The VistA Open Source Project

Building an Open Source Software community

supporting integrated Healthcare Information Systems

for the 21st Century

DRAFT

a report by

Joel West, Ph.D
Joel.West@sjsu.edu
Associate Professor
San Jose State University

and

Siobhán O'Mahony, Ph.D
somahony@hbs.edu
Assistant Professor
Harvard University.

December 31, 2003

Contents

Executive Summary

VistA is an integrated healthcare information system developed over the past two decades by the Department of Veterans Affairs[1] (VA) to serve the needs of more than 25 million VA eligible patients. The VA is the largest single integrated health care system in the United States and VistA has been deployed successfully throughout the entire organization. VistA has recently gained widespread attention as a model information technology system that could be widely deployed by private, non-profit and government health care providers in the creation of a robust national healthcare information infrastructure. To date, VistA has been deployed in a variety of domestic and international settings and has significant global potential to improve healthcare information management.

The VistA Open Source Project is an Open Source development project to develop the VistA source code for the global healthcare market. The VistA Open Source Project includes the necessary technical infrastructure to maintain the VistA source code and coordinate the activities of VistA developers and users. A prototype VistA Open Source Project infrastructure is currently online and provides the necessary support for project coordination, code access, bug tracking, versioning and community participation.

To support the VistA Open Source Project, the Vista Software Foundation, a non-profit 501(c)(3) organization has been created to provide assets to the project and hold these assets in a trust for the benefit of public and private stakeholders. Key VistA Community stakeholders will receive advance drafts of the VistA Open Source Project and Vista Software Foundation community plans. Collaboration is sought in the development of a robust governance structure for the project and foundation that will ensure that the diverse needs of VistA constituents are successfully met.

---

[1] In March 1989, the Veterans Administration became the U.S. Department of Veterans Affairs, a Cabinet-level position.

1. Introduction

This report presents a plan to formalize an open source community of developers, users, companies and public/private organizations interested in the transfer of VistA[2] to non-VA settings. The intent of the VistA Open Source Project is to extend the proven VistA code base, which has been used for more than two decades to provide superior patient management capabilities for millions of patients in VA hospitals.

This report:

- Explains the objectives of the VistA Open Source Project
- Identifies relevant stakeholders in the VistA Community
- Presents a plan to integrate members of the VistA Community
- Proposes an essential role and governance structure for the Vista Software Foundation

Only minimal information regarding the architectural design and other technical aspects of the VistA software itself are provided. Interested parties should consult the *VistA Technology Roadmap and the VistA Documentation Library* (see References for more information) for more details.

After summarizing the history of the VA's sponsorship of VistA and VistA's capabilities, this report shows how VistA is appropriate for an Open Source project. It then describes how the VistA source code provides the basis for the VistA Open Source Project, and how wide spread efforts to develop and maintain the VistA source code outside the VA will be integrated. The report concludes with a description of the proposed Vista Software Foundation and suggests milestones for launching a robust Open Source VistA Community.

---

[2] In this report, the term "VistA" when used alone refers to the software product developed by the VA. The terms "VistA Open Source Project", "Vista Software Foundation" and "VistA Community" are generic terms used to describe the actual project, the organizational body and the community of individuals who contribute to the success of VistA outside of the VA.

2. Background

2.1 VistA — A Proven Healthcare Information System

2.1.1 DHCP Becomes VistA

In 1982, the Veterans Health Administration (VA) of the U.S. Veterans Administration began an effort to automate more than 150 medical centers. The result was the Decentralized Hospital Computer Program (DHCP), which was deployed and in use at most VA facilities by 1985. In 1996, the VHA introduced an updated graphical version of DHCP under the name VistA (Veterans Health Information Systems and Technology Architecture). Additional modules were added over time to meet growing clinical and administrative demands. Today, the integrated VistA system comprises more than 100 modules, including electronic medical records, computerized physician order entry, medical imaging and systems for laboratory and pharmacy services. VistA is used by the VA to deliver health care to nearly 5 million patients across 1,300 sites in the U.S. (VA 2003; Marshall 2003; Medsphere 2003).

A spin-off of the DHCP/VistA technology is also in use in other government agencies and healthcare organizations around the world. In the early 1980's, the nation of Finland adopted a version of VistA in the creation of their national healthcare information system. In the mid 1980's, the Department of Defense contracted with Science Applications International Corporation (SAIC) and a group of former VA programmers to make a derivative system known as Consolidated Health Care System (CHCS). Later, the Indian Health Service leveraged the VistA code in the creation of their healthcare information system called Resource and Patient Management System (RPMS). Multiple other small and largescale implementations have demonstrated the diversity and flexibility of the platform in non-VA settings (VA 2003)

The VA continues to actively develop VistA to meet its own growing organizational needs. In fact, the VA has been able to objectively show the impact of VistA on the quality of care delivered at the VA (Jha 2003). The VA has also been actively involved in industry efforts to improve the standardization, adoption and implementation of information technology to improve healthcare quality and patient safety. In March 2003, the Department of Health and Human Services and other agencies announced a Consolidated Health Informatics initiative to promulgate VistA's record formats for use in Medicare, Medicaid and Department of Defense patient records. In November, the VA took the lead in bringing federal health care agencies and members of the private sector together to discuss a "virtual health system" of interoperable electronic medical records, termed "HealthePeople". VistA is widely considered as a foundation element in the creation of a National Healthcare Information Infrastructure (NHII).

2.1.2 MUMPS

DHCP and all subsequent incarnations (including VistA) were written primarily in the MUMPS programming language (a graphical user interface, written in Delphi, was later added). The MUMPS language is known for combining a higher-level programming language with an integrated multi-dimensional datastore. Because of its ease in manipulating database records, and

its origins in hospital research, MUMPS[3] has become an industry standard component for commercial healthcare information systems. MUMPS became a U.S. standard in 1977 (ANSI 1977), and through ANSI, was submitted to the ISO to become an international standard. The latest version of the ISO/IEC 15851 standard for MUMPS (aka "M") was approved in 1999. Because it has been primarily used in a single vertical market (health care), MUMPS is sometimes disparaged by industry experts and computer science purists for its age, its quasi-English syntax, or the fact that some implementations are interpreted . The reality is that MUMPS effectively incorporates a middleware abstraction of data storage that provides platform independence and allows for compact expression of common database concepts.
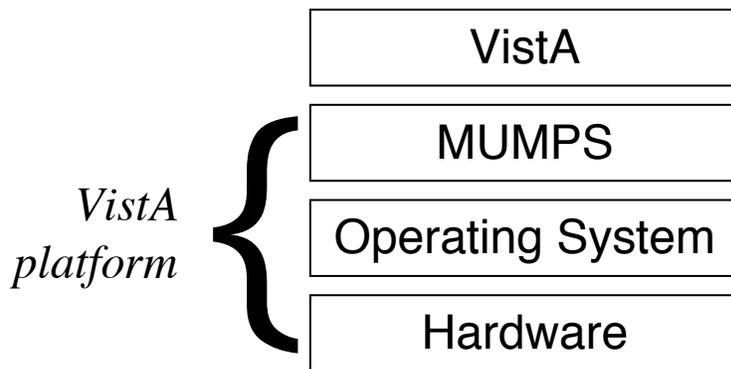

Figure 1: VistA source code and supporting platform

Due to the reliance on MUMPS, VistA has been traditionally limited to those platforms (combinations of hardware and system software) that provide a viable MUMPS compiler or interpreter (Figure 1). This dependence has also led to concerns about the viability of VistA in non-VA settings given the perception of a legacy system, limited MUMPS programming expertise and alternative technologies gaining popularity.

