

Storage Options in the AURO Cloud

AURO Enterprise Cloud (AURO) is a flexible, cost-effective, easy-to-use cloud-computing platform that provides cloud-based storage services in Canada. This whitepaper helps organizations and developers understand the primary data storage options available in the AURO cloud. We provide a brief overview of each storage option; describe ideal usage patterns, performance, durability and availability, cost model, scalability and elasticity and interfaces.

You can also review use cases at <http://www.auro.io/business-use-cases/use-cases> that discuss how you can use AURO cloud services. You can employ these use cases as a guide when designing your own storage architecture. One of the unique benefits of AURO's cloud storage services is that all data is 100% compliant with Canadian data regulations and will remain in Canada.

Traditional vs. Cloud-Based Storage Alternatives

Users of traditional, on-premises IT infrastructures and applications have potential data storage choices and in our data centres the below storage solutions are currently in production for our many of our enterprise cloud and non-cloud customers that include the following:

- *Memory*—In-memory storage, such as file caches, object caches, in-memory databases, and RAM disks, provide very rapid access to data.
- *Message Queues*—Temporary durable storage for data sent asynchronously between computer systems or application components.
- *Storage area network (SAN)*—Block devices (virtual disk LUNs) on dedicated SANs often provide the highest level of disk performance and durability for both business-critical file data and database storage.
- *Direct-attached storage (DAS)*—Local hard disk drives or arrays residing in each server provide higher performance than a SAN, but lower durability for temporary and persistent files, database storage, and operating system (OS) boot storage than a SAN.

- *Network attached storage (NAS)*—NAS storage provides a file-level interface to storage that can be shared across multiple systems. NAS tends to be slower than either SAN or DAS.
- *Databases*—Structured data is typically stored in some kind of database, such as a traditional SQL relational database, a non-relational database, or a data warehouse. The underlying database storage typically resides on SAN devices, or in some cases in memory.
- *Backup and Archive*—Data retained for backup and archival purposes is typically stored on non-disk media such as tapes or optical media, which are usually stored off-site in remote secure locations for disaster recovery.

There is a wide range of options and each of these traditional storage options differs in performance, durability, and cost, as well as in their interfaces. Users have to consider all these factors when identifying the right storage solution for the task at hand. In some cases, IT infrastructures and application architectures will employ multiple storage technologies in concert, each of which has been selected to satisfy the needs of a particular use of storage, or for the storage of data at a particular point in its lifecycle.

As you'll see in this document, AURO offers multiple cloud-based storage options. Each has a unique level of performance, durability, availability, cost, and interface, as well as other characteristics such as scalability and elasticity. These additional characteristics are critical for web-scale cloud-based solutions. As with traditional on-premises applications, you can use multiple cloud storage options together to form a comprehensive data storage hierarchy.

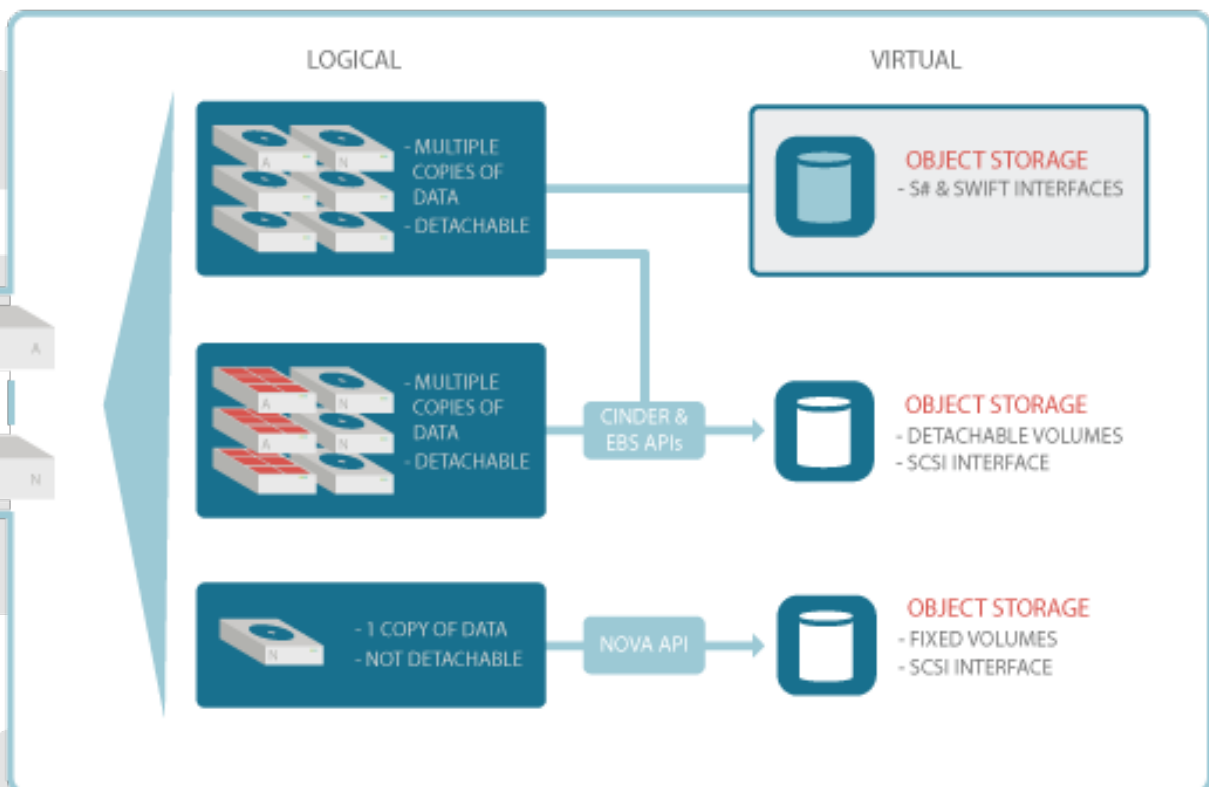
This whitepaper focuses on the following cloud storage options:

- **AURO Object Storage**
- **AURO Block Storage**

AURO Object Storage Service

AURO Object Storage is storage for the Internet. It's an easy to use, simple storage service that offers users a highly scalable, reliable, and low-latency storage service at low costs. AURO Object Storage can be used to store and retrieve any amount of data, at any time, from within AURO or from anywhere on the web. You can write, read, and delete objects and the number of objects you can store in AURO's Object Storage bucket is virtually unlimited.

AURO Object Storage is also highly scalable, allowing concurrent read or write access to data by many separate clients or application threads. Finally, in the near future AURO Object Storage will enable users to have data lifecycle management capabilities by being able to define rules to automatically archive AURO Object Storage data to AURO's long-term storage service. Described below is the architecture behind AURO's Object Storage offering that utilizes OpenStack Swift distributed storage technology.



Use Cases

One very common use for AURO Object Storage is the storage and distribution of static web content and media. Because of elastic nature of AURO Object Storage's, it works particularly well for hosting web content with extremely spiky bandwidth demands. Also, because no storage provisioning is required, it works well for fast growing websites including high usage, user-generated content, such as video and photo sharing sites including HTML files, images, videos, and client-side scripts such as JavaScript.

Another use is using object storage for big data and/or computational requirements such as analyzing financial transactions, and media transcoding. Because of the unique horizontal scalability of Object Storage, you are able to access your data from multiple computing nodes concurrently without being constrained by a single connection.

Finally, AURO's Object Storage is often used as a highly durable, scalable, and secure solution for backup and archival of critical data, and to provide disaster recovery solutions for business continuity. The cloud architecture stores objects redundantly on multiple nodes and possibly facilities; it provides a highly durable storage infrastructure.

Performance

Access to AURO's Object Storage from within AURO's Cloud is fast. The Object Storage service is designed so that server-side latencies are insignificant relative to Internet latencies in addition to leveraging built to scale storage, requests, and users to support a virtually unlimited number of web-scale applications.

To speed access to relevant data, we have seen many developers pair AURO's Object Storage with a database, such as MongoDB. In doing so, the service stores the actual information, and the database serves as the repository for associated metadata (e.g., object name, size, keywords, and so on). Metadata in the database can easily be indexed and queried, making it very efficient to locate an object's reference via a database query.

Durability and Availability

By automatically and synchronously storing your data across both multiple devices, AURO's Object Storage provides the highest level of data durability and availability in the AURO platform. Error correction is built-in, and there are no single points of failure. AURO's cloud services are designed for 99.95% availability over a one-year period.

