IBM Storage Insights

Security Guide

Note:

Before using this information and the product it supports, read the information in “Legal notices” on page 47.

This edition applies to the current version of IBM Storage Insights (product number 5725-U02) and to all subsequent versions until otherwise indicated in new editions.

Contents

About this guide

In IBM Storage Insights Pro and IBM Storage Insights, detecting and resolving issues in a storage environment has never been easier. It combines cognitive storage management capabilities with a simplified yet robust IBM support experience to help you spend less time troubleshooting storage problems and more time planning for your future storage needs.

Who should read this guide

This publication is intended for administrators or IT professionals who deploy IBM Storage Insights Pro or IBM Storage Insights and want to learn more about security and data collection.

Administrators should be familiar with the following topics:

- General procedures for installing software on Microsoft Windows, AIX®, and Linux®.
- Storage area network (SAN) concepts.
- Storage resources and management concepts.

Chapter 1. Security overview

Learn about the security measures related to deploying a data collector on-premises, processing and storing metadata off-premises, and session timeouts or call home with cloud services.

IBM Storage Insights Pro and IBM Storage Insights are cloud service offerings uses one of the following data collection method :

Call home with cloud services to collect detailed configuration, capacity and performance metadata.

A light-weight application that is called the data collector to securely and efficiently send configuration, capacity, performance, and status metadata for analysis to an IBM Cloud data center and for presentation in the GUI. Call home with cloud services to collect detailed configuration, capacity and performance metadata.

Important:

- The security policies for collecting, sending, accessing, protecting, and storing metadata for IBM Storage Insights Pro and IBM Storage Insights are identical.
- After you log in to the service, the security of your web browser session is important. To protect your session, you're automatically logged out after 2 hours 30 minutes of inactivity. For more security during extended use, the duration of an active login session is limited to approximately 8 hours. When you are logged out, you can log in again and pick up right where you left off.

  The timeout durations for a session are set by default and can't be changed.

The key differences between both cloud service offerings lie in the exclusive features that IBM Storage Insights Pro provides to its subscribers, such as capacity planning analysis, reclamation analysis, and tiering analysis, and in the access to the metadata that is presented in the GUI for the cloud service offerings. In IBM Storage Insights Pro, subscribers have access to all of the metadata in the GUI, whereas in IBM Storage Insights, non-subscribers have access to specific capacity and performance metadata only. IBM Support also has read-only access to the set of metadata that they need to troubleshoot and close support tickets.

Tip: In the security documentation, the name IBM Storage Insights is used to refer to both IBM Storage Insights and IBM Storage Insights Pro unless a notable difference exists between the offerings.

To address the security concerns that you might have, the following questions are answered:

- What security measures are built-in?
- What is the data collector?
- What are data collection methods
- What is call home ?
- How is the metadata protected?
- What types of metadata are collected?
- How long is the metadata kept?
- Who can access the metadata that is collected?

Lists of the asset, capacity, and configuration metadata and the performance metadata that is collected and stored about your storage systems are also provided.

Chapter 2. What security measures are built in to IBM Storage Insights

Key security measures are built in to IBM Storage Insights to help ensure that it's a secure part of your organization.

Security and Privacy by Design (SPbD) at IBM is an agile set of focused security and privacy practices, including threat models, privacy assessments, security testing, and vulnerability management. SPbD@IBM is aligned with the United States National Institute of Standards and Technology (NIST's) Secure Software Development Framework (SSDF), which drive processes that are required across all business units.

Because IBM Storage Insights is a cloud-based service, the security of the connection between it and your storage environment is paramount. The IBM Storage Insights team used SPbD to build in security measures at the start and continues to carry it up through every aspect of the service.

In summary, security wasn't something that was tacked on after the service was developed, but was and is baked into the design and DNA of IBM Storage Insights:

- ISO/IEC 27001/27017/27018/27701 ISM certified
- Communication is one way, encrypted and compressed
- Metadata at rest is AES 256-bit encrypted
- Metadata streamed to IBM Cloud® is 128-bit encrypted
- Only metadata about your storage is collected
- Personal, identity, and application data are never accessed
- HIPAA / Blue Diamond ready
- Dedicated vulnerability tracking and threat response team (IBM PSIRT) *****
- EU-US Privacy Shield and Swiss-US Privacy Shield Framework
- Meets the requirements of GDPR

*** About the IBM Product Security Incident Response Team (PSIRT):** This global team manages the receipt, investigation, and internal coordination of security vulnerability information related to IBM Storage Insights. IBM PSIRT is the centralized process through which IBM customers, security researchers, industry groups, government organizations, or vendors report potential IBM security vulnerabilities. IBM is committed to responding to new threats and risks. IBM's Secure Engineering practices were designed so that IBM can act in a timely fashion to a reported security vulnerability affecting IBM Storage Insights.

Trusting in the security of IBM Storage Insights is an important factor when organizations consider deploying the service within their environments. Understanding more about the security measures that IBM builds in can help address your concerns and gain the trust that you need to use it with peace of mind.

Chapter 3. Data Collection Methods

In IBM Storage Insights, you can use both Call Home with cloud services and data collectors as part of your overall monitoring strategy.

But keep in mind the following considerations:

- You can use one method to collect metadata for each storage system. If you use a data collector to collect metadata for a storage system, you cannot use Call Home with cloud services for that storage system.
- If you have more than one IBM Storage Insights, each service can monitor the same storage system by using different collection methods. You can use Call Home with cloud services to collect metadata on one of those services. If you have three services monitor a storage system, and one service uses Call Home with cloud services, you must use data collectors in the other two services.

Chapter 4. What is Call Home

IBM Cloud Call Home utilizes RESTful API to provide the most reliable call home method available today. These are industry standards for transmitting data through web services.The cloud call home adoption of this standard provides a better delivery mechanism of messages to the IBM call home servers. This way is not affected by spam filters or other technologies preventing IBM from receiving the call home messages.

Call Home with email notifications is a communication link between IBM storage systems, IBM Support, and IBM Storage Insights that monitors the health and status of your storage.

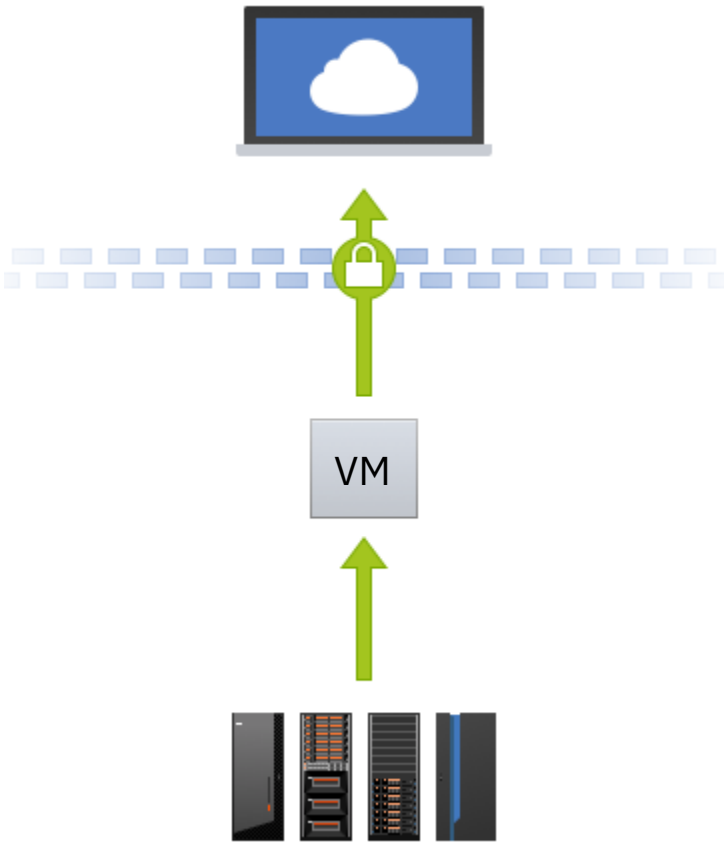
Call Home with cloud services integrates IBM Storage Virtualize storage systems with IBM Storage Insights to collect detailed configuration, capacity, and performance metadata.

Key security characteristics:

- ISO/IEC 27001/27017/27018/27701 ISM certified.
- Communication is initiated one way, encrypted and compressed.
- Metadata at rest is AES 256-bit encrypted.
- Metadata streamed to IBM Cloud is 128-bit encrypted.
- Personal, identity, and application data are never accessed.
- Works with IBM Enhanced Secure Support (Blue Diamond) framework for HIPAA compliance.
- Dedicated vulnerability tracking and threat response team (IBM PSIRT).
- IBM has EU–US Privacy Shield and Swiss-US Privacy Shield Framework certification.
- Integrated Security and Privacy by Design (SPbD).
- Meets the requirements of GDPR.

Chapter 5. What is the data collector

The data collector is the application that collects and delivers the metadata that is analyzed and presented in the GUI.



The data collector is a light-weight application that is installed on a server in your data center. It sends the metadata that is collected about your storage systems, such as asset, configuration, capacity, and performance metadata, from your data center to your instance of IBM Storage Insights Pro or IBM Storage Insights, which is in an IBM Cloud data center.

Important: Outbound metadata is sent by data collectors to the well-defined and secure network endpoint https://insights.ibm.com:443. Update your firewall rules to allow outbound communication to https://insights.ibm.com and to the HTTPS port 443 using the Transmission Control Protocol (TCP).

