Practical Application of Service Oriented Architecture

Teamcenter SOA
Steve Chesney,
Siemens PLM Software
Teamcenter Architecture Vision

• The Siemens vision is to create the industry leading comprehensive Product Lifecycle Management platform using a Service Oriented Architecture (SOA)
  • Significant benefit to our customers is gained by tight collaboration among related data within the same technology stack
  • Lower cost of ownership
  • Leverages broad range of common core functionality among many business domains
  • Allows customers, partners and third parties to safely and easily extend the Teamcenter platform using industry standard web service and import/export technologies
Platform Services Scope

- Teamcenter offers all services to authoring applications and downstream data consumers through a Service Oriented Architecture (SOA)
  - Single repository for heterogeneous data (design and manufacturing engineering: requirements, schedules, changes, designs, analyses, manufacturing process plans, …)
  - Model-driven common object, relation and action definitions and codeless modifications
  - Protection of intellectual property
  - Data versioning
  - Configuration management with options and variants
  - Workflow for review and approval process
  - Formal Change Control for regulated industries
  - Geographic distribution of clients and databases for both tight (“follow the sun”) and loose (“supplier integration”) models
Platform

SOA
Common Data Model
Model Driven Extensibility
Third Party Extensible
Service Oriented Architecture

- Clients use coarse grained interfaces and an abstracted information model designed to be independent from the internal server workings
  - This allows for better behavior over high-latency networks and independence between client and server software
  - Clients are upwardly compatible across Teamcenter versions
- Proven technology
  - Introduced in Teamcenter 2005
  - Current releases contain a comprehensive set of out of the box (OOTB) platform and application services
- WAN Friendly
  - SOA brings technology and capabilities to Teamcenter that enable deployment of high performance, scalable and Wide Area Network (WAN) friendly services
Teamcenter SOA Value Add

• SOA is the first step in providing a single set of services across all clients, all technology stacks
  • Not built on a specific platform -- may be used to create a loosely-coupled integration between Teamcenter and applications on a variety of technical stacks
  • Teamcenter services are accessible through a set of with C++, C# (.NET), and Java language-specific libraries that make it easy to add Teamcenter functionality into new and existing applications
    – WS-I compliant Web Services Definition Language (WSDL) and (soon) JSON bindings also provided to help integrate with almost any technology
  • Teamcenter SOA is focused on core infrastructure support for any size deployment as well as high performance to support large, widely-distributed deployments
Comprehensive Approach for Both Desktop and Server to Server Integrations

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Common Data Model

- Teamcenter architecture defines a common data model for the persistence and manipulation of information
  - All Teamcenter applications and extensions interpret the information in a consistent and compatible way
  - Based on prevailing and well-accepted industry standards to promote the ability to exchange and share information
Common Data Model Benefits

- Customer benefits in the ability to relate data across domains involved with different phases of the product development lifecycle
  - The data model directly captures natural relationships between objects from different applications
  - For example, within Teamcenter it is easy to link original requirements to specific product designs and then to manufacturing processes
Common Data Model Benefits

The Teamcenter data model can be easily extended to meet the specific needs of different application domains:

- Extensions are object-oriented – supporting inheritance of both properties and behaviors.
- Custom extensions are compatible across different versions of the platform as well as interoperable among other otherwise unrelated extensions.
Model Driven Extensibility

Teamcenter provides a rich set of functionality and capabilities that address the entire lifecycle of product development

- Standard capabilities may be tailored and extended to meet the needs of specific industries and customer operations
- Extensions include: local modifications to the common data model, behaviors, business rules, processes and user interface
Model Driven Definition

- Just as the definition and implementation of services are logically separated in the Services Oriented Architecture, so are the definition (model) and implementation (schema) of the data model and object behavior
  - The paradigm of “Model-Driven Architecture” (MDA) is encapsulated in the Business Modeler Integrated Development Environment (BMIDE) tool
  - Specifications are human readable and easily viewed and changed by GUI manipulation of industry-standard Unified Modeling Language (UML) diagrams
Benefits of Model Driven Definition

• The Business Modeler IDE allows a non-programmer to
  • Make extensions using an intuitive easy-to-use graphic user interface (GUI)
  • Enter and test specifications for changes to data model and behavior
  • Prepare install packages for extensions
Benefits of Model Driven Definition

