National Aeronautics and Space Administration

NASA CA Operations Devolution to Individual Missions

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Agenda

- Definition of devolution
- HQ/Science Mission Directorate (SMD) decision on devolution
- CARA devolution-related preparation activities
- Devolution current notional schedule information
- Mission devolution checklist
- Mission devolution survey

What is Devolution?

- CARA met with Greg Robinson/Deputy Associate Administrator for Programs in NASA SMD on 22 FEB 2018 meeting as follow-up to an action taken at 2017 PPBE
  - As part of response, CARA proposed options for devolving CARA operations to missions
- Devolution is a spreading of CA operations responsibilities to mission FOTs
  - Permits efficiencies in handling the increased workload caused by Space Fence and large constellations
  - Missions given more flexibility in choosing specific approach to CA requirements that resonates best with their particular needs
  - CARA retains Agency oversight through an established NASA Standard (e.g. training and tool certification)
  - CARA retains SME expertise for Agency support

Agency CA Ops Conduct: Options

- Centralized CA operations
  - Status quo approach: data receipt, risk assessment, reporting, High Interest Event management, and maneuver recommendations all by CARA
- Partial devolution
  - Ops devolution the standard, but CARA ops retained where devolution imprudent, undesirable, or not possible
    - Missions approaching end of life
    - Joint missions where CARA CA part of international agreement
- Full ops devolution, but with muster capability
  - Routine operations fully devolved to missions, but CARA retains operational hardware and skeleton ops personnel as cold backup
    - Hedge against changes in data availability/releasability or withdraw of industry capability
- Full ops devolution
  - CARA activities refocused to analysis, tech development, policy, and DoD/Classified interface management roles

Summary of SMD Devolution Decision

- SMD decision: to pursue partial devolution now
  - Plan for CARA to be ready for devolution by FY20
- SMD will have multiple opportunities to revisit/update this decision
  - Following Users Forum survey results
  - Following Pilot program(s)
  - At each year's PPBE
- Considerations that may impact full devolution option
  - Foreign partners may require CA support under international agreements
  - Missions close to end-of-life may not be well equipped for indigenous CA
  - Missions may simply not wish to take on CA activities

Continuity of Key CARA Functions

- CARA as SME to Agency for SSA
  - Tech development for new methodologies/procedures
  - General policy formation
  - Engaging with external organizations to further Agency goals
- Orbital Safety Analysts (OSAs) to be retained as part of CARA
  - VAFB-resident NASA employees that expedite CA and provide services
  - OSA role codified in interim CA guidance letter (June 2016)
- CARA as liaison manager to 18 SPCS/JSpOC (per NPR 8715.6b 2.7.1)
  - Missions to have direct access to OSAs in support of regular ops CA functions per CARA-provided procedures
  - CARA will oversee routine and conduct classified communications

Devolution Preparation Activities

- Preparing for devolution requires preparation of many items:
  - Development and coordination of CA Standard
  - Development and coordination of CA Handbook
  - Development of CONOPS for devolution, for both CARA and Missions (standard template tailored to each mission's situation)
  - CA training for missions
  - Transfer of CARA stand-alone CA tools to missions that desire them
  - Placement of essential CA algorithms and test cases into publicly-accessible Software Development Kits (SDKs)
    - Permits benchmarking of non-CARA CA tools
    - Enables industry by making key CA algorithms publicly available
  - RFI for commercially-available CA tools/services
  - Execution of a Pilot program(s) for beta testing of the above items

CA Standards/Guidelines

- In order to enable orbit regime protection under devolution, NASA Standard for CA operational conduct is needed
  - Outlines roles and responsibilities, data flow, training requirements, tool validation approaches, risk assessment activities, and reporting requirements
  - Written at conceptual level
    - CA Handbook to provide actual compliance methods and threshold values—easier to modify as industry matures
    - Goal is for Standard to be mission- and industry-friendly
- Presently in draft form (with accompanying handbook commentary)
  - Under review and reformatting by GSFC Code 300 (SMA)
- Next step is to obtain CARA Management Advisory Board (CMAB) approval and enter formal staffing and notice process
  - Hope is to have Standard approved close to beginning of FY19

