IP Future Technology

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January 1996

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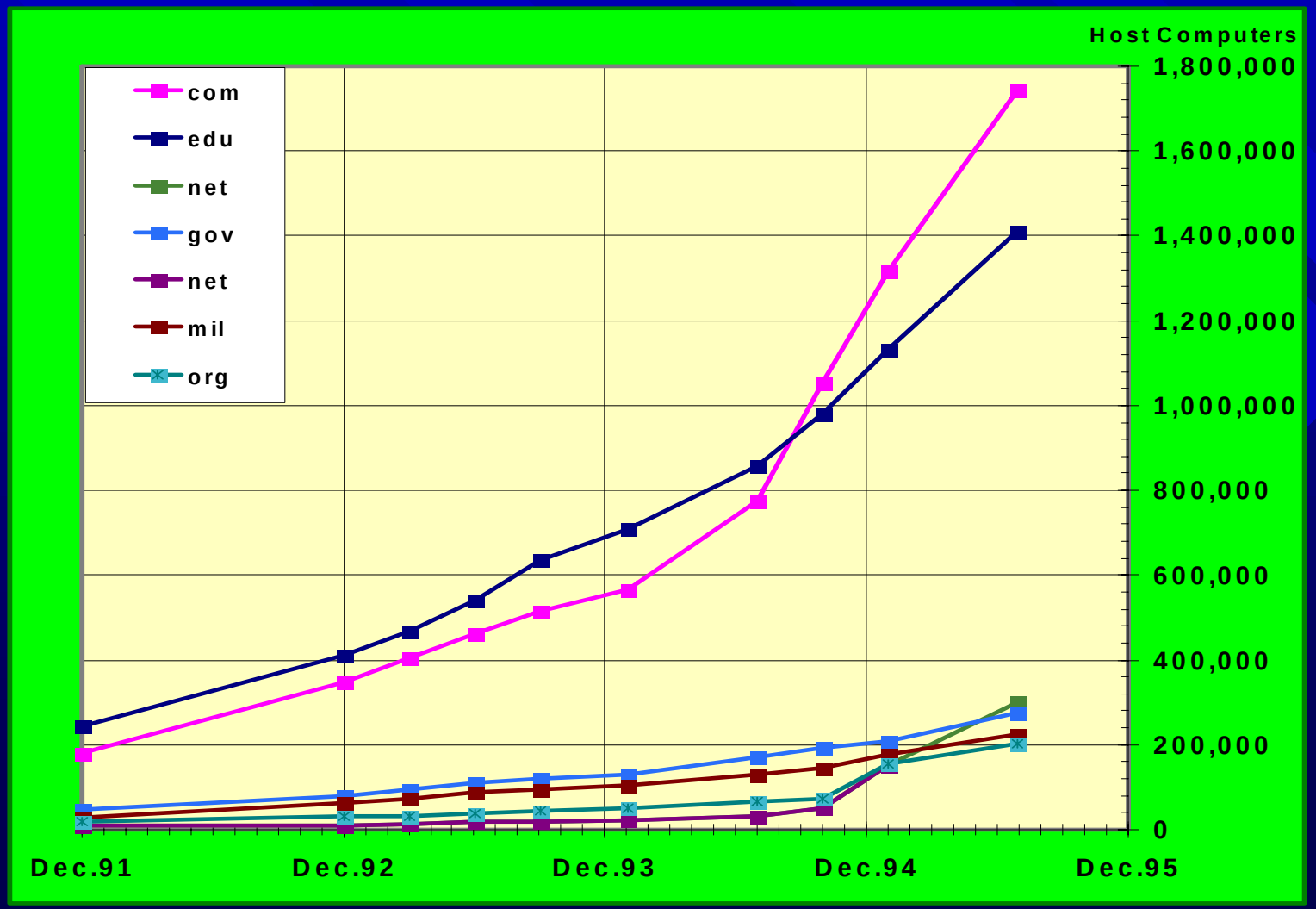

