PTC®

PTC Integrity Lifecycle Manager Solution Infrastructure Recommendations

Author: **Scott Milton**

Revision: **1.0**

Change History

Date	Author	Version	Description
2013/08/01	Smilton	0.1	Draft for Review
2015/02/28	Smilton	1.0	General Release

Table of Contents

1. Introduction

This document provides recommendations for server hardware and network architecture for a PTC Integrity Lifecycle Manager implementation. It provides supplementary material to the already available Integrity System Guidelines PDF available from here. It is highly recommended that readers review the Integrity System Guidelines as a prerequisite before proceeding.

It is a challenge to define a precise hardware configuration that will provide a targeted level of performance for a specific number of users without a detailed usage profile of these users. Although the total number of potential users needs to be considered, a more important criterion for Lifecycle Manager Server scalability is the number of concurrent, or simultaneously active, users and what operations these different users are performing. Different areas of functionality will require varied server resources and may experience different performance bottlenecks. Although the Lifecycle Manager server will almost certainly draw resources from all of the areas listed below for many operations, the main resource required for various areas of functionality is as follows:

- **DB Usage**: Item Branching, Historical Operations (Item Views, Computations and Reports), Item Revisioning, Historical operations
- **Server Memory Usage**: Run Reports, Charts & Dashboards, Web UI usage
- **Server Disk I/O Usage**: Member Based Source/Configuration Management Commands, Federated Server Architecture Caching
- **Network Usage**: Large File Operations in Source (Check-outs or Check-ins) , Federated Server Architecture Caching
- **LDAP Usage**: Authentication, Refreshing User and Group Caches

Note: A brief update on naming. The product formerly known as “PTC Integrity” is now named “PTC Integrity Lifecycle Manager”, since PTC Integrity now refers to a family of software and systems engineering products. For brevity and clarity, this guide uses “Lifecycle Manager” as an abbreviation for the full name, “PTC Integrity Lifecycle Manager”.

This document’s primary focus is on the immediate deployment of Workflows and Documents functionality; however, consideration for future inclusion of Configuration Management functionality in the Solution is also included.

2. Production Lifecycle Manager Server Hardware Recommendations

The following table outlines the recommended specifications for the hardware hosting the Production Lifecycle Manager Server. If other Lifecycle Manager Servers are being deployed, such as development and validation environments, they will not need to meet these requirements, unless they will be also experience high usage or be used to simulate the production environment for performance testing. One of the primary factors for performance of the Lifecycle Manager Server is the database being used. The production database should be hosted on a separate physical server to the Lifecycle Manager server and meet the hardware recommendations provided by the database vendor.

Criteria	Recommended Minimums	Recommended for Future Growth
Memory:	8+ GB total / 4 GB JVM heap	32+ GB total / 16 GB JVM heap
CPU:	Four core XEON Class @ 3 GHz+	Eight core XEON Class @ 3 GHz+
Disk:	10 000+ RPM	15 000+ RPM
Network:	100bT (100Mbps)	1000bT (1Gbps)
Database:	Oracle 11g R2 RAC	
Server OS:	Solaris 10 64-bit, MS Windows Server 2008 R2 Enterprise Edition	
Client OS:	MS Windows 7 Professional or Ultimate Edition	
Client browser:	MS Internet Explorer 9, Firefox 10+	

Table 1: Recommended Production Lifecycle Manager Server Hardware

Additional points of consideration:

- A full list of supported databases and operating systems may be found here. In general, Oracle is the preferred database vendor. If you do not currently have an existing database Oracle DB administrator, nor plans to hire one, then PTC recommends the choice of MS-SQL. When properly tuned and maintained, Oracle may provide superior performance, but MS-SQL provides the best out of the box, general, un-tuned performance of the three choices.
- With respect to CPU, a higher clock speed is of more value than extra cores to reduce Garbage Collection full pause times for Source Heavy Servers.
- A realistic maximum number of concurrent users on a single Production Lifecycle Manager Server would be in the range of 750-1500 users.

