

# CE 443 - Computer Networks

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*Acknowledgments:* Some of the slides are fully or partially obtained from other sources. Reference is noted on the bottom of each slide, when the content is fully obtained from another source. Otherwise a full list of references is provided on the last slide.



# What happens when you click on a URL?

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- When you click on a URL, 17 messages are exchanged on the internet
  - 6 message to translate the server name to IP address
  - 3 messages to setup a TCP connection
  - 4 messages for your browser to send the HTTP “get” request, and server response (assuming the page it self fits in one message)
  - 4 messages to tear down the connection

# History



# Early communication over Long Distance

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- Between human beings
- Letter and messenger
  - Information carried by physical objects
  - Speed limited by transportation means: horse, bird, train, car
  - Bandwidth? Distance? Security?
- Fire
  - Early optical communication
  - Speed of light
  - Bandwidth? Distance? Security?



# Communication Using Electrons

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- 1827 (1206) Ohm's Law
- 1837 (1216) "Workable" telegraph invented by Samuel Morse
- 1838 (1217) demonstration over 16 kilometers at 10 w.p.m.
- 1851 (1230) Western Union founded
- 1868 (1247) Transatlantic cable laid
- **1876 (1255) Alexander Bell invented the telephone**
- 1885 (1264) AT&T formed
- 1892 (1271) First automated commercial telephone switch

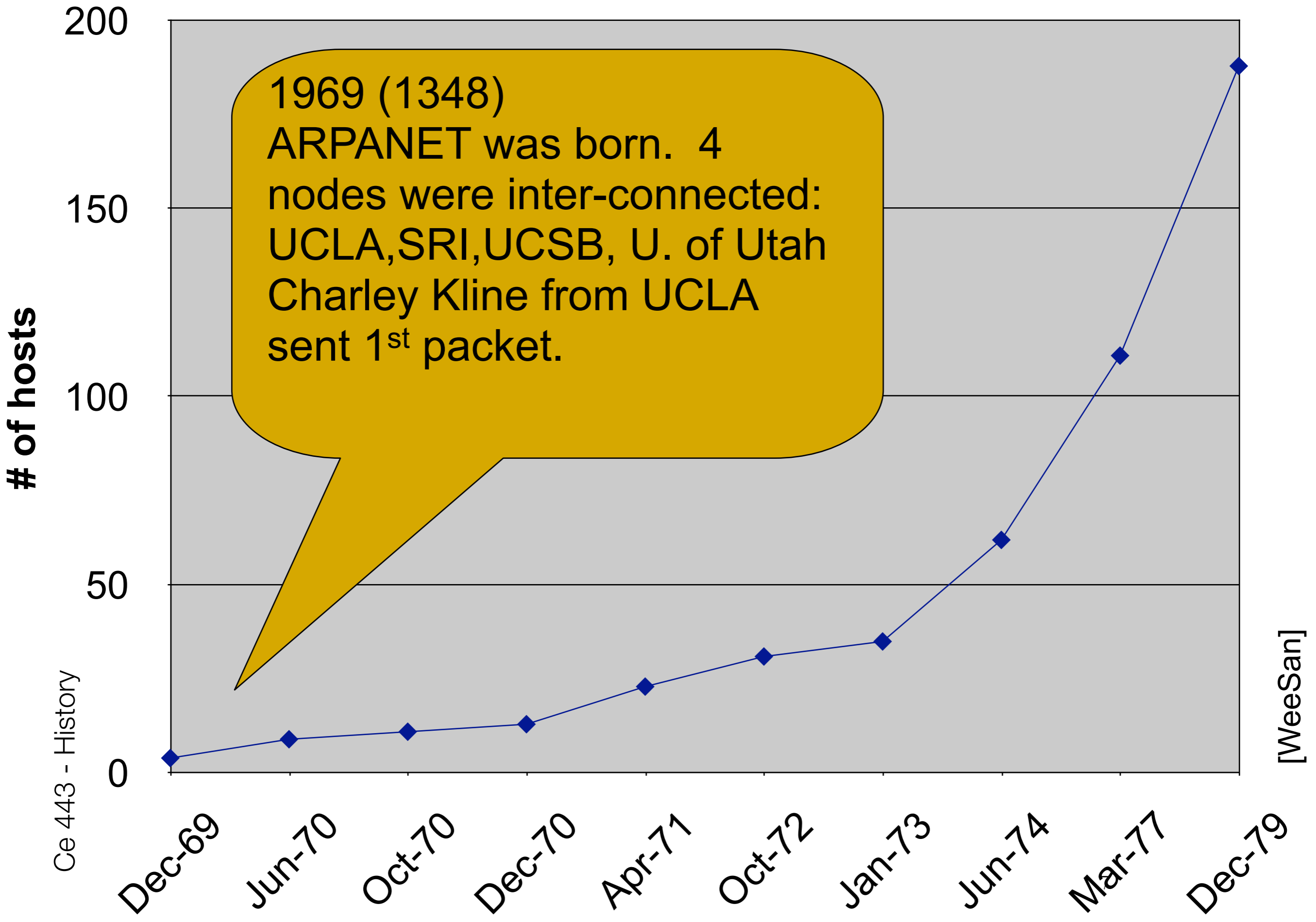


# Age of Telephones

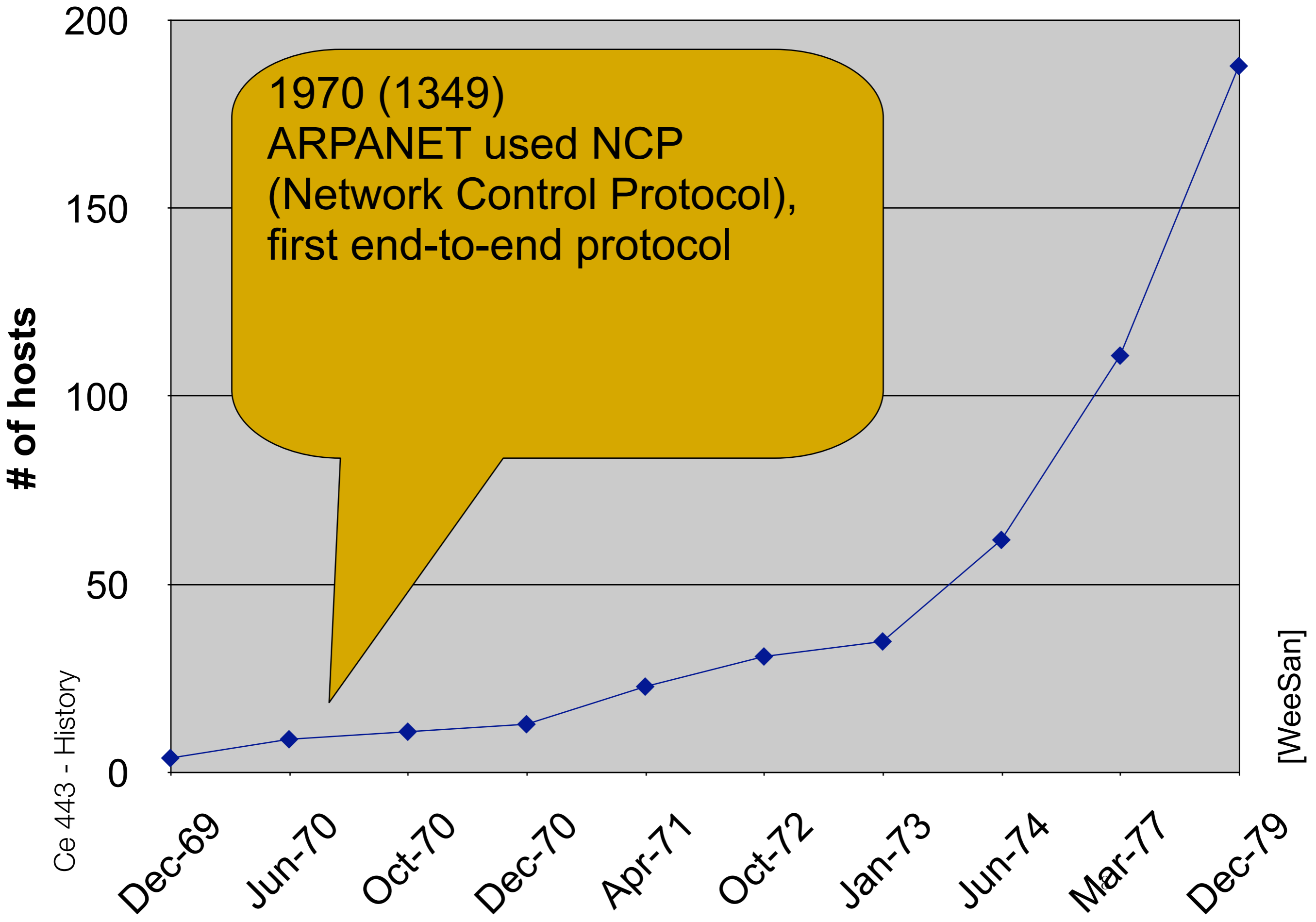
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- 1903 (1282) 3 million phones in the U.S.
- 1915 (1294) First transcontinental telephone line
- 1948 (1327) Transistor invented by Bell scientists
- 1963 (1342) Digital transmission introduced
- 1965 (1344) 1ESS central office switch introduced
- **1969 (1348) Arpanet was born**
- 1985 (1364) Last telegraph circuit closed down
- 1999 (1378) Last 4ESS install in ATT network

