

GPS Basics & Integration with Asset Management

Presenter: Doug Kotnik, GISP
Precision Laser & Instrument Inc.



Doug Kotnik, GISP

- 30+ Years in GIS / Mapping
- 13 Years with PLI (MGIS Sales for Ohio)
- Former GIS Coordinator
- Experience in GPS/GIS integration

PRECISION LASER AND INSTRUMENT IN OHIO



- Toledo
- Cincinnati
- Columbus
- Akron



GPS BASICS

GPS: (Global Positioning System)

Managed by the USAF

Min SV's: 24

Current SV's: 32+

Real-Time Accuracy

10-15m



GLONASS

Russian Space Forces

21+ SV's

Real-Time Accuracy

-approx 4.5-8.5m

(7+SV's)

Other Systems

Galileo – European Union

COMPASS – People's Republic of China

IRNSS – India

QZSS – Japan

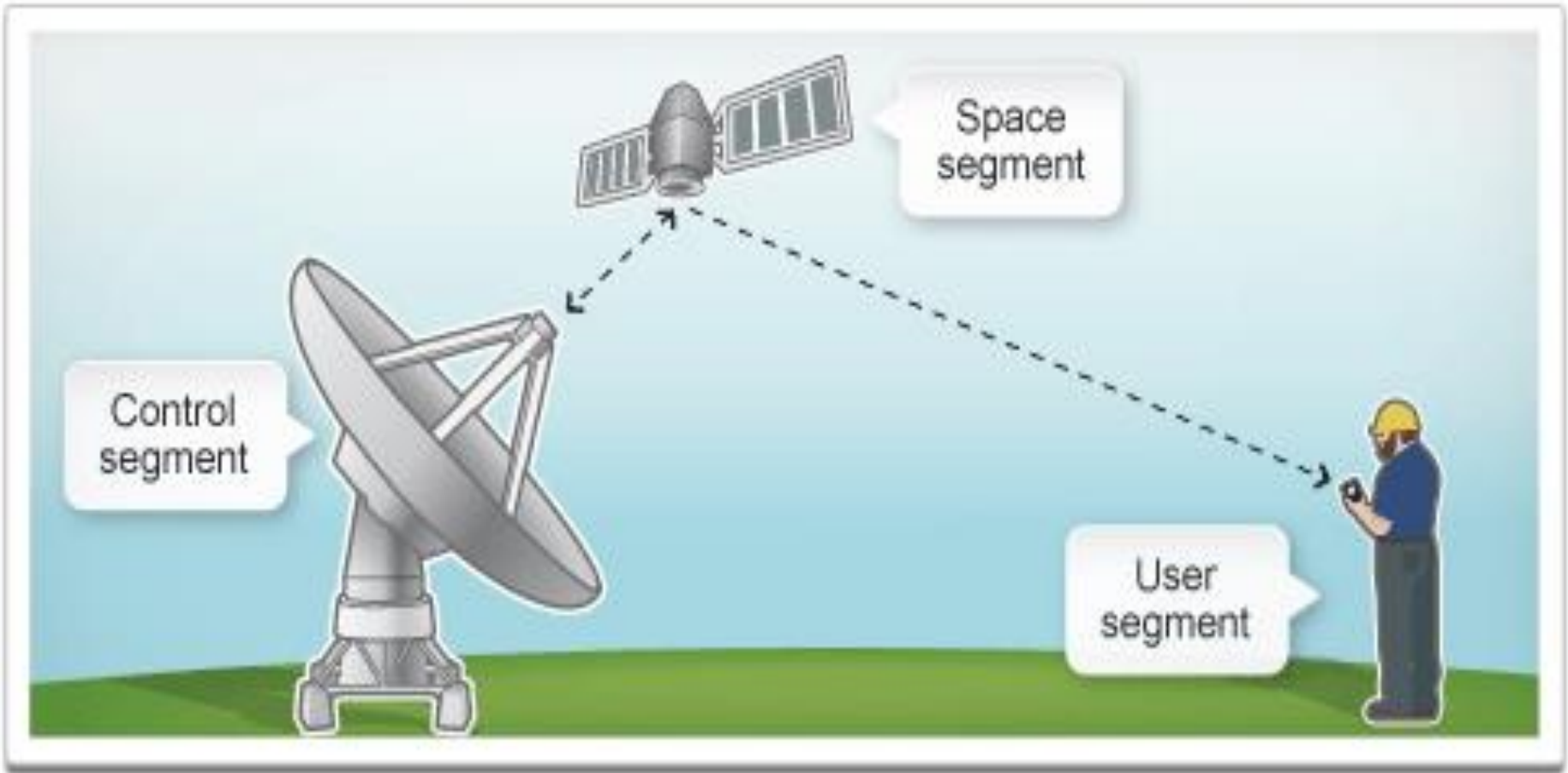
Put them all together...

