Status of International Architecture Development

ESA

ESA-ESRIN, 16 January 2009

Overview

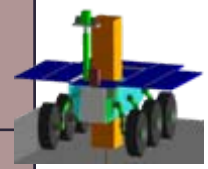
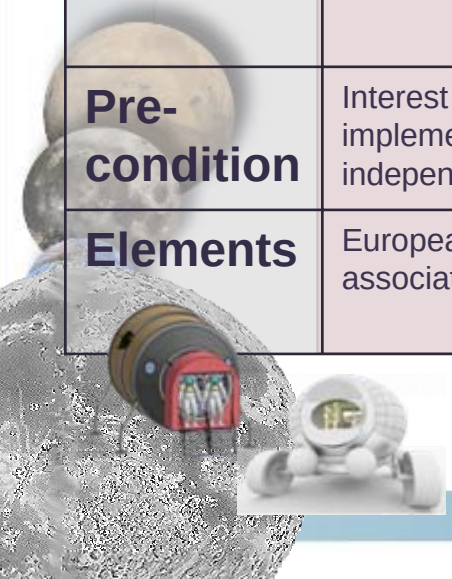
- ESA-NASA CAA Phase 1
  (February 2008 – July 2008)

- ESA-NASA CAA Phase 2
  (Since November 2008)
- ISECG ISWG International Architecture Development
  (September 2008 – Mid 2010)
- ESA-JAXA CAA Phase 1
  (October 2008 to May 2009

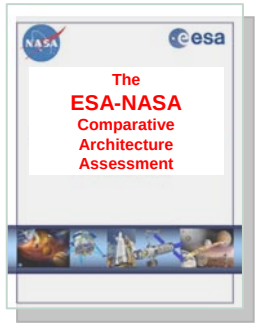
ESA-NASA Comparative Architecture Assessment

	I Autonomous Capabilities	II Complementary Transportation	III Surface Assets
Principle	International cooperation on the basis of sharing of autonomous capabilities	International redundancy of critical functions	International cooperation on the basis of complementary capabilities and mutual interdependence
Objective	Enable implementation of independent missions Contribute to international mission objectives Minimize technical interfaces	Secure redundant access to surface assets Facilitate international transportation scenarios Enhance international programme robustness Increase safety of humans in space Enable new types of missions and surface operations	Enable long-term presence Enable long-range exploration
Pre-condition	Interest and support for implementation of independent mission	Cooperation on transportation architecture	Existence of international cooperation framework
Elements	European lunar lander and associated communication	Crew space transportation capability Staging posts in LEO, LLO	Fixed and mobile habitats




CAA Findings for Autonomous Capabilities



ESA Ariane 5 based lunar landing system

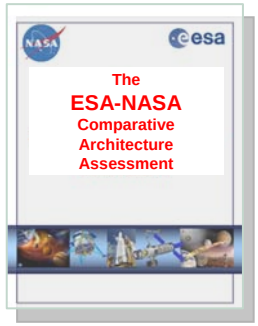
- Extends surface exploration opportunities through enhanced mobility or extended habitations
- Increases opportunities for exploration (automated missions or delivery of exploration tools)
- Enables human landing preparation (e.g. early technology demonstration, surface characterization, landing area preparation)
- Accelerates outpost build-up though delivery of surface assets
- Increases surface stay time of Astronaut during early outpost build-up phased (delivery of consumables)

ESA Communication and Navigation Systems

- Provide significant mission enhancement for all NASA mission scenarios
- Create opportunities for international commercial engagement

CAA Findings for Complementary Transportation

European Crew Transportation



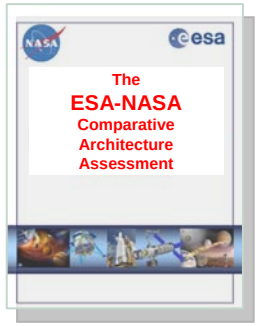
- Redundant crew transportation systems are always beneficial
- Detailed redundancy requirements/ concepts require further elaboration

European Low Lunar Orbit Station

- Enhance mission safety: Safe Haven in case of habitation failure, Orion failure, crew injury or health problem, radiation event
- Enhance mission performance: Extended crew rotations if the Orion could dock with an LLO station and depend on that station for power, orbital maintenance, and thermal control.
- Enables new mission profiles: Cargo-staging location; cargo transported to LLO could be “dropped” to the lunar surface via an automated Altair lander or smaller ESA lander.

CAA Findings for Lunar Surface Exploration Assets

Small Pressurized Rovers (both agency concepts)



- Support two astronauts for excursions of more than 100 km.
- Utilize “suitports” so that astronauts can rapidly leave the “shirtsleeve” environment to do work outside.
- Enable multiple (more than 5) EVAs per person per mission.
- Would enable “science on the spot” in support of astronaut EVAs.

