LECTRA FASHION PLM

Technical Architecture Overview

Date of last update: April 2017

Contents

Modifications made to the document since its last publication are highlighted in blue.

1. INTRODUCTION

This document provides technical information regarding the Lectra Fashion PLM software. It gives a technical overview of the solution architecture, deployment and performance

2. ACRONYMS

PLM	Product Lifecycle Management
LFPLM	Lectra Fashion PLM
Prod. Devt.	Product Development module
CM	Calendar Management
RDBMS	Relational Database Management System
CAD	Computer-Aided Design
SOA	Software Oriented Architecture
ETL	Extraction Transform Load
ERP	Enterprise Resource Planning
JEE	Java Enterprise Edition
SOAP	Simple Object Access Protocol
APM	Application Performance Monitoring
AS	Application Server
NTFS	New Technology File System
RCP	Rich Client Platform
LDAP	Lightweight Directory Access Protocol
LAN	Local Area Network
WAN	Worldwide Area Network

DMZ	DeMilitarized Zone
IT	Information Technology
NAS	Network Attached Storage
VLAN	Virtual LAN
OS	Operating System
JVM	Java Virtual Machine
QOS	Quality Of Service
VM	Virtual Machine
I/O	Input/Output
DBA	DataBase Administrator
SMTP	Send Mail Transfer Protocol
XML	eXtensible Markup Language
SQL	Structured Query Language
GUI	Graphical User Interface
CBR	Custom Business Rules
PDF	Portable Document Format
HTML	HyperText Markup Language
CSV	Comma-Separated Values
RTF	Rich Text Format
MS	Microsoft
WOA	Web Oriented Architecture
REST	Representational State Transfer

3. LECTRA FASHION PLM ARCHITECTURE OVERVIEW

3.1 Functional Overview

Figure 1: Lectra Integration Platform

The Lectra Integration Platform lies on **SOA** (Service Oriented Architecture), and provides a **collection of services** with their own life cycle. It provides **generic platform services** (Security management, File management, Session Management…) and **business services** (Product Management…).

Since the V4R2 version, new services are provided on **WOA** (Web Oriented Architecture). WOA Services are based on REST Stateless services that minimize adherence between client and server improving performance, scalability, portability…

The Lectra Integration Platform services manages the **data integrity** by addressing unitary **transactions** Create / Read / Update / Delete operations on PLM entities.

The Lectra Integration Platform is also responsible for the **system's interoperability**: many different applications can call the Lectra Integration Platform services to manage business data on the Integration Platform. All the Lectra Integration Platform clients (Product Developer, Calendar Manager, Collection Planning, Product Scenario Assessment, Material Forecast, Mobile applications, Administration tools and Client Applications) use web services as a standard to communicate with the Integration Platform. Furthermore, it manages the integration with 3PPrdPP party systems (LDAP, Mail servers, ERP etc).

3.2 Functional Architecture

An n-tier architecture to:

- Manage a large number of distributed users

- Map our customers' core business processes

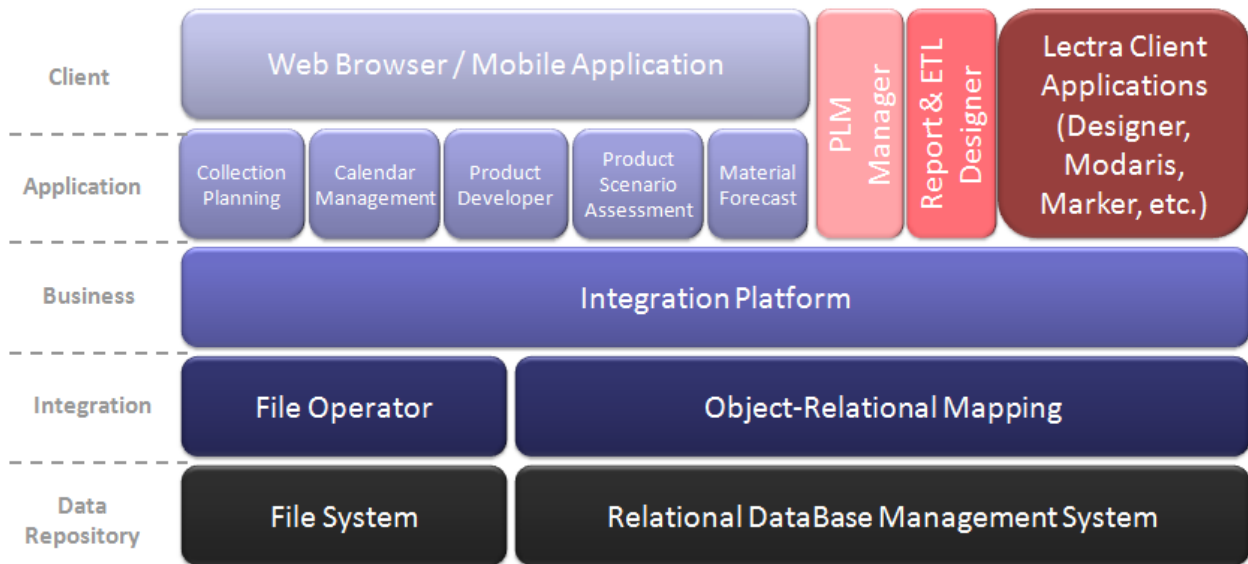 ➢ Are key drivers to define our solution architecture in a flexible way.

Figure 2: Functional Architecture Overview

Lectra Fashion PLM is a web-based application based on standard 5-layer architecture as illustrated in the diagram above. It is comprised of the following components:

- **Product Developer** module: a web application managing all the technical specification packages involved in product development.

- **Calendar Management** module: this web-based application manages all the data related to the business processes.

- **Collection Planning** module: a web based application to closely manage the development of lines of products. It aligns development teams with corporate financial goals, assuring that collections are managed to meet performance targets.

- **Product Scenario Assessment:** is a new tool in the Platform Integration targeted to the "Design To Cost" and Design For Manufacturing initiative.

- **Material Forecast:** is a web-based application to estimate product material consumption and forecast total material consumption. Calculation is relative to an multiple products Order expressed through a matrix Color/Size/Quantity. Algorithm takes into account relevant pre-production parameters.

- **Mobile Applications**: 4 new mobile applications have been developed:

  – Lectra ToDoList (task list): allows nomad users to consult the task list from the management of the PLM calendar.

- Lectra Collection: Nomad consultation of PLM products. It enables browsing a simplified view of product specifications.

- Lectra Snapshot (instant photos): Allows the capture and annotation of creative content and its storage in a PLM dedicated zone.

- Lectra 3D Review: Nomad consultation of a catalog of 3D PLM prototypes.

  ⇨ They are accessible from Apple App Store and Google Play Store.

- **Client Lectra Application** such as CAD applications (Textile Designer, Pattern Developer, Marker Maker, AI Plug-in, etc.) can also take advantage of the Lectra Integration Platform to store, modify and exchange business data.

- Client components: some specific PLM client-side administration tools have been developed (**PLM Manager, Report Designer, ETL Designer**) and are integrated on the Lectra Integration Platform.

