



Changes To The Survey Industry

- Transits
- Theodolites and Top-Mounted EDM's
- Semi-Total Stations
- Total Stations
- Finally, Motorized Units and Robotics
- Scanners
- GPS
- Drones
- Machine Control



We started out with old style Transits, chains, rods, poles



Transits

Chains

Poles

Rods

Buff & Buff – Dietzgen – Gurley – K & E



Theodolites and Top-Mounted EDM's



Wild – Nikon – Lietz – Hewlett Packard



- Semi-Total Stations

Topcon – Nikon – Lietz – Pentax



- Total Stations
- Reflectorless Total Station
- Auto Height
- Spark Resistance



Topcon – Kern – Lietz – Zeiss

- Motorized Units and Robotics
- Powered Prisms
- Radios
- WIFI
- Bluetooth

Geodimeter 4400



FIGURE 5.25 Remote-positioning unit (RPU)—a combination of prism, data collector and radio communicator (with the base station) that permits the operator to engage in one-person survey.

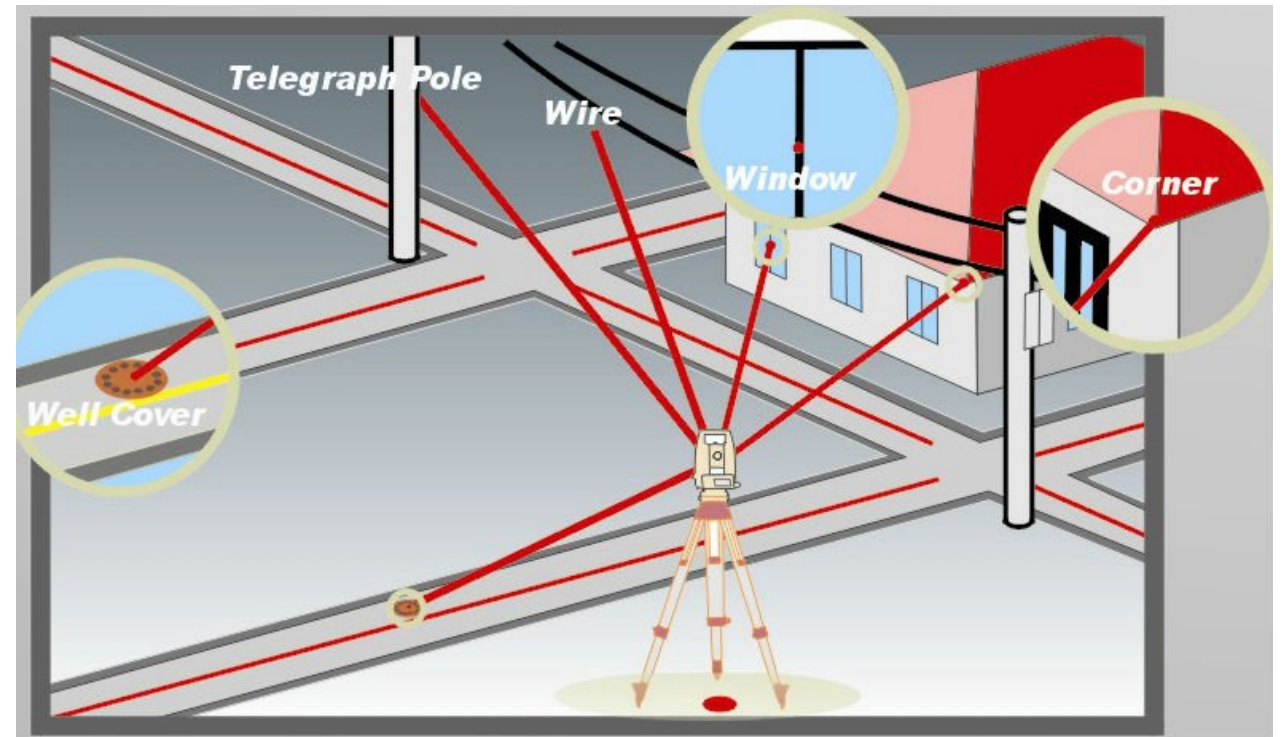
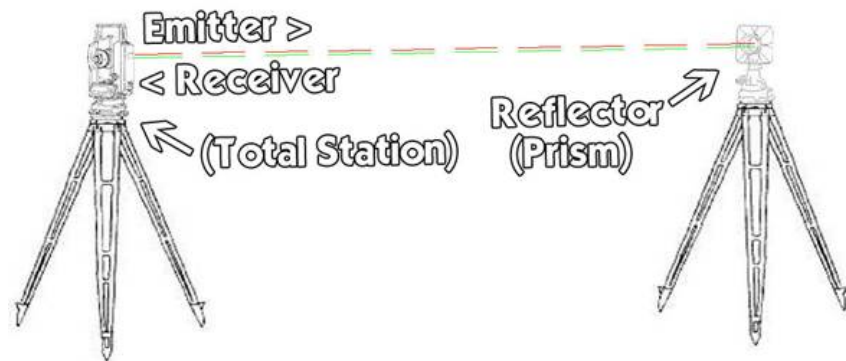


