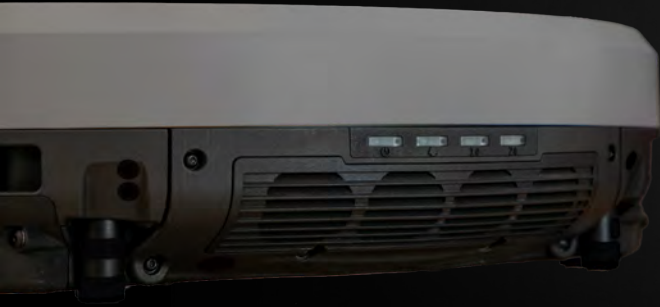# ALL.SPACE

DELIVERING
NETWORK
RESILIENCE WITH
INTELLIGENCE

ADVANCING NAVAL COMMUNICATIONS FOR MODERN OPERATIONS

Resilient SATCOM Solutions for Maritime Superiority

Today's naval operations demand agile, secure, and high-capacity communications that can withstand the challenges of contested maritime environments. As U.S. and allied fleets face growing threats across sea, air, space, cyber, and electromagnetic domains, reliable SATCOM is critical to maintaining command, control, and operational tempo.

ALL.SPACE delivers advanced communications capabilities through its Hydra 2 multi-link, multi-orbit flat-panel terminal for naval deployment. Hydra 2 integrates Radio Frequency-over-Fiber modules and will support coordinated multi-terminal operations and alternative PNT capabilities (currently in development), ensuring resilient connectivity, rapid decision-making, and interoperability across allied maritime forces.

2025

CASE STUDY | NAVAL COMMS

The Shifting Paradigm of Naval Warfare

Naval operations have moved beyond traditional ship-to-ship engagements and open-ocean supremacy. Today's mission success depends on the ability to command, control, and exchange intelligence in real time across widely dispersed maritime forces. With increasing reliance on unmanned systems, coalition interoperability, and near-shore engagements, naval communications must be resilient, scalable, and responsive, ensuring uninterrupted coordination across surface fleets, aviation elements, and support vessels operating in contested environments.

Challenges in Modern Naval Operations

Contested Electromagnetic and Cyber Environments
Naval forces face growing threats from electronic warfare and cyberattacks that can disrupt communications, degrade Intelligence Surveillance Reconnaissance (ISR) capabilities, and delay critical command decisions, putting missions and crews at risk.

**Disconnected, Intermittent, and Limited (DIL) Communications**
Ships and deployed naval units frequently operate in austere, infrastructure-poor environments where unreliable satellite or line-of-sight communications impede situational awareness and reduce operational tempo.

Fleet-Wide Coordination Across Complex Maritime Environments
Coordinating across diverse vessels, aviation detachments, and forward elements requires secure, high-throughput communications. Platform diversity and aging systems often hinder interoperability and introduce unnecessary complexity.

Solutions Enabled by the ALL.SPACE Hydra 2 Terminal

DISTRIBUTED CONNECTIVITY MULTI-TERMINAL OPERATION

Single Antenna
Sky coverage (blue)

Dual Antenna
Full-sky visibility with overlap in (green)
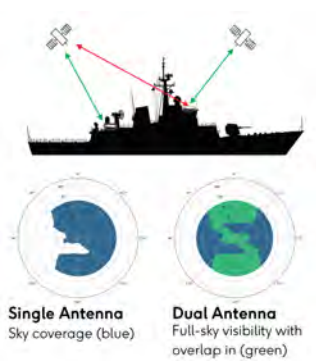
Multi-Link, Multi-Orbit Connectivity for Resilient Naval Communications
ALL.SPACE's Hydra 2 is a low-profile, MIL-STD ruggedized, next-generation all-electronic terminal featuring optical digital beamforming and two full-performance Ka-band links operating across commercial and military frequencies, in a single device. It enables concurrent connectivity across GEO, HEO, MEO, and LEO orbits (once fully operational), delivering layered resilience, low-latency ISR, and high-throughput Command and Control (C2), ensuring uninterrupted communications even in degraded environments. Its simultaneous dual-link capability supports make-before-break transitions across MEO and LEO satellite networks with zero packet loss, and concurrent connections to national and coalition networks, ensuring NATO and allied interoperability in mission-critical operations.

