CARLSON Viking Product & Technology

Joao Viana, August, 2025

Overview

Viking Product

- Viking Specs and Features

Viking Technology

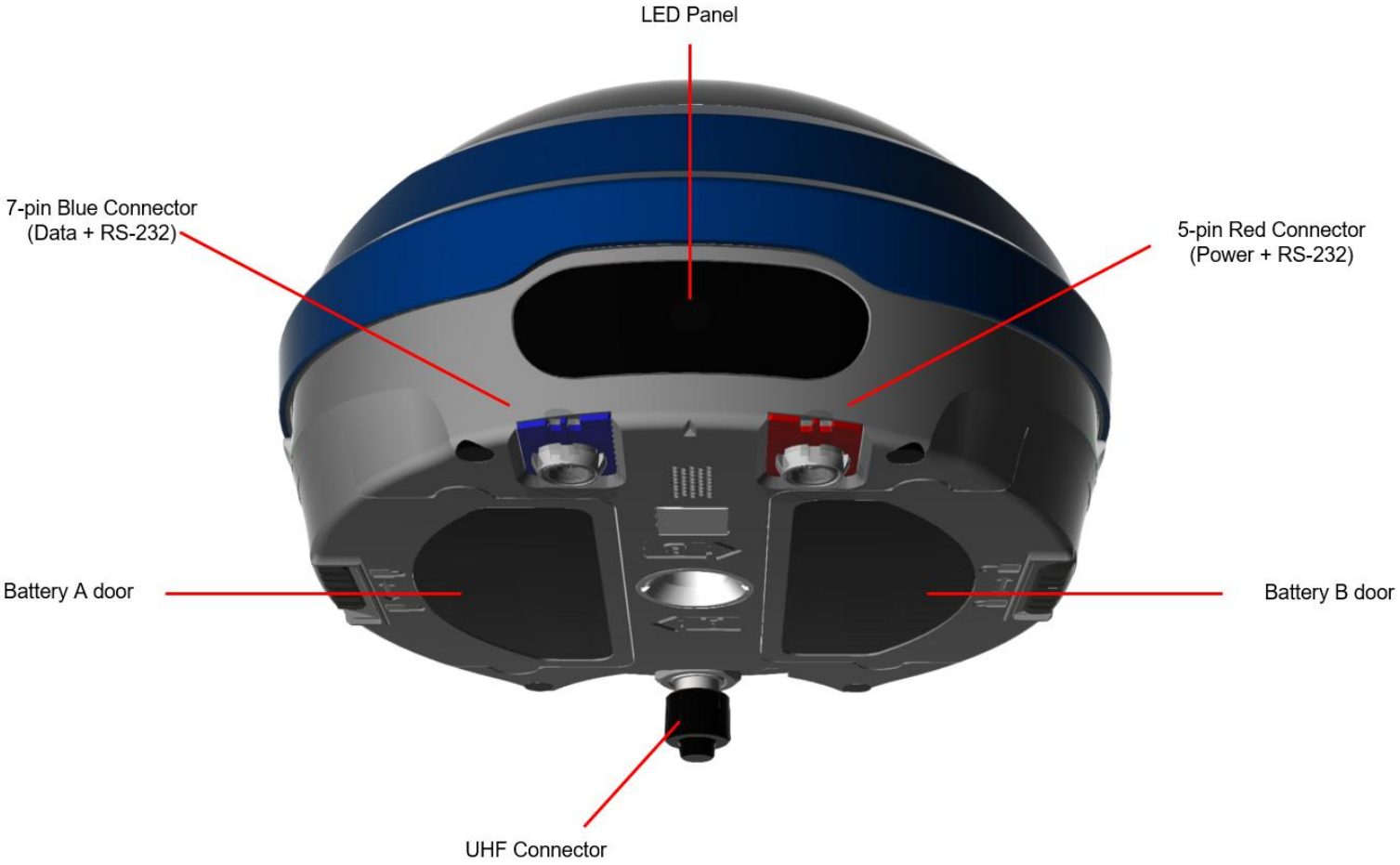
- Gama RTK Technology
- GNSS+ Technology

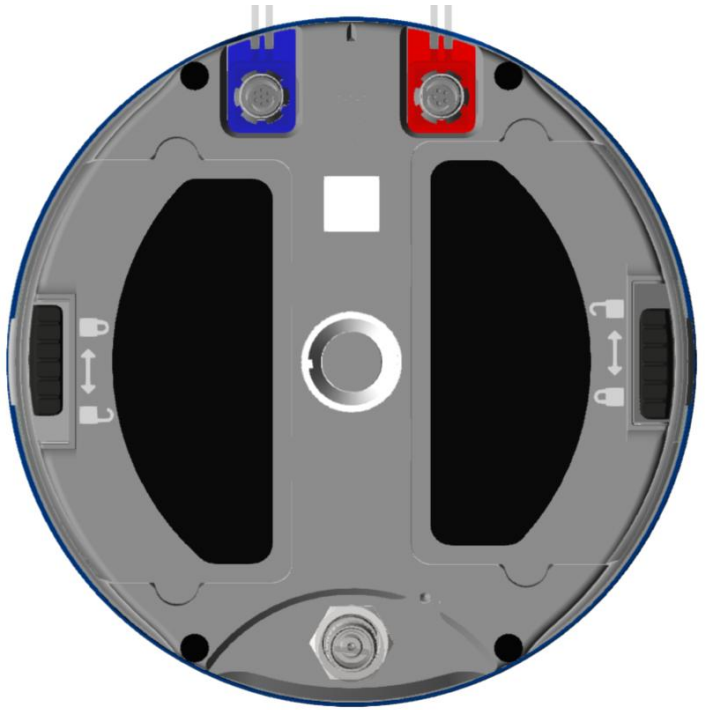
Competitive Testing

- Viking RTK competitive testing

Carlson Viking

Triple-Fixed RTK Receiver

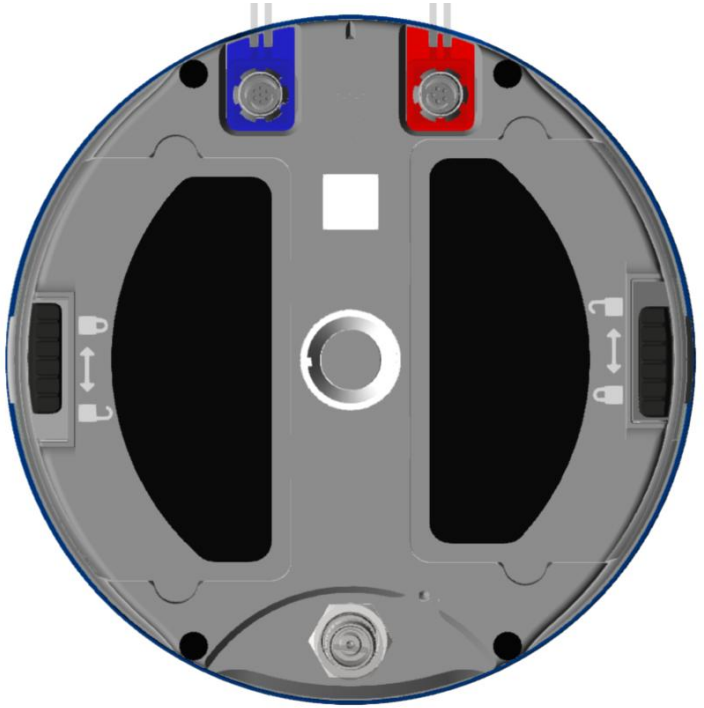


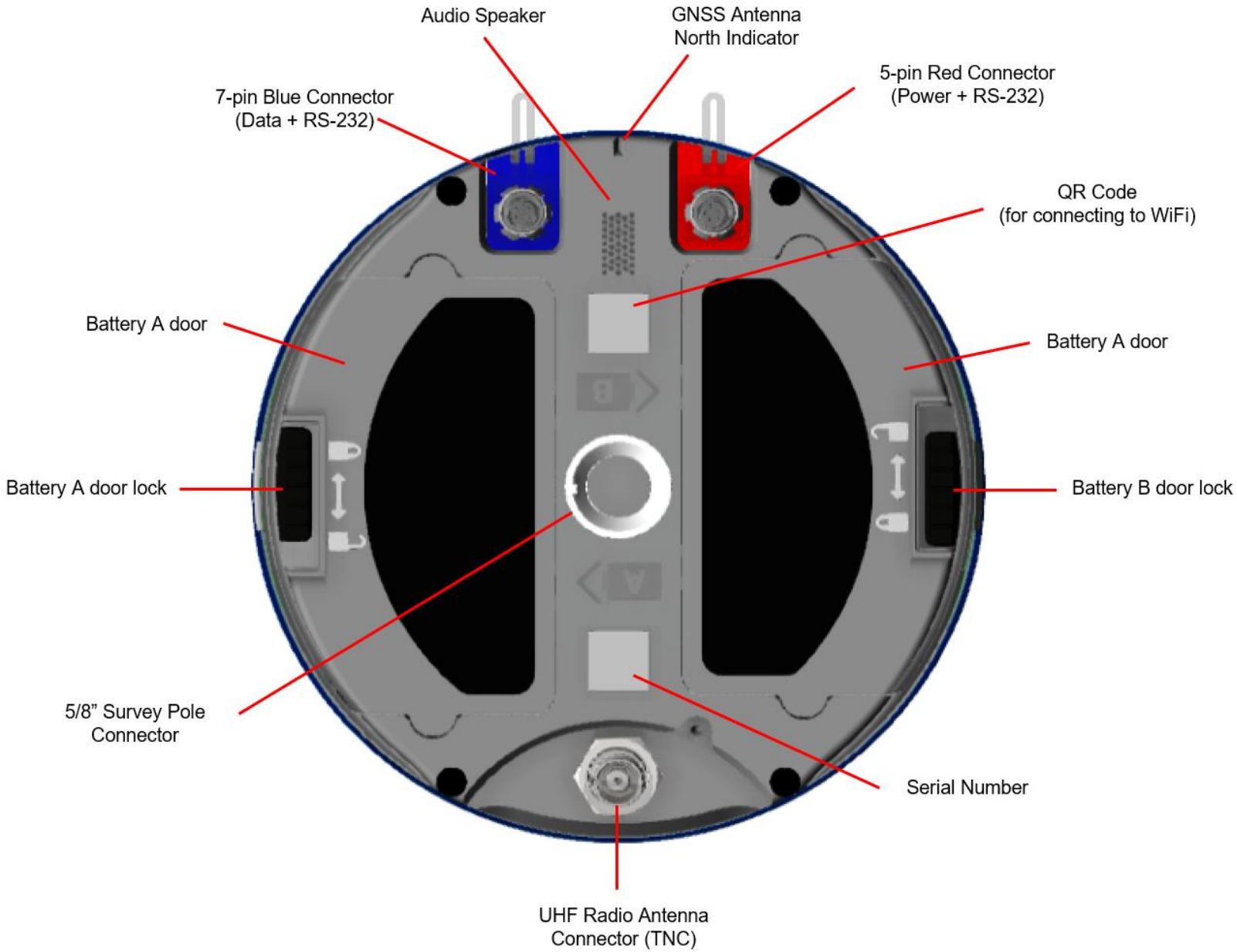


Carlson Viking

Triple-Fixed RTK Receiver

Battery lid release buttor




Audio Speaker
GNSS Antenna
North Indicator
7-pin Blue Connector
(Data + RS-232)
5-pin Red Connector
(Power + RS-232)
QR Code
(for connecting to WiFi)
Battery A door
Battery A door
Battery A door lock
Battery B door lock
5/8” Survey Pole
Connector
Serial Number
UHF Radio Antenna
Connector (TNC)

CARLSON Viking

BEST IN CLASS RTK SURVEY RECEIVER

DESIGNED TO MATCH AND SUPERSEDE THE BRX7

2 GNSS Receivers + 3 RTK Engines

- Triple-Fix RTK

RTK Rover and Base modes

- Bult-in NTRIP Caster
- Simultaneous multi-stream (cell, UHF, NTRIP, Listen-Listen)

L-Band Support

Galileo HAS Support

CARLSON Viking

BEST IN CLASS RTK SURVEY RECEIVER

DESIGNED TO SUPERSEDE THE CARLSON BRX7

2 GNSS Receivers + 3 RTK Engines

- Triple-Fix RTK

RTK Performance

- Horizontal accuracy: 0.6 cm + 0.5 ppm
- Vertical accuracy: 1.0 cm + 1.0 ppm

Tilt Compensation (with 2 m pole)

- 7 mm @ 20 deg
- 9 mm @ 30 deg
- 12 mm @ 45 deg
- 15 mm @ 60 deg

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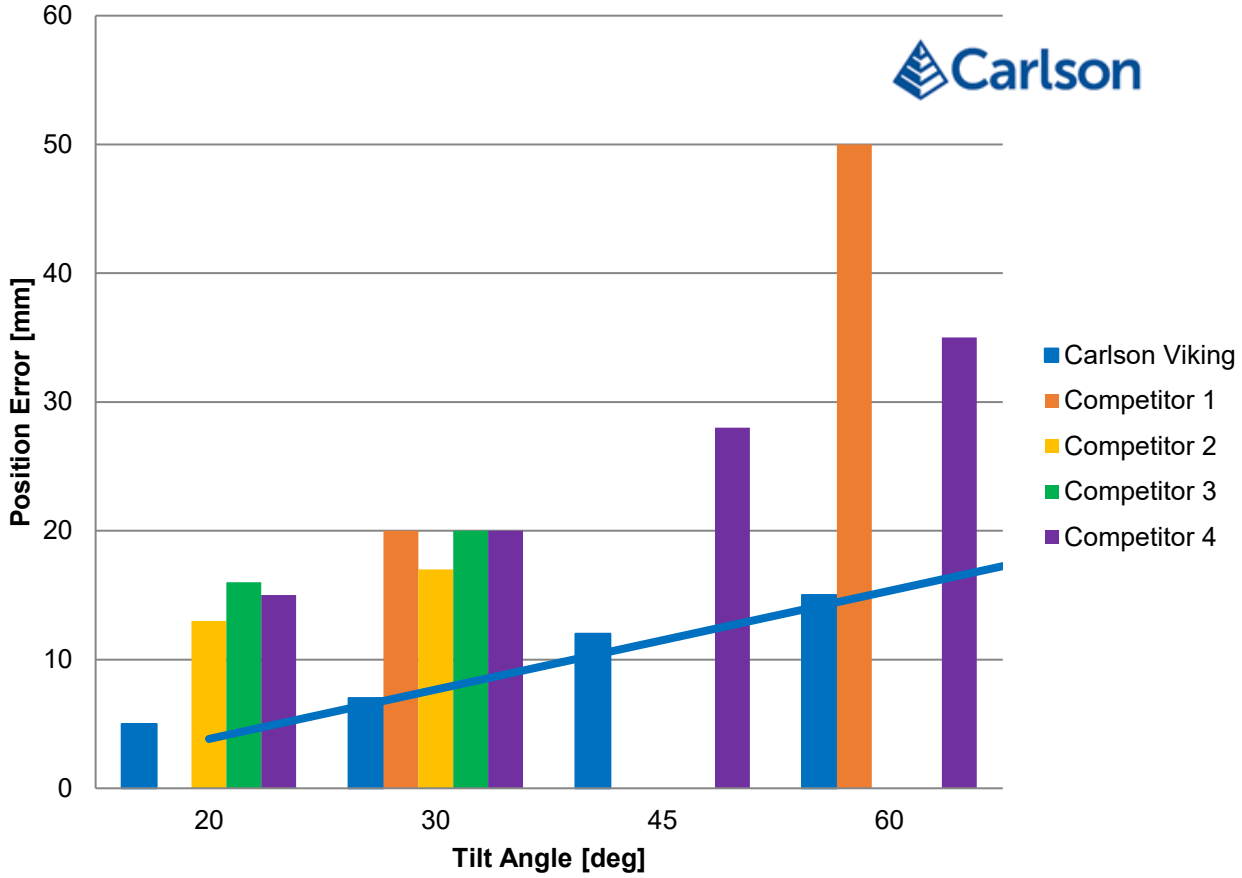


Tilt Error in mm					
Tilt Angle (deg)	**Viking**	**BRx7**	**Trimble R12i**	**Leica GS18**	**Topcon HiPer XR**
20	5		13	16	15
30	7	20	17	20	20
45	12		X	X	28
60	15	50	X	X	35

