THINK BIG
GO BIG

System Performance and Security Update

System Performance and Security Updates

David Howe, Fellow Infrastructure Architect

Agenda

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- System Performance Update
- Security Review and Update

System Performance Update

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SQL Server

Oracle

Basic Performance Advice

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- Check the Teamcenter Deployment guide for each version and look for latest SFBs
- New “Best Practices for Running Siemens Teamcenter on SQL Server” guide
- Any database needs:
  - Fast CPUs – queries are single threaded
  - Memory – the size depends on the database size not the number of users
  - Fast IO – a lot of activity is on disk if its slow then the system is slow
  - Power Management – Ensure lower latency response
    - Set OS and Hypervisor power manager to performance
    - BIOS
      - Ensure all processor C-states are disabled
      - Set power management to OS controlled or equivalent setting
    - On a VM right size vCPU, too many slow the system down
- If you have performance issue trying increasing memory. Databases grow and their memory requirements grow with them

Managing Fragmentation

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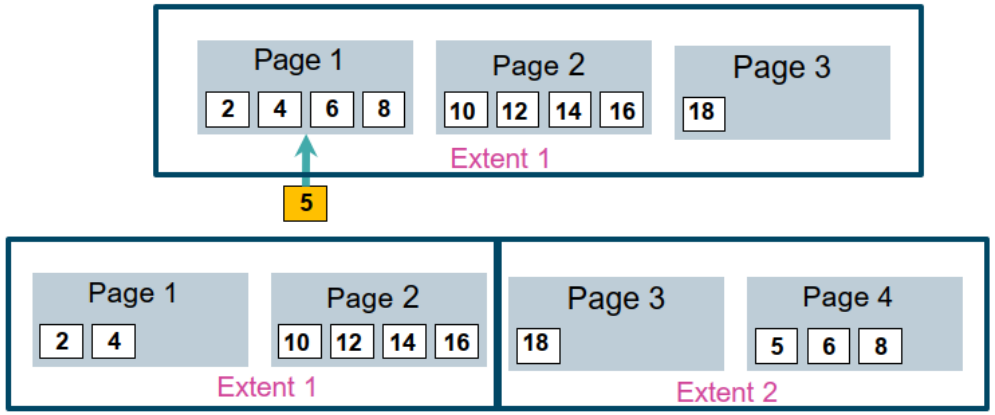
SQL Server

- Sensitive to fragmented indexes
- Use Ola Hallengren's index maintenance scripts or similar to choose between reorganization and rebuild.
  - Run nightly
  - Using the following priority list if you are using SQL Server Enterprise
    INDEX_REORGANIZE,INDEX_REBUILD_ONLINE,INDEX_REBUILD_OFFLINE
- Set index FillFactor to 20% for the POM_M_LOCK, POM_R_LOCK, PPOM_SESSION, POM_F_LOCK, POM_LOCK, POM_LOCK_LOGGING, PM_PROCESS_LIST tables to reduce fragmentation



Page split caused by insertion of data

Oracle and SQL Server Deadlocks

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Oracle

- If you find dead locks report them to GTAC. Check Alert logs for error messages and dead lock details

SQL Server

- If you see “you have been selected as a dead lock victim” messages in tcserver syslogs and have performance issues it is time to enable “Read committed snapshot Isolation” (SFB-Teamcenter-6464)
- This usually becomes an issue as the number of interactive users grow.

A Common Cause:

Laptops running 2-Tier where the User ejects the Laptop. from a docking port while performing a Teamcenter Action. This causes the communication to Oracle to “stop”. On Oracle, set “EXPIRE_TIME” to allow Oracle to detect the dead connection.

Oracle and SQL Server Managing Temp

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Oracle

- Keep Temp data file on fast disk.

SQL Server

- Follow the best practice guide and define any tempdb as CPU
- Keep tempdb's on fast disk
- The performance of Temp is critical to the overall database performance

SQL Server TEMPDB

- AUTO_UPDATE_STATISTICS=OFF
- AUTO_UPDATE_STATISTICS_ASYNC=OFF
- Async update = 1 for big databases only
- If you have a large database consider TF 2371 – this will trigger more frequent updates. It is not required compatibility level is 130 or higher.

SQL Server:
Problems with Tempdb size (ghost records)

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SQL Server Only

When there are a large number of users, performance drops and you have "Read Committed Snapshot Isolation" (RCSI) enabled, check the size and contents of tempdb.

RCSI keeps table/index versions in tempdb while a transaction open

Simple SELECT starts a transaction which results in versioning until it is closed.

On a long running process such as ODS, IDSM, Dispatcher, T4* an open transaction may last days

At one customer IDSM held over 100GB of data in tempd

11.2 and above changes to pom_m_lock usage increases the number of ghost records

SQL Server
Problems with Tempdb size (ghost records)

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Managing the issue

- At TC 11.2.3 and above TC_MSSQL_SELECT_AUTOCOMMIT=True
- TC 11.2.1 and earlier
- Monitor tempdb size
- Monitor processes and restart or disconnect any process running for more than two days

General Management

- Set the index FillFactor to 20% for the POM_M_LOCK, POM_R_LOCK, PPOM_SESSION, POM_F_LOCK, POM_LOCK, POM_LOCK_LOGGING, PM_PROCESS_LIST tables
- Maintaining the session related table indexes at least twice a day or more frequently if using SQL Server Enterprise. Session Tables are those above plus POM_TIMESTAMP
- Use scripts from Ola Hallengren or similar of maintain index optimisation nightly

SQL Server: Managing the plan cache

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In the latest versions of Teamcenter many queries are single use.
This fills the plan cache with many query plans that are not reused.

When the cache is full new queries are not cached, which means every use of a queries requires re-parsing. This additional parsing causes increased CPU load

Setting the option

- optimize_for_adhoc_workloads = 1

SQL Server will only cache a query plan on it second use

SQL Server: MAX DOP

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MAXDOP = Maximum Degree of Parallel

The default of 0 can cause performance issues and high CPU
Setting to 1 in general is a good solution but it stops some cases that would benefit.

A good compromise

Set

- MAXDOP = 4 – now a maximum of 4 parallel process can be run
- cost threshold to 50 – Setting a high threshold from

This allows queries that will benefit from parallel to use it.

Poor Performance after upgrading to SQL Server 2014/2016

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SQL Server 2014 introduced a new Cardinality Estimator (CE) which can cause Teamcenter problems

- If the SQL Server installation is upgraded to 2014 or 2016 the database compatibility is kept the previous level and you should not see an issue
- If the SQL Server is a new install of 2015 or 2016 and a database is imported the compatibility is at the new level

If the system experiences performance issues you can:

- Revert to the old CE which keeps the new optimizer functions

```
ALTER DATABASE
   SCOPED CONFIGURATION
       SET LEGACY_CARDINALITY_ESTIMATION = ON;
go
```

- Or revert to the old optimizer if there is still performance issue after switching to the old CE.

```
ALTER DATABASE <yourDatabase>
    SET COMPATIBILITY_LEVEL = 110;
go
```

Poor Performance Oracle 12.1 or higher

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The new Oracle 12 optimizer can cause issue, particularly when using Oracle Real Application Clusters.

