Considerations for High Throughput Digital Preservation

Jason Pierson
FamilySearch
1221 N Research Way
Orem,
UT, 84097
(1) 801 240 5836
jpierson@familysearch.org

Mark Evans
Tessella Inc
51 Monroe St #702
Rockville,
MD, USA 20850
(1) 240 403 7502
mark.evans@tessella.com

Dr James Carr
Dr Robert Sharpe
Tessella plc
26 The Quadrant,
Abingdon Science Park
Abingdon, Oxfordshire, UK
(44) 1235 555511
james.carr@tessella.com
robert.sharpe@tessella.com

ABSTRACT

In partnership with Tessella, FamilySearch is developing an automated approach to large scale digitization, ingest and long-term preservation of electronic content. The set of proposed processes and underlying architecture must support required ingest rates in excess of 20Tb a day.

Significant effort has been placed on examining the preservation architecture and processes for potential bottlenecks. Digital preservation requires computational intensive capabilities to provide functionality such as fixity checking, format identification and characterization of content. When operating at very large scale there is also a real need for a large network bandwidth and high speed storage systems.

By minimizing the need for human interaction and employing software parallelization our initial findings indicate that the primary bottleneck is not processor bound, but is directly associated with the movement of digital files into and within the application. In short the scalability problem is really a system engineering problem and not necessarily an issue for digital preservation per se.

Keywords

Digital Preservation, Digital Archiving, Scalability, Automation

1. INTRODUCTION

Since the 1930's FamilySearch have been actively involved in capturing images of records that have genealogical significance from all over the world. Up until recently content was captured using film cameras and preserved mostly on microfilm. To date FamilySearch have amassed more than 3.3 million rolls of microfilm in their records vault in the canyons above Salt Lake City UT, USA

In recent years a transition has been made to capturing the content in digital form. Capture rates are currently in excess of 130 million images a year[1]. It is anticipated that by the year 2020 this rate will have doubled. FamilySearch are also in the midst of an aggressive digitization effort with the intent to create digital copies of all the images from all existing microfilm rolls. The combined volume of content from both sources is expected to be in the order of 9Pb a year.

iPRES2011, Nov. 1–4, 2011, Singapore.

The volume of digital content and the required rate of ingest place large demands on both the processes involved in digital curation and preservation, and the design of infrastructure to support those processes. In order to keep pace with the desired ingest rate a fully automated process is required.

Over the past several years FamilySearch have developed a digital preservation pipeline for the lifecycle management of their digital content. The architecture and design has been driven by the need for both automation and scalability from the very beginning. A recent initiative has been to focus on the long term preservation aspects of the digital content, in particular to look beyond bit level preservation capabilities. This new initiative will use a phased approach with the Tessella Safety Deposit Box (SDB) platform initially running in parallel with the preservation component of the existing preservation pipeline.

2. DIGITAL PIPELINE WORKFLOW

The proposed digital pipeline for the ingestion and storage of content consists of the following processes:

Content acquisition: Digital content is primarily acquired as uncompressed Tiff and raw format from both microfilm scanning and digital camera capture.

Content preparation: Following acquisition, each image is de-skewed, cropped and enhanced using a suite of tools. JPEG2000 and JPEG derivatives for each image are created for preservation and dissemination purposes, and technical metadata to support long term preservation is extracted.

Ingest: The preservation copies and associated metadata are packaged into a SIP and ingested into the SDB platform. During ingest the following operations are performed:

- **Fixity checking –** All content files within a SIP are checked
- **Content and Metadata Integrity –** Checks are made to ensure the right content has been delivered and the metadata is correct and valid
- **Characterization** – The capture of technology-dependent properties of the content files, and the capture of technology-independent significant properties of the information object. This includes **format identification, format validation** and **property extraction.**

Storage: AIP's are stored logically with the metadata and relationships stored in a database and the content stored on a separate file system. In the initial deployment this will be to network attached disk, but in subsequent phases tape will be the primary storage medium. A background process performs periodic fixity checking of all content files once they are persisted.

3. SCALABILITY CONSIDERATIONS

The projected ingest rates for combined microfilm scans and digital camera images based on the estimated volume of microfilm digitization and digital capture are illustrated in table 1.