- The Lectra **Integration Platform** is at the very heart of the Lectra Fashion PLM architecture. This is the Business Layer of the Lectra Fashion PLM solution, based on a Service Oriented Architecture (SOA). It provides all the necessary services to manage PLM data. This layer is based on Java Enterprise (JEE) technologies and is contained in a JEE application server. This layer exposes services through a public API accessible through Java direct calls, RMI (Remote Method Invocation) for Java remote access, SOAP web services and REST Web Services to ensure interoperability. All client-side Lectra Fashion PLM software modules interact with these Integration Platform services to store and exchange data (Fashion PLM, CAD and Design components).

- **Data Repository**: Two locations are used, depending on the data type: graphical files are stored in a classic file system, while associated metadata are stored in a Relational Database Management System. Data is manipulated by the Lectra Integration Platform services that interact with the database through an Object / Relational mapping layer to translate Java objects into relational database objects. The **File Operator** component is responsible for managing graphical data, generating thumbnails in the appropriate format.
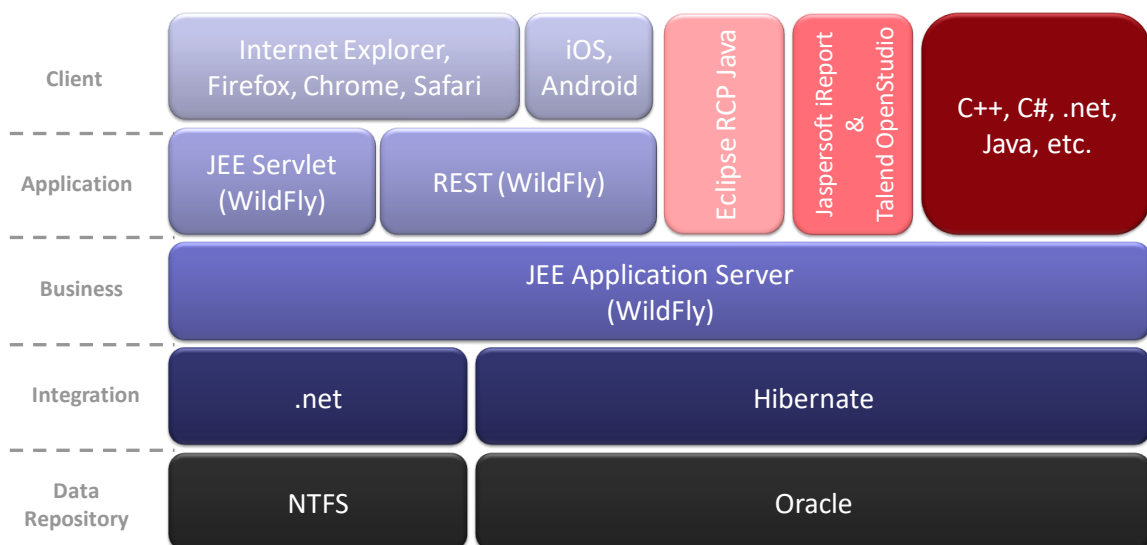
3.3 Software Technologies

Figure 3 : Software Technologies

Lectra Fashion PLM is based on industry standards:

- **Clients and Application**:

    - Product Development, Product Development, Calendar Management andCollection Planning modules are accessible from **standard Web browsers** pages and published by Java servlets and REST Stateless Web Services on WildFly Application Server.

    - Mobile Applications are developed with native mobile SDK: Objective C (iOS) and Java (Android),

    - Other technologies are used for PLM Client Components (Eclipse RCP/Java) and Lectra Clients (C++, C#, Java, etc.)

- **Business**: The **Lectra Integration Platform** is deployed on **WildFly** Application Servers.

- **Integration**:

    - The Object-Relational Mapping layer is based on Hibernate,

    - The File Repository is a Windows-based component (.NET) as it manipulates binary data.

- **Data Repository**: The supported relational database is Oracle Standard Edition One (or higher).

3.4 A Service Oriented Architecture

The Lectra Integration Platform is based on **SOA** (Service Oriented Architecture), and provides a **collection of services** with their own life cycle. It provides **generic platform services** (Security management, File management, Session Management…) and **business services** (Product Management…).

The Lectra Integration Platform services manage the **data integrity** by controlling, as unitary **transactions,** Create / Read / Update / Delete operations on PLM entities.

The Lectra Integration Platform is also responsible for the **system's interoperability**: many different applications can call Lectra Integration Platform services to manage business data on the Integration Platform. All Lectra Integration Platform clients (Product Developer, Calendar Management, Collection Planning, Material Forecast, Mobile applications, CAD applications and Administration tools) use web services as a standard to communicate with it. Furthermore, it manages the integration with 3PPrdPP party systems (LDAP, Mail servers, ERP…).

4. TECHNICAL ARCHITECTURE

4.1 Environments required

As with any project of this nature, the **production environment** must be the final state of the project; a **pre-production** environment is required in order to support:

- IT team training and procedure validation (start/stop, diagnose, backup/restore …)
- User training, avoiding changes to the production environment
- Upgrade/patch validation with key end users
- Any procedure validation to be applied on the production environment

The **pre-production/integration** environment should ideally be a replicate of the production environment; however, a smaller environment may be setup if this is prohibitively large / expensive.

A **development** environment may be required to manage any customization of the solution.

4.2 Logical Server Definition

	Front end server • Web server • Applicative server: generates dynamic web pages and Web modules (WildFly) • Lectra Integration Platform
	Back end server • Reports generation • Operator - File processing • Lectra Integration Platform
	Database server • Database server • License server

<div align="center">**Table 1 : Logical Server Definition**</div>

Lectra Fashion PLM Infrastructure is composed of several modules. This allows adjusting the software to our customers' usages.

Front-end Server comprises:

- ➢ A web server (Apache) serving static pages (including scripts, images, styles, etc.) and used to load balance the traffic if needed by the customers' usage. It is the link to dynamic application pages generated by the Application Server.
- ➢ The Application Server (WildFly) hosting dynamic pages (Product Developer, Calendar Management, Collection Planning and Material Forecast) and using web services.

> ➢ The Lectra Integration Platform that manages access to application business objects.

Back-End Server comprises:

> ➢ Report generation: reports asked in Product Developer module are served by this module in asynchronous mode.

> ➢ File Operator: this module is used by modules to transform or extract information from binary objects. For example, it's used to generate thumbnails from Designer, Pattern Developer and image format or other CAD files.

> ➢ The Lectra Integration Platform that manages access to application business objects.

Database Server:

> ➢ RDBMS is installed on this server and used to host core data.

> ➢ This server is also usually used for the License Server used to manage all Lectra licenses.

This definition of logical server is a typical one but since all clients have different practice we are able to adapt our solution for every need.

