Radford University Information Technology Infrastructure, Architecture & Ongoing Operations Standard 5001s-01

April 1, 2012

Preface

Date

April 1, 2012 - The initial version of the university's Information Technology (IT) Infrastructure, Architecture and Ongoing Operations Standard.

Policy Reference

Information Technology Infrastructure, Architecture and Ongoing Operations Policy

Notice

It is the reader's responsibility to ensure they have the latest version of this Standard. Revision questions should be directed to the Associate VP for Information Technology. The most recent, approved version of this Standard will always be available upon request and on the university's Division of Information Technology (DoIT) website.

History

April 1, 2012 – Original Version 1 (5001s-01)

Review Process

The Associate VP for Information Technology will ensure that reviews of this Standard and subsequent revisions are done when necessary, and will request reviews by the Information Technology Advisory Committee (ITAC) and the Office of Audit and Advisory Services (OAAS), as appropriate.

Scheduled Review

One (1) year from effective date

Approval Authority

The University President, or designee, has approval authority over this Standard.

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IT Infrastructure, Architecture & Ongoing Operations Standard

Section 1 Introduction

1.1 Purpose

The purpose of this compliance standard is to describe applicable standards and guidelines for the university's policy on Information Technology Infrastructure, Architecture, and Ongoing Operations. This standard documents the industry best practices with which the University will align its IT infrastructure, architecture and operations activities. When decisions are made regarding the acquisition and management of IT infrastructure, architecture and ongoing operations, the decision maker should consult this standard for guidance.

1.2 Authority

The Commonwealth of Virginia Restructured Higher Education Financial and Administrative Operations Act of 2005 and Chapter 824 of the Virginia 2008 Acts of Assembly grant institutions additional authority over financial and administrative operations, on the condition that certain commitments to the Commonwealth are met. Radford University's Management Agreement with the Commonwealth provides full delegated responsibility for management of the institution's information technology architecture, infrastructure and ongoing operations. This delegation includes the authority to conduct these activities in accordance with industry best practices appropriately tailored for the specific circumstances of the University, in lieu of following Commonwealth-determined specifications.

1.3 Scope

This document describes applicable standards and guidelines for the university's policy on Information Technology Infrastructure, Architecture, and Ongoing Operations. This standard applies to all current and planned IT Infrastructure, Architecture and Ongoing Operations management by Radford University.

1.4 Strategy

The university selects from among the best and most appropriate of the various national and international standards and practices when determining which course to follow for information technology infrastructure, architecture, and ongoing operations. These decisions are made at discrete intervals in time, typically when a new project begins or when an event occurs that causes the institution to rescan the technology environment and reselect from among the available standards and practices. This document should be reviewed and updated whenever there is a significant shift of focus in one of the technologies or operational domains described below and as industry best practices for technologies change or become obsolete.

A challenge for the University is the need to support a broad spectrum of information technology operations - from traditional administrative infrastructure to the dissimilar needs of research computing. Distinctions between the purely administrative aspects of higher education information technology and those related to the research and education missions of the institution frequently blur as a single infrastructure is optimized and deployed to support the many different aspects of the university's role in the Commonwealth.

Unlike much of industry, institutions of higher education tend to share information and collaborate on joint projects with other colleges and universities. This is especially true in the information technology arena where inter-university collaborations have resulted in significant progress and the deployment of large-scale services. Participation in these joint efforts is often critical as they frequently lay the technology foundation and develop infrastructure that is key to the institution's future competitiveness and its long-term ability to properly support faculty in their research and education activities. These inter-university collaborative projects sometimes help guide technology decisions and at other times represent a set of de facto standards that the institution must follow in order to be able to interoperate with its peers.

Section 2 Technology Domain Standards

The overarching intent of this document is to describe the technology domains and the standards and guidelines within each domain. It is expected that there will be some overlap between these domains. Technology choices are selected in alignment with the strategic direction of the university.

The needs of existing and planned applications, prevailing and developing industry trends, and the most efficient use of resources form the basis for selecting appropriate technology standards and operating practices. Open standards and interoperability between discrete technology components are important factors in selecting technologies to meet university needs.

The following technology domains are addressed by this document:

- Networking and Telecommunications
- Computing, Storage, and Operating Systems
- Databases
- Systems Management
- Security
- Applications
- Data

Standards and guidelines for each of these technology domains are provided in the sections that follow.

