

Chapter 4 Standards, Interfaces, and Hardware Requirements

Overview and Requirements Documentation Methodology

This chapter of the VES Documentation is provided to prospective proposers to identify hardware requirements, systems requirements that are common to all VES sub-systems, or requirements that involve standards and integration issues. A set of procurement and implementation assumptions are also included to provide a common starting point for all vendor proposals.

The chapter contains five parts:

- 1 VES Standards Requirements
- 2 VES Integration Architecture (VESIA) Requirements
- 3 Other VES System Requirements and Desirable Features
- 4 VES Edge Hardware Requirements
- 5 VES Procurement Timetable and Requirements

4.1 VES Standards Requirements

4.1.1 Goals of Standards Requirements

Learning Technology Standards

Many organizations are talking about learning technology standards and software standards for schools. Their common quest is interoperability. Vendors, academics, government agencies, industry consortia are all collaborating to define ways that will enable learning technology products to inter-operate. When this happens, learners everywhere can expect to benefit.

VES is positioned at the threshold of the convergence of these new and emerging standards. The VES team and its partners can be expected to break new ground in building VES, as an open, standards based environment. The challenge of specifying standards requirements in an environment of dynamically changing and evolving standards, which are sometimes incomplete, is always a challenge. The VES design team hopes to work with vendors and partners who recognize the importance and value of implementing standards in a project with the scope of VES. It is our hope that VES will become a model for open, standards based, distributed object based, learning environments.

Wherever relevant and applicable standards exist, we are anxious to adopt them. In areas where standards do not currently exist, or are in development, we hope to participate in, and advance such efforts.

VES Can Make a Difference

School districts throughout Massachusetts have recognized the potential of the Internet and are rapidly building, or have already built, network infrastructure in order to capitalize on the world of Internet resources. The Commonwealth has provided Massachusetts Community Network (MCN), a statewide network of broadband high-speed Internet connections for town, schools and libraries. Teachers and students throughout Massachusetts are developing the technology competencies, which will enable them to use the technology for teaching and learning in the context of the standards based curriculum.

One of the remaining problems with learning materials on the Internet, more specifically on the World Wide Web, is the "noise level" that must be transcended, before finding things of interest and relevance. Discovery of effective learning materials on the web is a difficult process because there are no inherent structures or sets of widely implemented standards for describing the available instructional content. The sheer volume of indexed pages, and the dynamic churning of pages, limits the utility of full-text search engines for finding quality learning materials.

There have been four main obstacles to widespread utilization of effective online instructional resources and learning environments:

- Lack of incentives and structure for developing and sharing content
- Lack of support for the collaborative and dynamic nature of teaching and learning
- Lack of standards for locating and using instructional resources
- Lack of incentives and structure for developing and sharing content

The standards-based VES architecture will overcome these obstacles to create a learning environment with:

- Support for the collaborative and dynamic nature of teaching and learning in the classroom

- Standards based tools for locating and using interactive platform-independent web resources
- Incentives and a structure for developing and sharing standards-based instructional resources

The goals of requiring vendors to implement standards, and to assure vendor commitment to standards, are to build a VES with the following enhanced capabilities:

- Interoperability
- Accessibility
- Reusability
- Discoverability
- Extensibility
- Affordability
- Manageability

In this section we will enumerate a set of standards requirements for VES. We will ask vendors to tell us and show us how they have implemented relevant standards in their products or proposals. We are committed to incorporating relevant standards, wherever we can, into those VES components, which must be developed, modified, or integrated.

4.1.2 VES Components to Standards Map

The following three charts are a valuable cross reference of VES components and the relevant and applicable standards. For the educational subsystems, support subsystems, and administrative subsystems of VES, we have identified, by module, the standards we feel are important for responders to the VES RFR to consider. A number of the standards are also relevant and applicable to the VES Common Application Service Element (CASE) Requirements, which are described in Chapter 3. Where a standard exists or is in development, that we have not enumerated, vendors should not hesitate to add that standard to their proposal.

In subsequent paragraphs of this section, we will describe some of the specific standards and their importance to VES.

Table 4-1: VES Standards Requirements - Educational Subsystems

Subsystem	Module	Applicable Standards
Curriculum Management	State Curriculum Frameworks	
	District Curriculum Guidelines	
Instructional Design	Course	P1484.6 Course Sequencing WG P1484.12 Learning Objects Metadata WG
	Unit	P1484.17 Content Packaging WG P1484.12 Learning Objects Metadata WG
	Lesson	P1484.12 Learning Objects Metadata WG
	Activity	P1484.12 Learning Objects Metadata WG
	Assessment	P1484.12 Learning Objects Metadata WG
Instructional Management	Planner and Journal	iCalendar Real-time Interoperability Protocol (IRIP) (77851 bytes) iCalendar v2.0 Formal Public Identifier (7708 bytes) Internet Calendaring and Scheduling Core Object Specification (iCalendar) (299202 bytes) Calendar Access Protocol (CAP)

	Class Registration	P1484.13 Student Identifiers WG P1484.15 Data Interchange Protocols WG
	Grading and Achievement Tracking	P1484.13 Student Identifiers WG P1484.12 Learning Objects Metadata WG
Student Tools	Assignment Book	ICalendar Real-time Interoperability Protocol (IRIP) (77851 bytes) iCalendar v2.0 Formal Public Identifier (7708 bytes) Internet Calendaring and Scheduling Core Object Specification (iCalendar) (299202 bytes) Calendar Access Protocol (CAP)
	Student Work	P1484.13 Student Identifiers WG P1484.15 Data Interchange Protocols WG
	Portfolio	P1484.13 Student Identifiers WG P1484.15 Data Interchange Protocols WG P1484.20 Competency Definitions (Study Group)

Table 4-2: VES Educational Support Subsystems

Subsystem	Module	Applicable Standards
Productivity Support	Resource Tools	ACAP -- Application Configuration Access Protocol (RFC 2244) Bookmark Reference Dataset Class P1484.17 Content Packaging WG
	Research Tools	P1484.12 Learning Objects Metadata WG
	Reference Tools	P1484.12 Learning Objects Metadata WG P1484.15 Data Interchange Protocols WG
	Desktop Tools	P1484.12 Learning Objects Metadata WG
Technology Support	Classroom Troubleshooting	P1484.1 Architecture and Reference Model WG P1484.2 Learner Model WG P1484.12 Learning Objects Metadata WG P1484.10 CBT Interchange Language WG
	Technology Competency	P1484.20 Competency Definitions (Study Group) P1484.10 CBT Interchange Language WG
	Standards Based Education	P1484.1 Architecture and Reference Model WG P1484.1 Architecture and Reference Model WG P1484.2 Learner Model WG P1484.12 Learning Objects Metadata WG P1484.10 CBT Interchange Language WG P1484.7 Tool/Agent Communication WG
	Network Troubleshooting	Authenticated Firewall Traversal (aft) Distributed Management (disman) G & R for Security Incident Processing (grip) IP Performance Metrics (ippm) Remote Network Monitoring (rmonmib) Secure Network Time Protocol (stime) Zero Configuration Networking (zeroconf)
Instructional Support	Online Courseware	P1484.6 Course Sequencing WG P1484.2 Learner Model WG P1484.17 Content Packaging WG P1484.12 Learning Objects Metadata WG P1484.10 CBT Interchange Language WG
	Tutoring - Mentoring	P1484.6 Course Sequencing WG P1484.2 Learner Model WG P1484.17 Content Packaging WG
	Distance Learning	P1484.6 Course Sequencing WG P1484.2 Learner Model WG P1484.17 Content Packaging WG P1484.12 Learning Objects Metadata WG P1484.10 CBT Interchange Language WG

