



Refer questions to Information Resources and Communications  
University of California Office of the President

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## DRAFT FOR COMMENT ONLY

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## I. Purpose

The University of California Policy on Stewardship of Electronic Information Resources (Stewardship Policy) establishes a high standard for protection of University information assets and the information technology resources that support the UC enterprise. The University electronic information resources (Resources) process, store, and transmit an enormous amount of information in support of its academic and business functions. These University information assets are subject to potential damage, compromise to confidentiality or privacy, or interruption of the activities of the University without the implementation of appropriate preventative strategies.

The Stewardship Policy and the supporting Guidelines for Stewardship of Electronic Information Resources outline the obligations of University campuses and medical centers, the Office of the President, and UC-managed national laboratories regarding management of its information assets. The standards and guidelines identified in this bulletin supplement the Stewardship Guidelines with more detailed recommendations for achieving compliance with the Stewardship Policy.

All faculty, staff, students, and authorized guests or visiting scholars are responsible for conformance with these Guidelines as appropriate to their roles.

## II. Definitions

The following terms used in these Guidelines are defined in Appendix A.

Authorized Individual  
Electronic Information Resource (Resource)  
Encryption  
Essential Resource  
Resource Custodian  
Resource Proprietor  
Restricted Resource

## III. Information Security Program

The University Stewardship Policy requires the implementation of an Information Security Program at all University locations. Achieving a secure information technology environment requires a comprehensive set of strategies that include a range of related technical and non-technical measures that comprise the campus Information Security Program. The campus Information Security Program should guide the strategic deployment of a consistent and multilayered security environment at each University location.

To ensure, as much as possible, the confidentiality, integrity, and availability of University information assets, the Information Security Program requires:

- the identification of an individual to be responsible for campus implementation of its security program,
- risk assessment to determine the level of risk and appropriate security measures, and
- management planning for preparedness, detection, response, and recovery with respect to protection of the information enterprise.

The Information Security Program shall undergo periodic evaluation of recommended managerial, operational, technical, and physical safeguards to ensure that the security program adequately addresses operational or environmental changes.

The Information Security Program shall include:

- identification of an individual who is responsible for campus compliance with its security program,
- risk assessment strategies to identify vulnerabilities and threats for departmental information resources as well as major enterprise systems,
- recommendations for administrative, technical, and physical security measures to address identified risks relative to their sensitivity or criticality,
- incident response planning and notification procedures,
- guidelines for security awareness training and education as appropriate for all University community members,
- appropriate review of third-party agreements for compliance with federal and state law and University policy.

#### **A. Identification of Information Security Officer (ISO)**

Each Chancellor and the Senior Vice President –Business and Finance shall designate an Information Security Officer (ISO) to be responsible for its campus Information Security Program. Responsibility for compliance with these Guidelines will rest with a number of individuals, and the ISO must facilitate compliance with these Guidelines through collaborative relationships with academic and administrative officials, consistent with campus governance structure and policy compliance strategies.

#### **B. Risk Assessment, Asset Inventory and Classification**

##### **1. Risk Assessment**

Appropriate risk assessments or business impact analyses shall be conducted:

- to inventory and determine the nature of electronic information assets held or managed by the department,
- to understand and document the risks in the event of failures that may cause loss of confidentiality, integrity, or availability, and
- to identify the level of security necessary for the protection of the resource.

Risk assessments should also take into account the potential adverse impact on the University's reputation, operations, and assets. Risk assessments should be conducted by teams composed of appropriate administrators, managers, faculty, and information technology and other personnel associated with the activities subject to assessment. See [Risk Assessment Resources](#) for more information.

## 2. Security Objectives: Confidentiality, Integrity, and Availability

Three primary security objectives cited in federal regulation are confidentiality, integrity, and availability. These objectives describe the chief goals for ensuring the protection of information and Resources from unauthorized access, use, disclosure, disruption, modification, or destruction.

- The sensitivity of an electronic information resource and its assigned level of **confidentiality** determine the types of security measures required for its protection from unauthorized access or disclosure.
- The level of impact of unauthorized modification or destruction of information resources describes the importance for maintaining the **integrity** of the Resource.
- Criticality describes the overall importance of **availability** of the electronic information resource to the continuing operation of a campus or of the University. Emergency management planning must take into account the level of criticality of a particular Resource to determine its inclusion in emergency and disaster recovery planning.

Risk assessments should ensure full review and classification of information assets by the level of security objectives assigned to them. See BFB IS-2 Inventory, Classification, and Release of University Electronic Information for detailed guidelines on assignment of classifications. Resources classified as *restricted* require the highest level of protection. See Appendix B, Guidelines for Restricted Resources for a summary of guidelines specific to *restricted* Resources. See "[Secure Computer Configuration for Wire Transfers](#)", an example analysis of system management for computers that support high risk processes.

See BFB IS-12, Continuity Planning and Disaster Recovery for more information on requirements for continued availability of Resources. Resources classified as *essential* must be included in emergency and disaster recovery planning.

### 3. Additional Risk Assessment Resources

Information Resources & Communications, UCOP provides the following resources:

- [Information Security Checklist](#)
- [Department Security Review and Planning](#)
- [The Successful Risk Assessment](#)

The EDUCAUSE/Internet2 Security Task Force Risk Assessment Working Group provides a high-level overview of conducting a risk assessment of information systems within higher education.

- [A Risk Assessment Framework](#)

### C. Security Plan

After completing a risk assessment, an information security plan should be developed that takes into consideration the acceptable level of risk for systems and processes. It should identify cost-effective strategies to be implemented consistent with department's goals and functions for mitigating that risk. The security plan must account for the management, use, and protection of sensitive data, and identify the procedures and controls that will be implemented to enhance security for all information assets.

Appropriate mechanisms to safeguard data must be selected relative to the *sensitivity* or *criticality* determined by the risk assessment. Controls selected to mitigate risks should include managerial, operational, technical, and physical measures as appropriate.

Note that the proliferation of data greatly increases risks of unauthorized access, particularly when data is stored in ad hoc analysis tools such as spreadsheets and desktop databases. When data is copied for analysis or research, *restricted* data should be deleted whenever possible or "de-identified" by removing data elements that, in combination with other data, would result in the identification or description of an individual. If it is not possible to delete *restricted* data from ad hoc analysis tools, adequate technical and physical security measures must be implemented.

Data should not be transferred to another individual or system without approval of the Resource Proprietor (see IS-2, Inventory, Classification and Release of University Electronic Information). Before *restricted* data is transferred to a destination system, the Resource Proprietor must ensure that Authorized Individuals implement appropriate security measures.

- Security measures on destination systems must be commensurate with physical and technical security measures on the originating system.
- Resource Proprietors for *restricted* data must ensure that Authorized Individuals are informed of this constraint when access is originally requested. The Resource Proprietor may choose to require the

authorized individual's signature to document approval of release of restricted data.