CARLSON Viking

BEST IN CLASS RTK SURVEY RECEIVER

BEST IN CLASS FEATURES

RTK Rover and Base modes

- Bult-in NTRIP Caster

L-Band Support

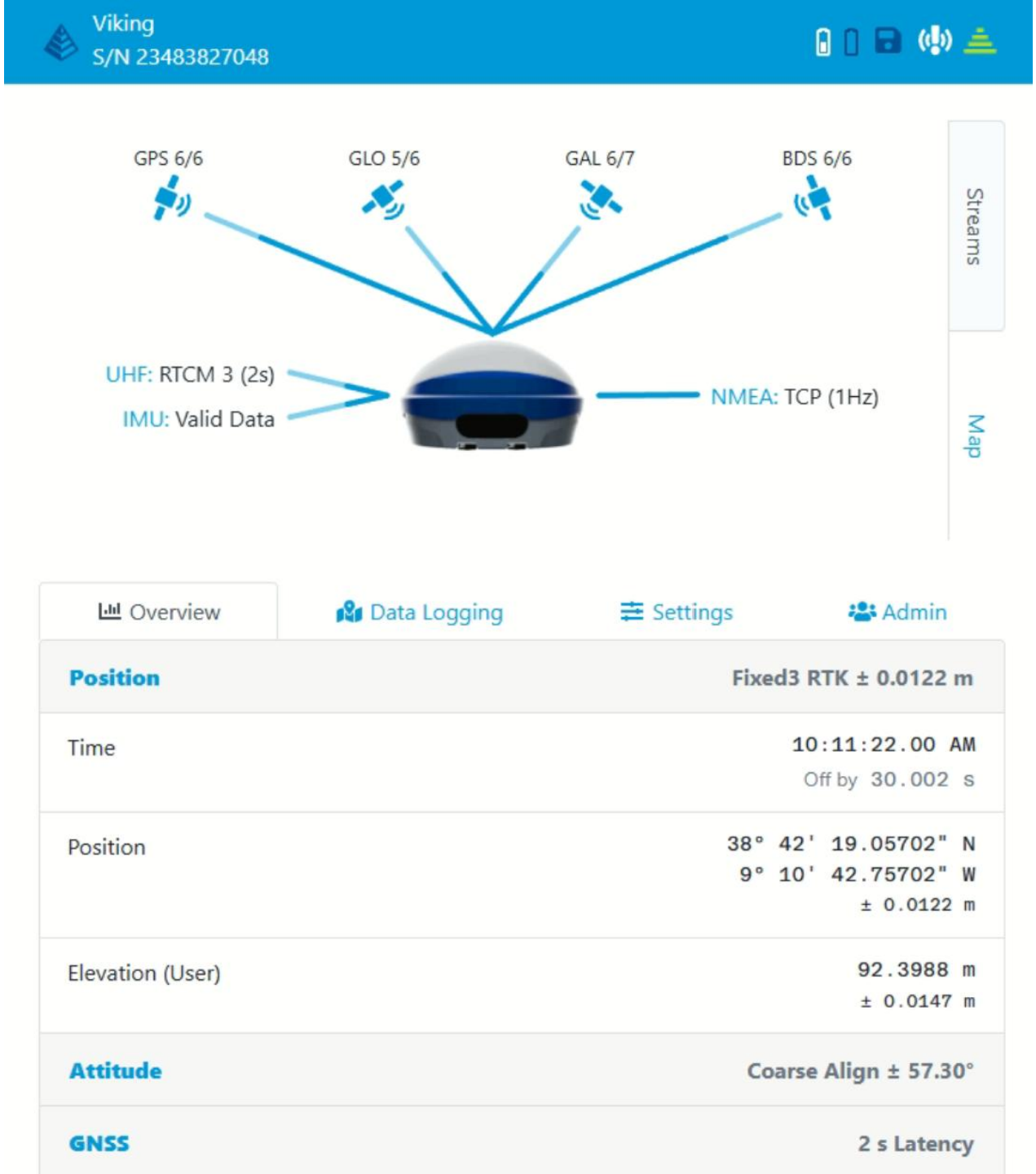
Galileo HAS Support

Advanced Web UI

- GNSS status and QA information
- Jamming and interference detection
- Seamless FW updates directly from internet
- Direct RINEX download

Carlson Remote Customer Support

- Remote access for customer support
- (requires SIM card)



CARLSON Viking

BEST IN CLASS RTK SURVEY RECEIVER

BEST IN CLASS HW

Best in class GNSS antenna element

- Accurate and stable phase center
- Excellent multipath rejection
- Excellent accuracy even while tilting

Best in class built-in IMU

- High-accuracy tilt-compensation
- No calibration required
- Tilt compensation in static and challenging environments

CARLSON Viking

BEST IN CLASS RTK SURVEY RECEIVER

2 hot swappable batteries

- Up to 15 h battery life
- Charge batteries without removing from 12 V or USB-C
- External dual-bay charger

Internal UHF Radio (400 MHz + 900 MHz)
Internal Cell Modem (SIM + eSIM)
WiFi
Bluetooth

Serial RS-232

- Connect to external high-power UHF Radio
- Output NMEA
- Connect to SurvPC

Viking Technology

GAMA RTK Technology

GNSS+ Technology

GAMA RTK Technology

The Gama RTK Engine

- Carlson Software's next generation RTK engine (named after famous explorer Vasco da Gama)
- Gama deploys a range of innovative technologies to deliver best-in-class performance
- See Gama RTK White Paper for details on Carlson's RTK technology

Key features of Gama include:

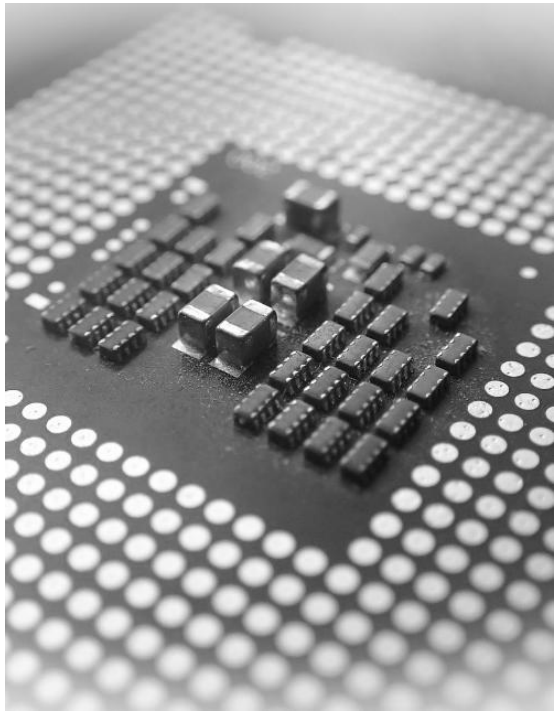
- Optimization for Next-Gen CPUs
- Next-Gen Filters
- GNSS Signal and Frequency Diversity
- Outlier Detection and Handling
- Real-Time Adaptive Filtering
- IMU Tight-Coupling

GAMA RTK Technology

FOR NEXT-GEN CPUs

Modern CPU architectures enable powerful multi-core computations in embedded and handheld devices.

Gama was designed to take full advantage of multi-threaded computation routines, unlocking new possibilities and computational performance.



NEXT-GEN FILTERS

At its core Gama relies on multiple Extended Kalman Filters that estimate individual error components, for each individual GNSS signal. New CPU architectures enable, for the first time, to deploy extended mathematical models eliminating approximations that were a necessity of the past. Gama can estimate more than 1000 parameters per second to ensure the highest accuracy in every environment.

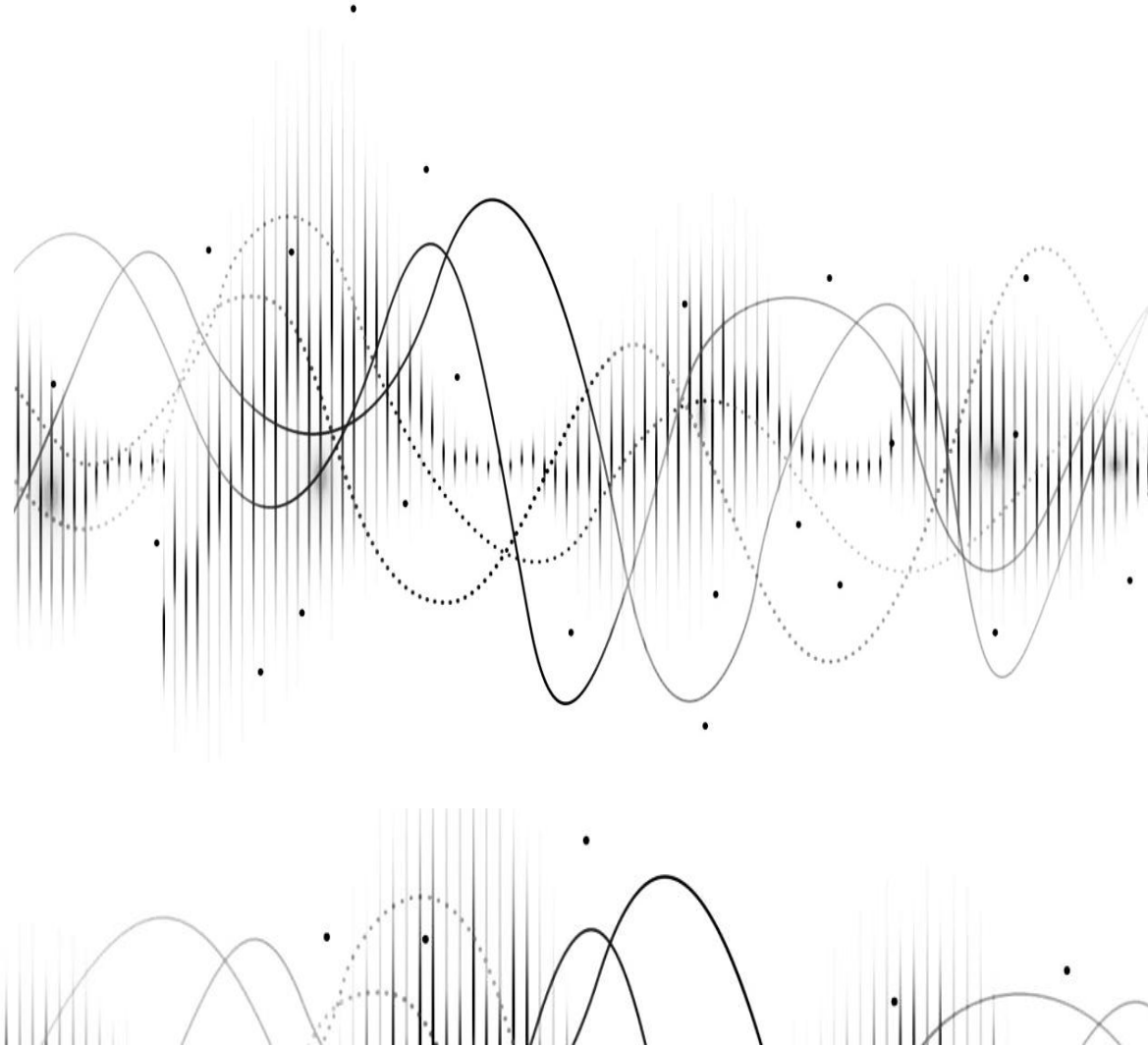
GAMA RTK Technology

GNSS SIGNAL AND FREQUENCY DIVERSITY

Gama was designed from the ground up to take maximum advantage of all GNSS signals available today as well as those that may become available in the future.

Strict independent handling of all GNSS signals available in multiple frequencies, including different modulations that signals have available in common GNSS frequency bands.

- Gama can fully use the legacy GPS L2P and the new L2C simultaneously, side by side with GPS L1 and L5
- Gama can also operate in single-frequency mode, or with any sub-set of frequencies, in case some signals are not available or become jammed

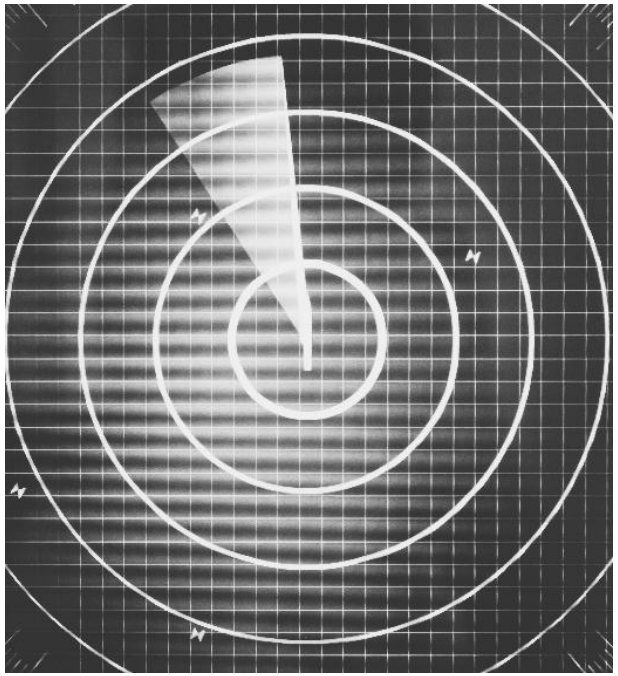


GAMA RTK Technology

OUTLIER DETECTION AND HANDLING

Multiple protection layers apply a variety of techniques for outlier detection and handling that protect the main estimation process responsible for the high-accuracy PVT computations.

Iterative Robust Statistics and strict statistical analysis is employed to identify measurements that do not fit in the predefined model.



Outlier handling mechanisms respond by either adapting the error models in real-time, and still use the affected observation, or by fully rejecting faulty observations if the error is too large to be useful. This logic is applied in the multiple Extended Kalman Filters that comprise Gama, as well as at the level of a range of pre-processing filters.

GAMA RTK Technology

REAL-TIME ADAPTIVE FILTERING

Gama employs multiple techniques to ensure all GNSS error models are as accurate as possible, regardless of the environmental conditions and dynamics.

Data-driven error models were carefully derived from a broad pool of real environment data, collected under controlled conditions, and provide a strong basis for all estimation processes within the Gama Engine.

To cope with changing conditions of the surrounding environment, a collection of **pre-processing filters** are used to monitor GNSS signal quality, not only in terms of magnitude of the errors but also its temporal behavior (how effects change over time windows), together with other signal characteristics such as the GNSS signal strength.1

Different multi-frequency signal combinations are computed, and filtered, to isolate different error sources (multipath, non-LOS signals, ionosphere) and interpret their magnitude and time behavioral characteristics.

All these metrics are combined to adjust in real-time the GNSS observation models of the main Extended Kalman Filters.

Viking GNSS+ Technology

Viking and VASCO use Septentrio GNSS chips with GNSS+ Technology

GNSS+ offers Advanced Positioning and Protection Technology

- First layer of protection for the Carlson Gama RTK engine
- GNSS RF, signal acquisition and tracking layer

Leverage the best of both Carlson and Septentrio technologies

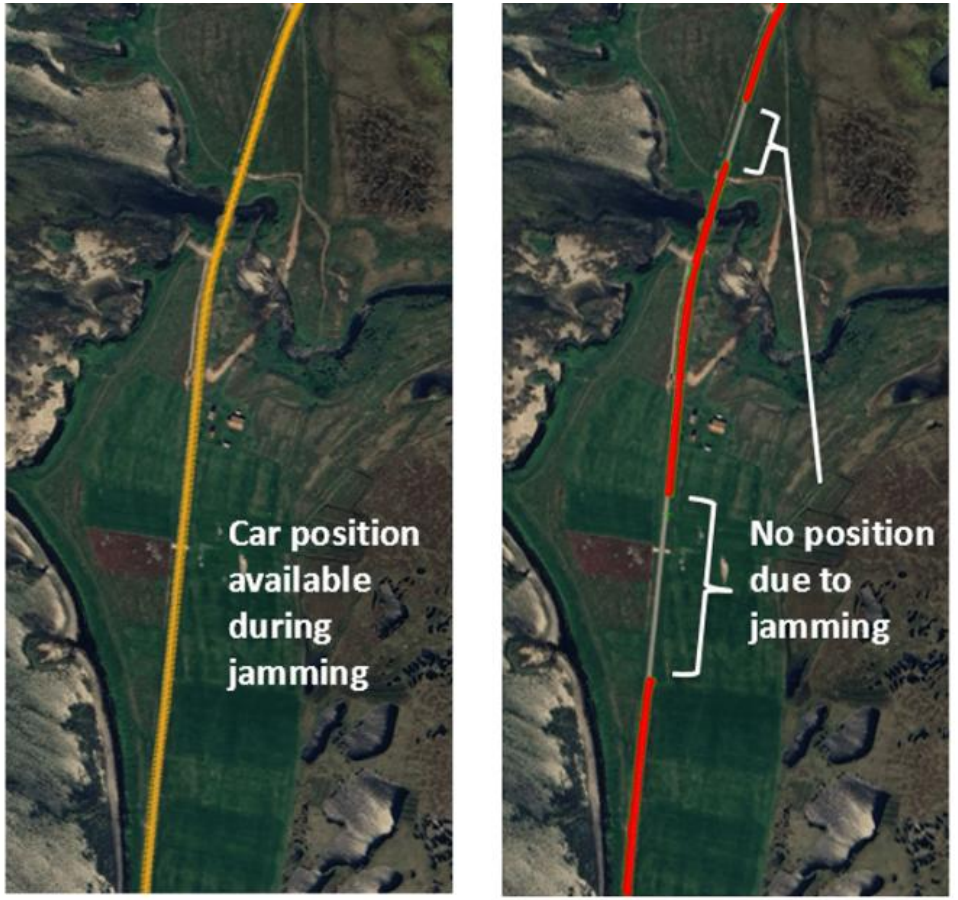
- ✓ AIM+
- ✓ LOCK+
- ✓ IONO+
- ✓ APME+
- ✓ RAIM+

AIM+

Anti-jamming and Anti-spoofing protection

- **Advanced Interference Monitoring and Mitigation** patented technology offers resistance against radio interference and protects against intentional GNSS jamming and spoofing

- **The most advanced anti-jamming, anti-spoofing** on-board interference mitigation technology on the market (narrow and wide band, chirp jammers)



