RSAConference2018
San Francisco | April 16–20 | Moscone Center

SESSION ID: TECH-W12

SDN AND SECURITY: A MATCH MADE IN HEAVEN - OR NOT?

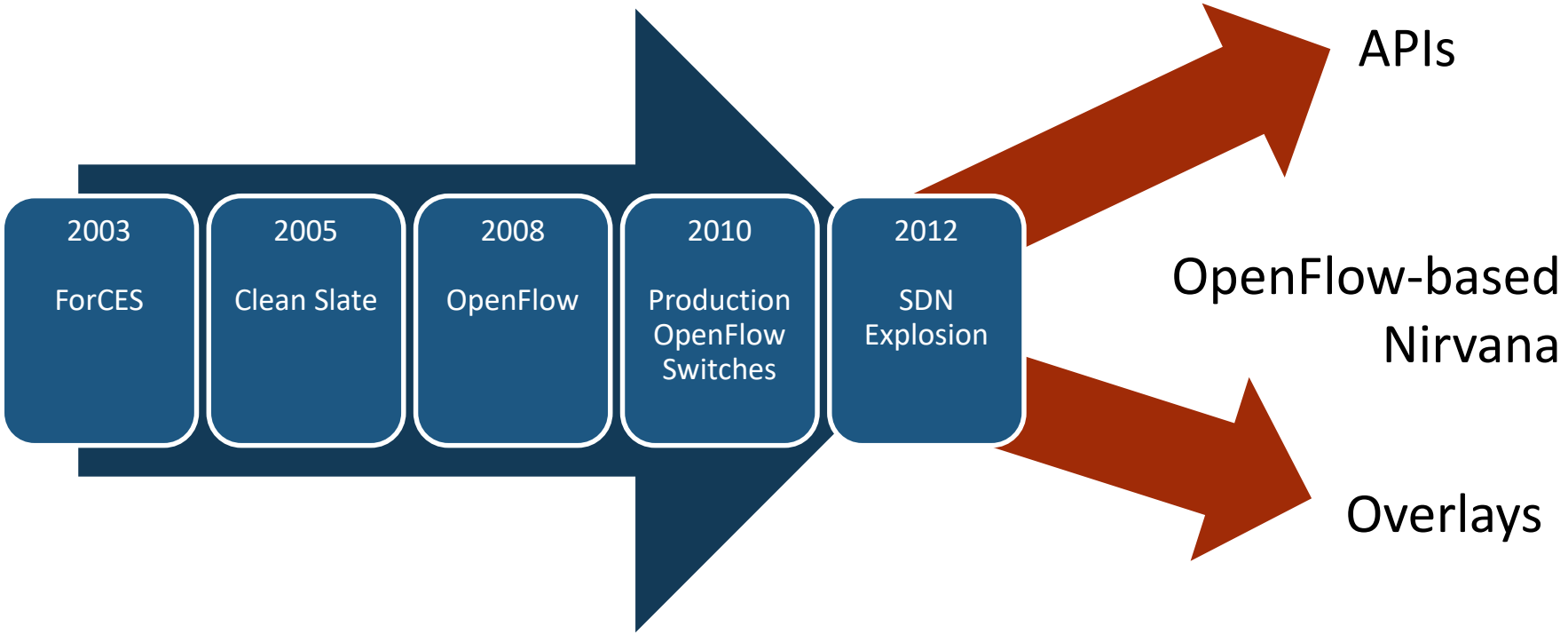
Chuck Black

Senior Software Developer
Tallac Networks

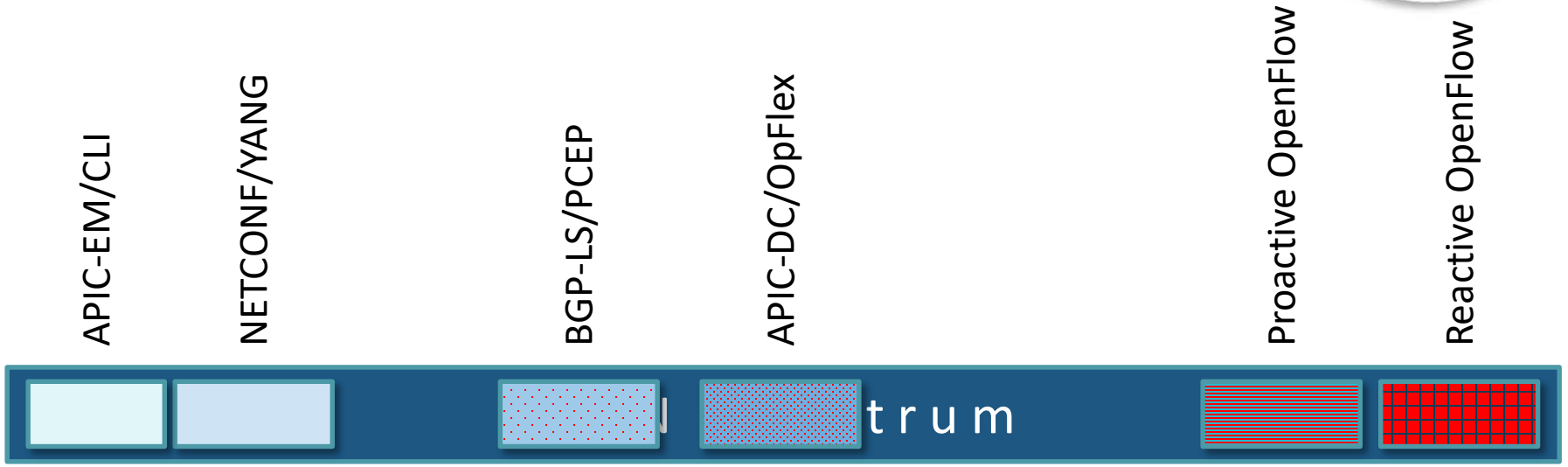
SDN TODAY

"Who Stole My SDN"?

A Brief History of SDN



The Cisco Effect



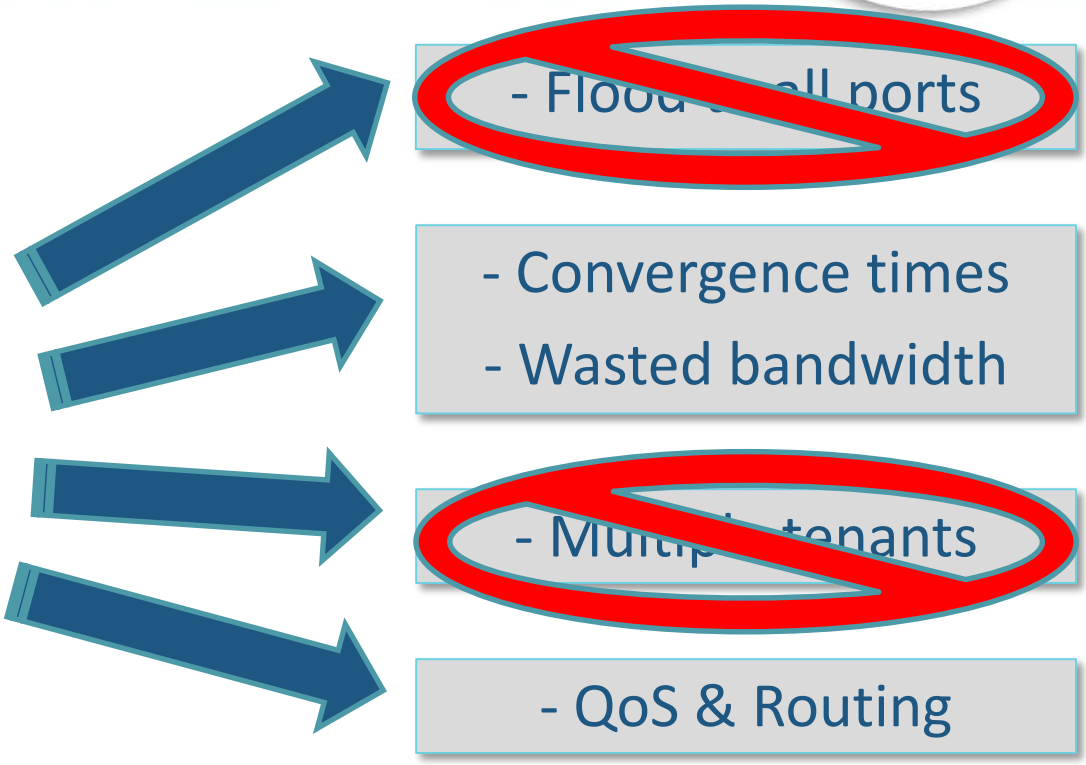
Legacy (no disruption)
Evolutionary (minimal changes)
Network Management ++

Disruptive
Revolutionary
Exciting

The Overlay Effect (Nicira)

