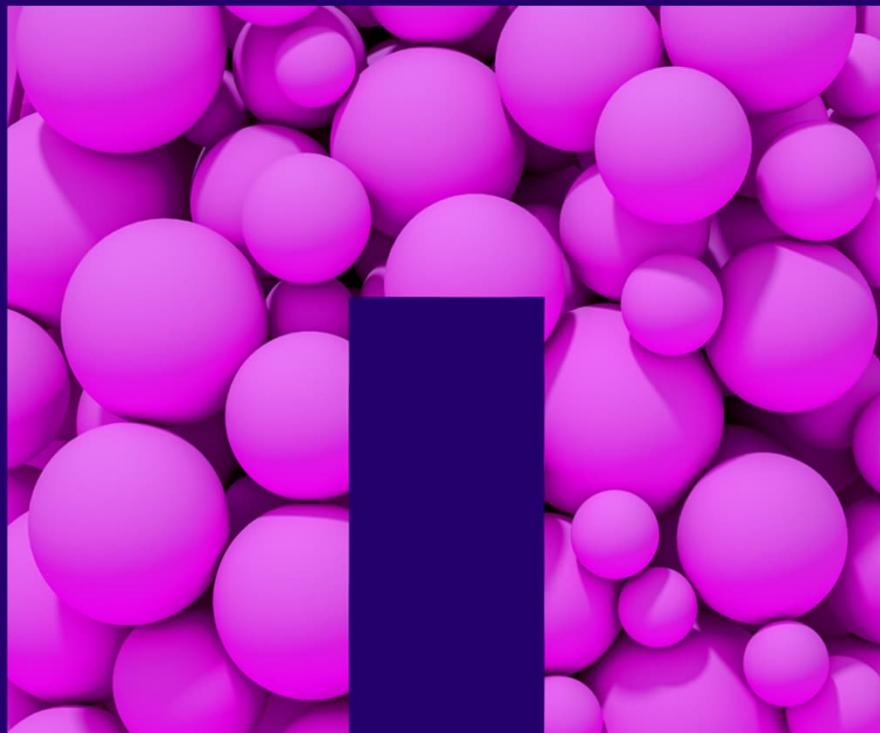




數據服務韌性 與IT成本優化 校園擺脫架構鎖定的新生之路

Will Huang
資深技術顧問



地表上最安全的儲存 後量子密碼 超前就緒

NetApp 獲得 美國國家標準技術研究院(NIST)認證的檔案和區塊儲存方案，為量子世界威脅構築前瞻性堅實防禦



III 財團法人資訊工業策進會
INSTITUTE FOR INFORMATION INDUSTRY

台灣後量子密碼學 合作備忘錄簽署儀式



唯一經過驗證、可用於儲存「最高機密」資料的企業級儲存廠商

美國國家安全局



Commercial Solutions
for Classified (CSfC)
Component List

解決方案在多層加密與安
全架構下，可合法用於處
理與儲存 Classified / Top
Secret 資料

美國國家標準與技術研究院



FIPS 140-3

產品所使用的加密模組符合
美國政府的安全標準，可用
於政府、金融與高安全環境

美國國防部



Department of Defense
Approved Product List
(DoDIN APL)

已通過安全與互通性驗證，被核
准可實際部署於美國國防部
(DoD) 網路環境

國際標準化組織



Common Criteria

安全架構與設計經過獨立第三方
評估並符合政府採購的安全要求

CYBER RESILIENCY

for any
workload

hosted
anywhere

SECURE BY DESIGN

唯一獲得美國國家安全局 (NSA) CSfC 驗證，可用於儲存「極機密 (Top-Secret)」數據的企業級儲存設備



Policy engine

自動封鎖已知的惡意檔案類型



WORM primary data and tamper-proof snapshots

透過「不可變 (Immutable)」與「不可刪除 (Indelible)」的快照技術



AI-powered autonomous ransomware protection

針對檔案 (File)、區塊 (Block)、原生雲端及使用者行為，提供即時的偵測與應變



Multi-admin / multi-factor verification

阻斷惡意管理員與非法使用者的破壞行為



End-to-end encryption

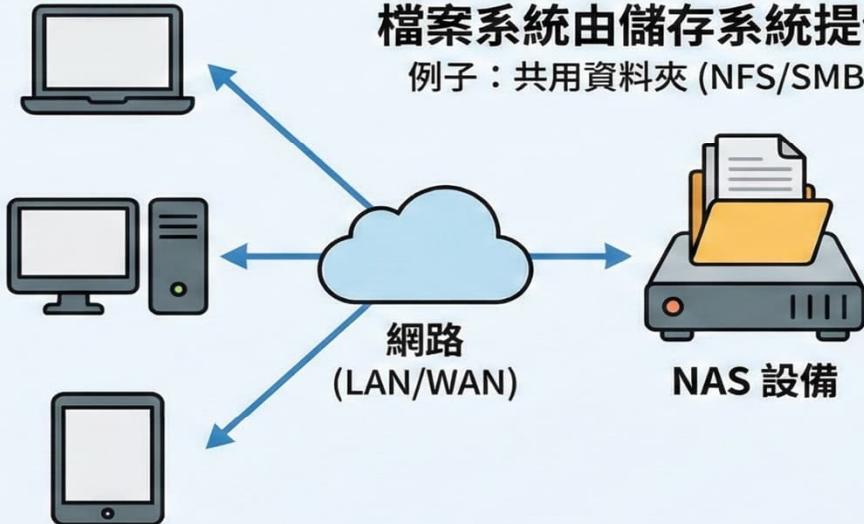
確保數據在「靜態儲存」、「傳輸過程」及「使用中」均安全無虞



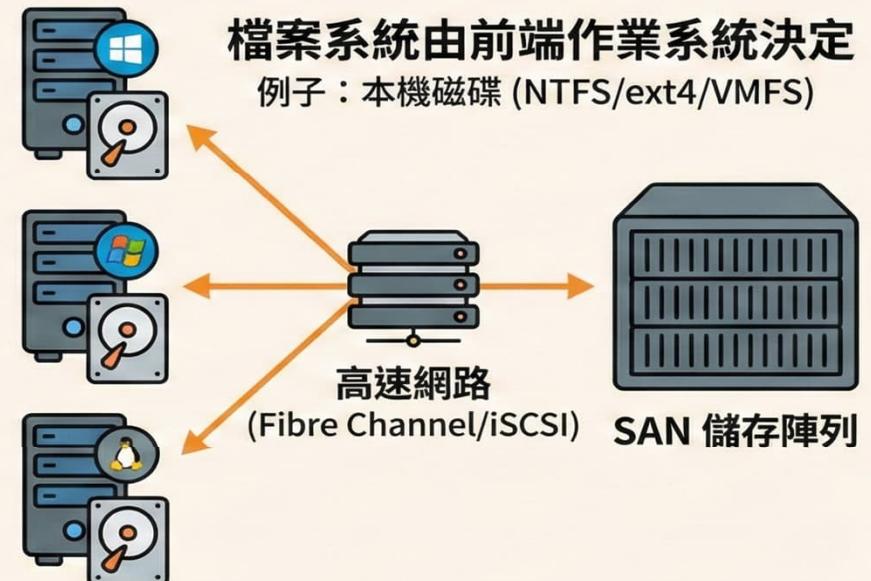
1. 需要注意架構穩定性

NAS 與 SAN 基本概念：檔案系統的差異

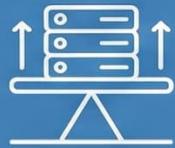
NAS (網路附加儲存)



SAN (儲存區域網路)



VMware VMFS 的核心優勢



1. 穩穩定性 (Stability)

叢集檔案系統，確保高可用性與持續運行。



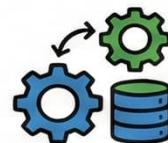
2. 安全性 (Security)

內建鎖定機制，保護資料完整不受損。

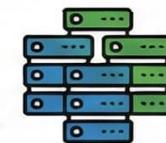


3. 效能 (Performance)

