

The BOW GNSS Receiver Project

Alex Morrow Alex.Morrow@olin.edu

Ziyi Lan Ziyi.Lan@students.olin.edu

Franklin W. Olin College of Engineering

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INTRODUCTION TO GNSS CONCEPTS

GNSS: Global Navigation Satellite System

- A *system* employing *satellites* to provide *global navigation* information to users
- There are four GNSS systems
 - **Galileo** European Union (*fully deployed 2020*)
 - **BEI-DOU** China
 - **GLONASS** Russia
 - **GPS** US
- ***We'll describe GPS as an example of how GNSSs work***
- The GPS system is divided into three segments
 - **GPS Space Segment (SS):** 24+ Satellites
 - **GPS Control Segment (CS):** 16 sites
 - **GPS User Segment (US):** Half the world's population?

GPS Technology Basics

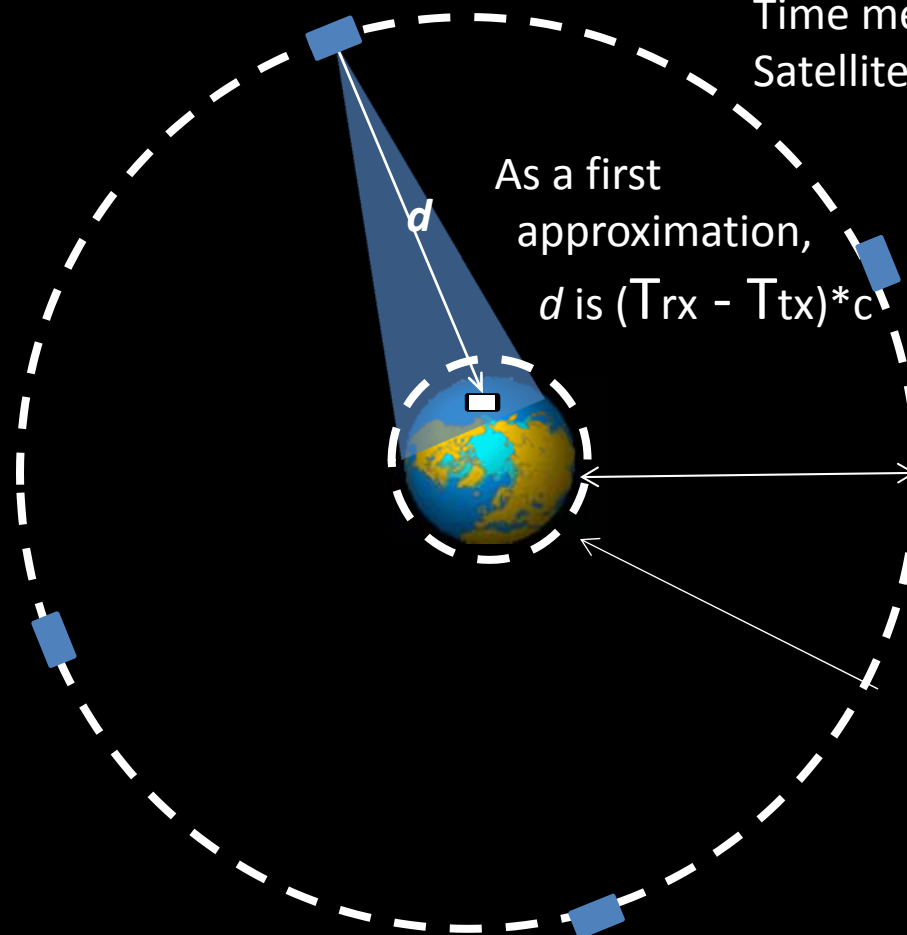
Six orbits, four satellites in a each

GPS Receiver

1. Determines time it received message (T_{rx})
2. Uses satellite's T_{tx} to determine distance d from receiver to satellite
- 3 Combines d from at least 4 satellites to determine:

Latitude
Longitude
Altitude

Each satellite has a schedule for broadcasting messages containing
Satellite identity,
Time message transmitted (T_{tx})
Satellite's precise location at T_{tx}



GPS Satellite orbit
22 000 kilometers
(14 000 miles)

Hubble and ISS orbits:
~400 kilometers
(250 miles)

THE BOW GNSS RECEIVER PROJECT

Existing GNSS Receiver Types in 2014

Surveying

Self-driving tractors

Undergraduate Research

Find way home



Missing Link!

Opportunity For BOW President's Fund Project



\$20K+	\$2K	Price	\$20
Centimeter ½ inch	Decimeter 6 inches	Accuracy	Ten meters 30 feet

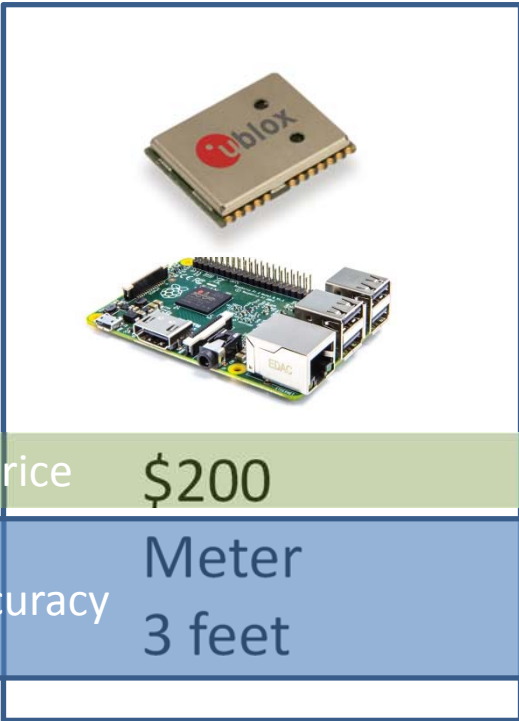
Way too expensive

Too expensive

Inadequate Technology

Existing GNSS Receiver Types in 2014

Surveying	Self-driving tractors	Undergraduate Research	Find way home
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\$20K+	\$2K	Price	\$200	\$20
Centimeter ½ inch	Decimeter 6 inches	Accuracy	Meter 3 feet	Ten meters 30 feet

