ViSION

SDN Traffic Orchestrator for Resource Scale-Out

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Software Defined Networking (SDN) is a very dynamic field that promises to change the way networks work, for the better. Grasping the technology potential early on, CERN found in HP – a company that pioneered SDN development – a partner for an R&D project on improving network resource utilization using an SDN approach.

Overview
- ViSION is a 3-year collaboration between CERN and HP Networking, within the CERN openlab framework, that started in February 2012.
- The project aims to build a flexible *Traffic Orchestrator* using OpenFlow/SDN technologies, with direct applicability for scaling out CERN's firewall system.
- HP's SDN framework is leveraged to accelerate the software development process and ensure robustness.

Software Defined Networking (SDN) – A Game-Changing Technology

SDN is a technology that decouples the forwarding decision logic (the *control plane*) from the underlying infrastructure performing data transmission (the *data plane*).

Openflow is the protocol that provides an open standardized API between the data and the control planes. It enables the fast specialized hardware forwarding engines from network devices to be "programmed" by an external software controller, allowing thus full flexibility for designing and implementing the control plane of the network.
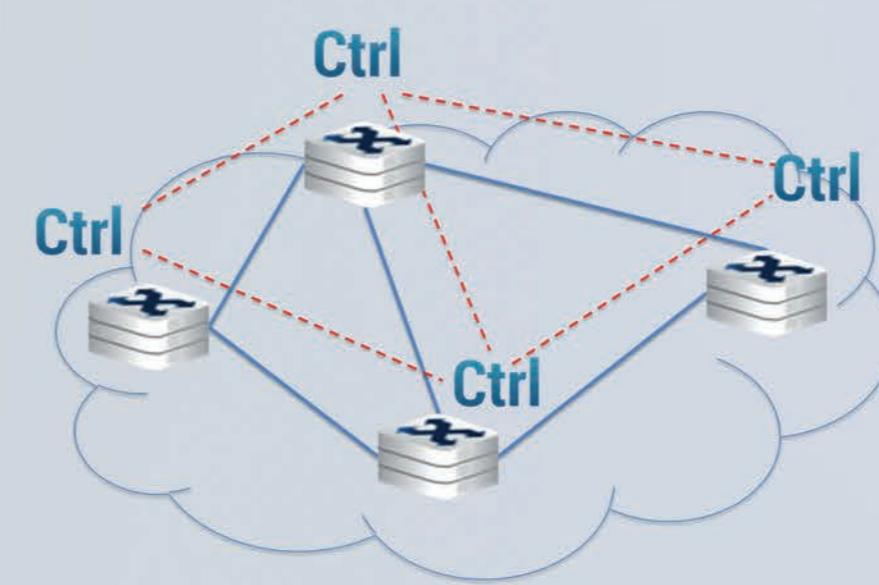
Traditional networking relies on each network device taking its own forwarding decisions. Thus, devices must interact with their peers through complex distributed protocols in order to have enough information about the state of the network.
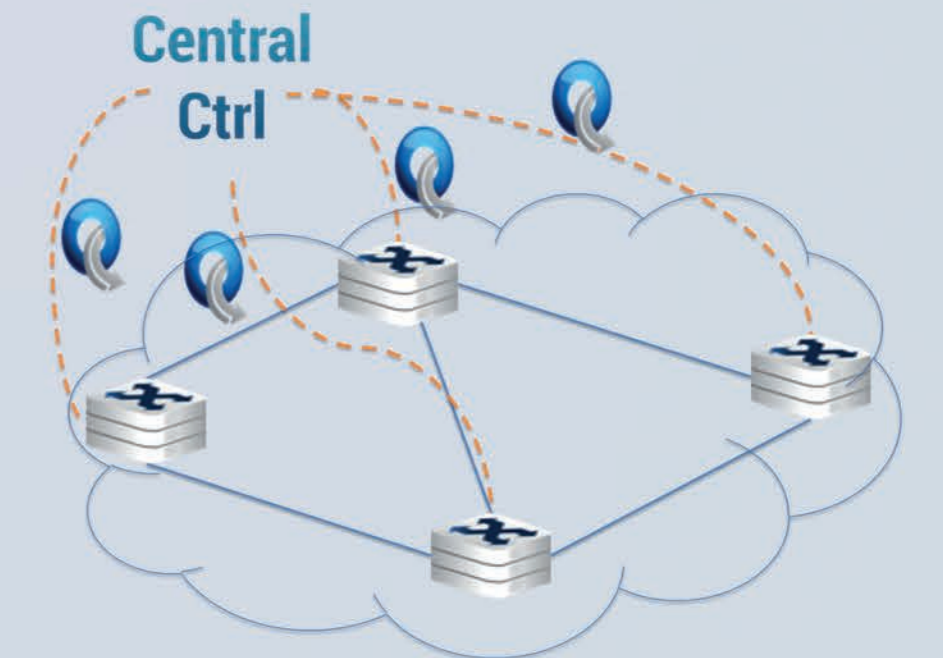
SDN exports the forwarding/decision logic from the networking equipment to an external software controller, that has a global view of the network and can make educated traffic engineering decisions.