優化 I/O 處理，滿足虛擬化高負載需求。

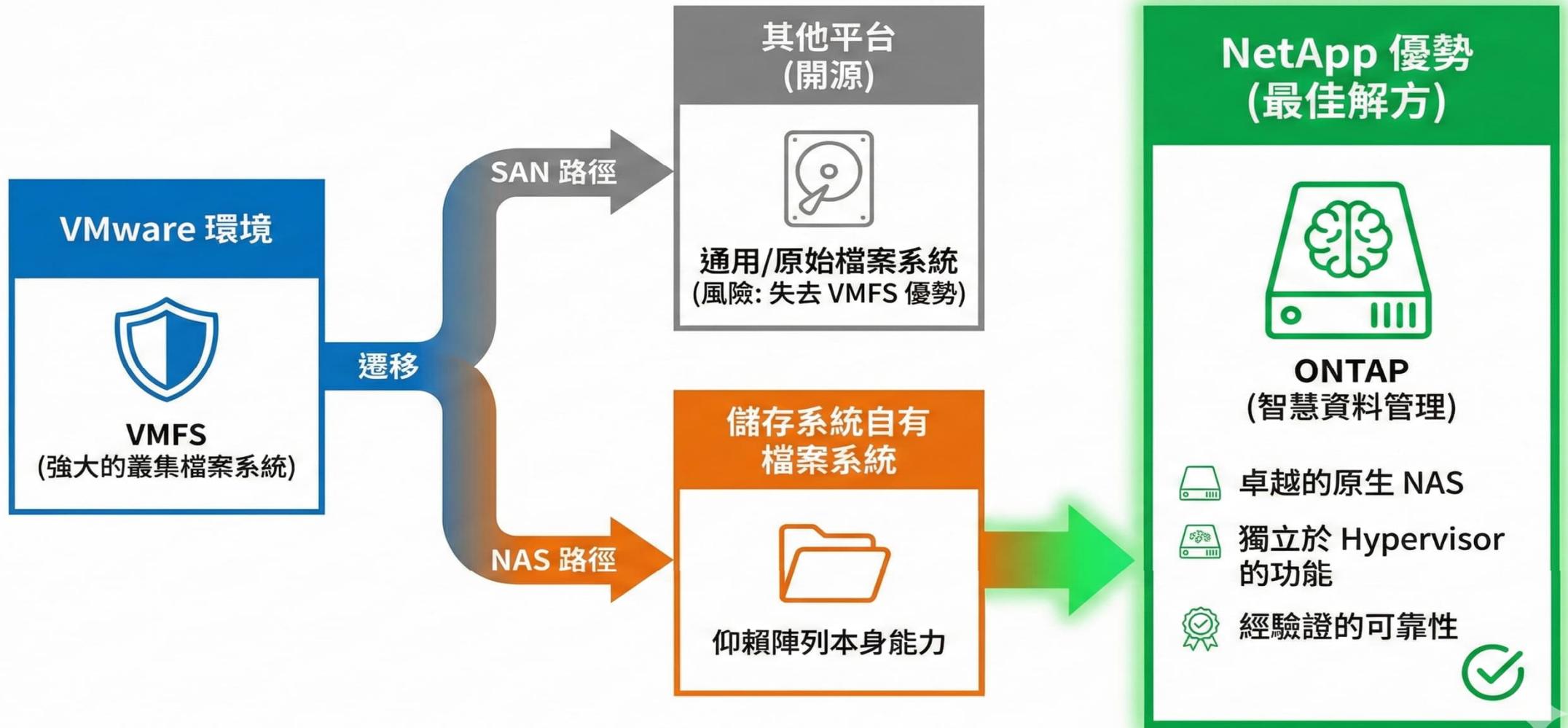


關鍵連動：儲存與虛擬化叢集



儲存的穩定性是虛擬化叢集可靠運行的基石！



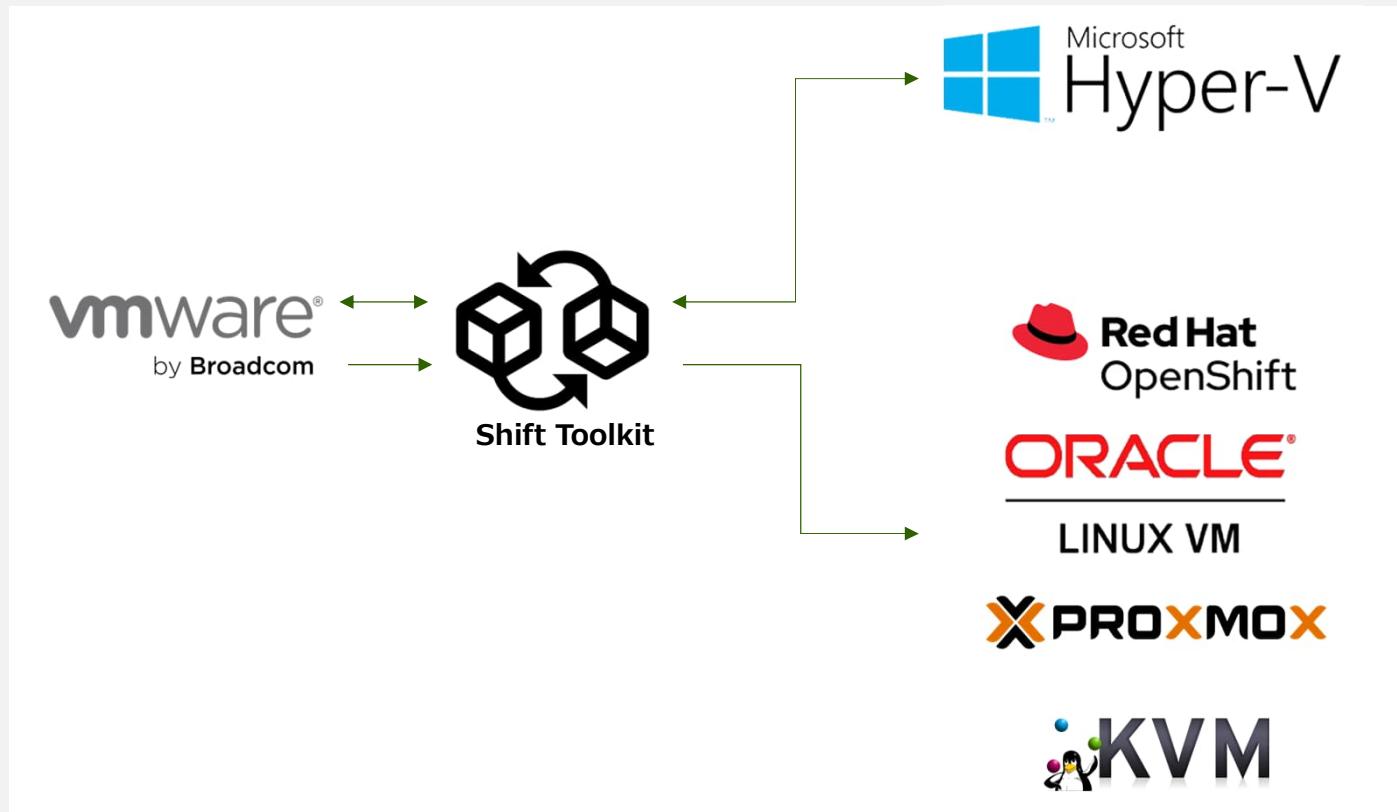


2. 需要注意虛擬化遷移

簡化遷移 NetApp Shift Toolkit

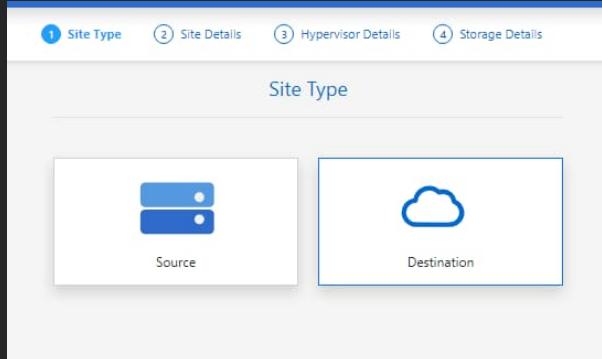
Convert and
migrate in
minutes

Reduced
downtime and
disruption

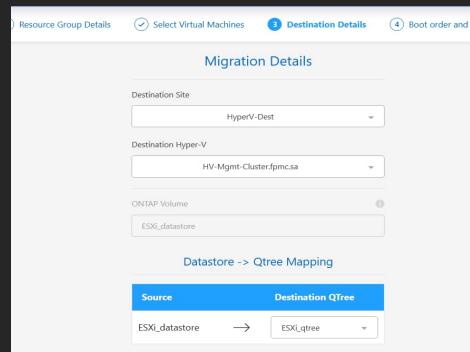


簡化遷移 NetApp Shift Toolkit

1. Add Source/Destination site



2. Create Resource Group



3. Define Blueprint

OS Username Password

Linux			Apply To All
Windows	administrator	NetApp23	Apply To All

IP Config

Do Not Configure Retain IP Assign New IP DHCP

1 VMs

VM Name	CPUs	Mem (MB)	NIC/IP	Power On	Boot Order Override	Gen	Remove VMware Tools	Retain MAC	Service Account Override
win-test-2025	4	8192	172.22.12.217		Override	Gen 1 Gen 2	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Activate Win

Resource Group : DEMO-RG

Previous Continue

4. Migration

Migrate Steps

Migration Plan: HyperV-Migration

Step	Status	Time
1. Deleting existing snapshots for all VMs in the setup	Success	0.1 Seconds
2. Triggering VM snapshots for resource groups at source before disk conversion (in parallel)	Success	30.1 Seconds
3. Triggering volume snapshots before disk conversion in parallel	Success	5.2 Seconds
4. Powering off VMs in protection group - DEMO-RG - in target	Success	9.8 Seconds
5. Unregistering VMs in target (in parallel)	Success	10.1 Seconds
6. Converting VMDK disks to VHDX format for all VMs (in parallel)	Success	24.2 Seconds
7. Registering VMs (in parallel)	Success	16.2 Seconds
8. Powering on VMs in protection group - DEMO-RG - in target	Success	7.4 Seconds
9. Registering Networks (in parallel)	Success	84.8 Seconds
10. Triggering config scripts for Target VMs	Success	153.8 Seconds

簡化遷移 NetApp Shift Toolkit

NetApp Shift Toolkit | Dashboard | Discover | Resource Groups | Blueprints | Job Monitoring | 1 🔍 ⚙️ 🎉 🚧 🙏

Sites: 2 | Resource Group: 1 | Blueprint: 1 | VMs: 8

VMs: Migrated: 0, Converted: 1, Yet to Move: 0

Environments: Virtual Environments: 2, Storage Environments: 2

Topology Canvas: Immersive View

Workflow:

Blueprint	Source	Destination	Action
BP01	vmware	kvm	Convert

Topology Canvas:

```
graph LR; vSphere_8[Source: vSphere_8<br/>hypervisor: vmware<br/>endpoint: 192.168.76.10] -- "Conversion - BP01" --> PVE_9[Destination: PVE_9<br/>hypervisor: kvm]
```

簡化遷移 NetApp Shift Toolkit

Edit Settings | IamWin2025

X

Virtual Hardware VM Options Advanced Parameters

ADD NEW DEVICE ▾

> CPU	2	ⓘ
> Memory	8	GB
> Hard disk 1	80	GB
> SCSI controller 0	LSI Logic SAS	
> Network adapter 1	VM Network	<input type="checkbox"/> Connected
> CD/DVD drive 1	Datastore ISO File	<input type="checkbox"/> Connect At Power On
> Video card	Specify custom settings	
> Security Devices	Not Configured	
> Other	Additional Hardware	

