



# STS-117 MDM OA2 Card 5 Failure

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Presenter: Tim Reith

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## Issue

- Card 5 on MDM OA2 failed at GMT 163/07:54:41

## Concerns

- Loss of functions on card 5
- Implications to other cards within OA2
- Implications to software processing as a result of card 5 failure

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## Timeline

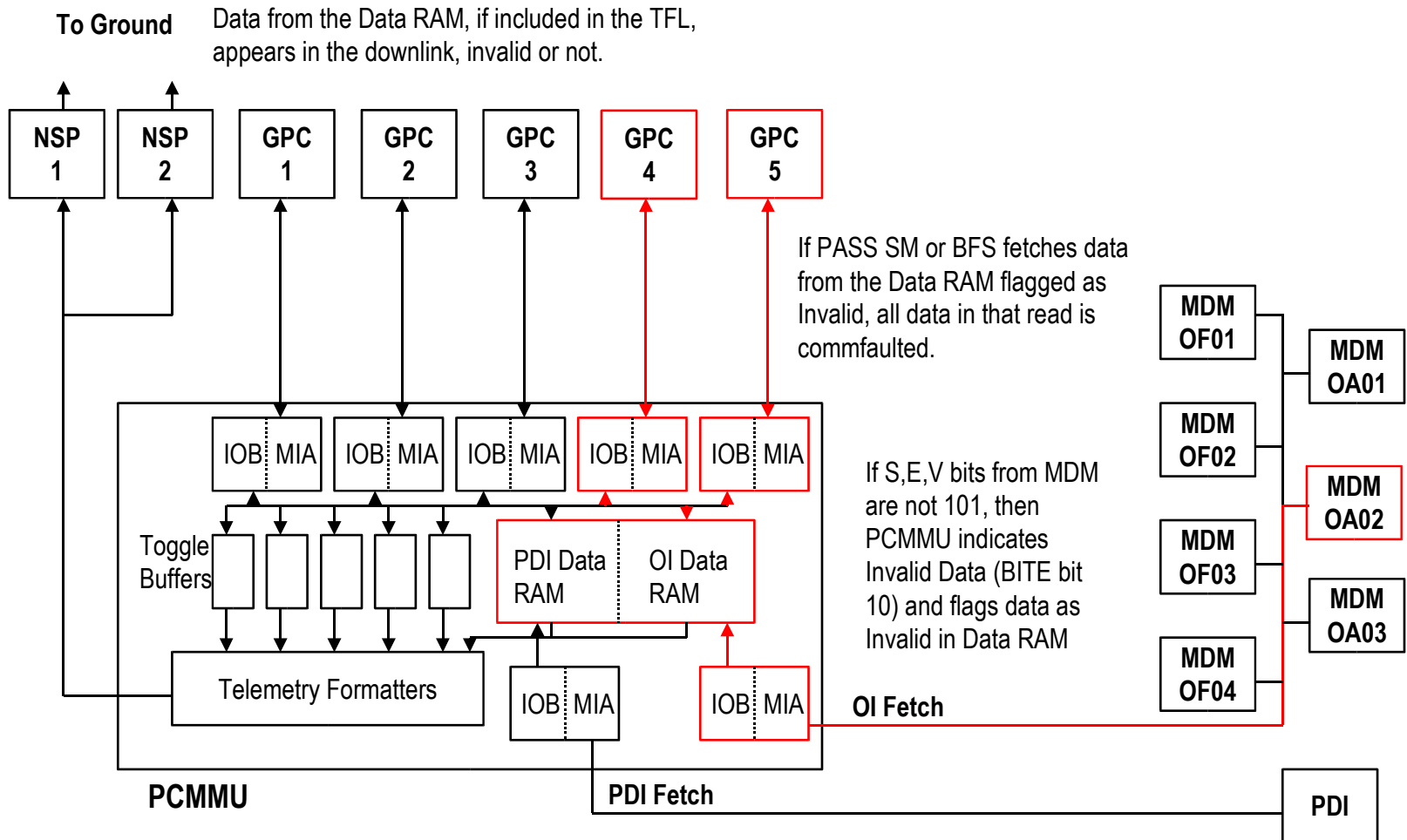
- GMT 163/07:54:41 - Card 5 in MDM OA2 fails
  - All data on card 5 (48 discretes) after the event are invalid
  - MDM sets BITE word to indicate a failure
- GMT 163/07:54:43 - SM alert “S62 BCE BYP OA” annunciated
  - Triggered by MDM OA2 BITE
- GMT 163/07:55:06 SM alert “S86 APU GBX P 2” annunciated
  - Measurement is not located on card 5

