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GOVERNMENT OF INDIA
इलेक्ट्रॉनिकी और सूचना प्रौद्योगिकी मंत्रालय
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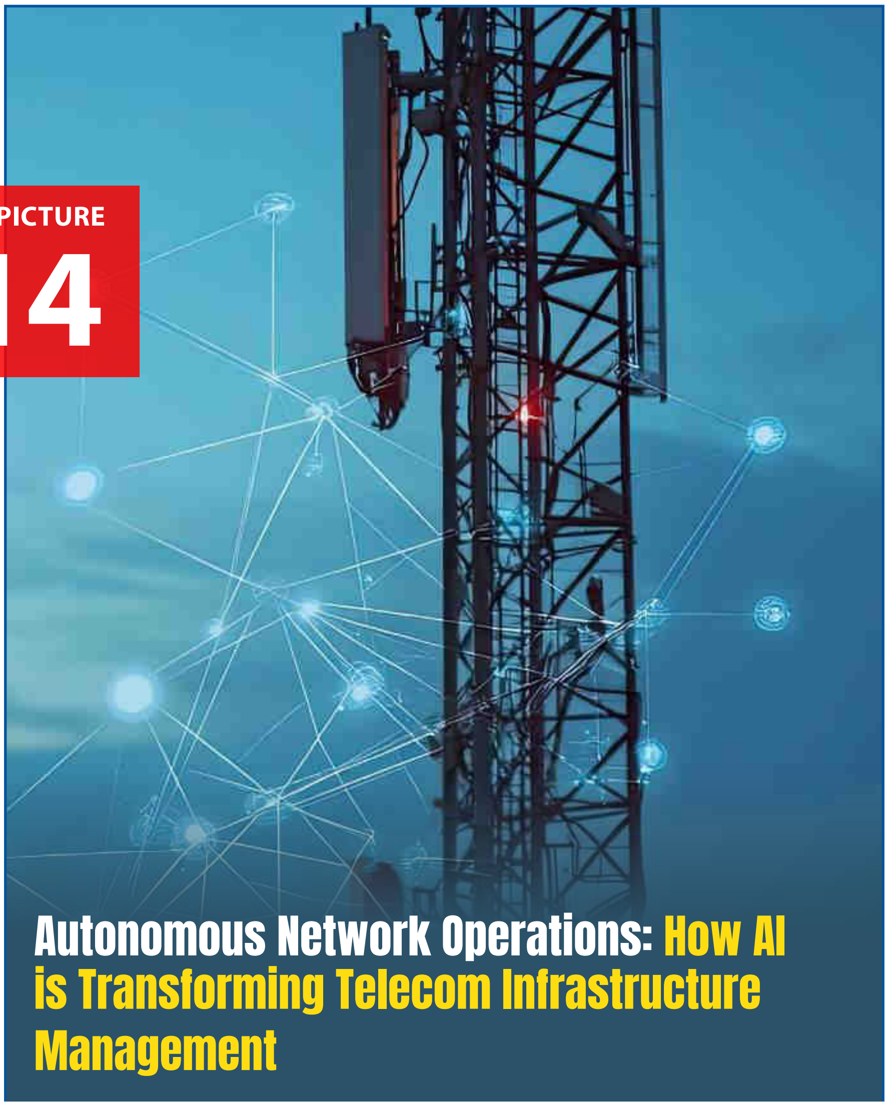

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EDITOR'S NOTE

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BISinfotech

Dear Readers,

Welcome to the August edition of BISinfotech.

The global transition towards clean energy is no longer an aspiration—it is a necessity. As nations strive to balance economic growth with environmental responsibility, technology is emerging as the driving force behind a more sustainable future. From renewable power generation and energy storage to advanced electronics and intelligent power management, innovation is redefining how the world produces, distributes, and consumes energy.

Our cover story, **"Powering the Clean Energy Transition: From Solar Fields to Nuclear Fusion,"** explores this remarkable journey. While solar and wind energy continue to expand at an unprecedented pace, emerging technologies such as green hydrogen, next-generation batteries, and nuclear fusion are opening new possibilities for meeting the world's growing energy demands. Together, they represent a future where clean, reliable, and affordable energy becomes the foundation of economic progress.

This edition also highlights the critical role of the **electronics and semiconductor industry** in enabling this transformation. Efficient **power devices, advanced sensors, intelligent automation,** and reliable **electronic systems** are making renewable energy solutions more accessible and effective. As industries embrace electrification and digital technologies, collaboration between innovators, manufacturers, policymakers, and researchers will be essential to building resilient and sustainable energy ecosystems.

India, too, is making significant strides in this direction. With ambitious renewable energy targets, expanding domestic manufacturing, and continued investments in innovation, the country is strengthening its position as a key contributor to the global clean energy movement.

At BISinfotech, we remain committed to bringing you meaningful industry insights and perspectives that inspire innovation and informed decision-making. We hope this edition offers valuable knowledge and a deeper appreciation of the technologies shaping a cleaner and more sustainable tomorrow.

Happy Reading!

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STRUGGLING WITH OBSOLESCENCE OR SUPPLY CHAIN DISRUPTIONS?

Rochester Electronics provides semiconductor lifecycle solutions that go beyond authorized distribution. As a licensed semiconductor manufacturer, Rochester has manufactured over 20,000 device types and holds over 12 billion die in stock, enabling continued manufacturing support for over 70,000 device types. For over 40 years, Rochester has supported companies facing obsolescence, EOL, and supply chain challenges.

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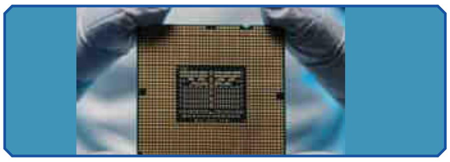
Samsung, Broadcom Partner to Advance AI Semiconductor Manufacturing Globally

Samsung Electronics has partnered with U.S.-based chip designer Broadcom in a strategic semiconductor alliance expected to exceed $200 billion by 2030. The collaboration will focus on memory chips, foundry services, advanced semiconductor packaging, and custom AI chips. Broadcom will secure production capacity at Samsung's advanced fabrication facilities, helping improve utilization while strengthening Samsung's position against rivals in the AI hardware market. The partnership combines Broadcom's expertise in application-specific integrated circuits (ASICs) with Samsung's advanced manufacturing technologies, including sub-2nm process nodes. The companies will also develop next-generation communication chips and high-bandwidth memory (HBM) solutions for AI workloads and data centers.

India's Electronics Manufacturing Surges with Record Production and Exports

India's electronics manufacturing sector has expanded significantly over the past decade, with production rising from ₹1.90 lakh crore in FY2014-15 to ₹13.11 lakh crore in FY2025-26, according to MeitY. Electronics exports also climbed from ₹38,263 crore to ₹4.24 lakh crore, while mobile phone production reached ₹6.27 lakh crore, making India the world's second-largest mobile phone producer. Mobile phone exports surged to ₹2.60 lakh crore, becoming the country's top export commodity in FY2025-26. Government initiatives such as Make in India, the Production Linked Incentive (PLI) scheme, supportive FDI policies, and stronger domestic supply chains have driven this growth. The sector has generated over 25 lakh direct and indirect jobs, including nearly 12 lakh in the mobile phone value chain.

UAE Plans Major Investments Across Gujarat's Strategic Growth Sectors



The UAE plans to expand investments in Gujarat across energy, semiconductors, food security, and logistics, reinforcing its growing economic partnership with India. During recent bilateral discussions, UAE representatives identified Gujarat as a preferred investment destination due to its strong industrial ecosystem, world-class ports, and investor-friendly policies. Planned initiatives include developing food parks, cold chain infrastructure, and agricultural export hubs to strengthen food supply chains between India and the Gulf. In the energy sector, both sides will collaborate on solar, wind, and green hydrogen projects while enhancing cooperation in conventional energy. The UAE is also exploring investments in Gujarat's semiconductor ecosystem, including Dholera and Sanand, focusing on chip manufacturing, assembly.

Goldman Sachs Sees Strong Growth for India Auto Components

Goldman Sachs expects India's auto component and precision engineering industry to grow at a 10% CAGR between FY2026 and FY2030, driven by diversification into high-value sectors. Industry revenue is projected to rise from $85.6 billion in FY26 to $124.4 billion by FY30, while EBITDA is forecast to grow at 15% annually, supported by higher-margin precision components. Indian manufacturers are expanding beyond traditional automotive markets into semiconductors, aerospace, defense, electric vehicles, and data centers, reducing dependence on cyclical vehicle demand. Global supply chain diversification is encouraging international firms to source advanced engineering products from India, prompting domestic companies to invest in modern tooling.

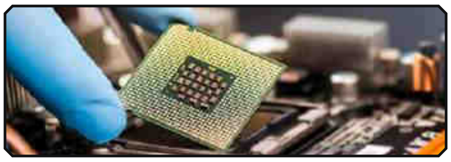
Karnataka Accelerates Semiconductor and Defense Manufacturing Growth Plans

Karnataka is strengthening its position as a hub for semiconductors, advanced manufacturing, and defense electronics through major investments and new industrial policies. Speaking at a defense technology conference, Industries Minister M. B. Patil announced that Phase I of the KWIN City Semiconductor Park will feature a 200-acre dedicated chip manufacturing and design zone, expected to be completed by year-end. Over the past two years, the state has approved more than ₹23,000 crore in semiconductor and ESDM investments, led by Lam Research (₹15,901 crore), Applied Materials India (₹4,851 crore), and Bharat Semi Systems (₹2,342 crore). Karnataka is also preparing its Aerospace and Defense Policy 2026–2031, focusing on electronic warfare systems, embedded software, e-VTOL aircraft.

Michigan Scientists Develop Laser Controlled Semiconductor Electron Flow Technology

Researchers at the University of Michigan have developed a breakthrough technique that controls electron flow in semiconductors using only laser light, eliminating the need for an external electrical power source. Created at the Lurie Nanofabrication Facility, the innovation uses two different laser wavelengths to direct electrons into a focused beam by adjusting the light's polarization. Unlike conventional electronics, which rely on electric fields, the new approach exploits quantum interference, where multiple light absorption pathways reinforce electron movement in a chosen direction while suppressing it elsewhere. The technology could transform data transmission within electronic and photonic devices, enabling faster and more efficient signal processing with greater information density.

Seoul Semiconductor Explores India Manufacturing Amid State Investment Competition



South Korea's Seoul Semiconductor is exploring the establishment of its first manufacturing facility in India and is currently in discussions with multiple state governments to finalize a suitable location. Tamil Nadu, Karnataka, and Gujarat have emerged as the leading contenders, offering strong electronics ecosystems, skilled talent, and semiconductor-focused infrastructure. The proposed investment aligns with India's push to strengthen domestic electronics manufacturing under the India Semiconductor Mission (ISM) 2.0, which supports the broader semiconductor supply chain beyond chip fabrication. Seoul Semiconductor is expected to evaluate government incentives alongside factors such as land availability, power and water supply, vendor ecosystems, and export logistics before making a decision.

India Approves Semicon 2.0 to Boost Advanced Chip Manufacturing

The Indian government has approved Semicon 2.0, a ₹1.27 lakh crore ($14 billion) initiative to strengthen the country's semiconductor ecosystem over six years beginning FY2026-27. The program expands beyond chip fabrication to support advanced semiconductor manufacturing, display production, memory chips, compound semiconductors, and packaging technologies. Under the scheme, companies establishing silicon fabrication plants will receive up to 40% capital support, while compound semiconductor projects using Silicon Carbide (SiC) and Gallium Nitride (GaN) will receive up to 35% funding. The government will also provide 35% support for advanced OSAT packaging facilities and 25% for conventional packaging units. A key feature of Semicon 2.0 is an equity co-investment model.

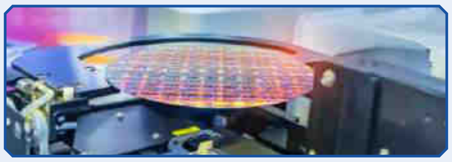
India Launches NIDAR 2.0 to Advance Indigenous Drone Technology

The Ministry of Electronics and Information Technology (MeitY), in partnership with the Drone Federation of India (DFI), has launched NIDAR 2.0 (2026-27) under the SwaYaan programme to accelerate indigenous drone and semiconductor development. The national innovation challenge aims to enable students, researchers, startups, and professionals to design drones and flight controllers powered by India's VEGA processor. Aligned with Atmanirbhar Bharat, the India Semiconductor Mission, and the Design Linked Incentive (DLI) scheme, the initiative seeks to reduce reliance on imported drone technologies. Participants will tackle advanced challenges, including autonomous drone swarms for disaster relief and GPS-denied drones for industrial inspections.

India Refines ISM 2.0 to Strengthen Domestic Chip Ecosystem

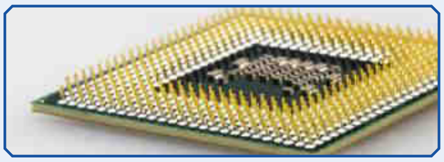
The Indian government is reshaping its India Semiconductor Mission (ISM) 2.0, backed by a ₹1.27 lakh crore budget, by prioritizing domestic chip design and ecosystem development over subsidies for technology transfers and land acquisition. Under the revised strategy, the Centre will no longer financially support the cost of acquiring semiconductor manufacturing technology or purchasing land for fabrication plants. Instead, state governments are expected to provide land incentives, while central funding will focus on chip design firms and allied industries supplying chemicals, gases, equipment, and raw materials. The policy aims to strengthen domestic value addition and build a self-reliant semiconductor supply chain. ISM 1.0 laid the foundation by attracting 12 semiconductor fabrication and packaging projects, including Tata's Gujarat fab.