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Communication and Collaboration Services	Unified Messaging Services	ACAP -- Application Configuration Access Protocol (RFC 2244) Internet Fax (fax) Mail and Directory Management (madman) Message Tracking Protocol (msgtrk) SNMP Version 3 (snmpv3)
	IP Conferencing Services	Application Configuration Access Protocol (acap) IP Telephony (iptel) H.320, H.323, T.120 Conferencing
	Collaboration Services	Authenticated Firewall Traversal (aft) Instant Messaging and Presence Protocol (impp)
	Web Publishing Services	P1484.15 Data Interchange Protocols WG
	Calendar Services	ICalendar Real-time Interoperability Protocol (IRIP) iCalendar v2.0 Formal Public Identifier) Internet Calendaring and Scheduling Core Object Specification (iCalendar) Calendar Access Protocol (CAP)
	Content Cache and Filtering Services	Authenticated Firewall Traversal (aft) Web Replication and Caching (wrec)
	Media and Content Services	P1484.17 Content Packaging WG P1484.12 Learning Objects Metadata WG Audio/Video Transport (avt) NNTP Extensions (nntpext) MBONE Deployment (mboned) Media Gateway Control (megaco) Multicast Source Discovery Protocol (msdp) NNTP Extensions (nntpext) Protocol Independent Multicast (pim) Reliable Multicast Transport (rmt)

Table 4-3: VES Educational Administration Subsystems

Subsystem	Module	Applicable Standards
VES Administration	VES Administration	P1484.13 Student Identifiers WG
	VES Individual Workspace	ACAP -- Application Configuration Access Protocol (RFC 2244) ACAP Message of the Day Class ACAP Email Personalization Class P1484.13 Student Identifiers WG WWW Distributed Authoring and Versioning (webdav) ANSI IISP security model P1484.7 Tool/Agent Communication WG
	VES Workspace Services	P1484.15 Data Interchange Protocols WG Authentication, Authorization and Accounting (aaa) Authenticated Firewall Traversal (aft) Common Authentication Technology (cat) Web Versioning and Configuration Management (deltav) Extensions to FTP (ftptext) Intrusion Detection Exchange Format (idwg) Internet Printing Protocol (ipp) IP Security Protocol (ipsec) An Open Specification for Pretty Good Privacy (openpgp) Public-Key Infrastructure (X.509) (pkix) Responsible Use of the Network (run) Secure Shell (secsh) Session Initiation Protocol (sip) Secure Network Time Protocol (stime) User Services (uswg) XML Digital Signatures (xmldsig)
	Instructional Administration	P1484.13 Student Identifiers WG P1484.10 CBT Interchange Language WG
	VES Directory Administration	ACAP -- Application Configuration Access Protocol (RFC 2244) P1484.13 Student Identifiers WG Common Authentication Technology (cat) Common Name Resolution Protocol (cnrp) Telephone Number Mapping (enum)

4.1.3 VES System Development Standards

We require that VES will be designed as an open, object oriented collection of software. There are a set of standards that are particularly important to that development process:

CORBA - An important issue in large heterogeneous networks like VES, is the support for interoperability. Interoperability is the ability of two or more entities, such as programs, objects, applications or environments, to communicate and cooperate despite differences in the implementation language, the execution environment or the model abstractions. The Object Management Group's (OMG) Common Object Request Broker Architecture (CORBA) is a common layer through which objects transparently exchange messages and receive replies and is the evolving de-facto standard for application interoperability.

The CORBA defines the mechanisms, interfaces and protocols by which objects can transparently make requests and receive responses. These include the Interface Definition Language (IDL), the Interface Repository, the Static and Dynamic Invocation Interfaces and the Inter-ORBility interfaces and protocols.

VES will be designed as a system operating on one or several closely interconnected servers. Future evolution of VES will almost certainly involve distribution of functionality and data. For these reasons, we believe that CORBA is an important standard to VES, and that the following CORBA elements are especially important.

The *Object Request Broker* (ORB) specification is the part of CORBA which describes a "software bus": a mechanism which handles communication between distributed objects. The ORB allows for client-server interaction between heterogeneous objects distributed over a wide-area network, and makes meta information describing the objects in a system and their interfaces available to any object in the system, so that it may access other objects as a client without prior knowledge of their existence. Any object connected to the ORB can play the role of both a client and server object. That is, it can initiate calls to other objects and respond to requests for services from other objects on the ORB.

The ORB specification is programming language, operating system and platform independent. It allows vendors considerable flexibility in their choice of implementation methods. CORBA compliant ORBs are currently available from a number of different vendors based on mechanisms such as RPC, TCP/IP and sockets. Furthermore, the ORB permits transparent communication between objects implemented using a variety of programming languages and operating systems.

The *Interface Definition Language* (IDL) defined by OMG is a language for describing the interfaces of software objects. According to the CORBA 2.0 specification "an interface is a description of the set of possible operations a client may request of an object". An interface does not specify the internal data-representation or executable code used to implement an object. In practice, an IDL interface specification may also contain declarations of types, exceptions and constants. In order to facilitate re-use and extensibility of classes, IDL supports multiple inheritance among interface definitions. IDL is independent of programming languages, and may be used to describe objects implemented using a variety of programming languages, compilers or operating systems.

In addition, the information represented by the IDL specification for any objects connected to an ORB is compiled and stored in the Interface Repository service which the ORB must provide. The interface repository can be examined by objects on the ORB in order to ascertain what other objects are connected to the ORB and what interfaces they provide. This allows an object to request services from other objects on the ORB without having prior knowledge of the other objects or their interfaces.

CORBA defines an architecture for working with component-based software that runs across multiple dissimilar computers. CORBA allows applications, written to the CORBA spec, to communicate with one another no matter where they are located or who has designed them. CORBA applications can handle audio and video content, allowing developers to add the ability to handle large amounts of streamed multimedia data to cross-platform applications. Applications written to the spec will recognize and understand audio and video streams, no matter where or on what operating system or hardware they run.

4.1.4 Educational Administration Standards - Schools Interoperability Framework (SIF)

One of the very important elements of the standards requirements for VES is the requirement to be able to interface the VES applications with school district administrative applications and other enterprise applications. In the past, such interfaces between DOE systems and local school district systems were non-existent. Any kind of data sharing required expensive conversions or re-entry of data.

The environment into which VES is being deployed is characterized by lack of interoperability in educational information and administrative applications resulting in the following problems:

- Applications and their data are isolated from one another
- Redundant data entry is common
- Disconnected applications increase support costs
- Data reporting is costly and inefficient

- Data is inaccessible to decision makers

This lack of interoperability also creates difficult purchase decisions for district and school technology coordinators who procure administrative and management applications. Many coordinators are experiencing an increase in technical support problems from maintaining numerous closed, proprietary systems that do not talk to each other. Do they invest more money in their aging, installed-base systems? Or invest in newer, more efficient systems? The Schools Interoperability Framework promises to address these issues.

The **Schools Interoperability Framework (SIF)** is an industry initiative to develop an open specification for ensuring that K-12 instructional and administrative software applications work together more effectively. SIF is not a product, but rather an industry-supported technical blueprint for K-12 software that will enable diverse applications to interact and share data seamlessly; now and in the future.

We will be interested in each vendor's support of SIF in areas of VES where such support would be beneficial, vendor's membership in the SIF consortium, and vendor's commitment to future SIF compatibility. VES will not solve all the problems caused by incompatible applications, but for the VES data, school districts can be sure that if they buy administrative software, which is SIF compatible, they will not have to worry about interoperability with VES.

4.1.5 Instructional Management and Delivery Standards – Instructional Management Systems Consortium (IMS)

VES is the exactly kind of project that the emerging IMS standards were designed to benefit. We share a common goal with IMS: to provide an open architecture for learning. With this goal as our target, and standards as one of our means, VES will help start to deliver the following benefits for schools throughout Massachusetts:

- Improved quality of online learning materials and environments
- Greater access to learning opportunities
- More customized/flexible learning experiences

The Instructional Management Systems Consortium (IMS) is a consortium of learning institutions and vendors defining a comprehensive architecture for online learning. The architecture encompasses platform independent interfaces for metadata, aggregated content, management services, user profiles and external services such as databases. The IMS architecture anticipates the widespread availability of emerging technologies such as XML and provides an excellent vision for the future of online learning.

