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IBM Tivoli Workload Automation
Process-Driven Delivery of Cross-Enterprise Services for
System z-Centric Enterprises

Tivoli. software

Mark A. Edwards
Sr. Market Manager
IBM Tivoli Workload Automation

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Agenda

- IBM Tivoli Workload Automation portfolio

- IBM Tivoli Workload Scheduler for z/OS

- IBM Tivoli Workload Scheduler for distributed systems

- IBM Tivoli Workload Scheduler for Applications

- IBM Tivoli Dynamic Workload Broker

- End-to-End Workload Automation

- Integration points

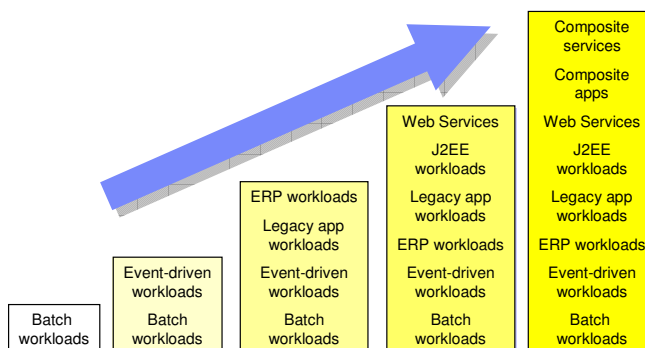## Enterprise Dilemma: Consolidating, Controlling and Optimizing the Delivery of Services Across Silos

- Many enterprises struggle to plan, choreograph, manage and optimize the delivery of services across application, system and organizational silos

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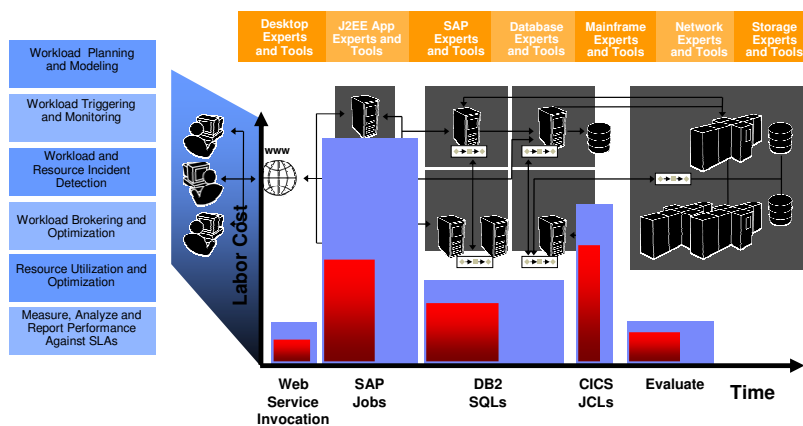
IBM's evolution from Scheduling to Workload Automation

- Workload Automation isn't just scheduling unattended, legacy batch jobs!
- IBM provides an enterprise backbone that
  - Aggregates and consolidates the planning, scheduling, execution and optimization of mixed, cross-enterprise workloads and services
  - Drives cross-enterprise workloads according to business demands, policies and process-related events, while resolving cross-system dependencies
  - Adapts the delivery of scheduled processes around planned and unplanned incidences

Composite services
Composite apps
Web Services
J2EE workloads
Legacy app workloads
ERP workloads
Event-driven workloads
Batch workloads

Web Services
J2EE workloads
Legacy app workloads
ERP workloads
Event-driven workloads
Batch workloads

