



Service Performance Analytics

Enabling predictive and preventative management...

PCTY2012 
Pulse Comes to You

Optimizing the World's Infrastructure
London



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The Need For Proactive Management

- Few companies truly operate their infrastructure in a truly proactive manner.
- Most organization react to service outage or degradation after it occurs, even though the impact may be counted in the million of dollars per hour.
- Compound service degradation, that spans operational silos is, is one of the biggest challenges for management teams.
- IT and Operations Management teams are now being tasked with avoiding these problems and ensuring service continuity.



So Why Are So Few Operational Teams Proactive?



- **Problems are not being detected in the emerging phase, before they become service impacting.**
 - **The manifestation of emerging problems in performance data may not be sufficient to trip traditional univariate thresholds**
 - **Problems may be complex, with a combination of faulty metrics compounding to contribute to a outage or service degradation.**

- **There is too much infrastructure management noise, so even if an emerging alert is produced, it is lost in the daily noise.**
 - **Too many performance threshold violations are produced.**
 - **Random threshold thrashing generate large volumes of events, that while valid, are a poor indication of actual problem conditions.**
 - **Many hundreds of threshold violations may be produced per problem, with many tens of problems existing concurrently.**

An Introduction to multivariate analytics

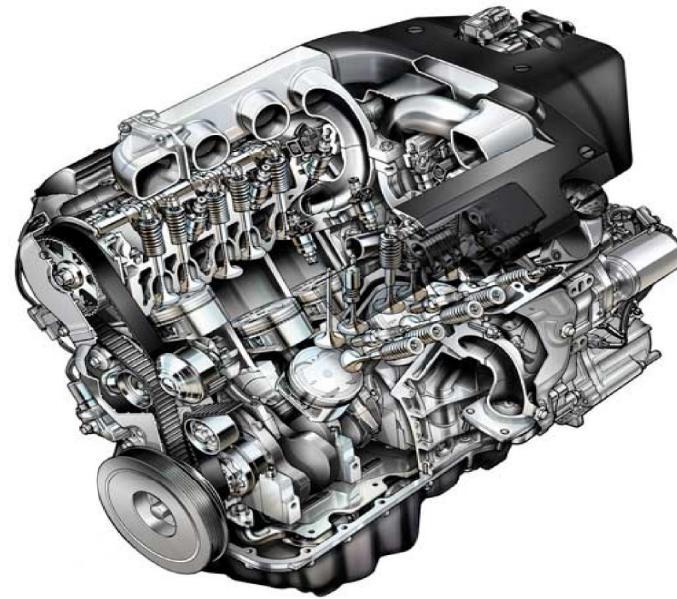


A Comparison Of Analytic Approaches

Monitoring the health of a regular car engine using basic metrics

- Fuel
- Engine Temp
- Outside Temp
- Oil Pressure
- Engine Revs
- Brake Usage
- Brake Fluid
- Battery
- Speedometer

Monitoring engine health with time series metrics



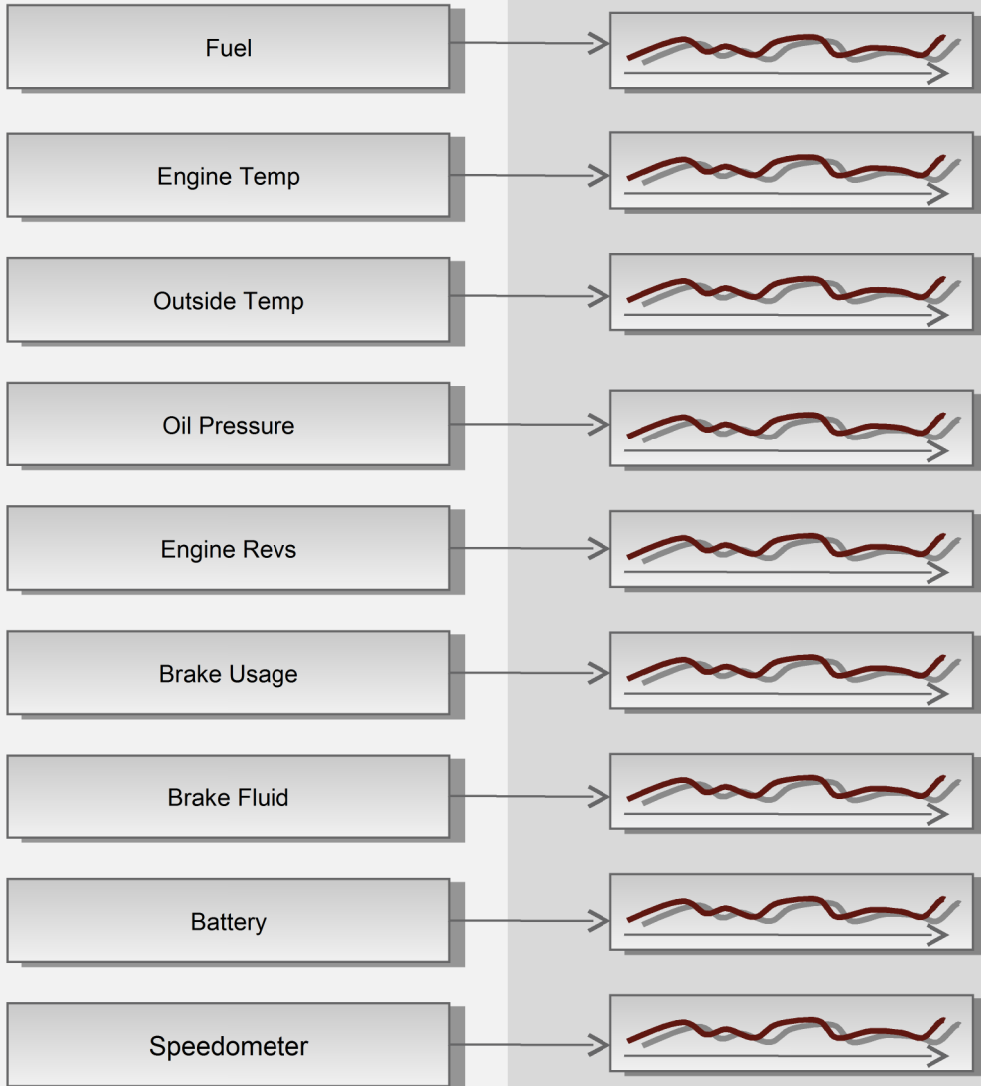
Monitoring Engine Health, A Univariate Approach



Metrics

Analysis

Alerts/Alarms



With univariate, each metric is considered in isolation.

Now imagine two problem occur simultaneously!

1. Blown oil gasket
2. Battery loses charge

Monitoring Engine Health, A Univariate Approach

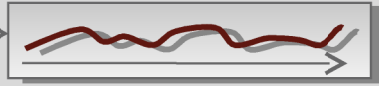


Metrics

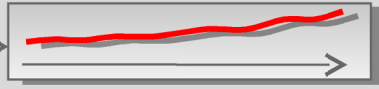
Analysis

Alerts/Alarms

Fuel



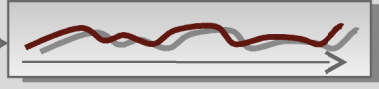
Engine Temp



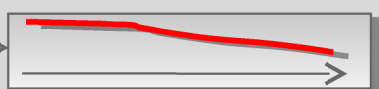
Alert!

