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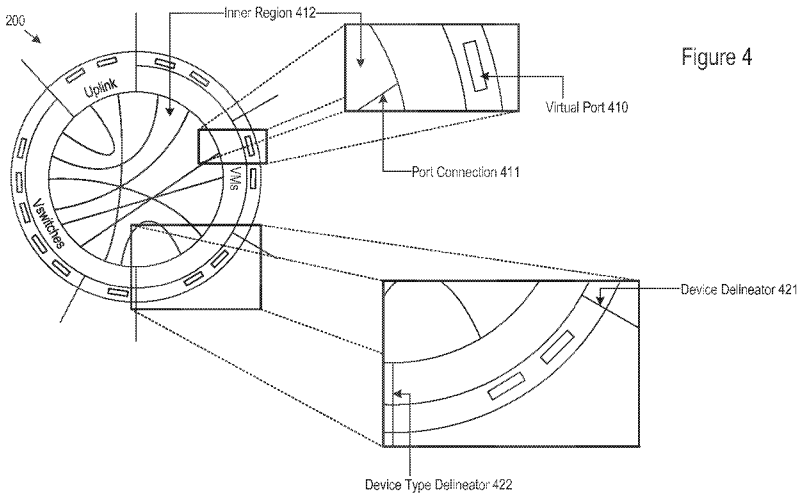

Figure 4

(57) Abstract: In some examples, a method includes generating a visualization ring for a visualization of a hypervisor configuration. The visualization ring may include an outer perimeter, an inner perimeter, and a middle perimeter between the inner and outer perimeters. The method may also include allocating an outer ring portion within the visualization between the middle perimeter and the outer perimeter for representing a device in the hypervisor configuration and allocating an inner ring portion within the visualization ring between the middle perimeter and the inner perimeter for indicating a device type of the device in the hypervisor configuration.

VISUALIZATION OF A RESOURCE CONFIGURATION WITH A VISUALIZATION RING

BACKGROUND

[0001] With rapid advances in technology, computing systems are increasingly prevalent in society today. Computing systems execute and support applications that communicate and process immense amounts of data. A computing system may host hundreds or thousands of applications, resulting in a complex distribution of resources to multiple virtual entities hosted by the computing system. Increasing the effectiveness, maintenance process, and reliability of such computing systems will increase user experience.

BRIEF DESCRIPTION OF THE DRAWINGS

[0002] Certain examples are described in the following detailed description and in reference to the drawings.

[0003] Figure 1 shows an example of a device that may generate a visualization of a resource configuration with a visualization ring.

[0004] Figure 2 shows an example of a visualization of a hypervisor configuration that the visualization circuitry may generate.

[0005] Figure 3 shows example elements of a visualization of a hypervisor configuration that the visualization circuitry may generate.

[0006] Figure 4 shows more example elements of a visualization of a hypervisor configuration that the visualization circuitry may generate.

[0007] Figure 5 shows an example of status indicators that the visualization circuitry may include in a visualization of a hypervisor configuration.

[0008] Figure 6A shows an example of a device highlight that the visualization circuitry may apply for a visualization of a resource configuration, such as a hypervisor configuration.

[0009] Figure 6B shows an example of a virtual resource highlight that the visualization circuitry may apply for a visualization of a resource configuration, such as a hypervisor configuration.

[0010] Figure 7A shows an example of a visualization of a hypervisor configuration with a compacted representation of a device in the hypervisor configuration.

[0011] Figure 7B shows an example of a visualization of a hypervisor configuration with compacted representations of devices of a particular device type.

[0012] Figure 8 shows an example of visualization filter that the visualization circuitry may apply to represent portions of a resource configuration correlated to a particular device.

[0013] Figure 9 shows an example of a visualization of a hypervisor configuration that represents a connection to an external device.

[0014] Figure 10 shows an example of logic that the visualization circuitry may implement.

[0015] Figure 11 shows another example of logic that the visualization circuitry may implement.

[0016] Figure 12 shows an example of a device that may generate a visualization of a resource configuration with a visualization ring.

DETAILED DESCRIPTION

[0017] The discussion herein may provide visualization features for visualizing a resource configuration. In particular, the circuitry, methods, devices, and logic below may visualize a resource configuration through a visualization ring, which may allow the visualization to provide a system-wide view of the resource configuration in a single diagram that may flexibly scale even for systems with large or complex configurations. Visualization circuitry may generate and adjust the visualization of a resource configuration to support views of varying granularity of the resource configuration, from broad system views to device-specific views.

[0018] Figure 1 shows an example of a device 100 that may generate a visualization of a resource configuration with a visualization ring. The device 100 may be any electronic device, and may thus take the form of any laptop or desktop computer, server, mobile or tablet device, and more. The device 100 shown in Figure 1 includes visualization circuitry 110. The device 100 may implement the visualization circuitry 110 through any combination of hardware, dedicated circuitry, sub-systems, modules, logic, executable instructions stored on a machine-readable medium, and more.

[0019] In operation, the visualization circuitry 110 may generate a visualization of a resource configuration. In the example shown in Figure 1, the visualization circuitry 110 generates the visualization of a resource configuration labeled as 112. The visualization of the resource configuration 112 may include, for example, a visualization ring; outer ring portions of the visualization ring to represent devices of the resource configuration; inner ring portions of the visualization ring to indicate device types of the resource configuration; and an inner region encompassed by an inner perimeter of the visualization ring to represent port connections between devices of the resource configuration.

[0020] The visualization circuitry 110 may generate a visualization of a resource configuration for any type of shared or managed computing resources. A resource configuration may refer to a set of resources (whether virtual or physical) that are used, managed, connected, available, or otherwise correlated to a particular entity. The resource configuration may include devices, interfaces, logic, processing capabilities, or other logical, physical, or virtual entities managed or used by a particular management device, network entity, or other computing logic.

[0021] As one specific example of a resource configuration used as continuing example herein, the visualization circuitry 110 may generate a visualization of a hypervisor configuration. A hypervisor may refer to logic that creates, hosts, manages, or runs virtual machines. Thus, a hypervisor configuration may include any combination of virtual or physical resources (e.g., devices) within a pool of resources provided by the hypervisor. Examples of such resources include

hosted virtual machines, virtual switches (vswitches) through which hosted virtual machines may exchange data, virtual network interface cards (vNICs) or other virtual network interfaces instantiated by hosted virtual machines, physical network interface cards of the hypervisor (hypervisor NICs), physical uplinks (e.g., data ports or physical interfaces through which the hypervisor may link to external network devices), and the like. The visualization circuitry 110 may generate a visualization of a hypervisor configuration to include any combination of hypervisor configuration elements, including any device provided, managed, or used by the hypervisor.

[0022] While a hypervisor configuration is but one example, the visualization circuitry 110 may generate a visualization for various other types of resource configurations as well. For instance, the visualization circuitry 110 may generate visualization for a resource configuration accessible to a distributed virtual switch. As another example, the visualization circuitry 110 may generate a neighbor view or a particular hypervisor, such as network layer 2 neighbor view of adjacent resources. As yet another example, the visualization circuitry 110 may generate a visualization for hardware resources managed in a rack-scare architecture, including compute nodes, memory nodes, processors, ports, interfaces, or any other available resources. In that regard, the visualization circuitry 110 may generate a visualization of any resource configuration according to any combination of the visualization features described herein.

[0023] Next, some examples and features of a visualization for a resource configuration that the visualization circuitry 110 may generate are presented. In particular, the example visualizations and features below are described in context of a visualization of a hypervisor configuration, though the visualization circuitry 110 may apply similar and consistent features for a visualization of any other resource configuration.

[0024] Figure 2 shows an example of a visualization 200 of a hypervisor configuration that the visualization circuitry 110 may generate. In particular, the visualization 200 shown in Figure 2 depicts a hypervisor configuration that includes the virtual machines labeled in the visualization 200 as Virtual Machine

1, 2, and 3 (along with their provisioned virtual network adapters), the virtual switches labeled as Vswitch 1 and 2 (along with virtual ports of these vswitches), uplink devices, as well as connections (e.g., communication links) between the various virtual machines, vswitches, and uplink devices. Some of the examples below reference the visualization 200 shown in Figure 2, including the specific virtual machines, vswitches, port connections, uplink devices, and other hypervisor configuration elements shown in the visualization 200. Features of the example visualization 200 are explained in greater detail below as well.

[0025] Figure 3 shows example elements of a visualization 200 of a hypervisor configuration that the visualization circuitry 110 may generate. In particular, the visualization circuitry 110 may generate the visualization 200 of the hypervisor configuration to include a visualization ring 310. The visualization ring 310 may be any shape around or within which the visualization circuitry 110 may represent devices in a resource configuration, and the visualization ring 310 may thus take the form of any circumferential extending shape. The visualization ring 310 may be bounded by an outer perimeter 311 and an inner perimeter 312, each of which may take various forms or shapes. In that regard, the outer perimeter 311 and the inner perimeter 312 may define a shape of the visualization ring 310. In the example shown in Figure 3, the visualization ring 310 takes a circular form, as the visualization circuitry 110 generates the outer perimeter 311 and inner perimeter 312 as concentric circles. As other examples, the visualization circuitry 110 may define a shape of the visualization ring 310 by generating the outer perimeter 311, the inner perimeter 312, or both, in the form of an oval, a polygon with any number of sides, a cyclic polygon, a shape with combinations of line segments and curved arcs, or in any other configurable shape or form.

[0026] The visualization circuitry 110 may allocate ring portions within a visualization ring 310 to represent elements of a resource configuration. A ring portion may refer to any section or area within the visualization ring 310. The visualization circuitry 110 may allocate a ring portion within the visualization ring 310 by setting visual boundaries within the visualization ring 310. In some examples, the visualization circuitry 110 generates the visualization ring 310 to

include a middle perimeter 313 located within the visualization ring, e.g., located between the outer perimeter 311 and the inner perimeter 312. The middle perimeter 313 may extend partially or completely around the interior of the visualization ring 310.

[0027] Through the middle perimeter 313, the visualization circuitry 110 may allocate outer ring portions and inner ring portions within the visualization ring 310. The outer ring portions may include ring portions between the middle perimeter 313 and the outer perimeter 311, such as the outer ring portion 321 shown in Figure 3. The visualization circuitry 110 may represent devices in the hypervisor configuration (or any other resource configuration) in outer ring portions of the visualization ring 310. Thus, for the hypervisor configuration example, the visualization circuitry 110 may represent virtual machines and virtual switches managed by the hypervisor as outer ring portions within the visualization ring 310. The inner ring portions of the visualization ring 310 may include ring portions between the middle perimeter 313 and the inner perimeter 312, such as the inner ring portion 322 shown in Figure 3. The visualization circuitry 110 may indicate device types of a resource configuration in the inner ring portions of the visualization ring, for example a virtual machine device type or a virtual switch device type for a visualization of hypervisor configuration.

