IBM WebSphere Application Server Migration - Planning and Best Practices

David Vines,

WebSphere Application Server

IBM

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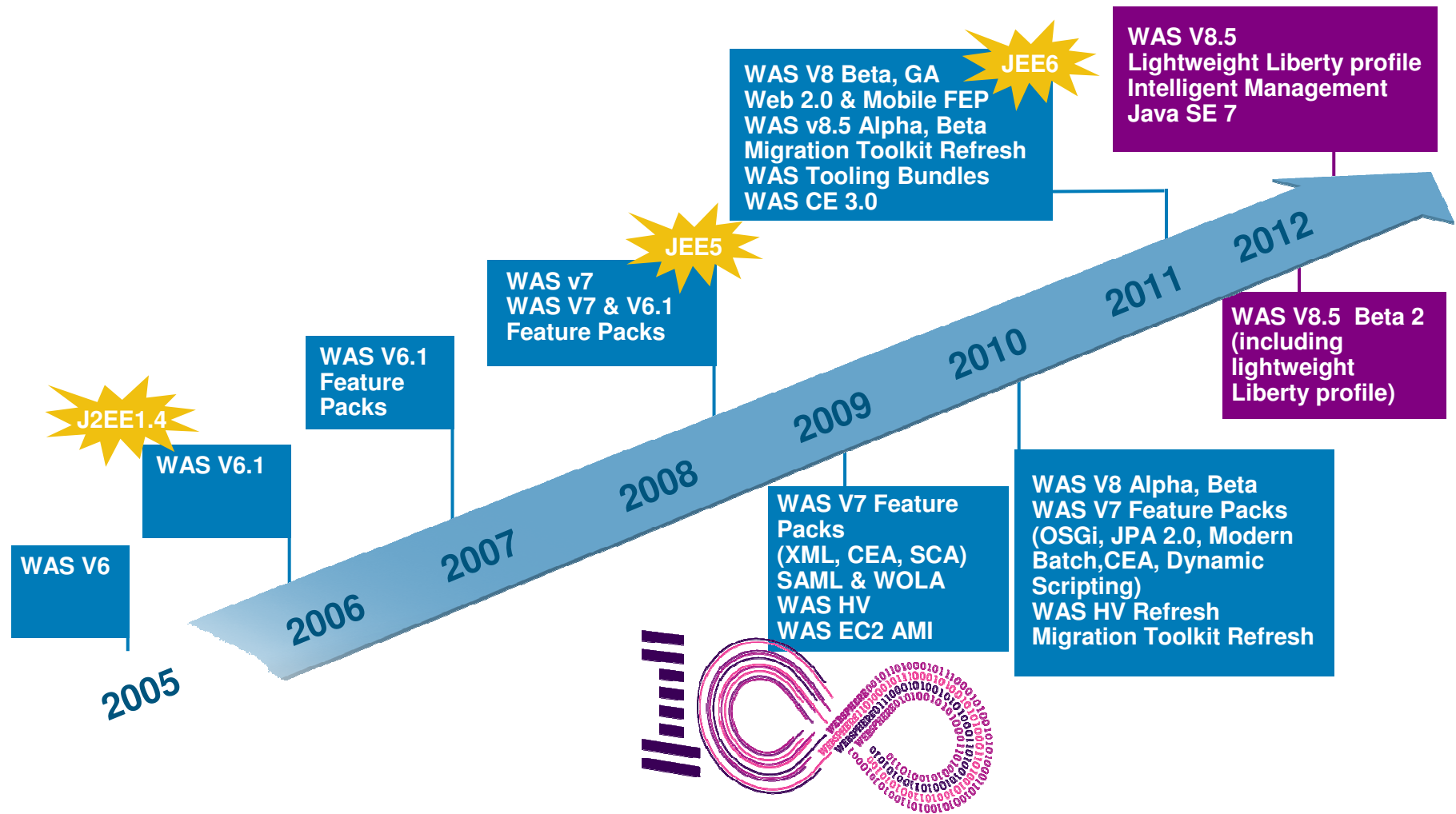
About the Speaker

Dave Vines is an IBM Master Inventor and Senior Software Engineer at the IBM Hursley Laboratory in the United Kingdom working in WebSphere Application Server Development specializing on the Liberty Profile and IBM workload Deployer. He joined the laboratory in 1984 and has worked on a wide variety of IBM program products including GDDM, MQSeries, LANDP and, since 1998, on Component Broker and WebSphere Application Server. He received a Bachelor of Science degree from the University of Exeter, England, in 1984.

WebSphere Application Server (WAS):
Over 14 years of Leadership & Trusted Delivery

WAS V8.5
Lightweight Liberty profile
Intelligent Management
Java SE 7

JEE6

WAS V8 Beta, GA
Web 2.0 & Mobile FEP
WAS v8.5 Alpha, Beta
Migration Toolkit Refresh
WAS Tooling Bundles
WAS CE 3.0

JEE5

WAS v7
WAS V7 & V6.1
Feature Packs

2012

2011

WAS V8.5 Beta 2
(including
lightweight
Liberty profile)

WAS V6.1
Feature
Packs

2010

2009

J2EE1.4

WAS V6.1

2008

WAS V8 Alpha, Beta
WAS V7 Feature Packs
(OSGi, JPA 2.0, Modern
Batch,CEA, Dynamic
Scripting)
WAS HV Refresh
Migration Toolkit Refresh

2007

WAS V7 Feature
Packs
(XML, CEA, SCA)
SAML & WOLA
WAS HV
WAS EC2 AMI

WAS V6

2006

2005

Agenda

- **Migration overview**
- Migration planning roadmap
- Application Migration
- Configuration Migration
- Overview of changes by version
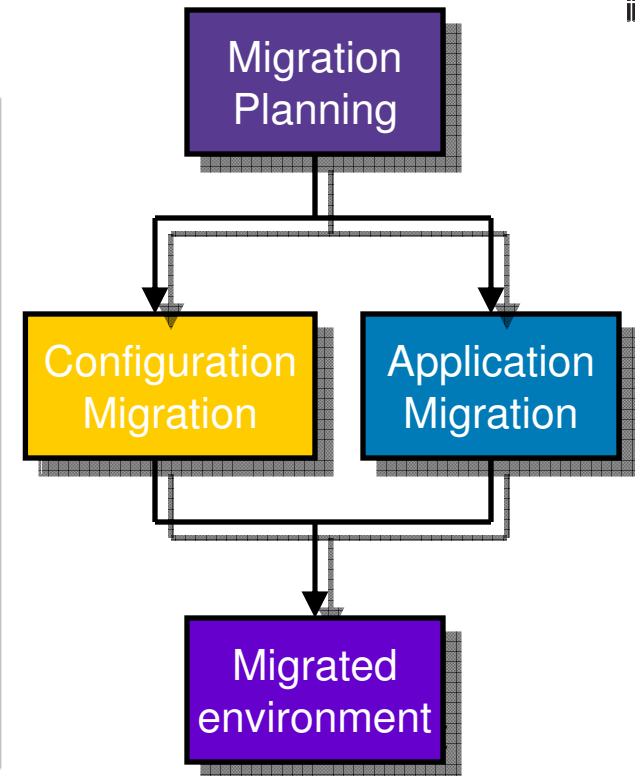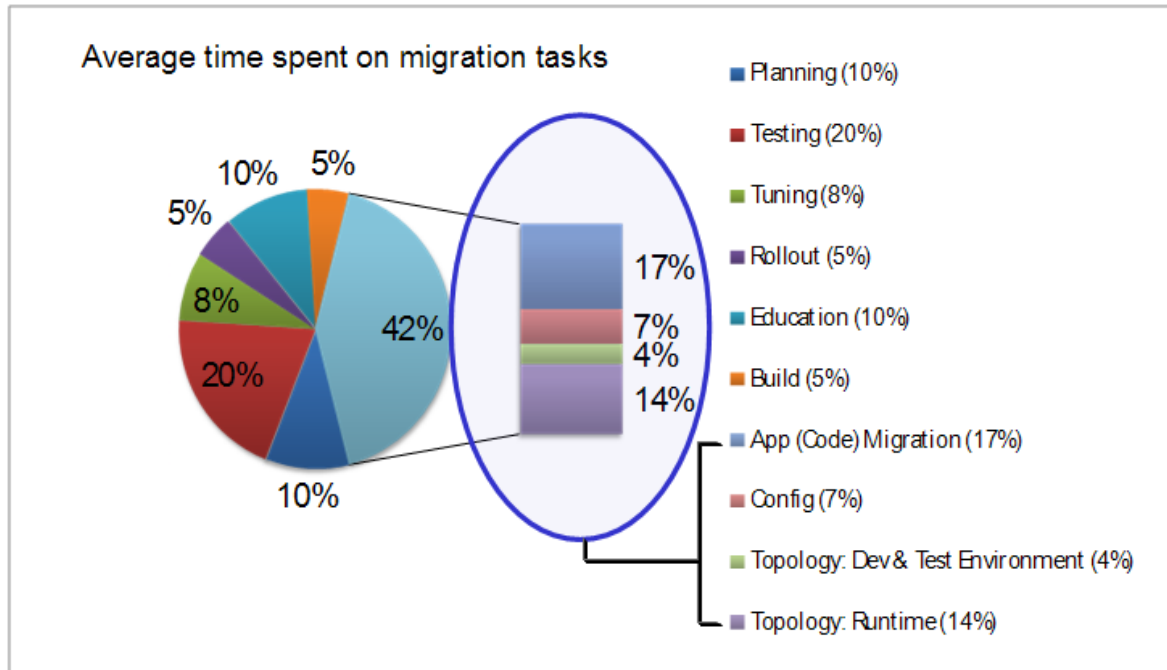- Summary
- References

