

A New Era of Software-Defined Everything -
Pioneers of storage management take
the lead in cutting-edge IT trends.

QNAP

QvPC Technology

White Paper

QNAP virtualized Personal
Computer Technology



- ◆ The emerging trend of **Software-defined everything (SDx)**
- ◆ QvPC Technology turns **NAS into a PC (HybridDesk Station)**
(QVM Desk + Defense Desk + Local Display Desk)
- ◆ **Benefits & applications of QvPC Technology**
- ◆ An Overview of **Built-in Virtual Machines**
- ◆ Diverse Built-in NAS Applications -
Create Infinite Business Opportunities



Use your NAS as a PC

Summary

In the constantly changing IT industry, any decision can be a do-or-die choice for businesses. In such an environment, businesses are constantly watching the development of new concepts and trends whilst carrying out research and product development to keep up with the unrelenting speed of technological advancement. The movement of the industry is closely linked with consumer demands, and predicting the needs of consumers and providing them with the best solutions are the basic abilities every IT business should possess.

In Gartner's recent forecast of the top 10 strategic technologies of 2014, several of them entail corporate development and consumer needs, including Mobile Apps and Applications, Internet of Things, The Era of Personal Cloud, and Software-Defined Everything. Among these strategic technologies, we see many of them centered on the applications of software instead of hardware. Therefore an IT business should know the significance of software, how it affects the industry, and how to keep up with applicable trends.

As a pioneer in Network-attached Storage (NAS), QNAP is very familiar with the industry and is dedicated to bringing users the best experience. We have taken great strides towards "Software-defined Everything" and have developed QvPC Technology (QNAP virtualized Personal Computer Technology). QvPC Technology redefines the concept of NAS through integrating multiple software-centric technologies and takes it beyond being "simple storage" to become a fully-fledged PC. Using HDMI-compatible displays devices, QvPC Technology enables users to enjoy application services offered by the integrated multifunctional "HybridDesk Station" and brings NAS applications into a whole new era.



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Foreword

In the 1990's, the massive demand for personal computers and the fast commercialization of low-cost servers and peripherals brought the first wave of prosperity to the ICT (Information and Communication Technology) OEM (Original Equipment Manufacturer) industry, leading to a vast number of hardware manufacturers and a race to the lowest price margins. In doing so, these manufacturers and OEM companies cut down their production costs and moved their operations to emerging countries for cheaper labor and tax incentives. But as the margins continued to dwindle, these companies were left with little to invest in research and development. As hardware technology continued to develop, product differentiation became indistinguishable as standards emerged and most companies were able to achieve similar levels of hardware performance. Lacking added values, the industry went back to the vicious cycle of price competition. And as emerging countries began to flock into the market with their lower costs, the OEM industry came to a very dangerous point.

Similarly, the thriving development of e-commerce and digital content is changing consumer behavior. For example, the Amazon Kindle and Apple iTunes are steadily replacing conventional books and CDs for mainstream consumers. To publishers, providing physical goods is no longer cost-effective or relevant to these consumers and instead they must offer digital content and online services in order to survive and create larger profits.

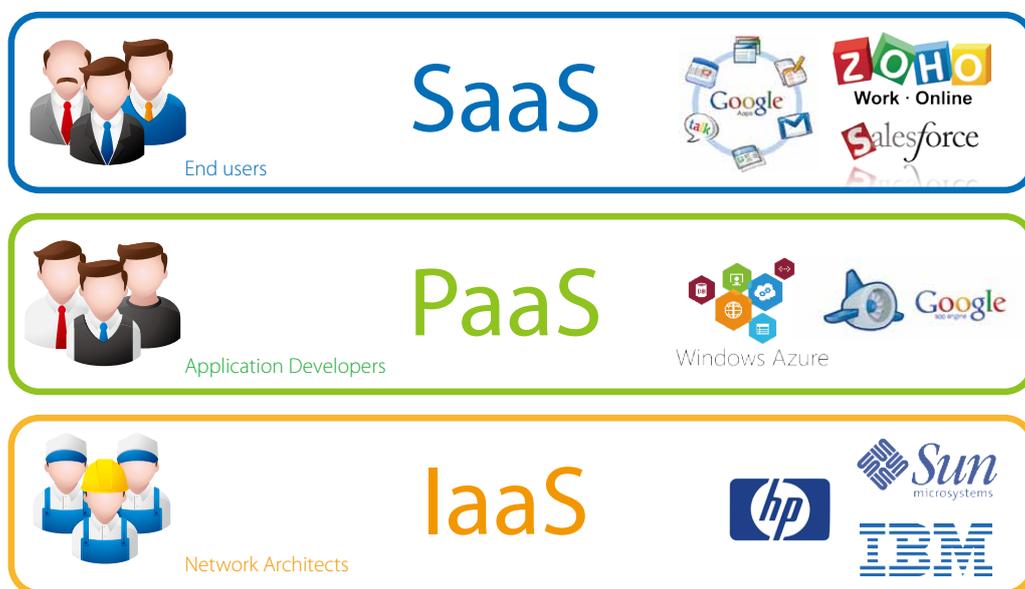
The high penetration of broadband internet access and high connection speeds enabled the integration of computing, storage, and application services dispersed in different locations worldwide into a large service platform which we call the "cloud". The cloud is a large resource-sharing pool where users can request various services, such as computing, applications, and data storage from cloud service providers in an instant and convenient fashion (Mell and Grance, 2011). Therefore, when the cloud computing concept of Software as a Service (SaaS) was proposed, hardware manufacturers (as well as manufacturers of conventional products) began to invest in developing software applications to provide users with complete solutions or cloud applications to enhance the value and market differentiation of their products.



Cloud Computing

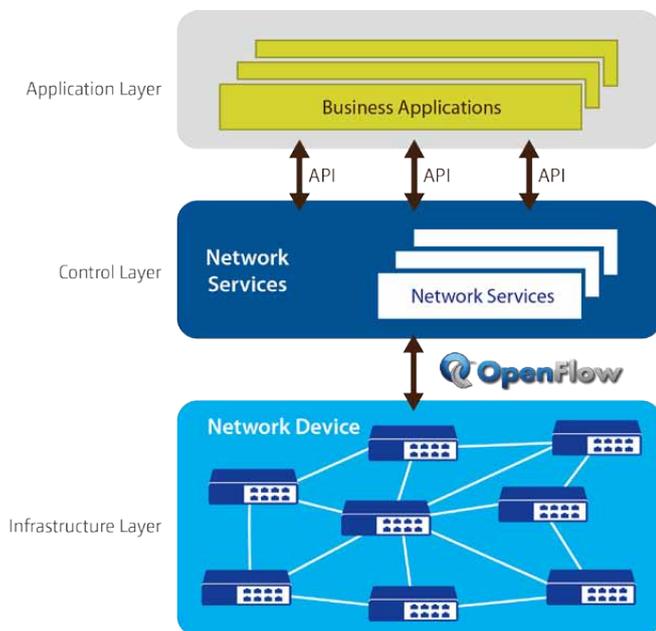
The basic structure of cloud computing involves hardware and software, with the hardware covering the infrastructure (including PCs, servers, and storage devices) and the software the actual platform. Based on this framework, cloud services can be divided into three parts: Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Software as a Service (SaaS). In an overall cloud system, infrastructure provides the bottom-layer computing ability, storage space, and relevant hardware resources with the platform linking between the hardware and software (for example, the operating system and service development platform). The operating system can be used to manage the hardware infrastructure and the service development platform offers the developers a platform for scriptwriting and relevant software services. SaaS also enables users to select application software services offered by the software developers based on their needs, including financial management and accounting systems, company administration systems, and more.