Success 0.3 Seconds ⓘ

Success 1.3 Seconds ⓘ

Success 30.2 Seconds ⓘ

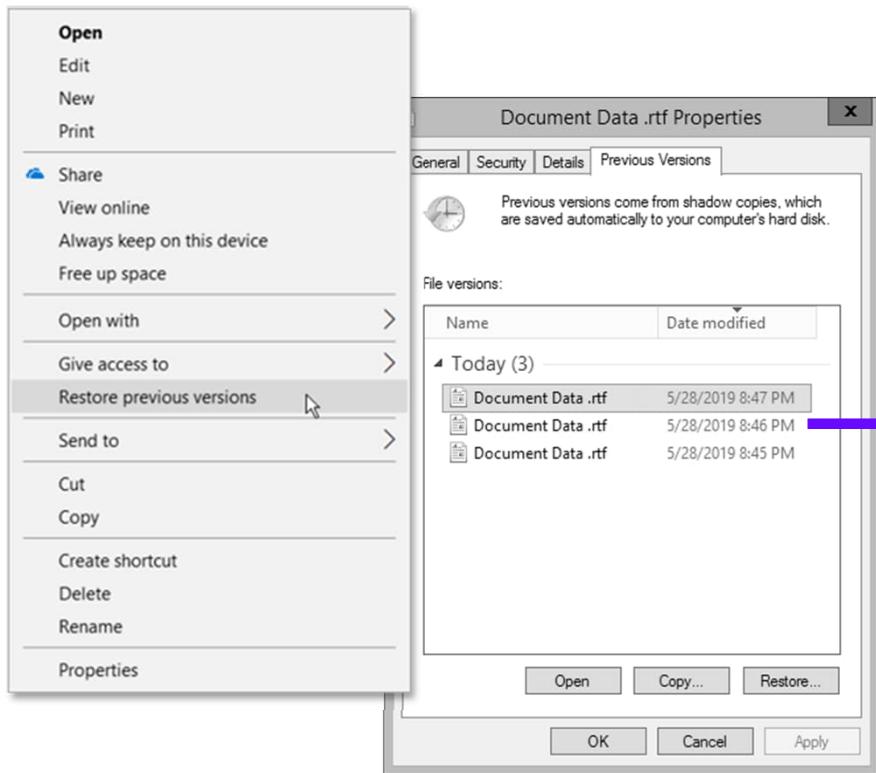
Success 5.1 Seconds ⓘ

Success 5.6 Seconds ⓘ

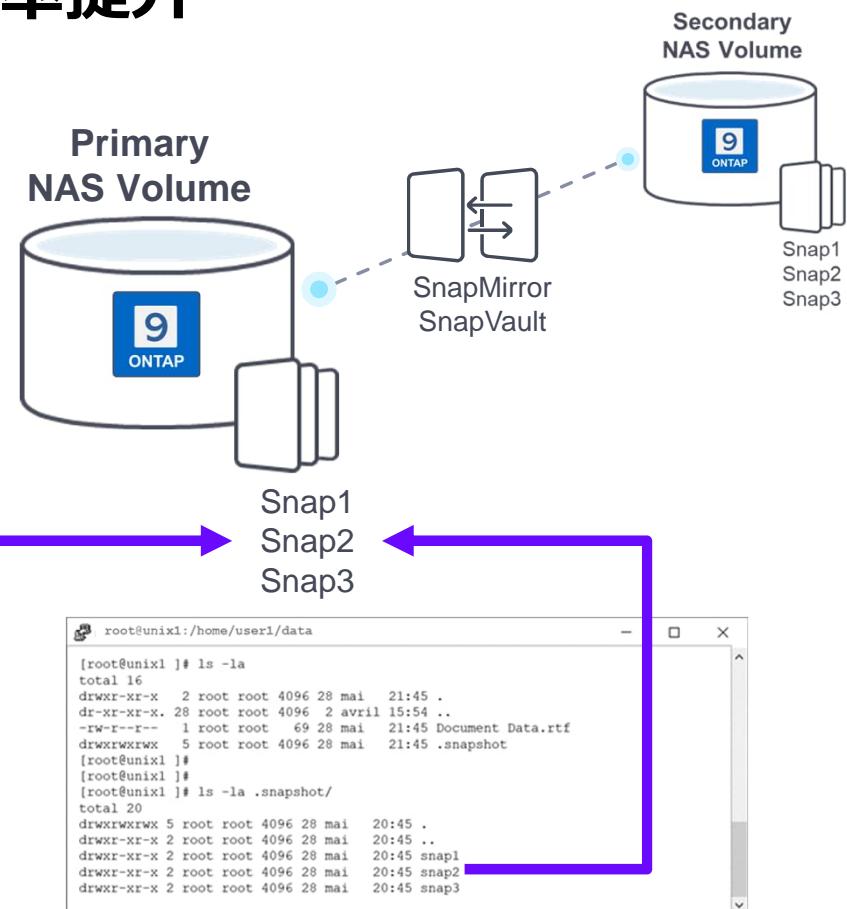
3. 需要注意備份備援

以快照技術為核心，實現營運簡化與效率提升

使用者可自行還原檔案，無需 IT 管理員介入



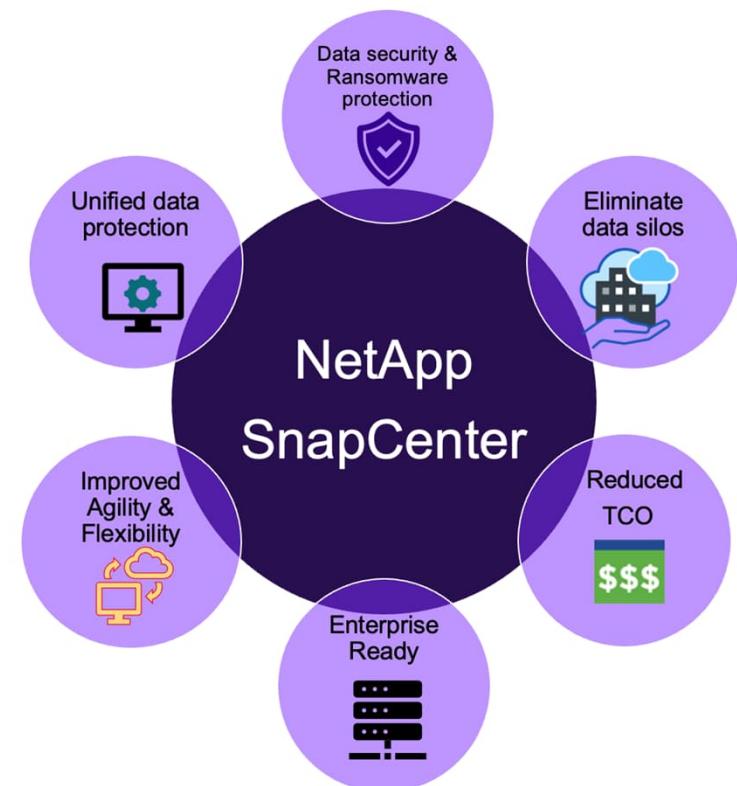
OR



SnapCenter

應用程式與虛擬機的一致性備份與復原

- 統一數據保護: Eliminate Data Silos by protecting On-premises ONTAP, Azure Netapp files, AWS FSxN
- 數據安全防禦: Safeguards data and snapshots, preventing tampering and ensuring their integrity and security using SnapLock and tamper proof snapshots
- 降低總持有成本: Incremental forever app -consistent backups, 100% space efficient clones and rapid restores are offered free for ONTAP, ANF, FSxN customers.
- 企業級架構: Designed to meet the demanding requirements of enterprise environments, offering scalability, high availability(HA), RBAC, Disaster recovery(DR) and seamless integration with existing infrastructure
- 卓越靈活性: SnapCenter offers flexibility to automate workflows in CLI, GUI, and REST API.



Locked down snapshots

不可變 (Immutable) 且不可刪除 (Indelible) 的快照副本

Immutable, indelible NetApp® Snapshot™ copies

在數位金庫內實施數據鎖定，結合嚴密的存取監控與高強度安全加固，構築無法逾越的防線

You can leverage the full spectrum of ONTAP® storage:

提供從經濟型的大容量快閃 (Capacity Flash) 與混合快閃 (Hybrid Flash)，到極致效能快閃 (Performance Flash) 的多樣化選擇，以滿足各類復原時間目標 (RTO)

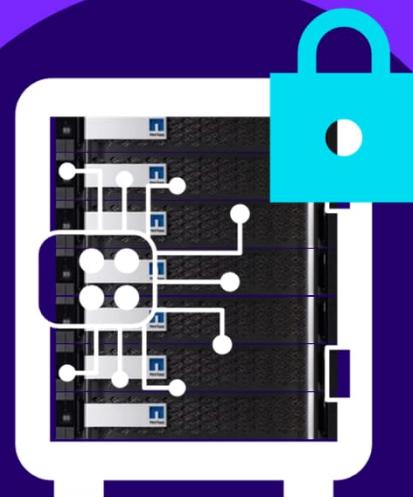
Same API and orchestration

提供與所有 ONTAP® 系統完全一致的全套技術支援

Integrated storage efficiency:

數據在整個生命週期中始終保持「重複數據刪除」與「壓縮」狀態，從而大幅加速復原過程

NETAPP CYBER VAULT



Immutable and indelible snapshots

THANK YOU



Proxmox VE

企業級虛擬化管理平台



技術總監
鄭郁霖
JASON CHENG





原廠

Proxmox

- 商業公司
成立於 2005 年
- 奧地利
- 開源軟體
- 商業服務

The screenshot shows the official Proxmox website. At the top, there's a navigation bar with links for Home, Virtualization, Backup, Email Security, Downloads, Services, Partners, and About. A "Buy now" button is also visible. The main headline reads "Simplify your data center." Below it, a sub-headline states: "Proxmox delivers powerful, enterprise-grade solutions with full access to all functionality for everyone - highly reliable and secure. The software-defined and open platforms are easy to deploy, manage and budget for." Three main service sections are displayed in cards: "Proxmox Virtual Environment", "Proxmox Backup Server", and "Proxmox Mail Gateway". Each card contains a brief description and a "About" button. At the bottom right, there's a "Grow faster together." callout.

X PROXMOX

Home Virtualization Backup Email Security Downloads Services Partners About

Get Help Buy now

Simplify your data center.

Proxmox delivers powerful, enterprise-grade solutions with full access to all functionality for everyone - highly reliable and secure. The software-defined and open platforms are easy to deploy, manage and budget for.

Proxmox Virtual Environment

Proxmox Virtual Environment is a complete open-source platform for enterprise virtualization. With the built-in web interface you can easily manage VMs and containers, software-defined storage and networking, high-availability clustering, and multiple out-of-the-box tools using a single solution.

About Proxmox Virtual Environment

Proxmox Backup Server

Proxmox Backup Server is an enterprise backup solution for backing up and restoring VMs, containers, and physical hosts. The open-source solution supports incremental backups, deduplication, Zstandard compression, and authenticated encryption.

About Proxmox Backup Server

Proxmox Mail Gateway

Proxmox Mail Gateway is an open-source email security solution that protects your mail server against all email threats from the moment they emerge. The full featured mail proxy can be easily deployed between the firewall and your internal mail server in just a few minutes.

About Proxmox Mail Gateway

Grow faster together.



公司

■ ■ ■ ■ ■

節省工具箱

- 商業公司
- 開源軟體
- 技術服務
- 臺灣在地
- 中文/發票/時區

The screenshot shows a modern website interface. At the top, there's a navigation bar with icons for back, forward, and search, followed by the URL 'jason.tools'. The main menu includes '服務項目' (underlined), '開源方案', '商業方案', '團隊實績', '公司簡介', and '聯絡我們'. Below the menu is a large banner image of a city skyline at sunset. Overlaid on the right side of the banner is the text '服務項目' in large white font. At the bottom left is a smaller image of a modern building's glass facade. To the right of this image is the text '自由與開源軟體' in bold black font, followed by the Chinese definition '「自由軟體 Free Software」、『開源軟體 Open Source Software』' and the English definition '自由組織布哈拉尼卡德'.

