

Cooperative Localization Across Mesh Units

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What Cooperative Localization Specifies

Each mesh unit contributes range observations against neighboring units. The collection of pairwise observations across the mesh produces a coordinate solution that places each unit relative to the others. Anchor units with externally-known position (surveyed reference markers, GNSS-fix nodes) bind the relative solution to an absolute frame.

The cooperation is governance-credentialed. Each contributing unit signs its range observations; the receiving solver evaluates admissibility before integrating. The cooperative solution carries lineage from each contributing observation.

Why Cooperation Beats Central Broadcast

Central-broadcast positioning (GNSS, terrestrial pseudolite networks) requires the central infrastructure to operate. Loss of the central infrastructure produces total positioning loss across the operating region.

Cooperative localization degrades gracefully. Loss of any subset of mesh units reduces solution quality but doesn't eliminate it. The remaining units continue to contribute, the remaining anchor bindings continue to bind absolute frame, and the architecture

supports operation across denial scenarios that central-broadcast systems cannot survive.

How Cooperative Solutions Compose

Range observations enter a multilateration solver as credentialed observations. The solver weights observations by declared uncertainty, integrates anchor bindings as constraints, and produces a coordinate estimate for each contributing unit. The estimate carries uncertainty bounds derived from the observation quality.

Cross-checks operate structurally. When the solution is over-determined (more observations than parameters), residuals identify likely-bad observations as candidates for re-evaluation. The architecture surfaces the residuals as credentialed diagnostic events.

What This Enables for Decentralized Positioning

Defense and contested operations gain positioning that survives loss of GNSS, central infrastructure, or coordinated jamming. Civilian operations in challenging environments (urban canyon, dense indoor, underground) gain the same.

The architecture also supports ad-hoc deployment. Mesh units deployed to new operating regions cooperatively bootstrap a coordinate frame; the frame binds to absolute reference as anchor units come online. Operations can begin in relative frame and progress to absolute frame as bindings accumulate.