The SaaS market is growing increasingly, with a value of \$14.5 billion in 2012 and projected value of \$22.1 billion in 2015 (Information Age 2012). With these financial projections, global software and hardware manufacturers have geared up to offer more application software services, and aim to create new business models as well as enhancing the competitiveness of their products. With the increasing focus on software, the concept of Software-defined Everything (SDx) has emerged, with examples including Google Glass and Samsung Gear, where the hardware belies their true software-driven potential.



Structure of Cloud Services

Software-Defined Everything

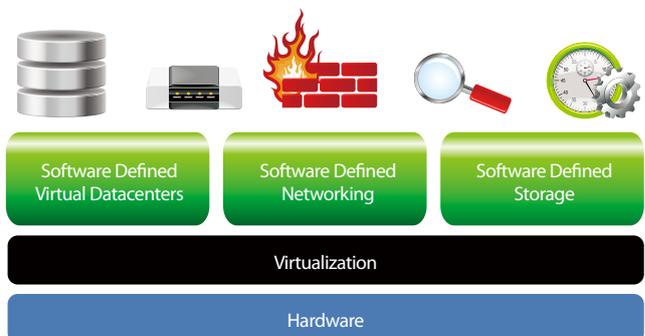


Software-Defined Network Architecture
(Open Networking Foundation 2012)

Software-defined Everything (SDx) is a collective body formed by a growing list of components including Software-defined Networking (SDN), Software-defined Storage (SDS) and Software-defined Data Center (SDDC). There is no defined scope for this concept. In the overall framework of cloud computing, both software and hardware developers launch their own defined software structures and application environment platforms in order to offer more easy-to-use cloud application services. SDN includes an open source code called OpenFlow that provides network administrators a type of software-defined interface that is used to control the base-layer network infrastructure facility (for example, the best path for a network packet). It becomes easier for the upper-layer software application developers to use and control the base-layer networking hardware. The advancement from manual to automatic configuration of hardware devices greatly enhances the quality of application services.

Software-defined Storage (SDS) offers the storage medium built into the base-layer of the cloud a shared and flexible communication platform (Robinson, 2013). SDS separates the software from the storage hardware, preventing it from being affected by the storage hardware system. Consolidating the differences in hardware through software provides a shared storage pool and enables management of data storage through relevant software applications (including data migration, RAID configuration, and data snapshot backup). Upper-layer application services can be efficiently and directly deployed to cloud storage hardware. Beyond which, storage hardware can also be expanded to accommodate the needed capacity. Scale-up or scale-out, whichever way is used, data can be migrated or backed up through software without suspending the application services running in the same system.

Software-defined Datacenter Services



The Software-defined Data Center (SDDC) was proposed by VMware (the pioneers of virtualization technology) in 2012. Through virtualization, SDDC turns the computing power, network service, and storage structure built into the base-layer hardware into abstract concepts and consolidates them through software to build an ideal structure suited for public, private and mixed clouds (VMware 2012). SDDC can also be seen as a virtual data center with automated management including deployment, storage, networking, safety, and availability, executed by software. Furthermore, IT administrators can manage multiple virtual data centers through software to achieve high availability (HA) and load balancing.

As the cloud industry continues to develop, it is apparent that software will dominate everything, be it in the development of mutually-compatible interface protocols through open source codes or building cloud data centers through the development of software management packages. Thus SDx is seen as a strategic technology that will have a definite effect on a large number of businesses in the near future (Gartner, 2013).

Starting from the concepts of cloud computing and IaaS, QNAP is dedicated to providing highly-efficient storage facilities and user experiences. To achieve its goals, QNAP strives for breakthroughs and innovation in hardware efficiency to provide the best infrastructure hardware facility for cloud services. For PaaS, QNAP continuously develops the simple & intuitive QTS operating platform and supplies software developers with APIs and SDKs for secondary development of application services through QNAP Turbo NAS storage management. For SaaS, QNAP continues to move towards the direction of SDx, aiming to provide customers the best user experience through providing diverse and value-added application services.

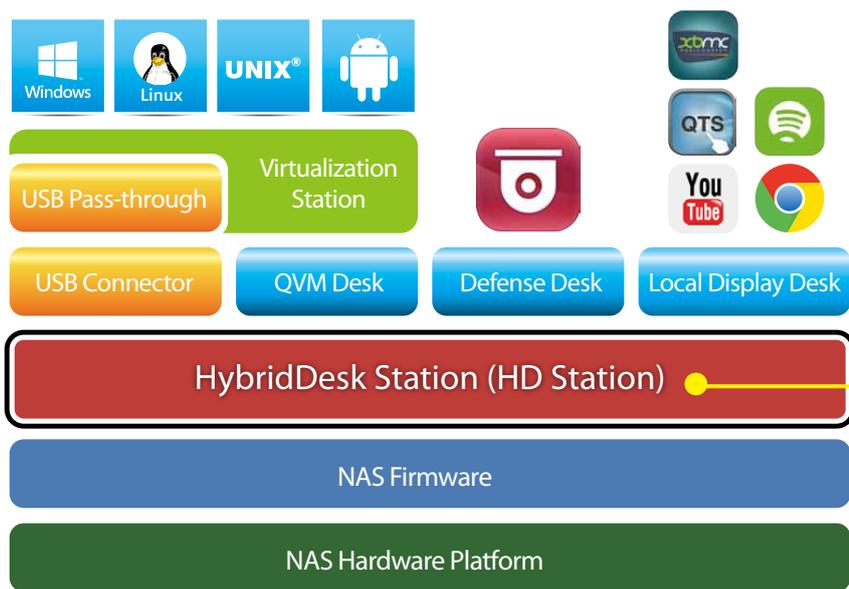
Developed from the concept of SDx, QNAP proposed the QNAP virtualized Personal Computer Technology or QvPC, which has redefined the concept of NAS. Through an HDMI-compatible display and keyboard & mouse, the QNAP Turbo NAS is expanded beyond simply being network-based storage. Using the Turbo NAS as a PC provides users with greater value and potentially limitless functionality.



What is QvPC technology?

QNAP virtualized Personal Computer?

QvPC Technology is a consolidation of several of QNAP's proprietary technologies, including virtualization, hardware-accelerated transcoding, cloud integration, unified & tiered storage, RAID protection, SSD acceleration, HDMI output, and more. The consolidated QvPC Technology is through the HybridDesk Station, which runs multiple desktops that are viewed through connections to external displays, including QVM Desk, Defense Desk, and Local Display Desk.



HybridDesk Station runs multiple services across multiple desks displayed on HDMI displays. Users can activate this service from the QTS operating system and select from the various application services for installation based on personal needs.



