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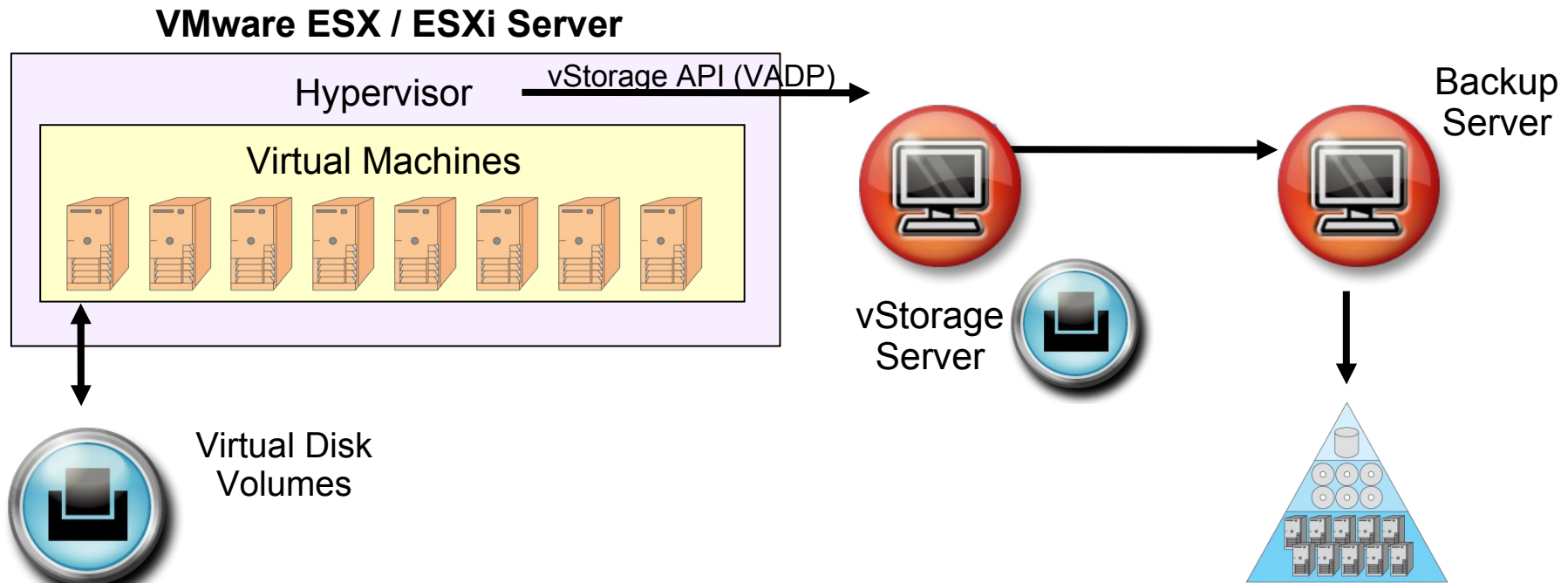
Tivoli Storage Manager for Virtual Environments

Technical Overview



The new approach: VMware vStorage APIs for Data Protection

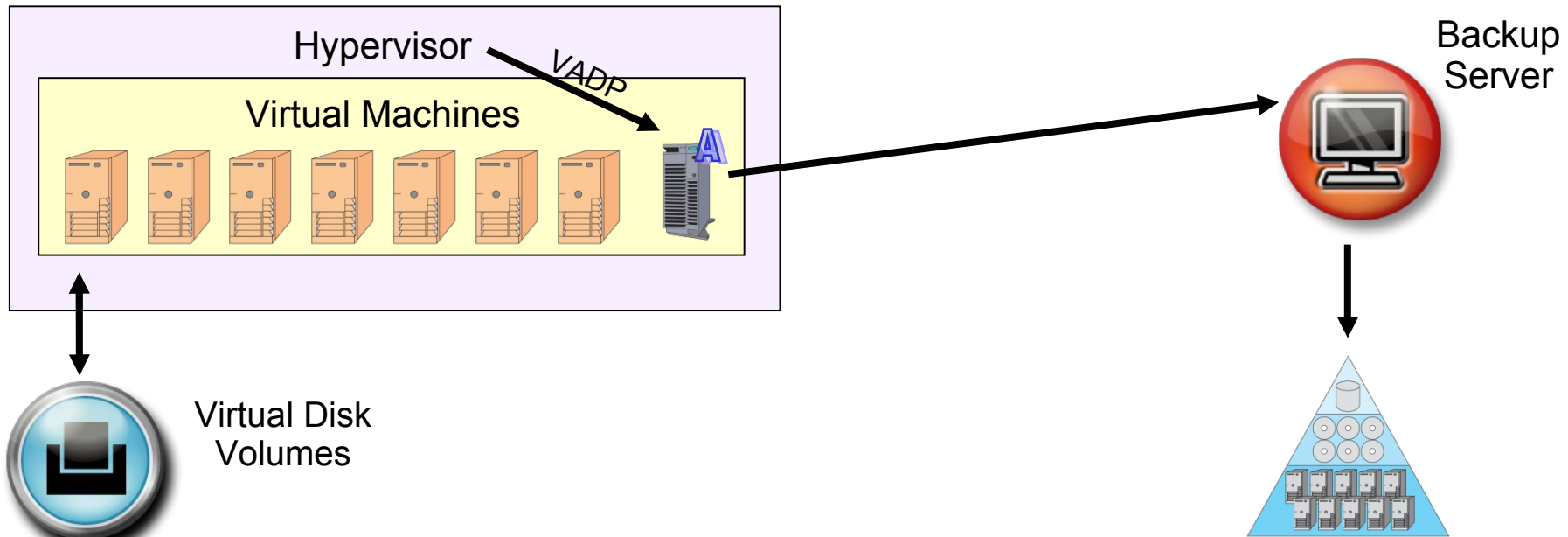
- Data is accessed directly from the VM storage and passed directly to the backup server (single hop, data is not stored on the vStorage Server)
- Changed Block Tracking allows incremental backups (with periodic fulls) without forcing a scan of the guest OS file system



The new approach: VMware vStorage APIs for Data Protection

- Data is accessed directly from the VM storage and passed directly to the backup server (single hop, data is not stored on the vStorage Server)
- Changed Block Tracking allows incremental backups (with periodic fulls) without forcing a scan of the guest OS file system
- The vStorage Server can be a virtual machine – no additional HW needed

VMware ESX / ESXi Server



Tivoli Storage Manager for Virtual Environments - Summary

- Advanced data protection for VMware ESX and ESXi servers
- Leverages vStorage APIs for Data Protection (VADP)
- Non-disruptive, single-pass, block-level backup
- Flexible recovery options: file, volume, VM image
- Near-instant restore of files and disk volumes (Windows and Linux)
- No additional hardware required
- Simplified agent management – one agent supports multiple VMs
- Automated discovery of new VMs
- Support for LAN-free data transfer from the VMware server's storage to the backup server —preserving bandwidth for other uses
- Integrated with Tivoli Storage Manager for:
 - Unmatched scalability – manage up to 2 billion objects in a single TSM Server
 - Unified Recovery Management
 - Built-in data reduction / data deduplication
 - Policy-based tiered storage / data lifecycle management



