Astra Missile

Context

- **Event:** DRDO & Indian Air Force successfully **test-fired Astra Beyond Visual Range (BVR) Air-to-Air Missile**.
- **Location:** Off the coast of **Odisha**.
- **Platform: Sukhoi-30 MKI** fighter aircraft.
- **Test Details:**
    - Two launches conducted against **high-speed unmanned aerial targets**.
    - Targets destroyed with **pin-point accuracy** under varied ranges & conditions.
    - Validated **indigenous seeker technology** & subsystems.

Key Features of Astra Missile

- **Type:** Beyond Visual Range Air-to-Air Missile (BVR-AAM).
- **Range: 100+ km**.
- **Guidance:** State-of-the-art **guidance & navigation system** with indigenous seeker.
- **Capability:** Engage aerial targets at long distances, beyond pilot's visual sight.
- **Platform compatibility:** Sukhoi-30 MKI (integrated), being adapted for **Tejas Mk1A, Mirage-2000, MiG-29**.

Significance

- Boosts **Atmanirbhar Bharat in Defence** – indigenous seeker → reduces dependency on foreign tech.
- Enhances **IAF's air combat superiority**.
- Positions India among select nations with **indigenous BVR missile capability**.
- Major step towards self-reliance in **critical defence technologies**.

Related Developments

- Astra is India's first **indigenously developed BVR AAM**.
- **Variants in pipeline:** Astra Mk-2 (range ~160 km), Astra Mk-3 (under development with SFDR tech, ~300 km).

India Test-fires Prithvi-II, Agni-I & Akash Prime

- **Context**
- **Location:** Integrated Test Range, **Chandipur (Odisha)** & Ladakh.
- **Conducted by: Strategic Forces Command (SFC)** under the guidance of **DRDO**.
- **Objective:** To validate operational readiness & strengthen **strategic deterrence capability**.

---

1. Prithvi-II

- **Type:** Nuclear-capable **short-range ballistic missile (SRBM)**.
- **Range:** ~350 km.
- **Payload:** Up to **500 kg** (conventional or nuclear).
- **Significance:** One of the earliest missiles developed under **IGMDP (Integrated Guided Missile Development Programme)**.
- **Role:** Integral to India's **nuclear deterrence arsenal**.

---

2. Agni-I

- **Type:** Nuclear-capable **short/medium-range ballistic missile (SRBM/MRBM)**.
- **Range:** 700–900 km.
- **Payload:** ~**1,000 kg** (nuclear/conventional).
- **Role:** Forms backbone of India's **credible minimum deterrence**, covers targets across neighborhood.

---

3. Akash Prime (Tested in Ladakh)

- **Type:** Upgraded **surface-to-air missile (SAM)** system.
- **Range:** ~25–30 km.

- **Altitude Adaptability:** Designed to operate **above 4,500 metres** (useful for LAC deployments).
- **New Features:**
- **Indigenous RF seeker**.
- Upgraded guidance & electronics.
- Based on **operational feedback** from Indian Army.
- **Relevance:** Enhanced air defence, especially in high-altitude regions (Ladakh, Arunachal).
- **Link:** Praised after performance in **Operation Sindoor**.
- ---
- **Strategic Significance**
- Strengthens **India's nuclear triad deterrence** posture.
- Showcases progress in **indigenous defence ecosystem**.
- Akash Prime reflects India's ability to **customise weapons for terrain-specific needs**.

DRDO conducts two consecutive successful flight tests of Pralay missile at Odisha coast

- **Date & Location:** 28th & 29th July, from Dr. APJ Abdul Kalam Island, Odisha.
- **Conducted by:** Defence Research and Development Organisation (DRDO).
- **About the Test:**
    - Two consecutive successful launches validated **maximum & minimum range capabilities**.
    - Achieved **pinpoint accuracy** in both cases.
- **About Pralay Missile:**
    - Indigenously developed **solid-propellant quasi-ballistic missile**.
    - Equipped with **state-of-the-art guidance & navigation systems**.
    - Capable of carrying **multiple types of conventional warheads**.
    - Designed for **high precision strikes** against varied targets.

- **Significance:**
    - Boosts India's **tactical strike capability**.
    - Strengthens indigenous missile development under the **Atmanirbhar Bharat initiative**.
    - Complimented by **Defence Minister Rajnath Singh** for the achievement.

Successful field trials of NAG MK 2 Anti-Tank Missile at Pokhran

- **Event:** Field evaluation trials of the **indigenously developed NAG MK 2**, a **third-generation Fire-and-Forget Anti-Tank Guided Missile**, were successfully conducted.
- **Location:** Pokhran Field Range, Rajasthan.
- **Trials Conducted:**
    - Three field trials carried out.
    - Missile **destroyed all targets** with precision.
    - Firing range validated successfully.
- **Additional Evaluation:**
    - **Nag Missile Carrier version-2** also evaluated.
    - Entire weapon system ready for **induction into the Indian Army**.
- **Significance:**
    - Strengthens **India's indigenous anti-tank capabilities**.
    - Supports **Atmanirbhar Bharat in critical defence technology**.
- **Acknowledgement:** Defence Minister **Rajnath Singh** congratulated DRDO, Indian Army, and industry partners.

India Successfully Conducts Flight Test of First Long-Range Hypersonic Missile

- **Event:** DRDO successfully conducted the **flight-trial of India's first long-range hypersonic missile**.
- **Date & Location:** Conducted from **Dr APJ Abdul Kalam Island**, Odisha coast.
- **Missile Details:**
    - **Type:** Long-range **hypersonic missile**.
    - **Range:** Capable of **>1,500 km**.
    - **Payload:** Can carry **various payloads** for Armed Forces requirements.
    - **Accuracy:** Flight data confirmed **successful terminal manoeuvres and impact** with high precision.
- **Significance:**
    - Puts **India in the select group of nations** with **hypersonic missile capabilities**.
    - Enhances **strategic deterrence** and strengthens **national security**.
- **Acknowledgements:**
    - Defence Minister **Rajnath Singh** congratulated **DRDO, Armed Forces, and industry**.
    - Missile tracked using **multiple range systems and down-range ship stations**.

Strategic Implication: India now possesses **advanced hypersonic technology**, improving **rapid strike capability** and strengthening its **defence posture** in the region.

Pakistan F-16 Shot Down by Indian Surface-to-Air Missile

- **Event:** India shot down a **Pakistan Air Force F-16 fighter jet** near the **Sargodha air base** using an **Indian Surface-to-Air Missile (SAM)**.
- **Background:**
    - Comes amid Pakistan's **foiled attempts to target Jammu** with **drones and missiles**.

- Sargodha is a **front-line and heavily defended airbase** in Punjab, Pakistan.
- This is the **first large-scale hostilities escalation** between India and Pakistan since **1971**.

- **Indian Response:**
  - **Air defence systems**, including the **S-400 missile defence system**, successfully intercepted Pakistani missiles and drones.
  - **HARPY drones** were deployed to disable Pakistani air defence radars.
  - Integrated Defence Staff (IDS) confirmed **no losses** on the Indian side; threats were neutralised using **kinetic and non-kinetic measures**.
- **Geographical Impact:**
  - Areas affected: **Jammu (RS Pura, Arnia, Samba, Hiranagar)**, **Pathankot**, and **Chandigarh & Mohali** (blackouts imposed).
  - **Pathankot** serves as a strategic entry point toward Jammu (~30 km from IB).
- **Historical Context:**
  - During the **2019 Balakot airstrikes**, India had previously shot down a Pakistani F-16 in aerial combat.
  - Sargodha airbase was targeted by India in **1965** during the Indo-Pak war.
- **Significance:**
  - Demonstrates **India's advanced air defence capabilities** and **strategic deterrence**.
  - Highlights **rapid response and integrated air defence measures** against cross-border threats.
  - Reinforces India's ability to **neutralise aerial threats and protect strategic assets**.

Strategic Implication: Enhances India's **defensive posture along the international border** and signals **strong retaliatory capability** to deter future aggression.

Mission Sudarshan Chakra – India's Ballistic Missile Defence Initiative

- **Overview:**
    - Prime Minister **Narendra Modi** has hinted at **Mission Sudarshan Chakra 2035**, aimed at developing **advanced anti-ballistic missile defence** and **long-range conventional ballistic missiles** to counter regional and global threats.
    - The announcement follows **Pakistan's missile attacks during Operation Sindoor**, highlighting the need for enhanced **strategic deterrence and homeland security**.
- **Key Features:**

1. **Anti-Ballistic Missile Defence:**
    - Expansion of **DRDO's Project Kusha / Extended Range Air Defence System**.
    - Development of **long-range surface-to-air missile systems** with **three interceptor variants** planned between **2028–2030**.
2. **Conventional Ballistic Missiles:**
    - DRDO is developing the **Pralay tactical ballistic missile** with:
        - **Range:** 500 km
        - **Warhead:** 500–1000 kg
        - **Capabilities:** Land and sea strike
3. **Nationwide Security Coverage:**
    - PM Modi indicated that by **2035**, all public spaces in India will be **covered by an expanded missile defence shield**.

- **Strategic Significance:**
    - Enhances India's **defensive and retaliatory capabilities** against **stand-off missile attacks**.
    - Strengthens **homeland security** and acts as a **deterrent against adversaries**.
    - Positions India among nations with **advanced ballistic missile defence and long-range strike capabilities**.
- **Timeline & Development:**

- **Project Kusha** approved by **Cabinet Committee on Security (CCS)** in **May 2022**.
- Missile testing for various components expected to begin in the near future.

