AccuRev

The TimeSafe® Configuration Management System

AccuRev Administrator’s Guide

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The AccuRev Repository

The AccuRev Server program manages a data repository, which provides long-term storage for your organization's development data — for example, all versions of all source files. (Among other things, AccuRev is a special-purpose database management system; the files in the repository — thousands of them — are part of this database.) By default, the repository resides in subdirectory **storage** of the AccuRev installation directory. The repository consists of:

- **site_slice** directory: implements a database that contains a user registry, list of depots, list of workspaces, and other repository-wide information.
- **depots** directory ("slice"): contains a set of subdirectories, each storing an individual depot. A depot subdirectory stores one or both of:
  - A version-controlled directory tree: all the versions of a set of files and directories, along with a database that keeps track of the versions.
  - A database of AccuWork issue records.

When it starts, the AccuRev Server program determines the location of the **site_slice** directory by looking at the SITE_SLICE_LOC setting in configuration file **acserver.cnf**. This file must reside in the same directory as the Server program (**accurev_server**) itself.

Repository Access Permissions

The operating-system user identity of the AccuRev Server process must have full access to all the files and directories within the data repository. For maximum security, this should be the *only* user identity with permission to access the repository. The only exception to this might be an **acadmin** AccuRev administrator account, as suggested in *Operating-System User Identity of the Server Process* on page 9.

This user identity must also have access to the **bin** directory where the AccuRev executables are stored.

READ ME NOW: Assuring the Integrity of the AccuRev Repository

The integrity of the AccuRev data repository is critically important. If information in the repository is lost or corrupted, your organization's ability to do business may be severely compromised. The integrity of the data repository relies on the integrity of underlying software (the file system, including the device drivers for data storage devices) and underlying hardware (the data storage devices themselves). Certain practices will enhance the safety and reliability of these underlying facilities. We strongly recommend the following:

- Use high-quality disk drives and disk controllers.
- Reduce the impact of a hard-disk failure by using disk mirroring (for example, using a RAID system) or other fault-tolerant disk subsystems.

- Power the AccuRev server machine with an uninterruptible power supply (UPS), with automatic shutdown of the server machine if the UPS is running out of power. This reduces the likelihood of interrupted data transfers to disk.
- Establish a good data-backup regimen, and make sure your backups are reliable by doing test restores on a regular basis. (See *Backing Up the Repository* on page 3.)

This section focuses on one aspect of data integrity: guaranteeing "write" operations to the repository. The AccuRev Server process does not, itself, perform the act of writing data on the disk. Like all application programs, it makes a "write" request to the operating system (Unix/Linux, Windows). In turn, the operating system performs a "write" operation to the disk itself. (On some larger systems, there may be additional links in this chain of write operations.)

Operating systems and disk subsystems often use special techniques that boost the performance of write operations, but can compromise data integrity. For example, when an application program makes a write request, the operating system might:

- Acknowledge the request immediately — good, because the application program can then proceed to its next operation.
- Delay actually sending the data to the disk ("write-behind") — bad, because a system failure at this point might result in the data never being stored on the disk.

It is essential that such techniques *not* be used when the AccuRev Server process sends information to the disk containing the AccuRev data repository. The Server always follows each write request with a "synchronize the disk" request. Sometimes, this ensures that data is safely on disk before the Server proceeds to its next task. For example, this is typically the case if the repository is stored on a disk that is local to the machine on which the Server is executing.

But in some situations delayed-write techniques may be used even when the AccuRev Server makes "synchronize the disk" requests. This is typically the case if the repository is located on a network shared file system. In such situations, the Server's "synchronize the disk" requests are effectively ignored, so that successful completion of write operations to the AccuRev repository cannot be guaranteed. (Some disk subsystems implement such a guarantee by having their own battery backup; buffered data is flushed to disk when the power fails.)

In an attempt to avoid such unsafe situations, the AccuRev Server process attempts to determine whether the file system where the repository is stored guarantees the successful completion of write operations. If it decides "no", the Server refuses to use the repository. This determination is not foolproof — both "false positives" and "false negatives" are possible.

There's a workaround in the "false negative" case — where the AccuRev Server process decides that the file system does not guarantee write operations, but *you* know that writes are, in fact, guaranteed. In this case, set environment variable AC_FS_WRITE_GUARANTEED to the value 1 in the environment in which the Server process runs; then restart the Server process.

If you have any question about the safety of your data-storage system, please contact AccuRev Support Services.

Backing Up the Repository

Note: before you start, consult *A Word of Caution on Windows Zip Utilities* below.

AccuRev supports live backup of the data repository: making copies of the data repository files while the AccuRev Server is running. The **backup** command takes just a few seconds to make checkpoint copies of certain **site_slice** files in a subdirectory named **backup**. It also records a "high water mark" file, **valid_sizes_backup**, in each depot directory, noting the depot's current transaction level. Transactions that are underway at the time the **backup** command executes are not included.

During **backup** command execution, clients can continue to work, but may notice a slight delay: transactions arriving at the AccuRev Server are queued for execution after completion of the **backup** command.

After executing the **backup** command, you can make a complete copy of the repository (the **storage** directory tree), without worrying about synchronization or time-skew.

CAUTION: Do not execute the **backup** command while you are running the repository-backup program. This can place incorrect data into the backup copy of the repository.

The append-only nature of AccuRev's databases makes this simple scheme possible. No matter when you make the backup copies, you'll be able to restore the repository to its state at the time you executed the **backup** command.

IMPORTANT NOTE: the live-backup scheme relies on the ability to copy files that are currently in use by the AccuRev Server process. To support this scheme, your backup/restore tool must be able to copy files that are currently "open" at the operating system level. In addition, the backup/restore tool should have these features:

- Ability to preserve files' timestamps.
- Ability to preserve files' ownership and execute permissions.
- Ability to back up zero-length files. (See *Server-Control Files* on page 18.)

If you have any doubts or questions, contact AccuRev Support Services.

Thus, the repository backup procedure is:

1. "Checkpoint" the database portion of the repository:

   ```
   accurev backup mark
   ```

2. If your backup utility cannot copy files that are currently open at the operating system level, stop the **accurev_server** program. (See *Controlling Server Operation* on page 17.)

3. Use a backup/restore tool provided with your operating system or a third-party backup/restore tool to create a backup copy of the entire directory tree below the **storage** directory. This backup can be all-at-once or piecemeal; for example, you can back up the **site_slice** directory and the individual subdirectories within the **depots** directory with separate commands.

   Note: if your site slice is in a non-standard location (as specified by the SITE_SLICE_LOC setting in the **acserver.cnf** file — see *Server Configuration File* on page 12), or if some depots are in non-standard locations (perhaps moved with the **chslice** command), then your job in backing up the entire repository is more complicated than simply to copy the **storage** directory.

4. If you stopped the **accurev_server** program in Step 2, start it again. (See *Controlling Server Operation* on page 17.)

Restoring the Repository

If you have backed up the repository according to the directions above, you can easily restore the repository to the time at which you executed the **backup** command:

1. Stop the **accurev_server** program. (See *Controlling Server Operation* on page 17.)
2. Restore the backup copy of the **storage** directory, using the backup/restore tool that you used to create it.

   Note: if your site slice is in a non-standard location (as specified by the SITE_SLICE_LOC setting in the **acserver.cnf** file — see *Server Configuration File* on page 12), or if some depots are in non-standard locations (perhaps moved with the **chslice** command), then your job in restoring the backup of the entire repository is more complicated than simply to restore the **storage** directory.
3. Go to the **site_slice** directory.
4. Overwrite database files with the checkpoint files in the **backup** subdirectory:

   ```
   cp backup/* .                (Unix/Linux)
   ```

   ```
   copy backup\*.* .            (Windows)
   ```

   This "rolls back" the database to the time of the **backup** command — which might be significantly before the time at which the repository was copied to the backup medium.
5. Reindex the site slice:

   ```
   maintain reindex
   ```
6. Restore and reindex each depot:

   ```
   maintain restore <depot-name>
   maintain reindex <depot-name>
   ```
7. Restart the **accurev_server** program. (See *Controlling Server Operation* on page 17.)

   Note: suppose a particular depot's files were not backed up for several hours after the **backup** command was executed. During that interval, several new versions of file **gizmo.c** were created with the **keep** command. All of those versions will officially be lost when the repository is restored to its state at the time the **backup** command was executed. But you can still retrieve a copy of the last-created lost version of file **gizmo.c** from the backup medium: it's in a container file in the **data** subdirectory of the depot directory.

Archiving Portions of the Repository

The container files that store the contents of individual file versions can be moved to offline storage, in order to save online storage space for the repository. For details, see *Archiving of Version Container Files* on page 27.

Moving a Workspace or Reference Tree

Note: before you start, consult *A Word of Caution on Windows Zip Utilities* below.

First, make sure that no user or script process is currently using the workspace or reference tree. Move the physical contents of the workspace tree or reference tree with a backup/restore tool (e.g. **tar**, **zip**, **xcopy /s**). Then, let AccuRev know about the move:

```
accurev chws -w <workspace-name> -l <new-location>

accurev chref -r <reftree-name> -l <new-location>
```

Moving a Depot

Note: before you start, consult *A Word of Caution on Windows Zip Utilities* below.

First, make sure that no user or script process is currently using the depot. (To guarantee this, you may wish to stop the AccuRev Server process.) Move the physical contents of the depot with a backup/restore tool (e.g. **tar**, **zip**, **xcopy /s**). Then, let AccuRev know about the move:

```
accurev chslice -s <slice-number> -l <new-location>
```

(Use **accurev show depots** to determine the slice number of the depot.)

Removing a Depot

A depot can be removed completely from the repository with the **maintain rmdepot** command. This operation is irreversible! For details, see *Removing a Depot from the AccuRev Repository* on page 87.

A Word of Caution on Windows Zip Utilities

Be careful when using WinZip® or PKZIP® on a Windows machine to perform the tasks described above: backup/restore of the entire repository, or moving a workspace, reference tree, or depot. You may want to use **tar** on a Unix/Linux machine to "pack up" a directory tree, and then use the Zip utility on a Windows machine to "unpack" it.

- When moving the entire repository or an individual depot, be sure to disable conversion of line-terminators during the "unpack" step:
  - In WinZip, make sure the option "TAR file smart CR/LF conversion" is not selected (**Options > Configuration > Miscellaneous**).
  - In PKZIP, make sure the "CR/LF conversion" setting is "None -- No conversion" (**Options > Extract**).

Enabling conversion of line-terminators during the “unpack” step will corrupt the text files in a depot's file storage area (see *File Storage Area* below). The AccuRev Server always expects lines in these text files to be terminated with a single LF character, no matter what kind of machine the server is running on.

- Conversely, when moving a workspace or reference tree, you may wish to enable “TAR file smart CR/LF conversion”. The files in a workspace or reference tree are handled directly by text-editors, compilers, testing tools, etc. Many Windows text-editors are incapable of handling text files whose lines are terminated with a single LF character.
- Zip utilities typically refuse to copy files that are open at the operating system level. Typically, you can work around this limitation by stopping the **accurev_server** program, but this defeats AccuRev’s “live backup” feature.

Storage Layout

Each AccuRev depot is stored in a separate directory tree under the installation area’s **storage** directory. The **storage** directory is a sibling of the executables (“bin”) directory. For example, if AccuRev is installed at **/usr/accurev** and depots named **moe**, **larry**, and **curly** are created, the directory layout would be:

```
/usr/accurev
    bin
    storage
        site_slice
        depots
            moe
            larry
            curly
```

A depot consists of three parts:

Configuration Files

The **mktrig** command creates a one-line configuration file that names the script to be executed when the trigger fires for transactions involving this particular depot. For example, making a trigger of type “pre-keep-trig” creates a configuration file in the depot named **pre-keep-trig**. (This file might contain the pathname **/usr/local/bin/accurev_prekeep.pl**.)

Metadata Area

The metadata area stores information about versions, times, and source file storage locations within the source file storage area of the depot. The metadata is stored in files ending with **.ndb** and **.ndx**.

The metadata area must be physically located on the machine where **accurev_server** is running. This guarantees the integrity of physical disk writes. Moving the metadata area to a remote file system compromises data integrity and is not supported by AccuRev, Inc.

File Storage Area

Whenever a user creates a new real version of a file with the **keep** command, the AccuRev Server copies the file from the user's workspace to the depot's file storage area. The newly created storage file is permanently associated with the real version-ID in the workspace stream (e.g. 25/13), and also with subsequently created virtual version-IDs in higher-level streams (7/4, 3/9, 1/4).

Storage files are located in subdirectory tree **data** within the depot directory. The files may be in compressed or uncompressed form. Compressed files may correspond to more than one real version. Conceptually, storage files are numbered sequentially starting with 1 and going up to 2**64. (That should be enough.) Within the **data** directory, they're arranged in a hierarchy for faster access. For example, storage file #123456 would be stored as **data/12/34/56.sto**. Recovery information for the storage file is stored in a like-named **.rrf** file (e.g. **data/12/34/56.rrf**).

You can relocate a depot's file storage area onto other disk partitions or even onto remote disks. The cautions about storing data locally do not apply to files in the data directories. However, exercise extreme caution when relocating storage in this area. Make sure you have first done a full backup and have shut down the **accurev_server** program.

The AccuRev Server

The AccuRev data repository is managed by a single program, the AccuRev Server (**accurev_server**). This program must be started prior to running any AccuRev client commands. The AccuRev Server process should be the *only* process that directly manipulates the AccuRev repository. No person should attempt to work directly with the repository, unless it is an emergency.

Operating-System User Identity of the Server Process

Like all processes, the AccuRev Server process has an operating-system user identity. It should be a unique user identity, not used by any other program. This helps to ensure that no other user or process has access to the data repository.

Unix//Linux Identity

> CAUTION: We strongly recommend that you do not run the AccuRev Server process run as **root**; this would open a large security hole. For example, some user-supplied trigger scripts run under the operating-system identity of the AccuRev Server. (See *Trigger Script Execution and User Identities* on page 74.) Running user-supplied scripts as the **root** user is a significant security risk!

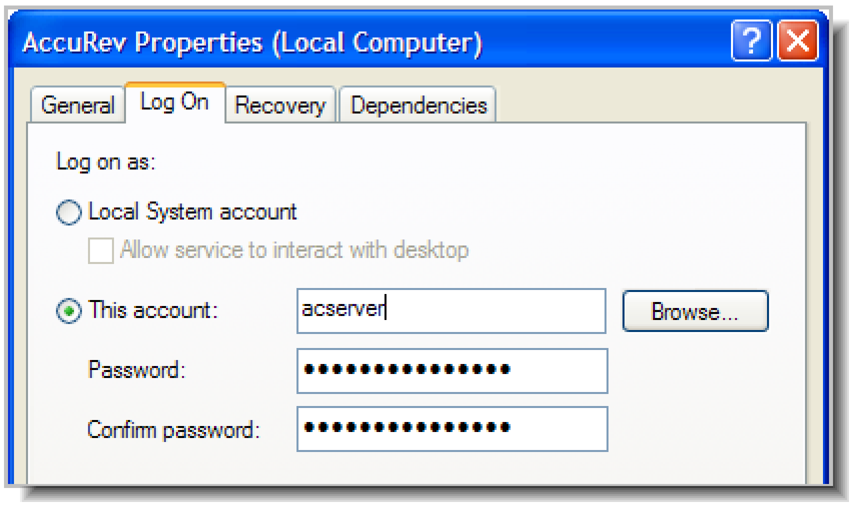
We suggest that you create an operating-system user named **acserver**, belonging to a group named **acgroup**. (Any similar names will do.) Only the AccuRev Server should run as **acserver**.

For emergency "manual" access to the repository, you can create another user identity — say, **acadmin** — and place that user in the same group, **acgroup**. You can configure Unix/Linux-level auditing and place other appropriate controls on this account; this leaves the **acserver** account (and thus, the AccuRev Server process) unencumbered by such controls.

Configure the AccuRev Server to run with the **acserver**/**acgroup** identity by placing these names in the server configuration file, **acserver.cnf**. See *Controlling the Server's Operating-System User Identity* on page 12.

Windows Identity

The AccuRev Server runs as a Windows service. By default, the AccuRev Server runs as the built-in local user named **System**. You can use the Services applet to configure the AccuRev Server to run under another identity ("account"):


AccuRev Properties (Local Computer)

General | Log On | Recovery | Dependencies

Log on as:

○ Local System account

☐ Allow service to interact with desktop

● This account: acserver

Password: •••••••••••••••

Confirm password: •••••••••••••••

This user identity must have access to the AccuRev executables (**bin**) directory and to the data repository. See *Repository Access Permissions* on page 1.

AccuRev User Identity of the Server Process

In addition to its user identity at the operating system level, the AccuRev Server process sometimes needs an AccuRev username (principal-name) identity:

- When it executes a server-side trigger script that invokes AccuRev client commands, such as **annotate** or **promote**.
- When it performs a synchronization with the master repository — explicit or implicit **replica sync** command. This applies only if the AccuRev Server is managing a replica repository.

If either of these situations applies to the AccuRev Server that you are administering, you must take steps to establish a valid AccuRev username for the AccuRev Server. The AccuRev username need not be special or reserved. Just make sure that any security controls — ACL permissions and/or **server_admin_trig** script — are configured to allow that particular AccuRev username to perform the required operations. See *AccuRev Security Overview* on page 49.

> Note: for security reasons, we recommend that the operating-system identity of the AccuRev Server process (for example, **acserver**) should *not* also be an AccuRev username.

The sections below explain how to do this; it depends on which user-authentication method your AccuRev Server employs: “traditional” or “AccuRev login”. For more on these schemes, see *User Authentication* on page 49.

If You’re Using the ‘Traditional’ User-Authentication Scheme

With the “traditional” user-authentication scheme, you can set the value of environment variable ACCUREV_PRINCIPAL to establish a process’s AccuRev user identity. On a Unix/Linux machine, set the environment variable in a login script for the designated operating-system identity — for example, **acserver**. Here’s a Bourne shell / Bash example:

```
export ACCUREV_PRINCIPAL=jjp
```

If You're Using the 'AccuRev Login' User-Authentication Scheme

With the "AccuRev login" user-authentication scheme, a session file establishes the AccuRev user identity of a process. Create a long-lived session file for the AccuRev Server's operating-system identity as follows:

1. Open a command-shell or C-prompt window.
2. Set environment variable ACCUREV_HOME to the home directory of the operating system user that the AccuRev Server runs as (for example, **acserver**).

   If the AccuRev Server is running as the local **System** account on a Windows machine, the home directory is **C:\**.
3. Create a long-lived session file for the AccuRev username that the AccuRev Server will use:

   ```
   accurev login -n jjp
   Password: ********
   ```

   Note: if you are creating a session file on a replica server machine, to be used for communicating with the AccuRev Server process on the master server machine, direct the **login** command to the master server machine. For example:

   ```
   accurev login -n -H bingo_master jjp
   Password: ********
   ```

This session file will be valid indefinitely, thanks to the **–n** option.

Starting the AccuRev Server

The following sections describe how to start the AccuRev Server program, either automatically at operating system bootstrap time, or manually at a command prompt. (You can also perform a "manual" startup with a Unix/Linux shell script or a Windows batch file.)

Running the Server Automatically at Operating System Startup

Typically, the Server program is started automatically when the operating system boots on the server machine. On Unix/Linux systems, an "rc" or "init.d" startup script starts the **accurev_server** program. The AccuRev installation program does not install the startup script automatically, however. You must customize and install the sample startup script, named **accurev**, located in the **extras/unix** subdirectory of the AccuRev installation directory. See the **README** file in that subdirectory for complete instructions.

On Windows systems, the AccuRev installation program automatically configures the **accurev_server.exe** program as a Windows service. Use the standard **Services** program on the Windows Control Panel to control the Server program.

Starting the Server Manually

The AccuRev Server must be started manually in the following environments:

- **Windows systems**: If you've changed the startup type of the **AccuRev** service to "Manual", you can start the service from the **Services** program. Alternatively, run the **server_start.bat** script, located in the AccuRev executables (**bin**) directory.
- **Unix/Linux systems**: Start the Server with the **acserverctl** utility:

  ```
  <AccuRev-executables-dir>/acserverctl start
  ```

  The Server will run with your operating-system user identity. (Make sure that the server configuration file's USER and GROUP settings are commented out. See *Controlling the Server's Operating-System User Identity* on page 12.)

