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Online Patching

Kevin Hudson
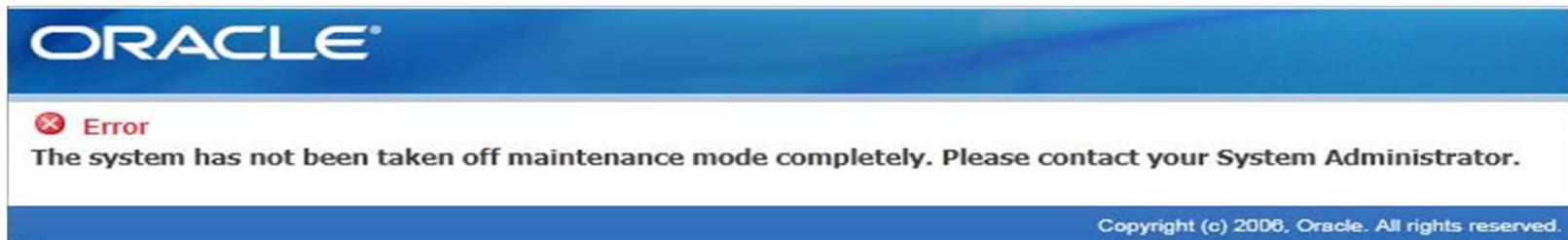Senior Director, Applications Technology

Program Agenda

- The Problem - Downtime

- The Solution - Online Patching

- The New 12.2 Patching Cycle

- Architectural Changes in 12.2 to Support Online Patching

- Preparing for Online Patching

- Q&A

Insert Information Protection Policy Classification from Slide 8

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EBS Downtime 12.1

System is down during patching

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❌ Error
The system has not been taken off maintenance mode completely. Please contact your System Administrator.

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Insert Information Protection Policy Classification from Slide 8

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EBS Downtime – A Major Concern

We Understand the Problem

- Production Outage
  - Major Release
  - Maintenance Rollups (RUPs)
  - Critical Patch Updates (CPUs)
  - Legislative and Regulatory updates

- When outages interfere with core business activity
  - Reluctance to upgrade to take advantage of new feature
  - Barrier to staying current with recommended patches

- Global Single Instance
  - Compounds the problem
  - Patching any one module causes the entire system to be down

Insert Information Protection Policy Classification from Slide 8

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What if the Following were True During Patching

- Critical business operations were **not interrupted** by maintenance operations
- Revenue generating activities were to **stay online**
  - Web Orders
  - Booking Orders
  - Service Requests
- Business users were to **stay online**
  - Pay Suppliers
  - Pay Employees
  - Uninterrupted manufacturing operations
- Downtime required by any patch was **predictable**
  - Measured in minutes not days or hours
- Global Single Instances **remained operational** 24*7
  - Maintenance window easier to allocate as shorter time required

Insert Information Protection Policy Classification from Slide 8

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Online Patching

What if the EBS remained online during patching?

- ## In 12.2 all patching operations are online
  - EBS will remain available to users during patching operations
  - HR Legislative updates can be applied during a payroll run
  - Users can enter expense reports while Payables is being patched

Insert Information Protection Policy Classification from Slide 8

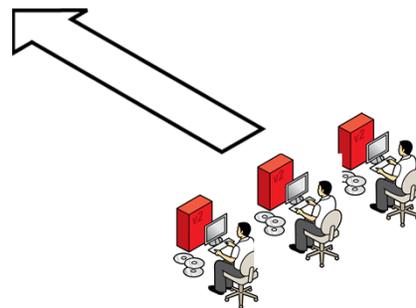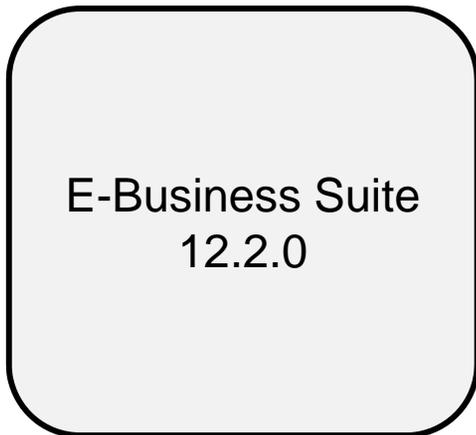**ORACLE®**

Oracle's Integrated Stack

- EBS uses an integrated Oracle technology stack
  - Applications
  - Middleware
  - Database

- Online patching uses the latest features of this stack
  - Edition Based Redefinition (EBR)
  - Web Logic Server

Applications

Middleware

Database

Operating System

Virtual Machine

Servers

Storage

 Insert Information Protection Policy Classification from Slide 8

Patches are Applied to a Copy of Production

Production Instance

Copy of Production

E-Business Suite
12.2.0

E-Business Suite
12.2.0

Patches
- ATG_PF.D
- AD.C
- FIN_PF.E

- Copy the production code
- Apply patches to the copy

Insert Information Protection Policy Classification from Slide 8

Copy the Code, NOT the Data

- EBS uses both the file system and the database to store the code and data that make up the application
  - Code
    - Stored both on the File system & In the Database
    - Any code object changed in a patch is copied
  - Data
    - Stored both on the File system & In the Database
   - Application data is NOT copied by a patch

 Insert Information Protection Policy Classification from Slide 8

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Downtime Redefined as "Cutover"

Changing the unit of measure for downtime
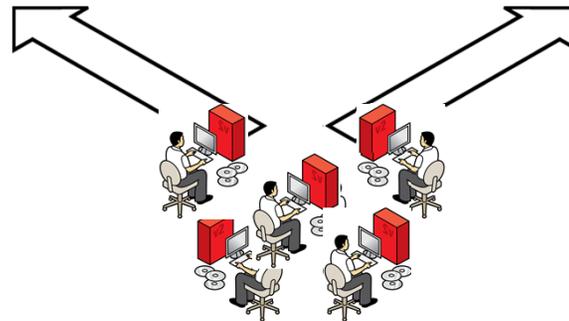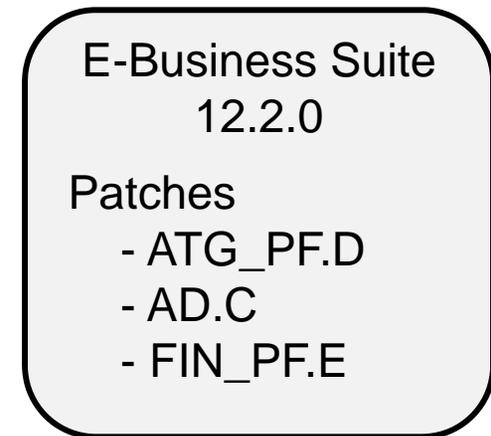
- Cutover is the time taken to switch users from the production system to the newly patched copy

- Cutover changes the unit of measure for downtime
  – Measured in minutes **NOT** hours or days

- Cutover time is very predictable
  – The time taken to bounce the Middle Tiers

Insert Information Protection Policy Classification from Slide 8

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Downtime Limited to Short Cutover

Production Instance
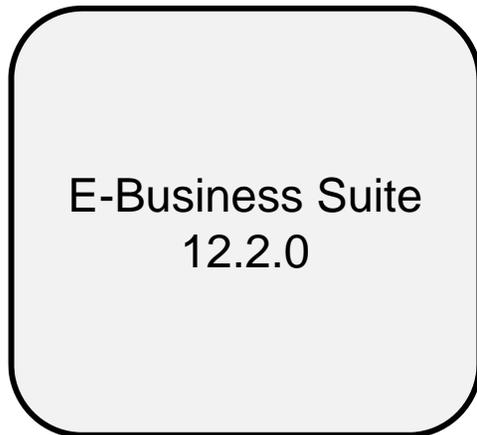
Patched Production Instance

E-Business Suite
12.2.0

E-Business Suite
12.2.0

Patches
- ATG_PF.D
- AD.C
- FIN_PF.E

- Users are logged off the production Instance
- When Users reconnect they are directed to the newly patched system

 Insert Information Protection Policy Classification from Slide 8

Patching Occurs on a Copy

- File system
  - All patches are applied to the secondary file system
  - Synchronization of the file systems is managed by the patching tools

- Database
  - A separate copy is maintained of all database code objects that are changed by a patch

Insert Information Protection Policy Classification from Slide 8

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Changing the Patching Paradigm

