Redefining Microsoft® SQL Server Data Management

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Purpose

The purpose of this paper is to provide a high-level overview of basic Actifio concepts and procedures used to capture and access Microsoft® SQL Server databases.

Actifio Data Virtualization

An Actifio appliance is a highly scalable copy data management platform that virtualizes application data to improve the resiliency, agility, and cloud mobility of your business.

It works by virtualizing data in much the same way other technologies have virtualized servers and networks.

Actifio Enterprise enables users to capture data from production systems, manage it in the most efficient way possible, and use virtual or physical copies of the data whenever and wherever they are needed.
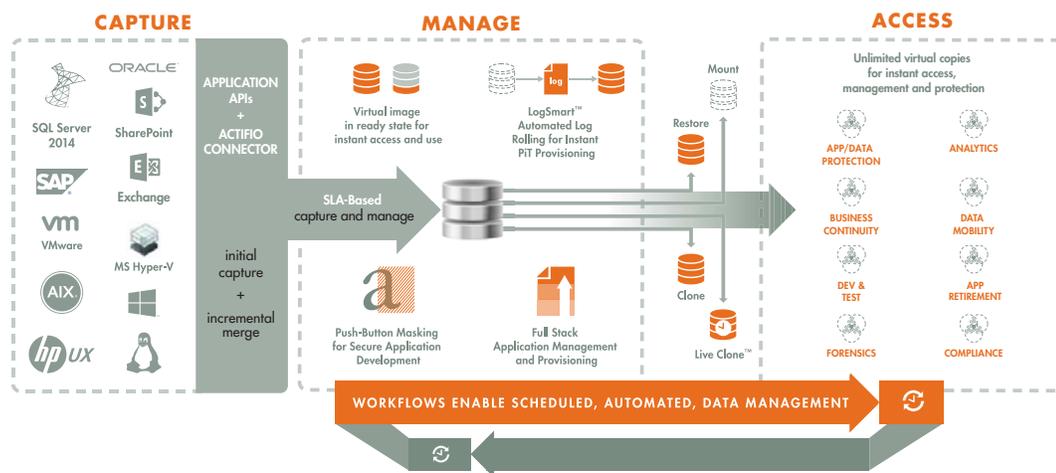
Figure 1 Capture, Manage and Access Application Data

Application data is captured at the block level, in native format, according to a specified SLA. A Golden copy of that data is created, moved, and stored once and is then updated incrementally with only the changed blocks of data in an "incremental forever" model. Unlimited virtual copies of the data can then be accessed instantly for use, without proliferating physical copies and taking up additional storage infrastructure.

Capturing Data

The Actifio Desktop allows you to capture SQL:

- Instances
- System Databases
- User databases
- Consistency Groups
- Individual members of a Consistency Group
- Primary database of an AlwaysOn Availability Group
- Databases in VMs.

When capturing and moving Microsoft® SQL Server data, production data is typically controlled by a non-Actifio storage controller on your existing storage arrays. The Actifio appliance moves and manages the Microsoft® SQL Server data separately from where Microsoft® SQL Server writes its primary storage.

As shown in Figure 2, an Actifio appliance presents captured data in a staging disk. That staging disk maintains a golden copy of the application's historical data that is an Actifio snapshot.
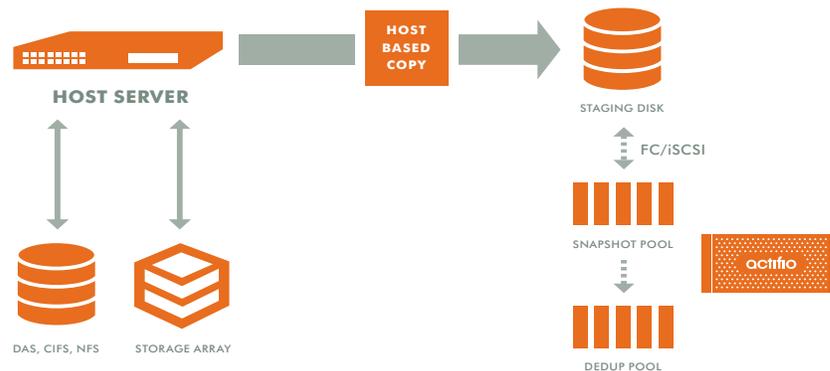
Figure 2 Actifio Data Capture

When capturing data:

- A staging disk is automatically created and mounted on a server via Fibre Channel or iSCSI.
- An initial full copy is made to the staging disk. Subsequent copies consist only of incremental change blocks.
- The staging disk is unmounted from the server.
- A snapshot of the staging disk is made on the Actifio appliance.

