Technical Overview

Active Circle Storage System

Active Circle

Version 4.1

Abstract

The purpose of this document is to provide a brief overview of the features and technology of the Active Circle storage system.

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Contents

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Overview

Active Circle is a software solution designed for storing, protecting, and managing large and rapidly growing file volumes. Active Circle creates an extendable, virtualized storage space using standard hardware with embedded services for data protection, storage optimization, and administration. The Active Circle software platform combines different devices into a single and scalable pool of storage. It delivers a comprehensive set of integrated services for storage management and sharing, data protection, and data lifecycle management.

Active Circle has been designed for organizations that manage large volumes of data — video content, images, scientific and technical data, and user data — to help them gain control over the lifecycle of their data while at the same time keeping down the costs of storage ownership and administration.

Hardware-Independent Storage

Because it can be installed on standard x86 servers and supports any disk or tape storage system, Active Circle is modular and extendable on demand, supporting hot scaling of storage space and/or servers, enabling the system to grow independently of storage technologies.

Integrated Data Protection Services

Active Circle offers integrated services for data protection, high availability, business continuity and disaster recovery.

- Files are protected against accidental modification or deletion through a versioning system that tracks all changes to files.
- High availability is delivered by the Virtual File Server cluster: if one node fails, another automatically takes its place.
- Business continuity and disaster recovery is ensured through the replication of data over multiple sites.

Data Lifecycle Management

Active Circle automatically manages data according to rules defined by the system administrator. Depending on the options being used, Active Circle will store your files on the appropriate media according to your performance and capacity needs. You can store your most recent and most frequently accessed data on fast disks close to your users to optimize performance. Older information can be placed on less expensive high-capacity disks. Lastly, tapes can be used for long-term, low-cost storage.

Storage Supervision

The Active Circle Administration Tool provides you with a single utility for supervising your storage network. The administrator can monitor the data volumes, available storage capacity, and rates of growth through the graphical interface and then allocate resources as required.

Shared Disk and Tape Storage

In a SAN configuration, all the attached LTO drives will be available through direct access from all the Active Circle nodes. Drives will be dynamically allocated to nodes with data. This functionality is managed by the Distributed Lock Manager.

In a SAN configuration with attached disk bays, the storage can be shared in failover/ failback mode. Access is managed through an Active Circle node, but if this node becomes unavailable, the storage will automatically be accessible via another node in a process transparent to the users. This improves continuity of service in terms of storage access without the need for replication.

Main Features

- Hardware-independent software platform running on standard x86 servers.
- Shared data storage on disk or tape libraries.
- Data access through standard network protocols — NFS, CIFS, and FTP
- Application programming interface based on REST web services.
- Optimization through the use of hierarchical storage and data lifecycle management.
- Data protection and high availability provided by versioning, replication, and clustering.
- Multi-site data sharing.

Distributed File System

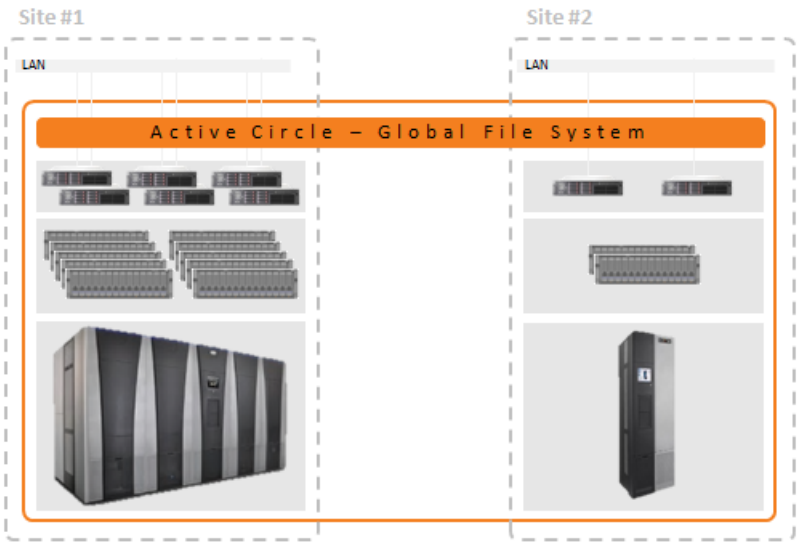
Architecture

The growth in unstructured data is fast and continuous, requiring organizations to rethink their storage architectures. Active Circle delivers a software solution that optimizes and simplifies data storage, delivering a distributed virtual file system capable of handling large volumes of growing data.

The Active Circle system consists of a collection of storage nodes, each a standard x86 server connected to one another over a LAN or a WAN. The Active Circle layer integrates file access and data management services traditionally found in complex and expensive software suites. Users can access files using any one of the integrated protocols: CIFS, NFS, or FTP.

No installation is required on the client side.

Figure 1. Distributed architecture



Every node in Active Circle is aware of the location of all the files on the system's various storage devices. When a client accesses a file, the node to which he or she is connected can fetch the data from the node "closest" to the client. The nodes are constantly being synchronized through the exchange of messages over dedicated IP connections. In the event of a network outage, the system automatically resynchronizes itself.

One of the challenges of a distributed system is concurrent access to individual files. The Active Circle software platform has an integrated global lock manager that can prevent multiple users from accessing a single file at the same time, thereby protecting files against the problems related to concurrent modification. The system can function both for local networks and wide area networks.

Virtualization

Virtualizing your storage space allows you to optimize use of resources while simplifying administrative tasks. The Active Circle file system offers users a global namespace, transparently enabling them to access data distributed over multiple storage nodes via a single point of entry.

Each node in an Active Circle storage system is aware of the physical location of the file data on the various storage devices. These can be:

- Any fixed disk drive recognized by the node's operating system. All of the storage space attached to a node can be used, whether it be internal, directly attached, or located in a bay accessed via SAN.
- Most of the tape libraries available on the market. Tape libraries are controlled without intermediary software.