Note: As mentioned above, the total unique number of users will often be much higher than the concurrent number of active users. This is because user connections are often idle and not consuming a significant amount of server resources, e.g., when users are passively reading content or multi-tasking or have gone offline to attend meeting. A general rule of thumb is to expect 10%-30% of all unique users to be active at a given time. The accuracy of this percentage will often depend heavily upon the role of the user and/or or the particular phase that a project is in, e.g., Requirements Analysts may have a very high usage ratio in the early phases of a Project, while Developers may have a high usage rate for a longer portion of the same project.

3. Administrative Staging

Lifecycle Manager is a highly configurable product, allowing administrators to define specific solutions that meet the needs of their users. These solutions usually include items and presentation templates, workflows and documents that are highly specific, including javascript-based triggers that automate business logic. Typically, a separate "Development" Lifecycle Manager Server is recommended both for new Solution development and ongoing Solution maintenance of admin configuration. A "Test" or "Validation" Lifecycle Manager Server is also invaluable to allow a testing of new administrative configuration without interfering with ongoing development.

Administrative staging is a core feature provided by Lifecycle Manager which allows multiple Lifecycle Manager Servers, typically representing Development, Validation and Production stages, to be locked together in an Administrative Staging System. The Staging System automates the transfer of administrative configuration between Lifecycle Manager Servers, reducing maintenance overhead and inadvertent copying errors. The development and Validation Lifecycle Manager servers do not require the same level of hardware as they will not have nearly the same number of concurrent users. Virtual servers could be used to host these Lifecycle Manager Servers if desired, but it is still required that these Lifecycle Manager Servers use the same database software version and operating system as the production server.

Note: The Administrative Staging System is not used for Configuration Management only servers or to validate & apply Service Packs or other upgrades provided by PTC. If validation of Lifecycle Manager Service Packs is desired before deploying to the production environment, a separate Lifecycle Manager Server distinct from the Administrative Staging System should be used.

As mentioned above, the database should be hosted on a separate physical server to the Lifecycle Manager server and meet the hardware recommendations provided by the database vendor. We also recommend hosting the Production database on a separate database server from Development and Validation; if there will be significant activity taking place on those stages which may compromise production such as performance or import testing.

4. High Availability

As a critical part of an organization's product development infrastructure, risks of an Lifecycle Manager Server outage should be mitigated whenever possible. As such, PTC provides a High Availability (HA) option implementing a warm failover for the Lifecycle Manager Server. This option involves two Lifecycle Manager Servers competing to start first. The Lifecycle Manager Server that starts first assumes the role of the primary node, and the other server, the secondary node, detects this and pauses midway through its startup routine. The secondary node pings the primary server periodically and only completes its startup routine when the primary node becomes unreachable. A network load balancer/switch handles routing traffic to the appropriate Lifecycle Manager. For full details, including instructions for how to configure a high availability environment, please refer to the Lifecycle Manager Server Failover Guide available from here.

The critical components necessary for implementing a HA environment are as follows:

- **Duplicate Lifecycle Manager Server**: A secondary Lifecycle Manager Server should be installed on separate physical server, thus doubling the number of physical servers required for a production environment. The duplicate Lifecycle Manager Server will also require an Lifecycle Manager Server license and a shared file system with the primary Lifecycle Manager Server.
- **Shared File System**: A shared file system, such as a Network Attached Storage (NAS) device, is used for the Lifecycle Manager Server installation and hosts both application and configuration files. If the Operating System utilizes drive letters, both platforms hosting the Lifecycle Manager Servers must refer to the shared file system with the same drive letter.
- **Shared Database**: A shared database repository accessible by both Lifecycle Manager servers. To avoid a single point of failure, an Oracle RAC is recommended.
- **Network Load Balancer**: A network load balancer/switch is responsible for making the failover transparent to clients by automatically and transparently re-directing client requests to the active node. PTC recommends using a hardware load balancer for speed and reliability, such as the Cisco Content Switching Module (CSM) or a modern Layer-4 network switch placed between the client and server nodes.
- **FLEXnet Triad**: The Lifecycle Manager Server uses Flexera FLEXnet as a license server. Flexera provides its own High Availability mechanism allowing for Three Server Redundancy. To avoid a single point of failure, it is recommended to implement this functionality. A set of three stable machines needs to be identified to host the FLEXnet servers, and reliable communication needs to be set between them. The FLEXnet servers require minimal resources and can be co-located with the Lifecycle Manager Servers or other applications. If the co-location option is chosen, a third server would need to be identified to host the final FLEXnet server in the Triad.