By creating a technical specification for learning materials and systems, the IMS provides a common framework for generating and leveraging information integral to the process of learning. A content developer may create materials that can be highly customized to unique learners' needs; a teacher may pull content from a variety of sources and integrate them into one system; a learner may be able to track their own progress and chart a personalized course through a training program. With a common base line, the different IMS Stakeholders can find innovative ways to add value to the learning environment.

There are a number of specific areas in which VES will benefit from implementation of the IMS standards. Several of the IMS specifications are now being considered for approval as standards by the IEEE Learning Technology Standards Committee (LTSC).

For a better understanding of IMS, and its importance to VES, one must understand the term **metadata**. Metadata is information about an object, be it physical or digital. Objects might be lesson plans, instructional videos, or student work in response to teacher assignments. As the number of these objects continues to grow exponentially and especially as our needs for learning expand equally dramatically, the lack of this information or metadata about these objects has produced a critical and fundamental constraint on our ability to discover, manage and use these objects.

Examples of Learning Objects include multimedia content, instructional content, learning objectives, instructional software and software tools, and persons, organizations, or events referenced during technology supported learning.

The Learning Object metadata standards will focus on the minimal set of **properties** needed to allow these Learning Objects to be managed, located, and evaluated. The standards will accommodate the ability for locally extending the basic properties as defined through data elements and entity types, and the properties can have a status of obligatory (must be present), optional (may be absent), conditional, or not allowed. Relevant properties of Learning Objects to be described include type of object, author, owner, terms of distribution, and format. Where applicable, Learning Object Metadata may also include pedagogical properties such as; teaching or interaction style, grade level, mastery level, and prerequisites. It is possible for any given Learning Object to have more than one Learning Object Metadata set.

The standard will support security, privacy, commerce, and evaluation, but only to the extent that metadata fields will be provided for specifying descriptive tokens related to these areas; the standard will not concern itself with how these features are implemented. We expect these standards will conform to, integrate with, or reference existing open standards and existing work in related areas. For example core properties of Learning Objects will be coordinated with or may simply defer to, the efforts to standardize content objects in general.

The use of the IMS metadata standards will complement VES plans to:

- To enable learners or instructors to search, evaluate, acquire, and utilize Learning Objects.
- To enable the sharing and exchange of Learning Objects across any technology supported learning systems.
- To enable the development of learning objects in units that can be combined and decomposed in meaningful ways.
- To enable computer agents to automatically and dynamically compose personalized lessons for an individual learner.
- To complement the direct work on standards that are focused on enabling multiple Learning Objects to work together within an open distributed learning environment.

- To enable, where desired, the documentation and recognition of the completion of existing or new learning & performance objectives associated with Learning Objects.
- To enable a strong and growing economy for Learning Objects that supports and sustains all forms of distribution; non-profit, not-for-profit and for profit.
- To enable learning organizations, to express educational content and performance standards in a standardized format that is independent of the content itself.
- To provide researchers with standards that support the collection and sharing of comparable data concerning the applicability and effectiveness of Learning Objects.
- To define a standard that is simple yet extensible to multiple domains and jurisdictions so as to be most easily and broadly adopted and applied.
- To support necessary security and authentication for the distribution and use of Learning Objects.

4.1.6 Instructional Resource Standards - GEM Metatags

There is great synergy between the GEM effort and VES. It is our objective to join the GEM consortium and to add VES resource collections to their library. It is also our intention to make GEM resources available to all Massachusetts teachers through VES. Vendors should understand the GEM metatags fully and be prepared to support their implementation.

GEM is a National Library of Education (NLE) and ERIC initiative, which expands educators' capability to access Internet-based lesson plans, curriculum units and other educational materials. NLE's goal is to improve the organization and accessibility of the substantial, but uncataloged, collections of materials, which are already available on various federal, state, university, non-profit, and commercial Internet sites. The NLE and the U.S. Department of Education are supporting a consortium effort to create an operational framework to provide America's teachers with "one-stop, any-stop" access to Internet-based educational resources. According to Michael B. Eisenberg, co-principal investigator for the GEM project, "This project's goal is to provide a new set of tools to get information into the hands of educators quickly and easily so that children can learn."

There are thousands of lesson plans, curriculum units and other educational materials distributed on web sites across the Internet. In many instances, these valuable resources are difficult for most teachers to find in an efficient and effective manner. The goal of the Gateway to Educational Materials (GEM) is to solve this **resource discovery problem** and to provide a gateway to quality collections of educational resources.

The Gateway currently includes resources from more than 100 collections, including the AskERIC Virtual Library, Math Forum, Microsoft Encarta, North Carolina Department of Public Instruction, and U.S. Department of Education.

Consult this link for a complete listing of GEM Metadata Elements with mapping to IMS Metadata.

In association with the GEM Consortium members, the GEM Administrative Group at the ERIC Clearinghouse on Information & Technology at Syracuse University, have been working on a number of data files and applications for implementing the GEM profile and creating sample GEM metadata records. Effort has also been made to create cross-platform indexing tools and a harvesting script for identifying GEM tagged resources. A companion effort has been launched to evaluate GEM resources to assure a high level of quality.

Visit this link for more technical details and information on GEM tools GEM Workbench

It is expected that VES vendors will be very familiar with the GEM Metatags, will support them in their resource offerings, and will support extensions to the Dublin Core and GEM to facilitate their inclusion in VES resource catalogs.

4.1.7 Instructional Resource Standards - Dublin Core: Metadata for Electronic Resources

As a key component of just about every learning object standard, the Dublin Core deserves special mention. For more information on the Dublin Core follow this link.

The Dublin Core is a metadata element set intended to facilitate discovery of electronic resources. Originally conceived for author-generated description of Web resources, it has attracted the attention of formal resource description communities such as museums, libraries, government agencies, educators, schools, and commercial organizations.

The characteristics of the Dublin Core that distinguish it as a prominent candidate for description of electronic resources fall into several categories:

Simplicity - The Dublin Core is intended to be usable by non-catalogers as well as resource description specialists. Most of the elements have a commonly understood semantics of roughly the complexity of a library catalog card.

Semantic Interoperability - In the Internet Commons, disparate description models interfere with the ability to search across discipline boundaries. Promoting a commonly understood set of descriptors that helps to unify other data content standards increases the possibility of semantic interoperability across disciplines.

International Consensus - Recognition of the international scope of resource discovery on the Web is critical to the development of effective discovery infrastructure. The Dublin Core benefits from active participation and promotion in some 20 countries in North America, Europe, Australia, and Asia.

Extensibility - The Dublin Core provides an economical alternative to more elaborate description models such as the full MARC cataloging of the library world. Additionally, it includes sufficient flexibility and extensibility to encode the structure and more elaborate semantics inherent in richer description standards

Metadata Modularity on the Web - The diversity of metadata needs on the Web requires an infrastructure that supports the coexistence of complementary, independently maintained metadata packages. The World Wide Web Consortium (W3C) has begun implementing an architecture for metadata for the Web. The Resource Description Framework, or RDF, is designed to support the many different metadata needs of vendors and information providers. Representatives of the Dublin Core effort are actively involved in the development of this architecture, bringing the digital library perspective to bear on this important component of the Web infrastructure.

4.1.8 IEEE 1484 - Learning Technology Standards Committee (LTSC)

Probably the most important of the organizations described in this document is the Institute of Electrical and Electronic Engineers (IEEE). Their importance lies in the fact that their work becomes national and international standards. That means that they employ a slow deliberate process to assure that their standards will be usable and add value.

In this document we are calling out a number of VES requirements to consult, consider, and implement IEEE 1484 standards. Although the LTSC effort is primarily directed at online interactive instruction, and the principal focus of VES is classroom instruction, the standards they are working on and drafts they have created go to the heart of building a Virtual Education Space. The standards enable the creation of on-line representations of the classroom process that add value to it. For that reason, the IEEE 1484 work is very important to the VES effort. Some of the working groups are less important right now, but will become more important later.

