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The Global Meeting in Rome

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CNIT Talk: The Software Network

Giuseppe Bianchi, Professore, CNIT / Università degli Studi di Roma Tor Vergata

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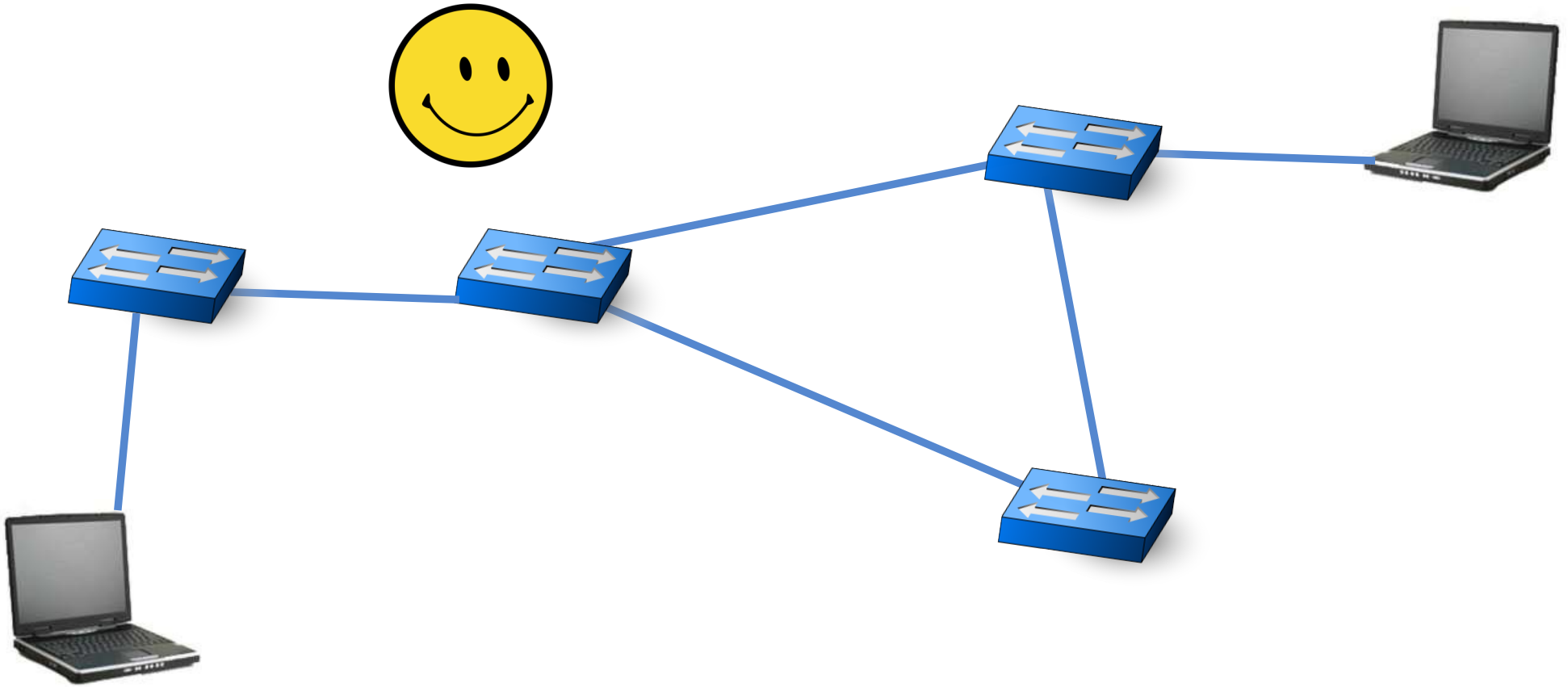
Networks: in our dreams



