Block Storage

IBM Cloud™ Block Storage is persistent, high-performance iSCSI storage that is provisioned and managed independently of compute instances. iSCSI-based Block Storage LUNs are connected to authorized devices through redundant multi-path I/O (MPIO) connections.

Block Storage brings best-in-class levels of durability and availability with an unmatched feature set. It is built by using industry standards and best practices. Block Storage is designed to protect the integrity of the data and maintain availability through maintenance events and unplanned failures, and provide a consistent performance baseline.

**Core Features**

Take advantage of the following features of Block Storage:

* **Consistent performance baseline**
  + Provided through the allocation of protocol-level input/output operations per second (IOPS) to individual volumes.
* **Highly durable and resilient**
  + Protects the integrity of the data and maintains availability through maintenance events and unplanned failures without the need to create and manage operating system-level redundant array of independent disk (RAID) arrays.
* **Data-At-Rest Encryption** ([Available in most data centers](https://cloud.ibm.com/docs/BlockStorage?topic=BlockStorage-selectDC))
  + Provider-managed encryption for data-at-rest at no additional cost.
* **All Flash Backed Storage** ([Available in most data centers](https://cloud.ibm.com/docs/BlockStorage?topic=BlockStorage-selectDC))
  + All flash storage for volumes that are provisioned with Endurance or Performance at 2 IOPS/GB or higher levels.
* **Snapshots** ([Available in most data centers](https://cloud.ibm.com/docs/BlockStorage?topic=BlockStorage-selectDC))
  + Captures point-in-time data snapshots non-disruptively.
* **Replication** ([Available in most data centers](https://cloud.ibm.com/docs/BlockStorage?topic=BlockStorage-selectDC))
  + Automatically copies snapshots to a partner IBM Cloud® data center.
* **Highly available connectivity**
  + Uses redundant networking connections to maximize availability.
  + iSCSI-based Block Storage uses Multipath I/O (MPIO).
* **Concurrent access**
  + Allows multiple hosts to simultaneously access block volumes for clustered configurations.
* **Clustered databases**
  + Supports advanced use cases, such as clustered databases.

**Provisioning**

Block Storage LUNs can be provisioned from 20 GB to 12 TB with two options:

* Provision **Endurance** tiers that feature pre-defined performance levels and other features like snapshots and replication.
* Build a high-powered **Performance** environment with allocated IOPS.

Provisioning with Endurance Tiers

Endurance Block Storage is available in four IOPS performance tiers to support varying application needs.

* **0.25 IOPS per GB** is designed for workloads with low I/O intensity. These workloads are typically characterized by having a large percentage of data inactive at any time. Example applications include storing mailboxes or departmental level file shares.
* **2 IOPS per GB** is designed for most general-purpose usage. Example applications include hosting small databases that are backing web applications or VM disk images for a hypervisor.
* **4 IOPS per GB** is designed for higher-intensity workloads. These workloads are typically characterized by having a high percentage of data active at any time. Example applications include transactional and other performance-sensitive databases.
* **10 IOPS per GB** is designed for the most demanding workloads such as those created by NoSQL databases, and data processing for Analytics. This tier is available for storage that is provisioned up to 4 TB in [most data centers](https://cloud.ibm.com/docs/BlockStorage?topic=BlockStorage-selectDC).

Up to 48,000 IOPS are available with a 12-TB Endurance volume.

Choosing the right Endurance tier for your workload is key. It's equally important to use the right block size, Ethernet connection speed, and the number of hosts necessary to achieve maximum performance. If any of these parts don't align with the other, it can have a significant impact on the resulting throughput.

Provisioning with Performance

Performance is a class of Block Storage that is designed to support high I/O applications with understood performance requirements that don't fit well within an Endurance tier. Predictable performance is achieved through the allocation of protocol-level IOPS to individual volumes. Various IOPS rates (100 - 48,000) can be provisioned with storage sizes that range from 20 GB to 12 TB.

Performance for Block Storage is accessed and mounted through a Multipath I/O (MPIO) internet Small Computer System Interface (iSCSI) connection. Block Storage is typically used when the volume is accessed by a single server. Multiple volumes can be mounted to a host and striped together to achieve larger volumes and higher IOPS counts. Performance volumes can be ordered according to the sizes and IOPS rates in Table 3 for Linux®, XEN, and Windows operating systems.

| **Size (GB)** | **Min IOPS** | **Max IOPS** |
| --- | --- | --- |
| **20** | **100** | 1,000 |
| **40** | **100** | 2,000 |
| **80** | **100** | 4,000 |
| **100** | **100** | 6,000 |
| **250** | **100** | 6,000 |
| **500** | **100** | 6,000 or 10,000 |
| **1,000** | **100** | 6,000 or 20,000 Footnote |
| **2,000** | **200** | 6,000 or 40,000 Footnote |
| **3,000-7,000** | **300** | 6,000 or 48,000 Footnote |
| **8,000-9,000** | **500** | 6,000 or 48,000 Footnote |
| **10,000-12,000** | **1,000** | 6,000 or 48,000 Footnote |
| Table comparison | | |

Footnote *IOPS limits that are greater than 6,000 are available in most data centers.*

Performance volumes are designed to operate consistently close to the provisioned IOPS level. Consistency makes it easier to size and scale application environments with a specific level of performance. Additionally, it's possible to optimize an environment by building a volume with the ideal price-to-performance ratio.

**Billing**

You can select hourly or monthly billing for a Block LUN. The type of billing that is selected for a LUN applies to its snapshot space and replicas. For example, if you provision a LUN with hourly billing, any snapshots or replica fees are billed hourly. If you provision a LUN with monthly billing, any snapshots or replica fees are billed monthly.

* With **hourly billing**, the number of hours the block LUN existed on the account is calculated at the time the LUN is deleted or at the end of the billing cycle, which ever comes first. Hourly billing is a good choice for storage that is used for a few days or less than a full month. Hourly billing is available in [most data centers](https://cloud.ibm.com/docs/BlockStorage?topic=BlockStorage-selectDC).
* With **monthly billing**, the calculation for the price is pro-rated from the date of creation to the end of the billing cycle and billed immediately. If a LUN is deleted before the end of the billing cycle, there's no refund. Monthly billing is a good choice for storage that is used in production workloads that use data that needs to be stored and accessed for long periods of time (one month or longer).

Endurance

| **Pricing options for predefined IOPS tiers** | **0.25 IOPS** | **2 IOPS/GB** | **4 IOPS/GB** | **10 IOPS/GB** |
| --- | --- | --- | --- | --- |
| **Monthly Price** | **$0.05/GB** | $0.12/GB | $0.16/GB | $0.48/GB |
| **Hourly Price** | **$0.0001/GB** | $0.0002/GB | $0.0003/GB | $0.0009/GB |
| Table comparison | | | | |

Performance

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