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FNSNF

Energy-efficient Data Center Networking

Jonas Fietz, Sam Whitlock, George Ioannidis, Katerina Argyraki, Edouard Bugnion

ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

1. Hardware vs. Software Network Switching

Hardware

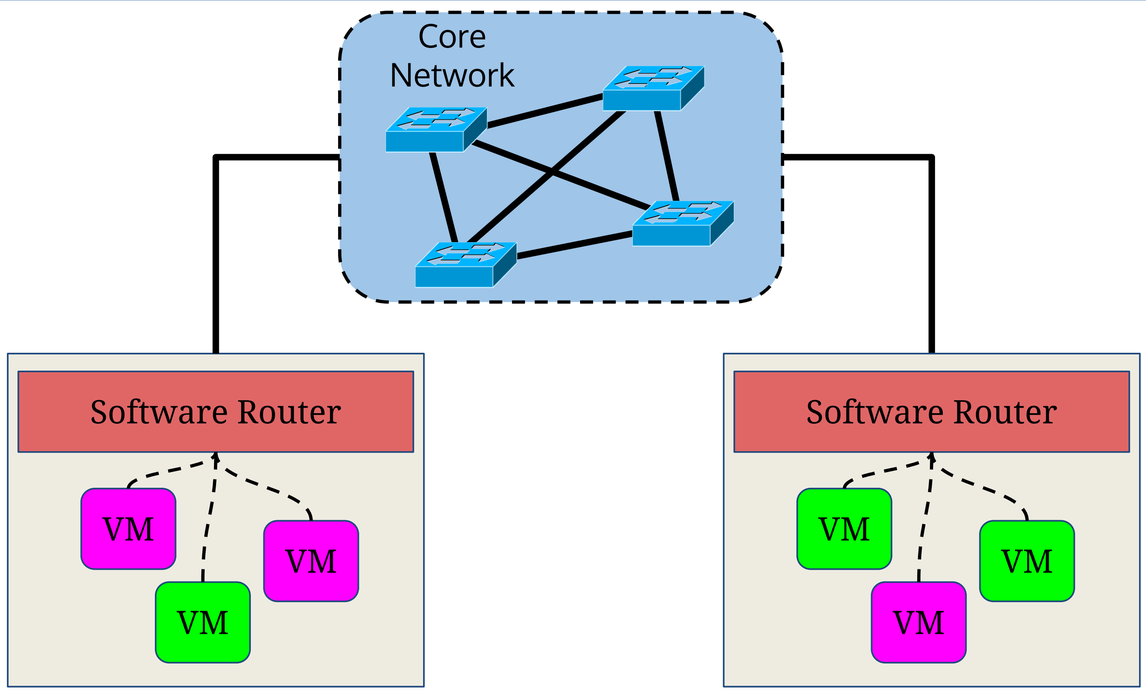
- ➔ Dedicated, special-purpose network silicon
- ➔ Pros: fast, energy-efficient { O(100ns) / packet }
  - ◆ One chip serves ~48 x 10Gbps ports
- ➔ Cons: fixed functionality
  - ◆ new features required new hardware

Software

- ➔ Servers running network protocols as software applications
- ➔ Pros: flexible, easily-upgradeable functionality
- ➔ Cons: slow, higher energy demand { O(10μs) / packet }
  - ◆ One CPU serves 2-4 x 10Gbps ports (at most)