Introduction

- This presentation is intended to educate and assist in performing WebSphere Application Server Version to Version Migrations

- It contains overall planning guidelines as well as detailed migration concerns for your awareness

- It does not prescribe one Migration path
  - Varies with customer policies
  - Varies with versions involved
  - Varies with customer procedures

- Use this information as a guide to build your own plan

- Get assistance if needed

Migration Aspects

Average time spent on migration tasks

- Planning (10%)
- Testing (20%)
- Tuning (8%)
- Rollout (5%)
- Education (10%)
- Build (5%)
- App (Code) Migration (17%)
- Config (7%)
- Topology: Dev & Test Environment (4%)
- Topology: Runtime (14%)

Pie chart values: 5%, 10%, 5%, 8%, 20%, 42%, 10%

Expanded segment (42%): 17%, 7%, 4%, 14%

Flow diagram:

Migration Planning → **Configuration Migration** / **Application Migration** → **Migrated environment**

- The whole migration process involves a variety of steps
    - Migration process needs planning and cannot compromise day-to-day business

- Each situation is unique
    - There is no one standard plan

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Migration impacts overview

Migration impact is gated by two overarching factors

1. The <u>versions involved</u> in the customer Migration scenario

    - Moving from v6.1 to v8.5 would be different than v5.1 to v8.5

2. The <u>amount of change</u> introduced in and between these versions

    - Moving from v6.1 to v8.5 involves changes introduced by v7.0, v8.0 and v8.5

    - Moving from v5.1 to v8.5 involves changes introduced by v6.0, v6.1, v7.0, v8.0 and v8.5

v5.1 to v8.5   v6.1 to v8.

	v6.0	v6.1	v7.0	v8.0	v8.5
Configuration	Port assignment	Security	None	None	None
Application	JSP and Servlet	Java Runtime	Minimal	Minimal	**None***

None* means no required code changes with default of JRE6 when using traditional WAS runtime

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Externals summary

	v5.x	v6.0	v6.1	v7.0	v8.0	v8.5
IDE	WebSphere Studio 5.1	RAD v6.0	RAD v7.0	RAD v7.5 WDT 7.0	RAD v8.0 WDT 8.0	RAD v8.5 WDT 8.5
Code	J2EE 1.3 JRE 1.3 (v5.0) JRE 1.4 (v5.1)	J2EE 1.4 JRE 1.4	J2EE 1.4 JRE 5	JEE 5 JRE 6	JEE 6 JRE 6	JEE 6 JRE 6/JRE 7
Deploy	EAR	EAR Config in EAR	EAR Config in EAR	EAR/BLA Config in EAR EBA(FeP)	EAR/BLA Config in EAR EBA	EAR/BLA Config in EAR EBA

- Rational Application Developer (RAD)
- WebSphere Development Tools (WDT)

Choosing the "right" version

- Question: "Which WebSphere Application Server version should I migrate to?"

- Answer, as always - "It depends"
  - End of Service date for your current version
    - WebSphere Application Server v5.1 was September 2008
    - WebSphere Application Server v6.0.2 was September 2010
    - WebSphere Application Server v6.1 is September 2013
  - Characteristics of your targeted version
    - End of Service date for the version – most likely an estimate
    - Stability in lifecycle
    - JEE/JDK levels relative to targeted version
    - New WebSphere Application Server features you want
    - Version requirements of vendor or IBM products that you have or want
    - Version your Enterprise has committed towards
    - What about fixpack level? – is there an implicit company policy?
    - What else that you use that depends on a WAS version number?

Support policies

- At least 12 months notice prior to an IBM branded product release's EOS date and the availability of support extensions for an extra charge set by IBM

  - Endeavor to coordinate most EOS dates to occur on 30 April or 30 September

- Enhanced '5+3' support statement as of March 2007

  - Five years for standard, three for extended support.

  - Updated April 2008 to include selected products within the Information Management, IBM Lotus, IBM Rational, IBM Tivoli and WebSphere...

    - http://www-1.ibm.com/support/docview.wss?uid=swg21256700

- Latest as of Summer 2011

  - One of our new initiatives is to support, on a going-forward basis for select IBM branded products that have not previously announced an EOS date, not only the 'current' version of the product, but also up to two previous versions, in an effort to limit disruptive technology transitions.

  - In this context, a 'version' is a major functional enhancement level. While not every IBM software product will be subject to this new initiative, our initial focus is to support key products from all of our software brands, and expand the number of products over time

  - http://www.ibm.com/software/support/lifecycle/lc-policy.html

Agenda

- Migration overview

- **Migration planning roadmap**

- Application Migration

- Configuration Migration

- Overview of changes by version

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Migration Plan Roadmap

- Assessment
- Planning
- Skills
- Development Environment
- Application Code Migration
- Runtime Environment Migration
- Test
- Production
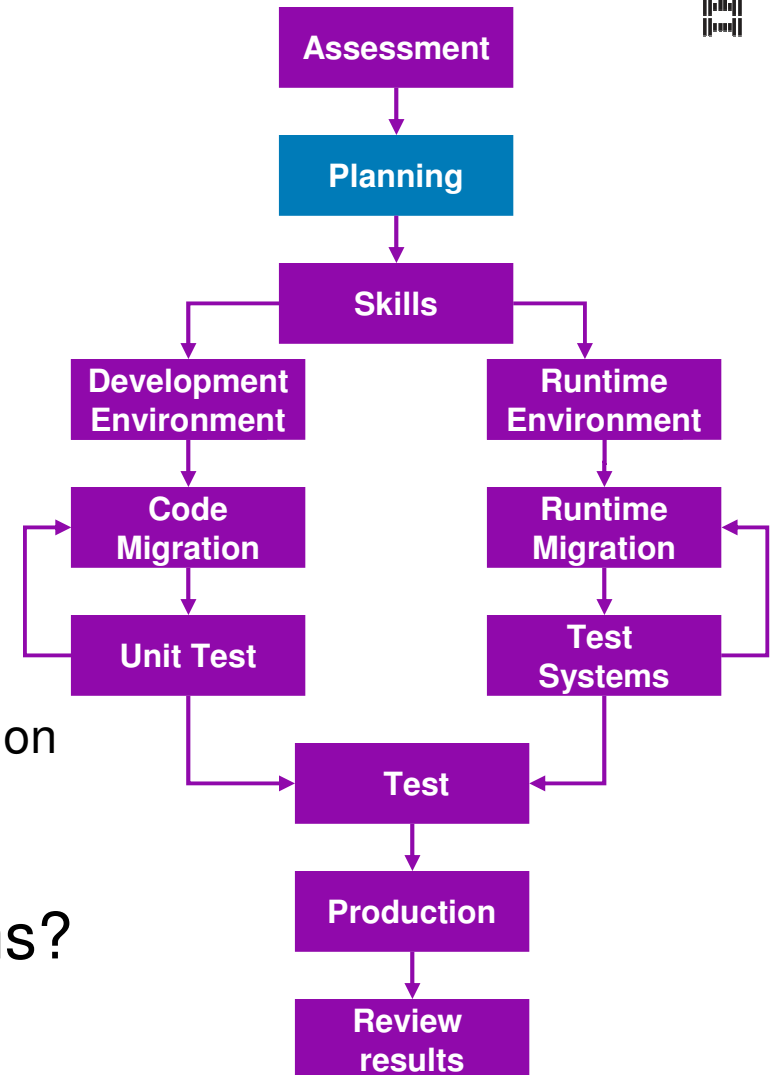- Review the results