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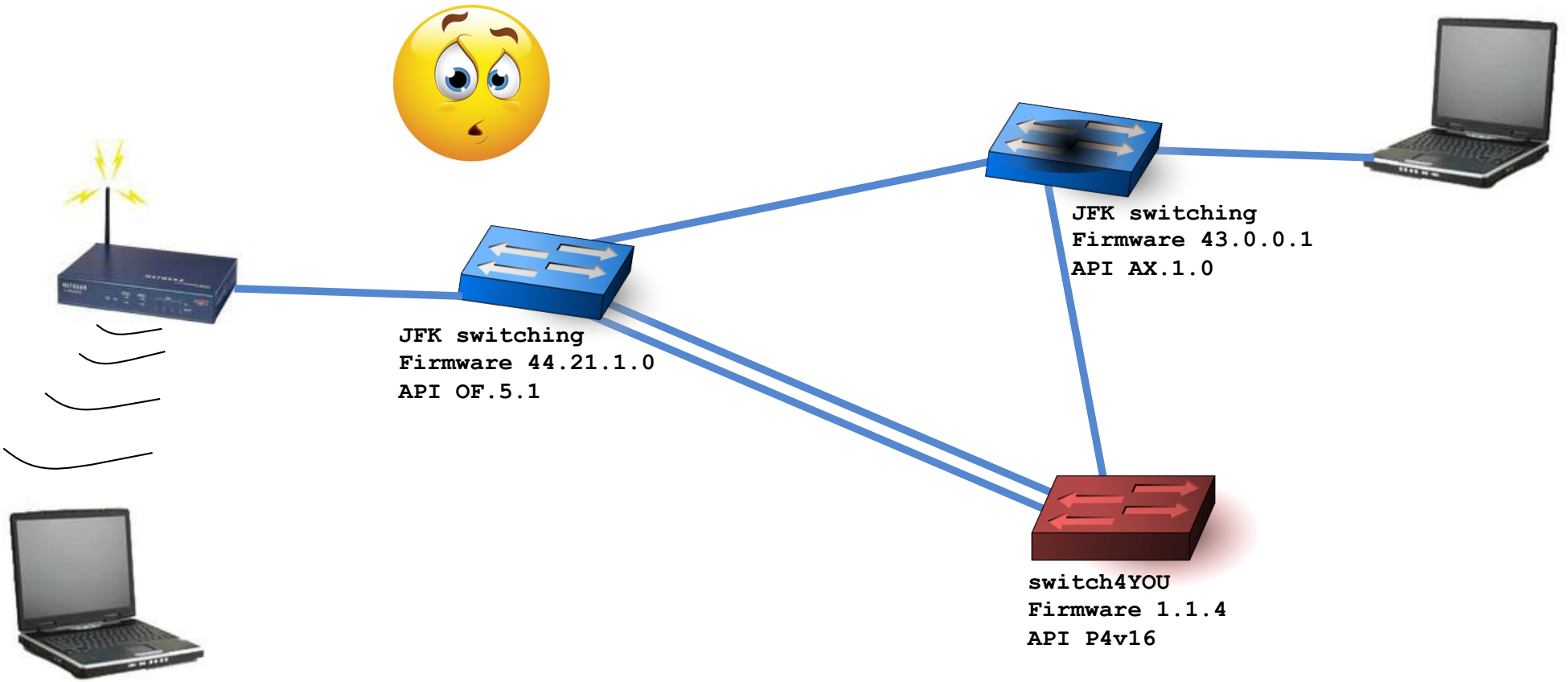
Networks: heterogeneity



