

FINe: Future (Inter)Net(works)

The day by day of the course:

What we did

What we learned

What we will do today

October 14, 2020 (i)

- ✓ What did we do last Tuesday (October 7)?
 - Second item of Chapter 2
(Lecturer: Prof. Jordi Perelló)
 - Introduced SDN¹ the Emerging technology for implementing the control plane of the future networks
 - Introduced the OpenFlow Architecture
 - Introduce dthe NFV² concept
 - Started the third item of Chapter 2
(Lecturer: Dr. Fernando Afgraz)
 - SDN on Optical Networks and Data Centers: Two case studies
 - Launched the second panel session
 - On a Tutorial paper on ASON Automatically Switched Optical Networks

¹⁾ SDN: Software Defined Networking

²⁾ NFV: Network Functions Virtualization

October 14, 2020 (II)

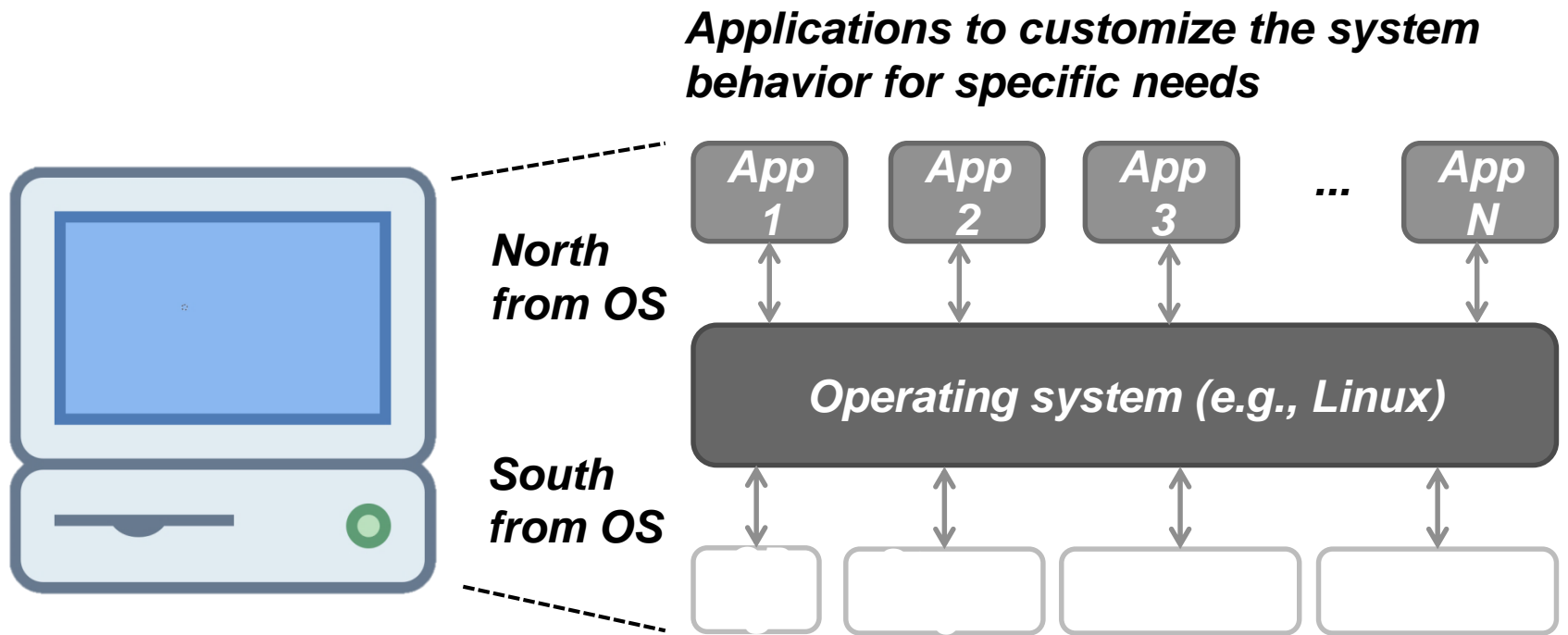
✓ What did we learn/refresh/understood?