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           Assessment
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               ▼
            Planning
               │
               ▼
             Skills
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          ▼         ▼
    Development    Runtime
    Environment    Environment
          │         │
          ▼         ▼
        Code      Runtime
      Migration   Migration
          │         │
          ▼         ▼
      Unit Test    Test
                  Systems
          └────┬────┘
               ▼
             Test
               │
               ▼
           Production
               │
               ▼
            Review
            results
```

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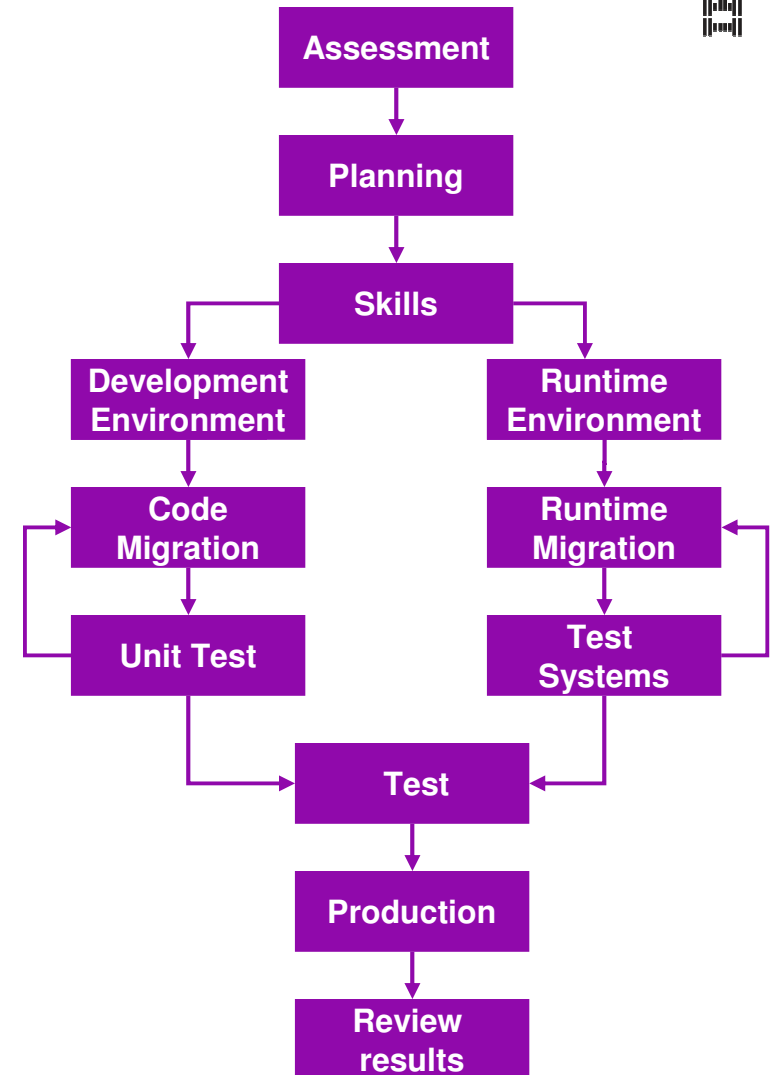
Assessment

- Gather the stakeholders
  - Communications with clients, peers, and leadership
  - Consider a core Migration team for larger scale

- Identify education requirements
  - Developer, Administrator…

- Hardware requirements
  - Possible Upgrades, 64 bit versus 32 bit

- Topology assessment
  - Downtime tolerance, Failover support

- Application architecture
  - Tightened JEE specifications
  - Dependencies between apps
  - API removal, JRE changes

- Review Testing practices
  - Standard practices and automation

- Vendor apps and WebSphere products
  - J2EE/JDK/WebSphere version requirements
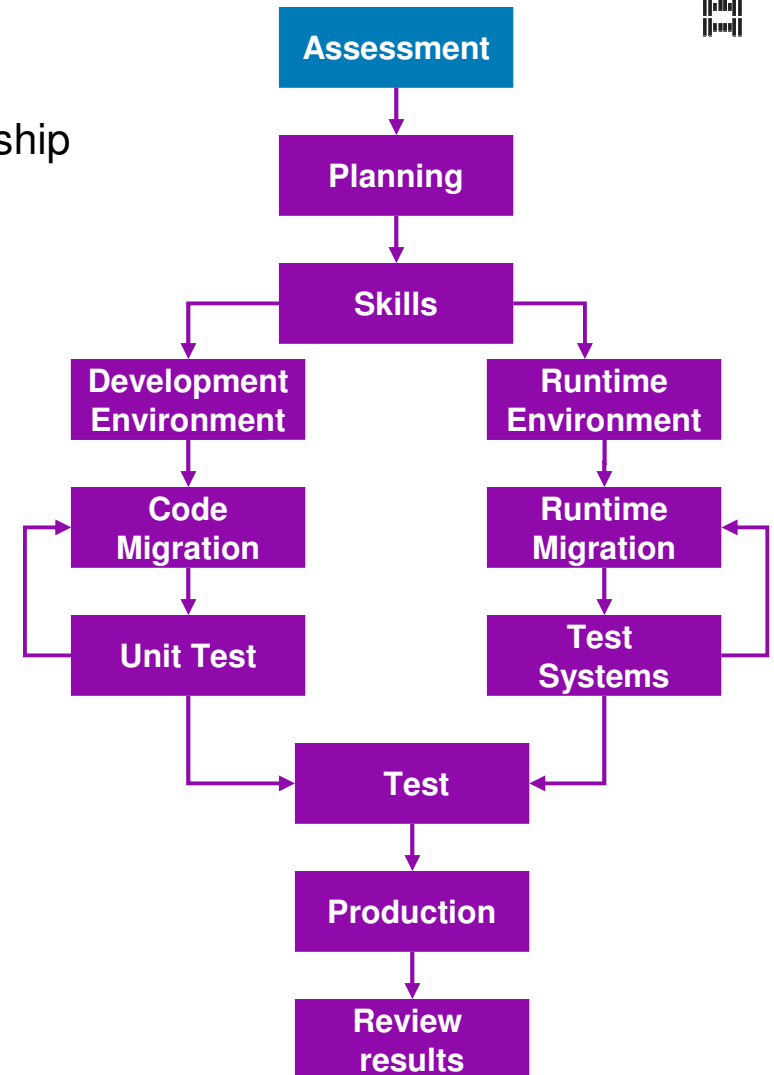
Planning (1)

- Build a plan based on assessment
  - Hardware and license requirements
  - Prerequisite and requisite software
    - Check with "Clarity" website – see references
  - Education
    - IBM Education Assistant, IBM Education ...
  - Account for many applications and multiple development teams?
    - Identify early adopters
    - Identify Pilot projects
    - Migration as an initiative or project?

Assessment → Planning → Skills

Skills → Development Environment → Code Migration → Unit Test

Skills → Runtime Environment → Runtime Migration → Test Systems

Unit Test → Test

Test Systems → Test

Test → Production → Review results

Planning (2)

- Build a plan based on assessment

  – Application rollout strategies

    • "Stealth", "Train", Voluntary…

  – Consider timeline factors

    • Availability, maintenance windows, lockdowns

  – Plan for High Availability

    • Mixed version clusters requires dual app compatibility

  – Create an execution timeline

  – Include a rollback plan

Assessment → Planning → Skills

Skills → Development Environment → Code Migration → Unit Test → Test

Skills → Runtime Environment → Runtime Migration → Test Systems → Test

Test → Production → Review results
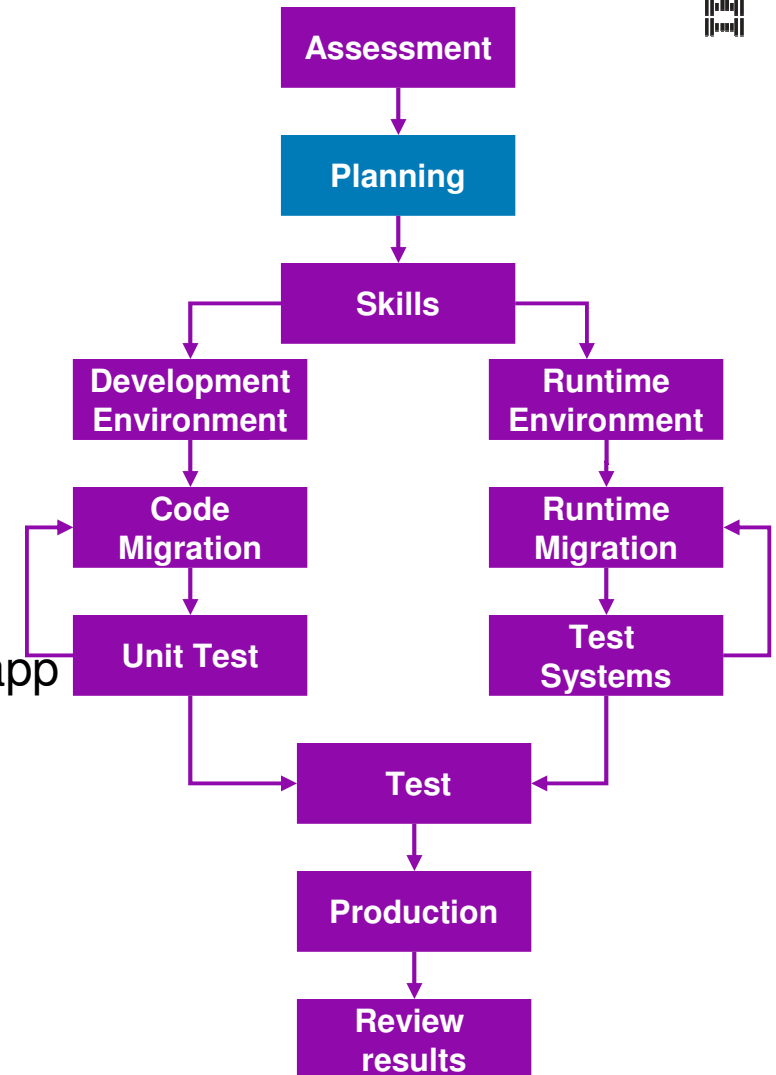
Skills

- Plan for education
  - New development tooling
  - Enhancements in WebSphere administration model
  - Changes in the latest WebSphere version
  - New standards

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                    Assessment
                        |
                        v
                     Planning
                        |
                        v
                      Skills
                   /          \
                  v            v