Note: If both Administrative Staging and High Availability options are being used, it is typically not necessary to have failover of Development and Validation Lifecycle Manager Servers; usually this is only enabled for the Production Lifecycle Manager Server.

5. PTC System Monitor (PSM)

PTC recommends that the PTC System Monitor (PSM) be deployed to monitor any Production Lifecycle Manager Server environments. The PSM can be used to generate proactive alerts for potential performance issues and provide additional troubleshooting resources. In addition, PSM data greatly assists PTC Technical Support in determining the potential causes and resolutions to a number of Lifecycle Manager Server issues. This tool is available free of charge from PTC, for additional information, please refer to the "PTC System Monitor Installation and Usage Guide – Lifecycle Manager", available here.

It is recommended that the PSM is installed on separate hardware from the Lifecycle Manager Server(s) being monitored. The reasons for this are twofold, firstly so it does not interfere with server resources required by the Production Lifecycle Manager Server and secondly, so it will still be usable to diagnose potential issues in the event that the physical Lifecycle Manager machine becomes unavailable due to an unforeseen outage.

If the PSM will only monitor the Production Lifecycle Manager Server, then it is possible to co-locate the PSM on the same hardware as the Development or Validation Lifecycle Manager Server and host the PSM database on the same database server as the Lifecycle Manager Development and Validation Databases. If the PSM will also be used to monitor the Development and Validation environments, or if the Validation Lifecycle Manager Server is going to be used for performance testing, it is recommended to host the PSM elsewhere.

Criteria	Recommended Minimums
Memory:	8+ GB total
CPU:	Four core XEON Class @ 3 GHz+
Database:	Oracle 11g R2 MS SQL Server 2012

Table 2: Recommended PTC System Monitor (PSM) Hardware

6. Scalability Levels

The figures presented below detail an ordered procession of scalability levels for Lifecycle Manager Solution Server architecture, with each subsequent option recommended for increasing numbers of concurrent users. It will be relatively easy to scale up from one level to another, as user demands increase. In other words, a single option should be selected as a realistic starting point and as server load increases, the next option should be considered. Proactively planning for the appropriate scalability needed is imperative, due to the lead time required in procuring new hardware.

Note: All of the levels mentioned below may be considered with a PTC System Monitor, Administrative Staging and High Availability options, but these can be omitted, if not desirable.

6.1. Single Production Lifecycle Manager Server (Co-Located CM and W&D)

With this most basic recommendation, a single Lifecycle Manager Server hosts both Workflows & Documents and Configuration Management functionality. High Availability is not considered in this level.

