Securing Users and Processes in Oracle® Solaris 11.4

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- **Audience** – Security administrators.
- **Required knowledge** – Site security requirements.

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♦ ♦ ♦ CHAPTER 1

About Using Rights to Control Users and Processes

Oracle Solaris provides rights that can be assigned to users, roles, processes, and selected resources. These rights provide a more secure administrative alternative to the superuser model.

This chapter provides information about the elements that support user and process rights management and discusses ways to expand users' rights, limit users' rights, add privileges to commands, and limit applications to just the privileges that they require:

What's New in Rights in Oracle Solaris 11.4

This section highlights information for existing customers about important new features in user rights, also called role-based access control (RBAC) and new features in process rights, also called privileges.

- Oracle Solaris adds privileges, and adds privileges to the basic privilege set. For a list and descriptions of basic privileges, run the `ppriv -lv basic` command. For more information, see the `privileges(7)` man page.
- Oracle Solaris puts labels on data and user processes. This feature provides data loss protection for directories and information that site security requires to have special protections. While labeling is always on, it does not change the behavior of the system until the administrator configures a labeling hierarchy, applies labels to particular files and directories, and enables trusted users to run labeled processes.

  For more information, see Chapter 3, "Labeling Files for Data Loss Protection" in *Securing Files and Verifying File Integrity in Oracle Solaris 11.4* and Chapter 6, "Labeling Processes for Data Loss Protection".

- The minimum password length is 8 characters instead of 6. For more information, see the `passwd(1)` man page.
- The Service Management Facility (SMF) is the repository for system-wide security attributes which were previously managed in the following files:

  ```
  /etc/security/policy.conf
  /etc/default/login
  /etc/default/passwd
  /etc/default/su
  ```

  The attributes and their values are loaded and managed as SMF services when the `svc:/system/account-policy:default` service is online and the security attributes from a legacy `/etc` file are enabled, for example, all security attributes from the `/etc/default/su` file.

  For more information, see the `account-policy(8S)` man page, "Modifying System-Wide Privileges, Authorizations, and Rights Profiles" on page 92, and "Security Attributes in Files and Their Corresponding SMF Properties" on page 171.
- You can administer an immutable zone over a remote RAD interface. For more information, see "Administering Immutable Zones" on page 111.
- The `user_attr` database includes additional security attributes.
  - By enabling the `login_policy/annotation=`*value* security attribute in the `account-policy` SMF stencil or by setting the value in a user account, the administrator can require (`yes`) or request (`optional`) that users annotate the purpose of their login. The annotation is added to the audit record for the login event. If the `account-policy` service is not enabled, the value can be set system-wide in the `policy.conf` file.

    For more information, see "New Feature – Annotating Reason for Access in the Audit Record" in *Managing Auditing in Oracle Solaris 11.4* and the `pam_unix_cred(7)` and `account-policy(8S)` man pages.
  - By enabling the `login_policy/auto_unlock_time=`*time* security attribute in the `account-policy` SMF stencil or by setting the value in a user account, the administrator can specify the time after which a successful authentication automatically unlocks a locked account. Administrators can specify the time as a number of minutes, hours, days, or weeks. If the `account-policy` service is not enabled, the value can be set system-wide in the `policy.conf` file.

    If a time for this attribute is not specified, the administrator must explicitly unlock the account, as shown in "How to Set Account Locking for Regular Users" on page 73.

Note - The `login_policy/auto_unlock_time` attribute does not apply to system accounts that are delivered as locked and have no password. The attribute does apply when an administrator locks a user account that has a password by using, for example, the `passwd -l` command.

For further information, see the `account-policy`(8S) and `user_attr`(5) man pages. See also "`user_attr` Database" on page 164.

- Oracle Solaris provides the `pam_otp_auth` PAM module for processing one-time passwords (OTP). OTPs provide a second authentication step before login. The package that installs the module also installs two PAM stacks in the `/etc/security/pam_policy` directory. For more information, see "Task Map: Using OTP in Oracle Solaris" in *Managing Authentication in Oracle Solaris 11.4*.
- Oracle Solaris provides the `pam_pkcs11` PAM module for managing smart card authentication. Smart cards enable users to log in only if they 1) possess a smart card that is recognized by the login server and 2) can supply the correct PIN. For more information, see Chapter 3, "Using Smart Cards for Multifactor Authentication in Oracle Solaris" in *Managing Authentication in Oracle Solaris 11.4*.

User Rights Management

User rights management is a security feature for controlling user access to tasks that would normally be restricted to the `root` role. By applying security attributes, or *rights*, to processes and to users, the site can divide superuser privileges among several administrators. Process rights management is implemented through *privileges*. User rights management is implemented through *rights profiles*, which collect rights that are then assigned to users or to roles. User rights can also be restricted, such as for kiosks or guest users.

- For a discussion of rights on kernel processes, see "Process Rights Management" on page 30.
- For procedures to manage rights, see Chapter 3, "Assigning Rights in Oracle Solaris", Chapter 4, "Assigning Rights to Applications, Scripts, and Resources", and Chapter 5, "Managing the Use of Rights".
- For troubleshooting information, see Chapter 8, "Troubleshooting Rights in Oracle Solaris".
- For reference information, see Chapter 7, "Listing Rights in Oracle Solaris" and Chapter 9, "Reference for Oracle Solaris Rights".

User and Process Rights Provide an Alternative to the Superuser Model

In conventional UNIX systems, the `root` user, also referred to as superuser, is all-powerful. Programs that run as `root`, as do many `setuid` programs, are also all-powerful. The `root` user has the ability to read and write to any file, run all programs, and send kill signals to any process. Effectively, anyone who can become superuser can modify a site's firewall, alter the audit trail, read confidential records, and shut down the entire network. A `setuid root` program that is hijacked can do anything on the system.

Assigning rights to users, resources, and processes provides a more secure alternative to the all-or-nothing superuser model. With rights, you can enforce security policy at a more fine-grained level. Rights follows the security principle of *least privilege*. Least privilege means that a user has precisely the amount of privilege that is necessary to perform a job. Regular users have enough privilege to use their applications, check the status of their jobs, print files, create new files, and so on. Rights beyond regular user rights are grouped into rights profiles. Users who are expected to do jobs that require some of the rights of superuser can be assigned a rights profile.

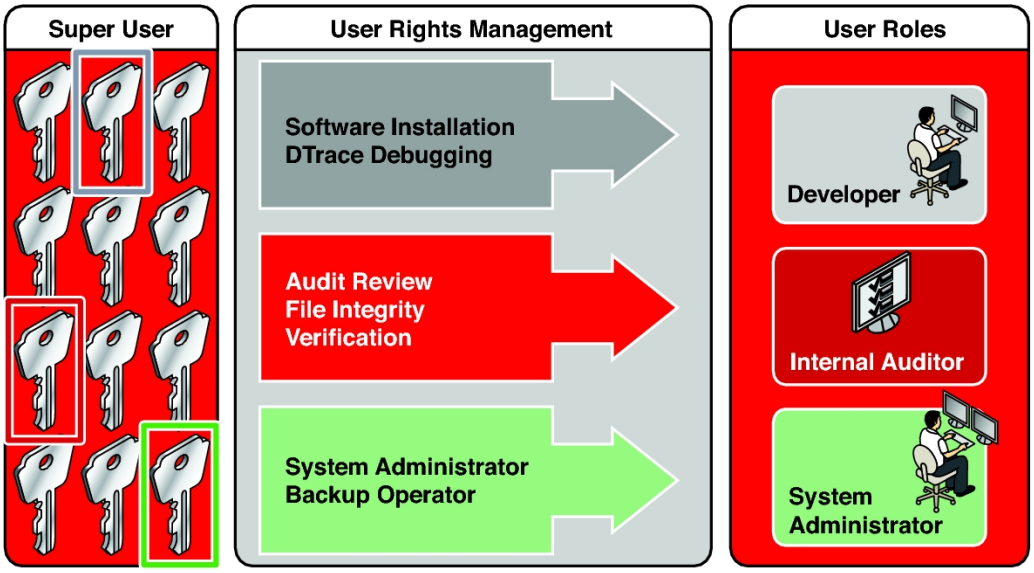
Rights that are grouped into a profile can be assigned directly to users. They can also be indirectly assigned by creating special accounts that are called *roles*. A user can then assume a role to do a job that requires some administrative privileges. Oracle Solaris supplies many predefined rights profiles. You create the roles and assign the profiles.

The ARMOR package provides a set of standardized roles. By auto-installing this package and assigning the roles to users, you can create a system that provides separation of duty at boot. For more information, see UNIX Authorization Roles Managed On RBAC (O-ARMOR) Reference: C125. In this guide, see “Following Your Chosen Rights Model” on page 48, and Example 2, “Using ARMOR Roles,” on page 58.

Rights profiles can provide broad administrative rights. For example, the System Administrator rights profile enables an account to perform tasks that are not related to security, such as printer management and cron job management. Rights profiles can also be narrowly defined. For example, the Cron Management rights profile manages `at` and `cron` jobs. When you create roles, the roles can be assigned broad administrative rights or narrow rights.

The following figure illustrates how Oracle Solaris can distribute rights to trusted users by creating roles. Superuser can also distribute rights by assigning rights profiles directly to trusted users.

FIGURE 1 Distribution of Rights



In the illustrated rights model, superuser creates three roles. The roles are based on rights profiles. Superuser then assigns the roles to users who are trusted to perform the tasks of the role. Users log in with their user names. After login, users assume roles that can run administrative commands and graphical user interface (GUI) tools.

The flexibility in setting up roles enables a variety of security policies. Although few roles are shipped with Oracle Solaris, roles are easily configured. Example 2, “Using ARMOR Roles,” on page 58 shows how to use roles that are based on the ARMOR standard. In addition to or in place of ARMOR roles, you can create your own roles based on the rights profiles that Oracle Solaris provides.

- **root –** A powerful role that is equivalent to the `root` user. However, like all roles, the `root` role cannot log in. A regular user must log in, then assume the assigned `root` role. This role is configured and assigned to the initial user by default.
- **System Administrator –** A less powerful role for administration that is not related to security. This role can manage file systems, mail, and software installation. However, this role cannot set passwords.
- **Operator –** A junior administrator role for operations such as backups and printer management.

Note - The Media Backup rights profile provides access to the entire root file system. Therefore, while the Media Backup and Operator rights profiles are designed for a junior administrator, you must ensure that the user can be trusted.

You might also want to configure one or more security roles. Three rights profiles and their supplementary profiles handle security: Information Security, User Security, and Zone Security. Network security is a supplementary profile in the Information Security rights profile.

Note that roles do not have to be implemented. Roles are a function of an organization's security needs. One strategy is to set up roles for special-purpose administrators in areas such as security, networking, or firewall administration. Another strategy is to create a single powerful administrator role along with an advanced user role. The advanced user role would be for users who are permitted to fix portions of their own systems. You can also assign rights profiles directly to users and not create roles at all.

The superuser model and the rights model can co-exist. The following table summarizes the gradations from superuser to restricted regular user that are possible in the rights model. The table includes the administrative actions that can be tracked in both models. For a summary of the effect of process rights, that is, *privileges*, see Table 2, “Visible Differences Between a System With Privileges and a System Without Privileges,” on page 33.

TABLE 1 Superuser Model Contrasted With Rights Model

User Capabilities on a System	Superuser Model	Rights Model
Can become superuser with full superuser privileges	Can	Can
Can log in as a user with full user rights	Can	Can
Can become superuser with limited rights	Cannot	Can
Can log in as a user, and have superuser privileges sporadically	Can, with `setuid root` programs only	Can, with `setuid root` programs and with rights
Can log in as a user with administrative rights but without full superuser privileges	Cannot	Can, with rights profiles, roles, and with directly assigned privileges and authorizations
Can log in as a user with fewer rights than a regular user	Cannot	Can, by removing rights
Can track superuser actions	Can, by auditing the `su` command	Can, by auditing calls to `pfexec()` Also, the name of the user who has assumed the `root` role is in the audit trail

Basics of User and Process Rights

The terms *unprivileged* or *without rights* do not apply in Oracle Solaris. Every process in Oracle Solaris, including regular user processes, has at least some privileges or other user rights, such as authorizations. To learn about the basic set of privileges that Oracle Solaris grants to all UNIX processes, see "Process Rights Management" on page 30.

The following elements enforce user rights in Oracle Solaris. These rights can be configured to enforce permissive security policies or restrictive security policies.

- **Authorization –** A permission that enables a user or role to perform a class of actions that require additional rights. For example, the default security policy gives console users the `solaris.device.cdrw` authorization. This authorization enables users to read and write to a CD-ROM device. For a list of authorizations, use the `auths list` command. Authorizations are enforced at the user application level, not in the kernel. See "More About User Authorizations" on page 28.
- **Privilege –** A right that can be granted to a command, a user, a role, or a specific resources, such as a port or SMF method. Privileges are implemented in the kernel. For example, the `proc_exec` privilege allows a process to call `execve()`. Regular users have basic privileges. To see your basic privileges, run the `ppriv -vl basic` command. For more information, see "Process Rights Management" on page 30.
- **Security attributes –** An attribute that enables a process to perform an operation, or the implementation of a right. In a typical UNIX environment, a security attribute enables a process to perform an operation that is otherwise forbidden to regular users. For example, `setuid` and `setgid` programs have security attributes. In the rights model, authorizations and privileges are security attributes in addition to `setuid` and `setgid` programs. These attributes, or rights, can be assigned to a user. For example, a user with the `solaris.device.allocate` authorization can allocate a device for exclusive use. Privileges can be placed on a process. For example, a process with the `file_flag_set` privilege can set immutable, no-unlink, or append-only file attributes.

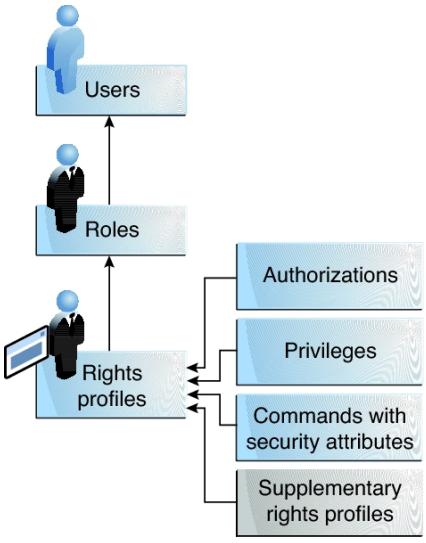
  Security attributes can also limit rights. For example, the `access_times` and `access_tz` security attributes set the days and times and optionally the timezone when specific security-relevant operations are permitted. You can limit users directly or by assigning them an authenticated rights profile that contains these keywords. For more information, see the `user_attr`(5) man page.
- **Privileged application –** An application or command that can override system controls by checking for rights. For more information, see "Applications That Check for Rights" on page 44 and *Developer's Guide to Oracle Solaris 11.4 Security*.
- **Rights profile –** A collection of rights that can be assigned to a role or to a user. A rights profile can include authorizations, directly assigned privileges, commands with security attributes, and other rights profiles. Profiles that are within another profile are called

supplementary rights profiles. Rights profiles offer a convenient way to group rights. They can be directly assigned to users or to special accounts called *roles*. You can use the commands in a rights profile only if your process recognizes rights. Additionally, you can be required to supply a password. Alternatively, password authentication can be supplied by default. See "More About Rights Profiles" on page 28.

- **Role –** A special identity for running *privileged applications*. The special identity can be assumed by assigned users only. In a system that is run by roles, superuser can be unnecessary after initial configuration. See "More About Roles" on page 29.
- **Qualified user attribute –** A security attribute that can be applied to user and role accounts in LDAP and therefore can be centrally managed. For example, you can limit a user to specified access times or assign a user a role or a rights profile on designated systems only. See "About Qualified User Attributes" on page 30.

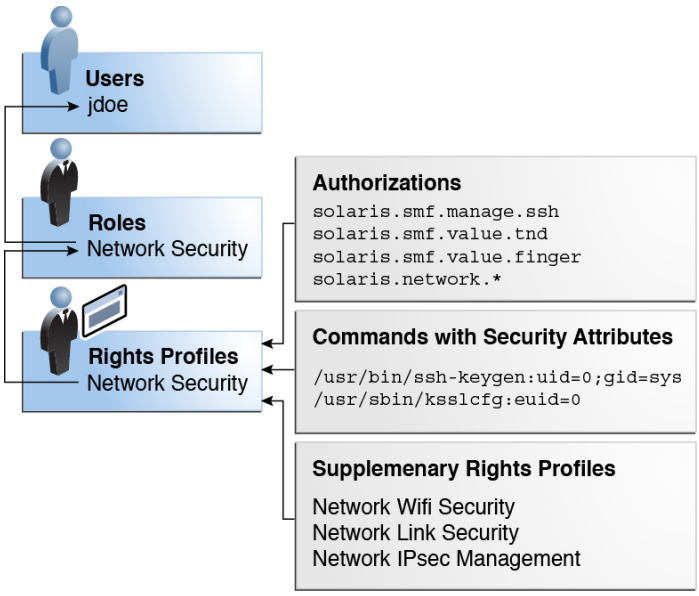
The following figure shows how user rights and process rights work together.

FIGURE 2 User Rights and Process Rights Working Together



The following figure uses the Network Security role and the Network Security rights profile to demonstrate how assigned rights work.

FIGURE 3 Example of a User Rights and Process Rights Assignment



The Network Security role is used to manage IPsec, wifi, and network links. The role is assigned to the user `jdoe`. `jdoe` can assume the role by switching to the role, and then supplying the role password. The administrator can enable the role to authenticate by using the user password rather than a role password.

In the figure, the Network Security rights profile is assigned to the Network Security role. The Network Security rights profile contains supplementary profiles that are evaluated in order, Network Wifi Security, Network Link Security, and Network IPsec Management. These supplementary profiles contain rights that complete the role's primary tasks.

The Network Security rights profile has three directly assigned authorizations, no directly assigned privileges, and two commands with security attributes. The supplementary rights profiles have directly assigned authorizations, and two of them have commands with security attributes.

When `jdoe` assumes the Network Security role, the shell changes to a profile shell. The profile shell process can evaluate the use of rights, so `jdoe` can administer network security.

More About User Rights

This section provides more details about the implementation and use of rights at the user level.

More About User Authorizations

An *authorization* is a right that can be granted to a role, a program, a zone, or a user. Authorizations enforce policy at the user application level. Like privileges, mistaken assignments of authorizations can result in more rights being granted than originally intended. For more information, see “Privilege Escalation and User Rights” on page 40.

The difference between authorizations and privileges concerns the level at which the security policy is enforced. Without the proper privilege, a process can be prevented from performing privileged operations by the kernel. Without the proper authorizations, a user can be prevented from using a privileged application or from performing security-sensitive operations within a privileged application. For a fuller discussion of privileges, see “Process Rights Management” on page 30.

Rights-compliant applications can check a user's authorizations prior to granting access to the application or specific operations within the application. This check replaces the check in conventional UNIX applications for `UID=0`.

For more information about authorizations, see the following sections:

- “Authorizations Reference” on page 161
- “`auth_attr` Database” on page 165
- “Selected Commands That Require Authorizations” on page 168

More About Rights Profiles

A *rights profile* is a collection of rights that can be assigned to a role or user to perform tasks that require administrative rights. A rights profile can include authorizations, privileges, commands with assigned security attributes, and other rights profiles. Rights profiles can also contain entries to reduce or extend the initial inheritable set of privileges and to reduce the limit set.

An *authenticated rights profile* is a rights profiles that requires the user to supply a password, or to *reauthenticate*. The administrator decides which profiles can be used without user reauthentication. A good example of a profile that would not require reauthentication is the

Basic Solaris User rights profile. Depending on site security requirements, rights profiles for security-sensitive tasks might require reauthentication.

For reference information about rights profiles, see the following sections:

- “Rights Profiles Reference” on page 160
- “`prof_attr` Database” on page 166
- “`exec_attr` Database” on page 166

More About Roles

A *role* is a special type of user account from which you can run privileged applications. Roles are created in the same general manner as user accounts. Roles have a home directory, a group assignment, a password, and so on. Rights profiles and authorizations give the role administrative rights. Roles cannot inherit rights from other roles or from the user who assumes the role. Roles distribute superuser privileges, and thus enable more secure administrative practices.

A role can be assigned to more than one user. All users who can assume the same role have the same role home directory, operate in the same environment, and have access to the same files. Users can assume roles at the command line by running the `su` command and supplying the role name and the role's password. The administrator can configure the system to enable a user to authenticate by supplying the user's password. See Example 18, “Enabling a User to Use Own Password for Role Password,” on page 67.

A role cannot log in directly. A user logs in, and then assumes a role. Once you have assumed a role, you cannot assume another role without first exiting your current role.

Also, while a rights profile adds rights to the user's environment, a role gives the user a clean execution environment that is shared with other users who can assume that role. When a user switches to a role, none of the user's authorizations or rights profiles applies to the role.

The `passwd`, `shadow`, and `user_attr` databases store static role information. You can and should audit the actions of roles.

For detailed information about setting up roles, see the following sections:

- “Following Your Chosen Rights Model” on page 48
- “Assigning Rights to Users” on page 51

The fact that `root` is a role in Oracle Solaris prevents anonymous `root` login. If the profile shell command, `pfexec`, is being audited, the audit trail contains the login user's real UID, any roles that the user has assumed, and the privileged operations that were performed. To audit the system for privileged operations, see “Auditing Administrative Actions” on page 118.

About Qualified User Attributes

Qualified user attributes are attributes that can be assigned to users and roles, and to hosts and groups of hosts called netgroups. Netgroups simplify administration of a set of systems, such as a lab network. These qualifiers apply only to LDAP accounts, not to the `files` naming service.

Qualified and unqualified user attributes are maintained independently, and cannot be combined. This independence allows administrators to assign both qualified and unqualified extended policy attributes to a single user or role. At runtime, the system first determines the hostname where the execution is occurring, then applies the appropriate set of policy attributes.

The `usermod` and `rolemod` commands accept a qualifier option, `-q` to indicate the host or netgroup where the security attributes apply. Separate `usermod` and `rolemod` commands are required to manage each set of qualified or unqualified attributes. The `userdel` and `roledel` commands can remove a complete set of qualified attributes without affecting other qualified or unqualified attributes.

The policy for applying the appropriate set of user attributes follows the search order specified by the `name-service/switch` service and is cached by the `name-service/cache` service. The order is:

1. A local entry matching the named user or role
2. One or more LDAP entries of the named user or role's qualified attributes
3. An LDAP entry whose hostname matches the current host
4. A netgroup (in LDAP) that has the current host as a member
5. An unqualified entry for the named LDAP user or role
6. In the absence of an assigned Stop rights profile, default attributes specified in the `account-policy` service. The attribute values in the `policy.conf` file usually reflect the service values.

If a match is found, it is cached to optimize subsequent queries. For examples, see Example 33, “Qualifying Where and When LDAP Users and Roles Can Use Their Rights,” on page 85.

Process Rights Management

Process rights management in Oracle Solaris is implemented by *privileges*. Privileges enable processes to be restricted at the level of command, user, role, and specific system resource. Privileges decrease the security risk that is associated with one user or one process having full superuser powers on a system. Process rights and user rights provide a compelling alternative model to the traditional superuser model.

Traditionally, privileges are used to add rights. However, privileges can also be used to restrict rights, for example, changing a `setuid root` program to a program that is privilege-aware. Also, with an *extended privilege policy*, administrators can allow only specified privileges to be used with a file object, user ID, or port. This fine-grained privilege assignment denies all other privileges except basic privileges to these resources.

- For information about extended privilege policy and restrictive privileges, see "Using Extended Privilege Policy to Restrict Privilege Use" on page 40.
- For information about user rights, see "User Rights Management" on page 21.
- For information about how to administer privileges, see Chapter 3, "Assigning Rights in Oracle Solaris".
- For reference information about privileges, see "Privileges Reference" on page 169.

Privileges Protecting Kernel Processes

A privilege is a right that a process requires to perform an operation. The right is enforced in the kernel. A program that operates within the bounds of the *basic set* of privileges operates within the bounds of the system security policy. `setuid root` programs are examples of programs that operate outside the bounds of the system security policy. By using privileges, programs eliminate the need for calls to `setuid root`.

Privileges enumerate the kinds of operations that are possible on a system. Programs can be run with the exact privileges that enable the program to succeed. For example, a program that manipulates files might require the `file_dac_write` and `file_flag_set` privileges. These privileges on the process eliminate the need to run the program as `root`.

Historically, systems have not followed the privilege model, or rights model, as introduced in "Basics of User and Process Rights" on page 25. Rather, systems used the superuser model. In the superuser model, processes were run as `root` or as a user. User processes were limited to acting on the user's directories and files. `root` processes could create directories and files anywhere on the system. A process that required creation of a directory outside the user's directory would run with a `UID=0`, that is, as `root`. Security policy relied on discretionary access control (DAC) to protect system files. Device nodes were protected by DAC. For example, devices owned by the group `sys` could be opened only by members of that group.

However, `setuid` programs, file permissions, and administrative accounts are vulnerable to misuse. The actions that a `setuid` process is permitted are more numerous than the process requires to complete its operation. A `setuid root` program can be compromised by an intruder who then runs as the all-powerful `root` user. Similarly, any user with access to the `root` password can compromise the entire system.

In contrast, a system that enforces policy with privileges provides a gradation between user rights and `root` rights. A user can be granted privileges to perform activities that are beyond the rights of regular users, and `root` can be limited to fewer privileges than `root` currently possesses. With rights, a command that runs with privileges can be isolated in a rights profile and assigned to one user or role. Table 1, “Superuser Model Contrasted With Rights Model,” on page 24 summarizes the gradation between user rights and root privileges that the rights model provides.

The rights model provides greater security than the superuser model. Privileges that have been removed from a process cannot be exploited. Process privileges can provide an additional safeguard for sensitive files and devices in contrast to DAC protections alone, which can be exploited to gain access.

Privileges, then, can restrict programs and processes to just the rights that the program requires. On a system that implements least privilege, an intruder who captures a process can access only those privileges that the process has. The rest of the system cannot be compromised.

Privilege Descriptions

Privileges are logically grouped on the basis of the area of the privilege.

- **FILE privileges –** Privileges that begin with the string `file` operate on file system objects. For example, the `file_dac_write` privilege overrides discretionary access control when writing to files.
- **IPC privileges –** Privileges that begin with the string `ipc` override IPC object access controls. For example, the `ipc_dac_read` privilege enables a process to read remote shared memory that is protected by DAC.
- **NET privileges –** Privileges that begin with the string `net` give access to specific network functionality. For example, the `net_rawaccess` privilege enables a device to connect to the network.
- **PROC privileges –** Privileges that begin with the string `proc` allow processes to modify restricted properties of the process itself. `PROC` privileges include privileges that have a very limited effect. For example, the `proc_clock_highres` privilege enables a process to use high resolution timers.
- **SYS privileges –** Privileges that begin with the string `sys` give processes unrestricted access to various system properties. For example, the `sys_linkdir` privilege enables a process to make and break hard links to directories.

Other logical groups include CONTRACT, CPC, DAX, DTRACE, GRAPHICS, VIRT, and WIN.

Some privileges have a limited effect on the system, and some have a broad effect. The definition of the `proc_taskid` privilege indicates its limited effect:

```
proc_taskid
        Allows a process to assign a new task ID to the calling process.
```

The definition of the `net_rawaccess` privilege indicates its broad effect:

```
net_rawaccess
        Allows a process to have direct access to the network layer.
```

The `privileges(7)` man page provides descriptions of every privilege. See also "Listing Privileges" on page 143.

Administrative Differences on a System With Privileges

A system that has privileges has several visible differences from a system that does not have privileges. The following table lists some of the differences.

TABLE 2 Visible Differences Between a System With Privileges and a System Without Privileges

Feature	No Privileges	Privileges
Daemons	Daemons run as `root`.	Daemons run as the user `daemon`. For example, these daemons are assigned limited privileges and run as `daemon`: `lockd` and `rpcbind`.
Log file ownership	Log files are owned by `root`.	Log files are owned by `daemon`, who creates the log file. The `root` user does not own the file.
Error messages	Error messages refer to superuser. For example, `chroot: not superuser`.	Error messages reflect the use of privileges. For example, the equivalent error message for `chroot` failure is `chroot: exec failed`.
`setuid` programs	Programs use `setuid root` to complete tasks that regular users are not allowed to perform.	Many `setuid root` programs run with just the privileges they need. For example, the following commands use privileges: `audit`, `ikeadm`, `ipadm`, `ipsecconf`, `ping`, `traceroute`, and `newtask`.
File permissions	Device permissions are controlled by DAC. For example, members of the group `sys` can open `/dev/ip`.	File permissions (DAC) do not predict who can open a device. Devices are protected with DAC *and* device policy. For example, the `/dev/ip` file has `666` permissions, but the device can only be opened by a process with the appropriate privileges.
Audit events	Auditing the use of the `su` command covers many administrative functions.	Auditing the use of privileges covers most administrative functions. The `cusa` audit class includes audit events that monitor administrative functions.

Feature	No Privileges	Privileges
Processes	Processes are protected by the rights of the process owner.	Processes are protected by privileges. Process privileges and process flags are visible as a new entry in the `/proc/<pid>/priv` directory.
Debugging	No reference to privileges in core dumps.	The ELF note section of core dumps includes information about process privileges and flags in the `NT_PRPRIV` and `NT_PRPRIVINFO` notes. The `ppriv` command and other commands show the proper number of properly sized sets. The commands correctly map the bits in the bit sets to privilege names.

More About Privileges

This section covers privilege implementation, use, and assignment details.

How Privileges Are Implemented

Every process has four sets of privileges that determine whether a process can use a particular privilege. The kernel automatically calculates the *effective set* of privileges. You can modify the initial *inheritable set* of privileges. A program that is coded to use privileges can reduce the program's *permitted set* of privileges. You can shrink the *limit set* of privileges.

- **Effective privilege set, or E –** The set of privileges that is currently in effect. A process can add privileges that are in the permitted set to the effective set. A process can also remove privileges from E.
- **Permitted privilege set, or P –** The set of privileges that is available for use. Privileges can be available to a program from inheritance or through assignment. An execution profile is one way to assign privileges to a program. The `setuid` command assigns all privileges that `root` has to a program. Privileges can be removed from the permitted set but not added. Privileges that are removed from P are automatically removed from E.

  A *privilege-aware* program removes the privileges that a program never uses from the program's permitted set. In this way, unnecessary privileges cannot be exploited by the program or a malicious process. For more information about privilege-aware programs, see Chapter 2, “Developing Privileged Applications” in *Developer’s Guide to Oracle Solaris 11.4 Security*.
- **Inheritable privilege set, or I –** The set of privileges that a process can inherit across a call to `exec`. After the call to `exec`, the inherited privileges are placed in the permitted set and the effective set, thus making these sets equal, except in the special case of a `setuid` program.

For a `setuid` program, after the call to `exec`, the inheritable set is first restricted by the limit set. Then, the set of privileges that were inherited (I), minus any privileges that were in the limit set (L), are assigned to P and E for that process.

- **Limit privilege set, or L –** The set that defines the outside limit of which privileges are available to a process and its children. By default, the limit set is all privileges. Processes can shrink the limit set but can never extend the limit set. L is used to restrict I. Consequently, L restricts P and E at the time of `exec`.

