

UAV surveying: accept the delivered result

For teams specifying orthophotos, point clouds or terrain models.

From position to deliverable

An accurate antenna position is not an accurate orthophoto by itself. Camera calibration, exposure timing, image geometry, control and independent checkpoints belong in the same test plan. Specify the output format, reference system and permitted checkpoint error first.

Who decides? Working hypothesis

Our working hypothesis is that the survey lead defines the need, the technical lead reviews the data chain, and procurement and the project owner approve the budget. Confirm these roles in the first conversation; no customer order is established.

For the first review

Provide the federal state, area, terrain and obstruction, UAV/firmware, camera, available raw data, target CRS, height system and an existing checkpoint report. Flight planning and operational approval remain with the responsible operator.

Sources: S11, S13

Repeatable inspection and autonomous systems

Define position reference and data continuity for recurring civil tasks.

Return and compare

Recurring asset inspection needs findings to be located in the same spatial and temporal reference.

Relative repeatability does not replace absolute surveying. Mobile robots add wheel slip, obstruction and sensor fusion to the review. These are planning considerations, not capabilities promised for a delivered platform.

Handle interruptions explicitly

GNSS can become unusable near facades, buildings or trees. A renewed Fixed indication alone must not authorise a safety-critical decision. Assess state, innovation checks, timestamps and a task-specific fallback plan together.

Assign responsibility before the pilot

Proposed roles: asset owner supplies access and acceptance criteria; integrator documents interfaces; operator owns safe operation. Named contacts, permissions and integration competence must be confirmed before a quotation.

Sources: S7, S11

Select the GNSS receiver and interfaces

A selection checklist, not our own product catalogue.

Use manufacturer examples correctly

ZED-F9P and NovAtel OEM7/SPAN are documentation examples only. This page establishes no distribution rights, stock or partnerships. Check the exact part number, firmware and enabled features before making compatibility claims.

Requirements matrix

Record frequency bands and constellations, RTCM messages including MSM variant, UART/USB/CAN and electrical levels, rates, raw output, PPS/event input, antenna supply, mass, power, temperature and EMC evidence. NTRIP may run on the receiver, companion or ground computer; explicitly assign its location.

Mechanics is part of the measurement chain

Antenna reference, IMU axes and camera reference need measurable installation coordinates. Mount stiffness, cable strain and electromagnetic environment belong in the integration evidence. Existing machining capability does not demonstrate validated GNSS integration.

Sources: S5, S6, S10

RTK, network RTK, PPK and GNSS/INS

Separate positioning method, data format and transport.

Methods

RTK resolves carrier-phase ambiguities using timely reference data. Network RTK uses a reference-station network to model spatial errors; VRS, FKP and MAC are different delivery approaches requiring compatibility checks. PPK processes recorded rover and reference data after the mission: useful for offline results, but no substitute for navigation needed in real time.

Format and transport

RTCM specifies standardised GNSS messages; NTRIP transports GNSS data over IP. Neither is itself a positioning algorithm. Mountpoint, RTCM version, message types, authentication, GGA return messages and update rates must match at both ends.

Fixed, Float and GNSS/INS

Fixed indicates an integer ambiguity solution; Float uses ambiguities not fixed to integers. Fixed is not an integrity certificate. GNSS/INS combines satellite and inertial observations. INS can propagate through a GNSS gap, but uncertainty grows; permissible duration comes from tests of the actual IMU and motion.

Sources: S4, S7, S8, S6

SAPOS, reference frames and deployment in Germany

Official information checked on 30 September 2026; reconfirm before procurement.

Service performance is not a system guarantee

AdV states 1–2 cm horizontal and 2–3 cm vertical for HEPS. These are correction-service figures, not a guarantee for our UAV, camera output or every location. Agree conditions, statistical definition and test method before acceptance.

Access and cost

The ZSS website lists nationwide HEPS at EUR 10 per credential per month and EUR 100 one-off registration administration. A credential is not for concurrent use on multiple devices. The Bavaria FAQ lists free service use with EUR 20 annual account administration. These are different offerings; verify region, concurrent connections, licence and current tariff for each project.

Name coordinates completely

Agree datum, realisation, epoch, projection/zone, units and height type. The Bavaria FAQ identifies ETRS89/DREF91 (R2025), DHHN2016 and GCG2016. Ellipsoidal height h and normal height H differ: $H = h - \zeta$ using the applicable quasigeoid model. A UTM zone conversion is not a datum transformation. Do not transfer state-specific settings without verification.

Approve operations separately

RTK does not remove operational rules. EASA distinguishes open, specific and certified by operational risk. The operator must verify the category, national geographical zones and required permissions for the actual flight. This website grants no operational approval.

Sources: S1, S2, S3, S11

Timing, lever arms and data responsibility

Keep the chain from antenna position to sensor result traceable.

A shared time basis

Distinguish measurement, reception and processing time. Do not mix GNSS time, UTC and monotonic system time without conversion. PPS alone does not identify image exposure: measure trigger, event feedback, delay and jitter. At constant speed, approximate position error $\approx$ speed $\times$ timing error.

Installation geometry

Document axes, signs and vectors between antenna reference, IMU and camera. Rotate lever arms into the target frame using orientation; a moving gimbal changes the geometry. Antenna phase centre, mechanical reference and camera projection centre are not interchangeable.