INS Surat Test-Fires Medium-Range Surface-to-Air Missile

- **Date & Location:**
  - **April 24, 2025**, Arabian Sea
- **Event:**
  - **Indian Navy's guided missile destroyer INS Surat** successfully **test-fired a medium-range surface-to-air missile (SAM)**.
  - The missile **intercepted a sea-skimming target**, demonstrating **precision cooperative engagement** capabilities.
- **Missile Details:**
  - **Type:** Medium-range surface-to-air missile
  - **Range:** ~70 km
  - **Capability:** Intercept aerial threats, including low-altitude sea-skimming missiles
- **Strategic Significance:**
  - Marks a **milestone in indigenous warship and missile development**.
  - Enhances **India's maritime defence capabilities** and **air defence shield** at sea.
  - Reinforces **Aatmanirbhar Bharat (self-reliant India)** in defence manufacturing.
  - Strengthens **India's preparedness against potential threats in the Indian Ocean Region (IOR)**.
- **Broader Context:**

- Part of India's ongoing efforts to **modernise naval fleet and defence systems**.
- Demonstrates **integration of advanced sensors, weapons, and operational systems** on indigenously built warships.

India Demonstrates Laser-Based Anti-Drone Capability

- **India becomes 4th nation having capabilities to shoot down fixed wing drone by laser beam**

- **Event:**
  - India successfully showcased the **ability to shoot down fixed-wing drones, missiles, and swarm drones** using a **30-kilowatt laser-based weapon system**.
  - Conducted by **Centre for High Energy Systems & Sciences (CHESS), Hyderabad**, a DRDO lab.
  - Demonstration location: **Kurnool, Andhra Pradesh**
- **Weapon System:**
  - **Name:** Vehicle-mounted **Laser Directed Weapon DEW MK-II(A)** (land version)
  - **Type:** Directed Energy Weapon (DEW), high-power laser
  - **Targets:** Fixed-wing UAVs, missiles, and swarm drones
  - **Effect:** Causes structural damage and disables surveillance sensors
- **Strategic Significance:**
  - India joins an **exclusive club of nations** (US, China, Russia) with operational **high-power laser DEW systems**.
  - Marks a **critical advancement in futuristic defence technologies**, enhancing counter-drone and missile-defence capabilities.
  - DRDO is also developing **other high-energy systems**: high-energy microwaves, electromagnetic pulse weapons, contributing to **"Star Wars"-type defence capabilities**.
- **Broader Context:**

- Demonstrates India's **self-reliance and technological edge** in advanced defence systems.
- Adds to India's **multi-layered air and missile defence architecture**.
- Supports modernisation of the Armed Forces for **emerging aerial threats and unmanned systems**.

India Joins Elite Global Tech League

1. Defence Sector Breakthroughs

- **Laser-Based Directed Energy Weapons:**
  - India demonstrated a **30-kilowatt laser system** capable of shooting down **fixed-wing drones and swarm drones**.
  - India became **4th nation globally** (alongside USA, Russia, China) to possess operational laser DEW capability.
- **Hypersonic Missile Development:**
  - DRDO tested India's **first long-range hypersonic missile** (maneuverable, >5× speed of sound).
  - Can carry **conventional and nuclear warheads**.
- **Strategic Impact:**
  - Positions India for **modern warfare readiness**.
  - Enhances **air, missile, and space domain defence capabilities**.

2. Space Sector Achievements

- **Moon South Pole Landing (2023):**
  - ISRO became **4th nation** to soft-land on the Moon after USA, USSR, China.
- **Satellite Docking & Undocking:**
  - India demonstrated **advanced orbital rendezvous technologies**, joining **elite nations** with such capability.
- **Hypersonic Scramjet Trials:**
  - Successfully tested **active-cooled scramjet** technology, critical for future hypersonic vehicles.

3. Semiconductor & Emerging Tech

- **Semicon India Initiative:**
    - India entered **global semiconductor manufacturing race**, attracting investments from tech giants.
    - Aims to make India a **major hub for chip manufacturing**, strengthening self-reliance.

4. Significance

- Demonstrates **technological self-reliance (Aatmanirbhar Bharat)**.
- Places India among **select global powers in defence, space, and critical tech**.
- Supports **strategic deterrence, high-tech warfare readiness, and economic advancement**.

Astra BVRAAM Missile

Overview

- **Type:** Beyond Visual Range Air-to-Air Missile (BVRAAM)
- **Platform Tested From:** Su-30 Mk-I fighter aircraft
- **Location:** **Off the coast of Odisha, Integrated Test Range, Chandipur**
- Range: >100 km
- **Guidance:** State-of-the-art navigation and **indigenous Radio Frequency (RF) seeker**

Test Highlights

- Two successful launches against **high-speed unmanned aerial targets**.
- Targets destroyed with **pin-point accuracy** at different ranges and target aspects.
- **All subsystems, including RF seeker, performed flawlessly**.
- Flight data validated the **precision and reliability** of the missile system.

Development & Collaboration

- Developed by **DRDO** in collaboration with Indian Air Force.
- Over **50 public and private industries** contributed, including **Hindustan Aeronautics Limited (HAL)**.
- The **indigenous RF seeker** marks a major milestone in critical defence technology.

Significance

- Strengthens India's **air superiority and BVR combat capability**.
- Demonstrates India's growing **self-reliance in missile technologies**.
- Contributes to India's **strategic edge in aerospace defence**.

Acknowledgements

- Defence Minister **Rajnath Singh** and **DRDO Chairman Dr. Samir V. Kamat** congratulated teams involved

---

Assam Rifles – IIT Manipur MoU on Drone Technology

- **Event:** MoU signed between **Assam Rifles (South)** and **IIIT Manipur**
- **Location:** **Mantripukhri, Manipur**
- **Date:** (Recent, 2025)
- **Key Leaders:**
    - **Maj Gen Ravroop Singh** – Inspector General (South), Assam Rifles
    - **Director, IIIT Manipur**

Key Highlights:

- Purpose: To **promote drone technology** for **defence and security applications**.
- Initiative: Launch of **Advanced Drone Training & Refresher Course** for Assam Rifles personnel.
    - Covers **drone flight operations, maintenance, surveillance**.
    - Includes **DGCA-certified training**.
- Participation: ~80 members (Assam Rifles + IIIT faculty).
- Focus Areas:
    - **Surveillance & reconnaissance**
    - **Logistics support** in border areas
    - **Capacity building** through defence–academia cooperation

---

India's Drone Capabilities:

- **Israeli-made drones:**
    - **Heron UAV** – "high-altitude eyes in the sky" (300 km range, 18 hrs endurance, 7,000 m ceiling).
    - **Searcher Mk II** – tactical UAV, frontline ops.
    - **Harpy / Harop loitering munitions** – drones that act as missiles, precision-targeting radars & high-value assets.
- **Upgradation:** $4bn deal for **31 MQ-9B Predator drones** (40 hrs endurance, 40,000 ft ceiling).
- **Experimenting with swarm drones** to overwhelm enemy air defences.

Pakistan's Drone Capabilities:

- Mix of **Chinese, Turkish, and indigenous** drones.
    - **Chinese CH-4**
    - **Turkish Bayraktar Akinci**
    - Indigenous **Burraq** and **Shahpar** drones.
- **Loitering munitions** & "loyal wingman" UAVs integrated with Pakistan Air Force.
- Estimated inventory: **1000+ drones**.

Strategic Significance:

- Drones → **low-risk, deniable, precision weapons** → lower threshold for conflict escalation.
- Can:
    - Conduct surveillance & targeting
    - Act as decoys for enemy radars
    - Perform precision strikes without risking manned aircraft.
- **Global concern:** First drone war between nuclear powers → high escalation risk.

India Foils Drone Swarm Attack

📌 **Context**

- Following **India's Operation Sindoor**, Pakistan launched coordinated drone & missile strikes on 15 Indian military installations (Jammu, Srinagar, Pathankot, Bhuj).
- **IAF activated a 1,800 km integrated air defence grid** → successfully intercepted threats.
- **Pak F-16 shot down**, possible JF-17 also destroyed.

IN India's Layered Air Defence in Action

1 Akash Missile System (Indigenous, DRDO)

- Range: **45–70 km**.
- Warhead: **60 kg high-explosive**.
- Engages **multiple targets simultaneously**.
- **Akash-NG variant** → 100% interception rate in trials, effective vs **low-altitude drones & loitering munitions**.
- Features: **ECCM (Electronic Counter-Countermeasures), high mobility**.

2 MRSAM (Medium-Range Surface-to-Air Missile)

- Indo-Israel collaboration.
- Range: **70–100 km**.
- Integrated with **IACCS (Integrated Air Command & Control System)** → network-centric warfare.
- Tech: **Active radar homing, vertical launch system** → precise engagement of cruise missiles & high-speed aerial targets.

3 Zu-23-2 Anti-Aircraft Guns

- Effective range: **2–3 km**.
- Role: **Terminal interception** (last line of defence).
- Cost-effective → shredded **low-flying drones** that escaped missile layers.

🛩️ Integrated Counter-UAS Grid

- **Radar fusion via IACCS** → real-time threat prioritization.
- **Jamming + spoofing systems** disrupted Pakistani drone navigation.
- Result: **No breach of Indian airspace**; drone debris recovered in Jammu, Punjab, Gujarat.

🔑 Strategic Takeaways

- **Indigenous + imported synergy** → Akash (DRDO), MRSAM (India–Israel), S-400 (Russia).
- Proves **layered defence doctrine** → long, medium, close-in defence.
- Demonstrates India's readiness for **"drone swarm warfare"**, a modern battlefield reality.
- **Escalation risk**: Use of drones, fighter jets (F-16, JF-17) = rapid conflict intensification.

India Foils Pakistan Swarm Drone Attack (May 8–9, 2025)

📌 Context

- **Event**: Pakistan launched a coordinated swarm drone attack (~50 drones) across **LoC & International Border**, accompanied by **ceasefire violations (CFVs)**.
- **Locations**: Udhampur, Samba, Jammu, Akhnoor, Nagrota, Pathankot (J&K).
- **Response**: Indian armed forces effectively repulsed drone attacks and responded to CFVs.

🛩️ Air Defence System (ADS) Overview

A **multi-layered network** of radars, missiles, and command infrastructure to detect, track, and neutralise aerial threats (drones, aircraft, helicopters, ballistic missiles).

Components & Functioning:

1. **Radar & Early Warning** → Detect potential intrusions.
2. **Command & Control Centres** → Process data, prioritise threats, and decide interceptions.
3. **Surface-to-Air Missiles (SAMs)** → Short to long-range, multi-target capability.
4. **Mobile Air Defence Units** → Vehicle-mounted, rapid redeployment for protection of key areas/convoys.

