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Automated Guideway Transit Without Rails: A Virtual Fixed Guideway From Credentialed Track Markers

Automated guideway transit, personal rapid transit, and automated freight corridors deliver rail-like predictability, but only after agencies pour dedicated track and acquire exclusive right-of-way, which puts most corridors out of reach. The credentialed marker-and-track layer makes the guideway virtual: passive infrastructure markers publish the track topology that pods, people movers, and freight platoons follow as their primary routing reference on existing pavement. It is built on the Marker and Track, disclosed in U.S. Provisional Application No. 64/049,409.

What This Application Specifies

An automated guideway transit (AGT) system gives passengers and cargo the defining property of rail: a vehicle that follows a known, fixed path under a known set of rules, with predictable speed, predictable spacing, and predictable behavior at junctions. Personal rapid transit (PRT) pods, airport people movers, busway and bus rapid transit (BRT) lanes, and automated freight corridors all reach for that property. The conventional way to get it is to build the guideway physically: lay dedicated track, string guide beams or guide wires, and acquire exclusive right-of-way so nothing else shares the path.

This application specifies the same operating discipline without the dedicated structure. The transport unit treats a governance-credentialed sequence of marker reads as its primary navigation reference. Infrastructure-resident markers, deployed in, on, or adjacent to existing transport infrastructure, each carry the authority credential of the authorizing transit, freight, or transport authority together with a topology payload. Reading those markers in sequence, a pod follows a virtual fixed guideway laid over public pavement, an express lane, or a shared corridor, producing dedicated per-unit track following, junction-aware routing, platoon coordination, yard marshaling, and a governed safety envelope without rail construction or right-of-way acquisition.

The marker-encoded track topology is explicit, not inferred. Linear-segment markers encode segment geometry including curvature, grade, speed envelope, lane assignment, and permitted vehicle classes. Switch-point markers mark where the track logically branches and carry branch identifiers and switching rules. Junction markers carry priority rules and coordination-agent identifiers where tracks cross or merge. Station markers for passenger transport encode boarding-zone geometry, passenger-loading sequences, and departure clearance; bus-stop markers encode passenger-waiting presence. Platooning-zone markers encode where close-spaced operation is admissible and the rules for forming and dissolving a platoon. Yard markers encode internal path graphs, marshaling sequences, loading-position identifiers, and dock assignments. Emergency-egress markers identify where a unit may safely exit the corridor under emergency conditions. This is the spec's core marker-track use case: a single credentialed marker fabric serving freight, passenger, transit, ride-sharing, delivery, and emergency-response operator classes concurrently.

Why It Matters

The economics of guideway transit are dominated by the guideway. A PRT network or an automated people mover earns its reliability from infrastructure that costs more per mile than the vehicles that run on it, and an automated freight corridor that demands its own grade-separated right-of-way competes with every other claim on scarce land.

The result is that the operating model many planners want, segregated automated transport with rail-like predictability, stays confined to airports, campuses, and a handful of purpose-built lines.

A virtual guideway changes what has to be built. Because the topology lives in passive markers rather than in continuous physical guidance, the spec describes incremental deployment: a freight corridor, a port-access run, a station-to-station passenger loop, or a specific authority-approved express segment can be commissioned by deploying marker coverage on that segment alone, without continuous coverage across the entire service area. Units already in service operate at higher density on a newly commissioned segment without fleet retrofitting and without modification, and a unit's rated operating area expands as marker coverage extends. An agency can stand up the predictable core of a corridor first and grow it, rather than financing a whole guideway before the first pod moves.

Provable routing is the second reason it matters. Sensor-primary autonomy produces a path by inference, with no credentialed attestation that the route was authorized. Marker-sequence-primary navigation produces provable route authorization through authority-credentialed attestation that admits regulatory and liability review, predictable operation through segment-governed parameters that infrastructure agents and other units can coordinate around, and governance-chain-preserving path provenance supporting incident reconstruction. A transit regulator can approve a corridor segment by segment, reviewing the credentialed topology before any service runs, rather than approving an entire opaque per-unit sensor stack.

How It Composes With the Domain

A trip begins before the pod moves. The unit issues a credentialed route request with origin, destination, and operational constraints; a route-manifest constructor retrieves the applicable credentialed topology from the shared view, verifies each segment's authority credential against the unit's operator class, and composes an authorized-route manifest across one or more credentialed track segments. Where a journey crosses jurisdictions, for example a regional freight corridor that hands off to a city transit authority's express lane, cross-authority composition stitches segments credentialed by different authorities together at credentialed authority-boundary markers, so the manifest spans authorities without forcing either to adopt the other's taxonomy.

