

Defence (10)

• IAF Dronathon-2026 at Pokhran — and Vayu UTtAm, the indigenous UTM

Body: Air Marshal Ashutosh Dixit, Vice Chief of the Air Staff, inaugurated the first IAF Dronathon-2026 at the Pokhran Field Firing Range, Jaisalmer, on 14 September 2026, running 14-16 September with over 20 defence companies, start-ups, MSMEs, DPSUs and innovators. Attended by MoD, HQ IDS, Indian Army and BSF. The IAF UAS Roadmap was released to give industry clarity on capability priorities. **Detail:** Demonstrated — surveillance and reconnaissance, autonomous operations, swarm technologies, electronic warfare and CUAS, with a stated shift from technology demonstration to operational effect. **Detail:** Vayu UTtAm — the IAF's indigenous multi-mode Unmanned Traffic Management (UTM) system. At Pokhran it detected and tracked both military and civil UAS, coordinating operations in congested airspace and identifying rogue drones. Civil applications: airspace safety, critical infrastructure, civil aviation, public safety. **Detail:** The distinction to hold — UTM = detect, identify, manage (the picture); CUAS = defeat through jamming, spoofing, net capture or kinetic means (the response). Cooperative tracking relies on the aircraft reporting itself; non-cooperative detection finds something trying not to be found, using radar, RF detection of the control link, electro-optical/infra-red and acoustic sensors fused together — hence multi-mode. **Law:** Classification by weight under the Drone Rules, 2021 (DGCA) — Nano up to 250 g, Micro 250 g-2 kg, Small 2-25 kg, Medium 25-150 kg, Large above 150 kg; the Digital Sky platform with green, yellow and red airspace zones. **Exam hook:** By endurance, MALE and HALE. By role, ISR, armed UAS and loitering munition (single-use — the drone is the weapon). A swarm is autonomous coordination among multiple platforms under one operator. Venue note: Pokhran is also the site of Exercise Vayu Shakti.

• Yudh Abhyas 2026 — the 22nd edition, at Auli and Mahajan at once

Body: 22nd edition of Yudh Abhyas, opening ceremony 15 September 2026 at the Auli Foreign Training Node, Uttarakhand, conducted simultaneously at Mahajan Field Firing Range, Rajasthan, with 600 personnel from each side. Commanders: Maj Gen Amaresh Gunjan, GOC 14 Infantry Division, and Col Benjamin Jackman, Commander, 1st Infantry Brigade Combat Team, 11th Airborne Division, US Army. **Detail:** The aim — joint capability for the employment of Integrated Battle Groups in mountainous and semi-mountainous terrain, with emphasis on infantry-dominated operations. Technology focus: drones and autonomous systems for surveillance and reconnaissance, contemporary weapon systems demonstrated at Mahajan, and expert exchanges on multi-domain warfare. **Detail:** An Integrated Battle Group is a self-contained, all-arms, brigade-sized formation with armour, artillery, engineers, air defence, signals and logistics integral to it — designed for rapid mobilisation and terrain-tailored composition, infantry-heavy in mountains and armour-heavy in plains. **Detail:** Two terrains in one exercise — Auli, Chamoli district, Garhwal Himalaya, high-altitude; Mahajan, Bikaner district, desert and semi-desert, one of the Army's largest field firing ranges. The formation ladder: section -> platoon -> company -> battalion -> brigade -> division -> corps -> command; a Brigade Combat Team is the US modular equivalent of a brigade group. **Lineage:** The series began 2004 and alternates between India and the US; the 2025 edition was in Alaska. It is the oldest and largest India-US military exercise. **Exam hook:** The India-US exercise map — Yudh Abhyas armies, Vajra Prahar special forces, Cope India air forces, Tiger Triumph tri-service amphibious/HADR, Malabar navies and multilateral (India, US, Japan, Australia). Foundational agreements: GSOMIA (2002), LEMOA (2016), COMCASA (2018), BECA (2020); India a Major Defence Partner since 2016. Multi-domain operations span land, sea, air, space and cyberspace, with the electromagnetic spectrum and information environment contested alongside.