## 1. Administrative Workforce Controls

Administrative controls consist of a range of administrative processes and procedures required to implement the organizational information security plan. They include appropriate assignment of responsibility within the organization and assignment of authorization to access Resources as necessary to perform tasks of the position. Responsibility for security should be clearly defined early in the employment process. Positions that require information technology skills should include an emphasis on security knowledge and skills throughout the hiring and employment process.

### a. Workforce and Authorization Management

All workforce members are expected to employ security practices as appropriate to their responsibilities and roles, which include, but are not limited to:

- taking appropriate actions to ensure the preservation of data confidentiality and integrity,
- taking appropriate precautions to ensure protection of data from unauthorized access or destruction,
- complying with license agreements, terms and conditions, and laws pertaining to intellectual property, and
- complying with departmental security procedures.

Procedures must be implemented

- to authorize access, both logical and physical, to only those individuals (*Authorized Individuals*) who have a legitimate business reason to access specific Resources and
- to revoke access upon termination of employment, or when job duties no longer require a legitimate business reason for access, except where specifically permitted by University policy and by the Resource Proprietor.

Procedures should include a requirement that the Resource Proprietor approve an individual's request for authorization and assignment of the associated level of privilege. Records of this approval should be retained consistent with BFB [RMP-2 Records Retention and Disposition: Principles, Processes and Guidelines](#).

- Procedures for providing individuals access to Resources must incorporate review and approval mechanisms to ensure that only Authorized Individuals are granted access.
- The principles of separation of duties should be followed when assigning job responsibilities relating to *restricted* or *essential* Resources. No one individual, for example, should have

authorization for both implementing programs into production and updating production data for an application managing *restricted* or *essential* information.

- Supervisors or other employees with responsibilities for security should periodically review the system administration work of personnel with access to privileged accounts on shared servers. Such action is intended to provide a periodic audit or review for those system administration functions that are not otherwise audited or reviewed in the course of being completed.
- System staff who are granted privileged accounts should be informed of responsibilities and constraints associated with privileged access. See Section III.C.2 Technical Controls - Privileged Access, below, for additional guidelines.
- Authorization should be immediately modified to reflect significant changes in job duties or status that impact rights of access.
- In certain circumstances, authorization should be removed for individuals who have announced their decision to terminate, where continued access might result in an unacceptable level of risk. Privileged access should be revoked immediately for individuals placed on investigatory leave.

#### **b. Critical Positions**

Some positions with job responsibilities related directly to Electronic Information Resources may be deemed *Critical Positions*<sup>1</sup> in accordance with University personnel policies and guidelines for staff (see [Personnel Policies for UC Staff Members](#)).

- Campuses should develop policies and procedures to ensure that candidates for critical positions related to *restricted* or *essential* Resources undergo applicable background checks as part of the selection process.
- For staff working in critical positions related to *restricted* or *essential* Resources, procedures should be established that can be implemented in the event of disciplinary action or termination. Where there is a concern that access to Resources endangers the integrity of such Resources, management should act to restrict, suspend or terminate access.
- During an investigatory leave, access privileges to the work location should be revoked.

All procedures must be established in accordance with University personnel policies and guidelines. See [Personnel Policies for UC Staff Members](#).

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<sup>1</sup> The term "Critical Positions" is used here as defined in University Personnel policies, and is not to be confused with the use of the term "critical" as used in these Guidelines with respect to information resources.

### c. Violations

It is a violation of these Guidelines and other University and campus policies for individuals to attempt to gain unauthorized access to Resources or in any way willfully damage, alter, or disrupt the operations of Resources.

It is also a violation of these Guidelines for individuals to capture or otherwise obtain or tamper with passwords, encryption keys, or any other access control mechanism that could permit unauthorized access, except where expressly required in the performance of their duties, such as when systems personnel need to provide access to Resources when passwords or other keys have been lost or misplaced.

Supervisors and department heads are responsible for promptly reporting any known or suspected violations of these Guidelines to the Resource Proprietor or Custodian, or to the Internal Audit department.

Employees (or contractor or consultant) who become aware of the occurrence of any violation of these Guidelines should report the violation promptly to their supervisors (or their client within the University in the case of contractors or consultants), department head, or the Internal Audit department. Resource Proprietors or Custodians should be notified of such violations in accordance with departmental procedures.

- Resource Proprietors may withdraw the privileges of any individuals who violate these Guidelines if, in their opinion, continuation of such privileges threatens the security (confidentiality, integrity, and availability) of a *restricted* electronic information resource.
- Appeals regarding revocation of privileges should follow normal campus conflict resolution procedures.

Depending on the nature of the violation and the likelihood of a recurrence, the Resource Proprietor or Custodian shall take prompt action to protect against future violations to the extent feasible, and/or remove the means by which the violation occurred. Depending on the nature of the violation, the Resource Proprietor or Custodian shall consult with other campus authorities in accordance with policies governing potential disciplinary action.

In the event of a violation of these Guidelines that involves possible unlawful action by an individual, the Locally Designated Official, the employee's immediate supervisor, or other appropriate official should immediately be notified in accordance with the Policy on Reporting and Investigating Allegations of Suspected Improper Governmental Activities (the "Whistleblower Policy"). Notification should take place

before any action is taken, unless prompt emergency action is required to prevent bodily harm, significant property loss or damage, loss of significant evidence of one or more violations of law or of University policy, or significant liability to the University or to members of the University community.

The University reserves the right to revoke access to any Resource for any individual who violates these Guidelines, or for any other business reasons in conformance with other applicable University or campus policies.

## 2. Operational and Technical Controls

This section addresses security measures related to controlling access to Resources through operational or technical measures, e.g., passwords, configuration settings, software or network controls, controls related to software development and change management, security of data and communications, and controls to reduce risk from known threats and malicious programs.

These Guidelines do not require any specific technology to be employed. However, selected technology must be adequate to ensure sufficient protection commensurate with the level of risk ascribed to the electronic information resource and the magnitude of the harm resulting from the loss, misuse or unauthorized access to or modification of information. The selected technology must be supported by operational controls designed to ensure that the Resource is adequately protected.

### a. Identity and Access Management

In conformance with the Guidelines for Stewardship of Electronic Information Resources, campuses must have an identity and access management strategy that ensures adequate identification of authorized University community members and that provides efficient and timely authenticated access to and use of network-based services.

University access control measures must include secure means of *authorization* and *authentication*.

- **Authorization** is the automated process of determining whether or not an identified individual or class has been granted access rights to an information resource (see section III.C.1.a, Workforce and Authorization Management, above), and determining what type of access is allowed, e.g., read-only, create, delete, and/or modify.
- **Authentication** is the process of confirming that a known individual is correctly associated with a given electronic

credential, for example, by use of passwords to confirm correct association with a user or account name.<sup>2</sup>

See BFB IS-11 Identify and Access Management for more information regarding authorization and authentication.