Tata Electronics Delays Advanced Chip Production, Revises Manufacturing Strategy



Tata Electronics has revised its semiconductor manufacturing roadmap, opting to begin production with 90nm and 55nm chips instead of the initially planned 28nm process, delaying commercial operations at its Dholera fabrication plant to mid-2028. The company said mature process nodes are less complex to manufacture, enabling workforce training, equipment calibration, and higher production yields before advancing to smaller geometries. These legacy chips remain widely used in automotive electronics, industrial equipment, power management systems, and sensors. The project is being developed with technology support from Powerchip Semiconductor Manufacturing Corporation (PSMC) of Taiwan. Despite the delay, the Indian government continues to back the sector.

NextGO Epi Raises €2 Million for Gallium Oxide Innovation



Berlin-based semiconductor startup NextGO Epi has secured €2 million in pre-seed funding to accelerate the commercialization of its gallium oxide epitaxial wafer technology. The funding round was led by Vireo Ventures, with participation from Ultratech Capital Partners, IBB Ventures, and angel investor Boris Habets. A 2025 spin-off from the Leibniz Institute for Crystal Growth (IKZ), NextGO Epi is currently Europe's only industrial-scale producer of gallium oxide epitaxial wafers up to four inches. The company claims gallium oxide offers up to 10 times greater power efficiency, six times higher voltage density, and manufacturing costs up to 75% lower than silicon carbide. Initially targeting the electric vehicle sector, the technology could reduce EV charging times from around 60 minutes to just 10 minutes while improving energy efficiency. The investment will support product development, talent acquisition and production expansion.

Arm Expands Arteris Partnership to Strengthen Chip Security Design

Arm has expanded its partnership with Arteris to strengthen hardware cybersecurity by integrating Cycuity Radix across a broader range of next-generation processor designs. The security assurance platform enables engineers to identify, analyze, and mitigate hardware vulnerabilities during the CPU design phase, reducing the need for costly post-production fixes. Following a successful pilot deployment, Arm will use the technology to conduct architectural risk assessments, threat modeling, define security objectives, and automate verification throughout processor development. Cycuity Radix also allows security testing frameworks to be reused across multiple chip programs, improving scalability and consistency. The collaboration reflects the semiconductor industry's growing focus on security by design as processors become increasingly critical for artificial intelligence.

Cabinet Approves Semicon 2.0 to Strengthen India's Chip Ecosystem

The Union Cabinet, chaired by Prime Minister Narendra Modi, has approved Semicon 2.0 with a ₹1.27 lakh crore outlay to accelerate India's semiconductor design and manufacturing ecosystem. The initiative is built on six pillars—chip design, semiconductor machines and materials, additional fabrication plants, advanced ATMP/OSAT facilities, research and development, and talent development. The scheme aims to strengthen India's position in semiconductor IP, incentivize manufacturing of critical materials and equipment, attract new silicon and compound semiconductor fabs, and promote advanced packaging technologies. It will also expand R&D for advanced process nodes and enhance industry-focused training. Under ISM 1.0, India has already approved 12 semiconductor manufacturing projects worth over ₹1.64 lakh crore.

Submer Invests $2 Billion in Madhya Pradesh Semiconductor Infrastructure

Spain-based Submer Group has announced a $2 billion (approximately ₹19,000 crore) investment in Madhya Pradesh to strengthen India's semiconductor infrastructure and advanced cooling technology ecosystem. The project is expected to generate around 5,000 direct jobs for engineers, technicians, and skilled professionals, while creating significant indirect employment opportunities. A global leader in immersion cooling solutions for data centers and high-performance computing, Submer's investment will support energy-efficient cooling technologies essential for semiconductor manufacturing and AI-driven computing systems. The company's entry highlights Madhya Pradesh's growing appeal as a destination for high-tech manufacturing, supported by strategic location, industrial infrastructure, and investor-friendly policies.

Mitsubishi Eyes West Bengal for Proposed Semiconductor Fab Investment

Japan's Mitsubishi Corporation has expressed interest in establishing a semiconductor fabrication plant in West Bengal, with Durgapur and Panagarh under consideration as potential locations. According to State Industry, Commerce and Enterprises Minister Tapas Roy, company representatives have initiated preliminary discussions with the state government and are expected to return later this month for site visits and further negotiations. If finalized, the project would mark a significant step in West Bengal's efforts to emerge as a destination for high-tech manufacturing. The proposed investment aligns with India's broader semiconductor expansion, as states compete to attract global chipmakers through infrastructure, policy support, and skilled talent. Beyond chip fabrication, such a facility could generate opportunities.

Thailand Unveils Strategy to Become Regional Semiconductor and AI Hub

Thailand has launched a long-term strategy to transform itself from an electronics assembly base into a regional hub for semiconductors and AI hardware. Building on its position as one of the world's leading exporters of AI-related hardware, the country aims to attract high-value investments, strengthen technology transfer, and create skilled employment. The plan focuses on expanding semiconductor infrastructure, developing energy-intensive facilities such as fabs and data centers, upskilling the workforce, and boosting research and innovation. Thailand's semiconductor roadmap targets over Bt2.5 trillion in investments by 2050 and the training of more than 230,000 skilled professionals. Priority sectors include power semiconductors, sensors, photonics, analog chips, integrated circuit design, and semiconductor assembly and testing. Supported by its strong automotive.

Vaishnaw Urges IT Industry to Lead Semiconductor Talent Growth

Union Minister Ashwini Vaishnaw has urged India's IT industry to capitalize on the global semiconductor talent shortage, projected to reach one million professionals, by strengthening the country's chip design and manufacturing capabilities. Addressing industry leaders, he said India's expertise in software and engineering positions it to become a global supplier of semiconductor talent. The minister highlighted that 12 semiconductor plants are under development, with three already in production and exporting chips to the US, Japan, and Europe. To support the growing ecosystem, the government has equipped 315 higher education institutions with advanced semiconductor design tools and partnered with NASSCOM to introduce AI-focused curricula. Vaishnaw also encouraged IT firms to transition toward an "AI as a Service" model, integrating software with semiconductor technologies.

India Emerges Preferred Destination for Rising European Manufacturing Investments

India has emerged as the leading destination for European Union (EU) greenfield manufacturing investments among emerging markets, according to a UNCTAD analysis. The report highlights a sharp rise in European investments as companies diversify supply chains beyond China under the "China+1" strategy. Between 2021 and 2025, India attracted 35% of the total value of the EU's outward greenfield investments in the materials and industrial manufacturing sectors. The country's share of EU greenfield investments also increased by 26 percentage points compared with the 2015–2019 period, marking the highest growth among all major investment destinations. The trend is supported by India's Production Linked Incentive (PLI) schemes, expanding logistics infrastructure, and ongoing negotiations for an India-EU Free Trade Agreement (FTA).

Modi Inaugurates CG Semi OSAT Facility in Gujarat's Sanand

Prime Minister Narendra Modi inaugurated CG Semi's OSAT (Outsourced Semiconductor Assembly and Test) facility in Sanand, Gujarat, marking a major milestone in India's semiconductor journey. The event was attended by Union Minister Ashwini Vaishnaw and Gujarat Chief Minister Bhupendra Patel. Built with an investment of over ₹7,500 crore, the plant is India's third semiconductor manufacturing facility and is expected to produce 200 million semiconductor chips annually in its initial phase, with plans to scale production to 5 billion chips per year. Addressing the gathering, the Prime Minister said the facility would strengthen India's semiconductor ecosystem, support the Make in India initiative, and accelerate the vision of Viksit Bharat. He also highlighted Sanand's emergence as a global semiconductor hub, praised the factory's diverse workforce.

Infineon Opens Smart Power Fab to Expand Semiconductor Capacity

Infineon Technologies AG has inaugurated its Smart Power Fab in Dresden, Germany, several months ahead of schedule following a €5 billion investment, the largest in the company's history. The facility doubles Infineon's manufacturing capacity in Dresden, creating the world's largest factory for power semiconductors and analog/mixed-signal technologies, while generating 1,000 direct jobs. The digitally enabled fab uses AI, digital twin technology, and a "One Virtual Fab" connection with Infineon's Villach site to accelerate production and process qualification. Chips produced at the facility will support AI data centers, software-defined vehicles, renewable energy systems, and industrial applications. The plant also strengthens Germany's and Europe's semiconductor supply chains and technological sovereignty. Designed with sustainability in mind, the fab eliminates natural gas use.

AGIBOT Unveils European Expansion with Humanoid Robot and RaaS

AGIBOT has launched its European Growth Roadmap at the UK AGIBOT Partner Conference (APC) 2026 in London, marking its expansion into Europe's embodied AI and robotics market. The company introduced the AGIBOT A3 humanoid robot, featuring a lightweight 55 kg magnesium-titanium frame, 10-hour battery life, and a 10-second battery swap system. Designed for education, hospitality, retail, and customer engagement, the robot supports multimodal interaction, shoulder touch sensing, and Ultra-Wideband (UWB) positioning for coordinated multi-robot operations. AGIBOT also unveiled its Robot-as-a-Service (RaaS) model in the UK, offering hardware, AI software, maintenance, and technical support through a subscription-based approach. The company has already deployed its robots at a Smart City retail site in Milton Keynes.

IIT Gandhinagar Launches SAMARTH to Build Semiconductor Talent Pipeline

IIT Gandhinagar will establish the SAMARTH (Silicon and Advanced Semiconductor Manufacturing Research and Training Hub) with an investment of ₹190 crore to strengthen India's semiconductor workforce. Supported by the Ministry of Electronics and Information Technology (MeitY), the Department of Science and Technology, the Gujarat Government, and IIT Gandhinagar, the center aims to train 10,000 "fab-ready" professionals over the next five years. The program will cover students, technicians, faculty, industry professionals, and school participants through degree programs, certification courses, and summer schools. SAMARTH will feature advanced laboratories for nanofabrication, CMOS technologies, semiconductor device characterization, process modeling, and IC design, providing hands-on training aligned with industry requirements.

Canada Germany Strengthen Semiconductor Partnership for Secure AI Supply Chains

Canada and Germany have signed a Statement of Intent to strengthen cooperation on semiconductor supply chains, supporting the growing demand for artificial intelligence, high-performance computing, and digital technologies. The agreement was signed during the IEA Annual Global Conference on Energy Efficiency by Carlos Leitão, Parliamentary Secretary to Canada's Minister of Industry, and Stefan Rouenhoff, Parliamentary State Secretary at Germany's Federal Ministry for Economic Affairs and Energy. The partnership will focus on expanding semiconductor investments and manufacturing, advancing scientific and technological collaboration, and supporting startups and small businesses in the chip sector. It also aligns with Canada's National Artificial Intelligence Strategy and builds on recent bilateral initiatives, including the Canada-Germany Digital Alliance.

Powering the Clean Energy Transition: From Solar Fields to Nuclear Fusion

Gianfranco Di Marco
Marketing Director, STMicroelectronics

> *"ST's strategies around power electronics are closely aligned with India's semiconductor ambitions and net-zero targets, which are driving strong demand for more efficient power conversion across renewable generation and storage, grid infrastructure, industrial electrification."*

The global energy landscape is undergoing a radical shift, expanding from established solar and wind ecosystems toward high-energy frontier concepts like nuclear fusion. This evolution demands an unprecedented leap in power density, extreme thermal resilience, and real-time operational intelligence. To keep pace with these harsh environments, next-generation power electronics, wide-bandgap (WBG) semiconductors, advanced packaging, and edge computing have transitioned from incremental upgrades to essential architectural pillars of the modern grid.

In an exclusive cover story feature, **Gianfranco Di Marco**, Marketing Director at **STMicroelectronics**, and **Padma Reddy Sama**, Co-Founder of **BharathCloud**, shared their perspectives on how hardware innovation and digital infrastructure are converging to support this energy pivot.

Di Marco highlighted the pivotal role of Silicon Carbide (SiC) and Gallium Nitride (GaN) devices paired with advanced packaging, robust thermal interface materials (TIMs), and fast-acting edge AI to ensure zero-failure reliability under severe physical and thermal stress. Simultaneously, Padma Reddy Sama emphasized that India's energy transition relies as heavily on digital infrastructure as it does on generation capacity. He noted that integrating edge computing with AI-ready cloud architectures is essential for managing the exponential data streams from distributed renewable assets, enabling real-time grid balancing, fault detection, and predictive maintenance.

As initiatives like the India Semiconductor Mission accelerate local manufacturing momentum, the synergy between high-efficiency power semiconductors and intelligent, secure digital ecosystems will form the backbone of a future-ready, resilient clean-energy infrastructure.

Evolution of Demands from Solar Field Operations to Nuclear Fusion

Gianfranco Di Marco, Marketing Director, **STMicroelectronics**, said, "Moving from established renewable energy systems to applications such as nuclear fusion significantly increases the demands placed on power electronics. Higher power levels, faster switching, stricter EMC requirements and operation in challenging thermal conditions all require a different level of performance and robustness. SiC and GaN are clearly part of the answer, but advanced real-time control, fast protection mechanisms and close interaction between sensing, processing, and power conversion are also becoming increasingly important."

Long-Term Reliability of Next-Gen Interconnects in Harsh Environments

Gianfranco Di Marco, Marketing Director, **STMicroelectronics**, said, "The reliability of electrical interconnections in energy applications depends not just on the connectors themselves but on the robustness of the entire electrical and thermal path. These systems must withstand current, heat, mechanical vibration, and environmental stress over many years of operation.

ST develops advanced packaging and interconnect solutions designed to maintain stable electrical performance under high current density, thermal cycling and mechanical vibration. Our power modules and interconnect structures are engineered to optimize current flow and heat dissipation while minimizing losses and long-term degradation. Reliability is verified through extensive lifetime testing under cyclic and dynamic operating conditions. Consistent design, manufacturing and quality processes throughout the product lifecycle are essential to achieving the level of reliability these applications require."

Real-Time Intelligence via Embedded AI and Edge Computing for Smart Grids

Gianfranco Di Marco, Marketing Director, **STMicroelectronics**, said, "In many energy applications, decisions often need to be taken locally and in real time, especially when system operation and reliability are at stake. ST helps customers deploy edge AI directly on embedded devices for applications such as condition monitoring, anomaly detection, and predictive maintenance. By analyzing signals like current, temperature, vibration, and switching activity at the source, systems can detect early signs of degradation and act before issues become failures."