4.3 Physical deployment view
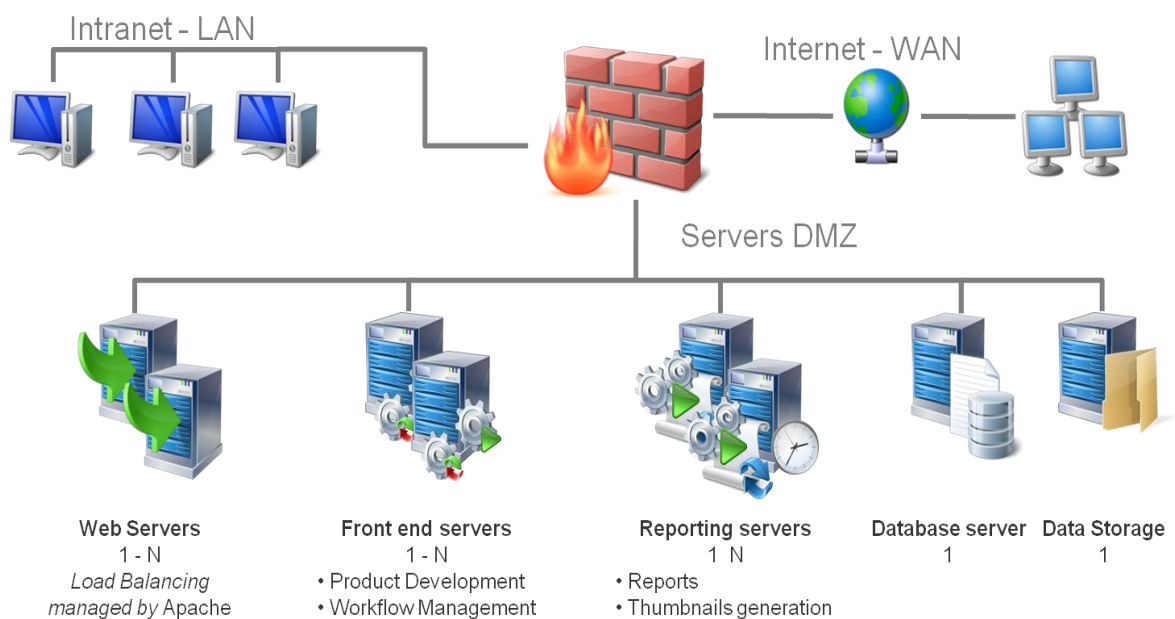
<p style="text-align:center">**Figure 4: Physical deployment view**</p>

The image above represents a sample of the physical architecture to be defined during the implementation project within the Project Work Package (phase) "IT Support".

The type and numbers of servers is indicative only and must be defined during the project.

This solution offers:

- **Load-balancing** between servers to leverage the load, managed by an Apache front server.

- **Failover** between servers: all servers are redundant for fault tolerance purposes, to ensure service continuity in case of a server failure.

- **Scalability**, as the layers-based architecture combined with the load balancing capability enable the deployment of the various modules on separate servers.

4.4 Standard requirements

Rôle	Serveur Applicatif	Serveur Central	Stockage Binaires	Base de Données
Nom de Serveur	SPLMFRONT1 .. N	SPLMREPORT1 .. N	FILESERVER	SPLMDB1
Quantité	N	N		1
Mémoire Vive	12 GB	12 GB		16 GB
Capacité disque C	30 GB RAID1	30 GB RAID1	BINARIES RAID5	30 GB RAID1
Capacité disque D	0 GB	0 GB		DATA ARCHLOG RAID0+1
Processeur	Quad core x64	Quad core x64		Quad core x64

Figure 5: Standard requirements

All Servers:

- Must be **located in the same data center** to offer reliable connectivity in terms of network (bandwidth / latency).

- Must be wired in **GbE** (Gigabit Ethernet).

- Must be in the **same subnet**.

- Can be on the same end user LAN or isolated in a DMZ or in a VLAN.

- Must be **dedicated to the solution** i.e. no software other than Lectra Fashion PLM and prerequisites can be installed (exceptions are made for IT tools such as anti-virus, monitoring and backup software).

Our standard hardware requirements are:

- **Hardware** server based (Virtualization is supported except for Database Server).

- 64bits processors, with **Quad Core** sockets at least**.**

- **12GB memory** to take advantage of the x64 OS in order to host several JEE application servers.

- RAID 1 disks for web, front end and reporting servers.

- RAID 0+1 disks for database servers.

- **30 GB of disk space for the database and binary objects.**

The data storage (required for files generated by the PLM system: reports, graphical files) should be managed on a disk array providing NAS capabilities (Netapp storage bays for example).

The file storage of the Database must be a storage page dedicated to very high performance SAN with fiber optic access (EMC bay or HP 3PAR for example).

5. SUMMARY OF SUPPORTED TECHNOLOGIES

Client side infrastructure (intranet workstation and laptop)	
Operating System	Windows 10
	Windows 8.1 64-bits Edition compliant (Update 1)
	Windows 7 Enterprise 32-bits & 64-bits Edition compliant (SP1)
	Windows 7 Professional 32-bits & 64-bits Edition compliant (SP1)
	Mac OS X 8.5 +
Internet browser	**Mozilla Firefox 45 ESR**
	Microsoft Internet Explorer 11
	Google Chrome 48
	Safari 6 & 7 on Mac OS

Server side software for Integration Platform Infrastructure	
Operating System	**Windows Server 2008 R2 sp1 & 2012 R2 Update 1 - English Standard 64 bits**
Operating System	**Apache 2.4.12 (default web server <u>embedded</u> with the solution)** Web server used for load-balancing (mod_jk) and static pages.
Application Server (container in which applications are deployed)	**WildFly-8.2.0.Final (default application server <u>embedded</u> with the solution)** Application servers are the containers in which applications are deployed.
JVM (Java Machine Runtime)	For WILDFLY deployments, Lectra Fashion PLM is delivered with a **Sun Java 8 64bits HotSpot runtime** (JDK 1.8.0 update 102). This is the runtime to be used. Lectra Fashion PLM will NOT BE SUPPORTED if it is run with any other JVM.
RDBMS (Database)	Oracle Standard Edition One 11g Release 2 (Patch Set 11.2.0.4)
Server Virtualization	VMware vSphere ESXi 6.0

6.   SIZING THE SERVER ENVIRONMENT

6.1 Dev/Preprod Environment Sizes

NUMBER OF USERS	TYPE OF INSTALLATION	NUMBER OF SERVERS
1 - 20	Small	1
21+	Typical	3

6.1.1 Small

For a **Small** installation, all components may be installed on a single server:

6.2 Production Environment Sizes

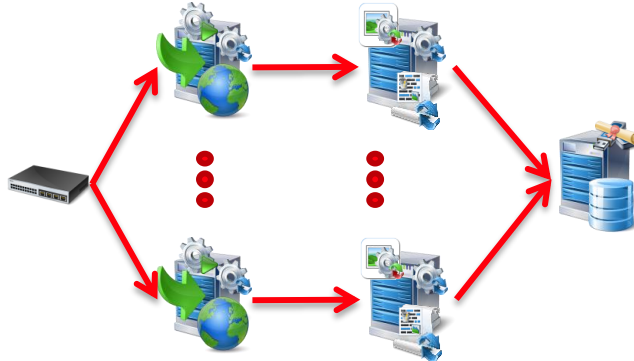| NUMBER OF USERS	TYPE OF INSTALLATION	NUMBER OF SERVERS
1- 120	Typical	3
121- 240	2xTypical	5
241-360	3xTypical	7
361+	Custom	7+

6.2.1   Typical

For a **Typical** installation, components are installed on three servers:

6.2.2 Double Typical

For a 2x**Typical** installation, components are installed on five servers:

6.2.3 3xTypical

For a 3x**Typical** installation, components are installed on seven servers:
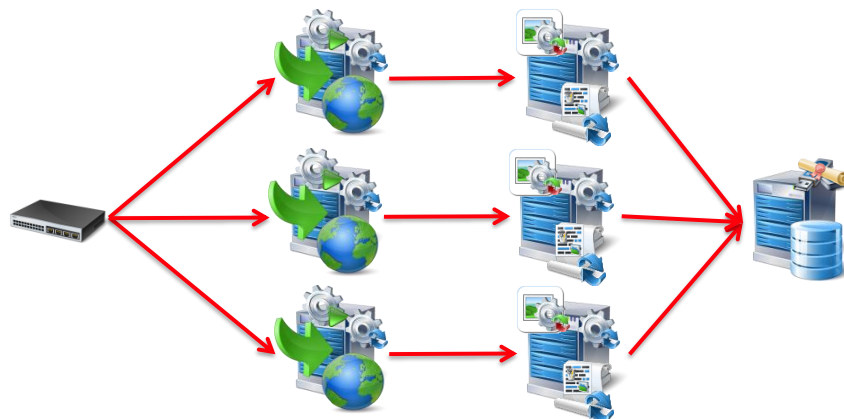
6.2.4 Custom

For a **Custom** installation, components are deployed on multiple servers:
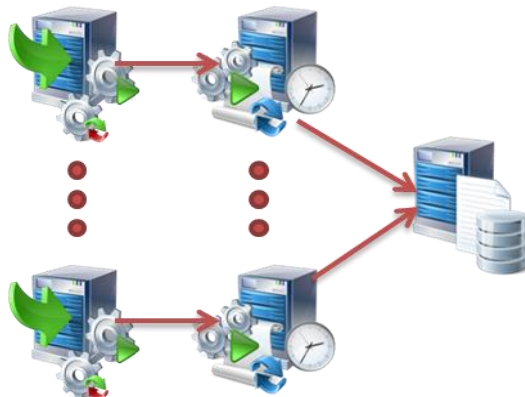
6.3 Factors that affect Sizing

The global sizing of the infrastructure will be managed at the beginning of the project. A dedicated Work Package is allocated to define the global Integration Platform solution. For this sizing, we need to consider:

- Capacity
    - Number of users and application usage
    - growth over three years
- Availability
- Preferred and in use technologies
- Network access capability
- Hardware Physical constraints
- Security
- Application modules required (Product Development, Calendar Management, Collection Planning, Material Forecast, Designer, CAD....)
- Business activity volume overview for 3 years

Thus we will be able to estimate:

- Hardware sizing
- Infrastructure global map
- Content repository sizing
- Database sizing
- Cost approach: Lectra does not provide hardware and Oracle licenses but based on Lectra's suppliers price list an estimation of total cost can be provided.

6.4 Network

Network bandwidth is key in a transnational deployment. Any type of file can be loaded into the PLM File repository and associated to instructions or products. Files are compressed using a Zip compression tool embedded in the solution. The bandwidth needs to be adapted according the volume of the files.

Time elapsed to transfer over various bandwidth available

Bandwidth in Mb/s	Reports/ PDF/ Doc files			AI / Images / Design files		
	Small 0,1 MB	Medium 4 MB	Large 8 MB	Small 4 MB	Medium 10 MB	Large 30 MB
100	0,0	0,5	1,0	0,5	1,3	3,8
40	0,0	1,3	2,5	1,3	3,1	9,4
10	0,1	5,0	10,0	5,0	12,5	37,5
2	0,6	25,0	50,0	25,0	62,5	187,5
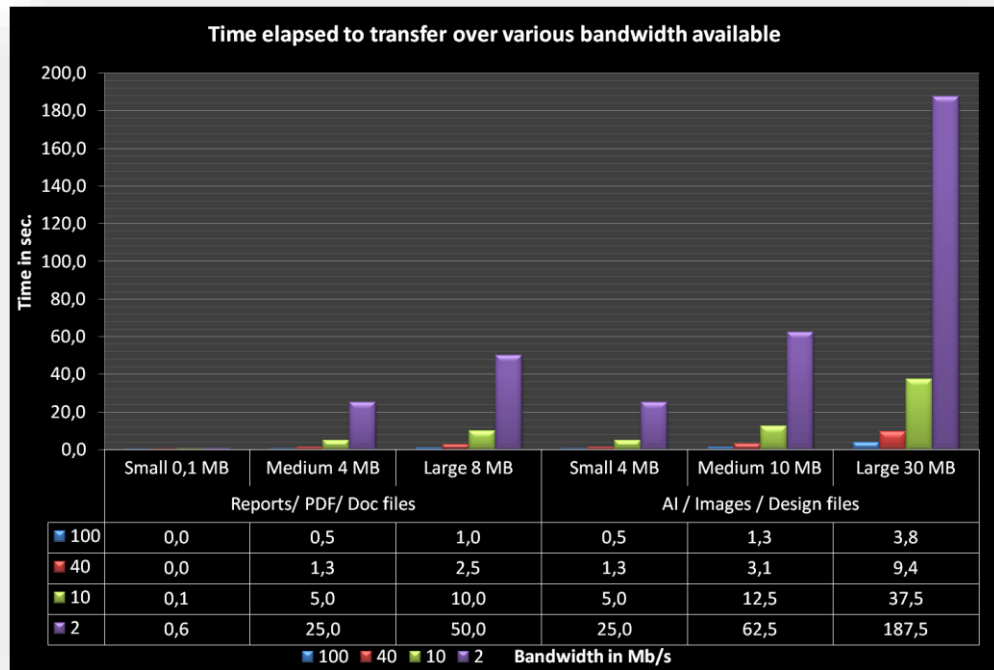
Figure 6: Network Sizing

A WAN Optimization Controller (WOC) may be implemented to optimize the network traffic between clients and the server, thereby reducing TCP/IP chattiness, providing data compression and delta content caching etc. Lectra have run a number of tests with Riverbed Steelhead (http://www.riverbed.com) WAN optimization solutions and observed major QOS improvements for users of the PLM modules:

- from 30% to 70% acceleration in lab environments
- from 40% to 60% acceleration on real networks

6.5 Server Virtualization

The server environment may be virtualized on VMware VSphere 5.1, however database virtualization is not recommended to ensure best I/O performance. In Lectra's experience, for performance reasons, it is better to maintain several VMware servers rather than one larger VMWare server for the production environment. This has to be discussed with customer IT based on their best practices.

7. BACKUP AND DISASTER RECOVERY

7.1 Backup

Back-up requires a synchronized back-up of database files and PLM data storage files.

To ensure backup consistency between database files and Lectra Fashion PLM data storage files, the backup must be made at the customers' convenience:

- Cold backup: i.e. system stopped.

- During non-working hours, avoiding end user access.

- Hot backups: may be managed by our customers with storage bay snapshot capabilities or third party backup software.

7.2 Disaster Recovery

The disaster recovery plan is the responsibility of the Customer. Lectra can provide a procedure to be followed in case of disaster to change the configuration (align the configuration on remaining servers). The mechanism required for the database replication and the switch active/passive would be addressed by Oracle DBA or support.

The configuration recommended by Lectra:

- ensures an easier disaster recovery plan

- leverages the load in case of peak of activity

- ensures fault tolerance on most of components

8. INTEGRATION WITH INFORMATION SYSTEM

8.1 Integration: LDAP, eMail and Security,

8.1.1 Users, Groups and Security

- Ability to authorize (login, password, validation) users using a central directory (LDAP implemented, for ex. Microsoft Active Directory)

- Ability to synchronize only a subset of users

  - ➢ using a group created in LDAP specified in configuration for synchronization, nested group offers the capability of using existing corporate groups

  - ➢ using a subset of the directory, defining the root of the hierarchy as the search base location

- Ability to define roles based on application groups using a dedicated administration tool (limit action capability for users)

- Ability to apply security on data to limit access on certain sub categories

- An administration tool is provided to configure and manage users (PLM Manager)

8.1.2 Authentication Delegation (SSO)

Single sign-on is a process that allows network users to access all authorized network resources without having to log in separately to each resource. Single sign-on allows you to validate user authorization against your corporate user database or other client application rather than having separate user passwords managed by Lectra Fashion PLM.

