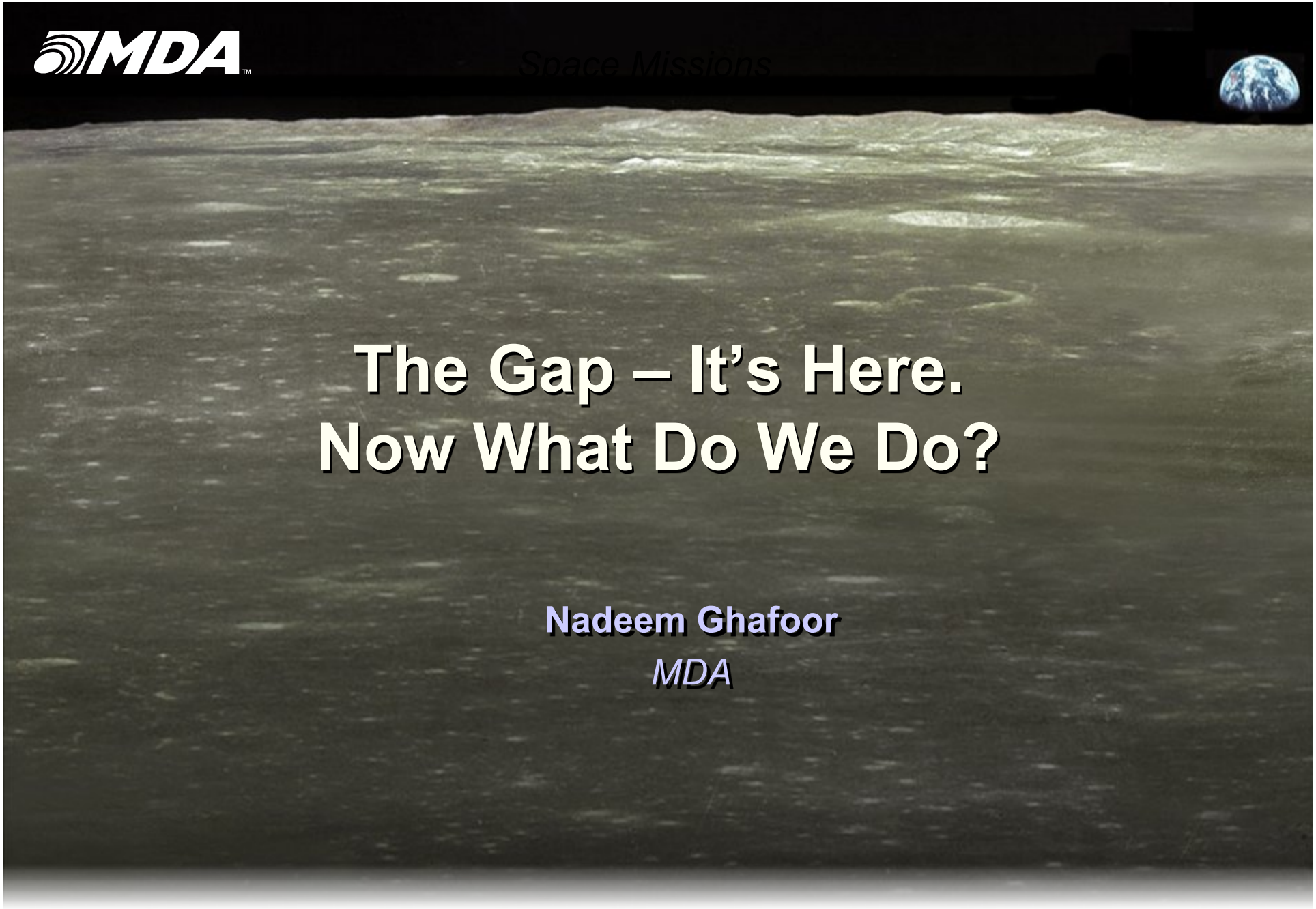