Actifio offers an alternate configuration where production data storage is controlled by an Actifio appliance. With this approach snapshots and changed-block tracking are native to the Actifio appliance and the Actifio appliance is placed in the data path between the SAN and the application host. This approach to data control is known as "In-Band."

Capture Mechanisms

An Actifio appliance captures data by making an initial full copy of the data, then making copies of incremental changes. This capability requires the ability to track and capture the changes that occur between capture operations. To track those changes the Actifio appliance uses either VMware API calls or the Actifio Connector.

VMware API Calls

An Actifio appliance can take advantage of VMware API for data protection (VADP) calls to capture an entire virtual server. Specifically, the API calls can:

Perform change block tracking - Makes an initial full snapshot of the entire VM, then going forward only snapshots the changes to the database thereby enabling Actifio's incremental forever capture strategy.

Quiesce applications - Ensures application consistency during capture.

When an entire virtual server is managed, a fully functional virtual server (operating system, applications, and their data) is captured. Having a copy of the entire virtual server guarantees that the data can be accessed fast and without issues. Because the image presented is a fully functional virtual server, if needed, it can be started and run from an Actifio appliance directly and then optionally migrated to a new, permanent location.

Virtual servers and their applications can be grouped and captured with a single SLA.

The Actifio Connector

The Actifio Connector is used to capture selected Microsoft® SQL Server databases. The Actifio Connector is a small-footprint, lightweight service that can be installed on either virtual or physical servers. The Actifio Connector takes advantage of Microsoft® SQL Server VSS Writer (SqlServerWriter) for discovery, capture, and access operations. SqlServerWriter is installed by default on most Microsoft® SQL Servers.

The Actifio Connector provides a more granular capability than what is provided by VMware API calls. It allows you to: capture selected Microsoft® SQL Server databases, capture databases that cannot be snapped by VMware, and capture Microsoft® SQL Server clusters. It offers more options for handling individual Microsoft® SQL Server database transaction logs.

Specifically, the Actifio Connector:

- Discovers SQL databases

- Quiesces SQL databases

- Identifies changes to database data for Actifio's incremental forever capture strategy.

- Captures databases in clustered Microsoft® SQL Server deployments.

- Captures and manages transaction logs:

    o Captures Microsoft® SQL Server database(s) and logs with one SLA

    o Truncates Microsoft® SQL Server database transaction logs

    o Rolls Microsoft® SQL Server database transaction logs forward for point-in-time recovery when accessing virtual copies.

- If multiple databases are resident on a server, they can be captured individually, as an entire instance, or as a consistency group using a single SLA Template for a point in time capture.

- For VMware VMs, the Actifio Connector captures databases that are on pRDMs and vRDMs and avoids virtual server "stun" issues.

- For Hyper-V Servers, the Actifio Connector enables capture of entire Hyper-V VMs.

Capturing Microsoft® SQL Server Data

Capturing Microsoft SQL Server data consists of four simple steps:

1. Add servers that host Microsoft SQL Server databases.

2. Discover VMs, Microsoft SQL Server databases, and AlwaysOn Availability Groups (AAGs).

   For Microsoft SQL Server failover instances, use the active node for the Microsoft SQL Server failover instance to discover all the databases in that instance.

3. Define Actifio SLA Policy Templates and Resource Profiles according to your RPOs and RTOs.

   Databases that use the Microsoft SQL Server Full Recovery Model can take advantage of Actifio's database and log capture technology. This technology allows you to define a single policy to capture both the database and its logs. Because a single policy captures both the database and its logs, a captured database can be recovered to a point in time by rolling its logs forward from the Actifio appliance's user interface.

4. Assign Actifio SLA Policy Templates and Resource Profiles to Microsoft SQL Server databases.

Capturing SQL Server Database Logs

Database log capture is enabled in a Snapshot policy's Advanced Options. It enables a single Snapshot policy to capture logs for individual Microsoft® SQL Server databases, SQL instances, AAGs, and consistency groups that contain Microsoft® SQL Server databases.

