



# GNSS History

## Disclaimer

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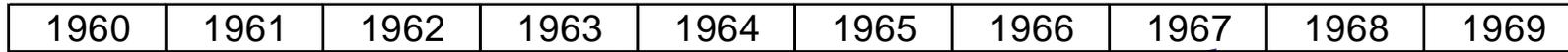
# Satellite Navigation in the 1950s

1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
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4 Oct 1957  
Sputnik I  
Launched

Dec 1958  
The U.S.  
Navy  
Navigation  
Satellite  
System  
(Transit)  
Approved  
and  
Funded

# Satellite Navigation in the 1960s (1 of 3)



13 April 1960  
First Successful  
Transit  
Experimental  
Satellite (1B)

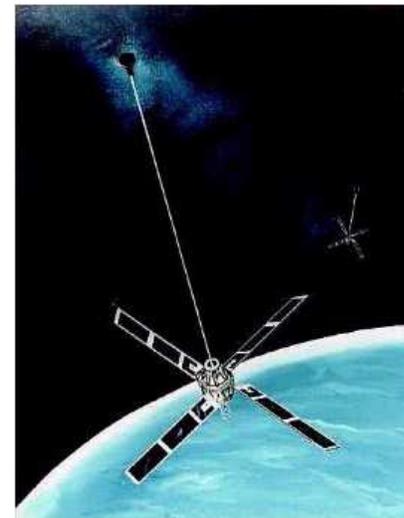
5 Dec 1963  
First  
Operational  
Satellite

Jan 1964  
Transit  
Became  
Operational

Other Successful  
Experimental  
Satellites:  
2A, 22 Jun 1960  
3B, 21 Feb 1961  
4A, 29 Jun 1961  
4B, 15 Nov 1961

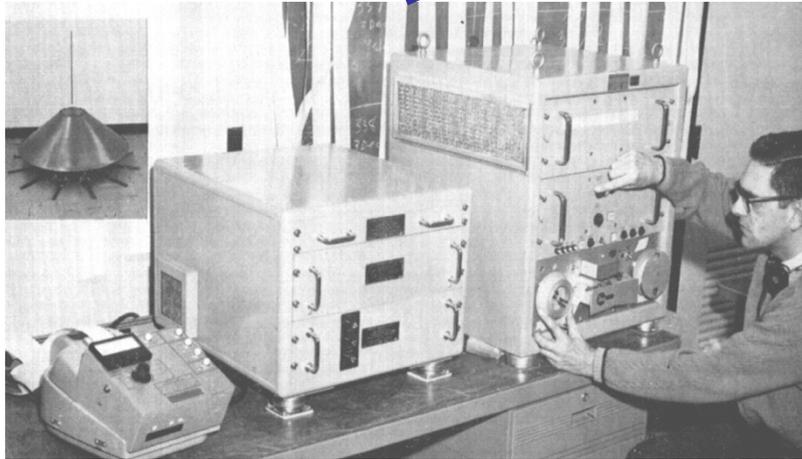
July 1967  
Transit  
Released  
for  
Commercial  
Use  
- - - -  
Establishing  
U.S. Dual  
Use SatNav  
Policy

Operational  
Transit  
Satellite



# Satellite Navigation in the 1960s (2 of 3)

1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
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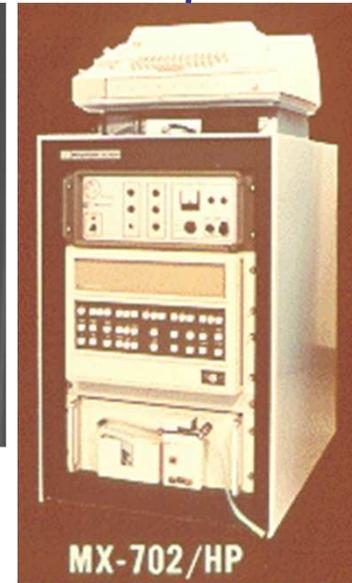
1964

