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(54) METHOD AND CLUSTER FOR TESTING ORCHESTRATION

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G06F 11/3668	(2025.01)
G06F 9/54	(2006.01)
G06F 11/3698	(2025.01)

(52) **U.S. Cl.**
CPC ***G06F 11/3688*** (2013.01); ***G06F 9/547*** (2013.01); ***G06F 11/3698*** (2025.01)

(58) **Field of Classification Search**
CPC ... G06F 11/3664; G06F 11/3688; G06F 9/547
See application file for complete search history.

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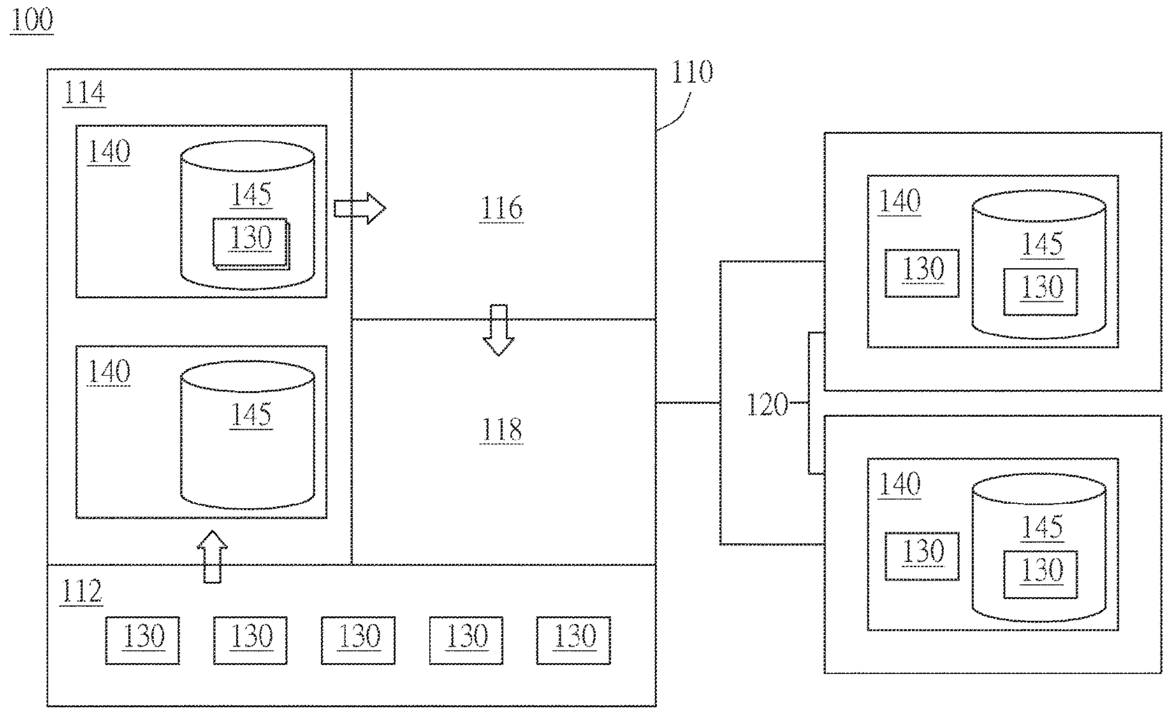
Primary Examiner — Jigar P Patel

(57) ABSTRACT

A method and a cluster for testing orchestration are provided. The method comprises: assigning a plurality of testing containers each including a specification file to provide testing details and stored in a repository of a control plane, by a testing controller of the control plane, to a plurality of pods each including at least one storage volume configured to store the assigned testing containers; dispatching the plurality of pods, by a scheduler of the control plane through an application program interface (API) server of the control plane, to at least one node; running the plurality of pods, by the at least one node, to execute the assigned testing containers, until all the assigned testing containers stored in the at least one storage volume have been finished; reporting execution results of the finished testing containers to the API server; and if any execution result indicates a failure, assigning the corresponding testing container again to a different pod.

