Luis Ros Valiente, Ph.D.
Trimble - Advanced Positioning Division

4th EUPOS Technical Meeting - Bratislava (Slovakia), November 21-22, 2017

Trimble Real-Time Network Solutions: PIVOT Software

Outline

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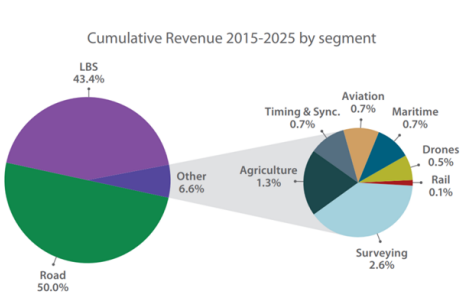
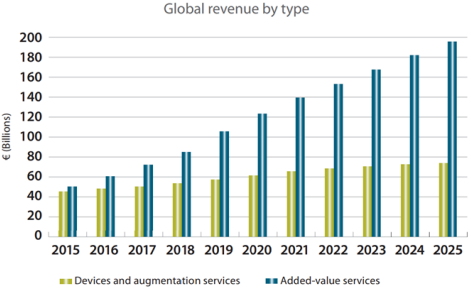
Introduction

- Evolution of GNSS markets in the 2015-2025 period:



(a)



(b)

Figure 1: GNSS revenue trends. Source: GNSS Market Report, Issue 5, copyright © European GNSS Agency, 2017.

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- But also new requirements and challenges:
  - Modernization and compatibility with new GNSS constellations and signals.
  - New critical applications might require increased robustness, redundancy and authentication.
  - Communications between networks and users are essential.

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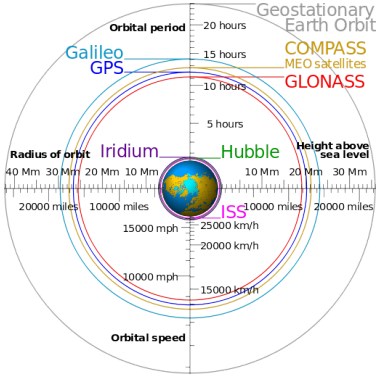

Figure 2: Comparison of satellite orbits. By Cmglee & Geo Swan, distributed under a CC BY-SA 3.0 license via Wikimedia Commons.

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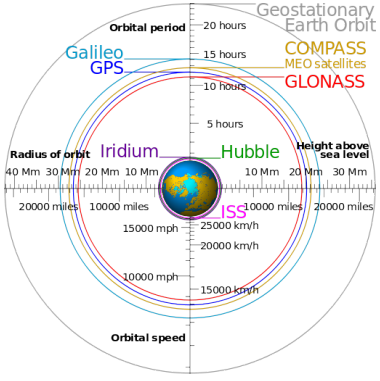

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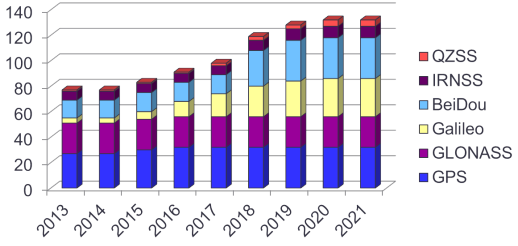

Figure 3: Evolution of the total number of available GNSS satellites for the 2013-2021 period.

New Satellites and Signals

- GNSS satellites visible *today* in Bratislava:

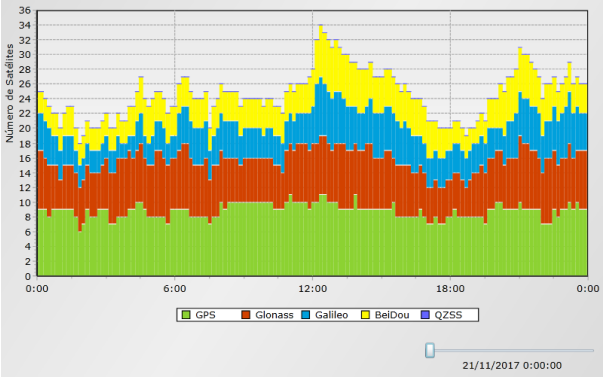

Figure 4: Number of GNSS satellites visible from Bratislava on Nov. 21st 2017. From Trimble GNSS Planning Online.

