3 segments of GPS

Space

The space segment is the NAVigation Satellite Timing And Ranging (NAVSTAR) constellation of satellites that broadcast GPS signals. When the system is at full operational capacity, there are 24 operational satellites. This number changes constantly as satellites are commissioned (put into operation) and decommissioned (removed from operation). These satellites orbit 20,200 km above the Earth (almost twice the diameter of our planet) and complete one revolution approximately every 11 hours and 58 minutes.

Control

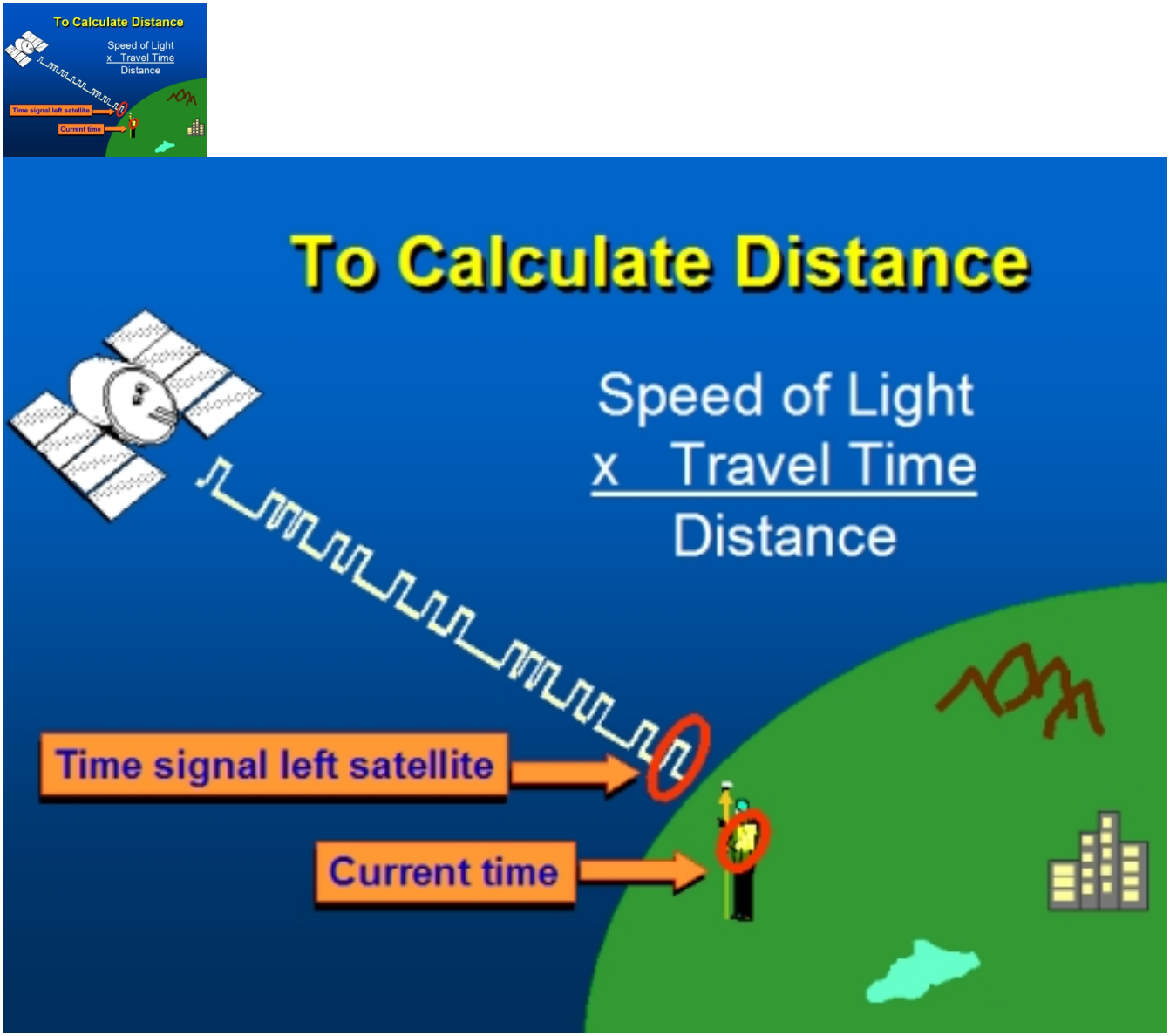
The control segment is the “brain” of GPS. A controller monitors the satellites’ transmission of navigation messages and sends adjustments as necessary. The Department of Defense operates this segment from Shriver Air Force Base in Colorado Springs, CO. The segment also includes 4 monitoring and upload stations distributed throughout the world. Each satellite passes over a monitoring station twice a day.

User

Civilian users currently outnumber military users worldwide. Applications include GIS data collection, surveying, agriculture, aviation, emergency services, recreation and vehicle tracking.

It's all based on distances

Your position is calculated by using distances from GPS satllites to the reciever.



Distance is calculated by multiplying:

Speed of light = The speed of GPS signal = 300,000 km/sec, and

Travel time = The difference between the time a signal was sent by the

satellite and the time the same signal was received by the user

Trilateration

Trilateration refers to measuring the distance from at least 3 known satellite locations to establish a position on Earth. Trigonometry requires 3 perfect measurements to define a point in 3-dimensional space. However, the accuracy of a measurement based on 3 satellites may be diminished due to non-synchronization of clocks in the GPS satellites and the receiver. A 4th measurement can eliminate these timing offsets. The microprocessor in the GPS receiver recognizes this timing offset when it receives a series of measurements that do not intersect at one point. It automatically starts subtracting the same amount of time from all of the measurements until a single point is determined. Trimble mapping receivers have 12 parallel channels to receive radio transmissions from up to 12 GPS satellites simultaneously.
An accurate position is calculated by using a minimum of 4 satellites.

