International Earth Science Constellation Mission Operations Working Group
April 13-15, 2016
Constellation Coordination System (CCS) Status
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Agenda

• CCS in the Present
  – CCS Purpose
  – CCS 7.1
  – Migration to Microsoft Server 2008

• CCS in the Future
  – CCS 7.2
  – CCS 7.3+
  – CCS Security
CCS in the Present
CCS Purpose

• System for coordinating and monitoring Constellation safety of the Earth Sciences Constellation (ESC) missions and is a central source of data sharing and operational planning
  – Primary tool for monitoring the Constellation configurations
  – Enables information exchange among/between domestic and international partner ESC missions, including access to 7-day mission ephemerides
  – Transfer critical product data between the Mission Operation Centers (MOCs), CARA, and other authorized mission users
  – Mission Analysis tools and automated health and safety monitoring
    • Automated constellation safety warning notifications
    • Graphical visualization of orbital data
• The latest release, CCS 7.1, was deployed to operations on December 14, 2015
The home page provides users with the status of the missions, including user input status flags for the satellite, instrument, and constellation.

### Status Flags

#### EOS Afternoon Constellation

<table>
<thead>
<tr>
<th>Categories</th>
<th>Aura</th>
<th>CALIPSO</th>
<th>CloudSat</th>
<th>Aqua</th>
<th>GCOM-W1</th>
<th>OCO-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Satellite</td>
<td>Green</td>
<td>Yellow</td>
<td>Green</td>
<td>Green</td>
<td>Green</td>
<td>Green</td>
</tr>
<tr>
<td>Instrument</td>
<td>Yellow</td>
<td>Yellow</td>
<td>Green</td>
<td>Green</td>
<td>Green</td>
<td>Green</td>
</tr>
<tr>
<td>Constellation</td>
<td>Green</td>
<td>Green</td>
<td>Green</td>
<td>Green</td>
<td>Green</td>
<td>Green</td>
</tr>
</tbody>
</table>

#### EOS Morning Constellation

<table>
<thead>
<tr>
<th>Categories</th>
<th>Landsat-8</th>
<th>Landsat-7</th>
<th>Terra</th>
<th>EO-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Satellite</td>
<td>Green</td>
<td>Green</td>
<td>Green</td>
<td>Green</td>
</tr>
<tr>
<td>Instrument</td>
<td>Green</td>
<td>Green</td>
<td>Green</td>
<td>Green</td>
</tr>
<tr>
<td>Constellation</td>
<td>Green</td>
<td>Green</td>
<td>Green</td>
<td>Green</td>
</tr>
</tbody>
</table>
CCS 7.1

- Home page plots visualize near-current orbital parameters for each mission in the constellation using the most recently acquired predicted ephemerides.
CCS 7.1

• CCS utilizes the latest ephemerides from each mission member to detect control box violations
  • If a violation is detected, CCS distributes emails with predicted control box exit and reentry dates along with other pertinent information to constellation members
Product files can be downloaded directly from CCS or delivered to the user via subscriptions.
Subscriptions to products can be easily created, allowing a user to have the product files delivered via email and/or SFTP.

Users can manage all aspects of their product subscriptions from a single location.
CCS 7.1

- CCS contains a collection of tools useful for quick analysis including ground track error and relative phasing, mean local time of the nodes, close approach analysis, and ad-hoc generation of orbital parameter reports and plots.
- Results of tool executions can be saved and shared with other CCS members.
Some of the enhancements released in CCS 7.1 include:

- The capability to use CCSDS OEM ephemeris files in analyses
- Improvements in email notifications, including standardizing the email format, adding additional email types, and delivering emails to all of the relevant recipients
- Quicker loading of the product subscription page
- Improved ability to re-run an analysis with the “Modify Parameters” button on the Results page
Migration to Microsoft Server 2008

• Identified 3 servers across the CCS prime (EOC) and backup (BEOC) environments that required migration due to Microsoft Server 2003 reaching end of life
  – Required issuing new IP addresses to 14 CCS servers
  – Affected mission interfaces with CCS servers

• Planned/coordinated CCS migration with international partner agencies, other NASA centers, and user community

• During migration, identified and deployed security-related improvements to internal CCS traffic

• All Microsoft Server 2003 systems were powered down and removed from the network in accordance with our schedule

Thanks to all of the missions for their help in making this critical project a success!
Migration to Microsoft Server 2008

This network diagram has been simplified for security purposes.
CCS in the Future
CCS in the Future

• The long term goals for CCS are:
  – Enhance CCS capabilities as an online tool that performs flight dynamics analyses relevant to the Morning/Afternoon Constellations
    • Will be accomplished by targeting improvements to CCS in future releases to contain functionality that users have asked for and by soliciting user feedback more frequently
  – Make CCS more secure to better protect each mission’s data
    • Will be accomplished through the use of RSA token for two-factor authentication for user login to the website, and by implementing password complexity and password cycling changes
CCS 7.2