Local and external

Proposed split: receiver and flight computer calculate navigation locally and log raw observations, states and sensor events. An external caster supplies corrections; later cloud processing is optional and separately authorised. Credentials stay in protected device storage. Data ownership, export, retention and update responsibility belong in the agreement.

Baseline and environment

Longer base-to-rover distances can increase atmospheric residuals and observation decorrelation. Network models reduce certain spatial errors but do not eliminate local obstruction or multipath at the rover. Record baseline, sky visibility, antenna installation and environment with every test; no universal range limit is promised here.

Failure handling

Log correction age, packet gaps, solution type and quality estimates. Do not claim constant centimetre accuracy during a network outage. PPK requires suitable overlapping raw data. Test obstruction, multipath, restart and reconnection only under a safe experiment plan.

Sources: S6, S7, S10

A testable acceptance plan

Engineering proposal for agreement; neither product performance nor a legal threshold.

Define the metrics

Per-point horizontal error: $\sqrt{\Delta E^2 + \Delta N^2}$; vertical error: ΔH . $RMSE_H = \sqrt{\text{mean}(\Delta E^2 + \Delta N^2)}$, $RMSE_V = \sqrt{\text{mean}(\Delta H^2)}$. Also report bias, 95th percentile, maximum error, sample count and failures. CEP is a 50% radius; RMS, 1σ and 95% are not interchangeable without distribution and dimensional assumptions.

Time and availability

Measure time to Fixed from a defined starting state, such as valid correction input; separate cold and warm starts. Re-fix begins after a defined interruption ends. Report median, 95th percentile and failures to fix. Fixed fraction = Fixed epochs / all expected epochs in the test window; do not silently remove missing data.

Test plan and records

Proposal: three independent repetitions per approved scenario, separate calibration and checkpoints, documented reference uncertainty. Scenarios: open sky, realistic obstruction, defined link interruption and reinitialisation. Store configuration, firmware, base CRS, baseline, weather, raw GNSS, timing events and processing version. H/V, fix-time and availability thresholds remain open until buyer approval.

Results beyond a status light

A tightly clustered series can be systematically displaced by incorrect base coordinates. Assess repeatability and absolute error separately. Accept orthophoto/point-cloud output against independent object checkpoints, not receiver status alone.

Sources: S9, S6, S8

From requirement to accountable delivery

Start with a documented technical request; delivery scope follows review.

Available now

This area provides technical information, source references, a requirements checklist and storage of your request in the platform inbox. A contracting entity, named integrator and verified test report must be established before binding delivery promises.

Distinguish business models

In-house development owns algorithm, firmware, validation and maintenance. Buying a module leaves receiver development with its maker, but integration with the integrator. Distribution requires evidenced rights and warranty responsibilities. Integration covers agreed interfaces and acceptance; it does not prove ownership of GNSS IP.

Proposed project stages

1. Receive requirements and files. 2. Confirm responsible parties and capabilities. 3. Produce interface/risk list. 4. Quote a prototype and test plan. 5. Compare results with agreed criteria. 6. Deliver configuration, logs and maintenance scope. Budget and dates follow the approved scope.

Engineering proposal; no confirmed delivery capability.

Quellen / Sources

Checked 2026-09-30. Manufacturer examples are not our performance evidence. Full source texts are linked, not reproduced.

S1 | AdV · SAPOS HEPS

<https://www.adv-online.de/de/produkte/saposr-heps>

S2 | ZSS · Gebühren & Anmeldung

<https://zentrale-stelle-sapos.de/gebuehren-anmeldung/>

S3 | LDBV Bayern · SAPOS FAQ

https://www.ldbv.bayern.de/produkte/dienste/sapos_faq.html

S4 | BKG · GNSS-Datenzentrum

<https://www.bkg.bund.de/DE/Produkte-und-Dienste/Servicestelle-Geodasie/GDC/gdc.html>

S5 | PX4 · RTK GNSS

https://docs.px4.io/main/en/gps_compass/rtk_gps

S6 | u-blox · ZED-F9P Integration Manual, UBX-18010802

https://content.u-blox.com/sites/default/files/ZED-F9P_IntegrationManual_UBX-18010802.pdf

S7 | NovAtel · Fundamentals of GNSS+INS

https://docs.novatel.com/OEM7/Content/SPAN_Install/Fundamentals_of_GNSS_INS.htm

S8 | NovAtel · Processing Modes and Solutions

https://docs.novatel.com/Waypoint/Content/Overview/Processing_Modes_Solutions.htm

S9 | NovAtel · GPGST

<https://docs.novatel.com/OEM7/Content/Logs/GPGST.htm>

S10 | NovAtel · Variable Lever Arm

https://docs.novatel.com/OEM7/Content/SPAN_Configuration/Variable_Lever_Arm.htm

S11 | EASA · Operating a drone

<https://www.easa.europa.eu/en/domains/drones-air-mobility/operating-drone>

S12 | LfDI Baden-Württemberg · Cookies & Tracking

<https://www.baden-wuerttemberg.datenschutz.de/cookies-tracking-faq-update/>

S13 | ZSS · Dienste & Anwendungen

<https://zentrale-stelle-sapos.de/dienste-anwendungen/>

<https://be-passive.com/sites/rtk/en/report>