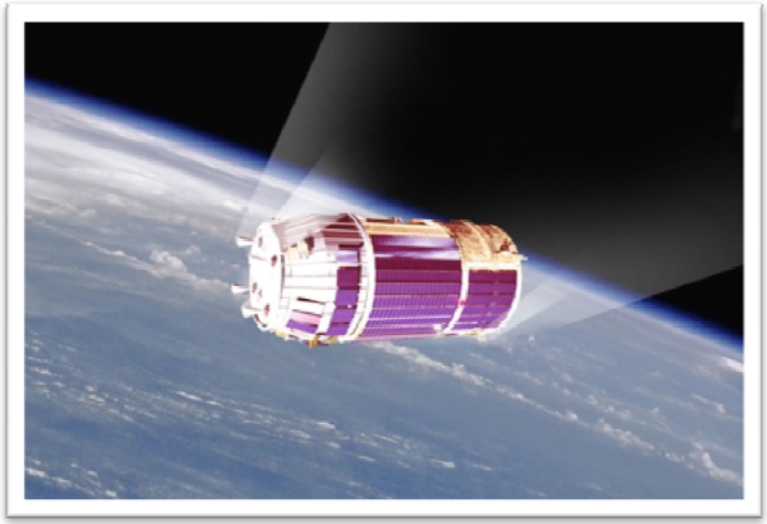
H-II Transfer Vehicle-3 (HTV) Mission Status Review and Lessons Learned



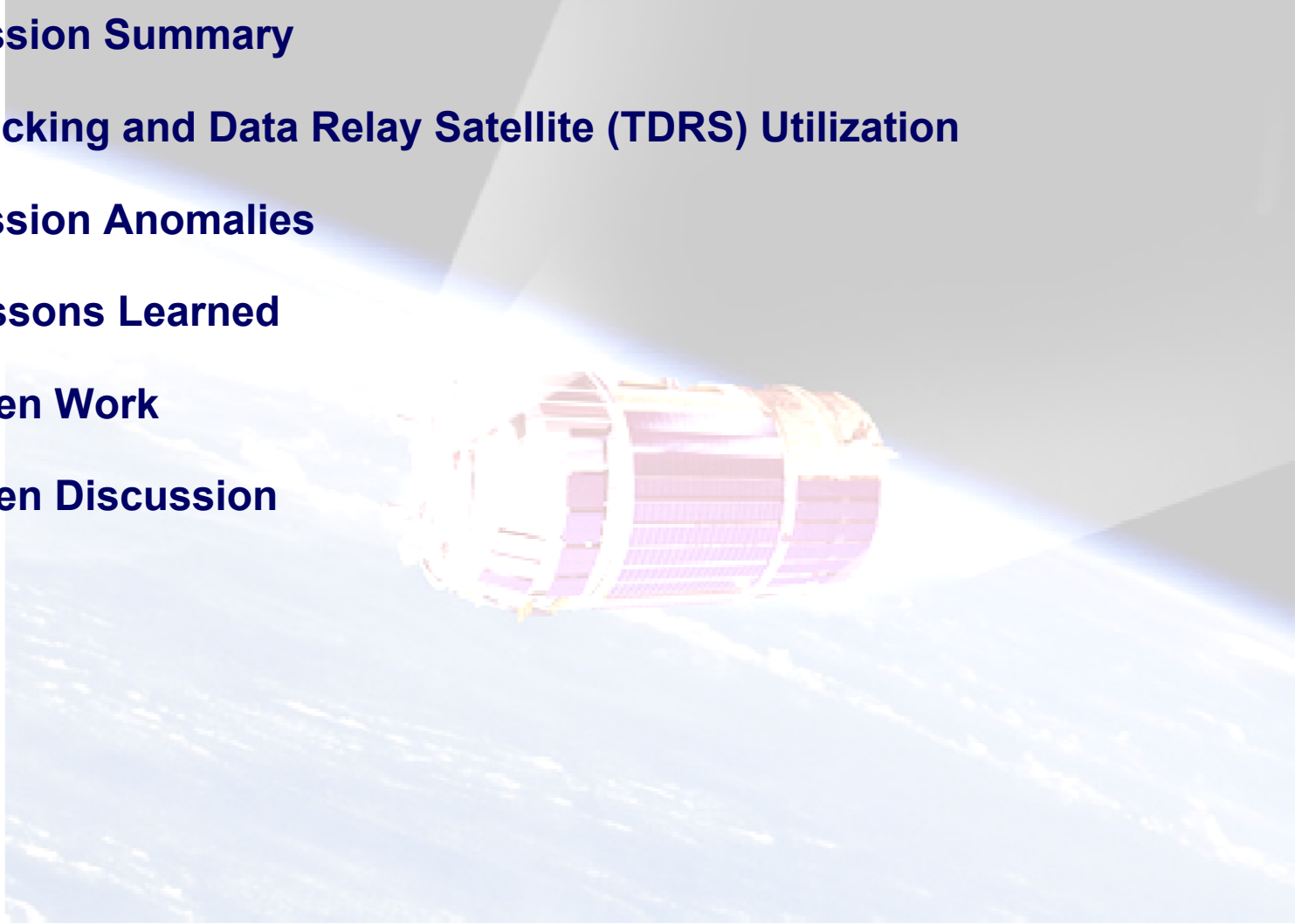
09/11/12

Network Support Group (NSG)

