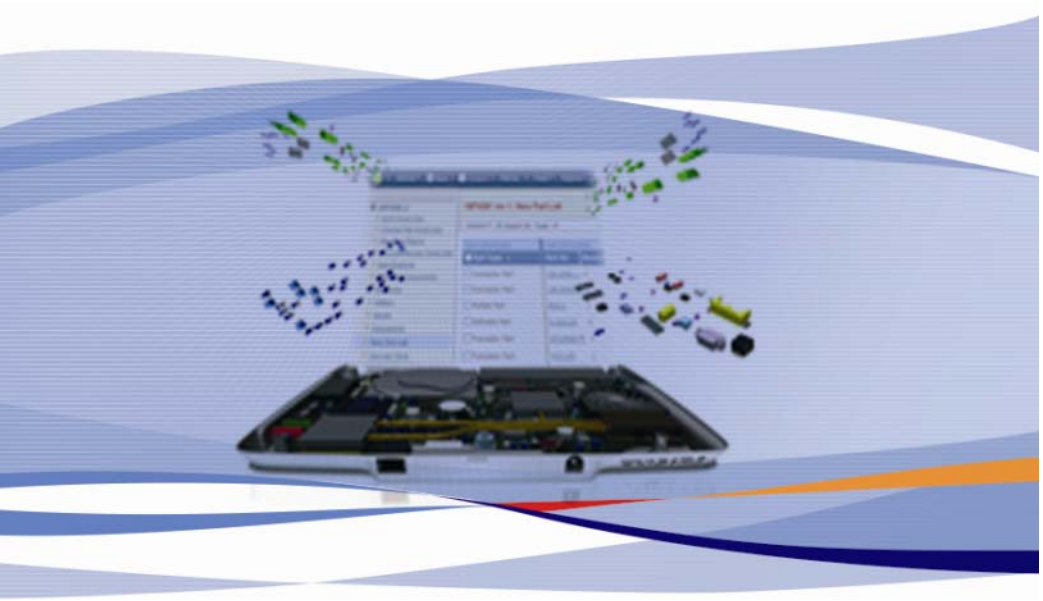
IBM Product Lifecycle Management

ENOVIA Synchronicity



ENOVIA Synchronicity products help Semiconductor companies streamline business processes and reduce new product development time. By providing one cohesive source of information, ENOVIA Synchronicity allows both management and collaboration of design information and visibility into every product development process.

Semiconductor companies use ENOVIA Synchronicity DesignSync to manage hardware and software data in their products, and provide a collaborative and secure environment for resolving product development issues among geographically dispersed development teams. Data can be managed at both the detailed file/directory level and at a "modular" level of abstraction, ensuring that design data contributed by individual teams can be seamlessly integrated into higher-level designs.

The products SITaR workflow manages design data through its "Submit," "Integrate," "Test" and "Release" phases. SITaR leverages the power of module-based design in an environment consisting of multiple design modules that are then aggregated by an integrator into a higher-level system.

Members use virtual workspaces to collaborate on design data and other product content through discussions, notifications, alerts and review/approval processes. And ENOVIA Synchronicity DesignSync Central's architecture eliminates the problems associated with integrating large designs by providing a single unified design data management system, which can exist at a single data center, or be distributed around the world.

The ENOVIA Synchronicity products are:

♦ENOVIA Synchronicity DesignSync Data Manager (SYN)
♦ENOVIA Synchronicity ProjectSync (SYP)
♦ENOVIA Synchronicity DesignSync Add-On for DFII (SYD)
♦ENOVIA Synchronicity DesignSync Add-On for Milkyway (SYM)
♦ENOVIA Synchronicity DesignSync Add-On for CTS (SYC)
♦ENOVIA Synchronicity DesignSync Central (SNC)

SNC includes SYN and establishes the link with ENOVIA Live Collaboration, which is the platform on which several products can be added to support most of the PLM Collaborative Business Processes adapted to specific industries.

The creation of complex electronic products is not an easy proposition, and is becoming increasingly complicated with the proliferation of globally dispersed teams. But since 1998, integrated circuit (IC) design teams have relied on ENOVIA Synchronicity products to help manage the hardware and software data in their products.

Like other industries, semiconductor companies face intense pressures in today's marketplace, including escalating design costs, growing product complexity, shrinking sales prices and a compelling need to increase the pace at which they innovate. And when combined with daunting design challenges, accelerated development lifecycles and complex supply chains, these difficult conditions can lead to slipped product launch dates, budget overruns and missed quality targets.

The creation of complex electronic products is not an easy proposition, and is becoming increasingly complicated with the proliferation of globally dispersed teams. But since 1998, integrated circuit (IC) design teams have relied on ENOVIA Synchronicity products to help manage the hardware and software data in their products.

Today, more than 120 development organizations, including 13 of the top 15 semiconductor companies, take advantage of ENOVIA Synchronicity products to boost design productivity. ENOVIA Synchronicity products are designed specifically for Design Data Management (DDM) of complex IC design, and continue to evolve as the challenges facing the semiconductor industry do.