[0028] The visualization circuitry 110 may indicate a device type of a particular device represented in a visualization of a resource configuration. In particular, the visualization circuitry 110 may do so by aligning the outer ring portion representing the particular device adjacent to the inner ring portion that indicates the particular device type of the particular device. Put another way, the visualization circuitry 110 may represent devices in the resource configuration of a particular device type (e.g., virtual machines in a hypervisor configuration) through outer ring portions in the visualization ring 310 and allocate the inner ring portion indicating the particular device type to extend and align with the outer ring portions for these devices. To further illustrate using the example visualization 200 in Figure 3, the outer ring portions representing Virtual Machines 1, 2, and 3

align with the inner ring portion indicating the virtual machine device type (indicated as "VMs" in Figure 3).

[0029] Continuing discussion of ring portions, the visualization circuitry 110 may allocate a ring portion within the visualization ring 310 that extends from the inner perimeter 312 to the outer perimeter 311. One example of such a ring portion is shown as the ring portion 323 in Figure 3. In allocating the ring portion 323, the visualization circuitry 110 may generate the middle perimeter 313 to not extend completely around the visualization ring 310, as seen in Figure 3. Thus, the ring portion 323 is not bounded by the middle perimeter 313, extending from inner edge to outer edge of the visualization ring 310. In some examples, the visualization circuitry 110 represents uplink devices in an edge-to-edge ring portion that extends, at least in part, from the inner perimeter 312 to the outer perimeter 311 (e.g., the ring portion 323).

[0030] Along the outer perimeter 311 of the visualization ring 310, the visualization circuitry 110 may provide text indicators for devices of a resource configuration. As seen the example in Figure 3, the visualization 200 includes text indicators for Virtual Machines 1, 2, and 3 as well as Vswitches 1 and 2. The text indicators for these devices are respectively located along the outer ring portion representing these devices. The visualization circuitry 110 may also provide text indicators for any number of virtual resources of the devices, such as network adapters, ports, link addresses, and the like. As seen in Figure 3, the Virtual Machines 1, 2, and 3 each respectively include two network adapters, labeled as network adapter 1 and 2 for each of the Virtual Machines 1, 2, and 3. Likewise, the uplink ring portion includes text indicators for two resources, labeled as vmnic 1 and vmnic 2. Thus, the visualization circuitry 110 may generate a visualization of hypervisor configuration that includes a visualization ring 310.

[0031] Figure 4 shows more example elements of a visualization 200 of a hypervisor configuration that the visualization circuitry 110 may generate. The visualization 200 shown in Figure 4 does not include the text indicators as shown in Figures 2 and 3.

[0032] In the example shown in Figure 4, the visualization circuitry 110 generates the visualization 20 of a hypervisor configuration to depict virtual ports of devices of the hypervisor configuration. In particular, the visualization circuitry 110 may represent any number of virtual ports of a particular device within an outer ring portion that represents the particular device. In the example shown in Figure 4, the visualization circuitry 110 represents a virtual port of a device as a rectangle within the outer ring portion of the device, such as the virtual port labeled as 410. However, the visualization circuitry 110 may use various other shapes or indicators to represent a virtual port of a device within the outer ring portion. The visualization circuitry 110 may similarly represent physical ports (when applicable) for any resource or device represented in a visualization as well, e.g., as a rectangle or other shape within the outer ring portion representing the device.

[0033] The visualization circuitry 110 may also depict port connections between various devices of the hypervisor configuration. In particular, the visualization circuitry 110 may depict such port connections in an inner region 410, located within and encompassed by an inner perimeter 312 of the visualization ring 310. One example of a port connection is shown through the port connection 411 in Figure 4, located within an inner region 412 of the visualization 200. By depicting the port connections within the inner region 412, the visualization circuitry 110 may visualize the connections between various devices and virtual resources of the hypervisor configuration, and within a specific, contained space. Even when the number of virtual devices in the hypervisor configuration increases (e.g., into the thousands or more), the visualization circuitry 110 may support visualization of the connections between these devices in a contained space, which may reduce the complexity and visualization size in displaying the hypervisor configuration. Thus, the visualization circuitry 110 may simplify the depiction of port connections, allowing for more efficient viewing of linked resources in the hypervisor configuration.

[0034] Continuing the discussion of visualization elements shown in Figure 4, the visualization circuitry 110 may insert delineators between different devices

represented in the visualization 200 as well as different device types indicated in the visualization 200. For example, the visualization circuitry 110 may generate the visualization 200 of the hypervisor configuration to include a device delineator to separate two outer ring portions from one another, e.g., to delineate between two represented devices of the hypervisor configuration. As one example shown in Figure 4, the visualization circuitry 110 aligns the device delineator 421 along the visualization ring 310 to separate two outer ring portions, and thus form a boundary between two outer ring portions. The device delineator 421 may take the form of a line between the two outer ring portions, which may extend outside the visualization ring 310 past the outer perimeter 311 to separate text indicators for the various devices.

[0035] Though one example of the device delineator 421 is shown in Figure 4, the visualization circuitry 110 may generate the device delineator 421 in various forms. In some examples, the visualization circuitry 110 may insert a device delineator as a gap in a perimeter of the visualization ring 310, such as a gap in the outer perimeter 311 to differentiate between two outer ring portions. In some examples, the visualization circuitry 110 may insert the device delineator as a gap between the two outer ring portions, though the gap may not extend to the inner perimeter 312 of the visualization ring 310. The visualization circuitry 110 may use any combination of visual indicators, shapes, gaps, or other visual forms to delineate between outer ring portions and distinguish between represented devices of a resource configuration.

[0036] In a similar way, the visualization circuitry 110 may delineate between device types indicated in the visualization 200. One example of a device type delineator that the visualization circuitry 110 may insert is shown in Figure 4 as the device type delineator 422. The device type delineator 422 may separate two of the inner ring portions indicating device types of the hypervisor configuration. Thus, the device type delineator 422 may take the form of a line or boundary between the two inner ring portions. In some examples, the device type delineator 422 includes a gap between the two inner ring portions to distinguish between device types, though the visualization circuitry 110 may implement a

device type delineator as any combination of other visual indicators, shapes, gaps, and other visual forms as well. Thus, the visualization circuitry 110 may generate a visualization of a hypervisor configuration to include device delineators, device type delineators, or both.

[0037] The visualization circuitry 110 may specify a status for any device, resource, connection, or other element represented in a visualization of a resource configuration. Figure 5 shows an example of status indicators that the visualization circuitry 110 may include in a visualization of a hypervisor configuration. To indicate a device status, the visualization circuitry 110 may color, shade, accent, or otherwise visually adjust an outer ring portion to indicate the device status. In the example shown in Figure 5, the visualization circuitry 110 applies particular visual patterns to outer ring portions to indicate devices in a hypervisor configuration as having a status of device status A, B, or C. In other examples, the visualization circuitry 110 may color the outer ring portions a particular color to indicate a status, and according to any status coloring formats (e.g., green, yellow, red, and more color shadings to indicate an operational status of the device). The device status indicators may specify an operational state of the device, for example.

[0038] Along similar lines, the visualization circuitry 110 may include status indicators for virtual resources represented in the visualization of a hypervisor configuration. For instance, the visualization circuitry 110 may color or shade virtual or physical ports depicted in the visualization to indicate a status of the ports, e.g., in colors corresponding to the operational status of the virtual ports. In doing so, the varying colors or shading of outer ring portions and virtual ports may provide a system-wide status overview of various devices and resources in the hypervisor configuration. In the example shown in Figure 5, the visualization circuitry 110 applies a visual pattern to the ports of the visualization to indicate the port as having resource status A or resource status B, which may indicate an operational status of the ports.

[0039] As another feature, the visualization circuitry 110 may include connection status indicators for connections represented in a resource configuration

visualization. Connections represented within an inner region of a visualization may be colored, shaded, patterned, or otherwise visually adjusted to indicate the connection status of connections in the resource configuration. In Figure 5, the visualization circuitry 110 applies differing line patterns to indicate the status of port connections in the inner region of the visualization of the hypervisor configuration. Specifically, the visualization in Figure 5 depicts two connections statuses, connection status A and connection status B, though the visualization circuitry 110 may indicate any number of connection statuses for the connections represented in the visualization. As another example, the visualization circuitry 110 may indicate varying connection status indicators through different colors or sizes of represented connections.

[0040] The visualization circuitry 110 may adjust or configure a visualization of a resource configuration in various ways to compact, emphasize, highlight, or expand representations of various elements of the resource configuration. In that regard, the visualization circuitry 110 may adjust, filter, or adapt a visualization of a hypervisor configuration, for example, to highlight or emphasize a particular device, set of resources, and the like. Doing so may support a network administrator or other management entity in easily and flexibly viewing specific portions of the hypervisor configuration. Some of these visualization adjustment features are described next in Figures 6A, 6B, 7A, 7B, and 8.

[0041] Figure 6A shows an example of a device highlight that the visualization circuitry 110 may apply for a visualization of a resource configuration, such as a hypervisor configuration. The visualization circuitry 110 may highlight or emphasize a particular device in the visualization of the hypervisor configuration in response to a highlight device indication. For example, the visualization circuitry 110 may receive the highlight device indication in the form of a user input, such as a cursor selection, mouse-over, touch gesture, or other user input to highlight a particular device in the visualization.

[0042] To apply a device highlight, the visualization circuitry 110 may emphasize the device in the visualization of the resource configuration. In Figure 6A, the visualization circuitry 110 applies the device highlight to the highlighted

device 610, which is Virtual Machine 1 in the visualization of a hypervisor configuration. In applying the device highlight, the visualization circuitry 110 may bold the text indicator of the device, apply a brighter or darker color shading to the outer ring portion of the device, or color an external area outside of the visualization ring 310 for the device. The visualization circuitry 110 may also emphasize any port connections of the device as well. In Figure 6A, the visualization circuitry emphasizes the port connections of the highlighted device 610, as shown in the highlighted connections 611. Thus, the visualization circuitry 110 may highlight port connections of a highlighted device by bolding or thickening connections for the port connections of Virtual Machine 1 shown in the visualization in comparison to other visualized port connections.

