

Precise Positioning Key Enabler for Smart Agriculture

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Arnaud Le Lannic, Director of Business Development Industrial
u-blox AG

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Arnaud Le Lannic, Director of Business Development Industrial

Arnaud Le Lannic is Director of Business Development Industrial at u-blox, based in Thalwil, Switzerland. With over 20 years of experience in the semiconductor industry, including 11 years specializing in GNSS and connectivity at u-blox, Arnaud plays a key role in driving strategic growth and partnerships across industrial markets.

His current focus includes enabling scalable and reliable GNSS technologies for autonomous systems in agriculture, helping drive innovation in precision farming.



Arnaud Le Lannic
Director of Business
Development Industrial

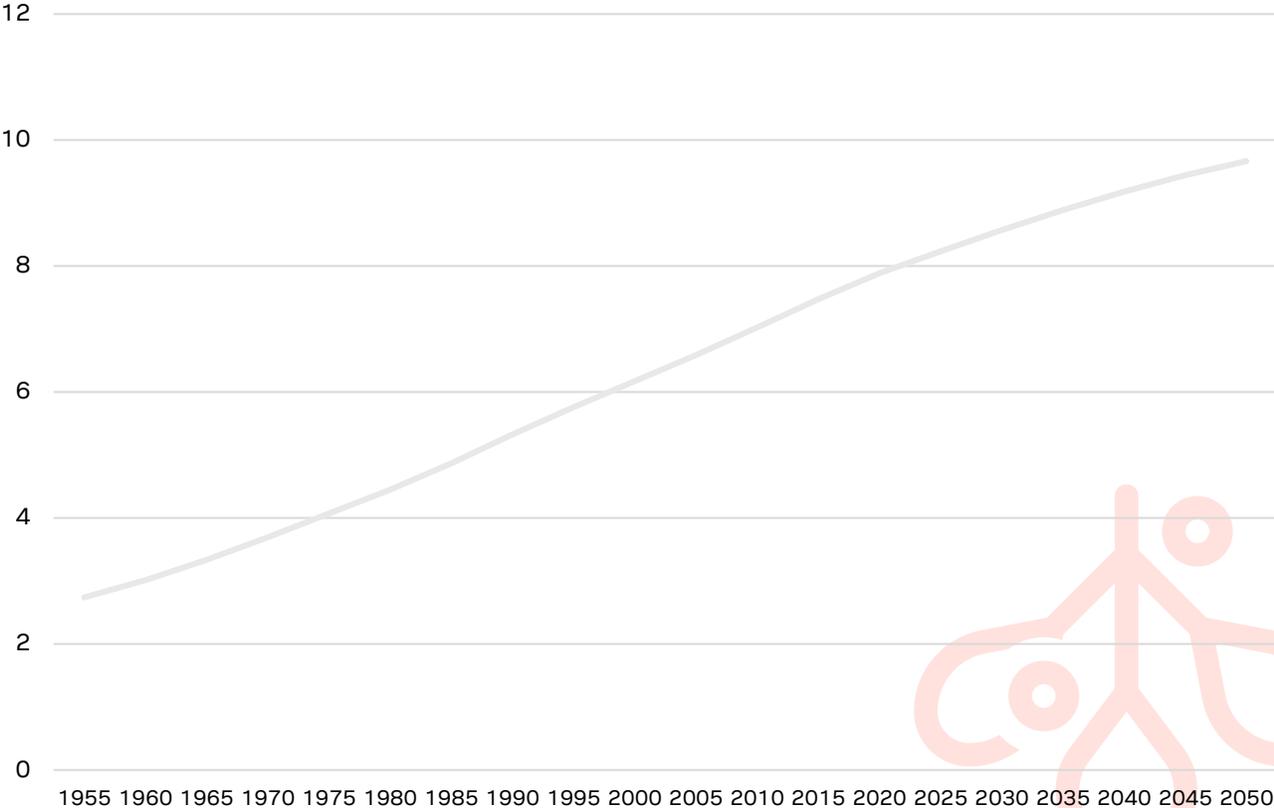
Agenda

- Trends and challenges
- Application & requirements
- Technology
- u-blox offering

World population



Population in Mio (Past and Prediction)



Source: [World Population Clock: 8.3 Billion People \(LIVE, 2025\) - Worldometer](#)

Less surface more output



Global decoupling of agricultural land and food production

Our World in Data

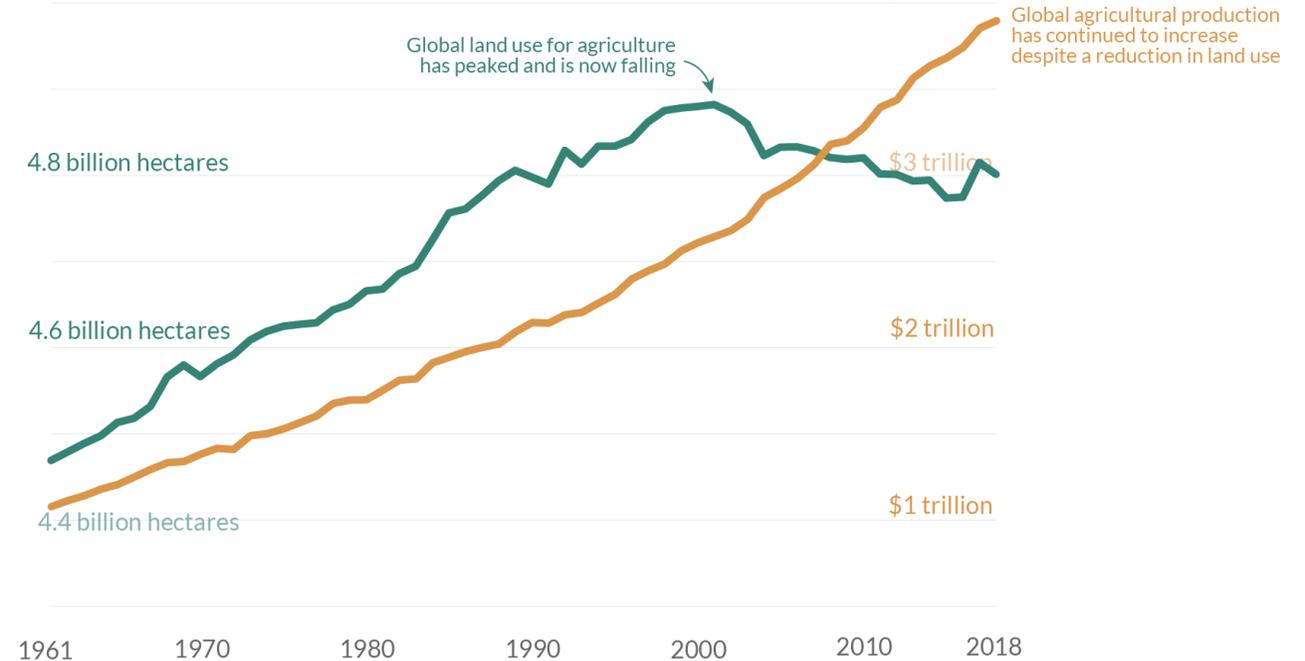
Agricultural land is the sum of cropland and pasture for grazing livestock. Production is measured in constant 2015 international-dollars, which adjusts for inflation. Includes all crops and livestock.

