Abstract

This white paper describes how Service Providers can leverage EMC Avamar and EMC Data Domain solutions to build effective cloud-based data protection services.

February 2012
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Executive summary

Over the last five years, the Service Provider (SP) market has gained a great deal of momentum. Enterprises of all sizes are increasingly procuring IT in “As a Service” (aaS) solutions. The need for rapid deployment, reduced Total Cost of Ownership, and overall agility are fueling this shift. Backup as a Service, Disaster Recovery as a Service along with other data protection as a Service offerings are exploding onto the scene enabling new revenue streams for SPs and unparalleled solutions and flexibility for consuming Enterprises.

Delivery of cloud-based services via shared/leveraged infrastructures has gained significant mindshare with enterprises, as they seek to solve data protection challenges caused by increasing volumes of data, shrinking backup windows, fewer IT personnel and 24x7 business operations. Today’s data protection solutions must protect diverse enterprise environments with various applications, data types and workloads on virtual as well as physical infrastructures residing in data centers, remote offices, and desktop/laptop systems. At the same time, they face stringent service levels, and the need to reduce costs and maximize available resources.

Increasingly, IT resources are stretched to the breaking point supporting new business-critical front-end applications. Mission critical applications are core to the revenue generating functions and can be very complex with cross interdependencies. Frequent application upgrades also drive new process requirements for data protection, which only increases the load on already scarce IT resources. Many organizations seek to leverage cloud-based data protection services to provide them with cost savings and more flexibility to address current and future needs.

SPs delivering cloud-based data protection services are gaining momentum by using technology solutions that enable scalable shared or leveraged multi-tenant infrastructures, multiple services for data protection, and the ability to meet or exceed service level agreements across a wide range of tenant needs. By delivering cloud-based data protection services, SPs can “operationalize” backup services and the costs associated with servers, software, tape libraries, tape, offsite transportation, storage and IT personnel. By leveraging new and industry leading technologies, SPs are delivering cost-effective data protection services to their customers, while reducing the requirement for upfront capital expenditures and dedicated personnel. This enables greater focus on their core business IT needs.

EMC is a world leader in backup and recovery solutions with integrated data deduplication technology. Developed to solve the challenges associated with traditional backup, EMC® Avamar® backup and recovery software and systems, equipped with integrated global, client-side data deduplication technology, provide fast, daily full backups for VMware® environments, LAN/NAS systems, remote offices, desktops/laptops, and enterprise applications. Avamar reduces the size of backup data at the client - before it is transferred across existing IP networks and stored to an Avamar Data Store server or EMC Data Domain® deduplication storage system. SPs gain tremendous performance and efficiency benefits by using a solution
that deduplicates data at the client, since this is ideal for backup via slow or congested WAN/LAN links or shared virtual/physical infrastructure.

EMC’s efficient solutions enable SPs to deliver data protection services to even broader markets. The integration of Data Domain deduplication storage systems into Avamar provides additional flexibility in development of the most efficient data protection solution possible. These tightly integrated solutions enable the SP community to build unsurpassed services that enable more efficient solutions for their customers and greater revenue streams for the SP’s at unsurpassed SLAs.

**Audience**

This white paper is intended for SP management and technical IT staff. It describes how to leverage EMC Avamar and Data Domain solutions to build effective cloud-based data protection services, and includes factors impacting deployment in multi-tenant environments.

It is important that the SP understand the inner workings of the solution including communication protocols, security, reporting and integration. These in-depth topics are covered in other technical documents. For a more in-depth understanding of the Avamar solution, please refer to the document links at the end of this paper.