By taking a software approach to the problem of storage, Active Circle frees you from the constraints and dependencies associated with closed, proprietary systems. This independence allows you to choose freely the most appropriate hardware for your storage system in terms of cost, performance, and capacity while at the same time benefiting from new technologies. The storage nodes can be made up of a mix of different hardware types, allowing you to capitalize on existing infrastructure. Older machines can be recycled within the system for secondary storage.

The file data is managed via the Active Circle policies, the system policies for defining the level of security and performance required for your different types of files. Once defined, the system optimizes available resources to meet these requirements, thereby simplifying system administration.

On each node, the physical data volumes are combined into *storage pools*. When a file is added to the system, it is automatically copied to multiple pools according to the rules defined in the policies by the administrator.

Service Continuity

Active Circle's clustered architecture delivers a high-availability file system that can guarantee service continuity in the event of an incident.

To protect users connected to an Active Circle share from the failure of one of the storage nodes, the administrator can define *clusters*. From the users' point of view, each cluster is seen as a logical NAS device that is accessed via a unique IP address. If a node fails, failover is automatic, taking a maximum of 30 seconds.

Automatic failover is managed entirely by the cluster and requires no special network configuration to be implemented, thereby simplifying system configuration. The administrator

can define multiple clusters, each consisting of a virtual IP address and/or a NetBIOS name representing an ordered list of nodes.

The first node in the list is assigned the cluster's address. Should that node fail for any reason, the next node in the list automatically takes over the address. If that node is unavailable, the next node in the list is tried, and so on.

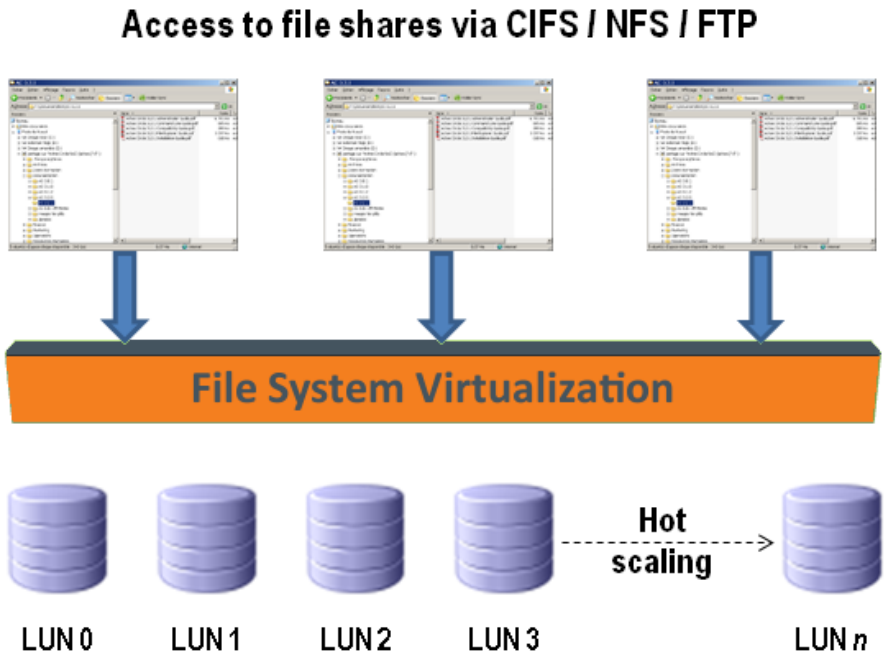
Finally, the cluster also manages the system's return to its normal state, called failback. When the node that failed comes back online, it is automatically updated with all the changes made to the files during its downtime. This requires no action from the administrator: synchronization is completely automatic.

Scalability

Active Circle's architecture is by its very nature scalable, in terms both of performance and storage capacity. As the nodes are not dependent on any particular hardware configuration, the system's overall bandwidth increases in direct proportion to the number of nodes added.

Adding nodes to Active Circle increases the overall performance of the system and improves its capacity to process input/output without compromising the existing architecture. The same software is installed on all nodes, which simplifies the implementation of new servers.

Figure 2. Expanding the File System



Increasing the volume of the system is as easy adding new disk bays and tape libraries. Storage resources can be directly attached to the nodes or connected via a SAN.

An Active Circle file system extends well beyond the limits of standard file systems — `Ext4`, XFS, NTFS — and can contain up to 4 petabytes of data. Furthermore, it is possible to create multiple file systems, rendering the system capacity virtually unlimited.

Integrated Services

Tiered Storage

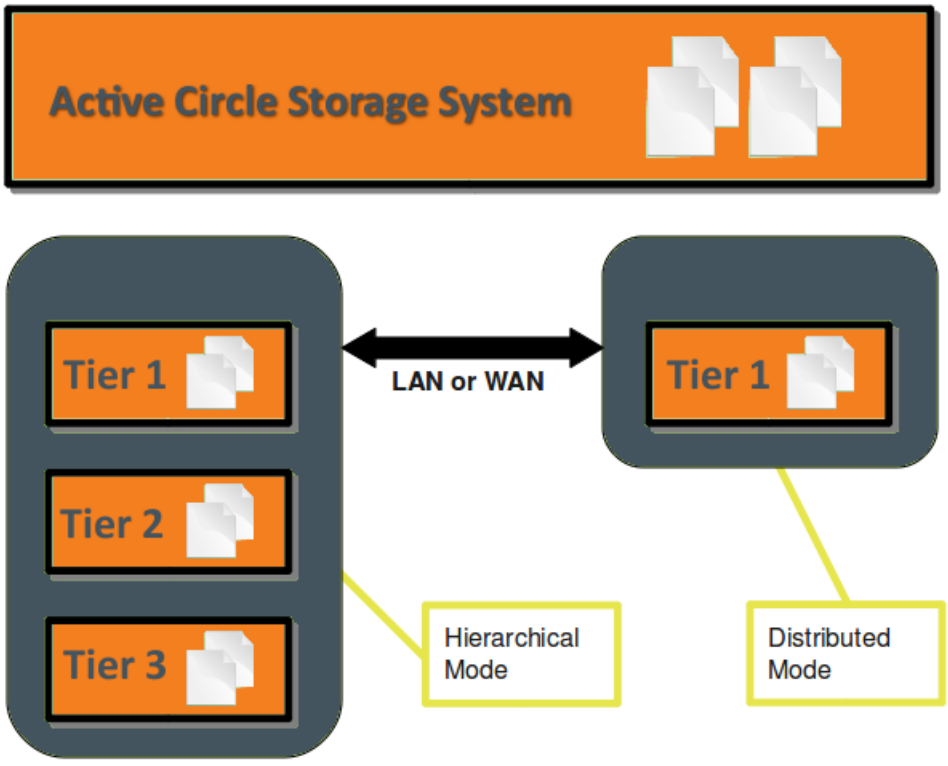
The enormous growth in the quantity of unstructured data that organizations are required to manage is largely responsible for the rising costs related to data storage. Backup operations