90+ total

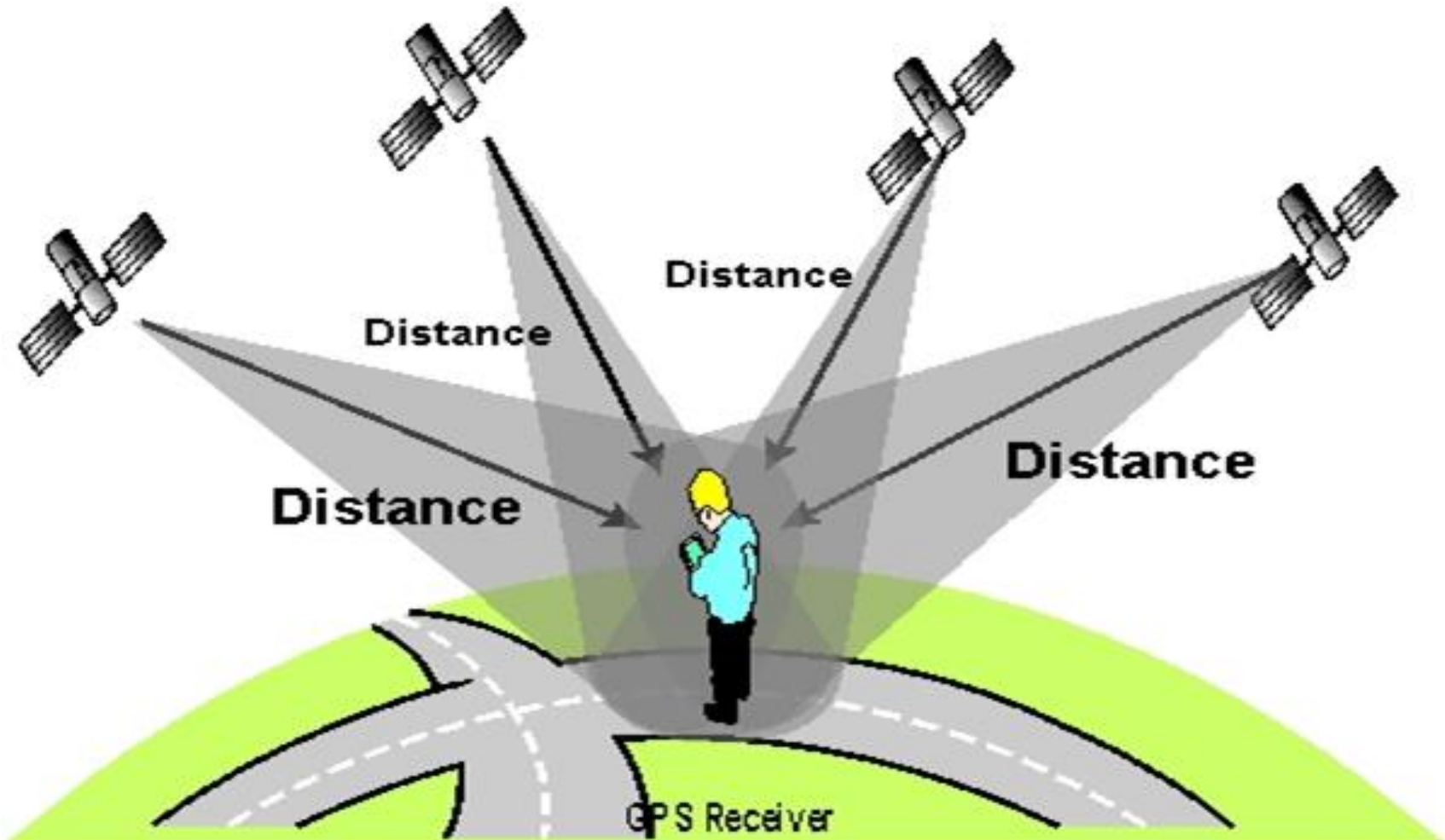
GNSS (Global Navigation Satellite System)

More is better!

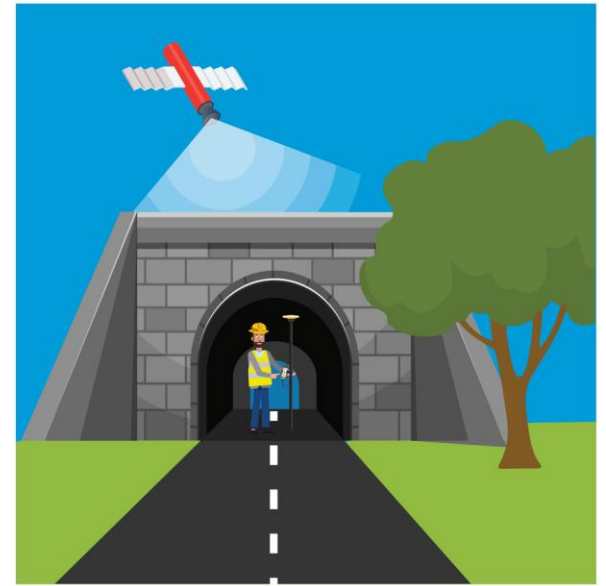
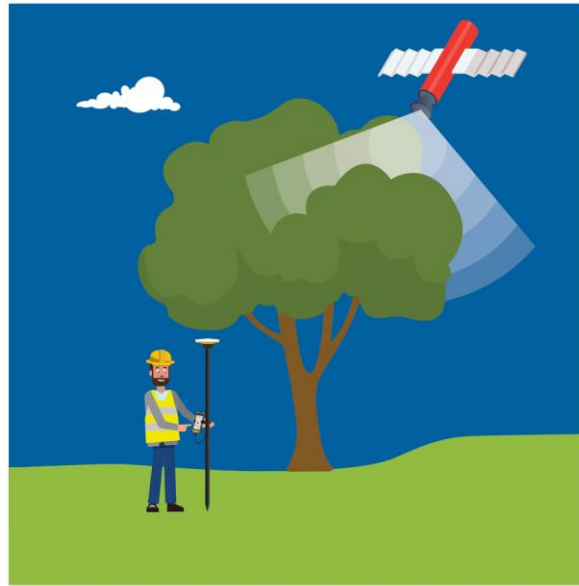
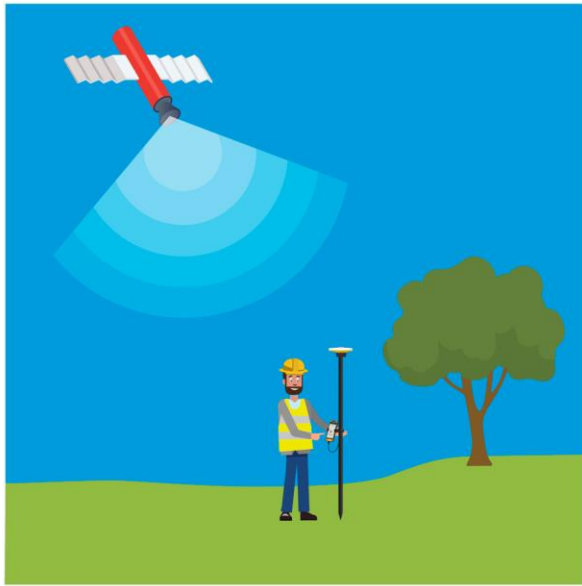
GNSS Segments