BOW GNSS Receiver Idea

Way too expensive

Too expensive

Just right

Inadequate Technology

BOW GPSS Receiver Goals

- Primary goal:
 - Actual shared technology between BOW colleges
 - Education about shared technology (here you are!)
- GPSS Receiver Objectives:
 - Low Price (about \$200 for whole receiver)
 - High Accuracy (looking for 1M accuracy)
 - Useful on all BOW campuses
 - Easy to adapt to different project types
 - Makes new technology available as soon as possible
 - Architectural design
 - Projects independent of GNSS technology changes

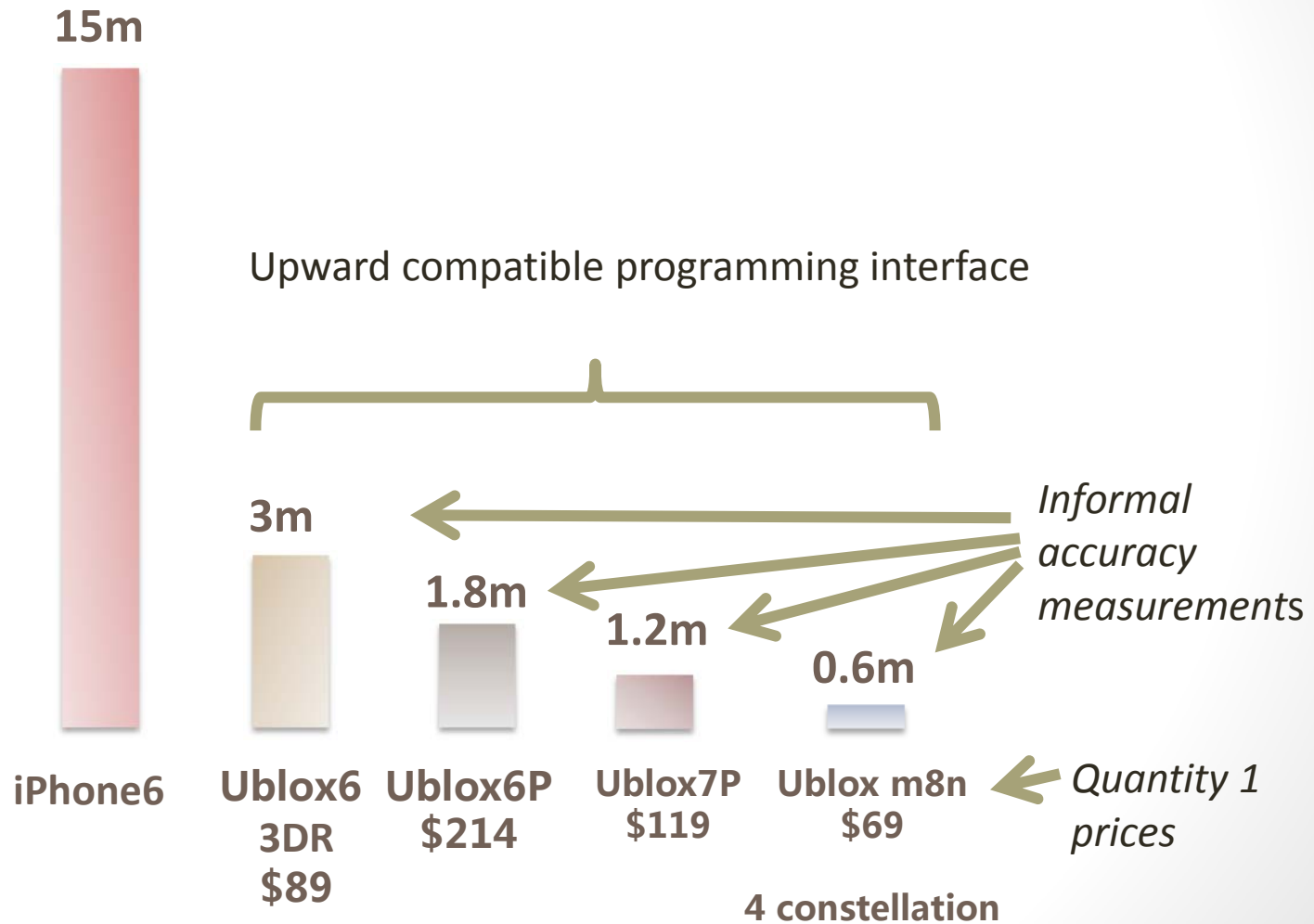
BOW GNSS Receiver technology search

Chosen for initial technology testing



u-blox GNSS chip

informal sanity testing



GNSS Receiver Application

Olin College Team Sailing Project

Navigation system to let competitive blind sailors be more autonomous.



**First on-water BOW
GNSS Receiver Test**

**Olin College Research
Boat Sailing in Charles
River Basin**

August 14, 2015

Cooperation with Wellesley

- Working with Prof. Katrin Monecke, Wellesley Department of Geosciences
GNSS Receiver appropriate for Bathymetric research
(How deep is the ocean?)
- Focus is for altitude (Z) accuracy
 - Harder than X/Y

Nice to talk to you!
Jason and Alex

Bibliography

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