         Development        Runtime
         Environment        Environment
              |                 |
              v                 v
            Code             Runtime
          Migration         Migration
              |                 |
              v                 v
          Unit Test         Test Systems
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                 Review
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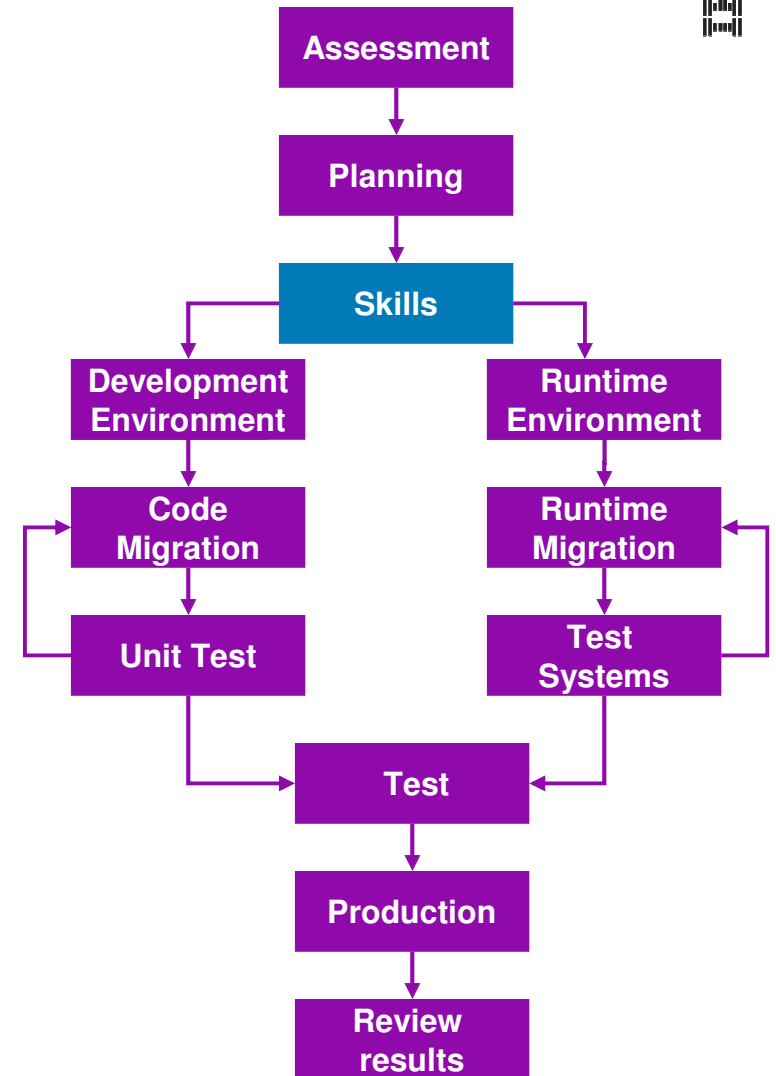
Runtime Environment

- Most likely will need to support parallel development

- Migrate some test systems iteratively
  - Integration
  - System test
  - Performance
  - Pre-Production
  - Production
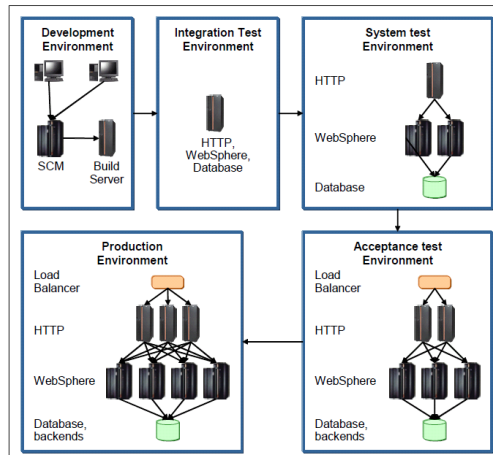
- Use the same migration process throughout if possible
  - Or at least before you do production migration…

Assessment → Planning → Skills

Development Environment → Code Migration → Unit Test

Runtime Environment → Runtime Migration → Test Systems

Test → Production → Review results
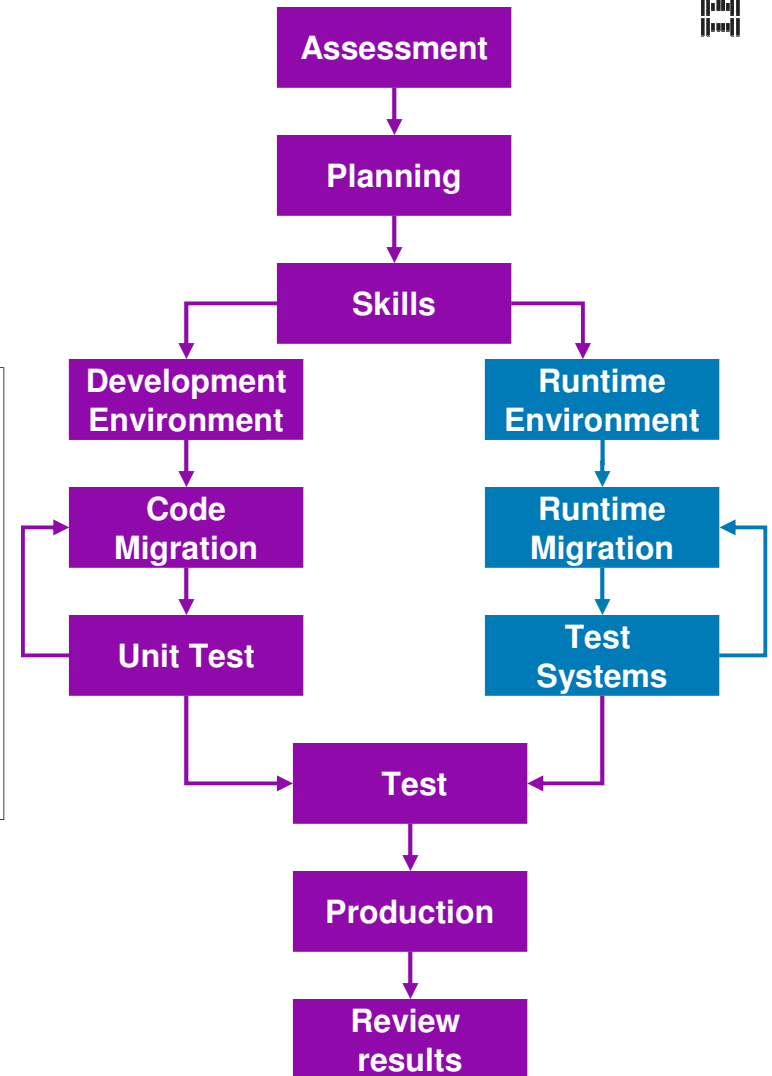
Development Environment

- Upgrades needed for some (Rational) IDEs
  - Progress iteratively, expand outward
- Assume good but not complete application compatibility
  - Assess apps, based on known issues
  - If no changes required, perform standard regression
- If development is required do it iteratively
  - Initially make changes that are <u>required</u> to support version migration
    - Reduces complexity of planning, diagnosis and debug - "**<u>Keep it Simple</u>**"
  - Require application code to be dual-compatible to support mixed version clusters?
  - Test to the depth of test environment that fits your comfort level
  - Then do any necessary new code development and iterate following your standard practices
- Address Deprecations at some point
  - Ideally later as part of application upgrades

Assessment

Planning

Skills

Development Environment	Runtime Environment
Code Migration	Runtime Migration
Unit Test	Test Systems

Test

Production

Review results
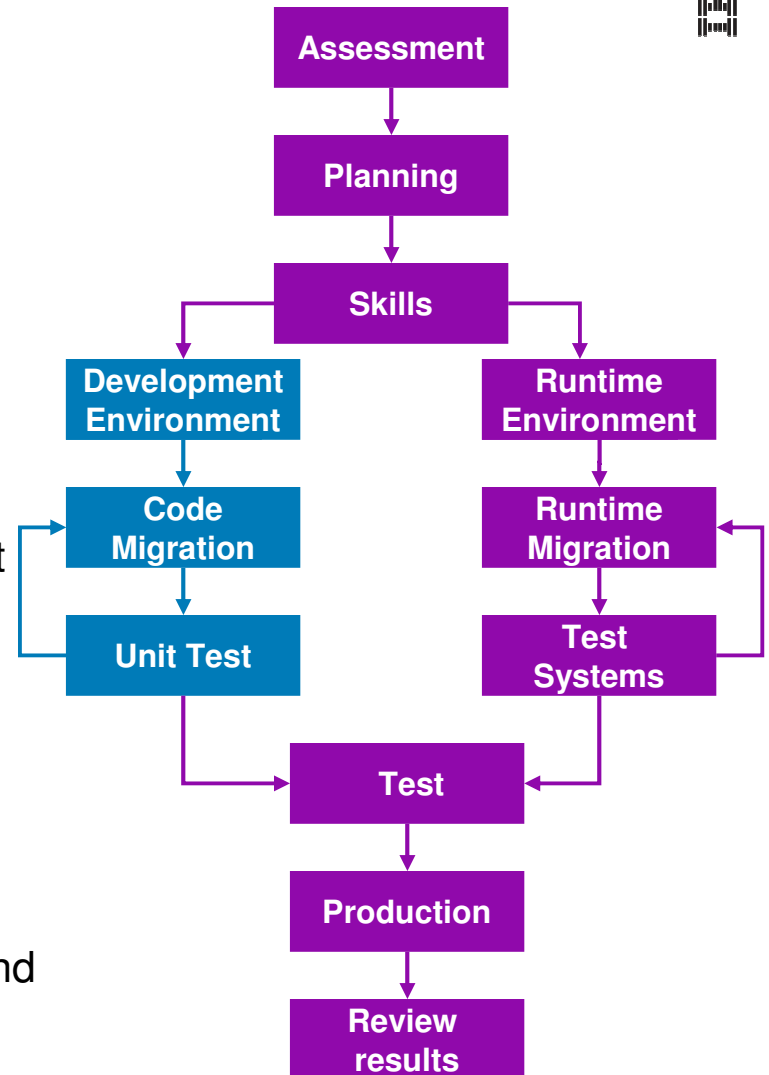
Test/Production/Review

- Run your standard test processes
  - Progress applications normally through the test environments
- Ensure Performance is measured
  - Differences exist between WebSphere versions
  - JDK changes may have occurred
- Have a rollback plan for production
  - Practice on another system earlier in the cycle
- Review the results of the Migration
  - Update the plan for next time
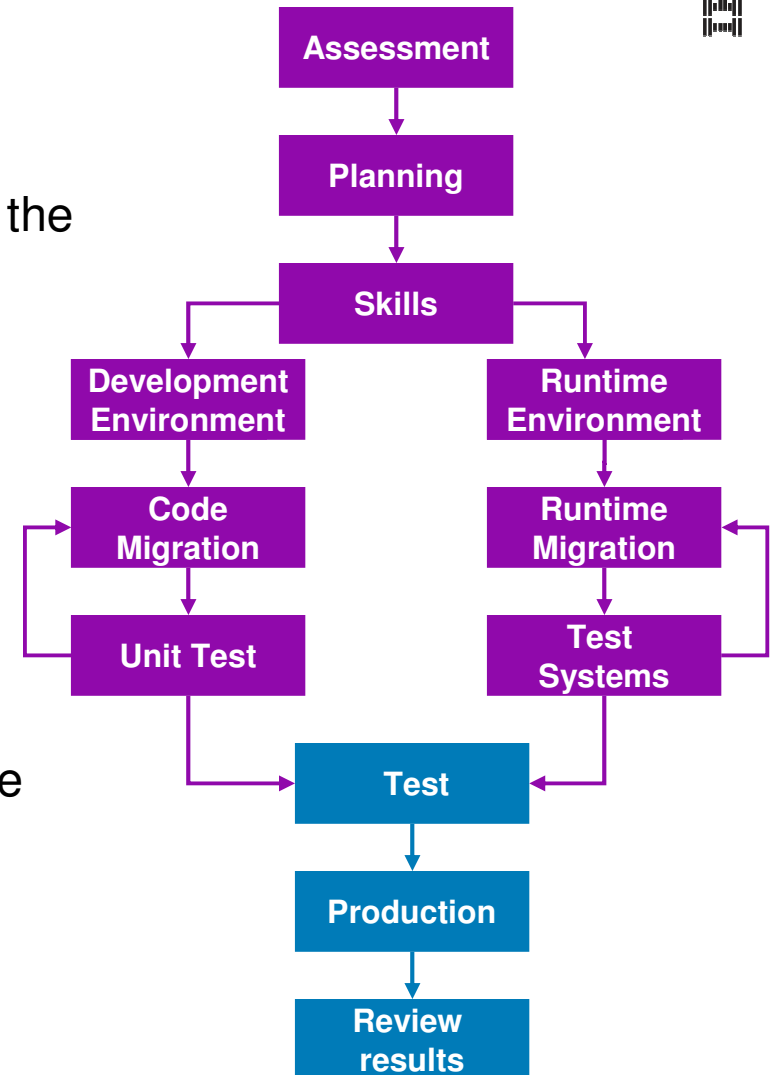
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Application Migration

- Java Runtime compatibility (JRE)

  - JREs focus on binary compatibility and are normally pretty good

  - However new APIs and behavior changes can cause migration work

- Java EE (JEE) compatibility

  - Newer JEE versions intend to support older JEE versions

  - But in some cases breaking clarifications do exist

  - JEE supports incremental upgrade

    - Modules within an application can be earlier versions

- In general WebSphere APIs very compatible

  - Many v4.x Applications interfaces unchanged (except for zOS)

  - Most interfaces after v5.0 are unchanged, although some removals