• NCC 'Aparajita - Parang La 2026' — 250 km over a 5,578 m pass

Body: 'Aparajita - Parang La 2026', the NCC's All India Girls High Altitude Long Trek — 20 NCC girl cadets, flagged off by the Raksha Mantri in New Delhi on 18 August 2026 and flagged in at Karzok, Ladakh, on 16 September 2026 by DG NCC Lt Gen Virendra Vats and Addl Secretary MoD Smt Dipti Mohil Chawla. **Detail:** The route — Kibber (Himachal Pradesh) to Karzok (Ladakh), crossing the Parang La at about 5,578 m; about 250 km in 30 days through glaciers, snowfields and river valleys. An old trade route between Spiti and Changthang, following the Pare Chu, a river that flows from India into Tibet and back. **Detail:** The geography — north of the pass lie the Rupshu plains of the Changthang, the western extension of the Tibetan Plateau, a cold desert. Pastoralists are the Changpa, whose Changthangi goats yield pashmina. Wildlife includes the kiang (Tibetan wild ass) and the black-necked crane. Karzok stands on Tso Moriri, a Ramsar site in the Changthang Cold Desert Wildlife Sanctuary; related lakes are Pangong Tso and Tso Kar, all brackish because they are endorheic — no outlet to the sea. **Detail:** Altitude physiology — the percentage of oxygen stays about 21%; it is the partial pressure that falls with total atmospheric pressure, which at about 5,500 m is roughly half that at sea level. Acclimatisation means faster and deeper breathing, a raised heart rate, then erythropoietin stimulating more red blood cells over weeks — hence a slow, staged ascent. Dangers: AMS, HAPE (pulmonary oedema) and HACE (cerebral oedema); the definitive treatment for the severe forms is to descend. Rule of thumb: climb high, sleep low. **Law:** The NCC was raised under the NCC Act, 1948 and sits under the Ministry of Defence — not Education. Headed by a Director General; motto 'Unity and Discipline'; Army, Navy and Air Wings; Senior and Junior Divisions; certificates A, B and C, with the 'C' certificate carrying entry benefits. **Exam hook:** The wider shift — women were admitted to the NDA from 2022 after Supreme Court orders, and the first 17 NDA-trained women officers were commissioned in 2026.

• Chief of the Army Staff in Russia — Moscow and Saint Petersburg

Body: General Dhiraj Seth, Chief of the Army Staff, visited Russia 16-18 September 2026. Programme: ceremonial Guard of Honour; tribute at the Tomb of the Unknown Soldier, Moscow; talks with Col Gen Andrei Nikolayevich Mordvichev, Commander-in-Chief of the Russian Land Forces; a visit to the National Defence Control Centre, Moscow; interaction with Vasily Sergeyevich Osmakov, Deputy Minister of Defence on defence industry and procurement; and a visit to the Mikhailovskaya Military Artillery Academy, Saint Petersburg. **Detail:** The three strands are training and professional cooperation (army chief to army chief), defence industry and procurement (deputy minister) and military education (artillery academy). **Lineage:** Strategic Partnership 2000, elevated to a Special and Privileged Strategic Partnership in 2010 — a term India uses for Russia alone. Annual summits and a 2+2 dialogue. **Detail:** Russian-origin inventory — T-72 and T-90 tanks, BMP ICVs, Su-30MKI, MiG-29, Kilo-class submarines, S-400 air defence. BrahMos is an India-Russia joint venture, named for the Brahmaputra and Moskva, and was India's first major missile export, to the Philippines in 2022. What is distinctive is licensed production in India (Su-30MKI at HAL, T-90 at HVF Avadi) and co-development rather than only off-the-shelf purchase. **Detail:** Diversification — major acquisitions now also from France (Rafale, Scorpene), the United States (C-17, C-130J, P-8I, Apache, Chinook, MQ-9B) and Israel, plus rising domestic production. Russia remains the largest single source but its share has fallen. **Exam hook:** Military diplomacy is the peacetime use of armed forces for foreign policy — exercises, visits, training, port calls, attaches — and its output is interoperability and trust, not a treaty. Exercise pairing: INDRA = Russia (naval from 2003, later tri-service and army); Indra Dhanush = United Kingdom, air force. Shared multilateral platforms: SCO, BRICS, RIC.