Benefits of VMware-TSM Integration

- Integrated supported product-based solution to protecting VMware with TSM
- Fast online (hot) backup into TSM
- ‘Near Zero Impact Backup’ on ESX Servers by using proxy backup server
- Coordinated backup of multiple virtual machines into TSM
- Management of virtual machine backup data in TSM
- Live user-transparent file-level restore from within running virtual machine
- Disaster Recovery from TSM via Full-VM restore*

*Not to confuse with TSM B/A Client Image level backup which works on volume basis and is not used

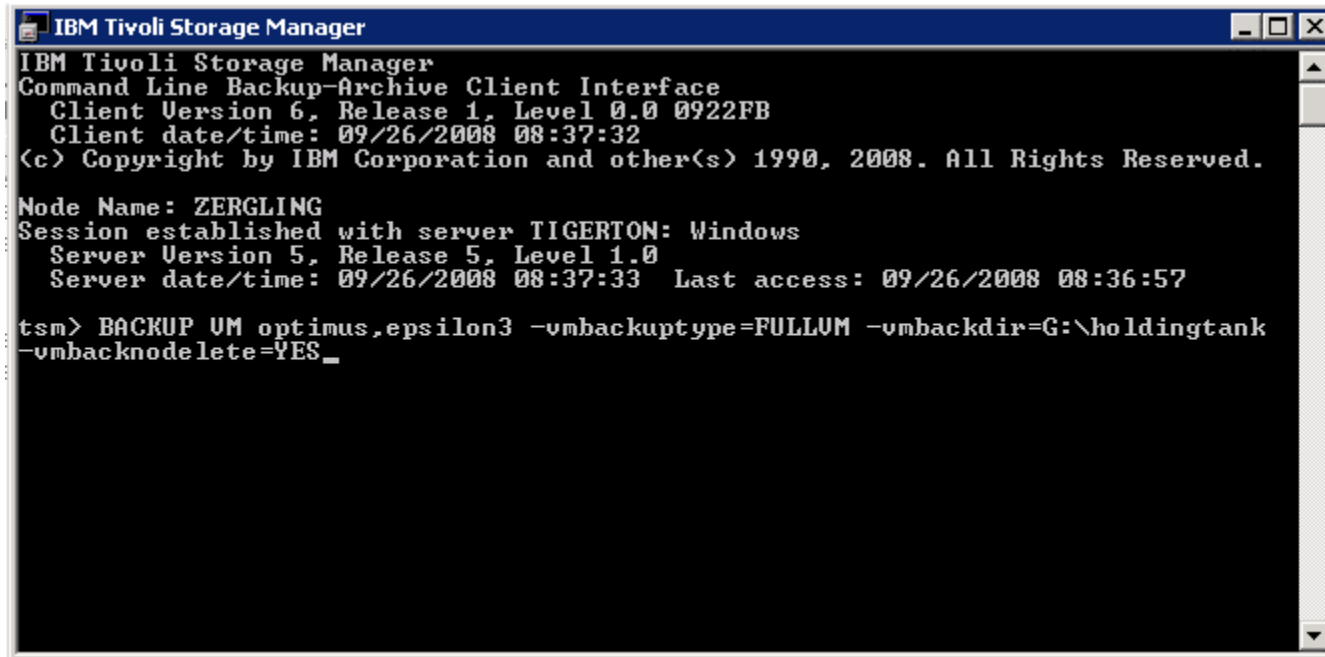


Introduced in TSM 6

- Full VM backup/restore integrated in TSM
 - Command Line: TSM Full VM backup
 - GUI: Action -> Restore
- VMware Backup/Restore integrated in TSM Client GUI
- vStorage API File Level Backup:
 - TSM 6.2 supports vStorage API File-Level Backups
- Exports are broken into 2 GB file chunks
 - TSM Client backs up chunks at a file level
 - Size is tunable (2 GB is default for subfile level backup)
- Enhanced password management
- ESX Server has no service console
 - TSM Linux client based backups are no option anymore



TSM 6 Command line options



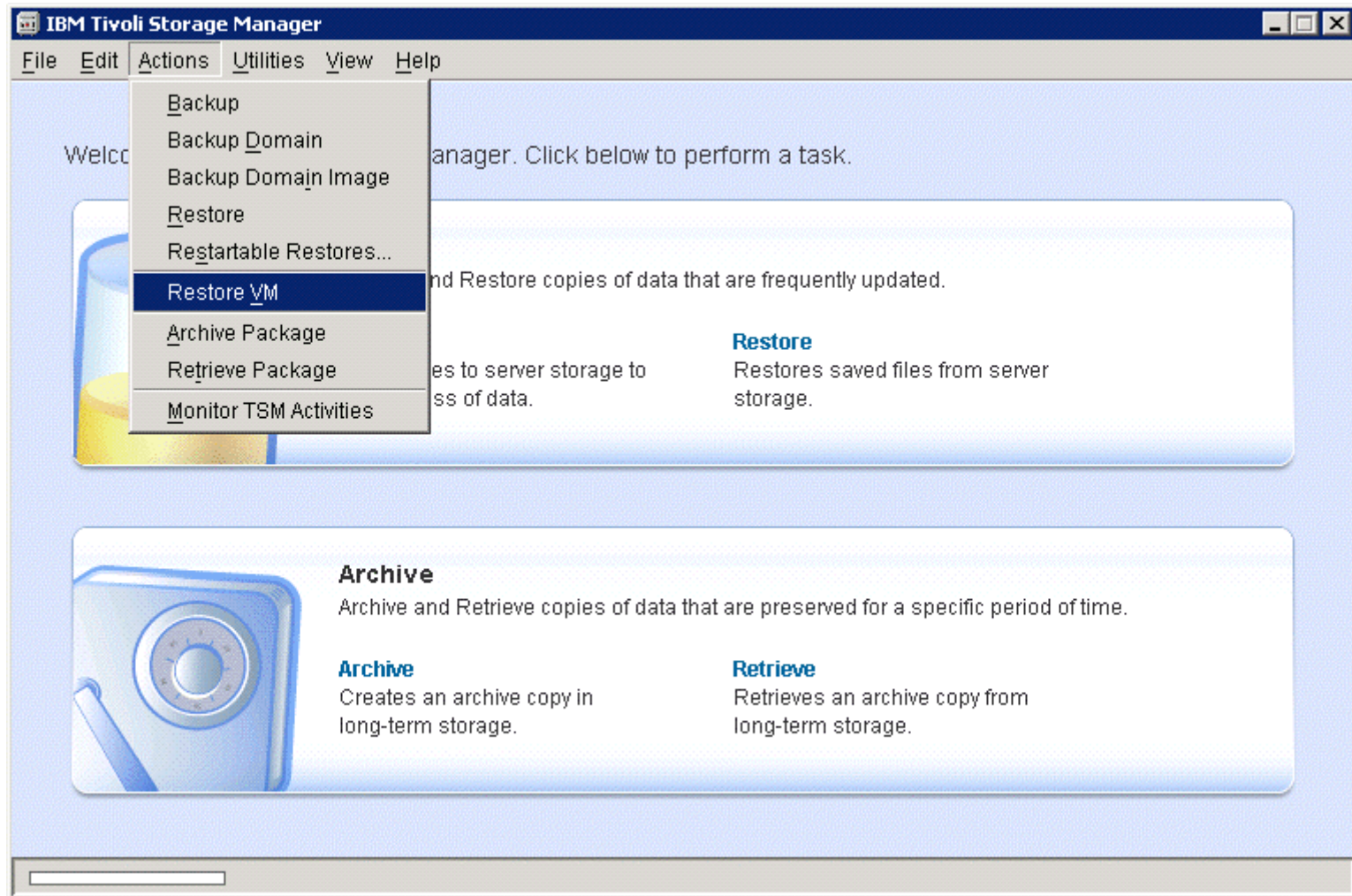
```
IBM Tivoli Storage Manager
Command Line Backup-Archive Client Interface
  Client Version 6, Release 1, Level 0.0 0922FB
  Client date/time: 09/26/2008 08:37:32
(c) Copyright by IBM Corporation and other(s) 1990, 2008. All Rights Reserved.

Node Name: ZERGLING
Session established with server TIGERTON: Windows
  Server Version 5, Release 5, Level 1.0
  Server date/time: 09/26/2008 08:37:33  Last access: 09/26/2008 08:36:57

tsm> BACKUP UM optimus,epsilon3 -vmbackuptype=FULLUM -vmbackdir=G:\holdingtank
-vmbacknodelete=YES_
```