- <u>However, no guarantee that applications will run unchanged</u>

Deprecation policy

v6.0.x

v6.1.x

v7.0.x

- New API introduced
- Deprecated but still supported
- Deprecated but still supported
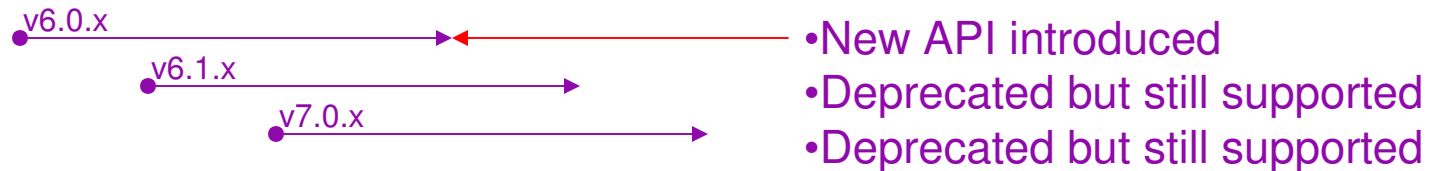
- Deprecation policy in place for all <u>WebSphere Application Server APIs</u>

- API supported for 2 full releases from the point of deprecation or 3 full years whichever is longer

- API <u>may</u> be removed at such point but not always

- Deprecations and Removals are documented in InfoCenter

- **As of v8.0 and later, changes to defaults are also documented in the InfoCenter**

WebSphere Application Migration tool

- **WAS Application Migration tool**
  - Analyzes customer application source code to find migration problems:
    - Removed features
    - Deprecated features
    - Behavior changes
    - JRE 5, 6 and 7 differences
    - Java EE specification changes or enforcements
  - **Free** download and supported -> use in Rational and Eclipse development environments
    - v7.0: Support for v5.1 through v6.1
    - v8.0: Support for v5.1 through v7.0
    - v8.5: Support for v5.1 through v8.0
- **Application Migration**
  - Few significant impacts in v8.0, **None** in v8.5
    - No required change in Java Runtime specification level
    - Java EE6 upgrade in v8.0 but 84% of the sub-specification is unchanged

WAS v7.0,v8.0 v6.x/5.x

WLS

OAS

JBoss AS

Tomcat

WAMT

WebSphere Application Server v7.0,v8.0 or v8.5
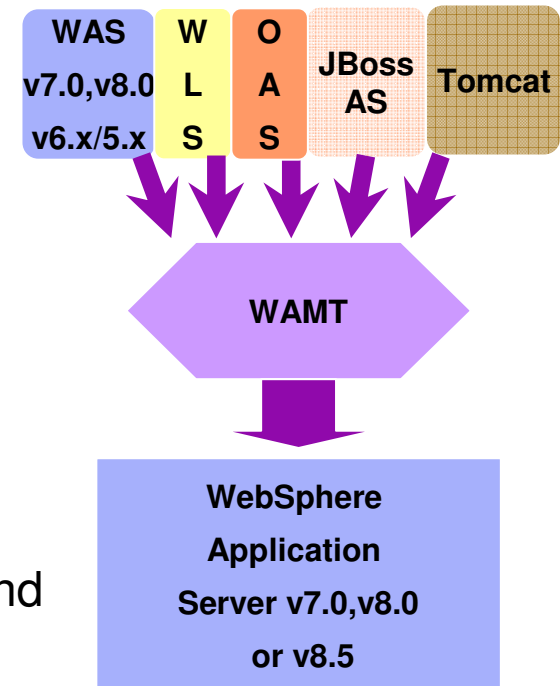
No more wading through documentation and source code or performing trial-and-error to determine what will break in your application!

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- Migration overview

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Administration

- Administration model changed starting in v5.0

  – Transition from DB repository to file based

  – Administration scripting tools changed

- Scripting model changed starting in v5.0

  – Stable scripting strategy starting v5.0

  – No changes moving from v5.0 to v5.1

  – Small number of changes in some later versions

- Used to differ in migration tooling and support between Distributed, iSeries and zOS platforms

  – Improvement starting in v5.0, with same underlying migration tooling, support and experiences

Administration scripting choices

- JACL or Jython?
- JACL was the only choice initially
- Jython is the preferred direction
  - More industry support
  - Better performance
  - Priority in future deliverables

- **<u>No need to convert JACL</u>**
  - <u>No longer deprecated!</u>
  - It is now "Stabilized" – meaning it will not be removed but it will not have further investment
  - Conversion tool available via download since v6.1 and included in RAD

- Suggest an evolution
  - Create new scripts using Jython

Tools and techniques

- Cross version plug-in support

  HTTP

  - Higher level Web Server plug-in can work to multiple WebSphere versions

    - The URI for a machine must be unique in the routing rules for the plug-in

    v6.1   v7.0   v8.0   v8.5

    - Support for n-3 (v6.1,v7.0 and v8.0 for v8.5)

- Coexistence

  WAS
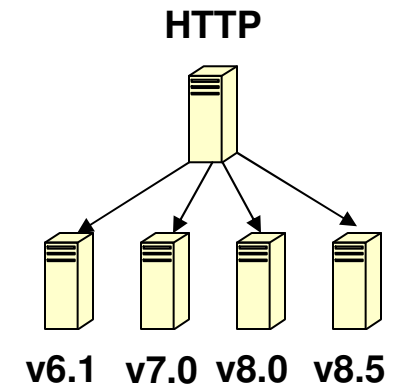
