Bootstrapping "softwarised" infrastructure trust: from SDN towards NFV

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“Softwarisation” of the infrastructure

Empowering the application to change the network topology

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Software-Defined Networking in a nutshell

- split the control and data planes
  - network elements expose new interfaces

- centralised control plane in the form of an SDN controller
  - decisions taken out of the boxes through protocol
  - but the controller has full visibility on the network topology
“Abusing software-defined networking”
BlackHat ‘14, G. Pickett, Hellfire Security

- infrastructure information disclosure (topology, credentials)
  - no encryption on northbound API (or turn-off by default)
  - no authentication on northbound API (or weak password)

- modification of flows/topology via unauthorised access
  - connect to the targeted network element and kick the genuine controller
    - change to malicious one
  - future suggests growing software attacks

- deny of Service on the controller
  - flooding
“Softwarised” infrastructure monitoring

Network monitoring needs automation too!

- hard for administrators to assess the network topology
  - used to manage switches individually
  - now must manage the topology through the SDN controller
    - loses a lot of observability

- network now changes dynamically
  - how can we have more assurance that routing is performed correctly?

- the SDN controller holds all the information
  - at large scale, can not be humanly processed
**SDN trustworthy monitoring architecture**

How do we regain trust in this new infrastructure paradigm?

- **SDN controller**
- **VM**
- **VM**
- **vSwitch**
- **backend servers**

**control plane**

**data plane**

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The Vision: automated and trustworthy monitoring for SDN

Introducing the SDN verifier

- assess that SDN configuration of switches match the controller expectation
  - out-of-band challenge/response
  - meant for continual attestation

- challenge:
  - build a trusted reporting mechanism for each network device (physical and virtual)

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Core Root of Trust for Reporting (CRTR)  
Monitoring the SDN rules in a network element

- introspection of the SDN context:
  - we need to monitor what is really enforced, not just the protocol
- the SDN “switch” still needs to be attested
- remote attestation must be possible by the SDN verifier

- prototype:
  - rely on TPM
  - software stack
  - SDN rules enforced

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Next steps: closing the loop
Acting on a misbehaving network elements

- automated response
- pass the information to the application layer
- application layer has the visibility to handle the error, e.g. quarantining a faulty switch

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SDN as a building block of NFV
ETSI VNF chaining and NFV Architecture

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SDN compliance monitoring for NFV

NFV software stack:
- OSS/BSS
- NFV orchestrator
- Virt. Infra. manager
- SDN controller

Control plane not shown

Dataplane
Monitoring plane

Sync
Errors

Attest switch configurations

outbound traffic

VNF
VMM
vSwitch
Hardware Switch
TrustedFW

inbound traffic

Hardware Switch
TrustedFW

VNF
VNF
VNF

VNF
VNF
VNF

SDN verifier

Sync

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THANK YOU!

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