TSM VMware Restore integrated in TSM GUI



TSM VM Selection

Restore Virtual Machine

File Edit View Help

Restore

Options

Point In Time

ZERGLING

Virtual Machines

bud

classic

coors

drone

droneclone10

droneclone11

droneclone18

droneclone19

droneclone7

droneclone8

droneclone9

epsilon3

europa

ganymede

hydralisk

longhorn

mgd

mini

mutalisk

optimus

vmsolx86

VM	Name	VM Hostname	Backed Up	Host Server	Size	VM Id
<input type="checkbox"/> hydralisk	win2003r2 - hydralisk	hydralisk	09/25/2008 03:32:34	odin.storage.usca.ibm.com	769.24 MB	502a193b-d5fa-f4a6-3acd-2bea069d93fb
<input checked="" type="checkbox"/> hydralisk	win2003r2 - hydralisk	hydralisk	09/26/2008 04:55:44	odin.storage.usca.ibm.com	770.54 MB	502a193b-d5fa-f4a6-3acd-2bea069d93fb

Object: hydralisk



TSM 6 Search and Filter VMs

Find Files (Restore)

File Edit View Actions Help

What to Search

Virtual Machines

Search All Objects

Start Path

ZERGLING

Object Name

any name

Search Options

Date

Size

Search...

