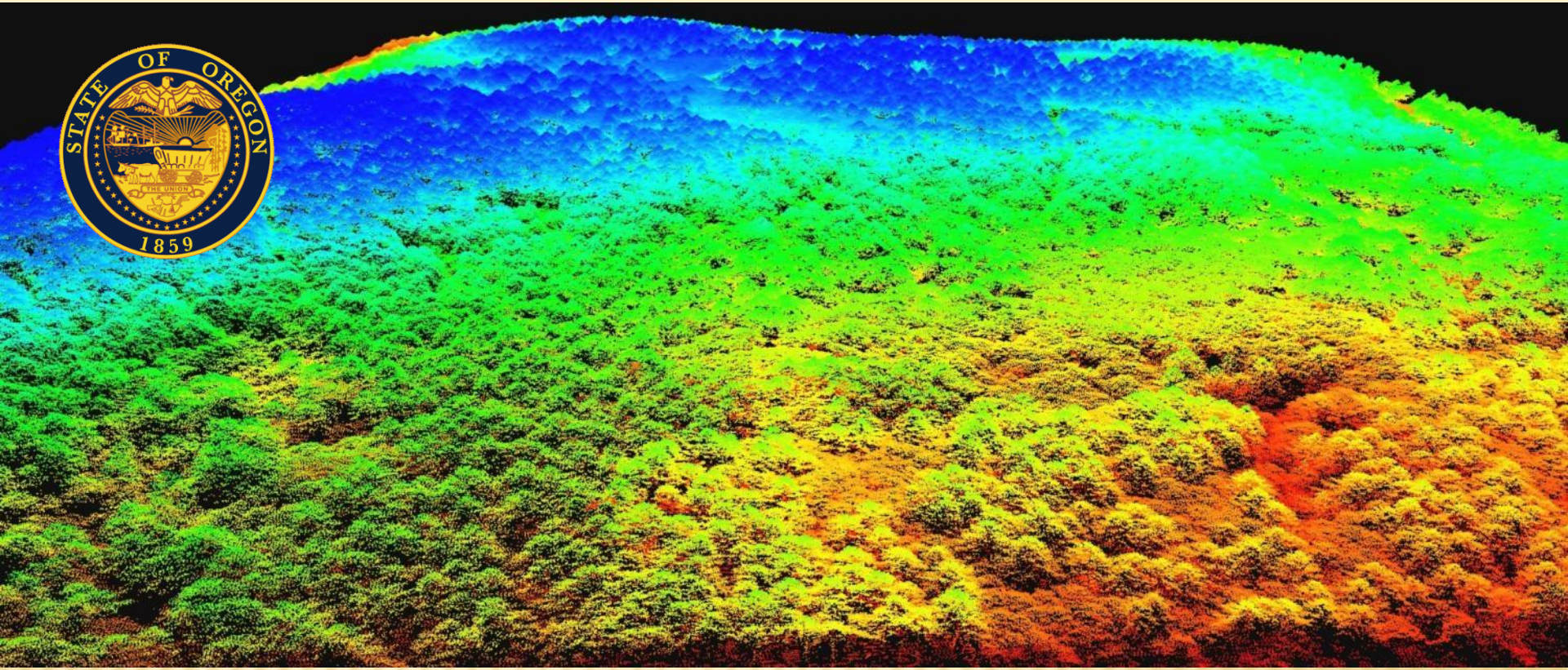


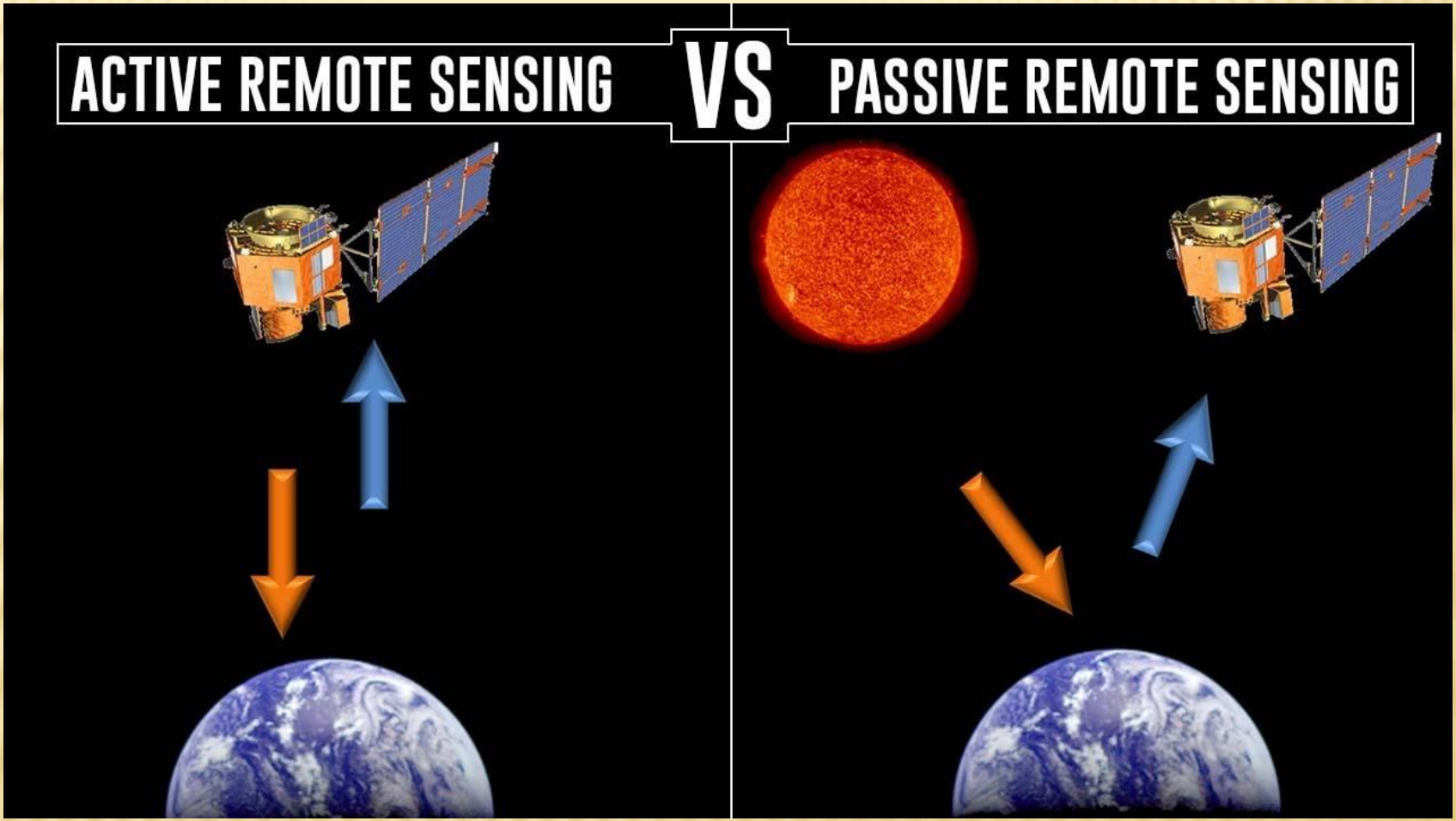
REMOTE SENSING POWER HOUR

JON RAWLINGS, PLS
CHRISTOPHER GLANTZ, PLS
Oregon Department of Transportation

REMOTE SENSING

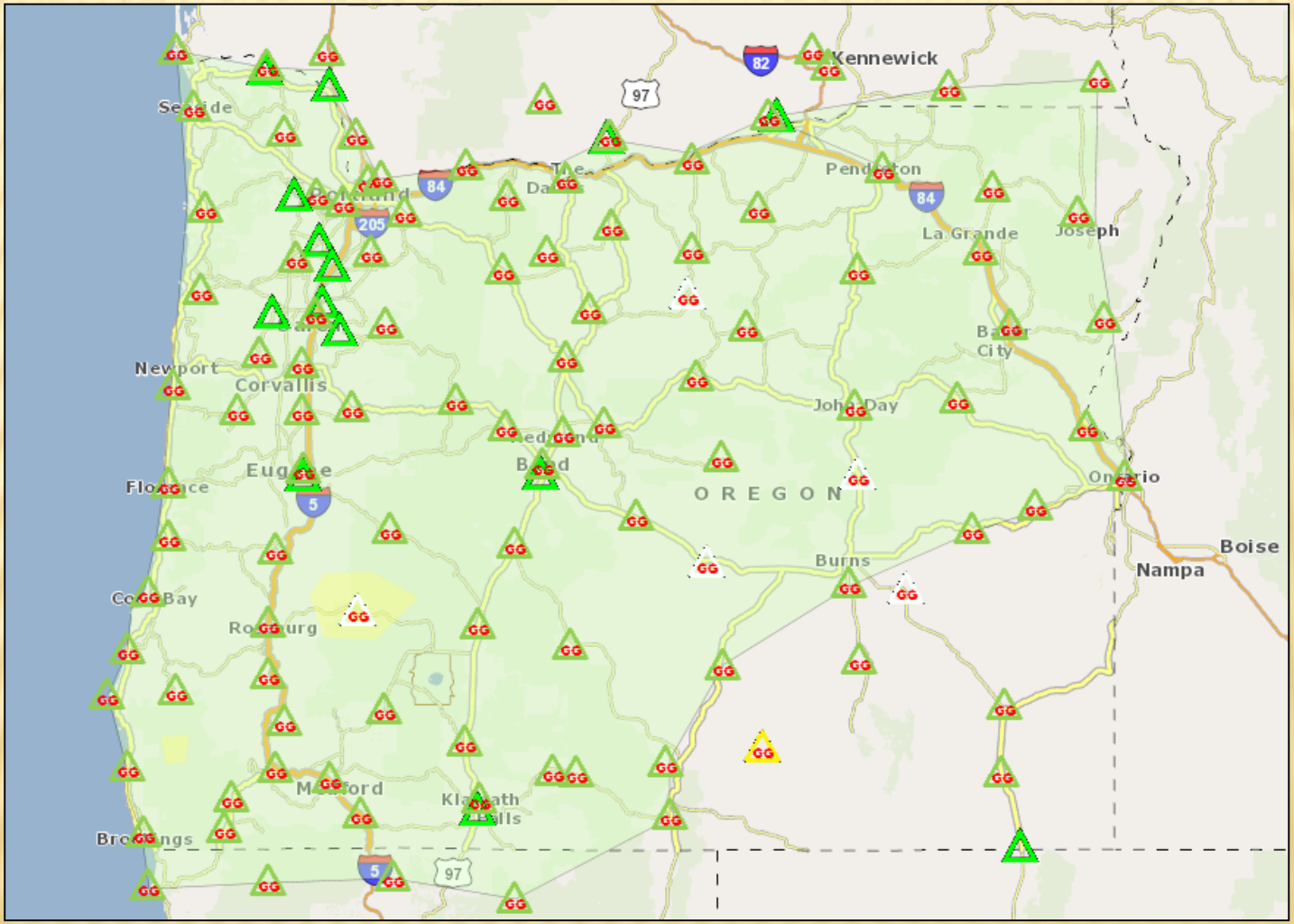
"…is the acquisition of information about an object or phenomenon without making physical contact with the object and thus in contrast to on-site observation, especially the Earth."

PASSIVE AND ACTIVE SENSORS



Source:
Sharma, Geospatial World 2018

GNSS IN REMOTE SENSING



GNSS IN REMOTE SENSING

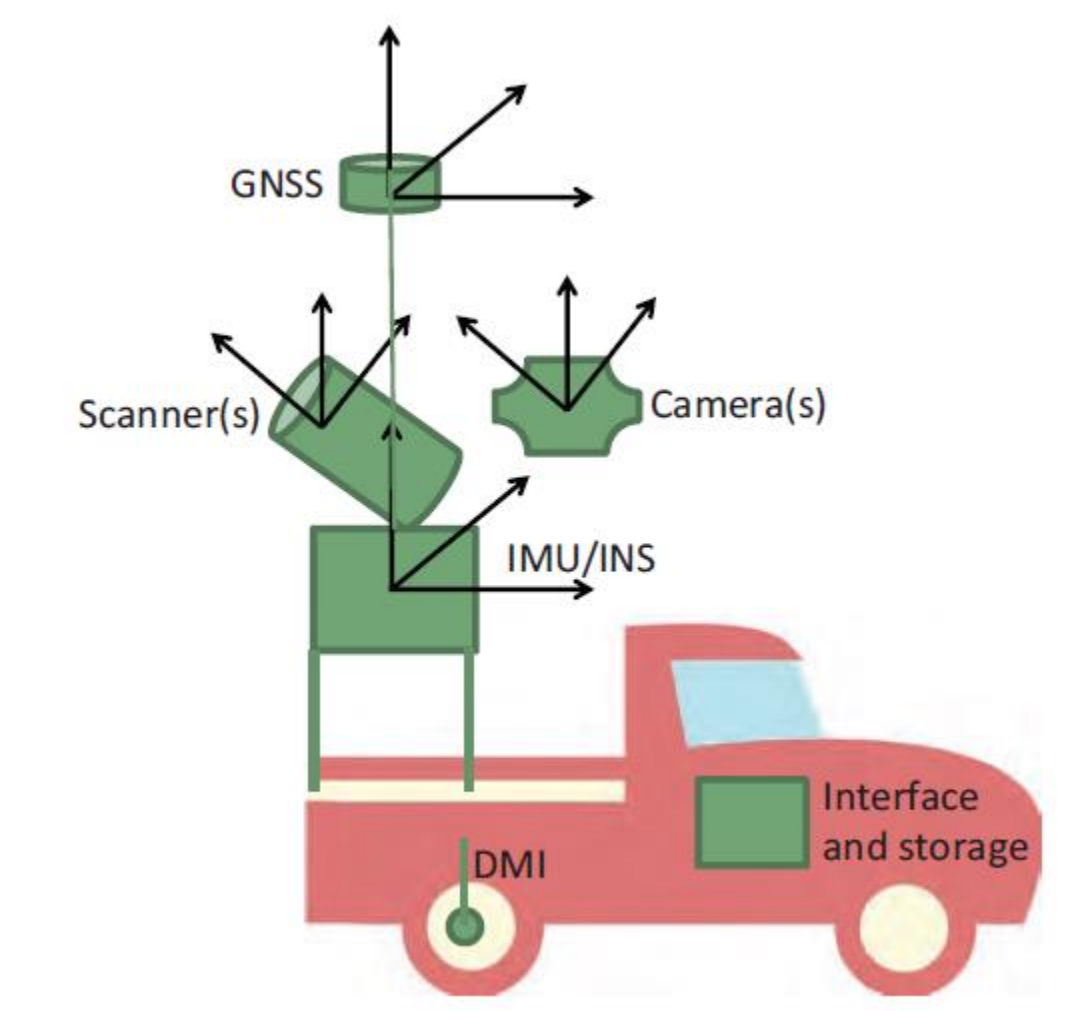
- Static
  - Base for RTK
  - Base for georeferencing
    - ORGN/CORS
    - Local base
  - Ground Control Points (GCP)
- Real-Time Kinematic (RTK)
  - Ground Control Points (GCP)
    - Lidar constraint marks
  - Photogrammetry Premarks/Air Targets
  - Survey Control
  - Confidence (QC) Points
- Post-Process Kinematic (PPK)
  - Geopositioning of aerial imagery

