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Using XQuery and XML for Data Management in HPSS

MSST 2011

Agenda

Data Management Challenges

History of Data Management in HPSS

Considered Architectures

Chosen Architecture

Results

Future Work

Data Management Challenges

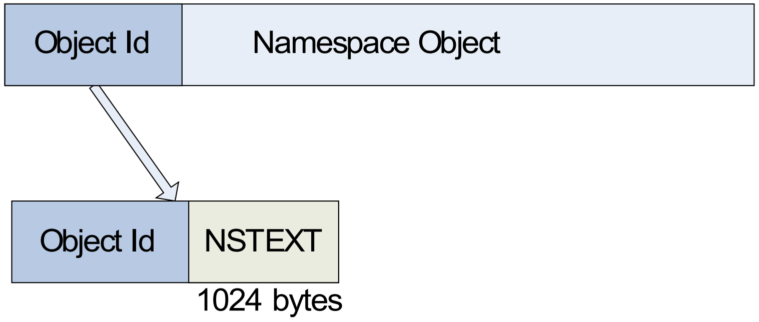
- How can we manage content for a facility with billions of files over decades?
  - What do these files contain?
  - How can we use their contents?
  - Are these files still needed?

- Information gleaned from a hierarchical file system structure is not sufficient for locating like-files in most circumstances.
  - Information is only sliced one way, when perhaps you'd like to see it organized based upon a different characteristic.

- Applications need a flexible space to store their own file metadata.

History of Data Management in HPSS

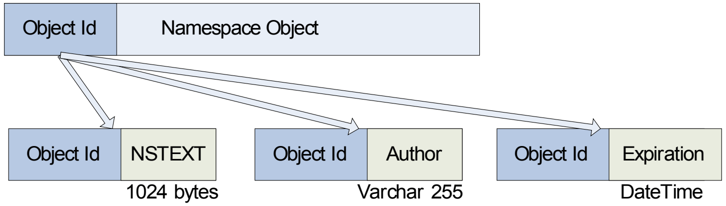
- HPSS is a hierarchical storage management solution capable of managing petabytes of data across disk and tape.
- HPSS stores file metadata within a DB2 database.
- HPSS has many components but the "Core Server" component handles Namespace and Bitfile operations. User metadata is handled by the namespace component.



HPSS Comment Field

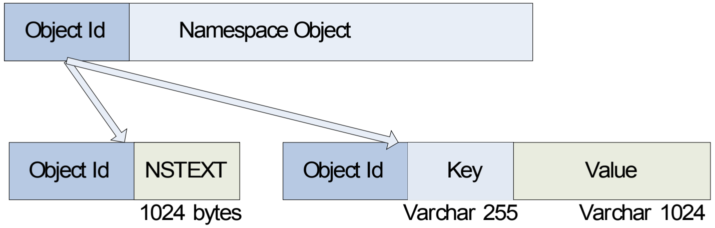
- Prior to HPSS 7.3, the **comment field** was the only place to store user metadata for files.
- The comment field could be up to 1024 bytes of unorganized text per file.
- The comment field was not indexed, and not searchable.
- This rarely met the data management requirements of customer sites if they had them.

Considered Architectures



Single Attribute Per Table

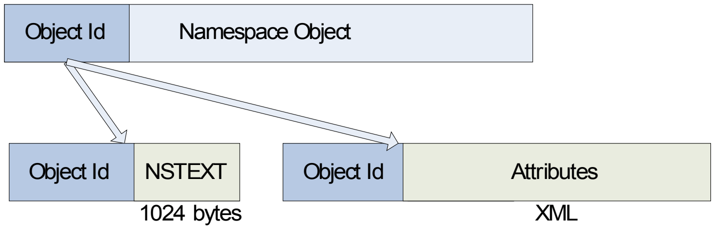
- Single table for every attribute using SQL types
- Provided maximum resource flexibility and per table indexing for fast searching.
- Increased administration burden – intervention required for any new attribute name.
- Attribute listing could require joining hundreds or thousands of tables.