Filter

Search Results

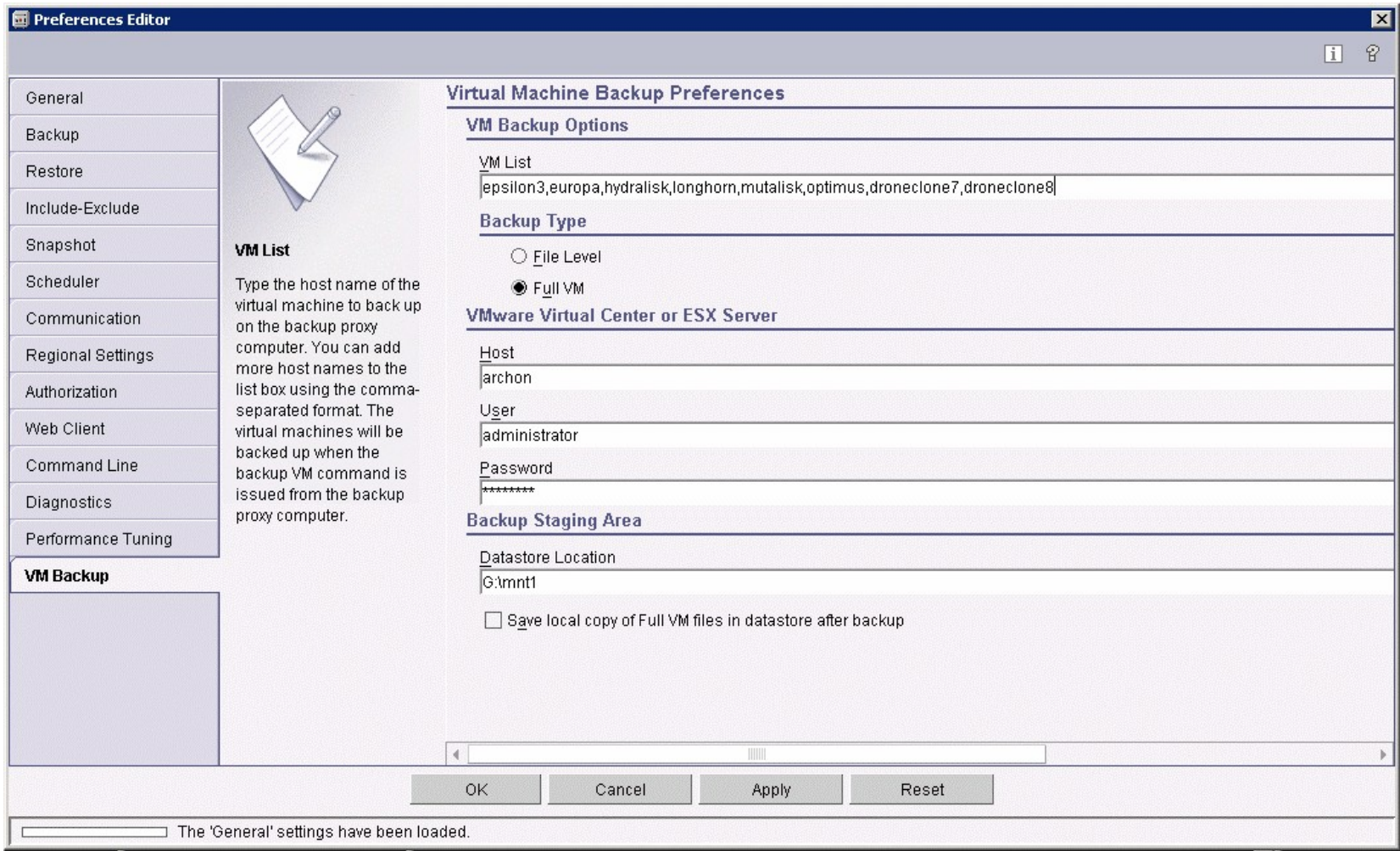
21 matches underneath ZERGLING

	Name	Name	VM Hostname	Backed Up	Host Server	Size	
<input type="checkbox"/>	mgd	win2003x64r2 - mgd	mgd	09/25/2008 04:02:48	dora.storage.usca.ibm.com	3.62 GB	501ad68d-52ea-
<input type="checkbox"/>	longhorn	win2008x64 - longhorn	longhorn	09/24/2008 04:30:48	dora.storage.usca.ibm.com	3.86 GB	502a57d8-6475-
<input type="checkbox"/>	ganymede	win2008x64 - ganymede	ganymede	09/25/2008 07:00:59	dora.storage.usca.ibm.com	2.1 GB	50122729-271f-
<input type="checkbox"/>	europa	win2008x64 - europa	europa	09/26/2008 02:41:14	dora.storage.usca.ibm.com	2.02 GB	501226af-4f85-1
<input type="checkbox"/>	coors	win2003x64r2 - coors	coors	09/26/2008 01:14:24	dora.storage.usca.ibm.com	720.33 MB	501aebd4-23a3-
<input type="checkbox"/>	bud	win2003x64r2 - bud	bud	09/26/2008 00:23:57	dora.storage.usca.ibm.com	3.46 GB	501aa08b-0478-
<input type="checkbox"/>	vmsolx86	sol10 - vmsolx86	vmsolx86	09/23/2008 11:28:13	odin.storage.usca.ibm.com	677.44 MB	501af5e8-8eec-4
<input type="checkbox"/>	mutalisk	mutalisk - win2003r2	mutalisk	09/25/2008 04:59:36	odin.storage.usca.ibm.com	2.07 GB	502a8c63-4e87-
<input type="checkbox"/>	hydralisk	win2003r2 - hydralisk	hydralisk	09/26/2008 04:55:44	odin.storage.usca.ibm.com	770.54 MB	502a193b-d5fa-f
<input type="checkbox"/>	epsilon3	WinVista - epsilon3	epsilon3	09/26/2008 02:12:28	odin.storage.usca.ibm.com	2.95 GB	501a10ea-e853-
<input checked="" type="checkbox"/>	optimus	win2003x32 - optimus	optimus	09/25/2008 05:22:48	pancake.storage.usca.ibm.com	3.8 GB	502adbe5-6b92-
<input checked="" type="checkbox"/>	mini	win2008x64 - mini	mini	09/25/2008 04:43:31	pancake.storage.usca.ibm.com	2.39 GB	502adecf-d889-0
<input checked="" type="checkbox"/>	droneclone9	droneclone 9	droneclone9	09/25/2008 06:18:56	pancake.storage.usca.ibm.com	2.36 GB	502a8dd9-bf89-c
<input checked="" type="checkbox"/>	droneclone8	droneclone 8	droneclone8	09/25/2008 06:04:14	pancake.storage.usca.ibm.com	2.21 GB	502a2c94-19cd-
<input checked="" type="checkbox"/>	droneclone7	droneclone7	droneclone7	09/25/2008 05:42:33	pancake.storage.usca.ibm.com	1.23 GB	501a99fc-4506-k
<input checked="" type="checkbox"/>	droneclone19	droneclone 19	droneclone19	09/25/2008 07:30:35	pancake.storage.usca.ibm.com	2.15 GB	502a4961-f49e-2
<input checked="" type="checkbox"/>	droneclone18	droneclone 18	droneclone18	09/25/2008 07:21:30	pancake.storage.usca.ibm.com	2.17 GB	502a4f6b-015b-a
<input checked="" type="checkbox"/>	droneclone11	droneclone 11	droneclone11	09/25/2008 06:42:52	pancake.storage.usca.ibm.com	2.2 GB	502ac021-92c4-
<input checked="" type="checkbox"/>	droneclone10	droneclone 10	droneclone10	09/25/2008 06:31:42	pancake.storage.usca.ibm.com	2.22 GB	502a376f-ae8d-f
<input type="checkbox"/>	drone	win2003r2 - drone	drone	09/26/2008 01:51:59	sanfs1.storage.usca.ibm.com	2.35 GB	501a824c-182f-3
<input type="checkbox"/>	classic	win2008x64 - classic	classic	09/26/2008 00:54:01	swiper.storage.usca.ibm.com	3.3 GB	502a4ddb-d29a-

Search completed

Files inspected: 21





TSM 6.2.2 B/A client support for vStorage API*



Utilize VMware vStorage APIs for Data Protection for image-level backup and recovery

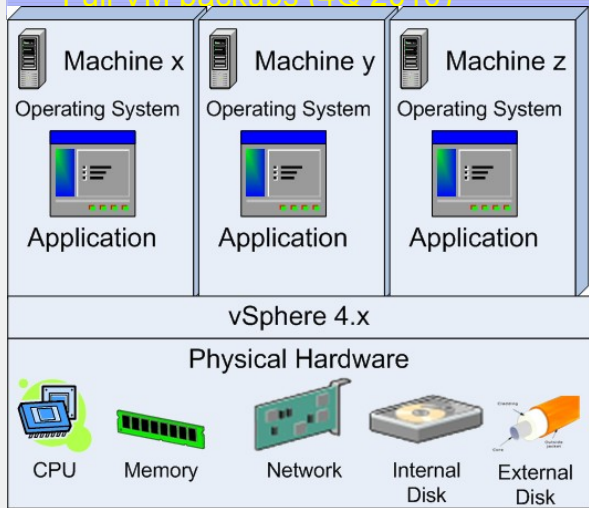
File level backup through Proxy server, File level recovery through TSM B/A client (**Windows only**)

Full VM level backup through Proxy server (using vStorage), Full VM restore through the Proxy server 

vStorage API support

File-level backups (1Q 2010)

Full VM backups (4Q 2010)

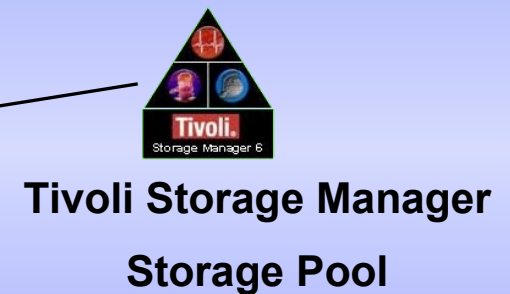


TSM B/A client

Running on Windows proxy*

vStorage API

vStorage APIs provides the capability to read **directly** from the ESX storage



*Proxy server can be a physical or virtual machine

*TSM b/a client already supports multiple ways of protecting VM environments, including in guest (TSM or Fastback), Console and VCB



