Which GPS Should I Buy?
11-2016

Johnny Thompson
Current GPS Units we recommend for use under canopy:
F4 Devices – Forge

- 1-3 Meter DGPS Internal Antenna
- Good Numeric Keypad
- 5 MP Camera
- Fully Ruggedized - IP 67
- 8 GB Storage
- $1299
Handhelds – Nautiz X8

- 1.5 GHz Dual Core Processor
- 1 GB RAM
- 4.7” FWVGA Chemically-Strengthened Screen
- 8 MP Camera
- Fully Ruggedized - IP 67
- 4 GB Storage
- $1399
- 2-5 Meter DGPS Internal Antenna
Trimble T-41 G

- Enhanced 1-2 meter GPS
- “Unbreakable” Gorilla Glass
- 4.3” display
- 8 MP Camera
- 1 GHz Processor
- IP 68 Ruggedness
- 32 GB Storage

$2099 -> $1575

25% Discount
Trimble Nomad 1050

• Numeric Keypad
• **15 hour battery**
• 1 GHz Processor
• **Fully Ruggedized - IP 68**
• 8 GB Storage
• Internal GPS L model = $1899
• B Model + Holux GPS = $1699
F4 Devices – Forge Echo

- Ultrasound technology for borderline tree determination
- 1-3 Meter DGPS Internal Antenna
- Good Numeric Keypad
- 5 MP Camera
- Fully Ruggedized - IP 67
- 8 GB Storage
- $1699
Juniper Systems – Archer 2

- 4.3” High Visibility, Scratch Resistant Screen
- Numeric Keypad
- 20 hour battery
- Tracks GPS + Glonass
- 1 GHz Processor
- Fully Ruggedized - IP 68
- 8 GB Storage
- Mini and USB Host data slots
- $1995
Trimble GeoExplorer 7

- XT Model – < 1 m accuracy realtime, 50 cm pp
- XH model – 10 cm accuracy realtime with H-Star or pp
- Floodlight Technology – tracks GLONASS
- XT ~ $6995
- XH ~ $8195
Trimble PG200 GNSS Receiver

- External, Bluetooth
- Windows, Windows Mobile, iOS, and Android
- Tracks GPS, SBAS, GLONASS, Galileo, QZSS & BeiDou
- Global sub-meter accuracy
- ip65 rugged
- $2495
Juniper Systems Geode

- External, Bluetooth
- Windows, Windows Mobile, and Android
- Tracks GPS, SBAS, GLONASS
- SBAS: <30 cm RMS and <60 cm 2DRMS
- 10 hr battery
- ip65 rugged
- $1860
Questions

1. Accuracy? – submeter or 1-3 meter
2. Numeric Keyboard necessary?
3. Screen? – Resistive or Capacitive
4. Speed?
5. Pricing?
6. Rugged or BYOD (Bring Your Own Device?)
Question #1 - Accuracy

- GPS Accuracy Test - Oct 28, 2016
- Starkville, MS
- GPS Surveyed with VRS to 10 cm
- Estimated Accuracy < 1 foot
## GPS Units Tested

<table>
<thead>
<tr>
<th>Consumer</th>
<th>Mapping (1-3 m)</th>
<th>Professional (Sub-meter)</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Image of consumer GPS units]</td>
<td>[Image of mapping GPS units]</td>
<td>[Image of professional GPS units]</td>
</tr>
</tbody>
</table>

- **PP**
Test Protocol

• **Static Test**
  – 30 one second observations on 14 surveyed benchmarks
    • Except for consumer which was a three 1 second observations
  – Computed error for each position
  – Averaged error
  – Analyzed # satellites used for each position

• **Dynamic Test**
  – One second logging interval
  – Buffered Course – 5 one meter buffers
  – Calculated the % of Positions in each buffer
## Static Test Results – All Stations

