

Beyond Jamming: Autonomy in Space, Deep Disconnection, and Delay-Tolerant Networks

The drone case is autonomy under an adversary who takes the link. Space is autonomy where the link was never there. A Mars rover sits many light-minutes from its operators; a deep-space, undersea, or disaster-zone system may have no continuous path home at all. Same conclusion, no enemy required: authority has to be carried.

Two Kinds of No Link

The drone case is autonomy under an adversary who takes the link away. Space is autonomy where the link was never continuously there to begin with. A Mars rover sits many light-minutes from its operators, so a round-trip command is tens of minutes old before it can possibly arrive; a deep-space probe, an undersea vehicle, or a disaster-zone robot may have no continuous path home at all for long stretches. The conclusion is the same, and it needs no enemy to force it: when there is no timely round-trip to any authority, the things authority would have supplied have to be carried. The contested case, developed in the analyses of [drone jamming](/articles/what-drone-jamming-proves-about-trustworthy-autonomy) and the [contested mesh radio](/articles/memory-native-protocol/contested-mesh-radio), and the disconnected case described here, bracket the full condition of no reachable authority: one where the link is denied, one where it was never there.

The Disconnected Regime

The disconnected regime already has its own engineering tradition, and it points the same way. NASA's work on delay- and disruption-tolerant networking abandons the assumption of an end-to-end path entirely: data is stored at each hop and forwarded when a next hop becomes available, so a message crosses an intermittently connected fabric in stages rather than in a single connected route. Onboard autonomy on Mars rovers makes decisions locally under multi-minute round-trips, selecting science targets and navigating around hazards without waiting for Earth. Undersea and disaster-response operations face the same intermittency for different physical reasons. In all of these, there is no central authority positioned to govern each action in real time, because the speed of light, the water, or the rubble has removed it.

Why the Same Architecture Applies

A store-and-forward, intermittently connected fabric needs exactly what the memory-native protocol carries. Because there is no authority to defer to at the moment of action, identity, policy, lineage, and routing must travel with the data unit, which is precisely the governed envelope: an authority-taxonomy field, a device-hash continuity field that proves the originator without a reachable certificate authority, a hop-history field that records the staged path, and store-and-forward propagation that preserves authority, scope, and freshness across the gaps. Routing keyed to trust state rather than to reachable addresses is the natural fit for a network with no stable end-to-end paths, because a node decides what to do with a held message from the governance the message carries rather than from a route to a destination it cannot currently reach. The same primitive that lets a jammed swarm govern itself lets a delay-tolerant or interplanetary system govern itself, because both are instances of acting with no round-trip to authority.

The markets follow the physics: civil and defense space, undersea and maritime autonomy, and disaster-response robotics are all domains where the link is absent rather than merely contested, and all are domains where carried governance is not a hardening option but the only thing that lets an autonomous system act accountably at all.

Disclosure Scope

Operation over delay-tolerant, intermittently connected, contested, and interplanetary links, with identity, policy, lineage, and routing carried in the data unit and routing keyed to trust state rather than to a central registry, is disclosed in the platform filing (PCT Application No. PCT/US26/22839 and U.S. Application No. 19/230,933) and the protocol filing (U.S. Application No. 19/366,760, published as US 2026/0052096 A1), including the store-and-forward and trust-weighted routing primitives. This article frames those disclosed mechanisms against the disconnected regime of delay- and disruption-tolerant networking and onboard planetary autonomy, and presents it as the no-base complement to the contested no-link case. References to NASA delay-tolerant networking and rover autonomy are to public materials and are used for context only.

Memory-Native Protocol ([/memory-native-prot](/memory-native-protocol) [All 36 steps → \(/inventive-steps\)](#) [ocol](#))

Authority intrinsic to the object. Routing by semantic properties.