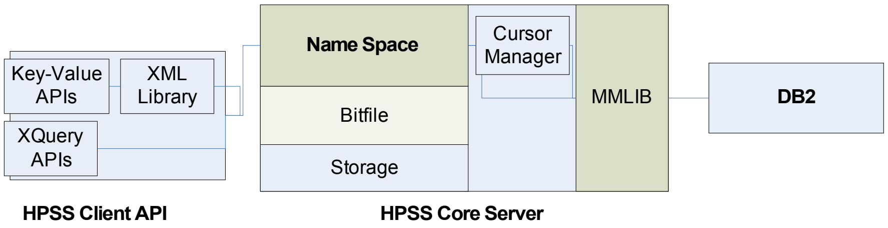


Multiple Attribute Per Table

- One table containing all attributes, all attributes are stored as strings
- Simplified resource allocation and administrative burden.
- Easy attribute listing
- Poor indexing options
- Complicated query interface
- Complex or non-standard validation mechanism
- Difficult to manage attribute relationships and groups

Chosen Architecture





- Single XML table per file, stores attributes as XML.
- Shares most of the positive characteristics of the multiple attribute table.
- XQuery interface for searching, XML Schema Definition for attribute or attribute value validation
- Optimized search capability with XML indexing
- Hierarchical organization and attribute duplication allows for better organization and relationship identification
- XML is verbose
  - Mitigated with compression
- Attribute listing is somewhat programmatically more difficult than the multiple attribute per table method

Example

Say you want to store information about a checksum associated with a file.

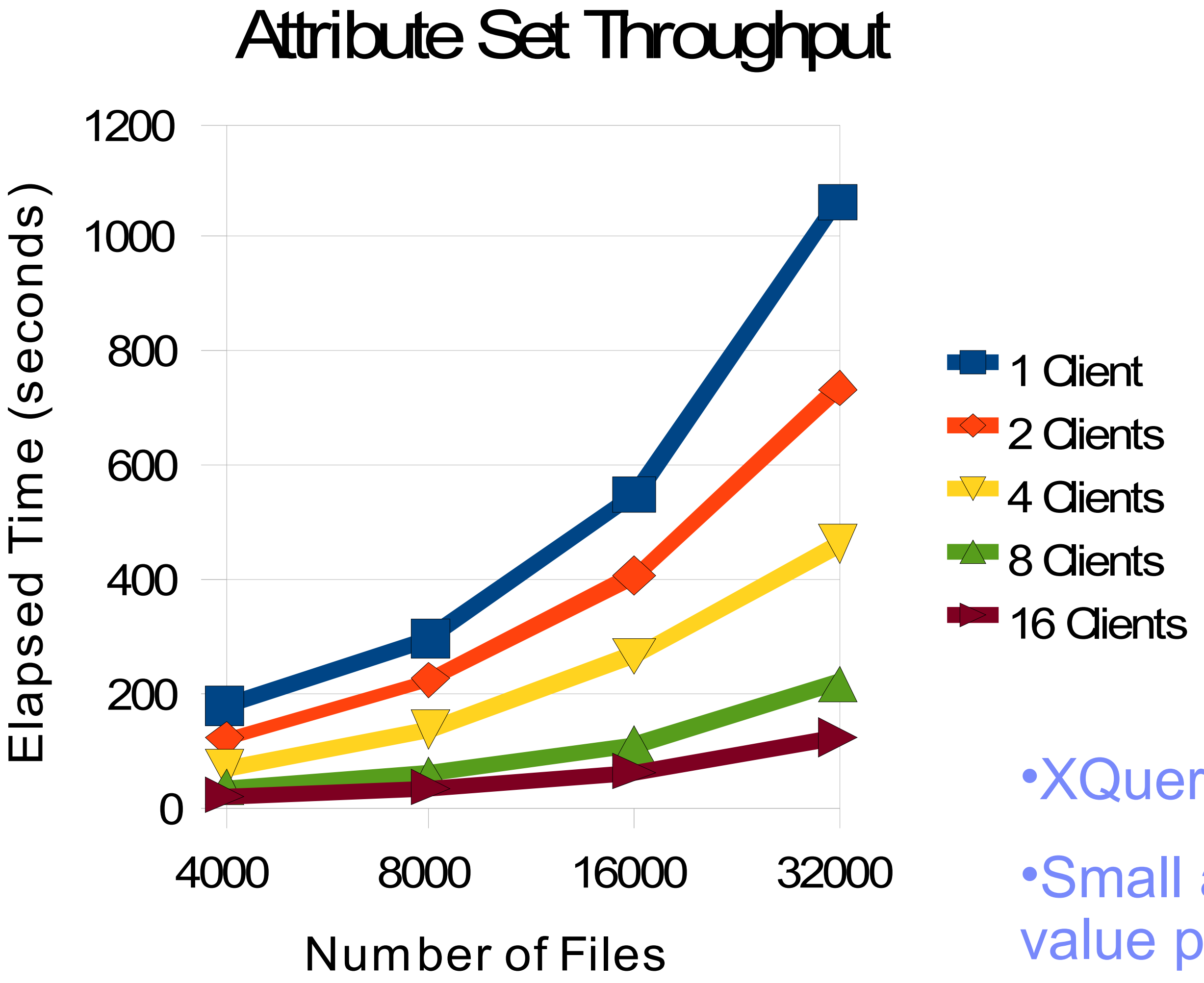
The attributes may look like:

/hpss/example/checksum/type = md5

/hpss/example/checksum/hash = b96d3aa0bd29a4e95b3b77049553fff3

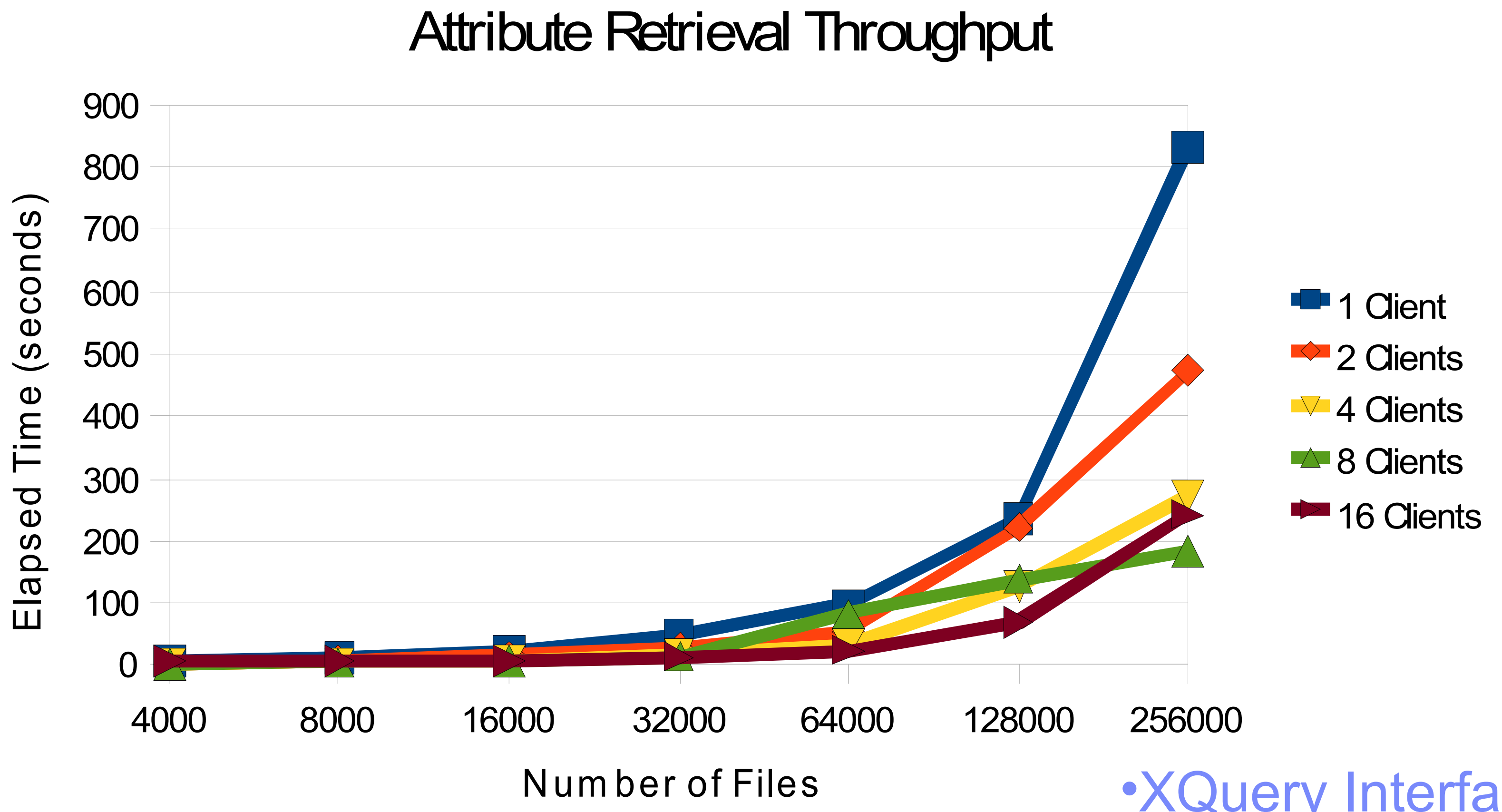
/hpss/example/checksum/time = 1306418968

