# AIR DEFENCE SYSTEMS - DEFENCE

NEWS: India's successful neutralisation of a Pakistani air defence system in Lahore highlights the strategic relevance of modern air defence capabilities in ensuring aerial supremacy and national security.

# WHAT'S IN THE NEWS?

- Definition of Air Defence Systems
- Air Defence Systems are complex military networks that integrate radars, sensors, missiles, and control units to detect, track, intercept, and destroy hostile aerial targets.
- These systems are designed to protect critical infrastructure, military assets, population centres, and national airspace from threats such as enemy aircraft, drones, cruise missiles, and ballistic missiles.
- Types of Air Defence Systems
- Surface-to-Air Missiles (SAMs):
  - Ground-launched missiles designed to target and destroy enemy aircraft and missiles.
  - Classified into short-range, medium-range, and long-range systems.
  - Form the core of modern air defence infrastructure.
- Anti-Aircraft Artillery (AAA):
  - Rapid-firing guns used for close-range engagement of lowflying aerial targets.
  - Effective against UAVs, helicopters, and aircraft flying at low altitudes.
  - Often deployed around high-value military and civilian assets.

- Electronic Warfare (EW) Systems:
  - Utilize electromagnetic signals to jam, deceive, or disable enemy radars, communication systems, or guidance systems.
  - Provide non-kinetic countermeasures and support conventional air defence systems.
  - Crucial in countering stealth and precision-guided weaponry.



## Working Mechanism of Air Defence Systems

- Detection:
  - Initiated by radars which emit electromagnetic waves to detect incoming targets by capturing their reflected signals.
  - Early-warning radars identify target types, range, and direction.
- Tracking:
  - Continuous observation of target's speed, altitude, and trajectory using advanced tracking radars and sensors.
  - Helps in establishing a real-time threat assessment.

- Interception:
  - Based on tracked data, the system launches interceptors (missiles or fighter jets) to destroy the incoming threat mid-air.
  - Interception relies on mid-course guidance and terminal homing technologies (e.g., radar, infrared).
- Command, Control, and Communication (C3):
  - Ensures real-time coordination between sensors, command units, and launch platforms.
  - Facilitates automated decision-making and rapid response to aerial threats.

System	Туре	Origin	Range	Target Types	Key Features
Akash	Short- range SAM	India (DRDO, BDL)	Up to 25 km	Aircraft, UAVs, cruise missiles	Radar-guided, fast reaction, deployed for area defence
S-400 Triumf	Long- range SAM	Russia	Up to 400 km	Stealth aircraft, UAVs, cruise and ballistic missiles	Multi-layered, mobile, EW- resilient, covers wide airspace
Spyder	Short- range SAM	Israel	Up to 15 km	UAVs, aircraft, guided munitions	Networked, electro-optical sensors, IAF + Army use
Igla-S	MANPADS	Russia	Up to 6 km	Helicopters, low- flying aircraft	Shoulder-fired, heat-seeking, agile against low-level

#### India's Key Air Defence Systems

**Key Features** 

threats

#### Strategic Importance of India's Air Defence Systems

- Deterrence Against Adversaries:
  - Long-range systems like the S-400 extend India's air defence envelope deep into Pakistani and Chinese airspace, deterring preemptive strikes.
- Protection of Critical Assets:
  - Strategic installations like nuclear command centres, airbases, and capital cities are safeguarded through layered defence setups.
- Force Multiplier in Offensive Operations:
  - By securing rear areas and air superiority zones, air defence systems enable safe execution of offensive air missions.
- Enhanced Maritime Defence:
  - Coastal deployment of S-400 enhances India's ability to monitor and engage naval aerial threats near its maritime borders.

#### Challenges in India's Air Defence Architecture

- Integration Complexity:
  - Diverse systems sourced from Russia, Israel, and indigenous platforms pose technical hurdles in interoperability and unified command.
- Coverage Gaps:

- Absence of very short-range systems (VSHORADS) leaves vulnerabilities against low-flying drones and rockets, requiring more MANPADS and SHORADS.
- Cost Constraints:
  - Systems like S-400 demand high acquisition and maintenance costs, impacting overall military modernisation budgets.
- Emerging Threats:
  - New-age threats like hypersonic glide vehicles, swarm drones, and stealth aircraft are harder to track and intercept with existing systems.
- Training and Maintenance Needs:
  - Operation of advanced systems requires skilled manpower, dedicated training, and logistics infrastructure for long-term upkeep.

#### Global Comparison of Air Defence Systems

System	Country	Radar Range	Engagement Range	Strengths	Limitations
S-400 Triumf	Russia	~600 km	Up to 400 km	Anti-stealth, layered, multi- missile	Costly, lacks short-range defence
MIM-104 Patriot (PAC-3)	USA	~150 km	~160 km	Hit-to-kill, combat- tested	Smaller radar range
THAAD	USA	~200 km	200 km+	Excellent against ballistic	Less effective vs aircraft

System	Country	Radar Range	Engagement Range	Strengths	Limitations
				missiles	
HQ-9	China	~200 km	~200 km	Cold-launch, active radar	Limited operational history
S-300PMU	Russia	~200 km	150–200 km	Multi-target, legacy system	Outdated vs modern platforms
Iron Dome	Israel	70+ km	4–70 km	High success rate, urban defence	Not suited for long-range threats
David's Sling	Israel	~300 km	Up to 300 km	Counter to MRBMs, cruise missiles	Not for short- range air threats

## Conclusion

- India's growing investment in air defence systems like S-400, Akash, Spyder, and Igla-S represents a strategic shift toward achieving a multi-tiered, layered defence network.
- However, effective air dominance requires:
  - Better inter-system integration.
  - Development of indigenous advanced radar and missile tech.
  - Continual upgradation to address evolving threats like hypersonic weapons and AI-enabled drone swarms.
- Going forward, India must adopt a synergised air defence doctrine backed by robust command and communication systems, training

infrastructure, and technology innovation to remain air secure in future warfare environments.

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