

# Interactive Digital Television Networks

Microware's DAVID System: A critical vehicle for the new  
"information superhighways"

by Eric Miller, Director of Multimedia

A WHITE PAPER

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## **Abstract**

A description of the DAVID System, a new family of Microware software products for the development of digital video and audio set-top decoders, the integral end-component of an interactive television network.

## **Introduction**

Microware Systems Corporation has been active in Interactive Digital Television (IDTV) technology for over two years. During that time we have developed several important pieces of software for a complete, consumer-oriented implementation of Video-Dial-Tone and Video-on-Demand services, including movie rental, electronic directory and educational services, home shopping and even multi-player games.

These developments are based on our historical work in Compact Disc Interactive (CD-i) as the supplier of Operating System and Application Program Interface (API) software for the system. As well, it takes advantage of our relationships with both Bellcore (the research and development arm of the Regional Bell Operating Companies) and OptImage Interactive Services (a limited partnership between Microware and N.V. Philips) to provide key authoring system tools and technology for building the applications that will be used in an interactive wide area network.

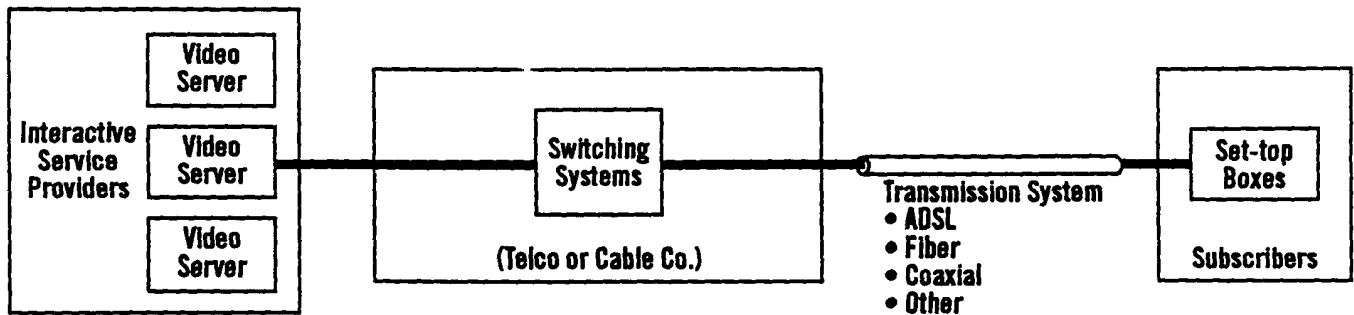
We have also gained valuable experience in applying our software innovations to the consumer electronics arena. This is a result of our ongoing relationships with several key consumer electronics manufacturers in Europe, the United States and the Asian-Pacific region. Our work with these and other companies manufacturing and marketing digital interactive products has given us business development expertise that, coupled with our technological developments, puts us in a unique position to help facilitate the creation and implementation of IDTV networks.

## The Digital Network

The infrastructure for IDTV lies in the fiber optic and copper wire that connects all of us to basic telephone and cable TV services. Advances in video compression and telecommunications technologies have made possible the delivery of high-quality video in a public switched network, without digging up and replacing the fiber and copper buried under our streets.

Most IDTV networks are based on the MPEG standard for video and audio compression. Early implementations of the technology are using MPEG-1, as silicon is readily available in quantities. Future trials and network deployments are based on MPEG-2, which delivers higher quality video at the cost of more bandwidth in the network.

The following is an illustration of a typical IDTV network:



## Microware's Goals

The primary interest for Microware in this technology is to provide software for both the TV set-top and head-end decoding devices. Our traditional business has always been in highly embedded systems such as consumer electronics and this is a simple extension of the software that we have already developed.

Our second interest is to help facilitate the development of the large-scale video servers which would be providing the data and command streams to subscribers' homes. Microware is developing a set of protocols and a layer of communication software that would link the video servers with the set-top decoder, independent of the video server's own operating system and related system software. We are currently working with several server vendors in the implementation of this protocol.

Our third interest is in the area of providing authoring system tools for building the applications and their data structures for use in the system. Microware has developed a set of tools for building and validating these applications and assembling the various

## Interactive Digital Television Networks

MPEG-encoded audio and video data into real-time data streams for delivery over wide area networks.

In order to achieve these goals, Microware has created the DAVID System for interactive television decoders.

## **The DAVID System**

DAVID (Digital Audio/Video Interactive Decoder) is a common operating system environment for interactive television decoders that can be used in telephone, cable TV and wireless networks. Created and licensed by Microware Systems Corporation, DAVID is based on Microware's OS-9 Real-Time Operating System, which can run on 68XXX, X86 and PowerPC microprocessors. The DAVID System supports both network and local interactive applications, graphics and user interfaces.

As of the first quarter of 1994, IBM, Philips, ICTV, GoldStar, Samsung, Kyocera and six other manufacturers are building DAVID-based decoder products that will be deployed in trials and network deployments during 1994. These networks include Bell Atlantic's planned deployment in Virginia and New Jersey, and Cox Cable's trial in Nebraska. Also, the DAVID System is supported by leading video server providers, such as Oracle and N-Cube, assuring an end-to-end solution for interactive television.