2.1.3 Diffusion of Public Domain Source

Because the Federal government cannot, by law, hold a copyright on software developed with tax dollars, the VistA (née DHCP) source code is in the public domain. This allows potential worldwide diffusion. The current mechanism for diffusion is the 1966 Freedom of Information Act (FOIA), which mandates disclosure of most Federal government records, except for a few categories such as valid military secrets. Among various provisions, the Act allows individuals and groups to request that specific information be disclosed.

---

[3] MUMPS was developed in 1966-1967 at the Massachusetts General Hospital in Boston; the acronym stands for Massachusetts General Hospital Utility Multi Programming System. The programming language is also referred to as "M"; commercial implementations are sold under brand names such as "DSM" or "Caché" (Industry Research, 2003).

For more than 20 years, the FOIA has been used by nonprofit, commercial and foreign entities to obtain copies of the VistA source code. Through such FOIA requests, versions of VistA are in active use in Finland, Germany, Egypt and Latin America, as well as by a number of state and local health care systems in the United States. Examples of external VistA user organizations can be found in Hardhats.org (2003), Marshall (2003) and Medsphere (2003). Each FOIA distribution has been a static snapshot of the VistA code as of that date. There is no formal mechanism to incorporate changes after the date of the request, although some recipients have applied subsequent patches distributed by the VA. Each VistA adopter has also modified and adapted the source code to meet local needs, but improvements have not been widely circulated.

As a consequence, there are dozens if not hundreds of different versions of the VistA source code in use outside the VA, each based on a different original code and each with customized adaptations. This has resulted in considerable duplicated effort, which could be reduced (if not eliminated) by applying the established Open Source software development principles. Innovations made independently could, if integrated, promote further cumulative development of the software for the benefit of the VA as well as other users.

2.2 Collaborative Development Using Open Source Software

The distribution of the VistA source code outside the Department of Veterans Affairs via the Freedom of Information Act means that, in some senses, VistA is an "Open Source" project already. However, independent efforts using the public domain code differ from traditional "Open Source" projects such as the Linux operating system and the Apache web server that are managed by a community of developers and users.

Such projects have a number of characteristics in common. Each has a common source code repository shared by all user-programmers, so that everyone has access to the same source code and changes made by one are available to all. To coordinate the development and integration of these changes, each project has some form of central authority over features and release schedules, oriented towards producing a sequence of integrated distributions of the source to various commercial and non-commercial users.

These projects differ in at least three important ways:

- *License terms*. The Open Source Initiative has defined a wide range of licensees that can be classified as "Open Source" (OSI 2003). These licenses are generally subdivided into two groups: those that incorporate the "copyleft" feature, and those that do not (Fink 2002). Copyleft is a method for "requiring all modified and extended versions of the program to be free software as well" (FSF, 2003). The Linux operating system is covered under the copyleft license, while the BSD operating system and Apache web server are not.

- *Provision of Labor*. Some Open Source communities began and remain supported by individual and non-profit volunteers. However, for-profit corporations play an increasingly important role in most Open Source projects. This might include employees of Internet service providers working on the Apache web server, or engineers at system vendors who make key modifications to Project GNU's *gcc* compiler or the Linux operating system. As project relations are managed independent of organizational

affiliation, the efforts of these 'sponsored contributors' are evaluated on their own merits: on the same terms as volunteer contributors.

- *Success*. While the visibility and popularity of key Open Source projects in the past decade have spawned a wide range of projects, the distribution of results has been highly skewed. A few projects are highly successful, but the vast majority attracts no outside developers and in most cases become abandoned "deadware" (Healy & Schussman, 2003).

Research is underway to explain why some projects are successful and others are not. A few projects have key inherent advantages, such as a large number of potential users who are skilled in software development. Still, projects targeting smaller, more focused audiences (such as web server administrators) have also been successful.

It is clear that the design of an Open Source community and its relationship to the technology play an important role in the success of a project. Projects must identify and attract skilled programmers (either volunteer or corporate sponsored), enable a sustainable motivation for ongoing contributions, and provide a structure for leading and channeling such efforts toward an identifiable shared goal. Software produced under these conditions can then, in turn, be used by different types of contributors to meet particular commercial or private needs.

The two most successful and best-known Open Source projects are the Apache web server and Linux operating system. Although both started as grassroots efforts, both have evolved to partner with governments, Fortune 500 firms and small businesses. Other projects worth modeling — because of their cooperation between volunteers and sponsors — include the OpenOffice business productivity suite (sponsored by Sun), the Darwin version of BSD Unix (sponsored by Apple) and the Mozilla web browser (formerly sponsored by Netscape).

2.3   VistA as an Open Source Project

The demand for integrated medical information systems is real. Outside the federal government, U.S. health care organizations spend more than $20 billion each year on information technologies, and yet health care providers either use a hodgepodge of systems that fragment user skills from patient management or do not maintain electronic health records at all. The American Academy of Family Physicians (AAFP) reports that although 95% of its members have practice management systems, fewer than 10% use an electronic health record. The AAFP would like half of its members to use electronic health records by 2005. Multiple other specialty organizations and government entities have also had a renewed interest in the widespread dissemination of affordable and effective healthcare information technology solutions.

The VistA technology has a proven track record within the VA and, as has been shown by various FOIA distributions over the last two decades, can be readily adapted for use in public, private, acute care, ambulatory, and international settings. VistA has the potential the meet the market needs for an affordable, integrated and proven healthcare information technology solution. The challenge will be to assist healthcare organizations in the development, deployment and support of VistA in non-VA settings. While the VA can actively promote the adoption of its crown jewel VistA, it cannot officially encourage nor discourage its use in the private sector and must carefully avoid any potential conflicts of interest with commercial VistA implementers.

The VA is further challenged to ensure some level of guidance over the direction non-VA users take the VistA code.

To date, there has been no mechanism for the VA to resolve this dilemma or interact with the growing community and industry interest in VistA. The VA has created a special Healthcare Information Technology Sharing (HITS) program to assist in the technology transfer of VistA, but there is no mechanism to engage those they intend to assist. A "buffer organization" that would provide a neutral forum to enable the VA to collaborate with a robust, diverse community interested in private sector adoption of VistA will provide a mutually beneficial solution to this dilemma. With an Open Source project, and a supporting neutral non-profit Foundation, the VA will be better able to engage a growing VistA Community without jeopardizing their mandated neutrality.