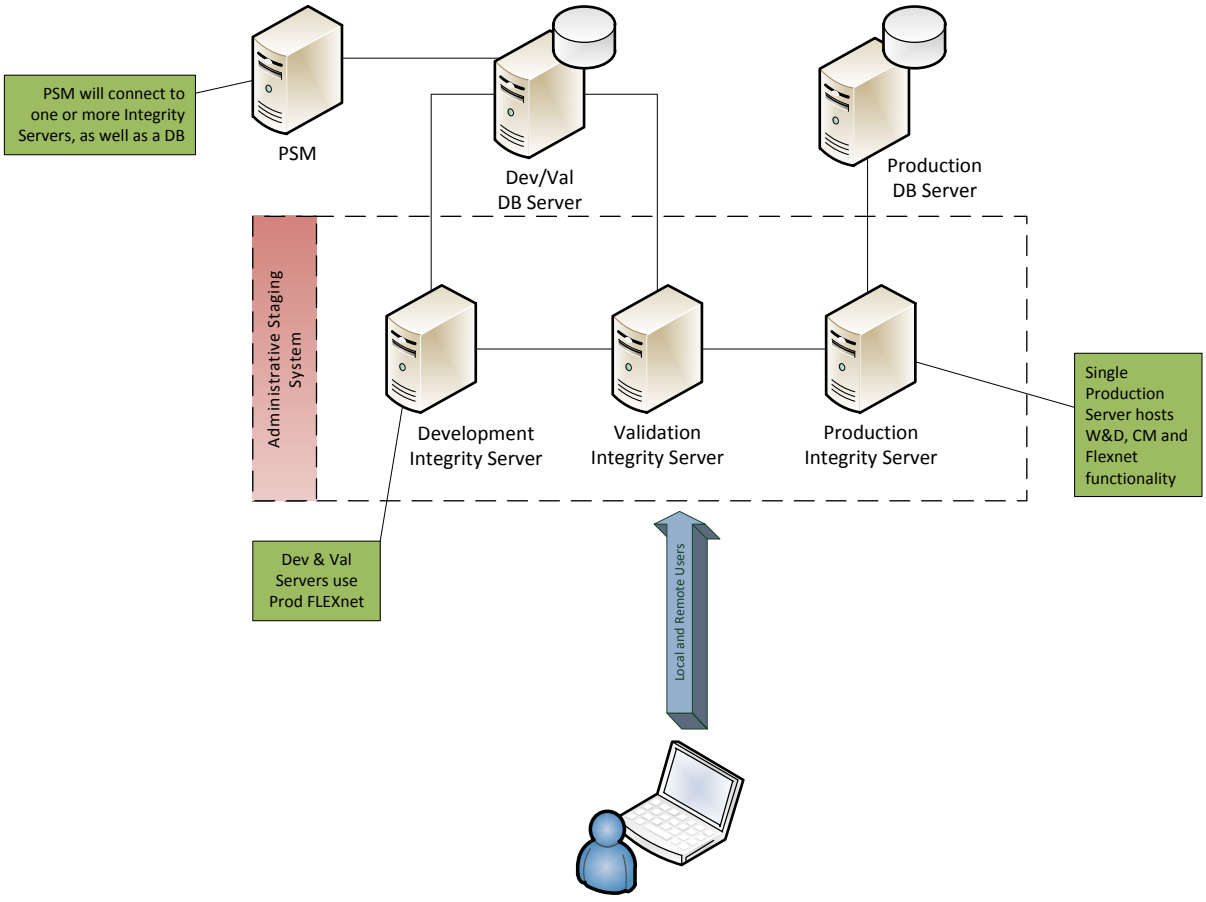

Figure 1: Administrative Staging, Single Production

Note: As mentioned above, the PTC System Monitor could potentially be co-located on the Development or Validation Lifecycle Manager Server hardware. In these diagrams, it is shown as sharing their database server, but not their hosting hardware. Network connections to the Lifecycle Manager Server(s) that are being monitored by the PSM have been omitted from the diagram for clarity.

6.2. Single, Highly Available, Production Lifecycle Manager Server (Co-Located CM and W&D)

With the next scalability level, a single Lifecycle Manager Server continues to host both Workflows & Documents and Configuration Management functionality; however a High Availability cluster now adds additional redundancy to the Production server.