Global agricultural land use

5 billion hectares

Global agricultural production

\$4 trillion



Data source: Food and Agriculture Organization of the United Nations.

OurWorldinData.org - Research and data to make progress against the world's largest problems.

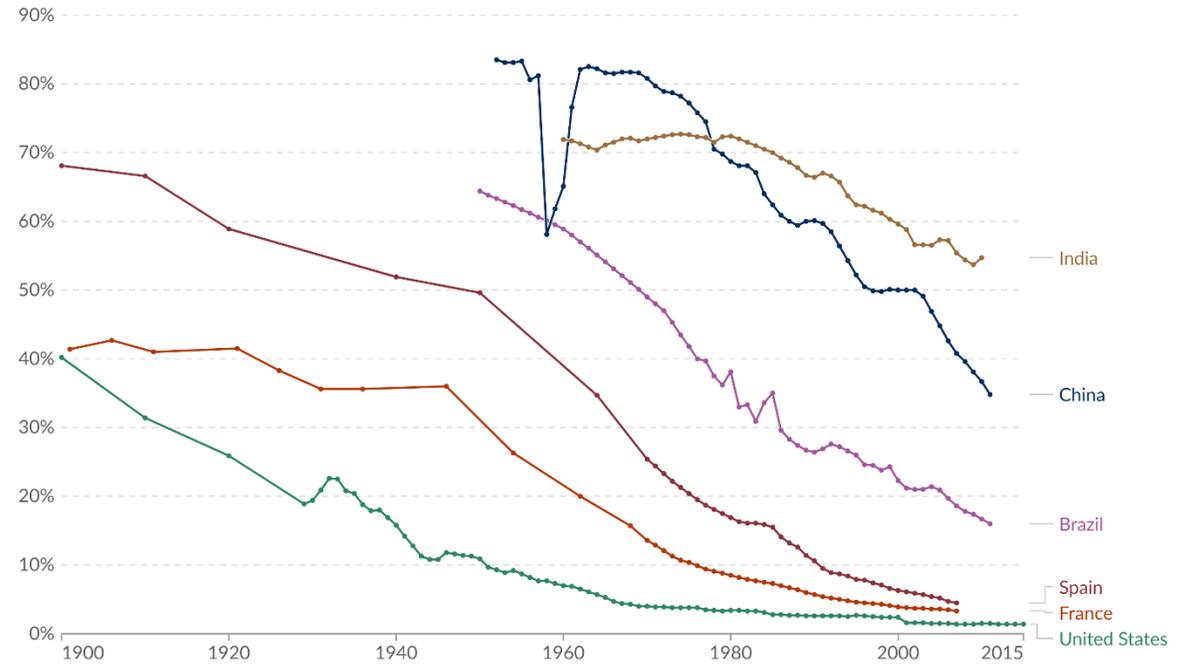
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Less workforce



Share of agriculture in total employment, 1900 to 2015

Our World in Data



Data source: Our World In Data based on Herrendorf et al. (2014) and GGDC-10 (2015)
OurWorldinData.org/employment-in-agriculture | CC BY



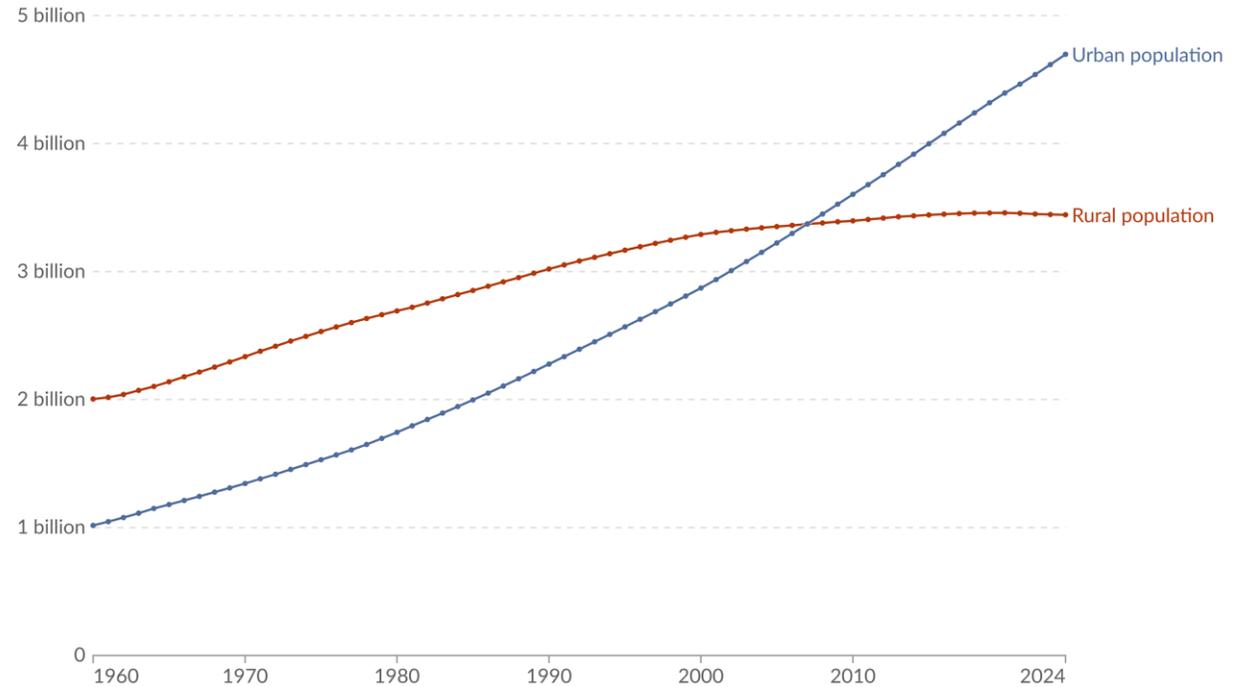
According to the International Labour Organization, in 1991 agriculture accounted for 43 per cent of global employment. By 2023, this share declined to 26 per cent.

Less candidates



Number of people living in urban and rural areas, World

Our World in Data



Data source: World Bank based on data from the UN Population Division (2025)

OurWorldinData.org/urbanization | CC BY

Note: Because the estimates of city and metropolitan areas are based on national definitions of what constitutes a city or metropolitan area, cross-country comparisons should be made with caution.

Aging workforce and attractiveness



Farms are declining across the world, and farmers are aging. **The average age of a farmer in the world is 55 years** (source: WEF), closer to the retirement age.