**EMC’s Next Generation Data Protection Solution**

EMC Avamar backup and recovery software and systems provide fast, efficient backup and recovery for VMware® environments, LAN/NAS systems, remote offices, desktops/laptops, and enterprise applications. By deduplicating the data before it is transferred across the network (LAN, WAN, NIC), Avamar delivers daily FULL backups in a fraction of the time when compared to traditional backup applications, which typically provide only weekly fulls/daily incrementals, while transferring and storing lots of redundant data. Avamar also deduplicates backup data globally across physical and virtual servers, desktops, laptops and offices. As a result, Avamar reduces the total required storage by up to 50x, and network traffic (LAN, WAN or NIC) by up to 99% daily. And Avamar backups can be quickly recovered in just one step - eliminating the hassle of restoring the last good full and subsequent incremental backups to reach the desired recovery point. In addition, data can be encrypted in flight and at rest for added security.

This enables industry leading backup, recovery, and disaster recovery via existing IP LAN/WAN links - all of which dramatically lower the SP’s capital and operating expenses, including floor space, power and cooling. As the SP environment grows, monitoring multiple Avamar systems is easy via the Avamar Enterprise Manager. This intuitive interface provides the SP with a dashboard view that shows the status of each system at a glance, providing data such as capacity utilization, system alerts and job status. And SP Administrators can drill down into individual systems as needed, simplifying management for local or remote Avamar systems. These operational benefits contribute to the delivery of cost-effective SP services.
Avamar 6.0 includes the ability to direct and manage backups simultaneously to Avamar Data Store servers and Data Domain deduplication storage systems. All management is performed via the Avamar Administration Console, allowing quick and easy direction of enterprise-wide backups to either storage platform based on data types and characteristics. This integration provides the SP with the benefits of the Avamar application’s simplicity, the efficiency of the Avamar Data Store and the increased scale and performance of Data Domain systems.

In a cloud-based SP delivery model, it is important to understand the benefits that each storage subsystem can deliver to the environment, and design the solution using one or both of these options based on the data protection needs. This allows the most efficient and cost-effective solution to be enabled for SPs and their customers. Some SP solutions may be best served utilizing Avamar Data Store servers, while others may benefit most from Data Domain systems, but in many cases a combination of the two will provide the best solution and the most flexibility. The single interface allows the SP to easily manage the solution from a single pane of glass, which reduces the overall complexity, management, and IT costs.

**Step 1 - Define the Data Protection Service Offering**

The first step is to determine what use cases and data protection services will be offered in each deployment model. Avamar is typically deployed to protect data residing in the following environments:

- VMware environments
- NAS systems
- Desktop/laptop systems
- Remote/Branch Offices
- Enterprise applications
Each of these use cases can dictate unique needs and deployment models. It is also possible to look at hybrid services spanning multiple deployment models. In each case, it is critical to clearly understanding a number of variables:

- Will the solution be deployed as single-tenant or multi-tenant systems?
- Will data protection services for physical/virtual servers be managed in my local data center?
- Will remote backup services across the WAN be part of the solution?
- Will disaster recovery replication services for customers with their own EMC Avamar or Data Domain systems be supported?

It is also important to define how the new services will complement other existing services already being offered. Understanding the breadth of services is critical in determining the best EMC solution to address the scenario.

**Single-Tenant or Multi-Tenant Systems**

Service offerings must be clearly defined. Once defined, the service offering requirements for customer control and data segregation can be mapped, each of which can have a significant impact on system deployment.

Within the Avamar system, incoming data is stored across all of the active Avamar Data Store data nodes within an Avamar environment (grid). There is no functional capability to segregate stored data from different customers into different areas of a given Avamar grid. Avamar domains logically separate data within the system, but the actual physical object storage is comiled across the Avamar grid. For customers that require physical separation of their data from the data of others’, a dedicated Avamar system sized specifically for their environment can be configured.

Avamar domains are distinct zones within the Avamar server that are used to organize and segregate clients, and define specific users roles within each domain based on the levels of control that the SP provides each tenant. The separate zones provide the ability to define specific domains for each customer, and assign roles to customer users for the desired domain level of access desired by the SP. This provides enhanced security by limiting access to only those user accounts authorized by the SP for the domain. Please note: Avamar domains are completely internal to the Avamar server and have nothing to do with Internet domains.

