# AP/ITEC 2210 3.0 A: System Administration Fall 2023

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**Date/Time: Wednesday, 19:00-22:00**
**Location: Zoom / ACE 003**
**Office hours: Via Mattermost any time**

# Class 4 - TCP/IP - Internet

- Midterm:
  - October 18, online during our 7-10pm time slot
  - We'll be using Zoom to collaborate on answers
  - Hopefully a change from the usual midterm tedium

# Class 4 - TCP/IP - Internet

- Lab 1/Assignment 1:
  - Clock is ticking. October 11 @ 23:59 due date.

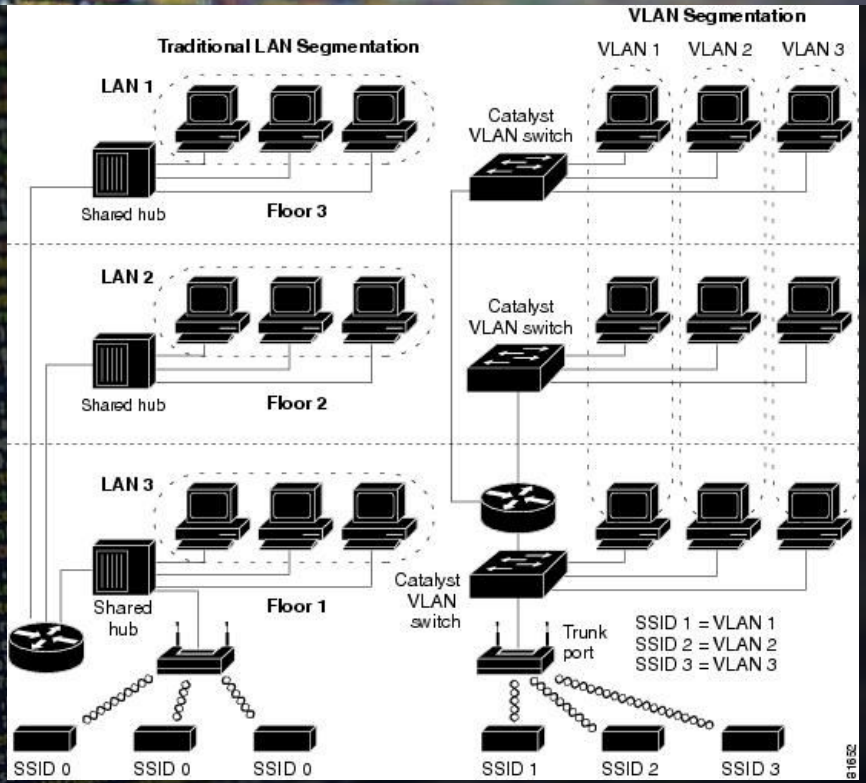
# Class 4/5 - TCP/IP - Internet

- Readings PSNA CH23 Network Architecture
  - p399-401 OSI model
  - p404 VLAN Myths
  - p408-422 Sections 23.5-23.8 inclusive
  - P425-430 Sections 23.10-23.12 inclusive

# Class 4/5 - TCP/IP - Internet

- VLAN is a Layer 2 construct in hardware switch or software
- Subnets are not VLANs
- VLANs are not subnets
- VLANs can contain multiple subnets
- To traverse VLANs (layer 3), firewalls or routers need interfaces in both, or hosts need physical interfaces in each VLAN (layer 2)

# Class 4/5 - TCP/IP - Internet




https://www.cisco.com/c/en/us/td/docs/wireless/access_point/15-3-3-JB/configuration/guide/cg_book/cg-chap14-vlan.html

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- LAN model has each switch or router separating traffic by subnet
- VLAN model allows systems on separate physical links to appear as if they are on the same subnet or network segment
- Diagram shows wireless SSIDs living in different VLANs, even though they may share the same physical uplink and switches