ERP workloads
Legacy app workloads
Event-driven workloads
Batch workloads

Event-driven workloads
Batch workloads

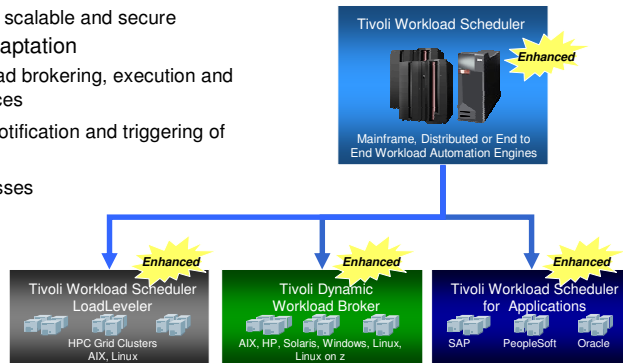| Batch workloads |
|---|

Tivoli Workload Automation is a highly autonomic enterprise backbone

- **What**
  - Define the business or IT service, its priority and its relationship to other services
  - Define process-related events needed to drive services
- **When**
  - Determine when the service is executed based on time-driven or process-driven plans, or IT resource availability
- **Where**
  - Determine which resource or pools of resources will execute the services based on service demands and priority, and IT resource availability and utilization policies
- **What-if**
  - Know the impact on critical services of planned changes and unplanned incidences, and determine how to adapt the delivery of services
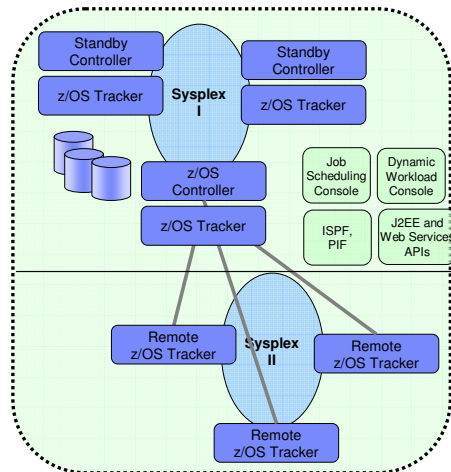
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Tivoli Workload Automation portfolio components

- Visibility
  - End-to-end monitoring, reporting and auditing
- Governance
  - End-to-end planning, coordination and management
  - Highly available, scalable and secure
- Optimization and Adaptation
  - Adaptive workload brokering, execution and delivery of services
  - Event alerting, notification and triggering of workloads
  - Recovery processes

Tivoli Workload Scheduler *Enhanced*

Mainframe, Distributed or End to End Workload Automation Engines

Tivoli Workload Scheduler LoadLeveler *Enhanced*

HPC Grid Clusters
AIX, Linux

Tivoli Dynamic Workload Broker *Enhanced*

AIX, HP, Solaris, Windows, Linux, Linux on z

Tivoli Workload Scheduler for Applications *Enhanced*

SAP   PeopleSoft   Oracle

Mainframe workload automation

- Components
  - Controller
    - Planning and scheduling engine
    - Can employ a single controller for multiple Sysplexes
    - Automatic failover to any Tracker
  - Trackers
    - Monitor resources, submit workloads, report status back to Controller
    - Automatic restart and recovery
  - User interfaces
    - Web-based Dynamic Workload Console
    - Java-based Job Scheduling Console
    - ISPF, PIF, etc
  - Programmatic interfaces
    - Published Java and Web Services APIs
- Key features
  - z/OS subsystem
  - Highly scalable and fault tolerant
  - Process-driven
  - Resource aware

Standby Controller   Standby Controller
z/OS Tracker   **Sysplex I**   z/OS Tracker
z/OS Controller
z/OS Tracker
Job Scheduling Console   Dynamic Workload Console
ISPF, PIF   J2EE and Web Services APIs
Remote z/OS Tracker   **Sysplex II**   Remote z/OS Tracker
Remote z/OS Tracker

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What's New for TWS z/OS

- Automation
  - Critical path analysis and workload prioritization
  - Workload brokering
  - Administration and operations with IBM Tivoli System Automation for z/OS
  - Virtual workstations
  - "NOERROR" enhancement

- Security and networking
  - NT password encryption for end-to-end environments
  - TCP/IP support

- Graphical user interfacing
  - New Web-based Dynamic Workload Console with reporting

- Service-oriented architecture
  - Open, published J2EE and Web Services APIs


TWS z/OS Critical Path Analysis

- In TWS, users identify milestone jobs critical to the business

- At Daily Plan, TWS calculates the Critical Path for critical jobs

- Updated views are provided to monitor milestone jobs and their Critical Paths

- Milestone jobs are automatically promoted to higher priority Workload Manager (WLM) Service Environments over less critical jobs when they are at risk of missing deadlines

