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Windchill 10.1 – Backup and Recovery

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Windchill 10.1 – Backup and Recovery

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Agenda

- Day 1
  - Module 1: Backup Types
  - Module 2: Windchill System Backup
  - Module 3: Windchill Data Stores
  - Module 4: Business Continuity Planning
  - Module 5: Oracle Physical Components
  - Module 6: Backup and Recovery with Oracle RMAN
- Day 2
  - Module 7: Backup and Recovery of Windchill Directory Server
  - Module 8: Backup and Recovery of Windchill File Vaults
  - Module 9: Backup and Recovery of Other Data Stores
  - Module 10: Backup and Recovery – Bringing it Together
  - Module 11: Advanced Backup Solutions

Module 1: Backup Types

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Objectives

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After completing this module, you will be able to:

- Understand each of the following terms:
  - Physical and logical backups.
  - Online and offline backups.
  - Data and system backups.
  - Full and incremental backups.

Types of Backup

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- Physical and Logical Backups
  - Physical: Copying the relevant operating system files to a backup location
  - Logical: Exporting the database
    - For example, using Oracle's Data Pump or Windchill Directory Server's export tool
    - Export most useful when transferring data to another system rather than when doing backup
- Online and Offline Backups
  - Online (or Hot)
    - Server is online and accessible to users.
  - Offline (or Cold)
    - Server is offline and Windchill, and database are stopped.
    - Data cannot be modified during the backup.

Types of Backup

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- Data and System Backups
  - Data
    - Stored in data repositories, e.g., file system, Oracle, LDAP
    - Changes constantly in line with usage
  - System
    - Application software and customization, stored on operating system
    - Changes when software is installed/upgraded, or customization applied
- Full and Incremental Backups
  - Full Backup
    - A full backup can be restored without dependency on other backups.
    - Be specific when talking about a full backup, a full Oracle backup is not the same as a full system backup.
  - Incremental Backup
    - Partial backup containing changes since last backup.
    - A full backup is normally required to be restored first before incremental backups can be restored to “roll forward” the data.

Module 2: Windchill System Backup

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Objectives

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After completing this module, you will be able to:

- Understand what system files should be backed up, and when.
- Know where the PTC Solution Installer stores its registry and how to back it up.
- Understand the importance of backing up Windchill configuration files (like xconf).
- Write a simple Ant script to backup the Windchill configuration files.

Software Installation and Configuration Files

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- Application software can be installed again from source media.
  - But…installation and reconfiguration can take a long time, and has chances for error.
  - Therefore, you should backup the installed applications from the server.
- For a shorter recovery time, backup of installation directories and configuration files are essential.
  - Backups should be taken any time a change is made to the configuration.
  - A change could be as small as changing an XCONF value, but could be critically important.
    - If the XCONF file is not backed up, the restored system will not be correct.
- Customizations are the most challenging files to incorporate into a robust backup and recovery plan.
  - The best implementers will maintain rigorous control of their customizations and will know exactly what is installed and be able to reproduce it.
  - The administrator must take account of human error and ensure backups exist before and after any customization is deployed.

PTC Solution Installer (PSI) Global Registry

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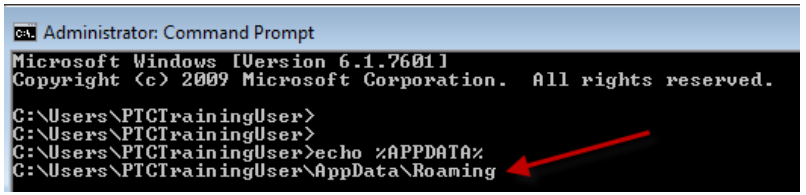
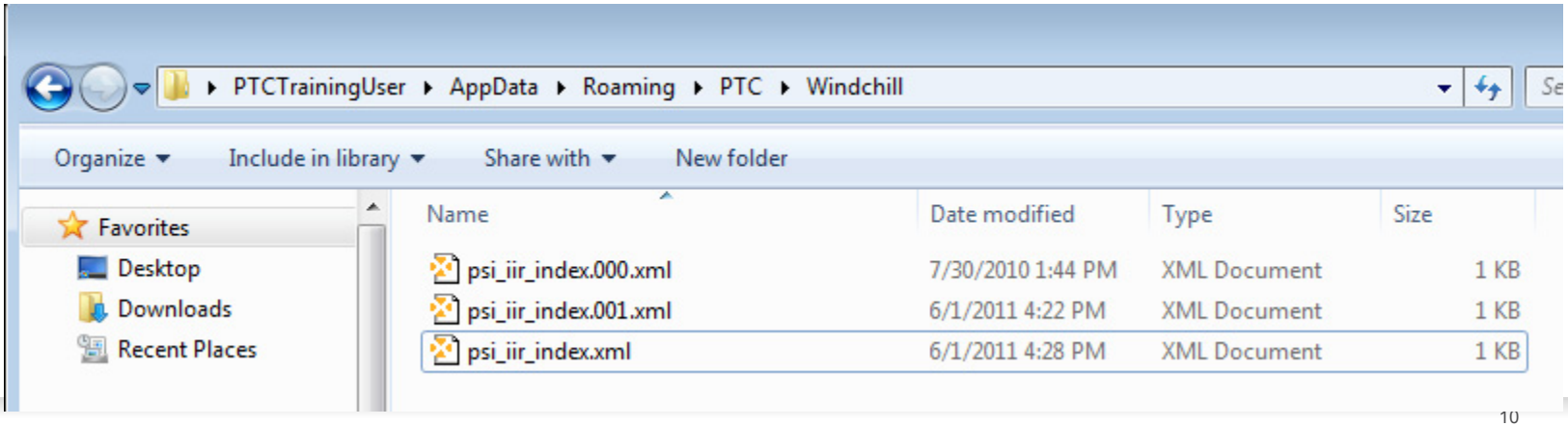
- PSI Creates a global registry file for each installation instance.
  - This file is needed to update an instance (e.g., install a new Windchill module)
- Registry is created under the user account who installed the software
- In Windows, the registry is created under:
  - `%APPDATA%\PTC\Windchill`
- To get location:
  - `echo %APPDATA%`



- There are only a few small files in this folder, but they are essential for re-running Solution Installer, so include the folder in your daily backups.



Windchill Configuration Files

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- Best practice dictates that all configuration changes should be backed up.
- However, in reality human error means that changes are made to properties such as XCONF files with a frequency that means they are sometimes not backed up.
- Recommend building important small files into the daily backup.
  - Following is an example, based on implementer field experience, of files to include in a daily backup.
  - All folders relative to WT_HOME. (** means recursive).

```
logs/*.*
**/*.xconf
codebase/*.properties
db/db.*
codebase/WEB-INF/*.*
tasks/wt/federation/*.xml
wtSafeArea/**
wtCustom/**
codebase/*.ini
codebase/com/ptc/windchill/cadx/cfg/**
codebase/instreg/**
*.properties
```

Using Ant for Backup

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- There are many scripting languages and tools for copying files.
  - Ant is included in this course as one example
- Ant is a cross-platform build tool.
  - Can be used to write scripts that perform tasks such as copying and deleting files.
- Included with Windchill distribution under `WT_HOME\ant`
- Has powerful features for copying files and directories.
  - Can recursively select files, e.g., copy all xconf files anywhere under WT_HOME.
  - By default, files are only copied if the source file is newer than the destination file, or when the destination file does not exist.

Exercise: Write script to back up often changed system files (30 min)

Module 3: Windchill Data Stores

Windchill 10.1 – Backup and Recovery

Objectives

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After completing this module, you will be able to:

- Understand the difference between primary and secondary Windchill repositories.
- Understand which are Windchill's primary data stores and which are secondary data stores.

Primary and Secondary Data Repositories

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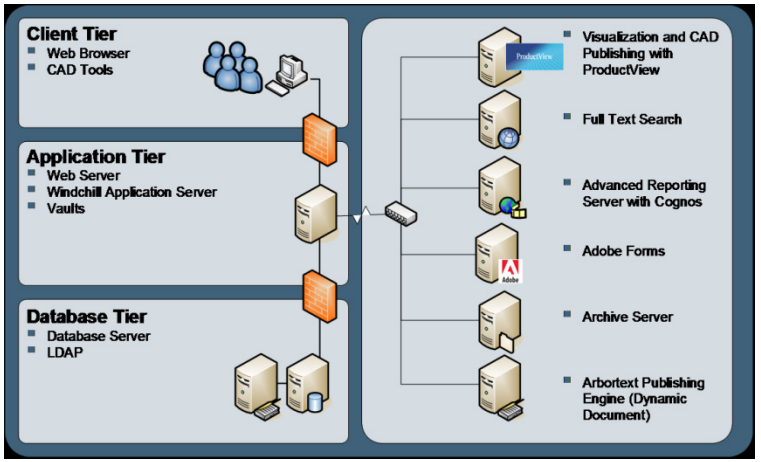
- Primary Repositories
  - Windchill stores different categories of persistent data in separate primary repositories.
  - Primary repositories contain original data that cannot be recreated, so they must be included as part of the backup scheme.
- Secondary Repositories
  - Contain information that is built from primary repository information.
    - Windchill Index Search indexes
    - Replica vaults on remote file servers
    - ESI transaction database
  - Whether to back them up depends on whether rebuilding them from the primary repository takes an unacceptably long time.



Primary Data Repositories

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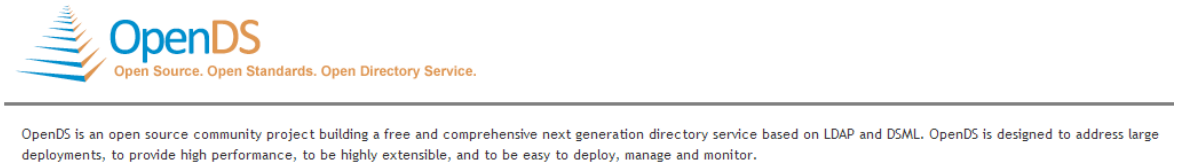
Your backup plan **MUST** include all primary data repositories that are installed.

- Windchill uses either Oracle or Microsoft SQL Server as the relational database engine.
  - This course will focus only on Oracle!
  - The relational database is the most complex of the primary repositories and requires trained administrators to ensure efficient operation.
- Windchill Directory Server (LDAP)
  - Since Windchill 9.0, only user, group, and organization information is stored in LDAP.
  - Windchill Directory Server derived from Open DS (http://opends.java.net/).



- Corporate LDAP (if configured)
  - Provides read-only source of usernames and passwords to Windchill.
  - Ideally, backup should be synchronized with Windchill, but not critical as discrepancies can be identified and resolved.

Primary Data Repositories (cont.)

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Your backup plan **MUST** include all primary data repositories that are installed.

- File Vaults
  - Physical folders on the operating system that store the content uploaded to Windchill.
  - File vaults are optional as content can be stored directly inside database, but for performance benefits most production deployments use them.
  - Are referred to by the database; therefore, backup and recovery must be synchronized with database.
- Remote Vaults
  - Remote cache vault: Temporary remote location to improve performance.
  - Remote master vault: Must be backed in and recovered in synchronization with main site.
- Windchill Business Reporting – Cognos
  - Additional database schema in either Oracle or Microsoft SQL Server.
  - Should be backed up using same methods and intervals as Windchill database.
- Windchill Archive
  - The optional Windchill Archive Server creates an additional primary repository that should be backed up whenever information is added to the archive.

Secondary Data Repositories

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- Windchill Index Search
  - Windchill supports LucidWorks Solr as a text based search index.
  - The index can be rebuilt from the primary repositories using a bulk indexing process, but that may take many days.
  - Solr supports hot backups as well as replication to additional index servers.
- Enterprise Systems Integration (ESI) using TIBCO
  - TIBCO is the messaging/transactional software between Windchill and the ERP system.
  - In the event that either Windchill or the ERP system has to be restored the administrator must manually identify synchronization issues and resolve.
  - To avoid this manual recovery process TIBCO may be configured as a cluster with mirrored data and failover as part of a backup strategy.
- Replica Vault
  - Contains copies of content files on a remote file server.
  - May be recreated from master vault; however, recreating them may take longer than restoring them, thus making backups necessary.

Module 4: Business Continuity Planning

Windchill 10.1 – Backup and Recovery

Objectives

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After completing this module, you will be able to:

- Understand how to agree a backup and recovery policy with your customer.
- Understand the terms:
  - System Maintenance Window.
  - Recovery Point Objective (RPO).
  - Recovery Time Objective (RTO).
- Understand the factors that will determine the type of backup strategy required.
- Understand what different levels of backup strategies involve.

Key Backup Terms

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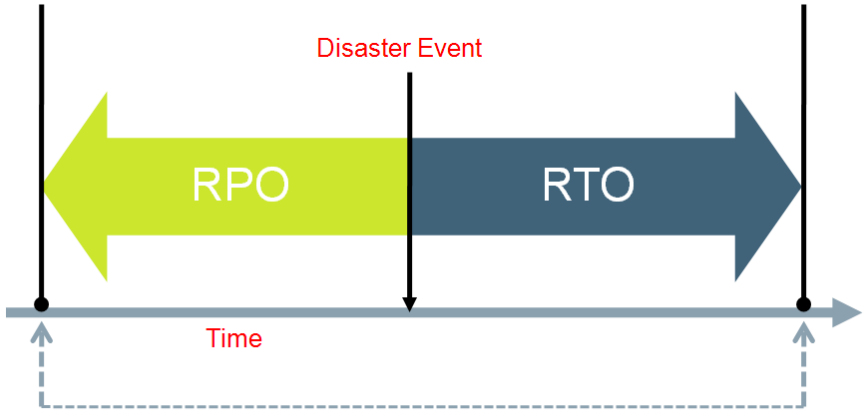
- System Maintenance Window
  - The periods of time during which the server is made unavailable to users in order to perform maintenance activities such as backups, upgrades, and hardware replacement.
- Recovery Point Objective (RPO)
  - The acceptable latency of data that will not be recovered.
  - This could vary from 15 minutes to 24 hours or more.
- Recovery Time Objective (RTO)
  - The amount of time required to bring the system back up in a usable state after a failure event.
  - If this is less than 24 hours, then consider high availability solutions.

The RTO and RPO time values combine to determine how much productivity is lost during a data loss or disaster event that requires a recovery.



Backup and Recovery Strategic Planning

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Define recovery and availability requirements.

- RPO and RTO should be agreed upon and documented with customer. Ask the following questions:
  - How much data loss can you afford in the event of a failure?
  - What is the maximum length of time you can allow for recovery of your Windchill system?
  - How much are you willing to spend to ensure that your data is recoverable?
  - Can the system be down during the backup?
  - How much time will it take to replace damaged hardware?
- Availability should also be agreed upon.
  - <how many days per week>/<how many hours per day>
  - For example: 5/12, 5/16, 5/20, 7/16, or 7/24.

Backup and Recovery Strategic Planning (cont.)

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Define recovery and availability requirements.

- Backup devices will affect RTO (how long to restore data) and the time it takes to perform the backup.
  - Tape
  - LTO (high speed) tape
  - Tape libraries
  - Virtual tape libraries (a disk array arranged to look like a tape device)
  - DVD disks
  - Hard disk (RAID) arrays
  - Storage Area Network (SAN) or Network Attached Storage (NAS) disk arrays
  - Optical disk libraries.
- Storage capacity should allow for a number of backups to be preserved without overwriting data.

Backup and Recovery Strategic Planning (cont.)

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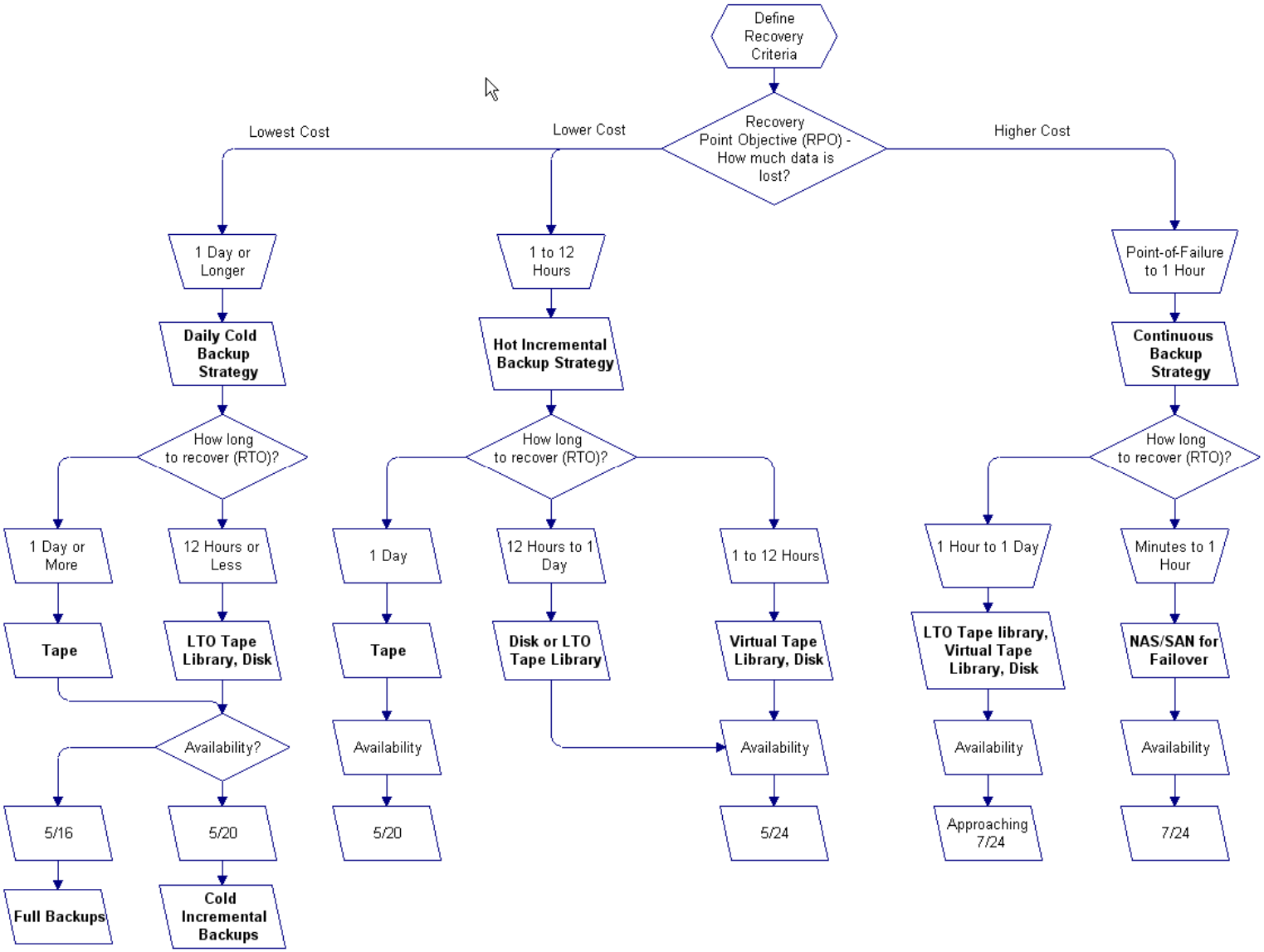
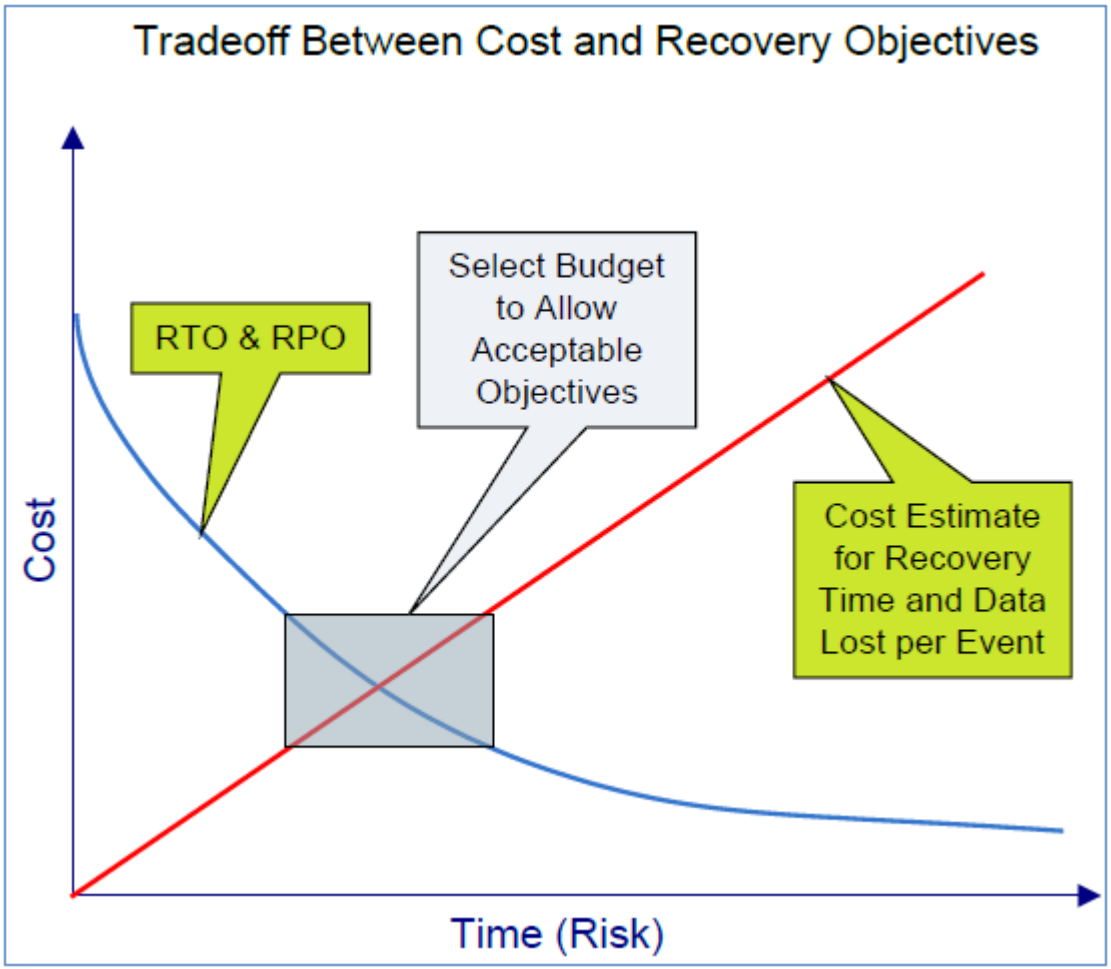
Apply decision tree to determine strategy and storage devices.



