IBM zAware
Using Analytics to Improve System z Availability

Garth Godfrey
IBM Poughkeepsie

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Session 13063

ggodfrey@us.ibm.com
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<thead>
<tr>
<th>DS8000</th>
<th>PR/SM</th>
<th>Z9*</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECKD</td>
<td>Redbooks*</td>
<td>z10</td>
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<tr>
<td>FICON*</td>
<td>System x*</td>
<td>z10 Business Class</td>
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<tr>
<td>GDPS*</td>
<td>System z*</td>
<td>z10 EC</td>
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<tr>
<td>GPFS</td>
<td>System z9*</td>
<td>z/OS*</td>
</tr>
<tr>
<td>HiperSockets</td>
<td>System z10*</td>
<td>z/VM*</td>
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<tr>
<td>IBM*</td>
<td>Tivoli</td>
<td>zEnterprise</td>
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<td>IBM (logo)*</td>
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<td>InfiniBand*</td>
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<td>Parallel Sysplex*</td>
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Agenda

• What is IBM zAware, and what can it detect?
  – How can it help identify problems on z/OS systems?
  – How can it help diagnose problems on z/OS systems?
• Operating requirements
• Use of the IBM zAware GUI
• Integration with other management products
Background

Systems are more complex and more integrated than ever

- Errors can occur anywhere in a complex system

- Some problems are particularly…
  - Difficult to detect
    - Several allowable anomalies can build up over time
    - Symptoms / problems can manifest for hours or days
    - Problem can grow, cascade, snowball
  - Difficult to diagnose
    - Sometimes finding the system in error is a challenge
    - Many times finding the component in error is a challenge
    - Volume of data is not humanly consumable, especially when seconds count
- Need information and insight
IBM zAware – IBM System z Advanced Workload Analysis Reporter

- Monitors z/OS OPERLOG including all messages written to z/OS console, including ISV and application generated messages
- Detects things typical monitoring systems miss due to:
  - Message suppression (message too common)
    Useful for long-term health issues
  - Uniqueness (message not common enough)
    Useful for real-time event diagnostics
- Color coded easy to use GUI via web browsers
- Output can be queued up to existing monitoring systems.
- Early detection and focused diagnosis can help improve time to recovery
IBM zAware – Smarter Computing Needs Smarter Monitoring

- New technology based on machine learning developed by IBM Research
- Cutting edge pattern recognition techniques look at the health of a system to pinpoint deviations from the ‘norm’
- High speed analytics facilitates the ability to consume large quantities of message logs
- Improves problem diagnosis across a set of System z servers
- Speeds up the time to decide on appropriate corrective actions on problems before they get bigger
- Allow establishment of procedures to prevent reoccurrence

zAware’s capacity as a ‘watch dog’ can help to detect unusual behavior in near real time
Inside IBM zAware

zAware Partition
Shipped as firmware with EC12

z/OS pieces
Shipped with z/OS v1.13 + PTF

View zAware results
Control zAware-specific knobs

zAware GUI

Customer network

z/OS operlog
LOGGER Data Transport

Persistent Storage
File System

Manage zAware Firmware partition

Complete your sessions evaluation online at SHARE.org/SanFranciscoEval
Inside IBM zAware Analytics

- OPERLOG is processed per-system
- zAware recognizes any well-formed message Ids, including IBM and non-IBM products and customer applications
- zAware summarizes the common message text and records the occurrences
- zAware builds a **model** of normal behavior based on the last 90 days
  - Called “Training”
  - Automatically trains every 30 days
  - Can be forced manually
  - Customizable
  - Unusual days can be excluded from future models
- z/OS utility is used to load historical logs into zAware
Inside IBM zAware Analytics

● Real-time OPERLOG data is compared to the model
● Assigns a **message anomaly** score to indicate deviation from the model
  - Rare messages
  - Out of context from normal patterns
  - High counts
● Uses z/OS-specific knowledge to influence the scores
● Generates an **interval anomaly** score per 10 minute interval
  - Current interval is updated every 2 minutes
  - GUI shows number of unique message IDs (bar height)
  - GUI shows interval anomaly score (bar color)
● Drill down on interval shows the message scores
● XML output available via HTTP APIs
Analysis View

Select which plex or systems to view

Height shows number of unique messageIDs

Color shows anomaly score

Anomaly score shows difference from normal patterns

Analysis

The System Anomaly Scores graph shows message analysis data for each system in ten minute intervals. For each interval, the bar height indicates the number of unique messageID. Click on an interval bar to access detailed message information. To view messaging analyses from other dates, use the date selector. To customize which systems are displayed, use the system selector.