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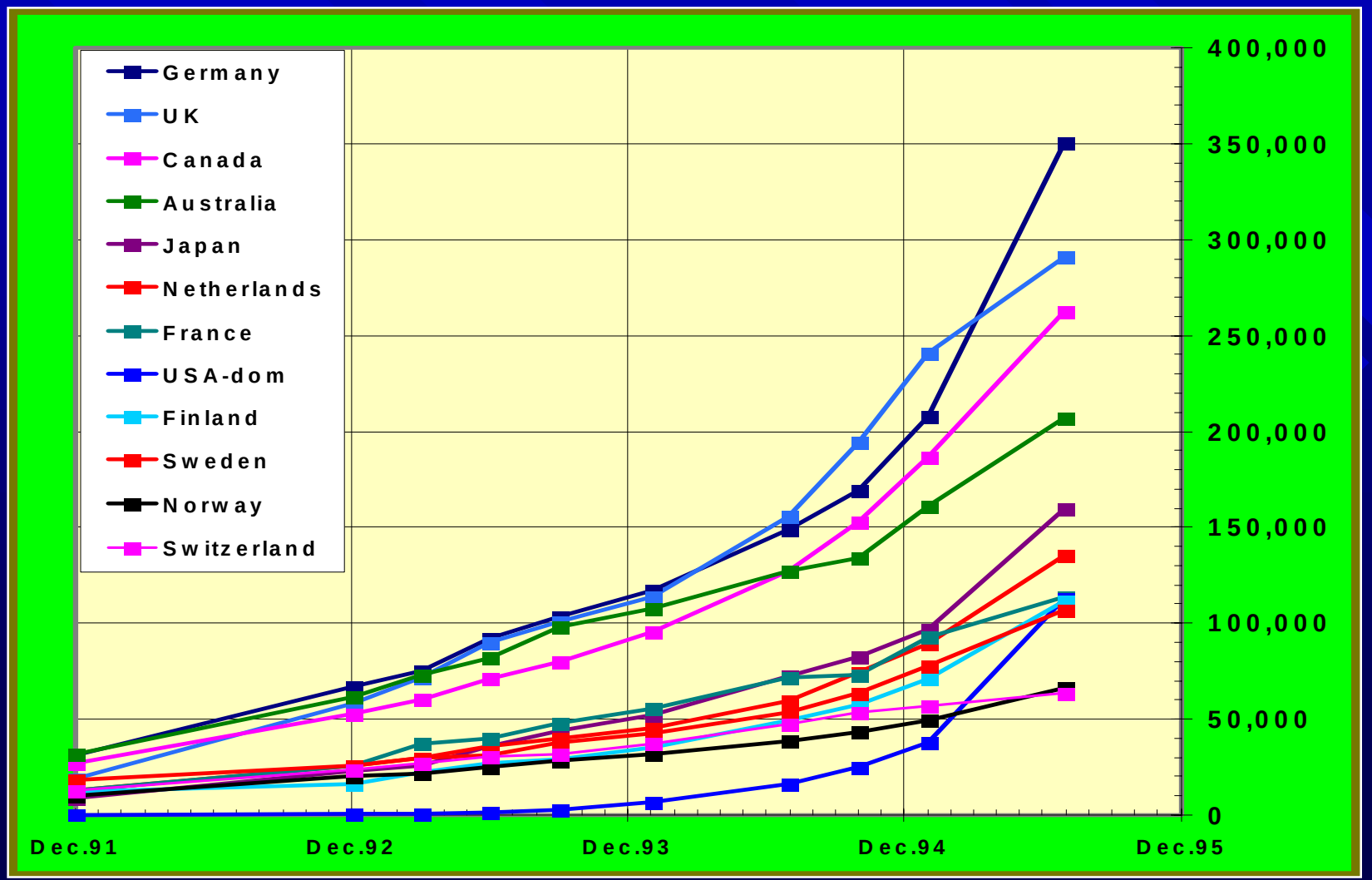

