2

image-based rendering. Solaris VISUAL also provides support for video display including efficient, high-performance software compression and decompression.

- Time-Critical Support
  To provide for the time sensitive requirements of multimedia, Solaris includes multiprocessing, multi-threading and multi-tasking capabilities. These facilities enable applications to effectively process data through priority-driven mechanisms. Mission critical applications require the guaranteed delivery of data which these technologies make possible.
- Distributed Processing
  Solaris employs a client-server computing model which facilitates the distribution of applications and data across the network. This permits multimedia services to be provided in a fashion which best supports the organizational structure and resources of the enterprise computing infrastructure.

Solaris LIVE! incorporates the foundations needed to deliver distributed multimedia through the technologies of Solaris VISUAL, ONC+, OpenWindows, and Solaris audio. And in the future, Solaris LIVE! will work in the object-oriented environment being charted by Project DOE. Figure 2.5 illustrates the integration of multimedia objects.

Application developers using these Solaris components today can be confident that they are building on a robust and stable platform. And with object-based multimedia, applications will ultimately share data in a completely interoperable way, permitting the use of multimedia across the entire enterprise regardless of its size or boundaries.

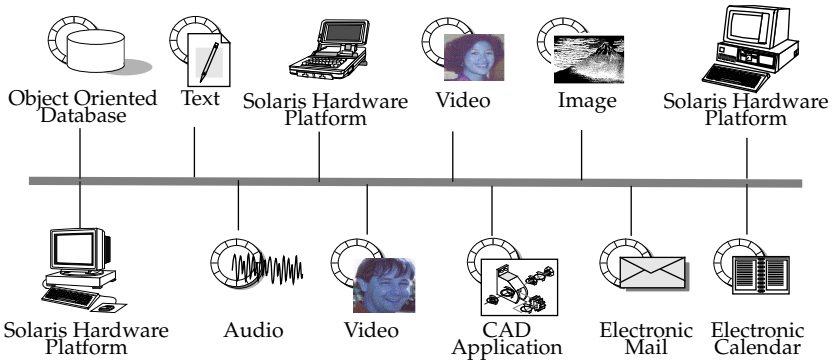

Figure 2.5 Object-based Multimedia Will Provide Interoperability Across Platforms

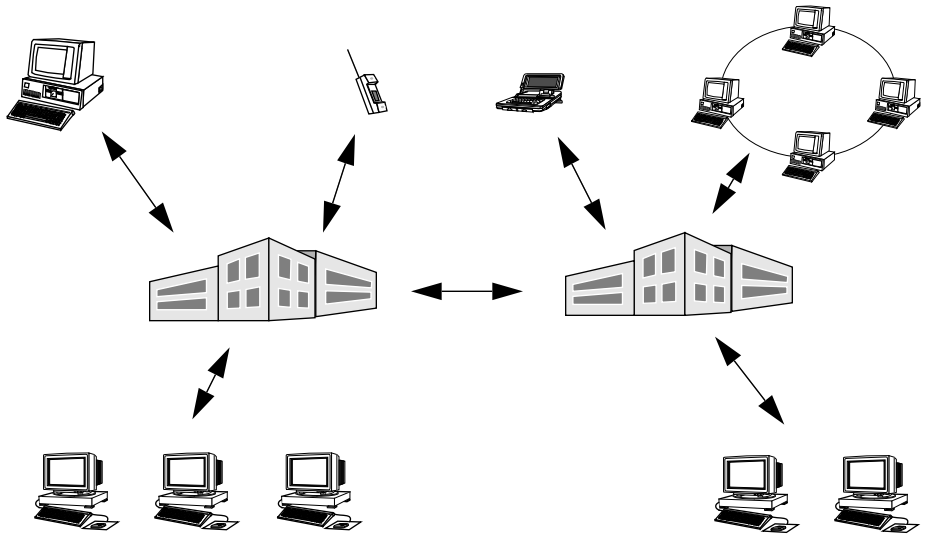

Figure 2.4 Collaborative Multimedia Spans the Entire Computing Enterprise

Solaris LIVE!

Solaris LIVE! builds upon the foundation of the Solaris operating system, to provide the interfaces and services necessary to support today's demanding multimedia applications.