FIGURE 5.26 Leica TPS System 1000, used for road-way stakeout. The surveyor is controlling the remote-controlled total station (TCA 1100) at the prism pole using the RCS 1000 controller together with a radio modem. The assistant is placing the steel bar marker at the previous set-out point. (Courtesy of Leica Geosystems Inc.)

for and then position the prism on the correct layout line—where the operator then notes the angle and distance readouts to determine the precise layout location. Figure 5.27 shows a motorized total station (Trimble 5600 total station). It has many features, including a four-speed servo; Autolock, a coaxial prism sensor that locks quickly and precisely on the target



- Reflectorless Technology
- Measuring Range Up To 6,500 feet

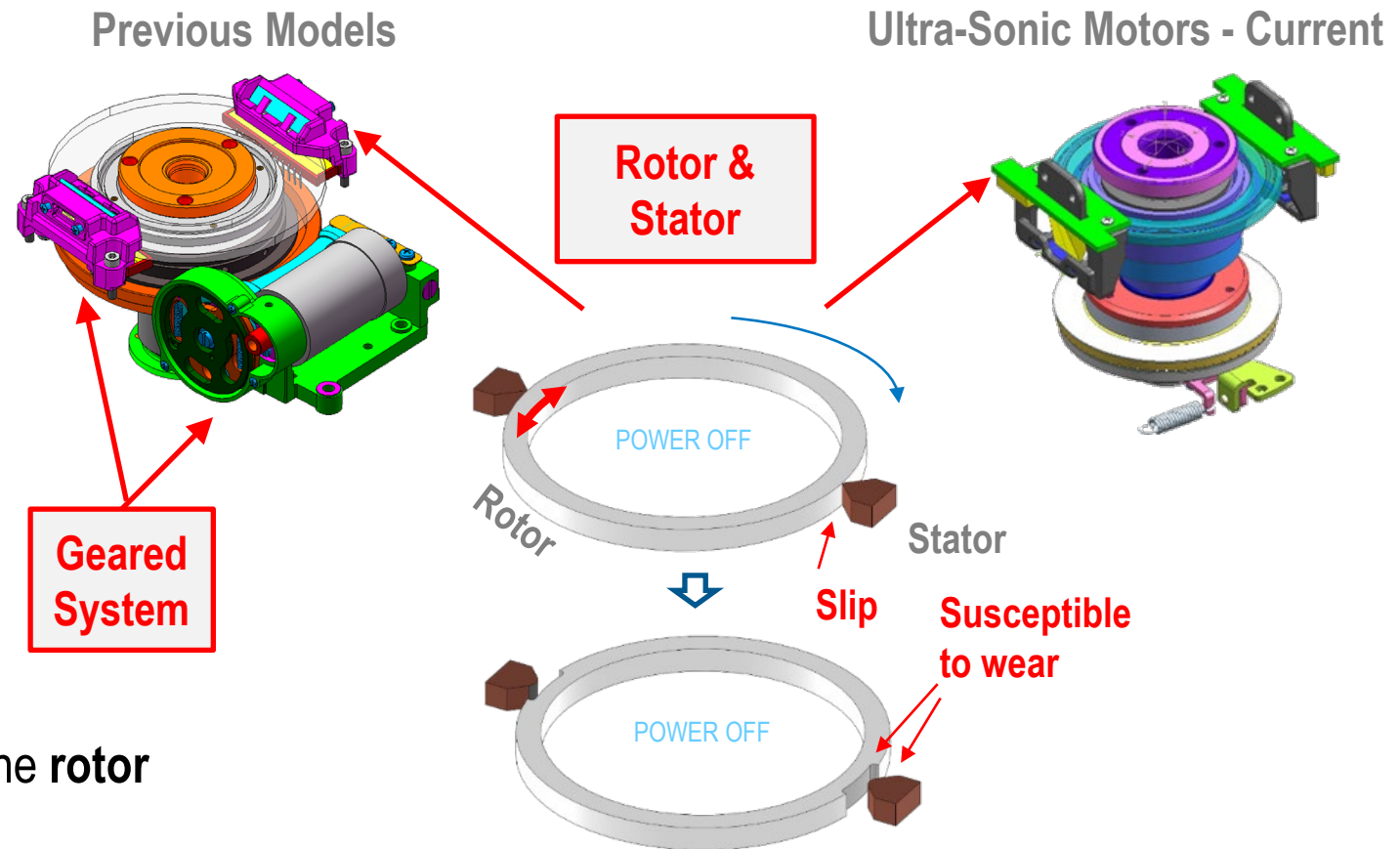


■ Advancements in Robotic Systems

- Motor Technology
- Servo-Driven to Mag Drive to Ultra Sonic
- Up to 5-Year Motor Warranty

■ Today's Robotic Motor Systems

- Completely **gearless** design
- Efficient **clutch hold** system
- Proven to **eliminate** the wear and / or failure of the **rotor** caused by manual rotation



■ Robotic Systems

- Legacy Systems – Cables!
- External Batteries
- Powered Prisms
- External Radios



Robotic Systems

- Today's Systems

- Internal Batteries
- Active vs Passive Prisms
- Radios - Bluetooth - Wireless

- **Todays Robotic Systems – ~~Cables~~**



Robotic Scanner Systems

- More Than Just a Robotic Instrument
 - Multiple Cameras – Live Video
 - Hybrid Scanning
 - Capture Images Remotely



■ Advancements in Robotic Systems

- More Than Just a Robotic Instrument
 - Measure Points Remotely
 - High Density 3D Scan Data with Imagery
 - Up to 100,000 points per second
 - Scan Range of up to 600 meters
 - Images – Verification - Documentation