# Internet Hosts



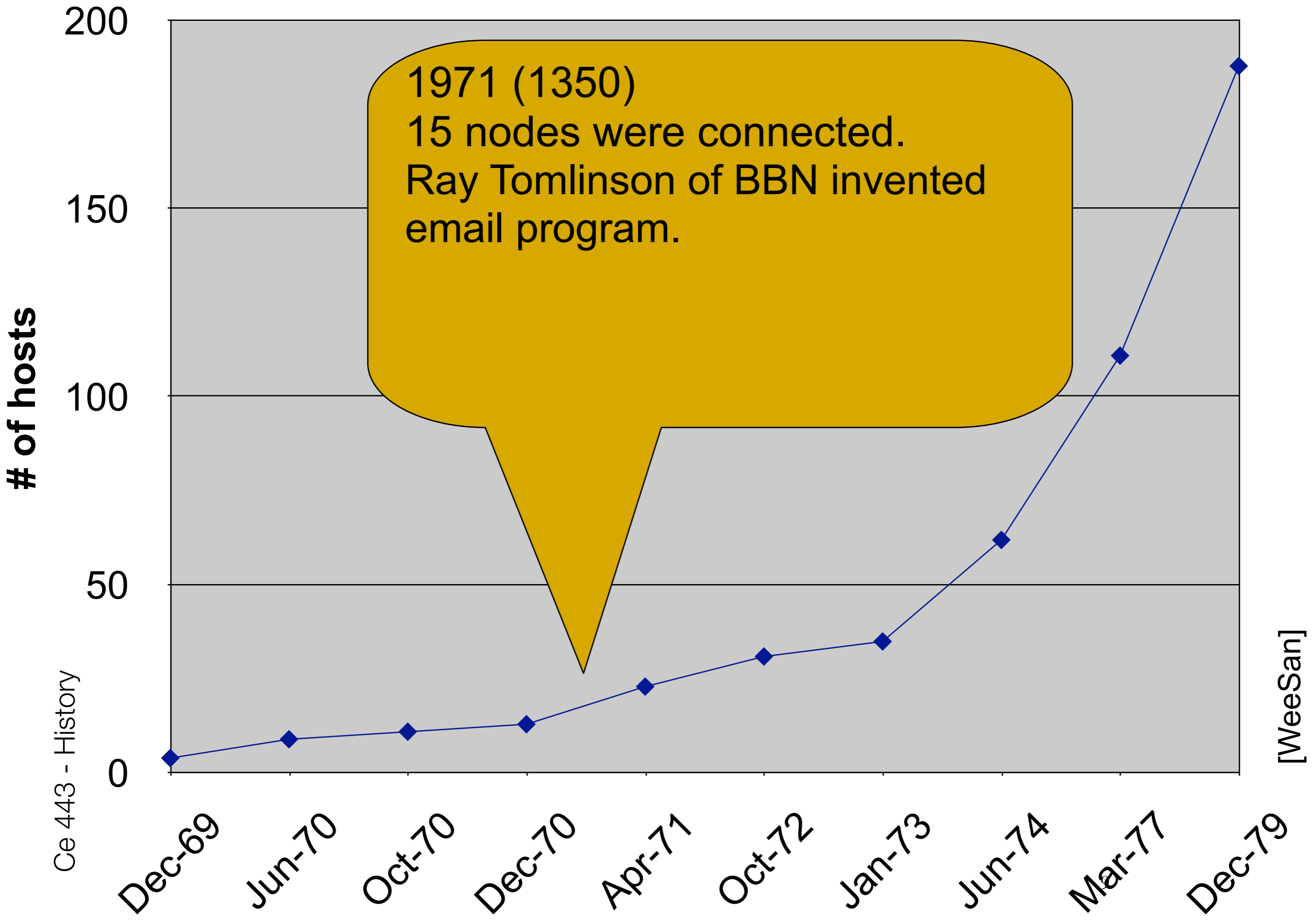
# Internet Hosts



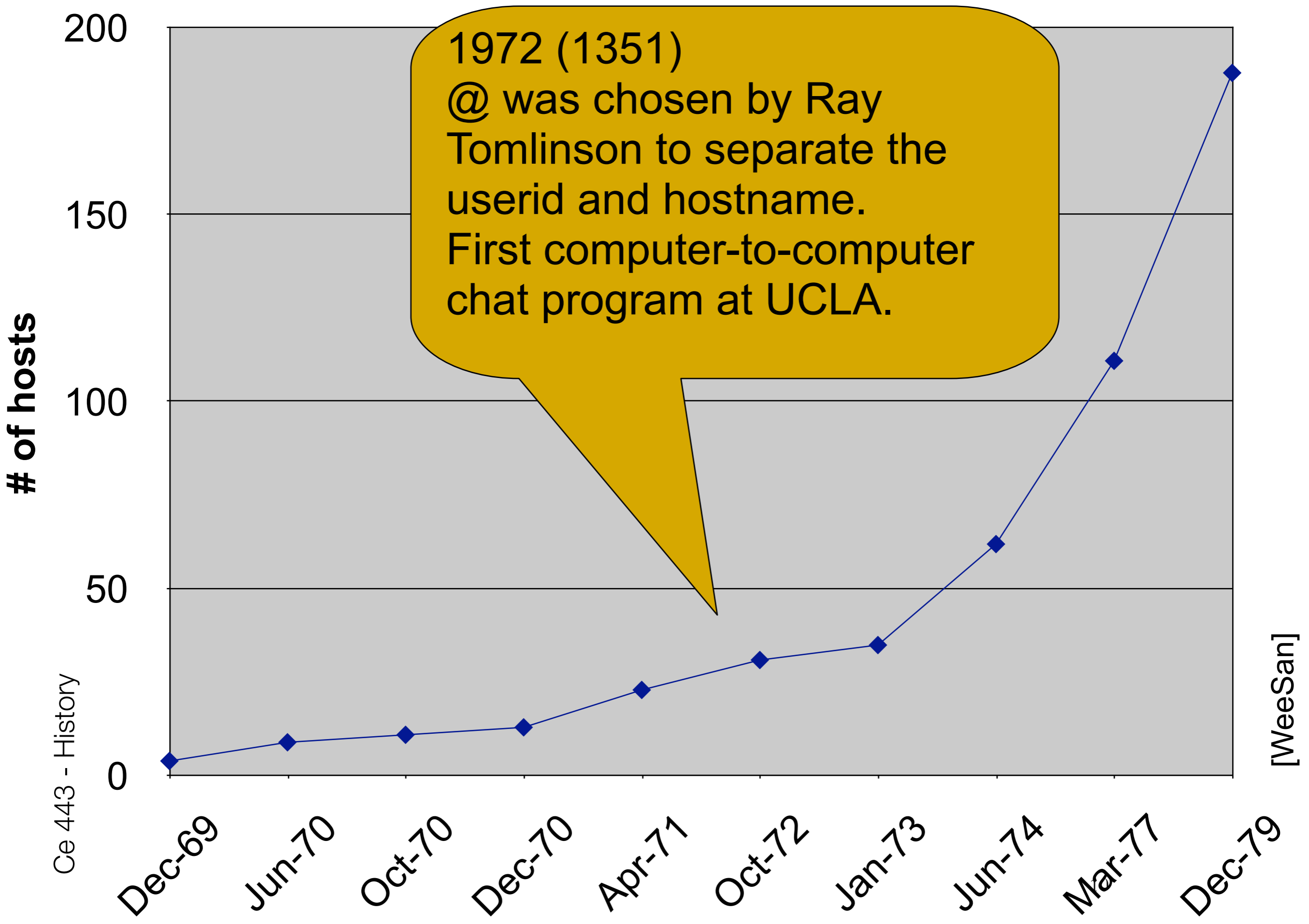
Ce 443 - History

[WeeSan]

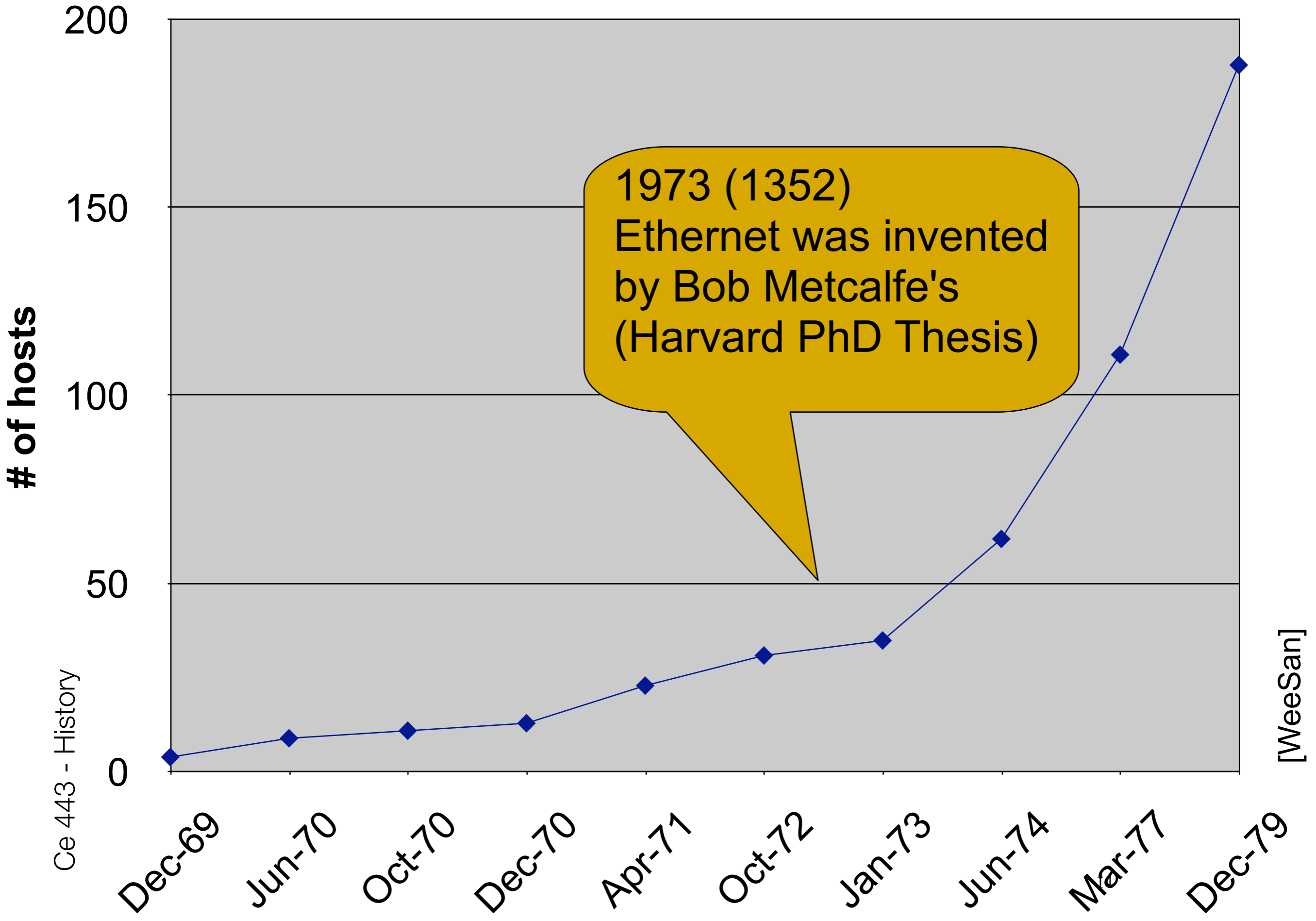
# Internet Hosts



# Internet Hosts



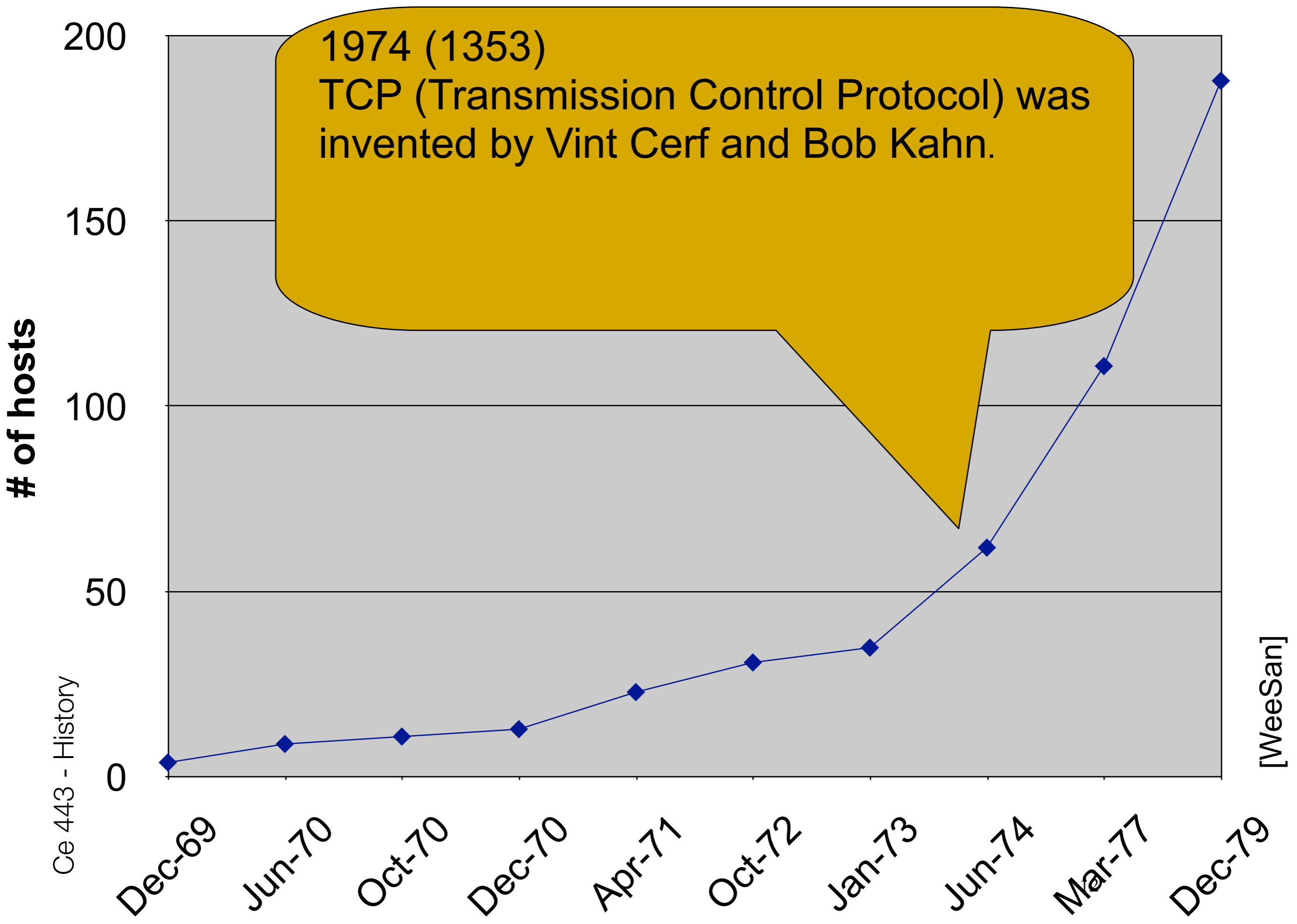
# Internet Hosts



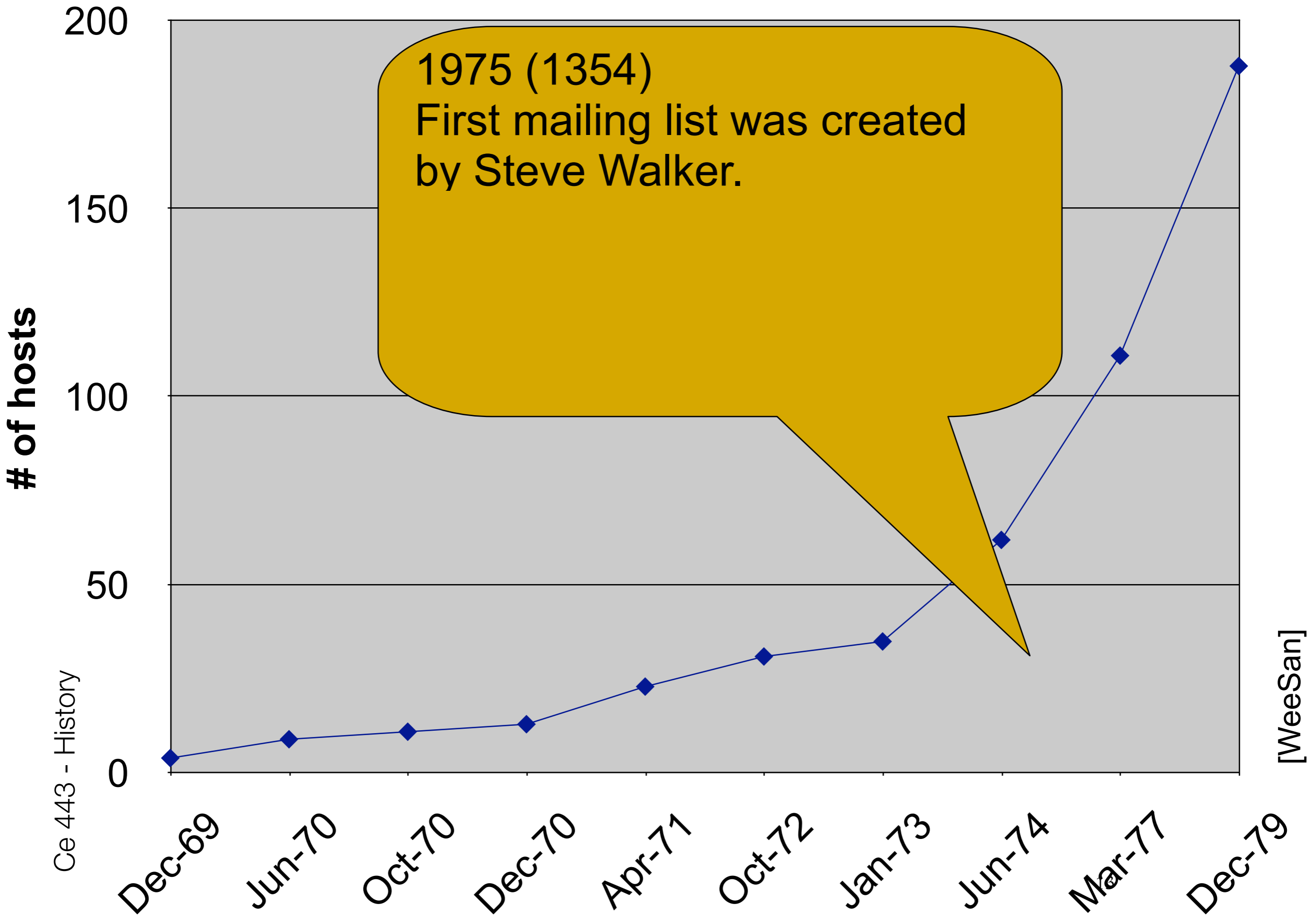
Ce 443 - History

[WeeSan]