  If a user has been assigned a profile that includes a program that has been assigned privileges, the user can usually run that program. On an unmodified system, the program's assigned privileges are within the user's limit set. The privileges that have been assigned to the program become part of the user's permitted set. To run the program that has been assigned privileges, the user must run the program from a profile shell.

The kernel recognizes a basic privilege set. On an unmodified system, each user's initial inheritable set equals the basic set at login. While you cannot modify the basic set, you can modify which privileges a user inherits from the basic set.

On an unmodified system, a user's privilege sets at login would appear similar to the following:

```
E (Effective): basic
I (Inheritable): basic
P (Permitted): basic
L (Limit): all
```

At login, all users would have the basic set in their inheritable set, their permitted set, and their effective set. A user's limit set is equivalent to the default limit set for the zone, global or non-global.

You can assign additional privileges directly to a user, or more precisely to a user's login process, indirectly to many users through a rights profile, and indirectly by assigning a privileged command to a user. You can also remove privileges from a user's basic set. For procedures and examples, see Chapter 3, “Assigning Rights in Oracle Solaris”.

How Privileges Are Used

Privileges are built into Oracle Solaris. This section describes how Oracle Solaris uses privileges with devices, in resource management, and with legacy applications.

How Processes Get Privileges

Processes can inherit privileges or be assigned privileges. A process inherits privileges from its parent process. At login, the user's initial inheritable set of privileges determines which privileges are available to the user's processes. All child processes of the user's initial login inherit that set.

You can also directly assign privileges to programs, users, roles, and specific resources. When a program requires privileges, you assign the privileges to the program's executable in a rights profile. Users or roles that are permitted to run the program are assigned the profile that includes the program. At login or when a profile shell is opened, the program runs with privilege when the program's executable is typed in the profile shell. For example, a role that includes the Object Access Management profile is able to run the `chmod` command with the `file_chown` privilege, and therefore can change the ownership of a file that the role does not own.

When a role or user runs a program that has been directly assigned an additional privilege, the assigned privilege is added to the role or user's inheritable set. Child processes of the program that was assigned privileges inherit the privileges of the parent. If the child process requires more privileges than the parent process, the child process must be directly assigned those privileges.

Programs that are coded to use privileges are called privilege-aware programs. A privilege-aware program enables and disables the use of privilege during program execution. To succeed in a production environment, the program must be assigned the privileges that the program enables and disables. Before you make a privilege-aware program available, you assign to the executable only the privileges that the program needs. You then test the program to see that the program succeeds in performing its tasks. You also check that the program does not abuse its use of privileges.

For examples of privilege-aware code, see Chapter 2, “Developing Privileged Applications” in *Developer’s Guide to Oracle Solaris 11.4 Security*. To assign privileges to a program that requires privileges, see Example 38, “Assigning Security Attributes to a Legacy Application,” on page 99 and Example 49, “Creating a Rights Profile That Includes Privileged Commands,” on page 120.

Privileges and Devices

In the rights model, privileges protect system interfaces that in the superuser model are protected by file permissions alone. In a system with privileges, file permissions are too weak to protect the interfaces. A privilege such as `proc_owner` could override file permissions and then gain full access to the system.

Therefore, in Oracle Solaris, ownership of the device directory is not sufficient to open a device. For example, members of the group `sys` are no longer automatically allowed to open the `/dev/ip` device. The file permissions on `/dev/ip` are `0666`, but the `net_rawaccess` privilege is also required to open the device.

Because device policy is controlled by privileges, you have more flexibility in granting permission to open devices. Privilege requirements are configurable for the device policy and for the driver proper. You can configure the privilege requirements when installing, adding, or updating a device driver.

For more information, see the `add_drv`(8), `devfsadm`(8), `getdevpolicy`(8), and `update_drv`(8) man pages.

Privileges and Resource Management

In Oracle Solaris, you can use the `project.max-locked-memory` and `zone.max-locked-memory` resource controls to limit the memory consumption of processes that are assigned the `PRIV_PROC_LOCK_MEMORY` privilege. This privilege allows a process to lock pages in physical memory.

If you assign the `PRIV_PROC_LOCK_MEMORY` privilege to a rights profile, you can give the processes that have this privilege the ability to lock all memory. As a safeguard, set a resource control to prevent the user of the privilege from locking all memory. For privileged processes that run in a non-global zone, set the `zone.max-locked-memory` resource control. For privileged processes that run on a system, create a project and set the `project.max-locked-memory` resource control. For information about these resource controls, see Chapter 6, “About Resource Controls” in *Administering Resource Management in Oracle Solaris 11.4* and Chapter 1, “Non-Global Zone Configuration Command and Resources” in *Oracle Solaris Zones Configuration Resources*.

Legacy Applications and the Use of Privileges

To accommodate legacy applications, the implementation of privileges works with both the superuser and the rights models. The kernel automatically tracks the `PRIV_AWARE` flag, which indicates that a program has been designed to work with privileges. Consider a child process that is not aware of privileges. Any privileges that were inherited from the parent process are available in the child's permitted and effective sets. If the child process sets a UID to `0`, the child process might not have full superuser rights. The process's effective and permitted sets are restricted to those privileges in the child's limit set. Thus, the limit set of a privilege-aware process restricts the root privileges of child processes that are not aware of privileges.

Debugging Use of Privilege

Oracle Solaris provides tools to debug privilege failure. The `ppriv` command and the `truss` command provide debugging output. For examples, see the `ppriv`(1) man page. For examples, see “Troubleshooting RBAC and Privileges” on page 147. You can also use the `dtrace` command. For more information, see the `dtrace`(8) man page and *Oracle Solaris 11.4 DTrace (Dynamic Tracing) Guide*.

Privilege Assignment

The term "privilege" traditionally indicates an increase in rights. Because every process on an Oracle Solaris system runs with some rights, you can decrease the rights on a process by removing privileges. In this release, you can also use an *extended privilege policy* to remove most privileges except the ones that are given to certain resources by default.

Assigning Privileges to Users and Processes

In your capacity as security administrator, you are responsible for assigning privileges. Existing rights profiles have privileges already assigned to commands in the profile. You then assign the rights profile to a role or user.

Privileges can also be assigned directly to a user, a role, or a rights profile. If you trust a subset of users to use a privilege responsibly throughout their sessions, you can assign the privilege directly. Good candidates for direct assignment are privileges that have a limited effect, such as `proc_clock_highres`. Poor candidates for direct assignment are privileges that have broader effects, such as `file_dac_write`. For a fuller discussion, see “Security Considerations When Assigning Rights” on page 45.

Privileges can also be denied to a user, role, or process. Care must be taken when removing privileges from the initial inheritable set or the limit set of a user or role.

Expanding a User or Role's Privileges

Users and roles have an inheritable set of privileges. The limit set can only be reduced because the limit set is initially all privileges. The initial inheritable set can be expanded for users, roles, and processes by assigning a privilege that is not in the inheritable set.

You can expand the privileges that are available in three ways:

- A privilege that is not in the initial inheritable set but is in the limit set can be assigned to users and roles. The assignment can be indirect, through a privileged command in a rights profile, or it can be direct.
- A privilege that is not in the inheritable set can be explicitly assigned to a process, such as adding privileges to a script or application.
- A privilege that is not in the inheritable set but is in the limit set can be explicitly assigned to a network port, UID, or file object. This use of privilege is called an *extended privilege policy* and is also a means of restricting available privileges. For more information, see "Using Extended Privilege Policy to Restrict Privilege Use" on page 40.

The assignment of a privilege to just the administrative task that requires the privilege is the most precise way to expand a user or role's privileges. You create a rights profile that includes the command or script with its required privileges. Then, you assign this rights profile to a user or role. Such assignment enables the user or role to run that privileged command. The privilege is otherwise unavailable to the user.

Expanding the initial inheritable set of privileges for users or roles is a less desirable way to assign privileges. All privileges in the inheritable set are in the permitted and effective sets. All commands that the user or role types in a shell can use the directly assigned privileges. For a fuller discussion, see "Security Considerations When Assigning Rights" on page 45.

To reduce unnecessary privilege availability, you can assign *extended privileges* to network ports, UIDs, and file objects. Such assignment removes privileges that are not in the extended privilege assignment from the effective set. For a discussion, see "Using Extended Privilege Policy to Restrict Privilege Use" on page 40.

Restricting Privileges for a User or Role

Privileges and rights profiles can also be applied to untrusted users to restrict their rights. By removing privileges, you can prevent users and roles from performing particular tasks. You can remove privileges from the initial inheritable set and from the limit set. You should carefully test removal of privileges before you distribute an initial inheritable set or a limit set that is smaller than the default set. By removing privileges from the initial inheritable set, you might prevent users from logging in. When privileges are removed from the limit set, a legacy `setuid root` program might fail because the program requires a privilege that was removed. For examples of privilege removal, see "Removing Privileges From Users" on page 78.

To limit the privileges that are available to a user ID, port, or file object, see "Using Extended Privilege Policy to Restrict Privilege Use" on page 40.

Assigning Privileges to a Script

Scripts are executables, like commands. Therefore, in a rights profile, you can add privileges to a script just as you can add privileges to a command. The script runs with the added privileges when a user or role who has been assigned the rights profile executes the script in a profile shell. If the script contains commands that require privileges, the commands with added privileges must also be in an assigned rights profile. For examples, see “Assigning Rights to Applications and Scripts” on page 97.

Using Extended Privilege Policy to Restrict Privilege Use

Extended privilege policy can restrict access to ports, user IDs, or file objects except for the basic privileges and the privileges that you explicitly grant. With so few privileges, the resource cannot easily be used to attack the system. In fact, users can protect files and directories that they own from access by potentially malicious processes. For examples of extended privilege policy, see “Limiting Applications, Scripts, and Resources to Specific Rights” on page 97.

Privilege Escalation and User Rights

Oracle Solaris provides administrators with a great deal of flexibility when configuring security. As installed, the software prevents privilege escalation. *Privilege escalation* occurs when a user or process gains more administrative rights than you intended to grant. In this sense, "privilege" means all rights, not just kernel privileges. See “Privilege Escalation and Kernel Privileges” on page 41.

Oracle Solaris software includes rights that are assigned to the `root` role only. With other security protections in place, an administrator might assign attributes that are designed for the `root` role to other accounts, but such assignment must be made with care.

The following rights profile and set of authorizations can escalate the privileges of a non-root account:

- **Media Restore rights profile –** This profile is not part of any other rights profile. Because Media Restore provides access to the entire root file system, its use is a possible escalation of privilege. Deliberately altered files or substitute media could be restored. By default, the `root` role includes this rights profile.
- `solaris.*.assign` **authorizations –** These authorizations are not assigned to any rights profile. An account with a `solaris.*.assign` authorization could assign rights to others

that the account itself is not assigned. For example, a role with the `solaris.profile.assign` authorization can assign rights profiles to other accounts that the role itself is not assigned. By default, only the `root` role has `solaris.*.assign` authorizations.

Assign `solaris.*.delegate` authorizations, rather than `solaris.*.assign` authorizations. A `solaris.*.delegate` authorization enables the delegater to assign other accounts only those rights that the delegater possesses. For example, a role that is assigned the `solaris.profile.delegate` authorization can assign rights profiles that the role itself is assigned to other users and roles.

For the prevention of escalation of kernel privileges, see "Privilege Escalation and Kernel Privileges" on page 41.

Privilege Escalation and Kernel Privileges

The kernel prevents privilege escalation. To prevent a process from gaining more privileges than the process should have, the kernel checks that vulnerable system modifications have the full set of privileges. For example, a file or process that is owned by `root` (`UID=0`) can be changed only by a process with the full set of privileges. The `root` account does not require privileges to change a file that `root` owns. However, a non-root user must have all privileges in order to change a file that is owned by `root`.

Similarly, operations that provide access to devices require all privileges in the effective set.

Specifically, the `file_chown_self` and `proc_owner` privileges are subject to privilege escalation.

- The `file_chown_self` privilege allows a process to give away its files. The `proc_owner` privilege allows a process to inspect processes that the process does not own.

  The `file_chown_self` privilege is limited by the `rstchown` system variable. When the `rstchown` variable is set to `0`, the `file_chown_self` privilege is removed from the initial inheritable set of all users of the system. For more information about the `rstchown` system variable, see the `chown(1)` man page.

  The `file_chown_self` privilege is most safely assigned to a particular command, the command placed in a rights profile, and the profile assigned to a role or a trusted user.
- The `proc_owner` privilege is not sufficient to switch a process UID to `0`. To switch a process from any UID to `UID=0` requires all privileges. Because the `proc_owner` privilege gives unrestricted read access to all files on the system, the privilege is most safely assigned to a particular command, the command placed in a profile, and the profile assigned to a role.

Caution - You can configure a user's account to include the `file_chown_self` privilege or the `proc_owner` privilege in the user's initial inheritable set. However, you should have overriding security reasons for placing such powerful privileges in any user or role's inheritable set.

For information about how privilege escalation is prevented for devices, see "Privileges and Devices" on page 36. For a general discussion, see the `privileges(7)` man page.

Rights Verification

The shell that a process runs in, the scope of the naming service, and the order of search can affect whether assigned rights are evaluated. Processes whose rights cannot be evaluated fail. For assistance in checking for rights assignments, see "Troubleshooting RBAC and Privileges" on page 147.

Profile Shells and Rights Verification

Users and roles can run privileged applications from a profile shell. A *profile shell* is a special shell that recognizes rights. Administrators can assign a profile shell to users as a login shell, or the profile shell is started when a user runs the `pfexec` command or the `su` command to assume a role. In Oracle Solaris, every shell has a profile shell counterpart. For a list of profile shells, see the `pfexec(1)` man page.

Users who are directly assigned a rights profile and whose login shell is not a profile shell must open a profile shell to run the privileged commands that they are assigned. Users and roles who are assigned an authenticated rights profile are prompted to authenticate, that is, to provide a password before the command can execute. For usability and security considerations, see "Considerations When Assigning Rights" on page 45.

Name Service Scope and Rights Verification

Name service scope affects when assigned rights are available. The scope of a role might be limited to an individual host. Alternatively, the scope might include all hosts that are served by a naming service such as LDAP. The name service scope for a system is specified in the name switch service, `svc:/system/name-service/switch`. A lookup stops at the first match. For example, if a rights profile exists in two name service scopes, only the entries in the first

name service scope are used. If `files` is the first match, then the scope of the role is limited to the local host. For information about naming services, see the `nsswitch.conf`(5) man page, *Working With Oracle Solaris 11.4 Directory and Naming Services: DNS and NIS*, and *Working With Oracle Solaris 11.4 Directory and Naming Services: LDAP*.

Order of Search for Assigned Rights

A user or role can be assigned security attributes directly or through a rights profile. The order of search affects which security attribute value is used. The value of the first found instance of the attribute is used.

Note - The order of authorizations is not important. Authorizations are cumulative.

When a user logs in, rights are assigned in the following search order:

- **Rights** that are assigned directly to the user with the `useradd` and `usermod` commands. For a list of possible rights assignments, see "`user_attr` Database" on page 164.
- **Rights profiles** that are assigned to the user with the `useradd` and `usermod` commands. These assignments are searched in order.
  - First, the authenticated rights profiles are searched.

    The order is the first profile in the authenticated profiles list and then its supplementary profiles, the second profile in the authenticated profiles list and then its supplementary profiles, and so on. The first instance of a value is the one that the system uses, except for `auths` values, which are cumulative. The attributes that can be assigned to rights profiles include all the rights that can be assigned to users, plus supplementary profiles. For the list, see "`user_attr` Database" on page 164.
  - Then, the rights profiles that do not require reauthentication are searched in the same fashion.
- **Console User rights profile** value. For a description, see "Rights Profiles Reference" on page 160.
- If the **Stop rights profile** is assigned, the evaluation of security attributes stops. No attributes are assigned after the Stop profile is assigned. The Stop profile is evaluated after the Console User rights profile and before the other security attributes, including `authorizations_granted`. For a description, see "Rights Profiles Reference" on page 160.
- `rbac/default_profiles astring Basic\ Solaris\ User`
- `rbac/default_authorizations`
- `rbac/default_auth_profiles`

- `rbac/default_profiles`
- `rbac/default_privileges`
- `rbac/default_limit_privileges`

Applications That Check for Rights

Applications and commands that can override system controls are considered privileged applications. Security attributes such as `UID=0`, privileges, and authorizations make an application privileged.

Applications That Check UIDs and GIDs

Privileged applications that check for `root` (`UID=0`) or some other special UID or GID have long existed in the UNIX environment. The rights profile mechanism enables you to isolate commands that require a specific ID. Instead of changing the ID on a command that anyone can access, you can place the command with an assigned UID in a rights profile. A user or role with that rights profile can then run the program as that UID without having to become superuser.

IDs can be specified as *real* or *effective*. Assigning effective IDs is preferred over assigning real IDs. Effective IDs are equivalent to the `setuid` feature in the file permission bits. Effective IDs also identify the UID for auditing. However, because some shell scripts and programs require a real UID of `root`, real UIDs can be set as well. For example, the `reboot` command requires a real rather than an effective UID.

Tip - If an effective ID is not sufficient to run a command, assign the real ID to the command.

Applications That Check for Privileges

Privileged applications can check for the use of privileges. The rights profile mechanism enables you to specify the privileges for specific commands that require security attributes. Then, you can isolate the command with assigned security attributes in a rights profile. A user or role with that rights profile can then run the command with just the privileges that the command requires.

Commands that check for privileges include the following:

- Kerberos commands, such as `kadmin`, `kprop`, and `kdb5_util`

- Network commands, such as `ipadm`, `routeadm`, and `snoop`
- File and file system commands, such as `chmod`, `chgrp`, and `mount`
- Commands that control processes, such as `kill`, `pcred`, and `rcapadm`

To add commands with privileges to a rights profile, see "How to Create a Rights Profile" on page 119 and the `profiles(1)` man page. To determine which commands check for privileges in a particular profile, see Chapter 7, "Listing Rights in Oracle Solaris".

Applications That Check Authorizations

Some Oracle Solaris commands check authorizations, including the following:

- Audit administration commands, such as `auditconfig` and `auditreduce`
- Printer administration commands, such as `cupsenable` and `lpadmin`
- Batch job commands, such as `at`, `atq`, `batch`, and `crontab`
- Device-oriented commands, such as `allocate`, `deallocate`, `list_devices`, and `cdrw`.

For guidance about checking a script or program for authorizations, see Example 40, "Checking for Authorizations in a Script or Program," on page 100. To write a program that requires authorizations, see "About Authorizations" in *Developer's Guide to Oracle Solaris 11.4 Security*.

Considerations When Assigning Rights

Security and usability issues can affect how administrators assign rights.

Security Considerations When Assigning Rights

Typically, users or roles obtain administrative rights through a rights profile, but direct assignment of rights is also possible.

- Privileges can be assigned directly to users and roles.

  Direct assignment of privileges is not a secure practice. Users and roles with a directly assigned privilege can override security policy wherever this privilege is required by the kernel. Also, malicious processes that compromise a user or role's process can use this privilege wherever it is required by the kernel.

A more secure practice is to assign the privilege as a security attribute of a command in a rights profile. Then, that privilege is available only for that command by someone who has that rights profile.

- Authorizations can be assigned directly to users and roles.

  Because authorizations are evaluated at the user level, direct assignment of authorizations can be less dangerous than direct assignment of privileges. However, authorizations can enable a user to perform highly secure tasks, such as assigning audit flags. For greater security, assign authorizations in an authenticated rights profile where the user must supply a password before the command can execute.

Usability Considerations When Assigning Rights

Direct assignment of rights can affect usability.

- Directly assigned authorizations and the commands and authorizations in a user's rights profile must be interpreted by a profile shell to be effective. By default, users are not assigned a profile shell. Therefore, users must remember to open a profile shell and execute the commands in that shell.
- Singly assigning authorizations is not scalable. Also, directly assigned authorizations might not be sufficient to perform a task. The task might require privileged commands.

  Rights profiles are designed to bundle authorizations and privileged commands together. They also scale well to groups of users.

♦ ♦ ♦ CHAPTER 2

Planning Your Administrative Rights Configuration

This chapter provides information to help you decide whether to use a traditional rights model or to fully take advantage of the Oracle Solaris rights model when administering your system. The chapter covers the following topics:

- "Deciding Which Rights Model to Use for Administration" on page 47
- "Following Your Chosen Rights Model" on page 48

For an overview of rights, see "User Rights Management" on page 21. For reference information, see Chapter 9, "Reference for Oracle Solaris Rights".

Deciding Which Rights Model to Use for Administration

Rights in Oracle Solaris include rights profiles, authorizations, and privileges. Oracle Solaris offers several ways to configure administrative rights on a system.

The following list is ordered from most secure to the less secure traditional superuser model.

1. Divide administrative tasks among several trusted users, each of whom has limited rights. This approach is the Oracle Solaris rights model.

   For information about how to follow this approach, see "Following Your Chosen Rights Model" on page 48.

   For a discussion of the benefits of this approach, see Chapter 1, "About Using Rights to Control Users and Processes".
2. Use the default rights configuration. This approach uses the rights model but does not customize it to your site.

   By default, the initial user has some administrative rights and can assume the `root` role. Optionally, the `root` role could assign the `root` role to another trusted user. For greater security, the `root` role would enable the auditing of administrative commands.

Tasks that are useful to administrators who use this model are the following:

- "Using Your Assigned Administrative Rights" on page 114
- "Assigning Rights to Users" on page 51
- "Auditing Administrative Actions" on page 118
- "Changing a Role Password" on page 63
- Chapter 7, "Listing Rights in Oracle Solaris"

3. Use the `sudo` command.

   Administrators who are familiar with the `sudo` command can configure `sudo` and use it. Optionally, they can configure the `/etc/sudoers` file to enable `sudo` users to run administrative commands without reauthentication for a set period of time.

   Tasks that are useful to `sudo` users are the following:

   - "Using Your Assigned Administrative Rights" on page 114
   - "Auditing Administrative Actions" on page 118
   - Example 45, "Caching Authentication for Ease of Role Use," on page 116

   The `sudo` command is the Linux equivalent of the Oracle Solaris RBAC commands. Unlike the RBAC commands, `sudo` cannot reference rights profiles. It runs as `root` with all privileges so that it can grant the rights that are specified for each program in the `/etc/sudoers` file for the current user. For more information, see the `sudo`(8) and `sudoers`(4) man pages.

4. Use the superuser model by changing the `root` role into a user.

   Administrators who use the traditional UNIX model must complete "How to Change the `root` Role Into a User" on page 124. Optionally, the `root` user can configure auditing.

Following Your Chosen Rights Model

User and process rights management can be an integral part of managing your systems deployment. Planning requires a thorough knowledge of the security requirements of your organization as well as an understanding of rights in Oracle Solaris. This section describes the general process for planning your site's use of rights.

1. Learn the basic concepts about rights.

   Read Chapter 1, "About Using Rights to Control Users and Processes". Using rights to administer a system is very different from using conventional UNIX administrative practices.

2. Examine your security policy.

Your organization's security policy details the potential threats to your system, measures the risk of each threat, and provides strategies to counter these threats. Isolating the security-relevant tasks through rights can be a part of the strategy.

For example, your site might require that you separate security administration from non-security administration. To implement separation of duty, see Example 5, "Creating Roles for Separation of Duty," on page 59. See also Appendix A, "Site Security Policy and Enforcement," in *Oracle Solaris 11.4 Security and Hardening Guidelines*.

Your site might require that users and roles annotate their logins. These annotations appear in the audit trail. For more information, see "New Feature – Annotating Reason for Access in the Audit Record" in *Managing Auditing in Oracle Solaris 11.4*.

If your security policy relies on Authorization Rules Managed On RBAC (ARMOR), you must install and use the ARMOR package. For its use in Oracle Solaris, see Example 2, "Using ARMOR Roles," on page 58.

3. Review the default rights profiles.

   The default rights profiles collect the rights that are required to complete a task. To review available rights profiles, see "Listing Rights Profiles" on page 140

4. Decide whether you are going to use roles or assign rights profiles to users directly.

   Roles can ease the administration of rights. The role name identifies the tasks that the role can perform and isolates role rights from user rights. If you are going to use roles, you have three options:

   - You can install the ARMOR package, which installs the seven roles that the Authorization Roles Managed on RBAC (ARMOR) standard defines. See Example 2, "Using ARMOR Roles," on page 58.
   - You can define your own roles and also use ARMOR roles. See "Creating a Role" on page 57 and Example 2, "Using ARMOR Roles," on page 58.
   - You can define your own roles and not use ARMOR roles. See "Creating a Role" on page 57.

   If roles are not required at your site, you can directly assign rights profiles to users. To require a password when users perform an administrative task from their rights profiles, use authenticated rights profiles. See Example 13, "Requiring a User to Type Password Before Administering DHCP," on page 66.

5. Decide whether you need to create additional rights profiles.

   Look for other applications or families of applications at your site that might benefit from restricted access. Applications that affect security, that can cause denial-of-service problems, or that require special administrator training are good candidates for using rights. For example, users of Sun Ray systems do not require all basic privileges. For an example of a rights profile that limits users, see Example 30, "Removing Basic Privileges From a Rights Profile," on page 84.

a. Determine which rights are needed for the new task.
b. Decide whether an existing rights profile is appropriate for this task.
c. Order the rights profile so that commands execute with their required privileges.

   For information about ordering, see "Order of Search for Assigned Rights" on page 43.

6. Decide which users should be assigned which rights.

   According to the principle of least privilege, you assign users to roles that are appropriate to the user's level of trust. When you prevent users from performing tasks that the users do not need to perform, you reduce potential problems.

Note - Rights that apply to all users of a system can be set and specified in the `account-policy:default` SMF service. For more information, see the `account-policy`(8S) man page and "Assigning Rights to Users" on page 51.

Once you have a plan, create logins for trusted users who can be assigned rights profiles or roles. For details on creating users, see "Setting Up and Managing User Accounts (Task Map)" in *Managing User Accounts and User Environments in Oracle Solaris 11.4*.

To assign rights, start with the procedures in "Assigning Rights to Users" on page 51. The sections that follow provide examples of expanding rights, limiting rights, assigning rights to resources, and troubleshooting rights assignments.

♦ ♦ ♦ CHAPTER 3

Assigning Rights in Oracle Solaris

This chapter describes tasks for assigning rights to users and roles. The chapter covers the following topics:

- “Assigning Rights to Users” on page 51
- “Expanding Users' Rights” on page 64
- “Restricting Users' Rights” on page 71
- “Modifying Rights System-Wide As SMF Properties” on page 86

For an overview of rights, see “User Rights Management” on page 21. For reference information, see Chapter 9, “Reference for Oracle Solaris Rights”.

Note - This chapter assumes that you protect your user passwords and role passwords as described in “Passwords and Password Policy” in *Oracle Solaris 11.4 Security and Hardening Guidelines*.

Assigning Rights to Users

Rights in Oracle Solaris exist on every process. You can add rights to users and roles, and remove rights. Rights include privileges on the user's process, privileges or special IDs on a command that the user runs, and authorizations to perform a particular action. To ease the administrative burden of assigning rights, Oracle Solaris collects rights for services and administrative actions into *rights profiles*. Rather than assign individual rights to users and roles, you can collect rights in a rights profile. You can then assign the rights profiles to users and roles.

Roles give a name to the administrative task that a user can perform, such as `auditadm`. To perform an administrative action, the user assumes an assigned role to perform the action. Roles can be required by security policy and they can simply be convenient. You can create roles or you can install the `armor` package which creates seven roles and their local home directories.

For more information about roles, see "User and Process Rights Provide an Alternative to the Superuser Model" on page 22.

You can also assign rights to a system, whereby all users who log in to the system are granted those rights. Typically, administrators remove rights from specialized systems, such as kiosks or systems designed only to administer other systems. The preferred method of changing the rights on a system is to enable the `account-policy` Service Management Facility (SMF) service and modify the system's security attributes as SMF properties. The legacy method is to edit individual files in the `/etc` directory.

To modify security attributes in SMF, you use a `setprop` command rather than editing a local file:

```
example-11u4 $ pfbash svccfg -s account-policy:default  \
  setprop config/etc_security_policyconf/disabled = boolean: false
example-11u4 $ svccfg -s svc:/system/account-policy:default \
  setprop rbac/default_privileges astring: = "basic,!file_link_any"
```

The preceding commands replace this legacy method:

```
example-11u3 $ pfexec vim /etc/security/policy.conf
PRIV_DEFAULT=basic,!file_link_any
```

Note - Oracle Solaris does not enable the `account-policy:default` service by default. However, you should enable it and use SMF to manage system, user, and role security. The editing of security policy files is deprecated.

For more information, see `account-policy`(8S) and "Modifying System-Wide Privileges, Authorizations, and Rights Profiles" on page 92.

Who Can Assign Rights

Initially, you must be in the `root` role to assign rights.

If the `root` role has distributed administrative tasks to you as a trusted user or by assigning a role to you, the following rights profiles assignments enable you to create users and roles or assign rights to them:

- To create a user or role, you must become an administrator who is assigned the User Management rights profile.
- To assign most rights to a user or role, you must become an administrator who is assigned the User Security rights profile.

You cannot assign audit flags. Only the `root` role can assign audit flags to a user or role.

You cannot change the password of a role. Only the `root` role can change a role's password.

If you are assigned administrative rights, review "Using Your Assigned Administrative Rights" on page 114 before you try to run administrative commands.

Determining Which Rights to Assign to Administrators

Administrators require rights to run privileged commands, and often require authorization to run the commands. Rights profiles supply privileged commands, authorizations, and sometimes supplementary rights profiles in a convenient bundle.

You have several ways to determine which rights profile is best to assign. The names of rights profiles indicate their function, so you can list and search the profile names for functional areas. You can also start with a command name, and determine which rights profiles include that command.

When you know the name of the rights profile that contains the commands you are interested in, and you review the rights in that rights profile, then you can determine whether to assign that particular profile to an administrator. You should not assign individual privileges or authorizations to administrators. For more information, see "Considerations When Assigning Rights" on page 45.

After you assign administrative rights, ask your administrators to review "Using Your Assigned Administrative Rights" on page 114 before they run administrative commands.

▼ How to Determine Which Rights to Assign

You can search for which rights to assign by starting with rights profiles or with command names. This procedure shows how to search by rights profile. Example 1, "Determining Which Rights a Command Requires," on page 55 shows how to search by command.

1. **List the available rights profiles.**

```
$ profiles -a | more
...
Administrative Command History
Administrator Message Edit
Audit Configuration
```

```
...
```

2. **Search for a functional area.**

   In the following example, you search for rights profiles about administering zones.

```
$ profiles -a | grep -i zone
Zone Security
Zone Configuration
Zone Management
Zone Migration
Zone Cold Migration
```

3. **Review the contents of the rights profile that best describes the rights you plan to assign.**

   Continuing with the zones example, you are going to assign rights to secure zones.

```
$ profiles -p "Zone Security" info
        name=Zone Security
        desc=Zones Virtual Application Environment Security
        auths=solaris.zone.*,solaris.auth.delegate
        cmd=/usr/sbin/txzonemgr
        cmd=/usr/sbin/zonecfg
        cmd=/usr/lib/rad/module/mod_zonemgr.so.1
```

   The output indicates that the assignee will have all authorizations that begin with the string `solaris.zone`, and the `solaris.auth.delegate` authorization. The assignee can run the `txzonemgr` and `zonecfg` commands, and use the RAD command `mod_zonemgr.so.1` module.