The formal creation of a "VistA Open Source Project", patterned after other successful Open Source projects appears to be the appropriate resolution to the aforementioned challenges. As with any Open Source project, to assure long-term success, the VistA Open Source Project must build a vibrant and sustainable community of programmers and users. As other successful projects have shown, the formal creation of a supporting foundation (The Vista Software Foundation) can ensure the continued robust development of mission-critical, enterprise solutions.
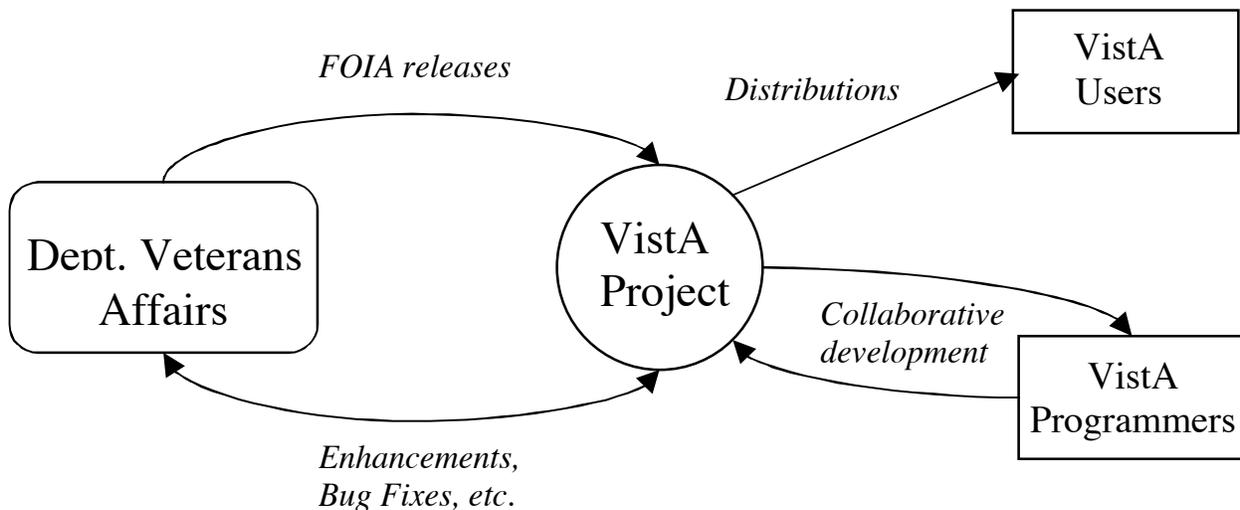
Figure 2: Relationship of VistA Open Source Project with VistA Community

The goals of the VistA Open Source Project are the following:

- Eliminate needless and redundant development labor by integrating external programming efforts into a single unified copy of the FOIA source code (a gold standard code base to work from);

- Attract a new community of VistA programmers to maintain the source code and enlarge the current talent pool of VistA programmers;

- Migrate the technology to facilitate future convergence between the VA and community copies of VistA code bases;

- Enable innovations and improvements to meet needs not contemplated by the VA's internal programmers;

- Provide fair and equal access to the shared technology to all comers; and

- Address the concerns of all relevant stakeholders, including the VA, external VistA users and programmers, and groups seeking to spread VistA technology worldwide.

The remainder of this report proposes how to nurture such a community, drawing from our understanding of what makes Open Source communities successful.

3 The VistA Open Source Project

The VistA Open Source Project refers to the public domain version of the VistA source code maintained by the VistA Community, as well as the Open Source development infrastructure and processes used to support that code base.

3.1 Activities

The VistA Open Source Project builds upon the VistA source code periodically released by the VA under the Freedom of Information Act (FOIA) and integrates contributions from developers and users world-wide. The project will model other successful Open Source projects by providing the following:

- Access to source code and development tools
- Bug reporting, tracking, and verification of resolution systems
- Periodic releases that are stable enough for production use by health care providers
- Infrastructure to support the above processes

In addition, the VistA Community will build a shared repository of technical documentation, support materials, success stories, and lessons learned from VistA implementations in non-VA settings.

3.2 Source Code

An obviously crucial activity for the VistA Open Source Project is to maintain a repository of VistA source code, including the latest stable build, older formal releases and newer experimental ones. As new FOIA releases become available from the VA every 2-6 months, VistA community programmers will merge the VA's newly released VistA code with the current VistA Open Source Project code base. In many cases, standard tools will make this merge automatic; in other cases, the judgment of one or more skilled VistA programmers will be required to reconcile conflicting changes by VA and non-VA programmers since the last merge.

If the VistA Open Source Project code was only an external copy of the VistA code, then its value would be limited. But the reality is that VistA is designed to meet specific needs of the VA, which has its own specific information technology platforms (hardware, OS, MUMPS interpreter, etc.) and specific functionality requirements (VA specific modules). Current deployment of VistA within the VA relies on proprietary platforms that are too expensive for small and medium sized U.S. health care installations — let alone users in developing countries. External users of the VistA Open Source Project will have a wider range of platform choices (Table 1) through the development efforts of an active VistA Community. In addition, some of the VA's design objectives are not applicable to external users, whereas some of the features crucial for external use (e.g. Financial/Billing, Emergency Department, OB-GYN functionality) would not be supported by the baseline VistA.

	VA Users	*External Users supported by the VistA Open Source Project*	
Code base	VistA	VistA	VistA
MUMPS compiler/interpreter	Caché	GT.M	*Multiple*
Operating system	OpenVMS Windows NT	Linux	*Multiple*
Hardware architecture	DEC Alpha	x86	*Multiple*

*Table 1: Comparison of Platforms used by the VA with
those supported by the VistA Open Source Project*

If external users of VistA decide that the VistA Open Source Project does not add enough value over the FOIA releases, then multiple external copies of VistA may emerge. These multiple versions, or "forks" of the original source code can lead to redundant investment, incompatibility and reduced adoption of the technology. A well run VistA Open Source Project that achieves the objectives of the VistA Community will reduce the risk of forking.

Therefore, to provide a common starting point for all external uses of the VistA source code, the VistA Open Source Project source code needs to:

- Incorporate known fixes for external uses, such as work-arounds for other MUMPS interpreters
- Provide a plug-in architecture to allow for external modules to support design goals beyond those of the VA

A proposed roadmap of the VistA Open Source Project's specific technical goals can be found in the *VistA Technology Roadmap (see reference)*.

3.3   Issue Tracking

Any sizable software development project needs a formal bug tracking system. This one must be able to support bug detection and correction from programmers distributed around the world. The goals of such a system would include:

- Reporting new defects by users or programmers, including (where possible) detailed information on how to reproduce the problem

*DRAFT VERSION – December 31, 2003
The VistA Open Source Project*

- Logging responses from responsible programmers as to work-arounds or other clarifications, as well as documenting the date in which the defect was corrected
- Searching for existing defects by users to reduce redundant reporting and provide feedback to users about known problems

An Open Source bug tracking system should make the activities transparent to all users, programmers, system administrators and other interested parties. Unlike a closed-source system, public discussion of defects is a strength and not a weakness for Open Source projects. This is because competing perspectives on the source and solution of technical problems from users in different computing environments helps unearth more efficient and robust solutions. Many Open Source projects have found that their users' diverse technical expertise and computing environments allows for many more permutations of bug testing and correction than could be reasonably supported by one firm.

Most modern software projects integrate tracking of actual software defects with the tracking of related issues, including:

- Planned enhancements
- Feature requests
- Other development tasks

Thus, the choice of a bug tracking system requires deciding whether to narrowly focus on software defects, or to use the system more broadly to identify and prioritize development activities.

3.4   Releases

A major concern of any Open Source project is combining the work of the Open Source community into a usable form that can be deployed to the intended users. This effort is normally referred to as a "release," and is one of the most important responsibilities of any Open Source project. For The VistA Open Source Project, release decisions will be made by the project's technical leaders, in consultation with various stakeholders (Section 4 will describe stakeholders and governance in more detail). The need to do periodic releases will be driven by a variety of imperatives, including the availability of updated code from the VA, the addition of new features desired by the VistA Community, as well as the need to maintain compatibility with platform elements.