Lectra Fashion PLM authentication delegation is based on a web module in charge of communication with an authentication server. Every authentication servers have their own approach/technology to handle user authentication ; the module is customizable to fit your IT requirements.
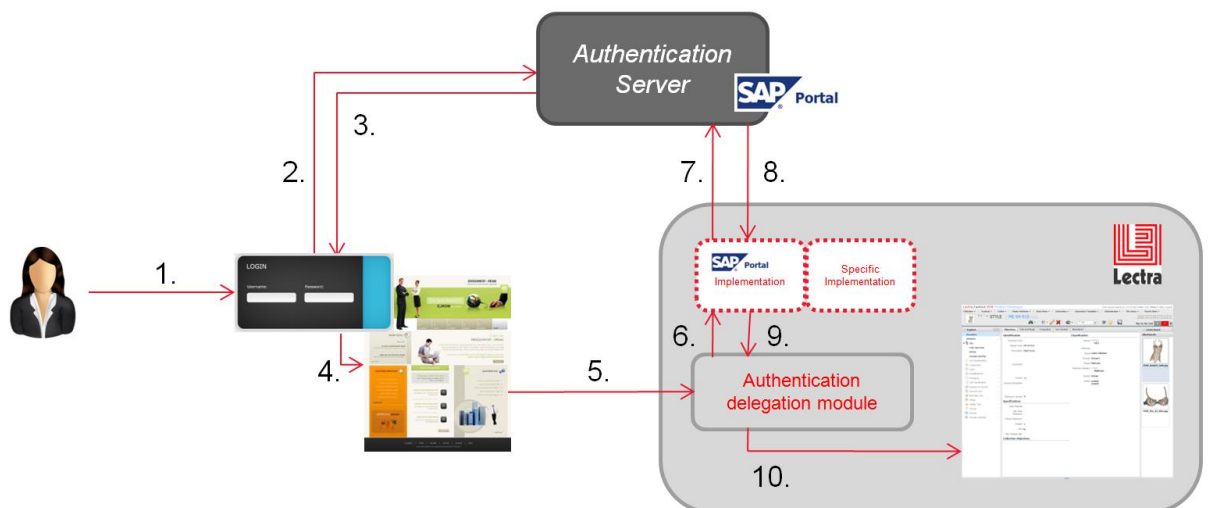

Figure 7: Authentication Delegation

1. A user logs into its main application (e.g. portal) using its current login and password

2. User and password are checked by the authentication server

3. If the User is authenticated, a token is sent back to the login module

4. Access to the application is granted

5. From the application, any hyperlink to the Lectra Fashion PLM will go through the authentication module: the user, token and Lectra Fashion PLM URL (e.g. http://<my.server>/pdm) will be sent to this module

6. This information will be sent to the implementation corresponding to your Authentication server.

7. The authentication server is contacted to check the user and token validity

8. It sends its response

9. The authentication delegation module receives the response

10. If the user and token are validated, a session is created on Lectra fashion PLM and the application is opened without prompting the user for its credential.

8.1.3 eMail Integration

Most of the collaboration between users is achieved within the application itself. This includes internal notifications.

The system handles a mail (SMTP) protocol to allow the users to send external notifications, annotations and reports sent as attachments.

8.1 Integration: ETL

Lectra Integration Platform services called in this context are responsible for the data integrity and coherence on the Integration Platform.

Three Goals:

⇨ Data exchanges between PLM and 3rd party Solutions such as ERP, Data Warehouse or CRM,

⇨ Data migration when upgrading from previous Lectra Fashion PLM version (before PLM V4R1),

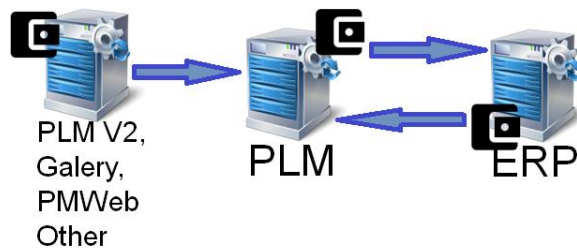⇨ Data migration from a legacy System to Lectra Fashion PLM.

Figure 8: ETL Exchanges

ETL is the integration solution of Lectra Fashion PLM to:

• Extract data through Lectra Integration Platform services from the Product Developer into XML

• Insert or update data through Lectra Integration Platform services into the Product Developer from XML
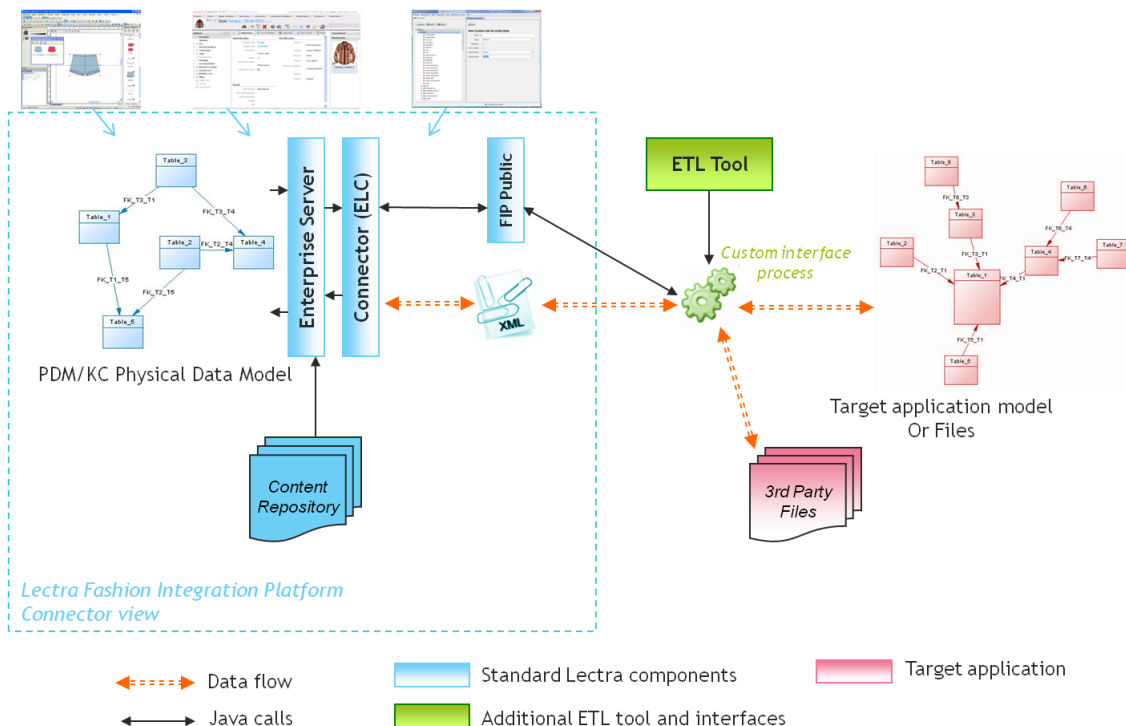

Figure 9: ETL Architecture

Lectra Fashion PLM has an integrated **connector** that ensures access to the Lectra Integration Platform for handling data. In addition, a user can **extract or inject data** which benefiting from the data integrity guaranteed by the services of the Lectra Integration Platform. Data are integrated as XML files. To manipulate these files, Lectra recommends the ETL and TALEND solutions.