Server Configuration File

When it starts, the AccuRev Server program reads configuration file **acserver.cnf**, located in the AccuRev executables directory. This configuration file is generated during installation, but can be edited manually thereafter.

Here is a sample **acserver.cnf**:

```
MASTER_SERVER = accurev_server_machine.company.com
SITE_SLICE_LOC = /partition0/site_slice
```

IMPORTANT NOTE: the white space surrounding the equals sign (=) in configuration files is mandatory.

The name of the server machine should be the fully-qualified server name, including a domain name and Internet extension. Using just the server name may work in most situations, but fully-qualified is preferred. Alternatively, you can use the IP address of the server machine.

The SITE_SLICE_LOC setting points to the directory that the Server uses for storing information about the site such as the user registry, depot information, etc. This directory:

- Must be owned by the operating-system account that the Server runs as (for example, **acserver**).
- Must be physically located on the server machine. The SITE_SLICE_LOC location must not be within a remotely mounted file system (Unix/Linux) or within a shared directory (Windows) on a remote machine.

Controlling the Server's Operating-System User Identity

Note: the settings described in this section apply to Unix/Linux machines only.

The following specifications determine the user identity and group membership of the operating system process in which the AccuRev Server runs:

```
USER = <user-name>
GROUP = <group-name>
```

When the AccuRev Server starts, it uses the Unix/Linux setUID facility to change its user identity and group membership. This succeeds if the Server is started by the **root** user — either automatically at system bootstrap time or manually, using the **acserverctl** utility. (See *Controlling Server Operation* on page 17.)

The setUID fails if the Server is started manually by an ordinary user. In this situation (for example, you are running a test installation of AccuRev), make sure that these settings are commented out:

```
#USER = ...
#GROUP = ...
```

With these settings commented out, the AccuRev Server runs under the identity of the user who started it.

Unix/Linux: Setting the Server's Home Directory

In addition to having a user identity and group membership, the AccuRev Server has an AccuRev home directory. This directory is used for a variety of purposes — for example, to store a login session file created by a **server_admin_trig** trigger script.

By default, the AccuRev home directory is the same as the operating-system home directory, as indicated by the environment variable HOME. It's a best practice to override the HOME value by setting the value of environment variable ACCUREV_HOME. If the AccuRev Server is started automatically at system startup time by a script in the "rc" or "init.d" directory, the most logical place to set the AccuRev home directory is in this startup script:

```
export ACCUREV_HOME=/users/acserver
```

Controlling Login Session Longevity

A successful user login creates a session that by default expires 4 hours (240 minutes) after the last AccuRev command is executed. You can change this behavior by creating or modifying this **acserver.cnf** setting:

```
SESSION_TIMEOUT = <number-of-minutes>
```

On Unix/Linux systems, a user can control the timeout for an individual session by setting environment variable SESSION_TIMEOUT before logging in. For example, to set a 15-minute timeout interval for a single session:

```
export SESSION_TIMEOUT=15
accurev login derek
```

Non-expiring login sessions

The following setting in **acserver.cnf** causes user sessions never to expire:

```
SESSION_TIMEOUT = 0
```

No matter what the setting, users can create non-expiring sessions with **login –n**.

Controlling Multithreading of the AccuRev Server

The AccuRev Server is a multi-threaded program, architected to support a maximum of 256 concurrent threads. To conserve system resources, you can specify a lower maximum in the **acserver.cnf** file:

```
MAX_THREADS = 25
```

As it's running, the AccuRev Server may reduce the maximum even further than the specified MAX_THREADS level, depending on the available computing resources.

Server Logging

The AccuRev Server maintains a log file, **acserver.log**, in subdirectory **logs** of the **site_slice** directory. Each log message includes a timestamp, the AccuRev username that invoked a client command, and the IP address of the client machine.

Logging Levels

Logging information can be preserved at various levels of detail, as specified in **acserver.cnf**:

```
# log level 2 or 3 is recommended by AccuRev support team
LOG_LEVEL = 2
```

Unix/Linux Systems Only: Log File Rotation

On Unix/Linux server machines, log file rotation keeps the log file from growing too large. Periodically, the AccuRev Server timestamps the current log file and moves it to subdirectory **logs** of the **site_slice** directory. For example, the log file might be renamed **acserver-2002-01-23-04-47-29.log**. The Server then creates a new **acserver.log** file. The log file is rotated weekly; it is also rotated whenever the AccuRev Server is restarted.

Controlling Server Log Verbosity

The AccuRev Server maintains a log file, **acserver.log**, in subdirectory **logs** of the **site_slice** directory. To enable the most verbose logging, add this line to the **acserver.cnf** file:

```
LOG_LEVEL = 3
```

At log level 1, each execution thread produces one line in the log. At log level 2, each execution thread can produce multiple log lines. Log level 3 essentially combines levels 1 and 2. At higher log levels, some of the messages detail the work of server subtasks.

Verbose Server Logging

The Server is a multi-threaded program, so it can handle several client commands concurrently. A typical AccuRev client command causes the AccuRev Server to execute a set of server subtasks. For each client command, the Server's "master thread" creates a new "worker thread" to perform the set of subtasks for that particular command. When the worker thread has performed all the subtasks, it exits. When the LOG_LEVEL is 2 or 3, the log messages indicate many of the details of server subtask execution.

For example, a single **update** command can generate a set of log messages like this:

```
2008/02/07 16:24:20  connection 1076 on 00000E98 cache 0 started
2008/02/07 16:24:20   1076 mary         *update       00000E98 1.2.3.101
2008/02/07 16:24:20   1076 mary         cur_wspace    00000E98 1.2.3.101
2008/02/07 16:24:20   1076 mary         ws_type       00000E98 1.2.3.101
2008/02/07 16:24:20   1076 mary         stream_top    00000E98 1.2.3.101
2008/02/07 16:24:20   1076 mary         check_time    00000E98 1.2.3.101
2008/02/07 16:24:20   1076 mary         update        00000E98 1.2.3.101
2008/02/07 16:24:20   1076 mary         end           00000E98 1.2.3.101
2008/02/07 16:24:20  connection 1076 on 00000E98 success 0.563 0 0 0 1.2.3.101 mary
```

These messages may or may not appear on consecutive lines of the log file. If multiple client commands are being executed concurrently by different worker threads, the log messages that the threads generate will be interleaved in the log file.

Let's examine each message in the above example:

```
2008/02/07 16:24:20  connection 1076 on 00000E98 cache 0 started
```

The first message is generated at the time (`2008/02/07 16:24:20`) a client request is accepted by the Server's master thread. This is `connection 1076` between the client and the server). The master thread creates a new worker thread (worker thread-ID `00000E98`) and hands the request off to it.

```
2008/02/07 16:24:20   1076 mary         *update       00000E98 1.2.3.101
```

This message indicates the user who invoked the command (`mary`), the name of the command, marked with an asterisk (`*update`), and the IP address of the client machine (`1.2.3.101`).

```
2008/02/07 16:24:20   1076 mary         cur_wspace    00000E98 1.2.3.101
2008/02/07 16:24:20   1076 mary         ws_type       00000E98 1.2.3.101
2008/02/07 16:24:20   1076 mary         stream_top    00000E98 1.2.3.101
2008/02/07 16:24:20   1076 mary         check_time    00000E98 1.2.3.101
2008/02/07 16:24:20   1076 mary         update        00000E98 1.2.3.101
2008/02/07 16:24:20   1076 mary         end           00000E98 1.2.3.101
```

Each time the worker thread begins a particular subtask, it sends a message to the log. In the lines shown above, the client command is implemented through server subtasks **cur_wspace**, **ws_type**, **stream_top**, **check_time**, **update**, and **end**. (The last subtask is always named **end**.) Each message also includes the username, thread-ID, and client IP address.

```
... connection 1076 on 00000E98 success 0.563 0 0 0 1.2.3.101 mary
```

The last message is generated by the worker thread after it has completed all subtasks and is about to exit. (If the LOG_LEVEL is 1, this is the *only* message generated for each client command.) In addition to the username, thread-ID, and client IP address data also included in the preceding messages, this message reports summary measures, listed in boldface above:

- **success** / **failure** (**`success`** in the example above): The overall result of the attempt to execute the client command.

- **run time** (`0.563`): the total time, in seconds, that the worker thread took to process the entire client command.
- **last check** (`0`): the time, in seconds, elapsed since last progress update from worker thread. In a success message, this value is 0. In a failure message, this value is non-zero.
- **time delta** (`0`): the time difference between the clocks on the client and server machines.
- **exit status** (`0`): the exit code for thread: 0 = success, non-zero = error.

Log Messages for Failed Commands

Internal AccuRev Server errors are logged like this:

```
2006/09/05 15:17:07 -Error- from 0000084C: 5 General internal error -
file.c:862 - Bad position requested for: wspaces.ndb o: 512 sz: 0
```

In this example, the database file **wspaces.ndb** had been accidentally renamed.

Server Watchdog

The AccuRev Server is designed for high reliability, to ensure the integrity of the repository and its availability to AccuRev users. But even the robust software systems are occasionally compromised; the AccuRev Server can be brought down by a bad disk sector or an administrator's mistaken command.

The reliability of the AccuRev Server is further enhanced by a companion program, termed the Watchdog, which runs on the same machine. The sole function of the Watchdog is to monitor the Server and restart it in the event of a failure. The effect of the Watchdog on Server performance is insignificant.

Note: both the Server and Watchdog show up in the operating system's process table with the same name: **accurev_server**.

Every 10 seconds, the Watchdog sends a simple command to the Server. If the Watchdog detects that the Server is not responding or is not functioning properly, the Watchdog restarts the Server. If the Watchdog detects 5 such failures within a 3-minute timespan, it doesn't restart the Server; such a situation indicates the need for server reconfiguration or investigation by the AccuRev support team. (If ACCUREV_WATCHDOG_FAST_FAIL_DISABLE is set in the Watchdog's environment, it keeps trying to restart the Server indefinitely.)

For the most part, the Watchdog is "transparent", making administration simple:

- The Watchdog process starts automatically when the Server process is started (typically, at operating system bootstrap time).
- The administrative commands for stopping the Server process cause both the Watchdog and Server to stop. These commands have been reworked to terminate the Watchdog directly; before it exits, the Watchdog terminates the Server.

Tools that control the execution of the Server and Watchdog are in described in section *Controlling Server Operation* on page 17.

Watchdog Logging

The Watchdog maintains a simple log file, **acwatchdog.log**, in subdirectory **logs** of the **site_slice** directory. On Unix/Linux server machines, the Watchdog log file is rotated similarly to the Server log file.

Controlling Server Operation

AccuRev includes facilities for controlling the operation of the AccuRev Server and the new Watchdog. The user interface varies by platform:

- Unix/Linux: the **acserverctl** command-line utility
- Windows: the standard **Services** console

Unix/Linux: 'acserverctl' Utility

If the AccuRev Server is running on a Unix/Linux machine, you can control its operation with the **acserverctl** program. This is a Bourne-shell script, located in the AccuRev **bin** directory. (It is based on the control script for the Apache Web server.)

> Note: by default, **acserverctl** assumes that AccuRev is installed at **/opt/accurev**. If this is not the case, you must run **acserverctl** in an environment where ACCUREV_BIN is set to the pathname of the AccuRev **bin** directory. For example:

```
env ACCUREV_BIN=/var/accurev/bin acserverctl ...
```

acserverctl provides a set of non-interactive commands. The format of each command is:

```
acserverctl <command-name>
```

(Omitting <*command-name*> is equivalent to executing **acserverctl help**.) The commands are:

start

Start the Server and Watchdog processes.

stop

Tell the Server and Watchdog processes to stop gracefully.

status

Report whether the Server is running or not.

pause

Tell the Server to stop accepting new requests from AccuRev clients.

resume

Tell the Server to start accepting new requests from AccuRev clients again.

restart

Tell the Server process to stop gracefully; this allows the Watchdog to restart it. If the Watchdog is not running, a **start** or **hardrestart** is performed.

kill

Forcibly stop the Server and Watchdog processes. This is accomplished by sending a TERM signal to each process. The script gets the process-IDs from files **acserver.pid** and **acwatchdog.pid**, located in the **site_slice** directory. These files are written automatically when the processes are started.

hardrestart

Perform a **kill**, followed by a **start**.

help

Display an **acserverctl** command summary.

The various "tell a process" capabilities are implemented through server-control files. (See *Server-Control Files* below.)

Windows: 'Services' Console

If the AccuRev Server is running on a Windows machine, you can control its operation from the standard Windows **Services** console. The **Services** console is located in the Windows **Control Panel**; in some versions of Windows, it's in a subdirectory called **Administrative Tools**.

The context (right-click) menu of the AccuRev service includes these commands:

start
stop
pause
resume
restart

For descriptions of these commands, see *Unix/Linux: 'acserverctl' Utility* above. On Windows, the **restart** command brings down both the Server and the Watchdog, by performing a **stop** followed by a **start**.

Server-Control Files

On all platforms, the AccuRev Server and Watchdog processes check, once per second, for the existence of several "server-control files" in the **site_slice** directory. The existence of the server-control file causes the process to perform a particular action. In most cases, the contents of the file are irrelevant; a zero-length file will do.

acserver.command.pause

(used by the **pause** server-control command) Tells the Server to stop accepting new requests from AccuRev clients. The Server completes transactions that are already in progress and logs its "paused" status to the log file. Then, it continues to run, but the only thing it does is monitor the **acserver.command.pause** file. When this server-control file is removed, the Server resumes normal operation.

This server-control file is *not* removed when a new Server process starts up. If the file exists, the Server starts up in the paused state.

acserver.command.shutdown

(used by the **stop** and **restart** server-control commands) Tells the Server to "finish up quickly" and exit. The Server immediately stops accepting new requests from AccuRev clients. It continues to work on transactions that are already in progress, but it aborts any transactions that are not completed within 10 seconds. Then, the Server exits.

If the Watchdog is running, it detects the Server's shutdown and starts up a new Server immediately. Thus, this server-control file typically causes a Server restart. In any event, this file is automatically removed whenever a new Server process starts up.

If 10 seconds is not the appropriate interval for "finishing up quickly", place another integer (such as 120) in the **acserver.command.shutdown** file. The Server exits when there are no more transactions to work on, or when the timeout interval has passed, whichever comes first.

acwatchdog.command.shutdown

(used by the **stop** server-control command) Tells the Watchdog to exit cleanly. When the Server detects that the Watchdog has exited, it exits also, just as if it had found an **acserver.command.shutdown** file (see above). In this case, however, there is no longer a Watchdog process, so no restart of the Server takes place.

This server-control file is automatically removed when a new Server process starts up.

acserver.command.taskkill

Use this capability only as a "last-resort". Typically, it's preferable to restart the entire AccuRev Server process (which allows in-progress tasks to complete), rather than terminating just one of its worker threads.

To terminate a particular worker thread:

- Go to the **site_slice** directory.
- Determine the ID number of the worker thread by examining the thread-status table (**Tools > Server Tasks** command).
- Place the thread's ID number (e.g. **42**) in the flag file:

  ```
  echo 42 > tempfile
  mv tempfile acserver.command.taskkill    (Windows: use ren command)
  ```

  Using the **mv** (or **move**) command instead of the **echo** command to create the **taskkill** file prevents a race condition that might cause the server to see **taskkill** as an empty file.

Important note: after terminating a thread, restart the AccuRev Server as soon as possible. This minimizes the likelihood that terminating the thread will cause a memory resource leak in the Server process, impairing overall system performance.

Open Filehandle Limits and the AccuRev Server

The AccuRev Server is designed to handle multiple client commands concurrently: any number of requests that "read" data, along with one command that "writes" data. Accomplishing such concurrency typically requires that the AccuRev Server have many files open at the same time. Each operating system imposes limits on how many files can be open simultaneously. There may be an "open file descriptor" limit for each user process, or an overall limit for all user processes, or both. If the AccuRev Server hits the open file descriptor limit, additional client requests will be queued until file descriptors become available. (No client command is cancelled, and no data is lost. Hitting the open file descriptor limit just slows AccuRev Server performance.)

The table below indicates the default open file descriptor limits for the various AccuRev-supported operating systems. Following the table are instructions for increasing these limits.

Operating System	Default Limit on Open Filehandles	Command to Change Limit on Open Filehandles
Windows 2000, Windows 2003, Windows XP	2048 per system	none
Solaris 7	64 per process	no command; must reconfigure Unix kernel (see below)
Linux (Red Hat Fedora 3)	about 3500 per system	/sbin/sysctl –w fs.file-max=10000
Linux (Power PC 2.4)	1024 per process	
AIX 5.1	2000 per process	
HP-UX 11	360 per process	no command; must rebuild Unix kernel (see below)
Tru64 5.1	4096 per process	
IRIX 6.2	1024 per process	
SCO UnixWare 7.1.1, 7.1.4	60 per process	no command; must rebuild Unix kernel (see below)

Note: If you are performing a pre-purchase evaluation of AccuRev in an environment with a limited number of users and a limited amount of data, there is no need to make any changes. The default limits will be more than adequate.

Changing the Per-Process Open File Descriptor Limit

The procedure for increasing a process's maximum number of open files varies from operating system to operating system.

Note: in all cases, be sure to remove file **acserver.handle.limit**, located in the AccuRev **site_slice** directory, before restarting the AccuRev Server or rebooting the operating system. This file caches the current value of the open-files limit.

Linux

You must be the **root** user to perform the following procedure.

1. Change the overall limit on the number of open file descriptors each process can have (e.g. to 10,000):

```
> /sbin/sysctl -w fs.file-max=10000
```

The number you specify is stored in file **/proc/sys/fs/file-max**.

2. Add this line to file **/etc/pam.d/login**:

```
session   required   /lib/security/pam_limits.so
```

3. Change the capabilities of the Bash shell command **ulimit**, by creating or editing the "nofile" (number of open files) lines in file **/etc/security/limits.conf**. Example:

```
*    soft    nofile    1024
*    hard    nofile    10000
```

These lines specify that:

- By default, a Bash shell (and its subprocesses) can have as many as 1024 open file descriptors.
- A Bash shell can execute the command **ulimit –n *number***, with 65535 as the maximum value of ***number***. This enables that particular shell (and its subprocesses) to have up to ***number*** open files. (The person executing the **ulimit** command doesn't need to know what the "hard limit" specified in **/etc/security/limits.conf** is — he can just enter the command as **ulimit –n unlimited** to get the maximum value.)

4. Test your change, by entering a **ulimit** command in a Bash shell, setting the limit somewhere in between the **soft** and **hard** specifications you made in Step 3. For example:

```
> /bin/bash

$ ulimit -n
1024

$ ulimit -n 5000

$ ulimit -n
5000
```

5. Restart the AccuRev Server process from a Bash shell:

```
> <AccuRev-bin-directory>/acserverctl stop(stop the AccuRev Server)

> /bin/bash(start a Bash shell)

$ <AccuRev-bin-directory>/acserverctl start(restart the AccuRev Server)
```

Solaris

You must be the **root** user to perform the following procedure.

1. Change the overall limit on the number of open file descriptors each process can have (e.g. to 5,000), by adding or changing this line in file **/etc/system**:

```
set rlim_fd_max=5000
```

2. Reboot the operating system.

HP-UX

You must be the **root** user to perform the following procedure.

1. Enter this command to start the System Administration Manager utility:

   ```
   > sam
   ```

2. Select **Kernel Configuration**, then **Configurable Parameters**.
3. Select the **maxusers** parameter.
4. Increase the value of this parameter, for example to 128.
5. Invoke the **Actions > Process New Kernel** command, to create a new HP-UX kernel.
6. Exit the System Administration Manager utility.
7. Reboot the operating system.

System Clock Synchronization

Time plays a fundamentally important role in AccuRev's architecture and in its day-to-day operations. Some examples: each transaction is logged in as depot database at a particular time; a snapshot reconstructs the state of a stream at an arbitrary time; the **stat** command and the AccuRev GUI use timestamps to optimize the lookup of modified files within a workspace.