Date:  

Analysis Source: Change Source


System

SVPLEX4.C00

SVPLEX4.C05

SVPLEX4.C06

SVPLEX4.C08

Interval Anomaly Score

Timeline (UTC)

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14

Zoom level:

1 hr 4 hrs 8 hrs 12 hrs 16 hrs 20 hrs 24 hrs

Interval anomaly score key:

0 99.5 99.5 - 100 101

No Difference Significantly Different

Complete your sessions evaluation online at SHARE.org/SanFranciscoEval
Analysis View

Hovering over a bar displays the values
Clicking on a bar drills down to Interval

Interval Anomaly Scores by System

System | Anomaly Scores
--- | ---
SVPLEX4.C00 (UTC)-5 | Time: 03:30 -- 03:40
Unique Msg Ids: 146
Anomaly Score: 100.0

Interval Anomaly score key:

No Difference | 99.5 | 99.6 - 100 | Significantly Different
Interval View

Several messages never seen in the model

Time Line shows occurrences within interval

Message ID is a link to LookAt

z/OS specific rules affect anomaly score
Identify unusual behavior quickly

Which z/OS image is having unusual message patterns?
- High score generated by unusual messages or message patterns
- GUI shows all systems or selected subsets

Which subsystem or component is abnormal?
- Examine high-scoring messages

When did the behavior start?
- Current 10 minute interval or earlier?
- Which messages are unusual?
- How often did the message occur?
- When did the messages start to occur?

Were similar messages issued previously?
- Easily examine prior intervals or dates
Identify unusual behavior quickly

Which z/OS image is having unusual message patterns?
- Recurring yellow and dark blue on CB8C

When did the behavior start?
- After an IPL at 13:30
Identify unusual behavior quickly

Interval View for System CB8C

The Messages table provides detailed analysis information for each message that occurred during the indicated time interval. To view message details for other intervals use the date and time interval Return to Analysis button to go back to the Analysis view.

Date:  
August 28, 2012

Time Interval (UTC):  
14:20 - 14:30

Analysis Source:  
UTCPLXCB.CB8C

Interval anomaly score:  
99.6

Messages

<table>
<thead>
<tr>
<th>Anomaly Score</th>
<th>Interval Contribution Score</th>
<th>Message Context</th>
<th>Rules Status</th>
<th>Appearance Count</th>
<th>Time Line</th>
<th>Message ID</th>
<th>Message Example</th>
<th>Rarity Score</th>
<th>Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.999</td>
<td>14.369</td>
<td>undclustered</td>
<td>None</td>
<td>2</td>
<td></td>
<td>IEE838i</td>
<td>TNPROC NON-CANCELABLE - ISSUE FORCE ARM</td>
<td>03</td>
<td>IEE</td>
</tr>
<tr>
<td>0.999</td>
<td>12.943</td>
<td>undclustered</td>
<td>None</td>
<td>2</td>
<td></td>
<td>EZ70621i</td>
<td>AUTOLOG FORCING TNPROC, REASON: TCP/IP HAS BEEN RESTARTED</td>
<td>100</td>
<td>EZZ</td>
</tr>
<tr>
<td>0.999</td>
<td>9.41</td>
<td>undclustered</td>
<td>None</td>
<td>1</td>
<td></td>
<td>IXG601i</td>
<td>10.27.18 LOGGER DISPLAY 081 CONNECTION INFORMATION BY</td>
<td>02</td>
<td>IXG</td>
</tr>
<tr>
<td>0.997</td>
<td>6.078</td>
<td>undclustered</td>
<td>None</td>
<td>3</td>
<td></td>
<td>IEA631i</td>
<td>OPERATOR GTHOMPS NOW INACTIVE, SYSTEM=CB8C, LU=TCP8C003</td>
<td>31</td>
<td>IEA</td>
</tr>
</tbody>
</table>

Which subsystem or component is abnormal?

- Examine high-scoring messages

When did the behavior start?

- When did the messages start to occur?

Were similar messages issued previously?