Padma Reddy Sama, Co-Founder, **BharathCloud** Shared, "India's energy transition is no longer only about adding renewable capacity; it is equally about building the digital infrastructure needed to manage that capacity intelligently. As power networks become more distributed with solar, wind, battery storage, and EV ecosystems, the volume of real-time data being generated is growing exponentially. Edge computing brings intelligence closer to where energy is generated and consumed, enabling faster grid balancing, predictive maintenance, fault detection, and more responsive operations."

He added, "At the same time, edge and cloud are not competing technologies; they complement each other. While edge enables real-time execution, cloud infrastructure provides the scale for AI, analytics, and long-term optimisation. As India moves towards a smarter and more resilient energy ecosystem, the convergence of edge computing, AI-ready cloud infrastructure, and cybersecurity will become fundamental. The future of smart energy will depend not only on how much power we generate, but on how effectively we manage it through intelligent digital infrastructure."

Advanced Thermal Management Innovations in Cooling High-Power Systems

Gianfranco Di Marco, Marketing Director, **STMicroelectronics**, said, "As the power density continues to increase, thermal dissipation becomes critical. At the device level, we concentrate on tangible solutions like improved substrates, optimized package designs and better thermal interface materials that provide better heat removal with lower thermal resistance to maintain cooler and more reliable and efficient power designs in a shrinking package."

Scaling Power Densities in the Future Roadmap of WBG Semiconductors

Gianfranco Di Marco, Marketing Director, **STMicroelectronics**, said, "At ST, we continue to support broader adoption of SiC and GaN through continued improvements to device performance and greater manufacturing capacity. Long-term reliability will remain a key determiner for the adoption of future energy infrastructures, so the route forward is to ensure efficiency, reliability, and predictable performance over the lifetime of any given system."

Aligning with India's Net-Zero Vision and the India Semiconductor Mission

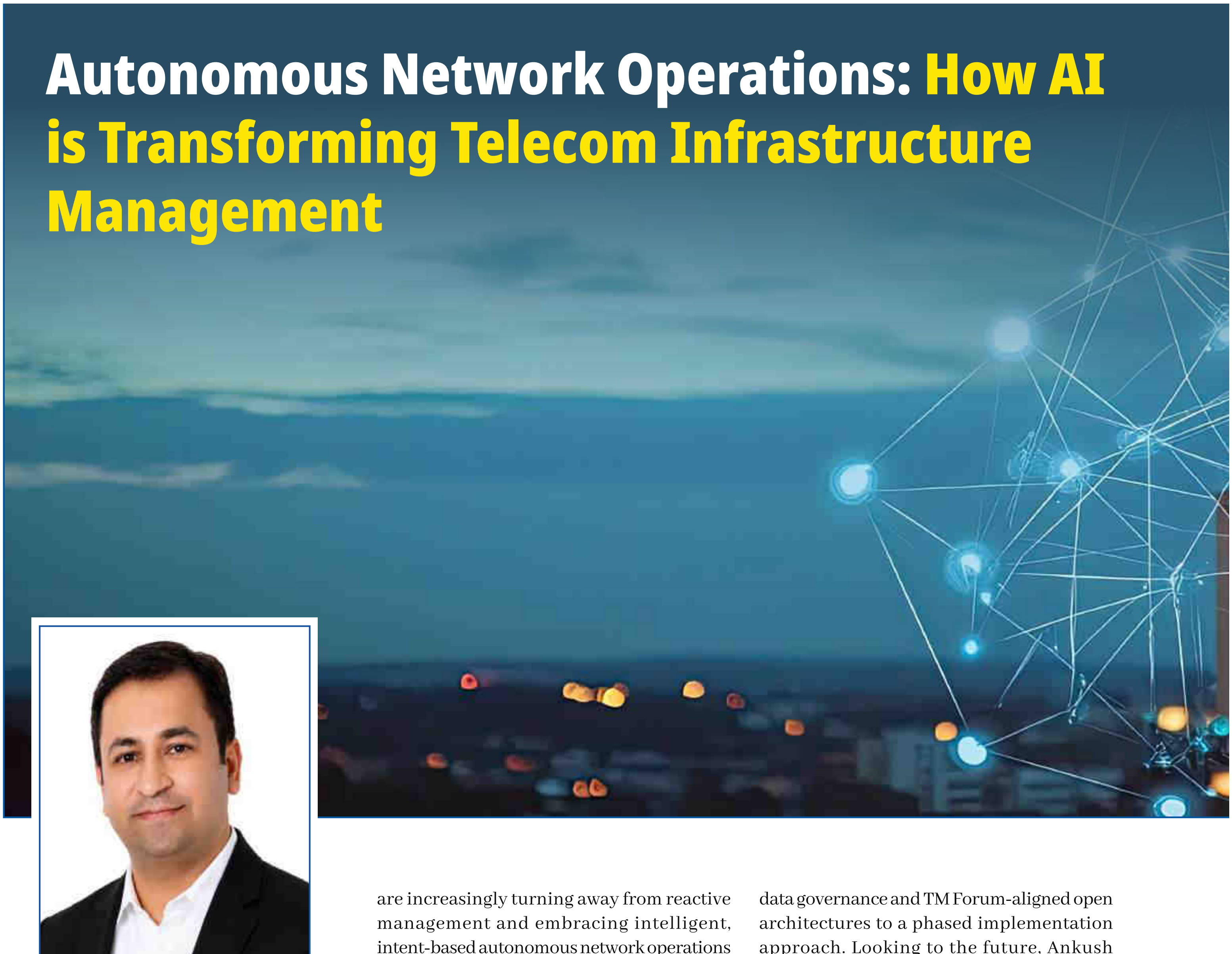
Gianfranco Di Marco, Marketing Director, **STMicroelectronics**, said, "India is one of the markets where we expect to see significant growth in the coming years, driven by energy transition and semiconductor investment.

ST's strategies around power electronics are closely aligned with India's semiconductor ambitions and net-zero targets, which are driving strong demand for more efficient power conversion across renewable generation and storage, grid infrastructure, industrial electrification. Our portfolio includes SiC, GaN, advanced power management solutions, and power modules that help improve efficiency, reduce energy losses, and increase system reliability."

Padma Reddy Sama
Co-Founder, BharathCloud

"India's energy transition is no longer only about adding renewable capacity; it is equally about building the digital infrastructure needed to manage that capacity intelligently."

Autonomous Network Operations: How AI is Transforming Telecom Infrastructure Management



Ankush Gupta
Telecom Industry Head, Tata Elxsi

As telecommunication networks evolve into complex, distributed ecosystems driven by 5G, edge computing, and cloud-native architectures, traditional manual operations are struggling to keep pace. The rising operational demands, combined with multi-vendor environments, call for a fundamental shift in how network infrastructure is monitored, managed, and optimized. To stay resilient, agile, and cost-effective, operators are increasingly turning away from reactive management and embracing intelligent, intent-based autonomous network operations powered by Artificial Intelligence (AI).

In a recent interaction with **Rashmi Verma**, **Ankush Gupta**, Telecom Industry Head at **Tata Elxsi**, discussed how AI-driven automation and unified observability are fundamentally reshaping modern network management. Highlighting the ongoing transformation of traditional Network Operations Centers (NOCs) into proactive, intelligent decision-making hubs, he explained how zero-touch provisioning, digital twins, and closed-loop automation drastically reduce Mean Time to Repair (MTTR) while delivering substantial OPEX and CAPEX savings.

He also addressed the critical considerations for scaling AI adoption—ranging from robust data governance and TM Forum-aligned open architectures to a phased implementation approach. Looking to the future, Ankush shared his vision for the next five years, emphasizing the pivotal role that emerging technologies like Agentic AI, knowledge graphs, and AI-powered network slicing will play in building fully self-optimizing, future-ready digital platforms.

As telecom networks become increasingly complex with the adoption of 5G, edge computing, and cloud-native architectures, what are the key operational challenges operators face today, and how can autonomous network operations help address them.

The telecom sector has been going through a real shift, as networks become more distributed, software-driven and spread across multiple

vendors. The fast rollout of 5G, cloud-native architectures and edge computing has added real operational complexity, and it's become harder for traditional, manually driven operations to keep up with environments that change this fast and at this scale.

Autonomous network operations tackle this by letting operators move from reacting to problems to catching them ahead of time. Bringing together AI, automation and intent-based orchestration, operators can keep an eye on network behaviour, catch anomalies early, automate root cause analysis, tune resources in real time, and trigger self-healing through closed-loop automation. The result isn't just better resilience and service availability, it also means operations teams can handle increasingly complex networks without it becoming unmanageable.

The business impact is equally significant. Industry experience shows that autonomous operations can deliver 20–40% savings in operational expenditure (OPEX), 10–20% reduction in CAPEX through automation, 10–25% lower energy consumption, and 40–70% faster Mean Time to Repair (MTTR) by simplifying day-two operations. As operators continue expanding standalone 5G, private networks and network slicing, autonomous network operations will become a strategic capability for delivering scalable, resilient and future-ready networks.

How is AI transforming traditional Network Operations Centers (NOCs), and what are the most significant advantages of moving toward autonomous network management?

The role of the Network Operations Center has changed significantly in the last two decades. At the beginning, NOCs were mainly set up to control alarms, handle incidents and work with specialized OSS and network management systems. With the development of telecom networks towards being more software-defined and cloud-native, operators started to use data from various systems leading to better visibility. Nowadays, the use of AI can help to further develop NOCs from monitoring centers to smart operational hubs.

Contemporary AI platforms conduct analysis of telemetry, network KPIs, logs, topological data and customer experience to spot any anomalies beforehand. Rather than just reacting to incidents, AI allows operators to foresee the failures, make the necessary recommendations and ensure the automation of network operations. The help of new technologies like Generative and Agentic AI enhances this feature of AI since they offer engineers assistance in troubleshooting, provision of operational advice and automation of their work.

The shift is from reactive management to predictive, increasingly autonomous operations. This means a drastic decrease in Mean Time to Detect (MTTD) and Mean Time to Repair (MTTR) that is important for improvements in service reliability. Ultimately, AI is transforming the NOC from a reactive monitoring centre into an intelligent decision-making hub. This enables operators to improve service reliability, optimise operational efficiency and free engineering teams to focus on innovation rather than repetitive operational tasks.

Could you elaborate on the role of AI-powered observability in enabling real-time network monitoring, predictive maintenance, and self-healing capabilities?

As telecom networks grow throughout radio access networks, transport, core, cloud, edge, and applications, operators are faced with enormous amounts of operational data. Not only is visibility limited through traditional monitoring tools across multiple domains, but it also makes identifying relationships among events or detecting problems challenging.

AI-powered observability addresses this challenge by providing a unified view across the entire network. By leveraging machine learning, it continuously correlates telemetry, KPIs, logs and service topology to detect anomalies, uncover hidden relationships and predict potential failures before they impact network performance. Anomalies can then be detected, and potential failures predicted. This becomes a part of predictive maintenance because it allows the operators to improve or replace infrastructure ahead of failure.

Thus, unified observability leads to improved network performance, decreased downtime, and better utilization of resources, which creates consistent customer experience. It has already been observed in the industry that operational efficiency has improved by 15-20% and MTTR has decreased by 40-70%.

At Tata Elxsi, we see unified observability as the foundation of autonomous network operations. Our Intent Based Autonomous Platform- NEURON platform brings together data from multiple network domains into a unified operational view, leveraging technologies such as knowledge graphs, digital twins and AI-driven intelligence to enable intelligent monitoring, analysis and automation. This helps operators progressively increase network autonomy while improving operational efficiency and service resilience.

With operators under pressure to optimize costs while maintaining service quality, how can zero-touch service provisioning contribute to greater operational efficiency and business agility?

Zero-touch service provisioning has become a key enabler of autonomous networks, as operators expand into services like private 5G, network slicing and cloud connectivity. The old way of doing this — manual processes stitched together across network domains and vendors — tends to mean higher costs, slower activation, and configuration errors that end up affecting service quality.

Intent-based orchestration, AI-driven validation, standardised APIs and automated workflows change that picture. Operators can provision services end-to-end with very little manual work, since they're no longer configuring the network by hand — they define the outcome they want, and the platform translates that into network policies, allocates resources and activates the service.

The business case is hard to ignore. Deployments across the industry have shown 80–90% faster provisioning and 70–90% fewer configuration errors, which translates into better SLA compliance, faster service delivery and quicker time-to-market. As enterprise connectivity needs keep evolving, zero-touch provisioning will keep playing a central role in cutting complexity and improving operational efficiency and business agility.

What are the key considerations telecom operators should keep in mind when implementing AI-driven automation across their network infrastructure?

Implementing AI-driven automation requires far more than deploying AI models. It starts with building a strong operational foundation based on high-quality, standardised and real-time network data. AI systems are only as effective as the data they learn from, making unified data management and observability essential for successful automation.

The next priority is interoperability. As telecom networks operate across multi-vendor environments, operators should adopt open architectures, TM Forum-aligned standards, standardised APIs and multi-vendor orchestration to enable interoperability and scalable automation. A phased transformation approach, beginning with AI-assisted operations, progressing to closed-loop automation and gradually increasing network autonomy, helps organisations scale automation while reducing implementation risks.

Governance and security become equally important as AI takes on a larger operational role. AI-driven automation should incorporate explainable decision-making, human oversight for mission-critical operations and robust governance frameworks to ensure regulatory compliance and secure collaboration between autonomous systems. As operators expand AI adoption, data sovereignty and AI governance will also play a critical role in building trusted and resilient network operations.

Ultimately, AI initiatives should be aligned with measurable business outcomes such as improving customer experience, accelerating service delivery, reducing operational expenditure and strengthening network resilience. With the right data foundation, governance framework and transformation roadmap, AI becomes a strategic business enabler rather than just another operational tool.

