

# Advanced Networking

## Introduction

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# Course goals

- Advanced topics in networking
  - cross-layer vision
  - advanced functionalities
  - design, performance, management
- Organization
  - 36 h course
  - concepts, exercises
- Lab
  - 18 h OSPF, BGP
- Grading
  - written examination - 2/3, open books
  - Lab - 1/3

# Contents

- Interconnection Layer 2
  - Bridges/switches, Spanning Tree Protocol
- Interconnection Layer 3 – Routing
  - Distance vector, Link State, external (BGP)
- Congestion control
- Quality of service
- MPLS
- SNMP
- Data Center Networking

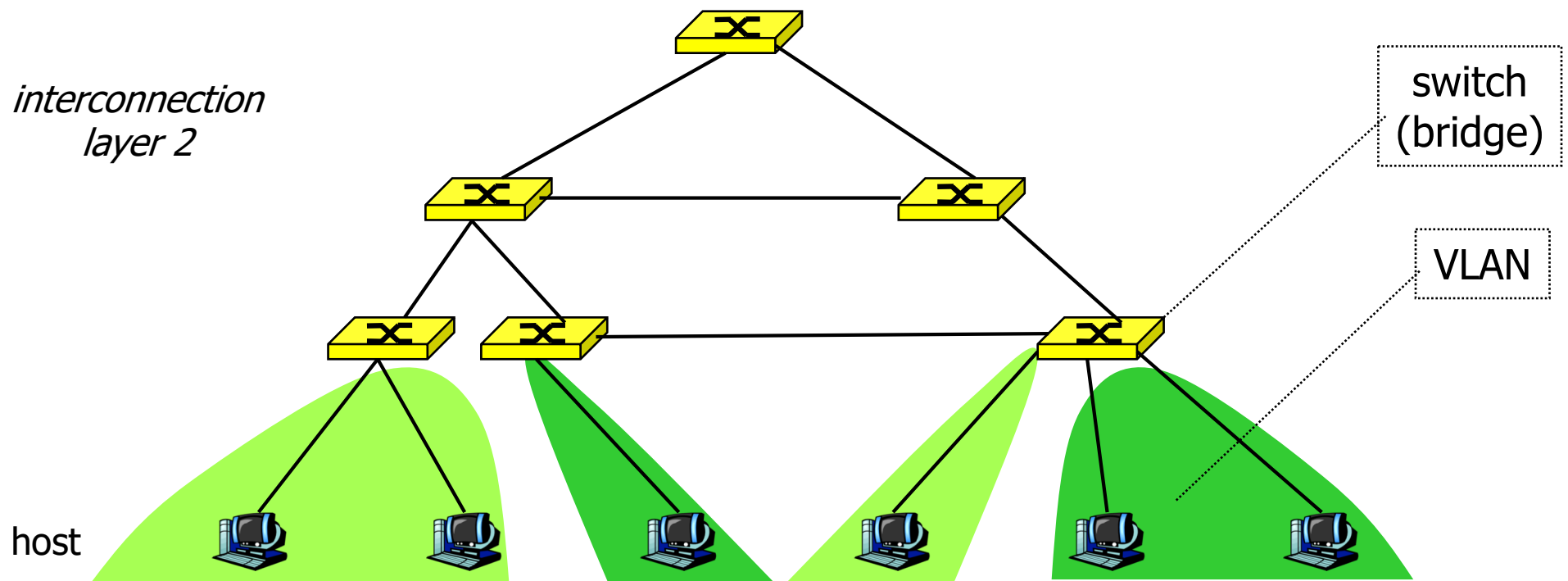
# Course support

- Chamilo
- C. Huitema "Routing in the Internet"
- R. Perlman " Interconnections: Bridges, Routers, Switches, and Internetworking Protocols"
- Web, papers