- About SDN and OpenFlow

- *SDN aims to counteract some limitations current networks operation*
 - Problematic vendor-specific configuration procedures
 - Inconsistencies of distributed control protocols
 - ...
- *SDN can be seen as an analogy of a computer OS, but operating over a network domain*
- *OpenFlow is the most widely used standard protocol for communicate the SDN controller and the Network Devices*
 - Initial OpenFlow main goal was to make Ethernet networks, which are native connectionless, able to operate in connection oriented mode.
 - ... as MPLS do with IP networks

SDN in analogy with a computer OS

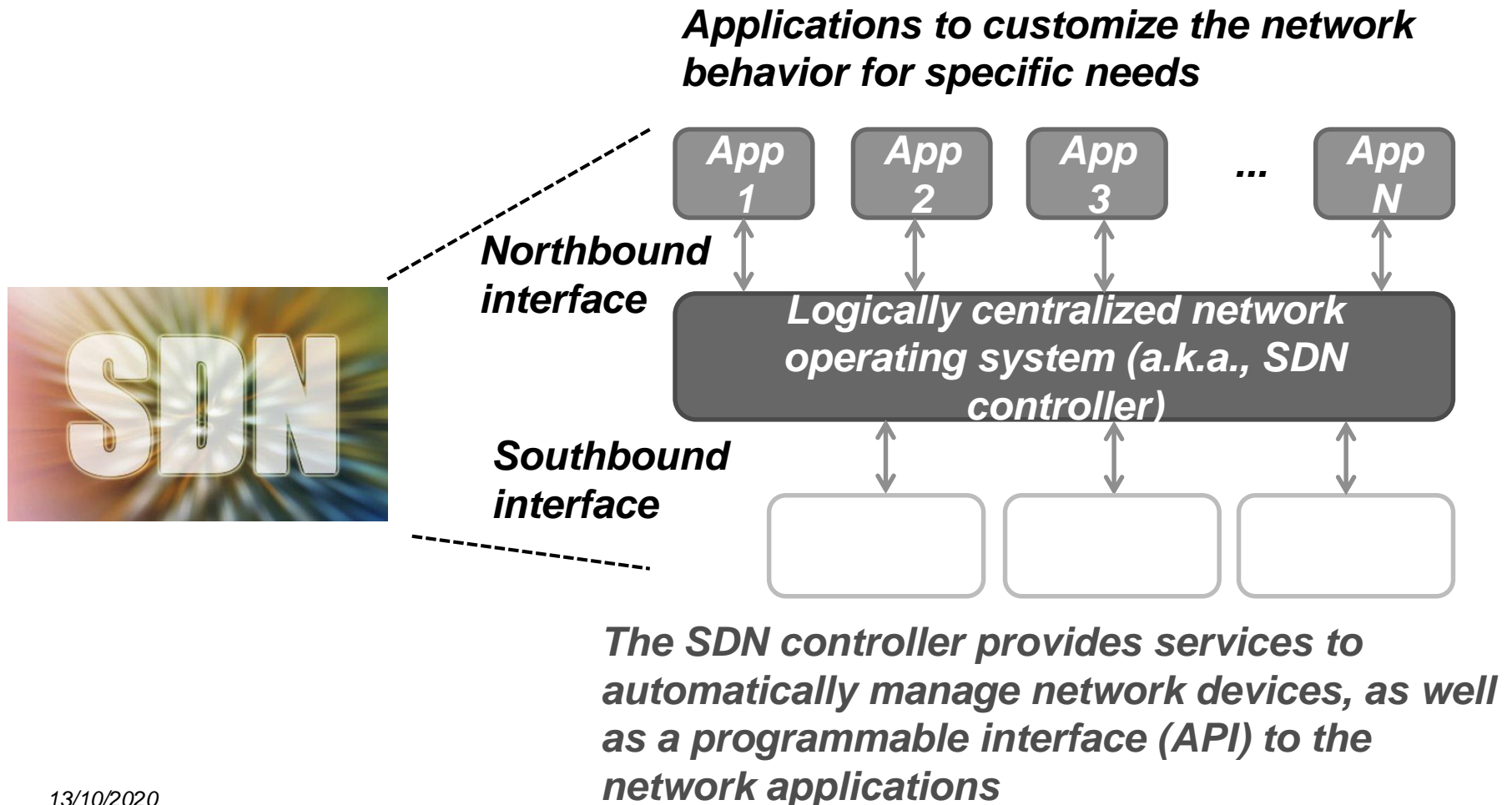
- The computer operating system model can be drawn in three basic layers: hardware, operating system and applications



