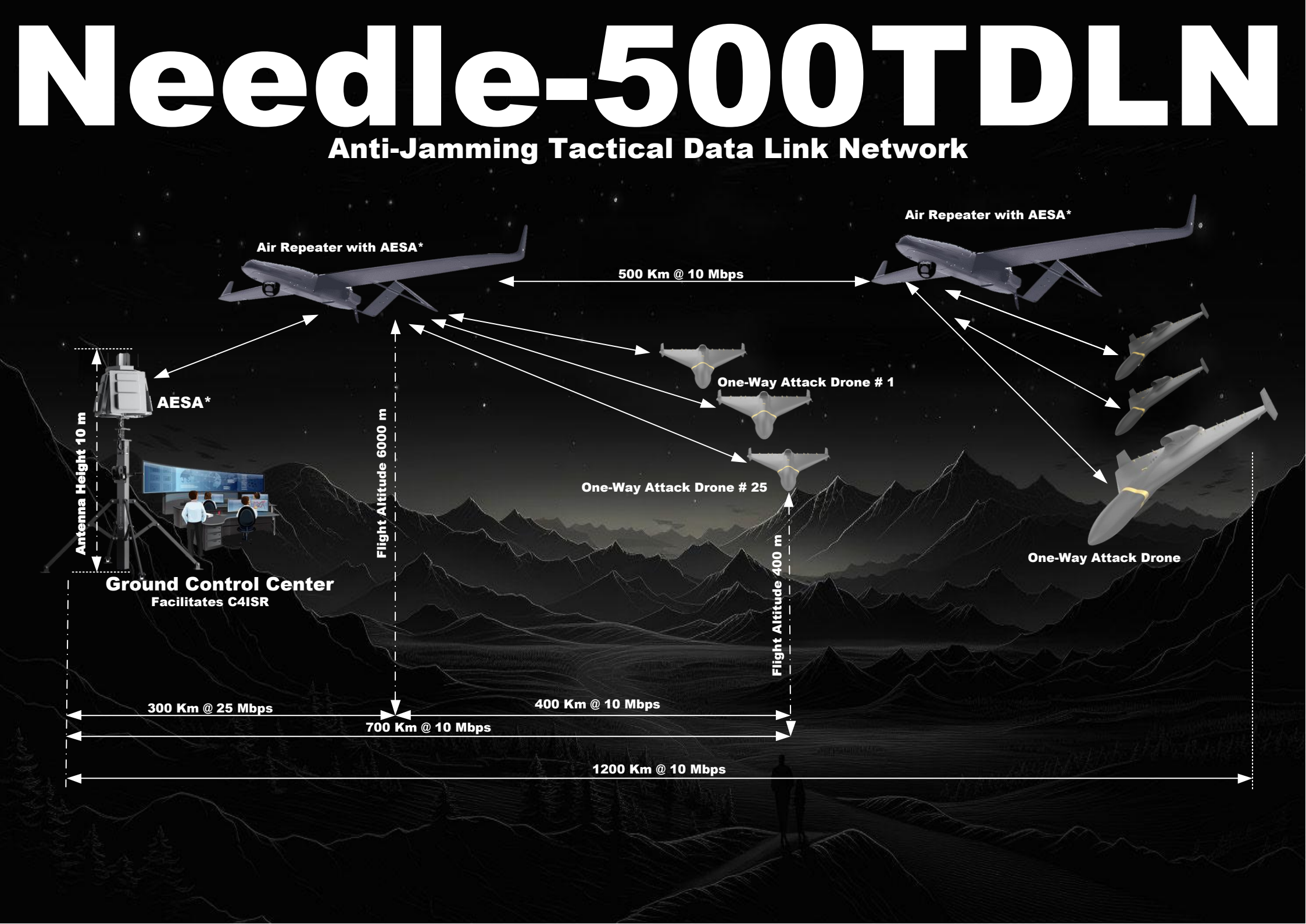
Needle-500TDLN

Anti-Jamming Tactical Data Link Network



Anti-Jamming Tactical Data Link Network

RIMCO' Needle-500TDLN is an AI-driven, anti-jamming tactical data link system engineered for high-resilience military operations, unmanned systems, and C4ISR networks over ranges up to 700 or 1200 km. The Needle-500TDLN uses Low Probability of Detection (LPD) and Low Probability of Intercept (LPI) method, are techniques used in tactical communications to reduce the visibility and vulnerability of signals on the battlefield. In contested battlespace, stealth equals survivability and operational success.