ID: 1 Threshold Violation: Engine Temp

Outside Temp



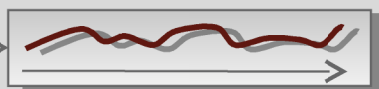
Oil Pressure



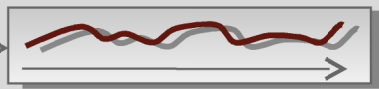
Alert!

ID: 2 Threshold Violation: Oil Pressure

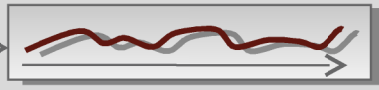
Engine Revs



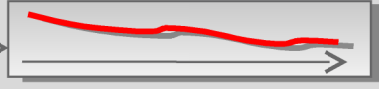
Brake Usage



Brake Fluid



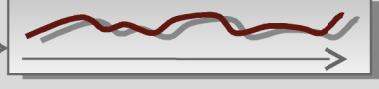
Battery



Alert!

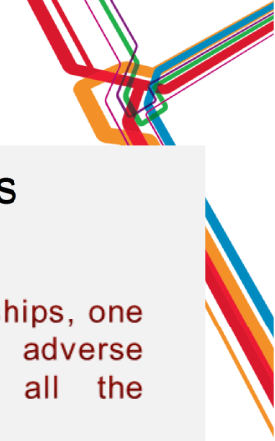
ID: 3 Threshold Violation: Battery

Accelerometer



Each metric generates an alert in isolation.

Monitoring Engine Health, A Multivariate Approach



Metrics

Fuel

Engine Temp

Outside Temp

Oil Pressure

Engine Revs

Brake Usage

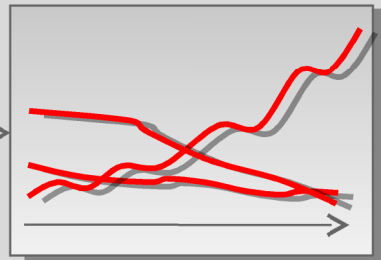
Brake Fluid

Battery

Accelerometer

Analysis

All metrics are considered together.



Relationships between metrics are discovered.

Alerts/Alarms

By learning metric relationships, one alert is generated for an adverse change, which includes all the deviating metrics involved.

Alert!

ID: 1 Anomaly

Anomaly Alert. Related Metrics:
• Oil Pressure Deviation: 46%
• Engine Temp Deviation: 16%

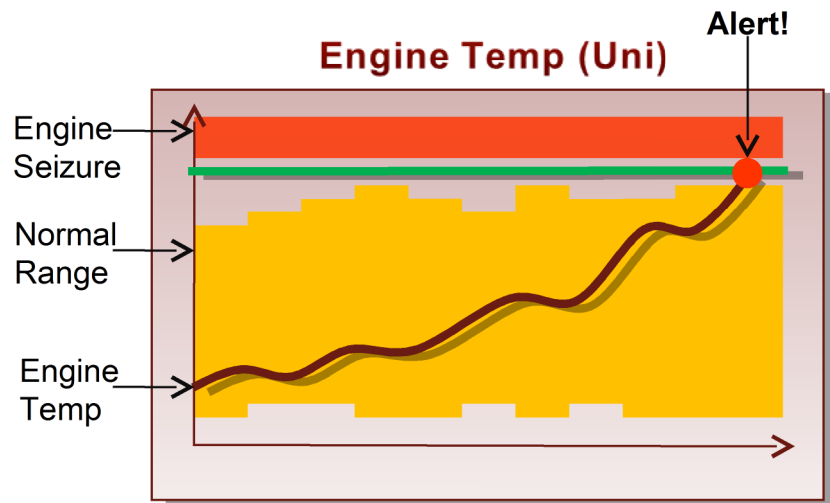
Alert!

ID: 2 Anomaly

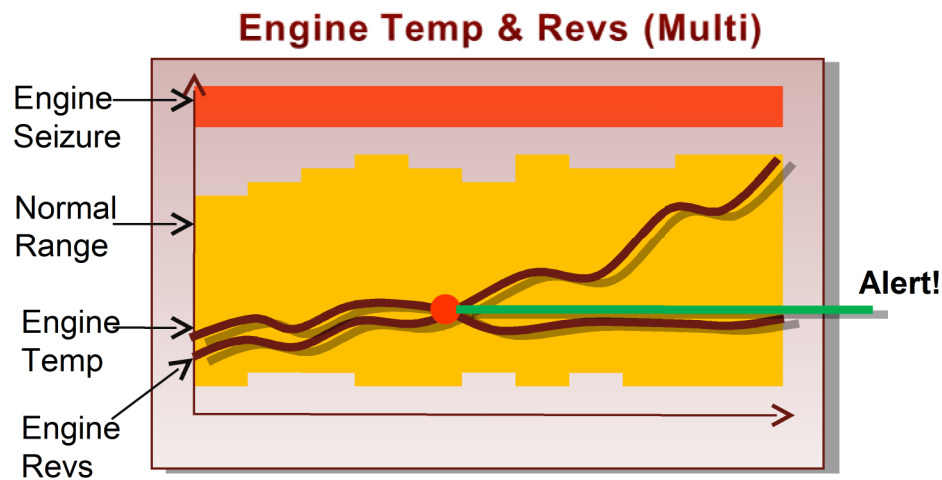
Anomaly Alert. Related Metrics:
• Battery Deviation: 32%

- Correlates metrics
- Fewer more accurate alerts
- Helps with root cause analysis.
- Detects problem sooner (how?, next)

How Does Multivariate Analytics Detect Problems Sooner?



Static Threshold = Short Warning



Multivariate = Alerts earlier on Deviation

Multivariate analytics detects problems sooner by detecting the deviation of metrics that normally move together.

For example:

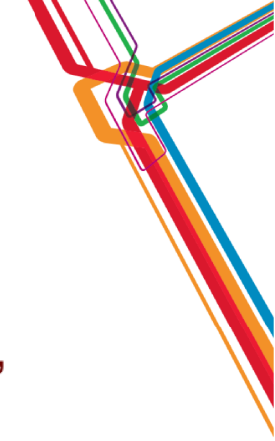
- Engine temperature and engine revolutions normal move together. This is healthy system behaviour...

- But when engine temperature deviates from engine revolutions, as would happen with coolant leak, this indicates a problem and an alert is generated.

- The alert is generated much sooner than waiting for engine temperature to exceed normal operational ranges.

This advanced warning time helps you become proactive and mitigate damage before service is impacted.

Value of a Multivariate Analytics System



- Learns normal operational behaviour across the infrastructure, including how metrics behave together.
- Maximize Advance Warning: Identifies metric relationship changes that signal a problem long before traditional thresholds
- Identifies problems before you know to look for them
- Detects service impacts that are not identifiable by fixed thresholds alone.
- Assists with root cause analysis by indicating the most offending metrics.
- Reduces expensive and time consuming false alerts.

An Introduction to service performance analytics



Ongoing Investment In Analytics, Both Acquisitions and Organic

IBM is helping the industry by continuing on a journey of innovation. We have committed over \$23 billion to acquire and develop best-of-breed tools

IBM is driving the future of integrated analytics through acquisitions and our strategic partnerships:



Trusted Information Platform



Business Analytics & Optimization Platform



Business Analytics & Optimization Solutions



NETEZZA

SPSS

EXEROS
princeton
softtech

unica

ILOG
changing the rules of business™

Core metrics
An IBM Company

COGNOS

solid.