If you have performance issues set

- **OPTIMIZER_ADAPTIVE_FEATURES=false**
- **or OPTIMIZER_ADAPTIVE_PLANS=false in 12.2**

With 12 we suggest a new faster dbms stats command

```
execute dbms_stats.gather_schema_stats(ownname=>'%s', estimate_percent=>100,
method_opt=>'FOR ALL COLUMNS SIZE AUTO',
degree=>DBMS_STATS.AUTO_DEGREE,
cascade=>true, no_invalidate=>FALSE);
```

Oracle/Linux HugePages

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Linux

- HugePages is a feature integrated into the Linux kernel 2.6. Enabling HugePages makes it possible for the operating system to support memory pages greater than the default (usually 4 KB). Using very large page sizes can improve system performance by reducing the amount of system resources required to access page table entries. HugePages is useful for both 32-bit and 64-bit configurations. HugePage sizes vary from 2 MB to 256 MB, depending on the kernel version and the hardware architecture. For Oracle Databases, using HugePages reduces the operating system maintenance of page states, and increases Translation Lookaside Buffer (TLB) hit ratio.

https://docs.oracle.com/database/121/UNXAR/appi_vlm.htm#UNXAR391

Oracle/Windows LargePages

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Windows

- Large page is a feature that provides a performance boost for memory-intensive database instances running on Windows Server. By taking advantage of newly introduced operating system support, Oracle Database can now make more efficient use of processor memory addressing resources. Specifically, when large page support is enabled, the CPUs in the system access the Oracle Database buffers in RAM more quickly. Instead of addressing the buffers in 4KB increments, the CPUs are told to use 2 MB page sizes in Physical Address Extension (PAE) mode and 4MB page sizes in non-PAE mode when addressing the database buffers.

https://docs.oracle.com/en/database/oracle/oracle-database/12.2/ntqrf/overview-of-large-page-support.html#GUID-2D68244B-7223-482A-BE5D-E410ABDB674C

Oracle/Solaris LargePages

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Solaris

- 8 KB is the default page size on Solaris 10 and 11
- both hardware and software must have support for 2 GB large pages
- SPARC T4 hardware is capable of supporting 2 GB pages
- Solaris 11 kernel has in-built support for 2 GB pages
- Solaris 10 has no default support for 2 GB pages

Add the following line to /etc/system and reboot

- set max_uheap_lpsize=0x80000000

Finally check the output of the following command when the system is back online

- pagesize –a

https://blogs.oracle.com/solaris/enabling-2-gb-large-pages-on-solaris-10-v2

Agenda

Teamcenter Security Approach

What's Different in the Cloud

Four 'A's of Security:

- Authentication
- Authorization
- Audit
- Asset Protection

Introduction

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Planning for Security
- On-Premise
- Cloud

- **What You Will Find is that *Securing for a Cloud Deployment* has the Same Approach as Securing an On-Premise Deployment**
  - Some Implementation Details Differ

- Customers Often Find that the Security for their Cloud Deployment ***Improves*** their Deployment Security
  - Current On-Premise Security is Typically Lacking
  - They Take a Close Look at Security When Going to Cloud

What This Presentation Is

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- **An overview of planning for Security – On-Premise or Cloud**
  - A Guide To What to Look At
  - Not a Comprehensive Checklist
- **What's new in Teamcenter Security**
  - New features in Teamcenter 11.5, 11.6 and 12.1 and Active Workspace 4.0/4.1
- **Not a "How-To"**
  - I Don't Explain how to Encrypt Data (for example)

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Teamcenter Security Approach

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Teamcenter Security Approach

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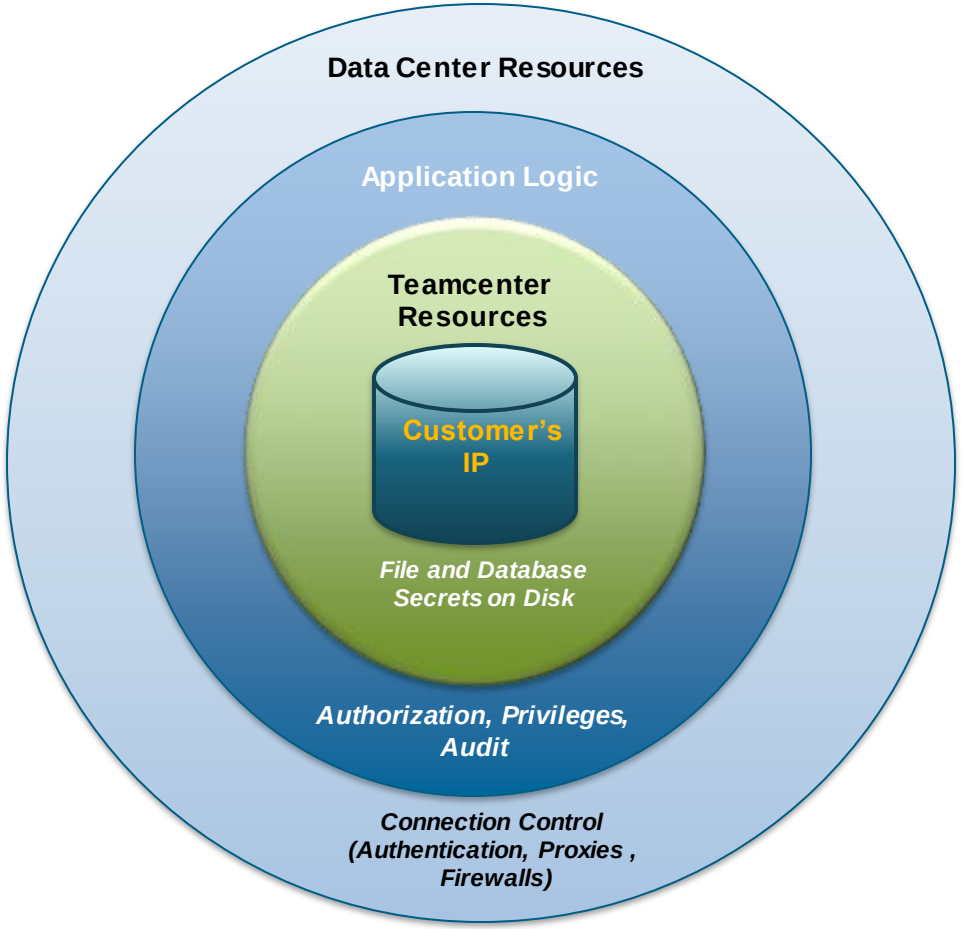
Teamcenter Customers Require a Globally Secure Environment to Share Safely Intellectual Property (IP) with Employees, Suppliers, and Customers

Three "**Rings of Defense**" .. in Teamcenter Protect Customer's Intellectual Property (IP)



Siemens PLM and Our Customers Each Play a Part in Each "Ring"

Teamcenter Security Capabilities – Four “A”s

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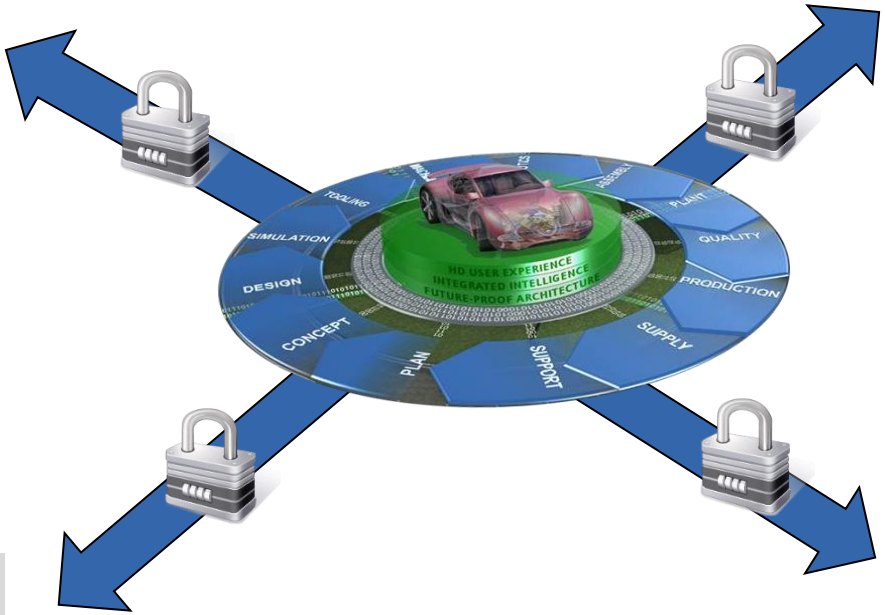
Authentication