IN India's Air Defence Arsenal

System	Range	Notes
S-400 Triumf	380 km	Long-range Russian system, 3 squadrons deployed, Rs 40,000 crore deal
Barak-8 MR-SAM	70+ km	India-Israel joint development, IAF/Army/Navy deployment
Akash	25 km	Indigenous, medium-range backbone for IAF & Army
Spyder	15 km	Israeli, quick-reaction, low-level protection
Shorter-range systems	2–25 km	Igla-S, Igla-1M, OSA-AK-M, Pechora, upgraded L-70 AA guns

Integration: All systems work in a **layered, networked grid** for real-time threat management.

PK Pakistan's Air Defence

- **HQ-9 missiles (China)** → 120–300 km range.
- **Spada systems (France)** → 20–25 km range.
- Heavy reliance on imported systems; comparatively **less integrated network** than India.

🔑 **Strategic Significance**

- First large-scale **swarm drone attack** marks **new-age cross-border warfare**.
- Highlights **importance of layered air defence & anti-drone technology**.
- Demonstrates India's **operational readiness** and maturity of air defence infrastructure.

- Signals an **escalation in drone warfare threats** in South Asia.

Byker YIHA III Kamikaze Drones Neutralised (May 10, 2025)

Context: Early hours of May 10, 2025, Pakistan launched **Byker YIHA III kamikaze drones** targeting **Amritsar, Punjab**, aimed at civilian areas. Indian Army Air Defence (AAD) shot down the drones using a **layered air-defence system**.

Key Details

- **Detection & Engagement:** Drones detected and tracked within seconds; engaged by quick-reaction guns along the border.
- **Systems Deployed:**
  - **Gun systems:** L-70 guns, Zu-23-2, self-propelled AA guns.
  - **Missile systems: Akash Surface-to-Air Missile (SAM)** for medium range; high-range systems (MR-SAM / S-400) provide outer layers.
  - **CUAS:** Counter Unmanned Aerial Systems for jamming/spoofing enemy drones.
- **Outcome:** No civilian casualties or property damage; drones neutralised mid-air.

Broader Developments

- Pakistani UAV & UCAV attacks reported along **Western borders & LoC**, with multiple ceasefire violations.
- Approx. **300–400 drones** used in operations on May 8–10, including **Turkish-origin Asisguard Songar drones**.
- Indian air-defence employs **three-layer defence**:
  1. **Gun/missile layer** (short-range/point defence)
  2. **Medium-range SAMs** (Akash)
  3. **High-range SAMs** (MR-SAM / S-400)
- Responsibility for coordination rests with the **Indian Air Force**; integrated radar, electro-optical sensors, and automated C2 systems ensure rapid response.

Strategic / UPSC Relevance

- Highlights **modern drone warfare & asymmetric threats** in India-Pakistan context.

- Demonstrates **effectiveness of layered, networked air-defence systems** combining indigenous & imported technologies.
- Raises issues of **civilian protection, escalation management**, and **regional security dynamics**.
- **Policy implication:** Need for **indigenous anti-drone tech**, rapid deployment protocols, and **multi-tiered air defence integration**.

Akashteer – India's AI-Powered Air Defence System

Context: During heightened India-Pakistan tensions after the **Pahalgam terror attack** and **Operation Sindoor**, Pakistan attempted drone and missile strikes on Indian territory (May 8–9, 2025). These were successfully foiled by **Indian Air Defence systems**, including the **Akashteer ADS**.

Key Details

- **Nature of System:** Indigenous, AI-powered **Air Defence System (ADS)**.
- **Development:** Jointly by **DRDO, ISRO, and BEL**.
- **Functionality:**
    - **Real-time surveillance, detection, tracking, and neutralisation** of aerial threats.
    - **Autonomous threat engagement** using AI; minimal human intervention.
    - Integrates **radar data, ground sensors, and space-based inputs** (NAVIC).
    - Capable of intercepting drones, loitering munitions, and cruise missiles stealthily.
- **Indigenous Advantage:** No foreign components; independent of external satellites.
- **Comparison:** Called India's version of **Israel's Iron Dome**.

Strategic Significance

- Successfully repelled attacks across **26 western border locations** during Pakistan's drone/missile strikes.
- First non-Western system integrating **autonomous drone swarm countermeasures, AI-based battlefield coordination, and indigenous satellite surveillance** in a single platform.

- Strengthens India's **multi-layered air-defence capabilities**, enhancing border security and civilian protection.

Bhargavastra – India's Indigenous Drone-Killer System

Context:

In response to the growing threat of hostile **drone swarms**—used extensively in modern conflicts like **Russia-Ukraine** and by Pakistan during **Operation Sindoor**—India successfully tested a low-cost indigenous counter-drone system named **Bhargavastra** on May 14, 2025.

Key Details

- **Nature of System:** Indigenous **counter-drone (C-UAS) system** with **hard-kill technology**.
- **Development:** Developed by **Solar Defence and Aerospace Limited (SDAL)**.
- **Testing:** Conducted at the **Seaward Firing Range, Gopalpur, Odisha**.
- **Functionality:**
    - Targets **hostile drone swarms** effectively.
    - Uses **micro rockets** to neutralise drones.
    - Operational range: **up to 2.5 km**.
    - Equipped with **advanced detection capabilities** for small or incoming drones.
- **Trials:** Three successful trials were carried out in the presence of **senior Army Air Defence (AAD) officials**.

Strategic Significance

- Provides a **low-cost, rapid-response solution** against emerging aerial threats.
- Strengthens India's **air-defence and counter-drone capabilities**.
- Complements existing systems like **Akashteer** and other ADS platforms.
- Enhances **border security and civilian protection** in case of swarm drone attacks

India debuts maiden MALE drone — FWD Kaal Bhairava

What happened

- **Platform:** FWD *Kaal Bhairava* — India's first indigenous **MALE** (Medium Altitude Long Endurance) autonomous combat aircraft.
- **Developer:** Flying Wedge Defence & Aerospace (Bengaluru; startup).
- **Key specs/claims:** **~30 hours** endurance; **3,000 km** range.
- **Roles:** Long-range surveillance, precision strikes, swarm operations, ISR (intelligence, surveillance, reconnaissance).
- **Local content & supply chain:** **~80% local components**; indigenous MRO (maintenance, repair & overhaul) ecosystem.
- **Cost claim:** Company states it can match MQ-9B Predator reconnaissance capability at **~1/10th** the cost (company claim).
- **Other projects:** loitering munition (100 km range) and an unmanned bomber (target ~800 km) under development.

🔑 **Strategic significance (exam-friendly)**

- **Strategic autonomy:** Reduces dependence on imported MALE platforms (e.g., MQ-9B, Israeli drones) and limits exposure to foreign kill-switches/data-routing vulnerabilities.
- **Force multipliers:** Multiple indigenous MALEs enable persistent surveillance, cross-theatre strike options and swarm-enabled tactics at lower cost.
- **Logistics advantage:** Local MRO & spare ecosystem shortens turnaround and lowers lifecycle cost — important in protracted conflicts.
- **Export & diplomacy:** Indigenous MALE could be a defence export item, altering regional balance and defence trade dynamics.
- **Tech & policy:** Raises questions on AI/autonomy, rules of engagement, export controls, and indigenous R&D policies.

Skye Air launches 7-minute drone delivery in Bengaluru

What happened

- **Company:** Skye Air, a New Delhi-based drone logistics startup.
- **City:** Bengaluru (Konankunte & Kanakapura Road areas) — second Indian city after Gurugram to adopt drone-based ultra-fast delivery.
- **Service:** Drone deliveries in **as little as 7 minutes** for parcels, medicines, and e-commerce products.
- **Drone platform: Skye Ship One** — flagship delivery drone with **10 kg payload capacity**, follows 3D "Skye Tunnel" air corridor at **120 m AGL**, lowers packages via **Skye Winch**.
- **Technology:**
    - 5G-enabled for real-time navigation & tracking.
    - Onboard parachute for safety.
    - Skye UTM Black Box logs flight data, diagnostics, and environmental conditions.

🔑 **Strategic & UPSC relevance**

- **Urban logistics:** Reduces traffic congestion and accelerates last-mile delivery.
- **Sustainability:** Saves **520 g CO_2 per delivery**; annual national-scale savings could reach **3,100 tonnes of CO_2** (~equivalent to planting 150,000+ trees).
- **Healthcare:** Ensures rapid delivery of medicines, healthcare supplies, and emergency consignments in urban and remote areas (e.g., Himachal Pradesh, Telangana, Meghalaya).
- **Cost efficiency:** Drone deliveries cut delivery costs by ~50% compared to conventional road transport.
- **Tech & policy:** Involves BVLOS operations, AI-enabled navigation, and drone corridor management — significant for India's Drone Rules 2021 and future urban air mobility policies.

Indian Startup Unveils 100 km Kamikaze Drone — FWD-LM01

What happened

- **Platform: FWD-LM01**, a loitering munition ("kamikaze" drone) introduced by **Flying Wedge Defence & Aerospace (FWDA)**.
- **Where shown:** Defence aviation exhibit in Paris (June 2025).
- **Role:** Long-range loitering strike + real-time reconnaissance (loitering munition = UAV that can surveil then strike by self-impact).

Key specifications (reported)

- **Range: 100 km** (≈62 miles).
- **Endurance: ~1.5 hours**.
- **Wingspan: 2 m**.
- **Takeoff weight: 6 kg**.
- **Warhead capacity:** up to **2 kg** explosives.
- **Operational ceiling:** up to **17,000 ft** (≈5,182 m).
- **Features:** Delta-wing design, man-portable, quick setup (<5 minutes), EO-IR sensor suite, **AI-enabled** autonomous targeting & navigation.
- **Local content:** Claimed full domestic manufacture and supply-chain sourcing.