and resource management are becoming increasingly complex. As it is not unusual to find that up to 80 percent of data are rarely or never used, the solution for coping with data growth while keeping costs under control is to use different storage tiers according to data access requirements. This is called Tiered Storage or Hierarchical Storage Management (HSM).

The rules for hierarchical storage are defined in the Active Circle policies. The system is capable of migrating data from one storage pool to another in a way that is completely transparent for users. Thanks to its virtual file system, the files are always visible and accessible for users in their locations on the file system regardless of what physical medium is used to store the data.

Unlike traditional Hierarchical Storage Management (HSM) systems, Active Circle is designed around a Circle architecture with storage nodes, avoiding a central server which would create a single point of failure. Systems that migrate data and leave behind *stub files*[1] introduce an unnecessary level of complexity and vulnerability to a storage infrastructure. To avoid these problems, Active Circle does not use stub files; the location of each file is recorded in the Catalog, which is itself replicated over multiple storage nodes.

Figure 3. Sample hierarchical storage configuration



Using the creation date of a file version as a reference, it is possible to configure:

- The number of copies.
- The location of copies on the storage devices.
- The type of medium used for storage (disk or tape).
- The length of time to retain any given file on that particular medium.

The number of levels in the storage hierarchy is unlimited and can be modified at any time, which means you can add new levels as the need arises. The Active Circle system automatically takes the changes into account without interrupting the service, even during migration from one level to another.

[1] A pointer file sitting on high-speed storage that redirects to the real file sitting on slower, lower-cost storage.

Continuous Data Protection

Real-Time Versioning

Active Circle offers your files continuous protection by reducing the risk of data loss to a minimum. Its file versioning service is capable of retaining the different versions of files.

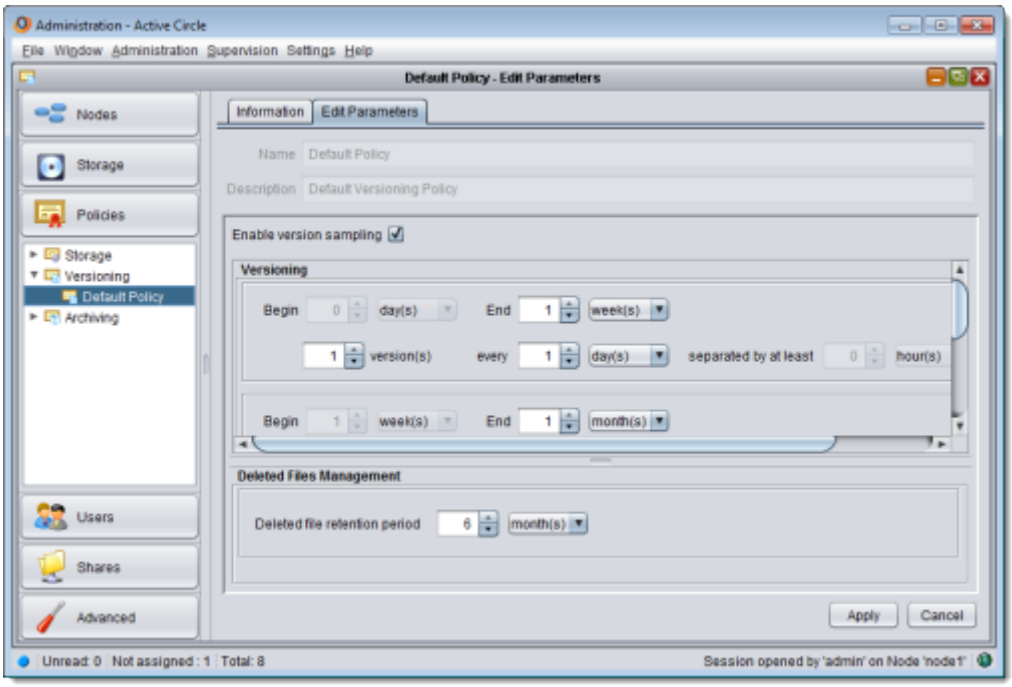
Each time a user modifies a file and saves the changes, a new version of the file is generated. Users can restore earlier versions of their files.

Furthermore, the system is capable of managing the number of versions stored, as well as their retention duration. An overall retention policy can be defined at the level of the share and specific rules for individual sub-directories.

Example of a versioning policy:

- For file versions created during the preceding week, retain two version per day separated by at least 4 hours.
- For file versions less than a month old (but older than one week), retain one version per week.
- For file versions less than a year old (but older than one month), retain one version per month.