At the same time, the release process for Open Source software is fundamentally different from those for proprietary software. While commercial software development is initiated and managed with explicit release dates in mind, Open Source software projects tend to be released only after contributors agree that certain objectives have been realized. As such, the release process requires value judgments to balance two conflicting goals:

- Disseminating enhancements (new features, bug fixes, etc.)
- Allowing adequate time for testing, qualification and deployment of the proposed release

As with commercial software development, short release cycles generates an excess testing load and makes new software available more rapidly than it can be evaluated and assimilated by user organizations. With longer release cycles, users do not benefit from better features, reliability or

performance improvements that programmers (internal and external to the VA) have worked so hard to develop. In some cases, release coordinators must also decide between conflicting implementations of a given enhancement, or decide when it is time to deploy experimental implementations. Such "branches" are one of the strengths of Open Source projects, but it must be up to the release coordinators to decide when to fold the "branch" back into the source code "trunk".

3.5 Technical Infrastructure

The VistA Open Source Project will require a technical infrastructure necessary to host the several million lines of source code and thousands of members. The hosting environment will be selected by the founding members to ensure the required capacity to meet expected demand.

3.5.1 Server and Internet Connection

The central element of the project's infrastructure will be a reliable 24/7 server with a broadband Internet connection. A combination of Open Source applications would be used to support the VistA Open Source Project:

- *Web server*. The logical choice is Apache, the most popular and versatile.

- *Downloads*. For those who want to download a complete distribution, this could be provided by existing ftp or http servers.

- *Source code repository*. The most popular and proven technology is CVS (http://www.cvshome.org/), but an improved repository underdevelopment is Subversion (http://subversion.tigris.org/).

- *Online source code browsing*. If using CVS, the separate CVSWeb tool is available.

- *Defect and issue tracking*. The most popular is BugZilla (http://www.bugzilla.org/), which is used by Apache, Linux, Mozilla, Gnome and KDE. The IssueZilla variant of BugZilla can be used to track a wider range of action items, but a newer alternative is Scarab (http://scarab.tigris.org/).

- *Mailing list management*. There is a wide range of such tools. This is a matter of personal preference, except that the authentication and data management should be (if possible) integrated with the source code repository and/or issue tracking.

- *Remote administration and security tools*.

- *Backup hardware/software,* including offsite storage of backups to protect against catastrophic disasters (e.g. an earthquake).

Given the applications available to meet these requirements, the server environment will be Linux.

3.5.2 Hosting Alternatives

The Project will need to decide to what degree it wants to administer the server and its activities directly. This can be done with either paid staff or an extremely dedicated group of volunteers. Initially a company or other organization providing in-kind support to the VistA Open Source Project could bootstrap the project hosting the code. Once the project attracts predictable and ongoing financial support, the server's Internet connectivity and basic administration can be

outsourced through collocation at an Internet service provider. Another alternative would be to outsource all infrastructure operations to a turnkey service provider such as Collab.Net.

If the project is buying its own system, calculations need to be made as to the required system bandwidth, storage capacity and performance commensurate with the expected demand during the lifetime of the system (ca. 18-36 months). If operations are outsourced, some or all of these capacity decisions can scale as demand requires.

3.5.3 Development Environment

Providing a source code repository allows globally dispersed programmers and users to make use of that source code. The project needs to designate one (or more) supported development environment that is proven to be compatible with that source code. The development environment decisions would recommend development platforms, compilers, an integrated development environment, debugging tools etc. Some of these issues are intimately tied to the target deployment platform, in particular the provision of a MUMPS compiler or interpreter. Consult the *VistA Technology Roadmap* for further details.

3.6 Subprojects

3.6.1 Role of Subprojects

An important institutional innovation of the Apache project was the decentralization of development into various subprojects. This approach was deliberately emulated by the OpenOffice project. The use of subprojects allows development to proceed independent of the constraints from the main project, and allows experimental development to begin without affecting the development of code used in active production. Each subproject will have its own technical leadership, which might (or might not) overlap with the overall VistA Open Source Project. Each subproject would also be supported by the technical infrastructure, with a dedicated subproject space on the source code repository and necessary mailing lists.

3.6.2 Examples of Subprojects

The VistA subprojects might include:

- Subprojects to replace code not released by the VA (financial systems, etc)
- A subproject to develop a general-purpose plug-in module architecture, to allow such modules to easily be developed without understanding the complexity of the entire VistA code base (Modularization, API wrapping, etc)
- Subprojects for specific modules to support common requirements of VistA users (ER, OB-GYN, ICU, etc)
- Subprojects to develop and maintain support for platforms beyond those supported by the VistA code base (rehosting efforts)
- Documentation and help for external users (reference guides for documentation library)
- Localization and Internationalization for non-English languages

3.6.3 Incubating New Subprojects

The VistA Open Source Project will also emulate the proven model for identifying and launching new subprojects. Both Apache and OpenOffice use the concept of an "incubator", where new subprojects begin their probationary existence. After demonstrating a feasible technology and self-supporting development community, these probationary projects are "hatched" into fully supported subprojects. Subprojects that fail to achieve critical mass are cancelled rather than languish indefinitely as "deadware."

3.6.4 Module Referral

Another important aspect of the success of Apache has been encouraging the independent development of plug-in modules (both free and for profit). The VistA Open Source Project will maintain a "VistA Module Registry", a database/ directory of related modules with links to the author's respective websites. This will be modeled on the Apache Module Registry (http:// modules.apache.org).

3.7 Community Participation

3.7.1 Access to Source Code

There are two decisions that must be made about the control of the source code that forms the heart of any Open Source project:

- *How much access is available to non-members?* Some sites allow browsing of source code (or mailing list archives) by non-members, others restrict it to registered users.
- *Who should be allowed to change the source?* The latter is a fundamental (and as yet unresolved) problem common to all Open Source projects. Not everyone who reads the source code will contribute changes, and not all contributing users to most Open Source projects have direct "commit access."

The latter is tied to fundamental assumptions about the role of hierarchy in the day-to-day technical management of Open Source projects. Raymond (1999) bifurcated Open Source projects into two archetypes, the cathedral and the bazaar. Such extremes have been subsequently misunderstood; today there are very few pure examples of either case:

- *No cathedrals.* Raymond's "cathedral" exemplar was the family of BSD operating system projects. Through their tight membership requirements, these teams squandered a tremendous technological lead during the 1990s and now lag more open Linux-related projects. As such, subsequent Open Source projects have rejected the purest form of the cathedral model.
- *No bazaars.* Despite misconceptions to the contrary, even the Linux kernel team is not a pure bazaar, since key decisions are made by an undisputed leader and an inner ring of key lieutenants (Moody 2001).

Open Source projects usually distinguish between four types of programmers:

- *Users:* Those who provide minor changes, or bug fixes.
- *Developers:* those that contribute a small number of changes
- *Committers:* those who have proven themselves through a series of valuable contributions and are granted direct access to the source code repository
- *Leaders:* the most experienced and knowledgeable committers, who make decisions about project direction and release, as well as control access to the source code

Submission of source code changes will require execution of an agreement assigning rights (or a license) to the VistA Open Source Project. The agreement details are not yet finalized but will be modeled on other projects. Both Apache and OpenOffice require all who contribute code to sign a "Contributor's Agreement" to ensure clean and reliable ownership of the code. Contributors most likely would retain individual rights to their work while assigning rights to the Vista Software Foundation.