# Overview

- Internet architecture

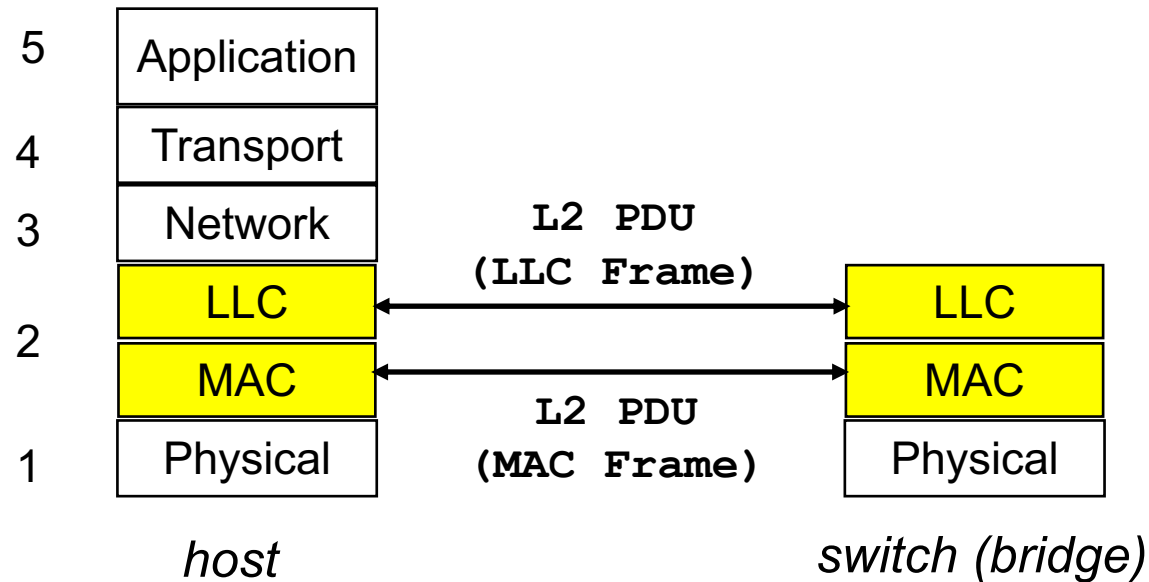
# Interconnection structure - layer 2



# Interconnection at layer 2

- Switches (bridges)
  - interconnect hosts
  - logically separate groups of hosts (VLANs)
  - managed by one entity
- Type of the network
  - broadcast
- Forwarding based on MAC address
  - flat address space
  - forwarding tables: one entry per host
  - works if no loops
    - careful management
    - Spanning Tree protocol
  - not scalable