- Jobs are dynamically routed to best available resources

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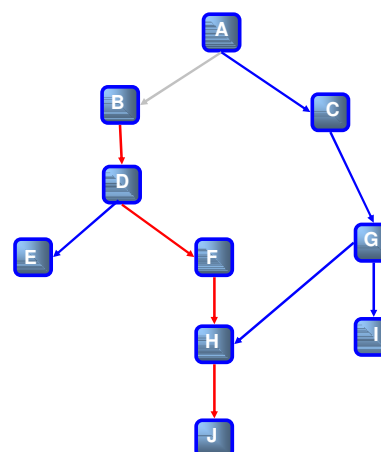
TWS z/OS Workload Brokering and Load Balancing

- TWS checks WLM Scheduling Environment (SE) availability status before jobs submission

- TWS routes jobs to MVS systems in the Sysplex (or in multiple Sysplexes) based on best available resources and Service Class priorities

- Jobs are automatically re-submitted if SE availability status changes

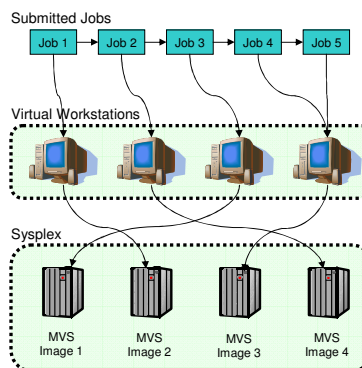- Jobs are promoted to a higher WLM Service Class if they are on the Critical Path
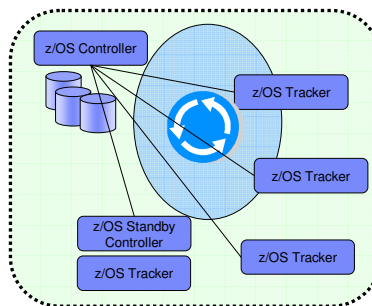
TWS z/OS Integration with System Automation for z/OS

- Advanced data center automation through integration with IBM Tivoli System Automation for z/OS

- Intuitive way for TWS operators to issue SA commands according to business and operational demands

- New TWS z/OS user and programmatic interfacing dedicated to scheduling SA commands

- Ability to start/stop/move applications and resources in a controlled fashion from within TWS

- Eliminates error-prone and time-consuming manual efforts to schedule SA commands via batch or command interfaces

- Greater visibility and control of System Automation from within TWS

TWS z/OS Controller Trackers

Status Observer | Req Receiver

SA z/OS

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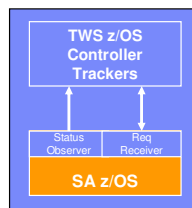
TWS z/OS Virtual Workstations

- Traditionally, workloads were assigned to one workstation, which has only one "destination"
  - Jobs 1-5 were submitted to one workstation and a single MVS image, although they may be executed in other images

- New "virtual" workstations allow multiple destinations and availability info with automatic distribution of workloads to different destinations

- Workloads are now assigned to virtual workstations, and automatically distributed to destinations currently active and connected to the Controller
  - Jobs 1-5 now submitted to several virtual workstations and dynamically brokered and submitted to MVS images
  - Alternate workstation implicitly implemented

Submitted Jobs
Job 1 Job 2 Job 3 Job 4 Job 5

Virtual Workstations

Sysplex

MVS Image 1   MVS Image 2   MVS Image 3   MVS Image 4

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TWS z/OS NOERROR Enhancement

- "NOERROR" feature provides the ability to monitor condition codes

- NOERROR LIST (error code entry, … , error code entry)
  - General entry: nnnn, Sxxx, Uxxx
  - Specific entry: jobname.stepname.procstepname.errorcode

- NOERROR enhanced
  - Relational operators in NOERROR statements
  - New specific entry: jobname.stepname.procstepname.errorcode.operator
  - Easy way to specify a range (ex. twsjob.step01.proc01.0004.GT, tws.step01.proc01.0032.LT)
  - New FLSH error code
  - New extended status