[0043] Figure 6B shows an example of a virtual resource highlight that the visualization circuitry may apply for a visualization of a resource configuration, such as a hypervisor configuration. In that regard, the visualization circuitry 110 may highlight a specific device resource and a port connection for the specific device resource. In the example shown in Figure 6B, the visualization circuitry 110 emphasizes the highlighted virtual resource 620, which is network adapter 1 of Virtual Machine 3. To do so, the visualization circuitry 110 may apply any of the highlight techniques described above. The visualization circuitry 110 may likewise emphasize the port connection of the highlighted virtual resource 620, which in Figure 6B is shown as the highlighted connection 621. In some examples, the visualization circuitry 110 identifies a highlight device indication or highlight virtual resource indication in the form of a mouse-over of a text indicator a device or virtual resource in the visualization of the hypervisor configuration.

[0044] As another feature, the visualization circuitry 110 may compact representations of any number of devices or device types in the visualization of a resource configuration. Figure 7A shows an example of a visualization 700 of a hypervisor configuration with a compacted representation of a device in the hypervisor configuration. The visualization circuitry 110 may compact the representation of a particular device of the resource configuration, such as a particular virtual machine or virtual switch of a hypervisor configuration. In doing

so, the visualization circuitry 110 may compact or reduce the size of the outer ring portion of the particular device by not including (e.g., filtering out) the ports of the particular device. The visualization circuitry 110 may also resize the outer ring portion without port representations, thus reducing the proportion of the visualization ring 310 used to represent the particular device. The visualization circuitry 110 may compact a representation of a particular device of a resource configuration to not represent a port (physical or virtual) of the particular device while continuing to represent ports of other devices in the resource configuration.

[0045] To illustrate, Figure 7A shows an example in which the visualization circuitry 110 compacts the representation of Virtual Machine 1 (e.g., as compared to the visualization 200 shown in Figure 2 with a non-compacted representation of Virtual Machine 1). In the example shown in Figure 7A, the visualization circuitry 110 also applies a device highlight to Virtual Machine 1. In compacting the representation of Virtual Machine 1, the visualization circuitry 110 may remove the virtual ports of Virtual Machine 1 from the outer ring portion representing Virtual Machine 1 and reduce the size of the outer ring portion as well. In a compacted representation of a device, the port connections of the device may stem from the device itself (e.g., from a location along the inner perimeter 312 of the visualization ring 310 aligned to the text indicator of the device), and not from the individual virtual ports of the particular device as may be the case in an non-compacted representation including the virtual ports.

[0046] The visualization circuitry 110 may adjust a visualization of hypervisor configuration to compact a representation of a particular device in response to a compact device indication. The visualization circuitry 110 may recognize the compact device indication in any number of ways, for example through a user selection (e.g., mouse click or touch gesture) of the outer ring portion for representing the particular device. The visualization circuitry 110 may, in some implementations, toggle between a compacted representation of the particular device (e.g., without virtual ports) and a non-compacted representation of the particular device (e.g., with virtual ports) through selection or clicking of the outer ring portion for representing the particular device. To expand a representation of

the particular device from a compacted representation to a non-compacted representation, the visualization circuitry 110 may include the port(s) of the particular device in the outer ring portion and adjust (e.g., increase) the size of the outer ring portion for representing the particular device.

[0047] Figure 7B shows an example of a visualization 710 of a hypervisor configuration with compacted representations of devices of a particular device type. The visualization circuitry 110 may compact the representations of the devices of the particular device type of a resource configuration similarly as described above in Figure 7A, and the visualization circuitry 110 may do so in response to receiving a compact device type indication. In some examples, the visualization circuitry 110 recognizes a compact device type indication through a user selection (e.g., mouse click) of the inner ring portion for indicating the particular device type. The visualization circuitry 110 may compact a representation of a particular device type of a resource configuration to not represent ports (physical or virtual) of devices in the resource configuration of the particular device type while continuing to represent ports of other devices in the resource configuration of a different device type.

[0048] The visualization circuitry 110 may generate a compacted representation of the visualization of a resource configuration in which the device representations of some or all of the device types are compacted. In this way, the visualization circuitry 110 may visualize a hypervisor configuration, for example, with lessened detailed, which may allow a broader view of the hypervisor configuration on a device-to-device granularity. To visualize details of specific devices (e.g., virtual ports and status port statuses), the visualization circuitry 110 may expand the representations of selected devices into a non-compacted representations. The visualization circuitry 110 may do so in response to recognizing a expand device indicator or expand device type indicator.

[0049] Figure 8 shows an example of visualization filter that the visualization circuitry 110 may apply to represent portions of a resource configuration correlated to a particular device. In particular, the visualization circuitry 110 may generate a filtered visualization for a particular device by filtering representations

of devices or resources not correlated to the particular device, while visualizing the devices or resources correlated to the particular device. In the example shown in Figure 8, the visualization circuitry 110 applies the visualization filter to generate the filtered visualization 800 displaying Virtual Machine 3 of a hypervisor configuration and its correlated devices and resources. The correlated devices and resources may refer to devices and resources linked to a particular device, and thus Figure 8 shows devices and resources linked to Virtual Machine 3. The visualization circuitry 110 may also show any number of uplink devices when applying a visualization filter.

[0050] Through a visualization filter, the visualization circuitry 110 may support a device specific view of a hypervisor configuration. Such a view may identify the links and connections active for a particular device in the hypervisor configuration, whether a virtual machine or virtual switch. Such a device specific view may allow a management entity or network administrator to identify specific connections or links for a particular device that may be inoperative or malfunctioning, allowing remedy of such issues.

[0051] Figure 9 shows an example of a visualization 900 of hypervisor configuration that represents a connection to an external device. In particular, the visualization circuitry 110 allocates an outer ring portion 902 within the Uplink ring portion to represent a connection to an external device. Thus, the visualization circuitry 110 may allocate an outer ring portion to represent a connection between elements, such as a managed local element (e.g., the vmnic2) and an element external to the hypervisor. In the specific example shown in Figure 9, the visualization circuitry 110 represents the connection between the vmnic2 and an external switch through the outer ring portion 902.

[0052] For connections to external devices, the visualization circuitry 110 may include an external device indicator in the visualization. In the example shown in Figure 9, the visualization circuitry 110 includes the external device indicator 904 through the text indicator “External Switch” and the arrow extending outside the visualization ring 310 from the outer ring portion 902 representing the connection between vminc2 and the External Switch. Similarly as described above, the

visualization circuitry 110 may indicate a connection status through shading or coloring the outer ring portion 902.

[0053] While some example visualization features were described above specifically with respect to a hypervisor configuration, the visualization circuitry 110 may apply any combination of the visualization features to visualize other resource configurations as well. That is, the visualization circuitry may apply any of the visualization generation, adjustment, emphasis, highlight, compacting, and expanding features described above to flexibly visualize resource configurations for various types of computing systems, networks, and the like.

[0054] Figure 10 shows an example of logic 1000 that the visualization circuitry 110 may implement. The visualization circuitry 110 may implement the logic 1000 as hardware, executable instructions stored on a machine-readable medium, or as combinations thereof. In some examples, the visualization circuitry 110 performs or executes the logic 1000 as a method to generate a visualization of a resource configuration with a visualization ring.

[0055] The visualization circuitry 110 may generate, for the visualization of a resource configuration, a visualization ring with an outer perimeter, an inner perimeter, and a middle perimeter between the inner and outer perimeters (1002). The visualization circuitry 110 may also allocate an outer ring portion within the visualization between the middle perimeter and the outer perimeter for representing a device in the resource configuration (1004) and allocate an inner ring portion within the visualization ring between the middle perimeter and the inner perimeter for indicating a device type of the device in the resource configuration (1006).

[0056] Figure 11 shows another example of logic 1100 that the visualization circuitry 110 may implement. The visualization circuitry 110 may implement the logic 1100 as hardware, executable instructions stored on a machine-readable medium, or as combinations thereof. In some examples, the visualization circuitry 110 performs or executes the logic 1100 as a method to support generation of a visualization of a resource configuration with a visualization ring.

[0057] The visualization circuitry 110 may insert any number of delineators into a visualization of a resource configuration with a visualization ring. For example, the visualization circuitry 110 may align a device delineator within the visualization ring to differentiate between the outer ring portion representing the device and another outer ring portion for representing another device of the resource configuration (1102). As another example, the visualization circuitry 110 may align a device type delineator within the visualization ring to differentiate between the inner ring portion indicating the device type of the device and another inner ring portion indicating another device type of another device in the resource configuration (1104).

[0058] The visualization circuitry 110 may allocate various inner ring portions to indicate the different device types of a resource configuration. Using a hypervisor configuration as an example, the visualization circuitry 110 may allocate an inner ring portion for indicating a virtual machine device type and allocate another inner ring portion within the visualization ring for indicating a virtual switch device type (1106). As yet another feature, the visualization circuitry 110 may indicate a port connection in an inner region encompassed by the inner perimeter of the visualization ring (1108). The port connection may represent a communication link between a physical or virtual port of the device and a physical or virtual port of another device in the resource configuration. The visualization circuitry 110 may also shade (e.g., color) an outer ring portion to indicate the device status of a device (1110).

[0059] Figure 12 shows an example of a device 1200 that may generate a visualization of a resource configuration with a visualization ring. The device 1200 may be any computing device, and may thus include a processor 1210. The processor 1210 may include a central processing unit (CPU), microprocessor, or any hardware device suitable for executing instructions stored on a machine-readable medium. The device 1200 may include a machine-readable medium 1220. The machine-readable medium 1220 may be any non-transitory electronic, magnetic, optical, or other physical storage device that stores executable instructions, such as the instructions 1222, 1224, 1226, and 1228 shown in Figure

12. Thus, the machine-readable medium 1220 may be, for example, Random Access Memory (RAM), an Electrically-Erasable Programmable Read-Only Memory (EEPROM), a storage drive, an optical disk, and the like.

[0060] The device 1200 may execute instructions stored on the machine-readable medium 1220 through the processor 1210. Executing the instructions may cause the device 1200 to perform any combination of the visualization features described herein, including generating a visualization of a resource configuration with a visualization ring. For example, executing the instructions 1222, 1224, 1226, and 1228 may cause the processor 1210 to generate a visualization ring for a visualization of a resource configuration, the resource configuration a hypervisor configuration; allocate a first ring portion of the visualization ring to represent uplink devices of the hypervisor configuration; allocate a second ring portion to represent virtual machines of the hypervisor configuration, the second ring portion including outer ring portions to represent the virtual machines and an inner ring portion to indicate a virtual machine device type; and allocate a third ring portion to represent virtual switches of the hypervisor configuration, the third ring portion including outer ring portions to represent the virtual switches and an inner ring portion to indicate a virtual switch device type.

[0061] In some examples, the machine-readable medium 1220 may further include instructions to represent ports of the virtual machines and virtual switches within the outer ring portions of the second and third ring portions. As another example, the machine-readable medium 1220 may further include instructions to, in response to a compact device indication, compact a representation of a particular virtual machine to not represent a virtual port of the particular virtual machine while continuing to represent virtual ports of other virtual machines. As yet another example, the machine-readable medium 1220 may further include instructions to, in response to a compact device type indication, compact representations of the virtual machines to not represent the virtual ports of the virtual machines while continuing to represent the virtual ports of the virtual switches.