# Internet Hosts

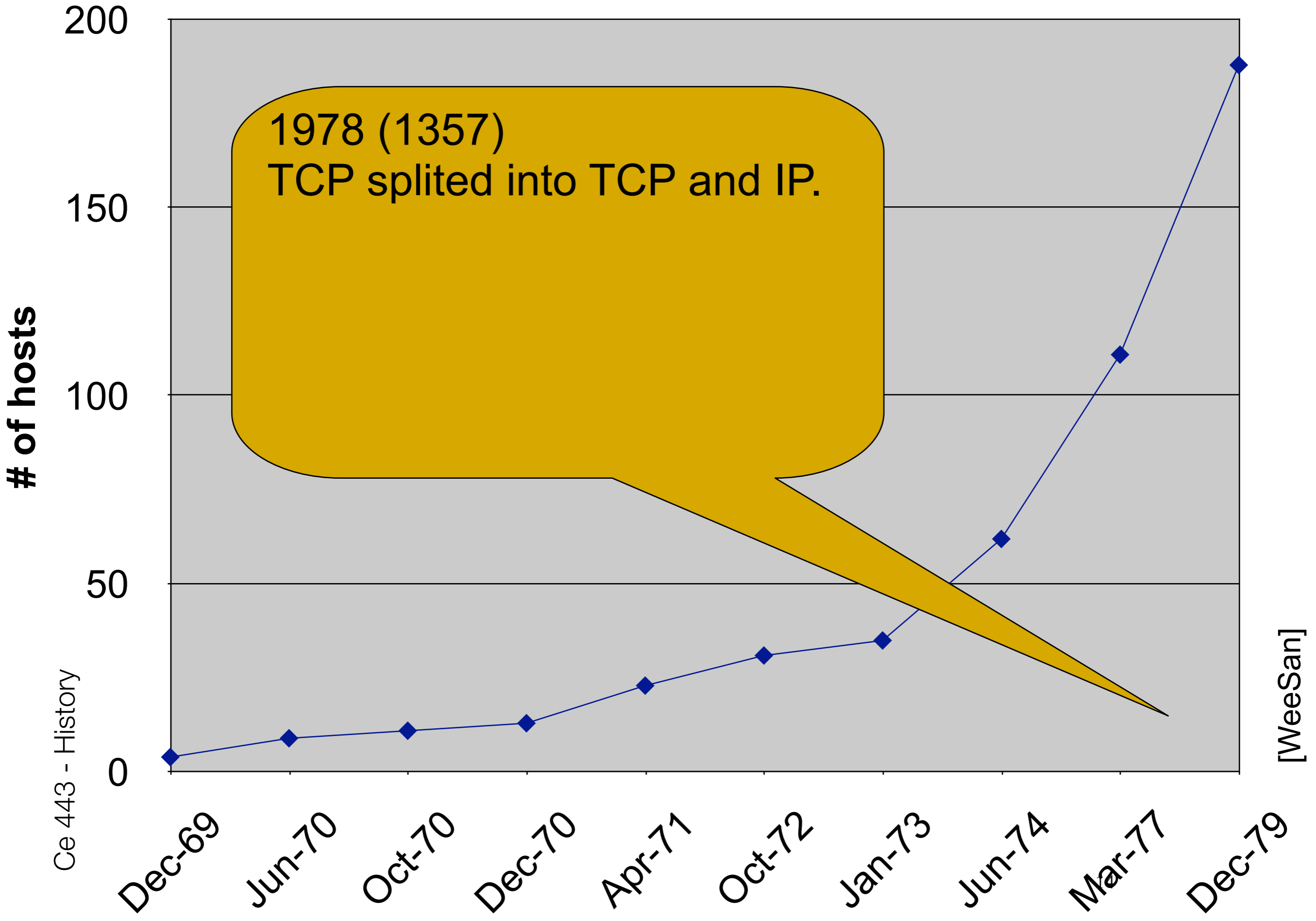


# Internet Hosts

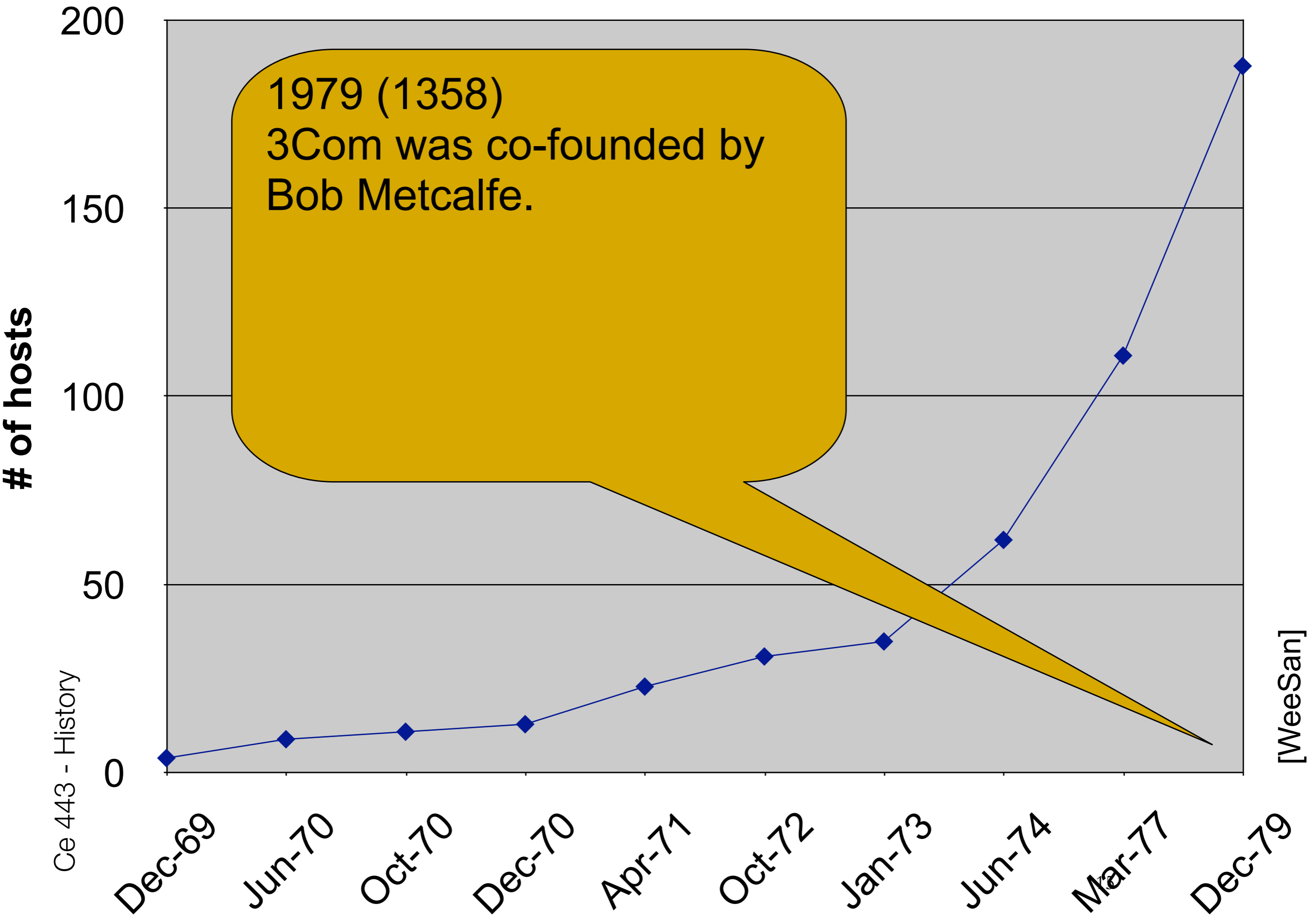


1975 (1354)  
First mailing list was created  
by Steve Walker.