Looking ahead, how do you envision autonomous network operations evolving over the next five years, and what emerging technologies will play a critical role in shaping the future of telecom infrastructure management?

Even at this stage, autonomous networks are still in the process of development. However, in the next five years, the sector will advance from isolated instances of automation to the creation of operational facilities that are fully guided by artificial intelligence and its goals. Consequently, we will see networks that can understand business objectives and make decisions on their own, while constantly improving their operation without the need for human involvement. The emphasis of operations will shift from automating operations to creating intelligent networks that could monitor, analyze, rectify, and optimize their performance.

To supercharge this process, several technologies will emerge and play especially important roles. Agentic AI will be a key driver of this transformation, enabling intelligent software agents to collaborate across planning, assurance, orchestration, optimisation and governance to automate increasingly complex operational processes. Alongside this, digital twins will allow operators to simulate network changes and validate deployments before implementation, while knowledge graphs, AI-powered observability and closed-loop automation will help understand service dependencies, correlate events and continuously optimise network performance.

Edge AI, cloud-native architectures, intent-based orchestration and open APIs will further accelerate autonomous operations as operators prepare advanced 5G and future 6G networks. AI-driven network slicing will evolve from manually configured services to intelligent, self-optimising services that can be dynamically managed based on business needs. Over the next five years, telecom networks will evolve from managed infrastructure into intelligent, self-optimising digital platforms. Operators that combine AI, unified observability, intent-based orchestration, digital twins and strong governance will be better positioned to build resilient and autonomous networks for the next generation of digital services.

Infineon Powers ADVANTICS Megawatt Charging Converter Platform

Infineon Technologies AG will supply its CoolSiC™ 1200 V MOSFETs and EiceDRIVER™ 2EDB9259Y dual-channel gate drivers to ADVANTICS for a new generation of liquid-cooled power converters. The collaboration aims to improve efficiency, power density, and reliability in megawatt charging systems (MCS), energy storage systems, and DC microgrids for data centers. The partnership supports the growing need for faster charging infrastructure for heavy-duty electric vehicles and vessels, enabling industries such as trucking, mining, and marine to accelerate their transition toward electrification. Megawatt charging systems can deliver charging speeds nearly ten times faster than conventional solutions, reducing downtime and improving operational efficiency. ADVANTICS' modular liquid-cooled platform is built around 100 kW power blocks, allowing systems to scale to the megawatt level.

Meta Readies Iris AI Chip for September Production

Meta Platforms is set to begin manufacturing its next-generation artificial intelligence (AI) chip, code-named Iris, in September as part of its strategy to strengthen AI infrastructure and reduce reliance on third-party chip suppliers. Designed under Meta's Meta Training and Inference Accelerator (MTIA) program, Iris will support AI workloads across platforms including Facebook and Instagram. According to an internal company memo, Iris is one of four generations of custom AI processors aimed at improving performance while lowering the cost of large-scale AI computing. The company also plans to expand its computing capacity to 14 gigawatts next year, reflecting the rapid growth of AI-driven services. Meta recently completed chip validation in just six weeks, with no major issues reported, marking significant progress in its in-house semiconductor development efforts.

CSL Acquires IoTM Solutions to Strengthen Global IoT Connectivity

CSL Group has acquired IoTM Solutions Ltd. to create a unified global platform for resilient, multi-carrier Internet of Things (IoT) connectivity and eSIM orchestration. The acquisition strengthens CSL's ability to support large-scale international IoT deployments by simplifying connectivity management across multiple operators and platforms. Founded in 2015, IoTM Solutions developed a cloud-native, vendor-agnostic platform that integrates fragmented connectivity management platforms (CMPs), carrier systems, and eSIM workflows into a single dashboard. The solution enables centralized SIM lifecycle management, eSIM profile updates, data usage monitoring, troubleshooting, and API access, significantly reducing deployment complexity. The platform currently manages over 30 million SIMs, supports more than one billion devices, integrates with over 20 CMPs and carrier platforms.

Powell Electronics Partners IOT Electronics to Expand African Presence

Powell Electronics, a global distributor of high-reliability connectors and electronic components, has partnered with IOT Electronics Ltd. to strengthen its presence across Southern Africa. The agreement will expand access to advanced interconnect solutions for industries including defense, aerospace, industrial manufacturing, healthcare, mining, telecommunications, and IoT. Through the partnership, IOT Electronics will distribute Powell's portfolio of high-performance components, enabling engineers, OEMs, and contract manufacturers to source globally recognized brands such as Amphenol, Bulgin, and Cinch Connectivity more efficiently. Customers will also benefit from technical support, design-in assistance, custom cable assembly services, and improved local inventory availability.

From Generative AI to Autonomous Intelligence– Building the Foundation for the Next Industrial Revolution

"Artificial Intelligence has learned to speak. The next challenge is teaching it to perceive, reason, and act in the physical world."

Abhinav Gupta
(B.Tech, M.Tech) AGM, Atlantis Robotics Pvt Ltd

Artificial Intelligence has learned to speak. The next challenge is teaching it to perceive, reason, and act in the physical world."

For decades, Artificial Intelligence (AI) has primarily existed in the digital realm—analyzing data, recommending products, recognizing speech, and more recently, generating text, images, and software code. The emergence of Generative AI has fundamentally changed how humans interact with computers, making AI more accessible and capable than ever before. Yet, despite these remarkable advances, one limitation has remained: AI has largely been confined to screens.

The next frontier is Physical AI—a new generation of intelligent systems capable of perceiving their surroundings, understanding context, making autonomous decisions, and interacting with the physical world in real time. Rather than simply responding to prompts, Physical AI empowers machines to sense, reason, and act.

From autonomous mobile robots navigating warehouses and robotic arms performing precision manufacturing to drones inspecting critical infrastructure and AI-powered healthcare systems assisting clinicians, Physical AI is bridging the gap between digital intelligence and real-world execution.

This evolution is not driven by a single breakthrough. It is the convergence of advances in edge computing, robotics, computer vision, embedded systems, intelligent sensors, and foundation AI models. Together, these technologies are redefining how industries operate and creating a future where intelligent machines collaborate seamlessly with humans.

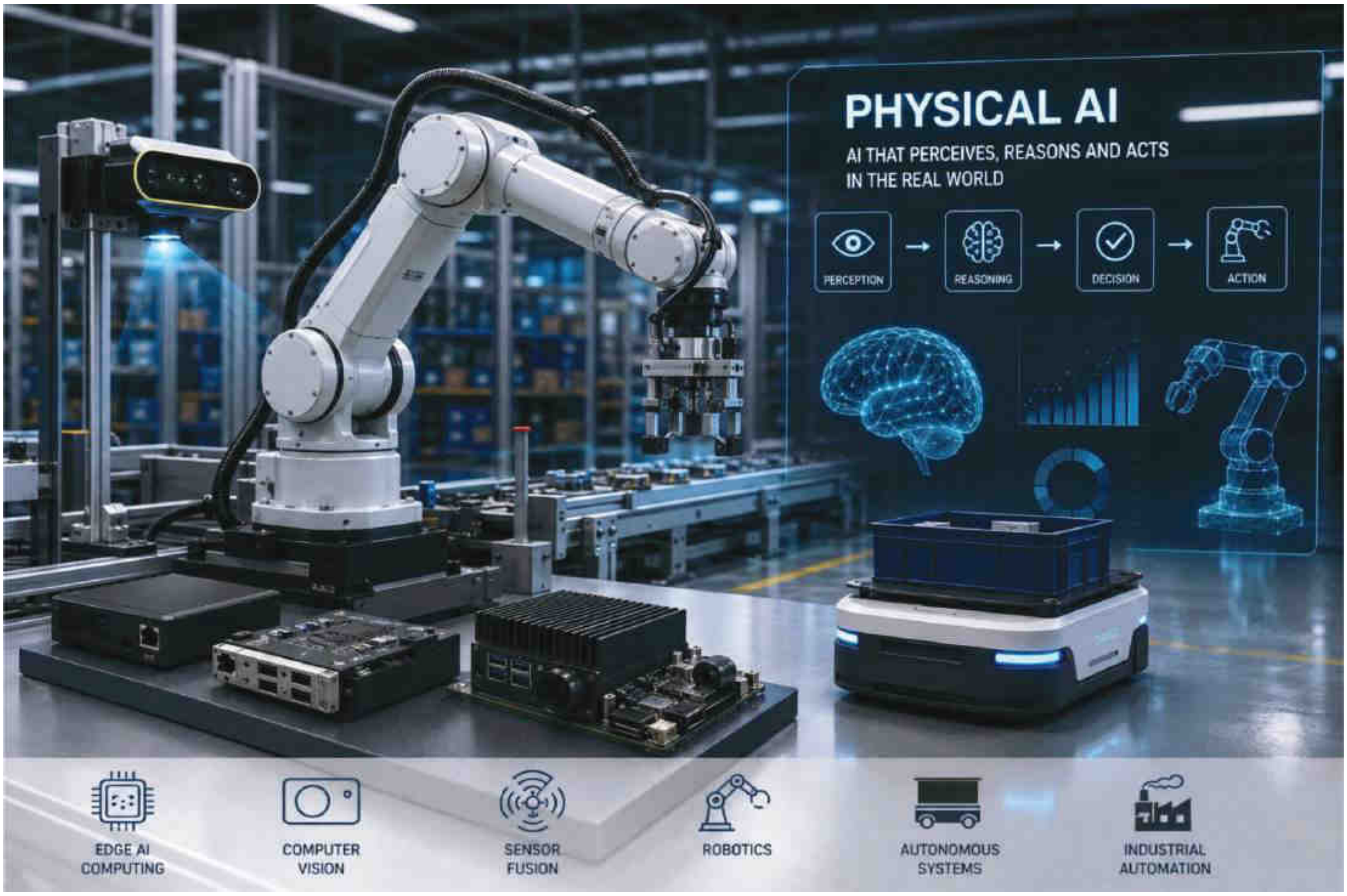
As enterprises accelerate digital transformation, Physical AI is poised to become the foundation of Industry 5.0, enabling safer, smarter, and more autonomous operations across manufacturing, logistics, healthcare, agriculture, energy, and beyond.

Beyond Generative AI: Understanding Physical AI

Generative AI has demonstrated extraordinary capabilities in creating content, summarizing information, writing software, and supporting decision-making. However, these models primarily operate within digital environments. They interpret text, images, and structured data but cannot directly interact with the physical world.

Physical AI extends intelligence beyond computation by integrating perception, reasoning, and action.

Imagine an autonomous warehouse robot. Unlike a chatbot, it must continuously process information from multiple sensors, recognize



obstacles, determine the most efficient route, avoid collisions, interact safely with people, and adapt instantly to changing conditions. Every decision must occur within milliseconds. This capability requires the integration of several technologies:

- High-performance edge computing
- Computer vision
- Sensor fusion
- Robotics
- Motion planning
- Embedded AI
- Real-time control systems

Together, these components enable machines to understand not just what exists around them, but how to respond safely and effectively.

Physical AI therefore represents the convergence of artificial intelligence with robotics and embedded engineering—transforming machines from automated tools into intelligent collaborators.

Why Physical AI Is Rising Now

Several technological shifts have converged to make Physical AI commercially viable.

Edge AI Computing

Traditional AI systems often rely on cloud infrastructure for processing. While suitable for many applications, cloud-based inference introduces latency and depends on reliable connectivity.

Physical AI requires decisions in milliseconds. Autonomous robots, industrial machines, and smart infrastructure cannot wait for cloud responses when safety and precision are critical.

Advances in edge AI platforms now enable sophisticated neural networks to run directly on embedded devices. This localized processing improves response times, enhances privacy, reduces bandwidth consumption, and increases operational reliability.

Smarter Sensors

Today's intelligent systems no longer rely on a single camera. They combine data from RGB cameras, depth sensors, LiDAR, radar, inertial measurement units (IMUs), force sensors, and GPS to develop a comprehensive understanding of their environment. This process, known as sensor fusion, allows machines to perceive depth, estimate motion, recognize objects, and navigate dynamic environments with significantly greater accuracy than any individual sensor could achieve.

Foundation Models for Robotics

Large language models transformed digital AI by enabling machines to understand and generate human language. Similar advances are now emerging in robotics through Vision-Language-Action (VLA) models.

These models integrate visual perception, language understanding, and physical actions, allowing robots to interpret natural language instructions and perform increasingly sophisticated tasks. Rather than being explicitly programmed for every scenario, future robots will learn and adapt from large-scale datasets and real-world experience.

Advances in Robotics

Industrial robots have long excelled at repetitive tasks within structured environments. Modern robotic systems, however, are becoming more adaptive, collaborative, and autonomous.

Collaborative robots (cobots), autonomous mobile robots (AMRs), robotic manipulators, quadrupeds, and humanoid robots are increasingly capable of working alongside people in dynamic environments. This transition represents one of the defining characteristics of Physical AI: machines that continuously learn rather than simply repeat programmed actions.

The Building Blocks of Physical AI

Physical AI is not a single product or software platform—it is an ecosystem of interconnected technologies.

Edge Computing

At the heart of every intelligent machine lies an embedded computing platform capable of executing AI models locally. These platforms process sensor data in real time, enabling rapid decision-making while minimizing dependence on external networks.
For industries where milliseconds matter, edge intelligence is essential.

Computer Vision

Vision AI enables machines to interpret images and video streams much like humans do.

Applications include:

- Quality inspection
- Object detection
- Facial recognition
- Defect analysis
- Autonomous navigation
- Safety monitoring
- Optical character recognition
- Inventory management

As vision algorithms continue to improve, cameras are evolving from passive recording devices into intelligent perception systems.

Sensor Fusion

No single sensor provides complete environmental awareness.

By combining information from cameras, LiDAR, radar, ultrasonic sensors, and inertial systems, Physical AI achieves greater accuracy, redundancy, and reliability.

This multi-sensor approach is particularly important in autonomous vehicles, robotics, drones, and industrial automation, where environmental complexity demands robust perception.

