Marker Consensus Calibration

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What Marker Consensus Calibration Specifies

The architecture treats passive markers as both reference points and writable observation accumulators. Each marker contains writable non-volatile memory; vehicles passing the marker contribute observations of their own position relative to the marker through credentialed observations. The marker's writable memory accumulates these contributions and applies consensus-based refinement to determine the marker's own position estimate.

Fleet-contributed pass readings produce position estimates more precise than any single contribution. Drift detection identifies markers whose accumulated observations indicate position migration (which can occur through ground settling, frost heave, vehicle impacts, deliberate displacement). The consensus mechanism is governance-credentialed: only credentialed contributions are admitted, and the consensus operates against published refinement policy.

Why Centralized RTK Networks Have Operational Limits

Centralized RTK reference networks (CORS, NTRIP, commercial RTK services like Trimble VRS Now and Hexagon SmartNet) maintain precision positioning through dedicated reference stations operated by survey-credentialed authorities. The architecture works for the geographies where it has been deployed; it doesn't extend to deployments where reference-station maintenance is impractical (mining, agriculture in remote areas, expeditionary deployment, deeply rural autonomy).

The maintenance cost is also significant. Each reference station requires periodic re-survey, hardware maintenance, and ongoing operational support. The cumulative maintenance burden across a global network is substantial, and the burden falls on a small number of authorities.

How Fleet Calibration Composes With Existing Reference Networks

The architecture composes additively with CORS-style reference networks. Where CORS coverage exists, the centralized references contribute to consensus alongside fleet contributions. Where CORS coverage is sparse or absent, fleet contributions provide the primary calibration signal; markers in such regions self-calibrate through the architectural primitive.

The architecture also supports gradual reference-network depopulation. As fleet calibration matures, the value of dedicated reference stations declines for regions with sufficient fleet density. The maintenance cost of reference-station infrastructure can be reduced over time without sacrificing positioning precision.

What This Enables for Precision Positioning

Mining operations gain precision positioning without dedicated mine-operator reference networks. Agricultural operations gain field-level precision without per-farm reference infrastructure. Autonomous-vehicle deployments in regions with sparse CORS coverage gain RTK-grade precision through fleet-self-calibration.

The architecture also supports expeditionary deployment scenarios. Disaster response, defense operations, and emergency-restoration scenarios where prepositioned reference infrastructure is unavailable gain structural precision-positioning capability. The patent positions the primitive at the layer where precision positioning extends to geographies that centralized-reference architecture cannot reach economically.