Strategic / UPSC relevance

- **Indigenisation & strategic autonomy:** Strengthens domestic defence manufacturing and reduces reliance on imports.
- **Modern warfare:** Loitering munitions combine ISR and strike—useful for precision, asymmetric operations and standoff engagements.
- **Doctrine & ethics:** Raises questions on autonomous targeting, rules of engagement, and export controls.
- **Export potential & geopolitics:** Entry into international UAS market; may affect regional balance and defence exports.

Operation Spider's Web – Ukrainian Drone Strikes on Russian Air Bases

What Happened

- **Operation Name: Spider's Web**
- **Conducted by:** Security Service of Ukraine (**SBU**)
- **Date:** June 1, 2025
- **Target:** Russian air bases, including Belaya air base in Irkutsk region (hosts Tu-22M long-range bombers).
- **Method:** Drones concealed in wooden sheds mounted on trucks; remotely activated roof panels released drones for attack.
- **Result:**
    - 41 Russian warplanes reportedly hit.
    - Estimated damage: **$7 billion**.
    - 34% of strategic cruise missile carriers at main airfields affected.
    - Longest-range drone operation by Ukraine (over **4,300 km from frontlines**).
    - 117 drones deployed.

Key Features of the Operation

- **Stealth & innovation:** Drones hidden inside trucks → released close to target.
- **High-level oversight:** Personally overseen by President Zelenskyy and SBU Head Vasyl Maliuk.
- **Preparation:** Operation took **1.5 years** to plan.
- **Technology:** Short-range quadcopter drones with real-time reconnaissance capabilities.

L-70 Guns Take Frontline Role as India Counters Pakistani Drone Attacks

Context

- **Date:** 8 May 2025
- **Trigger:** Escalation of Pakistani **drone & missile strikes** (Jammu, Jaisalmer, Samba, Tangdhar, Akhnoor).
- **India's Response:** Multi-layered aerial shield activated — including **S-400**, upgraded **Bofors L-70**, and Soviet-origin **Schilka** systems.

L-70 Anti-Aircraft Gun

- **Origin:** Developed by **Bofors (Sweden)**, now licence-produced in India.
- **Calibre:** 40 mm.
- **Rate of Fire:** 240–330 rounds/min.
- **Range:** ~4 km (effective).
- **Upgrades:**
    - **Electrical Servo Drives** – precision control.
    - **Electro-Optical Fire Control System** – better tracking.
    - **X-band Radar** – autonomous drone detection.
    - **Auto-Tracking & Video Tracking** – all-weather capability.
- **Utility:**
    - Highly effective against **low-altitude UAVs & drone swarms**.
    - India has inducted **1,000+ L-70s** → backbone of short-range air defence.

ZSU-23-4 Schilka (Upgraded)

- **Origin:** Soviet, mounted on **tracked platform**.
- **Weapon:** Four 23 mm autocannons.
- **Rate of Fire:** 4,000 rounds/min.
- **Radar Range:** Detects targets up to **20 km**.

- **Upgrades:**
    - **Fuse-based proximity shells**.
    - **Modern fire-control systems**.
- **Utility:** Neutralises **drones, helicopters, light armour**, mobile threats.

Operation Sindoor — India's Indigenous Weapons vs Chinese PL-15

🔷 **Context**

- **Date:** May 7–13, 2025
- **Trigger:** India launched **Operation Sindoor** as retaliation to the **Pahalgam terror attack (22 April, 26 killed)**.
- **Objective:** Neutralise terrorist camps inside **Pakistan & PoK**.
- **Significance:** India showcased its **indigenous defence capability**, while Pakistan relied on **Chinese weapons**.

🔷 **Chinese Weapons Used by Pakistan**

- **PL-15 Missile:**
    - Beyond Visual Range (BVR) **air-to-air missile**.
    - Equipped with **AESA radar**.
    - Speed: **Mach 5**, Range: **200+ km**.
    - Considered a **game-changer**, but **neutralised by India's defence shield**.
- **HQ-9P Missiles, JF-17 & J-10 Jets** → deployed.
- **Turkish Byker YIHA III Kamikaze Drones** → shot down near Amritsar.

🔷 India's Indigenous Response (Aatmanirbhar Bharat in Defence)

- **BrahMos Supersonic Cruise Missile**:

- Likely used in strikes on **Bahawalpur (JeM HQ)** and **Pakistani military bases (May 10)**.
- Destroyed **radars, command centres, and ammunition depots**.
- Symbol of India's precision-strike capability.

- **Akashteer Air Defence System:**
  - AI-driven network-centric system for **real-time air defence coordination**.
- **Army Air Defence Units:**
  - Successfully intercepted **Pak drones & missiles**.

🔷 **Strategic Outcomes**

1. **Exposed Limits of Chinese Tech** → PL-15 debris displayed by Air Marshal A.K. Bharti.
2. **Boost to Indigenous Defence Industry** → showcased India's **battle-readiness**.
3. **Policy Dimension:** Aligns with **Aatmanirbhar Bharat** and India's counter-terrorism doctrine.
4. **PM Modi's Statement:** "21st century warfare has proven the credibility of Made-in-India weapons."

BEL Signs ₹572 Crore Contract for Indigenous Counter-Drone System

- **Bharat Electronics Limited (BEL)** has signed a contract with the **Indian Army Air Defence** for the **Integrated Drone Detection and Interdiction System (IDDIS)**, worth **₹572 crore**.
- The system, jointly developed by **DRDO and BEL**, is a key milestone under the **Make in India** initiative.
- **IDDIS Capabilities:** Designed to detect, track, and neutralise hostile drones, it provides a crucial protective layer against evolving aerial threats.

Akashteer Air Defence System

- BEL's **indigenously developed Akashteer air defence system** proved highly effective during **recent tensions with Pakistan** following **Operation Sindoor (May 2025)**.
- **Performance Highlights:**

    - Neutralised drones, missiles, UAVs, and loitering munitions.
    - Integrated with ground-based air defence systems.
    - Provided a **seamless, unified air situation picture** for Army AD units.
- Developed under a **₹1,982 crore contract (March 2023)**, Akashteer integrates **radars, surveillance assets, and command units** into a unified network, enabling effective monitoring of low-level airspace.
- BEL called Akashteer a **"globally actionable defence asset"**, stating it had made Pakistan's air operations "hell" during the conflict.

Operation Sindoor & Indigenous Defence Success

- **Operation Sindoor (May 7, 2025)** – India's decisive military response to the **April 22 Pahalgam terror attack** that killed 26 people (25 tourists + 1 local).
- India targeted **nine terror camps** in Pakistan & Pakistan-occupied Kashmir (PoK).

Indigenous Weapons Performance

- India's defence industry proved **battle-ready**, highlighting **Aatmanirbhar Bharat** in defence manufacturing.
- **BrahMos Supersonic Cruise Missile** (developed by DRDO & Russia's NPO Mashinostroyeniya) stood as the **crown jewel** of India's firepower. Likely used in:
    - Strikes on JeM HQ in Bahawalpur.
    - Precision strikes on 8 Pakistani military bases (May 10), destroying radar, command centres, and ammo depots.
- **Akashteer Air Defence System** successfully intercepted drones and missiles, blunting Pakistani attacks.
- Indian Air Defence also destroyed **Turkish Byker YIHA III kamikaze drones** near Amritsar (May 10).

Chinese-Supplied Weapons Neutralised

- Pakistan deployed **PL-15 long-range air-to-air missiles**, **HQ-9P SAMs**, and **JF-17 / J-10 fighter jets**.
- Debris of a **China-made PL-15 missile** was recovered in **Hoshiarpur, Punjab**.

- Despite being considered a **game-changer** (range >200 km, Mach 5, AESA radar), the PL-15 was neutralised by Indian systems.

India's First Indigenous MALE Drone Export

- **Event (Aug 2025): Flying Wedge Defence and Aerospace (FWDA),** a Bangalore-based firm, secured a **$30 million export order** for its **AI-powered tactical unmanned aerial system (UAS)** from a **South Asian country**.
- The platform**: Kaala Bhairav,** India's **first indigenous Medium Altitude Long Endurance (MALE) drone**, unveiled earlier this month.

Significance

- Marks India's transition from a **defence importer** to an **exporter of advanced military tech**.
- Reduces dependency on costly foreign solutions (e.g., US Predator drones, ~10x costlier).
- Reinforces **strategic autonomy** and **Aatmanirbhar Bharat** in defence.
- Contract includes **MRO (Maintenance, Repair & Overhaul) package**, ensuring reliability and lower operating costs.

Kaala Bhairav – Key Specs

- **Wingspan:** 6.5 m (21 ft).
- **Endurance:** up to 30 hours.
- **Range:** 3,000 km with satellite communication.
- **Ceiling:** 6,096 m (20,000 ft).
- **Speed:** 187 km/h (cruise).
- **Features:** Short Take-Off & Landing (STOL), swarm warfare capability, coordinated autonomous strikes, precision multi-angle attacks.
- **Made fully in India:** ensures **zero foreign dependency** and a **sanctions-proof supply chain**.

Bengaluru Firm Develops Drone Armed with AK-203 Assault Rifle

- **Developer**: BSS Alliance (Bharat Supply and Service), Bengaluru-based defence firm.

- **Innovation**: AI-powered drone platform integrated with **AK-203 assault rifle**, capable of surveillance + precision firing in **low-altitude tactical operations**.
- **Trial**: Tested with **Indian Army** in 2025, including high-altitude trials (14,500 ft).

🔷 **Key Features**

- AI detects & engages targets remotely.
- Compatible with multiple firearms (up to .50 calibre).
- Equipped with **thermal + optical sensors** for night/low-visibility ops.
- Calculates ballistic paths (wind, temperature, distance).
- Effective firing range: **600m (tested), up to 1000m (rated)**.
- Operable remotely via encrypted network.
- Can function **autonomously in a bunker for 21 days**, also mountable on vehicles & ships.

🔷 **Related Defence Push**

- India's **first AI-lethal weapon trial** held in June 2025 (Negev LMG, 7.62×51mm).
- Government allocated **₹100 crore annually** for AI-based defence R&D under **Make in India**.
- India replacing **5.56mm INSAS rifles** with AK-203 (7.62mm) under Indo-Russian JV (770,000 rifles ordered).
- Also procured **140,000 SIG716 rifles** from USA.