AccuRev is a networked product: programs execute on one server machine and (typically) multiple client machines. In a perfect world, the system clocks on all these machines would always be perfectly synchronized. This would ensure that data items on the server machine (say, versions created by **keep** commands) and corresponding data items on a client machine (the files that were kept) have timestamps that are consistent with each other.

Software systems do exist that keep all the machines in a network synchronized to within milliseconds. If your organization has deployed such a system, then you don't need to read any further in this chapter!

Most software development organizations don't have — and don't need — synchronization at the millisecond level. AccuRev defines a 5-second tolerance as "good enough for software configuration management". This chapter describes AccuRev's own facilities for detecting and fixing system-clock discrepancies, along with other facilities commonly available on Windows and Unix/Linux systems.

Detecting System Clock Discrepancies — Timewarp

A timewarp (clock skew) occurs when the discrepancy between a client machine's system clock and the server machine's system clock exceeds the allowable tolerance of 5 seconds. Timewarp problems typically occur during initial system setup and during time zone adjustments. For example, the change from Eastern Standard Time to Eastern Daylight Time can cause a timewarp on a machine that is not configured correctly to handle the time zone adjustment.

For most AccuRev operations, a timewarp check is performed when the client contacts the server.

Fixing System Clock Discrepancies

The sections below describe various schemes for dealing with discrepancies between system clocks in the AccuRev client-server environment. We begin with the most desirable scheme: automatic, smooth clock adjustment. We end with the least desirable scheme: manual, sudden clock adjustment.

Automatic, Gradual Convergence of System Clocks

An optimal scheme for synchronizing machines' system clocks has these attributes:

- All machines in the network participate in the scheme, so the entire network is kept synchronized.
- Each machine's system clock is adjusted automatically (perhaps requiring some initial installation or configuration task).

- System clock adjustments can be made “smoothly”: for example, a discrepancy of 10 seconds can be gradually eliminated over the span of a few minutes by a minor speed-up or slow-down of a machine’s clock. Presumably, such adjustments are imperceptible to human users and won’t cause any “surprises” in time-sensitive applications.

Synchronization systems fitting this “gradual convergence” description are typically based on the standard Network Time Protocol (NTP) or its variant, the Simple Network Time Protocol (SNTP). One example, available on recent versions of Windows, is the Windows Time service (http://support.microsoft.com/default.aspx?scid=kb;en-us;307897&sd=tech). This provides a complete solution if all machines in your network are running Windows.

For a more general, multi-platform solution, see http://www.ntp.org. AccuRev has gotten good results from one particular SNTP client, **Automachron** (http://www.oneguycoding.com).

AccuRev-Related Guidelines

Here are guidelines for using a “smooth convergence” system in an AccuRev network:

- Configure the system so that a single machine in the network acts as the “time source” that other machines synchronize with.
- Ideally, have all AccuRev machines participate in the synchronization system.
- If this isn’t possible, make sure that the AccuRev server machine participates in the synchronization system. (AccuRev itself will take care of synchronizing its client machines to the server machine; see the next section.)

The purpose of these guidelines is to ensure that no AccuRev client machine gets into a situation of synchronizing itself with two different, and possibly conflicting, machines: the AccuRev server machine and the (S)NTP “time source” machine.

AccuRev’s Built-in Synchronization Scheme

The system clocks on all the machines running AccuRev client or server software are automatically synchronized by AccuRev. In contrast with the “smooth” clock-adjustment scheme used by sophisticated (S)NTP-based systems, AccuRev uses a simpler “sudden adjustment” scheme. For example, a 10-second discrepancy is eliminated all at once, not gradually. Moreover, adjustments are not made on a regularly scheduled basis, but only when an AccuRev client program contacts the server program.

> Note: you can disable auto-synchronization by having the AccuRev Server process run with environment variable AC_SYNCTIME set to 0. There is no way to include non-AccuRev machines in this scheme.

For many networks, AccuRev’s simpler scheme is altogether satisfactory. But some organizations may be running networked applications that don’t react gracefully to the “surprise” of a machine’s system clock suddenly changing by a significant number of seconds. Such organizations may not be satisfied with AccuRev’s simpler scheme.

AccuRev Synchronization Algorithm

Each time a client program contacts the server program, AccuRev compares the system clocks on the two machines:

- If the discrepancy is less than 5 seconds, no clock-related change occurs. AccuRev proceeds to execute the user's command.
- If the discrepancy is between 5 and 60 seconds:
    - AccuRev automatically tries to change the client machine's system clock to match the server machine's. (On a Unix/Linux client machine, this succeeds only if the client program is running as the **root** user, which is not advisable in most situations.)
    - For certain commands, AccuRev displays a warning message ...

      ```
      client_time:    2006/07/27 14:30:02 Eastern Standard Time (1154025002)
      server_time:    2006/07/27 14:24:29 Eastern Standard Time (1154024669)
      timewarp:       333 seconds
       ...
      ```

      ... then exits without executing the user's command. The following commands fall into this category:

      update
      co (with **–n** option)
      keep (with **–n** or **–m** option)
      promote (with **–p** option)
      stat or **diff** (with **–n** or **–m** or **–p** option)
      mkstream or **chstream** or **hist** (with **–t** option and an absolute time specification; for example, **–t 2006/07/12 00:00:00**)
    - For commands other than the ones listed above, AccuRev proceeds with command execution.
- If the discrepancy exceeds 60 seconds, AccuRev displays a warning message, listing both machines' system times and the size of the timewarp (as shown above), then exits without executing the user's command.

Manual Synchronization Tools

The least desirable scheme for keeping system clocks synchronized is to occasionally type clock-adjustment commands manually on one or more of the machines. This method can be improved a bit by using scripts and scheduling tools such as **cron** (Unix/Linux) and **at** (Windows).

Only the **root** user (Unix/Linux) or a user with administrator privileges (Windows) can set the system clock manually.

Setting the System Clock on the AccuRev Server Machine

On a Unix/Linux machine, the **date** command changes the system clock. What time should you set the clock to? In many cases, you can use **rsh** or **telnet** to determine the time on another “time source” machine.

On a Windows machine, use the **net time** command to synchronize with a specified “time source” machine, or with the domain controller machine. To set the clock to a particular time, use the **date** command in a Command Prompt window, or double-click the digital clock in the Windows task bar (lower-right corner of the screen).

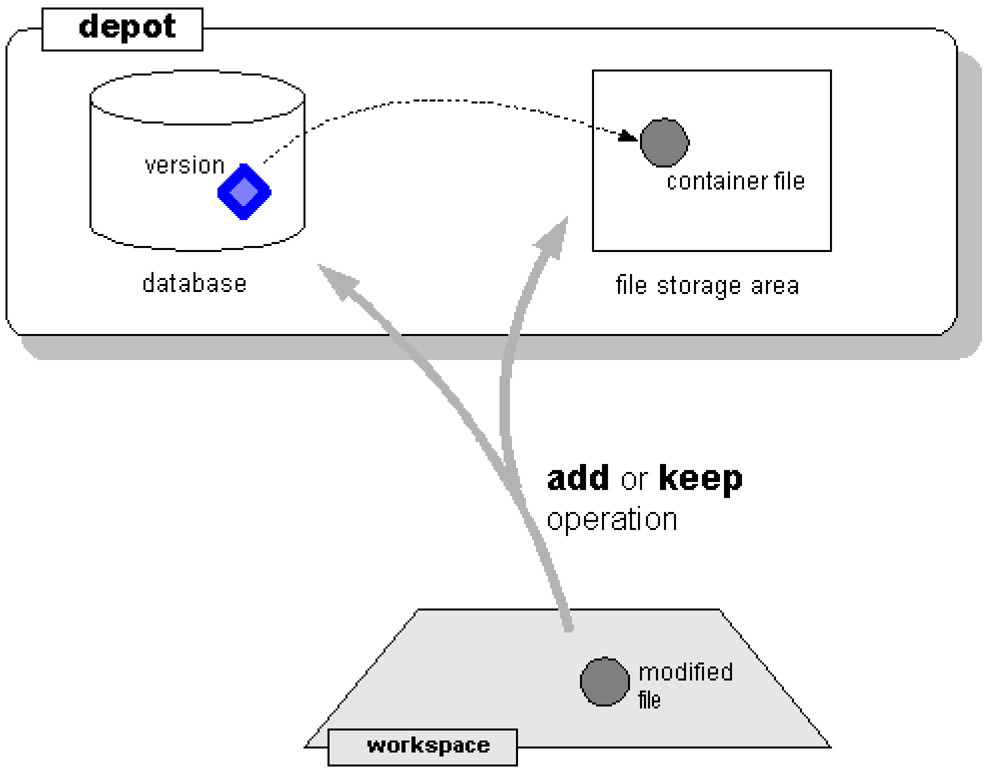
Setting the System Clock on AccuRev Client Machines

The **accurev synctime** command changes a client machine’s system clock to match the clock on the server machine. The GUI command is **Tools > Synchronize Time**. These commands should not be necessary very often, given the scheme described in section *AccuRev’s Built-in Synchronization Scheme* above.

Archiving of Version Container Files

Users execute a **keep** command to preserve the current contents of a version-controlled file ("file element") in an AccuRev depot. Similarly, users execute an **add** command to place a file under version control. The **add** and **keep** commands:

- copy the current contents of the file to a container file, located in the depot's file storage area.
- create an associated version object in the depot's database.



In accordance with the TimeSafe principle, the version object can never be deleted from the database or modified in any way. The corresponding container file is always accounted for, and can be in either of these states:

- **normal** — the container file is located in the depot's file storage area (the **data** subdirectory of the depot directory). AccuRev commands, such as **update**, **cat**, and **diff**, can access the contents of the version.
- **archived** — the container file has been moved to a gateway area outside the depot's file storage area. AccuRev commands cannot access the contents of an archived version. After container files have been moved to the gateway area, an administrator can use standard operating system or third-party tools to transfer the container files to off-line storage: tape, CD-ROM, removable disk drive, Web-accessible storage, etc.

The AccuRev CLI commands **archive** and **unarchive** shift container files back and forth between the normal and archived states. Before using **unarchive**, the administrator would transfer the appropriate container files from off-line storage back to the gateway area. Then, invoking **unarchive** moves the container files back into the depot's **data** directory.

The 'archive' Command

The command **accurev archive** processes one or more versions of file elements, shifting the versions' container files from **normal** status to **archived** status. The command has this format:

```
accurev archive [ -E <element-type(s)> ] [ -i ]
    [ -a | -I <stream-category(s)> ]
    [ -s <stream> ] [ -t <transaction-range> ]
    [ -c <comment> ] [ -R ] [ -Fx ] { -l <list-file> | <element-list> }
```

Determining Which Versions to Archive

archive determines the set of versions to archive as follows:

- Start with a particular set of file elements, which you specify as command-line arguments in the **<*element-list*>**, or in a list-file (plain-text or XML format). You can include directories in this list; in this case, use the **–R** option to include the recursive contents of those directories.
- Optionally, take the subset of versions whose element type matches the specification made with **–E**. (Note that different versions of an element can have different element types.)
- Optionally, take the subset of versions that were created in a particular streams (**–s**, for example, your current workspace stream). You can also archive versions from all streams in the depot (**–a**).
- Optionally, take the subset of versions created in a specific transaction, or range of transactions:

–t <*number*>	*single transaction*
–t <*number*>–<*number*>	*range of transactions*

- In addition to the multiple subsettings of versions described above, you can use the **–I** option to *include* versions in the set, based on where in the stream hierarchy they are referenced. For example, you can include versions that were not originally included in the set because they are referenced by one or more snapshots.

If you don't use the **–a** or **–I** option, **archive** refuses to archive any version that is currently visible in any stream or snapshot. Specified versions that are already archived are silently ignored.

Dry Run Capability

Using the **–i** option (in addition to the other options described above) generates an XML-format listing of the desired versions, but does not perform any actual archiving work. It is highly recommended that you do this "dry run" before actually archiving any versions, to avoid any surprises.

Archiving the Versions

After determining which versions to process, the **archive** command moves a version's container file from a "normal" location under the **data** directory:

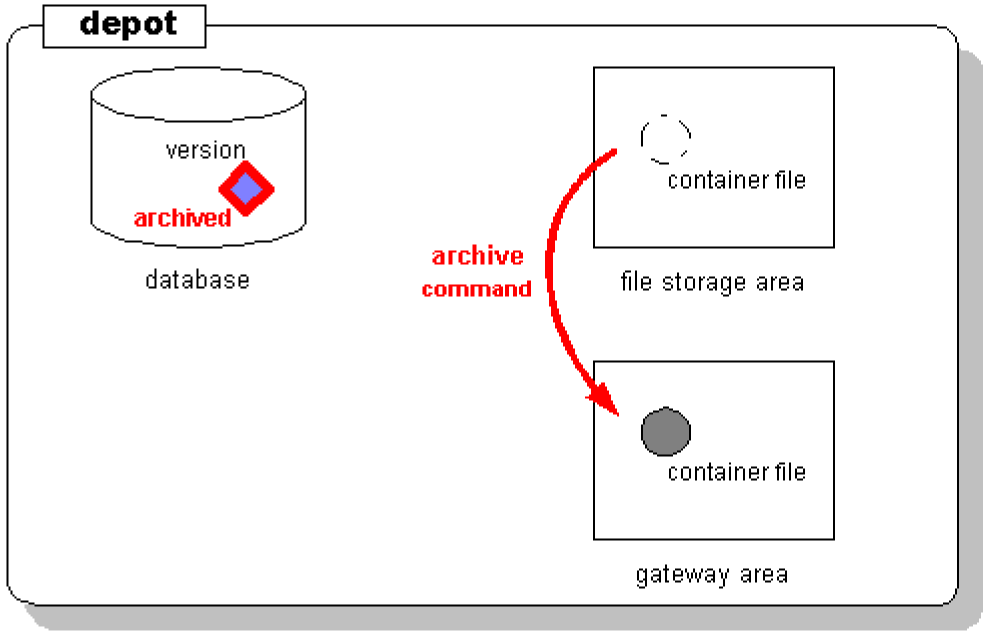
```
.../storage/depots/gizmo/data/25/07.sto
```

... to a corresponding "archived" location in the **archive_gateway/out** area:

```
.../storage/depots/gizmo/archive_gateway/out/data/25/07.sto
```

archive also marks the version as "archived" in the depot database.

Subsequent attempts by AccuRev commands to retrieve the contents of the archived version will fail.



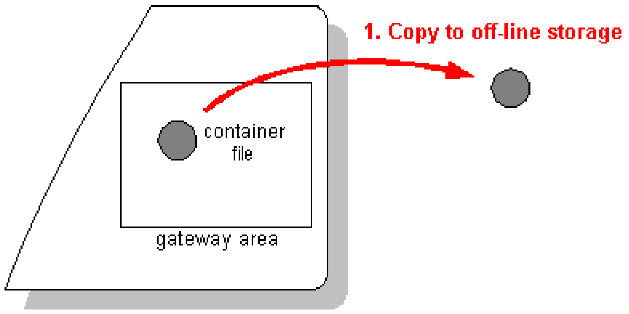
The changes made by this command are recorded in the depot database as a transaction of type **archive**. You can use the **–c** option to specify a comment string to be stored in this transaction. You can search for particular comment strings when using the **hist** command to locate previous **archive** transactions. See *Using 'hist' to Research Previous 'archive' Commands* on page 30.

The 'reclaim' Command

The **archive** command merely moves container files from one location (the depot's **data** area) to another location (the depot's **archive_gateway** area). To reduce the amount of disk space consumed by the archived versions, you must:

1. Copy the files from the **archive_gateway** directory tree to off-line storage. You can use operating system commands (**copy**, **xcopy**, **cp**, **tar**) and/or third-party data-backup utilities to accomplish this.

   Be sure to use a tool that preserves the source data's directory hierarchy in the copied data.

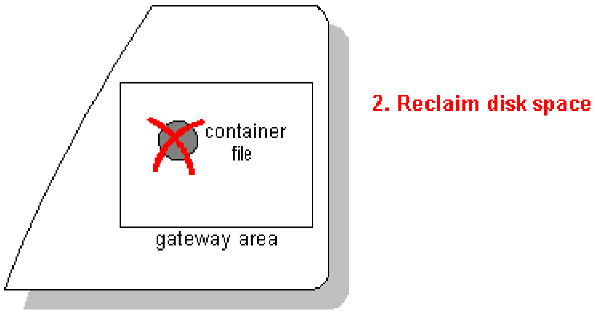


   WARNING! AccuRev has no way of tracking which tool you use for this purpose, or what off-line storage medium you copy the files to. It's up to you to maintain good records of these activities!

2. Delete the files from the **archive_gateway** directory tree, using the **reclaim** command:

```
accurev reclaim [ -p <depot> ]
   -t <archive-transaction>
```

   You must specify a single transaction of type **archive**, created by previous **archive** command(s).



Attempts to Access Archived Versions

The **archive** command affects depot storage only. It has no immediate effect on any workspace. But you might subsequently enter an AccuRev command that attempts to access a version that has been archived. For example, if version **gizmo_int/8** of file **floor_layout.gif** has been archived, then this command fails:

```
accurev cat -v gizmo_int/8 floor_layout.gif > old_layout.gif
```

In such cases, a message is sent to **stderr** and the command's exit status is 1.

Using 'hist' to Research Previous 'archive' Commands

Each depot's database contains a complete record of all version-archiving activity for that depot. Execution of the **archive** command is recorded as a transaction of kind **archive**. You can use the **hist** command to locate all such transactions:

```
accurev hist -a -k archive
```

You can also select just those **archive** transactions that were created with a particular comment string:

```
accurev hist -a -k archive -c "stadium images"
```

In a **reclaim** command, you must indicate the storage space to be reclaimed by specifying the number of an **archive** transaction.

Restoring Archived Versions — The ‘unarchive’ Command

After you have **archive**’d some versions and **reclaim**’ed the disk space:

- The versions’ container files are no longer in the depot’s **data** area.
- Copies of the container files are no longer in the depot’s **archive_gateway/out** area (since you’ve transferred them to off-line storage).

If you decide you need to restore some or all of the archived versions, you must first copy the container files from off-line storage back to the **archive_gateway** area. You must place the files under **archive_gateway/in**, at the same relative pathname as they were originally placed under **archive_gateway/out**. For example, if the **archive** command places a container file at:

```
.../storage/depots/gizmo/archive_gateway/out/data/25/07.sto
```

... you must restore the file from off-line storage to this pathname:

```
.../storage/depots/gizmo/archive_gateway/in/data/25/07.sto
```

After placing all the container files in the **archive_gateway/in** area, you can execute the **unarchive** command. This command has the same format as **archive**. That is, you specify the versions to be restored in exactly the same way as you originally archived them (with one exception — see below).

For example, to archive all non-active versions of GIF image files in stream **gizmo_maint_4.3**:

```
accurev archive -s gizmo_maint_4.3 *.gif
```

Later, you can restore all those versions:

```
accurev unarchive -s gizmo_maint_4.3 *.gif
```

Exception: you can use the **–a** option to unarchive *all* the versions currently in the **archive_gateway/in** area. In this case, the **unarchive** command syntax doesn’t mimic the **archive** command syntax exactly:

```
accurev unarchive -s gizmo_maint_4.3 -a
```

This set of restored versions might have been archived in a single step or in multiple steps.

Replication of the AccuRev Repository

This chapter describes how to set up and use AccuRev's repository replication feature. One server machine stores the "master" copy of the AccuRev data repository; any number of additional server machines can store "replicas" of the repository. Each replica contains some or all of the repository's depots. Users can send commands to the AccuRev Server software running on any of these machines.

Note: use of the repository replication feature requires purchase of the *AccuReplica* product from AccuRev, Inc.

Master and Replica

One host in the network acts as the AccuRev server machine: it runs the AccuRev Server process and contains the AccuRev repository in its local disk storage. In a replication scenario, this original host (or more precisely, this instance of the AccuRev Server process) is termed the master server.