- Advancements in GNSS Systems

- Evolution of GPS

- Static Technique – Post-Processing

- **RTK – Base & Rover**

- UHF - SS – Bluetooth

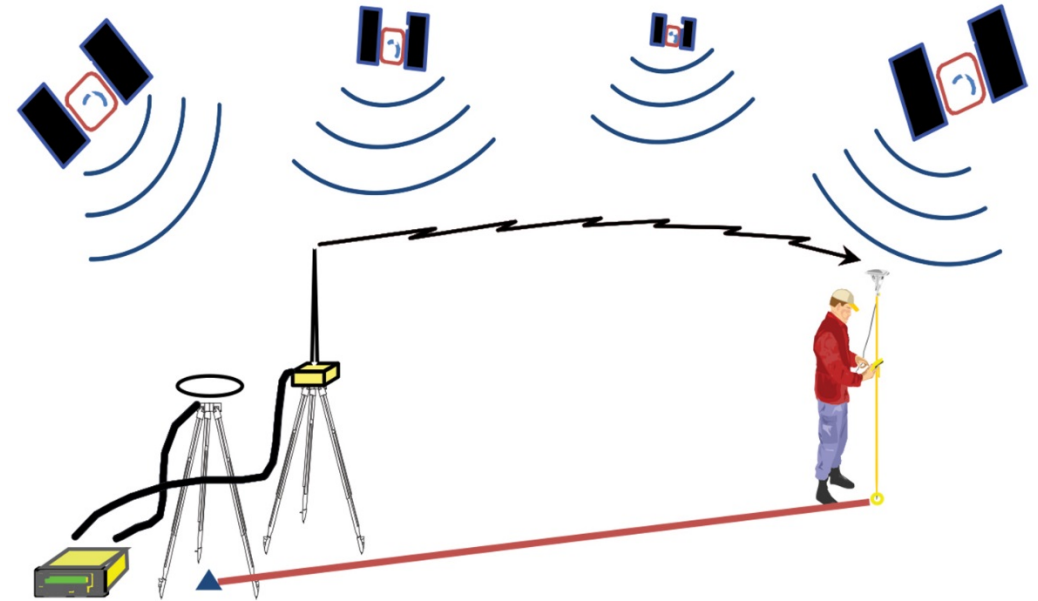
- GPS to GNSS

- Network Rovers

- Lighter

- Multi-Constellation

- Integrated GPS



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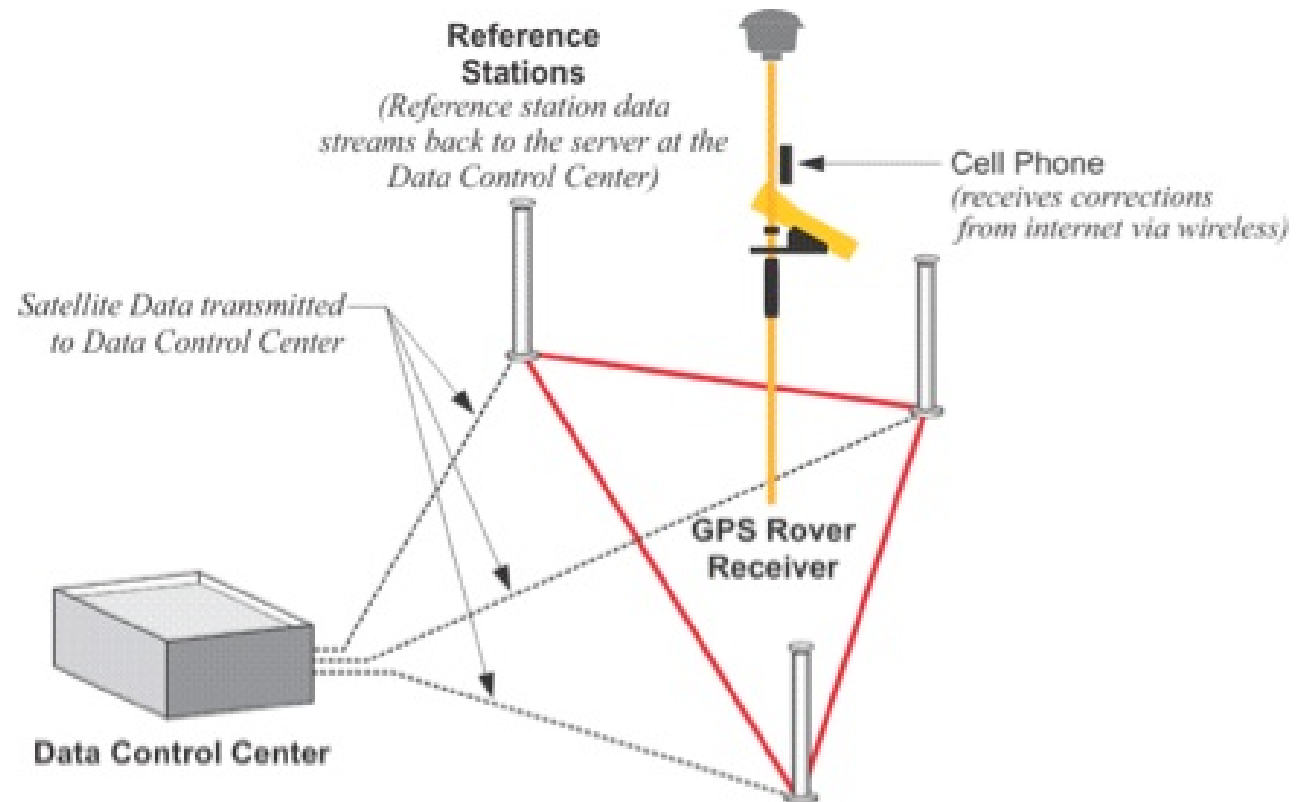
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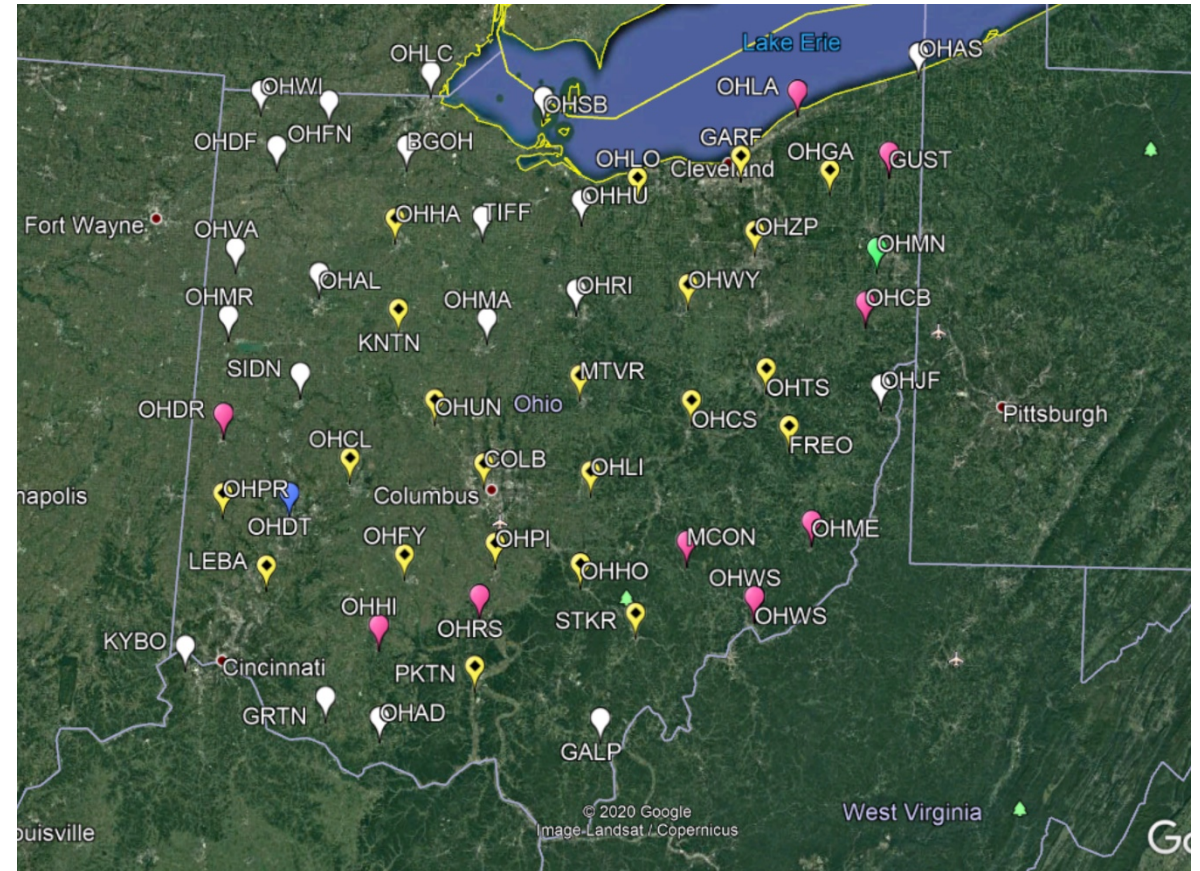
- **Network Rovers**

- Smaller & Lighter

- Multi-Constellation

- Cost Effective





- Advancements in GNSS Systems

- **Evolution of GPS**

- Waterproof IP67 IP68
 - Improved Operating Time
 - Offered with or without internal radio
 - Future Constellation Proof
 - Data & Image Capture
 - E-bubble with Full Tilt Compensation
 - Faster Field Measurements up to 20%
 - “Watch the Pole Tip and Not the Bubble”
 - Cannot Visually see the Bubble
 - Pole out of plumb