Figure 4. Defining version management rules



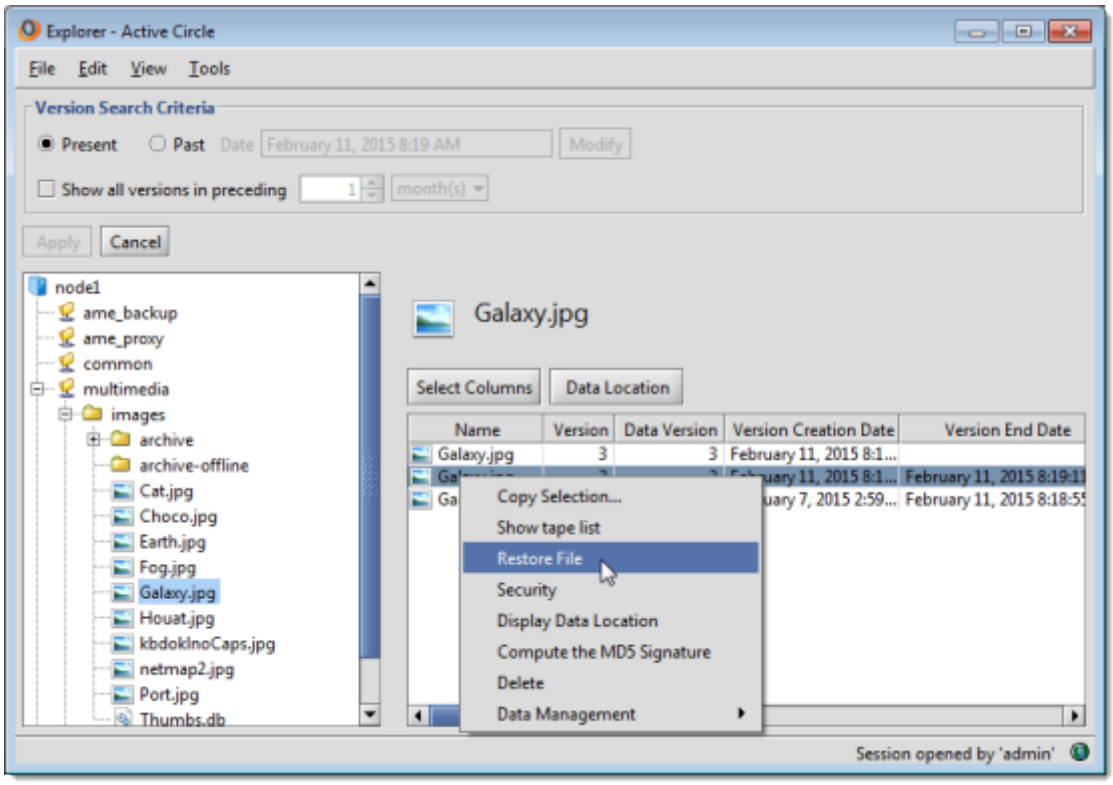
Older versions of files are sometimes more important than the most recent version, so Active Circle replicates *all* versions of *all* files across the system according to the rules of the policies.

Not all organizations require versioning across all of their file systems, so this feature can be deactivated at the file system level. It is mainly used in environments where the file contents are subject to change, such as for user data. In a typical office environment with a standard retention policy, version management consumes roughly 10% of the total used disk space.

Restore Functionality

The Active Circle File Explorer has been specially designed as a tool for viewing file history and performing restore operations.

Figure 5. The Active Circle File Explorer



Like the Administration Tool, the File Explorer is a thin client that can be launched from a browser from anywhere on the network. It enables users with the appropriate privileges to navigate the directory tree for a share, view file versions, and restore earlier versions of files or entire directories.

There are two modes for restoring objects:

- Viewing the file system at a time and date in the past.
- Viewing all of the files created and deleted during a given period.

Note

Access to the File Explorer must be granted by the system administrator

Restoring a file is as easy as right-clicking on an earlier version and selecting *Restore*. This creates a new “version” of the file (in fact, it is a pointer to the selected file version). Restoring a deleted file or an earlier version is instantaneous.

Replication

Data Protection

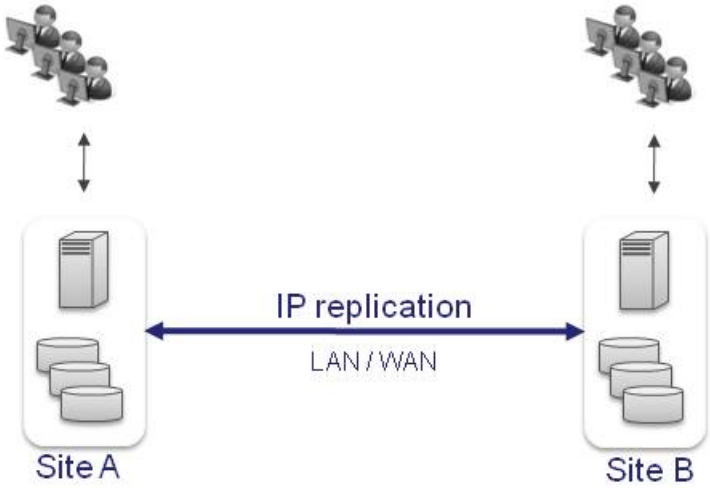
The policies are used to guarantee the security of files and service continuity by replicating data to multiple nodes across the system.

The replication system operates in asynchronous mode. For multi-site environments, administrators can schedule replication during periods of low activity, thereby preserving network bandwidth during working hours for users. In order to maintain system performance in terms of input/output, it is possible to dedicate a specific network interface on a node to synchronization tasks.

Depending on the configuration, each node can replicate its data to all the other nodes or only to those selected by the administrator. In addition to the number of copies, the retention time for copies can be configured in order to adjust the level of file security throughout the lifecycle of the files. By removing unnecessary copies of older files, the system can free up significant storage space.

The policies allow you to define the service in terms of the level of security (number of copies), rather than as a replication task with a source and a target. It is then a simple matter to set up cross replications between two sites on the storage network, with the data generated on site A replicated on site B and vice versa.

Figure 6. Two-way replication



Additionally, the policies can be used to respond to the requirements of a campus-type architecture, with the storage platform distributed across multiple sites in a geo-dispersed cluster.