AIM+

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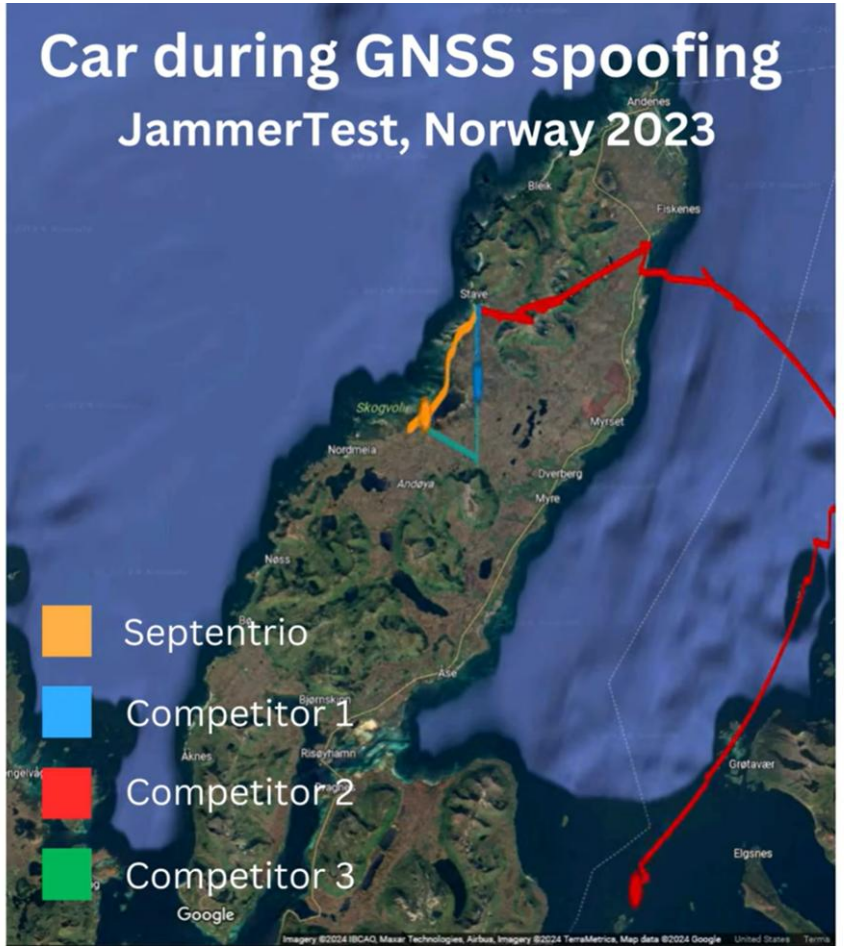
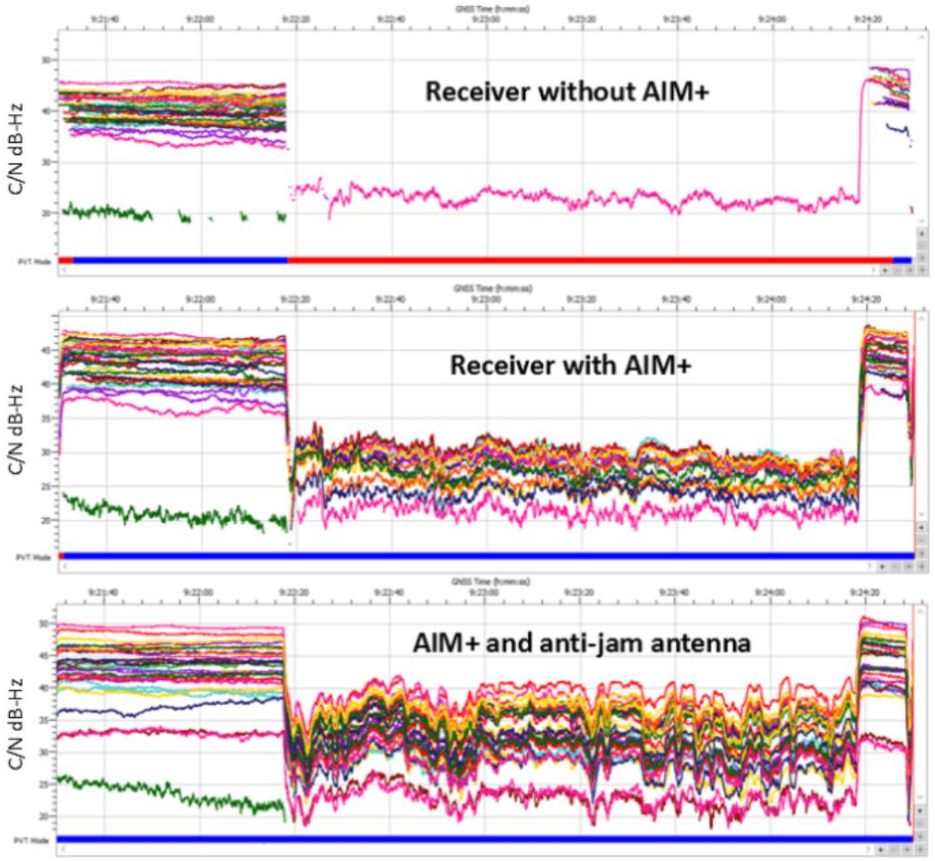


AIM+

Anti-jamming and Anti-spoofing protection

Most resilient GNSS receiver: results from JammerTest in Norway



Standard antenna: loss of position without AIM+

Standard antenna: positioning during jamming with AIM+

Anti-jam antenna: positioning with AIM+ and a small improvement in signal quality due to antenna

Figure 4: During heavy jamming Septentrio receiver with AIM+ mitigates interference and provides positioning (middle plot). With anti-jam antenna there is signal quality improvement and positioning (bottom plot). Without AIM+: no positioning (top plot)

LOCK+

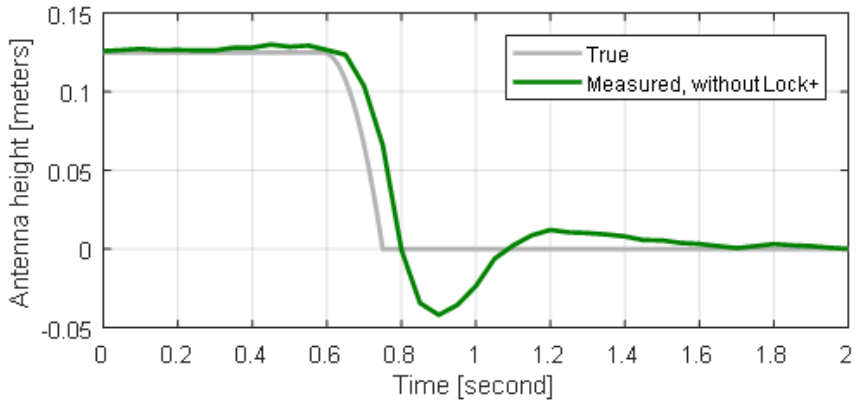
Robust tracking during high vibrations and shocks

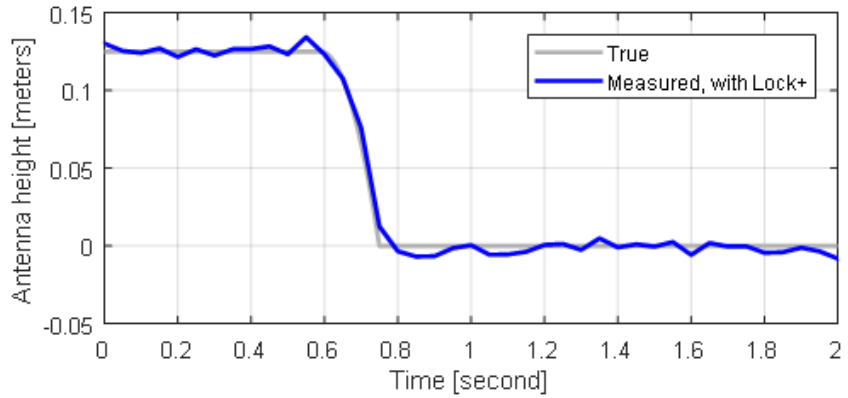
- Ensures optimal tracking even under rapid antenna displacement, maintaining high accuracy together with:
- **Resilience** to heavy vibrations and shocks
- **Stable operation** during high dynamics

LOCK+

Robust tracking during high vibrations and shocks

- LOCK+ significantly decreases the latency and overshoot effects.
- LOCK+ considerably helps under high dynamics.
- Automatic detection of antenna motion to enable LOCK+ only when needed, keeping the noise as low as possible during smooth motion or when the receiver is static.



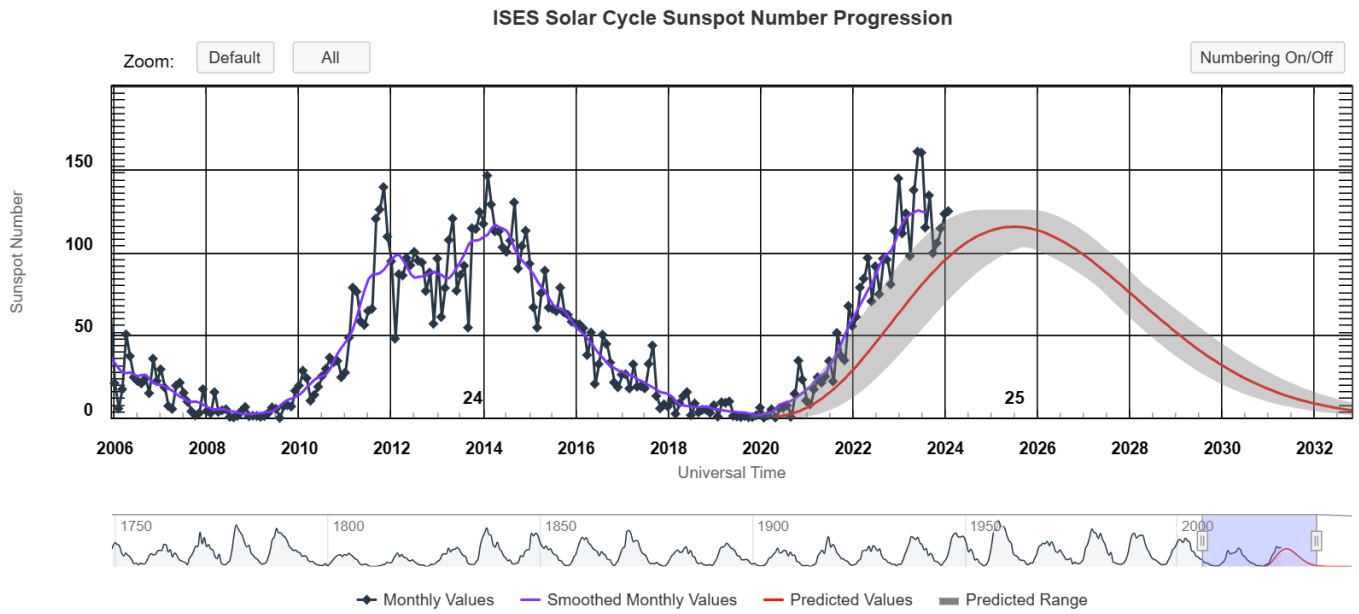


IONO+

Ionospheric scintillation monitoring and mitigation

Mitigates adverse impact of both normally active and scintillating ionosphere:

- **Resilience** to ionospheric scintillation
- **Stable operation** during solar storms



APME+

Ionospheric scintillation monitoring and mitigation

Multipath mitigation technology for higher accuracy and reliability:

- **Resilience** to multipath error
- **Stable operation** near buildings, heavy machinery and construction sites

Extra correlators in each tracking channel to estimate the multipath error on the pseudorange and carrier phase measurements.

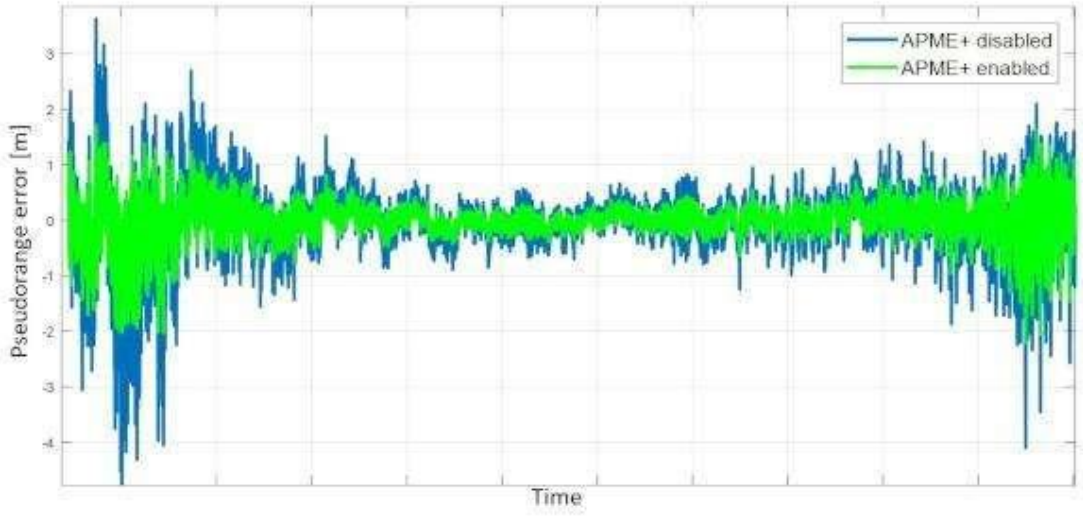


Figure 2. Pseudorange error, in meters, during the whole pass of a GPS satellite.

RTK COMPETITIVE TESTING

- FOREST
- URBAN ENVIRONMENT

RTK Competitive Testing
Pine Tree Foliage

Viking vs Best-in-class RTK Receivers

- Top-tier RTK smart antenna receivers
- Top 4 GNSS receiver brands in the USA
- Identities were withheld for confidentiality

Stop-and-go testing on 9 points

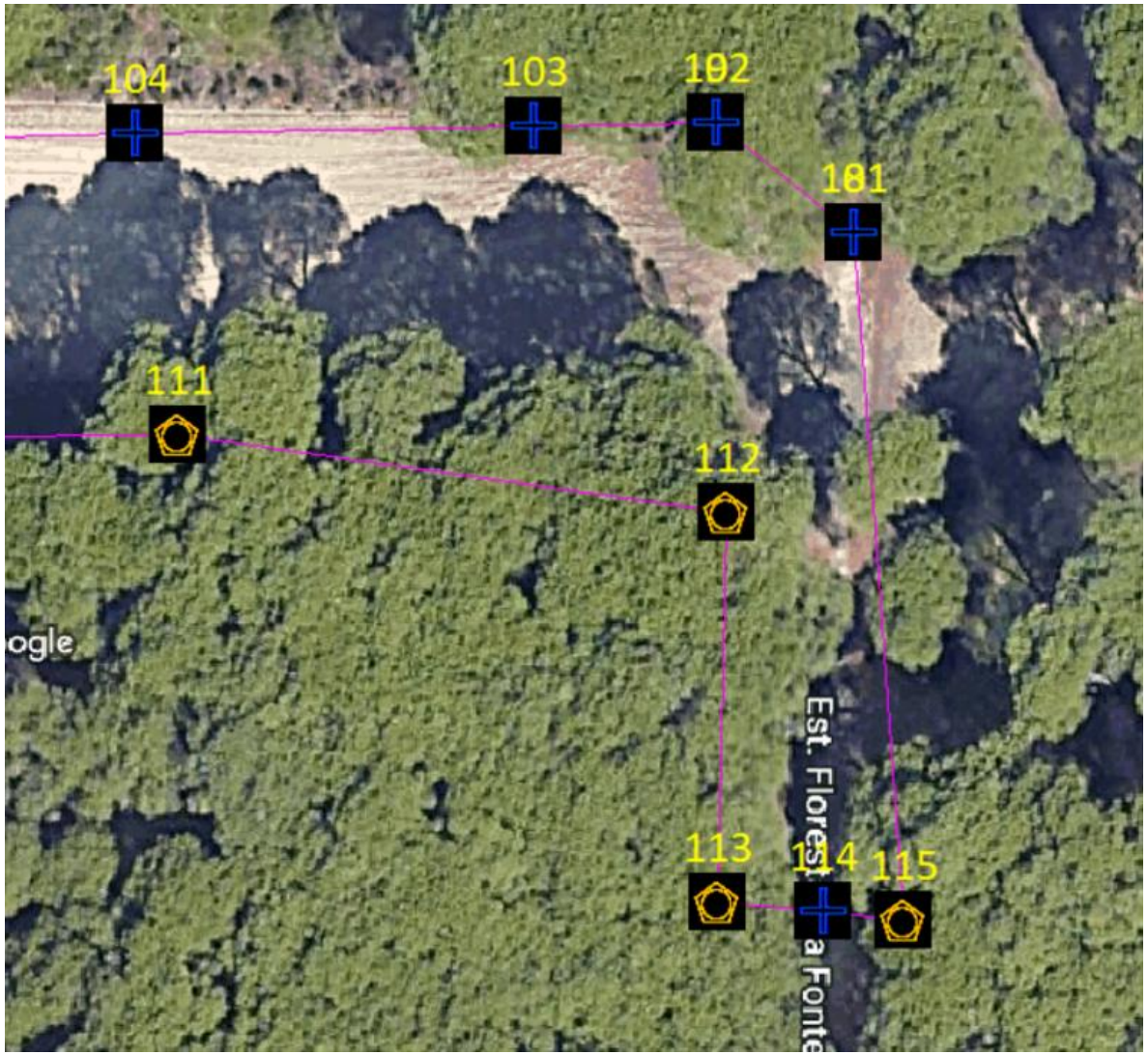
- Stake out pre-surveyed test track

207 points

- 23 laps

Single point storage

- No average, no static
- Level and store (do not wait for Fix)