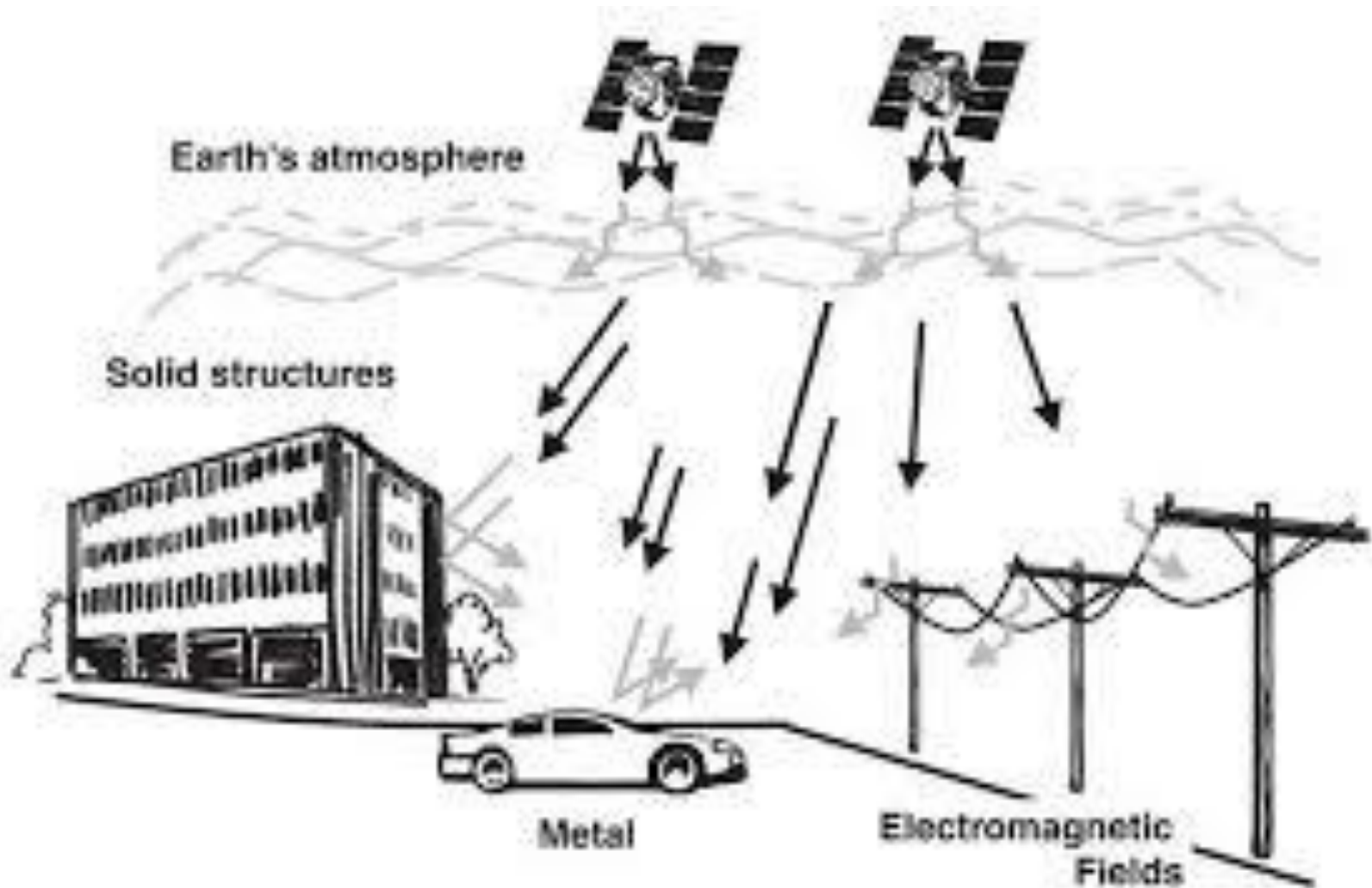
It's All About Distance and Time



It's All About Distance and Time



Sources of Error

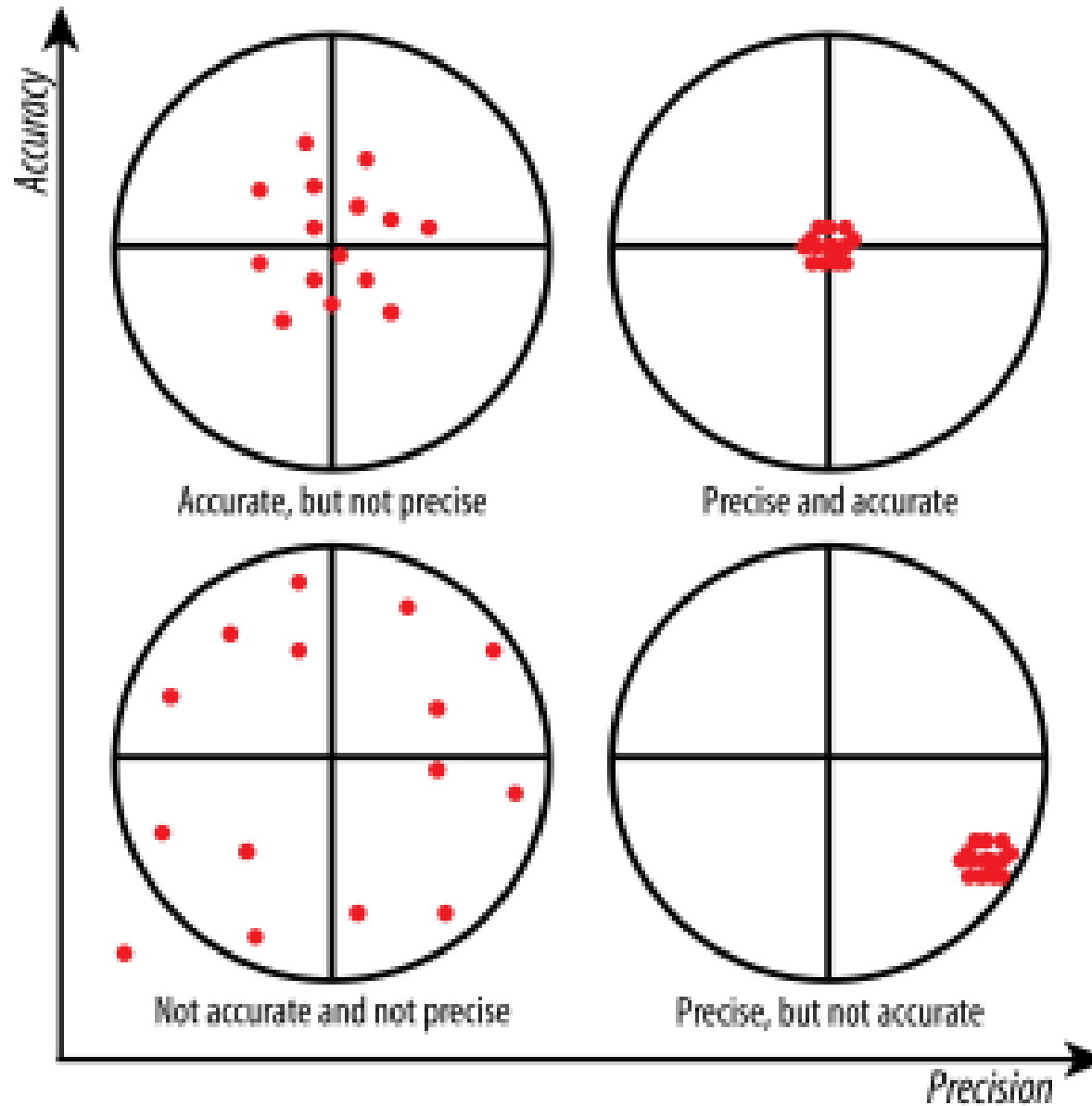




GNSS Accuracy vs Precision

Accuracy: how close a measured value is to true value

Precision: how close measured values are to each other





Horizontal Accuracy

Levels of Accuracy

Commercial

- Raw GPS signal
 - 10-15 meters
- Location Services
 - 8 meter

Mapping

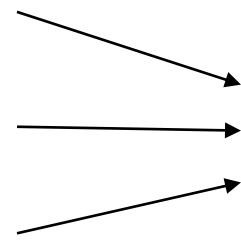
Sub-Meter

Sub-Foot

Centimeter

Real Time

Post Processing



- Location Services
 - Smart devices
 - Assisted GPS
 - Satellites
 - WiFi
 - Cell Towers
 - Determine Location Quickly

