Communication Networks:
Technology & Protocols

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Lecture 3
August 27

Logistics

- Web site:
  - www.cs.berkeley.edu/~amc/eecs122
- Book:
  - Jean Walrand, *Communication Networks, A first course*, **2nd edition**, 1998
- Enrollment:
  - Please check your name on the class list or waiting list (add your name if you are not there already).
- Office hours: Mon 10-11am, Thu 4-5pm
- Grading: 25% + 2*15% + 30% + [15,30]%

Summary of last lecture

- Networks provide **services.**
- Networks have to be **open** (interoperable, extensible).
- Networks have to be **scalable.**
- Networks have to support **diverse** applications.
- Designers have to make **good utilization** of the resources of the network (in order to achieve **cost-effectiveness**).

Note: diversity often in conflict with cost effectiveness.

Summary: applications

- Different applications have **different** (bit-rate) **requirements**:
  - Constant bit-rate traffic (e.g., voice, video).
  - Bursty traffic (e.g., file transfer, web, e-mail).
- Other requirements: delay, loss probability.
- Quality of service (QOS).

Summary: Telephone network & Internet

- Telephone network: circuit-switched.
  - Fixed allocation of resources.
  - Well-suited for CBR traffic, inefficient for bursty traffic.
  - Interoperable and scalable, but not easy to extend.
- Internet: packet-switched.
  - Allocation of resources on-demand.
  - Interoperable, scalable, diverse, very efficient.
  - But: no QOS guarantees.

The Internet: properties.

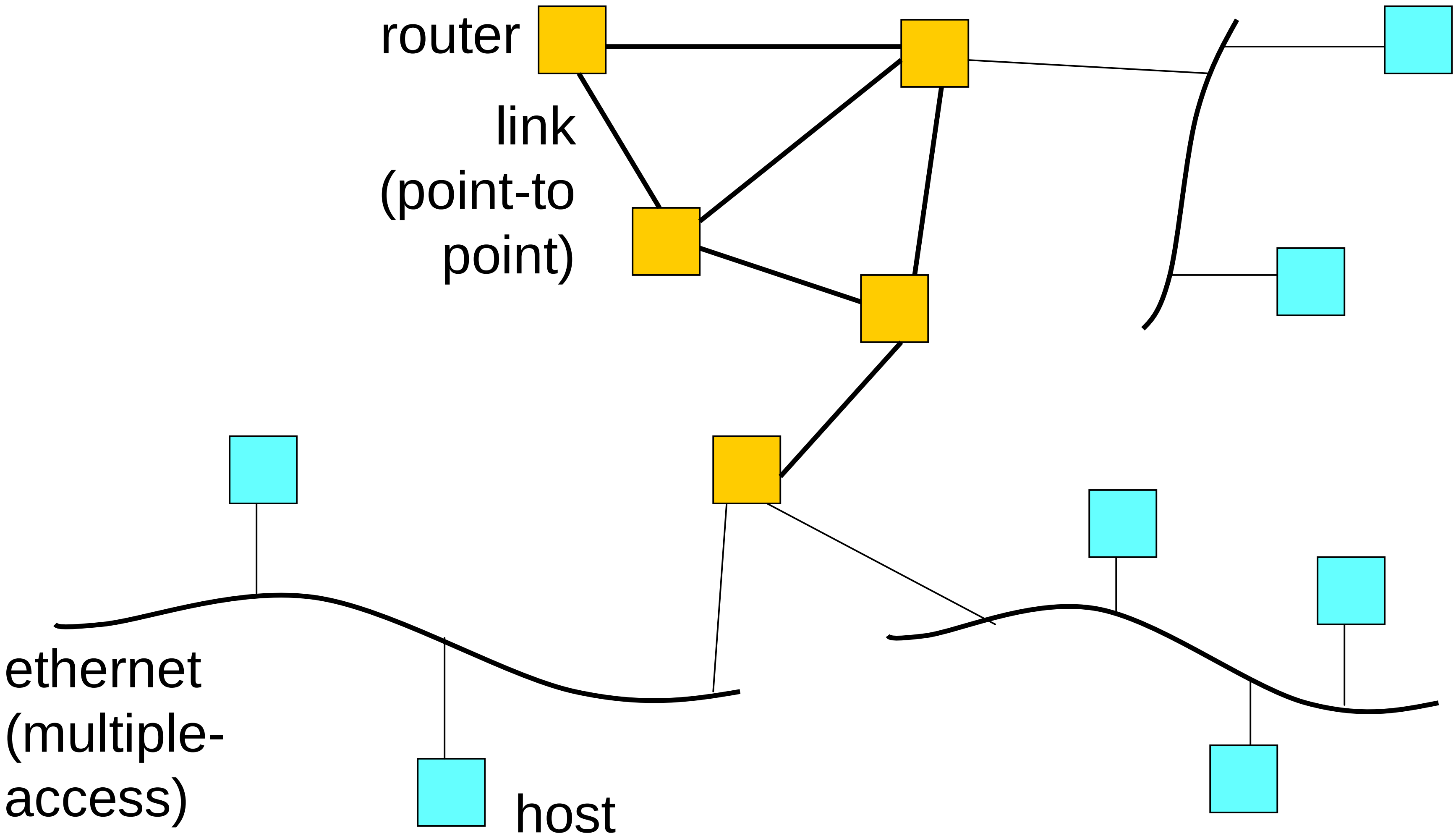
- Interoperability : good.
- Scalability: good (IP addresses ?).
- Diversity / Extensibility : very high, but no guarantees for applications.
- Cost-effectiveness : very good.

Broadband Integrated Services Data Network (BISDN)

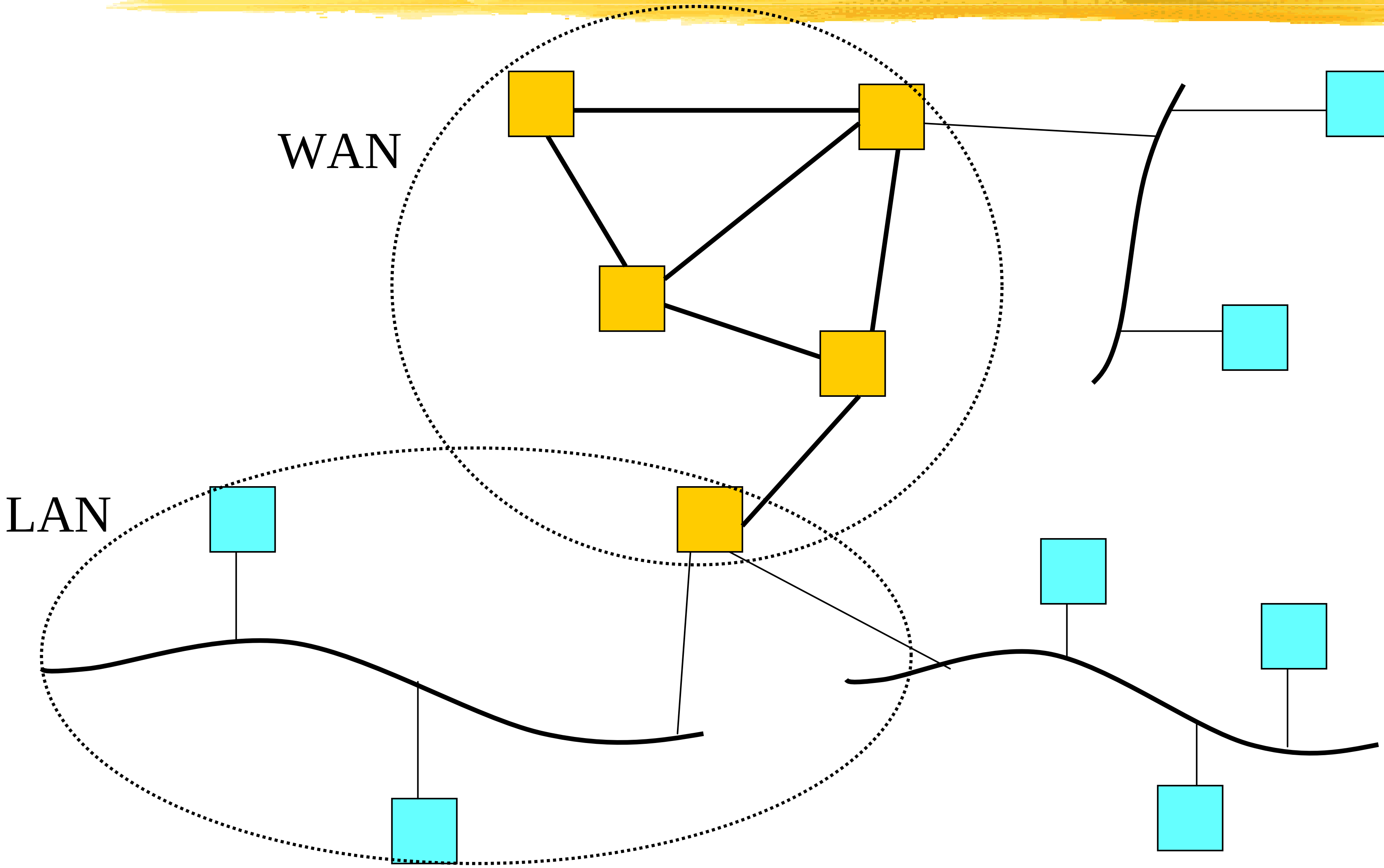
Can we extend the Internet so that it supports all kinds of applications ?

- ATM technology tries to achieve this.
- This course:
  - Understand Internet.
  - Learn ATM principles.