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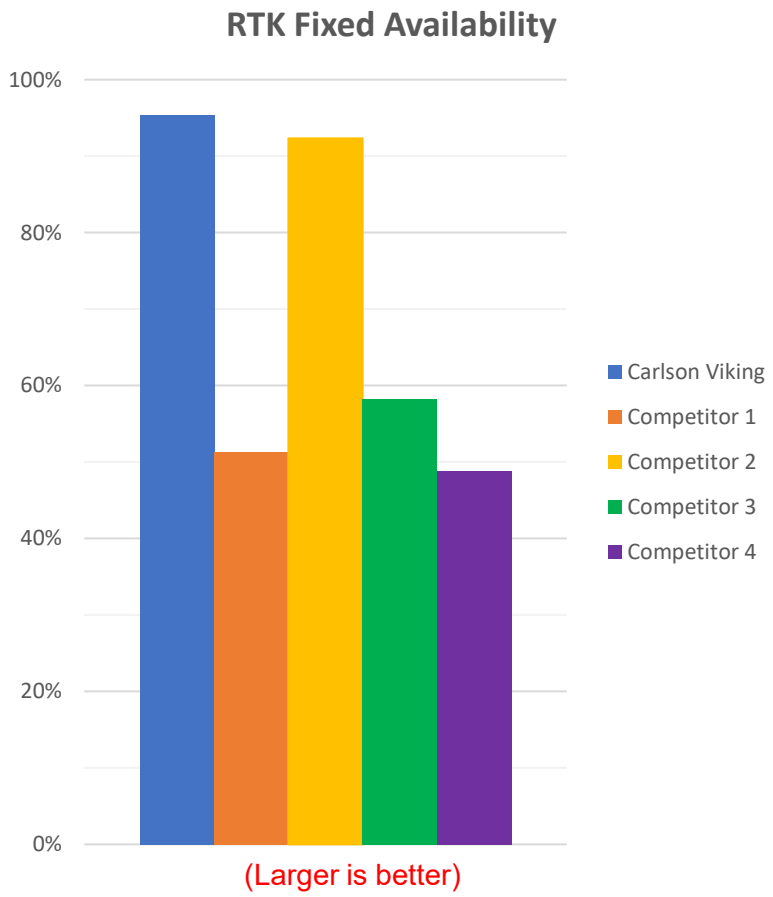
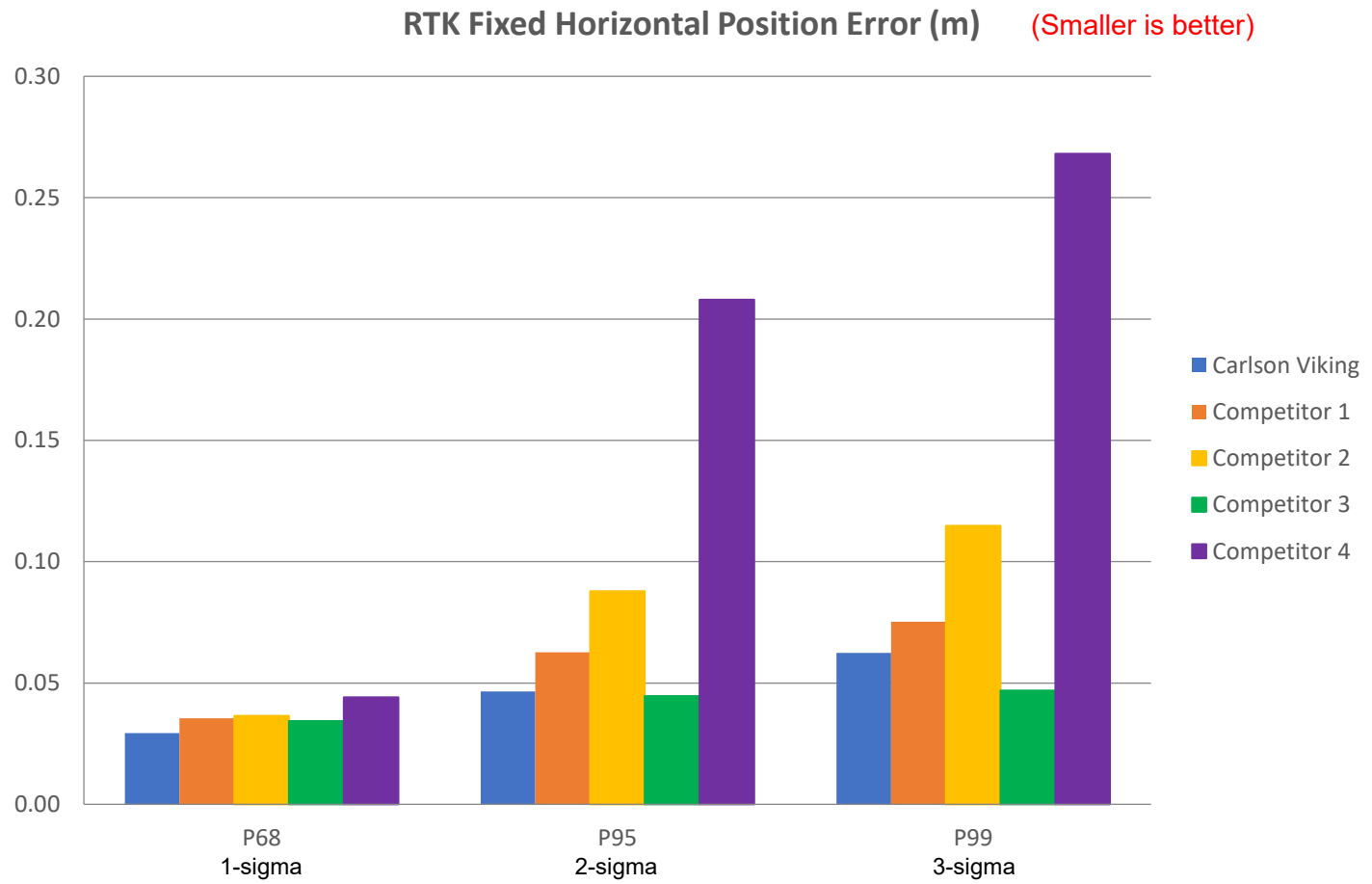
RTK Performance Summary

Viking delivers both 1) highest accuracy and 2) best reliability





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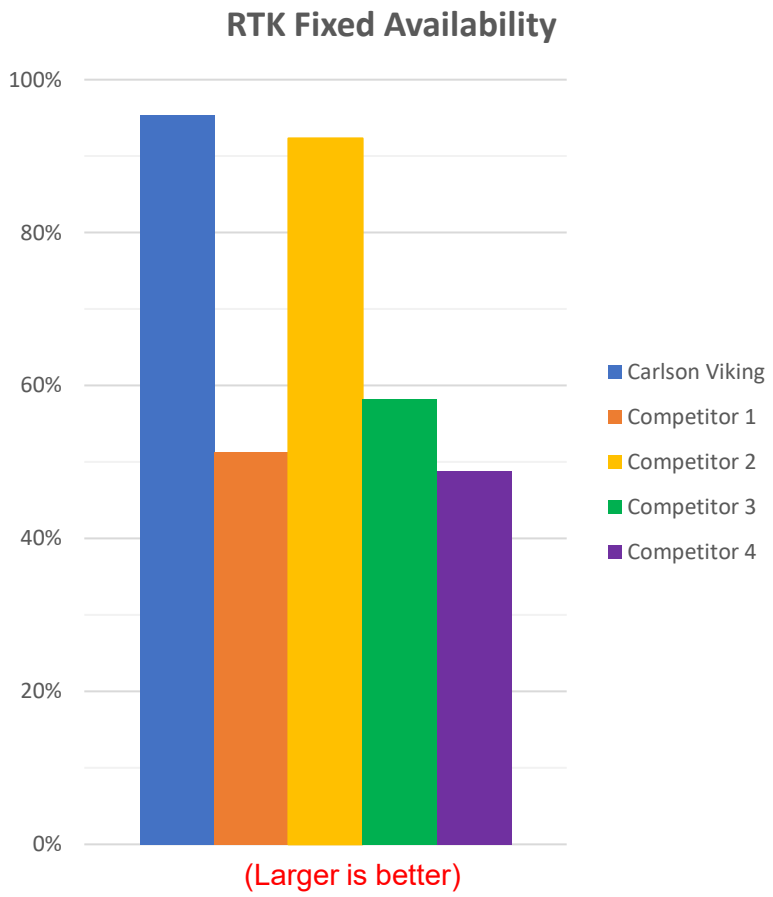
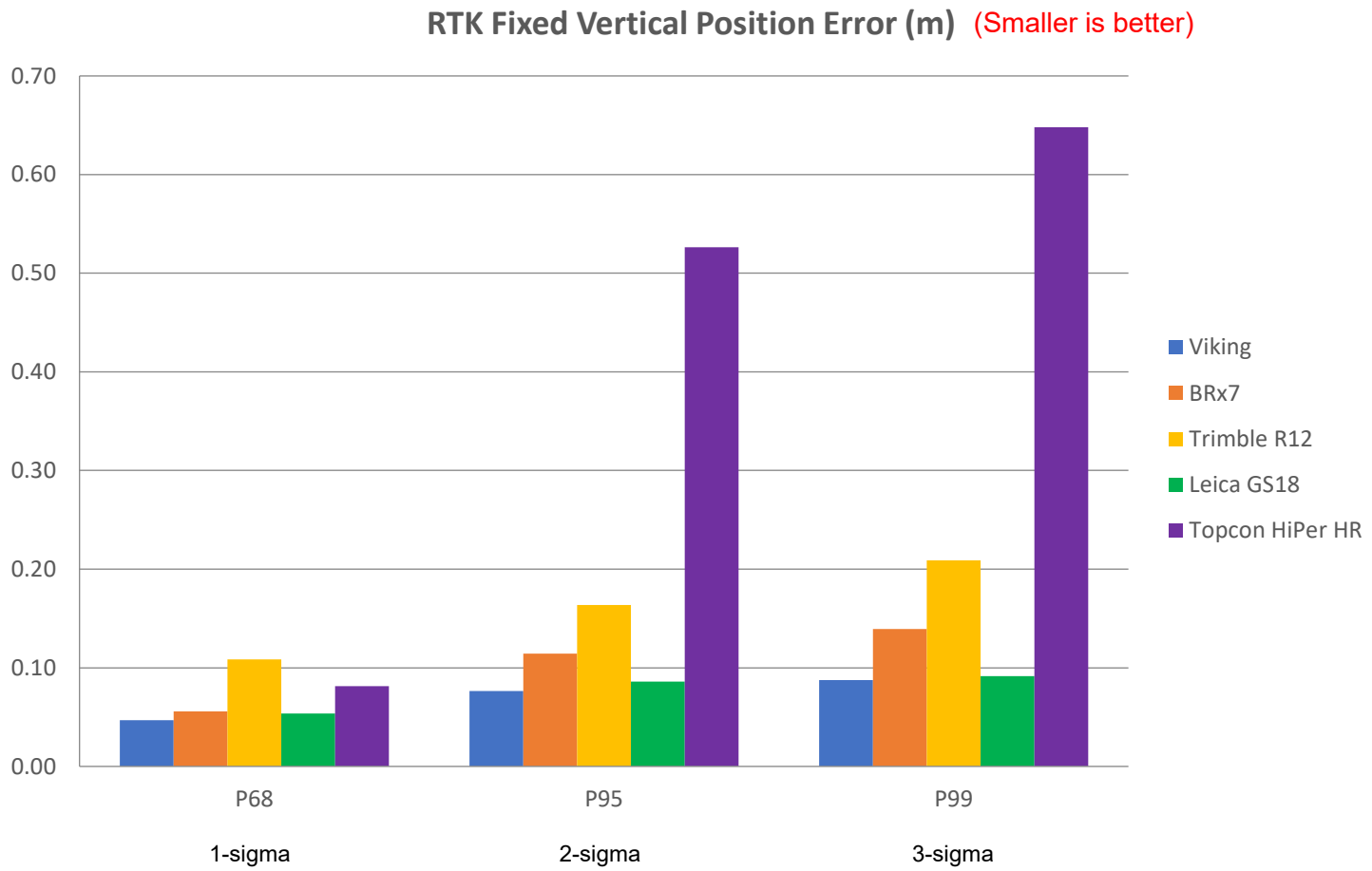
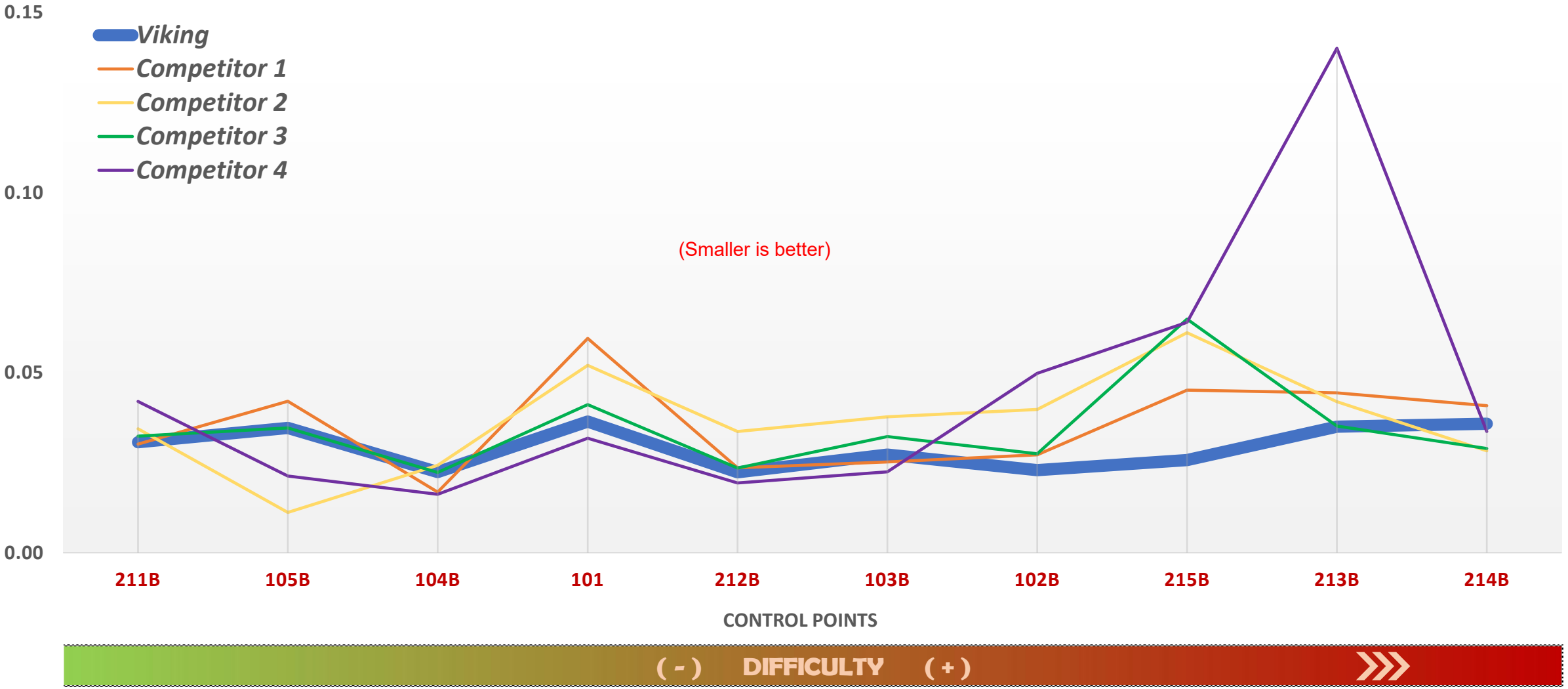




