

# International Space Station at Assembly Complete

## Canadian Robotics on the ISS: Past, Future and Lessons Learnt

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# Canadarm2 Operations

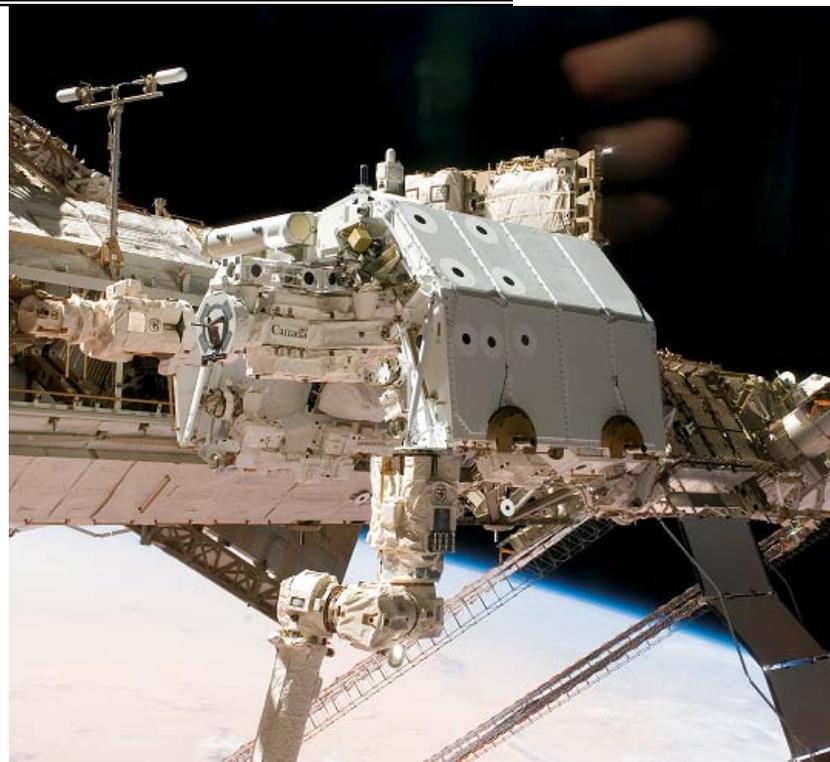
- ❑ Since 2001, Canadarm2 has been used to help build the ISS
- ❑ Canadarm2 missions have resulted in:
  - 38 Items removed from Payload Bay
  - 18 Assembly Operations (Nodes, Trusses, etc.)
  - 8 Resupply Operations (MPLM)
  - 89 EVA assists
  - 1 Free Flyer capture (HTV)



- ❑ By 2015 we anticipate:
  - 24 additional free flyer captures
    - 6 HTV, 10 Dragon, 8 Cygnus
  - ~ 30 module/pallet extraction/insertion/relocations
  - Multiple EVA assists and maintenance tasks!

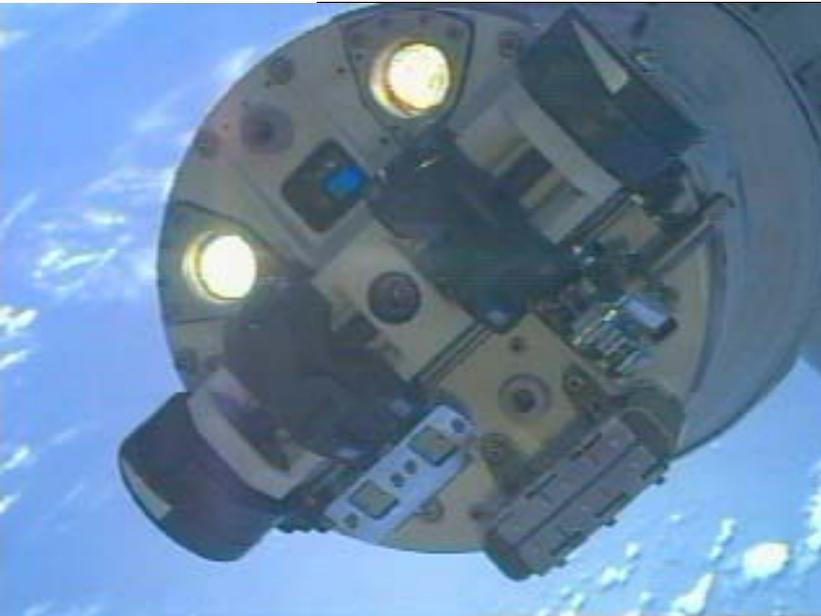
# Dextre Operations

- ❑ Dextre launched in March 08
  - Commissioning 85% complete
  - Final commissioning: June 2010
- ❑ Dextre's purpose is ISS maintenance:
  - ORU Replacement (RPCM's, batteries,...)
  - Over 100 ORUs are Dextre-compatible
  - Develop on-orbit servicing experience



- ❑ Ground Control is a key Dextre advantage
  - Nominal mode of operation
  - Operates by pre-scripted commands from MCC-H
  - Relieves demand for crew to perform EVAs or to operate robotics

# Dextre - Human Scale Robotic Servicing



**As Dextre executes its operational mission, each task performed will yield new knowledge in On-orbit Robotic Servicing**



