

Defence (7)

• 92 Soldiers at Chaubatia, and a Desert Army in the Himalaya

Body: Exercise: MOUNTAIN GUARDIAN 2026, India–UAE joint military exercise. 5 to 18 October 2026 at the Foreign Training Node, Chaubatia, Uttarakhand. Focus — mountain warfare.

Strength: 92 personnel, equal representation from both armies. India from a Bhairav Battalion; UAE from a Mountain Infantry Battalion. Women officers and combatants from both armies in specialist roles.

Aim: interoperability, mutual understanding and cooperation; exchange of tactics, techniques and procedures.

Activities: joint planning, tactical drills, firing practices, surveillance grids, drone operations, physical endurance, rock climbing, obstacle training, integrated field exercises.

Bhairav battalions: announced by COAS General Upendra Dwivedi on Kargil Vijay Diwas, 26 July 2025. About 250 soldiers each; light commando units for rapid strikes and quick border deployment, intended to create shock effect, not deep strategic operations. Five reported operational by October 2025, up to 25 planned by early 2026; first public appearance at the Army Day parade, Jaipur, 15 January 2026.

The 26 July 2025 package: Rudra all-arms brigades · Bhairav light commando battalions · Shaktibaan artillery regiments with drones and loitering munitions · Divyastra surveillance and loitering-munition batteries.

Three commando tiers: Ghatak platoon (within an infantry battalion) → Bhairav battalion (formation-level, near the border) → Para (Special Forces) (strategic, deep).

Foreign Training Node: a dedicated facility for hosting foreign contingents, so exercises do not divert operational formations or open sensitive areas. Chaubatia is in Almora district, Kumaon, Uttarakhand — real mountain terrain without the sensitivity of a forward area.

Why the UAE: the Hajar range on its eastern edge rises above 1,500 m and it maintains mountain infantry; mountain skill is expeditionary currency; and India has the world's deepest high-altitude operational experience.

The inversion worth noting: in mountain warfare India is the instructor, not the learner — a form of defence diplomacy that cannot be sanctioned and outlasts equipment contracts.

The India–UAE army series: Desert Cyclone I, 1–15 January 2024, Rajasthan, sub-conventional operations including FIBUA in desert/semi-desert, with a joint surveillance centre, cordon and search, domination of built-up areas and heliborne operations → Desert Cyclone II, concluded in Abu Dhabi → Mountain Guardian 2026, a new exercise in a new terrain. Desert plus mountain is the full span of India's own terrain problem.

Relationship frame: Comprehensive Strategic Partnership (2017), CEPA (2022), bilateral trade past \$100 billion. The defence leg is the newest.

Why mountain drones are a separate skill: thinner air cuts rotor lift, so payload and endurance fall with altitude; valley winds gust unpredictably; satellite navigation degrades in deep valleys.

Exam hook: Why a surveillance grid is hard in mountains: ridgelines break line of sight and every fold of ground creates dead space, so sensors must be sited so their blind spots do not coincide.

• 16,000 Feet to 13,700, and 500 Feet to Open a Canopy

Body: Event, 6 October 2026: DRDO conducted the maiden live jump of the Advanced High-Altitude Parachute (AHAP) at Nyoma (Mudh DZ), one of the highest-altitude drop zones.

The three altitudes: jump at 16,000 ft AMSL; canopy deployed at 15,500 ft; landing at 13,700 ft. That is 500 ft of fall before deployment and 1,800 ft of descent under canopy.

System: a static line parachute for the mass drop of paratroopers.

Multiple deployment modes; operational altitude range up to 18,000 ft; designed for the safest rate of descent in high-altitude terrain.

The four organisations: designed and developed by ADRDE, Agra; manufactured by Ordnance Parachute Factory (OPF), Kanpur; inspected by DGAQA; certified by CEMILAC through RCMA Kanpur. No body certifies its own work.

Rate of descent: a canopy descends where drag equals weight, and drag is proportional to air density. At 16,000 ft air is roughly 60% as dense as at sea level, so the same canopy and load descend faster — harder landings, on rock and scree.

