Maximo Performance Best Practices

Overview

- Application Architecture
- Approaches to Performance Tuning
  - Sizing and Planning Pre-implementation (proactive)
  - Best Practices
  - Problem Resolution (Reactive – responding to issues)
- Proactive Approach
  - Hardware and Storage Sizing
  - Application Sizing, Software Clustering
  - End to End Tuning
- Best Practices
  - Best Practices Tuning
- Reactive Approach
  - Problem Identification
  - Successful Resolution Identification
- Questions

Application Architecture

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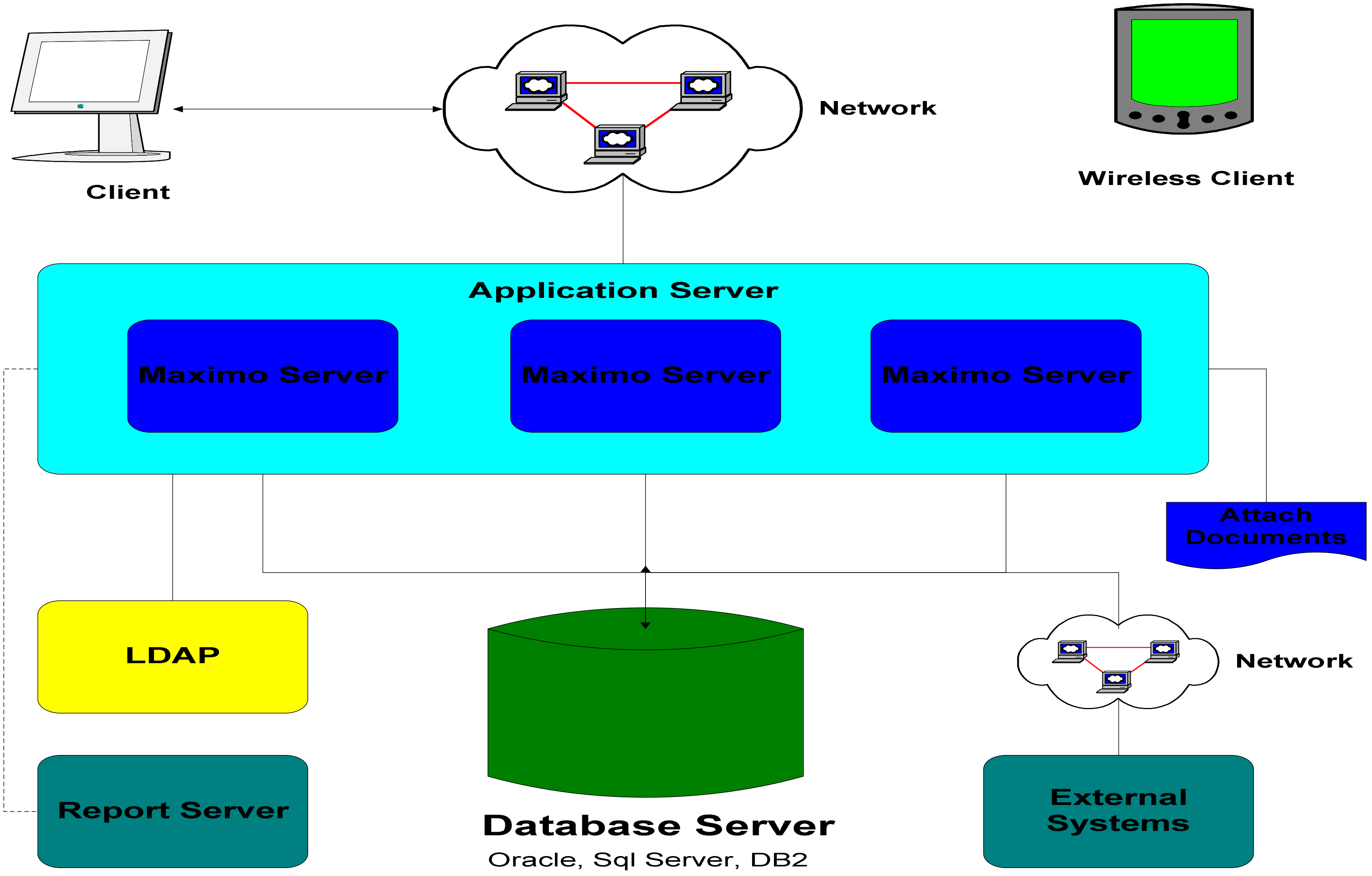
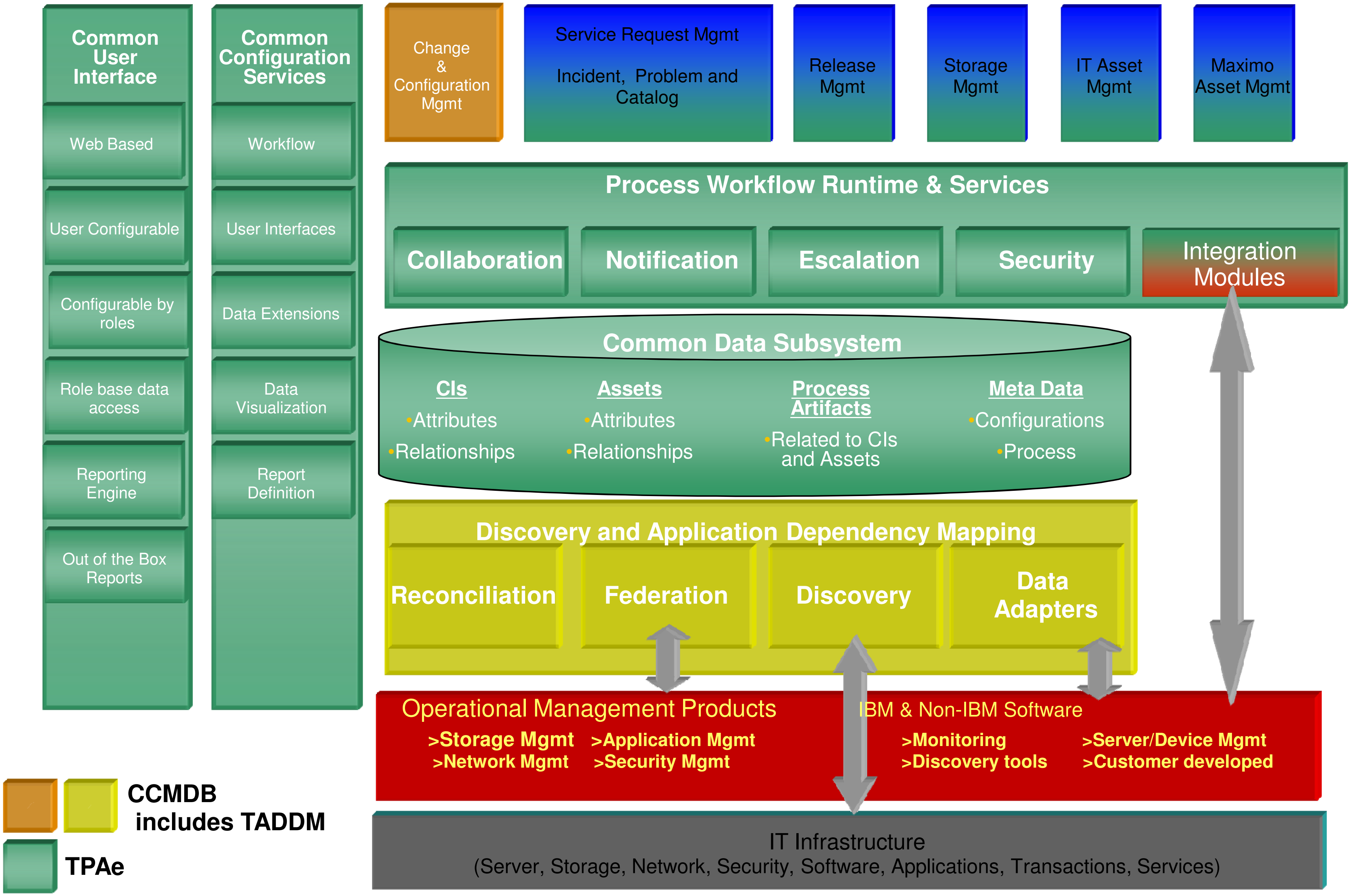
Application Architecture