CA Handbook

- To facilitate responsible CA, collective wisdom of ten years of CA activities needs to be documented and transitioned to users
- NASA Handbook proper vehicle for this; topics include
  - Introduction to and history of CA
  - Review and technical explanation of major CA methods/algorithms, along with operational lessons learned and cautions
  - Amplification of each section of CA Standard
  - Actual CA required performance methods, levels, and thresholds
  - Mission pre-launch, launch, and end-of-life activities/responsibilities
  - Treatment of advanced concepts
- Draft version of Handbook planned for SEP 18
- Plan is to circulate technical portion publicly, to broader industry, to help new and established actors improve safety of flight

CONOPS Development

- CONOPS for CARA
  - Requires update for interaction with devolved missions
  - Expected completion by 1 JUN, including OSA procedure updates
- CONOPS for missions
  - Each devolving mission will require a CONOPS detailing implementation of the CA Standard for the particular mission
  - To be written jointly between mission and CARA
  - Includes the following items:
    - Data flow, including reporting requirements
    - Methodology/protocols for direct contact with OSAs at 18th SPCS
    - Internal decision process and approach for Standard requirements compliance
    - Selection of CA toolset or service and (if necessary) tool certification
    - Training approach

CA Training for Missions

- Updating CARA internal training program to be appropriate to missions
  - Concept- rather than tool-based
  - Distanced-learning paradigms
  - Oral and written exam service available to missions for certification
- Beginner Training Program
  - Being offered as a trial run to ESMO (3 FOT participants) this June/July
    - 4 class times of 4 hours each
    - Students read the material and take a quiz prior to attending class
    - Class involves group discussion of quiz (to review any weak areas) and a group project
  - Material available in SATERN June 2018; annual updates planned
- Advanced Training Program
  - To be offered as part of bi-monthly Users' Forum meetings
  - Material will also be available in SATERN within the next year and will become part of formal training baseline

CARA Tools to Missions

- CARA possesses a number of stand-alone tools that can be helpful to missions performing their own CA
  - Maneuver Trade-Space (MTS) – helpful in selecting maneuvers
  - Sensor Coverage – predicts future SSN tracking opportunities of objects, both theoretically and empirically
  - Monte Carlo Workbench – performs Monte Carlo Pc calculation (from TCA) in equinoctial space, along with covariance repair
  - Pc Uncertainty – produces PDF of Pc values to compare against threshold, modeling covariance and HBR uncertainty
- Presently being packaged and made available for circulation
- Effort underway to move CARA to GovCloud environment
  - Possible deployment mechanism for difficult-to-circulate but potentially desirable services, such as Brute Force Monte Carlo

CA Software Development Kits (SDKs)

- Method for packaging and distributing established CA algorithms for distribution to missions and industry
  - Allows more rapid development of tools and thus more choices for missions; also seeds better safety of flight for industry
  - Publicly available kits contain a reference conference paper, relevant test and validation cases, and MATLAB source code for main algorithm with simple driver
- Planned SDKs include 2-D Pc, 3-D Pc, OD Quality, Monte Carlo from TCA (equinoctial conversions), collision consequence, single-covariance Pc, and Pc Uncertainty
  - Other functions seen as too basic to require SDK
- SDKs will be rolled out as ready, with first appearing early summer
  - Must be fully coordinated with GSFC tech transfer office
  - Routine updates envisioned for bug fixes and enhancements