FILENET
DataMirror

InfoSphere
software

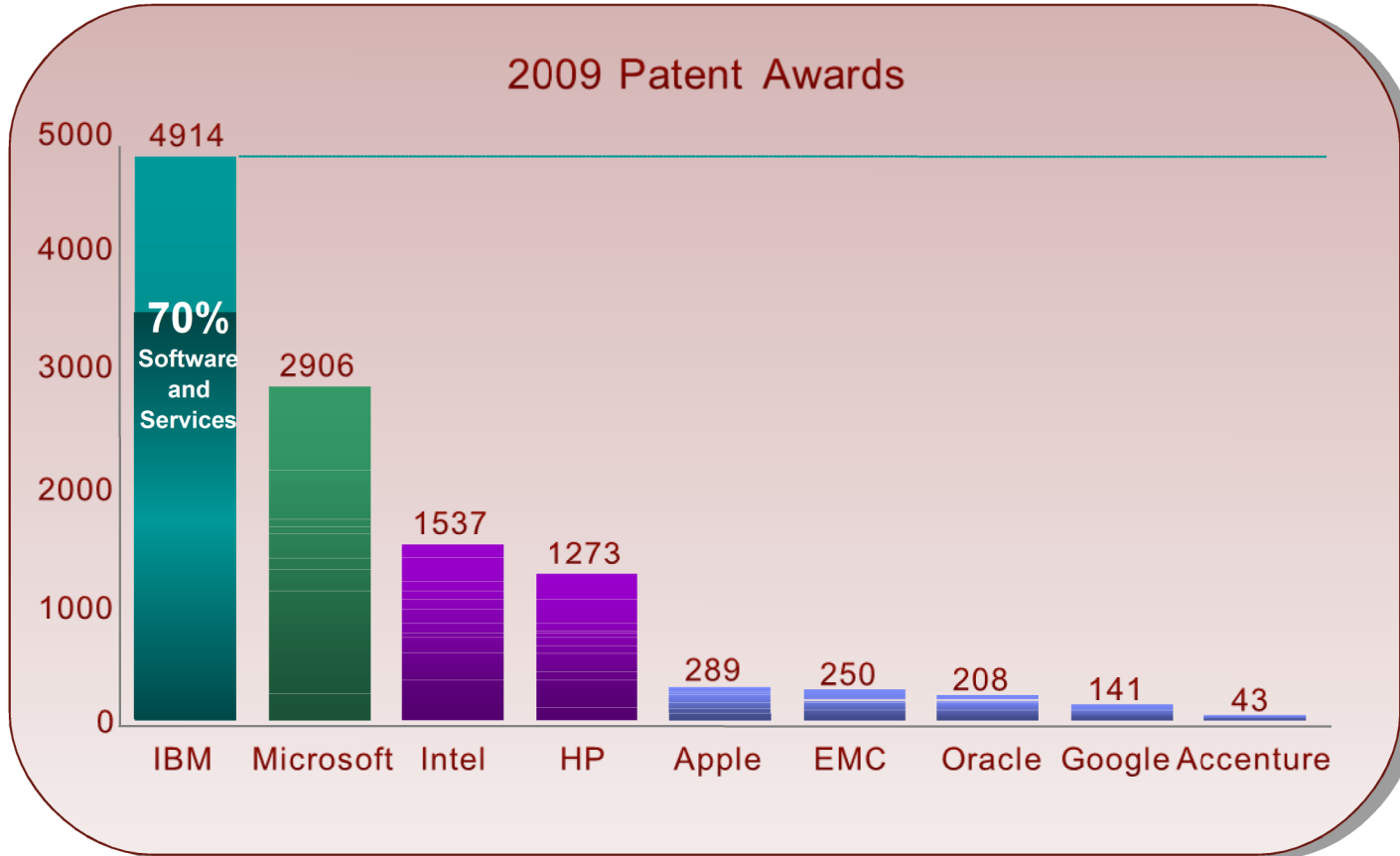
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Optimizing the World's Infrastructure

IBM Research

IBM holds more patents than any other U.S. based technology company and has eight research laboratories worldwide.

IBM employees have earned Five [Nobel Prizes](#), four [Turing Awards](#), five [National Medals of Technology](#), and five [National Medals of Science](#).



IBM Research Business Analytics and Optimisation

- Over 200 researchers with expertise in data analytics, operations research, mathematics, and industry applications of analytics
- Hold 300 patents and have an additional 450 pending on analytics and business applications
- Support IBM's "fact-based" management and processes in sales, supply chain, and services.
- Lead in the global scientific community
 - Over 250 publications in leading conferences and journals in recent years
 - Fellows at several leading professional societies
 - Successive wins at KDD Cup and INFORMS Data Mining Competitions (premier competitions)
 - Leaders in Optimization Open Source
 - Major INFORMS prizes and awards
 - Adjunct faculty at leading universities

Improved profitability through analysis of customer networks for a major telecom customer by providing better customer targeting

Deployed operational planning and scheduling to run steel plants at several leading Asian steel manufacturers - improved productivity

Design optimal maintenance plan for a set of interconnected offshore oil platforms - improve availability of oil platforms

Analytics-Driven Solutions for Increased IBM sales force productivity - increased revenue and profitability

Improved wafer yield at the IBM 300mm semiconductor plant deploying data mining and machine learning

Creation of state-of-the-art error correction code technology that is used in main memory systems of IBM's computers

Provide analysis of operational risk loss data for 36 leading banks from 13 countries - cross enterprise secure and anonymous data sharing

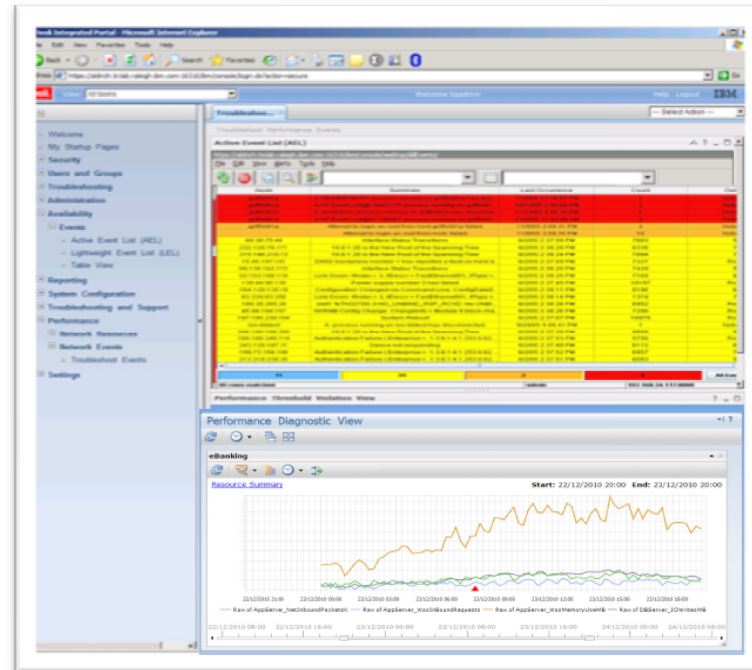
Centralized control and real-time visibility of the end-to-end supply chain for IBM supply chain - reducing inventory

Handwritten mathematical notes include:
 $f = \sum_{k=1}^n \frac{1}{\|p_k\|}$
 $\frac{1}{s} \frac{\partial u}{\partial s} + \frac{1}{s^2} \frac{\partial u}{\partial p^2} + \frac{\partial^2 u}{\partial z^2} = \frac{1}{c^2} \frac{\partial^2 u}{\partial t^2}$
 $J_0(0) = 1, J_n(0) = 0$ mit $n > 0$.
 $J_{-k}(x) = \frac{(-1)^k}{k!} J_k(x)$
 $J_{\lambda}(x) = \begin{cases} 0 & \text{für } \lambda > 0 \\ 1 & \text{für } \lambda = 0 \end{cases}$
 $N_k(x) = \lim_{\lambda \rightarrow k} \frac{\cos(\lambda\pi) J_{\lambda}(x) - J_{-\lambda}(x)}{\sin(\lambda\pi)}$
 $\lim_{\lambda \rightarrow 0} N_{\lambda}(x) = \infty$ Neumann-Fkt.