  - Different versions of WAS: same machine, same LPAR, same time

    - Requires port conflict resolution of concurrently running servers

    v6.1, v7.0, v8.0 and v8.5

    - Support for n-3 (v6.1,v7.0 and v8.0 and v8.5)
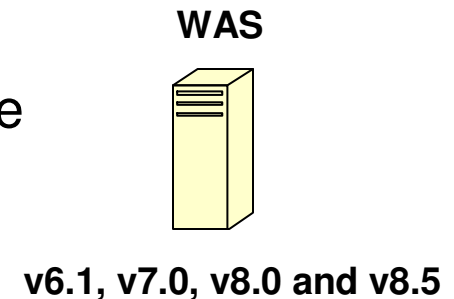
Tools and techniques…

- Interoperability

  – Different versions of WebSphere can communicate

    • Support for applications that are Secure, Transactional, EJB WLMable
    • Support for n-3 (v6.1,v7.0 and v8.0 and v8.5)

v6.1

v7.0   **v8.0**

v8.5
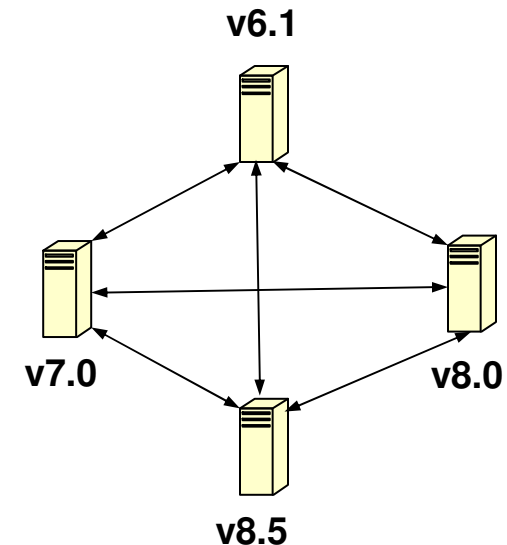
- Runtime migration tools

  – Merge existing configurations between versions

    • zOS - zMMT – create customized jobs

    • iSeries

      –Use commands directly

    • Distributed –

      –Migration Wizard

      –Or use commands directly

Old Profile **WASPreUpgrade** Migration Backup Files **Server Configuration Applications Resources**

Create new Profile New Profile **WASPostUpgrade** **Migrated Profile**
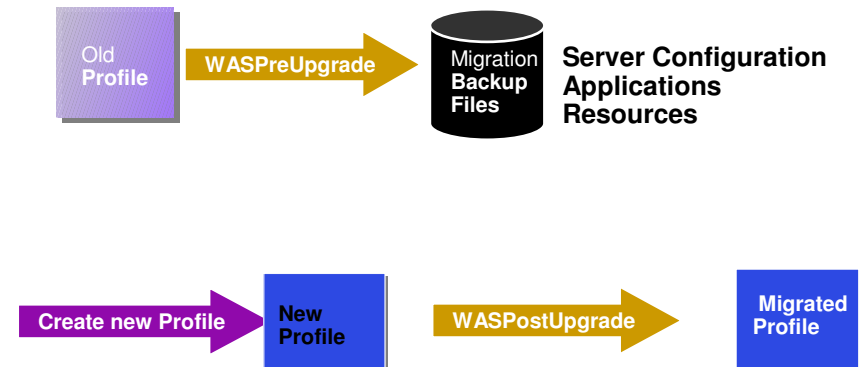
Runtime migration tools

- Migrated data
  - New configuration is used as the starting point
  - All Servers, TCP ports, IP names, resources etc. are migrated
  - Applications are migrated by default but can be just built to be deployed later if desired
  - Support for migrating across machines or LPARs
- zOS migration is only within the same LPAR

Old Profile → **WASPreUpgrade** → **Migration Backup Files** Server Configuration Applications Resources

Create New Profile → **New Profile** **WASPostUpgrade** → **Migrated New Profile**
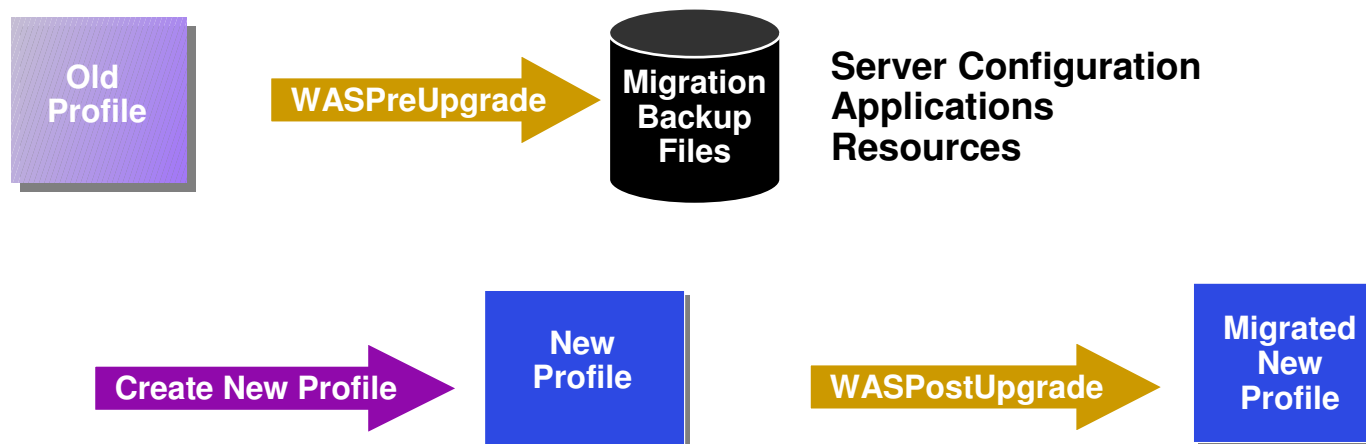
Continued Mixed Version Cell Support

Support for existing infrastructure in new deployments

1st provided in version v6.0

WAS Network
Deployment v8.5 Cell

v8.5 Deployment Manager

ND
Node
Agent

ND v8.5 Nodes

ND
Node
Agent

ND v6.1 Nodes

ND
Node
Agent

ND
Node
Agent

ND v7.0 Nodes

ND v8.0 Nodes
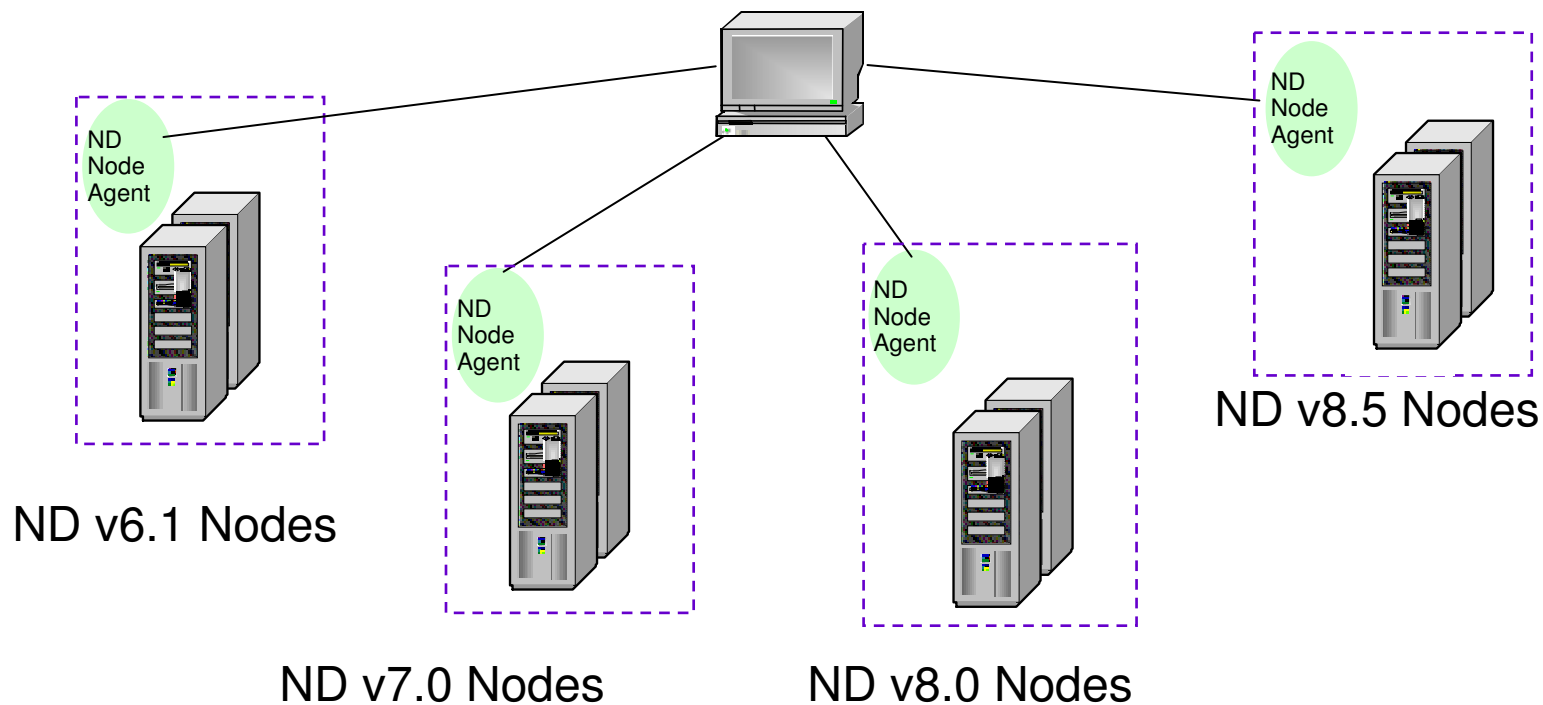
v8.5 Cell can contain v6.1,v7.0,v8.0 & v8.5 nodes: for continued operation as well as staging of upgrades
Note – Precompile options are not available for application deploy to back level nodes

Five Network Deployment strategies

1. ## Side by Side
   - Create a new cell and populate with scripts or manually
   - No runtime migration tools
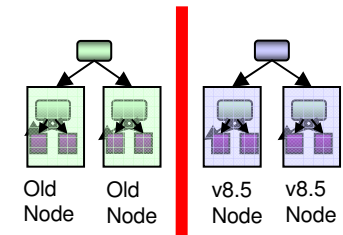
2. ## In Place - Copy and replace the cell
   - Recreates the **exact** existing configuration in the new cell
   - DMgr and nodes are migrated
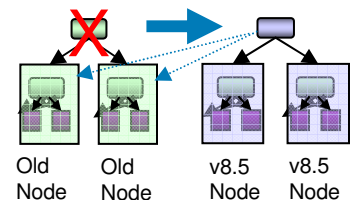
3. ## In Place - Copy and replace the DMgr
   - Recreates the **exact** existing configuration in new cell
   - Add new nodes and move incrementally
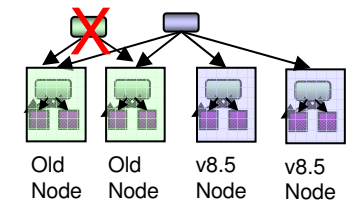
4. ## In Place - Copy and coexist
   - Recreates the **exact** existing configuration in the new cell
   - Modify the ports in the new cell and coexist
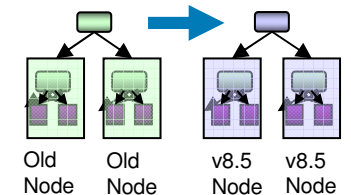
5. ## Side by Side - Fine Grained
   - Create a new cell and incrementally copy existing configuration
   - Uses an intermediate profile, runtime migration and wsadmin tools
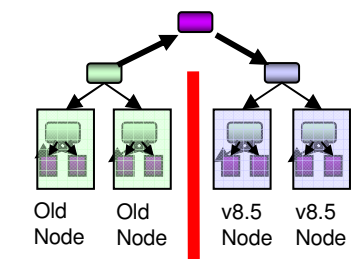
Side by Side

- Ignores the existing configuration

- Create a new cell and populate with administration scripts or manually