3.7.2 Levels of Participation

As with any public Open Source project, access to download the VistA source code should be free and open to all comers.[4] It is anticipated that prospective members would be provided instant registration, in which they choose a user name and password, and provide certain basic information (such as their e-mail, organization name, and some indication of technical proficiency). At the same time, there will be distinctions made among participants, including rights to modify the source code repository and make decisions regarding the main project or specific subprojects. As with other decisions, the Apache project offers an example (Table 2).

---

[4] The project team needs to verify that there are no U.S. export control restrictions on the distribution of VistA or VistA source code.

Category	Role
Users	Provide bug reports and feature suggestions; peer-to-peer tech support on e-mail list/user support forum.
Developers	Contributes code or documentation by sending patches to an e-mail list.
Committers	Regular contributors who have write access to source code repository, and an official project e-mail address
Project Management Committee	The lead committers of a project who make decisions about those projects
Foundation Members	Approximately 100 of the most active contributors, who are nominated by existing members
Foundation Board of Directors	Once a year, Foundation members elect a Board of Directors and Chairman

Source: Adapted from Apache Foundation, http://www.apache.org/foundation/roles.html

Table 2: Levels of Participation in the Apache Project

Legal control of the VistA Project's assets will be in the hands of foundation members. Normative control of the code is in the hands of all types of contributors. A certain level of stability and predictability is required for a project to attract cash and in-kind donations.

The VistA Project's stability and legitimacy would thus benefit from having a permanent and formal sponsoring organization, such as a non-profit foundation. This parent organization, the Vista Software Foundation, will serve as a conduit for resources and funding, and provide a definitive authority for managing collective resources. The Apache Foundation offers one of the earliest and most successful models for such an effort.

3.7.3 VA Participation

Supporting a vibrant, global development community contributing to the VistA Open Source Project is in the best interest of the VA. The VA has a talented pool of programmers familiar with VistA, but 20% of them plan to retire within the next five years, and half of them plan to retire within the next ten years (VA, 2002). Furthermore, almost one quarter of VistA programmers are concerned that their skills will become obsolete or that they are not sufficiently technically challenged - a frequent source of turnover for technical workers (VA, 2002). Fortunately, most VistA programmers within the VA indicate that they are interested in learning new things and want to realize their full potential (VA, 2002).

DRAFT VERSION – December 31, 2003
The VistA Open Source Project

The VistA Open Source Project will assist the VA in achieving its objective of a skilled labor force of expert VistA programmers. Large Fortune 500 companies that have introduced Open Source projects to their programmers have found that these projects can be a powerful retention tool. Open Source projects allow programmers greater technical challenge and a chance to work on cutting edge development work, which in turn, allows for greater visibility within their relevant technical communities (O'Mahony, 2002). As a result of direct participation in the VistA Open Source Project and the VistA Community, the VA may be better positioned to continue to support VistA and further a healthy and growing worldwide ecology of technical skill and knowledge.

3.8 Choosing an Open Source License

A variety of software licenses have been approved by the Open Source Initiative and thus qualify as "Open Source" (OSI 2003). They primarily fall into three categories:

- "Copyleft" (aka "perpetual") licenses that impose restrictions on the source code to force any derivative works to be held as Open Source. The best known such license is the GNU General Public License (GPL).[5] Many projects by intent or by default are launched using the GPL. For VistA, this would require that all changes to the code must be checked back into the VistA repository.

- Licenses that require acknowledgement of authorship (such as the BSD license or the Apache Software License), but otherwise impose no restrictions on the use of the source code.

- Other licenses that meet the concern of specific sponsors (such as those from Apple, IBM, Nokia, Sun, etc.)

What are the goals of the VistA Open Source Project's license choice? There are three conflicting goals:

1. Encourage the use of the VistA Open Source Project code as the unified distribution of VistA for use outside the VA;

2. Assure that contributions to VistA are widely disseminated to all possible users (including the VA); and

3. Attract a supply of complementary solutions (e.g. modules) to extend the capabilities of VistA for use by commercial, non-profit and government health care providers.

The major decision is whether to utilize a copyleft-style license such as the GPL.[6] In this case, the license would enforce goal #2 at the potential expense of #1 and #3. Also, certain restrictions of the GPL and other copyleft licenses are legally ambiguous in that they have not been tested in court — in particular, defining what level of integration comprises a derivative work. To meet

---

[5] Proponents of such licenses generally refer to software using copyleft licenses as "Free Software".

[6] A legal discussion of the various license types is given by ABA (2002), while competing views of the implications of copyleft can be found in FSF (2002) and Reese and Stenberg (2001).

goal #3, at a minimum, the GPL might be rejected in favor of the Lesser GPL — imposing the copyleft restrictions on the VistA code but not on any additional software written to work with it. This is exactly the purpose for which the LGPL was intended.

While the above discussion provides some good guidelines, the VistA Open Source Project represents a unique licensing challenge as any decision is potentially "trumped" by additional releases of FOIA VistA freely available in the public domain. Given a choice between the unrestricted VistA and a potentially limiting Open Source license for VistA, it seems plausible that, in an effort to insulate proprietary extensions to the core VistA code base, forking could occur.

Therefore, the VistA Open Source Project should use an approved Open Source license such as an Apache, BSD, or Mozilla (most similar to public domain) style license. This provides for the greatest developmental latitude by third parties and therefore increases the probability of further project collaboration. The actual licensing decision will be made in consultation with the Vista Software Foundation board and qualified legal counsel.

4. The VistA Community

The VistA Community comprises a diverse set of stakeholders who create, use, support and promote the VistA Open Source Project. Resources provided by the Vista Software Foundation support the technical development of VistA and assist in nurturing the Vista Community. This foundation is modeled on the Apache Foundation, the first and most successful non-profit sponsor for an Open Source project[7], but is tailored to meet the unique needs of the VistA Community. This plan for formalizing and nurturing the VistA Open Source community draws from studies of other successful Open Source communities (e.g. O'Mahony 2003; Lakhani and Wolf, 2003).

In the end, the organization of the community is up to the community members. Based on other Open Source projects, there is expected to be a startup period of 9-18 months during which the community develops its bylaws, criteria for membership and leadership positions, and elects a permanent board of directions. During this period, the community will be led by an initial group of Founding Members and a Founding Board, who will be selected to represent the broad range of stakeholders in the success of VistA.

4.1 Building an Open Source Community

4.1.1 Stakeholders in the VistA Community

A for-profit business has a well-defined set of stakeholders, with its primary responsibility to the company's owners (shareholders). The stakeholders for a non-profit organization are more complex. And that is particularly true for an Open Source project, which relies on an elaborate interdependence of individuals and organizations to create, maintain and evolve a complex technological architecture.

The VistA Open Source Project has an unusually broad group of stakeholders whose needs must be addressed. Stakeholders include:

- *The Department of Veterans Affairs,* in particular the Department of Veteran Affiars Veteran's Health Administration Office of Information and the VA's Healthcare Information Technology Sharing group. Existing FOIA distributions of VistA code will be a crucial resource for the VistA Open Source Project, and the success of the VistA Open Source Project could also aid the VA with issues such as testing, verification and interoperability. The visibility created by the VistA Open Source Project should also improve the VA's ability to attract and retain skilled technical workers.