Multi-Terminal Operation for Shipboard Redundancy and Coverage
Naval vessels often experience SATCOM blockage due to masts, superstructures, or platform layout. ALL.SPACE will address this with synchronized multi-terminal configurations that use digital beamforming to coordinate apertures. This will maintain consistent connectivity, even boosting throughput when both terminals have satellite visibility, ensuring uninterrupted operations in complex maritime environments.

ALTERNATIVE-PNT VIA SoOP

Hold one link for communications

GEO/HEO
MEO
LEO

RAPIDLY ACQUIRE, LOCK, AND MEASURE SIGNALS FROM MANY SATELLITES IN SEQUENCE, VALIDATING EACH AGAINST THE OTHERS FOR SPOOFING, JAMMING, AND OTHER ATTACKS.

Alternative Positioning, Navigation, and Timing (Alt-PNT) via Signals of Opportunity (SoOP)
Hydra 2 will leverage simultaneous multi-satellite tracking to extract Time Difference of Arrival (TDoA), Angle of Arrival (AoA), and Doppler data. This will provide resilient navigation capability using Ka-band satellites in GPS-denied or spoofed environments. With rapid beam switching and high satellite diversity, the system will provide reliable positioning to support mission continuity when GNSS is unavailable.

Radio Frequency-over-Fiber (RFoF) for Secure, Scalable Integration
Hydra 2 leverages RF-over-Fiber (RFoF) architecture to transmit RF signals from its topside terminal to below-deck systems with minimal signal loss and high signal integrity. This approach enables centralized encryption, switching, and network integration, while significantly reducing topside clutter, simplifying cabling, and minimizing electromagnetic interference (EMI). Optimized for space-constrained naval platforms, RFoF enhances both system security and scalability without compromising performance.

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Hydra 2 in Action: Naval Expeditionary Strike Group (ESG) Deployment Scenarios

Operational Context

A U.S. Navy Expeditionary Strike Group (ESG) is deployed to the Indo-Pacific region during a period of heightened tension. The ESG must maintain persistent situational awareness, secure command and control (C2), and enable rapid coordination with joint and allied forces across a contested, communications-degraded environment.

Challenge 1: Operating in a Contested Electromagnetic Environment.
Enemy jamming and spoofing tactics are actively degrading traditional SATCOM links, threatening the ESG ability to maintain secure command and control and real-time ISR during operations.

Solution: Resilient Multi-Link Connectivity with Hydra 2
Hydra 2 enables simultaneous dual-link Ka-band connections, one to GEO for strategic C2, and another to LEO or MEO for tactical ISR. If one link is disrupted by electronic attack, digital beamforming instantly reroutes traffic across the other, ensuring uninterrupted, mission-critical communications even under active jamming.

Result: The ESG maintains continuous operational awareness and decision-making authority, preserving mission tempo and tactical advantage in the face of electromagnetic interference.

Challenge 2: Multi-Domain Coordination Across Distributed Forces
The ESG's ships, aircraft, and Marine Corps elements are dispersed across a wide area with limited line-of-sight communications. Seamless coordination across air, sea, and cyber domains demands high-throughput, low-latency connectivity, without gaps or delays.

Solution: Dual-Link, Multi-Orbit Connectivity with Hydra 2
Hydra 2's rugged, MIL-STD low-profile terminal enables:

- Link 1: High-throughput GEO connection to fleet HQ for command, planning, and logistics.
- Link 2: Low-latency Ka-band MEO or LEO link for real-time Unmanned Aerial Vehicle (UAV), ISR, and coordination of distributed units.
- The simultaneous dual-link design removes the need for antenna repointing or bandwidth sharing, supporting continuous multi-domain operations.

Result: The ESG achieves synchronized, real-time coordination across platforms and domains, maintaining operational tempo and decision superiority in complex, distributed environments.
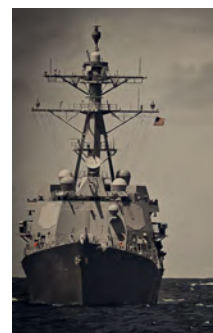
Challenge 3: Platform Space and Power Constraints
Smaller naval vessels and amphibious ships face strict limitations on topside space, weight, and power (SWaP), making it difficult to deploy traditional SATCOM systems without compromising performance or operational flexibility.