節省工具箱
JASON TOOLS

服務項目 開源方案 商業方案 團隊實績 公司簡介 聯絡我們

服務項目

自由與開源軟體

「自由軟體 Free Software」、「開源軟體 Open Source Software」
自由組織布哈拉尼卡德



公司

節省工具箱

繁中語言維護夥伴
銀級合作夥伴

2020 加入，台灣第一家



The screenshot shows the Proxmox website's 'Partners' page. The header features the Proxmox logo and navigation links: Home, Virtualization, Backup, Email Security, Downloads, Services, Partners (which is highlighted), and About. Below the header, there are buttons for 'Explore', 'All Partners', and 'Become a partner'. A sidebar titled 'Filter - Partners' includes dropdown menus for 'Partners' (selected) and 'Partner Type' (Reseller partner, Training partner, Hosting partner, Solution partner). Another dropdown for 'Country' lists Africa, Asia, Europe, Latin America, Northern America, and Oceania - Australia. The main content area displays 'Jason Tools Co., Ltd.' with its contact information: Street: 1F, No. 3, Ln. 71, Songshan St., Beitun Dist.; Zip code: 406; City: Taichung City, Taiwan; Email: service@jason.tools; Website: <https://www.jason.tools>. Below this, there are four small buttons: Silver partner, Reseller partner, Asia, and Taiwan. At the bottom of the page, there are sections for 'Products' (Proxmox Virtual Environment, Proxmox Backup Server, Proxmox Mail Gateway, Downloads), 'Resources' (Community, Developers, Success Stories, Press Room), and a 'Newsletter' form with a checkbox for 'I agree with the terms and conditions *'.

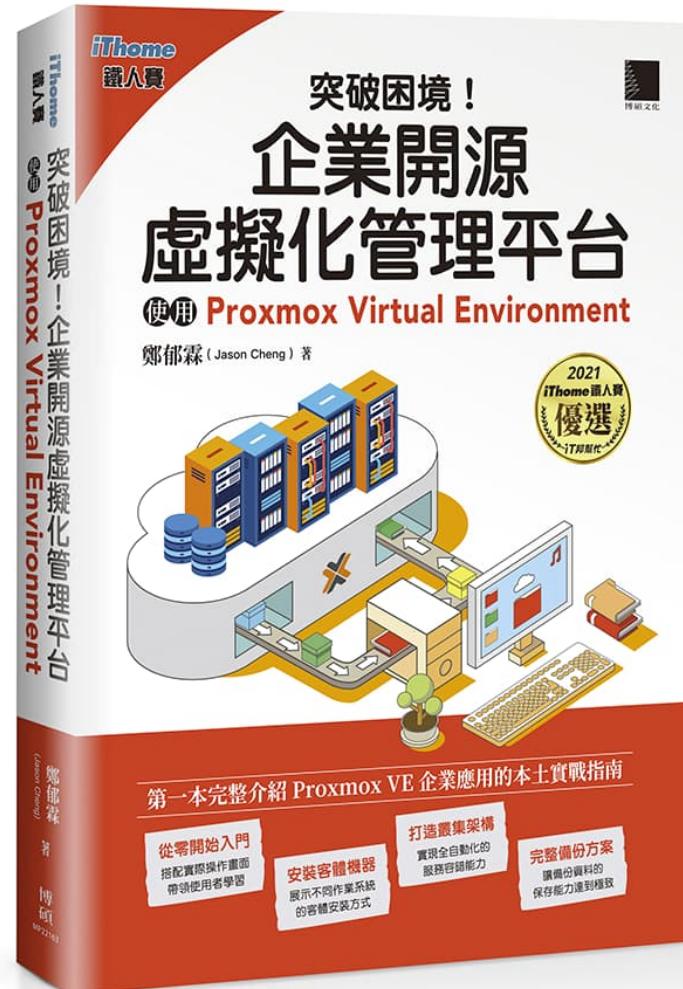


公司



節省工具箱

- 15年經驗萃取
- 首本繁中書籍
- 移交操作手冊





鄭
→



鄭郁霖

JASON CHENG



節省工具箱有限公司 / 創辦人兼技術總監

中華民國軟體自由協會 / 常務理事

耀達電腦、晟鑫科技、五倍紅寶石、豐康科技 / 技術顧問

資展國際、崑山科大推廣教育 / 講師

Proxmox VE 中文使用者社團 / 共同創辦人

2020, 2022 InfoSec Taiwan 台灣國際資安大會 / 講者

2020 COSCUP 開源人年會 / 講者

2019 OpenInfra Days Taiwan / 講者

2019, 2024, 2025 CyberSec Taiwan 台灣資安大會 / 講者

2018, 2019 國際資訊安全組織台灣高峰會 / 講者

CEH, ISO 27001 LA



功能概觀



好
用

系統特點

- 功能完整
- 網頁管理
- 叢集架構
- 開放源碼
- 不挑硬體
- 老牌穩定

自 2008 年至今

The screenshot shows the Proxmox Virtual Environment 8.2.2 web interface. The left sidebar lists hosts under '資料中心 (cluster1)': host-108, host-109, host-110, and host-111. Host host-111 is expanded to show numerous virtual machines (VMs) and containers (LXC). The main content area is divided into several sections:

- 健康狀況**: Status summary for cluster1, showing 5 healthy nodes and 0 disconnected nodes. A Ceph section indicates HEALTH_OK.
- 客體**: VM and LXC container statistics. VMs: 22 running, 61 stopped, 1 snapshot. LXC 容器: 26 running, 24 stopped.
- 資源**: Resource usage monitoring for CPU (37%), Memory (51%), and Storage (45%).
- 作業**: Task log table showing two recent backups:

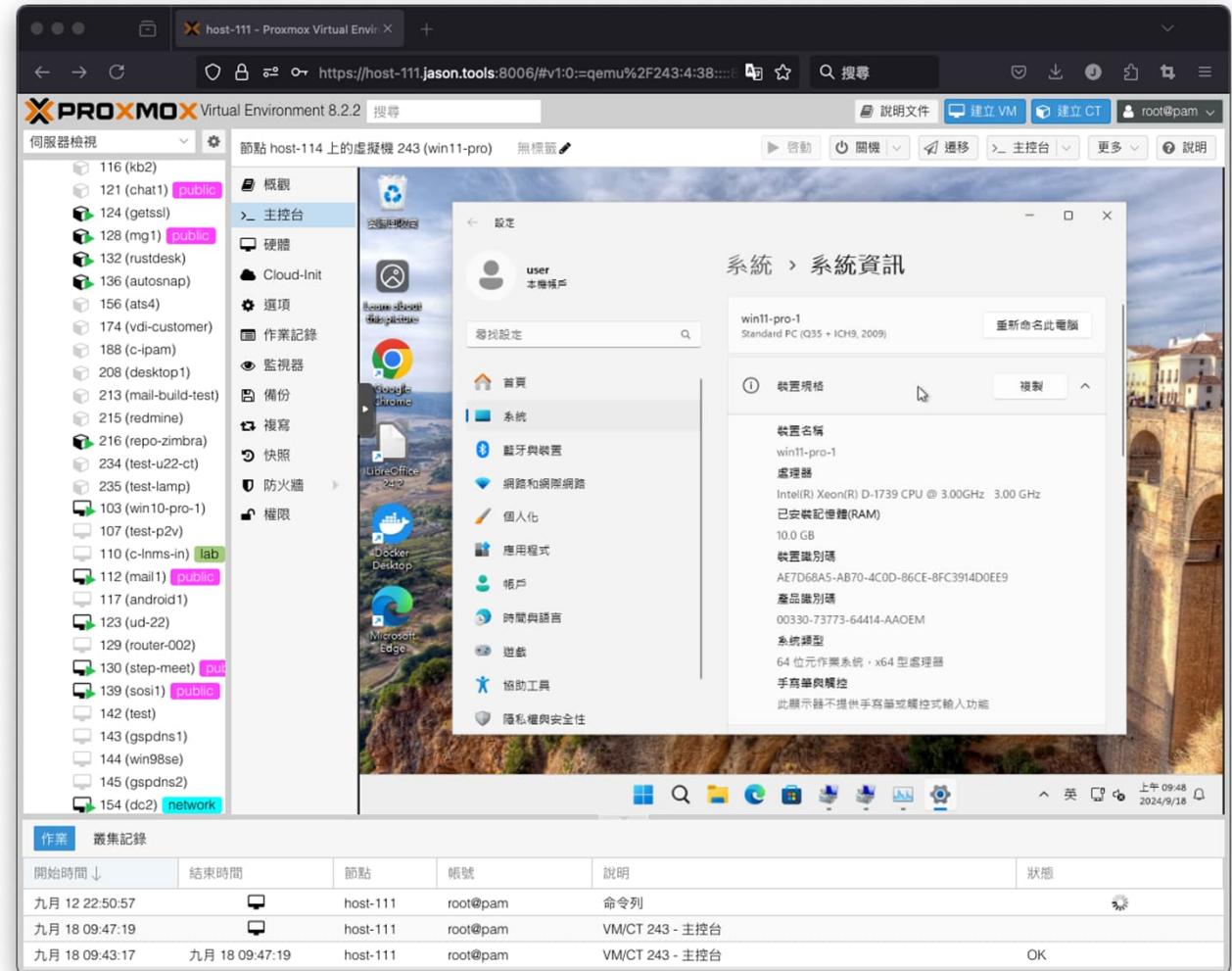
開始時間	結束時間	節點	帳號	說明	狀態
九月 08 20:00:11	九月 08 20:03:10	host-114	root@pam	備份作業	OK
九月 08 20:00:06	九月 08 20:00:42	host-110	root@pam	VM/CT 102 - 備份	OK



