# The Autonomic Computing Architecture

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Autonomic Computing

April 14, 2004

# Agenda

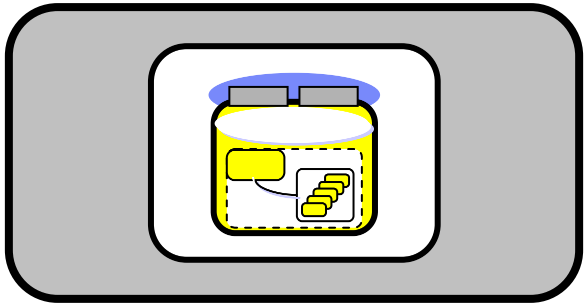
Self-Configuring
Self-Healing
Self-Optimizing
Self-Protecting

- Autonomic Computing Architecture
  - Touchpoints
  - Autonomic Managers
  - K-services
- Autonomic Computing Core Technologies
  - Problem Determination and Self-Healing
  - Solution Change Management and Self-Configuring
  - Autonomic Computing Policy Management for delivering policy-driven IT

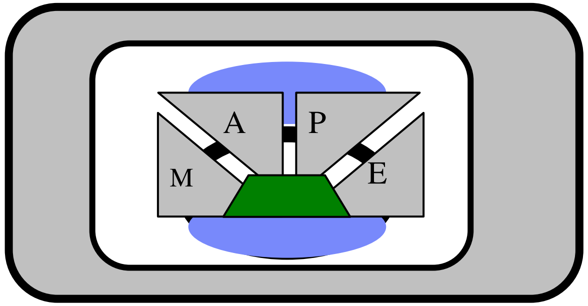
# Components of the Autonomic Computing Architecture

***The autonomic computing architecture abstracts or organizes the systems into some basic elements.***

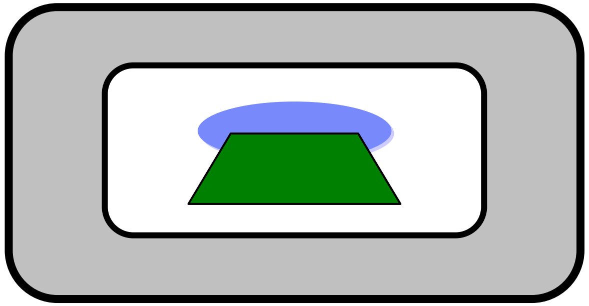
- **Touchpoints**



- **Autonomic Managers**



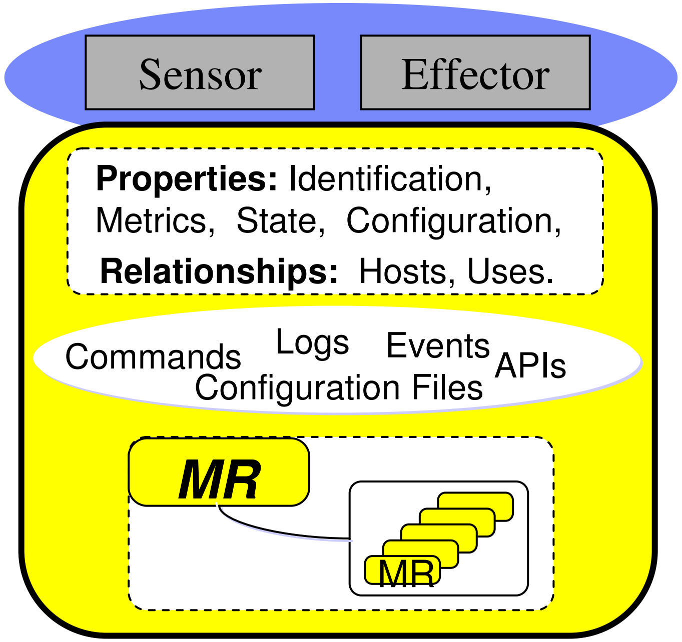
- **K-services**



# Building Block: Touchpoint

***A major contributor to the complexity of managing an IT infrastructure is the diverse syntax and semantics in the mechanism used for the manageability interface.***

A ***touchpoint*** is an autonomic computing system building block that implements the sensor and effector behavior for one or more of the managed resource manageability mechanism.


Sensor
Effector
**Properties:** Identification, Metrics, State, Configuration,
**Relationships:** Hosts, Uses.
Commands
Logs
Events
APIs
Configuration Files
MR
MR

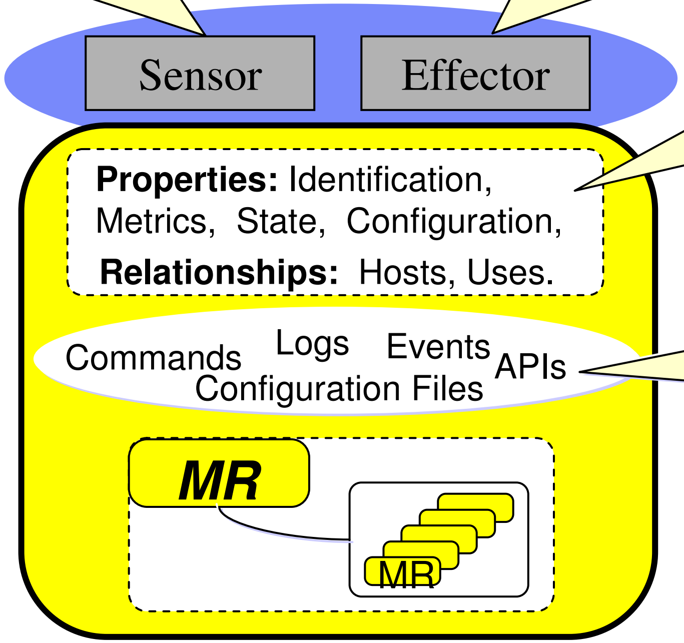
# Building Block: Touchpoint

## Overview

***A touchpoint is an autonomic computing system building block that implements the sensor/effector pattern for one or more of the manageability interface mechanisms.***

Managers obtains **details** through its **sensor**.
Two Modes:
(1) Manager request **details**
(2) Resource provides **details**

Managers **changes** details through its **effector**.
Two Modes:
(1) Manager initiates the **change**
(2) Resource requests the **change**.


Sensor
Effector
**Properties:** Identification,
Metrics, State, Configuration,
**Relationships:** Hosts, Uses.
Commands
Logs
Events
APIs
Configuration Files
MR
MR

The **details** a manager needs to monitor and control a managed resource.

The mechanisms used to monitor and control a managed resource form its **manageability interface.**

# Building Block: Touchpoint

***A manageability interface for a managed resource that incorporates these four interaction styles enables most self management scenarios.***

**A sensor enablers a client to access state using two styles:**

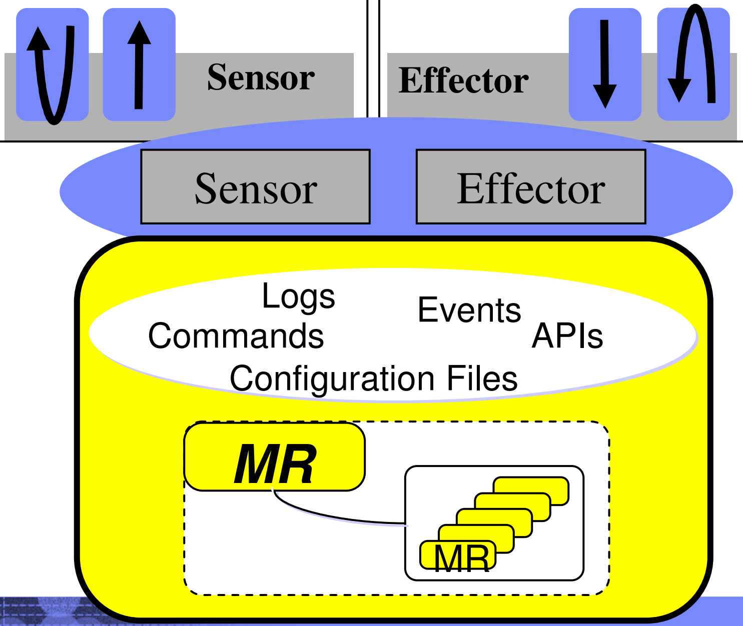
***Retrieve-State*** is an interaction style in which a client polls for some details.

***Receive-Notification*** is an interaction style in which a resource manager sends an unsolicited message.

**A effector enables a client to change state using two styles:**

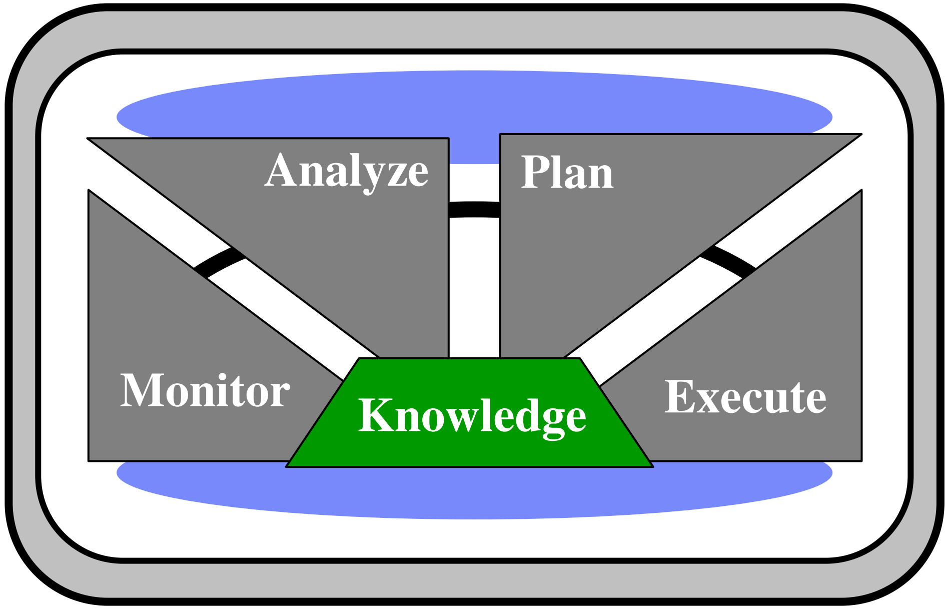
***Perform-Operation*** is an interaction style in which an client issues a command against a resource manager.

***Call-Out-Request*** is an interaction style in which the resource manager asks another capability for some details.



# Building Block: Autonomic Manager

***An autonomic manager is a configuration of automated functions that deliver "self management" capabilities.***

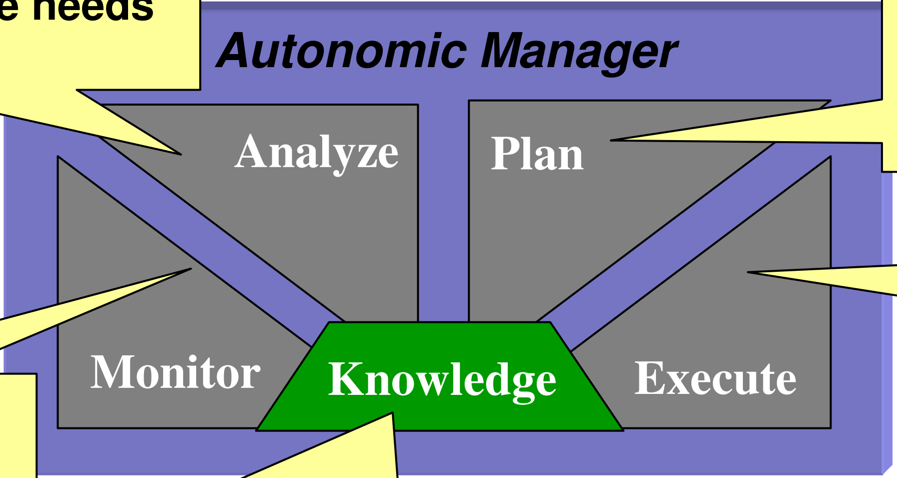


# Building Block: Autonomic Manager

***Self-Management is an automation style that implements a control loop that is driven by the circumstances observed in the system.***

**An autonomic manager is an autonomic system building block that implements a control loop.**

**Analyzes observed situations to determine if some change needs to be made.**



**Creates or selects a plan to make a desired change**

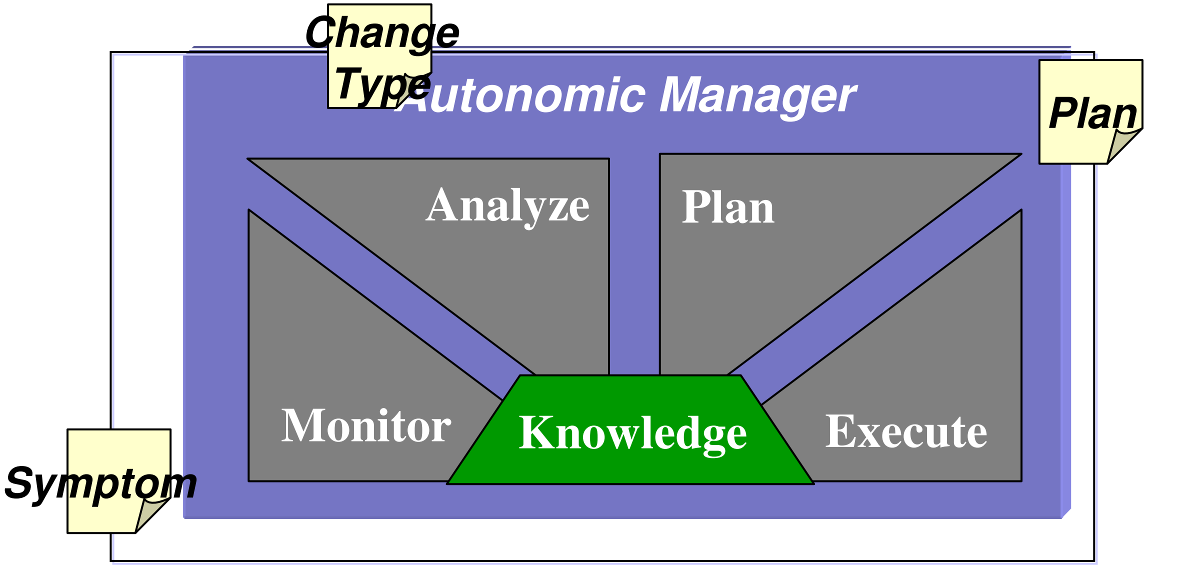
**Makes the changes by performing the plan**