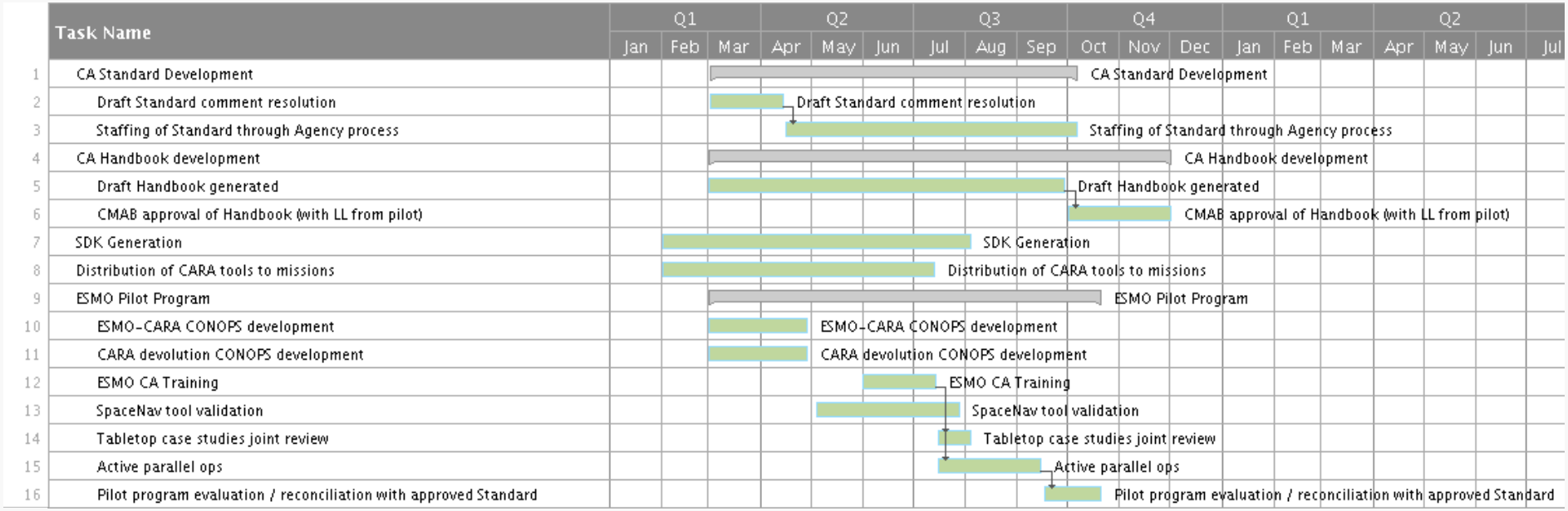
Commercial Tools RFI

- Released industry RFI in January 2017 for commercial CA tools and services
  - Wanted to assess industry maturity and range of possibilities
- Evaluated seven vendors against essential and elaborate functions
  - More vendors exist than chose to respond to RFI, but formal evaluation restricted to those choosing to respond
- Detailed evaluation results proprietary but can be discussed with mission civil servants or FFRDC support
- Bottom line: multiple reasonable choices expected to be available by fall 2018
  - Allows one year of tool/service selection, installation, and checkout before FY20 devolution preparation goal