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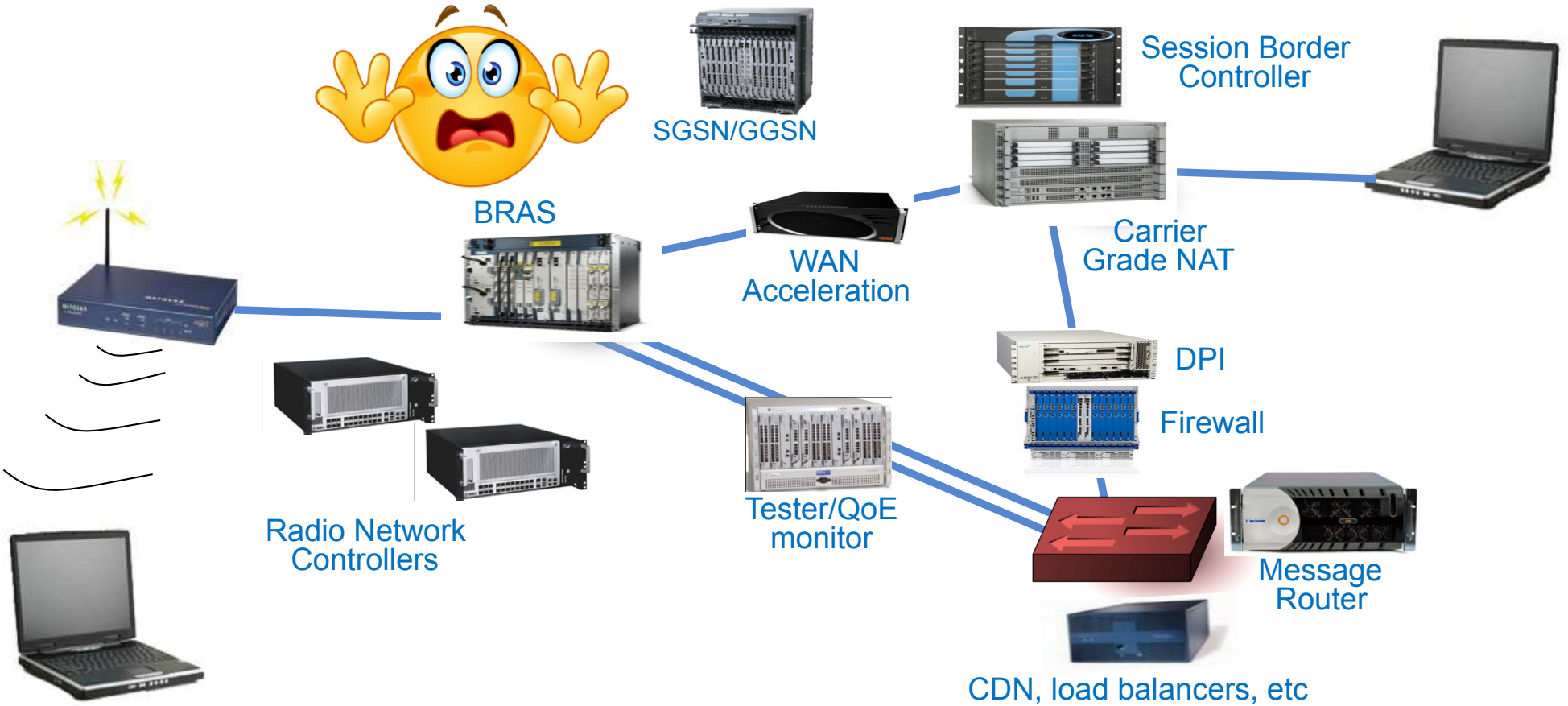
Networks: not only L2-L3!



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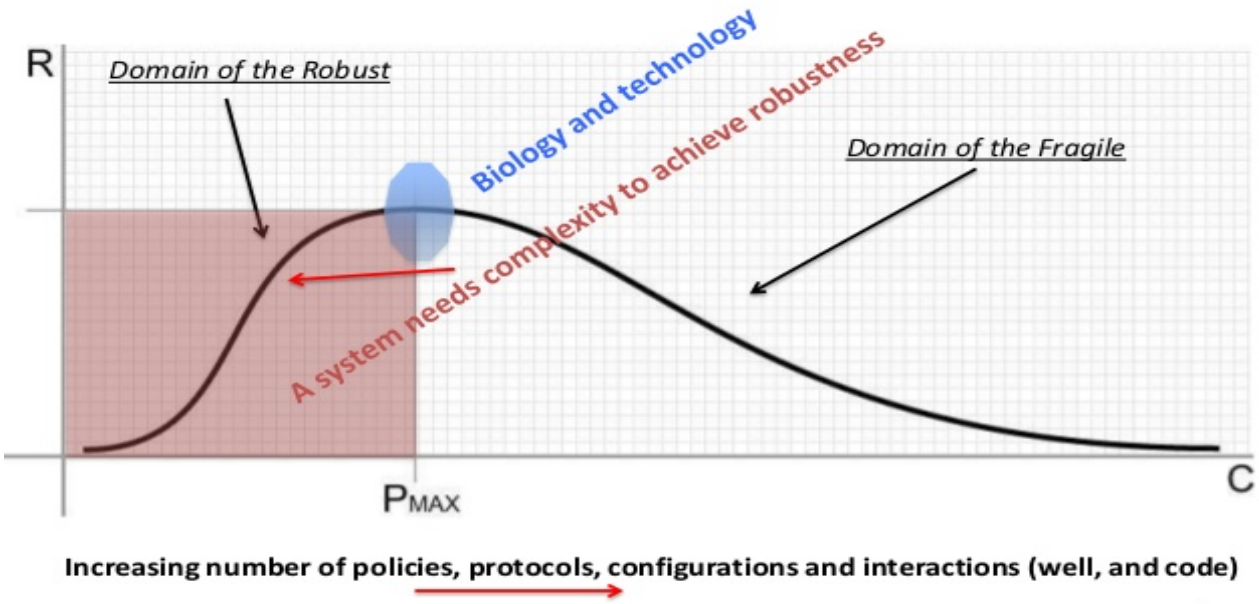
The management nightmare