Opening shock: at a given indicated airspeed, true airspeed is higher in thin air, so the canopy inflates against a faster airstream and the peak deceleration load on fabric, lines, harness and jumper is greater.

Why the two conflict: more canopy area reduces rate of descent but increases opening shock. The design has to slow inflation without preventing the canopy from opening within 500 ft.

Static line vs free fall: a static line is clipped to the aircraft and opens the canopy automatically at a fixed distance below the door — no ripcord, no judgement — which is how a stick of paratroopers exits in seconds and lands together. **Military free fall (HALO** — high altitude, low opening; **HAHO** — high altitude, high opening) uses individual jumpers with oxygen and altimeters for small special-forces teams. AHAP is a formation system, not a special-forces one.

Why Nyoma matters: eastern Ladakh. Few roads, seasonal passes, slow construction — so airborne and air-landed reinforcement is one of the few ways to move a formation quickly in that theatre.

ADRDE's domain: aerodynamic decelerators and lighter-than-air systems. On the same day it flew an indigenous High-Altitude Platform — a lighter-than-air stratospheric surveillance airship — to 21 km, holding 20 km for over 30 minutes before recovery.

Why indigenisation matters here: a parachute is a consumable with a service life and a jump limit, so it needs a standing supply chain rather than a one-time purchase.

Exam hook: Statements: Raksha Mantri Shri Rajnath Singh; Defence Secretary and Chairman, DRDO, Shri Rajesh Kumar Singh.

• 44,000 Tonnes of Fuel and Spares, and the Slipway Built to Hold Them

Body: Event, 6 October 2026: Raksha Mantri **Shri Rajnath Singh** at Hindustan Shipyard Limited (HSL), Visakhapatnam — launched FSS-1 'Surya', laid the keel of FSS-5, and inaugurated the upgraded Slipway-4 and a 300-tonne Goliath Crane. Launch honours by **Smt. Laila Swaminathan**, President, Navy Wives Wellness Association. **CNS Admiral Krishna Swaminathan** attended.

Programme: CCS approval **16 August 2023**; contract of about **Rs 19,000 crore** signed with HSL on **25 August 2023** for 5 Fleet Support Ships of about **44,000 tonnes** each — the first of their kind built in India by an Indian shipyard. First delivery in **4 years**, then one about every **10 months**. About **168.8 lakh mandays** of employment over 8 years.

Slipway-4: extended and strengthened to build and launch ships up to **45,000 DWT** — which is what makes a 44,000-tonne hull possible.

300-tonne Goliath Crane: spans **Slipways 3 and 4**; designed and made by **L&T Geostucture with Konecranes** under Make in India; PLC controls, variable frequency drives, **tandem lifting**, remote diagnostics, condition monitoring. Enables **block construction**.

Block construction: hull sections pre-fabricated and pre-outfitted in covered shops, then lifted and welded. **Crane capacity is the binding constraint on block size**; bigger blocks mean fewer joins and less time on the slipway.

Replenishment at Sea (RAS): fuel, aviation fuel, fresh water, lubricants, ammunition, provisions and spares transferred between ships **under way** — abeam by hose and jackstay, **astern** by trailed hose, and by **vertical replenishment** using helicopters.

Why it is strategic: without a support ship a task group's radius is set by its **thirstiest ship**, forcing a return to port or a foreign-port refuelling that needs **diplomatic permission**. With one, endurance is set by the tanker — the difference between **surging** and **sustaining presence**.

FSS features: enhanced **cargo and fluid capacity** (multiple grades carried separately); **first-line maintenance workshops** for repairs at sea;

helicopter deck for Multi-Role Helicopter operations; **self-defence systems** — a support ship is the highest-value, least-defended unit in a group and a priority target.

Launch ≠ commissioning: launch puts the hull in the water; then **fitting out** → **harbour acceptance trials** → **sea acceptance trials** → delivery and **commissioning**. Delivery of FSS-1 is expected around 2027. The five milestones are **steel-cutting, keel-laying, launch, delivery, commissioning**.

Precedent: India has operated fleet replenishment ships for decades; **INS Jyoti**, commissioned **1996**, is reported as due for decommissioning later this decade.