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TWS z/OS NT Password Encryption in End-to-End environments

- 2 options available

- Centralized encryption through the Controller
  - Windows passwords encrypted and stored on the mainframe
  - Same Windows user to run jobs on all Windows machines

- Decentralized, local agent encryption
  - Windows passwords encrypted and stored on local machines
  - Different Windows users for each local machine
  - User selects local encryption method
  - Mainframe checks on User and Passwords are skipped and a local user file on Windows is searched if Users and Passwords are not found in the Symphony file

TWS z/OS Controller

Events
Events

Time and calendaring rules

TWS z/OS Trackers

TWS Dist Agents

USRREC
USRCPU(cpu)
USRNAM(nam)
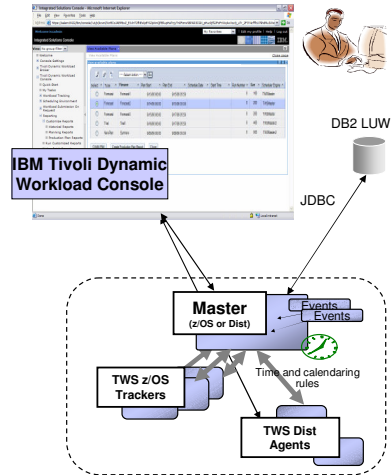USRPSW(pwd)

...
...
TOPOLOGY
USERMEM
...
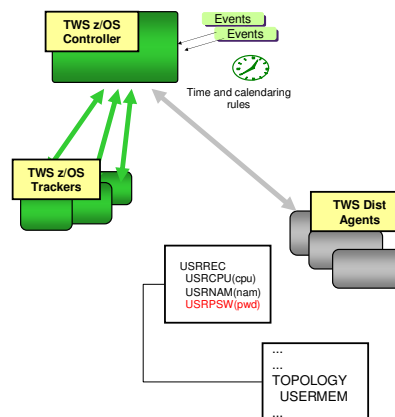
TWS z/OS TCP/IP Connectivity

- Traditionally supported communication protocols
  - Shared DASD, XCF, and SNA (ACF/VTAM) protocols between the Controller and Trackers
  - ACF/VTAM protocol used for the Controller to communicate with a remote z/OS APPC server to allow users to run ISPF dialogs and PIF's from remote systems
  - XCF and ACF/VTAM protocols are used between the Controller and the Data Store
  - TCP/IP protocol is used between Controller and distributed agents in end-to-end environments, and the old Tracker Agents
  - TCP/IP protocol is used between the Controller and Graphical User Interfaces

- New, additional TCP/IP support for customers switching from SNA to TCP/IP
  - TWS z/OS Controller and z/OS Trackers
  - Remote ISPF Dialogs and PIF
  - TWS z/OS Controller and Data Store

- New TCP/IP support implemented in compliance with the following
  - Virtual Internet Protocol Addressing (VIPA)
  - IPv6
  - Secure Sockets Layer (SSL)
  - New parameters provided to define the TCP/IP communication and activate SSL support
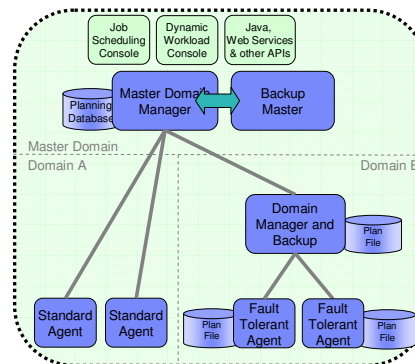
TWS z/OS Dynamic Workload Console and Reporting

- Customize, generate, view, print and save TWS-related reports

- Report types
  - Job Run History
  - Late jobs, missed deadlines, rerun indicators
  - Job Run Statistics
  - Success/error rates, min/max/average duration, late and long duration statistics
  - Workstation workload summary
  - Workload by workstation, aggregated by hour, day, etc.
  - Workstation workload runtime
  - Job run times and durations on the workstation
  - Custom SQL reports

- Data for reporting is extracted from a DB2 LUW

IBM Tivoli Dynamic Workload Console

DB2 LUW

JDBC

Master (z/OS or Dist)