Intractable Data Center Networking Problems

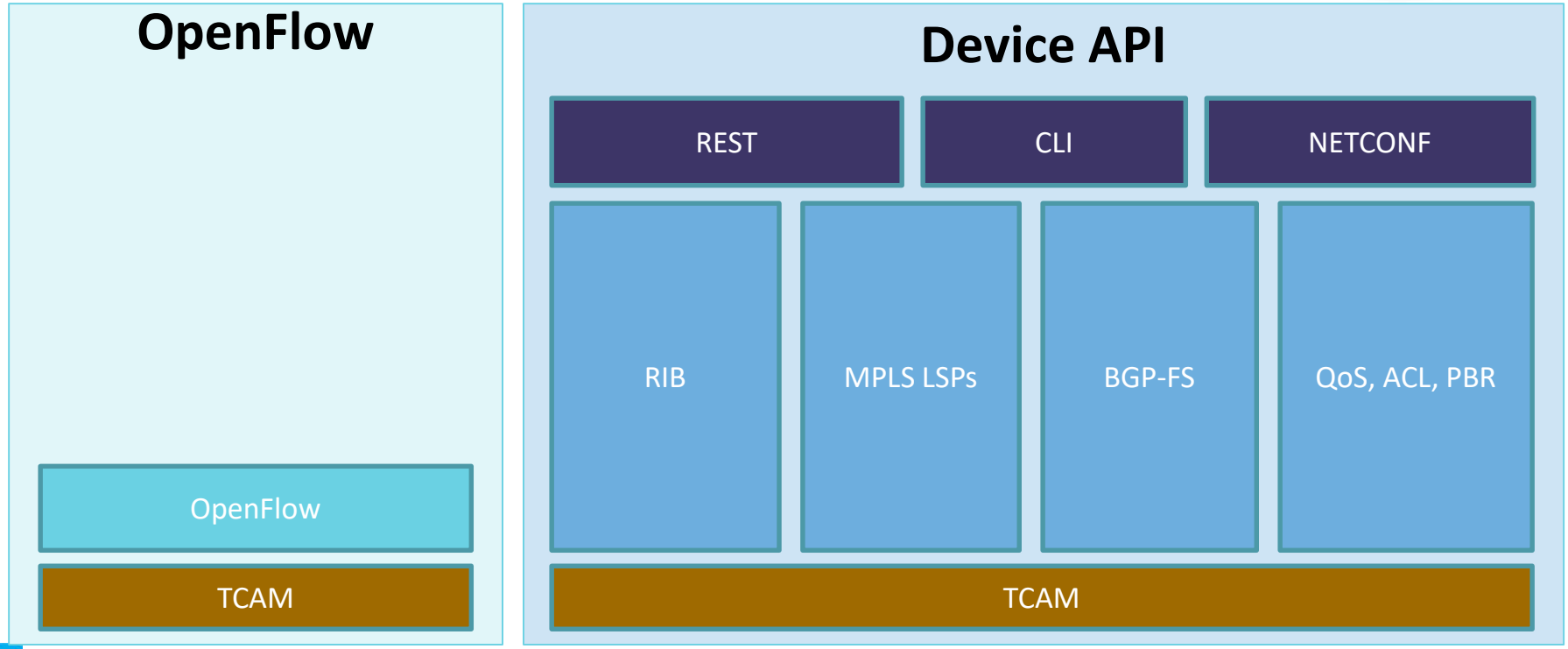
- MAC table overflow
- @#$%! Spanning Tree
- VLAN exhaustion
- Traffic Engineering



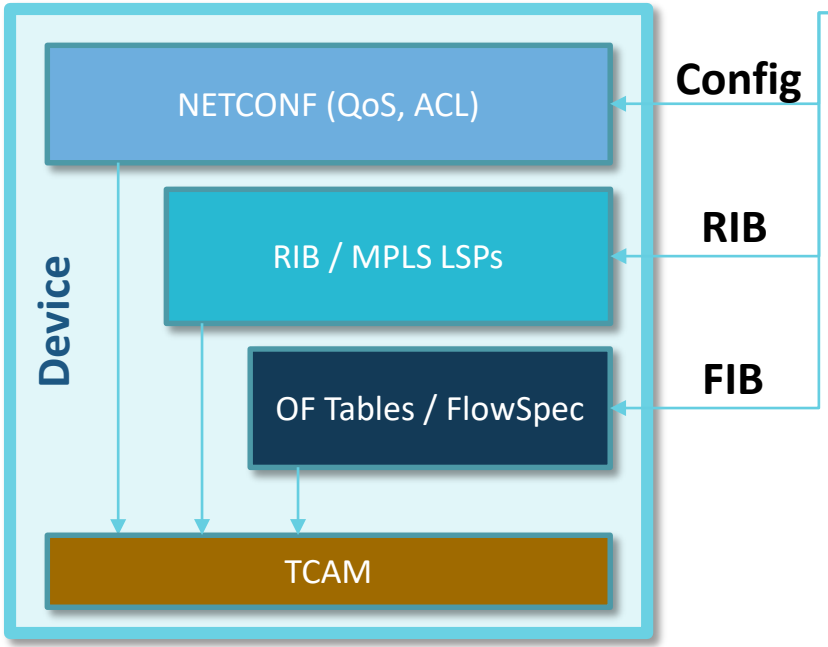
SDN Landscape Today

Overlay-based	API-based	OpenFlow-based
• VMware NSX • Juniper Contrail • Cisco ACI	• OpenDaylight • APIC-EM • Tail-f (NSO)	• ONOS • BigSwitch • NEC VTN
• Turnkey	• Application development	• Turnkey or App development

SDN Devices Today



SDN Device Control Points



Config

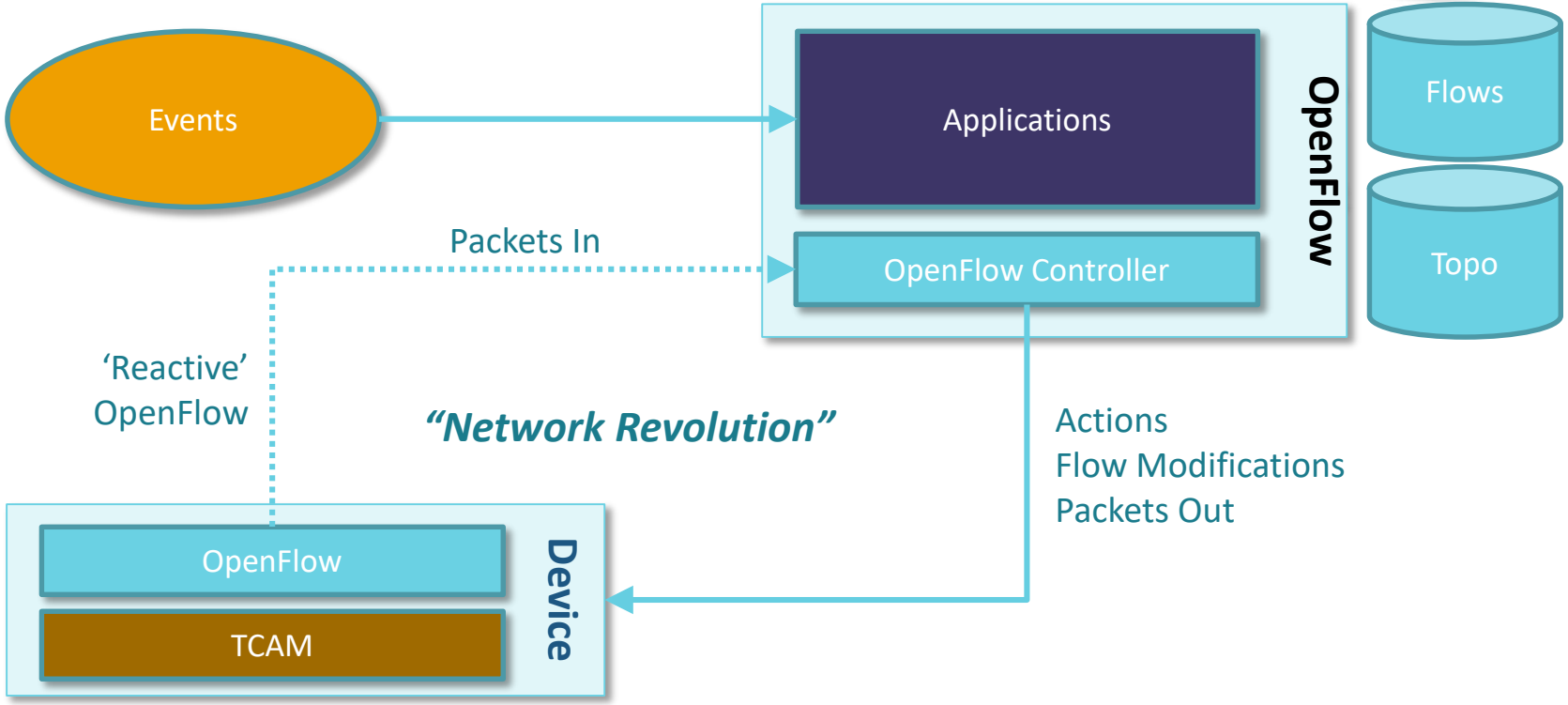
RIB

FIB

Applications

- **Config**: Configuration parameters for security and policy
- **RIB**: Routing Information Base entries, MPLS Label Switched Paths
- **FIB:** Forwarding Information Base entries such as OpenFlow and BGP-FS