One or more additional hosts in the network can act as replica servers. Each such host runs its own instance of the AccuRev Server process; likewise, each such host has its own copy of the AccuRev repository. The diagram below shows the servers in a replication scenario, along with various client machines.

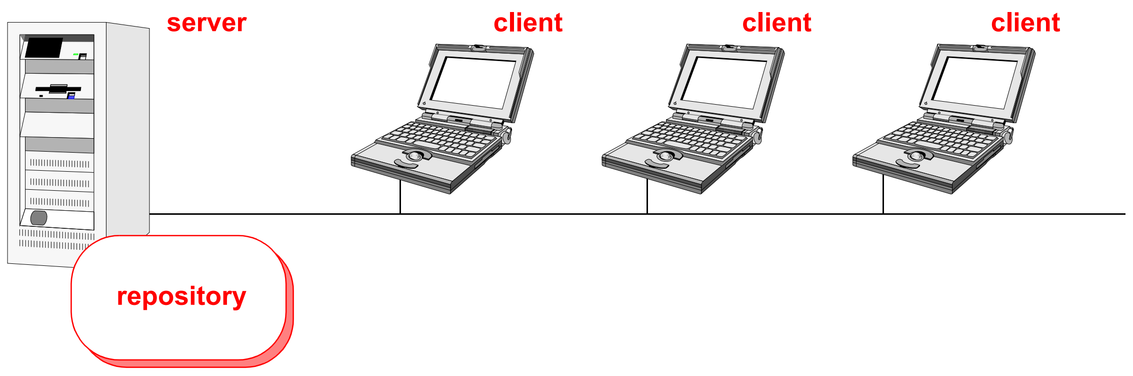
We use the terms master repository and replica repository to distinguish the multiple repositories in a replication scenario. The master repository is always complete and up-to-date; all transactions (operations that change the repository) are handled by the master server and are logged in the master repository.

By contrast, a replica repository can become out of date during day-to-day usage: it can be missing recent transactions initiated by clients using other replica servers or the master server. You can issue a simple synchronization command to download such missing transactions from the master repository to the replica repository. This makes the replica repository database into an exact copy (temporarily, at least) of the master repository database. Synchronization also occurs automatically whenever a transaction is initiated by a client using that replica server.

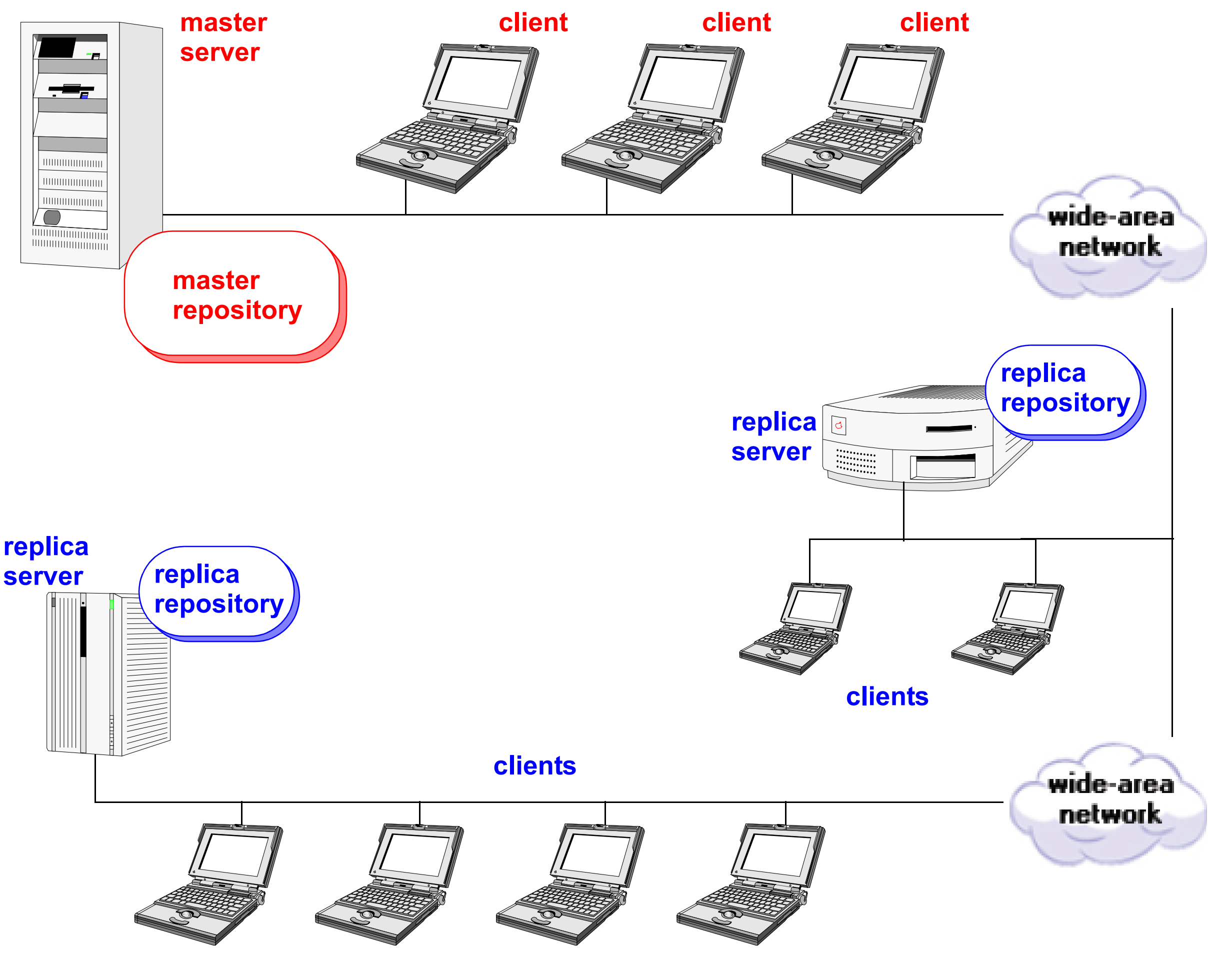
A replica repository can contain a selected subset of the depots in the master repository. If the master repository contains 10 depots, one replica repository might be configured to contain 4 of the depots, another replica repository might be configured to contain 7 of them, and a third replica repository might be configured to contain all 10 depots.

For more details on day-to-day operations involving master and replica repositories, see the sections starting with *Using a Replica Server* on page 39. First, we address licensing issues and describe the replica setup process.

Before Replication



After Replication



AccuRev Licensing in a Replication Environment

A standard AccuRev license (Professional Edition or Enterprise Edition) enables your organization to maintain a single data repository, managed by a single AccuRev Server process running on a particular machine. This license also enables a certain number of users to access the repository with AccuRev client software.

The most obvious (and easiest) way to add replication to this environment is to have the existing server machine become the master server. Let's say that you want to replicate the repository at two remote sites — one with 10 client users, the other with 25 client users. In this case, your organization needs to purchase:

- two copies of AccuRev Replication Server
- ten individual Remote User Licenses
- one Remote Site License (for the 25 users at the second remote site)

Installation Procedure: Assumptions

The procedures in the following sections make the following assumptions about your AccuRev installation:

- The original AccuRev server machine is named **masthost**. If one or more replicas have already been created, then this machine is already the master server.
- The machine to be made into a replica server is named **replhost**.

Restriction: **masthost** and **replhost** must both have "big-endian" hardware architectures, or must both be "little-endian". Little-endian architectures include Intel and AMD, running either Windows or Linux software. Big-endian architectures include Sparc (Sun) and PA-RISC (Hewlett-Packard), and PowerPC (AIX).

The same host can act both as the master server and as the replica server (or even as multiple replica servers). This can be convenient for performing testing of new releases, validating your organization's development procedures, etc. Before proceeding to the next section, read the notes in *Using the Same Host as Both Master Server and Replica Server* on page 38.

Setting Up the Master Server

The change described in this section needs to be made just once — when transitioning from a non-replicated setup to a replicated setup.

1. Stop the AccuRev Server process on **masthost**.
2. Edit the **acserver.cnf** file, which is located in the AccuRev **bin** directory. Add the following line:

   ```
   REPLICATION_ENABLED = true
   ```

   CAUTION: enabling replication poses a potential security risk. Before proceeding, be sure to read *Synchronization Security* on page 42.

3. Note the MASTER_SERVER and PORT settings in the **acserver.cnf** file. You'll need these settings in Step 9 below.
4. Restart the AccuRev Server process on **masthost**.
5. Create an AccuRev username that will be used as the user identity for all client requests from the new replica server. We'll use **repl43svr** as the username.

Setting Up the Replica Server

The following sections detail the steps for setting up **replhost** as an AccuRev replica server, using the repository data from **masthost**.

Install AccuRev

6. Obtain from AccuRev Support Services a **keys.txt** file containing a license to run the AccuRev Server software on **replhost**. Most specifications, including the number of users, should match the license on **masthost**. The host name will differ — and the port number might differ, too.
7. Install the AccuRev software on **replhost**. During installation, choose both the Custom and Full options. If you've already installed AccuRev on this machine, choose a new location for the installation directory. The installation wizard will prompt you to specify the storage location for the new, local repository on **replhost** ("Customize: Choose a Folder for AccuRev Server Data Storage").

Revise the Server Configuration File

8. Stop the AccuRev Server process on **replhost**.
9. Edit the **acserver.cnf** file, which is located in the AccuRev **bin** directory.
   - Change the keyword MASTER_SERVER to LOCAL_SERVER, and change the keyword PORT to LOCAL_PORT. But don't change the value of either setting.
   - Add new MASTER_SERVER and PORT settings, using the values of these settings on **masthost**. (These are the settings you noted in Step 3.)

   After these edits, the four lines might look like this:

   ```
   MASTER_SERVER = masthost
   PORT = 5050
    ...
   LOCAL_SERVER = replhost
   LOCAL_PORT = 5050
   ```

   Note: there is no relationship between the LOCAL_PORT and PORT numbers. They can be the same or different.

Establish an AccuRev User Identity for the AccuRev Server Process

These steps ensure that the **replhost** operating system process in which the AccuRev Server will run has an AccuRev username ("principal-name") identity with enough rights to access all the files in the **masthost** repository. AccuRev ACL permissions control access to depots and streams for specified AccuRev users and groups.

Be sure to use the same username that was created on **masthost** in Step 5 above — in our example, the name **repl43svr**.

10. Create an operating-system user named **repl43svr**. Then log in as **repl43svr**.

11. If **replhost** is running ...

    - ... Unix/Linux: by editing the server configuration file, configure **repl43svr** to be the operating-system user identity of the AccuRev Server on **replhost**. See *Operating-System User Identity of the Server Process* on page 9.
    - ... Windows: the AccuRev Server runs as a Windows service; you must reconfigure it to run as **repl43svr**, instead of as **LocalSystem**. In the Control Panel's Services program: open the Properties window for the AccuRev service, go to the Log On tab, select "This account", and enter **repl43svr** and its Windows password.

    Next, you'll establish **repl43svr**'s AccuRev-level credentials.

12. If you're using the "traditional" user-authentication scheme.

    - Make sure that **repl43svr**'s AccuRev-level password is set. (This password is independent of the user's operating-system password.) The AccuRev-level password is stored in file **authn**, in the **.accurev** subdirectory of **repl43svr**'s home directory.

    If you're using the "AccuRev login" user-authentication scheme.

    - Open a command-shell or C-prompt window.
    - Set environment variable ACCUREV_HOME to **repl43svr**'s home directory.
    - Create a "permanent" session file for user **repl43svr**, for accessing the AccuRev Server on **masthost** from the client machine **replhost**:

      ```
      accurev login -n -H masthost repl43svr
      Password: ********
      ```

      The –**n** option makes this session file valid indefinitely.

Synchronize the Site Slice

13. Start the AccuRev Server process on **replhost**.

14. Run this client command on **replhost**:

    ```
    accurev replica sync
    ```

This command copies data from **masthost**'s site slice to **replhost**'s site slice. In particular, it makes the AccuRev Server on **replhost** aware of all the depots in the master repository on **masthost**.

15. Create a standard session file for user **repl43svr**, for accessing the AccuRev Server on **replhost**:

    ```
    accurev login repl43svr
    Password: ********
    ```

    Note: there are now two session files for user **repl43svr**, one for accessing **masthost** and the other for accessing **replhost**.

Configure the Replica Server to Include the Desired Depots

The AccuRev repository on **replhost** now has an up-to-date site slice, but the repository doesn't yet contain detailed data on any depots.

16. List all the depots in the master repository, by executing this command on **replhost**:

    ```
    accurev show -fix depots
    ```

    In the XML-format output, the depots that exist in the master repository, but are not replicated on **replhost**, are listed with this attribute:

    ```
    ReplStatus = "missing"
    ```

17. For each depot that is to be replicated on **replhost**, execute a **mkreplica** command on **replhost**. For example, if depots named **widget**, **gadget**, and **cust_support** are to be replicated:

    ```
    > accurev mkreplica -p widget
    Created replica of depot 'widget'.
    Synchronizing ...
    Done.
    > accurev mkreplica -p gadget
        ...
    > accurev mkreplica -p cust_support
        ...
    ```

Using the Same Host as Both Master Server and Replica Server

In a production environment, it doesn't make sense to have the same machine act as both the master server and a replica server. But it *does* make sense to use a single machine to test new software or work processes. You can use the same machine as both **masthost** and **replhost** in the procedures described in sections *Setting Up the Master Server* on page 35 and *Setting Up the Replica Server* on page 36. If you do so, keep these points in mind:

- There must be two separate AccuRev installations on the machine.

- Each installation has its own **acserver.cnf** configuration file, located in the AccuRev **bin** directory. The SITE_SLICE_LOC setting must be different in each **acserver.cnf** file. Similarly, the DEPOTS_DEFAULT setting must be different.
- There is no way to associate the same depot slice with multiple repositories. A depot slice can be located outside the area specified by the DEPOTS_DEFAULT setting — with **mkdepot –l** on the master server; with **mkreplica –l** on a replica server; or with **chslice** on either kind of server. But don't use these techniques to make multiple instances of the AccuRev Server think that they are managing the same slice location.

Setting Up a Client Machine to Use a Replica Server

A machine on which the AccuRev client software is installed can use any server — either a replica server or the master server. As always, the SERVERS setting in the client configuration file — **acclient.cnf** in the AccuRev **bin** directory — specifies which AccuRev Server process is to be sent client command requests. Examples:

```
SERVERS = replhost:5050            (use replica server)

SERVERS = masthost:5050            (use master server)
```

You can switch a client back and forth among multiple replica servers (and possibly the master server, too). It's as simple as editing the client's **acclient.cnf** file.

Using a Replica Server

When your client machine is set up to use a replica server, you can issue all AccuRev commands in the usual way. In general:

- Configuration management commands that *read* data from the repository — such as **files**, **diff**, and **cat** — use the replica repository.
- Configuration management commands that *write* data to the repository — such as **keep**, **promote**, and **merge** — use the master repository. After the master repository has been modified, the local replica repository is automatically brought up to date. For details, see *Synchronizing a Replica Manually* on page 41, which describes how you can bring the local replica repository up to date when you are *not* writing data to the repository.
- All AccuWork issue management operations are handled by the master server. Thus, replication does not improve AccuWork performance.

The Update Command

The **update** operation works as follows when you execute it on a client that uses a replica server:

1. An implicit **replica sync** command is performed, copying database transactions from the master repository to the replica repository. This brings the replica database completely up to date.

2. A **stat** operation is performed on the replica server, to determine the state of the workspace stream and its backing stream.
3. Data files representing new versions of elements are copied from the file storage area in the master repository to the file storage area in the replica repository.
4. Data files are copied from the replica repository to your workspace tree. In addition to the files retrieved from the master repository in the preceding step, this can include files that have already been "downloaded" to the replica repository through other users' commands.
5. On both the replica server and the master server, the transaction level of the workspace is set to the most recent transaction (or to the transaction specified with **update –t**).

Triggers and Replication

A user's invocation of an AccuRev command on a client machine may cause a client-side trigger and/or a server-side trigger to fire. A client-side trigger fires on the user's client machine — no ambiguity there. But in a replication environment, there are two AccuRev Servers to consider: the one on the replica server machine and the one on the master server machine. Where does a server-side trigger fire?

- An **rmreplica** command fires a **server_admin_trig** trigger on the replica server. The AccuRev user identity ("principal-name") of the user who invoked the command is passed to the trigger script.
- An **replica sync** command fires a **server_admin_trig** trigger on the master server. The AccuRev user identity of the AccuRev Server process on the replica server is passed to the trigger script — not the identity of the user who invoked the command. The command-name is passed to the trigger script as **replica_sync**.
- For all other commands that write to the repository, a server-side trigger fires on the master server. The AccuRev user identity ("principal-name") of the user who invoked the command is passed to the trigger script.

Creating New Depots

New depots can be created only in the master repository, not in a replica repository. If a client using a replica repository issues a **mkdepot** command, an error occurs:

```
Cannot create a new depot on the replica server
```

After creating a new depot in the master repository, you can include it in a replica repository with this sequence of commands, issued on a client that uses the replica server:

```
accurev replica sync
accurev mkreplica -p <depot-name>
```

Adding and Removing Depots from a Replica Repository

After you have set up a replica repository, you can use the commands **mkreplica** and **rmreplica** to change which depots are included in the replica repository. These commands are described in the *AccuRev CLI User's Guide*.

Synchronizing a Replica Manually

During the course of development, your local replica repository typically becomes out-of-date with respect to the master repository. This occurs when other users send commands to other replica servers or directly to the master server. In both such cases, new transactions are entered in the master repository, but are not entered in the your local replica repository.

At any time, you can enter this CLI command to bring your local replica repository up to date:

```
accurev replica sync
```

This transfers data from the master repository site slice to the replica repository site slice. It also transfers database transactions from the master repository to the replica repository — but only for the depots that are included in the local replica. It does not transfer the corresponding storage files for **keep** transactions. See *On-Demand Downloading of a Version's Storage File* on page 41.

A **replica sync** command is performed automatically on the local replica after each operation that is initiated by a client of the local replica, and that makes a change to the repository. See *Using a Replica Server* on page 39.

Note: you never need to synchronize directly with other replicas; synchronizing with the master is sufficient to bring your replica up to date.

On-Demand Downloading of a Version's Storage File

As a performance optimization, AccuRev copies database transactions only — not storage files that hold the contents of **keep** versions — when it synchronizes the master repository with a replica repository ...

- ... during a **replica sync** command.
- ... during the automatic replica synchronization that follows an operation, invoked by a client using a replica server, that modifies the repository.

Storage files for versions are downloaded from the master repository to the local replica repository during an **update**. (See *The Update Command* on page 39.) The storage file for an individual version is downloaded when a client using a replica server explicitly references that version. Examples:

```
accurev cat -v talon_dvt/12 foo.c
accurev diff -v talon_dvt/12 foo.c
```

Both these commands cause the storage file for version **talon_dvt/12** of file **foo.c** to be downloaded to the local replica repository before the command itself is executed.

Automating Replica Synchronization

If a workgroup is much less active than other workgroups, its local replica repository can "fall behind" the master repository significantly. This can also occur if the workgroup uses the local replica repository mostly as a reference — for frequent read operations, but infrequent write operations. Falling behind in this way does no harm, but it can be bothersome. When some user finally does perform a write operation — keeping a new version of a file, or changing the location of a workspace — the local replica repository automatically "catches up", which might involve downloading tens or hundreds of transactions.

To prevent the local replica repository from falling too far behind, we recommend that you use operating system tools to perform an **accurev replica sync** command automatically, at regular intervals — say, every 15 minutes. On a Windows machine, use the Scheduled Tasks program in the Control Panel. On a Unix/Linux host, set up a **cron** job to execute this command.

Synchronization Security

Note: this section describes a security risk that exists only for organizations using the *AccuRev Replication Server* product. This risk does not apply to organizations that use the standard AccuRev software, without the replication option.

The repository synchronization scheme poses a potential security risk: the **acserver.cnf** server configuration file on an AccuRev server machine can name *any* master server machine in a MASTER_SERVER setting. And by default, the targeted master server will comply with *any* synchronization request — even an **accurev replica sync** command executed on a completely unrelated client machine.