There are three basic roles within Avamar that can be defined to allow various operations for each user account:

- Domain Administrator roles
- Domain Operator roles (Backup, Recover, Backup and Recover, and Activity Monitoring)
- Domain User roles

Users with these domain roles leverage the Avamar Management Console for login/access into the Avamar system. The appropriate network ports have to be
opened to allow for this management traffic to pass through from the customer site to the SP site as required.

Alternately, the SP can utilize the Management Console Command Line Interface (MCCLI) to integrate Avamar features into a custom portal to provide these types of capabilities as desired. Using the MCCLI requires the SP to manage the access to the specific functions made available via their custom portal.

**Local Backup Services**

Local Backup Services are defined as providing data protection services for physical/virtual servers or NAS storage located within the SPs data center. These servers may be provided by the SP in a Compute as a Service (CaaS) or Infrastructure as a Service (IaaS) model, or could be tenant-owned servers located in the SP data center in a co-location agreement. This Avamar data protection deployment model is a perfect complement for SPs that offer CaaS/IaaS via VMware infrastructure, or any other related services.
The key element in the Local Backup Service deployment model is the general proximity of the tenant’s primary data and the SP’s Avamar infrastructure. Some additional considerations in this model include:

- Tenant’s servers and the Avamar data protection infrastructure are connected via LAN and not WAN.
  - Network communication is typically not an issue, due to available bandwidth and quality/latency
  - Secure networking infrastructure (VPN) is not required.
- Are there overlapping IP address ranges across tenants? If so, these must be resolved outside Avamar such that Avamar is only presented with unique IP addresses.
- Utilize Avamar Data Store (all data types) or Data Domain storage (for five data types: SQL, Exchange, SharePoint, Oracle and VMware images)
  - Key considerations when Data Domain storage may be beneficial:
    - Dataset size: Any single dataset larger than 3 TBs
    - Daily change rates: Datasets with a daily change rate > 5%.
  - Hybrid Avamar Data Store/Data Domain storage all managed using Avamar.
- Support for native VLAN Tagging (Avamar Data Store Gen4 hardware only)
- Support for Network Address Translation (NAT)
- Options for SP-In-Control or Tenant-In-Control as required

Remote Backup Services

Remote Backup Services is a deployment model where the Avamar backup infrastructure is located within the SP data center, and is accessed for backup and recovery via Avamar agents installed on production servers that reside at the customer’s premises. The Avamar agents are the cornerstones of the Avamar data protection solution. The Avamar agent deduplicates backup data at the client, significantly reducing the impact on the supporting infrastructure (network, WAN and storage/NIC in virtual environments). The Avamar agents’ efficiency and overall solution flexibility in this deployment model are unparalleled in the industry, but they are still ultimately constrained by the bandwidth and quality of the WAN link.
The Remote Backup Services deployment model has additional considerations that must be taken into account due to the separation of the client data and the primary backup target across a wide area network connection. Avamar does provide incredibly efficient data deduplication during the backup and storage process, but the communication of that greatly reduced data set will still be subject to the achievable WAN speeds on the link between the tenant and the SP data center.

- Agent-to-Avamar network connectivity must be provided over a secure network infrastructure (VPN)
  - What infrastructure will be used to provide this secure connectivity?
  - Who will provide management of the network connection?
- Are there overlapping IP address ranges across tenants? If so, these must be resolved outside Avamar such that Avamar is only presented with unique IP addresses.
- What is the speed and quality of the WAN connections at the tenant location? Are these lines sufficient to support the backup (INITs and Dailies) and recovery (RTO) SLAs being proposed for the service based on data types and volumes?
- Is client-side NAT required and how does this interact with the VPN infrastructure? NAT overloading can be an effective method for bringing in a number of tenants into a single backup network at the SP data center, but it can also represent changes to the functionality that Avamar can provide (client paging/browsing). Be sure to understand how these changes affect
the solution and take those differences into account during the service definition phase.