[0062] The methods, devices, circuitry, and logic described above, including the visualization circuitry 110, may be implemented in many different ways in many different combinations of hardware, logic, circuitry, and executable instructions stored on a machine-readable medium. For example, the visualization circuitry 110 may include circuitry in a controller, a microprocessor, or an application specific integrated circuit (ASIC), or may be implemented with discrete logic or components, or a combination of other types of analog or digital circuitry, combined on a single integrated circuit or distributed among multiple integrated circuits. A product, such as a computer program product, may include a storage medium and machine readable instructions stored on the medium, which when executed in an endpoint, computer system, or other device, cause the device to perform operations according to any of the description above, including any features of the visualization circuitry 110.

[0063] The processing capability of the systems, devices, and circuitry described herein, including the visualization circuitry 110, may be distributed among multiple system components, such as among multiple processors and memories, optionally including multiple distributed processing systems. Parameters, databases, and other data structures may be separately stored and managed, may be incorporated into a single memory or database, may be logically and physically organized in many different ways, and may implemented in many ways, including data structures such as linked lists, hash tables, or implicit storage mechanisms. Programs may be parts (e.g., subroutines) of a single program, separate programs, distributed across several memories and processors, or implemented in many different ways, such as in a library, such as a shared library (e.g., a dynamic link library (DLL)). The DLL, for example, may store code that performs any of the system processing described above.

[0064] While various examples have been described above, many more implementations are possible.

CLAIMS

1. A method comprising:

through visualization circuitry:

generating, for a visualization of a resource configuration, a visualization ring with an outer perimeter, an inner perimeter and a middle perimeter between the inner and outer perimeters;

allocating an outer ring portion within the visualization between the middle perimeter and the outer perimeter for representing a device in the resource configuration; and

allocating an inner ring portion within the visualization ring between the middle perimeter and the inner perimeter for indicating a device type of the device in the resource configuration.

2. The method of claim 1, further comprising aligning a device delineator within the visualization ring to differentiate between the outer ring portion representing the device and another outer ring portion for representing another device of the resource configuration.

3. The method of claim 1, further comprising aligning a device type delineator within the visualization ring to differentiate between the inner ring portion indicating the device type of the device and another inner ring portion indicating another device type of another device in the resource configuration.

4. The method of claim 1, wherein the resource configuration comprises a hypervisor configuration and wherein allocating the inner ring portion comprises allocating the inner ring portion for indicating a virtual machine device type; and

further comprising allocating another inner ring portion within the visualization ring for indicating a virtual switch device type.

5. The method of claim 1, further comprising indicating a port connection between a port of the device and another port of another device in the resource

configuration in an inner region encompassed by the inner perimeter of the visualization ring.

6. The method of claim 1, further comprising shading the outer ring portion to indicate a device status of the device.

7. A device comprising:

visualization circuitry to generate a visualization of a resource configuration, the visualization including:

a visualization ring;

outer ring portions of the visualization ring to represent devices of the resource configuration;

inner ring portions of the visualization ring to indicate device types of the resource configuration; and

and an inner region encompassed by an inner perimeter of the visualization ring to represent port connections between devices of the resource configuration.

8. The device of claim 7, wherein the visualization circuitry is further to generate the visualization of the resource configuration to include a device delineator to separate two outer ring portions from one another.

9. The device of claim 8, wherein the device delineator comprises a gap in a perimeter of the visualization ring.

10. The device of claim 8, wherein the device delineator comprises a gap between the two outer ring portions, but not a gap in the perimeter of the visualization ring.

11. The device of claim 7, wherein the visualization circuitry is further to generate the visualization of the resource configuration to include a device type

delineator to separate two of the inner ring portions from one another, and wherein the device type delineator comprises a gap in a perimeter of the visualization ring.

12. A non-transitory machine-readable medium storing executable instructions to

generate a visualization ring for a visualization of a resource configuration, wherein the resource configuration is a hypervisor configuration;

allocate a first ring portion of the visualization ring to represent uplink devices of the hypervisor configuration;

allocate a second ring portion to represent virtual machines of the hypervisor configuration, the second ring portion including outer ring portions to represent the virtual machines and an inner ring portion to indicate a virtual machine device type; and

allocate a third ring portion to represent virtual switches of the hypervisor configuration, the third ring portion including outer ring portions to represent the virtual switches and an inner ring portion to indicate a virtual switch device type.

13. The non-transitory machine-readable medium of claim 12, wherein the executable instructions are further to:

represent ports of the virtual machines and virtual switches within the outer ring portions of the second and third ring portions.

14. The non-transitory machine-readable medium of claim 13, wherein the executable instructions are further to, in response to a compact device indication:

compact a representation of a particular virtual machine to not represent a virtual port of the particular virtual machine while continuing to represent virtual ports of other virtual machines.

15. The non-transitory machine-readable medium of claim 13, wherein the executable instructions are further to, in response to a compact device type indication:

compact representations of the virtual machines to not represent the virtual ports of the virtual machines while continuing to represent the virtual ports of the virtual switches.

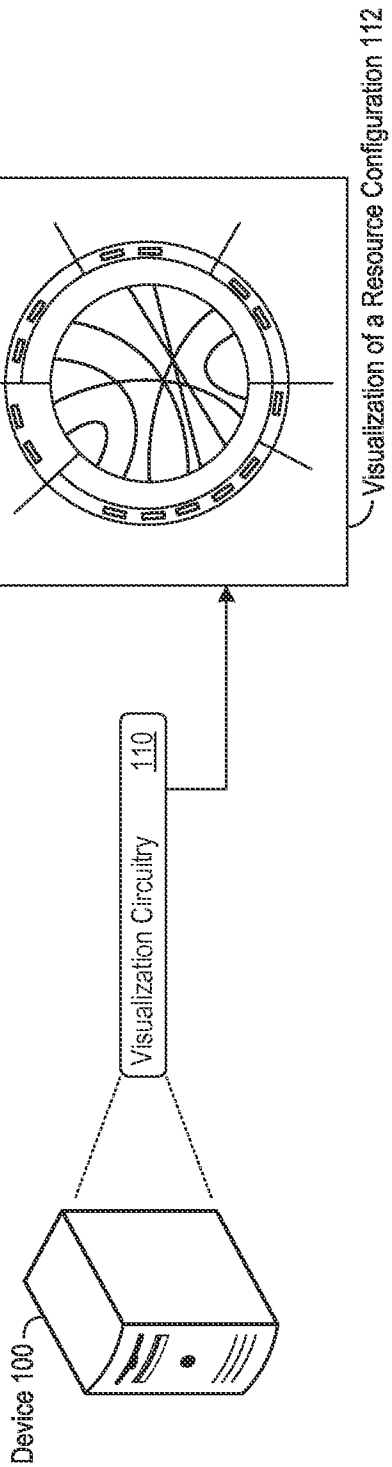
Visualization of a Resource Configuration 112
Visualization Circuitry 110
Device 100

Figure 1

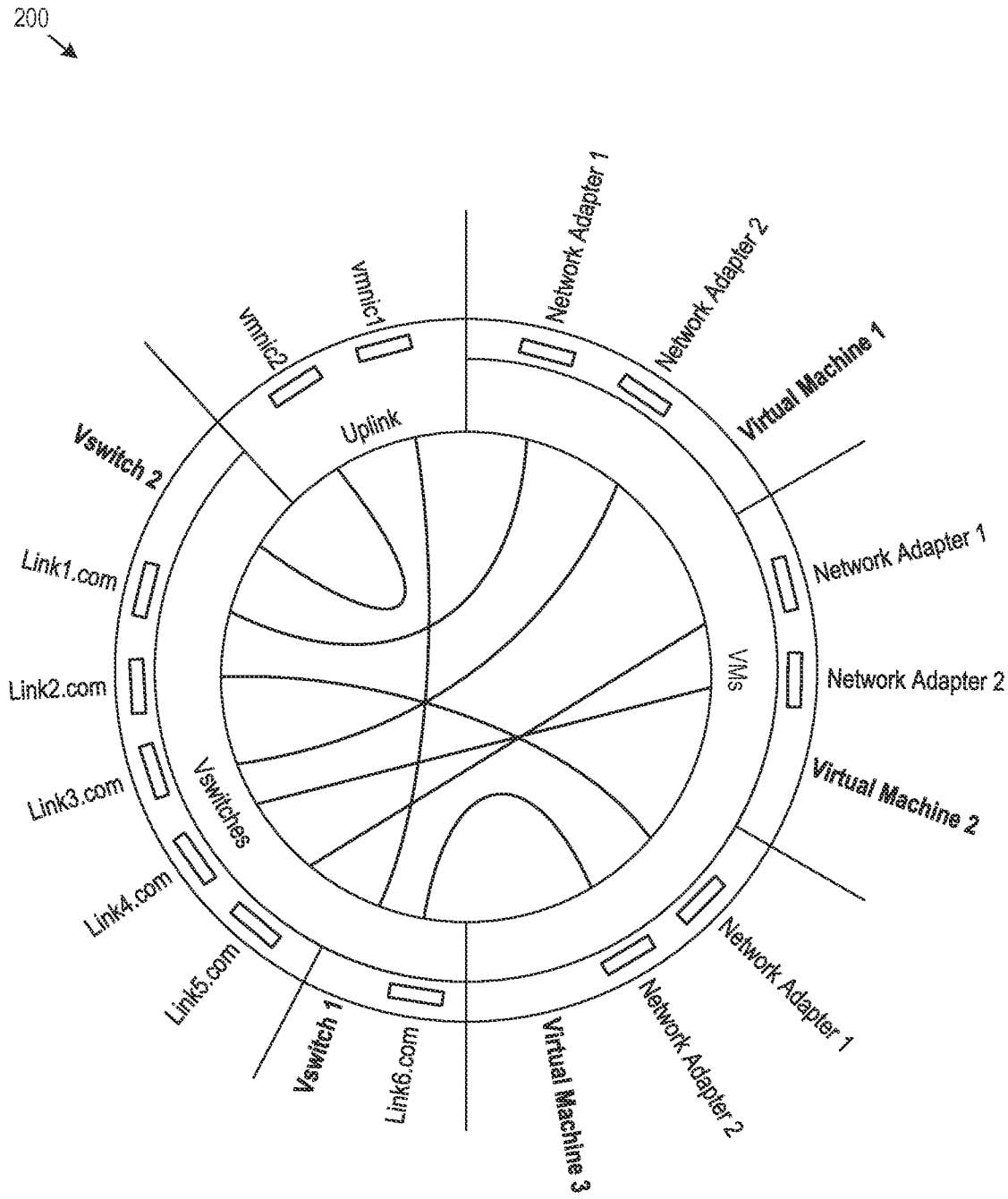
200
Network Adapter 1
Network Adapter 2
Virtual Machine 1
Network Adapter 1
Network Adapter 2
Virtual Machine 2
Network Adapter 1
Network Adapter 2
Virtual Machine 3
Link6.com
Vswitch 1
Link5.com
Link4.com
Link3.com
Link2.com
Link1.com
Vswitch 2
vmnic2
vmnic1
Uplink
VMs
Vswitches