We strongly recommend using the **server_admin_trig** trigger on the master server machine to implement an authentication scheme, so that the master server will send repository data over the wire only to valid requestors. The following Perl code might be added to the sample **server_admin_trig** script included in the **examples** subdirectory of the AccuRev distribution:

```
if ($command eq "replica_sync") {
  if ($principal ne "rep01_acadmin" and $principal ne "rep02_acadmin") {
    print TIO "Repository synchronization disallowed:\n";
    print TIO "Authentication by the server_admin_trig script failed.\n";
    close TIO;
    exit(1);
  }
}
```

This code allows users **rep01_acadmin** and **rep02_acadmin** to perform repository synchronization, rejecting requests from all other user identities.

Note: a **server_admin_trig** script identifies the command as **replica_sync**, even though the actual CLI command is **replica sync**.

The replica_site.xml File

Each replica repository's site slice directory contains an XML-format file, **replica_site.xml**. This file contains information about the depots that are replicated in that repository. The **mkreplica** and **rmreplica** commands maintain the contents of this file.

Moving the AccuRev Server and Repository to Another Machine

The AccuRev data repository should be physically located on the machine that runs the AccuRev Server process. (This is firm dictate, but not an absolute restriction — see *READ ME NOW: Assuring the Integrity of the AccuRev Repository* on page 1.) The repository consists of multiple slices: the site slice contains information that pertains to the entire repository, and each depot has its own slice. Each slice contains a database consisting of multiple files.

From time to time, you may want (or need) to have the AccuRev server process run on a different machine. To accomplish this, you must:

- Perform a "full" (client and server) installation of AccuRev on the new machine.
- Move the data repository to the new machine.

If the new machine has a different byte order than the old machine, you must migrate each slice to use the "opposite-endian" data format. This involves swapping the bytes in each machine-level word. The results of the migration are stored in a new subdirectory within each slice. This procedure is safe: the original slice data is never modified, and there is no harm in performing the migration procedure multiple times.

Procedure for Moving the Repository

Make sure you perform each of the following steps on the appropriate server machine. We call them:

- The "source" machine — where the AccuRev server is currently running and the data repository is currently located.
- The "destination" machine — the machine to which you want to move the data repository.

  Note: the steps below always show Unix/Linux pathname separators (/). When you're executing commands on a Windows machine (either source or destination), be sure to use Windows pathname separators (\ ).

The procedure calls for multiple stops and starts of the AccuRev Server process. For details on how to accomplish this, see *Controlling Server Operation* on page 17.

On the Destination Machine

1. Perform that a "full" (that is, both client and server) installation of AccuRev on this machine. In the steps below, we'll refer to the installation directory on the destination machine as ***<dest-install-dir>***. The installation directory pathname need not be the same as on the source machine. But if the pathnames differ, you'll need to do some extra work (Step 20 – *Step 24*).
2. Run this command on the destination machine:

   ```
   accurev hostinfo
   ```

3. Send the output of this command to AccuRev Support Services, as part of a request for a new license key for the destination machine. When you get the new license key, install it in the **site_slice** directory, according to the supplied instructions.
4. Store an additional copy of the license key outside the AccuRev repository, for use in Step 15.

Perform Step 5 only if the source and destination machines are opposite-endian:

5. Copy the following file to a secure location:

   ```
   <dest-install-dir>/storage/site_slice/datadict.ndb
   ```

On the Source Machine

6. Execute the command **accurev show slices** and **accurev show depots**, and save the output for reference in the following steps.
7. Stop the AccuRev Server process, as described in *Controlling Server Operation* on page 17.
8. Perform a full backup of the AccuRev repository, as described in *Backing Up the Repository* on page 3.

Perform Step 9 – Step 10 only if the source and destination machines are opposite-endian.

9. Migrate the site slice, using the **maintain** program located in the AccuRev **bin** directory:

   ```
   maintain migrate
   ```

   This creates a **swapped** subdirectory under the **site_slice** directory.
10. For each depot listed in the **show depots** output (Step 6), migrate the depot's slice:

    ```
    maintain migrate <depot-name>
    ```

    This creates a set of **swapped** subdirectories in the depot slices.
11. Copy the entire tree starting at directory **storage** within the AccuRev installation area. Be sure to use a method that preserves file ownership (e.g. **tar –cp**).

On the Destination Machine

12. Stop the AccuRev Server process.
13. Remove directory **<*dest-install-dir*>/storage**.
14. "Paste" (unpack, unzip, tar –x) the copy of the directory tree you made in Step 11, so that the pasted data becomes **<*dest-install-dir*>/storage**.

15. Overwrite file **<*dest-install-dir*>/storage/site_slice/keys.txt** with the copy of the license key that you saved in Step 4.

Perform Step 16 – Step 18 only if the source and destination machines are opposite-endian.

16. Move all ***.ndb** database files from the **site_slice/swapped** directory up to the **site_slice** directory. This overwrites the original ***.ndb** files there.
17. Move all ***.ndb** files from the **<*depot-name*>/swapped** directories up to the parent **<*depot-name*>** directories. This overwrites the existing ***.ndb** files in the **<*depot-name*>** directories.
18. Restore the copy of **<*dest-install-dir*>/storage/site_slice/datadict.ndb** that you made in Step 5.

Perform Step 20 – Step 24 only if the AccuRev installation directory is at a different pathname on the source and destination machines.

19. Remove file **sessions.dat** from the **site_slice** directory. This file contains data on client usage at the repository's old location.
20. Reindex the site slice:

```
maintain reindex
```

21. Restart the AccuRev Server process.
22. Log in to the AccuRev Server.
23. For each depot, determine the corresponding slice number (see Step 6) and run this command:

```
accurev chslice -s <slice-number>
   -l <dest-install-dir>/storage/depots/<depot-name>
```

24. Stop the AccuRev Server process.

Almost done!

25. Reindex each depot:

```
maintain reindex <depot-name>
```

26. Restart the AccuRev Server process.

AccuRev Security Overview

This chapter presents an overview of AccuRev's security-related features. We discuss and compare the following topics, and provide pointers to more detailed documentation.

- *Users and Groups*
- *User Authentication*
- *Locks on Streams*
- *Access Control List (ACL) Permissions*
- *Restricting Access to Commands using Triggers*

Users and Groups

Each AccuRev user must have an AccuRev username (also called a "principal-name"). AccuRev maintains its own user registry in the repository; it is separate from the registry maintained by your machine's operating system (or the network).

Optionally, you can create AccuRev user groups, and add users to the groups as "members". Starting in Version 4.5, groups can be nested within one another; that is, a group can be a member of another group. AccuRev groups are independent of operating system groups.

Groups are used by the ACL facility to grant or deny access to a particular resource for an entire set of users. They are used by the Locks facility to specify a set of users to which a stream lock does or does not apply. (See *Locks on Streams* on page 52 and *Access Control List (ACL) Permissions* on page 52.)

Usernames and Groupnames

Each AccuRev group has a user-defined name. Usernames and groupnames share a "namespace" in the AccuRev repository. This means that a user and a group cannot have the same name.

User Authentication

With a few exceptions, a user cannot execute AccuRev commands unless he is authenticated as a registered AccuRev user. For authentication purposes, each registered AccuRev user has a username/password pair recorded in the registry. A user's password can be empty.

AccuRev automatically distinguishes two categories of users — those who have non-empty passwords and those whose passwords are empty. The keywords **authuser** and **anyuser**, respectively, are used by the ACL facility to designate these categories. The keyword **notauth** indicates that the user is not authorized to execute AccuRev commands.

The "traditional" User-Authentication Method

Prior to Version 4.5, AccuRev supported a single method for authenticating users. This is now termed the **traditional** method. In this method, your AccuRev username is, by default, the same as your operating-system login name. The user can establish a different username by setting environment variable ACCUREV_PRINCIPAL.

Whenever the user invokes a command that requires user authentication:

1. AccuRev determines the username, by getting the value of ACCUREV_PRINCIPAL from the environment, or by asking the operating system for the user's login name.
2. If there's a non-empty password for this username in the AccuRev user registry, AccuRev compares this password with the contents of file **authn**, located in subdirectory **.accurev** of the user's operating-system home directory. The user is authenticated as an **authuser** if the strings match (case-sensitive). If they don't match, the user gets **notauth** status.

   If there's an empty password for this username in the AccuRev user registry, AccuRev still checks the **authn** file. The user is authenticated as an **anyuser** if the file is empty.

The "accurev_login" User-Authentication Method

Starting in Version 4.5, AccuRev also supports a method wherein a user is authenticated through an explicit login to the AccuRev Server. Using the GUI or the CLI, the user invokes the **Login** command and enters his password (possibly empty). This launches a user session, which is typically of limited duration (a few hours). When the session expires, the user must login again to continue using AccuRev.

The "custom" User-Authentication Method

AccuRev also supports script-based authentication of AccuRev users. This **custom** method works as follows:

1. The user invokes the **Login** command through the AccuRev GUI or CLI client, and types a password.
2. The client encrypts the password and transmits the username/password combination to the AccuRev Server.
3. The AccuRev Server verifies that the username exists in the repository's user registry. It does not check the password, however.
4. The AccuRev Server invokes a script named **server_auth_trig**, passing it an XML-format parameters file that includes the username/password combination. The exit status of this script determines the success/failure of the **Login** command. See *The 'server_auth_trig' Script* on page 51 for details.

This feature provides tremendous flexibility. For example, an authentication script could use an external user database, accessed through an LDAP interface, to perform AccuRev user authentication.

If you adopt the **custom** user-authentication method, it makes sense to purge user passwords from the AccuRev user registry. Passwords are stored in unencrypted format, and thus present a potential security problem. For example, user **derek** can remove his password from the AccuRev user registry with this command:

```
accurev chpasswd derek ""        (two consecutive double-quote characters)
```

Similarly, new users should be added to the AccuRev user registry with no password:

```
accurev mkuser justine        (no password argument following username)
```

The 'server_auth_trig' Script

The **server_auth_trig** user-authentication script, used by the **custom** user-authentication method, is similar to the **server_admin_trig** administrative trigger script. A sample script, implemented in Perl, is included in the AccuRev software distribution, in the **examples** subdirectory.

To deploy a user-authentication script, place an executable file in subdirectory triggers of the **site_slice** directory:

- Unix/Linux: the file must be named **server_auth_trig** or **server_auth_trig.pl**
- Windows: the file must be named **server_auth_trig.bat** or **server_auth_trig.exe**

The script is called when a user invokes the AccuRev **Login** command. It executes in a subprocess of the AccuRev Server. The script's standard input is a simple XML document, with the structure shown in this example:

```
<triggerInput>
   <hook>server_auth_trig</hook>
   <command>login</command>
   <ip>192.168.6.186</ip>
   <username>derek</username>
   <password>MyP@ssw0rd</password>
</triggerInput>
```

(No password encryption is necessary, because this XML document is passed to the subprocess through an operating system pipe, not through a file.) The script's standard output is appended to file **triggers.log**, located in the **logs** subdirectory of the **site_slice** directory. No output is required, however; only the script's exit status is significant:

- If exit status is zero, the user's Login command succeeds.
- If exit status is nonzero, the user's Login command fails.

The user's **Login** command also fails if the script does not execute properly — for example, if a runtime error occurs or the script file is not executable.

Selecting the User-Authentication Method

When you install AccuRev on the machine where the AccuRev Server process will run, the AccuRev Installation Wizard automatically sets the authentication method. Thereafter, you can switch methods with the **authmethod** command. Example:

```
accurev authmethod accurev_login
```

The switch takes place immediately. This might cause user confusion, so be careful!

How AccuRev Records the User-Authentication Method

The current user-authentication method is stored in file **preferences.xml** in the **site_slice** directory. (Don't confuse this with individual users' **preferences.xml** files.) For example:

```
<preferences>
   <authmethod>accurev_login</authmethod>
</preferences>
```

As an alternative to the **authmethod** command, you can change the user-authentication method by editing this file, then stopping and restarting the AccuRev Server process.

Restriction on Access to the "Add User" Command

User authentication is performed by the add-new-user command (GUI: **Add User**, CLI: **mkuser**). To prevent a chicken-and-egg problem, user authentication is bypassed if the AccuRev user registry is currently empty. After the first AccuRev user has been created, only an authenticated user can add users to the AccuRev user registry.

Locks on Streams

Each stream can have one or more locks on it. A lock prevents a certain set of users from using the stream to create new versions of elements. That is, it prevents execution of the **Promote** command — either promoting from the designated stream, or promoting to the designated stream, or promoting in either direction.

A lock can be absolute, applying to all users. Alternatively, you can specify that a lock applies to a particular AccuRev user, or to a particular AccuRev group. Conversely, you can specify that a lock applies to everyone *except* a particular AccuRev user, or to everyone *except* a particular AccuRev group.

Locks can also prevent reconfiguration of the contents of a stream with the include/exclude facility.

For more on locks, see the **lock** reference page in the *AccuRev CLI User's Manual*.

Access Control List (ACL) Permissions

In addition to (or instead of) locks, each stream can have one or more permissions on it. Whereas a lock controls the ability to create new versions (through the **Promote** command), a permission is more general: in addition to controlling **Promote**, it controls the ability to read data from the stream, using such commands as **Annotate**, **Diff**, and **Open**. A permission also controls workspace-specific commands, such as **Update** and **Populate**.

Unlike locks, which always apply to individual streams, ACL permissions can be configured to apply to entire stream subhierarchies.

You can create an ACL permission that applies to an entire depot. This provides a way of controlling access to all of a depot's file system data, in all streams. It also provides a way to control access to a depot's AccuWork issue database.

For more on ACL permissions, see the **setacl** reference page in the *AccuRev CLI User's Manual*.

Restricting Access to Commands using Triggers

By default, any registered AccuRev user can execute any AccuRev command. Many organizations wish to restrict users' access to certain commands, such as the ability to maintain users, groups, and passwords, the ability to lock streams and create ACL permissions, and so on. Triggers provide a flexible mechanism for implementing command-based security.

Many AccuRev commands can be configured to "fire a trigger". This causes a user-defined script to execute ...

- either before the command executes (pre-operation trigger), or afterward (post-operation trigger)
- either on the client machine, or on the server machine

A pre-operation trigger can affect the execution of the command or cancel it altogether. Typically, a security-related trigger checks the identity of the user invoking the command, then decides whether or not to allow the command to proceed.

Some triggers are configured on a per-depot basis, using the **mktrig** command. These triggers monitor individual commands (**add**, **keep**, and **promote**). Three are pre-operation triggers that fire on the client machine; one is a post-operation trigger that fires on the server machine.

Other triggers are configured, on a per-depot or whole-repository basis, by placing a script in a well-known location on the server machine. These triggers monitor groups of commands, rather than individual commands.

For more on triggers, see the chapter *AccuRev Triggers* on page 55.

Which Security Feature Should I Use?

AccuRev's security features overlap to a considerable extent. For example, when a user invokes the **promote** command, any of these mechanisms can prevent the command from proceeding:

- a lock on the source or destination stream
- an ACL permission on the destination stream, on a higher-level stream, or on the entire depot
- a **pre-promote-trig** trigger script, which runs on the client machine
- a **server_preop_trig** trigger script, which runs on the server machine

How do you decide which feature to use in a given situation? There are no absolute rules, but here are some guidelines:

To script or not to script?

The trigger mechanism depends on execution of user-supplied scripts, written in Perl, Python, or some other scripting language. There's a trade-off: scripting required development time and significant expertise, but is infinitely flexible.

In many situations, you may be able to use the AccuRev software distribution's sample Perl scripts, which are designed for fill-in-the-blanks customization.

It makes sense to implement as much security as possible with locks and ACL permissions (and perhaps the sample trigger scripts), before delving into original trigger scripting.

Locks vs. ACL permissions

Roughly speaking, a lock controls the placing of data *into* a stream, whereas an ACL permission controls the reading of data *from* a stream. (There are plenty of exceptions to this general rule.)

Both locks and permissions can be targeted at specific users or groups. The ACL is more flexible: you can create any number of permissions for the same stream, but only limited number of locks.

Running trigger scripts: client machine vs. server machine

Running trigger scripts on the client machine conserves networking and server resources. But keep in mind that all client machines must have copies of the scripts (or must have network access to a central script repository).

Running trigger scripts on the server machine provides administrative simplicity and centralized logging.

AccuRev Triggers

A trigger is a "code hook" or callback built into certain AccuRev commands. When a user enters the command, the corresponding trigger "fires"; this causes a user-defined or built-in procedure to be performed just before or after the command executes. Typically, a user-defined procedure is implemented as a script in the Perl scripting language. Sample Perl scripts are available in the **examples** subdirectory of the AccuRev installation directory.

> Note: in this chapter, "trigger script" refers to any executable program, written in any language, that is executed when a trigger fires.

AccuRev supports both pre-operation triggers and post-operation triggers. In addition, there are triggers that integrate AccuRev's configuration management facility with its issue management facility (AccuWork); these triggers have pre- and post-operation components.

Some triggers are set with the **mktrig** command; others are set by placing the script at a special location.

Pre-Operation Triggers

The following triggers execute a procedure before the user-requested command executes. Each of these triggers has the ability to cancel execution of the user's command. (See *Trigger Script Exit Status* on page 73.) Some of the triggers fire on the client machine, and others on the server machine. It's possible for a single command (e.g. **keep**) to cause triggers to fire both on the client and on the server.

Client-Side Triggers

The following pre-operation triggers fire on the client machine:

- **pre-create-trig**: fires on the client machine prior to execution of an **add** command (GUI: **Add to Depot**). It does not fire for an **ln** command (GUI: **Paste Link**), which creates a link element.)

  The trigger script must specify the element type (directory, text, binary, or ptext) of each element to be created by the command. This overrides the element type specified with the **add –E** option.

- **pre-keep-trig**: fires on the client machine prior to execution of a **keep** command.
- **pre-promote-trig**: fires on the client machine prior to execution of a **promote** command or a **purge** command (GUI: **Revert to Backed Version** or **Revert to Most Recent Version**).

Server-Side Triggers

The following pre-operation triggers fire on the server machine.

- **server_admin_trig**: fires on the server machine prior to execution of certain commands. This is a repository-wide trigger — it fires no matter what depot, if any, the user's command applies to. The following commands cause **server_admin_trig** to fire:

`addmember`	`lsacl`	`rmmember`
`chdepot (see note)`	`mkdepot`	`rmreplica`
`chpasswd`	`mkgroup`	`rmtrig`
`chref`	`mkreplica`	`rmws`
`chslice`	`mkstream`	`setacl`
`chstream`	`mktrig`	`unlock`
`chuser, chgroup`	`mkuser`	
`chws (see note)`	`mkws, mkref`	*`defcomp`*
`ismember`	`reactivate`	*`replica_sync`*
`lock`	`remove`	*`write_schema`*

Note: when the **chdepot** command renames a depot, **server_admin_trig** fires twice: there's a "chdepot" firing for the renaming of the depot object, followed by a "chstream" firing for the renaming of the depot's root-stream object. Similarly, when the **chws** command renames a workspace, **server_admin_trig** fires twice: there's a "chws" firing for the renaming of the workspace object, followed by a "chstream" firing for the renaming of the workspace stream object.

The last three commands are not standard AccuRev CLI commands:

  - The **defcomp** command is not user-visible; it's used in the implementation of the include/exclude facility CLI commands **incl**, **excl**, **incldo**, and **clear**.
  - The **replica_sync** command recognized by the **server_admin_trig** trigger corresponds to the CLI command **replica sync**.
  - The **write_schema** command is generated by the AccuRev GUI when the **Save** button is clicked in the Schema Editor.

Note: prior to Version 3.5, the services now provided by **server_admin_trig** were provided by a trigger named **server_all_trig**. (In the AccuRev-provided sample trigger script, this includes allowing commands to be executed only by a specified list of AccuRev users.) For backward compatibility, the older trigger is still supported.