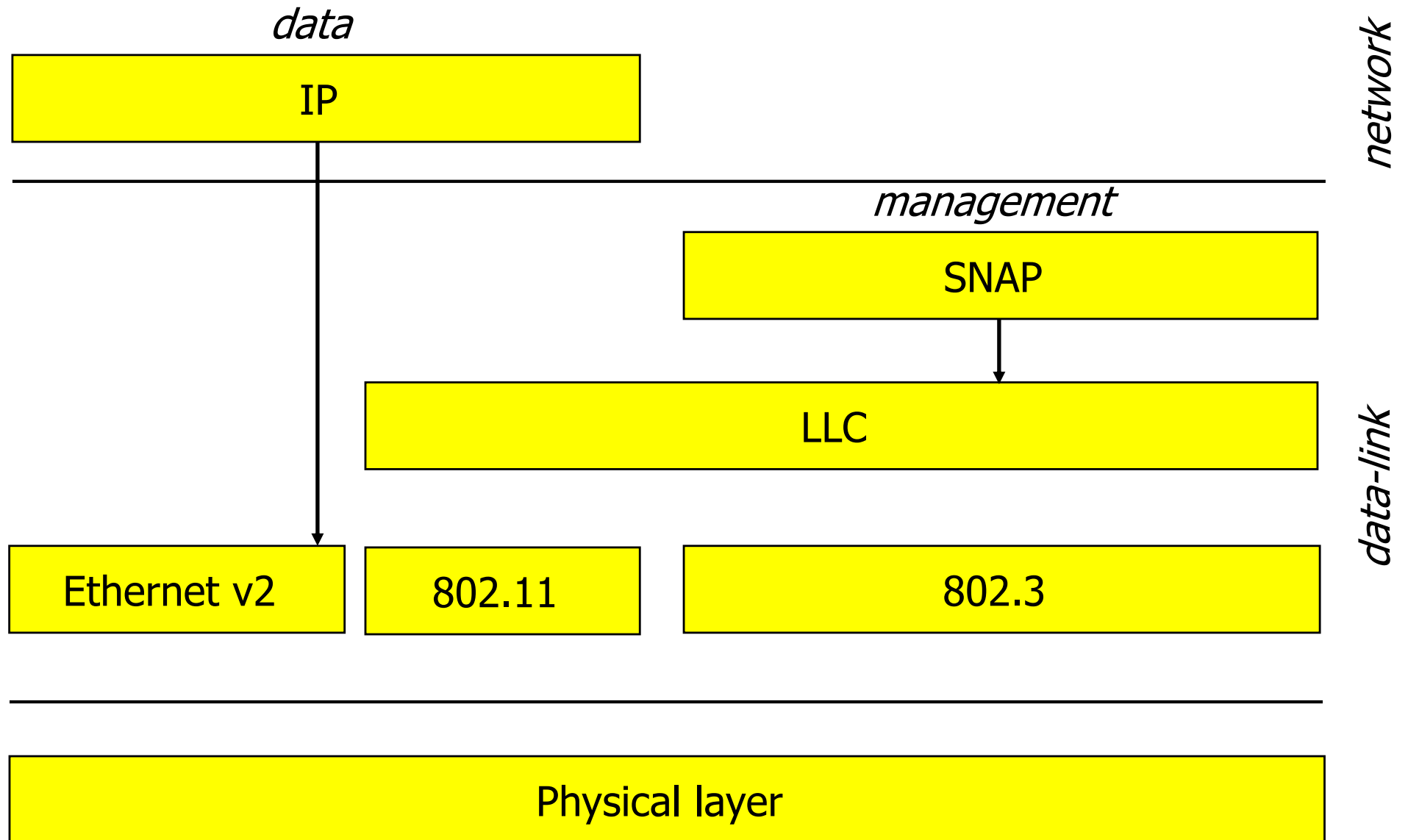
# Protocol architecture



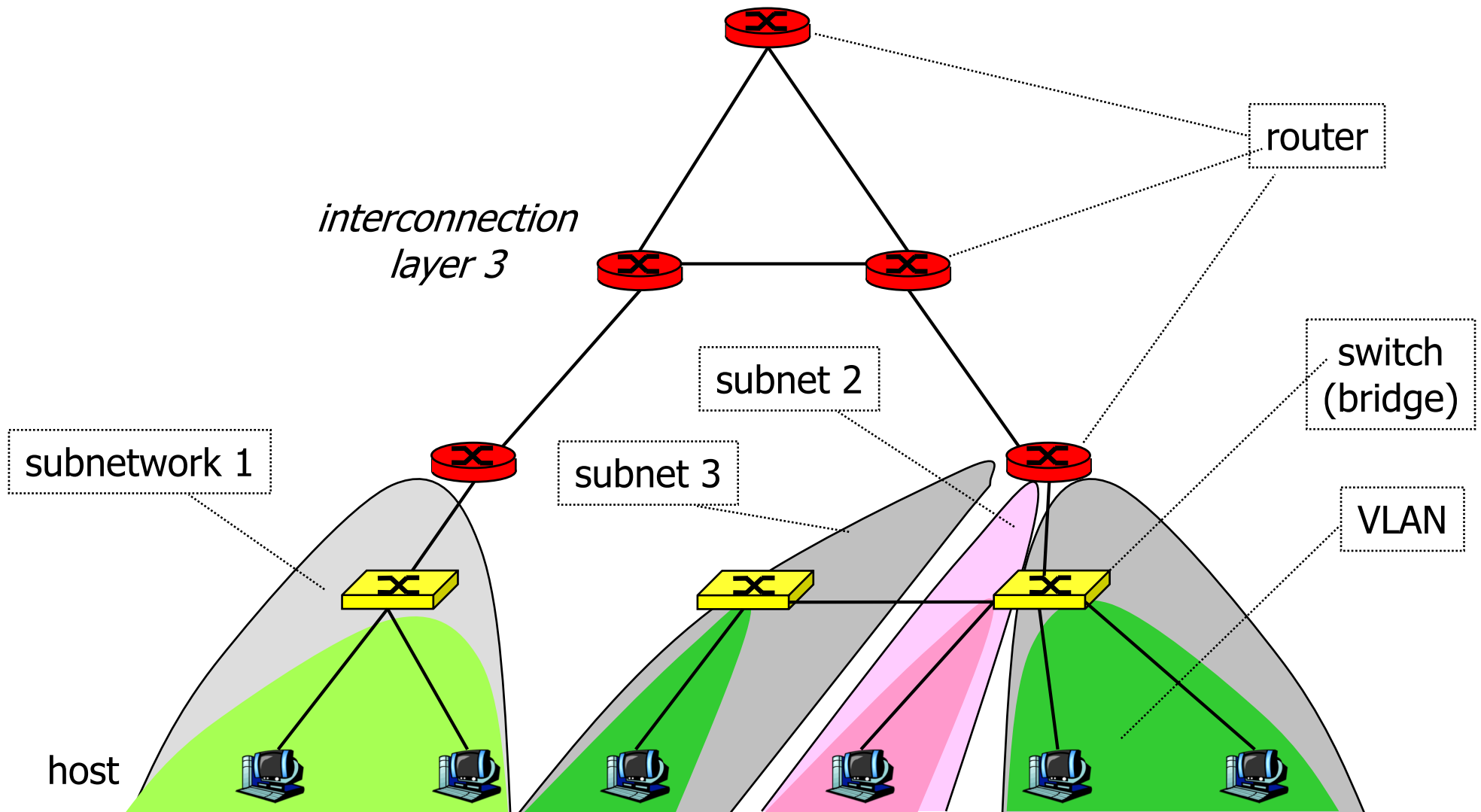
- Switches are layer 2 intermediate systems
- Transparent forwarding
- Management protocols (Spanning Tree, VLAN)