12 Claims, 5 Drawing Sheets



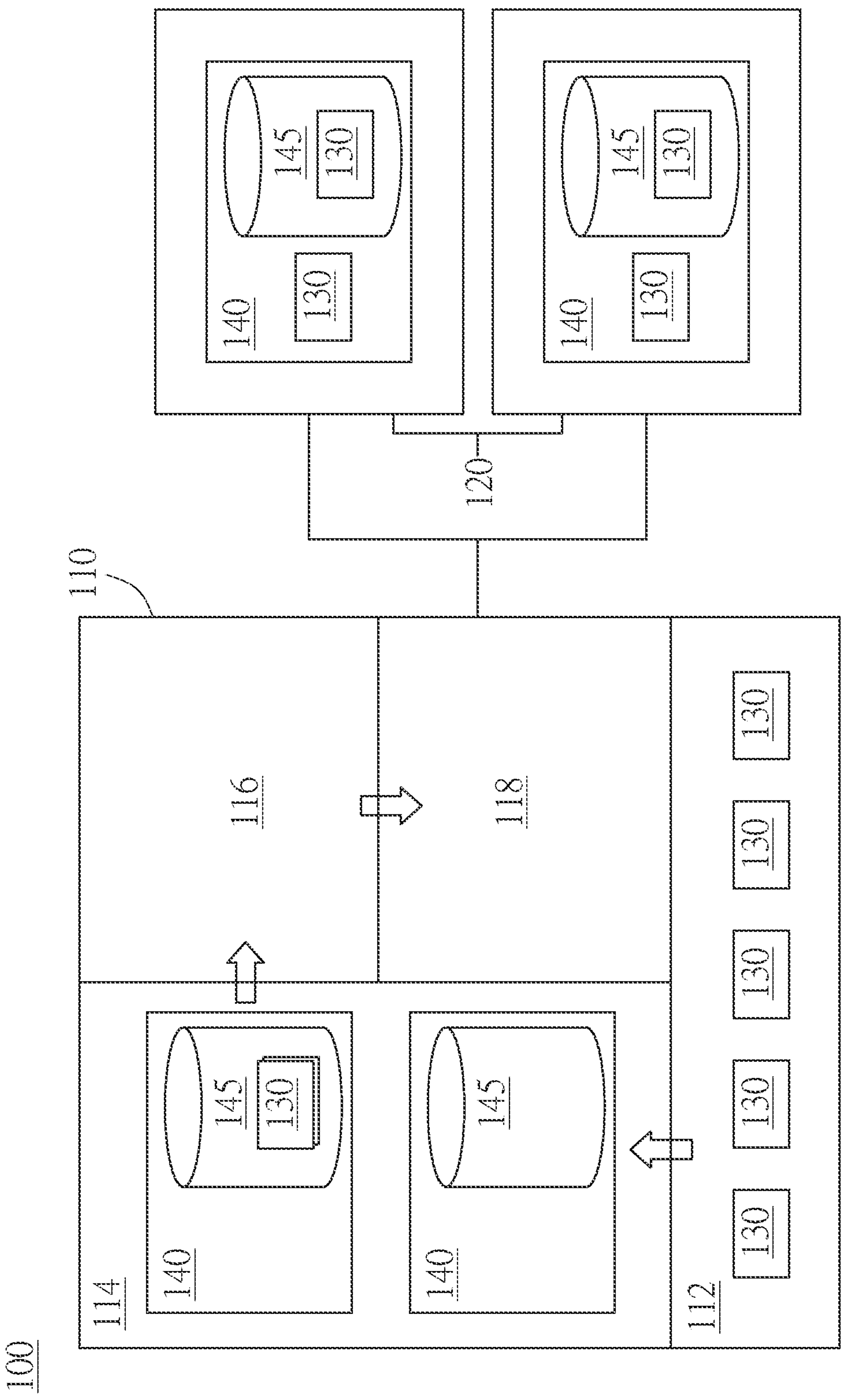


FIG. 1

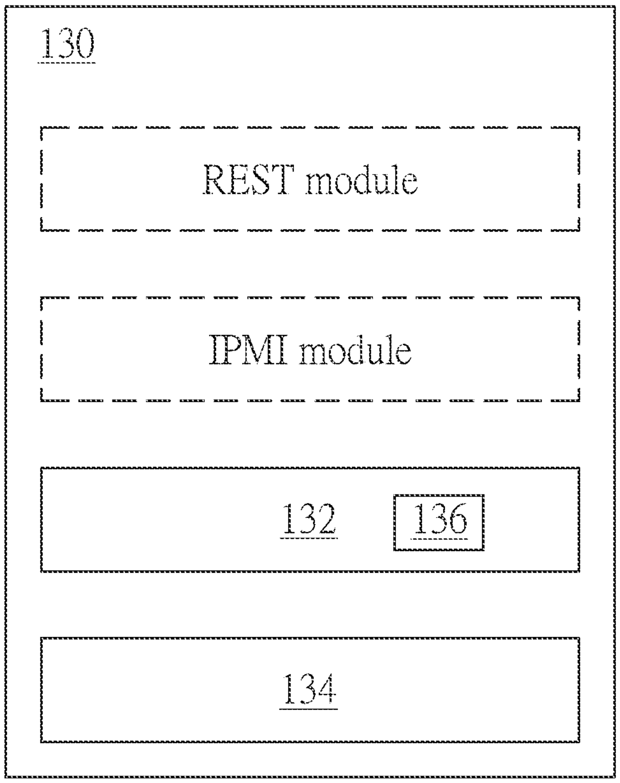


FIG. 2

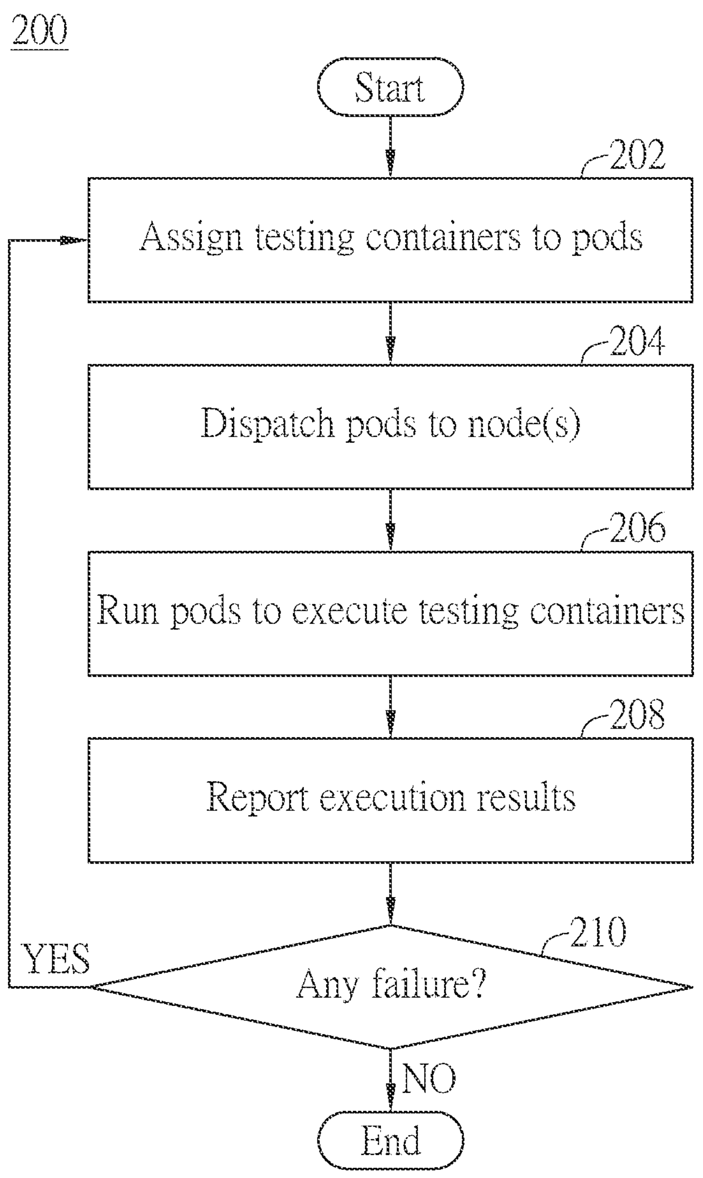
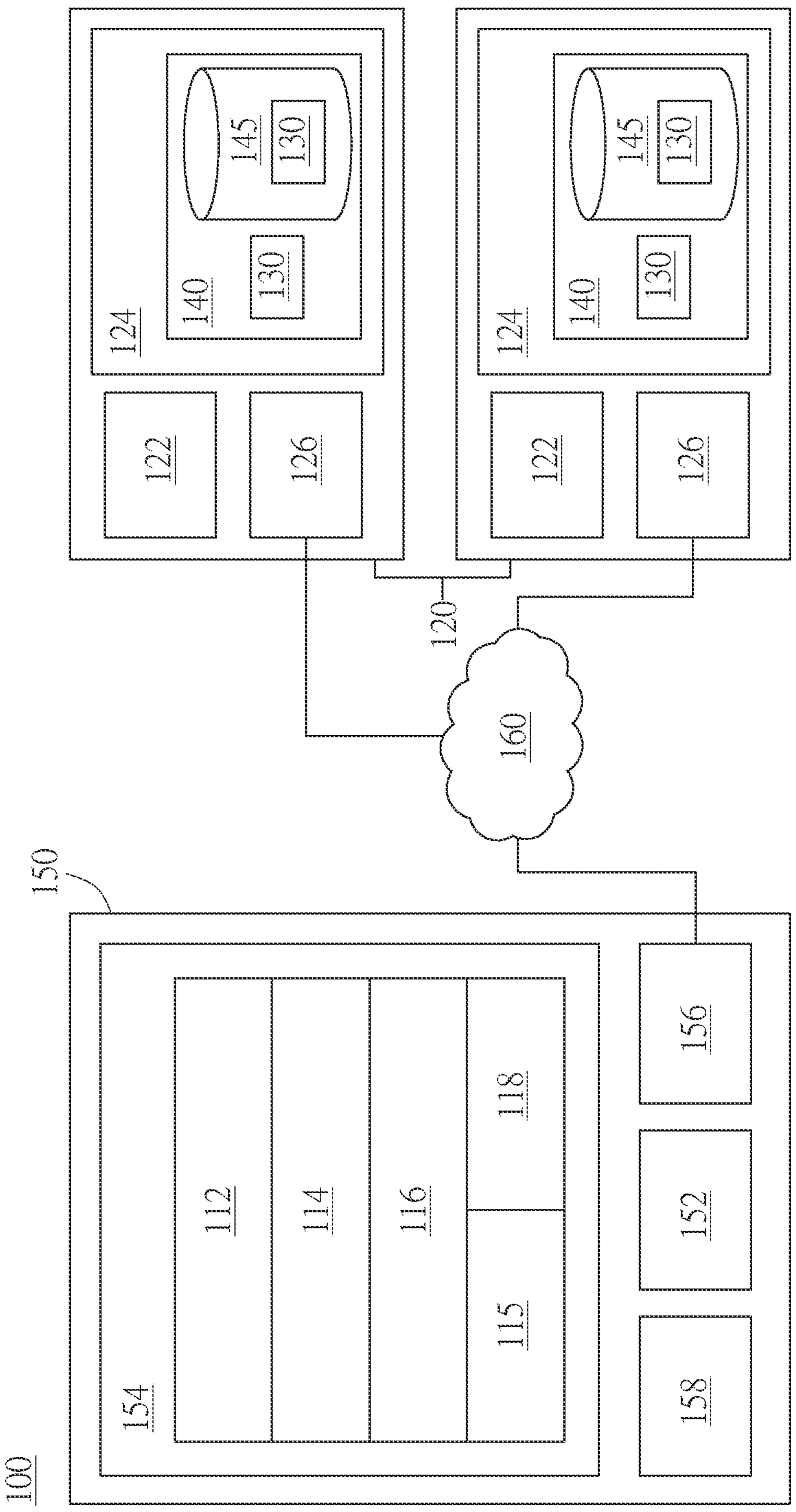

200
Start
202
Assign testing containers to pods
204
Dispatch pods to node(s)
206
Run pods to execute testing containers
208
Report execution results
210
Any failure?
YES
NO
End

FIG. 3


100
150
154
112
114
116
115
118
156
152
158
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120
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126
124
140
130
145
130
122
126
124
140
130
145
130