- Best results with a comprehensive set of scripts or tools for configuration automation

Old Node   Old Node   v8.5 Node   v8.5 Node

- Pros
  - No dependencies on tooling
  - Least risk assuming existing scripts are comprehensive
  - Can easily migrate applications singly
- Cons
  - Comprehensive set of scripts and ongoing maintenance of those scripts can be expensive
  - Any required changes to these scripts must be done before migrating
  - Any tuning of the old configuration is not carried forward
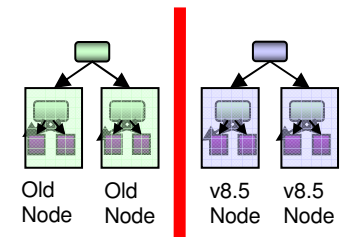
In Place - Copy and replace Cell

- Use Runtime migration tools on DMgr
  - Recreates the **exact** existing configuration in the new cell

- Later migrate the existing nodes using the runtime migration tools
  - All applications on a managed node are migrated at the same time

- Pros
  - Does not require comprehensive set of scripts
  - All configuration is moved forward

- Cons
  - Dependency on using the runtime migration tools
  - Requires all applications on a node be ready to migrate at the same time
  - Limited value if you are refactoring your topology
  - Carries default values forward from the old cell
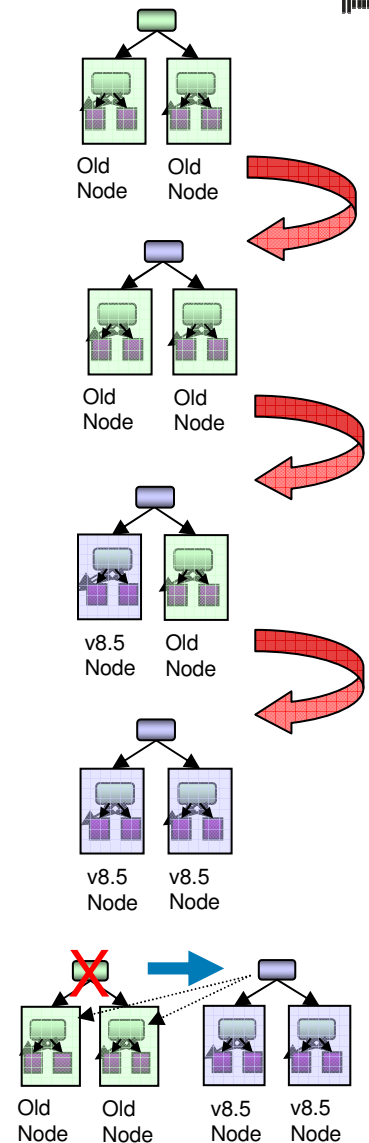
In Place - Copy and replace DMgr

- Use Runtime migration tools on DMgr

  - Recreates the **exact** existing configuration in the new cell

- Add new nodes

  - Applications can be migrated singly when ready

  - Remove old nodes when no longer needed

- Pros

  - Does not require comprehensive set of scripts

  - All configuration is moved forward

  - Cell and cluster level configuration accessible by older nodes

- Cons

  - Dependency on using the runtime migration tools

  - Limited value if you are refactoring your topology

  - Carries default values forward from the old cell
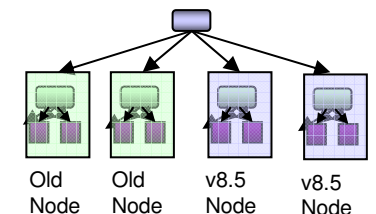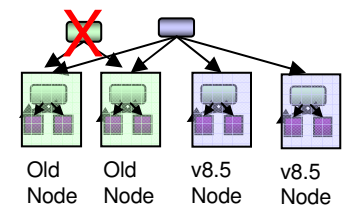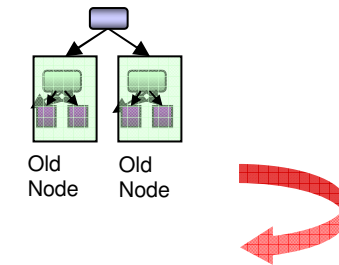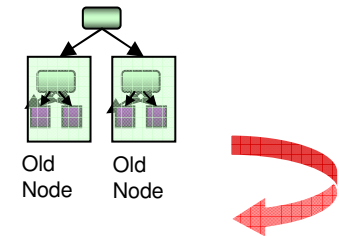
In Place - Copy and coexist

- Same steps as "Copy and replace Cell" except:

    – Use the options of the runtime Migration tools to not disable the DMgr

    – Turn off the old DMgr (the federated nodes should be able to continue running)

    – Migrate all the nodes

    – Modify the new cell to resolve port conflicts

    – Start old DMgr, new DMgr and all nodes in the new cell

- See latest Migration redpiece for example

    – http://www.redbooks.ibm.com/redpieces/abstracts/redp4635.html?Open
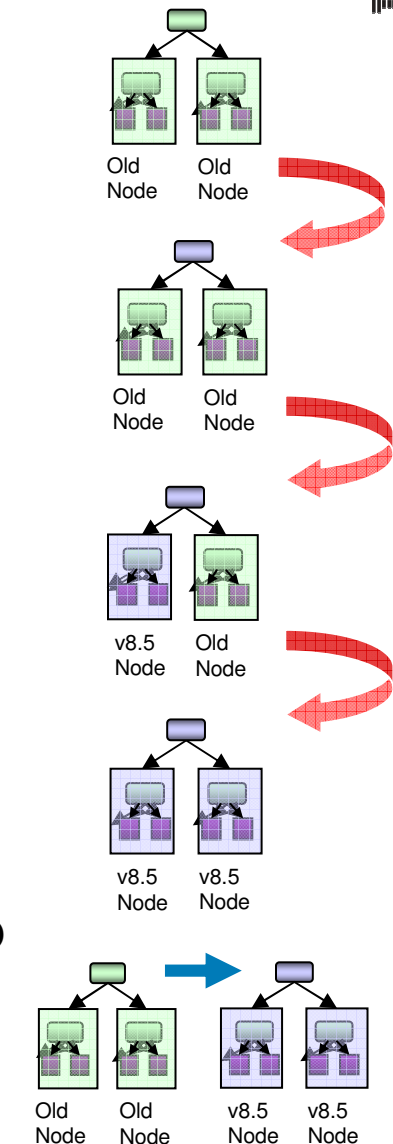
Side by Side - Fine Grained

- Uses a combination of tools

  – An intermediate profile

  – The runtime migration tools

  – Properties based configuration tool (PBC)

- Approach

  – Migrate the existing data to an intermediate profile

  – Extract portions of the configuration from that profile

  – Import them into the final DMgr profile using PBC

- See latest Migration redpiece for example
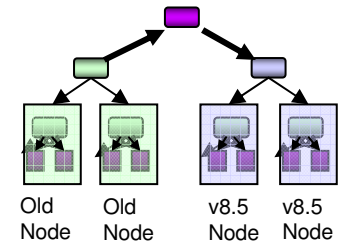
  – http://www.redbooks.ibm.com/redpieces/abstracts/redp4635.html?Open

Agenda

- Migration overview

- Migration planning roadmap

- Application Migration

- Configuration Migration

- **Overview of changes by version**

- Summary

- References

Migration impacts (worst case scenario)