TSM B/A Client Version 6.2.2

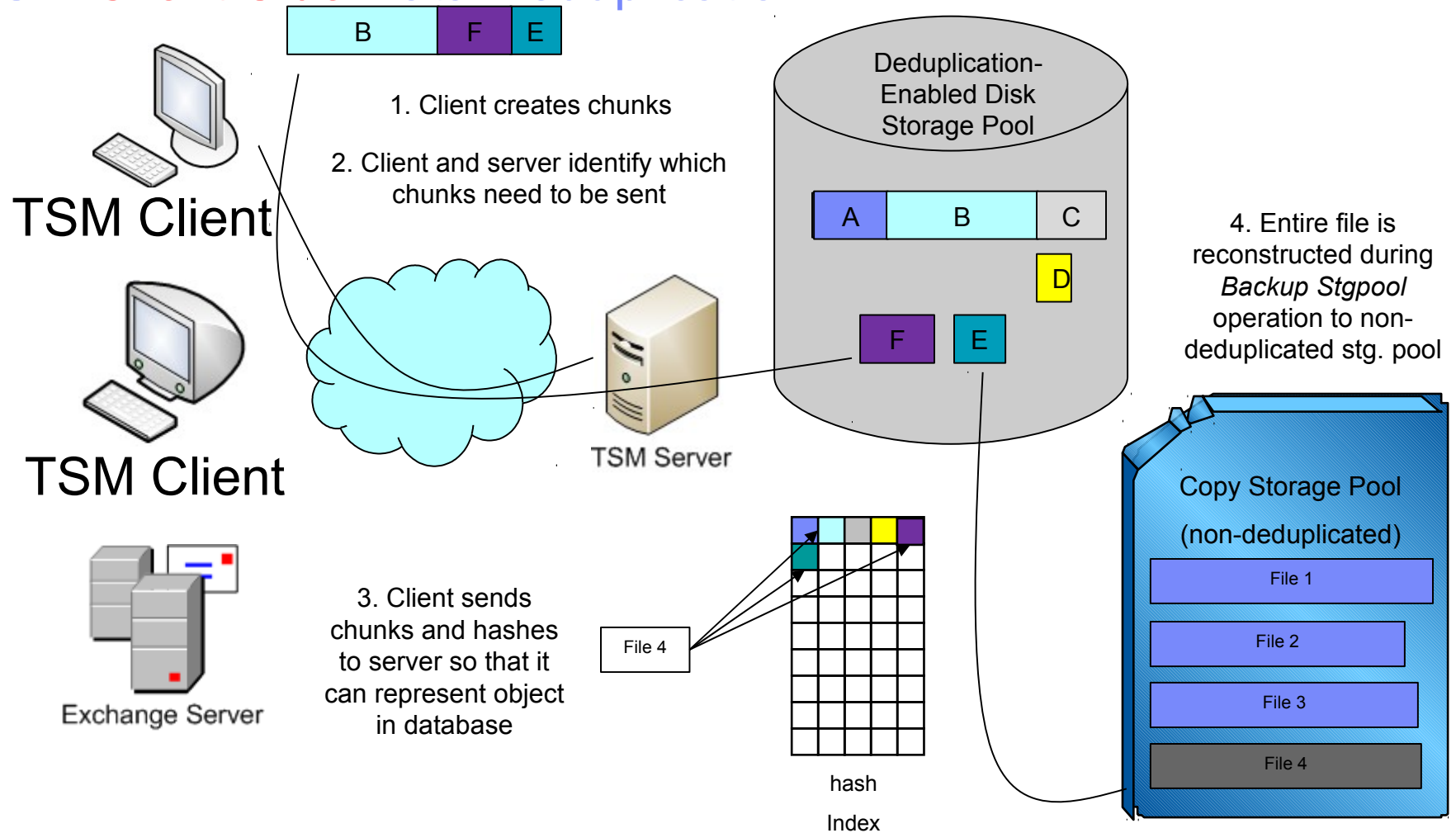
- Full VM Backup/Restore – VMware vStorage API for Data Protection (VDAP)
 - Next generation ‘VCB’ support
 - APIs provide advanced features like direct read of *.vmdk, and changed block tracking
 - Consists of two APIs: VI API and VDDK API
- Full replacement of TSM 6.2.0 VCB support (VMware Consolidated Backup)
 - VCB backup/restore functions are still available with TSM 6.2.2
- Full VM block-level backup streaming (from SAN or local datastore)
 - direct read of volume data to TSM Server (No staging area or ‘double hop’)
- Full VM restore directly to SAN/LAN/Local datastore - direct write *.vmdk
- VMware Converter tool no longer required on restore
 - Full virtual machine configuration restore/define directly to vCenter and ESX host server. TSM now provides function previously provided by Converter tool
- Easy to Install and configure TSM backup proxy
 - All required files shipped with TSM package. Eliminates install and configuration of VCB Framework
- Use existing TSM Client interface (Backup/Restore VM commands/schedules)



- Supports all guest-OS platforms
- Complete full snapshot of 'live' (running) virtual machine with pre/postsnapshot support(VMware tools)
- When Installing TSM B/A Client on physical backup proxy(off-host)
 - Backup load (CPU and I/O) off-loaded from ESX server
 - Lan Free
- VMotion aware
- Supported transports (data transfer path) SAN, HotAdd, LAN
 - Auto detected with vStorage APIs
- Backup proxy
 - Any Windows 2003 or Windows 2008
 - Physical or virtual machine running on guest VM
- TSM related features
 - TSM Server Event logging (Final stats – list of VM total attempted, success, failed, Reason for failure)
 - TSM schedule type 'Backup VM' – supports schedule results reporting
 - Action = "Backup"
 - Sub-action= "VM"
 - Client Dedup(Lan only) and Server Dedup
- Interface
 - Backup/Restore via command line from backup proxy via BACKUP/RESTORE VM commands
 - Backup/Restore GUI from backup proxy, displays all VM's available for backup/restore
- Data Format
 - Full VM Images are managed on TSM server (TSM policy) and displayed as single object for backup/restore
 - All data stored on backup proxy nodename on TSM server
 - Each VM stored in its own filespace – "\VMFULL-<vmname>"



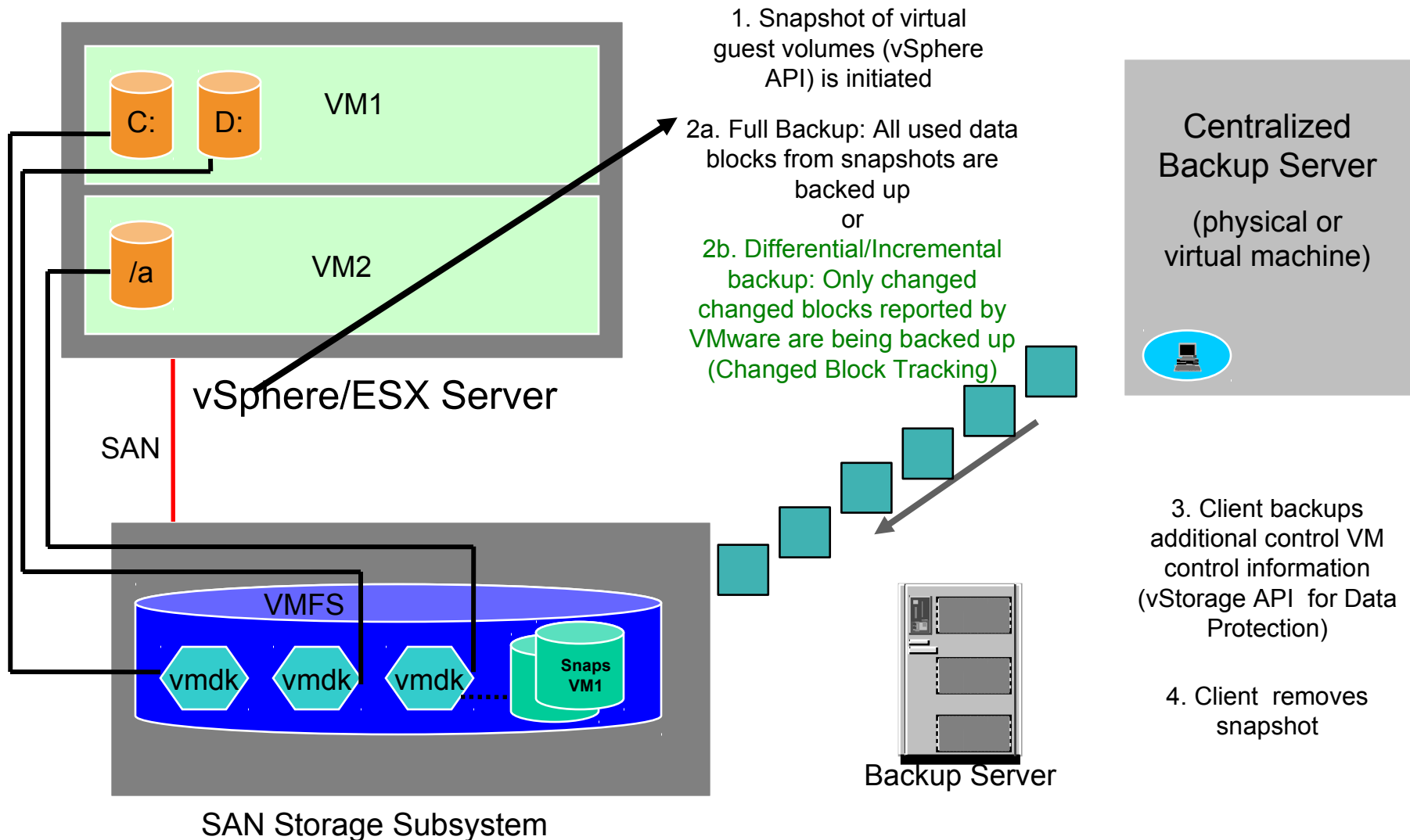
TSM Client Side Data Deduplication



Can be used in conjunction with VMware backups



What is CBT (Changed Block Tracking) ?