### **DAVID's Impact on Various Multimedia Segments**

#### **Application Developers**

For everyone who will providing content for interactive networks — such as movie and TV studios, educational and government institutions, banks and retailers — the DAVID System provides a complete platform to target multimedia applications.

Developers need only program their applications once under the DAVID System. DAVID's portability on a variety of decoders, coupled with DAVID network protocol support connecting the decoders to various video servers, assures application developers true interoperability across telephone, cable and wireless networks.

The DAVID Development Environment, aimed at application developers, integrates easily into existing popular multimedia tool sets. Existing CD-i, CD-ROM, Mac- and PC-based assets can be converted quickly into DAVID System applications. The DAVID Development Environment is supported on various low-cost platforms that allow both computer programmers and artists alike to emulate the actual network on their desktop, thus enabling not only the creation but also the validation of interactive applications.

#### **Video Server and Network Providers**

Low-cost DAVID-based decoders are currently being manufactured, and will soon be available in quantity. Existing video servers currently work with DAVID-based decoders via a common DAVID network protocol. Thus, DAVID is a complete system that can be integrated into existing switching systems, line cards and cable head-ends. For tele-

phone, cable and wireless networks, targeting DAVID is the fastest and most comprehensive path to interactive television deployment.

### Decoder Manufacturers

DAVID can be easily configured for use with digital video set-top and head-end decoders. The DAVID Installation Package consists of the OS-9 Real Time Operating System, a critical component for interactive television, plus all the system components necessary for decoder functionality such as network communications, MPEG decoding and user interface. This DAVID package also contains a comprehensive suite of device drivers for popular, off-the-shelf MPEG, graphics and communications hardware. Microware's nearly two-decades worth of experience in supporting embedded systems designs, along with DAVID's portability, makes integration fast and easy.

# DAVID System Components

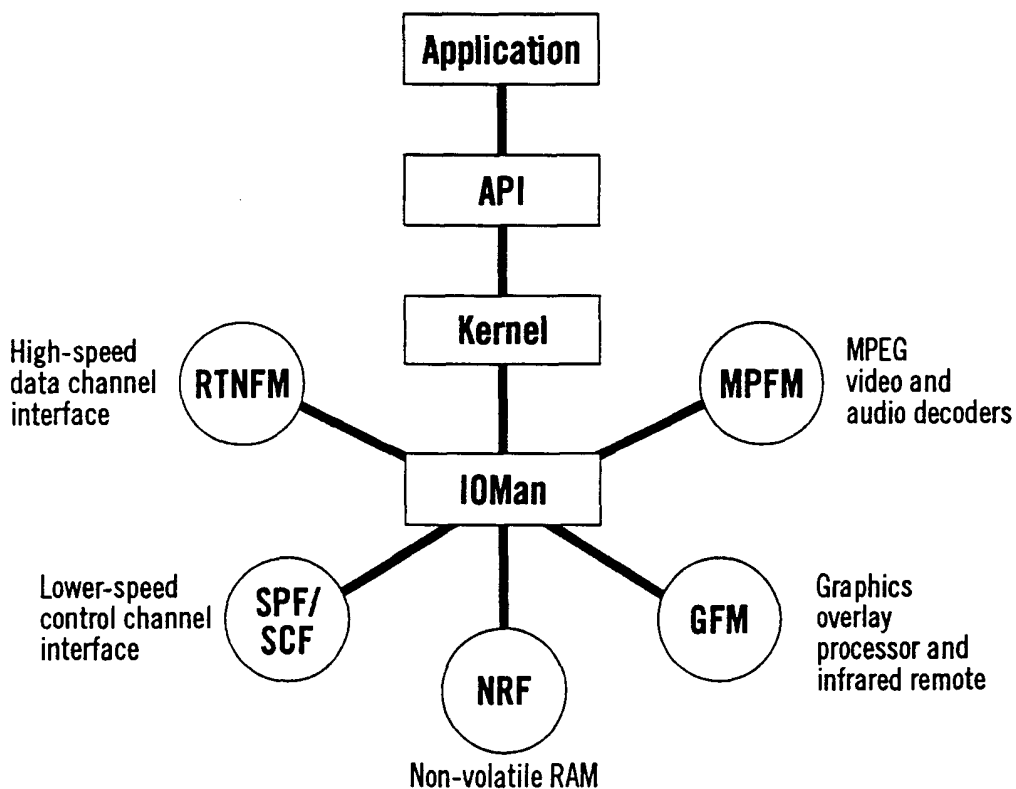
## OS-9 Real-Time Operating System

The most important software running in the set-top decoder is the operating system and environment management software. This provides the baseline for all additional application software developed for the system, regardless of the platform or configuration chosen.

Because of the high volume of data and the absolute precision with which it must be handled, a multitasking, real-time operating system, such as OS-9 or OS-9000, is a necessity. Traditional operating systems—such as those found in Macs, PCs and engineering workstations—cannot adequately provide the necessary functionality.

