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The New File System API in JDK 7

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Agenda

- Background
- File System API
  - Common classes
  - API Features
  - Service Provider Interface
- Summary

Background and Motivation

- Need something better than java.io.File
  - Doesn't work consistently across platforms
  - No useful exceptions when a file operation fails
  - Missing basic operations (file copy, move, ...)
  - Limited support for symbolic links
  - Limited support for file attributes, performance issues
  - No way to plug-in other file system implementations

- Need a new file system API
  - JSR-203 tasked to define this and more

Main concepts

- Path
  - Locates a file in a file system
- Files
  - Static methods to operate on files and directories
- FileSystem
  - A handle to a file system and factory for objects that access it
  - FileSystems.getDefault() returns the local/platform file system
- FileStore
  - The underlying storage (volume, concrete file system ...)

Path

- Immutable
- Create from path String, URI or java.io.File
- Syntax is essentially [name]+ or root [name]*
  - foo, /, /foo, foo/bar C:\, C:\foo, \\foofighter\bar
- Defines methods to access, compare and modify Paths

- Support old libraries
  - Create File from Path using toFile

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Files

- Static methods to operate on files and directories
  - Create/open for reading and write
  - Copy, move and delete
  - Read and set file attributes
  - …
- Methods accessing the filesystem may throw IOException
  - Specific exceptions for some recoverable errors

File Attributes

- Groups of related attributes
- Define view that provides
  - Typesafe access to attributes in group
  - Bulk access where appropriate
  - Convert to/from the file system representation
- Implementations required to support Basic view
  - Common file systems attributes (size, type, timestamps)
- Implementations may support additional views

File Attributes

```
PosixFileAttributes attrs =
 Files.readAttributes(path, PosixFileAttributes.class);

UserPrincipal owner = attrs.owner();
UserPrincipal group = attrs.group();
Set<PosixFilePermission> perms = attrs.permissions();

Files.createFile(newPath,
 PosixFilePermissions.asFileAttribute(perms));
```

DirectoryStream

- DirectoryStream to iterate over entries
  - Scales to large directories and uses less resources
  - Smooth out response time for remote file systems
  - Provides handle to open directory
- Filtering
  - Built-in support for glob and regex patterns and custom filters
- DirectoryStream
  - Extends Iterable to allow use of for-each construct
  - Extends Closeable, need to remember to close stream

DirectoryStream

```
Path dir = ...

try (DirectoryStream<Path> stream =
 Files.newDirectoryStream(dir, "*.java")) {
     for (Path entry : stream) {
         System.out.println(entry.getName());
     }
}
```


Symbolic Links

- Optionally supported
- API based on long standing Unix semantics
  - Windows Vista or newer with NTFS
- Symbolic links followed by default, some exceptions
  - delete, moveTo, walkFileTree
- Files.isSameFile
  - Check if two paths reference the same file

Recursive Operations

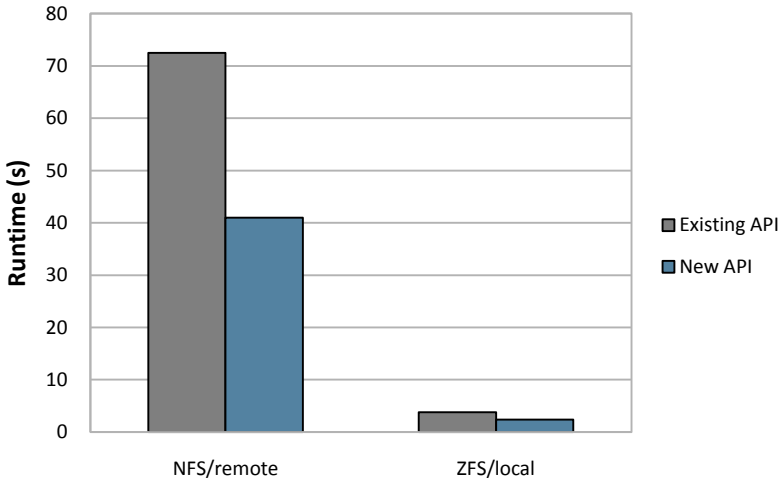
- Files.walkFileTree
  - Internal iterator to walk a file tree from a given starting point
  - FileVisitor invoked for each file/directory encountered
  - Depth first, invoked twice for each directory (pre/post)

```
interface FileVisitor<T> {
    FileVisitResult preVisitDirectory(T dir, BasicFileAttributes attrs);
    FileVisitResult visitFile(T file, BasicFileAttributes attrs);
    FileVisitResult vistFileFailed(T file, IOException ioe);
    FileVisitResult postVisitDirectory(T dir, IOException ioe);
}
```

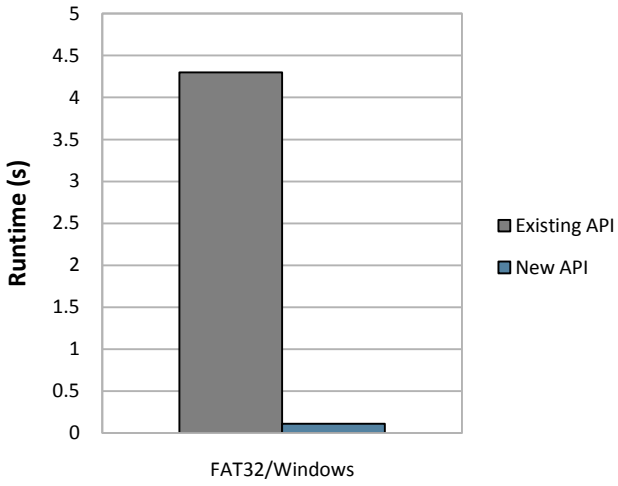
Recursive Operations

- Files.walkFileTree
  - Internal iterator to walk a file tree from a given starting point
  - FileVisitor invoked for each file/directory encountered
  - Depth first, invoked twice for each directory (pre/post)
  - Return value controls iteration, can also limit depth
  - Easy to develop recursive operations
  - SimpleFileVisitor with default behavior
- Symbolic links not followed by default, use FOLLOW_LINKS
  - Cycles detected and reported

Performance



du -k



find -name

File change notification

- Watch files and directories for changes
  - Typically done by polling
  - Scanning directories, checking file timestamps, ...
- WatchService
  - Watches registered objects for events
  - Makes use of native event notification facility where possible
  - All providers required to support monitoring of directories
    - Events when files are created, deleted, or modified
  - Extendable to other objects and events

File change notification – Registration

```
WatchService watcher =
 FileSystems.getDefault().newWatchService();

Path dir = ...
WatchKey key = dir.register(watcher, ENTRY_CREATE);
```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File change notification – Retrieving events

```
for (;;) {
    WatchKey key = watcher.take();
    for (WatchEvent<?> event: key.pollEvents()) {
        if (event.kind() == ENTRY_CREATE) {
            Path name = (Path)event.context();
            System.out.format("%s created%n", name);
        }
    }
    key.reset();
}
```


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Service Provider Interface

- FileSystemProvider is the factory for FileSystem instances
- Develop and deploy custom file system implementations
- Deploy as JAR file on class path or in extensions directory

- ZIP file system
  - Example provider included in the JDK 7 demos
  - Treats contents of zip or JAR file as a file system

Summary

- The JDK gets a comprehensive interface to the file system
- Easy to use, yet powerful and extendable

- Code samples and demos available in JDK 7


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