At the same time, there seems to be less interest among the youth to take up farming.



According to the European Commission, the average age of an EU farmer in 2025 is 57, and only 12% are under 40.

Trade-off yield and environment

Compensate for natural soil replenishment

Fertilizers



Prevent crop losses and stabilize food supply

Pesticides



Improve plant resilience and productivity

Growth Regulators & Biostimulants



Global agriculture uses millions of tons of chemical fertilizers and pesticides annually



Cost & Sustainability



Runoff & Water Pollution, Soil Degradation, Human Health Risks





Workforces

- Increases work efficiency and enables better working conditions
- Enable farmers to parallelize activities

Machines work precisely; humans focus on the important



Yield, cost, and environment

- Planters, precisely plant and locate seeds
- Precise sprayers and drones apply chemicals only where and what is needed

No dual spreading and no over-spraying





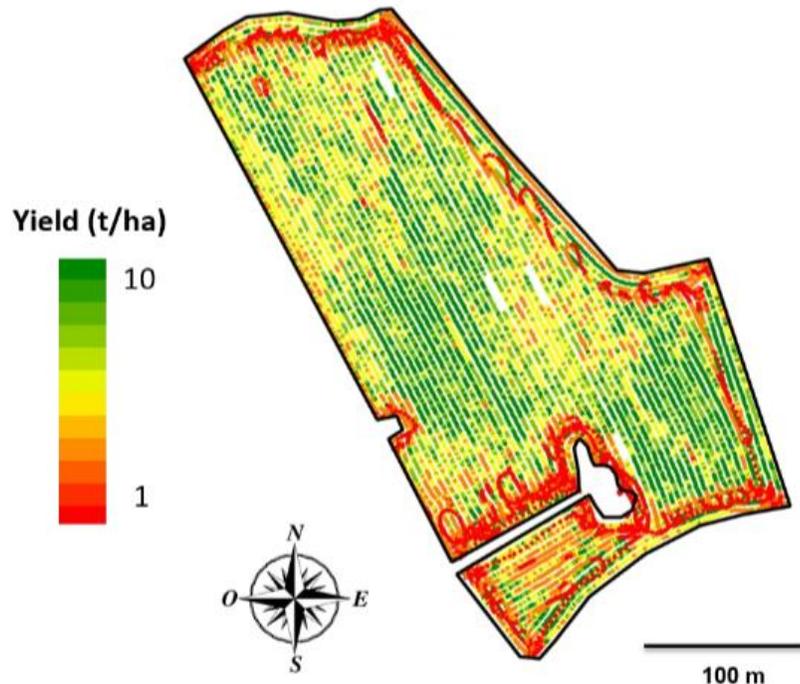
Applications



Yield monitoring and mapping

Use Case

Process of combining yield monitor measurements with GPS location data to create a spatial map showing how productivity varies across the field.



GNSS Requirements

Accuracy

±1m (sufficient for mapping as of today)

System Type

DGNSS or SBAS (RTK optional for detailed maps and going forward)

Update Rate

1–5 Hz

Hardware



GNSS receiver connected to the yield monitor



Compatible onboard data logger

Variable rate application

Use Case

Adjusting input rates like fertilizer or seed based on position and soil maps.



GNSS Requirements

Accuracy

5–30 cm, depending on the technology and the input data, like mapping

System Type

PPP, Galileo HAS, Madoca, BeiDou B2b, RTK for higher precision going forward

Update Rate

5–10 Hz

Hardware



GNSS receiver with correction capability



Equipment with variable-rate control interface

Use Case

Aerial imaging for crop health and growth, soil quality, and topography.



GNSS Requirements

Accuracy

< 10 cm to control the drone as well as geotag and post-process the collected images

System Type

RTK, PPP-RTK, historical usage of PPK (Post-Processed Kinematic)

Update Rate

1–10 Hz (depends on flight speed and altitude)

Hardware



Drone with RTK/PPP-RTK-compatible GNSS module



Multispectral or RGB camera

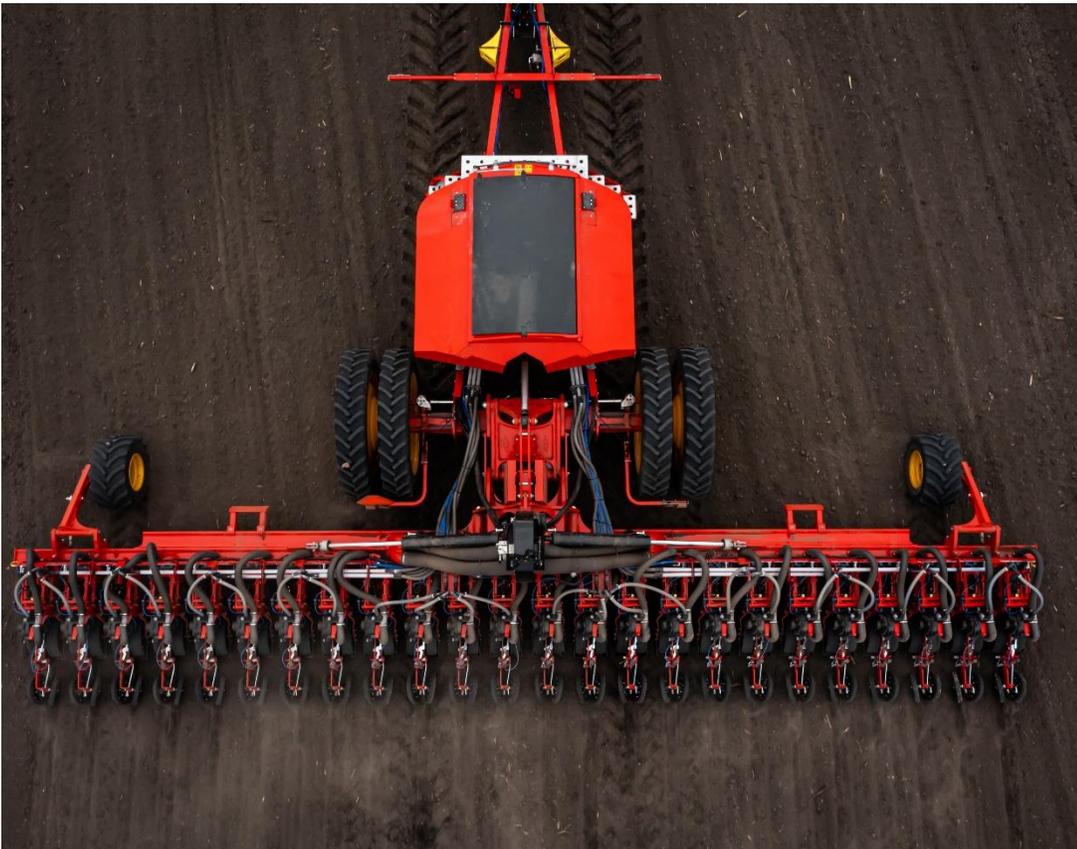


Optional ground station or GNSS base for RTK

Precision planting

Use Case

Exact placement of seeds to optimize spacing and yield as well as limit waste of seeds.