Cost Analysis

- Requires candid discussion with customer on the cost to them of server downtime and lost data (RTO and RPO) shown on the red line.
- Blue line shows costs of solution increasing to achieve lower RTO+RPO.
- Risk must also be assessed; more complex solutions introduce more risk.
  - Particularly if administrators do not have expertise to administer the implemented solution.



Backup Strategies

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Example backup strategies, in increasing level of cost and complexity

- Level I – Cold Backup
  - Shutd own server to back up.
  - Works with Oracle as configured by OCU.
  - Supports replica configurations if there is a time window for all sites to be down concurrently.
  - Synchronization of repositories is easy to manage.
  - Easy to administer.
  - Recovery is always to last cold backup, giving normal RPO of 24 hours.
  - RTO depends on media used, but likely to be 24 hours.

- Level II – Combined Cold, Hot, and Incremental
  - Include weekly cold backups.
  - Daily hot backups.
  - Requires Oracle to be reconfigured if installed by OCU.
  - Frequent incremental backups of Windchill Directory Server and file vaults.
  - Requires DBA to understand how to administer backup.
  - Could support an RPO of as little as 15 minutes.
  - RTO depends on media used, but likely to be 24 hours.

Backup Strategies

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- Level III – Snapshot backups and/or replication to a second server
  - Typically deployed by large customers
  - Often configured with the help of third party backup specialists
  - Could support an RPO of near point in time
  - RTO is minutes

- During this course we will focus on Level I and Level II type backups and you will learn how to support these directly.

Testing Your Backup and Recovery

Entropy: Inevitable and steady deterioration of a system or society

- Computer systems, if unmaintained, tend towards disorder.
- For end user software this is usually noticed as soon as errors become visible.
- For backup procedures it won't be evident until you have to restore the data.
- Don't wait for a disaster before testing your backup.
  - Restore it, not just once, but regularly.
  - Restore it to a test system annually at the very least.
  - Run maintenance checks as frequently as you can to validate and verify that the backup is sound.
    - Run some automated tests weekly.
      - Validate Oracle backup integrity with RMAN.
      - Compare count of vaulted files against backup.
    - Verify Windchill DS backup manually.

Module 5: Oracle Physical Components

Windchill 10.1 – Backup and Recovery

Objectives

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After completing this module, you will be able to:

- Identify the physical file types that Oracle uses to store data.
- Understand Oracle's startup states and the commands to set them.
- Run the necessary commands to be able to identify where the key physical files are located on an Oracle system.
- Understand the role that redo logs and archived redo logs play in restoring an Oracle backup to the point of failure.

Oracle Instance and Database

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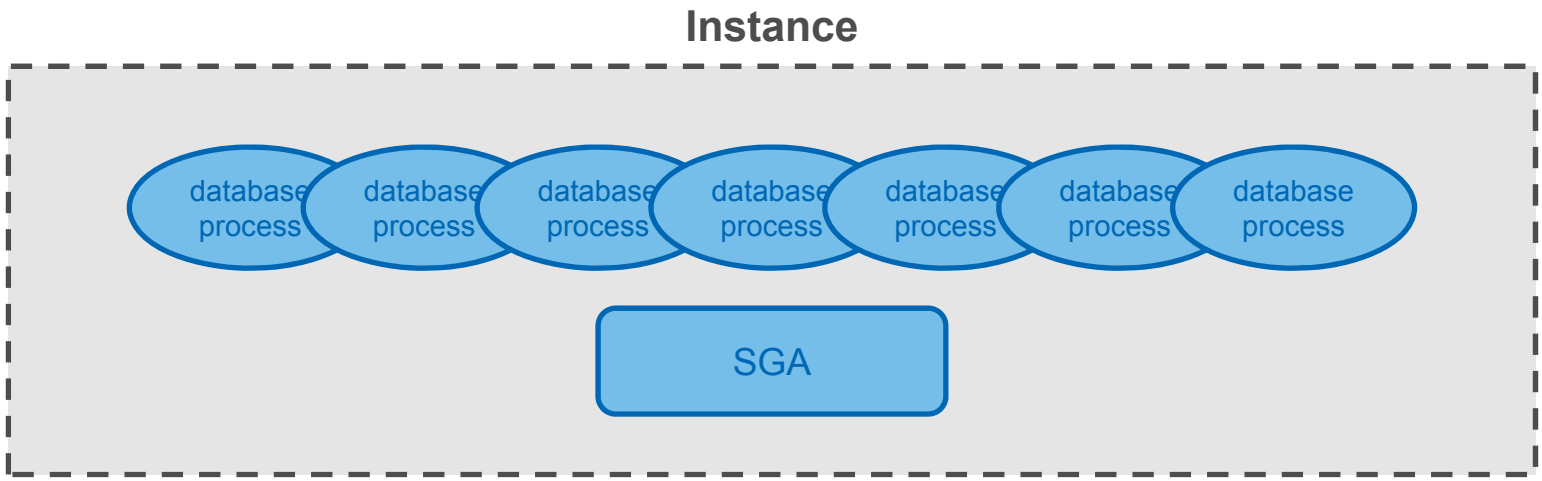
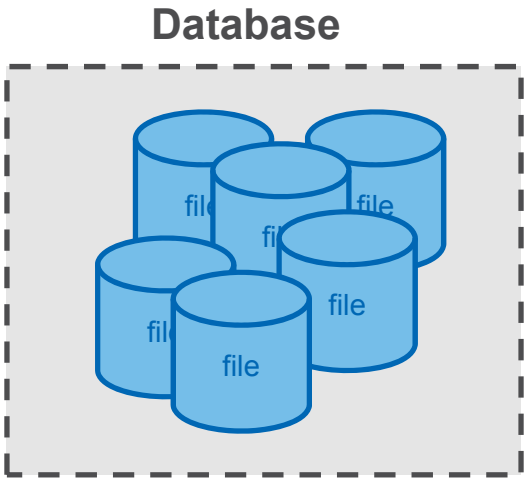
An Oracle instance consists of background processes and a memory structure.



- Instance – A set of Oracle processes and an SGA (System Global Area)
  - Exists in RAM
- Database – A collection of physical operating system files
  - Exists on file system



Oracle Identifiers

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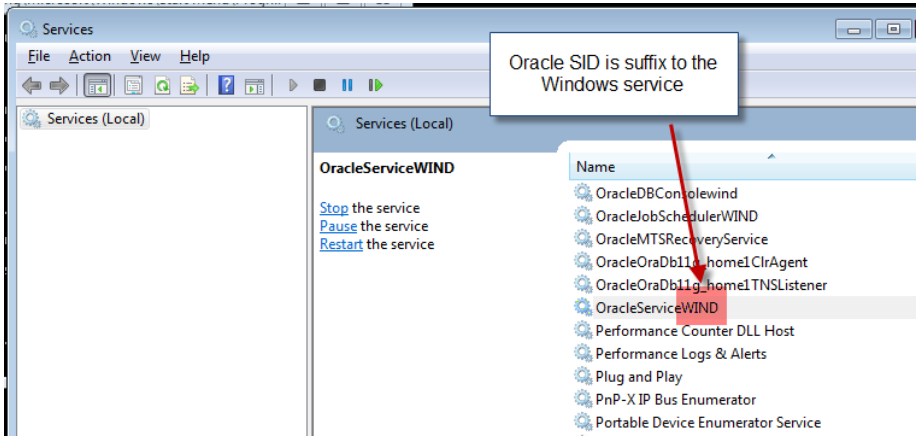
- Oracle Instance is identified by SID (System Identifier)
  - Uniquely identifies an Oracle instance.
  - Entered manually when creating the Oracle database.



- Oracle database is identified by DBID
  - Unique database identifier assigned by Oracle.
  - You may need this when recovering a backup, so make sure you record it!

```
sqlplus sys/change_on_install@WIND as SYSDBA
SQL> select DBID,NAME from V$DATABASE;
```

Oracle Physical Files

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Oracle physical files include:

- Datafiles
- Online Redo Logs
- Control Files
- Server Parameter File (spfile)
- Archived Redo Logs (optional)

Database

- Flash Recovery Area

Backup

- Trace Files
- Alert Log

Diagnostic Files

Datafiles and Online Redo Logs

- **Database Datafiles**
  - Store the data within the database.
  - Will grow in size, and must be managed by a DBA.
  - Appear on file system with extension DBF.
  - To list the data files in use for Windchill:

```
SQL> SELECT NAME FROM V$DATAFILE;
```

- **Online Redo Logs**
  - Store copies of all changes that are made to the datafiles.
  - Used in data recovery where datafiles may be restored from a backup location, and then rolled forward to the point of failure by applying the online redo logs.
  - Appear on file system with extension LOG.
  - To list the Online redo logs in use for Windchill:

```
SQL> SELECT MEMBER FROM V$LOGFILE;
```

Control Files and Server Parameter File

- **Control Files**
  - Store information about the database such as:
    - The database name.
    - Names and locations of associated datafiles and redo log files.
    - The timestamp of the database creation.
    - The current log sequence number.
  - Critical for the successful startup of the database, hence should be multiplexed.
  - Store information about the backups:
    - To list the control files in use for Windchill:

```
SQL> SELECT VALUE FROM V$PARAMETER WHERE NAME = 'control_files';
```

- **Server Parameter File (SPFILE)**
  - Stores the initialization parameters for the Oracle database.
  - Binary file that cannot be directly edited, but is saved when parameters are edited via SQL*Plus, or the Oracle administration UI.
    - To list the server parameter file in use:

```
SQL> show parameter spfile;
```

Database Files (cont.)

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- Archived Redo Logs
  - To enable Oracle to recover the data to the point of failure, the online redo logs must be archived.
  - Otherwise the online redo logs will be overwritten and it will only be possible to recover to the point of the last backup.
  - To ensure that a system can be restored to the point of failure, you must enable ARCHIVELOG mode, which will cause archived redo log files to be written.
  - Default file name is of the pattern ARC##########################.0001.
  - To list the location of archive redo log files generated when ARCHIVELOG mode is enabled, type the following as user wt.pom.dbUser (e.g., installpds):

```
SQL> select dest_name,destination from V$ARCHIVE_DEST where
destination is not null;
```

Exercise: Take full OS level backup of Oracle database (20 min)

Flash Recovery Area

- **Flash Recovery Area**
  - Disk area that can store backups of all database files.
  - By default is the place to store your Oracle backups.
  - The parameter `db_recovery_file_dest_size` sets a size limit on how much data you can store, but Oracle does not reserve the disk space for this, it is a somewhat artificial limit.
  - Should be on a separate disk from the database.
    - Check location and size of flash recovery area.

```
SQL> show parameter db_recovery_file_dest_size;

SQL> show parameter db_recovery_file_dest;
```

Alert Log and Trace Files

- **Alert Log**
  - Oracle writes all warnings and error messages to the alert log.
  - Diligent monitoring of the alert log will prevent many outages.
  - Administrator can subscribe to receive email notifications of important messages.
  - Alert log can be managed through the ADRCI (Automatic Diagnostic Repository Command Interpreter is a command-line tool that you use to manage Oracle Database diagnostic data).
    - Type `adrci` in a Windchill shell.
  - Or you can read the alert log with the Oracle Enterprise Manager.
    - To find location of alert log:

```
SQL> select name,value from v$parameter where
name='background_dump_dest'
```

- **Trace Files**
  - Each database process generates its own trace file.
  - Can be important to diagnose process errors.
  - Managed by ADRCI.
  - To determine the trace file for each Oracle Database process:

```
SQL> SELECT PID, PROGRAM, TRACEFILE FROM V$PROCESS;
```

Exercise: Receive email notification of Oracle errors (15 min)

Oracle Redo Log Writer Process

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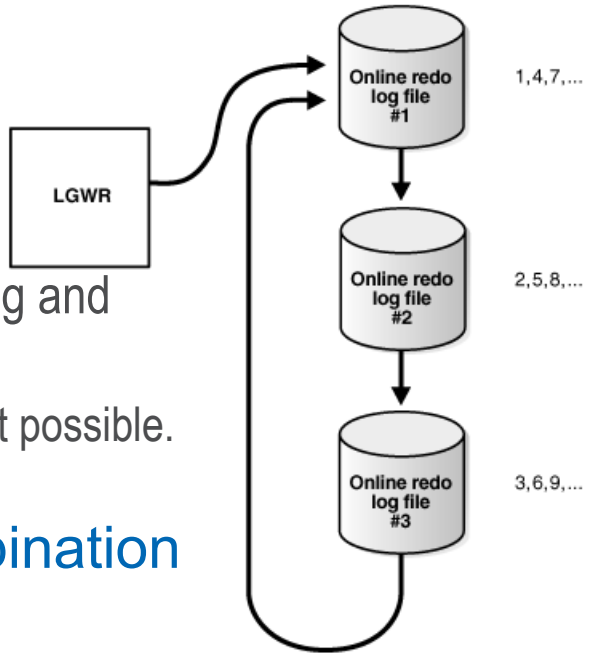
LGWR (Log Writer Process)

- All changes to the database are recorded in redo log files before being persisted to data files.
  - Online redo logs are transient, they will be overwritten.
- Redo logs are critical for enabling recovery of a database to point of failure.
  - If you lose them you can only roll back to the last scheduled backup.
  - With them, you can recover to the point of failure.
- LGWR writes to one active redo log at a time.
  - Once that log is full it progresses to next redo log.
    - If ARCHIVELOG mode is set then that redo log is archived.
  - Once the last redo log is full, LGWR cycles back to the beginning and overwrites contents of first log.
    - If NOARCHIVELOG mode, then recovery to point of failure is not possible.
- You should protect the online redo logs with a combination of:
  - Multiplexing to different disks.
  - Separating from datafiles.
  - Using redundant disk technology such as RAID.

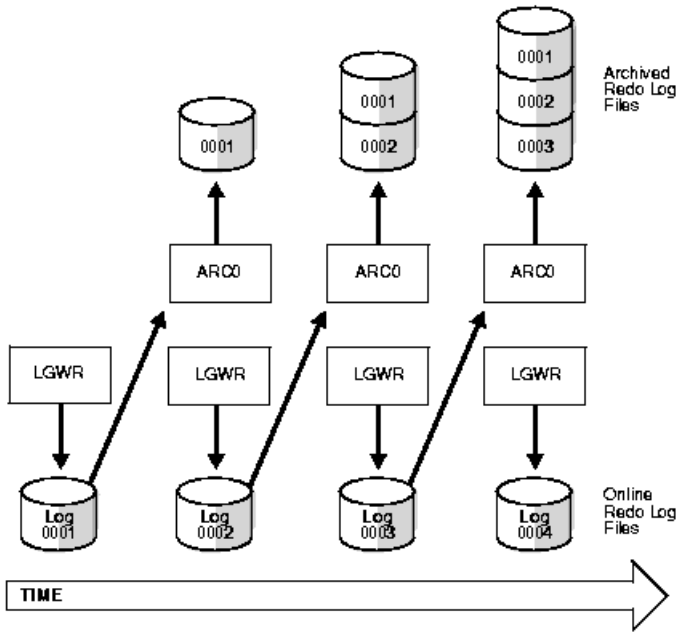


ARCn (Archiver Process)

- Archiver Process
  - The archiver process is optional and only occurs when database is in ARCHIVELOG mode.
  - In ARCHIVELOG mode online redo logs are archived before they can be overwritten.
  - Archived redo logs **plus** online redo logs **plus** backed up datafiles allow an Oracle database to be restored to point of failure.

- The ARC process is triggered by the LGWR process when a *log switch* occurs. A *log switch* normally occurs when an online redo log is filled, but it can be manually invoked with the command:
  - `alter system switch logfile;`

- You should protect the archived redo logs with combination of:
  - Multiplexing to different disks.
  - Separating from datafiles.
  - Using redundant disk technology such as RAID.