The mission of IEEE LTSC working groups is to develop technical Standards, Recommended Practices, and Guides for software components, tools, technologies and design methods that facilitate the development, deployment, maintenance and interoperation of computer implementations of education and training components and systems. Many of the standards developed by LTSC will be advanced as international standards by the International Standards Organization (ISO) Learning Technology Group: ISO/IEC JTC1/SC36 - Learning Technology

General

- P1484.1 Architecture and Reference Model WG
- P1484.3 Glossary WG

Learner-Related

- P1484.2 Learner Model WG
- P1484.13 Student Identifiers WG
- P1484.5 User Interfaces (Study Group)
- P1484.19 Quality System for Technology-Based Life-Long Learning (Study Group)
- P1484.20 Competency Definitions (Study Group)

Content-Related

- P1484.10 CBT Interchange Language WG
- P1484.6 Course Sequencing WG
- P1484.17 Content Packaging WG

Data and Metadata

- P1484.12 Learning Objects Metadata WG
- P1484.9 Localization (Study Group)
- P1484.14 Semantics and Exchange Bindings WG
- P1484.15 Data Interchange Protocols WG
- P1484.16 HTTP Bindings WG

Management Systems and Applications

- P1484.11 Computer Managed Instruction WG
- P1484.18 Platform and Media Profiles WG
- P1484.7 Tool/Agent Communication WG
- P1484.8 Enterprise Interfaces (Study Group)

4.1.9 Internet Engineering Task Force (IETF)

Because VES is an Internet based learning environment, many of the IETF protocols, recommendations, drafts, and specifications affect VES and are useful in adding standardization to VES components. This is a list of standards work-in-progress relevant to current or future VES requirements. For more information visit IETF.

[Authentication, Authorization and Accounting \(aaa\) -- 5 Internet-Drafts](#)

[Application Configuration Access Protocol \(acap\) -- 5 Internet-Drafts](#)

[Authenticated Firewall Traversal \(aft\) -- 4 Internet-Drafts](#)

[Audio/Video Transport \(avt\) -- 21 Internet-Drafts](#)

[Calendaring and Scheduling \(calsch\) -- 6 Internet-Drafts](#)

[Common Authentication Technology \(cat\) -- 21 Internet-Drafts](#)

[Common Name Resolution Protocol \(cnrp\) -- 3 Internet-Drafts](#)

[Web Versioning and Configuration Management \(deltav\) -- 1 Internet-Drafts](#)

[Distributed Management \(disman\) -- 6 Internet-Drafts](#)

[Telephone Number Mapping \(enum\) -- 1 Internet-Drafts](#)

[Internet Fax \(fax\) -- 13 Internet-Drafts](#)

[Extensions to FTP \(ftpext\) -- 1 Internet-Drafts](#)

[G & R for Security Incident Processing \(grip\) -- 3 Internet-Drafts](#)

[HyperText Transfer Protocol \(http\) -- 1 Internet-Drafts](#)
[Inter-Domain Multicast Routing \(idmr\) -- 10 Internet-Drafts](#)
[Intrusion Detection Exchange Format \(idwg\) -- 3 Internet-Drafts](#)
[Instant Messaging and Presence Protocol \(impp\) -- 4 Internet-Drafts](#)
[Internet Printing Protocol \(ipp\) -- 13 Internet-Drafts](#)
[IP Performance Metrics \(ippm\) -- 4 Internet-Drafts](#)
[IP Security Protocol \(ipsec\) -- 31 Internet-Drafts](#)
[IP Telephony \(iptel\) -- 8 Internet-Drafts](#)
[Mail and Directory Management \(madman\) -- 2 Internet-Drafts](#)
[MBONE Deployment \(mboned\) -- 8 Internet-Drafts](#)
[Media Gateway Control \(megaco\) -- 10 Internet-Drafts](#)
[Multicast Source Discovery Protocol \(msdp\) -- 3 Internet-Drafts](#)
[Message Tracking Protocol \(msgtrk\) -- 1 Internet-Drafts](#)
[Network File System Version 4 \(nfsv4\) -- 1 Internet-Drafts](#)
[Next Generation Transition \(ngtrans\) -- 9 Internet-Drafts](#)
[NNTP Extensions \(nntpext\) -- 1 Internet-Drafts](#)
[An Open Specification for Pretty Good Privacy \(openpgp\) -- 3 Internet-Drafts](#)
[Protocol Independent Multicast \(pim\) -- 7 Internet-Drafts](#)
[Public-Key Infrastructure \(X.509\) \(pkix\) -- 19 Internet-Drafts](#)
[Point-to-Point Protocol Extensions \(pppext\) -- 11 Internet-Drafts](#)
[Remote Network Monitoring \(rmonmib\) -- 6 Internet-Drafts](#)
[Reliable Multicast Transport \(rmt\) -- 3 Internet-Drafts](#)
[Responsible Use of the Network \(run\) -- 1 Internet-Drafts](#)
[Secure Shell \(secsh\) -- 5 Internet-Drafts](#)
[Session Initiation Protocol \(sip\) -- 8 Internet-Drafts](#)
[SNMP Version 3 \(snmpv3\) -- 4 Internet-Drafts](#)
[Secure Network Time Protocol \(stime\) -- 1 Internet-Drafts](#)
[Internet Open Trading Protocol \(trade\) -- 7 Internet-Drafts](#)
[Uniform Resource Names \(urn\) -- 3 Internet-Drafts](#)
[User Services \(uswg\) -- 1 Internet-Drafts](#)
[WWW Distributed Authoring and Versioning \(webdav\) -- 9 Internet-Drafts](#)
[Web Replication and Caching \(wrec\) -- 7 Internet-Drafts](#)
[XML Digital Signatures \(xmldsig\) -- 2 Internet-Drafts](#)
[Zero Configuration Networking \(zeroconf\) -- 1 Internet-Drafts](#)

4.1.10 Relationship of Standards Requirements to Database Requirements

As is shown in the set of tables above, many of the standards cited are applicable and relevant to VES objects. The database requirements for implementation of these standards will be represented in the VES Enterprise Data Model, and most particularly in the Entity Data Element listings. Implementation of the standards in software will be the responsibility of DOE and vendor development teams. Existing Products and Services, which do not currently implement available standards may be acceptable if vendors are committed to implementing the standards. Closed proprietary products are far less desirable than open, standards based products.

Standards in VES do not represent an additional set of functionality, but they do represent a particular way of doing things that will be done anyway. They are a way that adds value, synergy, interoperability, accessibility, reusability, discoverability, extensibility, affordability, and manageability.

4.2 VES Integration Architecture (VESIA)

The purposes of the VES Integration Architecture (VESIA) are:

- to enable seamless interoperability between VES components
- to enable the VES Workspace to complete user authentication for VES users with the DOE Directory Administration Application
- to enable the VES Workspace to pass proxy authentication tokens to other DOE applications
- to provide ways for third-party applications to integrate with VES at three levels of interoperability

The VESIA has been specified and made part of the VES Requirements Document because our vision for what distinguishes VES from other web portals, e-learning sites, and web application environments is the seamless integration and interoperability it assures.

VES is being procured with an open, standards based architecture, and we believe that these two features are quite important. The VESIA will add to these two important features a new dimension in ease of use and synergy between applications.

4.2.1 Levels of Integration

In order to provide the maximum in functionality, as well as integration, the VESIA will support four levels of integration. Proposers of VES components should identify their levels of integration and propose costs for each level of integration. Models of some of the integration architecture interfaces are described below to provide a basis for pricing vendor integration efforts.

Level 0 Integration - Linked Integration

This basic level of integration is enabled by providing simple HTTP links from a user's workspace to third party or DOE websites. It requires no changes to the web applications, and no modifications to VES.

Level 1 Integration - Access Integration

This level of integration is enabled by third party vendor, or DOE, adoption of VESIA authentication and role mapping services. It requires creation of a separate VESIA interface to vendor web applications and must be supported in the VES Workspace Services module.

Level 2 Integration - Functional Integration

This level of integration is enabled by full adoption by third party vendor, or DOE, of the VESIA. It requires modifications to vendor or DOE applications to open service ports, and it must be supported in the VES Workspace Services module. Functional Integration provides seamless interoperability and personalization across application boundaries.