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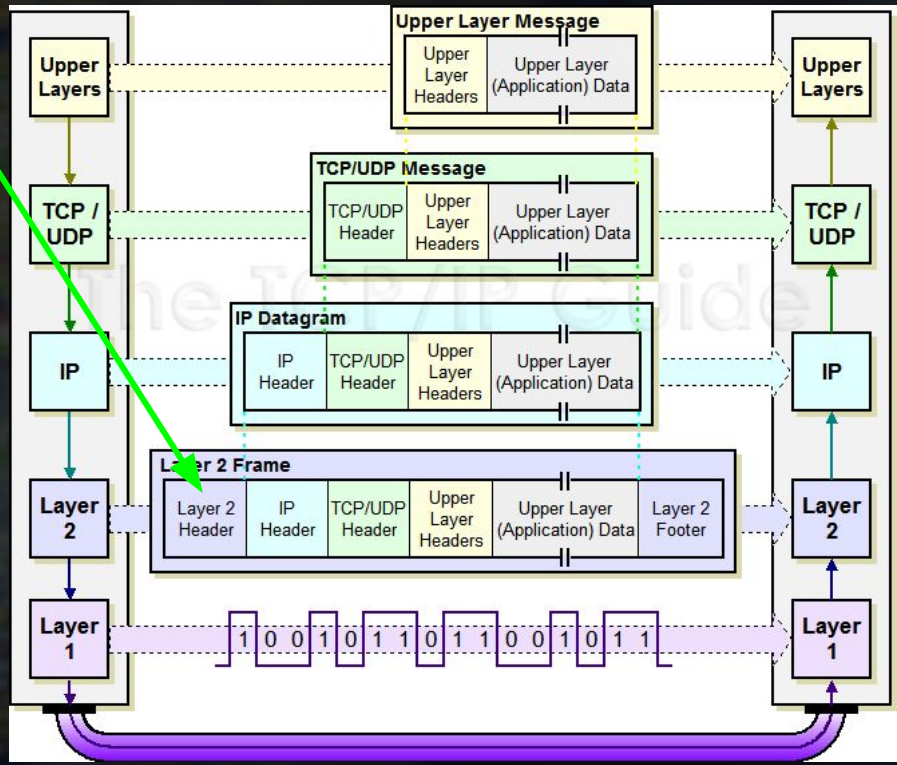
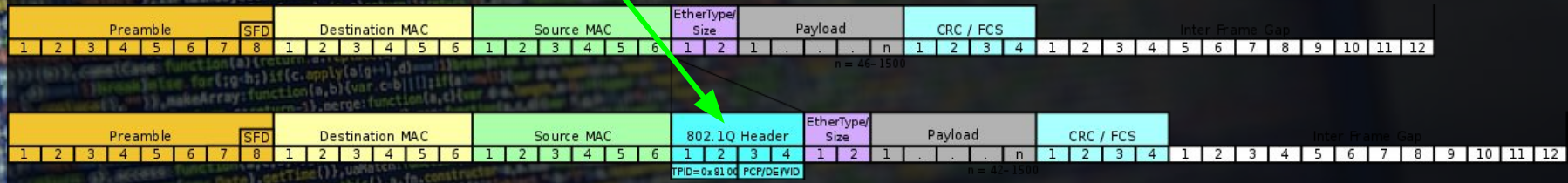
- 802.1Q VLAN tag lives in layer 2 frame header
- 12 bit VID gives 4096 VLAN values
- 0x000 and 0xFFF reserved
- 0x001 is usually default
- The rest are fair game




http://www.tcpipguide.com/free/t_IPDatagramEncapsulation.htm

# Class 4/5 - TCP/IP - Internet

- 802.1Q VLAN tag in Ethernet Frame



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- VLAN myths
  - CAM/TCAM (content/ternary addressable memory) table is a list of MAC addresses and can be overflowed
  - Many systems will fail open and revert to bridge mode
  - In bridge mode, every packet is broadcast to every port, which can lead to information leaking to an attacker, which can be used for ARP spoofing and full takeover of a network