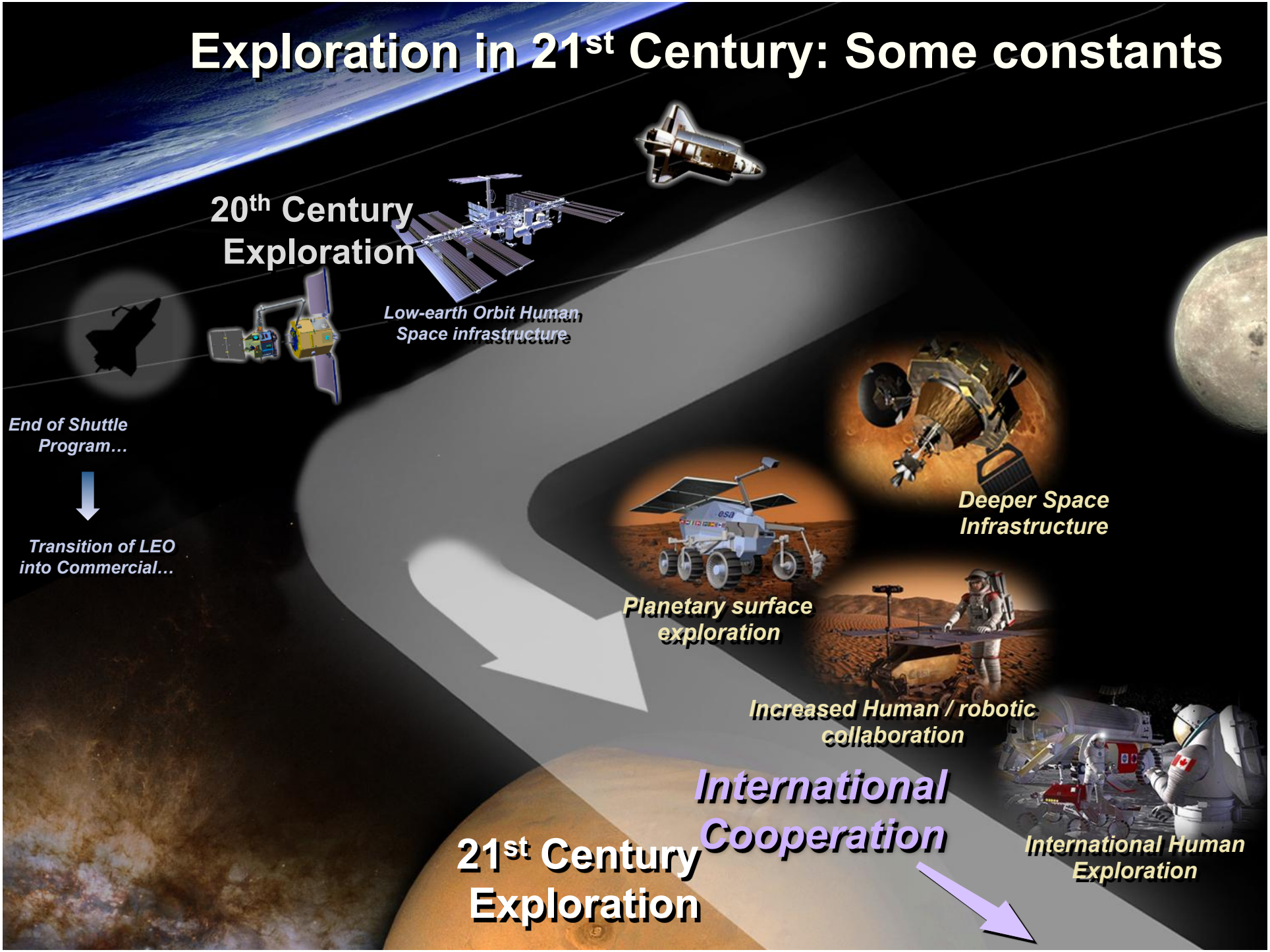