Maximo Based Products



Common User Interface

- Web Based
- User Configurable
- Configurable by roles
- Role base data access
- Reporting Engine
- Out of the Box Reports

Common Configuration Services

- Workflow
- User Interfaces
- Data Extensions
- Data Visualization
- Report Definition

Change & Configuration Mgmt

Service Request Mgmt

Incident, Problem and Catalog

Release Mgmt

Storage Mgmt

IT Asset Mgmt

Maximo Asset Mgmt

Process Workflow Runtime & Services

Collaboration | **Notification** | **Escalation** | **Security** | Integration Modules

Common Data Subsystem

CIs
- Attributes
- Relationships

Assets
- Attributes
- Relationships

Process Artifacts
- Related to CIs and Assets

Meta Data
- Configurations
- Process

Discovery and Application Dependency Mapping

Reconciliation | **Federation** | **Discovery** | **Data Adapters**

Operational Management Products

>Storage Mgmt **>Application Mgmt**
>Network Mgmt **>Security Mgmt**

IBM & Non-IBM Software

>Monitoring **>Server/Device Mgmt**
>Discovery tools **>Customer developed**

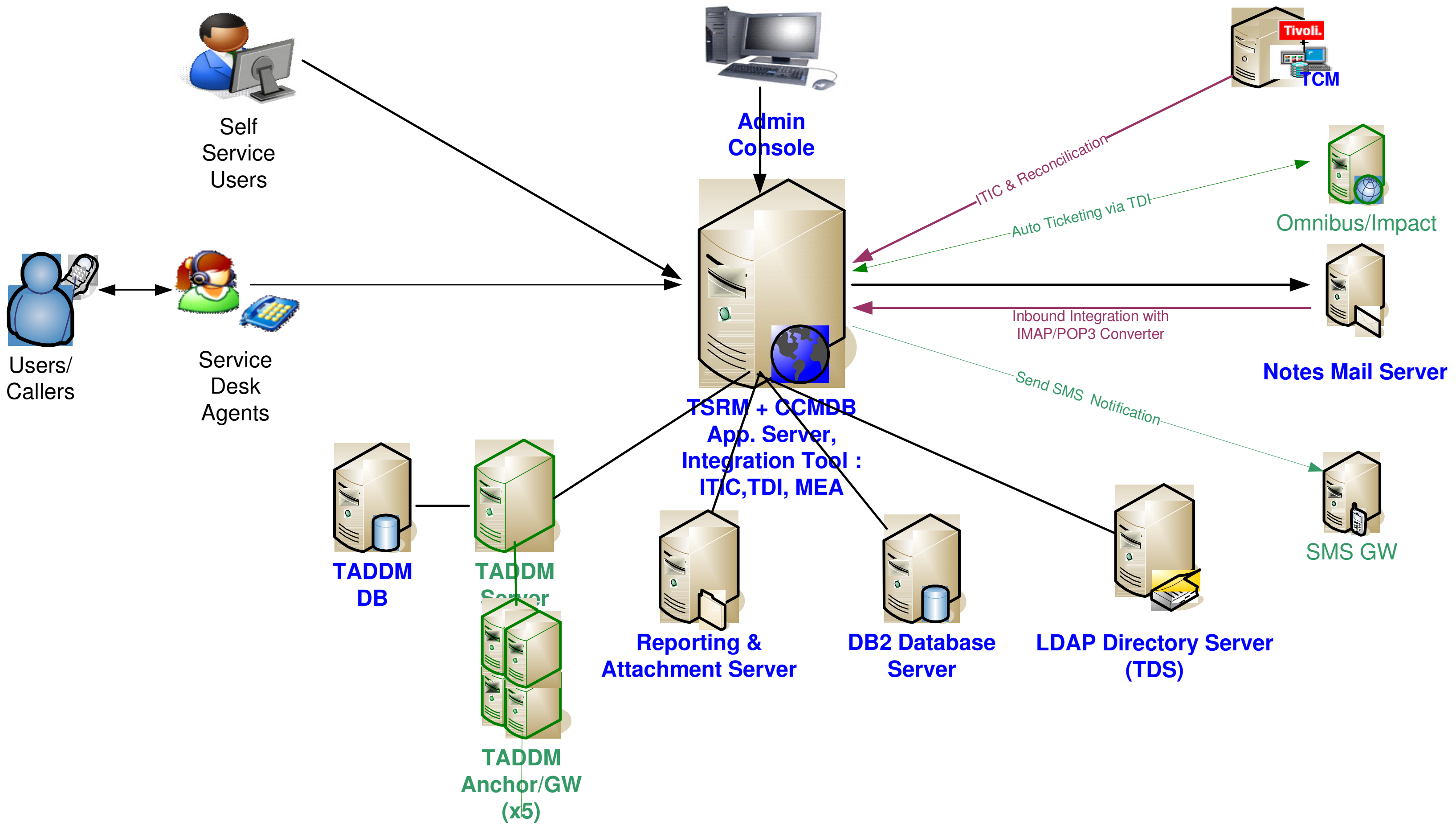
IT Infrastructure
(Server, Storage, Network, Security, Software, Applications, Transactions, Services)