Legacy network infrastructure is too complex, too brittle, and too closed



Quote: Michael Beesley
Figure: David meyer

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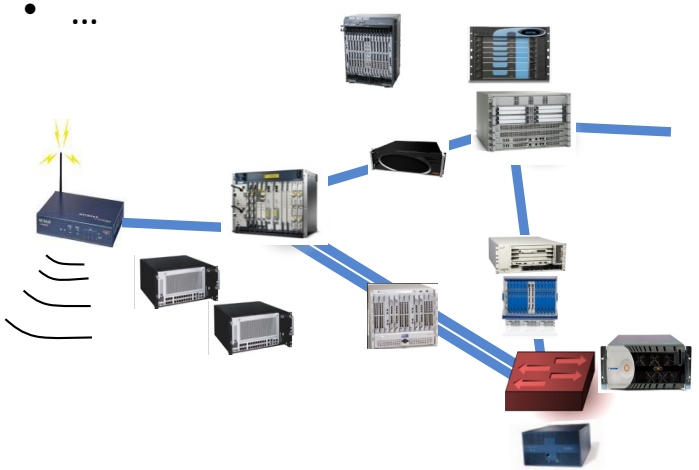
…only a decade ago…

Information technology

- Software-as-a-service
- Virtualization
- Automated updates
- Flexible workload management
- Applications lifecycle mgmt
- …

Networking

- Ping 160.80.82.21
- Traceroute 8.8.8.8
- Arp –d 160.80.1.1
- snmpwalk -mALL -v1 -cpublic *160.80.1.1*
- Ship HW router
- Update firmware
- …



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Software networks: a few milestones

2008 → Software-Defined Networking (SDN) conceived @ Stanford

- **2010 → SDN named as such and initial real world adoption!**
- **2011 → Open Networking Foundation started, 1° OpenFlow official standard**

2012 → Network Function Virtualization (NFV) white paper, ETSI support

- **2014 → Major steps in NFV MANO**

2014 → Mobile Edge Computing

2014 → pioneering work on data plane (wire speed) programmability

- **2015 → P4 and HW programming**
- **2015 → Carrier grade orchestrators & Network OS**
- **2016 → SD-WAN mass deployment**

2017+ → smart NICs, SW network functions offloading and perf. acceleration

5G → SW network as disruptive and distinguishing feature!