**Collects details from the system and organizes then into situation that need to be analyzed.**

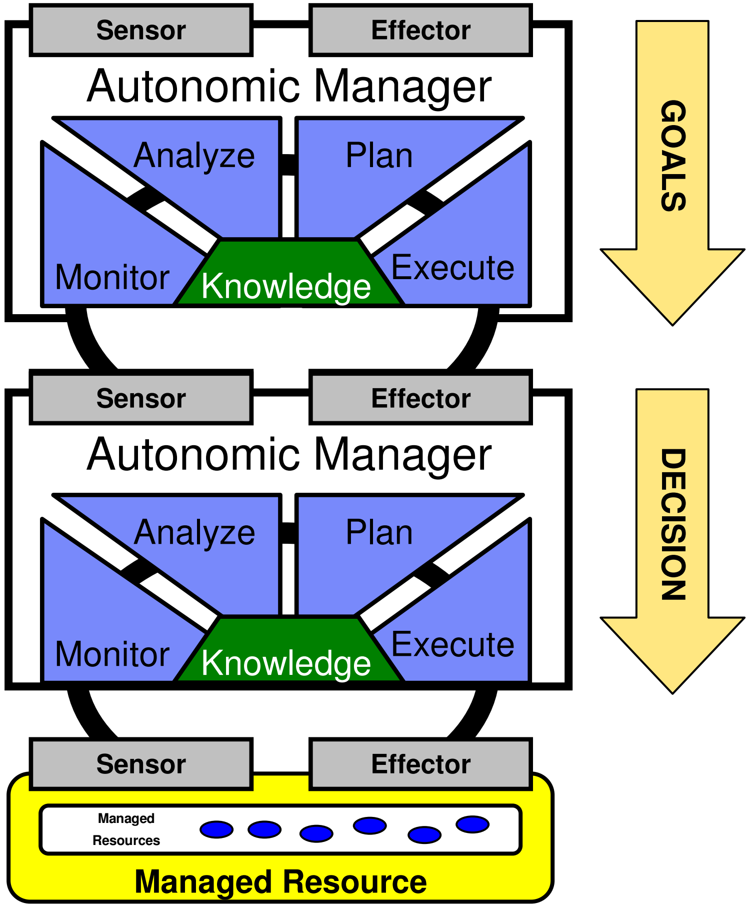
**Shares accumulated knowledge across the elements.**

# Building Block: Autonomic Manager

***Self-Management is an automation style that implements a control loop that is driven by the circumstances observed in the system.***



# Building Block: Autonomic Managers



## "Orchestrating" AUTONOMIC MANAGER

- Accepts higher level business goals
- Translates business policy into goals and objectives for the resource its managing
- Pushes Goals down onto its managed elements

## "Touchpoint" AUTONOMIC MANAGER

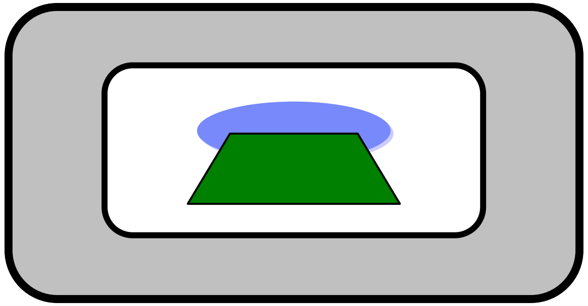
- Accepts goals
- Translates goals into effectors to be pressed
- Pushes down onto effectors and measures goals via sensors

## Managed Resource

- Accepts decisions
- Manages resources accordingly

# Building Block: K-Service

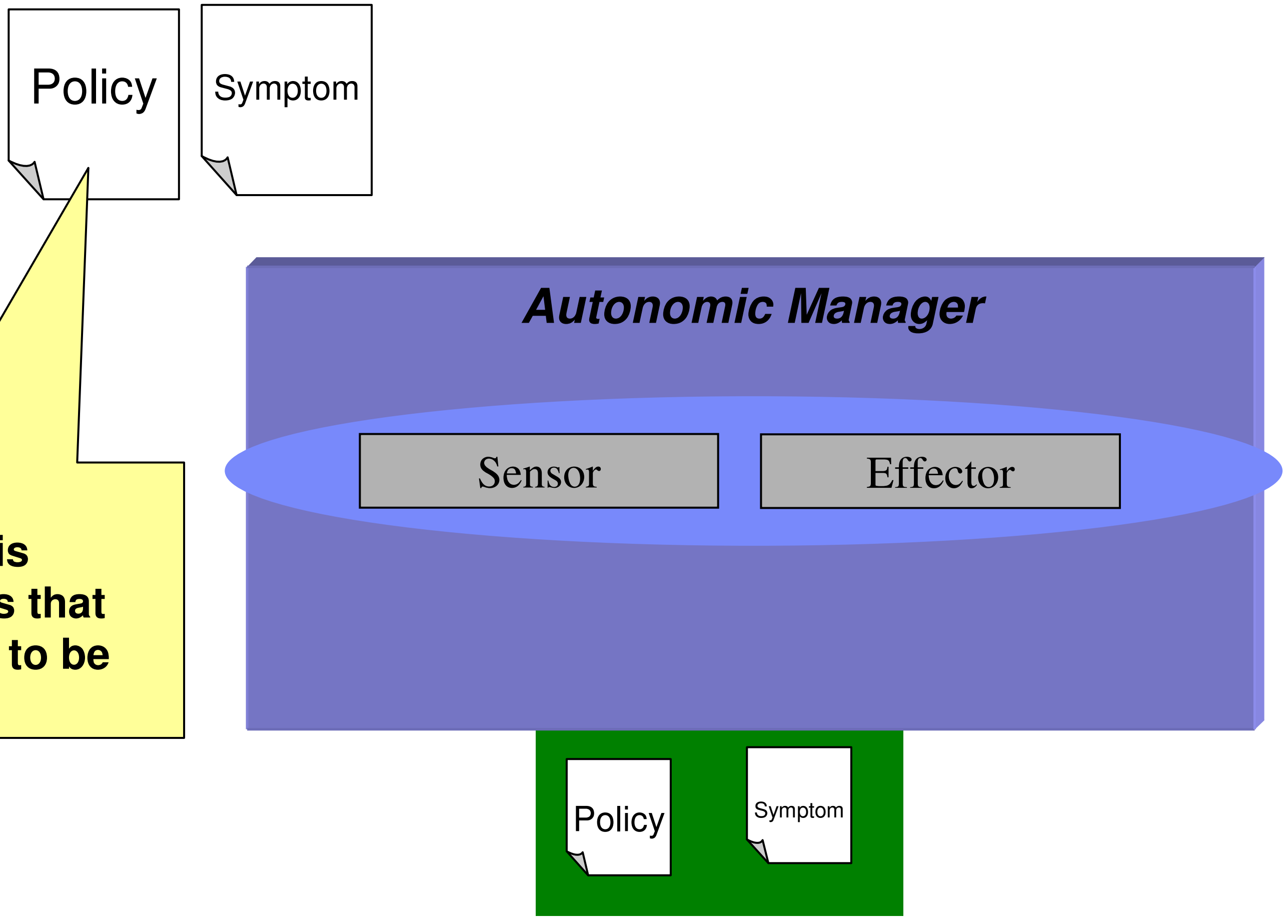
***A k-service is used to share knowledge between autonomic managers.***



***K-Types define the syntax and semantics for a type of knowledge.***
***K-Type is "configure" data for an AM.***
***When appropriate, identify/build enabling technology for k-types.***
***K-Service is a building block for sharing knowledge between AM.***
***K-Service existing for k-type/query combinations.***

# Building Block: K-Service

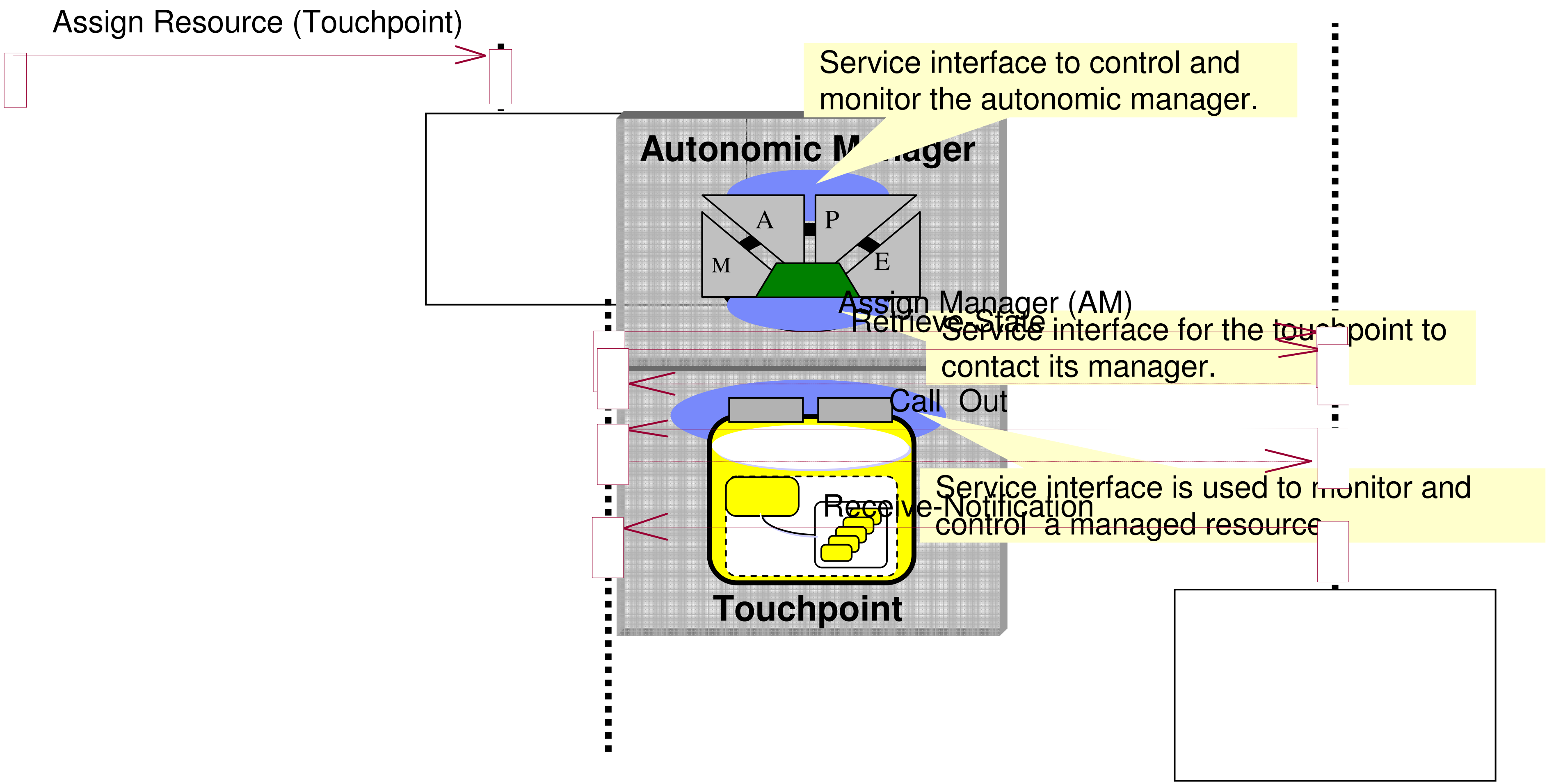
***Knowledge can be passed to the autonomic manager  as configuration data or the autonomic manager can request knowledge as configuration data.***



**The behavior of the autonomic manager is controlled by policies that describe what needs to be accomplished.**

# Interaction between components

***The interfaces for an Autonomic Manager and a Touchpoint are defined as "services".***



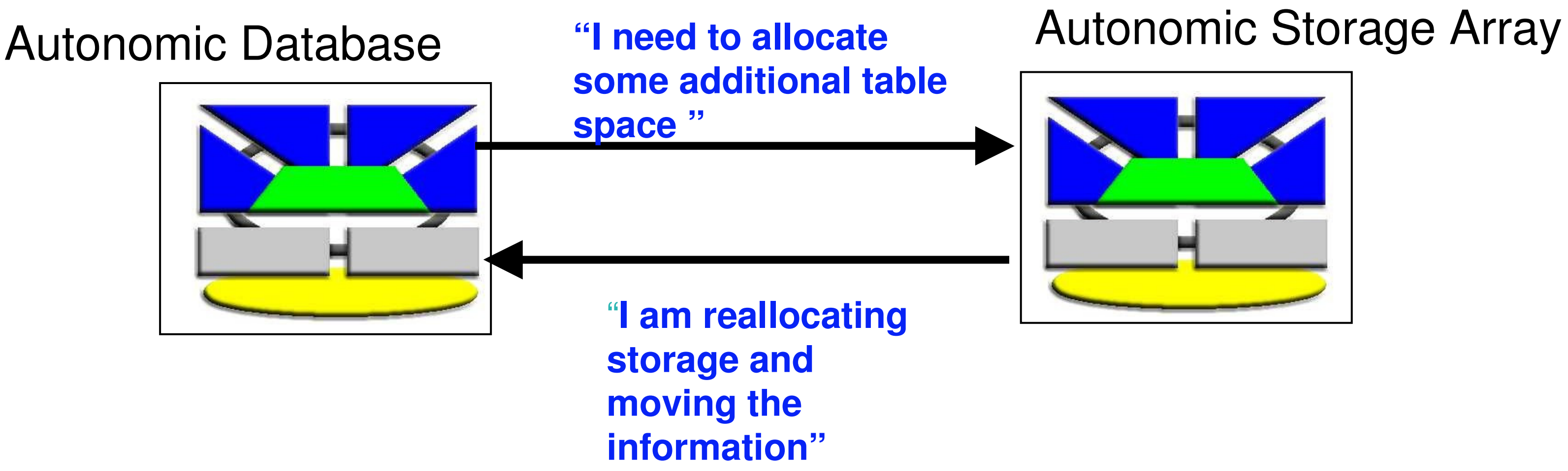
Service interface to control and monitor the autonomic manager.

Service interface for the touchpoint to contact its manager.