PRIMARY TECHNICAL DISCLOSURE

- [Memory-Native Networking: A Cognition-Compatible Protocol Substrate \(/articles/memory-native-networking-a-cognition-compatible-protocol-substrate\)](/articles/memory-native-networking-a-cognition-compatible-protocol-substrate)

SECONDARY TECHNICAL

- [Protocol-Native Carriers: Agents as the Fundamental Unit of Transmission \(/articles/memory-native-protocol/protocol-native-carrier\)](/articles/memory-native-protocol/protocol-native-carrier)
- [Dynamic Routing Protocol: Memory-Aware Path Selection for Semantic Agents \(/articles/memory-native-protocol/dynamic-routing\)](/articles/memory-native-protocol/dynamic-routing)
- [Trust-Weighted Route Scoring: Dynamic Path Selection Through Policy-Defined Trust Thresholds \(/articles/memory-native-protocol/trust-weighted-routing\)](/articles/memory-native-protocol/trust-weighted-routing)
- [Network Health Monitoring System: Signed Health Agents as Distributed Operational Telemetry \(/articles/memory-native-protocol/network-health-monitoring\)](/articles/memory-native-protocol/network-health-monitoring)
- [Health Agents as Semantic Objects: Operational Metrics That Route Like Any Other Agent \(/articles/memory-native-protocol/health-agents\)](/articles/memory-native-protocol/health-agents)
- [Dynamic Indexing Protocol: Entropy-Driven Restructuring of Semantic Flows \(/articles/memory-native-protocol/dynamic-indexing\)](/articles/memory-native-protocol/dynamic-indexing)
- [Soft-Index Anchors: Ephemeral Index Points Inferred From Agent Lineage \(/articles/memory-native-protocol/soft-index-anchors\)](/articles/memory-native-protocol/soft-index-anchors)
- [Adaptive Consensus Protocol: Memory-Native Quorum Without Fixed Validator Sets \(/articles/memory-native-protocol/adaptive-consensus\)](/articles/memory-native-protocol/adaptive-consensus)
- [Trust-Weighted Voting in ACP: Domain-Scoped Votes Accumulated Against Agent Memory \(/articles/memory-native-protocol/acp-trust-voting\)](/articles/memory-native-protocol/acp-trust-voting)
- [Dynamic Alias Resolution: Zone-Local Semantic Aliases Resolved Through Transport Headers \(/articles/memory-native-protocol/alias-resolution\)](/articles/memory-native-protocol/alias-resolution)
- [Horizontally Composable Protocol Stack: Independent Layers Operating in Parallel \(/articles/memory-native-protocol/composable-stack\)](/articles/memory-native-protocol/composable-stack)
- [Transport-Layer Agnosticism: One Protocol Stack Above Any Carrier \(/articles/memory-native-protocol/transport-agnosticism\)](/articles/memory-native-protocol/transport-agnosticism)
- [Federated Semantic Zone Deployment: Heterogeneous Nodes Coordinating Across Trust Boundaries \(/articles/memory-native-protocol/federated-zones\)](/articles/memory-native-protocol/federated-zones)
- [Health-Triggered Quorum Adjustment: Dynamic Thresholds From Network Stability Signals \(/articles/memory-native-protocol/health-triggered-quorum\)](/articles/memory-native-protocol/health-triggered-quorum)
- [Authority Credential as a First-Class Field on the Wire \(/articles/memory-native-protocol/governed-mesh-wire-format\)](/articles/memory-native-protocol/governed-mesh-wire-format)
- [Hop-History Relay and Byzantine Custody Chain \(/articles/memory-native-protocol/hop-history-relay\)](/articles/memory-native-protocol/hop-history-relay)
- [Dynamic Device Hash Continuity Without CRLs or OCSP \(/articles/memory-native-protocol/dynamic-device-hash-continuity\)](/articles/memory-native-protocol/dynamic-device-hash-continuity)
- [Rateless Forward-Error-Correction for Lossy Mesh Media \(/articles/memory-native-protocol/rateless-fec-fountain\)](/articles/memory-native-protocol/rateless-fec-fountain)

- [Mobile Store-and-Forward Without Cellular Backhaul \(/articles/memory-native-protocol/mobile-store-and-forward\)](/articles/memory-native-protocol/mobile-store-and-forward).
- [Credentialed Firmware and Policy Distribution Through the Mesh \(/articles/memory-native-protocol/firmware-via-mesh\)](/articles/memory-native-protocol/firmware-via-mesh).