- Easily examine prior intervals or dates

Moving left and right by interval shows messages due to TNPROC being cancelled by TCP/IP

Complete your sessions evaluation online at SHARE.org/SanFranciscoEval
### Identify behavior after a change

**Are unusual messages being issued after a change?**

- New software levels (operating system, middleware, applications)
- Updated system settings or system configurations
- Differentiate expected message traffic from side effects

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**Interval Anomaly Scores by System**

<table>
<thead>
<tr>
<th>System</th>
<th>Anomaly Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>SVPLEX4_C09 (UTC-5)</td>
<td>![Anomaly Scores Graph]</td>
</tr>
<tr>
<td>SVPLEX4_C0A (UTC-5)</td>
<td>![Anomaly Scores Graph]</td>
</tr>
<tr>
<td>SVPLEX4_C0B (UTC-5)</td>
<td>![Anomaly Scores Graph]</td>
</tr>
<tr>
<td>SVPLEX4_C0D (UTC-5)</td>
<td>![Anomaly Scores Graph]</td>
</tr>
</tbody>
</table>

**Timeline (UTC)**

<table>
<thead>
<tr>
<th>Time</th>
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<tbody>
<tr>
<td>0</td>
</tr>
<tr>
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<tr>
<td>16</td>
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<tr>
<td>17</td>
</tr>
</tbody>
</table>

**Interval anomaly score key:**

- No Difference
- 99.5
- 99.6 - 100
- 100.1
- Significantly Different

---

A new model included several days of new workload.
Diagnose Intermittent Problems

Are new unusual messages being issued when an intermittent problem occurs?

- Compare previous time periods
- Are more messages issued than expected?
- Are messages issued differently from the normal pattern?

Analysis

The System Anomaly Scores graph shows message analysis data for each system in ten minute intervals. For each interval, the bar height indicates the number of unique messages occurring during that interval. Click on an interval bar to access detailed message information. To view messaging analyses from other days, use the date selector on the graph. Click the Change Source button.

Interval Anomaly Scores by System

<table>
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<tr>
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<tr>
<td>SVPLEX4.C00</td>
<td></td>
</tr>
<tr>
<td>(UTC) -4</td>
<td></td>
</tr>
<tr>
<td>SVPLEX4.C05</td>
<td></td>
</tr>
<tr>
<td>(UTC) -4</td>
<td></td>
</tr>
<tr>
<td>SVPLEX4.C06</td>
<td></td>
</tr>
<tr>
<td>(UTC) -4</td>
<td></td>
</tr>
</tbody>
</table>

Timeline (UTC)

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
Connection Status

Which z/OS Monitored clients are connected?

System Status

System Status displays the IBM zAware analytics engine status, as well as monitored systems information for zOS systems connected to IBM zAware. Click the

System Name

- CB8C
- CB8D
- CB8E
- TA0
- TA1
- TA2

Status

- Active
- Inactive

Instrumentation Data Type

- OPERLOG

Connect Start Time

- January 18, 2013 11:38:53 AM EST
- January 18, 2013 11:40:05 AM EST
- July 23, 2012 6:19:39 PM EDT
- January 15, 2013 4:06:19 PM EST
- January 15, 2013 4:08:40 PM EST
- January 18, 2013 10:51:12 AM EST
Notifications

- zAware messages for asynchronous events
  - Storage, Training, Bulk load, ...
- Viewable by all users
- Persistent, until removed by an admin
- New ones indicated by ⚡ in header

### Notifications

<table>
<thead>
<tr>
<th>Message ID</th>
<th>Message Text</th>
<th>Message Date/Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIFT0001I</td>
<td>Training request for SVPLEXA-TA3 started Tue Jan 15 21:06 58 UTC 2013.</td>
<td>Tue Jan 15 2013 16:06:59 GMT-0500 (EST)</td>
</tr>
<tr>
<td>AIFT0103I</td>
<td>Modeling for SVPLEXA-TA3 did not complete successfully. Insufficient number of intervals with acceptable number of unique message ids.</td>
<td>Tue Jan 15 2013 16:07:21 GMT-0500 (EST)</td>
</tr>
<tr>
<td>AIFT0001I</td>
<td>Training request for SVPLEXA-TA4 started Tue Jan 15 21:10 07 UTC 2013.</td>
<td>Tue Jan 15 2013 16:10:07 GMT-0500 (EST)</td>
</tr>
</tbody>
</table>
Training Sets

- Admins can view
  - Model training status
  - Dates included in the current model and next model
- Admins can take action
  - Request training
  - Exclude days from the next model