The Needle-500TDLN uses a Cylindrical Active Electronically Scanned Array (AESA) architecture provides 360-degree azimuthal beam steering with consistent beamwidth and polarization diversity. Unlike planar arrays that are restricted to a wedge-shaped field of view, a circular array allows seamless electronic scanning all the way around the horizon.

RIMCO' Phased array technology is redefining what resilient military communications look like in contested environments. Ultra-narrow beams create significant more effect than legacy radios. In addition, advanced waveforms and state-of-the-art encryption give Needle-500 phased array radios unmatched jamming resilience and range. An adversary would need to be directly in the beam or having disproportionate jamming resources to interfere.

Legacy systems spread energy everywhere. Phased array technology directs it exactly where it matters. Ultra-long range communication is about more than reach. It is about ensuring continuous information flow, cross-domain coordination and real-time decision-making, even when conditions are at their most challenging. In today's operational landscape, distance, mobility and electronic interference are no longer background factors; they define mission success.

RIMCO' Needle-500TDLN delivers unmatched jamming resilience and stable connectivity in environments where communication matters most.

Needle-500TDLN-700 Kit #1

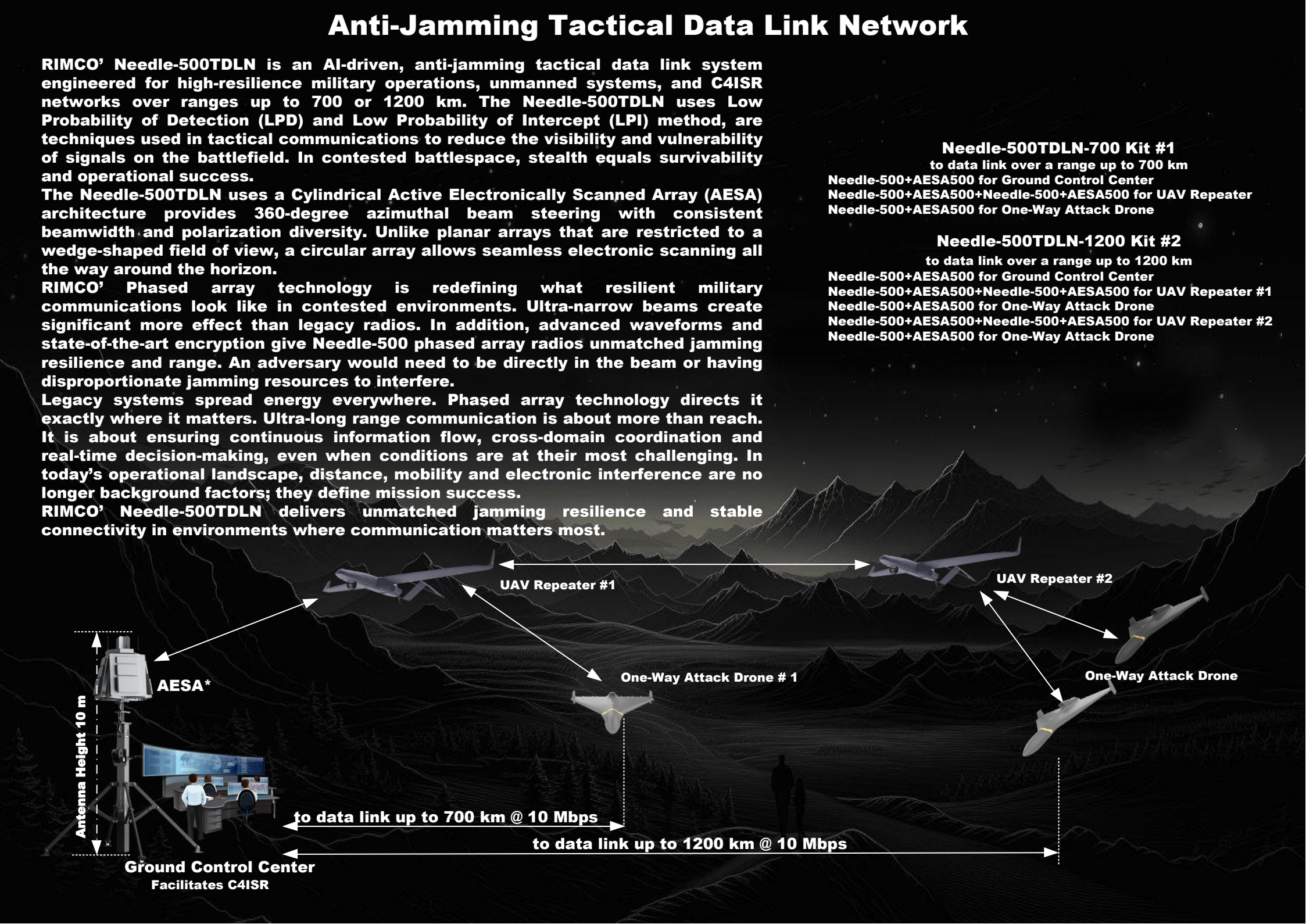
to data link over a range up to 700 km

Needle-500+AESA500 for Ground Control Center
Needle-500+AESA500+Needle-500+AESA500 for UAV Repeater
Needle-500+AESA500 for One-Way Attack Drone

Needle-500TDLN-1200 Kit #2

to data link over a range up to 1200 km

Needle-500+AESA500 for Ground Control Center
Needle-500+AESA500+Needle-500+AESA500 for UAV Repeater #1
Needle-500+AESA500 for One-Way Attack Drone
Needle-500+AESA500+Needle-500+AESA500 for UAV Repeater #2
Needle-500+AESA500 for One-Way Attack Drone