To overcome the challenges posed by managing large numbers of small files, Active Circle combines data in order to carry out replication on groups of files. On the other hand, there are also problems inherent to storing and replicating very large files. Active Circle overcomes this by organizing the data in its own format optimized for network transfer. Note that all the information for any given file is always stored in the same pool in order to avoid file dispersion.

Active Circle calculates a checksum for each file stored in the system in order to guarantee the integrity of replicated data. These checksums are stored, verified, and themselves replicated in a metadata index called the system *Catalogs*.

Automatic Back Up of the Catalogs

The Active Circle system metadata is stored in catalogs which contain all the information relating to the nodes and their configuration, the file data stored in the system (file size, type, creation date, modification date, location) and user account information.

This metadata is replicated multiple times across the system in order to achieve a high degree of reliability. It also frees Active Circle from the requirement for a centralized metadata server and the vulnerability represented by such a single storage point.

The mechanisms for verifying and synchronizing data between nodes are used for automatically backing up the catalogs and the system is constantly verifying the integrity of this metadata. If a corruption is detected on a node, the system automatically repairs and rebuilds its Catalog using reliable copies on other nodes, all the while ensuring the continuity of service for users.

Finally, in the unlikely event of the total loss of the catalogs and their back-up copies, it would still be possible to rebuild the metadata from the information retained on the data partitions.

Tape Libraries

Integrated Support for Tape Libraries, Drives, and VTL

Active Circle has built-in support for a wide range of tape libraries and virtual tape libraries (or VTLs). The complete list of supported hardware can be found in the *Active Circle Technical Requirements* document (available on demand).

Active Circle does not require any intermediary software because the system uses its own drivers, specifically developed for each tape library model.

Data Formats

The system supports multiple data storage formats:

- Active Circle's own pack format, optimized for data storage
- Posix TAR (open format)
- LTFS

Active Circle Format: File storage on tape

It is possible to use the tape resources associated with an Active Circle node as a storage pool in much the same way as one would with disks. When used in this way, the file data is written to tape in the Active Circle data format (known as “packs”). In order to avoid writing large numbers of small files when copying file data to tape, Active Circle groups them together to optimize the write processes, which is done by a background task.

When files are deleted from tapes, gaps occur in the written space and the amount of useful space on the tape decreases, a phenomenon known as fragmentation. Active Circle provides a tool for recovering this lost storage capacity by migrating the contents of one tape to another.

The administrator can define a *fragmentation threshold* for each tape pool. When a tape reaches this threshold, a message is sent to alert the administrator to launch a defragmentation process. The defragmentation process can be launched at any time in order to avoid using the drives at times when they might be required by users.

TAR Format: Archiving data to an open format

In order to guarantee the longevity of archived data, Active Circle supports the industry-standard TAR format (POSIX.1-2001). TAR files can be read independently of the Active Circle software on any system that supports the TAR format. The archiving process does not delete data from disk if there are policies specifying rules for retaining disk copies.

There are several parameters for managing how data is stored on tape. You can configure:

- The maximum number of files per TAR
- The maximum size of TAR files

It is also possible to create archives that reflect the tree structure of the file systems simply by configuring the archiving policy to store each directory in its own TAR file.

New files are systematically copied from shares to the TAR files. The archiving process can be launched manually or configured to run automatically, making the system completely autonomous. The progress of archiving processes and the status of completed archives can be monitored through the graphical interface.

In order to improve access to the tape archives, the system carries out a pre-processing operation to avoid multi-volume archives, which are more complicated to read. In this way, an archive is made up of one or more files in TAR format, which themselves contain the archived files. It is possible to run a number of special commands (like integrity checking) before running the archiving operation.

Finally, the system contains a *de-archiving* feature for optimizing access to data on tape. Accessible directly through the Active Circle File Explorer, this feature calculates the best way to access the data before reading a tape, in order to avoid unnecessary winding and rewinding.

Importing and Exporting Tapes

The Active Circle system also includes mechanisms for importing TAR files and exporting files in TAR or LTFS format.

When a tape is inserted into a tape library, Active Circle can automatically scan and index the contents, which will then be accessible to users in file mode from a network share.

Figure 7. Importing

Exporting in TAR or LTFS format is just as easy. A user can select a file, a group of files, or an entire directory structure, archive them to tape, and then remove the tape from the system.

Partial Restore of Video Files

In organizations managing video files, the time required to read a file from the archive is critical. When an editor wants images from the archives, he or she must be able to get them as quickly as possible to be able to get the finished product on air.

Usually a Media Asset Management System (MAM) is used to index the sequence with the relevant business information, and the time codes for the beginning and the end of the sequence. MAM systems are also capable of associating the time code with the byte offset in the file, in order to read only the relevant portion of the file. Active Circle uses the information to read only the sequence from the storage, regardless of the storage technology, and returns it to the MAM application.

However, some Media Asset Management systems do not offer this feature, so Active Circle has implemented extraction of only a part of a video by using its time-code, without having to load the entire file from the archive. This greatly reduces the time required to access the required material.

Several formats are supported. Please contact Active Circle for an updated list of formats.

As a general rule, when third-party applications such as Media Asset Managers (MAM) initiate a request for a video file, they do so using a command that includes the time-code for the beginning of the desired sequence and the duration. The system locates the correct position, extracts the sequence, converts it into a file with a readable format, and then delivers the file to the MAM. The content can be located on either disk or tape.

Communication between the MAM and the Active Circle partial restore feature is based on a REST API called Active Media Connector. An interface needs to be implemented to use this functionality.

Partial restore is a feature that is particularly useful in the areas of sports and news broadcasting, where it is very useful to be able to extract video sequences from the archives rapidly. Active Circle's partial restore speeds up this process by delivering only the required sequence, reducing the time for reading and transferring the data, and not using up disk space with unnecessary footage.