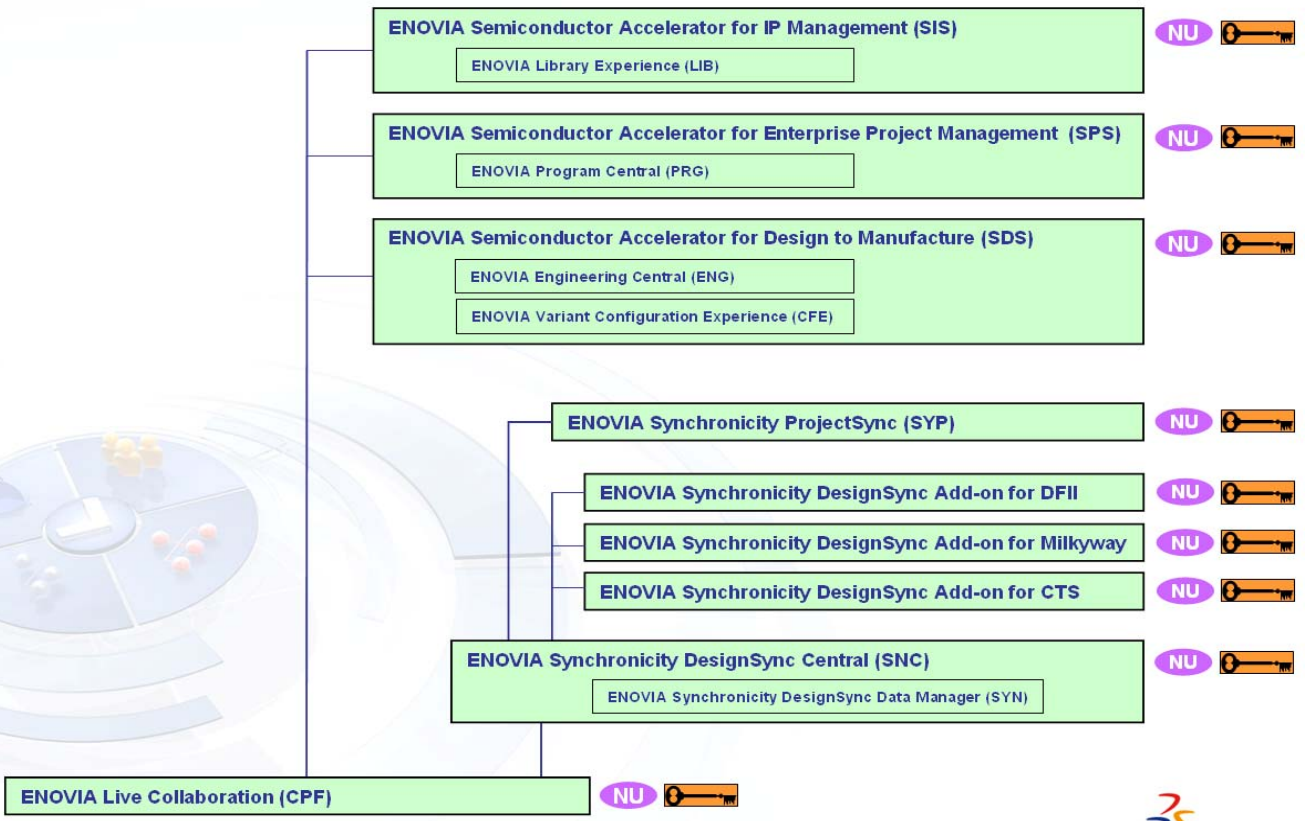
ENOVIA Synchronicity products:

♦Increase designer productivity through deployment of a collaborative infrastructure that ties together multiple design teams, partners, and customers
♦Reduce mask spins and increase first-sample success rate by managing complex, multi-vendor/tool IC design data and processes
♦Improve engineering efficiency through implementation of comprehensive IP reuse and hierarchical, top-down design methodologies, decreasing costs and reducing the design productivity gap
♦Reduce process costs through automation, system consolidation and data synchronization
♦Define, create, track and measure common enterprise processes
♦Consolidate and develop strategic suppliers and partners.

Furthermore, ENOVIA Synchronicity products can be deployed as the foundation for a semiconductor company's PLM strategy. When used in conjunction with ENOVIA Live Collaboration (CPF) and through the ENOVIA Semiconductor Accelerator solutions, semiconductor design data is available to product development processes such as issue management, project management, IP management and operations bill-of-material (BOM) management.

♦ENOVIA Semiconductor Accelerator for IP Management (SIS)
♦ENOVIA Semiconductor Accelerator for Enterprise Project Management (SPS)
♦ENOVIA Semiconductor Accelerator for Design to Manufacture (SDS)

Synchronicity Integrated with ENOVIA



ENOVIA Synchronicity – The Industry Leader

ENOVIA Synchronicity DesignSync Data Manager (SYN)

ENOVIA Synchronicity DesignSync Central – The Industry Leader

The creation of complex electronic products is not an easy proposition, and is becoming increasingly complicated with the proliferation of globally dispersed teams. Since 1998, integrated circuit (IC) design teams have relied on ENOVIA Synchronicity DesignSync Data Manager to help manage the hardware and software data in their products.

Today, more than 120 development organizations, including 13 of the top 15 semiconductor companies, take advantage of ENOVIA Synchronicity DesignSync Data Manager to boost design productivity. ENOVIA Synchronicity DesignSync Data Manager is tailored specifically for the design data management (DDM) of complex integrated circuits, and continues to evolve as the challenges facing the semiconductor industry do. ENOVIA Synchronicity DesignSync Central combines the capabilities of ENOVIA Synchronicity DesignSync Data Manager with ENOVIA's world class PLM collaboration platform, extending collaborative connections from local design teams to the global enterprise.

Local Optimization versus Global Efficiency?

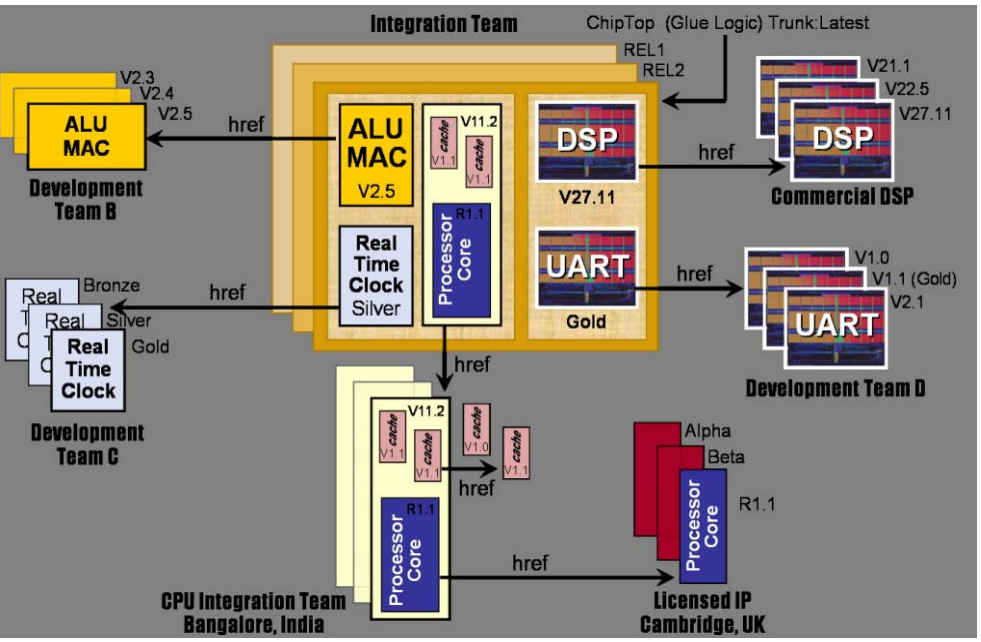
Today, designing an IC often requires integrating a multitude of datasets contributed by multiple, and often geographically dispersed, design teams. As ICs become more complex, design teams are required to specialize, because no one individual, or even a team of individuals, can do it all. But specialization results in the segregation of design tasks along specific lines such as analog or digital design – and then within those teams, further segregation occurs. For example, in analog design, different design teams perform schematic capture and physical layout. In digital design, specialties exist in the areas of register transfer level (RTL) design, design compilation, physical place and route, simulation and verification. ICs also include ever increasing amounts of embedded software, which is yet another area of specialization. Although specialization is necessary, in the end, all of the components contributed by the different design teams need to come together into one chip design. An integration team manages this daunting task.