Robotics

Robotics provides the physical interface through which AI interacts with the real world.

Whether manipulating components on an assembly line, transporting goods within warehouses, or inspecting hazardous environments, robots transform digital intelligence into measurable physical outcomes.

The next generation of robotics will increasingly rely on AI for perception, planning, and adaptive decision-making rather than predefined programming alone.

Physical AI Across Industries

The impact of Physical AI extends across virtually every sector.

In manufacturing, AI-powered robotic systems perform precision assembly, detect microscopic defects, and optimize production processes while improving worker safety.

In logistics, autonomous mobile robots streamline warehouse operations by transporting materials, managing inventory, and reducing fulfillment times.

Healthcare is leveraging intelligent robotic systems for surgical assistance, patient monitoring, rehabilitation, and hospital logistics, improving both operational efficiency and patient outcomes.

Agriculture is adopting AI-driven drones, autonomous tractors, and intelligent monitoring systems to maximize crop yields while minimizing resource consumption.

Energy companies are deploying autonomous inspection robots and drones to monitor wind turbines, solar farms, power transmission networks, and offshore infrastructure, reducing maintenance costs while improving safety.

Smart cities increasingly rely on Physical AI for intelligent traffic management, public safety, environmental monitoring, and infrastructure maintenance.

Across each of these industries, the objective remains consistent: augment human capabilities while improving efficiency, safety, and sustainability.

ThinkRobotics and the Physical AI Ecosystem
As organizations transition from digital intelligence to autonomous physical systems, access to the right hardware and development platforms becomes increasingly important.

Building Physical AI solutions requires more than advanced algorithms—it demands an integrated ecosystem of embedded computing, edge AI platforms, robotics, computer vision, intelligent sensors, and development tools. ThinkRobotics supports this ecosystem by providing engineers, researchers, startups, and enterprises with technologies that accelerate innovation. Its portfolio includes NVIDIA Jetson developer kits, edge AI computing platforms, robotic arms, LiDAR sensors, 3D vision cameras, embedded systems, ROS-compatible development platforms, and industrial automation solutions.

These technologies enable developers to prototype, validate, and deploy intelligent systems across manufacturing, logistics, agriculture, healthcare, education, and research. Rather than focusing on a single product, the emphasis is on empowering innovators with the foundational technologies required to build the next generation of autonomous machines.

As Physical AI adoption accelerates, organizations that invest in flexible, scalable development ecosystems will be better positioned to move from experimentation to real-world deployment.

Challenges on the Road Ahead

Despite its promise, Physical AI presents significant technical and operational challenges.

Real-world environments are unpredictable, requiring systems to make safe and reliable decisions under changing conditions. Ensuring cybersecurity, protecting data privacy, optimizing energy consumption, and meeting stringent safety standards remain critical priorities.

In addition, workforce readiness and interdisciplinary collaboration will play a key role in successful adoption. Engineers must combine expertise in AI, robotics, embedded systems, software, and systems integration to build robust Physical AI solutions.

Addressing these challenges will require continued innovation, open collaboration, and responsible deployment practices.

India's Opportunity in Physical AI

India is uniquely positioned to become a global hub for Physical AI innovation. The country's strengths in software engineering, electronics manufacturing, startup ecosystems, and digital infrastructure provide a strong foundation for developing intelligent machines tailored to both domestic and global markets.

Government initiatives such as the IndiaAI Mission, Make in India, and investments in semiconductor manufacturing are creating an ecosystem that supports advanced computing, embedded systems, and automation technologies.

As industries modernize and demand for autonomous systems grows, Indian companies have an opportunity not only to adopt Physical AI but also to design, develop, and manufacture solutions that address global challenges.

Conclusion

Generative AI transformed how we create, communicate, and collaborate in the digital world. Physical AI represents the next evolution—bringing intelligence into factories, hospitals, farms, warehouses, energy systems, and cities.

The future will not be defined solely by smarter software but by intelligent machines capable of perceiving, reasoning, and acting responsibly in the real world.

For technology providers, system integrators, and innovators, this is more than a new market opportunity—it is the beginning of a new era in engineering. By combining edge computing, robotics, vision systems, embedded intelligence, and AI-driven autonomy, the foundations of the next industrial revolution are already being built.

As the boundaries between the digital and physical worlds continue to blur, Physical AI will move from being an emerging concept to becoming the intelligent infrastructure that powers the industries of tomorrow. Companies that embrace this transformation today will help shape a future where humans and machines work together to solve complex challenges with greater efficiency, precision, and sustainability.

How AI, Secure Communications, and Software-Defined Systems Are Reshaping India's Defence Ecosystem

"Modern defence activity involves multiple domains, units, and stakeholders operating at once. Success depends on their ability to work from a shared understanding of objectives, priorities, and real-time conditions."

Mr. Shiv Kumar Singh
Chief Operating Officer, NEC Corporation India and Head, Global Smart City COE, NEC Corporation

Globally, defence modernisation is increasingly being shaped by advances in digital technologies. While military strength has traditionally been associated with physical platforms, structures, and conventional systems, there is growing recognition of the role that trusted networks, interoperability, and advanced computing play in strengthening military ecosystems.

Against this backdrop, artificial intelligence, autonomous systems, secure digital infrastructure, and modular frameworks are becoming important enablers of defence technology transformation. Their value lies not in standalone deployment, but in the combined effect they create across the broader security environment.

This reflects a larger trend towards digitally enabled defence ecosystems, where software, secure communications, and AI complement conventional capabilities.

From Platform-Centric Thinking to Software-Defined Defence

For years, capability development focused primarily on individual assets such as aircraft, ships, armoured vehicles, radars, and communication hardware. While these remain essential, defence organisations are complementing them with software-defined capabilities that improve connectivity and adaptability.

A remote monitoring aircraft, for example, becomes more valuable when its observations can be shared safely, fused with radar inputs, and paired with live feeds from unmanned aerial assets. A communication node also becomes more useful when it connects dispersed units into a coordinated operational network. This reflects a shift from standalone platforms to connected capability.

AI as the New Decision-Support Layer

Gathering information is no longer the primary challenge in complex military environments. Organisations now receive continuous streams of inputs through sensors, operational visibility tools, logistics networks, and mission-linked infrastructure. As the volume of operational data continues to grow, businesses are focused on converting information into timely, actionable insights. Within this evolving landscape, AI is increasingly being adopted as a decision-support capability to help interpret complex data and improve situational understanding. By identifying patterns, detecting anomalies, and supporting predictive analysis, it helps teams uncover signals that might otherwise be missed. Rather than replacing human judgment, AI strengthens assessment by helping personnel prioritise attention and evaluate situations with greater context. The practical value of this approach is visible in applications such as border-area monitoring, where AI-enabled analytics can help identify unusual patterns across difficult terrain and reduce the burden of manual review. India has also created institutional structures to support responsible adoption in this area. The Ministry of Defence has stated that the Defence AI Council and Defence AI Project Agency were created to provide guidance, structural support, and policy-level enablement. The government has also noted that a roadmap has been finalised for Defence Public Sector Undertakings, with relevant projects identified for development. These efforts sit within a broader modernisation context, including the Ministry of Defence allocation of ₹6.81 lakh crore for FY 2025-26 and ₹7.85 lakh crore for FY 2026–27. Generating insight is one part of the equation. Converting it into coordinated action requires effective command-support structures.

Integrated Command-and-Control as the Decision Backbone

Modern defence activity involves multiple domains, units, and stakeholders operating at once. Success depends on their ability to work from a shared understanding of objectives, priorities, and real-time conditions. Integrated command-and-control environments help create that alignment by bringing together inputs from across the operational space and presenting them within a unified framework. These platforms are designed to support coordination, continuity, and informed decision-making by bringing together information from multiple sources. When air, land, maritime, cyber, and space-linked inputs contribute to a common operational picture, planning becomes more coherent, task allocation becomes clearer, and resources can be deployed more efficiently. This reduces friction and supports faster decision cycles in rapidly changing conditions.Therefore, as defence environments grow more complex, the ability to coordinate effectively across domains is becoming an important factor in institutional readiness. For this coordination to succeed and truly matter, a trusted communications foundation is non-negotiable.

Secure Communications as the Strategic Backbone

Communications infrastructure is gradually being recognised as a strategic enabler of modern military ecosystems. As digital technologies become more deeply integrated into defence operations, the need for networks that are secure, resilient, and reliable continues to grow. Accordingly, the focus is shifting beyond reach alone towards trusted, resilient, and secure communications. To strengthen resilience, modern networks are adopting advanced encryption, secure architectures, and emerging quantum-safe communication frameworks. India's National Quantum Mission, approved with an outlay of ₹6,003.65 crore, reflects the growing national emphasis on next-generation quantum technologies, including quantum communication. Reliable connectivity also creates room for a more agile approach to technology enhancement.

Software-Defined Architectures and Faster Capability Evolution

Earlier models of modernisation were characterised by lengthy hardware replacement cycles. Software-defined architectures offer a different model. They allow new functions to be introduced through updates, modular enhancements, and algorithmic improvements rather than complete hardware replacement. This enables adaptability to changing requirements and increases the longevity of existing assets. One of the key advantages is speed. New functions can be introduced, vulnerabilities can be addressed, and performance can be improved without waiting for extensive procurement programmes. A shipboard network suite, for instance, can be upgraded to support updated encryption standards through software improvements rather than a complete refit. A command-support node can gain stronger analytical features without major hardware changes. As innovation cycles continue to shorten, this flexibility is seen as an important part of long-term readiness.

Autonomous Systems and Multi-Domain Operations

Autonomous platforms are expanding their role across different domains. Their significance extends beyond automation. They help organisations extend reach, maintain persistence, and operate in settings where human presence may be difficult or risky. A drone supporting operational visibility in challenging terrain can provide timely information without exposing personnel to unnecessary danger. Unmanned maritime platforms can support monitoring across large areas for extended periods. Autonomous logistics vehicles can help sustain movement in demanding conditions. These technologies also support faster transitions between detection, assessment, and response through integrated sensor-to-decision-maker links, helping ensure that relevant information reaches the right people at the right time for command support, logistics coordination, operational awareness, and informed judgment. Their long-term value lies in improving outcomes while reducing risk to personnel and assets.

Strengthening India's Defence Ecosystem

This technological shift presents a significant opportunity for India's indigenous defence ecosystem. As advances in digital technologies continue to shape defence modernisation globally, there is growing emphasis on strengthening capabilities across design, systems integration, advanced engineering, and intellectual property alongside manufacturing. India's annual defence production reached an all-time high of ₹1,50,590 crore in FY 2024–25, according to the Ministry of Defence, reflecting strong momentum in domestic capability development. At the same time, investments in defence corridors, start-ups, research ecosystems, and public-private participation are strengthening the innovation base needed for sustained growth. Looking ahead, continued investments in AI, secure communications, cyber resilience, sensors, and advanced engineering are expected to further strengthen India's indigenous defence technology ecosystem. For technology partners, the opportunity is to support this transition through scalable digital systems, which aligns with the broader need for resilient digital infrastructure and trusted technology ecosystems.

Conclusion:Building Readiness for the Future

The future of India's defence ecosystem will be shaped by its ability to convert innovation into dependable readiness. The real effectiveness of military systems lies in their ability to timely Predict to Prepare (avoid surprise element) and Detect to Mitigate (avoid damage). This is possible only through most innovative use of software defined implementations. The nations that gain lasting edge will be those that align research, industry, and mission priorities into a continuous cycle of adaptation. For India, the opportunity is clear: build the technological depth that can support long term growth and global competitiveness.

Building Resilient Electronics Supply Chains Amid Memory Price Volatility

The global electronics industry is navigating a volatile macroeconomic environment marked by sharp memory component price hikes, currency fluctuations, and an ongoing reliance on international semiconductor supply chains. For hardware brands operating in India, where affordability directly dictates technology adoption across digital education and enterprise sectors, managing these supply-chain constraints while driving innovation has become a critical balancing act. Designing resilient, agile operational frameworks is no longer a temporary fix, but a permanent structural priority.

In a recent interaction with **Rashmi Verma**, **Dr. Ramya Chatterjee,** CEO, Solitaire Brand Business, Director, **Prointek Global Innovations** (Manufacturing Division of Supertron Electronics), discussed how Solitaire is navigating these macroeconomic pressures to safeguard supply security for its Interactive Flat Panel Displays (IFPDs). He outlined the brand's proactive multi-sourcing strategies, value engineering approaches, and data-driven demand forecasting methods aimed at buffering against global component inflation and Indian Rupee depreciation. He also shared key insights on how Solitaire collaborates with government and institutional buyers operating within fixed budget cycles to ensure price stability and uninterrupted product delivery. Looking ahead, Dr. Chatterjee emphasized that building long-term supply chain resilience requires a structural shift—one driven by deeper ecosystems partnerships between semiconductor vendors, OEMs, and government bodies—to ensure next-generation technology remains accessible and scalable across India.

How is Solitaire thinking about its own supply chain strategy for memory components in this environment?

For Solitaire Interactive Flat Panel Displays, our supply chain strategy for memory components is focused on ensuring continuity, flexibility, and cost stability in a dynamic market environment. We maintain relationships with multiple qualified memory / main board suppliers, enabling us to mitigate supply disruptions and reduce dependency on any single source. We proactively forecast demand, secure component allocations in advance, and maintain strategic inventory levels for critical memory parts used in our IFPDs. Additionally, our product architecture is designed to support approved alternative memory components wherever feasible, allowing us to adapt quickly to market fluctuations, pricing volatility, and lead-time challenges while ensuring uninterrupted production and timely deliveries to our customers.

Memory chip prices are dollar denominated while products are priced in rupees. How does the current forex environment factor into Solitaire's cost planning?

