# SIS-AMS Working Group

Colorado Springs, USA

January 16-20 2007

# Agenda: Tuesday

- Tuesday 16 January:
  - 10:00 Overview of progress since June.
  - 10:30 Results of RAMS tree-structured network testing.
  - 11:30 Results of real-time message exchange testing.
    - VxWorks port, message queues.
  - 12:30 Adjourn.

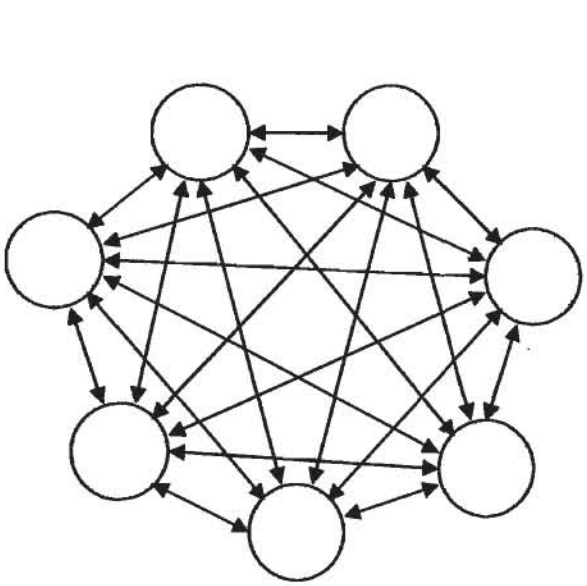
# Overview of Progress Since June

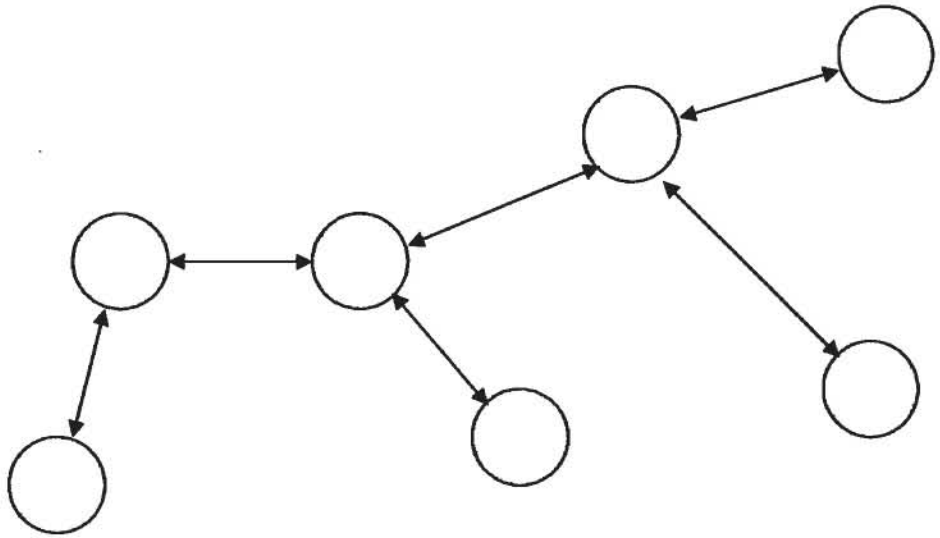
- Upgraded reference implementation per changes to draft Red Book (from June meetings).
- Upgraded and clarified Remote AMS specification.
  - Added support for RAMS networks that are configured as trees (as well as meshes).
- Successfully ported AMS to VxWorks, benchmarked real-time messaging performance.

# Remote AMS Progress

- Original RAMS design supported only RAMS networks configured as meshes (every gateway is directly connected to every other).
  - Simple and fast, but not scalable: too much overhead at each gateway as the number of gateways increases.
- Upgraded RAMS design supports option of configuring RAMS network as a tree.
  - End-to-end message latency may be greater but number of neighbors at each gateway can be kept small, enabling the network to scale up to large numbers of gateways.