Level 3 Integration - Workspace Integration

The highest level of VESIA integration is reserved for future implementations where distributed object oriented software actually uses the object architecture of the VES workspace as the building blocks of new applications. Workspace Integration provides all the ultimate value of an object oriented architecture.

4.2.2 VESIA Specifications

The implementation level details of the VESIA are still being finalized. Enough information is contained in this section for responders to this RFR to understand the implications of the integration architecture. Successful responders will be provided with the complete VESIA Specification, including full XML interface specifications, during Step 2 of the Procurement Process.

4.2.3 VESIA Concepts and Models

VESIA defines a number of services and interfaces, which must be supported by VES software. One of the most significant uses of the VESIA will be in the implementation of the VES Common Application Service Elements (CASE). To give vendors an idea of the functionality provided in the VESIA environment, a number of VESIA concepts, services, and interfaces are described in this section.

4.2.3.1 VESIA Service Ports

A basic concept represented in the VESIA is that VES components will be built with ports through which their services are provided. Service Ports are abstractions that relate to the encapsulation of functionality in VES. Task interfaces provide end user services and Service interfaces provide services to other modules. The Task interfaces and Service interfaces to an application are called the application's Service ports. The integration and use of Service Ports differentiate VES applications from standalone applications.

- **The Task Interface** provides end user functionality, typically through the user interface. An example of a Task Interface is an interactive web form for creation and editing of an email document. The Task Interface for email will be available from Email Application.
- **The Service Interface** provides application functionality to other applications. An example of the use of a Service interface is the Curriculum Guidelines module automatically emailing notification that the 4th grade math guideline draft had been approved and is now available for viewing by the community. The Curriculum Guidelines module would accomplish this by invoking email services from the Service interface of the Email Application.

4.2.3.2 VESIA User Friendly Services

A basic concept represented in the VESIA is that the VES Workspace and other components will be modified to satisfy user preferences, and to make the Workplace simpler and more relevant to each user's roles in their organization. There is great power in this kind of dynamic Customization, Personalization, and Localization.

Personalization of the VES Workspace is the organization and presentation of the user interface and portals for each user, based on their current or default preferences. A personalized Workspace is a customized Workspace that is organized and presented in ways the user has chosen, and in colors, styles, and ways specified by users in their current or default preferences.

Customization of the VES Workspace is the organization and presentation of the user interface and portals for each user, based on their current or default organizational roles. A customized Workspace presents only those interfaces and portals to tools, services, and resources for which a user is authorized, and which their current, or default, role requires.

Localization of the VES Workspace and its User Interface Elements is the use of local terminology and local document approval (workflow) processes in place of system defaults. To a degree, VES will support localization by district administrators to better match their local conventions. A localized Workspace is a customized and personalized Workspace that may use local district preferences for naming conventions, and local draft, review, and approval processes, in place of system defaults.

4.2.3.3 VESIA Authentication Concepts

Authentication of a user is a process of validating Log-in ID and password against the directory of the DOE Directory Administration Application. Authenticated users will be permitted access to VES applications, based on their organizational and assigned roles, and will have a personalized VES Workspace. Unauthenticated users access VES through a minimal default Workspace.

4.2.3.4 VESIA Token and Virtual Cookie Concepts

Tokens are object instances that exist for a Workplace Session and may be exchanged between VESIA Level 1 or 2 compliant applications. Tokens carry secure information between applications like authentication information, role information, etc. Token handling is controlled by a set of protocols.

User Authentication Token

When an authenticated user successfully logs in to VES, and for the duration of the current VES Workspace session, VES Workspace will maintain an Authentication Token which identifies that user as authenticated. If the user wishes to change the roles they have selected, the user authentication token will be passed to the DOE Directory Administration Application. Without reentering the login and password, the user will be presented with the role selection page, in which they will be asked to select from the set of VES roles, which they have been assigned by default, or by assignment in the VES Administration Module. Each time roles are changed, a new VES Workspace session is started.

Within their current role when a user selects an application to run, the User Authentication Token will be passed to that VES or DOE application. This will avoid the need for another Log-in and password.

Role Customization Tokens

When an authenticated user successfully logs in to VES, and for the duration of the current VES Workspace session, VES will maintain a Role Customization Token which identifies that user as having the selected role(s). Whenever the user is presented with icons, menus, options, and other objects in the Workspace user interface, the view of those user interface objects will be customized by the roles contained in the current instance of the role customization token. The user's Workspace will only present applications which the user's roles entitle them to use, and within those applications, only the application tasks which the user's roles entitle them to perform.

Workspace Integration and Virtual Cookies

Because the VES Workspace environment makes it transparent when users are entering and leaving different application environments, conventional use of end user cookies to contain personalization information will not always be possible. We also want to minimize the use of cookies by VES because many school network environments do not permit their use.

So, to contain personalization data from third-party applications that would otherwise wind up in cookies on the user's computer, VES Workspace will instantiate such data in Virtual Cookies. This will permit third party applications to maintain a high level of personalization, transparent to the end user.

To support personalization data from VES applications that would otherwise wind up in cookies on the user's computer, VES Workspace will store such data in Virtual Cookies. This will permit VES applications to maintain a high level of personalization, transparent to the end user.

Workspace Integration and Personalization Tokens

For the personalization of the Workspace interface itself, VES Workspace will maintain a Personalization Token. That token will contain a user's Workspace preferences. In VESIA Level 2 compliant applications, the Personalization Token can be used to bridge the application to Workspace and Workspace to application environment, and to maintain consistently personalized user interfaces.

Personalization Tokens relate only to Workspace and Application presentation issues and NOT to functional issues. They are an important feature of the Workspace, but are not the responsibility of the Directory Administration Application. They are the responsibility of the VES Administration Module.

4.2.4 VESIA Security Requirements

It is required that the VES environment be a secure, password authenticated, private environment. Rather than specify a particular security model and specific implementation strategies, we would prefer that VES vendors propose security technology alternatives. Beyond the VESIA and DOE Directory Administration Application password authentication model, we are open to public key, encryption, IP socket security, and other methodologies. In proposing a security architecture, vendors should document costs, performance and tradeoffs between several alternatives.

4.2.5 VESIA Conformance and Compliance Testing

A key component in the quality assurance and acceptance process for software developed for VES, software modified for VES, and software integrated into VES, will be a suite of VESIA conformance and compliance tests. Vendors should plan their own VESIA testing prior to delivery of VES deliverables, based on the VESIA specifications. Components of the VESIA test and validation suite will be made available to selected vendors, to assist in VESIA compliance testing.

4.3 Other VES Requirements and Desirable Features

VES Vendors should read and understand this section which contains important requirements which do not fit easily into the subsystems requirements (which were defined in Chapter 3), but run across multiple subsystems.

4.3.1 Scalability

One particularly important requirement is scalability. VES will initially begin prototype implementation of key components in just a few pilot districts. By the Winter of 2000, the VES 1.0 components will be rolled out to many more districts. In the year 2001, majority district adoption is anticipated. By 2002 the majority of teachers and hundreds of thousands of students will be using VES. By 2003, the majority of students will be using VES.

This deployment schedule does not include redesign at each new implementation phase. Therefore, we are expecting vendors who respond to this RFR to propose solutions for which scalability is NOT an issue. By that we mean, that scalability must be part of the proposed design. It should be neither an afterthought, nor an empty promise.

One of the reasons we are so insistent on the Oracle database support requirement, and the object oriented distributed architecture requirements, is because they are two important elements of the scalability we seek.

4.3.2 VES Security Issues

4.3.2.1 Overview - VES Security Envelope

The users of VES have a right to expect that the VES environment, and the work products and resources which they entrust to it, will be secure from unauthorized access, tampering, intrusion, and denial of service attacks. We are calling this environment the VES Security Envelope. To accomplish these things, and to build that envelope, vendors will propose significantly different security approaches. When preparing proposals for the VES Security Envelope, vendors should be sure that they meet these requirements:

- User identity, passwords, and personal information are not transmitted openly across the Internet.
- The vendor implementation of the VES security envelope does not pose unreasonable burdens upon end users or interfere with VES ease of use.
- The vendor implementation takes into consideration the fact that authenticated users operating within the Security Envelope will frequently link out of the envelope to access sites and resources on the Internet, and will need a way back into the envelope that is easy to use. This reentry to the Security Envelope should be implemented in a way that will not compromise VES security, but not require re-authentication.
- Vendors may wish to present several scenarios for their security proposal.