Figure 2

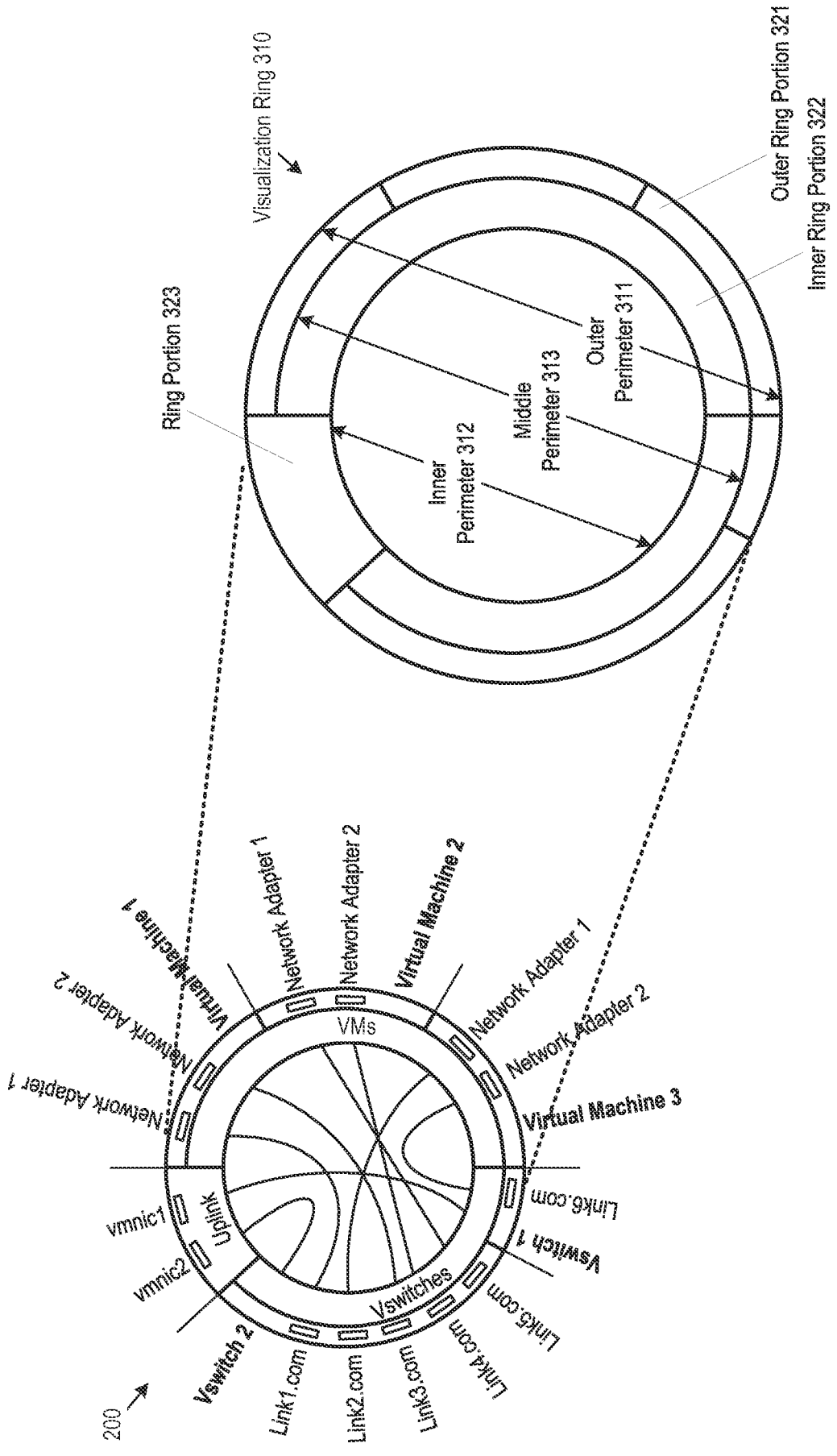
Visualization Ring 310
Outer Ring Portion 321
Inner Ring Portion 322
Ring Portion 323
Outer Perimeter 311
Middle Perimeter 313
Inner Perimeter 312
VMs
Vswitches
Uplink
vmnic1
vmnic2
Vswitch 2
Link1.com
Link2.com
Link3.com
Link4.com
Link5.com
Vswitch 1
Link6.com
Network Adapter 1
Network Adapter 2
Virtual Machine 3
Network Adapter 1
Network Adapter 2
Virtual Machine 2
Network Adapter 1
Network Adapter 2
Virtual Machine 1
200

Figure 3

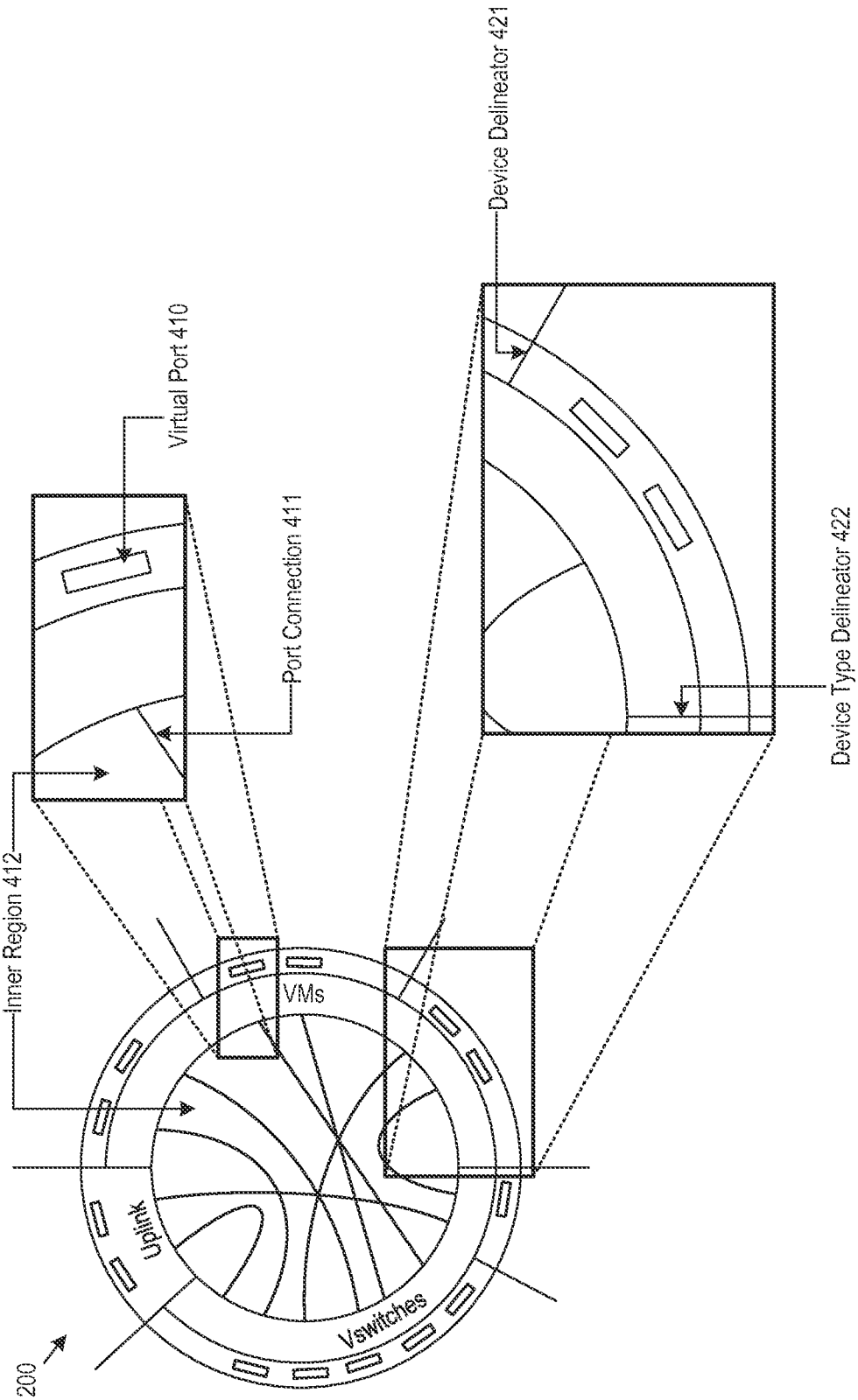
Device Delineator 421
Virtual Port 410
Port Connection 411
Device Type Delineator 422
Inner Region 412
VMs
Uplink
Vswitches
200