Service interface is used to monitor and control a managed resource

# A simple example

- Autonomic elements have two management tasks
  - They manage themselves
  - They manage their relationships with other elements through negotiated agreements



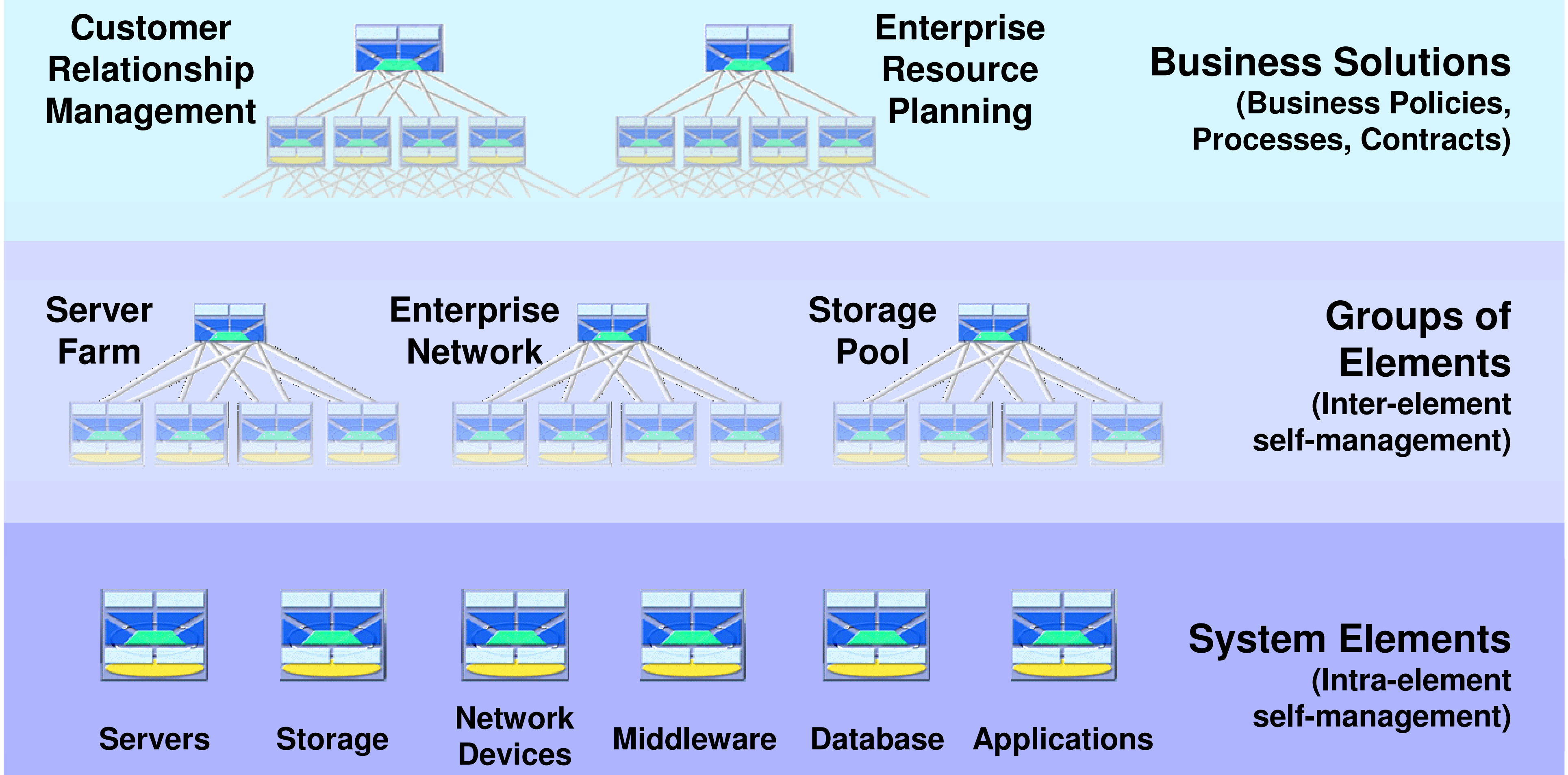
Autonomic Database

Autonomic Storage Array

"I need to allocate some additional table space "

"I am reallocating storage and moving the information"

# Multiple Contexts for Autonomic Behavior



Customer Relationship Management

Enterprise Resource Planning

**Business Solutions**
(Business Policies, Processes, Contracts)

Server Farm

Enterprise Network

Storage Pool

**Groups of Elements**
(Inter-element self-management)

Servers

Storage

Network Devices

Middleware

Database

Applications

**System Elements**
(Intra-element self-management)

# Core AC Problem Determination Technology: First steps towards Self-Healing Systems

1. ***Common Base Event (CBE) Model***
   - **Standard to facilitate intercommunication among components supporting logging and problem determination.**
2. ***Generic Log Adapter***
   - **Converts existing log files into CBE format**
3. ***Log and Trace Analyzer***
   - **Organizes log and trace data into CBE format for problem determination**
4. ***Symptom Database***
   - **File of symptoms, string match patterns, associated solutions and directives used in analysis of events and messages in a log.**

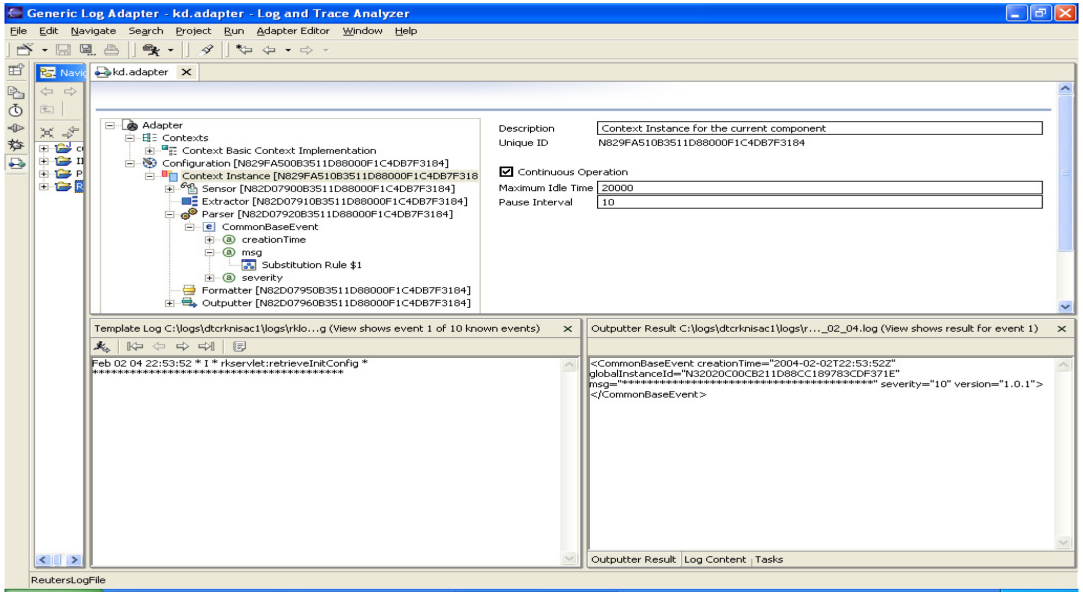
# Common Base Event Model: Overview

Common Base Event submitted to OASIS

- **Data elements in logs need to be in a consistent format to facilitate correlation of events from different infrastructure components, and to facilitate effective intercommunication among disparate applications and systems.**
- **Common Base Event (CBE) model is a standard describing how system activity is recorded and communicated.**
- **Common format for logging, management, problem determination, and autonomic computing**
- **CBE Elements:**
  1. **Identification of component reporting the situation**
  2. **Identification of component affected by situation**
  3. **The situation (REQUEST, START, REPORT, STOP, DEPENDENCY, CONFIGURE, CREATE, CONNECT, etc)**

# Generic Log Adapter:  Overview

- **An adapter for the conversion of existing log formats into CBE**
- **Standards based: Java plug-in on top of the Eclipse platform**
- **GUI:  For the creation of mapping rules.**
- **Runtime: Takes mapping rules as input and produces CBE records as output.**
- **Open Source – Project Hyades: http://eclipse.org/hyades**



- Adapter
  - Contexts
    - Context Basic Context Implementation
  - Configuration [N829FA500B3511D88000F1C4DB7F3184]
    - Context Instance [N829FA510B3511D88000F1C4DB7F318
      - Sensor [N82D07900B3511D88000F1C4DB7F3184]
      - Extractor [N82D07910B3511D88000F1C4DB7F3184]
      - Parser [N82D07920B3511D88000F1C4DB7F3184]
        - CommonBaseEvent
          - creationTime
          - msg
            - Substitution Rule $1
          - severity
      - Formatter [N82D07950B3511D88000F1C4DB7F3184]
      - Outputter [N82D07960B3511D88000F1C4DB7F3184]

Description: Context Instance for the current component
Unique ID: N829FA510B3511D88000F1C4DB7F3184

☑ Continuous Operation

Maximum Idle Time: 20000
Pause Interval: 10

Template Log C:\logs\dtcrknisac1\logs\rklo…g (View shows event 1 of 10 known events)

```
Feb 02 04 22:53:52 * I * rkservlet:retrieveInitConfig *
*****************************************
```

Outputter Result C:\logs\dtcrknisac1\logs\r…_02_04.log (View shows result for event 1)

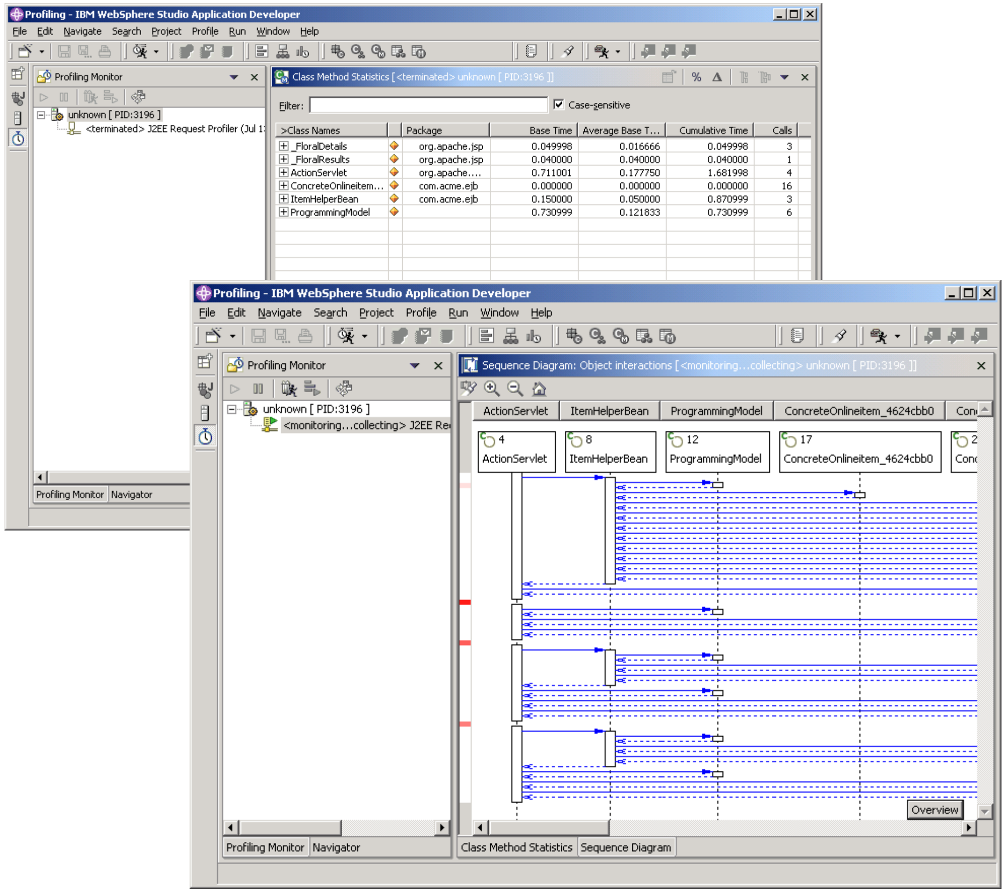
```
<CommonBaseEvent creationTime="2004-02-02T22:53:52Z"
globalInstanceId="N32020C00CB211D88CC189783CDF371E"
msg="*****************************************" severity="10" version="1.0.1">
</CommonBaseEvent>
```

# Log and Trace Analyzer:  Overview

***Customer pain point:***

**Difficulty in analyzing problems in multi-component systems**

- **Viewing, analysis, and correlation of log files**
- **Consolidated environment that deals with logs and traces produced by various components**
- **Easier and faster for developers and support personnel to debug and resolve problems**
- **Link to WebSphere symptom database available today**


Profiling - IBM WebSphere Studio Application Developer
File Edit Navigate Search Project Profile Run Window Help
Profiling Monitor
unknown [ PID:3196 ]
<terminated> J2EE Request Profiler (Jul 1
Profiling Monitor Navigator
Profiling - IBM WebSphere Studio Application Developer
File Edit Navigate Search Project Profile Run Window Help
Profiling Monitor
unknown [ PID:3196 ]
<monitoring...collecting> J2EE Re
Sequence Diagram: Object interactions [<monitoring...collecting> unknown [ PID:3196 ]]
ActionServlet
ItemHelperBean
ProgrammingModel
ConcreteOnlineitem_4624cbb0
4 ActionServlet
8 ItemHelperBean
12 ProgrammingModel
17 ConcreteOnlineitem_4624cbb0
Overview
Profiling Monitor Navigator
Class Method Statistics Sequence Diagram

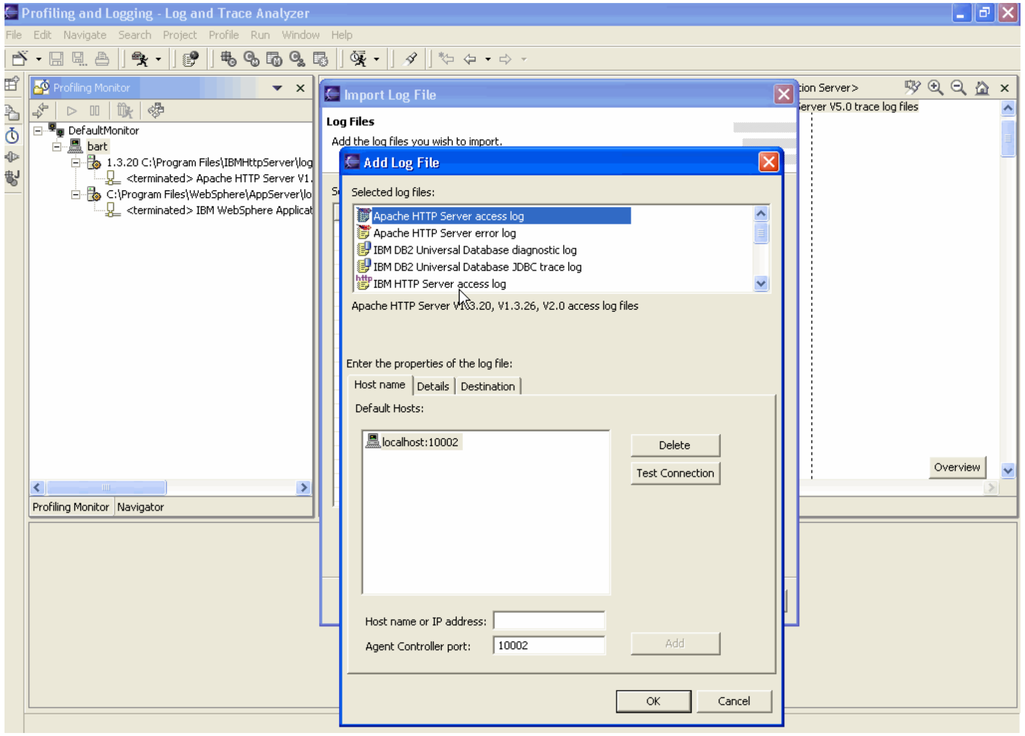
Class Method Statistics [<terminated> unknown [ PID:3196 ]]