ViSION Traffic Orchestrator

- A set of resources is connected to any number of OpenFlow fabrics.
- Each OpenFlow fabric connects the set of resources to one or several networks.
- Each OpenFlow fabric is "programmed" by the ViSION controller, which orchestrates the access to resources.
- The single centralized controller enables correlated traffic orchestration in multiple OpenFlow fabrics.

Adaptive orchestration can be achieved by monitoring relevant load metrics and providing feed-back to the ViSION controller
- Access to overloaded resources can be redirected to less loaded ones.
- If a resource becomes unavailable (outage or scheduled maintenance), the access is redirected to the remaining available ones.
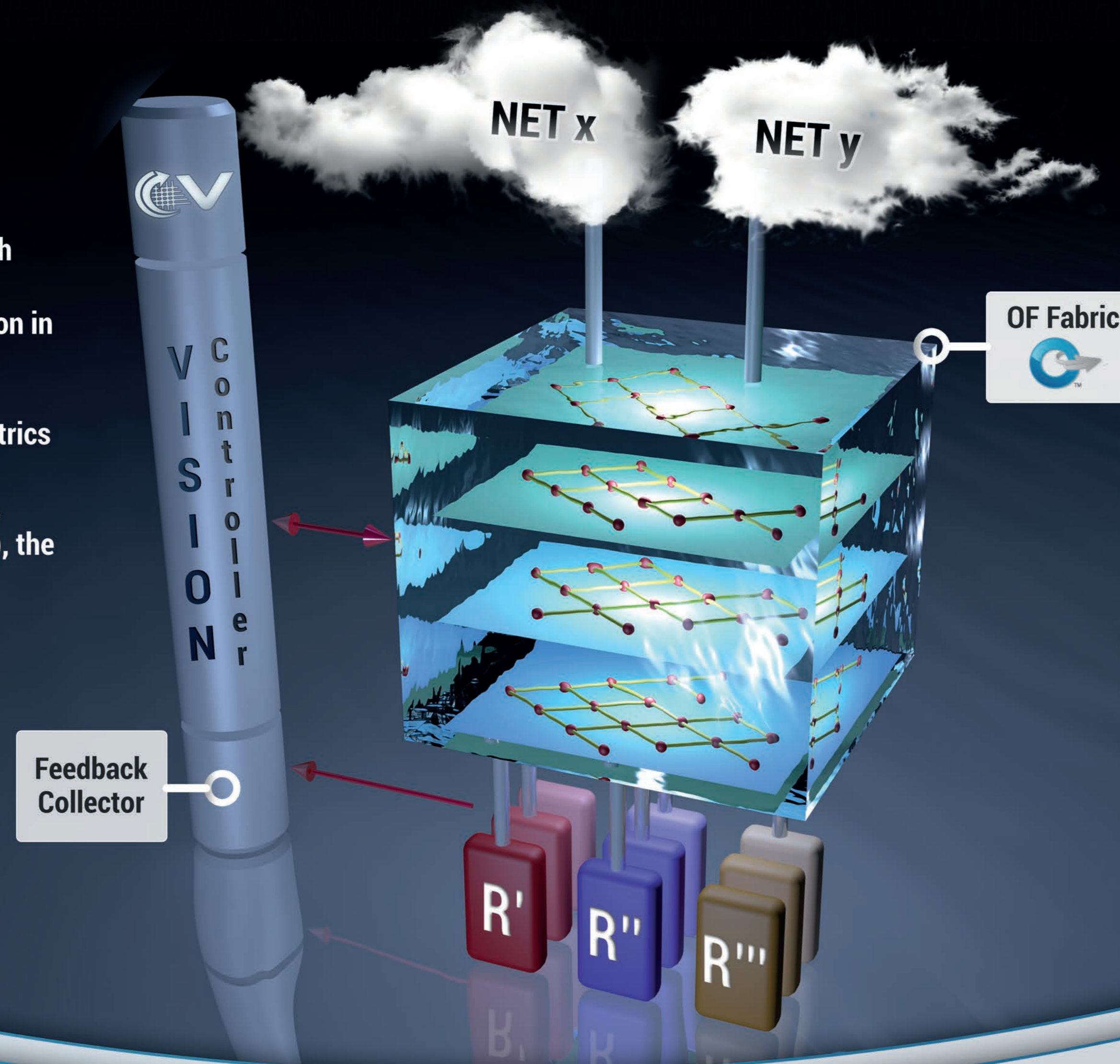
ViSION Application Overview