Both a pressurized rover and a surface habitation module are fundamental, enabling components of any surface architecture for the output scenario.

These systems are not meant to enhance a lunar surface architecture; they are the sine qua non of a lunar surface architecture.

ESA-NASA CAA Phase 2 Objectives

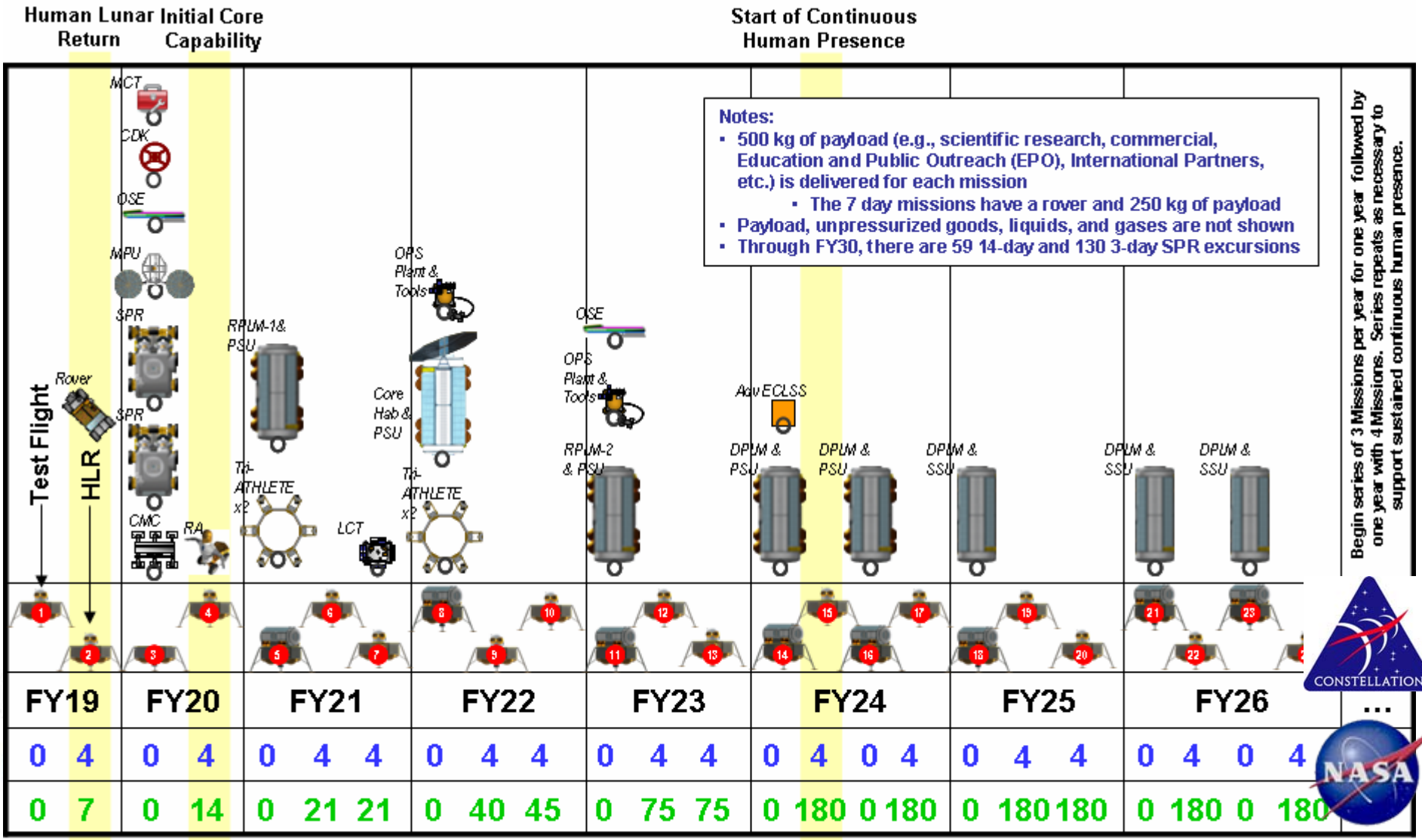
Integration of European lunar lander capability in NASA lunar exploration scenarios and associated manifest at strategic and tactical level

- Strategic value assessment
- Consolidation of mission, architecture and high-level system interface requirements
- Definition of cargo complement
- Collaborative risk mitigation activities

Comparative assessment of selected surface infrastructure concepts and identification of cooperation opportunities