While individual teams are focused on the details of the design data for which they are responsible, and are thus focused at the file level, the integration team needs to be able to manipulate data sets at a higher level of abstraction. Glue logic at the top-level instantiates configurations, or releases, of lower-level modules. This sounds straightforward, but in many cases is not. And that is because individual design teams are often using independent and unconnected DDM systems that require that the integration team extract data sets for different component parts from different systems. Extremely high rates of change for individual components make the maintenance of a consistent amalgamation at the chip level very difficult. While the various SCM (Software Configuration Management) and DDM tools in use by the individual design teams may satisfy local requirements, design data management breaks down at the integration level. As a result, manual procedures are used, which lead to errors and inefficiencies.

For this reason, many companies are attempting now to plot a roadmap that leads from a policy of local optimization into the realm of global design efficiency. And ENOVIA Synchronicity DesignSync Central enables collaboration between local design teams and the corporate enterprise.

Designing With Modules

ENOVIA Synchronicity DesignSync Central enables design teams to manage data at both the detailed file/directory level, and at a "modular" level of abstraction. It is this ability to efficiently manage design data at both of these levels of abstraction that differentiates ENOVIA Synchronicity DesignSync Central from other DDM systems and allows design data contributed by individual teams to be seamlessly integrated into higher-level designs.



ENOVIA Synchronicity DesignSync Data Manager Design Hierarchy Management

At the heart of the architecture is the "module," which represents a single coherent and consistent collection of files and folders. While the revision history of individual files is maintained at the file level, a revision history of the context, or structure, in which the files exist is maintained at the "module" level. A module version is stored in a "manifest," which represents a "bill of materials." The manifest for a module version stores a list of individual file versions along with the associated directory structure, and, if hierarchy is included, references to sub-modules. The revision history of a module records a complete genealogy, making it possible to resurrect the design as it existed at any Previous point in time. Storage of module versions in a manifest also eliminates the need to tag individual files in order to manage and maintain consistent data configurations.

The architecture under which module versions are stored in ENOVIA Synchronicity DesignSync Central affords many advantages:

Change Set Processing
Because "manifests" are stored for each module version, update operations employ a "change-set" paradigm, eliminating the need to enumerate over all objects in a directory structure to determine which subset needs updating.

High Performance
Change set processing also enables high performance, and high performance substantially increases the probability of the successful deployment of a DDM tool, which in turn encourages the use of best practices.

Atomic Operation
Operations such as check-in are "atomic," meaning that transactions involving multiple Files are not committed to the Data repository unless all the Individual files have been checked in successfully. Sophisticated recovery Mechanisms allow an interrupted check-in to proceed where it left off, without having to start over.

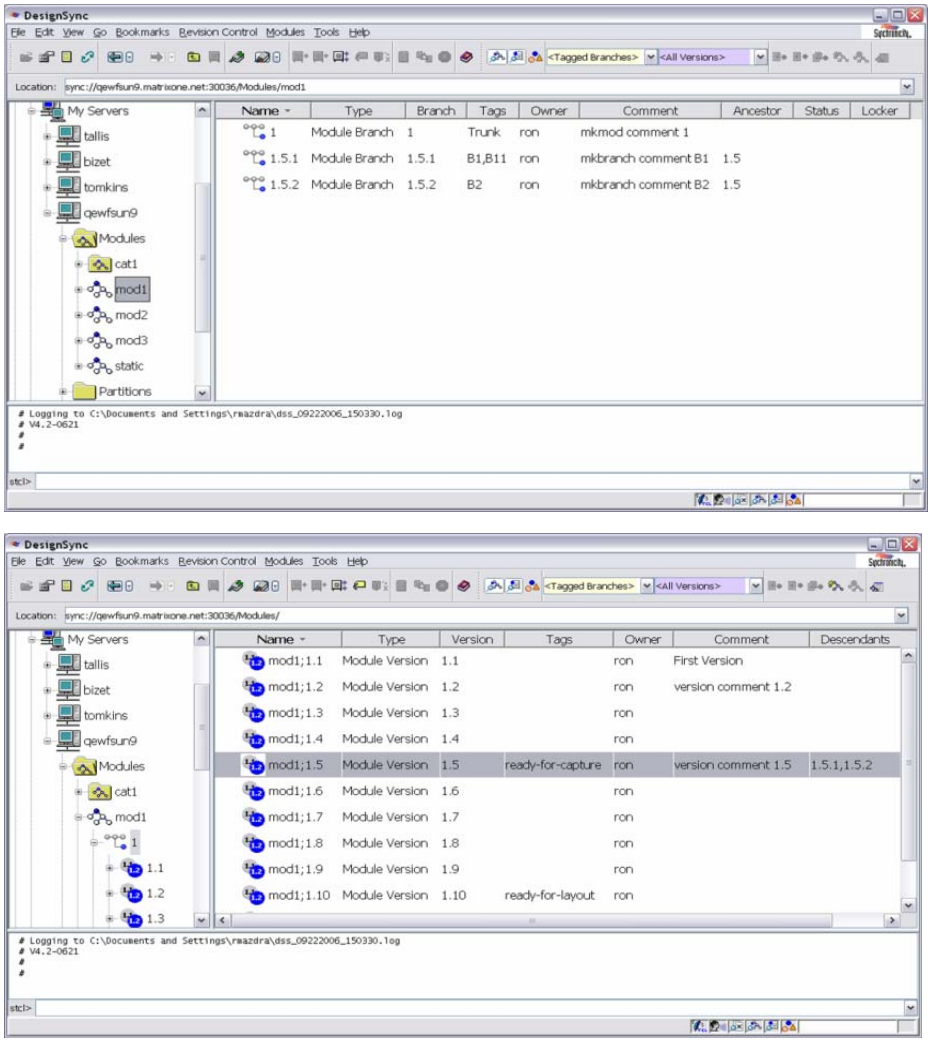
Directory Versioning
Creation, deletion or renaming of directories and files is captured in the module version history, providing a complete genealogy of changes to the design.

Distributed Data Repositories
Design data can be distributed over multiple repositories, thus maximizing local efficiencies.

Managing a Design Hierarchy ENOVIA Synchronicity
DesignSync Central enables the management of a design hierarchy of modules. In addition to file versions organized in folders, a module version may contain one or more "hierarchical references" (hrefs) to other module versions that may be stored in the same server or in another server located anywhere across the globe. Hrefs are processed when design data is fetched into a workspace.

