National Aeronautics and Space Administration

International Partnerships and Interface Standards for Exploration

Kathy Laurini
ESMD/Directorate Integration Office
Constellation Associate Program Manager for Lunar Formulation
February 25, 2009

Introduction

- Human and robotic lunar exploration will be an international endeavor
- NASA is actively engaged bilaterally and multilaterally with space agencies
  - Exploring areas of common interest, common objectives
  - Interest is high and growing
- Enabling a sustained and robust program of exploration
  - Strengthen existing partnerships, build new partnerships
  - Interoperability, standards
- Space Enterprise Council work was excellent and has guided NASA in developing the framework for multilateral dialog on standards
  - Focus on commercial standards that have long term applicability
  - Enabling Commercial Off The Shelf (COTS) type solutions
  - Identifying the best US and international standards that could be applied to lunar interfaces
  - Prioritizing work

International Space Exploration Coordination Group (ISECG)

- ISECG
  - 13 of 14 GES signatories participate
  - Voluntary, Non-binding, open, inclusive
  - Next Meeting, March 10-12, Yokohama
- Facilitates Communication
  - Objectives, Interests, Plans
  - Enables parties with common interests to work together
- Most Active Working Groups:
  - INTERSECT
  - Interface Standards Working Group (ISWG)/International Architectures Working Group (IAWG)
    - Multilateral Lunar Architecture Workshops

International Architectures Working Group

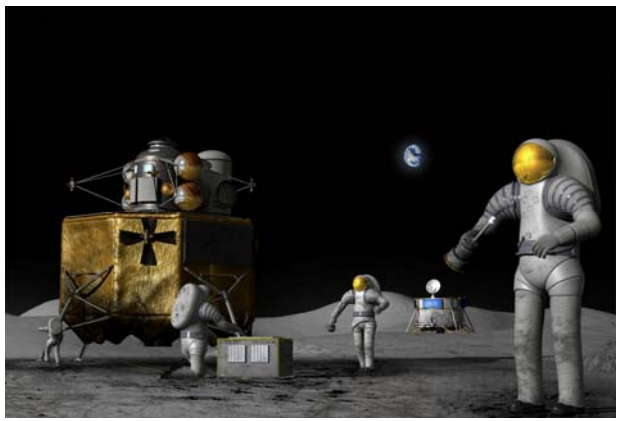
- Objective: Involve interested international agencies in a discussion of lunar surface system exploration scenarios and architectures in order to facilitate identification of interfaces benefiting from standardization and possible contributions to multilateral exploration activity
- NASA leadership, conducted openly and transparently
- Three workshops conducted: Bremen (Sept 2008), Cocoa Beach (Oct 2008), Houston (Feb 2009)
- Discussion topics to date:
  - Common human mission objectives and resultant exploration scenarios
    - Polar outpost buildup, sortie and extended stay sortie to anywhere on the moon
  - Importance of robustness in critical functions such as crew transportation and logistics
  - Initial look at interfaces that could benefit from standardization
    - Communication, Docking Systems underway
- Additional Workshops to perform multilateral lunar architecture study
  - Concludes in mid-2010 to inform NASA Lunar Surface System decisions (LSCR) and decision points for other participating agencies

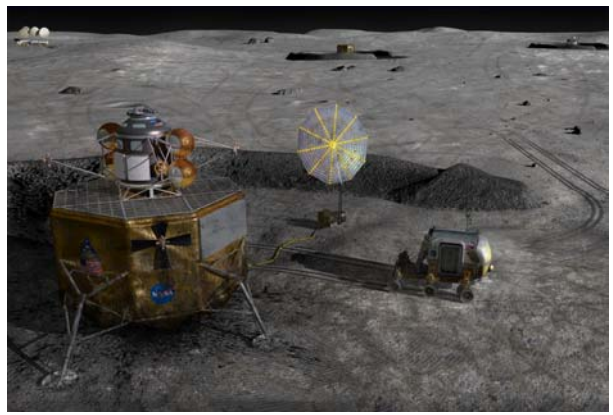
International Architectures Working Group

- Multiple Scenarios
  - 7 day sortie
  - Extended stay sorties
  - Polar outpost
- Multiple Function/Element Teams
  - Human Transportation
  - Habitation
  - EVA
  - Mobility
  - Cargo Transportation
  - Logistics
  - Crew Rescue
  - ISRU
  - Servicing
  - Science
  - Power
  - Comm

Mid-2010

Global Point of Departure Lunar Exploration Architecture





Building Partnerships for Exploration

ESMD Partnership Authority

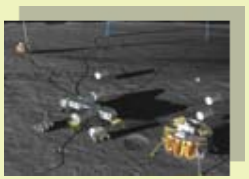
Sets Goals/Priorities
Decision Making Authority

ESMD AA/DAA

PIC

Cross Mission Directorate Coordination

Leads Partnership Implementation Activities



OSEWG
ESMD/SMD Science Requirements Coordination

ESMD coordination of external groups

ESMD DIO

ESMD Partnership Coordination Team (EPCT)

Partnership Strategy Review and Coordination (Including OER)

