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APPLICATION

FOR

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TITLE: Two-Phase Root Cause Analysis

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TWO-PHASE ROOT CAUSE ANALYSIS

Background

[0001]   The invention relates generally to the field of event detection and fault
diagnosis for computer systems and, more particularly but not by way of limitation, to
techniques (devices and methods) for defining and using fault models for the
monitoring, diagnosis and recovery of error conditions in a enterprise computing
system.

[0002]   Contemporary corporate computer networks comprise a plurality of different
computer platforms and software applications interconnected through a number of
different paths and various hardware devices such as routers, gateways and switches.
Illustrative computer platforms include desktop personal computers, engineering
workstations, dedicated file, application and mail servers and mainframe computer
systems. Illustrative software applications include accounting, payroll, order entry,
inventory, shipping and database applications. The collection of such entities - hardware
and software - is often referred to as an "enterprise."

[0003]   As enterprises have become larger and more complex, their reliability has
become ever more dependent upon the successful detection and management of
problems that arise during their operation. Problems can include hardware and software
failures, hardware and software configuration mismatches and performance
degradation due to limited resources, external attacks and/or loss of redundancy.
Operational problems generate observable events, and these events can be monitored,
detected, reported, analyzed and acted upon by humans or by programs. It has been
observed that as an enterprise grows (i.e., incorporates more monitored components -
hardware and software), the rate at which observable events occur increases
dramatically. (Some studies indicate event generation rates increase exponentially with
enterprise size.) Quickly and decisively identifying the cause of any given problem can
be further complicated because of the large number of sympathetic events that may be

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What is claimed is:

1.   1.   An enterprise fault analysis method, wherein at least a portion of the
2.   enterprise is represented by a enterprise-specific fault model having a plurality of
3.   nodes, comprising:
4.   receiving an event notification for a first node in the fault model;
5.   performing an up-stream analysis of the fault model beginning at the first node;
6.   identifying a second node, the second node having a status value modified
7.   during the up-stream analysis to indicate a failed status;
8.   performing a down-stream analysis of the fault model beginning at the second
9.   node;
10.   identifying those nodes in a contiguous path between the second node and the
11.   first node in the fault model whose impact values indicate an impacted performance
12.   condition in accordance with the down-stream analysis;
13.   reporting the second node as a root cause of the received event notification; and
14.   reporting at least one of the identified nodes as impacted by the root cause of
15.   the received event notification and not as root causes of the received event notification.

1.   2.   The method of claim 1, wherein the enterprise-specific fault model comprises
2.   an Impact Graph.

1.   3.   The method of claim 1, wherein the act of performing an up-stream analysis
2.   comprises:
3.   evaluating an inference policy associated with the first node and setting a status
4.   value associated with the first node in accordance therewith; and
5.   evaluating inference policies associated with up-stream nodes to the first node
6.   and setting a status value associated with each evaluated up-stream node in
7.   accordance therewith.

1   4.   The method of claim 3, wherein the act of evaluating inference policies is
2   terminated when no up-stream nodes from the last evaluated node exist.

1   5.   The method of claim 4, wherein the act of evaluating inference policies is
2   further terminated when a status value associated with a node does not change based
3   on evaluation of an inference policy associated with the node.

1   6.   The method of claim 4, wherein the act of evaluating inference policies is
2   further terminated when a status value associated with a node is a measured status
3   value.

1   7.   The method of claim 1, wherein the act of identifying a second node further
2   comprises identifying one or more nodes that are most up-stream from the first node.

1   8.   The method of claim 7 further comprising identifying, as the second node,
2   an arbitrary one of the one or more identified nodes.

1   9.   The method of claim 3, wherein the status value associated with a node
2   comprises a Boolean value.

1   10.   The method of claim 3, wherein the status value associated with a node
2   comprises a real-number value.

1   11.   The method of claim 3, wherein a status value associated with a node
2   further has one or more associated attributes.

1   12.   The method of claim 11, wherein one of the one or more associated
2   attributes comprises a temporal attribute.

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1   13.   The method of claim 11, wherein one of the one or more associated

2   attributes comprises an indication to identify the status value as being a measured

3   value or an inferred value.

1   14.   The method of claim 1, wherein the act of performing a down-stream

2   analysis comprises:

3   evaluating an impact policy associated with the second node and setting an

4   impact value associated with the second node in accordance therewith; and

5   evaluating impact policies associated with down-stream nodes to the second

6   node and setting an impact value associated with each evaluated down-stream node in

7   accordance therewith.

1   15.   The method of claim 14, wherein the act of evaluating impact policies is

2   terminated when no down-stream nodes from the last evaluated node exist.

1   16.   The method of claim 15, wherein the act of evaluating impact policies is

2   further terminated when an impact value associated with a node does not change

3   based on evaluation of an impact policy associated with the node.

1   17.   The method of claim 14, wherein the impact value associated with a node

2   comprises a Boolean value.

1   18.   The method of claim 14, wherein the impact value associated with a node

2   comprises a real-number value.

1   19.   The method of claim 14, wherein an impact value associated with a node

2   further has one or more associated attributes.

1   20.   The method of claim 19, wherein one of the one or more associated

2   attributes comprises a temporal attribute.

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