World's First Surface Ship  
Satellite Navigator  
AN/SRN-9 (XN-5)



1968

World's First  
Portable Satellite  
Doppler Geodetic  
Surveyor  
AN/PRR-14  
Geoceiver



1969

World's First  
Commercial  
Oceanographic  
Navigator

# Satellite Navigation in the 1960s (3 of 3)

1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
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1969

First Steps Toward GPS;  
Air Force 621B Program;  
World's First Spread Spectrum  
Navigation Receiver, MX-450



# Satellite Navigation in the 1970s



April 1973  
Formation of the GPS  
Joint Program Office  
(JPO)

1978 GPS Launches  
22 Feb, 13 May,  
7 Oct, 11 Dec



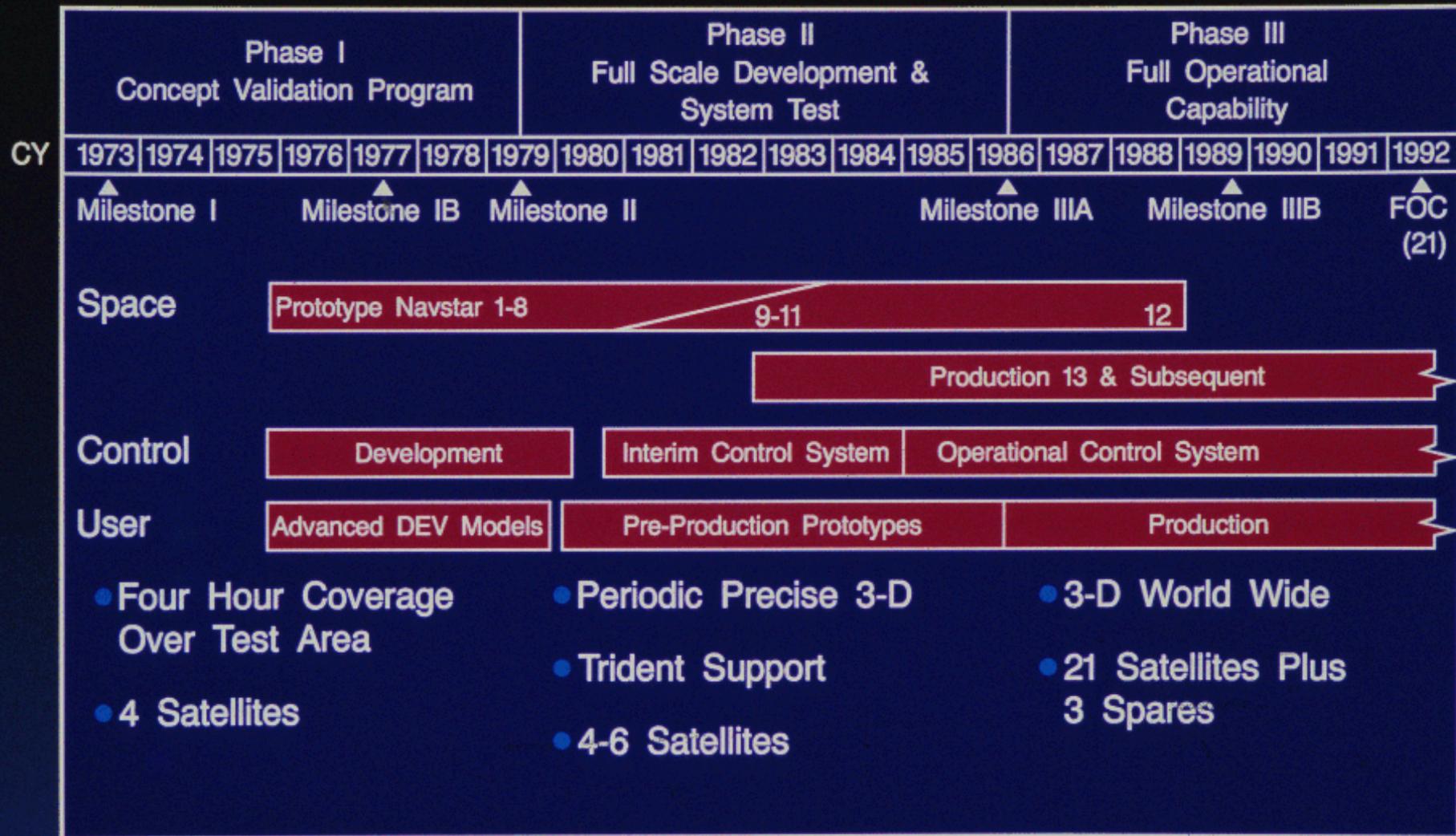
1971  
First Timing Receiver  
for the Naval Research  
Lab (NRL)



