

NAVIGATING WITH GPS

GPS & GIS | Fall 2016

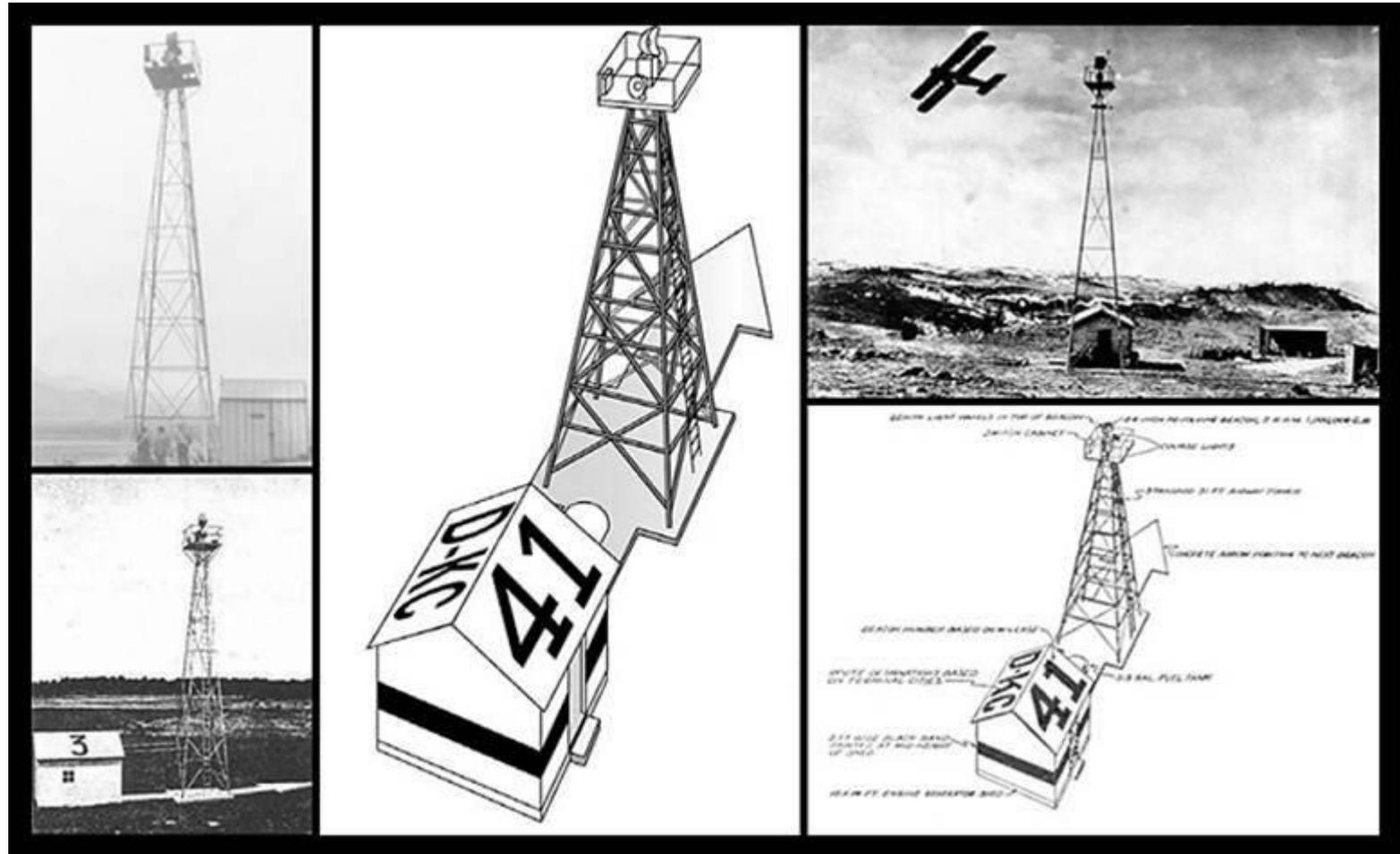


A historical look at navigation

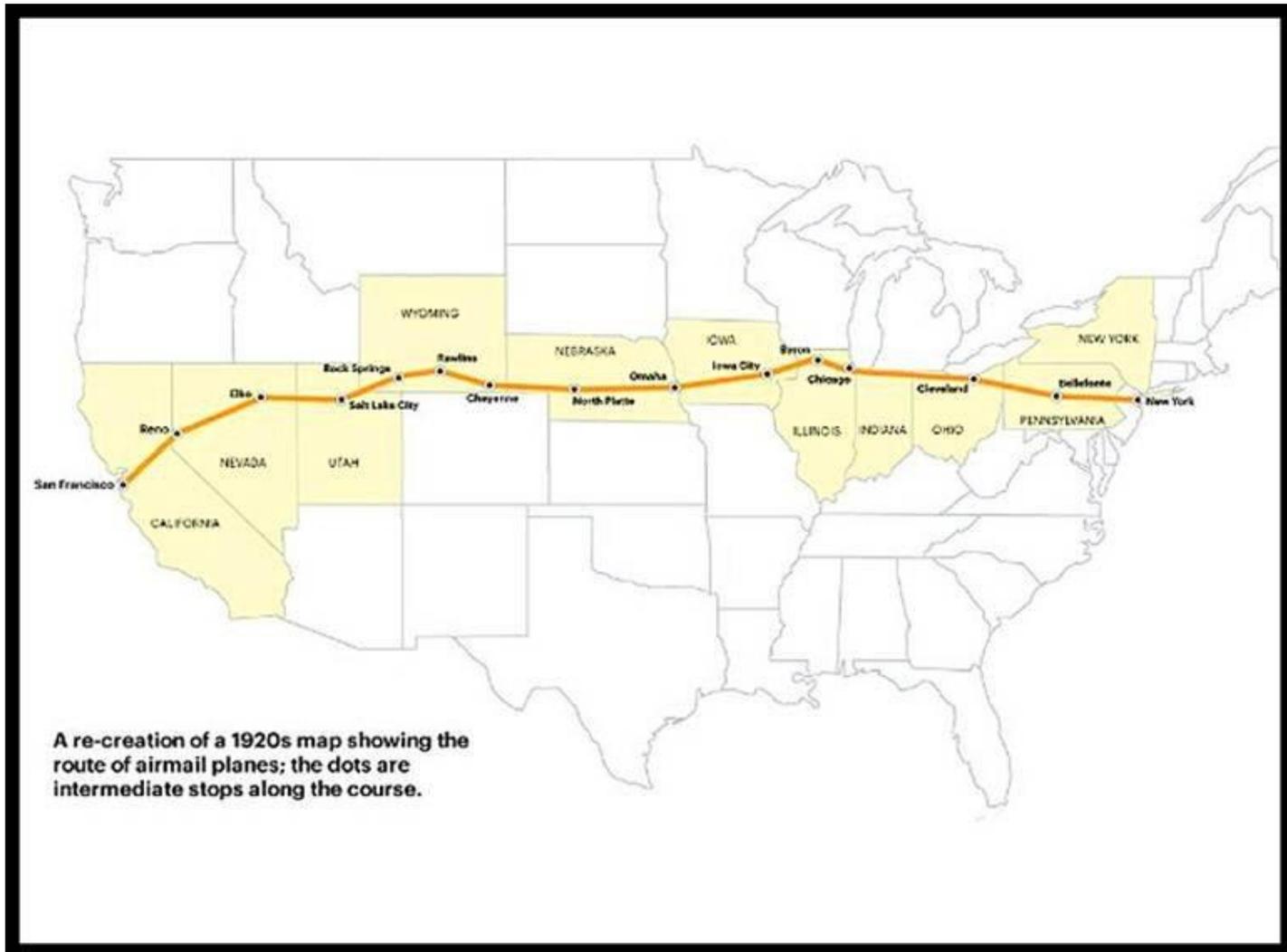
Transcontinental Air Route

- In 1920, the US opened its first coast-to-coast airmail delivery route
- No good aviation charts existed - pilots used landmarks to fly across the US.
- **Solution:** World's first ground-based civilian navigation system - a series of lit beacons from New York to San Francisco.
 - ▣ a bright yellow concrete arrow every ten miles
 - ▣ Each arrow would be surmounted by a 51-foot steel tower and lit by a million-candlepower rotating beacon.