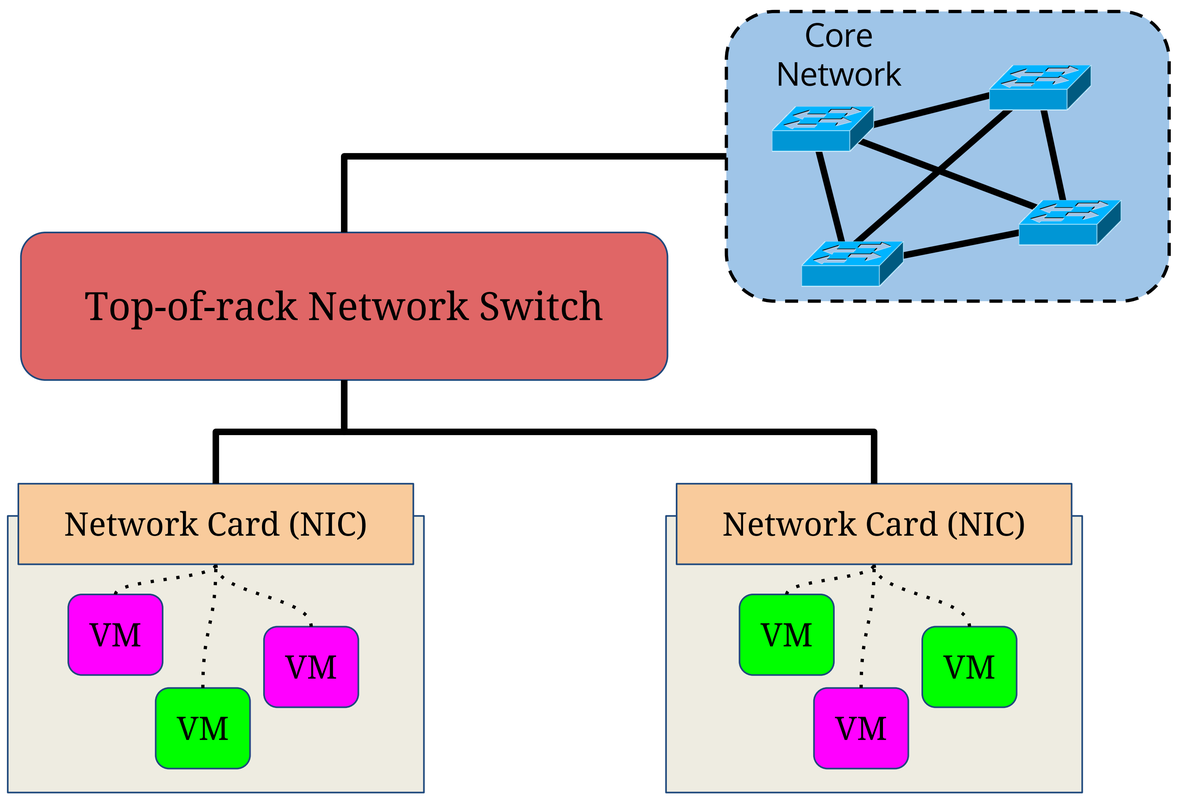
2. Software-defined Networking (SDN)

- ➔ Applications configure network *instead of humans*
- ➔ Demanded from cloud platforms (e.g. Amazon EC2)
  - ◆ SDN enables dynamic resource provisioning
- ➔ New protocols / functionality needed
- ➔ Status quo: software switching for SDN
  - ◆ Necessary at beginning for flexibility
- ➔ Lots of cycles (energy) to process a packet O(10k)
- ➔ Latency penalty for every packet!



3. Our Solution: Hybrid Software-Hardware Data plane

- ➔ Servers put unprocessed packets on the wire
- ➔ Accelerate software routing with hardware
- ➔ Run a traditional software router on a small computer in the switch chassis (a.k.a. packet processor / supervisor engine)
- ➔ Router control plane inserts “hot” rules into switch hardware.
- ➔ *Hardware is a cache on the most frequently used rules in the data plane.*
- ➔ Advantages
  - ◆ Flexibility of software *with the speed of hardware*
  - ◆ More efficient hardware (switch vs. server)
- ➔ Can replace 40 software routers with 1 hardware router



4. Results and Ongoing Research

- ➔ Results
  - ◆ Latency decreases when switching from software to hardware routing
- ➔ Ongoing
  - ◆ Understanding hybrid data plane behavior in a data center setting
  - ◆ Integrating hybrid data plane with existing data center software (e.g. OpenStack)