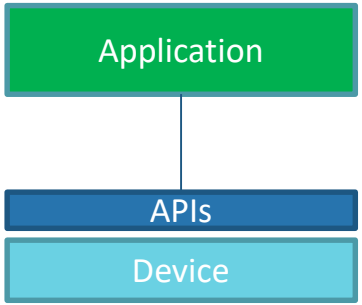
SDN Applications Today: OpenFlow



OpenFlow-based SDN Interfaces

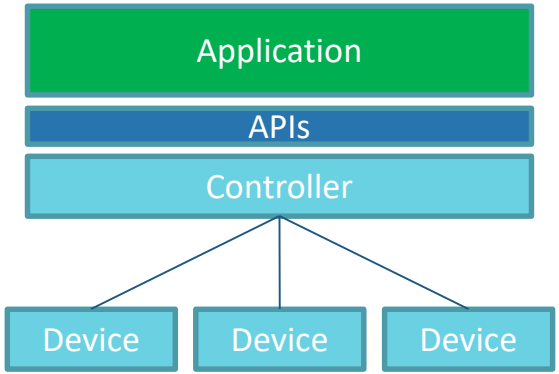
Device-level OpenFlow

- OVS-OFCTL



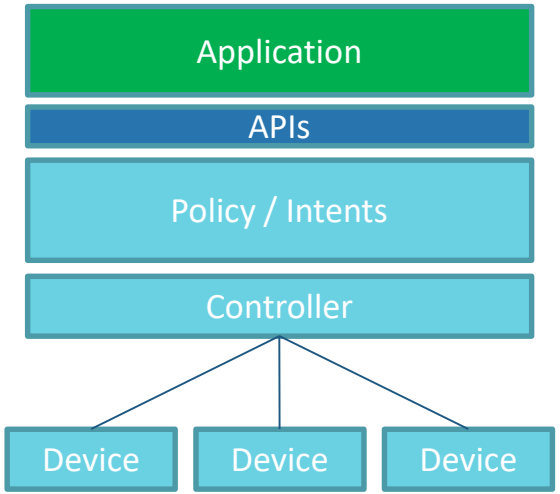
Controller-level OpenFlow

- Matches/Actions
- Set flows per-device

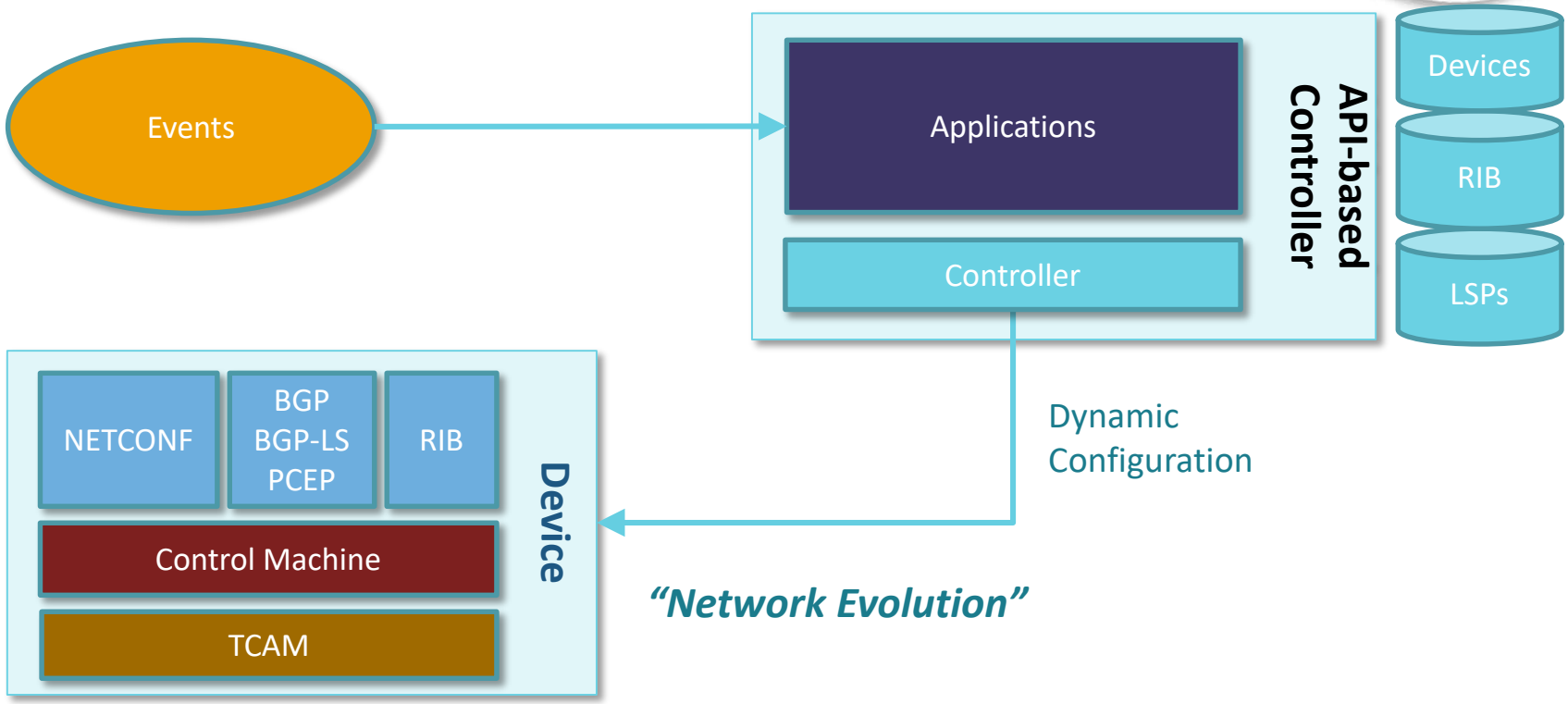


Policy-level OpenFlow

- Intents
- Declarative



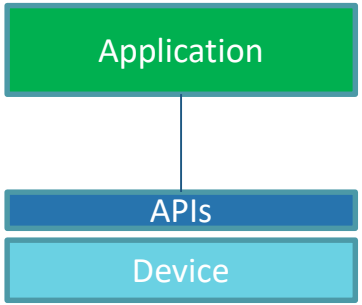
SDN Applications Today: APIs