Filter: ☑ Case-sensitive

| >Class Names | | Package | Base Time | Average Base T... | Cumulative Time | Calls |
|---|---|---|---|---|---|---|
| _FloralDetails | ◆ | org.apache.jsp | 0.049998 | 0.016666 | 0.049998 | 3 |
| _FloralResults | ◆ | org.apache.jsp | 0.040000 | 0.040000 | 0.040000 | 1 |
| ActionServlet | ◆ | org.apache.... | 0.711001 | 0.177750 | 1.681998 | 4 |
| ConcreteOnlineitem... | ◆ | com.acme.ejb | 0.000000 | 0.000000 | 0.000000 | 16 |
| ItemHelperBean | ◆ | com.acme.ejb | 0.150000 | 0.050000 | 0.870999 | 3 |
| ProgrammingModel | ◆ | | 0.730999 | 0.121833 | 0.730999 | 6 |

# Log and Trace Analyzer: Parsers and Correlation Engines

- **Eclipse based tools**
- **Built in parsers: Imports existing log files and converts to CBE format on the fly.**
- **Built in correlation engines: Visually displays the correlation between log records using a number of factors:**
  - **Sequential Correlation**
  - **Associative Correlation**



DefaultMonitor
bart
1.3.20 C:\Program Files\IBMHttpServer\log
<terminated> Apache HTTP Server V1.
C:\Program Files\WebSphere\AppServer\lo
<terminated> IBM WebSphere Applicat

Log Files

Add the log files you wish to import.

erver V5.0 trace log files

Selected log files:

Apache HTTP Server access log
Apache HTTP Server error log
IBM DB2 Universal Database diagnostic log
IBM DB2 Universal Database JDBC trace log
IBM HTTP Server access log

Apache HTTP Server V1.3.20, V1.3.26, V2.0 access log files

Enter the properties of the log file:

Default Hosts:

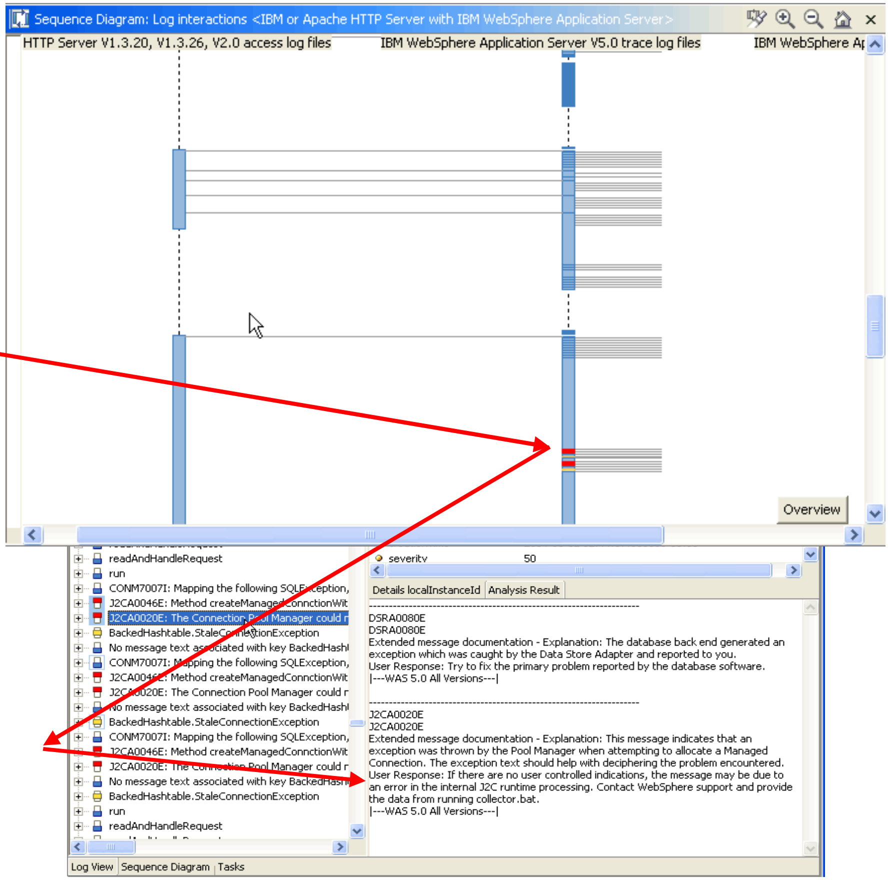
localhost:10002

Host name or IP address:

Agent Controller port: 10002

# Log and Trace Analyzer: Symptom Database

- **Used in the analysis of events and error messages that may occur in a log.**
- **XML file of symptoms, string match patterns, associated solutions, and directives.**


Sequence Diagram: Log interactions <IBM or Apache HTTP Server with IBM WebSphere Application Server>
HTTP Server V1.3.20, V1.3.26, V2.0 access log files
IBM WebSphere Application Server V5.0 trace log files
IBM WebSphere Ap
Overview
Log View
Sequence Diagram
Tasks

```
readAndHandleRequest
run
CONM7007I: Mapping the following SQLException,
J2CA0046E: Method createManagedConnctionWit
J2CA0020E: The Connection Pool Manager could r
BackedHashtable.StaleConnectionException
No message text associated with key BackedHash
CONM7007I: Mapping the following SQLException,
J2CA0046E: Method createManagedConnctionWit
J2CA0020E: The Connection Pool Manager could r
No message text associated with key BackedHash
BackedHashtable.StaleConnectionException
CONM7007I: Mapping the following SQLException,
J2CA0046E: Method createManagedConnctionWit
J2CA0020E: The Connection Pool Manager could r
No message text associated with key BackedHash
BackedHashtable.StaleConnectionException
run
readAndHandleRequest
```

severity 50

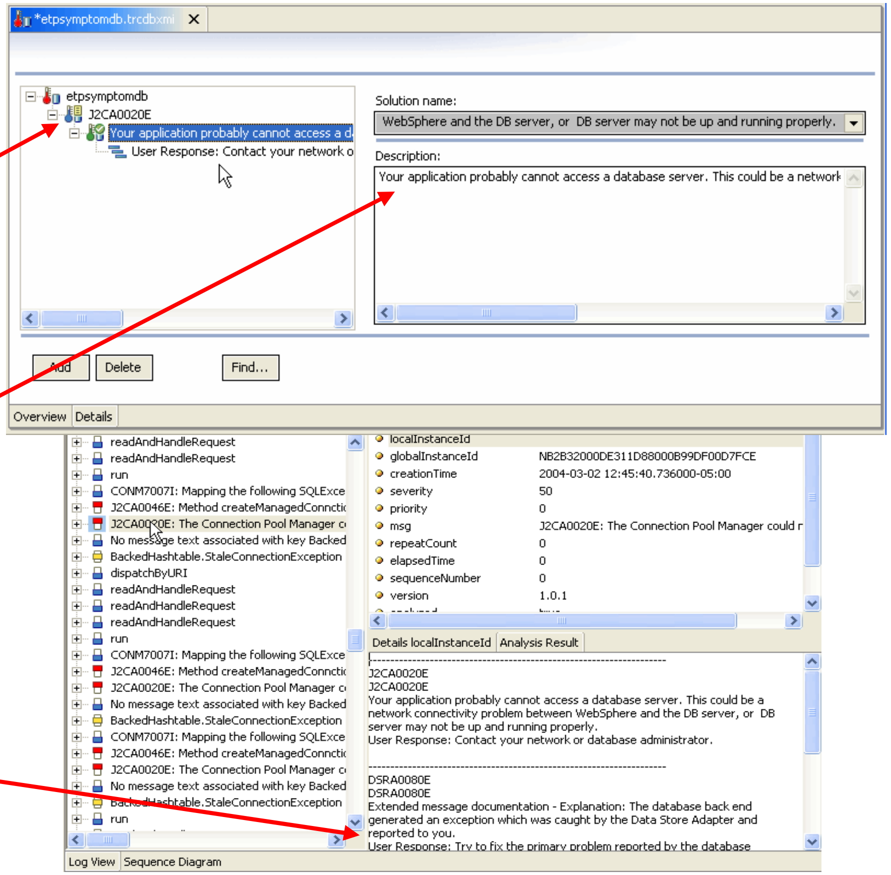
Details localInstanceId | Analysis Result

```
--------------------------------------------------------------------
DSRA0080E
DSRA0080E
Extended message documentation - Explanation: The database back end generated an
exception which was caught by the Data Store Adapter and reported to you.
User Response: Try to fix the primary problem reported by the database software.
|---WAS 5.0 All Versions---|

--------------------------------------------------------------------
J2CA0020E
J2CA0020E
Extended message documentation - Explanation: This message indicates that an
exception was thrown by the Pool Manager when attempting to allocate a Managed
Connection. The exception text should help with deciphering the problem encountered.
User Response: If there are no user controlled indications, the message may be due to
an error in the internal J2C runtime processing. Contact WebSphere support and provide
the data from running collector.bat.
|---WAS 5.0 All Versions---|
```

# Log and Trace Analyzer: Knowledge from experience

- ***Symptom Database Editor:*** **Edit existing symptom databases, or create custom symptom databases specifically for your environment or applications.**
  - **Define application specific directives and solutions**
  - **Augment a product's symptom database based on actual experience**



```
etpsymptomdb
  J2CA0020E
    Your application probably cannot access a d
      User Response: Contact your network o
```

Solution name: WebSphere and the DB server, or  DB server may not be up and running properly.

Description: Your application probably cannot access a database server. This could be a network

```
readAndHandleRequest
readAndHandleRequest
run
CONM7007I: Mapping the following SQLExce
J2CA0046E: Method createManagedConnctic
J2CA0020E: The Connection Pool Manager c
No message text associated with key Backed
BackedHashtable.StaleConnectionException
dispatchByURI
readAndHandleRequest
readAndHandleRequest
readAndHandleRequest
run
CONM7007I: Mapping the following SQLExce
J2CA0046E: Method createManagedConnctic
J2CA0020E: The Connection Pool Manager c
No message text associated with key Backed
BackedHashtable.StaleConnectionException
CONM7007I: Mapping the following SQLExce
J2CA0046E: Method createManagedConnctic
J2CA0020E: The Connection Pool Manager c
No message text associated with key Backed
BackedHashtable.StaleConnectionException
run
```

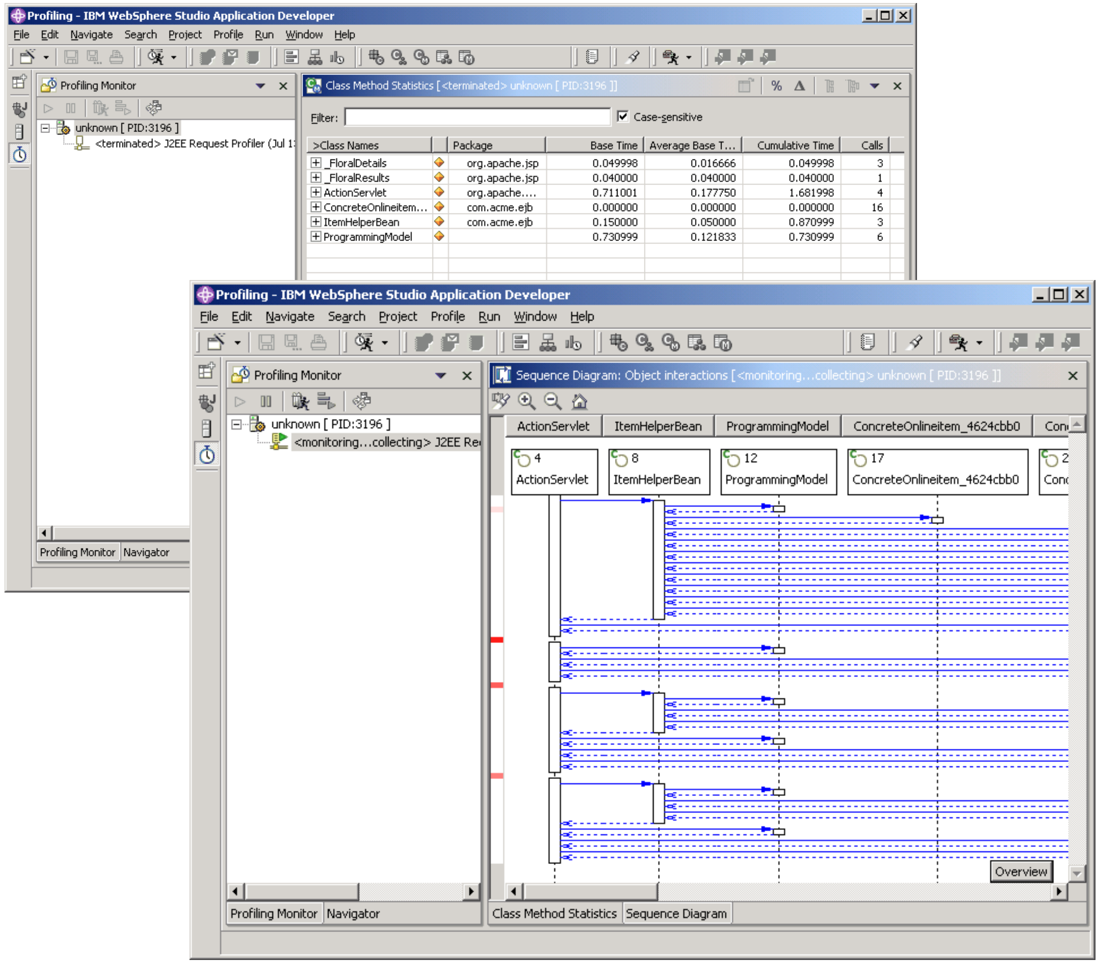
| | |
|---|---|
| localInstanceId | |
| globalInstanceId | NB2B32000DE311D88000B99DF00D7FCE |
| creationTime | 2004-03-02 12:45:40.736000-05:00 |
| severity | 50 |
| priority | 0 |
| msg | J2CA0020E: The Connection Pool Manager could r |
| repeatCount | 0 |
| elapsedTime | 0 |
| sequenceNumber | 0 |
| version | 1.0.1 |

```
----------------------------------------------------------------
J2CA0020E
J2CA0020E
Your application probably cannot access a database server. This could be a
network connectivity problem between WebSphere and the DB server, or  DB
server may not be up and running properly.
User Response: Contact your network or database administrator.

----------------------------------------------------------------
DSRA0080E
DSRA0080E
Extended message documentation - Explanation: The database back end
generated an exception which was caught by the Data Store Adapter and
reported to you.
User Response: Try to fix the primary problem reported by the database
```

# Log and Trace Analyzer: Profiling Tool

- **Tool for profiling applications in <u>real time</u> to diagnose <u>performance and memory leak</u> problems**
- **Interactively profile applications on local and remote <u>deployment environments</u>**



Profiling - IBM WebSphere Studio Application Developer

Class Method Statistics [<terminated> unknown [ PID:3196 ]]