<table>
<thead>
<tr>
<th>GPS Unit</th>
<th>Avg Error (m)</th>
<th>Satellites Used</th>
<th>Key</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trimble Geo7_PP</td>
<td>1.604</td>
<td>16.92</td>
<td>Submeter</td>
</tr>
<tr>
<td>Juniper Systems Geode</td>
<td>1.687</td>
<td>14.78</td>
<td>1-3 meter</td>
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<tr>
<td>Trimble PG200</td>
<td>1.717</td>
<td>18.49</td>
<td>Consumer</td>
</tr>
<tr>
<td>Trimble Geo7</td>
<td>1.888</td>
<td>16.92</td>
<td></td>
</tr>
<tr>
<td>Trimble T41G</td>
<td>2.290</td>
<td>10.16</td>
<td></td>
</tr>
<tr>
<td>F4 Devices Forge</td>
<td>3.238</td>
<td>9.38</td>
<td></td>
</tr>
<tr>
<td>Juniper Systems Archer2</td>
<td>3.299</td>
<td>12.00</td>
<td></td>
</tr>
<tr>
<td>Geneq iSX_Blue</td>
<td>3.380</td>
<td>15.57</td>
<td></td>
</tr>
<tr>
<td>DT Research 391GS</td>
<td>3.903</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Holux RCV3000</td>
<td>4.227</td>
<td>9.62</td>
<td></td>
</tr>
<tr>
<td>Handheld Nautiz_X8</td>
<td>4.250</td>
<td>10.06</td>
<td></td>
</tr>
<tr>
<td>Trimble Nomad_1050</td>
<td>5.163</td>
<td>8.35</td>
<td></td>
</tr>
<tr>
<td>DT Research 410</td>
<td>5.779</td>
<td></td>
<td></td>
</tr>
<tr>
<td>iPhone 6s</td>
<td>6.483</td>
<td></td>
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</tr>
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</table>
Dynamic Test Results – All Stations
### Dynamic Test Results - All Stations

<table>
<thead>
<tr>
<th>Unit</th>
<th>1m</th>
<th>2m</th>
<th>3m</th>
<th>4m</th>
<th>5m</th>
<th>Rank at 2M</th>
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</thead>
<tbody>
<tr>
<td>Trimble Geo7 PP</td>
<td>62.24</td>
<td>94.41</td>
<td>99.30</td>
<td>100.00</td>
<td>100.00</td>
<td>1</td>
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<tr>
<td>F4 Devices Forge</td>
<td>55.56</td>
<td>87.09</td>
<td>100.00</td>
<td>100.00</td>
<td>100.00</td>
<td>2</td>
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<tr>
<td>Trimble PG200</td>
<td>47.44</td>
<td>78.85</td>
<td>98.40</td>
<td>99.04</td>
<td>100.00</td>
<td>3</td>
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<tr>
<td>Trimble Geo7</td>
<td>31.83</td>
<td>76.28</td>
<td>89.49</td>
<td>98.20</td>
<td>99.70</td>
<td>4</td>
</tr>
<tr>
<td>Handhelds Nautiz X8</td>
<td>39.34</td>
<td>69.97</td>
<td>92.19</td>
<td>96.40</td>
<td>99.70</td>
<td>5</td>
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<tr>
<td>Trimble T41G</td>
<td>24.32</td>
<td>60.18</td>
<td>86.93</td>
<td>98.78</td>
<td>99.70</td>
<td>6</td>
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<tr>
<td>Juniper Systems Geode</td>
<td>39.56</td>
<td>56.70</td>
<td>70.40</td>
<td>94.08</td>
<td>98.44</td>
<td>7</td>
</tr>
<tr>
<td>Juniper Systems Archer2</td>
<td>29.88</td>
<td>55.18</td>
<td>79.57</td>
<td>96.65</td>
<td>97.87</td>
<td>8</td>
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<tr>
<td>Trimble Nomad 1050</td>
<td>26.35</td>
<td>48.20</td>
<td>63.77</td>
<td>79.64</td>
<td>86.53</td>
<td>9</td>
</tr>
<tr>
<td>Holux RCV3000</td>
<td>24.31</td>
<td>44.71</td>
<td>58.82</td>
<td>87.84</td>
<td>96.47</td>
<td>10</td>
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<tr>
<td>Geneq iSXBlue</td>
<td>16.35</td>
<td>40.13</td>
<td>69.41</td>
<td>90.13</td>
<td>100.00</td>
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<tr>
<td>DT Research H410</td>
<td>13.04</td>
<td>40.00</td>
<td>63.48</td>
<td>83.48</td>
<td>92.17</td>
<td>12</td>
</tr>
<tr>
<td>DT Research 391GS</td>
<td>10.44</td>
<td>23.42</td>
<td>46.52</td>
<td>60.44</td>
<td>71.20</td>
<td>13</td>
</tr>
</tbody>
</table>

**Key**
- **Submeter**
- **1-3 meter**
- **Consumer**
GPS Mapping Conclusions

1. If you need submeter accuracy, the Geode, PG 200, and Geo 7 are all great under canopy, but vary in cost

2. If you can’t afford sub-meter, the T41G is amazing for static points under canopy at +/- 2.29 meters avg

3. Consumer GPS – get what pay for
Question #2 - Keyboard

VS.
Question #3 - Screen

Resistive
- Older technology
- Stylus Entry
- Not affected by water
- More susceptible to trash and breakage
- Smaller