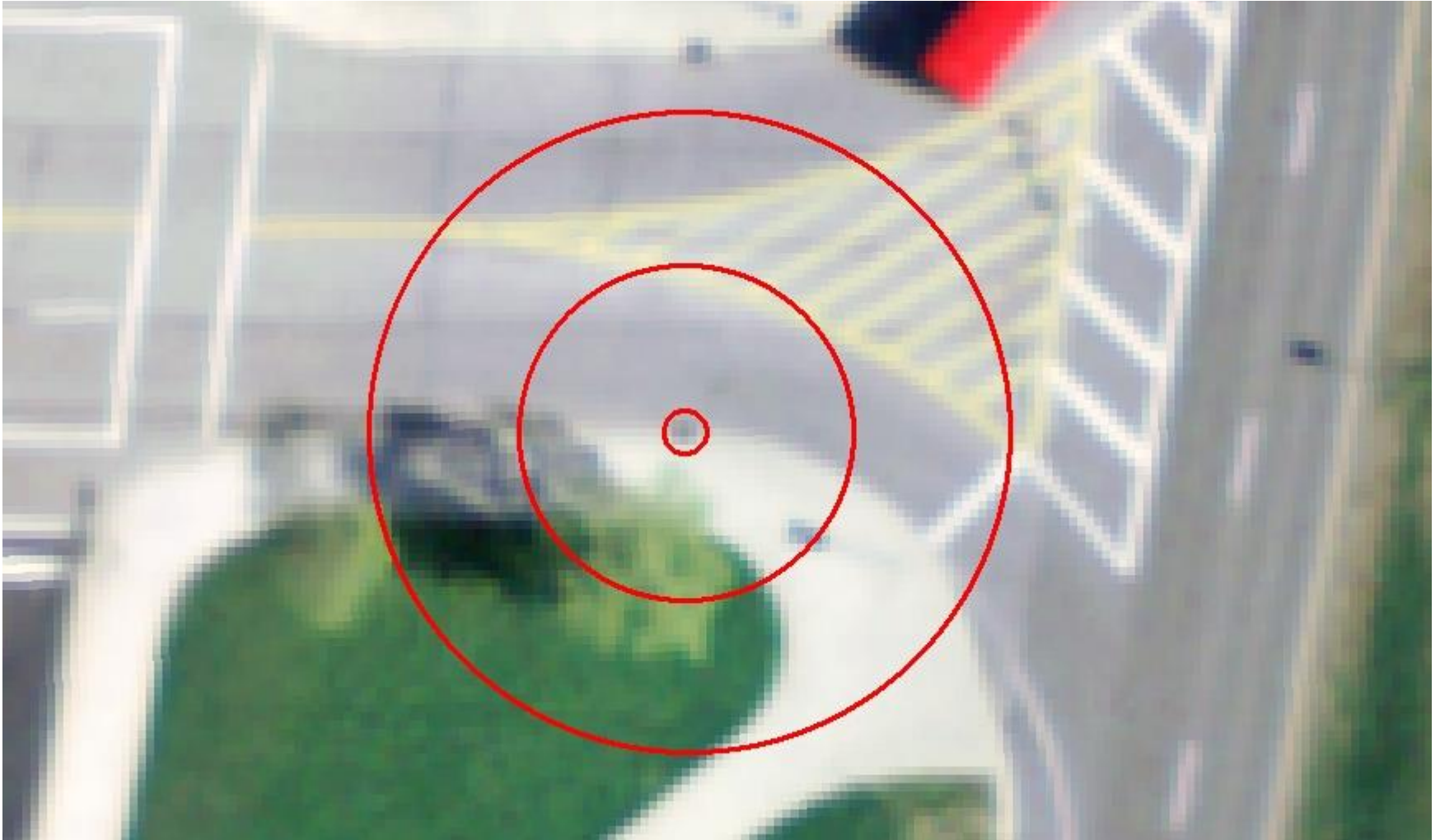
15 meter Accuracy (Raw GPS)



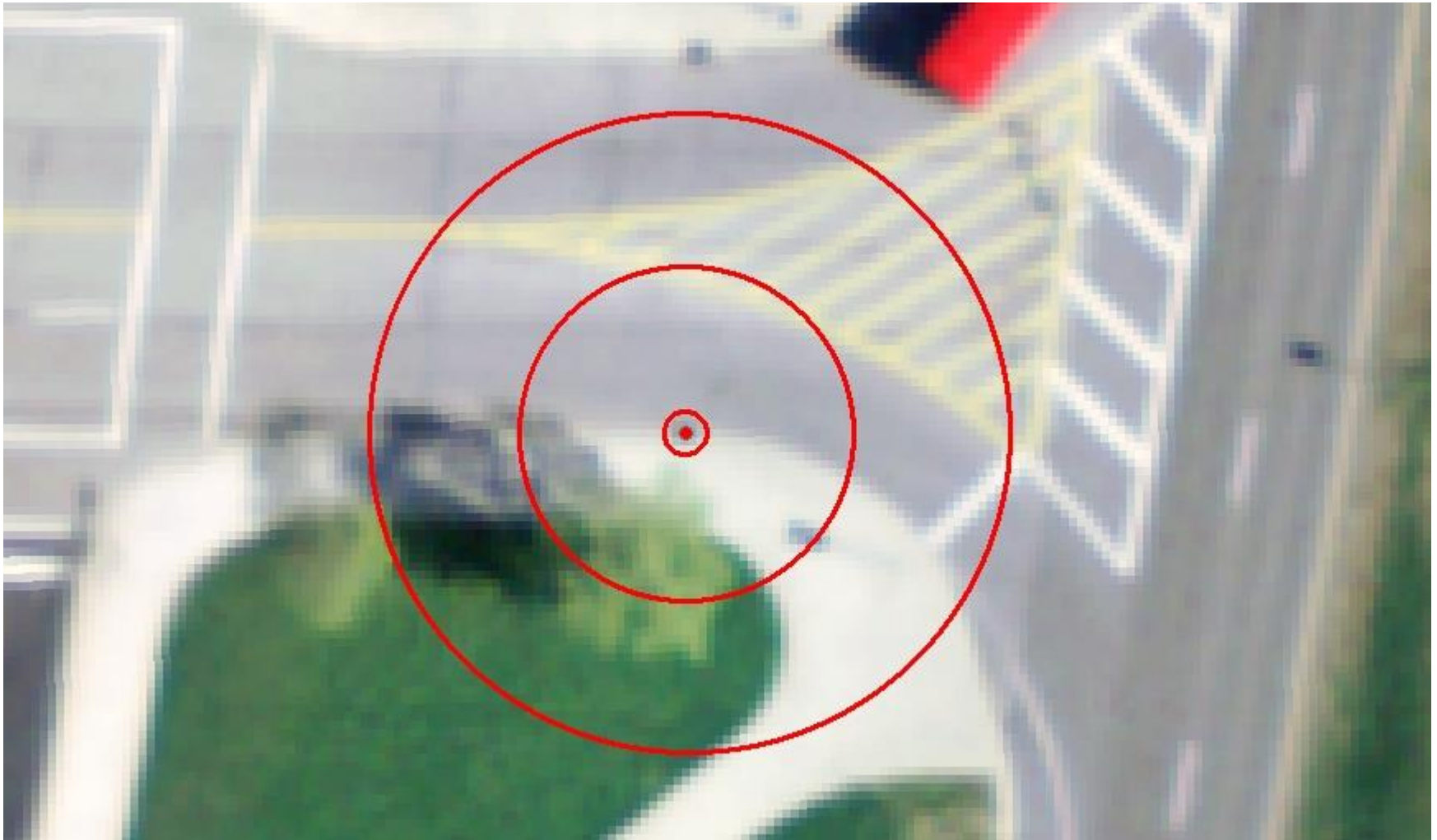
8 meter Accuracy (Location Services)