What is CBT continued

- CBT allows backup applications to query the VMkernel to find out which disk blocks have changed in a VM disk file since the last backup operation.
- CBT instantly finds out, which disk blocks need to be backed up. This enables fast incremental backups.
- Two block operations
 - 1. Identify empty blocks and do not back them up
Supported with TSM 6.2.2
 - 2. Identify changed blocks and backup only changed blocks as incrementals
Not supported with TSM 6.2.2
Refer to the Statement of Direction section
- Limitations, CBT does not work:
 - Virtual hardware version 6
 - Virtual RDM (raw device mapping) disks
 - Virtual Disks which are attached via shared iSCSI



Supported vSphere/ESX Datastores

All types of Datastores are supported (no TSM mounting required)

- SAN via Fiber
- SAN via iSCSI
- LAN via NFS
- Local

REPMONSERVER - vSphere Client

File Edit View Inventory Administration Plug-ins Help

Home Inventory Hosts and Clusters

Search Inventory

REPMONSERVER

DataCenter1

folder1

10.10.10.49

VM1_Local

VM2_SAN

VM3_NFS

Win_XP_SAN

Windows XP NFS

10.10.10.49 VMware ESX, 4.0.0, 164009

Summary Virtual Machines Resource Allocation Performance Configuration Tasks & Events Alarms Permissions Maps Storage Views Hardware Status

Hardware

Processors

Memory

Storage

Networking

Storage Adapters

Network Adapters

Advanced Settings

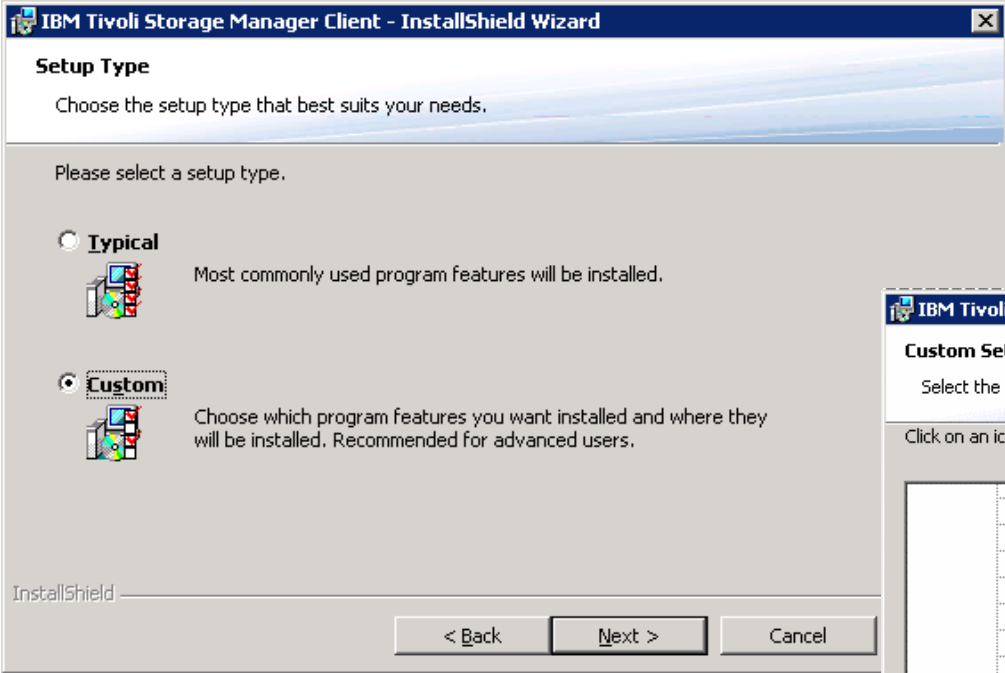
View: Datastores Devices

Datastores

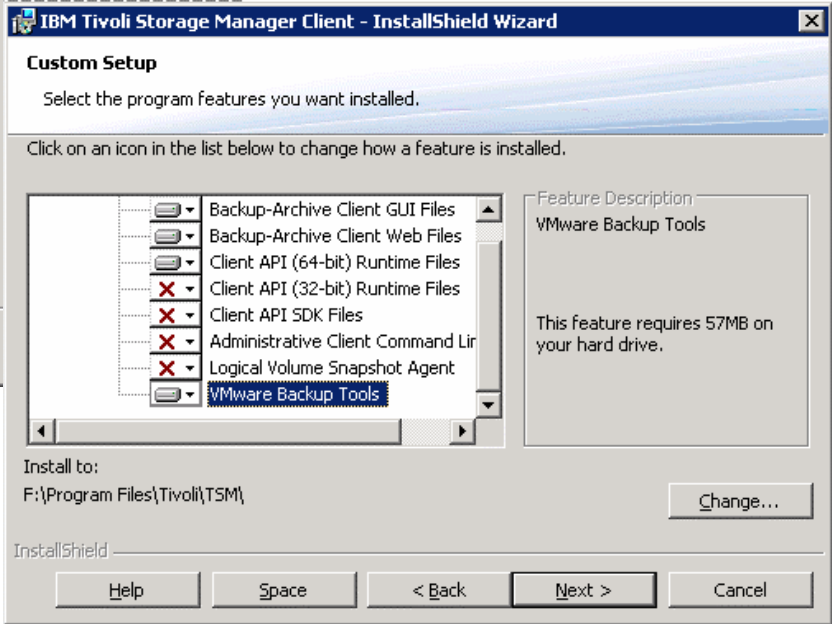
Refresh Delete Add Storage...