- Teamcenter Security Services
  - LDAP support
  - Single-Sign-On (SSO)
  - Multifactor Authentication
- Kerberos
- RSA



Authorization

- Access Manager
  - Workflow ACLs
  - Program Security
  - Project Security
  - Group / Status
- Authorized Data Access
  - ITAR
  - IP
- Non-Rule Tree
  - Style sheets (Read only)
  - BMIDE Conditions
  - BMIDE GRM Restrictions
  - Preferences

Audit

- Audit Manager
  - Workflows
  - CICO
  - Organization
  - IP Object Events
- Application logs

Asset protection

- Architecture
  - Four tier
  - MultiSite
- Infrastructure
  - Forward/Reverse proxy
  - Firewalls (zone-based)

Teamcenter Security – Protecting the Data

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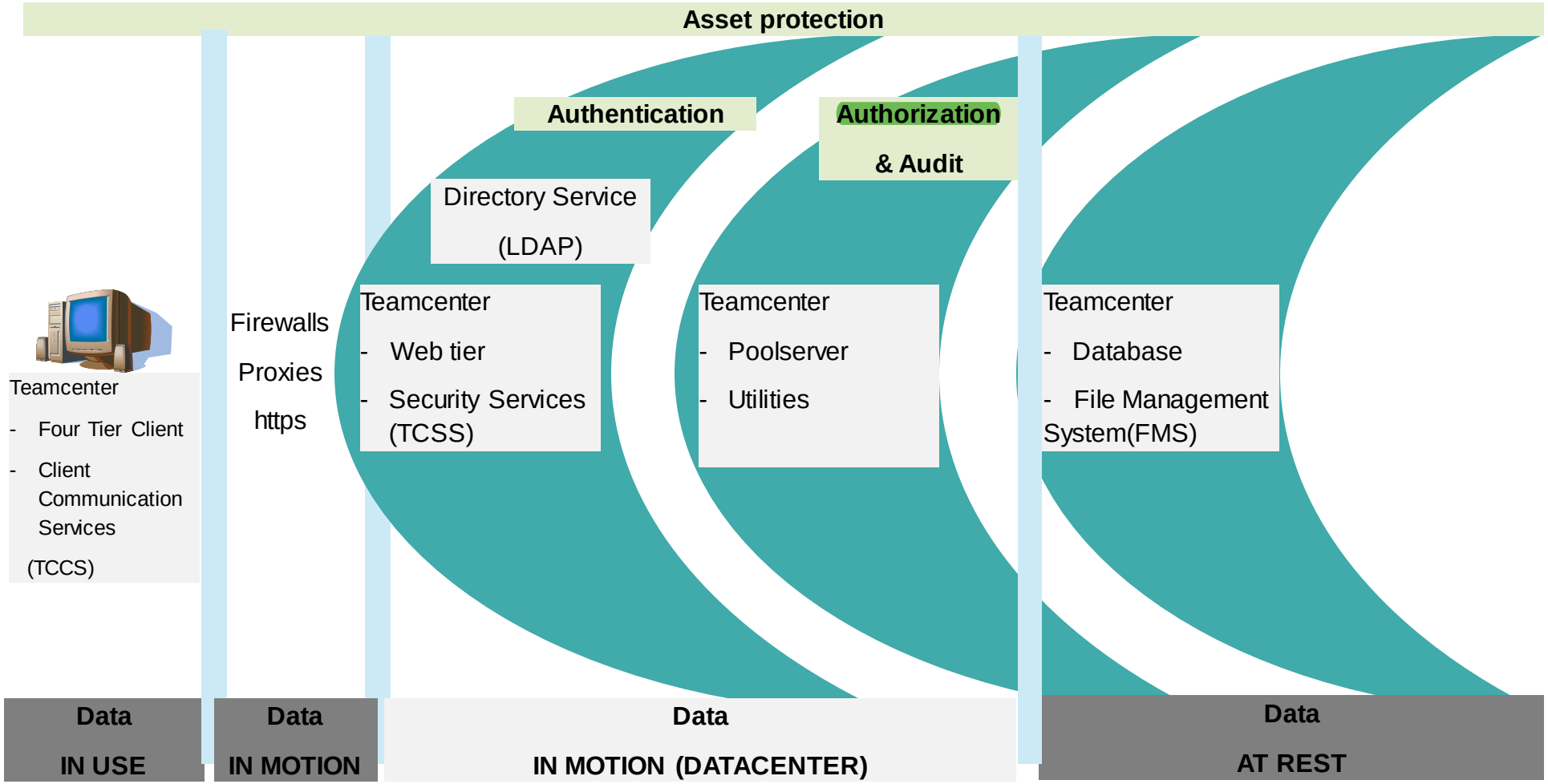

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Teamcenter Security Approach

What's Different in the Cloud

Four 'A's of Security:

--Authentication

--Authorization

--Audit

--Asset Protection

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Teamcenter Security Approach

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Two Keys for Security in the Cloud

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Encryption

- All Data Should be Encrypted, *Where Possible*
  - At Rest
    - Database
    - Files in Volumes and Caches
    - Logs?
  - In Motion
    - Network Traffic
      - Within Datacenter?
      - To / From Datacenter
  - In Use
    - Clients: Not a Cloud Thing

Defense in depth

- Use multiple layers of protection for data
  - Firewall
  - Proxy Servers
  - Virtual Private Cloud

What's Different About the Cloud

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- **Authentication**
  - Integration with Corporate Authentication System
    - Which is Still On-Premise
  - Cloud-Based Authentication: AzureAD?

- **Authorization**
  - 3rd Party Managed System
  - *Export Control Compliance*

- **Audit**
  - Who is Doing What?

- **Asset Protection**
  - Where are Servers and Data? *In Cloud Provider's Physical Locations*
  - Network
    - Connection(s) to Datacenter
    - Data Travel Paths

Who's Running The Deployment

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- **The Customer Is**
  - Does The Customer Have a Dedicated Cloud Group in IT?
    - Should Have Standards and Processes for Enterprise Applications *in the Cloud*
      - Already Has Them for On-Premise

- **3rd Party**
  - "Software as a Service" (SaaS)

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Teamcenter Security Approach

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Teamcenter Security Approach

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Teamcenter Security - Authentication

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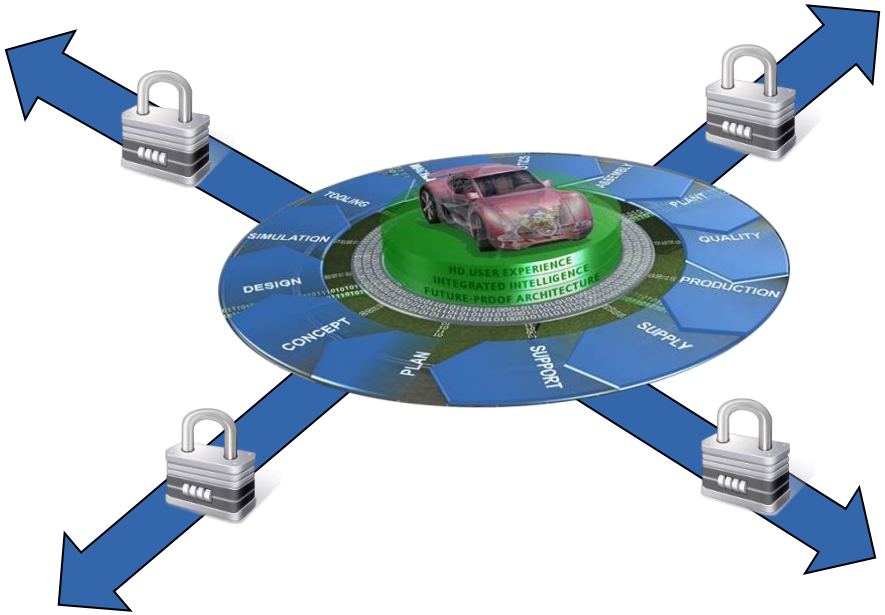