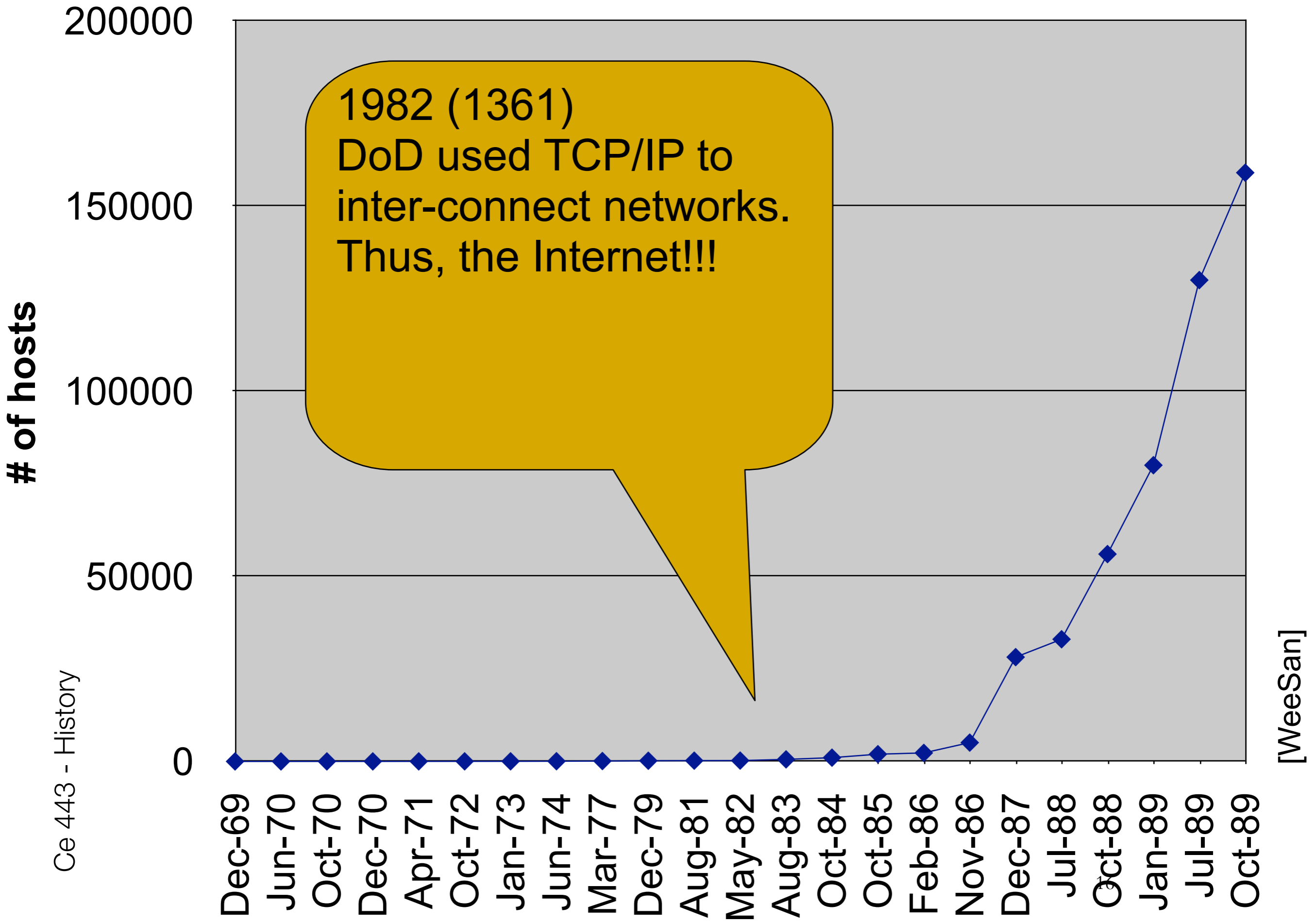
# Internet Hosts



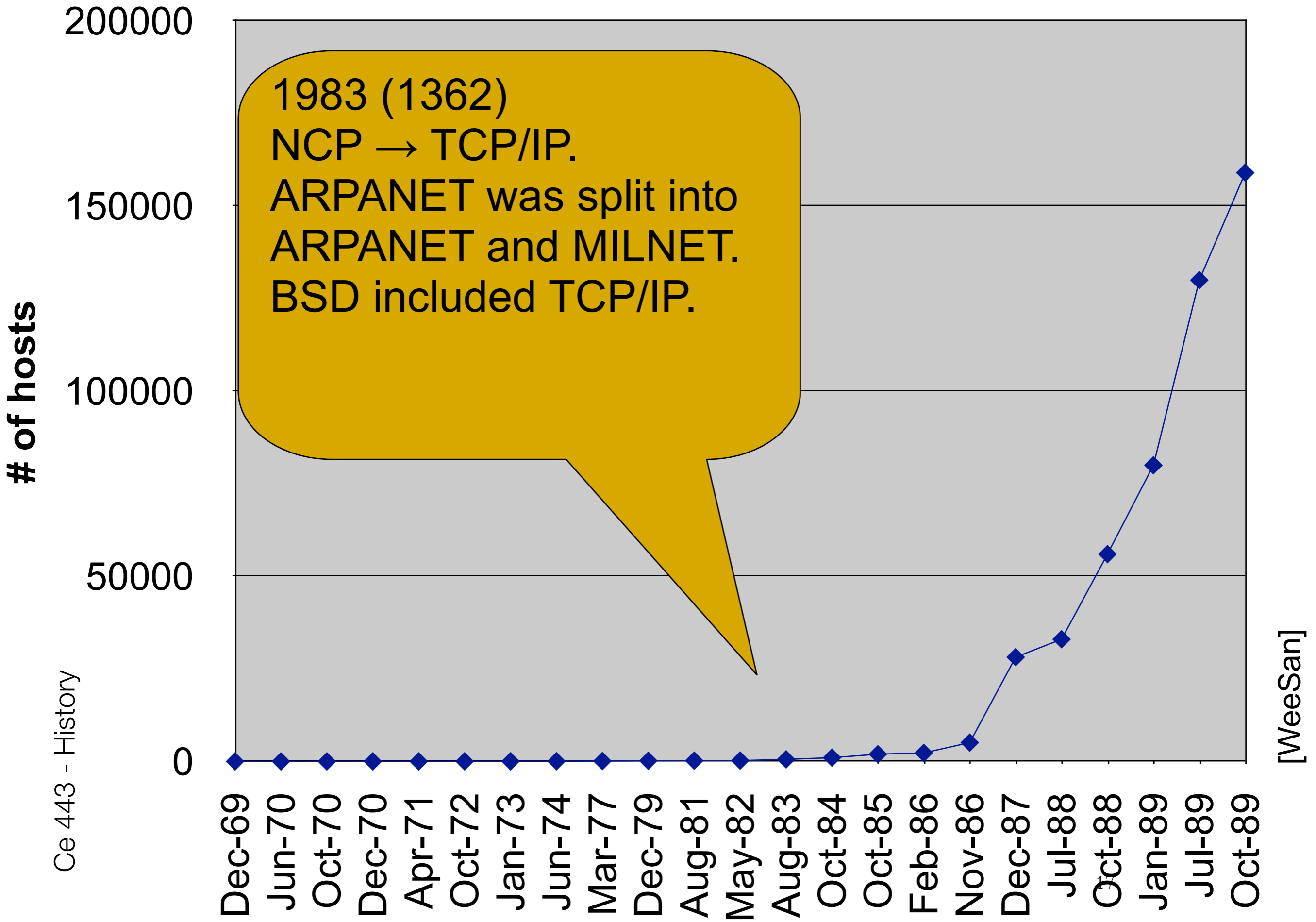
# Internet Hosts



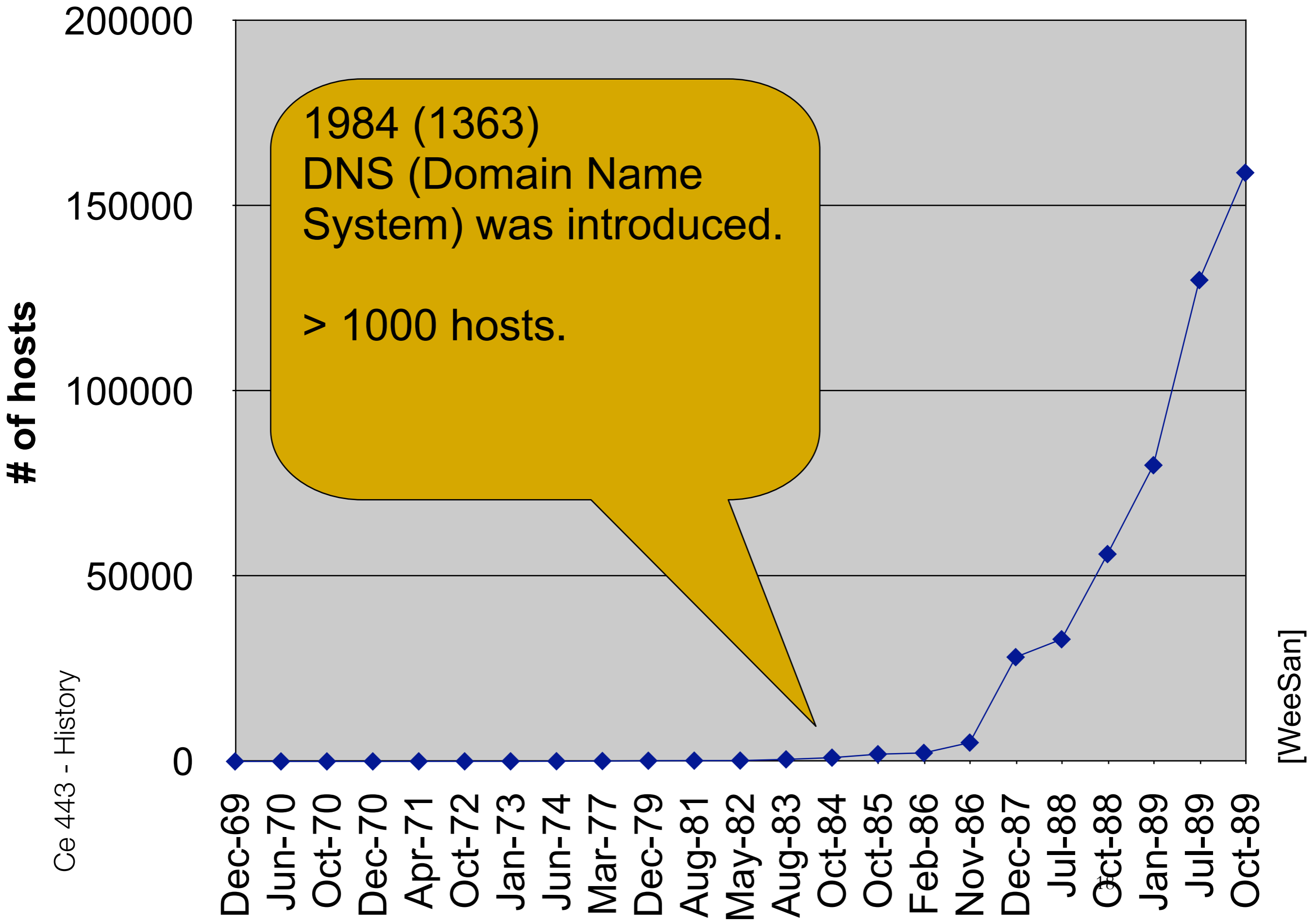
# Internet Hosts



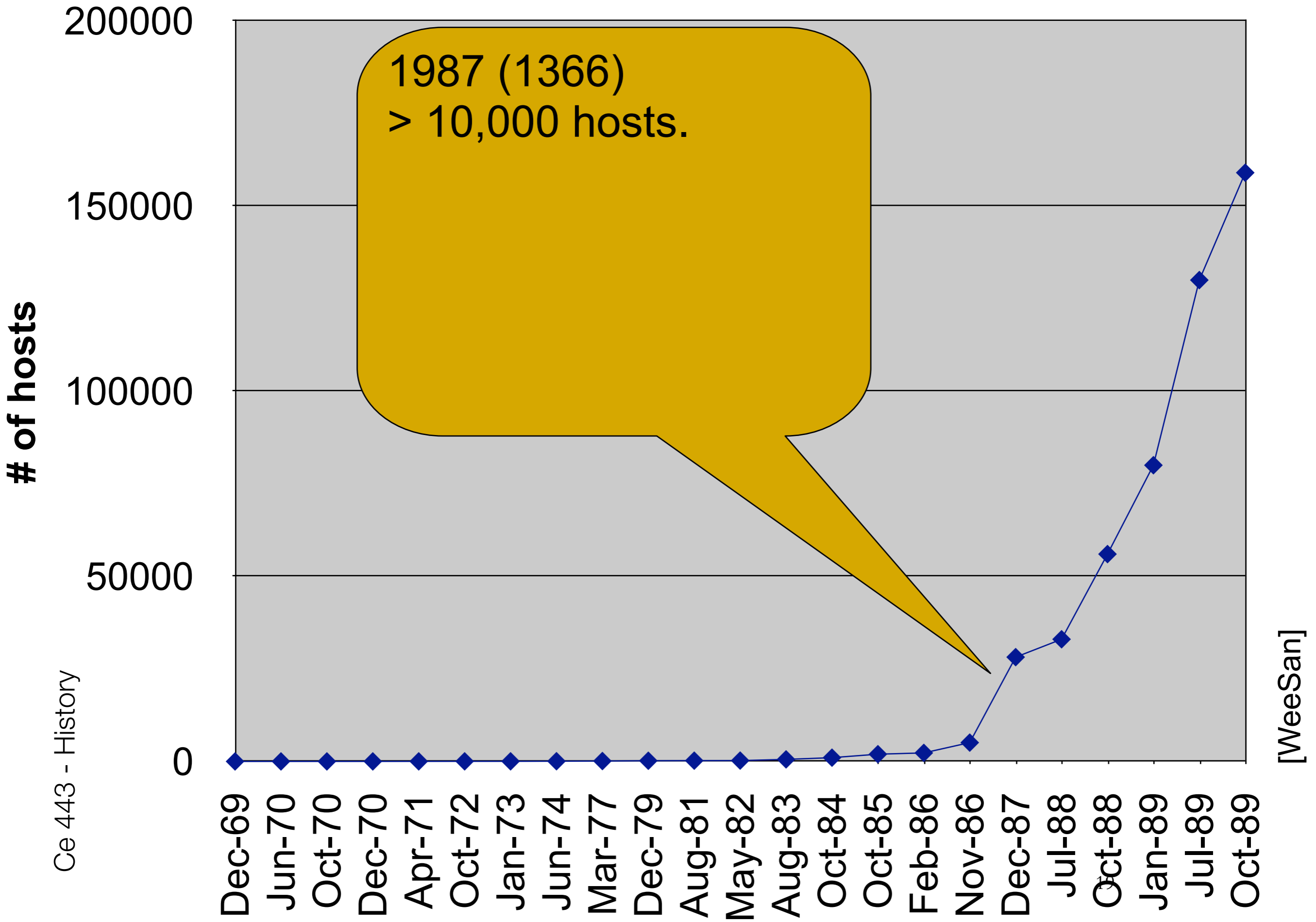
# Internet Hosts



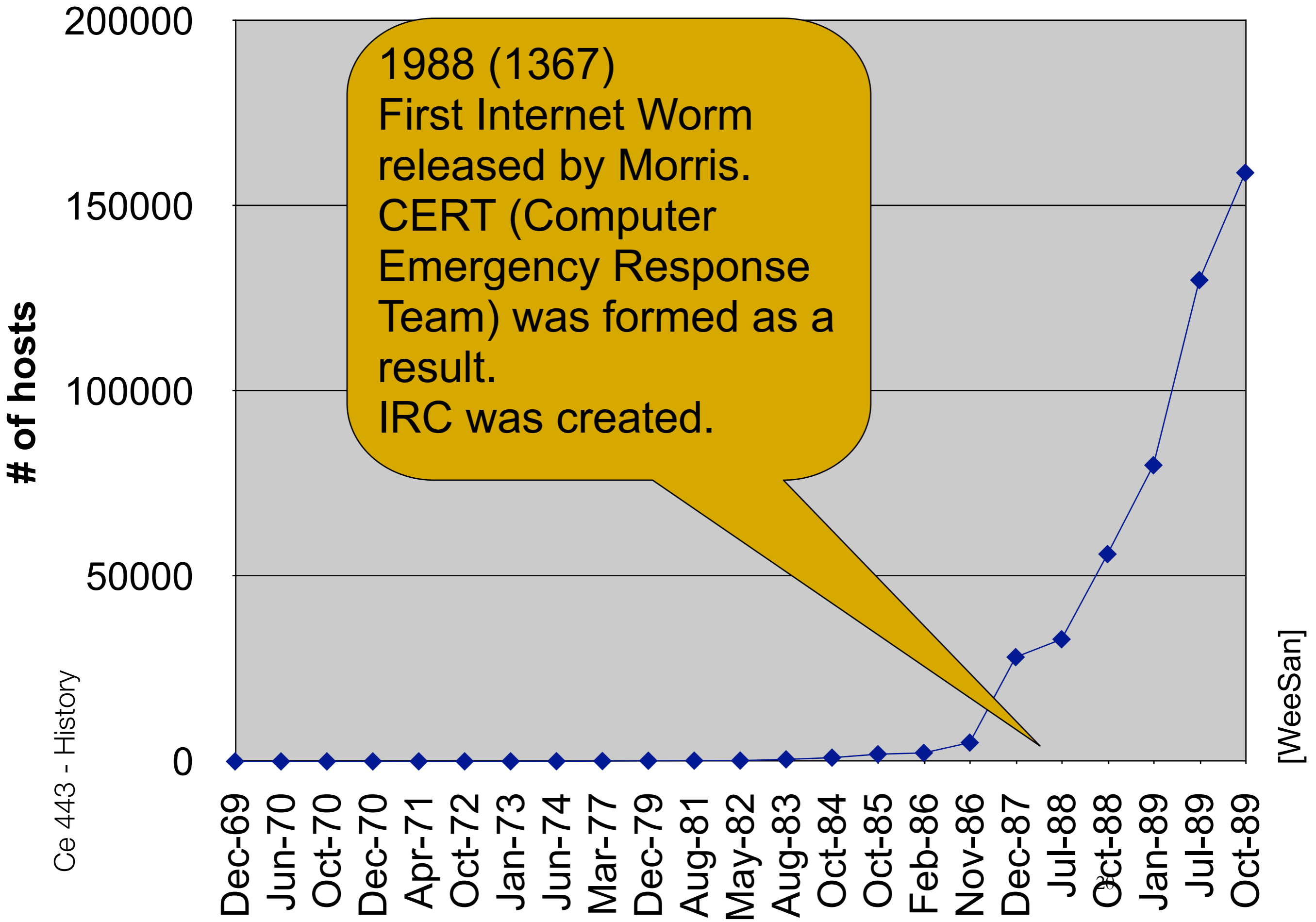
# Internet Hosts



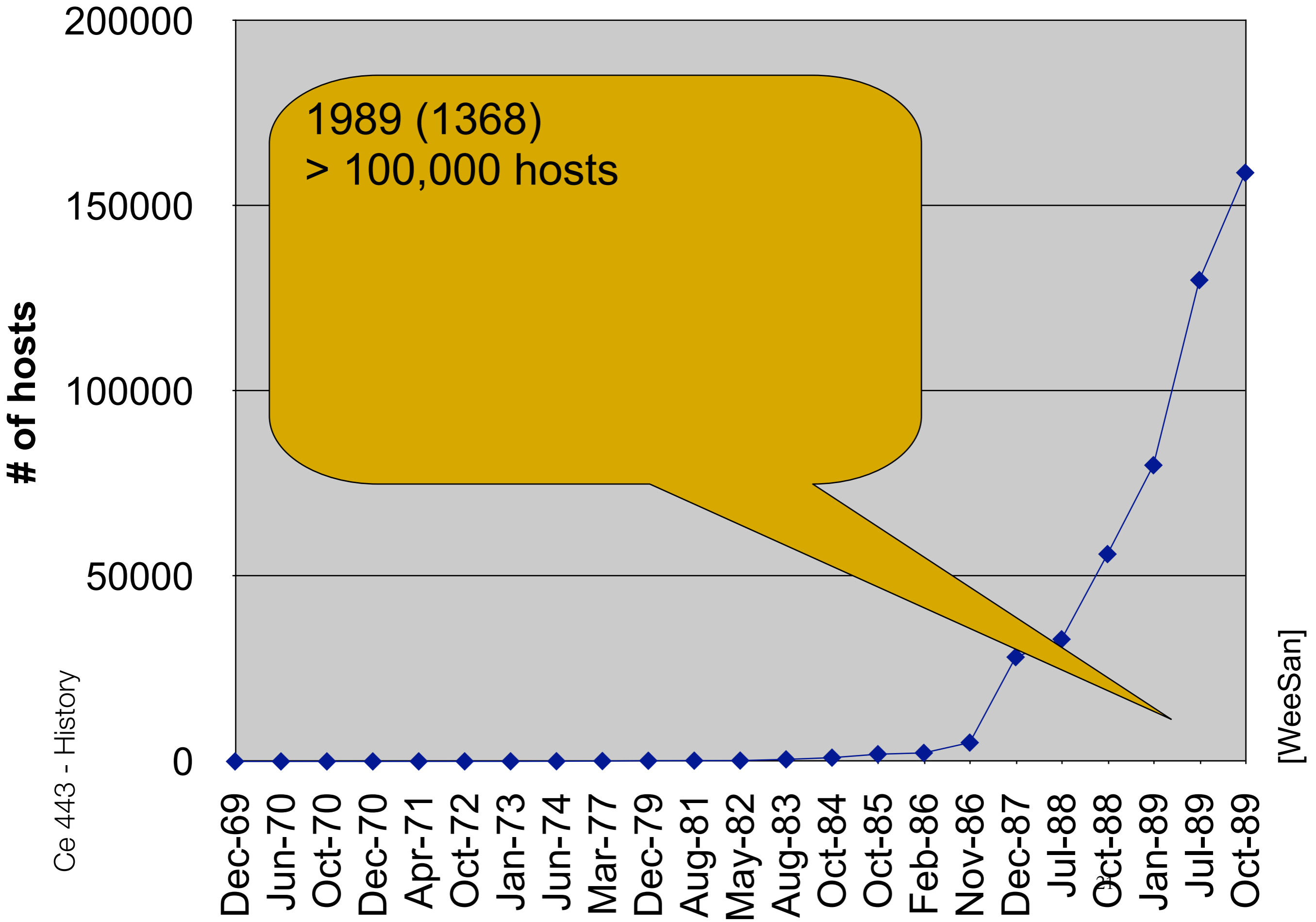
# Internet Hosts



# Internet Hosts



# Internet Hosts



# Internet Hosts

# of hosts

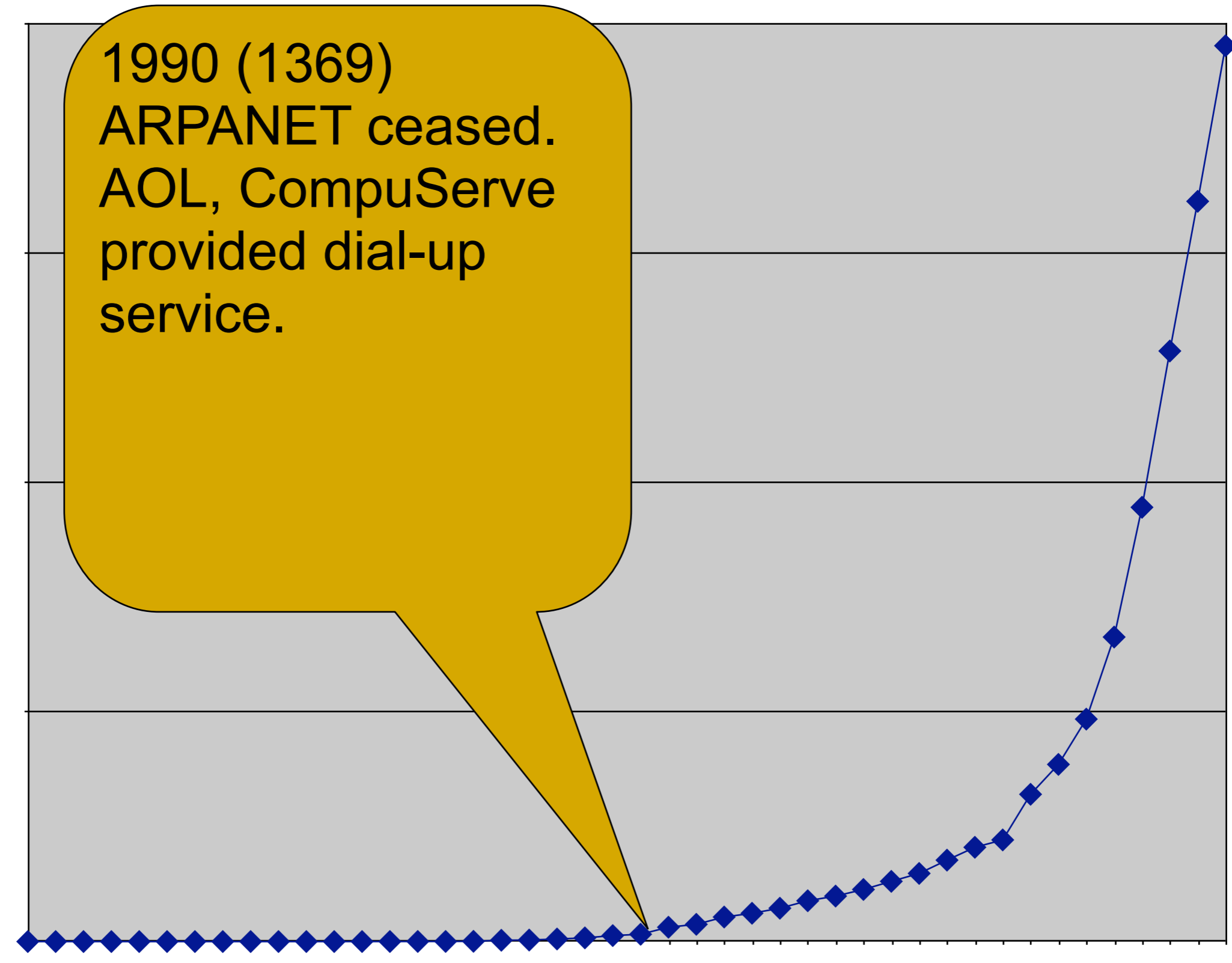
20000000  
15000000  
10000000  
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1990 (1369)  
ARPANET ceased.  
AOL, CompuServe  
provided dial-up  
service.

Ce 443 - History

Dec-69  
Oct-70  
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Jan-95  
Jan-96  