A small Internet

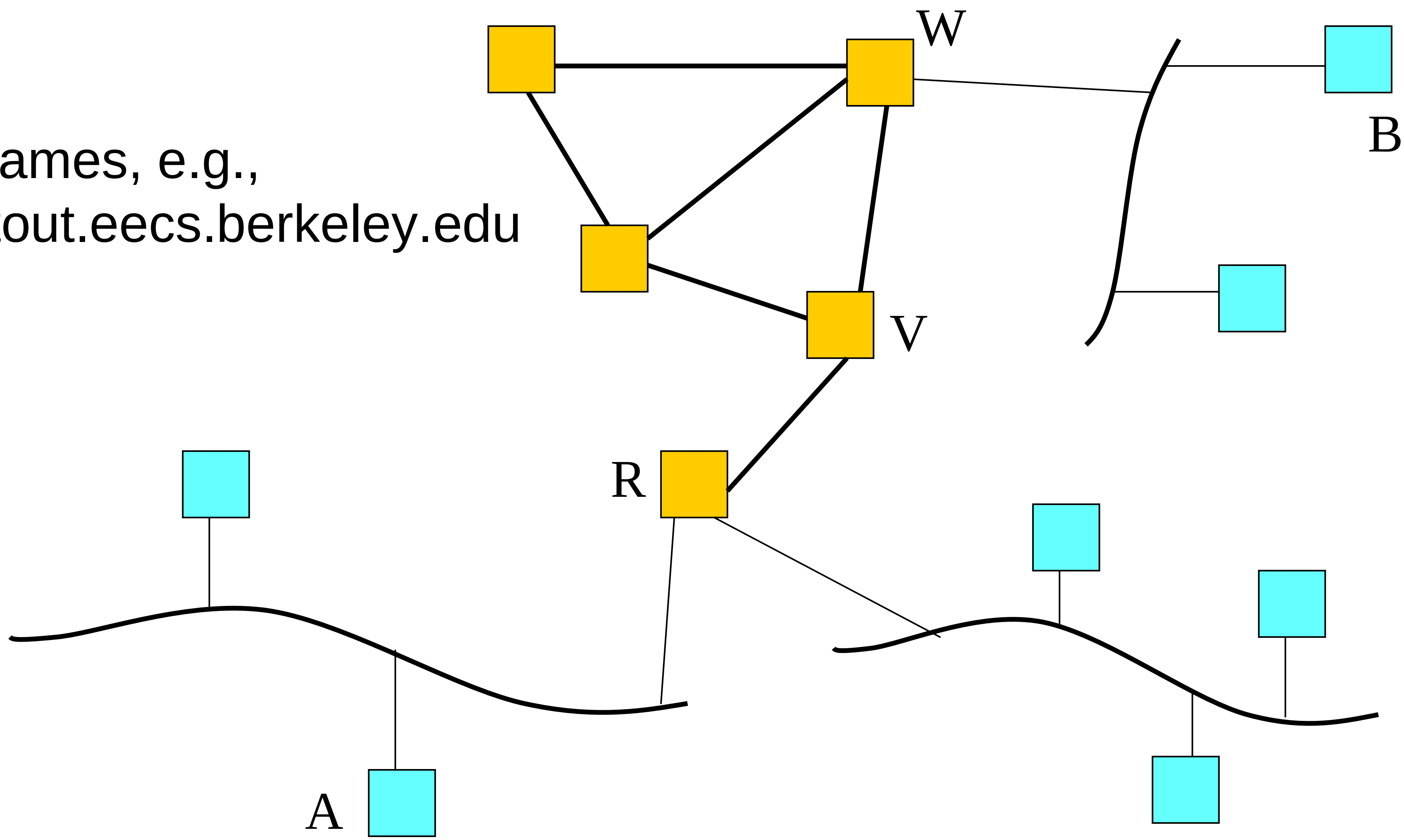


A small Internet



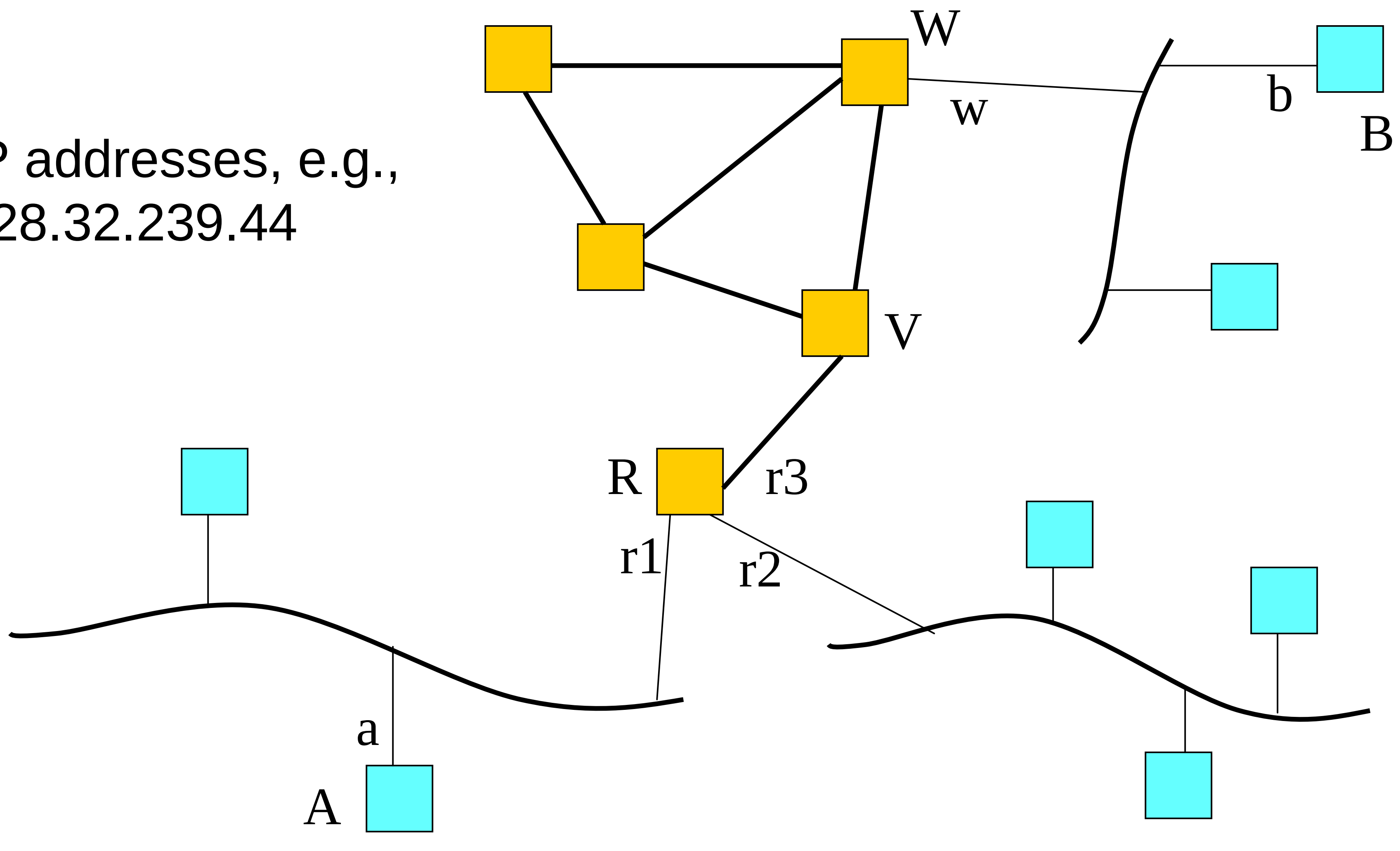
A small Internet

Names, e.g.,
stout.eecs.berkeley.edu



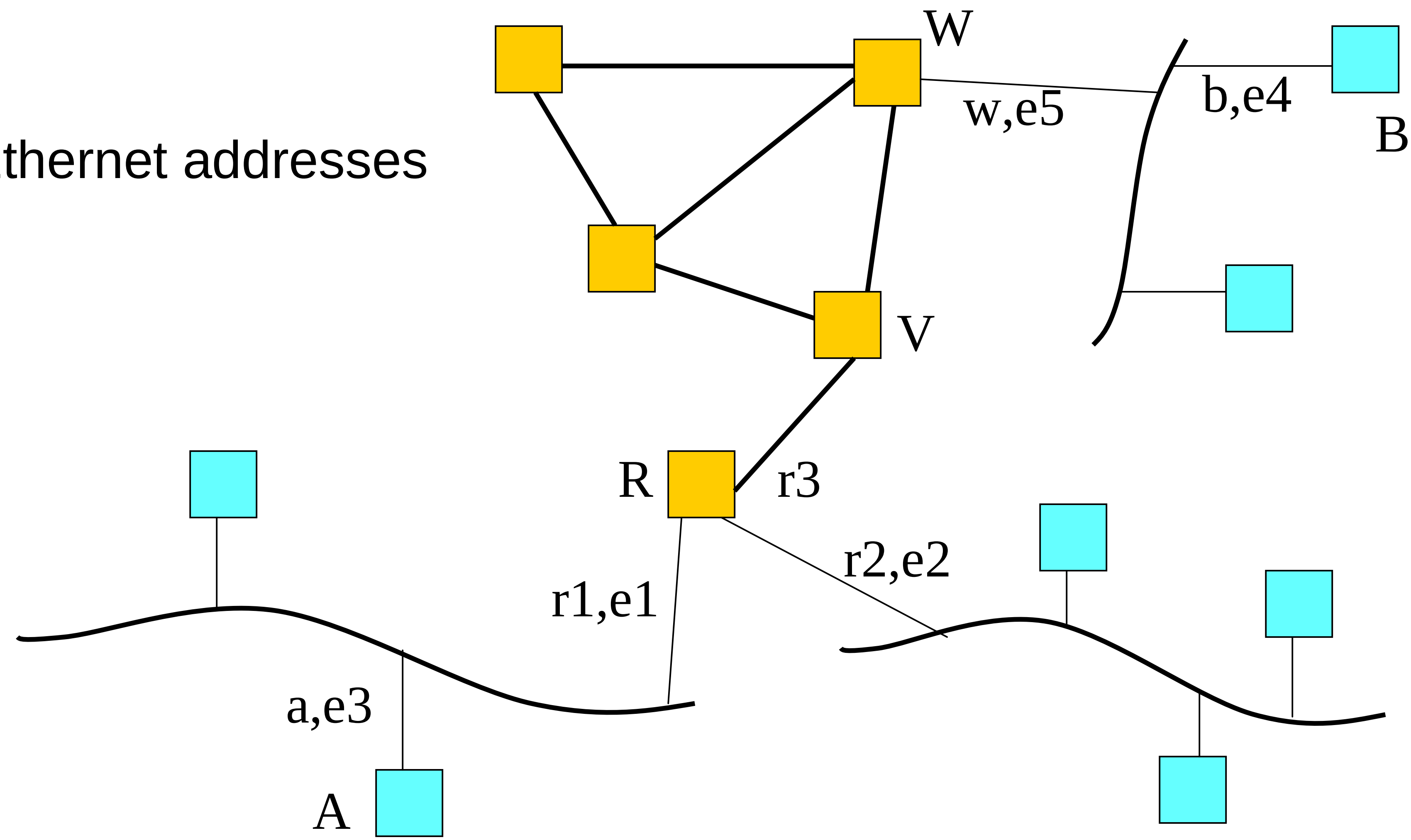