Solution: Compact, Integrated SATCOM with Hydra 2
Hydra 2's low-profile, rugged design, with no moving parts and a fully electronically steered terminal, ensures seamless installation on large capital ships as well as smaller naval and autonomous platforms. Leveraging RF-over-Fiber, it routes RF signals below deck with minimal loss, enabling secure signal processing, simplified system integration, and a reduced topside footprint, all while lowering electromagnetic interference (EMI) exposure.

Result: Naval forces can deploy advanced multi-orbit connectivity across the fleet, including constrained platforms, without sacrificing performance, stealth, or integration flexibility.

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Challenge 4: Coalition Interoperability and Network Resilience

While operating alongside NATO allies, the Expeditionary Strike Group (ESG) must maintain secure, resilient communications that are fully interoperable with partner systems, despite varying platforms, standards, and potential network disruptions.

Solution: Interoperable, Resilient Connectivity with Hydra 2

The Hydra 2 software-defined terminal features digital beamforming, modem-agnostic architecture, and compliance with NATO STANAG and IP-based protocols, enabling seamless integration with allied SATCOM networks. Its simultaneous dual-link capability enables seamless connectivity with coalition partner nodes, automatically rerouting traffic through alternate links when primary paths are degraded or compromised.

Result: The ESG achieves secure, resilient, and interoperable communications across joint and allied forces, strengthening coalition coordination and ensuring mission continuity under dynamic conditions.

## Challenge 5: Communications in Contested Littoral Operations

The ESG's ships, aircraft, and Marine Corps elements are dispersed across a wide area with limited line-of-sight communications. Seamless coordination across air, sea, and cyber domains demands high-throughput, low-latency connectivity, without gaps or delays.

Solution: Multi-Orbit Resilience with Hydra 2

Hydra 2 delivers robust Ka-band connectivity through dual- or triple-orbit operation:

- LEO provides low-latency ISR control for UAVs and Uncrewed Ground Vehicles (UGVs).
- GEO ensures persistent planning and ship-to-shore C2 links.
- MEO serves as a fallback in case of LEO disruption or atmospheric interference.
- Seamless orbit handovers preserve real-time communications from the beachhead to the mothership.

Result: Amphibious forces maintain uninterrupted command and ISR coordination, even in contested, communications-denied littoral environments.
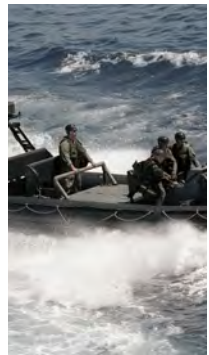
Challenge 6: Tactical Communications for Special Operations Forces (SOF) Maritime Insertions

Naval Special Warfare teams conducting stealthy insertions via Rigid Hull Inflatable Boats (RHIBs) and mini-submersibles operate in GPS- and comms-denied coastal zones. These missions demand secure, low-profile communications for ISR, C2, and situational awareness, without reliance on local infrastructure or line-of-sight relays vulnerable to detection or disruption.

Solution: Multi-Orbit SATCOM with Hydra 2

Hydra 2 terminals with Alt-PNT capability enable resilient and covert connectivity across orbits to support mobile SOF missions:

- LEO provides low-latency ISR relay to airborne platforms and mission control.
- GEO ensures long-range, encrypted C2 to distant support assets.
- MEO acts as a fallback in case of jamming, terrain blockage, or LEO denial.

Result: In denied environments, SOF teams retain reliable, infrastructure-free tactical communications throughout the mission, enhancing stealth, coordination, and mission success.

Challenge 7: Restoring Communications in Disaster Zones

After a typhoon, U.S. and allied naval forces must coordinate humanitarian relief in a region where terrestrial infrastructure is destroyed. With cell towers down and commercial networks offline, rapid, reliable communications are essential to enable joint military-civilian response efforts.

Solution: Rapid, Multi-Orbit SATCOM Deployment with Hydra 2

Hydra 2 terminals deliver resilient, dual-link connectivity from naval platforms:

- GEO enables long-duration planning and coordination with coalition HQs and NGOs.
- LEO/MEO support low-latency, high-bandwidth comms for UAVs, mobile teams, and local responders.
- Navy ships function as SATCOM hubs, extending coverage to land-based terminals and edge nodes.