- **Features**
  - User/Password definition and policy management
  - Integration with LDAP/Active Directory
  - Single Sign On (SSO)
  - Client container process as single point of communication
  - Proxy server protected login service
  - Kerberos support
  - Smart Card support with Public Key Infrastructure (PKI)
  - RSA support
- **Application Modules**
  - Teamcenter Security Services
  - Teamcenter Client Communication Services

Teamcenter Security - Authentication

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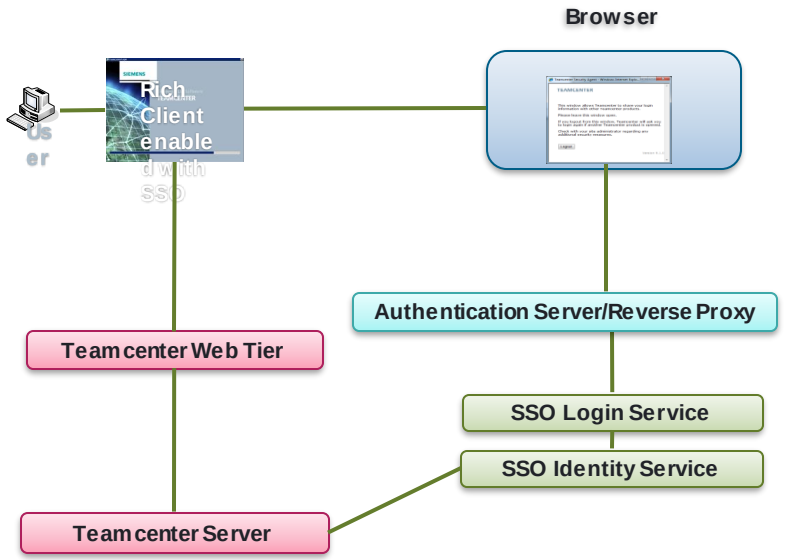
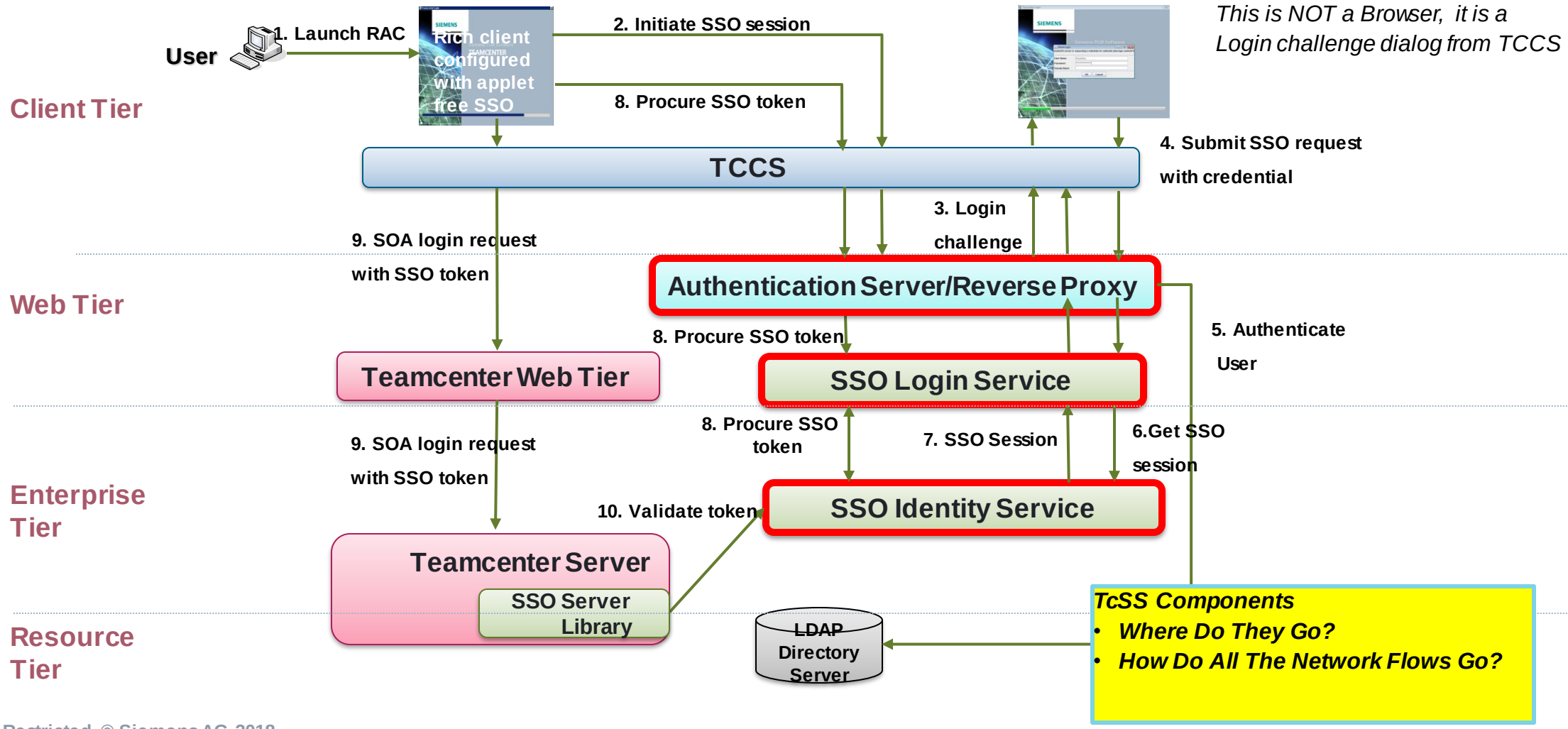
- What is the Authentication Method?
  - We See Customers Wanting to Change To:
    - SAML 2.0 Compliant
    - Multi-Factor Authentication (MFA)
    - Cloud-Based System (AzureAD)

- Integrating with Corporate Authentication System
  - Which is On-Premise
  - Encrypt the Connection! ←***Encrypting Traffic***

- Mix of Authentication Methods
  - 3rd Party Accounts May Need Separate Authentication
    - Such as LDAP in Cloud
  - Make Sure **Integrations** Work with Any New Authentication Method
    - E.g.: Integration with ERP ←***Encrypting Traffic***



Sample Teamcenter Security Services (Applet-Free Single Sign-On Mode)



Teamcenter Security - Authentication

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- AzureAD
  - We Have Worked Out How to Work with AzureAD
    - Simplest Approach: Using ***PingAccess***
      - A 3rd Party Product
      - N Free Licenses for Azure Customers
      - It's a Reverse Proxy in Front of Tc Security Services

