

Solaris LIVE!: Building a Framework for Distributed Multimedia

While Solaris LIVE! provides a powerful set of APIs for multimedia application development today, emerging standards from the IMA and OMG, as well as industry alliances such as the Common Open Software Environment are helping define and address broad industry requirements for multimedia. To facilitate the availability of next-generation interoperable multimedia applications, SunSoft has defined a framework for distributed, collaborative multimedia services known as the Solaris LIVE! Framework. Figure 3.6 illustrates Solaris LIVE! today and the Solaris LIVE! Framework that will be available in the near future.

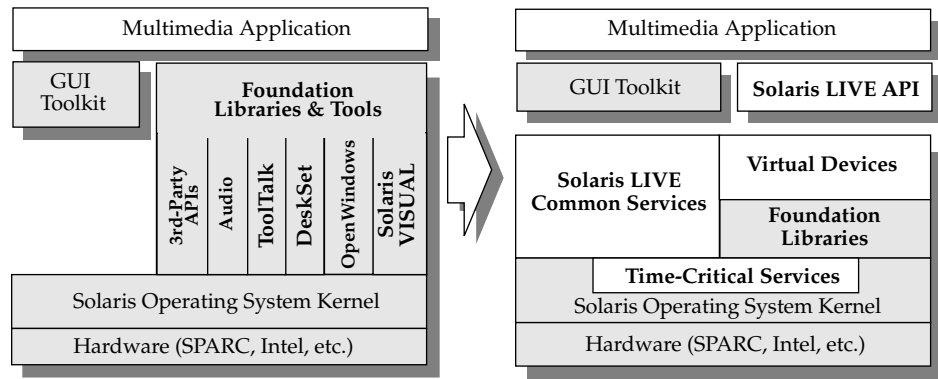


Figure 3.6 Solaris LIVE!: Today and in the Future

Future versions of Solaris LIVE! heavily leverage the API capabilities already present in Solaris, while extending it to support key needs of future distributed multimedia. The enhancements are largely associated with providing greater integration of tools, time-critical control capabilities, uniform and extensible API features, distributed object management facilities, IMA recommended practices support, and a flexible framework for portable, interoperable multimedia applications.

Given the large range of physical input and output devices available, SunSoft is working with Third-Party vendors to focus on this key area. SunSoft has recently announced an agreement with Matsushita Electric Industrial, a leading consumer electronics manufacturer, to co-develop device control software services to be incorporated into a future version of Solaris LIVE!.

Vendors currently providing device control support include EnerAnalytics (VISCA Protocol). EnerAnalytics markets the MediaEA Device Control Server which uses the X11 client-server model to allow applications to interact with external audio and video media devices. Endusers can control such functions as media positioning, record and playback and other features. Developers may integrate MediaEA client functionality into their multimedia applications using the facilities of the MediaEA toolkit.

Speech Technologies

In conjunction with the audio capabilities built into Solaris LIVE, it is sometimes desirable to add speech technology to multimedia applications. This might take several forms ranging from speech recognition within applications (to perform commands), to text-to-speech conversion of textual data.

The Americans with Disabilities Act (ADA) of 1992 also places requirements on many companies to facilitate access to the handicapped. Technologies such as speech recognition and text-to-speech are key elements in providing for reasonable accommodation of the handicapped in today's workplace.

As processing power on the desktop continues to increase, it is clear that speech capabilities will become a standard part of the computing environment. Numerous vendors provide speech technology under Solaris today, including Command Corporation, and Centigram. In many cases, these products require no additional hardware, and can be integrated easily into multimedia applications.

SunSoft has recently entered into an agreement with Toshiba, a leading computer equipment vendor, to co-develop text-to-speech technology to be incorporated into a future version of Solaris LIVE!.

various audio formats as well as to add file headers to raw audio files. File headers can be used by applications to identify characteristics of the audio file prior to playing, such as the format, sampling rate, compression type and whether the file is stereo or mono. Because *audioconvert* can convert from one audio format to another, a broad range of audio files can be accessed from Solaris. *Audioconvert* will translate file formats between the following:

- CCITT G.711 μ -law encoding (8-bit format used for telephony in the USA)
- CCITT G.711 A-law encoding (8-bit format used for telephony in Europe)
- Linear PCM encoding (8, 16, 24 and 32-bit format used for DAT and CD)
- CCITT G.721 compressed encoding (using ADPCM with 4-bit precision)

The audio driver under Solaris is implemented as a UNIX STREAMS device, and is optimized to manage continuous throughput. Developers can replace the Solaris UNIX `/dev/audio` device file if they are implementing their own audio hardware. Generally this requires STREAMS device knowledge and some experience producing device drivers.