- HAL hands over Tejas FOC trainers, HTT-40s and Dhruv NG**
Body: HAL handover at Bengaluru, 18 September 2026 — two LCA Tejas FOC twin-seat trainers and HTT-40 basic trainers to the IAF, and four Dhruv NG helicopters to Pawan Hans Limited. Present: Raksha Mantri Shri Rajnath Singh, Civil Aviation Minister Shri K Rammohan Naidu, CAS Air Chief Marshal AP Singh, Secretary (Defence Production) Shri Sanjeev Kumar, Secretary MoCA Shri Samir Kumar Sinha and CMD HAL Shri Ravi K.
Detail: The two trainers complete the 2010 FOC-standard order of 20 aircraft — 16 single-seaters (delivered 2022-23) and four twin-seaters.
Detail: IOC vs FOC — IOC means safe to fly and fight in a restricted envelope; Tejas IOC 2013, No. 45 Squadron 'Flying Daggers' July 2016. FOC means full envelope and full weapons fit (air-to-air refuelling, gun, BVR missiles); declared 20 February 2019, No. 18 Squadron 'Flying Bullets' 2020. Both at Sulur. ADA (under DRDO) designs; HAL manufactures. The Kaveri engine did not mature, so Tejas flies on the GE F404, with the F414 for the Mk2; current production focus is the Tejas Mk1A with AESA radar and an improved EW suite.
Detail: HTT-40 — HAL-designed basic trainer replacing the HPT-32 Deepak, grounded in 2009. 70 ordered March 2023 for about US\$388 million; Honeywell TPE331-12B turboprop of about 950 shp with FADEC; the first 16 engines from the USA, the rest to be built by HAL under technology transfer. Stated plainly: 12 aircraft were due in FY 2025-26 and none were delivered, owing to Honeywell engine supply bottlenecks, with first engines reaching HAL mid-2026.
Detail: Dhruv NG — the civil-certified development of the ALH Dhruv: 14 seats, Shakti engines, civil-certified glass cockpit, MTOW about 5,500 kg, top speed about 285 km/h, range about 630 km, endurance over 3.5 hours. The DGCA certified indigenous manufacture of the Shakti civil engine — the first aero engine so certified for indigenous production. Pawan Hans flies offshore support, regional connectivity, pilgrimage routes and air ambulance.
Exam hook: The IAF training pipeline — Stage I Basic: PC-7 Mk II, with HTT-40 entering; Stage II Intermediate: HJT-16 Kiran, with HJT-36 Yashas as replacement; Stage III Advanced: Hawk Mk 132; then type conversion, which is what the Tejas twin-seater is for. The honest summary: airframes indigenous and reliable, propulsion still dependent.

- CORE Programme 2026 — five days of tri-service argument at Manekshaw Centre**
Body: Combined Operational Review and Evaluation (CORE) Programme 2026, 14-18 September 2026, Manekshaw Centre, New Delhi — organised by HQ IDS, conducted by CENJOWS, with participants from the three Services, MoD, MEA and MHA, plus experts, academia and think tanks. The CDS, Chief of the Naval Staff and CISC interacted with participants, as did the Vice Chief of the Air Staff and Vice Chief of the Army Staff.
Lineage: HQ IDS was raised 23 November 2001 as the apex tri-service organisation for higher defence management, following the Kargil Review Committee and the Group of Ministers report. CENJOWS — Centre for Joint Warfare Studies — was raised 2007 under HQ IDS, registered under the Societies Registration Act, 1860.
Detail: CISC is the Chief of Integrated Defence Staff to the Chairman, Chiefs of Staff Committee — a three-star officer from any service, executive head of IDS, with oversight of inter-service intelligence, doctrine, joint planning, budgetary allocation and training, subordinate only to the CDS on jointness. The CDS is four-star, created 2019, also Secretary, Department of Military Affairs, principal military adviser on tri-service matters and permanent Chairman of the Chiefs of Staff Committee; service chiefs advise on their own service. Note the eighteen-year gap — HQ IDS in 2001, CDS only in 2019.
Detail: Three terms that are not synonyms — jointness (services plan and operate together, structures stay separate), integration (shared logistics, procurement, communications, intelligence, with service HQ integrated into the MoD via the Department of Military Affairs) and theaterisation (theatre commands under a single commander for all assets in an area). Progression: cooperate -> share -> unify. Existing joint commands: Andaman and Nicobar Command, the only geographical tri-service command, and Strategic Forces Command, which is functional.
Detail: Kinetic means destroying physically; non-kinetic achieves effect without destruction — electronic warfare, cyber, information operations, economic pressure. Cognitive warfare targets what an adversary population and leadership believe and decide, and success does not require belief in a falsehood — only the collapse of belief that anything can be verified. It is countered by strategic communication and counter-disinformation, whose real currency is credibility built in peacetime.
Exam hook: DIME — Diplomatic, Informational, Economic, Military — is the set of domains the programme concluded must be coordinated under a whole-of-nation approach. Technology on the agenda: artificial intelligence, robotics and quantum computing.

