QUALCOMM INSTITUTE | UC San Diego

# Internet of Things:

## Packet Switched Networks

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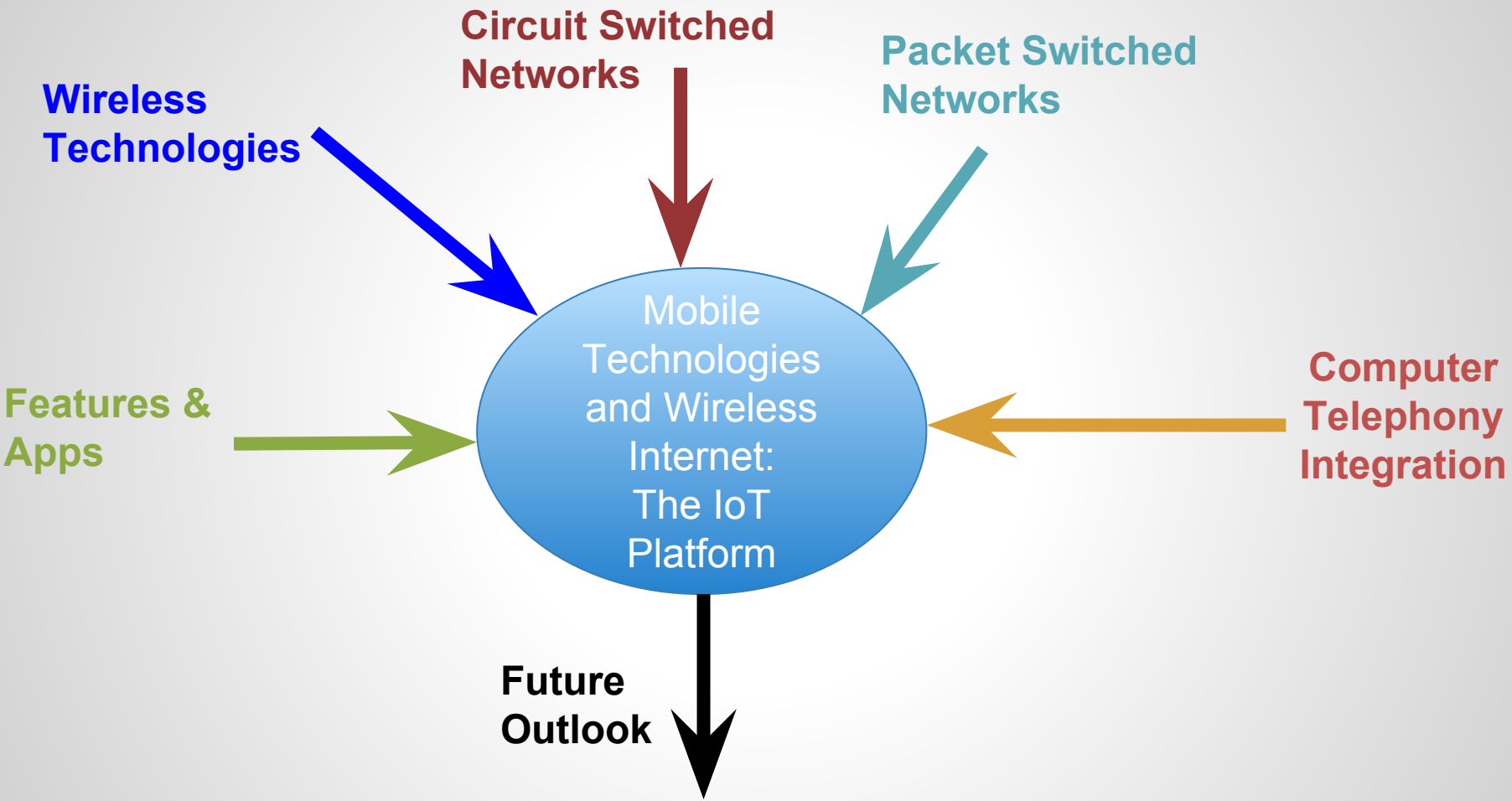
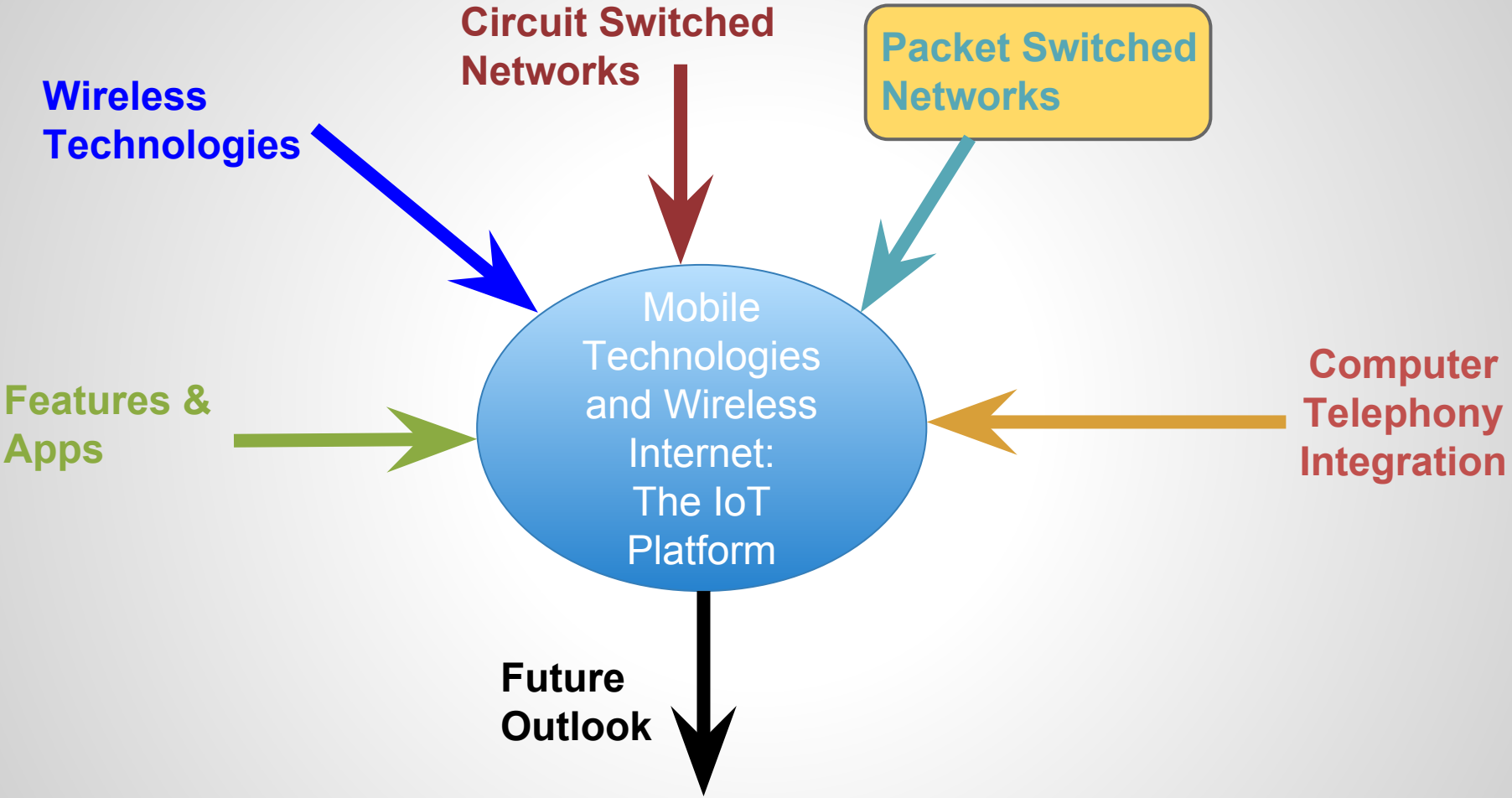
Qualcomm Institute of Calit2

University of California, San Diego


Circuit Switched Networks
Packet Switched Networks
Wireless Technologies
Mobile Technologies and Wireless Internet: The IoT Platform
Features & Apps
Computer Telephony Integration
Future Outlook


Circuit Switched Networks
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Future Outlook

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# **Module 2** | Packet Switched Networks