🟧🟨 **CCMDB includes TADDM**

🟩 **TPAe**

Application Architecture

- Sample Production System



Approaches to Performance Tuning

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Approaches to Performance Tuning

- Proactive
  - Usually done during roll out to prepare for go live loads
  - Planning hardware for required loads and throughput
  - Clustering for required loads and fault tolerance
  - Planning storage requirements
  - Implementation Options

- Best Practices
  - Implementation experiences
  - UAT Testing
  - Load Testing

- Reactive
  - Usually done in response to a problem. (this is the least preferable option as it means that users have already been impacted)
  - Expensive and time consuming
  - Focuses on analysis and most likely cause

Proactive Performance Sizing and Planning

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Proactive Performance Sizing and Planning

- Size your environment
  - Hardware Sizing
    - Application Server
    - Database Server
    - Reporting and LDAP Server
  - Application Server Sizing
    - JVM
    - Memory – Both physical memory and JVM memory
  - Integration Component Sizing
    - Transaction rates
    - Clustering
  - Database Sizing
    - Disk Usage sizing
    - CPU sizing
    - Database memory

Proactive Performance Sizing and Planning

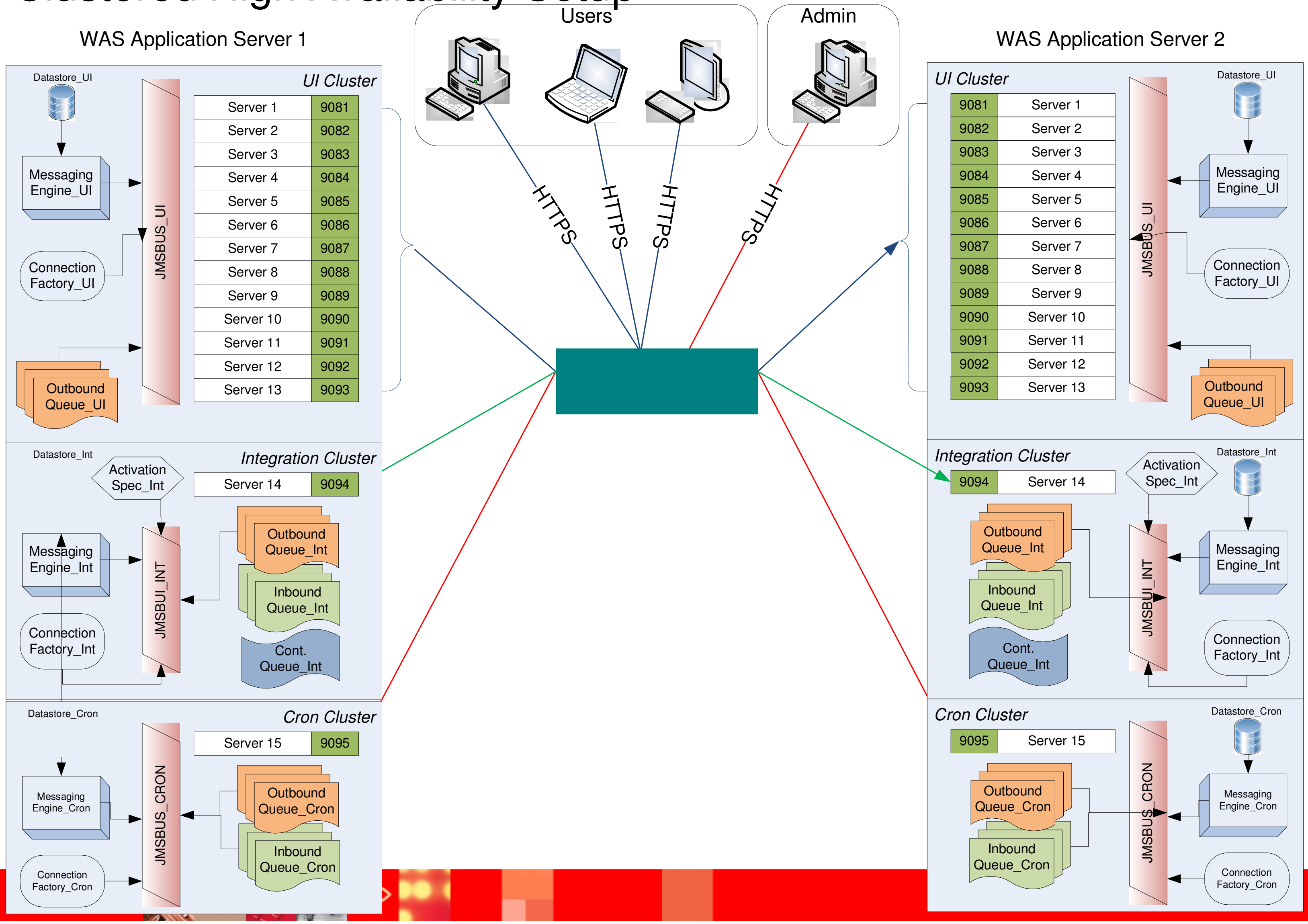
- Application Server Sizing and Setup
  - Application Servers should always be setup in a cluster
    - Cluster member JVM’s should be sized based on the user load
  - Why is clustering so important?
  - Various clusters of the system
    - UI Cluster - Supports end users.
    - Crontask Cluster - Supports background tasks
    - Integration Cluster - Supports integration transactions
    - Reporting Cluster - Supports reporting in a high performance, high availability mode