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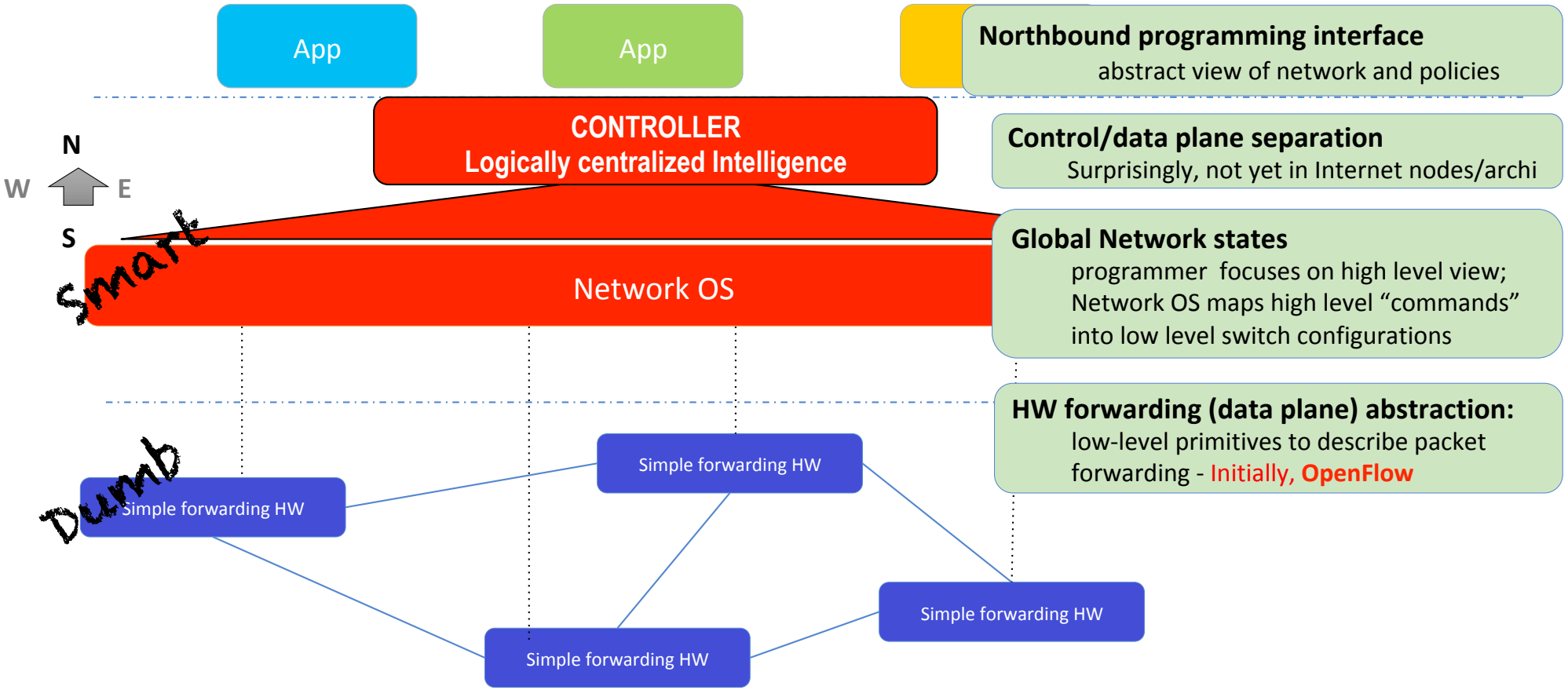
SDN in one slide