A small Internet

IP addresses, e.g., 128.32.239.44



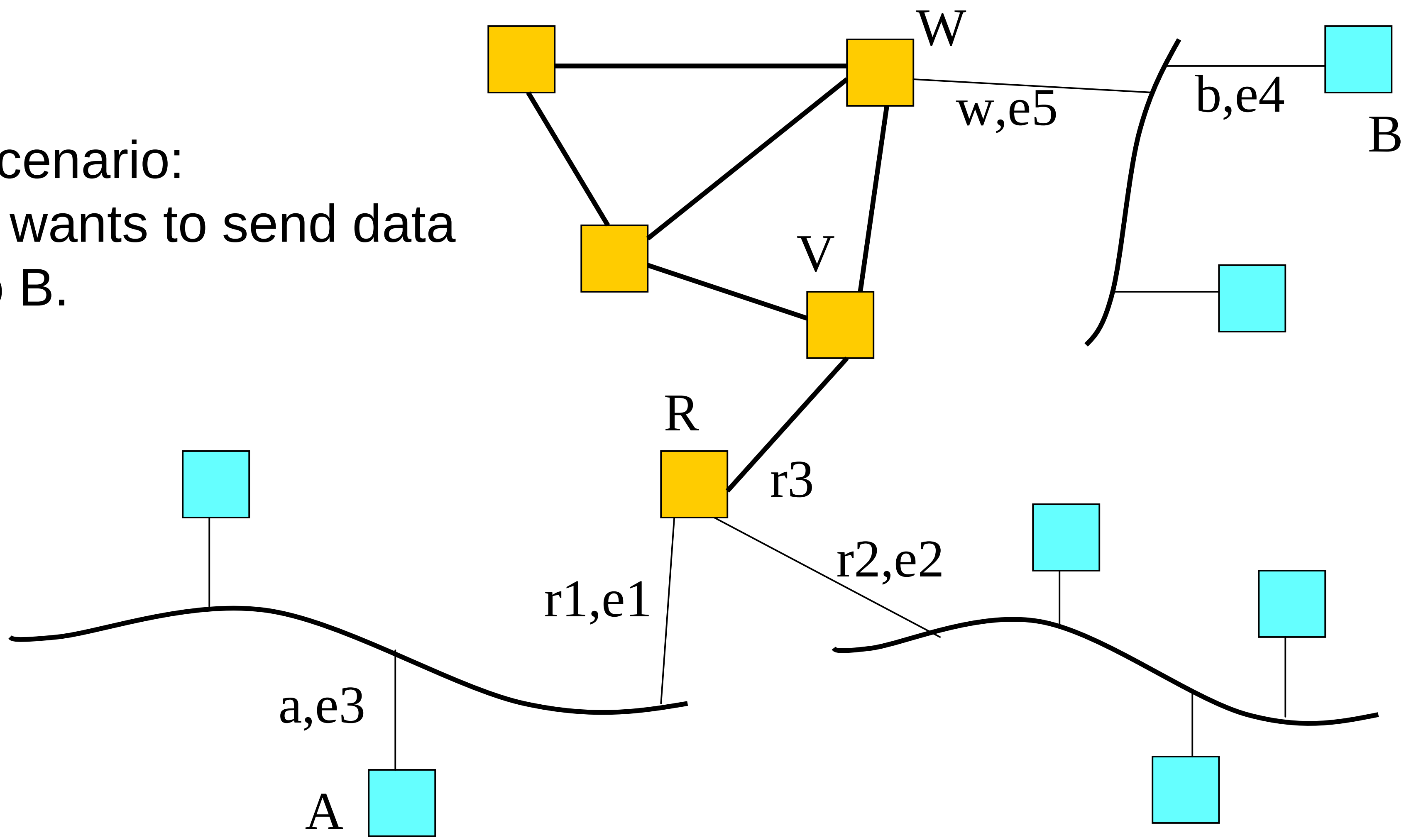
A small Internet

Ethernet addresses



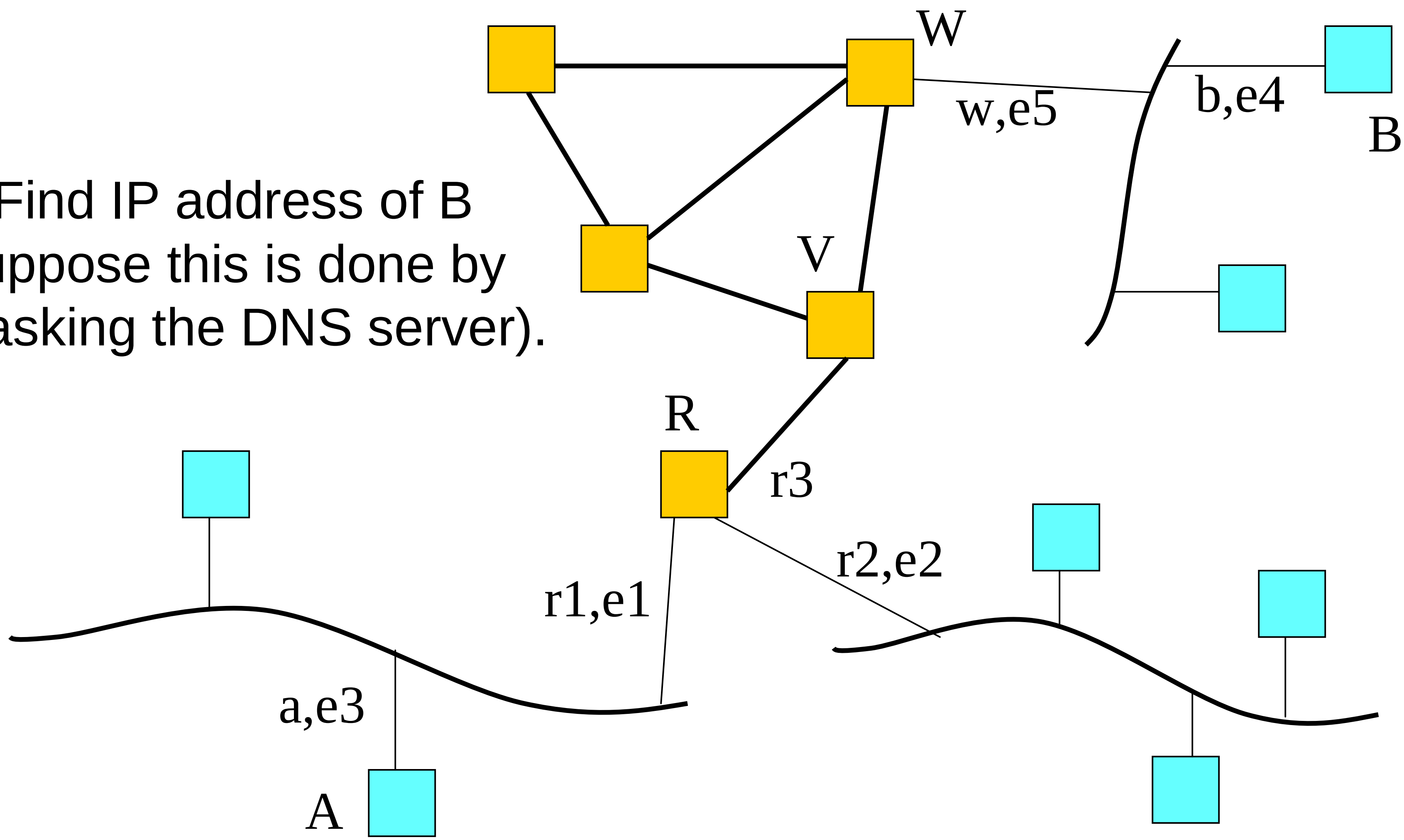
A small Internet

Scenario:
A wants to send data to B.