If a module version that contains an href is fetched, the href is resolved and the referenced module version is fetched as well. In this manner, a hierarchical design is assembled in the workspace.

By establishing containment relationships (hrefs) to other modules in modules themselves, ENOVIA Synchronicity DesignSync Central captures the design hierarchy and actively manages it throughout the evolution of the design. Thus, all of the individual design elements are managed, and interrelationships are maintained in a consistent manner, whether the entire dataset is stored in a single server, or distributed across servers around the world. Using ENOVIA Synchronicity DesignSync Central an entire design hierarchy that is distributed across multiple servers can be fetched with a single



ENOVIA Synchronicity DesignSync Data Manager Graphical User Interface – Module Visibility

command. However, without using a DDM tool that can efficiently manage a hierarchy of constituent components in a complex IC, many companies are struggling with capturing the "hierarchy" of a design even after it has been completed. If the components come from disparate and unconnected DDM systems, it can be very difficult to determine which components even ended up in a given design release.

Because ENOVIA Synchronicity DesignSync Central allows users to manage a design hierarchy, companies gain advantages including:

Task-based Workspace Creation
Workspaces can be tailored to particular tasks such as verification of an immutably released design hierarchy, a hierarchy containing work in progress or a mixture of both.

Single Command Builds or Updates an Entire Hierarchy
There is no need to fetch individual components of a design; ENOVIA Synchronicity DesignSync Central will fetch an entire hierarchy automatically.

Overlapping Module Data
A module hierarchy can be created to allow data from different modules to be fetched into the same directory in a workspace.

Filters
Sophisticated filtering can be applied to files, directories or hrefs to provide fine-grained control over what data is fetched or operated upon. Filters allow designers to construct workspaces comprised of consistent subsets of data, which eliminates fetching unnecessary data.

File-based designs can also be included in a design hierarchy

ENOVIA Synchronicity DesignSync Central still includes the file-based storage mechanisms that existed prior to the introduction of module-based storage. Design configurations based on tags, or HCM (Hierarchical Configuration Manager) releases, can also be "href'ed" into a module. (HCM is the predecessor to modules, but is file-based.) This provides a smooth transition to a module-based integration methodology, because there is no requirement that ALL components be designed using module based storage. Design teams with well-established, file-based methodologies can continue to use that approach, but their contributions easily can be integrated into higher-level systems.

Where Used
It is often important to be able to answer the question "where has this block of design data been used in other design blocks?" A common scenario is when a bug has been discovered in a design block that has already been included in delivered product. Determining which versions of which products contain the faulty block becomes vitally important. If design hierarchies are managed using ENOVIA Synchronicity DesignSync Central hrefs, the "whereused" command provides the answers. Given a module version, HCM release, or tagged configuration of files, the "whereused" command will trace hrefs upwards, reporting all design hierarchies in which the block has been included. Because design reuse is common, a single component might find its way into many other designs or finished products. Countless hours can be saved determining where a given design block has been used by leveraging this capability to extract the answers automatically.

Submit, Integrate, Test, and Release – SITaR
ENOVIA Synchronicity DesignSync Central provides an intuitive built-in workflow called SITaR (Submit, Integrate, Test, and Release). SITaR consists of a set of commands that leverage the power of module-based design in an environment consisting of multiple design modules aggregated together by an integrator into a higher-level system. Though individual design blocks (modules) may be contributed by different teams, design at the block level cannot occur in a vacuum. Simulations must include interactions with the other blocks in the design.

SITaR is based on the notion that there are two fundamental "roles" in play in such a design: A "Designer" is someone who is contributing at the block level. And an "Integrator" is responsible for integrating blocks together into a top level design, testing the system, and releasing the stable "baseline" (a system level configuration of blocks) from which all subsequent block level development occurs.

Working within such a flow, a Designer fetches the current stable baseline into a workspace. The block the designer is working on is then put in "edit" mode, and design activities proceed. All simulation takes place in the context of the baseline consisting of all the other blocks. The key is that design work and simulation are NOT done with work-in-progress configurations of other blocks, but only in the context of the stable baseline. When work is complete, the Designer "submits" the module for possible integration into a newer baseline. The Integrator monitors the submission queue, which could contain submissions for multiple blocks, and is able to build a workspace containing any mixture of submitted blocks. This is the "Integrate" step in SITaR.

Regression tests are performed against the newly integrated set of blocks (the "Test" step in SITaR), and if deemed stable by the integrator, can be released as a new stable baseline (the "Release" step in SITaR). Designer workspaces can then be updated, fetching the baseline for all blocks for which editing activity is not occurring.

Thus, ALL design work at the block level is performed in the context of a stable baseline of the rest of the blocks in the design. All this activity is performed using simple and intuitive commands such as "sitr submit" or "sitr integrate", alleviating the need to educate the contributing teams in the use of the more fundamental module design command set, or with complicated handoff and tagging schemes. SITaR commands wrap the underlying module commands such that the power of the module based DDM architecture is leveraged in the context of this well-defined use model.

EDA Data Awareness and Third party Tool Integrations

Because of the tight focus on integrated circuit design, ENOVIA Synchronicity DesignSync Data Manager (the functionality of which has been incorporated into ENOVIA Synchronicity DesignSync central) has been the industry leader in integrating DDM capabilities into the highly specialized design environments in which design work is performed from leading vendors such as Cadence and Synopsys. Electronic design automation (EDA) integrations are comprised of two components: an "EDA data recognition" capability and a plug-in for the EDA tools graphic environment. EDA data recognition enables ENOVIA Synchronicity DesignSync Central to manage complex data types, like the collections of files and directories which might represent an object such as a schematic diagram as "atomic" objects. For example, the end user would checkout a version of a schematic diagram, causing ENOVIA Synchronicity DesignSync Central to fetch the appropriate co-managed collection of files and directories that define the schematic on disk.

Integrations for EDA tools provided by Cadence and Synopsys are available as add-ons to ENOVIA Synchronicity DesignSync Data Manager. For other EDA tools, ENOVIA Synchronicity DesignSync Central supports a "Custom Types System" (CTS) as an add-on product that provides an API for creation of custom complex data types. Using the CTS, one can enable EDA data awareness for any EDA tool in-house, whether developed in house, or commercially available.