External Device Control in Solaris

Device control is an often overlooked, but extremely important aspect of multimedia technology. As new types of media information are integrated into distributed computing environments, the variety of display and recording devices handling the media will grow. Examples of devices which require control from multimedia applications include:

- Video devices (VCR, laserdisk, camera, scanners, TV tuner, etc.)
- Motion/position control (camera, microphone, infrared pointer, etc.)
- Workstation input devices (touchscreen, joystick, trackball, etc.)

Device control can be an important feature of multimedia applications in a variety of ways. For example, interactive simulation of a walkthrough of a home (for real estate) might require a joystick. Touchscreen use on an interactive information kiosk would be desirable. And automatic control of a VCR or laserdisk is required for video editing and interactive training. Particularly importantly, remote control of audio/visual devices are necessary for camera positioning, panning and focusing.

The Solaris XIL imaging library provides important capabilities for applications which manipulate images and image sequences. The XIL interface allows the developer to manipulate and display a variety of image types including:

- JPEG
- SunSoft Cell
- CCITT Group 3 FAX
- CCITT Group 4 FAX
- Raw Raster (rectangular bitmap)
- Sun Raster

These formats represent some of the most popular image data representations in use by multimedia applications today. For example, JPEG is a standard defined by the Joint Photographic Experts Group for individual image representation. JPEG is frequently used for both individual images and image sequences, and a number of hardware compression/decompression products are available which are optimized for JPEG. The Cell format is an efficient, highly-compressible, multi-image format developed by Sunsoft. CCITT Group 3 and Group 4 FAX standards focus on facsimile compression standards used by fax machines. Raw raster is an X Windows bitmap representation standard and Sun Raster is the Sun Microsystems common raster file format.

Audio

Audio facilities under Solaris are provided by programmatic access to the `/dev/audio` device. Developers can read or write to the UNIX `/dev/audio` device easily from any application. Additional tools such as *audioplay*, *audiorecord* and *audioconvert* assist developers and users in playing, recording, and converting audio files.

The `/dev/audio` device plays and records a single channel of sound using available built-in or optional sound controller hardware. Typically the digital audio is sampled at a rate of 8000 samples per second with 12-bit precision, though the data is compressed using μ -law encoding to 8-bit samples. The resulting audio quality is equivalent to that of standard telephone devices.

Audio formats supported under Solaris LIVE! include 16-bit Pulse Code Modulation (PCM) Linear Audio and the 8-bit μ -law CCITT G.711 mono audio standard. The *audioconvert* program provides the capability to convert between

The *Solaris VISUAL* environment consists of a set of Foundation Graphics APIs: XIL, XGL, PostScript, and X. This environment provides a flexible and feature-rich graphics platform for a broad range of applications.

XGL is a geometry graphics API providing a rich set of 2-D and 3-D primitives and data types. XGL is a foundation API supporting simulation and animation applications as well as other APIs. XIL contains a set of key functions from the fields of image processing and digital video, which address applications and APIs for the imaging, video and related markets. PostScript provides de facto standard PostScript Level 2 rendering within OpenWindows, and X is the industry standard 2-D protocol common to all X Windows environments. Each of these four foundation APIs meet the key requirements of graphics-oriented applications and layered third-party APIs such as PHIGS, GKS, HOOPS, GL, OpenGL, XIE, PIKS and many others.

Key features of Solaris 2.x include support for shared libraries and dynamic linking and loading which enables low-level foundation interfaces such as XGL and XIL to dynamically load device handlers associated with underlying display hardware. In this way, devices such as framebuffers, video boards and geometry accelerators can easily be incorporated with Solaris-based Intel x86 and SPARC platforms. The flexibility to link dynamically to devices is leveraged through the XGL and XIL libraries' support for a stable device porting interface which greatly simplifies the development and delivery of third-party display hardware on Solaris-based systems. Figure 3.5 illustrates the Solaris VISUAL Graphics Environment.