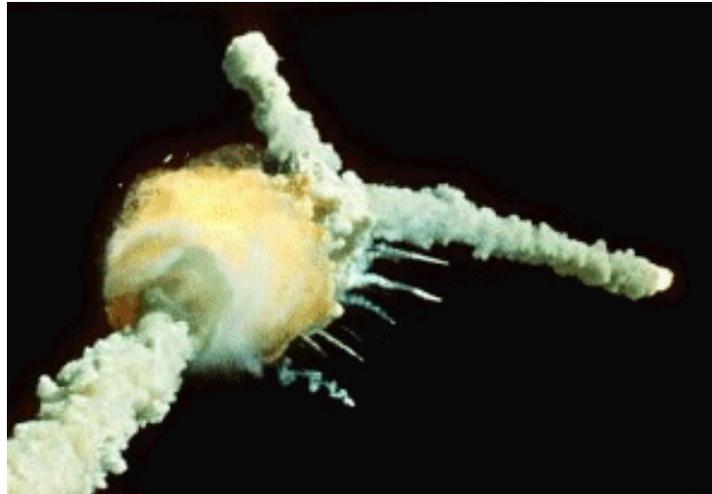
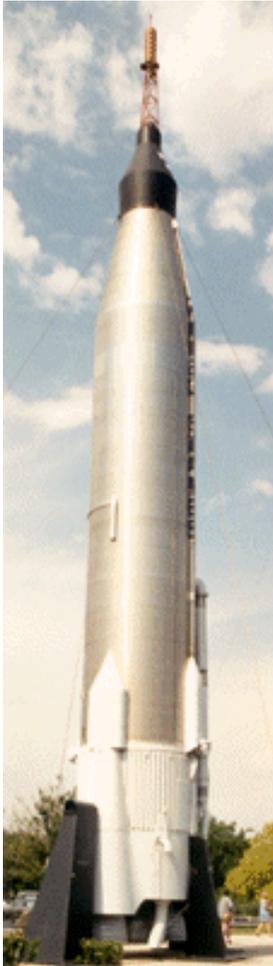
1975  
First Concept Validation GPS  
Navigator, the GPS X-Set

# Original

## GPS PROGRAM SCHEDULE



# GPS Launch Plans

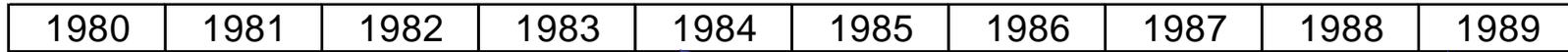


National policy was to launch all operational GPS satellites with the space shuttle

