BORDER SECURITY

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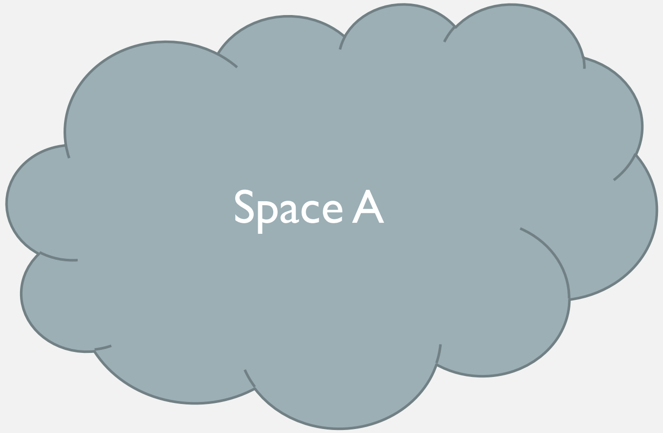
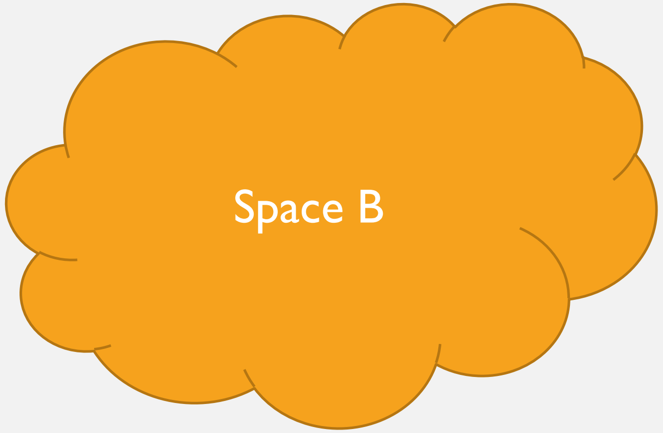
“SPACES”

“Space” is not a technical term.

I use it to represent the concept of separation



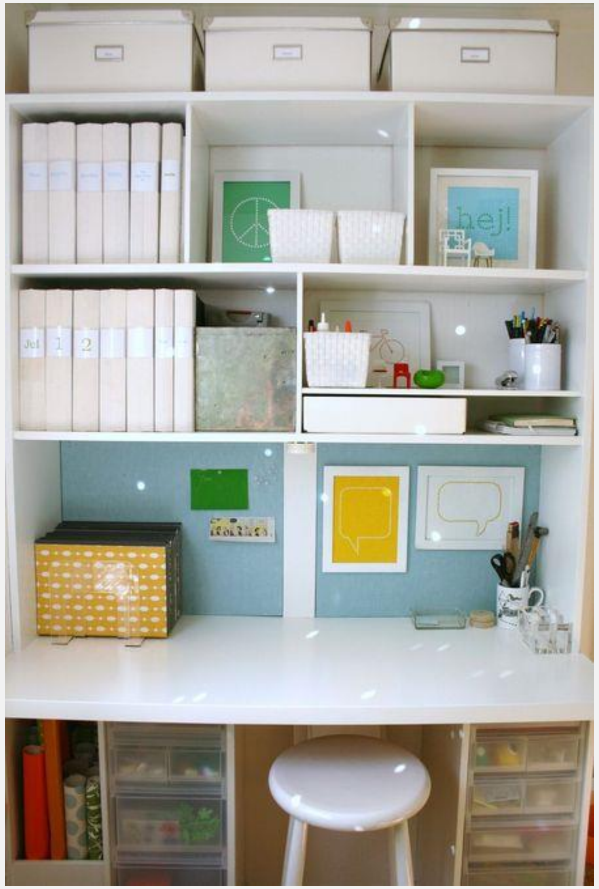
Space A



Space B

MACRO PHYSICAL SPACES

MICRO PHYSICAL SPACES



WHY DO WE SEPARATE PHYSICAL THINGS?