Events
Events

TWS z/OS Trackers

Time and calendaring rules

TWS Dist Agents

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Tivoli Workload Scheduler

- Components
  - Master Domain Manager
    - Planning and scheduling engine
  - Domain Manager
    - Separates a single Master network into multiple domains
  - Agents
    - Fault Tolerant Agents hold plans, continue to execute plans during network outages
    - Standard Agents are lighter weight, don't hold plans
    - Agentless triggering for low workload volume environments
  - User interfaces
    - Web-based Dynamic Workload Console
    - Java-based Job Scheduling Console
  - Programmatic interfaces
    - Published Java and Web Services APIs

- Key features
  - Service-oriented architecture
  - Highly scalable and fault tolerant
  - Event-driven

Job Scheduling Console

Dynamic Workload Console

Java, Web Services & other APIs

Planning Database

Master Domain Manager

Backup Master

Master Domain

Domain A

Domain B

Domain Manager and Backup

Plan File

Standard Agent

Standard Agent

Plan File

Fault Tolerant Agent

Fault Tolerant Agent

Plan File

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What's new for TWS

- Automation
  - Process and event-driven alerting, notification and execution of workloads
  - Trial and forecast planning through the Web-based Dynamic Workload Console
  - Agentless, remote triggering of workloads
  - TWS Agents connect directly to z/OS Controllers in end-to-end configurations
  - Option to install Oracle database

- Security and network connectivity
  - Full firewall support for secure, reliable execution across firewalls
  - SSL authentication to protect TWS domains and workstations
  - Centralized or decentralized user security and authentication models
  - Support for LDAP and IPv6

- Graphical user interfacing
  - New Web-based Dynamic Workload Console with reporting

- Service-oriented architecture
  - Open, published J2EE and Web Services APIs

TWS Event-Driven Workload Automation

- The main concept of the event-driven scheduling/notification architecture is the Event Rule

- The Event Rule object is a composition of:
  - Events
  - Events Correlation Conditions
  - Actions

- The Event Rule can be associated to:
  - Validity time interval
 - Status: draft or active

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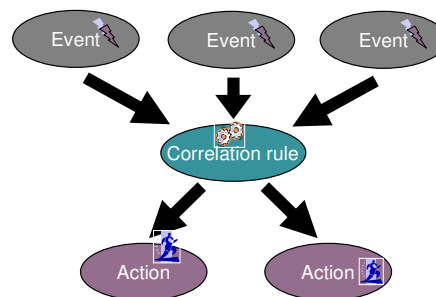
TWS Event-Driven Workload Automation

- The following Events, Correlation and Actions are available

- Events :
  - ➢ File event (transfer, creation, update, deletion)
  - ➢ Message in log
  - ➢ Status of TWS objects including job/jobstream status changes, return code conditions
  - ➢ Status of TWS agents including linked/unlinked and started/stopped
  - ➢ CPU utilization threshold
  - ➢ Generic, custom events
  - ➢ SAP base event

- Correlation Rules :
  - ➢ Set
  - ➢ Sequence
  - ➢ Filters
  - ➢ Timeout
  - ➢ Correlations

- Actions :
  - ➢ Submit Job, Jobstream, ad-hoc
  - ➢ Answer a prompt
  - ➢ Send an email
  - ➢ Send an EIF event to a monitoring solution (Tivoli Enterprise Portal) or event correlation engine (Tivoli Enterprise Console)
  - ➢ Write a message in a log
  - ➢ Time out actions, for example an action planned by the user in case a certain number of events are not received within a specified timeframe

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Tivoli Workload Scheduler for Applications

- Components
  - ➢Extended Agent for SAP business applications and data warehouse
  - ➢Extended Agent for Oracle e-Business applications
  - ➢Extended Agent for Oracle PeopleSoft business applications
  - ➢Extended Agent for MVS systems and non-IBM z/OS schedulers

- Key features
  - ➢Extends TWS to external applications and environments to aggregate and drive cross-enterprise workloads
  - ➢Fault Tolerance provided by FTA hosting eXtended-agent(s)
  - ➢More than one eXtended-agent can be hosted by the same FTA

