Chapter 3.7
A Distributed Storage System for Archiving Broadcast Media Content

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ABSTRACT

This chapter presents MediaGrid, a distributed storage system for archiving broadcast media contents. MediaGrid utilizes storage resources donated by computing nodes running in a distributed computing environment. A genetic algorithm for resource selection is built in MediaGrid with the aim to optimize the utilization of resources available for archiving media files with various sizes. Evaluation results show the effectiveness of MediaGrid in archiving broadcast media contents, and the performance of the genetic algorithm in resource utilization optimization.

INTRODUCTION

It was the mid 1950s when the Ampex Corporation’s Quadraplex professional video tape recording system was first widely available. Since then, production, storage and playout of television programs has been centered on magnetic tape technologies. Recently, the advancement of disc based, server technologies has had an impact on the broadcast industry. There is now an increasing trend towards the ‘tape-less’ production environment (Watkinson, 1990).

It is now possible to shoot an entire programme’s material directly to disc and edit it using software tools, such as Avid or Apple’s Final-Cut Pro. A completed programme can be delivered to a transmission playout centre using an optical fibre channel network. Here, the content is reviewed and verified from a video server before playing-out as a video stream, at the scheduled time, to
the transmitter. Recent consumer gadgets like Personal Video Recorder systems allow a viewer
to record or time-shift their favourite shows. At no
point in this example has the programme content
ever touched a piece of magnetic tape.

Server-based transmission has been widely used
in broadcast infrastructure. In the multi-platform,
multi-channel environment, transmission playout
from the server is preferred whenever possible.
Two of the many advantages are, being able to
preview any part of the content close to transmis-
sion without having to worry about whether there
is enough time to spool the tape back to the start
of the programme. Also, it is possible to view the
end of the file (on an alternative server output),
whilst the beginning is being transmitted. This
level of media access is not possible with tape.

Transmission playout servers are specialist
items of broadcast equipment which translate
content between a file stored on a disc array
and a real-time MPEG video stream. When the
programme’s scheduled air-time occurs, the
server plays back the file, under control of an
automation system, and outputs an MPEG video
stream. Because they are highly specified, these
are costly machines with a current price ranging
from £40k–£70k each, depending on capacity.
Their storage capacity therefore comes at a pre-
mium. There is an upper limit on both the number
of files each server can hold and the total storage
capacity. Due to the cost of these machines, their
capability is not a suitable option for longer term
storage and archive.

The past few years have witnessed a rapid
development of grid computing (Foster and Kes-
selman, 1998; Li and Baker, 2005; Berman et al.,
2003), a computing paradigm to facilitate utiliza-
tion of resources on the Internet. This article pres-
ents MediaGrid, a light-weighted storage system
for archiving broadcast media content utilizing
resources dispersed in a distributed environment.
We applied the concept of grid computing aim-
ing to provide a novel solution to the problem
of not having enough storage space to hold the
ever-increasing mass of media content. As such, it
performs a single function of the material manage-
ment systems within a broadcast infrastructure.

It is worth noting that MediaGrid is related
to GridCast (Harmer et al., 2003). The scope of
the GridCast project is much broader, aiming to
provide all the basic functions required within a
broadcast material or content management system.
The extent of this scope includes content sharing,
browsing and trafficking, as well as assisting in
broadcast scheduling. The GridCast project imple-
ments these functions as Web services using open
standards and the Globus Toolkit (Sotomayor and
Childers, 2005). MediaGrid can be plugged into
GridCast as an archive service exploiting desktop
PC storage at each site, so could be part of the
content storage and retrieval process.

BACKGROUND

Figure 1 shows how and where server based
technology is being used within a broadcast infra-
structure. This diagram is based on the design
model of an existing transmission playout centre.
The pale green blocks represent the areas where
the transmission infrastructure is still predomi-
nantly broadcast specific, single purpose, propri-
etary equipment. In the presentation chain, this
is equipment such as the video mixer, DVE
(Digital Video Effects) processors, and data
bridges or inserters. DVEs provide ‘real-time’
vision processing such as keying and manipulat-
ing video layers, providing effects like picture
squeezes, captions and picture-in-picture overlays.
Data bridges add data, such as teletext subtitling
information, or wide-screen-signal coding to the
video signal. This data is broadcast with the pic-
tures and decoded at the receiver.

The switching matrix, often called a video rout-
er, creates cross-point between video-bandwidth
input and output busses. These are used to switch
the processed signal onwards to its destination.
In the case of this diagram describing a playout
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