Transcontinental Air Route



Transcontinental Air Route



Transcontinental Air Route



LOng RAnge Navigation

- Radio navigation or LORAN (WWII)
 - ▣ Position is determined by noting differences in time of reception of synchronized pulses from a primary & secondary transmitting station (widely spaced)
 - ▣ Used for military ships & aircraft located within 600 miles off the American coast
 - ▣ Determines position and speed; accuracy was within tens of miles

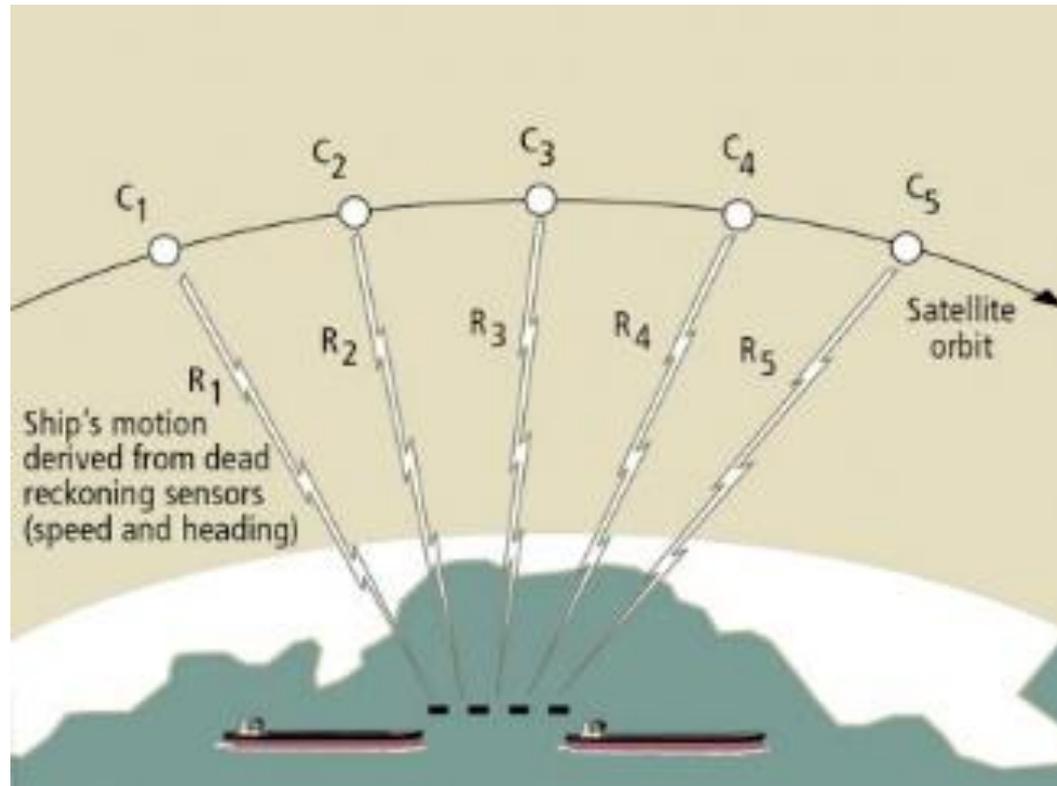
LOng RAnge NAvigation



TRANSIT

- NAVSAT OR NNSS for Navy Navigation Satellite System
 - First satellite system for Navigation
 - Successfully tested in 1960
 - US Navy used for position finding using a 2D system
 - Constellation of 5 satellites
 - Could provide a fix once per hour

TRANSIT



The Navy's Transit system, precursor to GPS, operated on a Doppler ranging Principle. A drawback was that a position fix could take 30 minutes to complete

SEquential COllation of RRange

- Used by the US Army in the 1960s
- 3 ground-based transmitters from known locations that would send signals to the satellite transponder in orbit
- A fourth ground-based station, at an undetermined position, could then use those signals to fix its location precisely
- The last SECOR satellite was launched in 1969.

Aerospace Corporation

- In 1963 completed a study that proposed:
 - ▣ System of space satellites that send signals to receivers on the ground
 - ▣ Could located vehicles moving rapidly on the ground or in the air

How did we get to NAVSTAR?

- Cold War
 - ▣ Nuclear threat justified the billions of dollars in research and implementation
 - ▣ Inspired by Soviet spacecraft Sputnik launching in 1957
 - ▣ How to deliver a bomb more accurately?
- In 1974, the first satellite was launched as part of the proposed 24-satellite GPS system
- 1978-85, 11 more satellites are in orbit, all containing atomic clocks

Civilian use

- 1983 – Russians shot down Korean airplane after wandering into Soviet airspace (Kamchatka peninsula).
- Reagan offered to let all civilian commercial aircraft use the GPS system to improve navigation & air safety (when finished!)

Other GPS milestones

- 1989 – Magellan is the first to market with a hand-held navigation device
- 1990 – Selective availability is implemented
- 1995 – Full 27 satellite constellation is fully operational
- 2000 – Selective availability is shut off and applications using GPS explode!