- ***CONTEXT***
- Countries have different
  - Social Models
  - Legal Frameworks
  - Rights and Responsibilities
- Binders, bins, and office “spaces”
  - Importance
  - Meaning

ACCESS

Most physical spaces try to control the flow
from one space to another

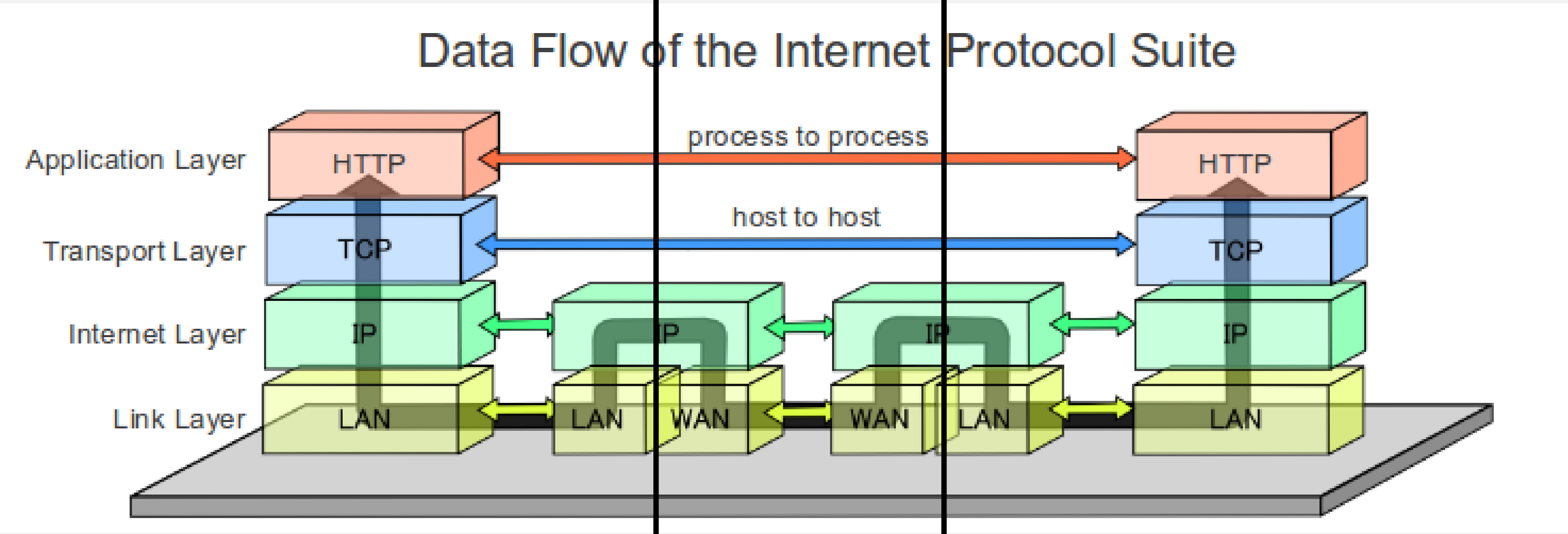
CYBER SPACES

- Often tied to a physical space and/or organization
  - All the people, equipment, data, etc. belonging to an entity
  - For example, a corporate network
- But there are far more conceptual spaces
  - Media piracy
  - Hacking communities
- Everything inbetween

LAN'S AS NATURAL SPACES

- LAN's have *historically* creates cyber spaces very naturally
- Typically tied to an entity, the LAN is
  - Hosted by the entity in physical space
  - Provides resources on behalf of the entity in cyber space
- Access is typically limited to individuals with physical relationships to the entity
  - Insiders typically have increased access to resources across the LAN
  - Outsiders typically have limited access to published resources on specific servers

LAN'S CREATE "BORDERS" ON THE INTERNET



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ROUTER (Gateway)

ROUTER (Gateway)