📌 **Significance**

- Marks India's entry into **AI-driven autonomous lethal weapon systems**.
- Boosts **Aatmanirbhar Bharat + Defence Export potential**.
- Enhances **modern asymmetric warfare capabilities** (anti-terror, border ops, urban warfare).

India counters Pakistan drone & missile attacks

Context

- **Event:** On the intervening night of **8–9 May 2025**, Pakistan launched **drones, missiles & munitions** along the **Western border** + **ceasefire violations** on LoC (J&K).

- **Indian response:** Army's Air Defence units + IAF deployed **layered systems** (legacy + modern) to repulse attacks.
- **Operation:** Part of **Operation Sindoor** (ongoing strikes on terror hideouts).

Weapons & Systems Deployed

1. L-70 Guns

- 40 mm anti-aircraft gun, origin: Bofors.
- High rate of fire → targets **low-altitude aircraft/drones**.
- **Upgrades in India:** Electro-optical fire control, automation, thermal sights.

2. Zu-23 mm (ZU-23-2)

- Twin-barrel Soviet-era AA gun (towed).
- Simple, effective, rapid fire → protection of static installations.
- Can be linked with radar & optical systems.

3. Schilka (ZSU-23-4)

- **Self-propelled, radar-guided system** on tracked chassis.
- 4×23 mm autocannons + integrated radar → can track & destroy **multiple aerial targets in real time**.
- Indian upgrades: digital fire control, thermal imagers.

4. Specialised Counter-UAS Systems

- Drone detection: radar + electro-optical sensors.
- Neutralisation: **jammers, directed-energy weapons (DEW)**, plus kinetic interceptors.
- Provides **layered defence** with guns/SAMs.

5. S-400 'Sudarshan Chakra'

- Indian name for Russian **S-400 Triumf**.
- Long-range SAM, engages targets **up to 400 km**, detects **600 km**.
- India's deal: $5.43 bn (2018) for 5 units, first deployed in **Punjab (2021)**.
- Symbolism: Sudarshan Chakra (Mahabharata) = precision & lethality.

Strategic Takeaways for UPSC

- **Layered air defence** = Long-range (S-400) + medium (SAMAR/Pechora) + short-range (L-70, Schilka, Zu-23) + CUAS.
- **Indigenisation push:** CUAS & upgrades show Atmanirbhar Bharat in defence.
- **New-age threat:** Drone swarms challenge traditional air-defence doctrines.
- **Geopolitics:** Strengthens India's case vs Pakistan's state-sponsored terror at global forums.

India Successfully Tests Agni-Prime Missile from Rail-Based Mobile Launcher

- **Event:** India conducted the first-ever launch of the **Intermediate Range Agni-Prime Missile** from a **rail-based mobile launcher system**.
- **Missile Range & Features:** Agni-Prime is a **next-generation missile** capable of covering up to **2,000 km**, featuring advanced navigation, accuracy, and quick-launch capabilities.
- **Significance of Rail-Based Launcher:**
    - Enables **cross-country mobility** on the rail network.
    - Allows **launch within a short reaction time**.
    - Provides **reduced visibility**, enhancing survivability and strategic deterrence.
- **Acknowledgment:** Defence Minister **Rajnath Singh** congratulated the **DRDO**, **Strategic Forces Command**, and the **Armed Forces** for the successful test.
- **Global Context:** This test positions India among a **select group of nations** capable of **canisterised launch systems from mobile rail networks**.

India Neutralises Pakistani Drones and Missiles in Response to Escalation Attempts

- **Background:** Following the **April 22 Pahalgam terror attack** in Jammu & Kashmir, where 26 civilians were killed by terrorists from **The Resistance Front** (a Lashkar-e-Taiba proxy), India carried out **precision strikes** at **terrorist camps in Pakistan and PoK**.
- **Operation Sindoor:**
    - Conducted over **25 minutes**, beginning **1:05 AM**, targeting **four terrorist camps in Pakistan** and **five in PoK**.

- **Weaponry used:** HAMMER smart bombs, SCALP missiles.
- Resulted in the **elimination of over 100 terrorists** and destruction of terrorist HQs and training camps.
- Focused on terror targets; **Pakistani military installations were not targeted**.

- **Pakistani Retaliation:**
  - Pakistan attempted attacks on **15 Indian cities** including **Jammu & Kashmir, Punjab, Gujarat**, using **drones and missiles**.
  - Indian forces responded by:
    - **Neutralising Pak air defence radars**, including in **Lahore**.
    - Using **HARPY drones** and **S-400 missile defence systems** to destroy incoming missiles.
  - Debris collection provides evidence of **Pakistan's support for cross-border terrorism**.
- **Casualties:**
  - **16 civilians killed** (including 3 women, 5 children).
  - **1 Indian soldier killed**.
- **Strategic Significance:**
  - Demonstrates India's **precision strike capability** and **robust air defence systems**.
  - Reflects India's **measured, non-escalatory military response**, while reinforcing deterrence against cross-border terrorism.
  - Highlights ongoing **India-Pakistan border tensions**, especially after terrorist attacks in J&K.

India — DRDO successfully flight-trials ULPGM-V3 (Kurnool)

- **What happened:** DRDO carried out **successful flight-trials of the UAV-Launched Precision-Guided Missile (ULPGM)-V3** (also called the extended-range ULM-ER) at the **National Open Area Range (NOAR), Kurnool, Andhra Pradesh**.
- **Official announcement:** Defence Minister **Rajnath Singh** announced and congratulated DRDO and industry partners for the successful trials.

- **Key technical features:**
    - **Weight:** ≈ **12.5 kg**; **fire-and-forget** air-to-surface missile.
    - **Propulsion & guidance:** Compact **dual-thrust solid motor**; **passive homing with an imaging infrared (IR) seeker** for day/night engagement.
    - **Range:** Reported **up to ~4 km by day** and **~2.5 km at night** (V3 / ULM-ER figures publicised at Aero India and in press reports).
    - **Other: Two-way datalink**, multiple warhead options; developed in partnership with industry (DcPPs), MSMEs and start-ups.

Indian Army to Receive Rs 30,000 Crore Quick Reaction Surface-to-Air Missile (QR-SAM) Systems

- **Procurement Plan:**
    - Defence Ministry to approve the acquisition of **three regiments** of indigenous **Quick Reaction Surface-to-Air Missile (QR-SAM)** systems for **₹30,000 crore**.
    - Proposal to be considered by the **Defence Acquisitions Council (DAC)** under Defence Minister **Rajnath Singh**.
- **System Capabilities:**
    - Highly **mobile**, capable of operating **on the move or from short halts**.
    - Designed to intercept **fighters, helicopters, and drones** at a range of **25–30 km**.
    - Tested extensively in **day and night scenarios** against high-speed aerial threats.
- **Co-Production:**
    - Developed and co-produced by **Bharat Electronics Limited (BEL)** and **Bharat Dynamics Limited (BDL)**.
    - Tailored to move along with **tanks and infantry combat vehicles**, providing **tactical battlefield air defence**.
- **Integration with Existing Air Defence Network:**
    - Complements India's **multi-layered air defence systems**, including:
        - **S-400 Triumf (380 km)** – long-range interceptor

        - **Barak-8 (70 km)** – medium-range SAM
        - **Akash & Akashteer (25 km)** – indigenous systems
        - **Igla-S (6 km)** – shoulder-fired
        - **L-70 guns (3.5 km)** – upgraded anti-aircraft
        - **Drone detection/interdiction systems (1–2 km)**
- **Strategic Context:**
    - Reinforces air defence **lessons from Operation Sindoor (May 2025)**, which saw successful interception of Pakistani drones and missiles.
    - Complements ongoing projects like **VSHORADS (6 km)** and **Project Kusha long-range SAM (350 km)**, expected operational by **2028–29**.

How India's Air Defence Protected the Golden Temple and Punjab Cities

- **Background:**
    - In retaliation for the **Pahalgam terror attack** in April 2025, India launched **Operation Sindoor** on 7 May, striking **terror camps in Pakistan and Pakistan-occupied Kashmir**, eliminating ~100 operatives.
    - Pakistan responded with drones, long-range missiles, and loitering munitions targeting Indian military and civilian sites, including religious places such as the **Golden Temple in Amritsar**, Shambhu Temple (Jammu), Gurdwara in Poonch, and Christian convents.
- **Air Defence Response:**
    - Indian Army and Air Force deployed **modern air defence systems** to protect civilian and strategic targets.
    - The **Golden Temple** received a **holistic air defence umbrella**, ensuring no damage to the religious site or surrounding areas.
    - Systems involved:
        - **AKASH Missile System** – indigenous surface-to-air missile
        - **L-70 Anti-Aircraft Guns** – upgraded for rapid response
        - **Akashteer AD System** – automated, mobile air defence control connecting **IACCS (Indian Air Force)** and **TRIGUN (Indian Navy)**

- **Major General Kartik C. Seshadri** stated that all Pakistani drones and missiles targeting the Golden Temple were intercepted successfully.

- **Significance of Akashteer:**
  - Core of the **Army Air Defence (AAD)** system.
  - Provides **real-time battlefield awareness** by integrating Army, Air Force, and Navy systems.
  - Vehicle-mounted and highly mobile, ideal for deployment in **active war zones**.
  - Demonstrated superiority over Pakistan's **imported HQ-9 and HQ-16 air defence systems**, which failed to detect Indian strikes.

- **Outcome:**
  - All incoming aerial threats were neutralised, with **minimal loss of life or property**.
  - The incident highlighted India's **multi-layered air defence capabilities** and the operational effectiveness of **indigenous systems** in safeguarding critical and civilian infrastructure.

India's Supersonic Firepower Upgrade: IAF Eyes Israeli AIR LORA Missile

Context:
The **Indian Air Force (IAF)** is evaluating the acquisition of **AIR LORA**, an air-launched missile developed by **Israel Aerospace Industries (IAI)**, to strengthen India's **long-range precision strike capabilities**. This comes after the successful deployment of the **Rampage missile** during **Operation Sindoor**.