SDN APIs Today

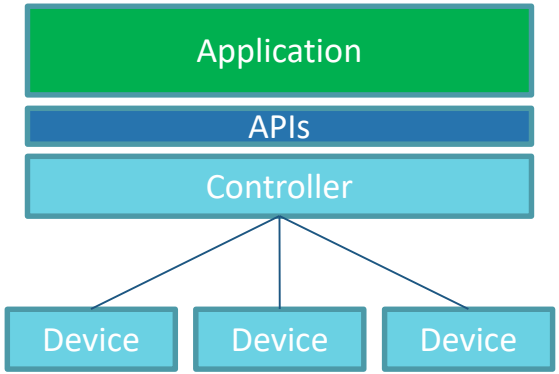
Device-level APIs

- NETCONF, REST, SNMP, CLI



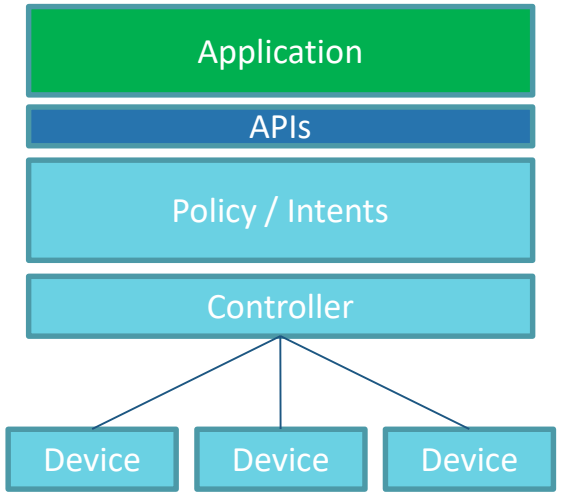
Controller-level APIs

- Abstraction
- Multiple-device operations

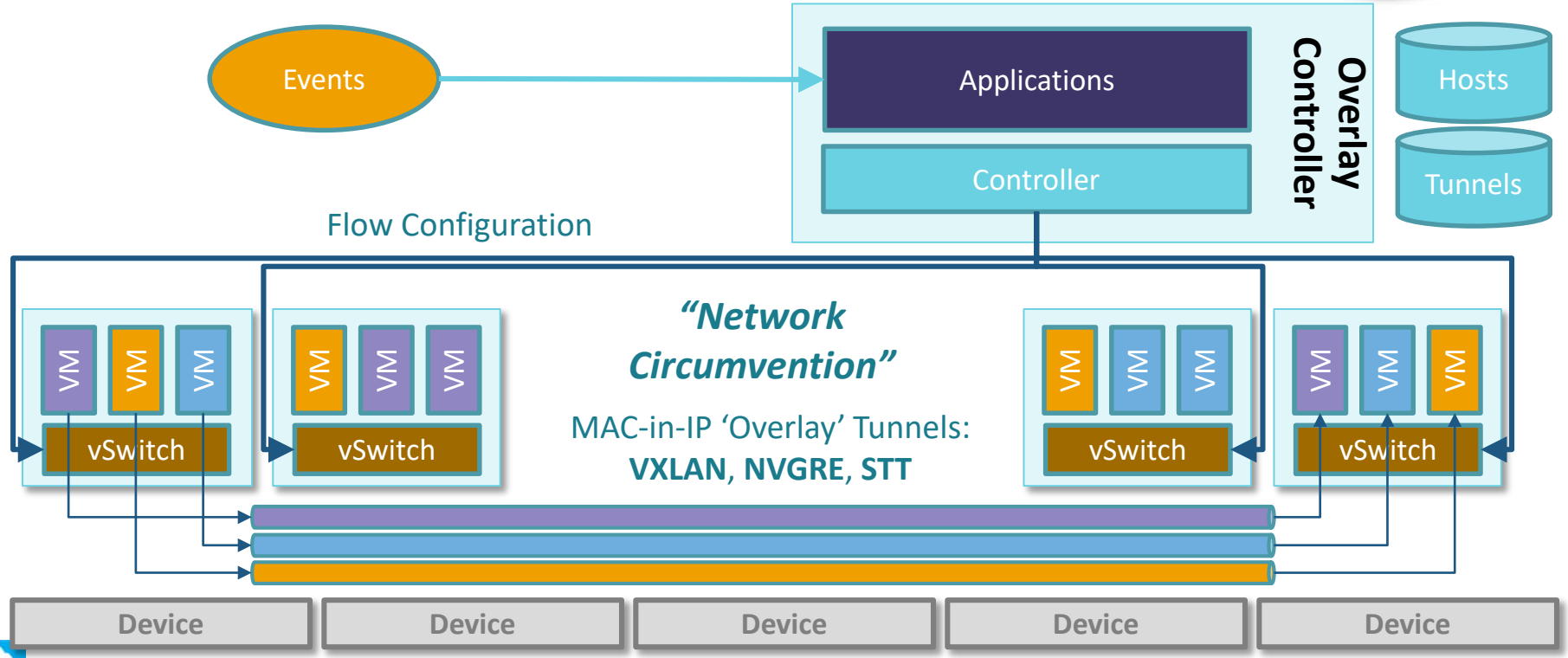


Policy-level APIs

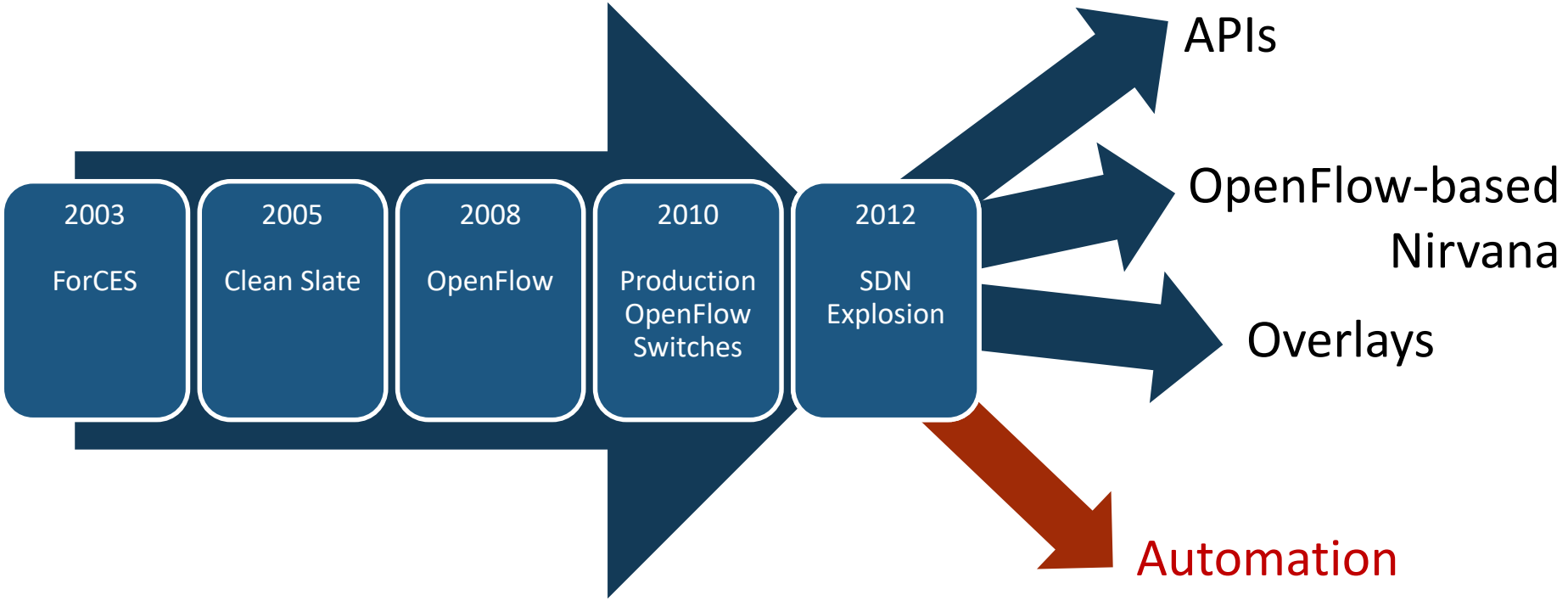
- Intents
- Declarative



SDN Applications Today: Overlays



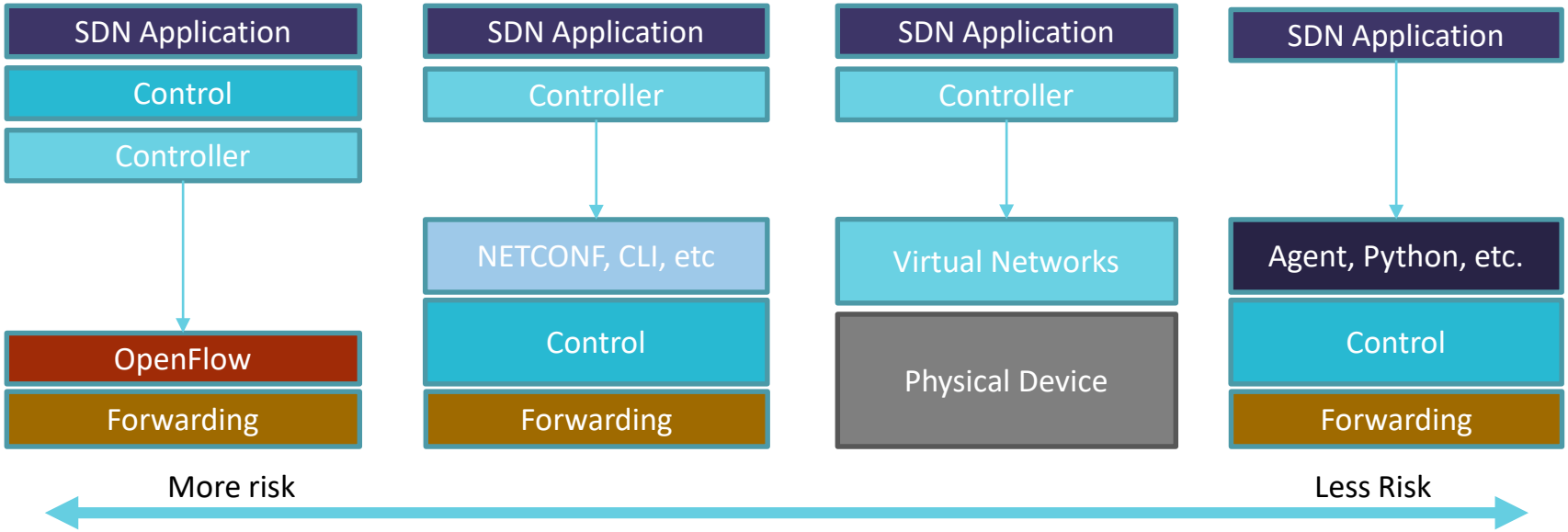
SDN – Automation?



Is Automation a Type of SDN?