GNSS Requirements

Accuracy

<15cm ideally, enabling **repeatability** for future plant care

System Type

RTK GNSS with repeatability support (important for returning to same field lines)

Update Rate

10 Hz or more

Hardware



High precision GNSS with optional inertial navigation for precise movement and orientation



Integrated control system with planting equipment

Autonomous tractor guidance

Use Case

Automated tractor navigation for tilling, harvesting, and unloading the harvester.



GNSS Requirements

Accuracy

<5 cm or better reference for system awareness of up to 20-25 meter radius

System Type

RTK GNSS with base station or network corrections (NTRIP)

Update Rate

10-20 Hz for smooth, responsive steering

System up time

To fulfill its role, the system cannot afford downtime. Reliability in extreme conditions

Hardware



2 dual- or multifrequency GNSS receivers



2 high precision GNSS antennas mounted symmetrically to the center of the tractor



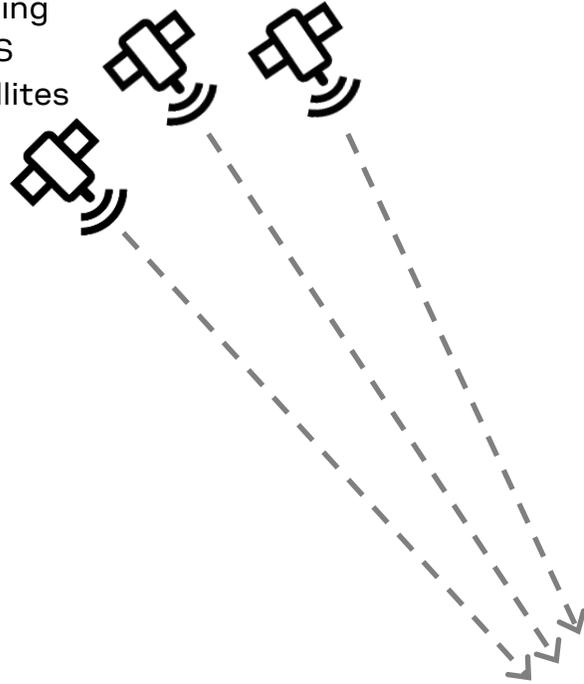
Lidar, Stereo Cameras (up to 8/vehicle), 100s of Sensors

Technology



Let's start with the basics

Orbiting
GNSS
Satellites



1 – 2 meters horizontal
2 – 4 meters vertical

Stand-alone GNSS position



Ideal for asset-tracking, aftermarket telematics, and for wearable devices



Not suitable for high precision use cases like autonomous vehicles, precision agriculture, service robots, or robotic lawn mowers

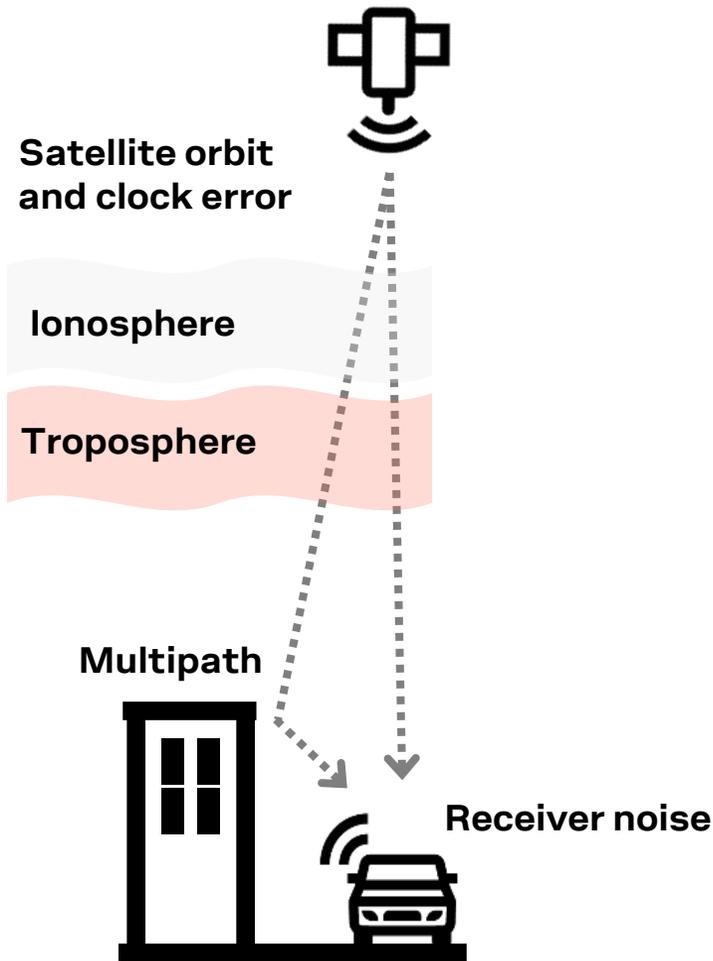


Low accuracy (meter-level)