The OS can be seen as a middleware permitting applications to access HW resources, based on policies

SDN in analogy with a computer OS

- Similarly, the SDN model can also be split into 3 different layers:



October 14, 2020 (ííí)

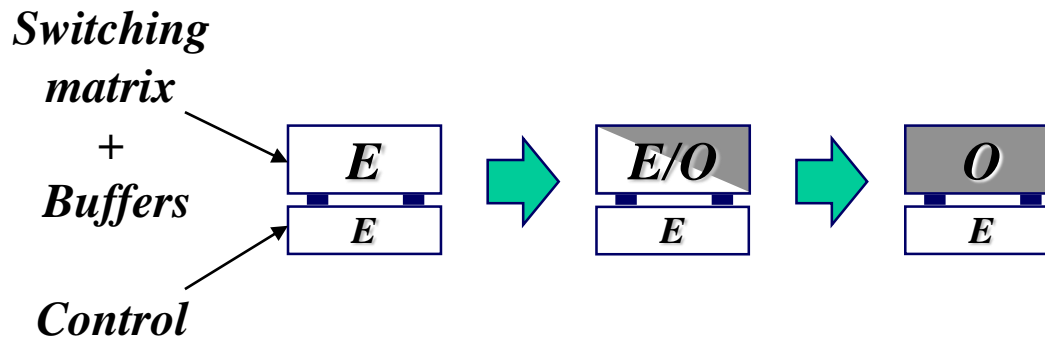
- ✓ What did we learn/refresh/understood?
 - About NFV
 - NFV consists of replacing specialized network appliances (like firewalls, load balancers, routers, etc.) with software running on VMs
 - SDN and NFV complement each other:
 - VNFs running on VMs in different servers can be connected over an SDN network to build an end-to-end service chain
 - Orchestrator is then required to coordinate both SDN and NFV
 - That the LIGHTNESS project was about designing a novel interconnection network architecture for *intra* data center network (DCN)
 - Based on both Optical Circuit Switching and Optical Packet Switching technology
 - Leveraging SDN and OpenFlow solution/specs

October 14, 2020 (iv)

- ✓ What will we do today?
 - Finishing the third item of Chapter 2
(Lecturer: Dr. Fernando Afgraz)
 - SDN on Optical Networks and Data Centers: Two case studies
 - Run the second panel session
 - On a Tutorial paper on ASON Automatically Switched Optical Networks
 - Erlang B Calculator
 - Launch the second set of questions
 - Devoted to Chapter 2
 - Deadline for posting the questions in ATENEA: October 21 (11:00 am.)
 - Evaluation period: From October 21 to October 28 (11:00 am.)
 - Technical reports assignment (tentative)

Packet Switching vs. Optical Packet Switching

- Electronic to optical packet switching evolution:















- Optical Packet Switches main characteristics:
 - Both switching matrix and buffers are optical
 - Bit rate independent payload (transparent bit rate)
 - Headers still processed electronically