- Downtime Patches
  - **No** online Users

  - Wall clock time **very important**

  - Consumes **all resources**

  - Upgrade designed to run as **fast as possible**

- Online Patches
  - Users remain **online**

  - Wall clock time is **no longer an overriding concern**

  - Online Users **share resources**

  - Data upgrades designed to **not affect** the running application

FILE SYSTEM

Insert Information Protection Policy Classification from Slide 8
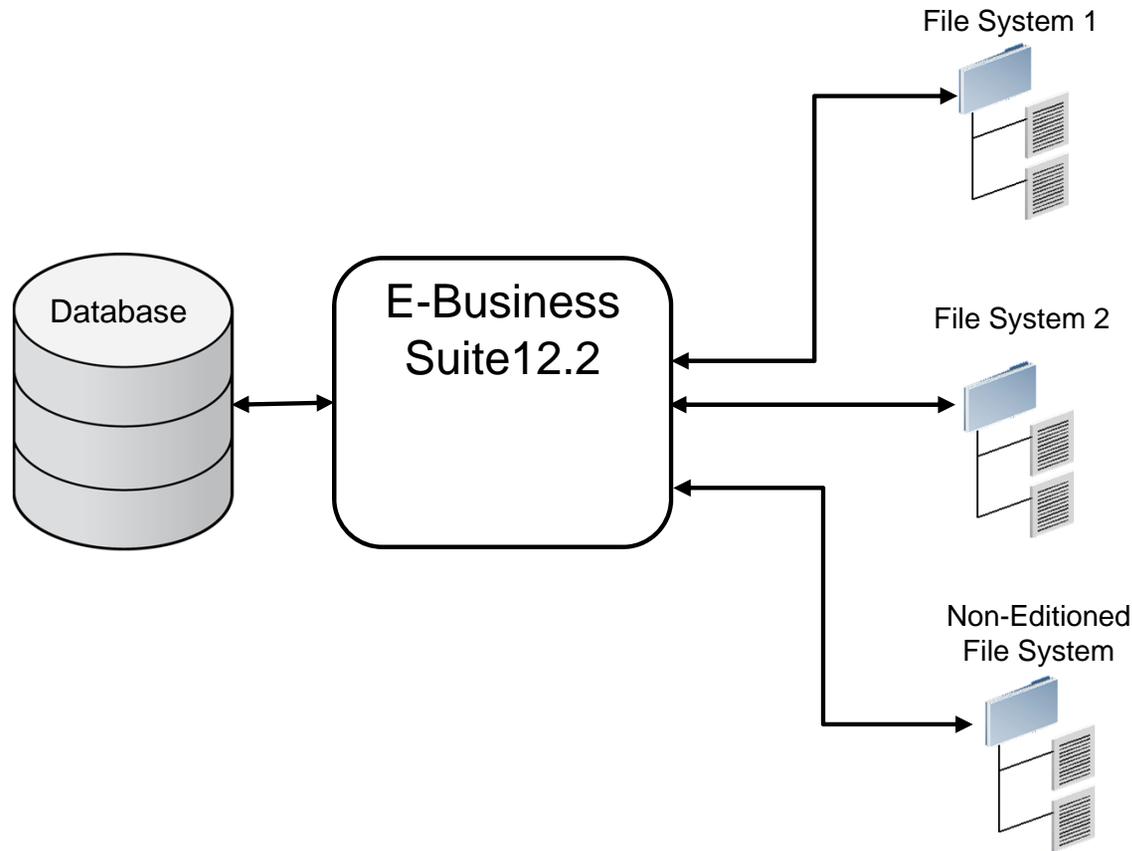
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Recap: 12.1.3 File System

- Single file system
  - Patches applied while system is down

- Optional staged APPL_TOP
  - Patches applied to staged file system while the system is online
  - System is off line to apply database updates
  - Staged `APPL_TOP` provided the basis for the 12.2 design

 Insert Information Protection Policy Classification from Slide 8

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EBS 12.2 is installed with 3 file systems

- FS-1 (Production file system)
  - Used by the current users of the system

- FS-2 (Copy of Production file system)
  - Used by the patching tools

- FS-NE (Non Editioned file system)
  - Stores data that is stored on the file system
    - Data import and export files
    - Report output
    - Log files

  Insert Information Protection Policy Classification from Slide 8

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Three File Systems and One Database

File System 1

File System 2

Database → E-Business Suite12.2

Non-Editioned File System

- All three file systems serve a single database
- The file system in use by the running application is never patched
- All patches are applied to secondary file system

  Insert Information Protection Policy Classification from Slide 8

DATABASE

F

Insert Information Protection Policy Classification from Slide 8
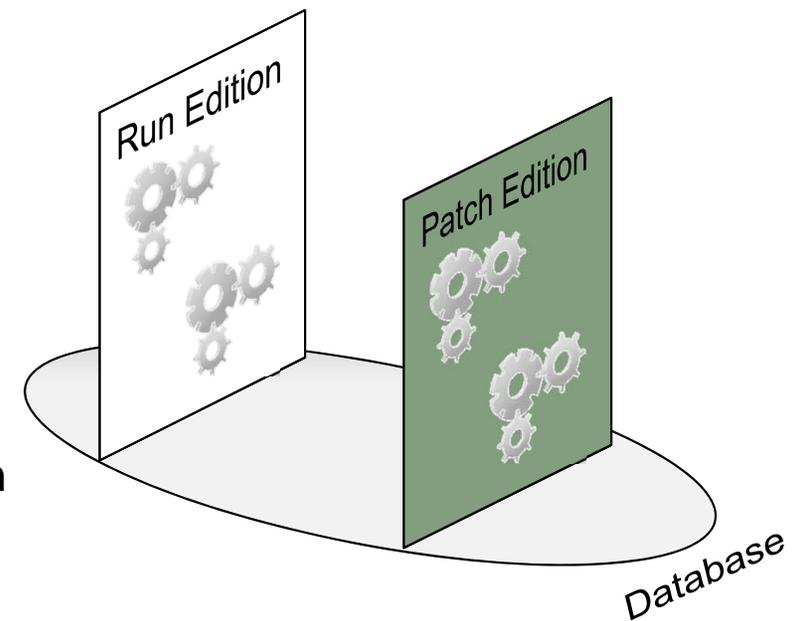
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11G R2 Edition-Based Redefinition (EBR)

- The final piece in the high availability puzzle
  - Enables the online upgrade of the database tier
  - Allows an application to efficiently store multiple copies of its application definition in the same database

- Provides an isolation mechanism that allows pre-upgrade and post-upgrade schemas to co-exist
  - Changes to database objects are made in the isolation of an "**Edition**"
  - Changes to database objects do not effect the running Application

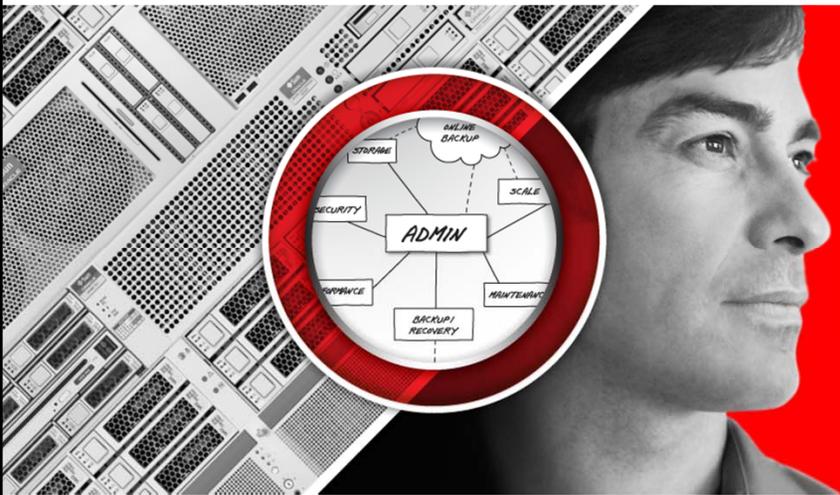 Insert Information Protection Policy Classification from Slide 8

Database Editions

- Client code chooses **The Edition** that it connects to
  - Run Edition
    - Used by Online Users
    - Never changed by a Patch
  - Patch Edition
    - Used by the Patching Tools
    - Changes do no affect the running Application

Run Edition

Patch Edition

Database

Insert Information Protection Policy Classification from Slide 8

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Online Patching Interacts with 3 Edition Types

- **Run Edition**
  - The edition currently in use by the running application
  - This is always the default database edition
- **Patch Edition**
  - The edition currently in use by the patching tools
  - This edition is only present when patching is in progress
  - Always the direct child of the Run Edition.
- **Old Edition(s)**
  - There maybe zero or more Old Editions
  - When the Patch Edition is promoted to production the previous Run Edition is now regarded as an Old Edition
  - Only retained until a full cleanup operation is run

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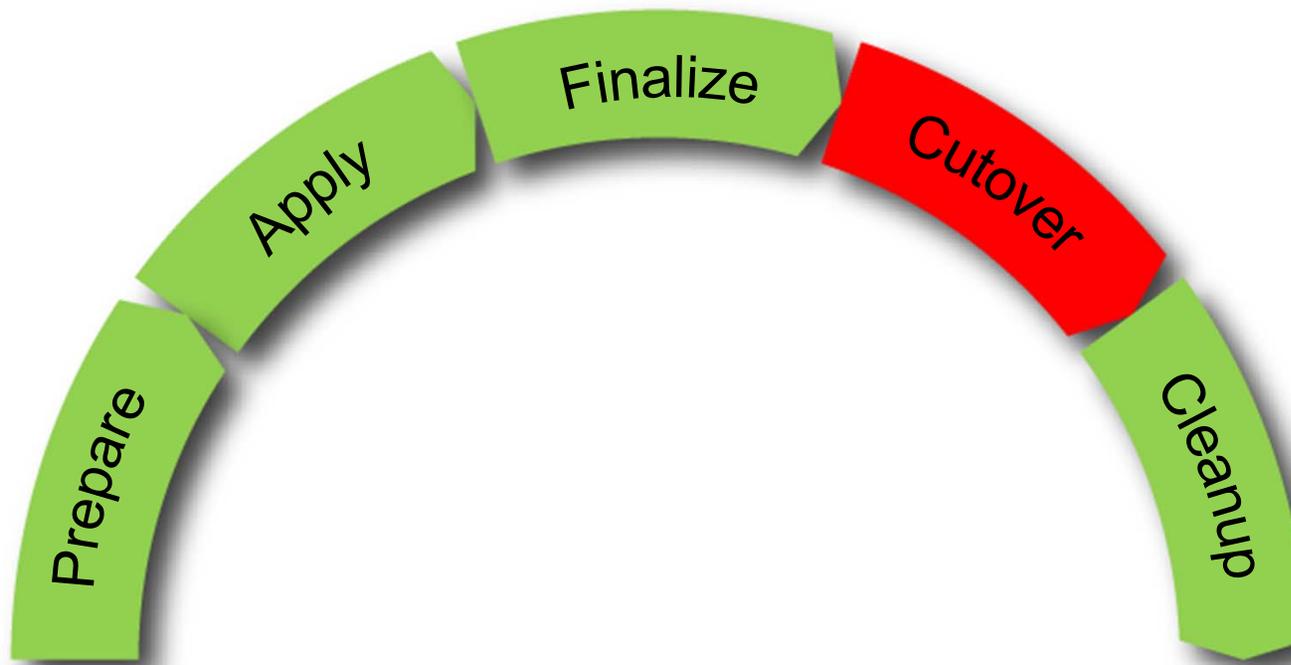E Business Suite 12.2
Patching Cycle