- The ViSION traffic orchestrator features a layered SDN architecture
    - The infrastructure layer consists of a fabric of interconnected OpenFlow enabled switches. In the ViSION context, it connects various networks to multiple sets of network resources.
    - The Control Layer is implemented using HP's Virtual Application Networks SDN Controller
    - The application layer sits on top and uses HP's northbound API for interacting with the controller. Multiple applications can be developed, and ViSION is one such example.
- ViSION's goal is to improve network resource utilization using a scale-out approach. It relies on the ability to perform flexible, customizable traffic classification and load balancing.
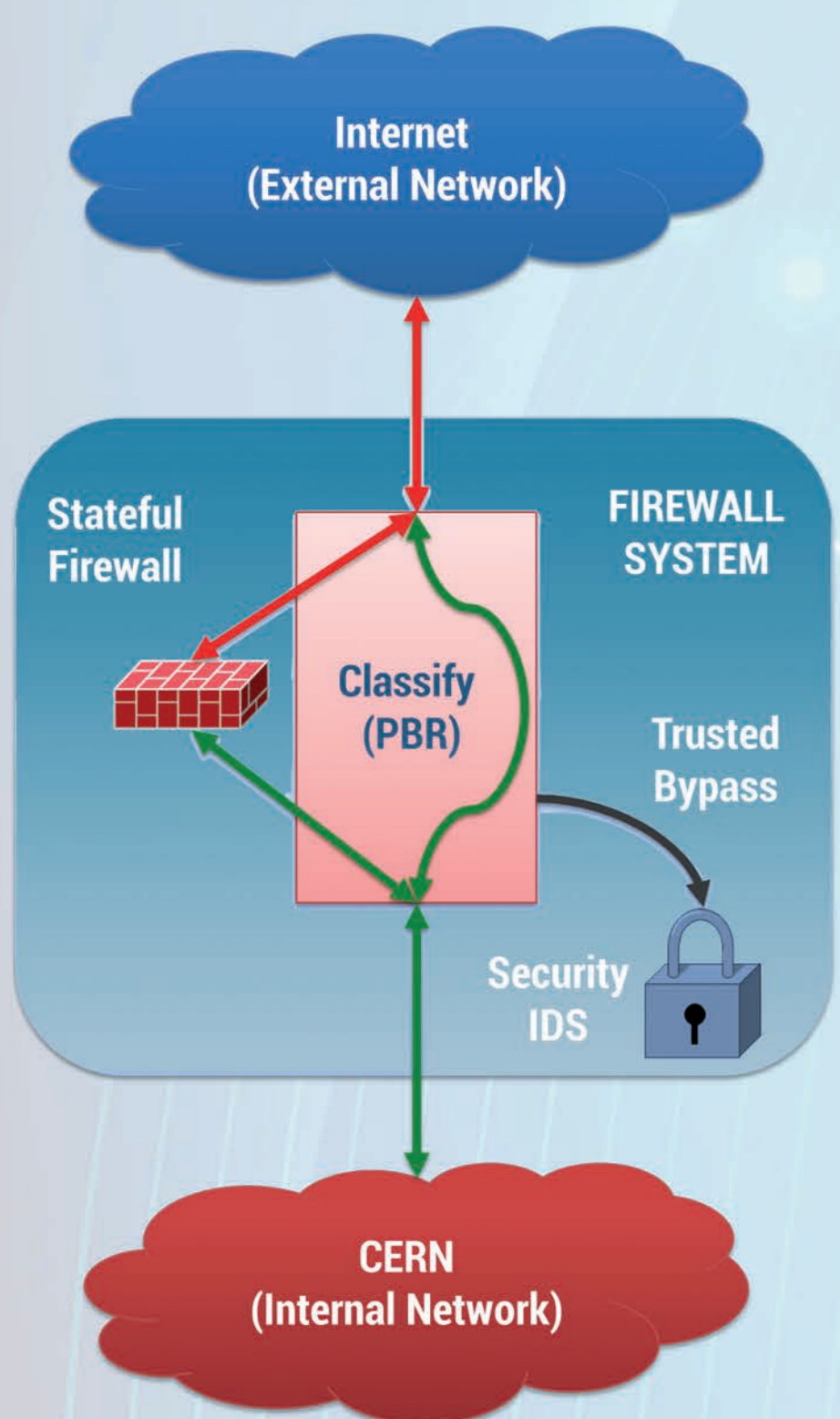
CERN's Firewall System – Scalability Issues