M. Calhoun – GSFC/SMM
A. Frith – JSC/ISS GC

Agenda

- Mission Summary
- Tracking and Data Relay Satellite (TDRS) Utilization
- Mission Anomalies
- Lessons Learned
- Open Work
- Open Discussion

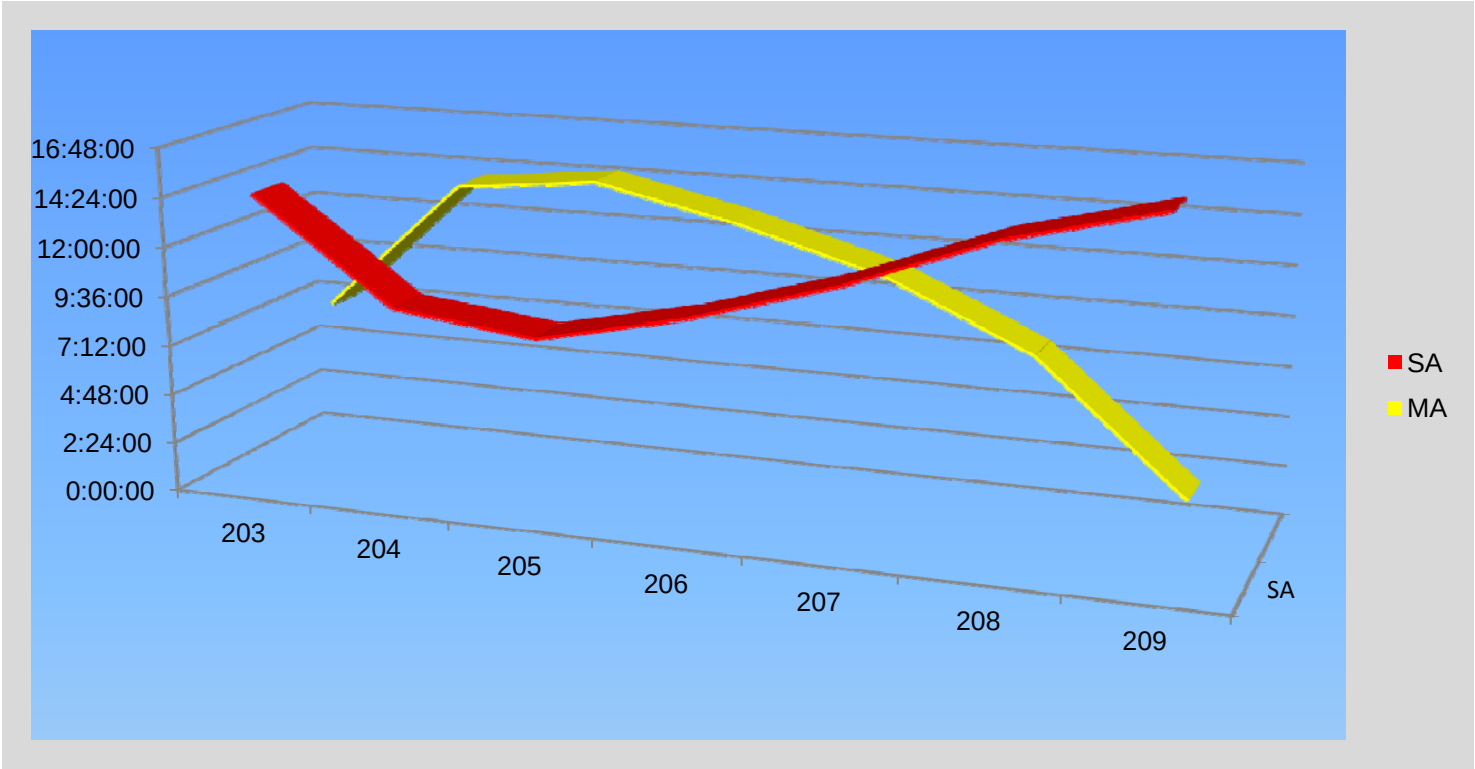


Mission Summary

Launch Date/Time:	203/0206:18Z
Berthing:	209/1223:40Z
Unberthing:	256/1550Z
De-orbit burn:	258/TBD
Re-entry:	258/TBD
TDRS support concluded:	258/TBD
Network released:	258/TBD