The Gap – It's Here. Now What Do We Do?

Nadeem Ghafoor
MDA

Exploration in 21st Century: Some constants



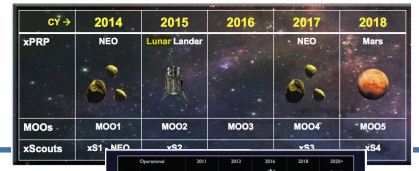
USA

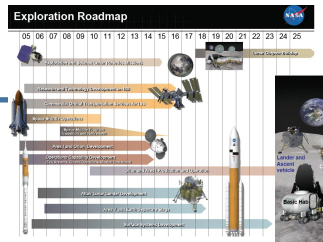
US VSE 2004

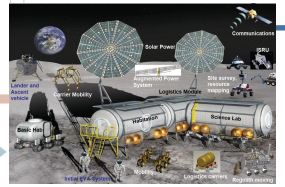
LAT….LCCR

Flexible Path 2011

Robotic & HSF Planning…







Mars Re-Planning…

NASA plans crystallize…

(TBC) CCDEV, MPCV etc…

International

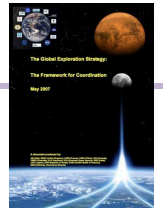
GES 2005

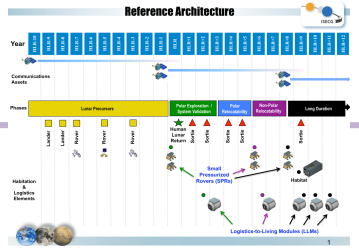
IAWG subgroups

ISECG GPOD 2010

International Ref architectures….

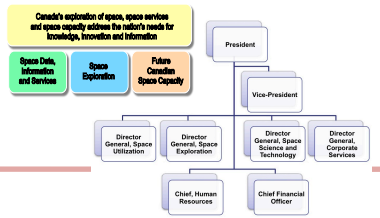
International plans respond…

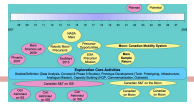




International waiting….

Canada





Planning & Preparation for future participation

CDN priorities emerge…

ExoMars

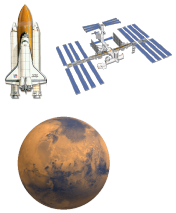
Next CDN exploration topic emerges

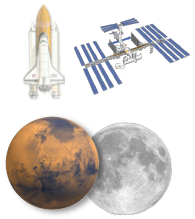
S&T

Ex Co

CSA Reorg

ESM 2010





pre-200

2005

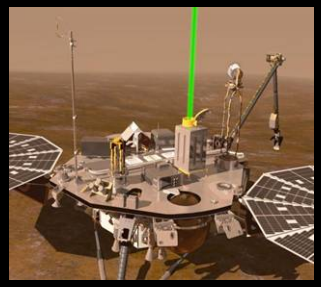
2010

2011

2012 - ….2014 / 15 / 16?

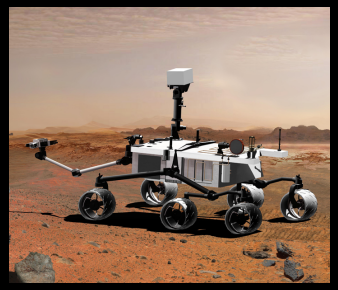
The Evolving Mission Timeline (2010)

NASA Phoenix MET



Credit: NASA

NASA MSL APXS



Credit: NASA

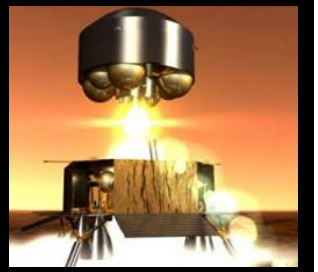
ESA ExoMars Orbiter

Credit: ESA

NASA-ESA Mars '2018'

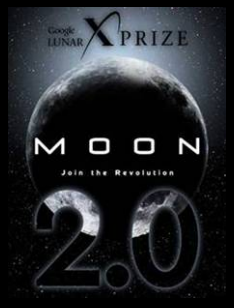
Credit: ESA

Towards Mars Sample Return

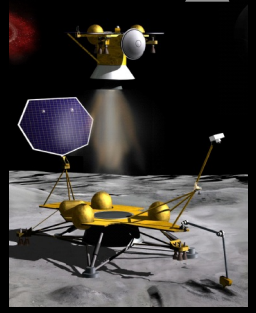


Credit: ESA

2007 2009 2012 2016 2018 2020+ …



Commercial Lunar



NASA New Frontiers

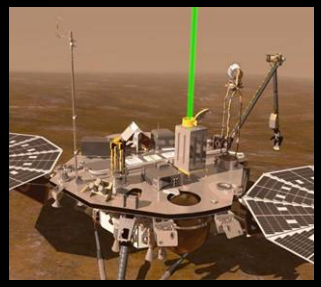
TBC Lunar Precursor?