Insert Information Protection Policy Classification from Slide 8

Online Patching Cycle

- Patch application is now part of a patching cycle

Insert Information Protection Policy Classification from Slide 8
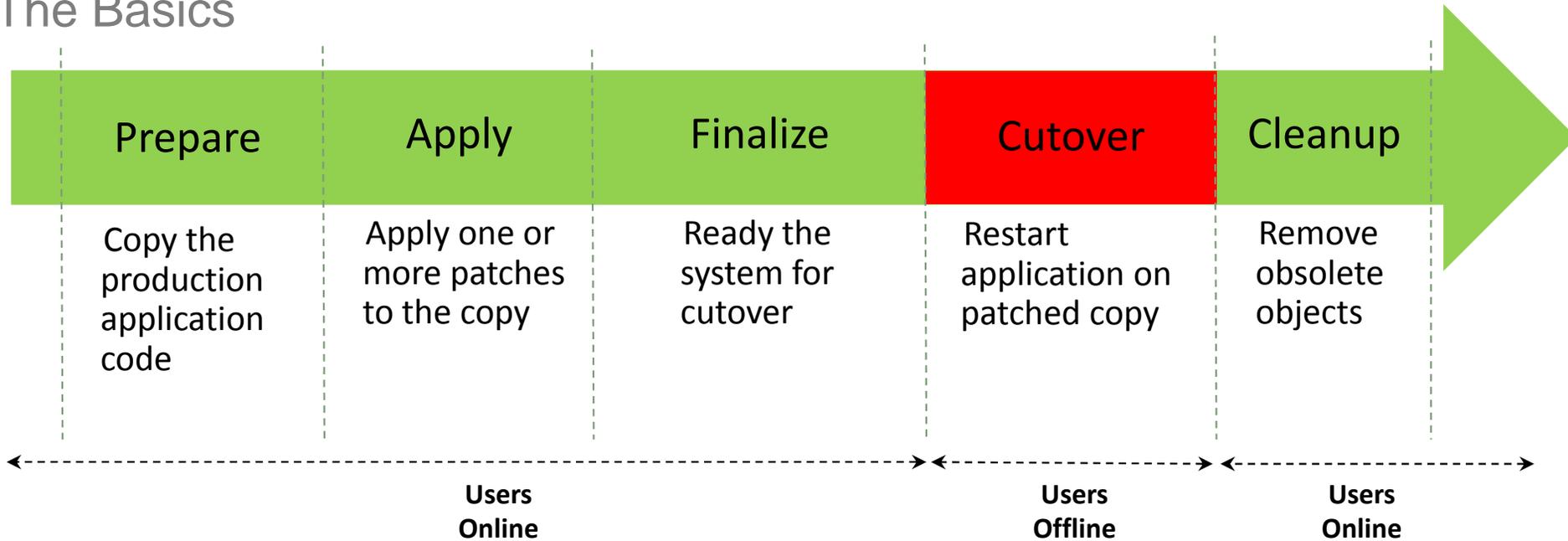
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New Tools for Managing Online Patching

- ADOP replaces ADPATCH as the 12.2 patching tool
  - ADOP (**AD O**nline **P**atching)

- ADOP orchestrates the patching cycle, steps the user through each of the patching phases
  - Prepare
  - Apply
  - Finalize
  - Cutover
  - Cleanup

Insert Information Protection Policy Classification from Slide 8

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Online Patching Cycle

The Basics

Prepare	Apply	Finalize	Cutover	Cleanup
Copy the production application code	Apply one or more patches to the copy	Ready the system for cutover	Restart application on patched copy	Remove obsolete objects

Users Online

Users Offline

Users Online

- Application is only offline during the Cutover phase
- Downtime is now redefined as Cutover

 Insert Information Protection Policy Classification from Slide 8

Online Patching Cycle - Prepare

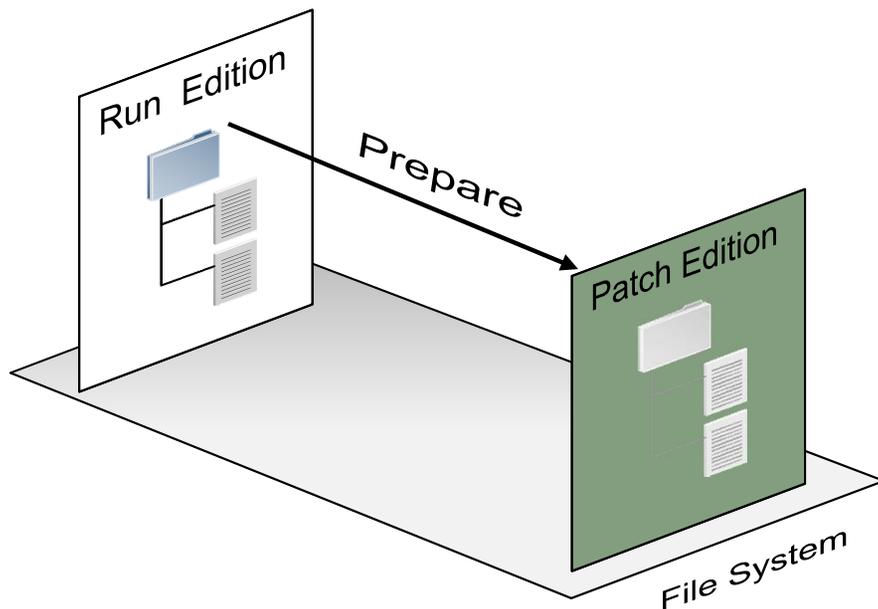| Prepare | Apply | Finalize | Cutover | Cleanup |

Copy the production application code

Users Online — Users Offline — Users Online
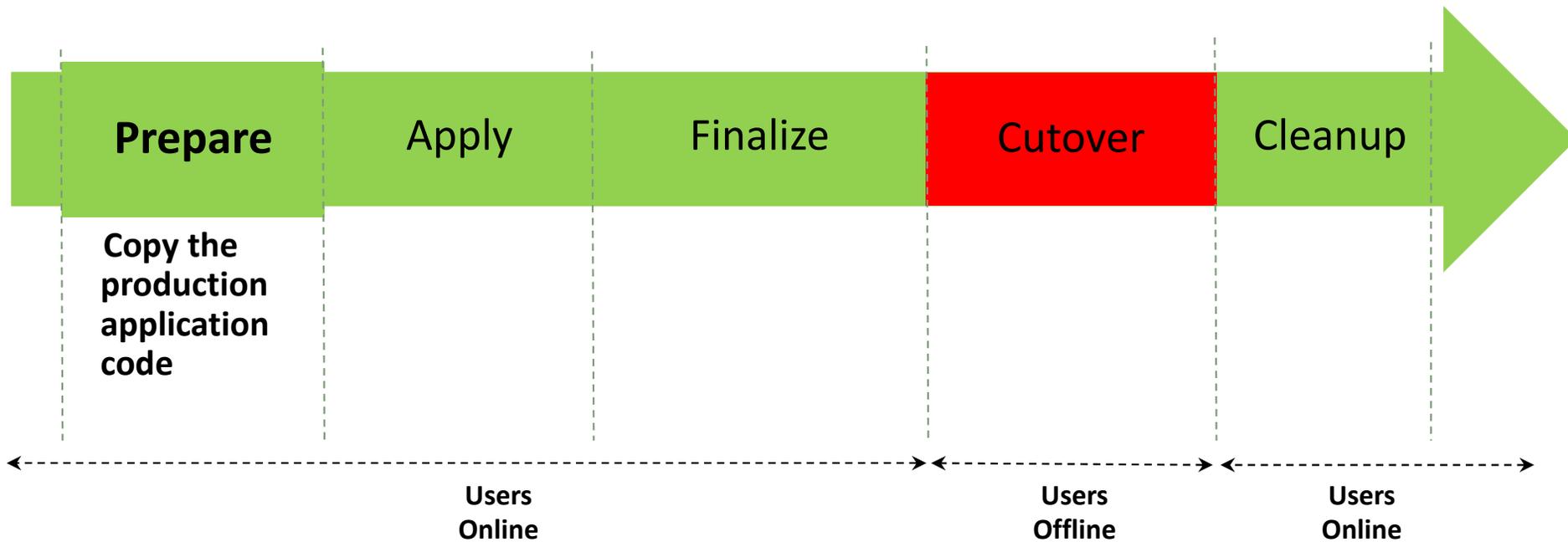
- Synchronizes Patch Edition and Run Edition on the file system
- Create a new Patch Edition in the database