- **What is Automation**? Using Ansible, Python, StackStorm, SaltStack, on-device containers, scripts, etc. to automate tedious manual processes, and to dynamically respond to network and policy changes.
- **Compare Automation to traditional SDN characteristics:**
  - **Plane Separation**: *Of forwarding and control planes?*
  - **Programmability**: *Automation of tasks?*
  - **Centralized Control**: *Network-wide views and policies?*
  - **Simplified Devices**: *Reduced device complexity?*
  - **Openness for Innovation**: *Ability to create new networking solutions to old or persistent problems?*
  - **Virtualization:** *Of network functions and resources?*

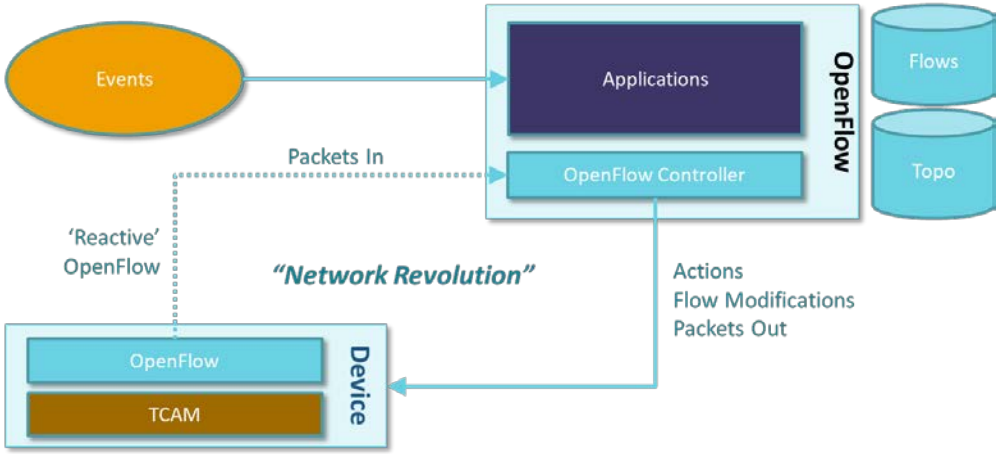
Summary: SDN Today



SECURITY ISSUES AND SDN

Vulnerability and SDN Type

Risk depends on
SDN application type

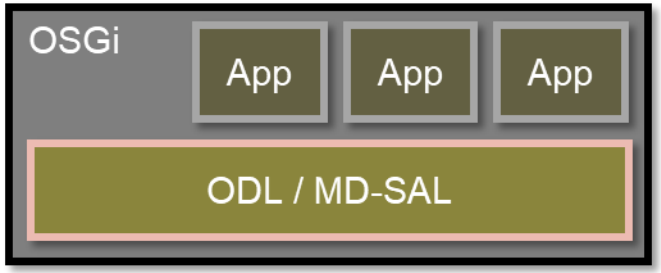


- **OpenFlow-based**
  - **Reactive**: susceptible to denial of service attacks, overloaded links, overloaded CPU/disk, as well as centralized attacks on controllers
  - **Proactive**: less risk, only centralized attacks on controllers
- **API-based**: less risk, really just network management ++
- **Overlay-based**: less risk, contained/secure datacenter environment

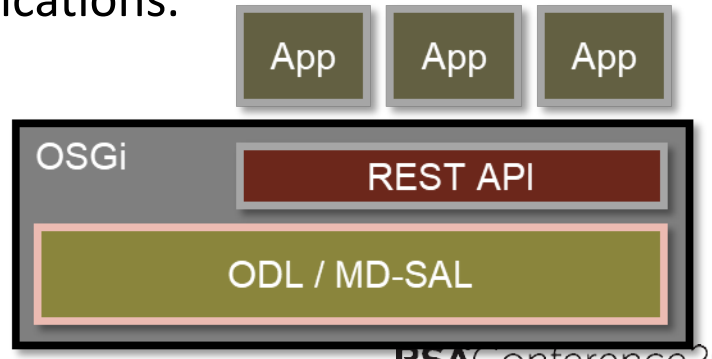
Vulnerability and SDN Application Type

Risk depends on SDN application type

- **Internal** (runs inside JVM container, uses Java APIs): Running inside controller mean greater performance and capabilities, but failures more likely to jeopardize operation of entire controller and other applications



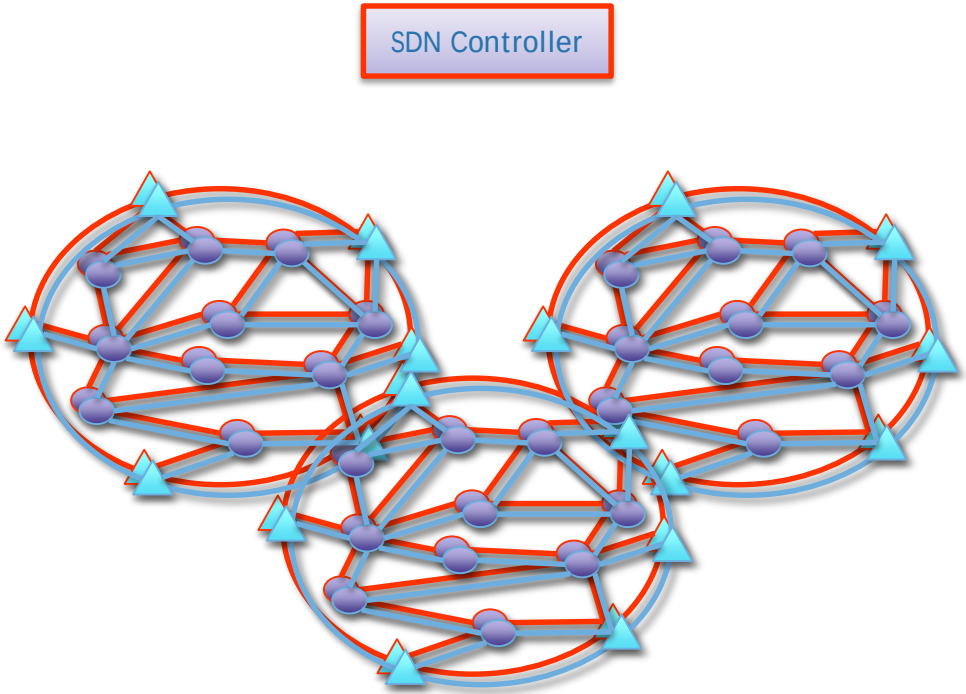
- **External** (runs elsewhere, uses REST API): Running outside controller, potentially on different system or location, protects controller from application failures. Still, invalid or incorrect requests can impact the controller and indirectly, other applications.



Vulnerability and Attack Surface

Attack surface a major criteria for understanding vulnerability

- Distributed Model
  - Huge attack surface, must secure entire network of devices because critical policy is spread throughout, one change can effect the entire network
- Centralized Model
  - Limited attack surface, just centralized controller(s). Easier to defend, protect, isolate, secure.



Reliability of Centralized Systems

Seriously? How can we expect centralized systems to be reliable?

- Telephony centralized their networks three decades ago
- Google, Amazon, Facebook, Twitter (okay maybe one of those *should* fail)
- Cloud (centralized servers, cloud management, massive quantities of data)

Centralized intelligence is not a new idea – just new to networking. Some other 'dangerous' new ideas:

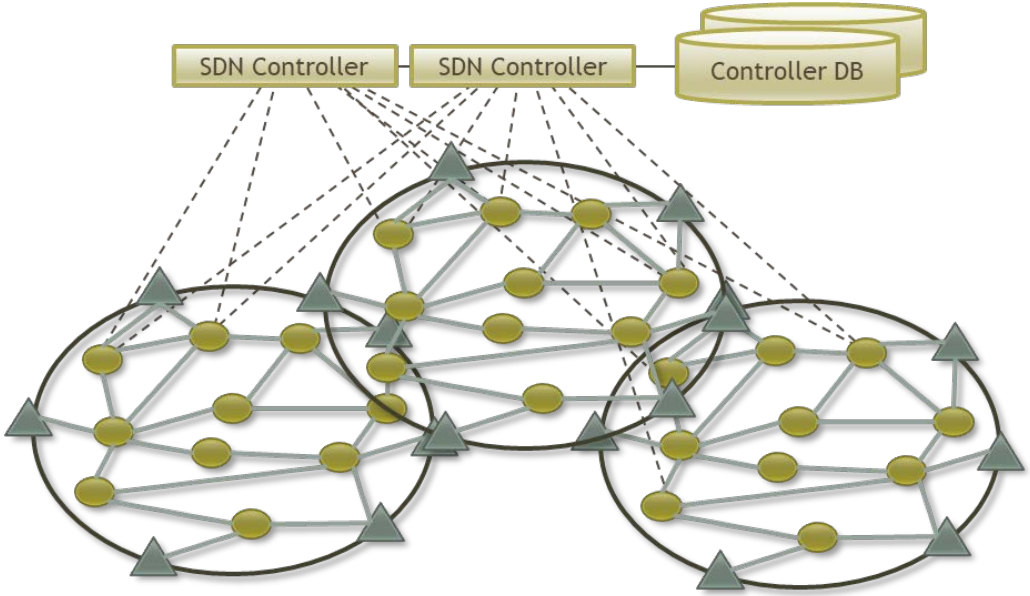
- Oog bagoog! Fire! We're all going to burn!

