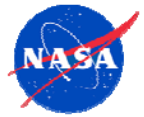


# AMS Prototyping Activities

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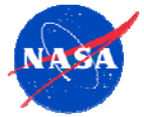
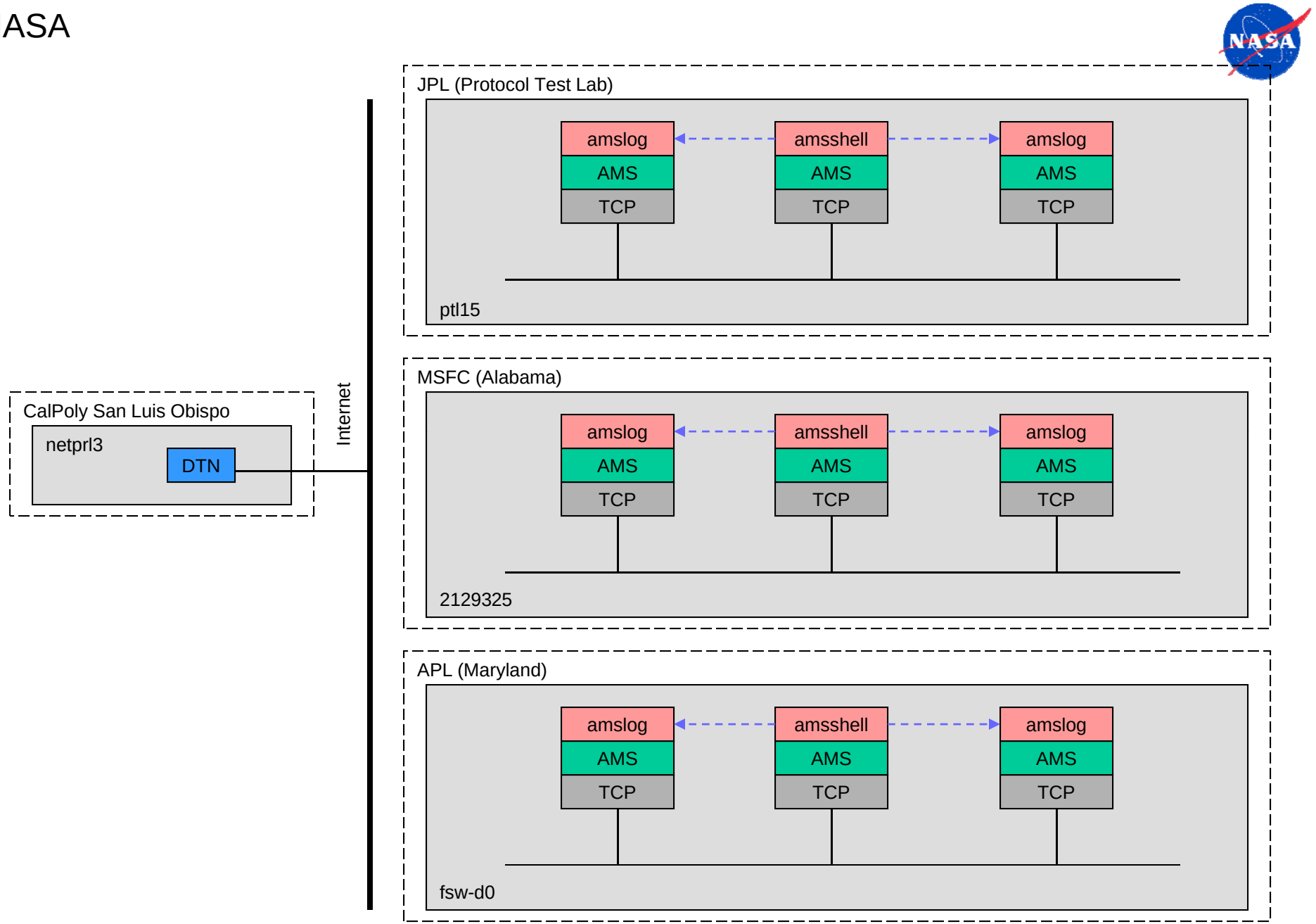
Jet Propulsion Laboratory,
California Institute of Technology
11 March 2008




# Overview

- AMS reference implementation available since late 2005, aimed at supporting message exchange both in on-board environments and over space links.
  - Wide-area network exercise in 2006.
  - Reference implementation features.