Insert Information Protection Policy Classification from Slide 8
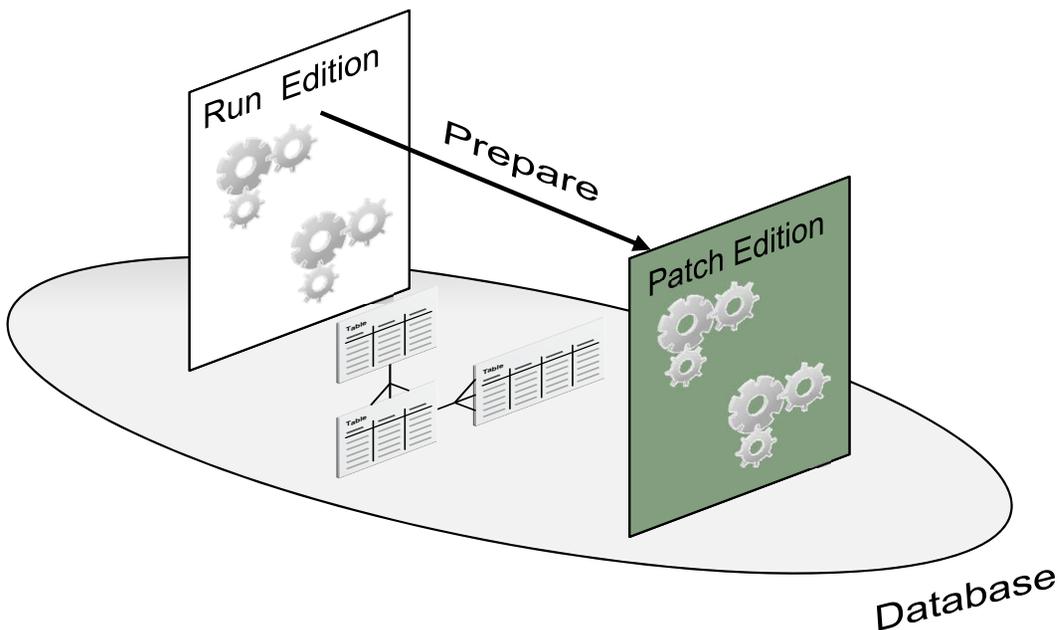
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Online Patching Cycle - Prepare

Preparing the File System

- Patch Edition & Run Edition of the file systems are synchronized
- All files on the Patch Edition are an exact copy of the files on the Run Edition
- Performant synchronization
  - Incremental synchronization is the default
  - Only files changed in the last patch application are copied
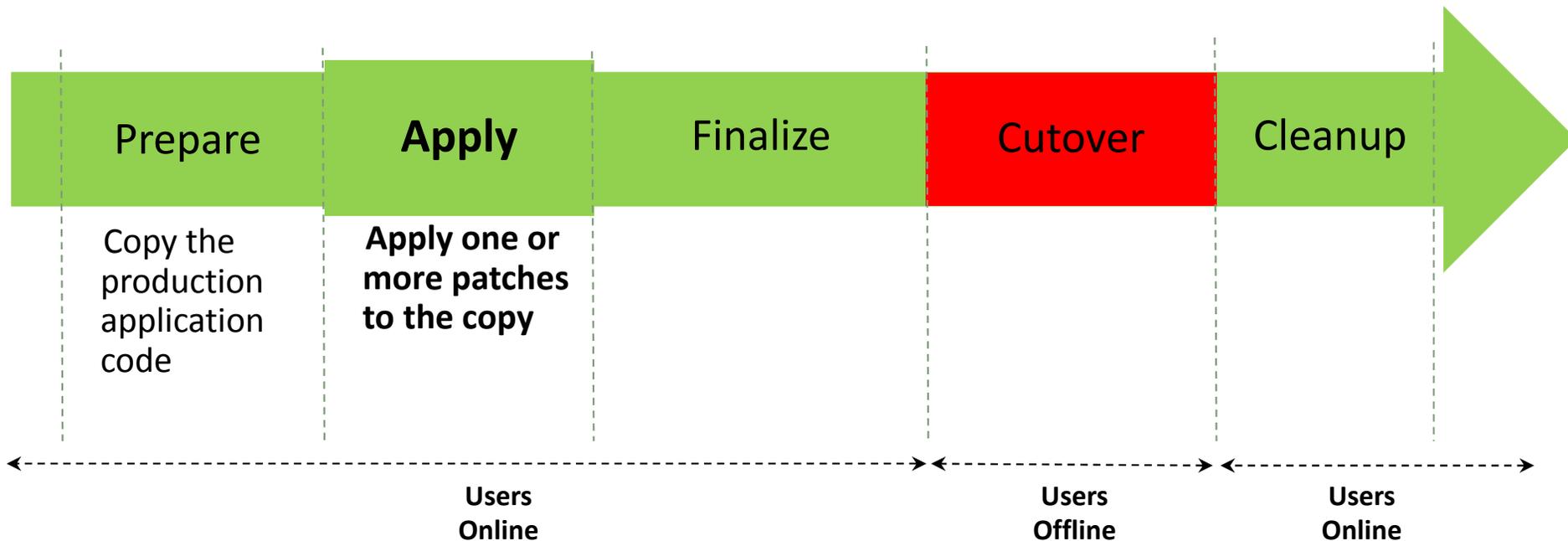 - Full synchronization available if necessary

Insert Information Protection Policy Classification from Slide 8

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Online Patching Cycle - Prepare

Preparing the Database

Run Edition

Prepare

Patch Edition

Database

- Patch Edition is created in the database
- All code objects in the Patch Edition begin as pointers to code objects in the Run Edition
- Efficient use of space
  - Objects are only "Actualized" into the Patch Edition when a new revision of the code is applied
- Storage objects such as tables are not copied
  - New patching standards are followed for upgrading storage objects

Insert Information Protection Policy Classification from Slide 8

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Online Patching Cycle - Apply

Prepare	Apply	Finalize	Cutover	Cleanup

Copy the production application code

Apply one or more patches to the copy

Users Online

Users Offline

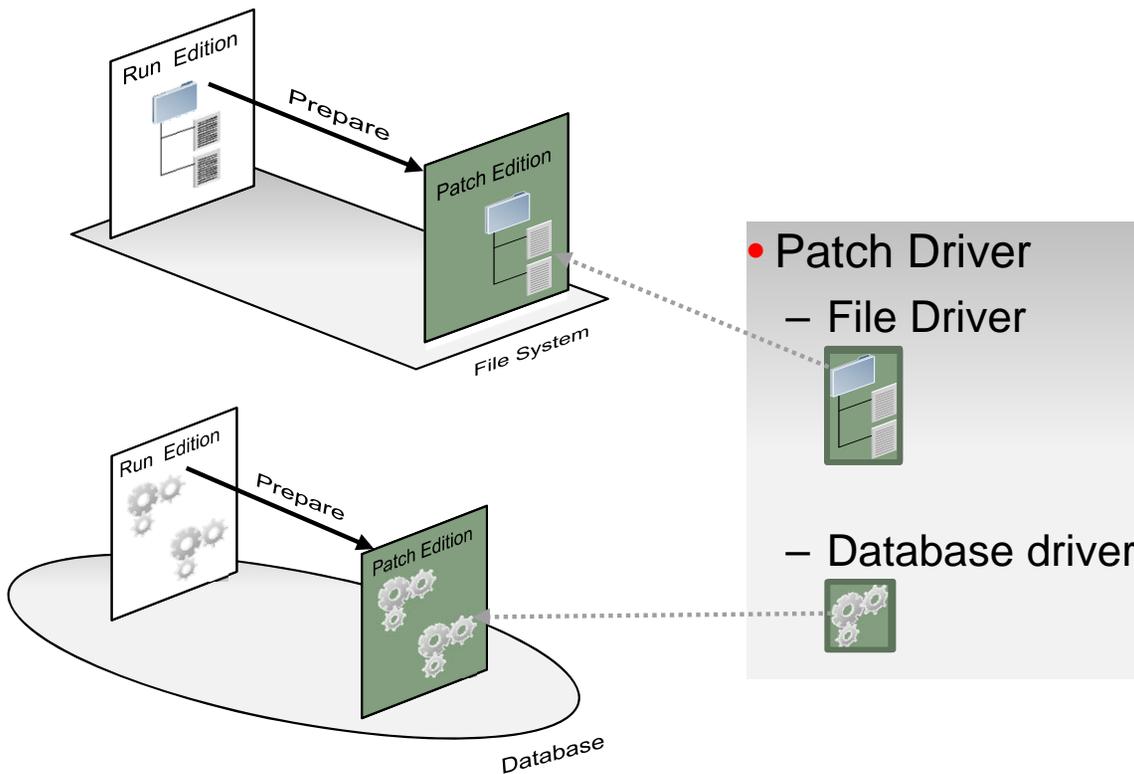Users Online

- Execute patch drivers to update Patch Edition
- Multiple patches can be applied, **including customizations**