• Many changes can be developed, entered and deployed from this environment without changing or writing source code in any language
  • Specifications are captured and managed by the IDE which generates C++ source code and RDBMS schema definition language. These products are automatically packaged for later installation and distribution
  • Some behavior changes will be very complex or need to interface with proprietary systems or data stores. In those cases it will be necessary to write source code in the C++ language to be linked to Teamcenter processes. Even this process is supported in a model-driven way by the generation of templates and packaging within which the custom-written pieces may be embedded.
Teamcenter Platform and Third Parties

- SOA, Model-Driven Extensibility allows Teamcenter Partners, Third Parties and Customers to independently and safely extend the Teamcenter Platform itself
  - Common Data Model and Behavior easily extended by non-programmers to new domains which can be related naturally to other domains using the Model-Driven Architecture embodied in the BMIDE tool
  - New Clients and Back Office Application Integrations based on Teamcenter SOA interfaces with global deployability
  - Extensions can be shared and combined in any combination: COTS Teamcenter, Siemens PLM Software Industry Solutions, Third Party Extensions, Customer-private Extensions
  - Investment in extensions are preserved across releases
Extensibility
Enabling Technologies

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BMIDE
SOA
PLMXML
Excel Import
Global Services
Business Modeler IDE

BMIDE unifies all aspects of both codeless & coded extensions

Business Analyst Friendly
- UML based
- Focus on usability

Configuration Management
- File based
- Uses standard SCM products

UML Editor

Naming Rules

Template Synchronization
Supports Business Extension Development Cycle

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- **Analyze & Design**
- **Develop**
- **Integrate**
- **Test**
- **Deploy To Production Environment**
- **Requirements**
Enhanced Deployment Tools
Supporting Development Cycle
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Supports deployment to any Teamcenter installation from a single point – BMIDE

Business Analysts defines business models, behaviors, and extensions for template test deployment

- After testing the same template can be deployed to Integration, Training, and Distributed Production Environments
SOA Framework

Custom Clients  New Application Interfaces  COTS Clients (Rich and Thin)

.Net client library  C++ client library  J2SE/J2EE client library  (Soon) JSON Services  WS-I Compliant Web Services

Value add: FMS access, SSO support, Data Validation, Localization, Metrics

TC SOA infrastructure

Service implementations

TC Core business logic

Database  File volumes  FMS
BMIDE SOA Definition / Extensions

Services defined in BMIDE
- Siemens uses for development
- Customers use for extensions
- Partners uses it for extensions and embedded integrations

Services can be published or unpublished
- Published services go through a deprecation policy
Teamcenter Services

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Foundation Services

- System
  - Login
  - Preferences
- Data Management
  - Create Item
  - Get Home Folder
- File Management
  - Get read/write security tickets
  - Commit file
- Identity and Rights Management
  - Get access rights
- Reservation
  - Check in/out
- Query

Application Services

- Product Structure
  - Create BOM Session
  - Close BOM Session
  - Show single level BOM

Application Integration

- Check License
- Show Related Objects
- Create / Update Parts
- Show folder contents
- Show related objects
- Attribute Mapping
PLM XML Import / Export

Open model for document-based data exchange
- Any transport medium that can exchange files can use PLM XML as payload: email, MQSeries, etc.

Provides flexibility for a rapidly changing environment
- Allows us to track application data model development
- Separation of application internal data model from the external view.
- Support for data model extensions

Simple mapping to other data models
- Enables us to map to standards-of-choice

Supported by a C++ and Java toolkits
Solves “N² Problem”
What data does PLM XML represent?

