Teach ICT

CASE STUDY

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Error sources and analysis in GPS

- The GPS project was developed in 1973 to overcome the limitations of previous navigation systems, integrating ideas from several predecessors, including a number of classified engineering design studies from the 1960s. GPS was created and realized by the U.S. Department of Defense (USDOD) and was originally run with 24 satellites. It became fully operational in 1994.
- Error analysis for the Global Positioning System is an important aspect for determining what errors and their magnitude are to be expected. GPS errors are affected by geometric dilution of precision and depend on signal arrival time errors, numerical errors, atmospherics effects, ephemeris errors, multipath errors and other effects.

Questions for students

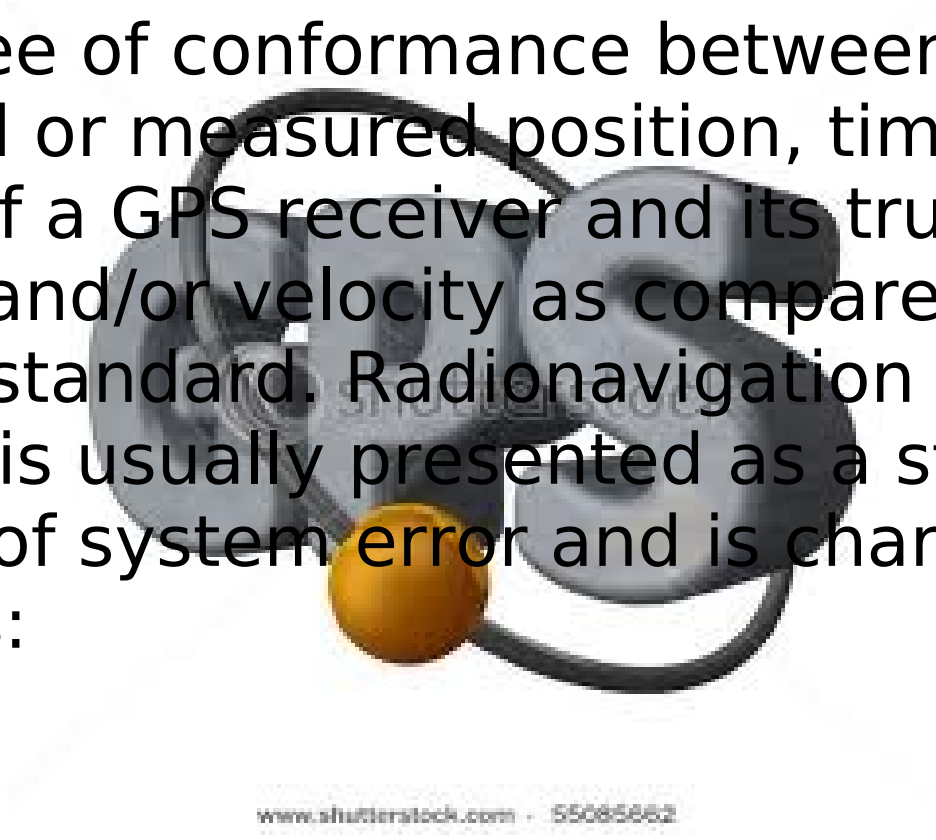
- What is GPS receiver’s clock?
- Explain the basic function of GPS
- Find out the Timeline and modernization of GPS
- Possible threat that GPS service might have in the future.
- Talk about the future of GPS.