Capacitive
- New technology
- Fat Stylus or Finger Entry
- Affected by sweat and rain – but most have Rain Mode
- Virtually unbreakable – less Repairs
- Larger, brighter, easier to see
Question #4 - Speed

Slow  Faster  Fastest

- 800 MHz Processor
- 512 MB RAM
- 8 GB Storage

- 1 GHz Processor
- 512 MB RAM
- 8, 32, and 8 GB Storage respectively

- 1.5 GHz Processor
- 1 GB RAM
- 4 GB Storage
Question #5 - Cost

Least

• $1299
• $1399
• $1575

Most

• $1699 with Holux or $1899 with internal GPS
• $1699
• $1995
Question #6 – Rugged vs BYOD

**Rugged**

- Better GPS (unless you use an external GPS)
- All day battery
- Faster data entry
- Rugged – less likely to fail in difficult conditions
- Runs Solo, TCruise, and RTI
- More expensive

**BYOD**

(Bring Your Own Device)

- Use phone – Pro and Con
- Cheaper to implement
- Use free or cheap apps
- Slower data entry
- Battery is a big issue especially in extreme heat and cold
- More fragile
## 2016 LandMark Spatial Solutions Mapping Grade Handheld Matrix

<table>
<thead>
<tr>
<th></th>
<th>F4 Devices Forge 912</th>
<th>Handhelds Route X9</th>
<th>Trimble Juno T41-C</th>
<th>Trimble Nomad 1200 B with Holter</th>
<th>Trimble F4 Devices Forge 912 ECH0</th>
<th>Juniper Systems Archer 2 Geo</th>
<th>Trimble Juno T41 CG</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pros</strong></td>
<td>Numeric Keypad, Good GPS</td>
<td>Smaller size, bigger Screen, Gorilla Glass, Very rugged</td>
<td>Brand new model of proven technology</td>
<td>Numeric Keypad, ECHO Location for advanced tree measurement, 6-Gmer for tree height measurement</td>
<td>Numeric Keypad, Big Screen, Fast Processor, Gorilla Glass, Screen, Most Memory, Very rugged</td>
<td>Most Accurate GPS, Big Screen, Fast Processor, Gorilla Glass Screen, Most Memory, Very rugged</td>
<td>Most Accurate GPS, Big Screen, Fast Processor, Gorilla Glass Screen, Most Memory, Very rugged</td>
</tr>
<tr>
<td><strong>Cons</strong></td>
<td>Slower operation</td>
<td>Screen is sensitive to excess rain or sweat, but small size is an advantage</td>
<td>Less accurate GPS</td>
<td>External Bluetooth GPS under Extended Cap</td>
<td>Slower operation</td>
<td>None</td>
<td>No numeric or directional keys</td>
</tr>
<tr>
<td><strong>Price</strong></td>
<td>$1,199</td>
<td>$1,299</td>
<td>$1,199</td>
<td>$4,999</td>
<td>$1,199</td>
<td>$1,495</td>
<td>$1,575</td>
</tr>
<tr>
<td><strong>Processor</strong></td>
<td>800 MHz</td>
<td>1.0 GHz, dual core</td>
<td>800 MHz</td>
<td>1.6 GHz, Texas Instruments</td>
<td>1.0 GHz ARM Cortex A5</td>
<td>1 GHz, Texas Instruments</td>
<td>1 GHz, Texas Instruments</td>
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<tr>
<td><strong>RAM</strong></td>
<td>512MB</td>
<td>1 GB</td>
<td>512MB</td>
<td>512MB</td>
<td>512MB</td>
<td>512MB</td>
<td>512MB</td>
</tr>
<tr>
<td><strong>Display size/Type</strong></td>
<td>3.5” Color LCD Transmissive, 480x640 Full VGA, resistive touch</td>
<td>4.7” WVGA capacitive touch display, chemically strengthened glass</td>
<td>4.3” WVGA resistive touch Corning® Gorilla® Glass display</td>
<td>4.3” WVGA capacitive touch display</td>
<td>4.3” WVGA LCD TFT (800x600), High visibility, Resistive touch, Resistive LCD</td>
<td>4.3” WVGA resistive-readable Corning® Gorilla® Glass display, capacitive touch</td>
<td></td>
</tr>
<tr>
<td><strong>Camera</strong></td>
<td>8 megapixel camera with auto focus and LED flash</td>
<td>8 megapixel camera with front and rear LCD flash</td>
<td>8 megapixel camera with front and rear LCD flash</td>
<td>8 megapixel camera with LED flash</td>
<td>8 megapixel camera with LED flash</td>
<td>8 megapixel camera with LED flash</td>
<td>8 megapixel camera with LED flash</td>