The Atlas Booster launched all Block I GPS Satellites

The January 28, 1986 Challenger disaster forced a change

# Satellite Navigation in the 1980s

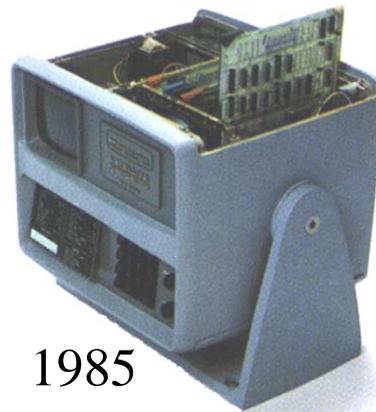


1984  
Commercial 5  
Channel GPS  
Navigator

9 Oct '85  
Last Block I  
Launch

28 Jan '86  
Challenger  
Disaster

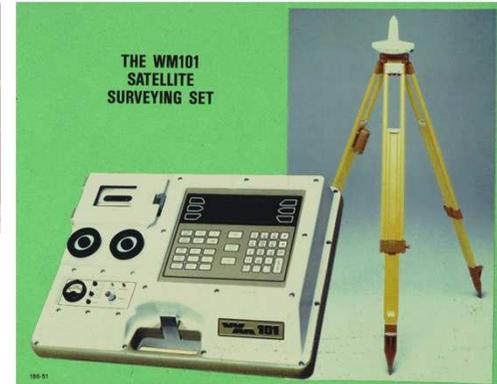
14 Feb '89  
Launches  
Resume



1985  
GPS + Transit + Omega