FIG. 4

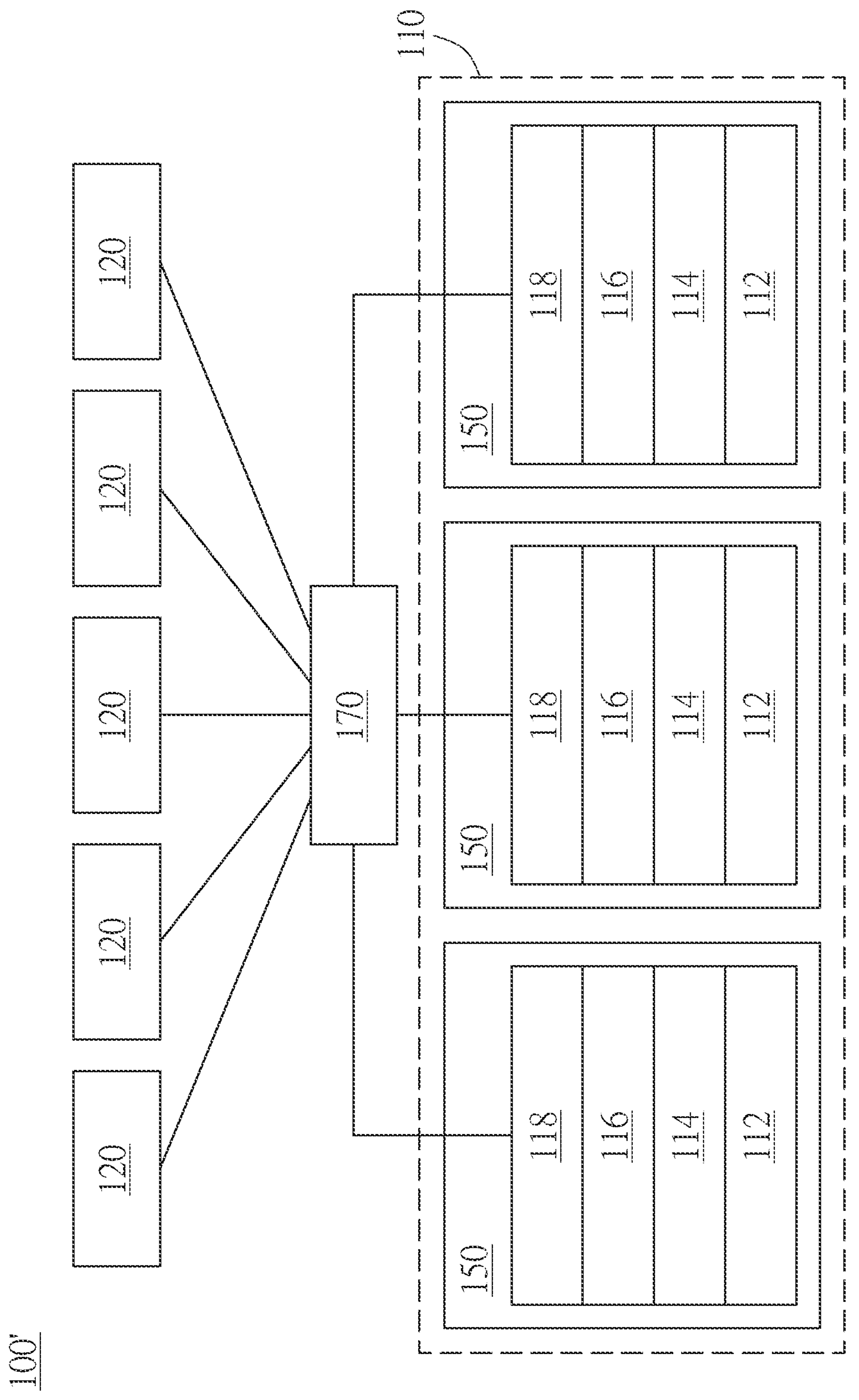
100'
110
120
120
120
120
120
170
150
118
116
114
112
150
118
116
114
112
150
118
116
114
112

FIG. 5

METHOD AND CLUSTER FOR TESTING ORCHESTRATION

FIELD OF INVENTION

The present invention relates to baseboard management controller (BMC) image testing, and more particularly to a method and a cluster for orchestration of BMC image testing.