TBC Other Precursor

Future Human Expln.

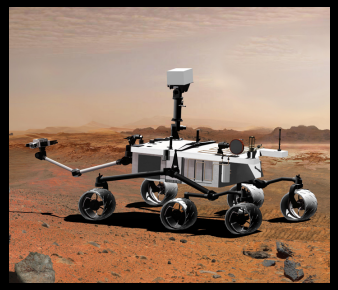
The Evolving Mission Timeline (2011)

NASA Phoenix MET



Credit: NASA

NASA MSL APXS



Credit: NASA

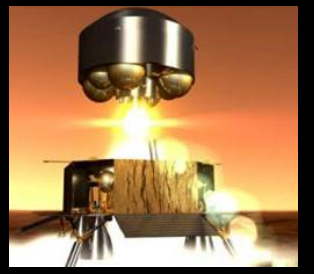
ESA ExoMars Orbiter

Credit: ESA

NASA-ESA Mars '2018'

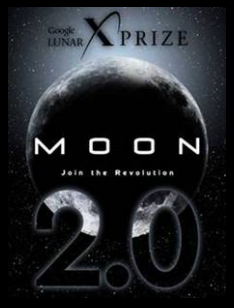
Credit: ESA

Towards Mars Sample Return

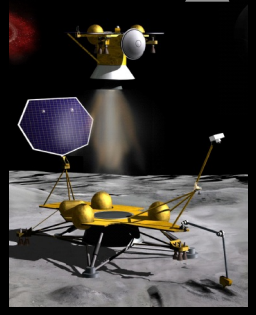


Credit: ESA

2007 | 2009 | 2012 | 2016? | ? | 2018? | 2020? | ~~2020+~~ … 2025+?



Commercial Lunar



NASA New Frontiers

TBC Lunar Precursor?

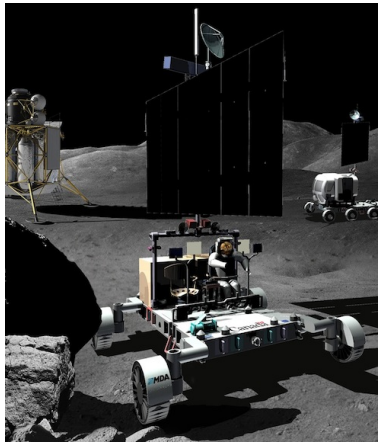
TBC Other Precursor

Future Human Expln.

It's Your Gap Too

- Why you should care:
  - #1: It is going to affect **everything** we've all been doing in recent years
  - #2: It's already here, and it's not going away soon
- Programmatic
  - Exploration missions & priorities in flux
  - Program plans continually revisited (near term = delay)
- Technical
  - Many areas of TRL advancement slowing
  - Spans tech dev, analogue activities, mission studies, +…
- Political
  - Exploration rationales being reviewed, internationally
  - Public & Political exploration momentum eroding (mid-term issue)
  - Commercial has opportunity, but may govt seed may be reqd
- Capacity
  - Significant staff / skill base issue, a growing global problem

Approaches to The Gap

	+	-
Technology Development		
	Necessary step	Lacks iconic / flagship appeal → less socioeconomic impact
	Affordable / Paceable	Typically draws less $ → caps depth of ind/acad engagement
	Opportunity for innovation	Conflict between innovation and flight readiness
	New player engagement	Only partial heritage establishes
Mission Concept Devlpt.		
	Necessary step	Typically small activity → limited direct economic impact
	Guides planning (tech dev, flight priorities, partnerships)	Takes time, but does not fully address flight prep / heritage
	Affordable, tailorable, quick turn-on	Balance of multiple paths vs consolidated effort
	Allows partnership exploration (new / old players, interntnl)	

Approaches to The Gap

Analogue Activity	+	-
	Exploration Field Ops, Sys, I/F experience Harsh environment surface expln. field experience (beyond labs) Visible, profile benefits Partnership simulation: international, sci/tech/ops	Different activities have different validity Care needed to avoid misleading drivers
Flight development	+	-
	What we're all trying to achieve in the first place Establishes / maintains genuine heritage for future intnl missions Full space activity, with associated soc/econ impacts Larger $ offers broader engagement potential	Expensive step Long, complicated lead time – should not be the sole activity

