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On Protected Persistent Reservation

Lansing Sloan

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Mail Stop L-60
Lawrence Livermore National Laboratory
7000 East Avenue
Livermore, CA 94550-9900

ljsloan@llnl.gov
Phone: 1-510-422-4356
FAX: 1-510-423-8715

Scalable I/O Facility Project
http://www.llnl.gov/liv_comp/siof.html

Outline

- Assumptions and Situation
- Proposal and analysis
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- Follow-up after Working Group Meeting (Rev 1)

Assumptions and Situation

NAP Goal

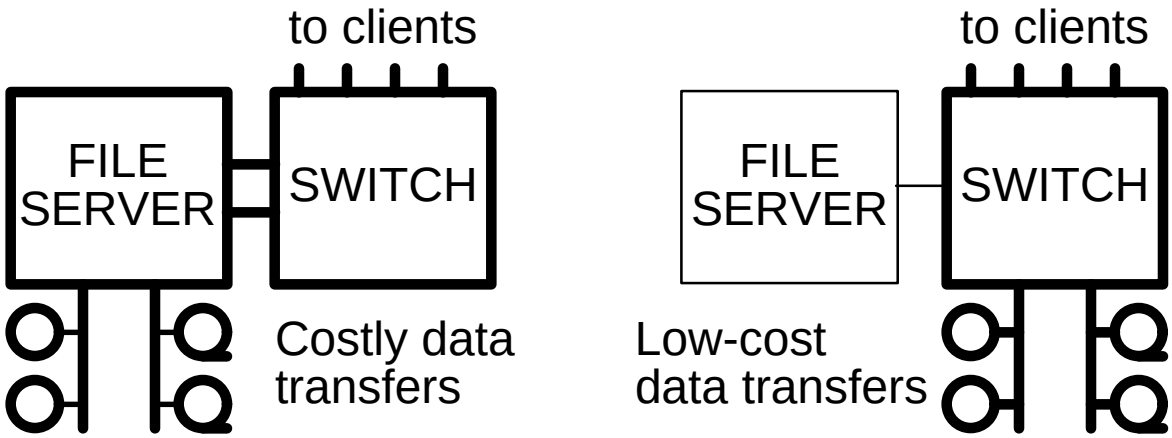
Competitive mass market secure Network Attached Peripherals (NAPs) that file servers can use. LLNL's main interest is for RAID boxes and high-end tapes.

Background of proposal

This proposal is based on discussions by Bob Snively (Sun Microsystems) and Lansing Sloan on July 13, 1995, after discussions at the ANSI X3T10 SCSI Working Group on July 12. Key ideas were the use of passwords to identify authorized initiators and rules to limit what other initiators can do. Bob presented these to the SCSI WG in Sep. 1995.

SIOF architectural assumptions

- Data flows directly between clients and peripherals.
- Authorized storage systems should control peripherals. Clients and others should not. IEEE P1244 Model.


to clients
FILE SERVER
SWITCH
Costly data transfers
to clients
FILE SERVER
SWITCH
Low-cost data transfers

Technology assumptions

- A mostly-switched interconnect is used for scalability and high performance.
- Address reassignments can be detected and systems can be restarted after such reassignment.
    - Note: Undetected address reassignment could result in spoofing and in sending sensitive information (e.g., passwords) astray (e.g., to attackers).
    - LANs, busses, loops are OK in special contexts.

Security-related assumptions

- Physical security for storage: Storage system modules, storage system peripherals, the interconnections among these, and interconnect management system(s) are sanctioned, trusted, physically protected, and managed appropriately.
    - Cannot snoop and forge within a storage complex.
    - If clients and storage components share parts of a path, storage interconnections remain protected.
- The interconnect ensures correct source addresses adequately.
- Encryption is not used or assumed here.

- Security and authentication among clients and components of storage systems is outside the scope.

SCSI traditionally has no security mechanisms.

- Any "Initiator" can send commands to any reachable "Target." There are no provisions for peripherals to obey only authorized storage systems.

SIOF Needs for SCSI security in peripherals

- Peripherals able to recognize "their" controlling storage systems.
- Storage systems able to find and recognize "their" peripherals.
- Peripherals obey only their controlling storage systems.
- When specified by their controlling storage systems, peripherals exchange specified data with whatever is at specified addresses.