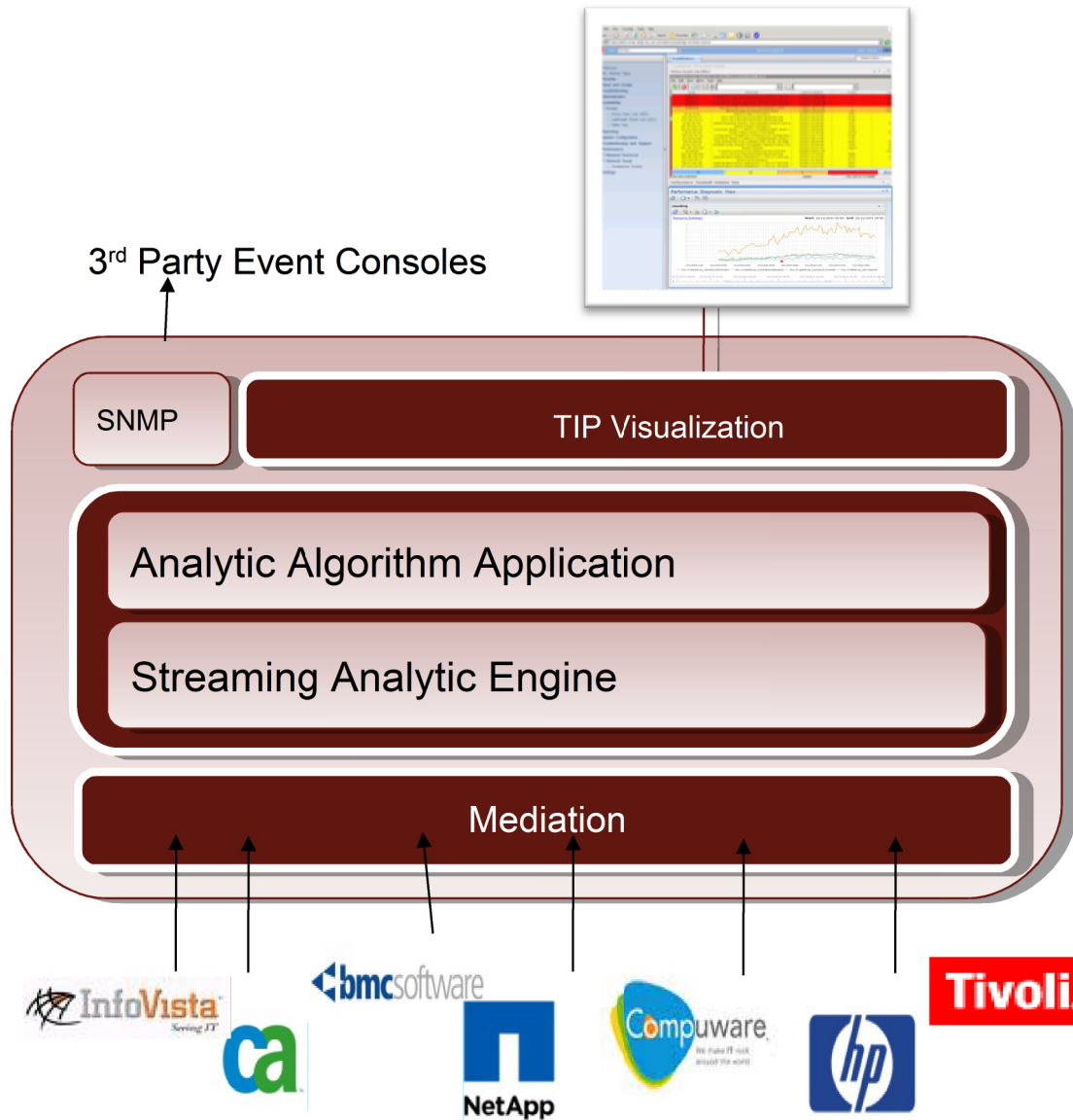
Coming Soon: Analytics for Service Performance

Proactive and self-learning performance and bsm intelligence

- Real-time analytics for detecting and avoiding service disruption.
- Uses advanced multivariate analytic algorithms; providing all the advantages mentioned previously.
- Correlates metric across multiple domains and heterogeneous data sources.
- Ultra scalable; analyzing massive volumes of metrics in a single multivariate instance.
- Leverages key IBM analytic engines and mediation
- Works in non-Tivoli environments, as well as integrating tightly with Tivoli suite.