# Lesson 1

The Internet Initiative

# **Lesson 1** | The Internet Initiative

**1 –** CS and PS

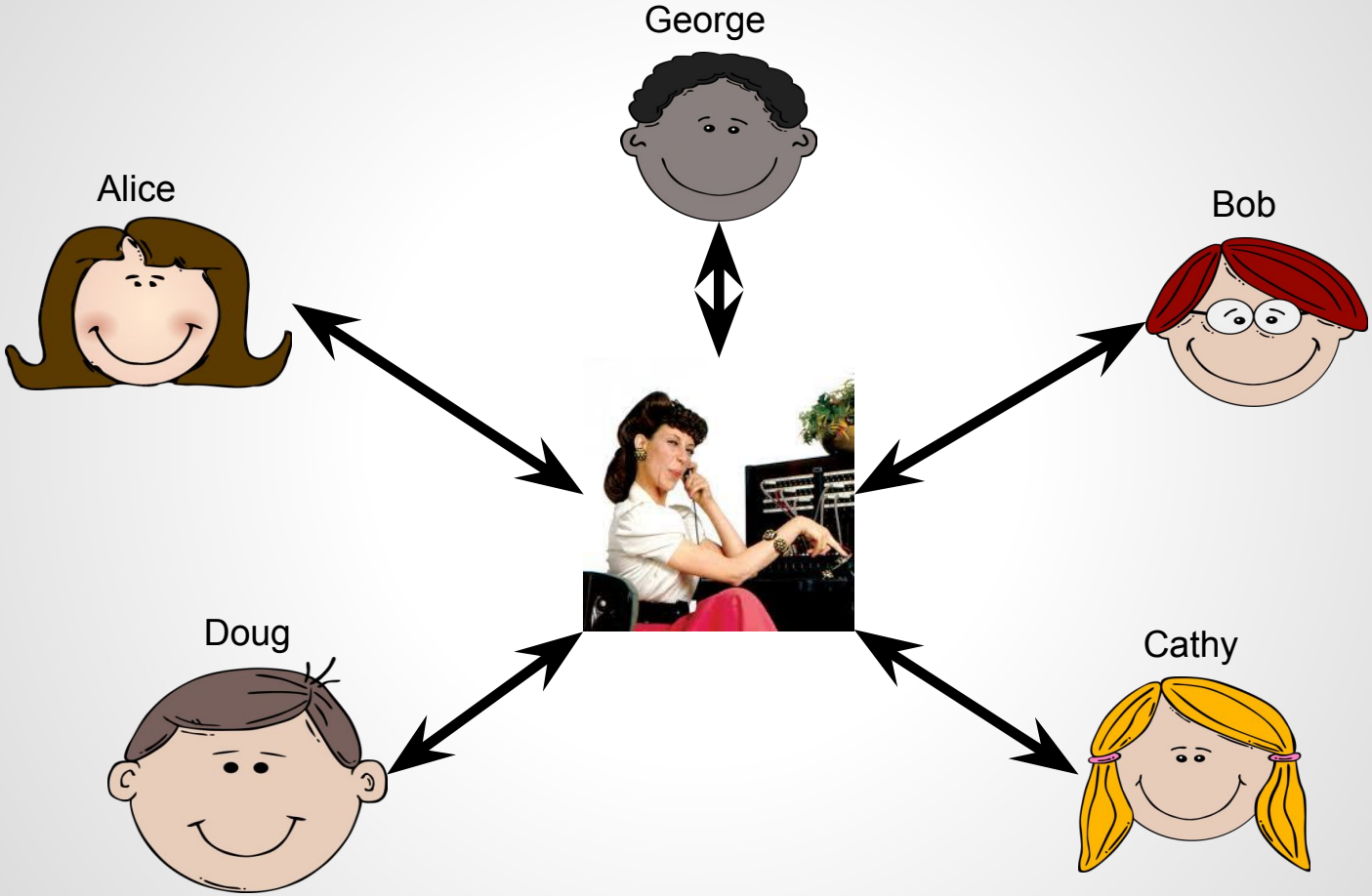
**2 –** Brief History

**3 –** TCP/IP Protocols

**4 –** Open Standards

# 1 - CS and PS

# 1 | CS and PS



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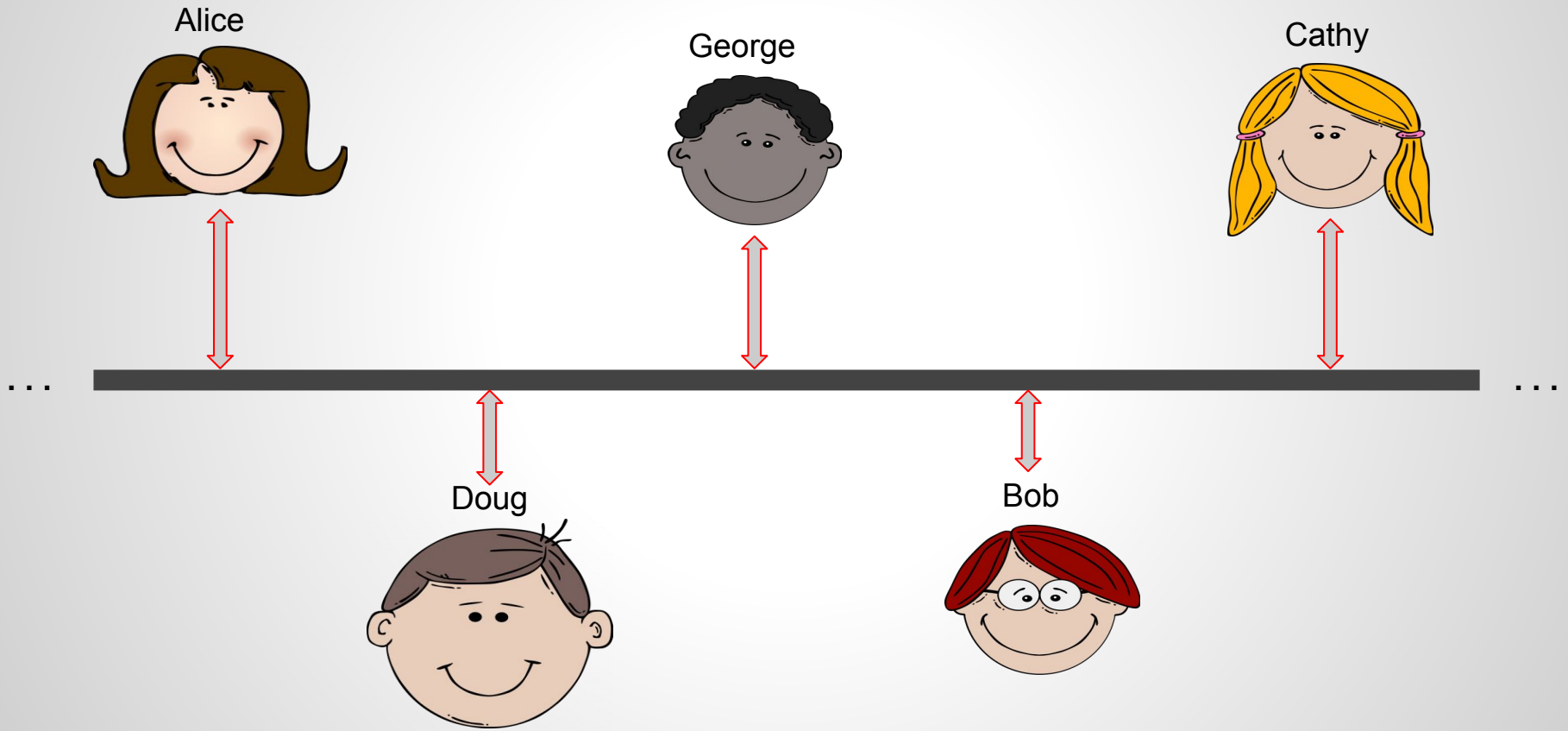

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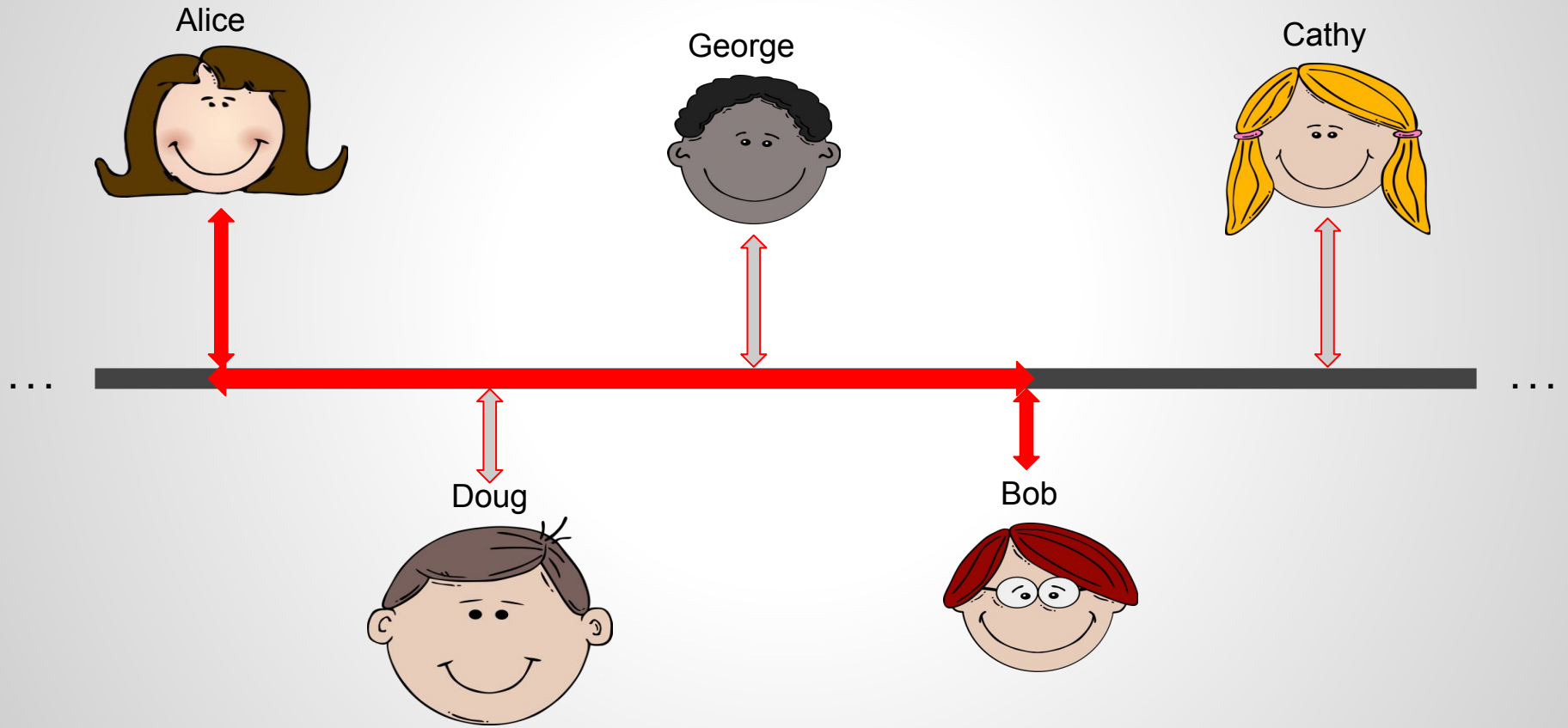