4.3.2.2 Security Threats

One way of specifying a set of security requirements is to specify and characterize required security features in the context of security threats. This security model is based on the ANSI IISP security model and the work of ISO/IEC JTC1 SC27. The following security threats to VES must be handled by any vendor proposal.

4.3.2.3 Perimeter Integrity - the VES Security Envelope

All security systems are defined in terms of a **security perimeter**. The "inside" of the security perimeter is intended to be secure. The "outside" of the security perimeter may not be secure.

The security perimeter itself must maintain its integrity (what good is a fence if one can move it?). Perimeter integrity is determined by maintaining the level desired of inbound and outbound threats, e.g., a perimeter has been violated if there more inbound threats are possible. User permissions and administration are aspects of perimeter integrity.

- **Inbound Threats**

An inbound threat is an external threat that breaches the security of a VES system. Examples: Unauthorized messages, injected into a data stream, changing information, destroying information.

- **Outbound Threats**

An outbound threat is the theft or duplication of information. Examples: Snooping network packets, taking information, destroying information.

- **Denial of Service Threats**

A denial of service threat is an external threat that uses well formed standard messages to saturate the system with bogus transactions and traffic, filling all system queues and using all system resources. Under this attack, real user transactions and traffic are denied service. Examples: Flooding VES with searches or emails, or password authentication posts.

4.3.2.4 Security Strength

The security strength is the features that characterize the implementation of the security system (e.g., is the fence made of wood, metal, or concrete?). The follow features may characterize security strength:

- **Quality Level.** What level of security is provided? Examples of security levels: minimal security (e.g., C2-Level), provable design (e.g., Ax-Level).
- **Contingencies.** What happens when the system is violated? What fallbacks are available? What is the extent of the damage?
- **Penalties.** What happens to violators of the security mechanism?

Example: Security strength might concern a proposal for the number of bits used in encryption keys.

4.3.2.5 VES Security Scenarios

The following scenarios address individual security issues, to be considered, for each of four types of VES user and system information. These four are representative of the security issues for other classes of user and system information:

- Personal Information
- Preference Information
- Performance Information
- Portfolio Information

4.3.2.6 Personal Information

Personal information is intended to be kept private. Privacy is enforced by policies, procedures, regulations, and laws. Techniques to assure privacy of personal information include:

Naming of views - The naming of HTTP views may be obvious:

personal.edu.john.doe.k12.boston.ma.us

or obscure:

personal.1234567.anonymous

Who has access - Personal information may be accessed by a teacher, student user and their parents or guardians, and other legally authorized representatives. Not all school district or DOE administrative personnel will have access to personal information.

Unauthorized reads - The "privacy" issue for users, districts, and administrators is preventing unauthorized reads of learner information.

Unauthorized write - Most districts and DOE administrators implement highly secure "back office administrative systems" like the Directory Administration Application, that protect against unauthorized changes to personal information. Typically, users may change some of their personal information via requests to these systems with "positive identification" (authentication). VES must be able to support these changes.

Transfer to/from back office - District and DOE Administrative systems may need to propagate personal information to VES personal information repositories. Grades from performance information repositories, MCAS student data, and other personal information, must be entered into VES from outside systems, but this transfer of data will be restricted, heavily authenticated, and audited.

4.3.2.7 Preference Information

Preference information is publicly available personal information. VES administrators may choose to limit access to preference information.

Naming of views - The naming of views may be obvious

preference.edu.john.doe.k12.boston.ma.us

or obscure:

preference.1234567.anonymous

Note: Certain naming conventions may reveal the identity of the user. It is the responsibility of administrators to choose appropriate techniques to keep names from being obvious.

Who has access - Preference information, typically, will have to be available to the user, appropriate VES modules, and some other modules.

User-initiated changes - Users may change some of their preferences. The level of security for preferences could be the same as that for changes to personal information.

Authorizing automated changes - Some VES system components may desire changes to user preference information. The requirements for these transactions are discussed further in the Security section of the VESIA.

4.3.2.8 Performance Information

Performance information may be shared by, and available to many VES modules and components. Performance information includes measures and documentation of student achievement. Privacy concerns may be reduced by de-identification of performance information.

Naming of views

The naming of views may be obvious

performance.edu.john.doe.k12.boston.ma.us

or obscure

performance.1234567.anonymous

The naming of views may be general,

performance.edu.john.doe

specific,

transcript.performance.edu.john.doe

or custom

resume-123.performance.edu.john.doe

Who has access - Typically, VES system components must have access to individual performance information, but this access may be restricted to the duration of the user's VES session.

Who can write - VES system components will have to be able to write performance information. Note: There are significant security issues to be resolved in this area.

Who can change - Typically, only the VES component that created the performance information can change it. Note: There are significant security issues to be resolved in this area.

Non-repudiated records - Some performance information cannot be changed or erased, e.g., a student fails an exam or a course.

Certification - Some performance information represents "certifications", official records of competency. These performance records may need to be digitally signed and/or secured to prevent tampering and to record certifying authorities.

Validation - Some VES components will need to validate the authenticity of certifications.

Expiration - Some performance information expires, e.g., some competency records, or course specific information when the course is over.

Granularity - Performance information is stored in various levels of granularity. It will be desirable to exclude or include certain levels of performance information, when retrieving records.

Anonymous access - The desire for widespread distance learning, and online professional development, implies that many remote systems will need both read and/or write access to some performance information. Since these systems can not be anticipated in advance, effectively, certain VES performance information repositories will need to support anonymous read and write access.

Controlled, selective, and timed access - Users and administrators may control access to performance information by who, where, and when.

Design for children - Young children (ages 5-10) provide the most difficult security scenario: they need sophisticated access to remote resources, yet they have little sense of security issues. (Of course, adults, too, may be aware of security issues but still may access with little sense of security.) Careful administration, configuration, and design are necessary to allow young student user's access to the wide resources of VES over the internet, while minimizing security risks.

Nomadic access - VES components may need to read/write performance information in nomadic environments. Handheld edge device hardware, wireless laptop computers, and thin client Internet computers all contribute to VES scenarios for nomadic access. Many of these systems have no local storage devices, or local content (e.g., CD-ROM), but need to maintain remote or distance records within VES.

4.3.2.9 Portfolio Information

Portfolio information is a repository of selected student work, created for a specific purpose, and which is organized to be available for human viewing.

Naming of views - The naming of views may be obvious

portfolio.edu.john.doe.k12.boston.ma.us

or obscure

portfolio.1234567.anonymous

The naming of views may be general,

portfiolio.edu.john.doe

specific,

art.portfolio.edu.john.doe

or custom

job-interview-3.portfolio.edu.john.doe

Who has access - Typically, the student creates the portfolio contents and the teachers, parents, instructional support personnel, schools and districts review the portfolio.

Non-persistence - Portfolio information may have a long lifetime, but it may also be very brief, too, e.g., available only for the purpose of a particular portfolio assessment. Portfolios may be maintained for different reasons.

Anonymous access - Some users may wish to make their portfolio information publicly available, e.g., a public resume for students seeking summer employment.

4.3.3 Encryption

To the extent that encryption is an element of a vendor's proposal for the Security Envelope they may propose encryption. Otherwise there is no specific encryption requirement within VES.

4.3.4 Data Integrity

It goes without saying in most system requirements, that data integrity is of paramount importance. Because of the heterogeneous, distributed, web based, environment in which VES and the VES tools will exist it is worth stating specifically the need to assure data integrity.

4.3.5 Performance

Performance is another generic requirement that is difficult to specify, hard to quantify, but relatively easy to measure. Any interactive system, to be successful, must meet response time, and wait time requirements. It is recognized that the Internet presents an environment in which delays are probabilistically and statistically distributed, difficult to predict, and affected by factors outside the control of VES or any vendor.

