Grid Based Pervasive Distributed Storage

WALSAIP

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1 Problem Formulation

The Wide Area Large Scale Automated Information Processing (WALS-AIP) project aims at developing an infrastructure for the treatment of signal-based information arriving from physical sensors in a wide-area, large scale environment. The proposed model accentuates a distributed space-time processing format. This approach demands efficient data and resource management techniques.

2 Proposed Solution

We have deployed the prototype of a grid-service based system to access and manipulate data from a sensor network: a grid portal interface provides transparent access to end-users; raw data from sensors are sent to a data server via wireless communication; GridFTP is used to improve data transport from the data server to a grid infrastructure; data exchange between server and the Grid testbed is authenticated using Grid Security Infrastructure (GSI); and finally a replication strategy based on the Information Dispersal Algorithm (IDA) is incorporate into the tool to manage the distributed storage of the data.

3 Theoretical Framework

Let $F = b_1, b_2, b_3, \ldots$ be a file, where $0 \le b_i \le 65535$. Each b_i is an element of the finite field Z_p.

In order to disperse F, a set of n vectors $a_1, a_2, a_3, \ldots, a_n \in E$, where $E = GF(2^B)$ is chosen, each of length m, and linearly independent. $A_{n\times m}$ is a matrix whose ith is a_i

The file is divided into sequences of length m $(b_1, b_2, b_3, \ldots, b_m)$

Then,

$$A_{n\times m}\begin{bmatrix} b_1 \\ . \\ . \\ b_m \end{bmatrix} = \begin{bmatrix} c_1 \\ . \\ . \\ c_n \end{bmatrix}$$

Each resulting element c_i is stored in a separate block of file.

To recover the first m elements of F, the first element from each different block is needed.

The whole file is obtained mapping sequences of m elements using the inverse of $B_{m\times m}$

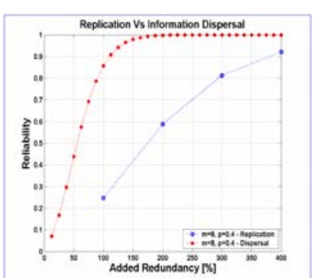
$$B^{-1}_{m\times m}\begin{bmatrix} c_1 \\ . \\ . \\ c_m \end{bmatrix} = \begin{bmatrix} b_1 \\ . \\ . \\ b_m \end{bmatrix}$$

$A_{n\times m}$ is Vandermonde matrix, therefore any sub-matrix of it, is invertible.

Finally, a non-reducible polynomial must be chosen. The polynomial of degree B over $GF(2^B)$, when $B = 16$ is:

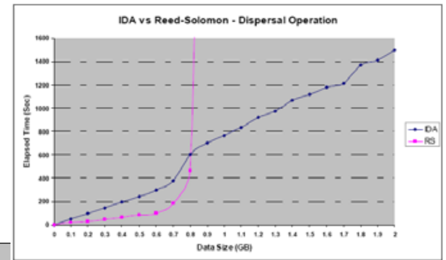
$$p(x) = x^{16} + x^{12} + x^3 + x^1$$

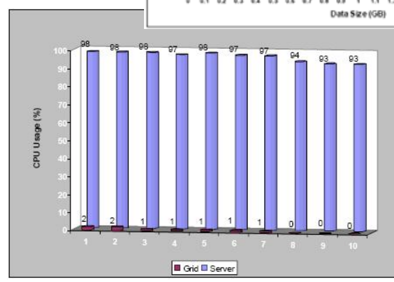
4 Experimental Results



Standard Replication versus **IDA**

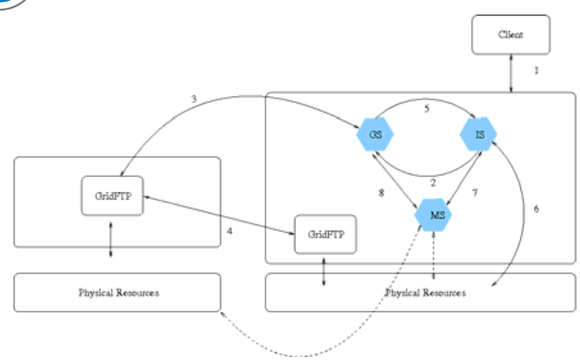
Reed Solomon versus **IDA**





Percentage of CPU usage

5 IDA Service Deployment



6 Conclusions

- The proposed redundancy scheme and its subsequent deployment as a grid service improves reliability.
- That work is considered as an initial proof of concept for a more complex project related to the design and implementation of adaptive resource allocation and migration.

7 References

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