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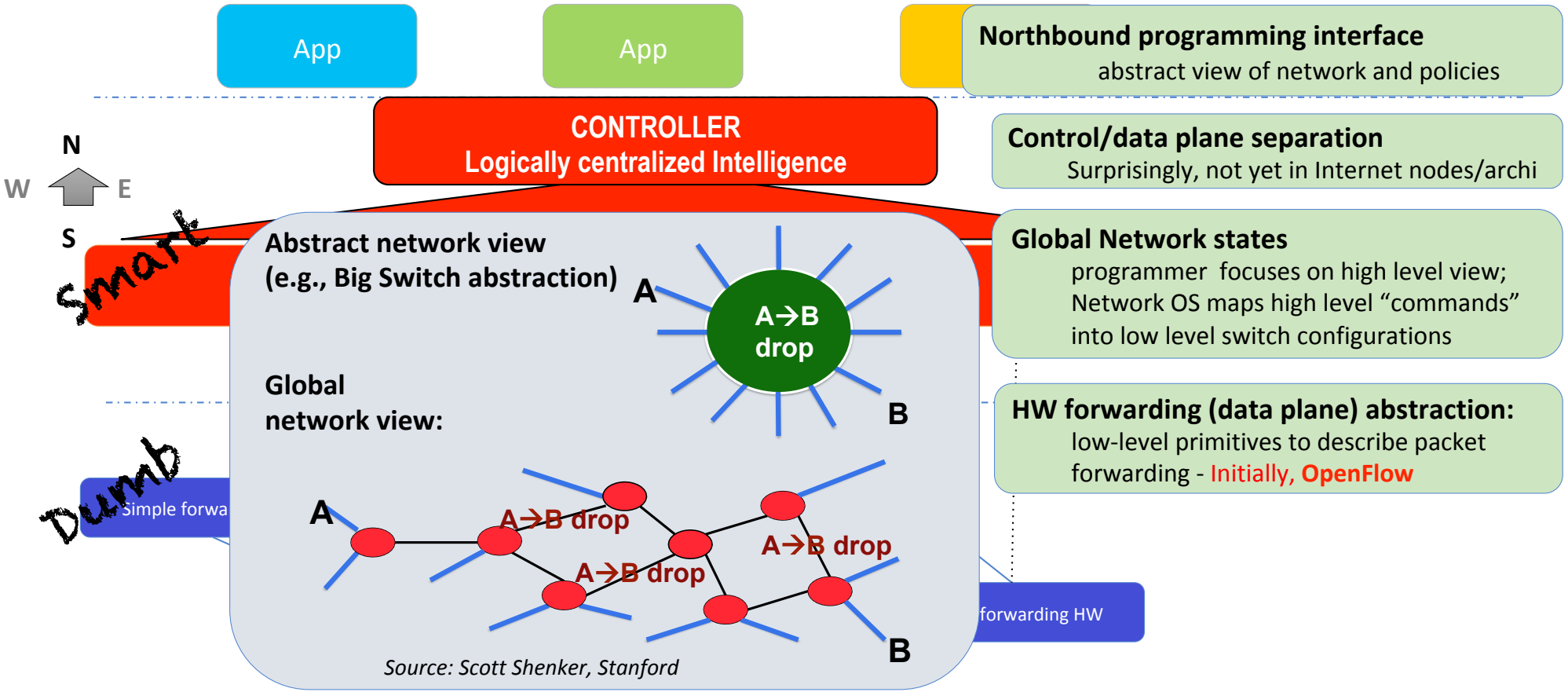
SDN in one slide



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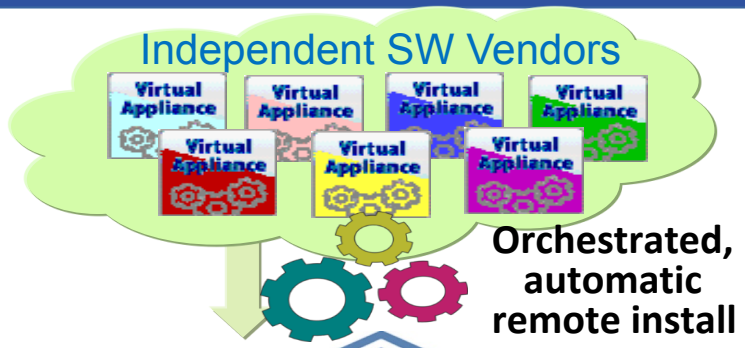
NFV in one slide

Network Function Virtualization – benefits

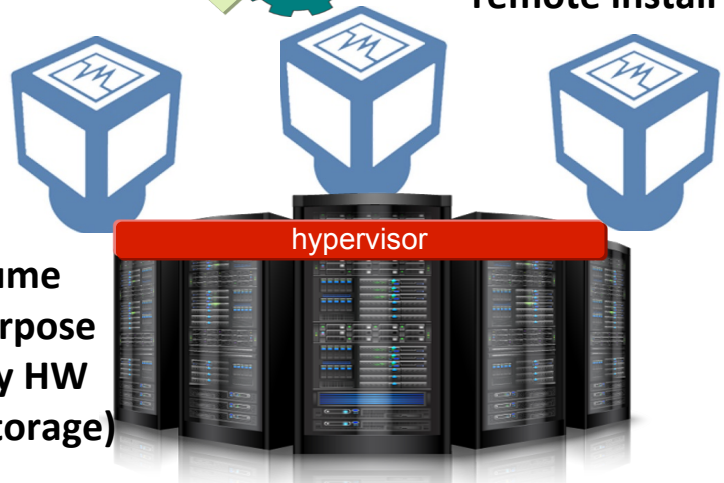
- **Cost – off the shelf merchant silicon!**
- **Flexibility - and fast deployment!**
- **Scalability – just provision extra resources!**
- **Relocation – deploy/move VNF anywhere**
- **Upgradability – control VNF lifecycle**

The Network goes in the Cloud!

