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S2-Controller: Securing Network Application Deployment in Software Defined Networking

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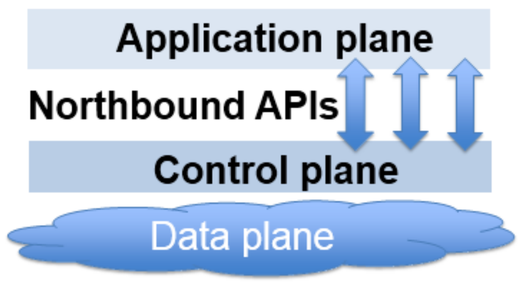
1. Background on SDN

Software-Defined Networking (SDN) architecture



Main components of SDN

- Data plane, Control plane, Application plane
- Southbound interfaces, northbound interfaces

2. Security Issues of SDN

Threats from the internal network application

- Code injection
- Command injection

Threats from the external network application

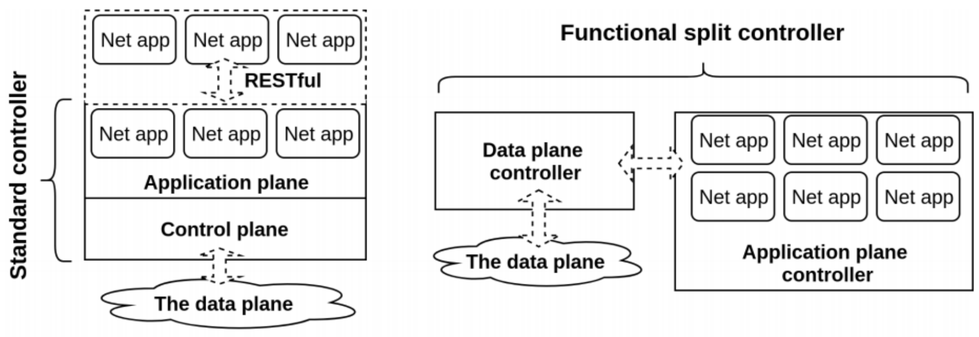
- API abuse

	FLOODLIGHT	ODL	ONOS
RAED	Packet dropping	Responding slower	Packet dropping
ADD	Flow entry limitation: 148223	Flow entry limitation: 140000	Flow entry limitation: 45000
UPDATE		/sal-flow:update-flow	/devices/<deviceId>
REMOVE		/sal-flow:remove-flow	/flows/<deviceId>/<flowId>

3. *S2-Controller* Design Principle

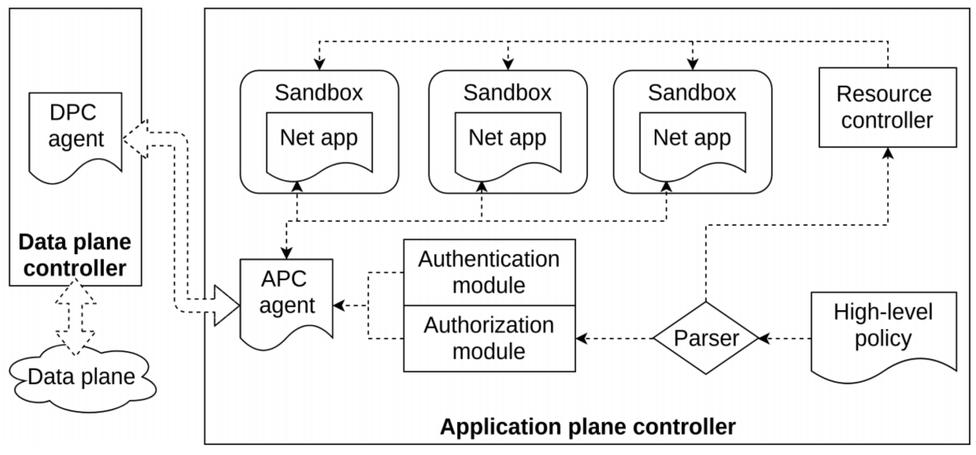
S2-Controller architecture

- ***S****plit*
- ***S****ecurity-by-design*



Standard SDN architecture ***S2-Controller*** architecture

4. Prototype Implementation



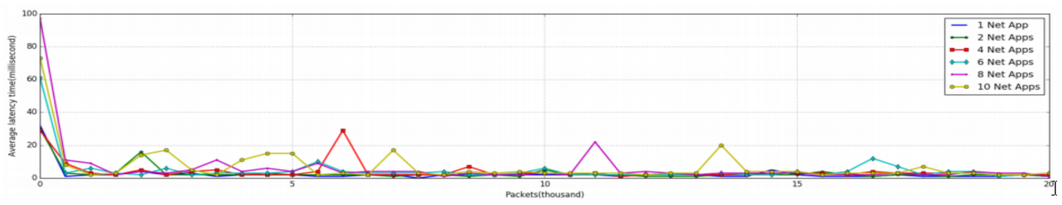
High-level view of the application plane controller

Main components of ***S2-Controller***

- Controller agents
- Policy engine
- Application sandbox and resource controller
- Authentication and Authorization modules

5. Performance Evaluation

Prototype components	Implementation
DPC	Floodlight(v1.2)
DPC agent	Kafka producer/consumer
APC agent	Kafka broker
Authentication module	Kafka truststore
Authorization module	Kafka truststore
Resource controller	Marathon, Sigar
Application sandbox	Docker container
High-level policy	YAML
Parser	Java application
Network simulator	mininet



- ***S2-Controller*** processing time for delivering 20 thousands *packet_in* messages
- The latencies can be maintained less than 5 milliseconds in long term

6. Conclusion & Future Work

- ***S2-Controller*** can protect SDN controller against command injection, code injection, and API abuse
- ***S2-Controller*** can be implemented in the existing SDN controller
- The *packet_in* messages delivering time in ***S2-Controller*** architecture can be maintained in 5 milliseconds in long term
- ***S2-Controller*** architecture would be applied to the distributed controllers in the SDN-enabled network

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