Why did we get the second SM alert and why did it occur 23 seconds later?

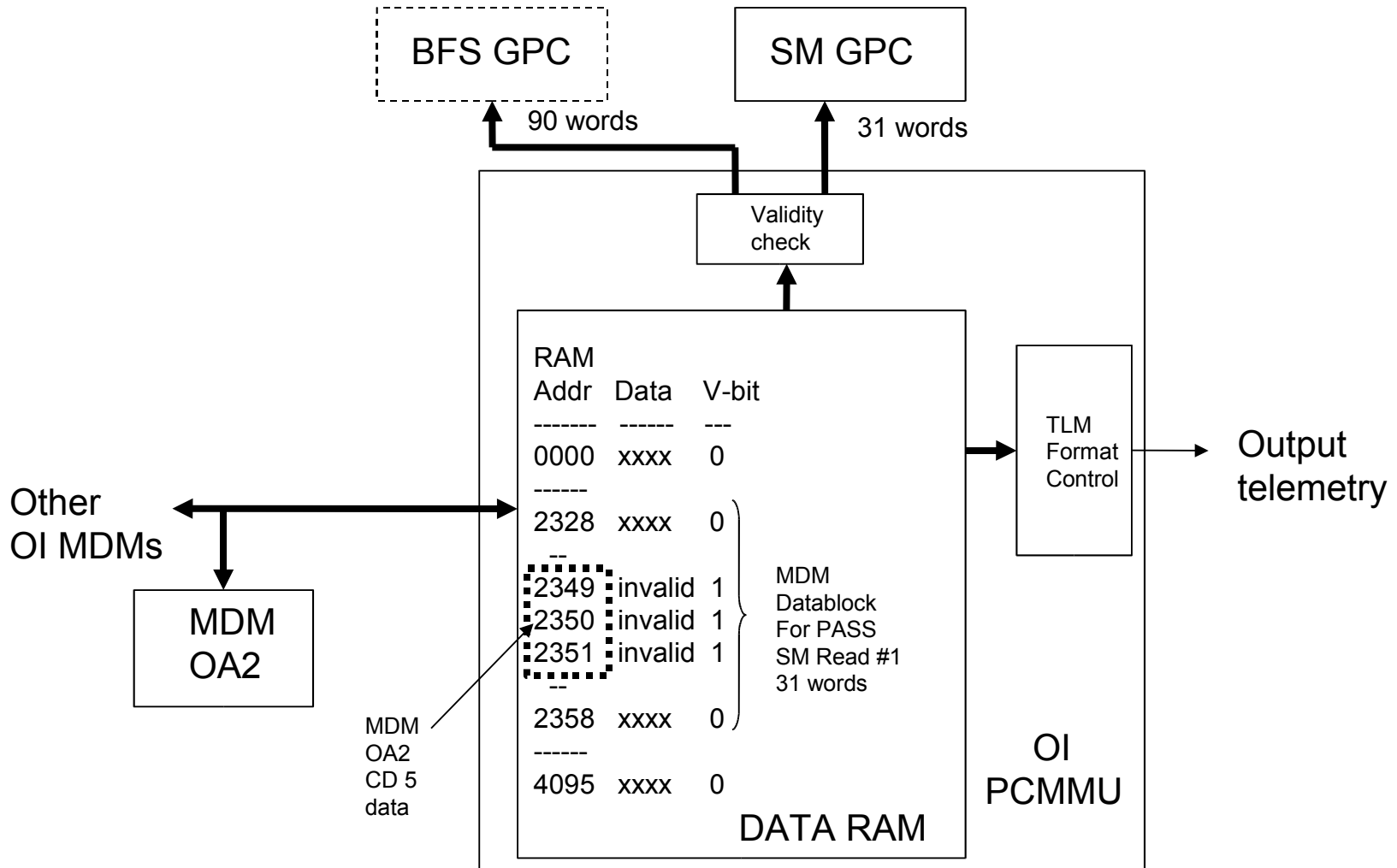
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## Data processing block diagram