APPLICATIONS · GENERAL

- [Edge Computing Without Central Routing Authority \(/articles/memory-native-protocol/edge-routing\)](/articles/memory-native-protocol/edge-routing).
- [IoT Device Mesh Governance at Scale \(/articles/memory-native-protocol/iot-mesh\)](/articles/memory-native-protocol/iot-mesh).
- [Vehicle-to-Vehicle Communication With Intrinsic Governance \(/articles/memory-native-protocol/autonomous-vehicle-networking\)](/articles/memory-native-protocol/autonomous-vehicle-networking)
- [Military Mesh Networks Without Central Routing Authority \(/articles/memory-native-protocol/military-mesh-networks\)](/articles/memory-native-protocol/military-mesh-networks).
- [Smart City Infrastructure With Self-Governing Transport \(/articles/memory-native-protocol/smart-city-infrastructure\)](/articles/memory-native-protocol/smart-city-infrastructure).
- [Satellite Communication With Delay-Tolerant Governance \(/articles/memory-native-protocol/satellite-communication\)](/articles/memory-native-protocol/satellite-communication)
- [Industrial IoT Protocols With Embedded Authority \(/articles/memory-native-protocol/industrial-iot-protocols\)](/articles/memory-native-protocol/industrial-iot-protocols).
- [Healthcare Device Mesh Networking \(/articles/memory-native-protocol/healthcare-device-mesh\)](/articles/memory-native-protocol/healthcare-device-mesh).
- [Contested-Mesh Radio for Defense and Public Safety \(/articles/memory-native-protocol/contested-mesh-radio\)](/articles/memory-native-protocol/contested-mesh-radio).
- [Expeditionary Mesh for GNSS-Denied Operations \(/articles/memory-native-protocol/expeditionary-mesh\)](/articles/memory-native-protocol/expeditionary-mesh).
- [Maritime, Agricultural, and Mining Mesh Without Cellular \(/articles/memory-native-protocol/maritime-iot-mesh\)](/articles/memory-native-protocol/maritime-iot-mesh).
- [The Mesh Ceiling: Why Packet-as-Payload Networks Plateau \(/articles/memory-native-protocol/carrying-authority-ceiling\)](/articles/memory-native-protocol/carrying-authority-ceiling)
- [The Malicious Host Problem, Reframed: Attribution, Quorum, and Routing Beat a Compromised Node \(/articles/memory-native-protocol/malicious-host-contained\)](/articles/memory-native-protocol/malicious-host-contained).
- [Beyond Jamming: Autonomy in Space, Deep Disconnection, and Delay-Tolerant Networks \(/articles/memory-native-protocol/disconnected-and-interplanetary\)](/articles/memory-native-protocol/disconnected-and-interplanetary)

APPLICATIONS · SPECIFIC

- [Starlink Built a Satellite Mesh. The Routing Authority Is Still Terrestrial. \(/articles/memory-native-protocol/starlink\)](/articles/memory-native-protocol/starlink)

