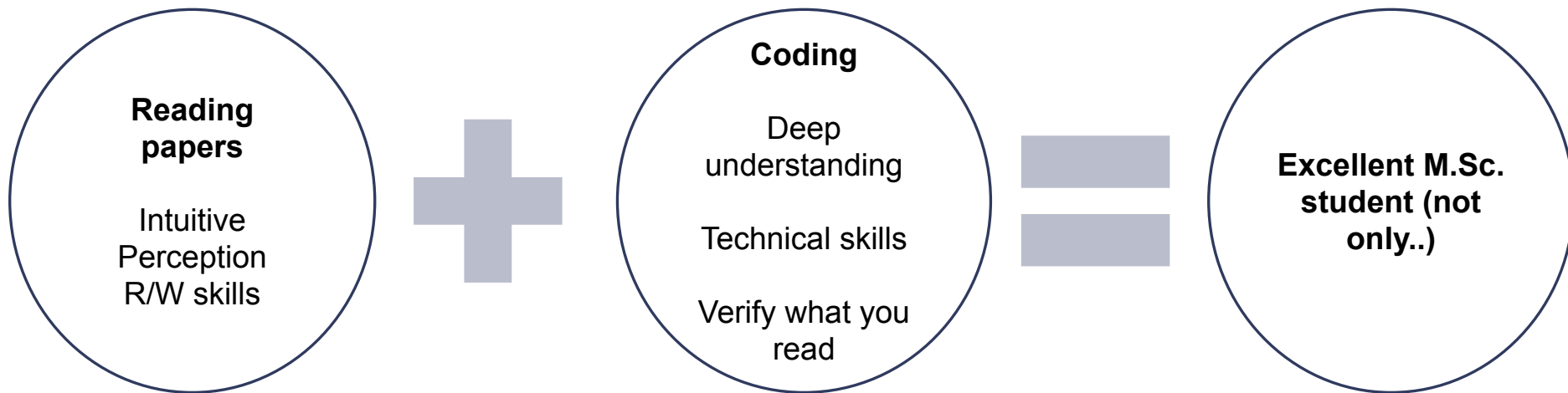

IK2220 SDN & NFV

Introduction

Prof: Dejan Kostic	(dmk@kth.se)
TAs: Tom Barbette	(barbette@kth.se)
Alireza Farshin	(farshin@kth.se)