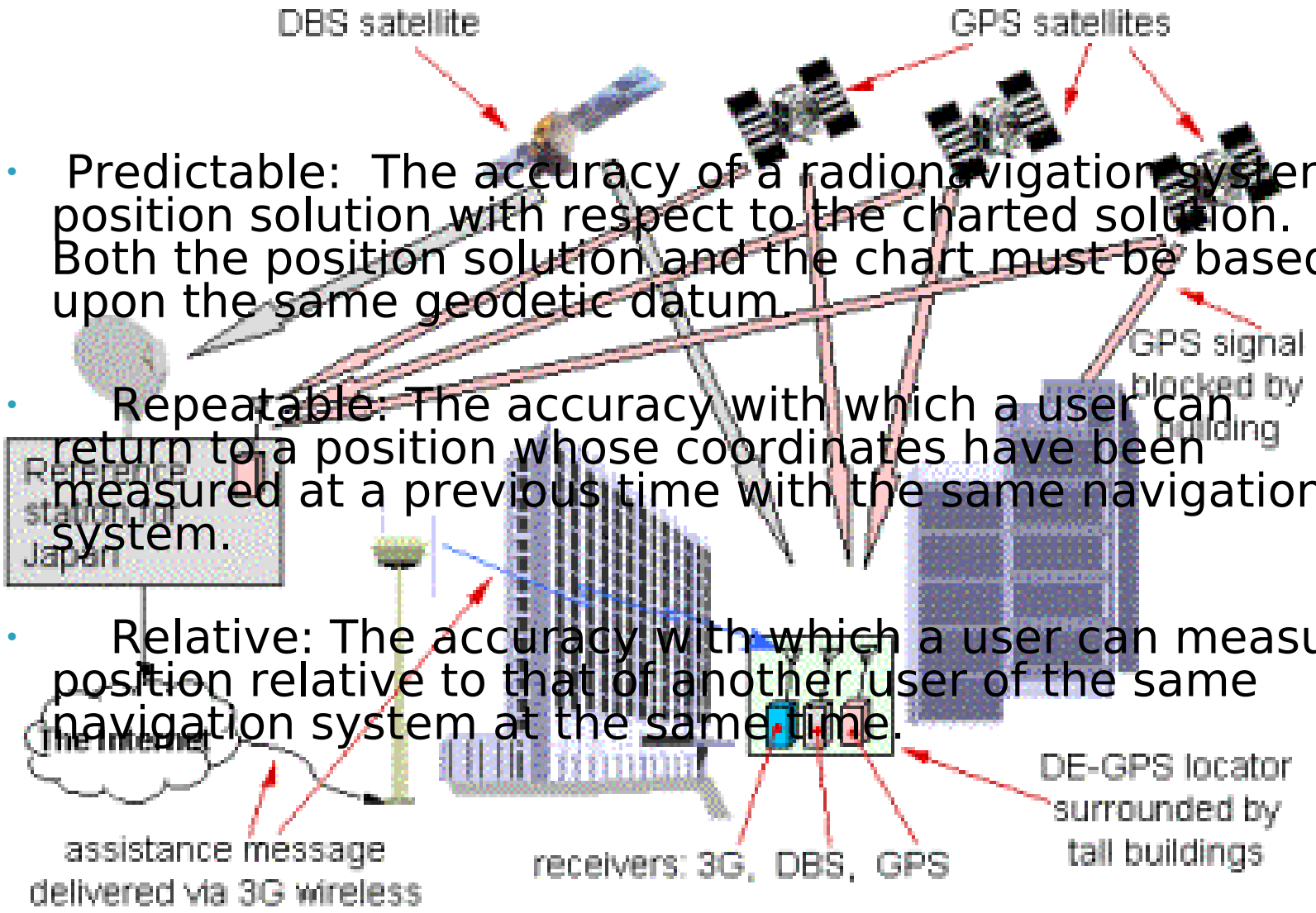
Correcting a GPS receiver's clock

- One of the most significant error sources is the GPS receiver's clock. Because of the very large value of the speed of light, the estimated distances from the GPS receiver to the satellites, the pseudoranges, are very sensitive to errors in the GPS receiver clock; for example an error of one microsecond (0.000 001 second) corresponds to an error of 300 meters (980 ft). This suggests that an extremely accurate and expensive clock is required for the GPS receiver to work. Because manufacturers prefer to build inexpensive GPS receivers for mass markets, the solution for this dilemma is based on the way sphere surfaces intersect in the GPS problem.

Accuracy

- The degree of conformance between the estimated or measured position, time, and/or velocity of a GPS receiver and its true time, position, and/or velocity as compared with a constant standard. Radionavigation system accuracy is usually presented as a statistical measure of system error and is characterized as follows:





- Predictable: The accuracy of a radionavigation system's position solution with respect to the charted solution. Both the position solution and the chart must be based upon the same geodetic datum.
- Repeatable: The accuracy with which a user can return to a position whose coordinates have been measured at a previous time with the same navigation system.
- Relative: The accuracy with which a user can measure position relative to that of another user of the same navigation system at the same time.

- Thus the quotient, provides an estimate of correct time (time indicated by the receiver's on-board clock), and the GPS receiver clock can be advanced if is positive or delayed if is negative.
- However, it should be kept in mind that a less simple function of may be needed to estimate the time error in an iterative algorithm as discussed in the Navigation equations section.