In operation, the pod validates each marker's authority credential through the governance chain at every read, updates its route-progress state against the pre-departure manifest, and confirms the next-expected marker is consistent with the current marker's distance-to-next and topology data. It holds the segment's governed speed envelope, lane assignment, and regulatory overlay. The unit's own sensors run in parallel, feeding a coherence evaluator that handles obstacles, interaction with human-driven vehicles, and conditions not represented in the topology; when a sensor reading conflicts with the credentialed topology, the unit resolves the conflict through multi-source resolution and a graduated response rather than blindly trusting either source. A marker-read admissibility evaluator rejects spoofed, injected, or stale marker reads by checking cryptographic integrity, authority credential, sequence consistency, position consistency against mesh-derived coordinates, and temporal validity, so an adversary cannot redirect a corridor by planting a counterfeit marker.

Capacity comes from platooning. At platoon-formation markers, pods submit credentialed join requests; an admissibility evaluator weighs platoon-size policy and downstream-topology compatibility before a coupling engine establishes close-spacing mode with coupled braking, acceleration, and lane-keeping at sub-second coordination intervals. Platoons dissolve at dissolution markers or on topology divergence, and the spec admits heterogeneous platoons mixing freight pods, passenger pods, transit buses, and personal vehicles under mixed-class compatibility policy. On shared right-of-way, the unit conforms to two governance layers at once: the general road-user governance that binds everyone and the marker-track governance that binds only participating units. Human-driven traffic is not required to read or conform to the marker-track layer; infrastructure agents enforce platoon gaps for cross-traffic, issue yielding directives at merges, and execute emergency-vehicle preemption. Yards, terminals, and stations carry their own marker networks, where a yard infrastructure agent coordinates arrivals, dock and loading-position assignments, internal routing, and departure clearance back onto the external network, with intermodal-transfer markers handing cargo or passengers across to rail, ship, or air modes.

What This Enables

- Personal rapid transit and people-mover loops that follow a credentialed virtual guideway over ordinary pavement, with station markers governing boarding-zone geometry, passenger-loading sequences, and departure clearance, and passenger-specific parameters for comfort envelope, accessibility, and route privacy.
- Automated freight corridors commissioned segment by segment, where port-access and industrial runs gain marker coverage incrementally and existing pods operate at higher density on new segments without retrofitting.
- Mixed-class express lanes where transit buses on marker-guided lanes, ride-sharing vehicles, and delivery vehicles share one credentialed fabric, each running under its own operator-class parameters and authority credential.
- Junction-aware platooning that holds rail-like spacing where the topology admits it and dissolves cleanly to let cross-traffic merge, tolerating a bounded fraction of adversarial or malfunctioning members without platoon failure.
- Continuous operation across mixed infrastructure: full marker-primary density where markers are dense, reduced-speed sensor-augmented operation where they are sparse, and governed-conservative autonomy on unmarked segments until coverage resumes.

Boundary Conditions

A virtual guideway is not a magic carpet. The marker-track layer governs only participating units; it does not control human drivers in the shared corridor, and safe operation alongside them depends on the unit's own sensor suite and on infrastructure-agent coordination, not on markers alone. Markers establish authorized topology and credentialed position reference, but obstacle avoidance, vulnerable-road-user detection, and reaction to conditions absent from the topology remain sensor and coherence-evaluator functions. On unmarked or sparsely marked segments the system degrades to credentialed autonomous operation under conservative parameters; it does not manufacture guideway predictability where no markers exist. The spec discloses an architecture and its mechanisms, not throughput, headway, or speed figures, and the comfort, accessibility, fare-settlement, and emergency-evacuation behaviors named for passenger service are governance-policy parameters an operator must configure rather than fixed guarantees. Whether a given corridor may carry automated passenger or freight service is a matter for the responsible transit, freight, or safety authority, and the per-segment credentialed approval described here is built to support that review, not to substitute for it.

Disclosure Scope

The marker-and-track technology described here, infrastructure-resident credentialed markers publishing self-describing positioning and marker-encoded track-topology observations, marker-sequence-primary navigation, credentialed route-manifest composition, platoon coordination, and yard and terminal coordination, is disclosed in U.S. Provisional Application No. 64/049,409. Every statement above about what the invention does traces to that disclosure. The automated guideway transit, personal rapid transit, bus rapid transit, and automated freight framing, including references to transit authorities, regulatory review, and intermodal handoff to rail, ship, or air modes, is provided as external domain context to show a faithful enabling implementation; it is not part of the disclosure and is not a representation about any specific deployment, agency requirement, or regulatory approval. Named transport modes and regulatory concepts are general domain references, and any particular corridor, vehicle, or service remains subject to the requirements of the applicable authority.

Marker Track Transport (/marker-track)

All 40 steps → (/inventive-steps)

Rail-analogous guidance on existing roads. Per-segment regulatory authorization.