Jan-97

[WeeSan]



# Internet Hosts

# of hosts

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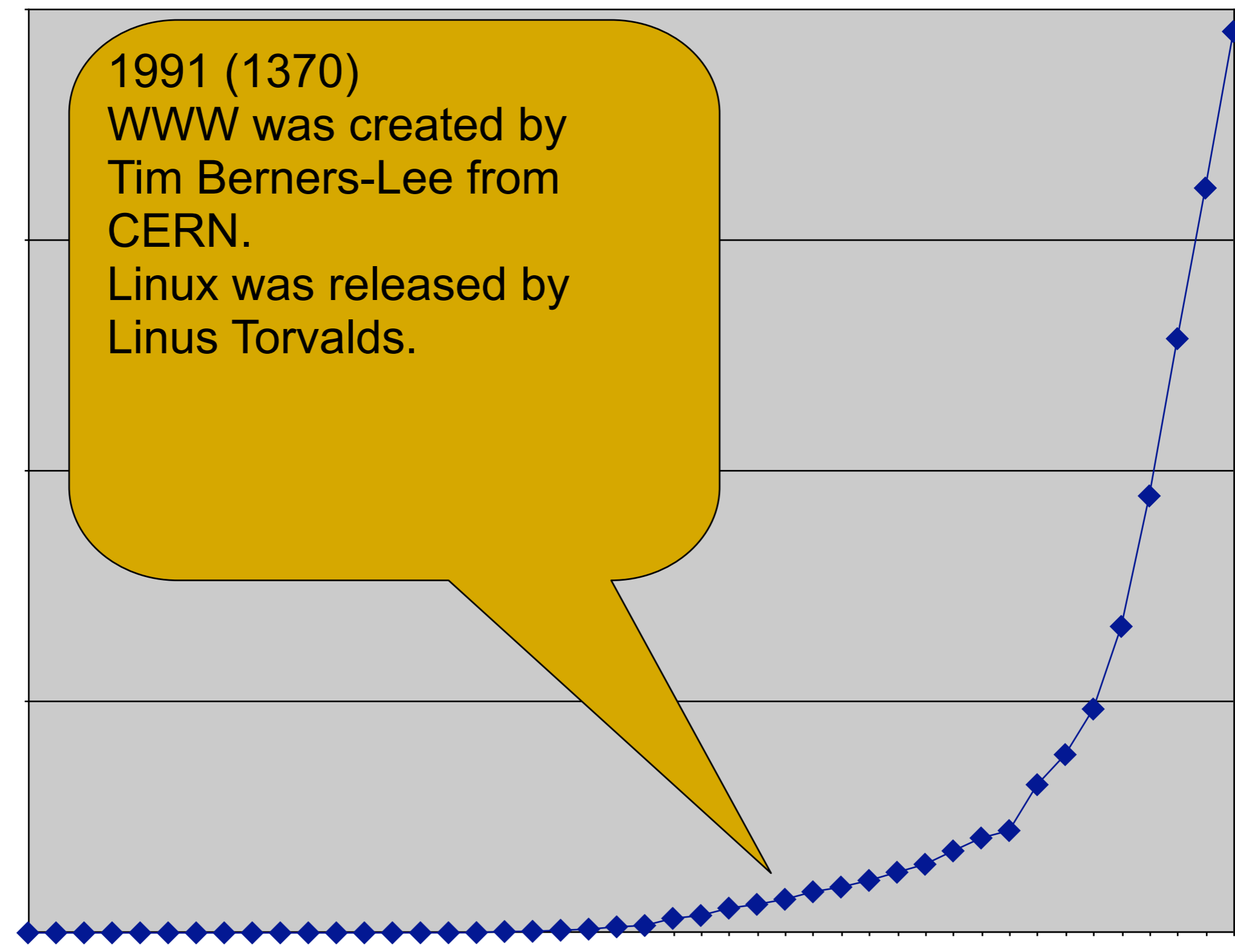
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Oct-93  
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Jan-95  
Jan-96  
Jan-97

[WeeSan]

1991 (1370)  
WWW was created by  
Tim Berners-Lee from  
CERN.  
Linux was released by  
Linus Torvalds.

Ce 443 - History



# Internet Hosts

# of hosts

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10000000

5000000

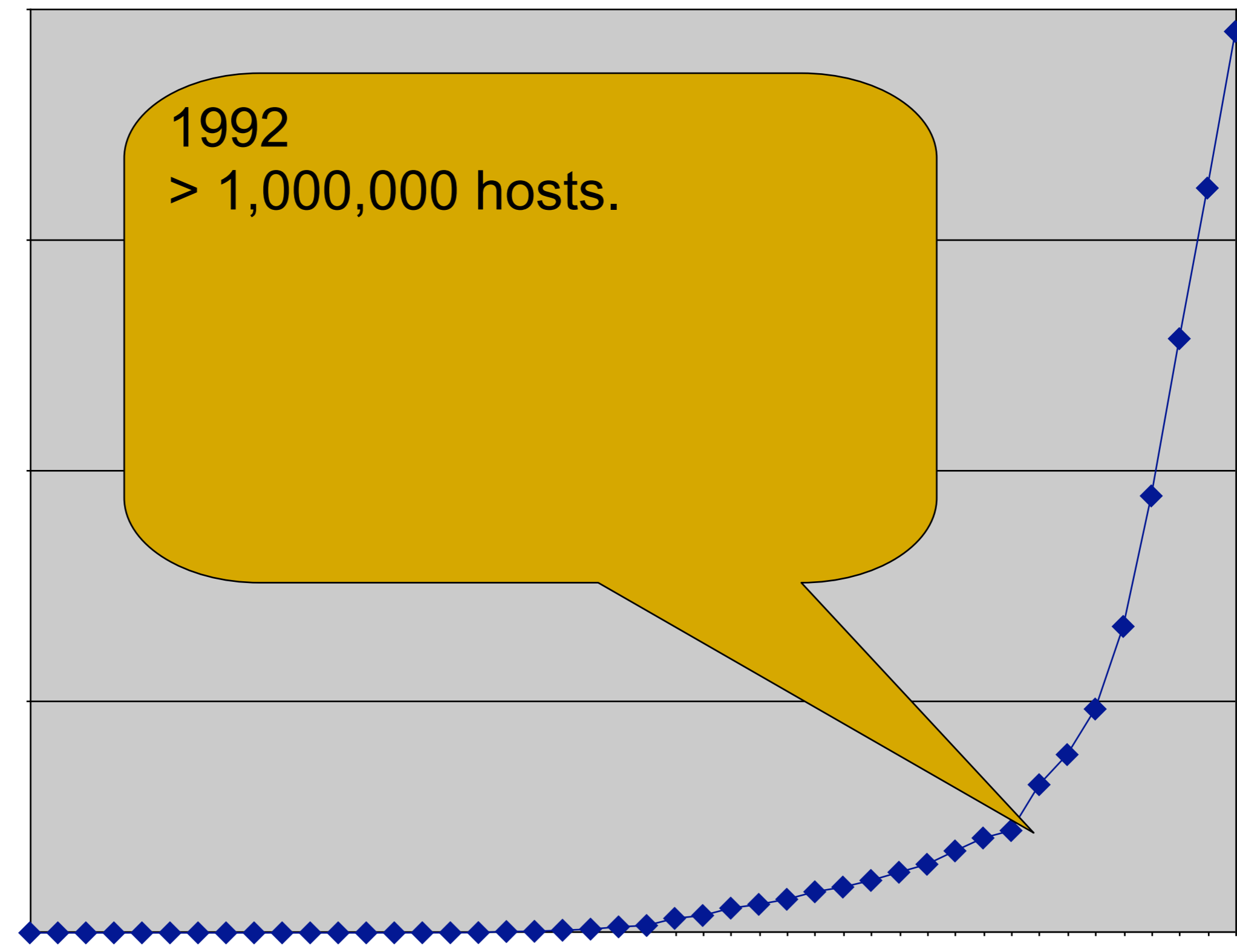
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Ce 443 - History

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Jan-96  
Jan-97

[WeeSan]

1992  
> 1,000,000 hosts.