節省
工具箱

客體機

- 虛擬機 KVM
- 容器 LXC
- 主控台
- 線上遷移
- 硬體透通
- USB/GPU/PCI



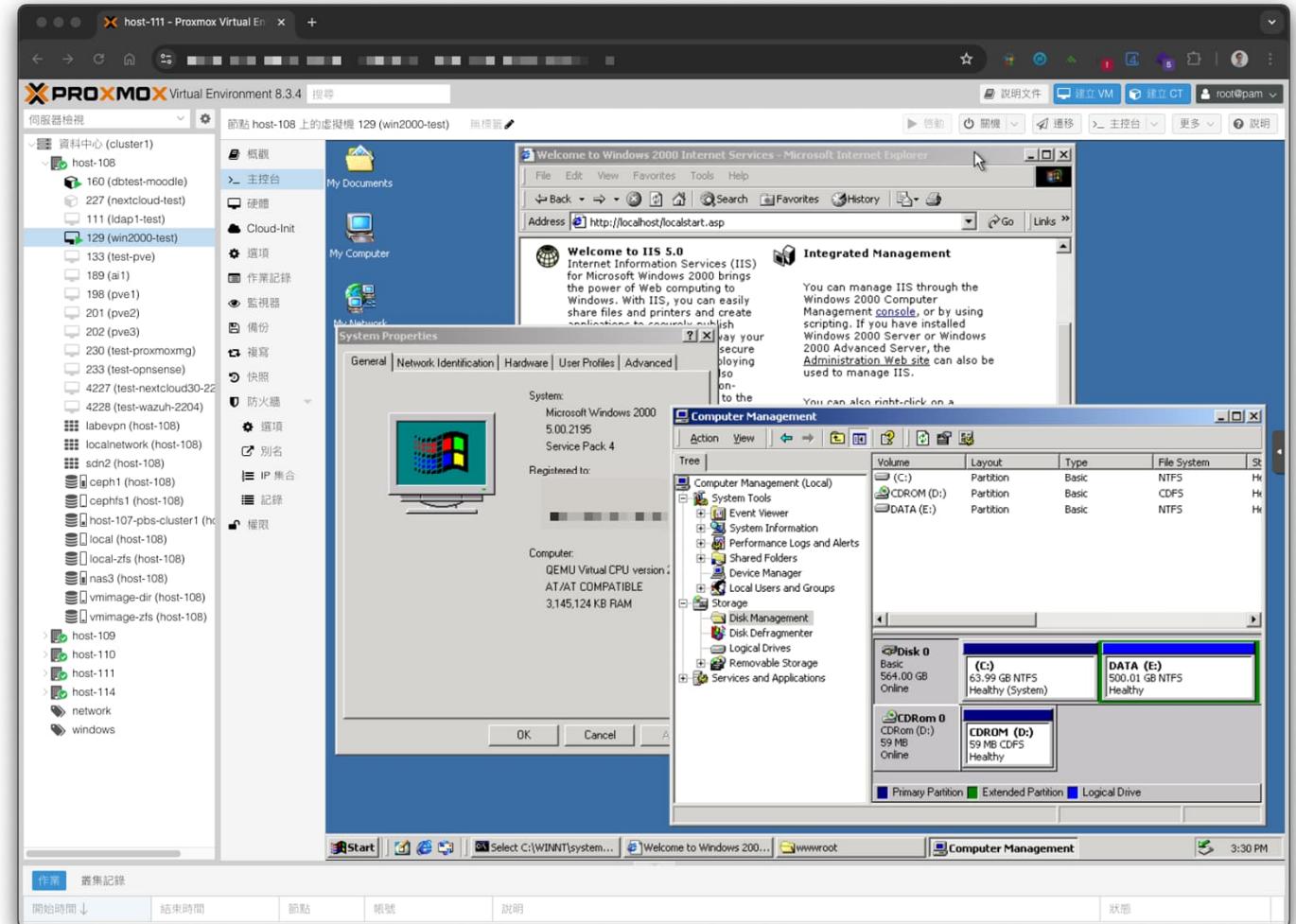
NVIDIA vGPU 18.0 起 Proxmox VE 已是官方認證平台



好設計

客體機

- 虛擬機 KVM
- 容器 LXC
- 主控台
- 線上遷移
- 硬體透通
- USB/GPU/PCI





存儲



本機儲存

共用儲存

分散式儲存

本機儲存

- 區塊 / 檔案級
ZFS
- 區塊級
LVM/LVM-Thin
- 檔案級
EXT4/XFS

狀態: vmimage

健康狀況: ONLINE

掃描: scrub repaired 0B in 04:57:57 with 0 errors on Sun Mar 13 05:22:03 2022

錯誤: No known data errors

名稱	健康狀況	READ	WRITE	CKSUM	訊息
vmimage	ONLINE	0	0	0	
raidz2-0	ONLINE	0	0	0	
/dev/disk/by-id/ata-HGST_HUST240... (1)	ONLINE	0	0	0	
/dev/disk/by-id/ata-HGST_HUST240... (2)	ONLINE	0	0	0	
/dev/disk/by-id/ata-HGST_HUST240... (3)	ONLINE	0	0	0	

開始時間	結束時間	節點	帳號	說明	狀態
四月 07 07:00:26		host-103	root@pam	命令列	
四月 09 05:26:43	四月 09 05:26:48	host-104	root@pam	更新套件資料庫	OK



節省
工具箱

共用儲存

- 區塊級
SAN/iSCSI
- 檔案級
NFS/CIFS

本機儲存

共用儲存

分散式儲存

容	路徑/目標	共用	啟用	頻寬限制	
ZDump 備份檔案	/opt/test	否	是		
碟映像, 容器		是	是		
O 映像, 容器範本	/mnt/pve/cep...	是	否		
port		否	否		
碟映像, 容器		否	否		
ZDump 備份檔案		是	否		
ZDump 備份檔案		是	是		
ZDump 備份檔案, 磁...	/var/lib/vz	否	是		
碟映像, 容器		否	是		
ZDump 備份檔案	/mnt/pve/nas1	是	否		
Proxmox Backup Server	ZDump 備份檔案	/mnt/pve/nas2	是	否	
ESXi	ZDump 備份檔案, IS...	/mnt/pve/nas3	是	是	
usb2-pve	Dir...	VZDump 備份檔案	/mnt/usb2/PVE	否	否
vmimage-dir	Dir...	VZDump 備份檔案, 磁...	/vmimage	否	是
vmimage-zfs	ZFS	磁碟映像, 容器		否	是

開始時間 ↓	結束時間	節點	帳號	說明	狀態
九月 08 20:00:11	九月 08 20:03:10	host-114	root@pam	備份作業	OK
九月 08 20:00:06	九月 08 20:00:42	host-110	root@pam	VM/CT 102 - 備份	OK



好
用



本機儲存

共用儲存

分散式儲存

分散式儲存

● 區塊級

Ceph (RBD)

● 檔案級

CephFS

The screenshot shows the Proxmox Virtual Environment 8.2.2 interface. The left sidebar lists hosts: host-108, host-109 (selected), host-110, host-111, host-112, host-114, network, and windows. The main content area is titled '節點 'host-109'' and shows the following information:

- 健康狀況**: Status is HEALTH_OK, Ceph 版本: 18.2.2, 沒有警告/錯誤.
- OSDs**: Total 16 OSDs, 16 In, 0 Out, 0 異線.
- PGs**: Total 193 PGs, all active+clean.
- 服務**: Monitors, Managers, and Relays sections, each showing hosts with green checkmarks.
- 作業**: Log viewer table with columns: 開始時間, 結束時間, 節點, 帳號, 說明, 狀態.



好
用

備份系統

掛接儲存區

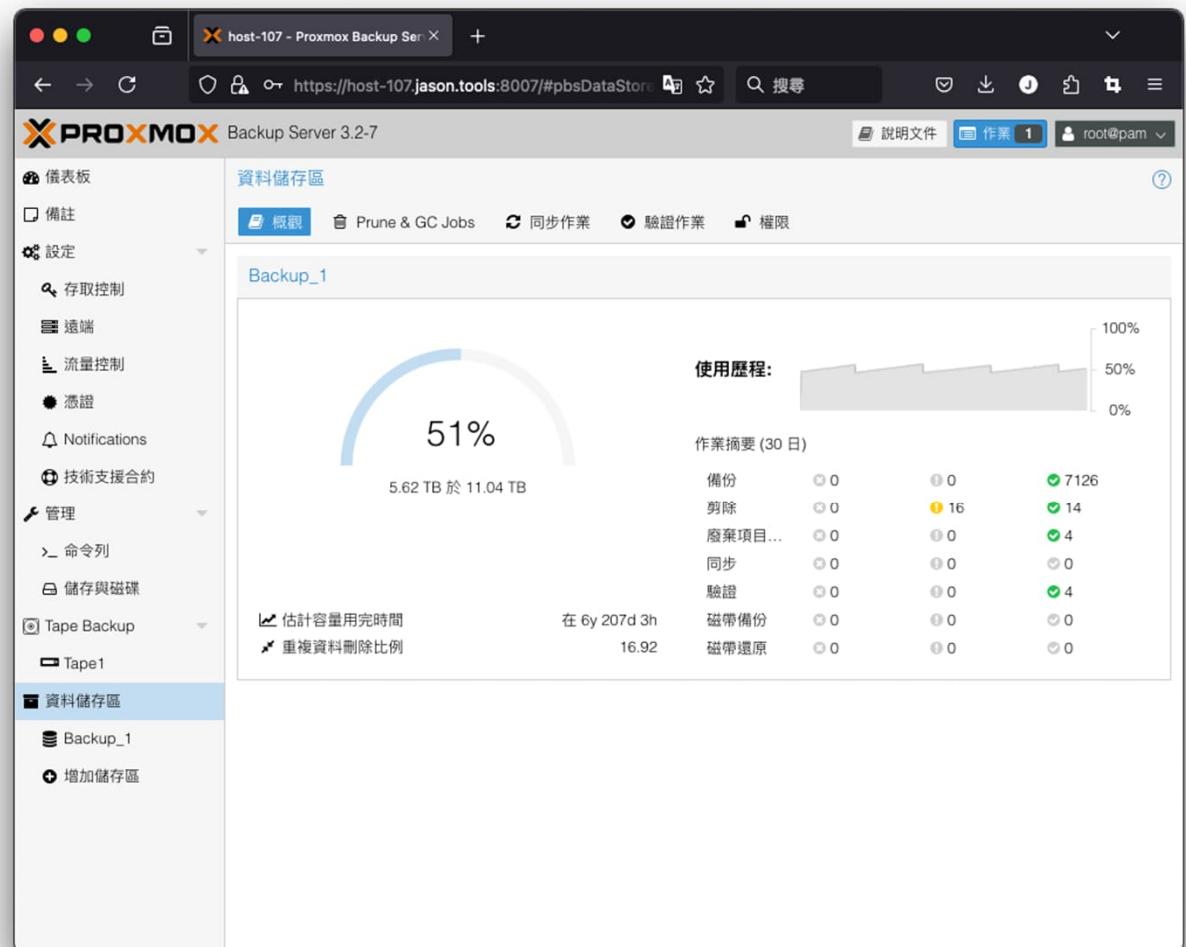
外部 NFS/CIFS
排程、完整備份、保留策略

原廠備份產品

Proxmox BS
排程、增量、壓縮、重複資料刪除
、加密、精細還原、即時還原、保
留策略...

其它商業產品

Veeam/Nakivo/Commvault/Acroni
s/
Vembu/Storware ...