The frequency at which database logs are captured is defined separately from that of the database. For example, a database can be captured every day and its logs captured every hour.

The frequency of database log backup is set in minutes, and the frequency at which logs are captured must not exceed the frequency at which its associated database is captured. For example, if a database capture frequency is every 24 hours, the log file capture frequency must be less than every 24 hours.

Log retention is also defined separately from its associated database. Having separate retention rates allows you to maintain enough log information to cover all Snapshot and Dedup versions of a database. For example:

> If a database's Snapshot data is kept for three days and its Dedup data kept for seven days, you can define log retention to span all seven days.

In this example, a single captured database image can be selected and its logs can be rolled forwards over the seven day period.

Database logs are not deduplicated, and regardless of how many logs are captured during a specified log retention period, a database's captured logs are staged to a single VDisk in the Actifio Snapshot pool. To conserve space in the Snapshot pool, you can use an advanced setting to instruct the database to compress its logs.

If required, you can specify replication of Microsoft® SQL Server database transaction logs to a remote Actifio appliance. You can use the logs at the remote site for any database image within the retention range of the replicated logs. Log replication uses StreamSnap technology to perform the replication between the local and remote Actifio appliances; the replication goes directly from the snapshot pool of the local Actifio appliance to the remote snapshot pool.

Capture Options

When capturing Microsoft® SQL Server data, you can capture:

- Instances, AAGs, individual databases, and groups of databases on physical or virtual servers
- Consistency groups
- Microsoft SQL Server databases on a VM along with the VM's boot volume
- Entire VMs

Capturing Instances, Individual Databases and Groups of Databases

The Actifio Connector is used to capture instances, individual databases and groups of databases on physical and virtual servers.
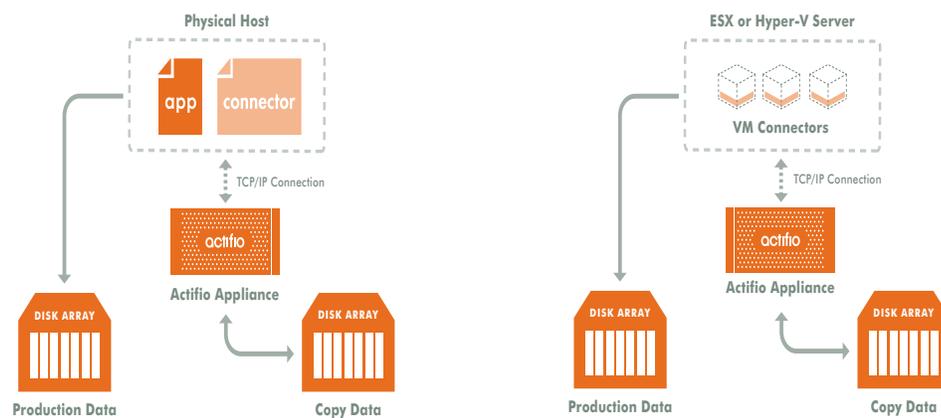
Figure 3 Capturing Individual or Groups of Databases

Installing the Actifio Connector on a physical server or VM allows you to create a single policy to capture all databases on the server or several policies to capture groups of databases.

Databases in an instance are quiesced and captured together with a single Actifio SLA Policy Template and Resource Profile. When capturing an SQL Instance, you have the option of capturing the entire instance or selected databases within the instance. When you protect the entire instance, as databases are added and removed to/from the instance, the capture operation will adjust accordingly.

If Actifio's database and log capture technology is enabled on the SLA Policy, then all databases in that instance can be recovered to the same point-in-time. Recovery and rolling forward of the logs for all or individual databases in an instance is performed from the Actifio user interface with a single action.

Individual members of an instance can be accessed by a standard mount, application aware mount, clone, LiveClone, restore operation as needed.

Capturing Consistency Groups

A consistency group is a group of databases that are quiesced and captured together with a single Actifio SLA Policy Template and Resource Profile. Membership to a consistency group is done manually and is suitable to groups of databases whose members do not change very often. To automatically protect new members of a group of databases, create and protect those databases in an SQL Instance.

As the name implies, consistency groups ensure consistent point-in-time capture and recovery across multiple databases. If Actifio's database and log capture technology is enabled on the SLA Policy, then all databases in that group can be recovered to the same point-in-time. Recovery and rolling forward of the logs for all or individual databases in a consistency group is performed from the Actifio user interface with a single action.