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QNAP Virtual Machine Desk (QVM Desk)

Modern virtualization technology offers users the option to set up isolated virtual machines (VM) on a server and to install operating systems and applications that operate independently. Each VM is essentially an independent PC with its own CPU, memory, storage and network resources for data processing and application without interfering with the server or other VMs. QVM Desk offers system administrators a fast and easy way to build an integrated IT environment, and with QNAP's Virtualization Station (which enables VMs to run directly on QNAP Turbo NAS) virtualization technology is transformed from an enterprise-level server application into a common service available to everyone.

Through Unified & Tiered Storage technology, VMs can also be installed on any compatible storage hardware customized to suit specific uses, which effectively cuts down the unit cost of storage space and enhances the performance of the VM I/O.



QVM Desk

By using the VMs in the QVM Desk through HDMI-compatible displays and with a keyboard & mouse, users can open any file stored on the Turbo NAS and have files displayed in the same way they operate a PC. Users can also switch between various VMs with differing operating systems to fit their needs, just as if they were operating multiple PCs simultaneously. Compared to web-based operating systems, QVM Desk users not only enjoy greater work efficiency, but are also freed from the worries of being unable to use their Turbo NAS files or operate on VMs when the network connection is unavailable.



Defense Desk

Defense Desk presents a professional surveillance system that enables users to both view real-time footage or to play back recorded footage from their IP cameras. Users do not need a dedicated workstation for this task, and can just use the connected HDMI display, assisting greatly in being able to view stored video files when the network is unavailable.



Surveillance Station (Local Display)

In addition to the network-enabled remote login surveillance functions, Surveillance Station-Local Display system also supports local output of real-time footage and playback through HDMI-compatible displays. This makes home security surveillance footage available instantly through household HDTVs. It can also be easily controlled using a keyboard & mouse or by using the QNAP Qremote mobile app.



Integrated surveillance system reduces hardware costs



Easy-to-use surveillance interface



Business-class hardware for reliable 24-7 operation



Instant Imaging

Surveillance Station-Local Display offers a range of convenient operation modes. Without logging into another computer, a Surveillance Station-Local Display user can simultaneously view the surveillance footage from up to 16 channels on one display or switch to a single view on an automatic rotating mode. The system also allows remote operation of a camera's PTZ functions and can enable audio for complete real-time surveillance. The system also supports event notifications that instantly display alarm icons to allow administrators to take immediate actions.



Video Playback

When connecting the Turbo NAS to an HDMI-compatible display for watching video recordings from one channel, the system allows users to search for videos based on when they were recorded. The user only needs to enter a range of time that they wish to search through in order to get the relevant video. The system supports rewinding, fast-forwarding up to 16X speed, and has a thumbnail display to allow users to quickly browse through videos. Audio output is also supported to enable searching for key evidence through simultaneous image and sound playback.

Local Display Desk

Direct access to files stored on the Turbo NAS data makes a wide range of applications instantly available through the connected HDMI display, including the XBMC media player, Google Chrome, YouTube, Spotify and the QNAP QTS desktop.



XBMC

QNAP Turbo NAS uses Intel® HD Graphics that provides superior playback of HD videos, allowing you to watch your videos free from lag and other detrimental effects. With the QNAP remote control (RM-IR 002) or the Qremote mobile app, you can completely turn the Turbo NAS into an effective Home-Theater PC and NAS combo.



Google Chrome

Many cloud applications are directly operated through browsers. With direct output to an HDMI display, users no longer need to settle for small screens on mobile devices, or get video streaming through other devices, like Google Chromecast and Apple TV. Files downloaded using Google Chrome can also be directly stored on the Turbo NAS. From downloading files to enjoying online media, all can be achieved through one synchronized process.



YouTube

The world's largest video website is directly available for access on an HDMI display, allowing you to watch videos directly on your HDTV.



Spotify

With dozens of music styles and personalized playlists, the Turbo NAS is instantly transformed into a digital radio, allowing you to directly listen to all your favorites and to discover new music.

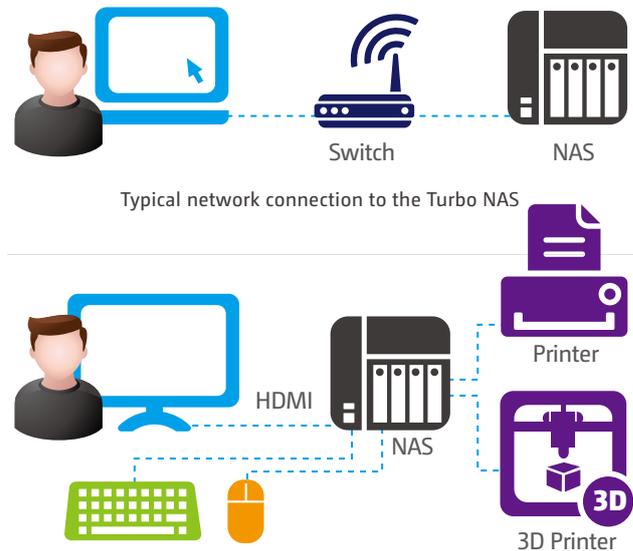


QTS Desktop Management

No computer or network connection to the Turbo NAS is needed. With the connected HDMI display and keyboard & mouse, folders stored on the Turbo NAS are immediately accessible, and backup/restore jobs or the configuration of application services can be easily achieved through external devices. QTS Desktop Management makes accessing the Turbo NAS simple and intuitive.

Advantages of QvPC Technology

- The two-layer service allows users to access and operate the Turbo NAS through HDMI-compatible displays with a keyboard & mouse. This can be especially useful if the network goes down, with the HybridDesk Station allowing users to access the Turbo NAS to retrieve data or to control connected devices (including printers and other common devices).
- Managing devices connected to the Turbo NAS through QvPC Technology is easy. Using the example of a 3D printer: QVM supports multiple operating systems, so users do not need to worry about driver incompatibility, nor do they have to switch physical PCs. Another example is using display devices, as with the HDMI output, media files stored on the Turbo NAS can be played directly, allowing for advertising and promotional materials to be opened and played through the Signage Station.
- Some users may be daunted by the task of configuring and operating the Turbo NAS via the internet. With QvPC Technology, there is a wizard to help them through a step by step process. All a user needs is connect the Turbo NAS to an HDMI display and with a keyboard & mouse they can follow on-screen instructions. It is as simple and intuitive as operating a PC.



QvPC Technology Applications

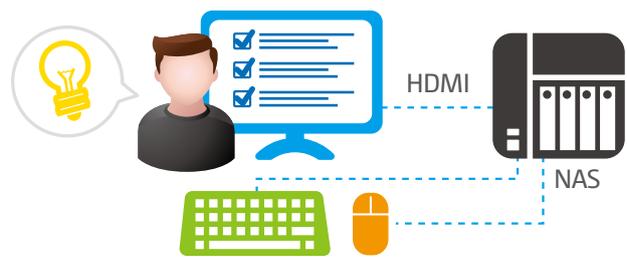
* Active installation

The conventional NAS installation process requires the user to initialize the firmware using a CD/DVD or through the manufacturer's website. For users with a lack of experience in configuring networks, this can be a difficult process. Some users will even use USB drives to directly install firmware as well. The downside of these methods is that there is a high risk of these storage mediums being lost or damaged, making it harder to install the NAS or potentially installing broken firmware.

