Introduction to GPS

Stephen L. Marsh

Burns & McDonnell Engineering
Kansas City, Missouri

Goals of This Course

- Understand the Basics of GPS
- Learn the “Language” of GPS
- Learn Basic Types of GPS Equipment
- Applications of GPS

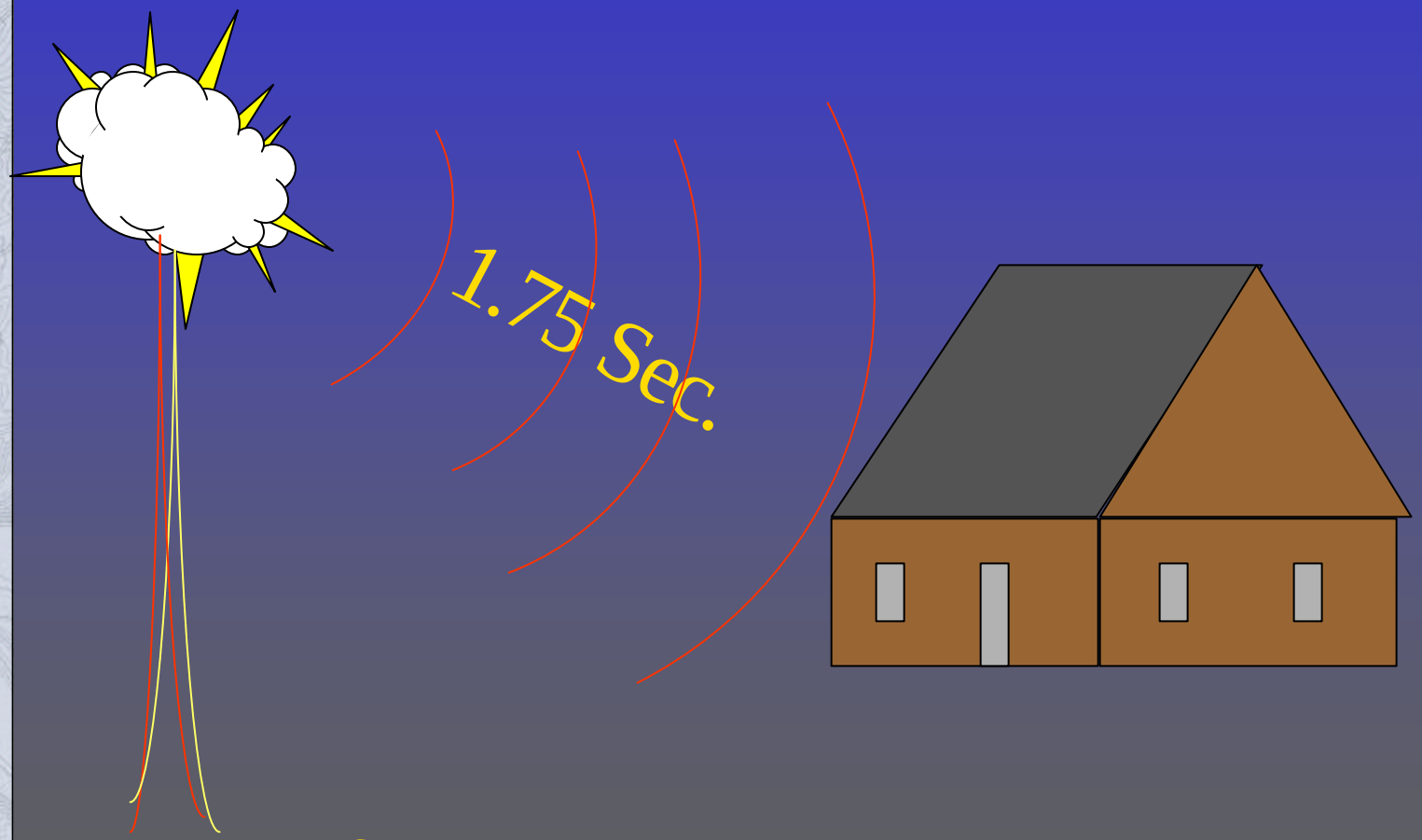
Basic GPS Concepts

GPS

Global Positioning System