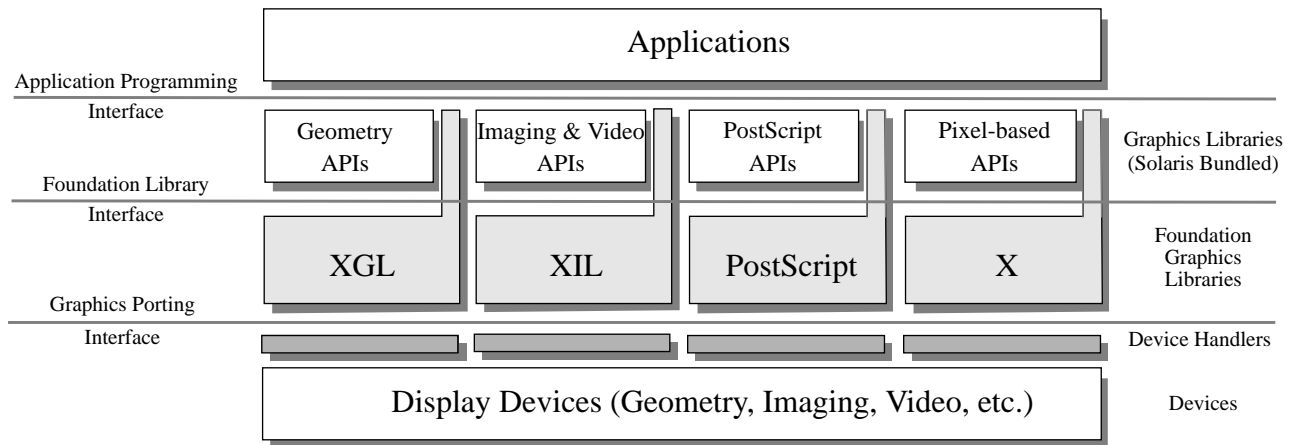


Figure 3.5 Solaris VISUAL Foundation APIs

Media Object	Application Area	Solaris LIVE API
Geometry Rendering	Animation	XGL, PEXlib
Pixel-based Rendering	Windowing, Business Graphics	Xlib
Stencil/Paint Rendering	Prepress, Graphic Arts	Display PostScript
Images	Publishing, Image Display	XIL
Video	Conferencing, Video Clips	XIL
Audio	Conferencing, Audio Clips	Solaris Audio
Device Control	Local and Remote Control of VCRs, Cameras, etc.	Third-Party
Integration	Interapplication Communication	ToolTalk
Text-to-Speech (TTS)	TTS of E-mail, Proofing, etc.	Third-Party
Speech Recognition	Interactive Voice Response, Transcription, etc.	Third-Party

The sections which follow describe the individual Solaris LIVE! components and their APIs.

The Solaris VISUAL Environment

Solaris VISUAL is the most complete set of foundation graphics display tools available today, and together with Solaris OpenWindows addresses application requirements in the key areas of:

- *Imaging*
- *Video Display*
- *Geometry*
- *PostScript Imaging*

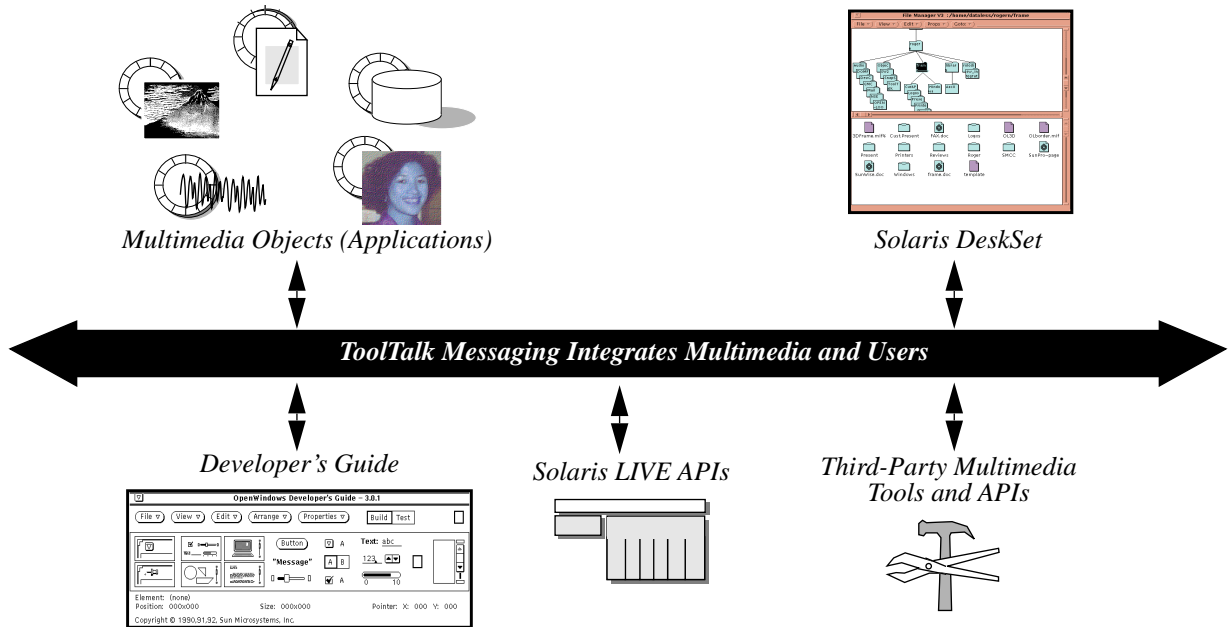


Figure 3.4 ToolTalk Interapplication Messaging Facility Applied to Multimedia

Media Objects

Within the Solaris LIVE! environment, the individual Solaris LIVE! APIs can be thought of as providing convenient access to multimedia *objects*. Each of the Solaris LIVE! APIs provides an object-based interface to applications which use them. As the Solaris LIVE! framework becomes available, these APIs will be more tightly integrated to provide greater uniform access and interoperability of their interfaces and the applications which use them.

The Solaris LIVE! environment provides for media objects to service the needs of a diverse range of multimedia applications, including those listed below.

ToolTalk

The ToolTalk Messaging Service is the enabling technology that allows developers to deliver interoperable applications. ToolTalk provides network-transparent communication between applications regardless of their location, and without requiring prior knowledge of applications which are called.

ToolTalk applications interoperate by sending and receiving messages. Applications can leverage functionality by requesting processing from other applications or by notifying other applications of events, thereby coordinating actions and data.

Developers first decide what types of messages their applications need to receive; then they register their requirements with the ToolTalk service which acts as a go-between, and delivers the messages to those specific applications. The set of messages exchanged defines a protocol to be used by the interoperating applications.

ToolTalk supports many messaging styles. A sender can address a ToolTalk message to a particular process or to an individual object, subject to the application developer or user's wishes.

Multimedia applications interact with ToolTalk by calling functions defined in its application program interface (API). The API gives ToolTalk the appearance of a simple library, hiding the details of its implementation as both a library and a collection of communicating processes running on multiple computers throughout the network.

ToolTalk is openly licensed by SunSoft and is available for a range of UNIX-based workstations. ToolTalk is available to run on over 75% of UNIX workstations shipping today, including Solaris (SPARC/x86), HP, IBM, Digital, Cray, NCR, Intergraph, and Silicon Graphics systems. Furthermore, ToolTalk was selected by HP, IBM, SunSoft, SCO, Univel and USL as the inter-application communication technology to support their common desktop environment. This level of support makes ToolTalk the compelling choice for messaging platforms supporting multimedia applications.

ToolTalk is also used to integrate SunSoft's OpenWindows DeskSet applications. It has been endorsed by over 50 independent software vendors (ISVs) in areas ranging from business applications and CAD to desktop publishing and multimedia. Figure 3.4 illustrates the ToolTalk Service.

The ToolTalk Media Exchange Message Set can be used for a range of purposes ranging from adding multimedia extensions to existing applications to extending simple cut and paste facilities to include complex media types.