   For details about the rights that are assigned to the commands, continue with the following step. For descriptions of the `solaris.zone` authorizations, see Step 5.

4. **Search for the commands in the privileged commands database.**

```
$ getent exec_attr | grep "^Zone Security"
Zone Security:solaris:cmd:RO::/usr/sbin/txzonemgr:uid=0
Zone Security:solaris:cmd:RO::/usr/sbin/zonecfg:uid=0
Zone Security:solaris:cmd:RO::/usr/lib/rad/module/mod_zonemgr.so.1:uid=0
```

   The output indicates that the commands will run with a UID of `0`, not with the assignee's UID. `RO` indicates that this rights profile is read-only.

5. **(Optional) Review the definitions of the authorizations that are in your chosen rights profile.**

```
$ getent auth_attr | grep solaris.zone
solaris.zone.:RO::Zone Management::
solaris.zone.clonefrom:RO::Clone another Zone::
```

```
solaris.zone.login:RO::Zone Login::
solaris.zone.manage:RO::Zone Deployment::
solaris.zone.config:RO::Modify the Persistent Zone Configuration::
solaris.zone.liveconfig:RO::Inspect and Modify the Live Zone Configuration::
solaris.zone.migrate:RO::Zone Migration::
solaris.zone.migrate.cold:RO::Zone Cold Migration::
$ getent auth_attr | grep solaris.auth.delegate
solaris.auth.delegate:RO::Assign owned authorizations::
```

Example 1 Determining Which Rights a Command Requires

In this example, the administrator wants to assign the `pfctl` command to a network administrator, but does not know what other rights the assignee might need to handle the Packet Filter (PF) firewall.

1. The administrator searches the privileged commands database, `exec_attr`, for the `pfctl` command.

   ```
   $ getent exec_attr | grep pfctl
   Network Firewall Management:solaris:cmd:RO::/usr/sbin/pfctl:privs=sys_ip_config
   ```

   The output indicates that the `pfctl` command is part of the Network Firewall Management rights profile and runs with the `sys_ip_config` privilege.
2. The administrator reviews the content of the rights profile.

   ```
   $ profiles -p "Network Firewall Management" info
           name=Network Firewall Management
           desc=Firewall Administration
           auths=solaris.smf.value.network.firewall,solaris.smf.manage.network.firewall
           cmd=/usr/sbin/pfconf
           cmd=/usr/sbin/pfctl
   ```

   The output indicates that the Network Firewall Management profile authorizes the assignee to modify the SMF properties of the firewall, and also contains the `pfconf` command.
3. The administrator looks up the `pfconf` command in the privileged commands database.

   ```
   $ getent exec_attr | grep pfconf
   Network Firewall Management:solaris:cmd:RO::/usr/sbin/pfconf:privs=sys_ip_config
   ```
4. The administrator reviews the definitions of the authorizations that are in the chosen profile.

   ```
   $ getent auth_attr | grep firewall
   solaris.smf.manage.network.firewall:RO::Manage Network Firewall::
   solaris.smf.value.network.firewall:RO::Change Network Firewall Configuration::
   solaris.smf.manage.firewall:RO::Manage Firewall Service::
   solaris.smf.value.firewall.config:RO::Change Service Firewall Config::
   ```

5. If the rights profile includes all the functions the assignee needs, the administrator assigns it to the user, or creates a role and assigns the role to the user. For examples, see "Creating a Role" on page 57 and Example 12, "Creating a Trusted User to Administer DHCP," on page 65.
6. If the assignee needs more network capabilities, the administrator continues to investigate.

   The administrator lists all network rights profiles, chooses another one, and repeats the search.

```
$ profiles -a | grep ^Network
Network Autoconf Admin
Network Autoconf User
Network ILB
Network Dot1x Management
Network LLDP
Network VRRP
Network DLMP
Network Management
Network Observability
Network TCP Key Management
Network Security
Network Wifi Management
Network Wifi Security
Network Link Security
Network IPsec Management
Network Firewall Management
```

   The administrator can also create a custom networking rights profile by following the instructions in "Creating Rights Profiles and Authorizations" on page 119.

Assigning Rights to Users and Roles

This section describes the commands that create and modify roles and users. To create or modify rights profiles, see "How to Create a Rights Profile" on page 119 and "How to Clone and Modify a System Rights Profile" on page 120.

For information about roles, see "Basics of User and Process Rights" on page 25.

The main actions in creating and modifying roles and users are as follows:

- Creating a role
- Creating a user who is trusted with additional rights
- Modifying the rights of a role

- Modifying the rights of a user
- Enabling users to use their own password to assume a role
- Changing a role password
- Deleting a role

Creating a Role

If you are going to use roles, you have several options. You can install the predefined roles from ARMOR and use them exclusively. You can also create roles. You can also combine the use of ARMOR roles with the roles that you create.

To use ARMOR roles, see Example 2, “Using ARMOR Roles,” on page 58.

To create your own roles, you use the `roleadd` command. For a full list of the arguments to this command, see the `roleadd`(8) man page.

Caution - Do not configure a role with both the `roleauth=user` and `auth_profiles=`*profiles* keywords. The authentication will fail because the `auth_profiles` keyword authenticates against the current process owner's password (role), which is not the `roleauth` password (user).

For example, the following commands create a local User Administrator role with a home directory and a `pfbash` login shell, and create a password for the role:

```
# roleadd -c "User Administrator role, local" \
-m -K profiles="User Security,User Management" accountadm
80 blocks
# ls /export/home/accountadm
local.bash_profile     local.login     local.profile
# passwd accountadm
Password: xxxxxxxx
Confirm Password: xxxxxxxx
```

where:

`-c` *comment*	Describes the role.
`-m`	Creates a home directory.
`-K profiles=`	Assigns one or more rights profiles to the role. For the list of rights profiles, see “Listing Rights Profiles” on page 140.

rolename The name of the role. For restrictions on acceptable strings, see the `roleadd`(8) man page.

Note - A role account can be assigned to more than one user. Therefore, an administrator typically creates a role password and provides the users with the role password out of band. For an alternative to the role password, see "Enabling Users to Use Own Password for Role Password" on page 63, Example 18, "Enabling a User to Use Own Password for Role Password," on page 67, and Example 20, "Modifying a Rights Profile to Enable a User to Use Own Password for Role Password," on page 68.

EXAMPLE 2 Using ARMOR Roles

In this example, the security administrator installs roles that are defined by the ARMOR standard. The administrator first verifies that the role names do not conflict with any existing accounts, then installs the package, views the role definitions, and assigns the roles to trusted users.

First, the administrator ensures that the following UIDs and names do not exist in the naming service:

- `57 auditadm`
- `55 fsadm`
- `58 pkgadm`
- `53 secadm`
- `56 svcadm`
- `59 sysop`
- `54 useradm`

After verifying that the UIDs and names are not in use, the administrator installs the package.

```
# pkg install system/security/armor
```

The package creates seven roles and local home directories in the `/export/home` directory.

To view the rights of each role, the administrator can list the profiles that are assigned to each role.

```
# profiles auditadm
# profiles fsadm
# profiles pkgadm
# profiles secadm
# profiles svcadm
```

```
# profiles sysop
# profiles useradm
```

The rights that are assigned to ARMOR roles cannot be modified. To create a different configuration of rights, see “How to Clone and Modify a System Rights Profile” on page 120.

Finally, the administrator assigns the roles to trusted users. The users' own passwords are used to authenticate to the role. Some users are assigned more than one role. Roles whose tasks are time-critical are assigned to more than one trusted user.

```
# usermod -R=auditadm adoe
# usermod -R=fsadm,pkgadm bdoe
# usermod -R=secadm,useradm cdoe
# usermod -R=svcadm ddoe
# usermod -R=svcadm edoe
# usermod -R=sysop fdoe
# usermod -R=sysop gdoe
```

EXAMPLE 3 Creating a Role for an Application Administrator

The administrator creates a role for the Oracle database administrator (DBA) to ensure that the administrator's login name is in the audit trail. Because the `oracle` account is a role, users must log in to their own account and then switch user to the `oracle` role. This site has three DBAs.

```
# usermod -K type=role oracle
# usermod -R oracle adoe
# usermod -R oracle bdoe
# usermod -R oracle cdoe
```

EXAMPLE 4 Creating a User Administrator Role in the LDAP Repository

The administrator creates a User Administrator role in LDAP. The user provides a password when assuming the role, then does not need to supply a password for individual commands.

```
# roleadd -c "User Administrator role, LDAP" -m -S ldap \
-K profiles="User Security,User Management" accountadm
```

EXAMPLE 5 Creating Roles for Separation of Duty

The administrator creates two roles. The `usermgt` role can create users, give them home directories, and perform other non-security tasks. The `usersec` role cannot create users, but can

assign passwords and change other rights assignments. Neither role can set audit flags for users or roles, or change a role's password. The `root` role must perform those actions.

```
# roleadd -c "User Management role, LDAP" -s /usr/bin/pfksh \
-m -S ldap -K profiles="User Management"  usermgt
# roleadd -c "User Security role, LDAP" -s /usr/bin/pfksh \
-m -S ldap -K profiles="User Security"  usersec
```

The administrator ensures that two people are necessary to create every regular user in Example 7, “Adding a Role to a User,” on page 61.

EXAMPLE 6 Creating and Assigning a Role to Administer Cryptographic Services

In this example, the administrator on an LDAP network creates a role to administer the Cryptographic Framework, and assigns the role to UID `1111`.

```
# roleadd -c "Cryptographic Services manager" \
-g 14 -m -u 104 -S ldap -K profiles="Crypto Management" cryptomgt
# passwd cryptomgt
New Password: xxxxxxxx
Confirm password: xxxxxxxx
# usermod -u 1111 -R +cryptomgt
```

The user with UID `1111` logs in, then assumes the role and displays the assigned rights.

```
$ su - cryptomgt
Password: xxxxxxxx
$ profiles -l
      Crypto Management
          /usr/bin/kmfcfg            euid=0
          /usr/sbin/cryptoadm        euid=0
          /usr/sfw/bin/CA.pl         euid=0
          /usr/sfw/bin/openssl       euid=0
```

For information about the Cryptographic Framework, see *Managing Encryption and Certificates in Oracle Solaris 11.4*.

Creating a Login for a Trusted User

You use the `useradd` command to create a login. For a full list of the arguments to the `useradd` command, see the `useradd(8)` man page. The rights-related arguments to the command are similar to the `roleadd` command, with the addition of the `-R` *rolename* option.

If you assign a role to a user, the user can use the role's rights after assuming the role. For example, the following command creates a trusted user who can assume the `accountadm` role that you created in "Creating a Login for a Trusted User" on page 60.

```
# useradd -c "Trusted Assistant User Manager user"  -m -R accountadm \
        -s /usr/bin/pfbash jdoe
80 blocks
# ls /export/home/jdoe
local.bash_profile     local.login     local.profile
```

where:

`-m` Creates a home directory for the user.

`-R` *rolename* Assigns the name of an existing role.

`-s` *shell* Determines the login shell for *username*. This shell can be a profile shell, such as `pfbash`. For reasons to assign a profile shell to a trusted user, see "Usability Considerations When Assigning Rights" on page 46. For a list of profile shells, see the `pfexec(1)` man page.

For more examples, see "Setting Up and Managing User Accounts (Task Map)" in *Managing User Accounts and User Environments in Oracle Solaris 11.4*.

Modifying a User's Rights

You use the `usermod` command to modify a user account. For a full list of the arguments to the `usermod` command, see the `usermod(8)` man page. The rights-related arguments to the command are similar to the `useradd` command.

If you assign a rights profile to a user, the user can use the rights after the user opens a profile shell. For example, assign a rights profile and a profile shell as the user's login shell:

```
# usermod -s /usr/bin/pfbash -K profiles="User Management" kdoe
```

The changes are in effect at the user's next login. For users to learn how to use their assigned rights, refer them to "Using Your Assigned Administrative Rights" on page 114.

EXAMPLE 7 Adding a Role to a User

In this example, the administrator ensures that two trusted users are necessary to create regular users. The roles were created in Example 5, "Creating Roles for Separation of Duty," on page 59.

```
# usermod -R +accountadm jdoe
# usermod -R +usersec mdoe
```

Modifying a Role's Rights

You use the `rolemod` command to modify a role account. For a full list of the arguments to the `rolemod` command, see the `rolemod(8)` man page. The rights-related arguments to the command are similar to the `roleadd` command.

The values of *key=value* pairs, and the `-A`, `-P`, and `-R` options can be modified by a minus (`-`) or plus (`+`) sign. The `-` sign indicates to subtract the value from the currently assigned values. The `+` sign indicates to add the value to the currently assigned values. For rights profiles, the value is prepended to the current list of profiles. For the effects of being an earlier rights profile, see "Order of Search for Assigned Rights" on page 43.

EXAMPLE 8 Adding a Rights Profile as the Role's First Rights Profile

For example, prepend a rights profile to the `accountadm` role:

```
# rolemod -K profiles+="Device Management" accountadm
# profiles accountadm
accountadm:
Device Management
User Management
User Security
```

EXAMPLE 9 Replacing a Local Role's Assigned Profiles

In this example, the security administrator modifies the `prtmgt` role to include the VSCAN Management rights profile after the Printer Management profile.

```
# rolemod -c "Handles printers and virus scanning" \
-K profiles="Printer Management,VSCAN Management,All" prtmgt
```

EXAMPLE 10 Assigning Privileges Directly to a Role

In this example, the security administrator entrusts the `realtime` role with a very specific privilege that affects system time. To assign the privilege to a user, see Example 16, "Assigning Privileges Directly to a User," on page 66.

```
# rolemod -K defaultpriv+='proc_clock_highres' realtime
```

The values for the `defaultpriv` keyword are in the list of privileges in the role's processes at all times.

Enabling Users to Use Own Password for Role Password

To enable users to use their own password rather than a role password when assuming a role, modify the role.

The following command enables all users who are assigned the `accountadm` role to use their own password when assuming any assigned role, including the `accountadm` role.

```
# rolemod -K roleauth=user accountadm
```

Caution - Do not configure a role with both the `roleauth=user` and `auth_profiles=`*profiles* keywords. The authentication will fail because the `auth_profiles` keyword authenticates against the current process owner's password (role), which is not the `roleauth` password (user).

The `auth_profiles` keyword is not designed for roles, though you can use it with roles. This keyword is designed for reauthenticating with a user's credentials without requiring the use of a separate role account.

Changing a Role Password

Because a role can be assigned to many users, users who are assigned a role cannot change the role password. You must be in the `root` role to change a role password.

```
# passwd accountadm
Enter accountadm's password: xxxxxxxx
New: xxxxxxxx
Confirm: xxxxxxxx
```

If you do not specify a repository, the password is changed in all repositories. For more command options, see the passwd(1) man page.

EXAMPLE 11 Changing the Password of a Role in a Specific Repository

In the following example, the `root` role changes the password of the local `devadmin` role.

```
# passwd -r files  devadmin
New password: xxxxxxxx
```

```
Confirm password: xxxxxxxx
```

In the following example, the `root` role changes the password of the `devadmin` role in the LDAP naming service.

```
# passwd -r ldap devadmin
New password: xxxxxxxx
Confirm password: xxxxxxxx
```

Deleting a Role

When you delete a role, the role immediately becomes unusable.

```
# roledel accountadm
```

Users who are currently performing administrative tasks in the role are prevented from continuing. The `profiles` command shows the following output:

```
accountadm $ profiles
Unable to get user name
```

Expanding Users' Rights

The tasks and examples in this section add rights to the rights that users receive by default. For information about rights, see Chapter 1, “About Using Rights to Control Users and Processes”.

- Assign a role to a trusted user –

  Example 2, “Using ARMOR Roles,” on page 58
  Example 6, “Creating and Assigning a Role to Administer Cryptographic Services,” on page 60
  Example 7, “Adding a Role to a User,” on page 61
- Assign a rights profile to a trusted user –

  Example 12, “Creating a Trusted User to Administer DHCP,” on page 65
  Example 22, “Enabling a Trusted User to Read Extended Accounting Files,” on page 69
  Example 38, “Assigning Security Attributes to a Legacy Application,” on page 99
- Assign an authenticated rights profile to a trusted user –

  Example 13, “Requiring a User to Type Password Before Administering DHCP,” on page 66
  Example 39, “Running an Application With Assigned Rights,” on page 99

- Assign an authorization to a trusted user or role –

  Example 14, “Assigning Authorizations Directly to a User,” on page 66
  Example 15, “Assigning Authorizations to a Role,” on page 66
- Assign privileges directly to a user or role –

  Example 10, “Assigning Privileges Directly to a Role,” on page 62
  Example 16, “Assigning Privileges Directly to a User,” on page 66

Caution - Inappropriate use of directly assigned privileges and authorizations can result in unintentional breaches of security. For a discussion, see “Security Considerations When Assigning Rights” on page 45.

- Enable a user to use own password when assuming a role –

  Example 18, “Enabling a User to Use Own Password for Role Password,” on page 67
  Example 20, “Modifying a Rights Profile to Enable a User to Use Own Password for Role Password,” on page 68
- Create a rights profile for the administrator of a third-party application – Example 19, “Creating a Rights Profile for Administrators of a Third-Party Application,” on page 68
- Modify a rights profile – “Removing Privileges From Users” on page 78
- Add security attribute to a command in a rights profile –

  Example 32, “Preventing Selected Applications From Spawning New Processes,” on page 85
  Example 49, “Creating a Rights Profile That Includes Privileged Commands,” on page 120
- Enable a user to read a `root`-owned file –

  Example 22, “Enabling a Trusted User to Read Extended Accounting Files,” on page 69
  Example 23, “Enabling a Non-`root` Account to Read a `root`-Owned File,” on page 70
- Enable a user or role to edit a `root`-owned file – Example 51, “Cloning and Removing Selected Rights From a Rights Profile,” on page 122
- Assign a rights profile that contains a new authorization – Example 53, “Adding Authorizations to a Rights Profile,” on page 123

EXAMPLE 12 Creating a Trusted User to Administer DHCP

The security administrator creates a user who can administer DHCP.

```
# useradd -K profiles="DHCP Management" -s /usr/bin/pfbash -S ldap  jdoe
```

Because the user is assigned the `pfbash` login shell, the rights in the DHCP Management rights profile are always evaluated, so the DHCP administrative commands succeed.

EXAMPLE 13 Requiring a User to Type Password Before Administering DHCP

In this example, the security administrator requires `jdoe` to provide a password before managing DHCP.

```
# usermod -K auth_profiles="DHCP Management" profiles="Edit Administrative Files" jdoe
```

When `jdoe` types a DHCP command, the password prompt appears. After authenticating `jdoe`, the DHCP command completes. In search order, authenticated rights profiles are processed before regular profiles.

```
jdoe$ dhcpconfig -R 120.30.33.7,120.30.42.132
Password: xxxxxxxx
    /** Command completes **/
```

EXAMPLE 14 Assigning Authorizations Directly to a User

In this example, the security administrator creates a local user who can control screen brightness.

```
# useradd -c "Screened KDoe, local" -s /usr/bin/pfbash \
-K auths=solaris.system.power.brightness  kdoe
```

This authorization is added to the user's existing authorization assignments.

EXAMPLE 15 Assigning Authorizations to a Role

In this example, the security administrator creates a role that can change the configuration information for the DNS server service.

```
# roleadd -c "DNS administrator role" -m -K auths="solaris.smf.manage.bind" dnsadmin
```

EXAMPLE 16 Assigning Privileges Directly to a User

In this example, the security administrator trusts the user `kdoe` with a very specific privilege that affects system time. To assign the privilege to a role, see Example 10, “Assigning Privileges Directly to a Role,” on page 62.

```
# usermod -K defaultpriv='basic,proc_clock_highres' kdoe
```

The values for the `defaultpriv` keyword replace the existing values. Therefore, for the user to retain the `basic` privileges, the value `basic` is specified. In the default configuration, all users have basic privileges. For the list of basic privileges, see “Listing Privileges” on page 143.

The user can view the added privilege and its definition.

```
kdoe$ ppriv -v $$
1800:   pfksh
flags = <none>
        E: file_link_any,…,proc_clock_highres,sys_ib_info
        I: file_link_any,…,proc_clock_highres,sys_ib_info
        P: file_link_any,…,proc_clock_highres,sys_ib_info
        L: cpc_cpu,dtrace_kernel,dtrace_proc,dtrace_user,...,win_upgrade_sl
$ ppriv -vl proc_clock_highres
        Allows a process to use high resolution timers.
```

EXAMPLE 17 Adding to a Role's Basic Privileges

In the following example, the role `realtime` is directly assigned privileges to handle date and time programs. You assigned the `proc_clock_highres` to `realtime` in Example 10, “Assigning Privileges Directly to a Role,” on page 62.

```
# rolemod -K defaultpriv='basic,sys_time' realtime
```

```
$ su - realtime
Password: xxxxxxxx
$ ppriv -v $$
1600:   pfksh
flags = <none>
        E: file_link_any,...,proc_clock_highres,sys_ib_info,sys_time
        I: file_link_any,...,proc_clock_highres,sys_ib_info,sys_time
        P: file_link_any,...,proc_clock_highres,sys_ib_info,sys_time
        L: cpc_cpu,dtrace_kernel,dtrace_proc,dtrace_user,...,sys_time
```

EXAMPLE 18 Enabling a User to Use Own Password for Role Password

By default, users must type the role's password to assume a role. By requiring a user password, the administrator makes assuming a role in Oracle Solaris similar to assuming a role in a Linux environment.

```
# rolemod -K roleauth=user auditrev
```

To assume this role, the assigned users can now use their own passwords, not the password that was created specifically for the role.

If the user has been assigned other roles, the user's password authenticates to those roles, too.

EXAMPLE 19 Creating a Rights Profile for Administrators of a Third-Party Application

Typically, administrators of third-party applications are not given `root` privileges. If the application uses commands that are not included in an Oracle Solaris rights profile, the `root` administrator should create a rights profile for the application administrators. This example shows a rights profile for an application whose user management commands rely on Oracle Solaris commands in the User Management and User Security rights profiles. The application also uses the `mv`, `rm`, and `cp` commands in ways that require privilege.

To determine which privileges the `cp`, `mv`, and `rm` commands required, the administrators tested the application as described in "How to Determine Which Privileges a Program Requires" on page 153.

```
# profiles -p "Application User Management"
profiles:Application User Management> set desc="Application User Management Profile"
profiles:Application User Management> add profiles="User Management,User Security"
profiles:Application User Management> add cmd=/usr/bin/cp
profiles:Application User Management:cp> set privs=zone
profiles:Application User Management:cp> end
profiles:Application User Management> add cmd=/usr/bin/mv
profiles:Application User Management:mv> set privs=zone
profiles:Application User Management:mv> end
profiles:Application User Management> add cmd=/usr/bin/rm
profiles:Application User Management:rm> set privs=zone
profiles:Application User Management:rm> end
profiles:Application User Management> add cmd=/opt/Appl/bin/addusr
profiles:Application User Management:addusr> set privs=zone
profiles:Application User Management:addusr> end
profiles:Application User Management> add cmd=/opt/Appl/bin/addgrp
profiles:Application User Management:addgrp> set privs=zone
profiles:Application User Management:addgrp> end
profiles:Application User Management> commit
profiles:Application User Management> info
    name=Application User Management
       desc=Application User Management Profile
       profiles=User Management,User Security
       cmd=/usr/bin/cp
       ...
profiles:Application Administrator> exit
```

EXAMPLE 20 Modifying a Rights Profile to Enable a User to Use Own Password for Role Password

```
# profiles -p "Local System Administrator"
profiles:Local System Administrator> set roleauth="user"
profiles:Local System Administrator> end
```

```
profiles:Local System Administrator> exit
```

When a user who is assigned the Local System Administrator rights profile wants to assume the role, the user is prompted for a password. In the following sequence, the role name is `admin`:

```
$ su - admin
Password: xxxxxxxx
$       /** You are now in a profile shell with administrative rights**/
```

EXAMPLE 21 Changing the Value of `roleauth` for a Role in the LDAP Repository

In this example, the `root` role enables all users who can assume the role `secadmin` to use their own password when assuming a role. This ability is granted to these users for all systems that are managed by the LDAP server.

```
# rolemod -S ldap -K roleauth=user secadmin
```

EXAMPLE 22 Enabling a Trusted User to Read Extended Accounting Files

You can enable a trusted user or group of users to read a file that is owned by the `root` account. This right can be useful to users who can run an administrative application that includes a `root`-owned file. This example adds one or more Perl scripts to the Extended Accounting Net Management rights profile.

After assuming the `root` role, the administrator creates a rights profile that adds the ability to read accounting files whose names begin with `network`.

The following profile uses extended privilege policy to grant the `file_dac_read` privilege to a script which can then access `/var/adm/exacct/network*` files only. This profile adds the existing Extended Accounting Net Management rights profile as a supplementary profile.

```
# profiles -p "Extended Accounting Perl Scripts"
profiles:Extended Accounting Perl Scripts >
set desc="Perl Scripts for Extended Accounting"
... Scripts> add profiles="Extended Accounting Net Management"
... Scripts> add cmd=/usr/local/bin/exacctdisp.pl
... Scripts:exacctdisp.pl> set privs={file_dac_read}:/var/adm/exacct/network*
... Scripts:exacctdisp.pl> end
... Scripts> commit
... Scripts> exit
```

For sample scripts, see "Using the Perl Interface to libexacct" in *Administering Resource Management in Oracle Solaris 11.4*.

After reviewing the rights profile entries for errors such as typographical errors, omissions, or repetition, the administrator assigns the Extended Accounting Perl Scripts rights profile to a role or a user.

```
# profiles -p "Extended Accounting Perl Scripts" info
Found profile in files repository.
name=Extended Accounting Perl Scripts
desc=Perl Scripts for Extended Accounting
profiles=Extended Accounting Net Management
cmd=/usr/local/bin/exacctdisp.pl
privs={file_dac_read}:/var/adm/exacct/network*

# rolemod -K profiles+="Extended Accounting Perl Scripts" rolename
# usermod -s /usr/bin/pfbash -K profiles+="Extended Accounting Perl Scripts" username
```

EXAMPLE 23 Enabling a Non-`root` Account to Read a `root`-Owned File

In this example, the administrator creates a rights profile that uses extended privilege policy to enable authorized users and roles to read the `/var/adm/sulog` file that `root` owns. The administrator adds the commands that the user can use to read the file. Unlisted commands cannot be used, such as the `head` command.

```
# profiles -p "Read sulog File"
profiles:Read sulog File
set desc="Read sulog File"
... File> add profiles="Read Log Files"
... File> add cmd=/usr/bin/cat
... File:cat> set privs={file_dac_read}:/var/adm/sulog
... File:cat> end
... File> add cmd=/usr/bin/less
... File:less> set privs={file_dac_read}:/var/adm/sulog
... File:less> end
... File> add cmd=/usr/bin/more
... File:more> set privs={file_dac_read}:/var/adm/sulog
... File:more> end
... File> add cmd=/usr/bin/page
... File:page> set privs={file_dac_read}:/var/adm/sulog
... File:page> end
... File> add cmd=/usr/bin/tail
... File:tail> set privs={file_dac_read}:/var/adm/sulog
... File:tail> end
... File> add cmd=/usr/bin/view
... File:head> set privs={file_dac_read}:/var/adm/sulog
... File:head> end
... File> commit
... File> exit
```

The `view` command enables the user to read a file but not to edit it.

Restricting Users' Rights

The procedures and examples in this section restrict login attempts, limit the rights of regular users, or remove some administrative rights from an administrator. They show how to modify users, roles, and rights profiles. For information about rights, see Chapter 1, “About Using Rights to Control Users and Processes”.

- Require users to supply a one-time password (OTP) – “Task Map: Using OTP in Oracle Solaris” in *Managing Authentication in Oracle Solaris 11.4*
- Provide stronger default file permissions for a user
  - Legacy – “How to Set a More Restrictive `umask` Value for Regular Users” on page 72
  - SMF – “How to Set a More Restrictive `umask` Value for All Logins” on page 88
- Limit consecutive unsuccessful login attempts
  - Legacy – “How to Set Account Locking for Regular Users” on page 73
  - SMF – “How to Set Account Locking for All Logins” on page 89
- Remove limit privileges from a user – Example 24, “Removing Privileges From a User's Limit Set,” on page 80
- Remove basic privileges from your own shell process – Example 25, “Removing a Basic Privilege From Yourself,” on page 80
- Prevent user processes from spawning subprocesses – Example 26, “Preventing Guests From Spawning Editor Subprocesses,” on page 81
- Create a restricted editor for guests – Example 26, “Preventing Guests From Spawning Editor Subprocesses,” on page 81
- Assign the restricted editor to a public system –
  - Legacy – Example 27, “Assigning the Editor Restrictions Rights Profile to All Users,” on page 82
  - SMF – Example 36, “Assigning the Editor Restrictions Rights Profile to All Logins,” on page 93
- Remove rights by using a rights profile – Example 30, “Removing Basic Privileges From a Rights Profile,” on page 84

  Example 29, “Creating a Remote Users Rights Profile,” on page 83
  Example 51, “Cloning and Removing Selected Rights From a Rights Profile,” on page 122

- Restrict an administrator to explicitly assigned rights – Example 31, “Restricting an Administrator to Explicitly Assigned Rights,” on page 84
- Prevent applications from creating subprocesses – Example 32, “Preventing Selected Applications From Spawning New Processes,” on page 85
- Remove rights from all users of a system
  - Legacy – Example 27, “Assigning the Editor Restrictions Rights Profile to All Users,” on page 82, Example 28, “Modifying the policy.conf File to Limit the Rights Available to System Users,” on page 83
  - SMF – Example 37, “Enabling Only the Console User to Log In,” on page 93, “Setting General User Restrictions” on page 72
- Create a system for restricted use –
  - Legacy – Example 28, “Modifying the policy.conf File to Limit the Rights Available to System Users,” on page 83
  - SMF – Example 37, “Enabling Only the Console User to Log In,” on page 93
- Qualify attributes in LDAP by user, role, system, or set of systems – Example 33, “Qualifying Where and When LDAP Users and Roles Can Use Their Rights,” on page 85 and user_attr(5) man page
- Limit user access to system by time or location – Example 33, “Qualifying Where and When LDAP Users and Roles Can Use Their Rights,” on page 85
- Remove an authorization from a user – Example 52, “Testing Then Removing an Assigned Authorization,” on page 123
- Remove a role assignment from a user – Example 55, “Preventing the root Role From Being Used to Maintain a System,” on page 126

Setting General User Restrictions

In this section, you change the default umask value for all users, prevent malicious login attempts by limiting failed logins, and remove the ability of console users to shut down the system. You can limit failed login attempts per system, per user, or through a rights profile. For a discussion of password constraints, see “Passwords and Password Policy” in *Oracle Solaris 11.4 Security and Hardening Guidelines*.

▼ How to Set a More Restrictive umask Value for Regular Users

The umask utility sets the file permission bits of user-created files. If the default umask value, 022, is not restrictive enough, set a more restrictive mask by using this procedure.

Before You Begin You must become an administrator who is authorized to edit the skeleton files. The `root` role is assigned these authorizations. For more information, see "Using Your Assigned Administrative Rights" on page 114.