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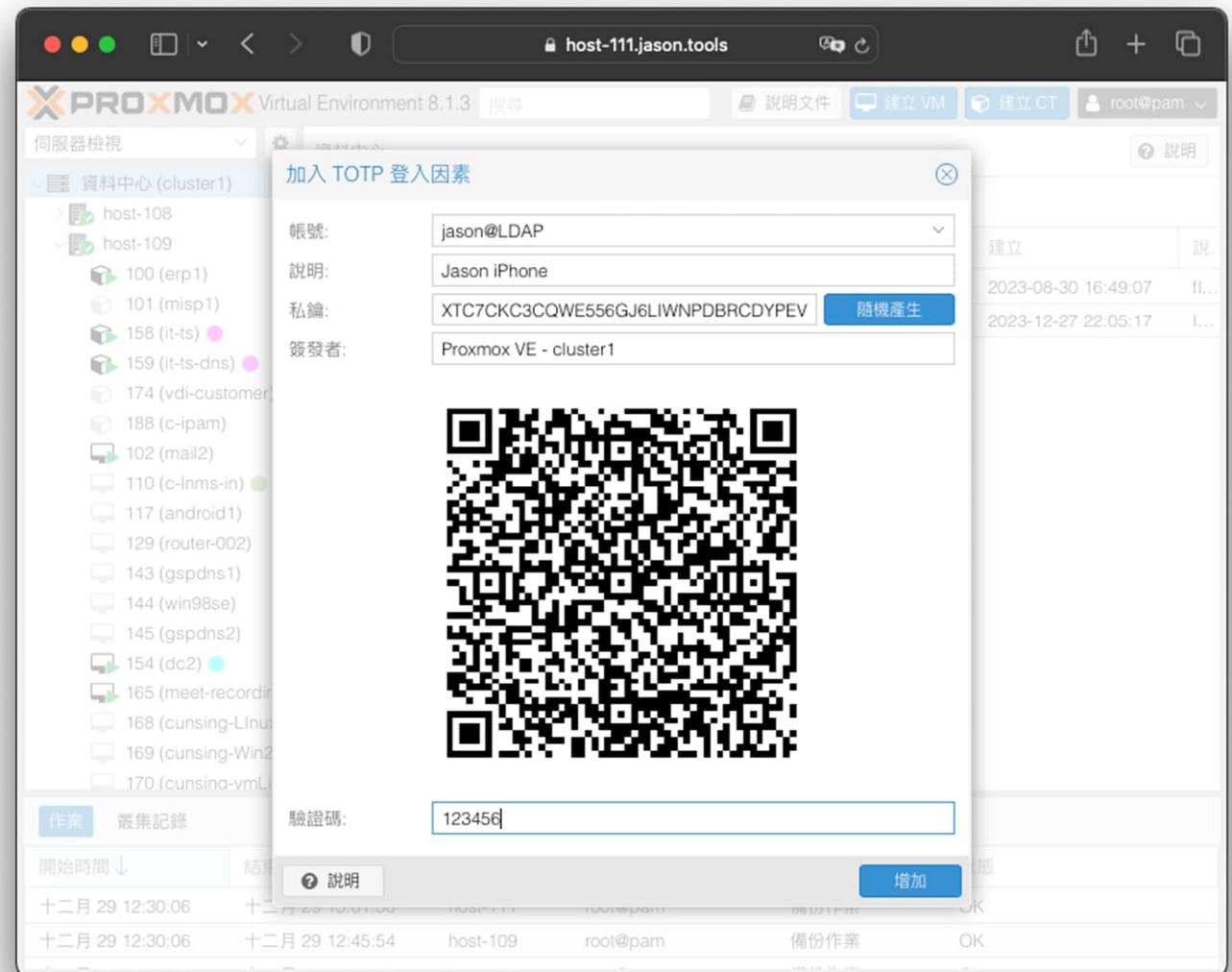
帳號安全

● 帳號認證

PAM / PVE
AD / LDAP
OpenID

● 雙因素認證

TOTP
Webauthn
Yubico OTP
Recovery Key





節省
工具箱

網路管理

- 網路組態
Bridge/Bond
- 虛擬區域網路
VLAN/VXLAN
- 防火牆
Node/Guest

伺服器檢視

資料中心 (cluster1)
host-101
100 (erp1)
115 (file1)
116 (kb2)
124 (getssl)
128 (mg1)
151 (photo1)
156 (ats4)
211 (meet)
108 (ats5)
109 (ceph1)
110 (ceph2)
111 (ceph3)
117 (ceph4)
119 (ucs-test)
144 (siem1)
154 (dc2)
166 (mon5)
203 (log2)
labevpn (host-101)
homedata-zfs (host-101)
host-107-pbs (host-101)
local (host-101)
local-zfs (host-101)
mylove2-nas (host-101)

節點 host-101 上的容器 128 (mg1)

... 類別 動作 巨集 介面 協定 來源位址 來源連... 目標位址	tcp	udp	+lan_mon_log	+lan_getssl	+lan_siem	+mail_service	+lan_trust
0 1 2 3 4 5 6	<input checked="" type="checkbox"/> out ACCEPT						

作業

開始時間 ↓	結束時間	節點	帳號	說明	狀態
四月 07 07:00:26		host-103	root@pam	命令列	OK
四月 09 05:26:43	四月 09 05:26:48	host-104	root@pam	更新套件資料庫	OK



好
用

持續營運

- 快照 / 倒回
- 備份 / 還原
- 複寫 / 副本
- 高可用性

The screenshot shows the Proxmox VE 7.1-12 interface. The left sidebar displays a tree view of hosts and their virtual machines. The main panel shows a table of backup history for host-104's VM 102 (mail2). The table includes columns for name, date, format, size, encryption, and status. Below the table, there are tabs for '作業' (Tasks) and '叢集記錄' (Cluster Log), with one task listed.

名稱	日期	格式	大小	加密	驗證狀態
vm/102/2022-04-08T18:00:30Z	2022-04-09 02:00:30	pbs-vm	64.42 GB	否	完成
vm/102/2022-04-07T18:00:23Z	2022-04-08 02:00:23	pbs-vm	64.42 GB	否	完成
vm/102/2022-04-06T18:00:33Z	2022-04-07 02:00:33	pbs-vm	64.42 GB	否	完成
vm/102/2022-04-05T18:00:23Z	2022-04-06 02:00:23	pbs-vm	64.42 GB	否	完成
vm/102/2022-04-04T18:00:24Z	2022-04-05 02:00:24	pbs-vm	64.42 GB	否	完成
vm/102/2022-04-03T18:00:20Z	2022-04-04 02:00:20	pbs-vm	64.42 GB	否	完成
vm/102/2022-04-02T18:00:21Z	2022-04-03 02:00:21	pbs-vm	64.42 GB	否	完成
vm/102/2022-04-01T18:00:21Z	2022-04-02 02:00:21	pbs-vm	64.42 GB	否	完成
vm/102/2022-03-31T18:00:20Z	2022-04-01 02:00:20	pbs-vm	64.42 GB	否	完成
vm/102/2022-03-30T18:00:23Z	2022-04-01 02:00:20	pbs-vm	64.42 GB	否	完成
vm/102/2022-03-29T18:00:20Z	2022-04-01 02:00:20	pbs-vm	64.42 GB	否	完成
vm/102/2022-03-28T18:00:22Z	2022-04-01 02:00:20	pbs-vm	64.42 GB	否	完成
vm/102/2022-03-27T18:00:21Z	2022-04-01 02:00:20	pbs-vm	64.42 GB	否	完成
vm/102/2022-03-26T18:00:20Z	2022-04-01 02:00:20	pbs-vm	64.42 GB	否	完成
vm/102/2022-03-25T18:00:21Z	2022-04-01 02:00:20	pbs-vm	64.42 GB	否	完成
vm/102/2022-03-24T18:00:17Z	2022-04-01 02:00:20	pbs-vm	64.42 GB	否	完成
vm/102/2022-03-23T18:00:19Z	2022-04-01 02:00:20	pbs-vm	64.42 GB	否	完成
vm/102/2022-03-22T18:00:20Z	2022-04-01 02:00:20	pbs-vm	64.42 GB	否	完成
vm/102/2022-03-21T18:00:37Z	2022-04-01 02:00:20	pbs-vm	64.42 GB	否	完成
vm/102/2022-03-20T18:00:24Z	2022-04-01 02:00:20	pbs-vm	64.42 GB	否	完成

作業

開始時間	結束時間	節點	帳號	說明	狀態
四月 07 07:00:26		host-103	root@pam	命令列	OK
四月 09 05:26:43	四月 09 05:26:48	host-104	root@pam	更新套件資料庫	OK



工具箱

節點安全

- 端點防護
- EDR / XDR
- CrowdStrike
- SentinelOne
- Trend Micro
- TeamT5
- Wazuh

皆可正常運作

The Open Source Security Platform

Unified XDR and SIEM protection for endpoints and cloud workloads.

Install Wazuh Free Cloud Trial

LINK Telefónica Globant ebay Rappi NASA

Endpoint and Cloud Workload Protection

Wazuh unifies historically separate functions into a single agent and platform architecture. Protection is provided for public clouds, private clouds, and on-premise data centers.