Figure 4

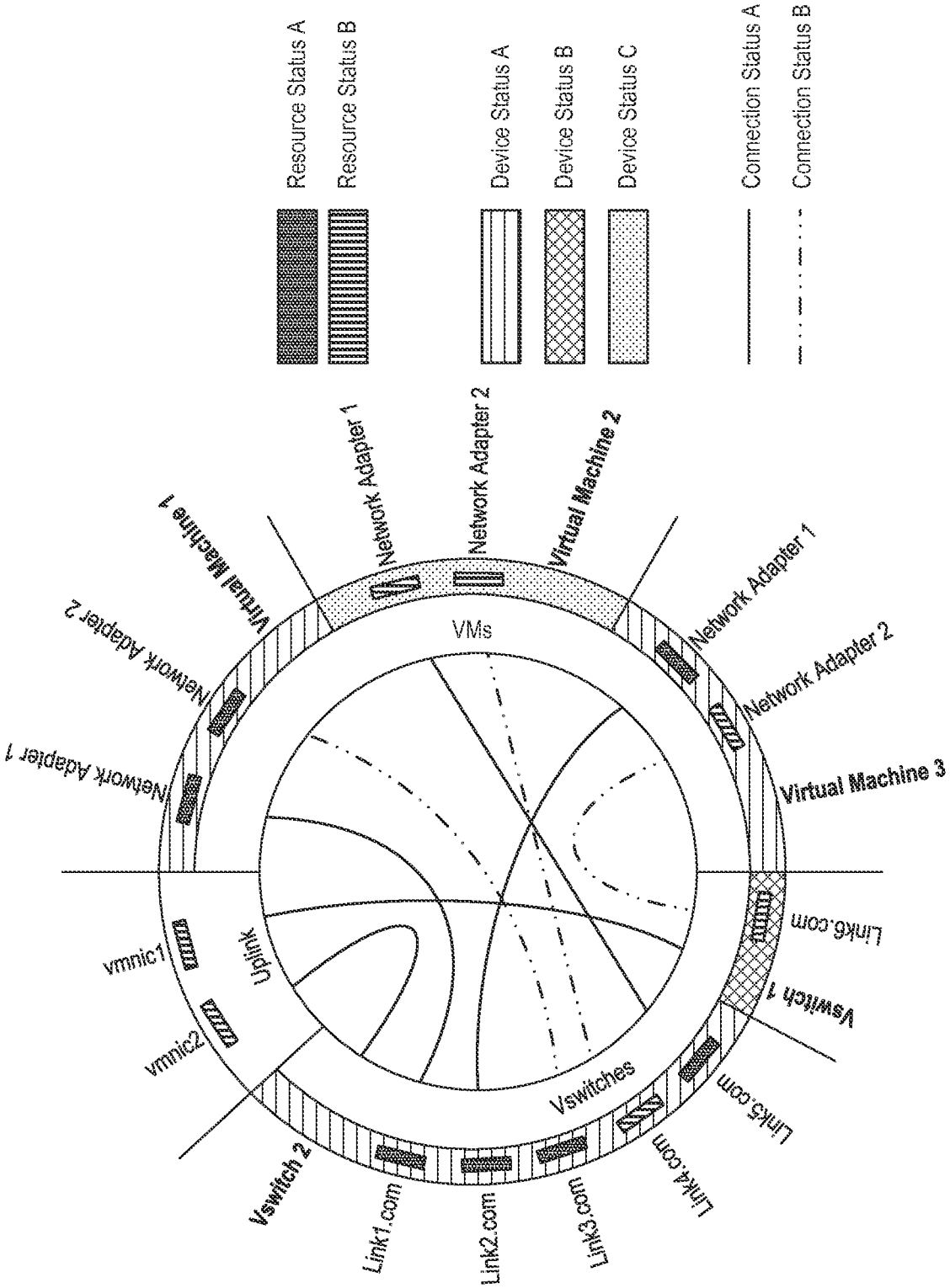
Resource Status A
Resource Status B
Device Status A
Device Status B
Device Status C
Connection Status A
Connection Status B
VMs
Vswitches
Uplink
Virtual Machine 1
Network Adapter 1
Network Adapter 2
Virtual Machine 2
Network Adapter 1
Network Adapter 2
Virtual Machine 3
vmnic1
vmnic2
Vswitch 2
Link1.com
Link2.com
Link3.com
Link4.com
Link5.com
Vswitch 1
Link6.com