Training Sets

The Monitored Systems table provides training statuses and results for IBM zAware monitored systems. The Actions menu provides functions for managing model dates, requesting or canceling training on ignored messages. Training details for a given system can be accessed by clicking on links in the Training Progress and Last Training Result columns.
Operating Requirements – IBM zAware Server

- Logical partition on a zEC12 server
  - Runs on IFLs or general purpose CPs – may be dedicated or shared
  - Runs its own self-contained firmware stack
  - Recommended 2 partial engines
    - Initial priming and training: 25-80% of 1 IFL
    - Analysis: 20-40% of 1 IFL

- Memory and DASD resources are dependent on the number of monitored clients, amount of message traffic, length of time data retained
  - Minimum Memory is 4 GB for 6 clients with light message traffic (500 msgs/sec)
    For > 6 clients, + 256 MB per client required
  - Estimated DASD storage is ~ 500 GB (ECKD)

- Network resources
  - HiperSockets or shareable OSA ports
  - IP address for partition

- Browsers
  - Internet Explorer 9
  - Firefox ESR 10
Operating Requirements -
\textbf{z/OS Monitored Clients}

- System z servers supported as IBM zAware monitored clients
  - zEC12
  - \textit{IBM zEnterprise™ 196 (z196) or z114},
  - \textit{IBM System z10™ EC or BC}
  - \textit{Prior generations that meet the OS and configuration requirements}

- Running \textit{z/OS 1.13 + PTFs}
  - \textit{APAR OA38747}
  - \textit{APAR OA38613}
  - \textit{APAR OA39256}

- System needs to be configured as a monoplex, system in a multisystem sysplex, or a member of a parallel sysplex
- Using operations log (\textit{OPERLOG}) as the hardcopy medium
- Sysplex name + system name must uniquely identify system
- Requires an OSA or HiperSocket for IP network connection
- \textit{z/OS zAware monitored client MIPs usage} ~ 1%
Setting up IBM zAware

- Session 13066  Setting up IBM zAware – Step by Step
  - Wednesday, February 6 11:00 AM-12:15 PM
  - Imperial A, Ballroom Level
Integration with other System Management products

- **z/OSMF**
  - Configure a new external **link**
  - Administration > Links > Actions > New
    - Provide link name, SAF suffix, zAware GUI URL,
    - Category – recommend Problem Determination
    - Define authority required to use the link
Integration with other System Management products

- **APIs**
  - Provides **XML** equivalent to GUI
    - Analysis page
    - Interval View page
  - Requires HTTPS
    - From z/OS, use AT-TLS
  - HTTP GET/POST requests
    - Connect and authenticate to IBM zAware server
      - *UserID known as a zAware user (e.g. LDAP)*
    - Retrieve analysis for a monitored client
      - *LPAR Interval scores for date*
      - *INTERVAL Message scores for a 10-minute interval*
Integration with other System Management products

- IBM Tivoli NetView for z/OS
  - Can use the APIs to get IBM zAware results
  - Sample programs are available from
  - described in detail in the Redbook:
    - Extending z/OS System Management Functions with IBM zAware
    - The samples can be tailored to drive NetView message automation and raise alerts on anomaly score.

- IBM plans to leverage IBM zAware results in the Tivoli Integrated Service Management products

Session 12791: Improve Service Levels with Enhanced Data Analysis
- Thursday, February 7 9:30 AM-10:30 AM  Golden Gate 6

- Other products can exploit the XML format results
Summary

You should now understand
- What IBM zAware is, and what can it detect
- How can it help identify problems on z/OS systems
- How can it help diagnose problems on z/OS systems
- Operating requirements
- Use of the IBM zAware GUI
- Integration with other management products

Questions?
References

- IBM System z Advanced Workload Analysis Reporter (IBM zAware) Guide SC27-2623-00
  http://www.ibm.com/systems/z/os/zos/bkserv/r13pdf/#E0Z

- Redbook: Extending z/OS System Management Functions with IBM zAware SF24-8070-00

- IBM Mainframe Insights blog www.ibm.com/systemz
  • The Journey to IBM zAware
  • zAware Installation and Startup
  • Top 10 Most Frequently Asked Questions About IBM zAware
  • IBM zAware Demo
IBM zAware
Using Analytics to Improve System z Availability

Garth Godfrey
IBM
ggodfrey@us.ibm.com

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