1 meter Accuracy

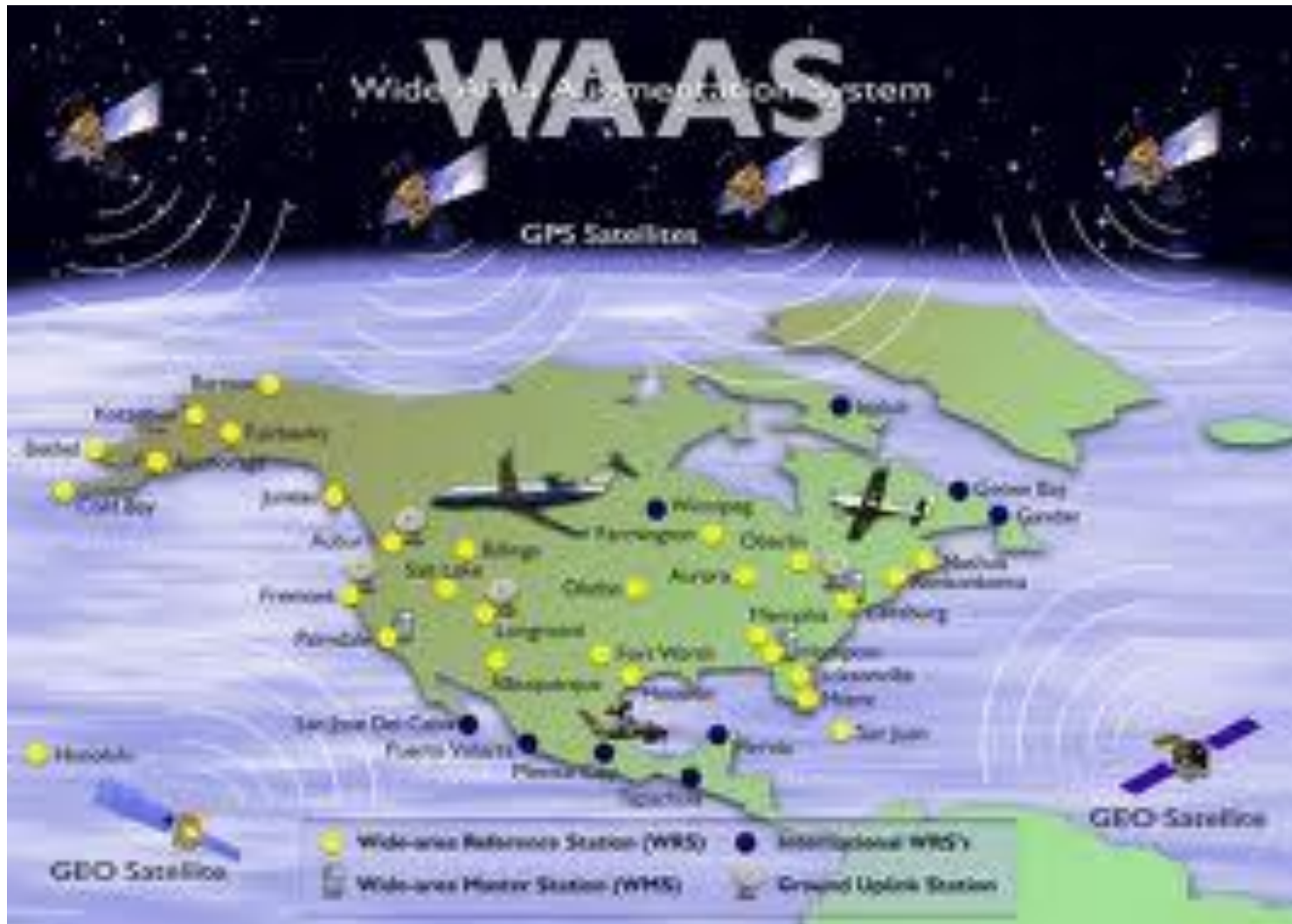


1 foot Accuracy



- Real Time
 - SBAS (WAAS: Wide Area Augmentation System)
 - Designed for aircraft navigation
 - No internet connection necessary
 - Free
 - < meters accuracy typically

- Real Time (WAAS)



- Real Time
 - VRS (Virtual Reference Stations)
 - Operated by ODOT
 - Tracks both GPS (US) and GLONASS (Russian)
 - Requires an internet connection
 - Free