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• Steel cutting for the second Next Generation Missile Vessel at Kochi

Body: Steel cutting of the second Next Generation Missile Vessel (NGMV) at Cochin Shipyard Limited, Kochi, on 17 September 2026. Chief Guest RAdm Kapil Mehta, Assistant Controller of Warship Production and Acquisition.

Detail: The project — six NGMVs, contracted with CSL in March 2023, order value about Rs 9,804 crore; displacement about 1,437 tonnes; high speed; waterjet propulsion. The first ship's steel was cut in December 2024, with first delivery expected March 2027. Armament and sensors: a surface-to-surface missile system, an anti-missile defence system, and air surveillance and fire control radars. The DAC accorded AoN in January 2023 for BrahMos launchers and fire control systems for NGMVs and Shivalik-class frigates.

Detail: The four stages, in order — steel cutting -> keel laying -> launch (named, enters water) -> commissioning (prefix INS, pennant number, enters service).

Detail: Role — offensive capability against enemy warships, merchantmen and land targets; maritime strike and anti-surface warfare; an instrument of sea denial, especially at choke points. Sea control means you can use the sea and the enemy cannot — expensive, needing carriers, destroyers, submarines and logistics. Sea denial means the enemy cannot use it even if you cannot either — cheaper, achieved with small fast missile craft, submarines, mines and shore-based missiles.

Detail: Why small works — cheap enough for numbers, hard to detect in coastal clutter, fast enough to strike and withdraw, and the missile does not care how big the launch platform is. Cost asymmetry between shooter and target is the whole idea.

Exam hook: Indian Ocean choke points — Strait of Hormuz, Strait of Malacca, Bab-el-Mandeb, Sunda and Lombok Straits, the Nine Degree Channel (Lakshadweep) and the Ten Degree Channel (Andaman and Nicobar). The five yards: Mazagon Dock (Mumbai, destroyers and submarines), GRSE (Kolkata, frigates and smaller combatants), Goa Shipyard, Hindustan Shipyard (Visakhapatnam) and Cochin Shipyard, builder of INS Vikrant.

• INS Trishul at Alexandria — and nineteen names at Chatby

Body: INS Trishul port call at Alexandria, Egypt, 14-17 September 2026, escorted into harbour by ENS Al Qadeer; Ambassador Shri Suresh K Reddy visited the ship; a PASSEX was conducted with ENS Bernees on departure. The Chatby War Memorial holds 12 burials and bears the names of 19 Indian soldiers who died in ships sunk in the Eastern Mediterranean in the two World Wars.

Detail: INS Trishul is a Talwar-class guided missile frigate — a modified Krivak III design built in Russia at Baltiysky Zavod, commissioned 25 June 2003 at St Petersburg. About 3,620 tonnes standard and 4,035 tonnes full load; 124.8 m long; about 30 knots. The Talwar class is closely associated with BrahMos in Indian service.

Detail: Ship hierarchy by size — patrol vessel -> corvette -> frigate -> destroyer -> cruiser -> aircraft carrier. A frigate is a general-purpose escort and patrol combatant; a destroyer is larger, with heavier air-defence and land-attack armament.

Detail: A PASSEX is a Passage Exercise — an unscheduled, short exercise between ships of two navies that happen to be in proximity, not a named annual bilateral exercise. With ENS Bernees it covered coordinated manoeuvring, communication exercises and approaches for replenishment at sea. Manoeuvring tests holding station with an unfamiliar ship; communications tests shared frequencies, procedures and vocabulary across two languages; replenishment approaches are the most demanding, two ships parallel and close for extended periods.

Detail: Why the Mediterranean matters to India — the Bab-el-Mandeb - Red Sea - Suez Canal - Mediterranean chain carries a large share of India-Europe trade, and the canal opens to the Mediterranean at Port Said.

Exam hook: India and Egypt were both founding movers of the Non-Aligned Movement. Historical hook: Indian troops fought in Egypt, Palestine and Mesopotamia in the First World War and across North Africa, including El Alamein, in the Second. Interoperability must exist before a contingency, not be created during one.