Reorganizing OCU Database

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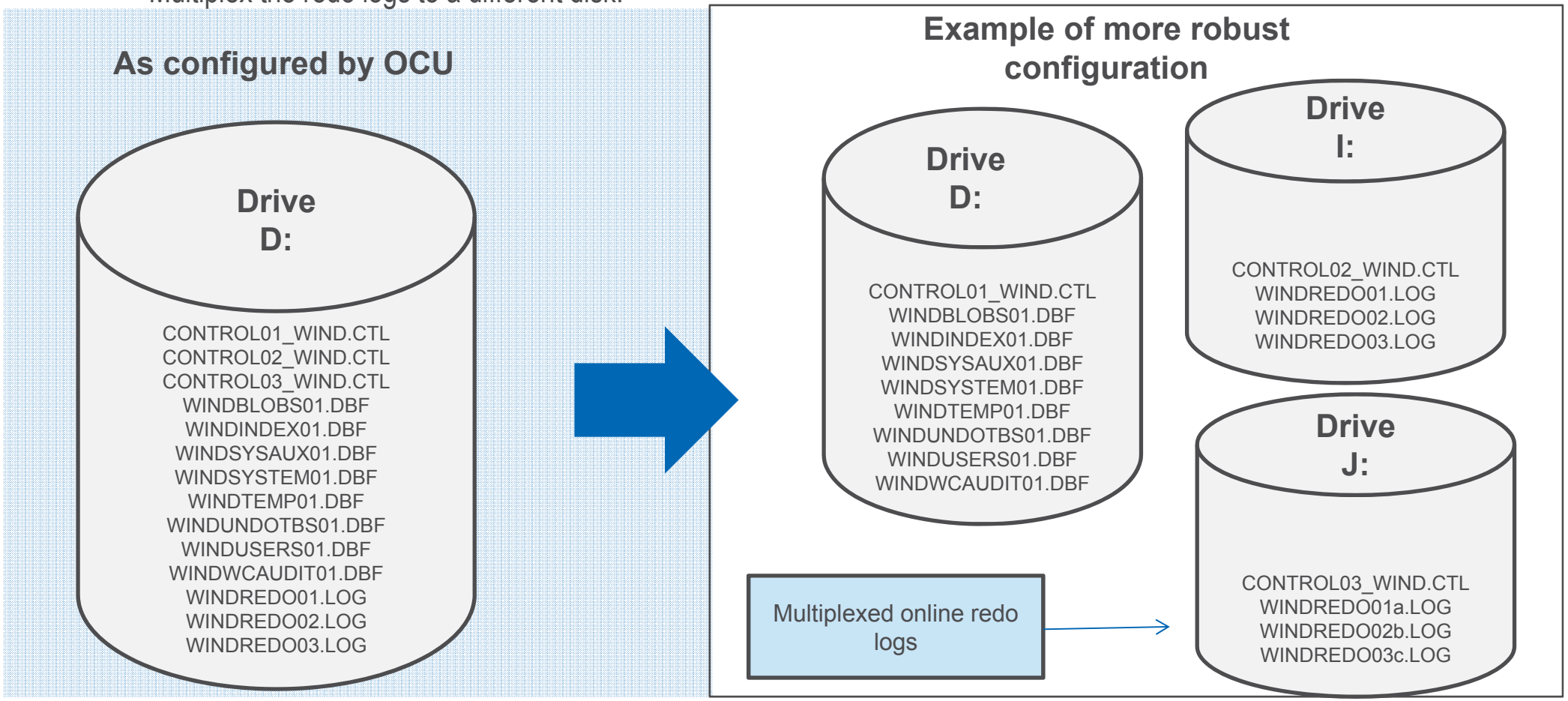
- Given the importance of control files, online redo logs, and archived redo logs to the subject of Oracle backup and recovery means that an OCU-created database requires some alteration to reduce the risk of data loss.

	File Name	Comment	Recommendation
Control Files	CONTROL01_[SID].CTL CONTROL02_[SID].CTL CONTROL03_[SID].CTL	OCU creates three multiplexed control files (duplicates of each other).	Relocate two of the control files to separate disks to reduce risk of data loss.
Datafiles	[SID]BLOBS.DBF [SID]INDEX01.DBF [SID]SYSAUX1.DBF [SID]SYSTEM01.DBF [SID]TEMP01.DBF [SID]UNDOTBS01.DBF [SID]USERS01.DBF [SID]WCAUDIT01.DBF	OCU creates these default datafiles of different sizes according to the profile you selected when creating the database. As the data grows the DBA will either expand these files, or add more datafiles.	No need to change anything except to ensure that sufficient space is available within the datafiles.
Redo Logs	[SID]REDO01.LOG [SID]REDO02.LOG [SID]REDO03.LOG	OCU creates three redo log groups. Each group contains one redo log file.	Multiplex the redo log groups so that there is more than one file per group. Ensure that different files in the same group are on different physical drives. Ensure that the redo logs are on a different physical drive from the datafiles.
Archived Redo Logs		Not enabled by default in OCU, but required for hot backup.	Multiplex the archived redo logs onto different disks, and keep separate from datafiles.

Reorganizing OCU for Offline Backup

Recommended Changes to Reduce Risk of Data Loss

- If you are relying on offline backup you could leave the OCU database files as they are: however, reorganizing the control files and redo logs could protect you against having to recover from backup.
  - Separate the three control files onto different disks.
  - Move the redo logs to a different disk from the datafiles.
  - Multiplex the redo logs to a different disk.

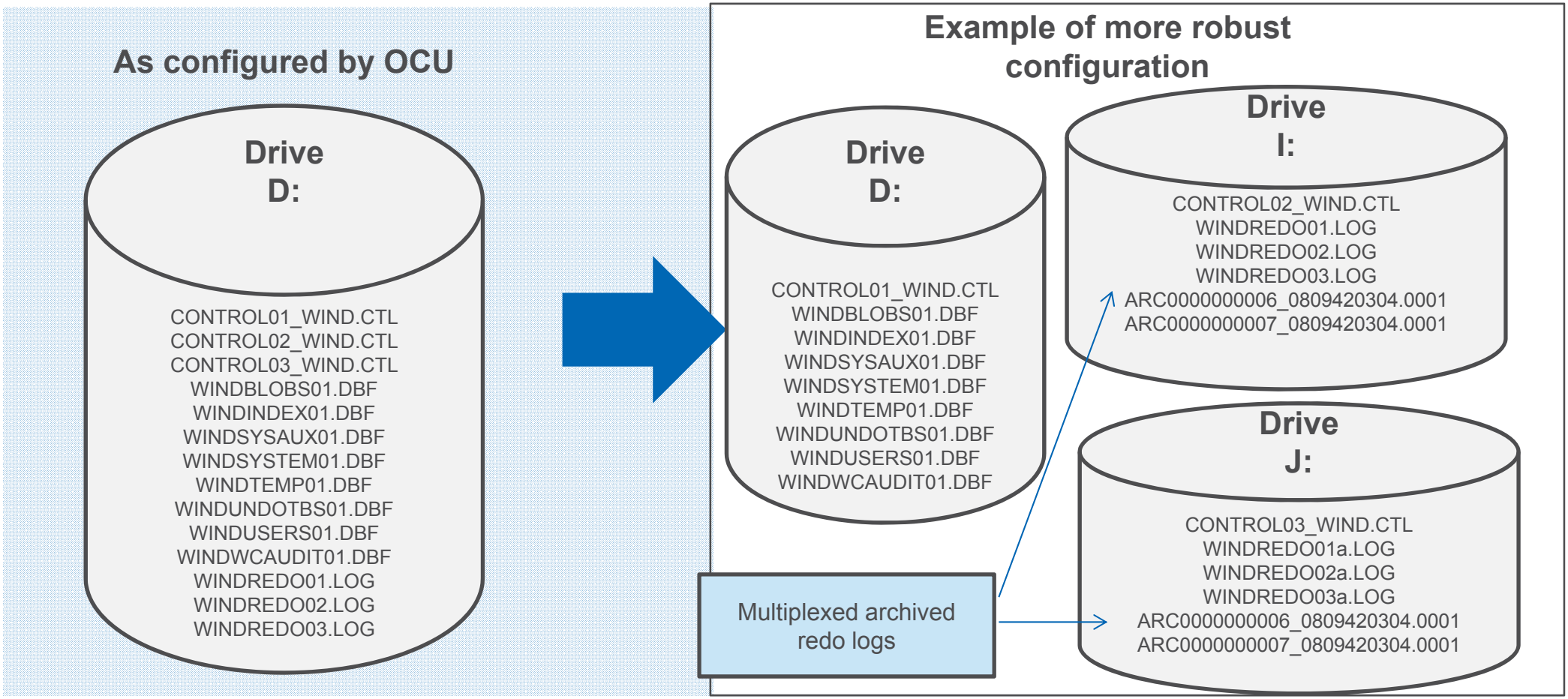


Reorganizing OCU for Hot Backup

PTC university

Recommended Changes to Reduce Risk of Data Loss

- Make changes from previous slide PLUS…
- Database must be in ARCHIVELOG mode to support hot backup.
- Multiplex archived redo logs to separate disks.



Operating System Authentication Enabled at Installation

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- When you install Oracle Database, a special Windows local group called ORA_DBA is created, and your Windows username is automatically added to it. Members of local group ORA_DBA automatically receive the SYSDBA privilege.
  - To check who is in ORA_DBA group, run:

```
net localgroup ora_dba
```

- Membership in ORA_DBA enables you to:
  - Connect to local Oracle Database servers without a password with the command:

```
sqlplus / as sysdba
```

  - You can confirm that you are connected as user SYS with:

```
SQL> show user
USER is "SYS"
```

Three Phases of Startup

- Oracle Database has three phases of startup which can be set from SQLPLUS (as SYSDBA).

Phase	Command	Comment
Startup (nomount)	`startup nomount`	Instance started, but not mounted. This reads the server parameter file, start the background processes, and opens the alert log and trace files. May be required during database recovery.
Mount	`alter database mount;` (if already in nomount state) `startup mount`	Reads the control file. Datafiles and redo logs are not yet opened. May be required during database recovery.
Open	`alter database open` (if already in mount state) `startup`	When database is open, this opens the datafiles and redo log files. If any of these files are missing or corrupted then Oracle will not start successfully and will return error.

Stopping an Oracle Instance

PTC university

Four Shutdown Commands

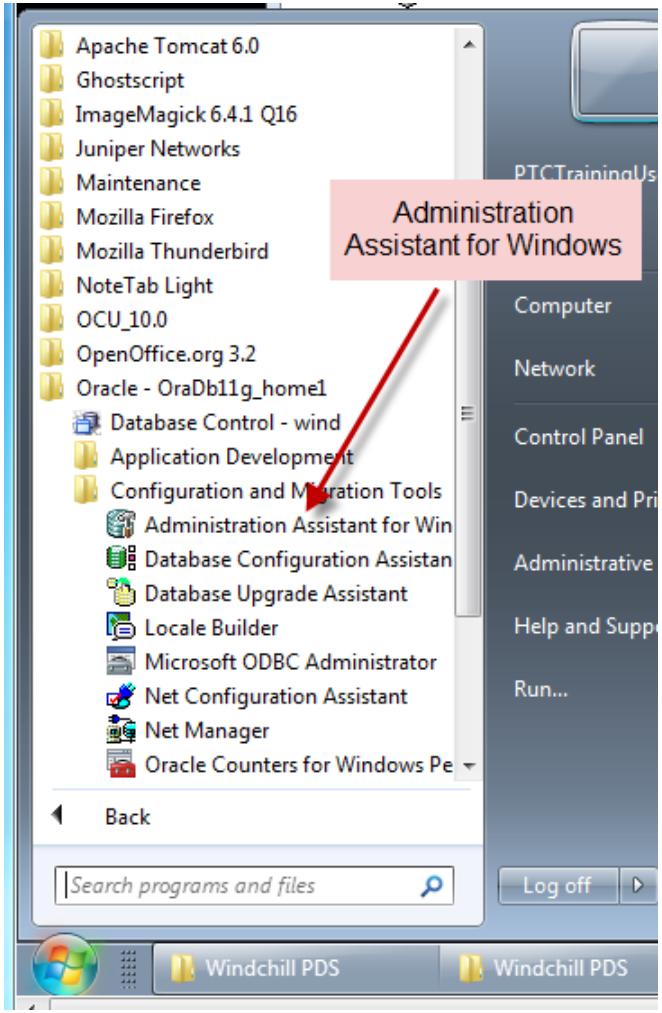
Command	Comment
`shutdown` (also `shutdown normal`)	Waits until all clients have disconnected, then shuts down.
`shutdown transactional`	Waits until all transactions are complete, then shuts down.
`shutdown immediate`	Terminates all transactions cleanly, then shuts down.
`shutdown abort`	Terminates all transactions and shuts down.

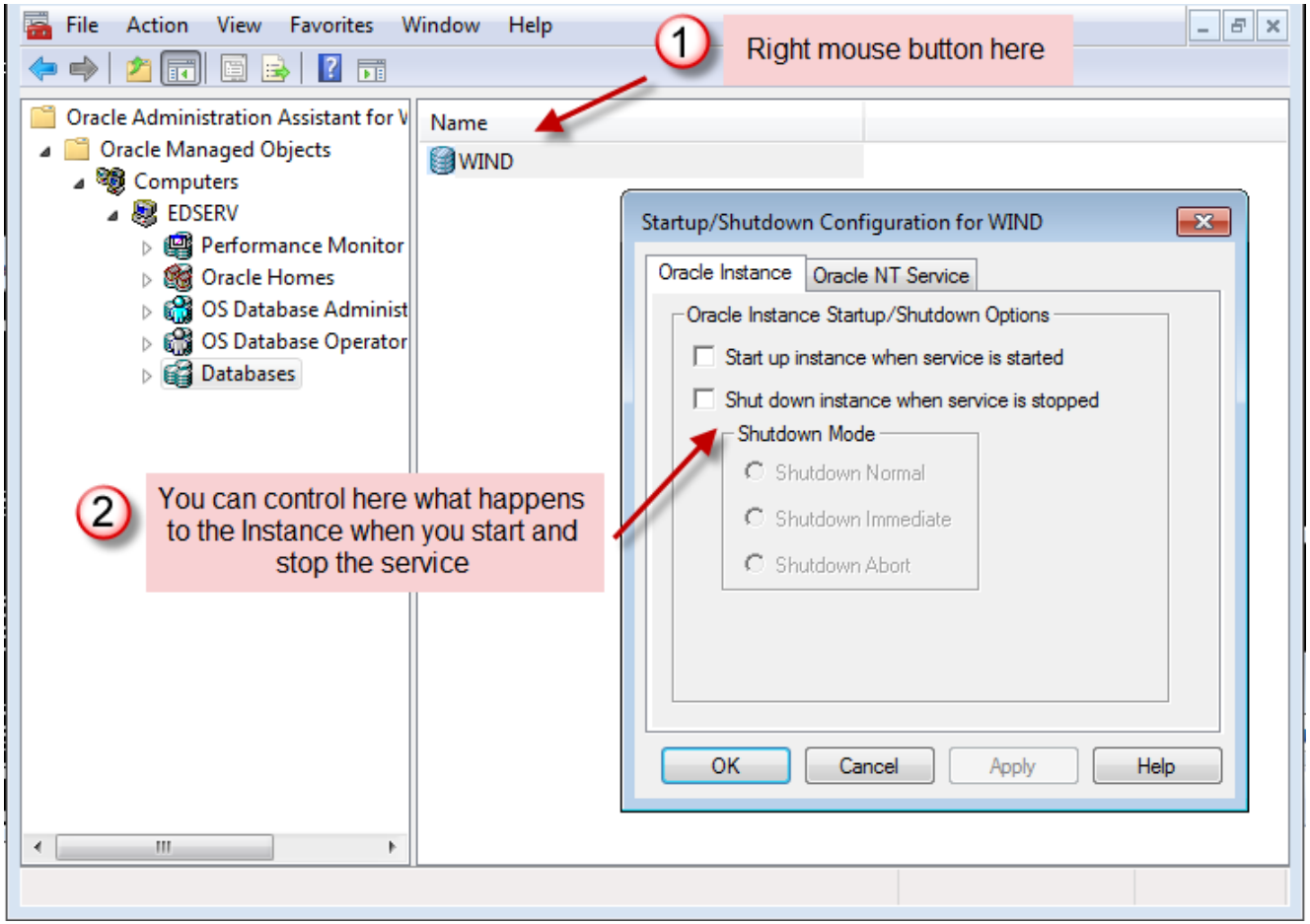
- General advice:
  - Do not use shutdown normal.
  - Use shutdown transactional *for attended shutdown only*, when you want to minimize cancelled transactions. (Should be attended only because this kind of shutdown is not guaranteed to shut the database down at all if timeouts are breached.)
  - Use shutdown immediate for unattended shutdown or when you do not care about current transactions.
  - Do not use shutdown abort unless you have to.

Windows-Specific Starting and Stopping

PTC university

- Use Administration Assistant for Windows to control the startup and shutdown modes of the Windows service.





Exercise: Reorganize OCU database (45 min)

Module 6: Backup and Recovery with Oracle RMAN

Windchill 10.1 – Backup and Recovery

Objectives

PTC university

After completing this module, you will be able to:

- Understand what Oracle's RMAN tool is.
- Understand the role of the flash recovery area in an Oracle backup..
- Write a script to perform an offline backup using RMAN.
- Restore a database from an RMAN backup.
- Understand the role of archived redo logs, and understand how to enable them.
- Write a script to perform an online backup using RMAN.

RMAN – Recovery Manager for Oracle

PTC university

- RMAN is Oracle's backup and recovery solution.
- Oracle recommends RMAN as its preferred method for backup and recovery.
- RMAN can integrate with third party media management products such as Veritas NetBackup, HP Data Protector, and Tivoli for tape backup.
  - Performing tape backups is outside the scope of this course.
- Note: Whole books are available on backup and recovery with RMAN; this course will give you a feel for the basics.

More about the Flash Recovery Area

PTC university

Flash Recovery Area (FRA) Introduced in Oracle 10g

- FRA is optional; you could use RMAN to back up directly to the file system without a flash recovery area.
- However FRA provides some powerful benefits.
  - Disk space for backup is managed; if the allocated disk fills then alerts are generated.
  - Backup retention is managed:
    - Based on redundancy (e.g., Keep three good backups available).
    - Or retention period (e.g., Keep one week worth of backups).
  - Based on retention policies, obsolete backups may be removed.
- Sizing the FRA can be complex, but should normally include:
  - A copy of all datafiles.
  - Incremental backups, as used by your chosen backup strategy.
  - Online redo logs.
  - Archived redo logs not yet backed up to tape.
  - Control files.
  - Control file autobackups (which include copies of the control file and SPFILE).