To provide such an environment for users, and the necessary development tools for application developers, SunSoft is focusing on the following areas:

- Inter-application Integration
  Solaris includes inter-application integration capabilities through the de facto standard Open Network Computing (ONC+) interfaces. Transport-independent remote procedure calls and the ToolTalk messaging facility provide the basis for this integration.
- Presentation
  The OpenWindows environment provides the X Window standard—a compliant distributed windowing environment for portable multimedia applications. In addition, Solaris VISUAL, SunSoft's graphics environment, includes the base level technologies for both geometry and

Multimedia in a collaborative computing environment requires that communication bandwidth between systems support the associated audio and video data rates, as well as effectively manage application and data access across the network.

With the significant demands for storage, compression processing, graphics for image presentation and support for distributed multi-user environments, only a robust and flexible client-server computing model will suffice. Solaris provides a powerful platform for the requirements of multimedia today. The additional capabilities of DOE will provide the foundation for distributed object-based multimedia in the future.

SunSoft's Vision of Multimedia

Realizing heterogeneous, collaborative multimedia is the essence of SunSoft's commitment to multimedia as reflected in the Solaris LIVE! platform framework. Solaris LIVE! incorporates the capabilities necessary to deliver distributed, mission-critical, industrial-strength multimedia.

In providing a true distributed multimedia environment, Solaris empowers companies and individuals to maximize the efficiency of sharing and interpreting information. Plus, in the near future, developers will be able to easily construct multimedia objects according to organizational structure of the specific requirements for information flow. Users will more easily combine multiple media types together, as well as craft new user tools to meet their immediate presentation or information needs.

Ultimately, users will span all possible individuals, and be represented by virtually limitless characteristics ranging from their job function and computer environment (mainframe, mini, PC, workstation, mobile) to their current type of computing (LAN, WAN, cellular, etc.). Figure 2.4 illustrates collaborative multimedia.

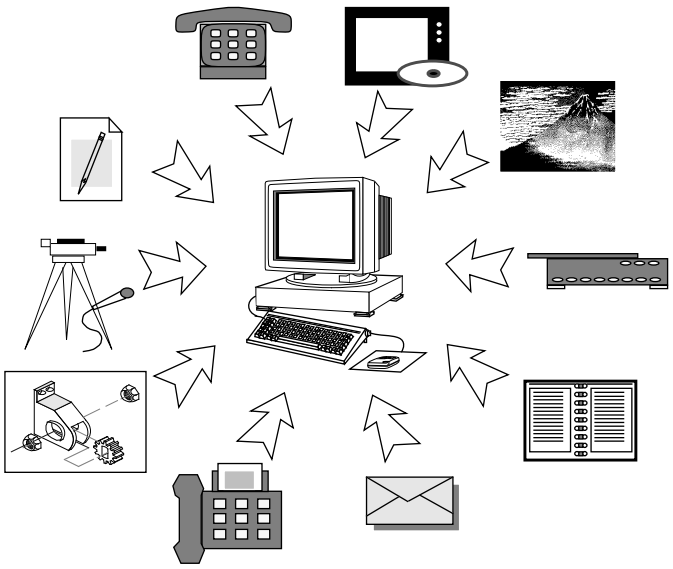

Figure 2.3 Integrated Media includes All Forms of Information

The Demands of Multimedia

Multimedia places significant demands on the computing environment both in terms of processing and data storage. For example, a 640x480 video frame displaying 24 bit data occupies approximately one megabyte of uncompressed storage. A 20 second video clip would occupy more than 450 megabytes of uncompressed storage. Like video, audio data can also place substantial storage demands on multimedia systems, demanding up to ten megabytes for an uncompressed 20 second audio segment.

Compression technology, either in hardware or software, provides the needed capabilities to reduce data storage requirements by as much as 80% - but storage and data rates for audio and video data are still extremely demanding. The communication rates for audio and video data are equally impressive, with each requiring rates of 1 to 1.5 megabits per second.

Providing acceptable audio and video quality is another important consideration. Multimedia systems must be able to manage continuous data streams for audio and video as well as insure correct synchronization between them. This places considerable demands on the operating system, requiring priority-based real-time control of media streams.

The Need for Interoperability

Several key elements are lacking in today's multimedia product offerings. For example, the capability to support heterogeneous systems, varying in processor architecture, operating system, network protocol, graphical user interface and multimedia data formats is critical. Network-based peer-to-peer communication is also extremely important. Given the range of technologies available today, standards are the only viable solution.