1. **View the sample files that Oracle Solaris provides for user shell defaults.**

```
# ls -1a /etc/skel
.bashrc
.profile
local.cshrc
local.login
local.profile
```

2. **Set the `umask` value in the `/etc/skel` files that you are going to assign to users.**

   Choose one of the following values:

   - `umask 026` – Provides moderate file protection (`751`) – `r` for group, `x` for others
   - `umask 027` – Provides strict file protection (`750`) – `r` for group, no access for others
   - `umask 077` – Provides complete file protection (`700`) – No access for group or others

See Also For more information, see the following:

- "Default umask Value" in *Securing Files and Verifying File Integrity in Oracle Solaris 11.4*
- Selected man pages include `useradd`(8) and `umask`(1).

▼ How to Set Account Locking for Regular Users

Use this procedure to lock regular user accounts after a certain number of failed login attempts. You can set account locking per user, per system, or for selected users through a rights profile.

Note - Roles are shared accounts. Do not set account locking for users who can assume roles or roles because one locked user can lock out the role.

Before You Begin Do not set this protection system-wide on a system that you use for administrative activities. Rather, monitor the administrative system for unusual use and keep it available for administrators.

You must assume the `root` role. For more information, see "Using Your Assigned Administrative Rights" on page 114.

1. **Set the `LOCK_AFTER_RETRIES` security attribute to `YES`.**

   Choose the scope of the attribute value.

   - **Set system-wide.**

     - **Modify the security attribute in SMF.**

       For the procedure, see "Modifying Login Policy" on page 89.

     - **DEPRECATED. Edit a system security file.**

       ```
       # pfedit /etc/security/policy.conf
       ...
       #LOCK_AFTER_RETRIES=NO
       LOCK_AFTER_RETRIES=YES
       ...
       ```

   - **Set per user.**

     This protection applies only to the user for whom you run this command. If you have many users, this is not a scalable solution.

     ```
     # usermod -K lock_after_retries=yes username
     ```

   - **Create and assign a rights profile.**

     This protection applies to any user or system where you assign this rights profile.

     a. **Create the rights profile.**

        ```
        # profiles -p shared-profile -S ldap
        shared-profile: set lock_after_retries=yes
        ...
        ```

        For more information about creating rights profiles, see "Creating Rights Profiles and Authorizations" on page 119.

     b. **Assign the rights profile to users or system-wide.**

        If you have many users that share a rights profile, setting this value in a rights profile can be a scalable solution.

        ```
        # usermod -P shared-profile username
        ```

You can also assign the profile per system in the `policy.conf` file.

```
# pfedit /etc/security/policy.conf
...
#PROFS_GRANTED=Basic Solaris User
PROFS_GRANTED=shared-profile,Basic Solaris User
```

2. **Set the `RETRIES` security attribute to `3`.**

   Choose the scope of the attribute value.

   - **Set system-wide.**

     - **Modify the security attribute in SMF.**

       For the procedure, see "Modifying Login Policy" on page 89.

     - **DEPRECATED. Edit a system security file.**

       ```
       # pfedit /etc/default/login
       ...
       #RETRIES=5
       RETRIES=3
       ...
       ```

   - **Set per user.**

     ```
     # usermod -K lock_after_retries=3 username
     ```

   - **Create and assign a rights profile.**

     Review "Creating Rights Profiles and Authorizations" on page 119 and create a rights profile that includes `lock_after_retries=3`.

3. **(Optional) Specify a time after which a user can re-authenticate to a locked account.**

   ```
   # usermod -K unlock_after=185m username
   ```

   This user can log in without administrative intervention three hours and five minutes after the account locks.

4. **To unlock a locked user, use the `passwd` command.**

   ```
   # passwd -u username
   ```

A user who is locked out cannot log in without administrative intervention. You can unlock user accounts in both the `files` and `ldap` naming services.

See Also

- For a discussion of user and role security attributes, see Chapter 9, "Reference for Oracle Solaris Rights".
- Selected man pages include `passwd`(1), `policy.conf`(5), `profiles`(1), `user_attr`(5), and `usermod`(8).

▼ How to Remove Power Management Capability From Users

Use this procedure to prevent users on the console of a system from suspending the system or powering it down. This software solution is not effective if the system hardware can be unplugged by the console user.

Before You Begin You must assume the `root` role. For more information, see "Using Your Assigned Administrative Rights" on page 114.

1. **Review the contents of the Console User rights profile.**

```
$ profiles -p "Console User" info
 name=Console User
 desc=Manage System as the Console User
 auths=solaris.system.shutdown,solaris.device.cdrw,
             solaris.smf.manage.vbiosd,solaris.smf.value.vbiosd
 profiles=Suspend To RAM,Suspend To Disk,Brightness,CPU Power Management,
                 Network Autoconf User
```

2. **Create a rights profile that includes any rights in the Console User profile that you want users to retain.**

   For instructions, see "How to Create a Rights Profile" on page 119.

   The following is a sample replacement profile:

```
$ profiles -p "Site Console User" info
 name=Site Console User
 desc=Read devices and control brightness on the console
 auths=solaris.device.cdrw,
 profiles=Brightness,CPU Power Management,Network Autoconf User
```

3. **Comment out the Console User rights profile in the `/etc/security/policy.conf` file.**

```
#CONSOLE_USER=Console User
```

4. **Assign the rights profile that you created in Step 2.**

   - Assign this rights profile to users.

     ```
     # usermod -P shared-profile username
     ```

   - You can also assign the profile per system, either in SMF or in the `policy.conf` file.
     - If the `account-policy` service is enabled, assign the profile in SMF, as shown in Example 35, “Adding a Rights Profile to Every Login,” on page 92.
     - DEPRECATED. If the `account-policy` service is not enabled, edit the `policy.conf` file.

       ```
       # pfedit /etc/security/policy.conf...
       #PROFS_GRANTED=Basic Solaris User
       PROFS_GRANTED=shared-profile,Basic Solaris User
       ```

See Also For more information, see the `account-policy`(8S), `policy.conf`(5) and `usermod`(8) man pages.

Setting Remote Login Restrictions

This section describes several ways to prevent remote login for specific non-root users. To prevent remote login by `root`, review the `CONSOLE` variable value description in the `/etc/default/login` file and “Securing Logins and Passwords” in *Securing Systems and Attached Devices in Oracle Solaris 11.4*.

Oracle Solaris provides several ways for you to prevent remote logins for specific non-root users.

- You can specify the days and times when users can access a PAM service such as `ssh`. For example, use the `access_times` security attribute to prevent `jdoe` from using Secure Shell:

  ```
  # usermod -K access_times={ssh}:Al0000-0000 jdoe
  ```

  The value indicates that for All Days (`Al`) no access times are available. For more information, see the `user_attr`(5) man page.

  One advantage of using RBAC security attributes is that you can use the `-S ldap` option to the user and role configuration commands to maintain the restriction in LDAP. Another advantage is that you can specify the service names, days, and times when access is allowed.
- You can add specific users to the `DenyUsers` property in Secure Shell. For more information, see the `ssh_config`(5) man page.

- You can customize a PAM stack to include the `pam_deny` module, and assign the customized PAM stack to specific users by using the `pam_policy` security attribute to the user and role configuration commands. For more information, see "Configuring PAM" in *Managing Authentication in Oracle Solaris 11.4* and the `pam_deny`(7) and `pam_user_policy`(7) man pages.
- You can create labeled directories and clearances for specific users that prevent all other users, including `root`, from accessing the data contained in those directories. Labels enable users to create sandboxes for projects. For more information, see Chapter 6, "Labeling Processes for Data Loss Protection" and the `sandboxing`(7) man page.

Removing Privileges From Users

Under particular circumstances, privileges can be removed from a regular or guest user. For example, you might prevent remote users from examining the status of processes that they do not own, individual users might do the same to highlight their own processes, and you might prevent guests from using too many resources.

▼ How to Remove Unneeded Basic Privileges From Users

Under particular circumstances, some basic privileges can be removed from a regular or guest user's basic set. For example, remote users might be prevented from examining the status of processes that they do not own.

Before You Begin You must assume the `root` role. For more information, see "Using Your Assigned Administrative Rights" on page 114.

1. List a full definition of the basic privilege set.

The following three basic privileges are likely candidates for removal.

```
$ ppriv -lv basic
file_link_any
 Allows a process to create hardlinks to files owned by a uid
 different from the process' effective uid.
...
proc_info
 Allows a process to examine the status of processes other
 than those it can send signals to.  Processes which cannot
 be examined cannot be seen in /proc and appear not to exist.
proc_session
 Allows a process to send signals or trace processes outside its
```

```
 session.
...
```

2. **Choose the scope of the privilege removal.**

   - **Set system-wide.**

     Any user who attempts to use the system is denied these privileges. This method of privilege removal might be appropriate for a publicly available computer.

     ```
     # pfedit /etc/security/policy.conf
     ...
     #PRIV_DEFAULT=basic
     PRIV_DEFAULT=basic,!file_link_any,!proc_info,!proc_session
     ```

   - **Remove privileges from individual users.**

     - **Prevent a user from linking to a file that the user does not own.**

       ```
       # usermod -K 'defaultpriv=basic,!file_link_any' user
       ```

     - **Prevent a user from examining processes that the user does not own.**

       ```
       # usermod -K 'defaultpriv=basic,!proc_info' user
       ```

     - **Prevent a user from starting a second session, such as starting an `ssh` session from the user's current session.**

       ```
       # usermod -K 'defaultpriv=basic,!proc_session' user
       ```

     - **Remove all three privileges from a user's basic set.**

       ```
       # usermod -K 'defaultpriv=basic,!file_link_any,!proc_info,!proc_session' user
       ```

   - **Create and assign a rights profile.**

     This protection applies to any user or system where you assign this rights profile.

     a. **Create the rights profile.**

        ```
        # profiles -p shared-profile -S ldap
        shared-profile: set defaultpriv=basic,!file_link_any,!proc_info,!proc_session
        ...
        ```

        For more information about creating rights profiles, see “Creating Rights Profiles and Authorizations” on page 119.

b. Assign the rights profile to users or system-wide.

If you have many users that share a rights profile, such as remote users, setting this value in a rights profile can be a scalable solution.

```
# usermod -P shared-profile username
```

You can also assign the profile per system in the `policy.conf` file.

```
# pfedit /etc/security/policy.conf
...
#PROFS_GRANTED=Basic Solaris User
PROFS_GRANTED=shared-profile,Basic Solaris User
```

Example 24 Removing Privileges From a User's Limit Set

In the following example, all sessions that originate from `jdoe`'s initial login are prevented from using the `sys_linkdir` privilege. The user cannot make hard links to directories or unlink directories even after running the `su` command.

```
# usermod -K 'limitpriv=all,!sys_linkdir' jdoe
# userattr limitpriv jdoe
all,!sys_linkdir
```

Example 25 Removing a Basic Privilege From Yourself

In the following example, a regular user modifies `.bash_profile` to remove the `proc_info` basic privilege. The output of programs like `ps` and `prstat` contain only the user's own processes, which can highlight useful information.

```
##  .bash_profile
## Remove proc_info privilege from my shell
##
ppriv -s EI-proc_info $$
```

The `ppriv` line removes the `proc_info` privilege from the user's effective and inheritable privilege sets (`EI-`) in the current shell process (`$$`).

In the following `prstat` output, the totals shrink from 74 to three processes:

```
## With all basic privileges
Total: 74 processes, 527 lwps, load averages: 0.01, 0.00, 0.00

## With proc_info removed from the effective and inheritable set
Total: 3 processes, 3 lwps, load averages: 0.00, 0.00, 0.00
```

Example 26 Preventing Guests From Spawning Editor Subprocesses

In this example, the administrator prevents users from creating subshells from one or more editors by removing the `proc_exec` basic privilege from the editor command.

1. The administrator creates a rights profile that removes `proc_exec` from the limit privilege set of the `vim` editor.

```
# profiles -p -S ldap "Editor Restrictions"
profiles:Editor Restrictions> set desc="Site Editor Restrictions"
... Restrictions> add cmd=/usr/bin/vim
... Restrictions:vim> set limitprivs=all,!proc_exec
... Restrictions:vim> end
... Restrictions> commit
... Restrictions> exit
```

2. The administrator adds other popular editors to the rights profile.

```
# profiles -p "Editor Restrictions"
profiles:Editor Restrictions> add cmd=/usr/bin/gedit
... Restrictions:gedit> set limitprivs=all,!proc_exec
... Restrictions:gedit> end
... Restrictions> add cmd=/usr/bin/vim
... Restrictions:vim> set limitprivs=all,!proc_exec
... Restrictions:vim> end
... Restrictions> add cmd=/usr/xpg4/ed
... Restrictions:ed> set limitprivs=all,!proc_exec
... Restrictions:ed> end
... Restrictions> add cmd=/usr/xpg4/ex
... Restrictions:ex> set limitprivs=all,!proc_exec
... Restrictions:ex> end
... Restrictions> add cmd=/usr/xpg4/vi
... Restrictions:vi> set limitprivs=all,!proc_exec
... Restrictions:vi> end
... Restrictions> commit
... Restrictions> exit
```

3. The administrator reviews the rights profile entries for errors such as typographical errors, omissions, or repetition.

```
# profiles -p "Editor Restrictions" info
Found profile in files repository.
name=Editor Restrictions
desc=Site Editor Restrictions
cmd=/usr/bin/vim
limitprivs=all,!proc_exec
```

```
...
```

4. The administrator assigns the Editor Restrictions rights profile to the `guest` user.

   ```
   # usermod -K profiles+="Editor Restrictions" guest
   ```

   By using `profiles+`, the administrator adds this rights profile to the account's current rights profiles.

5. To verify that the editor privileges are limited, the administrator opens the editor and in a separate window, examines the privileges on the editor process.

   ```
   # ppriv -S $(pgrep vim)
   2805:   vim .bash_profile
   flags = PRIV_PFEXEC       User is running a profile shell
           E: basic,!proc_info       proc_info is removed from basic set
           I: basic,!proc_info
           P: basic,!proc_info
           L: all,!proc_exec       proc_exec is removed from limit set
   ```

Example 27 Assigning the Editor Restrictions Rights Profile to All Users

In this example, the administrator adds the Editor Restrictions rights profile to the `policy.conf` file. The administrator ensures that this file is distributed to all public systems where guests can log in.

```
# cd /etc/security; cp policy.conf policy.conf.orig
# pfedit /etc/security/policy.conf
...
AUTHS_GRANTED=
AUTH_PROFS_GRANTED=
#PROFS_GRANTED=Basic Solaris User
PROFS_GRANTED=Editor Restrictions,Basic Solaris User
```

The User Security administrator has assigned a profile shell to every user. For the reasons and the procedure, see “Assigning Rights to Users” on page 51.

See Also For more information, see the `privileges(7)` man page.

Removing Rights From Many Users by Using a Rights Profile

Rights profiles can limit rights for a large number of users. They are easily maintained because after you modify the rights profile, users who are assigned the profile get the modified rights at next login.

Removing Rights System-Wide

EXAMPLE 28 Modifying the `policy.conf` File to Limit the Rights Available to System Users

In this example, the administrator creates a system that is useful only to administer the network. The administrator removes the Basic Solaris User rights profile and any authorizations from the `/etc/security/policy.conf` file. The Console User rights profile is not removed. The affected lines in the resulting `policy.conf` file are the following:

```
...
##AUTHS_GRANTED=
##AUTH_PROFS_GRANTED=
##PROFS_GRANTED=Basic Solaris User
CONSOLE_USER=Console User
...
```

Only a user who has been explicitly assigned authorizations, commands, or rights profiles is able to use this system. After login, the authorized user can perform administrative duties. If the authorized user is sitting at the system console, the user has the rights of the Console User.

EXAMPLE 29 Creating a Remote Users Rights Profile

In this example, the administrator creates a rights profile in the LDAP repository for users who log in remotely.

```
# profiles -p -S LDAP "Remote Users"
profiles:Remote Users> set desc="For all logins from remote systems"
... Remote Users> set defaultpriv="basic,!proc_info"
... Remote Users> set limitpriv="basic,!proc_info"
... Remote Users> end
... Remote Users> exit
```

The administrator verifies the contents.

```
# profiles -p "Remote Users" info
Found profile in LDAP repository.
        name=Remote Users
        desc=For all logins from remote systems
        defaultpriv=basic,!proc_info,
        limitpriv=basic,!proc_info
```

EXAMPLE 30 Removing Basic Privileges From a Rights Profile

In the following example, after thorough testing, the security administrator removes another basic privilege from the Remote Users rights profile created in Example 29, “Creating a Remote Users Rights Profile,” on page 83. Users who are assigned this profile cannot examine any processes outside their current session, and they cannot add another session.

```
# profiles -p "Remote Users"
profiles:Remote Users> set defaultpriv="basic,!proc_info,!proc_session"
profiles:Remote Users> end
profiles:Remote Users> exit
```

EXAMPLE 31 Restricting an Administrator to Explicitly Assigned Rights

You can restrict a role or user to a limited number of administrative actions in two ways.

- Assign the Stop rights profile as the last profile in the user's list of profiles.

  The Stop rights profile is the simplest way to create a restricted shell. The authorizations and rights profiles in the `policy.conf` file are not assigned to the user or role.
- Modify the `policy.conf` file on a system, and require the role or user to use that system for administrative tasks. See Example 28, “Modifying the `policy.conf` File to Limit the Rights Available to System Users,” on page 83.

The following command limits the `auditrev` role to performing only audit reviews.

```
# rolemod -K profiles="Audit Review,Stop" auditrev
```

Because the `auditrev` role does not have the Console User rights profile, the auditor cannot shut down the system. Because this role does not have the `solaris.device.cdrw` authorization, the auditor cannot read from or write to the CD-ROM drive. Because this role does not have the Basic Solaris User rights profile, no commands from that profile can be run in this role. Because the All rights profile is not assigned, the `ls` command will not run. The role uses the File Browser to select the audit files for review.

For more information, see “Order of Search for Assigned Rights” on page 43 and “Rights Profiles Reference” on page 160.

EXAMPLE 32 Preventing Selected Applications From Spawning New Processes

In this example, the administrator creates a rights profile for applications that do not require subprocesses for correct operation. For convenience, the administrator creates a directory to hold these executables. When new applications are added that do not require subprocesses, the executables can be added to this directory. Or, if the executable is required to be in a specific directory, the administrator can link to it from `/opt/local/noex/`*app-executable*.

```
# profiles -p "Prevent App Subprocess"
profiles:Prevent App Subprocess> set desc="Keep apps from execing processes"
profiles:Prevent App Subprocess> add cmd=/opt/local/noex/mkmod
... Subprocess:mkmod> set limitprivs=all,!proc_exec
... Subprocess:mkmod> end
... Subprocess> add cmd=/opt/local/noex/gomap
... Subprocess:gomap> set limitprivs=all,!proc_exec
... Subprocess:gomap> end
... Subprocess> commit
... Subprocess> exit
```

Qualifying Accounts to Assume Rights on Specific Systems

This set of examples illustrates how to centrally manage the assignment of security attributes to users and roles. These commands work only in the LDAP naming service, not in the `files` naming service.

EXAMPLE 33 Qualifying Where and When LDAP Users and Roles Can Use Their Rights

The following example enables the user `jdoe` to administer the systems `labsys1` and `labsys2`. `jdoe` is an LDAP account.

```
# usermod -q labsys1 -K profiles="System Administrator" jdoe
# usermod -q labsys2 -K profiles="System Administrator" jdoe
```

The following example limits administrative access to the role `admin` on `system1` to weekdays from 5am to 3pm. `admin` is an LDAP account. The system's local time zone is used.

```
# rolemod -q system1 -k access_times="(*}:Wk0500-1500" \
  -K profiles="System Administrator" admin
```

EXAMPLE 34 Qualifying the Systems Where Users and Roles Have Administrative Rights

This set of examples illustrates how to qualify the assignment of security attributes by hostname or by group of hosts called *netgroups*. See the `netgroup(5)` man page.

The following example enables the user `jdoe` to administer a set of systems defined as the `lab1` netgroup. `jdoe` and the `lab1` netgroup are managed in the LDAP directory.

```
# usermod -q @lab1 -K profiles="System Administrator" jdoe
```

The following example limits the user `jdoe` to administering the `lab1` netgroup to weekdays from 5am to 3pm.

```
# usermod -q @lab1 -k access_times="(*}:Wk0500-1500" -K profiles="System Administrator"
 jdoe
```

Modifying Rights System-Wide As SMF Properties

The following sections describe how to use the Service Management Facility (SMF) to manage the default rights that are assigned to all users who log in to a system. SMF enables you to manage the rights per system or in LDAP. While the default rights that Oracle Solaris installs are typically sufficient, you can modify the defaults to match your site security requirements. For information about rights, see Chapter 1, “About Using Rights to Control Users and Processes”.

New Feature – Enabling the `account-policy` Service

In Oracle Solaris 11.4, you can set the default rights for a system in SMF.

In legacy systems, you edited files in the `/etc` directory. When you use SMF, properties of the `account-policy` indicate the current policies. The security policies are grouped into four stencils:

```
config/etc_security_policyconf          config/etc_default_passwd
config/etc_default_login                config/etc_default_su
```

When you enable a stencil, you are then able to modify the security attributes that are in that stencil.

1. To enable the service and verify that it is in effect, run the following commands:

   ```
   $ pfexec svcadm enable account-policy
   ```

```
$ svcs account-policy
STATE          STIME    FMRI
online         0:10:00  svc:/system/account-policy:default
```

2. Then, you enable the security attribute to be changed and then change its value to your site policy.

```
$ pfbash svccfg -s account-policy  \
 setprop config/etc_security-stencil/disabled = boolean: false
 $ svccfg -s account-policy:default  \
 setprop security-stencil-group/property = [type:] value
$ svcadm refresh account-policy
```

Note - When the `account-policy: default` SMF service is online, changes to the legacy files, such as `/etc/default/login`, no longer affect the rights that the system enforces. Similarly, the contents of the files might not reflect current policy.

The rights that you can modify system-wide include the following:

- “Modifying Login Environment Variables” on page 87
- “Modifying Login Policy” on page 89
- “Modifying Password Policy” on page 91
- “Modifying System-Wide Privileges, Authorizations, and Rights Profiles” on page 92
- “Modifying Logging Policy” on page 94

For a list of security attributes that you can modify system-wide, see “Security Attributes in Files and Their Corresponding SMF Properties” on page 171.

Modifying Login Environment Variables

In this section, you change the default `umask` value for all users, prevent malicious login attempts by limiting failed logins, and remove the ability of console users to shut down the system. You can limit failed login attempts per system, per user, or through a rights profile. For a discussion of password constraints, see “Passwords and Password Policy” in *Oracle Solaris 11.4 Security and Hardening Guidelines*.

This section assumes that you have completed “New Feature – Enabling the `account-policy` Service” on page 86.

Security attributes that are properties of the `config/etc_default_login` stencil of the `account-policy` service include:

```
$ svcprop -p login/environment account-policy:default
```

```
login/environment/path astring
login/environment/root_path astring
login/environment/set_shell boolean
login/environment/timezone astring
login/environment/ulimit integer
login/environment/umask integer
```

For an example, see "How to Set a More Restrictive umask Value for All Logins" on page 88. See also the account-policy(8S) man page.

How to Set a More Restrictive umask Value for All Logins

In this procedure, you change the default umask value for all users. The umask utility sets the file permission bits of user-created files. If the default umask value, 022, is not restrictive enough, set a more restrictive mask by using this procedure.

Before You Begin You have completed "New Feature – Enabling the account-policy Service" on page 86. You must become an administrator who is assigned the User Security rights profile. The root role is assigned this profile. For more information, see "Using Your Assigned Administrative Rights" on page 114.

1. **Determine the value that satisfies your site security requirements:**

   - umask 026 – Provides moderate file protection

     (751) – r for group, x for others
   - umask 027 – Provides strict file protection

     (750) – r for group, no access for others
   - umask 077 – Provides complete file protection

     (700) – No access for group or others

2. **Set the umask property value in the account-policy SMF stencil.**

   a. **Find the full name of the umask property.**

   ```
   $ svcprop account-policy | grep umask
   login/environment/umask integer
   ```

   b. **Set the new value and refresh the service.**

   ```
   $ pfbash svccfg -s account-policy
   svc:/.../account-policy> setprop config/etc_default_login/disabled = boolean: false
   svc:/.../account-policy> setprop login/environment/umask = 026
   ```

```
svc:/.../account-policy> exit
$ svcadm refresh account-policy
```

See Also For more information, see the following:

- "Default umask Value" in *Securing Files and Verifying File Integrity in Oracle Solaris 11.4*
- Selected man pages include `useradd`(8), `account-policy`(8S), and `umask`(1).

Modifying Login Policy

This section assumes that you have completed "New Feature – Enabling the `account-policy` Service" on page 86.

Security attributes that are properties of the `config/etc_default_login` stencil of the `account-policy` service include:

```
$ svcprop -p login_policy account-policy:default
login_policy/annotation astring
login_policy/auto_unlock_time astring
login_policy/clearance astring
login_policy/disabletime count
login_policy/lock_after_retries astring
login_policy/pam_policy astring
login_policy/password_required boolean
login_policy/retries count
login_policy/root_login_device astring
login_policy/sleeptime count
login_policy/timeout count
```

For more information, see the `account-policy`(8S) man page.

▼ How to Set Account Locking for All Logins

Use this procedure to prevent malicious login attempts by locking a user's account after a certain number of failed login attempts.

Caution - Do not set this protection system-wide on a system that you use for administrative activities. Rather, monitor the administrative system for unusual use and keep the system available for administrators.

Before You Begin You have completed "New Feature – Enabling the `account-policy` Service" on page 86.
You must become an administrator who is assigned the User Security rights profile. The `root`

role is assigned this profile. For more information, see "Using Your Assigned Administrative Rights" on page 114.

1. **Find the full names of the `retries` SMF properties from the `account-policy` stencil.**

```
$ svcprop account-policy | grep retries
login_policy/lock_after_retries astring
login_policy/retries count
```

2. **Set the `lock_after_retries` property value to `yes`.**

```
$ pfbash svccfg -s account-policy
svc:/.../account-policy> setprop config/etc_default_login/disabled = boolean: false
svc:/.../account-policy> setprop login_policy/lock_after_retries = yes
svc:/.../account-policy> exit
```

3. **Set the `retries` count to `3` and refresh the service.**

```
$ svccfg -s account-policy \
setprop login_policy/retries = 3
$ svcadm refresh account-policy
```

4. **(Optional) Specify a time after which a user can re-authenticate to a locked account.**

   a. **Find the full name of the `unlock` SMF property from the `account-policy` stencil.**

```
$ svcprop account-policy | grep unlock
login_policy/auto_unlock_time astring
```

   b. **Set the `auto_unlock_time` property value and refresh the service.**

   The following command enables users to log in without administrative intervention three hours and five minutes after the account locks.

```
$ svccfg -s account-policy \
  setprop login_policy/auto_unlock_time = 185m
$ svcadm refresh account-policy
```

5. **To unlock a locked user, use the `passwd` command.**

```
# passwd -u username
```

   You as an administrator can unlock user accounts in both the `files` and `ldap` naming services.

See Also

- For a discussion of user and role security attributes, see Chapter 9, "Reference for Oracle Solaris Rights".

- Selected man pages include passwd(1) and account-policy(8S).

Modifying Password Policy

This section assumes that you have completed "New Feature – Enabling the account-policy Service" on page 86.

Security attributes that are properties of the config/etc_default_passwd stencil of the account-policy service include:

```
password/aging_defaults/max_days count
password/aging_defaults/min_days count
password/aging_defaults/warn_days count
password/complexity/max_repeats count
password/complexity/min_alpha count
password/complexity/min_diff count
password/complexity/min_digit count
password/complexity/min_lower count
password/complexity/min_nonalpha count
password/complexity/min_special count
password/complexity/min_upper count
password/complexity/namecheck boolean
password/complexity/passlength count
password/complexity/whitespace boolean
password/crypt/algorithms_allow astring 2a 5 6
password/crypt/algorithms_deprecate astring
password/crypt/default astring 5
password/dictionary/db_dir astring
password/dictionary/min_word_length count
password/dictionary/word_list astring
```

In the following example, the administrator sets a required password length longer than the default of 8 characters.

```
$ pfbash svccfg -s account-policy
svc:/.../account-policy> setprop config/etc_default_passwd/disabled = boolean
svc:/.../account-policy> setprop password/complexity/passlength = 13
svc:/.../account-policy> exit
$ svcadm refresh account-policy
```

Modifying System-Wide Privileges, Authorizations, and Rights Profiles

This section assumes that you have completed “New Feature – Enabling the account-policy Service” on page 86.

The following command displays the RBAC policy variables as SMF properties:

```
$ svcprop -p rbac account-policy
rbac/console_user_profiles astring Console\ User
rbac/default_auth_profiles astring
rbac/default_authorizations astring
rbac/default_limit_privileges astring
rbac/default_privileges astring
rbac/default_profiles astring Basic\ Solaris\ User
```

EXAMPLE 35 Adding a Rights Profile to Every Login

In this example, the administrator adds the Site Console User rights profile and removes access to the Console User rights profile by users of the system. This example assumes the administrator has completed “New Feature – Enabling the account-policy Service” on page 86.

```
$ pfbash svccfg -s account-policy
svc:/.../account-policy> setprop config/etc_security_policyconf/disabled = boolean
svc:/.../account-policy> setprop rbac/console_user_profiles astring = ""
svc:/.../account-policy> setprop rbac/default_profiles astring = "Site Console User,
 Basic Solaris User"
svc:/.../account-policy> exit
$ svcadm refresh account-policy
```

“How to Remove Power Management Capability From Users” on page 76 shows the contents of the Site Console User rights profile,

Modifying Which Privileges Are Available on a System

This section assumes that you have completed “New Feature – Enabling the account-policy Service” on page 86.

Under particular circumstances, you can remove privileges from a system. For example, you might prevent remote users from examining the status of processes that they do not own, Public systems might benefit from reduced privileges.

The following commands modify a public system to prevent file linking and viewing any processes outside of the user's session:

```
$ pfbash svccfg -s account-policy
svc:/.../account-policy> setprop config/etc_security_policyconf/disabled = boolean
svc:/.../account-policy> setprop rbac/default_privileges = "basic,!file_link_any"
svc:/.../account-policy> exit
$ svcadm refresh account-policy
```

Assigning a Rights Profile to a System

This section assumes that you have completed “New Feature – Enabling the `account-policy` Service” on page 86.

Rights profiles can specify the rights for a large number of users. They are easily maintained and can be applied to a system.

```
$ pfbash svccfg -s account-policy
svc:/.../account-policy> setprop config/etc_security_policyconf/disabled = boolean
svc:/.../account-policy> setprop rbac/default_profiles = "Example Rights Profile"
svc:/.../account-policy> exit
$ svcadm refresh account-policy
```

EXAMPLE 36 Assigning the Editor Restrictions Rights Profile to All Logins

This example shows how to require all users of an editor on a system to authenticate before editing.

```
$ pfbash svccfg -s account-policy
svc:/.../account-policy> setprop config/etc_security_policyconf/disabled = boolean
svc:/.../account-policy> setprop rbac/default_profiles = "Editor Restrictions"
svc:/.../account-policy> exit
$ svcadm refresh account-policy
```

The "Editor Restrictions" profile was created in Example 26, “Preventing Guests From Spawning Editor Subprocesses,” on page 81.