# Protocols



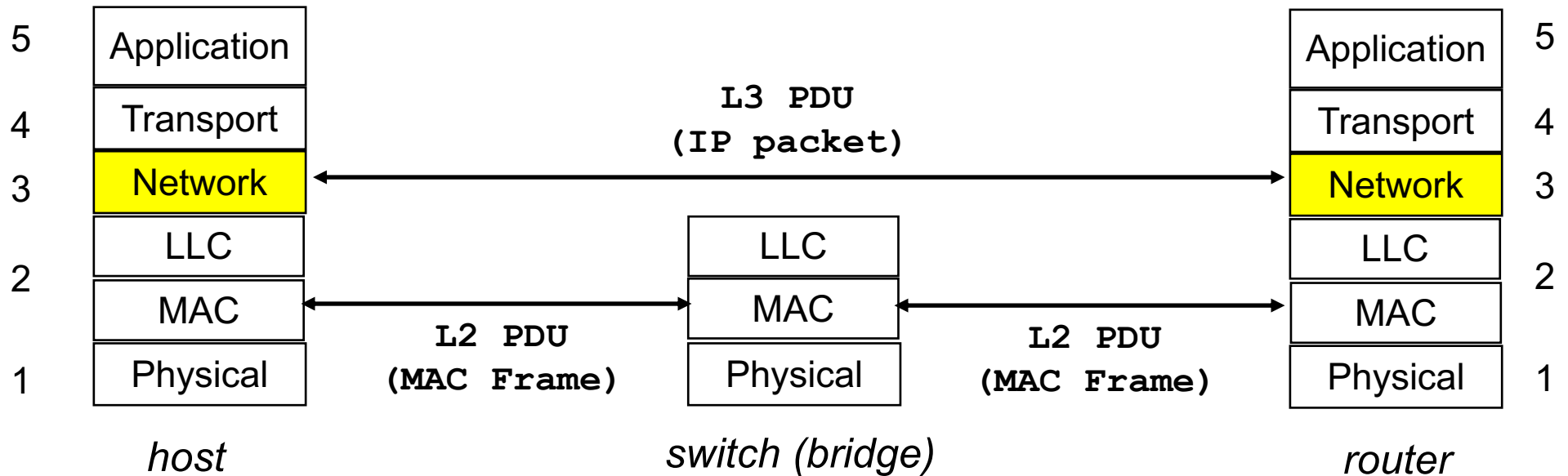
# Interconnection structure - layer 3



# Interconnection at layer 3

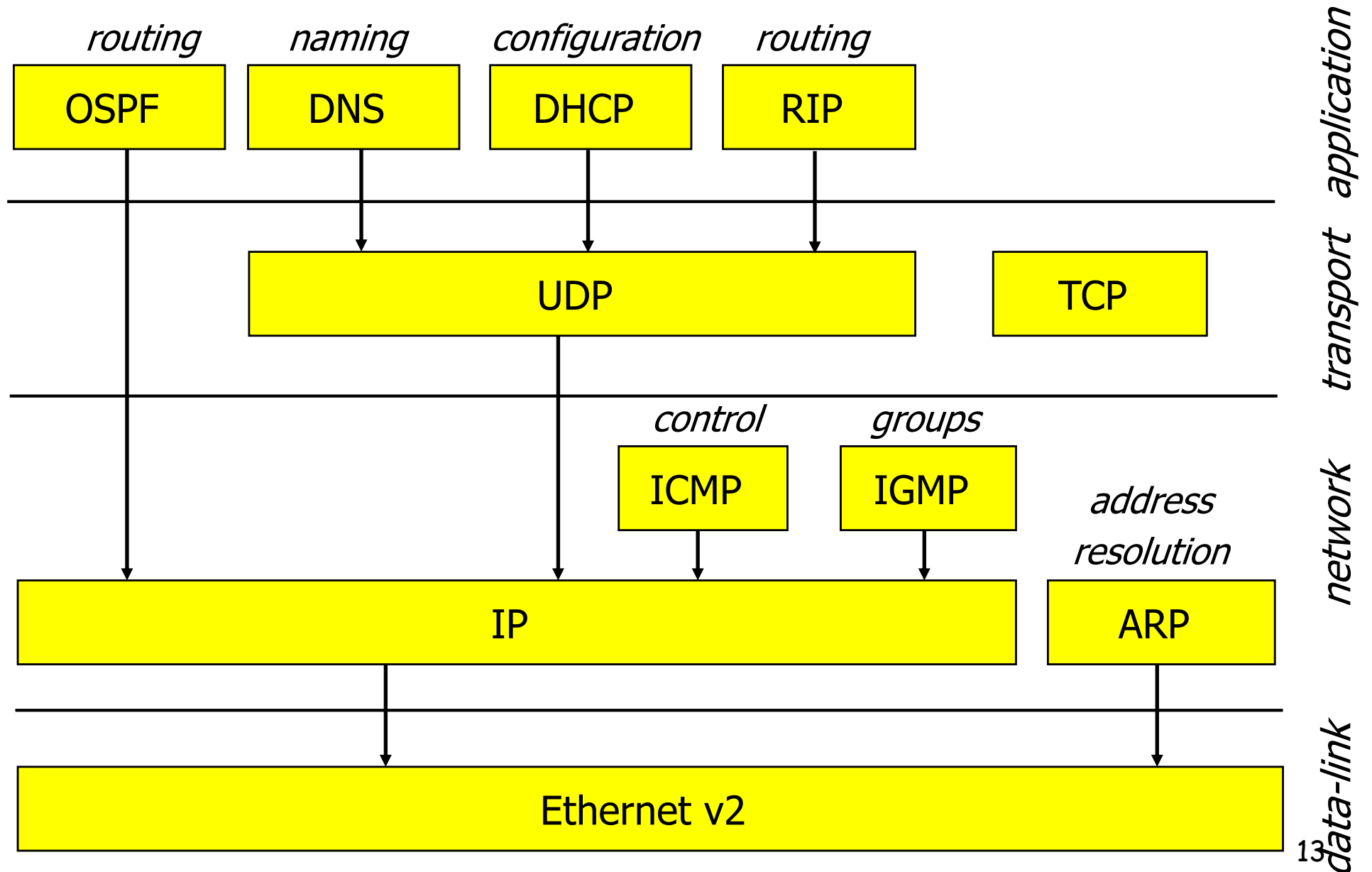
- Routers
  - interconnect subnetworks
  - logically separate groups of hosts
  - managed by one entity
- Forwarding based on IP address
  - structured address space
  - routing tables: aggregation of entries
  - works if no loops - routing protocols (IGP - Internal Routing Protocols)
  - scalable inside one administrative domain