Applications

What do we use GPS navigation for?

Applications



- Aviation
- Military
- Marine
- Recreation

- Others...

Aviation

- Commercial aviation
 - ▣ GPS devices that calculate location and feed that information to large multi-input navigational computers for
 - autopilot
 - course information and correction displays to the pilots
 - course tracking and recording devices

Military

- Military applications include devices similar
 - ▣ for foot soldiers (commanders and regular soldiers)
 - ▣ small vehicles and ships
- Devices similar to commercial aviation applications for aircraft and missiles

Marine

- Automatic Identification System (AIS)
 - unique identification, position, course, and speed
 - electronically exchanges data with other nearby ships, AIS base stations, and satellites
 - Integrates a standardized VHF transceiver with a positioning system such as a GPS receiver
 - Supplements marine radar
 - (which continues to be the primary method of collision avoidance for water transport)
- <http://www.marinetraffic.com/ais/>

Marine

□ Rescue

- imperative to have data on the position and navigation status of other ships in the vicinity.
- In such cases, AIS can provide additional information and enhance awareness of available resources
- To aid SAR vessels and aircraft in locating people in distress, an AIS-based SAR transmitter was added to Global Maritime Distress Safety System regulations effective January 1, 2010

□ <http://www.navcen.uscg.gov/>

Recreation

- Hiking

- <http://adventure.howstuffworks.com/outdoor-activities/hiking/compass-or-gps.htm>

- Sports

- Geocaching

Recreation

- Some golf carts are equipped with GPS displays
 - ▣ present a graphic image of the course
 - ▣ ability to zoom in on your present position and distance from the green
- Some units include fancy functions
 - ▣ display a trace (or track) of your entire "ballpath" for the round.



Recreation

□ Geocaching

- ▣ Free real-world outdoor treasure hunt
- ▣ Players try to locate hidden containers, called geocaches, using a smartphone or GPS
- ▣ The first documented placement of a GPS-located cache took place on May 3, 2000, by Dave Ulmer of Beavercreek, Oregon.
 - The location was posted on the Usenet newsgroup as $45^{\circ} 17.460' N$ $122^{\circ} 24.800' W$.

Mishaps

- Some people have gotten lost by asking for the shortest route
 - ▣ <http://www.ranker.com/list/9-car-accidents-caused-by-google-maps-and-gps/robert-wabash>
 - ▣ Other hazards involve an alley being listed as a street, a lane being identified as a road, or rail tracks as a road.

You can navigate with pretty much any of these....