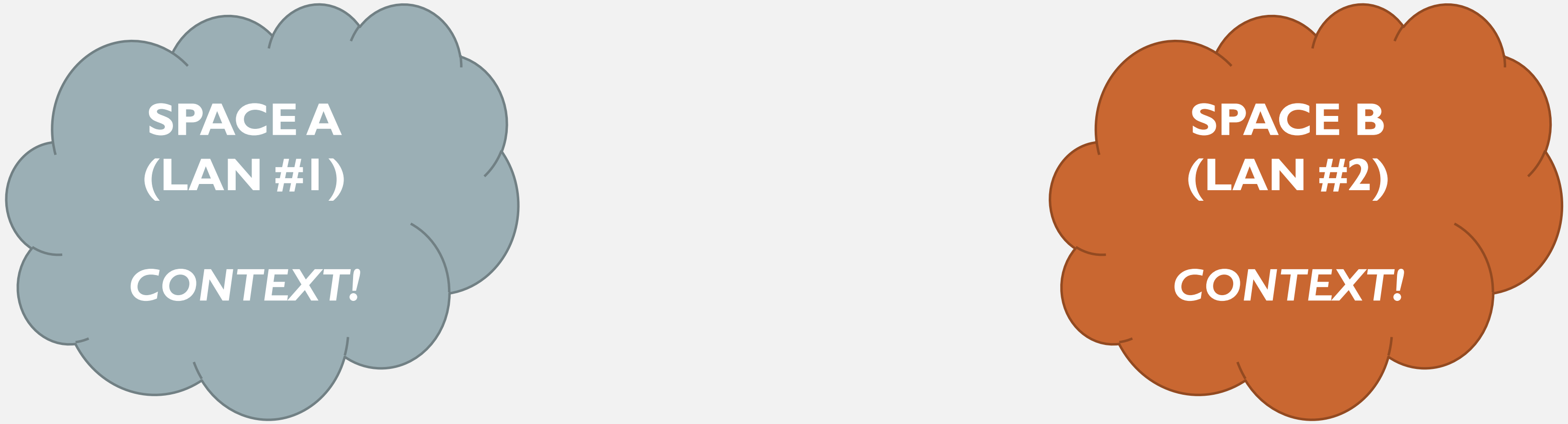
LAN #1

LAN #2

GATEWAYS: NATURAL BARRIERS

- Data can only get into a LAN via router
- We call the routers at the "edges" of a LAN ***gateways***
- Gateways are, therefore, ***natural chokepoints for data***

GATEWAYS: SPACE TRANSITION



SPACE A
(LAN #1)

CONTEXT!

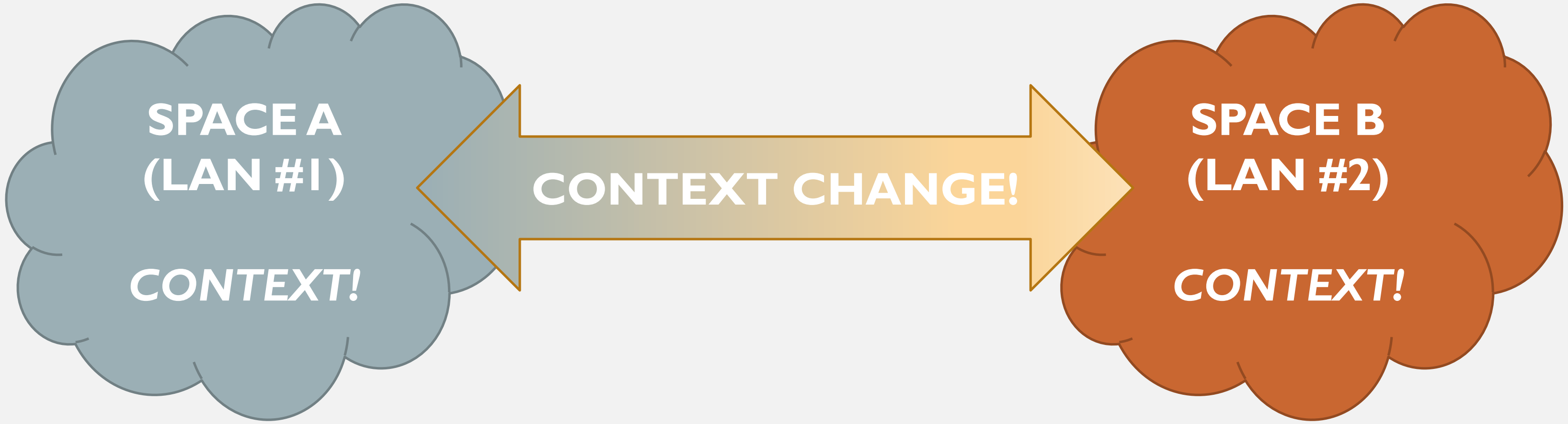
SPACE B
(LAN #2)

CONTEXT!

CONTEXT IS EVERYTHING

- Security is all about ***context*** (REPEAT AFTER ME!)
- Security has no meaning without context
- What is secure within one context may not be within another
- Data on different networks is *assumed* to have a different contexts
- It is reasonable and natural to examine data transitioning context

GATEWAYS: CONTEXT CHANGE



SPACE A
(LAN #1)

CONTEXT!