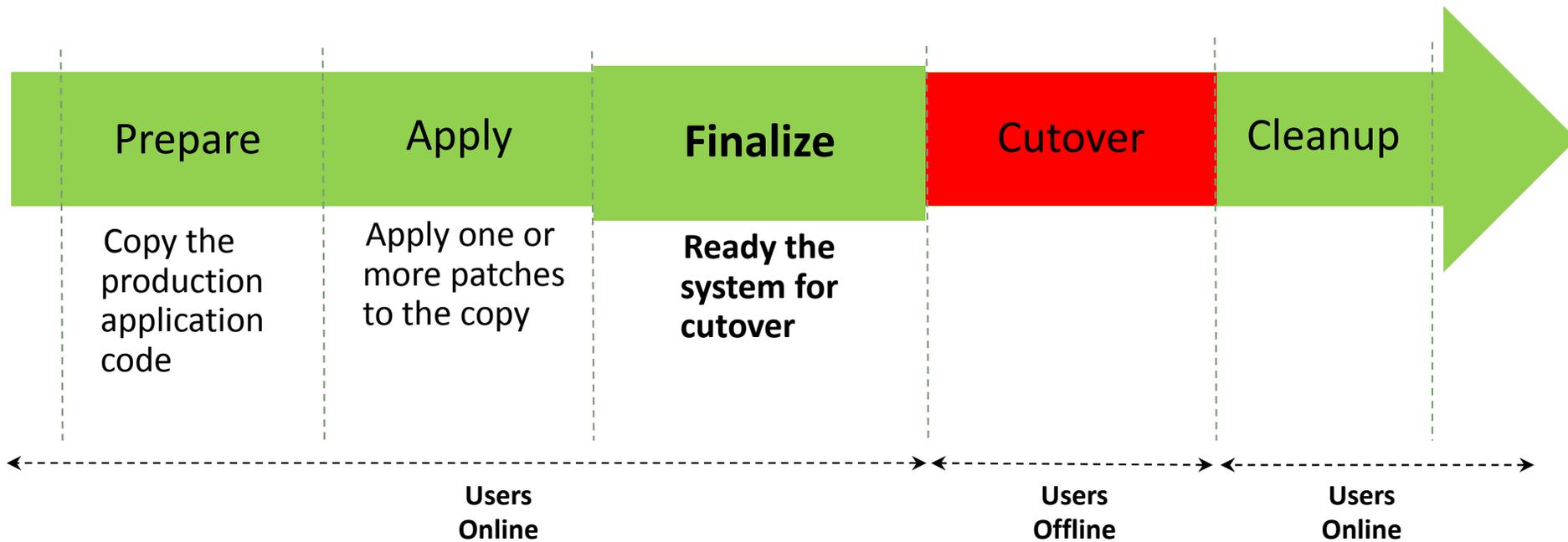 Insert Information Protection Policy Classification from Slide 8

Online Patching Cycle - Apply

Applying Patches

Run Edition

Prepare

Patch Edition

File System

Run Edition

Prepare

Patch Edition

Database

- Patch Driver
  - File Driver

  - Database driver

- Patches are applied to the copy (Patch Edition)

- The production application is unaffected by the changes
  - Users are connected to the Application and can perform their work unaffected by the patch

- Changes are made in the isolation of an Edition
  - The running application is unaffected by these changes

| Insert Information Protection Policy Classification from Slide 8

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Online Patching Cycle - Finalize

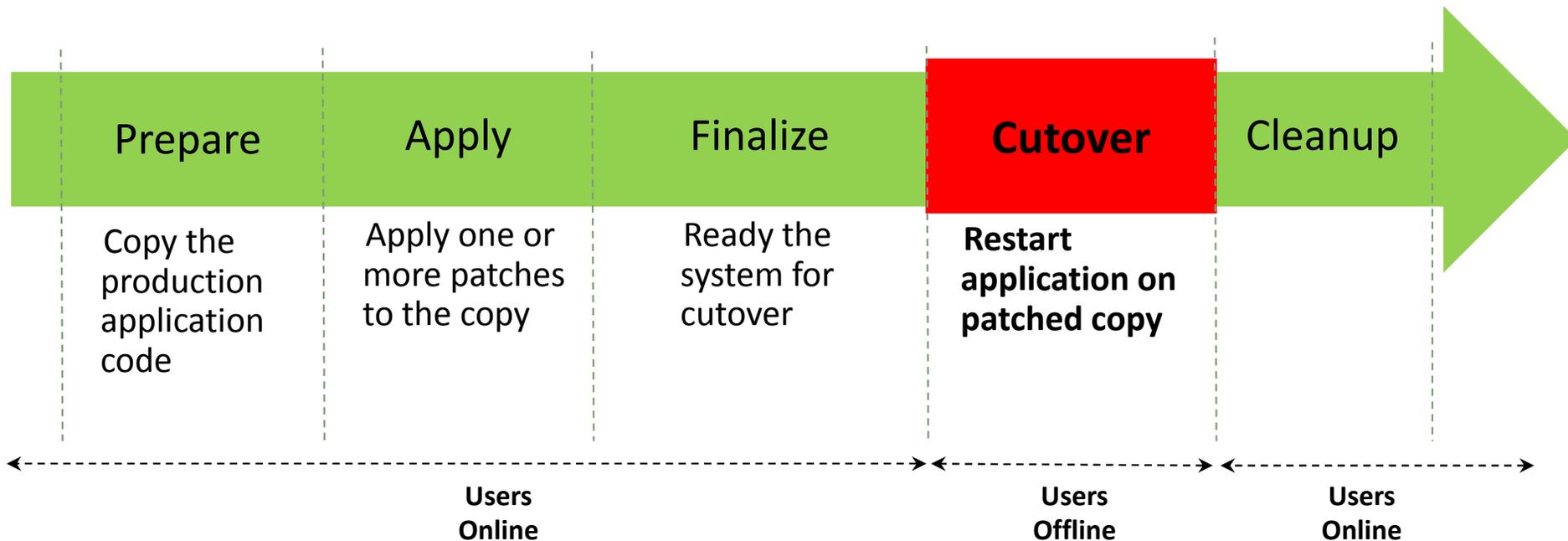| Prepare	Apply	**Finalize**	Cutover	Cleanup
Copy the production application code	Apply one or more patches to the copy	**Ready the system for cutover**		

Users Online

Users Offline

Users Online

- Compile invalid objects
- Generate derived objects

Online Patching Cycle - Finalize

- Perform the final operations that can be executed while the Application is Online
  - Compile invalid objects
  - Generate derived objects
  - Pre-compute DDL to be run at Cutover

Insert Information Protection Policy Classification from Slide 8

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Online Patching Cycle - Cutover

Prepare	Apply	Finalize	**Cutover**	Cleanup
Copy the production application code	Apply one or more patches to the copy	Ready the system for cutover	**Restart application on patched copy**	

Users Online   Users Offline   Users Online

- Cutover to the Patch Edition of the file system
- Cutover to the Patch Edition of the database
- Restart middle-tier service

Insert Information Protection Policy Classification from Slide 8

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Online Patching Cycle - Cutover

- During cutover a brief downtime is taken
  - Patching cycle can pause at this stage for as long as required
    - Waiting for an appropriate downtime window (minutes)
    - 2AM Sunday morning?
  - Users are logged off the system
  - The Patch file system is promoted to be the Run file system
  - The Patch database edition is promoted to be the Run database edition
  - Perform final maintenance operations
  - Users are brought back online on the patched system