- CERN's external traffic is expected to increase
- With the successful running of LHC experiments, the current firewall system is stretched close to its limits.
- While trusted sites have direct access through a bypass implemented by means of a Policy Based Router, the rest of the traffic undergoes stateful inspection in dedicated firewall hardware.
- Stateful inspection is a resource consuming operation and scaling such a system is tedious and heavily dependent on the performance of the firewall.
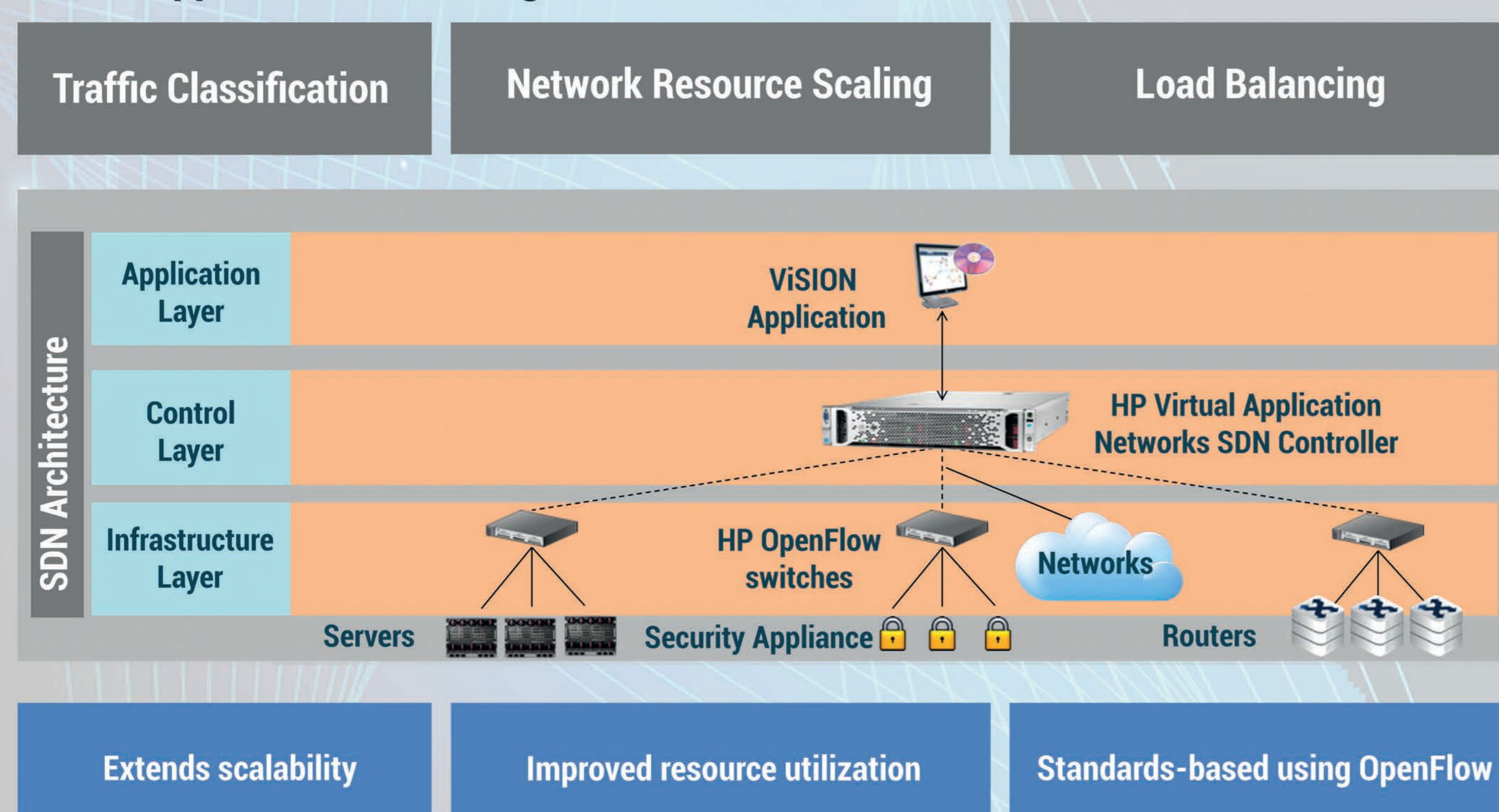
Openflow/SDN offers a promising alternative for scaling out stateful firewall inspection.
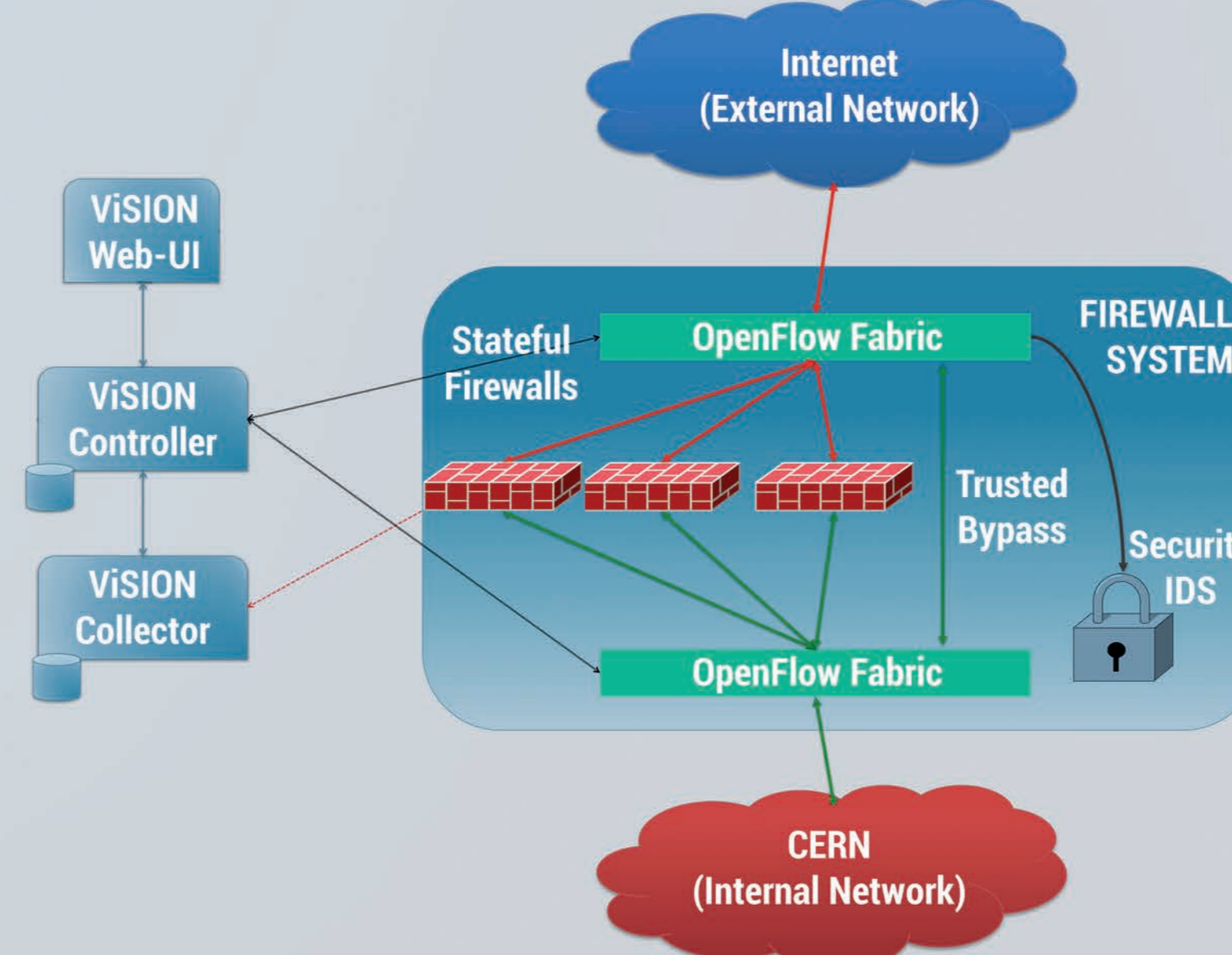
Scaling-out CERN's firewall using the ViSION traffic orchestrator