HSL: 'Jala Usha', the first ship built in independent India, launched at Visakhapatnam in **1948**. HSL attained **Miniratna Category-I** in **2025** after coming under the **Ministry of Defence** — which confers **delegated financial powers** for investment, the practical basis for the slipway and crane.

Exam hook: Minister's priorities: timely delivery as organisational culture; learning from global yards; indigenous design capability; **self-reliance as a milestone, global competitiveness as the next leap**; **Visakhapatnam as a maritime industrial hub** with MSMEs, universities and startups.

• 3 Days a Quarter, and the Range a Startup Could Never Book

Body: Decision, 7 October 2026: Raksha Mantri **Shri Rajnath Singh** approved a revised **Standard Operating Procedure for Utilisation of MoD Proof Ranges, Field Firing Ranges and Test Facilities by Indian Defence Industry**.

Five provisions: (1) proof and testing **charges waived** for **iDEX, TDF, Make** and other MoD developmental projects; (2) the SOP **lists** facilities held by **DRDO, Government Quality Assurance agencies** and the **three Services**; (3) calculation and payment procedure for charges incorporated, with formats; (4) **Arbitration** replaced by a **Conciliation Agreement Clause**; (5) a **three-day slot per quarter** reserved at proof ranges.

The operative clause: the reserved slot covers government-sponsored projects and projects on the **industry's own initiative**. A range's calendar is dominated by Service user trials and DRDO programmes, so "available when free" means never — reserving capacity converts a permission into a date.

Its limit: three days a quarter is **12 days a year** for the entire reserved category.

Why a proof range cannot be private: square kilometres of hazard-cleared land, a ground danger area, an airspace safety template, chronographs, tracking radar, high-speed cameras and pressure instrumentation — beyond any single firm, and idle most of the year.

The three waiver channels: **iDEX** (Innovations for Defence Excellence — startups and MSMEs, executed via the **Defence Innovation Organisation**, SPARK grants); **TDF (Technology Development Fund**, DRDO-administered, funds Indian industry); **Make (Make-I** government-funded, **Make-II** industry-funded, under the **Defence Acquisition Procedure**).

Why the waiver is well targeted: it raises the **effective value of a grant without increasing the grant**, and can only be used by a firm that already has something to test.

Arbitration vs conciliation: **arbitration** under the Arbitration and Conciliation Act, 1996, gives a **binding award** through an adversarial, expensive process. **Conciliation**, under **Part III** of the same Act, is a **facilitated settlement**, and a settlement agreement has the same status and effect as an arbitral award on agreed terms — a remedy a small firm can actually afford.

Why the catalogue matters: facilities sit with three different kinds of owner, with no common entry point, so a published list converts a search into a process.

The chain downstream: proof and test data → inspection by quality-assurance directorates → military airworthiness certification → order. Range access is the first link.

Defence Testing Infrastructure Scheme (DTIS): launched **8 May 2020**, **Rs 400 crore, 5 years, 6–8 greenfield** facilities. Up to **75% Grant-in-Aid**, remaining 25% from an **SPV** of Indian private entities and State governments, mainly in **Defence Industrial Corridors**. **7 approved** — **4 in Tamil Nadu, 3 in Uttar Pradesh** — in UAS, electronic warfare, electro-optics, communications, mechanical and materials, and ammunition.

Exam hook: Learn them as a pair: **DTIS builds new shared facilities with private capital**; the revised SOP opens the existing government ranges. An SPV can build a vibration table or an EMI cell; it cannot build a proof range.

• 94 Years From 4 Wapitis, and a Chief Who Said Human Authority Stays

Body: Event: the IAF marked its **94th anniversary** on **8 October 2026** at **Air Force Station Hindan, Ghaziabad**. Parade reviewed by the **Chief of the Air Staff, Air Chief Marshal AP Singh**; **COAS** and **CNS** among the guests; parade commanded by **Gp Capt Manish Sharma**. **Theme:** 'Indian Air Force: Infallible, Impervious and Precise' (■■■■■, ■■■■■■ ■ ■■■■■).