- Other SAML
  - We Have Configured Shibboleth in the Lab
    - Open Source Product
    - Not Officially Supported
    - Has Two Components:
      - SAML Identity Provider ← *Sometimes People think of AzureAD as One of These*
      - SAML Service Provider (An Authenticating Reverse Proxy) ← *Tricky with AzureAD (PingAccess)*

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Teamcenter Security Approach

What's Different in the Cloud

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Teamcenter Security - Authorization

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Authorization

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  - Workflow ACLs
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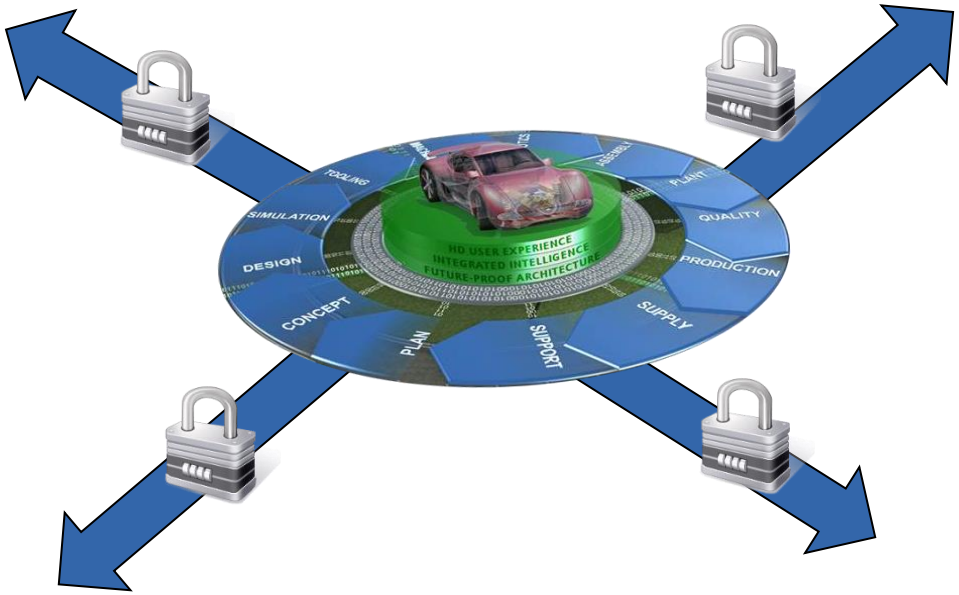

- **Features**
  - Rules based access manager with access control lists (ACL)
    - Organization – User/Group/Project
    - Object
  - Data access to meet corporate and government regulatory compliance
    - Intellectual Property management
    - ITAR

- **Application Modules**
  - Access Manager
  - Authorized Data Access

Teamcenter Security - Authorization

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- Is there a 3rd Party Managing The Deployment?
  - This May Already be the Case for non-Cloud Deployments
  - If They Admin Teamcenter,
    - Need Documented, Auditable Processes for Admin Users
    - Combined with Contractual Requirements

- Export Controls
  - **Know *Where* Your Data is Stored**
  - **Know *Where* Your Data Travels (Network)**
  - These May Change when a Deployment is Moved to the Cloud
    - Know Your Physical Network Traffic Map

    - Teamcenter Caches
    - Teamcenter Remote Volumes (Including Store & Forward)
    - Multisite

What's New in Teamcenter Security Authorization

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- Active Workspace 4
  - ADA Level Security for multiple objects in Active Workspace
  - ADA Level Security for configured structure in Active Workspace
- Active Workspace 4.1
  - User Consent Management (GDPR Compliance)
  - Change owning program/project on business object

- Teamcenter 11.5
  - Admin utilities enhancements
    - make_user, create_project, ADA_util

- Teamcenter 11.6
  - Project Categories for granular and flexible access control

- Teamcenter 12
  - **Operation Access Rules (OAR)** for simplified administration

Ref: Slides at the end of this presentation

NextGen Authorization Security
Operation Access Rules (OAR)

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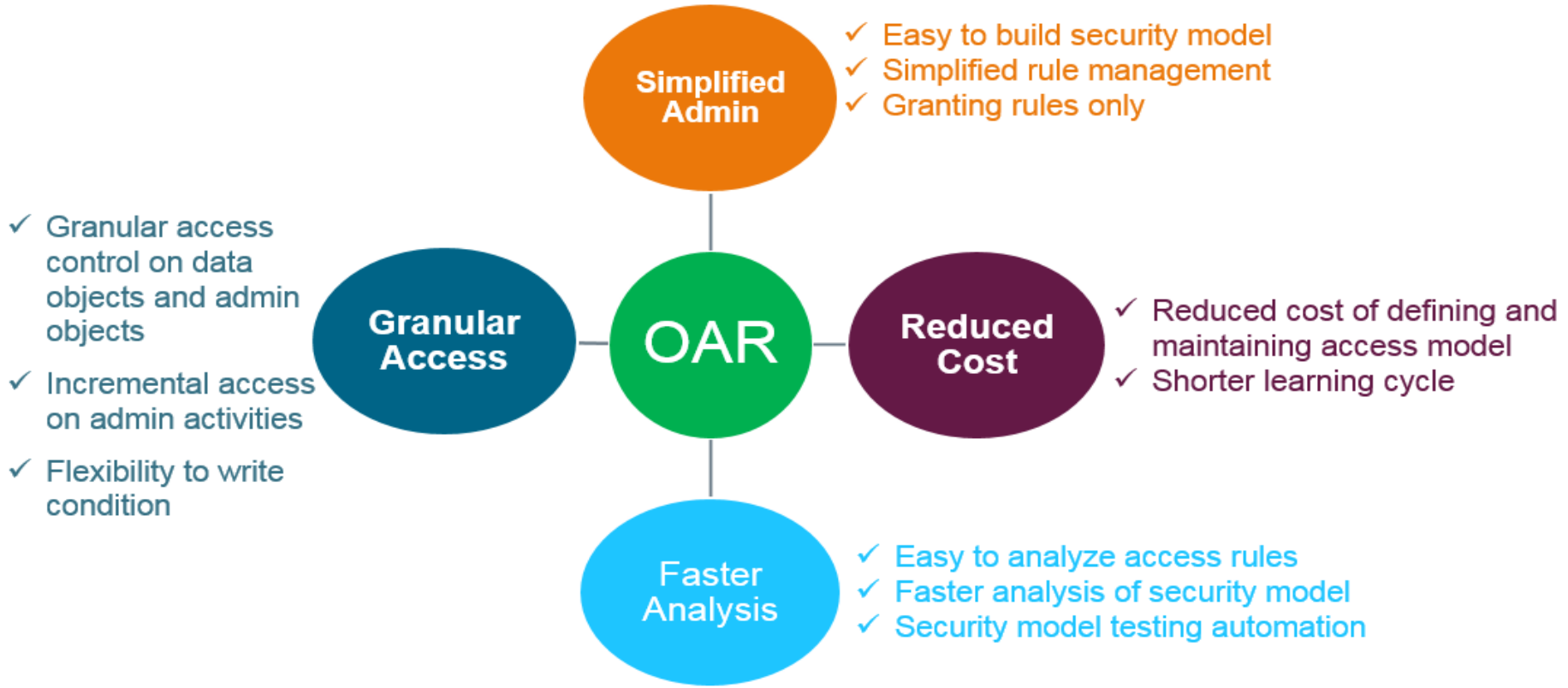
OAR is a radically improved access architecture to enable operation level controls with flexible conditions and simplified administration.