- CCS 7.2 is currently in development, and is scheduled for deployment in Q3 2016
- Some of the features to be included in CCS 7.2 are:
  - Upgraded plots: Classic and enhanced plots will be replaced by a single set of interactive plots containing the following capabilities:
    - Left-click and drag zoom
    - Right-click context menu containing options to zoom out, reset zoom, reload image to its initial state, save the plot as a .PNG image, and save all plots as a zipped file of .PNG files
    - Show/hide data series by clicking on the data series in the legend
    - Highlight data series upon mouse-over of the data series in the legend
    - Display of a tooltip containing the parameters of a data point upon mouse-over of that data point in the plot
    - Display of a tooltip containing the name of the input ephemeris of a data series upon mouse-over of that series in the legend
• Zoom in/zoom out/reset zoom
• Legend tool tip, series show/hide
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April 13-15, 2016

CCS 7.2

– Other Enhancements:

• Improvements in Control Box Violation emails to ensure that the same information is not sent more than once

• Delivery of Control Box Violation and Constellation Close Approach emails to all ESMO Constellation Management and System Administrator Users

• Improvements in the trend ephemeris to ensure that it accurately represents the ephemerides it is generated from
Mission Operations Working Group
April 13-15, 2016

CCS 7.2

• Users will be able to quickly view the results of a saved analysis without re-running it.
• Users will be able to modify and update previously saved analyses.
• Analyses shared with a user will be accessible from their Saved Analyses page.
CCS 7.2

- Input ephemerides included on saved plot images
Addition of links to download the input ephemerides used in analysis on each Results page

<table>
<thead>
<tr>
<th>Analysis Files</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mission</strong></td>
</tr>
<tr>
<td>Aqua</td>
</tr>
<tr>
<td>Aura</td>
</tr>
<tr>
<td>Terra</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Report Files</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>File Name</strong></td>
</tr>
<tr>
<td>Aqua_GTEControlBoxDataReport.txt</td>
</tr>
<tr>
<td>Aqua_PhaseControlBoxDataReport.txt</td>
</tr>
<tr>
<td>Aqua_ViolationDataReport.txt</td>
</tr>
<tr>
<td>Aura_GTEControlBoxDataReport.txt</td>
</tr>
</tbody>
</table>
• Ability to run the Ground Track Analysis Tool for multiple ephemerides/missions
• Option to specify the interpolation step size or use the ephemeris points in the Ad Hoc Tool
• Constellation Close Approach Tool plot will include the radial separation, cross-track separation, in-track separation, and range.
• New Ephemeris Conversion Utility converts a file in a CCS-supported ephemeris format uploaded by the user to a user-specified CCS-supported ephemeris format, which will then be available for download.
CCS 7.3+

• Some major enhancements being considered for future CCS releases are:
  – Ability for users to define their own homepage including user-defined automated analyses
  – Automatic ephemeris selection when running a manual analysis where CCS chooses the most recent applicable ephemeris
  – Improvements in the speed of the website

• Any other suggestions?
The CCS system administration team is currently planning several security and infrastructure improvements to all of the CCS operational and test systems:

- CCS EOC Ops
- CCS BEOC Ops
- CCS BEOC Test

Improvements will better protect NASA systems hosting the CCS software and your mission’s data located on these systems.

All changes will be communicated and coordinated with the Afternoon and Morning Constellation missions and the CCS user community beforehand.
## CCS Security

<table>
<thead>
<tr>
<th>Security Enhancement</th>
<th>Schedule (approximate)</th>
<th>Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual password changes for mission accounts on the CCS FTP servers to comply with NASA password complexity requirements (12 characters, requiring lower and upper case letters, numbers, and special characters)</td>
<td>May/June 2016</td>
<td>Will be communicated in advance of changes. New passwords to be provided to missions through secure NASA NOMAD file transfer service</td>
</tr>
<tr>
<td>Use of RSA tokens for two-factor authentication for logging into the website</td>
<td>Summer 2016</td>
<td>Initial testing planned to begin in Spring 2016. Tokens will be mailed to all users and configured in advance of going operational. Instructions will be provided to users unfamiliar with RSA tokens.</td>
</tr>
<tr>
<td>Migration of CCS servers to a virtual machine (VM) environment</td>
<td>Fall 2016</td>
<td>Moving CCS software off of aging physical servers. Will evaluate combining the CCS website and content servers into a single server to simplify infrastructure. Our approach will attempt to limit impacts on established mission interfaces with CCS</td>
</tr>
<tr>
<td>Periodic password changes for user accounts on the website</td>
<td>TBD</td>
<td>Evaluating periodic website password changes as a feature of CCS 7.3</td>
</tr>
</tbody>
</table>
Questions?

• Thank you for your continued support!

• For all CCS communications please contact:
  CCS_Support@ai-solutions.com