Ceremonial: marching-in of the **President's Colours**; aerial salute by **three Mi-17 1V helicopters** in '**Dhwaj**' formation; **investiture ceremony**; **Team Shakti**, the all-women Air Warrior Drill Team; **IAF Drummers Team** of 33; **IAF Heritage Flight** with a vintage **Tiger Moth**. Further aerial display at **Namo Ghat, Varanasi, 25 October 2026**.

Five Unit Citations: **24 Squadron 'The Hawks'**, **110 Helicopter Unit 'The Vanguards'**, **200 Squadron 'Skanda'**, **2402 Squadron 'Vajra'**, **Electronic Warfare Range**.

Currency note: the Government announced on **6 October 2026** the appointment of **Air Marshal Ashutosh Dixit** as Chief of the Air Staff; the 94th anniversary parade was reviewed by the incumbent, **Air Chief Marshal AP Singh**.

History: raised **8 October 1932** under the **Indian Air Force Act, 1932**, as an **RAF auxiliary**. **First flight 1 April 1933** at **Drigh Road, Karachi** — **four Westland Wapiti IIA**, six **RAF-trained officers**, nineteen ***Havai Sepoys***; date chosen to match the **RAF's own founding date**. '**Royal**' prefix granted by **King George VI** in **March 1945**; **dropped January 1950** on India becoming a republic. **First President's Colour** from **Dr Rajendra Prasad** at **Palam, 1 April 1954**.

Doctrinal statement 1 — **autonomy: AI and autonomous systems** to be integrated "**while keeping human authority at the core**." This is a position on **meaningful human control** in the debate on **lethal autonomous weapon systems**, and it accepts a slower detection-to-engagement cycle in exchange for accountability.

Doctrinal statement 2 — **the display: one-way attack unmanned aerial systems** exhibited alongside fighters, helicopters, **surface-to-air and surface-to-surface guided weapon systems** and radars. "**One-way attack UAS**" is the official term for a **loitering munition**. It changes the economics of striking: a fraction of a missile's cost, and nothing irreplaceable risked.

Readiness over inventory: "true strength is measured by **operational preparedness** — how quickly and confidently it can act." A statement about **generation rate and serviceability**, not squadron numbers.

Operation Sindoor cited as evidence of swift transition into combat operations and of effective **air defence operations**.

Other commitments: "**Atmanirbharta is our guiding principle**", with **Make in India** emphasis in the display; **joint planning and integrated combat application** with the Army and Navy described as a **daily activity**. **Exam hook:** **Space claim:** "**Space is a natural extension of air domain**", with **ISRO** and domestic space-industry collaboration and a role in **Gaganyaan**. Note the open question — India also has a tri-service **Defence Space Agency**, so whether space is an air-force extension or a joint function is unsettled.

• Why a KG School Counts as Naval Infrastructure

Body: What: **CDS General N.S. Raja Subramani** (also **Secretary, Department of Military Affairs**) inaugurated **Project Seabird Phase IIA** accommodation and trunk infrastructure at **Naval Base Karwar** on **8 October 2026**, with **VAdm Vivek Dahiya, Director General Seabird**. **Inaugurated:** **60** dwelling units for senior sailors (married) + **60** for naval defence civilians at **East of Manzil Creek** and **Amadalli**, in-living accommodation for **156 Defence Security Corps** personnel, a **KG school**; built by **NCC Ltd** (buildings) and **Cemindia Projects** (trunk infrastructure).

Phase IIA purpose: basing of **ships and submarines**; scope includes a **dual-use Naval Air Station**, a **full-fledged Naval Dockyard** and logistics facilities; base to hold about **10,000** uniformed and civilian personnel with families; **IGBC Gold** on completion; over **90%** domestic sourcing.

Why Karwar: deep, near-even depth, minimal **dredging and siltation**; hilly forested terrain for concealment; sheltered from cyclones; land for **dispersal**; near the **Gulf–East Asia** shipping route. Rejected: **Mumbai** (congestion, overlooking buildings, shallow water), **Visakhapatnam** (insufficient depth, awkward approach bend), **Kochi** (no room).