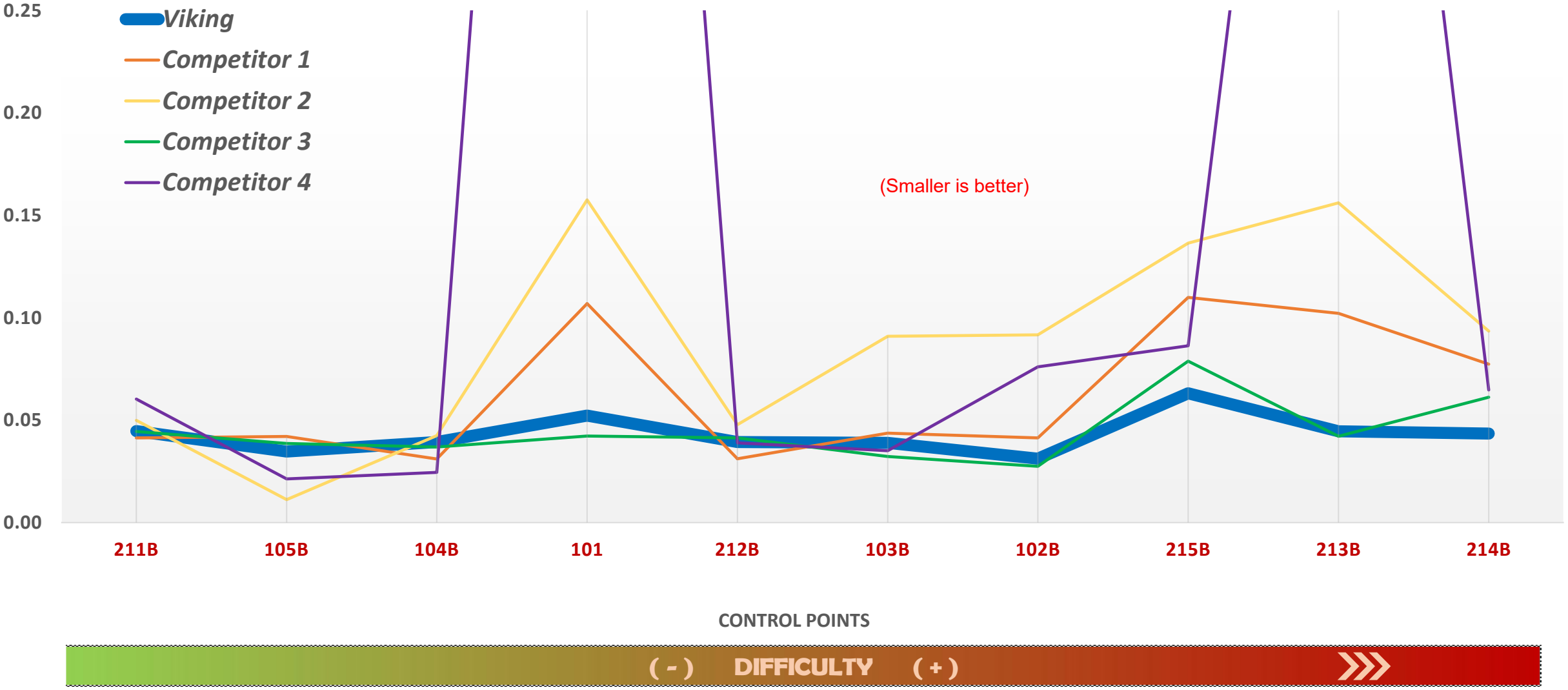
Horizontal Error RMS (m)

1-sigma (68th percentile)



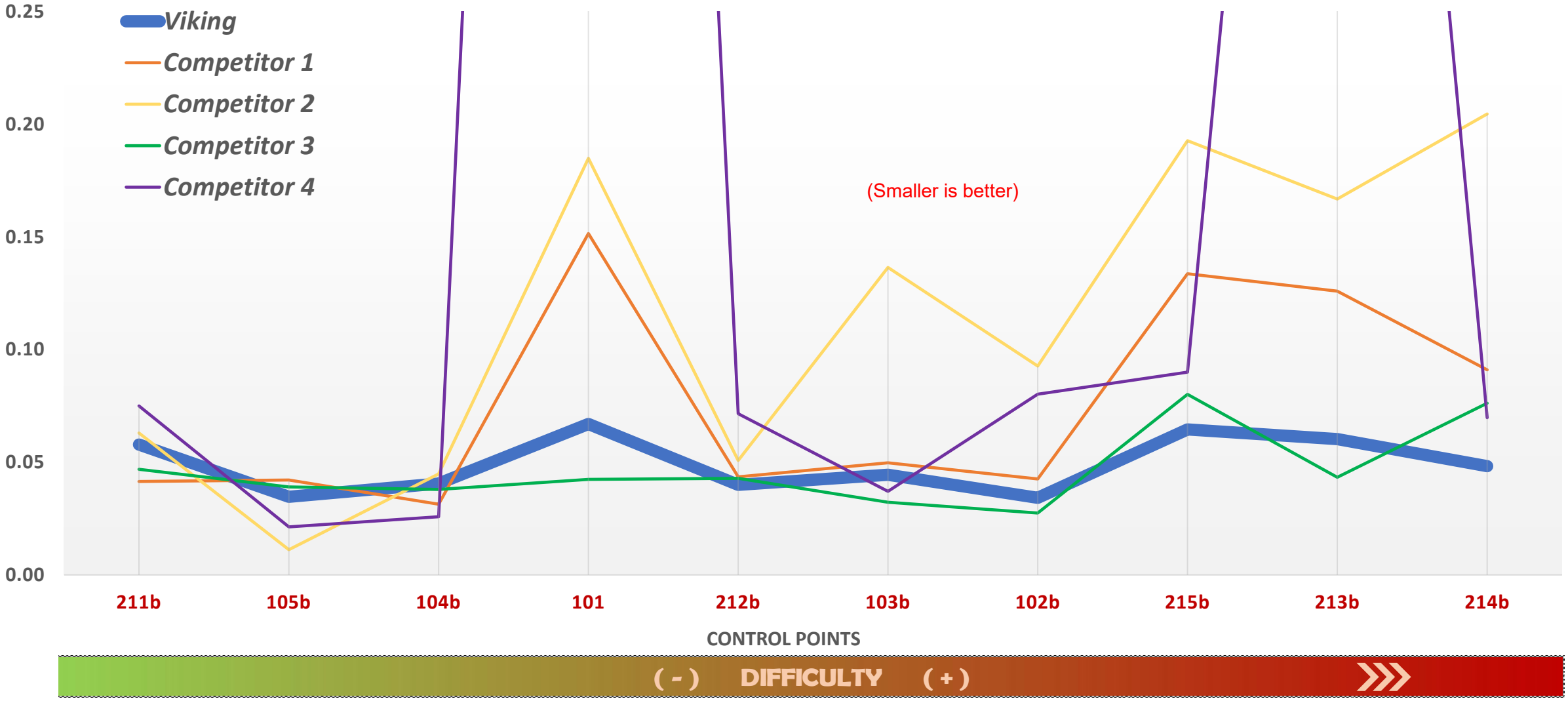
Horizontal Error RMS (m)

2-sigma (95th percentile)



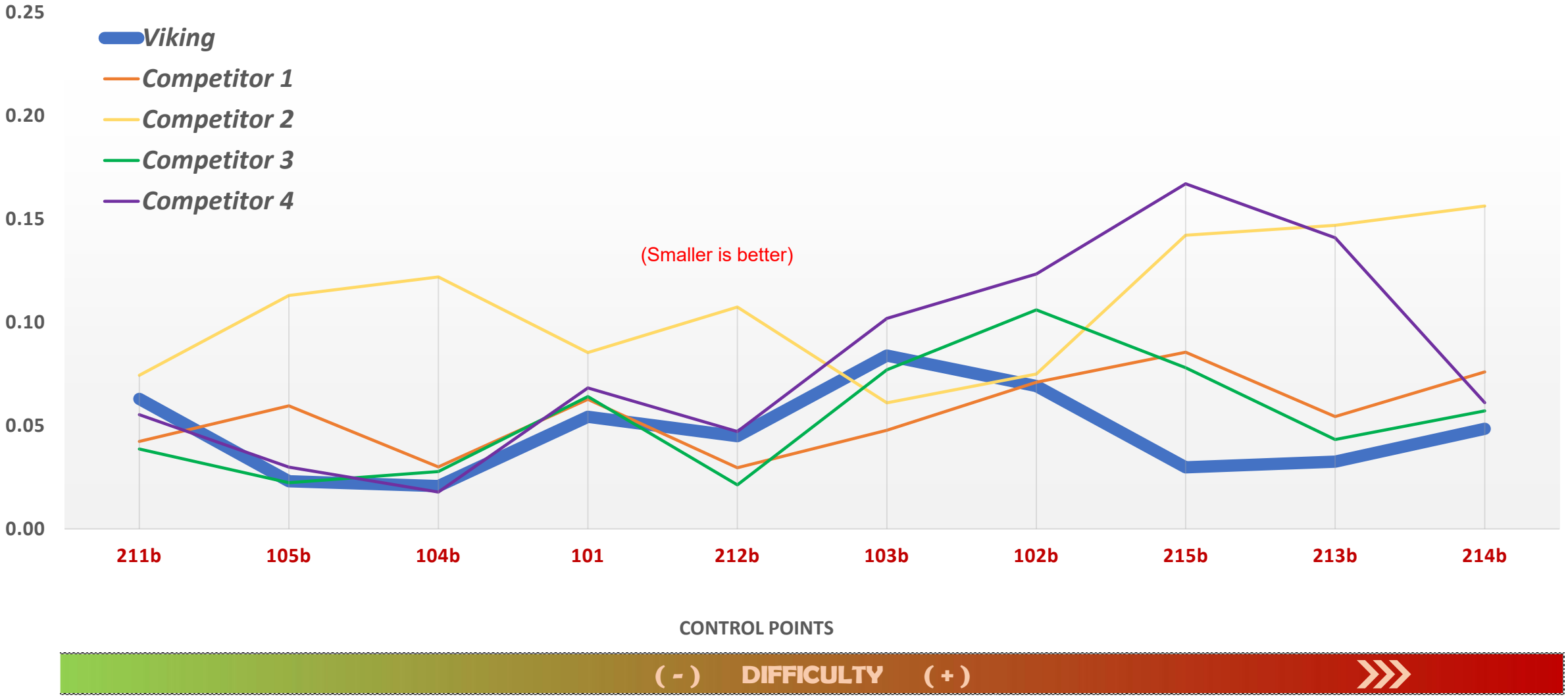
Horizontal Error RMS (m)

3-sigma (99th percentile)



Vertical Error RMS (m)

1-sigma (68th percentile)



Vertical Error RMS (m)

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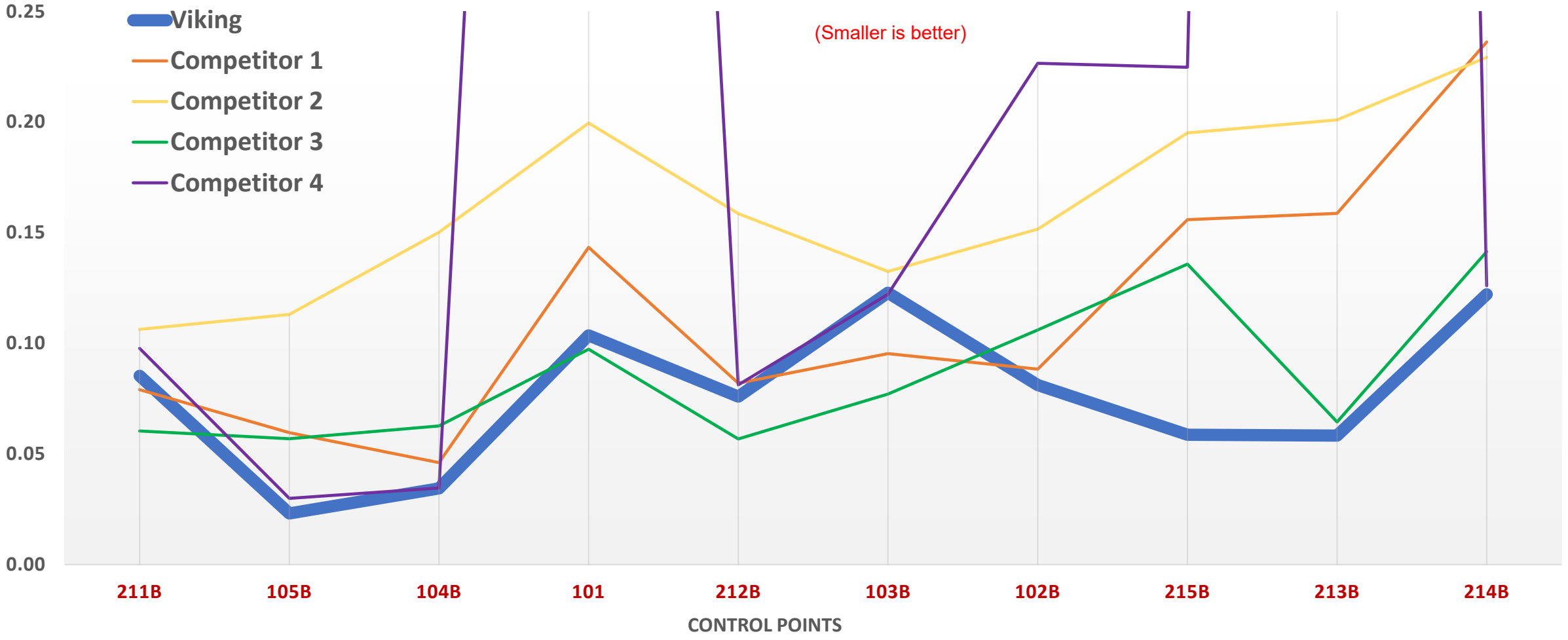