*WARNING: The **server_all_trig** trigger is now deprecated. Support for this trigger will be withdrawn in a future AccuRev release.*

- **server_preop_trig**: fires on the server machine prior to execution of certain commands. This is a depot-specific trigger — it fires only for commands that operate on the depot(s) where the trigger has been activated. The following commands cause **server_preop_trig** to fire:

  ```
  add         co          reclaim
  promote     revert
  keep        purge
  ```
  (GUI: Revert to Backed)

  For **add** or **keep**, the **server_preop_trig** script can specify the exclusive file locking state (parallel or serial) of the element(s) processed by the command. This overrides any specification made with the **–E** command-line option.

The **server_admin_trig** and **server_preop_trig** triggers are independent of each other and are fired by different sets of commands — for a given command, only one of these triggers will fire. But these triggers can fire in addition to the triggers enabled with the **mktrig** command (**pre-create-trig**, **pre-keep-trig,** pre-**promote-trig**, and **server-post-promote-trig**) and the **server_dispatch_post** trigger.

Post-Operation Triggers

The following triggers execute a procedure after the user-requested command executes successfully. If the user's command fails, the post-operation trigger does not fire. A post-operation trigger always fires on the server machine.

- **server-post-promote-trig**: fires on the server machine subsequent to execution of a **promote** command.
- **server_dispatch_post**: fires on the server machine each time an AccuWork issue record is created or modified. This trigger is intended to enable email notification to interested users. A sample Perl script is available in the **examples/dispatch** subdirectory of the AccuRev installation directory.

Triggers in a Replication Environment

See *Triggers and Replication* on page 40.

Transaction-Level Integration Trigger

You can achieve tight coordination of your organization's configuration management and issue management capabilities by enabling one or both of the integrations between AccuRev's configuration management and issue management facilities. The transaction-level integration is enabled by a trigger on a depot-by-depot basis:

```
accurev mktrig -p WidgetDepot pre-promote-trig client_dispatch_promote
```

The "client_dispatch_promote" integration routine is built into the AccuRev software — no scripts are required — and includes both pre-operation and post-operation components:

1. On the client machine, a user invokes the AccuRev **promote** command.

2. The pre-operation part of the trigger fires on the client machine, prompting the user to specify one or more AccuWork issue records (SPACE-separated). If this part of the trigger fails (e.g. the user specifies a non-existent issue record), the **promote** command itself is cancelled.
3. The **promote** command completes, and is recorded in the AccuRev repository as a transaction.
4. The post-operation part of the trigger fires on the server machine, updating the issue record that the user specified by adding the number of the **promote** transaction to the **affectedFiles** field.

If you use the built-in "client_dispatch_promote" integration routine as the **pre-promote-trig** trigger, you must not also set a **server-post-promote-trig** trigger. Doing so would suppress the post-operation component of the "client_dispatch_promote" routine. For information on handling this situation and other aspects of customizing the transaction-level integration, see *Implementation and Customization of the Transaction-Level Integration* on page 79. (This section also describes another integration between configuration management and issue management, which works at the change-package level instead of the transaction level.)

> Note: the **purge** command (GUI command **Revert to Backed**) also triggers this integration, because it is uses the depot's **pre-promote-trig** trigger capability.

Preparing to Use an AccuRev-Provided Trigger Script

Sample trigger scripts are installed with AccuRev, in the **examples** subdirectory. These sample scripts are implemented in the platform-neutral Perl scripting language. Use the following procedure to install and use one of these scripts:

1. **Install Perl**. There are many source on the Web for Perl. We recommend the ActivePerl distribution from http://www.activestate.com. This distribution includes a conversion utility, **pl2bat**, which makes a Perl script executable under Windows, by embedding the Perl code in a Windows batch file (**.bat**).

   Be sure to install Perl on all appropriate machines. Note that some pre-operation triggers run on the client machine, while others run on the server machine. All post-operation triggers run on the AccuRev server machine.
2. **Get a copy of the sample script**. Copy the sample script from the **examples** subdirectory of the AccuRev installation directory to an AccuRev workspace. Then use the **add** command to place the script under version control.
3. **Prepare the script**. Open the script in a text editor, and customize the script according to the instructions included as comment lines. Before embarking on heavy script customization, be sure to read *The Trigger Parameters File* on page 60.
4. **Enable the Trigger.** Enable the trigger, either with the **mktrig** command or by placing the script in the proper location. See the following section for details.

Enabling a Trigger

Depending on its type, an AccuRev trigger is enabled in one of these ways:

- Executing an **accurev mktrig** command, specifying the location of the script. AccuRev simply records the location you specify in the repository; it doesn't make a copy of the script. Make sure that no one moves it!
- Placing the executable script file in the location prescribed for that type of trigger.

For details, consult the appropriate subsection below:

pre-create-trig, pre-keep-trig, pre-promote-trig, server-post-promote-trig

Use the **mktrig** command to enable use of the script in a particular depot. For example:

```
accurev mktrig -p WidgetDepot pre-keep-trig /usr/ac_scripts/addheader
```

The **–p** option isn't necessary if your current directory is in a workspace associated with that depot. When the trigger fires, AccuRev will search for the script at the specified pathname (in the example above, **/usr/ac_scripts/addheader**).

We strongly suggest specifying an absolute pathname. Otherwise, when the trigger fires, AccuRev will use the user's search path (for **pre-create-trig**, **pre-keep-trig**, or **pre-promote-trig**) or the search path of the AccuRev Server's user identity (for **server-post-promote-trig**) to find the specified script file.

server_admin_trig

Place an executable file in subdirectory **triggers** of the **site_slice** directory:

- Unix/Linux: the file must be named **server_admin_trig** or **server_admin_trig.pl**
- Windows: the file must be named **server_admin_trig.bat**

Example:

```
C:\Program Files\AccuRev\storage\site_slice\triggers\server_admin_trig.bat
```

Note: for compatibility with previous AccuRev releases, the script can also be named **server_all_trig**, with the appropriate suffix. If the directory contains both **server_admin_trig** and **server_all_trig** executables, only **server_all_trig** is executed.

server_preop_trig

Place an executable file in subdirectory **triggers** of the slice directory of one or more depots (**accurev show slices** displays slice directory locations):

- Unix/Linux: the file must be named **server_preop_trig** or **server_preop_trig.pl**
- Windows: the file must be named **server_preop_trig.bat**

Example:

```
/opt/accurev/storage/depots/talon_tests/triggers/server_preop_trig
```

server_dispatch_post

Place an executable file in the AccuRev executables (**bin**) directory on the AccuRev Server machine:

- Unix/Linux: the file must be named **server_dispatch_post** or **server_dispatch_post.pl**
- Windows: the file must be named **server_dispatch_post.bat**

  Note: for compatibility with previous AccuRev releases, the script can also be named **dispatch_email**, with the appropriate suffix.

Example:

```
C:\Program Files\AccuRev\bin\server_dispatch_post.bat
```

Notes on Triggers in Multiple-Platform Environments

Observe these guidelines in a multiple-platform environment, where the trigger script will be accessed from both Windows machines and Unix/Linux machines:

- Don't even try to arrange for exactly the same script file to be accessed by all users, on all platforms. Instead, place scripts to be accessed by Unix/Linux users in one directory and equivalent scripts to be accessed by Windows users in another directory.
- Make sure the Windows script has a **.bat** suffix (e.g. **check_for_comments.bat**), and that the Unix/Linux script has no suffix (**check_for_comments**).
- Make sure the scripts run correctly on their respective platforms. And remember to revise *all* versions of the script when you revise any one of them!
- In the **mktrig** command, specify the script name without a suffix — e.g.:

  ```
  accurev mktrig -p WidgetDepot pre-keep-trig check_for_comments
  ```

The Trigger Parameters File

When a trigger fires and executes a user-supplied script, AccuRev passes two arguments to the script:

- The first argument is the pathname of a flat-text file containing information about the transaction that is about to be performed (or was just completed).
- The second argument is the pathname of an XML-format file containing the same information. (In some cases, detailed below, the XML-format file contains a small amount of additional information that is not contained in the flat-text file.)

Exceptions: only one argument, the pathname of an XML-format file, is passed to a **server_preop_trig** script or a **server_admin_trig** script.

These files are called trigger parameters files. The flat-text file contains a series of values — usually one value per line — in a prescribed order. The XML-format file contains a set of elements below the top-level **<triggerInput>** element. Each such element contains the information for one parameter: the parameter name is the element tag, the parameter value is the element contents (sometimes encoded as a set of subelements). For example, here are two trigger parameters files generated by the same user command:

Flat-text trigger parameters file

```
pre-create
talon
talon_dvt_john
4
adding some files
this multi-line
comment has
four lines
C:/wks/talon/dvt_john
john
/tools/cont.sh
/tools/end.sh
/tools/start.sh
```

XML-format trigger parameters file

```
<triggerInput>
  <hook>pre-create</hook>
  <depot>talon</depot>
  <stream1>talon_dvt_john</stream1>
  <changePackages></changePackages>
  <comment>adding some files
this multi-line
comment has
four lines</comment>
<topDir>C:/wks/talon/dvt_john</topDir>
  <principal>john</principal>
  <elemList>
    <elem>/tools/cont.sh</elem>
    <elem>/tools/end.sh</elem>
    <elem>/tools/start.sh</elem>
  </elemList>
</triggerInput>
```

The information contained in the trigger parameters file varies among the trigger types, as described in the following sections.

Format of the "pre-create-trig" Trigger Parameters File

The following table presents the information in the trigger parameters file sent to a **pre-create-trig** script. This information describes the creation of one or more new elements to a depot (CLI: **add**, GUI: **Add to Depot**).

Note: the trigger fires on creation of a new file or directory element, but not on creation of a new link element (CLI: **ln**, GUI: **Paste Link**).

The order of the parameters in this table is the order in which they appear in the flat-text trigger parameters file. (Less importantly, it's also the order in which they appear in the XML-format trigger parameters file.)

Parameter	Description
hook	Type of trigger: **pre-create**.
output_file	(XML-format parameters file only) Not used by this trigger.
depot	Name of depot targeted by the command.
stream1	Name of the workspace stream in which the new elements are to be created.

Parameter	Description
changePackages	(XML-format parameters file only) The change packages affected by this command; currently defined to be empty for a **pre-create-trig** trigger.
comment	Zero or more comment lines specified by the user (see *Encoding of Command Comments* on page 73 below).
elemType	(XML-format parameters file only) Integer indicating the element type specified by the user: **0**=none specified, **2**=text, **3**=binary, **4**=ptext.
topDir	Pathname to the top-level directory of the user's workspace tree, as it is listed by the **show wspaces** command.
principal	AccuRev username of person invoking the command.
elemList elements	One or more files/directories to be added to the depot. For general notes, see *Encoding of Element Lists* on page 72 below.

In the flat-text trigger parameters file, the elements to be created are listed, one per line, at the end of the file:

```
/tools/cont.sh
/tools/end.sh
/tools/start.sh
```

<-- end-of-file of trigger parameters file

There is no need to supply an element count, since an end-of-file condition signals the end of the element list.

In the XML-format trigger parameters file, the element paths are encoded as **<elem>** sub-elements of **<elemList>**:

```
<elemList>
    <elem>/tools/cont.sh</elem>
    <elem>/tools/end.sh</elem>
    <elem>/tools/start.sh</elem>
</elemList>
```

(There is also an **<elements>** element with the same **<elem>** sub-element data.)

Overwriting the 'pre-create-trig' Trigger Parameters File

A **pre-create-trig** script must overwrite its flat-text parameters file with data that indicates the type of each element to be created. Each line must describe one new element:

```
<element-pathname>  <element-type>
```

... where <*element-pathname*> is a pathname from the input "elemList", and <*element-type*> is a numeric code:

1	directory
2	text file

3 binary file
4 ptext file

Make sure that the element-type value is 1 for every directory in the original list. You can't change the element-type of a directory! You can however, change among the text-file, binary-file, and ptext-file types. For example, you might override AccuRev's default classification of file **ReadMe.html** as 2 (text-file), setting the element-type to 3 (binary-file) instead.

See *Controlling the Element Type and Exclusive File Locking State* on page 40 of the *AccuRev CLI User's Guide* for a discussion of element types.

Example: to have an **add** command create two text-file elements, two binary-file elements, and a directory element, a **pre-create-trig** script would replace its flat-text parameters file with this data:

```
/tools/end.sh 2
/tools/icons 1
/tools/icons/end.png 3
/tools/icons/start.png 3
/tools/start.sh 2
```

Note: there is currently no provision for the script to overwrite the XML-format trigger parameters file. The data to be passed to the AccuRev Server must be in flat-text format.

Format of the "pre-keep-trig" Trigger Parameters File

The following table presents the information in the trigger parameters file sent to a **pre-keep-trig** script. This information describes the creation of a new versions of one or more existing elements in a depot (CLI: **keep**, GUI: **Keep**).

The order of the parameters in this table is the order in which they appear in the flat-text trigger parameters file. (Less importantly, it's also the order in which they appear in the XML-format trigger parameters file.)

Parameter	Description
hook	Type of trigger: **pre-keep**.
output_file	(XML-format parameters file only) Not used by this trigger.
depot	Name of depot targeted by the command.
stream1	Name of the workspace stream in which the new versions are to be created.
changePackages	(XML-format parameters file only) change packages affected by this command; currently defined to be empty for a **pre-keep-trig** trigger.
comment	Zero or more comment lines specified by the user (see *Encoding of Command Comments* on page 73 below).

Parameter	Description
elemType	(XML-format parameters file only) Integer indicating the element type specified by the user: **0**=none specified, **2**=text, **3**=binary, **4**=ptext.
topDir	Pathname to the top-level directory of the user's workspace tree, as it is listed by the **show wspaces** command.
principal	AccuRev username of person invoking the command.
elemList elements	A specification for each new element version to be created. For general notes, see *Encoding of Element Lists* on page 72 below.

In the flat-text trigger parameters file, the versions to be created are listed, one per line, at the end of the file. Each line contains three specifications:

```
<element-pathname>  <version-ID>  <element-type>
```

There is no need to supply an element count, since an end-of-file condition signals the end of the element list. For example:

```
/tools/icons/end.png talon_dvt_john/5 3
/tools/icons/end.sh talon_dvt_john/9 2
/tools/icons/start.png talon_dvt_john/2 3
/tools/icons/start.sh talon_dvt_john/13 2
```

In the XML-format trigger parameters file, each version to be created is encoded as an as **<elem>** sub-element of **<elemList>**. The element's attributes specify the version-ID (**stream** and **version** attributes) and the element-type (**elemType** attribute). The element pathname is encoded as the contents of **<elem>**.

The following example contains the same data as the flat-text example above:

```
<elemList>
  <elem
      stream="talon_dvt_john"
      version="5"
      elemType="3">/tools/icons/end.png</elem>
  <elem
      stream="talon_dvt_john"
      version="9"
      elemType="2">/tools/icons/end.sh</elem>
  <elem
      stream="talon_dvt_john"
      version="2"
      elemType="3">/tools/icons/start.png</elem>
  <elem
      stream="talon_dvt_john"
      version="13"
      elemType="2">/tools/icons/start.sh</elem>
</elemList>
```

In either format, the element-type value can be either **2** (text file), **3** (binary file), or **4** (ptext file). Note that different versions of an element can have different types.

In addition to the **<elemList>** element, the parameters file includes an **<elements>** element, with additional information on each file: its element-ID and the real version-ID of the workspace's *current* version (not the one about to be created):

```
...
<elem
    eid="58"
    ver="3/4">/tools/icons/end.png</elem>
...
```

Format of the "pre-promote-trig" Trigger Parameters File

The following table presents the information in the trigger parameters file sent to a **pre-promote-trig** script. This information describes the creation of a new versions of one or more existing elements in a depot (CLI: **promote**, GUI: **Promote**).

Note: the **pre-promote-trig** trigger also fires on execution of a CLI **purge** command (GUI: **Revert to Backed**) — but only when the version is being purged from a dynamic stream, not a workspace.

The order of the parameters in this table is the order in which they appear in the flat-text trigger parameters file. (Less importantly, it's also the order in which they appear in the XML-format trigger parameters file.)

Parameter	Description
hook	Type of trigger: **pre-promote**.
output_file	(XML-format parameters file only) Not used by this trigger.
action	(XML-format parameters file only, and only for the **purge** command) The character string **purge**.
option_I	(XML-format parameters file only) The issue number (or numbers, SPACE-separated) specified by the user with the **promote –I** command-line option.
depot	Name of depot targeted by the command.
stream1	Name of the workspace or stream that the versions are to be promoted from.
stream2	(XML-format parameters file only) Name of the stream that the versions are to be promoted to.
changePackages	(XML-format parameters file only) change packages affected by this command; currently defined to be empty for a **pre-promote-trig** trigger.
comment	Zero or more comment lines specified by the user (see *Encoding of Command Comments* on page 73 below).

Parameter	Description
elemType	(XML-format parameters file only) Integer indicating the element type specified by the user: **0**=none specified, **2**=text, **3**=binary, **4**=ptext.
topDir	Pathname to the top-level directory of the user's workspace tree, as it is listed by the **show wspaces** command.
principal	AccuRev username of person invoking the command.
elemList elements	One or more files/directories to be promoted. For general notes, see *Encoding of Element Lists* on page 72 below.

In the flat-text trigger parameters file, the elements to be created are listed, one per line, at the end of the file:

```
/tools/cont.sh
/tools/end.sh
/tools/start.sh
```

<-- end-of-file of trigger parameters file

There is no need to supply an element count, since an end-of-file condition signals the end of the element list.

In the XML-format trigger parameters file, the element paths are encoded as **<elem>** sub-elements of **<elemList>**:

```
<elemList>
    <elem>/tools/cont.sh</elem>
    <elem>/tools/end.sh</elem>
    <elem>/tools/start.sh</elem>
</elemList>
```

In addition to the **<elemList>** element, the parameters file includes an **<elements>** element, with additional information on each element: its element-ID and the real version-ID of the version to be promoted):

```
<elements>
<elem
    eid="51"
    ver="8/13">/tools/cont.sh</elem>
</elements>
```

Overwriting the 'pre-promote-trig' Trigger Parameters File

A **pre-promote-trig** script can work in tandem with a **server-post-promote-trig** script, providing customized "before and after" processing around the execution of **Promote** commands:

- The **pre-promote-trig** script overwrites its flat-text triggers parameters file.
- The *first line* of the overwritten parameters file becomes the value of the <*fromClientPromote*> parameter passed to the **server-post-promote-trig** script.

Note: there is currently no provision for a **pre-promote-trig** script to pass data to a **server-post-promote-trig** script by overwriting the XML-format trigger parameters file.

Format of the "server-post-promote-trig" Trigger Parameters File

The following table presents the information in the trigger parameters file sent to a **server-post-promote-trig** script. This information is generated by AccuRev, and describes the **Promote** command that has just executed. The first line of this file provides a mechanism for passing user-specified data from a **pre-promote-trig** script to a **server-post-promote-trig** script. See *Overwriting the 'pre-promote-trig' Trigger Parameters File* on page 66.

The order of the parameters in this table is the order in which they appear in the flat-text trigger parameters file. (Less importantly, it's also the order in which they appear in the XML-format trigger parameters file.)

Parameter	Description
hook	Type of trigger: **server-post-promote**.
output_file	(XML-format parameters file only) Not used by this trigger.
depot	Name of depot targeted by the command.
stream1	Name of the stream that the versions were promoted to.
fromClientPromote	A single text line containing the issue number (or numbers, SPACE-separated) specified by the user during the **Promote** command. If no issue number was specified, the flat-text parameters file contains a blank line and the XML-format file contains an empty element.
changePackages	(XML-format parameters file only) A set of <changePackageID> subelements, specifying the same information as <fromClientPromote>.
transNum	The transaction number of the **Promote** transaction that just completed.
transTime	The time of the **Promote** transaction that just completed.
comment	Zero or more comment lines specified by the user in the **Promote** command (see *Encoding of Command Comments* on page 73 below).
principal	AccuRev username of person invoking the command.
elemList and elements	A specification for each version that was promoted. For general notes, see *Encoding of Element Lists* on page 72 below.