The operating system must provide I/O management software for the data and control channels in the network, MPEG video and audio decoders, graphics overlay planes, infrared remote controls and non-volatile RAM. Also, a high-level API must be available to provide an additional level of hardware abstraction from applications developed for the system.

A typical set-top box would have the following I/O configuration:



### **Real-Time Network File Manager (RTNFM)**

The Real-Time Network File Manager, or RTNFM, is responsible for handling real-time data streams received from a wide area network, such as over T1 line with ADSL (Asynchronous Digital Subscriber Line) technology. Anticipated data rates vary from 1.5Mbits/sec. to 45 Mbits/sec. The actual functions of RTNFM vary based on the hardware interfaces that it controls. Only a small portion of the RTNFM driver even knows the speed or format of the data that it processes. Future extensions will allow the sending of real-time data streams to support video conferencing applications.

### **Sequential Packet File Manager (SPF) and Sequential Character File Manager (SCF)**

SPF and SCF are responsible for handling the lower speed control channel communications. In addition, they are used for other optional serial devices or I/O ports in the system. Plug-in software modules allow the drivers to handle different protocols, such as X.25.

### **Motion Picture File Manager (MPFM)**

The Motion Picture File Manager is responsible for managing the MPEG video and audio decoders in the system. Current implementations allow an application to play MPEG-1 data at normal speed, slow motion, step frame, fast forward or fast reverse. In addition, the application has complete control over the size and position of the video window in the display.

As MPEG-2 chips become available, MPFM will also support them. In many implementations, MPFM drivers actually interface with additional digital signal processors (DSPs) in front of the decoders which provide a layer of stream demultiplexing services. In the absence of these DSPs, the drivers handle all stream demultiplexing functions.

### **Graphics File Manager (GFM)**

The Graphics File Manager is responsible for controlling the graphics overlay and infrared remote control. GFM provides functions for displaying images, drawing shapes, writing text and controlling a graphics cursor. If the graphics chip contains drawing functions, GFM drivers use them. If not, it implements a very robust set in software.

### **Non-Volatile RAM File Manager (NRF)**

Many set-top decoders will contain a small amount of non-volatile storage used to store PIN or serial numbers, as well as possibly store updates to the operating system held in ROM. This non-volatile RAM is managed by NRF.



## **Real-Time Audio/Video Environment (RAVE)**

RAVE is a high-level graphical user interface toolset for use with GFM. It handles menus, controls, hot spots and other multimedia objects.

## **Player Shell**

The Player Shell is the initial process to be executed on the DAVID System. It is specific to each decoder manufacturer, and performs system diagnostics and basic communication with the interactive network gateways.

All of the above software modules are available for OS-9 (for Motorola 68XXX and PowerPC systems) and OS-9000 (for 386/486 systems). These modules are all components of the DAVID Installation Package, which contains all the software modules necessary for the prototype development and production of a low-cost, highly-functional set-top decoder. It also includes support for a wide variety of off-the-shelf MPEG, graphics and communications hardware.

## Microware's IDTV Software Packages

### DAVID Installation Package

As previously stated, the DAVID Installation Package is a complete software solution for companies wanting to develop a cost-efficient, highly-functional set-top decoder device.

DAVID's modular operating system software architecture is fully ROMable, or can be quickly and efficiently downloaded over copper, fiber or coaxial cable to a targeted subscriber's decoder.

### DAVID Pak Contents

- Real-Time Operating System: OS-9 or OS-9000 kernel, Syscache, Init and Sysgo
- Real-Time Audio/Visual Environment (RAVE): RAVE run-time modules, and Presentation Support Library
- Motion Picture File Manager (MPFM) with sample drivers and descriptors
- Sequential Packet File Manager (SPF) and Sequential Character File Manager (SCF) with sample drivers and descriptors
- Real-Time Network File Manager (RTNFM) with sample T1 driver and descriptor
- Graphics File Manager (GFM) with sample pointer driver and descriptors
- Pipe File Manager (PEMAN) with sample drivers and descriptors
- Non-Volatile RAM File Manager (NRF) with sample drivers and descriptors
- DAVID File Manager C-bindings
- Sample Player Shell
- Installation and User's Manuals
- One-Year Hotline Support and Updates

NOTE: All file managers are supplied in object code form. All sample drivers and descriptors are supplied in source code form.

## **DAVID Development Environment**

For more information on the DAVID Development Environment, including the following, please contact Microware:

- The DAVID Server Pak — for converting OS-9/VMEbus systems into video servers for the transmission of MPEG-encoded applications
- DAVID Application Development Tools — including FasTrak and other authoring tools
- DAVID System-configured set-top decoders

## For More Information

For additional information regarding other Microware products mentioned in this white paper, refer to the following publications:

- OS-9 Product Overview (POV68NA68SL)
- OS-9000 Product Overview (POV9KNA9KSL)
- FasTrak Brochure (FASNANANASL)
- Motion Picture File Manager Data Sheet (MPFNANANADS)

To order these publications or for more information, contact Microware or your authorized Microware representative. To contact Microware offices, see the inside back cover of this white paper.

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Eric Miller is Microware's director of multimedia and the co-author of *Discovering CD-I*.

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