- Egads old chap! Electricity! We're all going to fry!

- OMG! Flying! In the sky? We're all going to die!

Redundancy Positive Side Effect: Scale

- Providing redundancy for reliability also provides scale-out
- Shared device load across controller in cluster
- Shared compute load across controllers in cluster
- Shared network load across links connecting to controller

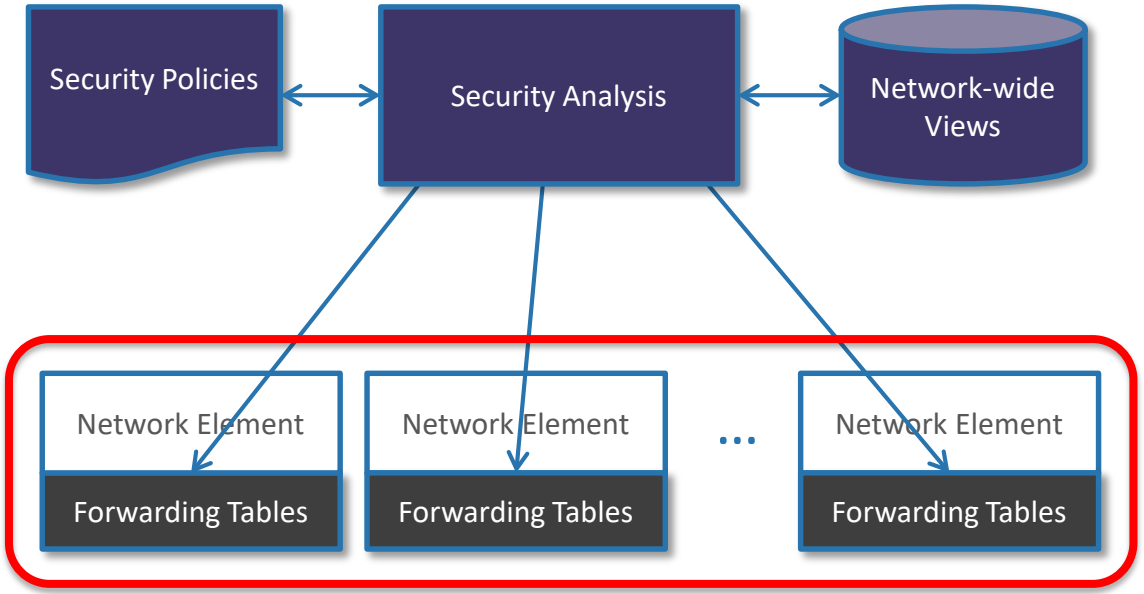


SECURITY ENHANCEMENT THROUGH SDN

SDN can actually make the network *more* secure

Simplified Devices

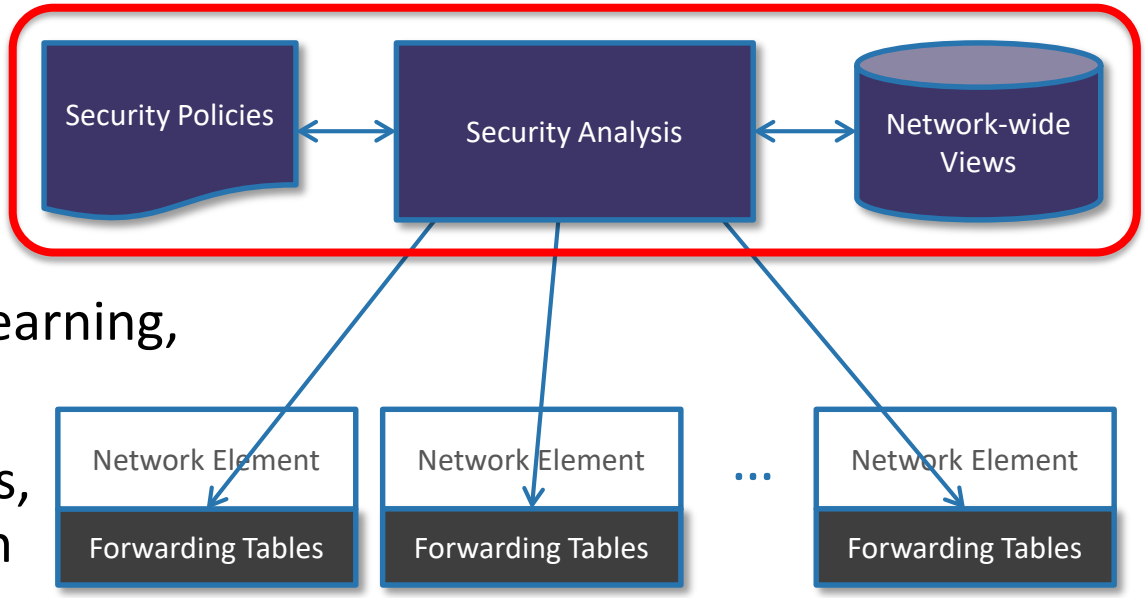
- Analysis done centrally, device only responsible for forwarding to centralized intelligence
- Frees up device to be less expensive, can concentrate on speeds and feeds, commoditized, not fancy extra proprietary functionality.



- Security application from anybody (no vendor lock-in)

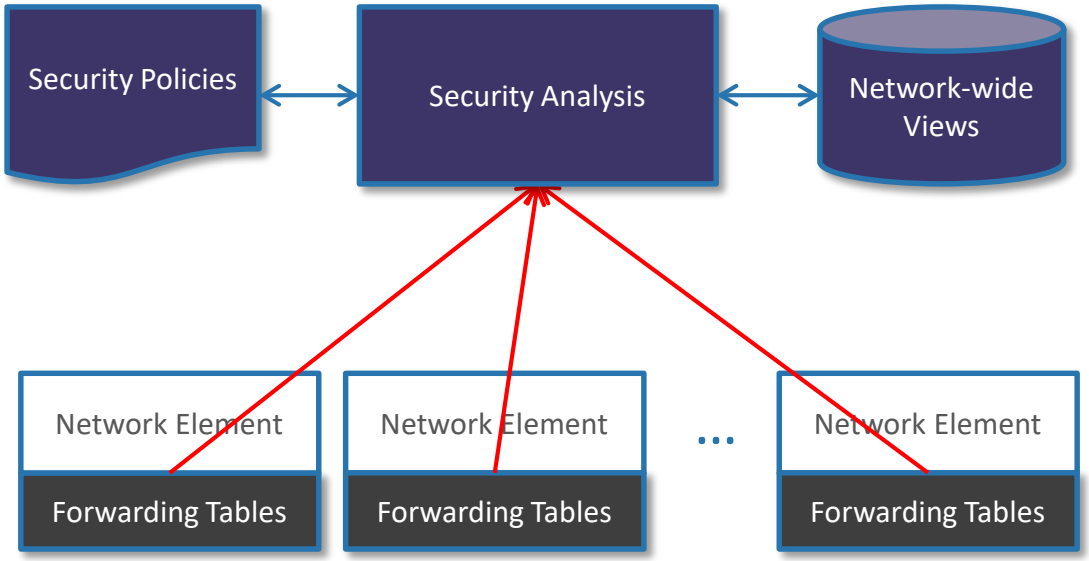
Centralized Analysis and Intelligence

- Gather intelligence and information from all locations and sites
- Processing power to do deep analysis, machine learning, network-wide views, etc.
- Ability to mitigate threats, dynamically closing down malicious users and/or systems, correlation with other data about users, systems, patterns, history, etc.



Dynamic Monitoring

- Detect anomaly, requires further snooping
- Dynamically enable port mirroring for highly granular type of traffic, source or destination of traffic, etc.
- Analyze traffic at central location benefitting from network-wide views, policies, etc.