Members of a consistency group must reside in the same instance.

A consistency group can be made up of:

- System and user databases
- Two or more system databases
- Two or more user databases

Individual members of a consistency group can be accessed by a standard mount, application aware mount, clone, LiveClone, restore operation as needed.

Databases in a clustered failover instance must be discovered from the active node. Once protected, the Actifio appliance follows the active SQL node in a cluster. Protection jobs continue to run even in a failover condition.

You can validate the integrity of database backup periodically by mounting a backup image to a server and running database consistency check. You can use the Workflow feature to automate the validation process.

In addition to making capture and access operations easy and fast, consistency groups consume fewer system resources (VDisks).

Capturing a VM's Databases and Boot Volume

When capturing databases on VMs you have the option of also capturing the VM's boot volume.

When a VM's boot volume is captured along with its databases, if needed, an image can be presented that is a fully functional database and VM. The image can then be migrated to a new, permanent location.

Capturing Entire VMware and Hyper-V VMs

To capture entire VMware VMs, the Actifio appliance takes advantage of VMware APIs. To capture entire Hyper-V VMs, the Actifio appliance uses an Actifio Connector installed on the Hyper-V server.
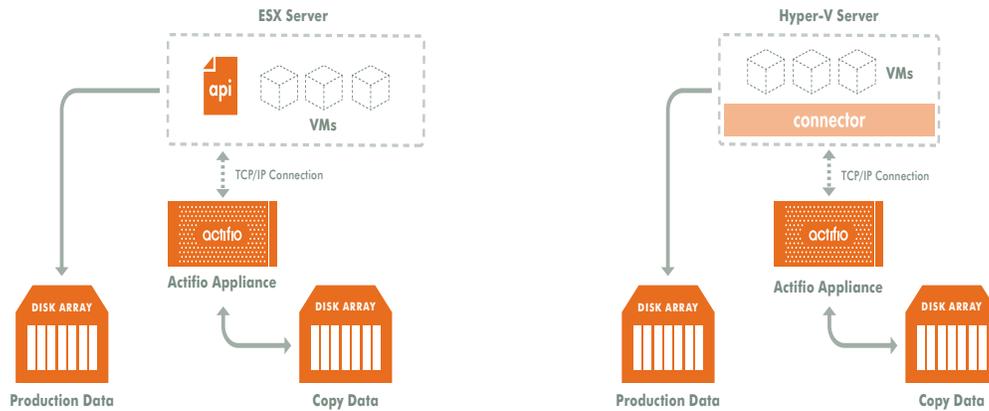
Figure 4 Capturing Entire VMs

Note: An Actifio Sky appliance is a VMware VM and can be on the same ESX server as the VMs it captures.

When an entire virtual server is captured, a fully functional virtual server (operating system, applications and their data) is captured. Having a copy of the entire virtual server guarantees that the data can be accessed fast and without issues. Because the image presented is a fully functional virtual server, if needed, it can be migrated to a new, permanent location.

Capturing whole virtual servers allows groups of virtual servers and their applications to be protected with a single SLA.

Replicating Data

Data replication has traditionally been an inhibitor to efficient data management in a geographically distributed environment. Actifio provides the following types of replication:

- Dedup Async Replication
- StreamSnap
- Dedup Backup to Dedup DR Replication
- Actifio OnVault

Dedup Async Replication

Dedup Async replication is policy driven and moves globally deduplicated and compressed production data over the network to a second Actifio appliance. Initially a full copy of production data is captured and replicated to a second Actifio appliance. Going forward, only changes to the production data are captured and replicated to the second Actifio appliance. Changes are merged with the copy on the second Actifio appliance to create an up-to-date, ready to use mirror copy of your data.

Because only change blocks are replicated, Dedup Async uses a fraction of the bandwidth required with traditional replication technologies. It also provides an application consistent copy of ready to use data on a second Actifio appliance.

StreamSnap

StreamSnap facilitates high-availability by allowing you to keep a remote copy of an application's storage and configuration up-to-date and ready for a failover scenario. When a StreamSnap-managed application fails, you mount a failover image of the application from the remote site. When the problem has been resolved, then you can restore the syncback image to the local site with the latest changes and then failback the application to the production site.