# Protocol architecture

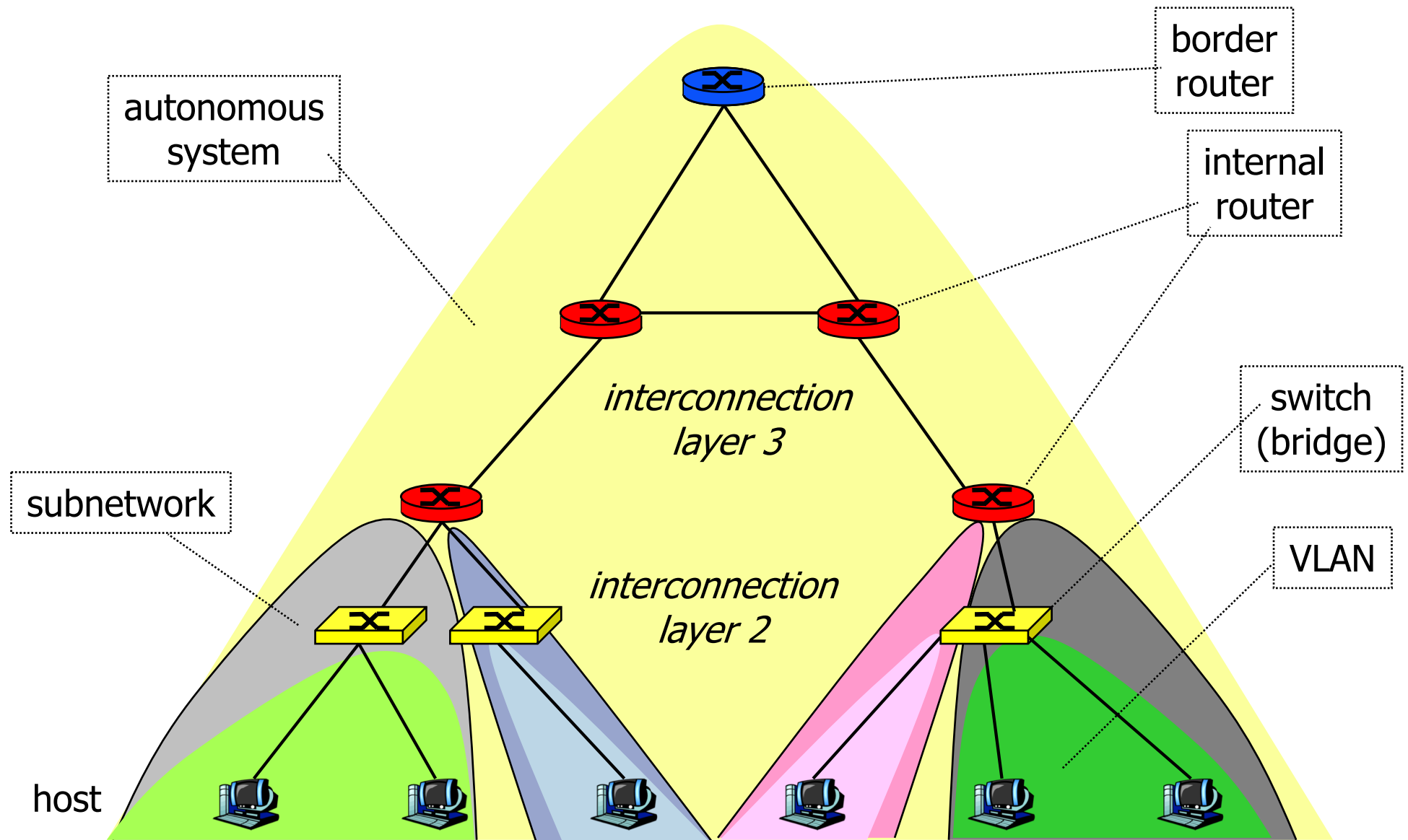


- Routers are layer 3 intermediate systems
- Explicit forwarding
  - host has to know the address of the first router
- Management protocols (control, routing, configuration)