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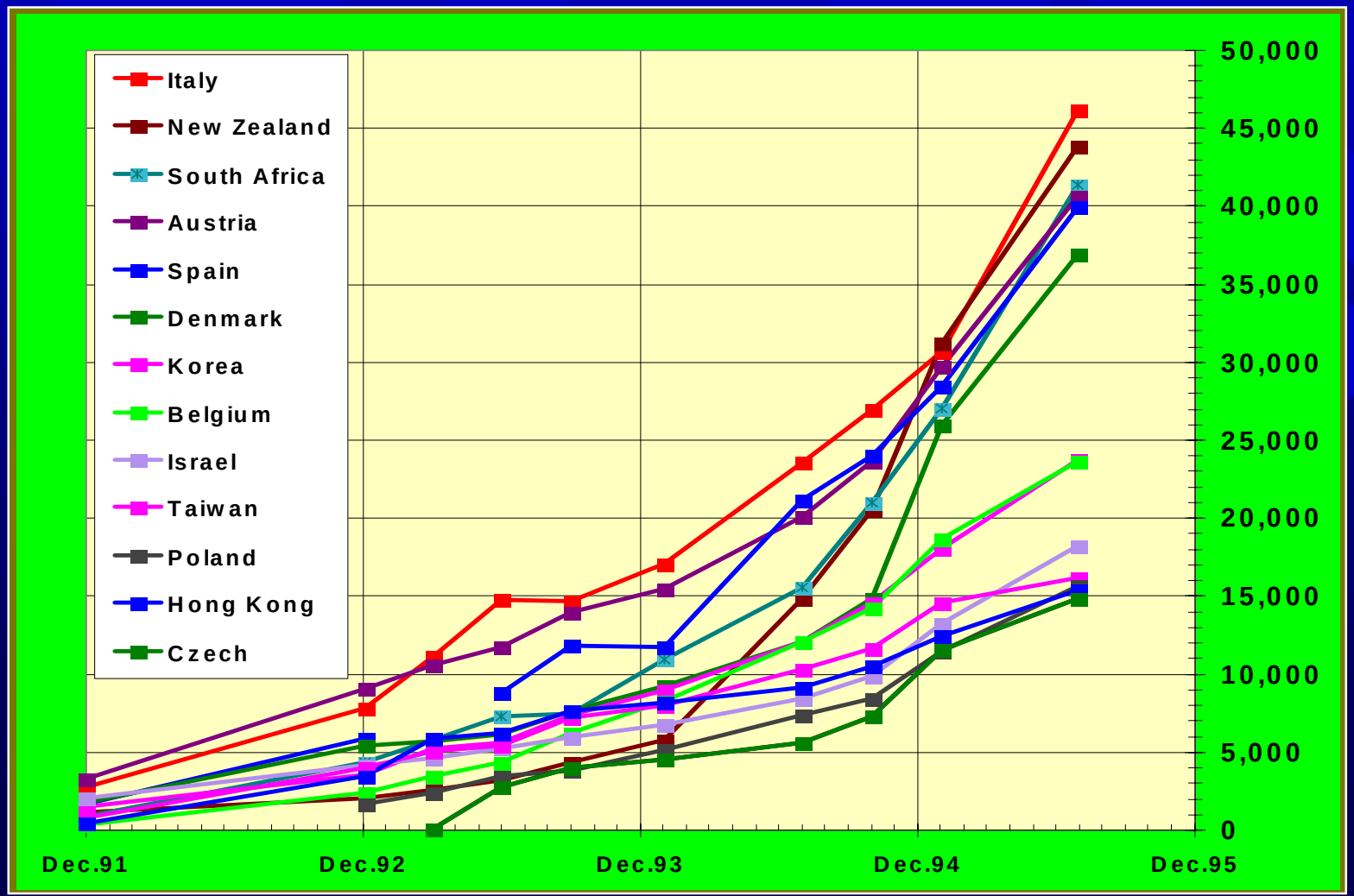