• SLINEX-26 — the 13th India-Sri Lanka maritime exercise

Body: SLINEX-26, the 13th edition of the Sri Lanka-India bilateral maritime exercise, at Visakhapatnam, 17 to 21 September 2026. Conceptualised in 2005. Harbour Phase under Eastern Naval Command. Participants — Indian Navy: INS Kavaratti (indigenous ASW corvette) and INS Jyoti (fleet tanker); Sri Lanka Navy: SLNS Sindurala.

Detail: Two phases — the Harbour Phase covers the opening ceremony and reception, professional interactions, cross-deck visits, sharing of best practices, yoga, sports and cultural activities. It settles frequencies, call signs, signals and procedures before the ships are at sea. The Sea Phase builds operational synergy and interoperability through coordinated activity at sea.

Detail: INS Kavaratti — the fourth and final Kamorta-class ASW corvette, Project 28, built by GRSE, Kolkata, commissioned 22 October 2020 at Visakhapatnam. About 109 m long, 14 m beam, 3,300 tonnes, up to 90 per cent indigenous content, with a carbon-composite superstructure for lower top weight, reduced maintenance and better stealth.

Detail: INS Jyoti is a fleet tanker. Replenishment at sea removes the fuel, water, food and ammunition constraint on endurance — without it a task group's radius is roughly half what it can travel on one tank. Sea legs are a logistics achievement, and cross-navy replenishment is among the most demanding things two fleets can practise.

Detail: Geography — Sri Lanka sits astride the lanes between the Arabian Sea and the Bay of Bengal, separated from India by the Gulf of Mannar and the Palk Strait, so activity around Sri Lanka is activity in India's immediate approaches. Thirteen editions matter because continuity produces officers who have worked together at successive ranks, refined procedures, and a relationship that survives changes of government.

Exam hook: Three categories of exercise — named bilateral: SLINEX (Sri Lanka), Varuna (France), Konkan (UK), SIMBEX (Singapore), Indra (Russia), AUSINDEX (Australia); named multilateral: Malabar (US, Japan, Australia), MILAN (multinational, hosted by India), AIKEYME (African navies); and PASSEX, short-notice and unnumbered.

• Suryakiran over Meerut — nine Hawks, five metres apart

Body: The Suryakiran Aerobatic Team (SKAT) displayed over Meerut for the first time on 19 and 20 September 2026 under the Seva Sankalp Abhiyan, following the team's 2026 training season. More than 1 lakh spectators including students, NCC cadets and NSS volunteers; Raksha Rajya Mantri Shri Sanjay Seth attended on 20 September. Three team members, including two display pilots, are from Meerut.

Detail: The team was established 1996. It is the only nine-aircraft aerobatic team in Asia and among few worldwide — most national teams fly six or seven. Over 800 displays in about 30 years, with international appearances in China, Sri Lanka, Myanmar, Thailand, Singapore, the UAE and Dubai. Known as the 'Ambassadors of the Indian Air Force'.

Detail: The aircraft are nine red-and-white Hawk Mk 132, licence-manufactured by HAL — the same type used for Stage III Advanced training, which is deliberate: using the trainer rather than a front-line fighter saves combat airframe hours. The indigenous smoke pods producing saffron, white and green trails were developed at the IAF's Base Repair Depot, Nashik — a maintenance establishment, not a design bureau. Aircraft fly less than five metres apart.

Detail: Manoeuvres include the loop, barrel roll, inverted flying and the signature DNA manoeuvre. The physics — a loop is a vertical circle, with centripetal acceleration towards the centre felt as positive g, and it must be entered fast enough or the aircraft stalls at the top. Inverted flight works because lift depends on angle of attack relative to airflow, not on attitude; it produces negative g, which is less tolerable than positive, hence short passes.

Detail: g-tolerance — high positive g pulls blood to the lower body, causing greying, tunnel vision and eventually G-LOC, managed by anti-g straining and conditioning. In formation flying, pilots fly visual references against the leader's aircraft, not the horizon: only the leader flies the manoeuvre and everyone else flies the leader. Wingtip vortices and wake turbulence constrain which formation geometries are flyable. **Exam hook:** Display teams exist for recruitment, public connection and professional flying standards, against a real cost in airframe hours, fuel and instructor time. The IAF pipeline in order: PC-7 Mk II basic, HJT-16 Kiran (HJT-36 Yashas replacing) intermediate, Hawk Mk 132 advanced.