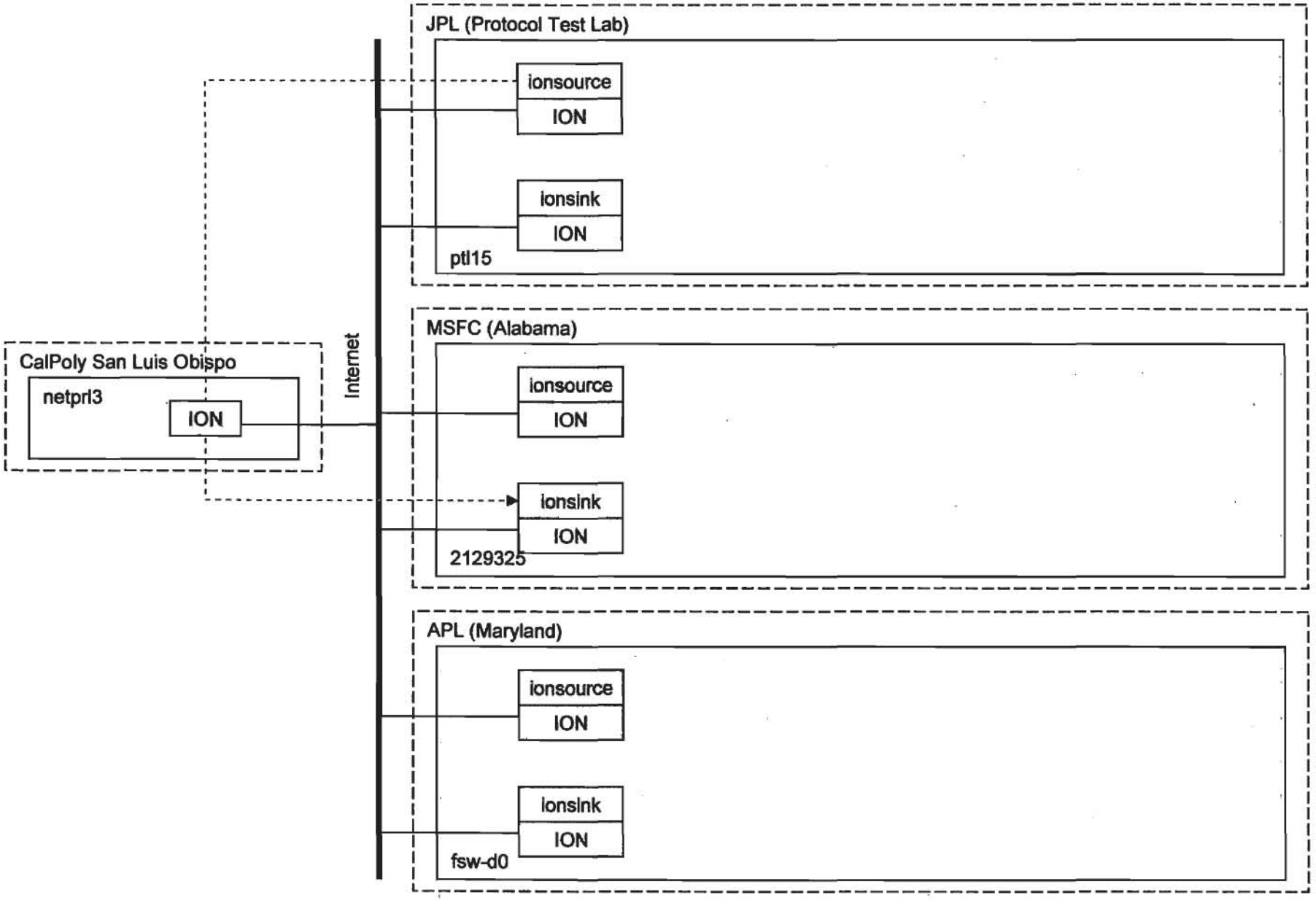
# RAMS Mesh vs Tree





# RAMS testing exercise

- Objective: demonstrate AMS message exchange over a wide-area network (the Internet), characterize performance.
- Method:
  - Operate AMS continua at JPL, APL, Marshall SFC.