Section 3 Networking & Telecommunications

Institutions of higher education have always been strong contributors to Internet standards and applications, even before the inception of the Internet. Our campus networks are designed as smaller local versions of the Internet with more secure zones implemented where needed and open segments available to foster innovation and support the needs of our researchers. Given this reliance on Internet technology and a requirement to interoperate with the rest of the community, our networks follow the Internet standards as implemented by the higher education community. The key standards areas and the inter-institutional efforts that influence standards adoption are listed below:

- The set standards defined by the Internet Engineering Task Force (IETF) that form the technical foundation for Higher Education networks
- The Institute of Electrical and Electronics Engineers (IEEE) networking standards. In particular the IEEE 802.x series of standards
- The EIA/TIA standards for building telecommunications wiring and facilities

- The ATM Forum.
- The Center for Internet Security (CIS) for router and switch configuration security benchmarks.
- Implementation of the networking standards needed to connect to Internet2's Abilene network.
- Implementation of the networking standards needed to connect to the National Lambda Rail network.

3.1 Cabling Requirements

3.1.1 Category 6 Cabling

The typical horizontal station wiring consists of two Category 6 UTP (unshielded twisted pair), four-pair station cables to each telecommunications outlet box.

3.1.2 T568 Wiring Standard

Radford University selected the T568B wiring standard for use when RJ-45 modular wiring was first established on campus. In order to maintain consistency throughout the campus, all campus buildings will remain based on the T568B standard.

3.1.3 Redundant Fiber Paths

Campus buildings will be interconnected utilizing fiber optic cabling. All new fiber installations will make use of single mode fiber optic cables. Where pathways permit, each building should be connected via a separate fiber to the two network distribution switches which are located in separate data centers. Overlap of these two fiber paths to these separate distribution switches should be eliminated or minimized unless it is cost prohibitive.

3.2 Network Hardware

During each acquisition cycle, network hardware should be reviewed by validating performance and performing costs comparisons. Network hardware with redundant power supplies should be purchased. Preference should be given to network hardware that includes redundant power supplies or the capability of adding redundant power module if a redundant power supply is not an option in the main chassis. All new networking switches will have IEE 802.3af-2003 Power over Ethernet (PoE) capabilities to ensure flexibility for current and future devices. If Power over Ethernet (PoE) is cost prohibitive, justification for this decision should be documented.

3.3 SNMP

All network access devices should be Simple Network Management Protocol (SNMP) compliant and be configured to allow SNMP management. SNMP management access to devices should however be restricted via firewalls and other access controls such that SNMP management can only occur from authorized devices and users. SNMP passwords shall comply with Information Technology Policy 5101 (Password Policy and Standards).

3.4 Internet Connectivity

Radford University shall maintain at least two high speed connections to the Internet. These connections should use paths that are as diverse as possible such that a single failure is not likely to impact both paths. BGP routing will be utilized for all traffic using these connections to provide automatic failover in the event of an outage on one of these connections. Radford University shall leverage contracts from VITA and other Commonwealth of Virginia agencies and institutions to maintain adequate bandwidth at cost effective rates.

3.5 Environmental Controls

Wiring closets shall provide well-ventilated and appropriately cooled spaces to protect technology investments and ensure continuity of services. Efforts should be made to review and update wiring closets established prior to 2000 with appropriate ventilation. All new wiring closets should contain UPS systems capable of maintaining network equipment for 15 minutes following a power outage to ensure phones, speakers and other devices continue to function for a brief period. All new wiring closets shall include electronic door access.

Section 4 Computing, Storage, and Operating Systems

Decisions on which operating systems to support and what storage environments to build are primarily based on strategic direction, the needs of existing and planned applications, staff expertise, industry trends, and efficient use of resources in operating the environment as a system. Relevant standards are leveraged when making the best decisions.

4.1 Servers

Hardware selection for central computing is based on the specific needs of applications. Servers may provide file and print controls, business applications, databases, Internet presence, voice communication, email and other important functions for the enterprise. Radford University will utilize x86 server hardware for all new hardware purchases unless a business reason warrants the purchase of a non x86 systems. The planned lifecycle for server hardware will be five years. Application performance will be reviewed after three years to determine if the server should be replaced at the end of four or five years.

4.1.1 Lights out Management – Remote Management

All server purchases shall include a lights-out management/out-of-band management interface also known as remote management (Example: DRAC, Dell Remote Access Controller). This remote management capability must be configured during initial configuration of the server and restricted to System Administrators for that system. Access to the remote management interface shall be restricted to users connected to the Infrastructure VPN.

4.1.2 RAID with Hot Spare

All servers which contain local storage shall include hot swap hard drives and a RAID controller. This will allow for failure of a hard drive with no impact on the operation of the server. Servers with local storage should be purchased and configured to include a hot spare drive that will automatically be used in the event of a drive failure.

4.1.3 Keep your Hard Drive

All servers should be purchased with keep your hard drive protection such that the warranty does not require the return of a defective hard drive.

4.1.4 Maintenance Agreements – Warranty

All servers should be purchased with a minimum of a four year next day onsite warranty. Critical and sensitive systems that require high availability shall be purchased with a four year support agreement with 24x7 4 hour response time.