Proactive Performance Sizing and Planning

- Keep JVM and Application Server fix packs updated
  - Within the same version, updated to latest fix packs to take advantage of application server fixes
- 32-bit environment versus 64-bit environment
  - 32-bit environment has memory limitations for JVM
  - Due to memory limitations, server stability becomes an issue
  - Convert 32-bit JVM environment to 64-bit environment

Proactive Performance Sizing and Planning

- Clustered High Availability Setup



WAS Application Server 1 – UI Cluster

Server 1	9081
Server 2	9082
Server 3	9083
Server 4	9084
Server 5	9085
Server 6	9086
Server 7	9087
Server 8	9088
Server 9	9089
Server 10	9090
Server 11	9091
Server 12	9092
Server 13	9093

Integration Cluster

Server 14	9094

Cron Cluster

Server 15	9095

WAS Application Server 2 – UI Cluster

9081	Server 1
9082	Server 2
9083	Server 3
9084	Server 4
9085	Server 5
9086	Server 6
9087	Server 7
9088	Server 8
9089	Server 9
9090	Server 10
9091	Server 11
9092	Server 12
9093	Server 13

Integration Cluster

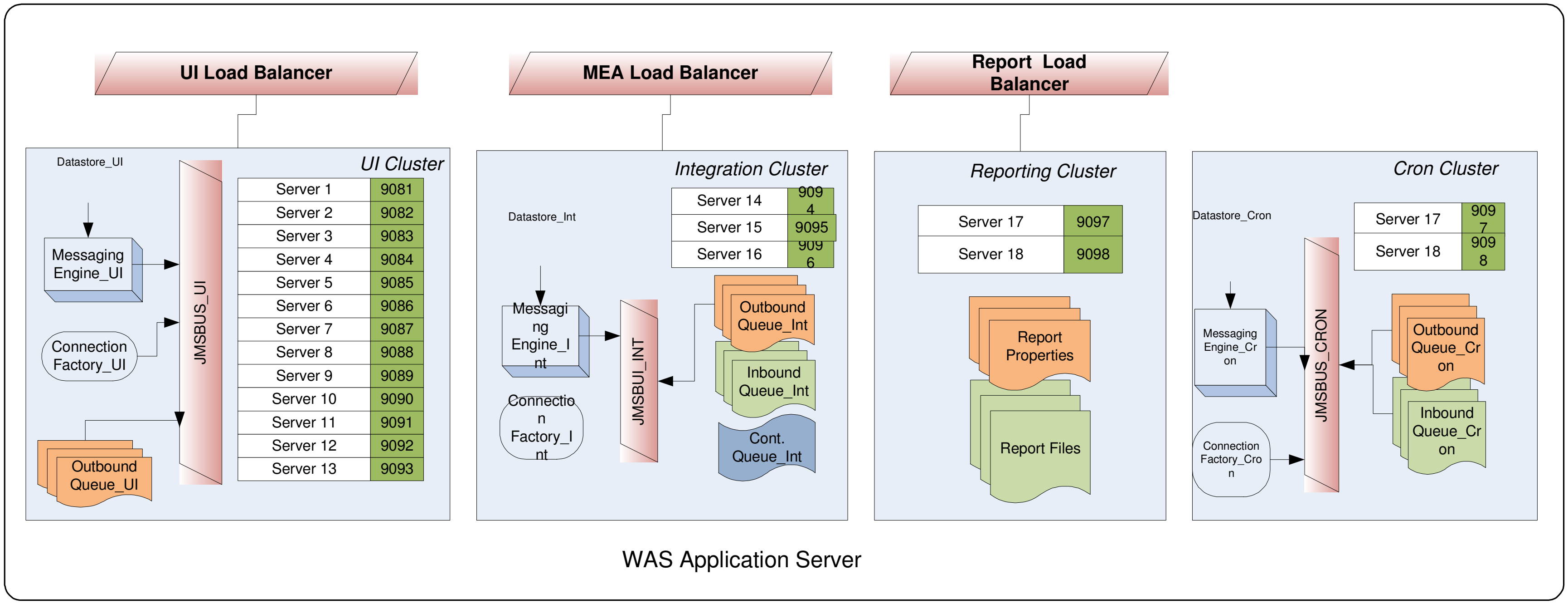
9094	Server 14

Cron Cluster

9095	Server 15

Proactive Performance Sizing and Planning

- High Performance Clustering
  - Create separate clusters to gain high throughput
    - UI, MEA, Reporting, Cron task
    - Transactions get load balanced across multiple servers