Figure 5

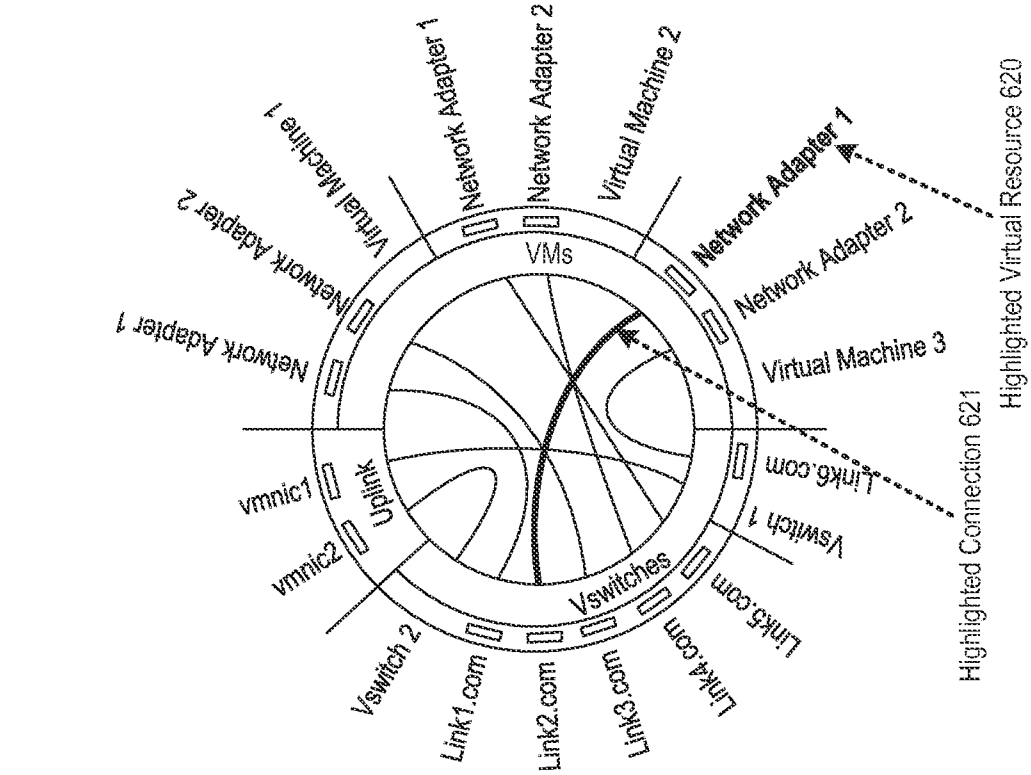

Figure 6B

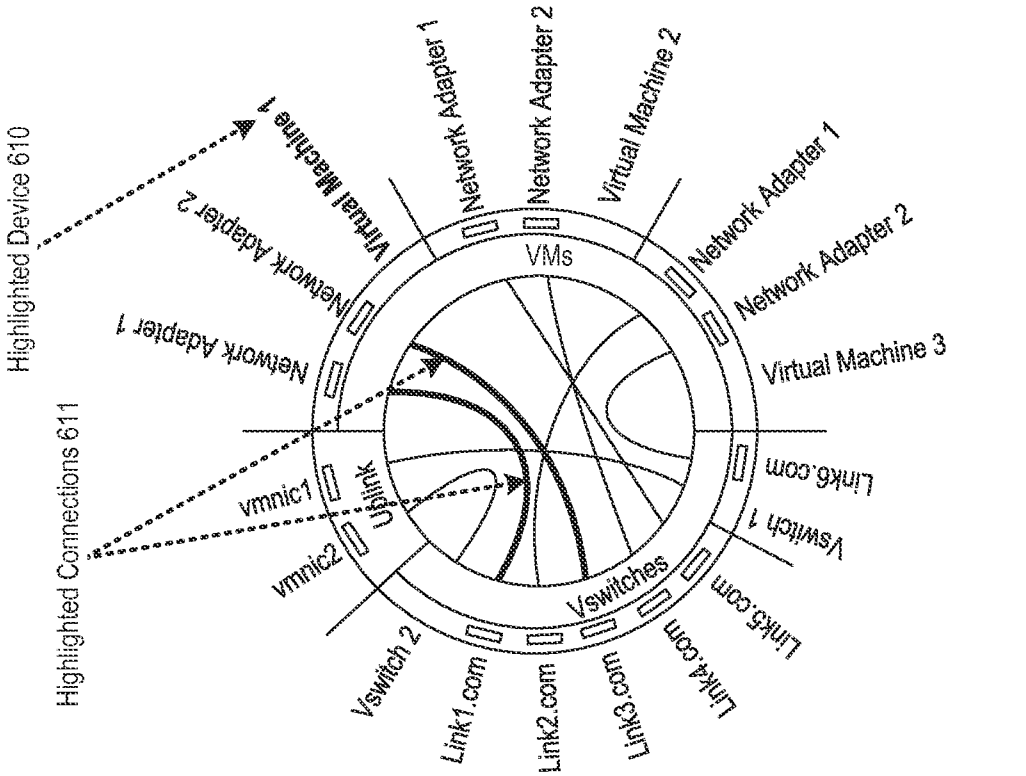

Figure 6A

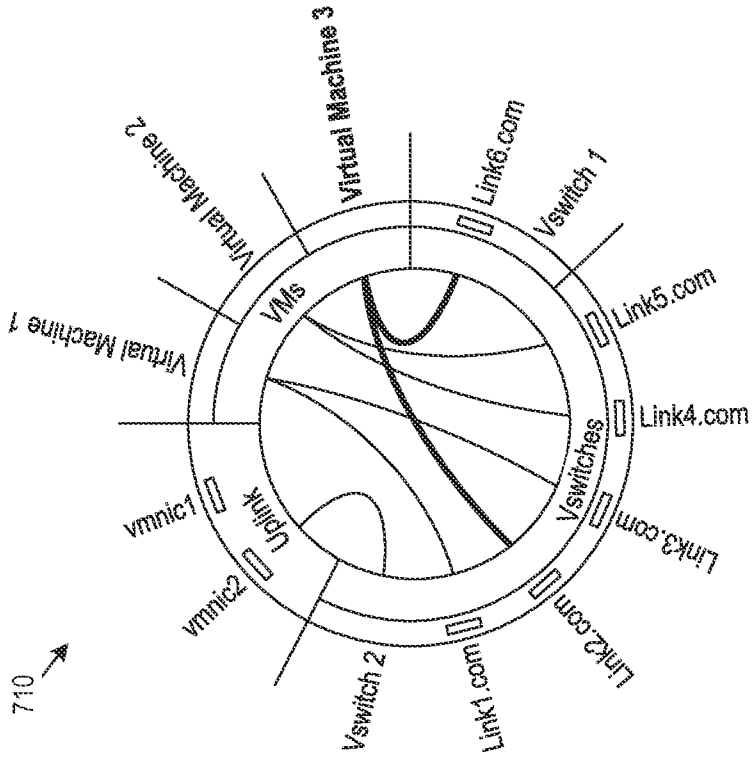

Figure 7B

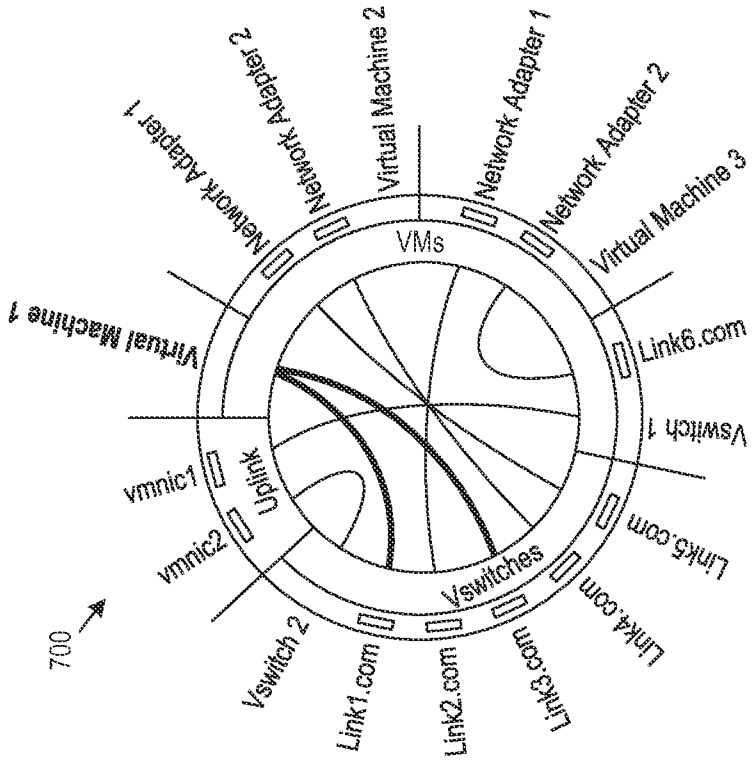

Figure 7A

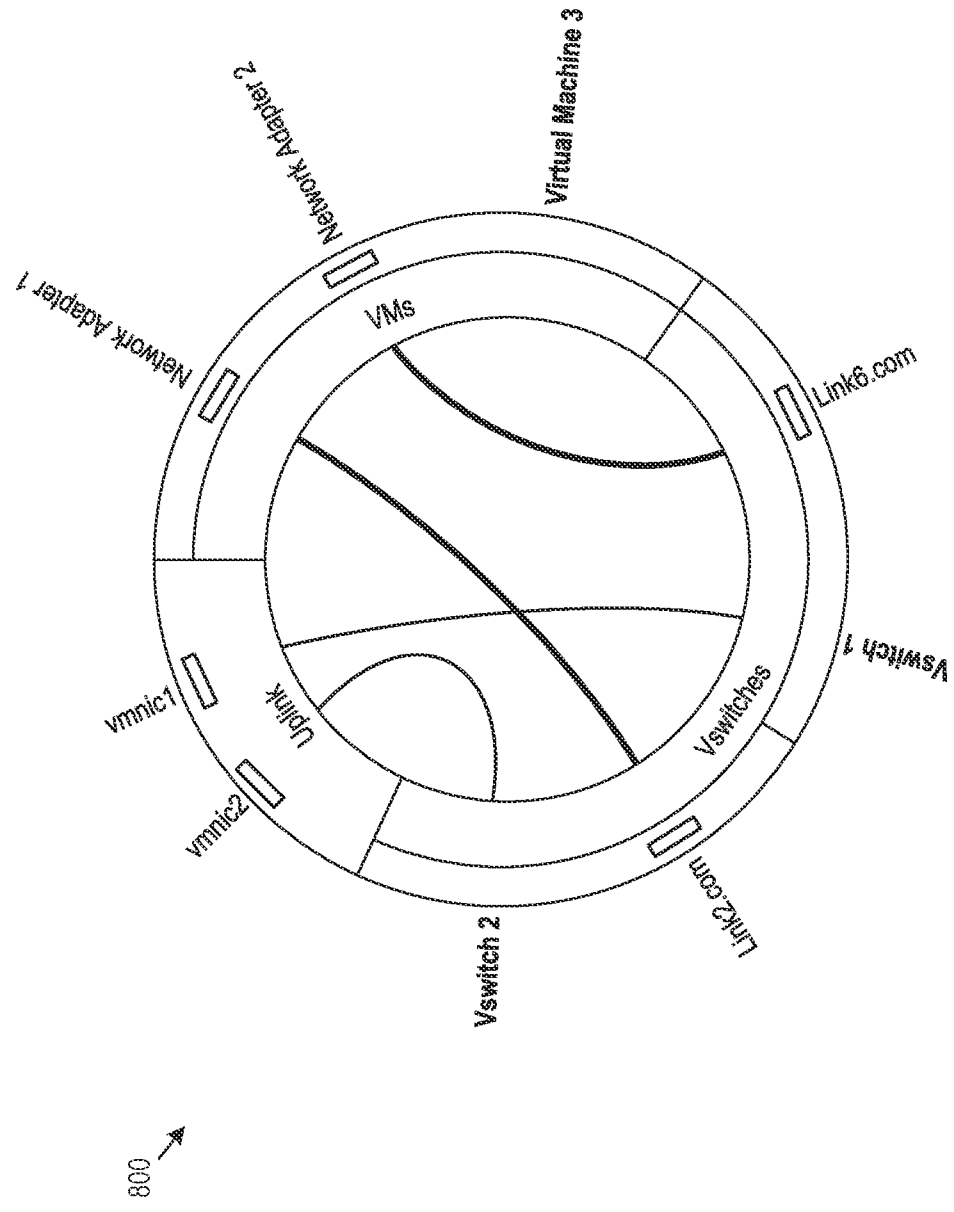
800
Virtual Machine 3
Network Adapter 2
Network Adapter 1
VMs
Link6.com
Vswitch 1
vmnic1
vmnic2
Uplink
Vswitches
Link2.com
Vswitch 2

Figure 8

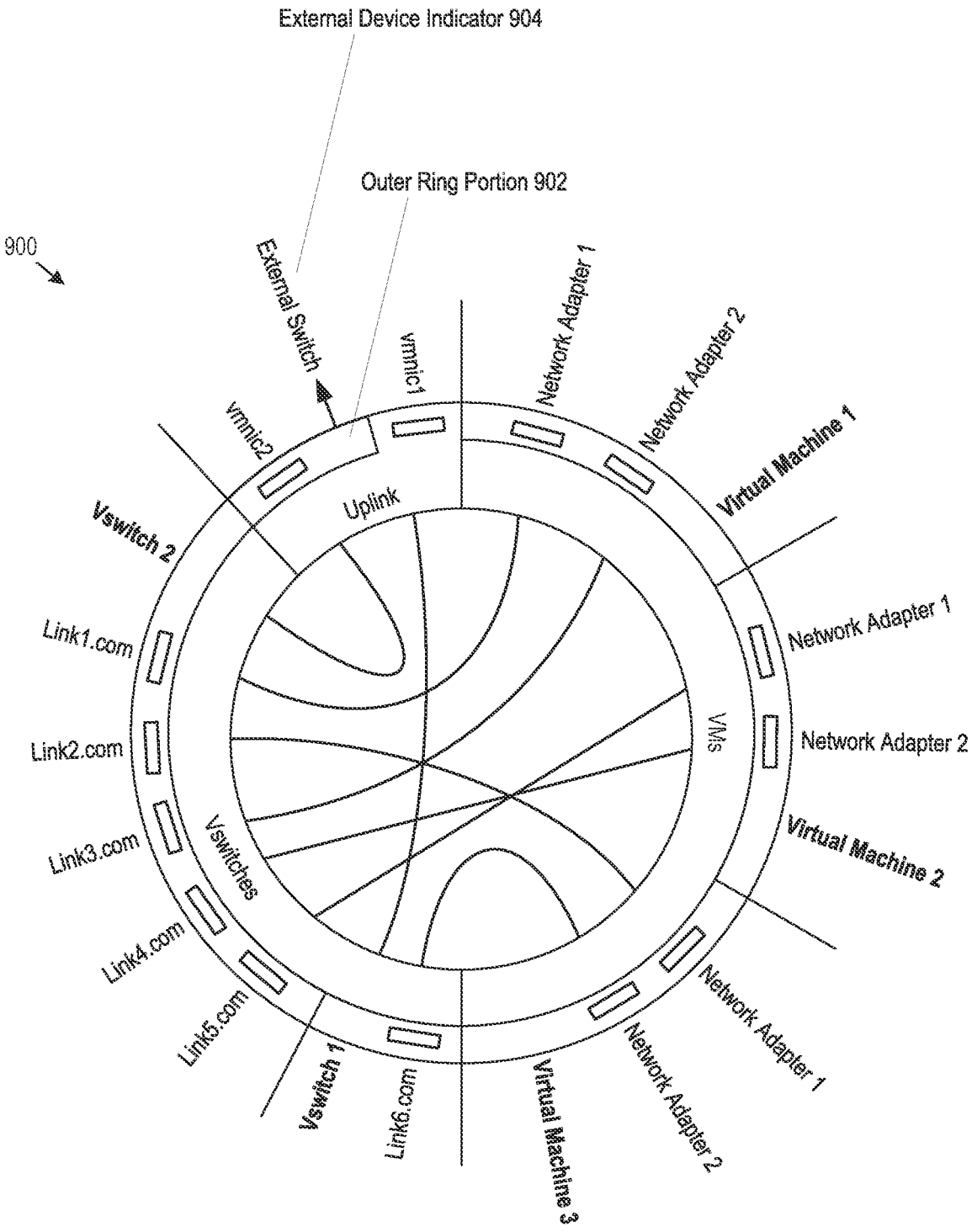
External Device Indicator 904
Outer Ring Portion 902
900
External Switch
vmnic1
vmnic2
Uplink
Network Adapter 1
Network Adapter 2
Virtual Machine 1
Network Adapter 1
Network Adapter 2
Virtual Machine 2
Network Adapter 1
Network Adapter 2
Virtual Machine 3
Vswitch 1
Vswitch 2
Link1.com
Link2.com
Link3.com
Link4.com
Link5.com
Link6.com
Vswitches
VMs