Insert Information Protection Policy Classification from Slide 8

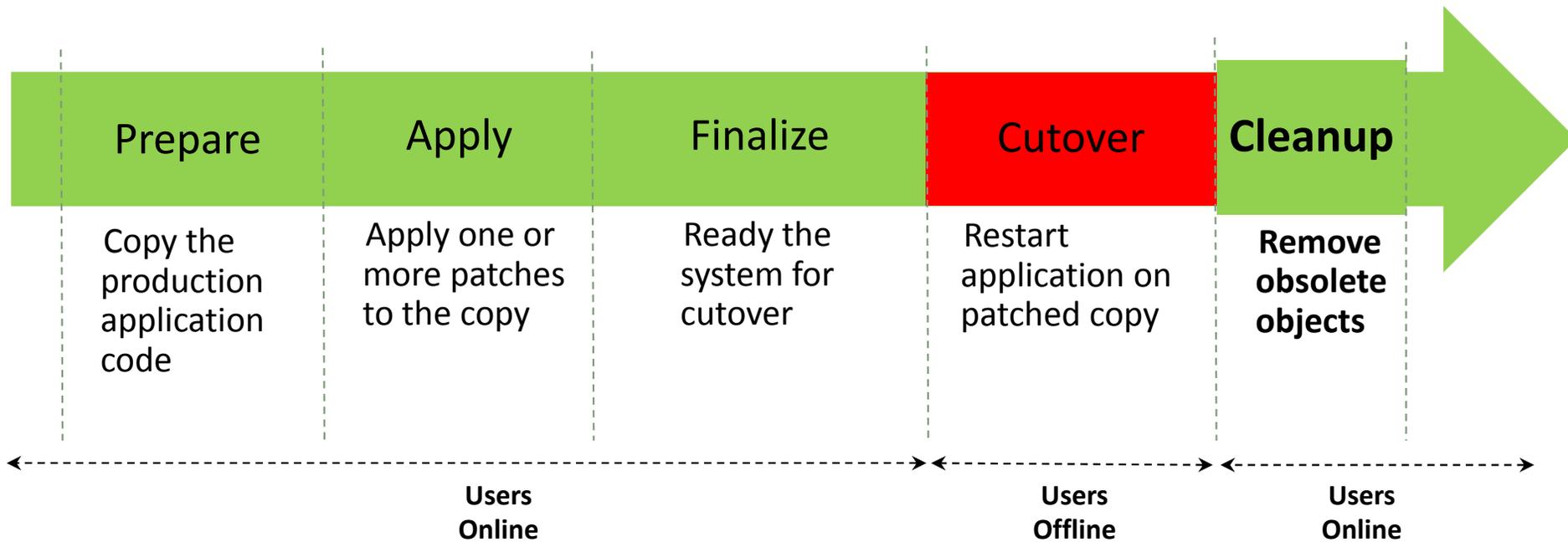**ORACLE**

Online Patching Cycle - Cutover

Cutover Requires a Brief Downtime
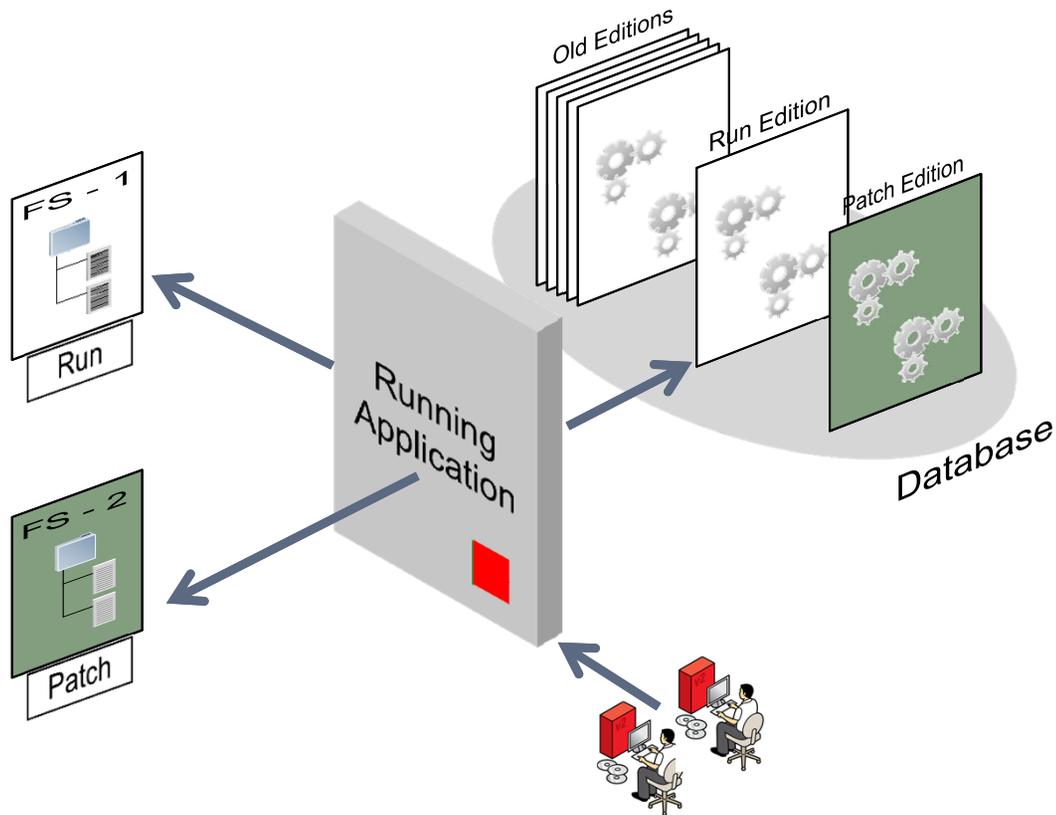
- Middle-tier processes stopped
  - End Users are disconnected
- File system roles swapped
  - Patched (FS-2) promoted to Run
  - FS-1 available for next patching cycle
- Database Patch Edition promoted to Run Edition
- Middle-tier processes restarted
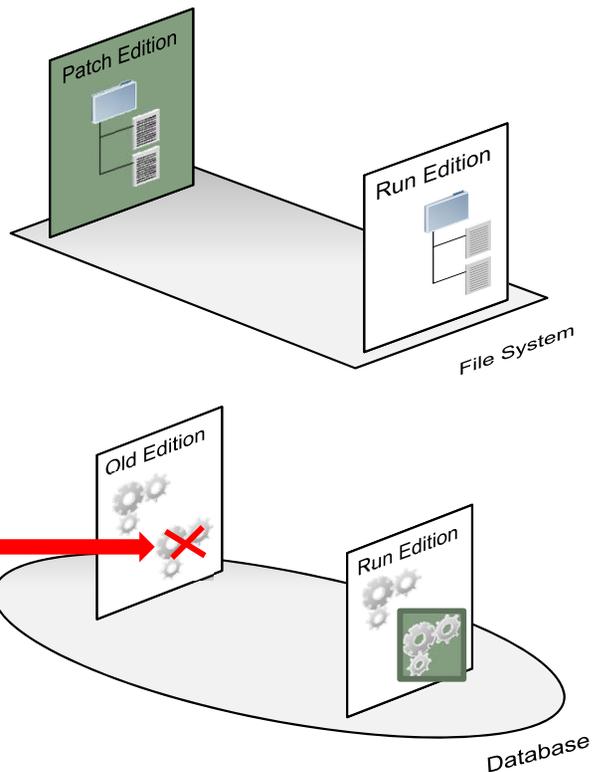 - End Users reconnect

Online Patching Cycle - Cleanup

Prepare	Apply	Finalize	Cutover	**Cleanup**
Copy the production application code	Apply one or more patches to the copy	Ready the system for cutover	Restart application on patched copy	**Remove obsolete objects**

Users Online	Users Offline	Users Online

- Cleanup old editions to recover space

Insert Information Protection Policy Classification from Slide 8
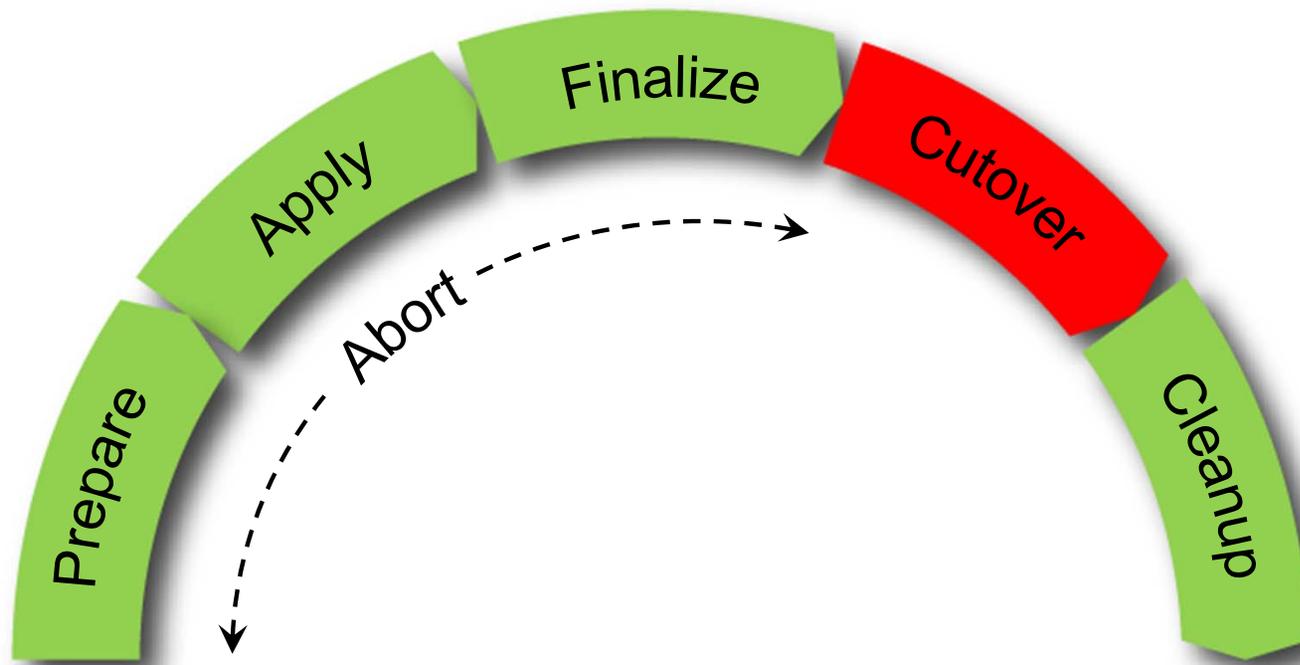
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Online Patching Cycle - Cleanup

- Cleanup occurs after users have been brought back online to the newly patched Application

- File system
  - The pre-patch file system is now ready for the next patching cycle
  - Re-synchronized

- Database
  - Code objects patched in the latest patching cycle are deleted from Old Editions
  - Once all objects are deleted from an Old Edition it is also deleted

Patch Edition

Run Edition

File System

Old Edition

Run Edition

Database

 Insert Information Protection Policy Classification from Slide 8

Online Patching Cycle - Abort

- The Online Patching Cycle can be aborted at any time prior to Cutover

Insert Information Protection Policy Classification from Slide 8

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E-Business Suite R12.2 Patching Cycle