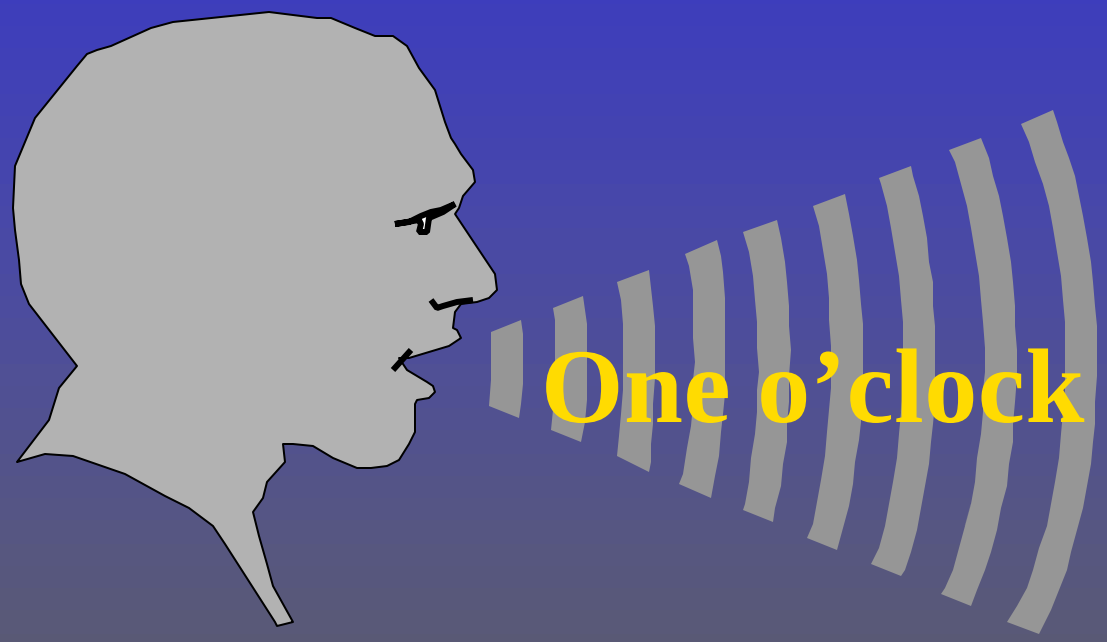
Rate x Time = Distance

Rate x Time = Distance

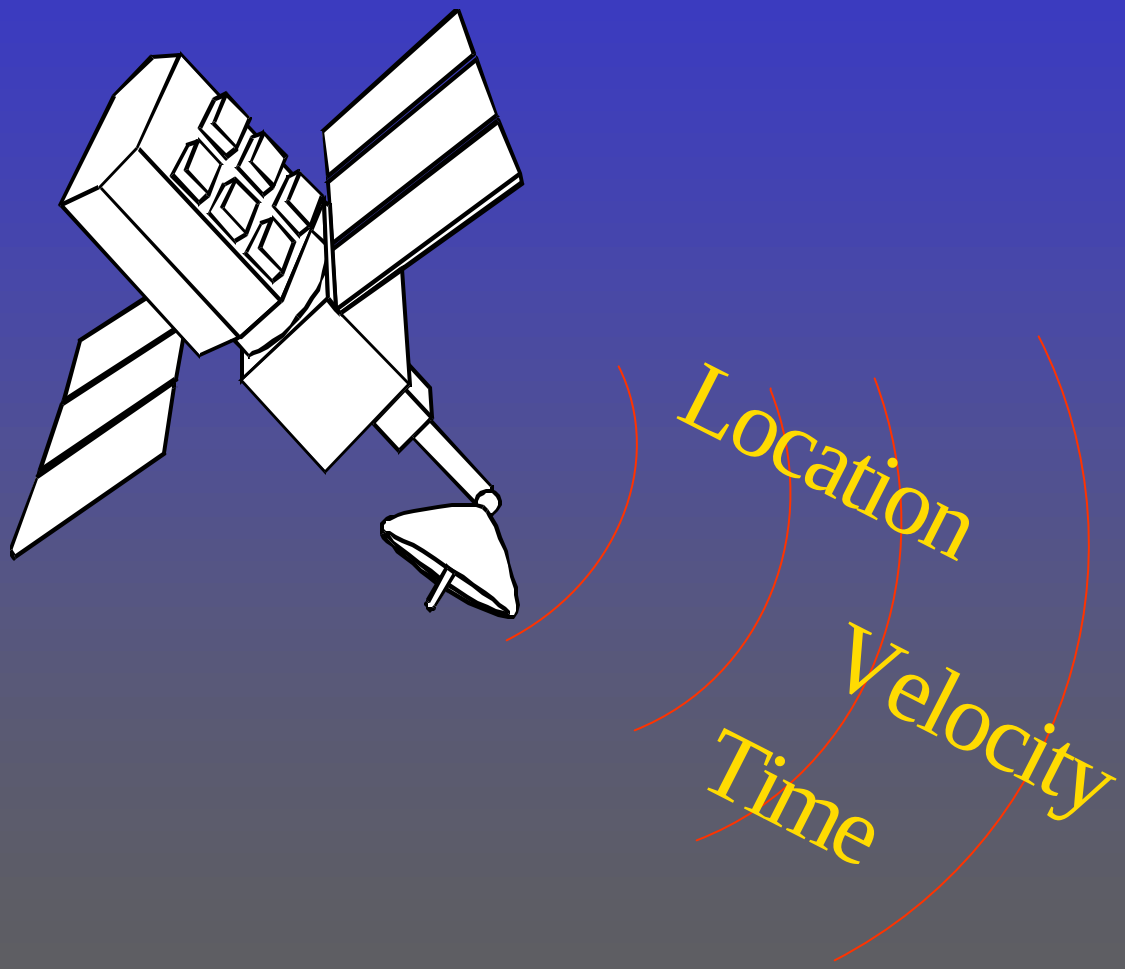


1,087 fps x 1.75 secs = 1,902.25

Time as An Internal Message

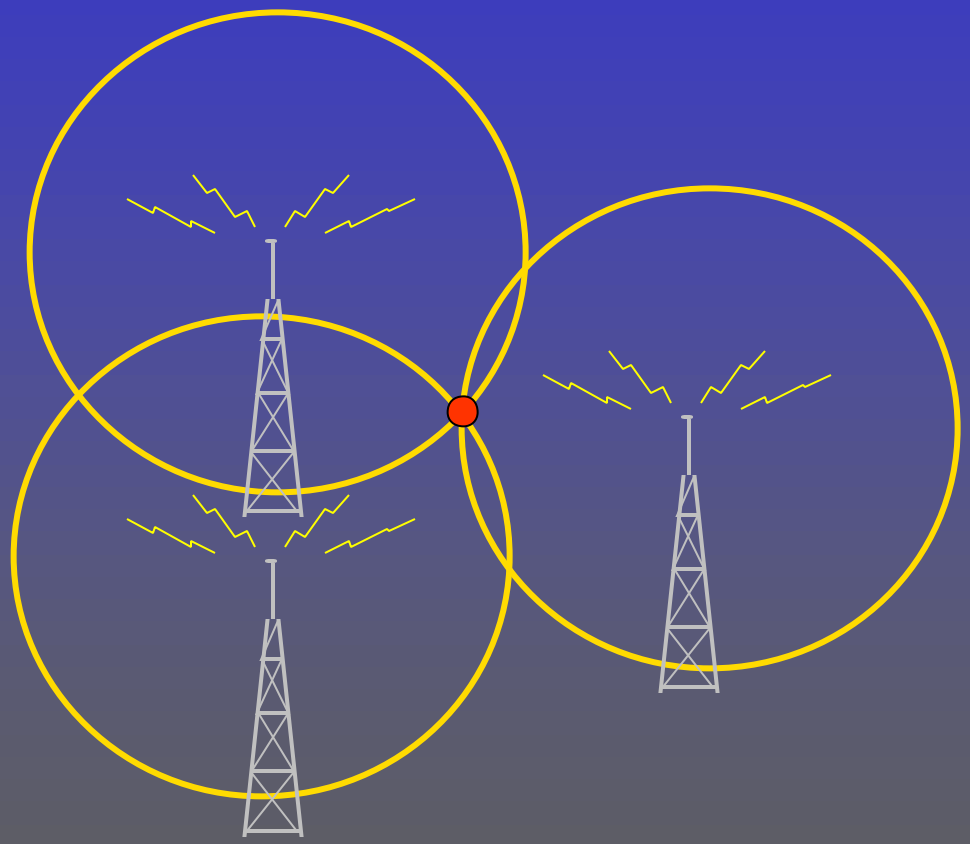


Flying Clocks



Location by Triangulation

(Trilateration)



The Language of GPS

Parts of the GPS System

- Space Segment
- User Segment
- Control Segment

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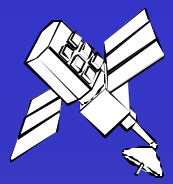
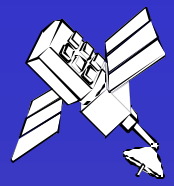
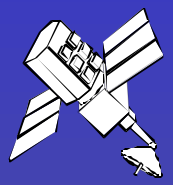
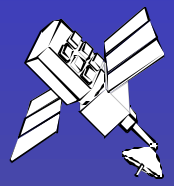