SunSoft sees the cooperative work within the *Interactive Multimedia Association* (IMA) and other standards organizations as the critical linchpin required to facilitate true heterogeneous multimedia. Only through the cooperative development of standards will vendors be able to deliver on the promise of low-cost collaborative multimedia, interoperable across a networked heterogeneous environment.

Application developers are equally dependent upon standards. To address a broad range of platforms without major rearchitecture, porting and maintenance efforts, developers need standard application program interfaces (APIs) and data formats to maximize portability.

Standards will be a critical factor in the growth and acceptance of multimedia technology. The market to date has been limited principally by the lack of coherent standards in data formats and interfaces for application execution and communication. While realistic widespread acceptance of multimedia standards is currently lacking, vendors continue to develop and promote their interfaces as standards themselves, thus creating competing alternatives for developers.

Only defined, widely accepted standards will resolve the confusion that exists in the market today. Through common standards in data formats and application program interfaces, developers will be freed to build multiple platform authoring tools and enduser applications. Stable, compatible interfaces and interoperable applications will in turn lead to better multimedia solutions, lower cost products and widespread usage. Figure 2.3 illustrates the variety of multimedia data types made possible by standards and integration.

SunSoft is deeply committed to standards and their effective definition to meet the needs of developers and the multimedia market. Through its association in organizations such as the Interactive Multimedia Association, the Object Management Group (OMG) and other groups, SunSoft is defining its development direction to keep pace with emerging standards in multimedia.

Often, enterprise multimedia applications add to the clarity of information presented or increase accessability to information not previously computer-based.

Examples of enterprise multimedia include an insurance company, which employs multimedia technology to store and share information such as video clips, pictures, scanned images, voice annotation, and even animation.

Another example might be a medical services provider, which selects to maintain all patient records, billing, and medical data (X-ray, CAT Scan, and other test results) on-line, and available to collaborating physicians in different locations. Images of patient data, together with audio annotation and other multimedia information could be shared via wide-area networks with other medical staff and specialists.

SunSoft's multimedia platform is designed to facilitate multimedia for a broad range of users, whether they are individuals using personal multimedia or corporations employing multimedia technology across the enterprise. SunSoft's Solaris LIVE! multimedia platform provides the base level needs of multimedia applications as well as an effective paradigm for workgroup and enterprise interaction using a distributed client-server model. Figure 2.2 illustrates the difference between personal and enterprise multimedia.