Approaches to The Gap

Political Engagement

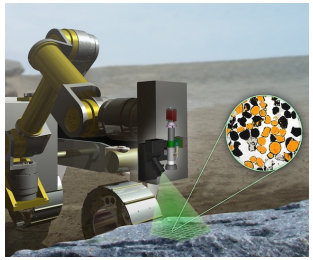
+	-
Critical to getting *any* sustainable budget	Future investment, rather than engagement today
Area of mutual interest between diverse stakeholders	Cannot trust to politics alone

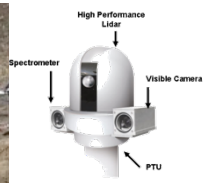
Program Planning

+	-
Necessary step within any future program	Does not provide meaningful external engagement today
Allows tailoring of program to address national needs	Balance between planning and doing

Striking the right Balance

Example: Focus on Tech Dev & Ops Simulation

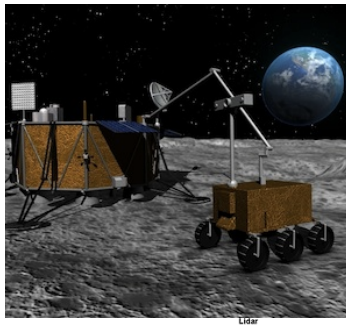


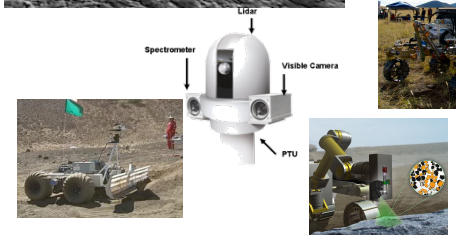


Credit: Neptec

Example: Focus on Large Flight Develpt

Example: Tech Dev & Analogue + Medium (Precursor) Flight





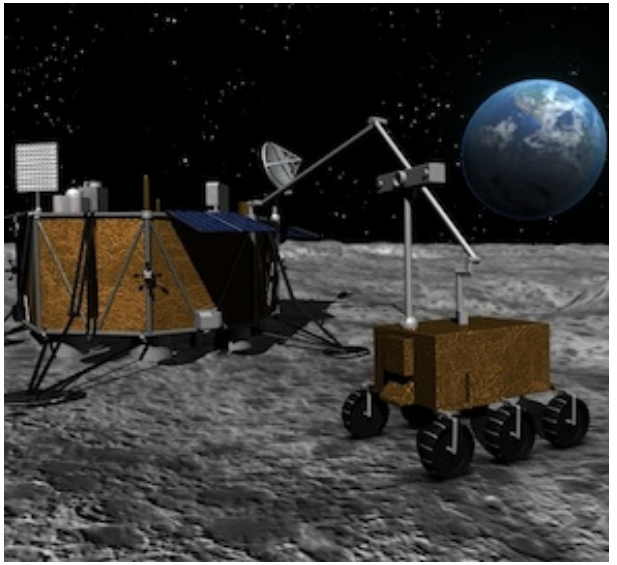
- Agencies have the unenviable job of balancing these priorities
- Function of budget, international context, domestic imperatives etc
- Different balance = significantly different outcomes (tech & economic)
  - The Gap is a critical period for such decisions
- Community can help by establishing a degree of consensus
  - Supports both agency as well as political stakeholders

The Elusive Precursor Mission

- Precursor, precursor – wherefore art thou
  - RLEP
  - LPRP
  - (nothing)
  - xPRP
  - etc etc…
  - Internationally – 10+ opportunities, varying stages of struggle
- Some questions for us to consider (and eventually agree on)
  - Should we fly a precursor or is tech dev enough?
  - How viable is a precursor in the next 3-5 yrs?
  - **Are there opportunities and how can we bring them forward?**
  - **Do we have sufficient consensus?**
  - Will there be roles for everyone?
  - Space sci / ISRU / space tech / planetary mining
    - All different motivations, constraints. How many can we satisfy?
  - When do we diversify, when do we harmonize?
  - Where are the forums for such discussion?