OAR is replacing Access Manager



Operation Access Rules
Key Guiding Principles

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- ✓ **Negative Biased System**
- ✓ **Operation based access control**
- ✓ **Flat list of rules with rules for granting access only**
- ✓ **No precedence or order for access rule evaluation**
- ✓ **Flexibility to define rule condition**
- ✓ **Simple administration and analysis of rules**

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Teamcenter Security Approach

What's Different in the Cloud

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Teamcenter Security - Audit

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  - Workflows
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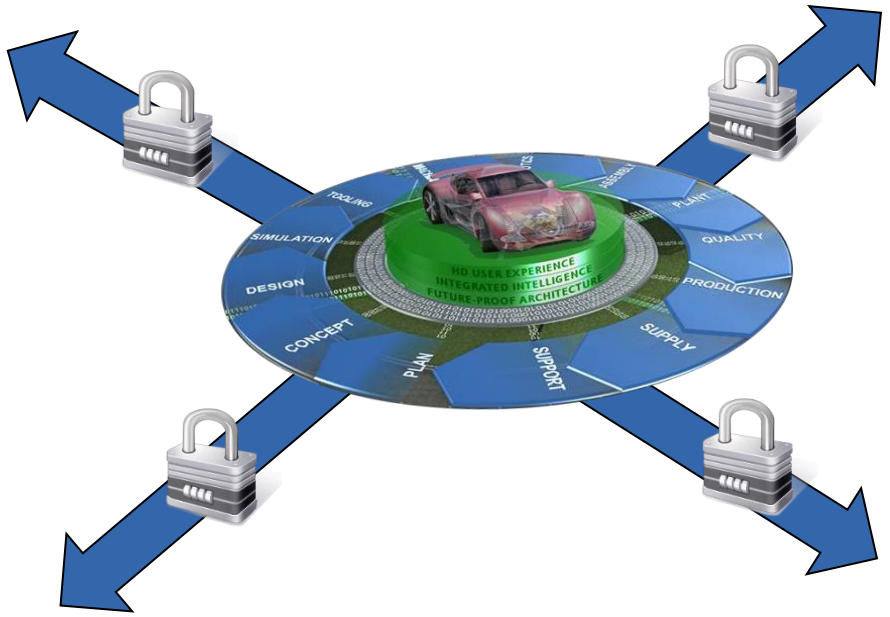
  - Organization
  - IP Object Events
- Application logs



- **Features**
  - Logging mechanism that keeps track of selected events
    - Who caused? What changed?
  - Support for
    - Workspace objects (such as forms, datasets, items, item revisions etc.)
    - Administration objects (such as users, groups, roles etc.)
  - Custom events can be defined using BMIDE
  - End user can Search and view audit records stored in the DB

- **Application Module**
  - Audit Manager

Teamcenter Security - Audit

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Application Audit

- Teamcenter Audit:
  - Be Careful, Trim the List Down Before Turning On
    - It's ON By Default
      - The Database Tables are Getting Full…Plan/Test for Cleanup!
  - If the Customer Doesn't Know What to Audit
    - Teamcenter Admins Won't Determine This
    - This is a Business Requirement

Environment Audit

- OS Accesses
  - All System Access
  - File System Access
- Infrastructure Activities
- Deployment Activities
  - Patches etc.
- Teamcenter Admin Activities

Teamcenter Security - Audit

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- **Audit Operations**
  - Audit reports – active regular monitoring is a key requirement
- Certifications and Processes for Admins and Systems Management
- **Cloud Audit Tools:**
  - AWS: CloudTrail
  - Azure: Azure Activity Logging, Log Analytics
- If 3rd Party Manages The Deployment:
  - How do They Audit Cloud Provider?
  - How does Customer Audit Them?

What's New in Teamcenter Security Audit

- Teamcenter 11.5
  - Conditional auditing
    - Reduce maintenance cost by limiting log generation in the system
    - Reduce audit tables size in the database by limiting audit log generation
    - Granular control on audit log generation for the user actions
    - Flexibility to write your own condition to control audit log generation
- Teamcenter 11.6/12.1
  - Purge/Archive Audit Logs at a more granular level

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Teamcenter Security Approach

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Teamcenter Security – Asset protection

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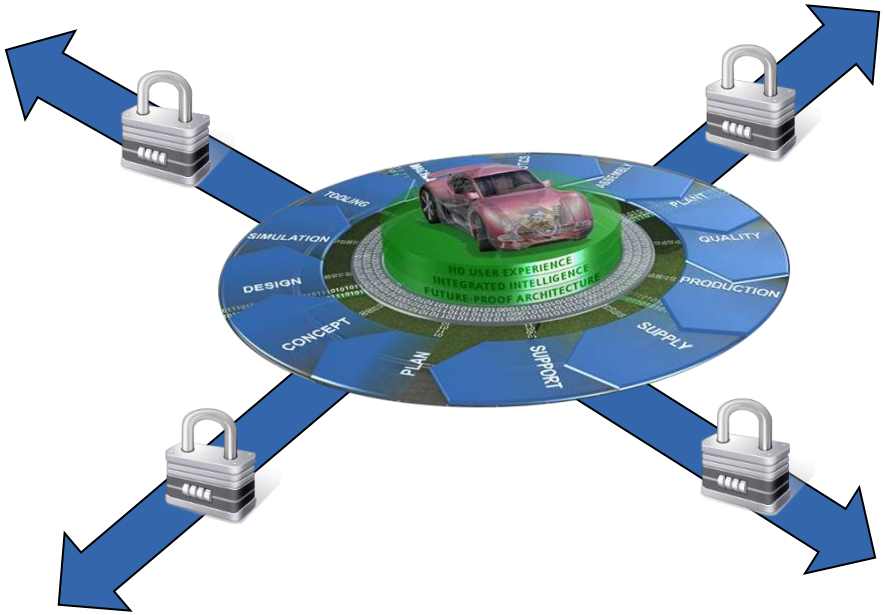
Asset protection

- Architecture
  - Four tier
  - MultiSite
- Infrastructure
  - Forward/Reverse proxy
  - Firewalls (zone-based)



- **Features**
  - Deployment architecture options
    - Centralized datacenter
      - Remote clients only
      - Remote clients with cache/volume servers
    - Multi-site architecture
      - Intra-company sites
      - Hub site for supplier access
  - Infrastructure configuration
    - Configurable ports for firewalls
    - Forward/Reverse proxy support
    - SSL
  - Enterprise Digital Rights Management
    - (DRM)

