concept
- (d) Initial insights into potential issues and external dependencies
- (e) Assessment surrounding the social implications of lunar laser reflectors for first moon-light timing and navigation applications
- (f) Determine the consequences of the proposed concept with respect to execution and sponsorship
- (g) Adequate documentation that can be effectively utilized upon adoption of the concept for execution.
- (h) Recommendations from IAA that can be passed to the UN and/or other organizations to promote implementation of such a solution.

The tasks will be split into two categories:

**Humanities & Broad Social Interest:**

In the social side of the work, we will gather feedback to determine the degree of interest in such a concept and promote this concept as a starting point to engage in space applications; thereby supporting the current missions to return to the moon and/or erect an international base on the moon. We will also get feedback from representative societies around the world regarding how people will perceive the adoption of artificial discontinuous light beamed from the moon to signal the beginning of the lunar month. Note that the importance of this matter resides in the fact that conjunction is not regarded as the beginning of the month. Instead, it is the detection of the new moon light that signals the beginning & end of festivities.

**Basic Science and Engineering:**

In the Basic Science category, we will determine top level requirements including the necessary equipments, quality, projected quantities, distribution, and maintenance requirements. In the Engineering category, the work entails first surveying the technological developments available to meet the above goals and subsequently devising a rough preliminary concept for the necessary instrumentation. The outcome would be an adequate starting point for an actual implementation.

### **Methodology:**

#### **Assumptions:**

IAA will provide support to the social aspect of the study by recommending appropriate IAA contacts in some representative countries; if not, the study team will identify and propose representative countries. The team will also contact representatives from relevant organizations around the world. We may need to update the list of participants for the social aspect. Such list will have to be accepted by the Secretary General. Additionally, it is assumed that responses will be received in a timely manner.

On the technical side, it is assumed that

- (1) we will adopt the English language for communication and documentation,
- (2) the team will use ISO and NASA standards by default,
- (3) the team will not limit choices to the least expensive solutions, but at the same time, the proposed concept costs must be reasonable.

#### **Technical Report:**

The study will provide a document which contains (a) top level architecture for a communication system framework between a distributed set of terminals to be placed on the surface of the moon, lunar spacecrafts and earth, (b) top level guidance architecture for autonomous spacecraft travel between earth and the moon, and (c) basic illumination detection system to signal the terminator crossings at a set of terminals. The report will summarize a coherent system that maximizes a return on investment for as many nations and interests as possible.

There will be approximately 6 teleconference meetings of the team members dealing with the technical aspects of the study.

#### **Social Report:**

The social investigation will be based upon the resulting answers to a set of questions defined by the study team members and other participants. The questionnaire will be distributed utilizing e-mail, postal mail or telephone interviews. Results will be evaluated and a report detailing the social implications and potential acceptance at a preliminary level will be provided.

There will be approximately 6 teleconference meetings of the team members dealing with the social aspects of the study.

### **Time Line:**

2 years and 3 months.

### **Final Product (Report, Publication, etc.):**

Two reports

1. Technical Report detailing concepts and development methodologies.
2. Social Report detailing interest and perception from societies at large.

### **Target Community:**

Populations from at least three major world faiths rely on first moon light as well as all Space Agencies.

### **Support Needed:**

- (1) Funds amounting to 60,000 Euros.
- (2) IAA General Secretary assistance to engage appropriate representation for the social aspect discussions.

**Potentiel Sponsors:**

- Laoucet Ayari & Associates, LLC, USA
- Association Tunisienne de la Communication, Tunisie
- United Nations

To be returned to the IAA Secretary General Paris

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**Date: October 8, 2009**

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*Follow-up Section for IAA use only*

**Initial Phase**

**Application received:**

**Commission Approved:**

**SAC Approved:**

**Web Site Section opened:**

**Members Formally Appointed:**

**Final Phase**

**Peer Review by Commission Completed:**

**Recommended by the Commission:**

**Final Report Received:**

**SAC Approved:**

**BOT Accepted:**

**Publisher Selected:**

**Study Published:**