* Available in QTS 4.1.2



Passive NAS Installation: Setup is performed via CD/DVD or through the manufacturer's website. It is potentially complicated for general users.



Active NAS Installation: Connect the NAS to an HDMI display, keyboard & mouse and follow the on-screen steps for a simple and easy process.

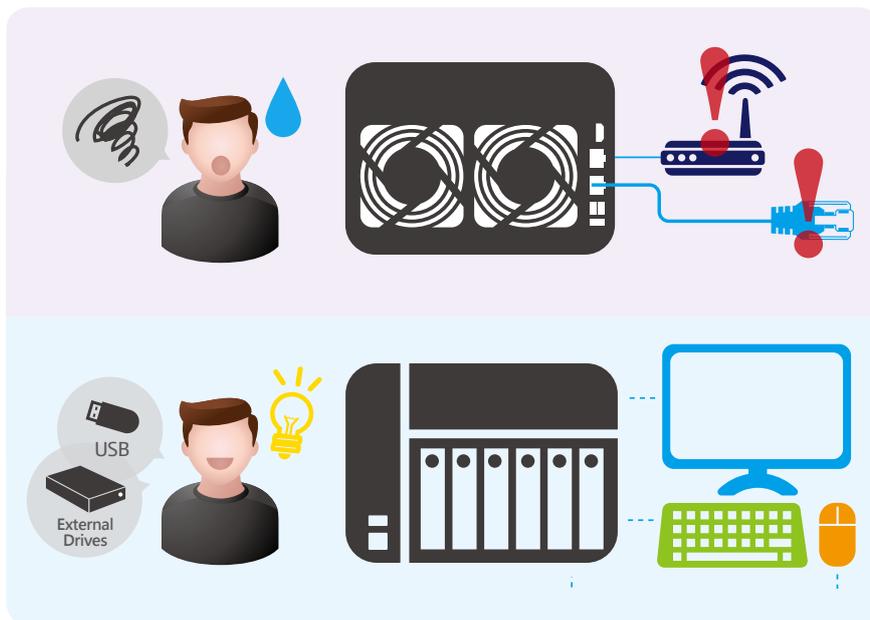
With QvPC Technology, installing and setting up a Turbo NAS is as simple as using a PC. All a user needs to do is connect the Turbo NAS to an HDMI display, keyboard & mouse and follow the on-screen instructions. The process is simple and intuitive, even to users without networking knowledge.

What do you do when your external or internal network is down, and you need immediate access to files on your Turbo NAS?

As the Turbo NAS is network-based storage, if the network is disrupted it may affect work that is reliant on shared folders or hold back users that need to urgently find certain files. With a conventional NAS, users are left with nothing to do except from wait until the network is restored.

With QvPC Technology, all you need to do is connect a USB drive to the Turbo NAS and click on QTS Desktop Management. Your data is immediately available and can be copied and used immediately.

Network issues can also cut off access to virtual machines, which would make it impossible for users to work. With QvPC technology, if this occurs all you need to do is plug in an HDMI display, keyboard & mouse and you will be able to immediately access the virtual machines.



▶ Since the Turbo NAS is accessed via network, data will become inaccessible during network downtime.

▶ Data stored on the Turbo NAS can be retrieved through QvPC Technology, even when the network is down.

Through QvPC Technology the Turbo NAS also runs Android, providing even more variety and enjoyment.

If you are sitting in front of your PC and feel like playing a quick game on your mobile phone, why not play it on a PC monitor or HDTV instead? QvPC Technology allows you to run an Android-based VM, and with a touch-enabled monitor you can effectively enjoy a large-screen tablet. The countless apps available in the Google Play Store are also immediately available for use on your VM.

In addition, if your Android device runs out of storage space and you want to back up files instead of deleting them, with an Android VM you can directly back up your using familiar applications such as App Backup & Restore and May Backup Pro. Just launch the app and move your desired files & data from your device to your Android VM. You can back up virtually everything, including logs from instant messengers, contacts, photos, videos and apps.

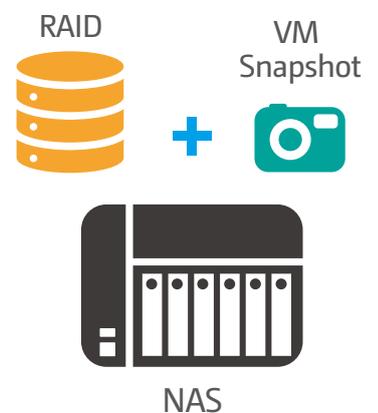


Protect virtual machine data with RAID and Snapshots.

Few things in the IT industry – whether at home or in the office – are as dreaded as the loss of data caused by hard drive failure. One solution to this is RAID (Redundant Array of Independent Disks) that can provide redundancy by spreading stored data across a number of hard drives.

With QvPC Technology, personal operating systems or small servers installed on QNAP Virtualization Stations are securely protected by the integrated RAID settings. In addition, if VMs are infected with a virus or malware – or even simply shut down by accident – the system can be easily restored using snapshots.

By making the server, file center, and the actual computer being used integrated into a RAID-enabled Turbo NAS, it not only saves a lot of money, but also provides the files with enterprise-level data protection.



Creating a family computer on a Turbo NAS

In the modern digital home, the Turbo NAS is the perfect home entertainment center. All of the media files stored on a Turbo NAS can be played on Smart TVs, PCs, mobile devices and media players throughout the home network. At the same time, QvPC Technology allows you to directly connect to a HDTV via HDMI.

With QvPC Technology you can use virtual machines (VM) to set up a computer for each member of the family. Children can do their homework, and parents can quickly check their email and favorite websites quickly. The virtual machines also support USB devices, such as USB drives and card readers, allowing users to quickly import, manage and use files on the VMs.

Since they are "virtual" machines, parents do not need to worry about whether their child will accidentally destroy their work or the operating system, as they can use snapshots to quickly revert to a previous state. As each VM is independent, it will not affect the VMs used by other family members. You can also share the desktop of a VM, allowing parents to monitor their child's usage of the computer and shut it down if necessary.

▼ The younger boy is painting in the study room with the help of a VM



▼ The older boy is watching his favorite soccer team play on the living room TV via HDMI



Most NAS run on Linux-based platforms, but they do not have support for modern devices including scanners and 3D printers. Through QvPC technology, this is now possible.

Most hardware is developed for Windows-based PCs, making their drivers and software incompatible with Linux-based computers. With QvPC technology, the Turbo NAS can create a Windows VM and use that as a server for operating these devices.

Some devices that require direct interaction (especially scanners) are often connected to independent PCs. With QvPC Technology, a VM can be set up for using the scanner, allowing users to save time by directly saving scanned files to the shared storage, copy them to USB drives, or by printing them out using attached printers.