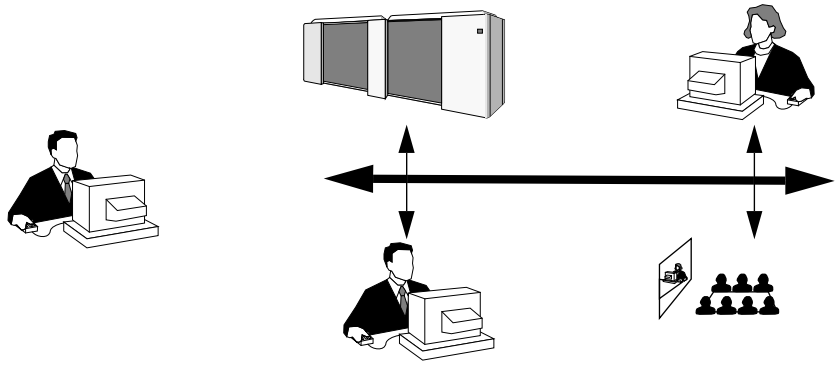

Figure 2.2 Personal Multimedia vs. Enterprise Multimedia

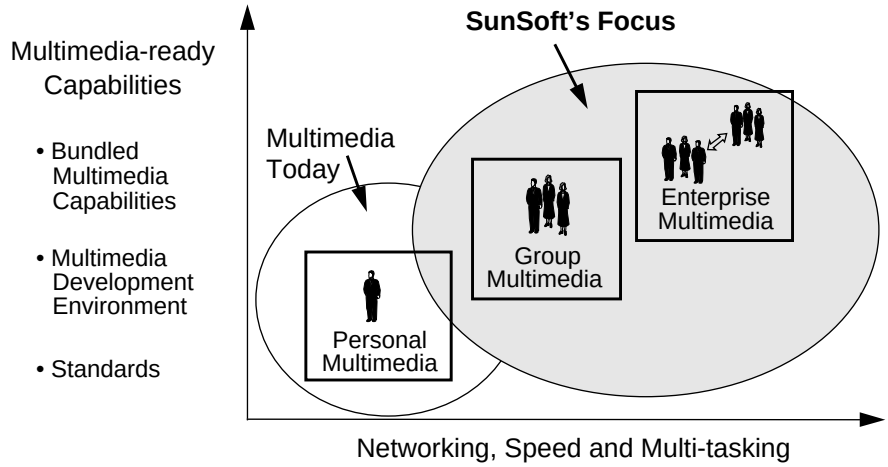

Figure 2.1 Types of Multimedia

To better understand the distinction between today's stand-alone systems and what Solaris LIVE! offers, multimedia may be categorized in one of several forms: *Personal, Group and Enterprise* multimedia.

Personal multimedia, representing the bulk of PC-based multimedia today is characterized by individual tools and applications which run on a single system and provide multimedia services to a single user. Interaction between users through the sharing of data is possible, but is not generally the principal goal of personal multimedia.

Personal multimedia includes applications such as consumer product review, on-line help facilities, "on the job training", and educational reference materials (such as hypermedia encyclopedias).

Group multimedia provides integrated multimedia for collaboration in a workgroup. Typically the group is localized and employs multimedia to facilitate interaction and the sharing of information related to work flow.

Examples of group multimedia include shared whiteboards, video conferencing, multimedia electronic mail and training.

Enterprise multimedia reflects a major commitment by a company to base "mission-critical" aspects of its business on multimedia technology, thus giving it a competitive strategic advantage.

- Advanced Compression Technology
  Recent advances in compression technology, particularly software-only algorithms, for audio, video and image data is enabling multimedia applications to become more common on lower-cost desktop systems.
- Declining Costs for Magnetic Storage Devices
  Like optical media, magnetic storage devices such as hard disks have declined substantially in the last few years. Their lower cost is important to the overall system cost of desktop multimedia systems which need on-line server storage for increasingly sophisticated and powerful applications, data, and window systems.
- CD-ROM and Other Optical Media
  Multimedia is extremely data storage intensive. Audio, video and hypertext data have substantial storage requirements which are facilitated by CD-ROM and other optical media (e.g. WORM, Laserdisk, etc.).

Multimedia on the Personal Computer

The increased availability of multimedia products has, until recently, been limited to single user products such as CD-ROM based encyclopedias, single-user video and sound boards, video editing and presentation applications. These generally serve the individual rather than focusing on groups of users.

Multimedia on the desktop is generally associated with personal computers, with add-on hardware providing sound or video capabilities. Frequently a CD-ROM is also added to the stand-alone system to provide multimedia applications and data in the form of documents (*titles*). Applications and data are distributed together on the CD-ROM - the data consisting of text, image, video and audio files accessible via the multimedia application.

The limits to the common platform described above relate to the isolation in which the user works, the fixed representation of multimedia information (versus dynamic, user-to-user exchange), and the lack of standards in multimedia data formats and application interoperability. Solaris and Solaris LIVE! are positioned to overcome the limitations of today's stand-alone multimedia systems, bringing powerful collaborative multimedia capabilities to networked users, and heralding a new generation of interactive multimedia applications. Figure 2.1 illustrates the types of multimedia.

Introduction 2

Multimedia Today

Multimedia today is represented by a range of products, both hardware and software, which integrate one or more multimedia data types on moderately-priced desktop computers. Up until a few years ago, the hardware necessary to support even limited multimedia was prohibitively expensive. Several key factors have led to increased growth in multimedia technology, including:

- High Performance Desktop Systems
  The last few years have seen a hundredfold increase in system processor performance - the resulting power in systems today is required to support the demands of multimedia applications and rich data types.
- Graphical User Interfaces (GUIs)
  Graphical user interfaces, in the form of window systems, have become the predominant environment in desktop computing today. Window systems are an essential requirement for the integration and use of multimedia.
- Developer Tools
  Developer tools are a key consideration driving multimedia application development. The availability of developer tools eases the development process by providing a stable environment and framework for multimedia applications.
- Improved Communications Bandwidth
  In recent years, network bandwidth between computers has improved substantially. Greater bandwidth is critical for the management and exchange of large volumes of multimedia data.