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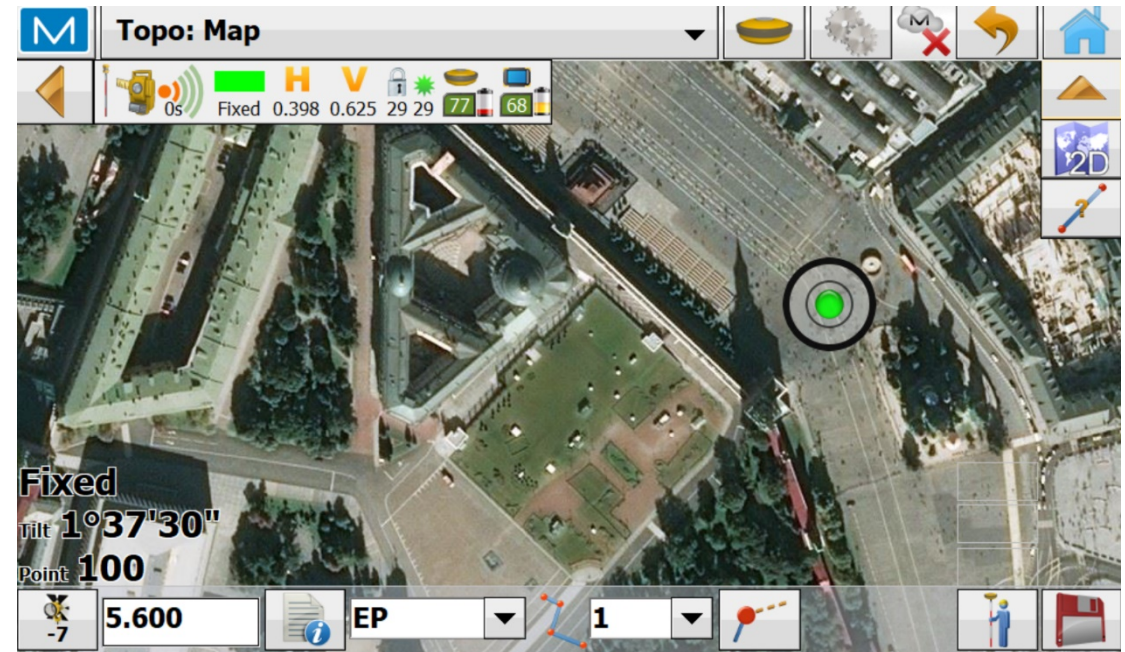
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- Advancements in Robotic Systems

- Legacy Data Collectors

- Windows Mobile/Embedded Operating System
 - No Longer Supported by Microsoft
 - Small – Smaller - Smallest
 - Small Screen Size
 - Limited Memory
 - 3G Internet Connection



■ Advancements in Robotic Systems

■ Advanced Field Computers

- Tablet Style – Landscape vs Portrait
- Optional Keyboard & Grounded Stylus
- Windows 10 Operating System
- Integrated Camera – 8MP
- WiFi – Bluetooth
- Integrated 4G Cellular
- Integrated GPS
- Operating Time 12-16hrs
- IP68 Ingress Protection
- Docking Station



- Utilizing Robotic & GNSS Technologies

- **Two Technology Pole**

Hybrid – Integrated – Smart

- Seamless:

- Quick Connection
 - Wireless
 - Lightweight
 - Resection – Occupy/Back-Sight
 - Geo-referenced Data