In a matter of minutes, you can install the data collector and when you add the storage systems that you want to monitor, you get the capacity and performance insights that you need to monitor your data center. Because the metadata that IBM Support needs to investigate and close tickets is also collected, you can also upload logs when you create or update tickets and IBM Support can access and investigate the metadata to resolve any issues that you might have.

Credentials for connecting to storage systems: To add and collect metadata from the storage systems that you want to monitor, you must provide the storage system's credentials. Depending on the type of storage system that you add for monitoring, you can provide the name and password of a user with privileges to collect the metadata, or an SSH user and SSH key. The credentials that are provided are encrypted before they are stored in the database for the instance, and the database is also encrypted. In addition, most storage systems support the creation of users with read-only roles, who can't make any changes to the configuration of the storage system.

Note: IBM Storage Insights now supports onboarding of IBM Storage Virtualize devices running on SSH4 secured connectivity by using data collector.

Supported operating systems: Data collectors can be installed on servers or virtual machine that run AIX, Linux, or Windows (64-bit systems only). On the server or virtual machine, you must provide at least 1 GB of RAM and 3 GB of disk space. For more information about the requirements for data collectors, see the following topics:

- https://www.ibm.com/docs/en/storage-insights?topic=collectors-installing-data-windows
- https://www.ibm.com/docs/en/storage-insights?topic=collectors-installing-data-aix-linux

Security certification: IBM Storage Insights, based on regular audits, has ISO/IEC 27001 Information Security Management certification. Annually, the following audits are conducted: two KPI audits, one external Veritas ISO27001, 27017, and 27018 audit, and one IBM internal audit for each ISO2700x.

Note: Security scanners can display an alert message 'Daemon is not managed by RPM' for IBM Storage Insights data collector. For more information, see Troubleshooting data collectors.

Key security characteristics

To ensure that metadata is collected securely, the data collector has the following characteristics:

Built-in security

Communication with other entities, such as storage systems in the local data center and the IBM Storage Insights service in the IBM Cloud data center are initiated solely by the data collector. The data collector does not provide any remote APIs that might be used to interact with the data collector.

Data collectors use prepackaged commands and code from IBM Storage Insights to run pre-defined operations only. Remote code loading is not possible.

One-way communication

The data collector sends metadata out of your network to your instance of IBM Storage Insights Pro or IBM Storage Insights. Communication is outbound only; the data collector can't receive data from the internet or any other entity in your network. Here's how the one-way communication works:

1. The data collector sends out a request for work.
2. IBM Storage Insights responds with a data collection request.
3. The data collector communicates with the storage resource or starts a log collection.

Secure transmission

All communication between the data collector and IBM Storage Insights Pro or IBM Storage Insights in the IBM Cloud data center uses encryption based on HTTPS.

The communication that the data collector initiates with the server where it is installed, and the communication between the server and IBM Storage Insights Pro GUI or IBM Storage Insights GUI. HTTPS connections use certificates issued by Google Trust Services and use TLS 1.2 and TLS 1.3 with 256-byte keys.

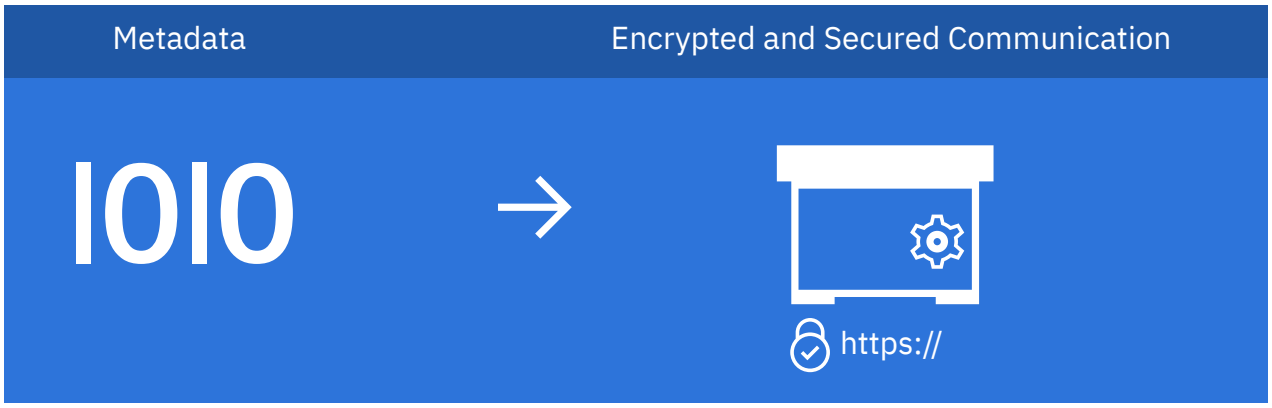
Tip: Because HTTPS connections are used, the data collector can run on any computer that can access the internet over an outbound TCP connection to port 443. Port 443 is the standard port for HTTPS connections.

Chapter 6. How is the metadata protected

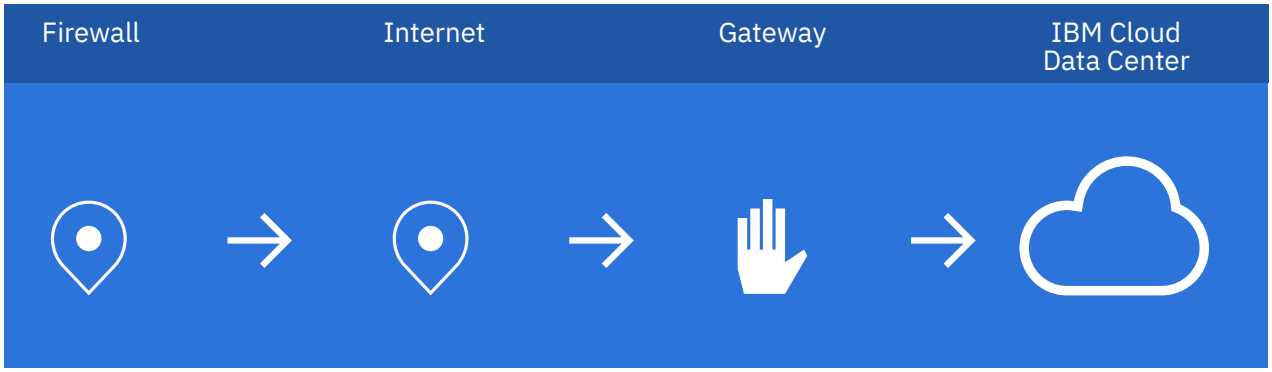
End-to end protection is provided for the metadata that is collected, delivered, and stored for your IBM Storage Insights service in the IBM Cloud data center. This protection includes meeting the requirements of the General Data Protection Regulation (GDPR).

Metadata collection, delivery, and storage in the cloud

To transform the metadata into insights and present them in IBM Storage Insights, the data collector / call home forwards metadata packages for analysis and storage to the IBM Cloud data center (located in Dallas).



To keep the metadata package safe on its journey to the cloud, the data collector / call home uses Hypertext Transfer Protocol Secure (HTTPS), which encrypts the metadata and sends the metadata package through a secure channel to the IBM Cloud data center.



At the gateway, or reverse proxy gateway, the metadata package gets instructions to deliver the package to your IBM Storage Insights service. Only data collectors that are associated with your service can collect and deliver metadata about your storage environment.

When the metadata package is delivered, the metadata is decrypted, analyzed, and stored.

From your data center to the internet

HTTPS connections are used to compress and encrypt the metadata that is collected about your storage systems and sent to the IBM Cloud data center.

After you sign up, you're provided with a host name and port number for your IBM Storage Insights service. To secure the outbound communication between the data collector and IBM Storage Insights at the well-defined and secure network endpoint https://insights.ibm.com:443, a Secure Sockets Layer (SSL) certificate is used. HTTPS connections use certificates issued by Google Trust Services and use TLS 1.2 and TLS 1.3 with 256-byte keys.

To send the metadata, complete the following tasks for your firewall:

- Update your firewall rules to allow outbound communication on the default HTTPS port 443 using the Transmission Control Protocol (TCP). The User Datagram Protocol (UDP) is not supported.
- Update your firewall rules to allow outbound communication to the following network endpoint: https://insights.ibm.com. If you use a proxy server with a separate firewall, ensure that you also update its rules.

Tip: The security of your web browser session is also important. To protect your session, you're automatically logged out after 2 hours 30 minutes of inactivity. For more security during extended use, the duration of an active login session is limited to approximately 8 hours. When you are logged out, you can log in again and pick up right where you left off.

At the IBM Cloud data center

IBM Storage Insights are hosted in IBM Cloud data centers, which comply with high physical, technical, and organizational security standards.

Key security

Each instance of IBM Storage Insights uses a local keystore that is dedicated to that instance and is password protected. The password for the keystore is generated randomly when the instance is created. The certificate in the keystore is unique to each instance and the keystore password is encrypted. (The encryption doesn't include hardware encryption.) The master password is kept encrypted in the service payload configuration in a secure location in IBM Cloud.

There is only one external customer key, which is the public key that is certified by DigiCert. As part of the TLS Handshake and certificate exchange, the client (Web Browser) uses the signed certificate to verify that it is communicating with the IBM Storage Insights gateway in IBM Cloud and that communications are not tampered with. For internal traffic, each customer's instance of IBM Storage Insights has a unique key, which is protected with a unique, encrypted password, and which is self-signed by IBM to validate that the communication is between the customer and the customer's instance.