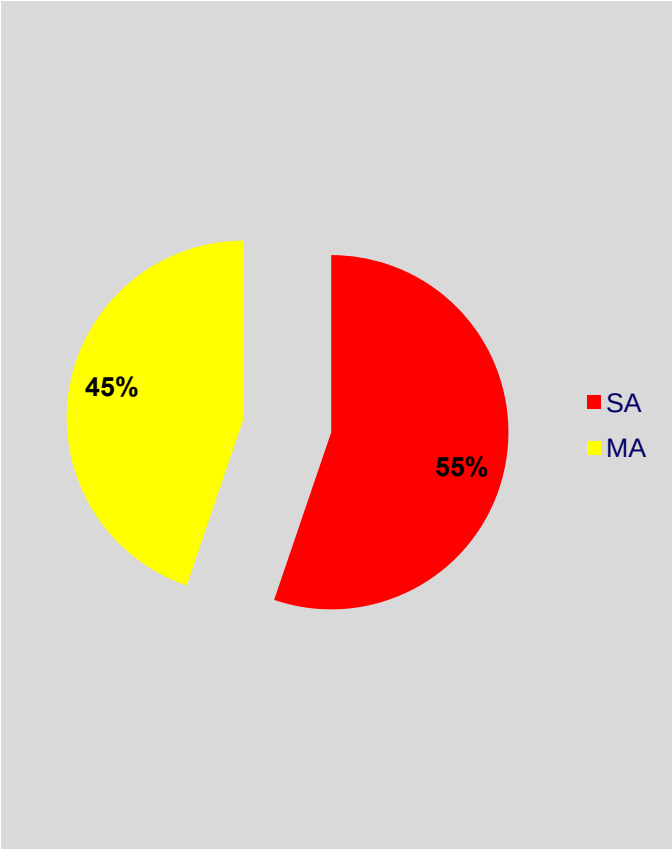
Mission Summary (cont'd)

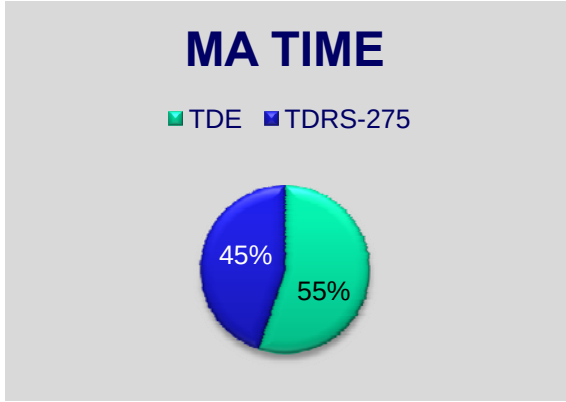
- **Space Network (SN)**
  - **Provided TDRS coverage throughout all phases of the mission (pre-mission, launch, early orbit, berth/unberth and re-entry)**

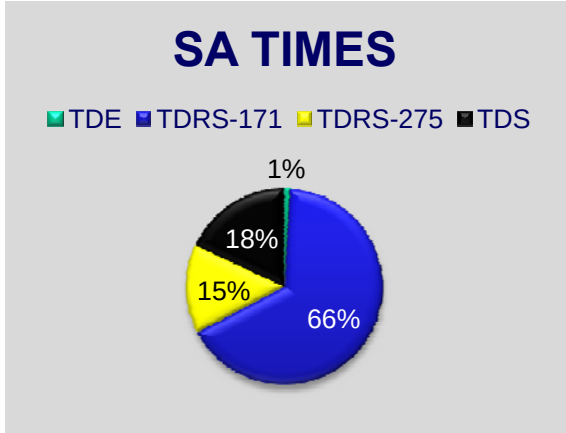


Mission Summary (cont'd)

- **SN (cont'd)**
  - **TDRS resources were allocated across the constellation as indicated below:**







Mission Summary (cont'd)

- SN (cont'd)
  - Provided exhaustive fault isolation support (~14 Delogs) throughout the mission
  - GCMR flowchart provided to aid in recovery from late acquisitions
  - TDRS Critical Periods:
    - Pre-Launch/Launch/Early Orbit/Berthing:
      - 203/0145:00-209/1402:54 GMT
    - Unberthing/Reentry:
      - 256/1420:00-258/0705:00 GMT

Mission Summary (cont'd)

- Flight Dynamics Facility (FDF)
  - Provided support to the following:
    - Pre-mission support for TDRS coverage
    - Acquisition data support to the SN
    - Orbit determination after insertion and sent solution vector to Johnson Space Center (JSC)
  - Performed a series of vector plots and analysis to investigate late acquisitions and telemetry dropouts that occurred during the mission
  - Supporting one-way tracking supports during post release to assist in fault isolation of the late acquisition anomalies
- Communications Service Office/Network Integration Services Network (CSO/NISN)
  - Provided voice and data circuits configuration support
  - No problems reported

Mission Summary (cont'd)

- **Network Integration Center (NIC)**
  - **Spaceflight Mission Managers (SMM) were on console pre-mission, launch, early orbit, berth/unberth and re-entry**
  - **Assisted in SN conflict resolutions**
  - **Fifteen (15) ISIs have been generated to date**