High accuracy requires **corrections**

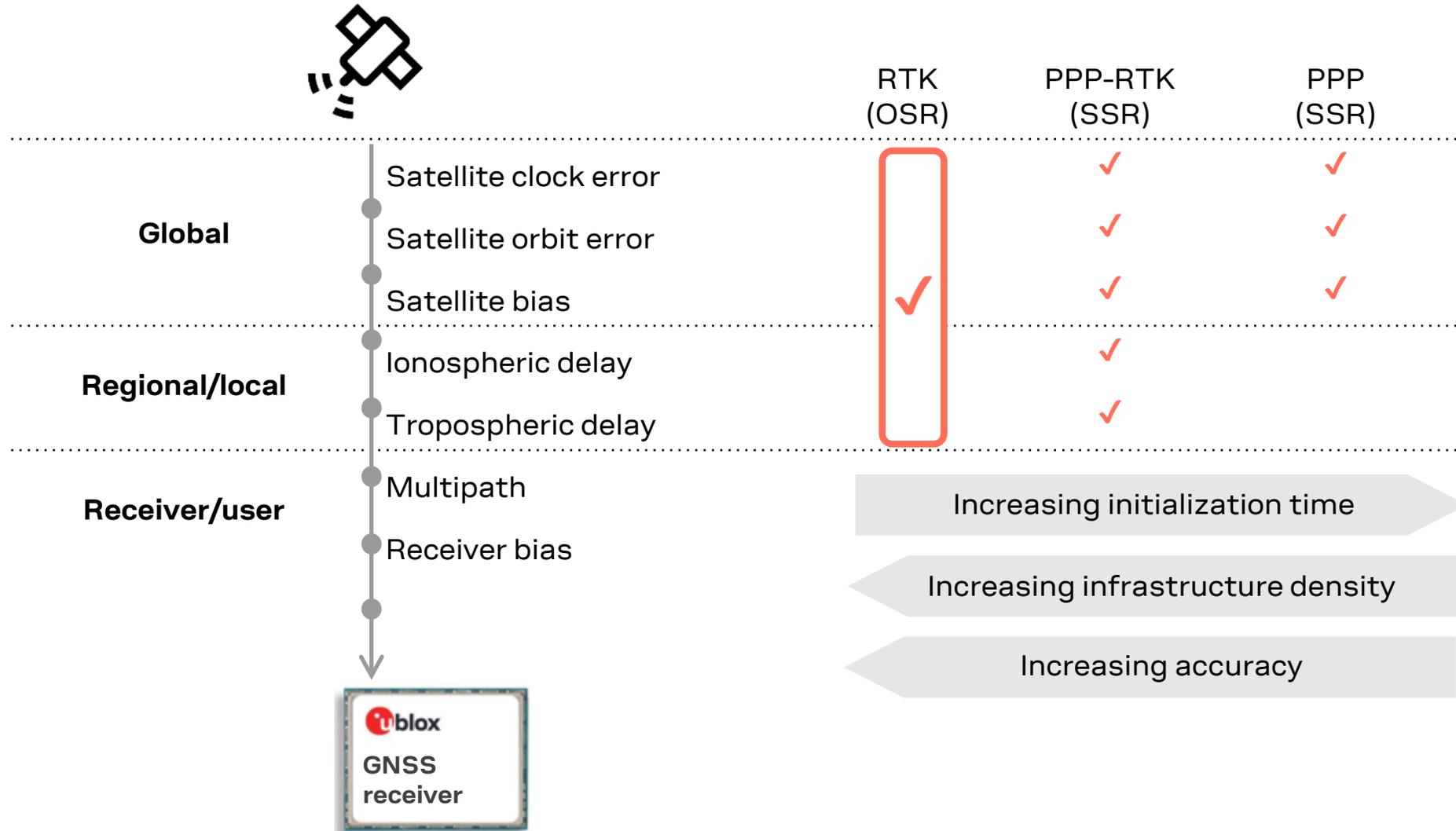
Why only meter-level accuracy in standalone GNSS positioning?



- GNSS signals travel through various atmospheric layers
- The ionosphere impacts signal propagation, and introduces measurement errors
- Standalone receivers are unable to correct these errors on their own
- Limiting accuracy to the meter level**

GNSS error sources		
Satellite based	• Sat. orbit error	~2.5m
	• Sat. clock error	~1.5m
	• Ionosphere	~5m
	• Troposphere	~1m
Environment & Receiver based	• Multipath	~2-20m
	• Receiver noise	~0.5m

Which errors are corrected?



All-band benefits



L1 / L2 / L5 / L6



Brings access to all constellations and all GNSS bands



Brings the best availability of the best accuracy



Brings built-in access to correction services, both on L-band, as well as PPP services



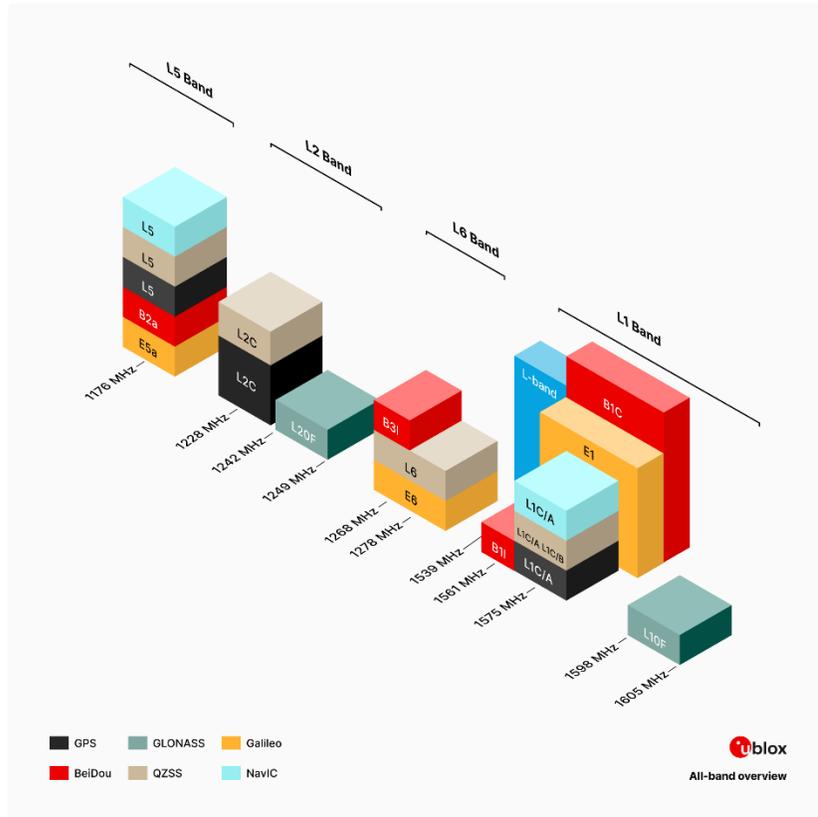
Brings PPP performance relevant to mass market applications



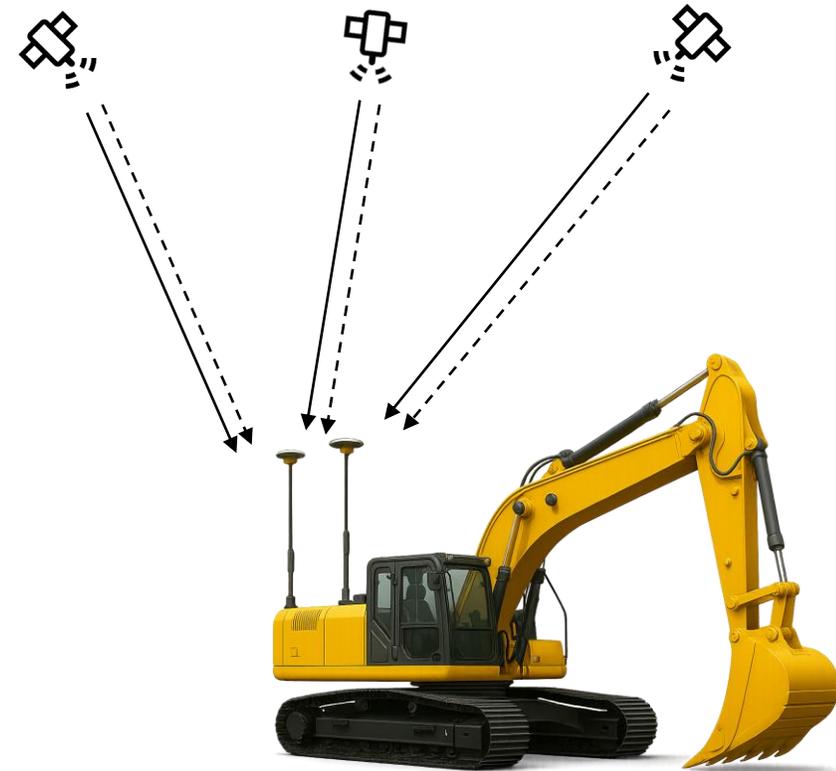
Brings GNSS integrity

GNSS infrastructure evolved

Civilians' **frequencies and satellite constellations** increased significantly.