TWS or
TWS z/OS

TWS Fault
Tolerant Agent

SAP X
Agent

Oracle X
Agent

SAP
System

Oracle
System

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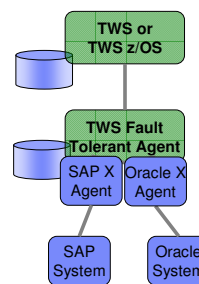
What's New for TWS for Applications

- SAP systems
  - SAP certification to provide full integration from the TWS Job Scheduling Console and Tivoli Dynamic Workload Console
    - SAP BC-XBP 2.0
    - SAP BW-SCH 3.0
  - New SAP-specific panels in the Job Scheduling Console to create, modify and delete SAP jobs
    - Submit SAP workloads through TWS
  - Monitor and manage SAP jobs whether created in SAP or in TWS
    - Preservation of all SAP job attributes
    - Management and resubmission of intercepted SAP jobs to ensure they are launched at optimal times
    - Enhanced parent-child feature to monitor and track instances when SAP jobs spawn child processes
    - Kill running SAP jobs and associated child processes
    - Deletion of SAP jobs and defined in SAP system
  - SAP Business Information Warehouse integration
    - Create, modify, delete, etc
    - Placeholders, replaced at runtime
  - SAP factory calendar integration with TWS
    - Import SAP calendars into TWS plans
    - Automatic updates for SAP calendars
  - SAP load balancing
    - Fine-tune SAP load balancing across server groups

- Oracle and PeopleSoft systems
  - Extended OS platform support for Oracle and PeopleSoft eXtended agents to Solaris and HP-UX
  - Simplified installation and configuration

- All components
  - Event automation for dynamic alerting, notification and triggering of jobs based on application and system events
  - IPv6, FIPS 140-2 standards

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Tivoli Dynamic Workload Broker

- Components

  - Tivoli Dynamic Workload Broker Server

    - Matches incoming workload requirements and attributes to IT resource attributes and availability
    - Distributes workloads to best available resources on demand and according to policies

  - Tivoli Dynamic Workload Broker Agents

    - Monitors local virtual and physical IT resources and submits workloads
    - Automatically discovers resource configuration changes

- Key features

  - Transforms TWS networks into virtual, adaptive and optimized enterprise computing environments

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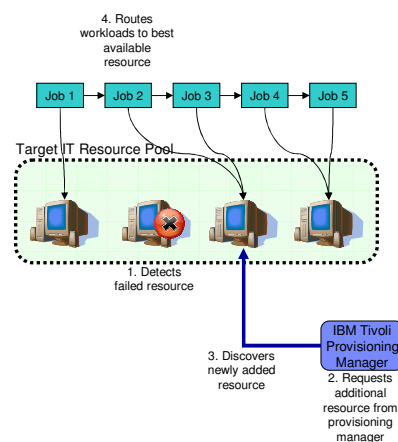
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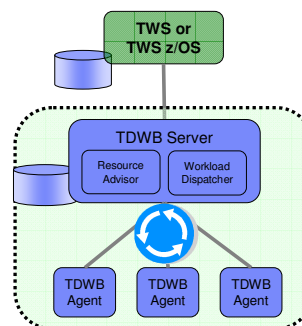
What's New for TDWB

- Manages the matching and dispatching of workloads to best available resources
  - Based on workload requirements, resource performance and attributes and business policies
  - Physical resources
  - Logical resources
- Optimizes the utilization of IT resources based on user-defined policies
  - Enable maximum throughput of high priority workloads when multiple workloads are competing for limited resources
  - Physical and virtual memory size and utilization
  - CPU architecture, quantity, speed and utilization
  - Operating system type and version
  - Logical resources
  - File systems required for running workloads
- Enables user-defined optimization objectives including minimums, maximums and exact values
- Provides automatic discovery and integration of newly added resources into the workload matching pool
- Full distributed OS platform support including AIX, Linux, Linux on z, Windows, Solaris and HP-UX
- Support for VMWare virtual machine environments
- Option to install Oracle database
- Enhanced audit logging for easier compliance report generation