# Class 4/5 - TCP/IP - Internet

- VLAN myths
- Bandwidth is a finite resource, VLANs cannot add more
  - Switch backplane or ports can only move so many bit/s
  - VLANs just segment who sends what where
  - VLAN traffic over an uplink can saturate the link
  - If you don’t have a good network topology, VLANs can make things worse by blocking connections

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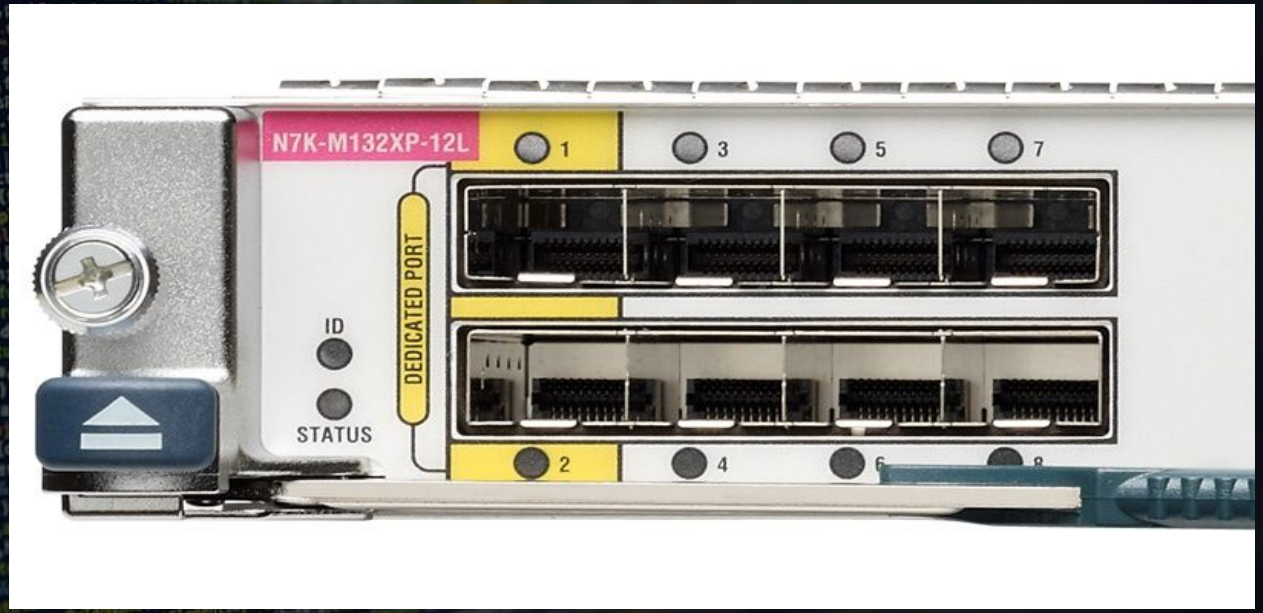
- VLAN myths




https://www.safaribooksonline.com/library/view/arista-warrior/9781449358921/ch04.html

# Class 4/5 - TCP/IP - Internet

- **Datacentre networking**
- Three main methods of physically connecting hosts that you'll encounter
  - **Central switch**
  - Top of rack switch (**TOR**)
  - **Switch fabric** (Clos, or Spine & Leaf)

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- Datacentre networking
- Central switch:
  - Each host connects to a patch panel, the panel then connects to the central switch or end of row switch
  - Desirable to have redundant connections, 2x cabling
  - Makes for a lot of cables, and painful upgrades or recabling hosts into different networks

# Class 4/5 - TCP/IP - Internet

- Datacentre networking
- Top of rack switch (TOR):
  - Usually each rack has redundant switches, so 2x TOR
  - Each host will connect to each switch for redundancy
  - Each switch connects to the other
  - Each switch connects to the core router/switch fabric

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- Datacentre networking
- Top of rack switch (TOR):
  - Means zero downtime for maintaining each switch, as long as the switches mirror each other
  - However, TOR switches need high bandwidth to core switches, otherwise upstream connectivity is limited
  - Much monitoring and upgrading work