Applications can be extended to call other unrelated ones which provide additional facilities. For example, a simple text-based calendar system can be extended to accept audio data for the generation of automatic reminders to be played at definable times. Another application, such as an on-line documentation tool, can easily be extended to play video clips whenever the user makes specific selections.

Figure 3.3 illustrates an example of a multimedia application using ToolTalk. In this example, a user wishes to display video on their workstation screen from a source (not shown) on the network. The user invokes the video application, which broadcasts a request for a decompression service application able to manage the particular format of the data to be displayed. On another system elsewhere on the network, a decompression services application responds to the ToolTalk request, decompresses the video data and passes it to the video display application on the users workstation. The decompression application employs the facilities of XIL for video compression, and the video display application employs Solaris LIVE! XIL for display and Solaris Audio for audio I/O.

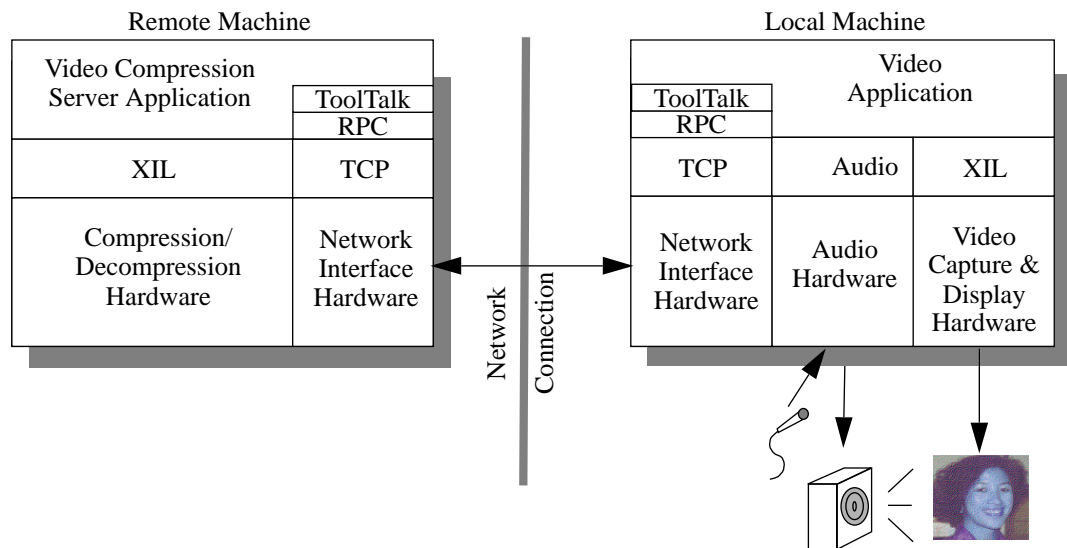


Figure 3.3 Collaborative Multimedia Application Using ToolTalk

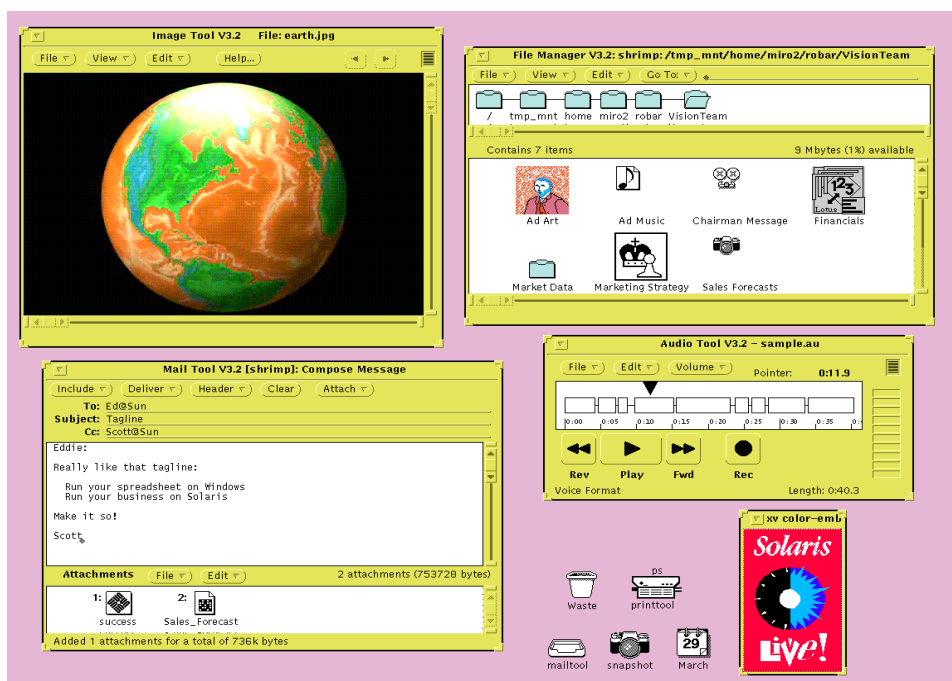


Figure 3.2 Solaris OpenWindows DeskSet Tools

The ToolTalk Media Exchange Message Set

No single vendor today provides a completely integrated solution to the needs of multimedia users. The multimedia marketplace is still emerging, and the importance of providing integration between disparate multimedia applications is growing. The *ToolTalk Media Exchange Message Set* is a genuine breakthrough in multimedia technology - providing a powerful messaging protocol designed to benefit both developers and users.

Using the ToolTalk Media Exchange Message Set, applications can easily share multimedia functionality with one another. Through the ToolTalk Media Exchange Message Set, applications can communicate with each other in a transparent manner, regardless of data formats, compression technology and other technical issues which have previously confined the use of multimedia to individual applications and users.

Other *imagetool* formats include: Atari Compressed, Uncompressed Spectrum, and Degas 1 & 3, AutoCAD Slide format, GEM, GIF, IFF ILBM, MGR, MTV/PRT Ray-Tracer, PC Paintbrush, CMU Window Manager, Benet Yee Face Slide, FITS, Gould Scanner, HIPS, HP PaintJet, TrueVision Targa, XPM, X Bitmap and many others.