Provisional application

PRIMARY TECHNICAL DISCLOSURE

- Marker Track Transport: Credentialed Marker Sequences as Primary Routing (/articles/marker-track-transport-credentialed-marker-sequences-as-primary-routing)

SECONDARY TECHNICAL

- Credentialed Markers as Primary Routing Reference (/articles/marker-track/credentialed-marker-primary)
- Per-Segment Authority Attestation (/articles/marker-track/per-segment-attestation)
- Route Manifest Composition (/articles/marker-track/route-manifest-composition)
- Cross-Authority Route Composition (/articles/marker-track/cross-authority-routes)
- Progressive-Density Fallback (/articles/marker-track/progressive-density-fallback)
- Byzantine-Robust Platooning Under Credentialed Sequences (/articles/marker-track/byzantine-platooning)
- Adversarial Marker Rejection (/articles/marker-track/adversarial-marker-rejection)
- Regulatory Segment Approval (/articles/marker-track/regulatory-segment-approval)
- Multi-Class Operator Parameterization (/articles/marker-track/multi-class-parameterization)
- Dual-Use Marker Article: Roadway Infrastructure as Credentialed Device (/articles/marker-track/dual-use-marker-article)

APPLICATIONS · GENERAL

- **Automated Guideway Transit Without Rails: A Virtual Fixed Guideway From Credentialed Track Markers (/articles/marker-track/automated-guideway-transit)**
- Credentialed Highway Marker Network for GNSS-Denied Autonomous Vehicle Positioning (/articles/marker-track/highway-infrastructure-marker-network)
- Indoor Positioning Without Vendor Lock-In: Credentialed Marker Infrastructure for Hospitals, Airports, and Multi-Tenant Buildings (/articles/marker-track/indoor-positioning-credentialed-infrastructure)
- Audit-Grade Warehouse RFID Positioning: A Credentialed Marker Mesh for DSCSA, FSMA 204, and FTZ Compliance (/articles/marker-track/warehouse-credentialed-rfid-mesh)
- Credentialed Field Markers for Precision Agriculture and GPS-Resilient Autonomy (/articles/marker-track/agricultural-marker-network)
- Credentialed Markers for Construction Site Safety and Autonomous Equipment Authorization (/articles/marker-track/construction-site-credentialed-markers)
- Credentialed Marker Positioning for Underground and Open-Pit Mining (/articles/marker-track/mining-credentialed-positioning)
- Credentialed Trail Markers for National Parks: Multi-Authority Positioning for Hikers, SAR, and Park Shuttles (/articles/marker-track/national-park-trail-markers)
- Smart Stadium Positioning: Credentialed Marker Networks for Event Venues (/articles/marker-track/smart-stadium-event-positioning)

APPLICATIONS · SPECIFIC

- 3M Connected Roads Lacks Credentialed RFID Layer Integration (/articles/marker-track/3m-connected-roads)
- Avery Dennison RFID Lacks Credentialed Marker Integration (/articles/marker-track/avery-dennison-rfid)
- Trimble RTK Corrections Lacks Cooperative Marker Integration (/articles/marker-track/trimble-rtk-corrections)
- Impinj RFID Platform Lacks Credentialed Substrate (/articles/marker-track/impinj-rfid)
- NXP RFID IC Manufacturing Lacks Credentialed Marker Specification (/articles/marker-track/nxp-rfid-ic)
- RoadVista Pavement Markers Lack Credentialed Substrate (/articles/marker-track/roadvista-tape)
- Trimble Survey Markers Lack Credentialed-RFID Integration (/articles/marker-track/trimble-survey-marker)
- Zebra Technologies RFID Lacks Credentialed Marker Substrate (/articles/marker-track/zebra-rfid)
- 6 River Systems (Shopify) Warehouse Robotics (/articles/marker-track/6-river-systems-shopify)

- AutoStore Cube-Storage Warehouse Robotics (/articles/marker-track/autostore-warehouse)
- Berkshire Grey Robotic Fulfillment (/articles/marker-track/berkshire-grey)
- Brain Corp Autonomous Floor Care (/articles/marker-track/brain-corp-floor-care)
- Fetch Robotics (Zebra) Cloud Robotics (/articles/marker-track/fetch-zebra-fulfillment)
- Geek+ Warehouse Robotics (/articles/marker-track/geek-plus-warehouse)
- inVia Robotics Warehouse Automation (/articles/marker-track/invia-robotics)
- Locus Robotics Mobile Fulfillment (/articles/marker-track/locus-robotics)
- Ocado Smart Platform Warehouse Robotics (/articles/marker-track/ocado-smart-platform)

Marker Track Transport overview → (/marker-track)