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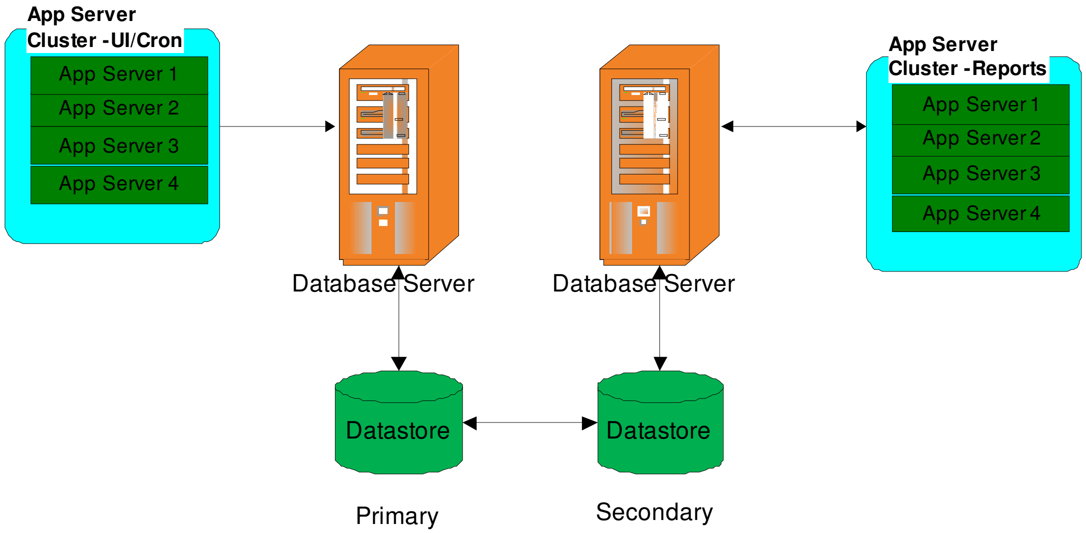
Server 15	9095
Server 16	9096

Server 17	9097
Server 18	9098

Server 17	9097
Server 18	9098

Proactive Performance Sizing and Planning

- High Availability Database Setup
  - Platform Specific
    - DB2 provides HACMP and HADR
    - Oracle has RAC
    - SQL Server High Availability
  - High Availability helps in failover
  - Separate reporting database helps reduce load on the primary database.



HADR Setup

Best Practices

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Best Practices

- JVM clusters for like functionality (UI, Integration, Cron, Reports, etc.)
- Application Server/JVM settings
- User queries and search types
- Reporting database
- IBM HTTP Server settings
- Database connection pooling properties
- Database parameters/indexes/statistics
- Network – acceleration/compression/cache
- Load test before going live
  - If adding new sites or increasing user load, repeat load test
- Maximo 7 Performance Best Practices
  - http://www-01.ibm.com/support/docview.wss?uid=swg21440192
- Best practice tip
  - Keep a spreadsheet of your entire setup information

Application Server/JVM Best Practices

- JVM clusters for like functionality (UI, Integration, Cron, Report, etc.)
- JVM heap memory settings are very important and play a big role in application server performance
  - Heap memory setting varies between 32 bit application servers and 64 bit application servers
  - 32 bit – Maximum is 3GB based on the platform. Windows 32 but machine can only handle 1.8GB of heap for a JVM
  - 64 bit – You can increase the heap memory.
  - Initial heap size and Max heap size
  - What is the best setting?
- -Dsun.rmi.dgc.ackTimeout=10000
  - Extremely important setting for Maximo due to heavy use of java rmi objects
  - Without this setting, maximo objects are held in memory for longer duration, which can lead to
    - Out of Memory situations
    - Too many database connections

Database Best Practices

- Tune database as per install and best practices documents
- Database tuning gives the best ROI for performance
  - Database is the most critical part of Maximo application
- Database specific settings are documented in install guide and best practices document
  - Oracle – cursor sharing, increase SGA
  - DB2 – lock timeout, memory settings
  - SQL Server – turn off page level locking, Maximo properties for SQL Server
- Analyze database memory and user I/O
  - Maximo fetches lot of data into application server
  - Increase system memory. Helps reduce user I/O
- Separate tablespaces and mount points to optimize I/O
- Educate users on ad-hoc queries
  - Check for newly created user queries and optimize them
- Reduce start center data retrieval
  - Keep the default start center to be a simple minimal data fetch
    - There can be multiple start center, but the first one displayed should be simple to avoid excessive data fetch

Database Best Practices

- Setup an index statistics update schedule
  - Weekly update helps in better performance
- Purge / Archive data
  - Transactional data needs archiving plus purging
  - Non-transaction data should be purged on a regular basis
  - E.g. Workflow transaction data, login tracking, start center
- Add indexes as they are needed
  - Do not be scared to add indexes
  - In Maximo, 80% is data fetch, 20% is data insert/update
  - Lack of right index causes more performance problem than slowing down on insert/update
- If possible, change WILD card searches to EXACT and educate users to use % wild card option in search fields
  - This reduces un-necessary like searches and greatly improves database query timings

Database Best Practices

- Use Maximo tool – Integrity Checker to find Maximo schema problems that can affect applications as well as performance
  - Integrity Checker can be found in the Maximo tools folder
  - Integrity Checker should be done in development phase to production phase

Report Performance Best Practice

- Decide whether to have separate report server cluster or use the UI cluster for reporting
- Each one has its own pros and cons. Both are fine as long as they are configured right
- UI Cluster for reporting
  - Pros
    - Able to utilize the UI JVM's for reporting
    - Less complex setup
    - Less Infrastructure needs
  - Cons
    - May experience user response degradation due to very large / complex reports taking up JVM resources
- BROS cluster for reporting
  - Pros
    - Separate JVM's provide better response
  - Cons
    - More complex setup
    - More infrastructure needs

Report Performance Best Practice

- BROS option
  - Helpful when using a separate reporting database
- Identify long running reports from report usage and tune them
  - Can identify poor performing ad hoc reports
- Scheduled report cron tasks
  - Separate these out of UI servers
  - mxe.crontask.donotrun=REPORTSCHEDULE
  - No need to explicitly mention the instance name, just put REPORTSCHEDULE in the do not run list to separate them out of UI server
- BIRT Reporting Performance document link
  - https://www-304.ibm.com/support/entdocview.wss?uid=swg21305031