MOBILE SCANNING

MOBILE SCANNING

MOBILE SCANNING

Mobile Lidar System – Typical Components

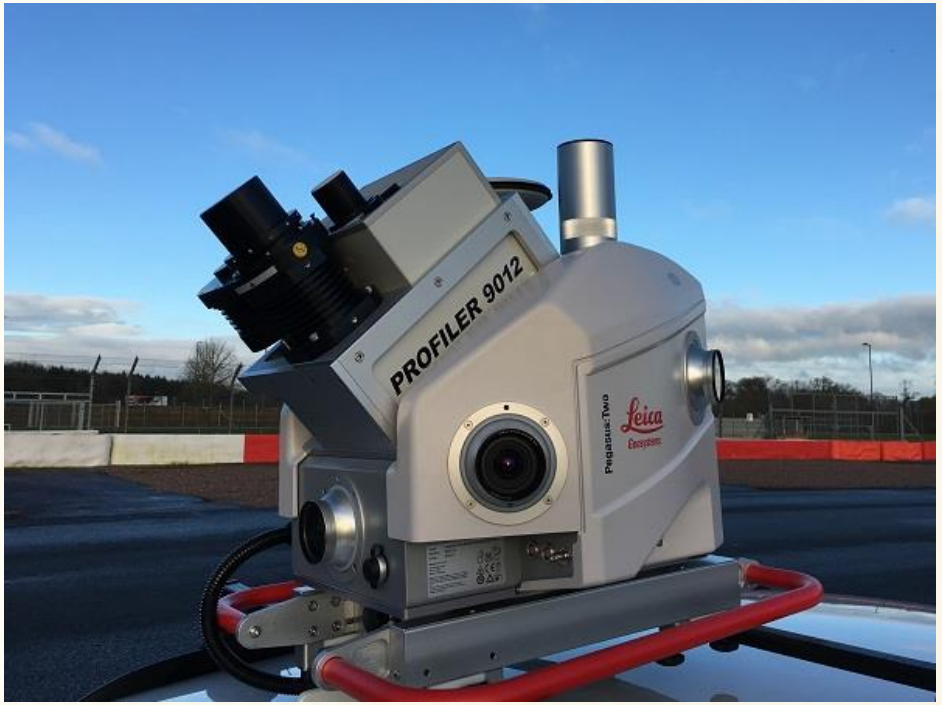


Source:
NCHRP Report 748

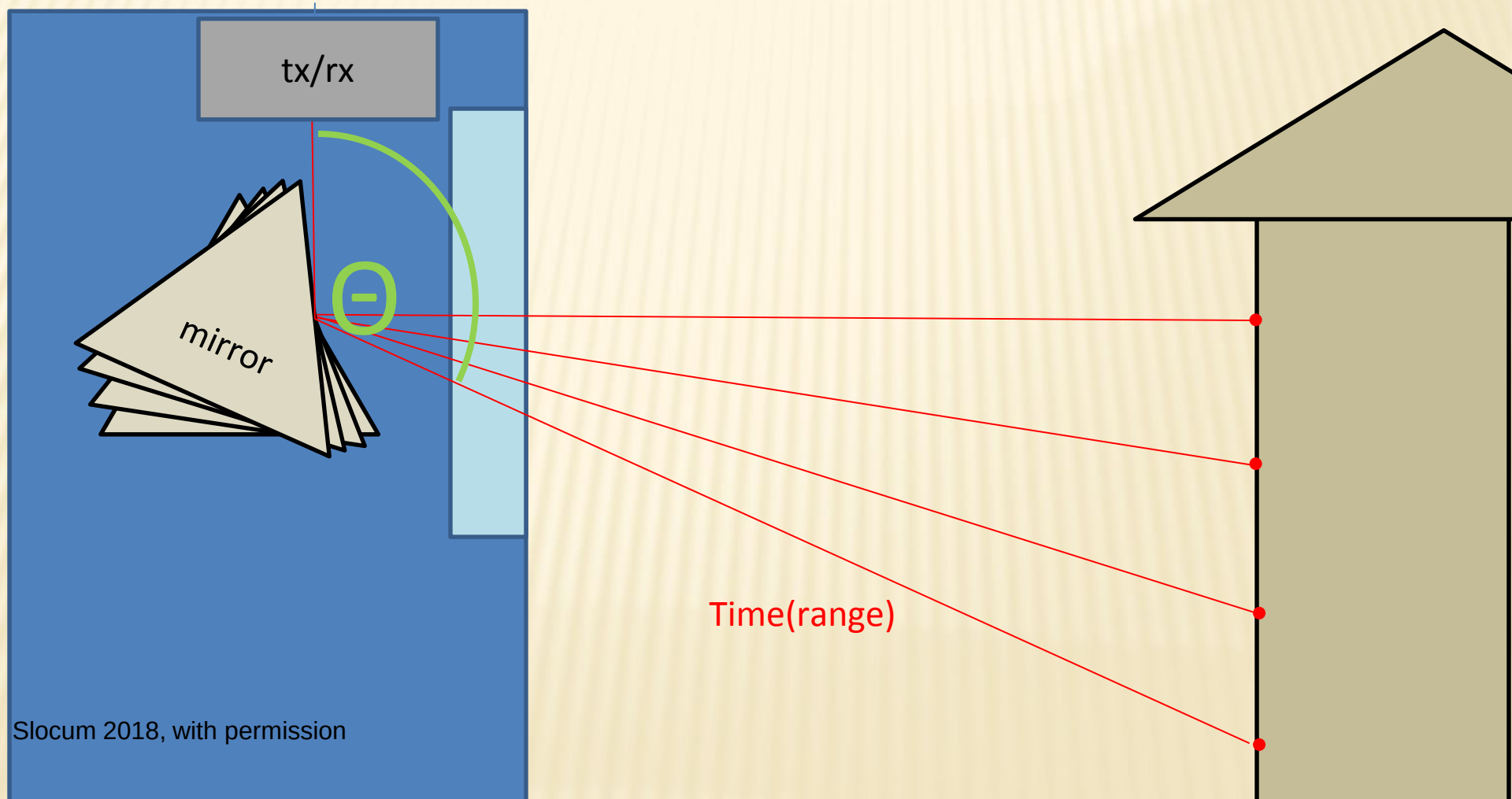
Laser Scanner(s)

Fires laser pulse at fixed angular rates to range objects

- Active sensor
- Phase-based or Time of Flight (ToF)
- Collects range, angular measurement, and time
- Single or multi-return
- Collect data at 200 Hz



Lidar



Slocum 2018, with permission

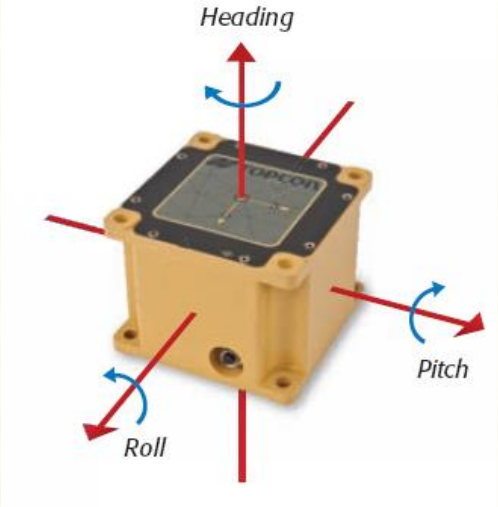
GNSS

GNSS receiver delivers the absolute position information to the system

- Absolute Position (Latitude, Longitude and Altitude)
- Multi-constellation (although only utilizing GPS and Glonass currently)
- Multi-frequency (L1/L2)
- Collect data at 1 – 10 Hz (1 to 10 measurements/second)
- Post Processed Kinematic (PPK)
  - PPK baseline length <30 miles, although <10 miles for best quality data
  - ORGN, CORS, or local base for static base
  - PDOP < 5

