

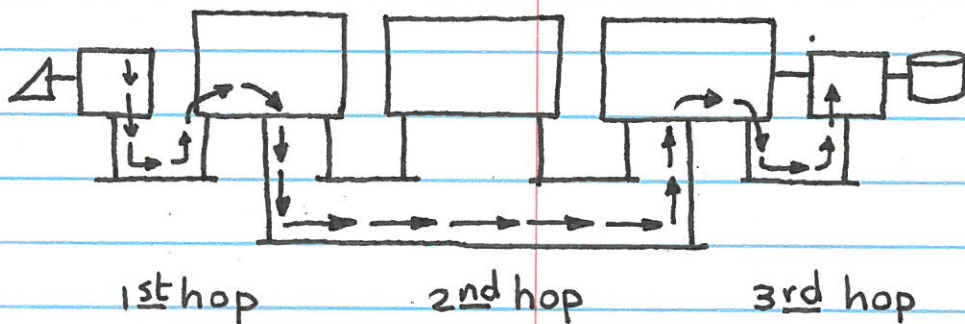
Outline  
of  
CS 356: Computer Networks

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# Architecture of Internet

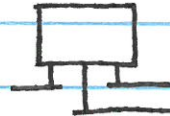
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- computers + subnetworks:



- types of computers:

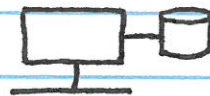
- router:



- client host:



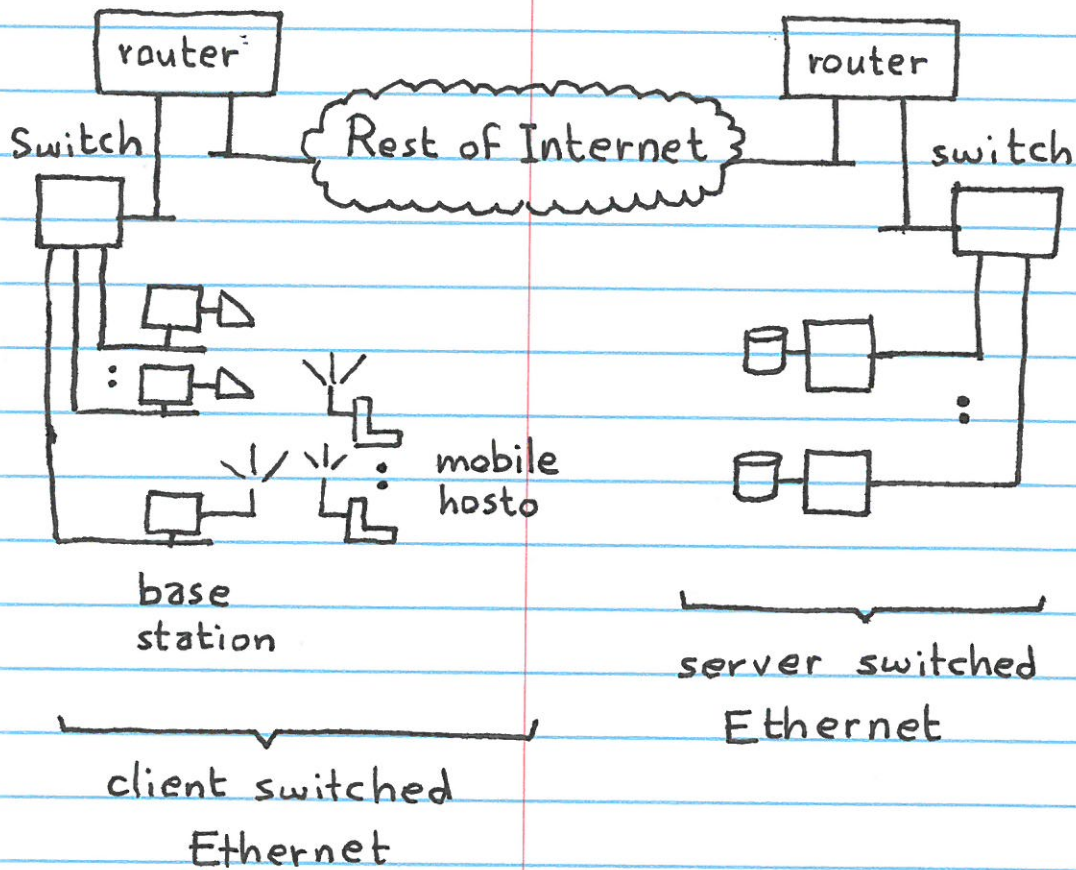
- server host:



- types of subnetwork technologies:

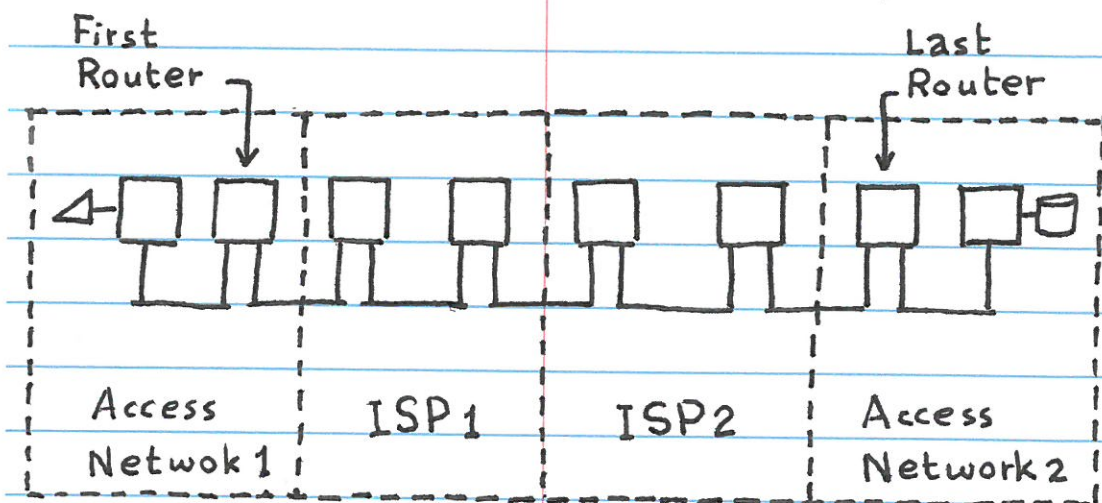
- LANs (switched Ethernets)
- wireless LANs
- phone lines
- TV cables
- satellite links

## Example: Enterprise Network 2



## Internet Service Providers (ISPs) 3

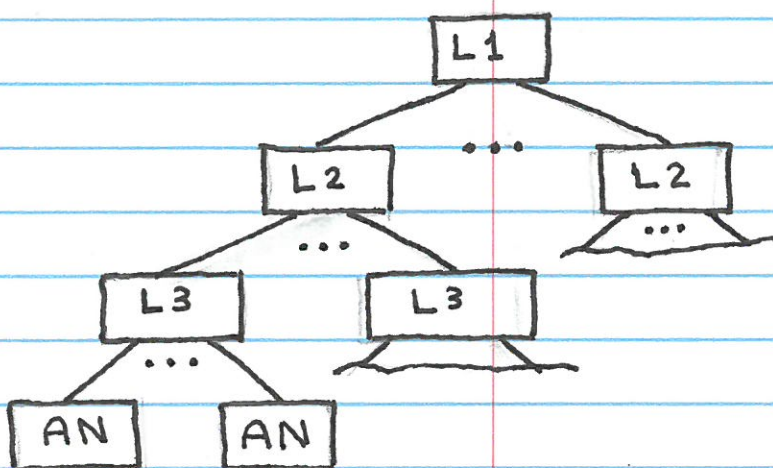
- to navigate a msg from a first router to a last router, the msg needs to go through a sequence of ISPs.
- each ISP is a set of inter-connected routers
- the ISPs are organized in a tree of 3 levels.