</tr>
<tr>
<td><strong>IP Rating</strong></td>
<td>IP 67</td>
<td>IP 67</td>
<td>IP 67</td>
<td>IP 67</td>
<td>IP 67</td>
<td>IP 67</td>
<td>IP 67</td>
</tr>
<tr>
<td><strong>Battery</strong></td>
<td>Lithium-Ion 1.2V 3000mAh</td>
<td>Lithium-Ion 1.2V 2500mAh</td>
<td>Lithium-Ion 1.2V 2000mAh</td>
<td>Lithium-Ion 1.2V 2000mAh</td>
<td>Lithium-Ion 1.2V 2000mAh</td>
<td>Lithium-Ion 1.2V 2000mAh</td>
<td>Lithium-Ion 1.2V 2000mAh</td>
</tr>
<tr>
<td><strong>SAR</strong></td>
<td>11.85 W/kg</td>
<td>11.50 W/kg</td>
<td>11.50 W/kg</td>
<td>11.50 W/kg</td>
<td>11.50 W/kg</td>
<td>11.50 W/kg</td>
<td>11.50 W/kg</td>
</tr>
<tr>
<td><strong>GPS Receiver Type</strong></td>
<td>U-Blox M5</td>
<td>U-Blox M5</td>
<td>U-Blox M5</td>
<td>U-Blox M5</td>
<td>U-Blox M5</td>
<td>U-Blox M5</td>
<td>U-Blox M5</td>
</tr>
<tr>
<td><strong>SBAS</strong></td>
<td>WAAS, EGNO, MSAS, GAGAN</td>
<td>WAAS, EGNO, MSAS, GAGAN</td>
<td>WAAS, EGNO, MSAS, GAGAN</td>
<td>WAAS, EGNO, MSAS, GAGAN</td>
<td>WAAS, EGNO, MSAS, GAGAN</td>
<td>WAAS, EGNO, MSAS, GAGAN</td>
<td>WAAS, EGNO, MSAS, GAGAN</td>
</tr>
<tr>
<td><strong>Accuracy (Autonomous)</strong></td>
<td>1.3 meters</td>
<td>1.3 meters</td>
<td>1.3 meters</td>
<td>1.3 meters</td>
<td>1.3 meters</td>
<td>1.3 meters</td>
<td>1.3 meters</td>
</tr>
<tr>
<td><strong>Accuracy with SBAS (Open Sky)</strong></td>
<td>1.3 meters</td>
<td>1.3 meters</td>
<td>1.3 meters</td>
<td>1.3 meters</td>
<td>1.3 meters</td>
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<tr>
<td><strong>GPS Filtering</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td><strong>Antenna Location</strong></td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td><strong>Integrated 10 or 2D Laser Scanner</strong></td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
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<tr>
<td><strong>S-G Sensor Height Measurement</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td><strong>Weight (lbs)</strong></td>
<td>3.75mm audio jack, MIK GPS antenna port, custom port that supports USB 3.0 Host USB Client</td>
<td>3.75mm audio jack, MIK GPS antenna port, custom port that supports USB 3.0 Host USB Client</td>
<td>3.75mm audio jack, MIK GPS antenna port, custom port that supports USB 3.0 Host USB Client</td>
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<td>3.75mm audio jack, MIK GPS antenna port, custom port that supports USB 3.0 Host USB Client</td>
</tr>
<tr>
<td><strong>Battery Life</strong></td>
<td>Up to 20 hours</td>
<td>12 hours</td>
<td>10-12 hours</td>
<td>12 hours</td>
<td>12 hours</td>
<td>12 hours</td>
<td>12 hours</td>
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<tr>
<td><strong>Capacity</strong></td>
<td>801.11</td>
<td>802.11b</td>
<td>802.11n</td>
<td>802.11n</td>
<td>802.11n</td>
<td>802.11n</td>
<td>802.11n</td>
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<td><strong>Bluetooth Support</strong></td>
<td>Class 2</td>
<td>Class 2</td>
<td>Class 2</td>
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<tr>
<td><strong>Operating System</strong></td>
<td>Windows Embedded Handheld 6.5</td>
<td>Windows Embedded Handheld 6.5</td>
<td>Windows Embedded Handheld 6.5</td>
<td>Windows Embedded Handheld 6.5</td>
<td>Windows Embedded Handheld 6.5</td>
<td>Windows Embedded Handheld 6.5</td>
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<td><strong>Operating Temp.</strong></td>
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<td>-22°F to 140°F</td>
<td>-22°F to 140°F</td>
<td>-22°F to 140°F</td>
<td>-22°F to 140°F</td>
<td>-22°F to 140°F</td>
<td>-22°F to 140°F</td>
</tr>
</tbody>
</table>
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