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- Datacentre networking
- TOR Fabric, also known as Spine and Leaf:
  - TOR switch connects to all core fabric switches
  - Each host can reach any other with the same number of hops across the whole fabric
  - Capacity can be added with more Fabric/Spine switches

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- TOR Fabric, also known as Spine and Leaf
- Pods can be linked with the same Spine/Leaf topology

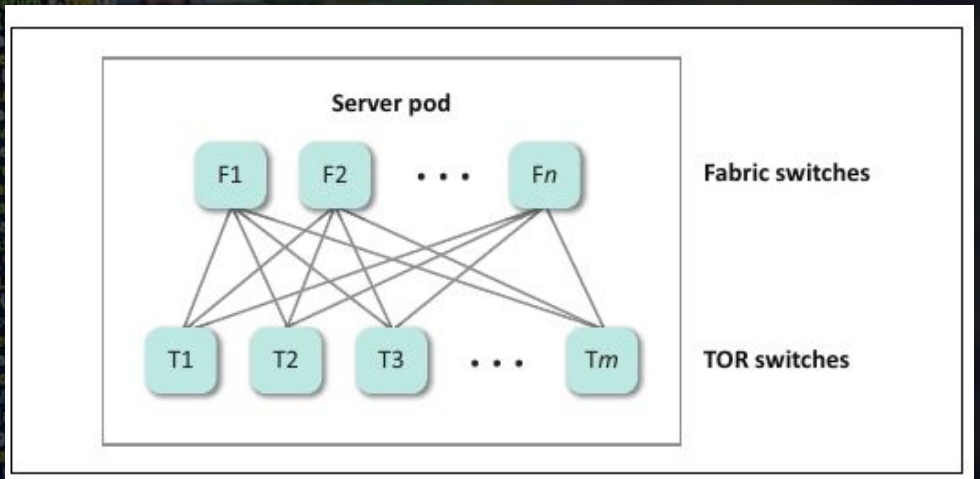


Figure 23.3: A fabric pod

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- WAN strategies
- How do you connect an office  and a datacentre?
  - **Topology** is what the network connections look like
  - **Technology** is the equipment & protocols to make and maintain the connections
  - **Demarcation point** is where ISP and your connections meet. You’re responsible for your side, end to end

# Class 4/5 - TCP/IP - Internet

- WAN strategies
- **Star topology**
  - Central datacentre, shared by various offices
  - Can be made redundant with a second datacentre, and or a disaster recovery site
  - Redundant version known as **dual star**

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- WAN strategies
- **Multi-star topology**
  many stars linked together via central hubs per region