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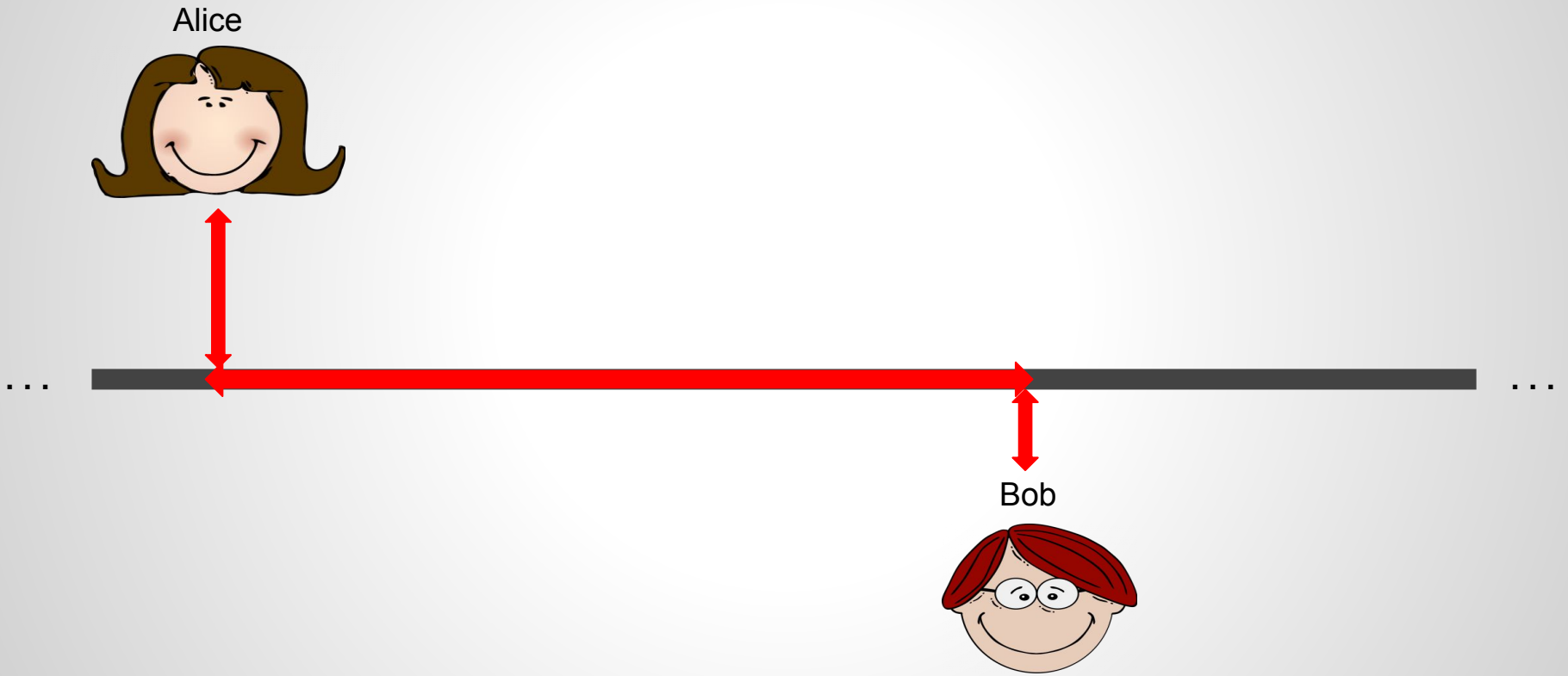
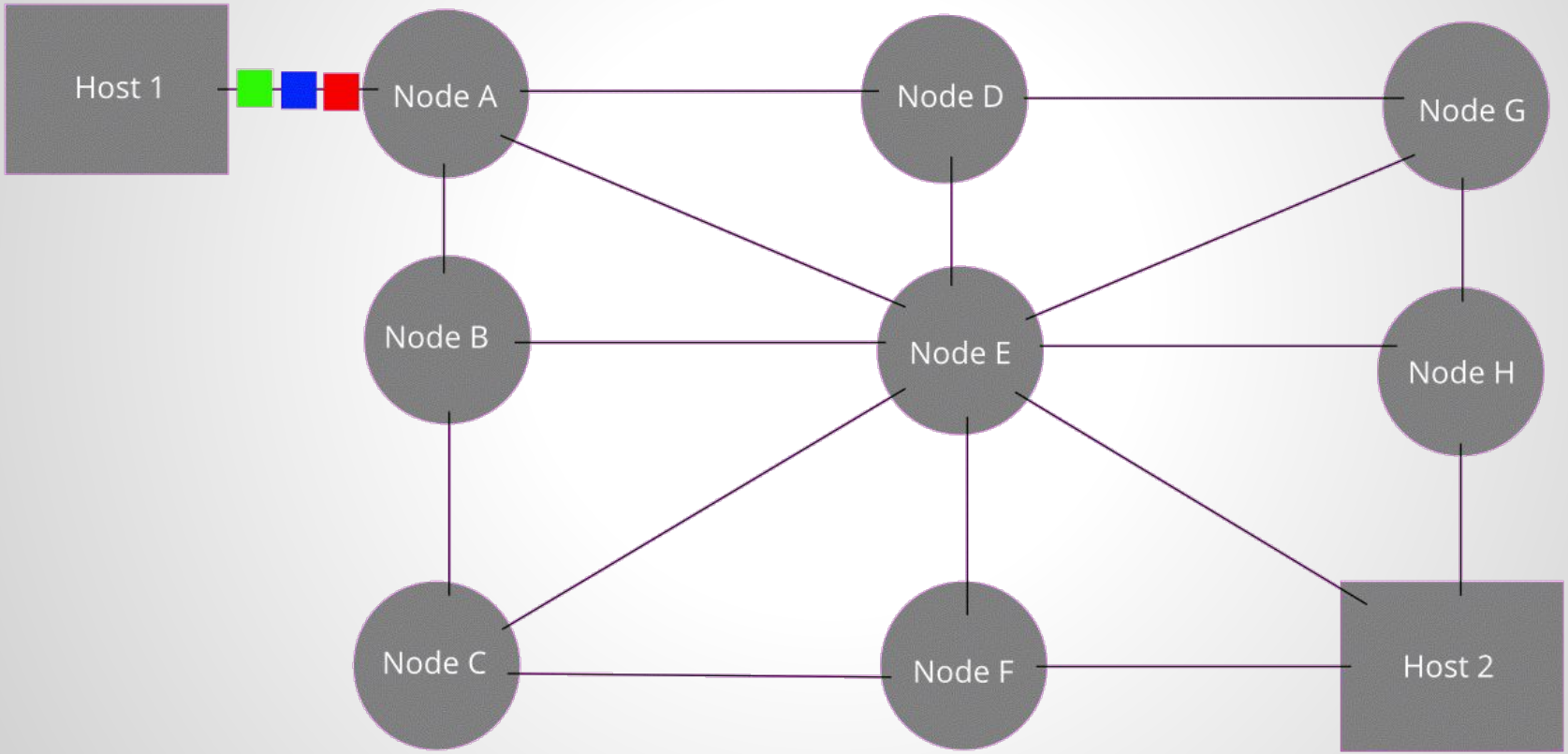


# 1 | CS and PS

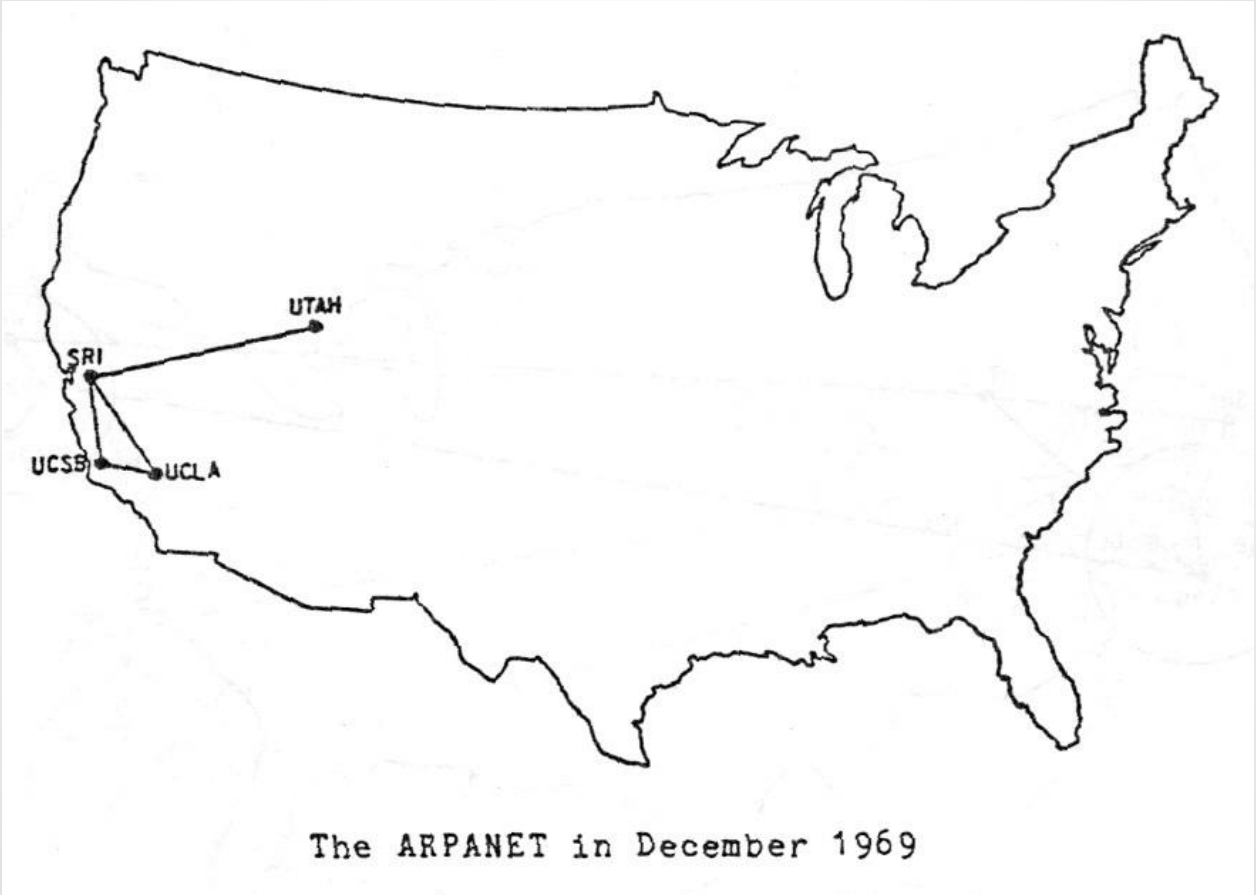
The original message is Green, Blue, Red.