Results



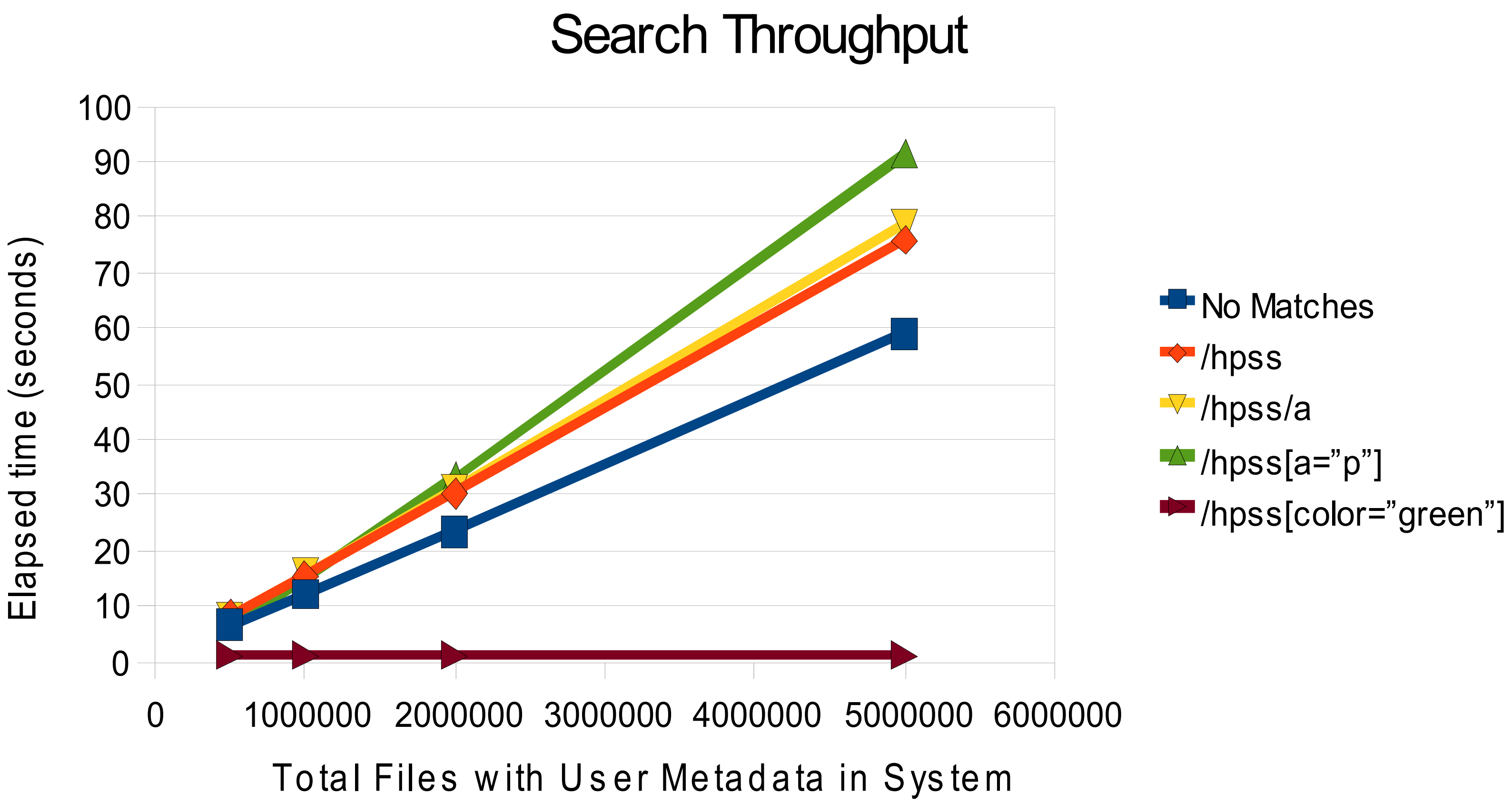
- XQuery Interface
- Small attribute / value pairs

Results



- XQuery Interface
- Retrieve small attributes

Results



- XML Indexes on /hpss/a and /hpss/color
- /hpss/a matches > 50% of all files
- /hpss/color matches ~1% of all files
- 10M total files in system

Results

Compression

System	Files	Compress
GHI Development System	16 million	68%
PNNL Production System	22 million	70%
HPSS System Test	100,000	70%
Benchmark System	320,000	71%

Current and Future Work

Current

- HPSS client application developers have plans to use UDAs
- GPFS / HPSS Interface (GHI) uses to track deletions and migrations across GPFS backups and reclaim space
- On demand File-based Checksum storage and verification
- Automated File-based Checksum over VFS

Future

- Present a unified view of system and user file attributes.
- Present an alternative to POSIX for navigating the namespace.
- Options for Automated or Hook-based metadata updates.

Questions?