Table 1: FamilySearch projected ingest rates

Year	Objects per second	MB per second
2011	25	346
2013	42	598
2014	58	776

A major activity to date has been to perform a comprehensive activity of scalability testing to determine the optimum configuration of SDB in order to meet the ingest requirements and identify potential hardware and software bottlenecks.

3.1 Testing configuration

Early testing indicated that a single server approach for SDB would not be sufficient to achieve the projected ingest rates, despite executing multiple ingest workflows in parallel. The main limiting factors in this case were a combination of CPU activity and i/o rates. As a result the SDB architecture has been modified to enable a clustered environment that can utilize a shared storage infrastructure. The actual test environment consisted of two SDB instances (Job Queue servers) connected to a large scale GPFS file system.

The test data was representative of that normally ingested by FamilySearch. Each SIP contained 50-50 mix of JPEG2000 (~10MB each) and XML metadata files (~5K each)

3.2 Variable thread count

A series of tests were conducted where the number of threads (concurrent ingest workflows) on each Job Queue server was steadily increased, until a degradation in throughput was observed.

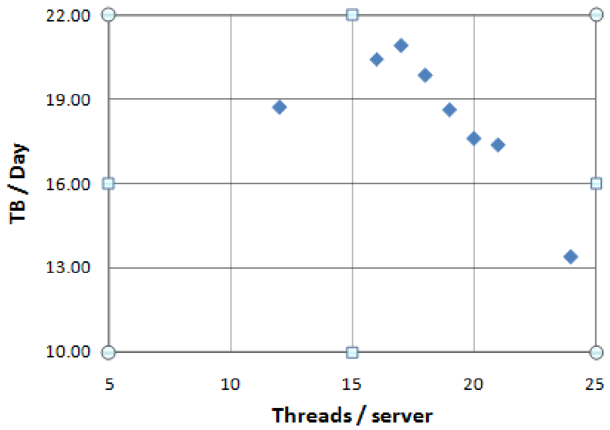

Figure 1: Effects of varying the number of concurrent workflows

For each test a total of 0.5TB was ingested, by using a SIP size of around 4GB and ingesting 120 SIPs.

For the hardware used in this deployment we found running 17 concurrent workflow steps on each server gave the maximum throughput. A subsequent increase in thread count causes a sharp decline in performance, due to the ever increasing demands on the storage system. This is illustrated in figure 1

3.3 Varying SIP size

A second series of tests were conducted to examine the effects of SIP size on the throughput. This was achieved by changing the number of files defined within a submission package, and hence keeping an individual file size constant. As the submission information package grows, the number of ingest workflows required to ingest a fixed amount of content reduces. Since we treat each submission package as an atomic unit, overall reliability may be increased by using larger numbers of small SIP's over a few large SIPs.

The table below shows that the extra cost overhead of running more small SIPs is not significant since the ingest rate is only reduced by around 5% when using 1GB SIPs over 4GB SIPs.

Table 3 Ingest rate results based on varying the SIP size.

	SIP Size				
	4GB	**2GB**	**1GB**	**0.5GB**	**0.25GB**
# Files per SIP	930	466	234	118	60
# SIPS	240	484	925	1749	3701
Time / Sec	8,555	8,739	8,773	9,036	10,408
Files /sec	26.09	25.81	24.67	22.84	21.33
% change	0	+1.07	+5.44	+12.45	+18.24

4. CONCLUSIONS

Our work to date has demonstrated that it is possible to implement a very large scale digital preservation solution. By using a parallelization approach there appears to be no practical limit on the software stack on the rate of ingest; it is more a restriction of the underlying hardware. There are three main areas of future investigations.

- Continuous improvements in the ingest process..For example the performance of format identification may be improved if only a limited number of file formats are being managed.
- Testing in other functional areas such a migration services, and periodic fixity checking
- Consideration of tape storage systems

5. ACKNOWLEDGEMENTS

The authors would like to thank Tom Creighton, Randal Stokes and Steve Lowry from FamilySearch and Alan Gairey from Tessella for their support, dedication and enthusiasm through this collaborative initiative.

6. REFERENCES

[1] Creighton, T; Evans, M; “Digital Object Curation at Scale”, Proceedings of Archiving 2011, Salt lake City UT, May 2011.