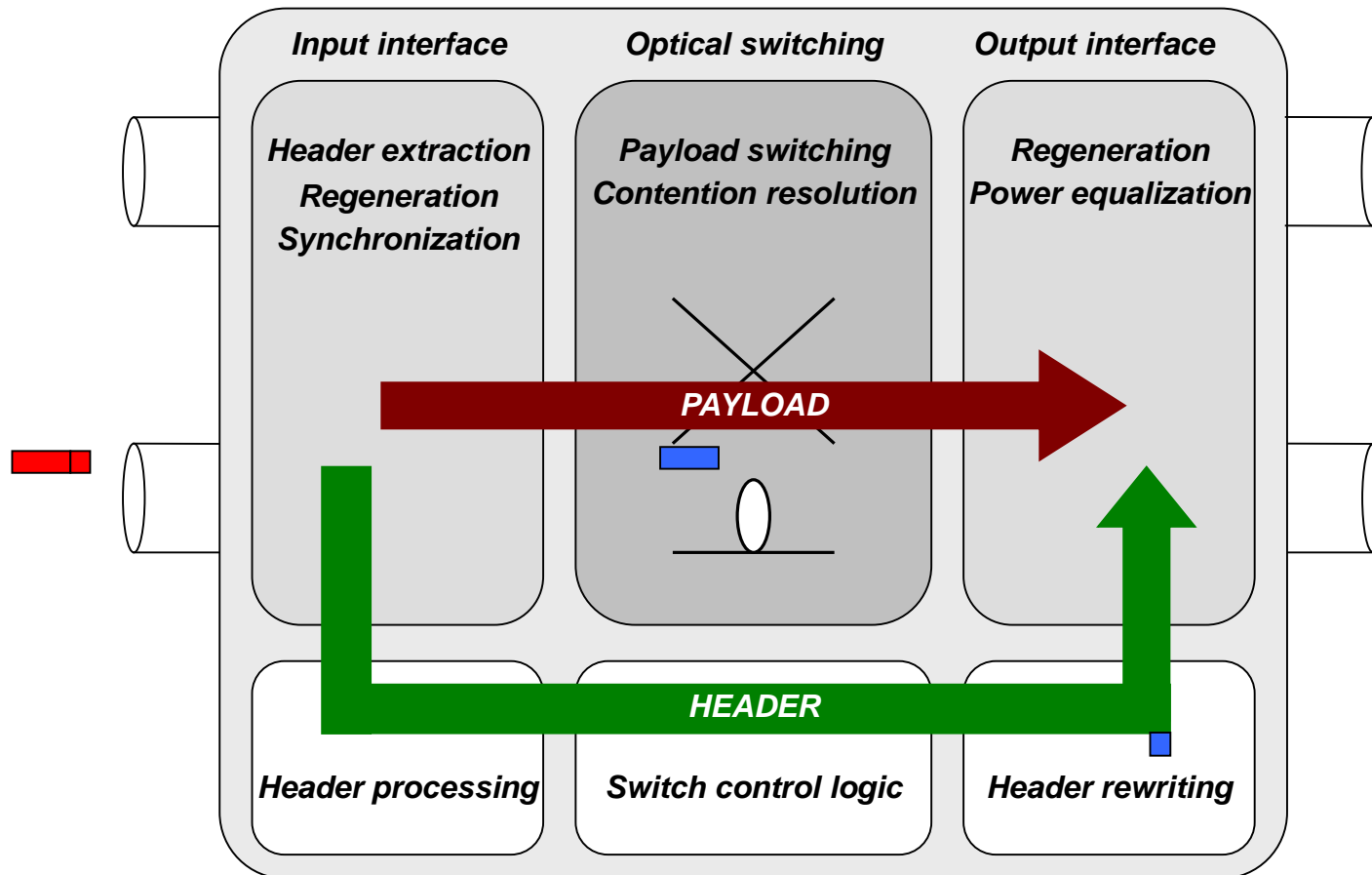
	Elec	Elec-Opt	Opt
Sw. Capacity	low	medium	high
Complexity	high	medium	low
Memory Dim.	high	high	low
Transparency	no	no	yes

Packet Switching vs. Optical Packet Switching

- Electronics are reacting to fill the opto-electronic capacity GAP:
 - > 1 Tbps throughput is reachable
- Photonic technology is also evolving fast
 - Solves the opto-electronic capacity GAP
 - Three dimensions: Space, Time, Wavelength

<i>Dimensio</i>	<i>Space</i>	<i>Time</i>			<i>Wavelength</i>	
<i>n_o</i> <i>Function</i>	<i>Switch</i>	<i>Mux</i>	<i>Syn/Asyn</i>	<i>Storage</i>	<i>Mux</i>	<i>Conv.</i>
<i>Electronic</i>						
<i>Optical</i>						

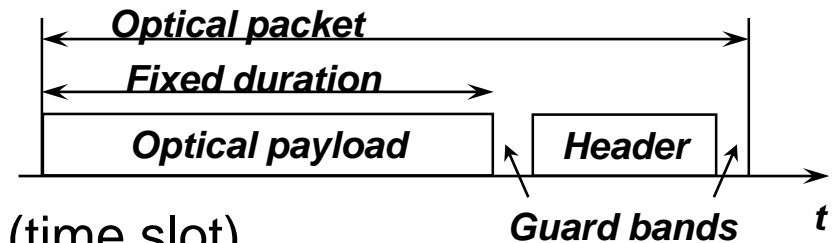
Optical Packet Switching operation



Optical Packet Switching operation



- Optical packets:
 - Electronic header
 - Optical transparent payload (time slot)



- Optical buffers?