# 2 - Brief History

# 2 | A Brief History

# **2** | A Brief History

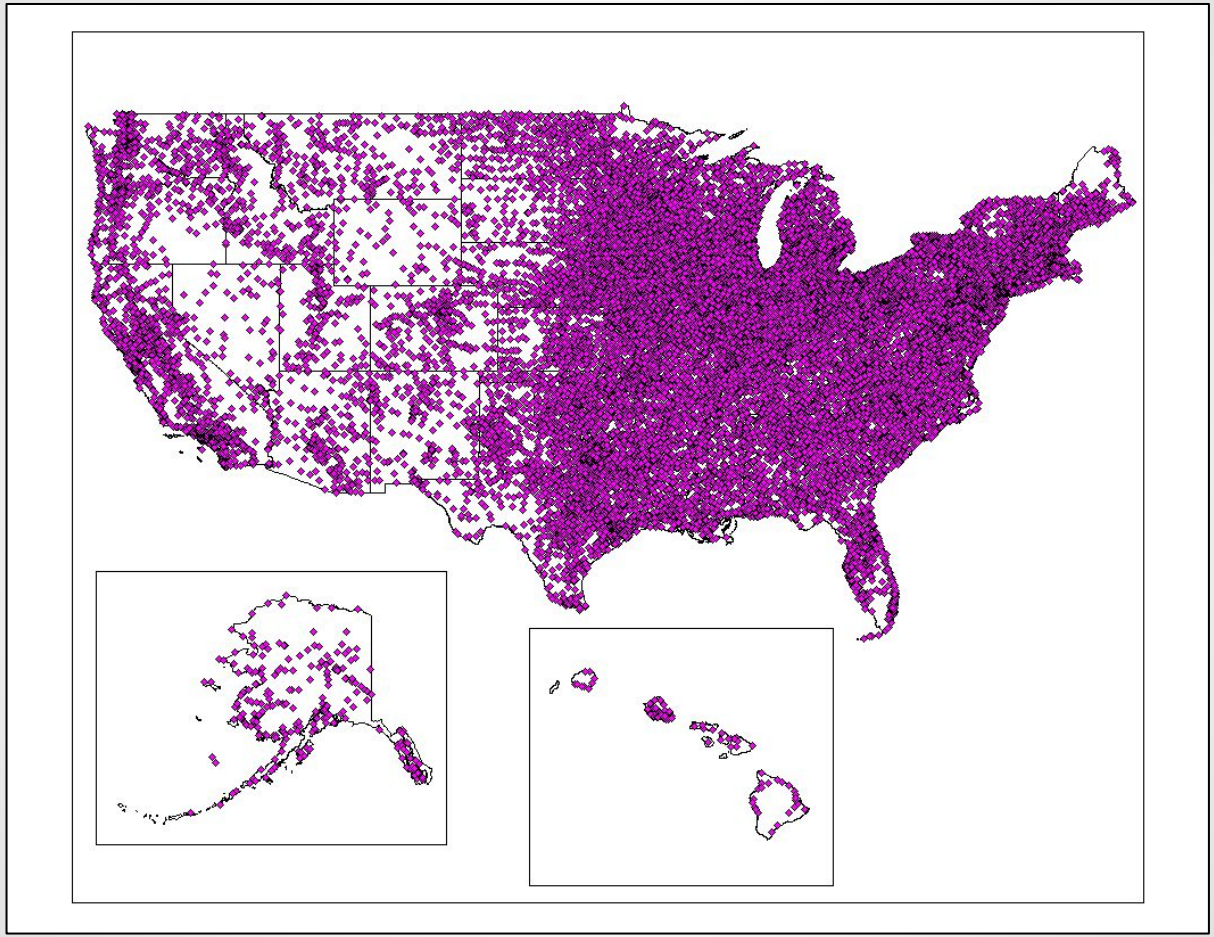



The ARPANET in December 1969

# 2 | A Brief History

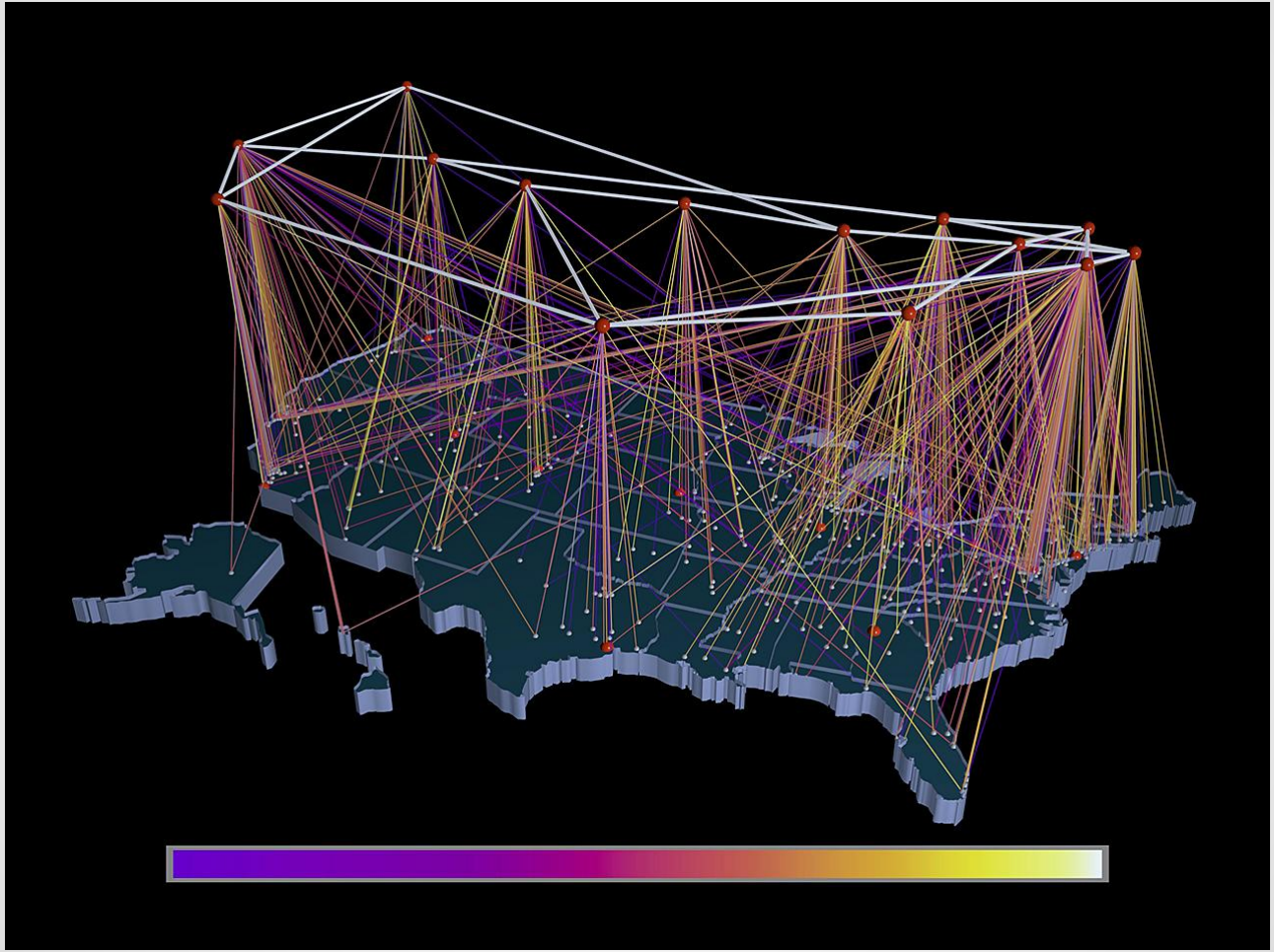

**Symbolic representation of the Arpanet as of September 1974**

# **2** | A Brief History



**Map of the Central Office locations in the US**

# 2 | A Brief History



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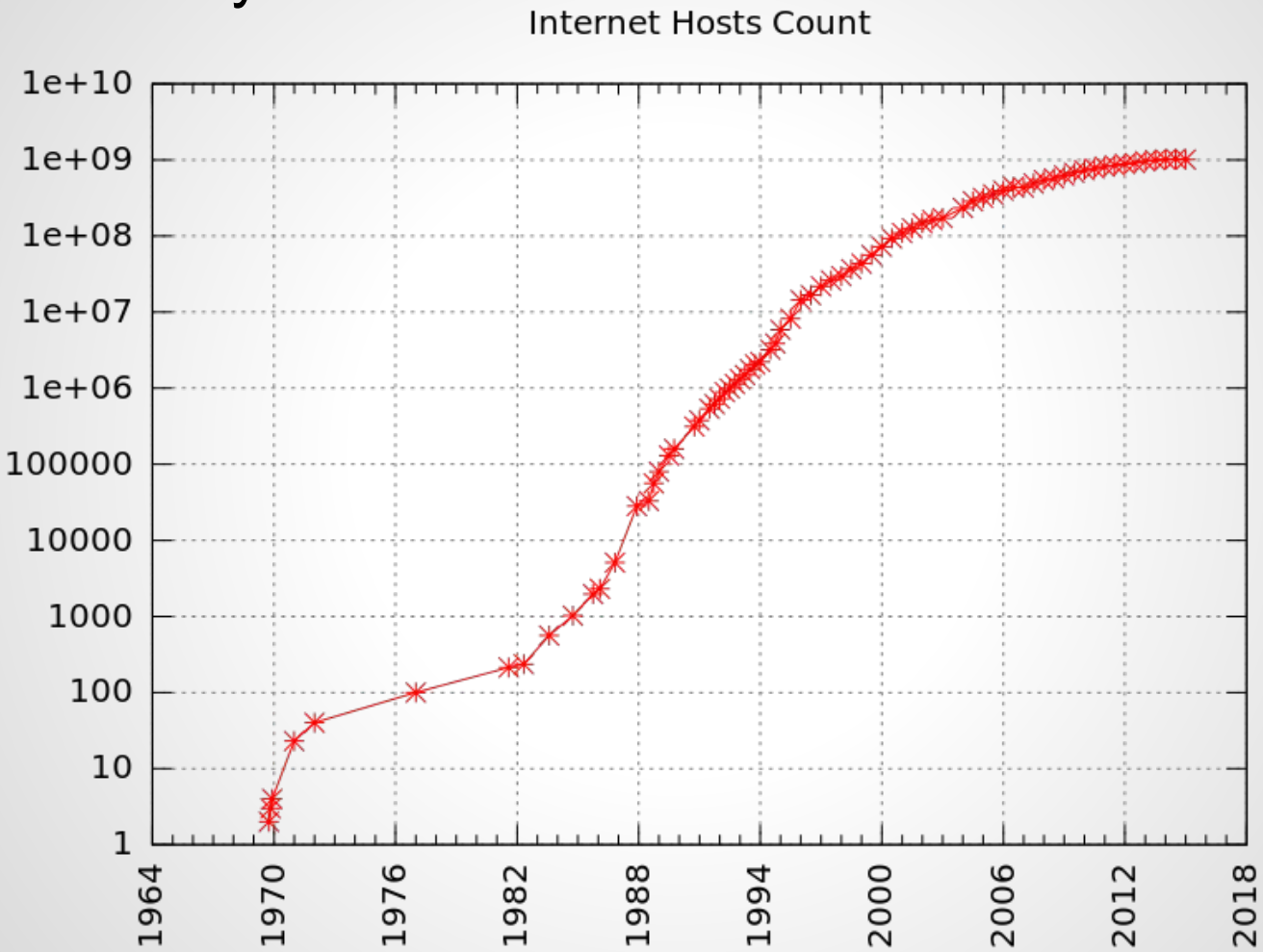
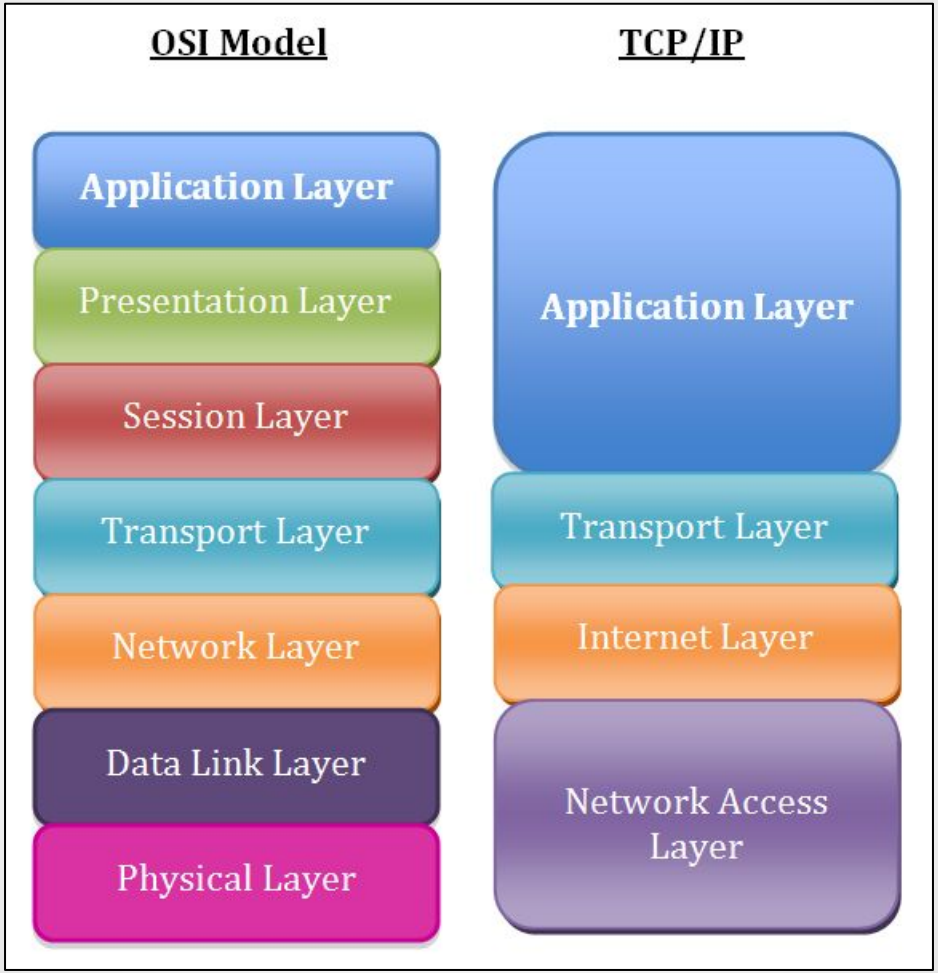
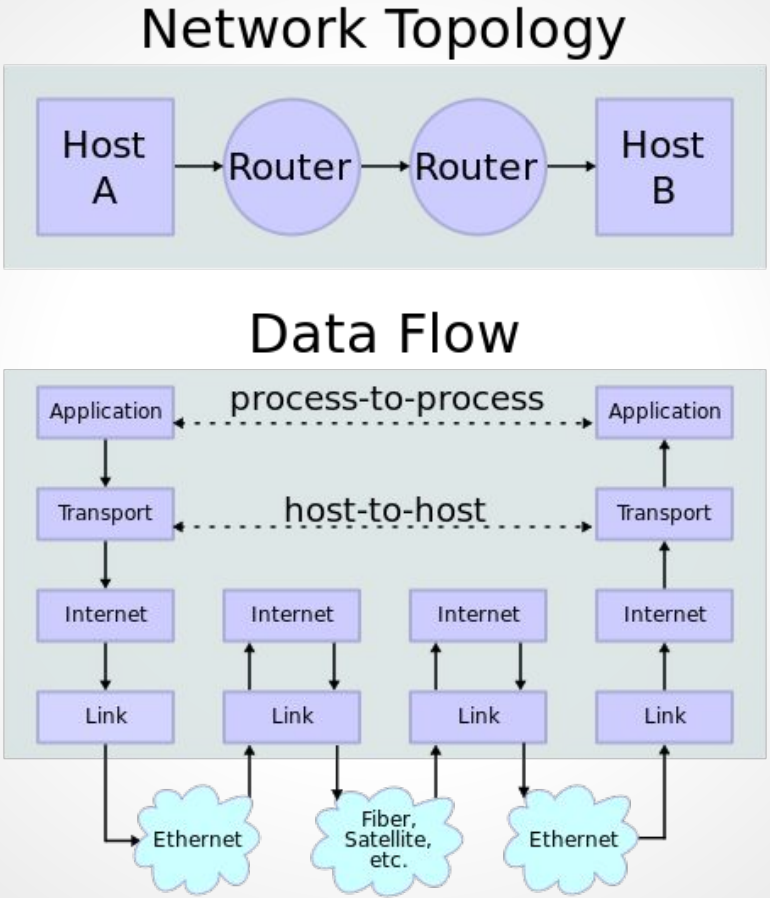