# Internet Hosts

# of hosts

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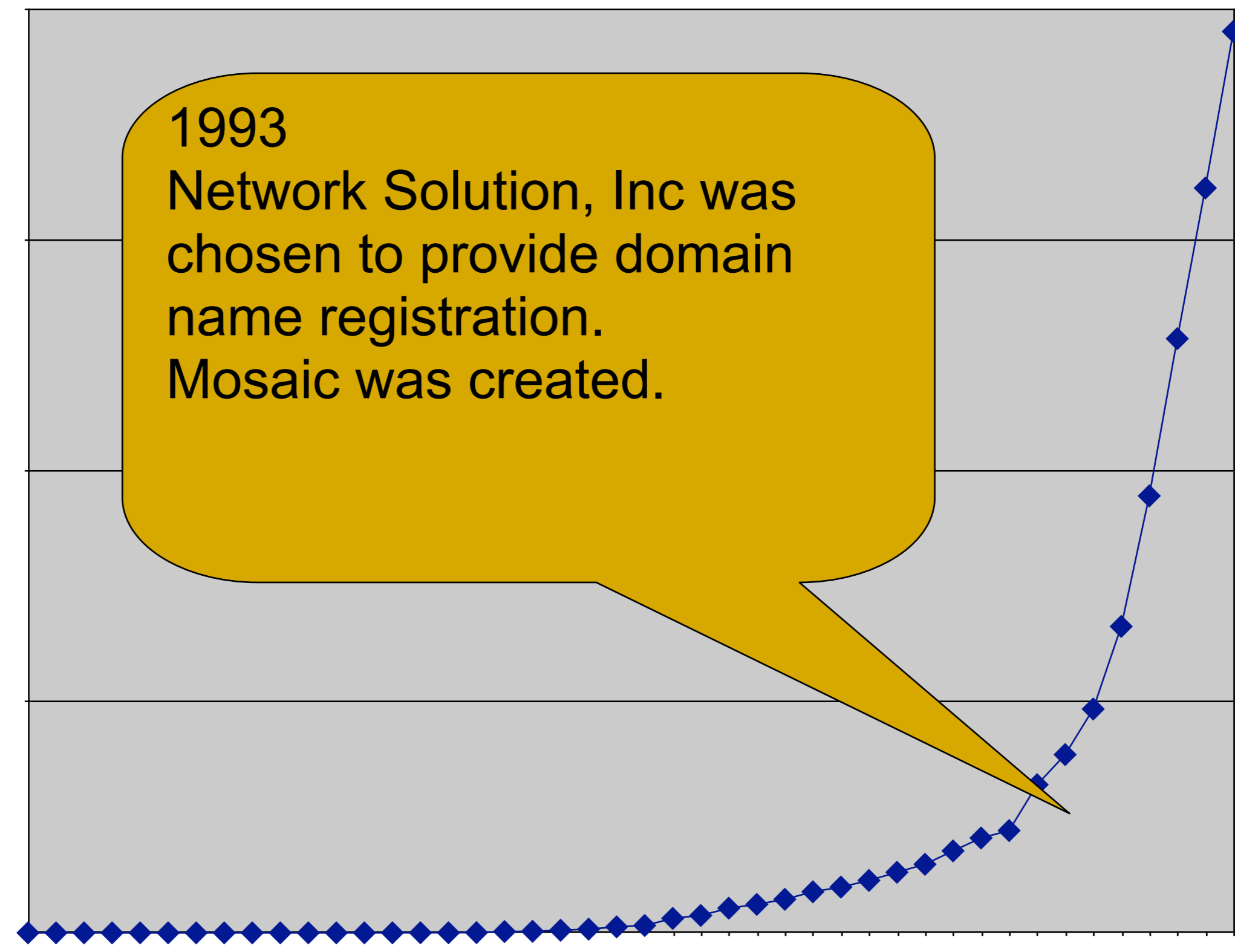
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Jan-97

1993  
Network Solution, Inc was  
chosen to provide domain  
name registration.  
Mosaic was created.

[WeeSan]

Ce 443 - History



# Internet Hosts

# of hosts

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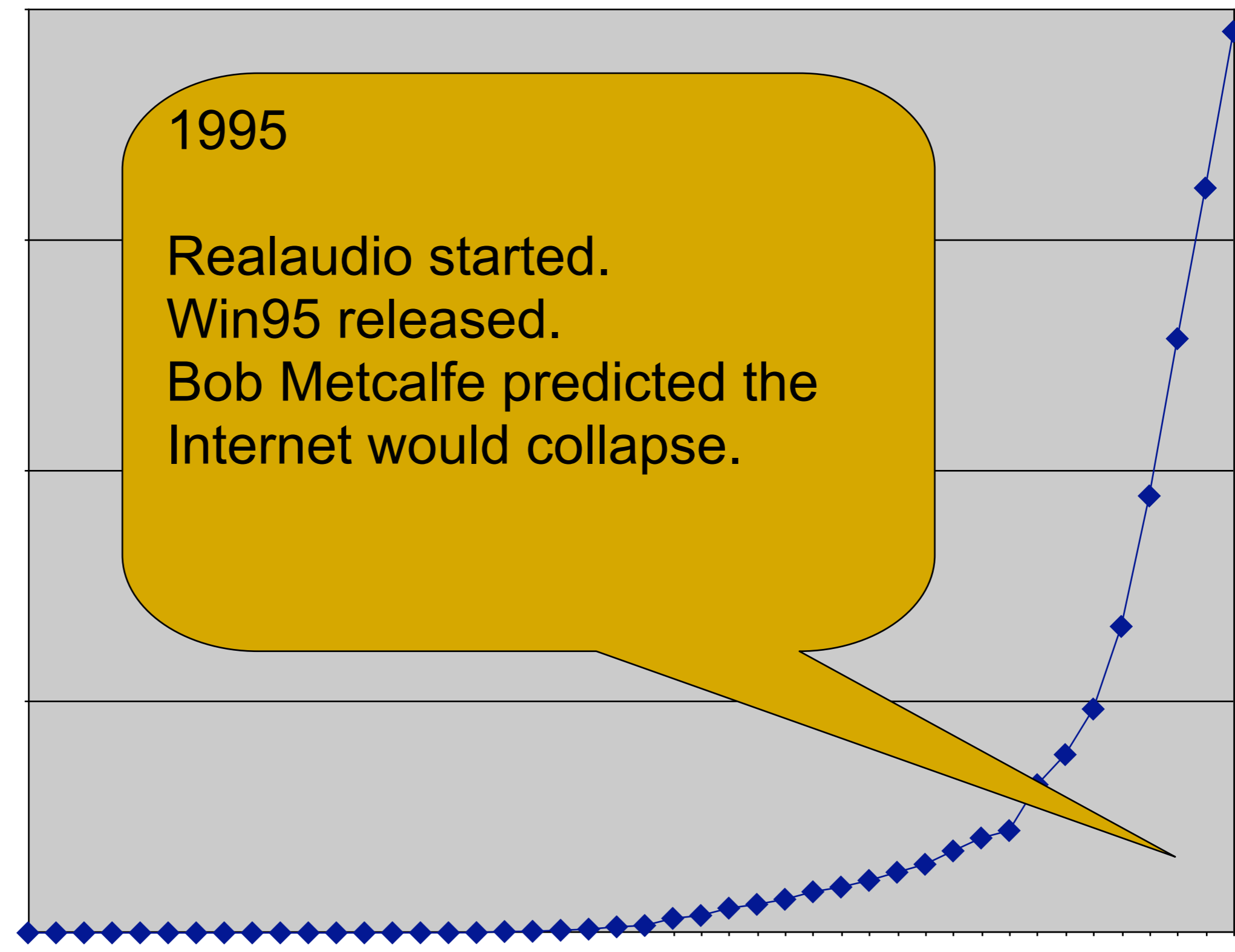
1995

Realaudio started.

Win95 released.

Bob Metcalfe predicted the  
Internet would collapse.

[WeeSan]



# Internet Hosts

# of hosts

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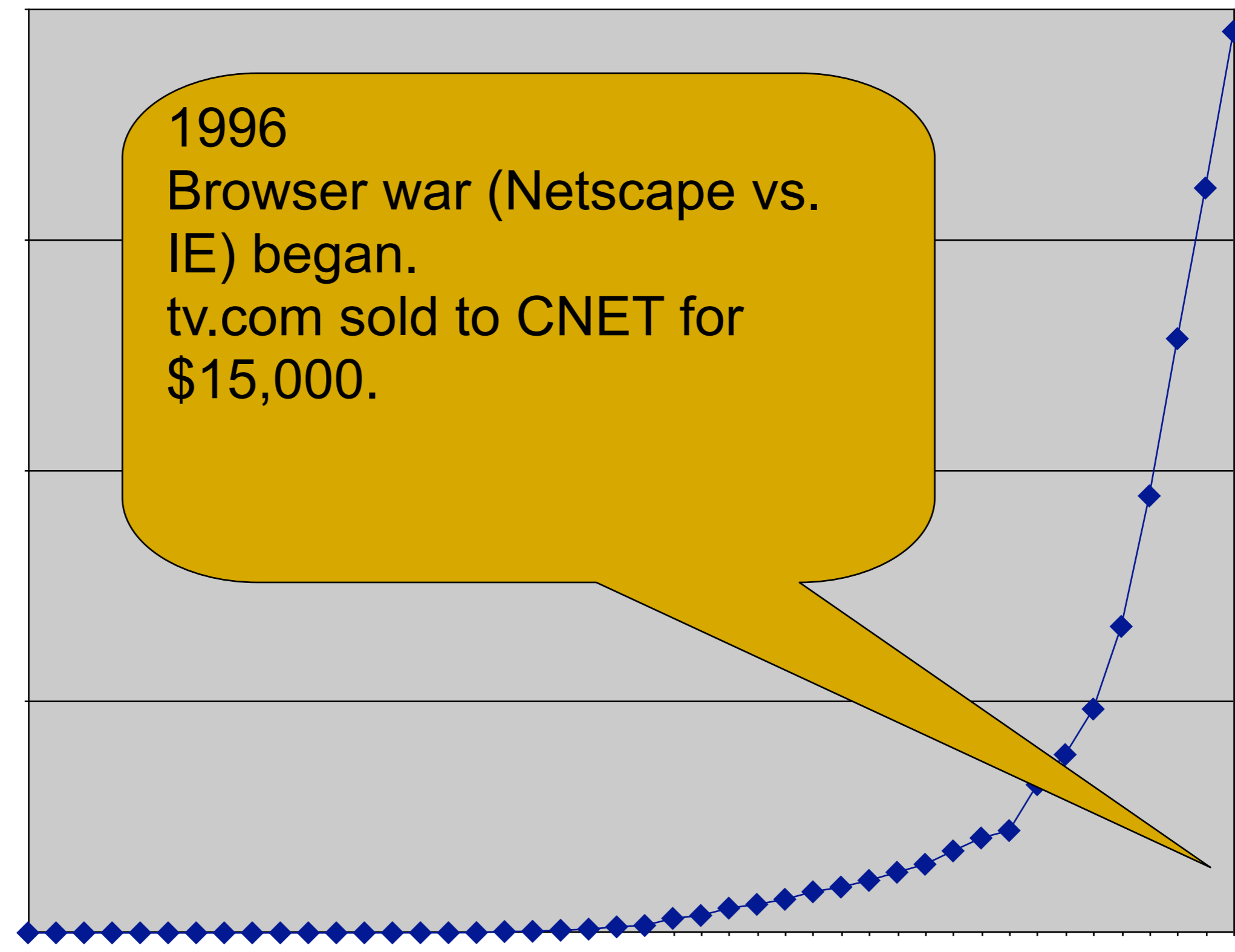
1996

Browser war (Netscape vs. IE) began.

tv.com sold to CNET for \$15,000.

[WeeSan]

Ce 443 - History



# Internet Hosts

# of hosts

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[WeeSan]

1998  
2M domain names registered.  
Compaq bought altavista.com for \$3.3M.  
Google founded.