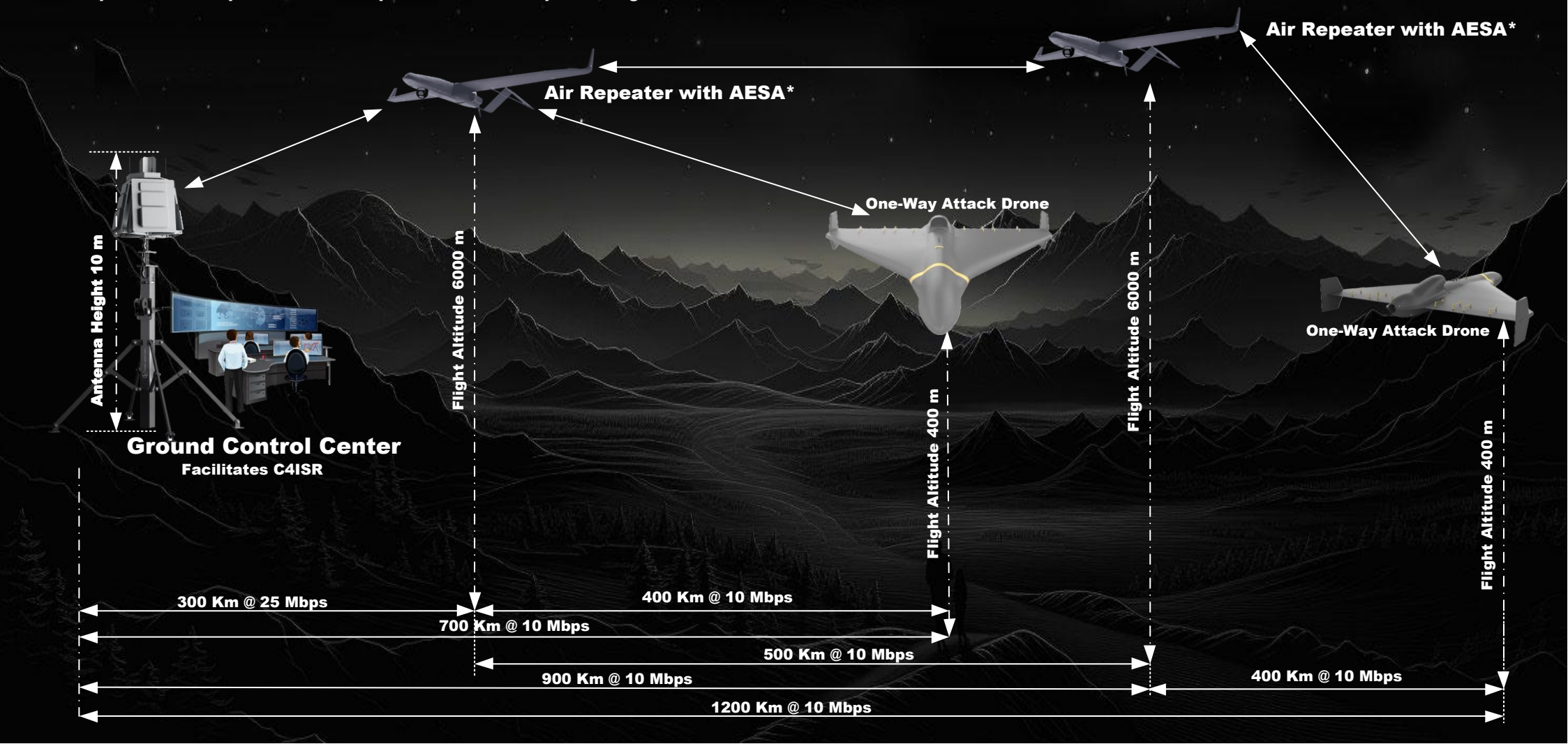


Needle-500TDLN Anti-Jamming Tactical Data Link Network

Needle-500TDLN Specifications

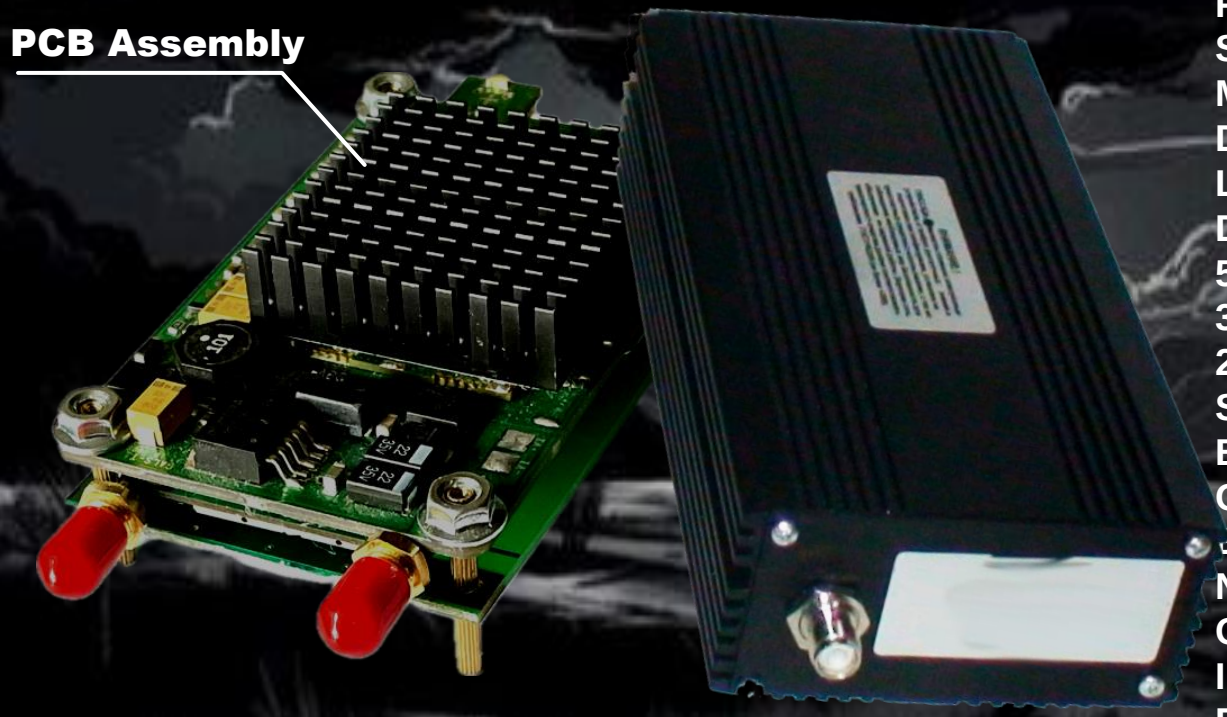
Frequency: UHF/L/S/Ku – Bands
Survivability: LPD/LPI and AI-driven anti-jamming architecture
Spread Method: DSSS+FHSS+Cognitive Radio
Link Rate: 10 Mbps or 25 Mbps
Duplex Mode: Time-Division Duplexing (TDD)
Ground Control Center Antenna Height up to 10-15 m
Air Repeater: Needle-500/R
Tactical Data Link Terminal with AESA-500: Needle-500AESA
Needle-500AESA Ready:
Utilizes electronically steered narrow beams and advanced encryption to maximize resistance to sophisticated electronic attacks
AESA Range of Beam Rocking from the Normal in Azimuth/Elevation Angle: 360°/0-50°
AESA Beam Switching Time: 30 microseconds
Data Link Range:
Ground Control Center to Air Repeater Data Link up to 300 km @ 25 Mbps with Flight Altitude 6000 m
Air Repeater to Air Repeater Data Link up to 500 km @ 10 Mbps with Flight Altitude 6000 m

Legend
*** Active Electronically Scanned Array (AESA)**
The integration of Active Electronically Scanned Array (AESA) technology with the Needle-500 Tactical Data Link focuses on spatial filtering, software-defined waveform agility, and adaptive power management to maintain communications in high-threat, high-jamming Electronic Warfare environments.