Image Source:
Novatel

IMU



IMU (Inertial Measurement Unit) supplies accurate attitude data for the system and estimates position estimation

- Accelerometer and Gyroscope to estimate attitude (acceleration, roll, pitch, and heading)
- Reports position at 100 – 2000 Hz (higher rate the faster the system can drive)
  - 60 MPH = 88 feet/second
- IMU can be utilized in GPS deprived situations, but drifts after a short period of time

Distance Measurement Indicator (DMI)

Vehicle odometry information is obtained via external wheel speed sensors

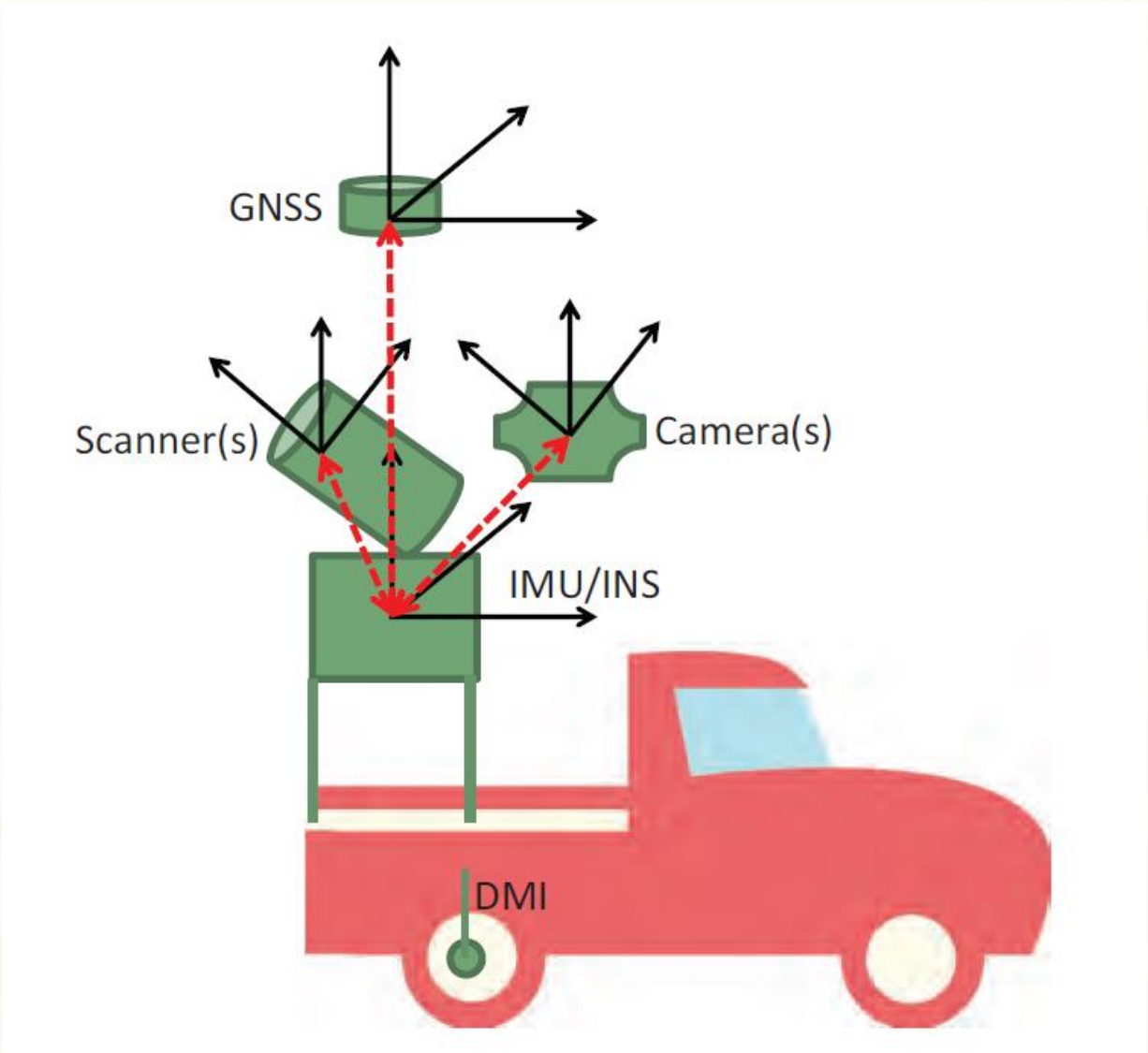
- Measures tire rotation and estimates distance traveled
- Can be used to trigger cameras
- Typically supplementary to GNSS and IMU
  - Can supply relative positioning
  - ODOT rarely uses this sensor

Camera(s)

Imagery captured to aid in visualization

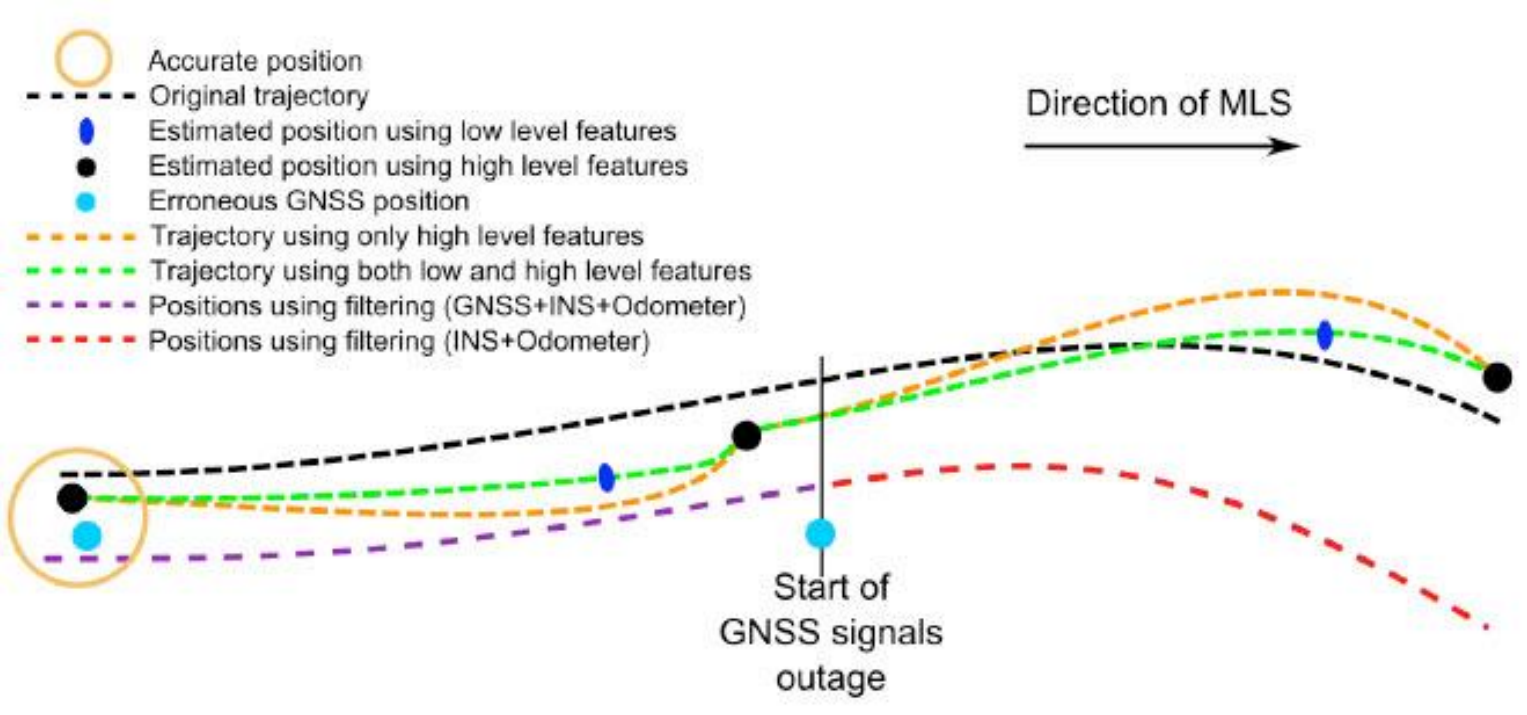
- Typically 360° panoramic
- Colorize point cloud with RGB values