Endpoint Security

- Configuration Assessment
- Malware Detection

Threat Intelligence

- Threat Hunting
- Log Data Analysis

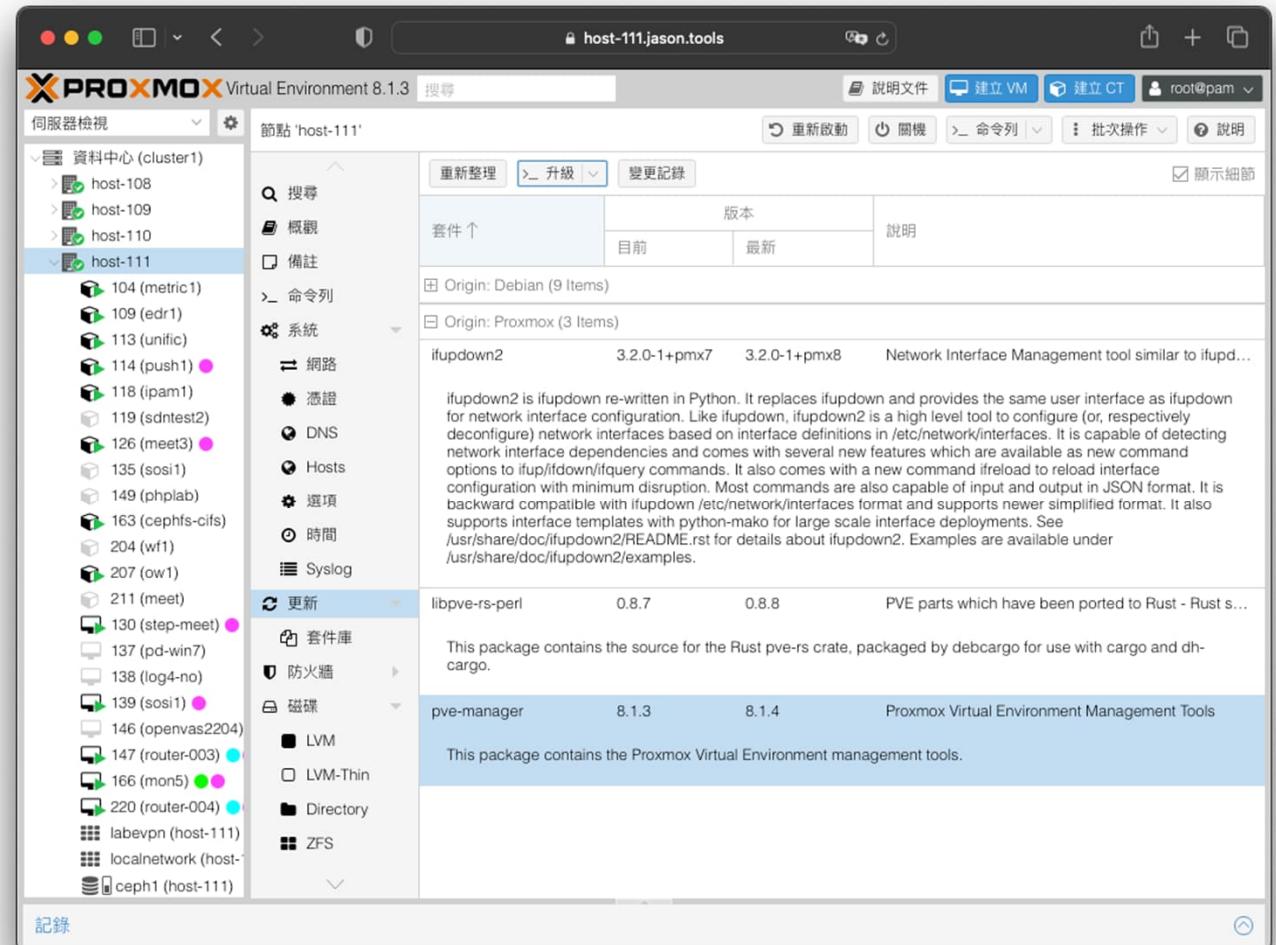


好用

安全更新

- 滾動更新
- 修補快速
- 操作容易
- 一鍵升級
- 無需停機

註：大版本除外

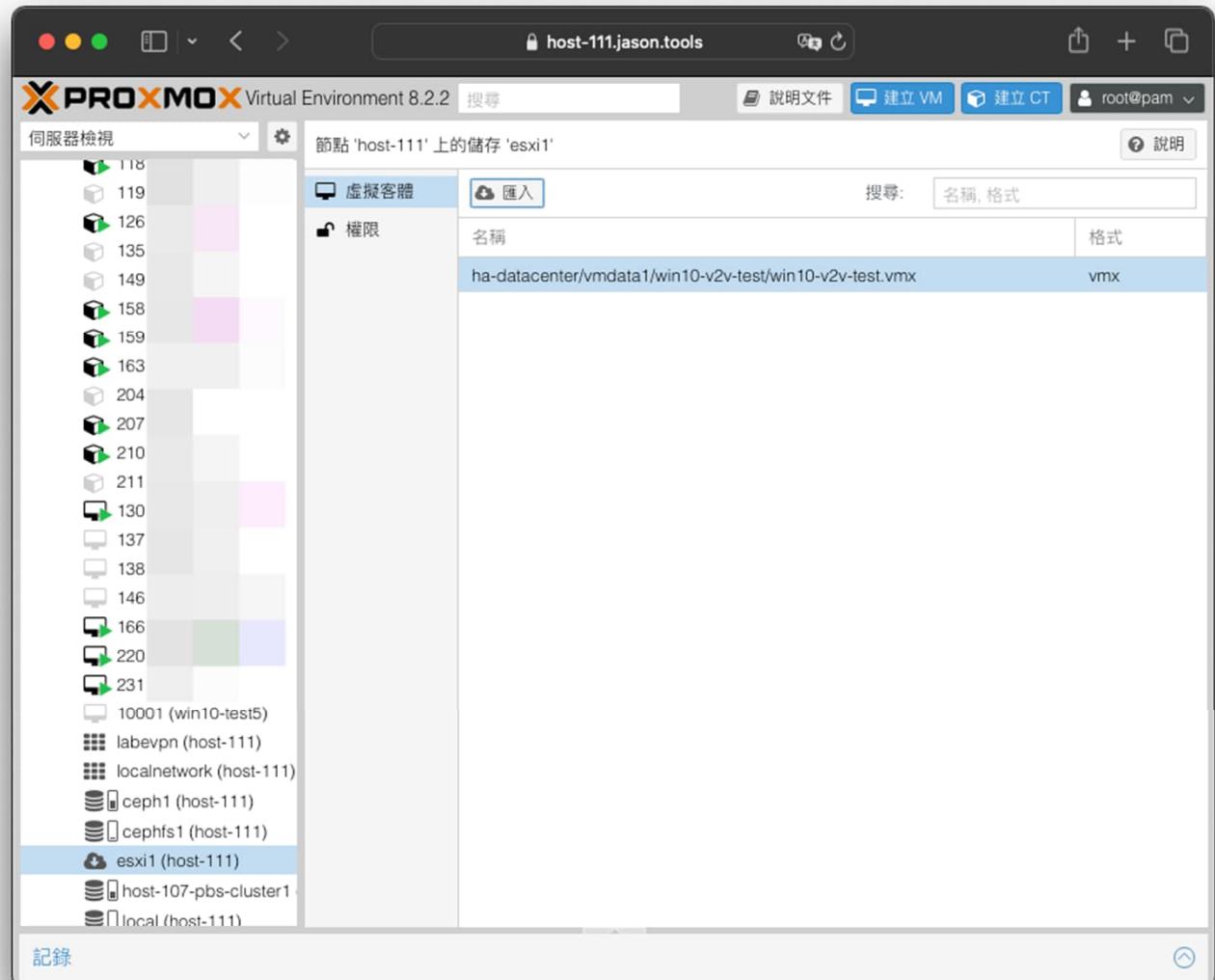




好
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系統移轉

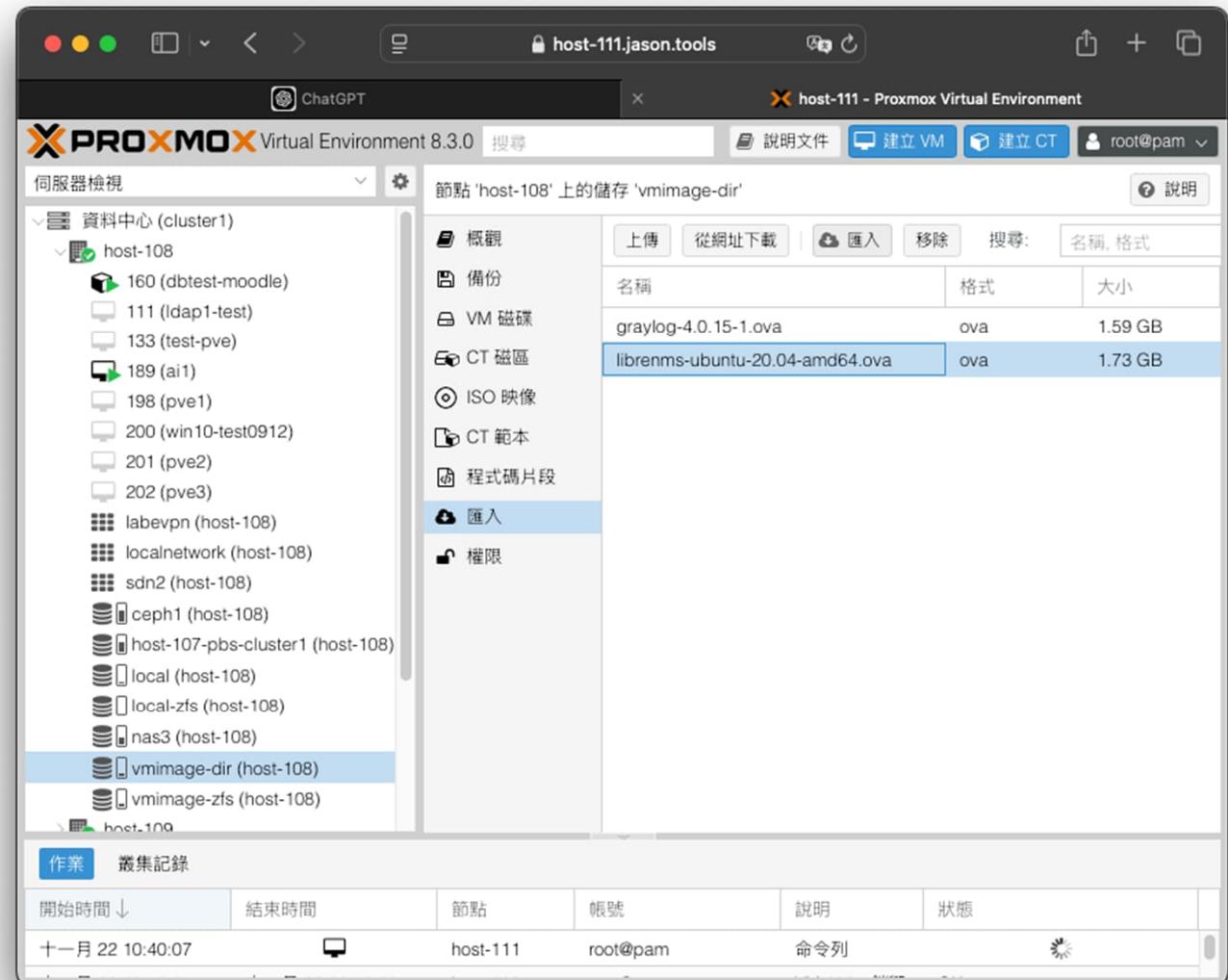
- 圖形介面
- 簡單點選
- ESXi 汇入





好
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- # 系統移轉
- 圖形介面
 - 簡單點選
 - OVA 汇入