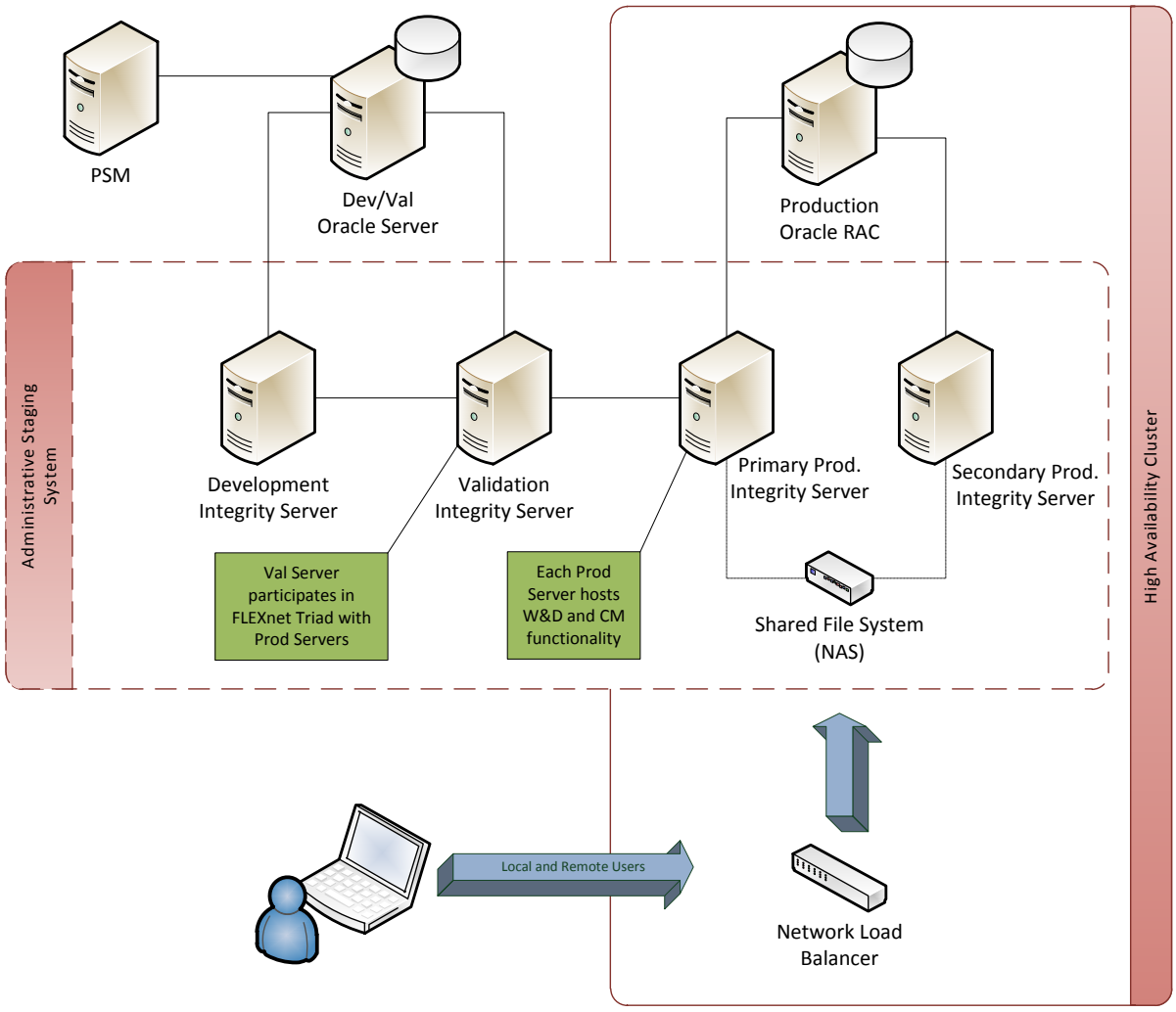

Figure 2: Administrative Staging, High Availability

Note: Each Lifecycle Manager Server will require a separate Lifecycle Manager Server license. At least three of the physical servers involved will need to host a FLEXnet server to ensure a FLEXnet triad is available, providing license server redundancy.

6.3. Highly Available, Split Production Lifecycle Manager Servers (Separate CM and W&D)

With the next scalability level, the production Lifecycle Manager Server has now split to host Workflows & Documents and Configuration Management functionality on separate servers. The purpose of this is to segregate the server load introduced by heavy configuration management usage from the Workflows & Document server. If necessary, multiple Configuration Management High Availability server clusters may be used to connect to the W&D servers, even further subdividing the server load. In other words, a single Workflows and Documents cluster may have two or more Configuration Management clusters using it as a central location to store common workflows, developer task assignments, change packages etc. This is useful if there are many CM projects and it is desirable to separate them to separate databases due to storage sizing or performance considerations. As of the time of this writing, PTC does not have sufficient information to provide recommendations on the number of CM Servers required; with further analysis, more concrete recommendations can be made.