The following example shows the data encoded in **<elemList>** and **<elements>**:

```
<elemList>
    <elem
        stream="9"
        version="7"
        elemType="2">/dir00/sub00/file04.txt</elem>
  </elemList>
  <elements>
    <elem
        eid="8"
        ver="9/7">/dir00/sub00/file04.txt</elem>
  </elements>
```

Format of the "server_preop_trig" Trigger Parameters File

The parameters file passed to a **server_preop_trig** script is in XML format:

```
<triggerInput>
  <hook> ... </hook>
  <command> ... </command>
  <principal> ... </principal>
  <ip> ... </ip>
  ...
</triggerInput>
```

The set of subelements under the **<triggerInput>** element depends on the user's command. The following table provides a summary. For full details, see the sample **server_preop_trig** script in the **examples** directory in the AccuRev installation area.

Parameter	Description
hook	Type of trigger: **server_preop_trig**.
output_file	(XML-format parameters file only) The name of the file that the **server_preop_trig** script can create in order to control the element type and/or exclusive file locking state of the elements processed by an **add** or **keep** command. See *Controlling Element Type and Exclusive File Locking with a "server_preop_trig" Script* on page 69.
hierType	(**add**, **keep** commands only) The exclusive file locking state specified with the **–E** command-line option: **serial** or **parallel**.
command	The user command: **add**, **keep**, **promote**, **purge**, or **revert**.
principal	AccuRev username of person invoking the command.
ip	The IP address of the client machine.
stream1	The user's workspace stream.
stream2	The workspace's parent (backing) stream.
depot	Name of depot targeted by the command.
fromClientPromote	(**promote** command only) The number of the AccuWork issue record entered by the user, when prompted by the transaction-level integration or the change-package-level integration.

Parameter	Description
changePackagePromote	(**promote** command only) A set of <changePackageID> subelements, specifying the change packages (that is, issue records) specified in the user’s command. These forms of the **promote** command generate a <changePackagePromote> element: • **promote –I** (user specifies issue record number(s) on the command line) • **promote** (user prompted to specify issue record number(s) by the transaction-level or change-package-level integration) • **promote –Fx** (user specifies a set of issue records with an XML file) The user can also specify issue record(s) through the AccuRev GUI.
comment	Comment string specified by the user. If the comment spans multiple lines, line-terminators are embedded in the string, but the final line does not have a line-terminator.
elemList elements	A set of <elem> subelements, each specifying one element processed by the user’s command.

Controlling Element Type and Exclusive File Locking with a “server_preop_trig” Script

The trigger parameters file sent to a **server_preop_trig** script contains an **<output_file>** element — for example:

```
<triggerInput>
  <hook>server_preop_trig</hook>
  <output_file>cache/0_0.out</output_file>
  ...
```

The script can create a file at this relative pathname (it doesn’t exist when the trigger fires), in order to control the element type and/or exclusive file locking state of some or all of the elements processed by the user command.

The XML element named **<elements>** in the trigger parameters file contains the data that the script needs to generate the output file— for example:

```
<elements>
  <elem
        count="0"
        eid="0"
        elemType="text"
        hierType="parallel">/dir03/sub05/able.txt</elem>
  <elem
        count="1"
```

```
            eid="0"
            elemType="text"
            hierType="parallel">/dir03/sub05/baker.bin</elem>
      <elem
            count="2"
            eid="0"
            elemType="text"
            hierType="parallel">/dir03/sub05/carr.doc</elem>
   </elements>
```

For each AccuRev element to be processed, **<elements>** contains information about how the new version of the element will be created — unless the script intervenes. This includes both the element type (**elemType** attribute) and the exclusive file locking state (**hierType** attribute).

Note: **<elemList>** contains a subset of the data in **<elements>**, and can be safely ignored.

Suppose the example code above was passed to the **server_preop_trig** script by the **add** command, which the user invoked to place three files under version control: **able.txt**, **baker.bin**, and **carr.doc**. And suppose that the script decides to specify that:

- Elements **baker.bin** and **carr.doc** are to be placed in the **serial** exclusive file locking state.
- The first version of **baker.bin** is to have the **binary** element type.

In this case, the output file should contain the following code:

```
<elemList>
  <elem count="1"  hierType="serial"  elemType="binary"></elem>
  <elem count="2"  hierType="serial"></elem>
</elemList>
```

Notes:

- The top-level XML element in the output file is **<elemList>**, not **<elements>**.
- Each **<elem>** XML subelement identifies an AccuRev element through the **count** attribute (representing the position on the command-line); no element pathname is required.
- The value of the **hierType** attribute must be either **serial** or **parallel**.
- An **<elem>** is required only for AccuRev elements whose exclusive file locking state is to be changed from the default (or with a **keep** command, to be changed from its existing state). Thus, there need not be an **<elem>** for file **able.txt**, which is to be created in the default locking mode, **parallel**.
- The number of **<elem>**s need not match the number of AccuRev elements being processed by the command; if there are "too many", the final **<elem>**s are silently ignored; if there are "too few", the final AccuRev elements get the default processing.
- A **server_preop_trig** script can coexist with a **pre-create-trig** script, both of them making element-type specifications. The **pre-create-trig** script must specify an element type for every new element; this is not a requirement for the **server_preop_trig** script. If both scripts specify an element type for the same element, the **server_preop_trig** script "wins".

Format of the “server_admin_trig” Trigger Parameters File

The parameters file passed to a **server_admin_trig** script is in XML format: The set of subelements under the **<triggerInput>** element depends on the user’s command. The following table provides a summary. For full details, see the sample **server_admin_trig** script in the **examples** directory in the AccuRev installation area.

Parameter	Description
depot	Name of depot in which the AccuWork issue database resides.
hook	Type of trigger: **server_admin_trig**.
command	The user command.
principal	AccuRev username of person invoking the command.
user	(chuser, chpasswd) AccuRev username being modified.
group	(ismember, addmember, rmmember) AccuRev groupname
newName	(chuser, chgrp) new AccuRev username or groupname.
newKind	(chuser) new user kind (**dispatch** or **cm**).
ip	The IP address of the client machine.
stream1	The stream targeted by the user command.
stream2	The parent (backing) stream of **stream1**.
stream3	(chws, chstream) The new name of the workspace or stream.
streamType	(mkstream, mksnap) The kind of stream being created by the command: **regular**, **pass-through**, or **snapshot**.
objectName	(remove, rmws, reactivate) Name of object targeted by the command.
objectType	(remove, rmws, reactivate) Type of object targeted by the command: **1**=reference tree; **2**=workspace; **3**=stream; **5**=user; **6**=group

Format of the “server_dispatch_post” Trigger Parameters File

The parameters file passed to a **server_dispatch_post** script is in flat-text format. The order of the parameters in the table below is the order in which they appear in the file.

Parameter	Description
hook	Type of trigger: **server-post-dispatch**.
project	Name of depot in which the AccuWork issue database resides.
stream	blank line.

Parameter	Description
from_client_promote	Two SPACE-separated fields: • The number of the transaction that created the previous version of this issue record. (The number **0** indicates that this is a newly created issue record.) • The issue number
transaction_num	The number of the transaction that created this new version of the issue record.
transaction_time	The time at which **transaction_num** was created.
comment_lines	blank line.
author	The AccuRev principal-name of the user who saved the issue record.

Encoding of Element Lists

In both kinds of trigger parameters files, each element is listed by its path relative to the depot's top-level directory:

```
/tools/cont.sh
```

The path begins with a slash in order to simplify constructing the element's full pathname on the client machine: just append the given element pathname to the **topDir** pathname (the top-level directory of the user's workspace tree).

In the flat-text trigger parameters file, the elements (or elements-to-be) to be processed by the user command are listed, one per line, at the end of the file:

```
/tools/cont.sh
/tools/end.sh
/tools/start.sh
```
<-- end-of-file of trigger parameters file

(Unlike the set of comment lines, there is no need to supply an element count; an end-of-file condition signals the end of the element list.)

- For **pre-create-trig** and **pre-promote-trig**, the element pathname appears alone on the line.
- For **pre-keep-trig**, each element is followed by the version-ID of the version about to be created (with the workspace specified by name), followed by the element-type code:

  ```
  /dir07/sub04/file02.txt  rack_dvt_john/3  2
  ```

  As always the element-type coding is: 1=directory, 2=text file, 3=binary file, 4=ptext file.
- For **server-post-promote-trig**, each element is followed by the real version-ID of the promoted version (with the workspace specified by number), followed by the element-type code:

  ```
  /doc/Chapter_03.rtf  9/7  4
  ```

In the XML-format **server_preop_trig** trigger parameters file, the element paths are encoded as **<elem>** sub-elements of the **<elemList>** element:

```
<elemList>
    <elem>/tools/cont.sh</elem>
    <elem>/tools/end.sh</elem>
    <elem>/tools/start.sh</elem>
</elemList>
```

Encoding of Command Comments

In the flat-text trigger parameters file, the user's comment is indicated by a line-count (0 or greater), followed by the lines of the comment, if any:

```
4                                <-- number of comment lines to follow
adding some files
this multi-line
comment has
four lines
```

In the XML-format trigger parameters file, the user's comment is encoded as the contents of the **<comment>** element: a single string. For a multi-line comment, this string has line-terminators embedded:

```
  <comment>adding some files   <-- embedded line-terminator
this multi-line                <-- embedded line-terminator
comment has                    <-- embedded line-terminator
four lines</comment>
```

Note that the final line-terminator is automatically stripped from all comment strings.

The sample set of trigger scripts includes a Perl script for each kind of trigger. The script's comments include a detailed description of the layout of the parameters file for that kind of trigger.

Trigger Script Contents

A trigger script can send email, start a build, update a Web site, or perform many other tasks. In particular, you can run AccuRev commands to get more information. One common use of the **server-post-promote-trig** trigger is to run the **hist** command using the transaction number of the promotion, generating the list of promoted elements for inclusion in an email notification.

Trigger Script Exit Status

The exit status (return value) of a **pre-create-trig**, **pre-keep-trig**, **pre-promote-trig**, **server_preop_trig**, or **server_admin_trig** script is important:

- A zero exit status indicates success: the AccuRev command is allowed to proceed.
- A non-zero exit status indicates failure: the AccuRev command is canceled and the depot remains unchanged.

File Handling by Trigger Scripts

A trigger script can overwrite its parameters file (after reading it, presumably). This provides a way for the script to communicate with the AccuRev command or with a "downstream" script:

- The parameters file for a **pre-keep-trig** script ends with a series of lines, one per element to be kept:

  ```
  <pathname-of-element>  <version-ID>  <element-type>
  ```

  <*pathname-of-element*> is not a full file system pathname, but starts at the workspace's top-level directory (which is included earlier in the parameters file). <*version-ID*> is the new version to be created for that element. <*element-type*> is the numeric code 1, 2, 3, or 4, as described above. Note that different versions of an element can have different types.

  See sample trigger script **addheader.pl** in the **examples** subdirectory of the AccuRev installation directory.

- The parameters file for a **pre-promote-trig** script ends with a series of lines, one per element to be promoted:

  ```
  <pathname-of-element>
  ```

  <*pathname-of-element*> is not a full file system pathname, but starts at the workspace's top-level directory (which is included earlier in the parameters file).

  A **pre-promote-trig** script can overwrite its parameters file, in order to communicate with a **server-post-promote-trig** script: the *first line* of the overwritten parameters file becomes the value of the **from_client_promote** parameter in the **server-post-promote-trig** script.

  See sample trigger script **client_dispatch_promote_custom.pl** in the **examples/dispatch** subdirectory of the AccuRev installation directory, along with **server_post_promote.pl** in the **examples** subdirectory.

A trigger script can also send data to STDOUT and STDERR. If the command for which the trigger fired was executed in the AccuRev CLI, this data appears in the user's command window. If a GUI command caused the trigger to fire, the script's exit status determines whether the user sees the STDOUT/STDERR data: in the "failure" case (non-zero exit status), the data is displayed in an error-message box; in the "success" (zero exit status) case, the data is discarded.

Trigger Script Execution and User Identities

When a trigger script executes on a client machine, it runs under the identity of the AccuRev user who entered the command. Since the user himself is registered (i.e. has a principal-name) in the AccuRev user registry, there won't be any authentication problems if the trigger script runs AccuRev commands that access the repository.

When a trigger script executes on the server machine, it runs under the AccuRev user identity of the AccuRev Server itself. Methods for setting an AccuRev username for the AccuRev Server process are described in *AccuRev User Identity of the Server Process* on page 10.

If you are using the “traditional” user-authentication method, you can also set the AccuRev username in the script itself. For example:

```
$ENV{ACCUREV_PRINCIPAL} = "jjp";
system("accurev hist ...");
```

If you are using the “AccuRev login” user-authentication method, we recommend against using the **login** command to set the AccuRev username in the script itself. You would have to include the password for the AccuRev username in the script; this presents a significant security risk.

‘Administrative Users’ in Trigger Scripts

The sample Perl trigger scripts supplied by AccuRev provide a very simple implementation of the “administrative user” concept: a user is permitted to perform certain operations only if his username is recorded in the **administrator** hash defined in the script:

```
$administrator{"derek"} = 1;
$administrator{"allison"} = 1;
   ...
if ( ! defined($administrator{$principal}) ) {
         print TIO "Execution of '$command' command disallowed:\n";
   ...
```

The Trigger Log File

When a trigger script runs on the AccuRev server machine — for a **server-post-promote-trig**, **server_preop_trig**, or **server_admin_trig** trigger — an invocation line is written to file **trigger.log** in the **logs** subdirectory of the repository’s **site_slice** directory:

```
##### [2004/06/28 20:50:42] running: '"C:\Program Files\AccuRev\bin\pst_pro.bat" ...
```

If the script produces console output (STDOUT and/or STDERR), this output is also sent to the **trigger.log** file.

As with other server log files, the **trigger.log** file is “rotated” periodically, to keep active logs from growing too large.

Integrations Between AccuRev and AccuWork

This section describes two similar, but separate facilities that integrate AccuRev’s configuration management functionality with its issue management (AccuWork) functionality. Both integrations record information about the **Promote** transaction in a user-specified AccuWork issue record. One of them uses an issue record’s change package as the point of integration; the other uses a particular field in the issue record as the point of integration.

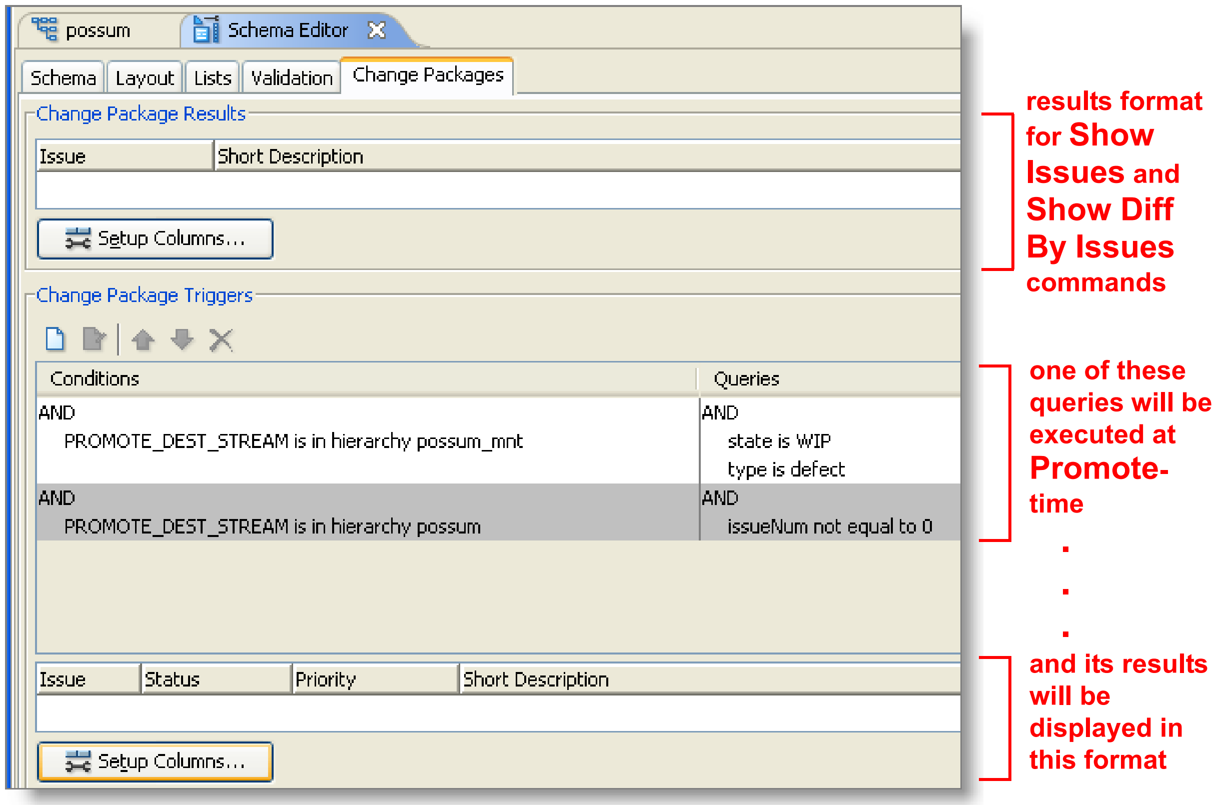
Change-Package-Level Integration

When a **promote** command is executed in a user’s workspace (but not in a higher-level dynamic stream), the change-package-level integration records all the promoted versions on the Changes subtab of a user-specified AccuWork issue record.

Enabling the Integration

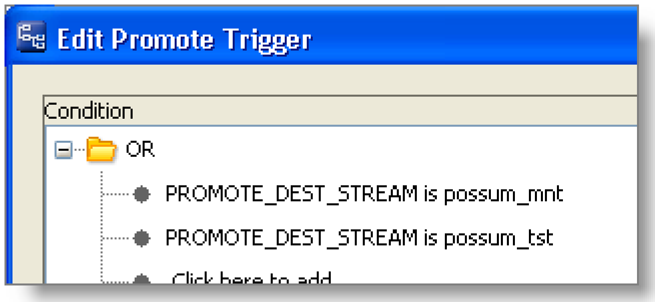
The change-package-level integration is enabled on a depot-by-depot basis. Open the AccuWork Schema Editor for a particular depot's issue database, and go to the Change Packages subtab. Filling in the lower section, "Change Package Triggers", enables the integration for that particular depot.

The Change Package Triggers section is structured as a set of condition/query pairs. One of the queries will be selected for execution at **promote**-time. If the first condition in the left column is satisfied, the first query in the right column will be executed; otherwise the second condition will be evaluated, and if it's satisfied, the second query will be executed; and so on.



Conditions	Queries
AND PROMOTE_DEST_STREAM is in hierarchy possum_mnt	AND state is WIP type is defect
AND PROMOTE_DEST_STREAM is in hierarchy possum	AND issueNum not equal to 0

Each clause of a condition performs a test on the **Promote** destination stream. For example, this condition is satisfied if the user is promoting to either of the streams **possum_mnt** or **possum_tst**:



```
OR
    PROMOTE_DEST_STREAM is possum_mnt
    PROMOTE_DEST_STREAM is possum_tst
    Click here to add
```

The query corresponding to each condition can be any AccuWork query, which selects a set of issue records.