Surveillance Station (Local Display) enables maximum home security

With Surveillance Station, real-time footage from security cameras can be watched from PCs and mobile devices. Through QvPC technology, you can also watch this footage on a HDTV, allowing you to have a larger viewpoint and also saving you on using (or buying) a computer.

When it comes to building surveillance systems, people instantly imagine a large control room with numerous servers controlling each camera and massive arrays of hard drives for storing recorded footage. But with QvPC Technology, a professional surveillance system can be set up with just a Turbo NAS – a three-in-one machine for managing surveillance, storage, and monitoring.



* Use a touch screen to manage "Internet of Things" devices and cloud

Many factory and warehouse systems were developed for older operating systems that are now discontinued (like Windows XP) and after a long term of using these systems, it can be hard or impossible to switch to a newer system. So this leaves these businesses with the task of finding a new, modern system when necessary for new hardware and with the task of preserving their existing data.

Through QvPC Technology, old management systems and archived files can be migrated to a Turbo NAS and run by virtual machines – eliminating the need to find a new management system. New hardware can be installed as necessary, including touch screens

to turn the Turbo NAS into a modern intuitive control center. With centralized file storage and virtual machines used to manage older systems, the factory/warehouse can create a centralized management platform enabled by devices like wireless sensors, barcode scanners, and card readers that are directly connected to the Turbo NAS. Storage facilities used for Internet of Things management can be used to create a private cloud, allowing users to not worry about the sudden suspension of service at and can update their data according to their needs to the public cloud.



The IS-400 Pro is a Turbo NAS built for non-office environments.

It is a multifunctional, industrial-grade, fanless NAS that can operate perfectly in -25° C to 50° C heat making it the optimum choice for factories, warehouses, and logistics operations.

* Available in QTS 4.1.2

QvPC Technology opens a new horizon for NAS applications

As well as developing newer and better hardware, QNAP is dedicated to developing application services to provide users with greater value and user experience. As QNAP moves towards "Software as a service" and "Software-defined everything", we continue to develop innovative application services for not only cloud services, but also for services run directly on the Turbo NAS.

Just enter the QTS Desktop and click on "Control Panel" to enter "Applications" and the option for HD Station (HybridDesk Station) will appear. Click "Get Started Now" to configure and install the applications developed from QvPC technology to turn the Turbo NAS from a simple storage device into a "Software-defined PC".



An Overview of Built-in Virtual Machines

Advancement in virtualization brings enhanced hardware compatibility and software support. Many businesses began to recognize the advantages of a virtualized environment and some of them took action to introduce virtualized work platforms including VMware vSphere 5.5 and Microsoft Hyper-V Server. In the HD Station (HybridDesk Station), the QVM Desk allows quick access to virtual machines installed on the Turbo NAS through the Virtualization Station platform. Each of the virtual machines can be directly operated through an HDMI display and keyboard & mouse. Virtualization Station is integrated into the Turbo NAS to form a system with the advantages of NAS (such as high-efficiency I/O, data security and

backup management) and the functions of virtual machines (flexible installation of multiple operating systems and direct access via web browsers). Compared to other virtualization platforms available in the market, the QVM Desk offers a direct connection to virtual machines with HDMI monitors. You do not need another PC to link to the system, and the virtual machines can be directly interacted with in the event of technical issues. The built-in virtual machines bring the Turbo NAS beyond the function of a simple storage device into an innovative application platform that manages and builds various virtual machines.

What is virtualization?

Virtualization allows users to run multiple operating environments through partitioning the available hardware resources (CPU, memory, and storage). The multiple operating environments can be separately installed or duplicates of other systems. Virtualization effectively cuts down the time IT staff needs to manage physical hardware. For R&D and testing personnel, virtualization offers a quick way to test the integration and effectiveness of applications in different operating environments. For general users, virtualization saves them time

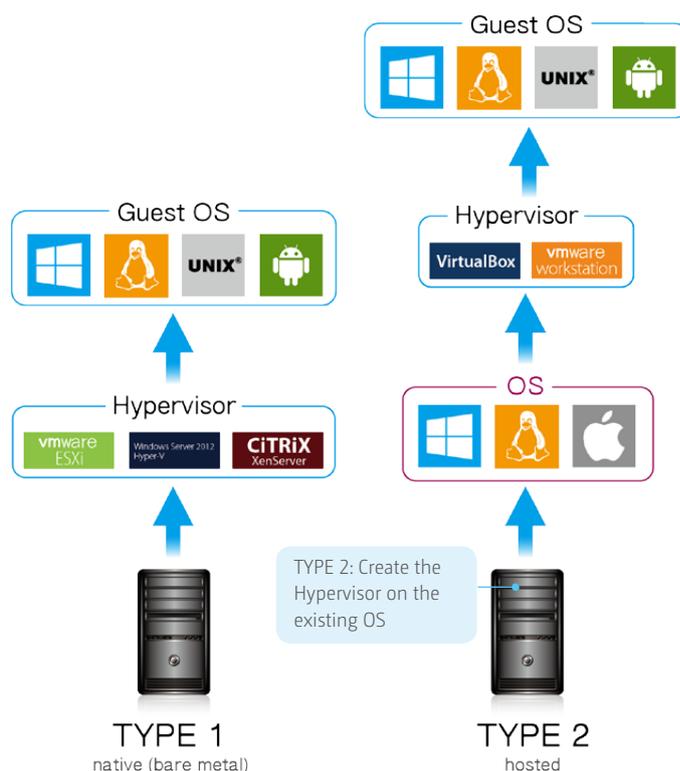
and money, as they no longer need to have different computers for different applications.

Computers continue to get powerful, and because of this many software developers launched their own virtual machine workstations, such as VMware Workstation and Oracle VirtualBox, which are intended for use on home PCs. Through these workstations, users can operate various operating systems without partitioning hard drive space of having multiple boot options.



Hypervisor

Hypervisors allow users to install and manage multiple virtual machines on one physical computer. There are two types of Hypervisor available today. (1) Bare metal, installed directly on the mainframe and (2) Hosted, installed on the primary operating system. Citrix XenServer, VMware ESX/ESXi and Microsoft Hyper-V Server belong to Type 1 and VMware Workstation and Oracle VirtualBox are Type 2. For operating and managing a large number of virtual machines, Type 1 hypervisors are more suitable for businesses. Type 1 hypervisors generally have lower hardware emulation efficiency loss and higher expandability, including high availability and fault-tolerance. Type 2 hypervisors, on the other hand, are more suitable for personal workstations as virtual machines can be installed and configured quickly and conveniently used in the PCs. For example, a Windows virtual machine can be installed inside a Mac operating system, allowing Mac users to use Windows applications on the same device.



