Cases for Including a Reference Monitor to SDN

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1. Motivation

Misconfigurations are considered a main source of network failures [1,2]:

- **SDN simplifies** and **automates** network operations, potentially reducing misconfigurations
- But…

Misconfigurations can still happen in SDN:

- Potentially **bigger impact** due to centralized controller access to the **entire network**
- Implementation **bugs** (controller, applications)
- Applications with **competing objectives**
- **Malicious** entities (e.g., compromised application)

Related Work: Data plane verification techniques [3] and checks at controller-application interfaces [4] **do not block the controller** sending configuration rules

2. Solution

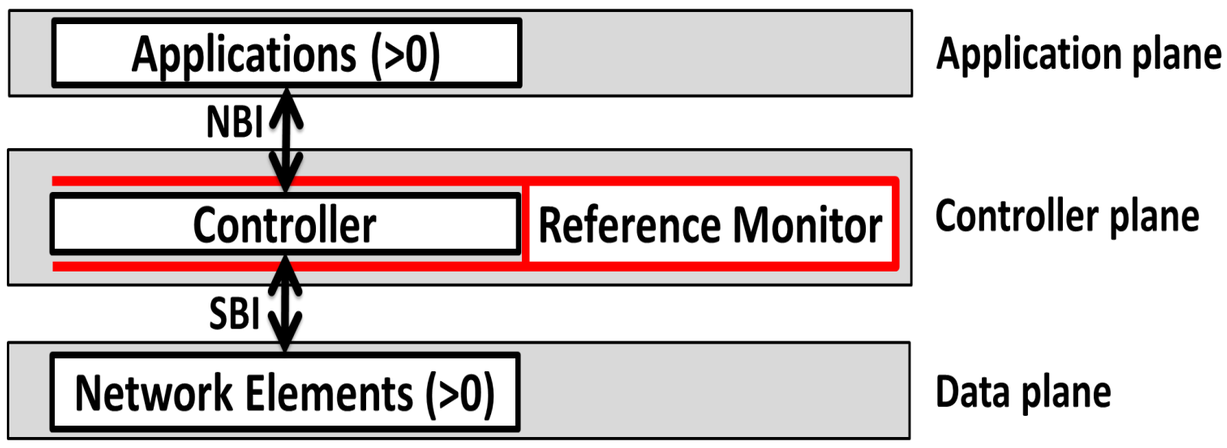
A **reference monitor** for SDN [5]:

- **Trustworthy** component
- **Limits** controller **actions** according to **policies**
- Similar to reference monitors in operating systems

3. Architecture

The **reference monitor** is an entity that runs independently from the controller:

- It hooks into the controller's **SBI** and **NBI**



NBI hook: Retrieves application information

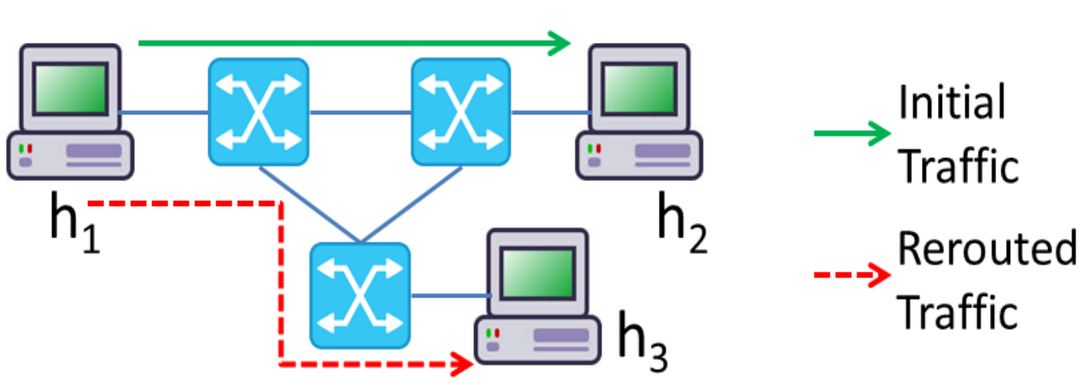
SBI hook: Intercepts SBI calls and blocks them if not policy-compliant

Proof-of-concept implementation for **ONOS**:

- Separate OSGi bundle
- **Minimal modifications** to **ONOS**
- SBI changes:
  - All calls intercepted by the reference monitor
  - Include application information (app ID)

Demo

Competing applications and careless administrators can misconfigure the network



Two forwarding applications on top of **ONOS**:

- Default forwarding application
- Command line interface (CLI) to submit intents:
  - Intents able to connect hosts or redirect traffic

Connectivity requirements:

- Connectivity between h_1-h_2 should be provided by the forwarding application
- The CLI should only be used to connect h_1-h_3

Without the **reference monitor**:

- **CLI can submit intents that "hijack" traffic between h_1 and h_2**

With the **reference monitor**:

- **Provided policy** is enforced
- **OpenFlow messages** violating the policy are **blocked**, e.g., whitelist of applications and network hosts accessing network elements

A second use case about bug prevention is described in the extended abstract

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www.virtuwind.eu www.5gensure.eu

References

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