ISI NUMBER	TITLE	DATE SENT
1	Mission Status	6/21/2012
2	Hardware and Software Freeze	6/29/2012
3	WSC Autothroughput Management	6/29/2012
4	Mission Meeting Number	6/29/2012
5	C-Band Radar Contingency Call Up Procedure	6/29/2012
6	Requirements for HTV-3 SN Daily Support	6/29/2012
7	Critical Mission Period Restrictions	7/12/2012
8	Vector Management	7/12/2012
9	Launch Count	7/13/2012
10	Launch Count (Updated)	7/13/2012
11	Launch Count (Updated)	7/19/2012
12	C-Band Radar Contingency Call Up Procedure	7/19/2012
13	Hardware and Software Freeze	7/20/2012
14	Critical Mission Period Restrictions	8/31/2012
15	Critical Mission Period Restrictions	9/4/2012

Mission Anomalies

- SN Discrepancy Reports (DR):
  - DRs were written to document anomalies in two main catergories:
    - Late acquisitions
    - Telemetry dropouts

Mission Anomalies
Late Acquisitions (cont'd)

- **Numerous discussions were conducted concerning the late acquisitions**
  - **JAXA reported TDRS link delay (>than 30 seconds) on 32 events out of a total of 290 (~11%)**

TDRS supports	Occurrences
AOS delay (30 sec – ≤1 min)	20
AOS delay (> 60 sec – 2 min 03 sec)	12
Total	32 out of 290 passes

  - **WSC Engineering performed an exhaustive investigation**
  - **The team developed GCMR flowcharts as a fault isolation tool in case of a late acquisition**
    - **They cover both coherent and non-coherent services (SSA, SMA/MA)**

Mission Anomalies
Late Acquisitions (cont'd)

- Flight analysis of the late acquisitions have not yielded any root cause
  - JSC Pointing and ISS GC have developed a test to further investigate this anomaly
  - Criteria that will be in place for this test are as follows:
    - It will be performed post HTV-3 release while the spacecraft is still in Proximity operations (PROX OPS) mode
    - ISS must have Solid S-band at each HTV-TDRS SHO AOS
    - SHO AOS vs. Coverage AOS
      - Have some SHO events start prior to the TDRS entering the IOS antenna FOV
    - Coherent vs. Non-Coherent
    - Various TDRS will be used in this test (171, 174, 41, 49, 275)
    - TDRS Services that will be utilized in the test (SSA, SMA and MA)
    - There will be HTV State Vector updates to Network throughout the test

Mission Anomalies
Late Acquisitions (cont'd)

- FDF's 1-way tracking passes
  - FDF has requested three one-way non-coherent passes to assist in investigating late acquisitions which occurred during the mission
    - One possible source of a SN acquisition problem is that the HTV transponder is operating at a frequency which differs from the nominal frequency that the transponder was designed to use
    - FDF will use the one-way track passes to generate a Local Oscillator Frequency (LOF) report
      - FDF generates the LOF reports to measure the difference between the actual frequency that the transponder is operating at from the nominal frequency that the transponder was designed to perform on
    - JSC GC have identified passes to be utilized for the one-way track
    - JSC GC has changed one track configuration codes for this test
      - They worked with the WSC Data Base Manager to change the track code

Mission Anomalies
Telemetry Dropouts

- **Telemetry Dropouts:**
  - **Four (4) TD-275 events experienced telemetry dropouts during the mission**
    - **WSC Engineering has extensively investigated these anomalies and have found the causes for each of the dropouts**
      - **Two of the events were caused by a software issue with the MA/SMA Integrated Receiver System (IRS) modems. A software delivery has been installed to correct this problem**
      - **One of the events was affected by radio frequency interference/mutual interference (RFI/MI) that was occurring during the event**
      - **One of the events was caused by a frequency shift that occurred as a result of a vector transmission during the event**
        - » **A vector management ISI will be generated detailing the procedure when the vectors will be transmitted**
        - » **FDF will coordinate with the SMM as to when is the best time to transmit an updated vector**

Unberth/Re-entry Activities

- Due to a problem with the ISS Main Bus Switching Unit (MBSU) installation anomaly, the HTV-3 departure was delayed
  - ISS EVA #19 was successfully performed on 09/06/12
    - The MBSU installation was completed
  - JSC/JAXA are working on plans for a release date of 09/12/12

Lessons Learned – GCMR Management

- This lesson learned refers to sequence 19 in the launch count

L-01:00:00	MCC-H WSC GSFC	HOU GC WSC ENG SMM	19	HOU GC transmit a GCMR to TDRS-171 and receives a reject 23 (service not scheduled)

  - A Return GCMR was sent yielding a reject code 22
  - The HTV launch count will be updated to reflect that a Forward GCMR is needed

L-01:00:00	MCC-H WSC GSFC	HOU GC WSC ENG SMM	19	HOU GC transmit a forward GCMR to TDRS-171 and receives a reject 23 (service not scheduled)

Lessons Learned – GCMR Management (cont'd)

- This lesson learned refers to sequence 24 in the launch count
- Sequence 24: Houston GC should wait until they get a confirmation from the WSC engineer that the GCMR has successfully processed prior to sending another GCMR

L-00:21:18	WSC MCC-H GSFC	WSC ENG HOU GC SMM	24	Start TDRS-171 event: Non-coherent Forward: 250 bps Return: 8 kbps 1.HOU GC confirms receipt of UPDs. 2.HOU GC submits an 8 kbps coho GCMR. 3.WSC ENG confirms GCMR. 4.HOU GC submits a 2 kbps coho GCMR. 5.WSC ENG confirms GCMR. 6.HOU GC submits an 8 kbps non-coho GCMR. 7.WSC ENG confirms GCMR.