Lever Arm Offsets



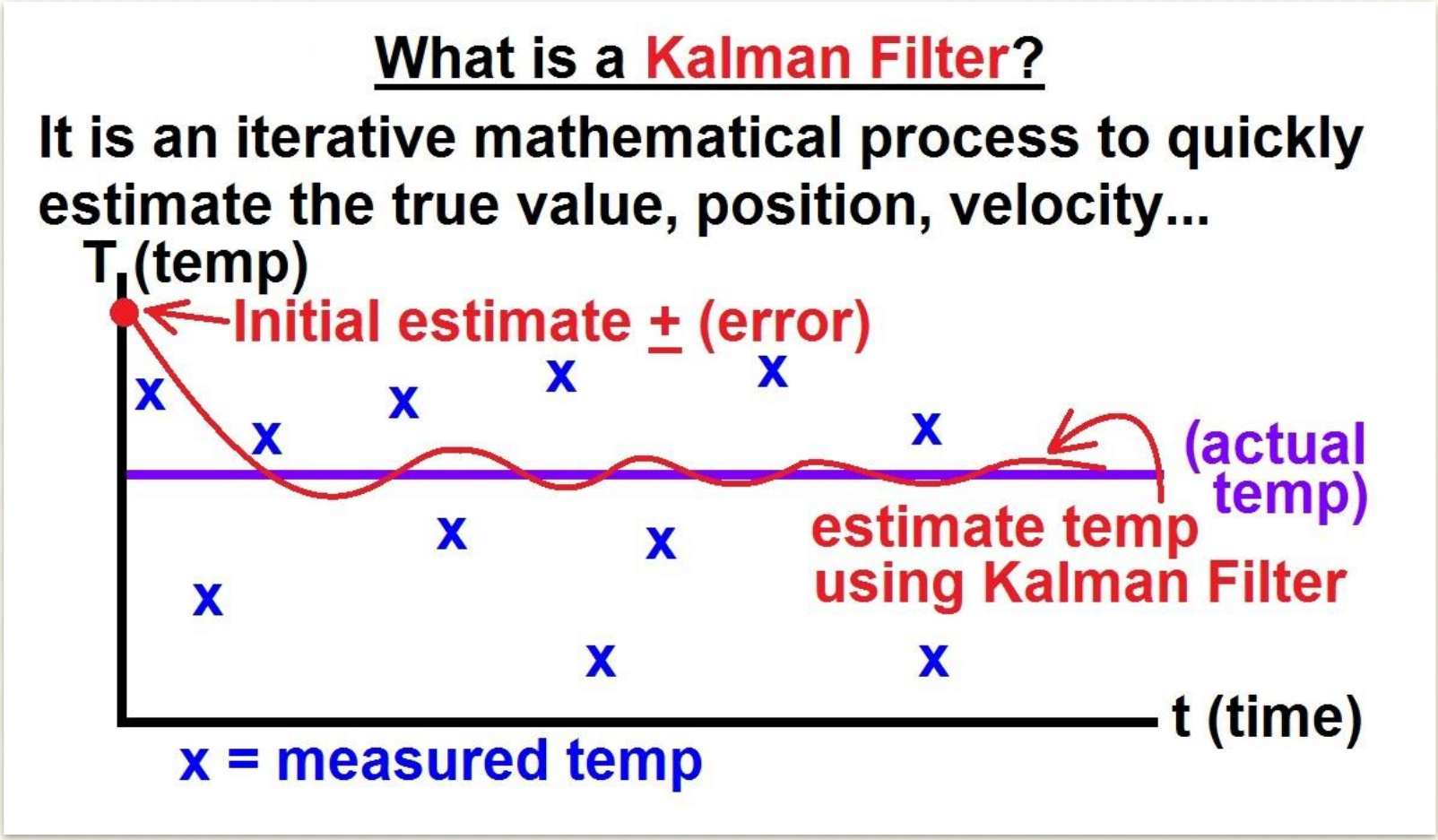
Source:
NCHRP Report 748

Putting it all together



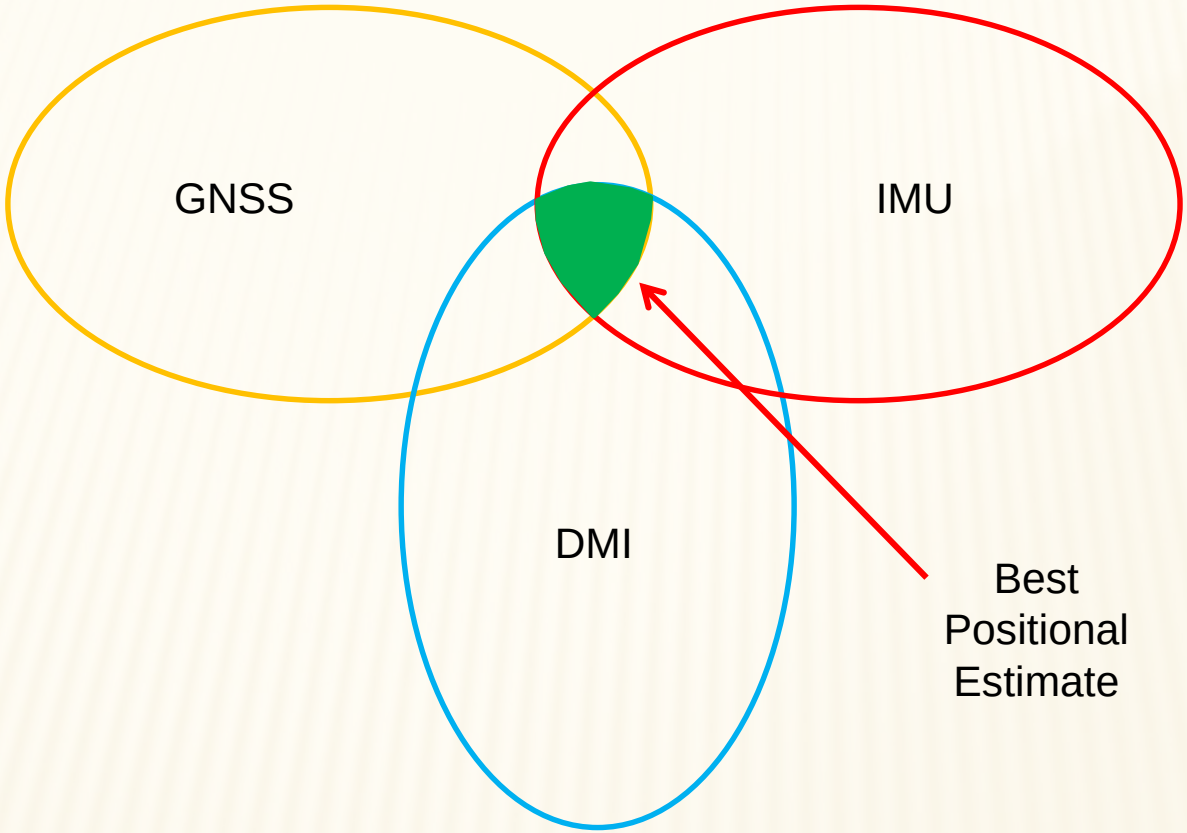
Source:
Hussnain, 2014

Kalman Filter (KF)