NASA


JPL (Protocol Test Lab)
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AMS
TCP
amsshell
AMS
TCP
amslog
AMS
TCP
ptl15
MSFC (Alabama)
amslog
AMS
TCP
amsshell
AMS
TCP
amslog
AMS
TCP
2129325
APL (Maryland)
amslog
AMS
TCP
amsshell
AMS
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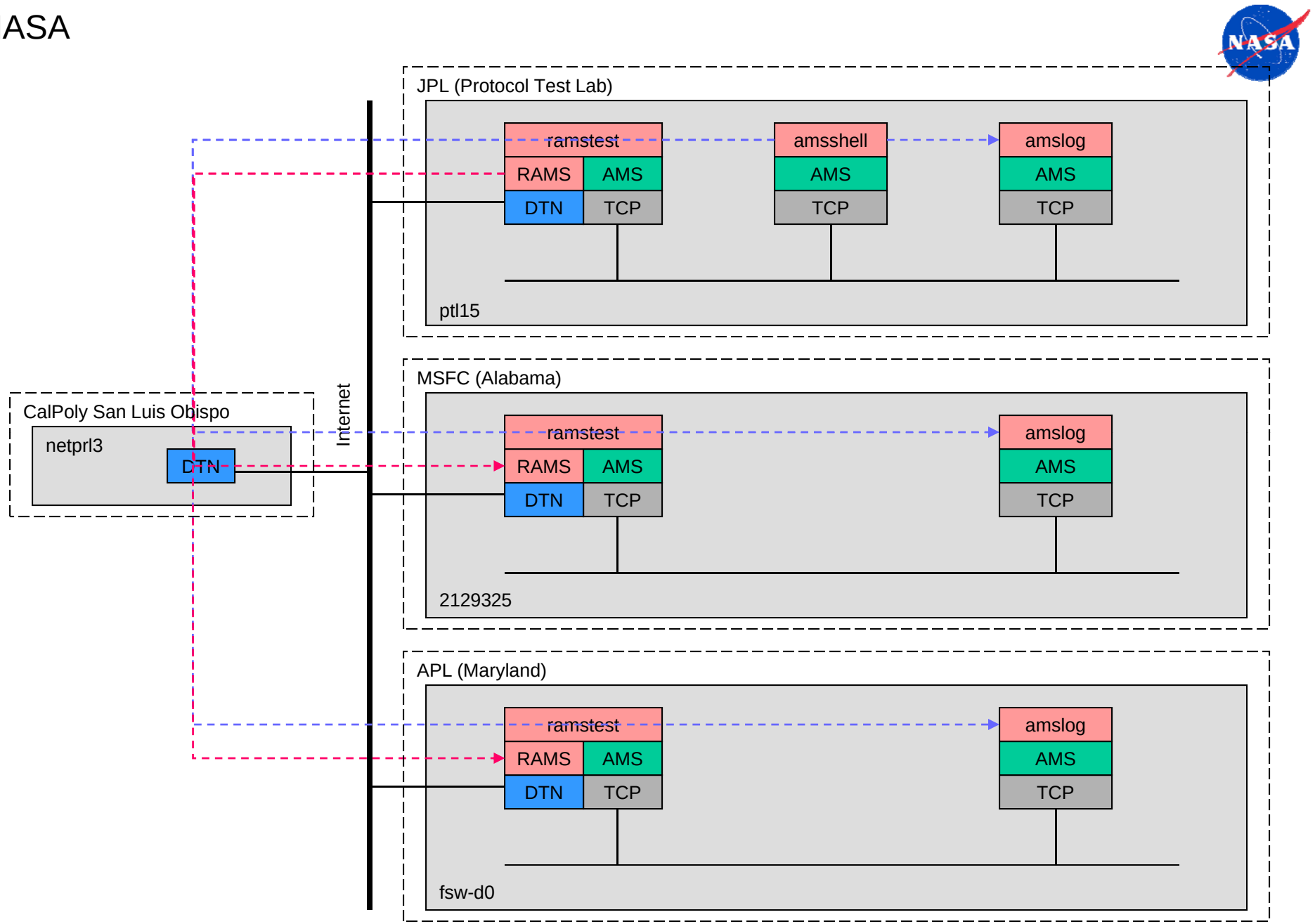
amslog
AMS
TCP
fsw-d0
Internet
CalPoly San Luis Obispo
netprl3
DTN

NASA


JPL (Protocol Test Lab)
ramstest
RAMS
AMS
DTN
TCP
amsshell
AMS
TCP
amslog
AMS
TCP
ptl15
MSFC (Alabama)
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RAMS
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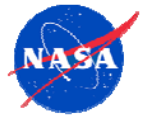
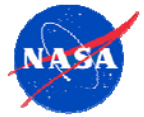



# Implementation Features

- Implements all mandatory elements of the AMS Draft Recommendation as of July 2007.
  - MAMS, AMS, and RAMS protocols.
  - Failover, heartbeats, resync.
  - “Hooks” for security, but no cipher suites included in the distribution.
  - Upgrade to December 2007 version is pending consensus on the new version within WG.