- *Existing and potential VistA user sites.* The concerns of the health care organizations that implement VistA are obviously crucial to the adoption and continued use of VistA. Such organizations would include hospitals and provider networks with government, non-profit

---

[7]   For more information on the Apache Foundation, see http://www.apache.org/foundation/

or private ownership. As with any mission-critical information system, their concerns will include reliability, affordability, security, and ongoing maintenance and support.

- *Organizations Implementing and Supporting VistA.* Some users will obtain their copy of VistA directly from the CVS repository, but others will need additional technical and administrative assistance to install, configure and support the system. Firms and non-profit organizations may develop value-added software and services and provide such assistance.

- *VistA developers.* The project will want to draw upon the expertise of those who developed and now maintain the VistA code both inside and outside the VA. This includes former employees of the VA who may now work independently on VistA. A core mission of the Project will be to ensure a growing pool of skilled and experienced VistA developers.

- *Patients and their advocates.* Non-profit and government advocates for health care quality, safety, cost, access, and patient privacy will play a vital role contributing programmatic expertise to improve future health care management modules

- *Sponsors and vendors.* These would include vendors of hardware and services related to VistA deployments.

This community of stakeholders shares an interest in the success of the VistA Open Source Project. The mission of the Vista Software Foundation will be to ensure that these interests are met.
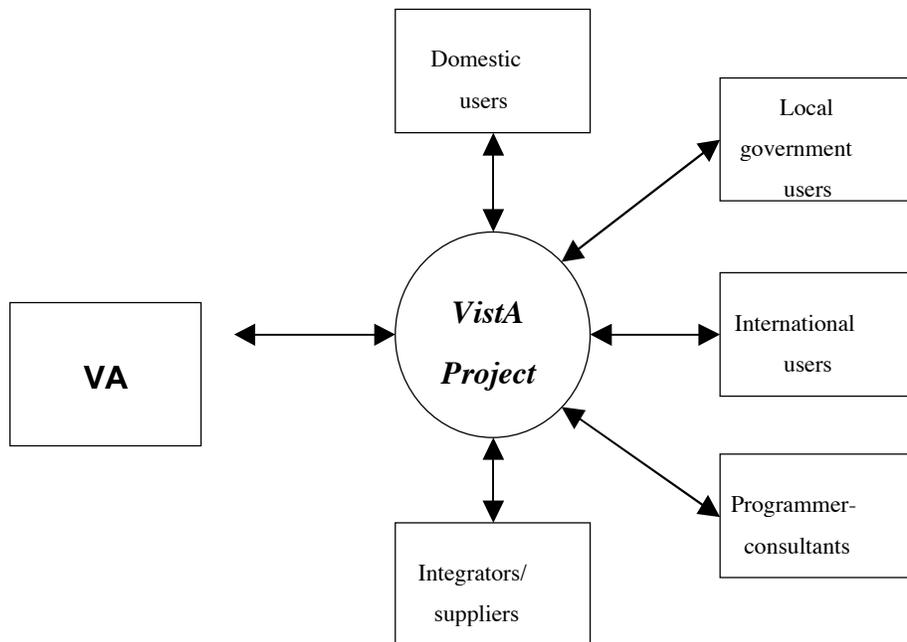

Figure 3: Stakeholders in the VistA Community

4.1.2 Differences from Other Open Source Communities

While the plan for the VistA Community builds upon the experience of other Open Source Communities, there are some crucial differences between the VistA Open Source Project, its Community and most analogs elsewhere in the Open Source world:

- *Central role of the VA*. The Department of Veterans' Affairs developed the VistA technology and has, in effect, donated it to VistA Open Source Project. By default, the VA has an ongoing role that is atypical for decentralized grass-roots Open Source projects and will be a direct beneficiary of the improvements that result.

- *Organizational embeddedness*. Even at its simplest, VistA is not a stand-alone software package like a web server or desktop GUI, but instead part of a complex mission-critical infrastructure. Because of the complexity, the development of VistA will benefit from collaboration with many types of contributors.

- *Healthcare informatics*. Most successful Open Source projects have not required domain specific expertise. Because of the expertise needed to develop future modules to VistA, subject matter experts in health care delivery and patient management will be needed in addition to software developers. The foundation's conception of membership and governance will be structured to reflect the different sources of expertise that will be necessary.

- *Centrality of users*. Because the core VistA technology already exists, the crucial issue for the VistA Open Source Project is deploying it in health care organizations with dissimilar infrastructure and environments. There will thus be less emphasis on overall architectural design issues and more on implementation and application development. As such, the role of user feedback (from both code developers and health care experts) is crucial to the future evolution of VistA.

- *Diversity of stakeholders*. Because reduced health care costs and improved quality continue to receive national attention from both public and private sectors, VistA will be receptive to an unusually diverse group of stakeholders. Industry organizations striving to create common medical records and health standards are potential collaborators.

4.2 The Vista Software Foundation

As with many other Open Source projects, the Vista Software Foundation will serve as the parent organization of the VistA Open Source Project. The foundation's mission is to provide resources to support the future development of VistA and be responsive to the needs of the community's stakeholders, without becoming dominated by any one stakeholder. While the exact structure of the foundation and its membership will be crafted and ratified by its founding members, the overarching goals and structure of the foundation are presented here.

4.2.1 Community Building

In addition to providing resources to support the technical development of VistA, the Vista Software Foundation will serve as a community integrator to a potentially large and growing audience that is currently dispersed and fractured. As a community integrator, the Vista Software Foundation's role will be to:

- Create a common development platform to which technical contributions can be accumulated and disseminated
- Support a central online community forum for the exchange of news, ideas, success stories and lessons learned
- Provide a means for all who work with or contribute to VistA to identify each other
- Develop a vendor neutral participatory governance process
- Facilitate knowledge sharing and learning among all VistA users by hosting community events
- Educate VistA users about improvements and options available to them
- Bring together potential collaboration partners for vertical delivery of VistA through project/labor exchange
- Help others customize and deploy VistA among public and private health care organizations
- Collaborate with other federal, non-profit and private organizations to support standardized secure formats for medical records
- Acquire a diverse and representative group of sponsors to support its mission

4.2.2 Legal Structure

Legally, the Vista Software Foundation will be incorporated as a membership-based, charitable not-for–profit corporation under section 501(c)(3) of the U.S. Internal Revenue Code.[8] As such, individual donations to the foundation are eligible for a tax deduction, but the activities of the foundation will be limited to those allowed by the IRS. This is the organizational form used by other foundations sponsoring Open Source projects, such as the Free Software Foundation, FreeBSD Foundation, Apache Foundation, Software in the Public Interest, the GNOME foundation and the Open Source Applications Foundation. Prior to incorporation, the Foundation will need to have bylaws drafted that specify its policies regarding the Board of Directors, Partners, Membership, Voting, Release Process, Intellectual Property, and Financial Contribution policies.

---

[8] It would be easier to incorporate as a 501(c)(6) trade association, and there would be fewer restrictions on operations (cf. http://www.irs.gov/charities/charitable/ and http://www.irs.gov/charities/business/) However, for legitimacy reasons the Vista Software Foundation should follow prior precedent: recognized Open Source foundations are 501(c)(3) qualified by the IRS or have applied for such status. Another consideration is that unlike 501(c) (3) organizations, donations to 501(c)(6) organizations are not tax deductible.

4.2.3 Members

Membership in the Vista Software Foundation is for individuals (rather than organizations), with each individual member having an equal vote. Unlike other Open Source projects, it is intended that membership not be limited to source code contributors, but to other key stakeholders who may have important programmatic contributions (particularly VistA users who may or may not contribute source code changes).