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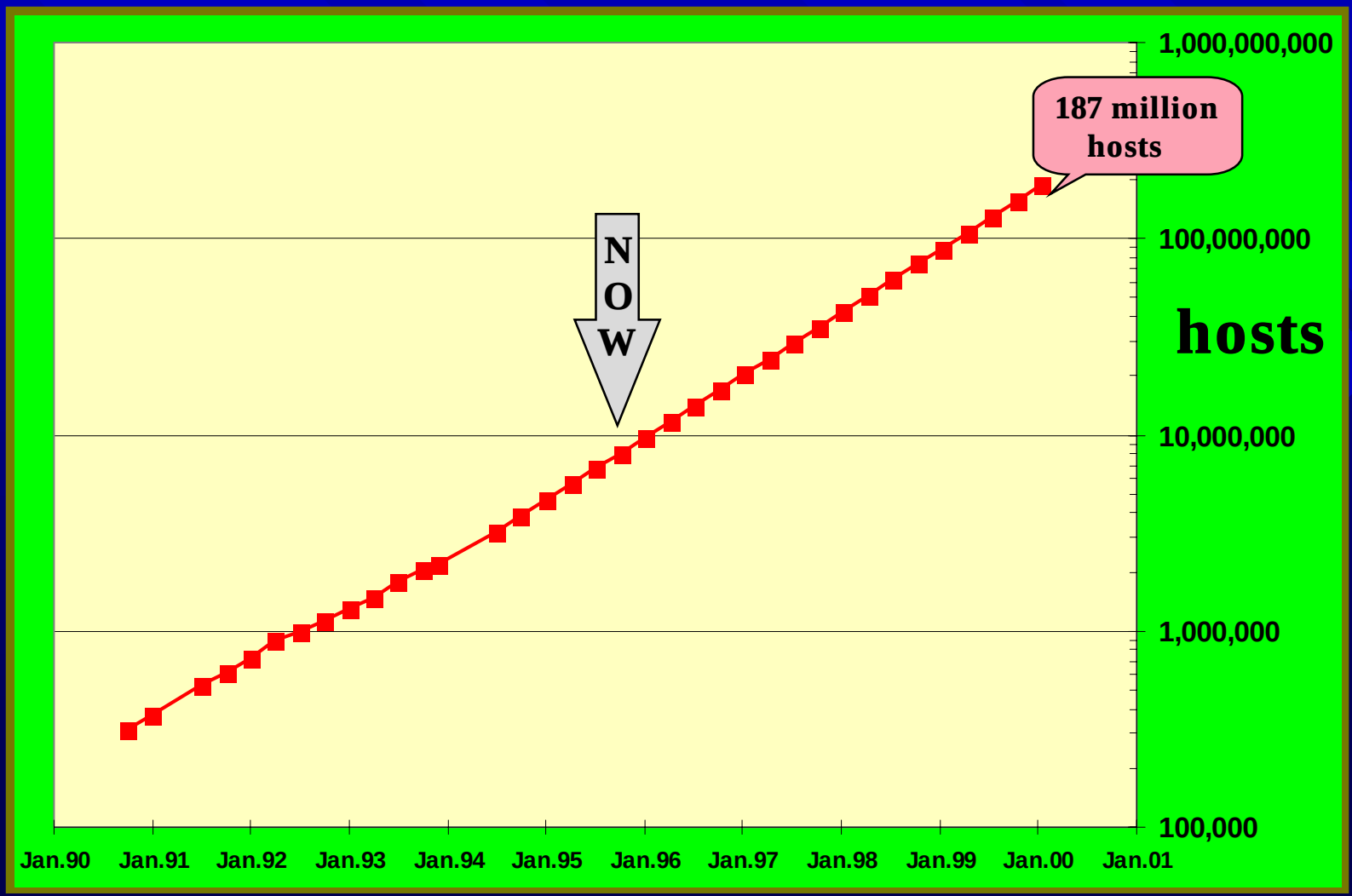