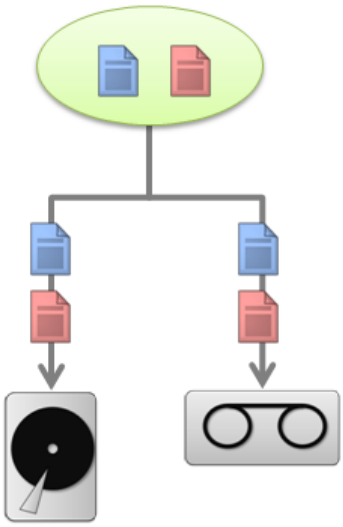
Usage Cases For Tapes

This section provides some examples of the use of tape libraries with Active Circle

Disk to tape replication

To provide security to data automatically, the system can be configured to replicate data from a disk pool to tape. Access to files will always occur via the fastest medium (disk, if it is not offline for some reason). Replication to disk can be done continuously in the Active Circle data storage format or through a scheduled process in TAR format.

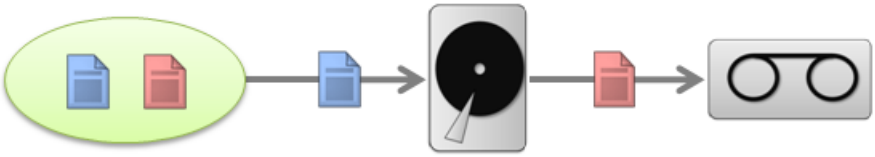
Figure 8. Replication



Automatic migration from disk to tape

To optimize storage costs, the system can automatically migrate older file versions from disk to tape. The storage format used in this case would be the Active Circle data storage format.

Figure 9. Migration



Administration

Centralized Administration

Policies

In traditional storage infrastructures, the administrator defines management rules in relation to the data volumes (replication, snapshots, etc.).

In Active Circle the policies are a set of rules that are defined in relation to the data itself. By taking this approach, Active Circle avoids the problems of hardware-dependent systems and delivers an easy-to-manage, scalable platform.

The policies operate by selecting the type of storage based on the importance of the data stored. The objective is to optimize the location of the files within the system to obtain the required level of security and performance.

Depending on the different categories of files to be managed, the administrator can define various policies, adjusting them over time as the need arises.

Table 1. Example of storage need analysis

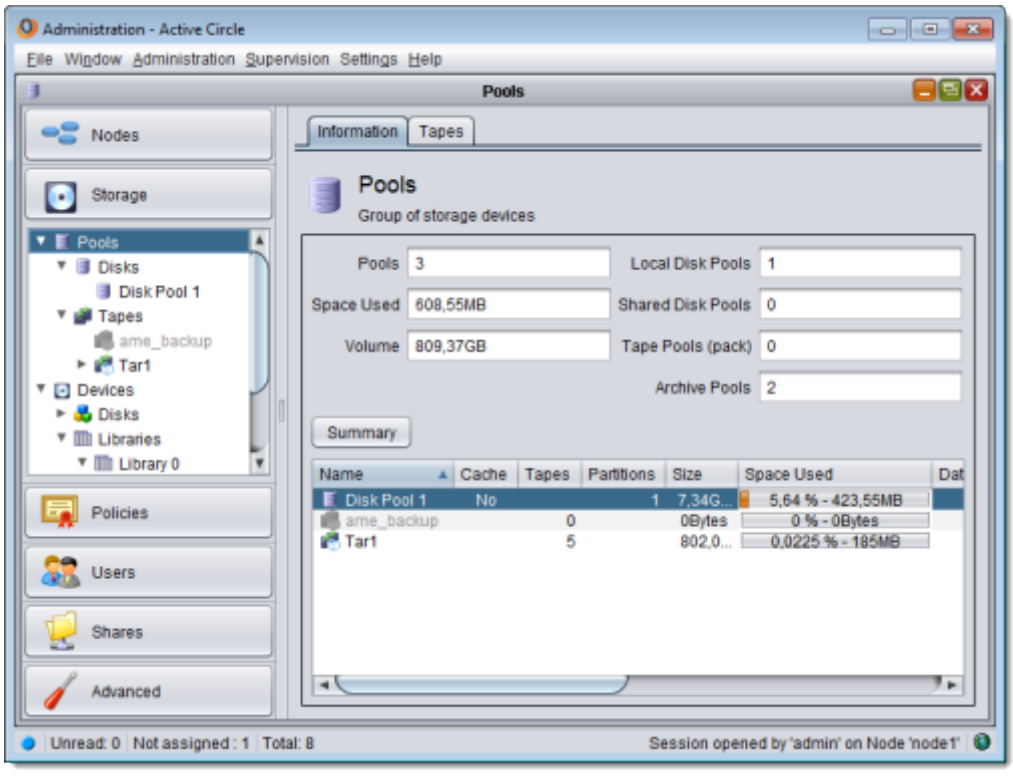
Data Type	Versioning	Performance	Replication	HSM	Copy to Disk
Office files	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Archive data	No	No	No	**Yes**	**Yes**
Multimedia, video	No	**Yes**	No	**Yes**	**Yes**
Temporary data	No	No	No	No	No

Graphical Interface

Managing large volumes of data on multiple servers can rapidly become an overwhelming task. Active Circle provides a single administrative console for managing all aspects of your storage network.

The Active Circle Administration Tool can be run either locally on one of the storage nodes or anywhere in your network from a Java-enabled web browser.

Figure 10. Active Circle Administration Tool



The Administration Tool enables you to perform all the management and monitoring operations for the system, including:

- Hot scaling of system storage capacity through the addition of storage devices
- Adding new storage nodes
- Viewing locked files
- Configuring policies
- Synchronizing with external user directories
- Viewing all file systems
- Monitoring replications and migrations
- Managing tape libraries
- Monitoring the state of the system, usage rate for storage devices, available space

Additionally, you can set quotas for each directory in order to control the space used on all levels of the storage.

To simplify the management and monitoring of events in the storage system, the tool includes a logging system that tracks such information as start-up of the various components, creation of new resources, and the initialization of certain operations.

To complete this view, the administrator can also view the system statistics that trace access from each node. The statistics are stored in CSV format to simplify the process of generating reports.