As memory components are procured in US dollars while our Interactive Flat Panel Displays are primarily sold in Indian Rupees, foreign exchange movements have a direct impact on our product costs. Over the past several months, we have witnessed not only a significant increase in global memory prices but also a depreciation of the Indian Rupee against the US Dollar, resulting in a substantial rise in our landed cost of materials. To manage this environment, Solitaire closely monitors forex trends, factors anticipated currency movements into its procurement and pricing strategies, and maintains appropriate inventory levels wherever feasible. While we continuously strive to absorb cost increases through operational efficiencies, the combined impact of higher memory prices and adverse forex movements inevitably necessitates periodic price adjustments to ensure sustainable business operations and continued product quality.

How is Solitaire managing the combined pressure of component cost increases and currency movements on its pricing strategy?

Solitaire is managing the combined pressure of rising component costs and adverse currency movements through a balanced and disciplined pricing strategy. Over the last two quarters, key input costs - particularly memory, chipsets, and other electronic components - have increased significantly, while the depreciation of the Indian Rupee against the US Dollar has further elevated landed material costs. While we continue to drive operational efficiencies, optimize procurement, and maintain strategic inventory levels to mitigate the impact, it is not feasible to absorb the entire increase indefinitely. Consequently, Solitaire has implemented selective price adjustments to reflect the higher cost environment while ensuring that our products remain competitively positioned in the market. Our objective is to strike the right balance between customer value, supply continuity, and sustainable business profitability.

Dr. Ramya Chatterjee
CEO, Solitaire Brand Business, Director, Prointek Global Innovations

“The supply-chain resilience required in the electronics and memory ecosystem is increasingly a structural, long-term shift rather than a short-term adjustment.”

Government smart classroom procurement typically works within fixed budget cycles. How is Solitaire working with institutional buyers in the current cost environment?

We understand that government and institutional digital classroom procurements are typically planned around fixed budget cycles and approved funding allocations. In the current environment of rising component costs and currency-driven input inflation, Solitaire is working closely with customers, system integrators, and procurement agencies to ensure transparency and advance planning. Wherever possible, we encourage early order finalization and procurement scheduling so that pricing can be secured before further cost escalations occur. At the same time, we continue to optimize our supply chain and product configurations to deliver the best possible value within budget constraints. Our focus remains on supporting digital education initiatives by ensuring product availability, reliable delivery timelines, and a competitive total cost of ownership, while responsibly addressing the realities of the current cost environment.

You flag demand forecasting as a key area for improvement across the industry. Are companies evolving procurement and inventory planning through this memory price cycle?

Yes, the current memory price cycle is encouraging companies across the electronics industry to adopt more disciplined procurement and inventory planning practices. At Solitaire, we have strengthened our demand forecasting processes by working more closely with channel partners, system integrators, and institutional customers to improve visibility into future requirements. This enables us to make more informed procurement decisions, secure critical components earlier, and maintain optimal inventory levels without carrying excessive stock. The volatility experienced over recent years has reinforced the importance of balancing supply assurance with inventory efficiency. As a result, procurement strategies are increasingly becoming data-driven, with greater emphasis on forward planning, supplier diversification, and proactive risk management to minimize the impact of sudden component price increases and supply disruptions.

India currently imports all its memory components. How does that shape the way Solitaire thinks about supply security for its product lines?

As India currently relies almost entirely on imported memory components, supply security remains a critical focus area for Solitaire's product planning and procurement strategy. We mitigate supply-chain risks by maintaining relationships with multiple global suppliers and sourcing partners, closely monitoring market developments, and securing component requirements well in advance based on demand forecasts. Wherever feasible, we maintain strategic inventory buffers for key memory components and qualify alternative sources to reduce dependence on any single supplier or geography. The lessons learned from recent supply disruptions have reinforced the importance of proactive planning and supply diversification. Our objective is to ensure uninterrupted product availability, stable delivery schedules, and consistent product performance for customers, even during periods of market volatility or global supply constraints.

You mention stronger partnerships across semiconductor vendors, OEMs, and governments as part of the long-term solution. What does that look like in practice for a company like Solitaire?

For a brand like Solitaire (owned by Supertron Electronics), stronger partnerships across semiconductor vendors and government stakeholders translate into greater supply-chain visibility, collaborative planning, and long-term ecosystem development. In practice, this means working closely with global component suppliers and manufacturing partners to share demand forecasts, secure component allocations, and improve responsiveness to market changes. It also involves collaborating with partners to optimize product designs around component availability and lifecycle planning. On the policy side, government initiatives that promote electronics manufacturing, component localization, and supply-chain resilience can help reduce dependence on imports over time. While memory manufacturing in India remains a long-term objective, enhanced collaboration across the value chain can significantly improve supply security, cost predictability, and the ability to support large-scale digital education and enterprise technology deployments with greater confidence.

For a market like India where affordability is central to adoption, how is Solitaire balancing the push toward next generation technology while keeping products accessible given the current inflation and forex environment?

Affordability remains a key driver of technology adoption in India, particularly in education and government-led digital transformation initiatives. At Solitaire, our approach is to ensure that customers continue to benefit from next-generation technologies without facing disproportionate increases in acquisition costs. We achieve this by carefully balancing product innovation with value engineering, optimizing component selection, strengthening procurement efficiencies, and leveraging economies of scale across our product portfolio. While rising component prices and currency depreciation have increased input costs, we remain focused on minimizing the impact on customers through selective price adjustments rather than passing through the full extent of cost increases. Our goal is to offer feature-rich, future-ready Interactive Flat Panel Displays that deliver strong long-term value and a competitive total cost of ownership, enabling broader technology adoption even in a challenging inflationary and forex environment.

What is your sense of the timeline for the supply chain resilience the industry needs to build? Is this a near term adjustment or a longer structural shift?

The supply-chain resilience required in the electronics and memory ecosystem is increasingly a structural, long-term shift rather than a short-term adjustment. While some tactical actions such as building higher inventory buffers, diversifying suppliers, and improving demand forecasting - are already being implemented across the industry, the underlying drivers of volatility, including geopolitical fragmentation, concentrated semiconductor manufacturing, and AI-led demand spikes, are not cyclical in nature. For Solitaire, this means planning for resilience as a permanent capability rather than a reactive measure: embedding multi-source procurement strategies, strengthening forward visibility with customers, and aligning product design with flexible component ecosystems. Over time, the industry is likely to move toward deeper collaboration across OEMs, component vendors, and policy ecosystems, making resilience a core design principle of supply chains rather than a temporary response to the current memory price cycle.

The Future of Packaging Is Not Just Material, It Is Automation, Quality and Traceability

"In the long term, success will come not only from the use of sustainable materials, but from the creation of intelligent packaging ecosystems in which automation, quality control and traceability work hand in hand."

Mr. Nitin Kaushal
Founder & CEO, SFK Group of Companies

The raw materials have consistently been an important driver for the development of packaging. The market has gone through the cycles of the transformation of materials, including various innovations like sustainable plastics, biodegradable foils, paper-based alternatives, and compostable packaging. While sustainable materials are definitely important, it is only one component of the much bigger transformation coming with the future of packaging. The newer packaging will not only be defined by the materials it is made of, but also by the production, inspection, tracking and management processes involved in its lifecycle. Currently, producers are under pressure from customers, government, distributors, and global supply chains. It is necessary for products to be delivered safely, to meet the changing requirements, to be environment friendly, and to provide complete transparency of all production means.

Thus, it can be concluded that the future belongs to the lines which are smart, connected, and able to make informed decisions. Ensuring automation means reducing the necessity of human involvement. Quality inspections guarantee higher product safety, and traceability provides necessary monitoring during the working processes.

The Changing Role of Packaging

The last ten years have seen considerable progress in the sphere of packaging. There is no more identity of packaging as just a way of giving protection to products or regulating sales. Modern packaging is used for various purposes such as:

- Protecting product integrity
- Ensuring regulatory compliance
- Extending shelf life
- Preventing contamination
- Supporting logistics efficiency
- Building consumer trust
- Enabling sustainability goals

Everything becomes more complicated in terms of products and the global supply chain. Manufacturers can no longer afford the use of manual techniques to get everything right. One mistake, such as a flaw, labelling error, or omission of the code, can make manufacturers recall the products, incur losses, and damage their reputation. As a result, packaging practices become more and more digital.

Why Material Innovation Alone Is Not Enough
Innovations in materials are definitely important for achieving sustainability goals. However, even the most eco-friendly packaging cannot be successful if it was manufactured incorrectly, sealed improperly, or labelled wrongly. Here are some of the typical problems:

- Incorrect filling
- Damaged seals
- Missing labels
- Wrong expiry dates
- Barcode printing mistakes
- Counterfeit products
- Batch identification failures

None of these problems can be solved just by changing the packaging material. Instead, one needs intelligent manufacturing systems that can detect flaws before the finished products leave the production line. As production volumes keep growing, depending on human inspection is becoming impossible. Even experienced workers may miss minor defects during high-speed production. Automation can solve this problem because it brings speed, consistency, and accuracy to the manufacturing process.

Automation Is Becoming the Backbone of Modern Packaging

Packaging automation extends far beyond robotic arms placing products into boxes. Today's automated packaging facilities integrate multiple intelligent systems that work together to improve productivity and reduce operational risks. Automation now supports:

- Product handling

- Filling operations
- Sealing
- Labeling
- Coding
- Inspection
- Case packing
- Palletizing
- Data collection
- Production analytics

These systems operate continuously with minimal human intervention while maintaining consistent quality standards. One of automation's greatest advantages is repeatability.

Machines perform identical tasks thousands of times without fatigue, ensuring uniform output regardless of production volume. Manufacturers also benefit from:

- Reduced labour dependency
- Faster production speeds
- Lower operational costs
- Improved workplace safety
- Better production planning
- Reduced material waste

As skilled labour shortages continue to affect manufacturing globally, automated packaging lines offer greater resilience and scalability.

Quality Has Become a Competitive Advantage
Consumers seldom pay attention to properly packaged goods. Instead, they see the damaged package, wrong label, leaking containers, or absence of information. Quality packaging has a big influence on how consumers view the product. The quality assurance in today's world emphasises prevention rather than the identification of defects after production. This trend has encouraged manufacturers to apply inspection technologies right on the packing lines. Automated inspection technologies can make sure that:

- Seal integrity
- Label placement
- Print quality
- Barcode readability
- Product presence
- Fill levels
- Cap alignment
- Packaging dimensions
- Surface defects
- Foreign object contamination

In contrast to arbitrary manual sampling, automated inspection checks every package. As a result, the likelihood of defective goods reaching consumers is significantly reduced. Consistent and good quality minimises the number of recalls, customer complaints, and expensive reworks.

Vision Inspection Is Transforming Packaging Quality

Machine vision has become one of the key technologies in the modern packaging industry. Industrial cameras working at high speeds with the help of artificial intelligence have better inspection capabilities than the human eye. Vision systems can detect faults in a product within milliseconds while the production keeps going. Possible applications include:

- Finding damaged packages
- Spotting missing items
- Reading captions
- Controlling batch numbers
- Checking QR codes
- Checking color
- Checking dimensions
- Finding incorrectly packaged items

Thanks to the improvements of AI, vision inspection systems have become more and more able to spot complex defects that were impossible to detect before. Thus, manufacturers can now be sure that every item leaving the manufacturing facility is safe and meets the quality requirements.

Traceability Becomes An Essential Factor
In the modern world, businesses must track the origin of every item it produces or distribute. This is exactly what traceability provides. Rather than relying on paper records or broken databases, modern packaging systems deliver a digital history of every batch produced and, more and more often, of every product produced.

- Raw material source
- Production date
- Machine used
- Operator information
- Batch number
- Quality inspection records
- Packaging parameters
- Shipping destination

Complete traceability supports faster decision-making during quality investigations and product recalls. Instead of recalling entire production lots, manufacturers can isolate only affected batches, reducing financial losses while protecting consumers.

Serialisation and Digital Identification

Unique product identification has become increasingly important across industries such as pharmaceuticals, food, beverages, cosmetics, and consumer goods. Technologies including:

- QR codes
- Data Matrix codes
- RFID tags
- NFC labels
- Digital watermarks

These technologies allow products to carry detailed digital identities, while improving inventory management, warehouse automation, retail scanning, consumer engagement, anti-counterfeiting and supply chain transparency. Consumers can also verify product authenticity by scanning packaging with smartphones, increasing trust in premium brands.

Data Is Becoming the New Packaging Asset
Modern packaging appliances produce huge amounts of production data. Each inspection outcome, production rate, machine downtime, malfunction, and maintenance action can bring useful operational intelligence. If connected via Industrial IoT platforms, manufacturers can analyse this data to enhance overall equipment efficiency (OEE). Data-driven packaging lets companies answer important questions:

- Which machine produces the most defects?
- Which shift has more downtime?
- Which packaging type generates the least waste?
- Which suppliers provide the most stable materials?
- Which maintenance plans allow achieving maximum uptime?

Manufacturers can forecast issues rather than deal with them. An ideal example of Industrial 4.0 means moving from reactive manufacturing to predictive manufacturing.

Artificial Intelligence Is Enhancing Packaging Decisions

Today, Artificial Intelligence has passed research and is now integrated into factories where it constantly processes operational data. It is capable of working out minor tendencies that can be missed by human workers. Among the functions of AI are the following:

- Predicting machine failures
- Detecting quality drift
- Optimising production parameters
- Identifying process bottlenecks

- Improving inspection accuracy
- Reducing false defect detection

As software is trained by large masses of historical data, the packaging systems become more advanced. Rather than waiting until the failure, manufacturers can plan preventive maintenance. Rather than being aware of the quality problem only after production, now AI is able to detect the deviation at every moment.

Sustainability Depends on Better Processes
Sustainability discussions usually revolve around the replacement of one packaging option with another. While it is important as well, productivity is equal in its contribution to sustainability. The automated packaging machines help to decrease the amount of waste and increase such aspects of efficiency as:

- Filling accuracy
- Material utilization
- Energy consumption
- Production efficiency
- Reject reduction
- Rework elimination

Each faulty package is a waste of raw material, energy, effort, transport, and product. Therefore, enhancing manufacturing quality helps in minimising the impact on the environment. Many times, optimising manufacturing processes provides the same benefits of sustainability as using new packaging materials.