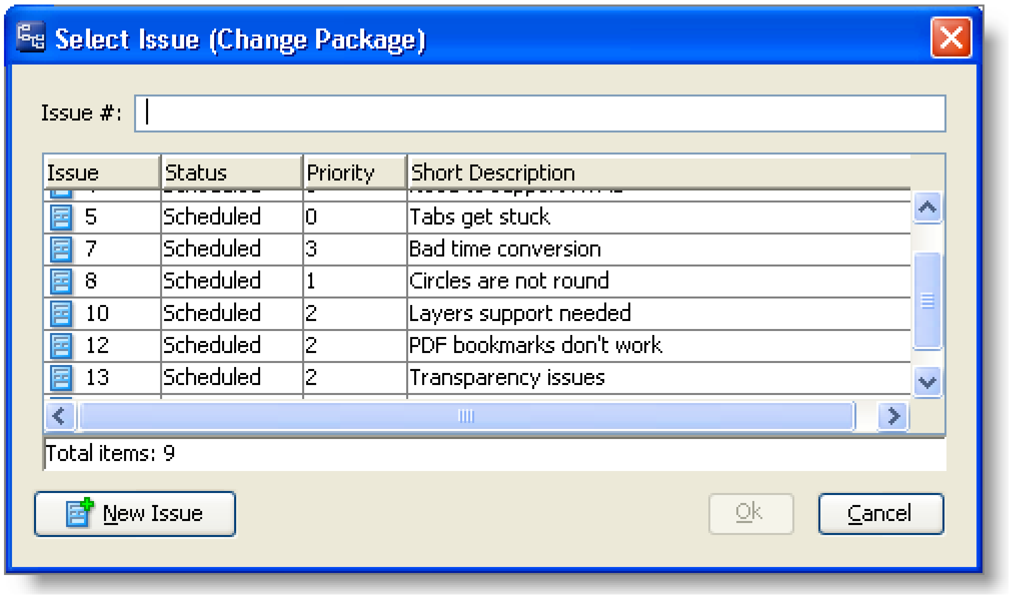
The Change Package Triggers section also specifies the format of each query's results table — the fields to appear as columns, the column widths, the order of the columns (fields), and the sort order of the rows (records).

Triggering the Integration

Once the integration is enabled for a depot, it is triggered whenever a user performs a **promote** command in a workspace associated with that depot.

If the **Promote** command is invoked through the AccuRev GUI:

1. One of the AccuWork queries specified in the Change Package Triggers section is executed, selecting a certain set of issue records.
2. Those records are displayed to the user in the results table format specified in the Change Package Triggers section.
3. The user selects one or more of the issue records. There is also a **New Issue** button, which enables the user to create a new issue record "on the fly".



Issue	Status	Priority	Short Description
5	Scheduled	0	Tabs get stuck
7	Scheduled	3	Bad time conversion
8	Scheduled	1	Circles are not round
10	Scheduled	2	Layers support needed
12	Scheduled	2	PDF bookmarks don't work
13	Scheduled	2	Transparency issues

4. The command completes its work.
5. The versions involved in the command are recorded in the change package section (Changes page) of the selected issue record(s).

If the **promote** command is invoked through the AccuRev CLI:

1. Just as with the GUI, one of the AccuWork queries specified in the Change Package Triggers section is executed, selecting a certain set of issue records.
2. The user is prompted to specify an issue record:

```
Please enter issue number ?
```

Users can bypass this prompt by specifying an issue number with the **–I** option:

```
> accurev promote -I 4761 chap01.doc
Validating elements.
Promoting elements.
Promoted element \.\doc\chap01.doc
```

You can specify multiple issue records with the **–I** option like this:

```
... -I "4761 4795 5006" ...
```

Note: attempting to update an existing change package entry might cause a “change package gap” or “change package merge required” situation, either of which cancel the **promote** command. For example:

```
Promoting elements.
Change package gap: /doc/chap01.doc
```

You can handle a change package gap by adding the **–g** option to the **promote** command. This combines the new and existing change package entries by “spanning the gap”:

```
> accurev promote -I 4761 -g chap01.doc
Validating elements.
Promoting elements.
Promoted element \.\doc\chap01.doc
```

There is no way to have the **promote** command automatically handle a “change package merge required” situation. You must either perform a merge on the element to be promoted, or remove the existing change package entry for that element.

For more on “change package gap” and “change package merge required” situations, see *Updating Change Package Entries* on page 37 of the *AccuRev Concepts Manual*.

3. Assuming the user-specified issue record is one of those selected by the query, the command completes its work, and the promoted versions are recorded in the change package section of the selected issue record.

What happens if the user specifies no issue record or a non-existent issue record, such as 99999 or 0? In both the GUI and CLI cases:

- If the user enters “0” (or equivalently, makes a blank or non-numeric entry), AccuRev checks whether issue record #0 is among the issues selected by the query executed in Step 1.

  Note: the query *can* select issue record #0, even though it doesn’t exist — for example with this clause:

  ```
  issueNum    equal to    0
  ```

  - If the query does select issue record #0, the user’s command completes but no information is sent to the issue database. This provides a way for the user to bypass the integration when performing the **promote** command.
  - If the query does not select issue record #0, the user’s command is cancelled, and no information is sent to the issue database.

- If the user specifies a non-existent issue record, such as “99999”, the command is cancelled, and no information is sent to the issue database.

Transaction-Level Integration

The integration between configuration management and issue management at the transaction level records the number of each **promote** transaction in a particular field of a user-specified issue record.

Enabling the Integration

The transaction-level integration is enabled on a depot-by-depot basis, by setting the depot’s **pre-promote-trig** trigger. For example:

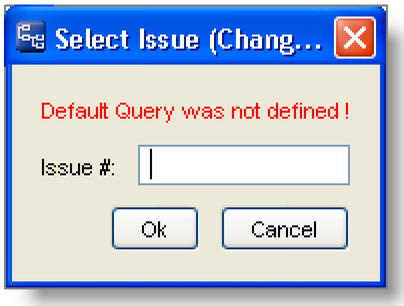
```
accurev mktrig -p kestrel pre-promote-trig client_dispatch_promote
```

Note that “client_dispatch_promote” is simply a keyword, not the name of a script file. The integration is implemented by two cooperating routines, one built into the AccuRev client software, one built into the AccuRev server software.

Triggering the Integration

Once the integration is enabled for a depot, it is activated whenever a user executes the **Promote** command in any workspace or dynamic stream.

1. The depot’s default query, as defined on the Queries tab (**Issues > Queries**), is executed and the results are displayed to the user.



Default Query was not defined !

2. The user selects one of the issue records. Note that if no default query is defined for the depot, the user is prompted to type an issue record number.
3. The **promote** command completes its work, propagating the versions to the backing stream.
4. The **promote** transaction number is recorded in the **affectedFiles** field of the selected issue record. (This change to the issue record is, itself, recorded as a transaction, of kind **dispatch**.)

If the user enters “0” or makes a blank entry, the **promote** command completes but no change is made to any issue record. This provides a way for the user to bypass the integration.

Over time, the **affectedFiles** field of a given issue record can accumulate a SPACE-separated list of **Promote** transaction numbers.

Implementation and Customization of the Transaction-Level Integration

When the transaction-level integration is activated, processing takes place on both the AccuRev client machine and the AccuRev server machine:

- The client-side processing — querying the AccuWork issue database and prompting the user to specify an issue record — is structured as a **pre-promote-trig** trigger routine built into the AccuRev client software.
- The server-side processing — updating of the AccuWork issue record — is structured as a **server-post-promote-trig** trigger routine built into the AccuRev server software.

You enable the integration by setting the **pre-promote-trig** trigger with the "client_dispatch_promote" keyword, as described above. You don't need to explicitly set a **server-post-promote-trig** trigger script. If you do, the script runs instead of — not in addition to — the server-side built-in routine.

In most cases, you'll want to avoid setting a **server-post-promote-trig** trigger script, just letting the built-in routines do their work. But suppose that after a **Promote**, you want the server machine to perform operations in addition to those defined in the transaction-level integration — for example, updating reference trees and sending email messages. In such cases:

1. Create a script that performs the server-side part of the transaction-level integration, along with the desired additional processing. Start with the sample script **server_dispatch_promote_custom.pl**, which is located in the **examples/dispatch** subdirectory of the AccuRev installation directory.
2. Place the script in the AccuRev **bin** directory.
3. Use a **mktrig** command to make the script the depot's **server-post-promote-trig** trigger script.

Further customizations of the transaction-level integration are possible. For example, you might want the user to be able to specify several issue records, not just one. Or you might want to link **promote** commands in one depot with the AccuWork issue database in another depot. Or you might want to update an issue record field other than **affectedFiles**. In such cases, you'll want to dispense with the built-in "client_dispatch_promote" routines altogether:

1. Start with the sample script **client_dispatch_promote_custom.pl** (in the **examples/dispatch** subdirectory), and create your own script for use as a **pre-promote-trig** script to execute on the client.
2. As described above, start with the sample script **server_dispatch_promote_custom.pl** (in the **examples/dispatch** subdirectory), and create your own script for use as a **server-post-promote-trig** script to execute on the server.

If Both Integrations are Enabled

Both the change-package-level and transaction-level integrations can be enabled for a given depot at the same time. In this case, a user performing a **Promote** command in a workspace is prompted to specify an issue record just once, not twice. The prompting for an issue record by the change-package-level integration takes place as usual. That issue record is then updated by both integrations.

Note that even if both integrations are enabled, a **Promote** command performed in a dynamic stream (not a workspace) activates just the transaction-level integration, not the change-package-level integration.

The ‘maintain’ Utility

This document describes AccuRev’s **maintain** utility, an administrative tool for occasional use under the guidance of an AccuRev Support Services representative. Before executing a **maintain** command, you must first stop the AccuRev Server process.

The **maintain** utility is a non-interactive command-line tool, with a simple command structure. For example:

```
maintain reindex <depot-name>
```

The **maintain** program is located in the AccuRev **bin** directory. If the command-line client program, **accurev**, is on your search path, then so is **maintain**.

Each of the **maintain** commands is described in the next section. Following that are “how to” sections involving use of **maintain** commands.

‘maintain’ Command Reference

chpasswd

```
maintain chpasswd <user> <new-password>
```

Changes the password stored in the AccuRev repository for an existing principal-name (named AccuRev user). To remove a user’s password, use two consecutive double-quote characters as the <*new-password*> parameter:

```
maintain chpasswd derek ""
```

If you are using AccuRev’s “traditional” user-authentication method, the user should invoke the **accurev setlocalpasswd** command to change his “local password” on each client machine that he uses. A user’s local password is stored in file **authn** in subdirectory **.accurev** of the user’s home directory.

chuser

```
maintain chuser <user-ID> <new-username>
```

Changes the principal-name (AccuRev username) of an existing user. You specify the user by the unique numeric user-ID, which is immutable. This command is similar to the **accurev chuser** command.

dbcheck

```
maintain dbcheck
```

Checks the consistency of the streams database (**streams.ndb**) in the **site_slice** directory, and checks the consistency of all the database (**.ndb**) files in all depots.

Note: be sure to stop the AccuRev Server process before running this command.

export

```
maintain export [ <depot-name> ] [ <table> [ <start-rec> [ <end-rec> ] ] ]
```

Produces an ASCII dump of one of the following:

- all the database tables in the repository's site slice directory
- all the database tables in the specified depot
- a particular database table in the site slice directory, or in a specified depot
- a range of records in a particular database table (the first record is **1**; omitting the final <*end-rec*> argument says "all the remaining records")

To export part or all of a database table in the site slice, you must specify an empty string as the <*depot-name*> argument — for example, with two consecutive double-quote characters. The <*table*> argument must be one of:

projects streams wspaces pools sec_group principal acl lock

For a database table in a depot, the <*table*> argument must be one of:

ancestry archives comp elems groups history issue issue0
issue_relate issue_ver link loc ser storage trans ver vir_ver

export_csv

```
maintain export_csv [ <depot-name> ] [ <table> [ <start-rec> [<end-rec>] ] ]
```

Like **export**, but produces a dump of comma-separated values.

export_indices

```
maintain export_indices [<depot-name>] [<table> [<start-rec> [<end-rec>]]]
```

Like **export**, but reports index tables only. For the site slice, the only index table is **stream**.

loc128

```
maintain loc128 <depot-name>
```

Changes the maximum length of a pathname segment (the simple name of a file or directory) to 128 characters, for the specified depot.

Use this command to "upgrade" depots created with earlier versions of AccuRev; in later versions, all depots are created with the 128-character maximum for pathname segments.

migrate

```
maintain migrate
maintain migrate <depot-name>
```

Converts the specified depot from little-endian to big-endian format, or vice-versa. If you omit the <*depot-name*> argument, it converts the **site_slice** directory. In all cases, the conversion is non-destructive: the data structure itself is not modified or deleted; the converted data is written to a subdirectory named **swapped** within the **site_slice** directory or depot directory. Converting the "endian-ness" consists of reversing the order of the 8-bit bytes in each machine-level word. For a step-by-step conversion procedure, see *Moving the AccuRev Server and Repository to Another Machine* on page 45.

reindex, restore

Along with **backup**, provides a facility for backing up and restoring the AccuRev repository. See *Backup/Restore of the AccuRev Repository* on page 86.

rmdepot

```
maintain rmdepot <depot-name>
```

Removes a depot from the AccuRev repository. All streams, snapshots, and workspace streams are also removed from the repository. (Workspace trees are *not* removed.) For details, see *Removing a Depot from the AccuRev Repository* on page 87.

sizes

```
maintain sizes [ <depot-name> ]
```

With no argument, lists information about each database file in the site slice: the name of the database file, the database schema version, the high water mark ("valid size"), the actual file size, and the number of records. Here's a sample line:

```
db: wspaces schema: 2 valid size: 434672 file size: 434672 valid records: 804
```

With a <*depot-name*> argument, lists information about each database file in the specified depot.

timeshift

```
maintain timeshift <depot-name> <earlier-trans-#> <later-trans-#> <seconds>
```

Adds/subtracts a number of seconds to the timestamps of a range of transactions, for the specified depot. The <*seconds*> parameter must be an integer; use a negative integer to shift timestamps backward. All transactions in the specified transaction range (inclusive) are time shifted.

This command refuses to make any change if any *shifted* transaction would move past any *ushifted* transaction. That is, the command refuses to change the order of transactions in the repository.

timeshiftstreams

```
maintain timeshiftstreams <depot-name> <earlier-time> <later-time> <secs>
```

Adds/subtracts a number of seconds to the **startTime** property of certain streams in a specified depot. This property, which appears in an XML-format listing of the stream (**show –fx streams**), records the stream's creation time (**mkstream**) or the time the stream was last modified (**chstream**).

Only those streams whose current **startTime** is in the specified time range are affected. You must specify the <*earlier-time*> and <*later-time*> arguments in "startTime style" — as a pair of integers, each of which is the number of seconds since Jan 1, 1970 UTC. Example:

```
   maintain timeshiftstreams duplo 1154016840 1154019950 5
```

Use an XML-format **show streams** listing to determine the appropriate values for the <*earlier-time*> and <*later-time*> arguments. You may also find the following Perl script useful: it converts an integer time to human-readable format:

```
>>> perl -e "print scalar localtime(1154019950)"
Thu Jul 27 13:05:50 2006
```

unmap

```
maintain unmap <depot-name>
```

Applies the AccuRev Server's temporary index maps to its actual index files. If a user accesses an index while it is being updated, a temporary map is created. This keeps the information accessed by any particular user stable and unchanging during the time of their request, while allowing new requests to see the more recent information.

The AccuRev Server uses any existing temporary maps to update the real index files whenever a repository write operation is performed and there are no other requests pending. If this opportunity does not present itself in a timely manner, you can stop the Server and run **unmap**, which applies all temporary maps for the specified depot. This operation will complete relatively quickly.

Note: be sure to stop the AccuRev Server process before running this command. You can run the equivalent AccuRev CLI command, **accurev unmap**, without stopping the AccuRev Server process.

vercheck

```
maintain vercheck [ -c | -q ] [ -e <eid> ] <depot-name>
```

Checks the storage containers in the specified depot's **data** directory tree, to verify that a storage container file (**.sto**) exists for each file version recorded in the depot database. It also reports occurrences of "crc mismatch" problems: the actual checksum (CRC) of a **.sto** file does not match the checksum recorded in the corresponding rapid recovery file (**.rrf**).

In addition, you can correct "crc mismatch" problems, using these options:

- **–q** option: for each file with a "crc mismatch", (step 1) compute the checksum of the **.sto** file, and (step 2) replace the "c:" value in the **.rrf** file with this newly computed value.
- **–c** option: like **–q**, start with this step for each file: (step 0) change the **.sto** file by removing all its CR characters — that is, all bytes with the value **0x0D**.

You can restrict the processing to versions of a particular element with the **–e** option. **vercheck** fixes all the versions of the element that have a "crc mismatch" problem, leaving other versions as is.

Backup/Restore of the AccuRev Repository

An **accurev** command (**backup**) and two **maintain** commands (**restore** and **reindex**) are involved in the scheme for backing up and restoring the AccuRev repository with a minimum of disruption to development activities.

The command **accurev backup mark** declares a “checkpoint” of the entire AccuRev repository, by:

- Copying all the database files (**.ndb**) and the index file **stream.ndx** from the **site_slice** directory to a subdirectory named **backup**.
- Recording the current state of each depot’s database files in file **valid_sizes_backup** in the depot directory.

This is an **accurev** command — it can be executed while the AccuRev Server process is running and development activities are ongoing. The **backup mark** command does not actually copy any files to a backup medium; it just marks a consistent state of the repository files. After executing this command, you can back up the repository files, in any order, and on any schedule, while users continue to use AccuRev. For more information, see *Backing Up the Repository* on page 3.

At any time after you’ve executed an **accurev backup mark** command and copied the repository files to a backup medium, you can restore the repository to its state at the time the **backup** command was executed. This is an offline procedure — the AccuRev Server must be stopped when you run it. The procedure is documented in section *Restoring the Repository* on page 4. The **maintain** commands involved are:

restore

```
maintain restore <depot-name>
```

Rolls back all the database files (**.ndb**) in the specified depot to their state at the time of the **accurev backup mark** command. This is a “logical truncate” operation — a file-system truncate is *not* performed on the database files.

reindex

```
maintain reindex [ <depot-name> ]
```

Reads various database files (**.ndb**) and recreates the corresponding index files (**.ndx**). This operation is performed on the database files of the specified depot; if you omit the <*depot-name*> argument, the operation is performed on the repository-wide database files in the **site_slice** directory

Removing a Depot from the AccuRev Repository

This section describes a procedure for removing a depot completely from the AccuRev repository. Removing a depot:

- Deletes every version of every file and directory in the depot.
- Deletes the entire history of the depot — all transactions involving the depot and its elements.

Removing a depot does not affect any of the workspaces or reference trees that contain copies of the depot’s elements.

Before You Begin

We strongly recommend that you preserve a backup copy of the AccuRev data repository before deleting any depots. See *Backing Up the Repository* on page 3. Much of a depot's data is stored in its slice of the repository. Use the command **accurev show slices** to determine the pathname of a depot's slice; you'll need it in Step 3 below.

Depot Removal Procedure

The following procedure must be performed on the machine where the AccuRev repository resides.

1. Stop the AccuRev Server process:

   - Unix/Linux: use the **acserverctl** utility, located in the AccuRev **bin** directory:

     ```
     acserverctl stop
     ```

   - Windows: use the **Services** program, or enter the command **net stop accurev** in a Command Prompt window.

2. Execute the **maintain** program's remove-depot command. This utility program is located in the AccuRev **bin** directory.

   ```
   maintain rmdepot <depot-name>
   ```

   For safety, the **rmdepot** command goes through two confirmation steps, including having you retype the depot name. The command displays some messages, ending with:

   ```
   Site reindex complete.
   ```

   The **rmdepot** command completely removes the depot's records from the repository database in the **site_slice** directory. (There's one exception: the depot's name remains in the database. See Step 5.)

3. Remove the depot directory subtree (slice) from the AccuRev **storage** directory tree. Be careful not to remove any other depot's directory subtree! If you're not sure where the depot's slice is located, use the command **accurev show –fi slices** to determine the pathname. (This command requires the AccuRev Server to be running.)

   For example, if the depot is named **widget** and AccuRev is installed on a Unix/Linux machine at **/opt/accurev**, use this command:

   ```
   rm -r /opt/accurev/storage/depots/widget
   ```

4. Restart the AccuRev Server process:

   - Unix/Linux: use the **acserverctl** utility, located in the AccuRev **bin** directory:

     ```
     acserverctl start
     ```

   - Windows: use the **Services** program, or enter the command **net start accurev** in a Command Prompt window.

5. At this point, the depot's name remains in the AccuRev repository database. It won't appear in an **accurev show depots** command listing, but *will* appear in an **accurev show –fi depots** command listing.

Reusing a Depot's Name

6. If you want to reuse the depot's name with **accurev mkdepot**, you must first rename the deleted depot with **accurev chdepot -p <depot-name> <new-name>.**