



# “Using the Feedback Process in the SSP to Understand & Design Data Storage Systems.”

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## Overview

System of System’s processes enables an abstract point of view of systems that serves to increase the level of understanding of specific systems and how they work. This in turn allows new insights on how to improve system functioning and why specific system solutions emerge.

This poster demonstrates this by exploring only one specific isomorph from the 80+ isomorphs of SSP in data storage systems. It describes the system processes features and functions and then gives examples of them in data storage systems. A specific improvement in data storage system design is then highlighted for this process.

The system processes (isomorph) explored in this poster is feedback.

## System Process - Feedback

### General Description and Features of Feedback

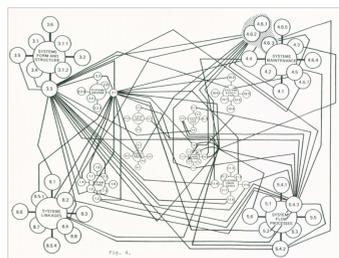
- A flow of information back to its origin. A circular causal process in which a system's output is returned to its input, possibly involving other systems in the loop
- Disturbance "an undesired input signal which affects the values of the controlled output"
- Forward path "transmission path from the actuating signal to the controlled output"
- Feedback path

### Data Storage Examples of Feedback Features:

- Simple feedback of errors and some monitoring happens between all levels of the storage system. Specific examples:
- Cabinet temperature
- Drive failure
- Read/Write failures to storage.

### Functions of Feedback

- Increases stability and long term survival
- Maintains systems openness
- Regulates system
- Elicits patterns
- Initiates corrective or continuing actions (negative and positive feedback)



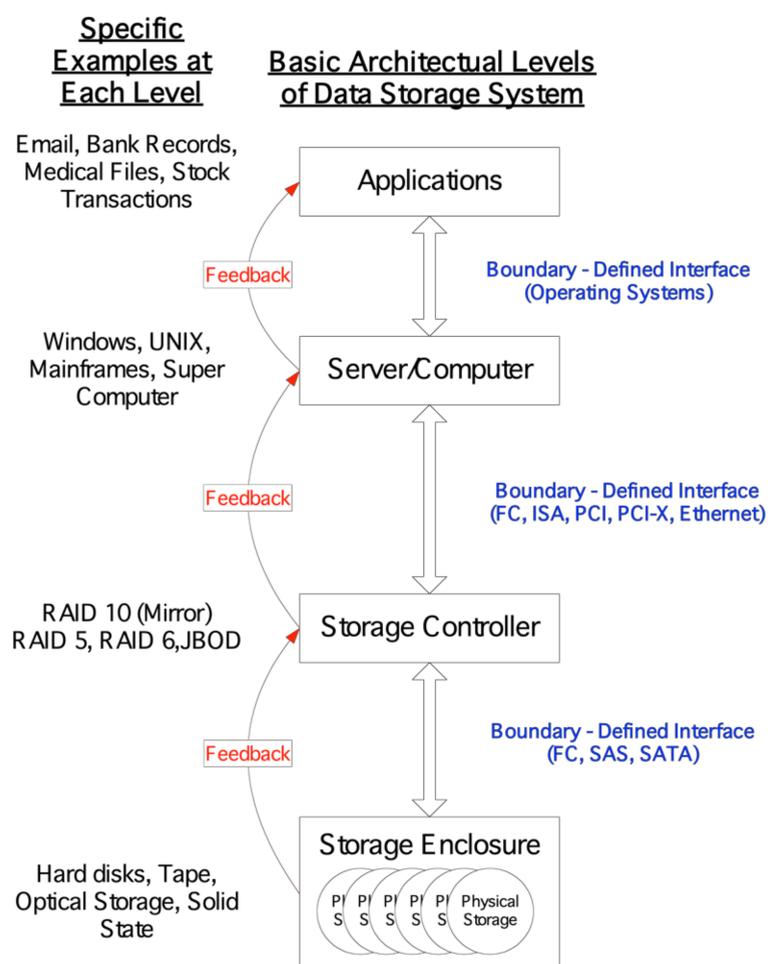
### Data Storage Examples of Feedback Functions:

- The simple feedback mechanisms of the data storage system increases the stability because errors can be managed and corrective action can be taken.
- They also regulate the storage system.