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# of hosts

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1999

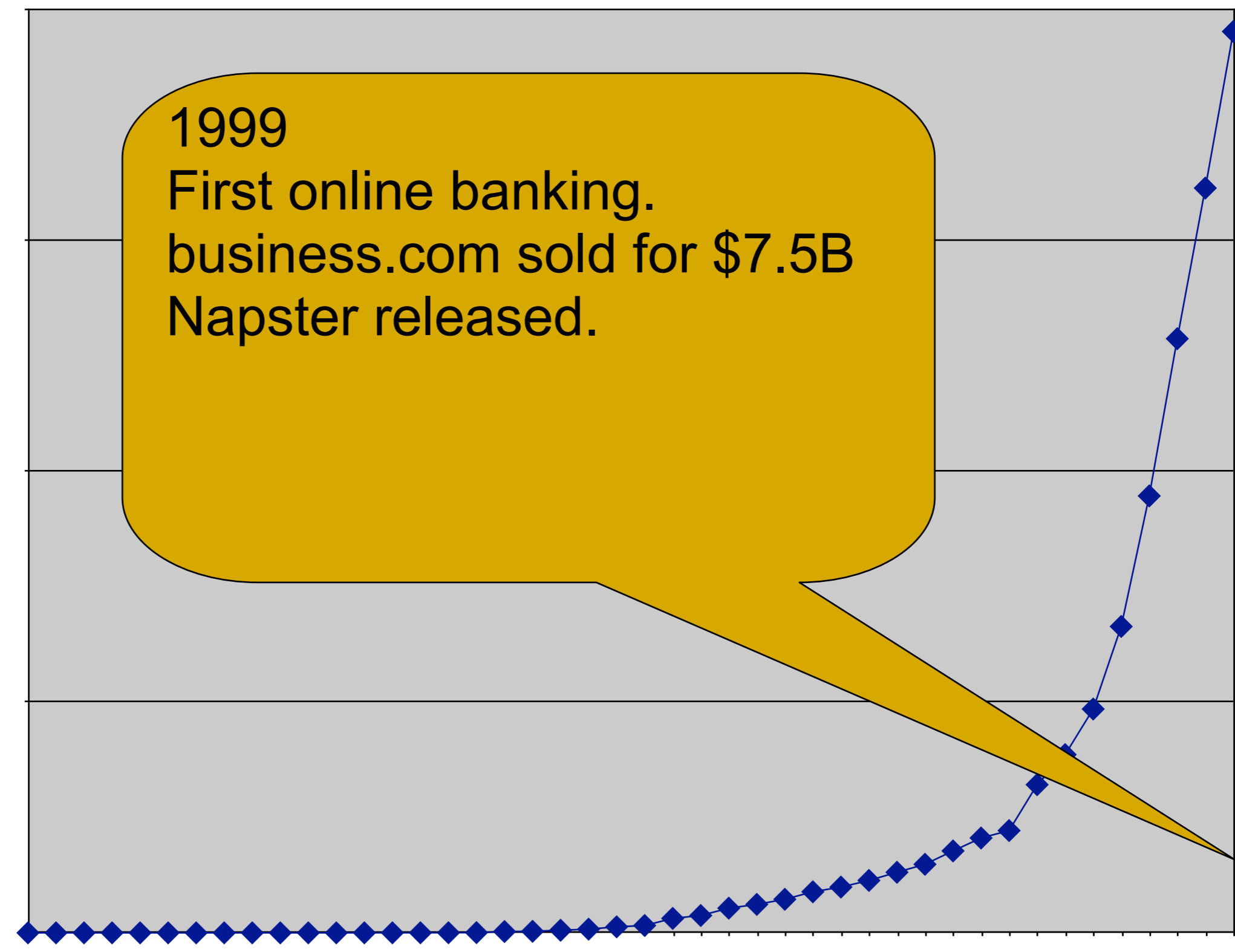
First online banking.

business.com sold for \$7.5B

Napster released.

Ce 443 - History

[WeeSan]



# Internet Hosts

# of hosts

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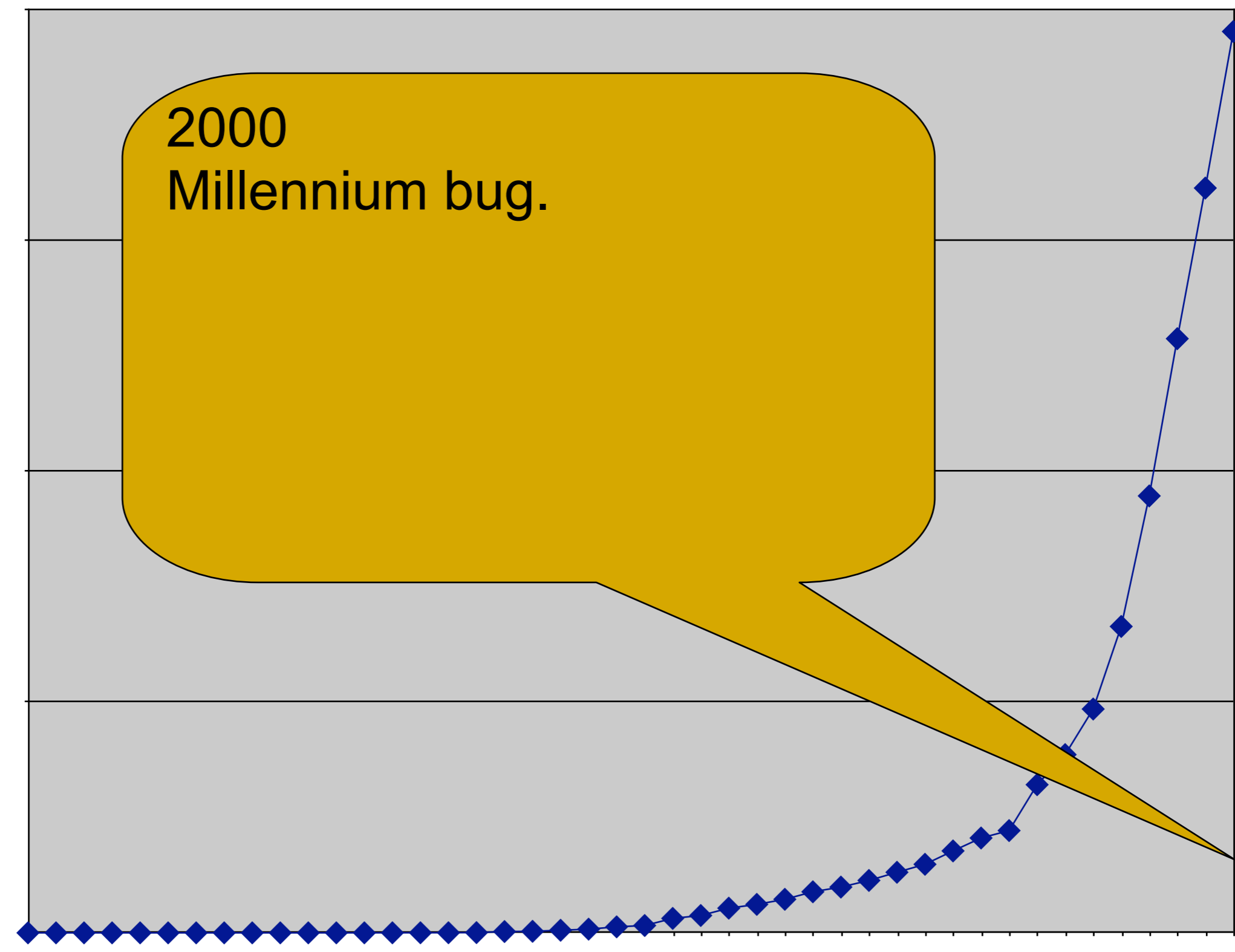
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2000  
Millennium bug.



# Internet Hosts

# of hosts

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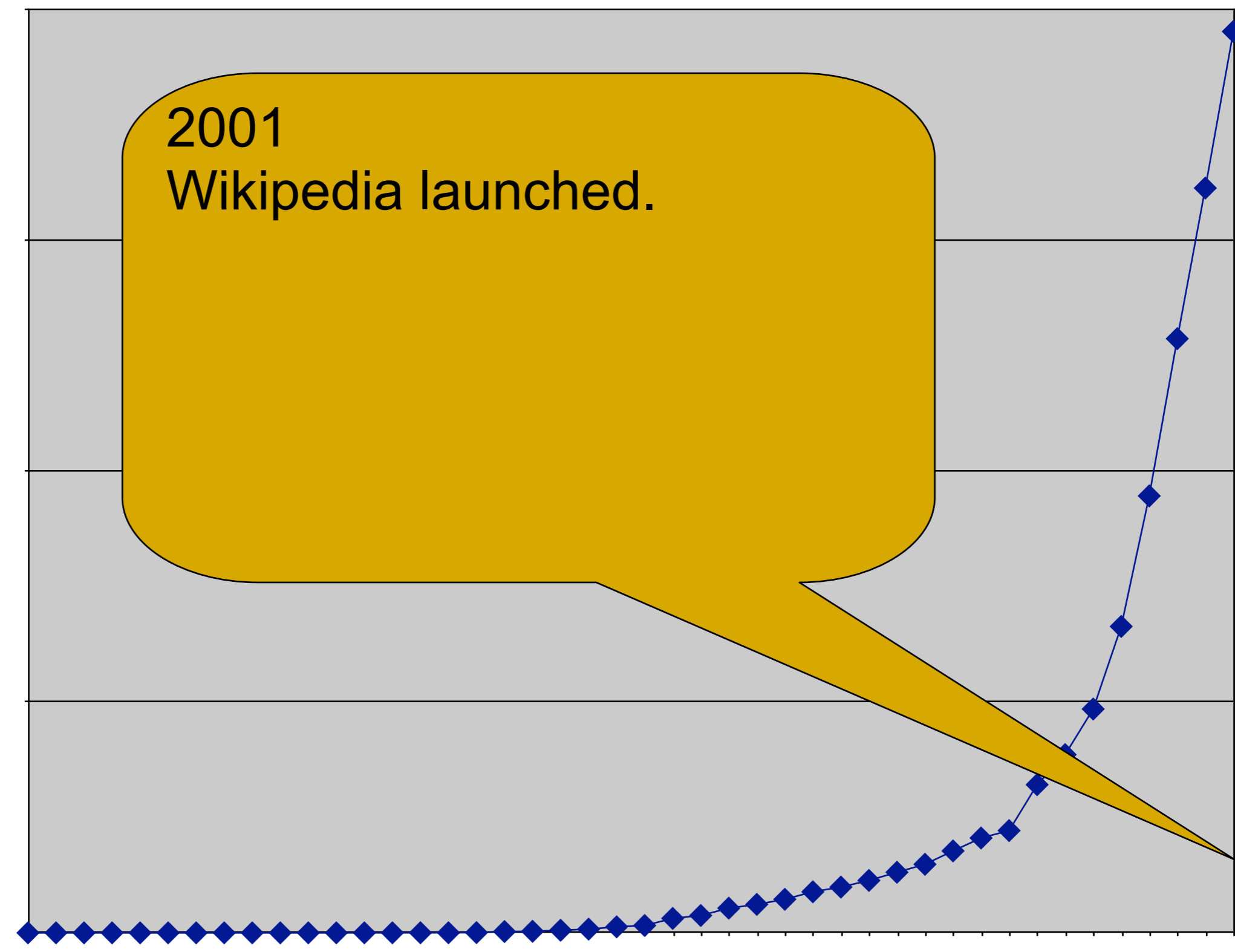
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[WeeSan]

2001

Wikipedia launched.

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# Internet Hosts

# of hosts

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Jan-97

[WeeSan]

2006  
> 439M hosts.  
10 new computers joined the Internet every second.