The Lectra Integration Platform contains a component that maps XML files on an RDBMS, so that the SQL requests access data in the XML files directly. This component is called Lectra XML-DB. Talend can be used in a nominal usage case. The XML grammar necessary to inject/extract data is documented in detail and provided in our standard package. No ETL interface is delivered as such in the standard package; the integration of 3rd party solutions via ETL is part of a personalization project.

9. LECTRA FASHION PLM CONFIGURATION AND CUSTOMIZATION
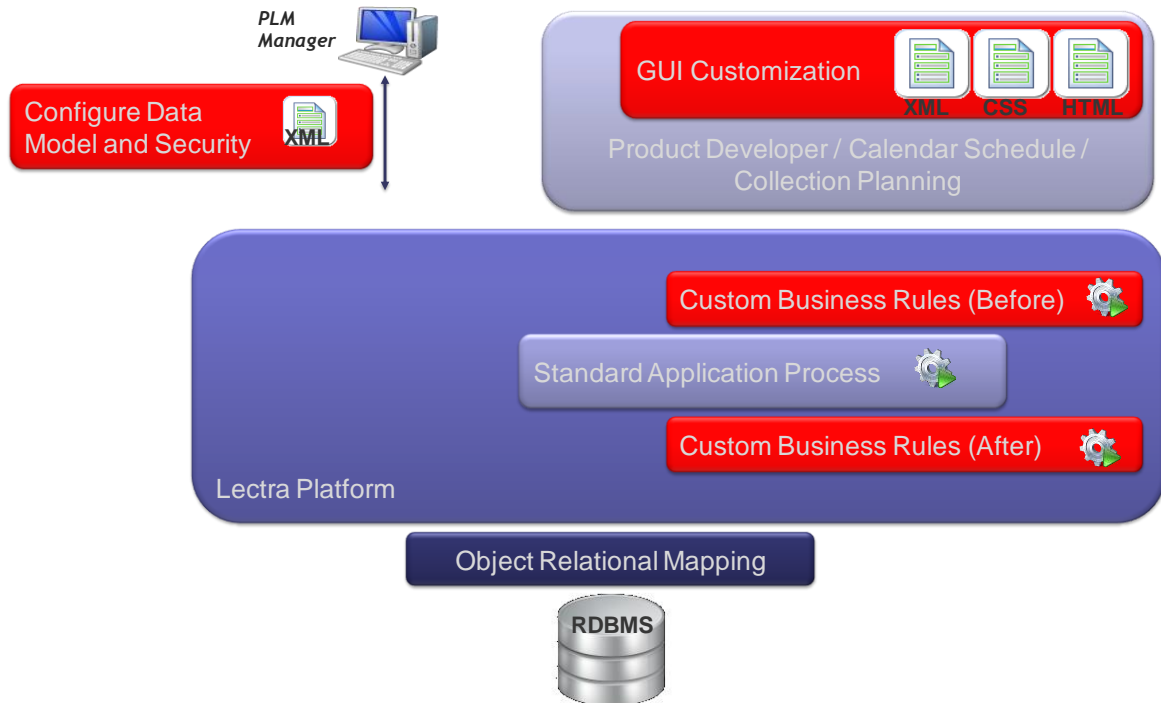
9.1 Product Development customization

Figure 10: Lectra Fashion Product Developer - Customization Overview

Lectra Fashion PLM may be configured and customized at different levels:

- **Graphical User Interface** customization: colors, layout, menus, labels, fields removal or addition

- **Model** configuration: addition of custom fields

- **Java Custom Business Rules** (before / after standard PLM services calls): custom JAVA code can be added to modify the standard PLM behavior and inject customer-specific business rules

The following tools are used to implement the customization:

- Custom fields and security rules are configured using the **PLM Manager**

- GUI look and feel is configured using XML files

- Java Custom Business Rules are pure Java code to be developed and integrated in the Lectra Fashion PLM software distribution.

9.1 Report Development

Standard report templates are delivered with the PDM application

● Can be modified by customers

New report templates can be developed by customers

● Using a dedicated editor, the **Report Designer**, based on a customisation of iReport from Jaspersoft: a dedicated plug-in has been developed by Lectra to integrate Report Designer on the Fashion PLM platform
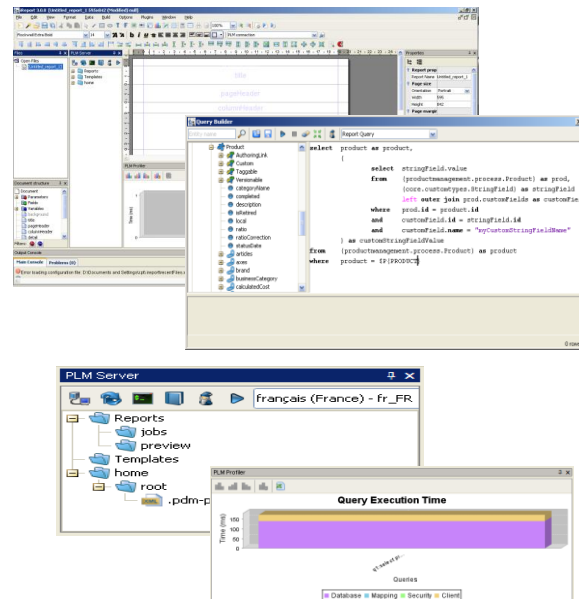

Figure 11: Lectra Fashion Product Developer - Customization Reporting

iReport from JasperReports is a powerful, intuitive and easy-to-use visual report builder/designer for JasperReports written in java. This tool allows users to visually edit complex reports with charts, images, and sub-reports, in various export formats such as PDF, HTML, XML, CSV, RTF, MS Excel.

The Lectra Fashion PLM iReport module enables:

• View and directly browse the PLM business model to write, execute and test report queries (query results and query performance)

• Provide a dedicated management of report parameters

• Provide dedicated PLM libraries to directly access and manipulate specific business objects (such as costing, images, colors …)

• Enable a preview from the template editor

• Store and classify the report templates on the Lectra Integration Platform

10. LECTRA FASHION PLM SOLUTION ADMINISTRATION

The administration of Lectra Fashion PLM is managed through different tools:

- **Lectra Single Installer**: a fully packaged installation tool, providing an easy and flexible PLM installation approach. Lectra Single Installer manages the deployment of all the PLM software on various servers, and data initialization. This tool manages also upgrades and is used to change Infrastructure modifications. Lectra Single Installer is finally used to repair installations.

- **Configuration tools**: Excel files providing an easy initial system set-up for configuration data. Initial configuration files are managed as bundles loaded with the PLM Manager tool.

- **PLM Manager**: a tool for managing and maintaining the PLM configuration.

- **Report Designer**: a tool for the development of custom reports.

10.1   PLM Manager

Shared
- Preferences
- PLM Connection

Security
- Groups
- Users
- Profiles

Master Data
- Currencies
- Measurement units
- Value lists

Reporting
- Monitoring
- Loading template

Content loading
- Standard contents
- Customer contents

Configuration
- Classification definition
- Data model
- Default values

Figure 12: PLM Manager

The PLM Manager is a Client / Server tool based on the Eclipse RCP framework; it connects to the Lectra Integration Platform to manage its administration and configuration.