Voting (on bylaws changes, for the board of directors or other matters) will be limited to dues-paying members in good standing. Additional membership qualifications will be established as part of the development and ratification of the Foundation's bylaws. Membership criteria is likely to include evidence of technical skill or significant contribution to VistA, agreement with the goals of the project and agreement with the project's intellectual property rights policy.

To assure representation of diverse stakeholders, during the Foundation's startup period, voting rights will be entrusted to the Founding Members, who will be selected to represent the interests of each stakeholder group.

4.2.4 Board of Directors

The Board of Directors are responsible for allocating the resources of the foundation to support the efforts of the project, as well as approving any major changes in the structure or the goals of the project. The Board would comprise a small number of members serving staggered one-year terms. The Founding Directors of the foundation will be selected upon incorporation. The exact process for selecting directors will be determined by the Founding Members in approving the foundation's bylaws. However, the following principles will be incorporated in the draft bylaws:

- Directors must be voting members in good standing.
- The Board's nominating committee must develop a list of candidates that represent the VistA Community's diverse range of stakeholders. After publication of the board's nominations, voting members may nominate additional eligible candidates.
- Directors are selected through a popular vote of the members.
- One director's seat is reserved for an employee of the VA, who is nominated by the VA's CIO and approved by the Board.
- No two directors can be employees or officers of the same organization.

4.3   Allocating Community Responsibilities

Various members of the community will play key roles in leading and governing the VistA Open Source Project. These include project technical leaders, the officers, employees and members of the Vista Software Foundation, as well as outside advisory groups.[9] The initial governance structure is shown in Figure 4. The actual governance of the VistA Open Source Project (and how it meets the needs of the VistA Community) will be specified by the bylaws of the Vista Software Foundations, as ratified by its members.

---

[9]   These classifications are not mutually exclusive. All directors will also be members, and project leaders may include technical advisors or employees of sponsoring organizations.

```
                    ┌──────────────────────┐
                    │    VistA Community    │
                    └──────────────────────┘
                                ↕
        ┌──────────────────────┐       ┌──────────────────────┐
        │    Vista Software     │←─────→│       Sponsors        │
        │    FoundationVista    │       │                       │
        └──────────────────────┘       └──────────────────────┘
              │             ↓
┌──────────┐  │  ┌──────────────────────┐       ┌──────────────────────┐
│  Staff   │←─┼─→│   VistA Open Source   │←─────→│      Technical        │
│          │     │       Project         │       │      Advisors         │
└──────────┘     └──────────────────────┘       └──────────────────────┘
                   │          ↓          │
        ┌──────────────────┐    ┌──────────────────┐
        │   Subproject #1   │    │   Subproject #2   │
        └──────────────────┘    └──────────────────┘
                       ↓
              ┌──────────────────┐
              │   Subproject #3   │
              └──────────────────┘
```
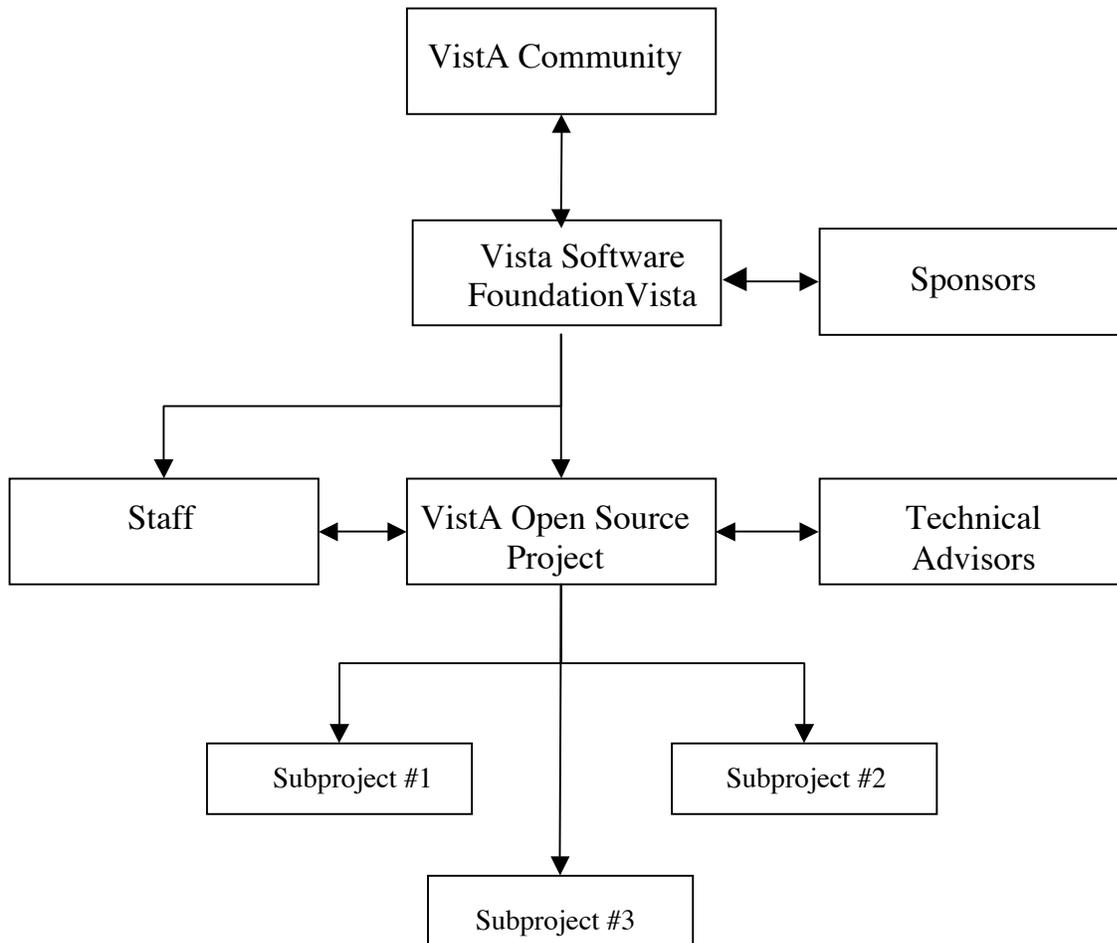
Figure 4: Governance of the VistA Open Source Project

4.3.1 Board of Directors

The Board of Directors of the Vista Software Foundation will have legal control of the key VistA assets, including:

- Intangible assets, including domain name(s), any copyrights, as well as the source code. The VistaProject.org and the VistaFoundation.org domain names have already been claimed in the name of the VistA Open Source Project.
- Tangible assets, such as infrastructure and other equipment
- Cash, obtained through donations and the sale of sponsorships to support the operations of the VistA Open Source Project

In conjunction with VistA Open Source Project leaders, the board will ratify key strategic decisions of the VistA Open Source Project technical leadership, including:

- Creating and deleting subprojects
- Selecting subproject leaders

The board will also have responsibility for setting the criteria for Sponsoring Organizations and accepting applications of sponsoring organizations.

4.3.2 VistA Open Source Project Leaders

Day-to-day control of the technical assets and infrastructure will be delegated to the participants and leaders of the VistA Open Source Project.