Key rotation: A new master key is created and added to the keystore when the instance is created and when the instance is upgraded. Instances are upgraded at least once every three months, which results in an implicit key rotation of not less than 90 days. The public key that is certified by DigiCert is updated every 2 years.

This results in end-to-end privacy and encryption for each instance of IBM Storage Insights.

Physical protection

The data centers are rigorously controlled and onsite security is provided round the clock. Access to server-rooms is limited to certified employees and security controls are vetted by third-party auditors.

See https://www.ibm.com/cloud-computing/bluemix/data-centers and https://www.ibm.com/cloud/security.

Technical security

IBM Storage Insights is built with a multi-tenant SaaS architecture. Multiple SaaS instances, or tenants, are hosted from a single multi-tenant application that spans the resources of many shared servers and services. Even though any two tenants might share common resources, each tenant does not see the data of other tenants; let alone even knows others exist.

In this multi-tenant SaaS architecture, IBM Storage Insights uses a virtualization technology called "containers". If you are familiar with Docker, containers is the technology behind it. The resulting container consists of just the application and a very small overhead for dependencies. The application within the container is comprised of multiple, independent micro-services based on a functional area. For example, there is one micro-service for the web server and another to process performance data. A collection of all the containers for the various micro-service applications make up the entire multi-tenant IBM Storage Insights server.

To keep track of all the IBM Storage Insights containers, Kubernetes is used as the container management tool. Kubernetes organizes containers into pods that are deployed on nodes in the cluster. Each IBM Storage Insights tenant is containerized within a Kubernetes cluster, which enables scalability, high-availability, and disaster tolerance. The Kubernetes cluster uses enterprise class IBM Cloud security, providing optimal communication and lower front-end latency to IBM Storage Insights containers and services. Additionally, back-end storage and SAN resources utilize the same enterprise class IBM Cloud security.

On a day-to-day basis, the following security software and services are used:

- Crowdstrike EDR and Crowdstrike Prevent to protect against malware
- IBM SOS® to comply with security and regulatory requirements
- IBM Security QRadar® SIEM to store and monitor system and application logs

For more information about IBM Cloud's compliance and certifications, see https://cloud.ibm.com/docs/overview?topic=overview-security.

Database security

IBM Storage Insights uses IBM Cloud databases built on Apache Cassandra. It’s designed to power real-time applications with high availability and massive scalability. With its NoSQL workloads, a smooth and secured experience is natively integrated into the IBM Cloud. Cassandra database protects against unauthorized access, provides data resiliency, is SOC/ISO certified, and GDPR/HIPAA/PCI DSS compliant.

For more information about Cassandra's compliance and certifications, see https://cloud.ibm.com/docs/databases-for-cassandra?topic=databases-for-cassandra-security-compliance.

Organizational security

Access to the infrastructure and instances for IBM Storage Insights, is controlled:

- By restricting access to the members of the DevOps team and cloud service infrastructure teams who qualify as privileged users.
- By conducting regular system health and vulnerability scans at the source code level and on the running instances.
- By conducting regular penetration tests. External companies conduct the penetration tests.

GDPR: IBM Storage Insights meets the requirements of the EU General Data Protection Regulation (GDPR). Additional information related to IBM's privacy policy can be found at https://www.ibm.com/privacy/us/en/.

Chapter 7. What types of metadata are collected

Metadata is the information that IBM Storage Insights collects about your storage devices and environment.

Metadata about your storage devices can include, but is not limited to the following information:

- Inventory and configuration metadata such as name, model, firmware, type, and more
- Inventory and configuration metadata for internal componentssuch as volumes, pools, disks, ports, and more
- Capacity metrics such as capacity, usable capacity, used capacity, compression ratios, and more
- Performance metrics such as read and write data rates, I/O rates, response times, and more
- Diagnostic data, system failure logs, maintenance levels, and more support-related information

IBM Storage Insights analyzes this metadata to help you identify problems with your storage before they impact your business. Performance bottlenecks, capacity usage and shortages, loss of connectivity or access to devices, and configuration issues are just a few of the things that metadata can spotlight. To get metadata, the information that is used to connect to devices is also collected and stored. The information is stored in the database that was created for your IBM Storage Insights service. Passwords are encrypted before they are stored in the database.

Important:

- Use of IBM Storage Insights and the collection and use of metadata is governed by the IBM Cloud Service agreement and the IBM Storage Insights Service Description.
- The data that is stored on your storage devices is never viewed or accessed by IBM Storage Insights.

IBM Support ticket and diagnostic log packages

When you create tickets in IBM Storage Insights, you provide a name, an email address, and a phone number so that IBM Support can contact you. IBM Storage Insights also collects and uploads the diagnostic data for IBM block storage systems to IBM Enhanced Customer Data Repository (ECuRep) or Blue Diamond Enhanced Secure Support, depending on your configuration.

What is ECuRep

ECuRep is an IBM strategic worldwide Post Sales Technical Support solution for diagnostic data transmission, storing, and analysis.

When the diagnostic log package is collected from a device, IBM Storage Insights transfers it to IBM Support and ECuRep. To secure the transmission of that data, multiple methods are used, such as HTTPS protocol. For more information, see https://www.ibm.com/support/pages/enhanced-customer-data-repository-ecurep-send-data-https.

About encryption: When diagnostic data is transmitted, that data is encrypted. For information about the data encryption that is used for ECuRep, see the following links:

- https://www.ibm.com/support/pages/ecurep-encryption-information-0
- https://www.ibm.com/support/pages/node/6259449

What is Blue Diamond Enhanced Secure Support

Blue Diamond Enhanced Secure Support is an enhancement to standard IBM remote software and hardware support. It adds extra layers of security and allows you to use a secure, dedicated portal to upload diagnostic data to IBM® Support.

If an IBM block storage system is configured to use Blue Diamond Enhanced Secure Support, IBM Storage Insights collects and uploads the diagnostic data that is collected for the storage system to the Blue Diamond environment.

About encryption: In Blue Diamond environments, data at rest is stored on encrypted storage.

Chapter 8. How long is the metadata kept

Information is provided about the retention periods for the metadata that is collected to provide storage services and to improve storage services.

As metadata about monitored devices is collected, the aggregation level of that metadata changes. For configuration, status, and capacity metadata, over a two years period, the aggregation levels of the metadata change from sample to hourly, then hourly to daily based on the age of the metadata. For performance metadata, over a one year period, the aggregation levels change from sample, to hourly, to daily based on the age of the performance metadata. In effect, a more granular view of new metadata is provided and a less granular view of aged metadata is provided.

The following table lists the aggregation levels for asset, configuration, and capacity metadata based on the age of the data that is collected:

Table 1. Asset, configuration, and capacity metadata

Aggregation level	**Metadata age**
Sample	2 weeks
Hourly	4 weeks
Daily	2 years

Capacity data is collected via the device probes: full probe, advanced mini probes (for DS8000 systems), and mini probes. The full probe is typically scheduled to run once every 24 hours, the advance mini probes run every hour, and mini probes are event-based. For example, as a volume's capacity changes over time, there may be more than one data point per day which is aggregated into the capacity data.

- Sample: Data that is collected directly from the device is stored at sample granularity, and then aggregated to hourly and daily aggregation levels.
- Hourly: The sample data collected within the hour is aggregated as an hourly data value. If no sample data is collected in an hour, the hourly data does not have a value for that particular hour.
- Daily: The sample and hourly data points of the day are aggregated into the daily data value.

The following table lists the aggregation levels for performance metadata based on the age of the data that is collected:

Table 2. Performance metadata

Aggregation level	**Metadata age**
Sample	2 weeks
Hourly	4 weeks
Daily	1 year

Based on the collection date, metadata is retained for up to two years.

Note: If you subscribe to IBM Storage Insights Pro and cancel your subscription, you'll still be able to use IBM Storage Insights. The metadata from IBM Storage Insights Pro is retained.

How long are diagnostic data packages kept

Typically, diagnostic data is automatically deleted from IBM Enhanced Customer Data Repository (ECuRep) 30 days after the ticket is closed. For information about the retention of data in ECuRep, see the IBM terms of use for Exchanging diagnostic data with IBM.

Blue Diamond Enhanced Secure Support uses a secure, dedicated portal for diagnostic data packages. For more information about diagnostic data and Blue Diamond, contact the Blue Diamond team at the Blue Diamond registration page.

Related tasks

Requesting the deletion of personal information

To delete the minimal personal information that was stored to provide you with monitoring and support services for your storage systems, you can submit a request to IBM Support.

Chapter 9. Who can access the metadata

Information is provided about access to the metadata that is collected and stored.

Access to metadata is carefully controlled and governed by the IBM Cloud Service Agreement and the IBM Storage Insights Service Description.

Key teams can access metadata. IBM Support, Development, DevOps, and cloud infrastructure teams have a level of access that's needed to help ensure that your day-to-day storage operations run smoothly. The wider IBM Storage Insights team has limited access to improve your product experience and help resolve any issues that you might encounter.

To access the metadata in the IBM Cloud network and ensure that the connection is secure, DevOps and cloud service infrastructure teams use a secure virtual private network (VPN) connection. Access to instances is only permitted from privileged user workstations, which must meet the strict security controls of IBM Security policies for production servers.

Metadata access controls and authorization

Access controls and authorization checks are enforced for SaaS infrastructure components and services.

