



International Committee on
Global Navigation Satellite Systems

GNSS Applications Workshop: Seminar on GNSS Spectrum Protection and Interference Detection and Mitigation

Course Introduction

25-26 June 2019

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

1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
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13 April 1960
First Successful
Transit
Experimental
Satellite (1B)

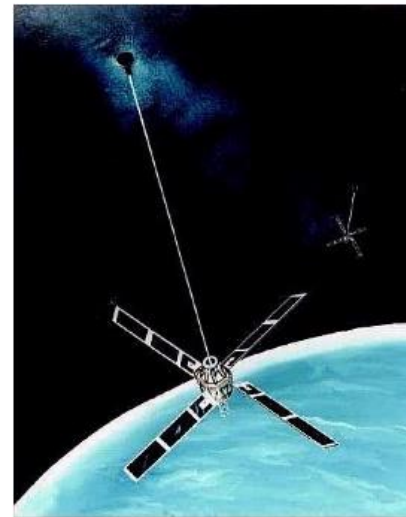
5 Dec 1963
First
Operational
Satellite

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

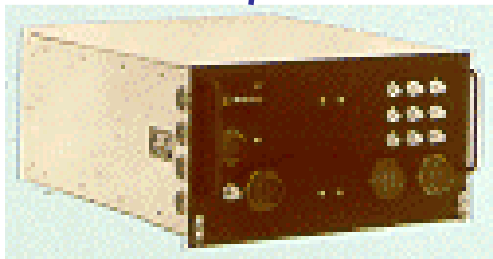


Satellite Navigation in the 1970s

1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
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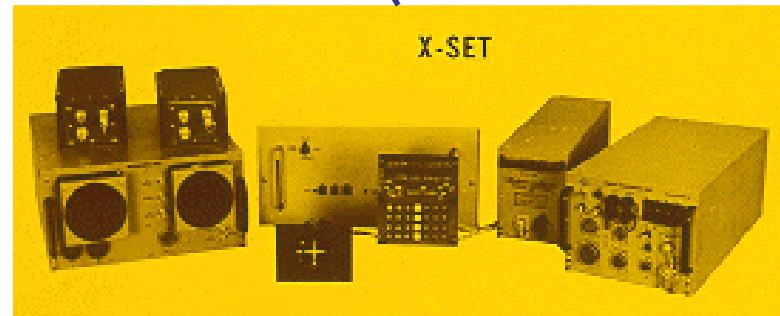
April 1973
Formation of the GPS
Joint Program Office
(JPO)

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



1971

First Timation Receiver
for the Naval Research
Lab (NRL)



1975

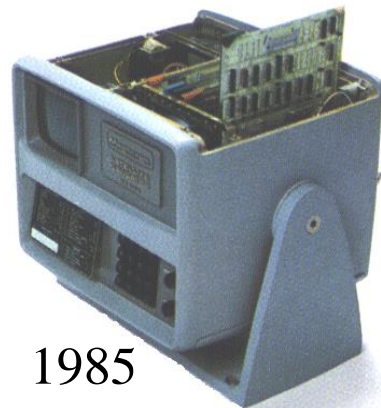
First Concept Validation GPS
Navigator, the GPS X-Set

Satellite Navigation in the 1980s

1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
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1984
Commercial 5
Channel GPS
Navigator



1985
GPS + Transit + Omega

9 Oct '85
Last Block I
Launch

28 Jan '86
Challenger
Disaster

14 Feb '89
Launches
Resume



1986
6 Channel GPS
Navigator



1986
WM101 GPS Satellite
Surveying Set

Satellite Navigation in the 1990s

1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
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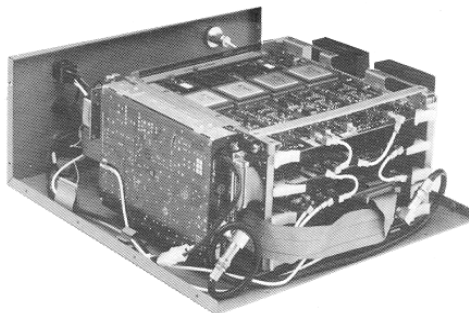
4 Apr '91
S/A Turned
On