Logging Best Practices

- Keep Maximo as well as application server logging to minimal level unless investigating a problem
  - Set everything except Maximo root logger to ERROR
  - Maximo logging adds 5% + overhead
- Clean up log folders from filling up
  - Watch out for heap dumps as these files are very large
- Since logging changes can be applied dynamically, turn logging on when needed and turn it off when done
- For SQL performance analysis
  - Use logSQLTimeLimit , extremely useful
  - Collect them in separate log files
- If analyzing memory usage
  - Use verbose GC logging. Clean up old log files
  - Use Garbage Collection and Memory Visualizer to analyze

Maximo Built in Tools to Help Troubleshoot

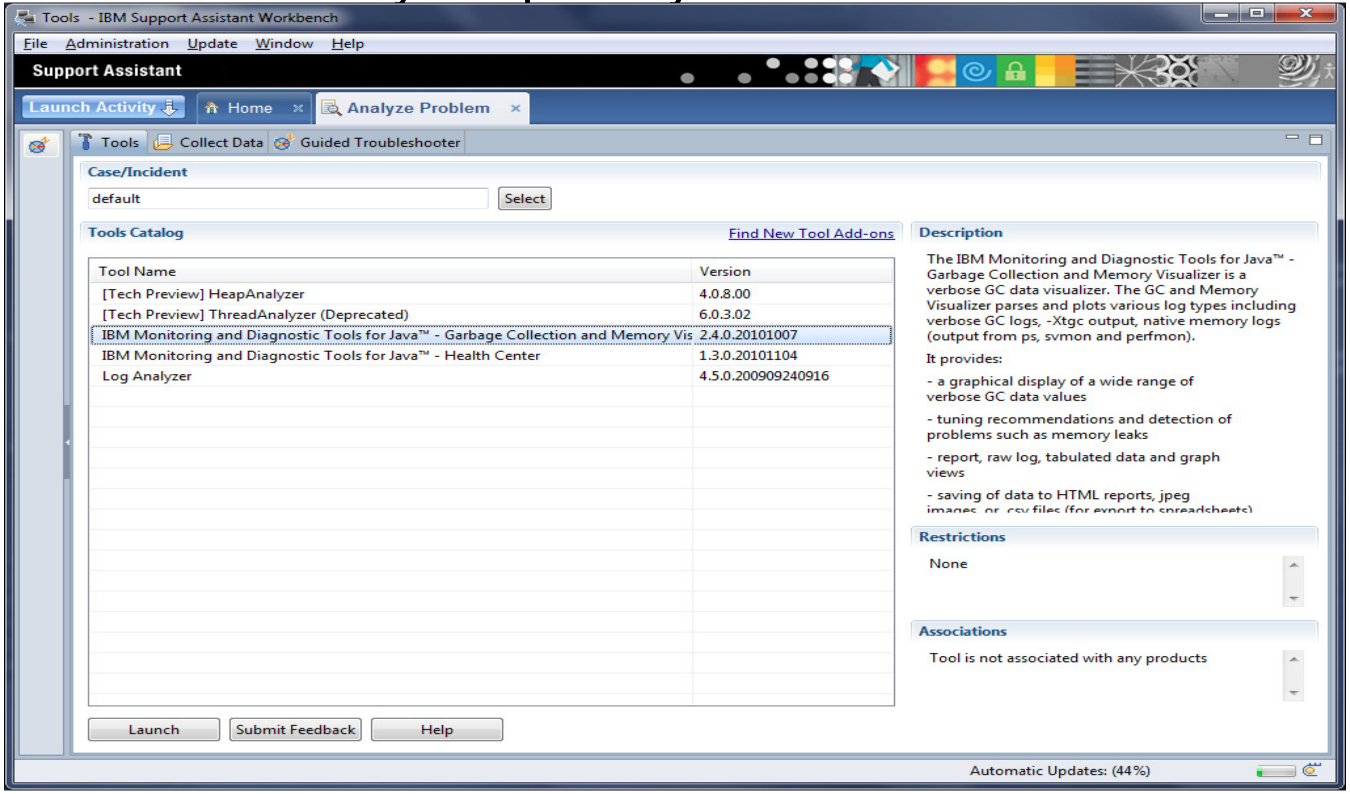
- FetchStopLimit
  - Enable and use until you reach a stable state. Returns an error to the end user. Can collect the information from the log and contact support
    - mxe.db.fetchStopLimitEnabled
    - mxe.db.fetchResultStopLimit
    - mxe.db.fetchResultStopLimit.OBJECTNAME
    - mxe.db.fetchStopExclusion
    - Using fetch stop limits to prevent out-of-memory errors
    - https://www-304.ibm.com/support/docview.wss?uid=swg21412865
- FetchResultLogLimit
  - This greatly helps in identifying excessive data fetch
  - Use this to identify the code that is fetching excessive data
  - Depending on data or code fix, adjust the data or get a code fix

Maximo Tools to Help Troubleshoot

- System Properties used as part of logging
  - Enabled through System Properties application. Dynamic, can be enabled without re-building application ear file
  - SQL logging to collect all SQL statements – Logging Application
  - Use the following system properties to collect useful log information
    - mxe.mbocount (5.2 P05 and later)
    - mxe.db.fetchResultLogLimit (5.2 P02A and later)
    - mxe.db.logSQLTimeLimit (5.2 P02A and later)
    - mxe.db.logSQLPlan (6.0 P01 and later; Oracle only)
    - mxe.db.sqlTableScanExclude (6.0 P01 and later; Oracle only)
- Use Maximo tool – Integrity Checker to find Maximo schema problems that can affect applications as well as performance
  - Integrity Checker can be found in the Maximo tools folder
  - Integrity Check should be done in development phase to production phase

IBM Support Assistant

- Available from IBM Support Site
- Contains many add-on tools
- Useful for memory heap analysis and JVM thread



Case/Incident

default

Tools Catalog

Tool Name	Version
[Tech Preview] HeapAnalyzer	4.0.8.00
[Tech Preview] ThreadAnalyzer (Deprecated)	6.0.3.02
IBM Monitoring and Diagnostic Tools for Java™ - Garbage Collection and Memory Vis	2.4.0.20101007
IBM Monitoring and Diagnostic Tools for Java™ - Health Center	1.3.0.20101104
Log Analyzer	4.5.0.200909240916

Description

The IBM Monitoring and Diagnostic Tools for Java™ - Garbage Collection and Memory Visualizer is a verbose GC data visualizer. The GC and Memory Visualizer parses and plots various log types including verbose GC logs, -Xtgc output, native memory logs (output from ps, svmon and perfmon).