The PLM Manager is used to perform maintenance and administration tasks on the business configuration, and to get a first level of technical trouble shooting:

- Security management (groups / users / profiles)

- Business configuration management (currencies, localization…)

- New content bundles upload management

- Model customization management (declaration of new custom fields)

- Report Queue monitoring and loading of new template reports

11. OS & PERFORMANCES
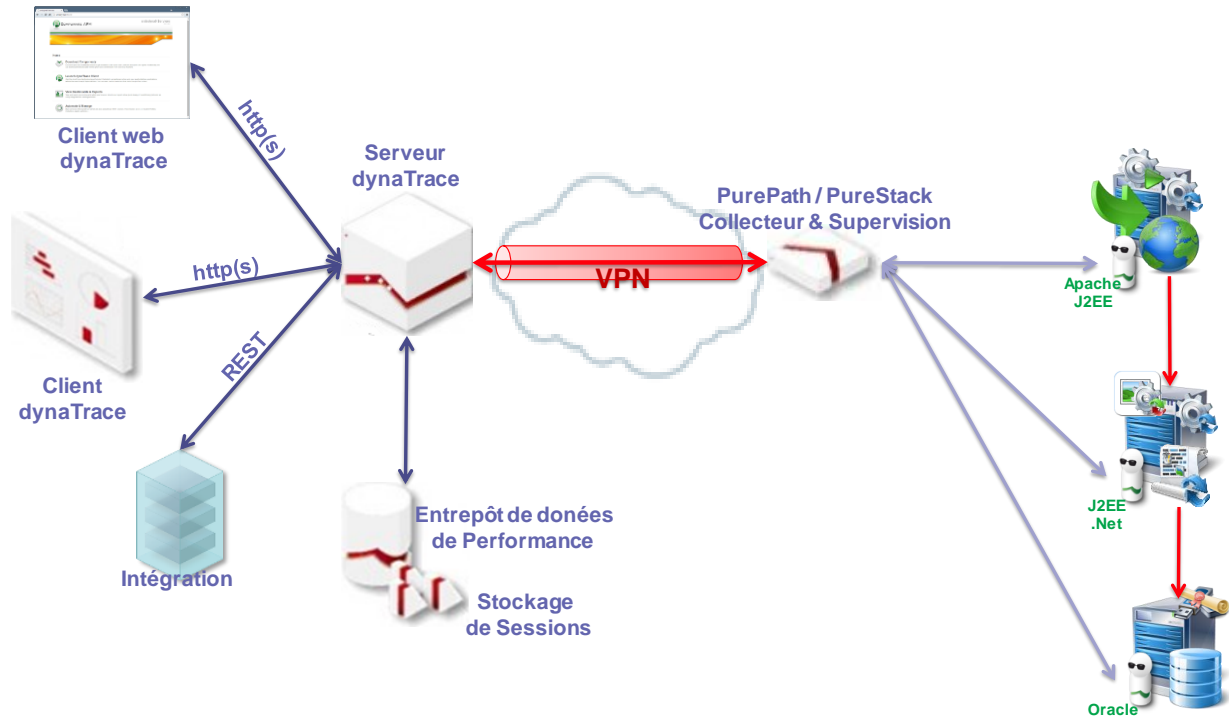
11.1 Customer Monitoring

Figure 13: PLM Application Performance Monitoring

Lectra can provide, as a dedicated Advanced Support Package, a remote monitoring service based on one of the leading Application Performance Monitoring (APM) systems on the market: **dynatrace**.

Dynatrace allows the control of all the technical counters of the various layers of the Lectra Fashion PLM architecture, and in parallel gives a view on the end-user experience, providing response time metrics and error rates for all functional transactions. The combination of the functional monitoring and the technical monitoring gives a unique view on the multiple layers of the architecture, enabling a strong **proactive** supervision.

This tool is also used internally by Lectra R&D during performance benchmarks to get a 360° view of the PLM behavior and to improve performances and verify non-regression.

11.1   Performance tests

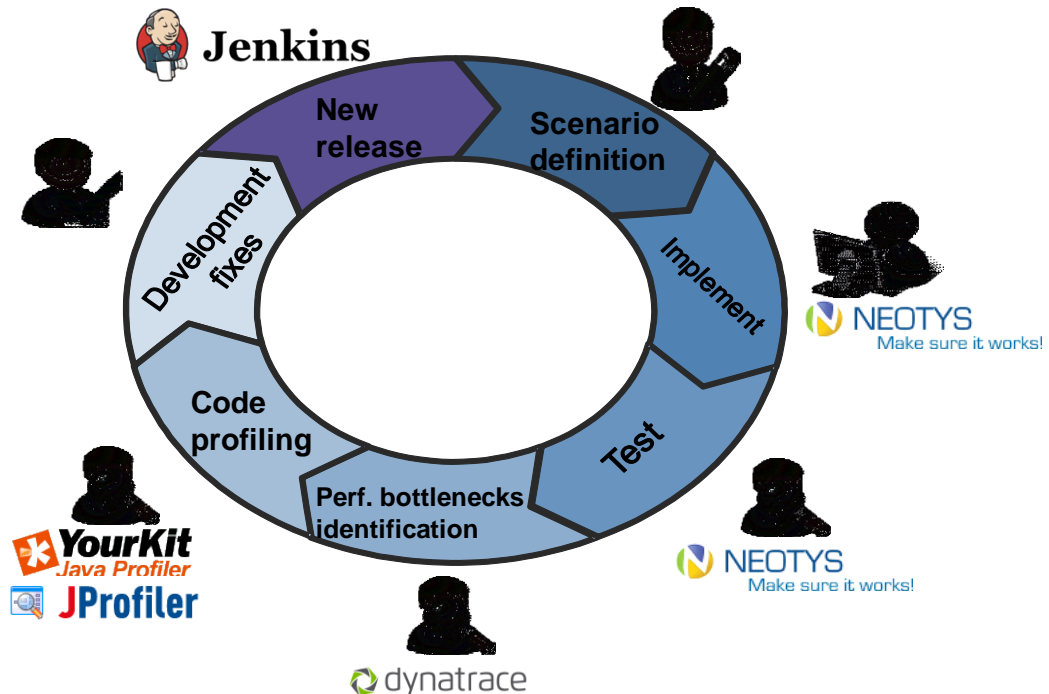## Performance tests: a continuous improvement process

Figure 14: Performance tests: A continuous improvement process

We continuously test the performance of our **standard** software as part of our validation process. The R&D department is equipped with the following tools to support this approach:

- Load tests managed with **Neoload** from Neotys. Neoload creates virtual users browsing Lectra Fashion PLM web pages and filling in forms with dynamic values. Different user profiles, each with its own load variation (constant, ramp-up, peak), may be run simultaneously in order to provide a measured increase in the load.

- Overall application behavior validation and performance bottleneck identification with **dynatrace**. Dynatrace allows us to have a 360° view on the application when it is load-tested by collecting technical metrics on each layer of our architecture and consolidating these metrics with functional transactions. We also use this tool within our support team in case of necessary investigations on a customer's production environment

- Code Profiling with **Jprofiler and YourKit** – once issues have been pinpointed during our load tests, the R&D team uses these tools to identify the root cause of the problem, then resolves it and delivers a new release for load tests.