BACKGROUND

To implement platform management for server-class computer systems, baseboard management controllers (BMCs) are typically included. A BMC is a specialized microcontroller embedded on the motherboard of a computer, which manages the interface between the system management software and the platform hardware. In line with significant and rapid advances in the area of server management, the BMC introduces various hardware and software services that require numerous and frequent image revisions and updates.

By convention, testing of BMC image builds is carried out using a single hardware entity. For test cycles where thousands of test passes are run, it may take several days to get results; moreover, erratic environment issues (operating system behavior, temperature, humidity, power supply voltage, fan speed, etc.) often cause failures that are difficult to duplicate, greatly hindering development processes. A solution to improve testing throughput and reproducibility is therefore needed.

SUMMARY

One objective of the present invention is to provide a method and a cluster for testing orchestration, which can run large numbers of test passes in parallel, thereby speeding up test cycles.

Another objective of the present invention is to provide a method and a cluster for testing orchestration, which facilitate verification and analysis of failures by repeating test passes using different software and/or hardware entities, thereby enhancing testing efficiency.

In a first embodiment of the present invention, a method for testing orchestration comprises: assigning a plurality of testing containers each including a specification file to provide testing details and stored in a repository of a control plane, by a testing controller of the control plane, to a plurality of pods each including at least one storage volume configured to store the assigned testing containers; dispatching the plurality of pods, by a scheduler of the control plane through an application program interface (API) server of the control plane, to at least one node; running the plurality of pods, by the at least one node, to execute the assigned testing containers, until all the assigned testing containers stored in the at least one storage volume have been finished; reporting execution results of the finished testing containers to the API server, and if any execution result indicates a failure, assigning the corresponding testing container again to a different pod.

In one aspect of the first embodiment, the assigning a plurality of testing containers is based on user selection.

In one aspect of the first embodiment, the repository functions as a version control system.

In one aspect of the first embodiment, each of the plurality of testing containers includes a virtual firmware configured

to simulate a baseboard management controller (BMC), and the specification file includes a BMC image.

In one aspect of the first embodiment, the pod being assigned the testing container corresponding to the failure-indicating execution result is dispatched to a different node.

In one aspect of the first embodiment, if the failure is confirmed, the corresponding testing container is not assigned again.

In a second embodiment of the present invention, a cluster for testing orchestration comprises: a control plane and at least one node, the control plane comprising: a repository storing a plurality of testing containers each including a specification file to provide testing details; a testing controller configured for assigning the plurality of testing containers to a plurality of pods each including at least one storage volume configured to store the assigned testing containers, and assigning any testing container corresponding to a failure-indicating execution result to a different pod; a scheduler configured for dispatching the plurality of pods; and an application program interface (API) server through which the plurality of pods is dispatched to the at least one node. The at least one node is configured for running the plurality of pods to execute the assigned testing containers, until all the assigned testing containers stored in the at least one storage volume have been finished, and reporting execution results of the finished testing containers to the API server.

In one aspect of the second embodiment, the repository functions as a version control system.

In one aspect of the second embodiment, each of the plurality of testing containers includes a virtual firmware configured to simulate a baseboard management controller (BMC), and the specification file includes a BMC image.

In one aspect of the second embodiment, the pod being assigned the testing container corresponding to the failure-indicating execution result is dispatched to a different node.

In one aspect of the second embodiment, the control plane is run across multiple control nodes.

In one aspect of the second embodiment, the cluster further comprises a load balancer between the control plane and the at least one node.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a logical block diagram of a cluster for testing orchestration according to one embodiment of the present invention.

FIG. **2** is a block diagram of a testing container.

FIG. **3** is a flow chart of a method for testing orchestration according to one embodiment of the present invention.

FIG. **4** is a physical block diagram of a cluster for testing orchestration according to one embodiment of the present invention.

FIG. **5** is a logical block diagram of a cluster for testing orchestration according to another embodiment of the present invention.