ESMD Commercial Partnership Council

Coordinates Commercial Partnership Review

Technical Support

Other Non CxP Program Implementation Schemes

Other Mission Directorates, IP's, etc

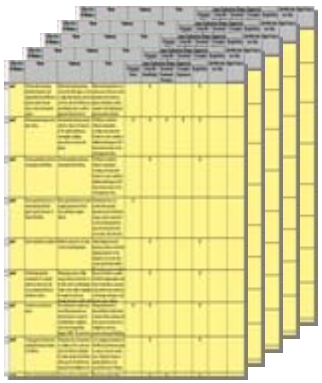
(CxP) CxLunar/Surface Systems
Future elements that could augment US architecture

Center Assigned Work

DIO – Directorate Integration Office, ISECG – International Space Exploration Coordinating Group, IP – International Partners, OER – Office of External Relations, OSEWG – Outpost Science Exploration Working Group, PIC – Partnership Integration Committee

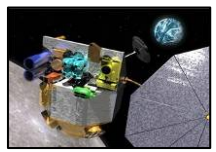
Lunar Architecture Team Science Capability Focus Element Work Flow

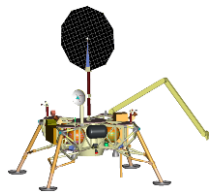
181 Objectives from Global Strategy Team



ALL Science Objectives (45 internal + external)

Each Objective Deconstructed to Define Needed Capabilities and Mapped to Architecture





PRIORITIES from Tempe Workshop

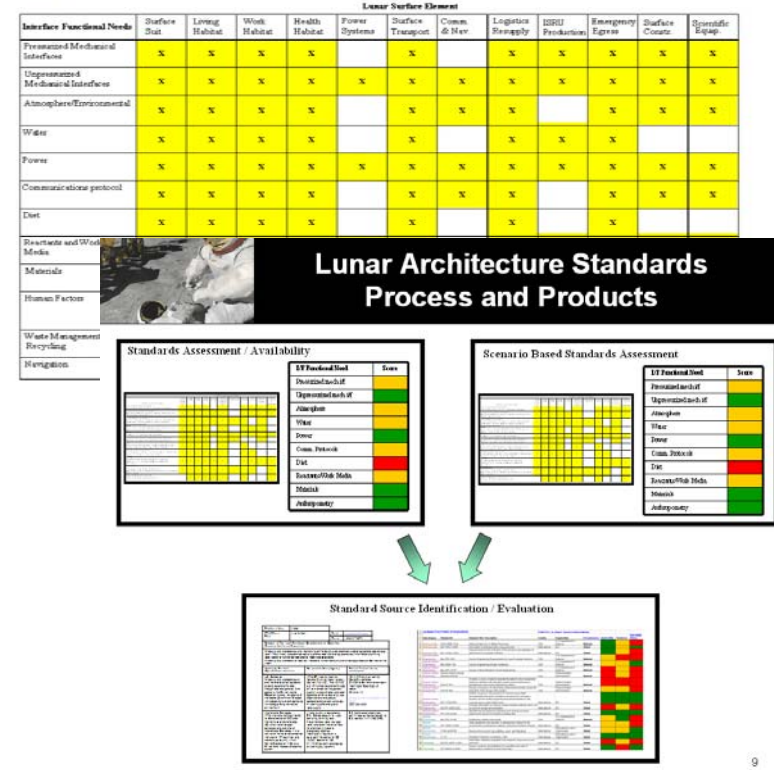
Top Objectives

Grouped into key reference payloads

Mapped to Architecture options

Space Enterprise Council – International Standards

Lunar Surface Elements versus Interface Functional Needs Matrix



Lunar Architecture Standards Process and Products

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Examples of Standards Sources

Functional Area for Standards	U.S. Standards	International Standards
Power		Enmax; International Space Station Program
Water	EPA, NDWAC	International Standards Organization (ISO)
Human Factors	Dept. of Defense (DOD), FAA	ISO, International Labour Organization (ILO)
Unpressurized Mechanical Interfaces	AIAA	ISO
Navig		

Standards Source Evaluation Database / Human Factors Example

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SEC work informed NASA on process, priorities, and availability of global standards.

ISECG Interface Standardization Principles

- Interface standards will benefit both human and robotic exploration programs
  - add robustness to an architecture
  - open new opportunities for collaboration
  - maximize efficient use of resources across the global community
- Opportunities for standardization/commonality will be guided by multilateral architecture work maturation
- Criteria should be applied to guide initiation of work on interface standardization/commonality
  - Opens new opportunities for collaboration
  - Maximizes efficient use of resources across the global community
  - Affordability
  - Opens a new area for a partners economic expansion
  - Number of partners involved
  - Number of times an interface is used across the architecture
  - A sole resource provider that each element will “see”
  - International standard exists and is applicable
  - Timeliness and level of complexity

- IAWG will identify interfaces that can benefit from standardization and recommend them to the ISECG
  - Including priorities, timeframes, necessary participants
- The ISECG will ensure that an appropriate organization is identified to define the specifics of the interface

ISECG Standardization Activities In-Work

- Communication
  - ISECG pursuing interaction with Interagency Operations Advisory Group (IOAG)
    - Includes necessary interfaces to CCSDS for standardization of data and information transfer
- Docking/Berthing Standardization for Operability
  - Discussions underway with NASA, Russia, JAXA, ESA, CSA
  - Soft Capture, Hard Docking, System implications
- ISECG intent is to let exploration architectures dictate future interfaces benefiting from standardization/commonality

Partnerships make dreams a reality