It provides:

- a graphical display of a wide range of verbose GC data values

- tuning recommendations and detection of problems such as memory leaks

- report, raw log, tabulated data and graph views

- saving of data to HTML reports, jpeg images, or .csv files (for export to spreadsheets)

Restrictions

None

Associations

Tool is not associated with any products

Automatic Updates: (44%)

Best Practices

- Implementation Options
  - RMI Server Deployment – Deploy RMIREG.WAR
  - Search Methodologies – Default to “EXACT”
  - User Training – Best practices and procedures for tasks
  - Network Appliances – Riverbed, Juniper, Citrix
  - Task Focused Screen Design – Create small screen
  - Off Hours WO Generation, Reorder, Crons, and Reporting
  - Client Browser Configuration – Page refresh to Automatic

Reactive Performance Tuning

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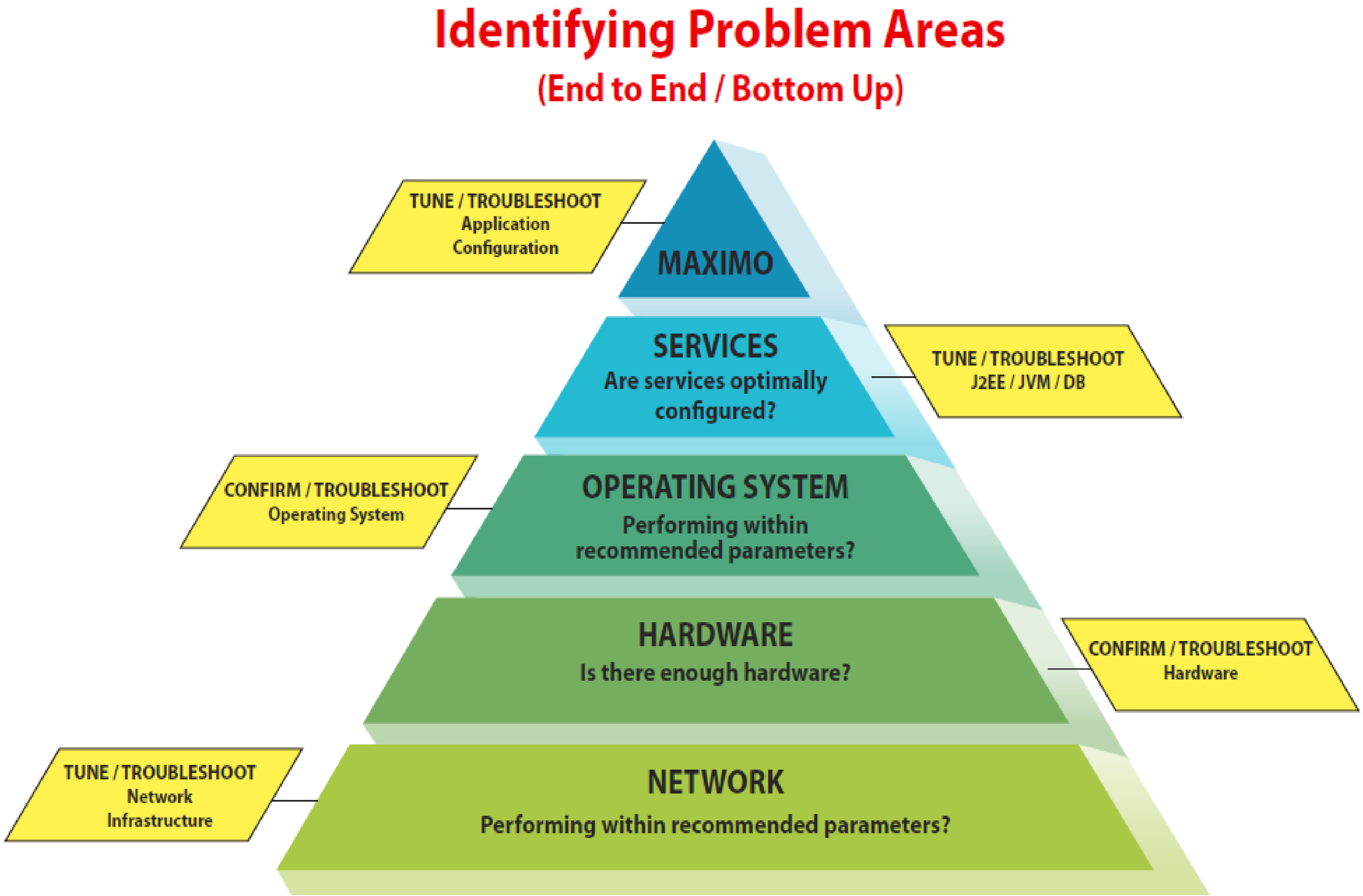
Reactive Performance Tuning

- Define problem, resolution, and focus
  - Analyze and clearly define reported problem
    - Reported problems are often not clear. Understand what is being reported. "Application is slow" is not a definition. Find out what is slow. See it for yourself if possible.
  - Determine/define what is "successful resolution"
    - Don't allow client perception to interfere with a solution. Get a clear definition of what is acceptable so you have a measure for success.
  - Focus on technologies that might impact issue
    - If users at one plant are affected but users at another plant are not affected, it is likely not a server problem. Focus on items that can impact the affected area.