• Wave-like heat transport in TiCu_5Se_3 — a zT of about 1.7 from JNCASR

Body: Researchers at JNCASR, Bengaluru (autonomous under DST) reported an unusual **wave-like thermal transport** regime in **thallium copper selenide**, TiCu_5Se_3 , reaching a thermoelectric figure of merit **zT of about 1.7** — among the highest for a pristine ternary chalcogenide. Published in *Science Advances*. Team: **Prof. Kanishka Biswas** with **Sayantoni Choudhury** and **Dr. Animesh Bhui**; theory with **Prof. Umesh V. Waghmare** and **Dr. Prasad V. Matukumilli**.

Detail: The effects — **Seebeck**: a temperature difference produces a **voltage**. **Peltier** (the reverse): a current produces a **heat flow**. **Thomson**: heating or cooling along a single current-carrying conductor in a temperature gradient.

Detail: The figure of merit is $zT = S^2 \times \sigma \times T / \kappa$, with S the Seebeck coefficient, σ electrical conductivity, T absolute temperature and κ total thermal conductivity. You want **S and σ high, κ low**.

Detail: Why it is hard — in metals electrons carry both charge and heat, so σ and κ rise together (**Wiedemann-Franz law**). Only the **lattice** part of κ can be attacked independently.

Detail: **Phonons** are quantised lattice vibrations, the main heat carriers in a crystal. In a **crystal** the mean free path is far greater than interatomic distance, giving particle-like transport; in a **glass** it is about equal, suppressing propagation. This material keeps **crystalline order** but its localised, closely spaced modes give **wave-like coherence** and **ultralow lattice thermal conductivity** — produced by **confined** copper dynamics inside a **tetragonal, cloverleaf knot-like 3D framework with open channels along the c-axis**, avoiding the instability of **superionic** conductors and producing strong **anharmonicity**.

Exam hook: Applications are waste-heat recovery in **power plants, cement, steel, automobiles, data centres and battery thermal management**, plus **thermal barrier coatings and quantum technologies**. Thermoelectric generators have **no moving parts** — which is why they power deep-space missions.

• Hanle Dark Sky Reserve — the fourth Star Party at 4,500 metres

Body: Fourth HDSR Star Party, 7-12 September 2026, at the **Indian Astronomical Observatory, Hanle, Ladakh** — about **40 amateur astronomers and astrophotographers** from 12 States and UTs over **four nights**. Organised by **IIA, the Department of Wildlife Protection, UT Ladakh, BARC and TIFR**. The **Open Night on 10 September** drew over **1,200 visitors**.

Detail: The **Hanle Dark Sky Reserve** was notified by the **Government of Ladakh in December 2022** — **India's first**, about **1,073 sq km** around the observatory. Two aims: **reduce light pollution** for research and **promote astro-tourism** benefiting local communities. **25 HDSR Astronomy Ambassadors** — local villagers trained to run tours, supplied with telescopes by the Ladakh administration.

Detail: Why the site works — **altitude** about **4,500 m** (less atmosphere overhead), a **cold desert** in the Himalaya's **rain shadow** (low humidity, few clouds), **stable air** (good 'seeing'), and darkness. Light pollution's components are **skyglow, glare, light trespass and clutter**; upward light **scatters off air molecules and aerosols**, raising the background brightness against which faint objects must be detected.

Detail: The instruments — **Himalayan Chandra Telescope**, a **2 m** optical/infrared telescope **operated remotely from Hosakote near Bengaluru**; and **MACE, the Major Atmospheric Cherenkov Experiment** run by **BARC**, the **world's highest imaging atmospheric Cherenkov telescope**, for **very-high-energy gamma rays**. Also **HAGAR** and **GROWTH-India**. Proposed: an upgrade of the HCT to **3.7 m** and a **13.7-m National Large Optical-infrared Telescope**.

Detail: **Cherenkov radiation** — a charged particle moving **faster than light in a medium** (not in vacuum) emits a faint bluish flash, the optical analogue of a sonic boom. A gamma ray is absorbed by the atmosphere, so **MACE** images the **particle cascade's Cherenkov flash** instead: the atmosphere is part of the detector.

Exam hook: The institutional split — **IIA** is autonomous under the **Department of Science and Technology**; **BARC** and **TIFR** are under the **Department of Atomic Energy**.