# Implementation Features (2)

- Implemented in C, portable across POSIX-based platforms.
  - Linux, Solaris, OS/X
  - VxWorks 5.4, RTEMS
- Multiple transport services supported.
  - TCP
  - UDP (includes optional “DGR” reliability system)
  - VxWorks message queues
  - Open interface for adding others




# Implementation Features (3)

- Open distribution and support, as part of “ION” protocol stack (which includes implementations of DTN protocols).
  - Approved for export (EAR-99).
  - https://ion.ocp.ohiou.edu/
- High performance (see next slides).


# Network performance

| *Number of messages sent* | *Size of each message (bytes)* | *Messages exchanged per second* | *Data rate (Megabits/sec)* |
|---|---|---|---|
| **10,000** | **20,000** | **5,337** | **814** |
| **100,000** | **2,000** | **25,739** | **393** |
| **1 million** | **200** | **107,910** | **165** |
| **10 million** | **20** | **154,335** | **23** |

Highly preliminary performance measurements, from JPL's Protocol Test Laboratory. Message exchange between a single publisher and a single subscriber on a Gigabit Ethernet. Each node was hosted on a dual-core 3Ghz Pentium-4 running Fedora Core 3. (Don't expect this kind of performance in spacecraft operations!)


# AMS – Benchmark Latency Tests over VxWorks Message Queues

**taskSpawn("publisher", 100, 0, 50000, publisher, 1000, 1000)**

**HISTOGRAM - Count vs microseconds per 1000-byte message**

```
107 [   1] | *
 90 [   1] | *
 86 [   1] | *
 67 [   1] | *
 61 [   2] | **
 60 [   2] | **
 59 [   5] | *****
 56 [   1] | *
 55 [   1] | *
 54 [   2] | **
 53 [  19] | ******************
 52 [  61] | ************************************************************
 51 [  39] | ***************************************
 50 [   2] | **
 49 [ 198] | ********************************************************************
 48 [ 415] | ****************************************************************************************************
 47 [ 249] | ************************************************************************
```

Publisher and subscriber colocated on an MCP750 single-board computer with 233 MHz processor. Operating system is VxWorks 5.4.


# AMS – Benchmark Latency Tests over VxWorks Message Queues

**taskSpawn("publisher", 100, 0,  50000, publisher, 1000, 10000)**

**HISTOGRAM - Count vs microseconds per 10000-byte message**

```
249 [   1] | *
215 [   1] | *
204 [   1] | *
202 [   1] | *
201 [   1] | *
200 [   3] | ***
199 [   7] | *******
198 [   3] | ***
197 [   3] | ***
196 [  23] | ***********************
195 [  33] | *********************************
194 [  52] | ****************************************************
193 [  14] | **************
192 [  12] | ************
191 [ 630] | ****************************************************************************************************
190 [ 188] | ********************************************************************
189 [  25] | *************************
188 [   2] | **
```

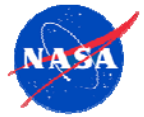

# AMS – Benchmark Latency Tests over VxWorks Message Queues

## taskSpawn("publisher", 100, 0, 90000, publisher, 1000, 65000)

## HISTOGRAM - Count vs microseconds per 65000-byte message

```
1993 [   1] | *
1981 [   1] | *
1969 [   1] | *
1921 [   1] | *
1845 [   1] | *
1844 [   2] | **

...
1837 [   2] | **
1836 [   3] | ***
1835 [   3] | ***
1834 [   4] | ****
1833 [   4] | ****
1832 [   7] | *******
1831 [   8] | ********
1830 [  16] | ****************
1829 [  14] | **************
1828 [  22] | **********************
1827 [  19] | *******************
1826 [  13] | *************
1825 [   5] | *****
1824 [   1] | *
1823 [   3] | ***
1822 [   2] | **
1821 [  13] | *************
1820 [  33] | *********************************
1819 [  90] | ******************************************************************************
1818 [ 136] | ************************************************************************************************
1817 [ 238] | ****************************************************************************************************
1816 [ 180] | ********************************************************************************************
1815 [  98] | ************************************************************************
1814 [  28] | ****************************
1813 [  20] | ********************
1812 [   4] | ****
1798 [   1] | *
```




# Prospects for On-board Infusion

- AMS has been proposed as a standard messaging layer for NASA Constellation “Framework”, but no final design decisions have yet been made.
- NASA is not yet funding any formal SOIS participation.