Sizing the Flash Recovery Area

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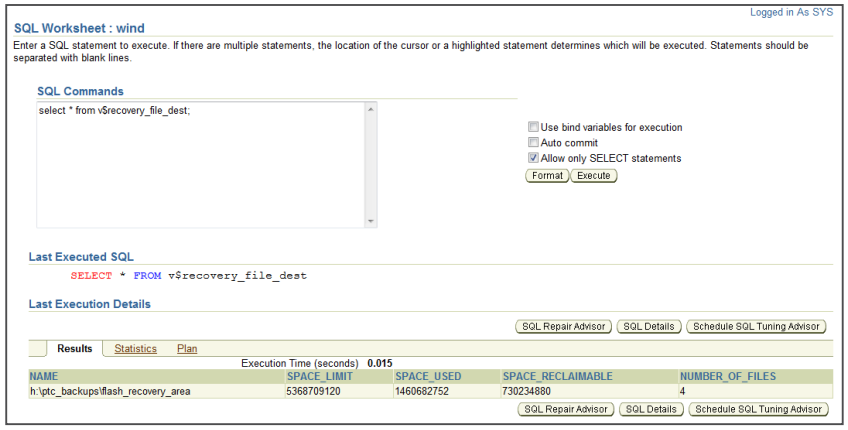
- You can check the current size of the datafiles with

```
sqlplus / as sysdba
SQL> select sum(bytes)/1024/1024 from dba_data_files;
SUM(BYTES)/1024/1024
--------------------
                3892.75
```

  - This gives the disk usage in MBs, therefore the example above shows 4 GB

- There are two useful views for checking used and available space in the FRA:
  - `v$recovery_file_dest;` (summary of space used)
  - `v$flash_recovery_area_usage;` (space used by file type)



It can be easier to read the output from a Select command in the SQL Worksheet available within the OEM than using SQL*Plus.

Verifying Use of a FRA

PTC university

- You can verify whether you are using a flash recovery area (FRA) by issuing the following SQL statement:

```
SQL> show parameter db_recovery_file_dest;
```

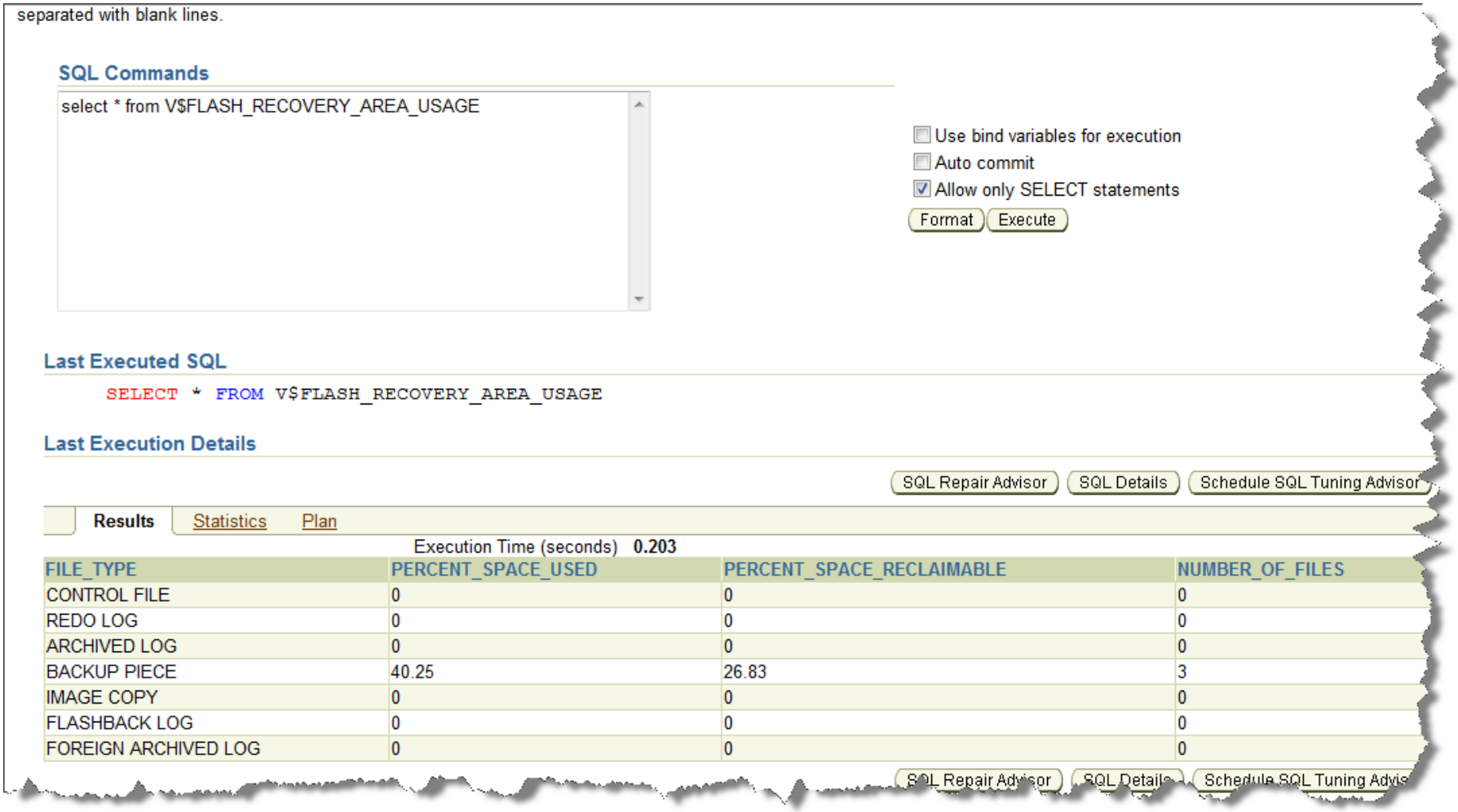
- If you are not using a flash recovery area, then the value of the db_recovery_file_dest initialization parameter will be null. If you are using a flash recovery area, then there will be a directory shown in the VALUE column. For example:

```
NAME                     TYPE   VALUE
------------------------ ------ ------------------------------
db_recovery_file_dest string h:\ptc_backups\flash_recovery_area
```

Reporting FRA Usage

PTC university

- `select * from V$FLASH_RECOVERY_AREA_USAGE`



Backup Retention Policies

PTC university

- If you are using an FRA, then RMAN allows you to define a retention policy that determines when your old backups become obsolete and can be removed to free up disk space.
- RMAN supports two types of retention policy:
  - Recovery Window-Based

Connect to RMAN from a Windchill shell with the command

```
RMAN target /
```

    - Ensures that your database can be recovered to an earlier point in time. For example, you could recover to any point in the last seven days by setting the policy:

```
RMAN> configure retention policy to recovery window of 7 days;
```

  - Redundancy-Based

    - Ensures that a fixed number of earlier backups are retained. For example, you may want to retain three good backups by setting the policy:

```
RMAN> configure retention policy to redundancy 3;
```

Backup Retention Policies (cont.)

PTC university

- You can check the current retention policy with the command:

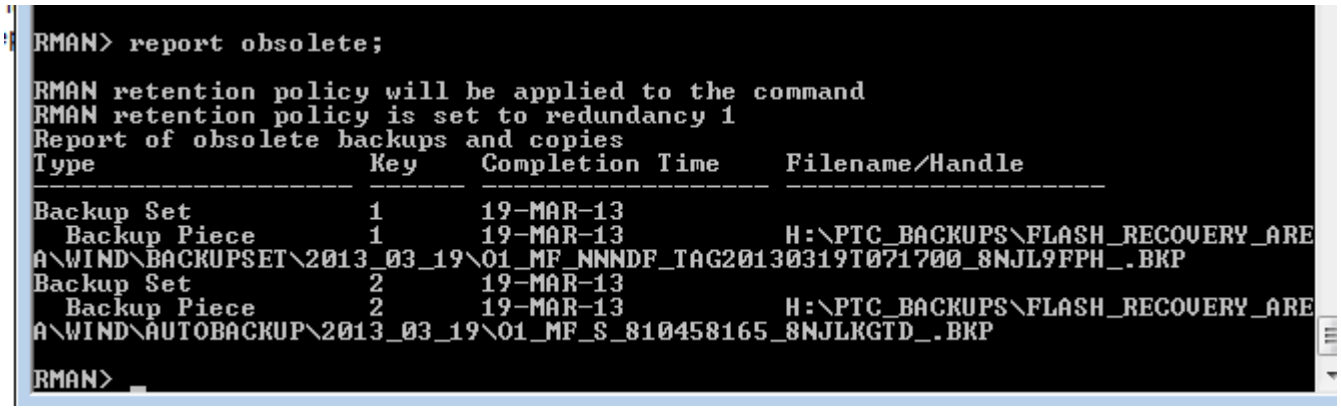
```
RMAN> show retention policy;

    RMAN configuration parameters for database with db_unique_name WIND are:

    CONFIGURE RETENTION POLICY TO REDUNDANCY 1; # default
```

- Backups existing in the FRA are marked as obsolete if they are outside of the retention policy.
- You can report on these with the command:

```
RMAN> report obsolete;
```



Deleting Backups

PTC university

- There are a variety of delete options with RMAN.
- Most useful is probably:

```
RMAN> delete obsolete;
```

  - This deletes all backups which are obsolete according to the current retention policy.

- If you use the FRA to manage backups, you do not need to manage obsolete backups; they will be deleted from the FRA automatically as disk space is needed.

RMAN Repository

PTC university

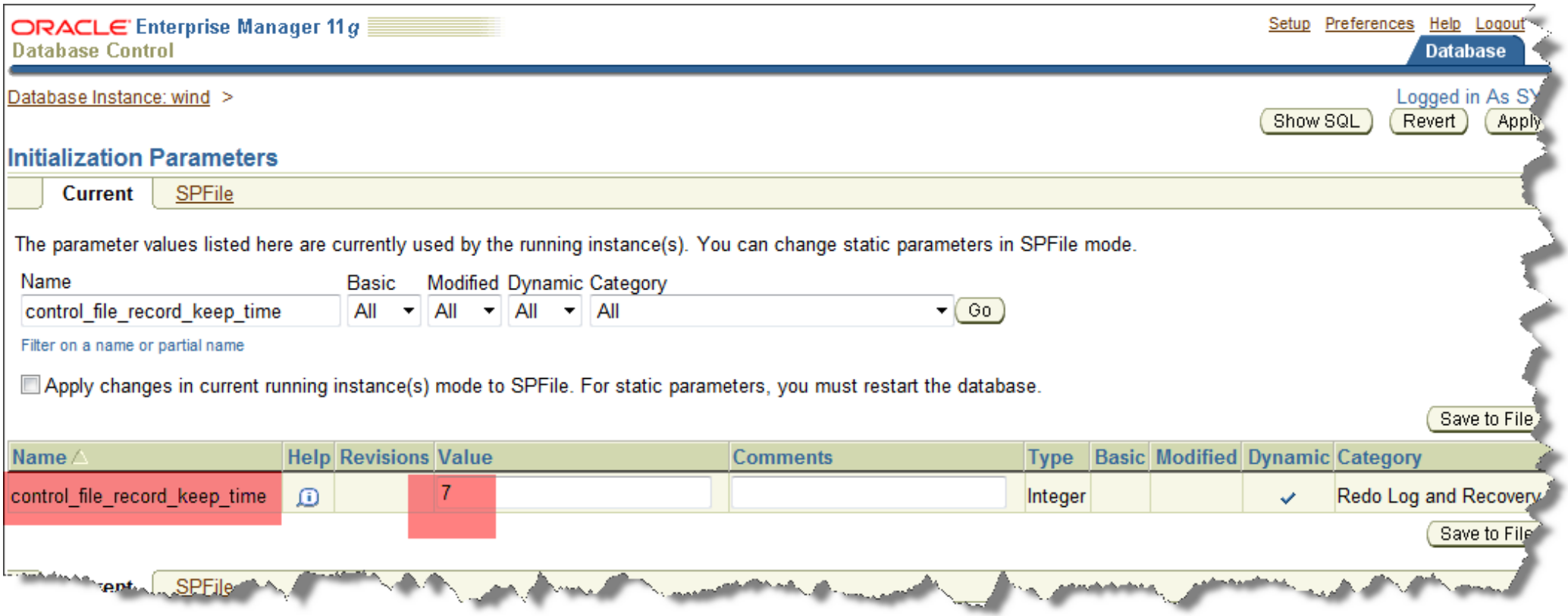
- RMAN repository stores information that RMAN needs to operate.
  - By default, this data is stored in the Oracle control files.
- You may optionally store this data in a recovery catalog.
  - A recovery catalog is persisted in an Oracle database (rather than externally like a control file).
  - For security, the catalog should be stored in a separate database from the one being backed up, ideally in its own database.
  - A recovery catalog is only recommended for large implementations with multiple databases and will not be used during this course.
- The RMAN repository provides the data that is available through the following commands.
  - LIST
    - `RMAN> list backup;`
    - `RMAN> list backup summary;`
  - REPORT
    - `RMAN> list backup;`
    - `RMAN> list backup summary;`
  - SHOW
    - `RMAN> show all;`
    - `RMAN> show retention policy;`

Monitoring Control File Records

PTC university

- If you do not use a recovery catalog, then eventually RMAN control file records are overwritten. Set this initialization parameter in the parameter file of the target database to determine how long records are kept:

```
CONTROL_FILE_RECORD_KEEP_TIME = number_of_days_to_keep
```



Control File Auto Backup

PTC university

- The control file is essential for performing an Oracle recovery.
- When you back up the entire database, the control file is backed up.
- Using controlfile autobackup option has advantages:
  - Control file and spfile will be backed up during every backup (not just full database backups).
  - Control file and spfile will be backed up for any schema change (such as adding a new tablespace, altering the state of a tablespace or datafile (e.g., bringing it online), adding a new online redo log, renaming a file, adding a new redo thread, and so on).
- To check current setting:
  - `RMAN> show controlfile autobackup;`
- To enable:
  - `configure controlfile autobackup on;`

RMAN Offline Backup

PTC university

- To perform an offline backup, database must be in mount state. This can be set from RMAN:
  - `RMAN>shutdown immediate`
  - `RMAN>startup mount;`
- Backup command to back up entire database is:
  - `RMAN> backup as compressed backupset database;`
- You can add a tag to help identify the backup:
  - `RMAN> backup as compressed backupset database tag XXX;`
- Compression
  - If you are using a third party software (e.g., Veritas) in conjunction with RMAN, then it may do the compression for you.
  - Hardware compression is available on tape devices so no need to use RMAN option.
  - Compression does require CPU and slows the backup, but preserves disk space.
- Once backup is complete, you can start database again:
  - `RMAN>alter database open;`

RMAN - Scripting Offline Backup

- A command file is a text file containing RMAN commands, exactly as you enter them at the RMAN prompt.
  - Any file extension may be used.
- RMAN supports a `run` block which allows commands to be executed as a block.
  - The block of commands is first parsed before the entire block is executed.
  - Typically used in scripts.
  - Prevents syntax errors from causing partial execution; whole block will fail.

RMAN - Scripting Offline Backup (cont.)

PTC university

- Example command file (ora_coldbackup.rman) to perform cold backup:

```
RUN {
    shutdown immediate;
    startup mount;
    backup as compressed backupset database;
    alter database open;
}
exit
```

- This can be called from a batch file, ora_coldbackup.bat:

```
rman target / cmdfile=ora_coldbackup.rman
```

RMAN Spool Output

PTC university

- SQLPlus supports:
  - `SQL> spool myoutput`
  - `SQL> select table_name from user_tables;`
  - `SQL> spool off`
  - This generates the text file myoutput.lst.
- RMAN is slightly different:
  - `RMAN>spool log to myoutput`
  - `RMAN>list backup summary;`
  - `RMAN>spool log off;`
  - This generates the text file myoutput (no extension).

RMAN Timestamps

PTC university

- By default, RMAN timestamps only show day, not time.

```
  SPFILE db_unique_name: WIND
  Control File Included: Ckp SCN: 4786448      Ckp time: 06-MAR-13

RMAN> list backup summary;


List of Backups
===============
Key     TY LV S Device Type Completion Time #Pieces #Copies Compressed Tag
------- -- -- - ----------- --------------- ------- ------- ---------- ---
7       B  F  A DISK        06-MAR-13       1       1       YES        TAG201303
06T081530
8       B  F  A DISK        06-MAR-13       1       1       NO         TAG201303
06T081936
9       B  F  A DISK        06-MAR-13       1       1       YES        TAG201303
06T092115
10      B  F  A DISK        06-MAR-13       1       1       NO         TAG201303
```

- Change this in the Windchill shell:

  D:\ptc\Windchill\Windchill>set NLS_DATE_FORMAT=dd-MON-YY hh24:mi

```
RMAN> list backup summary;

using target database control file instead of recovery catalog

List of Backups
===============
Key     TY LV S Device Type Completion Time #Pieces #Copies Compressed Tag
------- -- -- - ----------- --------------- ------- ------- ---------- ---
7       B  F  A DISK        06-MAR-13 08:19 1       1       YES        TAG201303
06T081530
8       B  F  A DISK        06-MAR-13 08:19 1       1       NO         TAG201303
06T081936
9       B  F  A DISK        06-MAR-13 09:25 1       1       YES        TAG201303
06T092115
10      B  F  A DISK        06-MAR-13 09:25 1       1       NO         TAG201303
```

Restoring the SPFILE

PTC university

- If you lose your SPFILE, you will need to restore it before you can mount the database.
  - You will need to know the DBID before you can restore the SPFILE.
  - Assuming that you have enabled autobackup, the commands are:

```
D:\set ORACLE_SID=WIND
D:\RMAN target /
RMAN>set DBID = 579025708;
RMAN>startup force nomount;
RMAN>restore spfile from autobackup;
RMAN>shutdown immediate;
```

Restoring the Control File

PTC university

- If you have lost your control file, you should have already restored your SPFILE.
  - Assuming that you have enabled autobackup, the commands are:

```
D:\set ORACLE_SID=WIND
D:\RMAN target /
RMAN>set DBID = 579025708;
RMAN>startup nomount;
RMAN>restore controlfile from autobackup;
RMAN>shutdown immediate;
```

Restoring Database from Offline Backup

PTC university

- Use the `restore` and `recover` commands for RMAN restore and recovery of physical database files.
  - Restoring datafiles is retrieving them from backups as needed for a recovery operation.
  - Recovery is the application of changes from redo logs and incremental backups to a restored datafile.
- To restore the database from the latest available backup:

```
RMAN>startup mount;
RMAN>restore database;
```

