Guest Editors' Introduction

Multimedia Applications and High-Performance Computing

Digitalization of traditionally analog data such as video and audio, and the feasibility of obtaining network bandwidths of gigabits per second or more, are two key advances that have made possible the realization of interactive distributed multimedia systems. Multimedia is normally perceived as combining text, video, audio, graphics and images in computers to provide information to users through a much richer interface.

The potential applications of multimedia systems span almost all domains for which computers have already proven useful, and seem likely to extend to many new domains as well. Examples of application domains include health care, education, command and control, entertainment, information systems, simulations in science and engineering, computer-aided design, and collaborative work. These applications will have far-reaching implications for diverse technologies, including personal computers, servers, networks, network management (and related software layers), operating systems, database systems, user interfaces, and authoring software.

Advanced multimedia systems depend on high-performance computing and communication technologies for the processing, storage, movement, and real time delivery of data. For example, parallel computers with large attached storage are natural candidates for media servers because they can provide the compute, storage, and communication rates required to store, manipulate, retrieve and schedule data for large
numbers of users, while satisfying real-
time requirements and providing high reli-
ability and availability. Similarly, future
immersive virtual reality interfaces will
require computing and communication
capabilities superior to today's supercom-
puters. In both cases, high-performance
systems originally designed for traditional
science and engineering applications are
being adapted to meet new requirements.
Multimedia systems can also benefit tradi-
tional high-performance computing applica-
tions by enabling richer forms of user
interaction. For example, future scientific
or engineering simulation systems will
likely permit the use of voice and gestures
to steer the simulation, provide users with
interactive multimedia help facilities, and
use virtual reality techniques to immerse
users in simulation results.

The five articles in this special issue
provide an introduction to the many inter-
esting issues that arise at the intersection
of multimedia and high-performance
computing. The first two articles describe
the application of advanced interface
techniques to two very different high-
performance computing problems: the
management of broad-band networks
and collaborative science. The other three
articles describe developments in software
and hardware architecture that are
intended to advance various multimedia
applications.

The article, "Management of Broad-
band Networks using a 3D Virtual World" by
Crutcher et al., examines the applica-
tion of multimedia techniques to the chal-
 lenging problem of managing high-speed
networks. ( These networks are in turn used for multimedia applications.) This
work tackles the fundamental problem of
observability and controllability of broad-
band networks. A virtual world provides a
network management interface through
which a user can observe and interact with
the network directly in real-time. It also
serves as a platform to experiment with
many aspects of network transport, con-
trol and management techniques.

The article, "Designing the Future" by
Disz et al., provides an introduction to the
work of the Futures Lab at Argonne
National Laboratory. The Futures Lab is
pursuing various projects intended to sup-
port collaborative science: that is, the use
of high-performance computing, net-
working, and display technologies to cre-
ate virtual environments in which remote
researchers can collaborate on challenging
problems in science and engineering. A
centerpiece of the lab is the CAVE, a high-
end, immersive virtual reality environment
developed at the Electronic Visualization
Laboratory at the University of Illinois.
Coupling the CAVE with a parallel super-
computer has allowed some exciting exper-
iments in computational steering.

The article, "DAVE: A Plug-and-Play
Model for Distributed Multimedia Appli-
cation Development" by Friesen et al.,
describes an enabling technology for high-
performance multimedia applications: an
environment that supports the develop-
ment of multimedia applications for col-
laborative engineering (for example, desk-
top video conferencing). DAVE uses
object-oriented techniques to achieve
device and media extensibility, and pro-
vides easy access for application developers
who do not wish to learn the details of the
media devices or who want to dynamically
change their applications at runtime.
DAVE's application program interface
provides support for real-time as well as
other services.

The article, "Design Issues in High-
Performance Media-on-Demand Servers" by
Jadav et al., addresses issues that arise
when high-performance computers are
used as media servers. The article outlines
a probable scenario for multimedia ser-
vices, and based on this scenario, identifies
the requirements for the server architec-
ture. Given that media servers need to
store and retrieve massive amounts of data,
efficient input-output of data is one of the
most important considerations, especially
to satisfy real-time delivery requirements
for video data. Furthermore, a server must
provide a high degree of reliability, avail-
ability, and fault tolerance, and at the same
time must be cost-effective. The article
also presents performance data that illus-
trate the tradeoffs in choosing different
design parameters and configurations.

Finally, "The Magic Video-on-Demand
Server and Real-time Simulation System"
by Taylor et al., describes a specific imple-
mentation of the media server concept. It
describes the design and implementation
of a video-on-demand server developed at
the Sarnoff Real Time Corporation. The
Magic system is intended both as a real-
time video processor and for sourcing
video streams to clients. The real-time
video processor permits video capture,
compression, encoding and processing.
The Magic system is based on a massively
parallel architecture with scalable I/O
bandwidth.

Readers interested in learning more
about research and development in multi-
media technology as well as applications
can read the following publications. IEEE
Multimedia is a technical magazine, pub-
lished by the IEEE Computer Society. It
contains papers describing new results,
tutorial papers, information on applica-
tions, and information on new products.
Multimedia Systems is a joint publication of
ACM and Springer Verlag and contains
technical articles and other information.
In addition, there are two main confer-
ences on multimedia. The IEEE Interna-
tional Conference on Multimedia Com-
puting and Systems (ICMCS) will next be
held in Hiroshima, Japan, June 17-21,
1996, while the ACM Multimedia Con-
ference will be held in San Francisco,
November 6-11, 1995. In addition to these
meetings, there are many others on topics
(such as compression) that are directly
applicable to multimedia systems.

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Alok Choudhary's biography can be found on
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Rick Stevens' biography can be found on page
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