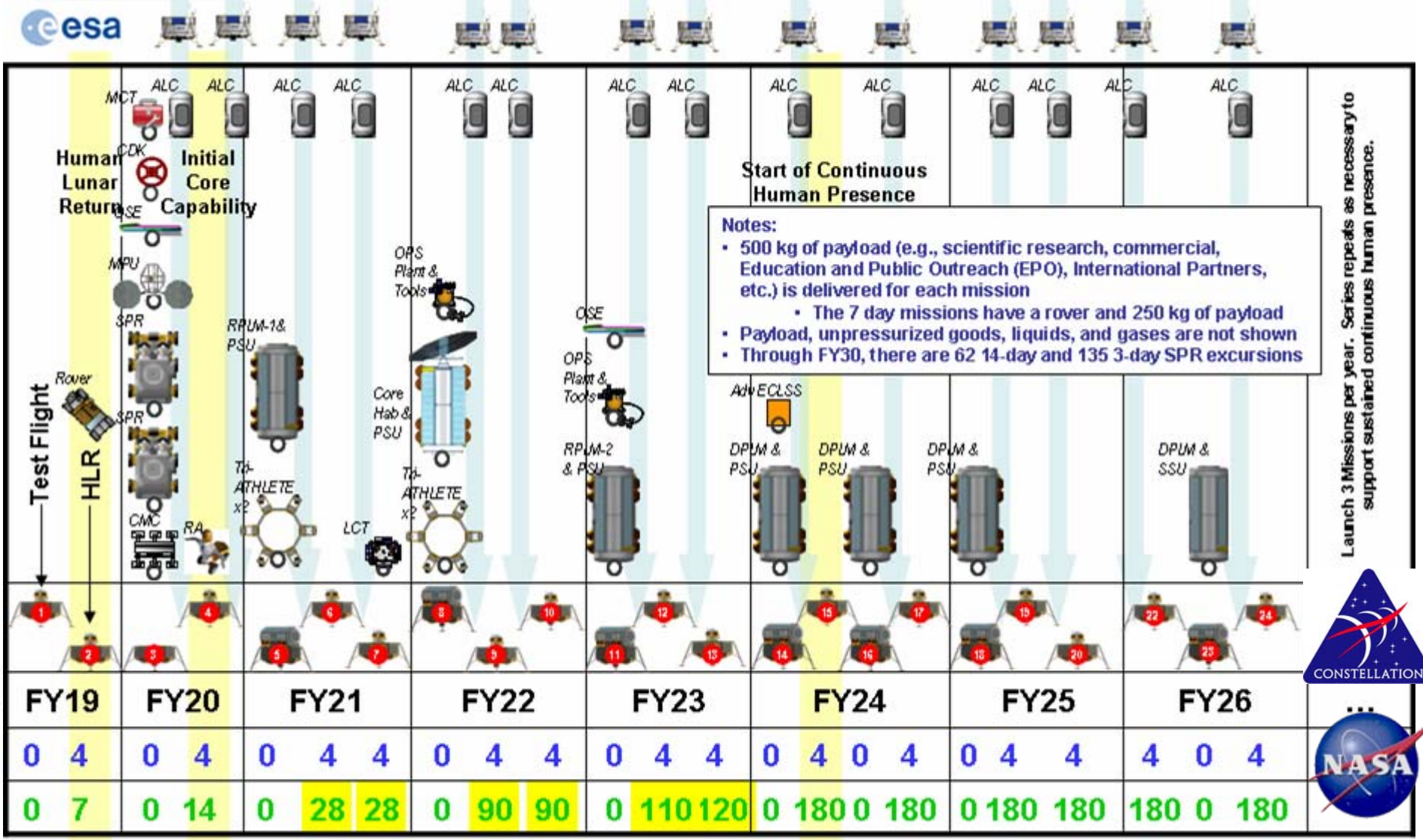
Proposal for partnership agreements

Scenario/ Manifest Integration



- Crew Size # - Surface Duration # - Mission Number

Scenario/ Manifest Integration



FY19		FY20		FY21			FY22			FY23			FY24				FY25			FY26			...
0	4	0	4	0	4	4	0	4	4	0	4	4	0	4	0	4	0	4	4	4	0	4	
0	7	0	14	0	28	28	0	90	90	0	110	120	0	180	0	180	0	180	180	180	0	180	

- Crew Size # - Surface Duration # - Mission Number # - Delta from 4.2.1

ISECG/ ISWG Architecture Development

Discuss architecture concepts for lunar exploration in an international context

- Understand how objectives of cooperating agencies can be met through coordinated lunar exploration activities
- Understand architectural level drivers and considerations

Expand on representative lunar exploration scenarios and characteristics

- Explore innovative element concepts for providing desired functions
- Define desired architecture elements and their key driving requirements
- Understand how surface and communication elements influence transportation element requirements
- Continue to pursue standardization of interfaces that will bring benefits to a global lunar exploration scenario