Classical Network Appliance
HW-based



Orchestrated, automatic remote install



High-volume General-purpose Commodity HW (compute, storage)

SOFTWARE Network Applicance Deployed inside Virtual Machines (or containers, unikernels, etc)

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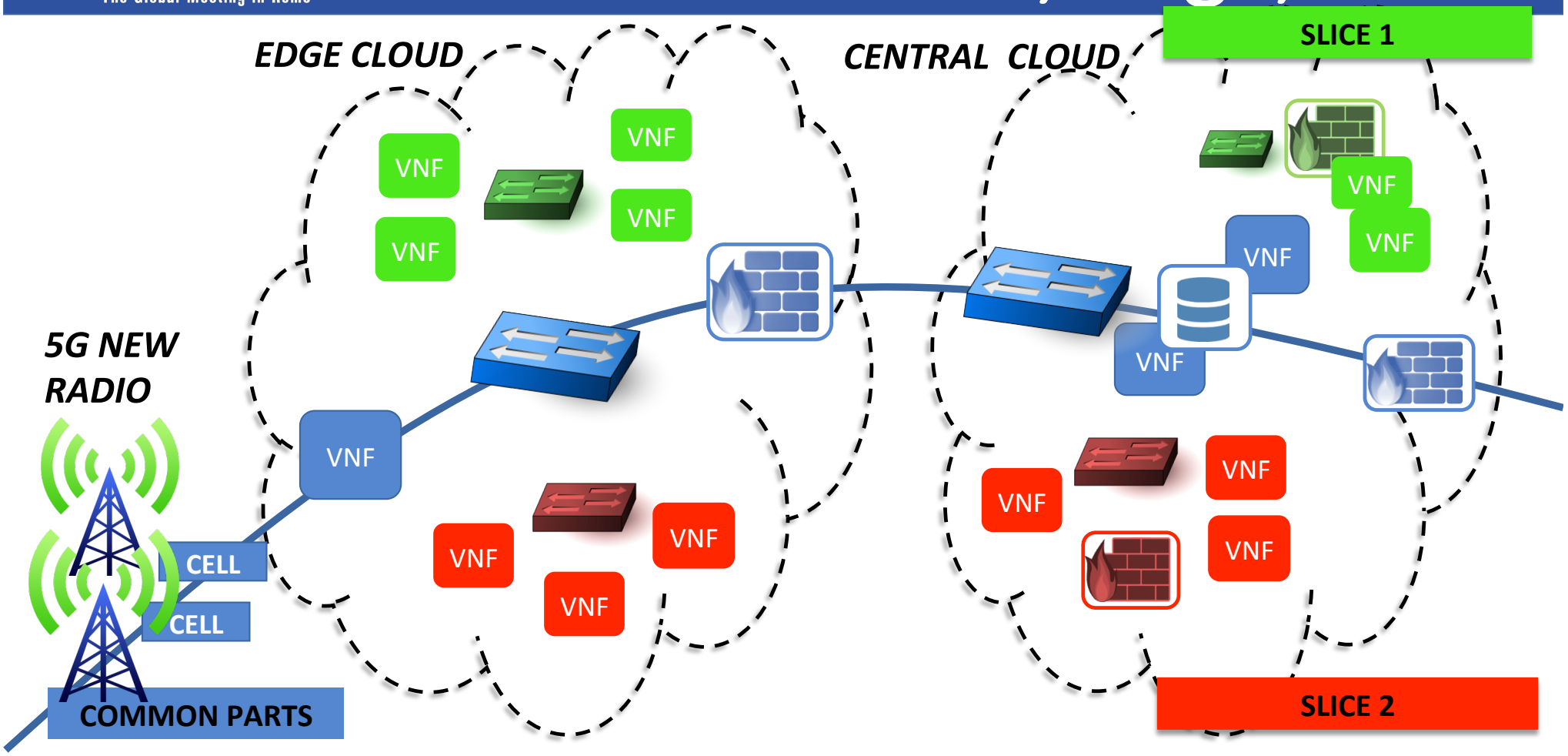
5G: central cloud, edge, slices