- To recover the database:

```
RMAN>recover database;
```

- To open the database:

```
RMAN>alter database open resetlogs;
```

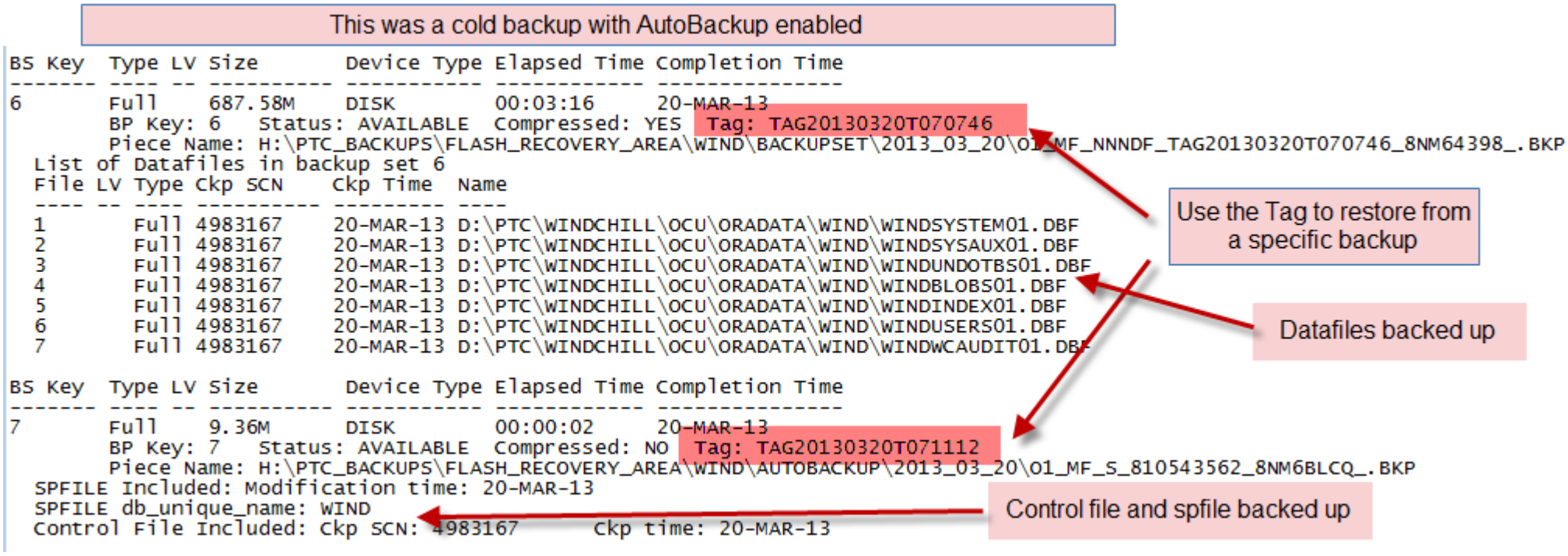
Exercise: Initialize RMAN and perform offline backup and recovery of Oracle (45 min)

Listing Backups

PTC university

- You can get a list of available backups using this command (spooling it to an output file for easier reading):

```
RMAN> spool log to list_backup
RMAN> list backup;
RMAN> spool log off
```



Exercise: Recover from older Oracle backup (15 min)

ARCHIVELOG Mode vs NOARCHIVELOG Mode

- To perform online backup with RMAN, the database must be in ARCHIVELOG mode.
- To check current mode:

```
SQL> select log_mode from v$database;
```

- Set the archived redo log destination directory with:

```
SQL> alter system set
log_archive_dest_1='location=H:\oradata\wind';
```

- For security, duplex the archived redo logs with:

```
SQL> alter system set
log_archive_dest_2='location=I:\oradata\wind';
```

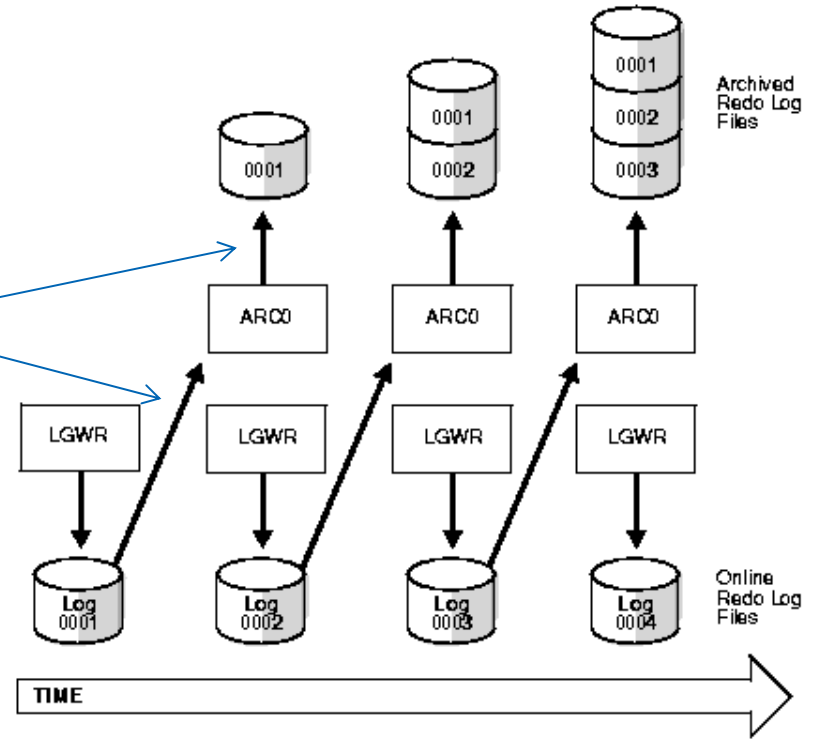
ARCHIVELOG Mode vs. NOARCHIVELOG Mode

- To enable ARCHIVELOG mode:

```
D:\sqlplus / as sysdba
SQL>alter database shutdown
SQL>startup mount
SQL> alter system set log_archive_dest_1='location=H:\oradata\wind';
SQL> alter system set log_archive_dest_2='location=I:\oradata\wind';
SQL>alter database archivelog;
SQL>alter database open
```

The log writing process is normally handled automatically by Oracle, but you can force it with the command

```
alter system switch logfile;
```



Exercise: Enable ARCHIVELOG mode (15 min)

Archived Redo Log Deletion Policies

PTC university

- Archived redo logs will grow and continue to consume disk space until they are deleted.
- You can store the archived redo logs in the FRA, which comes with the advantage that Oracle will delete them for you. But…
  - Logically the FRA is a backup area, the archived redo logs are part of the database, and therefore it can be confusing to have the live archived redo logs stored there.
  - Probably better to store the live archived redo logs elsewhere and keep a backup of them in the FRA, but this means you must take care of their deletion.
- By default, RMAN has no archived redo log deletion policy:

```
RMAN> show archivelog deletion policy;

RMAN configuration parameters for database with
db_unique_name WIND are:
CONFIGURE ARCHIVELOG DELETION POLICY TO NONE; # default
```

Archived Redo Log Deletion Policies (cont.)

- Solution is to define an archived redo log deletion policy:

```
RMAN> CONFIGURE ARCHIVELOG DELETION POLICY TO BACKED UP 2
TIMES TO DISK;
```

  - You can remove this again with:

```
RMAN> CONFIGURE ARCHIVELOG DELETION POLICY TO NONE;
```

- This tells RMAN to remove archived redo logs once they have been backed up twice to disk.
  - On a production system you would normally have a tape as the permanent media rather than disk, in which case the command uses `TO SBT`; rather than `TO DISK;`
- Archived redo logs are not removed until **both** of the following are true:
  - They meet the deletion policy specified
  - You inform RMAN via the backup command to delete them
- Append `delete all input` to the backup command:
  - The delete all input clause deletes all archived redo logs from all destinations after the backup.

Online Backup

PTC university

- The database remains running for an online (hot) backup.
- The basic command to backup Oracle online is:

```
backup database plus archivelog
```

- This command will:
  - Back up existing archived redo logs.
  - Back up database.
  - Run the autobackup (if enabled) of control file and spfile.
- Add the clause `as compressed` to compress backup.
- Add the clause `delete all input` to remove archived redo logs once they comply with the archived redo log deletion policy.
- For example:

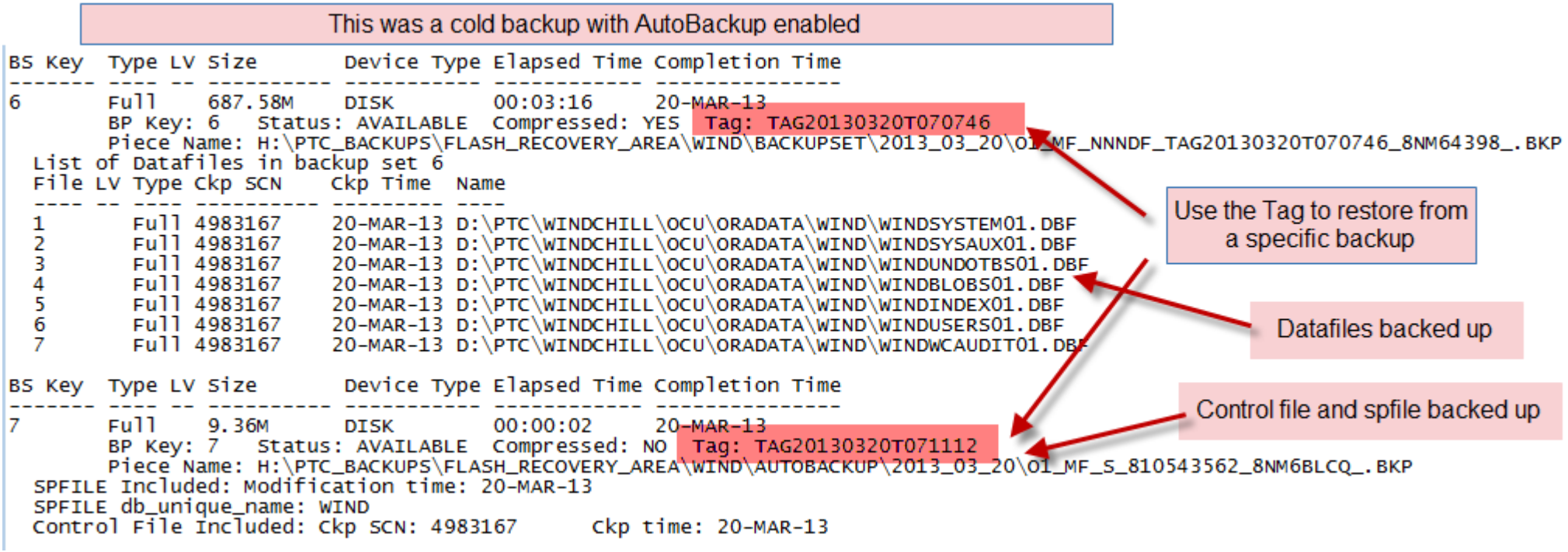
```
backup as compressed backupset database plus archivelog
delete all input;
```

Listing Backups

PTC university

- You can get a list of available backups using this command (spooling it to an output file for easier reading):

```
RMAN> spool log to list_backup
RMAN> list backup;
RMAN> spool log off
```



Exercise: Write hot backup script and run (15 min)

The Restore and Recover Commands

PTC university

RMAN separates restore and recover.

- Restore
  - Restore command restores the files from the backup in preparation for recovery
- Recover
  - Recover command will recover the database by
    - Extracting and applying available archived redo logs
    - Applying online redo logs
- By default, RMAN attempts to recover the database to the point of failure.
  - Key point! This shows the real power of RMAN, enabling automatic recovery to the point of failure
- If you have lost the online redo logs then this is not possible and you can only recover to the point of the last backup.
- You can perform an incomplete recovery in SQL*Plus with the command:
  - `SQL> recover database until cancel;`
  - This will recover the database to the point that you tell it to cancel.
  - You will need to do this if you have lost the online redo logs

Exercise: Restore from hot backup (30 min)

RMAN Maintenance

PTC university

- Detailed RMAN maintenance is beyond the scope of this course; however, if you are responsible for administering a backup solution you must be aware of at least the following
  - Cross-checking

    RMAN's record of backups can become out of step with the actual backups that exist on tape or disk. For example, a user may inadvertently delete backup pieces from disk using operating system commands, or one of the tapes used by the media manager may become corrupted.

    To ensure that data about backups in the recovery catalog or control file is synchronized with actual files on disk or in the media management catalog, perform a cross-check. The `crosscheck` command operates only on files that are recorded in the RMAN repository.
  - Deleting

    Always use `delete` rather than an operating system utility to remove RMAN backups and copies. If you do not, then the RMAN repository is not synchronized with what exists on the file system or on tape.
  - Reporting

    The RMAN repository, which is either a recovery catalog or the target database control file, contains a wealth of metadata about backups and copies as well as other useful things such as database schema and configuration settings. You can use RMAN commands `list`, `report`, and `show` to access this repository information.

RMAN Maintenance (cont.)

PTC university

- Validate
  - New in Oracle Database 11g, you can use the validate command to validate all backup pieces in the flash recovery area with the following command:

```
RMAN> validate recovery area;
```

- You can validate datafiles, backup sets, or even individual data blocks by using the validate command e.g., to validate a single backup set:
  - `RMAN> validate backupset 7;`

Module 7: Backup and Recovery of Windchill Directory Server

Windchill 10.1 – Backup and Recovery

Objectives

PTC university

After completing this module, you will be able to:

- Perform a full backup of Windchill Directory Server (DS).
- Write a script that can do a full backup of Windchill DS.
- Restore Windchill DS from a backup.
- Write a script to perform an incremental backup of Windchill DS.
- Understand when and how to perform a Windchill DS export.

Windchill Directory Server

- Windchill updates LDAP during normal operation as the result of user actions such as:
  - Creating new projects.
  - Creating new organizations.
  - Creating new users.
  - Installing additional Windchill products.
- This is important data that cannot be rebuilt if it is lost and thus must be backed up.
- Windchill uses Windchill DS as its LDAP implementation.
- Windchill DS is an implementation of Open DS.
  - You can find out more about Open DS at http://opends.java.net/.

Windchill Directory Server Backends

PTC university

- Windchill Directory Server organizes data into “backends”.
  - config
  - schema
  - tasks
  - userRoot

  config, schema, tasks: These are administrative data stores

  userRoot: Windchill data stored here

- For completeness, back up all backends, but userRoot is most important.

Windchill DS Backup

PTC university

- Windchill DS includes a backup command that may be executed while Windchill DS is still running.
  - No need or advantage to doing a cold backup.
- Windchill DS supports full and incremental backups
  - Incremental just backs up changes since last full backup.
- However, Windchill DS does not have a backup management tool like RMAN.
  - Backups remain indefinitely until you remove them since there is no built-in concept of a backup retention policy.
- Backups of Windchill DS are quick and small.
  - Obviously this depends on the size of the system, but you can expect a full backup to be < 5MB and take <1 min to perform.
  - Incremental backups are much smaller and quicker.

Windchill DS Backup (cont.)

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- A practical backup policy could be to perform a daily full backup plus incremental backups every 15 minutes.
  - Along with suitable Oracle and Vault backup policies this would give maximum 15 minutes data loss from LDAP

- Windchill DS does provide a Scheduled Task feature to allow recurring backups to be launched.
  - Scheduled tasks could be configured to support daily full backup and 15 min incremental backup.
  - Pros
    - Backup tasks can be configured to notify an email address on success or failure of the backup command.
  - Cons
    - The scheduled task simply performs the backups and performs no housekeeping. You would need a separate scheduled task outside of Windchill DS to remove the obsolete backups.

Windchill DS Backup (cont.)

PTC university

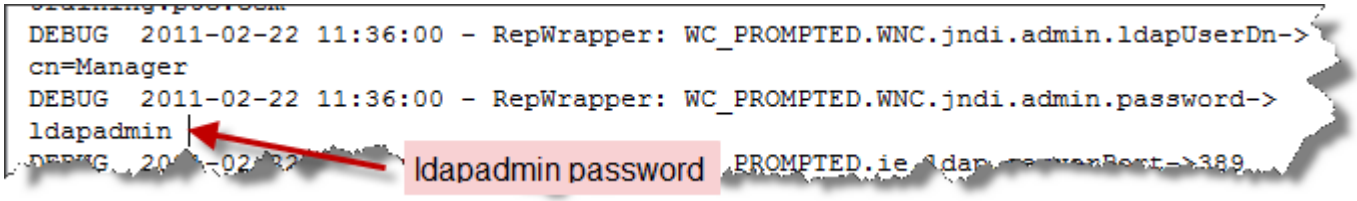
- Backup commands
  - Using the backup command you can specify which backend to back up, or back up all backends
  - By default, you should back up all backends, although userRoot is the most important.
- Commands are available under:
  - `D:\ptc\Windchill\WindchillDS\server\bat`
- For example, to do a full backup of all Windchill DS backends:
  - `backup --backupAll --compress -backupDirectory H:\ptc_backups\WindchillDS`
- To do an incremental backup of all Windchill DS backends:
  - `backup -incremental --backupAll --compress -backupDirectory H:\ptc_backups\WindchillDS`

Finding Passwords

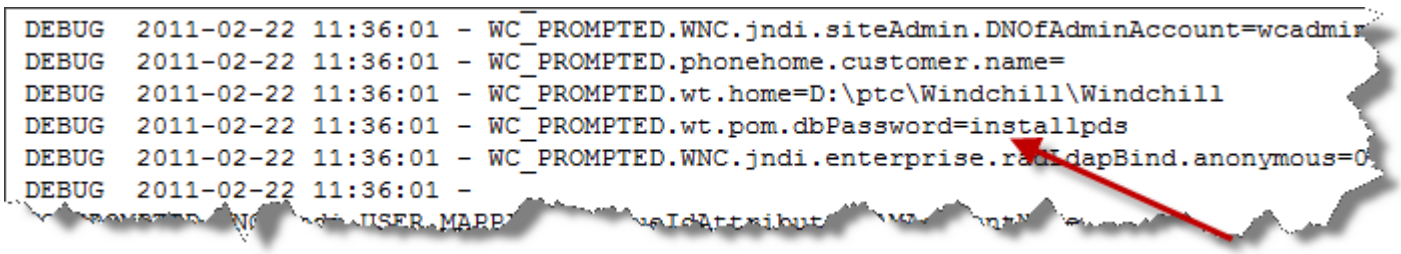
PTC university

Sometimes you don't know the admin passwords…

- They are logged in the installer logs, which may have been left in place.
- For example:
  - `D:\ptc\Windchill\Windchill\installer\logs\WNC_PtcInstall.log`
- To find LDAP admin password search for "cn=Manager":