Needle-500

Anti-Jamming Tactical Data Link Terminal



Needle-500 with AI-based Equalizer.
The minimum operating signal-to-noise ratio (SNR) is -26 dB, and the Needle-500 system operates significantly below the noise floor, ensuring high secrecy.
This is achieved by cascading spread spectrum with an error-correcting code, as well as wideband synchronization circuits that operate under noise.

Specifications*

Frequency: 50 – 12000 MHz (user selection)
Spread Method: DSSS+FHSS+Cognitive Radio
Modulation: SR-FQPSK
Duplex Mode: Time-Division Duplexing (TDD)
Link Rate: 10 Mbps or 45 Mbps
Data Link Range (visible):
500 km @ 10 Mbps
300 km @ 25 Mbps
200 km @ 45 Mbps
Sensitivity: - 171 dBm
Bandwidth: 80/40/20/10/5 MHz
Output Power: up to 0.1 - 5 W
Ethernet: 10/100/1000 Mbps (RJ45)
Network Protocols: MAVLink for UART/ Telnet/ SCPI
Operating Modes: Point-to-Point
Input Voltage: 12-14 VDC
Power Supply: 50 W
Environmental: -40°C to +50°C
Weight: Approx. 1400 g
Size: Approx.189 x 78 x 50 mm
***Specifications subject to change**

AESA-500

REVOLUTIONARY CAPABILITIES FOR MULTIPLE MISSIONS

Cylindrical Active Electronically Scanned Array (AESA) arranges radiating elements along a curved, 360-degree circular perimeter. This geometry provides constant beam performance during full azimuth scanning without mechanical rotation.
Integrating AESA solid-state transmit/receive modules allows instantaneous beam agility and multi-beam forming. Combining circular geometry with advanced processing algorithms improves angle-of-arrival tracking for multiple frequencies.

Specifications

Type: Circular Antenna Array
Antenna Array (antenna element): 30
Type of polarization: Circular
Radar Beam Performance:

- **Azimuth Coverage: 360 degrees**
- **Elevation Coverage: 0 to 50 degrees above the horizon.**

Beam Switching Time: 30 microseconds
VSWR (Voltage Standing Wave Ratio): 1.5
Interface: Ethernet, RS-485
Power consumption: 55 W
DC Power Supply: 24 V
Weight: 27 kg

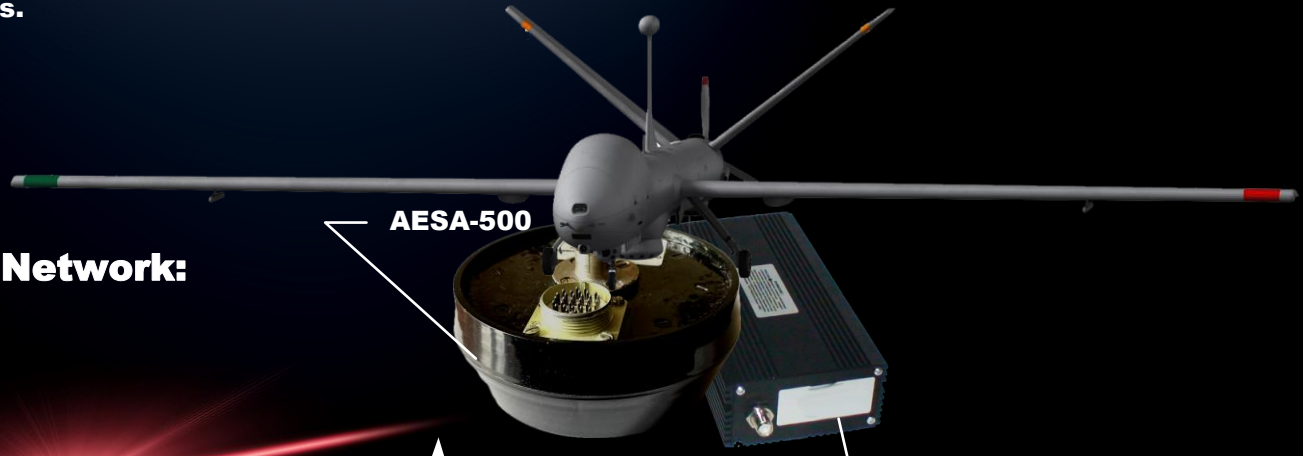
Performance: Actual performance for specific threat environments varies and is classified.
Contact us for more information info@rimco.ru