For that reason, user interface and Workplace design should be conservative. The physical data schema, data access and replication strategies should be designed to maximize the probability that user responsiveness of the system will be within acceptable parameters.

Where vendors can quantify tradeoffs between performance and cost, they should document those tradeoffs.

4.3.6 Synchronization Services

One of the most important requirements of the Virtual Education Space is that it is virtual. We are not merely specifying a remote computer resource for each teacher and student that is simply an alternative to having a desktop computer or a home computer. We are requiring a level of virtuality, which permits VES Workspace access from a number of different hardware edge devices, with customized and personalized user interfaces and full synchronization between the Workplace and any number of edge hardware devices.

There are three types of VES synchronization requirements to support this vision:

General synchronization:

The general synchronization requirements are based on the assumption that user edge devices are connected to the VES workspace by a dedicated connection.

What we are specifying and requiring in the general synchronization requirement is a system that works seamlessly and transparently with a teacher's classroom computer, and their computer at home. We are specifying and requiring a system that works seamlessly and transparently with a student's homeroom computer, their school library computer, the computer in the computer lab, and the one in physics, the one in the community center in the afternoon, **and** their computer at home.

The VES workspace should be a unified desktop that keeps track of what users were doing last time, and doesn't forget the context in which they were doing it, and in which documents are always the latest version, and things don't get lost, regardless of where they are working from. For those users that only have access to one computer the Workspace should be their desktop.

The general synchronization requirements also include the requirement that each of the Workspace sessions a user has during the day may be on a different type of computer, with different browsers, with and without hard drives, fat multimedia systems or thin clients, over dial-up, ADSL, ISDN or dedicated Internet connectivity.

Edge Device synchronization:

The edge device synchronization requirements are based on the assumption that user edge devices are connected to the VES workspace by a non-dedicated instance connection at a point in time.

VES users may utilize Edge Devices and productivity devices like 3com Palm Pilots, Windows CE Organizers, Laptop computers, and in future years other mobile devices.

There are two connection scenarios for these devices:

1. These devices may link to existing desktop computers through Infrared links, docking stations, or other technology.
2. They also may be connected to VES via wireless Internet connections to an Internet Service Provider or a school network infrastructure access point.
 - 1.

The Edge device synchronization requirements have to do with the following examples:

Plan book example: A teacher pulls today's schedule, and class roster from their desktop computer into a handheld device. During the day they make instructional journal entries to the lesson plans in their calendar to note significant events, things that worked, things that didn't work, etc. During the day the teacher also checked off homework completed against the assignments and student roster, and made annotations about several student achievements, general comments about other students' performance, made one note about disciplinary problem, and recorded an after school parent conference. At the end of the day the teacher should be able to place the handheld in a docking station, and resynchronize the VES databases with their notations.

Student assignment example: A student pulls today's schedule, and class assignments from their classroom computer into a handheld device. During the day they make notes on the calendar about additional things the teacher wants. When they get home, they share the assignments with their parents, complete the assignments on the handheld (if it fits and is capable enough) or on their own computer. While checking into their VES Workspace that evening, the student discovers that the teacher has changed the assignment by removing the second half. Now they have extra time to read that book...They can submit the work when it is completed, or bring it to class in the handheld the next day.

Some potential Edge Devices like simple telephones and fax machines do not have synchronization requirements because they are stateless and do not store user information. Phones could be used by parents to get status reports on student work, or to check homework assignments. Through the use of voicemail, text to speech synthesis, parent-to-teacher calls, and other technologies the telephone could become an important VES tool.

Database Synchronization Requirements:
See section 4.3.8.

4.3.7 Embedded Just in Time (JIT) Training and Support

There is a requirement that for every enterprise process, and task, and every VES tool, whether developed or licensed, that rich multimedia just-in-time tutorials and help be available to users from inside the tool or application. That user assistance should be available embedded at, or linked from, the place where they have a question or problem.

This requirement creates a parallel training and support requirement, which matches the required functionality a vendor delivers. Just as a vendor completes a system analysis to create a design, which meets the functional requirements, they should create a training analysis to create an instructional design to meet the user training and support requirements.

It is required that this training and support be embedded for several reasons:

- To make it accessible where and when users need it
- To record, and track user problems to assure that they are resolved
- To keep track of the acquisition of competencies by users and the time spent in training or seeking support
- To improve the quality of the applications and to reduce the need for training and support.
- To be able to deploy future applications with embedded training and support without the requirement for significant implementation training

Embedded training and support will be provided through three distinct user interfaces:

- A Task Assistant Interface (Show me how to...)
- An Expert Troubleshooting Interface (Help me fix...)
- An Interactive Learning Interface (Teach me about...)

Further details on these interfaces will be provided to qualified selected VES vendors.

Qualified vendors who are selected to help build VES will be provided access to the suite of VES Instructional Design Tools, which may assist them in meeting this requirement.

IEEE 1484.7 Tool/Agent Communication Working Group

Embedded Just in Time (JIT) training and support is a very important requirement for all VESIA Level 2 components. The IEEE 1484.7 Tool/Agent Communication Working Group is developing a standard which will be very important to the provision of embedded training and support within VES. The standard will define a protocol to govern interaction between software tools and instructional agents.

This standard applies to educational systems like VES consisting of one (or more) user tools (VES tools) and one (or more) instructional agents (VES embedded Technology Support subsystem modules). User tools are standard software applications that the VES user might work with in an educational context (such as VES lesson planning tools, curriculum development tools, and communications and collaboration tools). Instructional agents are software modules able to provide guidance to students using such tools in pursuit of some educational goal.

We expect to use this IEEE 1484.7 standard to address ways that currently-existing tools (third party) can be made to comply with the VES requirements, as well as ways that newly-developed tools, which are developed as part of VES, can be designed to take advantage of the standard. In addition, the standard will address communication between multiple instructional agents, which may exist in the VES environment.

The communication protocol has three elements:

- Communication from the tool to the instructional agent, regarding actions that the student is performing with the tool and direct student requests of the instructional agent.
- Communication from the instructional agent to the tool, with the goal of setting some state in the tool or providing feedback to the student.
- Communication between different instructional agents, with the goal of sharing information on judgments of student actions and resolving conflicts that may arise in giving feedback or making evaluations.

Since different tools are composed of different objects (for example, lesson plans have "activities", while courses have "units"), the protocol will specify the existence and general form of object references but not their semantics. We expect other standards to define the semantics of objects for tools of specific classes.

The existence of such standards will provide guidance to developers of standards governing the semantics of specific classes of tools. Together with such semantic description standards, this standard would allow vendors of educational software to view tools of a particular class as interchangeable. This would permit, for example, VES requirements for a web based gradebook to be satisfied from among several gradebooks conforming to the standard.

The requirement for, and existence and development of, tools complying with this standard as part of the VES project will encourage educational software developers to incorporate these protocols into their tools.

The requirement for, and existence of, instructional agents complying with the standard will encourage the development of additional instructional agents which can interact with them in VES, and other learning environments.

4.3.8 Distributed Data Requirements

VES will be a centrally managed server and back end database site, possibly with site mirroring. The VES components will be installed at and integrated into that (those) sites.

Users of VES will maintain local copies of many of the documents created within VES. Documents will be printed locally and some web pages will be hosted locally.

Some school districts will choose to house database entities on local computer systems to ease integration with district administrative systems. Some school districts will choose to host published web pages on district web servers. In both of these cases a database synchronization requirement exists. It is expected that vendors will propose and implement CORBA functionality to satisfy this requirement.

4.3.9 User Interface Design Guidelines

Vendors will exercise good judgement in the proposal and design of user interfaces, keeping performance and usability in mind. Vendors should be prepared to discuss the user interface design philosophy, principles, and user interface engineering tools, which they intend to, or customarily, employ.

4.3.10 Local School District - Localization Issues

Wherever possible throughout the VES System Requirements we have striven to articulate requirements which would facilitate Local School District Localization of features and the user interface. From localization of the shared Calendar, to the Object Workflow design process, the desire to achieve a flexible system which will be able to be implemented easily using defaults, and with a little more effort may be localized to accommodate local preferences and choices.