Introduction



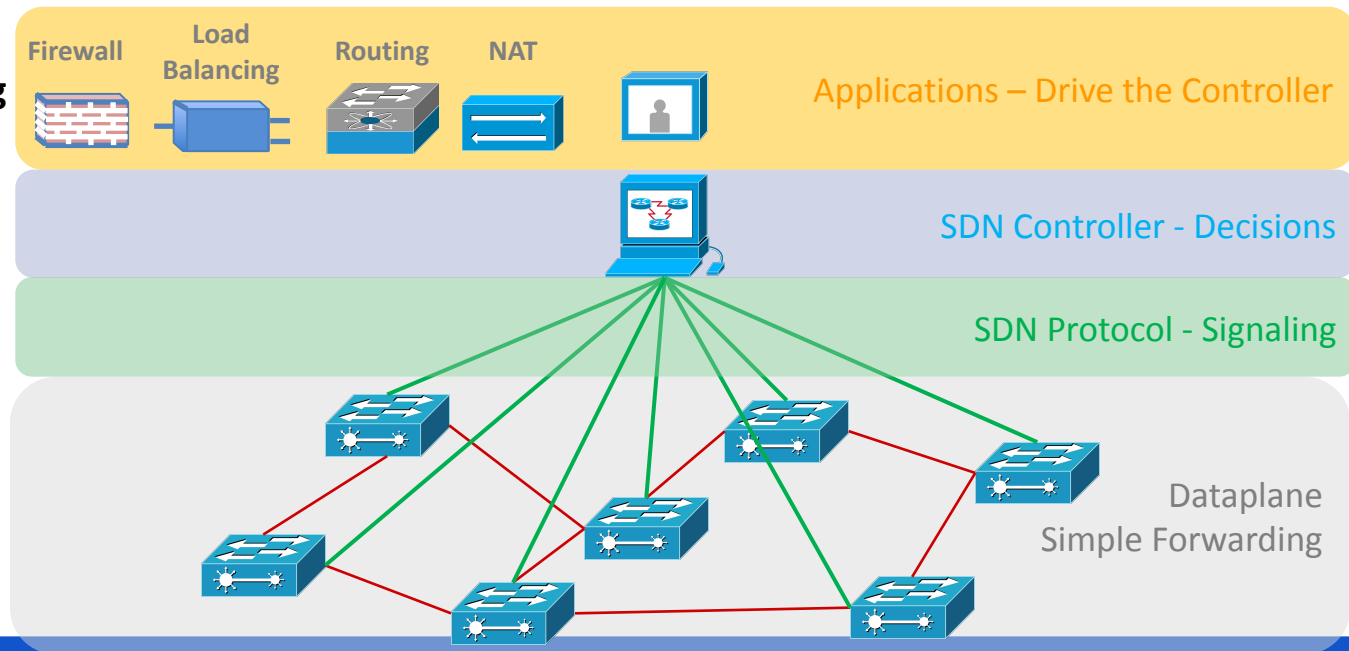
SDN in a Nutshell



Modern Network Management

Software Defined Networking

- Keep the switch simple.
- Separate control from data plane.
- Controller and switches communicate over a protocol (e.g., OpenFlow).
- Controller makes the decisions.
- Switches install the rules dictated by the controller.





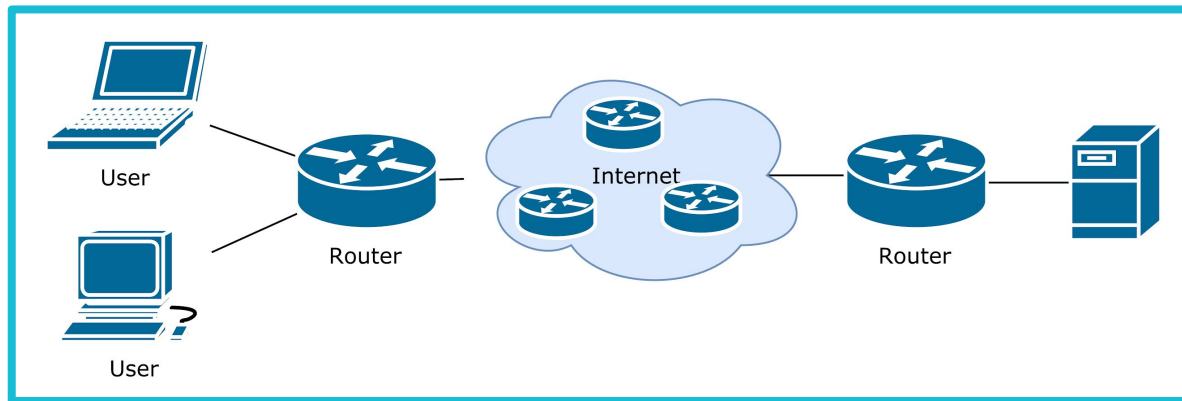
Assignment - Phase I

- Become familiar with SDN
 - Write your own dataplane topology and SDN controller.
- Learn useful tools
 - Mininet, OpenVSwitch, POX Controller, Wireshark, tcpdump, and iperf.
- Deadline: 18th April