Teamcenter Security – Asset protection

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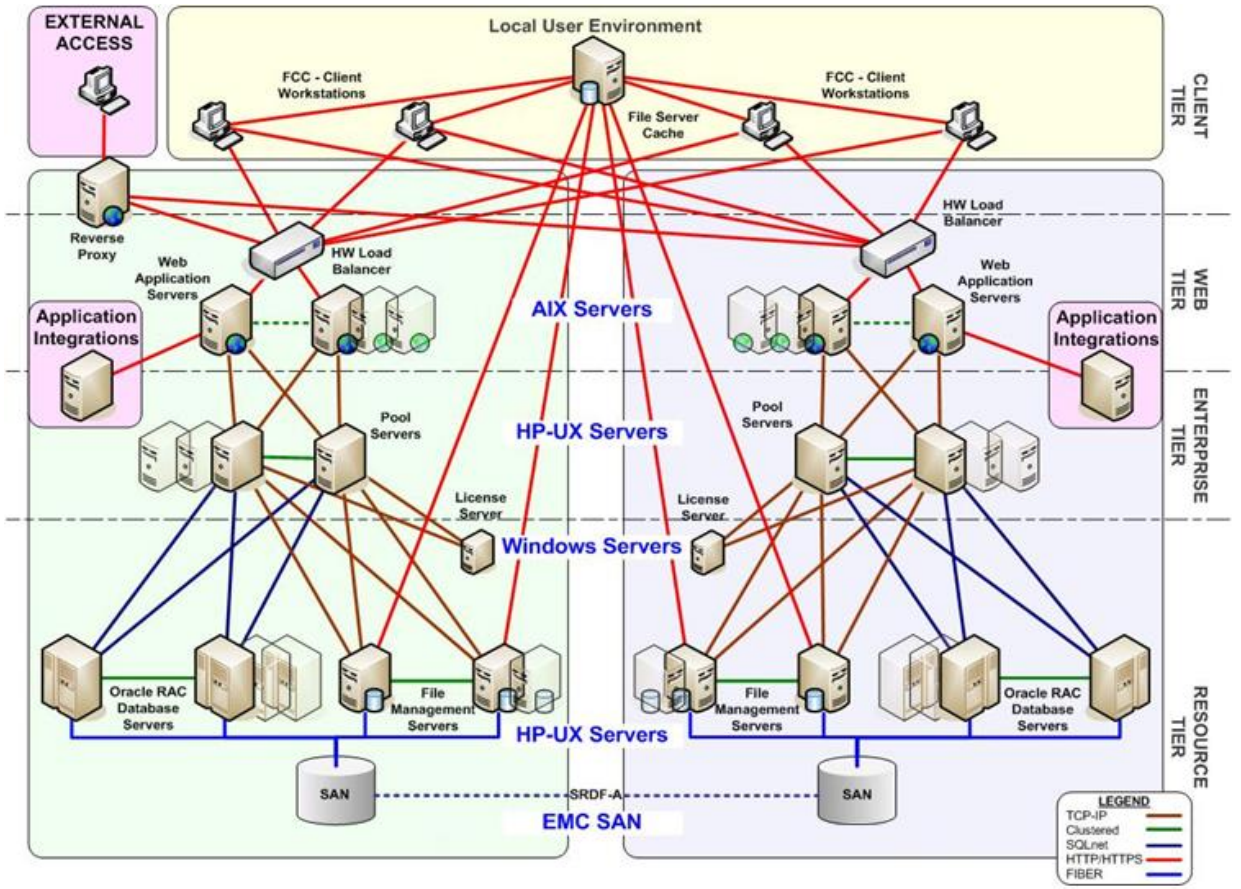
- This is Probably the Largest Area

- Most of the Deployment is now ***Off-Premise***
  - Who Has Access to Infrastructure?
    - Servers
    - Network
    - Data

  - Physical Security
    - It's Not Customer's Facility Any More
      - *Do They Even Know Where It Is?*

    - Do the Locations comply with HA & DR expectations (know what disasters can hit)



Teamcenter Security – Asset protection; Architecture

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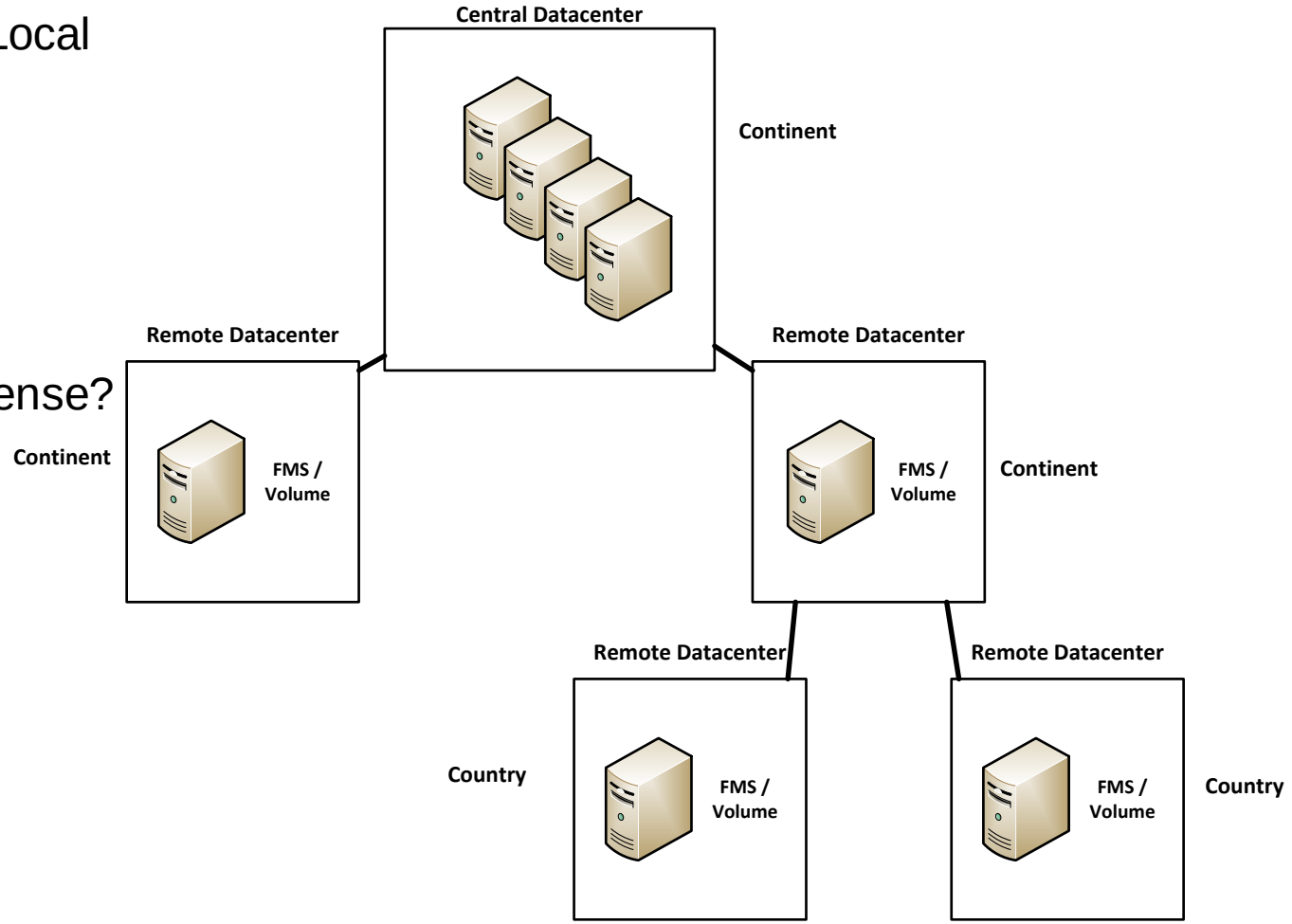
- Do You Put Anything in On-Premise for Local Users?
  - FMS Cache
  - FMS Volume – WATCH OUT!
    - S&F
- Does a Hierarchy in a Continent Make Sense?
- If It's *All* In the Cloud:
  - Cache-to-Cache Network Traffic
    - Traverses Cloud Provider's Network
    - $$$