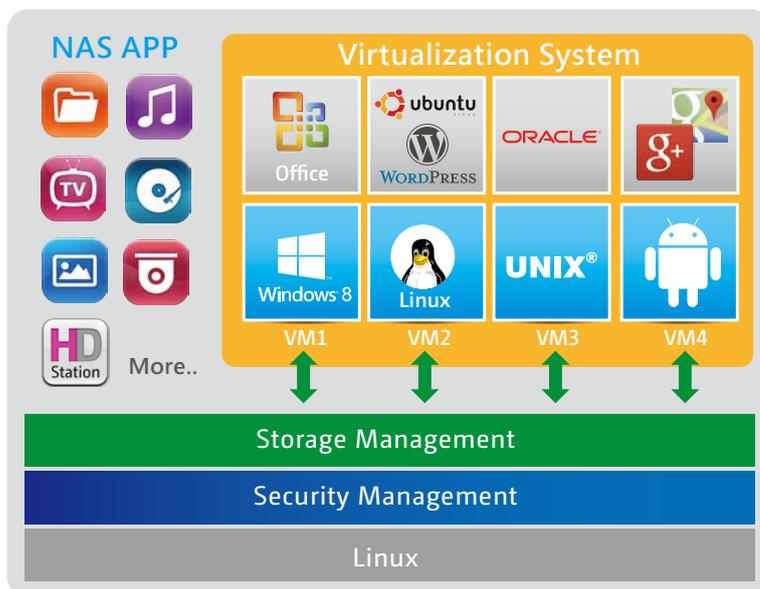
In summary, although Type 1 hypervisors have a wider scope of support for expanded operations, the costs for suitable hardware and authorization for expanded functions are far higher than the Type 2 hypervisors. Therefore, for personal use or small businesses, Type 2 hypervisors are more than enough.

	Hypervisor (Bare-metal)	Hypervisor (Hosted)
	<ul style="list-style-type: none"> - VMware ESXi - Citrix XenServer - Microsoft Hyper-V 	<ul style="list-style-type: none"> - Oracle VirtualBox - QNAP Virtualization Station
Suitable hardware	Mostly server-class (Dual processor)	Personal workstations, PC (Single Processor)
Hardware compatibility support	Moderate	High
Performance for VM hardware	High	Moderate
Support for VM remote replication or other solutions, e.g. HA, Fault-tolerance	Yes	No
Expansion of applications	Many (Expensive)	Few (Free)

Have Full Control over Virtualization Station

Different operating systems can be installed on different virtual machines, allowing for multiple applications can be run simultaneously on each virtual machine and providing users endless possibilities for application services. Data stored on the Turbo NAS can be retrieved through virtual machines via web browser or with an HDMI display.

Turbo NAS has high-speed I/O and a large storage capacity. Using virtual machines to operate server services (like databases and Customer Relationship Management software) simplifies IT hardware architecture, and enables centralized management of the collected data. Not only that, but built-in virtual machines can also run data mining applications for simultaneously analyzing the data. There is no need to download the data to a separate PC and as the files are not transmitted externally, this setup minimizes the security risk of data being intercepted and saves time and bandwidth.



Virtual Machines Import/Export



The virtual machine format used by each hypervisor can differ. Therefore, to enable users to import from existing virtual machines, Virtualization Station supports importing industry-standard formats such as *.ova, *.ovf, and *.vmdk. When exporting virtual machines, Virtualization Station uses *.ovf and QNAP's proprietary *.qvm format. This support enables the migration of virtual machines to other hypervisors and directly moving virtual machines between different Turbo NAS, providing IT administrators with unprecedented flexibility.

Snapshot : The Best Solution for High-security Backup and Restore



- **Snapshot 1**
2013/12/18 19:27
- **Snapshot 2**
2013/12/19 10:45
- **Snapshot 3**
2013/12/21 12:15
- **Snapshot 4**
2013/12/30 22:40

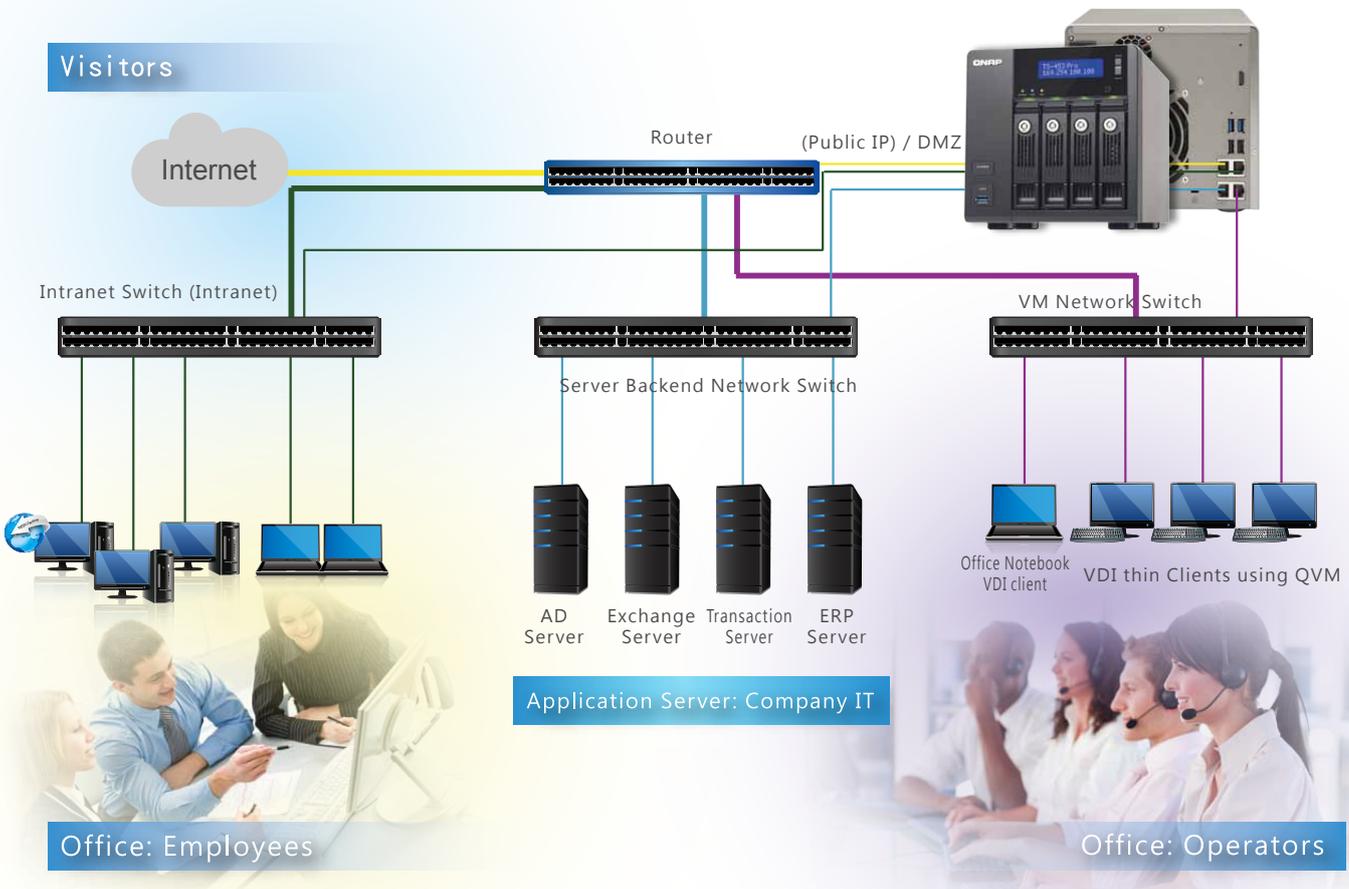
Virtualization Station offers a Snapshot function that records the complete file status of virtual machines at the exact moment it was taken. Snapshots provide a quick way to restore systems if problems or errors occur on the virtual machine. For example, take a snapshot before opening downloaded files to protect against virus infection, or take periodic snapshots to prevent against accidental shutdown. For software developers, virtual machines can be essential for testing and being able to quickly restore them is a godsend for saving time and effort when errors occur.