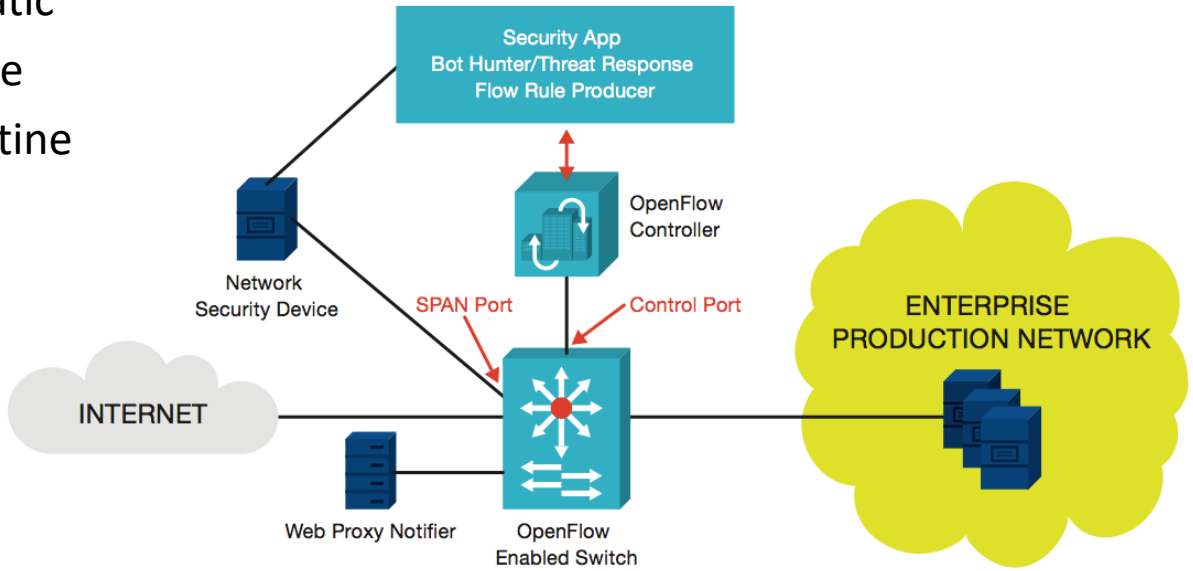


SDN Security Example - AMQ

Automatic

Malware

Quarantine



Source: ONF

Dynamic Mitigation

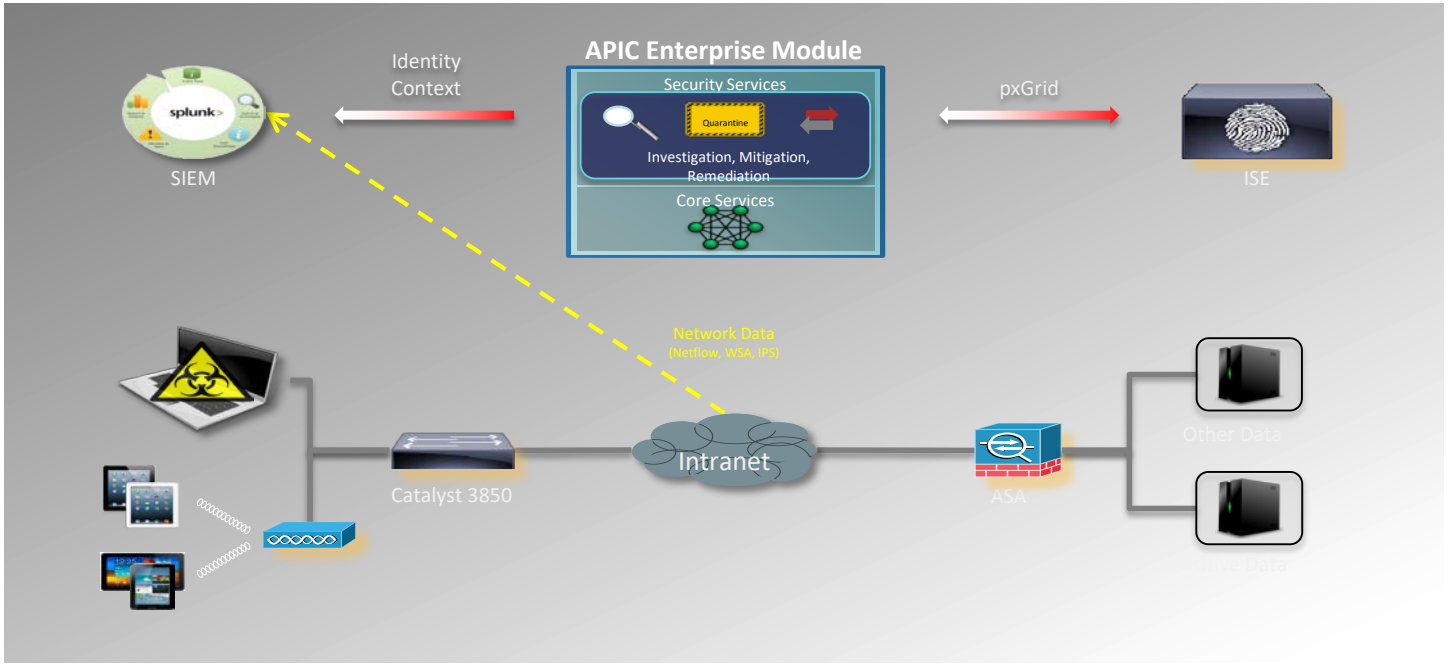
OpenFlow:

- Redirect suspicious traffic through IDS/IPS, firewall, etc.
- Place user or traffic into quarantine zone
- Drop packets from malicious user
- Only allow certain traffic types

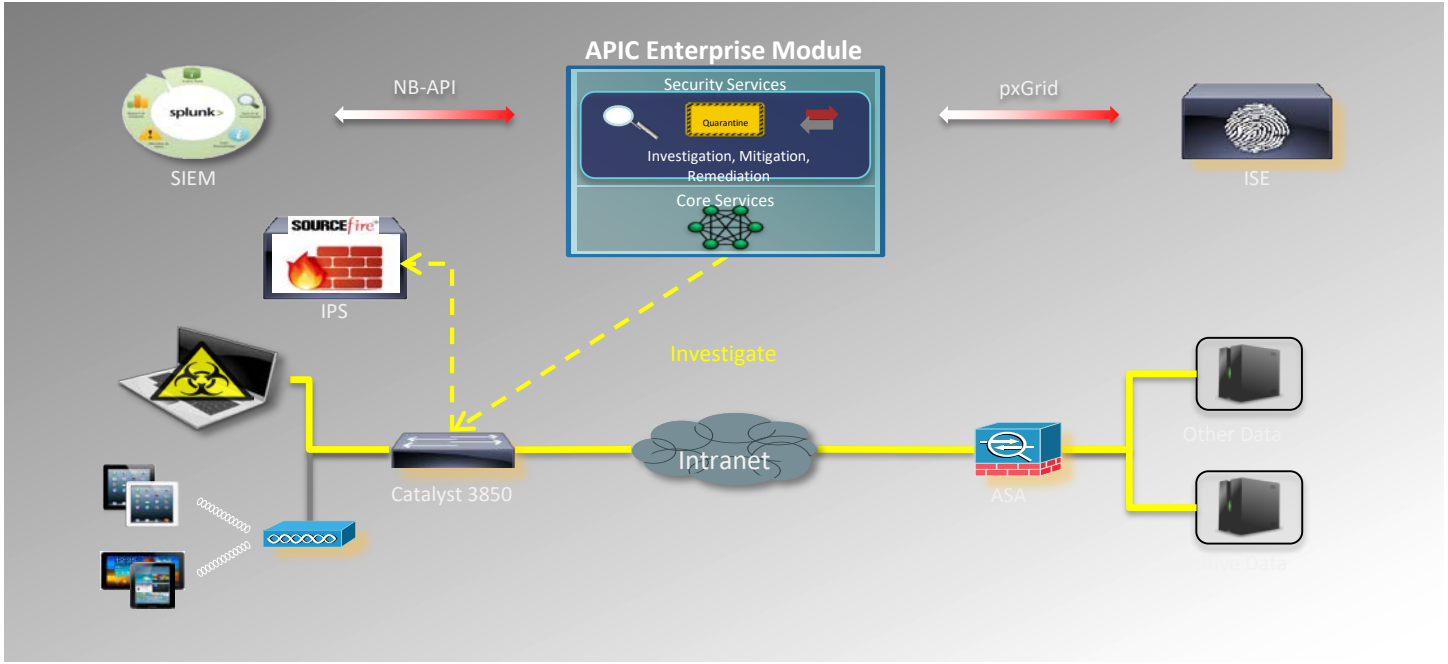
NETCONF or BGP-LS/PCEP:

- Static routes for certain users or traffic types to keep them off main network
- RIB entries to redirect traffic on different path or to IDS/IPS, firewall, etc.
- Deny traffic for malicious users