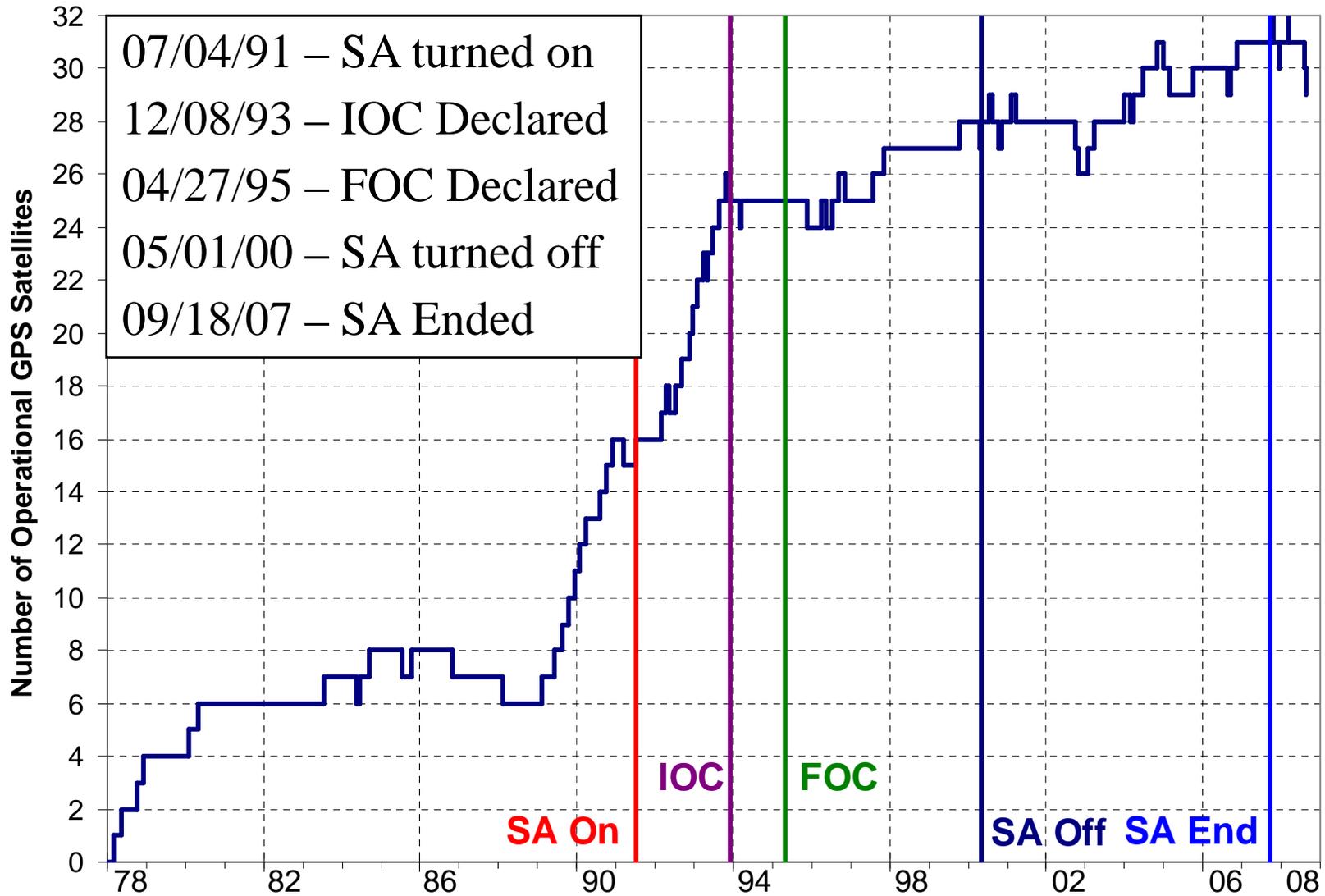


1986  
6 Channel GPS  
Navigator

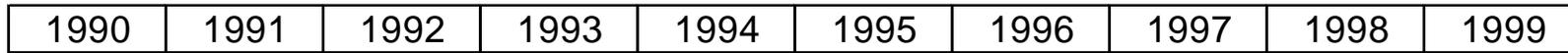


1986  
WM101 GPS Satellite  
Surveying Set

# GPS SA/AS, IOC, and FOC



# Satellite Navigation in the 1990s



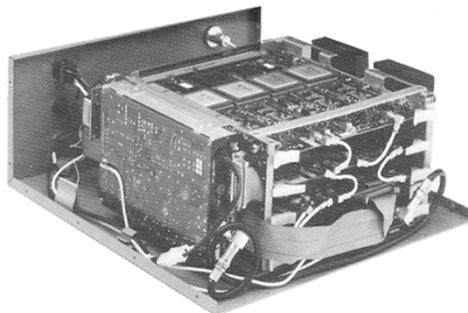
4 Apr '91  
S/A Turned  
On

8 Dec '93  
GPS IOC

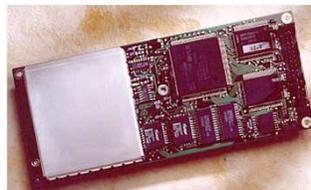
27 Apr '95  
GPS FOC



1996 Professional  
Marine DGPS  
Navigator