Regulatory Compliance Is Becoming More Complex

Countries across the globe keep introducing laws that regulate packaging safety, labelling, and product traceability, among others. Certain industries such as pharmaceuticals, devices, food, beverage, and chemicals have stricter regulations to adhere to than others. That is why manufacturers have to keep accurate records of:

- Product identification
- Batch history
- Inspection reports
- Manufacturing conditions
- Label verification
- Packaging validation

Automated recordkeeping solves the problem of regulatory compliance to some extent by creating a digital trail for process verification, which regulators can check and significantly simplify the work of the administrators of manufacturers.

Connected Packaging Lines Improve Operational Visibility

Commonly, production lines are not connected. Modern smart factories set connections between production equipment using centralised systems for manufacturing processes – MES (manufacturing execution systems) and ERP (enterprise resource planning). Managers can instantly view:

- Production output
- Downtime
- Quality metrics
- Reject rates
- Inventory status
- Machine utilization

With greater visibility comes faster decision-making. Small production issues can be corrected before they escalate into costly disruptions.

Human Expertise Remains Essential

Automation does not eliminate the need for skilled workers. Instead, it changes their responsibilities. Rather than performing repetitive manual inspections, employees increasingly focus on:

- Process optimization
- Equipment supervision
- Data analysis
- Preventive maintenance
- Quality improvement
- Continuous innovation

Human expertise becomes more valuable as manufacturing systems grow increasingly sophisticated. The most successful organisations combine advanced automation with highly trained professionals capable of managing intelligent production environments.

The Business Value of Intelligent Packaging Operations

Organisations investing in packaging automation frequently experience benefits beyond operational efficiency. These include:

- Faster time to market
- Improved customer satisfaction
- Lower recall risks
- Better regulatory compliance
- Increased production flexibility
- Higher profitability
- Stronger brand reputation

As competition intensifies, packaging quality increasingly influences purchasing decisions. Consumers associate consistent packaging with consistent product quality. For manufacturers, intelligent packaging systems become a competitive differentiator rather than simply a production expense.

The Road Ahead

The packaging industry is entering a new era where digital technologies play an equally important role as material science. Future packaging facilities will increasingly feature:

- AI-driven inspection systems
- Autonomous packaging equipment
- Real-time quality monitoring
- End-to-end digital traceability
- Predictive maintenance
- Cloud-connected manufacturing
- Sustainable production optimization
- Intelligent data analytics

This technology will allow producers to manufacture safer, greener and more trustworthy products while rapidly reacting to changes in the marketplace. Companies that adopt this change now will be in a better position to meet requirements from regulators, consumers, and rivals in the future.

Conclusion

While sustainable materials are still an important area of development, the future of packaging goes much further. In the long term, success will come not only from the use of sustainable materials, but from the creation of intelligent packaging ecosystems in which automation, quality control and traceability work hand in hand. Automation makes it possible to ensure speed and efficiency in operations, while quality control can prevent defects before the products reach consumers. Traceability brings transparency to the complex process of global logistics and enables quicker recall of goods and better compliance.

The development of these technologies is revolutionising packaging, moving it from an afterthought production step to a strategic tool for manufacturing. With the ongoing development of Industry 4.0 technologies, companies that invest in integrated, data-driven packaging processes will have opportunities to reduce waste, boost productivity, and ensure sustainable growth.

Engineering Precision: Unimech's Decade of Scaling India's Advanced Manufacturing Footprint

Over the past decade, India's advanced manufacturing ecosystem has undergone a structural paradigm shift, transitioning from a cost-competitive sourcing destination into a high-precision, strategic engineering hub for global Original Equipment Manufacturers (OEMs). Anchored by national manufacturing mandates, rising private sector participation, and deep integrations into global aerospace and defence supply chains, domestic enterprise capabilities have matured rapidly across high-tech domains. Standing at the forefront of this industrial evolution is Unimech Aerospace & Manufacturing Ltd., which has grown from a single facility into a globally diversified precision engineering platform.

In a recent interaction with **Rashmi Verma**, **Rajanikanth Balaraman**, Co-founder, Chief Technology & Growth Officer, **Unimech Aerospace & Manufacturing Ltd.** discussed the company's decade-long evolution, its strategic initiatives across the Middle East, key acquisitions expanding its advanced engineered portfolio, and how long-term production agreements with global OEM giants are driving the platform's multi-

Rajanikanth Balaraman
Co-founder, Chief Technology & Growth Officer, Unimech Aerospace & Manufacturing Ltd

"As India strengthens its position as a global hub for advanced manufacturing, we aspire to contribute meaningfully to next-generation aerospace platforms, aero-engines, nuclear reactors, propulsion systems and other mission-critical technologies."

sector growth across aerospace, defence, semiconductor equipment, and energy.

As Unimech celebrates its 10th anniversary, how has India's advanced manufacturing ecosystem matured over the past decade, and what key milestones defined your evolution into a global precision engineering partner?

The past decade has been transformative—not just for Unimech, but for India's advanced manufacturing ecosystem as a whole. India has evolved from being viewed primarily as a cost-competitive manufacturing destination to becoming a strategic engineering and precision manufacturing partner for global OEMs. This transformation has been driven by initiatives such as Make in India and Atmanirbhar Bharat, increasing private sector participation, significant investments by global aerospace leaders, and the emergence of a highly skilled engineering talent base. Today, India is no longer just manufacturing components—it is increasingly delivering complex precision systems, critical assemblies and engineering-led manufacturing solutions that are deeply integrated into global supply chains.

Our own journey over the last ten years mirrors this evolution. What began as the vision of five founders with a single 30,000 sq. ft. manufacturing facility in Peenya, Bengaluru, focused on niche aerospace tooling, has evolved into a globally diversified precision engineering platform. Today, Unimech operates four manufacturing facilities across India—three in Bengaluru and one in Visakhapatnam—with an operating footprint of over 600,000 sq. ft., while our next manufacturing facility is being established in Saudi Arabia through our joint venture with the Yusuf Bin Ahmed Kanoo Group. This expansion reflects not just an increase in scale, but our ability to build manufacturing ecosystems closer to our customers and participate in regional industrial growth.

As our customers' requirements evolved, so did our capabilities. From being predominantly an aerospace tooling company, we have expanded into precision manufacturing for multiple high-growth sectors, including commercial aerospace & defence, semiconductor manufacturing equipment, energy, nuclear and industrial applications. Today, our manufacturing platform supports approximately 6,000 SKUs, demonstrating the breadth and complexity of products we have developed and industrialised over the years. This diversification has enabled us to leverage a common precision manufacturing platform while reducing dependence on any single product or end market.

A significant milestone has been our evolution from executing build-to-print assignments to becoming a trusted manufacturing partner capable of delivering complex precision components, sub-assemblies and engineered solutions that demand exceptional quality, repeatability and process control. Long-term relationships with leading global OEMs across aerospace, semiconductor and energy sectors are a testament to the confidence customers place in our manufacturing capabilities.

Beyond organic growth, we have also undertaken strategic initiatives that strengthen our long-term positioning. Our joint venture in Saudi Arabia extends Unimech's precision engineering expertise into the oil & gas sector while expanding our global manufacturing footprint and reducing geographical concentration. We have also established a Free Trade Warehouse Zone (FTWZ) to better support global customers with faster deliveries, inventory optimisation and supply chain resilience. In addition, our acquisition of Hobel Bellows significantly enhances our portfolio by adding niche capabilities in metallic bellows, hydroforming, tube assemblies and engineered products, enabling us to offer customers a much wider range of precision-engineered solutions.

Innovation has been another important pillar of our journey. Our strategic investment in Dheya Engineering, a deep-tech startup developing indigenous micro gas turbine technology, reflects our commitment to supporting next-generation propulsion systems and contributing to India's advanced engineering ecosystem beyond conventional manufacturing.

Perhaps the milestone we are most proud of is the organisation we have built. What started as an entrepreneurial vision of five founders has grown into a team of over 1,200 professionals, united by a culture of engineering excellence, quality and innovation. It is this collective capability that has enabled Unimech to transform from a niche precision manufacturer into a trusted global engineering partner.

As we enter our second decade, our ambition extends beyond manufacturing individual components. We aspire to be a globally recognised precision engineering platform that partners with customers across the product lifecycle—from engineering support and complex manufacturing to integrated assemblies and specialised manufacturing solutions. We believe India's advanced manufacturing story is only beginning, and Unimech is well positioned to contribute meaningfully to the next phase of that growth.

What are the primary opportunities and challenges for India in strengthening its aerospace and defence manufacturing, and how is Unimech positioning itself to capture a larger share of the global supply chain?

India's aerospace and defence sector is entering a defining phase of its evolution. While global supply chain diversification and geopolitical realignments have certainly accelerated the opportunity, the larger story is that India is steadily establishing itself as a strategic engineering and manufacturing destination. Today, global OEMs are not only sourcing components from India but are also establishing engineering centres, technology hubs and advanced manufacturing facilities here. Investments by companies such as Airbus, Boeing, Safran, GE Aerospace and Collins Aerospace, alongside the emergence of Indian champions like Tata Advanced Systems and Dynamatic Technologies, reflect growing confidence in India's engineering capabilities and its ability to support increasingly complex aerospace programmes.

At the same time, India's aerospace ambitions are extending well beyond manufacturing structural components. Indigenous programmes such as the LCA Tejas, Advanced Medium Combat Aircraft (AMCA), GTRE's Kaveri engine programme and next-generation propulsion initiatives are steadily building capabilities in some of the most technologically demanding areas of aerospace engineering. Similarly, India's remarkable progress in space exploration—from successful lunar and solar missions to the expansion of the commercial space ecosystem—is creating demand for highly specialised precision manufacturing capabilities. We are also witnessing Indian companies increasingly expanding their global presence through strategic acquisitions, technology partnerships and international joint ventures, enabling access to advanced technologies, specialised manufacturing capabilities and global customer relationships. Collectively, these developments indicate that India is moving beyond being a manufacturing destination to becoming an innovation-driven aerospace ecosystem.

However, the next phase of growth will not be determined by manufacturing capacity alone. Aerospace is built on uncompromising quality, precision and consistency. Customers qualify manufacturing partners through rigorous audits, process validations and years of operational performance. While anyone can acquire advanced manufacturing equipment, it is not possible to compress years of audit history, quality validation and customer trust into a few months. That qualification base becomes the real competitive moat, strengthening with every new programme, certification and customer approval.

For India, this also highlights the key challenge ahead. While significant progress has been made, the ecosystem must continue to deepen through greater availability of aerospace-grade materials, specialised manufacturing processes, globally certified Tier-II and Tier-III suppliers and advanced quality systems. Building scale while maintaining zero-defect quality, delivery reliability and global certification standards will ultimately determine how much of the global aerospace value chain India can capture.

At Unimech, we recognised this opportunity well before it became an industry trend. Our philosophy has always been capability before capacity. Rather than simply adding manufacturing infrastructure, we have consistently invested in advanced precision manufacturing technologies, specialised processes, automation, digital quality systems and engineering talent. This enables us to manufacture highly complex products for global aerospace, defence, semiconductor and energy customers while meeting the stringent quality and traceability requirements expected by leading OEMs.

Our strategy is also aligned with how customer expectations are evolving. Global OEMs are increasingly moving beyond sourcing individual components to partnering with suppliers capable of delivering complete manufacturing work packages, complex assemblies and long-term production programmes. We are continuously expanding our precision engineering capabilities to participate in this evolution. Strategic initiatives such as our joint venture with the Yusuf Bin Ahmed Kanoo Group in Saudi Arabia strengthen our proximity to customers in the Middle East while extending our precision engineering expertise into the oil & gas sector. Similarly, the acquisition of Hobel Bellows has significantly broadened our product portfolio and manufacturing capabilities, enabling us to address a wider range of mission-critical applications. Our investment in Dheya Engineering, which is developing indigenous micro gas turbine technology, also reflects our belief that India's long-term competitiveness will increasingly be driven by innovation, indigenous technology development and advanced engineering.

Ultimately, the single biggest factor that will determine whether companies like Unimech capture this global opportunity is the ability to scale execution without compromising precision, quality or delivery standards. Our objective is not to become the fastest-growing precision engineering company, but to build one of the world's most trusted integrated precision engineering platforms. We believe that trust—earned through consistent execution, engineering excellence and long-term customer partnerships—will remain the most valuable differentiator as India continues to strengthen its position in the global aerospace and defence supply chain.

What is the strategic significance of your long-term agreements with global high-precision manufacturing partners, and what specific milestones are in focus for the next quarter?

Long-term manufacturing agreements represent an important strategic evolution for Unimech. Historically, our aerospace tooling business has been characterised by high-value, project-based engagements with relatively shorter execution cycles. While this business continues to be an important part of our portfolio, the next phase of our growth is centred on increasing the share of long-term manufacturing programmes that provide greater revenue visibility, improve capacity utilisation and strengthen long-term customer relationships.

These agreements are significant because they transform the nature of our engagement with customers. Instead of participating in one-off manufacturing assignments, we become an integral part of their production programmes, supporting them throughout the lifecycle of an aircraft platform or industrial programme. This creates a more predictable and recurring business model while providing opportunities to continuously expand the scope of work as new components and assemblies are qualified.

Our recently announced long-term agreement with FACC Operations GmbH, one of the world's leading aerospace manufacturing companies, is an excellent example of this strategy. Under this programme, Unimech will manufacture precision-engineered flying parts that form part of the outboard flap system on Airbus aircraft. While the programme begins with a defined set of components, the real opportunity lies in successfully executing the initial phase and progressively expanding into additional work packages over time. More importantly, such programmes establish Unimech as a qualified manufacturing partner for critical flying parts, opening opportunities to participate in future aerospace platforms and broader OEM supply chains.