- **Stacked concentric rings forming a cylinder.**
- **Activating only a specific sector (arc) of the circle at any given time.**
- **Reduces the number of active transmit/receive (T/R) modules needed simultaneously, lowering power consumption and heat.**

Needle-500TDLN Anti-Jamming Tactical Data Link Network

REVOLUTIONARY CAPABILITIES FOR MULTIPLE MISSIONS

The combination of DSSS (Direct Sequence Spread Spectrum), FHSS (Frequency Hopping Spread Spectrum), and CRS (Cognitive Radio System) forms an intelligent radio communication system that adapts to the environment on the airwaves, dynamically adjusts signal parameters, and is protected from interference. The integration of Active Electronically Scanned Array (AESA) technology with the Needle-500 Tactical Data Link Modem focuses on spatial filtering, software-defined waveform agility, and adaptive power management to maintain communications in high-threat, high-jamming Electronic Warfare environments.



Anti-jamming Solutions for Data Link Network: DSSS+FHSS+CRS+AESA500

Advantages of Military Applications of DSSS+FHSS+CRS+AESA:

- **Resistance to "smart" and tracking electronic warfare: even if the enemy's EW station manages to reconfigure the frequency following FHSS (jammer-follower), it physically cannot instantly teleport in space. The AESA will maintain a spatial "zero" on the jammer, regardless of the frequencies it operates on.**
- **Operation in conditions of critical Signal-to-Noise ratio: The combination of AESA spatial beam amplification and DSSS code compression allows the system to steadily transmit data when the interference power at the entrance to the antenna system exceeds the power of the useful signal by 60-80 dB (hundreds of thousands of times).**
- **Ultra-high stealth (LPI/LPD): By cutting off the side lobes of the antenna's radiation using AESA and reducing the signal power density below the noise level using DSSS, the system becomes virtually invisible to the enemy's electronic reconnaissance systems. The enemy will only learn about the communication operation if its reconnaissance station physically ends up exactly on the line of the narrow beam between the transmitter and the receiver.**

Needle-500TDLN-700 Kit #1 to data link over a range up to 300 km

- **Needle-500+AESA500 for Ground Control Center**
- **Needle-500+AESA500 for UAV**

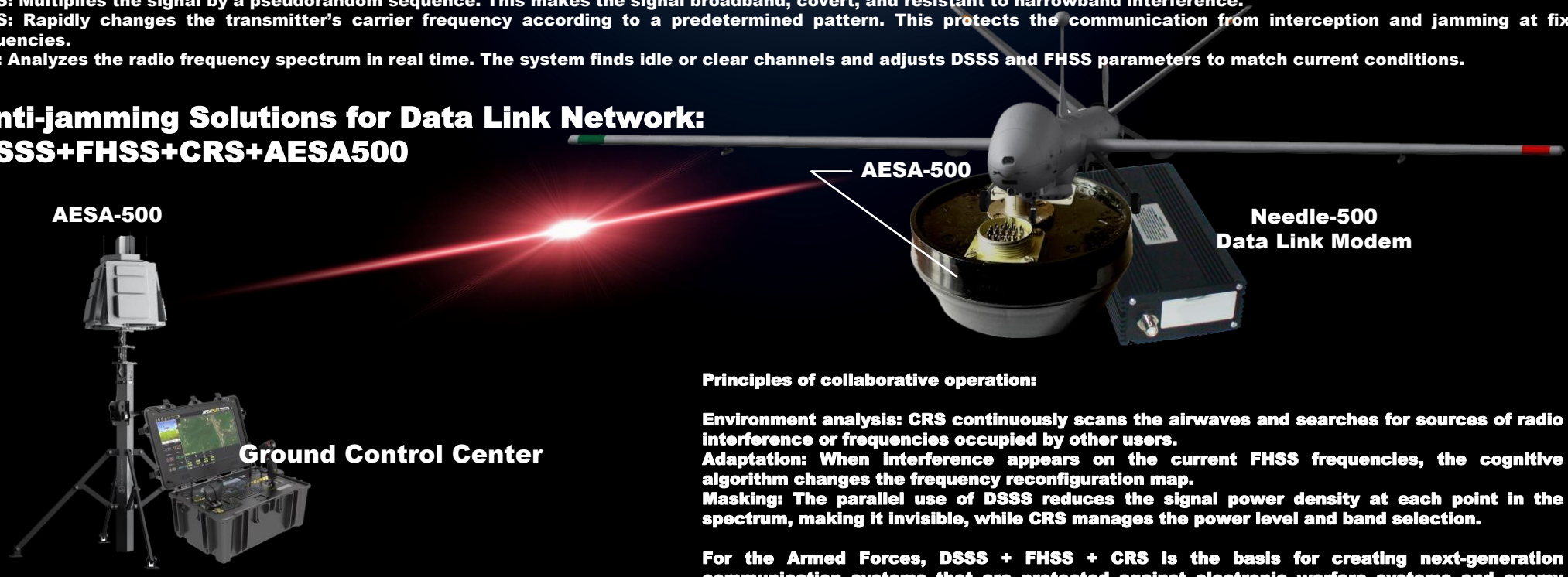
Needle-500TDLN Anti-Jamming Tactical Data Link Network

