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ABSTRACT

A rule based service is provided for Configuration Simulation and Validation (CSV) for the devices managed on given network. With an understanding of the architecture of a network, the service can be employed to determine which devices need to be in the same Internet Protocol (IP) subnet. The service can be employed to suggest one or more configuration changes to the administrator such as, changes to address as a potential misconfiguration, improve operation, etc.

DETAILED DESCRIPTION

In conventional network management, when a network administrator is bringing up a network or making changes in the network, the administrator adds the device configuration(s) manually to ensure that the devices are able to interoperate. However, an invalid configuration may result, for example, when devices are misconfigured to a mismatched or different virtual local area networks (VLANs). Moreover, an invalid configuration may result when static IP assignment, instead of dynamic host configuration protocol (DHCP), is employed. For example, some devices (like printers on a local area network) have static IP assignment, and some devices have dynamic IP assignment.

An invalid configuration may also result from IP address conflicts. For a given LAN network, duplicate IP address assignments typically occur. Further, multiple entities acting as DHCP servers (unintentionally) on the same IP pools may result in an invalid configuration. Conflicts between DHCP pool configuration and static IPs that are required across an organization may result in an invalid configuration.

Accordingly, a rule based service for Configuration Simulation and Validation (CSV) for the devices is provided herein. With an understanding of the architecture of a network, the service may be employed to determine which devices need to be in the same

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IP subnet and, in certain examples, to suggest various configuration changes to the administrator (e.g., for addressing a potential misconfiguration, for improving operation, etc.). The use of the CSV service makes the detection of IP and other misconfigurations easier which, in turn, can significantly enhance the debugging power of the customer. This can also significantly improve the time required to bring the network up and running.

The techniques described herein will also allow for reduced turn-around times for technical assistance center (TAC) cases for existing and new customers. In general, the CSV service does not require any third party tools for simulation and topology planning. This leads to a significant cost reduction for the customer. In addition, the service is capable of projecting network performance based on live network configuration and loads and the service is easily extendable. In particular, since the service is rule based, it can easily be extended to accumulate more devices in the network on scale.

The CSV service allows for user driven and/or auto mode of operation. In the user driven mode, a user can explicitly request that network component compatibility to be checked. More specifically, the user can explicitly request to check compatibility of operation between two or more network components from the topology. Alternately, in the auto mode, the CSV service can flag device configurations which can lead to the network being disconnected/misconfigured.

Various aspects of the proposed CSV service, such as design and implementation of the service, are described in more detail below.

Figure 1, below, illustrates example of modes of operations of the service. As shown in Figure 1, the CSV service may operate in a simulated topology validation path mode or a live network validation and monitoring mode.

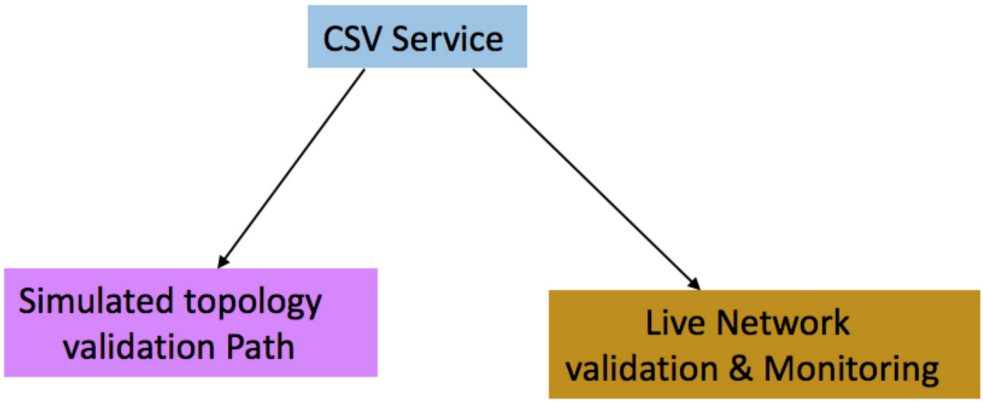

Figure 1

Initial configuration validation (which is simulated topology validation path) is operated during service bring up. In this mode of operation, the CSV service validates whether the network is connected as expected in the current configuration. Alternatively, based on the desired connectivity in the network, the service determines a possible IP and VLAN configuration.

Continuous configuration validation (which is live network validation and monitoring path) is an ongoing validation for deployed networks. In this mode of operation, the service is notified when one or more configuration changes occur in the network. When the service is notified, it validates that they are connected as expected.

The CSV service can be deployed under a Digital Network Architecture Center (DNAC). Figure 2, below, illustrates a service architecture within DNAC.

