

# GNSS & Electronic Nav

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Lecture: 10/6/2009 & 10/27/2009  
GPS User Training 11/24, or by arrangement

## I. GNSS Overview (October 6<sup>th</sup>)

### **A. Basics of GNSS (GPS/Galileo/GLONASS)**

- How is the signal structured?
- Components of the Space and Ground Segments
- User Segment – who started the “channel wars”?
- Why are some receivers fast and others slow to acquire satellites?
- Where is the best place to locate my antenna?
- How much power does the GPS draw?
- Navigation accuracy and dilution of precision – what they mean

### **B. WAAS – what is it and how accurate is it**

- SBAS – satellite based augmentation
- When is augmentation required?
- When is RAIM?
- Other modes of augmentation – (A)GPS etc.

### **C. DGPS – how it works and why**

- DGPS tools and what it does
- Does DGPS provide more than just accuracy?
- Installing a DGPS receiver

### **D. GPS and GLONASS versus GALILEO**

- How the US forced Europe to create Galileo
- Will GPS and Galileo get along, or just co-exist
- Will there be much difference in the power required

### **E. GPS – what’s planned for modernization**

- Will my old GPS still work?
- Can I use my old GPS as a backup? Where should I store it?

## II. Chart Plotters and Electronic Charting Systems

Brief overview of features and organization of the November 1:1 sessions

- What is the difference between ECDIS and ECS?
- Should I buy paper charts anymore?

### **III. AIS – Automatic Identification System (Oct 27<sup>th</sup>)**

#### **A. Class B AIS units**

- Why buy a transmitter version, is a receive only “good enough”
- How far can they see me?
- How much power does the AIS transceiver draw?
- What’s next for AIS-B?

#### **B. MMSI**

- What is the 9 digit Maritime Mobile Service Identities (MMSIs) for?
- Installing a AIS and EPRIBS that require an MMSI
- Is a separate MMSI required for the tender if it has a VHF radio?

#### **C. eNavigation**

- What is eNavigation and why should a yachtsman care about it?

### **IV. Global Maritime Distress and Safety System (GMDSS)**

#### **A. Digital Selective Calling (DSC)**

- Can I use DSC on my boat to call other vessels?
- How do I connect the DSC radio feature to my GNSS receiver?
- Common mistakes when making a DSC call

#### **B. EPRIBS**

- How does GMDSS help in a distress situation
- What EPRIRB must I carry?
- What should I carry?

#### **C. COSPAS/SARSAT**

- Overview of IMO’s Search & Rescue Master plan
- What are the key elements of GMDS search plan?
- How can I maximize my opportunity to be found?

#### **Instructor Bio:**

Chris Carver has spent most of his career around electronic navigation and holds several patents on GPS and digital charting. A graduate of the NY Maritime College, he holds multiple USCG deck and engine licenses. Chris served in the US Navy Submarine Service for 10 years. After qualifying as Ships Engineer aboard USS Dace (SSN607), he went on to serve as a Navigation instructor and then become the Navigator of the first submarine to go to sea with GPS, USS West Virginia (SSBN 736). Two individuals from that navigation team are now among the world’s experts on ECDIS systems. In 1986 he used his first “conventional” GPS aboard an Alden 44 as a Navigator in the Marion Bermuda Cruising Race (electronic navigation is only allowed in the last few miles of the race, the race that’s best known for its “Celestial only” component).

Following the Navy, Chris joined Magellan Systems and participated in the building of one of the world’s first handheld GPS receivers, along with a number of other industry first’s in GPS and Telematics. Since that time he has led product development efforts at a number of well known GPS and AIS companies including CSI/Hemisphere GPS, Trimble, Shine Micro and Northstar. Chris holds a Master’s in Engineering from Cornell and an MBA from University of Pittsburgh. He resides in Victoria with his wife and two children, where he operates a GPS/AVL consulting company called Swiftsure Technologies ([chris.carver@swiftsuretech.com](mailto:chris.carver@swiftsuretech.com)).