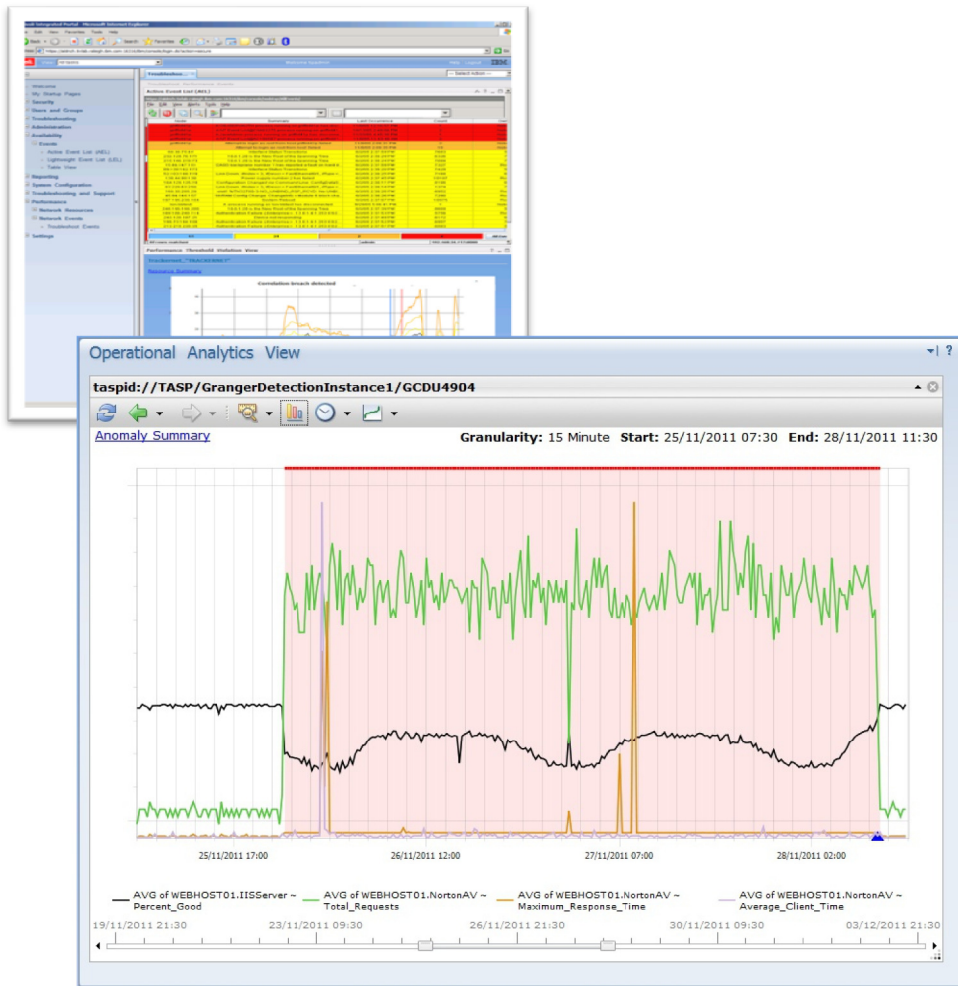


Software Architecture



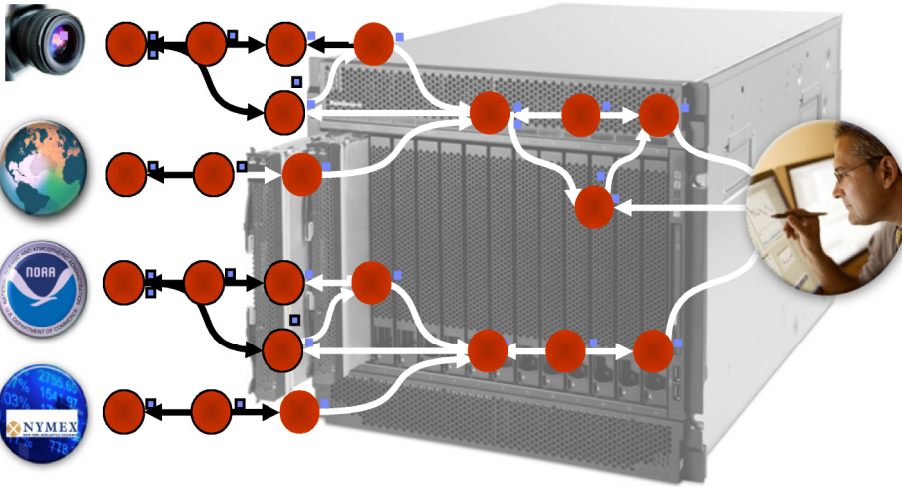
- Leverages IBM Information Management assets to fields a state-of-the-art solution:
- Highly scalable and resilient streaming analytic engine.
- Powerful analytic algorithms, combining uni & multivariate approaches, designed to leverage InfoSphere Streams engine for unlimited scalability.
- Highly scalable and flexible data mediation layer providing turn-key integrations and easily extendable capabilities.
- TIP based, native visualisation.
- SNMP and Netcool/Omnibus native predictive alerts

Embedded Analytic Visualization:



- Modular design plugs into Tivoli environment or installs independently, quickly accepting data from any source (including Tivoli products of course)
- TIP based user & security framework.
- TIP based native WEB 2.0 visualisation
- Multiple metric chart overlay.
- Toggle display of individual metrics.
- See correlated metrics and relationships.
- See deviations details.
- Out of the Box integration with Tivoli Netcool/OMNIBus event management console.
- Easily linked to any event system that receives SNMP traps and supports HTML Launch in Context

Streaming Engine Deployed in World's Fastest Options Trading Environments

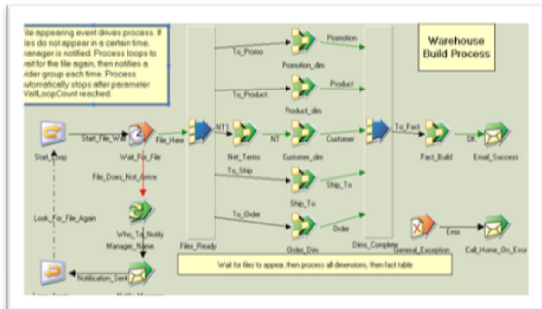
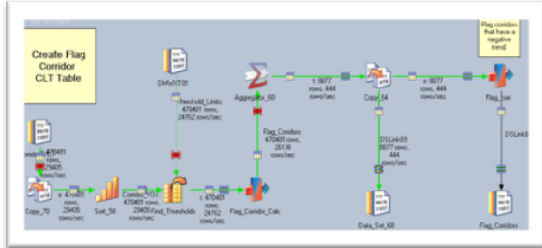
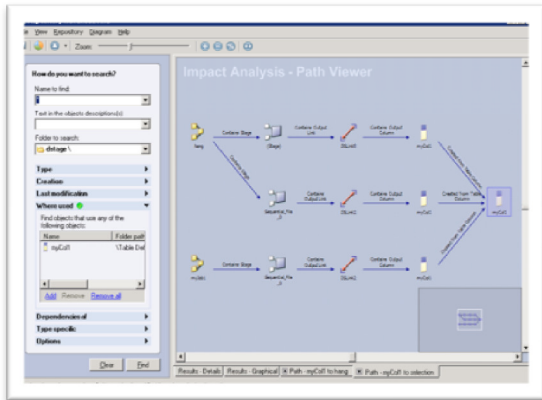


- Proven in the most unforgiving high volume low latency environments – processing 5 Million events/second with 150ms average latency
- Also deployed in finance, defence and security applications world-wide
- Core product of IBM's Smarter Planet strategy

High performance and scalability:

- Simplifies deployment setup (no splitting service metrics across multiple multivariate instances).
- Reduces human “guesswork” on which metrics to ignore or analyse
- By evaluating many metrics, the maximum value of multivariate analytics is gained.
- Allows for continuous learning configuration; one instance learning, one running; always adapting to dynamic environments.

Under the covers: Market Leading Mediation



- Market leading mediation software, used in thousands of accounts
- Proven rapid integration with new data sources
- Platform Productivity & Collaboration (Tooling & Metadata, Reuse)
- Performance & Scalability (True Parallel Pipelining & Partitioning, Seamless Grid Support)
- Large framework of connectors available to make new integrations;
- Turn-key integrations to common performance monitoring suites...



Large Framework of Connectors:

RDBMS

DB2 (on Z, I, P or X series)
Oracle
Informix (IDS and XPS)
Ingres
Netezza
Progress
RDB
RedBrick
SQL/DS
SQL Server
Sybase (ASE & IQ)
Teradata
Universe
UniData
NonStop SQL
InfoSphere Federation Server
InfoSphere Classic Federation
And more.....

General Access

Sequential File
Complex Flat File
File Set
Data Set
Named Pipe
iWay
FTP
SFTP
Compressed / Encoded Data
External Command Call
Parallel/wrapped 3rd party apps
EMC InfoMover
Web logs
Email

Enterprise Applications

JDE/PeopleSoft OneWorld
Oracle Applications
PeopleSoft
SAS
SAP BW
SAP R/3
Siebel
Ariba
Manugistics
I2
Etc...