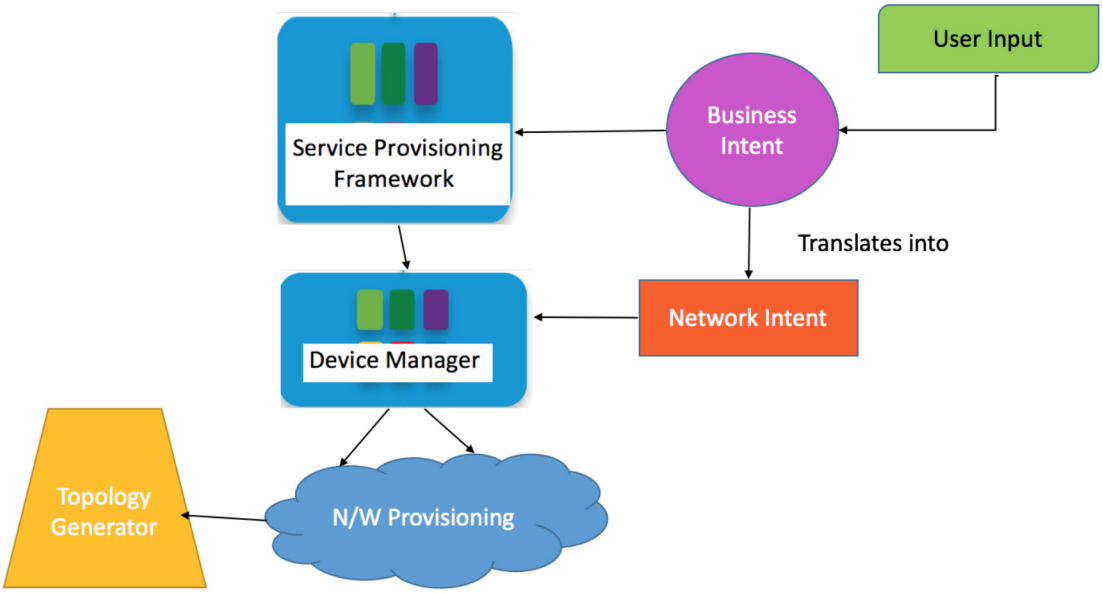

Figure 2: DNAC Architecture

As shown in Figure 2, user inputs are captured. Business intent is formulated and provided to the DNAC's service provisioning framework. The service provisioning framework includes a service manager (who processes this business intent) and a device

manager (who reacts to the network intents); business intent is translated into these network intents. Then device configurations are pushed to the network for provisioning. A basic sanity check occurs during per device validation. Inventory is maintained and devices are managed for given configurations. A topology generator may run continuously. More specifically, the topology generator may run as an ongoing job to calculate a topology. The topology can be calculated based on network devices and device links captured in this process. When one or more network configurations change happens, they are captured in the physical topology of the DNAC application.

Figure 3, below, illustrates a service architecture that is a modification of the architecture shown in Figure 2.

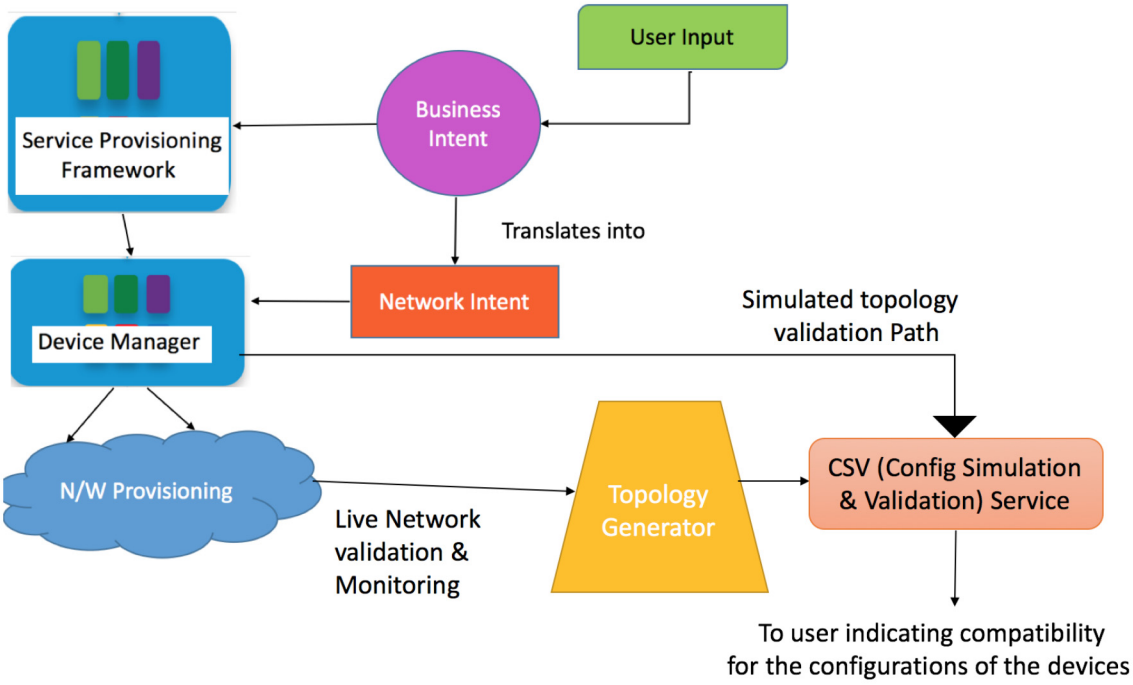

Figure 3: DNAC Architecture with CSV (Configuration Simulation and Validation) Service