StreamSnap replicates data snapshots that are not deduplicated to a remote Actifio appliance over a high quality bandwidth IP network, which can provide RPOs as low as one hour.

Production to Mirror policies that use StreamSnap replication are tied to a specific Production to Snapshot policy. They use the schedule and frequency settings of their associated Production to Snapshot policy.

You have the option to retain snapshot images from multiple available points in time at the remote site by applying retention in a StreamSnap policy. When retaining snapshot images at the remote Actifio appliance, a new snapshot image will be created at the remote appliance with a specific retention expiration date. Each remote snapshot image supports all operations associated with a local snapshot image.

Dedup Backup to Dedup DR Replication

Dedup Backup to Dedup DR replication is policy driven and provides a means for secure and efficient long-term storage of deduplicated backup data. Actifio's proprietary deduplication-aware replication protocol transmits only deduplicated, unique blocks to a another Actifio appliance. This approach minimizes the bandwidth required to move data between Actifio appliances.

Dedup Backup to Dedup DR replication also provides the added benefit of allowing data to be replicated to a second Actifio appliance, then from the second Actifio appliance, the same data can be replicated to a third Actifio appliance.

Actifio OnVault

Undeduplicated Snapshot data can be sent to a remote storage location defined by an Actifio OnVault Storage Pool. A schedule within a policy is used to send the most recent snapshot data to the remote location. Actifio OnVault Pool storage is typically used for long-term retention.

An HTTPS connection is used to ensure data security over the network. The OnVault Pool's default compression option minimizes network traffic.

Replicating Logs

When a policy's **Enable Database Log Backup** is set to **Enable**, the Replicate Logs advanced setting allows Microsoft® SQL Server database transaction logs to be replicated to a remote Actifio appliance. For a log replication job to run, there must be a replication policy (StreamSnap, Dedup-Async, or Remote Dedup) included in the template along with a resource profile that specifies a remote Actifio appliance, and at least one successful replication of the

database must first be completed. You can then use the logs at the remote site for any database image within the retention range of the replicated logs. This function is enabled by default.

Log replication uses StreamSnap technology to perform the replication between the local and remote Actifio appliances; log replication goes directly from the local snapshot pool to the snapshot pool on the remote appliance.

Note: *Log replication does not occur until an SQL Server database has been protected and the database is replicated to the remote Actifio appliance.*

Accessing Data

For Microsoft® SQL Server databases that use the Full Recovery Model, the Actifio appliance, thanks to its LogSmart capabilities, can instantly present a copy of the database rolled forward to a specific point of time. The roll forward operation is performed from the Actifio appliance's user interface.

For Microsoft® SQL Server databases that use the Simple Recovery Model, the Actifio appliance can instantly present the most recent backup of the database.

Regardless of the Microsoft® SQL Server recovery model used, Microsoft® SQL Server data can be accessed via a Fibre Channel or iSCSI interface, just as if accessing a traditional storage system.

Role-based Access Control

Actifio administrators can control which users have access to data, Actifio features, processes, and resources. In addition, captured data can be defined as sensitive or non-sensitive. Actifio users can be granted permission to access sensitive or non-sensitive data.

Mounts

The Actifio mount function provides instant access to data without moving data. Captured copies of databases can be rolled forward via the Actifio user interface and mounted on any database server.

An Actifio appliance provides two ways to mount an Microsoft SQL Server database:

- **The standard mount** presents and makes the captured Microsoft SQL Server data available to a target server as a file system, not as a database. This is useful if a database is corrupt, lost

- **The Virtual Application mount** presents and makes the captured Microsoft SQL Server data available to a target server as an Microsoft SQL Server database. This allows you to address the unique challenges associated with creating and managing copies of production databases for non-production use. Virtual application mounts are created from the Actifio appliance and do not require manual intervention by database, server, or storage administrators. Virtual application mounts can be used for such things as database reporting, analytics, integrity testing, and test and development.

  Note: *If you mount an SQL database as a virtual application to an SQL instance, the virtual application cannot be captured along with the other databases in the instance. Virtual databases must be captured separately.*

LiveClones

The LiveClone is an independent copy of Microsoft® SQL Server data that can be refreshed when the source data changes. The advantage of LiveClones is that they are independent copies of data that can be incrementally refreshed and masked before being made available to users. This allows teams such as development and test to ensure they are working on the latest set of data without having to manually manage the data and not access or interfere with the production environment.