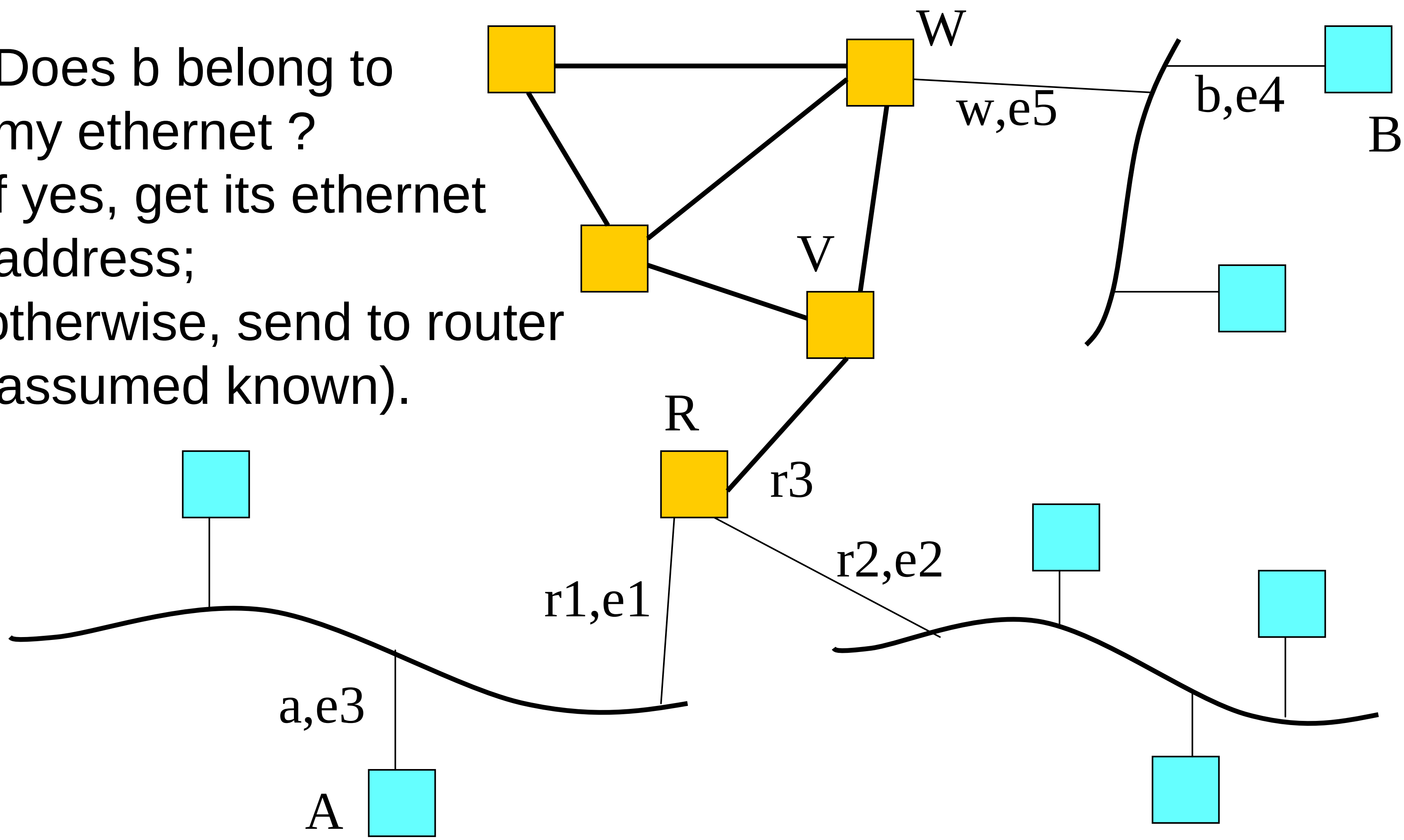
A small Internet

1. Find IP address of B (suppose this is done by A asking the DNS server).



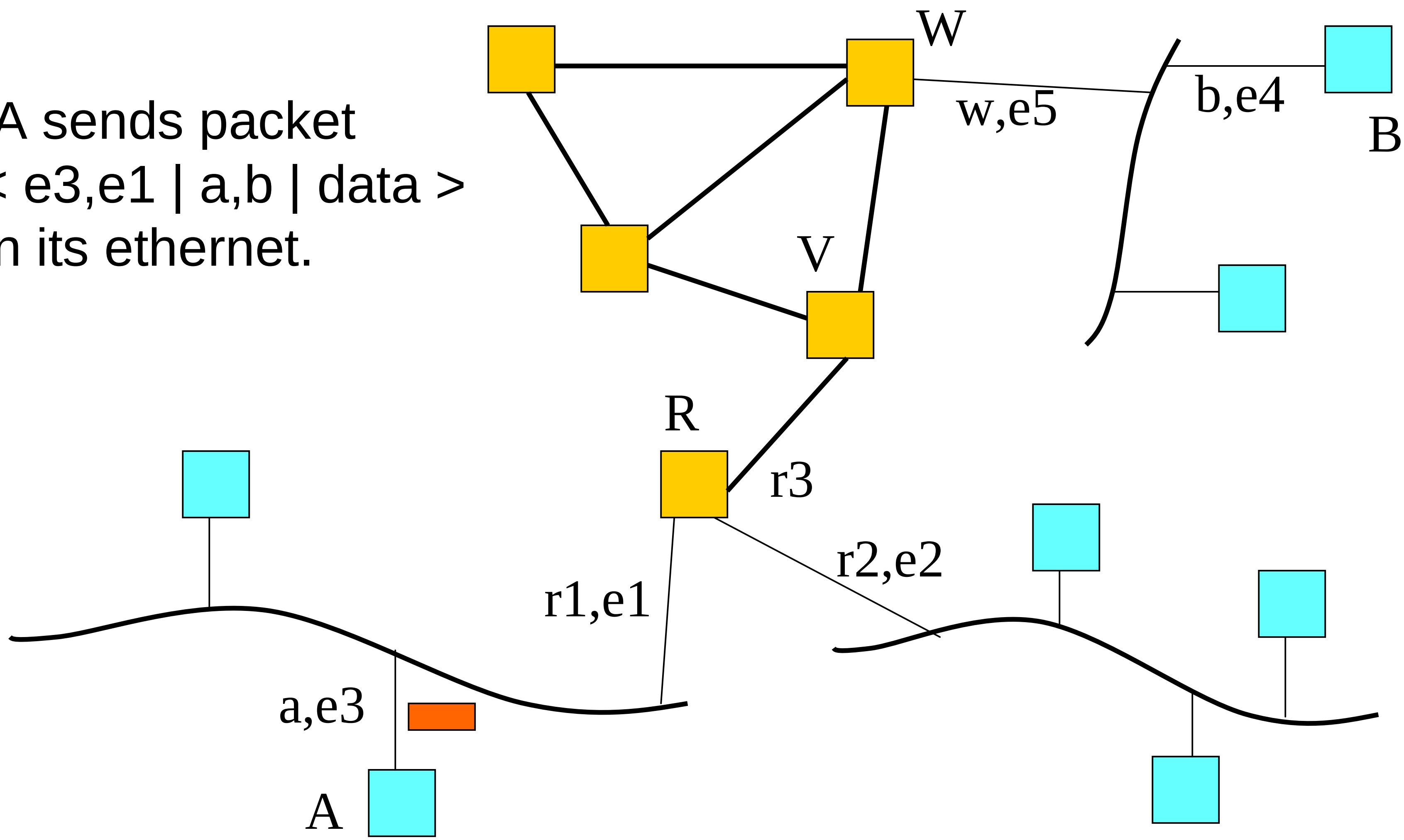
A small Internet

2. Does b belong to my ethernet ?
- if yes, get its ethernet address;
- otherwise, send to router (assumed known).



A small Internet

3. A sends packet
< e3,e1 | a,b | data >
on its ethernet.



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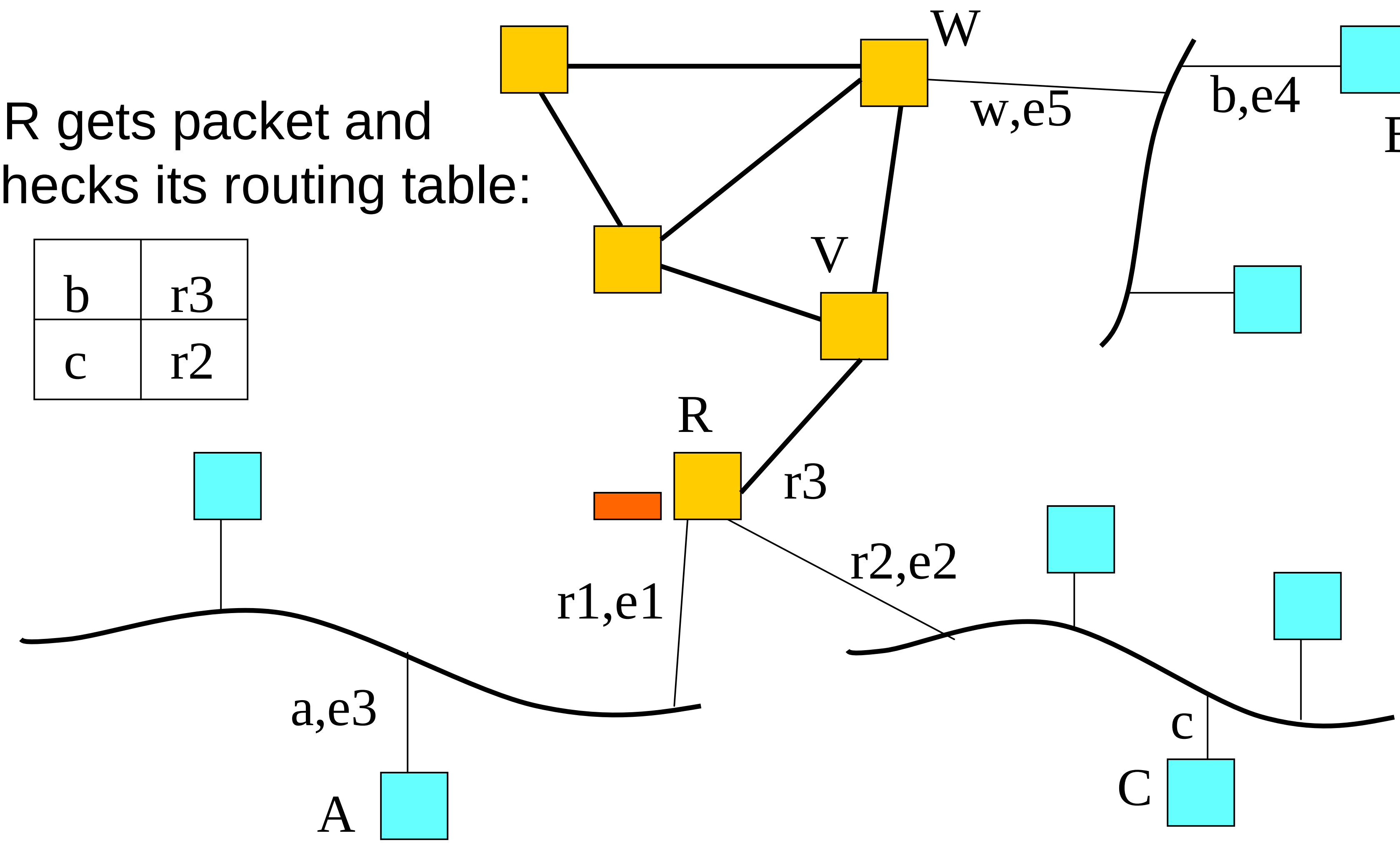
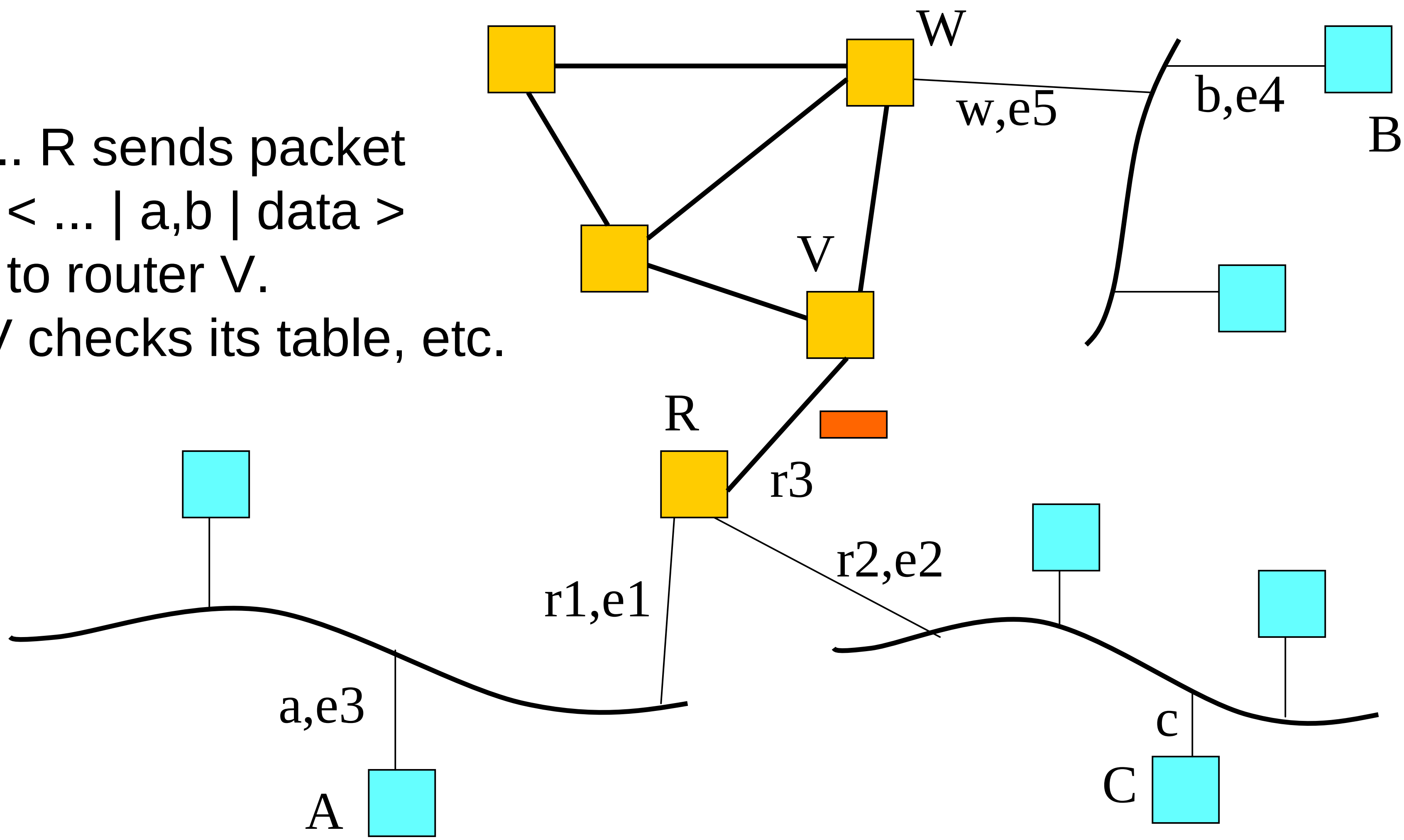
4. R gets packet and
   checks its routing table:

b	r3
c	r2



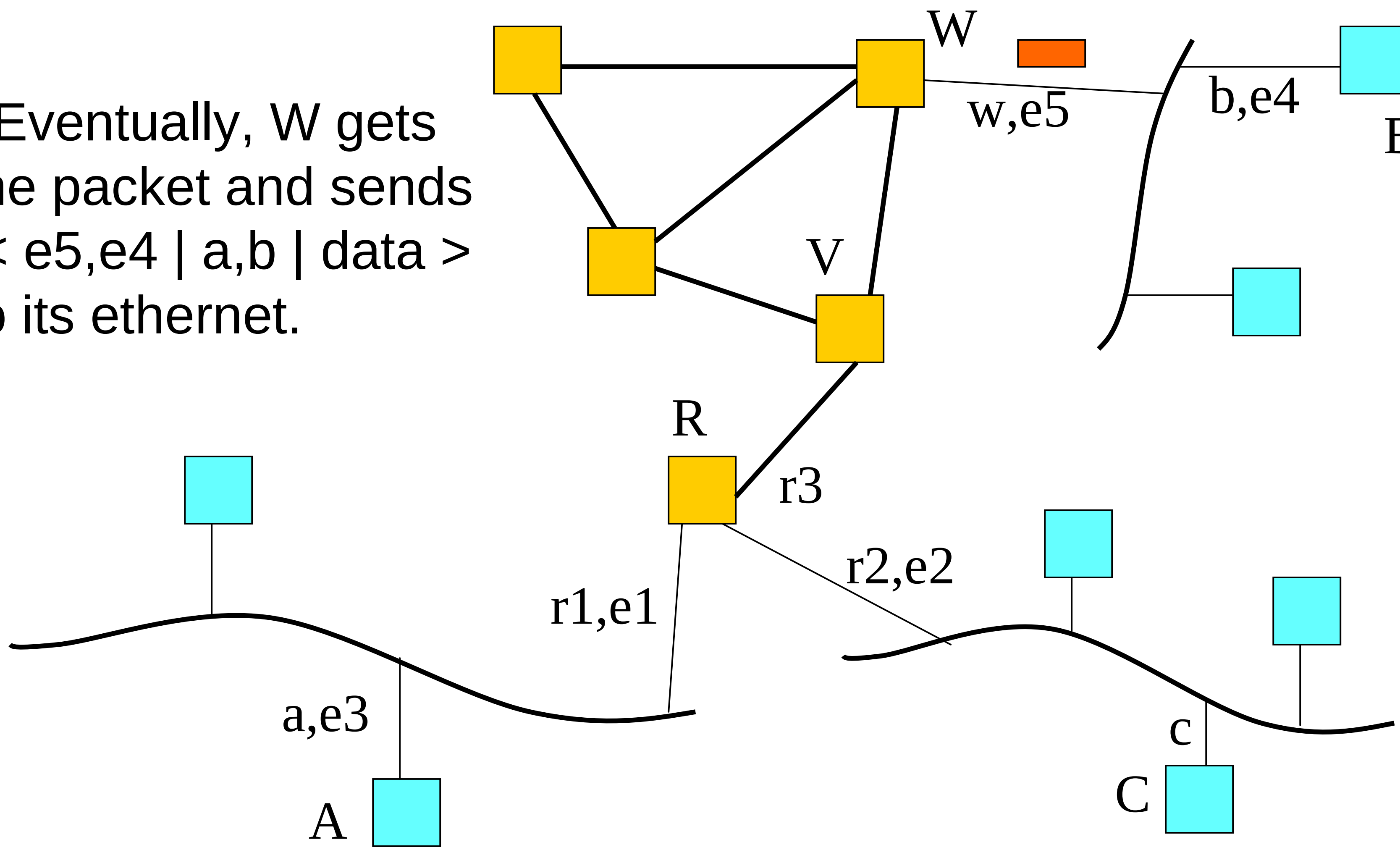
A small Internet

5-... R sends packet
< ... | a,b | data >
to router V.
V checks its table, etc.