Potential Missions: No Shortage of Ideas

Example: Medium-scale Lunar Rover

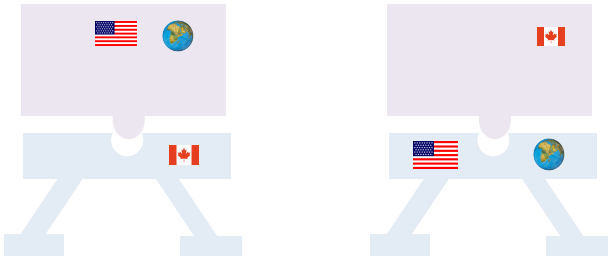


Example: Small Lunar Science Lander & Rover

- Many examples of concept / Ph 0 studies (15+ at MDA in last 5 yrs)
  - Provides support to CSA for future program planning & evaluation
  - Partnership development – international & domestic
- Need for study in light of new (i) science data, (ii) new exploration reality
  - Studies have a lead-time to setup and conduct, so for impact ~2014/2015 the time is now
  - Open qn: *[several small studies]* vs *[single, large & broadly engaging study]* ?

Tech Partnership potential - landers

- No shortage of roles
  - Lander structure
  - Landing GNC
  - Avionics (OBDH, Comms)
  - Power
  - Thermal
  - Vision systems
  - Science payloads
  - Manipulators (eg arm)
  - Subsurface sampling (eg drill / corer)
  - Sample transfer / handling
  - Ground Segment & Ops
  - Mission analysis
  - System integration



Tech Partnership potential - rovers

- No shortage of roles
  - Chassis & Locomotion
  - Wheels / tracks
  - Mobility GNC
  - Avionics (OBDH, Comms)
  - Power
  - Thermal
  - Vision systems
  - Science payloads
  - Manipulators (eg arm)
  - Subsurface sampling (eg drill / corer)
  - Sample transfer / handling
  - Ground Segment & Ops
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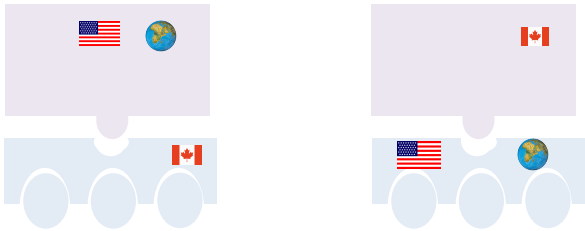
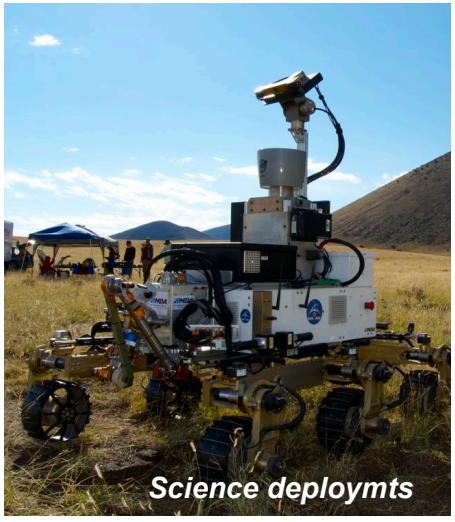


Stakeholders, Stakeholders

- Diverse organizations
  - Large system integrators
  - Small-medium enterprise
  - Academia – technology
  - Academia – science
  - Political - International
  - Public & Political - Domestic