Teamcenter Security – Asset protection

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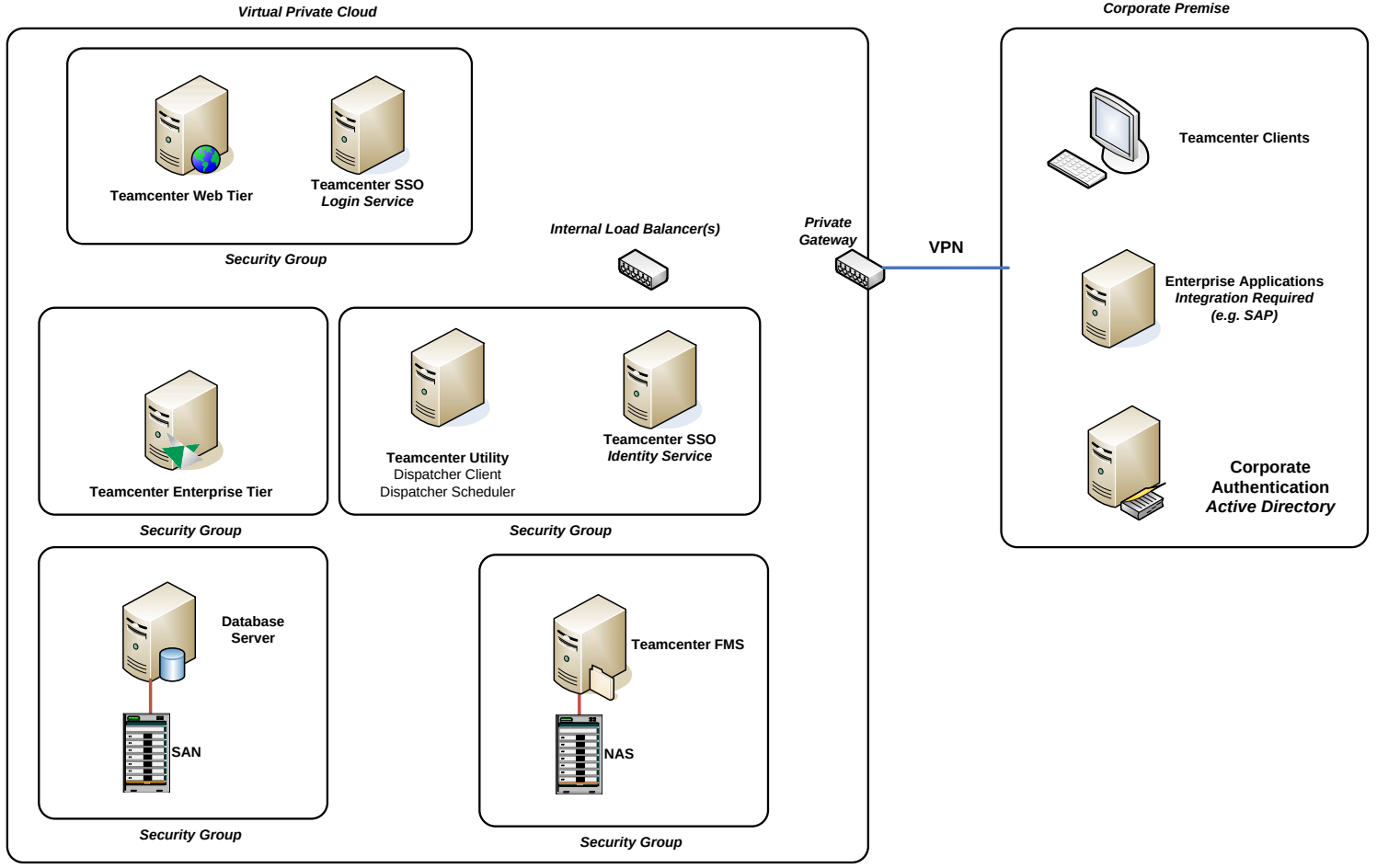
- Don't Have *Anything* Open to Public Internet
  - Internet Gateways, Public Subnets
- Use **Network Security Groups** to Control Access from Tier-to-Tier
  - ***Multi-Layer Defense***
- How to Get to Cloud from On-Premise
  - VPN Tunnel, Direct Connect
  - *Don't Go Over the Open Internet*
- How to Get from Cloud to On-Premise
- Things Get Even More Complicated with HA / DR



Teamcenter Security – Asset protection

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- Networks
  - Virtual Private Cloud (AWS), Virtual Network (Azure)
  - Virtual Private Gateways
  - Private Subnets
  - Network Security Groups, Access Control Lists
  - **Encrypt ALL Traffic crossing datacenter boundaries** (“data in motion”)
    - VPN
    - HTTPS
      - Load Balancers on the Boundary
        - Cloud Provider Terms: Network Load Balancer, Application Gateway
  - On-Premise Integrations with Cloud Components:
    - Authentication
    - Performance
  - Do you Need to Encrypt Intra-Datacenter Traffic?
    - This can Get Complicated, Very Involved
    - HIPAA, for Example

- Also: Encryption Standards
  - Cipher Suites
    - For All HTTPS,LDAPS Connections

Teamcenter Security – Asset protection

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Data Storage

- Data Encryption ("Data at Rest")
  - AWS: EBS, EFS
  - Azure Storage Service Encryption
  - Database
  - **Volume Files**
  - Don't Forget FMS Caches
    - Whole File Cache
    - Segment Cache
    - SSL Between Cache—Volume
    - 2-way SSL for Cache—Volume?
- Secure Deletion

Connecting to Cloud:

- AWS:
  - VPN Gateway (encrypted tunnel over the Internet)
  - Direct Connect
  - Internet ← Not Advised
- Azure
  - VPN (Azure VPN Gateway) (encrypted tunnel over the Internet)
  - ExpressRoute
  - Internet ← Not Advised

Miscellaneous Topics

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- Backups
  - Where Are They
- Disaster Recovery
  - Especially in context of Export Controlled Data
- Key Management
  - Key Management Service (AWS), Key Vault (Azure)
- Data Migrations
  - Moving Data from On-Premise to Cloud
  - Encrypted Traffic
- Security Monitoring, Incidents, Response
- Service Level Agreements
  - Contractual Requirements
- Supplier Management
- Security Testing (Verification, Validation)
  - Vulnerability Scanning, Results
  - Penetration Tests
    - Software
    - Network
- Forensics
  - Figuring Out What Went Wrong

Miscellaneous (3)

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- Staff Security Training & Certification
- Performance Questions Pervade Cloud Deployments
  - Virtualized Database Servers
  - Network Hops to Datacenters
  - Nearness of FMS Caches to Clients

What's New in Teamcenter Security
Asset Protection

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- Teamcenter 11.5
  - Partial download support for encrypted files
- Teamcenter 11.6
  - Kerberos not longer requires AllowTGTSessionKey
  - update_propagation_data utility
  - Login click jacking prevention
  - LDAP fall back user
- Teamcenter 11.5
  - Audit triggered on event
- Teamcenter 11.3 and earlier
- Applet free for all cases (session agent)
- Enhance LDAP support – multiple LDAP servers

What's New in Teamcenter Security
Asset Protection

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- Teamcenter 12
  - Teamcenter Encryption Key Manager
  - Flexible password protection algorithm using Key Manager
- Teamcenter 12.1
  - Secure e-mails from Teamcenter
  - Encryption Key Manager Failover

Advanced Technical Services (ATS)
Security Solution Workshop

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- **Objectives:**
  - Provide overview of Teamcenter security solution options in the areas of:
    - Authentication
    - Audit
    - Asset protection
    - Authorization (generic guidelines)
  - Align customer's security requirements with solution options
  - Define implementation proposal for solution options
- **Prerequisites**
  - Customer responses to security questionnaire (capture customer's view of security needs and info on Teamcenter implementation
- **Deliverable**
  - Report with proposed security solutions and recommended next steps
- **Timing**
  - 5 days (with 2 or 3 days onsite workshop)
  - Off site – preliminary analysis and report

Summary Points

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Security has to be planned, designed and tested

Understand product capabilities and align with business requirements

- Business requirements can consist of Business Process and Corporate Compliance requirements

With Teamcenter, The DATA is the Customer's Intellectual Property

- Focus on Protecting it *At Rest, In Motion, In Use*
- Encryption
  - Network Traffic
  - Data at Rest

Multiple Layers of Defense

- Always Consider: How is this Element protected if one measure is cracked?

Questions & Answers

Contact Information

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Thank you.