Filter: ☑ Case-sensitive

| >Class Names | | Package | Base Time | Average Base T… | Cumulative Time | Calls |
|---|---|---|---|---|---|---|
| _FloralDetails | ◆ | org.apache.jsp | 0.049998 | 0.016666 | 0.049998 | 3 |
| _FloralResults | ◆ | org.apache.jsp | 0.040000 | 0.040000 | 0.040000 | 1 |
| ActionServlet | ◆ | org.apache.… | 0.711001 | 0.177750 | 1.681998 | 4 |
| ConcreteOnlineitem… | ◆ | com.acme.ejb | 0.000000 | 0.000000 | 0.000000 | 16 |
| ItemHelperBean | ◆ | com.acme.ejb | 0.150000 | 0.050000 | 0.870999 | 3 |
| ProgrammingModel | ◆ | | 0.730999 | 0.121833 | 0.730999 | 6 |

Sequence Diagram: Object interactions [<monitoring…collecting> unknown [ PID:3196 ]]

# Solution Change Manager

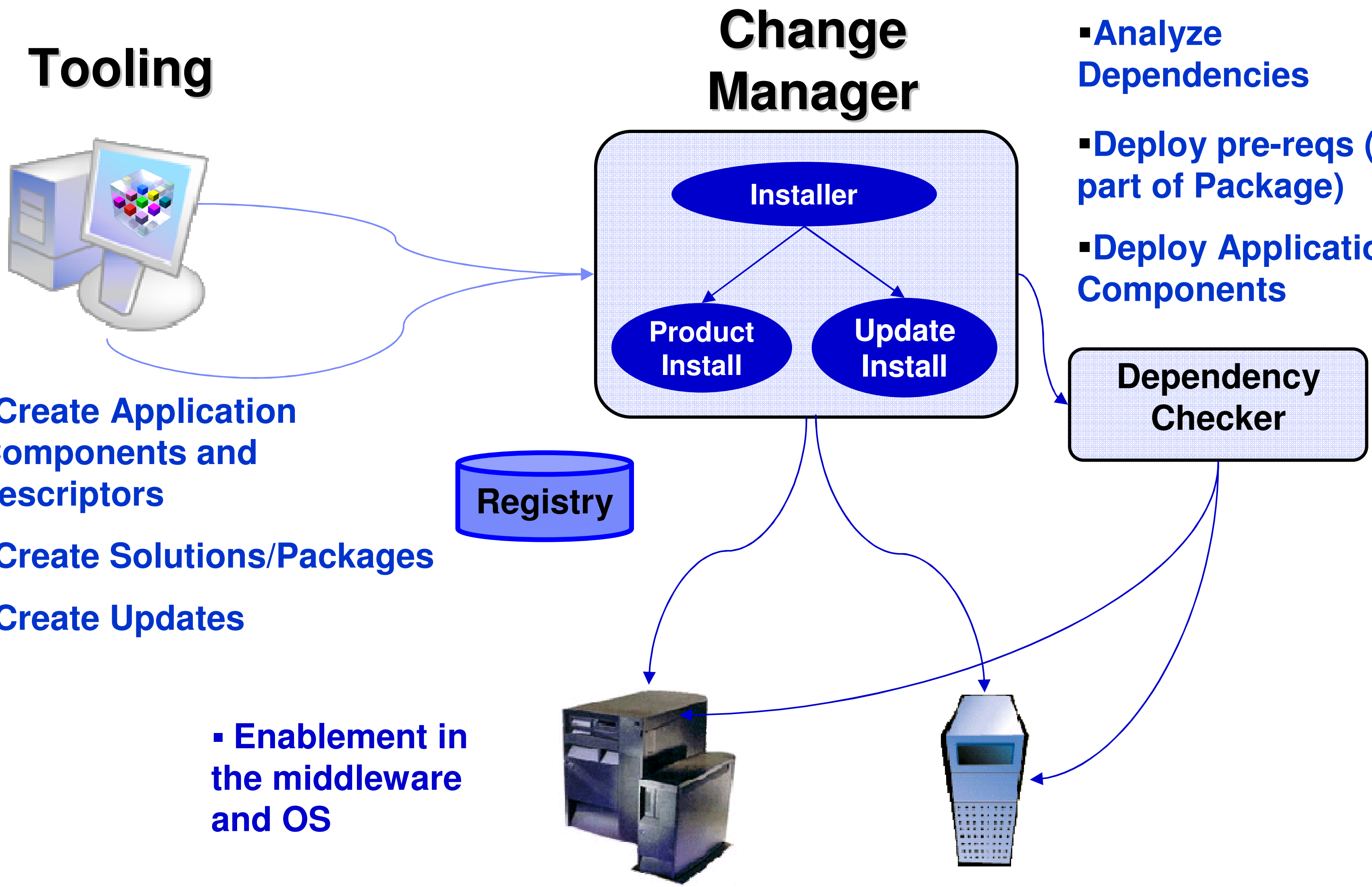
***Customer pain point:***
**Difficulty of deployment in complex systems**

- A common infrastructure to ensure a simpler and more consistent deployment experience.
  - Common **tooling** to reduce the cost and complexity of building, deploying, and maintaining software solutions.
  - Common **deployment descriptors** to describe the installation capabilities and dependency requirements for a given software package.
  - Common **packaging** to which can be used for new installations, upgrades, and maintenance.
  - Common **dependency checking** technologies to validate environment (hardware, OS, software, configuration, etc.)
- Consistent methodology for creating software packages
- Install, update, fix, uninstall, repair, rollback, commit the package
- Verifying the deployment so the software is ready to use

**Architecture and Standards**

- **Data model of an installation package and installable units**
- **Interfaces of components to process this data**

# Solution Change Manager Highlights



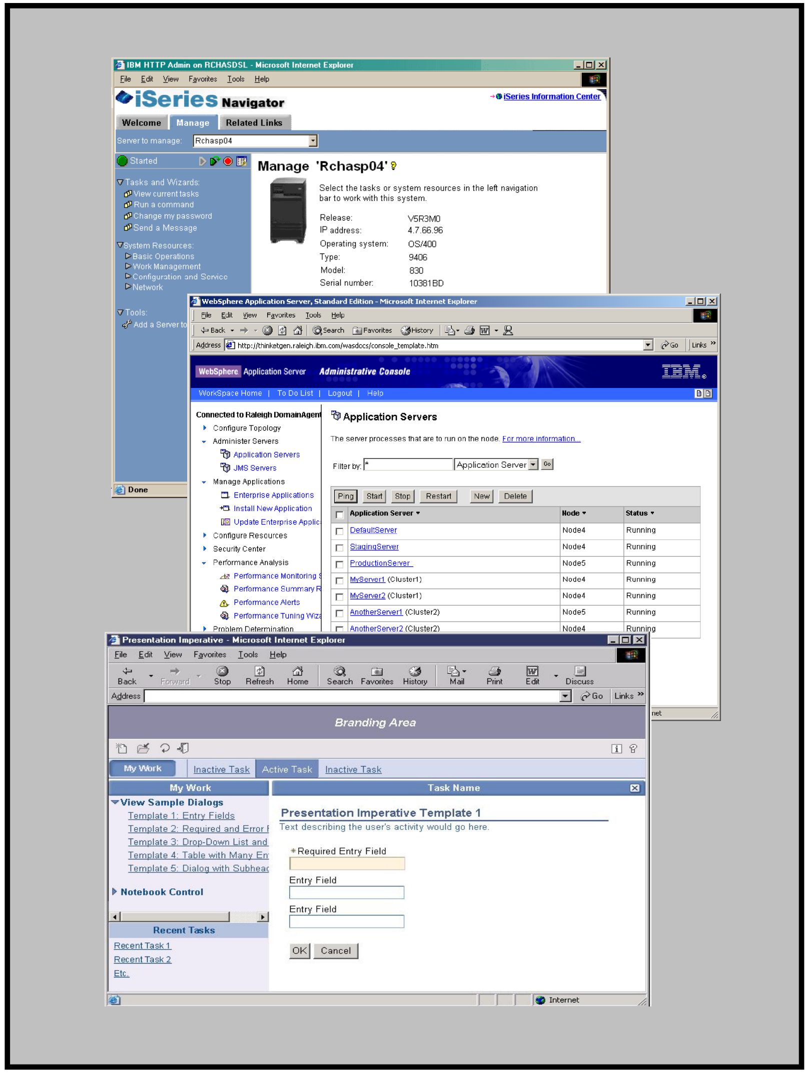
- Create Application Components and descriptors
- Create Solutions/Packages
- Create Updates

- Analyze Dependencies
- Deploy pre-reqs (as part of Package)
- Deploy Application Components

- Enablement in the middleware and OS

# Solutions Administration Today

- Industry Solutions include...
  - eServer, WebSphere, Tivoli, DB2, Lotus, Rational...
  - Business Partner Applications
  - Customer Applications
- Different Admin consoles
  - No look & feel consistency
  - No administration integration
- Multiple - costly learning curves
  - Delayed deployment of solution
  - Increased admin training costs
- Different technologies
  - Java, C, C++, HTML, XML
  - Installed Client
  - Web based



Server to manage: Rchasp04

Manage 'Rchasp04'

Select the tasks or system resources in the left navigation bar to work with this system.

| | |
|---|---|
| Release: | V5R3M0 |
| IP address: | 4.7.66.96 |
| Operating system: | OS/400 |
| Type: | 9406 |
| Model: | 830 |
| Serial number: | 10381BD |

Address: http://thinketgen.raleigh.ibm.com/wasdocs/console_template.htm

Application Servers

The server processes that are to run on the node. For more information...

Filter by: * Application Server Go

| □ | Application Server | Node | Status |
|---|---|---|---|
| □ | DefaultServer | Node4 | Running |
| □ | StagingServer | Node4 | Running |
| □ | ProductionServer | Node5 | Running |
| □ | MyServer1 (Cluster1) | Node4 | Running |
| □ | MyServer2 (Cluster1) | Node4 | Running |
| □ | AnotherServer1 (Cluster2) | Node5 | Running |
| □ | AnotherServer2 (Cluster2) | Node4 | Running |

Presentation Imperative - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Forward Stop Refresh Home Search Favorites History Mail Print Edit Discuss
Address
Go Links
Branding Area
My Work
Inactive Task
Active Task
Inactive Task
My Work
Task Name
View Sample Dialogs
Template 1: Entry Fields
Template 2: Required and Error F
Template 3: Drop-Down List and
Template 4: Table with Many En
Template 5: Dialog with Subhead
Notebook Control
Recent Tasks
Recent Task 1
Recent Task 2
Etc.
OK
Cancel
Internet

Presentation Imperative Template 1

Text describing the user's activity would go here.

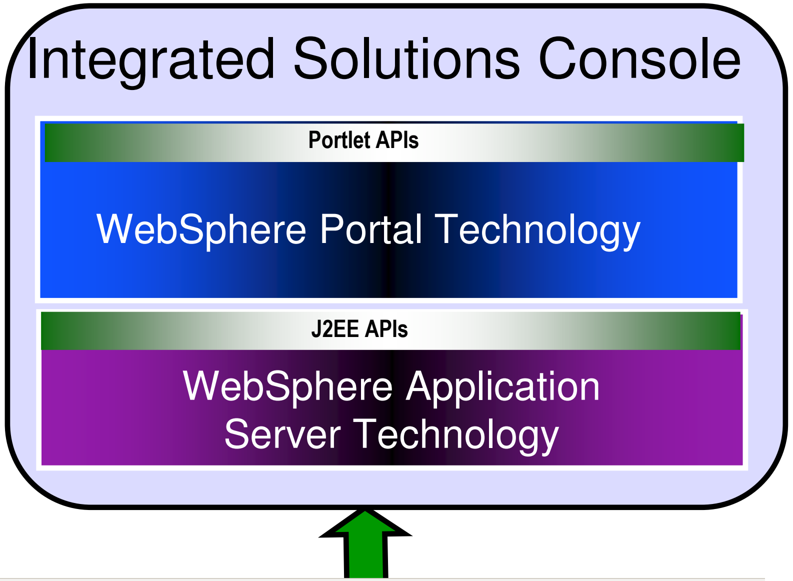
*Required Entry Field

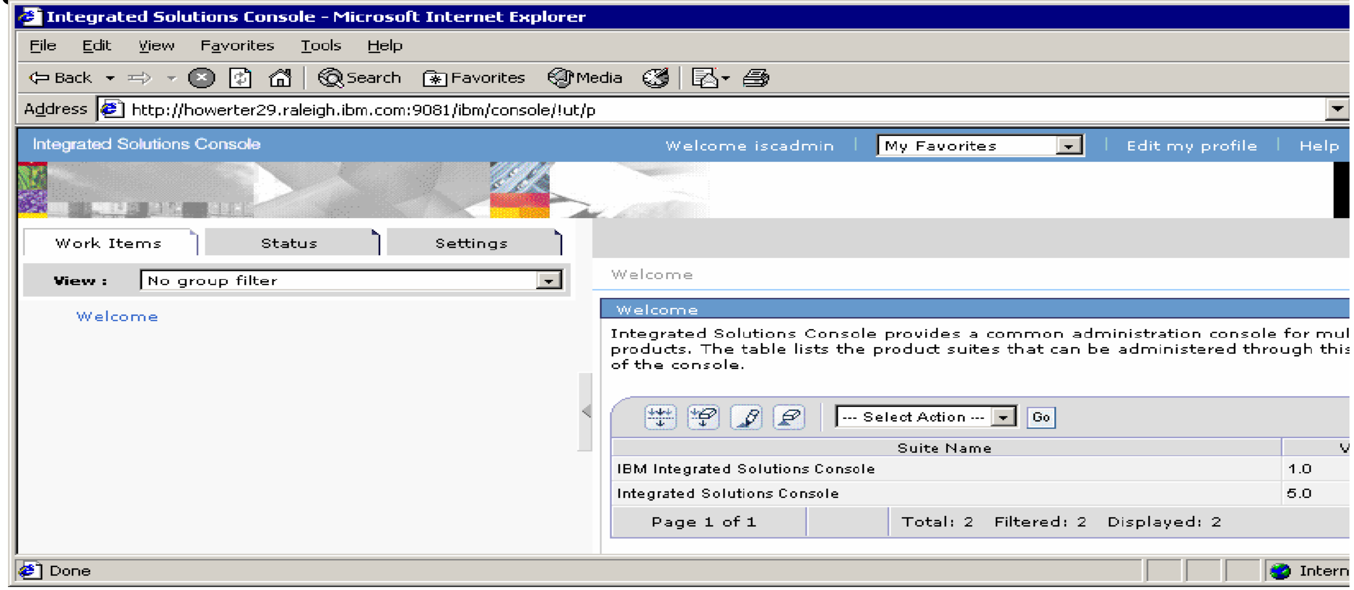
Entry Field

Entry Field

# Integrated Solutions Console Technology

- Standards-based architecture
  - J2EE, Java, XML
  - JSR 168 - Portlet API's
- Portlets allow administration functions to be developed in a solution-oriented manner
- Packaged and deployed like J2EE Web Applications