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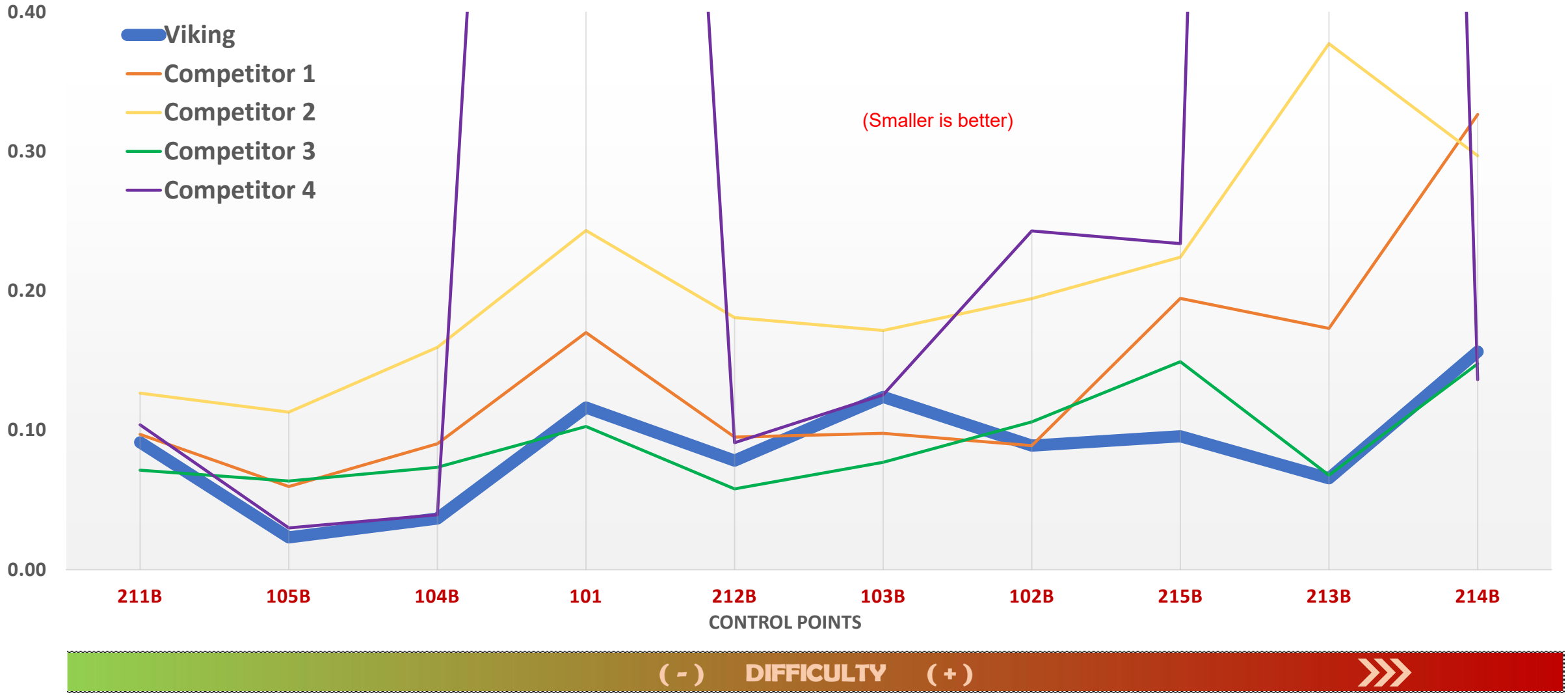
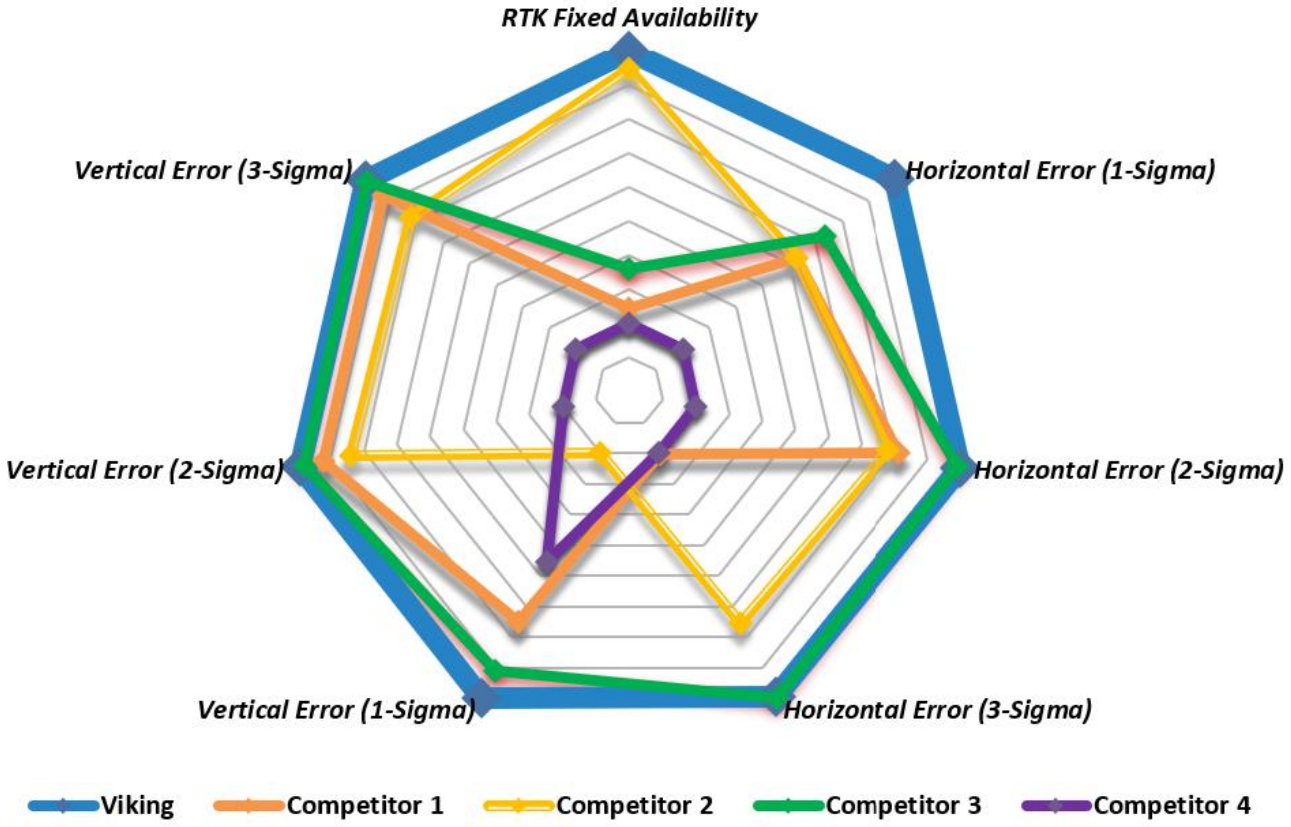
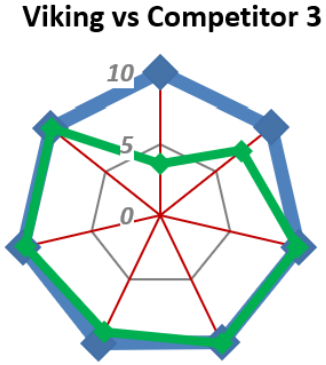
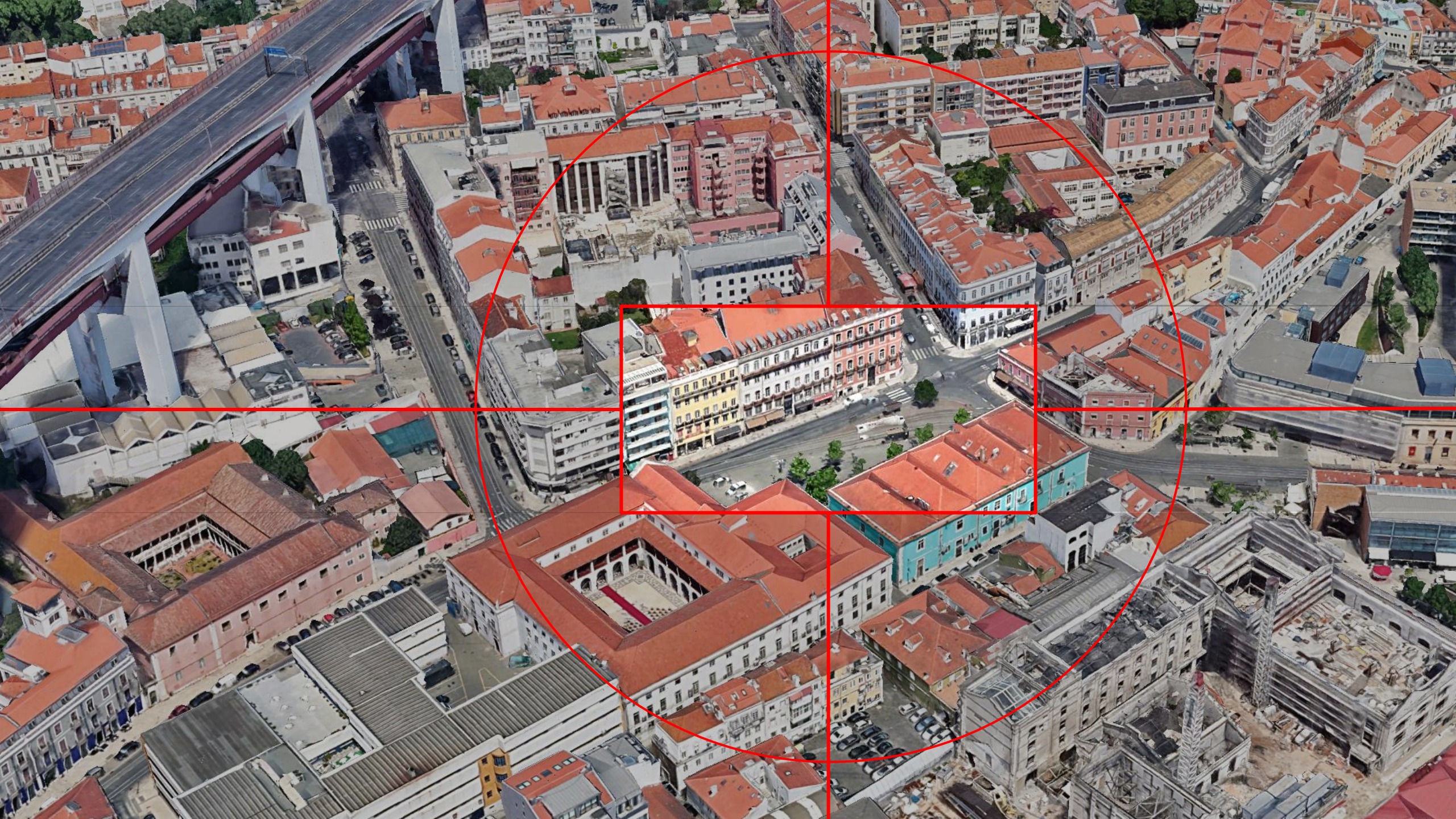


Normalized Quality Comparison – Pine Tree Forest

Viking outperforms competitors on every metric







RTK Competitive Testing
Urban Environment

Viking vs Best-in-class RTK Receivers

- Top-tier RTK smart antenna receivers
- Top 4 GNSS receiver brands in the USA
- Identities were withheld for confidentiality

Stop-and-go testing on 12 points

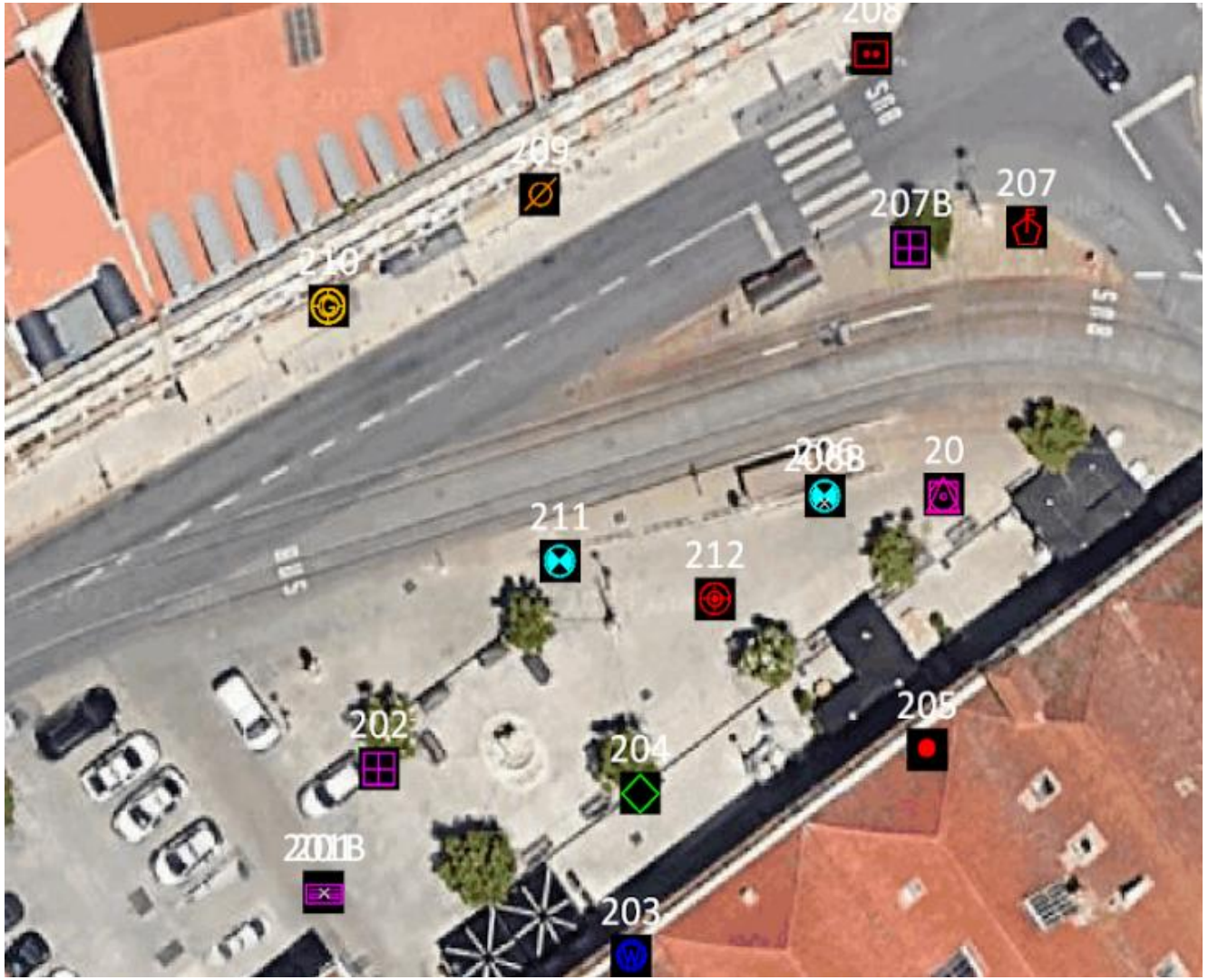
- Stake out pre-surveyed test track

144 points

- 12 laps

Single point storage

- No average, no static
- Level and store (do not wait for Fix)



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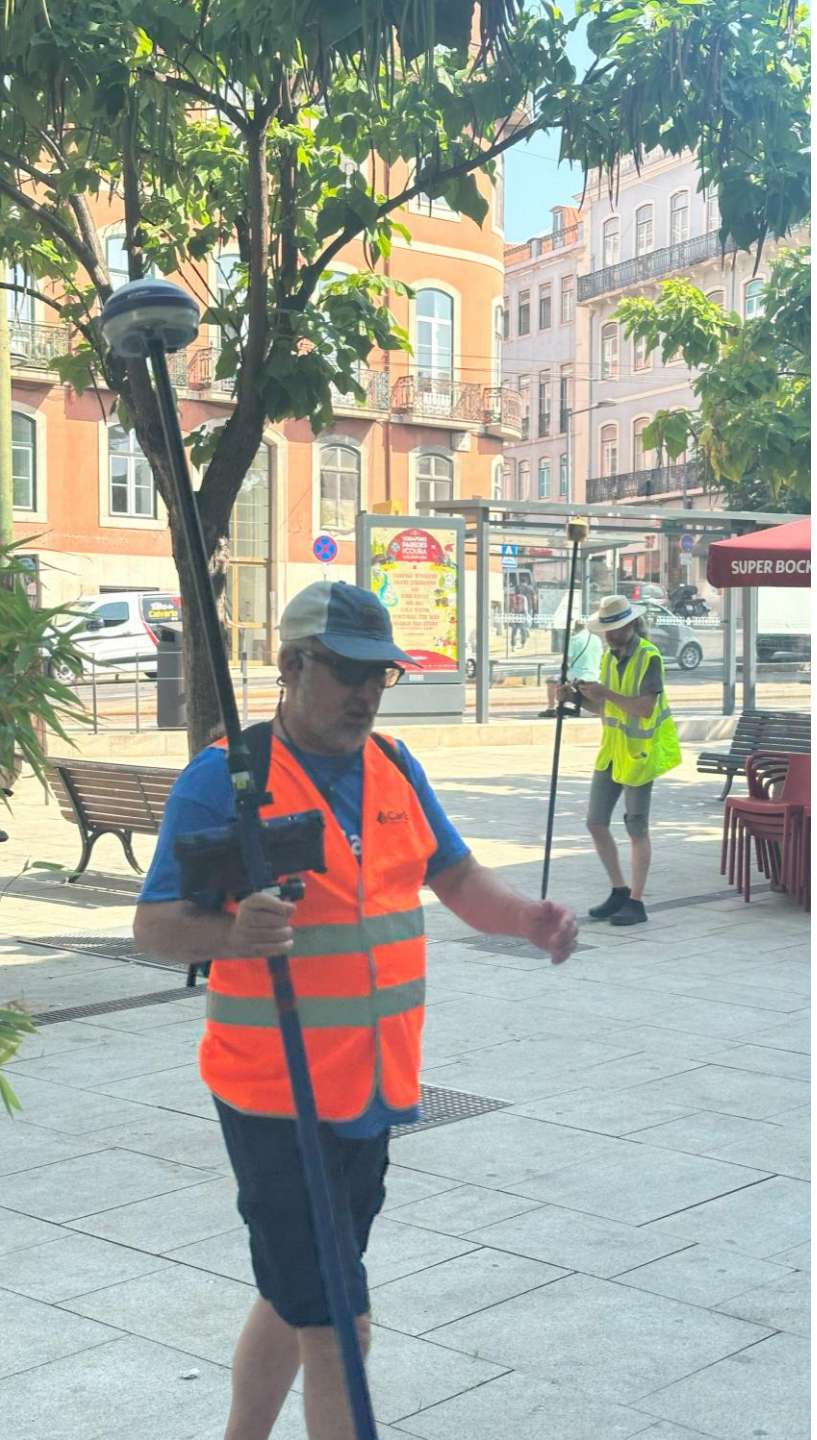
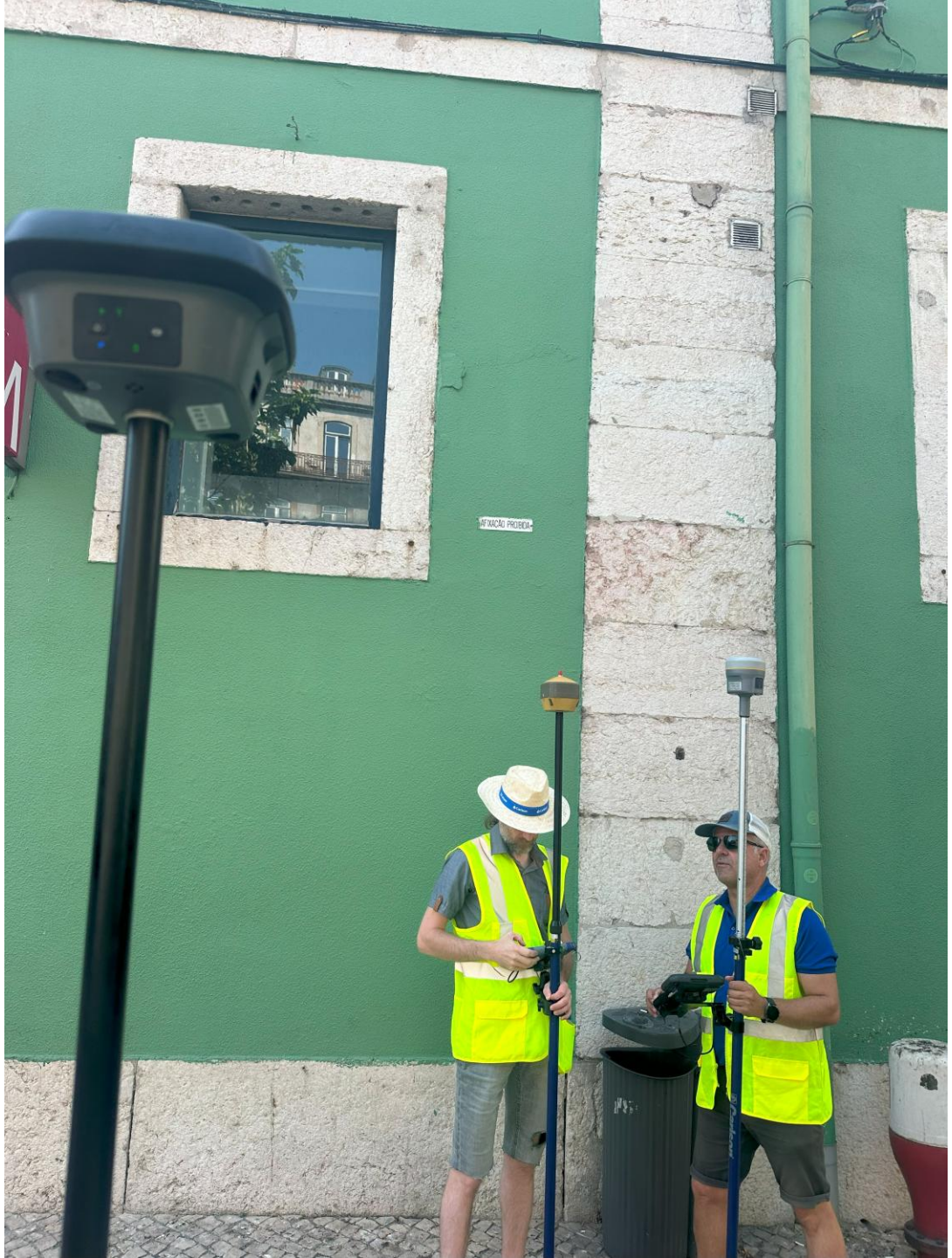

