programming SDN

5590: software defined networking

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TTLMAN 401B, R 17:30-20:00

overview

abstractions for SDNs

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rich abstractions for realizing the vision of SDN

- network-wide structure
- distributed updates
- modular composition
- virtualization
- formal verification

abstraction — network wide structure

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problems

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- example: spanning tree

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SDN solutions

- OpenFlow, P4 …
- programmable dataplane
  - rudimentary, thin-wrapper of the underlying hardware

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- Pyretic, Kinetic, PGA …
  - raise the level of abstraction
  - enable creation of sophisticated controller programs from smaller modules

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  - coordinate multiple applications simultaneously operating on the shared network state
- update abstractions
  - consistency semantics

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programmable dataplane — OpenFlow and P4

OpenFlow

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programmable network?

- GENI
  - nationwide facility are ambitious (and costly)

problems

commercial solutions

- too closed, inflexible

research solutions

- insufficient packet-processing performance, fanout (port-density)

OpenFlow approach

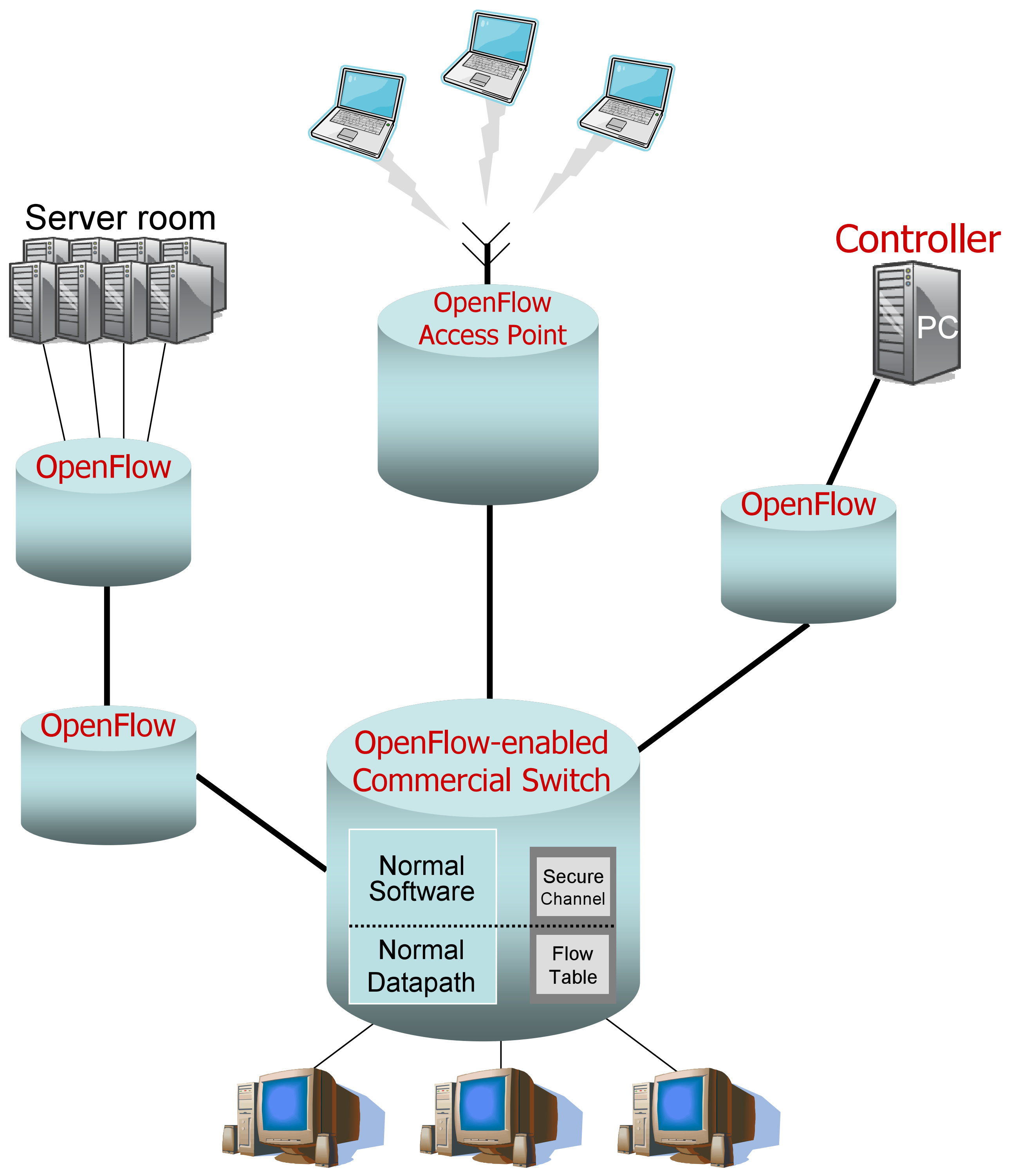
break vendor lock-in

- a pragmatic compromise
  - run experiments on heterogenous switches with unified interface
    - line rate, high port-density
  - vendors need not to expose internals of their switches

assure isolated experiments

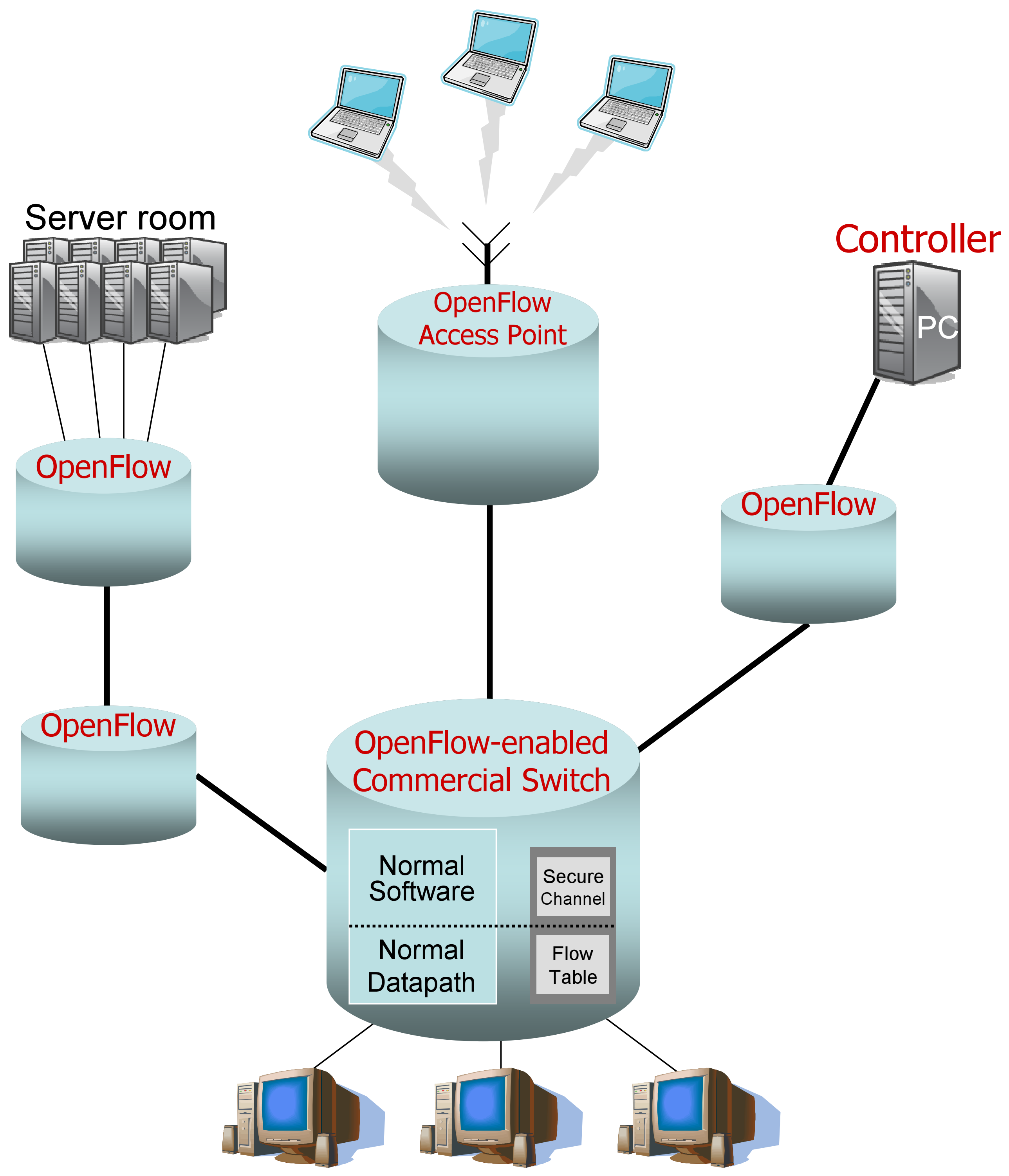
- pull out decision to a remote controller