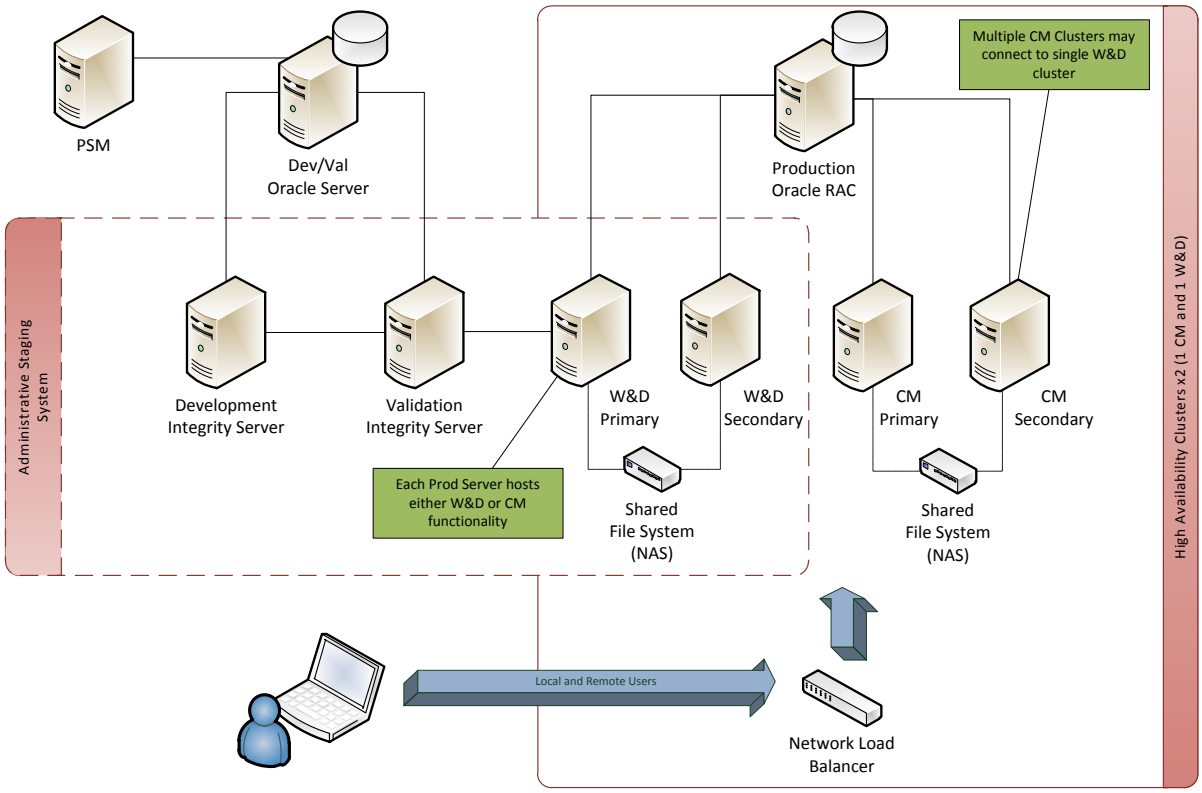

Figure 3: Administrative Staging, High Availability, Split CM and W&D

Note: Each Lifecycle Manager Server will require a separate Lifecycle Manager Server license. At least three of the physical servers involved will need to host a FLEXnet server to ensure a FLEXnet triad is available, providing license server redundancy.

6.4. Highly Available, Split Production Lifecycle Manager Servers (Separate CM and W&D) with FSA Proxies

With the next scalability level, the level of remote CM usage is sufficient to warrant one or more Federated Server Architecture (FSA) proxy servers. These proxy servers act as a local cache for Configuration Management data, drastically increasing the network time needed for participating in Configuration Management Projects. A proxy server can also be used to cache W&D file attachments. As an example, if the Lifecycle Manager server(s) are located in the United States, the proxy server(s) could be installed in India and China to cater to the needs of these remote developers. As of the time of this writing, PTC does not have sufficient information to provide recommendations on the number and location of FSA Proxy Servers; with further analysis, more concrete recommendations can be made.