Proposal and remarks

Extended proposal for secure NAPs

Based on the Protected Persistent Reservation proposal (X3T10/95-322).

- An SCSI peripheral accepts non-LUN commands from an Initiator that registered with a top-level password.
  - A top-level password survives power off/on.
  - A command changes the top-level password.
  - A command sets a one-LUN second-level password.
- An SCSI LUN accepts LUN commands from an Initiator that registered with the LUN using the LUN's second-level password.
- Initiators that provide passwords to SCSI peripherals are authorized to fully control the peripherals.
- Other "untrusted" Initiators are very limited in commands allowed (more details come later).
- An SCSI "third-party reservation" made by an authorized Initiator permits specific access by an untrusted Initiator.

Capabilities of Untrusted Initiators

- Some commands (REQUEST SENSE, INQUIRY, TEST UNIT READY) seem OK without passwords.
- Some commands are enabled by third-party reservations.
- Some task management functions seem OK.
  - TERMINATE TASK and ABORT TASK affect only the Initiator's functions. (Corrupted media?)
  - CLEAR ACA seems OK.
- These are not OK because they can affect other Initiators (and fixing them does not seem needed):
  - TARGET RESET
  - CLEAR TASK SET
  - ABORT TASK SET
- No Asynchronous Event Notification?
- Lower-level events (FC examples such as FCP Login, FC Fabric logout) appear to be acceptable.

Does extended proposal satisfy our needs?

- Peripherals recognize "their" controlling storage systems when systems provide passwords (yes).
- If addresses change, storage systems cannot easily dynamically find and identify peripherals (concern).
  - Protecting passwords is a concern.
  - Static addresses allow static config tables (yes).
- Peripherals obey only Initiators with password, hence only controlling storage systems (yes).
- When specified by storage systems, peripherals exchange specified data with whatever is at specified addresses (qualified "yes").

  1 READ/WRITE with third-party RESERVE.

  2 COPY command (doesn't even need RESERVE).

Remarks on how to identify peripherals.

- Not a serious issue if addresses are static.
- Commands like INQUIRY can be allowed without passwords. They neither prevent nor facilitate attacks on security but help detect non-malicious changes.
- A storage system can write a unique unguessable data pattern on a storage peripheral or medium.
- The storage system can later retrieve the data pattern. If it is not correct, the peripheral may be misidentified (and passwords may be disclosed).
    - This assumes the medium is not removable.

Remarks on protecting the password

- Protect all paths between storage system and its peripherals from snooping.
- Ensure storage system never sends password to wrong destination. Hard with dynamic addresses.
    - Assume done somehow based on lower-layer mechanisms, e.g., static addresses or fabric provides configuration information to storage systems.
- We are looking at ways to ease installing new passwords (if lost or disclosed, or to ease re-sale).

- Three-state switch in peripheral: "disabled", "acquire one password", and "running".

Perspective

Alternative approaches are being pursued.

- LLNL SIOF NAP front-end (our main current effort)
- CMU/NSIC Network Attached Storage Devices (NASD)

Status of LLNL NAP effort

- Plan to demo (remotely) during Supercomputing 1995.
- Data has been written and read (as of Nov. 10 1995).
- Initial implementation is to front-end ordinary peripherals with workstation (and switched Fibre Channel). Workstation provides NAP functions.
- Later effort is with VxWorks and PCI interfaces, and is intended to be embeddable in devices.
- This effort remains IP oriented.
- Have recently decided to allow byte-aligned transfers, not restrict to blocks.

Direction of CMU/NSIC NASD

- There are proposals for authentication, authorization, and data protection using encryption protocols related to Kerberos.

- Clients directly access files on "devices" as authorized by file servers.

Follow-up after Working Group Meeting (Rev 1)

Feedback during the presentation

- Passwords inside devices (especially low-cost, high-volume) are unacceptable if they survive power cycles, because the device is unusable if the password is unknown. This complicates reusing devices.
- Switches are too costly, hence unacceptable.
- Security should be outside SCSI, architecturally.

Hallway discussions after the presentation

The following ideas appear to handle passwords at power-on in a way satisfying the above concerns.

1. At power-on, a device enters secure mode. No password, so no access.
2. The device seeks password from a security server at a standard address.

   2a If the interface says there is no security server, the device enters normal mode and behaves normally.

   2b If a security server returns a password, the device obeys Initiators that register with the password.