Command Line Interface

Active Circle also has its own command-line interface which allows for the scripting of a number of administrative tasks and data operations.

The syntax and behavior of the Active Circle commands have been designed to map as closely as possible to Unix/Linux commands, making them a complementary tool for querying, counting, listing, deleting, and extracting files and information from the system.

Global Supervision

The Administration Tool has a window dedicated to supervising the system. In the event of an incident or anomaly, a *supervision note* is sent to the administrator indicating the origin of the problem. Supervision notes can be seen or delivered in several ways:

- A color-coded indicator in the Supervision window of the Administration Tool
- An e-mail
- Via SNMP traps sent out to a global supervision tool

Each note is assigned a level of importance with an associated color code. The system logs the history of incident resolution, whether the incident is handled automatically by Active Circle or through the intervention of an administrator.

To simplify resource management and the monitoring of storage device usage, the administrator can use the Administration Tool to view the space occupied by the data at multiple levels, through the storage pools, shares, tapes, etc.

Software updates

Updating the Active Circle software can be carried out without interrupting the service to end users. The system allows for the migration of nodes one after another while maintaining the service continuity.

Nodes running different versions temporarily interrupt all communication with one another, with the exception of the part that maintains the service: the high-availability cluster. The automatic synchronization that occurs when restarting a node guarantees the data integrity by replicating the changes that took place during the upgrade.

Multiple Access Protocols

Access to data

The file system can be accessed through the standard network protocols CIFS, NFS and FTP in the same way you would access through a Network Attached Storage (NAS), without the need to install special software on the client machine. The network protocol service is integrated in the Active Circle layer and the global namespace guarantees the interoperability of file names regardless of the protocol used.

Users typically access their data through either a mapped network drive in Windows or MacOS, or via an NFS mount point in Linux.

User directories

Active Circle recognizes the main directory services available on the market — Active Directory, LDAP, NIS — and integrates in your existing user management infrastructure.

The Active Circle directory can map users and groups coming from multiple directories.

In a context where an organization manages two directory services (an Active Directory for Windows users and a NIS directory for Unix users), an administrator can merge two users, one from each of the directories, who correspond in fact to a single user. As a result, the user need log in only once, regardless of the environment the user connects from.

There are two ways of merging users and groups:

Automatic merge	The merge is performed based on the login name. If a user has the same log in name in the different directories, he or she will be recognized by Active Circle as a single user.
Manual merge	With a manual merge, an administrator can take any two users or groups and map them to a single account.

Rights management

One of the challenges of systems that support multiple access protocols is the management of the user access rights specific to each.

In Active Circle access rights are managed in a central location that tracks:

- Access Control Lists (ACLs) for Windows environments
- NFS access permissions
- Active Circle-specific permissions, which can be defined at any level (share, directory and file):

  History This gives a user access to file version history through the Active Circle File Explorer.

  View This gives a user the right to see a particular file. It can be used to render certain files invisible to users.

In multi-protocol environments, Active Circle applies a policy of security: a user can only perform an operation on a file if he or she has those rights in *both* protocols.

The management of access rights is itself divided into independent parts. There is no connection between the two systems, each functioning in parallel on the file systems.

The system functions as follows:

Create	If a user creates a file via CIFS, the default NFS attributes for that file are 777. If a file is created via NFS, then the ACLs applied are those inherited from the parent folder.
Read	In order to be able to read a file, a user must have read permissions in the Windows ACLs and in NFS.
Modifying Rights	From the point of view of a Windows client, an Active Circle share is identical to a standard NTFS file system. The access rights can therefore be edited directly through a file explorer. For Unix/Linux clients, NFS rights (Read, Write, and eXecute) can be modified with the command **chmod**.

Technology Migration

The Active Circle policies simplify the problem of replacing old hardware and technology migrations. Copying data from one media pool to another, migrating data from one disk bay to another can be configured to occur automatically thanks to the storage rules in the policies. By integrating this service into the software, the policies help you avoid service interruptions and to guarantee the integrity of the migrated data.

By using standard operating systems, the system can remain compatible with new storage bays as they come to market. For tape libraries, Active Circle integrates new generations of tape drives so that clients can continue to benefit from technological advances in this area. Because new devices are automatically recognized, implementation times are reduced and the whole process simplified.

When a new generation of tapes becomes available, the default location for data can be changed. Existing data can be migrated to the new media so that the old ones can eventually be abandoned. You can also retain the data on the existing media and copy only new data to the new tapes, thereby avoiding a massive data migration while still extending the system's capacity.

Business Continuity — Disaster Recovery

Recovery time

One of the key parameters in a Disaster Recovery Plan (DRP) is the time required to return to a state in which users can once again access their data after a disaster, what is called the Recovery Time Objective (RTO).

In the event of a disaster and the loss of a node, the data stored on the node is automatically regenerated from copies stored on other nodes in the system. As soon as the replacement node is connected to the system, Active Circle synchronizes the catalogs. Users do not need to wait for all the data to be restored in order to access their data. As soon as the metadata has been regenerated, they will be able to connect via the new node.

Management of Tape Pools between Sites

Each tape pool can be activated on all the nodes that have tape drives. This global management enables administrators to move tapes physically from one library to another without the need for complex administrative tasks.

This feature is particularly well adapted to environments in which the bandwidth between two sites is low in relation to the amount of data to be secured. It enables the creation of double copies of data at the main site and then to ship the copies to a back-up site. The system automatically recognizes the bar codes on the tapes and is constantly aware of the precise physical location of each tape.

Options: AMC, AME and Data Mover

Active Circle has developed optional products which work in conjunction with the Active Circle Storage System. Currently the following options are available:

- **Active Media Connector** (AMC): This is the Active Circle REST-based API, which enables integration between the Active Circle Storage System and external applications. The other optional products from Active Circle are based on AMC.
- **Active Media Explorer** (AME): This product allows users to access, view, download, edit and transfer media resources stored in Active Circle.
- **Active Data Mover**: This option transfers files from external sources to the Active Circle Storage System using the Active Media Connector.