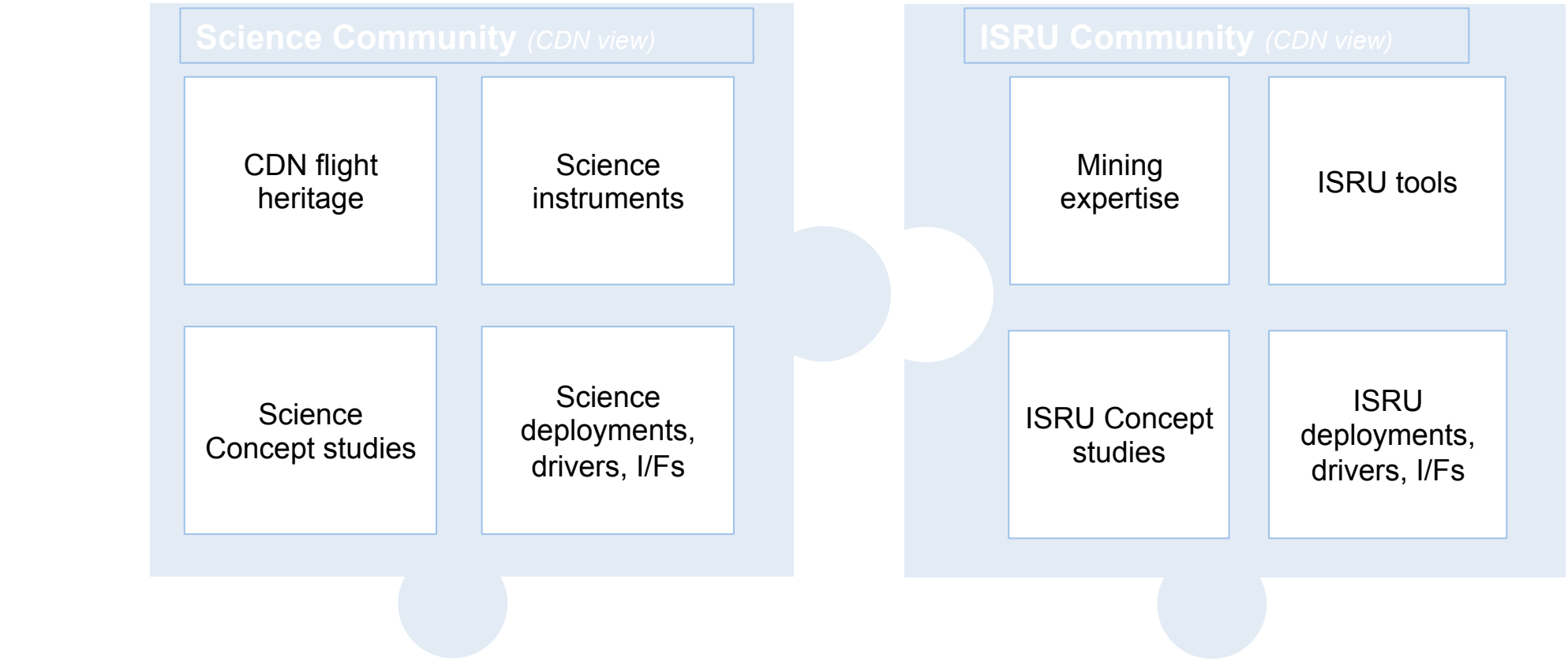
Credit: Neptec

- Diverse discipline communities
  - Planetary Science
  - Resources & ISRU
  - Life Sciences
  - Human spaceflight & Astronaut offices
  - Infrastructure (e.g. Ops, Comms, Nav)
  - Commercial / New Space
  - Non-Space (e.g. terrestrial mining, transport, +…etc)