Inform policy/programmatic/partnership decisions from a technical perspective

Typical ISWG Discussion Points

International exploration scenarios and associated architecture elements

Value of redundant/ overlapping capabilities for transportation and surface elements

Role of staging posts in LEO/LLO

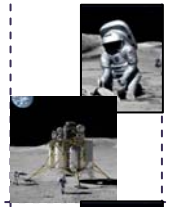
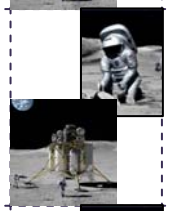
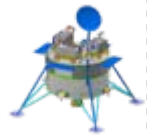
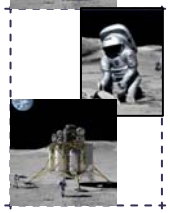
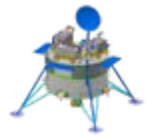
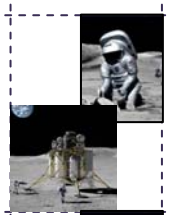
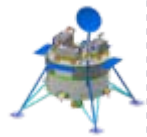
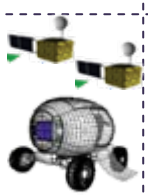
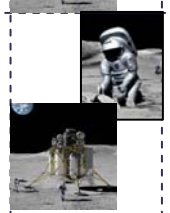
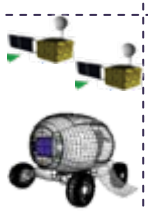
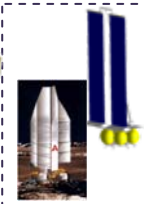
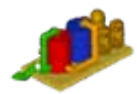
Impact of ISRU capability on exploration scenario

Modular surface infrastructure for enhanced mission flexibility

Opportunities for industrial services

Framework for international architecture integration

International Lunar Surface Exploration Scenarios

Sortie Mission Scenarios	Lander EVA	Logistics	Mobility Com/ Nav	Power	Habitats	
Human lander only (Altair)						
Human lander with pre-deployed assets						
Night survival capability						
Outpost scenario						
Minimum outpost enabling human surface stays of up to 60 (TBC) days						
Full outpost enabling quasi permanent human presence and extended exploration of base terrain						Crew Rescue Greenhouse ISRU 

ESA-JAXA CAA Phase 1

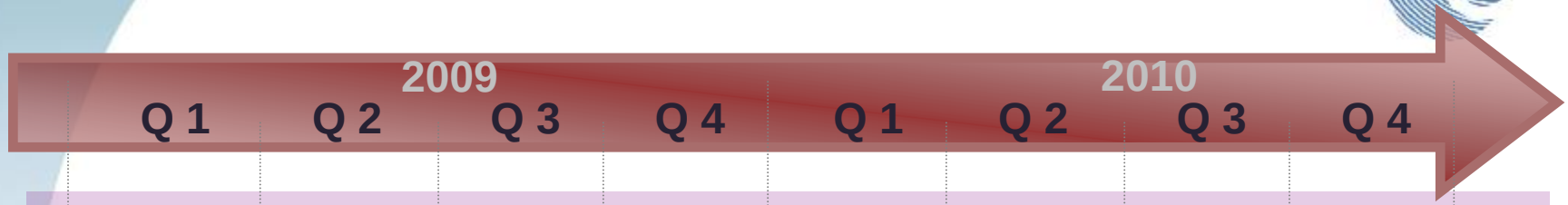
Objective

Identify opportunities for cooperation and contribute proactively to international architecture development through

Discussion Points

- High-level requirements for (a) lunar power systems and (b) mobility systems
- Modular pressurised rover concept facilitating cooperative development
- Power architectures for lunar exploration
- Cooperation opportunities for lunar cargo lander missions
- Requirements for an international human lunar transportation architecture enabling ESA and JAXA contributions

Overall Schedule



International Space Exploration Coordination Group

3rd ISECG Meeting, Japan

4th ISECG Meeting, TBD

5th ISECG Meeting, Houston

Interface Standard WG

Workshop, Houston
Reference Scenario
Architecture Interfaces

Lunar Architecture WG

Defines reference architecture, international mission scenarios and mission/ element requirements

International Architecture Concept Review

Other Related WG's on Cooperative Mechanism, Private Sector Engagement, Roadmap, INTERSECT

Comparative Architecture Assessments

ESA-NASA CAA Phase 2

Defines ESA-NASA cooperation scenarios, Supports international architecture development

ESA-JAXA CAA Phase 1

ESA-JAXA CAA Phase 2 (TBC)

Defines ESA-JAXA cooperation scenarios, Supports international architecture development

Bilateral Discussions with other International partners (e.g. CSA, KSA, Roscosmos)

Identifies cooperation opportunities