- Real Time
 - VRS (Virtual Reference Stations)
Ohio

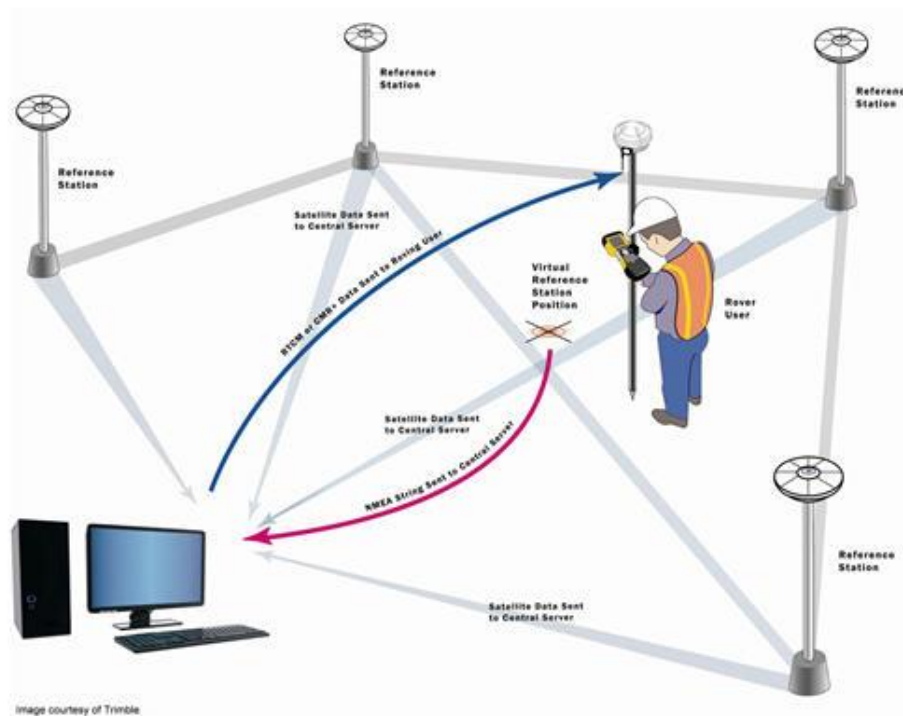
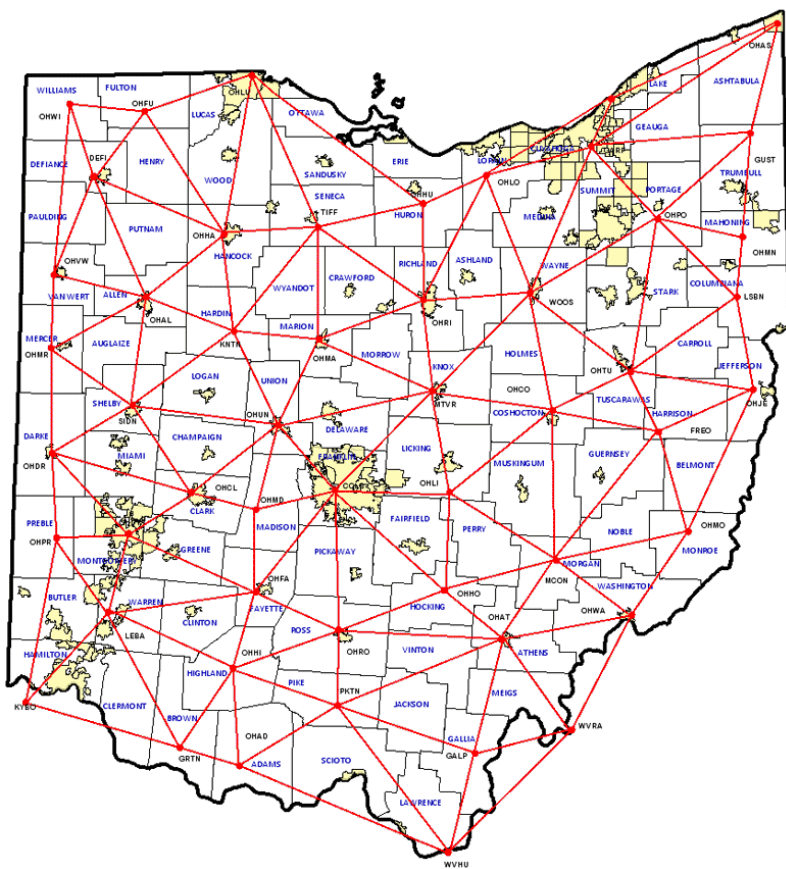
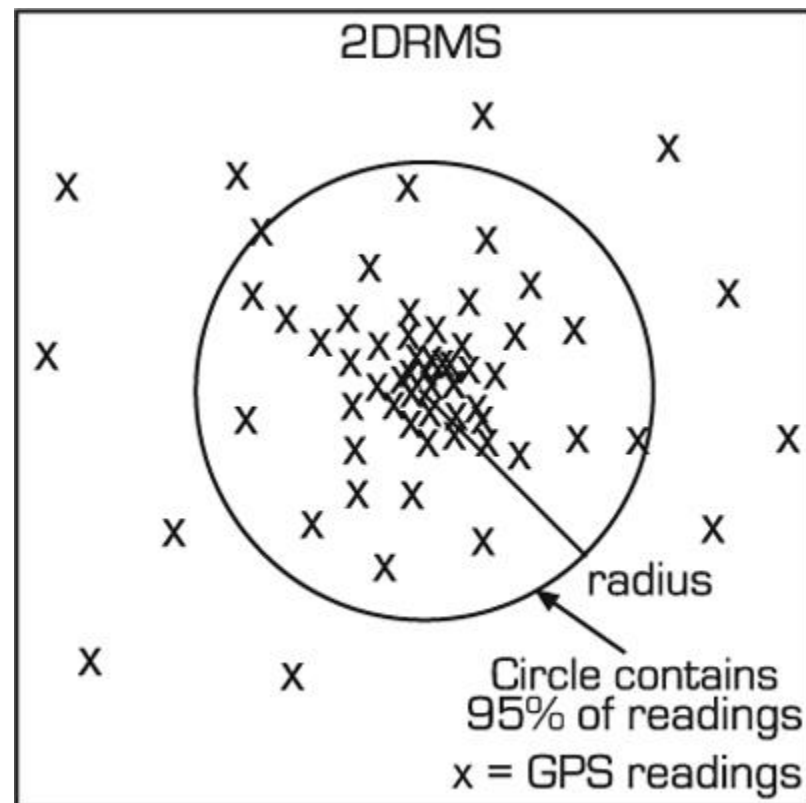
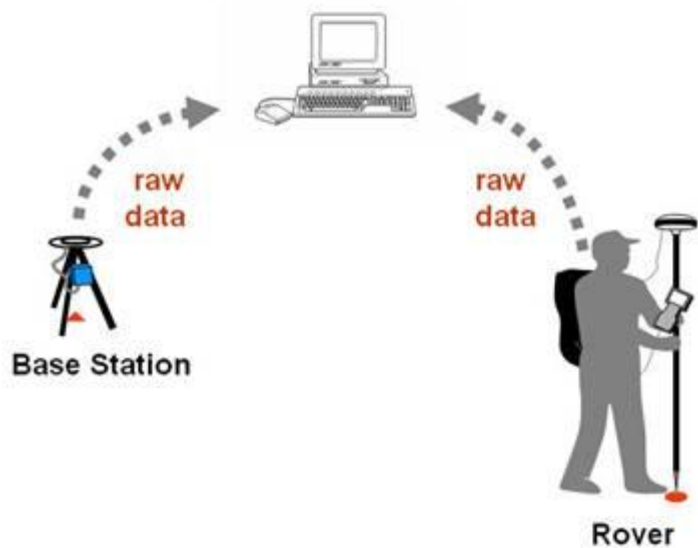


