COMP9332 Network Routing and Switching

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Content Addressable Memory (CAM)
Software Defined Networking (SDN)

Lecture overview

This lecture provides a high-level introduction to the concepts and applications of CAM and SDN.

Content Addressable Memory (CAM)

Binary CAM

Ternary CAM (TCAM)

Issues Random Access Memory (RAM)

- With RAM, the OS needs to read memory contents address by address
- For large routing table, longest prefix match would be painfully slow with RAM
- New mechanisms are needed to speed up table look up in network routers

Content Addressable Memory (CAM)

- With CAM, OS can examine the contents of the entire memory (all memory locations or addresses) in a single cycle (operation)
- Therefore, if we are trying to find out whether a given content is stored somewhere in the memory, we can do this in one operation, instead of reading address by address
- CAM there is considerably faster than RAM, but is also very expensive
- CAMs are used in routers, but not in consumer PCs or mobile devices

Binary CAM

- Can search for binary contents
- Example: search for 10100111
- In one operation, the OS will find out the locations where this content is stored
- Binary CAM cannot handle 'masks' efficiently

Ternary CAM (TCAM)

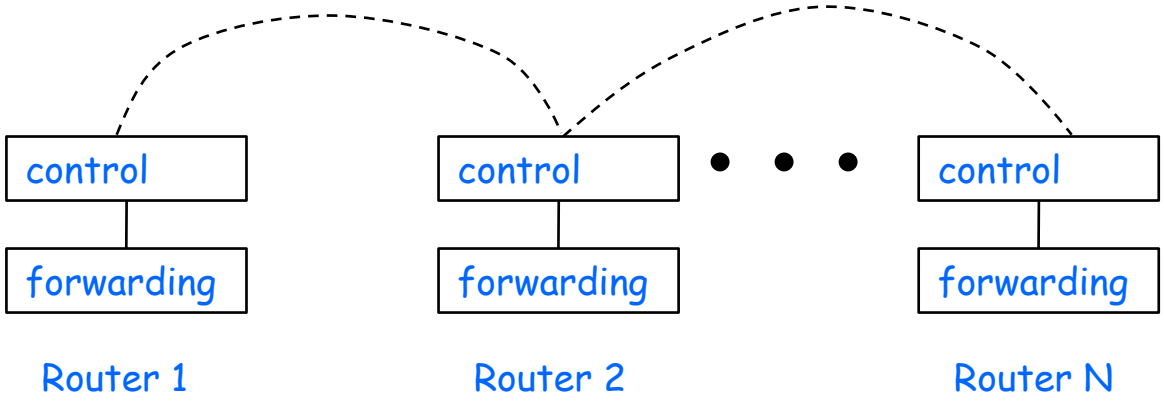
- Can handle '1', '0', and 'X' ('X' means 'don't care')
- Example of masks: 10100XXX (last 3 bits are masked)
- Routers match network addresses, i.e., masks host-id bits
- Routers therefore need TCAMs
- Most routers store entire routing table in TCAMs
  - Longest prefix match completed in a single memory cycle

Software Defined Networking (SDN)

OpenFlow

Existing Routing Infrastructure

- Each router is responsible for generating control intelligence as well as implementing data packet forwarding based on generated control intelligence
- Distributed control

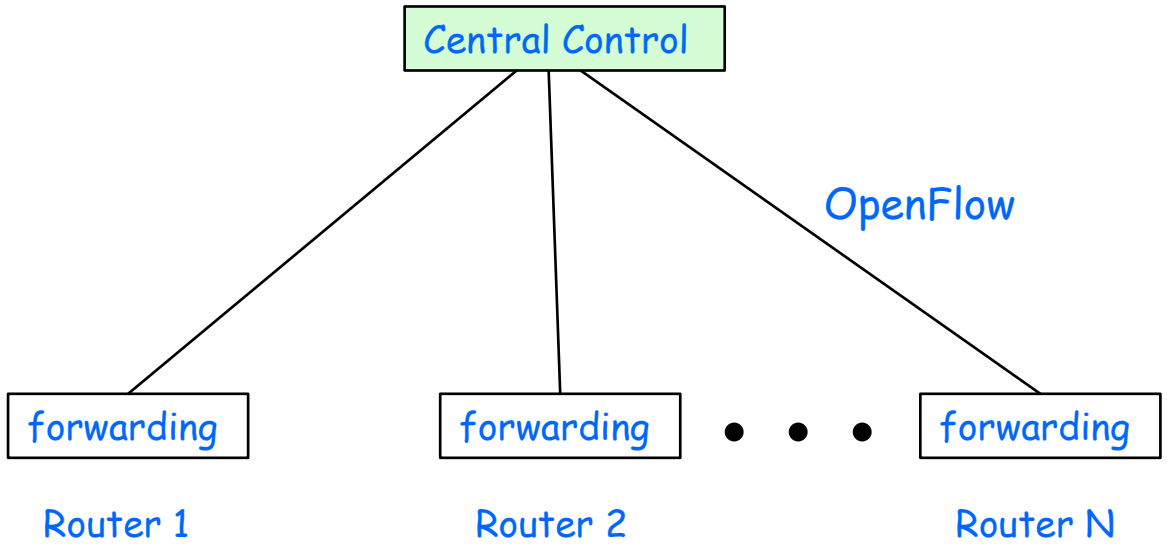


Issues with Existing Routing Infrastructure

- Complex hardware boxes (due to control logic)
  - Expensive
  - Reconfiguration needed for each box (labour intensive for dynamic reconfiguration for load balancing and traffic engineering
- Not suitable for large, complex, dynamic, and multi-tenanted networks, such as data centres and clouds
- New mechanisms are needed to quickly reconfigure all routers in a given network, preferably from a central adminstration
- SDN appears to be the solution
  - Very recent concept, but achieving rapid acceptance from vendors and industry

Routing Control and Forwarding with SDN

- Each router is responsible only for forwarding data packets
  - Low cost hardware, does not require per box control reconfiguration
- Control decisions for the entire network is made at centrally
  - Central controller transfers software controlled control logic to each router dynamically



OpenFlow

- OpenFlow is a standard specifies how SDN routers communicate with a central control server.
- Many vendors are making their swicthes and routers OpenFlow compatible
- Using OpenFlow, a central controller tells a router how to treat certain type of packets (routing table entries)
- Behaviour of routers in a network can be rapidly modified from a central server
  - Useful for load balancing in response to rapid changes in network data paths etc.