Other DeskSet tools provide additional capabilities for the multimedia user. Among them are:

- The File Manager
A graphical file management program for display and manipulation of files and directories
- The Calendar Manager
A collaborative, network-based appointment and resource scheduling tool
- The Print Tool
A graphical tool for managing network-based printing, including support for format filters
- The Snapshot Application
A screen image capture tool
- Audioplay and Audioconvert
Tools for the play and conversion of audio files

The OpenWindows DeskSet tools ship standard with OpenWindows on every Solaris-based system. Individual tools may be called directly by the user from the desktop window system menu, invoked via command line, or executed via the ToolTalk messaging service. Additional tools for manipulating video, fax, and more advanced compound multimedia mail documents are available from third-party developers.

Figure 3.2 illustrates some of the Solaris OpenWindows DeskSet tools.

The OpenWindows DeskSet

The OpenWindows DeskSet is a set of 15 integrated applications which provide ease-of-use features to Solaris and OpenWindows. The DeskSet tools interact through a “drag-and-drop” metaphor and utilize ToolTalk messaging for communication.

Of particular interest to users is the *Multimedia Mailtool* which presents a simple yet powerful interface to users of electronic mail. The Multimedia Mailtool provides multimedia capabilities through the use of “attachments” wherein application data may be *attached* to a text-based electronic mail and sent between users on a network. This data may be of virtually any form, ranging from text and images to Display PostScript, audio or video clips.

SunSoft is tracking standards definition of the Multipurpose Mail Internet Extensions (MIME) currently defined as a draft Internet standard (RFC-1341). MIME addresses some of the complex issues associated with providing a standard format for multiple data types attached to text-based Email messages. Over time, MIME, and other standards, will result in completely interoperable electronic mail exchange which includes multimedia information.

The *Audiotool* provides a user interface to the audio device, and permits the recording or playback of audio through a Solaris-based system’s audio hardware. The audiotool can further deliver its audio data stream to other applications even over the network through the ToolTalk facility. Audio formats supported through the Solaris audio facility are described in more detail in the Audio section of this chapter.