Project leaders will:

- Propose new subprojects and subproject leaders
- Set criteria for VistA releases
- Make decisions on specific releases
- Help negotiate among competing technical ideas and solutions
- See that access and membership rights are properly managed

4.3.3 Staff

As budget permits, the day-to-day administration of the VistA Open Source Project will be handled by a paid Executive Director and assistant who will assist with the coordination and operation of the foundation; answer inquiries about VistA, and disseminate information to members, participants and stakeholders.

4.3.4 Department of Veterans Affairs

The role of the VA is TBD, depending on its desires and interests.

4.3.5 Sponsors

Sponsors[10] are companies and other organizations that donate significant cash, equipment and other in-kind resources to the Vista Software Foundation. Examples could include systems vendors, integrators and major existing or potential users (such as the VA, DoD, etc.). The Board will define the associated rights and responsibilities at each different level of sponsorship. Sponsors will have an advisory role and provide input (either individually or as a group) to the directors of the Vista Software Foundation as needed.

4.3.6 Technical Advisors

These are individuals with specific technical expertise relevant to the VistA development. Examples might include current or retired VistA programmers, authors of MUMPS interpreters, or others with technical expertise that is valuable to the project. Technical advisors provide input (either individually or as a group) to the leaders of the VistA Open Source Project.

---

[10] Most Open Source communities define a role for such organizations, terming them "sponsors" or "partners." For examples, see the Debian (http://www.debian.org/partners/) and Mozilla projects (http://www.mozilla.org/foundation/partnerships.html).

5. Going Forward

A prototype VistA source code repository is currently live. However, before the VistA Open Source Project can kick off for collaboration, certain key steps must be taken.

5.1   Technical Milestones

- Set up interim (or permanent) technical infrastructure, including servers, source code, issue tracking and mailing lists
- Register any additional domain names
- Establish user registration and login procedures
- Check in baseline project source code
- Launch subprojects (if any)
- Designate initial project and subproject leaders
- Establish mail lists for appropriate purposes (project news, foundation announcements)
- Launch website and community resource portal

5.2   Administrative Milestones

- Have founding members review and comment on VistA Open Source Project, Community and Foundation plans.
- Select appropriate OpenSource license
- Finalize membership criteria and application
- Draft intellectual property policy and contributor agreement form
- Draft Foundation bylaws and finalize governance
- Prepare incorporation papers
- Plan and hold the first VistA members meeting and ratify bylaws
- Nominate directors and hold election
- Plan and hold first Foundation board meeting
- File for non-profit status with the IRS
- Establish bank account and principal office
- Attract sponsors and technical advisors
- Solicit donations to support initial operations
- Recruit Foundation leadership
- Plan a 2004 summit or workshop to discuss the future technical trajectory of VistA and encourage subproject and application development

6. Conclusion

The transfer of the VistA healthcare information system to non-VA settings will be a seminal event within healthcare. The public availability of this proven solution should facilitate the diffusion of VistA as the standard electronic health record. By using Open Source development methodologies, VistA will become not just publicly available, but more easily disseminated and more representative of the collective efforts of all who use it.

The formalization of the VistA Open Source Project, supported by the Vista Software Foundation, provides a tremendous opportunity to successfully transition VistA beyond the VA to a global VistA Community of developers and users. The Vista Software Foundation will facilitate this process by providing a neutral forum that promotes collaboration, stimulates communication, encourages coordination of effort and ensures a proven framework to satisfy the demands of multiple constituents. This will foster cumulative innovation for the VistA technology. A thriving VistA Open Source Project has significant potential to make an enduring contribution to improving healthcare quality on a global scale.

7. References

ABA, "An Overview Of 'Open Source' Software Licenses," American Bar Association Section of Intellectual Property Law, March 2002, http://www.abanet.org/intelprop/opensource.html

ANSI, "MUMPS Language Standard," American National Standards Institute, X11.1, 1977.

ANSI, "American National Standard for Information Systems-Programming Language-MUMPS," American National Standards Institute, ANSI/MDC X11.1, 1990.

Department of Veterans Affairs, "Information Technology Workforce Survey 2002: Report for Survey Participants," November 14, 2002, Version 2.0.

FSF, "Various Licenses and Comments about Them," Free Software Foundation, 2002. http://www.gnu.org/philosophy/license-list.html

FSF, "Licenses – GNU Project," Free Software Foundation, Inc., August 28, 2003, http://www.gnu.org/licenses/licenses.html

Hardhats.org, "VISTA Adopters Worldwide," accessed October 17, 2003, http://www.hardhats.org/adopters/vista_adopters.html

Healy, Kieran and Alan Schussman, "The Ecology of Open-Source Software Development," working paper, Department of Sociology, University of Arizona, January 29, 2003, http://opensource.mit.edu/papers/healyschussman.pdf

ISO, "Information technology -- Communication protocol -- Open MUMPS Interconnect," International Organization for Standardization, ISO/IEC 15851, 1999

Ashish Jha, Jonathon Perlin, Ken Kizer, et al, "Effect of the transformation of the Veterans Affairs Health Care System on the quality of care," New England Journal of Medicine, May 29, 2003.

Karim R. Lakhani and Robert G Wolf, "Why Hackers Do What They Do: Understanding Motivation Effort in Free/Open Source Software Projects," MIT Sloan School of Management Working Paper 4425-03, September 2003, http://opensource.mit.edu/papers/lakhaniwolf.pdf

Marshall, Rick, "About VistA," WorldVistA, February 17, 2003, http://www.worldvista.org/About/VistA/

Martin Fink, *The Business and Economics of Linux and Open Source,* Upper Saddle River, NJ: Prentice Hall, 2002.

Medsphere, "History of VistA," Medsphere Systems Corporation, 2003, http://www.medsphere.com/development/history.wpl.

Moody, Glyn, *Rebel Code: Inside Linux and the Open Source Revolution,* Cambridge, Mass.: Perseus, 2001.

 "MUMPS," Wikipedia, September 2003, http://en.wikipedia.org/wiki/MUMPS

O'Mahony, Siobhán, "The Emergence of a New Commercial Actor: Community Managed Software Projects", unpublished dissertation, Stanford University, 2002.

O'Mahony, Siobhán, "Guarding the commons: how community managed software projects protect their work," *Research Policy* 32, 7 (July 2003): 1179–1198.

OSI, "Open Source Initiatives — Licensing," Open Source Initiative, 2003 http://www.opensource.org/licenses/

Raymond, Eric S., "The Cathedral and the Bazaar," Chapter 2 of *The Cathedral and the Bazaar*, Cambridge, Mass.: O'Reilly & Associates, 1999. Also available online at http://catb.org/~esr/writings/cathedral-bazaar/

Reese, Bjørn and Daniel Stenberg, "Working Without Copyleft," O'Reilly Network, Dec. 19, 2001, http://www.oreillynet.com/pub/a/policy/2001/12/12/transition.html

Shreeve, Steven, *VistA Technology Roadmap,* white paper, VistA.net, November **??**, 2003.

Sun, *The OpenOffice.org Project: Foundations of Office Productivity in a Network Age,* Sun Microsystems, Inc., July 2000,

 http://www.openoffice.org/white_papers/OOo_project/OOo_project.pdf

VA, "VistA Monograph: 2003-2004," Veterans Health Administration, Department of Veterans Affairs, September 2002, http://www.va.gov/vista_monograph/

West, Joel, "How Open is Open Enough? Melding Proprietary and Open Source Platform Strategies," *Research Policy* 32, 7 (July 2003): 1259-1285.