EXAMPLE 37 Enabling Only the Console User to Log In

In this example, the administrator creates a system that is useful only to administer the network. The administrator removes the Basic Solaris User rights profile and any authorizations from the system. The Console User rights profile is not removed.

```
$ pfbash svccfg -s account-policy
svc:/.../account-policy> setprop config/etc_security_policyconf/disabled = boolean
svc:/.../account-policy> setprop rbac/default_authorizations = ""
svc:/.../account-policy> setprop rbac/default_profiles = ""
svc:/.../account-policy> exit
$ svcadm refresh account-policy
```

Only a user who has been explicitly assigned authorizations, commands, or rights profiles is able to use this system. After login, the authorized user can perform administrative duties. If the authorized user is sitting at the system console, the user has the rights of the Console User.

Modifying Logging Policy

This section assumes that you have completed "New Feature – Enabling the `account-policy` Service" on page 86.

The following command displays the logging policy variables as SMF properties. Note that the properties are in two stencils:

```
login/log/syslog boolean
login/log/syslog_failed_attempts count
su/log/device astring
su/log/logfile astring
su/log/syslog boolean
```

The following command enables the logging policy for `syslog` to be set:

```
$ pfexec svccfg -s account-policy \
setprop config/etc_default_login/disabled boolean true
```

The following command enables the logging policy for `su` to be set:

```
$ pfexec svccfg -s account-policy \
setprop config/etc_default_su/disabled boolean true
```

For the effects of changing the values of logging properties, see the `account-policy`(8S) man page.

Setting Account Policy During Automated Installation

The setting of `account-policy` is best done as part of an Automated Installation (AI) through an SMF profile.

The following SMF profile example enables stenciling for all `account-policy` configuration files and sets selected properties. This AI profile would be delivered into `/etc/svc/profile/{`*node,site,enterprise*`}` by a customer's IPS package during initial AI.

```
<?xml version='1.0' encoding='US-ASCII'?>
<!DOCTYPE service_bundle SYSTEM
"/usr/share/lib/xml/dtd/service_bundle.dtd.1">

<service_bundle type="profile" name="site-account-policy">
  <service version="1" type="service" name="system/account-policy">
      <!-- Enable stenciling -->
      <instance name="default" enabled="true" />

      <property_group name="config" type="system">
        <property_group name="etc_default_login" type="configfile">
          <propval type="boolean" name="disabled" value="false"/>
        </property_group>
        <property_group name="etc_default_passwd" type="configfile">
          <propval type="boolean" name="disabled" value="false"/>
        </property_group>
        <property_group name="etc_default_su" type="configfile">
          <propval type="boolean" name="disabled" value="false"/>
        </property_group>
        <property_group name="etc_security_policyconf" type="configfile">
          <propval type="boolean" name="disabled" value="false"/>
        </property_group>
      </property_group>'

      <!-- Set account policy -->
      <property_group name="login_policy">
          <propval name="disabletime" type="count" value="0"/>
          <propval name="pam_policy" type="astring" value="ldap"/>
          <propval name="annotation" type="astring" value="yes"/>
      </property_group>

  </service>
</service_bundle>
```

♦ ♦ ♦ CHAPTER 4

Assigning Rights to Applications, Scripts, and Resources

This chapter covers tasks that apply privileges, extended privilege policy, and other rights to users, ports, and applications:

For an overview of rights, see "User Rights Management" on page 21.

Limiting Applications, Scripts, and Resources to Specific Rights

The tasks and examples in this section assign privileges to executables and system resources. Typically, you assign a privilege to an executable to enable a trusted user to run that executable. In "Assigning Rights to Applications and Scripts" on page 97, the privilege assignment enables the application or script to be run by a trusted user in a profile shell. In "Locking Down Resources by Using Extended Privileges" on page 101, extended privilege policy limits a user ID, port, or file object, to a smaller set of privileges than the default effective set. Privileges that are unspecified are denied to that user's process, port, or object. Such an assignment approximates least privilege policy.

Assigning Rights to Applications and Scripts

Applications and scripts execute one command or a series of commands. To assign rights, you set the security attributes, such as set IDs or privileges, for each command in a rights profile. Applications can check for authorizations, if appropriate.

Note - If a command in a script needs to have the `setuid` bit or `setgid` bit set to succeed, the script executable *and* the command must have the security attributes added in a rights profile. When the script is executed in a profile shell, the command runs with the security attributes.

- Run a script that needs rights – "How to Run a Shell Script With Privileged Commands" on page 98
- Batch edit sensitive files – Example 41, "Scripting the Batch Editing of Files in a Directory," on page 100
- Enable privilege-aware applications to be run by non-`root` users – Example 38, "Assigning Security Attributes to a Legacy Application," on page 99
- Enable `root`-owned applications to be run by non-`root` users – Example 39, "Running an Application With Assigned Rights," on page 99
- Check for authorizations in a script – Example 40, "Checking for Authorizations in a Script or Program," on page 100

▼ How to Run a Shell Script With Privileged Commands

To run a privileged shell script, you add privileges to the script and to the commands in the script. Then, the appropriate rights profile must contain the commands with privileges assigned to them.

Before You Begin You must assume the `root` role. For more information, see "Using Your Assigned Administrative Rights" on page 114.

1. **Create the script with `/bin/pfsh`, or any other profile shell, on the first line.**

```
#!/bin/pfsh
# Copyright (c) 2015 by Oracle
```

2. **As a regular user, determine the privileges that the commands in the script need.**

   By running the script with no privileges, the `debug` option to the `ppriv` command lists the missing privileges.

```
$ ppriv -eD script-full-path
```

   For more information, see "How to Determine Which Privileges a Program Requires" on page 153.

3. **Create or modify a rights profile for the script.**

   Add the shell script, and the commands in the shell script, with their required security attributes to the rights profile. See "How to Create a Rights Profile" on page 119.

4. **Assign the rights profile to a trusted user or role.**

   For examples, see "Assigning Rights to Users" on page 51.

5. **To run the script, do one of the following:**

   - **If you are assigned the script as a user, open a profile shell and run the script.**

     ```
     $ pfexec script-full-path
     ```

   - **If you are assigned the script as a role, assume the role and run the script.**

     ```
     $ su - rolename
     Password: xxxxxxxx
     # script-full-path
     ```

Example 38 Assigning Security Attributes to a Legacy Application

Because a legacy application is not privilege-aware, the administrator assigns the `euid=0` security attribute to the application executable in a rights profile. Then, the administrator assigns it to a trusted user.

```
# profiles -p LegacyApp
profiles:LegacyApp> set desc="Legacy application"
profiles:LegacyApp> add cmd=/opt/legacy-app/bin/legacy-cmd
profiles:LegacyApp:legacy-cmd> set euid=0
profiles:LegacyApp:legacy-cmd> end
profiles:LegacyApp> exit
# profiles -p LegacyApp 'select cmd=/opt/legacy-app/bin/legacy-cmd;info;end'
 id=/opt/legacy-app/bin/legacy-cmd
 euid=0

# usermod -K profiles+="Legacy application" jdoe
```

Example 39 Running an Application With Assigned Rights

In this example, the administrator assigns the rights profile from Example 49, "Creating a Rights Profile That Includes Privileged Commands," on page 120 to a trusted user. The user must provide a password when executing the script.

```
# usermod -K auth_profiles+="Site application" jdoe
```

Example 40 Checking for Authorizations in a Script or Program

To check for authorizations, write a test that is based on the `auths` command. For detailed information about this command, see the `auths(1)` man page.

For example, the following line tests whether the user has the authorization that is supplied as the `$1` argument:

```
if [ `/usr/bin/auths|/usr/xpg4/bin/grep $1` ]; then
        echo Auth granted
else
        echo Auth denied
fi
```

A more complete test includes logic that checks for the use of wildcards. For example, to test whether the user has the `solaris.system.date` authorization, you would need to check for the following strings:

- `solaris.system.date`
- `solaris.system.*`
- `solaris.*`

If you are writing a program, use the function `getauthattr()` to test for the authorization.

Example 41 Scripting the Batch Editing of Files in a Directory

This example shows how to batch edit sensitive files by using two scripts. The first script switches out the default editor and calls the second script. The second script is the editing script. By changing the second script, you keep a record of the changes to the files.

1. Create the first script.

```
# pfedit batchpfedit.sh
    #!/usr/bin/bash
    OLDEDITOR=$EDITOR
    export EDITOR=~/bin/key-edit.sh
    pfedit /var/ITdemos/firstdemo-directory
    export EDITOR=$OLDEDITOR
```

Where:

`OLDEDITOR=$EDITOR` Defines the `OLDEDITOR` variable to hold the value of the current editor.

`~/bin/key-edit.sh` Is the script that contains the edits.

`pfedit /var/ITdemos/firstdemo-directory`	Is the command that creates a temporary `pfedit` file for the script to use.
`export EDITOR=$OLDEDITOR`	Replaces the original `$EDITOR` definition.

2. Create the editing script.

```
# pfedit batchpfedit.sh
    #!/usr/bin/bash
    OLDEDITOR=$EDITOR
    export EDITOR=~/bin/key-edit.sh
    pfedit /var/ITdemos/firstdemo-directory
    export EDITOR=$OLDEDITOR
```

   The second script contains the editing changes. In this example, the `key-edit.sh` script substitutes the word `key` for the word `pey`.

```
#!/usr/bin/bash
    perl -pi.pfedit -e 's/pey/key/g' $1
    rm $1.pfedit
```

   - The `$1` finds the temporary file.
   - The `perl -pi.`*extension* creates a temporary file and writes back to the original file.
   - The `rm` command removes this extra temporary file.

3. Call the first script.

   You can create more editing scripts, then replace the `key-edit.sh` script in the `batchpfedit.sh` with the new script name.

Locking Down Resources by Using Extended Privileges

Extended privilege policy can limit attacker access to a system when an attack on an application is successful. An extended policy rule limits the scope of the effect of a privilege assignment to just the resource that is in the rule. Extended policy rules are expressed by enclosing the privileges between curly braces, followed by a colon and the associated resource. For more discussion, see “Expanding a User or Role's Privileges” on page 38. For examples of the syntax, see the `ppriv(1)` and `privileges(7)` man pages.

Both administrators and regular users can lock down resources by using extended privileges. Administrators can create extended privilege rules for users, ports, and applications. Regular users can use the command line or write scripts that use the `ppriv -r` command to prevent applications from writing files outside of user-specified directories.

- Limit the access available to a malicious user who enters by a port – "How to Apply Extended Privilege Policy to a Port" on page 102
- Run a database as a non-`root` daemon – "How to Lock Down the MySQL Service" on page 103
- Run the Apache HTTP Server as a non-`root` daemon – "How to Assign Specific Privileges to the Apache HTTP Server" on page 106
- Verify that the Apache HTTP Server is running with privileges – "How to Determine Which Privileges the Apache HTTP Server Is Using" on page 107
- Prevent Firefox from writing to directories on your system – Example 42, "Running a Browser in a Protected Environment," on page 108
- Limit your applications to specific directories on your system – Example 43, "Protecting Directories on Your System From Application Processes," on page 109

▼ How to Apply Extended Privilege Policy to a Port

The service for the Network Time Protocol (NTP) uses the privileged port `123` for `udp` traffic. Privileges are required for this service to run. This example procedure modifies the service manifest to protect other ports from being accessed by a malicious user who might gain the privileges that are assigned to this port.

Before You Begin You must assume the `root` role. For more information, see "Using Your Assigned Administrative Rights" on page 114.

1. Read the default service manifest entry for the port.

From the following `/lib/svc/manifest/network/ntp.xml` `start` method entry, the `net_privaddr`, `proc_lock_memory`, and `sys_time` privileges could be used on other processes:

```
privileges='basic,!file_link_any,!proc_info,!proc_session,net_privaddr,
proc_lock_memory,sys_time'
```

The removed privileges specified by `!file_link_any,!proc_info,!proc_session` prevent the service from signaling or observing any other processes, and from creating hard links as a way of renaming files. That is, the process that is started by the service is only able to bind to NTP's port `123`, not to any of the other privileged ports.

If a hacker could exploit the service to start another process, that process would be similarly limited.

2. **Modify the `start` and `restart` methods to limit the `net_privaddr` privilege to this port only.**

```
# svccfg -s ntp editprop -a
```

   a. **Search for the string `net_privaddr`.**

   b. **Uncomment the entries that contain `net_privaddr`.**

   c. **In both entries, replace `net_privaddr` with `{net_privaddr}:123/udp`.**
   The extended privilege policy removes all privileges from this service except the specified privileges plus the basic privileges that are not specified. Therefore, the set of over eighty potentially exploitable privileges is reduced to less than eight.

3. **Restart the service to use the extended privilege policy.**

```
# svcadm restart ntp
```

4. **Verify that the service is using extended privilege.**

```
# svcprop -s ntp | grep privileges
start/privileges    astring  basic,!file_link_any,!proc_info,!proc_session,
                    {net_privaddr}:123/udp,proc_lock_memory,sys_time
restart/privileges  astring  basic,!file_link_any,!proc_info,!proc_session,
                    {net_privaddr}:123/udp,proc_lock_memory,sys_time
```

▼ How to Lock Down the MySQL Service

At installation, the MySQL database is configured to run with the full privileges of `root` over an unprotected port. In this task, you assign extended privilege policy to the MySQL service in a rights profile. After the rights profile becomes the `exec` method of the service, MySQL runs over a protected port as the user `mysql` with limited database access by non-MySQL processes.

Before You Begin The initial user can install the package. The remaining steps must be performed by the `root` role. For more information, see "Using Your Assigned Administrative Rights" on page 114.

1. **Install the MySQL package.**

```
# pkg search basename:mysql
...
basename ... pkg:/database/mysql-57@version
# pfexec pkg install mysql-57
```

2. **Display the FMRI and state of the MySQL service.**

```
# svcs mysql
STATE          STIME    FMRI
disabled       May_15   svc:/application/database/mysql:version_57
```

3. **Create a rights profile that modifies the execution method of the service.**

   The service manifest for this service specifies that the execution method is a shell script wrapper, `/lib/svc/method/mysql_57`.

```
# svcprop -s mysql | grep manifest
... astring     /lib/svc/manifest/application/database/mysql_57.xml
# grep exec= /lib/svc/manifest/application/database/mysql_57.xml
                exec='/lib/svc/method/mysql_57 start'
                exec='/lib/svc/method/mysql_57 stop'
```

   Use the `/lib/svc/method/mysql_57` wrapper for the command in the profile.

```
$ su -
Password: xxxxxxxx
# profiles -p "MySQL Service"
MySQL Service> set desc="Locking down the MySQL Service"
MySQL Service> add cmd=/lib/svc/method/mysql_57
MySQL Service:mysql_57> set privs=basic
MySQL Service:mysql_57> add privs={net_privaddr}:3306/tcp
MySQL Service:mysql_57>  add privs={file_write}:/var/mysql/5.7/data/*
MySQL Service:mysql_57>  add privs={file_write}:/tmp/mysql.sock
MySQL Service:mysql_57>  add privs={file_write}:/var/tmp/ib*
MySQL Service:mysql_57> end
MySQL Service>  set uid=mysql
MySQL Service>  set gid=mysql
MySQL Service>  exit
```

   The `file_write` privilege is a basic privilege granted by default to all processes. By explicitly enumerating the writable paths, write access is restricted to just those paths. This constraint applies to the specified executable and its child processes.

4. **Make the default port for MySQL a privileged port.**

```
# ipadm set-prop -p extra_priv_ports+=3306 tcp
# ipadm show-prop -p extra_priv_ports tcp
PROTO PROPERTY            PERM CURRENT     PERSISTENT   DEFAULT    POSSIBLE
tcp   extra_priv_ports    rw   2049,4045,  3306         2049,4045  1-65535
                                 3306
```

   The `net_privaddr` privilege is required to bind to a privileged port. In the case of MySQL, binding to the default port number, 3306, does not normally require this privilege.

5. **Assign the rights profile to the MySQL service and tell the service to use it.**

```
# svccfg -s mysql:version_57
...version_57> setprop method_context/profile="MySQL Service"
...version_57> setprop method_context/use_profile=true
...version_57> refresh
...version_57> exit
```

6. Enable the service.

The last component of the FMRI, `mysql:version_57`, is sufficient to uniquely specify the service.

```
#  svcadm enable  mysql:version_57
```

7. (Optional) Verify that the service is running with the rights that are specified in the MySQL Service rights profile.

```
# ppriv $(pgrep mysql)
103697:   /usr/mysql/5.7/bin/mysqld --basedir=/usr/mysql/5.7
                                    --datadir=/var/mysql/5.7/data
flags =   PRIV_XPOLICY
      Extended policies:
                  {net_privaddr}:3306/tcp
                  {file_write}:/var/mysql/5.7/data/*
                  {file_write}:/tmp/mysql.sock
                  {file_write}:/var/tmp/ib*
        E: basic,!file_write
        I: basic,!file_write
        P: basic,!file_write
        L: all
103609:  /bin/sh /usr/mysql/5.7/bin/mysqld_safe --user=mysql
                             --datadir=/var/mysql/5.7/data
flags =  PRIV_XPOLICY
      Extended policies:
                  {net_privaddr}:3306/tcp
                  {file_write}:/var/mysql/5.7/data/*
                  {file_write}:/tmp/mysql.sock
                  {file_write}:/var/tmp/ib*
        E: basic,!file_write
        I: basic,!file_write
        P: basic,!file_write
        L: all
```

▼ How to Assign Specific Privileges to the Apache HTTP Server

This procedure locks down the web server daemon by assigning to it only the privileges it needs. The web server can only bind to port 80, and can only write to files that the `webservd` daemon owns. No `apache24` service processes run as `root`.

Before You Begin You must assume the `root` role. For more information, see "Using Your Assigned Administrative Rights" on page 114.

1. Create the web server rights profile.

```
# profiles -p "Apache2"
profiles:Apache2> set desc="Apache HTTP Server Extended Privilege"
profiles:Apache2> add cmd=/lib/svc/method/http-apache24
profiles:Apache2:http-apache24> add privs={net_privaddr}:80/tcp
...http-apache24> add privs={zone}:/system/volatile/apache2
...http-apache24> add privs={zone}:/var/apache2/2.4/logs/*
...http-apache24> add privs={zone}:/var/user
...http-apache24> add privs={file_write}:/var/user/webserv*
...http-apache24> add privs={file_write}:/tmp/*
...http-apache24> add privs={file_write}:/system/volatile/apache*
...http-apache24> add privs={file_write}:/proc/*
...http-apache24> add privs=basic,proc_priocntl
...http-apache24> set uid=webservd
...http-apache24> set gid=webservd
...http-apache24> end
---Apache2> exit
```

2. Add the rights profile to the apache24 SMF start method.

```
# svccfg -s apache24
svc:/network/http:Apache2> listprop start/exec
start/exec  astring "/lib/svc/method/http-apache24 start"
...
svc:/network/http:Apache2> setprop start/profile="Apache2"
svc:/network/http:Apache2> setprop start/use_profile=true
svc:/network/http:Apache2> refresh
svc:/network/http:Apache2> exit
```

When the `apache24` service is enabled, the Apache2 profile will be used.

3. Enable the `apache24` service.

```
# svcadm enable apache24
```

4. Verify that web server is working.

Open a browser and type `localhost` in the Firefox URL field.

Next Steps To verify that the privileges are applied correctly, continue with "How to Determine Which Privileges the Apache HTTP Server Is Using" on page 107.

▼ How to Determine Which Privileges the Apache HTTP Server Is Using

In this task, you determine which privileges the web server is using by creating a debug version of the Apache2 rights profile.

Before You Begin You have completed "How to Assign Specific Privileges to the Apache HTTP Server" on page 106. The `apache24` service is disabled. You are in the `root` role.

1. **Clone the Apache2 profile to call a different command.**

   Debugging a command is simpler than debugging an SMF service. The `apachectl` command starts the Apache service interactively.

   ```
   # profiles -p "Apache2"
   profiles:Apache2> set name="Apache-debug"
   profiles:Apache-debug> sel <Tab><Tab>
   profiles:Apache-debug:http-apache24> set id=/usr/apache2/2.4/bin/apachectl
   profiles:Apache-debug:apachectl> end
   profiles:Apache-debug> exit
   ```

   For more information, see the `apachectl`(8) man page.

2. **Assign the cloned profile to the `webservd` account.**

   ```
   # usermod -K profiles+=Apache-debug webservd
   ```

3. **Switch to the `webservd` identity.**

   ```
   # su - webservd
   ```

4. **(Optional) Verify the identity.**

   ```
   # id
   uid=80(webservd) gid=80(webservd)
   ```

5. **Start the web service in debug mode in a profile shell.**

   Do not use SMF directly. Use the command in the `Apache-debug` rights profile.

   ```
   $ pfbash
   ```

```
# ppriv -De /usr/apache2/2.4/bin/apachectl start
```

6. **In the `root` role, examine the privileges of the first `http` daemon.**

```
# ppriv $(pgrep httpd|head -1)
2999:   httpd
flags = PRIV_DEBUG|PRIV_XPOLICY|PRIV_EXEC
  5         Extended policies:
  6                 {net_privaddr}:80/tcp
  7                 {zone}:/system/volatile/apache2
  8                 {zone}:/var/apache2/2.4/logs/*
  9                 {zone}:/var/user
 10                 {file_write}:/var/user/webserv*
 11                 {file_write}:/tmp/*
 12                 {file_write}:/system/volatile/apache*
 13                 {file_write}:/proc/*
 14         E: basic,!file_write,!proc_info,proc_priocntl
 15         I: basic,!file_write,!proc_info,proc_priocntl
 16         P: basic,!file_write,!proc_info,proc_priocntl
 17         L: all
```

Users Locking Down the Applications That They Run

Users can remove basic privileges from applications by using extended privilege policy. The policy prevents access to directories that the applications should not access.

Note - Order is important. Broader privileges for directories such as `$HOME/Download*` must be assigned after narrower privileges for most `$HOME/.*` directories.

EXAMPLE 42 Running a Browser in a Protected Environment

This example illustrates how users can run the Firefox browser in a protected environment. In this configuration, the user's `Documents` directory is hidden from Firefox.

By using the following command, the user removes basic privileges from the `/usr/bin/firefox` command. The extended privilege arguments to the `ppriv -r` command limit the browser to reading and writing in only the directories that the user specifies. The `-e` option and its arguments open the browser with the extended privilege policy.

```
$ ppriv -r "\
{file_read}:/dev/*,\
```

```
{file_read}:/etc/*,\
{file_read}:/lib/*,\
{file_read}:/usr/*,\
{file_read}:/var/*,\
{file_read}:/proc,\
{file_read}:/proc/*,\
{file_read}:/system/volatile/*,\
{file_write}:$HOME,\
{file_read}:$HOME/.*,\
{file_read,file_write}:$HOME/.mozill*,\
{file_read,file_write}:$HOME/.gnome*,\
{file_read,file_write}:$HOME/Downloa*,\
{file_read,file_write}:/tmp,\
{file_read,file_write}:/tmp/*,\
{file_read,file_write}:/var/tmp,\
{file_read,file_write}:/var/tmp/*,\
{proc_exec}:/usr/*\
" -e /usr/bin/firefox file:///$HOME/Desktop
```

When the `file_read` and `file_write` privileges are used in an extended policy, you must grant explicit access to every file that should be read or written. The use of the wildcard character, `*`, is essential in such policies.

To handle automounted home directories, the user would add an explicit entry for the automount path, for example:

```
{file_read,file_write}:/export/home/$USER
```

If the site is not using the `automount` facility, the initial list of protected directories is sufficient.

Users can automate this command-line protected browser by creating a shell script. Then, to launch a browser, the user calls the script, not the `/usr/bin/firefox` command.

EXAMPLE 43 Protecting Directories on Your System From Application Processes

In this example, a regular user creates a sandbox for applications by using a shell script wrapper. The first part of the script limits applications to certain directories. Exceptions, such as Firefox, are handled later in the script. Comments about parts of the script follow the script.

```
1 #!/bin/bash
2
3 # Using bash because ksh misinterprets extended policy syntax
4
5 PATH=/usr/bin:/usr/sbin:/usr/gnu/bin
6
7 DENY=file_read,file_write,proc_exec,proc_info
```

```
8
9 SANDBOX="\
10 {file_read}:/dev/*,\
11 {file_read}:/etc/*,\
12 {file_read}:/lib/*,\
13 {file_read,file_write}:/usr/*,\
14 {file_read}:/proc,\
15 {file_read,file_write}:/proc/*,\
16 {file_read}:/system/volatile/*,\
17 {file_read,file_write}:/tmp,\
18 {file_read,file_write}:/tmp/*,\
19 {file_read,file_write}:/var/*,\
20 {file_write}:$HOME,\
21 {file_read}:$HOME/.*,\
22 {file_read,file_write}:$PWD,\
23 {file_read,file_write}:$PWD/*,\
24 {proc_exec}:/usr/*\
25 "
26
27 # Default program is restricted bash shell
28
29 if [[ ! -n $1 ]]; then
30     program="/usr/bin/bash --login --noprofile
       --restricted"
31 else
32     program="$@"
33 fi
34
35
36 # Firefox needs more file and network access
37 if [[ "$program" =~ firefox ]]; then
38     SANDBOX+=",\
39 {file_read,file_write}:$HOME/.gnome*,\
40 {file_read,file_write}:$HOME/.mozill*,\
41 {file_read,file_write}:$HOME/.dbu*,\
42 {file_read,file_write}:$HOME/.puls*\
43 "
44
45 else
46     DENY+=",net_access"
47 fi
48
49 echo Starting $program in sandbox
50 ppriv -s I-$DENY -r $SANDBOX -De $program
```

The policy can be adjusted to permit specific applications more or less access. One adjustment is in lines 38-42, where Firefox is granted write access to several dot files that maintain session information in the user's home directory. Also, Firefox is not subject to line 46, which removes

network access. However, Firefox is still restricted from reading arbitrary files in the user's home directory, and can save files only in its current directory.

As an extra level of protection, the default program, at line 30, is a restricted Bash shell. A restricted shell cannot change its current directory or execute the user's dot files. Therefore, any commands that are started from this shell are similarly locked into the sandbox.

In the final line of the script the `ppriv` command is passed two privilege sets as shell variables, `$DENY` and `$SANDBOX`.

The first set, `$DENY`, prevents the process from reading or writing any file, executing any subprocess, observing other user's processes, and (conditionally) accessing the network. These restrictions are too severe, so in the second set, `$SANDBOX`, the policy is refined by enumerating the directories which are available for reading, writing, and executing.

Also, in line 50 the debug option, `-D`, is specified. Access failures display in the terminal window in real time and include the named object and the corresponding privilege that is required for success. This debugging information can help the user customize the policy for other applications.

Administering Immutable Zones

Immutable zones ensure the integrity of the files on the system. The policy of the zone specifies which files can be modified. Administrators must be authenticated to enter the Trusted Path Domain (TPD) to be able to change files on the system. Oracle Solaris provides several policies for immutable zones that offer trade-offs between flexibility and immutability. The `mwac(7)` man page describes the policies that can be applied to make a zone immutable, and the `tpd(7)` man page describes the Trusted Path Domain.

Chapter 10, "Configuring and Administering Immutable Zones" in *Creating and Using Oracle Solaris Zones* describes how to configure and administer immutable zones.

You have two options when administering an immutable zone:

- If you have access to a terminal window in the global zone, you can change the zone to mutable, administer, then return the zone to immutable.

  This option does not use the TPD. Refer to "Administering Immutable Non-Global Zones" in *Creating and Using Oracle Solaris Zones* for administering an immutable zone by making it temporarily mutable.
- If you have access to a console or a RAD interface, you can leave the zone immutable, enter the zone by the authenticating to the Trusted Path Domain (TPD), administer the zone, then exit the TPD.

This more secure option requires that the zone administrator has the rights to enter the TPD. For RAD access, the RAD process must be running in the trusted path. Refer to "Administering an Immutable Zone by Using the Trusted Path Domain" in *Creating and Using Oracle Solaris Zones*

The steps for these methods are described in the following sections:

- Mutable zone administration – With the `zlogin -T` or `zoneadm` command, see "Administering an Immutable Zone by Making It Writable" in *Creating and Using Oracle Solaris Zones*.
- Physical or virtual console entry – See "How to Enable Administrative Access to an Immutable Zone From the Console" in *Creating and Using Oracle Solaris Zones*.
- Remote RAD entry – See "How to Enable Remote Administrative Access to an Immutable Zone by Using RAD" in *Creating and Using Oracle Solaris Zones*.

♦ ♦ ♦ CHAPTER 5

Managing the Use of Rights

This chapter covers tasks that maintain systems that use the rights model for administration. Several tasks extend the rights that Oracle Solaris provides by creating new rights profiles and authorizations.

The chapter covers the following topics:

For information about rights, see Chapter 1, "About Using Rights to Control Users and Processes". For information about maintaining the assigned rights of users and roles, see Chapter 3, "Assigning Rights in Oracle Solaris".

Managing the Use of Rights

The tasks and examples in this section describe how to use the rights that you have been assigned, and how to change the rights configuration that is provided by default.

Note - For troubleshooting assistance, see "Troubleshooting RBAC and Privileges" on page 147.

- Use your assigned rights – "Using Your Assigned Administrative Rights" on page 114
- Audit administrative actions – Example 48, "Using Two Roles to Configure Auditing," on page 118
- Add rights profiles and authorizations – "Creating Rights Profiles and Authorizations" on page 119
- Configure `root` to be a user – "How to Change the `root` Role Into a User" on page 124

- Change `root` back into a role – Example 54, “Changing the `root` User Into the `root` Role,” on page 125
- Prevent `root` from administering a system – Example 55, “Preventing the `root` Role From Being Used to Maintain a System,” on page 126

Using Your Assigned Administrative Rights

In the `root` role, the initial user has all administrative rights. As `root`, this user can assign administrative rights, such as a role, a rights profile, or specific privileges and authorizations to trusted users. This section describes how these users can use their assigned rights.

Note - Oracle Solaris provides a special editor for administrative files. When editing administrative files, use the `pfedit` command. Example 44, “Editing a System File,” on page 116 shows how to enable non-`root` users to edit specified system files.

To perform your administrative tasks, open a terminal window and choose from the following options:

- If you are using `sudo`, type the `sudo` command.

  For administrators who are familiar with the `sudo` command, run the command with the name of an administrative command that you are assigned in the `sudoers` file. For more information, see the `sudo`(8) and `sudoers`(5) man pages.
- If your task requires superuser privileges, become `root`.

  ```
  $ su -
  Password: xxxxxxxx
  #
  ```

  Note - This command works whether `root` is a user or a role. The pound sign (#) prompt indicates that you are now `root`.

- If your task is assigned to a role, assume the role that can perform that task.

  In the following example, you assume an audit configuration role. This role includes the Audit Configuration rights profile. You received the role password from your administrator.

  ```
  $ su - audadmin
  Password: xxxxxxxx
  #
  ```

Tip - If you did not receive a role password, your administrator has configured the role to require your user password. Type your user password to assume the role. For more information about this option, see Example 18, “Enabling a User to Use Own Password for Role Password,” on page 67.

The shell in which you typed this command is now a profile shell. In this shell, you can run the `auditconfig` command. For more about profile shells, see “Profile Shells and Rights Verification” on page 42.