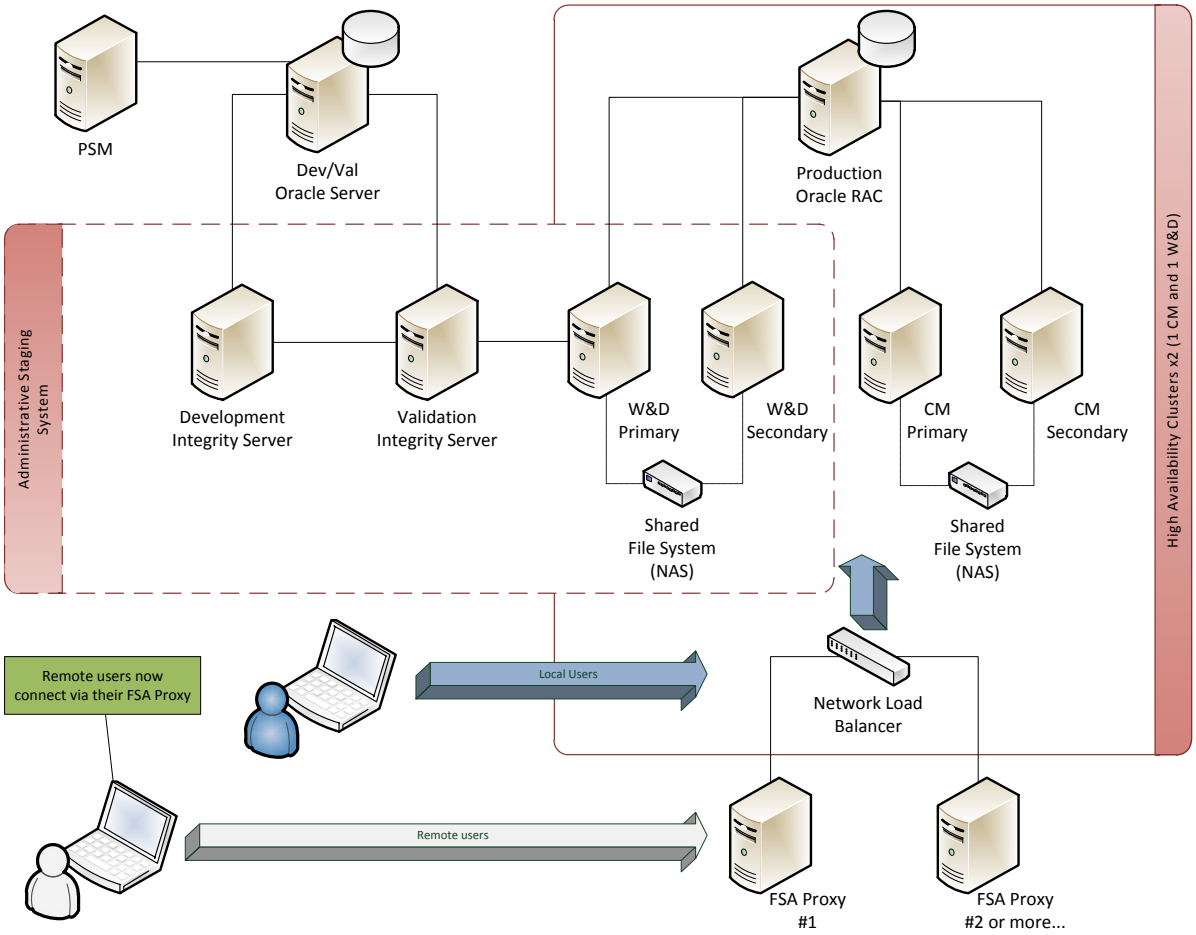

Figure 4: Administrative Staging, High Availability, Split CM and W&D, Proxy servers

Note: Each Lifecycle Manager Server will require a separate Lifecycle Manager Server license. Each proxy will also require a Proxy license, in addition to its Lifecycle Manager server license. At least three of the physical servers involved will need to host a FLEXnet server to ensure a FLEXnet triad is available, providing license server redundancy.