1990  
GPS/GLONASS  
Navigator



1991 6 Channel  
GPS Engine

26 Dec '91  
Dissolution of  
the Soviet  
Union Enacted

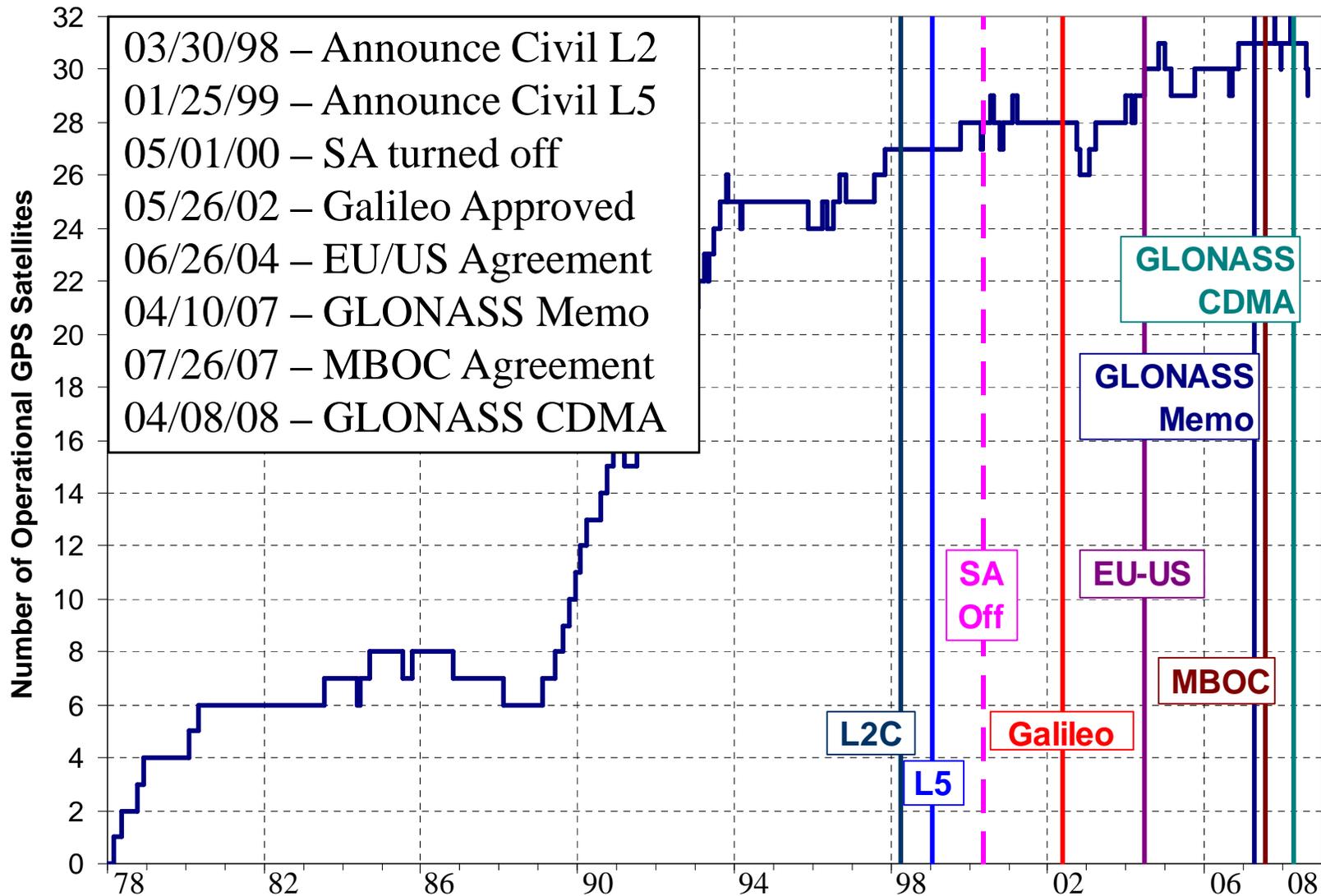


1991 Compact  
GPS Surveyor

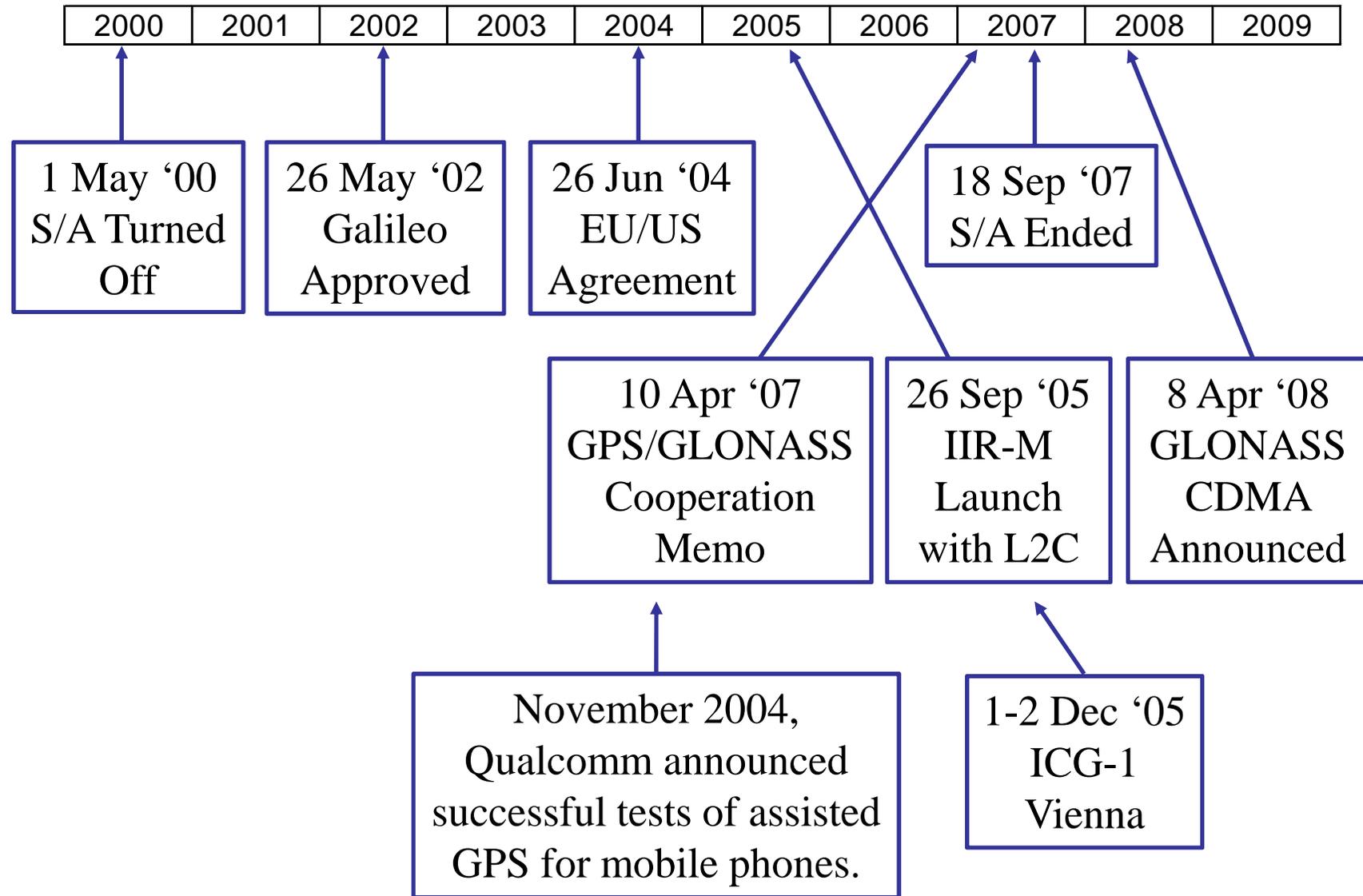


1997 Machine  
Control, 10 Hz,  
30 ms, 1 cm

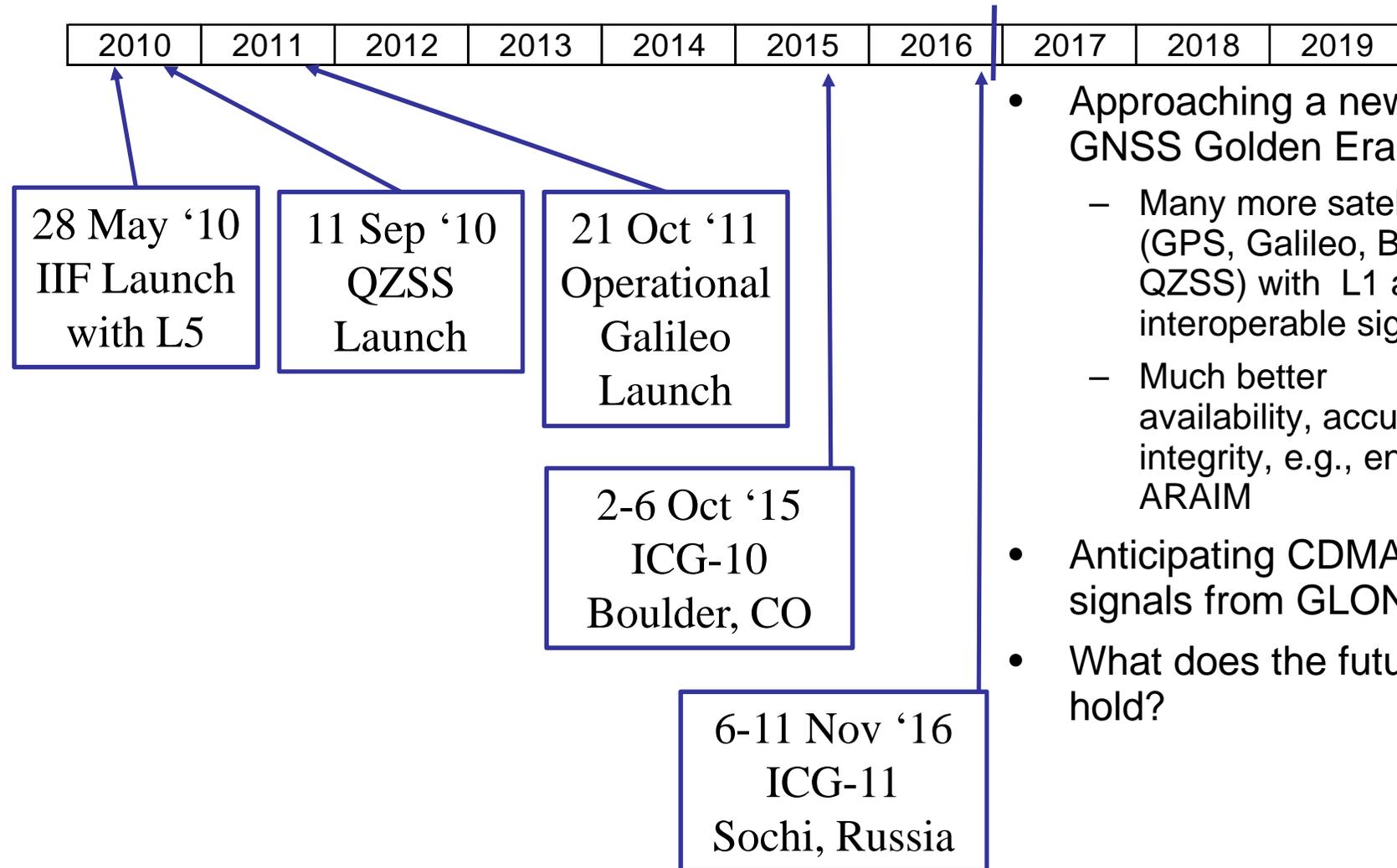
# Modernization and GNSS Initiatives



# Satellite Navigation in the 2000s



# Satellite Navigation in the 2010s



- Approaching a new GNSS Golden Era
  - Many more satellites (GPS, Galileo, BeiDou, QZSS) with L1 and L5 interoperable signals
  - Much better availability, accuracy, integrity, e.g., enabling ARAIM
- Anticipating CDMA signals from GLONASS
- What does the future hold?

# Who Anticipated GPS in Cell Phones?



More than a Billion Cell Phone GPS Users

- Sparked by the E911 requirement
- Use of Location Based Services (LBS) is exploding
- Improved by Assisted GPS (A-GPS)
  - Better accuracy
  - Location in seconds
  - Turn-by-turn navigation

# Who Anticipated Precision Agriculture?

- One to 10 cm accuracy
- Far better productivity, efficiency, and protection of the environment
- Enabled, e.g., by MSS signals for the John Deere StarFire Service and several others



Automatic Steering

Automatic Spray Control

Thank You

Questions?