Tip - To view the rights of your role, see “Listing Rights Profiles” on page 140.

- If your task is assigned directly to you as a user and you are not running a profile shell as described in Example 76, “Determining Whether You Are Using a Profile Shell,” on page 151, create a profile shell in one of the following ways:
  - Use the `pfbash` command to create a shell that evaluates administrative rights.

    In the following example, you have been directly assigned the Audit Configuration rights profile. The following set of commands enables you to view audit preselection values and audit policy in the `pfbash` profile shell:

    ```
    $ pfbash
    $ auditconfig -getflags
    active user default audit flags = ua,ap,lo(0x45000,0x45000)
    configured user default audit flags = ua,ap,lo(0x45000,0x45000)
    $ auditconfig -getpolicy
    configured audit policies = cnt
    active audit policies = cnt
    ```

  - Use the `pfexec` command to run one administrative command.

    In the following example, you have been directly assigned the Audit Configuration rights profile as an authenticated rights profile. You can run a privileged command from this profile by using the `pfexec` command with the name of that command. For example, you can view the user's preselected audit flags:

    ```
    $ pfexec auditconfig -getflags
    Enter password:       Type your user password
    active user default audit flags = ua,ap,lo(0x45000,0x45000)
    configured user default audit flags = ua,ap,lo(0x45000,0x45000)
    ```

    Typically, to run another privileged command that is included in your rights, you must type `pfexec` again before you type the privileged command. For more information, see

the pfexec(1) man page. If you are configured with password caching, you can run subsequent commands within a configurable interval without providing a password, as shown in Example 45, “Caching Authentication for Ease of Role Use,” on page 116.

EXAMPLE 44 Editing a System File

If you are not root with the UID of 0, by default you cannot edit system files. However, if you are assigned the solaris.admin.edit/*path-to-system-file* authorization, you can edit *system-file*. For example, if you are assigned the solaris.admin.edit/etc/security/audit_warn authorization, you can edit the audit_warn file by using the pfedit command.

```
# pfedit /etc/security/audit_warn
```

For more information, see the pfedit(4) man page. This command is for use by all administrators.

EXAMPLE 45 Caching Authentication for Ease of Role Use

In this example, the administrator configures a role to manage audit configuration, but provides ease of use by caching the user's authentication. First, the administrator creates and assigns the role.

```
# roleadd -K roleauth=user -K profiles="Audit Configuration" audadmin
# usermod -R +audadmin jdoe
```

When jdoe uses the -c option when switching to the role, a password is required before the auditconfig output is displayed:

```
$ su - audadmin -c auditconfig option
Password: xxxxxxxx
    auditconfig output
```

If authentication is not being cached, when jdoe runs the command again, a password prompt appears.

The administrator creates a file in the pam.d directory to hold an su stack that enables the caching of authentication. When authentication is cached, a password is initially required but not thereafter until a certain amount of time has passed.

```
$ pfedit /etc/pam.d/su
## Cache authentication for switched user
#
auth required           pam_unix_cred.so.1
auth sufficient         pam_tty_tickets.so.1
```

```
auth requisite          pam_authtok_get.so.1
auth required           pam_dhkeys.so.1
auth required           pam_unix_auth.so.1
```

After creating the file, the administrator checks the entries for typos, omissions, or repetitions.

The administrator must provide the entire preceding `su` stack. The `pam_tty_tickets.so.1` module implements the cache. For more about PAM, see the `pam_tty_tickets`(7) and `pam.conf`(5) man pages and Chapter 1, "Using Pluggable Authentication Modules" in *Managing Authentication in Oracle Solaris 11.4*.

After the administrator adds the `su` PAM file and reboots the system, all roles including the `audadmin` role are prompted only once for a password when running a series of commands.

```
$ su - audadmin -c auditconfig option
Password: xxxxxxxx
    auditconfig output
$ su - audadmin -c auditconfig option
    auditconfig output
...
```

EXAMPLE 46 Assuming the `root` Role

In the following example, the initial user assumes the `root` role and lists the privileges in the role's shell.

```
$ roles
root
$ su - root
Password: xxxxxxxx
#       Prompt changes to root prompt
# ppriv $$
1200:   pfksh
flags = <none>
        E: all
        I: basic
        P: all
        L: all
```

For information about privileges, see "Process Rights Management" on page 30 and the `ppriv`(1) man page.

EXAMPLE 47 Assuming an ARMOR Role

In this example, the user assumes an ARMOR role that the administrator assigned.

In a terminal window, the user determines which roles are assigned.

```
$ roles
fsadm
sysop
```

The user then assumes the `fsadm` role and supplies the user's password.

```
$ su - fsadm
Password: xxxxxxxx
#
```

The `su - `*rolename* command changes the terminal's shell to a profile shell. The user is now the `fsadm` role in this terminal window.

To determine which commands can be run in this role, the user follows the instructions in "Listing Rights Profiles" on page 140.

Auditing Administrative Actions

Site security policy often requires that you audit administrative actions. The `116:AUE_PFEXEC: execve(2) with pfexec enabled:ps,ex,ua,as` audit event captures these actions. The `cusa` metaclass, which provides a group of events that is appropriate for use with roles, is another option when auditing administrative actions. For more information, review the comments in the `/etc/security/audit_class` file.

EXAMPLE 48 Using Two Roles to Configure Auditing

In this example, two administrators implement the audit configuration plan of their site security officer. The plan is to use the `pf` class for all users, and specify the `cusa` metaclass for individual roles. The `root` role will assign the audit flags to the roles. The first administrator configures auditing and the second enables the new configuration.

The first administrator is assigned the Audit Configuration rights profile. This administrator views the current audit configuration:

```
# auditconfig -getflags
active user default audit flags = lo(0x1000,0x1000)
configured user default audit flags = lo(0x1000,0x1000)
```

Because the `pf` class does not include the `lo` class, the administrator adds the class to the system configuration.

```
# auditconfig -setflags lo,pf
```

To read the new audit configuration into the kernel, the administrator who is assigned the Audit Control rights profile refreshes the audit service.

```
# audit -s
```

Creating Rights Profiles and Authorizations

You can create or change a rights profile when the provided rights profiles do not contain the collection of rights that you need. You might create a rights profile for users with limited rights, for a new application, or various other reasons.

The rights profiles that Oracle Solaris provides are read-only. You can clone a provided rights profile for modification if its collection of rights is insufficient. For example, you might want to add the `solaris.admin.edit/`*path-to-system-file* authorization to a provided rights profile. For background, see "More About Rights Profiles" on page 28.

You can create an authorization when the provided authorizations do not include the authorizations that are coded in your privileged applications. You cannot change an existing authorization. For background, see "More About User Authorizations" on page 28.

For examples of limiting privileges in a rights profile, see Example 29, "Creating a Remote Users Rights Profile," on page 83 and Example 30, "Removing Basic Privileges From a Rights Profile," on page 84.

▼ How to Create a Rights Profile

Before You Begin You must assume the `root` role. For more information, see "Using Your Assigned Administrative Rights" on page 114.

1. **Create a rights profile.**

   ```
   # profiles -p [-S repository] profile-name
   ```

   You are prompted for a description.

2. **Add contents to the rights profile.**

   Use the `set` subcommand for profile properties that have a single value, such as `set desc`. Use the `add` subcommand for properties that can have more than one value, such as `add cmd`.

The following command creates the custom PAM rights profile in "How to Assign a Modified PAM Policy" in *Managing Authentication in Oracle Solaris 11.4*. The name is shortened for display purposes.

```
# profiles -p -S LDAP "Site PAM LDAP"
profiles:Site PAM LDAP> set desc="Profile which sets pam_policy=ldap"
...LDAP> set pam_policy=ldap
...LDAP> commit
...LDAP> end
...LDAP> exit
```

Example 49 Creating a Rights Profile That Includes Privileged Commands

In this example, the security administrator adds privileges to an application in a rights profile that the administrator creates. The application is privilege-aware.

```
# profiles -p SiteApp
profiles:SiteApp> set desc="Site application"
profiles:SiteApp> add cmd="/opt/site-app/bin/site-cmd"
profiles:SiteApp:site-cmd> add privs="proc_fork,proc_taskid"
profiles:SiteApp:site-cmd> end
profiles:SiteApp> exit
```

To verify, the administrator selects the `site-cmd`.

```
# profiles -p SiteApp "select cmd=/opt/site-app/bin/site-cmd; info;end"
Found profile in files repository.
  id=/opt/site-app/bin/site-cmd
  privs=proc_fork,proc_taskid
```

Next Steps Assign the rights profile to a trusted user or role. For examples, see Example 12, "Creating a Trusted User to Administer DHCP," on page 65 and Example 22, "Enabling a Trusted User to Read Extended Accounting Files," on page 69.

See Also To troubleshoot rights assignment, see "How to Troubleshoot Rights Assignments" on page 148. For background, see "Order of Search for Assigned Rights" on page 43.

▼ How to Clone and Modify a System Rights Profile

Before You Begin You must assume the `root` role. For more information, see "Using Your Assigned Administrative Rights" on page 114.

1. **Create a new rights profile from an existing profile.**

```
# profiles -p [-S repository] existing-profile-name
```

- **To add content to an existing rights profile, create a new profile.**

  Add the existing rights profile as a supplementary rights profile to the new profile, then add the enhancements. See Example 50, “Cloning and Enhancing the Network IPsec Management Rights Profile,” on page 121.

- **To remove content from an existing rights profile, clone the profile and then rename it and modify.**

  See Example 51, “Cloning and Removing Selected Rights From a Rights Profile,” on page 122.

2. **Modify the new rights profile by adding or removing supplementary rights profiles, authorizations, and other rights.**

Example 50 Cloning and Enhancing the Network IPsec Management Rights Profile

In this example, the administrator adds a `solaris.admin.edit` authorization to a site IPsec Management rights profile so that the `root` role is not required. This rights profile will be assigned only to users who are trusted to modify the `/etc/hosts` file.

1. The administrator verifies that the Network IPsec Management rights profile cannot be modified.

```
# profiles -p "Network IPsec Management"
profiles:Network IPsec Management> add auths="solaris.admin.edit/etc/hosts"
Cannot add. Profile cannot be modified
```

2. The administrator creates a rights profile that includes the Network IPsec Management profile.

```
# profiles -p "Total IPsec Mgt"
... IPsec Mgt> set desc="Network IPsec Mgt plus /etc/hosts"
... IPsec Mgt> add profiles="Network IPsec Management"
... IPsec Mgt> add auths="solaris.admin.edit/etc/hosts"
... IPsec Mgt> end
... IPsec Mgt> exit
```

3. The administrator verifies the contents.

```
# profiles -p "Total IPsec Mgt" info
        name=Total IPsec Mgt
        desc=Network IPsec Mgt plus /etc/hosts
        auths=solaris.admin.edit/etc/hosts
```

```
                profiles=Network IPsec Management
```

Example 51 Cloning and Removing Selected Rights From a Rights Profile

In this example, the administrator separates managing the properties of the VSCAN service from the ability to enable and disable the service.

First, the administrator lists the contents of the rights profile that Oracle Solaris provides.

```
# profiles -p "VSCAN Management" info
        name=VSCAN Management
        desc=Manage the VSCAN service
        auths=solaris.smf.manage.vscan,solaris.smf.value.vscan,
              solaris.smf.modify.application
```

Then, the administrator creates a rights profile that can enable and disable the service.

```
# profiles -p "VSCAN Management"
profiles:VSCAN Management> set name="VSCAN Control"
profiles:VSCAN Control> set desc="Start and stop the VSCAN service"
... VSCAN Control> remove auths="solaris.smf.value.vscan"
... VSCAN Control> remove auths="solaris.smf.modify.application"
... VSCAN Control> end
... VSCAN Control> exit
```

Then, the administrator creates a rights profile that can change the properties of the service.

```
# profiles -p "VSCAN Management"
profiles:VSCAN Management> set name="VSCAN Properties"
profiles:VSCAN Properties> set desc="Modify VSCAN service properties"
... VSCAN Properties> remove auths="solaris.smf.manage.vscan"
... VSCAN Properties> end
... VSCAN Properties> exit
```

The administrator verifies the contents of the new rights profiles.

```
# profiles -p "VSCAN Control" info
        name=VSCAN Control
        desc=Start and stop the VSCAN service
        auths=solaris.smf.manage.vscan
# profiles -p "VSCAN Properties" info
        name=VSCAN Properties
        desc=Modify VSCAN service properties
        auths=solaris.smf.value.vscan,solaris.smf.modify.application
```

Next Steps Assign the rights profile to a trusted user or role. For examples, see Example 12, “Creating a Trusted User to Administer DHCP,” on page 65 and Example 22, “Enabling a Trusted User to Read Extended Accounting Files,” on page 69.

See Also To troubleshoot rights assignment, see "How to Troubleshoot Rights Assignments" on page 148. For background, see "Order of Search for Assigned Rights" on page 43.

▼ How to Create an Authorization

Before You Begin Developers have defined and used the authorization in the applications that you are installing. For instructions, see "About Authorizations" in *Developer's Guide to Oracle Solaris 11.4 Security*.

- **Create the authorization by using the `auths add` command.**
  For example, the following command creates the `com.newco.siteapp.data.modify` authorization on the local system.

  ```
  # auths add -t "SiteApp Data Modify Authorized" com.newco.siteapp.data.modify
  ```

  You can now test the authorization, then add it to a rights profile and assign the profile to a role or user.

Example 52 Testing Then Removing an Assigned Authorization

In this example, the administrator tests the `com.newco.siteapp.data.modify` authorization with the SiteApp rights profile from Example 49, "Creating a Rights Profile That Includes Privileged Commands," on page 120.

```
# usermod -A com.newco.siteapp.data.modify -P SiteApp tester1
```

When the test succeeds, the administrator removes the authorization.

```
# rolemod -A-=com.newco.siteapp.data.modify siteapptester
```

For ease of maintenance, the administrator adds the authorization to the SiteApp rights profile in Example 53, "Adding Authorizations to a Rights Profile," on page 123.

Example 53 Adding Authorizations to a Rights Profile

After testing that the authorization works correctly, the security administrator adds the `com.newco.siteapp.data.modify` authorization to an existing rights profile. Example 49, "Creating a Rights Profile That Includes Privileged Commands," on page 120 shows how the administrator created the profile.

```
# profiles -p "SiteApp"
profiles:SiteApp> add auths="com.newco.siteapp.data.modify"
profiles:SiteApp> end
profiles:SiteApp> exit
```

To verify, the administrator lists the contents of the profile.

```
# profiles -p SiteApp
Found profile in files repository.
  id=/opt/site-app/bin/site-cmd
  auths=com.newco.siteapp.data.modify
```

Next Steps Assign the rights profile to a trusted user or role. For examples, see Example 12, “Creating a Trusted User to Administer DHCP,” on page 65 and Example 22, “Enabling a Trusted User to Read Extended Accounting Files,” on page 69.

See Also To troubleshoot rights assignment, see “How to Troubleshoot Rights Assignments” on page 148. For background, see “Order of Search for Assigned Rights” on page 43.

Changing Whether root Is a User or a Role

By default, root is a role in Oracle Solaris. You have the option to change it to a user, change it back in to a role, or remove it from use.

You must change root to a user if you are using Oracle Enterprise Manager or are following the traditional superuser model of administration rather than the rights model. For background, see “Deciding Which Rights Model to Use for Administration” on page 47.

If you are following the rights model, you might change root to a user when decommissioning a system that has been removed from the network. In this scenario, logging in to the system as root simplifies the cleanup.

Note - If you administer remotely with the root role, see “How to Remotely Administer ZFS With Secure Shell” in *Managing Secure Shell Access in Oracle Solaris 11.4* for secure remote login instructions.

At some sites, root is not a legitimate account on production systems. To remove root from use, see Example 55, “Preventing the root Role From Being Used to Maintain a System,” on page 126.

▼ How to Change the root Role Into a User

This procedure is required on systems where root must be able to log in directly to the system.

Before You Begin You must assume the root role.

1. **Remove the `root` role assignment from local users.**
   For example, remove the role assignment from two users.

```
$ su -
Password: xxxxxxxx
# roles jdoe
root
# roles kdoe
root
# roles ldoe
secadmin
# usermod -R "" jdoe
# usermod -R "" kdoe
#
```

2. **Change the `root` role into a user.**

```
# rolemod -K type=normal root
```

   Users who are currently in the `root` role remain so, Other users who have root access can `su` to `root` or log in to the system as the `root` user.

3. **Verify the change.**
   You can use one of the following commands.

   - **Examine the `user_attr` entry for `root`.**

```
# getent user_attr root
root::::auths=solaris.*;profiles=All;audit_flags=lo\:no;lock_after_retries=no;
min_label=admin_low;clearance=admin_high
```

     If the `type` keyword is missing in the output or is equal to `normal`, the account is not a role.

   - **View the output from the `userattr` command.**

```
# userattr type root
```

     If the output is empty or lists `normal`, the account is not a role.

Example 54 Changing the `root` User Into the `root` Role

In this example, the `root` user turns the `root` user back into a role.

First, the `root` user changes the `root` account into a role and verifies the change.

```
# usermod -K type=role root
```

```
# getent user_attr root
root::::type=role...
```

Then, root assigns the root role to a local user.

```
# usermod -R root jdoe
```

Example 55 Preventing the root Role From Being Used to Maintain a System

In this example, site security policy requires that the root account be prevented from maintaining the system. The administrator has created and tested the roles which maintain the system. These roles include every security profile and the System Administrator rights profile. A trusted user has been assigned a role that can restore a backup. No role can change the audit flags for a user, role, or a rights profile or change the password of a role.

To prevent the root account from being used to maintain the system, the security administrator removes the root role assignment. Because the root account must be able to log in to the system in single-user mode, the account retains a password.

```
# usermod -K roles= jdoe
# userattr roles jdoe
```

Troubleshooting In a desktop environment, you cannot directly log in as root when root is a role. A diagnostic message indicates that root is a role on your system.

If you do not have a local account that can assume the root role by performing the following steps:

- As root, log in to the system in single-user mode, create a local user account and password.
- Assign the root role to the new account.
- Log in as the new user and assume the root role.

♦ ♦ ♦ CHAPTER 6

Labeling Processes for Data Loss Protection

This chapter addresses how to access labeled files and file systems on an Oracle Solaris system with a configured label policy. With a label policy, selected files and file systems can be labeled. Only users who have the clearance to handle these labeled files can view or modify them. Even privileged users and roles can be prevented from accessing the contents of labeled files. For information about labeled files and file systems, see Chapter 3, "Labeling Files for Data Loss Protection" in *Securing Files and Verifying File Integrity in Oracle Solaris 11.4*.

This chapter covers the following topics:

About Process Labels and Clearances in Oracle Solaris

Oracle Solaris labels files and processes. The default policy is transparent; the system behaves as if no labels exist. Administrators who create a label policy can assign labels to files to indicate the sensitivity of the information. Typical labels are Public and Confidential - Restricted. The label encodings file defines the labels on your system. For information about creating a label policy and defining labels, see "Overall Process for Configuring Labeling" in *Securing Files and Verifying File Integrity in Oracle Solaris 11.4*.

The label policy includes defining the starting labels of user processes and SMF services. The label encodings file, which defines the labels for your system, also defines the initial label of user processes. The `clearance` value in your encodings file is the label that you decide is suitable for users in the organization, such as Confidential - Internal. The `login_policy/clearance` value in the `account-policy` service is the label that most processes should run at. When you create a label policy, you set the `CLEARANCE` value to `ADMIN_LOW`. After a reboot, user processes start at the `clearance` value in the encodings file and SMF services start at `ADMIN_LOW`. To start authorized users and sensitive processes at higher labels, you configure

authorized users and selected SMF services with higher clearances. For issues to consider when assigning clearances to users and processes, see "Customizing a Label Policy" in *Securing Files and Verifying File Integrity in Oracle Solaris 11.4*.

The default clearance when labels are not configured is the highest label, `ADMIN_HIGH`, so access is not restricted by label.

The value of `clearance` in the encodings file applies to users or roles who do not have an explicit key-value setting for the `clearance` security attribute. The `root` role and the initial account that was created during the installation of Oracle Solaris have an explicit clearance, `ADMIN_HIGH`.

Caution - Never change the explicit `ADMIN_HIGH` clearance of the `root` account.

User processes inherit the clearance of the user's primary login process. To view the clearance of your current process, type `plabel` in a terminal window. You have access to all labels from your clearance to `ADMIN_LOW`. The following example shows what the initial user and `root` see when they run the `plabel` command.

```
$ plabel
ADMIN_HIGH
```

About Access to Labeled Files

Labels on processes are called *clearances*, because they indicate the highest label that the process is cleared for. A clearance indicates the upper bound of a range of labels. Users can access labeled data when the label of their process dominates the label of the file containing the data. Similarly, other processes can access data when the process label dominates the file label. *Dominate* means that the label of the process is at least equal to, and can be higher than, the label of the data. For example, a user whose clearance is Confidential - Restricted can access data at that label and all lower labels, such as Confidential - Internal and Public.

During access attempts, Oracle Solaris translates to and from the textual strings to the internal representation. If a process attempts to translate a label that the process's label does not dominate, the translation is disallowed. The `sys_trans_label` privilege is required to override this restriction.

Regular users inherit the organization's default clearance, so are not cleared to access sensitive data. As the administrator, you assign higher clearances to just those services and users who must access this data. A user clearance is in effect when the user first logs in. Secondary logins, such as assuming a role, retain the clearance from the original login.

Users whose clearance is high can operate at a lower clearance by using the `sandbox` command, which starts a new process at a lower clearance. Processes running in a sandbox are isolated so cannot observe processes outside of the sandbox. For more information and examples, see "Configuring Sandboxes for Project Isolation" on page 132, Example 43, "Protecting Directories on Your System From Application Processes," on page 109, and the `sandbox`(1) and `sandboxing`(7) man pages.

Configuring Users and Processes With Labels

The procedures and examples in *Securing Files and Verifying File Integrity in Oracle Solaris 11.4* include steps where you configure users with the required clearance.

- "How to Assign a Label to a File System" in *Securing Files and Verifying File Integrity in Oracle Solaris 11.4*.
- "How to Isolate a Labeled File System in a Zone" in *Securing Files and Verifying File Integrity in Oracle Solaris 11.4*.
- "How to Create a Labeled Audit Trail" in *Securing Files and Verifying File Integrity in Oracle Solaris 11.4*.

This section covers the following information:

Enabling Access to Labeled Files

As the administrator, you are responsible for assigning the appropriate clearance to users who need access to labeled files. Only users whose clearance is at least equal to the label on the files can view or modify labeled files. All users receive a clearance through the label encodings file. To give them access to sensitive files, you can directly authorize users to have a higher clearance, or you can assign to authorized users a rights profile that contains commands that run at a high clearance. You can also assign to users a role whose rights profiles run commands at a high clearance.

▼ How to Assign Clearances to Users

This procedure shows how to assign a high clearance to users directly, through a rights profile, or through an assigned role.

Before You Begin You must be assigned the User Management rights profile or be in the `root` role. For more information, see "Using Your Assigned Administrative Rights" on page 114.

1. **List the labels that are available on the system.**

   ```
   $ labelcfg list
   label-list-from-highest-to-lowest-label
   ```

2. **Assign specific users or roles the ability to handle labeled files.**

   ```
   # usermod -K clearance=label username
   ```

   ```
   # rolemod -K clearance=label rolename
   ```

   You can also assign a clearance to users indirectly through a rights profile.

3. **Create a rights profile whose commands run at a higher clearance to handle labeled files.**

   The commands must have sufficient privilege in addition to the higher clearance. Sufficient privilege might include a UID or EUID whose clearance is sufficient for the command to run, or a privilege that the command requires.

   The Labeled Audit Review rights profile in the following examples is from "How to Create a Labeled Audit Trail" in *Securing Files and Verifying File Integrity in Oracle Solaris 11.4*. You can assign this rights profile directly to the user or to a role that the user assumes.

   - **To add a rights profile to a user, use the `profiles+=` or `auth_profiles+=` keyword.**

     ```
     # usermod -K profiles+="Labeled Audit Review" username
     # usermod -K auth_profiles+="Labeled Audit Review" username
     ```

   Note - If the user is also assigned the Audit Review rights profile, the Labeled Audit Review profile must precede it.

   - **To add the rights profile to a role and assign the role to a user:**

     a. **Use a `profiles` keyword.**

        ```
        # rolemod -K profiles+="Labeled Audit Review" rolename
        # rolemod -K auth_profiles+="Labeled Audit Review" rolename
        ```

     b. **Assign the role to the user.**

        ```
        # usermod -R +rolename username
        ```

▼ How to Verify User Access to Labeled Files

After assigning clearances to users, you verify that the configuration enables users with clearances to access files at their clearance, and that users without clearances cannot view or back up the files, or view the audit trail of those files.

1. **Become a user with an assigned clearance.**

   ```
   # su - cleared-user
   cleared-user$ plabel
   user's explicit clearance
   ```

2. **Change to the labeled dataset directory.**

   ```
   $ cd labeled-dataset
   ```

   To test a labeled dataset in a zone, see "How to Isolate a Labeled File System in a Zone" in *Securing Files and Verifying File Integrity in Oracle Solaris 11.4*.

3. **Perform tasks that the user would perform.**

   For example:

   - List the files in the directory.
   - Add files to the directory and view the label of the files.
   - Remove files from the directory.
   - Modify a file in the directory.
   - Change to a directory at a different label that is within the user's clearance.
   - Send files to a similarly labeled file system.
   - Change to a different user and try to send the original user's files to an unlabeled file system.

     This test should fail.

   Note - If you are assigned a rights profile that contains commands that run at a higher clearance, you must run those commands in a profile shell, as in `pfexec praudit`.

4. **In the `root` role, examine the audit trail by running the `auditfiles.ksh` script from the `/usr/demo/tsol` directory and then reading the output in your browser.**

   If the audit trail is in a labeled file system, you must have clearance to read `ADMIN_HIGH` files. See "How to Create a Labeled Audit Trail" in *Securing Files and Verifying File Integrity in Oracle Solaris 11.4*. In the following example, a user who is assigned the Labeled Audit Review rights profile executes the command.

   ```
   $ pfexec /usr/demo/tsol/auditfiles.ksh audit-html-file
   ```

Example - Protecting the FTP Service With a Label

In this example you label the FTP service for your organization. The FTP server contains labeled datasets that contain company-internal files that are labeled Confidential - Internal. Users who are cleared for Confidential - Internal files can use `ftp` to transfer those files. Users who are not cleared cannot get the files nor can they see them.

1. On the FTP server, the administrator determines the hexadecimal number of the label at which the FTP service will run and installs the `network/ftp` package.

```
# atohexlabel "Confidential - Internal"
0x0002-08-20

# pkg install network/ftp
```

2. The administrator assigns the hexadecimal number of the "Confidential - Internal" clearance to the start method of the `svc:/network/ftp` service and restarts the service.

```
# svccfg -s ftp
svc:/network/ftp> set start/clearance = astring: 0x0002-08-20
svc:/network/ftp> refresh
svc:/network/ftp> exit

# svcadm restart ftp
```

3. The administrator creates a multilevel dataset and mounts it.

```
# zfs -o multilevel=on rpool/ftp-files
# zfs set mountpoint=/ftpsource rpool/ftp-files
```

4. The administrator transfers datasets that are labeled Confidential - Internal to the new server.

```
rs-sys # zfs send -r rpool/research-intern | ssh ftp1 zfs receive -d rpool/ftp-files
hr-sys # zfs send -r rpool/hr-intern | ssh ftp1 zfs receive -d rpool/ftp-files
tr-sys # zfs send -r rpool/training-intern | ssh ftp1 zfs receive -d rpool/ftp-files
```

5. Before deployment, the administrator tests that users with the Confidential - Internal clearance can get files from the server.

Configuring Sandboxes for Project Isolation

Sandboxes are isolated environments where authorized users can run an application that is protected from other processes on the system. Sandboxes provide security isolation to files,

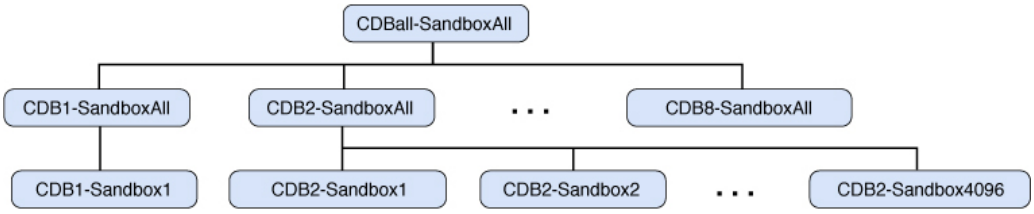
processes, and shared memory; and provide resource isolation to file allocation, memory allocation, and the CPU.

Sandboxes are lightweight. In Oracle Solaris, they are implemented by using labels. Sandboxes isolate applications by restricting the applications' process attributes, such as their clearances and privileges. Regular users can create temporary sandboxes by using the `sandbox` command. Administrators can create persistent, named sandboxes with specific security attributes by using the `sandboxadm` command. Authorized users access their named sandboxes by using the `sandbox` command.

Named sandboxes have hierarchical and disjoint properties that correspond to their clearances. For example, each parent sandbox can have up to 4096 child sandboxes, each of which is isolated from the others. Up to eight disjoint parent sandboxes can be created on a system. In addition, you can create a top-level parent sandbox which dominates every other sandbox. Named sandboxes also have an associated user ID, primary and supplementary group IDs, and projects. You as the administrator must be assigned the Sandbox Management rights profile to create and configure named sandboxes.

In the following sample hierarchy, CDBall-SandboxAll is the top-level parent sandbox. It has two disjoint child sandboxes, CDB1-SandboxAll and CDB2-SandboxAll. The ellipses indicate that the top-level parent can have more children. Each child sandbox has named children and can have more, up to 4096. As you traverse the tree from the top-level parent to the child sandboxes, process privileges and clearances are reduced. The child sandboxes are for operations that require fewer privileges than are granted to the top level. Each sandbox has a unique project name associated with it and can have resources assigned to it.

FIGURE 4 Sample Sandbox Hierarchy



You can use the `sandbox` command to enter either temporary or named sandboxes. Although this command is unprivileged, the security attributes of the invoking process must be consistent with the security attributes of the target sandbox. For example, the current process clearance must dominate the target sandbox clearance. Before you enter a sandbox, you should set the current working directory to a directory whose label is dominated by the target sandbox. For more information, see the `sandbox(1)` man page.

To enter a named parent sandbox, the current effective UID must match the UID that is assigned to the target sandbox. Before entering a named child sandbox, the caller must previously have entered its parent sandbox. After you enter a sandbox, the process project is set to that of the sandbox and the clearance is set to the clearance of the sandbox. For more information, see the `sandbox_create`(3SANDBOX) man page.

You use the `sandboxadm` command to create named sandboxes. This command works with a special version of the encodings file, "Sandbox Labels v1.0". For information about installing and using this file, see the `sandboxadm`(8) man page.

When you use the `sandboxadm` command to create named sandboxes, the relationships you specify enable the command to automatically assign the appropriate clearance to the sandbox. Parent sandboxes must be created prior to creating any of their child sandboxes. If a parent sandbox is specified, then the new sandbox is assigned a clearance which is dominated by the parent sandbox, and disjoint from every other sandbox except the top-level sandbox. Although each child sandbox must have a unique username, multiple parent sandboxes can be owned by the same user. In that case, the clearance of that user is automatically set to a clearance that dominates all of the sandboxes that the user owns.

