Summary of Hexagon's Plans in Safety Critical High Precision GNSS

20-21 June, 2018

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Hexagon AB 🇸🇪

Hexagon Positioning Intelligence

Global OEM positioning solutions and services

Land   Air   Sea

Assured Positioning - Anywhere

NovAtel   veripos   TERRASTAR   ANTCOM   GPS Solutions

RTCM Paper 094-2018-SC134-013

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Current Focus is on Automotive Applications

- Enabling lane level accuracy for AD/ADAS

4.0 m separation over 9 laps

0.9 m separation over 9 laps

0.5 m separation over 9 laps

60 m
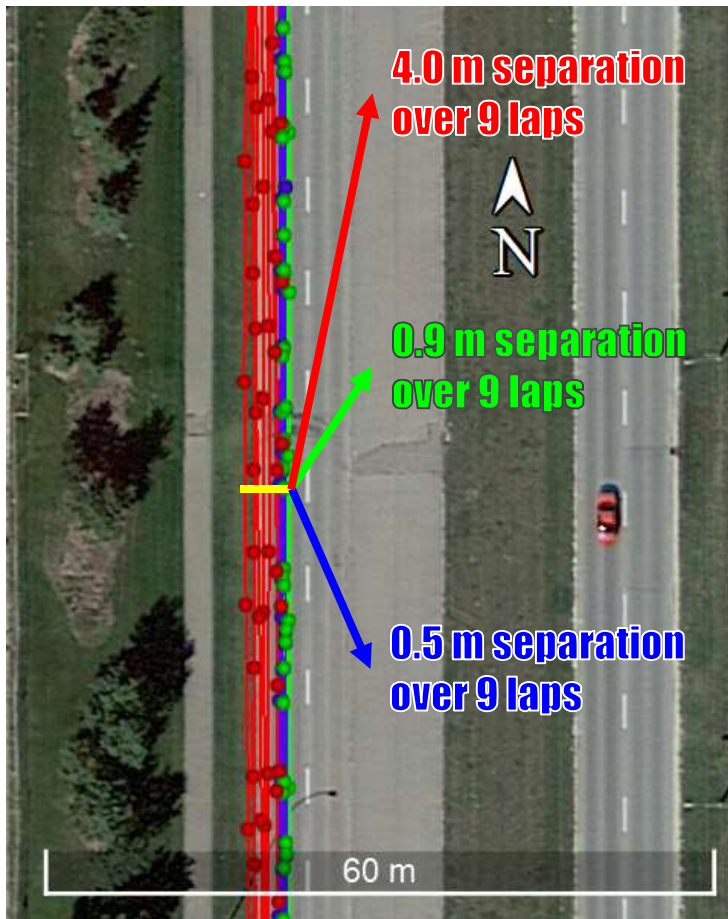
— Automotive Today

— L1 Automotive with Corrections

— L1/L2 Automotive with Corrections

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Other Applications

- Also interested in other applications for safety critical high precision GNSS
- UAV
- Agriculture
- Mining
- Rail

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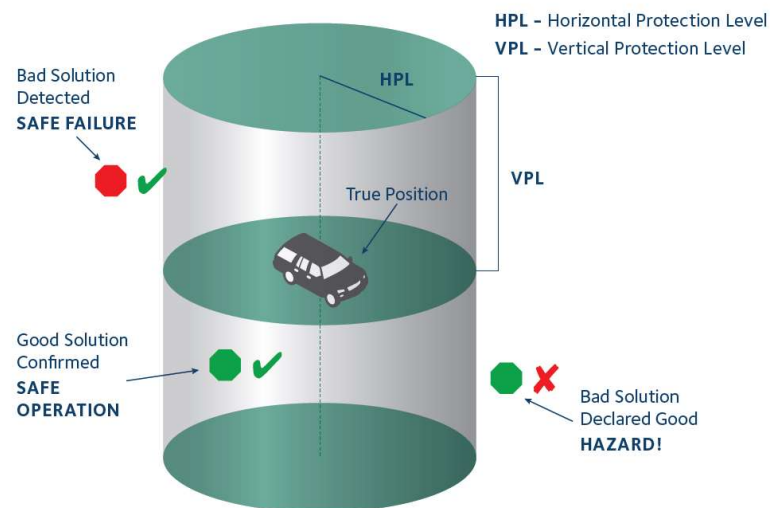
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PPP-RTK is Proposed Technology

Method	What is transmitted?
RTK/NRTK (HxGN SmartNet Corrections Service)	Corrections in the observations space. I.e., corrections per satellite and per (virtual) reference station
PPP (HxGN PI TerraStar/Veripos Corrections Service)	Models of errors: ■ Orbits ■ Clocks ■ Biases
PPP Fast (HxGN Correction Service)	Models of errors: ■ Orbits ■ Clocks ■ Biases ■ Troposphere ■ Ionosphere ■ …

PPP
- Orbits
- Clocks
- Biases

PPP Fast
- Troposphere
- Iononsphere

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Solution Integrity and Academic Engagement

- NovAtel has experience with safety critical GNSS through the WAAS and EGNOS programs

- Aviation RAIM techniques must be translated into the land GNSS use cases

- Systems must be designed to keep integrity risk very low, less than 10^{-7} / h

- NovAtel has been working with Stanford and IIT since 2016 to analyze the integrity case for automotive PPP positioning techniques

HPL – Horizontal Protection Level
VPL – Vertical Protection Level

Bad Solution Detected
SAFE FAILURE

HPL

True Position

VPL

Good Solution Confirmed
SAFE OPERATION

Bad Solution Declared Good
HAZARD!

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Client and Network Integration

- Hexagon is assessing the integrity risk through a combined safety case
- Correction network can mitigate some error sources for user
- User must protect against failures in the corrections
- Overall integrity risk is calculated considering both sides

Loss of Integrity

1×10^{-7} / h

OR

Multipath — Satellite Fault — Corrections Fault — ...

OR

Clock Error — Orbit Error — Signal Deformation — ...

6.25×10^{-11}

AND

Prior probability — P_{md} Network — P_{md} RAIM — P_{md} other mitigation

5×10^{-5} — 0.0025 — 0.01 — 0.05

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