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## Explanation of the two SM alerts and their relative timing

- At GMT 163/07:54:41, card 5 in MDM OA2 fails (BITE failed)
- At GMT 163/07:54:43, SM alert “S62 BCE BYP OA” annunciated
  - All OA2 SM read 1 words (31) are commfaulted and bypassed
  - Parameters from cards 2, 4, & 6 are also in this read
    - Included in this effect is V46R0235A (APU 2 turbine speed) from card 6
- Commfaulted V46R0235A (APU 2 turbine speed) triggers limit set change for V46P0253A (APU 2 gearbox lube oil press)
  - Limit set change in effect after defined delay of 9.6 seconds
- New limit set is nominal ascent/entry limits for V46P0253A (APU 2 gearbox lube oil press) - Current value at that time violated lower limit
  - Noise filtering delays annunciation for 13.4 seconds
- At GMT 163/07:55:06, PASS SM annunciates “S86 APU GBX P 2”
  - Total delay  $9.6 + 13.4 = 23$  seconds from “S62 BCE BYP OA”
- Given this multi-card scenario, further investigations into all potential PASS and BFS effects were initiated

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- PASS assessment – Cory Driskill
- BFS assessment – Terry McClain

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## Safety Assessment

- Evaluated 31 Affected PASS parameters & Card 5 MSIDs.
  - Worst Case MDM OA2 Failure addressed in ORBI 038 Cause G.
    - Loss of Vehicle Due to MDM or EMDM (Loss of output from OA1, OA2, or OA3)
    - No additional hazard impacts identified at this time.
  - MDM OA2 Card 5 failure is loss of insight onboard. Other data exists to assess subsystem health.
- BFS impacts are similar to PASS
  - Worse case is LOS and a subsystem failure during the LOS



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## Summary

- MDM OA2 card 5 declared failed, downlink is invalid
- Remaining MDM OA2 cards and their downlink are good
- SM alerts at time of failure are understood and expected
- System impacts for PASS SM and BFS have been assessed and communicated to MOD
  - PASS – no more messages/alarms
  - BFS – upon activation, crew will receive 1 alarm/message for the card failure and 1 I/O error message will be logged in the downlist
- Integrated hardware and software team are unanimous that no action should be taken to attempt to recover OA2 card 5
  - Low likelihood of success
  - Current posture is stable and understood
  - Available options for recovery are very disruptive to other functions

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## Backup

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## Failure History

- 20 reports found searching the failure history for the flight OA MDMs, P/N MC615-0004-6410
  - One failure of this particular MDM, S/N 127
    - AC4870 – Isolated to a connector problem (circa 1982)
- Further flight DIH failure history searches revealed:
  - 9 failures related to flight DIH modules (2 in-flight)
    - 09F031(OA1 S/N 18) – Measurement V42S2345E “RCS LEFTAFT TANK ISOLATION VALVES 3/4/5 A OPERATE” failed OFF
    - 66RF20 (FA3 S/N 65) – Measurement V56X1365X “ET UMB DR LCH 2 IND2” failed ON
    - Both were single bit failures, not entire card
- Per the Reliability and Maintainability Report.
  - MTBF for the flight DIH is 1,792,727 hours
  - Failure rate of 5.58E-7