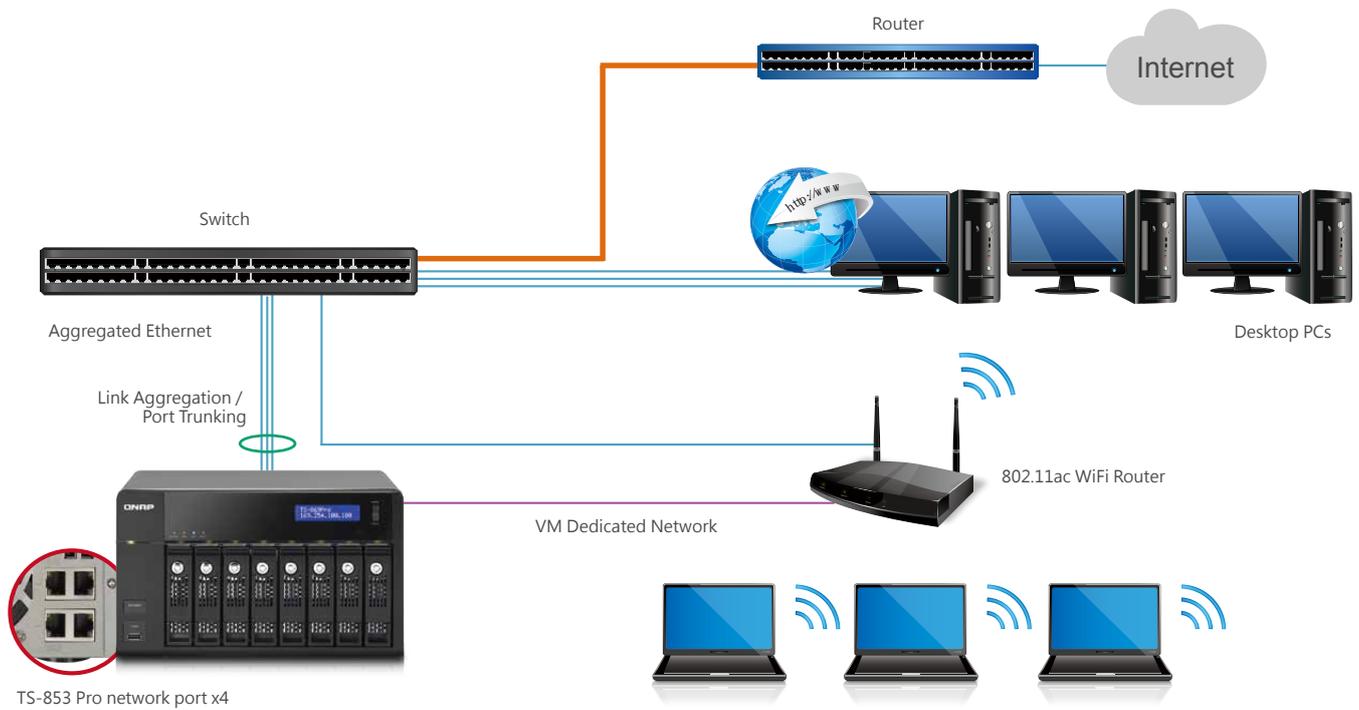
The snapshot function takes an active image of the running virtual machine and compares the image to the original image of the virtual machine. The difference is then stored in the snapshot and sets the original virtual machine image as read-only. Thus, after restoration, the final virtual machine image includes the original image plus the difference.

Dedicated Network for VMs

The Turbo NAS is equipped with multiple network ports, and each one can be managed by separate application services to achieve high-security deployment and zoned application management (including public IP, intranet, server backend network, and VM network). In addition, port trunking-link aggregation can be achieved between two ports to provide highly-efficient file transmission and load balancing adjustments.

TS-x53 Service Binding By LAN ports





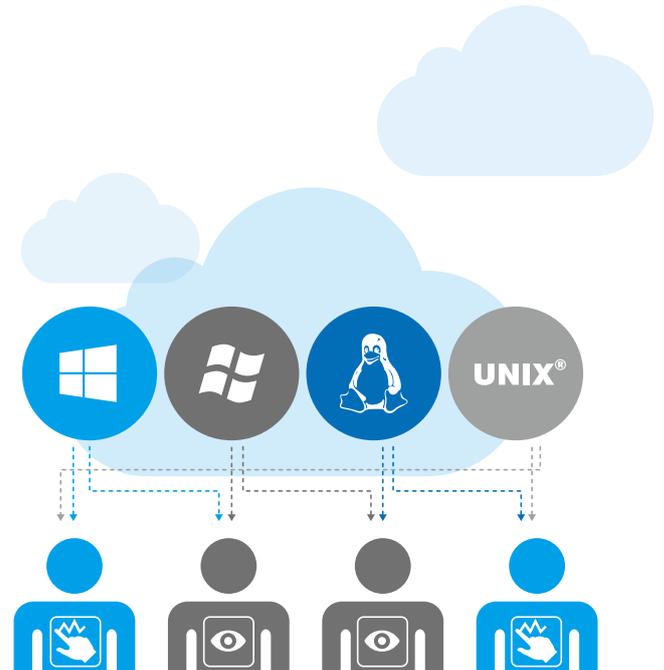
Under the zoned application management framework, the network used by the virtual machines is independent from the network used by the Turbo NAS. This ensures that application services running on the Turbo NAS are not affected by the virtual machines using the network and also sets aside bandwidth to run a large packet server service. Furthermore, depending on the number of network ports available, VMs can be set up to use independent network ports for dedicated bandwidth requirements. Virtualization Station also offers the "Network Setting" function, which checks if all network ports on Turbo NAS are properly linked to the network and displays bandwidth statistics. The "Default Gateway" is the network port used by Turbo NAS and other network ports are used for virtual machines. The network traffic analysis charts displays the network traffic of each "Dedicated Network".



Account Management

When multiple users are accessing virtual machines on the same Turbo NAS, there would be no privacy whatsoever in the private files or confidential business files if each user is allowed to access & operate other virtual machines. The Turbo NAS performance would also suffer if too many users attempt to simultaneously access multiple virtual machines. And what if a user mistakenly shuts down or suspends a virtual machine running a very important application? These could seriously impact the running of a business or small office.

With Account Management, the Turbo NAS administrator can create accounts for each user and configure their access controls, including access to VM power, snapshot, advanced setup and general virtual machine viewing options. Account Management provides administrator with a quick way to assign virtual machines to different users and to conduct effective management and virtual machine resource consolidation.