## The ISP Tree

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- has 4 levels:
  - L1: Tier-1 ISP
  - L2: Regional ISPs
  - L3: Local ISPs
  - L4: Access Networks (ANs)



- if  $L_i$  ISP is connected to  $L_{(i+1)}$  ISP then  $L_i$  ISP is a provider for  $L_{(i+1)}$  ISP and  $L_{(i+1)}$  ISP is a customer for  $L_i$  ISP

## ISP Tree Is Not Perfect

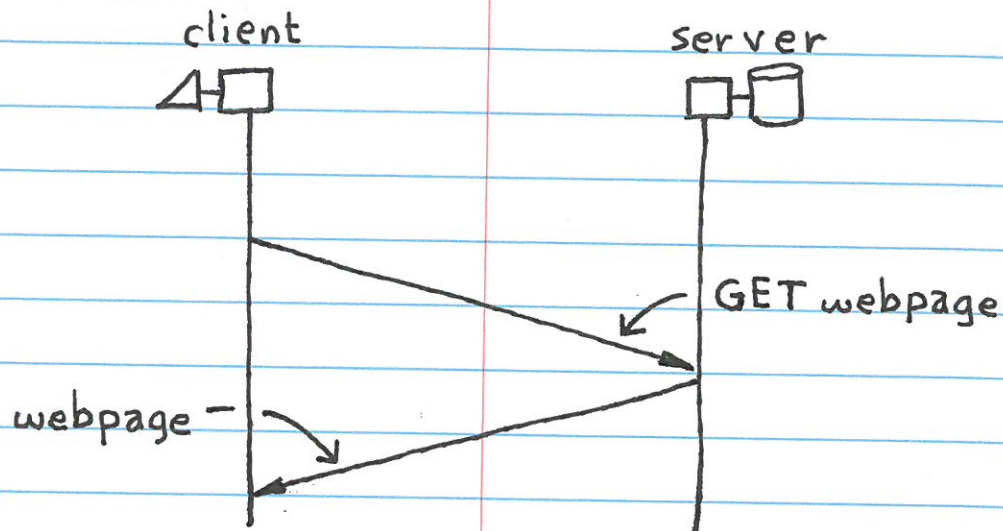
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- there is a dozen Tier-1 ISPs: AT&T, Sprint, NTT
- there are multiple regional ISPs for same region
- multihoming:  
an ISP in level  $i$  can be connected to 2 or more ISPs in level  $(i-1)$
- peering:  
two Access Networks can be connected on settlement-free basis
- shortcut:  
an Access Network or an ISP in level 3 can be connected directly to Tier-1 ISP

## Network Protocols

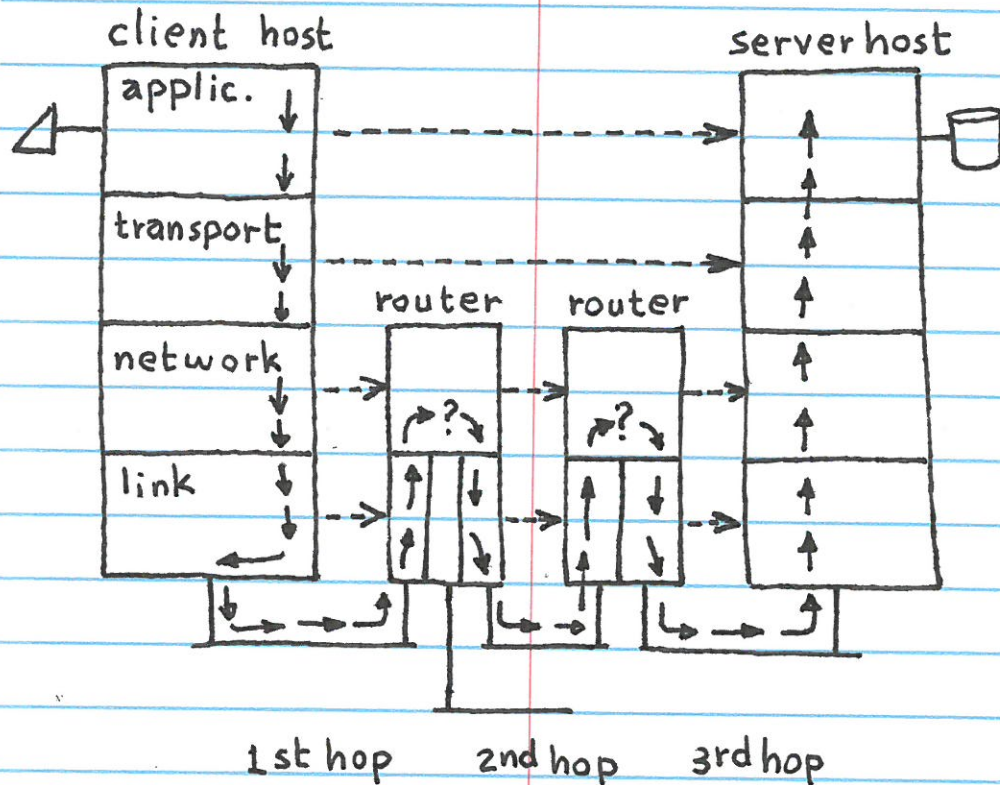
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### • example:



- A network protocol specifies:
  - formats of exchanged msgs
  - order in which msgs are sent and rcvd
  - actions that need to be executed when a msg is sent or rcvd

## Four Protocol Layers in Internet 7



- 2 types of communications:

-----> virtual

-----> physical



## Functions of Protocol Layers in Internet

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- application layer:

allows human user to execute desired applications, e.g. web, email, ...

- transport layer:

ensures that communication between original src and ultimate dst satisfies some end-to-end properties, e.g. reliable data transfer, flow control, ...

- network layer:

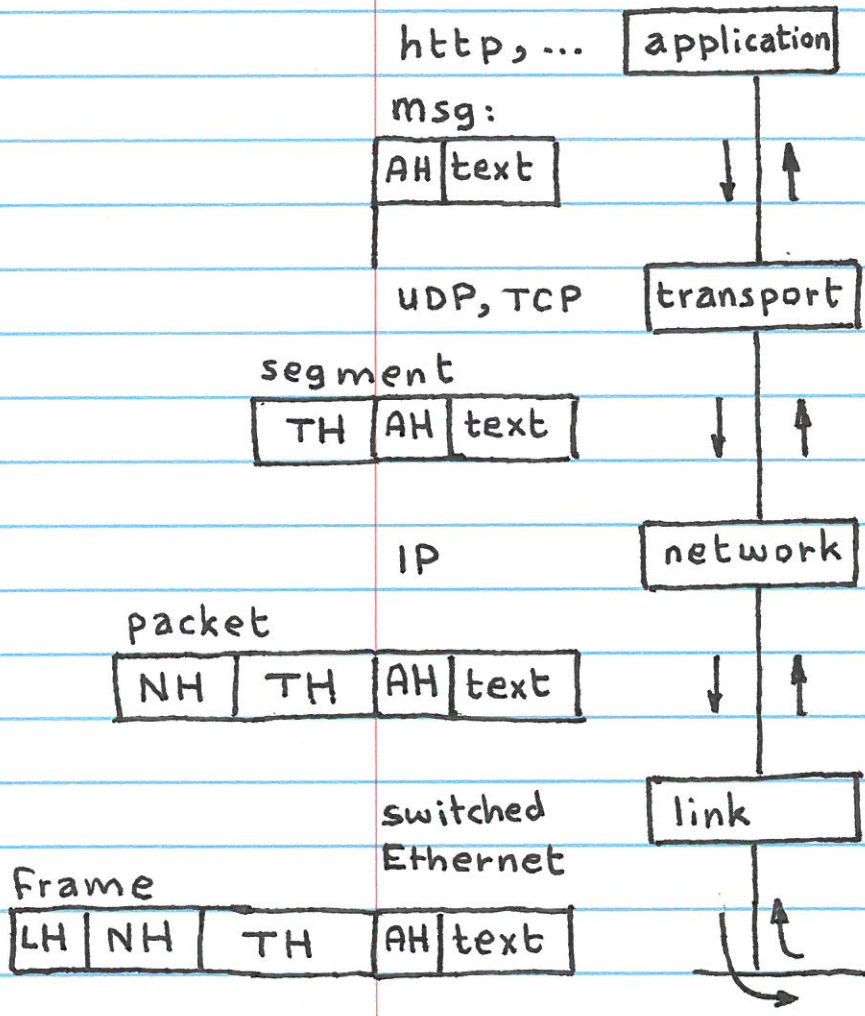
routes a msg through several hops from original src and ultimate dst

- link layer:

transmits a msg one hop from one computer to another over one subnetwork

# Msg Encapsulation

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- AH : application header
- TH : transport header
- NH : network header
- LH : link header