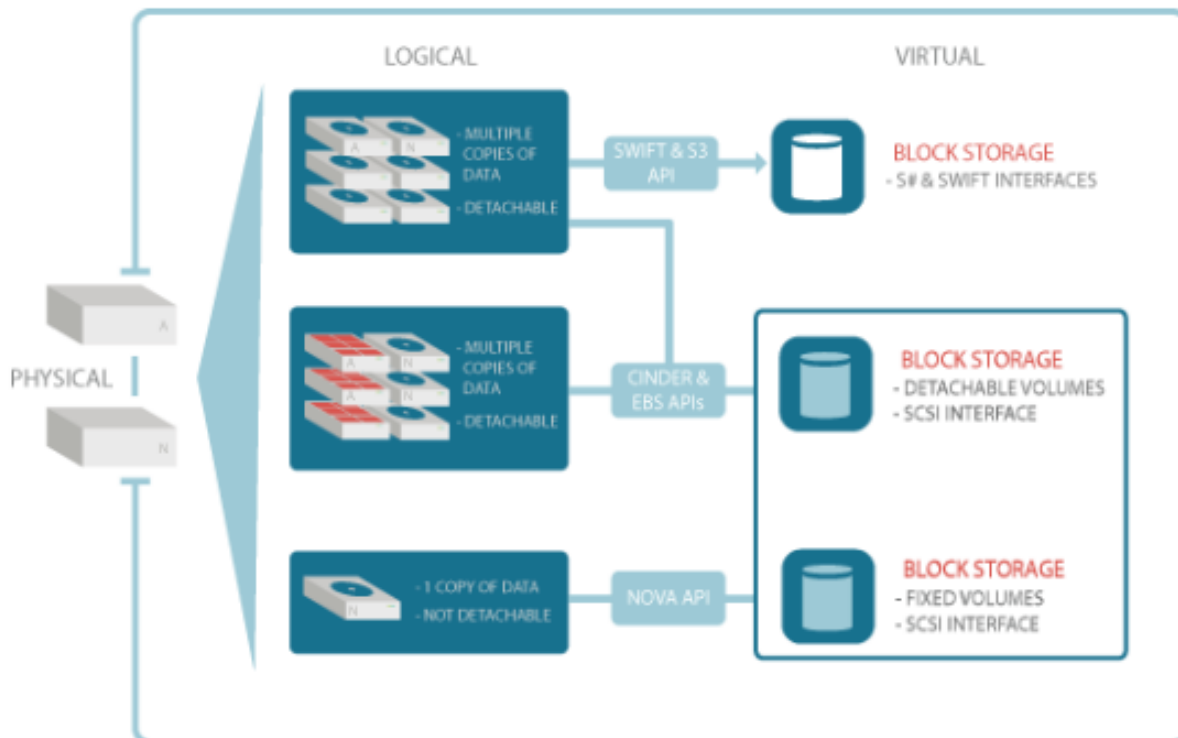
Cost Model

With AURO Object Storage, you pay only for what you use and there is no minimum fee. To keep usage simple, AURO has a simple pricing structure for Object Storage. Pricing is a flat fee based on actual data used per month. Customers can also receive additional discounts based on volume and commitment.

AURO Block Storage

AURO Block Storage provides durable block-level storage for use with AURO compute instances (virtual machines). AURO Block Storage volumes are off-instance, network-attached storage (NAS) that persists independently from the running life of a single AURO compute instance. After an AURO Object Storage volume is attached to an instance, you can use it like a physical hard drive, typically by formatting it with the file system of your choice and using the file I/O interface provided by the instance operating system. You can use a volume of AURO Block Storage to boot an AURO compute instance and you can attach multiple AURO volumes to a single AURO instance. Note, however, that any single AURO Block Storage volume may be attached to only one AURO compute instance at any point in time.

Block Storage also provides a user with the ability to create point-in-time snapshots of volumes, which are persisted across to AURO's Object Storage. These snapshots can be used as the starting point for new volumes, and to protect data for long-term durability. Described below is the general architecture of AURO's Block Storage system that utilizes Cinder technology.



Use Cases

AURO Block Storage is meant for data that changes relatively frequently and requires long-term persistence, and is particularly well suited for use as the primary storage for a database or file system, or for any applications that require access to raw block-level storage. In the future, AURO will also provide IOPS volumes that will be well suited for use with databases applications that require a high and consistent rate of random disk reads and writes.

Performance

AURO Block Storage currently provides a single volume type that offers cost effective storage for applications with moderate or burst I/O requirements. Standard volumes are designed to deliver above average performance with a best effort ability to burst to hundreds of IOPS. Standard volumes are also well suited for use as boot volumes, where the burst capability provides fast instance start-up times.

Durability and Availability

Block Storage volumes are designed to be highly available and highly reliable. AURO's Block Storage volume data is replicated across multiple servers in a single Availability Zone to prevent the loss of data from the failure of any single component. The durability of your volumes depends on both the size of your volume and the amount of data that has changed since your last snapshot. Snapshots are incremental, point-in-time backups, containing only the data blocks changed since the last snapshot.

To maximize both durability and availability of a users data, one should create snapshots of Block volumes frequently. Note, for data consistency it is a good general best practice to briefly pause any writes to the volume, or unmount the volume, while the snapshot command is issued.) In the event that a Block Storage volume does fail, all snapshots of that volume will remain intact, and will allow easy creation of a volume from the last snapshot point. When additional zones become available, AURO Block Storage snapshots can also be copied from one region to another. Because of this, these snapshots provides an easy-to-use disk clone or disk image mechanism for backup, sharing, and disaster- recovery.

Cost Model

With Block Storage, you pay only for what you use. AURO's Block Storage pricing has three components: provisioned block storage, snapshot storage that is based on the block snapshot volume provisioned and volume backups stored in Object Storage. Similar to other services, AURO's Block Storage volumes are charged per GB-month of provisioned storage. Block Storage snapshots are charged per GB-month of data stored and snapshot it's important to remember that for AURO Block Storage, usage is charged for provisioned (allocated) storage, whether or not it is actually used. For Volume Backups with Object Storage you are charged only for storage actually used (consumed).

Pricing information for AURO Storage Services can be found at:

https://auro.io/public_cloud_hosting/pricing

You can also get more information by contact AURO's team at sales@auro.io or at <https://www.auro.io/start>.