#### **b. Access Controls**

Access controls are technical mechanisms that restrict Resource access to Authorized Individuals. Such mechanism must be implemented to ensure that integrity, availability, privacy, and confidentiality of data are in compliance with federal and state law and UC policies. When any Resource manages or contains *restricted* data, appropriate measures must be in place to safeguard against unauthorized access to that data. This includes not only the primary operational copy of the information, but also data extracts and backup copies. Authorized Individuals and their specific level of privilege should be specified by the Resource Proprietor, unless otherwise defined by University policy.

Access controls typically consist of

- by login accounts set up directly on the Resource to be accessed or
- by use of a “Net ID,” which is associated with an authentication mechanism incorporated in the campus identity and access management system.

In either case, campuses should ensure the timely maintenance of login accounts or NetIDs to ensure that authentication credentials, such as passwords or authentication keys, meet campus standards and that access privileges are revoked in a timely manner. See IS-11, Identity and Access Management.

Records of access events should be maintained consistent with audit log guidelines (see section III.C.2.f below and Appendix C).

Rights of access to modify *restricted* data should be performed according to procedures that ensure data integrity. Exceptions may be made on a case-by-case basis but should always be performed in a controlled manner and with the knowledge of the Resource Proprietor.

#### **i. Passwords**

Passwords selected by individuals or automatically generated to protect access to information resources should be difficult to ascertain. The campus Information Security Program should

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<sup>2</sup> Authentication is a term that is also used to verify the identity of network nodes, programs, or messages.

identify appropriate password management conventions, including periodic identification of weak passwords, password encryption, and other security measures as deemed appropriate

Passwords may be specific to a single application, or they may be used for access to multiple applications by means of the campus identity and access management system authentication mechanism, such as use of the campus NetID.

- Passwords typically should never be shared with other individuals.
- Exceptions for password sharing should be approved by Resource Proprietors of the authentication mechanism.
- When there is a need for shared passwords, additional measures should be implemented that record specifically who accessed the Resource or other control mechanisms that will provide an audit trail of the access.

#### *ii. Session protection*

Technical security mechanisms should be in place that prohibit or minimize the risk of unauthorized access to Resources by others who might gain control of the working session, for example, by accessing the Authorized Individual's computer if that individual leaves it unattended. Measures such as secure screensavers, automatic logout, and/or other means of session protection should be operative on all devices with access to *restricted* Resources. Also see section IV, Minimum requirements for Network Connectivity.

#### *iii. Privileged access*

System administrators routinely require access to Resources to perform essential system administration functions critical to the continued operation of the resource. Such privileged access is often termed "superuser" or "administrative" access. Privileged accounts enable vital system administration functions to be performed, such as installing or modifying applications, conducting system administrator programming tasks, establishing userids, accounts, or passwords, maintaining authorization for these accounts, correcting problems, and other broadly-defined system or other electronic information resource privileges.

Such privileged accounts are especially sensitive and campuses must establish procedures, commensurate with the level of risk involved, to ensure that abuse will not occur. Privileged accounts should be made available only after personnel assigned such accounts have been fully informed regarding restrictions on access

to user accounts or transaction monitoring. Procedures should include that an agreement be reviewed or signed and filed, as appropriate to the needs and function of the Resource.

- Those assigned the use of privileged accounts must be fully informed that privileged accounts should never be used to seek out personal or confidential information relating to others, or to disclose or otherwise use what they may have observed in conformance with the [Electronic Communications Policy](#) section [IV.C.2.b](#). System Monitoring.
- The number of privileged accounts must be kept to a minimum, and only provided to those personnel whose job duties require them.
- Personnel who require privileged accounts should also have less powerful accounts to use when not performing system administration tasks and must be instructed not to use their privileged accounts for other than authorized purposes.
- Activities performed using a privileged account should be logged, where feasible, and the logs should be reviewed, on a regular basis, by an independent and knowledgeable person.
- Privileged accounts should be monitored periodically to ensure they are being used for designated purposes.

For more guidelines on logging, refer to Audit and System Logs at the end of this section.

### **c. Systems and Application Security**

The following guidelines apply to equally to central or departmental-managed computing systems operated by the campus workforce.

#### ***i. Systems personnel***

University personnel who operate and support University Resources are expected to follow all applicable UC policies, follow departmental procedures, and use appropriate professional practices in providing for the security of the systems they manage.

Classifications should accurately document the nature of the information resources managed by systems personnel, and procedures should be implemented that ensure security measures appropriate to the classification of Resources. Procedures for action in response to security incidents or other emergency events should be documented and communicated to support personnel.

Responsibility for systems and application security should be assigned to an individual knowledgeable in the information technology used in the system and in providing security for such technology. This individual should determine security plans as appropriate to the supported systems and applications.

Systems personnel should evaluate Resource exposure to known threats and deploy mechanisms commensurate with the level of risk and magnitude of the harm that could result from loss, misuse, or unauthorized access to supported systems and applications.

The principles of separation of duties should be employed to ensure that responsibilities for critical functions are divided among different individuals. For example, one system programmer can create a critical piece of operating system code, while another authorizes its implementation. Such a control keeps a single individual from subverting a critical process.

## **ii. *Back up and retention***

Sound professional system administration practices require the implementation of routine back up of applications and data. See IS-12, Continuity Planning and Disaster Recovery.

- Backup copies of applications and data associated with *essential* Resources must be sufficient to satisfy emergency planning and disaster recovery requirements, application, or other Resource processing requirements, and any functional requirements of any Resource Proprietor dependent upon such data.
- Backup copies of *essential* data for disaster recovery purposes must be stored at a secure, commercial site that provides standard protection or at a non-commercial off-campus site providing equivalent protection.
- *Restricted* data should be encrypted if there is a risk of physical security in the storage of backup copies.
- These backup requirements extend to *essential* or *restricted* applications and data stored on personal computers as well as applications and data stored on shared servers.
- Backup and other retention services for data must also comply with University of California policies regarding data retention. See:
  - [UC Records Disposition Program and Procedures](#) (BFB RMP-2)
  - [Vital Records Protection](#) (BFB RMP-4)
  - UC Records Disposition Schedules Manual
  - [Systems Development Standards](#) (BFB IS-10)

**iii. Protection measures**

Measures, such as firewalls, should be deployed to protect supported systems from “malicious software” and to limit access to systems that host *restricted* or *essential* resources.

- The term “malicious software” defines a set of software programs that pose serious threats, not only to the specific computer where the software has been installed, but potentially to all devices on the local network.
- Malicious software includes programs, such as virus, worm, Trojan horse, and spyware, depending on their context and purpose. They are usually installed on a device without a user’s knowledge or under false pretenses, and they can potentially affect any type of computer or server on the network. They may damage or consume resources, use devices to infect other devices on the network, or expose information.
- The area of greatest risk is personal computers that receive files from external sources, whether over a network or via shared detachable storage devices.