Source:
ilectureonline

Kalman Filter (KF)



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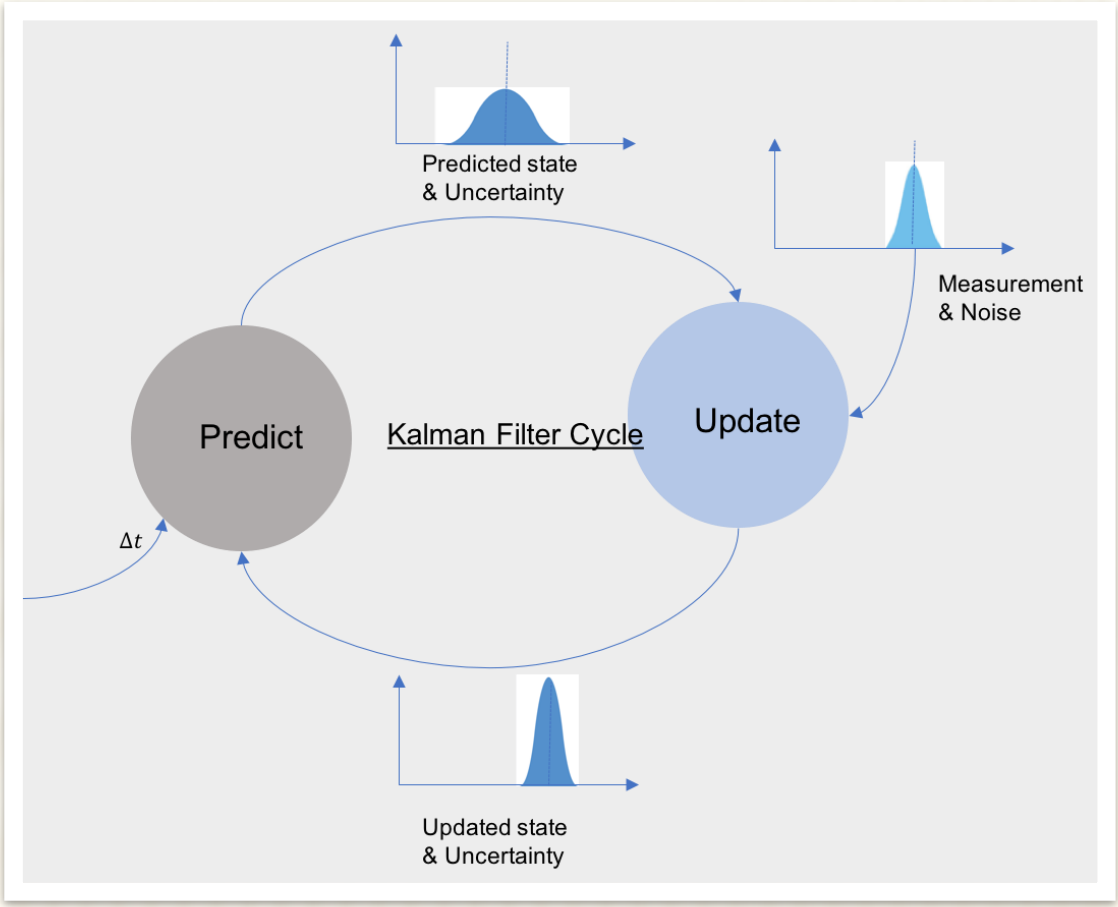
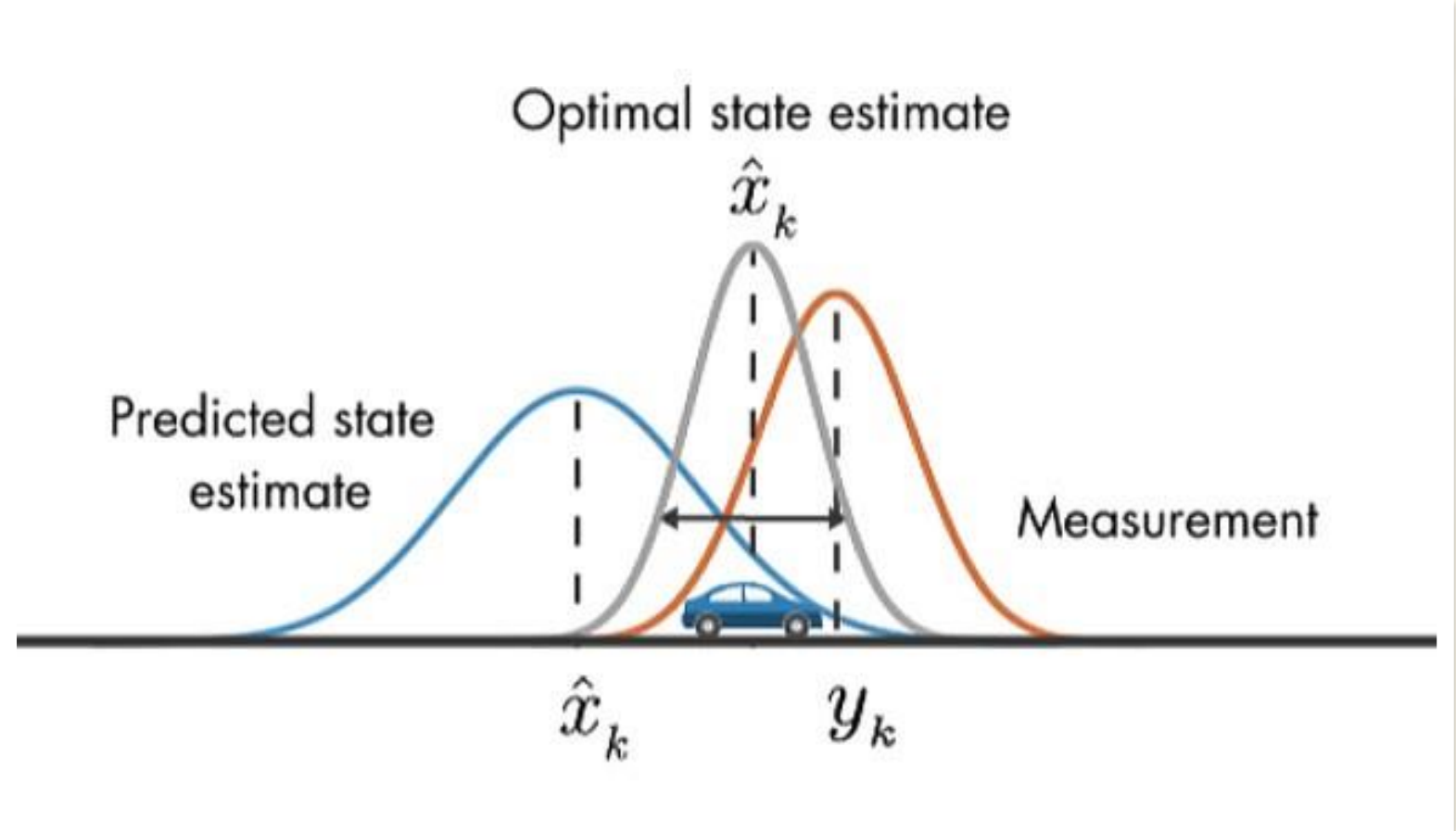