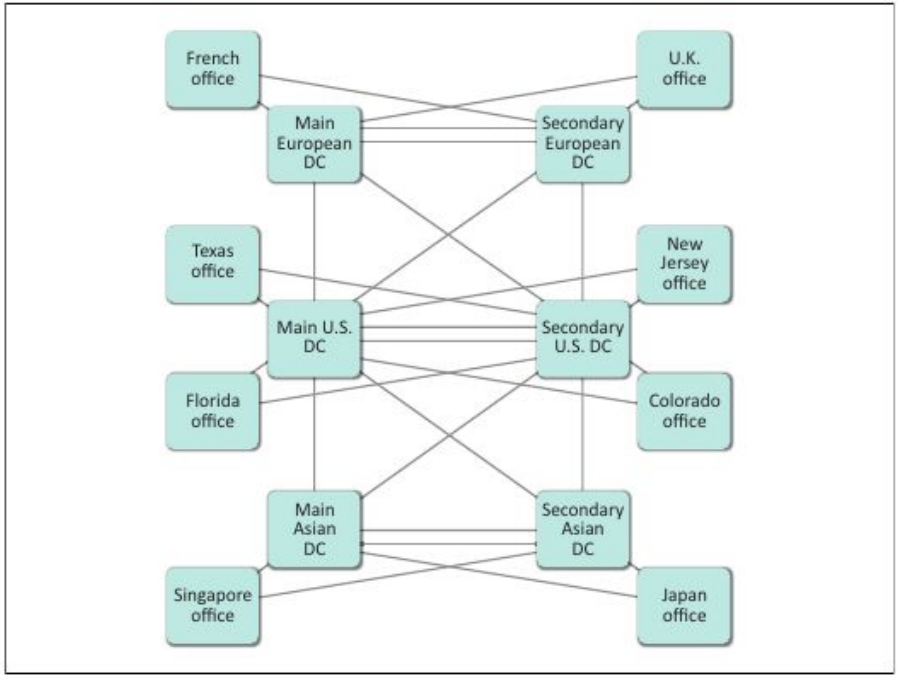


Figure 23.5: A redundant multi-star topology for a WAN

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- WAN strategies
- **Ring topology**
  - Every office connects to at least 2 others
  - New offices mean disruptive changes, more latency as more hops are added

# Class 4/5 - TCP/IP - Internet

- WAN strategies
- **Cloud topology**
  - Every office connects to a cloud provider’s network
  - Packets are like a letter, they reach their destination, you just don’t know how or care how it happens
  - Can be slow depending on other tenants

# Class 4/5 - TCP/IP - Internet

- WAN strategies
- **Technology**
  - **Dedicated** line or **VPN**?
    - Dedicated circuit is just that, a physical connection that is dedicated to your sites only. Fibre, copper, wireless, can be any layer 1 medium
    - VPN is a virtual circuit running on layer 2 or 3

# Class 4/5 - TCP/IP - Internet

- WAN strategies
- **Dedicated**
  - Well understood capacity & SLA commitments
  - Can scale linearly with more circuits
  - Isolates traffic between sites & other companies
  - Redundancy can be added with another circuit
  - Costly depending on distance to PoP or datacentre
  - Can have multiple providers for failover

# Class 4/6 - TCP/IP - Internet

- WAN strategies
- **VPN**
  - Cheaper, but more variable performance depending on provider's networks and other customers
  - Harder to troubleshoot and diagnose because of routing or intermediate network issues
  - Different security paradigm - encrypt everything

# Class 4/5 - TCP/IP - Internet

- **SDN (Software-defined networking**)
- Programmable networking, e.g. routers with APIs
- Just like virtual machines, physical networks can host multiple virtual networks
- Two components, **overlay** (virtual network), and **underlay** (physical or core network). Underlay usually Clos/Spine-Leaf for consistency and cost savings