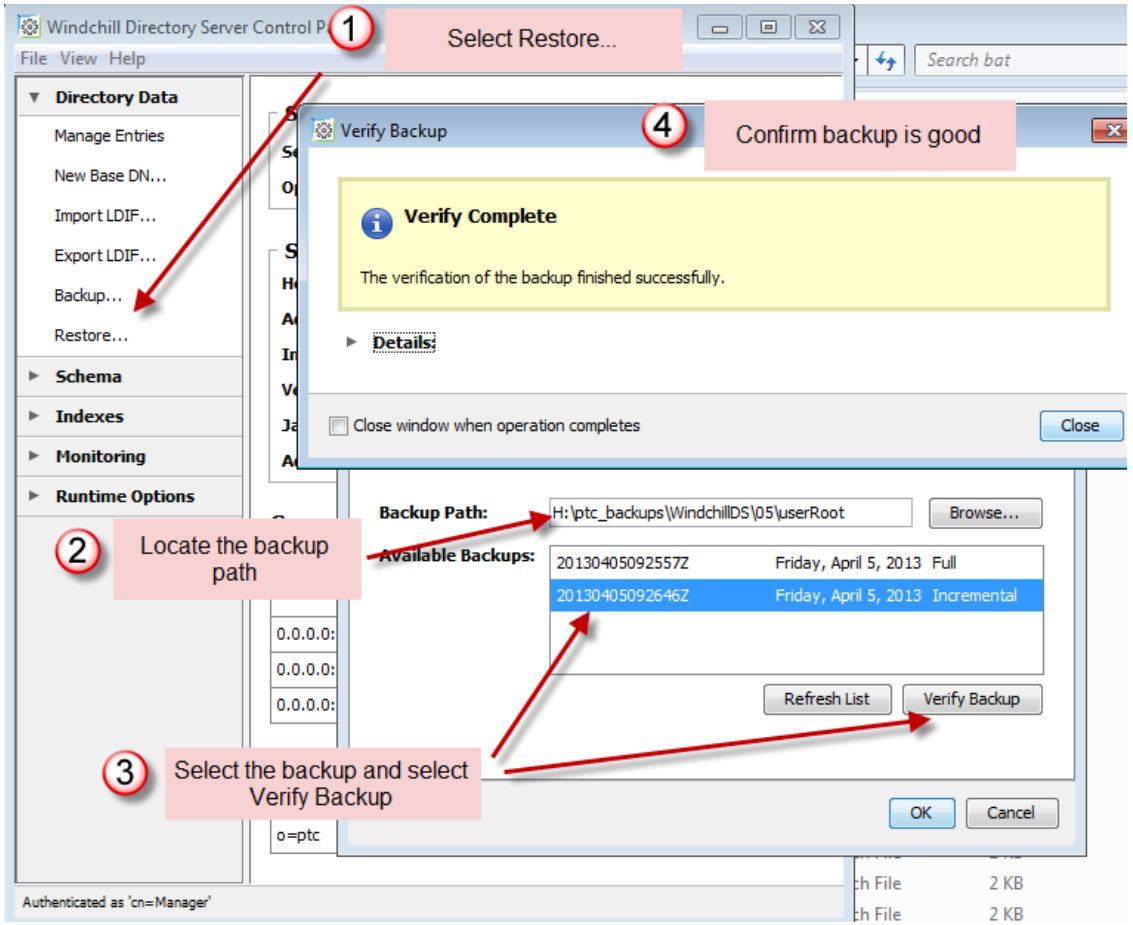


- To find Oracle password search for "wt.pom.dbPassword":



Control Panel

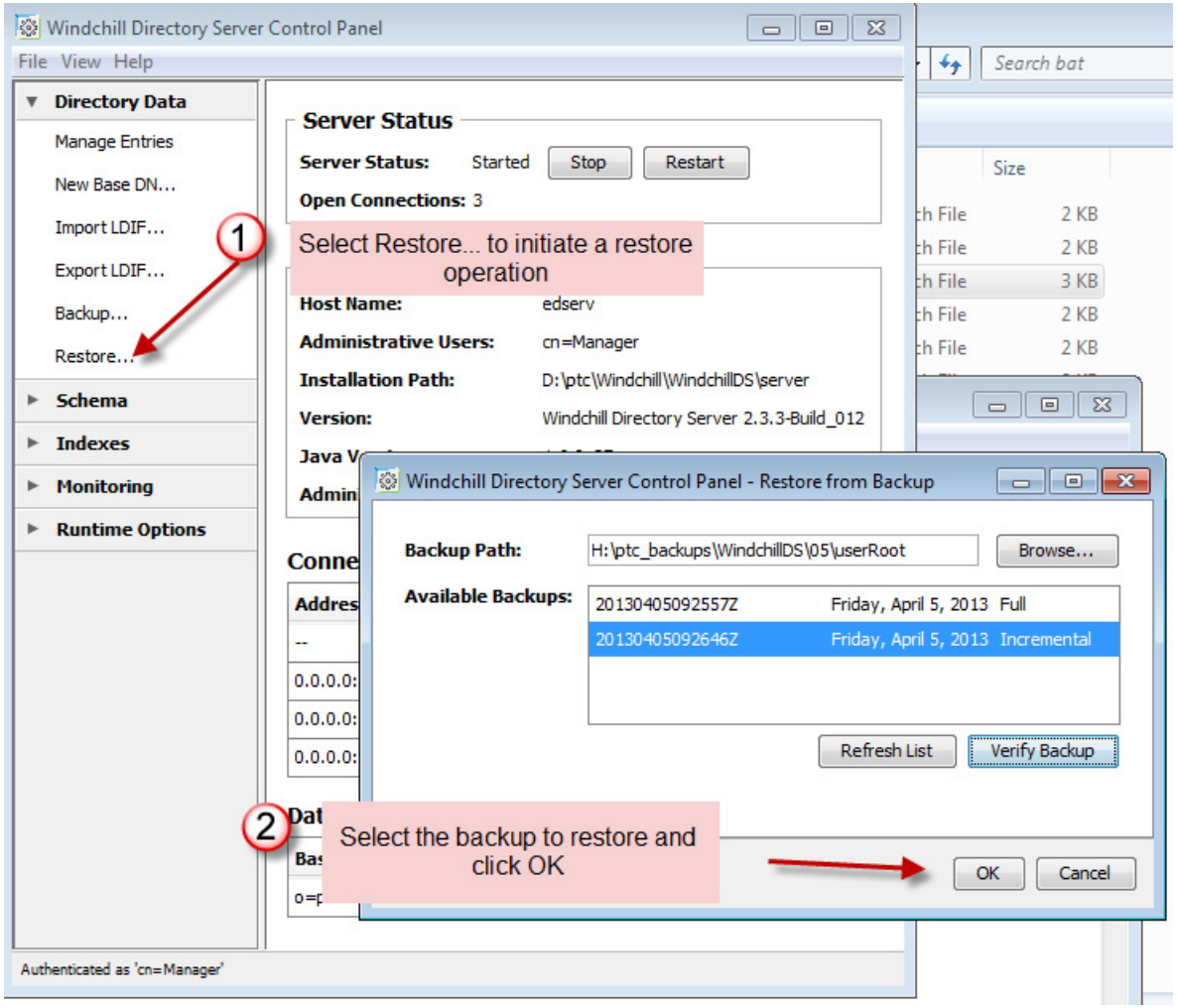
- Launch the Control Panel with:
  - `D:\ptc\Windchill\WindchillDS\server\bat\control-panel.bat`
- Control Panel allows you to perform an attended backup.
- More usefully it allows you to monitor and verify your backups.
  - For an incremental backup to be verified it must exist in the same folder as the full backup that it is related to.



Scripting a backup

- A practical Windchill DS backup script would:
  - Perform a full daily backup.
  - Perform frequent incremental backups (e.g., every 15 mins).
  - Perform basic housekeeping by complying with whatever backup retention policy you have agreed with customer.
  - Maintain a log of successful backups.
  - Alert an admin in the event of a backup error.
- In the example script we will:
  - Retain seven days of backups by assigning a backup folder for each day of the week.
  - Each day, delete the backup from the previous week and then generate a new full backup.
  - Perform incremental backups for the remainder of the day.
- The script you create in the exercise is just an example!
  - It has no error handling; you would need to add this in a production deployment.
  - You may prefer a more powerful scripting language such as Ant or VBScript.
  - Advanced scripting is beyond the scope of this course.

- Restore of a backup can be performed via the Windchill DS Control Panel.
  - Restoring from an incremental backup does not remove entries.
  - Recommend to restore from last full backup, and then restore from latest incremental backup.



Exercise: Create backup script for Windchill DS and restore missing data (30 min)

Exporting Data as LDIF

- For longer term backup, PTC also recommends performing a periodical LDIF export.
- LDIF is a version-independent text format (whereas the Windchill DS backup is binary and version-dependent).
- However, it can only back up one backend at a time.
  - Use it to back up userRoot.
  - For example:

```
export-ldif --ldifFile
H:\ptc_backups\WindchillDS\ldif\export.ldif --backendID
userRoot
```

Example Monthly LDIF Export

- Following script creates a monthly LDIF export into a folder structure like:
  - H:\ptc_backups\WindchillDS\ldif\Month01
  - H:\ptc_backups\WindchillDS\ldif\Month02
  - ....

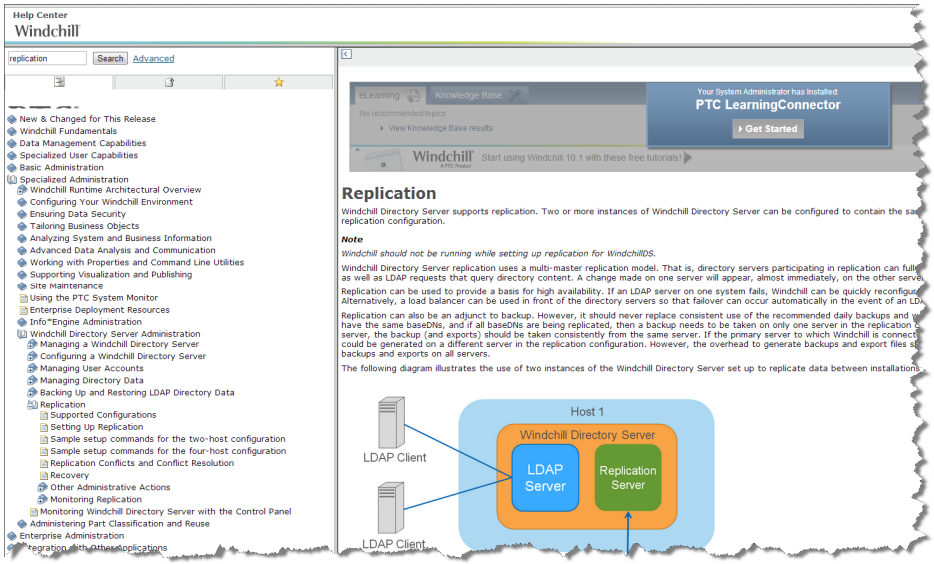
```
@echo off

REM Following lines work when date locale is US
REM Would need adjusting for different locales!
@For /F "tokens=2,3,4 delims=/ " %%A in ('Date /t') do @(
    Set Month=%%A
    Set Day=%%B
)
set "backup_dir=H:\ptc_backups\WindchillDS\ldif\Month%Month%"

echo Performing ldif export to %backup_dir%
rmdir %backup_dir% /s /q
md %backup_dir%
D:\ptc\Windchill\WindchillDS\server\bat\export-ldif --ldifFile
%backup_dir%\export.ldif --backendID userRoot
```

- Windchill DS can be configured so that a replica Windchill DS is running on a separate host.
  - Pros
    - All content is written immediately to the replica server with each change to Windchill DS.
    - Avoids the 15 min data loss risk present in the previously described backup solution.
    - Not difficult to configure.
  - Cons
    - Must be run on an additional server. Does not need to be dedicated; any available server would do.
    - Does not replace backup, you still need backup to be able to restore to an earlier point in time.

- Configuring Windchill Replication is described in help center:
  - http://www.ptc.com/cs/help/windchill_hc/wc101_hc/index.jspx?id=WCDirectoryServerAdmin_ReplicationOview&action=show



Module 8: Backup and Recovery of Windchill File Vaults

Windchill 10.1 – Backup and Recovery

Objectives

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After completing this module, you will be able to:

- Understand the different types of vault that Windchill supports.
- Understand the role of the cache vault.
- Investigate an existing Windchill server and understand how its vault storage is configured.
- Revault a Windchill server so that content currently stored as BLOBs is stored externally in file vaults.
- Understand the concept of unreferenced files, and how to manage them.
- Write a backup script to backup the Windchill file vaults.

Start Windchill in your image now to be ready for the next exercise!

Types of File Vaults

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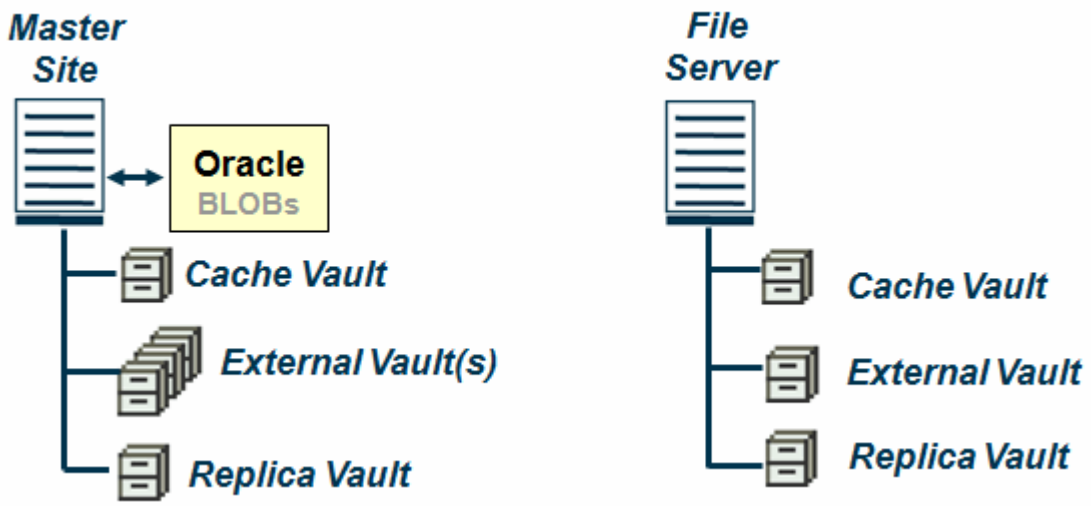
Windchill master sites and file servers can contain three different types of vaults.

Types of vaults:

Cache vault – A temporary local storage space for new content files until a revaulting or synch process occurs to move the file into a external vault.

External vault – The permanent storage location for the master copy of a content file.

Replica vault – A permanent storage location for a replicated copy of a content file.



Mapping Vaults to the Operating System

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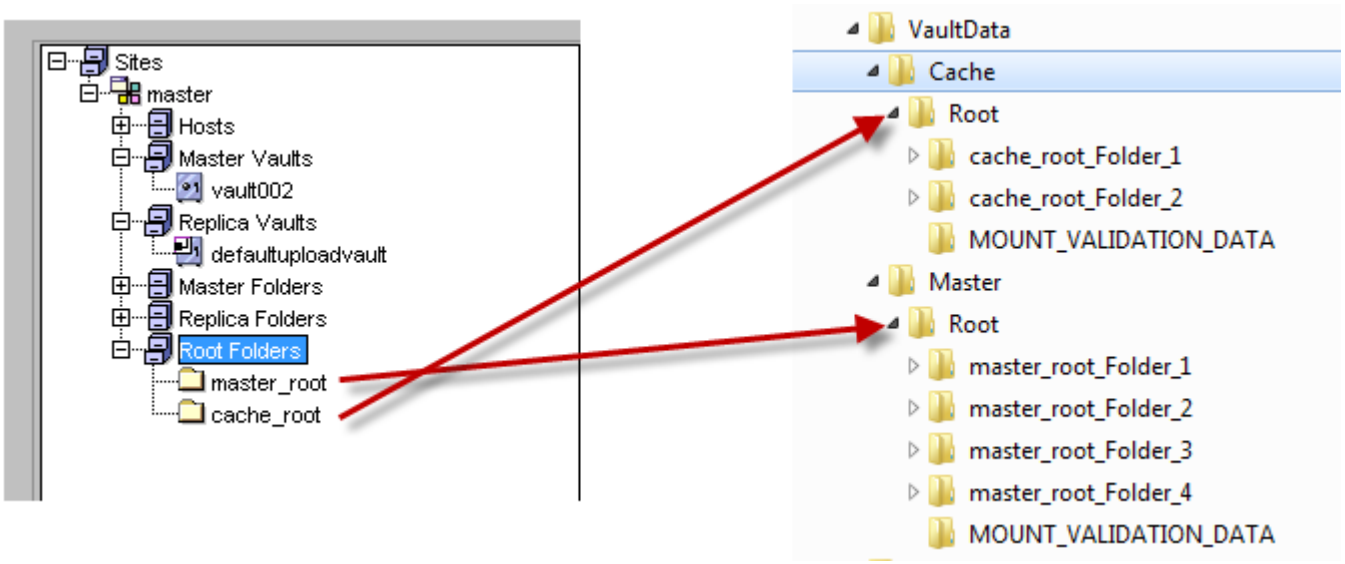
- Each vault maps to a Windchill folder, which then maps to an OS folder.
- Administrators may either manage all of their vault folders manually, or use a Windchill root folder.
- A Windchill root folder is mapped to an OS folder, allowing Windchill to manage the creation of subfolders so that content is manageable.
  - The following properties control the behaviour of the root folders:
    - wt.fv.useFvFileThreshold=true
    - wt.fv.fvFileThreshold=50000



Role of the Cache Vault

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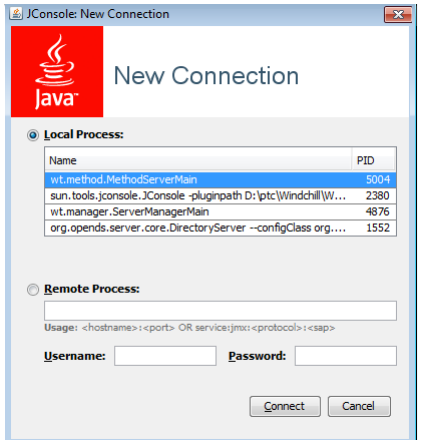
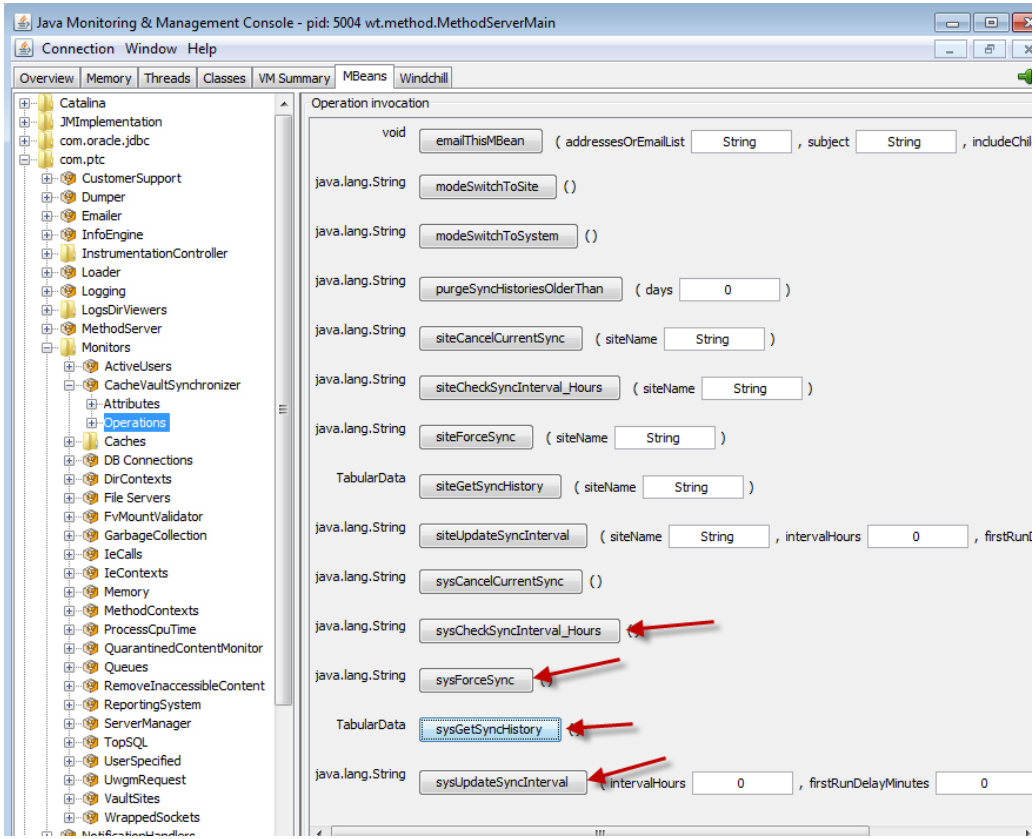
- The cachevault is the initial location when content is stored as it is uploaded from the client.
- Content is then transferred to its permanent storage location by the CacheVaultSynchronizer operation
  - The CacheVaultSynchronizer is managed by the queue “RevaultingQueue”. If this queue is not started then the synchronizer will not run.
  - Normally the queue manages synchronization but it may be forced using Jconsole.
  - By default, the CacheVaultSynchronizer executes every 3 hours, although this may be altered.
- The permanent storage location may be a BLOB in the database, or may be a vault.
- The property `wt.fv.forceContentToVault` causes the cachevault not to be used; content goes directly to the master vault.
  - This is not necessarily a bad thing, but should be understood.