Lessons Learned – Incorrect EIRP min/max values

- During the pre-mission period it was determined that the EIRP min/max values were incorrect
  - WSC Engineering reported that the EIRP min/max values in the RFICD were not correct
    - JAXA provided the correct EIRP min/max value
  - Post HTV-3 mission, the RFICD will be updated with the correct EIRP values

Lesson Learned – Testing

- The Launch minus 7 day test was scheduled 4 days from launch. OIP C6.10.1 states that this test should be performed at least 7 days from launch
  - There's some coordination that goes in to making this test a reality
    - Scheduling WSC and MSFC BCC-HOSC resources
      - Tests do not have the same priority as real-time events
    - Scheduling the WSC engineering personnel
      - The WSC Engineering personnel support other non JSC events
  - Also, if there's a problem during the test, there would be time to reschedule the test prior to the launch date

Lesson Learned – Anomaly Reporting

- This is concerning the late acquisitions that occurred during the mission
  - Not all late acquisitions were reported
  - It is imperative that all anomalies are reported so that they can be documented
  - This helps all parties, especially WSC Engineering and GSFC entities (such as FDF), in fault isolating the anomaly near real-time

Open Work

- Support Unberth and Re-entry mission phases
- Support the post release testing
- FDF one-way tracking passes
- Generate the Mission Termination ISI
- Submit On-orbit and Re-entry Report to the Human Space Flight (HSF) Network Director (ND)
- Update RFICD with correct EIRP min/max values

Open Discussion

Backup Slides

Discrepancy Reports (DR)

CDS #	TDRS	Event start	Anomaly	Status
64252	N/A	181/1800:00Z	Scheduling difficulty	Assigned to JSC
64702	N/A	188/1700:00Z	Scheduling difficulty	Assigned to JSC
64703	TDE	204/2331:06Z	Scheduled non-coho vice coho	Assigned to JSC
64705	TDE	203/0206Z	Multipath errors	Closed
64707	171	205/0520:40Z	Late acquisition	Assigned to JSC
64708	275	205/0938:24Z	Telemetry dropout	Closed
64955	275	206/0338:24Z	Telemetry dropout	Closed
64709	TDE	205/1524:04Z 205/1701:24Z 205/2154:20Z 205/2329:21Z	Late acquisition	Assigned to JSC
64714	275	206/0752:52Z	Telemetry dropout	Closed
64722	275	207/0309:32Z	Late acquisition	Assigned to JSC

Discrepancy Reports (DR)

CDS #	TDRS	Event start	Anomaly	Status
64725	275	207/0617:00Z	Telemetry dropouts	Closed
64730	275	208/0144:17Z	Telemetry dropouts due to inclement weather	Closed
64740	TDE	208/1941:50Z	Late acquisition	Closed
64919	N/A	234/2059:00Z	Scheduling Difficulty	Assigned to JSC