Image courtesy of Trimble

- Real Time
 - Satellite Delivered Correction Services
 - No Internet connection required
 - Ideal for remote environments
 - Not limited by state locations
 - Subscription required

- Post Processing





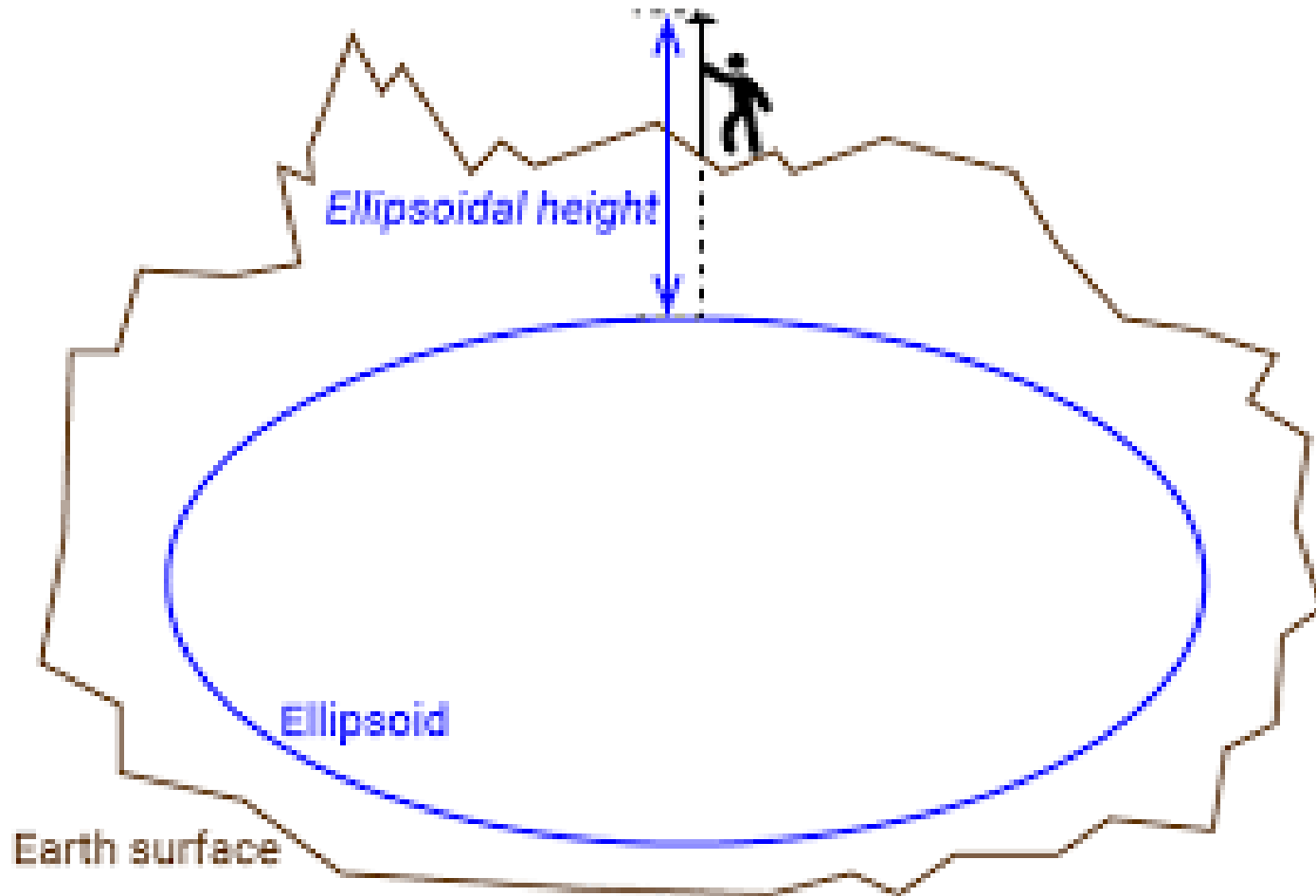
Vertical Accuracy

Vertical Accuracy / Elevation

- Key Terms

- **(HAE) Ellipsoid:** A mathematical representation of the Earth as an oval
- Geoid: a locally calculated geometric representation of the actual physical shape of the earth.
- Orthometric Height: the practical elevation that tries to describe the heights of points on the earth's surface

HAE (Height Above Ellipsoid)