Identification	Status	Device	Capacity	Free	Type	Last Update
SAN_Repository	Normal	OPNFILER iSCSI ...	13.75 GB	11.68 GB	vmfs3	12/14/2010 3:42:42 PM
NFS_Repository	Normal	10.10.10.46:/mnt...	987.31 MB	982.99 MB	NFS	12/14/2010 3:42:42 PM
Local_Repository	Alert	Local VMware, Di...	8.25 GB	250.00 MB	vmfs3	12/14/2010 3:42:42 PM
NFS_Win_Reposit...	Normal	10.10.10.47:/sha...	39.99 GB	22.69 GB	NFS	12/14/2010 3:42:42 PM

Installing vStorage API (VDAP) Support



1. Select Custom Install



1. Select VMware Backup Tools



TSM Full VM Image

■ Commands

- **BACKUP VM** vmname
 - Domain.vmfull option is used if no 'vmname' specified
- **RESTORE VM** vmname **–name=newname –datacenter=TivoliARCLab –host=esxhost1.ibm.com –datastore=ds4700_svt1**
 - Restore to original virtual machine location
 - Override virtual machine **name, datacenter, ESX host or datastore** location with command line option or GUI Restore options dialog.
 - No VMware Converter tool needed
 - TSM 6.2.2 supports both VCB-type and VSTOR-type Full VM Image restores
 - When restoring a VCB-type Image – TSM 6.2 restore steps required – vcb full image files restored to staging area, Converter tool required for final restore step
- No change from TSM 6.2.0 command syntax, no need to change existing schedule definitions
- New option **vmfulltype=[vstor | vcb]** to enable vStorage-type backups



The screenshot shows the 'Backup Virtual Machine' dialog box in IBM Tivoli Storage Manager. The dialog has a menu bar (File, Edit, View, Help) and a toolbar with icons for information, search, and backup. Below the toolbar is a 'Backup' button and a dropdown menu set to 'VMWare Full VM (vStorage)'. The main area is divided into two panes. The left pane shows a tree view of the backup structure: GUEST_VM1 (expanded) contains Virtual Machines (expanded), which contains a folder 10.10.10.49. Inside this folder are five items: VM1_Local, VM2_SAN, VM3_NFS, Win_XP_SAN (checked), and Windows XP NFS. The right pane is a table with columns: VM, Name, VM Hostname, and Status. The table contains one row for Win_XP_SAN, which is checked in the VM column. The status is 'running'.

VM	Name	VM Hostname	Status
<input checked="" type="checkbox"/>	Win_XP_SAN	Win_XP_SAN	running

Object: Win_XP_SAN



Backup VM Progress

The screenshot displays the vSphere Client interface for a host named 'REPMONSERVER - vSphere Client'. The left sidebar shows the inventory tree with 'DataCenter1' containing a 'Folder1' which has a sub-entry '10.10.10.49'. The main pane shows the configuration for '10.10.10.49 VMware ESX, 4.0.0, 164009'. The 'Configuration' tab is active, showing 'Datastores' and 'Devices'. A 'Task List' dialog box is open, showing a 'Backup' task with a 'Stop' button and a 'Report' button. The task is 'Inspected: 1' and 'VM Configuration' is '4.86 KB'. The 'Recent Tasks' pane at the bottom shows a completed task: 'Create virtual machine snapshot' for 'VM1_Local'.

Identification	Status	Device	Capacity	Free	Type	Last Update
GB	11.68 GB	vmfs3				12/14/2010 4:42:45 PM
MB	982.99 MB	NFS				12/14/2010 4:42:45 PM
GB	250.00 MB	vmfs3				12/14/2010 4:42:45 PM
GB	22.69 GB	NFS				12/14/2010 3:42:42 PM

Name	Target	Status	Details	Initiated by	vCenter Server	Requested Start Time	Start Time	Completed Time
Create virtual machine snapshot	VM1_Local	Completed		Administrator	REPMONSERVER...	12/14/2010 4:58:17 ...	12/14/2010 4:58:17 ...	12/14/2010 4:58:24 ...



Restore Full VMs (replaces VMware Converter tools)

IBM Tivoli Storage Manager

File Edit Actions Utilities View Help

Welcome to the IBM Tivoli Storage Manager. Click below to perform a task.

Restore Virtual Machine

File Edit View Help

Restore Options Point In Time

Find Files (Restore)

File Edit View Actions Help

Search/Filter Criteria

What to Search: Virtual Machines

Search All Objects

Start Path: ZERGLING

Object Name: any name

Search Options

☐ Date ☐ Size

Search Results

21 matches underneath ZERGLING

VM	Name	VM Hostname	Backed Up	Host Server	Size	VM Id
hydrallisk	win2003r2 - hydrallisk	hydrallisk	09/25/2008 03:32:34	odin.storage.usca.ibm.com	769.24 MB	502a193b-d5fa-f4a6-3acd-2bea069d93fb
hydrallisk	win2003r2 - hydrallisk	hydrallisk	09/26/2008 04:55:44	odin.storage.usca.ibm.com	770.54 MB	502a193b-d5fa-f4a6-3acd-2bea069d93fb

Restore Destination

Select destination for restored objects

Restore to:

☒ Original location

☐ Following location

Name: dronedclone12

Datacenter: TivoliARClab

Host: boots.storage.usca.ibm.com

Datstore: ds4700_svt

Restore Cancel Help

Search completed

Files Inspected: 21



The screenshot shows the IBM Tivoli Storage Manager (TSM) interface. In the background, the main window displays 'Welcome to IBM Tivoli Storage Manager' and sections for 'Backup' and 'Archive'. Overlaid on this is a 'Restore' dialog box. The dialog has a menu bar (File, Edit, View, Help) and a toolbar with icons for file selection, search, and other functions. Below the toolbar are three tabs: 'Restore', 'Options', and 'Point In Time'. The 'Restore' tab is active, showing a tree view of nodes on the left and a list of backup copies on the right. The tree view shows a hierarchy starting with 'Nodes', followed by 'GUEST_VM1', 'Backup Sets', 'Local', 'Server', 'File Level', and finally '\guest_vm1\c\$'. Under '\guest_vm1\c\$', there are several folders: 'Demo_Data_VM', 'Documents and Settings', 'Program Files', 'WINDOWS', 'WMFULL-VM1_Local', 'WMFULL-VM3_NFS', and 'WMFULL-Win_XP_SAN'. The 'File Level' folder is expanded, showing a list of files. The file 'Copy (13) of doc1.doc' is selected. The list of files shows columns for Name, Size, Modified date, and a checkbox. The file 'Copy (13) of doc1.doc' is highlighted in blue. The status bar at the bottom of the dialog shows 'File: Copy (13) of doc1.doc'.

Name	Size	Modified
Copy (10) of doc1.doc	16.21 KB	10/27/2010 18:49:56
Copy (11) of doc1.doc	16.21 KB	10/27/2010 18:49:56
Copy (12) of doc1.doc	16.21 KB	10/27/2010 18:49:56
Copy (13) of doc1.doc	16.21 KB	10/27/2010 18:49:56
Copy (14) of doc1.doc	16.21 KB	10/27/2010 18:49:56
Copy (2) of doc1.doc	16.21 KB	10/27/2010 18:49:56
Copy (3) of doc1.doc	16.21 KB	10/27/2010 18:49:56
Copy (4) of doc1.doc	16.21 KB	10/27/2010 18:49:56
Copy (5) of doc1.doc	16.21 KB	10/27/2010 18:49:56
Copy (6) of doc1.doc	16.21 KB	10/27/2010 18:49:56
Copy (7) of doc1.doc	16.21 KB	10/27/2010 18:49:56
Copy (8) of doc1.doc	16.21 KB	10/27/2010 18:49:56
Copy (9) of doc1.doc	16.21 KB	10/27/2010 18:49:56
Copy of doc1.doc	16.21 KB	10/27/2010 18:49:56
doc1.doc	16.21 KB	10/27/2010 18:49:56