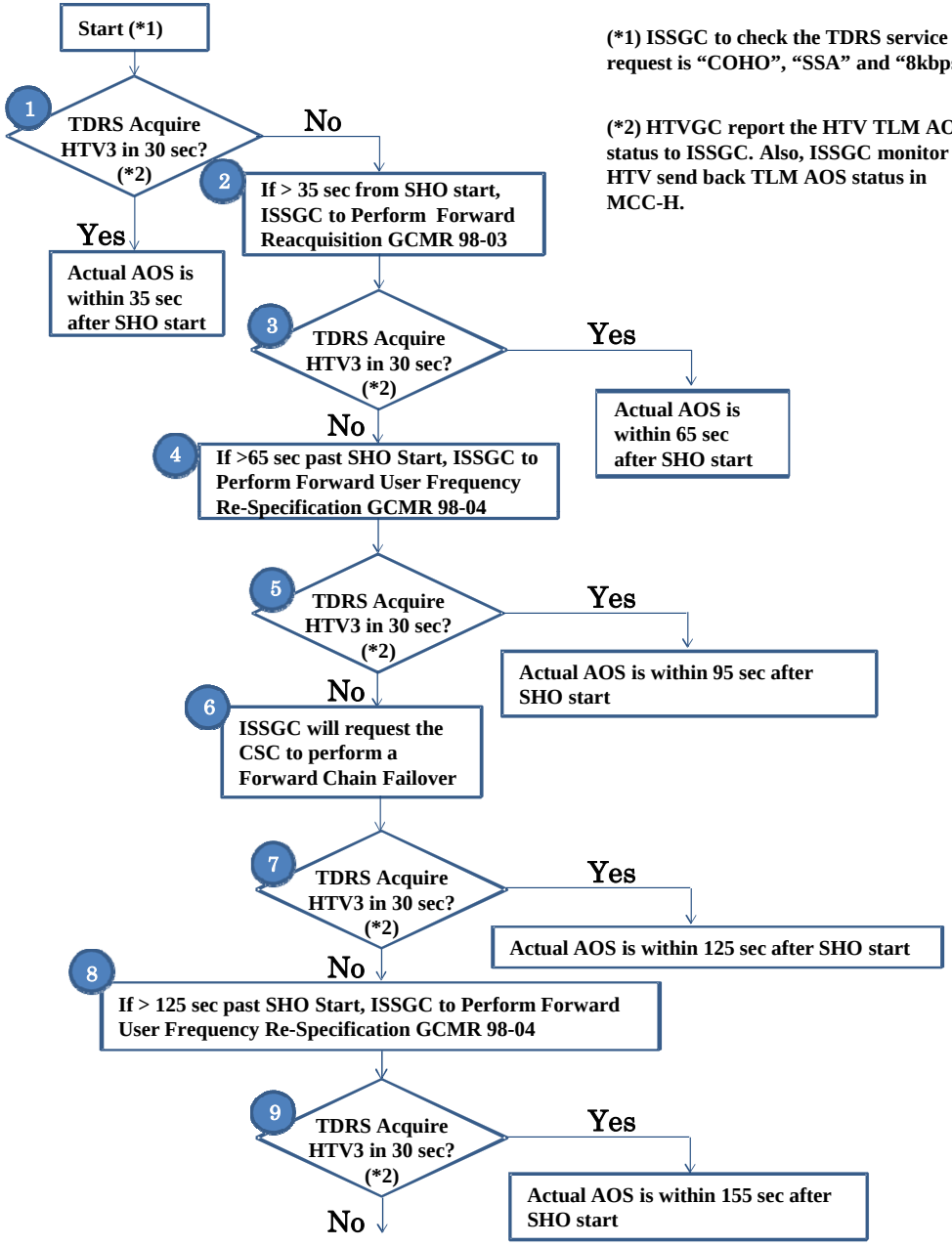
HTV-4 Information

- The HTV-4 flight information schedule according to the ISS FPWG (Flight Program Working Group) is as follows:
  - HTV4 Launch: 06/10/13
  - HTV4 berth to ISS: 06/15/13
  - HTV4 unberth: 07/15/13
  - HTV4 Re-entry: A few days after unberth
    - This is not formally approved but just for planning information only
    - There is no other readily available HTV-4 information at this time
      - Checked both the JAXA and JSC web page