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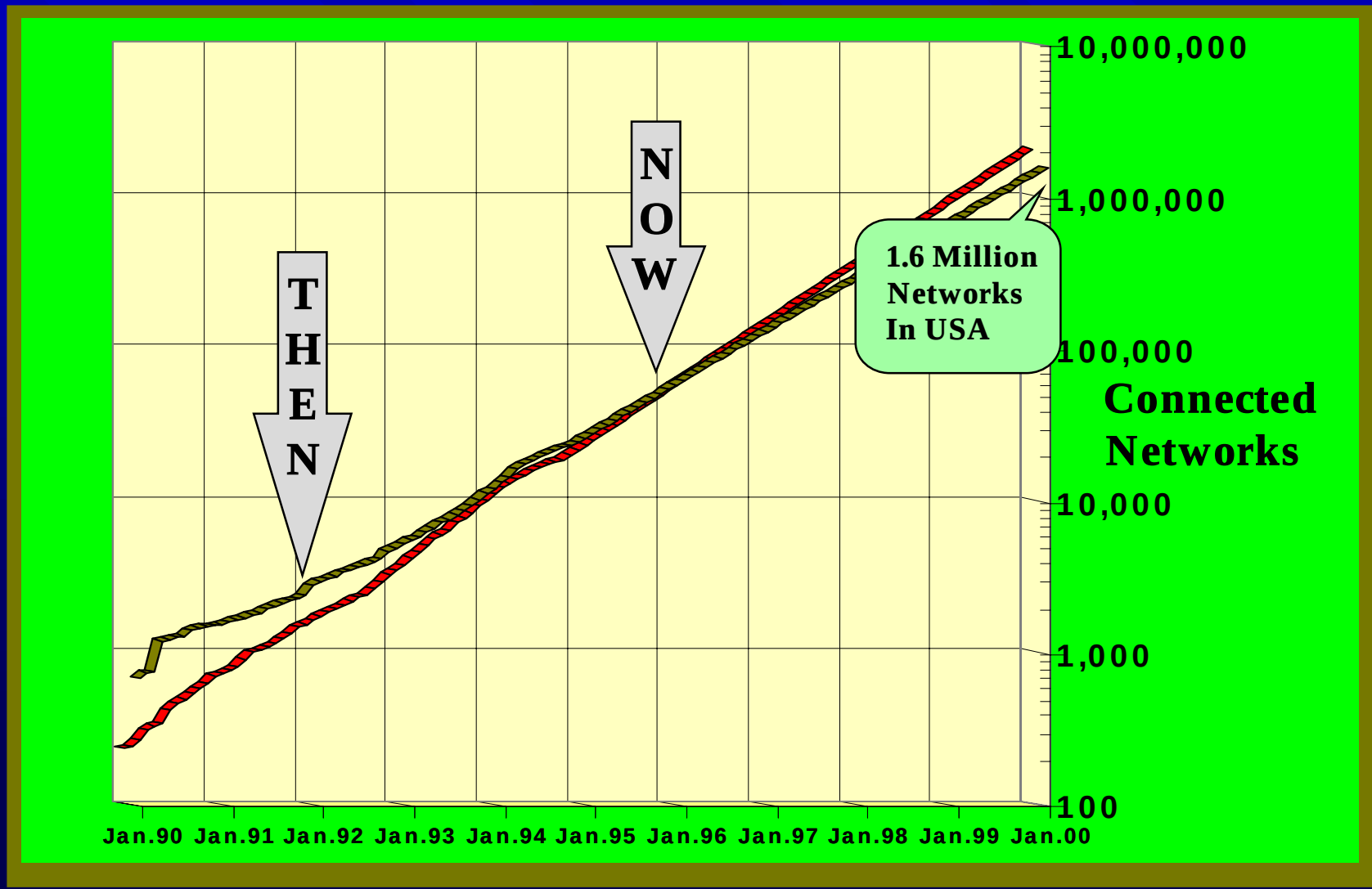

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- The problem
  - 32 bit IP address space
  - Foreseen in 1991 by the IETF
  - Class B exhaustion
    - » 16,284 class B's, by 1992 half used, predicted by March 1994 no more class B's
  - Routing Table Explosion
    - » In July 1990 router manufacturer built on card cache to cope with 10,000 routes, when only 1700 nets were routed
    - » In July 1993 the NSFNET routed 14,000 nets
  - IP Address depletion

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- **The Solution - CIDR**
  - Router technology not keeping up with growth
  - RFC1517, 1518, 1519, 1520 - September 1993
  - IETF interim solution for years 1993-2003
  - Classless Inter-Domain Routing
  - Allows IP address prefixing
  - Also known as route aggregration
  - Problem with address ownership
  - IP addresses no longer allocated for individual users
  - IP addresses now allocated in block to ISPs (Internet Service Providers

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Coordinated Address Allocation:

Multiregional	**192.0.0.0 - 193.255.255.255**
Europe	**194.0.0.0 - 195.255.255.255**
Others	**196.0.0.0 - 197.255.255.255**
North America	**198.0.0.0 - 199.255.255.255**
Central/South America	**200.0.0.0 - 201.255.255.255**
Pacific Rim	**202.0.0.0 - 203.255.255.255**
Others	**204.0.0.0 - 207.255.255.255**

