QSAN
Official Document

QSeal (AirGap Backup)

White Paper

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ANNOUNCEMENT

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PREFACE

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- Via the Web: https://www.qsan.com/technical_support
- Via Telephone: +886-2-77206355
- (Service hours: 09:30 - 18:00, Monday - Friday, UTC+8)
- Via Skype Chat, Teams / Skype ID: qsan.support
- (Service hours: 09:30 - 02:00, Monday - Friday, UTC+8, Summer time: 09:30 - 01:00)
- Via Email: support@qsan.com

Information, Tip, and Caution

This document uses the following symbols to draw attention to important safety and operational information.



INFORMATION

INFORMATION provides useful knowledge, definition, or terminology for reference.



TIP

TIP provides helpful suggestions for performing tasks more effectively.

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CAUTION

CAUTION indicates that failure to take a specified action could result in damage to the system.

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1. INTRODUCTION

As ransomware attacks become increasingly frequent and sophisticated, backup systems themselves have become a critical vulnerability for enterprise security. Traditional backup architectures require continuous network connectivity, making them highly susceptible to external threats and lateral movement attacks.

QSeal backup (also known as AirGap backup) redefines the backup connection model by introducing network stealth and a pull-based mechanism, significantly reducing the risk of backup targets being exposed. By disconnecting network access during idle periods, the system ensures that targets remain hidden at the network level.

Furthermore, QSeal integrates automatic snapshot functionality, providing multi-version recovery capabilities, enabling enterprises to quickly restore data to a secure state in the event of data corruption or ransomware attacks. This design achieves a balance between security and availability, providing a comprehensive and reliable data protection solution.

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2. THEORY OF OPERATION

QSeal backup employs a target-initiated synchronization model, eliminating the need for the source system to be continuously exposed to the network. During idle periods, the system disables network interfaces and ports, creating a logical isolation barrier that effectively prevents attackers from compromising backup nodes through lateral movement.

To enhance data protection, the system automatically generates snapshots after each backup job, ensuring data is preserved across multiple points in time. This multi-versioning capability enables rapid recovery in case of data loss or system failure.

2.1. Rsync-Based Differential Transfer

QSeal deeply integrates the Rsync engine, achieving efficient and accurate data synchronization through block-level comparison. When a file changes, only the modified data blocks are transferred, rather than the entire file, significantly reducing bandwidth consumption and improving performance.

Before synchronization, the system performs initial filtering based on file size and modification timestamps, limiting subsequent verification to files that may have changed, thus minimizing computational overhead. During backup, the target device acts as an Rsync client, actively pulling data from the source device. During recovery, the target device initiates a push operation to restore the data to the source device.



CAUTION

It is important to note that the recovery process uses an overwrite mechanism. If data already exists in the target directory on the source device, it will be completely replaced based on the backup image. Therefore, careful verification must be performed before performing the recovery operation.

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2.2. Stealth Mode

To maximize security, QSeal implements multiple isolation strategies at the network layer, with the dynamic floating IP mechanism being a core feature. When creating a backup task, the user must define an IP address range. The system automatically assigns a random IP address from this range to the target device before each task execution.

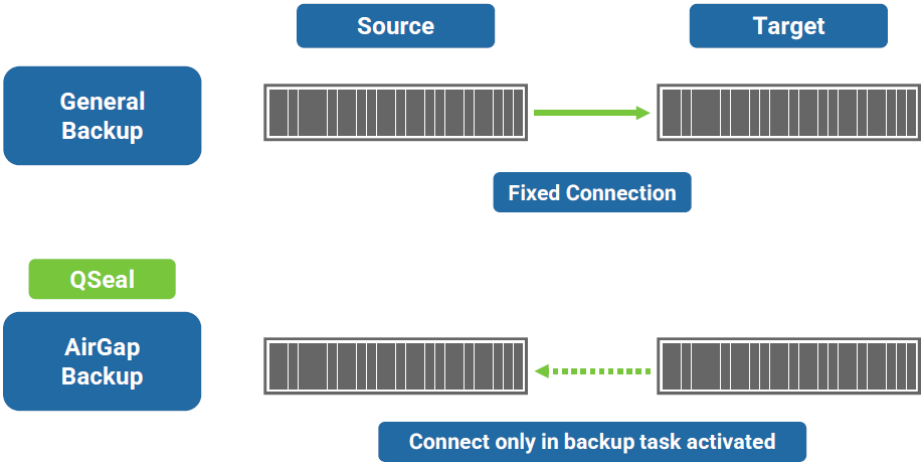


Figure 2-1 QSeal Backup

Because each backup session uses a different identity, attackers cannot rely on connection logs to track or identify the backup target. Upon task completion, the system immediately resets the IP address to 0.0.0.0, effectively removing the device from the network.

Furthermore, the system implements strict control over designated backup interfaces. Once assigned to QSeal, manual IP address configuration is prohibited to ensure the integrity and consistency of the security mechanisms.

2.3. Backup Functionality

Managed Objects

QSeal backup operates based on a structured set of managed objects. The source side defines a dedicated user for authentication and configures modules to specify the source path and access permissions. Backup tasks are created and managed on the target side, with synchronization

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frequency and network behavior controlled there, providing flexibility and centralized management.