REVOLUTIONARY CAPABILITIES FOR MULTIPLE MISSIONS

The combination of DSSS (Direct Sequence Spread Spectrum), FHSS (Frequency Hopping Spread Spectrum), and CRS (Cognitive Radio System) forms an intelligent radio communication system that adapts to the environment on the airwaves, dynamically adjusts signal parameters, and is protected from interference.
The integration of Active Electronically Scanned Array (AESA) technology with the Needle-500 Tactical Data Link Modem focuses on spatial filtering, software-defined waveform agility, and adaptive power management to maintain communications in high-threat, high-jamming Electronic Warfare environments.

DSSS: Multiplies the signal by a pseudorandom sequence. This makes the signal broadband, covert, and resistant to narrowband interference.
FHSS: Rapidly changes the transmitter's carrier frequency according to a predetermined pattern. This protects the communication from interception and jamming at fixed frequencies.
CRS: Analyzes the radio frequency spectrum in real time. The system finds idle or clear channels and adjusts DSSS and FHSS parameters to match current conditions.

Anti-jamming Solutions for Data Link Network: DSSS+FHSS+CRS+AESA500



Modern electronic warfare systems are constantly being improved and are capable of adapting. Therefore, rigid algorithms are giving way to neural networks (built into the FPGA chips of Needle-500 Data Link Modem).
How electronic warfare detects signals: the AI module in the CRS builds a spectrum map and analyzes the "behavior" of the noise.
If, when a radio attempts to switch to another frequency (FHSS), the interference follows it within a few milliseconds, the AI concludes that we are being targeted by an adaptive (tracking) electronic warfare jammer.
Counteraction: CRS changes its strategy - instead of randomly hopping frequencies, it starts using false jumps (generating deceptive signals) to lure the tracking electronic warfare system to idle frequencies while the main data flow is transmitted via a hidden DSSS channel.

Principles of collaborative operation:

Environment analysis: CRS continuously scans the airwaves and searches for sources of radio interference or frequencies occupied by other users.
Adaptation: When interference appears on the current FHSS frequencies, the cognitive algorithm changes the frequency reconfiguration map.
Masking: The parallel use of DSSS reduces the signal power density at each point in the spectrum, making it invisible, while CRS manages the power level and band selection.

For the Armed Forces, DSSS + FHSS + CRS is the basis for creating next-generation communication systems that are protected against electronic warfare systems and enemy radio reconnaissance complexes. It addresses the main task of modern military communications: to ensure transmission secrecy and resistance to jamming in conditions of active radio countermeasures.

In conditions where electronic warfare systems suppress standard drone control frequencies, a hybrid system saves the devices from losing control.

How it works: the CRS on board the UAV detects which frequencies the enemy is trying to jam or direct a jamming beam at. The UAV's transmitter and the ground station synchronously adapt the FHSS algorithm, switching to non-standard frequencies that the electronic warfare system is not currently blocking, while DSSS protects the telemetry and video stream from targeted pulse interference.
The combination of technologies makes it possible to implement the LPI/LPD concept (Low Probability of Intercept / Low Probability of Detection) - low probability of interception and detection. Thanks to DSSS, the signal appears as natural noise from the ocean or atmosphere; FHSS constantly changes its position, and CRS selects frequencies that are least susceptible to attenuation over water under current weather conditions.