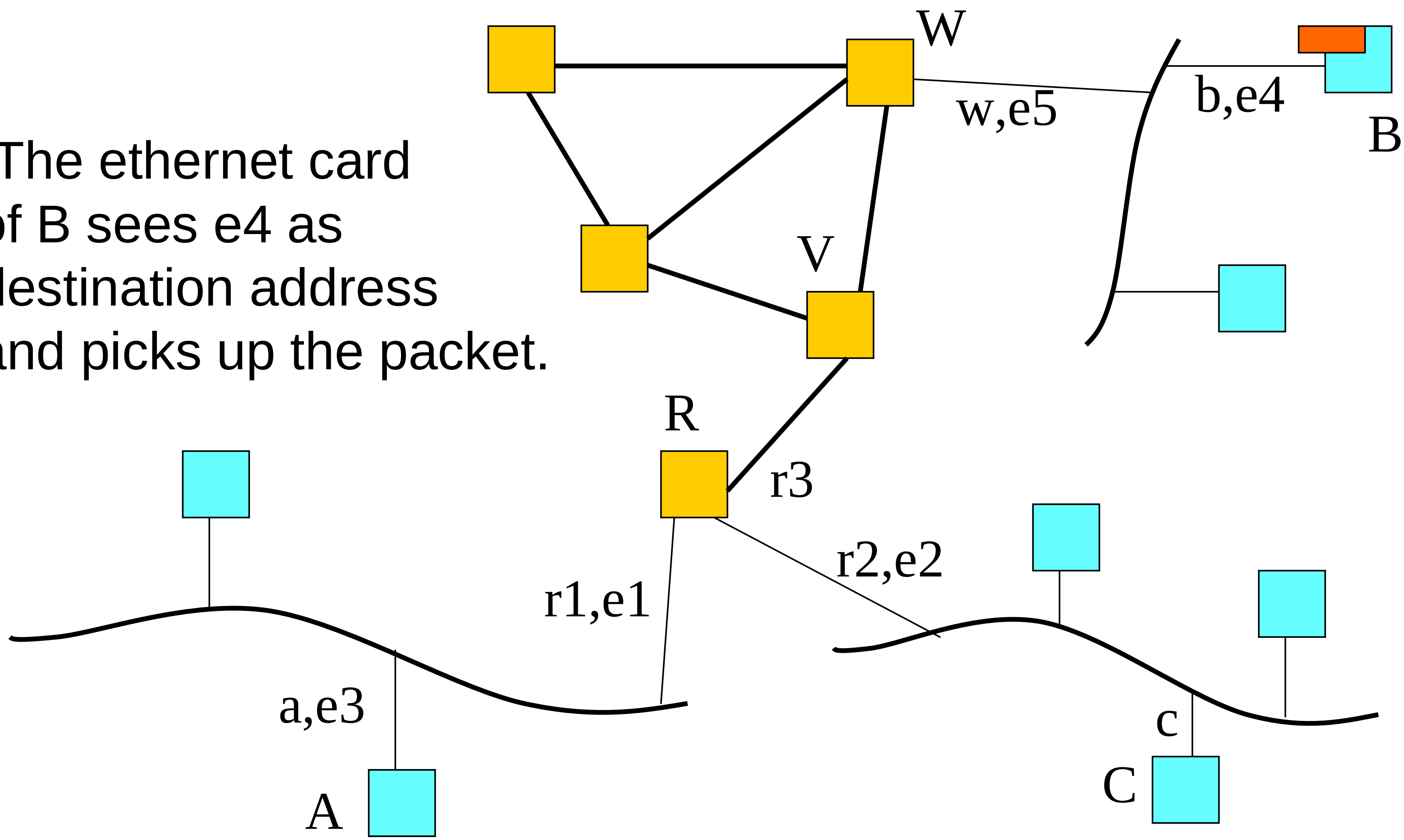
A small Internet

6. Eventually, W gets the packet and sends < e5,e4 | a,b | data > to its ethernet.



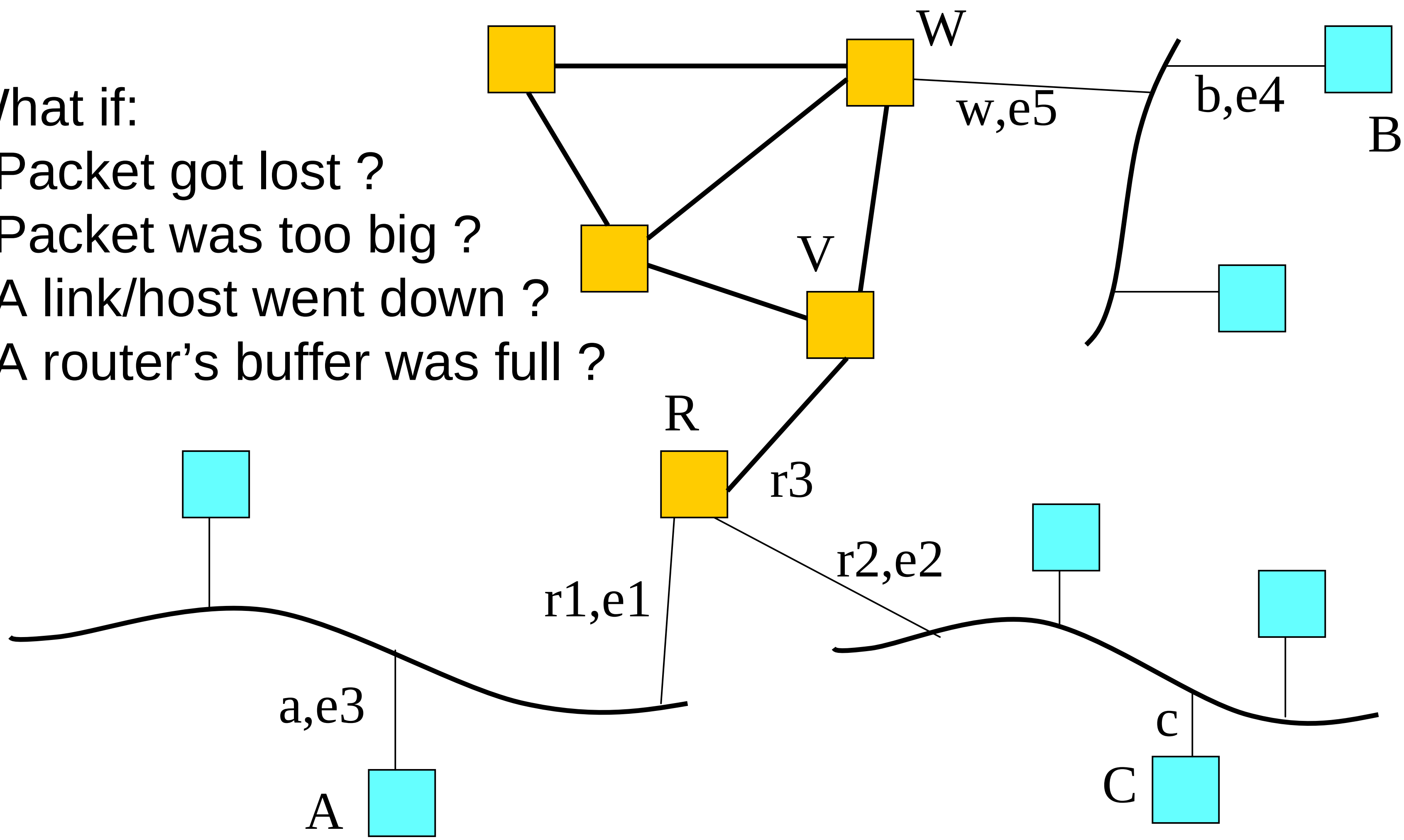
A small Internet

7. The ethernet card of B sees e4 as destination address and picks up the packet.

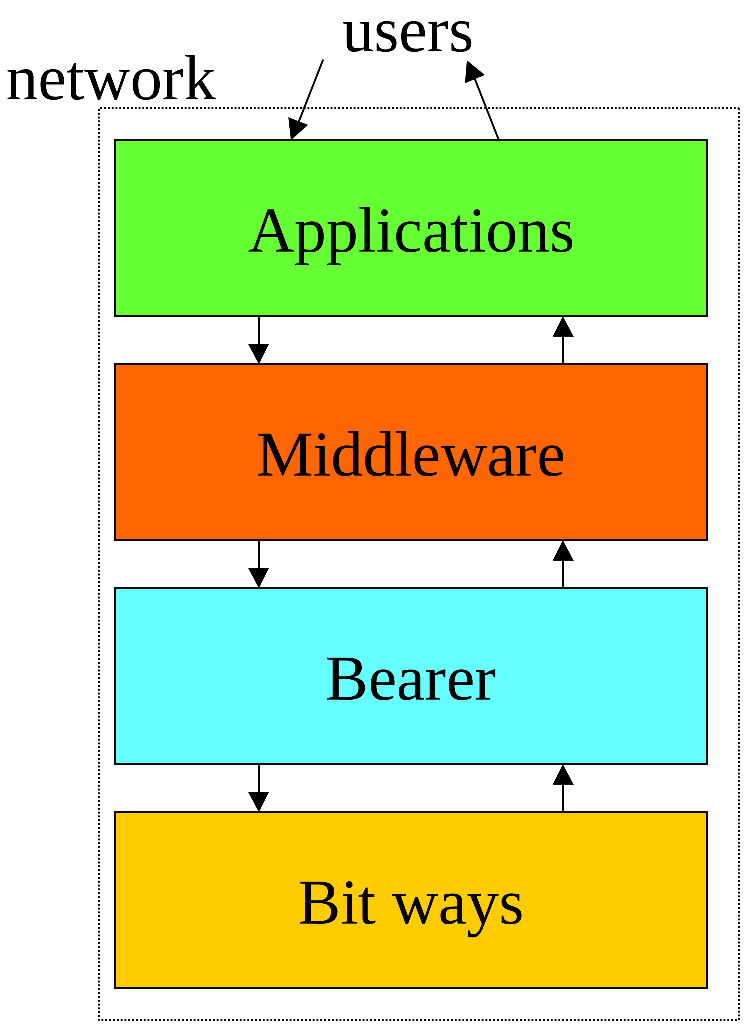


A small Internet

What if:
- Packet got lost ?
- Packet was too big ?
- A link/host went down ?
- A router's buffer was full ?



Layered Architecture



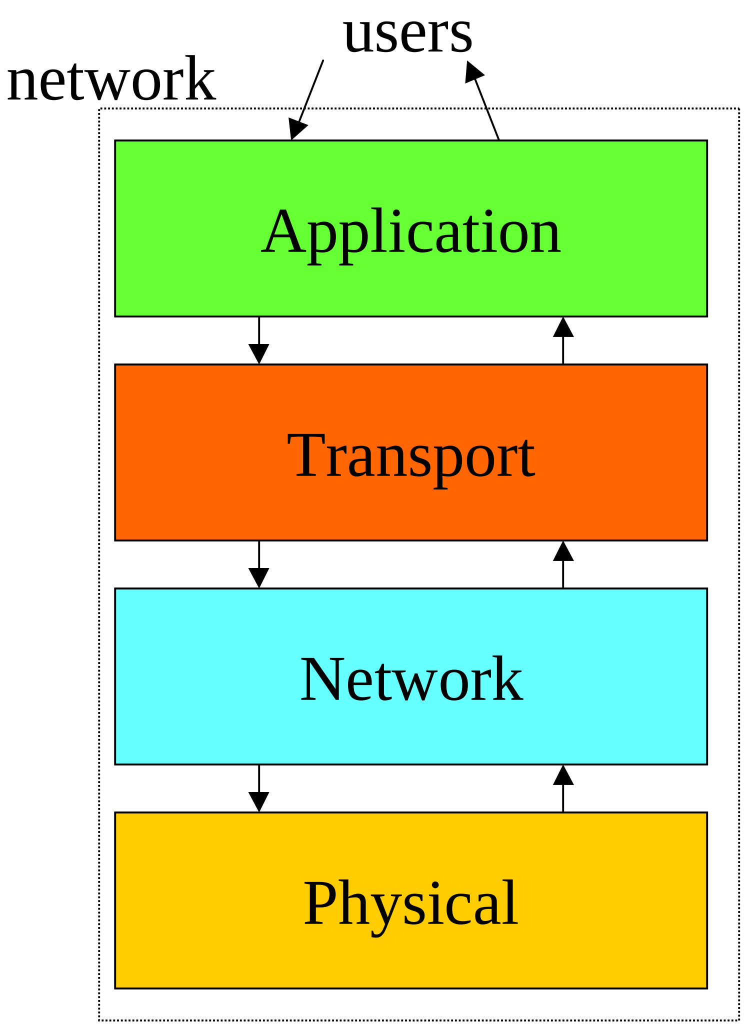
Web, e-mail, file transfer, ...

Reliable/ordered transmission, QOS, security, compression, ...