NFV in a Nutshell

The Internet

- Computers interconnected by router and switches



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- ```
graph LR; User1[User] --- CPE_Router[Router]; CPE_Router --- ISP_Network[ISP Network]; ISP_Network --- Ingress_Router[Ingress Router]; Ingress_Router --- Egress_Router[Egress Router]; Egress_Router --- Internet((Internet)); Datacenter[Datacenter] --- DC_Router[Router]; DC_Router --- Internet;
```
- The diagram illustrates a network topology for Internet access. On the left, two 'User' icons (a laptop and a desktop PC) are connected to a 'CPE' (Customer Premises Equipment) box containing a 'Router'. This CPE Router is connected to the 'ISP Network' box, which contains an 'Ingress Router' and an 'Egress Router'. The Ingress Router is connected to the Egress Router. The Egress Router is connected to a cloud icon labeled 'Internet'. Below the ISP Network, there is a 'Datacenter' box containing a server icon and a 'Router'. The Datacenter Router is connected to the 'Internet' cloud.

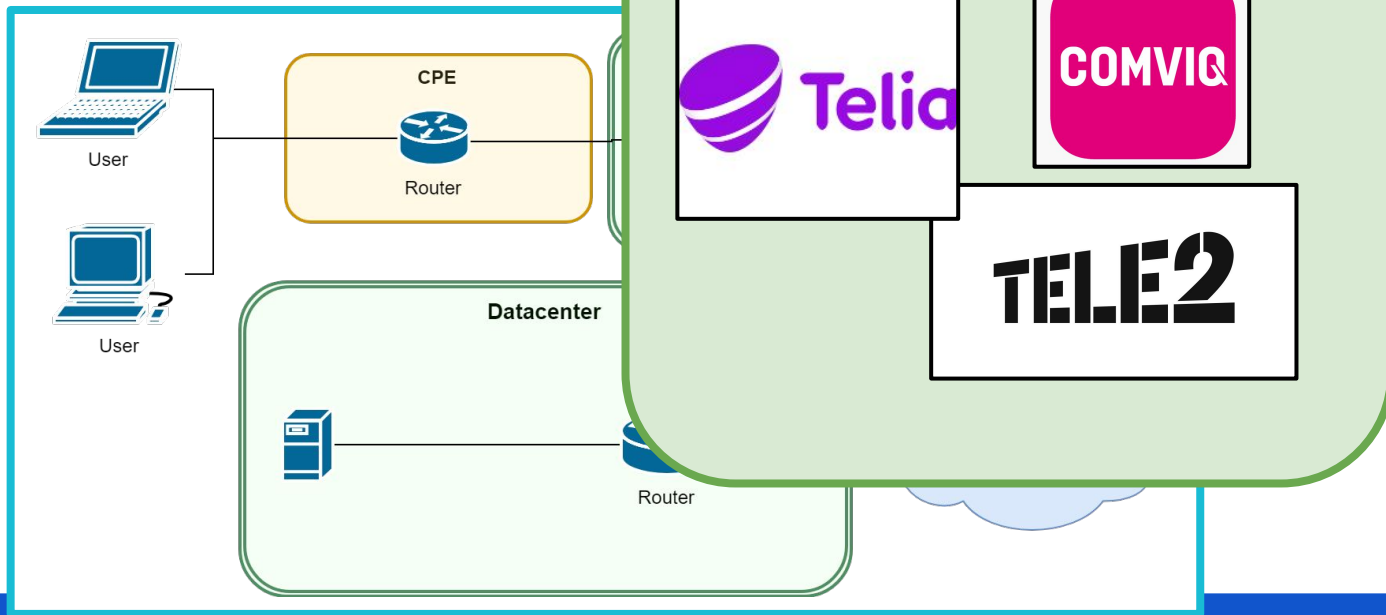
● A



Router



Internet



- 
- The diagram illustrates a cloud network architecture. On the left, a green rounded rectangle labeled "Datacenters" contains the logos for Google, Facebook, Amazon EC2, and Azure. To the left of this rectangle, two laptop icons represent "User" devices. To the right, a light green rounded rectangle labeled "Network" contains an "Egress Router" (a blue circular router icon). A line connects the "Datacenters" area to the "Egress Router". Below the "Network" box, a blue cloud icon represents the "Internet", connected to the "Egress Router".

- 
- ```
graph LR; User1[User] --- CPE_Router[Router]; CPE_Router --- Ingress_Router[Router]; Ingress_Router --- Egress_Router[Router]; Egress_Router --- Internet((Internet)); Datacenter[Datacenter] --- Internet;
```