An approval process is used to authorize access to the following infrastructural elements and services:

- The network
- The operating system
- The middleware components
- The application
- Administrative services

When managing the changes to a production environment, the following change management processes are adhered to:

- Changes to the production environment must be recorded and must be approved by the change advisory board
- All support activities must be tracked in the IBM Support Portal for cloud services
- All operational and maintenance activities must be tracked by the internal ticketing system

Metadata access for resolving issues

To investigate and resolve issues, access is required to metadata and the related IBM Storage Insights service.

To find the causes of issues, investigations are undertaken that might require access to the metadata that is collected and stored, or access to infrastructural elements, or both. For example, the DevOps team or IBM Support, might need to monitor instances of the application to determine the cause of interruptions in service, or to investigate interruptions in the collection of metadata. To resolve such issues, it might be necessary:

- To analyze the configuration of the instance
- To analyze log files
- To analyze the metadata that was collected

To thoroughly investigate some issues, it might also be necessary to package the metadata and transfer it to a secure IBM system so that the development team can complete the investigation.

IBM Support access for troubleshooting your tickets

To investigate hardware and software tickets, IBM Support has read-only access to the asset, configuration, capacity, and performance metadata that is collected for IBM storage systems and their internal storage resources.

The metadata might not provide enough information to close the ticket, so IBM Support might need to collect a log package from your storage systems. In this case, IBM Support can attach the log package to an open ticket and submit the log package to IBM Enhanced Customer Data Repository (ECuRep). Depending on the data governance requirements of a client, the diagnostic data package might be uploaded to the Blue Diamond Enhanced Secure Support environment instead of ECuRep.

Permit IBM Support to collect log packages: To save time when IBM® Support troubleshoots your ticket, you can permit IBM® Support to collect and upload log packages remotely without contacting you. To set this permission, click **Configuration** > **Settings**, and then click **Edit** in the **IBM Support Log Permissions** section. You can set this permission for each storage system.

This is the procedure for uploading the log packages to tickets:

1. The data collector submits a request to the storage system to create a log package or collect the existing log packages.
2. The data collector uses Hypertext Transfer Protocol Secure (HTTPS), which encrypts the metadata, and sends the log package through a secure channel to IBM Storage Insights.
3. IBM Storage Insights sends the log package to ECuREP or to Blue Diamond Enhanced Secure Support environment.

Metadata access for quality improvements

Anonymized metadata is used to improve the quality of service and to enhance the product offering.

A subset of the metadata from all of the instances is aggregated and condensed for further analysis. The data that is used is anonymized:

- It does not include instance-specific metadata
- It does not include customer-specific metadata such as IP addresses

For example, the aggregated metadata contains such information as the number of different types of storage systems or the number of different firmware levels for the storage systems that are monitored. The aggregated metadata might contain GUI and usage metrics, but it doesn't contain the names, the serial numbers, or the IP addresses of the storage systems.

Data backup and restore

To restore instances, regular backups of the data are made automatically.

Backups are made daily, which means that recovery point objective (RPO) is one day, and the recovery time objective (RTO) is between 1.5 and 2 days.

Backups are stored both locally, in the same data center, and remotely. The latest backup of the instance is stored in a remote data center, whereas the five previous backups are stored in the local data center.

Requesting the deletion of personal information

To delete the minimal personal information that was stored to provide you with monitoring and support services for your storage systems, you can submit a request to IBM Support.

If you cancel your subscription for IBM Storage Insights Pro or decide that you no longer want to monitor your storage environment with IBM Storage Insights, you can request that the minimal personal information is deleted.

1. Go to IBM Support.

2. Sign in.
3. Click **Go to my cases**.
4. Create a new case and request the deletion of your personal information.

Chapter 10. Asset, capacity, and configuration metadata

The data collector collects and stores asset, capacity, and configuration metadata for block, file, and object storage systems and their resources. A list of the supported storage systems is provided.

Asset, capacity, and configuration, metadata is collected and stored for the following IBM block storage systems and non-IBM block storage systems when they are added for monitoring.

Table 3. Asset, capacity, and configuration metadata by storage system

Storage System	IBM Storage Insights Pro	IBM Storage Insights
DS8000	Yes	Yes
Dell EMC Unity	Yes	No
Dell EMC VMAX	Yes	No
Dell EMC VNX, VNXe	Yes	No
IBM Storage FlashSystem 5000	Yes	Yes
IBM Storage FlashSystem 5100	Yes	Yes
IBM Storage FlashSystem 7200	Yes	Yes
IBM Storage FlashSystem 9100	Yes	Yes
IBM Storage FlashSystem 9200	Yes	Yes
IBM Storage FlashSystem 900	Yes	Yes
IBM FlashSystem® A9000	Yes	Yes
IBM FlashSystem A9000R	Yes	Yes
IBM Storage FlashSystem V9000	Yes	Yes
Hitachi VSP	Yes	No
IBM Storage Accelerate	Yes	Yes
NetApp ONTAP 9	Yes	No
Pure FlashArray//M and FlashArray//X	Yes	No
SAN Volume Controller	Yes	Yes
Storwize V3500	Yes	Yes
Storwize V3700	Yes	Yes
Storwize V5000	Yes	Yes
Storwize V7000	Yes	Yes
Storwize V7000 Unified	Yes	Yes
XIV	Yes	Yes

In IBM Storage Insights Pro, asset, capacity, and configuration metadata is collected for the following file, object, and software-defined storage systems when they are added for monitoring:

- Dell EMC Unity
- Dell EMC VNX

- Dell EMC VNXe
- IBM Cloud Object Storage
- IBM Storage Scale
- NetApp ONTAP 9
- Storwize V7000 Unified

Block storage system metadata

View the list of the asset, configuration, and capacity metadata for block storage systems.

Depending on the type of storage system, and the features that the storage system supports, some or all of the following metadata is collected and stored:

Available Capacity (GiB) (Previously known as Available Pool Space)
Available Written Capacity (GiB) (Previously known as Effective Available Capacity)
Compressed
Compression Savings (%)
Custom Tag 1, 2, 3
Deduplication Savings (%)
Data Collection
Data Reduction (GiB)
Data Reduction Ratio
Disks
FC Ports
Firmware
FlashCopy®
IP Address
IP Ports
Location
Managed Disks
Mapped Capacity (GiB) (Previously known as Assigned Volume Space)
Model
Name
Overhead Capacity (GiB)
Pools
Ports
Raw Capacity (GB)
Read Cache (GiB)
Remote Relationships
Reserved Volume Capacity (GiB) (Previously known as Unused Space)
Safeguarded Capacity (GiB)
Serial Number
Shortfall (%)
Time Zone
Total Provisioned (%) (Previously known as Provisioned Capacity (%))
Total Provisioned (GiB) (Previously known as Provisioned Capacity (GiB))
Total Savings (%) (Previously known as Total Capacity Savings (%))
Total Savings Ratio
Turbo Performance
Type
Unmapped Capacity (GiB) (Previously known as Unassigned Volume Space)
Usable Capacity (GiB) (Previously known as Capacity(GiB))

Used Capacity (%) (Previously known as Physical Allocation)
Used Capacity (GiB) (Previously known as Used Pool Space (GiB))
Used Written Capacity (%) (Previously known as Effective Used Capacity)
Used Written Capacity (GiB) (Previously known as Effective Used Capacity)
VDisk Mirrors
Vendor
Volumes
Write Cache (GiB)
Written Capacity Limit (GiB) (Previously known as Effective Capacity)

Block volumes metadata

View the list of the asset, capacity, and configuration metadata for volumes.

Depending on the type of storage system, and the features that the storage system supports, some or all of the following metadata is collected and stored for block storage volumes.

Auto Expand
Available Capacity (%) (Previously known as Unallocated Space)
Capacity (GiB)
Compression Savings (%)
Copies
Copy ID
Copy Relationship
Easy Tier®
Enterprise HDD Capacity (GiB)
Enterprise HDD Capacity (%)
Fast Write State
Formatted
Grain Size (KiB)
Hosts
I/O Group
ID
Last Data Collection
Mirror Role
Name
Nearline HDD Capacity (GiB)
Nearline HDD Capacity (%)
Node
Pool
Provisioned Capacity (%) (Previously known as Virtual Allocation)
RAID Level
Reserved Volume Capacity (GiB)
Safeguarded
Safeguarded Capacity (GiB)
Safeguarded Location
SCM Capacity (GiB)
SCM Capacity (%)
Shortfall (%)
SSD Capacity (GiB)
Storage System
Storage Virtualizer
Tier 0 Flash Capacity (GiB)

Tier 0 Flash Capacity (%)
Tier 1 Flash Capacity (GiB)
Tier 1 Flash Capacity (%)
Tier 2 Flash Capacity (GiB)
Tier 2 Flash Capacity (%)
Thin Provisioned
Tier Distribution (%)
Unique ID
Used Capacity (%)
Used Capacity (%) (Previously known as Physical Allocation)
Used Capacity (GiB) (Previously known as Allocated Space)
Virtualizer Disk Type
Virtualizer Disk
Warning Level (%)
Written Capacity (GiB) (Previously known as Written Space)

Block pools metadata

View the list of the asset, capacity, and configuration metadata for block storage pools.