**Replicated Backup Services**

The Replicated Backup Services deployment model is centered on providing a replication target for customers who own their own Avamar and/or Data Domain infrastructure and have a desire to offsite a second copy of their data. This would be comparable to the process they use to off-site tapes, but in this model, data is transferred via IP WAN connections verses trucks transporting physical tapes.

Within the Avamar system, it is important to note that if a customer has deployed both the Avamar Data Store and the Data Domain deduplicated storage systems with a requirement to replicate, both storage components MUST be replicated. Replicating both storage components ensures that the relationship of the data objects stored on each system will be maintained across to their associated replica systems.

The Replicated Backup Services deployment model has similar considerations as those outlined in the Remote Backup Services deployment model, once again driven by the requirements for the WAN links connecting the primary Avamar system used for backup and the Avamar system at the SP data center used as the replications target.

- Avamar-to-Avamar network connectivity for replication must be provided over a secure network infrastructure.
  - What infrastructure will be used to provide this secure connectivity?
  - Who will provide management of the network connection?
• Are there overlapping IP address ranges across tenants? If so, these must be resolved outside Avamar such that Avamar is only presented with unique IP addresses.

• Will the communication lines provide sufficient bandwidth to enable the daily replication processes to complete within the defined backup/replication window?
  • Will the initial replication be done over the WAN?
  • What are the SLAs around replication?

• How will the tenant access the target replication system for any required recovery processes?

• Will the SP provide any management services for the Avamar system located at the remote site?
  • How does this impact network connectivity?
  • How do I access the Avamar Admin GUI over this replication network connection?

Step 2 - Define the market

Once the service offerings are defined, it is important to take a close look at the “Target Market” to be addressed clearly analyzing the services and the number of customers that can realistically be served. This market sizing impacts the overall configuration of the solution and generally defines the sizing requirements.

Closely examining the scope of the market and how the service offerings will be delivered are important steps to building a successful business plan.

• A horizontal approach - trying to adapt the service offering to a broad range of markets. This approach generally increases the size of the addressable market, but due to a potential lack of specialization and typical “trusted” relationship, the service can be seen as a “commoditized” offering, with price being the biggest driver.

• A specific vertical approach - is creating a focused, tailored solution with specific SLAs targeted to a specific industry application or process. Financial Services, Healthcare and Energy are a few examples of vertical markets that could be targeted with focused services. In many cases, a vertical market approach will reduce the overall market available to the SP, but the pricing for those focused services may be higher due to less “commoditization” as is often seen in the horizontal market. Vertical market focus also allows SP’s with specific domain knowledge to leverage their expertise, customer base and relationships to create new revenue streams.
Once these market dynamics are understood, assumptions can be made about data types, data volumes and retention policies in order to develop sizing requirements for the Avamar/Data Domain solution. It is important to examine the expected rollout and annual data growth over at least one year to ensure that the SP can maintain effective system availability SLAs without impacting all multi-tenant users. The solution sizing and design must be framed around the other detailed requirements for Restore Point Objectives (RPO) and Restore Time Objectives (RTO) to ensure the proposed offering meets the key drivers within the defined market.

Step 3 - Define interactions
As documented earlier, an SP can interact with its tenants using various methods. In most cases, each SP creates a custom portal to provide the entry point for new or existing customers to interact with the SP. This existing web portal provides the tenant interface into the services and defines and controls the end user experience. Whether setting up new services, checking status of backup jobs or requesting assistance, this portal is the primary relationship vehicle between the customer and the SP. As new services are added, the portal needs to be updated with the desired controls and functions required in the service enablement definition.