8 Dec '93
GPS IOC

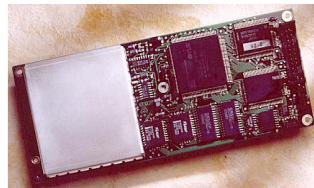
27 Apr '95
GPS FOC



1996 Professional
Marine DGPS
Navigator



1990
GPS/GLONASS
Navigator



1991 6 Channel
GPS Engine

26 Dec '91
Dissolution of
the Soviet
Union Enacted

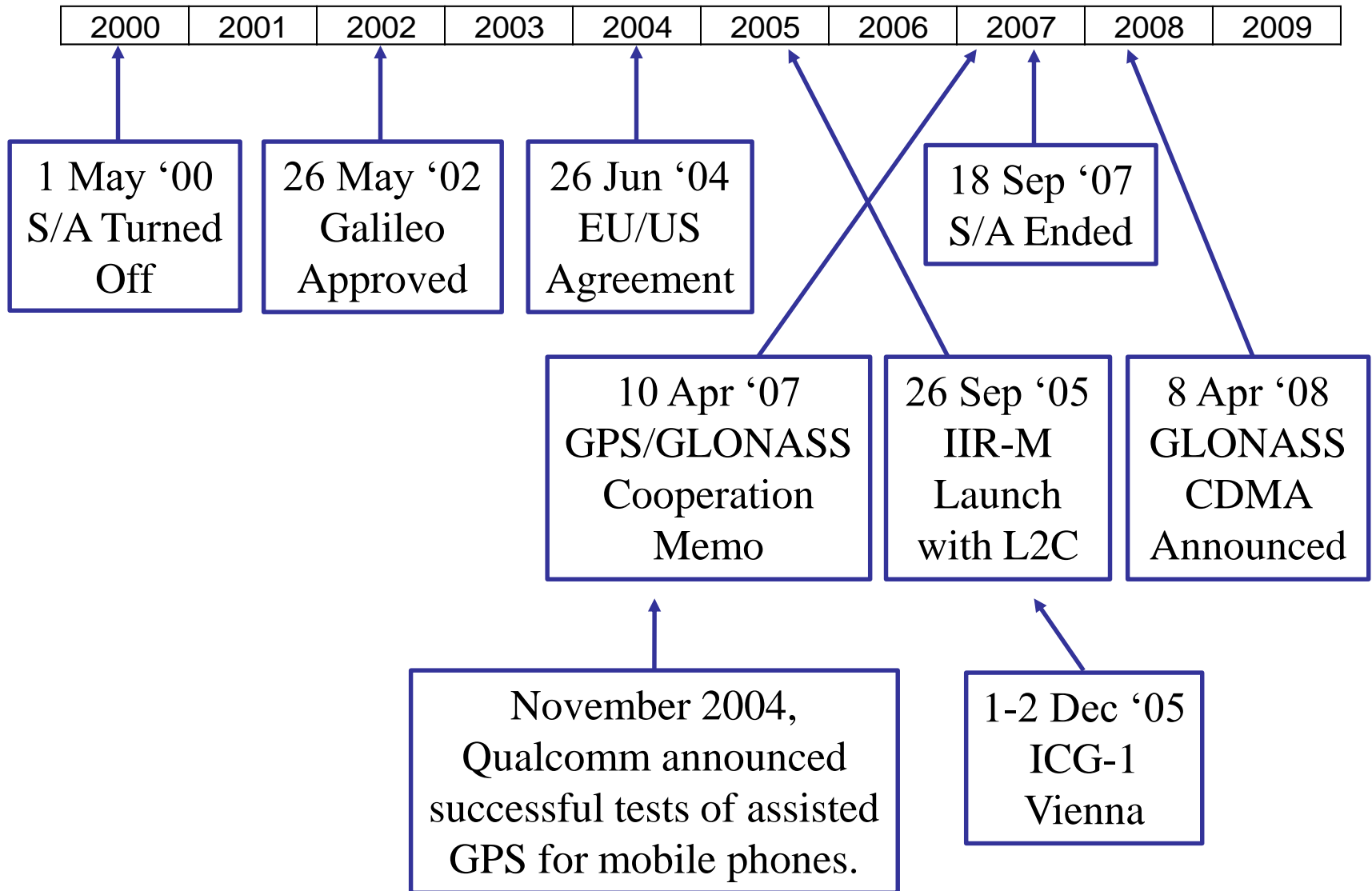


1991 Compact
GPS Surveyor

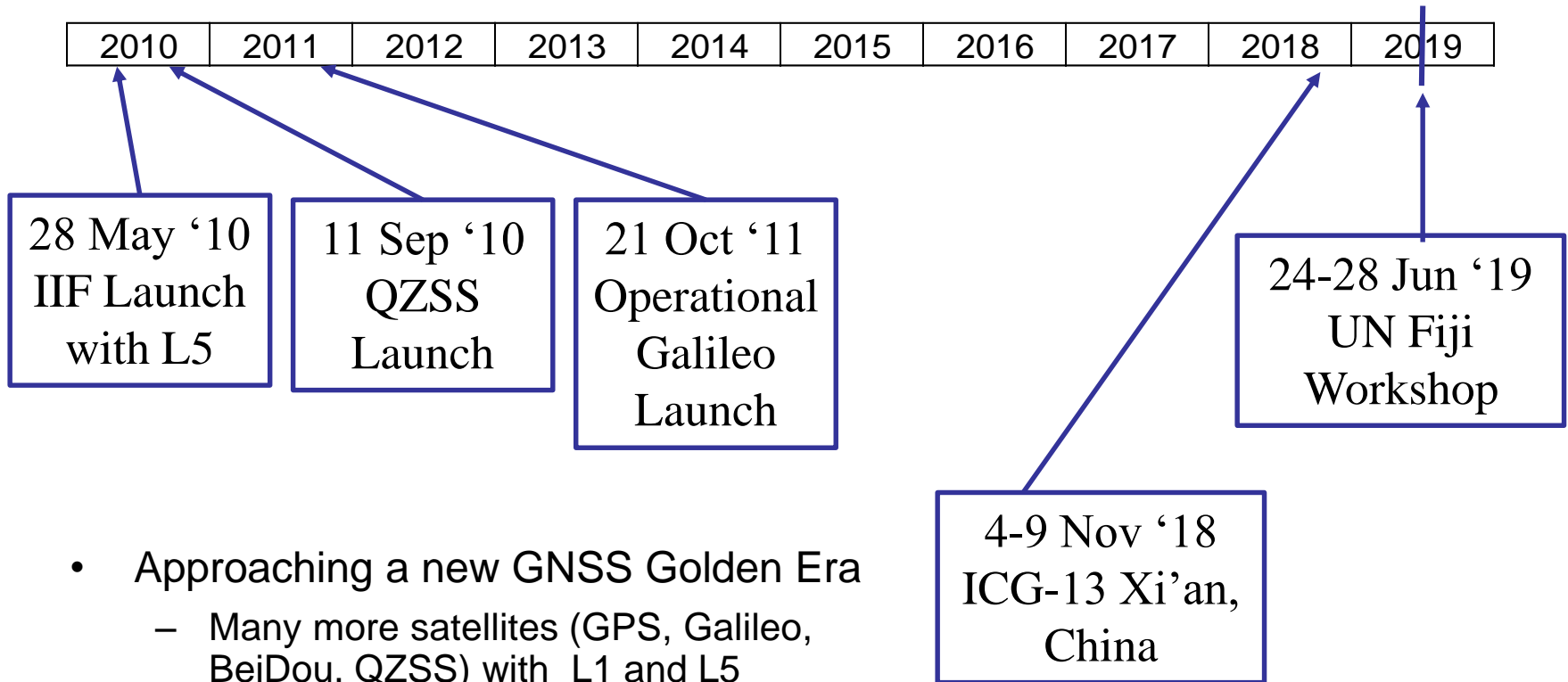


1997 Machine
Control, 10 Hz,
30 ms, 1 cm

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?

Global Perspective

- Global Constellations

- GPS (24+3)
- GLONASS (24+)
- GALILEO (24+3)
- BDS/BEIDOU (27+3 IGSO + 5 GEO)

- Regional Constellations

- QZSS (4+3)
- IRNSS/NAVIC (7)
- Korea – KPS (7)

- Satellite-Based Augmentations

- WAAS (3)
- MSAS (2)
- EGNOS (3)
- GAGAN (3)
- SDCM (3)
- BDSBAS (3)
- KASS (2)
- Australia SBAS (2)



Who Anticipated GPS in Cell Phones?



- 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

More than a Billion Cell Phone GPS Users

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

Seminar History

- Pre-ICG Action Team on GNSS (1999-2005)
 - Regional Meetings 2000-2003
 - Fall 2004: 1st effort to develop Workplan for ICG
 - Spectrum protection and Interference detection and mitigation (IDM) drafted into ICG Workplan from the beginning
- Proposal by U.S. for Educational Seminar on Spectrum Protection and IDM at Final Pre-ICG Experts Meeting in 2005
 - Never took place... until 2015!