The *Imagetool* is a image manipulation tool which allows users to manipulate the format of stored image files, as well as share data with other applications via ToolTalk. The *imagetool* allows the user to perform simple imaging manipulation such as pan, flip, rotate and zoom. *Imagetool* allows the user to convert between a variety of image data types including:

- Encapsulated PostScript and PostScript
- JFIF (JPEG File Interchange Format)
- Portable Bit Map (PBM)
- Apple MacPaint
- PGM
- TIFF
- PICT

Solaris LIVE! Components

Today's Solaris LIVE! multimedia environment provides core features for a broad range of multimedia applications. The APIs and interfaces used by Solaris LIVE! multimedia applications include:

- OpenWindows DeskSet Tools
- ToolTalk's Media Exchange Message Set
- Audio Facilities
- Solaris VISUAL Graphics APIs
- Third-Party APIs and Tools (Text-to-Speech, Speech Recognition, etc.)

The sections which follow describe Solaris LIVE! today. Figure 3.1 illustrates some of these applications, tools and APIs. Multimedia applications running under Solaris can share data and execution using the ToolTalk messaging facility. These applications in turn employ Solaris VISUAL, Audio, and Third-Party APIs.

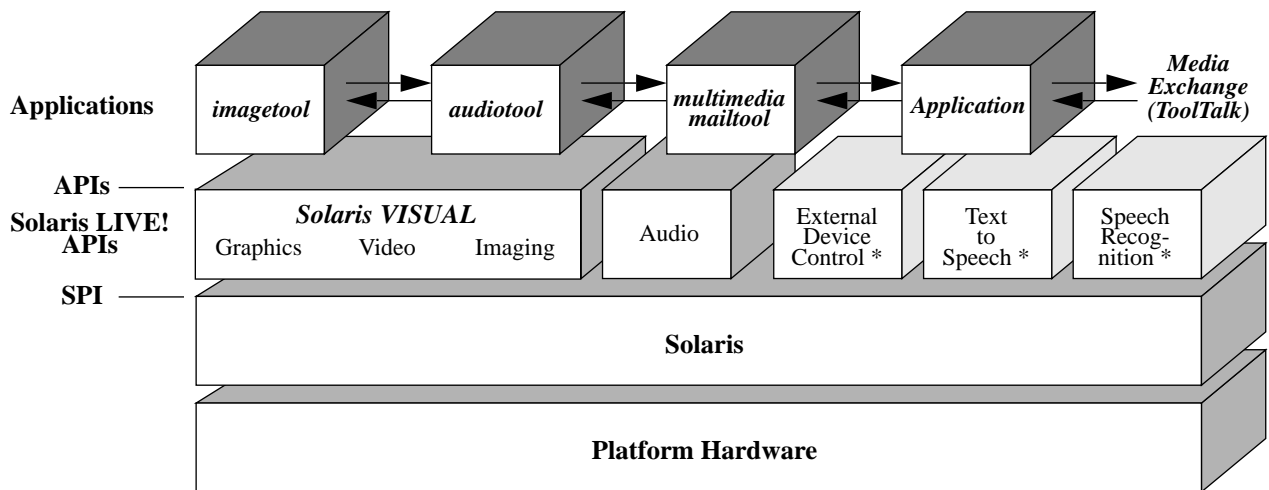


Figure 3.1 Solaris LIVE! Today

* Third-Party Products

Solaris and Multimedia

The Solaris LIVE! environment today provides integration of multimedia applications using SunSoft's Solaris VISUAL graphics interfaces, Solaris OpenWindows and OpenWindows DeskSet applications, Solaris audio capabilities and a variety of third-party products providing device control, text-to-speech and other technologies. Each of the foundation graphics library APIs, DeskSet applications, and third-party APIs can be used within an application, and applications may share data and execution capabilities through the ToolTalk-based Media Exchange Messaging Set.

A key goal of SunSoft's multimedia plan is to insure that multimedia applications developed today can run with minimal change under the Solaris LIVE! Framework in the future. Existing APIs for graphics (geometry and imaging), video, audio, and application messaging will all be supported in the future. Those applications wishing to take advantage of additional features of the multimedia framework can do so through application porting using available migration tools.