Figure 9

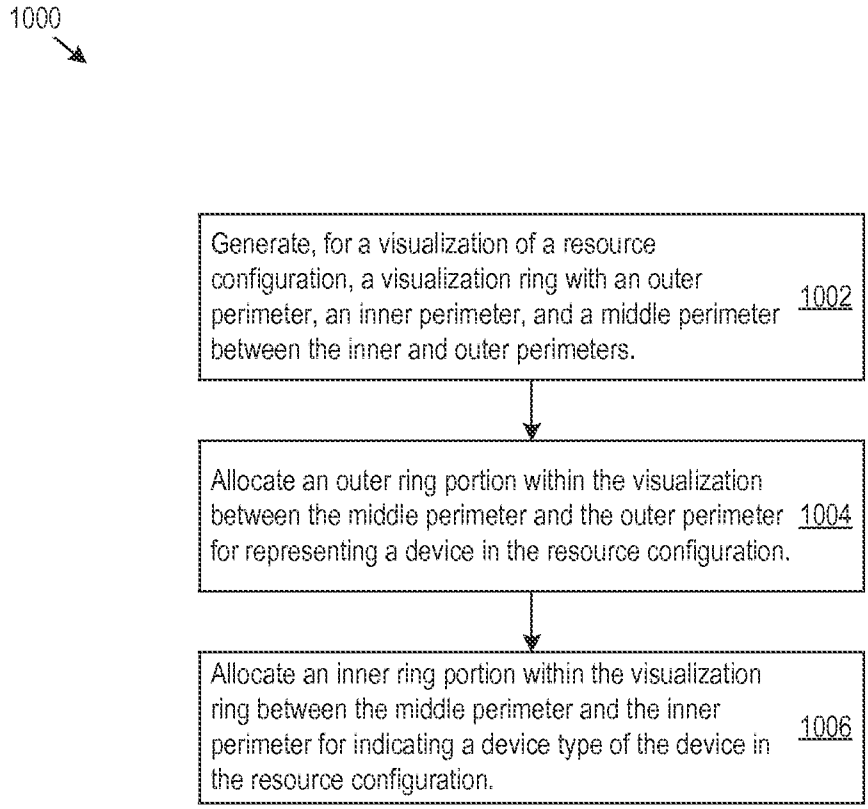
1000
Generate, for a visualization of a resource configuration, a visualization ring with an outer perimeter, an inner perimeter, and a middle perimeter between the inner and outer perimeters.
1002
Allocate an outer ring portion within the visualization between the middle perimeter and the outer perimeter for representing a device in the resource configuration.
1004
Allocate an inner ring portion within the visualization ring between the middle perimeter and the inner perimeter for indicating a device type of the device in the resource configuration.
1006

Figure 10

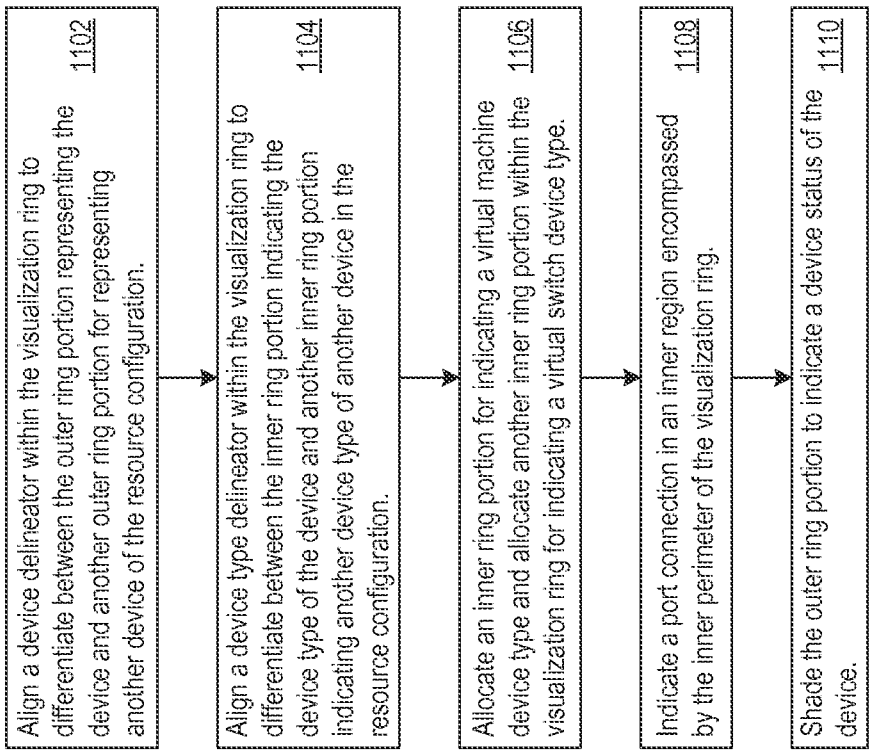
1100
Align a device delineator within the visualization ring to differentiate between the outer ring portion representing the device and another outer ring portion for representing another device of the resource configuration. 1102
Align a device type delineator within the visualization ring to differentiate between the inner ring portion indicating the device type of the device and another inner ring portion indicating another device type of another device in the resource configuration. 1104
Allocate an inner ring portion for indicating a virtual machine device type and allocate another inner ring portion within the visualization ring for indicating a virtual switch device type. 1106
Indicate a port connection in an inner region encompassed by the inner perimeter of the visualization ring. 1108
Shade the outer ring portion to indicate a device status of the device. 1110

Figure 11

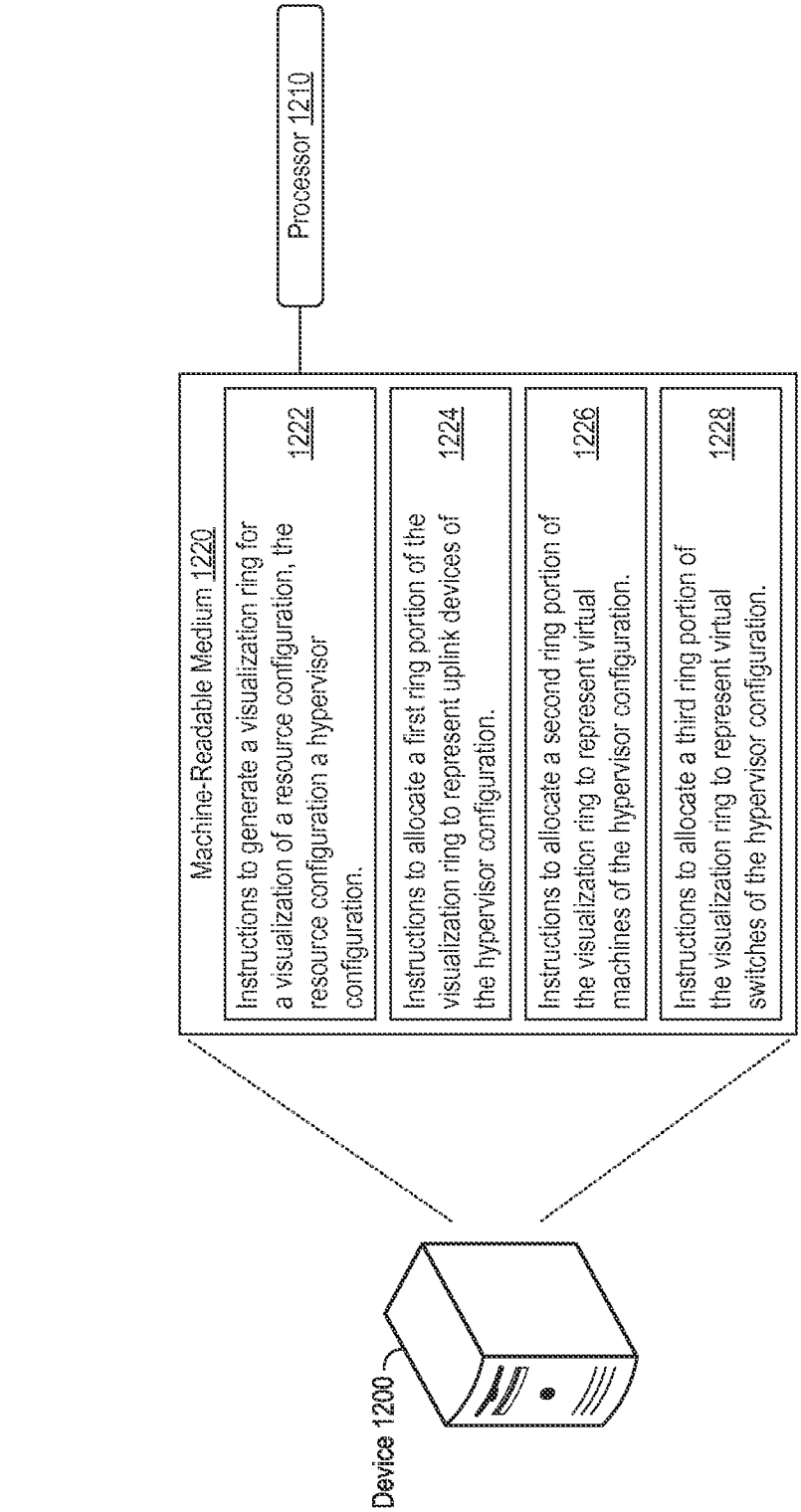
Processor 1210
Machine-Readable Medium 1220
Instructions to generate a visualization ring for a visualization of a resource configuration, the resource configuration a hypervisor configuration.
1222
Instructions to allocate a first ring portion of the visualization ring to represent uplink devices of the hypervisor configuration.
1224
Instructions to allocate a second ring portion of the visualization ring to represent virtual machines of the hypervisor configuration.
1226
Instructions to allocate a third ring portion of the visualization ring to represent virtual switches of the hypervisor configuration.
1228
Device 1200

Figure 12

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2015/040906

A. CLASSIFICATION OF SUBJECT MATTER

G06F 1/16(2006.01)i, G06F 9/455(2006.01)i, G06F 9/50(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G06F 1/16; G06F 3/048; G06F 15/173; H04L 12/24; G06F 9/46; G06F 9/455; G06F 9/50

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & Keywords: visualization, ring, virtual, hypervisor, resource, configuration

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2013-0275919 A1 (HARISH B. KAMATH et al.) 17 October 2013 See paragraphs [0014], [0037]; claim 1; and figures 4, 6.	1-15
A	US 2012-0151399 A1 (STELLA EDITH SOERENSEN et al.) 14 June 2012 See paragraphs [0014], [0022]; and figure 1.	1-15
A	US 2014-0032761 A1 (DANIEL JAMES BEVERIDGE) 30 January 2014 See paragraph [0061]; and figure 3.	1-15
A	US 2015-0195129 A1 (DELL PRODUCTS L.P.) 09 July 2015 See paragraph [0031]; and figure 7.	1-15
A	US 2014-0173628 A1 (DYNAVISOR, INC.) 19 June 2014 See paragraph [0068]; and figure 1.	1-15

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
25 May 2016 (25.05.2016)	**25 May 2016 (25.05.2016)**

Name and mailing address of the ISA/KR
International Application Division
Korean Intellectual Property Office
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Authorized officer
LEE, Dong Yun
Telephone No. +82-42-481-8734

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2015/040906

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2013-0275919 A1	17/10/2013	None	
US 2012-0151399 A1	14/06/2012	CN 102591924 A	18/07/2012
		US 8443293 B2	14/05/2013
US 2014-0032761 A1	30/01/2014	US 9003037 B2	07/04/2015
US 2015-0195129 A1	09/07/2015	US 2012-0278802 A1	01/11/2012
		US 8990824 B2	24/03/2015
US 2014-0173628 A1	19/06/2014	US 2014-0173600 A1	19/06/2014
		US 2014-0189690 A1	03/07/2014
		WO 2014-100273 A1	26/06/2014
		WO 2014-100279 A1	26/06/2014
		WO 2014-100281 A1	26/06/2014