# 3 - TCP / IP Protocols

# 3 | TCP / IP Protocol

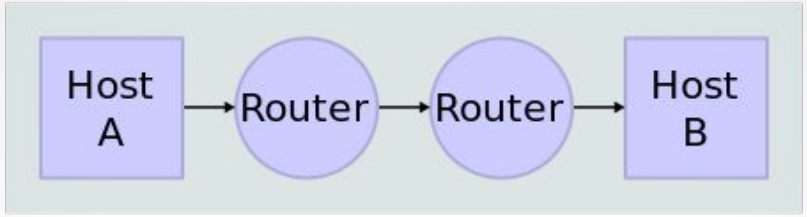


# 3 | TCP / IP Protocol

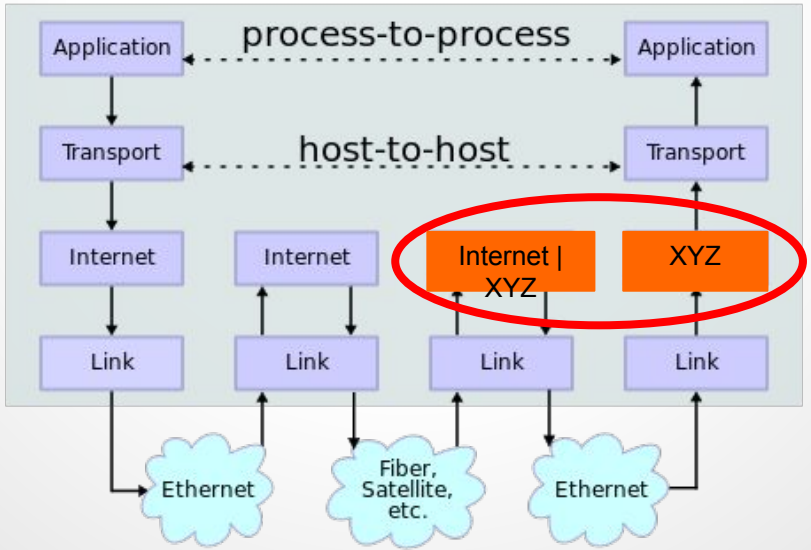


# 3 | TCP / IP Protocol

## Network Topology




## Data Flow



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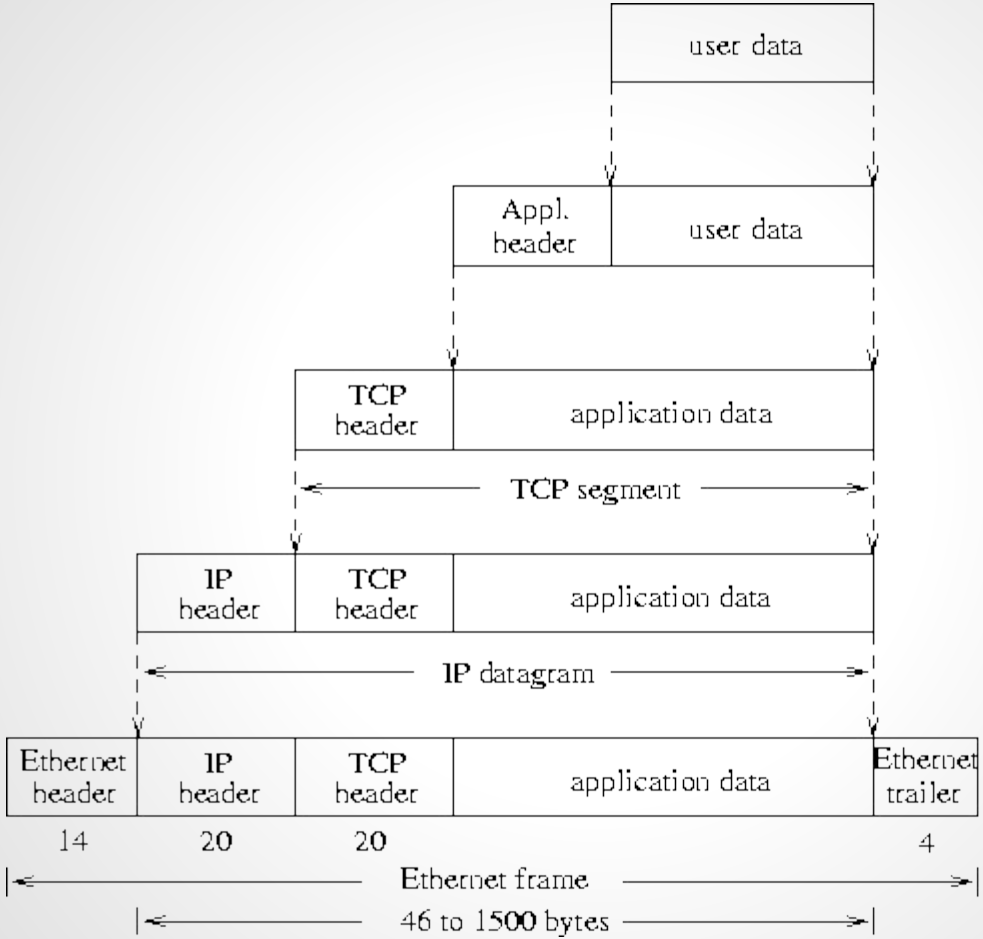


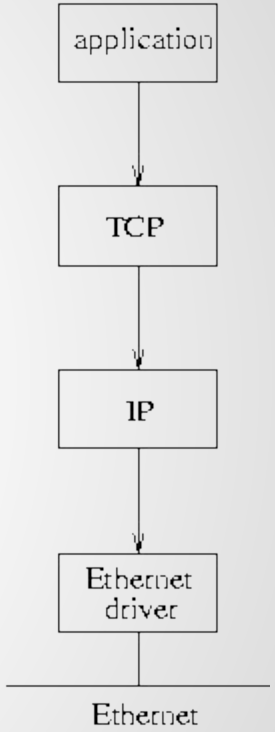

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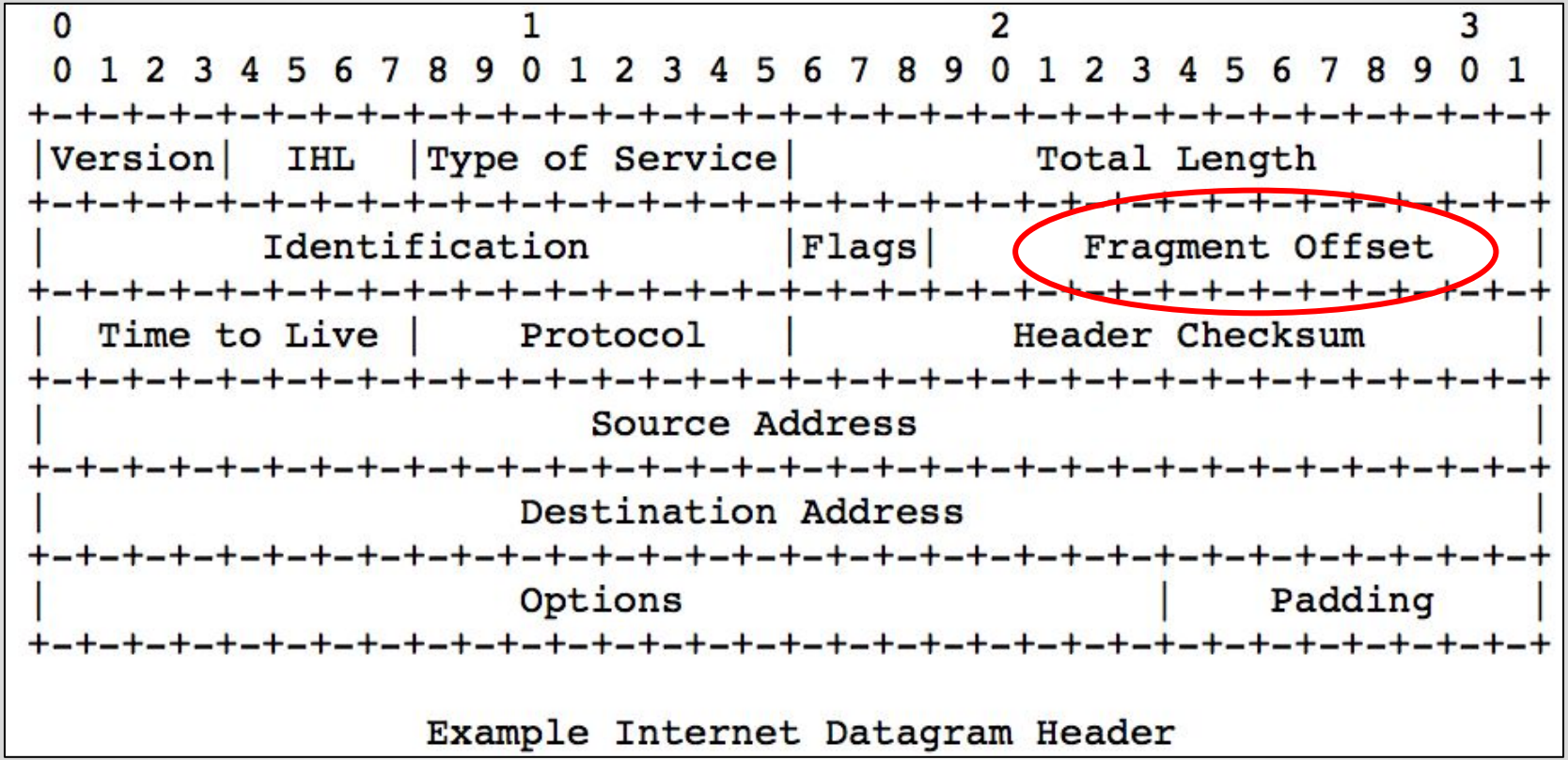
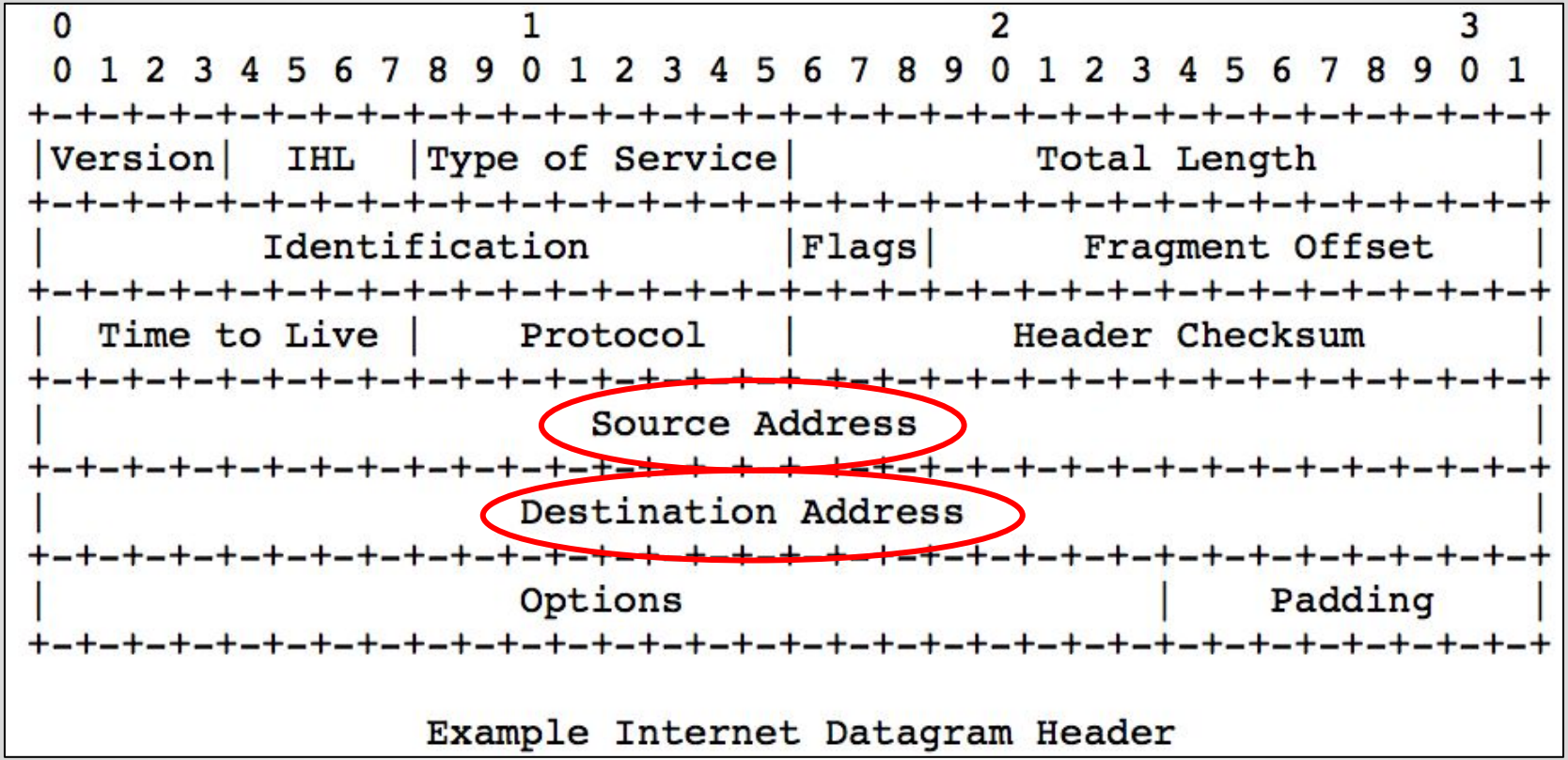