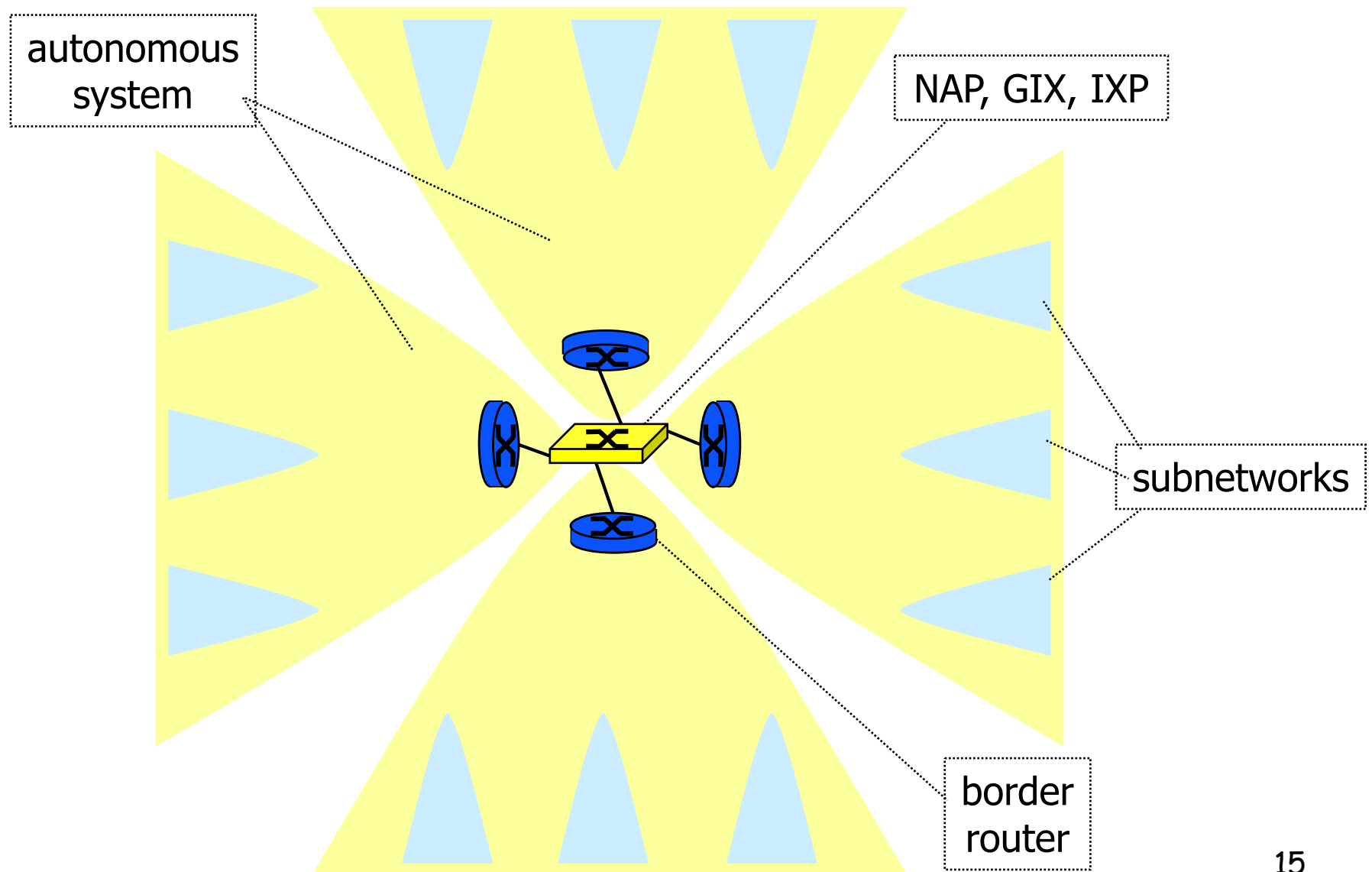
# Protocols



# Autonomous systems



# Internet

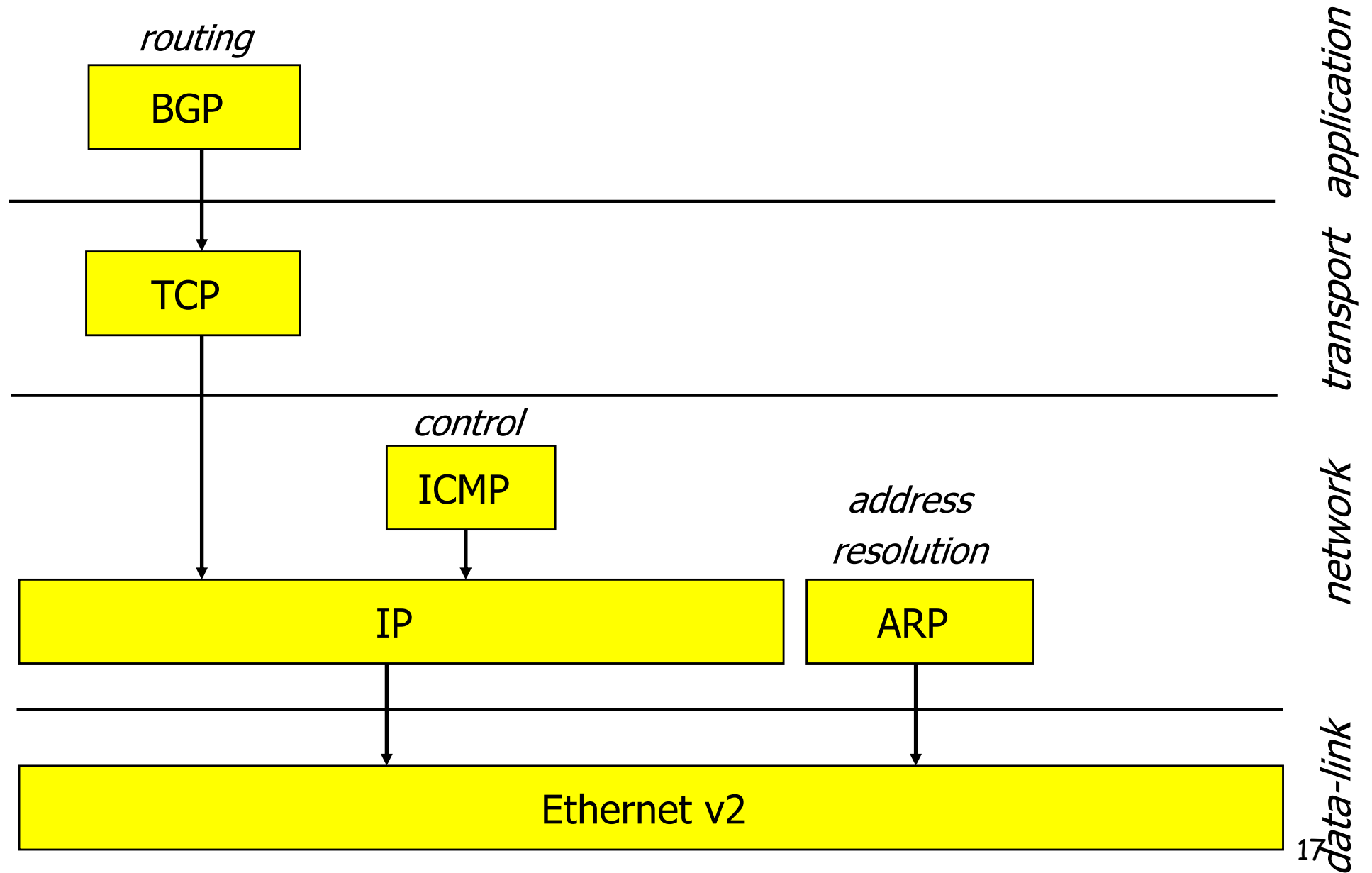


# Interconnection of AS

- Border routers
  - interconnect AS
- NAP or GIX, or IXP
  - exchange of traffic - peering
- Route construction
  - based on the path through a series of AS
  - based on administrative policies
  - routing tables: aggregation of entries
  - works if no loops and at least one route - routing protocols (EGP - External Routing Protocols)



# Protocols



# Conclusion

- Complex architectures
  - other types of networks used as data links
- Internet
  - Rapid growth
    - scalability
  - No central control
    - consistent development
  - Three level hierarchy
    - host, subnetwork, autonomous system
    - manage complexity
  - Advances
    - larger address space - IPv6
    - performance - quality of service, congestion control