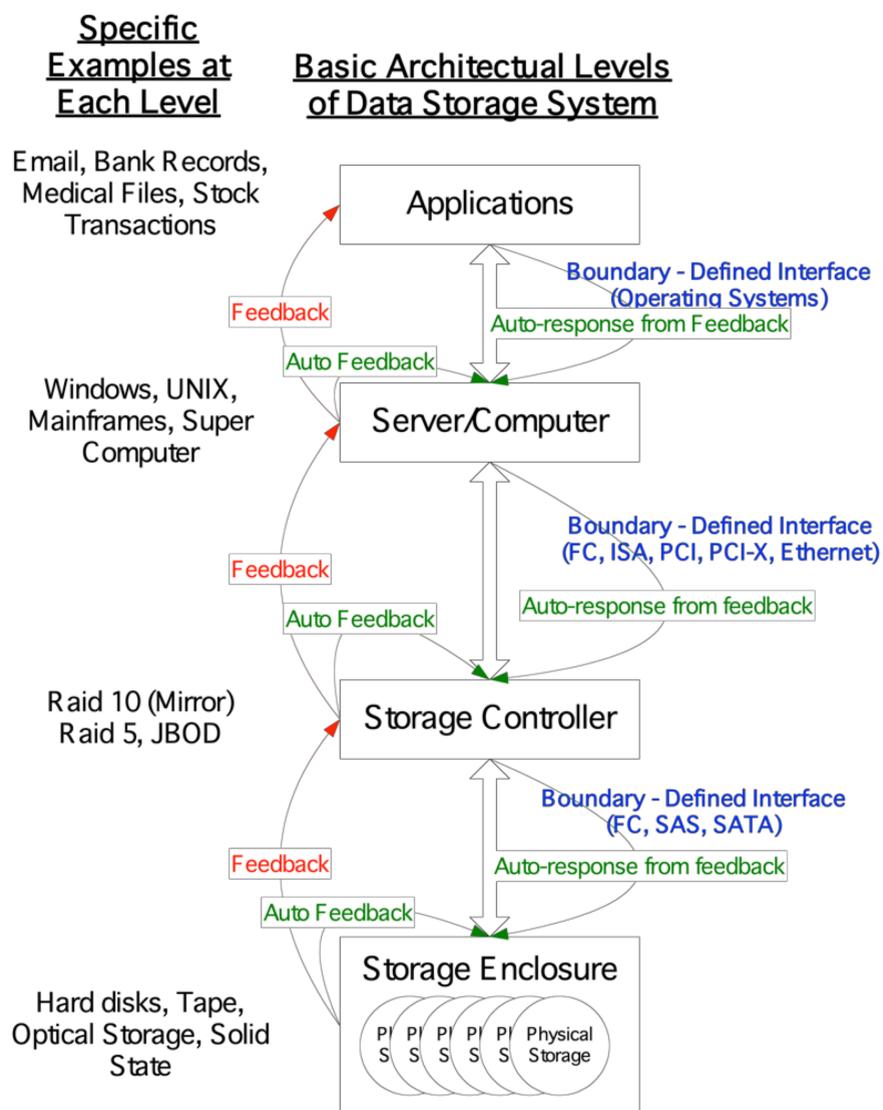
### Data Storage Improvement Example:

- Adding additional feedback and making the response to feedback more automatic would improve system performance. Current feedback mechanisms in storage systems are very rudimentary and often require human interaction. The system could be improved by making the response more automatic and adaptive. Specific examples:
- Workload distribution for better performance
- Storage usage patterns to improve efficiency
- “Soft” errors so that corrective action can be taken before total failure.

## Data Storage Diagram



## Data Storage Diagram with Improvement



### Technical Definitions

- RAID – Redundant Arrays of Inexpensive Drives. These are different ways of distributing the data across the storage devices. Depending on the levels, it can improve performance and allow data to be recovered if a number of devices fail.
- JBOD – Just a Bunch of Disks – no data layout techniques are used.
- FC, SAS, SATA – Different types of communication interfaces used for communicating to storage devices. Each of them have standards that are developed so that any controller using a certain protocol can communicate with any device using the same protocol.
- ISA, PCI, PCI-X, Ethernet – Some examples of communication protocols used to communicate to internal or external storage controllers.
- SAN, NAS – Storage Area Network, Network Attached Storage. Different ways of creating another level of abstraction for organizing storage devices for servers.