All signals and corrections can be received **globally from satellites**.





u-locate



u-blox locate, fast and easy go-to-market



Complete solution that brings together leading hardware, services, and support, covering the entire lifecycle from successful go-to-market to ongoing support throughout the solution's lifetime.

Advanced high-precision receiver

u-blox
ZED-X20P

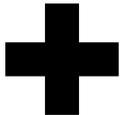
u-blox
ZED-F20P



High-performance antenna

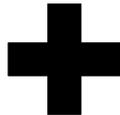
u-blox

u-blox



Best fit correction service

PointPerfect
GNSS correction service



Leading expertise & support

2023
First multi-mode Cellular and Satellite module

2018
Launch of high-precision GNSS platform that delivers centimeter-level accuracy in seconds

2016
First Cellular module with proprietary modern technology and integrated GNSS

2014
Wi-Fi and Bluetooth module markets entry

2009
Cellular module market entry

2007
IPO at the SIX Swiss Exchange

2000
First mobile phone with GNSS
Decision to strongly invest into own IP in GNSS

1997
Founded
Created the world's first GNSS module and later its own chip

Raising performance worldwide



All-band GNSS and cm-technology integrated in a small module (L1/L2/L5/L6 + L-band)



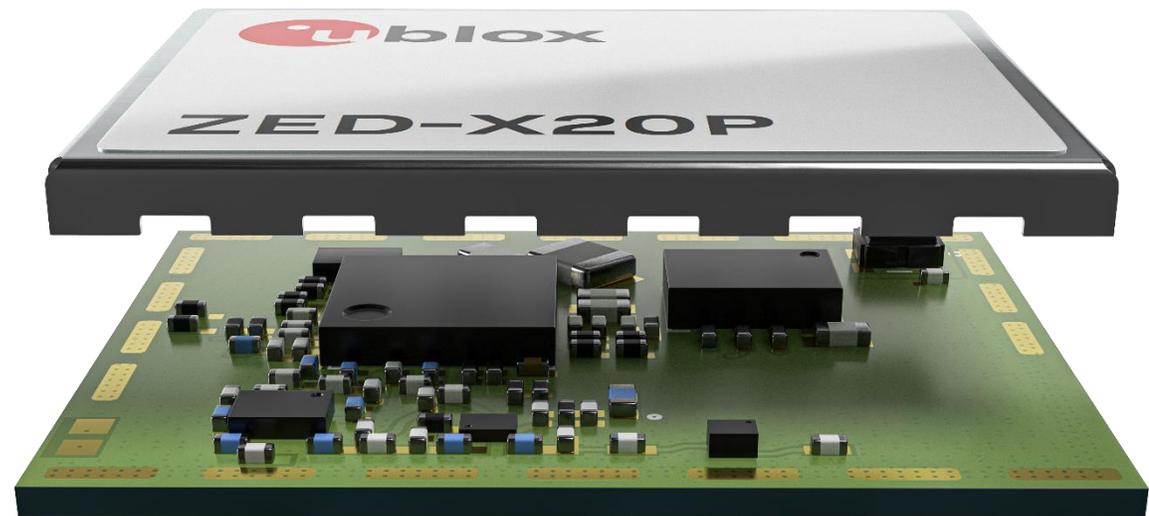
World leading RTK, PPP-RTK and PPP support including Galileo High Accuracy Services (HAS)



u-blox End-to-end Security providing Confidentiality, Integrity, and Authentication from satellites to the host



Single chip design for a robust hardware and reliable supply chain



Importance of antennas in GNSS system

Antenna - critical part of GNSS receiver design

GNSS signals are extremely weak, and unique antenna demands.

Antenna choice and implementation play a significant role in GNSS performance.

Even the best receiver cannot bring back what is lost due to a poor antenna, in-band jamming, or a bad RF design.

Challenges from modern multi-band GNSS system



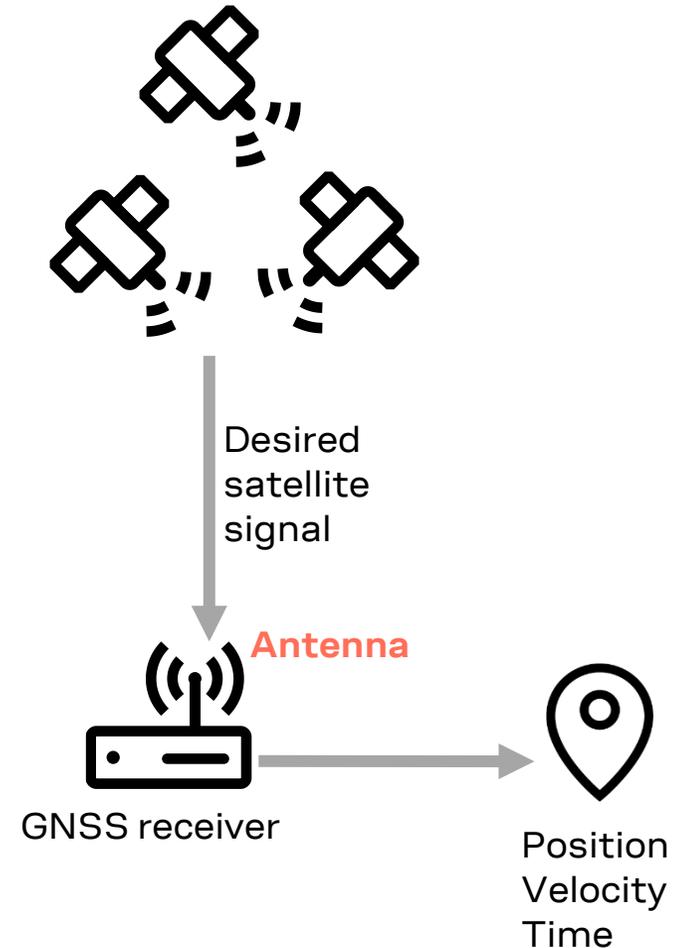
Wide frequency coverage



Antenna size, performance (multipath effects, interference & coupling, etc.)



Affordable price



ANN-MB2 – our all-band antenna



Developed according to the u-blox all-band antenna specification, tuned for the u-blox X20 high precision GNSS platform.