DETAILED DESCRIPTION

Embodiments of the present invention are set forth below in connection with the appended drawings, for the purpose of providing a thorough understanding of various concepts while not intended to represent the only configurations in which the concepts described herein may be practiced. It will be apparent to those skilled in the art that these concepts may be practiced without these specific details. Well known structures and components are omitted in order to avoid obscuring such concepts.

FIG. **1** is a logical block diagram of a cluster for testing orchestration according to one embodiment of the present invention. The containerized cluster **100** may be created using existing orchestration software such as Kubernetes or Docker Swarm. As shown in FIG. **1**, the cluster **100** comprises a control plane **110** and at least one node **120**, the control plane **110** comprising a repository **112**, a testing controller **114**, a scheduler **116** and an application program interface (API) server **118**. The repository **112** stores a plurality of testing containers **130**, which are minimalistic virtual instances offering an environment for objects to be tested (in this case, BMC images); in an aspect, the repository **112** may function as a version control system for managing changes to the objects, implemented using software like Git, Subversion or Mercurial. To orchestrate test passes in the cluster **100**, the testing containers **130** have to be assigned by the testing controller **114** to a plurality of pods **140**, which are the basic scheduling units in in the cluster **100** and consist of one or more co-located testing containers; in an aspect, the assignment of the testing containers **130** may be based on user selection. Each of the pods **140** includes at least one storage volume **145** configured to store the assigned testing containers **130**, as well as any other data to be shared within the pod. The scheduler **116** watches for the pods **140** having newly assigned testing containers, and dispatches these pods to the API server **118**, which is the front end for the control plane **110** and in charge of communication with the at least one node **120**. The at least one node **120** is configured for running the pods **140** to execute the assigned testing containers **130**, until all the assigned testing containers **130** stored in the at least one storage volume **145** have been finished; execution results of the testing containers **130** are reported to the API server **118** for the control plane **110** to steer the overall test cycle. By scaling the numbers of the at least one node **120** and/or the pods **140**, test cycles can be massively parallel, significantly reducing time consumption.

FIG. **2** is a block diagram of a testing container. As shown herein, the testing container **130** includes a specification file **132** to provide testing details. In an aspect, to realistically simulate a BMC, the testing container **130** may also include a virtual firmware **134**, and the specification file **132** may include a BMC image **136**. The specification file **132** may further include an Intelligent Platform Management Interface (IPMI) module and/or a Representational State Transfer (REST) module as needed, but the present invention is not limited hereto.

FIG. **3** is a flow chart of a method for testing orchestration according to one embodiment of the present invention. The method **200** starts at step **202**, where the testing controller **114** assigns a plurality of testing containers **130** stored in the repository **112** to a plurality of pods **140**; the assigned testing containers **130** are in turn stored in the at least one storage volume **145**. At step **204**, the scheduler **116** dispatches the pods **140** to the at least one node **120**. At step **206**, the at least one node **120** runs the pods **140** to execute the assigned testing containers **130**, until all the assigned testing containers **130** stored in the at least one storage volume **145** have been finished. At step **208**, the at least one node **120** reports execution results of the testing containers **130** to the API server **118**; the execution results are checked for failure(s) at decision **210**. If any execution result indicates a failure, the corresponding testing container is returned to step **202**, where it is assigned again to a different pod **140**; otherwise, the method ends and the overall test cycle is completed. In an aspect, to rule out the influence of hardware environment, the pod **140** being assigned the testing container **130** corresponding to the failure-indicating execution result may be dispatched to a different node **120**. In a further aspect, to avoid unnecessary repetition, the failure(s) may undergo a confirmation procedure at decision **210**, and the corresponding testing container **130** is not assigned again if the failure is confirmed.

FIG. **4** is a physical block diagram of a cluster for testing orchestration according to one embodiment of the present invention. For simplicity, the control plane **110** of the cluster **100** herein is shown to be run on a single control node **150**. The at least one node **120** and the control node **150** include respectively processors **122** and **152**, storage devices **124** and **154**, as well as a network interface controllers (NICs) **126** and **156**. The processor **122** is configured for running the repository **112**, the testing controller **114**, the scheduler **116** and the API server **118** residing in the storage device **124**; analogously, the processor **152** is configured for running the pod(s) residing in the storage device **154**. The NICs **126** and **156** are configured to communicatively connect the at least one node **120** and the control node **150** via an intranet **160**. The control node **150** running the control plane **110** may further include a user interface (UI) **115** and an input/output (I/O) system **158** that collaborate to enable interaction with users for selection of and change to the testing containers **130**, access to testing outcomes, etc.; the I/O system **158** may also provide connections with external networks such as the Internet.