Integrated Solutions Console
Portlet APIs
WebSphere Portal Technology
J2EE APIs
WebSphere Application Server Technology


Integrated Solutions Console - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address
Integrated Solutions Console
Welcome iscadmin
My Favorites
Edit my profile
Help
Work Items
Status
Settings
Welcome
Welcome
Select Action
Go
Done
Intern

Address: http://howerter29.raleigh.ibm.com:9081/ibm/console/!ut/p

View : No group filter

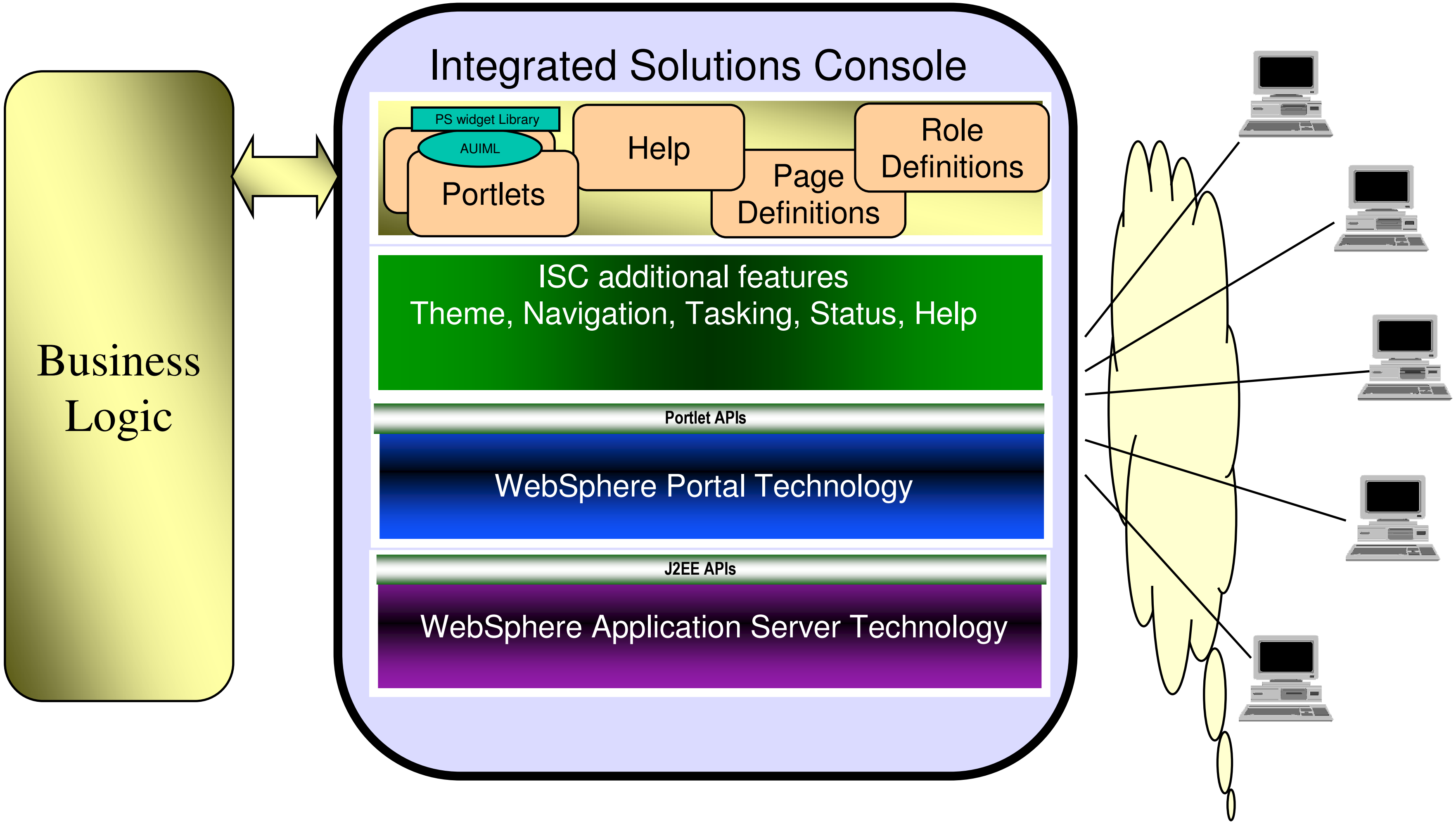
Welcome

Integrated Solutions Console provides a common administration console for mul products. The table lists the product suites that can be administered through this of the console.

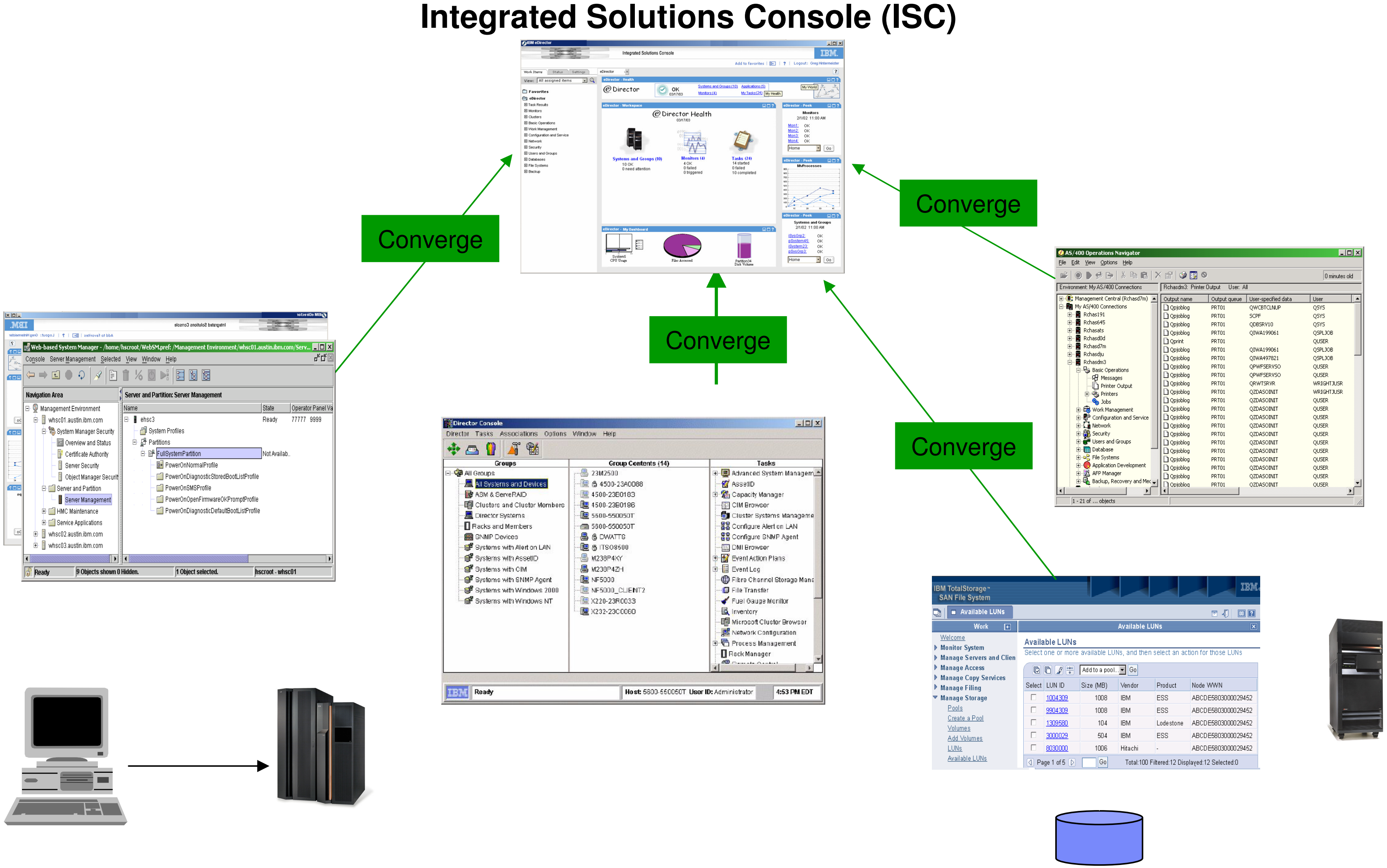
| Suite Name | V |
|---|---|
| IBM Integrated Solutions Console | 1.0 |
| Integrated Solutions Console | 5.0 |

Page 1 of 1 Total: 2 Filtered: 2 Displayed: 2

# Console Components built on ISC

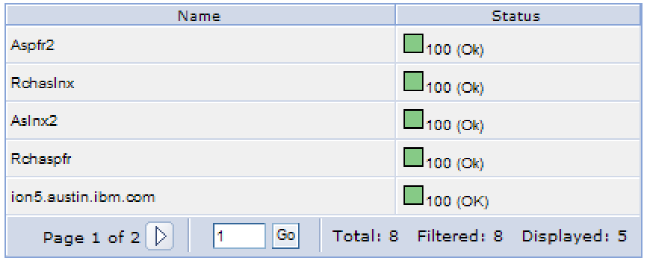

Business Logic
Integrated Solutions Console
PS widget Library
AUIML
Portlets
Help
Page Definitions
Role Definitions
ISC additional features
Theme, Navigation, Tasking, Status, Help
Portlet APIs
WebSphere Portal Technology
J2EE APIs
WebSphere Application Server Technology

# Goal: Admin Console Convergence


Integrated Solutions Console (ISC)
Integrated Solutions Console
Converge
Converge
Converge
Converge
Converge
Web-based System Manager
Director Console
AS/400 Operations Navigator
IBM TotalStorage SAN File System
Available LUNs

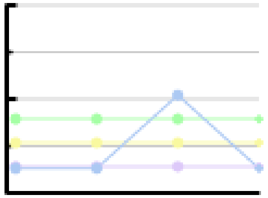
# Example Functions

- System Health
  - ➢Group Status and Properties
  - ➢System Status and Properties
  - ➢Resource Status and Properties
- Problem Identification
  - ➢Consolidated Monitoring
  - ➢Access to logs and message queues
- Corrective Management
  - ➢System Control (e.g. shutdown, restart, etc.)
  - ➢Job/Process Management and Control (e.g. kill a process)
  - ➢Resource Management and Control (e.g. delete an event,
  - ➢Task Execution

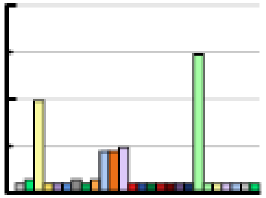


| Name | Status |
|---|---|
| Aspfr2 | 🟩100 (Ok) |
| Rchaslnx | 🟩100 (Ok) |
| Aslnx2 | 🟩100 (Ok) |
| Rchaspfr | 🟩100 (Ok) |
| ion5.austin.ibm.com | 🟩100 (OK) |

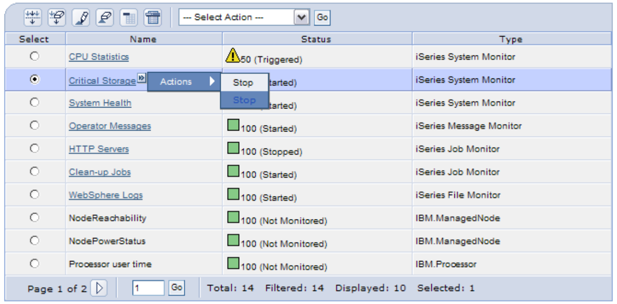
Page 1 of 2 ▷ 1 Go Total: 8 Filtered: 8 Displayed: 5



High Process CPU Usage (System: rchaslnx)



Process CPU Usage (System: rchaslnx)



| Select | Name | Status | Type |
|---|---|---|---|
| ○ | CPU Statistics | ⚠50 (Triggered) | iSeries System Monitor |
| ● | Critical Storage | tarted) | iSeries System Monitor |
| ○ | System Health | tarted) | iSeries System Monitor |
| ○ | Operator Messages | 🟩100 (Started) | iSeries Message Monitor |
| ○ | HTTP Servers | 🟩100 (Stopped) | iSeries Job Monitor |
| ○ | Clean-up Jobs | 🟩100 (Started) | iSeries Job Monitor |
| ○ | WebSphere Logs | 🟩100 (Started) | iSeries File Monitor |
| ○ | NodeReachability | 🟩100 (Not Monitored) | IBM.ManagedNode |
| ○ | NodePowerStatus | 🟩100 (Not Monitored) | IBM.ManagedNode |
| ○ | Processor user time | 🟩100 (Not Monitored) | IBM.Processor |

Page 1 of 2 ▷ 1 Go Total: 14 Filtered: 14 Displayed: 10 Selected: 1

# Summary of Autonomic Computing Policy Goals

- Develop the AC Policy Language (4-tuple) specification
  - XML grammar that provides a unified view of policy content across a heterogeneous enterprise
- Develop technology – Policy Management for Autonomic Computing – which delivers a policy-driven autonomic manager for resource management
  - Used to configure and manage resources
- Provide design to guidance for developing system-level Autonomic Managers
  - Goal-based Autonomic Managers, like eWLM
  - Joint work w/ ODDC