Origin: conceived in the early 1980s by **Admiral O.S. Dawson**, **CNS**, after the Western Fleet's exposure in congested **Mumbai harbour** in 1971.

Timeline: sanctioned **1985**; foundation stone **PM Rajiv Gandhi, 24 October 1986** (estimate **Rs 1,760 crore**); shelved; revived **1990, 1995**; approved **1999** after **Pokhran-II** by Defence Minister **George Fernandes**; construction from **October 1999**.

INS Kadamba: commissioned **31 May 2005** — **third** operational naval base after **Mumbai and Visakhapatnam**, and India's **first dedicated** naval base.

Phase I: completed **2011**, reported **Rs 2,629 crore**; about **11,200 acres** over **26 km** of coast; jetty ~**420 m × 185 m** for up to **11 frontline warships** including a carrier plus **10 yardcraft**; **10,000-tonne shiplift**; **INHS Patanjali**.

Phase IIA: MoD approval **May 2012**, **CCS clearance 6 December 2012**; reported at **Rs 13,500 crore**, later reported near **Rs 19,600 crore**; environmental clearance **June 2014**; planned **32 ships and submarines** + **23 yardcraft**, **6+ km** berthing, four covered dry berths, a **2,700 m** runway. **Exam hook:** **Exam hook:** fleets deliver **ship-days at sea**, not hulls. Basing and refit capacity set availability — which is why quarters, water, sewerage and a school are load-bearing military infrastructure.

• 60,000 Leave Every Year, Most of Them in Their 30s

Body: What: Vice-President **C. P. Radhakrishnan** visited the **Sainya Sampark Mela – Sadaiv Aapke Saath** at **Deoghar, Jharkhand**, on **10 October 2026**, organised by the **Indian Army** with the **Deoghar District Administration** for **ex-servicemen, Veer Naris** and dependents of the **Santhal Pargana** region.

DESW: **Department of Ex-Servicemen Welfare**, created **2004**, under the **Ministry of Defence**; nodal for veterans and pensioners; covers **welfare, resettlement and rehabilitation**.

KSB: **Kendriya Sainik Board**, the apex policy body; secretariat an attached office of **DESW**; **President = Raksha Mantri**, **Vice President = Raksha Rajya Mantri**, Secretary **KSB**, and **46 members** under the composition notified in **March 2023**.

Tiers: designations changed in 1975 to **Kendriya Sainik Board** (Centre), **Rajya Sainik Board** (State) and **Zila Sainik Board** (district); reported network about **34 RSBs** and **407 ZSBs**.

Cost sharing: establishment expenditure of **RSBs** and **ZSBs** shared Centre:State at **75:25** for special category States/UTs and **60:40** for the rest.

DGR: **Directorate General Resettlement**, an **inter-service organisation** under **DESW** — resettlement training, placement, self-employment.

Funds: **Armed Forces Flag Day Fund (AFFDF)** and **Raksha Mantri Ex-Servicemen Welfare Fund (RMEWF)**; health cover through **ECHS**.

Scale: about **60,000** personnel retire or are released every year, at a comparatively young age; registered ex-servicemen reported in Parliament at about **27.8 lakh** (estimates vary with definition).

Distribution: **Punjab, Haryana and Himachal Pradesh** together account for roughly a **quarter** of India's ex-servicemen on about **4.5%** of its area.

Veer Nari: the widow of a soldier — the hardest category, since the entitlement passes to someone who was not the service member and often lacks the records.

Exam hook: **Exam hook:** the military is the only large Indian employer that releases most of its people mid-career, which is why **resettlement** is a Directorate General and not an HR function. Under **Agnipath**, four-year engagements with up to **25%** retention will raise the outflow of much younger, non-pensioned leavers.

• **60 Years of Uranium, and a Dark Matter Lab 815 Metres Down**

Body: UCIL: Uranium Corporation of India Limited, a PSU under the **Department of Atomic Energy**, incorporated **4 October 1967**; headquartered at **Jaduguda**, East Singhbhum, Jharkhand. **Diamond Jubilee Year** marked **4 October 2026**.