- Product structure
- Geometry (by reference)
- Geometry-related data
- Manufacturing Data
- Workflow
- Ownership
- Person/Organisation
- More…
**Excel Import Utilities**

- Teamcenter includes domain-specific excel-based import utilities which can be leveraged in specific migrations
  - Not general purpose, limited flexibility
  - Product Structure, Requirements and other domains represented
  - May be easier than other techniques if migration requirements are simple and performance requirements are modest
  - Also support end user use cases including “live update” of DB from Excel
• Global Services is an extension to Teamcenter that allows multiple semi-autonomous Teamcenter and/or non-Teamcenter data sources to share information
  • Supports a set of independent sites which are self sufficient, yet cooperate with each other
  • Each site has its own resources: data model, sets of users and groups
  • Each site has its own business rules: access controls, release procedures, workflow, change management practices, and other extensions
Global Services (GS) Platform

- Global Services Multi-Site is an extension to Teamcenter that allows multiple semi-autonomous Teamcenter sites to share information with each other.
- Built on industry standards such as SOA, J2EE, BPEL, JCA connectors, Web Services, JMS/MQSeries.
- Contains specific components to address many use cases:
  - Teamcenter to Teamcenter
  - Teamcenter Enterprise to Teamcenter
  - Teamcenter Briefcase (between OEM and suppliers Tc systems)
  - Teamcenter to 3rd Party Server
Client Deployment

Value Add to SOA for “Rich” Clients
Teamcenter Client Communications Service (TCCS) takes the place of the Web Browser for managing “rich” client secure SOA communications

- Centralized configuration for client to server connections
- Single endpoint on client machine

Better support for Teamcenter servers deployed behind forward and reverse proxies (support for forms and 401-based authentication)

- Support for Kerberos based authentication and (soon) “Smart Cards”
- Support for “Applet Free” Single Sign On in Rich and SOA Client Integrations
- Credential and session context sharing
- Reuse and single challenge across multiple clients
Teamcenter Communications Service (TCCS)
Forward and Reverse Proxy Support

Teamcenter Communications Service (TCCS)

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Teamcenter 9.1

• Teamcenter rich clients and CAD integrations can be deployed in a secure environment using forward and reverse proxies
• Teamcenter resources remain safe behind firewalls
• Prevent direct access to Teamcenter servers from outside the network
• Allow 3rd party access to your Teamcenter installation while maintaining network security
• Teamcenter thin client already supports proxies using web browser features
Integrator Toolkit

It’s more than Technology
Extensibility is more than “just APIs”

• A successful integration depends on
  • A superior unified and extensible platform
  • Reliable Support Policies
  • A support and consulting organization capability
Server API Support Policies

- Siemens provides detailed SOA and API documentation for
  - A set of published C++ classes and methods
  - A set of published ITK functions (ITK Function Reference Manual)
  - Rich Client Java classes and methods
  - Thin Client Teamcenter Script (NEW in Teamcenter 8)
- At each major release Siemens will add new API functionality by
  - adding
  - modifying
  - publishing previously private API
  - identifying existing API to be deprecated or removed
- Incident and Problem Reports can be filed for published SOA and API
Server API Support Policies

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- Siemens PLM Software provides warnings and messages regarding future deprecation or retirement of published functionality
  - These warnings are documented in the Release Bulletin and API Reference Manuals
  - The warnings are summarized in the Release Notes

- Deprecated functions are supported for a minimum of two full releases prior to removal or modification of the code
  - Example: announce in Teamcenter 9, remove in 11
  - Example: announce in Teamcenter 9.1, remove in 12
• **Guide to Teamcenter Services** defines the published set of Teamcenter’s service oriented architecture interfaces
  - C++, Java, .NET and WSDL client bindings

• Customization using the documented procedures will be supported

• Most SOA interfaces are published and versioned
Deprecation Policy

Siemens is committed to maintaining compatibility between Teamcenter product releases.
- Those who customize functions and methods using published APIs are assured that the next successive release will honor these interfaces.

In general, it is not Siemens’ intention to change the behavior of published interfaces. On occasion, it may become necessary to make behaviors more usable or to provide better integrity. Siemens’ policy is to notify customers two releases prior to the one that contains a published interface behavior change or removal.
- When a notification is not possible, and a published interface behavior change might affect customizations, Siemens’ policy is to provide this information in the documentation for that release.

Siemens documents known changes in the release notes or the upgrade procedure section of the Teamcenter product Release Bulletin.
- If a published interface in a new release is called and customizations will not build, or if they behave unacceptably, an IR should be reported to GTAC.
Support Organizations

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• **World Wide Customer Support (GTAC)**
  • “Hot Line” and Incident Reporting infrastructure
  • Backup from Development Organization

• **World Wide Consulting Organization (GSS)**
  • Available for specific projects: migration, extension
  • Supported by toolkits, best practices and methodologies