A Unified DDM System is a Major Competitive Advantage

The majority of data management problems associated with integrating large designs can be eliminated if all the data is managed in a single unified DDM system, which could exist at a single design center, or could be distributed around the world. ENOVIA Synchronicity DesignSync Central is the collaborative platform of choice to make such a vision a reality. In 13 of the top 15 global semiconductor companies and in hundreds of other organizations, ENOVIA Synchronicity DesignSync Data Manager is the standard for management of complex EDA data created by hardware design tools from companies such as Cadence, Synopsys and Mentor Graphics. And the platform also is uniquely suited for the management of RTL Verilog or VHSIC Hardware Description Language (VHDL) design, cell library development or even documentation development. Plug-ins for the Microsoft Visual Studio IDE and Eclipse IDEs (Integrated Development Environment) are included with ENOVIA Synchronicity DesignSync Central for use by software designers.

ENOVIA Synchronicity DesignSync Central enables individual design teams to release IP modules independently, while the integration of multiple modules can be managed at a higher level of abstraction. A single command can fetch an entire design hierarchy, and another can create an immutable release of the same hierarchy, eliminating inefficient and error prone manual integration procedures.

ENOVIA Synchronicity DesignSync Data Manager enables individual design teams to independently release IP modules, while the integration of multiple modules can be managed at a higher level of abstraction. A single command can fetch an entire design hierarchy, and another can create an immutable release of the same hierarchy. Inefficient and error prone manual integration procedures can be completely eliminated. Imagine what that would mean in practice at your company!

Extending the Infrastructure to the Enterprise

ENOVIA Synchronicity DesignSync Central provides capabilities to address a number of key business challenges specific to the semiconductor industry. Companies who deploy this product gain:

♦Competitive advantage through accelerated development and shortened time-to-market through the ability to create/link issues easily and other business objects to work in process design data stored in DesignSync.

♦Decreased development costs through reduced design cycles, shortened design cycle time and formalized best practices.

♦Improved collaboration by enabling team members across the enterprise to find and add their own data to overall product knowledge.

Chip development today is based on shorter lifecycles, more competitive environments, and less forgiving technology than ever before. And although product complexity and density continue to increase, average sales prices and margins continue to shrink. So, problems that increase the length or number of design cycles or mistakes that cause additional re-spins of a die can make the difference between profit and loss for a new product or even result in project cancellation.

Consider these facts from a recent industry study:

♦Only 45% of new product launches meet their original launch date

♦More than 60% of all semiconductor designs require at least one re-spin

♦Only 59% of semiconductor designs make it into production

♦More than 40% of development projects exceed the planned budget

♦Less than 60% of semiconductor projects hit their product cost targets

♦83% of issues identified during validation are design-related

Source: Kalypso Partners LLC, Semiconductor research 2006

Companies looking to be better than these industry norms and positively impact design cycle time need well-managed team collaboration, issue management, structured data sharing and tools to allow them to react to issues rapidly. Key to this is the ability to relate and track issues directly to design data, as well as any other relevant product content throughout the enterprise. All teams, not just engineering, must be able to get rapidly involved, because well-documented design decisions are essential in today's business environment, where audit traceability is mandatory.

Key Customer Benefits

ENOVIA Synchronicity DesignSync Data Manager is targeted at two process areas:
•Integrated Circuit Design (hardware) Data and Configuration Management
•Software Configuration Management

These two targeted business processes are critical for semiconductor companies to meet product design execution goals in an increasingly complex competitive global environment.

With ENOVIA Synchronicity DesignSync Data Manager, companies can:

•Connect and manage the entire design chain with a unified Design Data Management system

•Significantly boost design productivity for a rapid payback and strong ROI

•Maximize the ability to reuse existing designs and embedded software

•Manage design hierarchy as part of the design process

•Utilize an intuitive built-in Submit, Integrate, Test, and Release (SITaR) workflow

•Reduce time-to-market by increasing collaboration efficiency

•Win the first-to-market advantage

•Manage complex data types from a variety of EDA tool vendors

•Manage software projects using the Microsoft Visual Studio Plug-in

ENOVIA Synchronicity DesignSync Central is targeted at several critical process areas:

•Integrated Circuit Design (hardware) Data and Configuration Management

•Software Configuration Management

•Management of issues associated with hardware and software design

ENOVIA Synchronicity DesignSync Central allows companies to:

•Connect and manage the entire design chain with a unified DDM system

•Significantly boost design productivity for a rapid payback and strong return on investment (ROI)

•Maximize the ability to reuse existing designs and embedded software

•Manage design hierarchy as part of the design process

•Utilize the intuitive built-in Submit, Integrate, Test, and Release (SITaR) workflow

•Reduce time-to-market by increasing collaboration efficiency

•Win the first-to-market advantage

•Manage complex data types from a variety of EDA tool vendors

•Manage software projects using the Microsoft Visual Studio plug-in

•Associate issues directly to semiconductor design data for quicker resolution, avoiding schedule delays and cost overruns

• Provide accurate issue status to avoid uninformed management decisions

•Track all key issue management communications to avoid delays

•Provide traceability between design and issue management decisions by capturing on-line discussions that can be searched and audited

•Provide non-engineering inputs to the issue management process to more quickly reach a resolution and avoid project interruptions

•Ensure a standard, repeatable issue management process is implemented to obtain input from all cross-functional stakeholders and drive continuous improvement

•Provide data access controls to avoid financial and legal risks

ENOVIA Synchronicity ProjectSync (SYP)

ENOVIA Synchronicity ProjectSync is a Web-based project collaboration and management solution that enhances team productivity by enabling distributed team members to share ideas, bug reports and engineering change information. Managers can instantly see the state of the whole design and fully understand the open issues.

The creation of complex electronic products is not an easy proposition: design sizes are growing rapidly, while development cycles are shrinking; feature sizes are reduced, requiring many additional design and verification steps and iterations; and large teams spread across multiple cities, time zones and even companies are required to manage these projects. All of these factors increase the complexity of the development process and a single miscommunication can be costly, resulting in a huge loss in time and money.

ENOVIA Synchronicity ProjectSync meets these challenges with a project-based issue management and collaboration product tailored to enhance engineering productivity by boosting collaboration at each stage in the design process.

ENOVIA Synchronicity ProjectSync enables issues and other project collaboration information to be directly connected to design data vaulted in ENOVIA Synchronicity DesignSync Data Manager. Team members can browse the design data and easily create and connect defects to the exact versions of the design objects affected. Designer engineers are notified of issues that they are responsible for solving within the related design context and team members can easily continue communication via email while the thread of discussion is captured and stored as part of the design record. New versions of design objects that correct the defect are also connected to the defect and remain part of the history of the design.

Key Customer Benefits

ENOVIA Synchronicity ProjectSync is targeted at issue management and collaboration for project-based teams doing integrated circuit (IC) development and related software design.