Standards & Real Time

WebSphere MQ
Java Messaging Services (JMS)
Java
XML & XSL-T
EBXML
Web Services (SOAP)
Enterprise Java Beans (EJB)
EDI
FIX
SWIFT
HIPAA

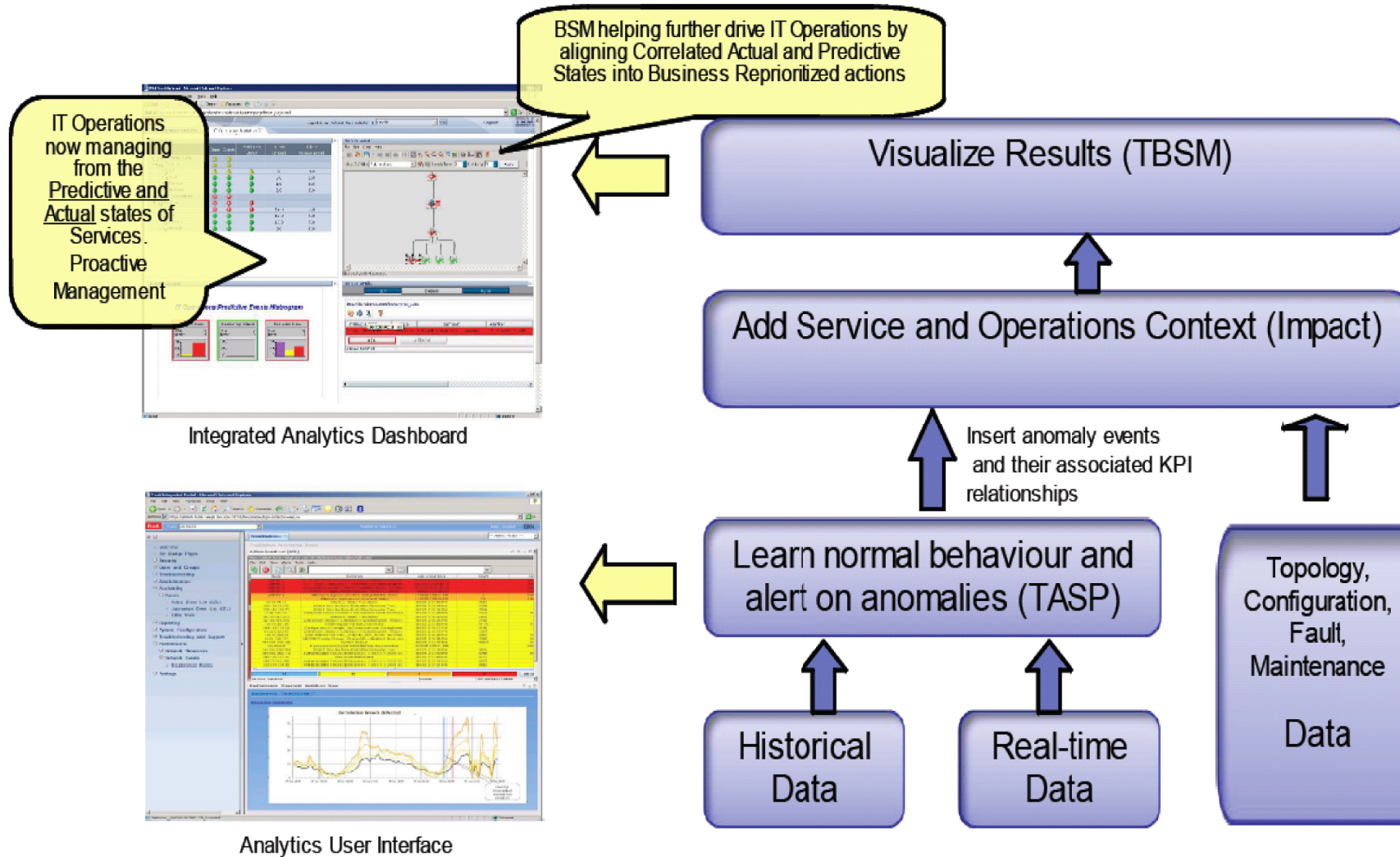
CDC

DB2 (on Z, I, P, X series)
Oracle
SQL Server
Sybase
Informix
IMS
VSAM
ADABAS
IDMS
Datacom

Legacy

Allbase/SQL
C-ISAM
D-ISAM
Datacom/DB
DS Mumps
Enscribe
Essbase
FOCUS
IDMS/SQL
ImageSQL
Infoman
KSAM
M204
MS Analysis
Nomad
Nucleus
RMS S2000
Supra
TOTAL
TurboImage
Unify
And many more....

Presenting Anomalies in Context



Tivoli's solutions allows you see anomalous conditions prioritized for business impact associated with other environmental data, such as faults, configurations changes, maintenance activities, etc...

Presenting Anomalies in Context

The screenshot displays a service management interface with two main panels. The left panel, 'Equities Service Navigator', shows a hierarchical tree of services across various locations (Chicago, HongKong, London, Tokyo) and their performance metrics. The right panel, 'Service Canvas View', provides a detailed view of the 'ExchangeTrading' service, including a hierarchical diagram of its components and a 'Service Details' table.

| Service | State | Infrastructure State | % Throughput vs. Baseline | ResponseTime | Historical Baseline | Total Tickets |
|----------------------------|--------|----------------------|---------------------------|--------------|---------------------|---------------|
| ExchangeTrading | Green | Green | 64% | 805 | 521 | 71 |
| Chicago | Yellow | Yellow | 56% | 1211 | 689 | 71 |
| ET_Convert | Red | Red | 68% | 306 | 210 | 24 |
| ET_Login | Red | Red | 47% | 747 | 353 | 0 |
| ET_Transfer | Yellow | Yellow | 79% | 158 | 125 | 47 |
| HongKong | Yellow | Yellow | 88% | 399 | 353 | 0 |
| OnlineBanking | Green | Green | 85% | 635 | 540 | 9 |
| Chicago | Green | Green | 89% | 455 | 408 | 0 |
| ET_CheckAccountBalance | Green | Green | 124% | 22 | 27 | 0 |
| ET_Deposit | Yellow | Yellow | 82% | 302 | 250 | 0 |
| ET_Login | Green | Green | 100% | 131 | 131 | 0 |
| HongKong | Green | Green | 82% | 816 | 672 | 9 |
| ET_CheckAccountBalance | Green | Green | 115% | 131 | 151 | 0 |
| ET_Deposit | Red | Red | 69% | 292 | 202 | 0 |
| ET_Login | Yellow | Yellow | 81% | 393 | 319 | 0 |
| ET_Transfer | Green | Green | 0% | 0 | 0 | 9 |
| StockTrader | Green | Green | 96% | 635 | 612 | 82 |
| London | Green | Green | 104% | 643 | 671 | 20 |
| ET_CancelOrder | Red | Red | 47% | 146 | 69 | 0 |
| ET_ChangeOrder | Green | Green | 138% | 135 | 187 | 0 |
| ET_ExecuteBuyOrder | Yellow | Yellow | 79% | 151 | 120 | 0 |
| cluster34 | Red | Red | | | | |
| ET_ExecuteSellOrder | Green | Green | 147% | 91 | 134 | 12 |
| ET_GetQuote | Green | Green | 150% | 12 | 18 | 8 |
| traderouter (server1) | Green | Green | | | | |
| caesar51:server1 (WebSphe) | Green | Green | | | | |
| ET_Login | Green | Green | 131% | 108 | 142 | 0 |
| New York | Green | Green | 96% | 565 | 542 | 31 |
| ET_CancelOrder | Green | Green | 95% | 159 | 152 | 7 |
| ET_ChangeOrder | Green | Green | 96% | 181 | 175 | 0 |
| ET_ExecuteBuyOrder | Yellow | Yellow | 80% | 142 | 114 | 0 |
| ET_ExecuteSellOrder | Green | Green | 146% | 5 | 7 | 0 |
| ET_GetQuote | Green | Green | 120% | 16 | 19 | 8 |
| ET_Login | Green | Green | 120% | 62 | 75 | 16 |
| Tokyo | Yellow | Yellow | 89% | 698 | 622 | 31 |
| ET_CancelOrder | Green | Green | 154% | 101 | 156 | 7 |
| ET_ChangeOrder | Red | Red | 66% | 218 | 144 | 4 |
| ET_ExecuteBuyOrder | Green | Green | 125% | 112 | 140 | 6 |
| ET_ExecuteSellOrder | Red | Red | 61% | 38 | 23 | 0 |
| ET_GetQuote | Yellow | Yellow | 78% | 74 | 58 | 14 |
| ET_Login | Red | Red | 65% | 155 | 101 | 0 |