People: Ms Seema Jain, Member-Finance, **Atomic Energy Commission** (Chief Guest); **Dr Ajit Kumar Mohanty**, Secretary DAE and Chairman AEC; **Dr Kacham Anand Rao**, CMD, UCIL.

Announced detail: the **Dark Matter Laboratory** of the **Saha Institute of Nuclear Physics** is proposed to move to the **815-metre level** of the **Jaduguda mine**; she also visited the **Technology Demonstration Pilot Plant** at **Jaduguda**.

Fuel-cycle division of labour: **AMD** explores → **UCIL** mines and mills to **yellowcake** → **NFC Hyderabad** converts and fabricates fuel → **NPCIL** operates reactors → **BARC** does R&D.

Mines: **6 underground** — **Jaduguda**, **Bhatin**, **Narwapahar**, **Turamdih**, **Bagjata**, **Mohuldih** — and **1 open pit**, **Banduhurang** (India's first opencast uranium mine, **June 2007**), all in the **Singhbhum Shear Zone**, Jharkhand; plus **Tummalapalle**, Andhra Pradesh. **Jaduguda, 1967** — India's first uranium mine. **Turamdih** commissioned **2003**.

Processing: plants at **Jaduguda** and **Turamdih** produce **magnesium diuranate**; **Tummalapalle** produces **sodium diuranate**. Both are yellowcake.

Tummalapalle: ore grade about **0.04% U₃O₈**, roughly half **Jaduguda's**. Uses **alkaline pressure leaching with sodium carbonate** because the **dolomitic limestone** host rock would consume acid. Commissioned **2012**.

Why grades matter: Indian uranium runs **0.03-0.06% U₃O₈** — very low — while India holds among the world's largest **thorium** reserves in **monazite** beach sands. The **three-stage programme** (PHWRs on natural uranium → **fast breeders** on plutonium → **thorium-U233 breeders**) is therefore a **resource-endowment strategy**, not only a technological vision.

JUSL: **Jaduguda Underground Science Laboratory**, a refurbished **37 sq m** cavern at the **-555 m** level, inaugurated **September 2017**, run by **SINP**.

Mine depth about **905 m** — India's **second-deepest operating underground mine** after **Hutti** gold mine, Karnataka (over 1,000 m).

Why depth: the dominant background for rare-event searches is the **cosmic-ray muon**, whose flux falls steeply with overburden. Underground depth is quoted in **metres water equivalent (m.w.e.)** to allow comparison across rock densities.

The irony: uranium and thorium in the host rock emit gammas and, via (α, n) reactions and spontaneous fission, **neutrons** — the worst dark-matter background, since a neutron recoil mimics the signal. Background fluxes at **JUSL** have been measured and published.

Context: the **India-based Neutrino Observatory** at **Bodi West Hills, Theni**, Tamil Nadu, has faced prolonged delays; an operating mine supplies overburden, shaft, hoisting and ventilation already built.

Occupational and environmental: **radon** is the miner's hazard, controlled by **ventilation**; **tailings** retain most of the ore's radioactivity (thorium-230, radium-226 and their radon) and need permanent engineered impoundment. Regulator — **Atomic Energy Regulatory Board**.

Law: uranium is a **prescribed substance** under the **Atomic Energy Act, 1962**, and atomic-mineral prospecting and mining are **reserved to government entities**. The **MMDR Amendment of 2023** delisted **6 of 12** atomic minerals in **Part B of the First Schedule** — **lithium, beryllium, titanium, niobium, tantalum, zirconium** bearing minerals — opening them to private bidding, while **uranium and thorium remained reserved**.

Exam hook: **The real constraint:** uranium projects in **Telangana, Karnataka** and **Meghalaya** have stalled on local consent rather than geology or finance.

• **96% of Platinum, Built From Carbon, Nitrogen and Sulfur**

Body: **Reported 7 October 2026** by the **Department of Science and Technology**: a **metal-free catalyst** for the **oxygen reduction reaction (ORR)**, named **TTT-DHTD**, reaching about **96%** of commercial platinum performance and stable over **120 hours** of continuous operation. Published in **Science Advances**.