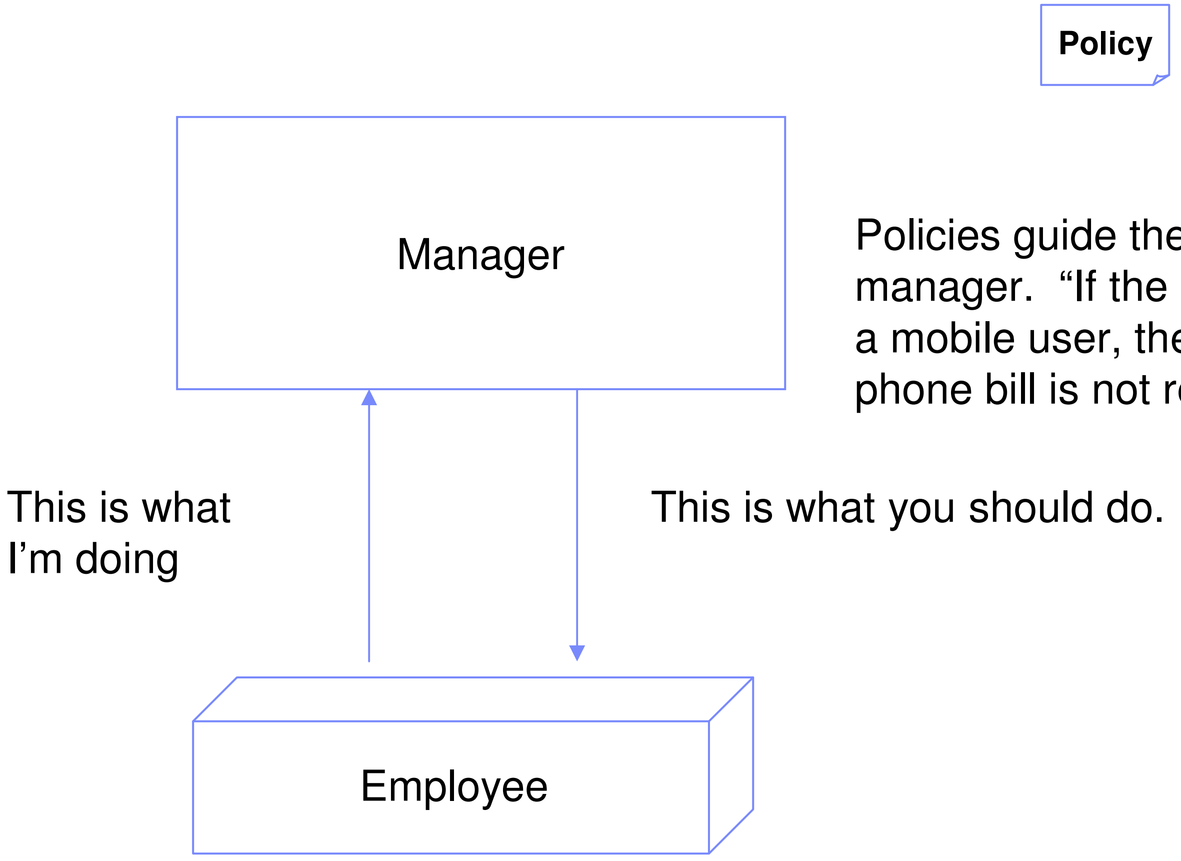
# Types of Policies

- Business Policy
  - Typically encoded into applications, or associated w/ rules
  - E.g., Gold customers get better airline seats, faster service
- IT Policy
  - Typically encoded into the IT application, or occasionally w/ policy-based management
  - E.g., Gold transactions get 500ms average response time
- Seldom intersect, but should
  - Gold customer gets preferential application treatment (gold seating), and preferential IT treatment (workload)

Our aim is an integrated, policy-based system:
Easier to manage, better customer experience

# Background: Autonomic Managers and Policy

Manager / managed is a common IT paradigm



Policy

Manager

This is what I'm doing

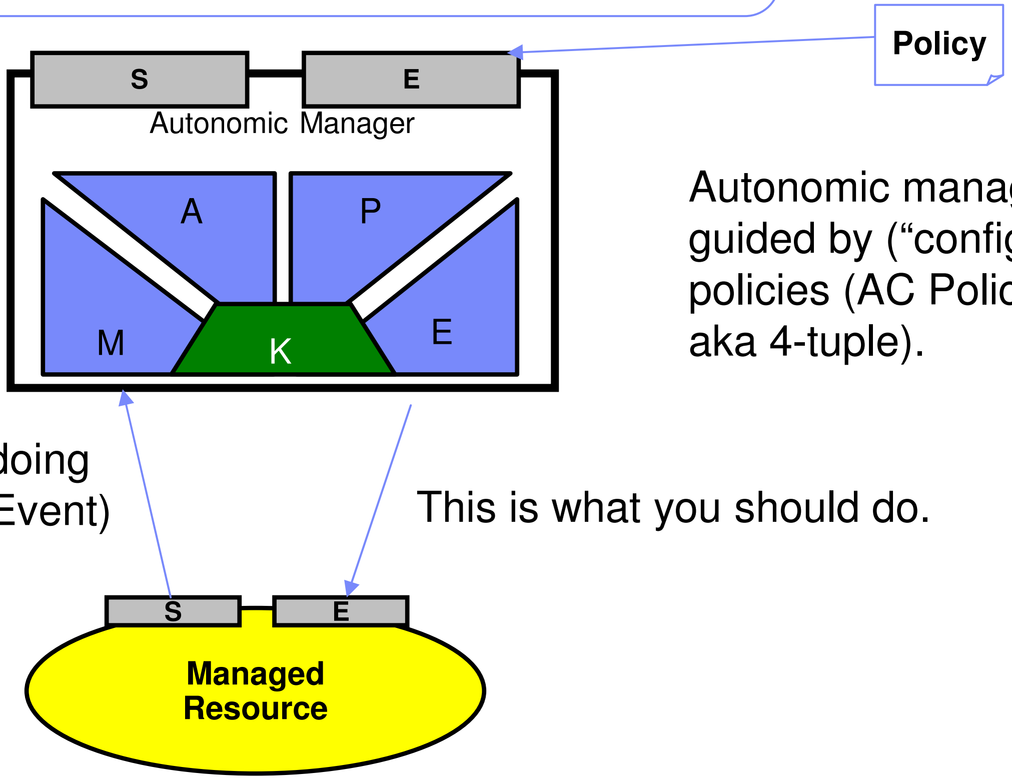
This is what you should do.

Employee

Policies guide the behavior of the manager. "If the employee is not a mobile user, then their cell phone bill is not reimbursable".

# Background: Autonomic Managers and Policy

Autonomic Managers are simply Managers conforming to AC interfaces and data formats



Autonomic managers are guided by (“configured by”) policies (AC Policy Language, aka 4-tuple).

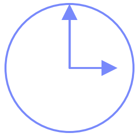
This is what I’m doing (Common Base Event)

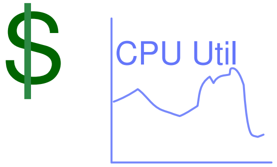
This is what you should do.

Sensor and effector interfaces, event, policy, etc.

# Anatomy of the AC Policy Language (“4-tuple”)

- Four common concepts identified:
  - **Scope**
    - Specifications to identify **what** is or is not subject to the intent.
  - **Precondition**
    - Specifications to express **when** a policy is to be applied or is active.
  - **Business Value**
    - Specifications to express utility functions to make **economic trade offs**
  - **Decision** (Goal/Action/Result)
    - Specifications to describe **observable behavior** or objective.

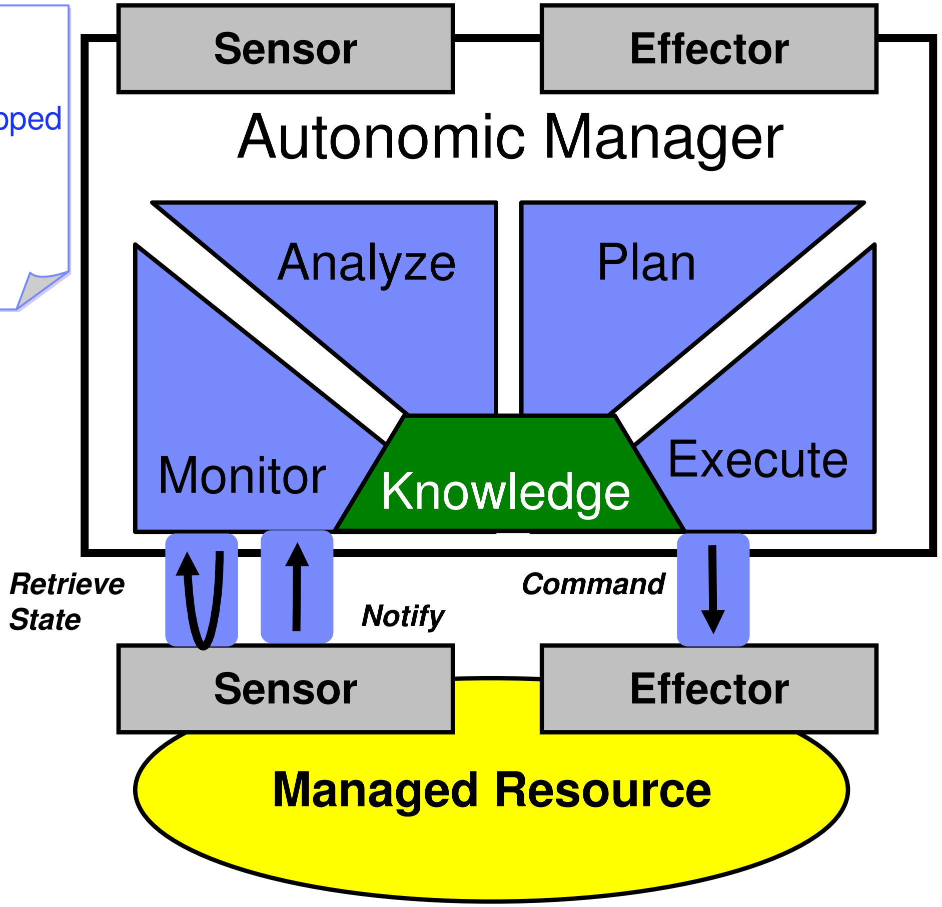




- Designed by adopting concepts from the industry policy languages
  - Workload Mgmt, Provisioning, IETF/DMTF standard, Storage policies

# A Simple Policy Example

Scope: server type X
PC:
  event: application stopped
  condition:
    service X=running
BV: 10
Decision: Restart app



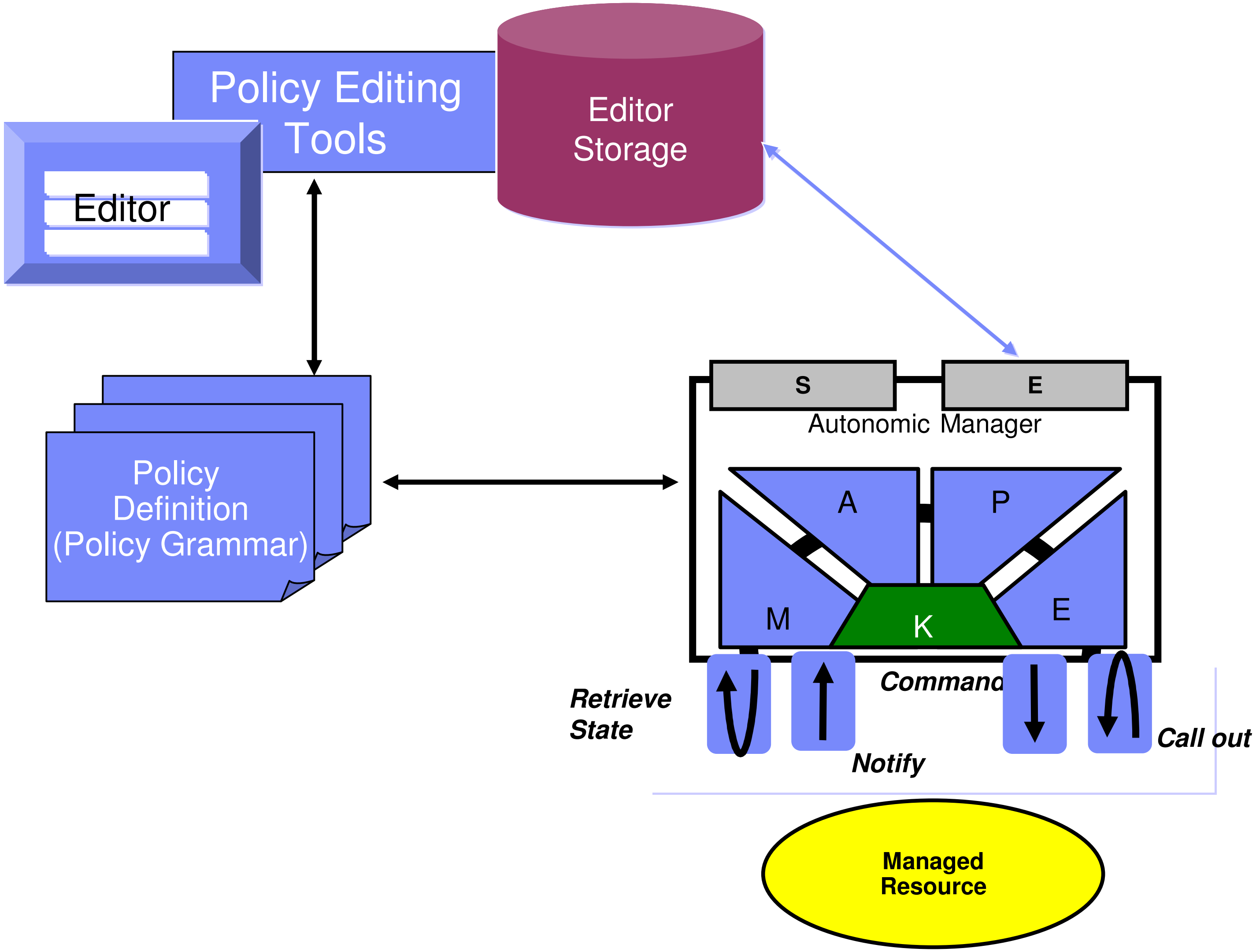
Monitors for "application stopped" CBE.

Retrieves "service X state".

Evaluates the policy conditions and business value

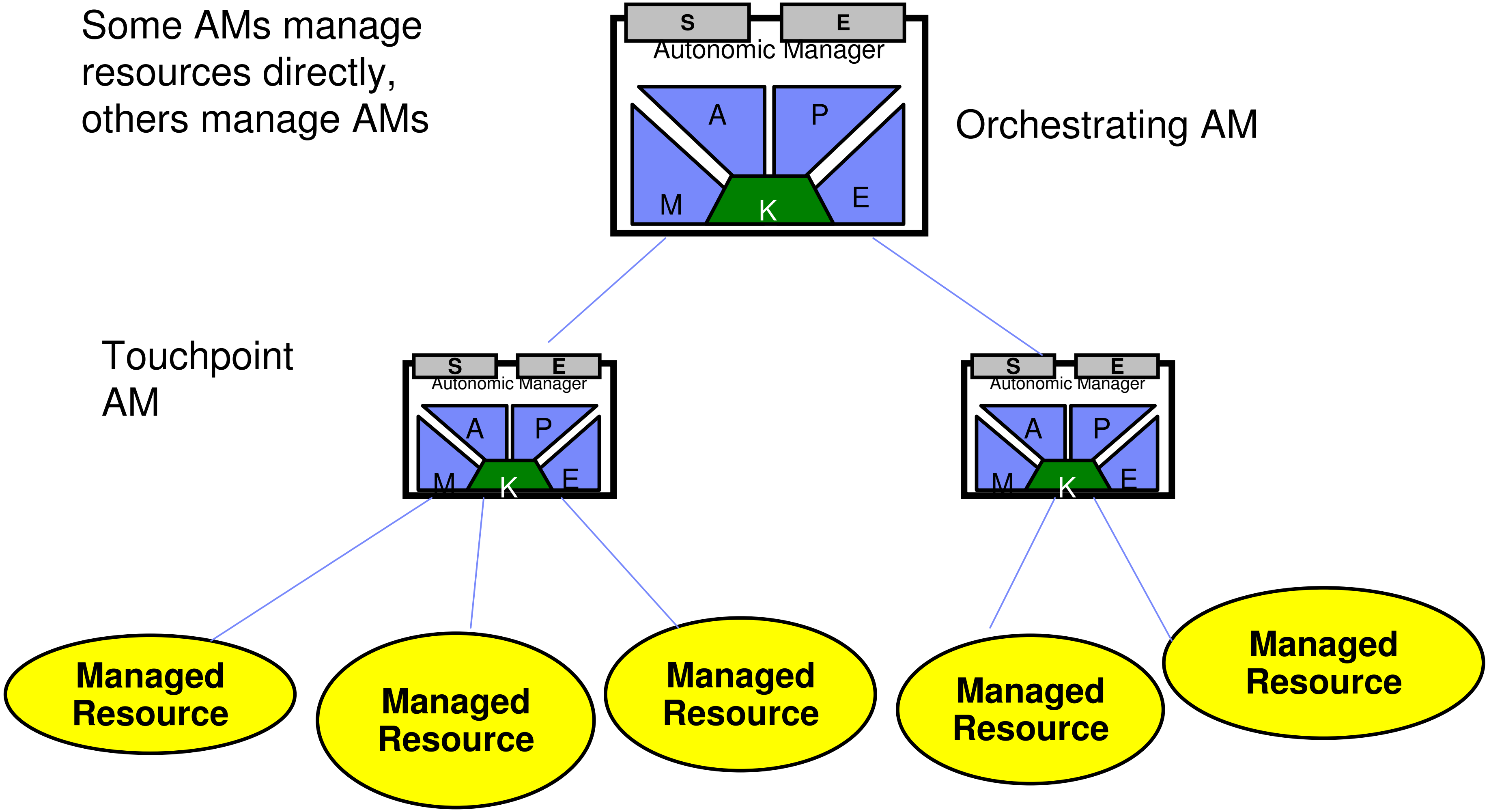
Restart the app.