Reactive Performance Tuning



Identifying Problem Areas

(End to End / Bottom Up)

MAXIMO

TUNE / TROUBLESHOOT
Application
Configuration

SERVICES
Are services optimally configured?

TUNE / TROUBLESHOOT
J2EE / JVM / DB

OPERATING SYSTEM
Performing within recommended parameters?

CONFIRM / TROUBLESHOOT
Operating System

HARDWARE
Is there enough hardware?

CONFIRM / TROUBLESHOOT
Hardware

NETWORK
Performing within recommended parameters?

TUNE / TROUBLESHOOT
Network
Infrastructure

Reactive Performance Tuning

- Indentifying Problem Areas
  - Application Physical Server
  - Operating System (AIX,HP-UX,Linux,Solaris,Windows)
  - **Java Application Server (WebSphere/WebLogic)**
  - Java Virtual Machine
  - **Application (Maximo, CCMDB, SRM, TAMIT, etc)**
  - Database Physical Server
  - Operating System
  - **Database Server (DB2, Oracle, SQL Server)**
  - **Network Connections (DB and Client)**
  - Client Physical Equipment
  - **Client Browser Configuration**

- *** Bold items most common with highest impact**

Maximo Index Analysis

- Use database tools to find long running queries and recommended indexes
- In Maximo, use Maximo logging to collect long running queries and analyze index usage
  - If needed alter the query to better utilize existing indexes
  - Enable mxe.db.logSQLTimeLimit = 1000 to collect all SQL statements that are longer than 1 second
  - Extract from logs and order by longest time consuming queries
  - Run them through SQL development tools and add required indexes
  - Always make sure the indexes are added through Maximo DB Configure to retain during fixpack application and upgrades
  - Add non-standard indexes through scripts and run the script after each database configuration (configdb) operation

Search Methodology Change

- Converting WILDCARD search to EXACT match has resulted in better performance
- Application users need to be educated
  - Change impact on them
  - How it improves the performance
  - Resulting benefits
- This change improves
  - Query retrieval times
  - Reduces data volume
  - Improves the overall database response
- End users can still use %value% to achieve WILDCARD searches
  - The default behavior is set to EXACT
- Change LIKE functionality in stored queries and custom relationships

Reactive Performance Tuning

- **Maximo Logging and Activity Dashboard**
  - **Activity Dashboard - Used to be called as performance monitor**
    - Not a monitor, but a debugging tool
  - **Available by default from Maximo 7.1.1.6 onwards**
    - It was introduced during Maximo 5.2, but is part of the product now
  - **Enable in development / test / breakfix area to identify the problem**
    - Enabled through web.xml and requires a ear file rebuild and re-deployment
    - Do not use in production environment, uses lot of memory and will bring down the server
  - **You can identify the SQL statements for a transaction and the time taken**
    - Can also identify for the origin of the sql statement
    - SQL timings are noted
    - Object counts are noted

Maximo Performance Monitor Configuration

https://www-304.ibm.com/support/docview.wss?uid=swg21448706

Support Documents

Application Server

- IBM WebSphere Tuning (can cause application to hold objects too long if not set correctly)
  - http://www.ibm.com/support/docview.wss?rs=3214&uid=swg21261874
- Oracle WebLogic Tuning
  - http://www.ibm.com/support/docview.wss?rs=3214&uid=swg21261853

Network Performance

- Network caching and compression properties
  - http://www.ibm.com/support/docview.wss?rs=3214&uid=swg21262009
- Browser Caching (Helps with Wide Area Network -WAN- performance and high latency)
  - http://www.ibm.com/support/docview.wss?rs=3214&uid=swg21292557

Support Documents

Database Server Performance

- All SQL Server Environments (applies to all SQL Server 7, 2000,2005)
  - http://www.ibm.com/support/docview.wss?rs=3214&uid=swg21261979
- SQL Server 2000 with Maximo 6.2 and above (required additional parameters)
  - http://www.ibm.com/support/docview.wss?rs=3214&uid=swg21313428
- SQL Server 2000 with Maximo 6.1 and below (correct parameter settings)
  - http://www.ibm.com/support/docview.wss?rs=3214&uid=swg21295983
- SQL Server 2005 (correct parameter settings)
  - http://www.ibm.com/support/docview.wss?rs=3214&uid=swg21296072
- SQL Server 2005 (row versioning)
  - http://www.ibm.com/support/docview.wss?rs=3214&uid=swg21440598

Support Documents

Database Server Performance

- Oracle Cursor Sharing (All Oracle Releases)
  - http://www.ibm.com/support/docview.wss?rs=3214&uid=swg21262959
- DB2 Performance
  - https://www-304.ibm.com/support/docview.wss?uid=swg21421645
- DB2 Parameter Tuning
  - https://www-304.ibm.com/support/docview.wss?uid=swg21451593

Support Documents

Troubleshooting

- Debug properties
  - http://www-01.ibm.com/support/docview.wss?uid=swg21291250
- Must Gather – General Information
  - http://www-01.ibm.com/support/docview.wss?uid=swg21313647
- Must Gather – Performance
  - http://www-01.ibm.com/support/docview.wss?uid=swg21313341
- Logging
  - http://www-01.ibm.com/support/docview.wss?uid=swg21264064
- Logging Appenders
  - http://www-01.ibm.com/support/docview.wss?uid=swg21446599

Support Documents

Best Practices

- Maximo 5 and 6 Performance Best Practices
- http://www-01.ibm.com/support/docview.wss?uid=swg21395387
- Maximo 7.1 Performance Best Practices
  - http://www-01.ibm.com/support/docview.wss?uid=swg21440192
- Maximo 7.5 Performance Best Practices
  - http://www.ibm.com/support/docview.wss?uid=swg21591070
- Maximo Wiki
  - http://www.ibm.com/developerworks/wikis/display/maximo/Home