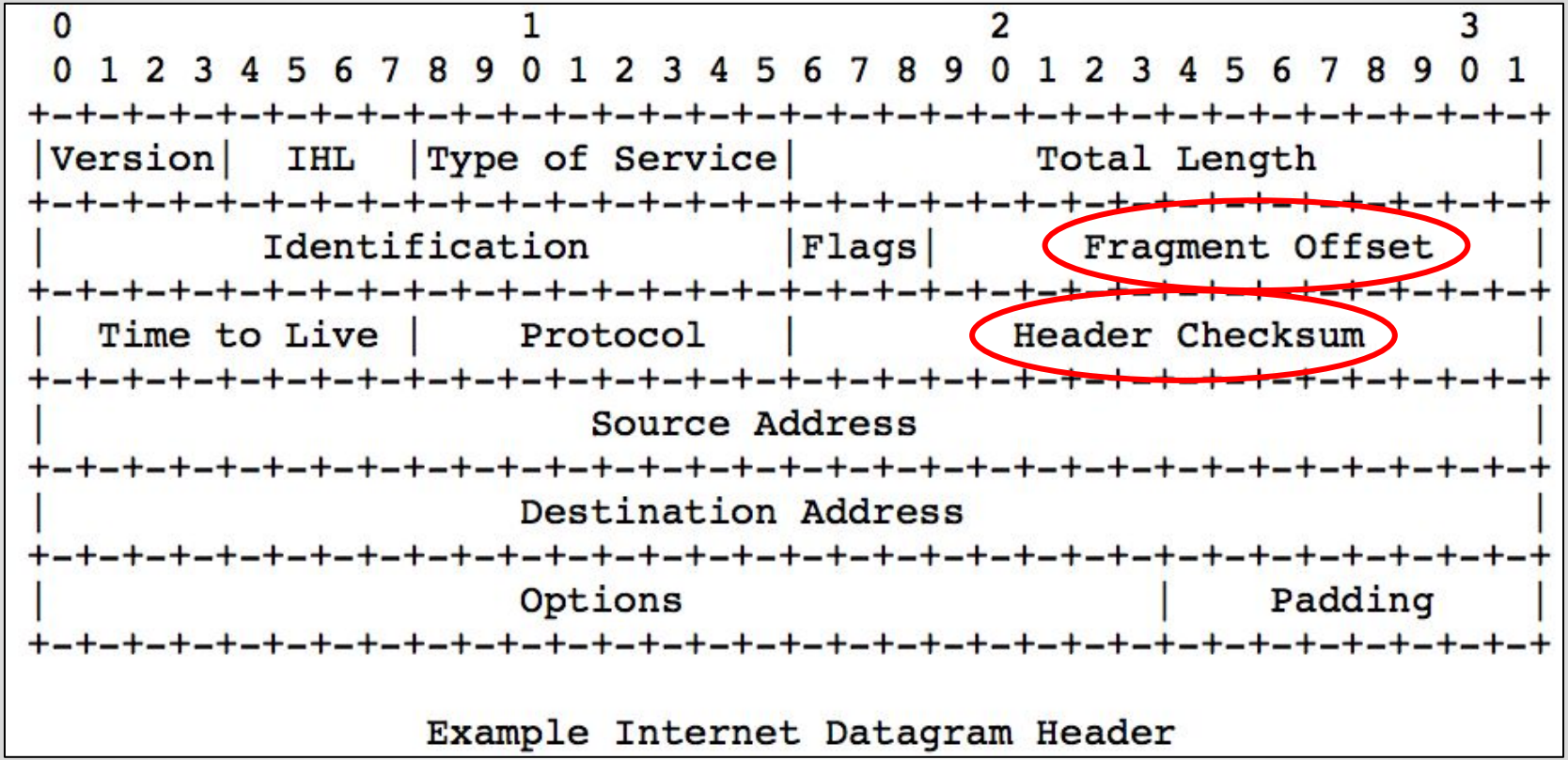

**RFC 791 Internet Protocol**

# 3 | TCP / IP Protocol



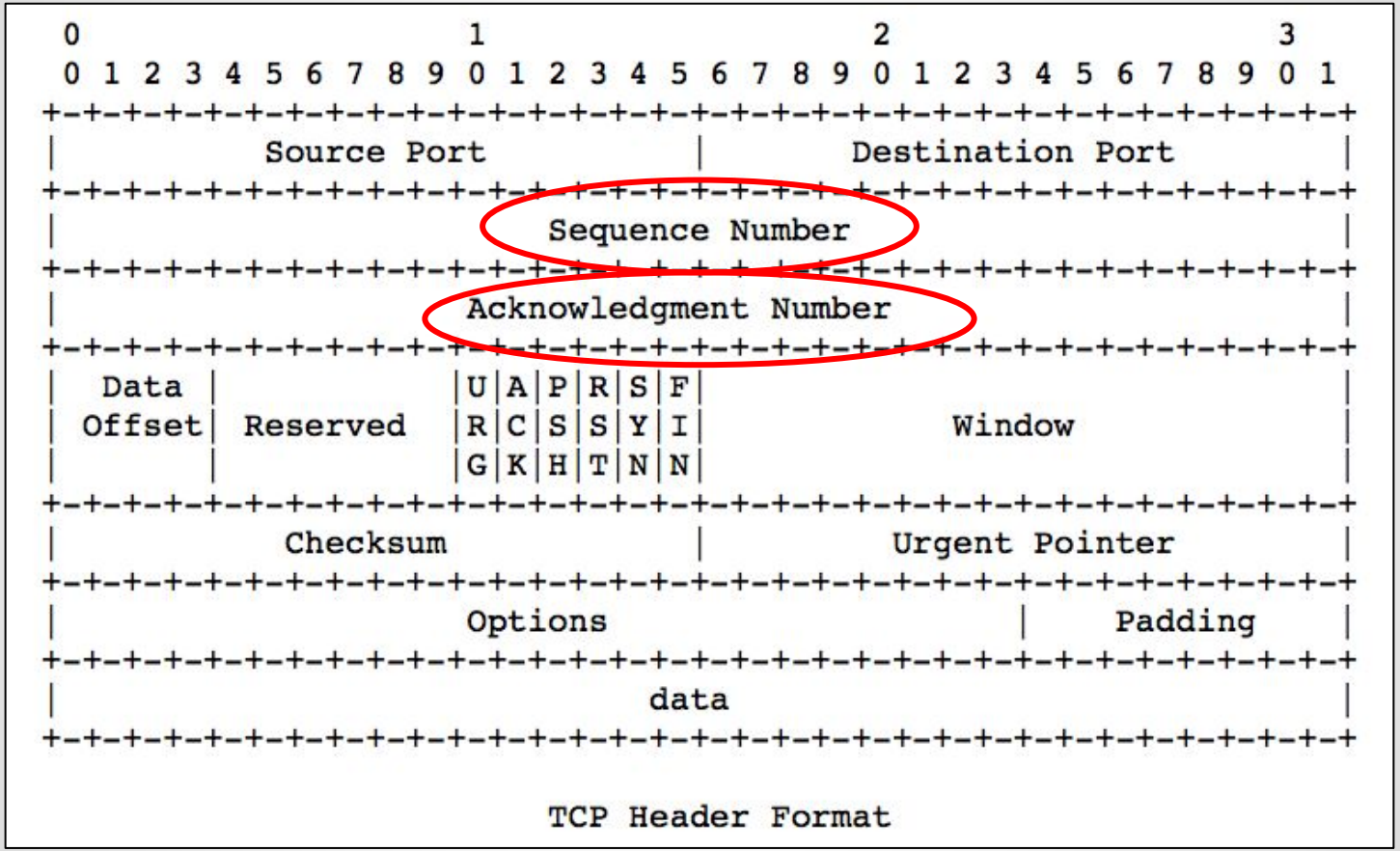

**RFC 791 Internet Protocol**

# 3 | TCP / IP Protocol




**RFC 791 Internet Protocol**

# 3 | TCP / IP Protocol




**RFC 793 Transmission Control Protocol**

# 4 - Open Standards

# The Internet Engineering Task Force (IETF®)

**The goal of the IETF is to make the Internet work better.**

The mission of the IETF is to make the Internet work better by producing high quality, relevant technical documents that influence the way people design, use, and manage the Internet. Newcomers to the IETF should start here.