ANN-MB2



92.9x108.5x24.7mm, 5m cable with SMA connector

Band/application

L1, L2, L5/E5/B2/NavIC, E6/B3, L-band
High Precision, with RTK

Suitable u-blox products

ZED-F9T-20B & other F9 customers need triple/wide-band antennas
ZED-X20P, ZED-F20P & other upcoming X20/F20 products

Product status

Mass production!

Excellent performance

Product summary

ANN-MB2 antenna

All-band high precision GNSS antenna

Easy-to-use, reliable all-band antenna as part of a u-blox high precision solution

- Robust L1/L2/L5/E5/B3/L active external GNSS antenna
- High performance all-band antenna for the mass-market
- Supports all major GNSS systems for maximum position availability
- Versatile mounting options to meet diverse installation needs
- Enables fast time-to-market



Product description

The u-blox ANN-MB2 multi-band (L1/L2/L5/E5/B3/L) active GNSS antenna is designed to reduce time-to-market for the modern wide-frequency, multi-constellation, high-precision GNSS applications, which require centimeter-level accuracy and a reliable RTK positioning fix, even in challenging environments. Its robust design, excellent price-to-performance ratio, and flexible mounting options make the ANN-MB2 an ideal choice for mass market applications requiring an all-band high-precision GNSS antenna.

The ANN-MB2 is a perfect match to the u-blox F9 high-precision products (e.g. ZED-F9C, ZED-F9L, EA-F9T, and ZED-F9T) supporting L1, L2, and L5 bands, along with the L-band for RTK corrections. With ANN-MB2 customers have a reliable, ready-to-use all-band antenna that streamlines evaluation, minimizes design efforts, and speeds up mass adoption.

Patch antenna characteristics:

	L1/L2 band	L5/L2/E5/B3 band
Frequency	1551 - 1602 MHz	1158 - 1295 MHz
Impedance	50 Ω	50 Ω
Peak gain (Z _{ant})	L: Typ. 5.4 dBi; L1: Typ. 5.0 dBi	L5: Typ. 4.5 dBi; L2: Typ. 5.0 dBi; E5: Typ. 4.2 dBi
Efficiency	L: Typ. 64% L1: Typ. 55%	L5: Typ. 55% L2: Typ. 50% E5: Typ. 50%
Antenna ratio (Z _{ant})	Typ. 0.5 - 1.3 dB	Typ. 1.9 - 2.9 dB
Polarisation	RHCP	RHCP

Amplifier characteristics

	L1/L2 band	L5/L2/E5/B3 band
Frequency	1551 - 1602 MHz	1158 - 1295 MHz
Gain without cable	31 dB at 5 V	31.5 dB at 5 V
Noise figure (at 5 V)	Typ. 2.2 - 2.9 dB	Typ. 2.9 - 2.6 dB
Output VSWR	Typ. 2.0	Typ. 2.0
DC voltage	3.0 - 5.0 V	
DC current (at 5 V)	Typ. 15.0 mA	

Mechanical data

Weight	280 g (Typ. including cable)
Size	108.5 x 92.9 x 24.7 mm
Cable	5 m, RS174 standard
Connector	SMA
Mounting	Magnetics base, Feed installation option (screw)
Mounting color	Black

Environmental data

Operating temperature	-40 °C to +85 °C
Storage temperature	-60 °C to +85 °C
Water proof	IP67

Product variants

ANN-MB2-00	Multiband (L1/L2/L5/E5/B3/L) active GNSS antenna, High precision, with 5 meter cable and SMA connector
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UBD00-463800116-12861 - R01

Objective Specification - CS-8/2024

Further information

For contact information, see www.u-blox.com/contact-u-blox.



Easy-to-use, **reliable all-band antenna** as part of u-blox high precision solution



Maximum position availability
as it supports all major GNSS systems

High performance
mass-market solution



Robust all-band GNSS antenna
Including L1/L2/L5/E6/B3/L

Versatile mounting options
for diverse installation requirements



Easy deployment
that enables fast time-to-market



Fast, centimeter-level positioning services



PointPerfect Live

Superior performance for the most demanding applications on a highly reliable and dependable network.



Network RTK

1cm–2cm <10 seconds

Construction, surveying,
precision agriculture, mining

PointPerfect Flex

Scalable and flexible solutions for wide-ranging use cases.
Unbeatable performance / price balance.



PPP-RTK

3cm-6cm <30 seconds

Mobile outdoor robotics,
automotive, precision agriculture,
UAVs

PointPerfect Global

Seamless worldwide coverage for truly global solutions and use cases operating in remote areas.



PPP-AR

<10cm ~2 minutes

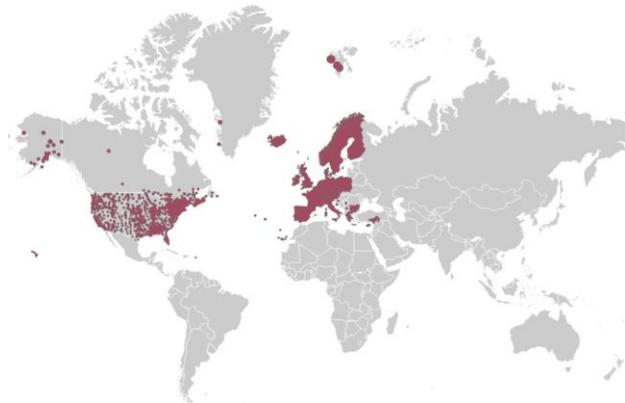
Precision agriculture, outdoor
robotics, UAVs

PointPerfect: Service coverage



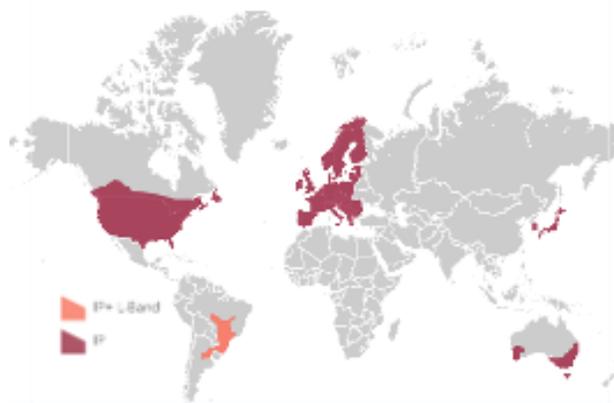
PointPerfect Live

Superior performance for the most demanding applications



PointPerfect Flex

Scalable and flexible solutions for wide-ranging use cases



PointPerfect Global

Seamless worldwide coverage for truly global solutions



Upcoming service to be launched during 2026

<https://www.u-blox.com/en/pointperfect-service-coverage>



Application example: UAV



UAV flight

using u-blox
locate solution

in Sjökulla /
Kirkkonummi /
Finland

ANN-MB2

ZED-X20P

Point Perfect

PointPerfect Live (VRS)