節省
工具箱

系統移轉

僅需圖型介面點選，操作簡單無痛移轉

直接匯入



上傳匯入



中轉匯入



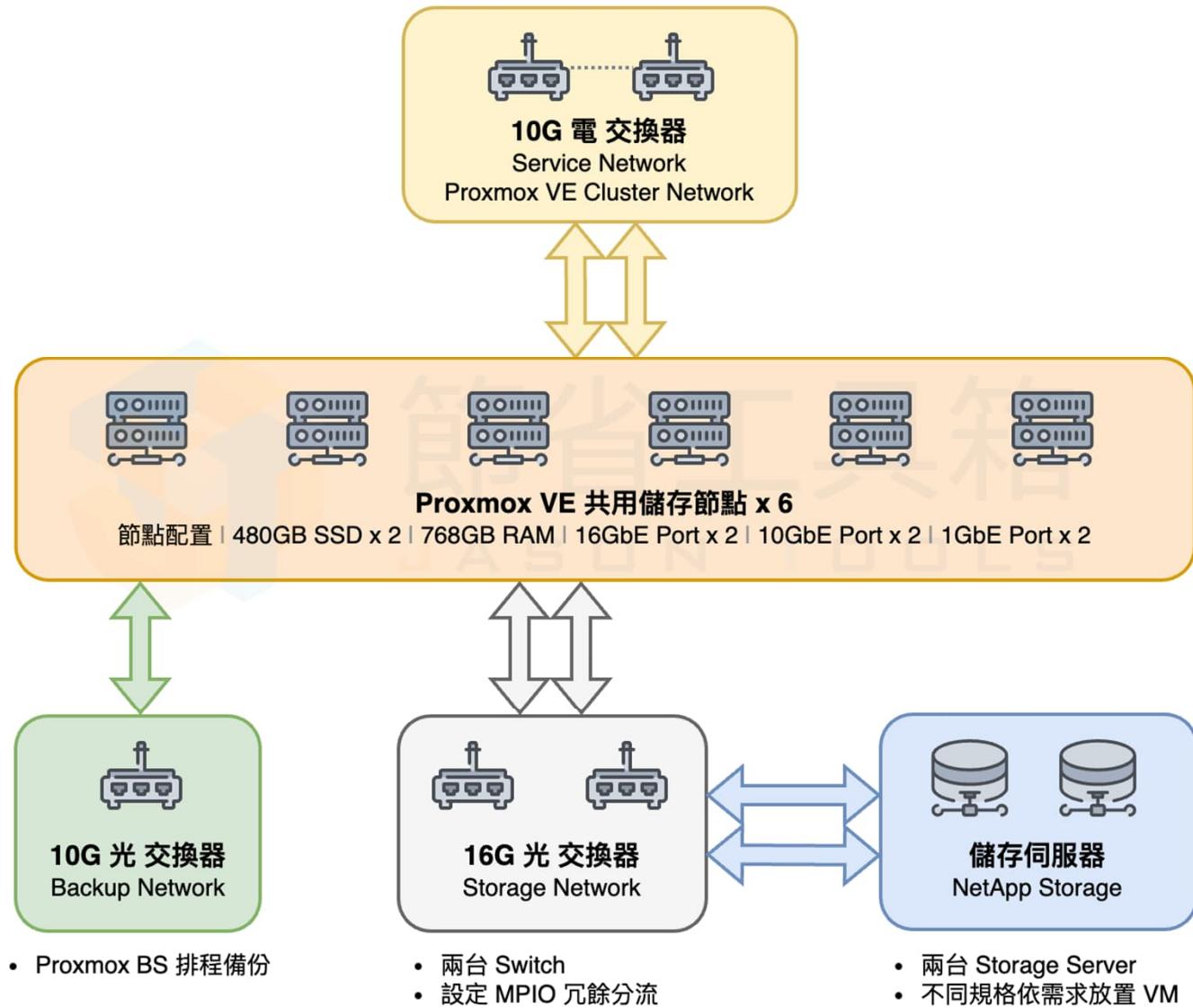


架構規劃



實際案例

- 共用式架構
醫療院所
線上服務





產品比較



比較指標	Proxmox VE	Nutanix	VMware vSphere	Microsoft Hyper-V	備註
虛擬機	✓	✓	✓	✓	
容器	✓	✓	✓		PVE 採用 LXC VMware 需另購 Tanzu
快照	✓	✓	✓	✓	
備份	✓	✓		✓	PVE 內建整合 PBS 備份伺服器
叢集	✓	✓	✓	✓	
高可用	✓	✓	✓	✓	
線上遷移	✓	✓	✓	✓	
異機複寫	✓	✓	✓	✓	
硬體相容彈性	✓	NG	NG	✓	ESXi 需 HCL，Nutanix 特定硬體
分散式檔案系統	✓	✓	✓	✓	Hyper-V 需加購 SCVMM
開放原始碼	✓				
價格費用	💰	💰💰💰💰💰	💰💰💰💰💰	💰💰💰	

● 本表內容依據網路資訊整理，如有錯誤敬請不吝指正。



開源方案比較



比較指標	Proxmox VE	OpenStack	OKD	XCP-ng	備註
虛擬機	✓	✓	✓	✓	XCP-ng 採用 XEN，其餘皆為 KVM
容器	✓	✓	✓		PVE & OpenStack 採用 LXC OKD 採用 Podman
快照	✓	✓	✓	✓	
備份	✓	✓	✓	✓	
叢集	✓	✓	✓	✓	
高可用	✓	✓	✓	✓	
線上遷移	✓	✓	✓	✓	
異機複寫	✓	✓	✓	✓	OpenStack & OKD 需要搭配外掛
雲原生平台		✓	✓		OpenStack & OKD 適用超大規模
分散式檔案系統	✓	✗	✗	✗	PVE 可統一管理，其餘僅純掛接
維運容易程度	😎	😱	😱	😱	
商業支援版本	\$	\$ \$ \$ \$ \$	\$ \$ \$ \$ \$	\$ \$ \$ \$	OKD 商業支援需改用 OCP

● 本表內容依據網路資訊整理，如有錯誤敬請不吝指正。



擴充整合



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NetApp 整合

- 自主開發
節省工具箱技術開發
- 正確容量
原生機制
- FC SAN
- iSCSI

The screenshot displays two windows side-by-side. The top window is the 'PROXMOX Virtual Environment 9.1.4' interface, showing a tree view of storage resources under '資料中心 (cluster1)'. One item, 'netapp1 (pc-pve2)', is selected and highlighted in blue. The bottom window is the 'ONTAP System Manager - na_cluster' interface, showing an 'Overview' of the 'na_cluster_0...' cluster. It provides details like Status (Online), Node (na_cluster-01), Type (HDD (10 disks)), RAID (RAID-DP), and Capacity (633 MiB Used and reserved, 6.41 GiB Available, 13.4 GiB Committed). A red box highlights the capacity information in the ONTAP interface.



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NetApp 整合

- 當地快照
- 原生機制
- 介面同步
- 高效完成

The screenshot displays two browser windows side-by-side, illustrating the integration of NetApp storage management with a virtualization environment.

Top Window (Proxmox VE 9.1.4): This window shows the "Virtual Environment" interface. A red box highlights the "Snapshots" tab under the "107 (gg)" VM details. The table lists two snapshots:

名稱	記...	日期/狀態	說明
kkk	是	2026-01-03 23:05:00	
os_install_ok	否	2026-01-13 07:47:27	

Bottom Window (ONTAP System Manager): This window shows the "Snapshots" tab for the "pve_n..." volume. A red box highlights the snapshot table. The table lists two snapshots:

Name	Snapshot creation time	Snapshot restore size
pve_snap_os_install_ok	Jan/13/2026 7:47 AM	428 KIB
pve_snap_kkk	Jan/3/2026 11:05 PM	316 KIB



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AI 整合

MCP 開發

已驗證 Claude Desktop
已驗證 Open-WebUI + mcpo

客體操作

建立/遷移/開機/關機

設定檢查

資料統計

效能分析

The screenshot displays the 'VM Firewall Rule Audit' application. At the top, there's a summary dashboard with four boxes: 17 VMs/容器數, 11 運行中, 6 已停止, and 3 安全風險. Below this is a '安全警示' (Security Alert) section with three items: '高風險: VM 139 (sosi1) 防火牆已停用, 且有未啟用的 SSH 規則來自公網 IP 203.74.122.229-234', '中風險: VM 167 (vdi2) 所有防火牆規則都已停用, 包括管理群組規則', and '注意: VM 115 (file1) 防火牆選項配置為空, 建議檢查防火牆設定'. The main area shows detailed audit reports for four VMs: log3 (VM 128), vdi2 (VM 167), push2 (VM 155), and sosi1 (VM 139). Each report lists rules by type (IN/OUT), action (DROP, ACCEPT), source/destination, port, and status (Enabled, Disabled).

範例：所有 VM 客體機防火牆規則檢查設定與分析



機
器
人

AI 整合

MCP 開發

已驗證 Claude Desktop
已驗證 Open-WebUI + mcpo

客體操作

建立/遷移/開機/關機

設定檢查

資料統計

效能分析

The image shows two side-by-side screenshots. On the left is a dark-themed terminal window titled 'Proxmox VE Server Management Script Enhancement'. It displays AI-generated commands for managing Wazuh and LibreNMS agents across VMs and containers. On the right is a light-themed web-based monitoring dashboard titled 'Proxmox VE 監控狀態分析'. This dashboard provides a summary of monitored hosts, highlighting 53 running hosts, 27 hosts not managed by Wazuh (requiring agent installation), and 29 hosts not managed by LibreNMS (requiring SNMP configuration). A detailed table lists each host's type, VMID, name, status, and recommended action.

類型	VMID	名稱	狀態	建議行動
VM	203	graylog5-customer	Running	需安裝 WAZUH AGENT
VM	225	push-customer	Running	需安裝 WAZUH AGENT
VM	167	vdi2	Running	需安裝 WAZUH AGENT
VM	228	pdm1	Running	需安裝 WAZUH AGENT
VM	125	log3	Running	需安裝 WAZUH AGENT
VM	165	meet-recording2	Running	需安裝 WAZUH AGENT
VM	147	router-003	Running	需安裝 WAZUH AGENT
VM	169	win10-test-0613	Running	需安裝 WAZUH AGENT
VM	148	log4	Running	需安裝 WAZUH AGENT
CT	161	dnspl	Running	需安裝 WAZUH AGENT
CT	113	unific	Running	需安裝 WAZUH AGENT

範例：所有 VM 客體機被 LibreNMS 與 Wazuh 監控納管分析



結束

謝謝您。

節省工具箱有限公司
企業應用開源軟體方案導入專家