Restoring Full-VM backups

- **RESTORE VM vmname**
 - vmname=newname
 - datacenter=TivoliARCClab
 - host=boots.usca.ibm.com
 - datastore=ds4700_svt
- **VMName: Virtual machine display name**
- **Datacenter: VMware datacenter name defined to the vSphere vCenter**
- **Host: VMware ESX host server defined to vCenter Datacenter**
- **Datastore: Location for volume data and configuration files**



TSM Policy

- TSM Management Class policy settings will control the number of Full VM backups
- The default MC of the backup proxy node will be used. VMMC option can be set to override the default MC.
- VCB-type Full VM Images will not be expired by VSTOR-type Full VM backups



Considerations with vStorage API Full-VM backup in V6.2.2

- No subfile backup
- Client-side deduplication is available
 - Assuming V6.2 TSM server
- No compression
 - Except when used with client-side deduplication
- No client encryption



TSM v6.2.2 Other Functions

- Auto discovery new virtual machines
 - TSM communicates with VMware vCenter inventory (VMs, Host, VM containers)
 - DOMAIN.VMFULL keywords maps to VMware containers all-vm, vmhost, vmfolder
- Auto detect transport – SAN, LAN, Hotadd
- Server Dedup / Client Dedup (LAN only)



Reporting

- TSM Server Event logging
 - Final stats – list of virtual machines, total attempted, success, failed
 - Reason for failure per virtual machine
- TSM Schedule type ‘Backup VM’
 - replaces sched type=command/macro for schedule results reporting

```
Backup VM command complete
Total number of virtual machines backed up successfully: 5
virtual machine vn1 backed up to nodename vn1
virtual machine vn2 backed up to nodename vn2
virtual machine vn4 backed up to nodename vn4
virtual machine vn5 backed up to nodename vn5
virtual machine vn6 backed up to nodename vn6
Total number of virtual machines failed: 2
virtual machine vn3
virtual machine badvm
Total number of virtual machines processed: 7

ANS1900I Return code is 12.
ANS1901I Highest return code was 12.
```

← Backup VM Final Statistics –
Total VM processed, successful, failed
Logged to TSM Server Activity Log

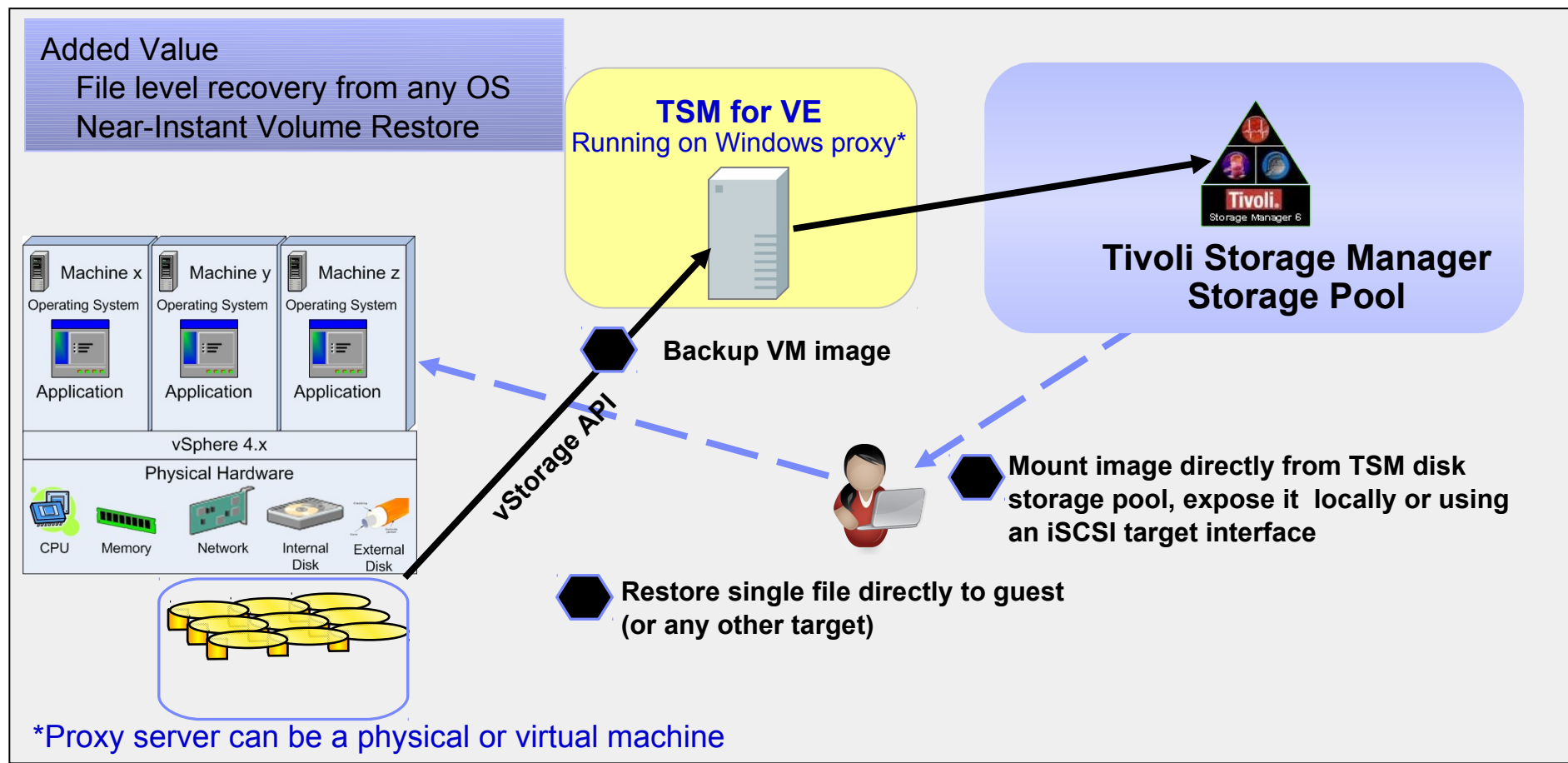
```
01/27/2018 10:14:44 ANE4140I (Session: 11348, Node: WIN2003R2) Backup VM
command complete(SESSION: 11348)
01/27/2018 10:14:44 ANE4141I (Session: 11348, Node: WIN2003R2) Total number
of virtual machines backed up successfully: 1(SESSION:
11348)
01/27/2018 10:14:44 ANE4142I (Session: 11348, Node: WIN2003R2) virtual
machine idevntest backed up to nodename
idevntest(SESSION: 11348)
01/27/2018 10:14:44 ANE4143I (Session: 11348, Node: WIN2003R2) Total number
of virtual machines failed: 0(SESSION: 11348)
01/27/2018 10:14:44 ANE4149I (Session: 11348, Node: WIN2003R2) Total number
of virtual machines processed: 1(SESSION: 11348)
01/27/2018 10:15:06 ANE4158I (Session: 11350, Node: WIN2003R2) File level
BACKUP VM of virtual machines 'idevntest'.(SESSION:
11350)
```

← TSM Serer Activity Log
Total number of VMs failed. List of
VMs by name and reason for failure



TSM for Virtual Environment – VMware integration

Support **multiple recovery options** from image backup and vStorage API change block tracking (CBT)
 - File/Volume/Disk/Full VM restores from an image backup (multiple OSs are supported)





THANK YOU ...



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