## Acronym List:

1 PPM - 1 Pulse Per Minute  
1 PPS - 1 Pulse Per Second  
2-D - Two Dimensional  
2DRMS - Two times the standard deviation or Twice Distance Root Mean  
3-D - Three Dimensional  
4-D - Four Dimensional (3-D plus time)

A/C - Aircraft  
A/D - Analog to Digital  
A/J - Anti-Jamming  
ABAS - Aircraft-based Augmentation Systems  
A/D - Analog To Digital  
ADC - Analog to digital converter  
ADS - Automatic Dependent Surveillance (aviation version of AIS)  
AGL - Above Ground Level  
AIS - Automated Identification System  
ALT - Altitude  
ANSI - American National Standards Institute  
AS - AntiSpoofing  
ASCII - American Standard Code for Interface and Interchange  
AtoN - Aids To Navigation  
Autonav - Autonomous Navigation  
AVL - Automatic Vehicle Location -

BER - Bit Error Rate  
Bps - Bits per second  
BPSK - Binary Phase Shift Keying

C/A - Coarse Acquisition Code  
C/No - Carrier to Noise Ratio  
CCZ - Coastal And Confluence Zone  
CDMA - Code Division Multiple Access  
CDMA - Code Division Multiple Access (GPS)  
CEP - circular error probable  
CNS - Communications, Navigation, And Surveillance  
COP - Circle Of Position  
CONUS - Continental United States  
CS - Control Segment

D/A - Digital To Analog  
dB - Decibel ( $X = 10 \log X$  dB)  
DGNS - Doppler GPS Navigation System  
DGPS - Differential Global Positioning System

ECDIS - Electronic Chart Display And Information System  
ECEF - Earth Centered, Earth Fixed  
ENC - Electronic Navigation Chart

EGNOS - European Geostationary Navigation Overlay Service

EOS - Earth Orbiting System

ELEV - Elevation

ESGN - Electrically Suspended Gyro Navigator

ETA - Estimated Time of Arrival

f - Frequency

FAA - Federal Aviation Administration

FCC - Federal Communications Commission

FHWA - Federal Highway Administration

FMEA Failure Mode and Effects Analysis

FOC - Full Operational Capability

FOM - - Figure Of Merit

FRP - Federal Radionavigation Plan

GBAS - Ground-based augmentation system

GDOP - Geometric Dilution Of Precision

GEO - Geosynchronous Earth Orbit

GEOREF - World Geographic Reference System

GHz - Gigahertz

GIAC - GPS Interagency Advisory Council

GIC - GPS Integrity Channel

GIS - Geographic Information Systems

GLONASS - Global Navigation Satellite System

GMT - Greenwich Mean Time

GNSS - Global Navigation Satellite Systems

GPS - Global Positioning System

GPSE - GPS Enhancement

GPSIC - GPS Information Center

GRS - Geodetic Reference System

HADGPS - High Accuracy DGPS

HDOP - Horizontal Dilution of Precision

HF - High Frequency

Hz - Hertz (cycles per second)

ICD - Interface Control Document

ICS - Interim Control Segment

IEEE - Institute Of Electrical And Electronics Engineers

IFR - Instrument Flight Rules

IGEB - Interagency GPS Executive Board

IG - Inspector General

IGS - International GNSS Service

IMO - International Maritime Organization

INMARSAT - International Maritime Satellite

INS - Inertial Navigation System

IOC - Initial Operational Capability

ION - Institute Of Navigation

ISO - International Standards Organization  
ITP - Integrated Test Plan  
ITU - International Telecommunication Union