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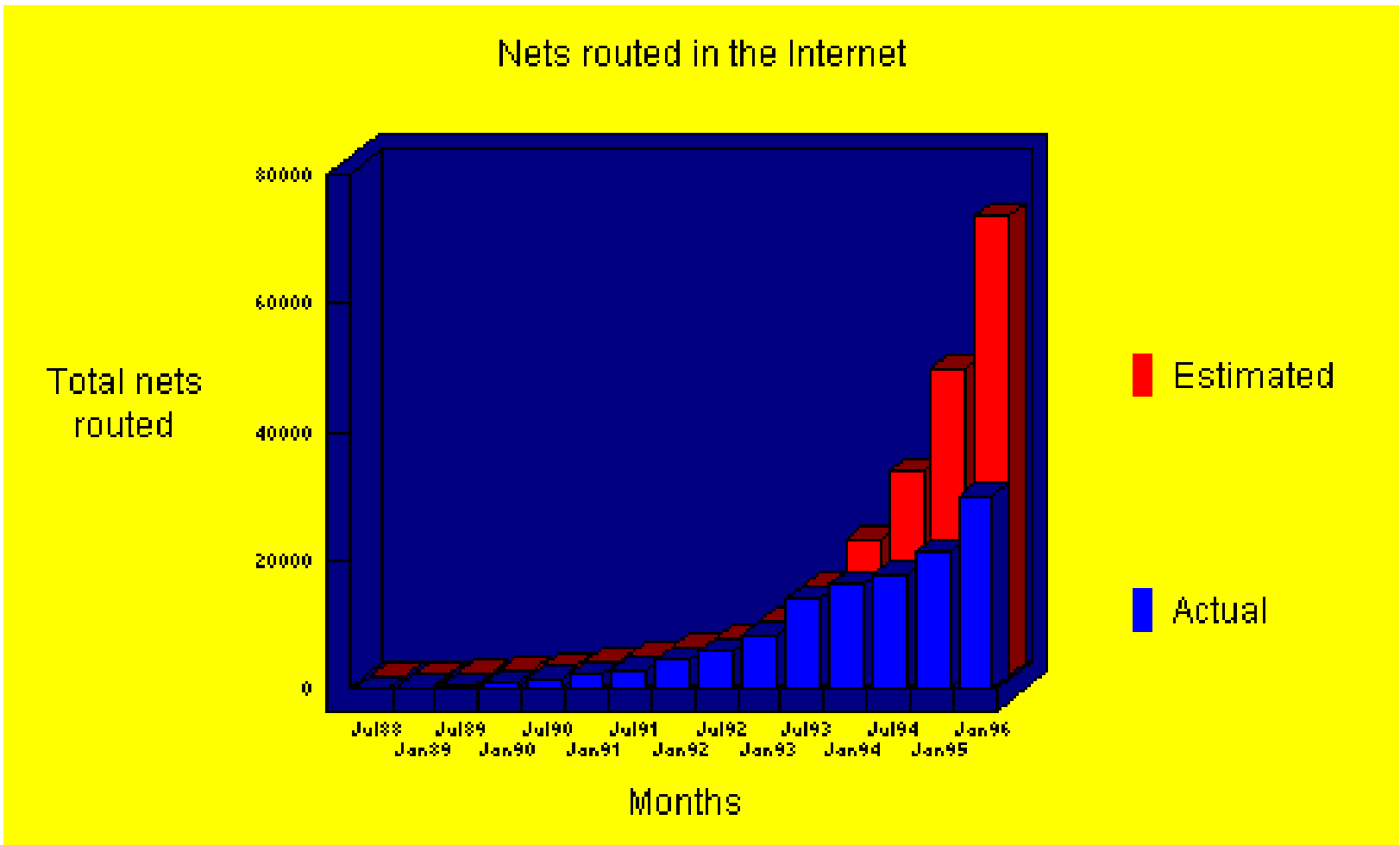

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- **CIDR continued**
  - Customers need to renumber when switching providers
  - Black box IP address translation devices
  - IPv6 to allow IP number portability
  - Customers unaware that IP addresses assigned the past 2 years do not belong to them
  - CIDRization to be with us for the next 10 years
  - Currently 3 routers handle full routing tables: Cisco, Wellfleet and IBM

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- **Multicast**
  - First audio transmission from IETF in March 1992
  - First audio and video transmission from IETF in June 1992
  - Uses special IP address of 224.0.0.0 - reserved for multicasting
  - Algorithms include flooding (just like Usenet news), spanning trees, reverse path forwarding, Steiner trees and core based trees
  - Steve Deering, Stanford University, PhD thesis
  - Mbone uses RPF
  - Mbone is an overlay network on top of the Internet