OpenFlow overview



an open protocol to program different switches and routers

OpenFlow overview



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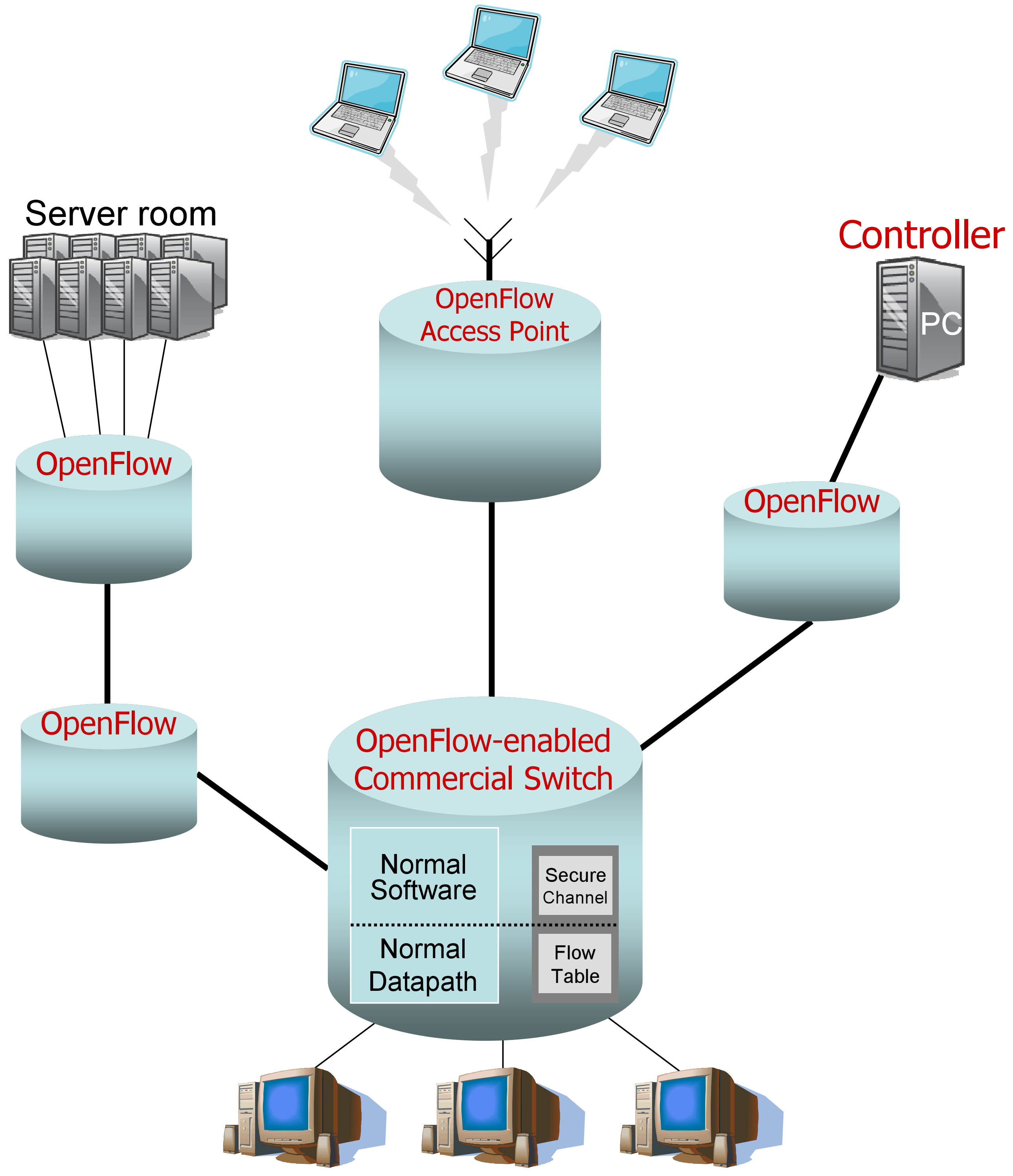

identify common functions

- flow-tables
  - implement FW/NAT/QoS, collect statistics
- secure channel to controller
- OpenFlow protocol
  - open, standard switch-controller communication