Space Segment



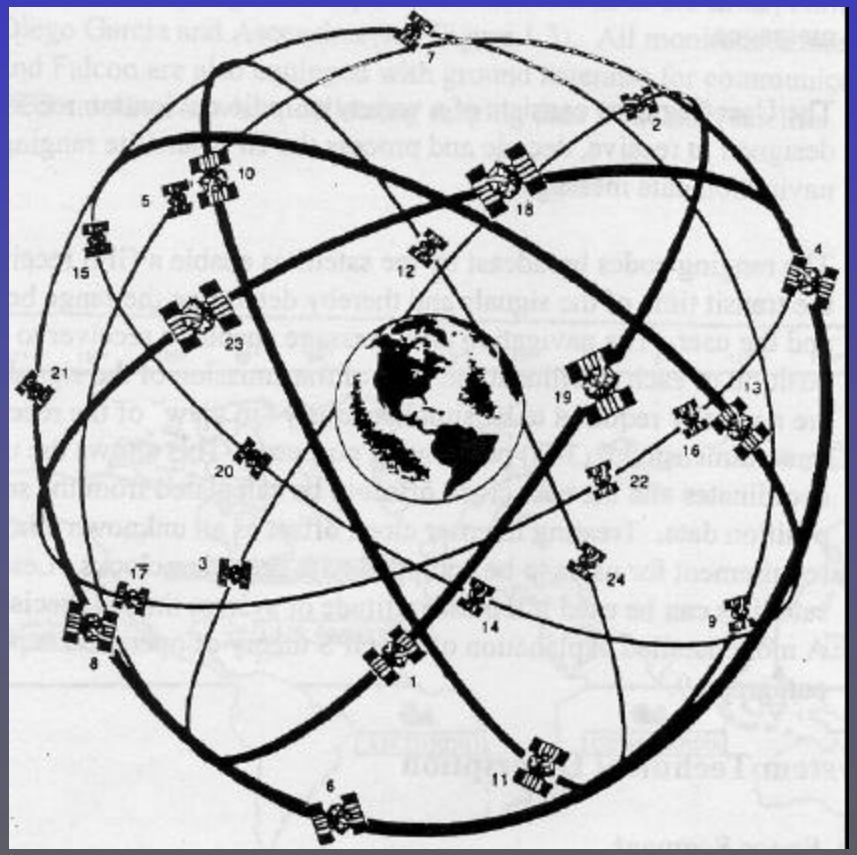
Constellation of 24 Satellites



6 Orbital Planes

3 to 4 Operational Satellites Per Plane

Satellite Constellation



User Segment

Users of GPS Satellite Signals

Department of Defense

Non-Defense Government

Commercial (Engineers, Airlines)

Private (hunters, autos)

Control Segment

Master Control Station (Colorado Springs)

Monitor Stations

Ground Antennas

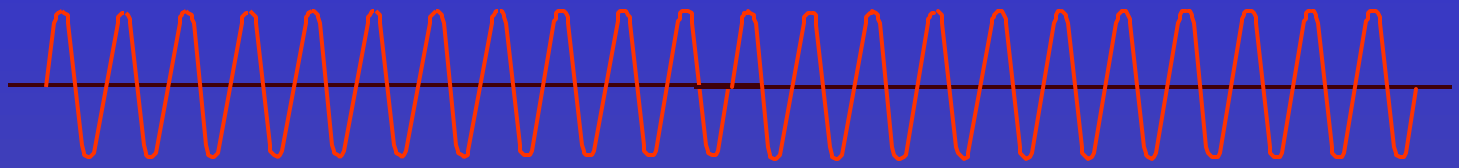
Introduced Error

Selective Availability (SA)

Anti-Spoofing (A-S)

Effects of SA-
Long-Term Mean of Zero

GPS Satellite Signals



Transmitting Bands

Transmitted Information

Transmitting Bands

L1

Primary GPS Frequency

1575.42 MHZ

Blocked By SA

Transmitting Bands

L2

Secondary GPS Frequency

1227.6 MHZ

Open to All GPS Receivers

Transmitted Information

C/A Code

P(Y)-Code

C/A-Code

Coarse/Acquisition

Civilian Code

1 MHZ

Pseudo-Random

P(Y)-Code

Carried on Transmission Bands L1 & L2

P-Code Encrypted (Y)