SUPER BOCK

SUPER BOCK
Sabor Autêntico
EU ANDO A TODO O GÁS
carris

TVDE
99€
ESCOLA DE CONDUÇÃO
M&G
SEASIDE

Faz o match perfeito


AFIXAÇÃO PROIBIDA

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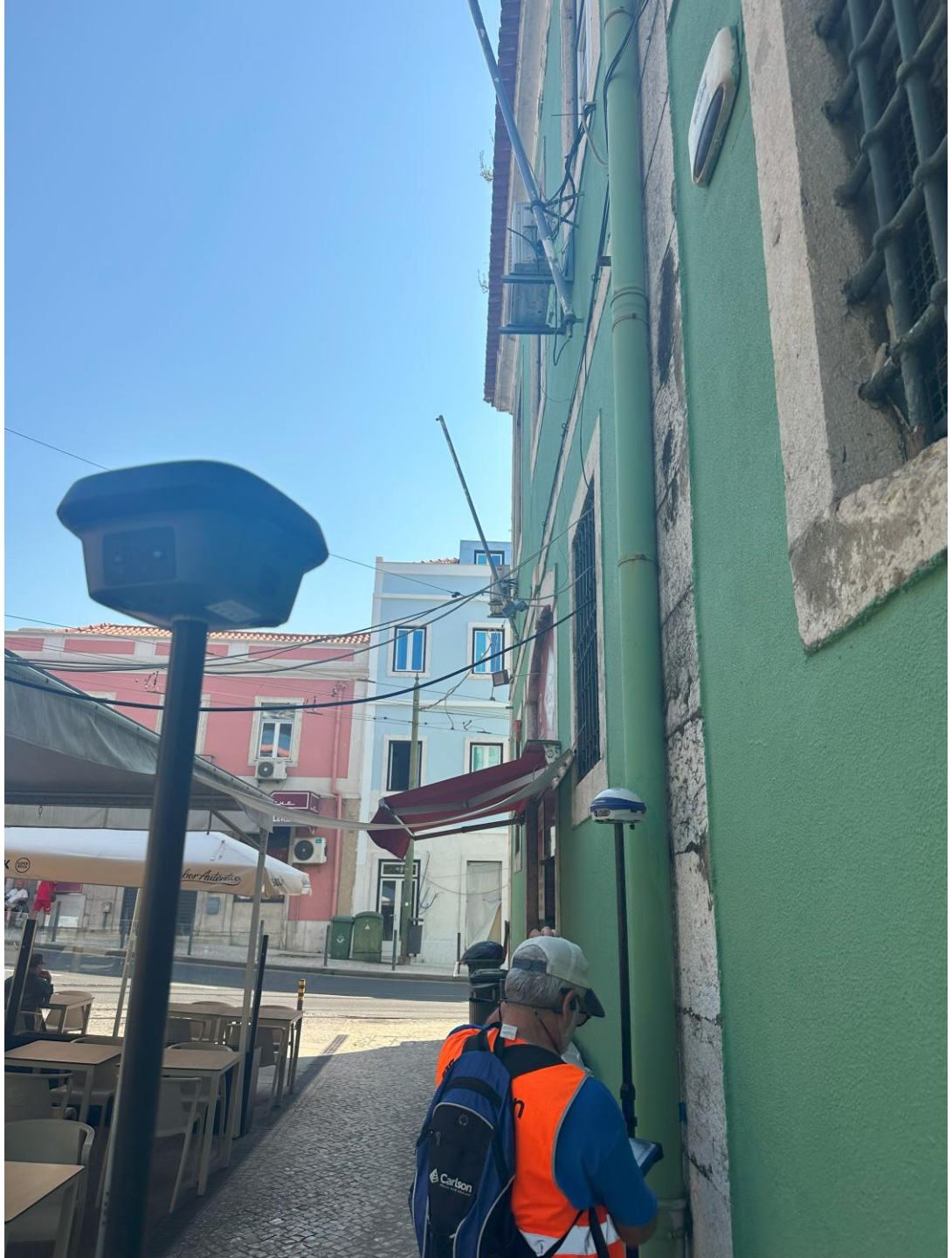
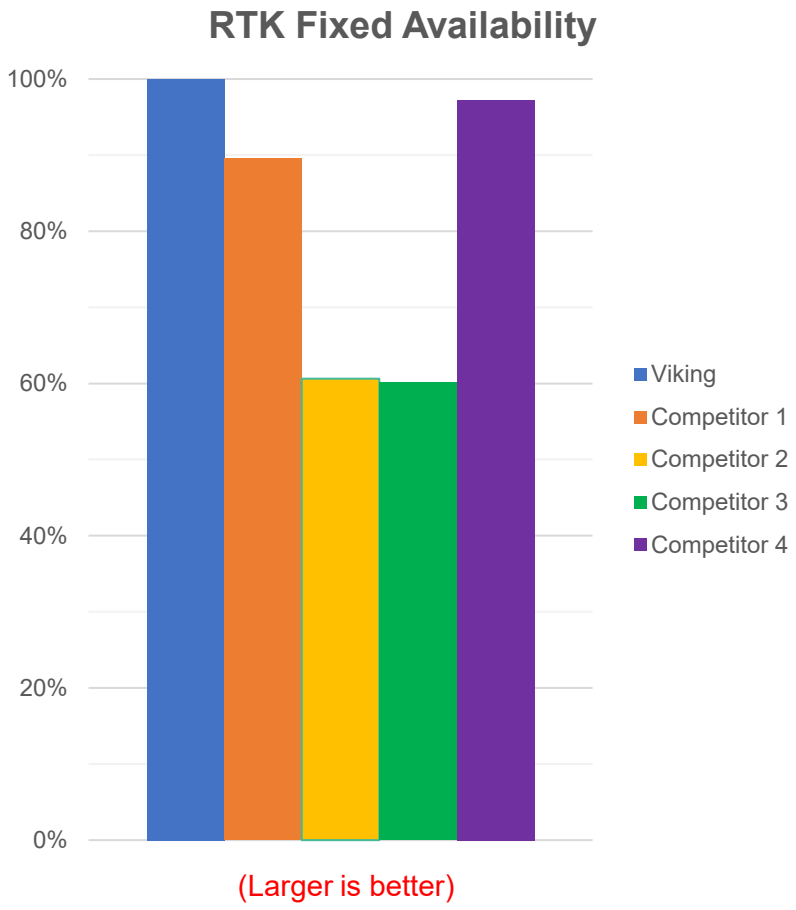
Millennium bcp
Sociedade Promotora
SETOR RECREATIVO
BURGER RANCH
Sabor Autêntico

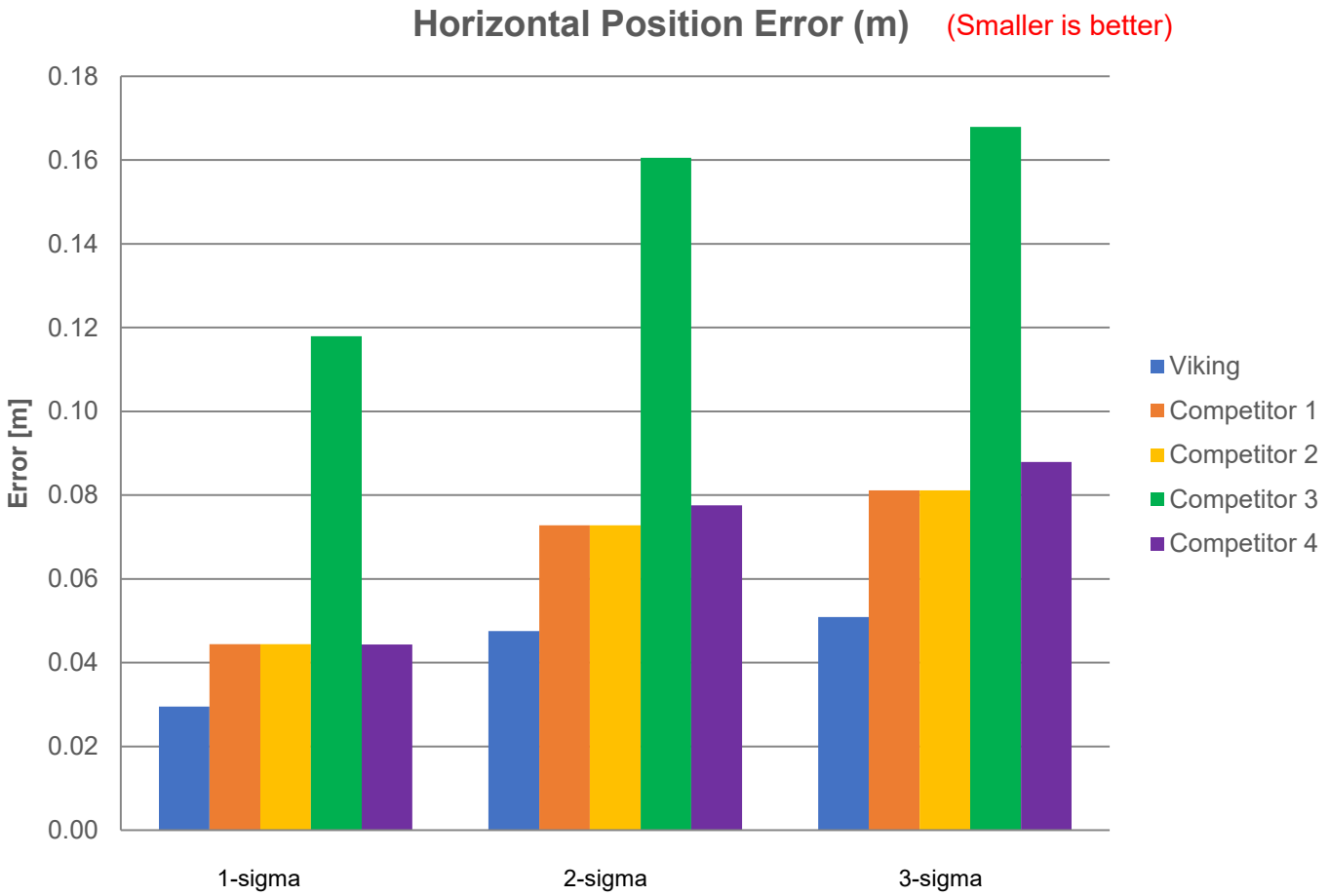

Carlson

Carlson

RTK Performance Summary

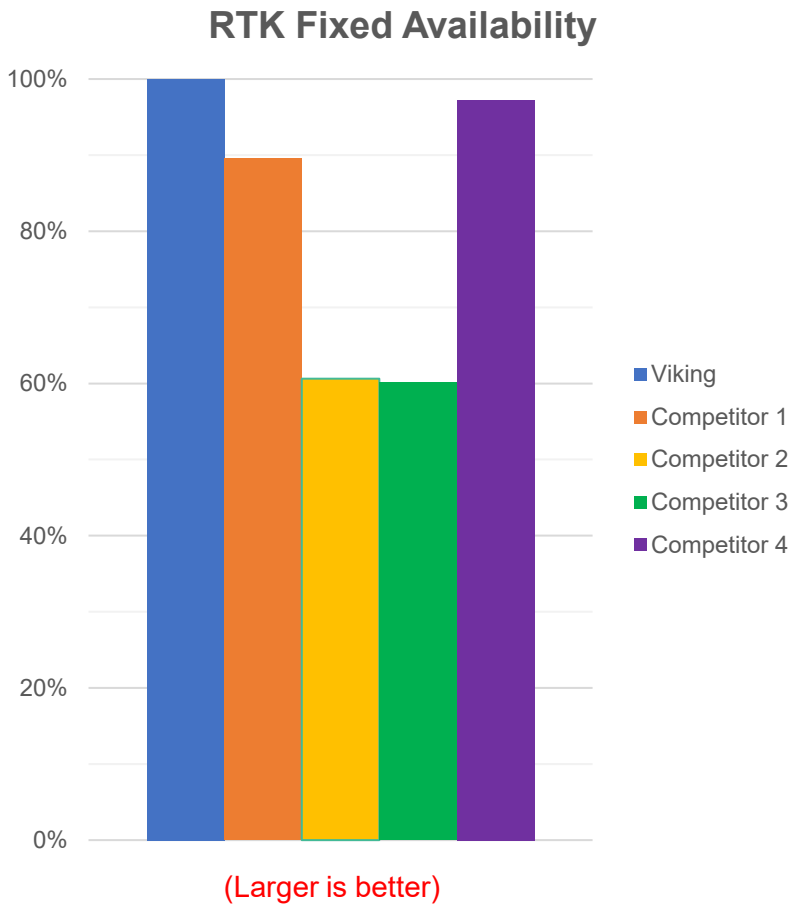
Viking delivers 100% RTK Fixed availability while maintaining accuracy