As shown in Figure 3, device configuration information is also provided from the device manager to the CSV service. This is done so that the CSV service can validate configuration changes. More specifically, the configuration changes intended by the user can be determined to be valid and feasible for the network. If configuration validation is passed, the changes are then pushed to the networks. If configuration validation is not passed, an indication with configuration errors is provided to the user through a simulated

topology. More specifically, the configuration errors are highlighted for the user to take further action. Also, once the network is setup and the topology is generated, a user can select any two endpoints to perform this validation. Thus, using the modified service architecture, Configuration Simulation and Validation can be supported inside a DNAC using this CSV service.

The techniques presented herein may allow for rule-based topology simulation and validation and may be triggered automatically and/or manually.

Automatically triggered: CSV service can be configured for complete topology validation. CSV service can also be configured for configuration change driven partial topology validation for connected devices. This validation may be based on DNAC subscriptions and user's policies supported under DNAC through easy quality of service (QoS). The CSV service iterates through pairs of devices in the network. The CSV service validates the pairs of devices for configuration compatibility.

Manually triggered: This is a selective validation use case. In particular, a user specifies two network endpoints to be verified for configuration compatibility. These devices can be selected directly from the topology (if from an existing network). These devices can additionally or alternatively be selected while processing new business intent.

Configuration compatibility and correctness not only validates the configuration of the two end points being considered, but also validates the configuration of all intermediate nodes. Figure 4 illustrates an example topology. With reference to Figure 4, a wireless access point (e.g., sapro-4) and a wireless controller (e.g., sparo-11), are selected by the user (manually triggered mode).

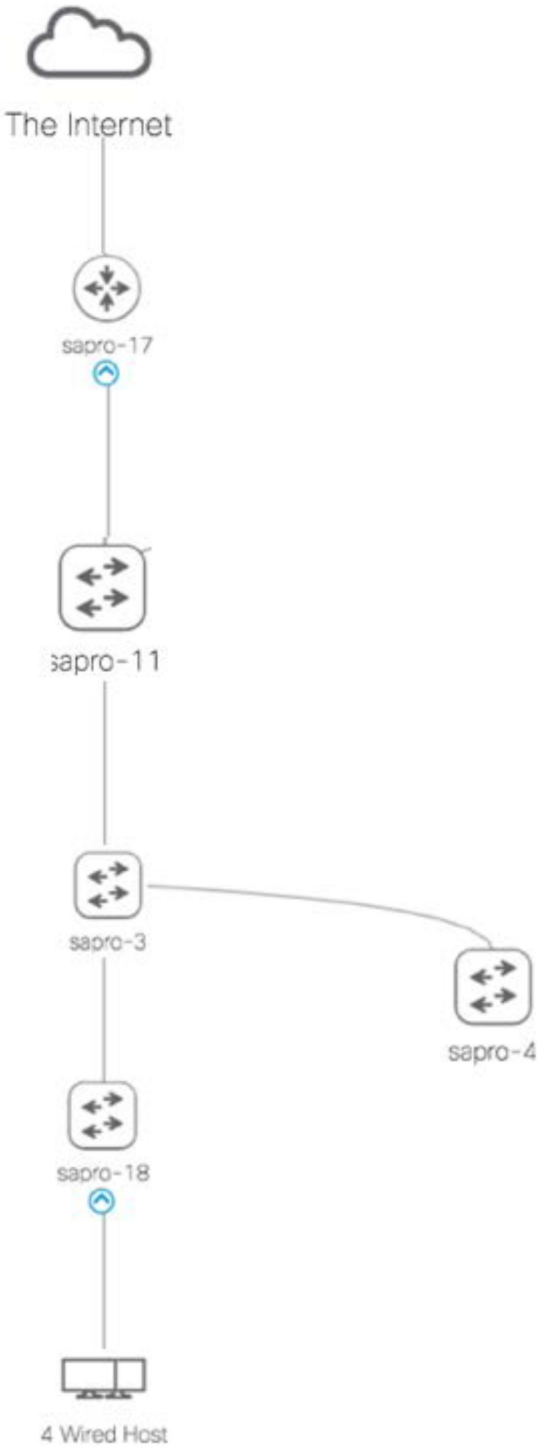

Figure 4

Then, the CSV service will make sure that all the rules for the manually triggered mode for these type of devices are satisfied. The same would be applicable in case when multi hop devices (e.g., sapro-17 and sapro-18) are selected.

An example set of rules may include: IP configuration validation; VLAN configurations. The IP configuration validation may include: duplicate IP configuration; IP configuration causing loops; and/or unreachable device IP. VLAN configuration works in conjunction with the IP configuration validation. This will make sure that the VLANs are configured in such a way that devices are reachable.