Service Canvas View: ExchangeTrading

View Definition: AppManagerView | Levels Down: 4 | Levels Up: 0 | Apply

ExchangeTrading

- Chicago
 - ET_Login (Response: 747.0, Total Tickets: 0.0)
 - ET_Convert (Response: 306.0, Total Tickets: 26.0)
 - ET_Transfer (Response: 158.0, Total Tickets: 47.0)
- HongKong
 - ET_Login (Response: 393.0, Total Tickets: 0.0)
 - ET_Convert (Response: 292.0, Total Tickets: 0.0)
 - ET_Transfer (Response: 319.0, Total Tickets: 0.0)

Updating status: requesting...

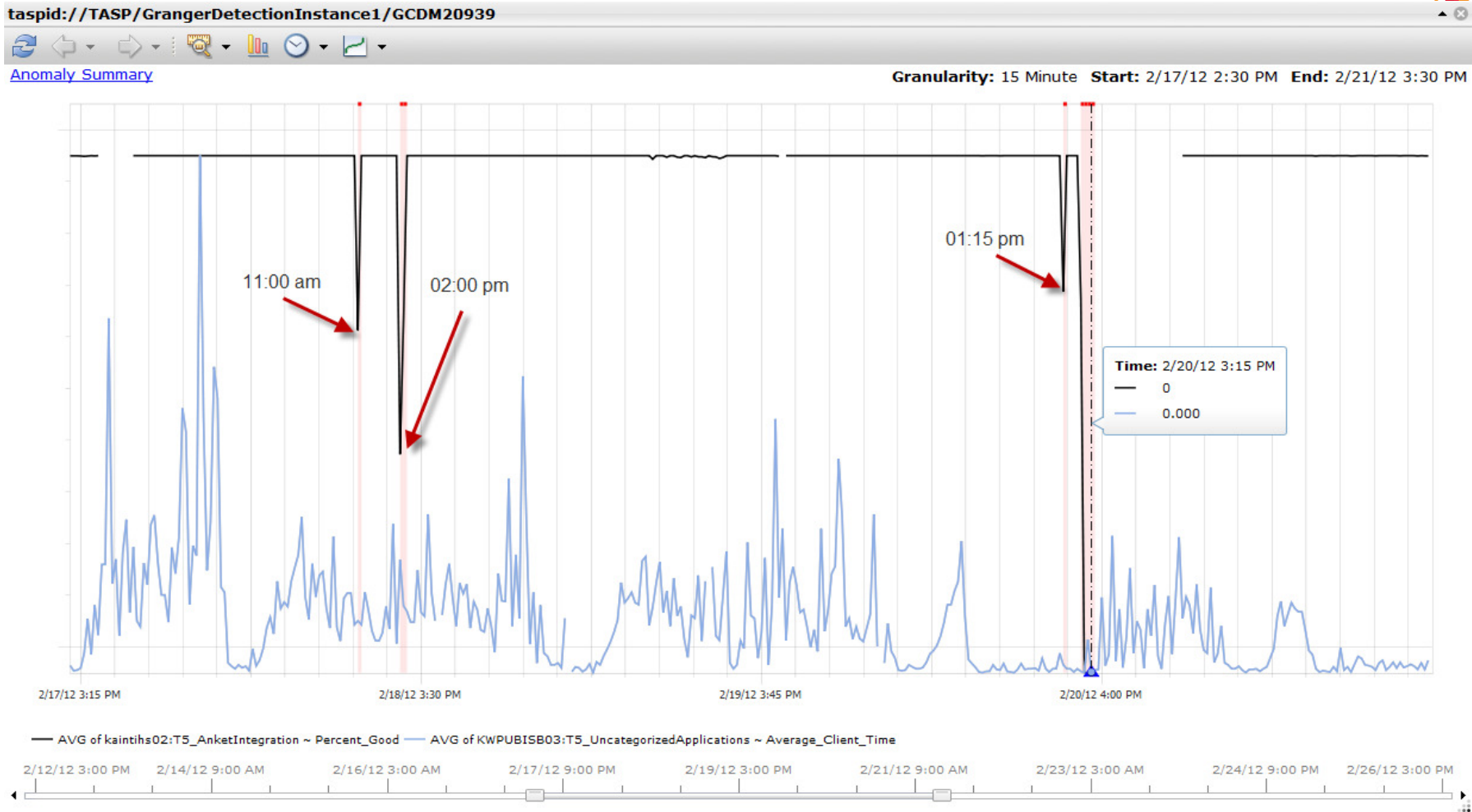
Service Details

SLA | Events | Rules

http://192.168.74.30:8787/ServiceState_254

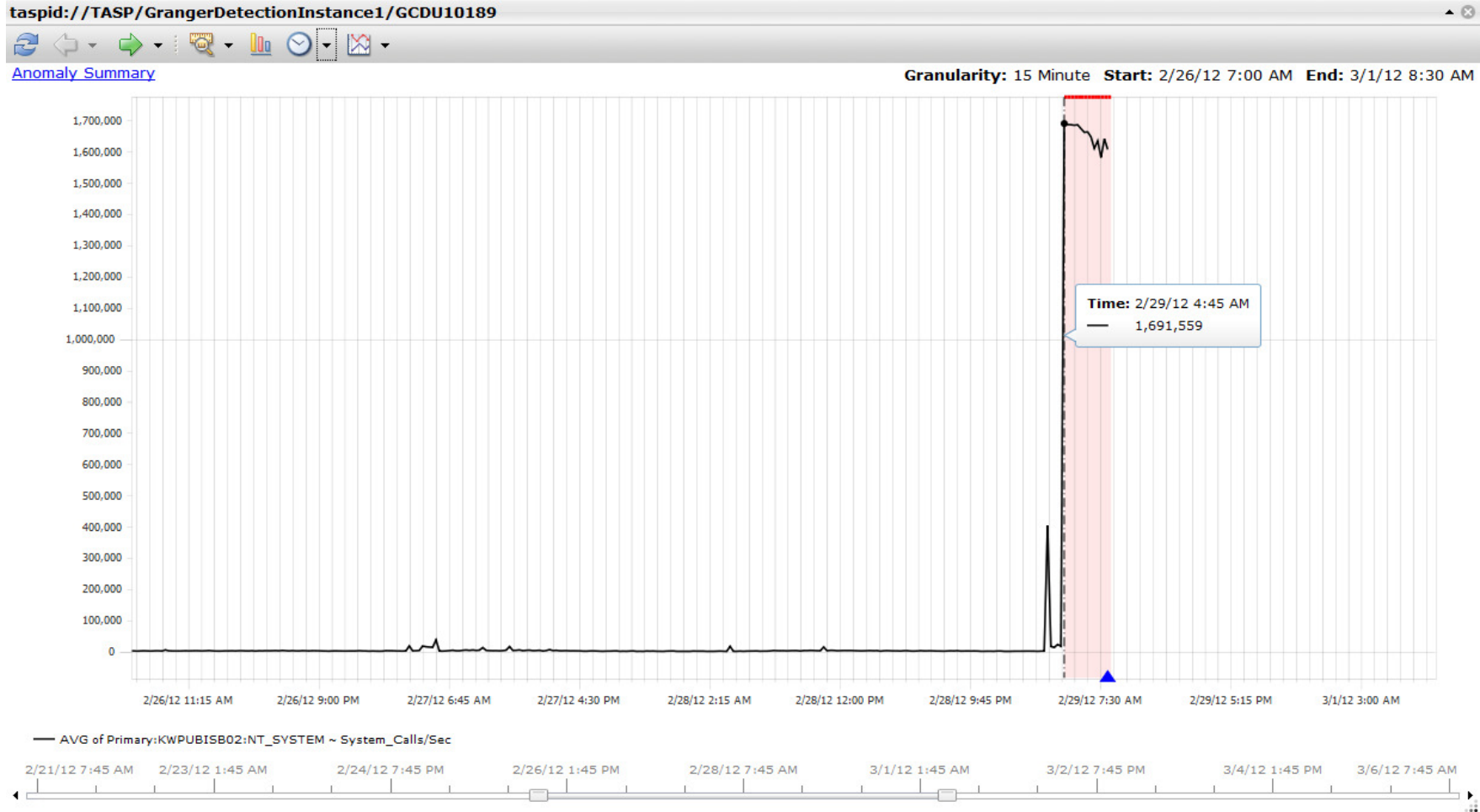
| ServiceName | Attribute | Summary |
|-----------------|--------------------|--|
| ET_ExchangeTrac | OverallAttribute | Overall Attribute of the BSM_MonitoredAppLocationS |
| ET_ExchangeTrac | OverallAttribute | Overall Attribute of ET_Login is Bad. |
| ET_ExchangeTrac | PctWorseThanAvgRes | PctWorseThanAvgRespTime_Status of the BSM_Moni |
| ET_ExchangeTrac | PctWorseThanAvgRes | PctWorseThanAvgRespTime of the BSM_MonitoredAg |
| ET_ExchangeTrac | AvgRespTime | Event based attribute AvgRespTime of template BSM |