1 Gigahertz

Higher Frequency/Higher Accuracy

Levels of Service

PPS:
Precise Positioning Service

SPS:
Standard Positioning Service

Precise Positioning Service

Highly Accurate

Positioning, Velocity, and Timing

Available Only to Military

Standard Positioning Service

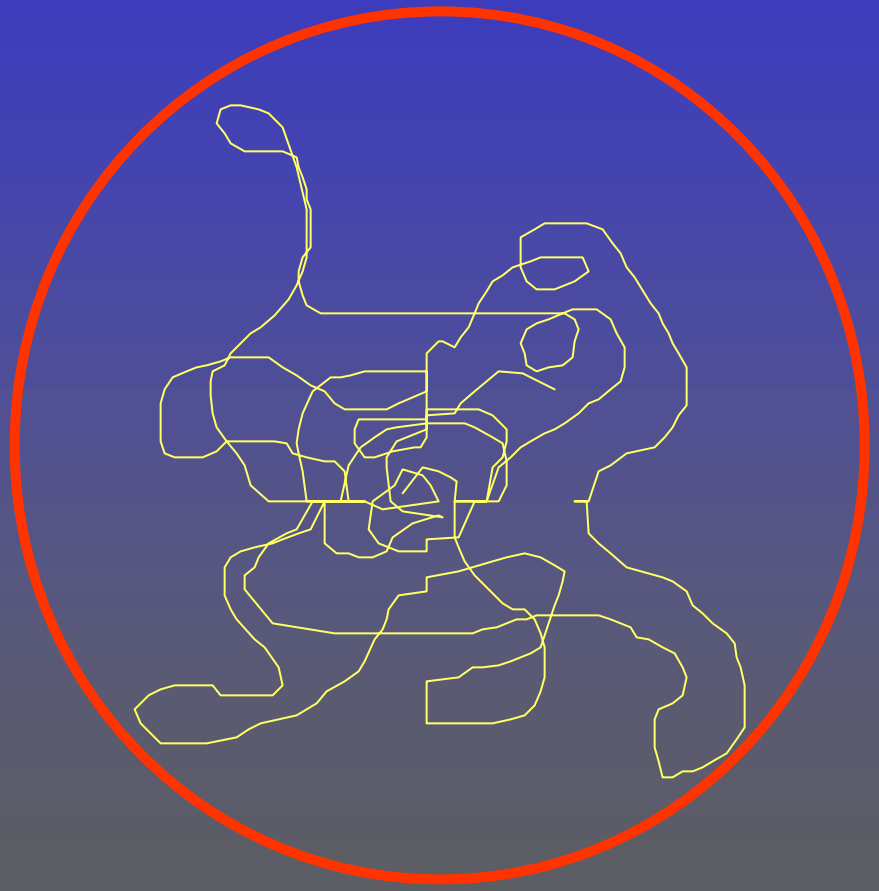
Less Accurate

Positioning and Timing

Available to All Users

Created with SA

Long-Term Mean of Zero



Types of GPS Receivers

Receiver Architectures

Sequential

Continuous

Multiplex

Key Terms for this Section