With ENOVIA Synchronicity ProjectSync, companies can:

•Significantly boost design productivity for rapid payback and strong ROI
•Enable collaborative development of complex electronic products between geographically distributed teams
•Avoid costly mistakes with issue tracking and release management Provide accountability and traceability through audit trail
•Reduce time-to-market by increasing collaboration efficiency Win the first-to-market advantage

Remark

ENOVIA Synchronicity ProjectSync offers capabilities very similar to the collaboration capabilities of ENOVIA Synchronicity DesignSync Central, but with a very different technical architecture. ProjectSync is focused at project-based deployments, while DesignSync central is positioned at the enterprise-level. In some cases, installed base customers may prefer the architecture of ENOVIA Synchronicity ProjectSync and may need to continue using it with the current V6 release to avoid migration of their implementation, especially when there have been multiple customizations on a project-by-project basis. However, newer customers may benefit from ENOVIA Synchronicity DesignSync Central, instead.

ENOVIA Synchronicity DesignSync Add-On for CTS (SYC)

ENOVIA Synchronicity DesignSync Add-On for CTS (Custom Types System) provides design data management for commercial and customer proprietary EDA (Electronic Design Automation) tools beyond those supported by predefined DesignSync interfaces. The ENOVIA Synchronicity DesignSync Add-On for CTS extends ENOVIA Synchronicity DesignSync Data Manager and ENOVIA Synchronicity DesignSync Central.

The ENOVIA Synchronicity DesignSync Add-On for CTS is a programming interface used to customize ENOVIA Synchronicity products to enable data recognition and management of arbitrary EDA tool data structures. ENOVIA Synchronicity DesignSync Add-On for CTS allows you to customize ENOVIA Synchronicity products for use with your in-house design tools, or to integrate with other tools for which an ENOVIA Synchronicity DesignSync Add-On product is not available. Using the ENOVIA Synchronicity DesignSync Add-On for CTS, Custom Type Packages (CTPs) are developed which are registered with ENOVIA Synchronicity products to support the recognition and management of complex EDA data structures.

EDA Data Awareness

Data created and modified by EDA tools, such as a schematic diagram or physical layout, is typically not stored on disk as a single file. Rather, the data may be distributed over multiple files and/or directories. Such "complex" data structures pose a challenge for the deployment of a DDM system. For example, a given version of a schematic diagram might consist of a specific set of directories and files which must be managed as a "co-managed" set, also referred to as a "collection object." Without built-in EDA data awareness, one would have to navigate to the correct directory, and then individually check out each of the files which define the data view.

Collection objects may be organized in a larger data structure typically referred to as a "library." The data structure is often a well defined hierarchy of directories. For example, a Cadence DFII library directory contains subdirectories which represent "cells." In a standard cell library, a cell might be an "and" gate. Each cell directory can contain sub-directories, each of which represents a cell "view." Different views are different representations of the same cell. The "and" gate, for example, might contain views representing both a schematic diagram and a physical layout. The "view" directories representing a schematic or a layout each contain multiple files, for instance the aforementioned collections.

ENOVIA Synchronicity DesignSync Add-On for CTS allows users to define special object types and group files into abstract objects, such as a design view encompassing a number of files. Users can check in, check out, and tag this abstract object, called a collection, as a single object. The data is safeguarded by preventing users from checking in the constituent parts of a collection. Instead, users have to operate on the collection as a whole, because operations on collection objects are atomic.

The Custom Type System can also be used to define special object types (files or folders). For example, particular object types might need to be checked in together or listed in a special way. In effect, the Custom Type System is used to instruct ENOVIA Synchronicity products on the nature of the design data so that it can efficiently traverse the data hierarchy, performing revision control operations on special objects or collections of the data. The Custom Type System allows for the use of special icons within ENOVIA Synchronicity products.

The Custom Types System is used in both the ENOVIA Synchronicity DesignSync Add-On for DFII (Cadence integration) and the ENOVIA Synchronicity DesignSync Add-On for Milkyway (Synopsys integration). Special icons for these integrations can be seen in Figures 1 and 2. The Custom Types System can be used to integrate ENOVIA Synchronicity products with other EDA tools for which an integrated product is not available.

CTS Development

To model data, a Custom Type Package (CTP), a Tcl file containing procedures that recognize and traverse the custom data hierarchy, is created, yielding new object types and grouping the data into collections. The CTP is installed within the ENOVIA Synchronicity custom hierarchy. And the next time an ENOVIA Synchronicity product is invoked, the Custom Type System registers the CTP so that each revision control operation can now recognize and manage the special types and collections defined in the CTP.

Key Customer Benefits

ENOVIA Synchronicity products are targeted at two process areas:

- Integrated Circuit Design (Hardware) Data and Configuration Management
- Software Configuration Management

These two targeted business processes are critical in order for Semiconductor companies to meet product design execution goals in an increasingly complex competitive global environment.

The ENOVIA Synchronicity DesignSync Add-On for CTS provides a programming interface for the integration of ENOVIA Synchronicity products with any EDA design tool that stores data on disk as a complex data type.

With ENOVIA Synchronicity DesignSync Add-On for CTS, companies receive:

- The undisputed industry leader in the management of complex EDA design data
- A programming interface to customize ENOVIA Synchronicity products to recognize and manage complex data types generated by any EDA design tool

ENOVIA Synchronicity DesignSync Add-On for DFII (SYD)

ENOVIA Synchronicity DesignSync Add-On for DFII leverages ENOVIA Synchronicity to provide design data management for Cadence data, in either CDBA (Cadence® DataBase Access) or OpenAccess formats. It extends the design data management capabilities of both ENOVIA Synchronicity DesignSync Data Manager and ENOVIA Synchronicity DesignSync Central.

The ENOVIA Synchronicity DesignSync Add-On for DFII integrates ENOVIA Synchronicity DesignSync Data Manager and ENOVIA Synchronicity DesignSync Central with the Cadence DFII (Design Framework II) graphical IC (Integrated Circuit) design environment, recognizing and efficiently managing Cadence library design data. The Cadence DFII IC graphical design environment is modified with the addition of ENOVIA Synchronicity menus and commands. Designers are able to perform DDM (Design Data Management) operations such as check-in, checkout or tag, without leaving the familiar Cadence graphical environment, and without having to manage the actual collections of files and directories on disk which represent Cadence objects such as schematic diagrams.