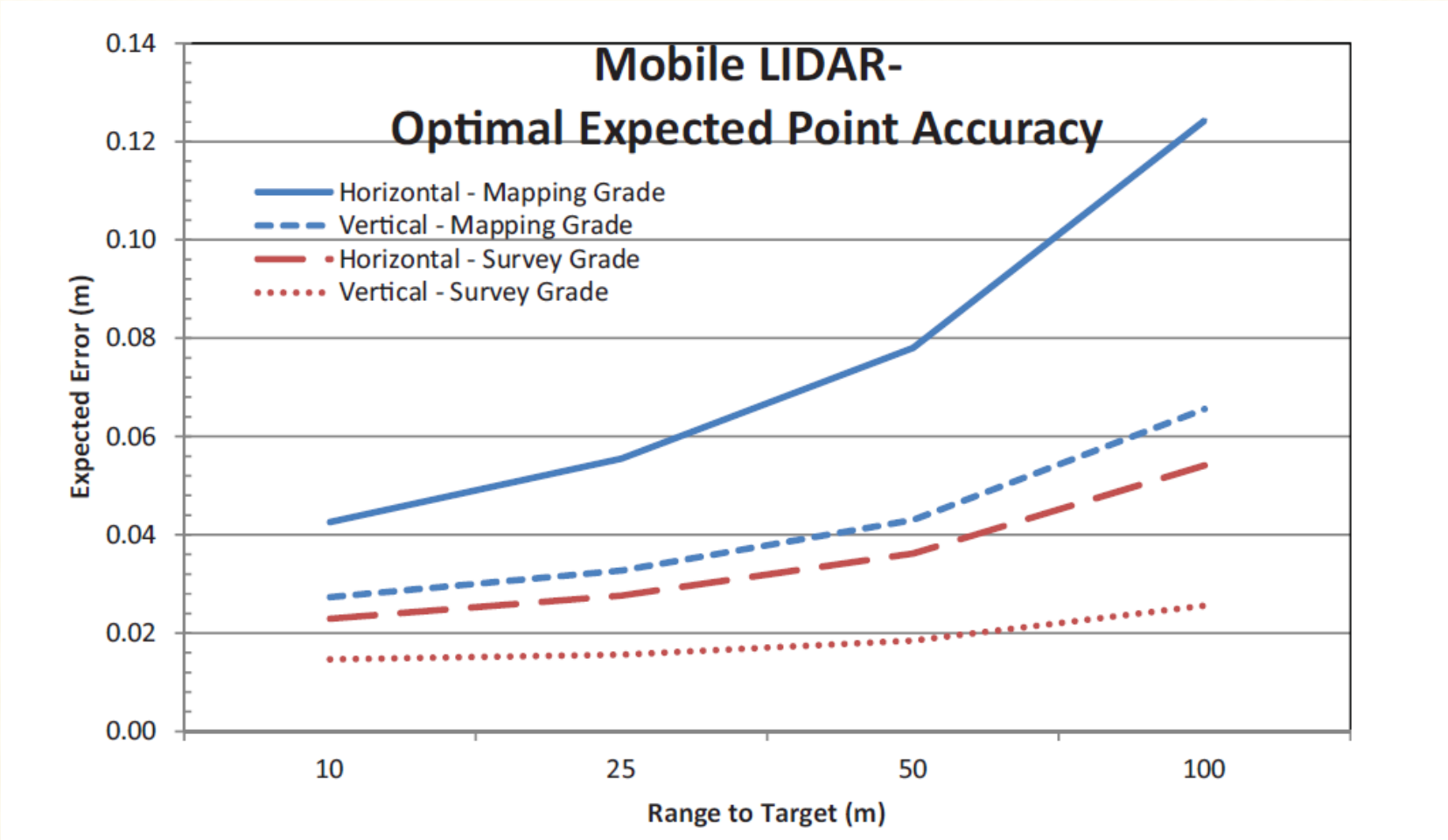
Source:
Ness Digital Engineering

Kalman Filter (KF)