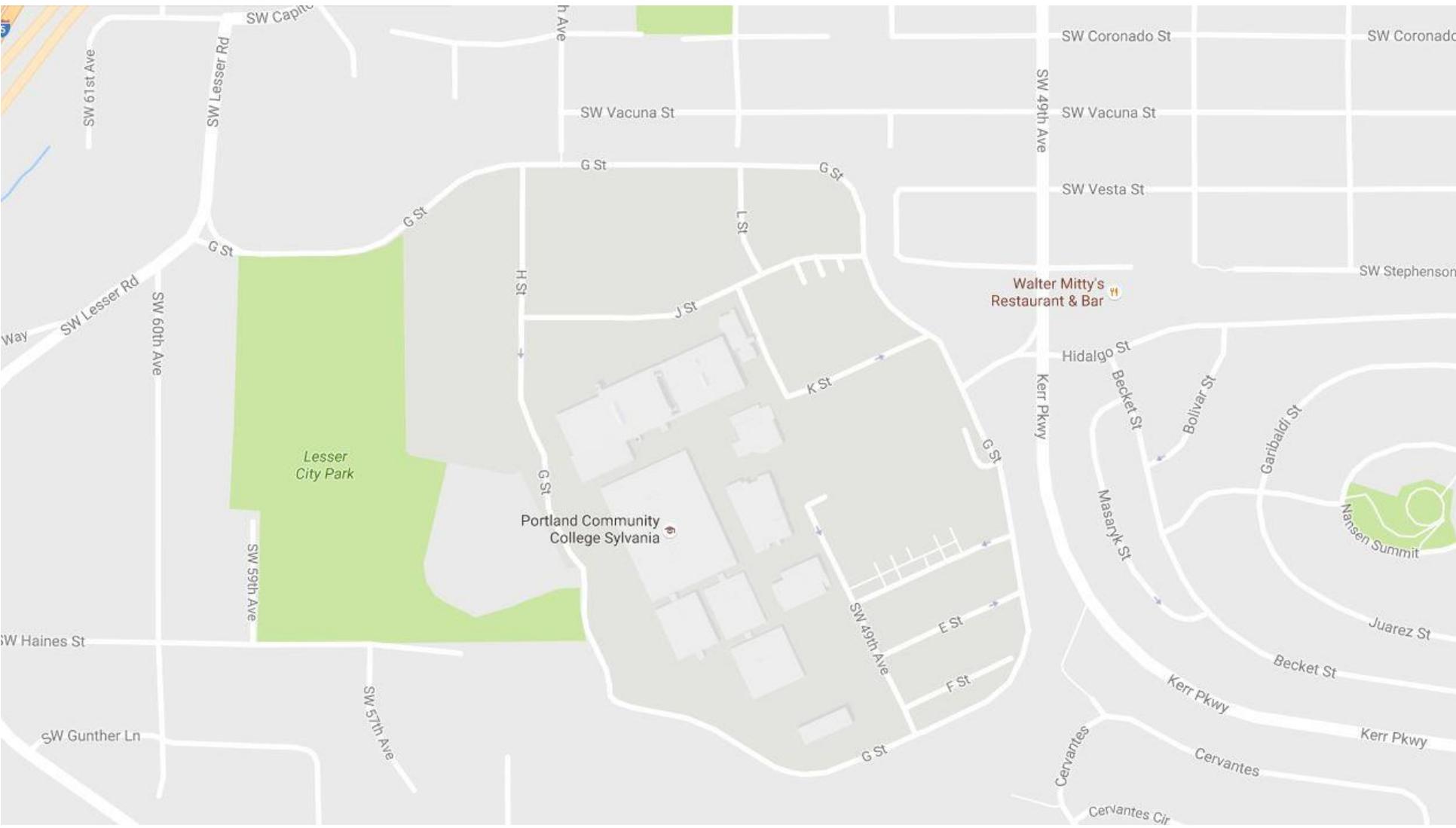


But how do we navigate?

But how do we navigate?

- Our location
 - ▣ How do we find ourselves?
 - ▣ Maps: You are here
- General direction
 - ▣ Compass-only navigation
- Destination routing
 - ▣ Combine our location with that of where we want to be to determine direction
 - ▣ Map + Compass