CONTEXT CHANGE!

SPACE B
(LAN #2)

CONTEXT!

FIREWALL: GATEWAY SECURITY

- What is a “firewall”?
- Informally, it’s security within a network connector, such as a gateway

FIREWALL MARKETING

- If you read marketing, it’s Super Man.
    - Juniper: “control over applications, users, and content to stop advanced cyber-threats”
    - PAN: “Instantly find and stop attacks with a fully automated platform”
    - Cisco: “Prevent breaches, get deep visibility to detect and stop threats fast”

IGNORE MARKETING. THINK ***ENGINEERING***

- Ross Anderson proposed a framework for ***Security Engineering***
  - Policy: ***WHAT*** you’re supposed to achieve
  - Mechanism: ***HOW*** you’re supposed to achieve it
  - Assurance: ***RELIABILITY*** of the mechanism
  - Incentives: ***MOTIVES*** of defenders and attackers

CORE CONCEPTS:
POLICY AND MECHANISM

- This is not a security engineering class
- But we will use it to help us frame how we look at security
- PAY SPECIAL ATTENTION TO ***POLICY*** vs. ***MECHANISM***
    - Policy is WHAT you want
    - Mechanism is HOW you do it
- Most “Policy” you see elsewhere, including CISSP, certifications, is different

EXAMPLE: TLS

- What is the ***<u>POLICY?</u>***
  - Authentication: a party can claim an identity ONLY if they're authorized to do so
  - Confidentiality: only authorized parties can READ the communications
- What is the ***<u>MECHANISM?</u>***
  - Authentication is enforced by certificates, signatures, and trusted authorities
  - Confidentiality is enforced by encryption
- ENCRYPTION IS MECHANISM NOT POLICY

FIREWALLS: POLICY AND MECHANISM

- Firewalls are MECHANISMS for enforcing certain network security POLICIES
    - Borders are natural places to want a policy
    - Borders are also, conveniently, an easy place to enforce some policies
    - BUT DON'T CONFUSE THE TWO!

“SECURITY” IS A MEANINGLESS WORD

- Firewalls, like every other mechanism, don’t “create security”
- Consider the marketing descriptions
  - What is a “threat”?
  - What does it mean to “block”?
  - What is an “attack”?
- As a security professional, how would you even evaluate these claims?

ENFORCING POLICY

- Firewalls are ONLY useful to the extent they can enforce a policy
- Corollary: Policies come BEFORE firewalls
- What security policies might you like to have?
  - Example 1: No malware can enter the network
  - Example 2: No unauthorized external network services
  - Example 3: External network services accessible only by authorized users
- Once you have a policy, you can start looking for enforcement mechanisms.