Institutions: **S.N. Bose National Centre for Basic Sciences (SNBNCBS)**, **Kolkata** and the **Institute of Nano Science and Technology (INST)**, **Mohali** — both **DST** institutes — with **SRM University, Amaravati**.

Researchers: **Dr Pradip Pachfule** (SNBNCBS), **Prof. Ramendra Sundar Dey** (INST), **Prof. Ranjit Thapa** (SRM University, Amaravati).

The material: a porous organic framework from the linkers **TTT** (2,4,6-tris(4-aminophenyl)-1,3,5-triazine) and **DHTD**. Built only from **carbon, sulfur, nitrogen and hydrogen**; an ultra-porous **honeycomb-like** network.

Why the ORR matters: it is the **slow step** in both **hydrogen fuel cells** and **metal-air batteries**, and **platinum** is the incumbent catalyst — scarce and expensive, which is the barrier to large-scale deployment.

The catalysis principle: a catalyst must bind oxygen **neither too strongly nor too weakly**. Too weak and it does not attach; too strong and the product never leaves, so the site stays blocked. Platinum sits near the optimum.

How a metal-free catalyst works: heteroatom doping — nitrogen and sulfur in the carbon framework redistribute electron density, creating sites with the right oxygen affinity. **Computational simulations identified which sites and why**, making the result designable rather than accidental.

Covalent organic framework (COF): a crystalline polymer of rigid organic blocks joined by **covalent** bonds into a periodic porous lattice. Gives **enormous internal surface area** (more active sites per gram) and **ordered uniform pores** (reactants reach sites, products leave). **Distinguish from a MOF**, which joins linkers at **metal nodes** — a COF has no metal in the framework.

Zinc-air batteries: zinc is abundant, cheap and relatively safe; oxygen is drawn **from the air**, so no active cathode material is carried. Versus **Li-ion** — higher theoretical energy density, lower material cost, better safety, greater sustainability. Versus **hydrogen fuel cells** — simpler and more compact, with no high-pressure storage or hydrogen infrastructure. **Both rely on the same oxygen electrochemistry**.

Open problems in zinc-air: rechargeability, cycle life and **ORR kinetics**. The catalyst addresses the third; the first two turn largely on the **zinc electrode** on repeated cycling and on an alkaline electrolyte exposed to atmospheric **carbon dioxide**.

ORR vs electrolysis: electrolysis **splits water**, driving oxygen **evolution**; the ORR **consumes oxygen** at a cathode to release energy. Reversed reaction, different catalyst requirement.

Read the figures honestly: **96%** at near-zero platinum cost is an excellent trade, but **120 hours** is **5 days** against a commercial requirement of thousands of hours and thousands of cycles. A **research-stage** result.

Exam hook: Strategic significance: platinum is a **platinum-group metal**; India has negligible PGM resources and global supply is concentrated. Designing the metal **out** of the device is more durable than securing access to it — **you cannot be denied a material you do not use**. India is also a significant **zinc** producer.

• 10% of the Patents, Not 10% of the Network

Body: Event, 8 October 2026: the 3rd International Bharat 6G Symposium 2026, organised by the Bharat 6G Alliance (B6GA) at Yashobhoomi, Dwarka, inaugurated by Communications Minister Shri Jyotiraditya M. Scindia. Held alongside India Mobile Congress 2026. **The target:** at least 10% of global 6G patents and standards, announced by MoS Dr Chandra Sekhar Pemmasani, with operators asked for measurable annual and quarterly targets on contributions to standards, SEPs and university research.

Standard-essential patent (SEP): a patent that cannot be avoided by anyone implementing a standard — compliance is infringement. Must be licensed on FRAND terms (fair, reasonable and non-discriminatory). Cellular standards are written principally in 3GPP.

Why SEPs decide the money: SEP share determines whether a country pays royalties on every device or receives them. India in 4G and 5G was a large market with a small SEP share — an indigenous 4G stack but few essential patents.

Why "patents and standards" together: a patent nobody needs is worthless; a standard you shaped without holding patents in it earns nothing. The value is at the intersection, and contributions are how a patent becomes essential.