We use a set of 49 functional scenarios for our load tests that match together a full end-to-end product development process. These functional test scenarios are executed on the following types of load tests:

- "Stress tests" simulating 75 concurrent users with very short end-users inter-click timers (500 ms between each clicks) on a full end-to-end product development process

- "Normal customer behavior tests" simulating 120 concurrent users with regular inter-click timers (5 seconds) on a full end-to-end product development process

- "Endurance tests" simulating 120 concurrent users with a normal behavior (5 seconds inter-click) simulated during 48 continuous hours

Our benchmarks are run on Typical Configuration: 3-server architecture (1 for the Product Developer , Calendar Manager, Collection Planning and Material Forecast modules application server, 1 for the RDBMS, 1 for the Reporting application server), which is the basic target to support 120 concurrent users.

At the end of each benchmark test, our Neoload tool provides us a detailed report with PLM requests and web page response time measures (minimum, maximum, average, standard deviation), the bandwidth used, the number and type of errors, along with graphs displaying the evolution of these measures during the benchmark test. These tests allow us to detect specific issues with requests' response time, and to test the system stability under stress and on a long run basis (to detect potential memory leaks for example).

The tests reports are then analyzed to determine if any actions on the performances of our solution are required. A software release is considered as shippable when the requests' average measured response time during our benchmarks is under 250 milliseconds, with no technical errors detected. This 250 ms threshold is derived from real-life measures taken on production environments used by end-users that were satisfied with response times. The average page response time is the total time taken by the server side to prepare the web page to be displayed by the web browser.

The example below is a summary of Lectra Fashion PLM V4R2sp1 benchmarks results. The Lectra Fashion PLM V4R2sp1 benchmarks are ongoing.
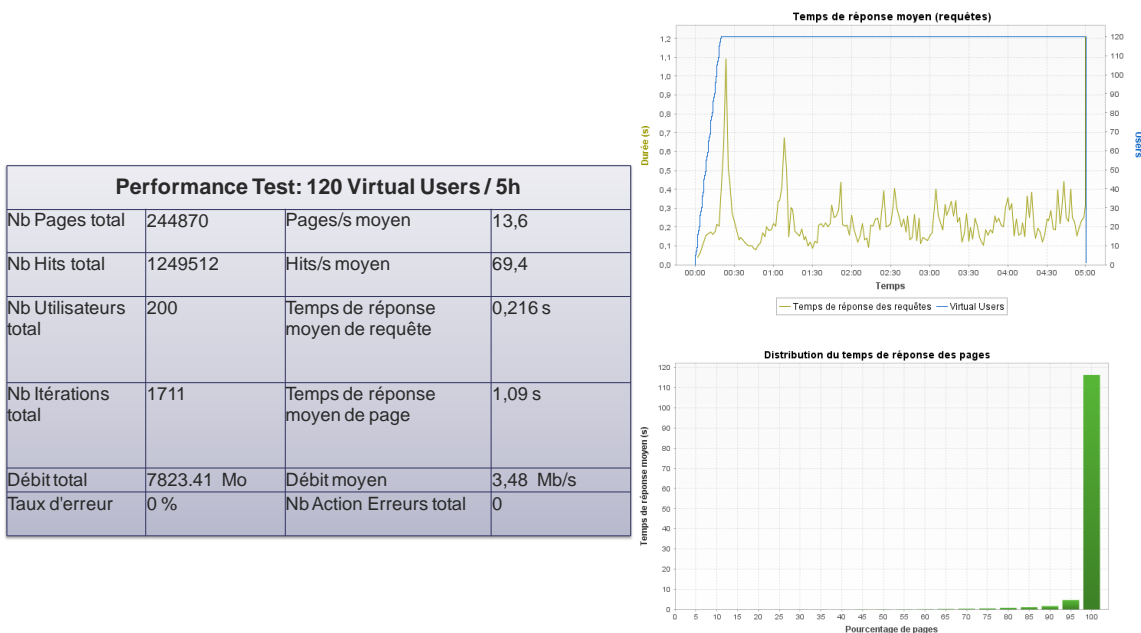
Performance Test: 120 Virtual Users / 5h			
Nb Pages total	244870	Pages/s moyen	13,6
Nb Hits total	1249512	Hits/s moyen	69,4
Nb Utilisateurs total	200	Temps de réponse moyen de requête	0,216 s
Nb Itérations total	1711	Temps de réponse moyen de page	1,09 s
Débit total	7823.41 Mo	Débit moyen	3,48 Mb/s
Taux d'erreur	0 %	Nb Action Erreurs total	0

Figure 15: Performance Tests Results

11.2   Production monitoring and feedback

With 4 years of production feedback and more than 20 customers using the solution to support their own product development process, Lectra Fashion PLM is a robust solution with optimized performance based on real life production monitoring. We closely support our customers with a

dedicated Support Team composed of technical experts, who have the experience and tools to provide support in case of production issues.

Production issues can come from different sources, not only from the software itself, and may happen from time to time: environment issues (OS, database configuration, hardware, customer IT environment …), customization not properly designed or if the infrastructure needs to be upgraded to accommodate the growing numbers of users and data etc. If required, our Application Performances Management tool Foglight can be deployed remotely on any production system, to help us analyze the overall performance of the Lectra Fashion PLM system.

Foglight gives a full view of any multi-server production infrastructure, on the technical layers of the solution (OS, JEE application server, database …), and from an end-user perspective with a full breakdown of all Lectra Fashion PLM transaction response times per technical tier. This helps us to accelerate the Support Teams initial analysis before starting any action plan. Once the initial analysis is complete, we have the means to reproduce the issue in our labs, and to resolve, sometimes with a configuration change.

In case of a critical issue, a dedicated action plan is managed by our Support Team, with a tight follow-up (from daily to weekly) with our customers until the problem is resolved. For example, we recently helped our biggest customer (with more than 350 active users), where the customer had developed for several years their own PLM customization, with a dedicated internal team. Progressively, the system got more and more complex (with the introduction of new customizations), and stored more and more historical collection data. As a consequence, the system's response times progressively increased. Our first analysis with APM enabled us to identify the top 10 PLM transactions that required a review. We reproduced the issues in our labs, and the conclusion was that a detailed audit of the customization was required. Our R&D team then worked closely with the Customers' customization team to make a step-by-step performance analysis of the customization, and we provided optimized customization source code or recommendations. As a result, the top transaction times where significantly reduced within 2 months of collaborative work with the customer.

The following figures have been collected on the customer's production infrastructure over a 1.5-month period:

- Average Page response time: 0.15 seconds

- No system downtime due to technical errors during the test period

12. TABLE OF FIGURES

13. APPENDICES

13.1   Configuration of the PLM application behind a reverse-proxy

For a PLM deployment behind a reverse-proxy, whether for an internal company network or online, it is crucial to open a certain number of URIs to enable the PLM to function correctly.

To carry this out, use the following files as a base.

- <Installation folder>\Apache24\conf\mod-jk\uriworkersmap.conf (in all cases)

- <Installation folder>\Apache24\conf\mod-jk\uriworkersmap.properties (in addition, in the case of installed extensions)

Extract:

```
JkMount /platform fipbalancer

JkMount /platform/* fipbalancer


JkMount /authentication fipbalancer

JkMount /authentication/* fipbalancer
```

For this example, it will be necessary to add the URI/platform and /authentification for the reverse-proxy.

WARNING

For security reasons, we recommend that you open the URL/plm-console