• India's 51st Doppler Weather Radar at Sambalpur

Body: **India's 51st Doppler Weather Radar**, at **Sambalpur, Odisha**, inaugurated virtually on **17 September 2026** by **Dr Jitendra Singh**, MoS (IC) **Earth Sciences**, with Odisha CM **Shri Mohan Charan Majhi**. The network has grown from **14 radars in 2014 to 51 in 2026**, with about **40 more** planned under **Mission Mausam**, taking the total to roughly **81**. Odisha now has **three** — **Gopalpur, Paradip, Sambalpur** — with **Balasore, Puri and Bhubaneswar** in the pipeline.

Detail: The **Doppler effect** is the change in **observed frequency** due to **relative motion** between source and observer. In radar this yields **reflectivity** from return strength (how much rain) plus **radial velocity** from the frequency shift (how fast, toward or away).

Detail: Why velocity matters — adjacent inbound and outbound returns reveal **rotation**, a **mesocyclone**, plus **wind shear** and **gust fronts**. The limitation is that only the **radial** component is measured: wind exactly perpendicular to the beam gives **no shift**. **Dual-polarimetric** radars compare horizontal and vertical pulses to infer **shape** — flattened raindrops versus near-spherical hail versus ice — separating **rain, hail and snow**.

Detail: Bands — **S-band about 400 km** (least attenuation, best for cyclones), **C-band about 250 km** (general purpose), **X-band about 100 km** (highest resolution, attenuates fastest, for urban and hilly nowcasting). **Longer wavelength means longer reach**. Supporting layers: **Automatic Weather Stations and rain gauges** for surface ground truth, **radiosondes** for balloon-borne **vertical profiles**, and **microwave radiometers**, which are **passive**.

Detail: **Mission Mausam** sits with the Ministry of **Earth Sciences**, executed through the **IMD**. The **IMD** was established **1875**, marked its **150th anniversary** in 2025, and is the **RSMC** for tropical cyclones over the **North Indian Ocean** under the **WMO** — it issues advisories and **names cyclones** for the basin, and supports **13 neighbouring countries** under 'Neighbour First'.

Exam hook: The limitation worth stating — radar is **line-of-sight**, so Earth curvature means long-range beams overshoot low-level rain, and terrain casts permanent shadows in hills. That is why the radar count matters more than radar range.

• Ayush wires AI to old texts — retrieval-augmented generation on Ayush Grid

Body: **19 September 2026, Ministry of Ayush** — an AI programme built on **Ayush Grid**, the Ministry's digital backbone.

Detail: **RAG — Retrieval-Augmented Generation** — the system **retrieves** relevant passages from a defined corpus **first**, then **generates** an answer **grounded** in them. The gains are **grounding** (less fabrication), **traceability** (the answer can be cited) and **currency without retraining** (refresh the index, not the model). A **hallucination** is a language model producing a **fluent and confident but false** answer from its parameters — and fluency, not hesitancy, is what makes it dangerous.

Detail: The showcase — '**AI-driven Decision Support for Ayurveda: A Retrieval-Augmented Generation (RAG) Approach**', featured in the **AI Impact Casebook on Health** developed with the **World Health Organization**, at the **IndiaAI Impact Summit 2026**.

Detail: Six assistants — **MAISP Chatbot** (citizen information), **ARP Research Assistant** (Ayush Research Portal), **eLMS Chatbot** (student life-cycle management), **e-CHARAK Chatbot** (medicinal-plant trade), **Yoga Saarthi** (yoga recommendation) and **Nivesh Saarthi** (investment facilitation).

Detail: The language layer — collaboration with **IndiaAI** and the **Digital India Bhashini Division, MeitY**; Ayush Grid portals now in the **22 scheduled languages**, those in the **Eighth Schedule**; Ministry artefacts placed on **AI Kosh**. Models perform worse on **low-resource languages** where digitised text is scarce, which is why Bhashini and AI Kosh focus on **data creation**, not just model training.

Exam hook: The international frame is the **WHO, ITU and WIPO** technical brief of **11 July 2025**, '*Mapping the Application of Artificial Intelligence in Traditional Medicine*' — the three agencies mapping to **health, technology standards and intellectual property**. The tension worth stating: AI can make existing knowledge **easier to find and apply**, or it can lend **unearned authority** to efficacy claims the evidence does not support.