| ET_ExchangeTrac | ResponseTime | Event based attribute ResponseTime of template BSI |

Detected Problem 2 Days Ahead of Outage



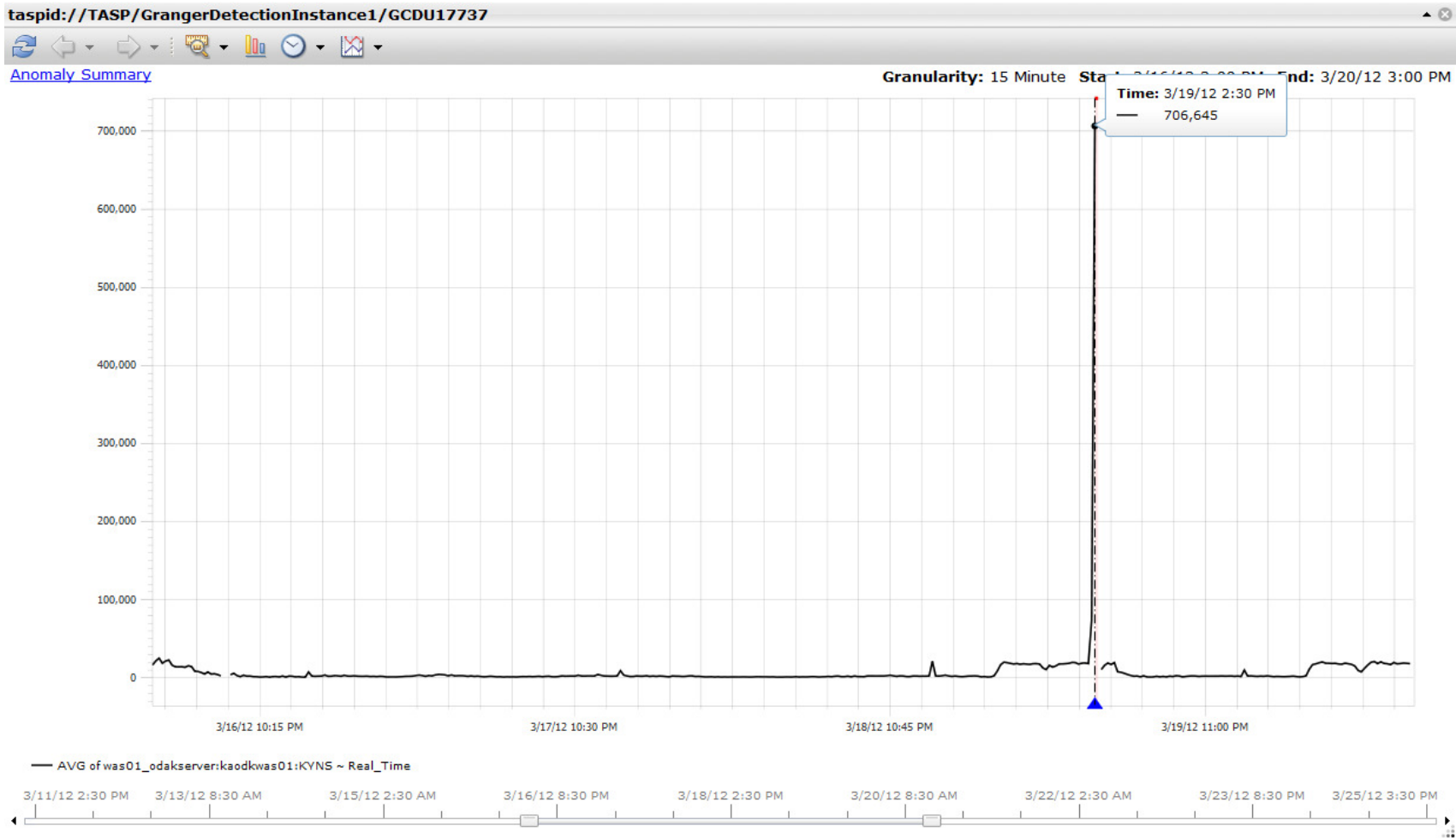
Customer comment: If they had seen the first couple of anomalies and investigated the root- cause, they might have averted the outage.

Confirmed Server Problem



Customer suspected a problem in server that was causing application problems, but Microsoft had returned 'no fault found' when a case was opened. IBM information helped confirm suspicions and the workload was moved to an alternative.

Earlier Detection Of Known Problem



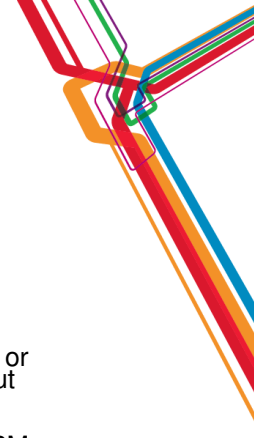
Customer comment: IBM anomaly correlated with known incident where the application gets stuck and has to be restarted (which happens every so often in reaction to services hanging). IBM detection occurs earlier so application reset can be triggered before service quality is impacted.

Detecting Unknown Problems



Customer comment: IBM detected an outage on an important service (virtual 'point of sale' system for customers to shop and pay with credit cards etc), it had gone unnoticed with the customer operators had failed to complain.

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