  - Delay over the Internet is probably low enough to enable all three centers to be in a single continuum; to make RAMS necessary, did no firewall modification at any center.
  - Therefore all traffic had to travel through a third-party routing point at Cal Poly San Luis Obispo – a star-shaped overlay network.
  - Needed an overlay network protocol for this, so used JPL's DTN Bundle Protocol implementation ("ION").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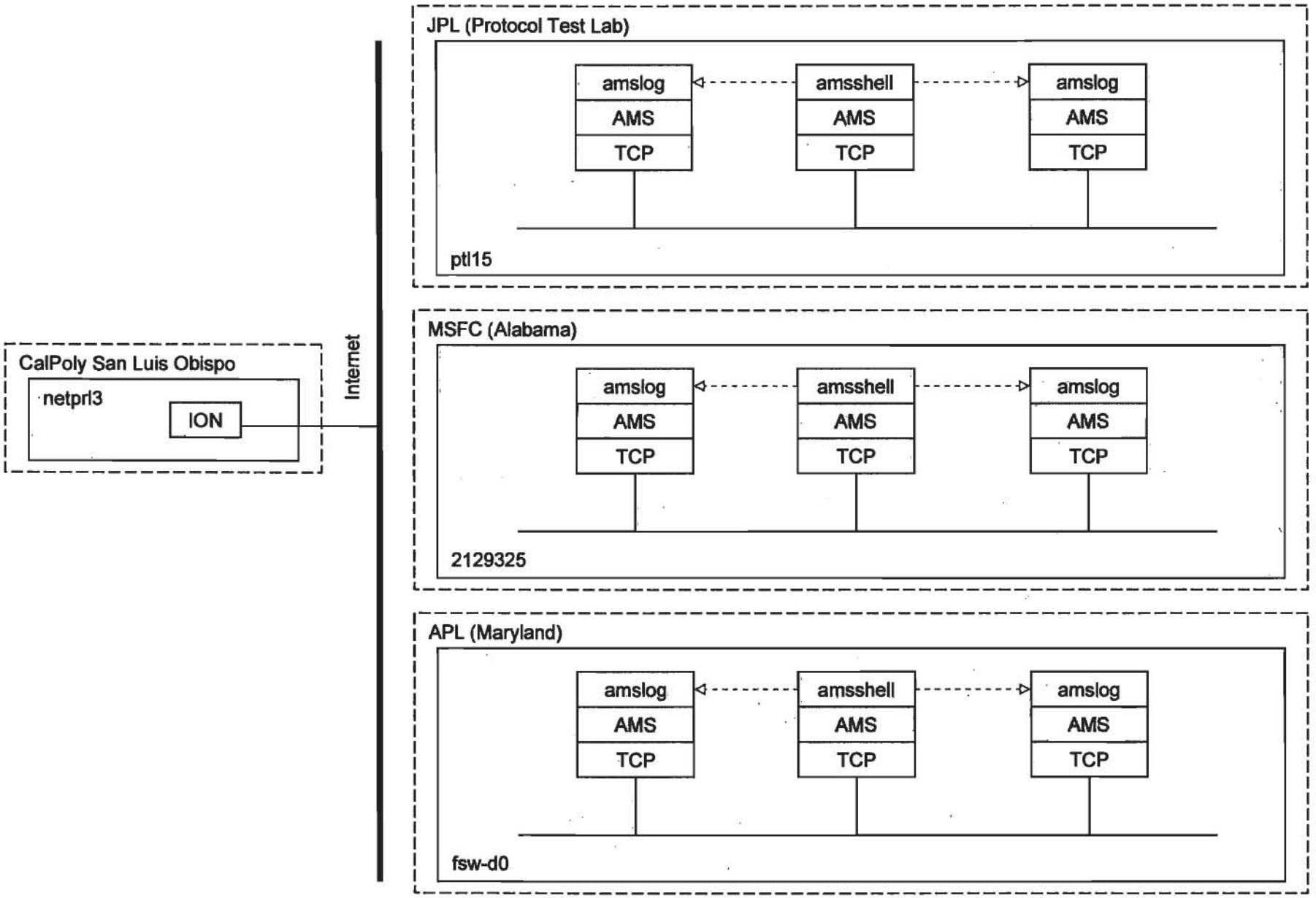
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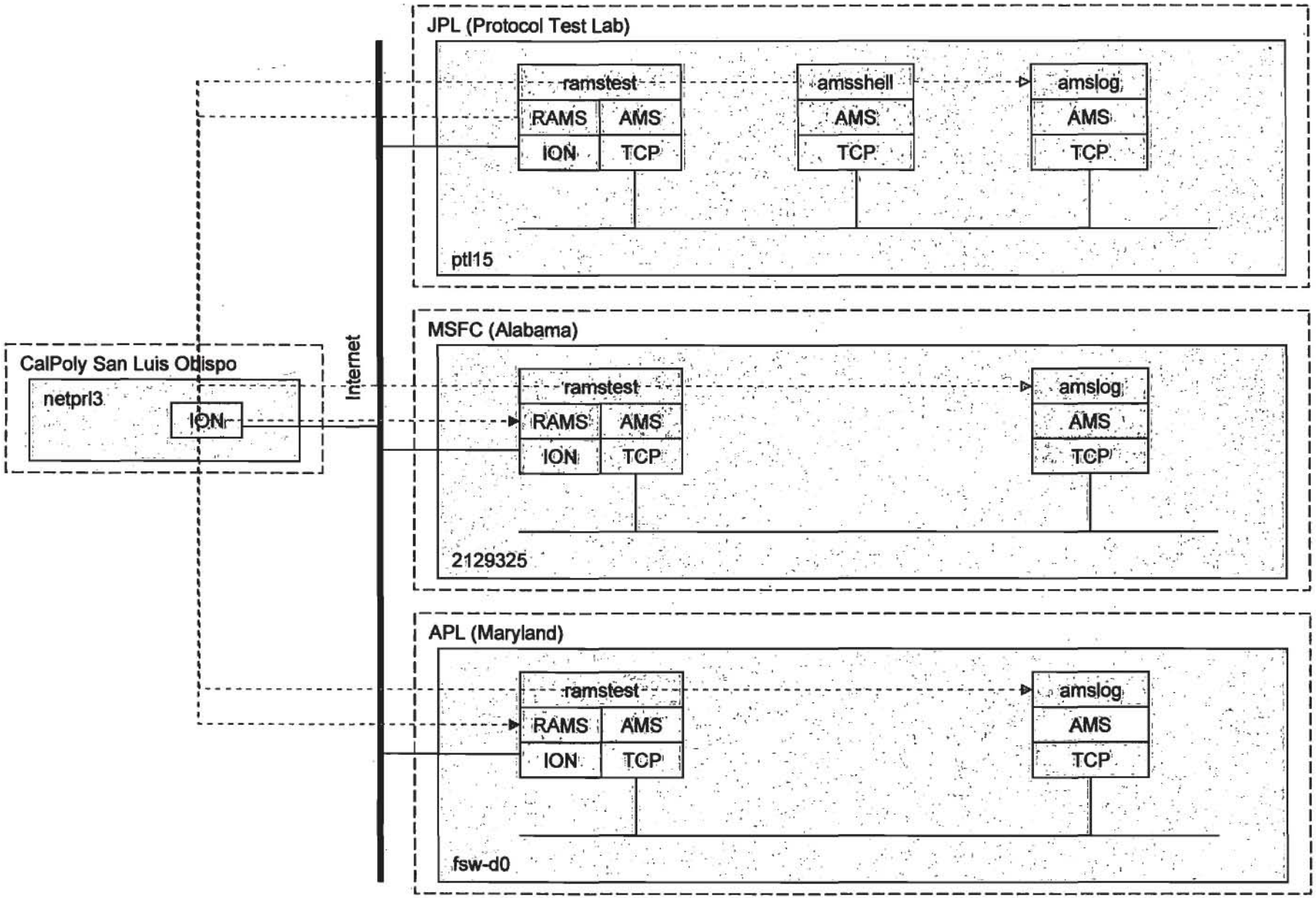