4.2 Server Operating Systems

In order to reduce the complexity of the environment being managed by the IT Infrastructure system administrators, Radford University will standardize on two main Operating systems for servers. Windows Server (2003 and 2008) and a variant of Linux that provides vendor support for patches and updates.

Radford University will phase out the small number of HP/UX and Solaris servers as systems are replaced. Server operating system licenses will be purchased through volume license agreements rather than via OEM (Original Equipment Manufacturer) licenses from vendors to allow for easier upgrades and transitions to a virtualized environment as appropriate.

4.3 Virtualization

In order to attain more efficient use of hardware including electrical and cooling, Radford University will use server virtualization as a mechanism to consolidate multiple systems onto a single server. This virtualization will also enhance disaster recovery capabilities and planning. When a new system is implemented, it should be reviewed to determine if the system is a candidate for virtualization before hardware is ordered. High transaction based systems such as database servers and Exchange mailbox servers should remain on physical servers rather than being placed in a virtual environment. When a system reaches its five year replacement period, the system should be reviewed to determine if it is a candidate for virtualization before new hardware is ordered. The virtual environment maintained by Radford University should utilize consolidated storage and provide the ability to move running systems between hardware located in the same data center without down time.

4.4 Storage and Storage Consolidation

Storage selection is driven by application considerations such as selection and retrieval of data, retention requirements, anticipated growth and expected response time. Consolidated storage systems should be evaluated and utilized to help reduce IT expenditures while meeting business needs. Each new system shall be evaluated for cost-effective storage solutions and consolidated storage shall be used unless dedicated storage is deemed to be more cost effective. Consolidated storage platforms must provide support for industry standards including:

- American National Standards Institute (ANSI) for Fiber Channel, SCSI, and various other storage connectivity standards.
- Network Attached Storage de facto standards such as the Sun Microsystems developed NFS and Secure-NFS protocols and Microsoft's CIFS.

Replication and disaster recovery plans should be included in analysis of storage planning and implementation.

4.5 Backup and Recovery

Radford University should use commercial off-the-shelf tools to perform system backups. These tools provide for backup and recovery of all critical systems. Recovery testing of backups shall be performed on a regular basis. Systems shall be backed up to a different data center to ensure the backups are maintained off site. Tapes shall be removed to a third off site location.

In the event that a commercial product is unsupported by the vendor, standard tools may be used to transfer a backup of the system to another system that can be backed up by a commercial product. A procedure to monitor, log and test these backups must be established.

4.6 Personal Computing

Hardware selection for desktop computing is driven by the needs of application users. Faculty and researchers often have different desktop computing needs than typical users. The CPU, memory, disk resources, display resources, and input devices are tailored to the needs of applications the user requires. The standard for personal computers will be x86 based laptop and desktop computers running Microsoft Windows or Apple laptop and desktop computers running Mac OS. The planned lifecycle for laptop computers will be four years and the planned lifecycle for desktop computers will be five years. System

performance, support issues, technology needs and available funding will be reviewed after three years for laptops and four years for desktops to determine if machines should be replaced a year in advance.

Section 5 Databases

Decisions about database products are based upon the requirements of university applications. Existing database solutions (e.g. those already supported by the institution) are generally preferred over different but equivalent technology. The use of relational database technologies and SQL are considered best practices. Relational databases and the query language are well-understood and have a long history of successful implementation in a variety of applications. Object-relational mapping strategies are preferred over object-oriented databases, as the requirements for long-term success with the latter are not as well understood as relational databases. The use of database access standards that avoid database vendor lock-in is a best practice. For example, the Java Database Connectivity (JDBC) API allows Java applications to work with relational databases in a vendor-independent manner.

5.1 Oracle as Primary Database for Systems

Oracle is the preferred database for all Radford University systems. During the acquisition of new systems if an option for databases is available, Oracle is preferred.

5.2 Microsoft SQL as Second Choice Database

Due to the wide array of applications written utilizing Microsoft SQL, this database will be fully supported by Radford University and should be the second choice database for new systems if Oracle is not an option. Radford University will maintain a centralized Microsoft SQL database server for consolidation of Microsoft SQL instances. If necessary or warranted by the system due to performance or security concerns a local Microsoft SQL database may be installed on the server in lieu of using the centralized Microsoft SQL database.

5.3 Other Databases

Postgres and MySQL are free database alternatives that provide a robust database environment, but should only be utilized where absolutely necessary. A detailed rationale and justification should be provided for any system utilizing a database other than Oracle and Microsoft SQL.

Section 6 Systems Management

Systems management concerns the monitoring of system and network components for faults and performance, accounting for the use of resources, configuration management, and the intersection between security policy and the operating practices that lead to a secure IT infrastructure. The goal of systems management is management of the IT environment as a whole. Guidelines on systems management are largely derived from the ISO FCAPS framework, along with the supporting standards for network management as defined by the IETF.