Our Location

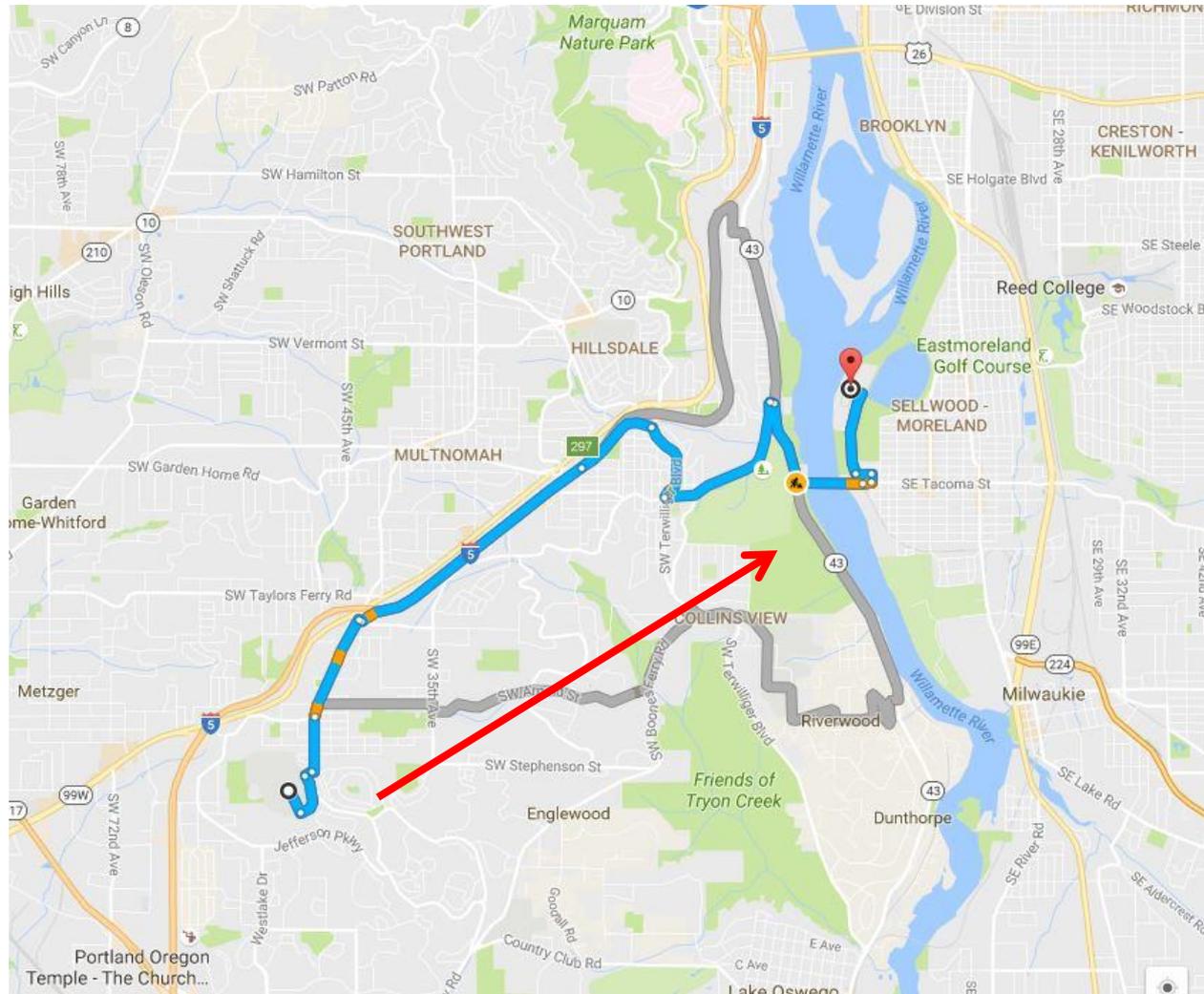


General Direction

- We're located on the earth
- Established cardinal directions



Destination Routing

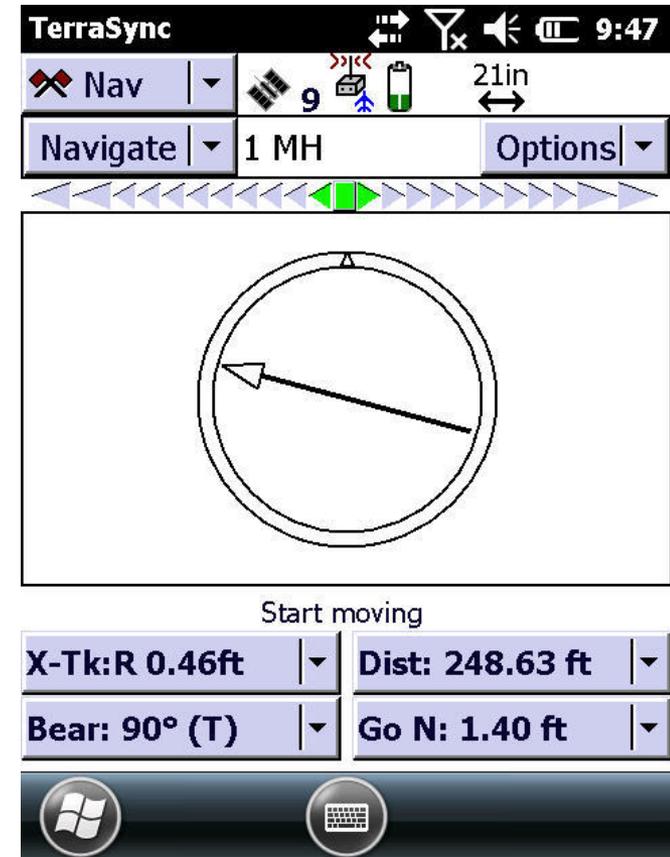


Navigation in TerraSync

- In TerraSync, Go to Data > Existing File and select the file you want to navigate to
 - ▣ Open it
- Go to Map and view your data
 - ▣ Tap a point to select it
- In the Options drop down, click Set Nav Target and select the name of the point you wish to navigate to
 - ▣ The symbol will change to two blue flags
- Then go to the Navigate Screen

Navigation in TerraSync

- In the Navigation Screen you'll see...
 - ▣ The arrow won't appear till you start moving
 - ▣ Follow the direction the arrow indicates
 - ▣ It will change as you walk
 - It won't pick up if you just rotate your body
 - It's looking for a track of motion



Navigation in TerraSync

- When you get close to your target
 - The Navigate Screen will change to look like this....
 - You are the X
 - Target will be labeled
 - If you have the sound on the unit will beep at you that you're close