Key Features of AIR LORA:

Feature	Details
Range	Up to 400 km (stand-off capability)
Target Type	High-value, well-defended targets: airbases, command & control centers, naval vessels, critical infrastructure
Launch Platform	Su-30MKI (Indian fighter aircraft)

Feature	Details
Weight	1,600 kg
Speed	Supersonic; reaches targets within minutes
Accuracy	Circular Error Probable (CEP) < 10 meters
Guidance	GPS/INS with anti-jamming; fire-and-forget; mid-flight target update
Survivability	Steep-angle, high-speed attack; seekerless design; all-weather operational capability

Significance:

1. **Stand-off capability**: Can strike from a safer distance, reducing risk to aircraft from enemy air defenses.
2. **High precision**: Minimal collateral damage due to very low CEP.
3. **Operational flexibility**: Mid-flight target updates allow adaptive strikes in dynamic battlefields.
4. **Strategic advantage**: Enhances India's ability to neutralize critical military infrastructure in adversary territory.

Comparison with Rampage Missile:

Missile	Range	Deployment Requirement
Rampage	250 km	Direct launch from aircraft
AIR LORA	400 km	Stand-off, fire-and-forget, mid-flight update

Implication for India's Defence:

- Strengthens India's **long-range precision strike doctrine**.
- Supports **credible deterrence** and strategic options against potential adversaries.
- Enhances **all-weather, electronic warfare-resistant strike capability**.

Reconstruction at Pakistan's Nur Khan Airbase After India's Operation Sindoor

Context:

Following the **Pahalgam terror attack** on April 22, 2025, which killed 26 civilians, **India launched Operation Sindoor**, targeting key military and terrorist infrastructure in Pakistan. The **Nur Khan Airbase**, a strategic facility located **less than 25 km from Islamabad**, was one of the targets.

Key Details of the Strike:

- **Date of Strike:** May 10, 2025
- **Target:** Two specialized military trucks and an adjoining complex within the airbase, possibly involved in **command and control of drone assets**.
- **Weapon Systems Likely Used:**
    - **BrahMos missile** (launched from Su-30 fighters)
    - **SCALP air-launched land attack missile** (launched from Rafale fighters)
- **Impact:** Complete destruction of the trucks and significant damage to surrounding structures.

Strategic Importance of Nur Khan Airbase:

- Houses key assets of the **Pakistan Air Force** including:
    - Saab Erieye airborne early warning systems
    - C-130 transport aircraft
    - IL-78 mid-air refueling planes
- Located near the **Pakistan Army Headquarters**, facilitating air mobility, surveillance, logistics, and operational coordination.

Aftermath and Reconstruction:

- **Satellite Imagery:** Shows reconstruction underway as of September 2025.
- **Reconstruction Focus:**
    - Erection of new walls similar to original building layout
    - Possible reuse of intact foundations from partially damaged sections
- **Geo-Intelligence Insights:** Secondary damage structures were dismantled due to internal system failures or structural compromise.

Operational Significance of Operation Sindoor:

- **Planning Timeline:**
    - April 29: Targets shortlisted
    - May 6: Strike date and time finalized
    - May 7–10: IAF executed calibrated attacks
- **Depth of Strike:** Up to 200 km inside Pakistani airspace – **deepest since 1971 war**.
- **Targets:** Terror centres, enemy radars, runways, hangars, and aircraft.
- **Outcome:** Forced Pakistani leadership to come to **ceasefire negotiations**.

Implications for India's Strategic Posture:

1. Demonstrates **rapid operational planning and execution** in response to terror attacks.
2. Shows India's **long-range strike capability and precision targeting**.
3. Reinforces the concept of **preemptive tactical strikes** on high-value assets.
4. Highlights **IAF's evolving role** in strategic deterrence and airspace dominance.

India-Pakistan Missile Escalation: Operation Bunyan Marsoos

Context:
Following the **Pahalgam terror attack** on April 22, 2025, in which 26 Indian civilians were killed, **India launched Operation Sindoor** targeting terrorist infrastructure in Pakistan and Pakistan-administered Kashmir. This triggered **reciprocal missile strikes**, escalating tensions toward a potential full-scale conflict.

Pakistan's Response – Operation Bunyan Marsoos:

- **Name Meaning:** Arabic for "a structure made of lead," symbolizing unity and strength in battle (from Quranic context).
- **Objective:** Retaliatory strikes on Indian military bases.
- **Scope:** Targeted at least **six Indian military bases**, using missiles, drones, and fighter aircraft.
- **Significance:** Marks an unprecedented escalation, with strikes exchanged outside Kashmir, the traditional conflict zone.

Sequence of Events (May 2025):

1. **India's Strikes:**
    - **May 7–10:** Targeted terror centers and military infrastructure in Pakistan and Pakistan-administered Kashmir.
    - **Targets in Pakistan:** Nur Khan, Murid, and Rafiqui airbases.
    - **Impact:** India claimed destruction of at least 100 terrorists and key terror infrastructure; Pakistan reported civilian casualties.
2. **Pakistan's Response:**
    - **May 10:** Launched ballistic missile strikes on Indian airbases.
    - **Targets in India:** Udhampur, Pathankot, Drangyari artillery positions, Uri, Nagrota, Beas, Adampur, and Bhuj airbases.
    - **Reported Losses:** Pakistan claimed downing 5 Indian jets, including 3 Rafales; India neither confirmed nor denied.
3. **Drone and Loitering Munition Warfare:**
    - Both sides deployed drones and loitering munitions for precision strikes.
    - Strikes reached urban centers (e.g., Karachi, Lahore, Rawalpindi) and critical military facilities.

Strategic Implications:

- **Escalation Beyond Kashmir:** Strikes targeted bases deep inside each other's territory – an unprecedented scale since the 1971 war.
- **Air Defence Mapping:** Both sides gained critical intelligence on adversary air defenses, enabling standoff and long-range missile capabilities.
- **Nuclear Dimension:** The conflict involves nuclear-armed neighbors, emphasizing the risk of rapid escalation.
- **International Concern:** The US and other powers urged immediate de-escalation; diplomatic interventions were initiated.

Operational Lessons:

1. Modern conflicts involve **missile, drone, and loitering munition integration** for both tactical and strategic objectives.
2. **Rapid retaliation cycles** increase the risk of unintended escalation.
3. Importance of **early warning, air defense readiness, and strategic deterrence** in high-tension regions.

4. **Naming of operations** (e.g., Operation Sindoor, Operation Bunyan Marsoos) reflects **symbolic, cultural, and psychological dimensions** of warfare.

India's Advanced Missile Development and Lessons from Operation Sindoor

Context:

During **Operation Sindoor** (May 2025), the **Indian Air Force (IAF)** successfully struck Pakistani airfields, drones, and air defence systems. India's premier defence research body, **DRDO**, deployed multiple indigenous weapon systems effectively, including **BrahMos**, **Akash surface-to-air missiles**, and the **D4 anti-drone system**.

---

1. BrahMos Missile Program

Feature	Details
Type	Supersonic cruise missile
Origin	Developed jointly with Russia
Platforms	Land, sea, and air (Su-30MKI for air variant)
Developments	**BrahMos-NG** – smaller variant for wider air platform integration
Enhancements	Increasing range; compatibility with multiple fighter jets

Strategic Significance:

- Provides **rapid strike capability** against airfields and strategic targets.
- Air-launched version offers **stand-off precision strikes** from safer distances.
- BrahMos-NG will enhance **flexibility and deployment options** across all platforms.

---

2. Hypersonic Missile Program

Type	Development Stage	Timeline for Induction
Hypersonic Glide Missile (HGV)	Advanced stage; 1 development trial completed	2–3 years

Type	Development Stage	Timeline for Induction
Hypersonic Cruise Missile	Scramjet propulsion proven for >1000 seconds	5–7 years

Capabilities:

- Speeds **>5 times the speed of sound** (Mach 5+)
- Highly **maneuverable**; difficult for air defenses to intercept
- Designed for **long-range precision strikes**, evading modern air defense systems

Global Context:

- Inspired by hypersonic missile use in **Iran-Israel conflicts**.
- India is advancing both **cruise and glide hypersonic systems** to maintain strategic parity.

---

3. Other DRDO Weapon Systems in Development

System	Purpose
Astra Mk II & III	Air-to-air missiles with increased range
Rudram 2–4	Air-to-ground missiles with extended range
KUSHA	Surface-to-air missile for air defense
Directed energy weapons	Anti-drone systems using lasers and high-power microwaves
Zorawar Light Tank	25-tonne combat platform for high-altitude operations (Ladakh, Sikkim)
AMCA (Advanced Medium Combat Aircraft)	Indigenous fifth-generation stealth fighter; private-public partnerships planned

Significance:

- Ensures **autonomy in air and ground combat capabilities**
- Focused on **high-altitude, rugged terrain deployments**
- Strengthens **electronic warfare resilience**

---

4. Lessons Learned from Operation Sindoor

1. **Electronic Warfare Resilience:**
    - All systems must operate in **GPS-denied and communication-denied environments**.
    - Emphasis on **fully autonomous weapon systems**.
2. **Precision and Integration:**
    - Integration of multiple weapon platforms (air, land, sea) is essential for **rapid, coordinated strikes**.
3. **Operational Feedback Loop:**
    - Real-world deployment validated **system reliability, targeting accuracy, and survivability** under hostile conditions.

Strategic Implications

- India is on track to field **hypersonic weapons capable of deep-strike precision**.
- BrahMos-NG and HGVs will enhance **stand-off strike and deterrence capabilities**.
- DRDO's advancements in **autonomous systems, high-altitude platforms, and stealth aircraft** support **future-proofing India's defence posture**.
- Operational lessons highlight the **critical need for electronic warfare readiness** in modern conflicts.