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- **Multicasting continued**
  - DVRMP - Distance Vector Multicast Routing Protocol
  - IGMP - Internet Group Membership Protocol
  - Tunnels used to link multicast islands
  - Public domain software provided on various Unix platforms
    - » mrouted turns Unix into a multicast router
  - Mbone first broadcast from Israel at Jenc95 in May 1995 by Machba
  - Mbone first demonstrated at Infotech 1995 in October 1995 by IBM
  - Overwhelming demand to “book” broadcast slots on an experimental service

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- **Multicasting continued**
  - **Unix workstations have limited I/O capability as compared to routers and therefore can’t handle as many packets per second**
  - **Result: Mrouted stations have to limit the number of tunnels they can handle**
  - **Future:**
  - **Multicast extensions to OSPF - MOSPF published March 1994**
  - **PIM - Protocol Indepedent Multicast to be published by end of 1995**

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- **Mobility**
  - Mobile computing is not portable computing
  - Requirements for mobility
    - » No weakening of security
    - » Multicast capability
    - » Location privacy
  - IETF working group started September 1993
    - » Beaconing
    - » Registration
  - Problems such as varying throughput and delay will require changes to TCP itself

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- **RSVP**
  - Async packet switching technology can provide guarantees of service
  - Reservation Setup Protocol - September 1993
  - Realtime applications
  - Will allow Internet applications to obtain a required quality of service
  - RSVP can allocate bandwidth along a data path for video via the Internet
  - Receiver indicates interest in “data flows” to the network
  - RSVP to change the charging model currently existing in the Internet

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- **Resource Reservation, continued**
  - vat - part of Mbone audio package
  - smoothes packet handoff to loadspeakers
  - known as resynchronization
  - in audio - slightly increases or decreases silence between words to handle resynchronization
  - Compression

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Rate (bps)	Quality	Procedure
2400	40	Highly compressed LPC
3600	45	Compressed LPC
4800	50	LPC
13000	55	GSM
16000	54	2khz ADPCM
24000	60	ADPCM, 3 bit samples
32000	65	ADPCM, 4 bit samples
40000	68	ADPCM, 5 bit samples
64000	73	PCM , 8 bit samples

PCM - Pulse Code Modulation

ADPCM - Adaptive Differential PCM

LPC - Linear Predication Coding

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- **RTP**
  - **Real Time Protocol**
  - **Indicates what type of data is being sent**
  - **Includes a time-stamp so that data syncronization of audio and video packets can be accomplished at the receiving end**
  - **Draft RFC for payload format for H.261 video**
  - **Draft RFC for encapsulated JPEG video**
  - **Draft RFC for payload format of MPEG1/MPEG2 video**

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- IPv6
  - IP address depletion moved from 2004 to 2008 due to CIDR
  - Some wanted to use CLNP from OSI
    - » Would lose multicasting, mobility and resource reservation work already done
  - SIP - Simple IP - increase IP address size to 64 bit
  - PIP to ease mobility and advanced routing techniques
  - PIP and SIP merged in September 1993 to becomes IPng
  - IETF decided July 1994 on IPng -> IPv6
  - Increase IP addresses from 32 bits to 128 bits
  - Automatic Network Configuration
    - » Allows network devices to find and claim their own IP addresses as soon as they are connected to the network
    - » Auto-readdressing to handle mobile users
    - » Mobile IP can replace GSM

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- Applications
  - VRML - Virtual Reality Markup Language
  - Active Web documents such as Sun Microsystems Java
    - <IMG> for images
    - <APP> for applications
  - Visually impaired able to navigate the Web via “listening” to Web pages
  - <APP> opens many serious security questions
  - Alleviating bandwidth shortage by moving graphics to compute power located at user

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- **PTT**
  - **Sweden's Telia announced “IP networks could ultimately replace parts of the operator’s existing access network”**
  - **Telecom Finland continues to push its commercial offering of its voice over IP service**

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- **ISDN**
  - 128kb
  - $500-$1000 for ISDN “modem”
- **Satellite**
  - Hughes Network Systems - DirecPC Turbo Internet
  - via Galaxy IV satellite
  - aggregate speed of 11.79Mb/sec
  - maximum incoming 400kb
  - outgoing via modem
  - $1300 for 24 inch satellite dish
  - $20-$40/month for 130Mbytes
  - http://www.direcpc.com/home.html

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- Cable TV
  - Hybrid systems
  - 500kb to 10Mb incoming
  - outgoing via modem
  - $1000 per cable modem
  - serious security problems - Ethernet sniffing