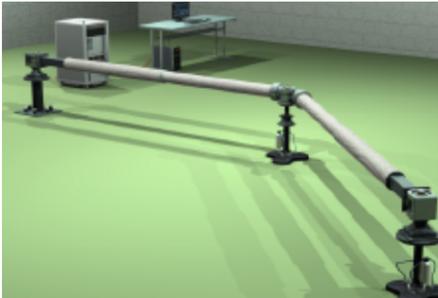
# Next Generation Canadarm

 **Current**

Future

NGC Prototyping Project

2009 - 2012



NGC Tools DTOs using  
Dextre

2013

NGC On-Orbit Tech Demo

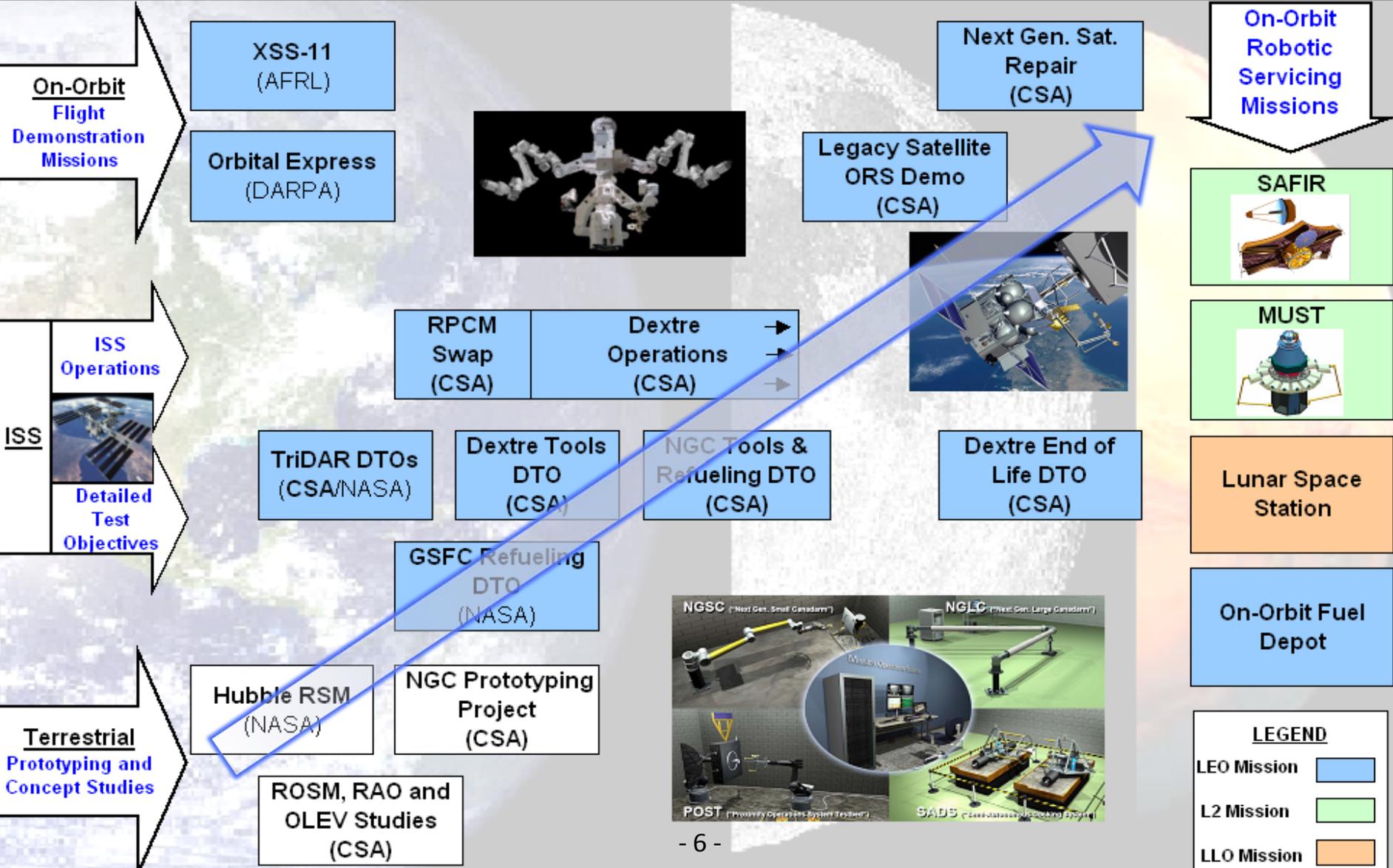
2018

NGC Operational OOS  
Missions

2020

# Potential On-Orbit Servicing Roadmap

Past                      2010                      2012                      2014                      2016                      2018                      2020                      Distant Future





# Application of ISS Lessons Learned to On-Orbit Servicing

Many of the ISS Lessons Learnt identify early partner co-operation:

- ❑ 1: Accommodate Each Partner's Own Objectives
  - Partnerships should be established well in advance and be complementary
- ❑ 7: Establish Appropriate Interdependencies
  - Different partners have different aspirations and capabilities
- ❑ 13: Apply Common Standards and Interfaces to Support Interfacing Interfaces
- ❑ 24: Employ Common Procedures, Practices and Standards
  - Plan for and manage interfaces and standardization early
- ❑ 47: Integrate Servicing into Mission and Operations Strategy
  - Servicing is preferred so that the "next steps" are not developed on their own
- ❑ 52: Consult with End-Users Early in the Program
- ❑ 55: Consider Commercial Engagements Early in the Process...
  - On-orbit servicing has potential for significant user-involvement

**If ISS lessons learned are to be applied to On-Orbit Robotic Servicing then we must work together NOW rather than LATER**

# Canadian Robotics on the ISS:

**HERE'S TO THE FUTURE!**



Canadian Space Agency  
Agence spatiale canadienne