Result: Scalable, resilient communications are restored within hours, empowering coordinated disaster response, accelerating relief operations, and saving lives in austere, infrastructure-denied environments.

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| **Mission Outcome** | Throughout the deployment, the Expeditionary Strike Group (ESG) maintains continuous SATCOM coverage, resilient command and control (C2), and effective ISR-sharing across all domains. Hydra 2 ensures seamless, high-performance communication in dynamic, contested environments. |

Throughout the deployment, the Expeditionary Strike Group (ESG) maintains continuous SATCOM coverage, resilient command and control (C2), and effective ISR-sharing across all domains. Hydra 2 ensures seamless, high-performance communication in dynamic, contested environments.

During a cyber-electromagnetic attack, the dual-link terminal automatically shifts ISR traffic from a jammed LEO link to an unaffected MEO beam, while C2 remains uninterrupted via the GEO link.

Hydra 2's compact form factor and RF-over-Fiber ntegration enable secure below-deck routing and centralized network management, enhancing survivability and execution speed. The ESG achieves operational superiority with improved mission execution and interoperability across U.S. and allied forces, ensuring success in multi-domain environments.

Hydra 2: Seamless SATCOM for Blue Water Dominance

To dominate the dynamic maritime battlespace, naval forces require resilient, scalable SATCOM solutions that enable real-time command, control, and interoperability.

The ALL.SPACE Hydra 2 terminal, with its rugged, low-profile design and simultaneous dual-link Ka-band connectivity, empowers naval platforms with uninterrupted multi-orbit communications, spanning GEO, MEO, and LEO.

Hydra 2 enhances coalition coordination, sustains mission continuity in contested environments, and supports modern, multi-domain naval operations.
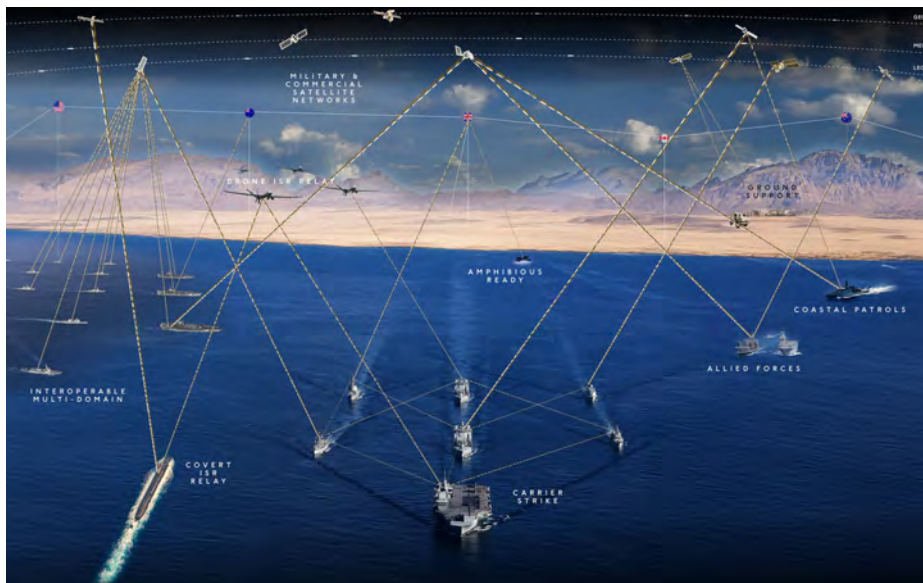
Strategic Impact

- **Decisive C2 Superiority** — Enables real-time command and control (C2) even in denied or degraded environments, ensuring mission assurance and operational tempo.

- **Mission Agility** — Seamless, automated handover between orbital layers allows rapid adaptation to shifting operational demands across theaters.

- **Force Integration** — Supports interoperable operations across Navy, Marine Corps, Air Force, and Allied/Coalition partners, enhancing joint mission success.

- **Multi-Orbit Resilience** — Simultaneous access to multiple constellations provides communications redundancy, resistance to jamming, and adaptive link performance.

- **Compact Maritime Integration** — The small, rugged form factor allows for deployment across a wide range of naval platforms, from destroyers to autonomous surface vessels, without major retrofits.

**Making the difference
In the moments that matter**

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