**iv. Patch management**

In conformance with campus minimum standards (see section IV, Minimum Requirements for Network Connectivity), operators must, in a timely manner, update versions of operating system and application software for which security patches are made available.

**v. System and applications software development**

Development and maintenance of any systems, whether performed by University personnel or performed by any vendor engaged by University personnel, must conform to the specifications of BFB IS-10, Systems Development and Maintenance Standards. BFB IS-10 describes the circumstances under which standards apply, as well as delineating roles and responsibilities, project planning and management, phases of systems development, and data retention and privacy considerations. Application development and maintenance efforts must also conform to any local standards, procedures, guidelines and conventions. See IS-7, Guidelines for Maintenance of University Payroll System. for an example of procedures and responsibilities for system maintenance.

In general, campuses are encouraged to involve Internal Audit and the campus Controller in the development or implementation of *essential* administrative systems in order to obtain advice on establishing proper controls. Internal Audit should be notified of all administrative system development projects early in the development process. (See BFB IS-10 for more information.)

**d. Network Security**

Each campus must implement strategies to achieve compliance with the University minimum requirements for network connectivity. See Section IV below.

Firewalls and Intrusion/Detection Systems should be deployed to augment normal system security measures to prevent the flow of Denial of Service attacks, malicious code, or other traffic that threatens systems within the network. Firewalls should also be deployed to limit access to systems that host *restricted* or *essential* resources.

**e. Change Management**

Maintaining system integrity requires that all changes to a system are conducted according to a planned and supervised change management process. In particular, changes to any *restricted* or *essential* system must be performed according to authorized change management procedures that monitor all changes to ensure conformance with the change management plan and that detect any unauthorized changes. Change procedures should include confirmation of testing, authorization for moving programs to production, backout plans, user training, monitoring and logging of all changes, periodic review of logs, and documentation.

**f. Audit Logs**

Most components of an information technology infrastructure are capable of producing logs chronicling their activity over time. These logs often contain very detailed information about the activities of applications and the layers of software and hardware that support those applications. With proper management, these logs can be of great benefit in a variety of scenarios to enhance security, system performance and resource management, to monitor access controls, and to achieve regulatory compliance.

Audit logs should be managed in a manner that facilitates these benefits while protecting the confidentiality and integrity of the information contained in these logs. In particular, a log management infrastructure can capture information and aid analysis about access, change monitoring, cost allocation, malfunction, resource utilization, security events, and user activity. Campuses are encouraged to develop a log management infrastructure to provide common management of log records.

See Appendix C for recommended log management practices.

**g. Encryption**

The University Guidelines for Stewardship of Electronic Information Resources requires that, when deemed appropriate, suitably strong encryption measures be employed and implemented for data during transmission. For data in storage, at least one authoritative copy of the electronic information must be available in unencrypted form, or if encrypted, the means to decrypt it must be available to more than one person. Additionally, campuses are required to implement encryption key management plans to ensure the availability of encrypted authoritative data.

Encryption cannot be used as a substitute for other security measures required in these Guidelines.

Current encryption strategies for the following situations are recommended in Appendix D:

- whole disk encryption
- file encryption
- database storage
- interactive sessions
- file transfers
- web-based applications
- electronic mail
- network printer communications
- remote file services
- database access
- application to application communication
- virtual private network.

**3. Physical and Environmental Controls**

Each campus should establish procedures for the physical protection of its Resources. In particular, campuses shall develop policies and procedures to protect departmental or central facilities containing shared Resources that support *restricted* or *essential* systems or data. All facilities hosting *restricted* or *essential* resources should conform to the following recommended guidelines commensurate with the level of risk.

**a. Risk Mitigation Measures**

Campus should implement appropriate measures for the prevention, detection, early warning of, and recovery from emergency conditions, including earthquake, fire, water leakage or flooding, disruption or disturbance of power, air conditioning failures, and environmental conditions exceeding equipment limits. Procedures should include measures to protect Resources from theft, damage, or improper use.

**b. Physical Access Controls**

Controls for limiting physical access to facilities housing *restricted* or *essential* Resources should be implemented through the use of combination locks, key locks, badge readers, manual sign in/out logs, verification of identification, etc. The ability to track both ingress and egress of all individuals should be maintained.

Limiting physical access to facilities may also include technical mechanisms, such as use of proximity card readers. In those instances, technical access control guidelines for logging ingress and egress apply (see III.2.b above).

**c. Tracking Reassignment or Movement of Devices, Stock Inventories**

Procedures should be implemented that:

- track the receipt, reuse, and removal of hardware and electronic media, including documentation of hardware reassignment,
- maintain records documenting repairs and modifications to physical components of the facility related to security, such as hardware, walls, doors, and locks, and
- track financial instruments, such as check stock and produced checks, in conformance with University policy. See [Section C 173-15, Cash and Banking Operations](#) in the UC Accounting Handbook and [BUS-49, Policy for Handling Cash and Cash Equivalents](#).

Physical inventories of equipment should be completed and maintained in accordance with BFB [Bus-29, Management and Control of University Equipment](#).

See IS-12 Emergency Planning and Disaster Recovery for more information on requirements for *essential* Resources.

**d. Final Disposition of Equipment**

Procedures should ensure implementation of controls to address the final disposition of hardware and electronic media, including requirements that ensure complete removal of *restricted* or other sensitive data before disposition, such as shredding, overwriting the disk, or employing professional services. Encryption of the disk may be used as an alternative mitigation. See [RMP-2, Appendix B Recommendations for Record Disposal](#).

**e. Portable Devices and Media**

Departments must establish procedures to ensure physical security for personal computers and portable devices housed within their

immediate work area or under their control, such as laptop computers, PDAs, memory sticks, CD ROMs, etc.

- *Restricted* data may be retained on portable equipment only if protective measures, such as encryption, are implemented that safeguard the confidentiality or integrity of the data in the event of theft or loss of the portable equipment (see III.C.2.g, Encryption above).

#### **D. Incident Response Planning and Notification Procedures**

##### **1. General**

Campuses are responsible for establishing and implementing procedures to ensure the ability to respond expeditiously to:

- known information security breaches,
- disruptions caused by the failure of a security mechanism, and
- suspected or known security threats.

These procedures should include mechanisms for documenting the incidents, determining notification requirements, implementing remediation strategies, and reporting to management.

##### **2. Notification in Instances of Security Breaches Involving Personal Information Data**

In the event of a breach to the security of unencrypted computerized personal information, campuses must notify California residents whose information is affected if an unauthorized person is reasonably believed to have acquired the information.<sup>3</sup>

The definition of “personal information” for this policy is an individual’s **first name or first initial, and last name, in combination with any one or more of the following** (unless the information is encrypted):

- social security number
- driver’s license number or California identification card number
- account number,<sup>4</sup> credit or debit card number, in combination with any required security code, access code, or password that would permit access to an individual’s financial account

The list of data elements considered personal information may be expanded based on departmental risk assessments.