# Policy Management for Autonomic Computing: High-level Solution Architecture

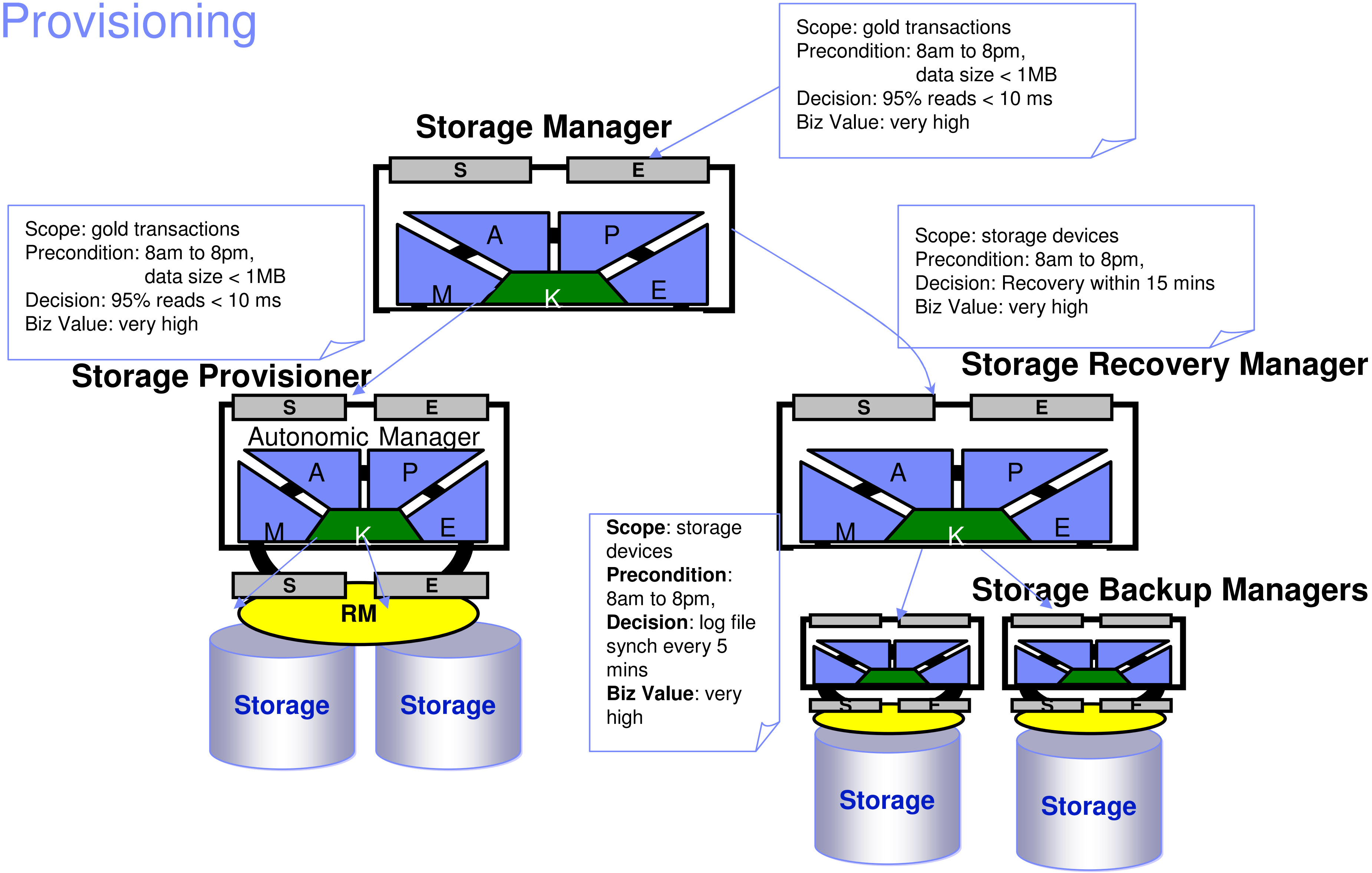


# Autonomic Manager vocabulary: Touchpoint Autonomic Managers and Orchestrating Autonomic Managers

Some AMs manage resources directly, others manage AMs



# Assembling storage components: Business Continuity and Provisioning



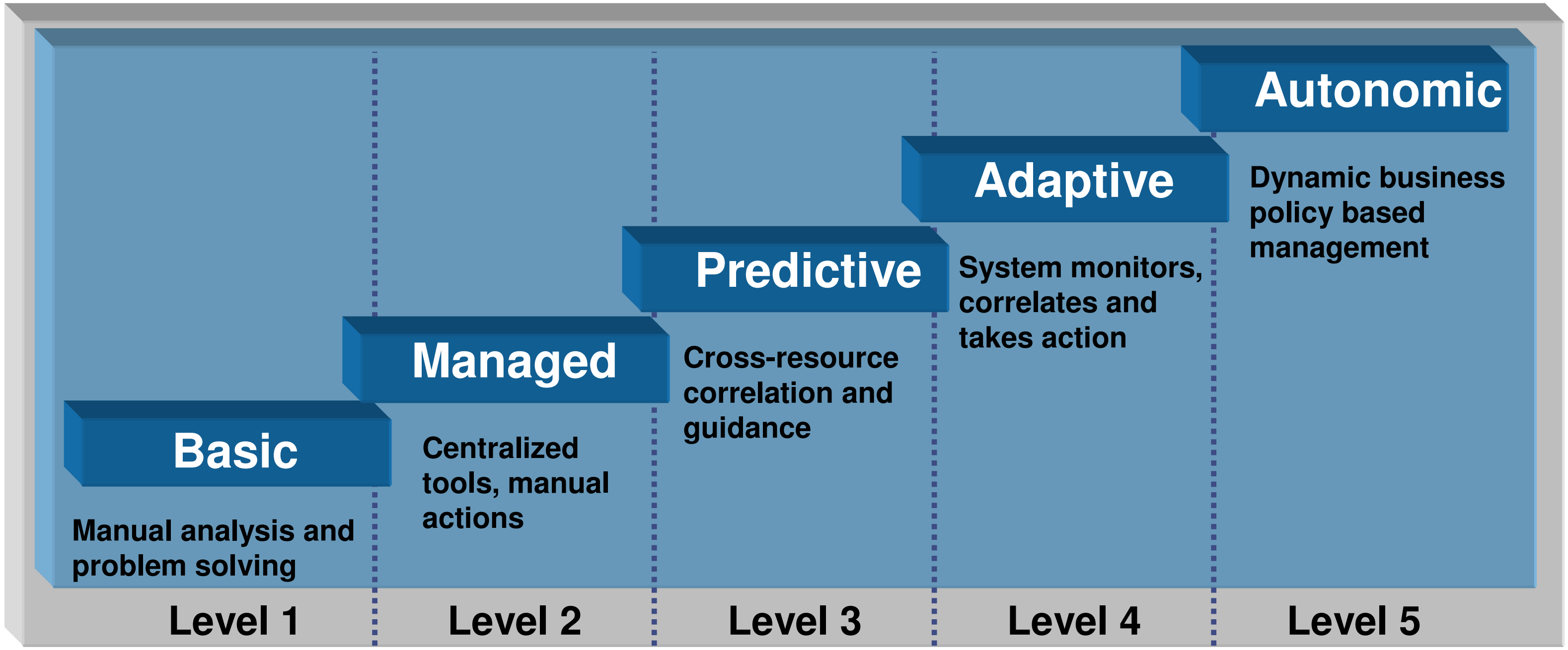
Scope: gold transactions
Precondition: 8am to 8pm,
data size < 1MB
Decision: 95% reads < 10 ms
Biz Value: very high

Scope: gold transactions
Precondition: 8am to 8pm,
data size < 1MB
Decision: 95% reads < 10 ms
Biz Value: very high

Scope: storage devices
Precondition: 8am to 8pm,
Decision: Recovery within 15 mins
Biz Value: very high

**Scope**: storage devices
**Precondition**: 8am to 8pm,
**Decision**: log file synch every 5 mins
**Biz Value**: very high

# Toward an Autonomic, Policy-driven System



Basic

Manual analysis and problem solving

Managed

Centralized tools, manual actions

Predictive

Cross-resource correlation and guidance

Adaptive

System monitors, correlates and takes action

Autonomic

Dynamic business policy based management

Level 1

Level 2

Level 3

Level 4

Level 5

Static Code

- Unable to tailor the behavior of the resource

Parameterized Code

- Tailoring possible, but requires manual effort and monitoring

Scripts (current state of most customers)

- Automate set of actions
- Programming skill required

Resource Policies

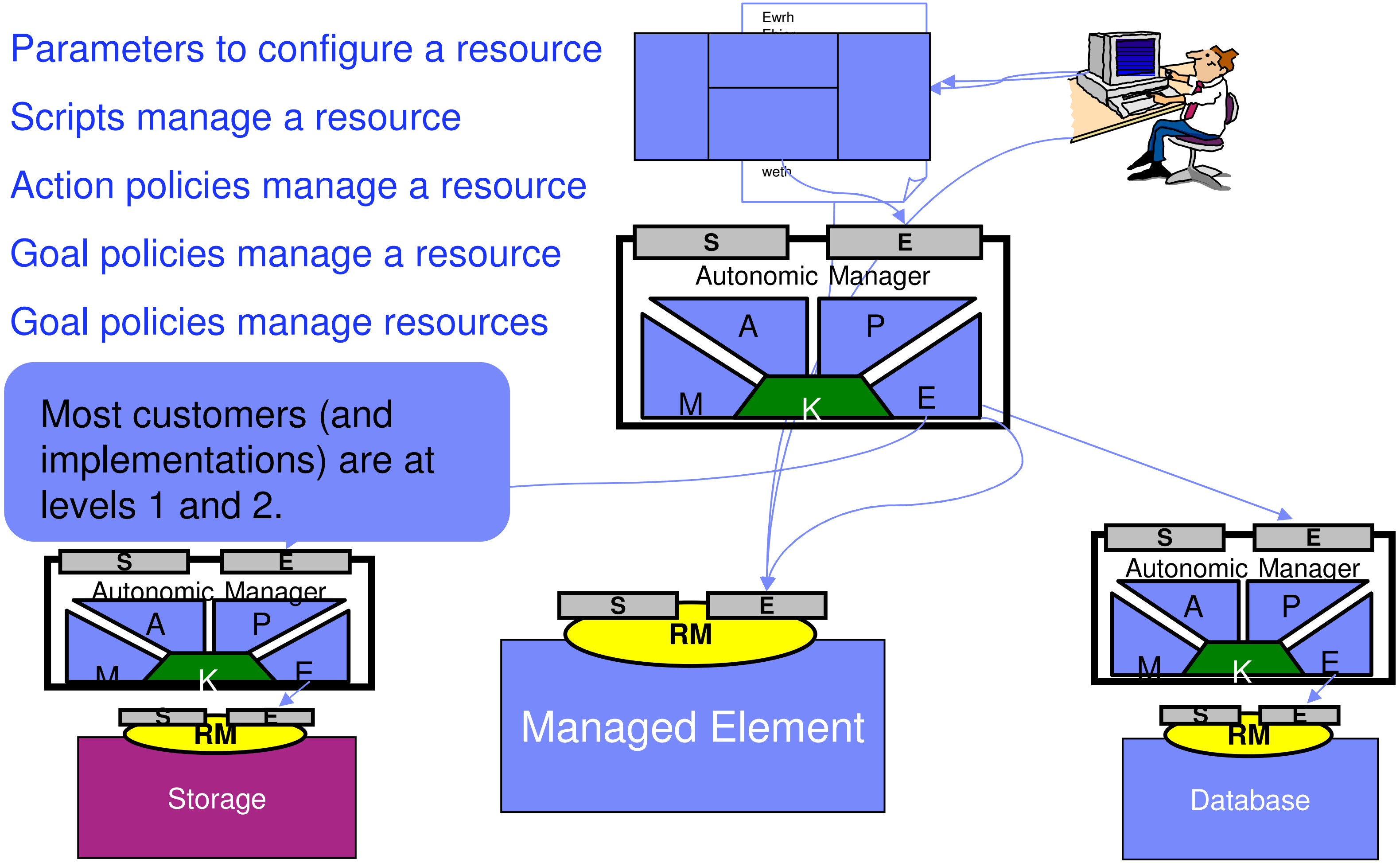
- Declarative version of monitor and react scripts
- No programming

Cross-resource System Policies

- Declarative, cross-resource specification of intentions

# Toward an Autonomic, Policy-driven Systems

0. Static Code
1. Parameters to configure a resource
2. Scripts manage a resource
3. Action policies manage a resource
4. Goal policies manage a resource
5. Goal policies manage resources



Most customers (and implementations) are at levels 1 and 2.

# Summary

- Autonomic Computing represents the future of managing complexity in IT
- Autonomic Computing needs to be implemented in a consistent way to ensure interoperability across components, hence the need for an architecture and standards
- Autonomic Computing can be accelerated by having a common set of core technologies – common problem determination, install and policy are critical

Gartner
insight for the connected world

> IBM’s autonomic computing initiative will become its most important cross-product initiative—Thomas Bittman, Gartner Group

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