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- Is Differential GNSS the best approach?

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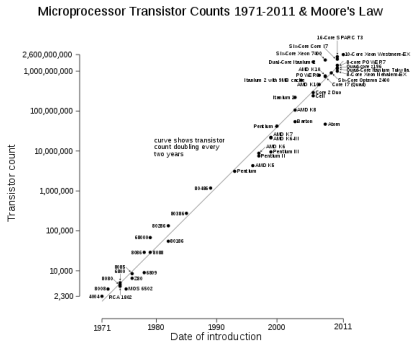

Figure 5: Graph by Wgsimon, distributed under a CC BY-SA 3.0 license via Wikimedia Commons.

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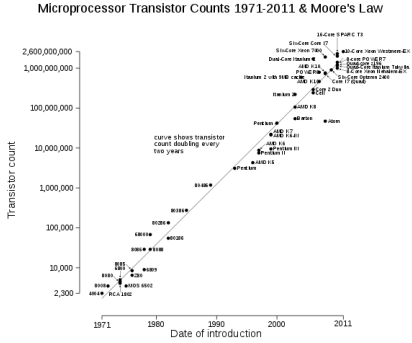

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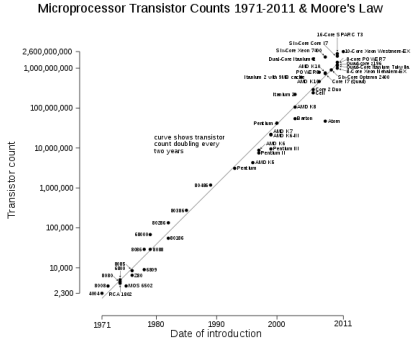

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Trimble RTX: a New Approach for GNSS Network Processing

- One way of handling CPU load is to introduce absolute positioning and ambiguity resolution instead of differential.

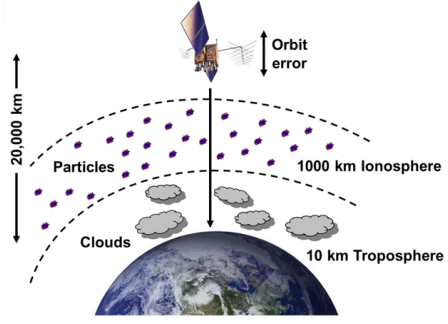

Figure 6: Unlike DGNSS, RTX does not use relative positioning to other reference stations.

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- Trimble RTX introduced in 2012 through the CenterPoint RTX correction service.

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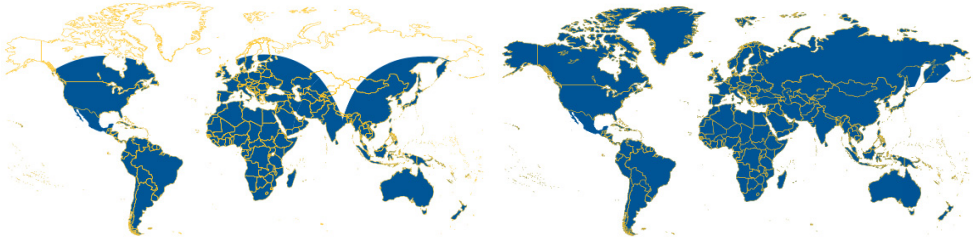
- Centimetre-level accuracy worldwide in real-time.



(a) Coverage via L-band. (b) Coverage via Internet.

Figure 7: Trimble CenterPoint RTX coverage maps. Source: http://www.trimble.com.

Trimble RTX: a New Approach for GNSS Network Processing

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  - GNSS errors are cancelled out or modelled.
  - Residuals remain constant across the VRS network.

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  - Residuals are used to generate network RTK corrections (VRS, RTC3Net and FKP).
  - Transparent process for the network users: rovers work in RTK network mode.