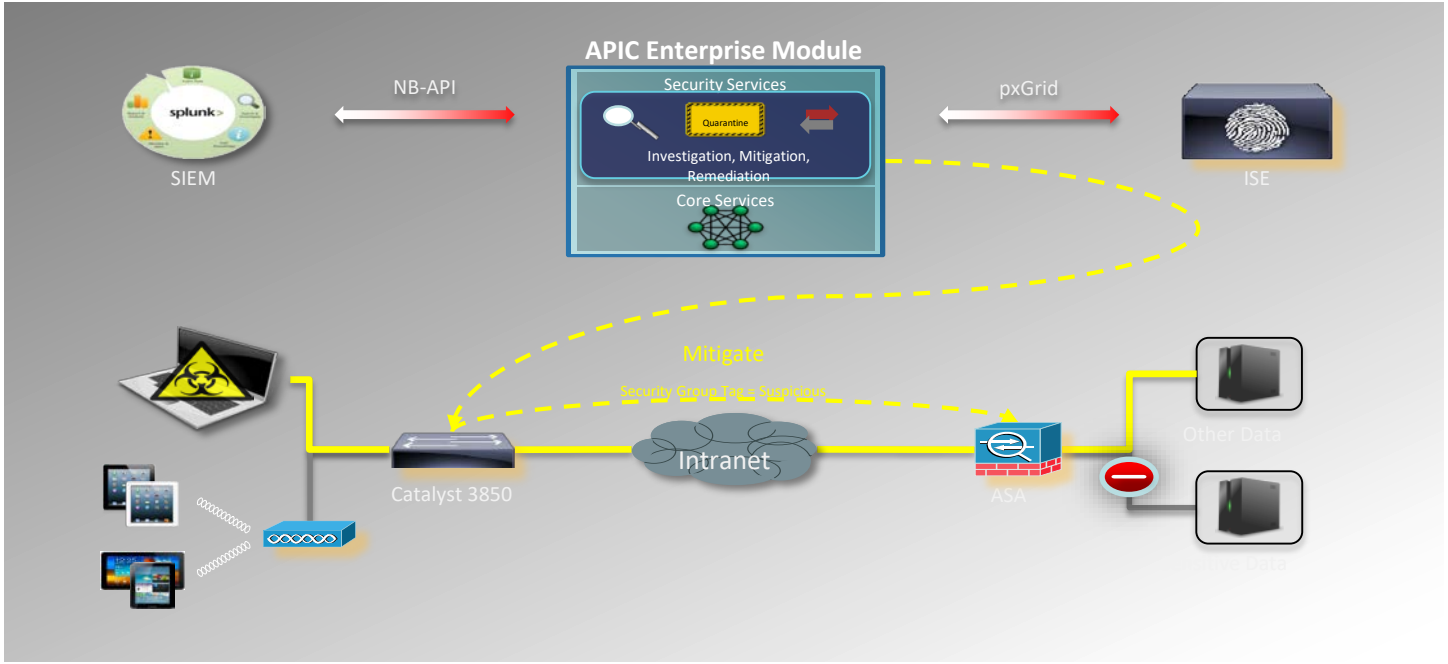
Cisco – APIC-EM: Using clunky old CLI



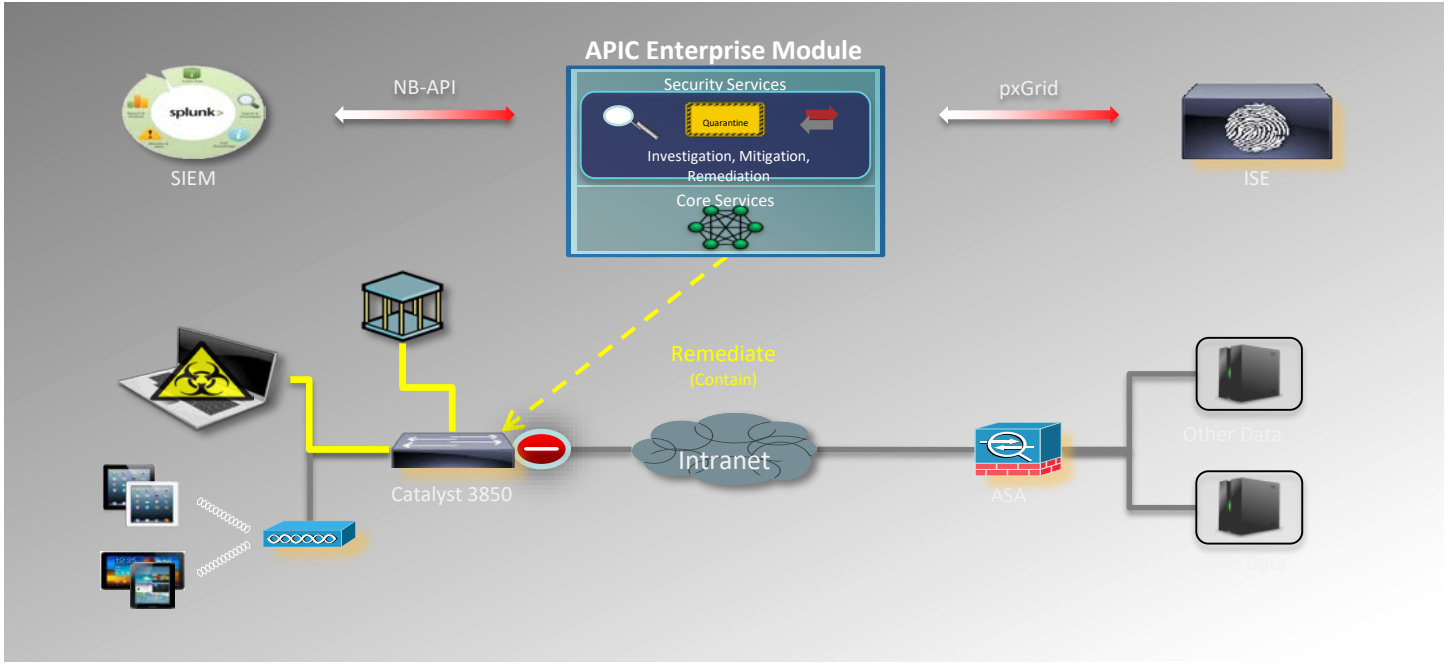
Cisco – APIC-EM



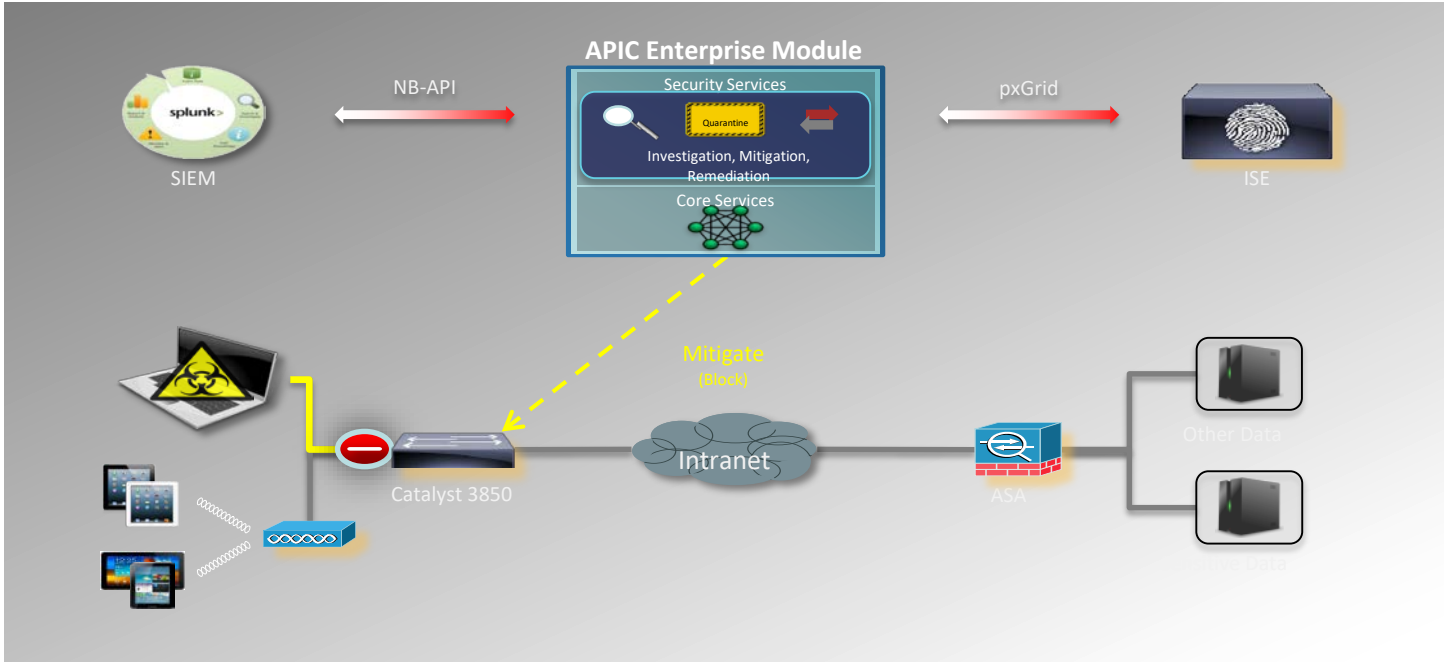
Cisco – APIC-EM



Cisco – APIC-EM



Cisco – APIC-EM



SDN and Security: Application

Assuming your organization has chosen to begin its SDN Adventure, the following actions will help you build and maintain a secure SDN network:

- Make sure you have a redundant architecture (controller and links)
- Make sure you have secured communication between network devices and controller
- Make sure you have secured the controller from threats (authentication/authorization of requests, protection from DoS threats, protection from malicious or buggy applications

Thanks!