Using Jconsole to Control Vault Synch

PTC university

- Connect to the method server with Jconsole.
  - Goto the CacheVaultSynchronizer object (Mbeans / com.ptc / Monitors).
- Operations include:
  - sysForceSync: Force an immediate sync.
  - sysGetSyncHistory: Inspect when sync last occurred.
  - sysChecSyncInterval_Hours: Defaults to 3.
  - sysUpdateSyncInterval: Change interval.





Understanding Existing Configuration

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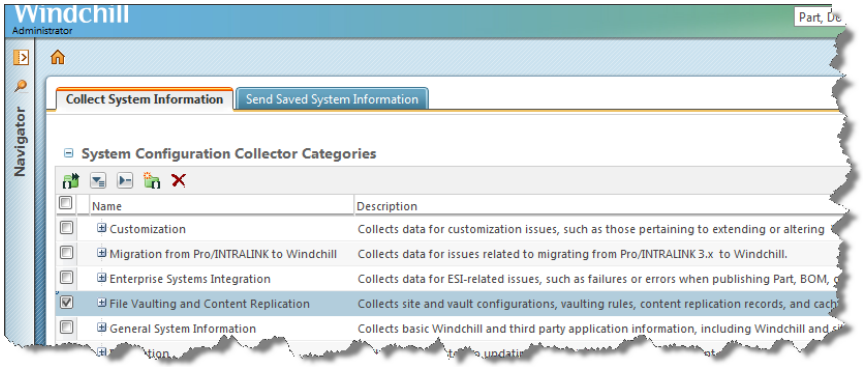
- The System Configuration Collector can help you understand the existing vaulting configuration.
  - Site / Utilities / System Configuration Collector
- Select Vaulting and Content Replication.
- Reports include:
  - File Server Configuration
  - Folder Configuration
  - Replication Status Report
  - Storage Space User by Location
  - Vault Configuration
  - Vaulting Rules



Report: Vaulting Rules

Executed By: Administrator
Time Of Execution: 2013-04-09 06:27:32 EDT
Records Retrieved: 2

Context	Administrative Domain	Class	Lifecycle State	Site	Vault
Drill - 750 Series	Default	wt.doc.WTDocument	ALL	master	vault002
Drill - 750 Series	System	wt.doc.WTDocument	ALL	master	vault002

Exercise: Examine current vaulting configuration (15 min)

Exercise: Reorganize vault configuration (40 min)

Exercise: Revault BLOBs to external vaults (40 min*)

* This exercise will take about 20min to set up and 20min of unattended processing; best to take a break!

Unreferenced Files

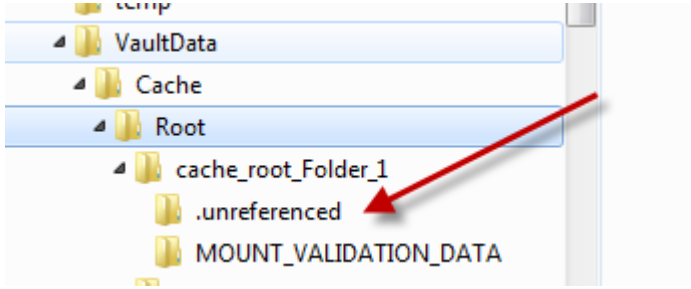
- When a file is transferred from the cache vault to its permanent location, it remains as an unreferenced file (redundant) on the operating system.
- Unreferenced files remain in the cache vault until **both** of the following occur:
  - File is revaulted (via synch process) to final location.
  - File is older than x days.
- The period x days defaults to 30; the last 30 days of content remain in the cache vault.
  - This default may be changed with the property `wt.fv.purgeUnreferencedFilesOlderThan:`

```
<Property name="wt.fv.purgeUnreferencedFilesOlderThan"
overridable="true" targetFile="codebase/wt.properties"
value="1"/>
```

Purging Unreferenced Files

PTC university

- Unreferenced files may be removed by one of three methods:
  - Using the Vault Configuration applet, manually select the vault and select Object / Remove Unreferenced Files.
  - Use the command line (which may be included in a script). `windchill wt.fv.tools.RemoveUnreferencedFiles`
  - Windchill will run a job to remove unreferenced files scheduled by the queue "commonScheduleQueue"
    - The frequency of this job defaults to daily but may be set with the property. `wt.fv.purgeUnreferencedFilesInterval`
- When unreferenced files are purged, they are permanently deleted from the operating system.
  - You can choose to move them instead to a subfolder called `.unreferenced` that exists in every vault folder.



Backing Windchill File Vaults

PTC university

- Windchill vaults are stored externally on operating system folders, which must be backed up.
- You can get a list of the OS folders in use from two places:
  - Vault Configuration Applet
    - Select Host and pick File / Generate Backup Info, which generates WTHOME/logs/MountInfo.log.

```
ptc-training.ptc.com D:\VaultData\Master\Root\master_root_Folder_3
ptc-training.ptc.com D:\VaultData\Master\Root\master_root_Folder_4
ptc-training.ptc.com D:\VaultData\Master\Root\master_root_Folder_1
ptc-training.ptc.com D:\VaultData\Master\Root\master_root_Folder_2
ptc-training.ptc.com D:\VaultData\Cache\Root\cache_root_Folder_1;H:\VaultData\Cache_Mirror\Root\cache_root_Folder_1
ptc-training.ptc.com D:\VaultData\Cache\Root\cache_root_Folder_2;H:\VaultData\Cache_Mirror\Root\cache_root_Folder_2
```

  - System Configuration Collector (more useful!!)
    - Select Category File Vaulting and Content Replication and inspect report Folder Configuration.html.
    - Indicates whether folders are Read Only.

Report: Folder Configuration

Executed By: Administrator
Time Of Execution: 2013-04-11 04:38:16 EDT
Records Retrieved: 6

Vault Name	Folder Name	Host	Mount Path	Sequence No.	Read Only	Enabled	Mount Status
vault002	master_root_Folder_3	ptc-training.ptc.com	D:\VaultData\Master\Root\master_root_Folder_3	3	No	Yes	Valid
vault002	master_root_Folder_4	ptc-training.ptc.com	D:\VaultData\Master\Root\master_root_Folder_4	4	No	Yes	Valid
vault002	master_root_Folder_1	ptc-training.ptc.com	D:\VaultData\Master\Root\master_root_Folder_1	1	Yes	Yes	Valid
vault002	master_root_Folder_2	ptc-training.ptc.com	D:\VaultData\Master\Root\master_root_Folder_2	2	Yes	Yes	Valid
defaultuploadvault	cache_root_Folder_1	ptc-training.ptc.com	D:\VaultData\Cache\Root\cache_root_Folder_1;H:\VaultData\Cache_Mirror\Root\cache_root_Folder_1	1	No	Yes	Valid
defaultuploadvault	cache_root_Folder_2	ptc-training.ptc.com	D:\VaultData\Cache\Root\cache_root_Folder_2;H:\VaultData\Cache_Mirror\Root\cache_root_Folder_2	2	No	Yes	Valid

Backing Up Windchill Read Only Folders

PTC university

- Folders are automatically marked as Read Only once they are full.
- A deleted document remains as an unreferenced file in the vault.
  - It will be removed once it is older than `wt.fv.purgeUnreferencedFilesOlderThan`
- Therefore, content in a Read Only vault folder may be removed.
- Nonetheless, to save backup time, you may choose to stop backing up folders once they become Read Only knowing that you will have **at least** all of the files backed up.
  - You can resolve the redundant files in your backup on recovery.

Backing Up File Vault Folders

PTC university

- There are many tools for copying files from an OS folder. PTC does not endorse or support any particular tool.
- For the purposes of this Windows-based training we will use Microsoft's Robocopy (Robust Copy).
  - Robocopy is part of the Windows Resource Kit and is a standard feature of Windows Server 2008.
  - There is a 64-bit version available; the version on the training image is 32-bit (installed under C:\Windows\System32).
- Robocopy example syntax:
  - To copy contents of d:\VaultData to h:\ptc_backups\VaultData:

```
robocopy d:\VaultData h:\ptc_backups\VaultData
```

  - To mirror contents, i.e., copy all subfolders and remove any additional files in destination folder:

```
robocopy d:\VaultData h:\ptc_backups\VaultData /MIR
```

  - **Be aware that /MIR will delete files in the destination!**
  - To copy contents including subdirectories without removing from destination folder:

```
robocopy d:\VaultData h:\ptc_backups\VaultData /E
```

Backing Up File Vault Folders (cont.)

PTC university

- If the backup process takes too long, you may exclude Read Only folders once they have been fully backed up.
  - To exclude specific folders from being copied:

```
robocopy d:\VaultData h:\ptc_backups\VaultData /MIR /XD
D:\VaultData\Master\Root\master_root_Folder_1
D:\VaultData\Master\Root\master_root_Folder_2
```

- Rather than editing a longer and longer single command, use a Robocopy job file to manage the parameters.

```
::
:: Source Directory :
::
      /SD:d:\VaultData\ :: Source Directory.

::
:: Destination Directory :
::
      /DD:h:\ptc_backups\VaultData\ :: Destination Directory.

::
:: Include These Files :
::
      /IF         :: Include Files matching these names
::          *.*   :: Include all names (currently - Command Line may override)

::
:: Exclude These Directories :
::
      /XD         :: eXclude Directories matching these names
            D:\VaultData\Master\Root\master_root_Folder_1
            D:\VaultData\Master\Root\master_root_Folder_2
```

Backing Up File Vault Folders (cont.)

PTC university

- Create the job file with:

```
robocopy d:\VaultData h:\ptc_backups\VaultData /MIR /XD
D:\VaultData\Master\Root\master_root_Folder_1
D:\VaultData\Master\Root\master_root_Folder_2
/save:fv_backup_job
```

- Run the job with the command:

```
robocopy /job:fv_backup_job
```

- Robocopy Monitoring
  - Although robocopy has a monitoring mode, it is not very robust. It runs in the foreground and can easily be cancelled, and will not reconnect.
  - Better to run it from a scheduler at desired frequency.

Backing Up File Vault Folders (cont.)

PTC university

- Robocopy Logging
  - Logging will be pretty verbose if left to default; recommend switching off file names:

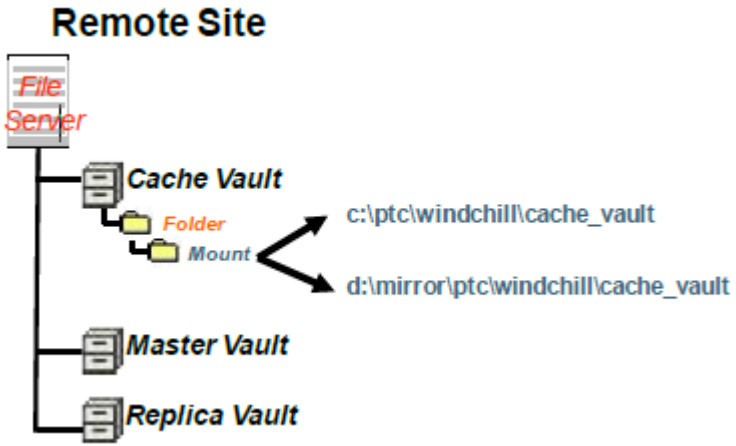
```
::
:: Logging Options :
::
    /NFL            :: No File List - don't log file names.
    /LOG:D:\ptc\backup_script\fv_backup.log :: output status
to LOG file (overwrite existing log).
```

Exercise: Create backup script for Windchill vault folders (30 min)

Backing Up Remote File Servers

PTC university

- Content stored in a remote file server is stored in vaults, so backing up a remote file server is essentially the same as backing up any Windchill vault.
  - If using Robocopy or similar on the remote site, you should execute it for the period that the queues have been suspended.



Module 9: Backup and Recovery of Other Data Stores

Windchill 10.1 – Backup and Recovery

Objectives

PTC university

After completing this module, you will be able to:

- Have an awareness of how to backup and restore the other Windchill data stores, including:
  - Index
  - Windchill Business Reporting
  - Windchill Archive Server

Index Search Backup and Recovery

PTC university

- Backing Up Index Search Collections
  - To back up Windchill Index Search collections, simply copy the index directory to a backup location. The location of your index search directory is saved as the value of the Solr property solr.data.dir. Go to the following location to see the value of this property on your Windchill system:
    - `WT_Home/solr_home/<library>/conf/solrcore.properties`
- Recovering Index Search Collections from Backup
  - Use the following steps to restore a Windchill Index Search collection from a backup location:
    1. Stop the Windchill method server.
    2. Copy the backup index directory to the original index directory location.
    3. Start the Windchill method server.
    4. Use the bulk indexing tool to verify the index data against the Windchill database.
    5. Reset any failed entries and run the bulk indexing tool to re-index.

Windchill Business Reporting

PTC university

- WBR (Cognos) is a primary data store.
  - It must be backed up, as it cannot be recreated from other sources!
- Windchill Business Reporting is an additional database schema and can be installed into the same database as Windchill.
  - In this case, backup is taken care of with existing processes, provided you back up the entire database, which in this course we do.
- If you install into a separate database, you must add an additional database backup job to your backup schedule.
  - Potentially you could then have to deal with synchronization issues between Windchill database and Cognos database.

Backing Up the PTC Windchill Archive Server

- Windchill Archive Server is a primary data store.
  - It must be backed up, as it cannot be recreated from other sources!

- To back up the Archive server:
  1. Stop the PTC Windchill Archive Server, TRIP Daemon, and TRIPnet Daemon services.
  2. Back up the PTC Windchill Archive platform installation directory, including all of its contents and subdirectories.
  3. Back up the file C:\TRIPrcs.
  4. Back up any archive volume or search database files that are located outside the PTC Windchill Archive installation directory structure. These files are located in the directory specified in the Data File Location property for the archive volume or search database. If you followed recommended procedures when you created these databases, these files are located in the installation directory structure and this step is unnecessary.
  5. Back up the root directory of any file system archive devices, including contents and subdirectories.
  6. Start the PTC Windchill Archive Server, TRIP Daemon, and TRIPnet Daemon services.

Windchill® Archive Administration Guide
Windchill 10.1 M040
April 2013

http://www.ptc.com/view?im_dbkey=135850

Backing Up and Restoring the Windchill Archive Server (cont.)

PTC university

Restoring the PTC Windchill Archive Server from a Backup

- To restore the Archive server
  1. Reinstall the PTC Windchill Archive server in its original installation directory, with the same “system” password as the previous installation.
  2. Stop the TRIP Daemon and TRIPnet Daemon services.
  3. Using the most recent backup, restore the PTC Windchill Archive platform installation directory, including all of its contents and subdirectories.
  4. Restore the file C:\TRIPrcs from the most recent backup.
  5. If necessary, restore any archive volume or search database files that were located outside of the PTC Windchill Archive server installation directory structure from the most recent backup.
  6. If necessary, restore the root directory, including contents and subdirectories, of any file system archive devices from the most recent backup. This step may not be necessary if file system based archives are located on a network share which has not been affected by a failure that is confined to the PTC Windchill Archive server machine.
  7. Start the PTC Windchill Archive Server, TRIP Daemon, and TRIPnet Daemon services.

Windchill® Archive Administration Guide
Windchill 10.1 M040
April 2013

http://www.ptc.com/view?im_dbkey=135850

Module 10: Backup and Recovery – Bringing it Together

Windchill 10.1 – Backup and Recovery

Objectives

PTC university

After completing this module, you will be able to:

- Understand the sequence of backup steps required to perform a complete Windchill backup.
- Write a script that can stop and start the Windchill queues.
- Write a script that can perform a full hot backup of Windchill.
- Write a script that can perform an incremental hot backup of Windchill.
- Understand how to restore a Windchill server from a backup.
- Fix synchronization issues following a restore that may arise between:
  - Windchill database and Windchill DS (Disconnected Principals).
  - Windchill database and external file vaults

Windchill Queues and Backup

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- Robust Windchill backup and recovery depends on being able to synchronize the recovery of the primary data stores.
- This is made easier during a hot backup if you stop the queues during the backup.
- Stopping the queues means that the external vaults will not change.
  - Content accumulates in the cache vault (which should be mirrored), but the master vault will not be written to (because the commonScheduleQueue manages that).
  - Content will not be revaulted.
  - Content will not be purged from external vaults.
  - Replication will be suspended.
  - CAD Worker will be suspended.
- OOTB the only option to stop queues is to use the Admin user interface in Queue Management.

Windchill Queues and Backup (cont.)

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- To be able to stop queues from a script you need to write a simple Java class.
  - StopAllQueues.java

```
package ext;
import wt.queue.QueueHelper;
import wt.util.WTException;
import java.io.PrintStream;
public class StopAllQueues
{
     public StopAllQueues()
     {
     }
     public static void main(String args[])
               throws WTException
     {
               try {
                         System.out.println("Stopping all queues...");
                         QueueHelper.manager.stopAllQueues();
                         System.out.println("Queues stopped...");
               } catch (Exception e){};
     }
}
```

Windchill Queues and Backup (cont.)

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- To be able to start queues from a script you need to write a simple Java class.
  - StartAllQueues.java

```
package ext;
import wt.queue.QueueHelper;
import wt.util.WTException;
import java.io.PrintStream;
public class StartAllQueues
{
     public StartAllQueues()
     {
     }
     public static void main(String args[])
     throws WTException
     {
        try {
        System.out.println("Starting all queues...");
        QueueHelper.manager.startAllQueues();
        System.out.println("Queues started...");
        } catch (Exception e){};
     }
}
```

Windchill Queues and Backup (cont.)