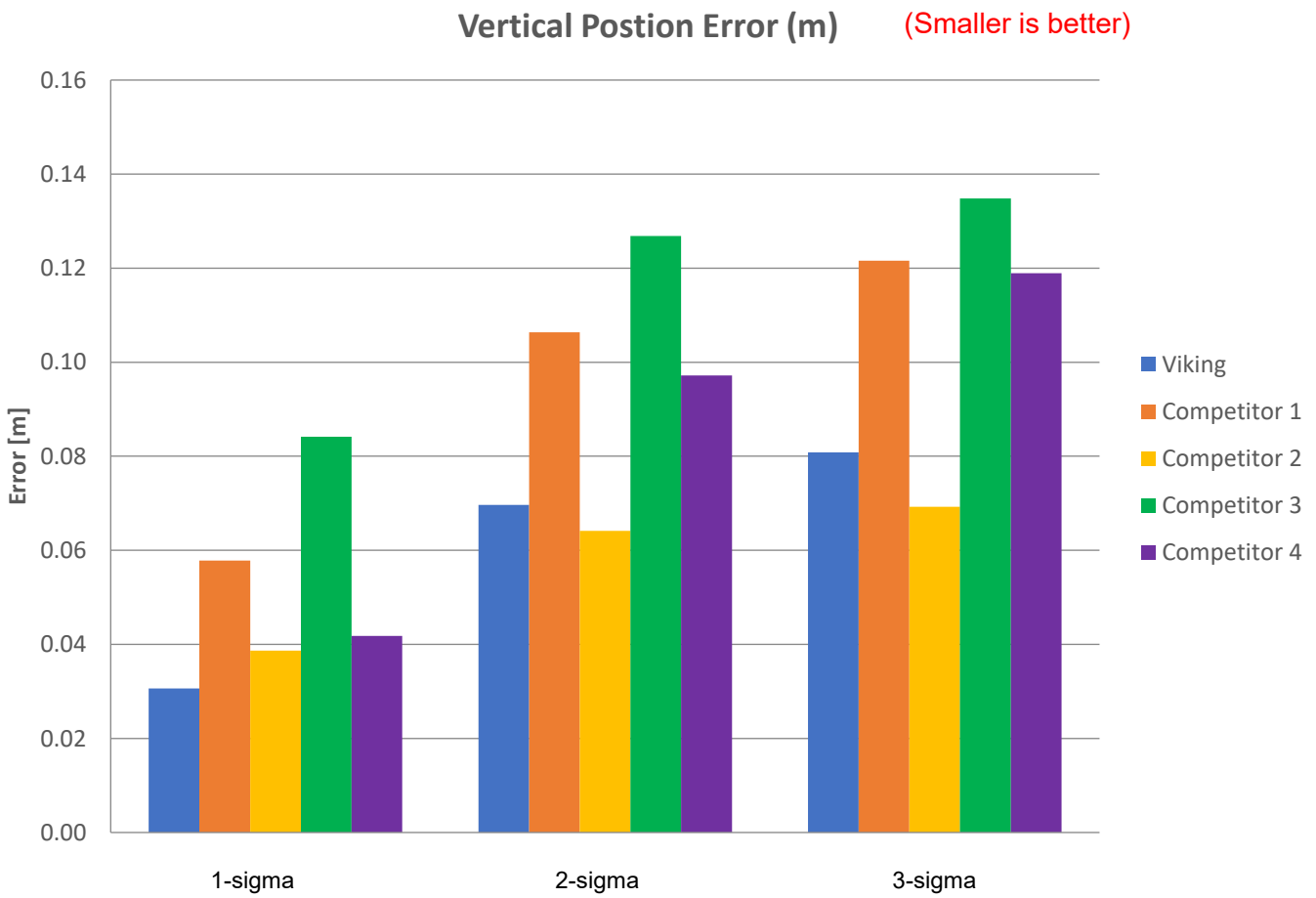




RTK Performance Summary

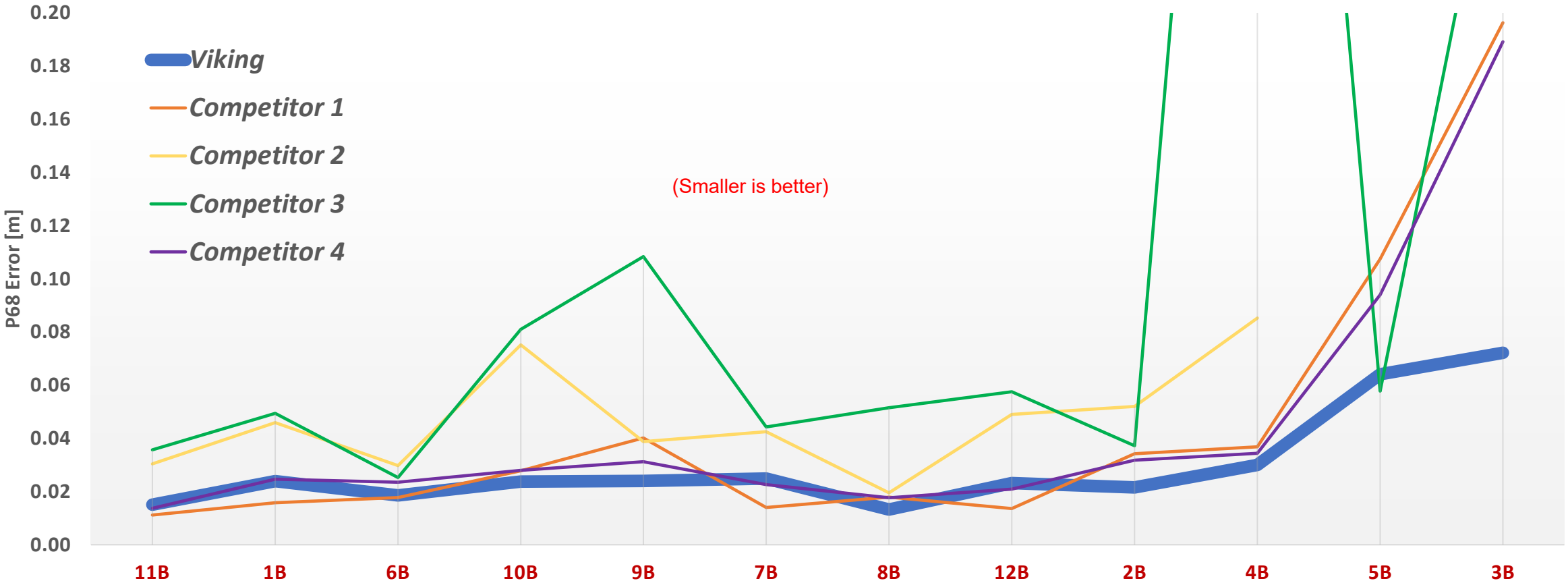
Viking delivers 100% RTK Fixed availability while maintaining accuracy





Horizontal Error RMS (m)

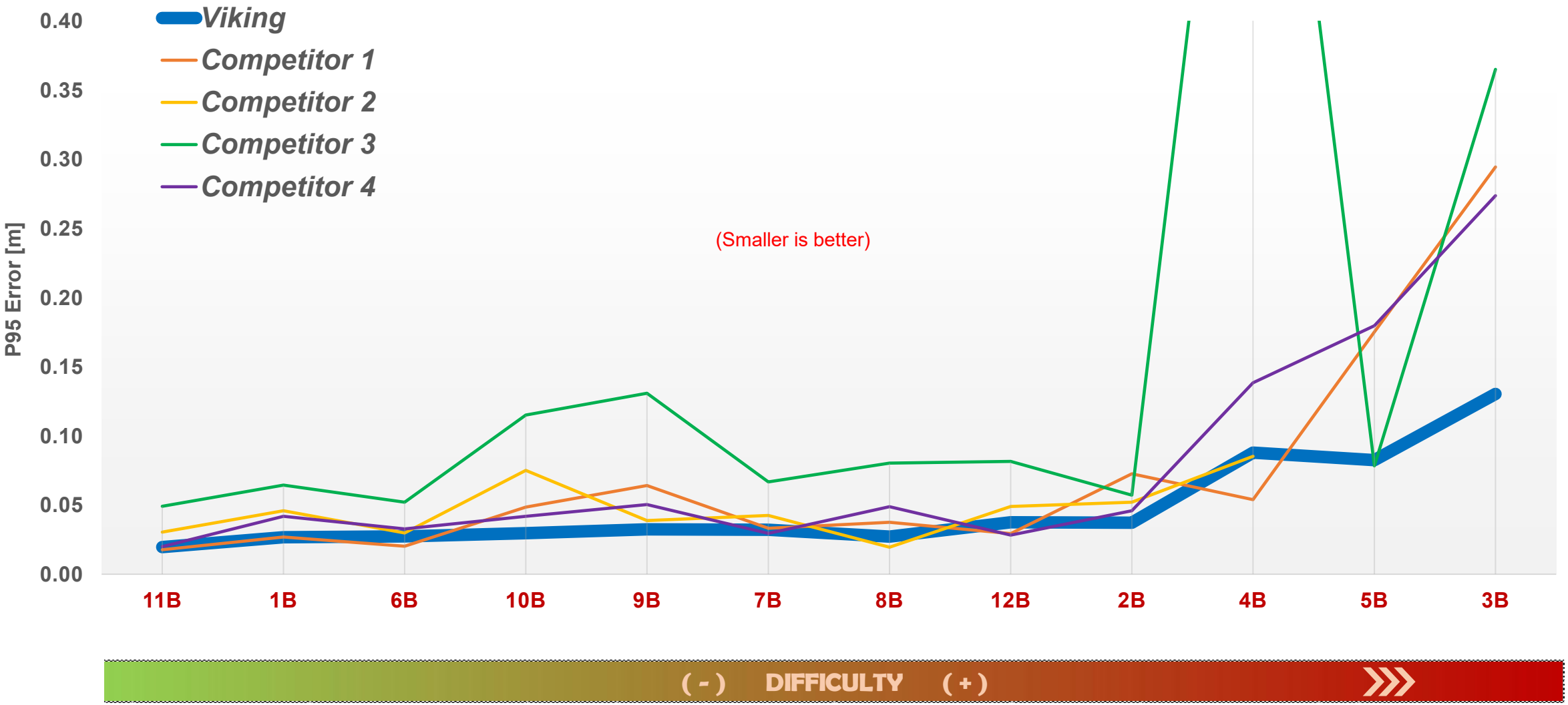
1-sigma (68th percentile)



(-) DIFFICULTY (+)

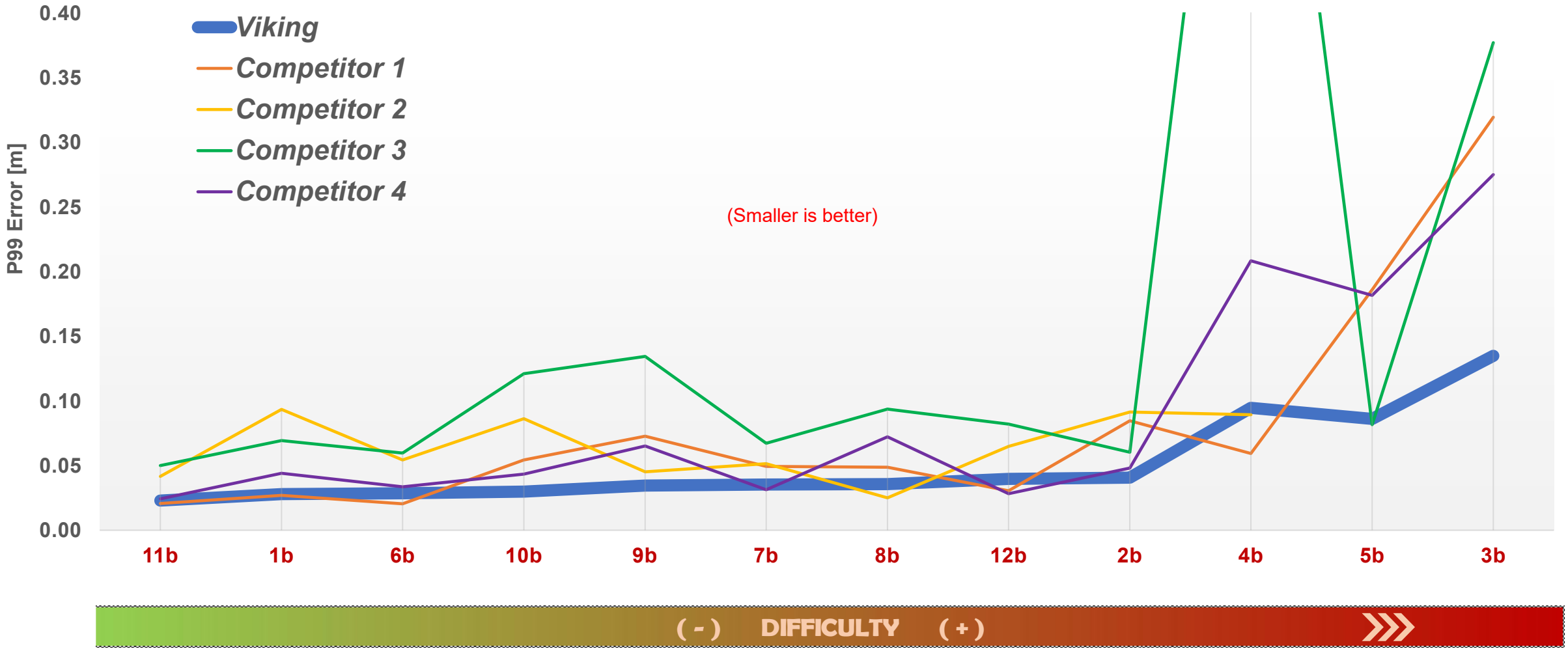
Horizontal Error RMS (m)

2-sigma (95th percentile)



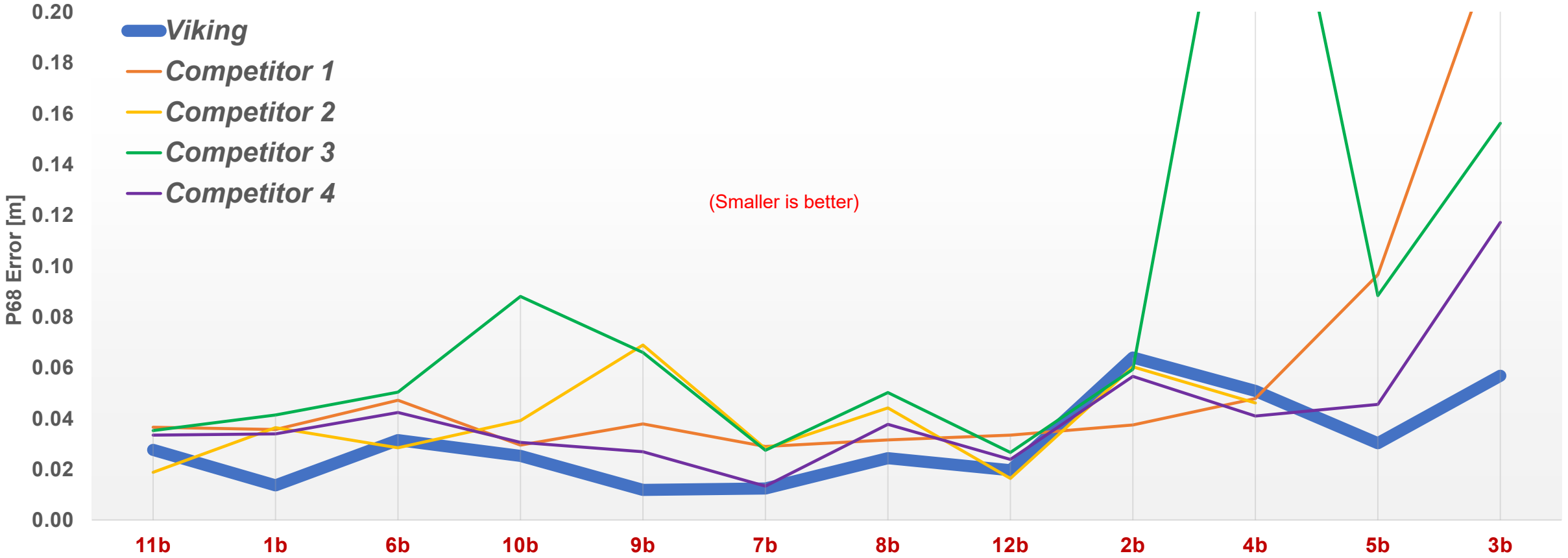
Horizontal Error RMS (m)

3-sigma (99th percentile)



Vertical Error RMS (m)

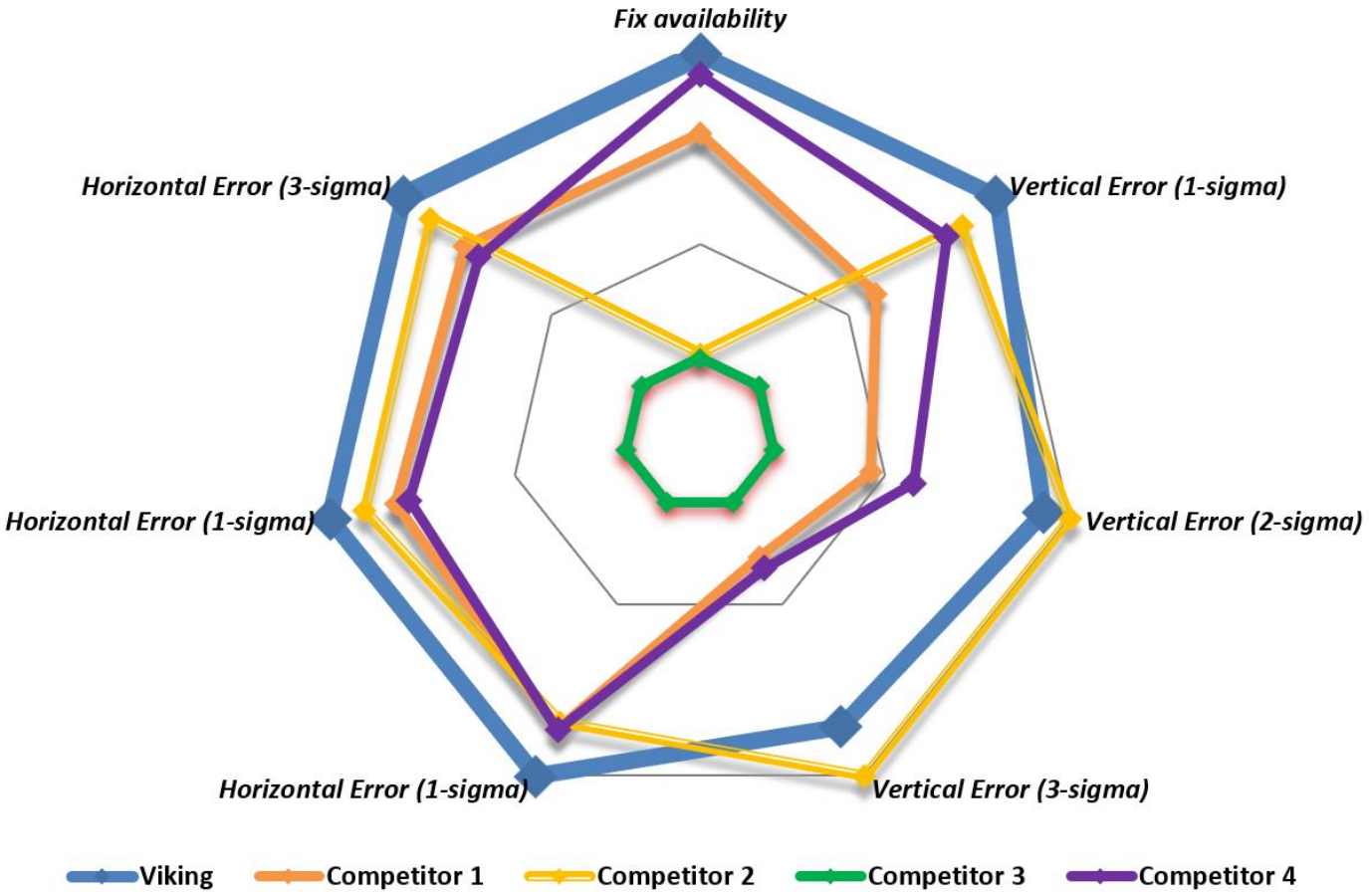
1-sigma (68th percentile)



(-) DIFFICULTY (+)

Normalized Quality Comparison – Urban Environment

Viking delivers 100% RTK Fixed availability while maintaining accuracy



QUESTIONS?

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