USB Passthrough

Virtualization Station supports USB passthrough to every virtual machine. Generic USB devices including hard drives and card readers can be connected to virtual machines through the Turbo NAS USB ports and activated through the virtual machine information page.

With a QVM Desktop, it is as simple as operating a PC. In factory management applications, USB devices such as card readers and barcode scanners, can be installed directly on the Turbo NAS and linked to the virtual machines to read and scan the data directly, saving bandwidth and time needed for data to travel back and forth through the network.



Diverse Built-in NAS Applications- Create Infinite Business Opportunities

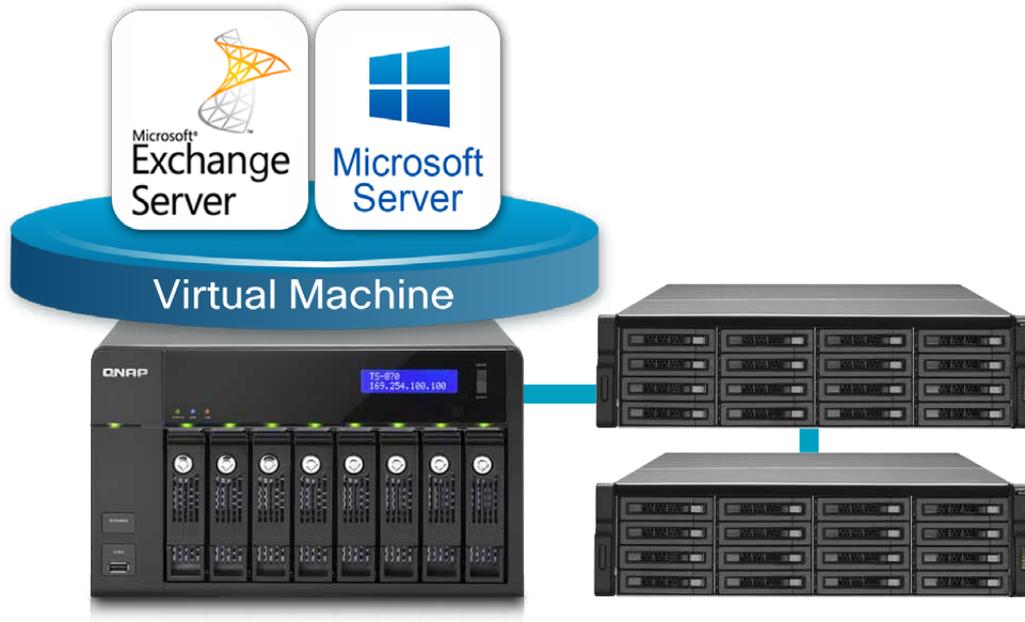
Application Service Server

By using the powerful storage management features of a Turbo NAS, built-in virtual machines can be used to run 24/7 server applications including a Microsoft IIS Internet Information Services, Exchange, AD (Active Directory) and other corporate management systems, such as Enterprise Resource Planning (ERP). The data is stored directly on the Turbo NAS and the virtual machines can be used to install databases for data mining and analysis.



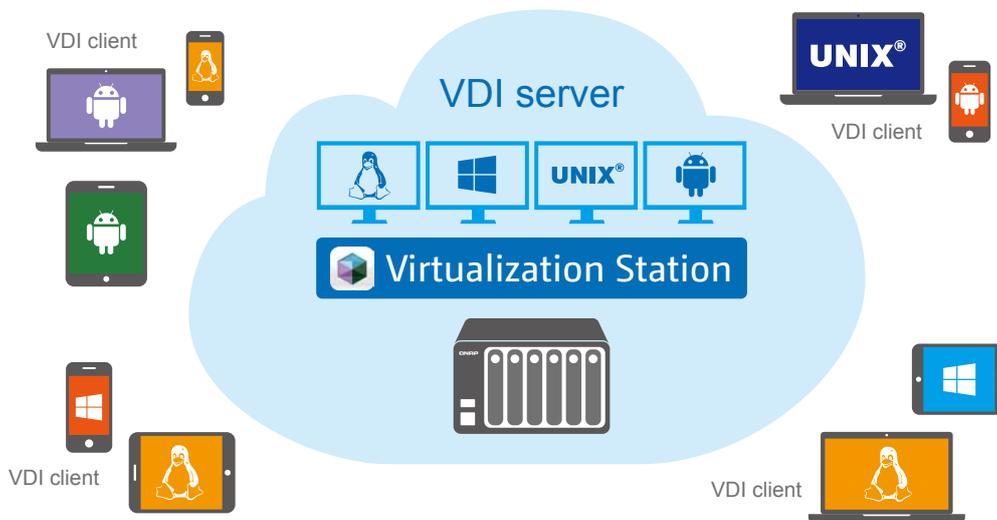
Diverse Built-in NAS Applications- Create Infinite Business Opportunities >

Virtualization Station is built using the KVM (Kernel-based Virtual Machine) framework and VirtIO is used to accelerate I/O of the virtual devices, such as the network cards and hard-disk. Therefore, even though the virtual machine components are emulated as virtualized hardware resources, lower loss of effectiveness is achieved and the access efficiency of application servers is enhanced. Furthermore, the virtual machines can also run with Samba or iSCSI to make full use of the Turbo NAS file storage and sharing functions, as well as the powerful backup and antivirus capabilities, to achieve optimum data protection.



VDI (Virtual Desktop Infrastructure)

For small and home businesses, Virtualization Station can be used to build a Virtual Desktop Infrastructure (VDI). Multiple users can log on to the independent desktops or access the data stored in the Turbo NAS through URL links in the office or on the move.



Online Virtual Machine Market

An increasing number of software developers now pack their proprietary software into virtual machine formats directly and call them the "Virtual Appliances". They are offered through direct download and are ready for users to import into their hypervisors without having to spend time to install and configure them. There are currently several markets available online, including Bitnami and VMware Virtual Appliances Marketplaces. Users can find the application services they need on an online market, download, and then import the applications directly into Virtualization Station and they are ready to go without hassle.



References

- Mell, P; Grance, T. (2011). The NIST Definition of Cloud Computing. NIST Special Publication. 800-145, 2
- Information Age. (2012). SaaS will be \$14.5bn market this year - Gartner. Available: [http://www.information-age.com/technology/cloud-and-virtualisation/2095578/saas-will-be-\\$145bn-market-this-year---gartner](http://www.information-age.com/technology/cloud-and-virtualisation/2095578/saas-will-be-$145bn-market-this-year---gartner). Last accessed 3rd Jul 2014.
- Gartner. (2013). Gartner Identifies the Top 10 Strategic Technology Trends for 2014. Available: <http://www.gartner.com/newsroom/id/2603623>. Last accessed 3rd July 2014.
- Robinson, S. (2013). Software-defined storage: The reality beneath the hype. Available: <http://www.computerweekly.com/opinion/Software-defined-storage-The-reality-beneath-the-hype>. Last accessed 8th July 2014.
- VMware. (2012). The Software-Defined Data Center. Available: <http://www.vmware.com/software-defined-datacenter/>. Last accessed 8th July 2014.
- Open Networking Foundation. (2012). Software-Defined Networking: The New Norm for Networks. ONF White Paper. 7.



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