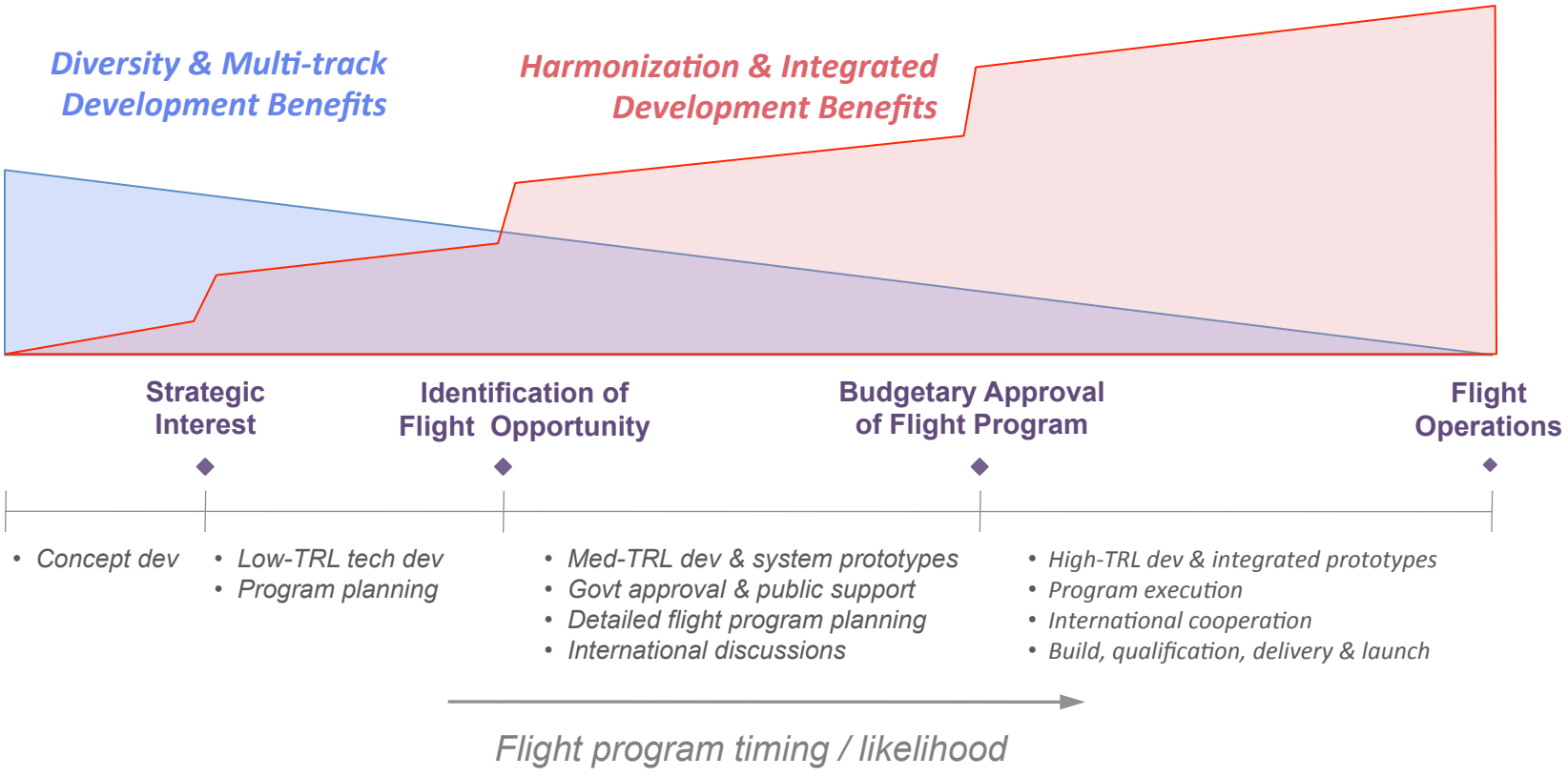
2003-2010: No shortage of players

Harnessing Strengths



- Historically distinct communities naturally exist; Mix of overlap & complementarity
- **Mutual interest in near-term exploration precursor (especially lunar)**
- Consensus may be a key enabler, but demands reconciliation of community perspectives
- *Debate: Has The Gap advanced the urgency of this convergence?*
  - *i.e. the "Half of nothing = nothing" argument*

United we stand / fall



Where first? Some suggestions

- Understand near term precursor interests from both community perspectives
  - eg SPAB vs Small Polar Mission
- Identify synergies, overlaps, conflicts
- Explore complementary developments
  - Deployments, test complementary roles
  - Common tech dev (eg dust)
  - Hawaii 2012 first real opportunity
- Explore single large mission study
  - Focused investment vs distributed to maximize progress and establish early cohesion
- Begin this discussion asap
  - Possible to commence flight dev in 2-3 years
  - But communities would need to support agencies / political stakeholders with consensus position
  - This means discussion would need to start now

Summary

- The Gap is here and will *deeply* impact our lunar & planetary ambitions
  - Whether working on Tech Dev or Flight Missions, if one hasn't felt the impacts already it will happen soon (especially '11-'13)
  - May be experienced differently in US vs internationally, but universally serious
- The Gap is not showing signs of going away quickly
- Different approaches exist to address the challenge, spanning tech dev, terrestrial analogue preparations, and flight activity
- The flight option provides several unique advantages, and several groups internationally have mutual interest in a small-medium lunar precursor mission addressing both science & early ISRU goals
- Enabling such an activity requires significant effort and consensus between key stakeholders (LSI / SME, Intnl, Sci / Tech) will be crucial
- Opportunities exist and the time is may be right to explore this now
- SRR this week provides valuable chance to gather ISRU opinions