“Cloud & Datacenter Networking” course

• 3 CFU
• Laurea Magistrale Ingegneria Informatica @ Università degli Studi di Napoli Federico II
  – 2° year 2° semester
• Course topics:
  – Datacenter architecture
  – Datacenter networking technologies
  – Cloud Computing networking aspects
    • In Amazon AWS, OpenStack, etc...
  – Network Virtualization
  – Emerging networking paradigms (Software Defined Networking, Network Function Virtualization, ...)

![Datacenter Network Diagram]
Datacenter engineering

• In a datacenter multiple infrastructures coexist:
  – IT: Computers, storage systems, switches, routers
  – Cabling
  – Servers cooling and air conditioning
  – Power supply systems
  – Physical security systems

• Design (and building) of a datacenter requires a number of engineering professionals with diverse competencies and expertise
Datacenters: highly complex infrastructures

• **A datacenter simply **cannot **be badly engineered**
  – Service continuity requirements
    • High availability: 99,999% (five nines) $\rightarrow$ at most 5.26 minutes of outage in a whole year
  – Elasticity
    • It must be possible to reconfigure the infrastructure to adapt to a higher demand of resources
  – **Energy Efficiency**
    • Power Usage Effectiveness (PUE)
    • In traditional datacenters non-IT plants (including air conditioning, uninterruptible power supply, emergency power systems, etc.) may consume as much energy as (or even more than) the IT equipments (servers, switches, ...)

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[Image of a datacenter infrastructure diagram]
Datacenter networking challenges (1)

• Highly interactive and data-intensive applications
  – A single user interaction produce as a consequence a high number of interactions among server-side components (eg. many db queries)
    • Max response time for each server component estimated 10ms
    • The majority of the traffic remains within the datacenter
    • Traditional networking protocols exhibit problems in a DC environment
      – multipath, TCP incast, ...

[Image of a datacenter with a laptop connected to it]
Datacenter networking challenges (2)

• How is it possible to make a LAN network of 10000+ servers?
  – A single big switch is unfeasible ....
  – Traditional WAN solutions are not adequate
  – A switch hierarchy!
  – Main goal: 
    make “non-blocking” the interconnection system
  – Agility, i.e. the possibility of moving (migrating) the computational load (eg. a VM) from one server to any other server in the DC with no performance penalties for the application
  – Other goals:
    – avoid bottlenecks,
    – avoid loops,
    – exploit the existence of multiple paths between servers