EDA Data Awareness - Cadence Library Recognition

EDA data awareness is important because data created and modified by EDA (Electronic Design Automation) tools, such as a Cadence schematic diagram or physical layout, is typically not stored on disk as a single file. Rather, a design object such as a schematic diagram consists of a specific set of files. In order for a DDM system to maintain a version history of changes to the schematic diagram, this set of files must be managed as a group. The group of files is also referred to as a "co-managed" set, or "collection object." These collection objects are stored in a larger directory structure called a "library." A Cadence "library" consists of "cells," and a cell may contain multiple "views," which are models used for different purposes, such a schematic view, a layout view, etc.

The ENOVIA Synchronicity DesignSync Add-On for DFII recognizes Cadence DFII libraries on disk so as not to confuse them with ordinary directories and files. Collection objects are managed transparently to the end user. So, when a user issues a command to checkout a version of a schematic diagram, the appropriate versions of each of the member files of the collection object are checked out automatically. The member files of the collection are each individually version controlled, and a mapping is maintained between the version of the design object and the versions of the member files which constitute the version of the object. Storage of data in the DDM repository is efficient, because only member files of a collection which are modified in an edit operation are stored in the new version of the design object. And because the design object is managed as a "collection," the tool prevents direct modification to individual member files, which can result in the corruption of the object as a whole.

The User Interface

With the ENOVIA Synchronicity DesignSync Add-On for DFII, Cadence data recognition allows users to operate on familiar constructs such as libraries, cells, and views. ENOVIA Synchronicity menus are included in the Cadence graphical environment, and its commands appear in menus in the Cadence Library Manager tool. Commands are integrated in the Cadence environment using both the Cadence SKILL API, and the GDM (Generic Data Management) layer. Menus are added using the SKILL API, and AutoCheckout/AutoCheckin functionality is enabled through the GDM layer. Where appropriate, Synchronicity commands are overlaid in Cadence menus in the Library Manager tool.

In addition to being able to operate on libraries, cells and views, DDM operations may also be performed on a data "Category." For example, if a standard cell library has been categorized by types such as "FlipFlops," all of the "FlipFlops" could be checked out for edit in a single operation.

A unique capability is also provided to perform data management operations based on the "Hierarchy" of the design. Knowledge of a design is obtained by walking its instance hierarchy using Cadence SKILL functions. For example, a Cadence library may include ALU and MULTIPLIER design blocks. If the top level ALU schematic is fetched, a user might issue the "Synchronicity > Tag > Hierarchy" command, which would identify and tag each version of each instance of the lower level schematics. The level of hierarchical depth can be controlled. For example, a user might want to tag the hierarchy of a standard cell design, yet not descend into the transistor level representations of the standard cells themselves.

Once a hierarchy is tagged, it could be fetched into a new workspace. The result would be that one or more libraries could be fetched, creating valid Cadence library structures on disk, but the local libraries would only include the cells/views which constitute the ALU design hierarchy. This is an example of the capability to construct a workspace with a subset of the data contained Cadence libraries as stored in the DDM repository.

Some operations are more efficient if performed using the ENOVIA Synchronicity products rather than running the commands from within the Cadence environment. For example, when starting a new project, it is typical that multiple libraries are put under revision control. Due to the restriction within Cadence that one must select a library before performing any operations, checking in multiple libraries requires that each be checked in separately. If a project consists of 50 libraries, for example, this is a tedious operation at best. Using ENOVIA Synchronicity products, all 50 libraries can be checked in by running a single command.

Key Customer Benefits

ENOVIA Synchronicity DesignSync Data Manager and ENOVIA Synchronicity DesignSync Central are targeted at two process areas:

•Integrated Circuit Design (Hardware) Data and Configuration Management
•Software Configuration Management

These two targeted business processes are critical in order for Semiconductor companies to meet product design execution goals in an increasingly complex competitive global environment.

The ENOVIA Synchronicity DesignSync Add-On for DFII enables the management of Analog IC design data produced in Cadence's DFII graphical design environment.

ENOVIA Synchronicity DesignSync Add-On for DFII:
•Is the undisputed industry leader in the management of Cadence DFII design data
•Integrates into the Cadence DFII graphical design environment – designers work in the tools with which they are familiar
•Is aware of the unique structure of a Cadence data library
•Manages Cadence data, along with non-Cadence project data, letting users connect and manage the entire design chain with a unified Design Data Management system.

ENOVIA Synchronicity DesignSync Add-On for Milkyway (SYM)

ENOVIA Synchronicity DesignSync Add-On for Milkyway provides design data management for Synopsys Milkyway data. The ENOVIA Synchronicity DesignSync Add-On for Milkyway extends ENOVIA Synchronicity DesignSync Data Manager and ENOVIA Synchronicity DesignSync Central.

The ENOVIA Synchronicity DesignSync Add-On for Milkyway integrates ENOVIA Synchronicity products with the Synopsys Galaxy Design Platform. And the Synopsys Milkyway Database provides unified design data storage for Synopsys' Galaxy Design Platform.

The ENOVIA Synchronicity DesignSync Add-On for Milkyway modifies both ENOVIA Synchronicity products and design tools included in the Synopsys Galaxy Design Platform such as Astro™ and JupiterXT™:

•ENOVIA Synchronicity products are extended with the capability to recognize and efficiently manage Synopsys design data stored in a Milkyway database.

•The Synopsys Galaxy Design Platform is enhanced with the addition of Synchronicity menus and commands.

Designers are able to perform DDM (Design Data Management) operations such as check-in, checkout, or tag without leaving the familiar Synopsys design environment, and without having to manage the actual collections of files and directories on disk, which represent Synopsys design view types such as place and route abstracts (FRAM) or physical layouts (CEL).

Collaboration Enabled
Most importantly, the ENOVIA Synchronicity DesignSync Add-On for Milkyway allows companies to leverage the efforts of multiple designers on a single Milkyway database, eliminating the need to maintain multiple copies. Because physical design generates large amounts of data, the potential for disk savings alone is enormous.

The application of DDM in the Synopsys Galaxy Platform environment is complicated by the fact that the underlying Milkyway database, which is entirely binary, cannot be directly shared by multiple users. In addition to design data, it includes user-specific information, complicated technology information, and reference library dependencies. Only the ENOVIA Synchronicity DesignSync Add-On for Milkyway supports an environment in which multiple users working in individual workspaces can collaborate on a single Milkyway database stored in the DDM repository. Synopsys API functions are utilized to construct local user workspaces in a manner in which design objects, technology information and reference library pointers can be revision controlled as a project evolves. The Milkyway database can be tagged at important milestones, facilitating data handoffs and eliminating the need to make copies of the database in order to revert to a previous state.