Each named sandbox also has a corresponding project of the same name which is automatically applied when the sandbox is entered. The user associated with the named sandbox is automatically assigned to that project. Resource management attributes can be assigned to sandboxes through the `projmod` command.

Processes within a child sandbox can not observe any processes outside of their sandbox. Processes in parent sandboxes can only observe processes in their own sandbox and those of their children. Similarly, file access is restricted so that only files and directories that are dominated by the sandbox clearance are visible. Shared memory that has been labeled by the `shmctl` system call can be also be isolated to individual sandboxes.

Preparing for Persistent Sandboxes

Named sandboxes provide persistent sandboxes that authorized users can log in to when performing operations that do not require the level of privilege that these users are assigned by default. In a labeled environment that is not designed for sandboxes, authorized users can use the `sandbox` command to create sandboxes to run applications or processes at a lower clearance, but these sandboxes do not persist after the session is closed.

Persistent, named sandboxes require you to configure a special label encodings file. Then, you or the user whom you authorize to access a sandbox must create directories on a file system at the label of the sandbox. Only one user can access a sandbox – it is an isolated environment for that user. For information about creating labeled directories and file systems, see Chapter

3, “Labeling Files for Data Loss Protection” in *Securing Files and Verifying File Integrity in Oracle Solaris 11.4*.

♦ ♦ ♦ CHAPTER 7

Listing Rights in Oracle Solaris

This chapter describes how to list all rights on the system, rights that are assigned to specific users, and your own rights:

For an overview of rights, see "User Rights Management" on page 21. For reference information, see Chapter 9, "Reference for Oracle Solaris Rights".

Listing Rights and Their Definitions

The commands in this section enable you to find rights that are defined on the system, and list the rights that are in effect on a user's process.

For a full description of the commands in this section, see the following man pages:

- `auths`(1)
- `getent`(8)
- `ppriv`(1)
- `profiles`(1)
- `privileges`(7)
- `roles`(1)
- `useradm`(8)

Listing All Rights Assigned to a User

Note - `useradm` is the CLI for the User Manager GUI. Load the `useradm` package to access this command.

- `useradm list` *username* – Lists the direct rights assignments of *username*
- `useradm list -S [files|ldap]` *username* – Lists the direct rights assignments of *username* in the specified naming service.
- `useradm list -q` *qualifier username* – Lists the qualified attributes of *username*

EXAMPLE 56 Listing a User's Rights in LDAP

This user has different rights in LDAP and in files. For comparison, see Example 57, “Listing a Local User's Rights,” on page 138.

```
$ useradm list -S ldap jdoe
inactive = 0
userID = 1234
groupName = staff
defaultShell = /bin/bash
username = jdoe
description = Jane Doe
groups  =
        docusers
        test_src
        web_publish
accountStatus = Unknown
homeDirectory = /home/jdoe
groupID = 123
```

EXAMPLE 57 Listing a Local User's Rights

This user has different rights in files and in LDAP. For comparison, see Example 56, “Listing a User's Rights in LDAP,” on page 138.

```
$ useradm -S files jdoe
inactive = 0
Profiles  =
        Compliance Assessor
userID = 1234
groupName = staff
defaultShell = /bin/bash
```

```
username = jdoe
description = Jane Doe
accountStatus = Unknown
homeDirectory = /home/jdoe
groupID = 123
```

Listing Authorizations

- `auths` – Lists the current user's authorizations
- `auths list` – Lists the current user's authorizations, one authorization per line
- `auths list -u` *username* – Lists the authorizations for *username*
- `auths list -x` – Lists the current user's authorizations that require authentication
- `auths list -xu` *username* – Lists the *username*'s authorizations that require authentication
- `auths info` – Lists all authorization names in the naming service
- `getent auth_attr` – Lists the full definition of all authorizations in the naming service

EXAMPLE 58 Listing All Authorizations

```
$ auths info
    solaris.account.activate
    solaris.account.setpolicy
    solaris.admin.edit
...
    solaris.zone.login
    solaris.zone.manage
```

EXAMPLE 59 Listing the Content of the Authorizations Database

```
$ getent auth_attr | more
solaris.:::All Solaris Authorizations::
solaris.account.:::Account Management::
...
solaris.zone.login:::Zone Login::
solaris.zone.manage:::Zone Deployment::
```

EXAMPLE 60 Listing the Default Authorizations of Users

The following authorizations are included in the rights profiles that are assigned to all users by default.

```
$ auths
solaris.device.cdrw,solaris.device.mount.removable,solaris.mail.mailq
solaris.network.autoconf.read,solaris.admin.wusb.read
solaris.smf.manage.vbiosd,solaris.smf.value.vbiosd
```

Listing Rights Profiles

- `profiles` – Lists the current user's rights profiles
- `profiles -a` – Lists all rights profiles names
- `profiles -l` – Lists the full definition of the current user's rights profiles
- `profiles` *username* – Lists the rights profiles for *username*
- `profiles -x` – Lists the current user's rights profiles that require authentication
- `profiles -x` *username* – Lists the *username*'s rights profiles that require authentication
- `profiles -p` *profile-name* `info` – Pretty prints the contents of specified rights profile
- `getent prof_attr` – Lists the full definition of all rights profiles in the naming service

EXAMPLE 61 Listing the Names of All Rights Profiles

```
$ profiles -a
        Console User
        CUPS Administration
        Desktop Removable Media User
...
        VSCAN Management
        WUSB Management
```

EXAMPLE 62 Listing the Contents of the Rights Profiles Database

```
$ getent prof_attr | more
All:::Execute any command as the user or role:
Audit Configuration:::Configure Solaris Audit:auths=solaris.smf.value.audit;
...
Zone Management:::Zones Virtual Application Environment Administration:
Zone Security:::Zones Virtual Application Environment Security:auths=solaris.zone.*,
solaris.auth.delegate;...
```

EXAMPLE 63 Listing the Default Rights Profiles of Users

List your rights profiles. The following rights profiles are assigned to all users by default.

```
$ profiles
Basic Solaris User
All
```

EXAMPLE 64 Listing the Rights Profiles of the Initial User

The initial user is assigned several rights profiles.

```
$ profiles Initial user
System Administrator
Audit Review
...
CPU Power Management
Basic Solaris User
All
```

To show all the security attributes that are assigned to the initial user's profiles, use the `-l` option.

```
$ profiles -l Initial user | more
Initial user:
System Administrator
 profiles=Install Service Management,Audit Review,Extended Accounting
Flow Management,Extended Accounting Net Management,Extended Accounting Process
Management,Extended Accounting Task Management,Printer Management,Cron Management,
Device Management,File System Management,Log Management,Mail Management,
Maintenance and Repair,Media Catalog,Name Service Management,Network Management,
Project Management,RAD Management,Service Operator,Shadow Migration Monitor,
Software Installation,System Configuration,User Management,ZFS Storage Management
          /usr/sbin/gparted          uid=0
Install Service Management
 auths=solaris.autoinstall.service
 profiles=Install Manifest Management,Install Profile Management,
Install Client Management
...
```

EXAMPLE 65 Listing the Contents of an Assigned Rights Profile

The initial user lists the rights that are granted by the Audit Review profile.

```
$ profiles -l
Audit Review
  solaris.audit.read

  /usr/sbin/auditreduce  euid=0
  /usr/sbin/auditstat    privs=proc_audit
  /usr/sbin/praudit      privs=file_dac_read
```

EXAMPLE 66 Listing the Security Attributes of a Command in a Rights Profile

This variant of the `profiles` command is useful for viewing the security attributes of a command in a rights profile that is not assigned to you.

First, list the commands in the profile.

```
$ profiles -p "Audit Review" info
 name=Audit Review
 desc=Review Solaris Auditing logs
 cmd=/usr/sbin/auditreduce
 cmd=/usr/sbin/auditstat
 cmd=/usr/sbin/praudit
```

Then, list the security attributes of one of the commands in the profile.

```
$ profiles -p "Audit Review" "select cmd=/usr/sbin/praudit ; info; end;"
select: command is read-only
 id=/usr/sbin/praudit
 privs=file_dac_read
end: command is read-only
```

EXAMPLE 67 Listing the Contents of Rights Profiles That Are Recently Created

The `less` option displays the most recently added rights profiles first. This variant of the `profiles` command is useful when you create or modify rights profiles at your site. The following output shows the contents of the profile that was added in Example 38, “Assigning Security Attributes to a Legacy Application,” on page 99. A regular user can run this command.

```
$ profiles -la | less
LegacyApp
          /opt/legacy-app/bin/legacy-cmd
                                     euid=0
OpenLDAP...
```

Listing Roles

- `roles` – Lists the current user's roles
- `roles` *username* – Lists the roles for *username*
- `logins -r` – Lists all available roles

EXAMPLE 68 Listing Your Assigned Roles

The `root` role is assigned to the initial user by default. `No roles` indicates that you are not assigned a role.

```
$ roles
root
```

Listing Privileges

- `man privileges` – Lists privilege definitions and their names as they are used by developers
- `ppriv -vl` – Lists privilege definitions and their names as they are used by administrators
- `ppriv -vl basic` – Lists names and definitions of privileges in the basic set of privileges
- `ppriv $$` – Lists the privileges in the current shell (`$$`)
- `getent exec_attr` – Lists all commands that have security attributes (`setuid` or privileges) by rights profile name

```
$ getent exec_attr | more
All:solaris:cmd:::*:
Audit Configuration:solaris:cmd:::/usr/sbin/auditconfig:privs=sys_audit
...
Zone Security:solaris:cmd:::/usr/sbin/txzonemgr:uid=0
Zone Security:solaris:cmd:::/usr/sbin/zonecfg:uid=0 ...
```

EXAMPLE 69 Listing All Privileges and Their Definitions

The privilege format described in the `privileges(7)` man page is used by developers.

```
$ man privileges
Standards, Environments, and Macros                privileges(7)

NAME
     privileges - process privilege model
...
     The defined privileges are:

     PRIV_CONTRACT_EVENT

         Allow a process to request reliable delivery  of  events
         to an event endpoint.

         Allow a process to include events in the critical  event
```

```
         set  term  of  a  template  which  could be generated in
         volume by the user.
...
```

EXAMPLE 70 Listing Privileges That Are Used in Privilege Assignment

The `ppriv` command lists all privileges by name. For a definition, use the `-v` option.

This privilege format is used to assign privileges to users and roles with the `useradd`, `roleadd`, `usermod`, and `rolemod` commands, and to rights profiles with the `profiles` command.

```
$ ppriv -lv | more
contract_event
 Allows a process to request critical events without limitation.
 Allows a process to request reliable delivery of all events on
 any event queue.
...
win_upgrade_sl
        Allows a process to set the sensitivity label of a window
        resource to a sensitivity label that dominates the existing
        sensitivity label.
        This privilege is interpreted only if the system is configured
        with Trusted Extensions.
```

EXAMPLE 71 Listing the Privileges in Your Current Shell

Every user is assigned the basic privilege set by default. The default limit set is all privileges.

The single letters in the output refer to the following privilege sets:

`E` Effective privilege set

`I` Inheritable privilege set

`P` Permitted privilege set

`L` Limit privilege set

```
$ ppriv $$
1200:   -bash
flags = <none>
        E: basic
        I: basic
        P: basic
```

```
       L: all
$ ppriv -v $$
1200:   -bash
flags = <none>
 E: file_link_any,file_read,file_write,net_access,proc_exec,proc_fork,
          proc_info,proc_self, proc_session,sys_ib_info
 I: file_link_any,file_read,...,sys_ib_info
 P: file_link_any,file_read,...,sys_ib_info
 L: contract_event,contract_identity,...,sys_time
```

The double dollar sign (`$$`) passes the process number of the parent shell to the command. This listing does not include privileges that are restricted to commands in an assigned rights profile.

EXAMPLE 72 Listing the Basic Privileges and Their Definitions

```
$ ppriv -vl basic
file_link_any
 Allows a process to create hardlinks to files owned by a uid
 different from the process' effective uid.
file_read
 Allows a process to read objects in the filesystem.
file_write
 Allows a process to modify objects in the filesystem.
net_access
 Allows a process to open a TCP, UDP, SDP or SCTP network endpoint.
proc_exec
 Allows a process to call execve().
proc_fork
 Allows a process to call fork1()/forkall()/vfork()
proc_info
 Allows a process to examine the status of processes other
 than those it can send signals to.  Processes which cannot
 be examined cannot be seen in /proc and appear not to exist.
proc_self
 Allows a process to access files under /proc, including /proc/self.
proc_session
 Allows a process to send signals or trace processes outside its
 session.
sys_ib_info
 Allows a process to perform read InfiniBand MAD (Management Datagram)
 operations.
```

EXAMPLE 73 Listing the Commands With Security Attributes in Your Rights Profiles

The Basic Solaris User profile includes commands that enable users to read and write to CD-ROMs.

```
$ profiles -l
  Basic Solaris User
...
   /usr/bin/cdrecord.bin   privs=file_dac_read,sys_devices,
     proc_lock_memory,proc_priocntl,net_privaddr
   /usr/bin/readcd.bin     privs=file_dac_read,sys_devices,net_privaddr
   /usr/bin/cdda2wav.bin   privs=file_dac_read,sys_devices,
     proc_priocntl,net_privaddr
  All
   *
```

Listing Qualified Attributes

- `man user_attr` – Defines qualifiers of security attributes
- `getent` – Lists qualified security attributes of a user or role on the system where the command is run
- `ldapaddent` – Lists all qualified security attributes of a user or role

EXAMPLE 74 Listing a User's Qualified Attributes on This System

```
system1$ getent user_attr | grep jdoe:
jdoe:system1:::lock_after_retries=no;profiles=System Administrator
```

EXAMPLE 75 Listing All Qualified Attributes for a User in LDAP

```
system1$ ldapaddent -d user_attr | grep ^jdoe:
jdoe:system1:::lock_after_retries=no;profiles=System Administrator
jdoe:sysopgroup:::lock_after_retries=no;profiles=System Operator
```

♦ ♦ ♦ CHAPTER 8

Troubleshooting Rights in Oracle Solaris

This chapter provides troubleshooting suggestions when managing and using administrative rights in Oracle Solaris:

- "Troubleshooting RBAC and Privileges" on page 147
- "Troubleshooting Passwords" on page 156

For information about using rights, review the following information:

- Chapter 3, "Assigning Rights in Oracle Solaris"
- "Who Can Assign Rights" on page 52
- "User Rights Management" on page 21
- "Process Rights Management" on page 30

For information about passwords, see "Special System Accounts" in *Securing Systems and Attached Devices in Oracle Solaris 11.4* and the `passwd`(1) and `user_attr`(5) man pages.

Troubleshooting RBAC and Privileges

The tasks and examples in this section suggest ways to solve problems with rights assignments. For background information, see "Rights Verification" on page 42.

Use the command-line interfaces to assign rights. The following commands modify the rights databases:

- `passwd`
- `useradd`, `usermod`, and `userdel`
- `roleadd`, `rolemod`, and `roledel`
- `profiles`
- `auths`

Caution - Do not use an editor to modify a rights database. The editor cannot check for syntax validity or update kernel processes.

How to Troubleshoot Rights Assignments

Several factors can affect why rights are not being evaluated and correctly applied. This procedure helps you debug why assigned rights might not be available to users, roles, or processes. Several of the steps are based on "Order of Search for Assigned Rights" on page 43.

Before You Begin You must assume the `root` role. For more information, see "Using Your Assigned Administrative Rights" on page 114.

1. **Verify and restart the naming service.**

   a. **Verify that the security assignments for the user or role are in the naming service that is enabled on the system.**

   ```
   # svccfg -s name-service/switch

   svc:/system/name-service/switch>
   listprop config

   config                      application
   config/value_authorization  astring  solaris.smf.value.name-service.switch
   config/default              astring  files ldap
   config/host                 astring  "files dns mdns ldap"
   config/netgroup             astring  ldap
   config/printer              astring  "user files"
   ```

   In this output, all services that are not explicitly mentioned inherit the value of the default, `files ldap`. Therefore, `passwd` and its related attribute databases, `user_attr`, `auth_attr`, and `prof_attr`, are searched first in files, then in LDAP.

   b. **Restart the name service cache, `svc:/system/name-service/cache`.**

   The `nscd` daemon can have a lengthy time-to-live interval. By restarting the daemon, you update the naming service with current data.

   ```
   # svcadm restart name-service/cache
   ```

2. **Determine where a right is assigned to the user by running the `userattr -v` command.**

   Run the command once for every attribute. For example, the following commands indicate which rights are assigned and where the assignment was made for the user `jdoe`. The lack of output indicates that `jdoe` is using the defaults.

   ```
   $ userattr -v access_times jdoe
   ```

```
$ userattr -v access_tz jdoe
$ userattr -v annotation jdoe
$ userattr -v auth_profiles jdoe
$ userattr -v defaultpriv jdoe
$ userattr -v limitpriv jdoe
$ userattr -v idlecmd jdoe
$ userattr -v idletime jdoe
$ userattr -v lock_after_retries jdoe
$ userattr -v pam_policy jdoe
$ userattr -v unlock_after jdoe

$ userattr -v auths jdoe      Output indicates authorizations from rights profiles
Basic Solaris User :solaris.mail.mailq,solaris.network.autoconf.read,
solaris.admin.wusb.read
Console User :solaris.system.shutdown,solaris.device.cdrw,
solaris.device.mount.removable,solaris.smf.manage.vbiosd,solaris.smf.value.vbiosd
$ userattr -v audit_flags jdoe
user_attr: fw:no      Output indicates jdoe is individually assigned audit flags
$ userattr -v profiles jdoe
user_attr: Audit Review,Stop      Output indicates two assigned rights profiles
$ userattr roles jdoe
user_attr : cryptomgt,infosec      Output indicates two assigned roles
```

The output indicates that `jdoe` is directly assigned audit flags, two rights profiles, and two roles. The assigned authorizations are from default rights profiles, set either in the `account-policy` SMF stencil or in files in the `/etc` directory. To determine the source of the default rights profiles on your system, see "New Feature – Enabling the `account-policy` Service" on page 86.

- Because `jdoe` is directly assigned audit flags, no audit flag values in the rights profiles will be used.
- The rights profiles are evaluated in order, first the Audit Review rights profile, then the Stop profile.
- All other rights are assigned to `jdoe` in the roles `cryptomgt` and `infosec`. To view those rights, `jdoe` must assume each role, then list the rights.

Tip - If the `useradm` package is installed, you can run the `useradm list jdoe` command to view the rights that are directly assigned. See "Listing All Rights Assigned to a User" on page 138.

If the right is not directly assigned to the user, continue with the following checks.

3. Verify that the assigned authorizations are spelled correctly.

The source of an authorization assignment is not important because authorizations accumulate for users. However, a misspelled authorization fails silently.

4. **For rights profiles that you have created, verify that you have assigned the appropriate security attributes to the commands in that profile.**

   For example, some commands require `uid=0` rather than `euid=0` to succeed. Review the man page for the command to determine whether the command or any of its options require authorizations.

5. **Check the rights in the user's rights profiles.**

   a. **In order, check for the rights in the list of authenticated rights profiles.**

      The value of the attribute in the earliest rights profile in the list is the value in the kernel. If this value is incorrect, either change the value in that rights profile, or reassign the profiles in the correct order. See "How to Reorder Assigned Rights" on page 152.

      For privileged commands, check that the privileges are not removed from the `defaultpriv` or `limitpriv` keyword.

   b. **In order, check for the rights in the list of regular rights profiles.**

      Follow the same checks as you performed for authenticated rights profiles.

   c. **If the rights you are searching for are not listed, check the roles that the user is assigned.**

      If the right is assigned to a role, the user must assume the role to obtain the rights.

6. **Check whether a failed command requires authorizations to succeed.**

   a. **Check whether an existing rights profile includes the required authorization.**

      If the profile exists, use it. Assign it to the user as an authenticated rights profile or a regular rights profile. Order the profile before any other rights profile that includes the command that requires this authorization to succeed.

   b. **Check whether an option to the command requires authorization.**

      Assign the privilege to the command that requires it, add the required authorizations, place the command and authorizations in a rights profile, and assign the profile to the user.

7. **If a command continues to fail for a user, verify that the user is executing the command in a profile shell.**

   Administrative commands must be executed in a profile shell. Example 76, "Determining Whether You Are Using a Profile Shell," on page 151 shows how to test for a profile shell.

   To reduce the likelihood of user error, you can try the following:

   - Assign a profile shell as the user's login shell.

- Instruct users to precede all privileged commands with the `pfexec` command.
- Remind the user to run administrative commands in a profile shell.
- If your site is using roles, remind the user to assume the role before running administrative commands. For an example of successful command execution as a role rather than as a user, see Example 78, “Running the Privileged Commands in Your Role,” on page 152.

8. **If a command fails for a role, assume the role and perform the same steps that you performed when checking for a user's rights.**

Example 76 Determining Whether You Are Using a Profile Shell

When a privileged command does not work, the user tests for the `PRIV_PFEXEC` flag, then runs the command. The error message might not indicate that the problem is a privilege problem.

```
$ praudit 20120814200247.20120912213421.example-system
praudit: Cannot associate stdin with 20120814200247.20120912213421.example-system:
Permission denied

$ ppriv $$
107219: bash
flags = <none>
...

$ pfbash
$ ppriv $$
1072232: bash
flags = PRIV_PFEXEC
...

$ praudit 20120814200247.20120912213421.example-system
     /** Command succeeds **/
```

Example 77 Determining the Privileged Commands of a Role

In this example, a user assumes an assigned role and lists the rights that are included in one of the rights profiles. The rights are truncated to emphasize the commands.

```
$ roles
devadmin

$ su - devadmin
Password: xxxxxxxx

$ profiles -l
Device Security
```

```
       ...
profiles=Service Configuration
         /usr/sbin/add_drv          uid=0
         /usr/sbin/devfsadm         uid=0
                                    privs=sys_devices,sys_config,
                                          sys_resource,file_owner,
                                          file_chown,file_chown_self,
                                          file_dac_read
         /usr/sbin/eeprom           uid=0
         /usr/bin/kbd
         /usr/sbin/list_devices     euid=0
         /usr/sbin/rem_drv          uid=0
         /usr/sbin/strace           euid=0
         /usr/sbin/update_drv       uid=0
         /usr/sbin/add_allocatable  euid=0
         /usr/sbin/remove_allocatable   euid=0
Service Configuration
         /usr/sbin/svcadm
         /usr/sbin/svccfg
```

Example 78 Running the Privileged Commands in Your Role

In the following example, the `admin` role can change the permissions on the `useful.script` file.

```
$ whoami
jdoe
$ ls -l useful.script
-rwxr-xr-- 1 elsee eng 262 Apr 2 10:52 useful.script

$ chgrp admin useful.script
chgrp: useful.script: Insufficient privileges

$ su - admin
Password: xxxxxxxx

$ chgrp admin useful.script
$ chown admin useful.script
$ ls -l useful.script
-rwxr-xr-- 1 admin admin 262 Apr 2 10:53 useful.script
```

▼ How to Reorder Assigned Rights

You must reorder a user's rights profiles assignments when an unprivileged command is in effect for the user rather than its privileged version. For more information, see “Order of Search for Assigned Rights” on page 43.

Before You Begin You must become an administrator who is assigned the User Security rights profile. For more information, see "Using Your Assigned Administrative Rights" on page 114.

1. **View the list of rights profiles that are currently assigned to the user or role.**
   The list displays in order.

   ```
   $ profiles username | rolename
   ```

2. **Assign the rights profiles in the correct order.**

   ```
   # usermod | rolemod -K profiles="list-of-profiles"
   ```

Example 79 Assigning Rights Profiles in a Specific Order

In this example, the administrator determines that a rights profile with privileged commands is listed after the All rights profile for the role `devadmin`.

```
# profiles devadmin

    Basic Solaris User
    All
    Device Management
```

Therefore, the `devadmin` role cannot run the device management commands with the role's assigned privileges.

The administrator reassigns the rights profiles to `devadmin`. In the new order of assignment, the device management commands run with their assigned privileges.

```
# rolemod -K profiles="Device Management,Basic Solaris User,All"

# profiles devadmin

    Device Management
    Basic Solaris User
    All
```

How to Determine Which Privileges a Program Requires

Use this debugging procedure when a command or process is failing. After finding the first privilege failure and fixing it, you might need to run the `ppriv -eD` *command* command again to find additional privilege requirements.

1. **Type the command that is failing as an argument to the `ppriv` debugging command.**

```
$ ppriv -eD touch /etc/acct/yearly

touch[5245]: missing privilege "file_dac_write"
     (euid = 130, syscall = 224) needed at zfs_zaccess+0x258
touch: cannot create /etc/acct/yearly: Permission denied
```

2. **Use the `syscall` number from the debugging output to determine which system call is failing.**

   You find the name of the `syscall` number in the `/etc/name_to_sysnum` file.

```
$ grep 224 /etc/name_to_sysnum

creat64                 224
```

   In this example, the `creat64()` call is failing. To succeed, the process must be assigned the right to create a file in the `/etc/acct/yearly` directory.

Example 80 Using the `truss` Command to Examine Privilege Use

The `truss` command can debug privilege use in a regular shell. For example, the following command debugs the failing `touch` process:

```
$ truss -t creat touch /etc/acct/yearly

creat64("/etc/acct/yearly", 0666)
                        Err#13 EACCES [file_dac_write
]
touch: /etc/acct/yearly cannot create
```

The extended `/proc` interfaces report the missing `file_dac_write` privilege after the error code in `truss` output.

Example 81 Using the `ppriv` Command to Examine Privilege Use in a Profile Shell

In this example, the `jdoe` user can assume the role `objadmin`. The `objadmin` role includes the Object Access Management rights profile. This rights profile allows the `objadmin` role to change permissions on files that `objadmin` does not own.

In the following excerpt, `jdoe` fails to change the permissions on the `useful.script` file:

```
jdoe$ ls -l useful.script
```

```
-rw-r--r--  1 aloe  staff  2303 Apr 10 10:10 useful.script
jdoe$
chown objadmin useful.script

chown: useful.script: Insufficient privileges
jdoe$
ppriv -eD chown objadmin useful.script

chown[11444]: missing privilege "file_chown"
            (euid = 130, syscall = 16) needed at zfs_zaccess+0x258
chown: useful.script: Insufficient privileges
```

When `jdoe` assumes the `objadmin` role, the permissions on the file are changed:

```
jdoe$ su - objadmin
Password: xxxxxxxx

$ ls -l useful.script
-rw-r--r--  1 aloe  staff  2303 Apr 10 10:10 useful.script

$ chown objadmin useful.script
$ ls -l useful.script
-rw-r--r--  1 objadmin  staff  2303 Apr 10 10:10 useful.script
$ chgrp admin useful.script

$ ls -l objadmin.script
-rw-r--r--  1 objadmin  admin  2303 Apr 10 10:11 useful.script
```

Example 82 Changing a File Owned by the `root` User

This example illustrates the protections against privilege escalation. For a discussion, see "Privilege Escalation and Kernel Privileges" on page 41. The file is owned by the `root` user. The less powerful role, `objadmin` role needs all privileges to change the file's ownership, so the operation fails.

```
jdoe$ su - objadmin
Password: xxxxxxxx

$ cd /etc; ls -l system
-rw-r--r--  1 root  sys   1883 Oct 10 10:20 system

$ chown objadmin system
chown: system: Insufficient privileges
$ ppriv -eD chown objadmin system
chown[11481]: missing privilege "ALL"
     (euid = 101, syscall = 16) needed at zfs_zaccess+0x258
chown: system: Insufficient privileges
```

Troubleshooting Passwords

The following examples suggest ways to debug problems with passwords. For background information, see the passwd(1) and user_attr(5) man pages.

EXAMPLE 83 Using the openldap System Account to Run a cron Job

In this example, the administrator changes the password string for an Oracle Solaris-delivered system account from *LK* to NP. The account runs a cron job that updates the data in the directory periodically with an external data source over a UNIX domain socket that is locked down to the openldap user only.

Initially, the openldap account is locked. The time that the password was locked is 12111.

```
# grep openldap /etc/shadow
openldap:*LK*:12111::::::
# passwd -N openldap
WARNING: changing account in reserved uid range: openldap.
passwd: password information changed for openldap
```

The -N makes the password entry a value that cannot be used for login with UNIX authentication.

```
# passwd -u openldap
WARNING: changing account in reserved uid range: openldap.
passwd: password information changed for openldap
```

The -u option unlocks the account. The account remains a non-UNIX authentication account.

```
# grep openldap /etc/shadow
openldap:NP:13222::::::
```

In the final entry, the openldap non-UNIX authentication account has no password. The account is protected by the locked-down UNIX domain socket.

EXAMPLE 84 Creating a Role That Requires the User's Password

This example shows how to configure administrative accounts to be authenticated with the user's password, similar to the way the sudo user is configured. In the root role, you create the user and the role, make the role require the user password, and assign the role to the user.

```
# useradd [ ... ] jdoe
# roleadd [ ... ] administrator
```

```
# rolemod -K roleauth=user administrator
# usermod -K type=role administrator jdoe
```

EXAMPLE 85 Overriding the Password Requirements for an Account

In this example, the `root` role changes a password several times, overriding the password constraints.

```
# passwd -n 14 -x 25 user1
```

The `/etc/shadow` entry resembles the following:

```
user1:$5$Cuz1WCgx$4CFN...:last-changed-date:14:25::::
```

The administrator in the `root` role is able to change the password several times the same day:

```
# passwd user1
Enter user1's password: password
# grep user1 /etc/shadow
user1:$5$Cuz1WCgx$4CFN...:11333:14:25::::
# passwd user1
Enter user1's password: password
user1:$5$Cuz1WCgx$4CFN...:11444:14:25::::
```

Because the `root` role has the `solaris.passwd.assign` authorization, `root` can override the password constraints of a minimum of 14 days between password changes (`-n 14`) and a maximum of 25 days (`-x 25`). `user1`, who does not have the `solaris.passwd.assign` authorization, cannot change the assigned password for at least two weeks. As the following shows, the user also cannot change another user's password:

```
$ passwd user2
Enter user1's password: password
Permission denied: Missing authorization: solaris.passwd.assign
```

♦ ♦ ♦ CHAPTER 9

Reference for Oracle Solaris Rights

This chapter provides reference material about the use of administrative rights in Oracle Solaris:

For information about using rights, including privileges, see Chapter 3, "Assigning Rights in Oracle Solaris". For overview information, see "User Rights Management" on page 21 and "Process Rights Management" on page 30.

`account-policy` SMF Stencil

Enabling the `account-policy` service and specific security attributes is the preferred method of managing security attributes for your system. When the `account-policy` service is in effect, the databases that are described in this chapter might not reflect the current security policy.

Oracle Solaris loads but does not enable the `account-policy` SMF stencil at boot time. After you enable the `account-policy` service and enable the security attributes that your site security policy requires be different from the default, all system security attributes are SMF properties whose values can be viewed by the `svcprop` command. Security attributes that are enabled in the `account-policy` service can be modified.

Note - The files that list security attributes, such as `/etc/policy.conf` and `/etc/default/login`, might no longer reflect existing security policy. Also, modifying the contents of those files has no effect on security policy.