Five new MoUs: GSMA, one6G Association, GTI Alliance Ltd, 6G Industry Forum (6GIF), VoICE. Added to 10 global and 2 domestic existing collaborations — 17 in all.

Nine white papers, including Integrated Sensing and Communication (ISAC), Fixed Wireless Access, optical technologies, IMT spectrum readiness to 2030, sustainable 6G, cellular-WiFi synergy, Captive Non-Public Networks (CNPN), and security for 6G.

New Delhi Declaration: endorsed at the 2025 Symposium; frames 6G as secure, resilient, open, interoperable, inclusive and sustainable. First annual progress report released, October 2026.

ISAC explained: the same radio signals that carry data are used to detect and locate objects from their reflections — a base station becomes a low-grade radar. Dual-use, with tracking and privacy implications, and a dense network becomes a distributed sensing grid.

CNPN explained: a private cellular network for a single enterprise or campus — a factory, port, mine or military installation — independent of a public operator's core.

Import-substitution priority: identify 10–20 critical network technologies now imported and build Indian alternatives in component manufacturing, chipsets, radios, routers and optical systems. India has an indigenous 4G stack (software and core) but an imported hardware layer — software sovereignty without silicon sovereignty.

Research base: 136 R&D projects, about Rs 500 crore, under the Telecom Technology Development Fund (TTDF) — 5G, 6G, quantum communications, non-terrestrial networks, advanced optical systems, indigenous core, telecom security. Plus 5G testbeds in academic institutions.

Deployment status cited: more than a billion people connected; every district covered by 5G through almost 5.6 lakh Base Transceiver Stations (BTS); villages on 4G; most rules under the Telecommunications Act, 2023 notified, aiming at a simpler, technology-neutral framework; BharatNet and 4G saturation continuing.

Quantum instruction: C-DOT to begin real operator trials — quantum-safe encryption on critical links and QKD where economically justified — "rather than leaving these technologies in research laboratories."

Exam hook: Other priorities: move from AI-assisted to AI-native networks; national, equipment and supply-chain security, fraud prevention, protection of critical telecom infrastructure. Framing — "The last decade was Digital India. Our goal is to make the next decade an Intelligent India."*

• The Number on Your Screen Was Never Verified

Body: What: At the ITU Roundtable on Implementing ITU Standards to Combat Fraudulent Communications, alongside IMC 2026 at Yashobhoomi (inaugurated by the PM on 8 October 2026), MoS Communications Dr Chandra Sekhar Pemmasani welcomed the ITU proposal for joint trials of digital caller identity verification across international networks.

India's proposed method: trials between willing countries on selected international routes, spanning different network technologies, with lessons fed back into the standards.

The underlying flaw: the calling party number is asserted by the originating network and trusted downstream; there is no cryptographic binding between a number and the right to use it.

The comparison to know: STIR/SHAKEN — STIR (IETF) defines the identity token, SHAKEN defines carrier deployment; the signature travels in SIP signalling.

Attestation levels: full (my customer, my number), partial (my customer, not their number), gateway (I know only which network handed me the call) — gateway attestation is the international gateway case, and the reason national frameworks stop at the border.

Why the ITU: globally interoperable telecom standards are agreed between national administrations there; regional frameworks create islands of trust.

India's five layers: real-time blocking of spoofed international calls; ASTR (C-DOT's AI tool) for fraudulent connections; Sanchar Saathi for citizen reporting; the Digital Intelligence Platform for intelligence sharing; measures for emerging channels.

Figures cited: over 82 lakh connections disconnected via ASTR; Sanchar Saathi app ~25 million downloads; DIP connects 1,600+ organisations; Financial Fraud Risk Indicator prevented suspected losses over Rs 5,000 crore in 15 months; losses to such fraud put at over Rs 22,800 crore in 2024.

The honest limit: verification proves the number is authorised, not that the caller is honest — it defeats impersonation, which is the opening move of digital-arrest and fake-official frauds.

Exam hook: trust must be a property of the protocol, not an overlay. Retrofitting identity onto legacy signalling is why this needs a decade of international coordination.