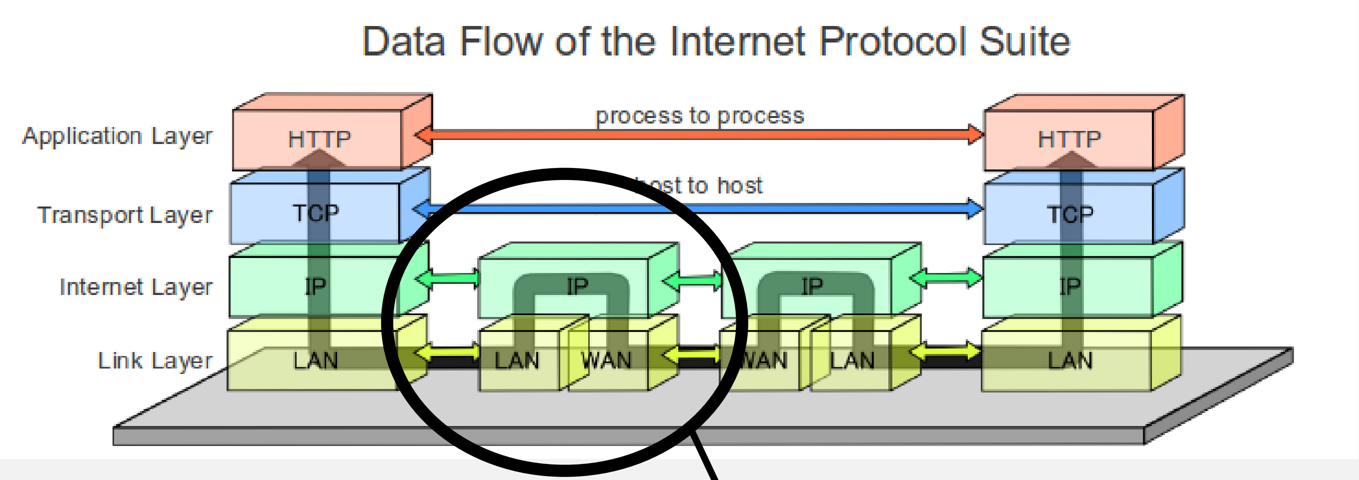
COMMON POLICIES: ACCESS CONTROL

- Policy #1: Only authorized LAN services are accessible outside the LAN
- Policy #2: Only authorized users from outside the LAN can access LAN resources
- Policy #3: Only authorized users on the LAN can access authorized services outside the LAN

EARLY FIREWALLS: LAYER-3 MECHANISMS

- The first firewalls were LAYER 3 (IP level)
- Layer-3 filtering can *partially* enforce all three policies:
  - Policy #1 by blocking access to computers without authorized services
  - Policy #2 by blocking access from computers without authorized IP's
  - Policy #3 by blocking outbound requests to unauthorized IP's

HOW DOES LAYER-3 ENFORCEMENT WORK?



Router/Firewall
-> Has to inspect the IP packet for routing
-> Will drop packets from "bad" addresses

LAYER-4 FIREWALL
(PACKET FILTER ONLY)

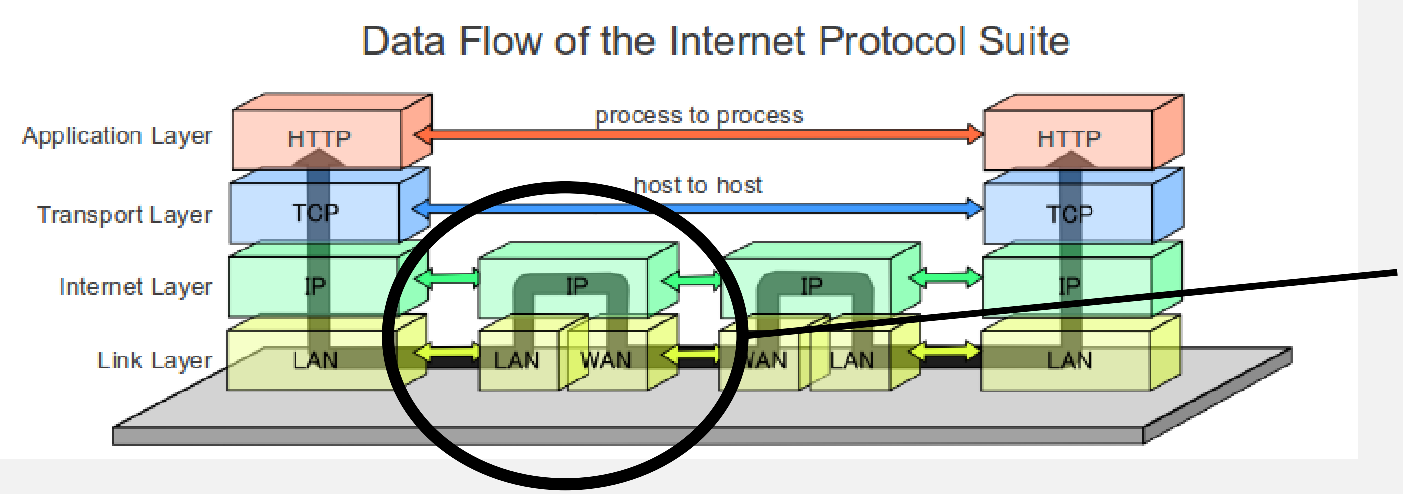
- Firewall developers quickly realized that IP-layer info was insufficient
- Examining TCP packets made it policy enforcement better
  - TCP ports typically represented a specific service
- Policy enforcement mechanism improvements:
  - Policy #1 by blocking access to *ports* not related to required services
  - Policy #3 by blocking outbound requests to unauthorized IP's *or ports*.