# Internet Hosts

# of hosts

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0

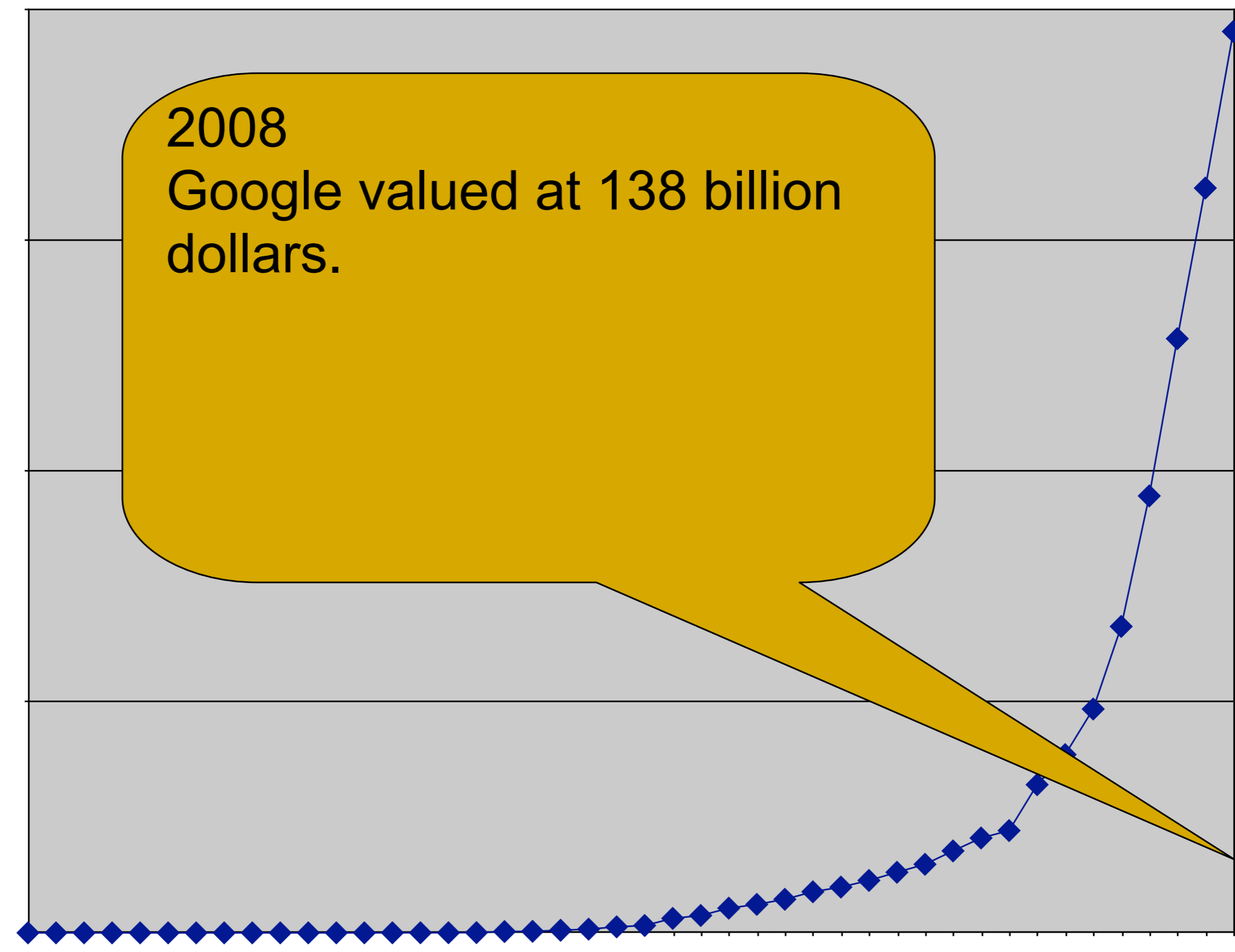
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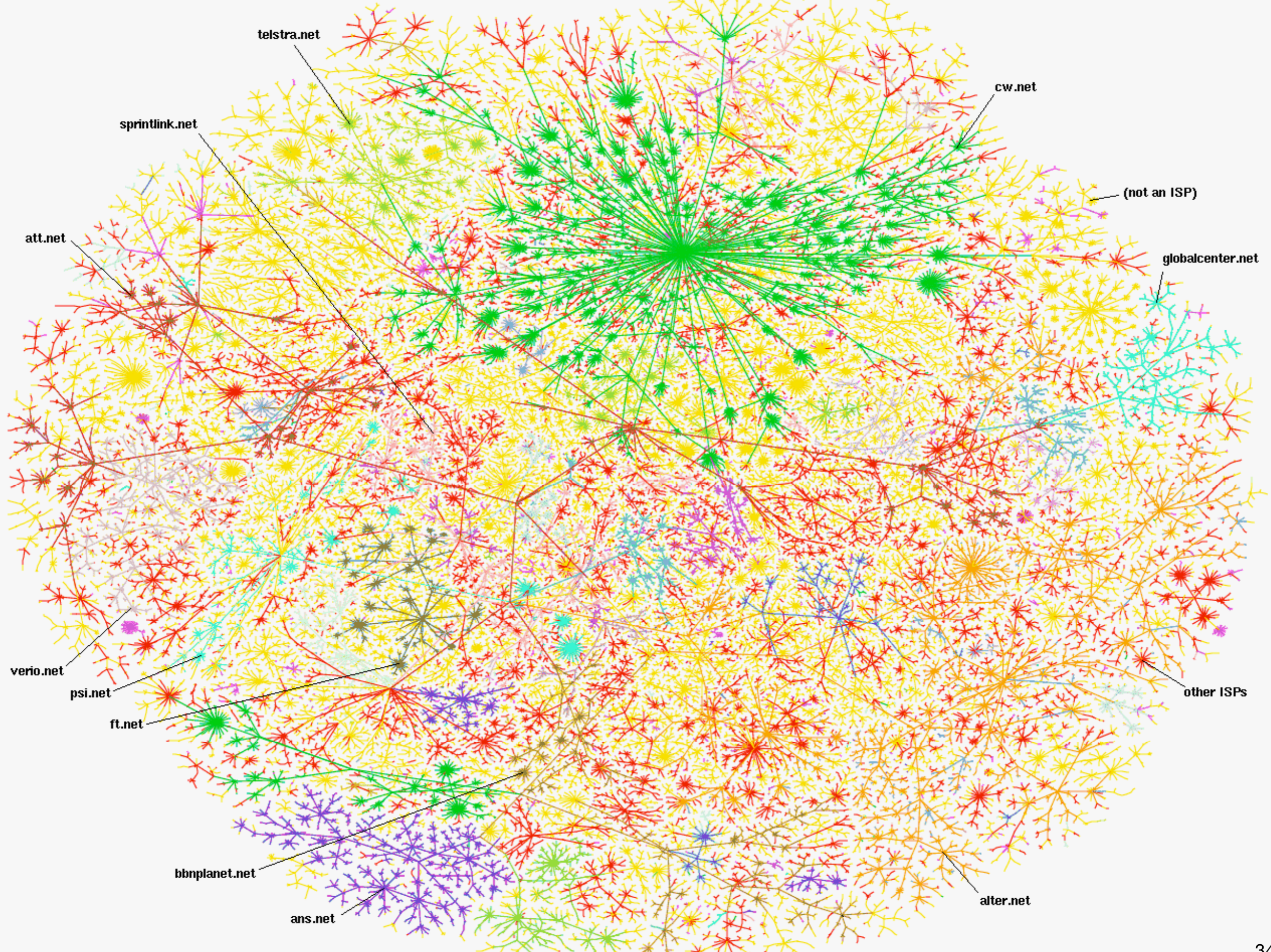
[WeeSan]

2008

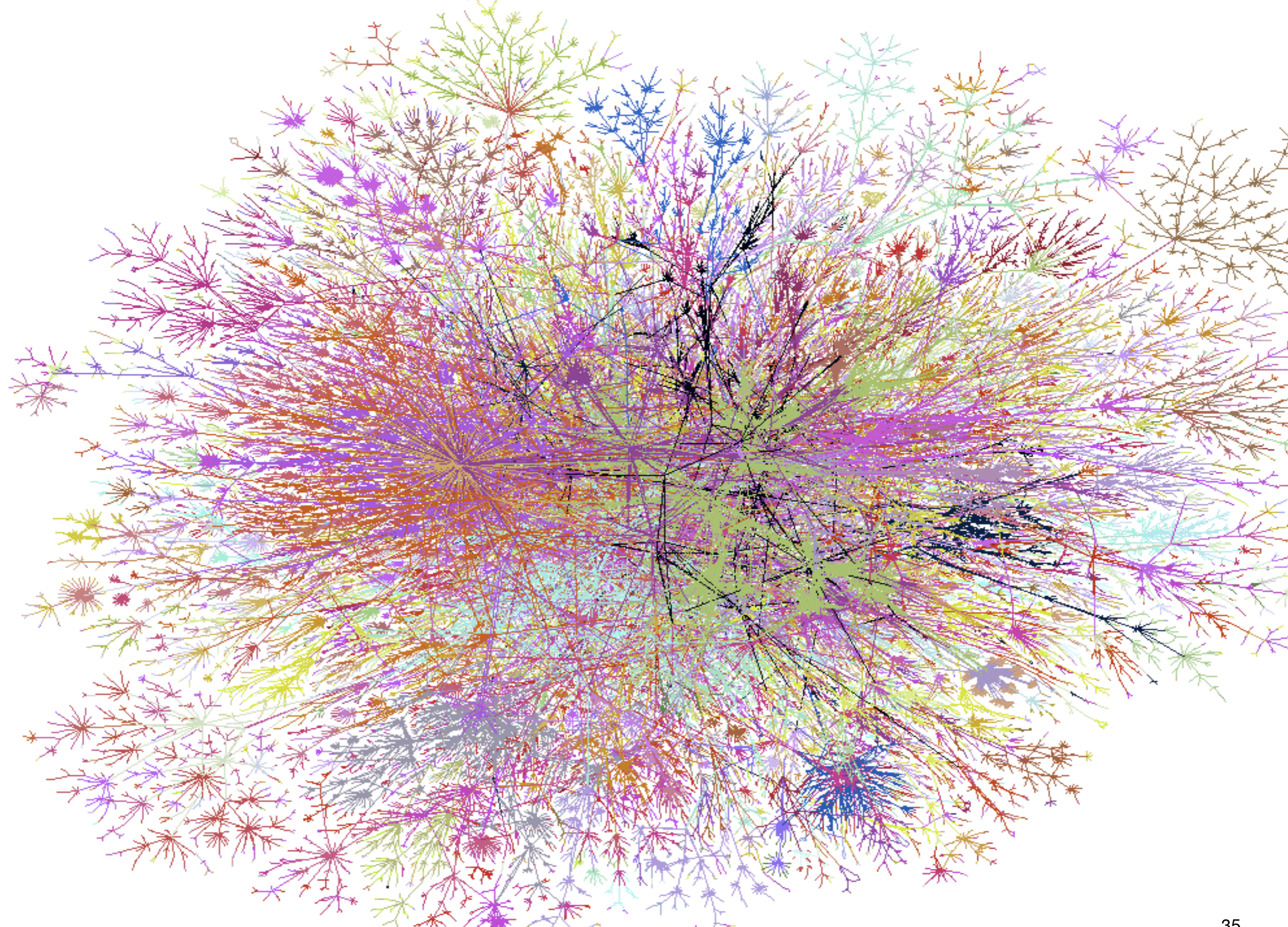
Google valued at 138 billion dollars.

Ce 443 - History



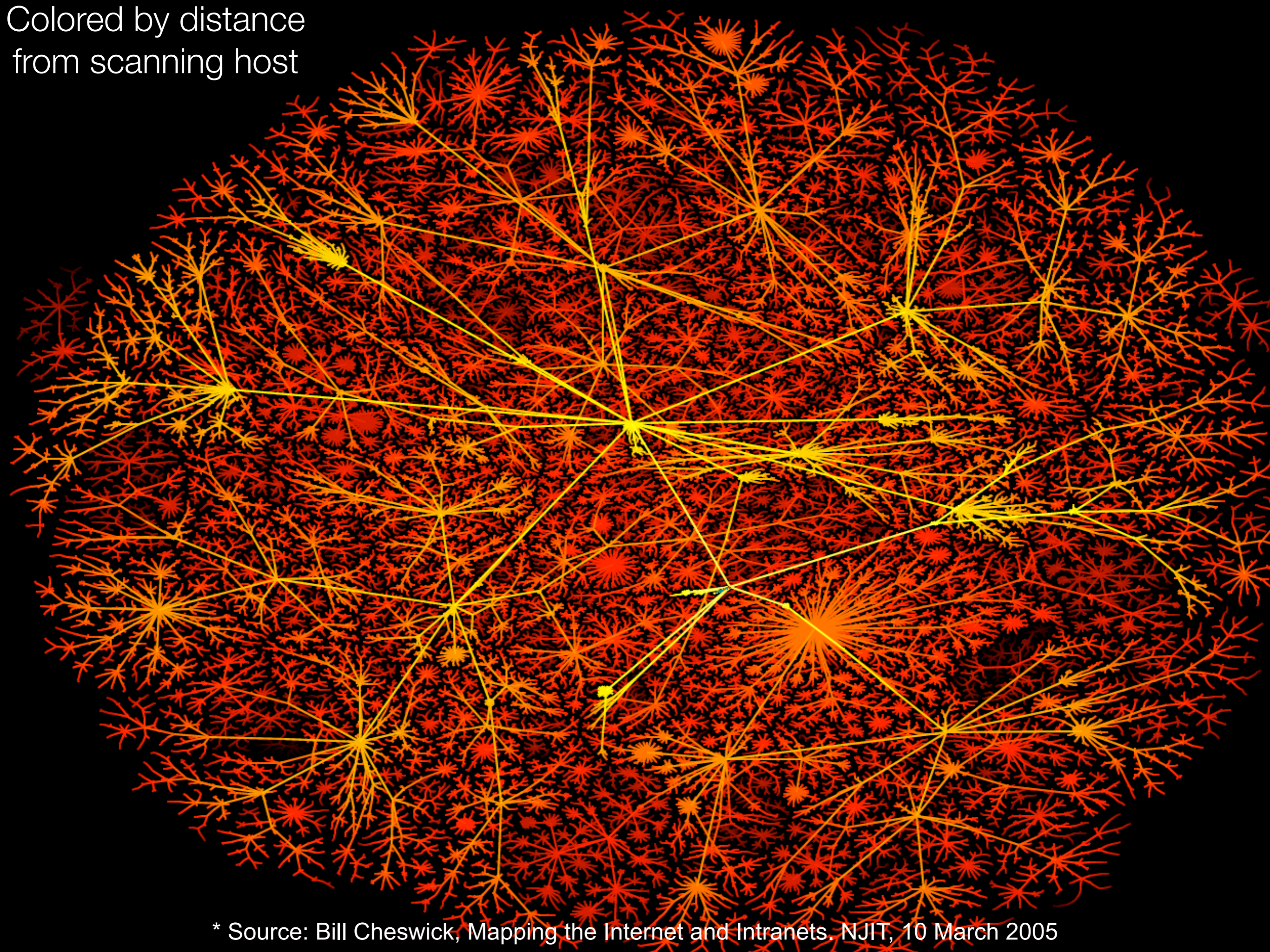


Burch/Cheswick map of the Internet showing the major ISPs. Data collected 28 June 1999



\* Source: Bill Cheswick, Mapping the Internet and Intranets. NJIT, 10 March 2005

Colored by distance  
from scanning host



\* Source: Bill Cheswick, Mapping the Internet and Intranets, NJIT, 10 March 2005



# Today's Networks

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- What are common applications?
  - Web
  - Email
  - Video Streaming
  - file sharing (p2p)
  - Gaming
  - e-commerce
  - VoIP

# Details on the Course



# Administrivia

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- Website:
  - [sharif.edu/~kharrazi/courses/40443-901/](http://sharif.edu/~kharrazi/courses/40443-901/)
  - You are expected to check the website regularly
- Textbook:
  - Computer Networks: A Systems Approach (Fourth Edition), by Larry L. Peterson, Bruce S. Davie, March 2007.
- Prerequisites: 40-181 Probability and Statistics
- Corequisites: 40-424 Operating Systems
- You must also take, 40-416 with 40-443



# Administrivia

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- TAs
  - Behnam Momeni
  - Amir Shaikhha
  - Mehdi Ahmadinejad
  - Kamyar Allahverdi
  - Sajjad Fouladi
  - Mehrdad Moradi
- Grading
  - 10% quiz
  - 40% homework
  - 20% midterm
  - 30% final



# Policies

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- Late Homework
  - One day late will cost you 25%, two days 50%, and three days 75%.
  - No homework will be accepted after the third day.
- Cell phones
  - Please turn them off before entering class.
- Cheating and Copying
  - First time you are caught you will get a zero for the task at hand.
  - Second time you are caught you will fail the course.
  - Providing your assignment to someone else is considered cheating on your behalf.



# Acknowledgments/References

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- [WeeSan] History of the Internet, WeeSan Lee weesan@cs.ucr.edu, [www.cs.ucr.edu/~weesan/cs6/01\\_history\\_of\\_the\\_internet.ppt](http://www.cs.ucr.edu/~weesan/cs6/01_history_of_the_internet.ppt)
- [Zhang07] Hui Zhang, 15-441 Networking, Fall 2007, School of computer science, CMU.
- [Peterson07] Computer Networks: A Systems Approach (Fourth Edition), by Larry L. Peterson, Bruce S. Davie, March 2007.