GCMR Flowcharts

These charts will be utilized in the event of late acquisitions

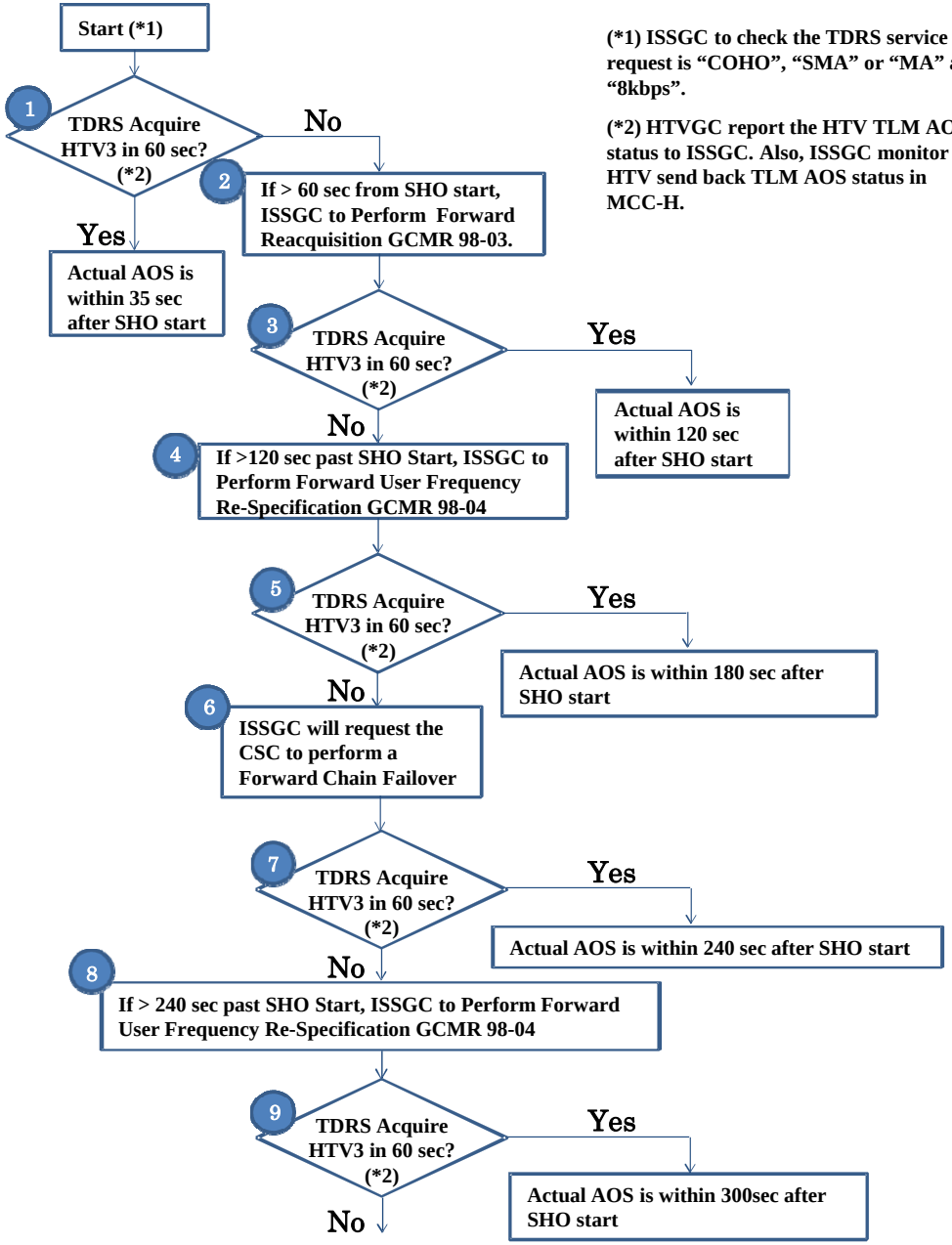
Coherent (SSA) service



(*1) ISSGC to check the TDRS service request is “COHO”, “SSA” and “8kbps”.

(*2) HTVGC report the HTV TLM AOS status to ISSGC. Also, ISSGC monitor HTV send back TLM AOS status in MCC-H.

Coherent (SMA, MA) service



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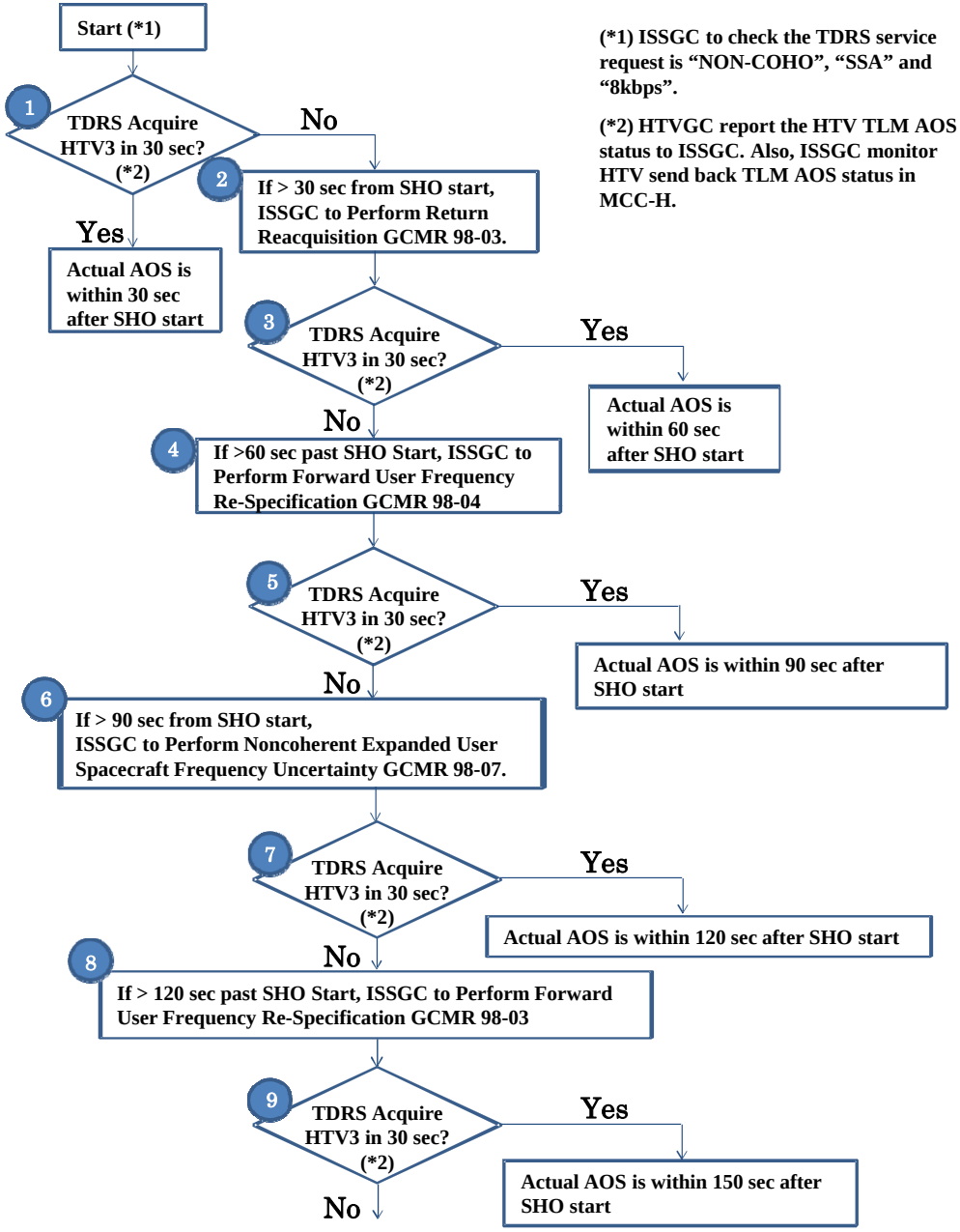
At this point we should consider proper vector or vehicle is not in view.