Source:
GISCLE

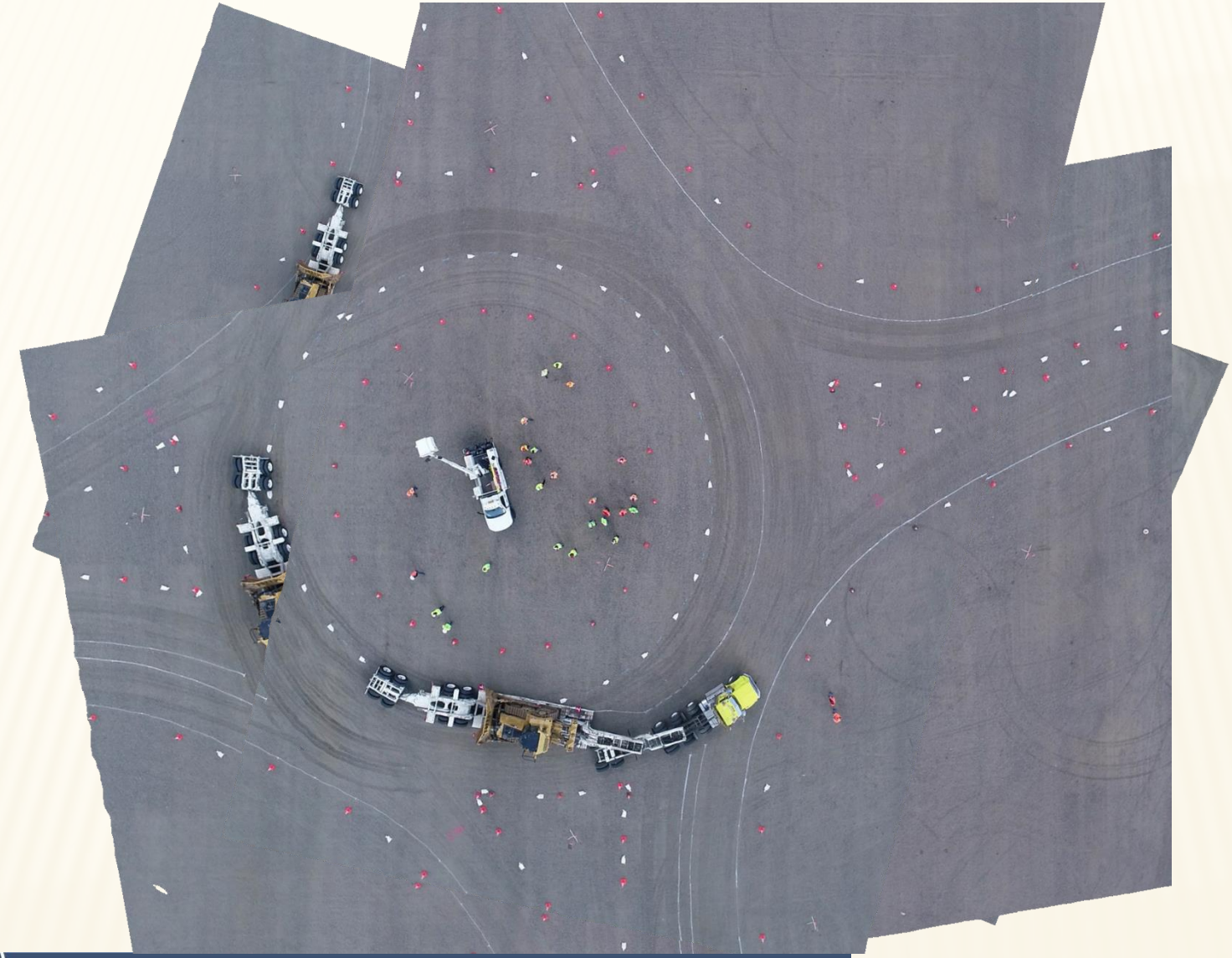
Mobile Lidar – Expected Accuracy



Source:
NCHRP Report 748

Oregon Department of Transportation

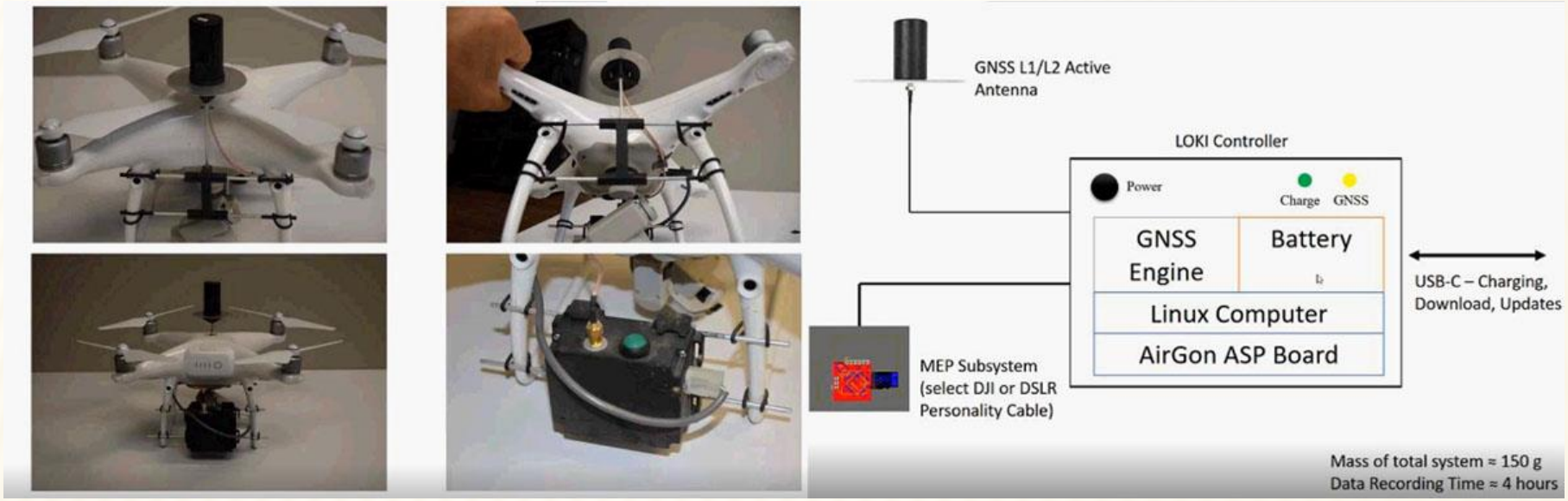
Aerial Imagery – Passive Sensor



Direct Geopositioning

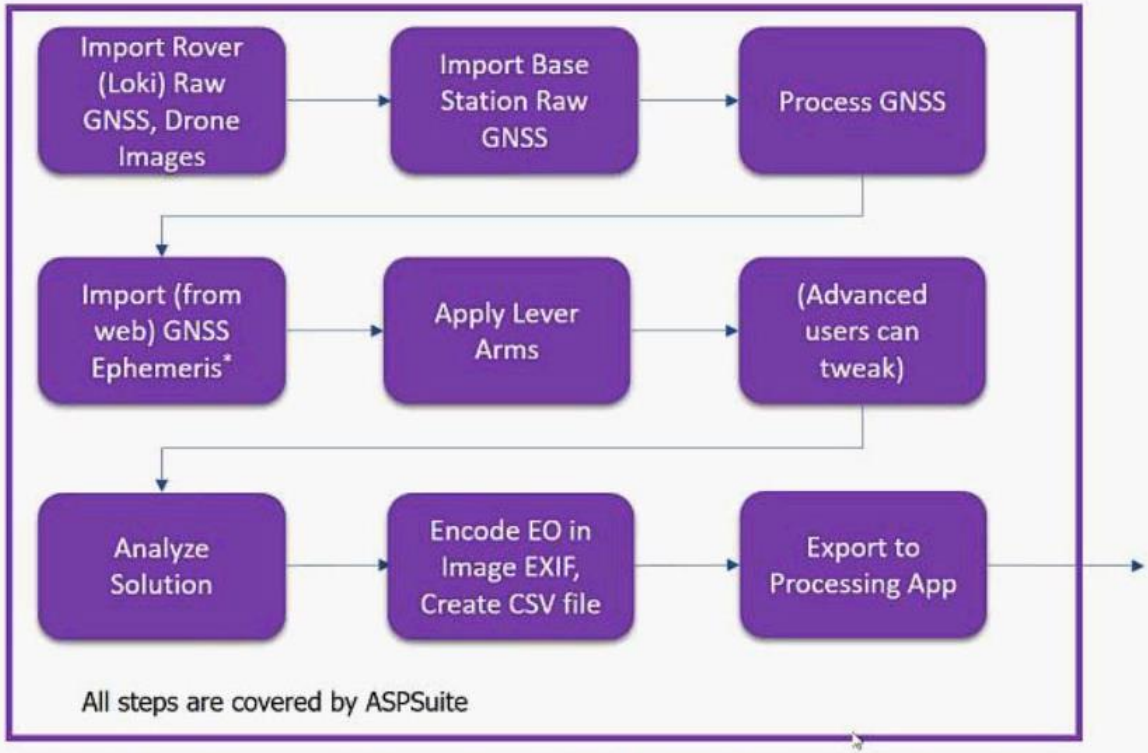
Source:
GeoCue

Direct Geopositioning



Source:
GeoCue

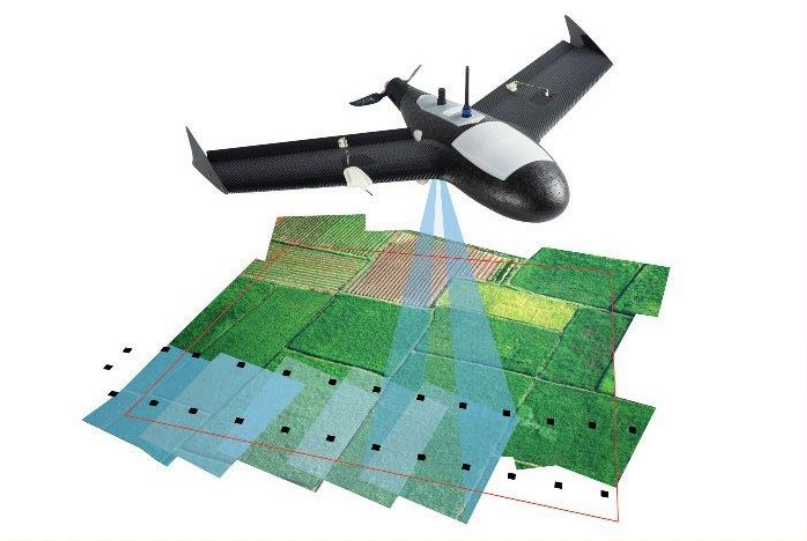
Direct Geopositioning - Process



*Availability of post-pass ephemeris (satellite locations) is what improves a PPK solution as compared to RTK

Source:
GeoCue

And…



https://sourceable.net/wp-content/uploads/2015/10/uav-surveying.jpg