**News**

- New Internet Engineering Steering Group and Internet Architecture Board Members Selected
- Contract Awards January 2015
- IETF 97 - Seoul, South Korea!
- IETF 98 - Montreal!
- IETF 95 - Buenos Aires!
- Juniper to Host IETF 96 in Berlin!
- Chair's Blog
- IETF Daily Dose

**Next Meeting: IETF 94, Yokohama, Japan**

IETF 94, Yokohama, Japan (UTC +9)
November 1-6, 2015

- Register
- Important Dates
- IETF 94 Agenda
- Meeting Materials
- Venue Information
- Remote Participation

# Lesson 2

Reliable Services

# **Lesson 2** | Reliable Services

**1 –** Email

**2 –** Browsing

# 1 - Email

# 1 | Email

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# 1 | Email

**SMTP – Simple Mail Transfer Protocol, RFC 5321 (2821, 821)**

**IMAP – INTERNET MESSAGE ACCESS PROTOCOL - VERSION 4rev1, RFC 3501**

**MIME – Multipurpose Internet Mail Extensions, RFC 2405—2409**

# 2 - Browsing


<HTML>
<html>
<title>HTML</title>
<body>
This is HTML!
</body>
</html>

# **2** | Browsing


Cross-Site Scripting

HTML Code Injection

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# Lesson 3

Realtime Services

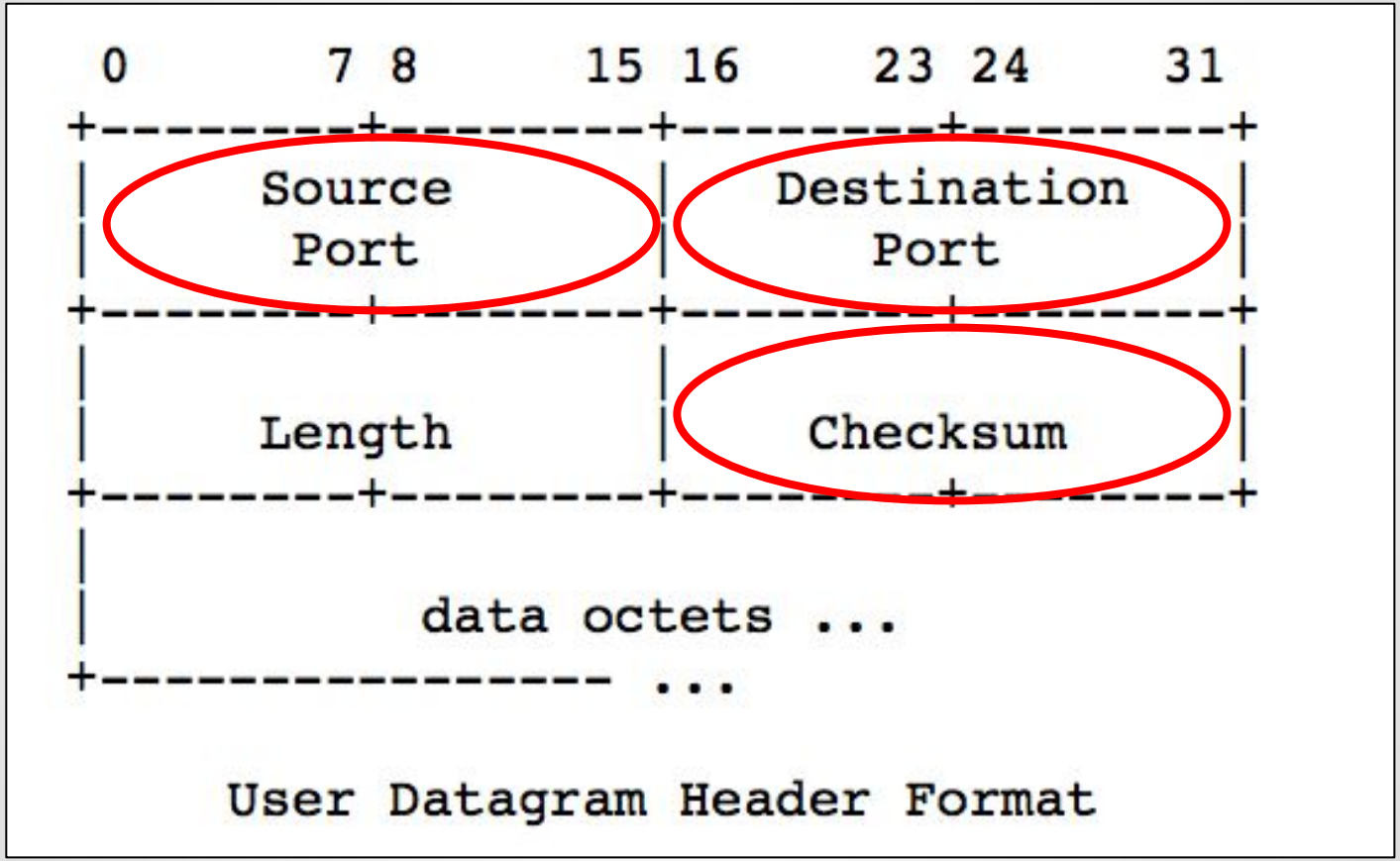