- The diagram illustrates a network topology for Internet access. On the left, two 'User' icons (a laptop and a desktop PC) are connected to a 'CPE Router' (a blue router icon) inside a yellow box labeled 'CPE'. This router is connected to an 'Ingress Router' (a blue router icon) inside a green box labeled 'ISP Network'. The 'Ingress Router' is connected to an 'Egress Router' (a blue router icon) also within the 'ISP Network' box. The 'Egress Router' is connected to a blue cloud icon labeled 'Internet'. Additionally, a 'Datacenter' (a server rack icon) is connected to the 'Internet' cloud. The 'Datacenter' is located inside a green box labeled 'Datacenter'.

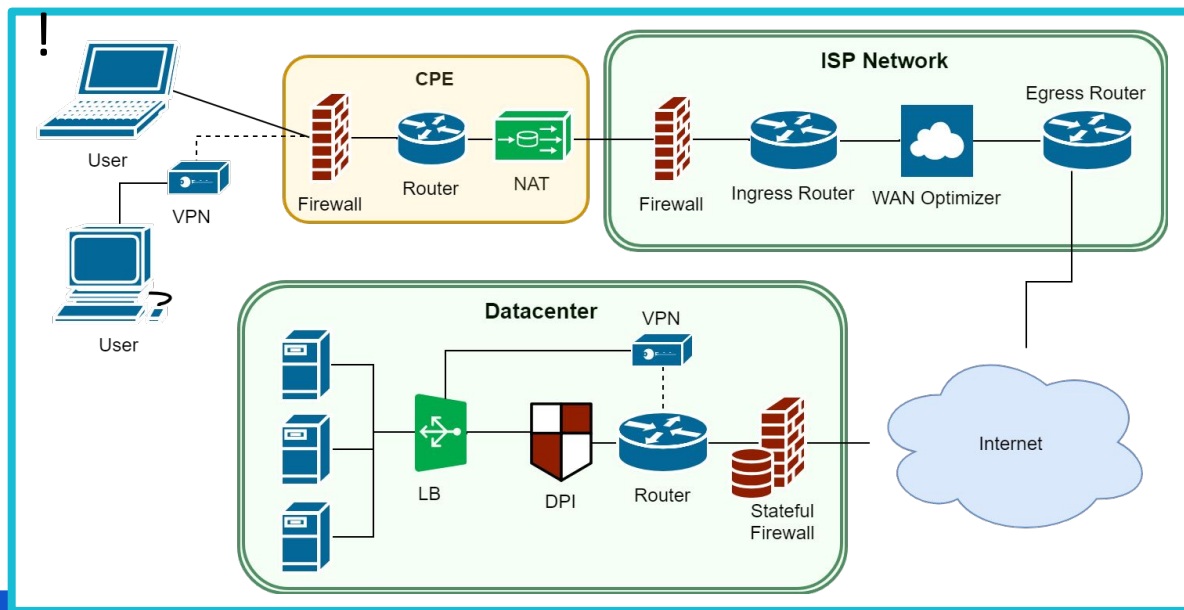
-
- The diagram illustrates a network architecture with the following components and connections:
- Users:** Two laptops labeled "User" are connected to the CPE network.
 - CPE (Customer Premises Equipment):** A yellow rounded rectangle containing a "Firewall" (brick wall icon) and a "Router" (blue circle with four arrows).
 - ISP Network (Internet Service Provider Network):** A green rounded rectangle containing a "Firewall" (brick wall icon), an "Ingress Router" (blue circle with four arrows), and an "Egress Router" (blue circle with four arrows).
 - Datacenter:** A green rounded rectangle containing a server icon, a "Router" (blue circle with four arrows), and a "Stateful Firewall" (brick wall icon with a database cylinder below it).
 - Internet:** A blue cloud icon labeled "Internet".
- Traffic Flow:** The flow starts from the "User" laptops, passes through the CPE Firewall and Router, then through the ISP Network Firewall and Ingress Router, and finally through the ISP Network Egress Router to the Internet cloud. The Datacenter is also connected to the Internet cloud.

-