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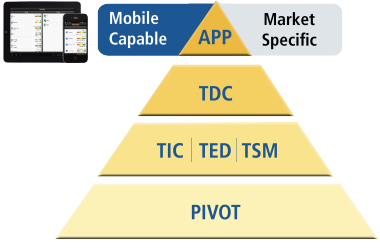
- Trimble PIVOT Software: one platform, multiple applications:



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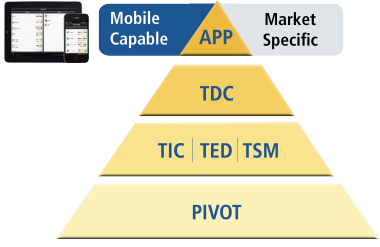

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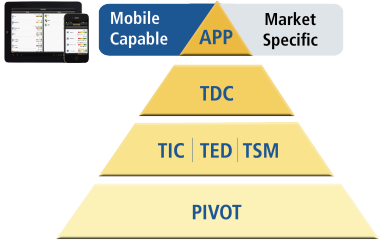

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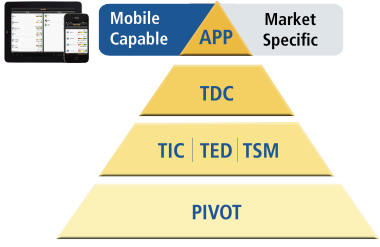

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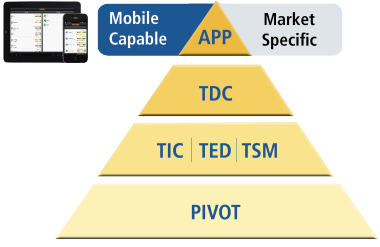

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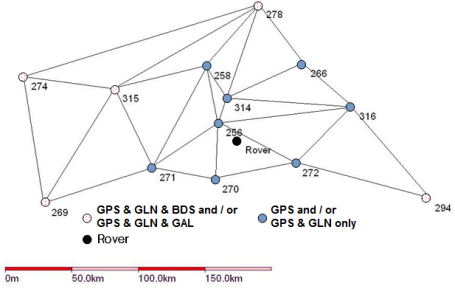

Figure 9: Sample network with sparse GNSS configuration.

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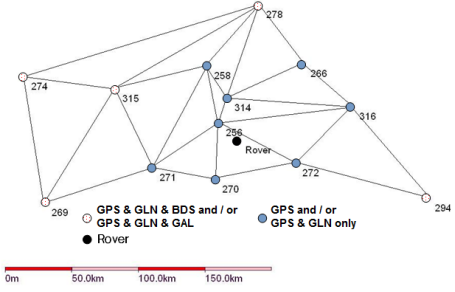
  - Sparse GNSS: allows full GNSS network solution in heterogeneous networks.
  - Supports correction services providers a smother transition to full GNSS.



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- Trimble works in cooperation with major receiver manufacturers to support them in PIVOT.

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- Benefits of using Trimble NetR9 with PIVOT software:

Figure 10: Trimble NetR9 and Trimble Choke Ring antenna.

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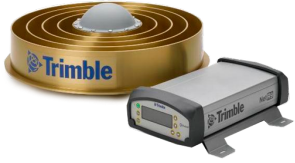

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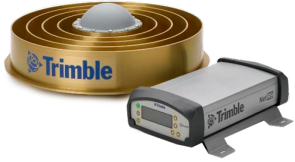

Figure 10: Trimble NetR9 and Trimble Choke Ring antenna.

Compatibility With 3rd Party Receivers

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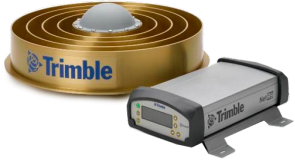

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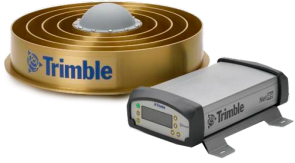

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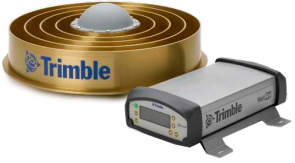
  - ... and once again: receiver biases are essential for optimal results.



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Outline

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- GNSS modernization is one of the biggest challenges in front of us.
- Trimble has already the technology and solutions ready to support correction services providers in the GNSS modernization process:
  - Trimble RTXNet processor uses state-of-the art technology fully compatible with new constellations and signals.
  - Trimble PIVOT and its RTXNet network processor allow correction services providers an easy and smooth transition to full GNSS.
  - Trimble PIVOT software comprises all the solutions required by network operators.

Outline

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Trimble - Advanced Positioning Division

4th EUPOS Technical Meeting - Bratislava (Slovakia), November 21-22, 2017

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