Almanac

The **almanac file** specifies where each GPS satellite will be at any given time in the future. It is a set of parameters used to calculate the general location of all the satellites. Trimble receivers automatically download an almanac upon finding a satellite. The receiver uses this to quickly

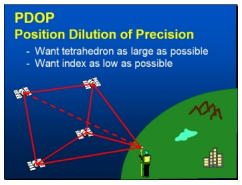
acquire the position of other satellites in the sky. Trimble field mapping software such as GPScorrect can display predicted DOP values for the next 12 hours using information found in the almanac.

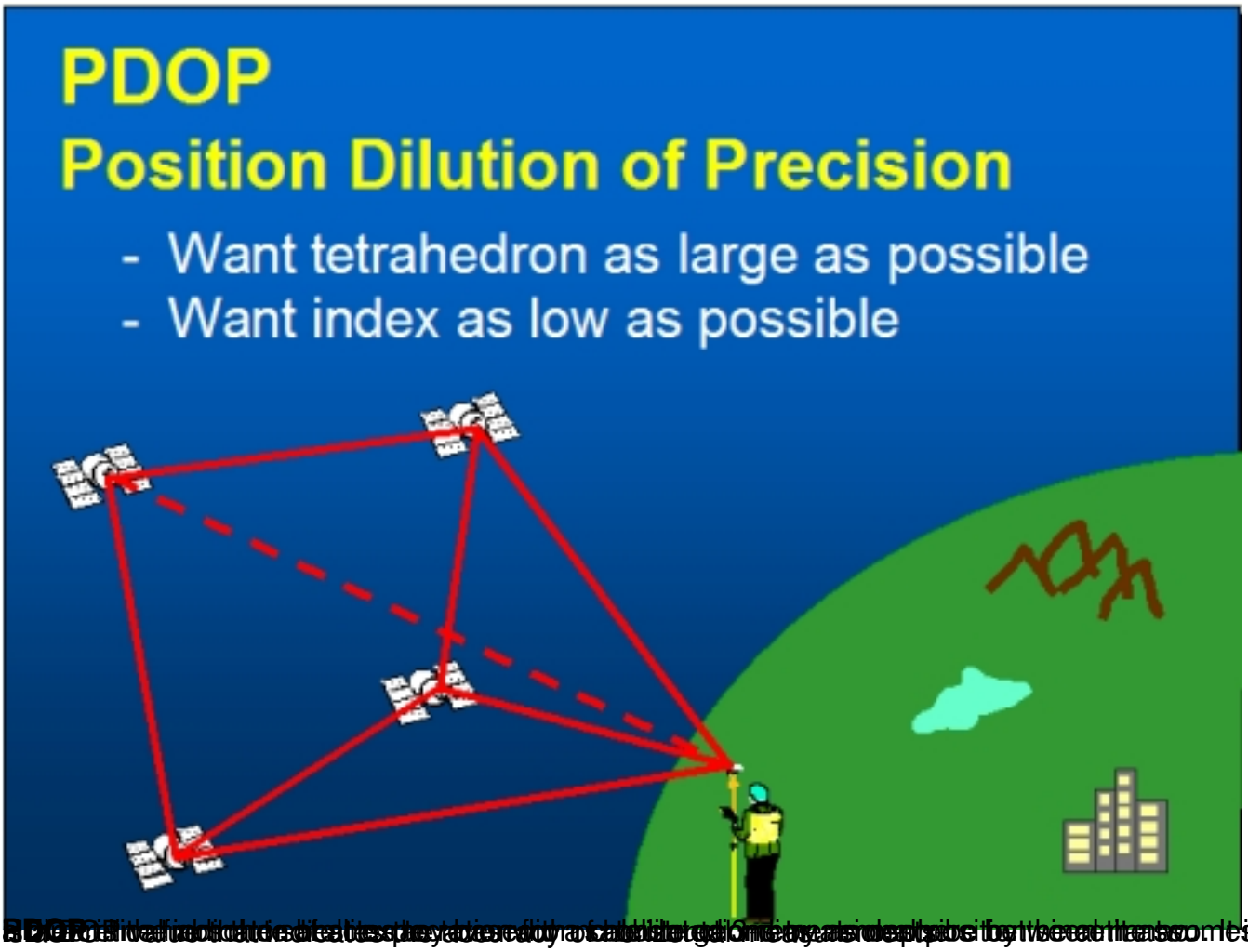
An almanac can be downloaded from the receiver or from the Internet. It is used with planning tools such as Trimble Planning software for choosing fieldwork times that are predicted to have optimal satellite geometry. Trimble Planning software is free.

Ephemeris

The **ephemeris file** is the satellite's report of its exact location and is encoded as part of the satellite signal. The ephemeris information contains orbit information for one particular satellite. This information is used by the GPS receivers along with their internal almanac to establish precisely the position of the satellite. After all, trilateration requires not only distance measurements, but also the exact locations of the satellites.

Position dilution of precision (PDOP)




PDOP
Position Dilution of Precision
- Want tetrahedron as large as possible
- Want index as low as possible