The definition of a “security breach” for this Guideline is when a California resident’s unencrypted personal information, as defined above, is reasonably believed to have been acquired by an unauthorized person. Good faith acquisition of personal information by a University employee

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<sup>3</sup>The notification is a requirement of California Civil Code Section 1798.29, effective July 1, 2003.

<sup>4</sup> The “account number” corresponds to an individual’s *financial* account.

or agent for University purposes does not constitute a security breach, provided that the personal information is not used or subject to further unauthorized disclosure.

### **3. Systemwide Notification Procedures**

In the case of a security breach as defined in this policy, all campuses must follow the systemwide procedures presented here to provide notification of the breach to those California residents whose personal information is reasonably believed to have been acquired by an unauthorized person. In addition, campuses may develop detailed local guidelines based upon the steps in these systemwide procedures.

Notification must occur without unreasonable delay, except

- when a law enforcement agency has determined that notification will impede a criminal investigation (in this case, notification must occur as soon as the law enforcement agency determines that it will not compromise the investigation) or
- in order to discover the scope of the breach and restore the integrity of the system.

In coordination with campus counsel, campuses may determine the language to be used in the notification, which may be distributed by one of the following methods:

- written, hard copy notice or
- email notice

If sufficient contact information is not available for direct hard copy or e-mail notice, a substitute method of notice may be used. Substitute notice should include prominent display on the campus's Web site or other commonly used Web site for at least forty-five days. Both campus counsel and the campus community relations or public information office should be consulted to develop the substitute notice.

Campuses may decide, in coordination with campus counsel, to provide notification to affected individuals if personal information beyond the data elements defined here is accessed by an unauthorized person.

### **4. Campus Implementation Plan**

Campuses must develop an Implementation Plan for Security Breach Notification. A copy of the plan must be sent to the Associate Vice President for Information Resources and Communications, who must subsequently be notified of any changes to the plan. The plan should contain, at a minimum, the following components.

**a. Designation of Authority**

Each chancellor shall designate an individual, or a functional position, that will act as the lead campus authority responsible for reporting to UCOP and that may delegate to other personnel, when appropriate, responsibilities for

- ensuring that the campus incident response process is followed,
- ensuring that systemwide and, if applicable, campus notification procedures are followed, and
- coordinating with campus counsel.

The functional position of the lead campus authority should be at a level high enough to allow that individual to speak with authority for the campus.

**b. Data Inventory**

Campuses must establish a process or processes to identify

- where “personal information,” as defined above, is used and stored,
- the primary employee positions that have access to and use the data,
- the Resource Proprietor and Custodian of the data, and
- an acceptable level of security protection for the data.

**c. Incident Response Process**

Campuses must develop an incident response process to determine

- whether a security breach has occurred, as defined in this policy and
- local notification procedures.

Campuses should ensure coordination with the Office of General Counsel if a decision to notify is under consideration.

Campuses that develop detailed local notification procedures to supplement the systemwide procedures must include these in the implementation plan.

**d. Reporting Requirements**

The campus authority or its delegate must report immediately in writing to the Associate Vice President for Information Resources and Communications at UCOP any security breach involving personal information as defined above.

The campus authority or its delegate must report in writing to the Associate Vice President for Information Resources and

Communications when the incident is closed. The incident closure report should provide

- a description of the incident, including the nature of the incident and the numbers of individuals impacted,
- the incident handling process,
- a copy of the notification,
- the actions taken to prevent further breaches of security.

The Information Resources and Communications, UCOP website [IT Security at UC](#) includes recommendations for [incident handling](#) planning.

### **E. Education and Security Awareness Training**

Departmental managers and supervisors should routinely ensure that appropriate security awareness training programs are conducted for management, staff, and contract employees.

- Training programs shall include review of University and campus security policy, guidelines, and standards, and departmental procedures and best practices established to safeguard sensitive data.
- Training must be in compliance with regulations governing specific *restricted* data, such as student data subject to FERPA, financial data subject to the Financial Services Modernization Act of 1999 (Gramm-Leach Bliley Act), and electronic Protected Health Information subject to HIPAA.
- Training materials should include topics such as password management and use, best practices for handling restricted data, incident reporting, and security reminders regarding current threats to technical environments in which individuals are working.

For security awareness training resources, see [IT Security at UC](#) for [online training modules](#).

### **F. Third-party Agreements**

- When agreements are established with contractors, consultants, or outside vendors, those agreements must include satisfactory assurances that the contracting third-party will appropriately safeguard sensitive information in accordance with federal and state laws and University policies. Access should be terminated when the work has been completed.
- Background checks are required for non-University contractors or consultants engaged to work on *restricted* or *essential* electronic information resources. Consideration should be given to limiting outside vendor access to restricted or essential electronic information resources.

Sample contract language and supporting information is posted at [IT Security at UC](#).

## **IV. Minimum Requirements for Network Connectivity**

Each campus must establish minimum standards for devices connected to their networks. Standards must address, at the least:

### **A. Access Control Measures**

to allow only authorized individuals access to information resources.

Typically current access controls measures are passwords (see section III.C.2, Technical Controls, above). Shared-access systems must enforce passwords standards whenever possible and appropriate. In situations where systems that ship with default passwords for network accessible devices, those passwords should be changed upon first use.

### **B. Encrypted Authentication**

to protect against surreptitious monitoring of passwords.

Unencrypted device authentication mechanisms are only as secure as the network upon which they are used. Traffic across campus networks may be surreptitiously monitored, rendering these authentication mechanisms vulnerable to compromise. Appropriate encryption must be employed when passwords are transmitted over a network. Encryption-capable services, such as SSH, SFTP, SCP, POPS, and IMAPS, may be used to meet this requirement..

### **C. System Security and Change-management Practices**

to ensure timely update of security patches.

Networked devices should run versions of operating system and application software for which security patches are made available and installed in a timely fashion. Exceptions may be made for patches that compromise the usability of critical applications following campus exception procedures. Implementation of additional measures may be required when exceptions are granted.

### **D. Anti-virus Software**

to protect every level of device as appropriate for specific operating systems.

When readily available, anti-virus software must be running, up-to-date, and have current virus definition files installed on all network devices as appropriate.

### **E. Removal of Unnecessary Services**

to prevent surreptitious use of services not needed for the intended purpose or operation of the device.

If an application or service is not necessary for the intended purpose or operation of the device, it should not be running on that computer; such services should be turned off.

#### **F. Host-based Firewall Software**

to limit network communications to only those services required to be accessible over the network.