Database Vs File System Editions

Insert Information Protection Policy Classification from Slide 8

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# File Systems Patching Cycle
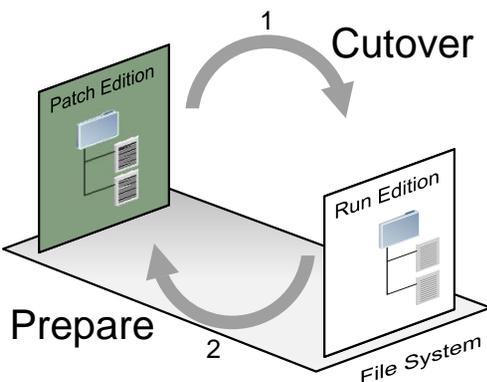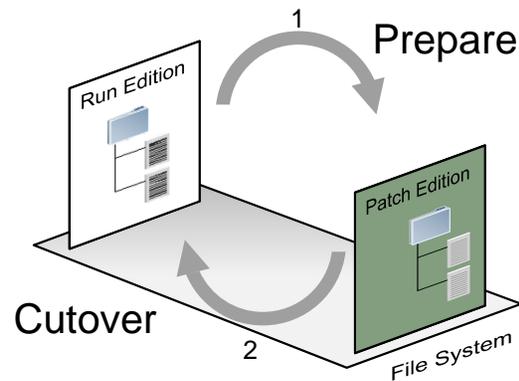
- Two complete file systems are always present
  - Run Edition - Used by the running Application
  - Patch Edition – Either:
    - Currently being patched

    or
    - Waiting for the next patch cycle
  - The two files systems are rotated between Run and Patch during every patch cycle

Insert Information Protection Policy Classification from Slide 8

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E-Business Suite R12.2 Patching Cycle

Database Edition Patching Cycle
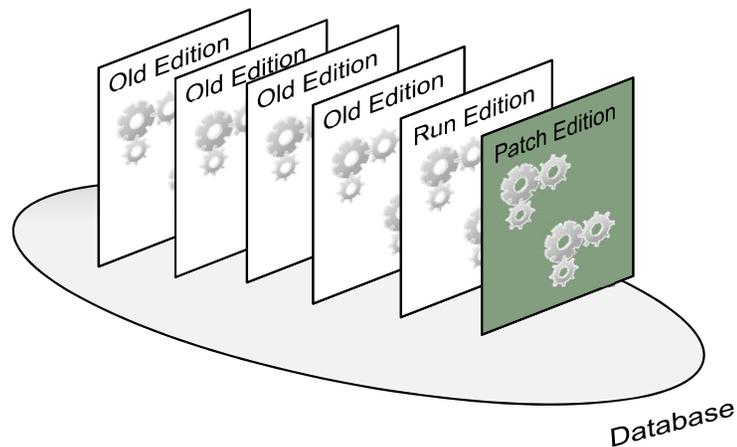
- One or more database editions are always present
  - Run Edition
    - Used by the running application
    - Always exists
  - Patch Edition
    - Used by the patching tools
    - Only exists during a patching cycle
  - Old Editions
    - These editions are only used to store code objects that have not been patched in a later edition
    - Remove by cleanup when no longer needed

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   Insert Information Protection Policy Classification from Slide 8
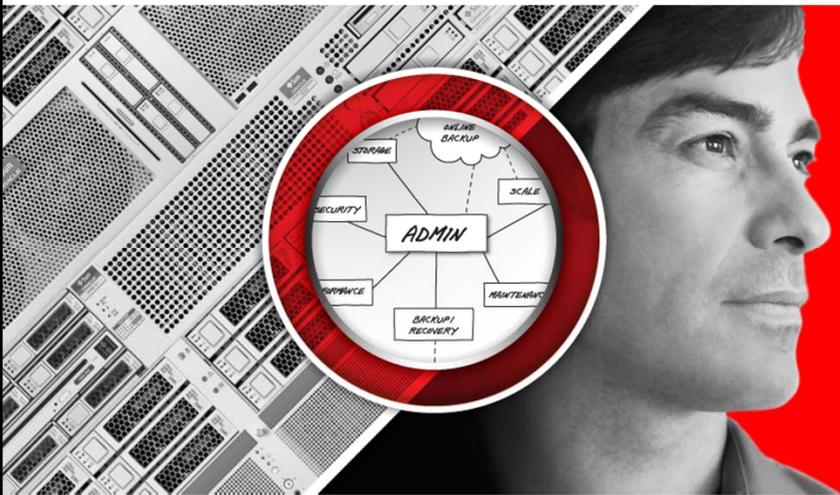
E Business Suite 12.2 Architectural changes to Support Online Patching

Insert Information Protection Policy Classification from Slide 8

Editioned Database Objects

- All code type objects support editioning
- The Database automatically manages multiple copies of these objects during patching

Editioned Objects		
	• PLSQL Spec Body Function Procedure	• Views • Editioning Views • Triggers • Types • Synonyms

Insert Information Protection Policy Classification from Slide 8

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Non-Editioned Database Objects

- Storage objects do not support editioning

- Online Patching uses advanced features of EBR to manage these objects during patching

Non-Editioned Objects

- Tables
- Indexes
- Materialized Views
- Sequences

Insert Information Protection Policy Classification from Slide 8

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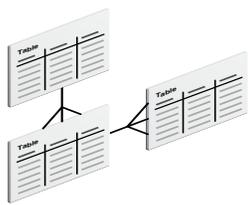
Managing Non-Editioned Objects

What about the data?

- Logical view of the data model
  - Isolates the running Application from changes to the data model
  - Editioning Views

- In place upgrade of transactional data
  - New transactions entered into the system are upgraded in place
  - Cross Edition Triggers

- Seed data
  - Data in seed data tables is replicated and the patch operates on a private copy
  - Editioned Data Storage

 Insert Information Protection Policy Classification from Slide 8

Relationship between Editioned and Non Editioned Objects

- Non-Editioned Objects can't reference Editioned Objects
- 12.2 upgrade removes all such dependencies

Non-Editioned Objects

- Tables
- Indexes
- Materialized Views
- Sequences

Editioned Objects

- PLSQL
  - Spec
  - Body
  - Function
  - Procedure
- Views
- Editioning Views
- Triggers
- Types
- Synonyms

Insert Information Protection Policy Classification from Slide 8

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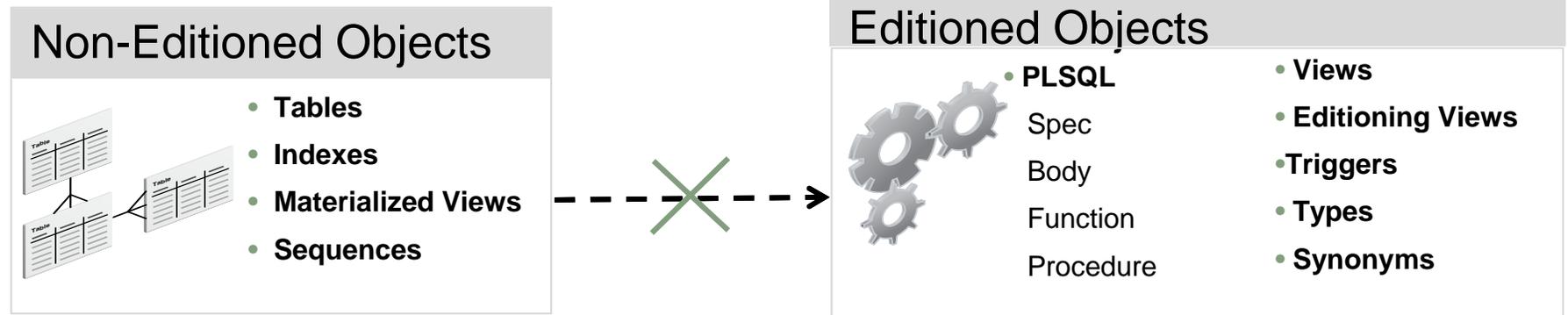
Logical view of the Application Data Model

- ## EBS data model now has a cover layer
  - A logical rather than physical representation is presented
  - <u>Editioning views</u> provide this cover layer
  - Editioning views project different views of a table to the Run and Patch Edition if the data model of a table is patched

- ## All code must access EBS data via this cover layer
  - Accessing the data model via the physical layer may result in obsolete data been returned