Purpose of this Workshop

Describe the importance of GNSS spectrum protection at the National level, and what you can do to reap the benefits of GNSS



Session Agenda: Day 1

Day One: Tuesday, 25 June 2019

Subject

1. Overview

Course Introduction

Participant Introductions - Country, Meeting Participants, GNSS Use Within Country

2. Introduction to GNSS

How GNSS Works and Applications

GNSS Receiver Fundamentals

Introduction to Interference

Break

3. Spectrum Management

What is Spectrum Management

The ITU and Spectrum Management

Introduction to National Spectrum Agencies and National Applications

Q&A Session

Conclusion: Summary and Homework Assignment

Adjourn

End Day One Session



Session Agenda: Day 2

Day Two: Wednesday, 26 June 2019

Subject

Day 2 Introduction and Recap
Interactive Discussion and Participant presentations

4. Spectrum Protection

Introduction to Spectrum "Protection"
ICG Activities and its Role in Spectrum Protection and Interference Detection and Mitigation
Case Studies: Ultra Wide Band & Ligado

Break

5. Interference Detection and Mitigation

Proliferation of GNSS Jammer Devices
Interference Detection Concepts
Interference Detection and Mitigation and GNSS Jammers

6. Summary/Interactive Discussion

Summary and Q&A Session

End of Day Two Session/Course Completed



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Participant Introductions