EDA Data Awareness - Synopsys Library Recognition
EDA data awareness is important because data created and modified by EDA (Electronic Design Automation) tools, such as the Synopsys Astro place and route tool, is not stored on disk as a single file. Rather, a design object, such as an Astro layout, consists of a specific set of files. In order for a DDM system to maintain a version history of changes to layout, this set of files must be managed as a group. The group of files is also referred to as a “co-managed” set, or “collection object.” These collection objects are stored in a larger directory structure called a “library.” A Synopsys “library” consists of “view types,” such as a place, and route abstracts (FRAM) or a layout (CEL), each of which can represent multiple design objects. A binary “catalog” file is included as well, and the set of all the directories and files which represent the library are collectively referred to as the Milkyway database.

The ENOVIA Synchronicity DesignSync Add-On for Milkyway extends ENOVIA Synchronicity products with the capability to recognize Synopsys Milkyway libraries on disk, so as not to confuse them with ordinary directories and files. Collection objects are managed transparently to the end user, and a local binary catalog file is maintained so that a valid Milkyway data structure exists in the workspace. When a user issues a command to checkout a version of a layout, the catalog is updated, and the appropriate versions of each of the member files of the collection object are checked out automatically. The member files of the collection are each individually version controlled, and a mapping is maintained between the version of the design object and the versions of the member files which constitute the version of the object. Storage of data in the DDM repository is efficient, because only member files of a collection which are modified in an edit operation are stored in the new version of the design object. And because the design object is managed as a “collection,” the tool prevents direct modification to individual member files, which can result in the corruption of the object as a whole.

When ENOVIA Synchronicity products are enabled with the ENOVIA Synchronicity DesignSync Add-On for Milkyway, Synopsys data recognition becomes evident. Users operate on familiar constructs such as libraries, view types and cell views.

Support for Tagging Methodologies

Every engineer has stories of bad files overwriting good files, and of the taped-out configuration being lost during the test run. But support for tagging the Milkyway database at various milestones allows users to take snapshots of known good configurations to safeguard against such occurrences. Libraries or individual cells may be tagged. Tagging is especially useful for data handoffs, making it easy for the recipient to know which version of a cell or library to fetch.

The ability to tag libraries at various stages of development also alleviates the need to make copies of the entire library to retain these stages. Because Synopsys libraries can become extremely large, the ability to tag various versions of a library instead of copying the library can result in enormous disk space savings.

The User Interface

ENOVIA Synchronicity menus are included in the Synopsys Galaxy Platform environment's "Cell Checkout" and "Library Tag" forms. The "Export Library Information" form enables users to extract technology or reference library information from the binary database into ASCII files that can be modified. Changes can then be "Imported" back into the binary database, and a revision history is maintained.

Key Customer Benefits

ENOVIA Synchronicity products are targeted at two process areas:

- Integrated Circuit Design (Hardware) Data and Configuration Management
- Software Configuration Management

These two targeted business processes are critical in order for Semiconductor companies to meet product design execution goals in an increasingly complex competitive global environment.

The ENOVIA Synchronicity DesignSync Add-On for Milkyway enables the use of ENOVIA Synchronicity products for managing the Digital IC design data produced in the Synopsys Galaxy Platform design environment.

ENOVIA Synchronicity DesignSync Add-On for Milkyway:

Is the undisputed industry leader in the management of Synopsys Milkyway design data

Integrates into the Synopsys Galaxy Platform design environment – allowing designers to work in the tools with which they are familiar

Isaware of the unique structure of a Milkyway database

Manages Milkyway data, along with non-Milkyway project data, letting companies connect and manage the entire design chain with a unified Design Data Management system

ENOVIA Synchronicity DesignSync Central (SNC)

ENOVIA Synchronicity DesignSync Central includes ENOVIA Synchronicity DesignSync Data Manager and establishes the link with ENOVIA Live Collaboration, which is the platform on which several products can be added to support most of the PLM Collaborative Business Processes adapted to the Industry.

ENOVIA Synchronicity products can be deployed as the foundation for a semiconductor company's PLM strategy. When used in conjunction with ENOVIA Live Collaboration (CPF) and through the ENOVIA Semiconductor Accelerator solutions, semiconductor design data is available to product development processes, including issue management, project management, IP management and operations bill-of-material (BOM) management.

•ENOVIA Semiconductor Accelerator for IP Management (SIS)
•ENOVIA Semiconductor Accelerator for Enterprise Project Management (SPS)
•ENOVIA Semiconductor Accelerator for Design to Manufacture (SDS)

In addition to ENOVIA Live Collaboration, several other Business Processes can be covered and open up the possibility of PLM 2.0 by offering:

Global Collaborative Innovation - The future of PLM is about allowing the breadth and depth of collaboration. Everyone, regardless of location or status, can collaborate across business processes — from the lowest level of details across all engineering disciplines to the full product definition, bringing together Requirements, Functional, Logical and Physical (RFLP) Definitions of the product.

Online Creation and Collaboration - Product creation and collaboration is enabled for real time, concurrent work across multiple remote locations with only a Web connection. This capability is a major breakthrough for any company implementing a global engineering and manufacturing strategy.

A single platform for Intellectual Property (IP) Management - On a single platform, V6 supports both IP modeling applications spanning all engineering disciplines, as well as collaborative business processes (CBP) covering the entire product lifecycle:

CATIA / DELMIA / ENOVIA / SIMULIA applications are built natively on this single, open SOA platform.
Data management is supported for most mechanical, electrical and artwork CAD tools.
V6 gives a unified, federated view and access to Intellectual Property, whether the information is in the PLM system, another enterprise system or from an unstructured data source.

Ready to Use PLM Business Processes - ENOVIA V6 covers PLM processes across multiple industries, and unifies engineering processes and all enterprise business processes including program management, compliance management and sourcing, as examples. The ENOVIA solution “speaks the customer’s language,” by providing the best practices and capabilities specific to these industries: Aerospace and Defense, Consumer Packaged Goods, Automotive, Footwear and Apparel, Industrial Equipment, Life Sciences, High Technology and Semiconductor. ENOVIA V6 Industry Accelerators speed deployment and cut time to Return on Investment (ROI).

A Lifelike Experience - V6 provides all of the above with an intuitive interface critical to a fully immersive product experience. A common interface, across all applications, brings IP to life in 3D. Any user can find/search information, understand others using the universal language of 3D, experience the product and collaborate in an immersive online 3D environment.

Lower Total Cost of Ownership (TCO) – Breakthrough ROI - The flexible SOA architecture allows easy integration with existing systems, and modeling of business process with no programming skills, supporting an adaptable business model. Industry-specific solutions capture the value within each industry and provide the best and most tailored path to PLM. This will spur the adoption and evolution towards complete PLM strategies, and lead to breakthrough ROI.

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