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- Create these Java classes in WT_HOME/src/ext.
- Compile them with the commands:
  - `Javac StopAllQueues.java`
  - `Javac StartAllQueues.java`
- Move the resultant class files to WT_HOME/codebase/ext.
- The utilities may now be called with the command line:
  - `WT_HOME\bin\Windchill ext.StopAllQueues`
  - `WT_HOME\bin\Windchill ext.StartAllQueues`

Performing a Windchill Full Hot (Online) Backup

- To perform a full online backup:
  1. Stop Windchill Queues.
     - Run StopAllQueues.class.
  2. Back up the database server.
     - Run full RMAN backup.
  3. Back up the file vaults.
     - Run Robocopy or similar to synch vaults with backup.
  4. Back up the Windchill Directory Server.
     - Use Windchill DS full backup command.
  5. Start Windchill Queues.
     - Run StartAllQueues.class.
- Normally you would expect to run the above steps daily at a quiet time (to minimize the effect of stopping the queues).

Exercise: Write script to perform Windchill full hot backup (40 min)

Performing a Windchill Incremental Hot (Online) Backup

- An incremental backup can only be used in conjunction with the full backup upon which it is based.
- Oracle RMAN supports incremental backups.
  - An Oracle incremental backup is faster and uses less space in the flash recovery area than a full backup.
  - You would be likely to use an RMAN incremental backup as a daily backup and perform a full RMAN backup weekly.
  - Archived redo logs and redo logs are used to recover to point of failure.
    - These can be used in combination with full RMAN backups, or full + incremental backups.
- Windchill DS supports incremental backups.
  - These are smaller and quicker than a full backup.
  - Could be taken every 15 minutes to minimize data loss.
  - Command to take incremental backup is.

```
WindchillDS\server\bat\backup --incremental --backupAll --compress
--backupDirectory h:\ptc_backups\WindchillDS
```

  - Note: The backupDirectory must contain a full backup for the incremental backup to be usable.

Windchill Online Incremental Backup

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- Incremental backups of file vaults can be managed by software such as Robocopy, or by hardware disk mirroring.
- A practical combination of full and incremental backups would be:
  - Daily:
    - Run full hot backup of Windchill.
  - Every 15 minutes:
    - Run incremental backup of Windchill DS.
    - Synch vaults with backup.

Exercise: Write script to create frequent incremental backup (20 min)

Recovery from Offline Backup

- All data store backups were taken when system was shut down, so recovery is straightforward. However, the customer will lose all data since the backup was taken.
  1. Restore database (Oracle).
  2. Restore Windchill DS.
  3. Analyze missing vault contents and recover necessary files.

Restore and Recovery of Windchill from Backup (cont.)

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Recovery from Online Backup

- Requires greater analysis of the problem as there may be synchronization issues between database and vaults, and between database and Windchill DS.
  1. Restore database (Oracle).
     - RMAN allows you to restore to point of failure, or even to a specific point in time.
  2. Restore Windchill DS.
     - Use Disconnected Principals tool to synchronize with database.
  3. Analyze missing vault contents and recover necessary files.
     - Use wt.fv.tools.WContentVerify to synchronize with database.

Synchronizing Windchill DS and Windchill

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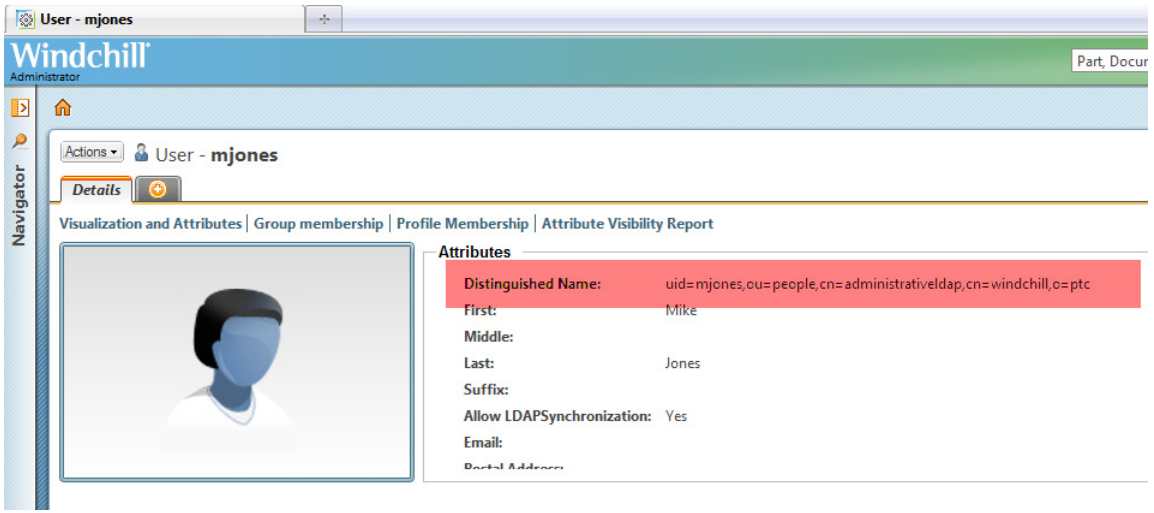
- It is possible that Windchill DS and Windchill database are not in synch after restoration.
  - Entries may exist in Windchill that do not exist in Windchill DS.
  - The opposite is also true, but it is not a concern if there is an entry that exists in Windchill DS but not in Windchill.
- Users exist in both Windchill and Windchill DS and are linked by the Windchill DS distinguished name.
- Missing Windchill DS entries can be found and fixed using Participant Administration Utility.



Exercise: Fix disconnected principals (15 min)

Synchronizing Vaults with Database

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Vault Synchronization

- Windchill will start even if vault data is missing or corrupt.
- To analyze vaults, the Windchill system should be started.
  - Users should not have access.
  - Queues should be stopped to ensure vaults are not changing.
- Use the tool `wt.fv.tools.WContentVerify` in a Windchill Shell.
  - Windchill must be running.
  - Identifies missing files in file vaults.
  - Verifies actual content file sizes with the sizes in the metadata in the database.

Identifying Location of Business Object

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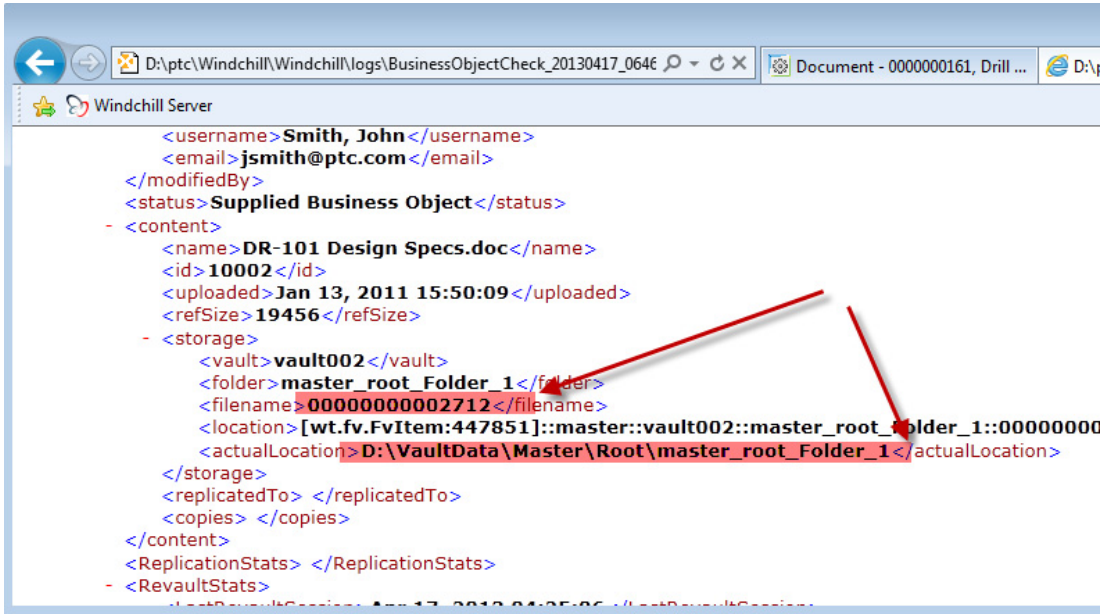
- You can also use WContentVerify to identify location of a document or other business object in the file vaults:
  - `windchill wt.fv.tools.WContentVerify -user=wcadmin -password=wcadmin -checkBusinessObject`

```
D:\ptc\backup_script>windchill wt.fv.tools.WContentVerify -user=wcadmin -passwor
d=wcadmin -checkBusinessObject
Select Content Type :
1. WTDocument
2. WTPart
3. CAD Document
1
Enter Document Number
0000000161
Enter Document Name
Drill Specification
Enter Version :
A
Enter Iteration :
2
Report Filename = D:\ptc\Windchill\Windchill\logs\BusinessObjectCheck_20130417_0
646.xml
```



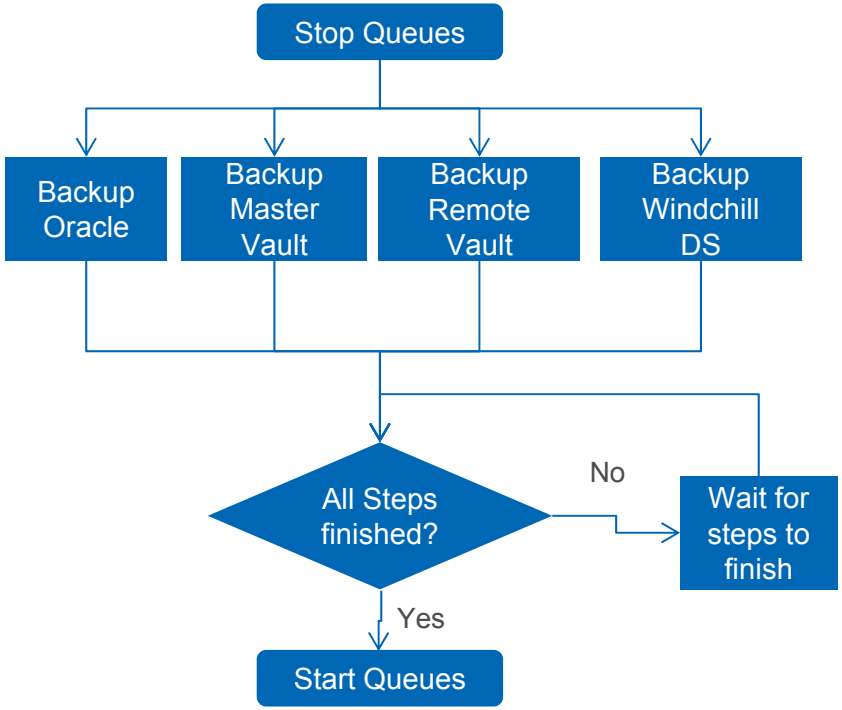
Exercise: Synchronize file vaults (20 min)

Optimizing Backup Script

- Backups for the various data stores are independent tasks and these could be run in parallel.
- For a hot backup, once the queues are stopped, you could initiate all of the other backup routines.
- This requires whatever is controlling the backup jobs, e.g., a script, to support parallel tasks.
- Ant supports parallel tasks.

  `<parallel>` Executes nested tasks in parallel. While the tasks within the parallel task are being run, the main thread is blocked, waiting for all the child threads to complete.

- There are many alternative scripts, such as Groovy (libraries available with Windchill) or Windows Powershell, that support parallel tasks.



Module 11: Advanced Backup Solutions

Windchill 10.1 – Backup and Recovery

Objectives

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After completing this module, you will be able to:

- Have an awareness of the products that exist for providing advanced backup capabilities.
- Know where to seek additional information regarding Windchill backups.

Backup Technologies

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- Asynchronous Storage Area Network (SAN) replication
  - Can be used to synchronize SAN data over large distances where the network connection is slower than what is needed for synchronous replication.
- Snapshots
  - The entire set of repositories can be captured at regular intervals by the disk array.
  - Snapshots work with most types of software, including Windchill.
  - Examples include NetApp Snapshot and EMC Clarion Snapview.
    - See “Windchill Backup and Recovery Execution Featuring NetApp Storage Solutions “– Technical Brief for a detailed example of implementing snapshots for Windchill backup.
- Deduplication
  - A specialized data compression technique for eliminating duplicate copies of repeating data. Results in lower storage space requirements for data.
- Hierarchical storage management (HSM)
  - Data storage technique which automatically moves data between high-cost and low-cost storage media.
  - HSM systems exist because high-speed storage devices, such as hard disk drive arrays, are more expensive (per byte stored) than slower devices, such as optical discs and magnetic tape drives.

Advanced Backup Solutions

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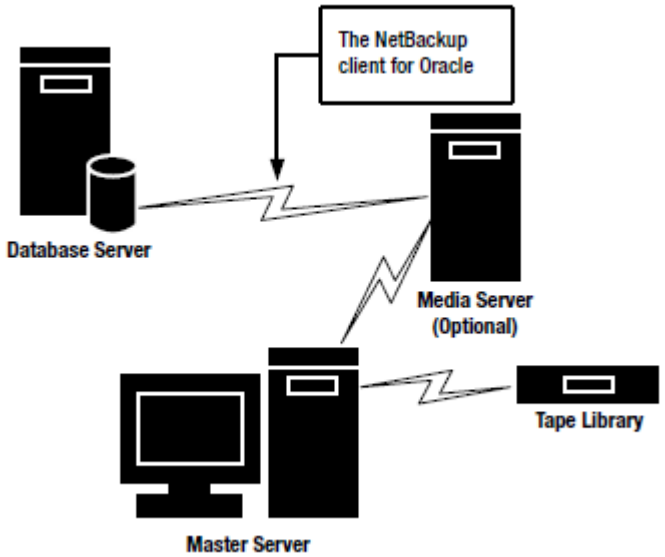
- Backup Management Software
  - Most of the advanced solutions will collaborate with Oracle RMAN rather than replace it.
  - There are many software packages to manage backups.
    - PTC has no specific recommendations.
    - Customers normally do their own research or have already selected a product.

Backup and Recovery Management Software

- Owned by Symantec
  - Runs on dedicated Netbackup Master Server.
  - Cross platform.
- Integrated with Oracle RMAN
- Major Features



Feature	Benefit
Data deduplication	Reduces storage requirements.
Synthetic backups	Conserves network bandwith, providing performance benefit.
Data encryption	Secures data as it is written to tape.
Unified management of snapshots	Simplified management and fast recovery.
Checkpoint restart	Allows backups to resume where they left off in the case of a failure.

Backup and Recovery Management Software

- Integrated with Oracle RMAN
  - See “Windchill Backup and Recovery Execution Featuring NetApp Storage Solutions – Technical Brief” for a detailed example of implementing snapshots for Windchill backup (http://www.ptc.com/view?im_dbkey=124226).

Feature	Benefit
Supports snapshots	Recovery using snapshot backups is faster because data is restored more quickly.
Fast backup	Create near-instant, space-efficient NetApp Snapshot copies and clones.
Backup management	Automate and simplify Oracle Database management.
Smaller backup Footprint	Transfer only new or changed blocks to minimize network traffic and reduce disk capacity with deduplication by 50% or more.

Backup Management Software

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And more…..

- Further examples of backup management software:
  - BakBone
  - EMC Legato
  - EMC Networker
  - IBM Tivoli
  - NetApp Snapvault
  - Symantec Backup Exec
  - Symantec Veritas Storage Foundation
  - VMWare ESX VMFS Snapshot Consolidated Backup

Additional Information

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- The following sources contain additional information related to planning the backup and recovery strategy for Windchill:
  - PTC Documents
    - Windchill Backup and Recovery Execution Featuring NetApp Storage Solutions – Technical Brief (www.ptc.com/view?im_dbkey=124226)
    - Windchill Architecture Overview (www.ptc.com/view?im_dbkey=123332)
    - Windchill 10.1 Specialized Administration Guide (www.ptc.com/view?im_dbkey=135852)
    - Windchill 10.1 Administration – Configuring Your Windchill Environment Guide (www.ptc.com/view?im_dbkey=135850)
    - Windchill 10.1 Enterprise Administration Guide (www.ptc.com/view?im_dbkey=135851)
    - Windchill Vaulting and Replication Planning – Technical Brief (www.ptc.com/view?im_dbkey=123336)
    - Windchill 10.1 Advanced Deployment Guide (www.ptc.com/view?im_dbkey=137350)
    - Windchill System Validation – Technical Brief (www.ptc.com/view?im_dbkey=123337)
    - Windchill Future Platform Support Summary (www.ptc.com/view?im_dbkey=69784)
    - Windchill 10.1 Archive Administration Guide (www.ptc.com/view?im_dbkey=137672)
    - Windchill Enterprise Systems Integration Implementation Guide – Oracle Applications (www.ptc.com/view?im_dbkey=124628)

Additional Information (cont.)

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- The following sources contain additional information related to planning the backup and recovery strategy for Windchill:
  - PTC Documents (cont.)
    - Windchill Enterprise Systems Integration Implementation Guide – SAP (www.ptc.com/view?im_dbkey=124631)
  - External Tools and Documents
    - Unison (http://www.cis.upenn.edu/~bcpierce/unison/)
    - Rsync (http://rsync.samba.org/)
    - RoboCopy (http://technet.microsoft.com/en-us/library/cc733145(v=ws.10).aspx)
    - HP D2D2T (http://h71028.www7.hp.com/enterprise/us/en/solutions/storage-d2d2t-data-protection.html)
    - IBM TS7650G (http://www-03.ibm.com/systems/storage/tape/ts7650g/?ca=agus_spdilligent-20090401&me=psearch&met=google&re=backup_and_recovery&s_tact=usdlk001&cm_mmc=agus_spdilligent-20090401-usdlk001-_-k-_-google-_-backup_and_recovery)

Timings

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	Lecture	Exercises	
Module 1: Backup Types	20		
Module 2: Windchill System Backup	15		
Write script to backup often changed system files		30	
Module 3: Windchill Data Stores	15		
Module 4: Business Continuity Planning	20		
Module 5: Oracle Physical Components	20		
Take full OS level backup of Oracle Database		20	
Receive email notification of Oracle errors		15	
Reorganize OCU database		45	
Module 6: Backup & Recovery with Oracle RMAN	30		
Initialize RMAN and Perform Offline Backup and Recovery of Oracle		45	
Recover from older Oracle backup		15	
Enable ArchiveLog mode		15	
Write Hot Backup script and run		15	
Restore from Hot Backup		30	
Module 7: Backup and Recovery of Windchill Directory Server	20		
Create backup script for Windchill DS and restore missing data		30	
Module 8: Backup and Recovery of Windchill File Vaults	20		
Examine current vaulting configuration		15	
Reorganize vault configuration		40	
Revault BLOBs to external vaults		40	
Create backup script for Windchill Vault Folders		30	
Module 9: Backup and Recovery of Secondary Data Stores	10		
Module 10: Backup and Recovery - Bringing it together	20		
Write script to perform Windchill full Hot Backup		40	
Write script to create frequent incremental backup		30	
Fix disconnected principals		15	
Synchronize file vaults		20	
Module 11: Advanced Backup Solutions	30		
Total Mins	**170**	**460**	
Total Hours	**2.8**	**7.7**	