System management and monitoring activities include but are not limited to, network monitoring, monitoring servers, applications monitoring, net-flow analysis, troubleshooting tools, asset management, storage management, wireless LAN management, event management, event log monitoring and performance management.

Radford University establishes a separate secure VPN for management and monitoring of infrastructure related systems. Access to this VPN will be restricted to only those that require access to monitor, manage and maintain the environment.

RU should use commercial off-the-shelf tools to monitor campus systems. If an open-source tool is available, a cost analysis of a similar commercial product shall be performed before an open-source tool is selected to meet the need.

Section 7 Security

A comprehensive IT security program includes policy, user awareness and training coupled with strong technical controls on computer and network systems, the associated data, and data transmission. Mechanisms for the proper protection of systems and their associated data are included in the Radford University Information Technology Security Standard 5003s.

Section 8 Applications

In general, the application infrastructure and operations are managed with an emphasis on cost containment. They are also provisioned on the basis of perceived value or future needs. Given the diverse missions and needs of the University, the portfolio of applications can be divided into two distinct groups.

- Enterprise applications support the mission-critical operations and include systems to manage student information, human resource and financial processes and support collaboration, portals, digital repositories, content management and web applications. Enterprise applications at the University also include systems unique to higher education such as learning management systems. Decisions regarding enterprise applications are centralized and there is an emphasis on deploying integrated technologies that are mature, stable, secure, and proven in the field.

- Desktop applications support the individual needs of faculty, staff and students at the University and are typically office productivity applications used by them. Decisions about desktop applications are distributed across departments and business units. Desktop applications at the University include word processing, spreadsheet, presentation, database, Internet browser, and mail client software.

The selection and deployment of enterprise and desktop applications is often guided by requirements, standards, and recommendations such as those imposed by:

- Professional Associations such as EDUCAUSE
- University and Information Technology Strategic Plans
- University Procurement Policies and Standards
- IETF standards for messaging; e.g. SMTP, IMAP
- Calendaring and Scheduling
    - Widely accepted higher education practices such as Microsoft Exchange
    - Promote the further development and use of open standards such as iCal for calendaring to the extent such standards meets the needs.
- Extensible Markup Language and Style sheets; e.g. XML, XSL, CSS
- Open Web Application Security Project (OWASP)
- Accessibility Standards such as Section 508 of the Rehabilitation Act and W3C Guidelines
- Java Servlet specification (JSR-154)
- Java Portlet specification (JSR-168)

- Separation of business model and related logic from the means used to present the application to the user; i.e. MVC design pattern for web applications is a best practice.

Section 9 Data

The use and protection of institutional data is described in Data Storage and Media Protection Policy (IT 5102) and the Encryption Policy (IT 5100). These polices establish uniform data management standards, identify the shared responsibilities for assuring data integrity, and work to ensure that data is used to meet the needs of the university. The use and protection of data is often prescribed by requirements, standards, and guidelines such as those imposed by the following:

- Gramm-Leach-Bliley Act
- Family Educational Rights and Privacy Act (FERPA)
- Health Insurance Portability and Accountability Act (HIPAA)
- Payment Card Industry Data Security Standards (PCI-DSS)

Section 10 Acronyms

ANSI — American National Standards Institute
API — Application Programming Interface
ATM – Asynchronous Transfer Mode
BGP – Border Gateway Protocol
CIFS — Common Internet File System
CSS — Cascading Style sheet Specifications
EIA — Electronic Industries Association
FCAPS – Fault, Configuration, Accounting, Performance, Security
IEEE — Institute of Electrical and Electronics Engineers
IETF — Internet Engineering Task Force
IMAP — Internet Message Access Protocol
ISO — International Standards Organization
JDBC — Java Database Connectivity
JSR — Java Specification Request
LDAP — Lightweight Directory Access Protocol
MIME — Multipurpose Internet Mail Extensions
MVC — Model-View-Controller
NAS — Network Attached Storage
NFS — Network File System
OWASP — Open Web Application Security Project
POSIX — Portable Operating System Interface
RAID – Redundant Array of Independent Disks
RSA — Rivets, Shamir, Adleman; a public key cipher
S-MIME — Secure Multipurpose Internet Mail Extensions
SAML — Security Assertion Markup Language
SAN — Storage Area Network
SANS — SysAdmin, Audit, Networking, and Security
SASL — Simple Authentication and Security Layer
SCSI — Small Computer Systems Interface
SMTP — Simple Mail Transport Protocol
SQL — Structured Query Language
SSL — Secure Sockets Layer
TIA — Telecommunications Industry Association
TLS — Transport Layer Security XML — eXtensible Markup Language
UPS – Uninterruptable Power Supply
VITA – Virginia Information Technologies Agency
VPN – Virtual Private Network
XSL — eXtensible Style sheet Language