Depending on the type of storage system, and the features that the storage system supports, some or all of the following metadata is collected and stored for storage pools:

Activity
Available Capacity (GiB) (Previously known as Available Pool Space)
Available Repository Capacity (GiB)
Available Soft Capacity (GiB)
Available Written Capacity (GiB) (Previously known as Effective Available Capacity)
Back-end Storage Disk Type
Back-end Storage Disks
Back-end Storage RAID Level
Back-end Storage System Type
Compression Savings (%)
Custom Tag 1, 2, 3
Deduplication Savings (%)
Easy Tier
Encryption
Encryption Group
Enterprise HDD Available Capacity (GiB)
Enterprise HDD Capacity (GiB)
Extent Size (MiB)
Format
Last Data Collection
LSS or LCU
Managed Disks
Mapped Capacity (GiB) (Previously known as Assigned Volume Space)
Name
Nearline HDD Available Capacity (GiB)
Nearline HDD Capacity (GiB)
Overhead Capacity (GiB)
Overprovisioned Capacity (GiB) (Previously known as Unallocatable Volume Space)
Owner Name
RAID Level

Rank Group
Repository Capacity (GiB)
Reserved Volume Capacity (GiB) (Previously known as Unused Space)
Safeguarded Capacity (GiB)
SCM Capacity (GiB)
SCM Available Capacity (GiB)
Shortfall (%)
Soft Capacity (GiB)
Solid State
SSD Available Space (GiB)
SSD Capacity (GiB)
Status
Storage System
Tier
Tier 0 Flash Capacity (GiB)
Tier 0 Flash Available Capacity (GiB)
Tier 1 Flash Capacity (GiB)
Tier 1 Flash Available Capacity (GiB)
Tier 2 Flash Capacity (GiB)
Tier 2 Flash Available Capacity (GiB)
Tier Distribution (%)
Total Provisioned (%) (Previously known as Provisioned Capacity (%))
Total Provisioned (GiB) (Previously known as Provisioned Capacity (GiB))
Total Savings (%) (Previously known as Total Capacity Savings (%))
Unmapped Capacity (GiB) (Previously known as Unassigned Volume Space)
Unused Volume Capacity (%) (Effective Previously known as Unallocated Volume Space)
Usable Capacity (GiB) (Previously known as Capacity(GiB))
Used Capacity (%) (Previously known as Physical Allocation)
Used Capacity (GiB) (Previously known as Allocated Space)
Used Written Capacity (%) (Previously known as Effective Used Capacity)
Used Written Capacity (GiB) (Previously known as Effective Used Capacity)
Volumes
Written Capacity Limit (GiB) (Previously known as Effective Capacity)
Zero Capacity

I/O groups, nodes, and ports metadata

View the lists of the asset, capacity, and configuration metadata for I/O groups, nodes, Fibre Channel (FC) ports, and IP ports.

I/O groups

Depending on the type of storage system, and the features that the storage system supports, some or all of the following metadata is collected and stored for I/O groups:

Compression
Enclosure
Name
Total FlashCopy Memory (MiB)
Total Mirroring Memory (MiB)
Total Remote Copy Memory (MiB)
Used Mirroring Memory (MiB)
Used Remote Copy Memory (MiB)

Volumes

Nodes

Depending on the type of storage system, and the features that the storage system supports, some or all of the following metadata is collected and stored for nodes:

Compression
Configuration node
Enclosures
FC ports
I/O group
IP address
IP ports
Model
Name
Panel name
Serial number
Spare nodes
WWN

FC Ports

Depending on the type of storage system, and the features that the storage system supports, some or all of the following metadata is collected and stored for FC ports:

Acknowledged
Connected NPIV Ports
Connected Port
Connected Resource
Connected WWPN
FC Port ID
Frame
Host Adapter
I/O Enclosure
Location
Name
Protocol
Speed (Gbps)
Status
WWPN

IP Ports

Depending on the type of storage system, and the features that the storage system supports, some or all of the following metadata is collected and stored for IP ports:

Acknowledged
Duplex
Failover
Gateway
Host Attach
IP Address
IQN
Management

MTU
Name
Node
Remote Copy Relationship
Speed (Gbps)
Status
Storage Attach
Storage System
Subnet

Disks and managed disks metadata

View the lists of the asset, capacity, and configuration metadata for disks and managed disks.

Disks

Depending on the type of storage system, and the features that the storage system supports, some or all of the following metadata is collected and stored for disks:

Capacity (GB)
Capacity (GiB)
Class
Firmware
Hardware
Name
Serial number
Slot
Spare
Speed (RPM)
Status
Vendor

Managed Disks

Depending on the type of storage system, and the features that the storage system supports, some or all of the following metadata is collected and stored for managed disks:

Active Quorum
Available Capacity (GiB)
Back-end Storage System
Capacity (GiB)
Class
Easy Tier
Easy Tier Load
Mode
Name
Pool
RAID Level
Storage System
Volumes

Enclosures metadata

View the list of the configuration metadata for block storage system enclosures.

Metadata about enclosures is collected for the following block storage systems:

- IBM Storage FlashSystem 9100
- IBM Storage FlashSystem V9000
- IBM Storage FlashSystem 900
- SAN Volume Controller
- IBM Storwize family

Depending on the type of storage system, some or all of the following metadata is collected and stored for enclosures:

Canisters
Canister status
Disks
Disk slots
I/O groups
Machine Type Model
Name
Nodes
Power® supplies
Power supply status
Site
Status

File storage system metadata

View the list of the asset, configuration, and capacity metadata for file storage systems.

Depending on the type of file storage system, and the features that the file storage system supports, some or all of the following metadata is collected and stored:

Restriction: Applies only to IBM Storage Insights Pro.

Available File System Capacity (GiB)
Cluster
Custom Tag 1, 2, 3
Data Collection
Disks
External Pool Used Capacity (GiB)
File System Capacity (%)
File System Capacity (GiB) (Previously known as Total File System Capacity)
IP Address
Location
Model
Name
Raw Capacity (GB)
Serial Number
Type
Used File System Capacity (GiB)
Vendor
Version

File system metadata

View the list of the asset, configuration, and capacity metadata for file systems.

Depending on the type of file storage system, and the features that the file storage system supports, some or all of the following metadata is collected and stored:

Restriction: Applies only to IBM Storage Insights Pro.

Available Inodes
Available Capacity (%)
Capacity (%)
Capacity (GiB) (Previously known as Total Capacity)
Cluster
Custom Tag 1, 2, 3
File System Type
Filesets
Last Probe Time
Maximum Inodes
Name
NSDs
Path
Physical Capacity (GiB)
Pools
Storage System
Used Inodes
Used Inodes (%)
Used Capacity (GiB)

Fileset metadata

View the list of the asset, configuration, and capacity metadata for filesets.

Depending on the type of file storage system, and the features that the file storage system supports, some or all of the following metadata is collected and stored.

Restriction: Applies only to IBM Storage Insights Pro.

Cache Role
Comment
File System
Home System Name
Name
Path
State
Used Capacity (GiB)

File shares metadata

View the list of the asset, configuration, and capacity metadata for file shares.

Depending on the type of file storage system, and the features that the file storage system supports, some or all of the following metadata is collected and stored.

Restriction: Applies only to IBM Storage Insights Pro.

Cluster
Discovered Time

Name
Path
Protocols
Shared Servers
State
Storage System
Ticket

File system pools metadata

View the list of the asset, configuration, and capacity metadata for file system pools.

Depending on the type of file storage system, and the features that the file storage system supports, some or all of the following metadata is collected and stored:

Restriction: Applies only to IBM Storage Insights Pro.

Available Capacity (GiB)
Capacity (%)
Capacity (GiB) (Previously known as Total Capacity)
Cluster
External Used Capacity (GiB)
File System
Inactive Used Capacity (%)
Inactive Used Capacity (GiB)
Name
Storage System
Used Capacity (GiB)

Network shared disks metadata

View the list of the asset, configuration, and capacity metadata for network shared disks.

Depending on the type of file storage system, and the features that the file storage system supports, some or all of the following metadata is collected and stored about network shared disks:

Restriction: Applies only to IBM Storage Insights Pro.

Available Capacity (GiB)
Capacity (%) (Previously known as Disk Capacity)
Capacity (GiB) (Previously known as Total Disk Capacity)
Cluster
Correlated Storage Volume
Custom Tag 1, 2, 3
Failure Group
File System
ID
Name
Pool
Probe Time
Storage System
Type
Used Capacity (GiB)

File nodes metadata

View the list of the asset, configuration, and capacity metadata for file nodes.

Depending on the type of file storage system, and the features that the file storage system supports, some or all of the following metadata is collected and stored about file nodes.

Restriction: Applies only to IBM Storage Insights Pro.

Cache Gateway Node
Cluster
IP Address
Name
Role
Serial number
Storage System
Version

Object storage systems metadata

View the lists of the asset, configuration, and capacity metadata for object storage systems and their internal resources.

Some or all of the following metadata is collected and stored for object storage systems and their internal storage resources such as:

- Access pools
- Accesser® nodes
- Storage pools
- Slicestor® nodes
- Sites
- Vaults

Restriction: Applies only to IBM Storage Insights Pro.

Storage systems metadata

Access pools
Available Capacity (GiB)
Capacity (%), Capacity (GiB) (Previously known as Total Capacity)
Containers
Custom Tag 1, 2, 3
Data Collection
IP Address
Location
Name
Objects
Type
Used Capacity (GiB)
Vaults
Vendor
Version

Access pools metadata

Mirrors

Name
Protocol
Vaults
Site

Accesses nodes metadata

Access Pool
IP Address
Model
Name
Serial Number
Site
Software Version

Storage pools metadata

Capacity (%), Capacity (GiB) (Previously known as Total Capacity)
Name
Sets
Site
Storage Pools
Used Capacity (GiB)
Vaults

Slicestor nodes metadata

Available Capacity (GiB)
Capacity (%), Capacity (GiB) (Previously known as Total Capacity)
Drives
IP Address
Model
Name
Serial Number
Set ID
Site
Software Version
Storage Pool
Used Capacity (GiB)

Sites metadata

Access Nodes
Accessibility
Available Capacity (GiB)
Capacity (%), Capacity (GiB) (Previously known as Total Capacity)
Name
Slicestor Nodes
Used Capacity (GiB)
Vaults

Vaults metadata

Access Pools

Accessibility, Capacity Quota (%)
Creation Date
Hard Quota (GiB)
IDA
Mirror
Name
Sites
Soft Quota (GiB)
Storage Pool
Storage System
Used Capacity (GiB)

Switches metadata

View the list of the asset, configuration, and status metadata for switches.