OpenFlow in action

goal: experiments in production network

- production traffic routed using some standard protocol
- Amy testing innovations on her isolated traffic

solution

- OpenFlow-enabled switch for production traffic
- controller assured to isolate Amy's traffic

from OpenFlow to P4

OpenFlow

- populate fixed-function switches with pre-determined set of header fields
  - grows from 17 to 41 (in 2014)
- inflexible?

from OpenFlow to P4

OpenFlow

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from OpenFlow to P4

OpenFlow

- populate fixed-function switches
- inflexible?

P4

- populate switches
- configure the switches
  - define and/or modify the functionality of the switches
  - define header fields and actions
- flexible?

from OpenFlow to P4

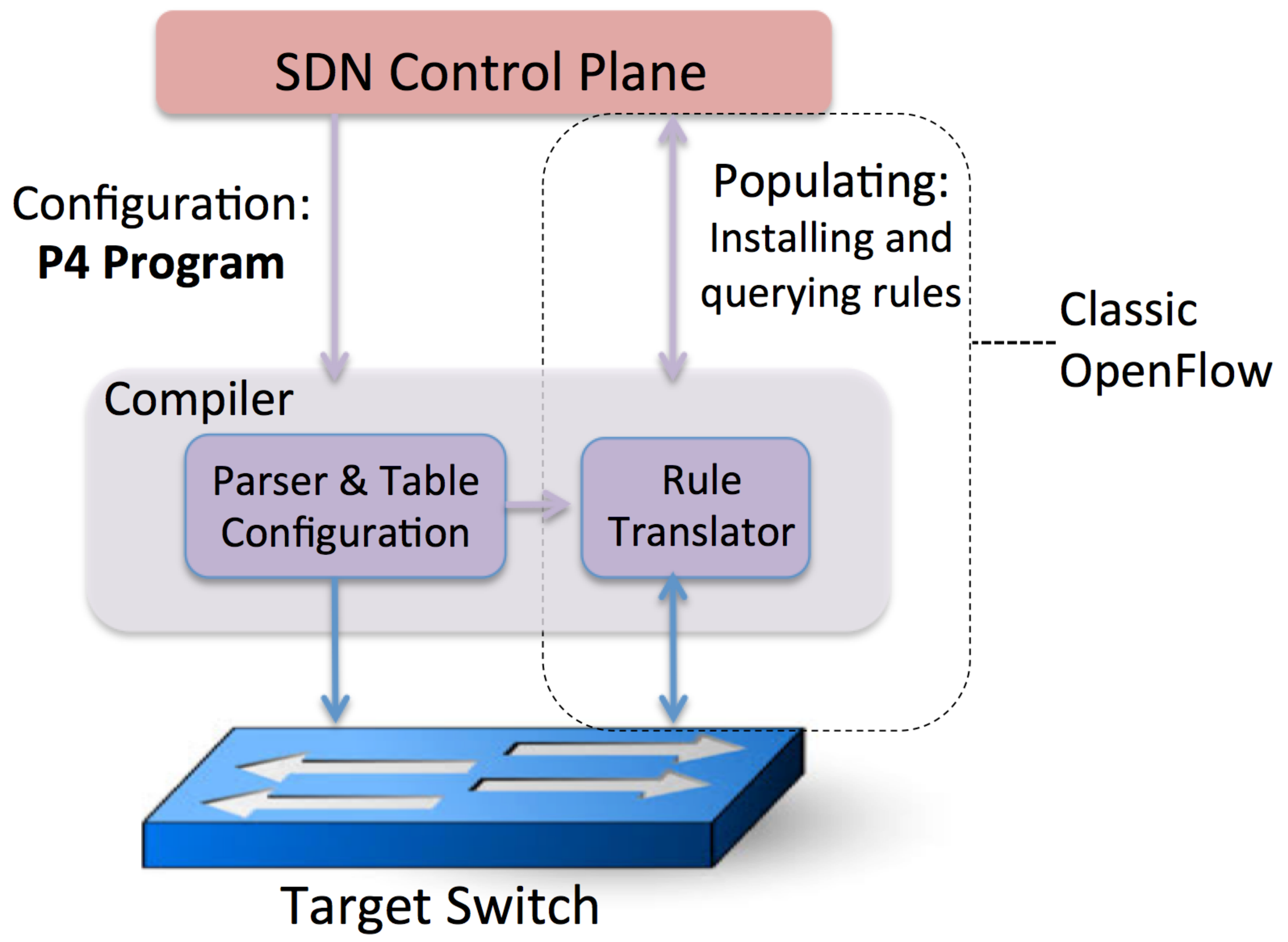
OpenFlow

- populate fixed-function switches

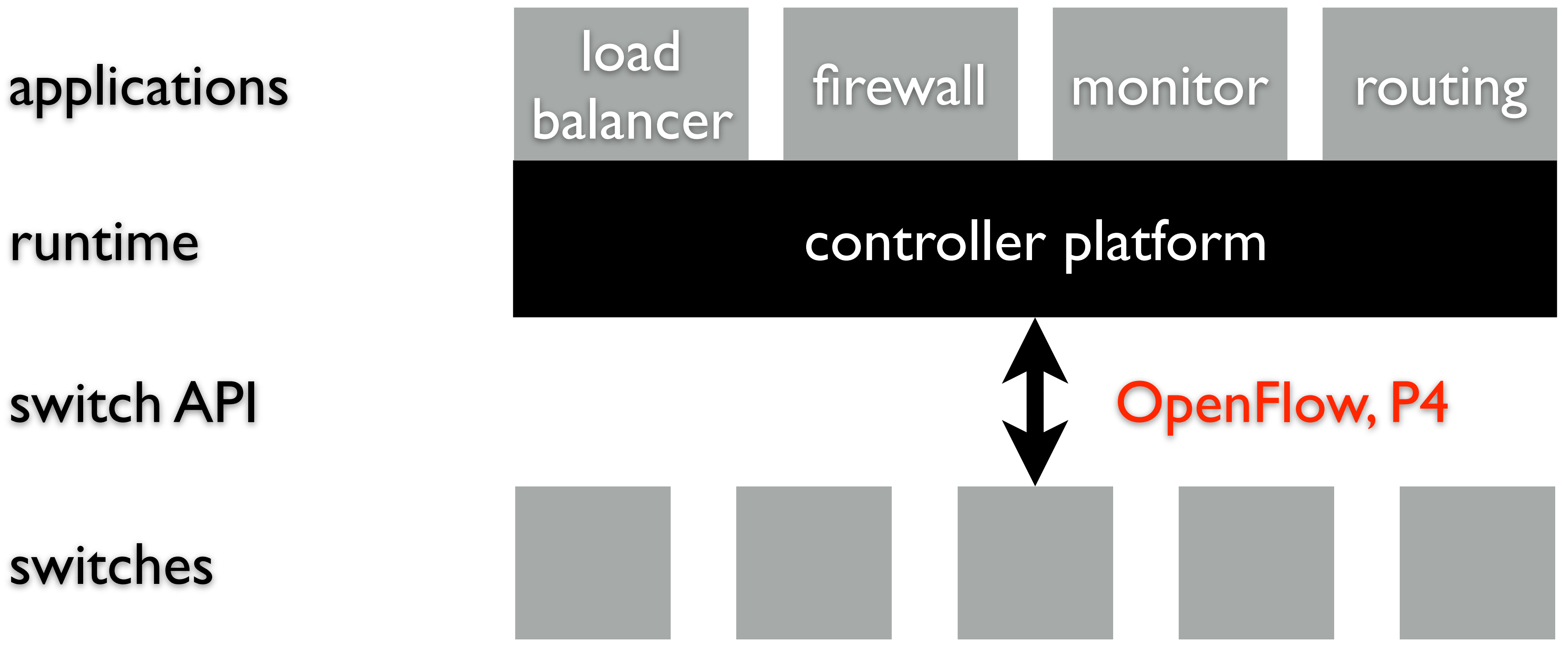
P4

- populate switches
- configure the switches

from OpenFlow to P4



P4 — towards fast reconfigurable packet-processing


applications
runtime
switch API
switches
load balancer
firewall
monitor
routing
controller platform
OpenFlow, P4