The following command indicates whether the administrator has enabled the `account-policy` service and a particular property can be modified:

```
$ svcs account-policy
$ svcprop -p config/ -s account-policy
```

`online` indicates that the service is enabled.

To display the value of a security attribute, use the following syntax:

```
$ svcprop -p property account-policy:default
```

For a list of security attributes in SMF and their corresponding names in the `/etc` files, see "Security Attributes in Files and Their Corresponding SMF Properties" on page 171 man page.

Rights Profiles Reference

This section describes some typical rights profiles. Rights profiles are convenient collections of authorizations and other security attributes, commands with security attributes, and supplementary rights profiles. Oracle Solaris provides many rights profiles. If they are not sufficient for your needs, you can modify existing ones and create new ones.

Rights profiles must be assigned in order, from most to least powerful. For more information, see "Order of Search for Assigned Rights" on page 43.

To view the contents of the following rights profiles, see "Viewing the Contents of Rights Profiles" on page 161.

- **System Administrator rights profile –** Provides access to most tasks that are not connected with security. This profile includes several other profiles to create a powerful role. Note that the All rights profile is assigned at the end of the list of supplementary rights profiles.
- **Operator rights profile –** Provides limited rights to manage files and offline media. This profile includes supplementary rights profiles to create a simple role.
- **Printer Management rights profile –** Provides a limited number of commands and authorizations to handle printing. This profile is one of several profiles that cover a single area of administration.
- **Basic Solaris User rights profile –** Enables users to use the system within the bounds of security policy. This profile is the default users' rights profile. Note that the convenience that the Basic Solaris User rights profile provides must be balanced against site security requirements. Sites that need stricter security might prefer to remove this profile or assign

the Stop rights profile. For the implementation of the Basic Solaris User rights profile, see Example 73, “Listing the Commands With Security Attributes in Your Rights Profiles,” on page 145.

- **Console User rights profile –** For the workstation owner, provides access to authorizations, commands, and actions for the person who is seated at the computer.
- **All rights profile –** For roles, provides access to commands that do not have security attributes. This profile can be appropriate for users with limited rights.
- **Stop rights profile –** A special rights profile that stops the evaluation of later profiles. This profile also prevents the evaluation of the `AUTHS_GRANTED`, `PROFS_GRANTED`, and `CONSOLE_USER` security attributes. With the Stop profile, you can provide roles and users with a restricted profile shell.

Note - The Stop profile affects privilege assignment indirectly. Rights profiles that are listed after the Stop profile are not evaluated. Therefore, the commands with privileges in those profiles are not in effect. See Example 31, “Restricting an Administrator to Explicitly Assigned Rights,” on page 84.

Viewing the Contents of Rights Profiles

You have three views into the contents of rights profiles:

- The `getent` command enables you to view the contents of all of the rights profiles on the system. For sample output, see Chapter 7, “Listing Rights in Oracle Solaris”.
- The `profiles -p "`*Profile Name*`" info` command enables you to view the contents of a specific rights profile.
- The `profiles -l` *account-name* command enables you to view the contents of the rights profiles that are assigned to a specific user or role.

For more information, see Chapter 7, “Listing Rights in Oracle Solaris” and the `getent`(8) and `profiles`(1) man pages.

Authorizations Reference

An *authorization* is a discrete right that can be granted to a role or a user. Authorizations are checked by compliant applications before a user gets access to the application or specific operations within the application.

Authorizations are user-level, and therefore extensible. You can write a program that requires authorization, add the authorizations to your system, create a rights profile for these authorizations, and assign the rights profile to users or roles who are allowed to use the program.

Authorization Naming Conventions

An authorization has a name that is used internally. For example, `solaris.system.date` is the name of an authorization. An authorization has a short description that appears in the graphical user interfaces (GUIs). For example, `Set Date & Time` is the description of the `solaris.system.date` authorization.

By convention, authorization names consist of the reverse order of the Internet name of the supplier, the subject area, any subareas, and the function. The parts of the authorization name are separated by dots. An example would be `com.xyzcorp.device.access`. Exceptions to this convention are the authorizations from Oracle, which use the prefix `solaris` instead of an Internet name. The naming convention enables administrators to apply authorizations in a hierarchical fashion. A wildcard (*) can represent any strings to the right of a dot.

As an example of how authorizations are used, the Network Link Security rights profile has the `solaris.network.link.security` authorization only, while the Network Security rights profile has the Network Link Security profile as a supplementary profile, plus the `solaris.network.*` and `solaris.smf.manage.ssh` authorizations.

Delegation Authority in Authorizations

An authorization that ends with the suffix `delegate` enables a user or a role to delegate to other users any assigned authorizations that begin with the same prefix.

The `solaris auth.delegate` authorization enables a user or a role to delegate to other users any authorizations that the delegating users or roles are assigned. For example, a role with the `solaris auth.delegate` and `solaris.network.wifi.wep` authorizations can delegate the `solaris.network.wifi.wep` authorization to another user or role.

Rights Databases

The following databases store the data for rights in Oracle Solaris:

- **Extended user attributes database** (`user_attr`) – Associates users and roles with authorizations, privileges, and rights profiles, among other keywords.
- **Rights profile attributes database** (`prof_attr`) – Defines rights profiles and lists the profiles' assigned authorizations, privileges, and keywords
- **Authorization attributes database** (`auth_attr`) – Defines authorizations and their attributes
- **Execution attributes database** (`exec_attr`) – Identifies the commands with security attributes that are assigned to specific rights profiles

The `policy.conf` database contains authorizations, privileges, and rights profiles that are applied to all users. For more information, see "`policy.conf` File" on page 166. See also "New Feature – Enabling the `account-policy` Service" on page 86.

Rights Databases and the Naming Services

The name service scope of the rights databases is defined in the SMF service for the naming service switch, `svc:/system/name-service/switch`. The properties in this service for the rights databases are `auth_attr`, `password`, and `prof_attr`. The `password` property sets the naming service precedence for the `passwd` and `user_attr` databases. The `prof_attr` property sets the naming service precedence for the `prof_attr` and `exec_attr` databases.

In the following output, the `auth_attr`, `password`, and `prof_attr` entries are not listed. Therefore, the rights databases are using the `files` naming service.

```
# svccfg -s name-service/switch listprop config
config                        application
config/value_authorization    astring       solaris.smf.value.name-service.switch
config/default                astring       files
config/host                   astring       "files ldap dns"
config/printer                astring       "user files ldap"
```

`user_attr` Database

The `user_attr` database contains user and role information that supplements the `passwd` and `shadow` databases. The *attr* field contains security attributes and the *qualifier* field contains attributes that qualify or limit the effect of security attributes to a system or group of systems.

The security attributes in the `attr` field can be set by using the `roleadd`, `rolemod`, `useradd`, `usermod`, and `profiles` commands. They can be set locally and in the LDAP naming scope.

- For a user, the `roles` keyword assigns one or more defined roles.
- For a role, the `user` value to the `roleauth` keyword enables the role to authenticate with the user password rather than with the role password. By default, the value is `role`.
- For a user or role, the following attributes can be set:
  - `access_times` keyword – Specifies the days and times that specified applications and services can be accessed. For more information, see the `getaccess_times`(3C) man page.
  - `access_tz` keyword – Specifies the time zone to use when interpreting the times in `access_times` entries. For more information, see the `pam_unix_account`(7) man page.
  - `annotation` keyword – Specifies whether to prompt the user to annotate their login for the audit record. By default the user is not prompted. For more information, see "New Feature – Annotating Reason for Access in the Audit Record" in *Managing Auditing in Oracle Solaris 11.4*.
  - `audit_flags` keyword – Modifies the audit mask. For more information, see the `audit_flags`(7) man page.
  - `auths` keyword – Assigns authorizations. For more information, see the `auths`(1) man page.
  - `auth_profiles` keyword – Assigns authenticated rights profiles. For reference, see the `profiles`(1) man page.
  - `defaultpriv` keyword – Adds privileges or removes them from the default basic set of privileges.
  - `limitpriv` keyword – Adds privileges or removes them from the default limit set of privileges.

    The `defaultpriv` and `limitpriv` privileges are always in effect because they are assigned to the user's initial process. For more information, see the `privileges`(7) man page and "How Privileges Are Implemented" on page 34.
  - `idlecmd` keyword – Logs out the user or locks the screen after `idletime` is reached.
  - `idletime` keyword – Sets the time that the system is available after no keyboard activity. Set `idletime` when you specify a value for `idlecmd`.

- `lock_after_retries` keyword – If the value is `yes`, the system is locked after the number of retries exceeds the number that is allowed in the `/etc/default/login` file. For more information, see the `login(1)` man page. To unlock a locked account, see the `passwd(1)` man page.
- `pam_policy` keyword – Specifies a per-user PAM policy. See the `pam_user_policy(7)` man page.
- `project` keyword – Adds a default project. For more information, see the `project(5)` man page.
- `profiles` keyword – Assigns rights profiles. For more information, see the `profiles(1)` man page.
- `unlock_after` keyword – Specifies the time after which a locked account can be unlocked by a successful authentication . You can specify the time as a number of minutes, hours, days, or weeks. If a time for this attribute is not specified, the administrator must explicitly unlock the account. To unlock a locked account, see the `passwd(1)` man page.

Note - Because the `access_times` and `access_tz` attributes are PAM attributes, they are checked during authentication. Therefore, they must be assigned either directly to a user or role, or in an authenticated rights profile. They are ignored in a regular rights profile.

The qualified attributes can be set for users and roles in the LDAP naming scope only. These qualifiers limit a user or role's attribute assignment, such as a rights profile, to one or more systems. For examples, see the `useradd(8)` and `user_attr(5)` man pages.

The qualifiers are `host` and `netgroup`:

- `host` qualifier – Identifies the system where the user or role can perform specified actions.
- `netgroup` qualifier – Lists systems where the user or role can perform specified actions. `host` assignments have priority over `netgroup` assignments.

For more information, see the `user_attr(5)` man page. To view the contents of this database, use the `getent user_attr` command. For more information, see the `getent(8)` man page and Chapter 7, “Listing Rights in Oracle Solaris”.

`auth_attr` Database

The `auth_attr` database stores authorization definitions. Authorizations can be assigned to users, to roles, or to rights profiles. The preferred method is to place authorizations in a rights profile, then to assign the rights profile to a role or user.

To view the contents of this database, use the `getent auth_attr` command. For more information, see the `getent`(8) man page and Chapter 7, “Listing Rights in Oracle Solaris”.

`prof_attr` Database

The `prof_attr` database stores the name, description, privileges, and authorizations that are assigned to rights profiles. The commands and security attributes that are assigned to rights profiles are stored in the `exec_attr` database. For more information, see “`exec_attr` Database” on page 166.

For more information, see the `prof_attr`(5) man page. To view the contents of this database, use the `getent exec_attr` command. For more information, see the `getent`(8) man page and Chapter 7, “Listing Rights in Oracle Solaris”.

`exec_attr` Database

The `exec_attr` database defines commands that require security attributes to succeed. The commands are part of a rights profile. A command with its security attributes can be run by roles or users to whom the profile is assigned.

For more information, see the `exec_attr`(5) man page. To view the contents of this database, use the `getent` command. For more information, see the `getent`(8) man page and Chapter 7, “Listing Rights in Oracle Solaris”.

`policy.conf` File

Note - This file is superseded by the SMF `account-policy` service. For more information, see “New Feature – Enabling the `account-policy` Service” on page 86 and the `account-policy`(8S) man page.

The `/etc/security/policy.conf` file provides a way of granting specific rights profiles, specific authorizations, and specific privileges to all users of a system. The relevant entries in the file consist of *key=value* pairs:

- `AUTHS_GRANTED=`*authorizations* – Refers to one or more authorizations.
- `AUTH_PROFS_GRANTED=`*rights profiles* – Refers to one or more authenticated rights profiles.

- PROFS_GRANTED=*rights profiles* – Refers to one or more rights profiles that are not authenticated.
- CONSOLE_USER=Console User– Refers to the Console User rights profile. This profile is delivered with a convenient set of authorizations for the console user. You can customize this profile.
- PRIV_DEFAULT=*privileges* – Refers to one or more privileges.
- PRIV_LIMIT=*privileges* – Refers to all privileges.

The following example shows some rights values from a policy.conf database:

```
##
AUTHS_GRANTED=
AUTH_PROFS_GRANTED=
CONSOLE_USER=Console User
PROFS_GRANTED=Basic Solaris User
#PRIV_DEFAULT=basic
#PRIV_LIMIT=all
```

Commands for Administering Rights

This section lists commands that are used to administer rights. It also includes a table of commands whose access can be controlled by authorizations.

Commands That Manage Authorizations, Rights Profiles, and Roles

The commands listed in the following table retrieve and set rights on user processes.

TABLE 3 Rights Administration Commands

Command	Description
account-policy(8S)	SMF stencil for system security policy.
auths(1)	Displays authorizations for a user. Creates new authorizations.
getent(8)	Lists the contents of the rights databases.
nscd(8)	Name service cache daemon, useful for caching the rights databases. Use the svcadm command to restart the daemon.

Command	Description
pam_roles(7)	Role account management module for PAM. Checks for the authorization to assume a role.
pam_unix_account(7)	UNIX account management module for PAM. Checks for account restrictions, such as time restrictions and inactivity.
pfbash(1)	Used to create a profile shell process that can evaluate rights.
pfedit(8)	Used to edit administrative files.
pfexec(1)	Used to execute a command with security attributes.
profiles(1)	Displays rights profiles for a specified user. Creates or modifies a rights profile.
roles(1)	Displays roles that a specified user can assume.
roleadd(8)	Adds a role to a local system or to an LDAP network.
roleadd(8)	Adds a role to a local system or to an LDAP network.
rolemod(8)	Modifies a role's properties on a local system or on an LDAP network.
userattr(1)	Displays the value of a specific right that is assigned to a user or role account.
useradm(8)	Displays all the rights that are directly assigned to a user or role account. Requires installation of the useradm package.
useradd(8)	Adds a user account to the system or to an LDAP network. The -R option assigns a role to a user's account.
userdel(8)	Deletes a user's login from the system or from an LDAP network.
usermod(8)	Modifies a user's account properties on the system.

Selected Commands That Require Authorizations

The following table provides examples of how authorizations are used to limit command options on an Oracle Solaris system. For more discussion of authorizations, see "Authorizations Reference" on page 161.

TABLE 4 Commands and Associated Authorizations

Command	Authorization Requirements
at(1)	solaris.jobs.user required for all options (when neither at.allow nor at.deny files exist)
atq(1)	solaris.jobs.admin required for all options
cdrw(1)	solaris.device.cdrw required for all options, which is granted by default in the policy.conf file
crontab(1)	solaris.jobs.user required for the option to submit a job (when neither crontab.allow nor crontab.deny files exist) solaris.jobs.admin required for the options to list or modify other users' crontab files
allocate(8)	solaris.device.allocate (or other authorization as specified in device_allocate file) required to allocate a device

Command	Authorization Requirements
	`solaris.device.revoke` (or other authorization as specified in `device_allocate` file) required to allocate a device to another user (`-F` option)
`deallocate`(8)	`solaris.device.allocate` (or other authorization as specified in `device_allocate` file) required to deallocate another user's device `solaris.device.revoke` (or other authorization as specified in `device_allocate`) required to force deallocation of the specified device (`-F` option) or all devices (`-I` option)
`list_devices`(1)	`solaris.device.revoke` required to list another user's devices (`-U` option)
`roleadd`(8)	`solaris.user.manage` required to create a role. `solaris.account.activate` required to set the initial password. `solaris.account.setpolicy` required to set password policy, such as account locking and password aging.
`roledel`(8)	`solaris.passwd.assign` authorization required to delete the password.
`rolemod`(8)	`solaris.passwd.assign` authorization required to change the password. `solaris.account.setpolicy` required to change password policy, such as account locking and password aging.
`sendmail`(8)	`solaris.mail` required to access mail subsystem functions; `solaris.mail.mailq` required to view mail queue
`useradd`(8)	`solaris.user.manage` required to create a user. `solaris.account.activate` required to set the initial password. `solaris.account.setpolicy` required to set password policy, such as account locking and password aging.
`userdel`(8)	`solaris.passwd.assign` authorization required to delete the password.
`usermod`(8)	`solaris.passwd.assign` authorization required to change the password. `solaris.account.setpolicy` required to change password policy, such as account locking and password aging.

Privileges Reference

Privileges restrict processes are implemented in the kernel, and can restrict processes at the command, user, role, or system level.

Commands for Handling Privileges

The following table lists the commands that are available to handle privileges.

TABLE 5 Commands for Handling Privileges

Purpose	Command	Man Page
Set and list default and limit privileges on a system.	`svccfg -s account-policy`	`account-policy`(8S)
Debug privilege failure	`ppriv -eD` *failed-operation*	`ppriv`(1)

Purpose	Command	Man Page
List the privileges on the system	`ppriv -l`	ppriv(1)
List a privilege and its description	`ppriv -lv` *priv*	ppriv(1)
List extended privilege policy on a UID, process, or port	`ppriv -lv` *extended-policy*	ppriv(1)
Examine process privileges	`ppriv -v` *pid*	ppriv(1)
Add extended privilege policy to a UID, process, or port	`ppriv -r` *rule*	privileges(7)
Set process privileges	`ppriv -s` *spec*	ppriv(1)
Remove an extended privilege policy rule	`ppriv -X` *rule*	privileges(7)
Assign privileges to a rights profile	`profiles -p` *profile-name*	profiles(1)
Assign privileges to a new role	`roleadd -K defaultpriv=`	roleadd(8)
Add privileges to an existing role	`rolemod -K defaultpriv+=`	rolemod(8)
Assign privileges to a new user	`useradd -K defaultpriv=`	useradd(8)
Add privileges to an existing user	`usermod -K defaultpriv+=`	usermod(8)
Add device policy to a device	`add_drv -p` *policy driver*	add_drv(8)
Set device policy	`devfsadm`	devfsadm(8)
View device policy	`getdevpolicy`	getdevpolicy(8)
Update device policy on open devices	`update_drv -p` *policy driver*	update_drv(8)

SMF Stencil That Contains Privilege Information

The `account-policy` SMF stencil contains and sets the following privilege information:

- `default_privileges` – Inheritable set of privileges for the system
- `limit_privileges` – Limit set of privileges for the system
- `syslog` – System logging file

  The path for debug messages is set in the `priv.debug` entry.

Privileged Actions in the Audit Record

Privilege use can be audited. Any time that a process uses a privilege, the use of privilege is recorded in the audit trail in the `upriv` audit token. When privilege names are part of the record, their textual representation is used. The following audit events record use of privilege:

- `AUE_SETPPRIV` **audit event –** Generates an audit record when a privilege set is changed. The `AUE_SETPPRIV` audit event is in the `pm` class.

- `AUE_MODALLOCPRIV` **audit event –** Generates an audit record when a privilege is added from outside the kernel. The `AUE_MODALLOCPRIV` audit event is in the `ad` class.
- `AUE_MODDEVPLCY` **audit event –** Generates an audit record when the device policy is changed. The `AUE_MODDEVPLCY` audit event is in the `ad` class.
- `AUE_PFEXEC` **audit event –** Generates an audit record when a call is made to `execve()` with `pfexec()` enabled. The `AUE_PFEXEC` audit event is in the `as`, `ex`, `ps`, and `ua` audit classes. The names of the privileges are included in the audit record.

The successful use of privileges that are in the basic set is not audited. An attempt to use a basic privilege that has been removed from a user's basic set is audited.

For per-privilege auditing, see "What's New in the Audit Service in Oracle Solaris 11.4" in *Managing Auditing in Oracle Solaris 11.4*.

Security Attributes in Files and Their Corresponding SMF Properties

The following tables list the variable names of security attributes in the files in the `/etc` directory and their corresponding SMF properties in the `account-policy` service.

- Table 6, "Login Security Attributes in Files and SMF," on page 171
- Table 7, "Password Security Attributes in Files and SMF," on page 172
- Table 8, "User Account Security Attributes in Files and SMF," on page 173
- Table 9, "User Environment Security Attributes in Files and SMF," on page 173
- Table 10, "Logging and `su` Security Attributes in Files and SMF," on page 173

The SMF properties in Table 6, "Login Security Attributes in Files and SMF," on page 171 can be modified when the `config/etc_default_login` stencil in the `account-policy` service is enabled.

TABLE 6 Login Security Attributes in Files and SMF

Variable Name	Legacy File	SMF Property
ANNOTATION	/etc/security/policy.conf	login_policy/annotation
CLEARANCE	/etc/security/policy.conf	login_policy/clearance
CONSOLE	/etc/default/login	login_policy/root_login_device
DISABLETIME	/etc/default/login	login_policy/disabletime
LOCK_AFTER_RETRIES	/etc/security/policy.conf	login_policy/lock_after_retries
PAM_POLICY	/etc/security/policy.conf	login_policy/pam_policy

Variable Name	Legacy File	SMF Property
PASSREQ	/etc/default/login	login_policy/password_required
RETRIES	/etc/default/login	login_policy/retries
SLEEPTIME	/etc/default/login	login_policy/sleeptime
TIMEOUT	/etc/default/login	login_policy/timeout
UNLOCK_AFTER	/etc/security/policy.conf	login_policy/auto_unlock_time

The SMF properties in Table 7, "Password Security Attributes in Files and SMF," on page 172 can be modified when the `config/etc_default_passwd` stencil in the `account-policy` service is enabled.

TABLE 7 Password Security Attributes in Files and SMF

Variable Name	Legacy File	SMF Property
CRYPT_DEFAULT	/etc/security/policy.conf	password/crypt/default
CRYPT_ALGORITHMS_ALLOW	/etc/security/policy.conf	password/crypt/algorithms_allow
CRYPT_ALGORITHMS_DEPRECATE	/etc/security/policy.conf	password/crypt/algorithms_deprecate
DICTIONDBDIR	/etc/default/passwd	password/dictionary/db_dir
DICTIONLIST	/etc/default/passwd	password/dictionary/word_list
DICTIONMINWORDLENGTH	/etc/default/passwd	password/dictionary/min_word_length
HISTORY	/etc/default/passwd	password/history
MAXDAYS	/etc/default/passwd	password/aging_defaults/max_days
MAXREPEATS	/etc/default/passwd	password/complexity/max_repeats
MAXWEEKS	/etc/default/passwd	password/aging_defaults/max_weeks
MINALPHA	/etc/default/passwd	password/complexity/min_alpha
MINDAYS	/etc/default/passwd	password/aging_defaults/min_days
MINDIFF	/etc/default/passwd	password/complexity/min_diff
MINDIGIT	/etc/default/passwd	password/complexity/min_digit
MINLOWER	/etc/default/passwd	password/complexity/min_lower
MINNONALPHA	/etc/default/passwd	password/complexity/min_nonalpha
MINSPECIAL	/etc/default/passwd	password/complexity/min_special
MINUPPER	/etc/default/passwd	password/complexity/min_upper
MINWEEKS	/etc/default/passwd	password/aging_defaults/min_weeks
NAMECHECK	/etc/default/passwd	password/complexity/namecheck
PASSLENGTH	/etc/default/passwd	password/complexity/passlength
WARNDAYS	/etc/default/passwd	password/aging_defaults/warn_days
WARNWEEKS	/etc/default/passwd	password/aging_defaults/warn_weeks
WHITESPACE	/etc/default/passwd	password/complexity/whitespace

The SMF properties in Table 8, "User Account Security Attributes in Files and SMF," on page 173 can be modified when the `config/etc_security_policyconf` stencil in the `account-policy` service is enabled.

TABLE 8 User Account Security Attributes in Files and SMF

Variable Name	Legacy File	SMF Property
AUTH_PROFS_GRANTED	/etc/security/policy.conf	rbac/default_auth_profiles
AUTHS_GRANTED	/etc/security/policy.conf	rbac/default_authorizations
CONSOLE_USER	/etc/security/policy.conf	rbac/console_user_profiles
PRIV_DEFAULT	/etc/security/policy.conf	rbac/default_privileges
PRIV_LIMIT	/etc/security/policy.conf	rbac/default_limit_privileges
PROFS_GRANTED	/etc/security/policy.conf	rbac/default_profiles

The SMF properties in Table 9, "User Environment Security Attributes in Files and SMF," on page 173 can be modified when the `config/etc_default_login` stencil in the `account-policy` service is enabled.

TABLE 9 User Environment Security Attributes in Files and SMF

Variable Name	Legacy File	SMF Property
ALTSHELL	/etc/default/login	login/environment/set_shell
HZ	/etc/default/login	login/environment/hz
PATH	/etc/default/login	login/environment/path
SUPATH	/etc/default/login	login/environment/root_path
TIMEZONE	/etc/default/login	login/environment/timezone
ULIMIT	/etc/default/login	login/environment/ulimit
UMASK	/etc/default/login	login/environment/umask

The SMF properties in Table 10, "Logging and `su` Security Attributes in Files and SMF," on page 173 can be modified when the `config/etc_default_login` and `config/etc_default_su` stencils in the `account-policy` service is enabled.

TABLE 10 Logging and `su` Security Attributes in Files and SMF

Variable Name	Legacy File	SMF Property
SYSLOG	/etc/default/login	login/log/syslog
SYSLOG_FAILED_LOGINS	/etc/default/login	login/log/syslog_failed_attempts
CONSOLE	/etc/default/su	su/log/device

Variable Name	Legacy File	SMF Property
PATH	/etc/default/su	su/environment/path
SULOG	/etc/default/su	su/log/logfile
SUPATH	/etc/default/su	su/environment/path
SYSLOG	/etc/default/su	su/log/syslog

Securing Users and Processes Glossary

authenticated rights profile A rights profile that requires the assigned user or role to type a password before executing an operation from the profile. This behavior is similar to `sudo` behavior. The length of time that the password is valid is configurable.

authentication The process of verifying the claimed identity of a login or process.

authorization A right that can be assigned to a role or user (or embedded in a rights profile) for performing a class of operations that are otherwise prohibited by security policy. Authorizations are enforced at the user application level, not in the kernel.

basic set The set of privileges that are assigned to a user's process at login. On an unmodified system, each user's initial inheritable set equals the basic set at login.

effective set The set of privileges that are currently in effect on a process.

inheritable set The set of privileges that a process can inherit across a call to `exec`.

least privilege A security model which gives a specified process only a subset of superuser powers. The least privilege model assigns enough privilege to regular users that they can perform personal administrative tasks, such as mount file systems and change the ownership of files. On the other hand, processes run with just those privileges that they need to complete the task, rather than with the full power of superuser, that is, all privileges. Damage due to programming errors like buffer overflows can be contained to a non-root user, which has no access to critical abilities like reading or writing protected system files or halting the system.

limit set The outside limit of what privileges are available to a process and its children.

password policy The encryption algorithms that can be used to generate passwords. Can also refer to more general issues around passwords, such as how often the passwords must be changed, how many password attempts are permitted, and other security considerations. Security policy requires passwords. Password policy might require passwords to be encrypted with the AES algorithm, and might make further requirements related to password strength.

permitted set The set of privileges that are available for use by a process.

policy Generally, a plan or course of action that influences or determines decisions and actions. For computer systems, policy typically means security policy. Your site's security policy is the set of rules that define the sensitivity of the information that is being processed and the measures that are used to protect the information from unauthorized access. For example, security policy might require that passwords be changed every six weeks. See also password policy and rights policy.

privilege 1. In general, a power or capability to perform an operation on a computer system that is beyond the powers of a regular user. Superuser privileges are all the rights that superuser is granted. A privileged user or privileged application is a user or application that has been granted additional rights.

2. A discrete right on a process in an Oracle Solaris system. Privileges offer a finer-grained control of processes than does `root`. Privileges are defined and enforced in the kernel. Privileges are also called *process privileges* or *kernel privileges*. For a full description of privileges, see the `privileges(7)` man page.

privilege escalation Gaining access to resources that are outside the range of resources that your assigned rights, including rights that override the defaults, permit. The result is that a process can perform unauthorized operations.

privilege model See rights model.

privilege set A collection of privileges. Every process has four sets of privileges that determine whether a process can use a particular privilege. See limit set, effective set set, permitted set set, and inheritable set set.

Also, the basic set set of privileges is the collection of privileges that are assigned to a user's process at login.

privilege-aware Programs, scripts, and commands that turn on and off the use of privilege in their code. In a production environment, the privileges that are turned on must be supplied to the process, for example, by requiring users of the program to use a rights profile that adds the privileges to the program. For a full description of privileges, see the `privileges(7)` man page.

privileged application An application that can override system controls. The application checks for security attributes, such as specific UIDs, GIDs, authorizations, or privileges.

privileged user A user who is assigned rights beyond the rights of regular user on a computer system. See also trusted users.

profile See rights profile.

profile shell In rights management, a shell that enables a role (or user) to run from the command line any privileged applications that are assigned to the role's rights profiles. The profile shell versions correspond to the available shells on the system, such as the `pfbash` version of `bash`.

RBAC Role-based access control, the user rights management feature of Oracle Solaris. See rights.

RBAC policy See rights policy.

reauthentication The requirement to provide a password to perform a computer operation. Typically, `sudo` operations require reauthentication. Authenticated rights profiles can contain commands that require reauthentication. See authenticated rights profile.

rights An alternative to the all-or-nothing superuser model. User rights management and process rights management enable an organization to divide up superuser's privileges and assign them to users or roles. Rights in Oracle Solaris are implemented as kernel privileges, authorizations, and the ability to run a process as a specific UID or GID. Rights can be collected in a rights profile and a role.

rights model A stricter model of security on a computer system than the superuser model. In the rights model, processes require privilege to run. Administration of the system can be divided into discrete parts that are based on the privileges that administrators have in their processes. Privileges can be assigned to an administrator's login process. Or, privileges can be assigned to be in effect for certain commands only.

rights policy The security policy that is associated with a command. Currently, `solaris` is the valid policy for Oracle Solaris. The `solaris` policy recognizes privileges and extended privilege policy, authorizations, and `setuid` security attributes.

rights profile Also referred to as a profile. A collection of security overrides that can be assigned to a role or user. A rights profile can include authorizations, privileges, commands with security attributes, and other rights profiles that are called supplementary profiles.

roles Accounts with rights that you create and assign to trusted users to perform administrative tasks. The `armor` package contains seven predefined roles.

security attributes Overrides to security policy that enable an administrative command to succeed when the command is run by a user other than superuser. In the superuser model, the `setuid root` and `setgid` programs are security attributes. When these attributes are applied to a command, the command succeeds no matter who runs the command. In the privilege model, kernel privileges and other rights replace `setuid root` programs as security attributes. The privilege model is compatible with the superuser model, in that the privilege model also recognizes the `setuid` and `setgid` programs as security attributes.

security policy See policy.

separation of duty Part of the notion of least privilege. Separation of duty prevents one user from performing or approving all operations that complete a transaction. For example, in RBAC, you can separate the creation of a login user from the assignment of security overrides. One role creates the user. A separate role can assign security attributes, such as rights profiles, roles, and privileges to existing users.

superuser model The typical UNIX model of security on a computer system. In the superuser model, an administrator has all-or-nothing control of the system. Typically, to administer the system, a user becomes superuser (`root`) and can do all administrative activities.

trusted users Users who you have decided can perform administrative tasks at some level of trust. Typically, administrators create logins for trusted users first and assign administrative rights that match the users' level of trust and ability. These users then help configure and maintain the system. Also called *privileged users*.

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