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TDWB Illustration on Autonomic Adaptability

- Optimize capacity of IT infrastructure to execute more workload with less hardware
  - Jobs can be submitted to the less loaded resource
  - Similarly a load policy can be configured to use a given amount of available resource

- Improve Business Efficiency and reduce TCO by automatically adapting execution to environment changes
  - Distribute workloads to "best available" resource across dynamically shifting, cross-enterprise resource pool
  - Provides Automatic Routing: job can be routed to any available node that matches the resource requirement
  - Automatic discovery of newly available servers as part of the pool of possible job targets

4. Routes workloads to best available resource

Job 1   Job 2   Job 3   Job 4   Job 5

Target IT Resource Pool

1. Detects failed resource

IBM Tivoli Provisioning Manager

3. Discovers newly added resource

2. Requests additional resource from provisioning manager

Tivoli Workload Automation End-to-End Solutions

- Tivoli Workload Automation components can be deployed into different solutions, to accommodate any customer need and organization requirement

- Maximum flexibility without feature limitations

- Meets any customer organization requirements

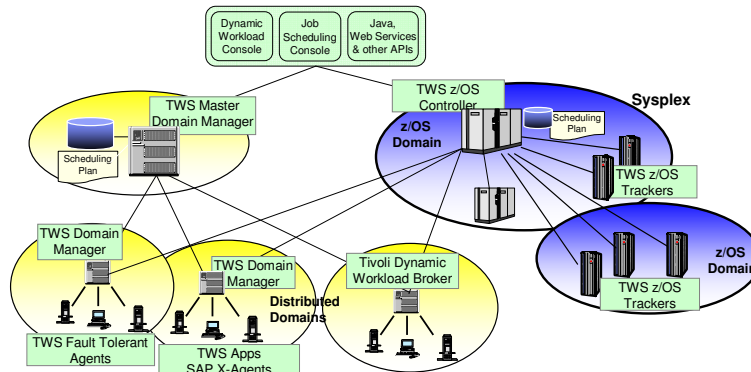- High Availability, scalability and fault tolerance

- Any deployment scenario can leverage dynamic workload brokering

- All the different solutions can be monitored by a single Web-based user interface

Parallel Schedulers with a Common Console

Mainframe-Centric End-to-End

Peer-to-Peer Schedulers with a Common Console and Connected Agents

Distributed-Centric End-to-End

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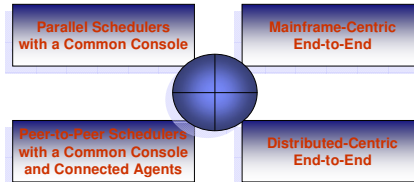
Tivoli Workload Automation End-to-End Illustration

Dynamic Workload Console

Job Scheduling Console

Java, Web Services & other APIs

TWS z/OS Controller

Sysplex

TWS Master Domain Manager

Scheduling Plan

z/OS Domain

Scheduling Plan

TWS z/OS Trackers

TWS Domain Manager

TWS Domain Manager

Tivoli Dynamic Workload Broker

z/OS Domain

Distributed Domains

TWS z/OS Trackers

TWS Fault Tolerant Agents

TWS Apps SAP X-Agents

- Peer-to-peer configuration

- Centralized planning, monitoring and control of cross-enterprise workloads

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Tivoli Workload Automation Integration Points

Tivoli Service Request Manager

Tivoli INFOMAN

Tivoli CCMDB

WebSphere Service Registry & Repository

WebSphere Application Server

WebSphere Extended Deployment

Tivoli Business Service Manager

Web Services and J2EE

Tivoli Enterprise Portal

Tivoli OMEGAMON

Tivoli Workload Automation

SAP Systems

Tivoli Monitoring

Oracle Systems

Tivoli Netcool

PeopleSoft Systems

Tivoli Enterprise Console

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Tivoli System Automation z/OS & Multiplatforms

Tivoli Storage Manager

Tivoli NetView

Tivoli Provisioning Manager

Workload Manager

Tivoli Configuration Manager

Open Grid Services Architecture

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