RCVR: Receiver

Pseudoranges: The Calculated Distance Between the Satellite and RCVR

TTFF: Time to First Fix

Cannel: Circuitry needed to receive Satellite Signals

Sequential RCVRs

Use 1 or 2 Channels

Momentarily Check Satellite Location

Slowest TTFF

Cheapest

Continuous RCVRs

Use 4 or 5 Channels

Simultaneously Check Satellite Locations

Lowest TTFF

Most Expensive

Multiplex RCVRs

Maintains 20 Continuous Observables

High C/N Ratio

All-In-View RCVRs

Separate Channels for Each Satellite

Continuous Position, Velocity, Time (PVT) Solutions

Adds Satellites as They Come into View

Surveying RCVRs

Differential GPS RCVRs

Interferometric GPS RCVRs

Codeless GPS RCVRs

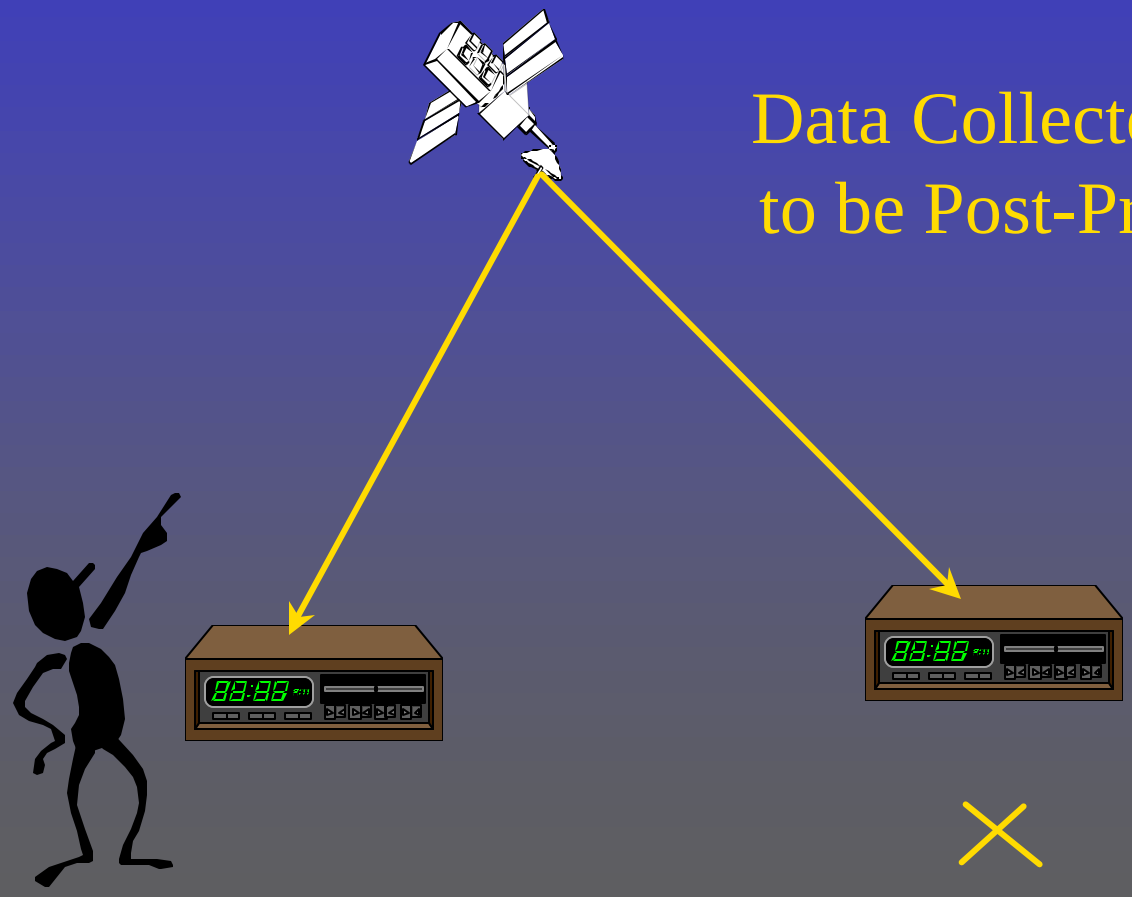
Differential RCVRs

Base/Rover Configuration

RCVR uses one of the previous Architectures

Differential RCVRs

Base/Rover Configuration

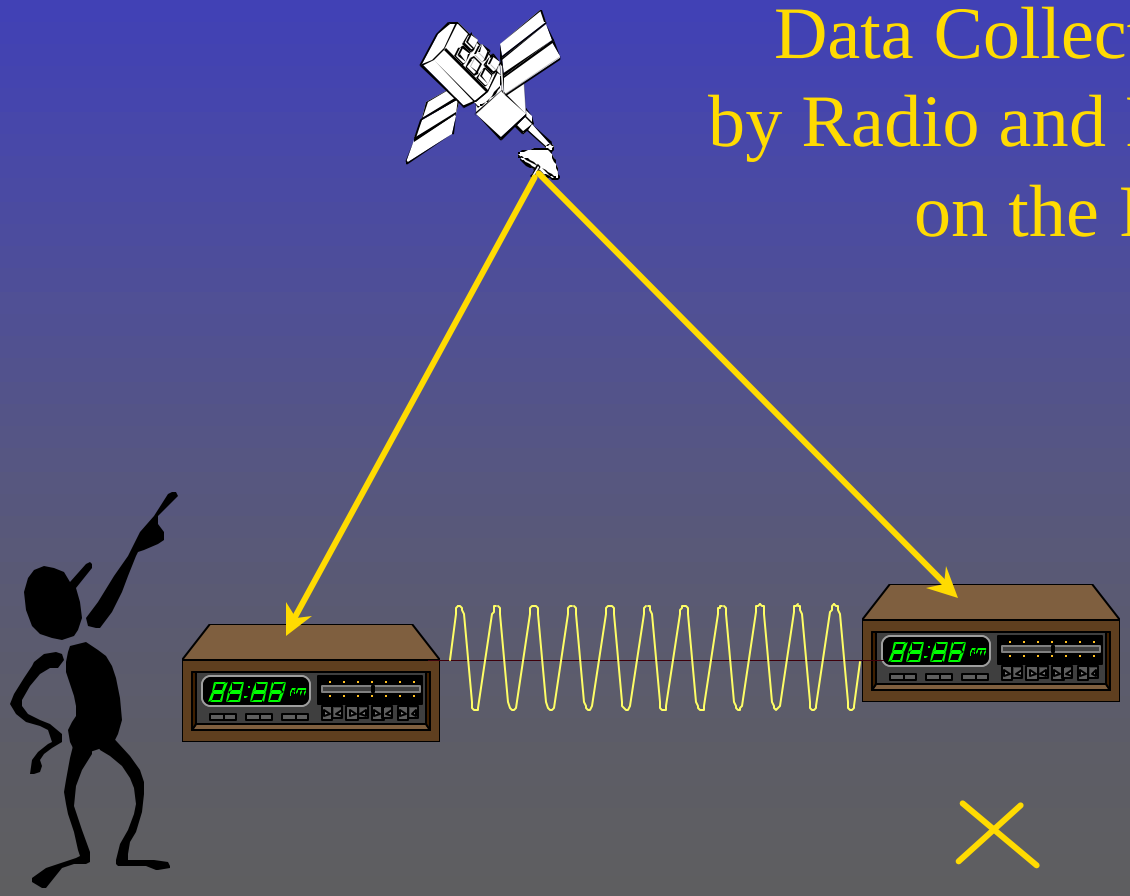


Data Collected needs to be Post-Processed

Differential RCVRs

Real-Time DGPS

Data Collected sent by Radio and Processed on the Fly



Performance Capability of GPS Receivers