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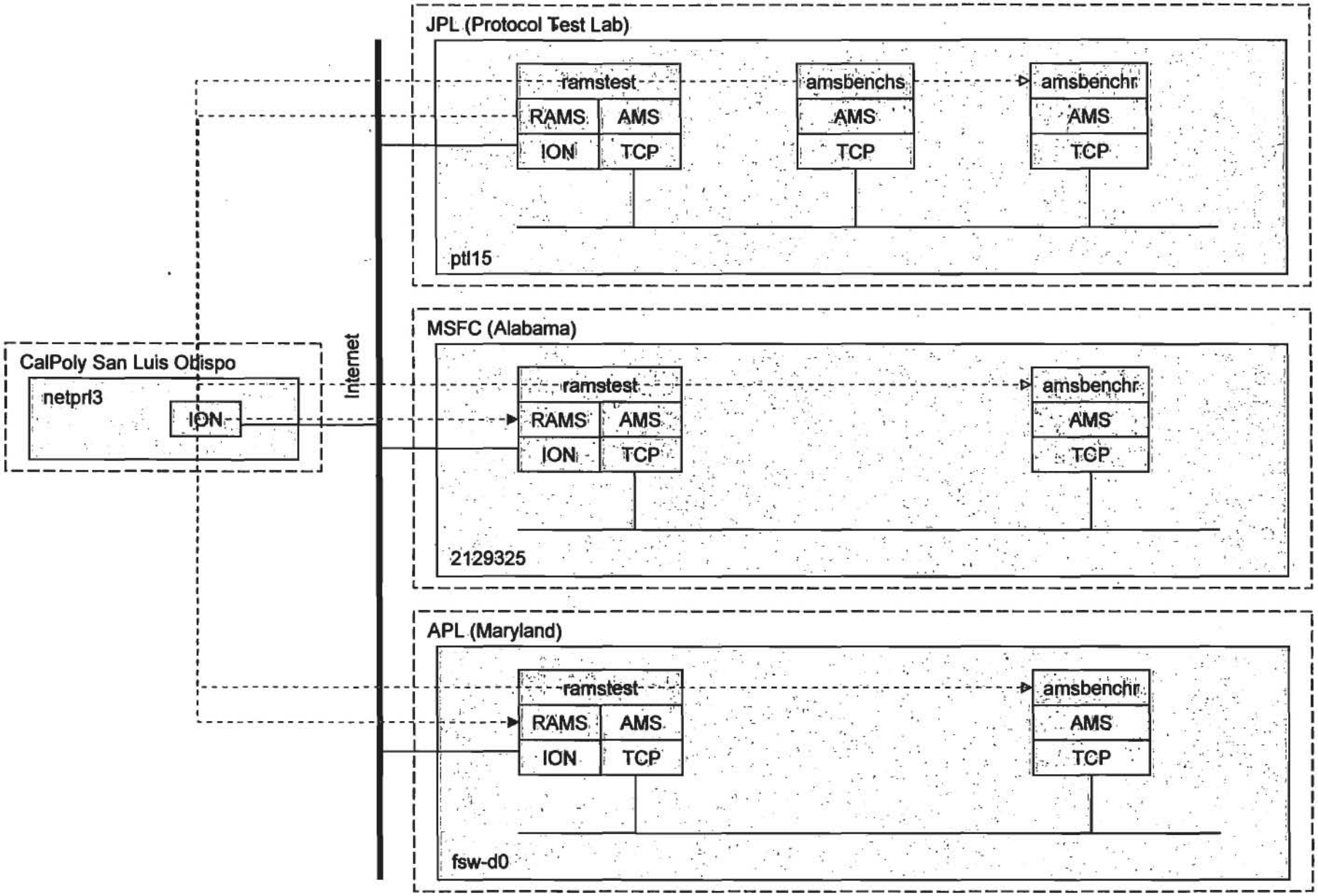
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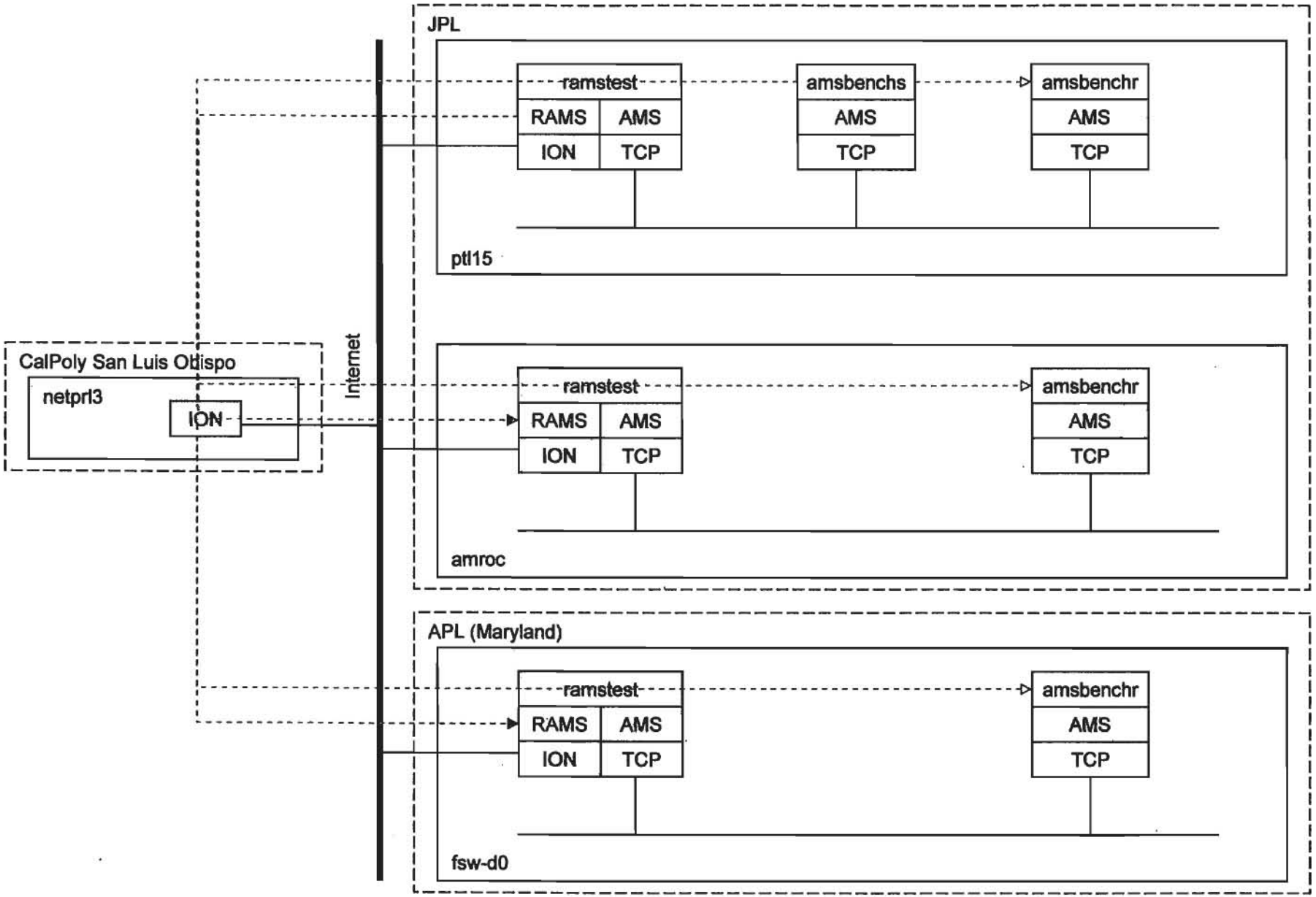
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# Real-Time Message Exchange