2D one-sigma: 1.2cm

3D one-sigma: 1.9cm

Max error (p100%, abs) components during flight:

N 2.2cm, E 2.3cm, D 3.6cm

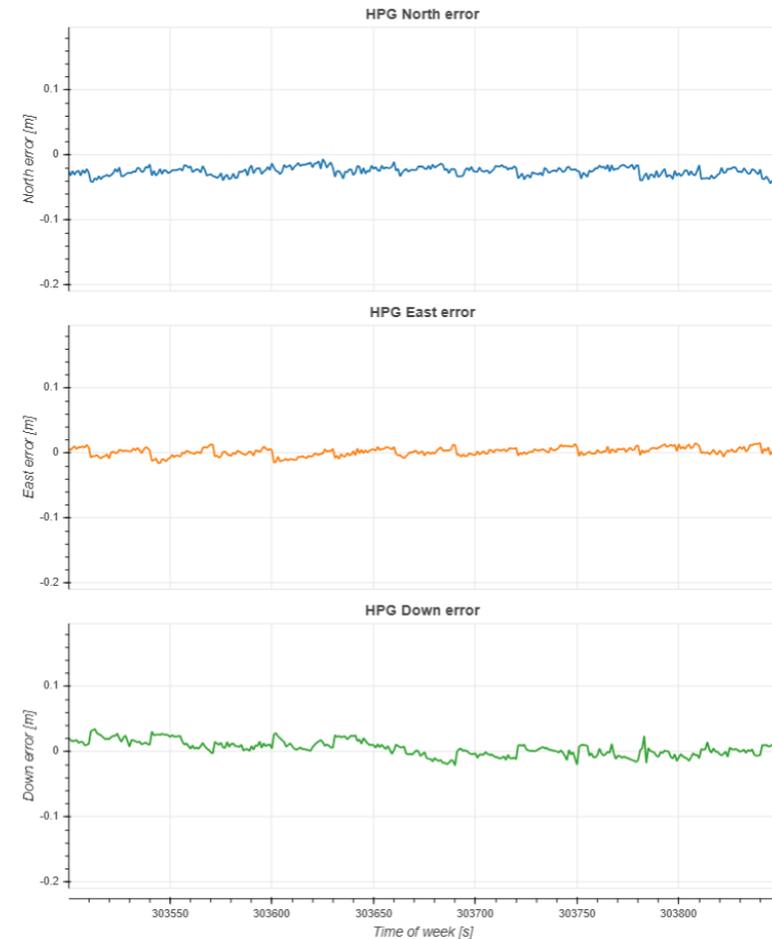
PointPerfect Flex (PPP-RTK)

2D one-sigma: 3.3cm

3D one-sigma: 3.4cm

Max error (p100%, abs) components during flight:

N 5.6cm, E 2.8cm, D 6.0cm

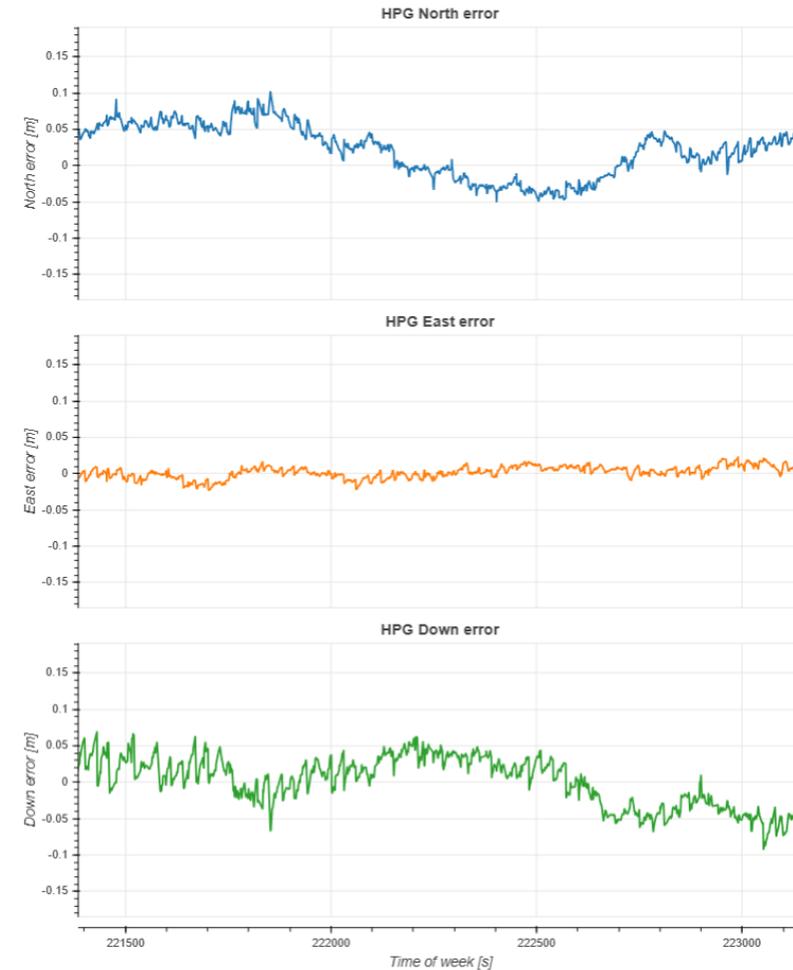


PointPerfect Flex (PPP-RTK)
Zoom in (5-6min) on the NED accuracies during flight

Static testing – with PointPerfect Live (VRS) service



VRS / PointPerfect Live for 1 hour:
2D one-sigma: 6.0cm (N 4.4cm, E 2.3cm)



More information on u-blox.com



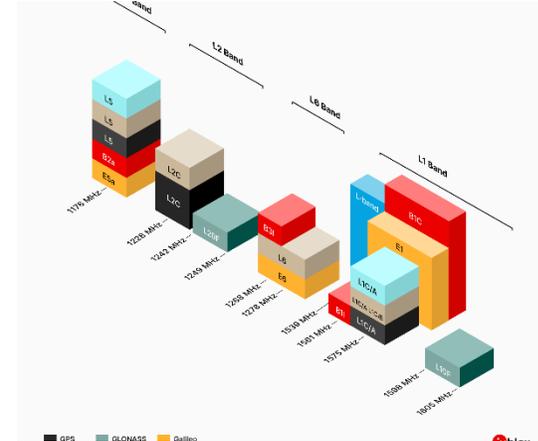
Precision agriculture

<https://www.u-blox.com/en/precision-agriculture>



PointPerfect portfolio

<https://www.u-blox.com/en/iot-location-service#High-precision-positioning>



All-band whitepaper

<https://www.u-blox.com/en/publication/white-paper/all-band-whitepaper>



Technology page

<https://www.u-blox.com/en/technologies/high-precision-positioning>

Q&A