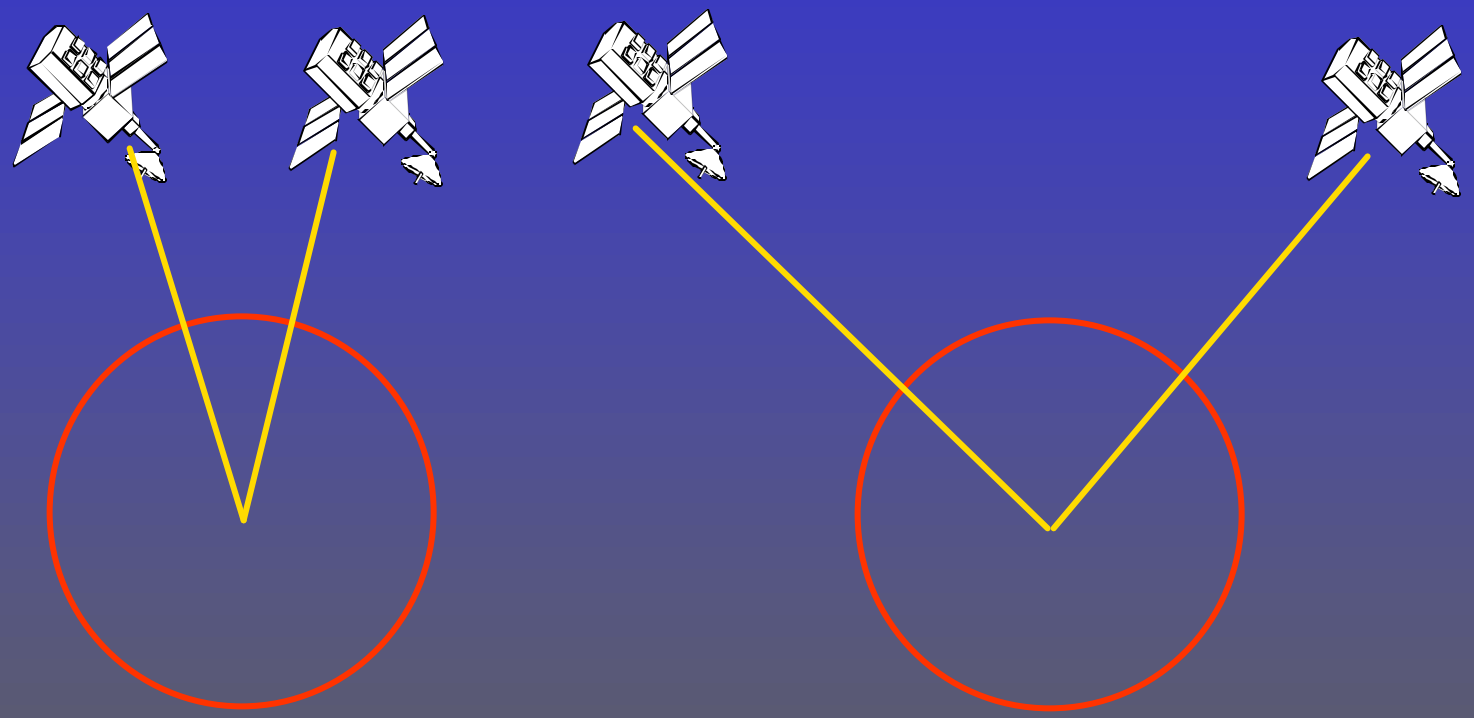
Geometric Dilution of Precision

TTFF

Cold Start-up

Almanac Collection

GDOP: Geometric Dilution of Precision



Also: PDOP, HDOP, VDOP, TDOP

TTFF

Cold Start-up

Almanac Collection

Non-Introduced Errors

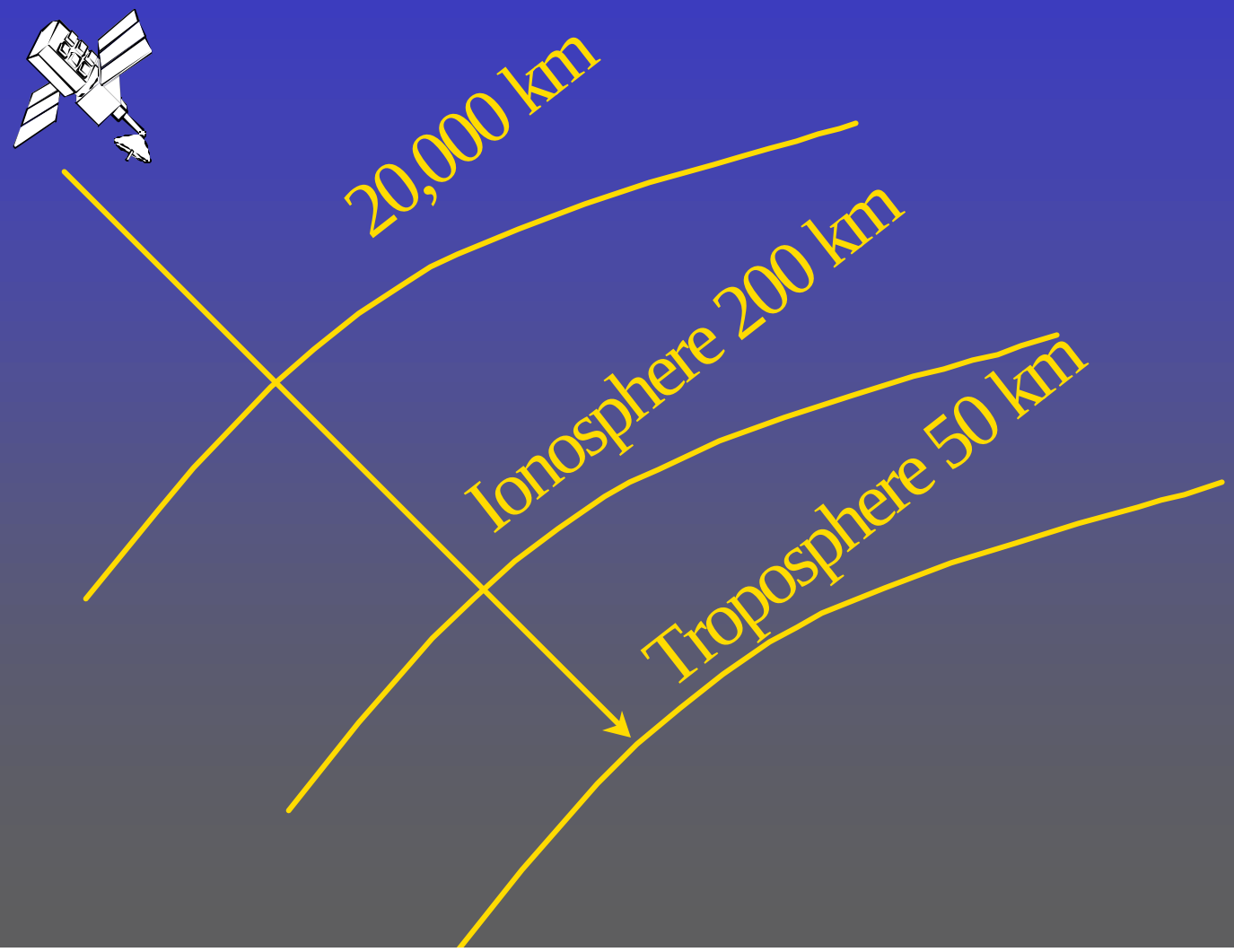
Satellite

Receiver

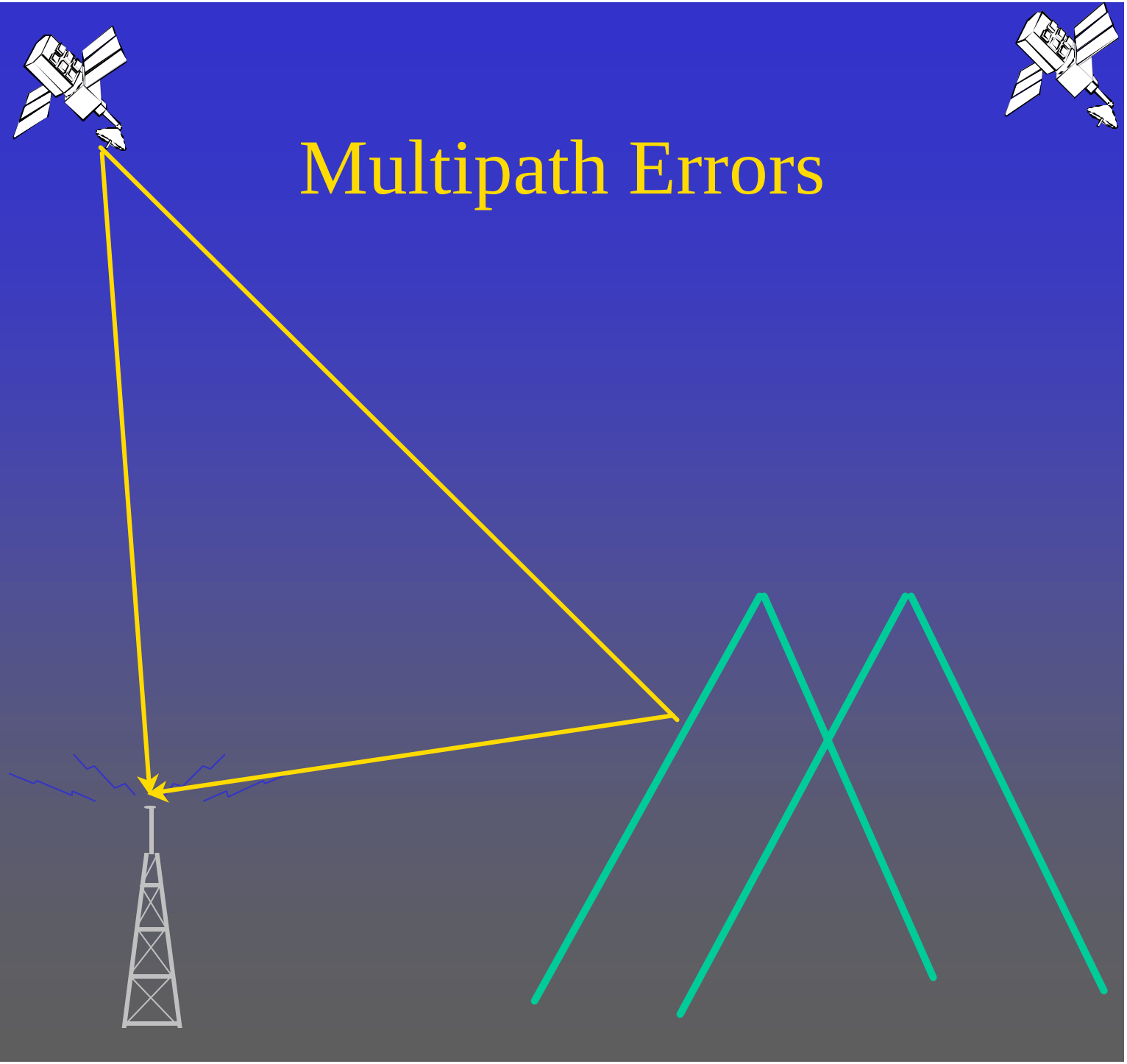
Atmosphere

Multipath

Atmospheric Errors



Multipath Errors



Applications of GPS

Aviation

Agriculture

Natural Resource Management

Transportation/Shipping/Asset Management

Utilities