Incremental Backup

The system performs a full data copy during the initial backup and automatically switches to incremental mode in subsequent operations, significantly reducing backup time and system load. After each backup task is completed, the system automatically creates a snapshot to establish a restorable version.

Version Control

This version control mechanism allows users to select a specific point in time for data recovery, effectively addressing situations such as ransomware attacks or accidental deletion. The system uses a pre-defined Rsync port for data transfer to ensure stable and efficient operation.

2.4. State Machine Description

QSeal Backup goes through different operating states during its lifecycle. In idle state, the system remains in stealth mode with the network interface set to 0.0.0.0. When a task is started, the system enters the execution state and assigns a random IP address to perform data comparison and transfer.

During the recovery operation, the system enters the recovery state, using a dynamically assigned IP address. After synchronization is complete, the system creates a snapshot as the recovery point. After the task is completed, the system returns to stealth mode, ensuring that the backup node is no longer exposed to the network.

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3. DEPLOYMENT AND OPERATIONS

3.1. Prerequisites

This system has explicit limitations on the number of tasks and execution capabilities. Each system supports a maximum of 32 QSeal tasks, which share resources with the Rsync service. In terms of execution, a maximum of four tasks are allowed to run concurrently to maintain overall system performance and stability.

Table 3-1 QSeal Parameters

ITEM	VALUE
Maximum number of QSeal tasks per system	32
Maximum number of backup and restore tasks to execute simultaneously	4
Task name character range	1 ~ 32
Username character range	4 ~ 32
Password character range	4 ~ 32
Source rsync port range	1 ~ 65535
Maximum number of IP probes	2,048



TIP

To ensure a simplified and controllable transmission environment, the system does not support VLAN tagging. Furthermore, to maximize data transmission performance, SSH encryption and compression are disabled by default.

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3.1.1. Deployment Recommendation

To ensure stable and efficient data transmission, direct point-to-point connections between devices are strongly recommended. This approach avoids packet contention and bandwidth limitations caused by switches or routers, while mitigating the impact of network topology changes.

Direct physical connections also isolate backup traffic from the corporate network, further enhancing security and reliability, especially in environments handling sensitive or mission-critical data.

3.2. Configure QSeal Backup

Before deploying QSeal backup, the environment must be prepared, including allocating sufficient snapshot space and planning suitable connection architecture. On the source side, users and modules need to be configured to define the data source and access permissions.

On the target side, when creating a backup task, the source IP address and a dynamic IP address range must be specified. During execution, the system will automatically assign a random IP address and perform differentiated transfer. After the transfer is complete, the system will create a snapshot and reset the IP address to stealth mode.

For data recovery, the administrator must identify overwrite risks before initiating the recovery process from the target side to ensure that the data can be accurately restored to the target location.

Video Tutorial

This is a tutorial example to configure a QSeal backup. See QSeal - AirGap Backup for Ransomware-Proof Storage.

3.3. Best Practices

Network Interface Display

QSeal's dedicated network interface displays 0.0.0.0 when idle, which is normal security behavior. Administrators should not attempt to manually modify or correct this setting, as doing so may interfere with the system's protection mechanisms.

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Dynamic IP Address Range Configuration and Port Guidelines

When creating a task, a dedicated IP address range must be configured in the management interface for dynamic allocation. This configuration must be done through the designated interface; do not manually assign IP addresses in the regular network settings page, as this may compromise the hiding and randomization mechanisms.

Snapshot Space Allocation Recommendations

To ensure proper functioning of version control, it is recommended to reserve at least 20% of the storage capacity at the target location as snapshot space. Insufficient space may prevent the creation of new backup versions or the automatic deletion of old snapshots, thereby affecting the integrity of data protection.

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4. CONCLUSION

As ransomware attacks continue to evolve, protecting backup data requires more than maintaining conventional copies. Traditional backup environments with persistent network connectivity can expose backup targets to unauthorized access and lateral movement. QSeal addresses this risk with an AirGap Backup architecture that combines network stealth, target-initiated synchronization, dynamic IP assignment, and automated snapshots. During idle periods, the backup interface is disabled and the target remains hidden with an IP address of 0.0.0.0. When a backup task starts, QSeal dynamically assigns an IP address from a predefined range and allows the backup target to initiate data synchronization. After the task is completed, the address is removed and the system returns to stealth mode, significantly reducing the backup target's network exposure.

QSeal also provides efficient and reliable data protection through Rsync-based differential backup, transferring only changed data after the initial full backup to reduce backup time and network consumption. Automatic snapshots after each backup job create multiple recovery points, enabling administrators to restore data to a specific point in time when recovering from ransomware, accidental deletion, corruption, or system failures. Combined with direct point-to-point connectivity, dedicated backup configuration, and controlled network behavior, QSeal provides a practical and easy-to-manage protection architecture. By transforming the backup target from a continuously accessible network resource into a hidden, task-driven recovery repository, QSeal strengthens ransomware resilience while maintaining efficient backup operations and flexible data recovery.

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5. APPENDIX

5.1. Apply To

- QSM firmware 4.2.0 and later

5.2. Reference

Product Page

- QSeal

Data Sheet

- QSM 4 Data Sheet

Document

- QSM 4 Software Manual

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