J/S - Jamming to Signal Ration

kHz - kilohertz

L1 - GPS Carrier Frequency, 1575.42 MHz  
L2 - GPS Carrier Frequency, 1227.6 MHz  
LAAS - Local Area Augmentation System  
Lat - Latitude  
Lat/Lon - Latitude/Longitude  
LBS - L Band System  
L2C - Civil signal on L2  
L2M - Military-code on L2  
L5 - Link 5, carrier frequency = 1176.45 MHz  
LAAS - Local Area Augmentation System  
LAT - latitude  
LEO - Low Earth Orbit  
LEP - Linear Error Probable  
LEO - Low Earth Orbit  
LEP - linear error probable  
LF - low frequency  
LIS - Land Information System  
LF - Low Frequency  
Lon - Longitude  
LOP - Line Of Position  
Loran - Long Range Navigation  
LOS - Line Of Sight

m - Meter(s)  
M/S - Meters per Second  
Mbps - Mega bits per second  
MF - Medium Frequency  
MGRS - Military Grid Reference System  
MHz - Megahertz  
MILSPEC - Military Specifications  
MSG - Message  
MSS - Mobile Satellite Service  
MSL - Mean Sea Level  
MTBF - Mean Time Between Failures

NAD - North American Datum -  
NADU - Notice Advisory to DGPS Users  
NAGU - Notice Advisory to Glonass Users  
NANU - Notice Advisory to Navstar Users  
NAV - Navigation  
NAVAID - Navigational Aid

NAV-msg - . - Navigation Message  
NAVSTAR - Navigational Satellite Timing and Ranging  
NDGPS - Nationwide Differential Global Positioning System  
Nm - Nautical Mile  
NNSS - Navy Navigation Satellite System (Transit)  
NMEA – National Marine Electronics Assoc. (NMEA 2000)  
NOS - National Ocean Survey  
NRL - Naval Research Laboratory  
NOAA - National Oceanic and Atmospheric Administration  
NS - Nanosecond  
NTS - Navigation Technology Satellite

OAB - Operational Advisory Broadcasts  
OGE - Operational Ground Equipment  
OIS - Orbital Insertion System  
ONC - operational navigation chart  
OP - Operational  
OPCON - operational control

P-Code - Precision/Protected Code  
PADS - Position Azimuth Determining System  
PDOP - Position Dilution Of Precision  
PE - Probable error  
PLGR - Precise Lightweight GPS Receiver  
POS - Position  
POS REF - Position Reference  
Pos/Nav - positioning/navigation  
PPM - Parts Per Million  
PPS - Precise Positioning Service  
PPS - Pulse Per Second  
PR - Pseudorange  
PRN - Pseudo Random Noise  
PTTI - precise time and time interval

QA - Quality Assurance

RAIM - Receiver Autonomous Integrity Monitoring  
RCVR - Receiver  
RDOP - Relative Dilution of Precision  
RDSS - Radio Determination Satellite Systems  
REF - Reference  
RF - Radio Frequency  
RFI - Radio Frequency Interference  
RINEX - Receiver INdependent EXchange format  
RMS - Root Mean Square  
RTCM - Radio Technical Commission for Maritime Services  
RTK - Real-Time Kinematic  
RSS - Root Sum Square  
RTS - Remote Tracking Station

S - South

SA - Selective Availability

SATNAV - Satellite Navigation

SINS - Shipborne INS

SONAR - sound navigation ranging

SPS - Standard Positioning Service

SRP - Selected Reference Point

SS - Space Segment

SPS - Standard Positioning Service

SVN - Space Vehicle NAVSTAR, Space Vehicle Number

TBD - To Be Determined

TD - Time Difference

TDOP - Time Dilution of Precision

TE - Test Equipment

TEMP - Temperature

TOD - Time Of Day

UAV - Unmanned Aerial Vehicle

USGIC - US GPS Industry Council

USGS - US Geological Survey

USNO - US Naval Observatory

UT - Universal Time

UTC - Coordinated Universal Time

UTC (USNO) - Coordinated Universal Time as maintained by the USNO

VDOP - Vertical Dilution of Precision

VLF - very low frequency

VTS - Vessel Traffic Services

W - West

WAAS - Wide Area Augmentation System

WADGPS - Wide Area Differential GPS

WAGE - Wide Area GPS Enhancement

WAN - Wide Area Network

WGS - World Geodetic System

WGS 84 - World Geodetic System 1984

WPT - Way point

WRC - World Radio Conference

Y code - Precise code (GPS)

Y2K - Year 2000

Z - Zulu (GMT time)