Depending on the type of switch, some or all of the following metadata is collected and stored for switches.

Acknowledged
Chassis
Condition
Connected Ports
Custom Tag 1, 2, and 3
Data Collection
Domain ID
Fabric
Firmware
IP Address
Last Successful Monitor
Last Successful Probe
Links
Location
Mode
Model
Name
Performance Monitor Status
Probe Status
Ports
Principal Switch of Fabric
Serial Number
System UUID
Vendor
WWN

Fabrics metadata

View the list of the asset, configuration, and status metadata for fabrics.

Depending on the type of fabric, some or all of the following metadata is collected and stored for fabrics.

Acknowledged
Active Zone Set
Condition
Connected Ports

Custom tag 1, 2, and 3
Fabric Type
Links
Location
Name
NPV Switches
Principal Switch of Fabric
Switches
Switch Ports
System UUID
WWN

Groups metadata

View the lists of the asset, configuration, and capacity metadata for general groups, applications, and departments.

Metadata for the resources in general groups, applications, and departments is also collected and stored. That metadata includes filter definitions for applications.

Restriction: Applies only to IBM Storage Insights Pro.

General groups metadata

Name
Subgroups

Applications metadata

Block Capacity (GiB)
Custom Tag 1, 2, 3
Departments
File Capacity (GiB)
Name
Object Capacity (GiB)
Hosts
Subtype
Type
Vaults
Volumes

Accesses nodes metadata

Access Pool
IP Address
Model
Name
Serial Number
Site
Software Version

Storage pools metadata

Capacity (%), Capacity (GiB) (Previously known as Total Capacity)
Name

Sets
Site
Storage Pools
Used Capacity (GiB)
Vaults

Slicestor nodes metadata

Available Capacity (GiB)
Capacity (%), Capacity (GiB) (Previously known as Total Capacity)
Drives
IP Address
Model
Name
Serial Number
Set ID
Site
Software Version
Storage Pool
Used Capacity (GiB)

Sites metadata

Access Nodes
Accessibility
Available Capacity (GiB)
Capacity (%), Capacity (GiB) (Previously known as Total Capacity)
Name
Slicestor Nodes
Used Capacity (GiB)
Vaults

Vaults metadata

Access Pools
Accessibility, Capacity Quota (%)
Creation Date
Hard Quota (GiB)
IDA
Mirror
Name
Sites
Soft Quota (GiB)
Storage Pool
Storage System
Used Capacity (GiB)

Hosts metadata

View the list of the asset, capacity, and configuration metadata for hosts.

Metadata is collected about hosts, their drives, HBAs, datastores, VMDKs and the related storage resources, such as the volumes that they use.

The following metadata is collected and stored for hosts:

Cluster
Domain Name
Drive Capacity (GiB)
Flash Copy Provisioned Capacity (GiB)
Flash Copy Used Capacity (GiB)
IP Address
Location
Model
Name
OS Type
Primary Provisioned Capacity (GiB)
Primary Used Capacity (GiB)
Remote Mirror Provisioned Capacity (GiB)
Remote Mirror Used Capacity (GiB)
SAN Capacity (GiB)
Serial Number
Used SAN Capacity (GiB)
vCenter
VDisk Mirror Provisioned Capacity (GiB)
VDisk Mirror Used Capacity (GiB)
Vendor

The following metadata is collected and stored for HBAs:

Associated Drives
HBA WWN
Name
Type
IQN

The following metadata is collected and stored for drives:

Available Drive Capacity (GiB)
Capacity (GiB)
Capacity (GB)
Name
Paths
Serial Number
Vendor

The following metadata is collected and stored for datastores:

Available Datastore Capacity (GiB)
Available File System Capacity (GiB)
Cluster
Datastore Capacity (GiB)
Datastore Capacity (GB)
File System
File System Capacity (GiB)
Name
Paths
Serial Number
Swap Space
Type

Vendor
Used Capacity (%)
Used Datastore Capacity (GiB)
Used File System Capacity (GiB)

The following metadata is collected and stored for VMDKs:

Datastore
Drives
Paths
Size (GiB)
Used Capacity (GiB)
Virtual Machine
Virtual Machine Drive

Chapter 11. Performance metadata

The data collector collects and stores performance metadata for IBM block storage systems and non-IBM block storage systems and it collects and stores file system and node performance metadata for IBM Storage Scale storage systems.

Performance metadata is collected and stored for the following IBM block storage systems and non-IBM block storage systems when they are added for monitoring:

Table 4. Block performance metadata by storage system

Storage System	IBM Storage Insights Pro	IBM Storage Insights
DS8000	Yes	Yes
Dell EMC Unity	Yes	No
Dell EMC VMAX	Yes	No
Dell EMC VNX, VNXe	Yes	No
IBM Storage FlashSystem 5000	Yes	Yes
IBM Storage FlashSystem 5100	Yes	Yes
IBM Storage FlashSystem 7200	Yes	Yes
IBM Storage FlashSystem 9100	Yes	Yes
IBM Storage FlashSystem 9200	Yes	Yes
IBM Storage FlashSystem 900	Yes	Yes
IBM FlashSystem A9000	Yes	Yes
IBM FlashSystem A9000R	Yes	Yes
IBM Storage FlashSystem V9000	Yes	Yes
Hitachi VSP	Yes	No
IBM Storage Accelerate	Yes	Yes
NetApp ONTAP 9	Yes	No
Pure FlashArray//M and FlashArray//X	Yes	No
SAN Volume Controller	Yes	Yes
Storwize V3500	Yes	Yes
Storwize V3700	Yes	Yes
Storwize V5000	Yes	Yes
Storwize V7000	Yes	Yes
Storwize V7000 Unified	Yes	Yes
XIV	Yes	Yes

Node and file system performance metadata is also collected and stored for IBM Storage Scale storage systems.

Restriction: Applies to IBM Storage Insights Pro.

Performance metadata for storage systems that run IBM Storage Virtualize

View the lists of the performance metadata for IBM SAN Volume Controller, IBM Storage Virtualize for Public Cloud, IBM Storage Virtualize as Software Only, IBM Storwize storage systems, and for IBM Storage FlashSystem devices that run IBM Storage Virtualize.

Overview

The performance metadata is divided into the following categories:

Volume metadata

The following key metadata is collected for volume performance:

- Data Rate (Read, Total, Unmap, Write)
- Overall Host Attributed Response Time Percentage
- Overall I/O Rate (Read, Total, Unmap, Write)
- Pool Activity Score
- Response Time (Overall, Read, Unmap, Write)
- Volume Utilization
- Write Cache Delay Percentage

The following I/O rate metadata is collected for volume performance:

- Transfer Rate (Cache-to-Disk, Disk-to-Cache)
- Unaligned Unmap I/O Rate
- Write-Cache Delay I/O Rate

The following cache hit percentage metadata is collected for volume performance:

- Overall I/O Cache Hits (Read, Total, Write)

The following response time metadata is collected for volume performance:

- Peak Response Time (Read, Unmap, Write)

The following remote mirror metadata is collected for volume performance:

- Global Mirror (Overlapping Write I/O Rate, Overlapping Write Percentage, Secondary Write Lag, Write I/O Rate)

The following volume cache metadata is collected for volume performance:

- Cache Hits (Dirty Writes, Read, Total, Write)
- I/O Rate (Destage, Read, Total, Write)
- Response Time (Destage, Stage)
- Transfer Rates (Cache-to-Disk, Disk-to-Cache)
- Write Delay Percentage (Flush-through, Total Delay, Write-through)
- Write Delay Rate (Flush-through, Total Delay, Write-through)
- Data Rate (Fast-Write Writes)

The following volume copy cache metadata is collected for volume performance:

- Cache Hits (Dirty Writes, Read, Read-ahead, Total, Write)
- I/O Rate (Destage, Prestage, Stage, Total)
- Response Time (Destage, Prestage, Stage)
- Transfer Rates (Cache-to-Disk, Disk-to-Cache)
- Write Delay Percentage (Flush-through, Total Delay, Write-through)
- Write Delay Rate (Flush-through, Total Delay, Write-through)
- Data Rate (Fast-Write Writes)

The following compression metadata is collected for volume performance:

- Compressed Volumes (Data Rate, I/O Rate, Response Time)
- Uncompressed Volumes (Data Rate, I/O Rate, Response Time)

The following miscellaneous metadata is collected for volume performance:

- Cache to Host Transfer Response Time
- Non-Preferred Node Usage Percentage
- Transfer Size (Overall, Read, Write)
- Unaligned Write I/O Rate

The following legacy cache metadata is collected for volume performance:

- Dirty Write Percentage of Cache Hits
- Write-Cache I/O Rate (Flush-through, Overflow, Write-through)
- Write-Cache Percentage (Flush-through, Overflow, Write-through)

Disk metadata

The following key metadata is collected for disk performance:

- Data Rate (Read, Total, Write)
- I/O Rate (Read, Total, Write)
- Response Time (Overall, Read, Write)

The following response time metadata is collected for disk performance:

- Peak Back-end Response Time (Read, Write)
- Peak Back-end Queue Time (Read, Write)
- Queue Time (Overall, Read, Write)

The following miscellaneous metadata for disk performance:

- Cache Destage (In-Flight I/O, Target I/O)
- Transfer Size (Overall, Read, Write)

Pool metadata

The following key metadata is collected for pool performance:

- Max Write Cache Fullness
- Write Cache Fullness

Port metadata

The following key metadata is collected for port performance:

- Data Rate (Receive, Send, Total)

- I/O Rate (Receive, Send, Total)

The following I/O rate metadata is collected for port performance:

- Port-to-Disk I/O Rate (Receive, Send, Total)
- Port-to-Host I/O Rate (Receive, Send, Total)
- Port-to-Local Node I/O Rate (Receive, Send, Total)
- Port-to-Remote Node I/O Rate (Receive, Send, Total)

The following data rate metadata is collected for port performance:

- Port-to-Disk Data Rate (Receive, Send, Total)
- Port-to-Host Data Rate (Receive, Send, Total)
- Port-to-Local Node Data Rate (Receive, Send, Total)
- Port-to-Remote Node Data Rate (Receive, Send, Total)

The following response time metadata is collected for port performance:

- Port-to-Local Node Response Time (Overall, Receive, Send)
- Port-to-Remote Node Response Time (Overall, Receive, Send)

The following error rate metadata is collected for port performance:

- Frame Errors (CRC Error Rate)
- Link Errors (Invalid Link Transmission Rate, Invalid Transmission Word Rate, Link Failure Rate, Primitive Sequence Protocol Error Rate, Loss of Signal Rate, Loss of Sync Rate)
- Port Congestion Index
- Port Protocol Errors (Port Send Delay I/O Percentage, Port Send Delay Time, Zero Buffer Credit Percentage, Zero Buffer Credit Timer)

The following miscellaneous metadata is collected for port performance:

- Port-to-Local Node Queue Time (Overall, Receive, Send)
- Port-to-Remote Node Queue Time (Overall, Receive, Send)

Node metadata

The following metadata is collected for node performance:

- Cache Fullness (Max Read Cache Fullness, Max Write Cache Fullness, Read Cache Fullness, Write Cache Fullness)
- Compression CPU Utilization (Core 1 to Core 8)
- CPU Utilization (Compression CPU, System CPU)
- Garbage Collection (Data Movement Rate, Data Rewrite Rate, Extent Collection Rate, New Address Write Rate, Reclaimable Capacity, Recovered Capacity Rate)
- Node Utilization by Node
- System CPU Utilization (Core 1 to Core 48)

Performance metadata for DS8000

View the lists of performance metadata for DS8000 storage systems.

Overview

The performance metadata is divided into the following categories:

- "Volume metadata" on page 37
- "Disk metadata" on page 37

- “Port metadata” on page 37

Volume metadata

The following key metadata is collected for volume performance:

- Cache Holding Time
- Data Rate (Read, Total, Write)
- Overall I/O Rate (Read, Total, Write)
- Pool Activity Score
- Response Time (Overall, Read, Write)
- Volume Utilization
- Write-Cache Delay Percentage

The following I/O rate metadata is collected for volume performance:

- Average Transfer Rate (Cache-to-Disk, Disk-to-Cache)
- High Performance FICON® (Read, Total, Write)
- Normal I/O Rate (Read, Total, Write)
- PPRC Transfer Rate
- Record Mode Read I/O Rate
- Sequential I/O Rate (Read, Total, Write)
- Write-Cache Delay I/O Rate

The following cache hit metadata is collected for volume performance:

- Normal I/O Cache Hits (Read, Total, Write)
- Overall I/O Cache Hits (Read, Total, Write)
- Record Mode Read Cache Hit Percentage
- Sequential I/O Cache Hits (Read, Total, Write)

The following average miscellaneous metadata is collected for volume performance:

- Average Transfer Size (Overall, Read, Write)
- HPF I/O Percentage
- Sequential I/O Percentage

Disk metadata

The following key metadata is collected for disk performance:

- Data Rate (Read, Total, Write)
- Disk Utilization Percentage
- I/O Rate (Read, Total, Write)
- Response Time (Overall, Read, Write)

The following transfer size metadata is collected for disk performance:

- Average Transfer Size (Overall, Read, Write)

Port metadata

The following key metadata is collected for port performance:

- Bandwidth (Overall, Receive, Send)
- Data Rate (Receive, Send, Total)

- I/O Rate (Receive, Send, Write)
- Port Utilization (Overall, Receive, Send)
- Response Time (Overall, Receive, Send)

The following I/O rate metadata is collected for port performance:

- FCP I/O Rate (Receive, Send, Total)
- FICON I/O Rate (Receive, Send, Total)

The following data rate metadata is collected for port performance:

- FCP Data Rate (Receive, Send, Total)
- FICON Data Rate (Receive, Send, Total)

The following response time metadata is collected for port performance:

- FCP Response Time (Overall, Send, Total)
- FICON Response Time (Overall, Send, Total)

The following error rate metadata is collected for port performance:

- Frame Errors (CRC Errors, Error Frame, Invalid Relative Offset Rate)
- Link Errors (Invalid Link Transmission, Invalid Transmission Words, Link Failures, Primitive Sequence Protocol Error Rate, Sequence Timeouts, Signal Loss, Sync Loss)
- Overload Errors (Extreme I/O Concurrency Percentage, I/O Busy Percentage, I/O Busy Rate, I/O Overrun Percentage, I/O Overrun Rate)
- Port Protocol Errors (Credit Recovery Link Resets, Duplicate Frames, Link Reset Received, Link Reset Transmitted, Out of Order ACK, Out of Order Data)
- Zero Receive Buffer Credit Percentage
- Zero Send Buffer Credit Percentage

The following remote mirror metadata is collected for port performance:

- PPRC Data Rate (Receive, Send, Total)
- PPRC I/O Rate (Receive, Send, Total)
- PPRC Response Time (Receive, Send)

The following transfer size metadata is collected for port performance:

- Average Transfer Size (Overall, Receive, Send)

Performance metadata for XIV, IBM Spectrum Accelerate, IBM FlashSystem A9000, and IBM FlashSystem A9000R

View the lists of performance metadata for XIV® systems, IBM Storage Accelerate, IBM FlashSystem A9000, and IBM FlashSystem A9000R.

Overview

The performance metadata is divided into the following categories:

- “Volume metadata” on page 38
- “Port metadata” on page 39

Volume metadata

The following key metadata is collected for volume performance:

- Data Rate (Read, Total, Write)

- Overall I/O Rate (Read, Total, Write)
- Response Time (Overall, Read, Write)

The following cache hit metadata is collected for volume performance:

- Data Cache Hits (Overall, Read, Write)
- Overall I/O Cache Hits (Read, Total, Write)
- SSD Read Cache Hits (I/O, Data)

The following response time metadata is collected for volume performance:

- Cache Hit Response Time (Overall, Read, Write)
- Cache Miss Response Time (Overall, Read, Write)
- Response Time by Transfer Size (Small, Medium, Large, Very Large)
- SSD Read Cache Hit Response Time

The following miscellaneous metadata is collected for volume performance:

- Average Transfer Size (Overall, Read, Write)
- Data Transfer Size (Small, Medium, Large, Very Large)
- I/O Transfer Size (Small, Medium, Large, Very Large)
- Pool Activity Score
- Volume Utilization

Port metadata

The following I/O rate metadata is collected for port performance:

- I/O Rate (Receive, Send, Total)

The following data rate metadata is collected for port performance:

- Data Rate (Receive, Send, Total)

The following response time metadata is collected for port performance:

- Response Time (Receive, Send, Total)

The following miscellaneous metadata is collected for port performance:

- Bandwidth (Overall, Receive, Send)

Performance metadata for IBM Spectrum Scale

View the lists of performance metadata for IBM Storage Scale storage systems.

Overview

The performance metadata that is collected and stored is divided into these categories:

- “Node metadata” on page 39
- “File system metadata” on page 40

Node metadata

The following key metadata is collected for IBM Storage Scale cluster node performance:

- CPU Utilization (User, System, Total)
- Memory Used (Cache and Buffer, Total)
- I/O Rate (Read, Total, Write)

File system metadata

File system metadata is collected for these resources:

- File systems
- IBM Storage Scale storage systems

  Tip: For a storage system, the metadata consists of summary values for all the file systems on the storage system.

The following file system performance metadata is collected:

- Data Rate (Read, Total, Write)
- I/O Rate (Read, Total, Write)
- Maximum Data Rate (Read, Total, Write)
- Maximum I/O Rate (Read, Total, Write)
- Response Time (Overall, Read, Write)

Performance metadata for Dell EMC Unity, VMAX, and VNX

View the lists of performance metadata for Unity, VMAX, and VNX storage systems.

Overview

Performance metadata is collected and stored for the following storage systems:

- “Unity storage systems” on page 40
- “VMAX storage systems” on page 41
- “VNX storage systems” on page 42

Restriction: For Dell EMC, performance metadata is available only for block storage systems.