Indian Navy Tests Medium-Range Surface-to-Air Missile (MR-SAM)

Date & Location:

- **Test Date:** April 24, 2025
- **Location:** Arabian Sea
- **Platform:** INS Surat (Guided Missile Destroyer, P15B class)

Key Highlights

1. **Missile Tested:**
    - **Medium-Range Surface-to-Air Missile (MR-SAM)**

- Purpose: Effective against **surface-to-surface missiles** and other **aerial threats**
- Role: Air defence in **network-centric maritime operations**

2. **INS Surat:**
   - Fourth and final ship of the **P15B Guided Missile Destroyer Project**
   - **Indigenous content:** 75%
   - Equipped with **advanced weapon-sensor packages** and **network-centric capabilities**
   - Significance: One of the **largest and most sophisticated destroyers** globally
3. **Operational Context:**
   - Test conducted **ahead of planned surface-to-surface missile testing by the Pakistan Navy**
   - Demonstrates India's **maritime self-reliance** and readiness for **multi-dimensional threats**

AIKEYME Exercise

- **Ships Involved:** INS Chennai and INS Kesari
- **Location:** Dar es Salaam, Tanzania
- **Date:** April 19–24, 2025
- **Objective:** Strengthen **naval cooperation and interoperability** with Tanzania People's Defence Force (TPDF)
- **Significance:**
  - **Diplomatic and strategic engagement** with Indian Ocean partners
  - Demonstrates India's **blue-water naval capabilities** and commitment to **regional security**

Strategic Significance

1. **Defence Modernization:**
   - MR-SAM enhances **area air defence** for Indian warships, critical for **carrier strike groups and fleet protection**.
   - Supports **indigenous warship design, construction, and weapons integration**.

2. **Maritime Security and Diplomacy:**
    - Exercises like AIKEYME bolster **India's presence in the Indian Ocean Region (IOR)**.
    - Enhances **bilateral ties and operational coordination** with friendly navies.
3. **Deterrence:**
    - Preemptive missile tests signal **readiness against potential maritime threats**.
    - Strengthens India's **strategic posture vis-à-vis Pakistan and other regional actors**.

Indian Army to Acquire QRSAM Surface-to-Air Missile System

Context:

- Following **Operation Sindoor (May 2025)**, where the Indian Air Defence successfully countered Pakistani **aircraft, missile, and drone attacks**, the Indian Army is set to acquire an **indigenous Quick Reaction Surface-to-Air Missile (QRSAM) system**.
- **Estimated Cost:** ₹30,000 crore
- **Approval:** Expected soon from the **Defence Ministry**

Key Features of QRSAM

Feature	Details
Type	Quick Reaction Surface-to-Air Missile (mobile air defence system)
Range	~30 km (short-to-medium range)
Mobility	Highly mobile; can **search and track targets on the move** and fire at short halts
Complementary Systems	Works alongside **MRSAM, Akash, and other existing air defence systems**
Operational Performance	Extensively evaluated under **day and night conditions**

Deployment & Strategic Role

- **Regiments Planned:** Three regiments for deployment along **Western and Northern borders**
- **Role:**
    - Rapid interception of **low-to-medium altitude aerial threats** including **drones, helicopters, and fighter aircraft**
    - Enhances **integrated air defence network** alongside **Indian Air Force systems** (S-400, Spyder, Sudarshan)
    - Strengthens **multi-layered air defence capability** for the Army

---

Complementary Upgrades

- **New Radars:** To improve target detection and tracking
- **Very Short Range Air Defence (VSHORAD) systems**
- **Electronic Warfare & Jammers:** To counter drones and incoming missiles

---

Strategic Significance

1. **Enhanced Border Security:**
    - Provides rapid response to threats along sensitive **India-Pakistan borders**
    - Reduces reliance on IAF for immediate interception
2. **Indigenous Capability:**
    - Developed by **DRDO**, aligns with **Atmanirbhar Bharat / Swadeshi Defence Policy**
3. **Integration with Existing Systems:**
    - Acts as a **layered air defence shield**, complementing **Akash (short-medium range)** and **MRSAM (medium-range)** systems
4. **Operational Lessons from Op Sindoor:**
    - Demonstrated the need for **highly mobile, quick-reaction systems** to counter drone and missile swarms
    - Strengthens India's **electronic warfare resilience**

India's Next-Generation Air Defence Systems: S-400 and S-500

Context:

- During **Operation Sindoor (May 2025)**, India conducted precision airstrikes against **terrorist camps and Pakistani airbases**.
- Pakistani retaliatory missile and drone attacks targeted **border cities in Jammu & Kashmir, Rajasthan, and Punjab**.
- **Indian Air Defence systems**, particularly **S-400 (Sudarshan Chakra)**, played a decisive role in neutralising threats.

S-400 Missile Defence System (India: Sudarshan Chakra)

Feature	Details
Role	Long-range surface-to-air missile system
Target Types	Aircraft, drones, cruise missiles, ballistic missiles
Detection Range	Up to 600 km
Interception Range	Up to 400 km
Multi-target Capability	Can track >100 targets simultaneously and engage multiple threats
Mobility	Mobile launchers allow rapid redeployment
Operational Deployment	First deployed in Punjab in 2021 to counter Pakistan threats
Strategic Impact	Forced Pakistani jets and missiles to abort or alter strike missions during Operation Sindoor

---

S-500 (Prometheus) – Next-Generation Air Defence

Feature	Details
Role	Advanced air and missile defence system capable of countering **emerging threats**

Feature	Details
Target Types	Ballistic missiles, hypersonic glide vehicles (HGVs), aircraft, UAVs, LEO satellites, space weapons
Detection Range	Up to 2,000 km for ballistic targets; 800 km for airborne targets
Interception Range	Up to 600 km for ballistic targets; 400 km for airborne targets
Altitude Engagement	Up to 180–200 km (near space)
Missile Types	Includes **40N6M long-range missile** and other interceptor missiles
Advantages over S-400	Can engage **hypersonic glide vehicles and LEO satellites**, which are beyond S-400 capabilities

---

Strategic Significance

1. **Layered Air Defence:**
    - S-400 covers **long-range interception** of conventional aerial threats.
    - S-500 adds **next-generation capability** against hypersonic, space-based, and low-Earth-orbit threats.
2. **Deterrence:**
    - Demonstrates India's ability to **neutralise high-speed, low-altitude, and hypersonic threats**.
    - Strengthens India's **multi-tiered defence posture** along the western border and in strategic airspace.
3. **Operational Lessons from Op Sindoor:**
    - S-400's success underlines the importance of **electronically resilient, mobile, and multi-target tracking systems**.
    - S-500 development aligns with **future-proofing air defence against emerging technologies** like HGVs and space-based weapons.

India Intercepts Pakistan's Fateh-II Missile in Sirsa

Context:

- Pakistan launched a **new wave of drone and missile attacks** across India, from Jammu & Kashmir to Gujarat.
- Key targets included **airbases and strategic installations**.
- India's air defence systems successfully **intercepted Fateh-II ballistic missiles**, neutralizing the threat.

Details of the Fateh-II Missile

- **Type:** Hypersonic ballistic missile (guided artillery rocket system)
- **Range:** ~400 km
- **Purpose:** Designed for **precision strikes** on high-value targets such as:
    - Military bases
    - Communication facilities
    - Air defence installations
- **Warhead:** Conventional (high-explosive)
- **Origin:** Pakistan claims indigenous development; China assisted in earlier missile programs (Fateh-I).
- **Comparable Systems:**
    - US HIMARS-launched GMLRS
    - China's PHL-series guided rockets

Significance of the Interception

- The missile was **destroyed mid-air over Sirsa, Haryana**, showing the effectiveness of India's **air defence network**.
- Prevented potential casualties and damage to **critical infrastructure**.
- Demonstrates India's **readiness against hypersonic and ballistic threats**.

Key Takeaways for UPSC

1. **Fateh-II missile:** Pakistan → range 400 km, conventional warhead, strategic strike capability.

2. **Indian defence response:** Mid-air interception by Indian air defence (S-400, QRSAM, Akash, and complementary systems).
3. **Geopolitical relevance:** Part of **India-Pakistan escalations in May 2025**, highlighting **cross-border ballistic threats and countermeasures**.
4. **Strategic lesson:** Effective missile defence reduces escalation risk and protects key military and civilian targets.

India to Get Remaining S-400 Missile Systems by 2026

Key Points:

1. **Delivery Timeline**:
   - India signed a $5.43 billion deal with Russia in 2018 for **five S-400 Triumf air defence systems**.
   - **Three squadrons** have already been delivered.
   - **Remaining two squadrons** expected to be delivered by **2025–26**.
2. **System Performance:**
   - S-400 performed **efficiently during India-Pakistan tensions** in 2025, intercepting missiles and drones.
   - Highly capable of engaging **multiple aerial threats** at long ranges.
3. **Russia-India Defence Cooperation:**
   - Russia hinted at **expanding bilateral collaboration** in:
     - Air defence
     - Anti-drone systems
   - Anti-drone technology is especially relevant after the **extensive drone use in India-Pakistan clashes**.
4. **Strategic Importance:**
   - The S-400 strengthens India's **long-range air defence capability**.
   - Enhances India's preparedness against **ballistic missiles, drones, and cruise missiles**.

5. **Diplomatic Context:**
    - Russian Deputy Chief of Mission, Roman Babushkin, emphasized ongoing **defence dialogue**.
    - Possible visit of Russian FM Sergey Lavrov to India expected soon.

BrahMos: India's Fastest Cruise Missile System

Background:

- Developed as a **joint venture between India (DRDO) and Russia (NPO Mashinostroyenia)** since 1998.
- Named after the **Brahmaputra (India) and Moskva (Russia) rivers**.
- Authorized capital at inception: **$250 million (~₹2,135 crore)**; India contributed 50.5%, Russia 49.5%.