LAYER-4 FIREWALL (STATEFUL)

- In addition to examining ports, layer-4 packets also reveal *connection state*
- Some malicious packets violate TCP session rules, for example
- Layer-4 firewalls could also keep track of TCP sessions
- Better enforcement mechanism improvements:
  - Out-of-session packets almost certainly represent a violation of all three policies
  - Servers should not START an out-bound connection

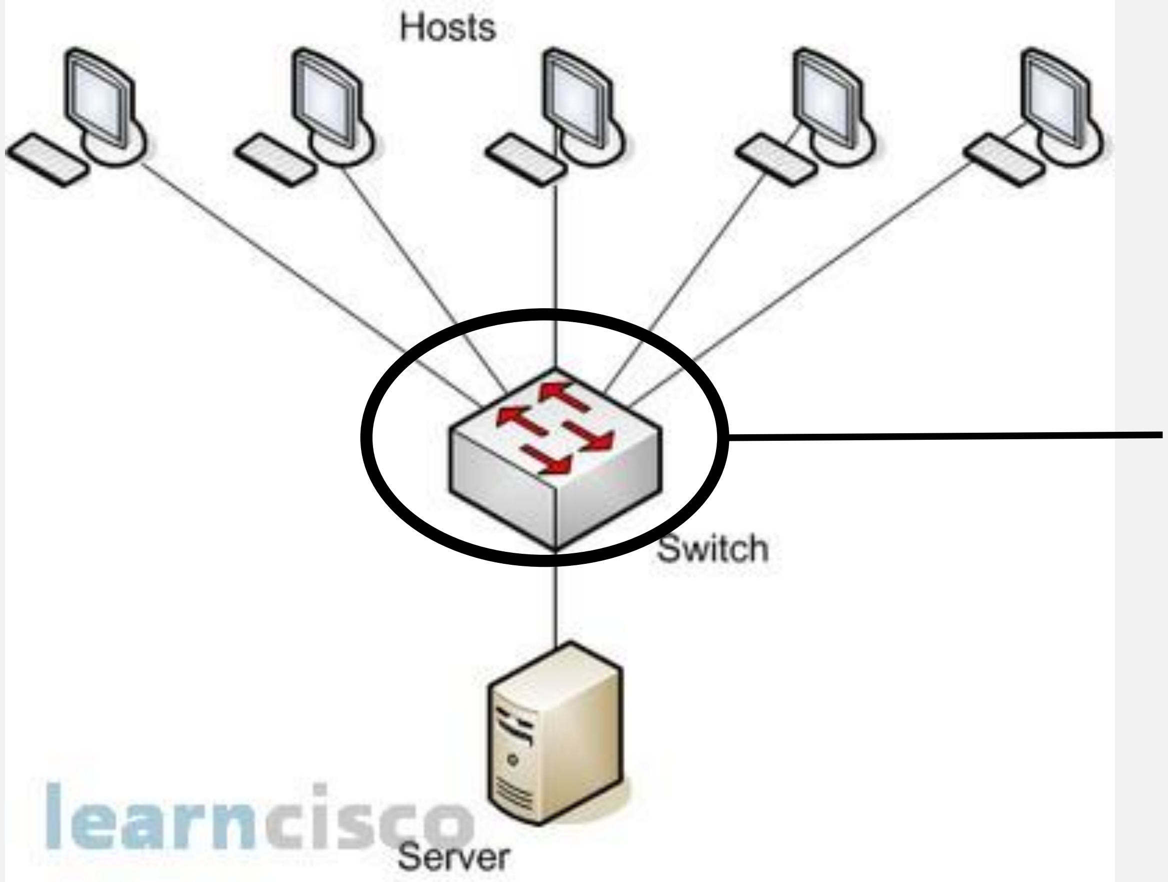
LAYER-4 STILL LAYER-3 ROUTING

- Important.
- Just because a router is doing L3 routing doesn't mean it cant look at L4 data



Router/Firewall can examine ***any*** data, not just data used for routing

YOU CAN ALSO HAVE AN L2 FIREWALL



Firewalls can go here too!

In this case, L2 refers to the routing, not the inspection!

LAYER 2 FIREWALLS

- Might be better for enforcing different policies
  - Insider threat policies
  - Different types of devices on the same LAN (e.g., wireless, wired)
- Have some neat defensive properties
  - If only a switch, ***HAS NO IP ADDRESS!!! HARDER TO ATTACK!!!***
  - Called "bump in the wire"

L7 FIREWALLS

- Probably to confuse you personally, L7 refers to the inspection, not the routing
- L7 firewalls examine application data
- Even more "stateful"