- Presentation by Amalaye Oyake.

# Agenda: Thursday

- Thursday 18 January:
  - 8:30 Use of AMS in wireless avionics testbed.
  - 9:30 Prospects for real-time message exchange over ring bus.
  - 10:00 Use of AMS in support of SharedNet.
  - 10:30 Open discussion of other applications and ops concepts.
  - 12:30 Break for lunch.
  - 13:30 Review of revisions to AMS Red Book, discussion of other potential revisions.
  - 17:30 Adjourn.

# AMS in Wireless Avionics

- Presentation by Amalaye Oyake.

# Real-time AMS Over Ring Bus

- Presentation by Amalaye Oyake.

# DARPA Content-Based Routing

1. Want to push data, so that it's there as soon as it's needed.
   - Minimize latency.
2. But don't want to push everything to everybody; targets must pull what they need.
   - Minimize bandwidth consumption.
3. Must retain data until user is ready to use it, and not decrypt until then.
   - Minimize need for repeated transmission.
   - Minimize security exposure.

# AMS/SharedNet Concept

- For secure data retention within the network fabric:
  DTN Bundle Protocol (BP).
- To strike a balance between data "push" and "pull":
  AMS publish/subscribe functionality.
- For secure data cache at the edge of the network:
  Sharednet relevant common operational picture.
- Sharednet client registers as an AMS node.
  - Uses AMS to subscribe on user's behalf.
  - Receives remotely published data via RAMS gateway.
  - Caches data locally, securely, pending retrieval by the user.

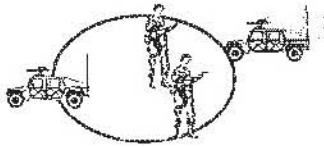
# Overview of Sharednet

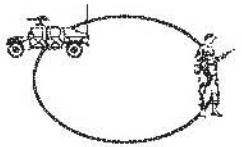
- Middleware developed by JPL for the US Navy and Marine Corps.
- Objective:
  - Distribute the C2 information needed to assemble a *relevant* common operational picture (COP).
  - Provide the distribution framework required to facilitate collaborative planning and increased situational awareness (i.e. storage, translators, and agents).
- Design Principles
  - Consumers, not producers, drive information flow.
  - Operating environment failures are inevitable and must be gracefully handled.
    - Communication sessions must survive network outages and loss of nodes.