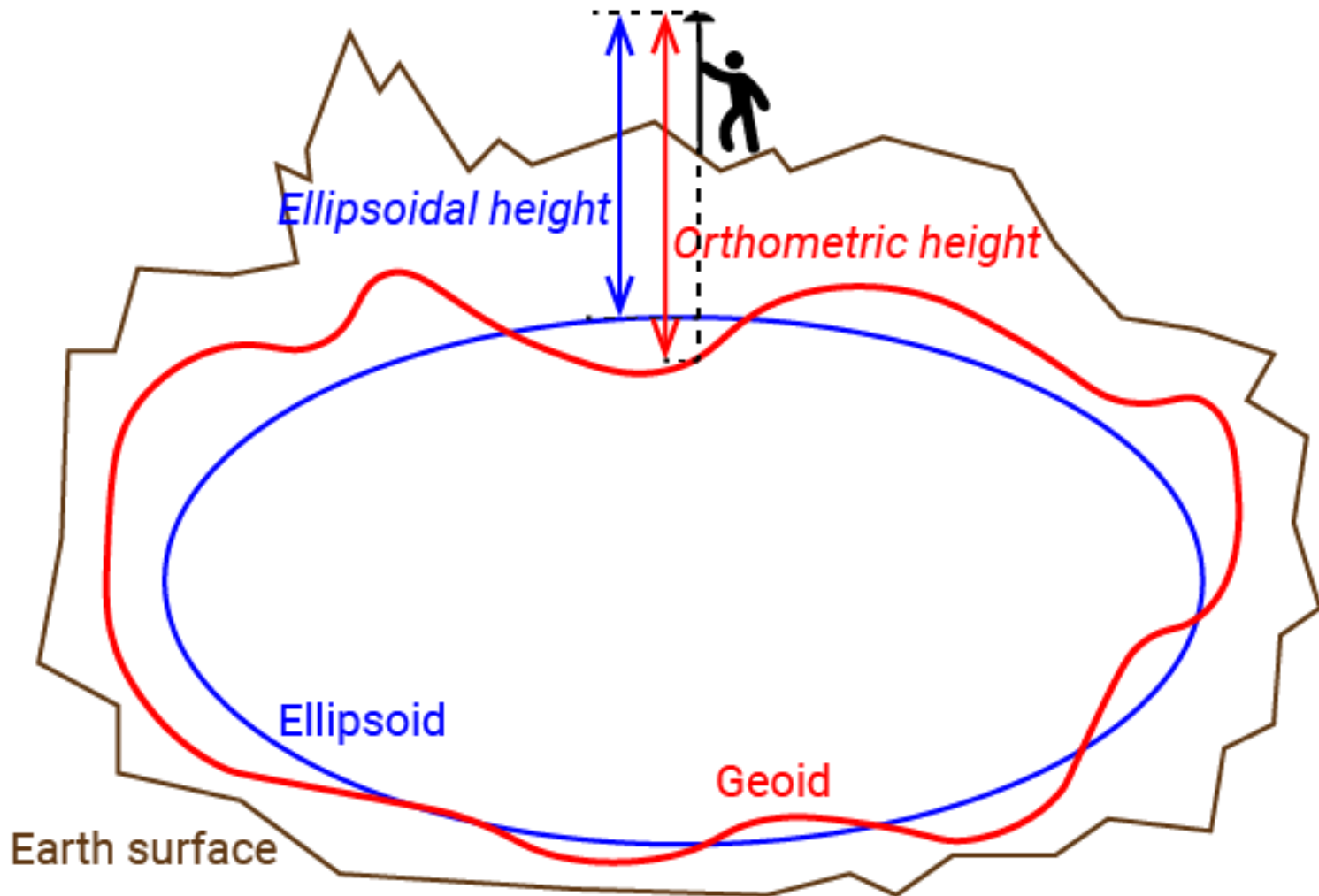


Vertical Accuracy / Elevation

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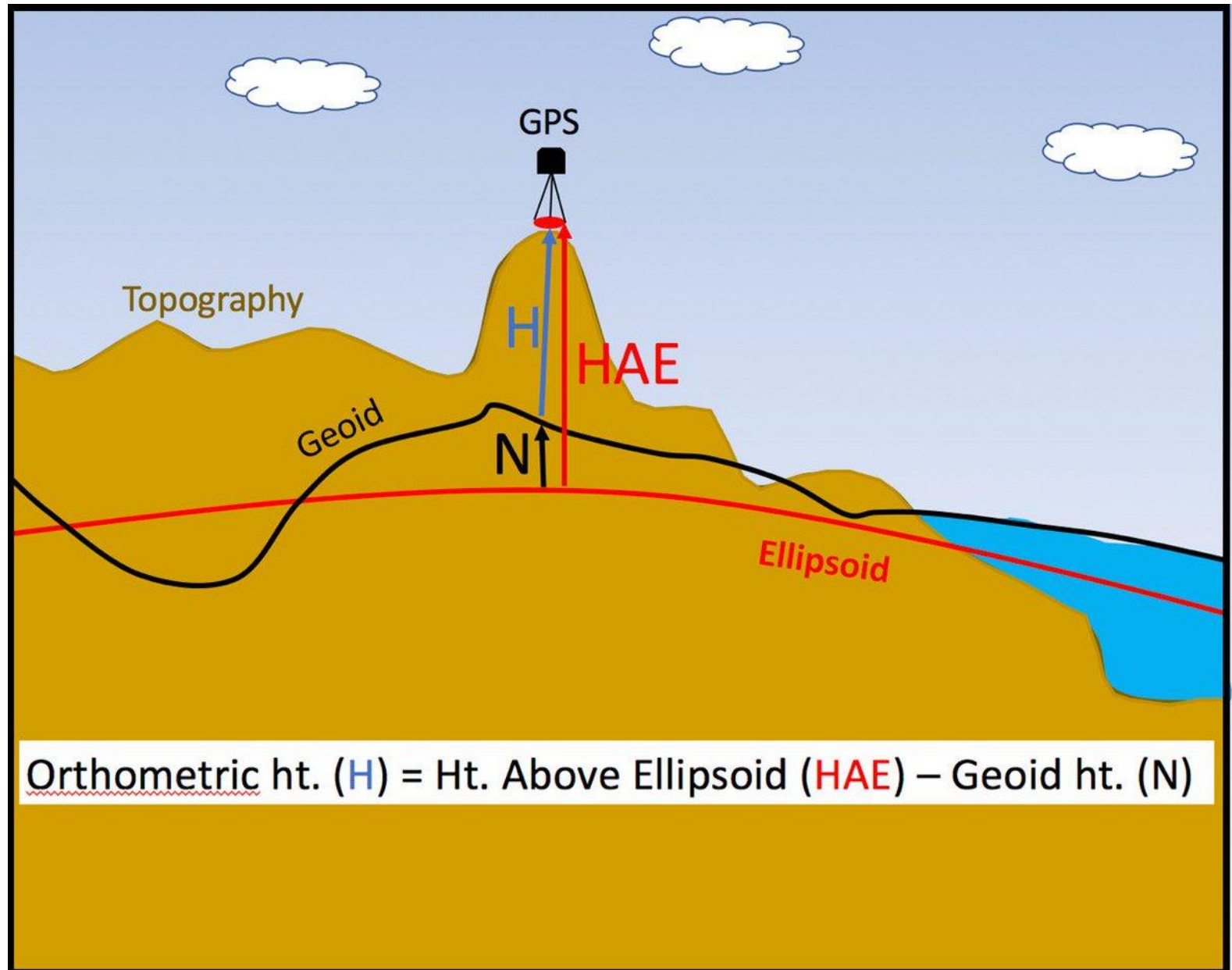
Geoid



Vertical Accuracy / Elevation

- Key Terms

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- Geoid: a locally calculated geometric representation of the actual physical shape of the earth.
- **Orthometric Height:** the practical elevation that tries to describe the heights of points on the earth's surface (pole height)





Integration with Asset Management

Integration with Asset Management

Tablet / Phone (Stand-alone GPS)

VS

All-In-One Handheld

- Convenience
- Ruggedness
- Platform
- Security
 - Find my Android
- Power usage



Integration with Asset Management

- Platform
 - Android
 - iOS
 - Windows



android



Integration with Asset Management

- Software for data collection
 - IAMGIS
 - ESRI
 - QGIS





Next Generation GNSS

New GPS Signal

- L1 Signal
 - Oldest
 - Available on most GPS devices
 - Slow and most prone to distortion
- L2 Signal
 - Lower frequency
 - Travels better through trees, clouds
 - Military and Civilian portion

New GPS Signal

- L5 Signal
 - Higher frequency
 - Transmitted with more power
 - Indoors and autonomous vehicles

Questions

Doug Kotnik

dpk@laserinst.com

614-588-7085