- [Zigbee Built a Mesh Protocol for IoT. The Messages It Carries Have No Memory. \(/articles/memory-native-protocol/zigbee\)](#)
- [Matter Unified Smart Home Devices. The Protocol Still Separates Data From Authority. \(/articles/memory-native-protocol/matter\)](#)
- [Helium Decentralized Wireless Coverage. The Protocol That Uses It Did Not Follow. \(/articles/memory-native-protocol/helium\)](#)
- [LoRaWAN Solved Long-Range IoT. The Messages Are Still Passive Payloads. \(/articles/memory-native-protocol/lorawan\)](#)
- [Tailscale Made WireGuard Usable. The Coordination Server Still Holds the Authority. \(/articles/memory-native-protocol/tailscale\)](#)
- [QUIC Modernized Transport. The Protocol Carries No Semantic Authority. \(/articles/memory-native-protocol/quic-protocol\)](#)
- [MQTT Connected Billions of IoT Devices. The Broker Still Holds the Authority. \(/articles/memory-native-protocol/mqtt\)](#)
- [CoAP Brought REST to Constrained Devices. The Protocol Carries No Governance Semantics. \(/articles/memory-native-protocol/coap\)](#)
- [gRPC Made Service Communication Type-Safe. The Protocol Carries No Trust Semantics. \(/articles/memory-native-protocol/grpc\)](#)
- [ZeroMQ Eliminated the Broker. Routing Authority Still Lives in Application Code. \(/articles/memory-native-protocol/zeromq\)](#)
- [WireGuard Simplified VPN Tunnels. The Protocol Has No Semantic Routing Layer. \(/articles/memory-native-protocol/wireguard\)](#)
- [Nebula Built Overlay Mesh Networks. The Certificate Authority Is Still Central. \(/articles/memory-native-protocol/nebula-mesh\)](#)
- [Calico Enforces Network Policy at the Kernel Level. Policy Authority Is Still External. \(/articles/memory-native-protocol/calico\)](#)
- [Cilium Made eBPF the Network Data Plane. The Protocol Layer Carries No Governance. \(/articles/memory-native-protocol/cilium\)](#)
- [Weave Net Built a Virtual Network for Containers. The Protocol Carries No Semantic Authority. \(/articles/memory-native-protocol/weave-net\)](#)
- [Persistent Systems Wave Relay Hardens Mesh Without Authority Semantics \(/articles/memory-native-protocol/persistent-systems\)](#)
- [Silvus StreamCaster Solves the Radio Layer, Not the Trust Layer \(/articles/memory-native-protocol/silvus-streamcaster\)](#)
- [Rajant Kinetic Mesh Has Mobility, Lacks Credential Authority \(/articles/memory-native-protocol/rajant-kinetic-mesh\)](#)

- [Trellisware TSM Optimizes Routing, Not Authority Resolution \(/articles/memory-native-protocol/trellisware-tsm\)](/articles/memory-native-protocol/trellisware-tsm).
- [Autotalks Craton2 Is V2X Silicon Without Governance \(/articles/memory-native-protocol/autotalks-craton2\)](/articles/memory-native-protocol/autotalks-craton2).
- [Qualcomm 9150 C-V2X Authenticates Messages, Not Behavioral Authority \(/articles/memory-native-protocol/qualcomm-9150\)](/articles/memory-native-protocol/qualcomm-9150).
- [NXP RoadLink Implements DSRC, Not the Authority Taxonomy \(/articles/memory-native-protocol/nxp-roadlink\)](/articles/memory-native-protocol/nxp-roadlink).
- [Chroma Vector Database \(/articles/memory-native-protocol/chroma-vector-db\)](/articles/memory-native-protocol/chroma-vector-db)
- [Milvus Vector Database \(/articles/memory-native-protocol/milvus-vector-db\)](/articles/memory-native-protocol/milvus-vector-db)
- [Pinecone Vector Database \(/articles/memory-native-protocol/pinecone-vector-db\)](/articles/memory-native-protocol/pinecone-vector-db).
- [Qdrant Vector Database \(/articles/memory-native-protocol/qdrant-vector-db\)](/articles/memory-native-protocol/qdrant-vector-db).
- [Weaviate Vector Database \(/articles/memory-native-protocol/weaviate-vector-db\)](/articles/memory-native-protocol/weaviate-vector-db).
- [Anduril Lattice Mesh: Defense-Grade Mesh, Without Carried Authority \(/articles/memory-native-protocol/anduril-lattice-mesh\)](/articles/memory-native-protocol/anduril-lattice-mesh)
- [Hivemind: Onboard Autonomy Without an Onboard Authority Substrate \(/articles/memory-native-protocol/shield-ai-hivemind\)](/articles/memory-native-protocol/shield-ai-hivemind).

[Memory-Native Protocol overview → \(/memory-native-protocol\)](/memory-native-protocol)