End-to-end transmission, resource allocation, routing, ...

Point-to-point links, LANs, radios, ...

Internet protocol stack



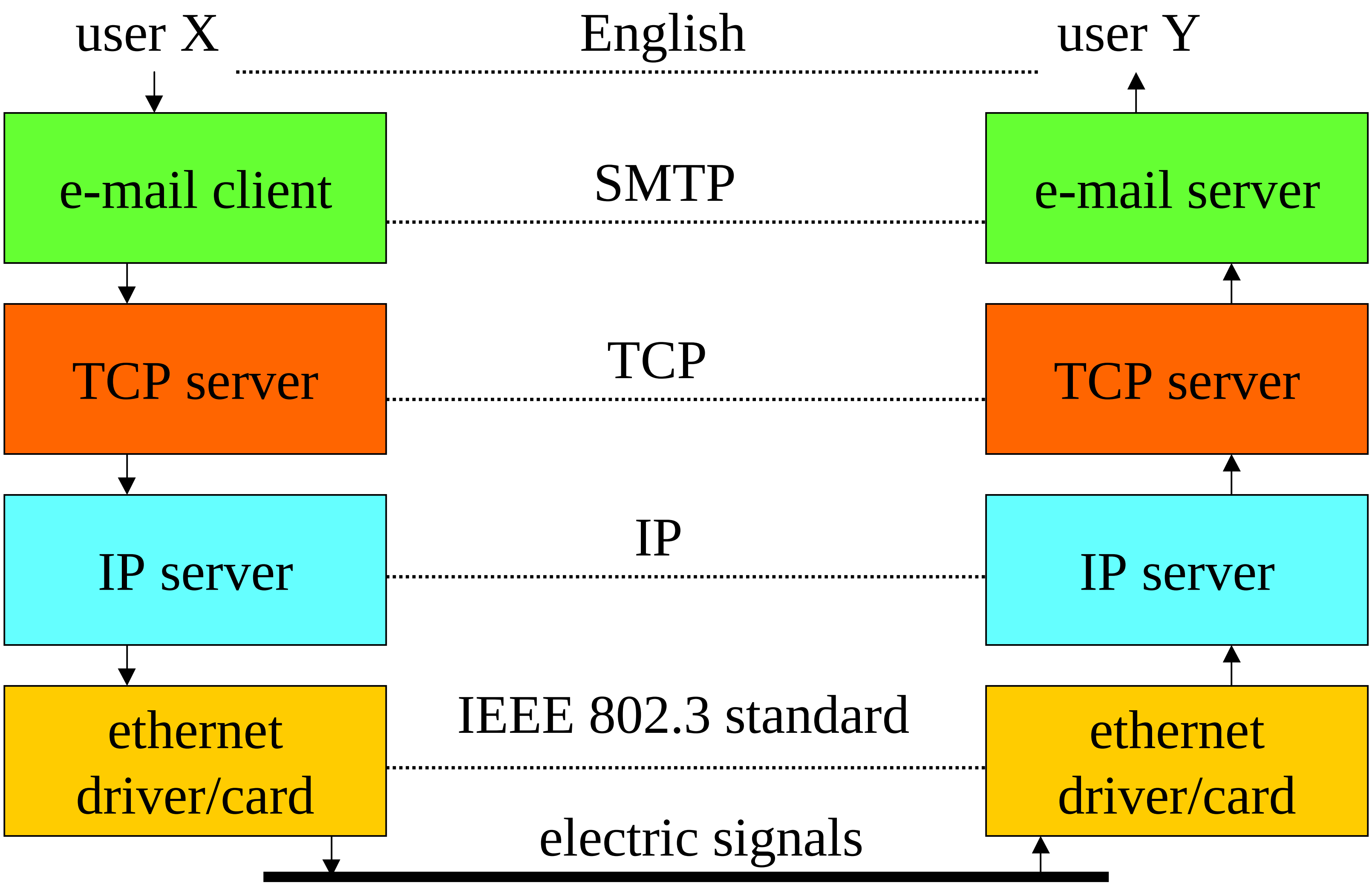
HTTP, SMTP, FTP, TELNET, DNS, …

TCP, UDP.

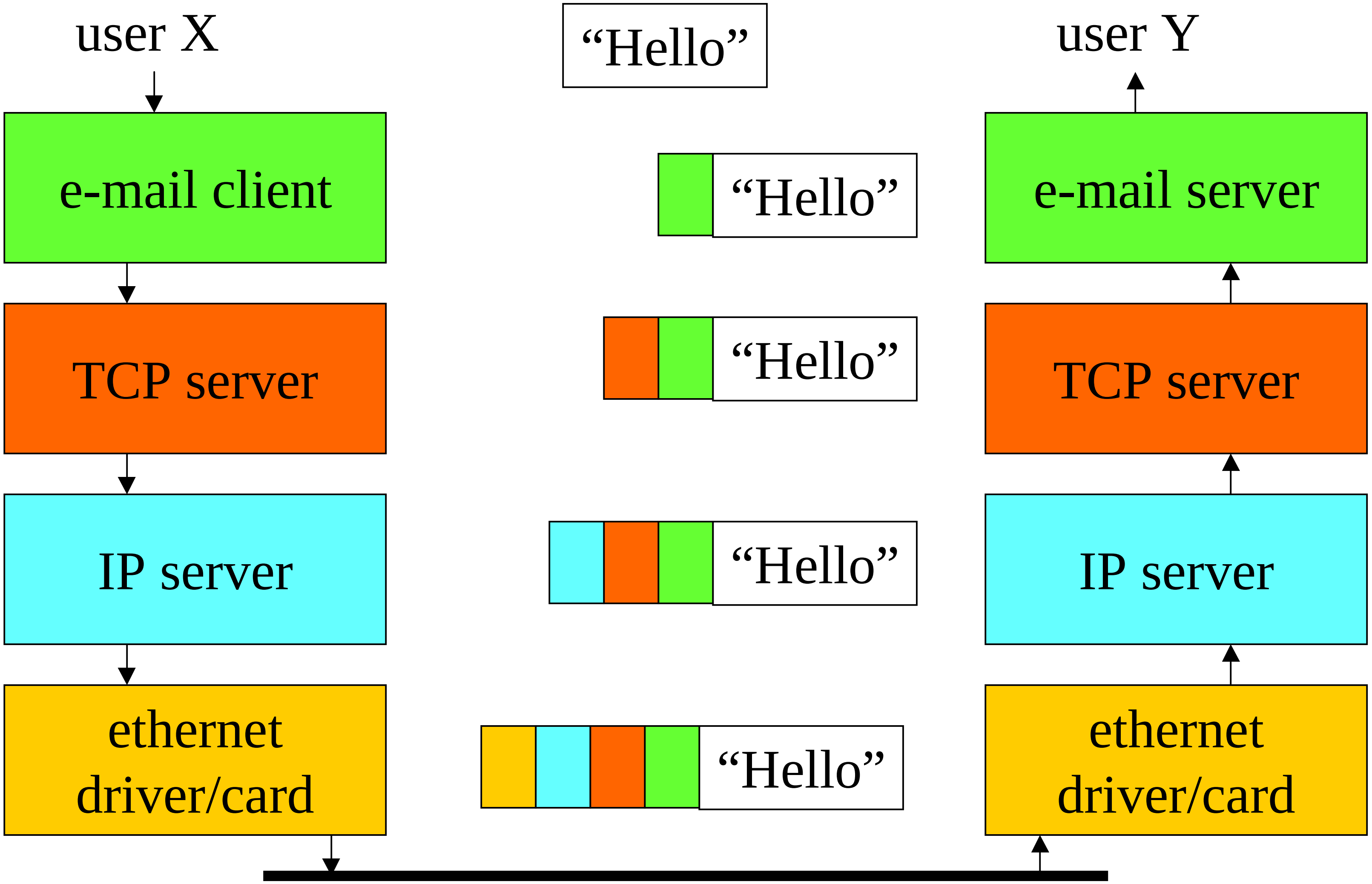
IP

Point-to-point links,
LANs, radios, ...