# **Lesson 3** | Realtime Services

**1 –** Voice over RTP/UDP/IP or VoIP

**2 –** Broadcast/Multicast

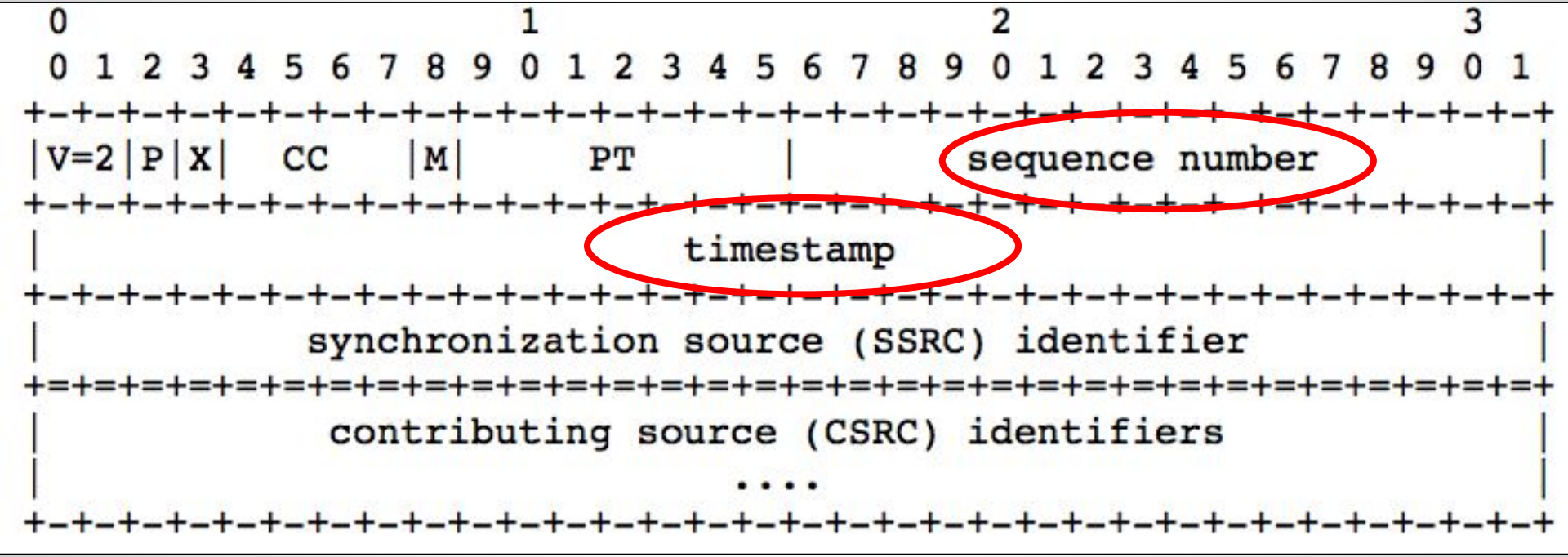
# 1 - Voice over RTP/UDP/IP or VoIP

# 1 | Voice over RTP/UDP/IP or VoIP



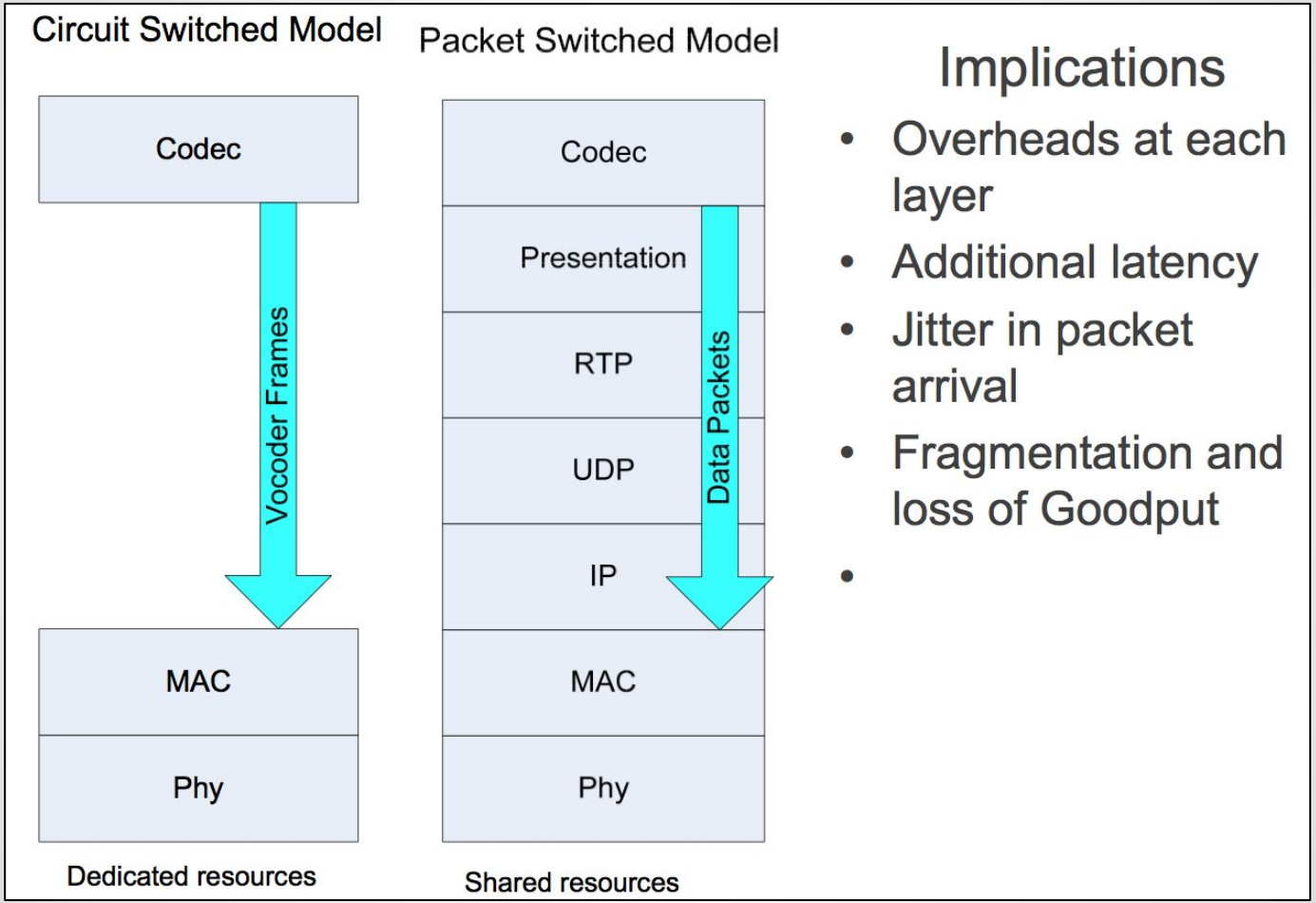

RFC 768 User Datagram Protocol

# 1 | Voice over RTP/UDP/IP or VoIP




**RFC 3550 Real-time Transport Protocol**

# 1 | Voice over RTP/UDP/IP or VoIP

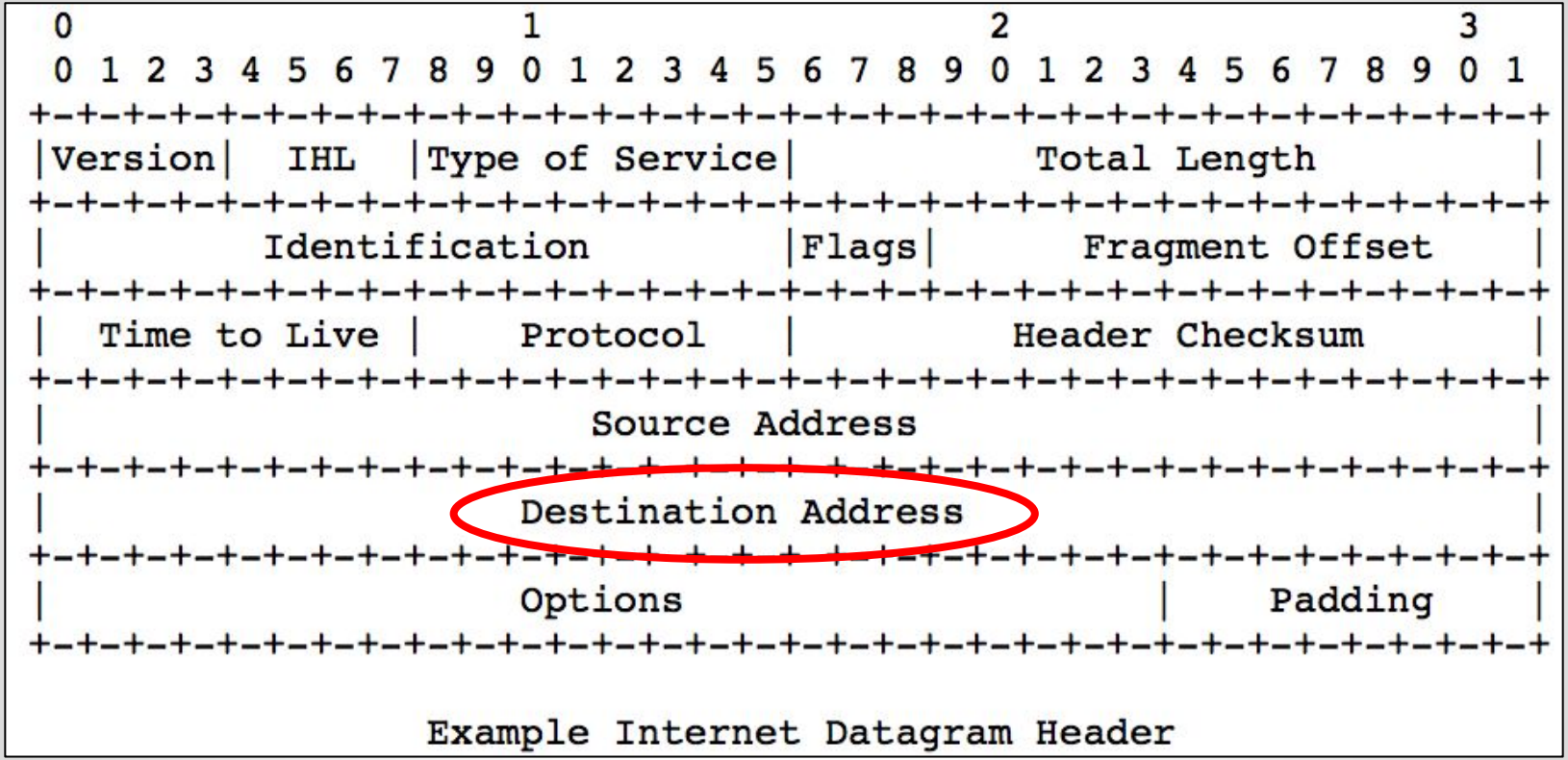



## Implications

- Overheads at each layer
- Additional latency
- Jitter in packet arrival
- Fragmentation and loss of Goodput
-

# 2 - Broadcast / Multicast

# 2 | Broadcast / Multicast

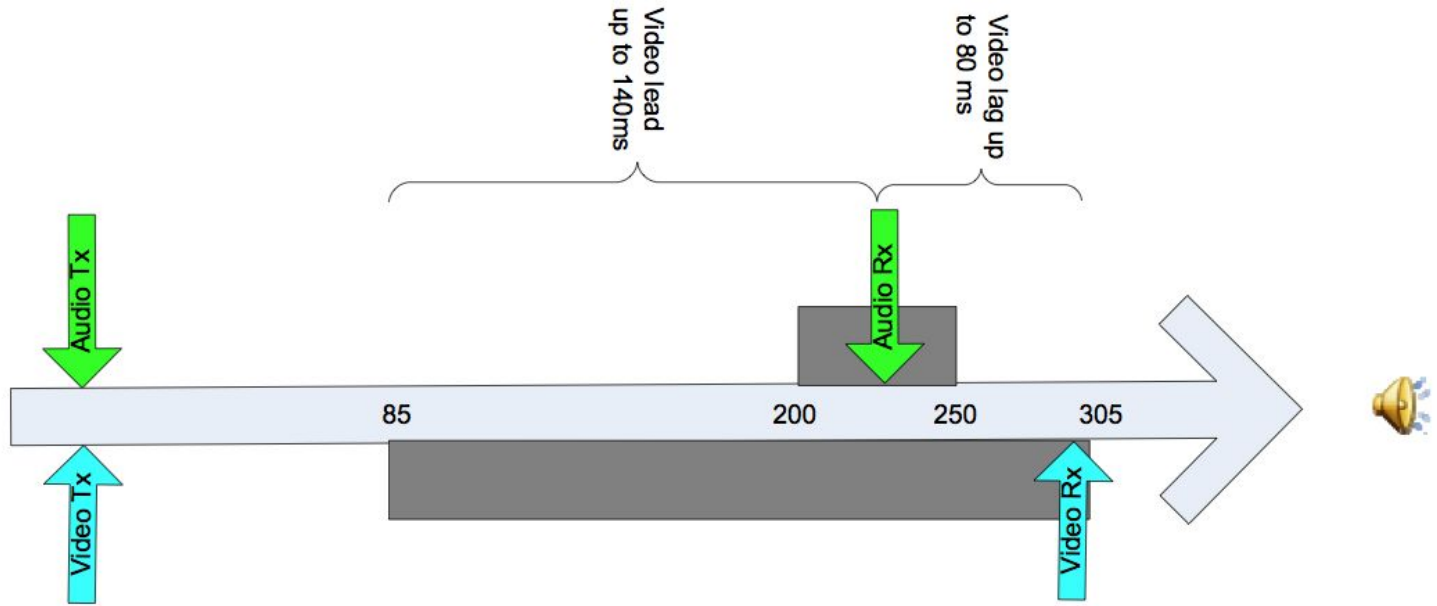



**Address 255.255.255.255 for local broadcast**

**Addresses 224.0.0.0 – 239.255.255.255 for multicast**

**RFC 791 Internet Protocol**

- Video one-way latency for synchronization with voice
  - Video arriving after voice by no more than 80 ms
  - Video arriving before voice by no more than 140 ms
  - Based on perceptual studies in lip reading; Hearing aids



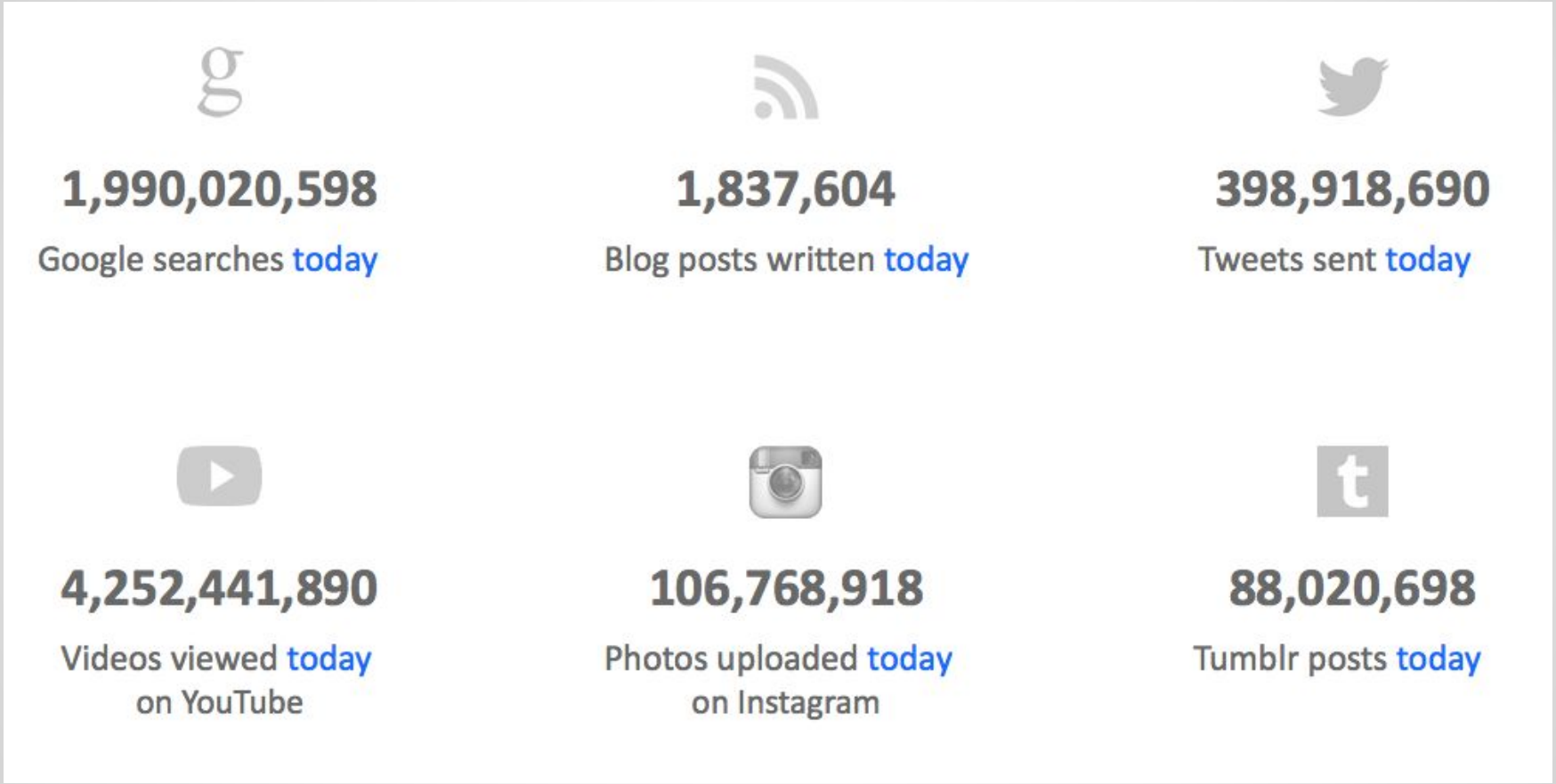
# 2 | Broadcast / Multicast

YouTube


# 2 | Broadcast / Multicast




# 2 | Broadcast / Multicast




**http://www.internetlivestats.com**