Noncoherent (SSA) service



(*1) ISSGC to check the TDRS service request is “NON-COHO”, “SSA” and “8kbps”.

(*2) HTVGC report the HTV TLM AOS status to ISSGC. Also, ISSGC monitor HTV send back TLM AOS status in MCC-H.

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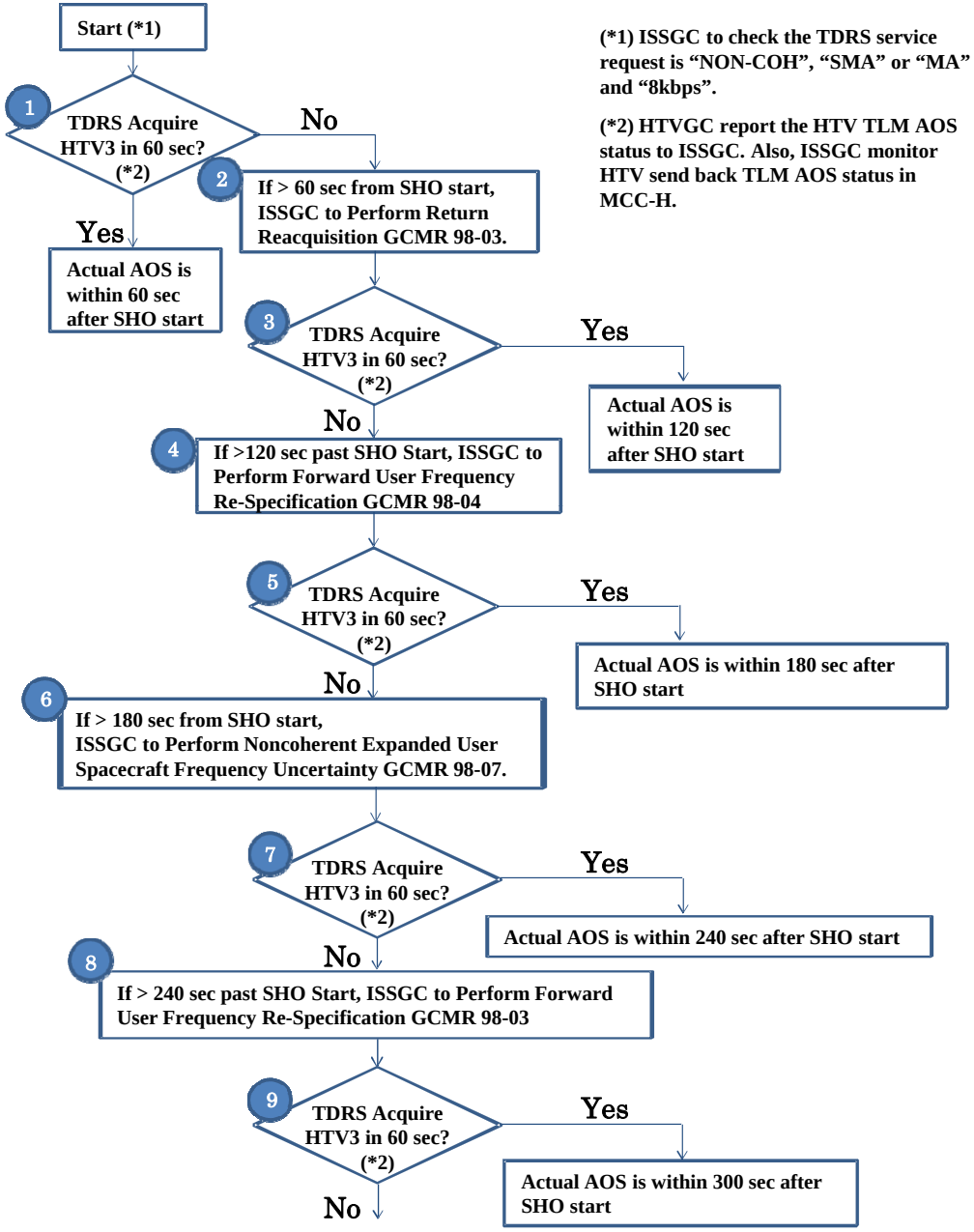
Noncoherent (SMA, MA) service



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