Needle-500TDLN Anti-Jamming Tactical Data Link Network

Anti-jamming Solutions for Data Link Network: DSSS+FHSS+CRS+AESA500

For the Armed Forces, DSSS + FHSS + CRS is the basis for creating next-generation communication systems that are protected against electronic warfare systems and enemy radio reconnaissance complexes.
DSSS technology - protection against targeted (narrowband) interference and radio direction finding. The enemy cannot locate the very fact of transmission, as the signal is hidden under noise.
FHSS technology - protection against jamming interference and signal structure interception. The enemy does not have time to tune their electronic warfare systems to the required frequency, as it changes thousands of times per second.
CRS Technology - protection against the enemy's intelligent electronic warfare. The system dynamically bypasses those parts of the spectrum that the enemy has begun to jam or control. The algorithms of CRS in military broadcasting work like an intelligent radar. Their main task is not just to detect noise, but to distinguish natural interference (atmosphere, terrain) and friendly signals from the targeted effects of enemy electronic warfare. To do this, the CRS performs three consecutive steps: Sensing (Detection) → Classification (Recognition) → Making a decision.

The addition of AESA to the DSSS + FHSS + CRS stack creates the ultimate, to date, anti-Jamming solution in radio communications.
If the DSSS+FHSS+CRS bundle protects the signal in the frequency, code and time domains, then AESA adds a fourth dimension of protection - Spatial Domain.
The system gets the opportunity to physically control the direction of radiation and "cut out" enemy Electronic Warfare SytEms (EWS) jammers on the battlefield.
When the enemy activates powerful electronic warfare jamming, the CRS instantly detects an energy surge. But thanks to AESA, the system sees not just the frequency of interference, but its exact azimuth and location angle (3D coordinates of the electronic warfare source).

The CRS issues a command to the AESA processor, and the AESA redistributes the phases among its radiators so that a "null" of the radiation pattern is formed in the direction of the enemy's electronic warfare interference (a deep sensitivity dip down to -40...-60 dB).
The Needle-500 Data Link Modem literally "turns its back" to the enemy, reducing the interference power at the input by millions of times, but continues to "see" its subscriber.

Instead of radiating in all directions (like a conventional antenna), AESA forms a radio beam channel that is as thin as a laser beam, strictly in the direction of the friendly receiver.

This increases the equivalent isotropically radiated power by hundreds of times. The signal becomes so powerful at the receiving point that the enemy's weak blocking interference simply doesn't have enough energy to overpower it.
If the enemy uses an advanced multi-position electronic warfare system (jamming from different directions and at different frequencies simultaneously):CRS builds a four-dimensional situational matrix: Frequency × Time × Code × Spatial angle.

If the AESA cannot completely nullify the interference, CRS activates FHSS and starts hopping across frequencies, taking the AESA beams out of the strike zone. Within each FHSS frequency, DSSS is activated, which spreads the signal across the code. If the electronic warfare system still partially penetrates the beam, DSSS, thanks to Processing Gain (processing gain), "compresses" the signal and restores the data.

The use of a AESA allows you to determine the azimuth of the radiation source or electronic warfare equipment (DoA - Direction of Arrival). If electronic warfare equipment with high interference energy is located on enemy territory or is moving along the trajectory of an enemy electronic warfare aircraft, the CRS classifies it as a threat and issues a command to the FHSS transmitter to "zero" the antenna in that direction (cut this sector from reception).

When the base FHSS grid is completely suppressed by a blocking interference, the cognitive system temporarily disables (or slows down) frequency hopping and switches to the Ultra-Wideband DSSS mode. How it works: the transmitter instantly increases the signal base (the spread spectrum factor) to its maximum. The signal is "smeared" across a wide frequency band.

Result: The energy density of the enemy's electronic warfare system at each specific point in the spectrum becomes lower than the total energy of the DSSS signal collected by the receiver after code compression. The command to change the FHSS grid is transmitted at a very low speed, but with 100□% transmission regardless of interference.

DSSS (Direct Sequence Spread Spectrum) receives a useful command from under the powerful interference of electronic warfare using the spectrum expansion coefficient (Processing Gain) and the correlation operation. In DSSS, "compression" does not occur in the usual sense, but in the frequency-energy sense. The signal is compressed over the frequency band, due to which its power in this band increases dramatically, cracking the interference of the enemy's electronic warfare systems.