# SharedNet – AMS – DTN

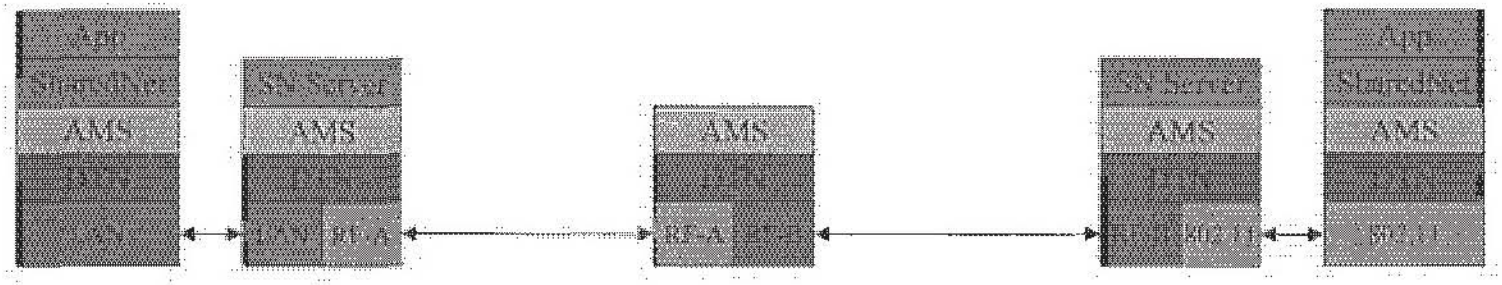
Mission Operations at Sea HQ

Airborne & Orbital Relays





UAVs, people & sensors

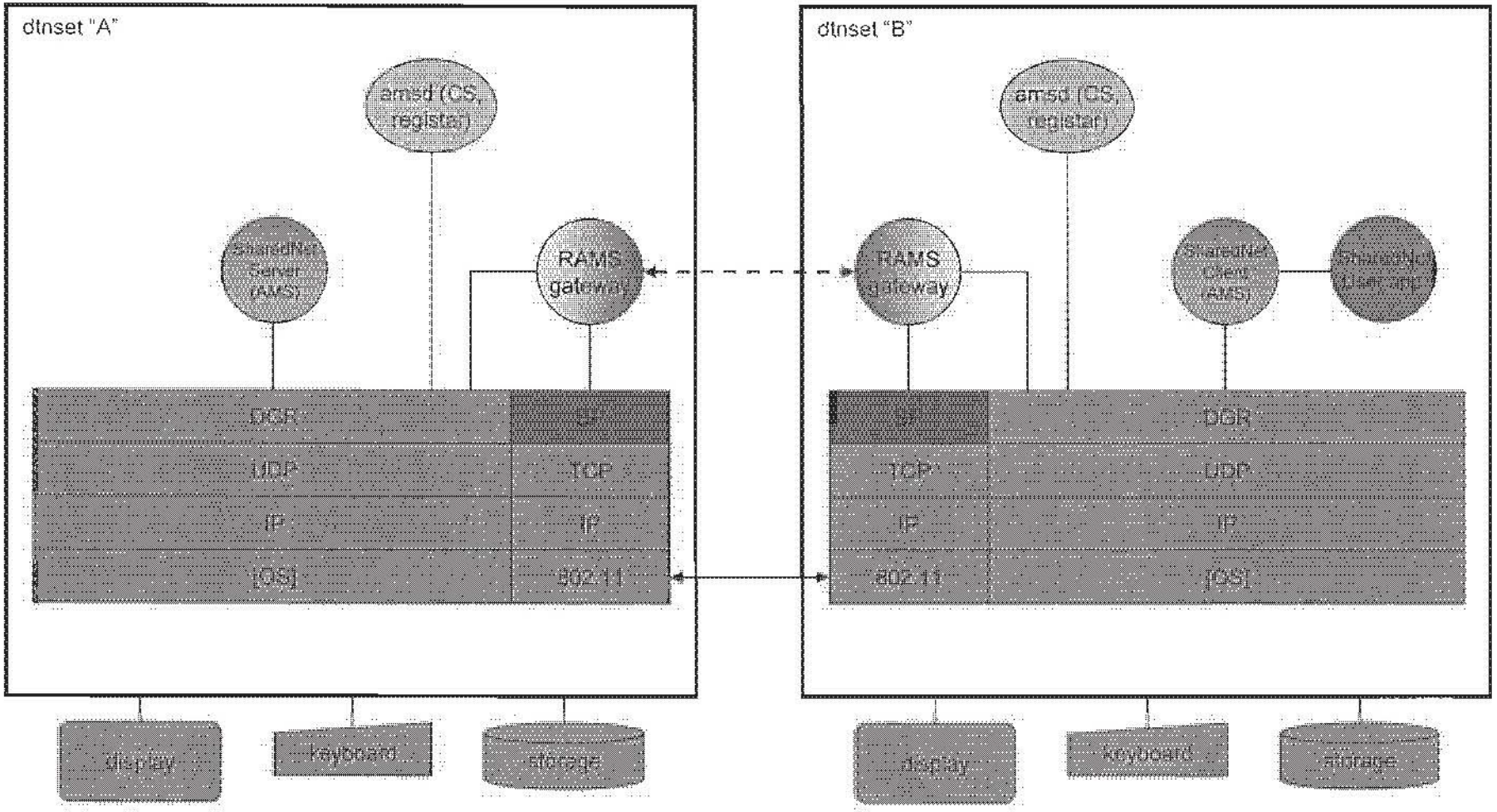



- Servers with well-connected clients
- Reachback to other information sources (e.g. through GIG)
- Interface with other systems via translators and web services

- DTN nodes enable reliable transmission and routing over transient and variable relay platforms.

- Local servers automatically synchronize with remote servers according to subscriptions on behalf of end users.
- End users can communicate within local groups even if link to HQ is down.
- All information produced/consumed by end users is stored on their devices and on local server.

# Detailed Structure



# Red Book Revisions

- Substantial change to the discussion of Remote AMS.
  - Still somewhat in flux as we implement and test the protocol.
  - But no known problems at this time.
- No other significant changes to the AMS red book.

# Agenda: Friday

- Friday 19 January:
  - 8:30 Discussion of plans for development of a second AMS implementation.
  - 9:00 Review of reference implementation, discussion of implementation issues.
  - 12:30 Break for lunch.
  - 13:30 Continue review of reference implementation and discussion of implementation issues.
  - 17:30 Adjourn.

# Reference Implementation

- JPL's implementation of AMS has the following components:
  - Daemon process (**amsd**) that can function as:
    - Configuration server
    - Registrar for a single unit of a single message space
    - Or both, depending on the values of command-line parameters.
  - Library (**libams**) that implements AMS application programming interface.
    - This library is typically provided as a "shared object" that is dynamically linked with application code at run time.
- All code written in C.

# Reference Implementation (2)

- Common infrastructure library ("ICI")
  - Portability layer ("platform") simplifies compilation and execution of common code in multiple operating environments.
    - Linux
    - VxWorks
    - Interix (Windows Services for Unix)
    - Future candidates: Solaris, RTEMS.
  - Dynamic memory management system ("PSM") provides dynamic management of a privately allocated block of memory. (Optional)