When readily available for specific operating systems, host-based firewall software must be running and configured to limit network communications to only those protocols required to be made accessible over the network

#### **G. Authenticated Email Relay**

to prevent unauthorized third parties to relay email messages.

Devices must not provide an active SMTP service that allows unauthorized individuals to send or relay email messages, i.e., to process an e-mail message where neither the sender nor the recipient is a local user.

Before transmitting email to a non-local address, the sender must authenticate to the SMTP service. Authenticating the machine, e.g., IP address/domain name, rather than the sender is not sufficient to meet this standard.

#### **H. Authenticated Network Proxy Servers**

to prevent an attacker from executing malicious programs on servers by use of anonymous user accounts.

Although properly configured unauthenticated proxy servers may be used for valid purposes, such services commonly exist only as a result of inappropriate device configuration. Unauthenticated proxy servers may enable an attacker to execute malicious programs on the server in the context of an anonymous user account.

#### **I. Session Timeout**

to prevent unauthorized users to access *restricted* or *essential* services or devices left unattended for an extended period of time.

Devices that access *restricted* or *essential* services that are left unattended for an extended period of time should employ measures that require access control before users return to interactive use. Devices that host highly sensitive or critical information may be subject to additional requirements.

## V. Major Responsibilities

### A. *Systemwide*

The Associate Vice-President – Information Resources and Communications, Office of the President is responsible for the Policy on Stewardship of Electronic Information Resources and supporting Guidelines.

The Information Technology Leadership Council, whose membership is appointed by Chancellors, medical center directors, and UC managed national laboratory directors, works in partnership with the UC academic and administrative leadership to identify systemwide and common campus implementation strategies.

### B. *Campus*

Chancellors, and for the Office of the President, the Senior Vice President, Business and Finance, are responsible for delegating responsibility for implementation of these Guidelines at their respective locations. Information Security Officers are responsible for facilitating campus compliance with the campus Information Security Program.

### C. *Divisions and Departments*

Division deans, department chairs, and appropriate administrative officials are responsible for establishing pertinent procedures and identifying appropriate practices to achieve departmental compliance with campus implementation recommendations.

### D. *Individuals*

All members of the University community are expected to comply with campus implementation plans and to exercise responsibility appropriate to their position and delegated authorities. Each individual is expected to conduct the business of the University in accordance with the Statement of Ethical Values and the Standards of Ethical Conduct, exercising sound judgment and serving the best interests of the University.

All community members are responsible for the protection of their passwords, card access keys, or other access control measures. These credentials should never be shared without proper authorization.

## VI. References

### [Electronic Communications Policy](#)

Policy on Stewardship of Electronic Information Resources

Guidelines for Stewardship of Electronic Information Resources

IS-2, Inventory, Classification, and Release of University Electronic Information

[IS-7, Guidelines for Maintenance of the University Payroll System](#)

[IS-10, Systems and Development Standards](#)

IS-11, Identity and Access Management

IS-12, Continuity Planning and Disaster Recovery

[RMP-2, Records Retention and Disposition:: Principles, Processes, and Guidelines](#)

[RMP-8, Legal Requirements on Privacy of and Access to Information](#)

## Appendix A. Definitions

**Authorized Individual:** A University employee, student, or other individual affiliated with the University who has been granted authorization by the Resource Proprietor, or his or her designee, to access a Resource and who invokes or accesses a Resource for the purpose of performing his or her job duties or other functions directly related to his or her affiliation with the University. The authorization granted is for a specific level of access to the Resource as designated by the Resource Proprietor, unless otherwise defined by University policy.

**Electronic Information Resource (Resource)** A resource used in support of University activities that involves the electronic storage, processing or transmitting of data, as well as the data itself. Electronic Information Resources include application systems, operating systems, tools, communications systems, data – in raw, summary, and interpreted form – and associated computer server, desktop (workstation), portable devices (laptops, PDAs) or media (CD ROM, memory sticks, flash drives) communications and other hardware used to conduct activities in support of the University’s mission.

**Encryption:** The process of converting data into a cipher or code in order to prevent unauthorized access. The technique obfuscates data in such a manner that a specific algorithm and key are required to interpret the cipher. The keys are binary values that may be interpretable as the codes for text strings, or they may be arbitrary numbers. Appropriate management of these keys allows one to store or transmit encrypted data “in plain sight” with little possibility that it can be read by an unauthorized entity. For example, encryption can protect the privacy of restricted data that is stored on a laptop computer, even if that laptop computer is stolen. Similarly, it can protect data that is transmitted, for example, over a network, even if that network is tapped by an unauthorized third party

**Essential Resource:** A Resource is designated as Essential if its failure to function correctly and on schedule could result in (1) a major failure by a campus to perform mission-critical functions, (2) a significant loss of funds to a campus, or (3) a significant liability or other legal exposure to a campus.

**Resource Custodian:** The authorized University personnel who have physical or logical control over the Electronic Information Resource. This includes, for example, central campus information technology departments with maintenance responsibility for an application; departmental system administrators of a local area network; and database administrators for campus-wide or departmental databases. This role provides a service to the Resource Proprietor.

**Resource Proprietor:** The individual designated responsibility for the information and the processes supporting the University function. Resource Proprietors are responsible for ensuring compliance with federal or state statutory regulation or University policy regarding the release of information according to procedures established by the University, the campus, or the department, as applicable to the situation. Responsibilities of Resource Proprietors

may include, for example: specifying the uses for a departmentally-owned server; establishing the functional requirements during development of a new application or maintenance to an existing application; and determining which individuals may have access to an application or to data accessible via an application. All Electronic Information Resources are University resources, and Resource Proprietors are responsible for ensuring that these Resources are used in ways consistent with the mission of the University as a whole.

**Restricted Resource:** A Resource that supports the storage, transmission, or processing of confidential data to which access requires the highest degree of restricted access and requires the highest level of security protection. The term restricted information is defined in IS-2, Inventory, Classification, and Release of University Electronic Information. The term “restricted” should not be confused with that used by the University-managed national laboratories where federal programs may employ a different classification scheme. See Appendix C for a list of the security measures mandated for restricted information.

## Appendix B. Guidelines for Restricted Information

### Restricted Resources

A Resource that supports the storage, transmission, or processing of confidential data to which access requires the highest degree of restricted access and requires the highest level of security protection. The term restricted information is defined in IS-2, Inventory, Classification, and Release of University Electronic Information. **[add changes to definition from IS-2]** The term “restricted” should not be confused with that used by the University-managed national laboratories where federal programs may employ a different classification scheme.

### General Recommendations

- Restricted information should not be collected and stored unless absolutely necessary.
- Access to restricted data should be authorized only as needed to perform assigned duties.
- Delete restricted data when there is no longer a business need for its retention.
- Avoid using actual data when testing an application; rather “mask” the restricted data, such as the Social Security Number, with dummy information. If this is not possible, ensure implementation of appropriate security measures.
- When restricted information is distributed, include notification that the data is restricted and that it requires specific security protection.
- Restricted data should not be stored on portable devices. If it is necessary to store restricted data on portable devices, ensure that appropriate protections measures, such as encryption, are in place before installing restricted data on the device.