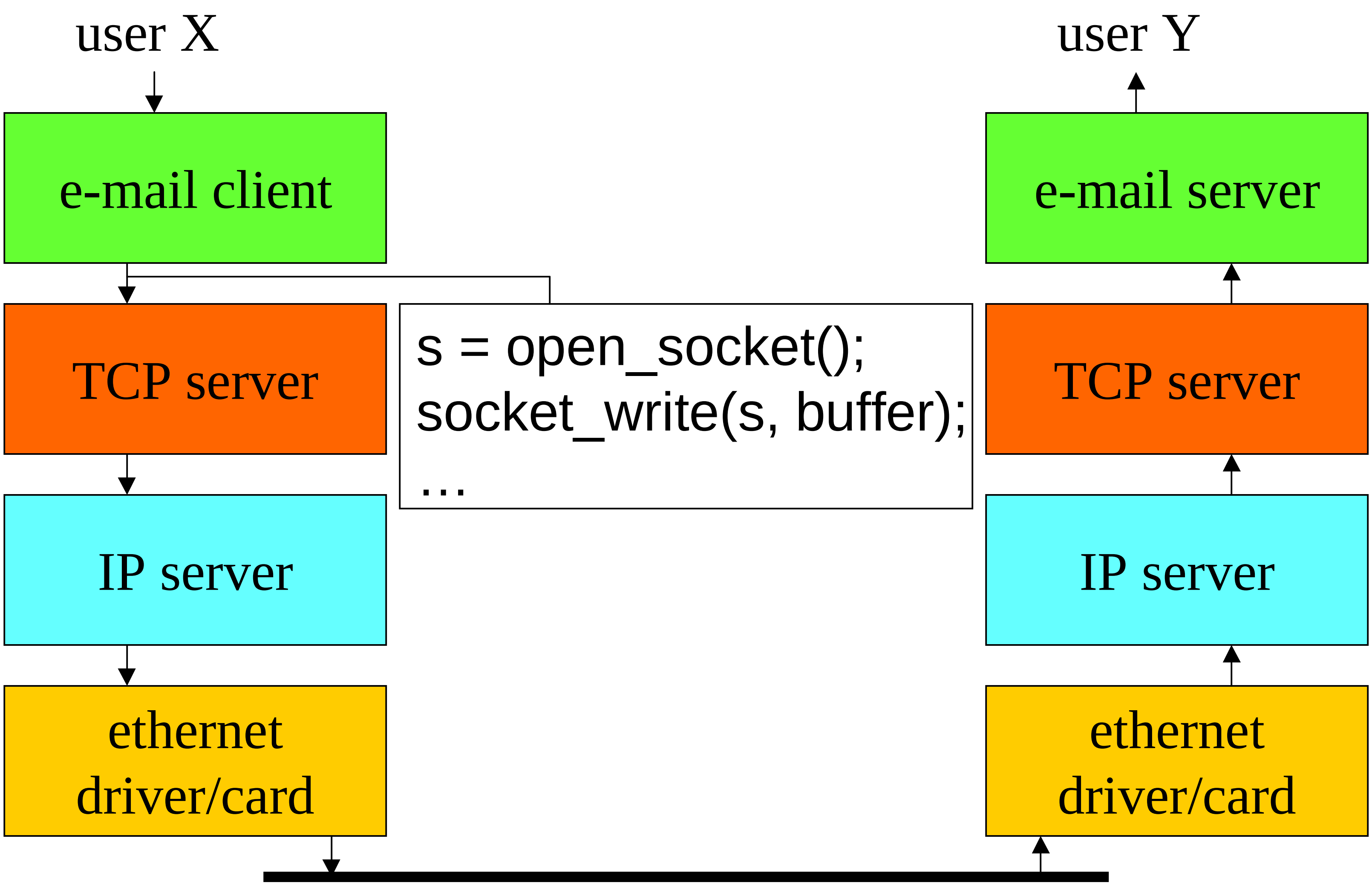
Protocol stack



Protocol encapsulation



Protocol interfaces



A small Internet

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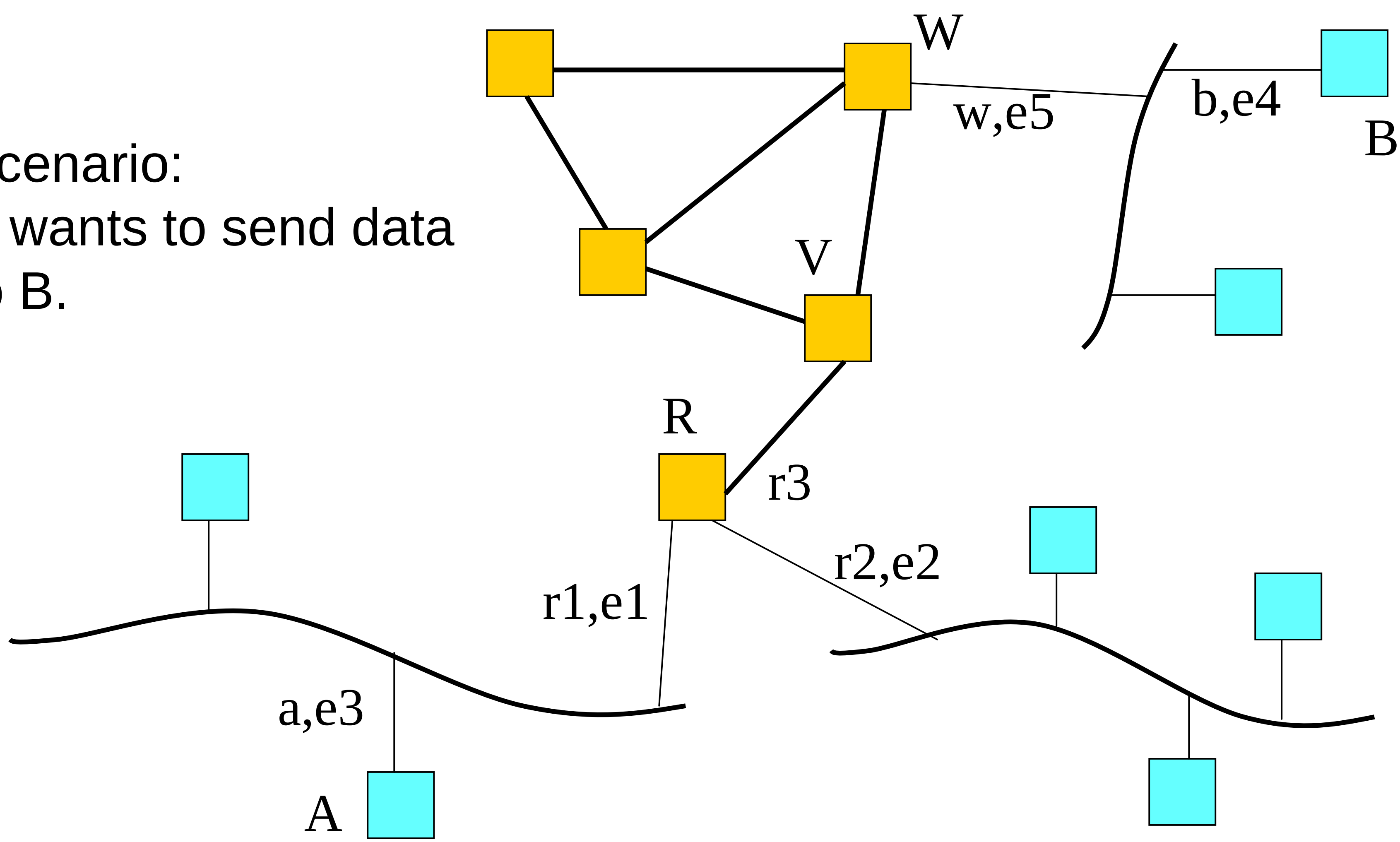
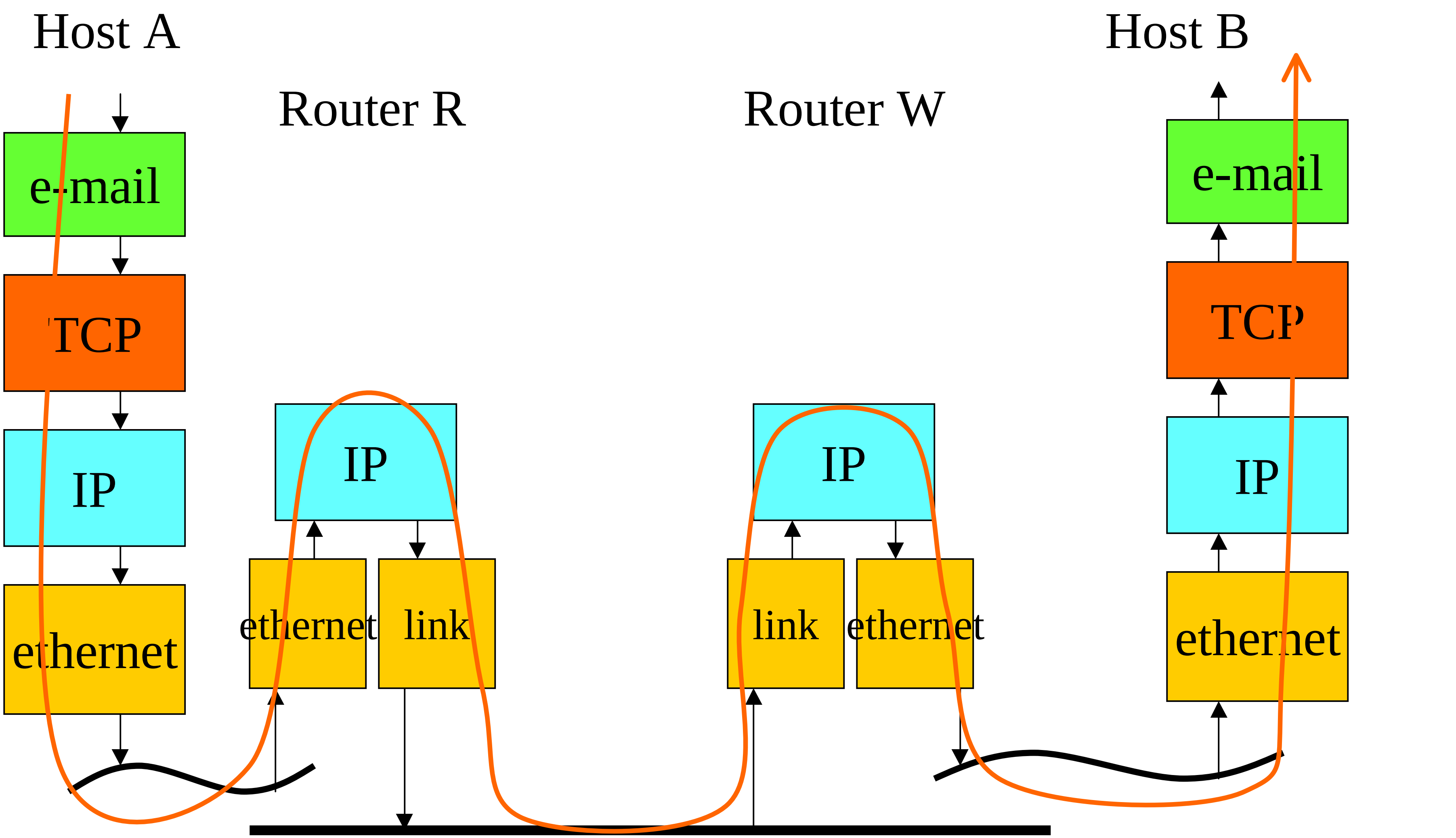


Protocol stack: packet forwarding



Layered Architectures

- Break-up design problem intro smaller, more manageable problems.
- Modular design: easy to extend/modify.
- Difficult to implement (careful with interaction of layers for efficiency).

Syllabus:

- Introduction (ends on Friday).
- Applications (e-mail, web, etc).
- Internet: architecture, protocols, addressing, routing.
- LANs (ethernet, token rings, wireless).
- ATM (quality of service).
- Reliable-transmission protocols (error correction, ordered transmission, etc).

Syllabus (continued):

- Congestion control.
- Physical layer: copper, fiber, radio.
- Internet programming (sockets, etc) and network simulation (perhaps).
- Security.
- Compression.
- Special sessions: invited people will talk about interesting projects in communications going on in UCB.