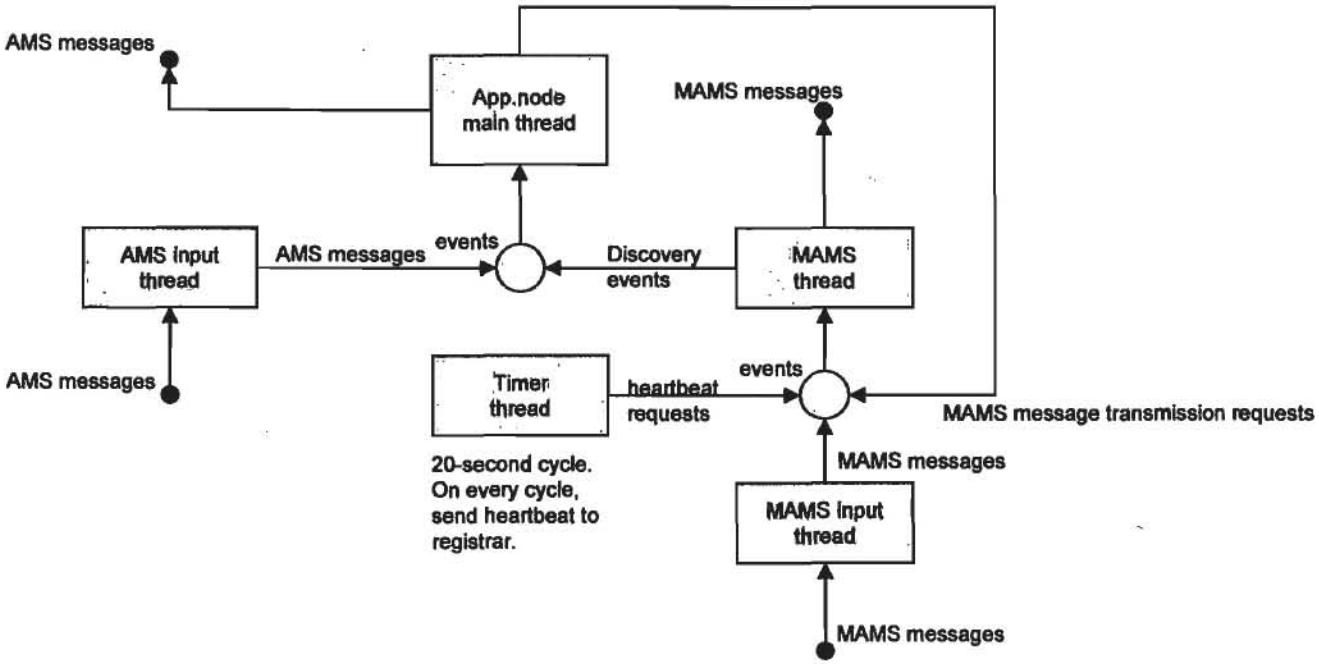
# Reference Implementation (3)

- An AMS application program, linked with **libams**, uses the *ams_register* function to instantiate an AMS node registered within a specified unit of a specified message space.
- Once registration is accomplished, the application may commence *inviting*, *subscribing* to, *publishing*, *announcing*, *sending*, and *replying* to messages.

# Reference Implementation (4)

- The implementation is multi-threaded.
  - Registration causes two POSIX threads (pthreads) to be started, to handle timing and MAMS events in the background.
  - One more pthread is started to handle MAMS messages.
    - Receives MAMS messages via the primary transport service.
    - Inserts them into the MAMS event queue (merging them with MAMS message transmission requests).
  - One additional pthread is started for each transport service on which the node is able to receive AMS messages.
    - Receives AMS messages via this transport service.
    - Inserts them into the AMS event queue (merging them with "discovery" events inserted by the MAMS event handling thread).

# Elements of a single AMS node



# Report of AMS WG Meetings

16-20 January 2007

# AMS Working Group Meetings

- Met with MOIMS/SM&C WG to discuss use of AMS for SM&C.
  - Reviewed RAMS "tree" option, for enhanced scalability.
  - Agreed to identify two "service classes" of AMS.
    - Class 1: Implementation of MAMS and AMS protocols only.
    - Class 2: Implementation of RAMS as well as MAMS and AMS protocols.
  - Agreed to add illustrative sequence diagrams to section 4 of the AMS specification and to document the "wire" representation of data items marshaled by AMS.
  - Agreed to use AMS as the standard end-to-end underlying messaging service for SMCP.

# AMS Working Group Meetings (2)

- Met with SOIS/TCOAS WG members to discuss suitability of AMS for real-time on-board messaging.
  - Reviewed results of real-time AMS message exchange testing on VxWorks platform at JPL.
  - Reviewed use of AMS in wireless avionics testbed at JPL.
  - Reviewed prospects for real-time message exchange over on-board ring bus.
  - Reviewed use cases and message transfer requirements developed by SOIS since June 2006 meetings.
  - Agreed that AMS is suitable for real-time on-board message exchange as characterized by the SOIS Message Transfer Service specification.

# AMS Working Group Meetings (3)

- Discussed plans for developing second implementation of AMS.
  - NASA/GSFC will begin this development in February of 2007.
- Briefly discussed protocol enhancements as reflected in first edition of AMS Red Book.
  - No problems identified.
- Plan for between now and next working group meeting:
  - Complete second implementation of AMS (service class 2).
  - Begin interoperability testing between the two implementations of AMS.
  - Publish second edition of AMS Red Book reflecting changes agreed on at WG meetings and modifications emerging from interoperability testing.

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