## Summary of Information Security Program Requirements

### Risk Assessment

Appropriate risk assessments or business impact analyses shall be conducted to inventory and determine the nature of electronic information assets held or managed by the department and to understand and document the risks in the event of failures that may cause loss of confidentiality, integrity, or availability. Resources classified as *restricted* require the highest level of protection.

### Security plan

When data is copied for analysis or research, *restricted* data should be deleted whenever possible or “de-identified” by removing data elements that, in combination with other data, would result in the identification or description of an individual. If it is not possible to delete *restricted* data from ad hoc analysis tools, adequate technical and physical security measures must be implemented.

Before *restricted* data is transferred to a destination system, the Resource Proprietor must ensure that Authorized Individuals implement appropriate security measures.

- Security measures on destination systems must be commensurate with physical and technical security measures on the originating system.
- Resource Proprietors for *restricted* data must ensure that Authorized Individuals are informed of this constraint when access is originally requested. The Resource Proprietor may choose to require the authorized individual's signature to document approval of release of restricted data.

## Administrative Workforce Controls

### Workforce and authorization management

The principles of separation of duties should be followed when assigning job responsibilities relating to *restricted* or *essential* Resources. No one individual, for example, should have authorization for both implementing programs into production and updating production data for an application managing *restricted* or *essential* information.

### Critical Positions

Campuses should develop policies and procedures to ensure that candidates for critical positions related to *restricted* or *essential* Resources undergo applicable background checks as part of the selection process.

For staff working in critical positions related to *restricted* or *essential* Resources, procedures should be established that can be implemented in the event of disciplinary action or termination. Where there is a concern that access to Resources endangers the integrity of such Resources, management should act to restrict, suspend or terminate access.

### Violations

Resource Proprietors or Custodians should be notified of violations of IS-3 guidelines in accordance with departmental procedures.

- Resource Proprietors may withdraw the privileges of any individuals who violates these Guidelines if, in their opinion, continuation of such privileges threatens the security (including confidentiality, integrity, and availability) of a *restricted* electronic information resource.

## Operational and Technical Controls

### Access Controls

When any Resource manages or contains *restricted* data, appropriate measures must be in place to safeguard against unauthorized access to that data. This includes not only the primary operational copy of the information, but also data extracts and backup copies. Authorized Individuals and their specific level of privilege should be specified by the Resource Proprietor, unless otherwise defined by University policy.

Rights of access to modify *restricted* data should be performed according to procedures that ensure data integrity. Exceptions may be made on a case-by-case basis but should always be performed in a controlled manner and with the knowledge of the Resource Proprietor.

#### ***Session protection***

Technical security mechanisms should be in place that prohibit or minimize the risk of unauthorized access to Resources by others who might gain control of the working session, for example, by accessing the Authorized Individual's computer if that individual leaves it unattended. Measures such as secure screensavers, automatic logout, and/or other means of session protection should be operative on all devices with access to *restricted* Resources.

### **System Security**

#### ***Data Backup and Retention***

*Restricted* data should be encrypted if there is a risk of physical security in the storage of backup copies.

IS-3 backup requirements extend to *essential* or *restricted* software and data stored on personal computers as well as software and data stored on shared servers.

#### ***Protection Measures***

Measures, such as firewalls, should be deployed to protect supported systems from "malicious software" and to limit access to systems that host *restricted* or *essential* resources.

### **Network Security**

Firewalls should be deployed to limit access to systems that host *restricted* or *essential* resources.

### **Change Management**

Changes to any *restricted* or *essential* systems must be performed according to authorized change management procedures that monitor all changes to ensure conformance with the change management plan and that detect any unauthorized changes.

### **Physical and Environmental Controls**

Each campus should establish procedures for the physical protection of its Resources. In particular, campuses shall develop policies and procedures to protect departmental or central facilities containing shared Resources that support *restricted* or *essential* systems or data. All facilities hosting *restricted* or *essential* resources should conform to the recommended guidelines commensurate with the level of risk.

#### **Physical Access Controls**

Controls for limiting physical access to facilities housing *restricted* or *essential* Resources should be implemented through the use of combination locks, key locks,

badge readers, manual sign in/out logs, verification of identification, etc. The ability to track both ingress and egress of all individuals should be maintained.

**Final Disposition of Equipment**

Procedures should ensure implementation of controls to address the final disposition of hardware and electronic media, including requirements that ensure complete removal of *restricted* or other sensitive data before disposition, such as shredding, overwriting the disk or employing professional services. Encryption of the disk may be used as an alternative mitigation.

**Portable devices and media**

*Restricted* data may be retained on portable equipment only if protective measures, such as encryption, are implemented that safeguard the confidentiality or integrity of the data in the event of theft or loss of the portable equipment.

**Education and Security Awareness Training**

Training must be in compliance with regulations governing specific *restricted* data, such as student data subject to FERPA, financial data subject to the Financial Services Modernization Act of 1999 (Gramm-Leach Bliley Act), and electronic Protected Health Information (ePHI) subject to HIPAA.

**Third-party Agreements**

Background checks are required for non-University contractors or consultants engaged to work on *restricted* or *essential* electronic information resources. Consideration should be given to limiting outside vendor access to restricted or essential electronic information resources.

**Minimum requirements for network connectivity**

All minimum requirements for network connectivity (see Section IV) are required.

## Appendix C. Log Management

Application Logs	<p>Applications should log their activity in a manner that correlates well with the business processes the applications support, particularly any operations that modify permissions or access rights. These logs should include, at a minimum:</p> <ul style="list-style-type: none"> <li>• The business operation that was requested</li> <li>• Whether the request was accepted or denied</li> <li>• The time and date the operation was performed (Start and end times may be appropriate for long operations.)</li> <li>• Who initiated the operation</li> <li>• System and network resources used</li> <li>• Any information needed for business process controls</li> <li>• Client hardware and software characteristics</li> </ul>
System Logs	<p>System logs should include the following types of information:</p> <ul style="list-style-type: none"> <li>• The server operation that was requested</li> <li>• Whether the request was accepted or denied</li> <li>• The time and date the operation was performed (Start and end times, or duration, may be appropriate for long operations.)</li> <li>• Who and/or what system initiated the operation</li> <li>• System and network resources used</li> </ul>
Network Logs	<p>Information logged for a network flow should include:</p> <ul style="list-style-type: none"> <li>• Network (IP) addresses of the end points</li> <li>• Service identifiers (port numbers) for each of the end points</li> <li>• Whether the flow was accepted or denied</li> <li>• Date, time, and duration of the flow</li> <li>• Number of packets and bytes used by the flow</li> </ul>
Time Synchronization	<p>One of the important functions of a log management infrastructure is to relate records from various sources by time. Because of this, it is important that all components of the IT infrastructure have synchronized clocks. Use of a time service, such as NTP, is highly recommended.</p>

