

Spitzer Space Telescope Use of the Virtual Machine Language

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Abstract—Spitzer Space Telescope makes the most extensive use of the Virtual Machine Language (VML) sequencing language of any mission launched to date. The use of VML has presented minor ground integration challenges to the mission and provides many benefits. While other missions such as Cassini use sequencing languages that can provide similar capabilities, VML’s syntax, tools, and approach provide greater functionality in practice.

Benefits of the sequencing approach taken include reduction in uplink volume, increased science efficiency, simplified operations, and increased mission safety. VML provides more commonality between missions than previous sequencing approaches, in an environment more like high level programming. It would be difficult to determine the life-cycle cost impact of using VML on Spitzer, but Spitzer’s investment in the technology should enable future missions to achieve cost savings while simultaneously increasing automation and safety.^{1,2}

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1. INTRODUCTION

The Spitzer Space Telescope is the fourth and final of NASA’s great observatories. It was launched on August 25, 2003, and at that time was known as SIRTF (Space InfraRed Telescope Facility). Its expected life is 2.5 year minimum, with a 5 year goal, which is limited by the liquid helium

cryogen used to cool the telescope to about 5 degrees Kelvin. It is in an earth trailing, heliocentric orbit. It studies the origin and composition of planets and debris disks, brown dwarves, star lives from formation in dust clouds through death, distant galaxies, and the early universe. Additional information and dramatic images may be found at <http://www.spitzer.caltech.edu/> [1].

Virtual Machine Language (VML) is a key element of the spacecraft architecture. The VML sequencing language presented many challenges to the mission and provides many benefits. While VML has been used on several missions, the Spitzer case is instructive because it has the most extensive use of VML to date. VML’s syntax and approach provide greater functionality than other sequencing languages in practice. Special tools are provided, including a fast-running open loop simulator (Offline VM). Benefits include virtual machine sequence engines that provide isolation of the sequence from other flight software functions.

2. VML OVERVIEW

VML was first developed for SIRTF (now Spitzer), although the first subset was deployed on the Mars ’98 missions due to their shorter development cycles. Updates have included changes to VM commands and adaptations for missions. Support for VML by the uplink tools has been improving and has reached relatively mature level for Spitzer. The Jet Propulsion Laboratory (JPL) owns all rights to VML and is available royalty-free for use on any NASA funded mission.

VML 1 has been used on spacecraft built by Lockheed Martin with RAD 6000 processors, including:

- Stardust (launched 1999) (subset)
- MCO, MPL (launched 1998, 1999) (subset)
- Mars Odyssey (launched 2001)
- Genesis (launched 2001)
- Spitzer Space Telescope (launched 2003)
- Phoenix (2007 launch)

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² IEEEAC paper #1068, Version 5, December 1, 2004