6.5. Using the Lifecycle Manager Integration Platform (IIP) to extend W&D Solutions

The final scalability option presented in this document specifically covers the case of a single Workflows and Documents Lifecycle Manager Server not having sufficient resources to handle the concurrent users of single solution (e.g., 750-1500+ concurrent W&D users). When this limit is exceeded, introducing a second Lifecycle Manager Server also hosting the same Solution configuration may be the best option. If a single Solution is being maintained on multiple Lifecycle Manager Servers, ideally only the Admin Configuration needs to be identical. The user base could be divided between W&D servers by department, project or region depending upon which logical segregation of item data is easiest. If Lifecycle Manager data also needs to be shared amongst the users of the spread out on multiple Lifecycle Manager Servers, another level of complexity is introduced. Although it is significantly more difficult to replicate data on multiple Lifecycle Manager Servers, data replication is possible using the Lifecycle Manager Integration Platform (IIP). In the following diagram, the administrative staging, PSM, HA, etc. options have been omitted for clarity.

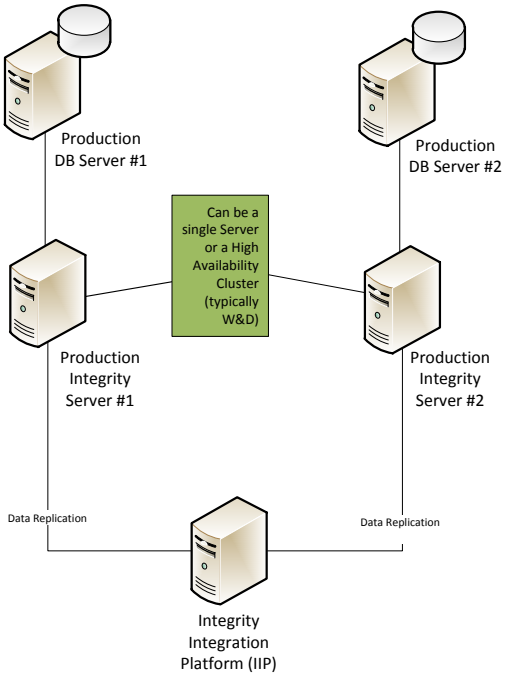

Figure 5: Administrative Staging, High Availability, Split CM and W&D, Proxy servers

The potential drawbacks of this strategy are:

- Replication would not be instantaneous and would have to be done on a schedule.
- Custom BPEL scripts would need to be written to ensure the data can be replicated.
- Unless one of the servers is considered read-only, there may be some differences to system controlled fields between both servers, such as ID numbers and Created/Modified dates.

Note: Before adopting a data replication approach, it is worthwhile to determine whether the user base can be subdivided based on their data usage, rather than geographic proximity to a Lifecycle Manager Server. E.g., if there is a Lifecycle Manager Server in Beijing and another in Shanghai, it may be more appropriate to for some users in Shanghai to connect directly to the Beijing Lifecycle Manager Server and vice versa, if it means avoiding data replication.

7. Additional Considerations

If a third party hosted solution is being used to host the Lifecycle Manager Server, it is necessary to consider which authentication realm will be used to provide User and Group information, such as Active directory or LDAP.

It is often the case that multiple departments or Business units will have their own unique Lifecycle Manager solutions and do not need to share administrative configuration or item data. If that is indeed the case, and if scalability of a single Server past 750-1500 concurrent users is a concern, it might be best to segregate each Solution to a separate Lifecycle Manager Server hosted on its own hardware.

The topics of "Lifecycle Manager Server Performance Tuning" and "Database Tuning" are both beyond the scope of this document. There are additional publications available from PTC that cover these topics in detail from http://support.ptc.com. It is highly recommended that the suggestions in these documents be applied to your implementation before proceeding with formal deployment Enterprise-level Relational Database Management Systems have a wealth of monitoring tools available, and for more sophisticated monitoring the expertise of a DBA of the RDBMS is invaluable. It is highly encouraged that the reader should involve one in ongoing performance tuning, monitoring and testing.

It may be the case that an early deployment of a prototype solution is released to production, while an administrative staging system for future solution development is desired. In this case, if a large amount of development will stay resident in the administrative staging system for a prolonged period of time, multiple production W&D servers, or multiple staging systems, may be needed. If this is the case, careful consideration will be needed in conjunction with PTC as to how the admin configuration and/or data of these solutions will be merged in the future.