- The diagram illustrates a network topology for traffic flow. On the left, two 'User' devices (a laptop and a desktop PC) are connected to a 'CPE' (Customer Premises Equipment) box. The CPE box contains a 'Firewall' and a 'Router'. The CPE is connected to an 'ISP Network' box. The ISP Network box contains a 'Firewall', an 'Ingress Router', and an 'Egress Router'. The Egress Router is connected to a 'Datacenter' box. The Datacenter box contains three server racks, a 'LB' (Load Balancer), a 'Router', and a 'Stateful Firewall'. The Datacenter is connected to the 'Internet' cloud.

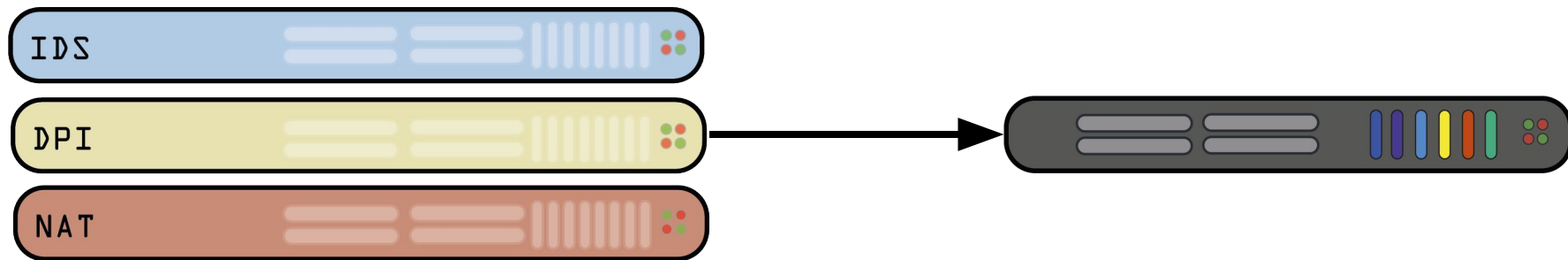
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- The diagram illustrates a network architecture with the following components and connections:
- Users:** Two desktop computers labeled "User" are connected to the CPE network.
 - CPE (Customer Premises Equipment):** A yellow box containing a Firewall, Router, and NAT.
 - ISP Network:** A green box containing a Firewall, Ingress Router, and Egress Router.
 - Datacenter:** A green box containing a Load Balancer (LB), Router, and Stateful Firewall.
 - Internet:** Represented by a blue cloud.
- Traffic Flow:**
- Users connect to the CPE Firewall.
 - Traffic passes through the CPE Router and NAT.
 - Traffic enters the ISP Network through the Firewall and Ingress Router.
 - Traffic exits the ISP Network through the Egress Router.
 - Traffic enters the Datacenter through the Stateful Firewall.
 - Traffic passes through the Datacenter Router and Load Balancer to the servers.

The Internet

- [Sherry12] $\frac{1}{3}$ of network equipments are MiddleBoxes



Network Function Virtualization

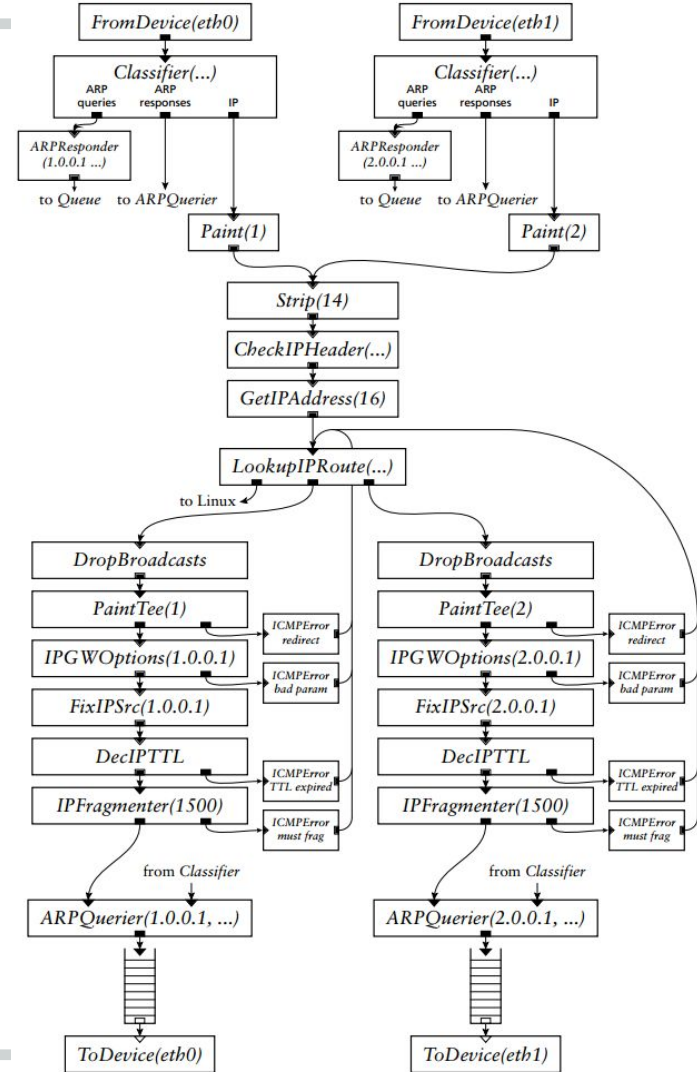


Specialized, inflexible,
expensive boxes

General purpose software

The Click Modular Router

- NFV router only at first
- Many more functions over the last decades





Assignment - Phase II

- Become familiar with NFV
 - Implement basic network functions.
- Learn
 - About Click.
 - How the OS networking stack works.

- Deadline: 23th May

Ready?
Make groups of up to 4 students
Until next week (31th March)

Thank you!