Potential Impact areas	v6.0	v6.1	v7.0	v8.0	v8.5
Java Runtime (v8.5 has JRE6 and 7)	n/a	6	2	n/a	0/22[note]
JEE - JSP	8	n/a	1	1	0
JEE - Servlet	5	n/a	0	1	0
JEE - Other	3	n/a	5	6	0
WAS Specific	1	6	0	4	0
3rd party packages	2	0	1	0	0
Development total	**19**	**12**	**9**	**12**	**0/22**
Administrative script	4	3	2	0	0
WAS directory structure	1	1	0	0	0
Other administrative	5	2	6	7	0
Total administrative	**10**	**6**	**8**	**7**	**0**
Total potential impact areas	**29**	**18**	**17**	**19**	**0/22**

Note: Java7 introduces a number of potentially breaking changes. "0" represents Java6 and "22" is for Java7. Not all breaking changes will impact all applications

Changes in v8.5

- Administration changes

  - One new port used for Liberty profile management

  - A number of minor default setting changes

    - Information provided in the v8.5 InfoCenter

- Development changes

  - Java7 upgrade – Java6 is the default

    - Breaking changes in Java 7: (AWT, Internationalization, IO, JAXP, JMS, Language, NIO, Networking, Runtime, Text and Utilities)

  - JPA (2)

    - Custom settings are provided to provide compatibility

Changes in v8.0

- Administration changes

  – Installation changes

  – Centralized Install Manager

  – Install Factory alternative

  – WebServer Plug-in installation and configuration

  – Java Garbage collection and dump format changes

  – Security default changes

  – Other miscellaneous changes

- Development changes

  – Development tool changes

  – JEE 1.6

  – WebSphere API changes

Changes in v7.0

- **Administration changes**
  - SessionInitiationProtocol(SIP) Migration Considerations
  - zOS Migration tool
  - Administration script required changes
  - Port usage
  - Security Migration considerations
  - Mixed version considerations

- **Development changes**
  - Development tool change
  - JRE 6 impacts
  - JEE 5 impacts
  - WebSphere removed features

Changes in v6.1

- Administration changes

  - Migration and Feature Packs

  - zOS Migration tool

  - Administration script required changes

  - Install response file format changes

  - Port usage

  - Profile directory structure

  - New administrative tool IDE

  - Migration tools and v6.1 Security model

- Development changes

  - Development tool change

  - JRE 5 impacts

  - WebSphere changes and removed features

Changes in v6.0

- Administration changes

  - Administration script required changes

  - Port usage

  - Profiles

  - CoreGroup considerations

- Development changes

  - Development tool change

  - J2EE 1.4 impacts

  - WebSphere API migration details

Enablement

- This information and more is available <u>online</u>!

- Includes general planning with detailed notes and WebSphere AppServer version specific information

- Updated with timely information

- IBM Migration Knowledge collection
  - http://www-1.ibm.com/support/docview.wss?rs=180&uid=swg27008724

- Google: "websphere application server migration"

Summary

- Migration needs to be a pragmatic, well designed and repeatable process

- WebSphere Application Server migration is becoming easier!

  – More tools

  – More techniques

  – Minimizing Application changes

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