Unity storage systems

The following performance metadata is collected and stored for Unity resources:

- “Volume metadata for Unity” on page 40
- “Disk metadata for Unity” on page 41
- “Port metadata for Unity” on page 41
- “Node metadata for Unity” on page 41
- “File system metadata for Unity” on page 41

Volume metadata for Unity

The following key metadata is collected for volume performance on Unity storage systems:

- Overall I/O Rate (Read, Write, Total)
- Transfer Size (Read, Write, Overall)
- Data Rate (Total)

The following cache hit metadata is collected for volume performance on Unity storage systems:

- Overall I/O Cache Hits (Read, Write, Total)

The following data rate metadata is collected for volume performance on Unity storage systems:

- Data Rate (Read, Write)

The following response time metadata is collected for volume performance on Unity storage systems:

- Response Time (Overall)

The following miscellaneous metadata is collected for volume performance on Unity storage systems:

- Transfer Size (Read, Write)

Disk metadata for Unity

The following key metadata is collected for disk performance on Unity storage systems:

- Overall I/O Rate (Read, Write, Total)
- Response Time (Overall)
- Data Rate (Read, Write, Total)
- Transfer Size (Read, Write, Overall)

Port metadata for Unity

The following key metadata is collected for port performance on Unity storage systems:

- Overall I/O Rate (Total)
- Data Rate (Send, Receive, Total)
- Transfer Size (Send, Receive, Overall)

The following I/O rate metadata is collected for port performance on Unity storage systems:

- I/O Rate (Send, Receive)

The following data rate metadata is collected for port performance on Unity storage systems:

- Data Rate (Send, Receive)

Node metadata for Unity

The following key metadata is collected for node performance on Unity storage systems:

- CPU Utilization (System CPU)

File system metadata for Unity

The following key metadata is collected for file system performance on Unity storage systems:

- Overall I/O Rate (Read, Write, Total)
- Data Rate (Read, Write, Total)
- Transfer Size (Read, Write, Overall)

VMAX storage systems

The following performance metadata is collected and stored for VMAX storage systems:

- “Volume metadata for VMAX” on page 41
- “Disk metadata for VMAX” on page 42
- “Port metadata for VMAX” on page 42

Volume metadata for VMAX

The following key metadata is collected for volume performance on VMAX storage systems:

- Data Rate (Read, Total, Write)
- Normal I/O Rate (Read, Total, Write)
- Overall I/O Rate (Read, Total, Write)
- Response Time (Overall, Read, Write)

- Sequential I/O Rate (Read, Total, Write)
- Volume Utilization

The following cache hit metadata is collected for volume performance on VMAX storage systems:

- Normal I/O Cache Hits (Read, Total, Write)
- Overall I/O Cache Hits (Read, Total, Write)
- Sequential I/O Cache Hits (Read, Total, Write)

The following transfer size metadata is collected for volume performance on VMAX storage systems:

- Average Transfer Size (Overall, Read, Write)

Disk metadata for VMAX

The following key metadata is collected for disk performance on VMAX block storage systems:

- Data Rate (Read, Total, Write)
- Disk Utilization Percentage
- I/O Rate (Read, Total, Write)
- Response Time (Overall)

The following transfer size metadata is collected for disk performance on VMAX block storage systems:

- Transfer Size (Overall, Read, Write)

Port metadata for VMAX

The following key metadata is collected for port performance on VMAX storage systems:

- Data Rate (Total)
- I/O Rate (Total)
- Response Time (Overall)
- Transfer Size (Overall)

VNX storage systems

The following performance metadata is collected and stored for VNX storage systems:

- Volume metadata
- Disk metadata
- Port metadata

Volume metadata for VNX

The following key metadata is collected for volume performance on VNX storage systems:

- Data Rate (Read, Total, Write)
- Overall I/O Rate (Read, Total, Write)

The following transfer size metadata is collected for volume performance on VNX storage systems:

- Average Transfer Size (Overall, Read, Write)

Disk metadata for VNX

The following key metadata is collected for disk performance on VNX storage systems:

- Data Rate (Read, Total, Write)
- I/O Rate (Read, Total, Write)

The following transfer size metadata is collected for disk performance on VNX storage systems:

- Transfer Size (Overall, Read, Write)

Port metadata for VNX

The following key metadata is collected for port performance on VNX storage systems:

- Data Rate (Total)
- I/O Rate (Total)
- Transfer Size (Overall)

Performance metadata for Hitachi VSP storage systems

View the lists of performance metadata for Hitachi VSP F and G Series storage systems/>.

The following performance metadata is collected and stored for Hitachi resources:

- “Volume metadata for Hitachi” on page 43
- “Port metadata for Hitachi” on page 43
- “Node metadata for Hitachi” on page 43

Volume metadata for Hitachi

The following key metadata is collected for volume performance on Hitachi storage systems:

- Overall I/O Rate (Read, Write, Total)
- Data Rate (Read, Write, Total)
- Response Time (Read, Write, Overall)
- Transfer Size (Read, Write, Overall)

The following cache hit metadata is collected for volume, pools, and storage systems performance on Hitachi storage systems:

- Overall I/O Cache Hits (Read, Write)

Port metadata for Hitachi

The following key metadata is collected for port performance on Hitachi storage systems:

- Overall I/O Rate (Total)
- Data Rate (Total)
- Response Time (Overall)
- Transfer Size (Overall)

Node metadata for Hitachi

The following key metadata is collected for node performance on Hitachi storage systems:

- CPU Utilization (System CPU)

Performance metadata for NetApp storage systems

View the lists of performance metadata for NetApp storage systems running ONTAP 9.

The following performance metadata is collected and stored for NetApp resources:

- “Volume metadata for NetApp” on page 44
- “Disk metadata for NetApp” on page 44

Volume metadata for NetApp

The following key metadata is collected for volume performance on NetApp storage systems:

- Overall I/O Rate (Read, Write, Total)
- Transfer Size (Overall)
- Data Rate (Total)

The following cache hit metadata is collected for volume performance on NetApp storage systems:

- Overall I/O Cache Hits (Read, Total)

The following data rate metadata is collected for volume performance on NetApp storage systems:

- Data Rate (Read, Write)

The following response time metadata is collected for volume performance on NetApp storage systems:

- Response Time (Read, Write, Overall)

The following miscellaneous metadata is collected for volume performance on NetApp storage systems:

- Transfer Size (Read, Write)

Disk metadata for NetApp

The following key metadata is collected for disk performance on NetApp storage systems:

- Overall I/O Rate (Read, Write, Total)
- Response Time (Overall)
- Data Rate (Read, Write, Total)
- Transfer Size (Read, Write, Overall)

The following response time metadata is collected for disk performance on NetApp storage systems:

- Response Time (Read, Write)

Port metadata for NetApp

The following key metadata is collected for port performance on NetApp storage systems:

- Overall I/O Rate (Total)
- Response Time (Send, Receive, Overall)
- Data Rate (Total)
- Transfer Size (Send, Receive, Overall)

The following I/O rate metadata is collected for port performance on NetApp storage systems:

- I/O Rate (Send, Receive)

The following data rate metadata is collected for port performance on NetApp storage systems:

- Data Rate (Send, Receive)

Node metadata for NetApp

The following key metadata is collected for node performance on NetApp storage systems:

- CPU Utilization (System CPU)

File system metadata for NetApp

The following key metadata is collected for file system performance on NetApp storage systems:

- Overall I/O Rate (Read, Write, Total)
- Response Time (Overall)
- Data Rate (Read, Write, Total)
- Transfer Size (Read, Write, Overall)

The following response time metadata is collected for volume performance on NetApp storage systems:

- Response Time (Read, Write)

Performance metadata for Pure Storage systems

View the list of performance metadata for Pure FlashArray//M and FlashArray//X.

Volume metadata for Pure

The following key metadata is collected for volume performance on Pure FlashArray//M and FlashArray//X.

- Overall I/O Rate (Read, Write, Total)
- Data Rate (Read, Write, Total)
- Response Time (Read, Write, Overall)

Performance metadata for switches

View the lists of the performance metadata for switches.

Overview

The performance metadata is divided into the following categories:

- "Key metadata" on page 45
- "I/O rates metadata" on page 45
- "Error rates metadata" on page 46
- "Port Protocol Errors metadata" on page 46
- "Link Errors metadata" on page 46
- "Miscellaneous metadata" on page 46

Key metadata

The following key metadata is collected for switch performance:

- Data Rate (Receive, Sent, Total)
- Bandwidth (Overall, Receive, Send)
- Other (Total Port Error Rate)

I/O rates metadata

The following I/O rate metadata is collected for switch performance:

- Frame Rate (Receive, Send, Total)

Error rates metadata

The following error rate metadata is collected for switch performance:

- Bad EOF CRC Error Rate
- CRC Errors
- Discarded Class 3 Frames
- Error Frames
- F_BSY Frames
- F-RJT Frames
- Long Frames
- Short Frames

Port Protocol Errors metadata

The following port protocol error metadata is collected for switch performance:

- Class 3 Receive Timeout Frame Rate
- Class 3 Send Timeout Frame Rate
- Credit Recovery Link Reset Rate
- Discarded Frames
- Link Reset Received
- Link Reset Transmitted
- Port Congestion Index
- Zero Buffer Credit Percentage
- Zero Buffer Credit Rate

Link Errors metadata

The following link error metadata is collected for switch performance:

- Encoding Disparity
- Invalid Link Transmission Rate
- Invalid Transmission Words
- Link Failures
- Primitive Sequence Protocol Errors
- Signal Loss
- Synch Loss

Miscellaneous metadata

The following miscellaneous metadata is collected for switch performance:

- Frame Size (Overall, Receive, Send)
- Other (Link Quality Percentage)

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