Key Features:

- **Type:** Supersonic cruise missile
- **Speed:** Up to **Mach 3** (supersonic), BrahMos-II hypersonic variant aims for **Mach 8**
- **Range:** 290 km for current variants; advanced variants aim for 500–800 km (BrahMos ER up to 1,500 km)
- **Warhead:** 200–300 kg high-explosive
- **Launch Platforms:** Air-launched, land-based, ship-based, submarine-based
- **"Fire and Forget" capability:** Low radar signature, high precision, long-range targeting

Development & Commissioning:

- **First test launch:** June 12, 2001
- **Indian Navy:** 2005
- **Indian Army:** 2007
- **Indian Air Force:** Air-launched version for **Su-30MKI**

Cost:

- Estimated production cost per missile: ~₹34 crore (official cost not disclosed)

Current & Future Variants:

1. **BrahMos Block I** – Standard operational missile
2. **BrahMos Air-Launched** – For Su-30MKI
3. **BrahMos ER (Extended Range)** – Up to 1,500 km
4. **BrahMos-II Hypersonic** – Mach 8 speeds
5. **BrahMos-NG (Next Generation)** – Lighter, can be fired from multiple platforms

Strategic Significance:

- Likely used in **precision strikes on Pakistan airbases** in May 2025.
- Enhances India's **long-range strike capability** with **high speed, precision, and versatility**.

BrahMos Production Unit Inaugurated in Lucknow

- **Event:** Defence Minister Rajnath Singh virtually inaugurated the BrahMos Aerospace Integration and Testing Facility in Lucknow on May 11, 2025.
- **Location:** Lucknow, part of **Uttar Pradesh Defence Industrial Corridor** (six nodes: Lucknow, Kanpur, Aligarh, Agra, Jhansi, Chitrakoot).
- **Capacity:**
    - Assemble/test existing supersonic BrahMos missiles (80–100 per year).
    - Future production of next-generation (NG) BrahMos: 100–150 per year.
- **BrahMos Features:**
    - Universal precision-strike missile: land, sea, air platforms.
    - Range: 290–400 km; speed: Mach 2.8 (~3,430 kmph).
    - "Fire and forget" guidance system.
    - Next-gen variant lighter (1,290 kg vs 2,900 kg), enabling up to 3 missiles on Su-30MKI.
- **Facility Highlights:**
    - Cost: ₹300 crore; area: 80 hectares (land provided free by UP Govt).

- Houses **Strategic Materials Technology Complex** (Titanium & Super Alloys Plant) for aerospace-grade materials.
- Planned **Defence Testing Infrastructure System (DTIS)** for testing/certification of defence products.

- **Significance:**
  - Enhances India's **precision-strike capabilities**.
  - Strengthens **Make in India** and defence self-reliance initiatives.
  - Supported by PM Modi's 2018 UP Defence Industrial Corridor initiative.

"India Preparing To Test 1,500 Km-Range Hypersonic Cruise Missile" – Swarajya,

---

1. Strategic Significance

- **Extended Strike Capability:** With a range of 1,500 km, the ET-LDHCM can strike deep into adversary territory.
- **Hypersonic Advantage:** Speed up to Mach 8 (~11,000 kmph) ensures reduced reaction time for enemy defences.
- **Maneuverability:** Low-altitude, mid-air course correction makes interception by conventional air defence systems extremely difficult.

---

2. Technological Highlights

- **Scramjet Propulsion:** Uses atmospheric oxygen to sustain hypersonic speeds; successful 1,000-second ground test completed.
- **Materials Science:** Heat- and oxidation-resistant materials withstand temperatures exceeding 2,000°C.
- **Payload Flexibility:** Can carry conventional or nuclear warheads up to 2,000 kg.
- **Launch Platforms:** Compatible with land, sea, and air launch, enhancing operational flexibility.

---

3. Defence & Security Implications

- **Strategic Deterrence:** Places India among the few nations with operational hypersonic weapon systems (US, China, Russia).
- **Regional Balance:** Strengthens India's deterrence posture vis-à-vis Pakistan and China.
- **Deep Strike Capability:** Complements existing missile systems like BrahMos, BrahMos-II, and Agni series.

India's Gandiva Missile

- **What:** India's latest air-to-air missile, **Gandiva** (formerly Astra MK-III), developed by **DRDO**, enhances the Indian Air Force's long-range strike capability.
- **Deployment: Su-30MKI** and **Tejas** aircraft; future integration planned with **AMCA** (Advanced Medium Combat Aircraft).
- **Range & Speed:** Up to **340 km** at high altitude (20 km), **190 km** at lower altitude (8 km); flies at **Mach 4** (4× speed of sound).
- **Significance:**
    - Strengthens **air superiority** against China's PL-15 and Pakistan's AIM-120 missiles.
    - Boosts **indigenous defence capability** and supports **Atmanirbharta** in aerospace.
    - Provides **long-range beyond-visual-range (BVR)** engagement and high-precision strike.
- **Strategic Implication:** Improves deterrence, modernizes the IAF's missile inventory, and complements future 5th-generation aircraft development.

"Arjun's Gandiva will now haunt Pakistan and China: India's most advanced air-to-air missile"

---

1. Overview

- **Missile Name:** Gandiva (formerly Astra MK-III)
- **Developer:** DRDO (Defence Research and Development Organisation)
- **Deployment Platforms:** IAF's Sukhoi Su-30MKI, Indigenous Light Combat Aircraft (Tejas)

2. Technical Specifications

Feature	Details
Type	Beyond-Visual-Range (BVR) Air-to-Air Missile
Range	340 km (target altitude 20 km); 190 km (target altitude 8 km)
Speed	Four times the speed of sound (Mach 4 approx.)
Guidance	Likely active radar homing and high-precision tracking
Target	Enemy aircraft, drones, UAVs, fighter jets
Platforms	Su-30MKI, Tejas (planned AMCA in future)

3. Strategic Significance

- **Air Superiority:** Enhances India's capability to engage aerial threats at long distances.
- **Regional Balance:** Can counter China's PL-15 and Pakistan's AIM-120, improving strategic deterrence.
- **Indigenous Advancement:** Strengthens India's self-reliance (Atmanirbharta) in defence aerospace technology.
- **Future Integration:** Supports deployment on upcoming 5th-generation stealth fighter jet – Advanced Medium Combat Aircraft (AMCA).

4. Defence & Security Implications

- **Extended BVR Capability:** Increases IAF's lethality and survivability in air combat.
- **Platform Synergy:** Integration with both current-generation (Su-30MKI, Tejas) and future platforms (AMCA) ensures long-term utility.
- **Technological Edge:** Speeds and ranges put India in elite group of nations with advanced air-to-air missile systems.

BrahMos-NG and Extended Range BrahMos

- **Context:** India is advancing two parallel projects –
    1. **BrahMos-NG (Next Generation)** – compact, air-launched version.

2. **Extended Range BrahMos** – upgraded to **800 km** (from original 290 km).

- **Key Features of BrahMos-NG:**
  - **Weight:** ~1.33 tonnes (half the current 2.65-tonne air-launched BrahMos).
  - **Platforms:** Can be mounted on **Su-30MKI** (up to 4 missiles) and **LCA Tejas** (up to 2 missiles).
  - **Timeline:** Flight testing in 1 year; induction in 1–2 years.
  - **Speed/Range:** Supersonic cruise missile, ~Mach 2.8, with >400 km range.
  - **Advantage:** Lightweight → wider deployment, better operational flexibility.
- **Extended Range BrahMos:**
  - Original cap: **290 km** (due to **MTCR** restrictions).
  - After India joined MTCR (2016), range extended to **450 km**; trials for **800 km** ongoing.
  - Recent strikes on Pakistan (May 7–10, 2025) demonstrated its effectiveness — Pakistani Chinese-origin air defence systems failed to intercept it.
- **Strategic Significance:**
  - Enhances IAF's **precision strike capability** against high-value targets.
  - Provides **long-range deterrence** against adversaries.
  - Supports **Atmanirbharta** in defence & strengthens Indo-Russian collaboration.
  - Former IAF Chief described BrahMos-NG as the IAF's **"primary deterrent weapon."**
- **Background:**
  - BrahMos is a **joint venture** between **India (DRDO)** and **Russia (NPO Mashinostroyeniya)**, named after the **Brahmaputra & Moskva rivers**.
  - Inducted in **2005** (anti-ship variant); capable of launch from **land, sea, sub-sea, and air**.

Bhargavastra – Indigenous Counter-Drone System

- **Context:**
  India has unveiled a **low-cost counter-drone system** named **Bhargavastra**, developed by **Solar Defence and Aerospace Ltd (SDAL)** in collaboration with **Economic Explosives Ltd**, to tackle the rising threat of **drone swarms**.
- **Key Features:**
  - **Type:** First **micro-missile / micro-rocket based counter-drone system** for Army Air Defence.
  - **Detection Range:** Can detect **small UAVs beyond 6 km**.
  - **Engagement Range:** Neutralises targets **beyond 2.5 km**.
  - **Launch Capacity:** Can **simultaneously launch over 64 guided micro-missiles**.
  - **Mobility:** Mounted on mobile platforms for **rapid deployment** in diverse terrains, including **high-altitude regions**.
  - **Trials:** Successfully tested at **Seaward Firing Range, Gopalpur (Odisha)**.
- **Strategic Importance:**
  - Provides a **cost-effective solution** against drone swarms.
  - Helps **preserve costly air defence systems** (e.g., S-400) for larger aerial threats.
  - Few comparable systems exist globally → boosts India's **Atmanirbharta in Defence**.
  - Air Force has also shown **interest** in its deployment.
- **Operation Sindoor Context:**
  - Recently, the **S-400 missile system** intercepted multiple Pakistani **missiles, drones, and aircraft** during the India–Pakistan conflict, securing borders in **Jammu, Punjab, Rajasthan, Gujarat**.
  - Highlighted the need for **cheaper indigenous anti-drone solutions** like **Bhargavastra**.

📩 **Have Suggestions?**

- Mail us at **support@eminent-ias.com**
- 🌐 Visit our website: **www.eminent-ias.com**
- 📚 If you liked these notes and want to request **more FREE Notes, PYQs, Demo Classes, and Mock Tests**,
  👉 Register now at: **https://www.eminent-ias.com/get-free-mock-tests-notes-pyqs-sign-up-now**