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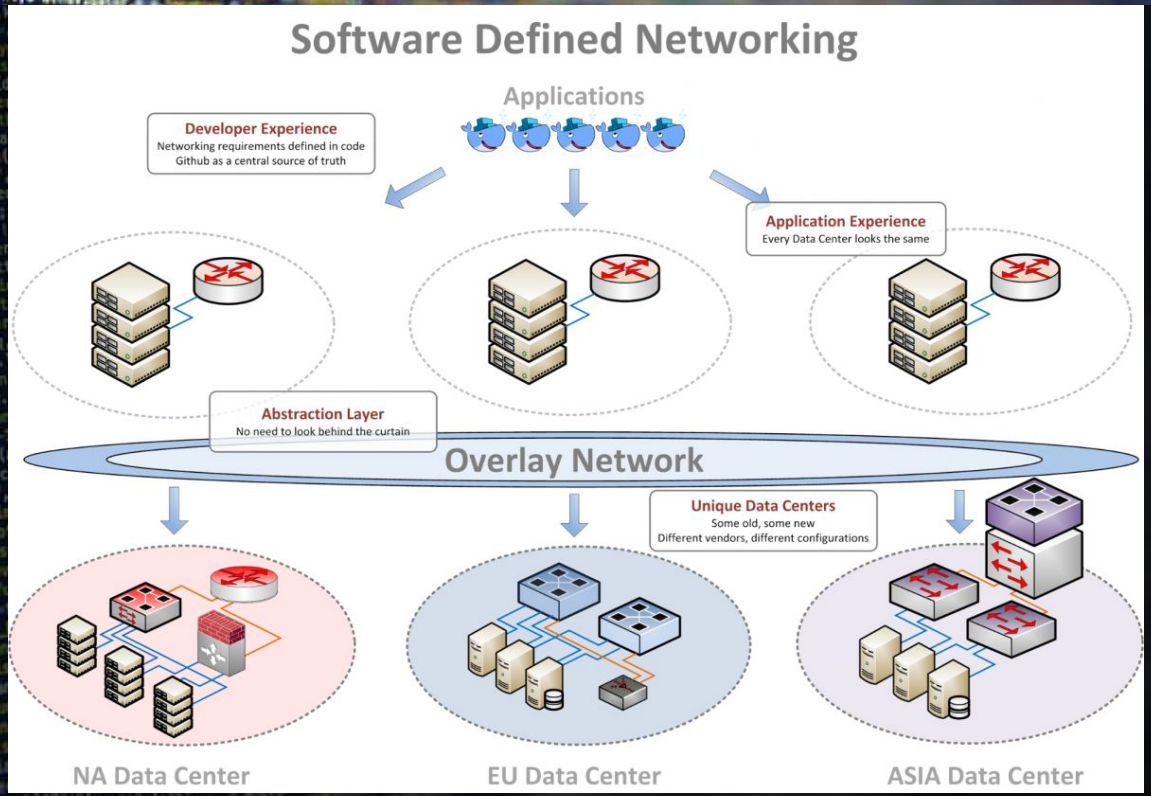
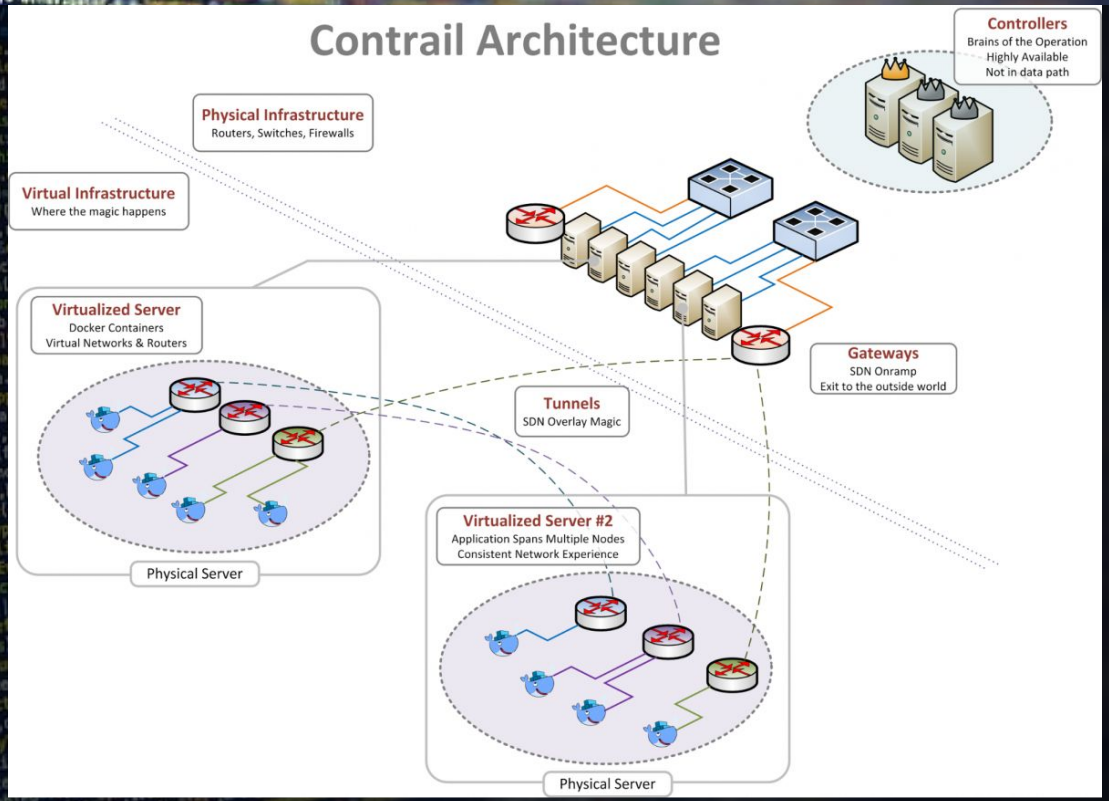
- SDN