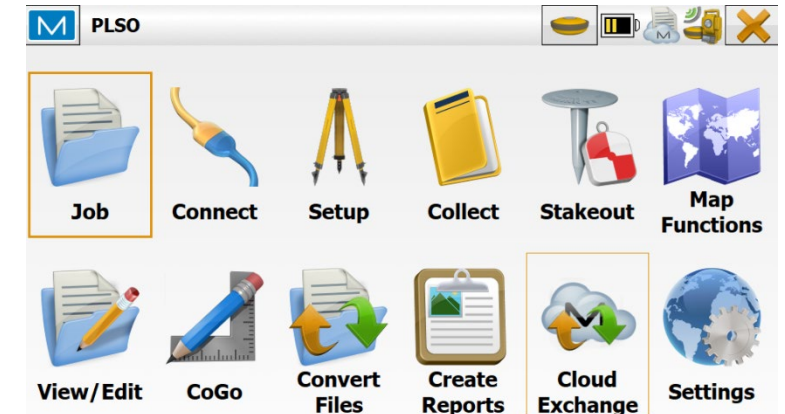
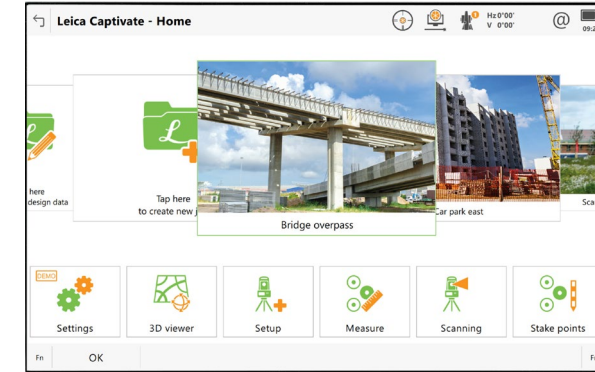
- Utilizing Robotic & GNSS Technologies
 - The Power of the **Field Computer** & Field Software
Windows 10 Operating Software
- **Benefits:**
 - 12+ operating hours, Hot swappable batteries
 - Waterproof IP68 Cold Temperatures -4°F
 - 4G LTE Integrated Cellular
 - 8MP Camera
 - Powerful Processor Extended Memory
 - Desktop Software Programs
 - Eliminates Need for other equipment
 - PC, Camera, Navigation GPS, etc.
 - Docking Station – Ethernet, Multiple USB



- Utilizing Robotic & GNSS Technologies
 - The Power of the Field Computer & **Field Software**

Can Operate Two Technology Seamlessly

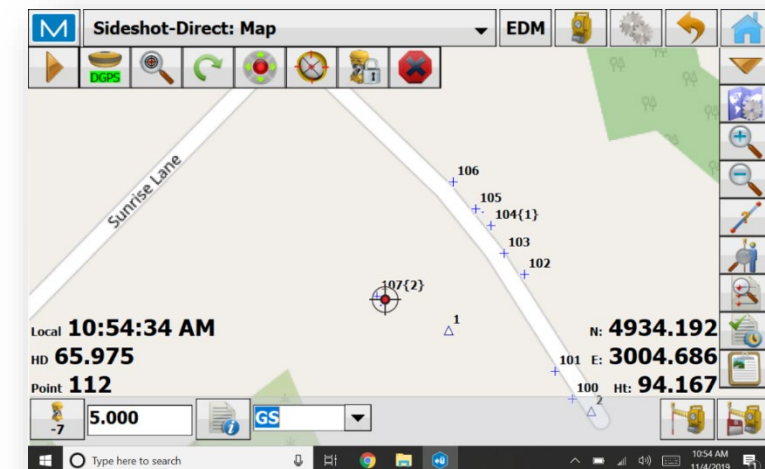
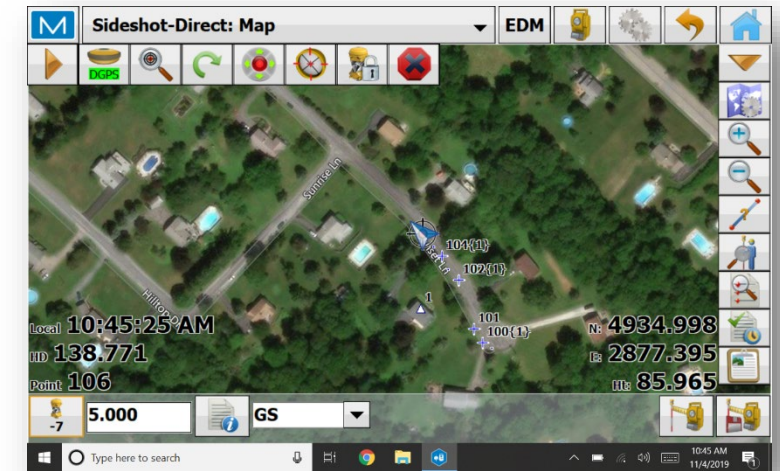
Utilizes Internet Connection
- **Benefits:**
 - Network Rover & Robotic Simultaneously
 - Connects to Cloud for Efficient Data Exchange
 - Offers Background Maps, Bing or Street Maps
 - Supports Live Video, High-Speed Scans with Imagery
 - Flexible Field Software
 - Customizable
 - Quick Codes
 - Stakeout Reports