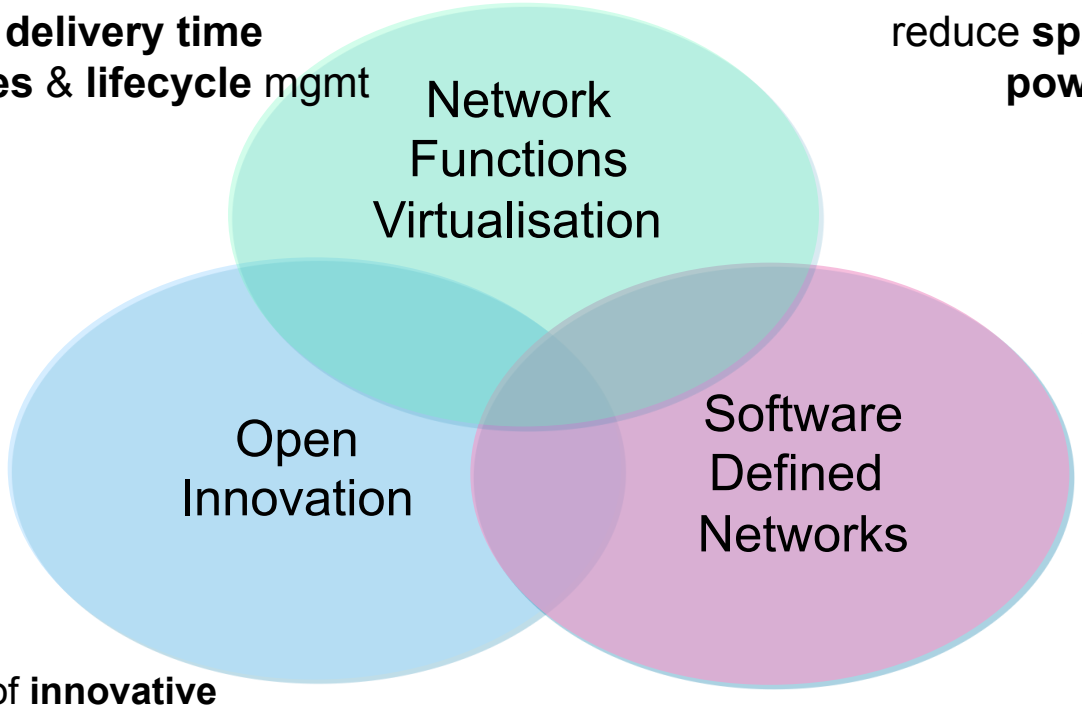


3 complementary trends

Reduce cost – HW network appliances → SW/virtual appliances on commodity IT servers

minimize **delivery time**
automated **updates** & **lifecycle** mgmt

reduce **space** &
power consumption



Abstractions (e.g., intent):
simplify/automate
multi-vendor network
Config, control, mgmt

Centralized intelligence

Leverage R&D
from **Third parties**

Competitive supply of **innovative**
applications

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3 complementary trends

Key asset: Agility!

Business cycles shrink: move quickly!

promptly add new services when customers face a need

Modules, interfaces, third party SW
→ Greater innovation rate

Functions
Virtualization

Automation, orchestration, better visibility/cont
→ Reduced OPEX

Innovation

Defined

virtualization → Reduced CAPEX

Key asset: management!

Effortless upgrade of SW appliances (vs. HW upgrade!)

Same/consistent versions/ updates with just a click!

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SW network: open challenges

- **Beyond Virtual Machines!**
  - **Containers → Unikernels → …**
    - Lower footprint, isolation, multi-tenancy
    - (much!) faster o(10ms) migration/boot
- **Performance?**
    - (Fundamental 50x gap between HW and SW)
  - **Data plane programmability**
  - **Smart Network Interface Cards x HW offloading**
- **Security?**
  - **SW network improves security**
    - isolation, easier policy mgmt, security appliances, on-the-fly mitigation, etc
  - **SW network: new security concerns!**
    - SW vs HW: greater attack surface
    - New (2018) critical attacks to virtualization (Spectre, Meltdown, foreshadow –CNIT thesis later on)

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Conclusion

5G: network softwarization for agile and flexible service deployment!