https://engineering.riotgames.com/news/running-online-services-riot-part-iii

# Class 4/5 - TCP/IP - Internet

- SDN

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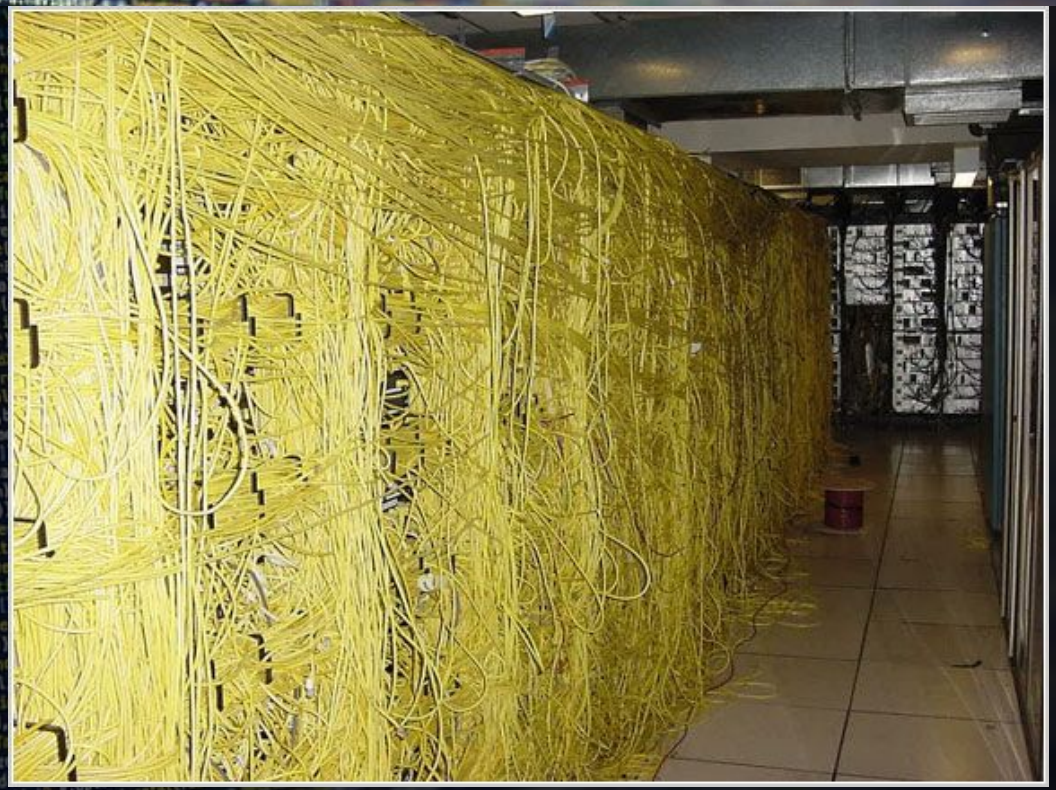
# Class 4/5 - TCP/IP - Internet

- **Summary**
  - Network engineers, usually responsible for layers 1-3
  - System administrators, usually layers 3-7
  - Developers, usually layers 6-7
  - Physical networks are messy, logical is usually where you will spend most time designing, and working

# Class 4/5 - TCP/IP - Internet



http://royal.pingdom.com/2008/01/09/the-worst-cable-mess-ever/