These options are independent packages which are installed separately from the Active Circle base product, and they have their own prerequisites.

Active Media Connector

The Active Media Connector (AMC) provides a service-oriented programming interface for integrating the Active Circle Storage System into the digital media workflow. This is achieved through an API based on REST web services. The API makes it possible for a client application to perform many of the operations of the Active Circle Storage System. The AMC provides access to resources via URI paths. To use this REST-based API, applications make HTTP requests and parse the response. The AMC services use standard HTTP methods like GET, PUT, POST and DELETE. Because the AMC is based on open standards, any web development language can be to access it.

The Active Media Connector features a web application which is hosted on a Tomcat application server. This server can be an Active Circle node or a dedicated server. The nodes communicate with the AMC through a plugin that can be deployed and updated on each node without having to restart the host node. Internally, the AMC uses a PostgreSQL database which is hidden from the client and the circle. The metadata of the Active Circle system are duplicated in this database.

Basic features of the AMC are:

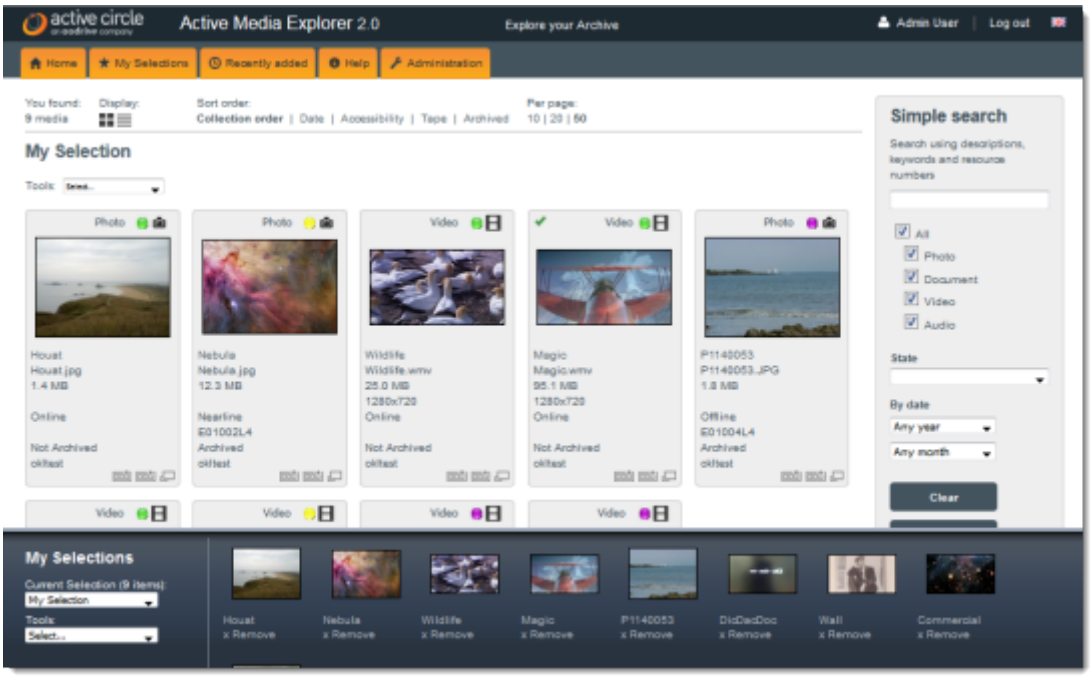
- HTTP for client requests and communication between API and Active Circle nodes
- Plugin on each Active Circle node manages communication with API
- Requests and responses use JSON
- File transfers in FXP directly between Active Circle and the FTP server
- Basic HTTP authentication

Active Media Explorer

The Active Media Explorer (AME) allows users to search, browse, index, edit, download and transfer media. Media can be organized in selections to perform further actions on them. Previews (proxies) for all media are automatically generated, making it possible to perform any media action regardless of storage status, even for archived media. Video previews are

full-length, low resolution versions of the original, and they can be played directly in the AME interface. Requests for offline media can be made by users directly through the user interface.

Figure 11. The AME Interface



The administrator defines storage volumes from which media will be automatically ingested into the AME system. Storage volumes can be Active Circle shares, NFS shares, CIFS shares, local shares or other specifically supported volume types (such as mxfs). Active Circle shares can also be defined as secondary archive volumes associated with primary volumes of the other types.

Depending on permissions, users can also add media manually by uploading media to be processed by AME.

User access is managed through domains which define accessible volumes, media sets and group permissions.

The Active Media Explorer allows external media metadata to be imported in XML format both automatically and manually.

In addition to its own database of users and groups, the Active Media Explorer supports LDAP directories for user authentication (OpenLDAP and Active Directory).

Active Data Mover

The Data Mover software allows you to move, copy and synchronize data between your primary storage and the Active Circle secondary storage. In the secondary storage, also called the archive, the data are protected while still being accessible to the users. The data source can be any primary storage accessible via SAN or the LAN.

The data transfers are defined, scheduled and monitored through a web-based application which can be accessed with any browser. Data Mover requires a connection to the Active Media Connector. The server hosting the Data Mover software can be an Active Circle node. Data transfers are managed using policies. A policy defines the type of data transfer, the source server, any file filters, the destination share and the scheduling. The Data Mover allows jobs to be started manually or automatically through scheduling. Transfer jobs can be monitored through the user interface.

Summary

The virtualization of storage space enables the simplification, sharing and optimization of data storage and management.

The Active Circle Storage System delivers numerous features:

- System scalability
- Built-in high availability and redundancy
- Integrated services for intelligent storage management: versioning, replication, and data lifecycle management.
- Lower storage costs through the use of industry-standard hardware running a single, integrated software solution.
- Protection from catastrophic data loss, errors, and corruption.
- Simplification of technology migrations
- Centralization of storage management and administration.

For more information

For more information, contact your Active Circle representative or use the contact information below.

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