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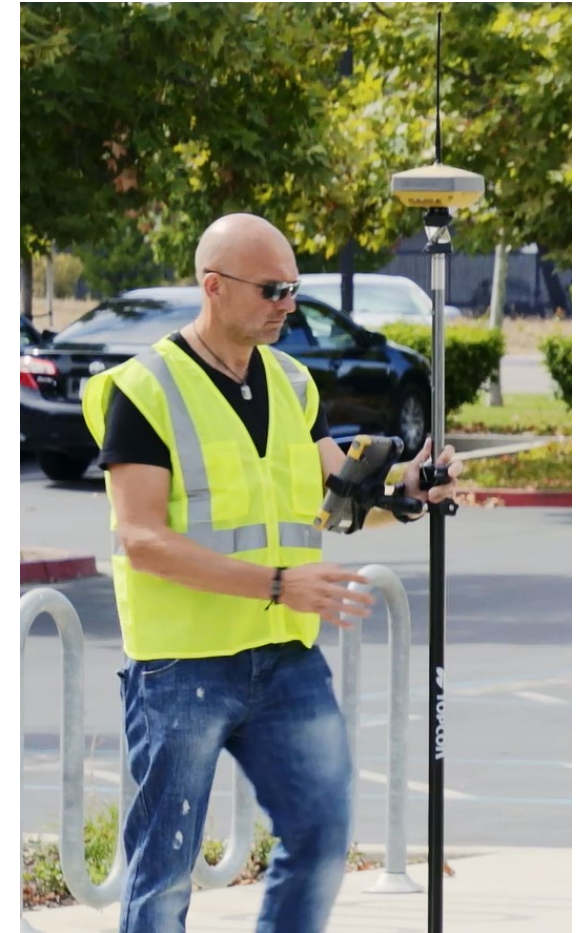
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GT Robotic Accuracy vs GNSS Accuracy

Is there a Difference?

Dime thickness = 1.3mm



- Utilizing Robotic & GNSS Technologies

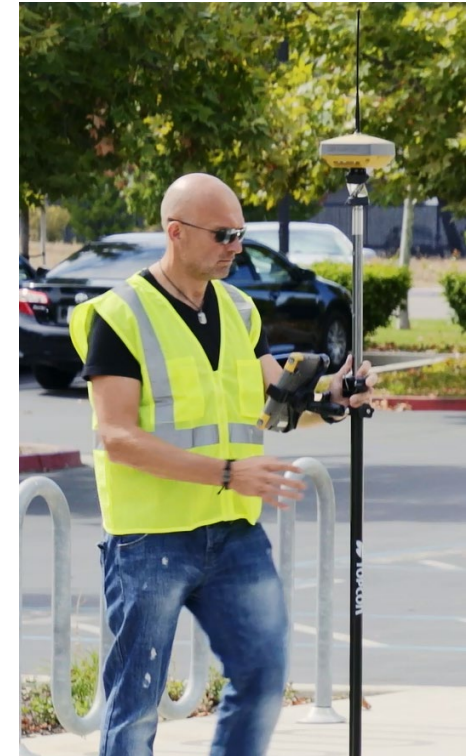
- Two Technology Pole

Hybrid – Integrated – Smart



- **Benefits:**

- Horizontal & Vertical Needs;
 - Robotic – 1-3mm
 - GNSS – H 10mm/ V 15mm



- Utilizing Robotic & GNSS Technologies
 - Who is using these Technologies Today?
 - **Building Construction**
 - **New Robotic Models**
 - **Simpler – Easy Setup – Self-Leveling**
 - **Short Range**



- Machine Control
- Dozer
- Grader
- Excavator
- Paver
- Concrete Screed Machine



- Drones
 - Standard
 - RTK
 - Lidar Scanning
 - Thermal Imaging Camera
- Boats
- Sonar