Avamar can be integrated into these web portals by using the Avamar Management Console Command Line Interface (MCCLI). The MCCLI is a Java software application that provides command line access to Avamar Administrator features and functions. The MCCLI is currently the only method of interfacing with the Avamar solution outside of the Avamar Management Console user interface.

The MCCLI can be leveraged by SPs to develop custom connection methods into the Avamar system and administration utilities. This enables the SP to integrate the desired Avamar Admin features and functions into their custom web portal to deliver a common end user experience. The shell script wrapper sets various environment arguments that are required to invoke a Java application, thereby simplifying use of the MCCLI and making it easier to integrate into the custom portal. For additional information on MCCLI and its specific features and functions, please refer to the EMC Avamar 6.0 MCCLI Programmer Guide available on EMC PowerLink.

If the SP does not have a portal and plans to use the Avamar Administration Console to provide end-user direct control of the Avamar, additional considerations need to be taken into account around the domains and the role-based security offered within Avamar. For additional details, please refer to the EMC Avamar 6.0 Product Security Guide available on EMC PowerLink.

Service formally defined
Formal definition of the Service Offering is directly dependent on the market definition, solution design, technology identification and solution sizing. This section of the paper briefly describes the pricing of the offering, Service Level Agreement (SLA) for the offering and publishing the solution architecture.
Once the solution technology is defined and sized, cost estimates can be determined. Based on the costs plus desired margin a potential price for the service offering can be calculated. A clear analytical comparison of this price to others in the market should occur to ensure competitive alignment.

Prices range for various solutions dependent on the type of as a service offering and Service Level Agreements (SLA's). SLA’s such as Recovery Time Objective (RTO), Backup frequency, reporting, availability etc should all be considered. Certain industries are required to adhere to various requirements for retention on alternate media, backup frequency, and restorability of data all of which should be clearly outlined prior to finalizing the solution architecture and design.

The architecture and design once finalized can be published to the customer showing the “Current State” of the Service Offering. Additionally other options such as output of data to tape, deployment of a local device enabling more rapid RTO by eliminating recovery over WAN, and replication option for central storage subsystems can all be introduced to provide future potential service improvements for customers.

**Conclusion**

The Service Provider market has gained significant momentum in the last 24 months due to new technologies that efficiently move, store and manage data. The declining cost of network bandwidth coupled with technologies such as data deduplication bring the cost of disk-based backup on par with or often lower than tape, and end users are turning to Service Providers for help in removing tedious, expensive tasks in the data center so they can focus on more strategic activities.

This growth in data protection outsourcing is driving Service Providers to obtain the most efficient and cost effective technology on the market in an effort to maximize profits and resources. This includes the ability to efficiently move data (minimize impact on network infrastructure), efficiently store data (to optimize $/GB costs), high RAS (reliability, availability and scalability) as well as ease of deployment in an effort to reduce their operational expenditures.
EMC provides end-to-end, integrated solutions, with the scale, performance, flexibility and security that Service Providers demand. Flexible solutions can be deployed entirely at the Service Provider’s data center, or in combination with elements on the tenant’s premises. As a result, Service Providers can build a long-term, differentiated and profitable set of offerings, powered by EMC Backup and Recovery solutions.

Links to additional information
The following documents provide additional details for the Avamar Backup and Recovery solution, including technical white papers for both Avamar and Data Domain. All of these documents are available via EMC PowerLink. If you need any assistance, please contact your EMC BRS sales representative.

- White Paper: Efficient Data Protection with EMC Avamar Global Deduplication Software
- White Paper: Planning for EMC Avamar and EMC Data Domain Integration
- White Paper: EMC Avamar Integration with Data Domain – A Detailed Review
- EMC Avamar 6.0 MCCLI Programmer Guide
- EMC Avamar 6.0 Administration Guide
- EMC Avamar 6.0 Product Security Guide
- EMC Data Domain Product Overview
- EMC Data Domain Boost for Avamar
- EMC Avamar V6 Technical Deployment Considerations for Service Providers