In production setups where fault-tolerance and high availability are of importance, the control plane is usually run across multiple control nodes. As such, FIG. **5** is a logical block diagram of a cluster for testing orchestration according to another embodiment of the present invention. The repository **112** herein may be centralized in one control node or distributed across multiple control nodes, while instances of the testing controller **114**, the scheduler **116** and the API server **118** are run by each of the control nodes **150**. The cluster **100'** having such a topology may further comprise a load balancer **170** between the control plane **110** and the at least one node **120** for coordination among the control nodes **150**.

It is understood that the specific order or hierarchy of blocks in the processes/flowcharts disclosed is an illustration of exemplary approaches. Based upon design preferences, it is understood that the specific order or hierarchy of blocks in the processes/flowcharts may be rearranged. Further, some blocks may be combined or omitted. The accompanying method claims present elements of the various blocks in a sample order, and are not meant to be limited to the specific order or hierarchy presented.

The foregoing description is provided to enable any person skilled in the art to practice the various aspects described herein, and is not intended to be exhaustive or to limit the present invention to the precise forms disclosed. Various modifications to these aspects will be readily apparent to those skilled in the art, and the generic principles defined herein may be applied to other aspects. Accordingly, the scope of the present invention is to be accorded the broadest scope consistent with the appended claims rather than the foregoing description and the exemplary embodiments described therein.

What is claimed is:

1. A method for testing orchestration, comprising:

assigning a plurality of testing containers each including a specification file to provide testing details and stored in a repository of a control plane, by a testing controller of the control plane, to a plurality of pods each including at least one storage volume configured to store the assigned testing containers, wherein the specification file includes a baseboard management controller (BMC) image;

dispatching the plurality of pods, by a scheduler of the control plane through an application program interface (API) server of the control plane, to at least one node;

running the plurality of pods, by the at least one node, to execute the assigned testing containers, until all the assigned testing containers stored in the at least one storage volume have been finished;

reporting execution results of the finished testing containers to the API server; and

assigning any testing container corresponding to a failure-indicating execution result to a different pod.

2. The method of claim **1**, wherein the assigning a plurality of testing containers is based on user selection.

3. The method of claim **1**, wherein the repository functions as a version control system.

4. The method of claim **1**, wherein each of the plurality of testing containers includes a virtual firmware configured to simulate a BMC.

5. The method of claim **1**, wherein the pod being assigned the testing container corresponding to the failure-indicating execution result is dispatched to a different node.

6. The method of claim **1**, wherein if the failure is confirmed, the corresponding testing container is not assigned again.

7. A cluster for testing orchestration, comprising:

a control plane and at least one node, the control plane comprising:

a repository storing a plurality of testing containers each including a specification file to provide testing details, wherein the specification file includes a baseboard management controller (BMC) image;

a testing controller configured for assigning the plurality of testing containers to a plurality of pods each including at least one storage volume configured to store the assigned testing containers, and assigning any testing container corresponding to a failure-indicating execution result to a different pod;

a scheduler configured for dispatching the plurality of pods; and

an application program interface (API) server through which the plurality of pods is dispatched to the at least one node,

the at least one node being configured for running the plurality of pods to execute the assigned testing containers, until all the assigned testing containers stored in the at least one storage volume have been finished, and reporting execution results of the finished testing containers to the API server.

8. The cluster of claim **7**, wherein the repository functions as a version control system.

9. The cluster of claim **7**, wherein each of the plurality of testing containers includes a virtual firmware configured to simulate a BMC.

10. The cluster of claim **7**, wherein the pod being assigned the testing container corresponding to the failure-indicating execution result is dispatched to a different node.

11. The cluster of claim **7**, wherein the control plane is run across multiple control nodes.

12. The cluster of claim **11**, further comprising a load balancer between the control plane and the at least one node.

* * * * *