Whenever further opportunities for Localization present themselves, beyond the System Requirements, vendors should propose localized solutions and cost vs. localization tradeoffs. In many cases localization has a net cost benefit.

4.4 VES Edge Device Hardware Requirements

School Districts will be procuring end-user hardware as part of their ongoing Technology Plans and to create the conditions, which will enable their students and teachers to get the most from their use of VES. As part of this RFR we seek quantity purchase quotes from hardware vendors and resellers for the following five classes of hardware. Because these hardware systems sit at the outer boundary of the VES environment in the hands, and on the desks, of VES users, we call them edge devices.

4.4.1 Handheld Devices

Table 4-4: Handheld Device

Device Type	Features	Software Operating Environments
Handheld Device	<ul style="list-style-type: none"> Capable of display of calendar data and user input Capable of synchronization with desktop computers and network databases IR communications link capability 	Palm OS, Windows CE, JVM, Other

4.4.2 Wireless Portable Internet Devices

Table 4-5: Wireless Portable Internet Devices

Device Type	Features	Software Operating Environments
Wireless Internet Device	<ul style="list-style-type: none"> Capable of display of calendar data and user input Capable of synchronization with desktop computers and network databases Wireless IEEE 802.11 2Mbps or 11Mbps communications link capability Keyboard, Display 	Palm OS, Windows CE, JVM, Windows, etc. Internet Browser Intelligent Telephone

4.4.3 Thin Client Network Appliances

Table 4-6: Thin Client Network Appliances

Device Type	Features	Software Operating Environments
Thin Client	<ul style="list-style-type: none"> Network Computer System VGA display (or TV alternative) Ethernet LAN Capability (or 56k dialup) DSL compatibility Keyboard, Diskette, 64-128Mb RAM Audio capabilities 	JavaMachine, Windows, Linux, WebTV, etc. Productivity Suite Browser

4.4.4

4.4.5 Conventional Multimedia Personal Computers

Table 4-7: Conventional Multimedia Personal Computers

Device Type	Features	Software Operating Environments
Conventional Multimedia Personal Computer	<ul style="list-style-type: none"> • Full Function Computer System • PC-Celeron 400Mhz or Pentium III 350Mhz • Mac G3, G4, iBook, iMac 350 Mhz • VGA display, RGB display (Mac) • 4.3 Gb Hard drive, CD-ROM 16x • Ethernet LAN Capability 10/100 Mbit (or 56k dialup) • DSL compatibility • Keyboard, 64Mb RAM, USB • Audio capabilities 	Macintosh OS9, Windows 9x or 2000, Linux

4.4.6 Refurbished Multimedia Personal Computers

Table 4-8: Refurbished Multimedia Personal Computers

Device Type	Features	Software Operating Environments
Refurbished Multimedia Personal Computer	<ul style="list-style-type: none"> • Full Function Computer System • Pentium 200MMX or faster - • MAC First generation iMac 300 Mhz • VGA display • 2.1 Gb Hard drive, CD-ROM 8x • Ethernet LAN Capability 10/100Mbit (or 56k dialup) • DSL compatibility • Keyboard, Diskette, 32-64Mb RAM • Audio capabilities 	Macintosh OS9, Windows 9x or 2000, Linux

4.4.7 Quotation Format

Vendors who wish to provide Hardware Quotations as part of their proposals should attach a table in this format to the proposal. For each type of device quoted they should indicate pricing in quantity three ranges. They should make their quotations effective for 120 days and attach hardware and software specifications. Do not combine hardware and software in quotations.

Vendors may also use this for Operating System software quotes. For each type of OS quoted they should indicate pricing in three quantity ranges. They should make their quotations effective for 120 days and identify specific versions. Do not combine hardware and software in quotations.

Table 4-9: Hardware or Software Quotation

Edge Hardware Type	100-500	500-5000	5000-50,000
Handheld Devices			
Wireless Portable Internet Devices			
Thin Client Network Appliances			
Conventional Multimedia Personal Computers			
Refurbished Multimedia Personal Computers			

4.5 VES Procurement and Implementation Assumptions

These are the set of assumptions on which vendors should base their proposals. Any proposals based on other assumptions should clearly state those assumptions, their rationale, and the rationale for proposing changes to the assumptions in this Section.

For purposes of this section, the expression "run transparently" means: providing identical functionality and comparable elements of the user interface.

4.5.1 Overview and Need for Assumptions

There are a number of important reasons why the documentation of a set of operating assumptions is necessary in the specification of requirements for VES:

- User organizations need to understand the hardware, software, and communications capabilities needed to make the best use of VES.
- Proposing vendors need to have the scope of deployment options and end user configurations narrowed to a practical set of options.
- Proposing vendors need to understand the requirement to focus on a few key core technologies, rather than to impose a confusing, redundant, and inconsistent set of requirements on users.

4.5.2 Assumptions about User Hardware

For purposes of VES proposals it should be assumed that users have either:

- IBM PC Compatible - Pentium 166Mhz, 64 Mb RAM, 2 Gb HD, multimedia, etc.
- MAC Compatible - PowerPC 5200, 32 Mb RAM, multimedia, etc.

All VES applications must run transparently on both end user hardware configurations.

In addition, users **may** have one of the following:

- IBM PC Compatible Laptop Computer - Pentium class, 32 Mb RAM,
- MAC Powerbook 1400 or Powerbook G3, 32Mb RAM Computer
- PalmPilot or comparable PalmOS device
- Windows CE device

All VES applications with Synchronization requirements must be able to synchronize transparently on these hardware configurations.

4.5.3 Assumptions about User Software

For purposes of VES proposals it should be assumed that users have either:

- Windows 9x or 2000
- MAC OS 8.6 (Powerbook 1400& PPC5200) or OS 9

All VES applications must run transparently on both end user software configurations.

No assumptions about user productivity software should be made except that users will have:

- Word Processing software
- Adobe PDF Document Readers

VES applications should not depend on the features of particular productivity suites, but can depend on the availability of a Adobe PDF Reader to display and print documents (where printers are available).

4.5.4 Assumptions about User Connectivity

For purposes of VES proposals it should be assumed that users have either:

At their School or Office Location:

- T1 Internet Connectivity or equal
- LAN

Home or Community Location:

- 56k Dialup Internet Connectivity
- ADSL
- Cable Modem

All VES applications must run transparently on all listed end user communications configurations.

4.5.5 Assumptions about User Browsers and JVM

For purposes of VES proposals it should be assumed that users have either:

- PC - Microsoft Internet Explorer 5.0 or greater, with JVM
- PC - Netscape Communicator 4.6 or greater, with JVM
- Mac - Microsoft Internet Explorer 4.51,5.0 or greater, with JVM
- Mac - Netscape Communicator 4.7 or greater, with JVM

All VES applications must run transparently on all listed end user browser configurations.

4.5.6 Assumptions about other Client Software

For purposes of VES proposals it should be assumed that users have either:

- H.323 VoIP and Conferencing Client
- T.120 Whiteboard Client
- POP3 Email Client
- Streaming Video Client (Quicktime or RealMedia)

All VES applications must run transparently on all listed end user client configurations.

For other client services software including communications, collaboration, media, etc., proposing vendors should provide a no cost downloadable client plug-in or application, or specify a no-cost industry standard client software which is generally available.

4.5.7 Assumptions about Hosting Server Environment

For purposes of VES proposals it should be assumed that the Hosting Server Environment will support:

Application Server Environment:

- Windows 2000 Server, with ASP
- Linux with Java Servlets
- Mac OS9, OSX Server

Web Server Environment:

- Windows 2000 Server, with IIS
- Mac AppleShare, WebStar, Apache Web Server
- Linux with Apache Server

Database Environment:

- Windows 2000 Server - SQL Server V7
- UNIX Oracle 8

All VES applications must be designed to run on one Server and one Database environment, meet at least VESIA Level 1 requirements, and be transparent to users running assumed configurations.