- A properly sized tier of firewalls is deployed in-between two OpenFlow fabrics.
- A single ViSION SDN controller takes synchronized traffic orchestration decisions in both fabrics, ensuring that both directions of the same flow are handled by the same firewall.
- Traditional networking equipment cannot perform such a synchronized traffic orchestration.
- Scale-out is straight forward: adding more firewalls in the tier increases the system performance in a linear fashion.
- A feed-back loop with information about the network and firewall farm utilization can be used to optimize the traffic orchestration.

ViSION Application Block Diagram

Traffic Classification | Network Resource Scaling | Load Balancing

SDN Architecture:
- Application Layer — ViSION Application
- Control Layer — HP Virtual Application Networks SDN Controller
- Infrastructure Layer — HP OpenFlow switches / Networks / Servers / Security Appliance / Routers

Extends scalability | Improved resource utilization | Standards-based using OpenFlow

Project progress timeline and outlook

February 2012
- Get up to speed with OpenFlow/SDN technology and state of the art research; HP kickoff visit;
- Identify areas where ViSION can bring value through SDN.

February 2013
- Finalized project scope: Traffic Orchestration;
- Orchestrator architecture design; endorsed by HP and CERN;
- Prototype development;
- Core framework functionality and UI;
- Test-bed setup using HP OpenFlow-enabled switches.

February 2014
- Consolidated and refined ViSION core framework;
    - Latest HP SDN framework and tools;
    - Service oriented core module implementation;
- Developed integrated system-testing environment;
- Developed health monitoring module;
- Wrap up.