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Handling Non Editioned Objects in Online Patching
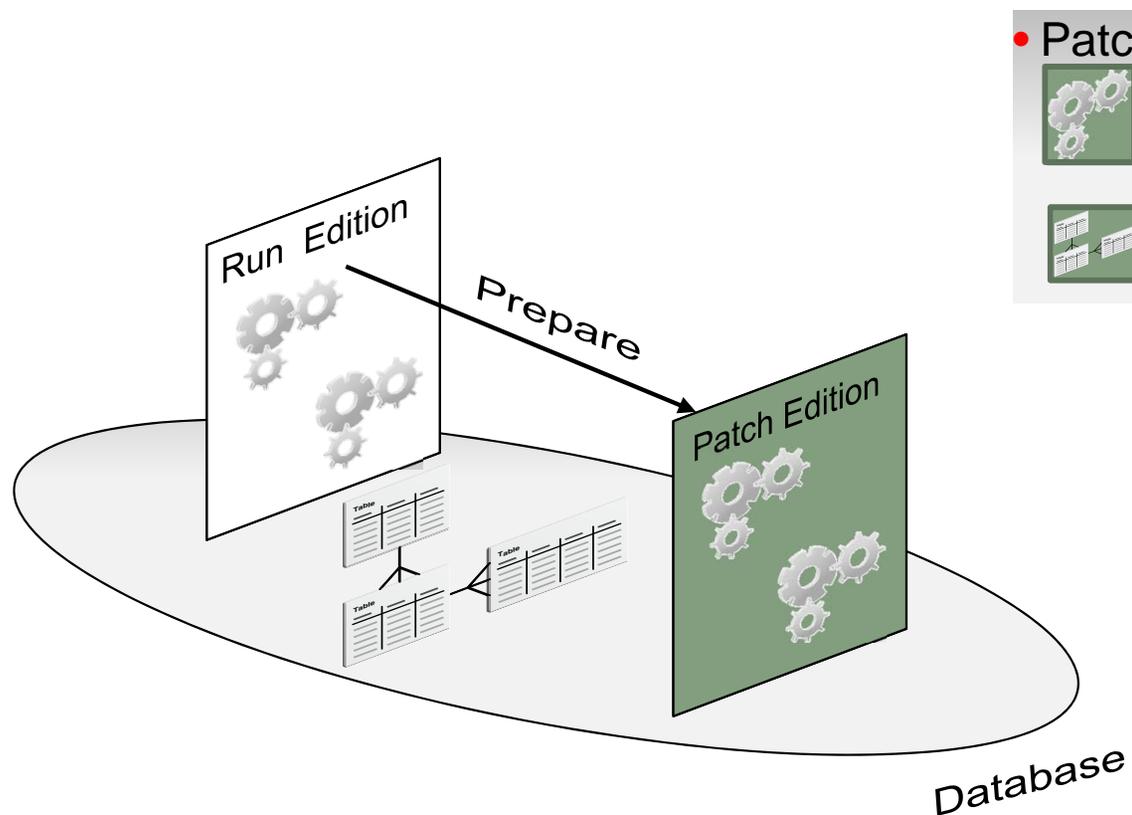
- Patch Driver
  - Code Changes
  - Data Model Changes

- Existing columns are never changed in a patch
  - Data model changes are implemented as new columns
  - Running application does not see the new column

Insert Information Protection Policy Classification from Slide 8

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Logical view of the data model

- E-Business Code

- Custom Code

- 3rd Party Code

Apps

**WF_ITEMS
(Synonym)**

APPLSYS

Table

**WF_ITEMS#
(Editioning view)**

**WF_ITEMS
(Table)**
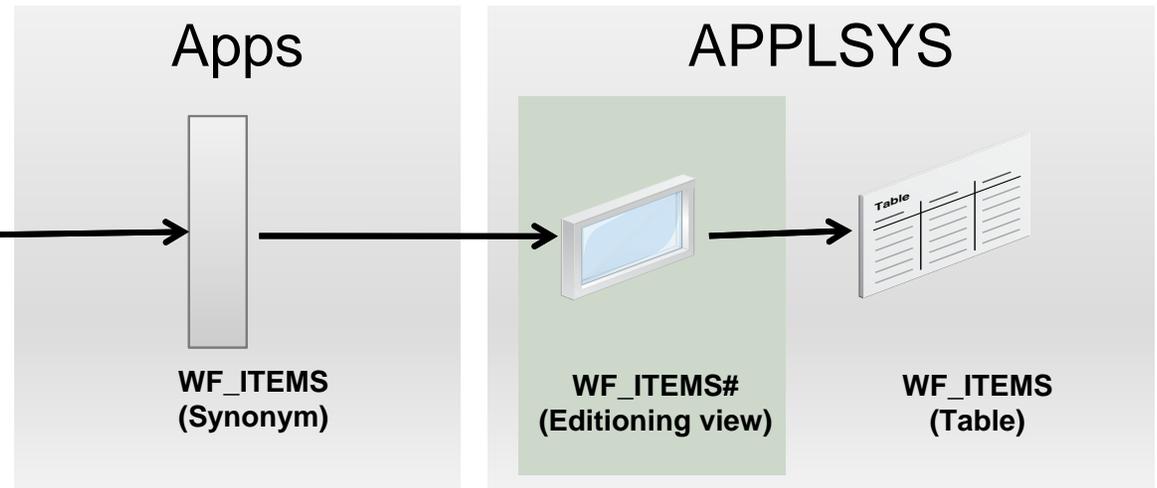
- All code must access the data model via the APPS synonym
- APPS synonym points to the Editioning View (Logical Model)
- Any code accessing the physical model risks accessing obsolete columns

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Insert Information Protection Policy Classification from Slide 8

Database Editioning Views
Data Model Upgrades

Desc   FND_TABLE

Name	Type
ID	NUMBER
NAME	VARCHAR2(30)
DESCRIPTION	VARCHAR2(30)
DESCRIPTION#2	**VARCHAR2(80)**

Run Edition View

Desc FND_TABLE (Editioning View)

Name	Type
ID	NUMBER
NAME	VARCHAR2(30)
DESCRIPTION	**VARCHAR2(30)**

Patch Editon View

Desc FND_TABLE (Editioning View)

Name	Type
ID	NUMBER
NAME	VARCHAR2(30)
DESCRIPTION	**VARCHAR2(80)**

- Patch & Run Edition see a different projection of the table
  - Code in the Run edition will treat description as 30 characters
  - Code in the Patch edition will use the new expanded 80 characters

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Insert Information Protection Policy Classification from Slide 8

Cross Edition Triggers
Data Model Upgrades and Data Transformations

- Cross Edition Triggers replace traditional upgrade scripts
- Allows the Run Edition code to signal that a data upgrade is required
  - Fires in response to an insert, update of FND_TABLE
- Upgrades the column "Description" from mixed to upper case
  - Running Application still sees the column data as mixed case
  - Patched Application sees the column data as upper case

  - Editioning views project different views of the table to each Edition

FND_TABLE

ID	NAME	DESCRIPTION	DESCRIPTION#2
1	Table	A thing with 4 legs	A THING WITH 4 LEGS
2	Window	Something to see thru	SOMETHING TO SEE THRU
3	Door	Keeps the cold out	KEEPS THE COLD OUT

Run Edition
```
Insert into FND_TABLE
values (1,'Table', 'A thing with 4 legs';

Insert into FND_TABLE
values (2,'Window', 'Something to see thru';

Insert into FND_TABLE
values (3,'Door', 'Keeps the cold out';
```

Patch Edition

Cross Edition Trigger
Maintains the new column

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 | Insert Information Protection Policy Classification from Slide 8

Handling Seed Data

- Seed data is data stored in database tables that affects the behavior of the application and is patched by EBS development
  - Patches cannot be allowed to modify the seed data seen by the running application
- Editioned Data Storage
  - Allows an Online Patch to modifying seed data
  - A copy is made of seed data and stored within the same table
  - Patches only interact with the copy
  - Old copy is deleted during cleanup

 | Insert Information Protection Policy Classification from Slide 8

Editioned Data Storage

Database

Run Edition

- Always operates on a private copy of the seed data

- Never affected by patching

Patch Edition

- Seed data Loader

  - Prepares table for patching

  - All rows are copied

  - Loads seed data changes into the copy

FND_SEED_TABLE

Insert Information Protection Policy Classification from Slide 8

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Preparing for Online Patching

Insert Information Protection Policy Classification from Slide 8

Preparing for Online Patching

Don't worry, the 12.2 upgrade handles the changes

- Logical data model is installed by the 12.2 upgrade

- Cross Edition Triggers needed by a patch are automatically installed by the patch

- Seed data tables are automatically upgraded to support Editioned Data Storage

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Preparing for Online Patching

Readiness Report

- Online patching analysis report
  - Available for all releases prior to 12.2
- Reports all violations of "Non-Editioned Objects can't reference Editioned Objects"
  - EBS Code
  - Custom Code
- Violations within EBS code are automatically fixed by the 12.2 upgrade
- Customer should study the report prior to upgrading to 12.2 to determine the scope of work for their custom code
  - Most violations in custom code can be fixed by the 12.2 upgrade by simply registering the custom schema with EBS
  - **Only a small number of violations require human intervention**

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Preparing for Online Patching

Consider the New Operational Characteristics

- Downtime windows
  - What operations other than applying patches do you perform?
  - Can these operations be performed while the E-Business Suite is online?

- Customizations
  - New utilities to help identify & correct compliance issues
  - Advice on how to fix objects that are not compliant
  - New set of coding standards for online patching

- Testing
  - Patch Edition is not a testing environment
  - Patches still need to be tested on a test system
  - Consider new test scenarios
    - Users can be Online during patch application

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Online Patching Summary

- 12.2 Upgrade is NOT an Online Patch

- 12.2 Upgrade
  - Automatically fixes all compliances issues in EBS code
  - Can automatically fix compliance issues in customizations
  - Installs a logical view of the data model that all code must use to access the E-Business Suite

- All patches delivered post 12.2 will be Online Patches
  - New patching tool (ADOP) used to apply patches

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Benefits of Online Patching

- Removes barriers to uptake
- Much easier to negotiate downtime with lines of business
- Much easier to identify downtime windows as they are so brief
- Applications stays online during patch application

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Q&A

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