Workflows

While SLAs govern the automated capture of production Microsoft® SQL Server data. Workflows automate access to the captured Microsoft® SQL Server data.

Workflows are built with captured production Microsoft® SQL Server data. Workflows can present data as either a direct mount or LiveClone:

- Direct mounts (standard or application aware) work well for Microsoft® SQL Server data that does not need to be masked prior to being presented. Mountable data can be updated manually or on a scheduled basis. Direct mounts allow you to instantly access captured Microsoft® SQL Server data without actually moving the data.

- A LiveClone is a copy of your production Microsoft® SQL Server data that can be updated manually or on a scheduled basis. You can mask sensitive Microsoft® SQL Server data in a LiveClone prior to making it available to users.

Combining Actifio's automated Microsoft® SQL Server data capture, access control, with Workflows and their optional data masking capabilities allows you to create self-provisioning environments. Now, instead of having to wait weeks for DBAs to update test and development environments, users can provision their own environments almost instantly.

For example, an Actifio administrator can create an SLA that captures Microsoft® SQL Server data according to a specified schedule. Optionally, the administrator can mark the captured production Microsoft® SQL Server data as sensitive and only accessible by users with the proper access rights.

After access rights have been defined and data has been captured, the administrator can create a Workflow that:

- Makes the captured Microsoft® SQL Server data available as a LiveClone or a direct mount

- Updates the LiveClone or mountable Microsoft® SQL Server data on a scheduled or on demand basis

- Optionally automatically applies scripts to the LiveClone's Microsoft® SQL Server data after each update. This is useful for masking sensitive Microsoft® SQL Server data.

Once the Workflow completes, users with proper access can, via the Actifio user interface, provision their environments with the LiveClone or mountable Microsoft® SQL Server data.
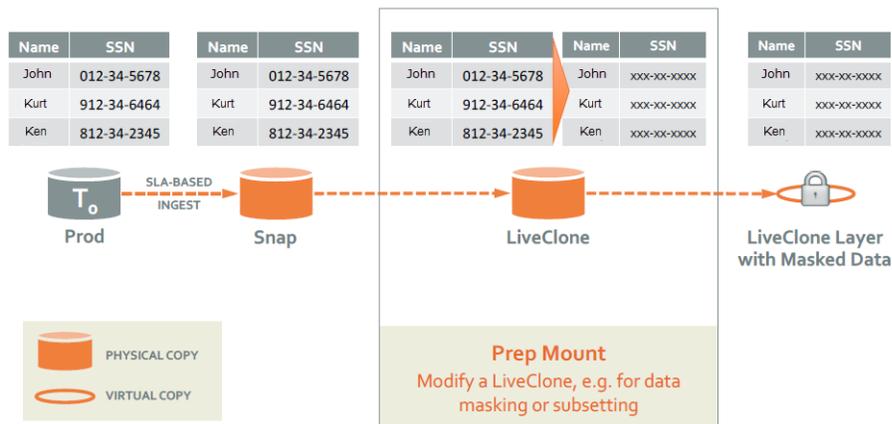

Figure 5 Workflow With Masked Social Security Data

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Restores

The restore function reverts the production data to a specified point in time. Restore operations actually move data. Typically restore operations are performed to restore a database to a valid state after a massive data corruption or storage array failure. The amount of time required to complete a restore operation depends on the amount of data involved.

To restore a database and then apply logs, the database must be online and the restored database must be in Restoring Mode. Actifio's log restoration functionality allows you to, from the Actifio user interface, restore the database in Restoring Mode and then roll the logs forward to a specific point in time.

If you restore the database through the Actifio user interface without specifying Restore with no Recovery, the database will be restored and brought on line without applying logs.

About Actifio

Actifio is radically simple copy data management. Our copy data management lets businesses manage and recover anything instantly, for up to 90 percent less. Actifio eliminates siloed data protection applications, virtualizing data management to deliver an application-centric, SLA-driven solution that decouples the management of data from storage, network, and server infrastructure. Actifio has helped liberate IT organizations and service providers of all sizes from vendor lock-in and the management challenges associated with exploding data growth. Actifio is headquartered in Waltham, Massachusetts, with offices around the world. For more information, please visit www.actifio.com or email info@actifio.com.