Baseline Behavior	<p>The baseline of activity within the IT infrastructure should be established and tracked as it changes over time.</p> <ul style="list-style-type: none"> <li>• For system and network administrators, this should include the volume of activity for major applications and systems, as well as traffic volume over the network, and should be presented over a common time scale.</li> <li>• It may also be desirable to present application activity to business managers in a manner that enables them to correlate the information with business volume.</li> <li>• Procedures should be in place to ensure that this information is reviewed on a regular and timely basis.</li> </ul>
Investigation	<p>When conducting an investigation, it will be necessary to retrieve and report log records based on a variety of selection criteria. Preparations should be made to perform ad hoc queries based on criteria, such as the following:</p> <ul style="list-style-type: none"> <li>• Source(s) of the log records</li> <li>• Time</li> <li>• Network address</li> <li>• Application or service</li> <li>• User</li> </ul> <p>When matching records from multiple sources, time and network address will be the most valuable for matching records. Application, service, and user may also be desired for matching, but it is likely that they will need to be associated with network address and time in order to accomplish this.</p>
Appropriate Use of Log Information	<p>While it is necessary for the University to perform regular collection and monitoring of these logs, this activity should be consistent with the provision of “least perusal” described in UC’s Electronic Communication Policy.</p>
Retention	<p>In order to facilitate investigation as well as to protect privacy, the retention of log records should be well-defined to provide an appropriate balance among the following</p> <ul style="list-style-type: none"> <li>• confidentiality of specific individuals’ activities,</li> <li>• the need to support investigations, and</li> <li>• the cost of retaining the records</li> </ul>
Log Management Infrastructure	<p>Each campus should establish a log management infrastructure to do the following:</p> <ul style="list-style-type: none"> <li>• move log records into the infrastructure,</li> <li>• provide secure storage for the records,</li> <li>• implement record retention policies,</li> <li>• provide analysis tools that enable correlations among records from multiple sources, and</li> <li>• protect the chain of evidence for the possibility that log records are used in legal proceedings.</li> </ul>

## Appendix D. Encryption

Restricted data should be encrypted whenever it is stored in or transmitted across an untrusted environment. The following table provides recommendations that apply to selected application scenarios.

<i>Application Scenario</i>	<i>Recommendations</i>
All Scenarios	<ul style="list-style-type: none"> <li>You don't need to protect data you don't have. Restricted data should be retained only when necessary.</li> <li>Never store the encryption key with the encrypted data and use an alternate secure method to convey the decryption measure to the recipient.</li> <li>Resource Proprietors and Custodians should assess the sensitivity of the data they store or transmit. All copies of the data should be considered, including backup copies, "shadow" copies, and extractions used for analysis (<i>e.g.</i>, spreadsheets) or software testing.</li> <li>When restricted data cannot be given an appropriate level of physical protection when it is stored or transmitted, it should be encrypted with an appropriate "strength." For commonly-deployed encryption algorithms, this implies a key length of 128 bits to 256 bits.</li> <li>Restricted data cannot be protected with encryption while it is being processed. Other security measures must be employed to protect data while it is being processed.</li> </ul>
"Whole Disk" Encryption	<ul style="list-style-type: none"> <li>The priority for implementation of "whole disk" encryption should be 1) mobile devices and media, then 2) other devices and media for which appropriate physical security is not provided.</li> <li>Campuses should implement managerial and technical infrastructures to facilitate the encryption of mobile devices and media.</li> </ul>
File Encryption	<ul style="list-style-type: none"> <li>Campuses should promulgate recommended tool sets to facilitate file encryption.</li> </ul>
Backup and Archiving	<ul style="list-style-type: none"> <li>Backup procedures should be assessed to ensure that backup copies of restricted data are appropriately protected by physical and/or technical means, particularly when they are sent off-site.</li> </ul>
Interactive Sessions	<ul style="list-style-type: none"> <li>Interactive sessions that transmit restricted data should be encrypted. Note that login passwords should often be considered to be restricted, even when no other restricted data is transmitted.</li> </ul>

<i>Application Scenario</i>	<i>Recommendations</i>
File Transfers	<ul style="list-style-type: none"> <li>When encrypted files are transmitted, the keys should be transmitted via a method other than that used for the encrypted files themselves.</li> </ul>
Web-Based Applications	<ul style="list-style-type: none"> <li>The X.509 certificates installed on servers should be acquired from Certificate Authorities that are included in common browser distributions.</li> <li>Display of restricted data should be limited to only what is required by the application. When restricted data must be displayed, however, that data should be sent with the “Cache-Control: no-cache” HTTP header to limit caching by web browsers. Application developers should also be aware that not all browsers honor this control for all file types.</li> <li>Authorized users of applications that display restricted data should be admonished not to use web browsers that are shared with people who do not have the same level of authorization.</li> </ul>
Electronic Mail	<ul style="list-style-type: none"> <li>Campuses should promulgate recommended tools for sending encrypted data through electronic mail. This is likely to include the tool set identified under “File Encryption.”</li> </ul>
Network Printer Communication	<ul style="list-style-type: none"> <li>Resource Custodians for departmental and campus print services should assess the secure printing needs of their communities and provide solutions and education, as appropriate.</li> </ul>
Remote File Services	<ul style="list-style-type: none"> <li>Resource Custodians for departmental and campus file service organizations should assess the need to protect restricted data on their servers and implement encrypted protocols (and provide user education) as appropriate.</li> </ul>
Application-to-Application Communication	<ul style="list-style-type: none"> <li>Use SOAP with HTTPS or some other commonly-available encrypted protocol to transmit restricted data when possible. When not possible, restricted data should be transmission by means of a Virtual Private Network.</li> </ul>
Virtual Private Network (VPN)	<ul style="list-style-type: none"> <li>VPNs should be implemented to protect restricted information when other methods are not feasible.</li> <li>Campuses should assess the need for a VPN to encrypt traffic for devices in untrusted or hostile portions of the network, such as campus wireless networks or the rest of the Internet.</li> </ul>
Application-Level Encryption	<ul style="list-style-type: none"> <li>When it is necessary to implement encryption within an application, utilize a suitably strong, well-tested encryption algorithm, preferably from an “off the shelf” library.</li> </ul>

<i>Application Scenario</i>	<i>Recommendations</i>
Encryption Strength	<ul style="list-style-type: none"><li>• Care must be taken to use an appropriately-strong algorithm. For commonly-deployed encryption algorithms, this implies a key length of 128 to 256 bits.</li></ul>
Key Management	<ul style="list-style-type: none"><li>• Campuses should implement key management services to ensure appropriate controls have been applied.</li></ul>