Pilot Program

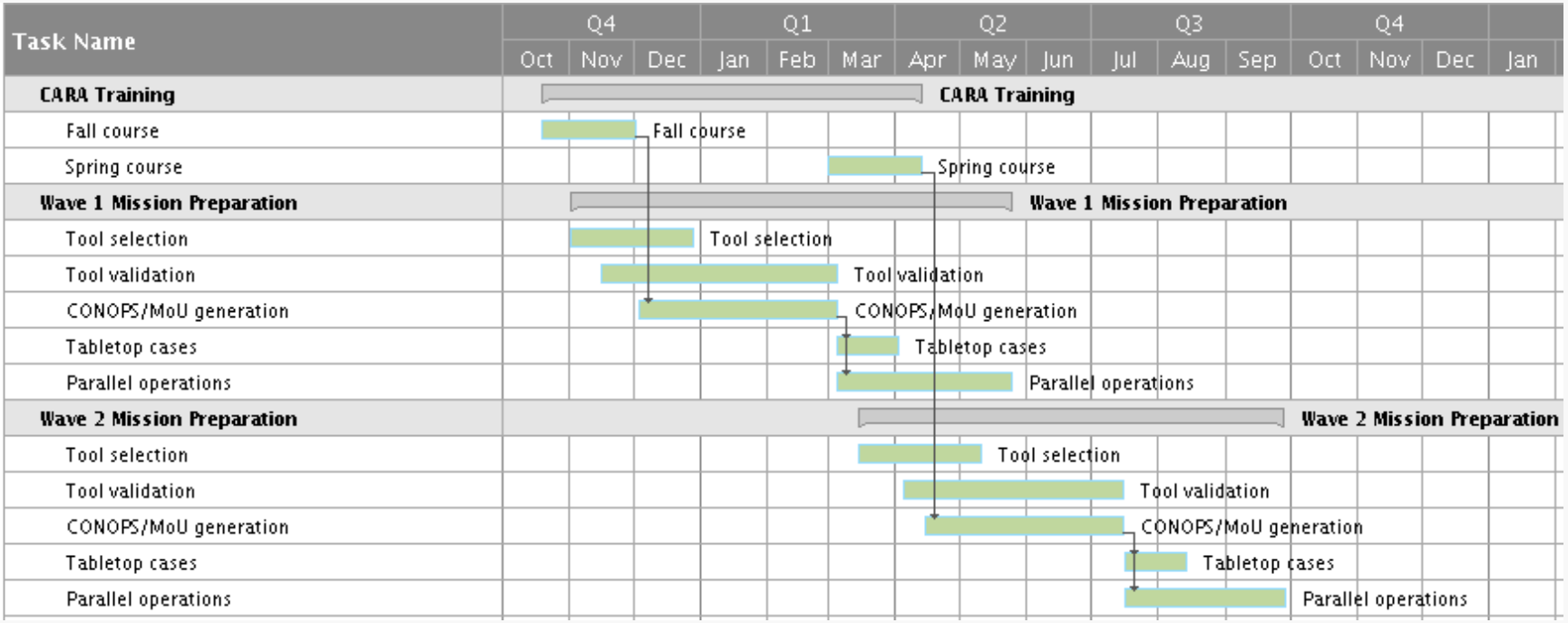
- Pilot program will be run to beta test devolution paradigm, including:
  - Ensuring all necessary procedures and tools are in place
  - Identification, training, and certification of mission CA personnel
  - Parallel operations (both tabletop and live ops conduct)
- Success criteria (to be spelled out specifically, but at high level):
  - Presence of all above items (any CARA/mission disagreements resolved through dissenting opinion process)
  - "Substantially equivalent" ops decisions (during parallel operations) from perspective of orbital regime protection
  - Pilot results to be evaluated by CMAB for readiness to devolve
- Currently working with ESMO to execute a pilot
- Another mission that has not already begun its own CA operations will be selected for a follow-on pilot

Devolution Schedule: FY 2018



- ESMO pilot parallel ops period shortened somewhat due to extensive experience with present tool
- Certification for actual devolution contingent on draft Standard emerging from coordination without substantive changes that affect pilot

Devolution Schedule: FY 2019



- Presumes reasonable guidance in place (Standard, Handbook) to begin these processes in FY19
- Presumes missions can arrange themselves in groups that result in similar documents and activities
- Amount of actual workload required variable based on mission choices, so difficult to estimate number of missions devolvable in a given timeframe

Next Steps

- Complete mission devolution survey (next slide)
- Feel free to send additional comments via email to CARA or your HQ PE
- Economies of scale can be realized if missions participate as groups
  - Gets more missions into a devolved status in the fastest way possible
  - Cheaper for all if use same tools/procedures
  - Negotiations are needed but take time, so may be beneficial to initiate discussions now
- CARA will need to limit number of missions/groups of similar missions that can be devolved at a time due to limited resources
  - Prioritization can be accomplished by SMD

Mission Devolution Survey

- Survey will be circulated following this meeting seeking mission views on and response to devolution
  - Desired by SMD in tendering future devolution-related decisions
- Online version crafted to receive basic information in standardized way
  - However, amplifying comments, sent by e-mail, would be very helpful for process; please respond in this way if desired
- CARA devolution PoC is Joe Rosa (joseph.d.rosa@nasa.gov)