This is also reflective of a larger industry trend. Global OEMs are increasingly consolidating their supplier base and looking for manufacturing partners who can deliver not just individual components but complete work packages, assemblies and long-term production support. Our objective is to position Unimech as one of those trusted partners.

Looking ahead, one of our key priorities over the coming quarter is to successfully industrialise and ramp up the FACC programme while continuing to progress discussions with several global aerospace and defence OEMs for additional flying-part programmes. These engagements are at various stages of technical evaluation and qualification, and as they mature into commercial contracts, we will make the necessary disclosures in line with our regulatory obligations.

Beyond aerospace, we are equally encouraged by the momentum we are seeing in our energy and semiconductor verticals. Although we entered these sectors only over the last three years, our ability to execute qualifications quickly, deliver consistently and steadily increase the size of work packages has enabled us to build strong relationships with leading global companies. These industries demand the same precision engineering, process discipline and quality standards that define aerospace manufacturing, allowing us to leverage a common manufacturing platform across multiple high-growth sectors.

Ultimately, our strategy is to build a balanced portfolio of long-term manufacturing programmes across aerospace, defence, energy and semiconductor industries. As more customers transition from qualification to serial production and expand the scope of work entrusted to us, we believe these partnerships will provide the foundation for sustained, predictable growth over the next decade while reinforcing Unimech's position as a globally trusted precision engineering partner.

How do your recent strategic moves, the Saudi Arabia JV with YBA Kanoo, the acquisition of Hobel Bellows, and your stake in Dheya Engineering strengthen your competitive moat across the energy and propulsion sectors?

There's a common thread running through all three, even though they look like separate deals on paper, we are not chasing three opportunities, we are building one platform. The idea is to put together a globally integrated precision engineering business with differentiated capabilities across aerospace, energy, semiconductors and advanced manufacturing. Each of these moves gives us something that would otherwise have taken years to build in-house.

Start with Saudi Arabia. The YBA Kanoo joint venture with a 51% stake gives us our first manufacturing footprint in the Middle East. Beyond the geographical advantage, it plugs us directly into Saudi's industrial localisation programmes and puts us inside one of the fastest-growing energy and industrial ecosystems in the world. This will help us serve global OEMs with more agility as the JV progresses.

Hobel Bellows is a bigger shift than it might look from outside. This is about moving from being a precision component supplier to a provider of complex, higher-value engineered assemblies and sub-systems. We did the acquisition through Unimech and our subsidiary Innomech Aerospace Toolings, and it brings a specialised tech stack in hydroforming and thin-wall metal bellows that complements our core machining strengths. There's real scale here too — a 200,000 sq. ft. facility at Duvvada SEZ in Visakhapatnam — and nearly 90% of Hobel's revenue comes from exports to markets like the US, UK, Singapore and China, which mirrors our own export-led model closely. Rather than spending years and capex building this from scratch, we've absorbed an accredited capability in advanced metal forming, robotic welding, precision pipe bending and high-end testing in one move.

Beyond what Hobel already does, some of its platforms sit on leading global engines, including ones used in hyperscaler data centre infrastructure. The bigger opportunity is combining that with our own presence across aerospace, defence, semiconductor and nuclear, so we can offer larger integrated work packages rather than individual components.

The minority stake in Dheya Engineering Technologies, on the other hand, gives us the propulsion edge. Their DET-500 micro gas turbine recently validated at over 90% load with more than 500 minutes of continuous runtime, across certification processes and aerospace-grade manufacturing standards. That is a real technology milestone, not just a promising prototype. But the significance for us goes beyond any one programme — building advanced propulsion systems demands precision, repeatability, materials expertise and quality systems that are rigorous by definition, and those capabilities transfer directly across aerospace, defence and other mission-critical sectors. Getting in early on the development and industrialisation side means we keep deepening exactly the kind of engineering depth that positions us as a precision manufacturing partner for increasingly complex work.

So our moat comes up as a mix of geographic reach, technological depth, and propulsiongrade engineering capacity, all complementing each other in our stride to build a globally integrated precision engineering platform.

Unimech manufactures highly complex components for mission-critical sectors like semiconductors, energy, and aerospace. How do you consistently meet stringent quality certifications while building long-term relationships with leading global OEMs?

Quality is a non-negotiable prerequisite to everything we do - it has to be designed into the system from the start, especially when you are making components that go into aircraft, nuclear plants or semiconductor fabs, where there is simply no margin for error.

What that means in practice is investment in testing infrastructure, rigorous documentation at every stage, and people who understand that a single deviation can compromise an entire component. We have built our systems so that quality is not a separate department checking work at the end, it is embedded in how each part is engineered and produced from day one.

Global OEMs, whether in aerospace, energy or semiconductors run on trust. That trust is earned slowly, through consistent delivery over years, not won in a single contract. Once an OEM has qualified you on their processes and seen you deliver without fail across multiple programmes, that becomes a relationship that compounds — they bring you into new programmes earlier, share more of their roadmap, and expand the scope of what they trust you to build.

Looking at your roadmap for the next ten years, what are your core plans for capacity expansion, technology investments, and market diversification to transform Unimech into a fully integrated global engineering platform?

Our vision for the next decade goes far beyond expanding manufacturing capacity. We aspire to build Unimech into one of the world's most trusted integrated precision engineering platforms, delivering mission-critical products, complex assemblies and engineering-led manufacturing solutions across multiple high-technology industries.

As global OEMs increasingly consolidate their supplier base, they are looking for partners capable of delivering complete work packages rather than individual components. Our objective is to progressively move higher up the value chain and establish Unimech as a Tier-1 manufacturing partner across the businesses we serve—whether in aerospace tooling, precision components, flying parts or integrated assemblies. This evolution will be driven by continued investments in advanced manufacturing technologies, specialised processes, automation, digital quality systems and engineering talent.

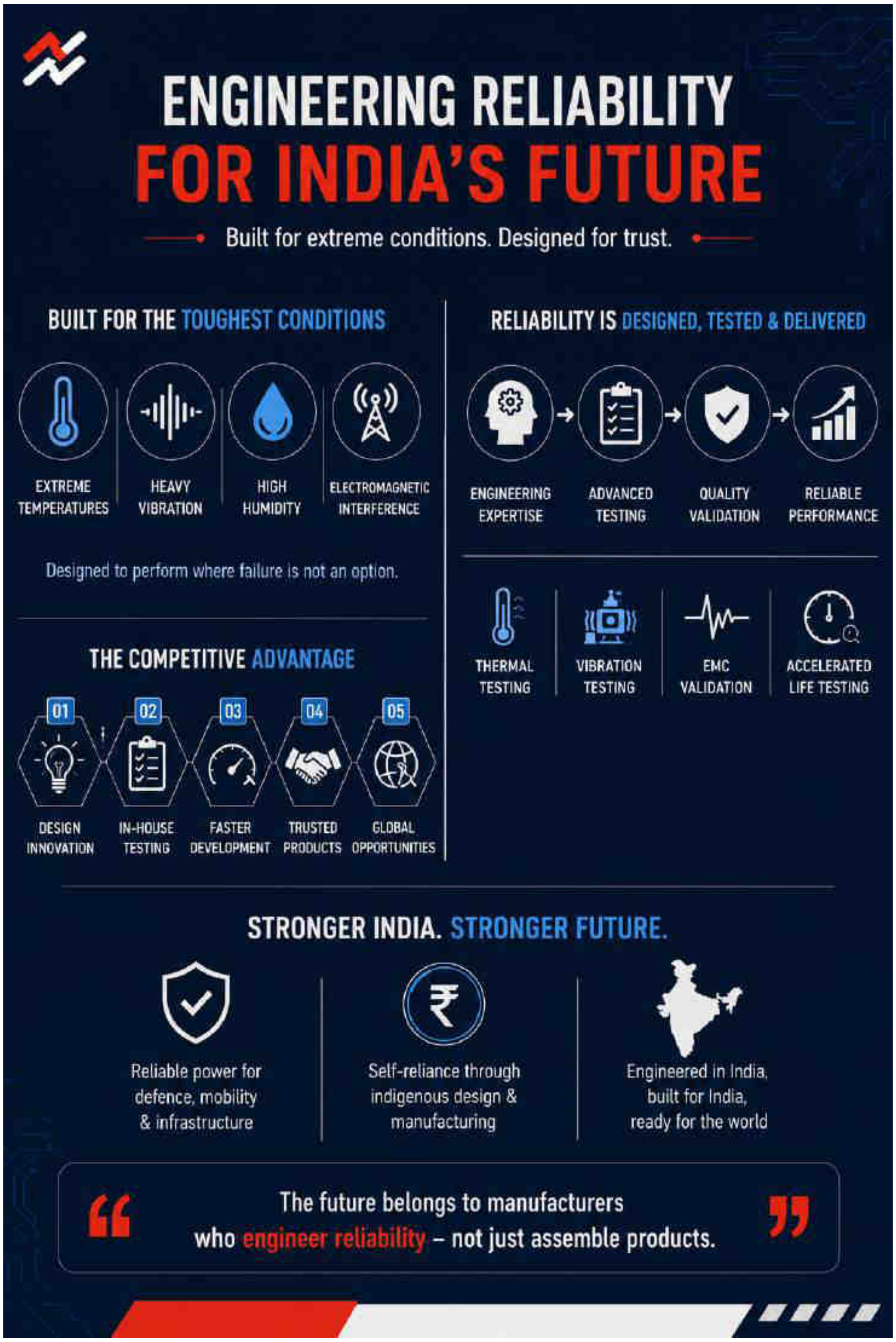
We also see significant opportunities as India's advanced manufacturing ecosystem continues to evolve. In aerospace and defence, we aim to expand our role from precision components to larger aerostructures, aero-engine components and next-generation propulsion systems. Similarly, with India's ambitious nuclear power expansion plans, our long-term vision is to contribute towards larger reactor systems and critical nuclear equipment. We will also continue investing in emerging technologies that strengthen indigenous innovation and India's long-term capabilities in advanced precision engineering.

Market diversification will remain another important pillar of our strategy. Alongside aerospace, we will continue strengthening our presence in semiconductor manufacturing equipment, energy and oil & gas—industries that demand the highest levels of precision, quality and engineering excellence. At the same time, we will continue expanding our global manufacturing footprint and strategic partnerships to remain closer to customers and emerging opportunities.

Ultimately, our success will not be measured by the number of facilities we build or the machines we install, but by the complexity of the products we manufacture, the strategic role we play in our customers' programmes and the trust we earn from leading global OEMs. As India strengthens its position as a global hub for advanced manufacturing, we aspire to contribute meaningfully to next-generation aerospace platforms, aero-engines, nuclear reactors, propulsion systems and other mission-critical technologies. Success will be defined by the complexity of the products we manufacture, the strategic role we play in our customers' programmes and the trust we earn from leading global OEMs. That is the pathway we believe will establish Unimech as one of the world's most trusted integrated precision engineering platforms.

Why Power Electronics Are Becoming a Strategic Pillar of India's Make in India Vision

Enabling Everything from Defence and Mobility to Critical Infrastructure



India's manufacturing narrative has, in recent years, centred on semiconductors, electric vehicles, and defence platforms as the sectors defining the country's industrial ambition. Power electronics is rarely part of that conversation, yet it underpins every one of those domains. Converters, rectifiers, and regulated power supply systems form the critical layer that converts incoming AC electrical power into the precise, conditioned form each downstream system requires. Without this layer functioning reliably, no amount of sophistication elsewhere in a system's design is of consequence.

This asymmetry between visibility and importance is beginning to correct itself. India's parallel efforts in defence indigenisation, semiconductor manufacturing, electric mobility, and grid modernisation have, collectively, elevated power electronics from a peripheral consideration to a strategic one. Having led an organisation engaged in the design and manufacture of power supply systems for Indian industry for close to three decades, I have observed this shift materialise through more exacting design specifications, compressed procurement timelines, and a client base that increasingly evaluates power electronics with the same rigour once reserved for more prominent components.

From Commodity Component to Strategic Asset

For much of its history, the power electronics sector was regarded as a commodity layer — sourced on cost, interchangeable across suppliers, and rarely subject to the same scrutiny applied to the systems it served. That perception is no longer tenable. A system inherits the reliability profile of its power conversion layer regardless of how advanced the rest of its architecture may be. A radar installation equipped with a sophisticated sensor suite offers no operational value if its power supply cannot withstand field conditions. An electric vehicle with a highly efficient drivetrain will underperform if its onboard charging and conversion hardware is poorly matched to the grid conditions it operates within.

As India works to build greater domestic capability across its critical technology sectors, this dependency has become difficult to overlook. Genuine self-reliance in defence, mobility, or infrastructure cannot be claimed while the power conversion layer continues to be treated as a secondary procurement decision. This recognition, more than any single policy intervention, has been the principal driver behind the sector's re-evaluation.

Defence Applications Demand an Uncompromising Standard

The clearest demonstration of this shift lies in defence electronics. Communication systems, radar installations, and unmanned platforms are only as dependable as the power supplies that sustain them, and defence equipment is not permitted the tolerance for failure that consumer or even industrial applications allow. These systems must operate reliably under sustained vibration, extreme temperature variation, high humidity, and demanding electromagnetic environments — conditions under which commercial-grade power modules would degrade rapidly.

India's defence indigenisation programme has established domestic sourcing for this category of component as a genuine procurement requirement rather than an aspirational preference. This has altered the underlying economics for manufacturers prepared to invest in ruggedised, field-hardened power systems: a segment that was once a narrow, specialised order book is now evolving into sustained demand aligned with platform production timelines.

"A power supply failure in a consumer product results in a warranty claim. In a defence platform, it can determine whether a mission is completed or a communication link is lost at a critical moment," said Sagar P. Brahmbhatt, CEO of Powertec Supplies. "Designing for defence applications requires engineering teams to account for worst-case operating conditions from the outset, not as a consideration introduced during later-stage testing."

Electric Mobility and Rail Electrification Are Power Conversion Challenges

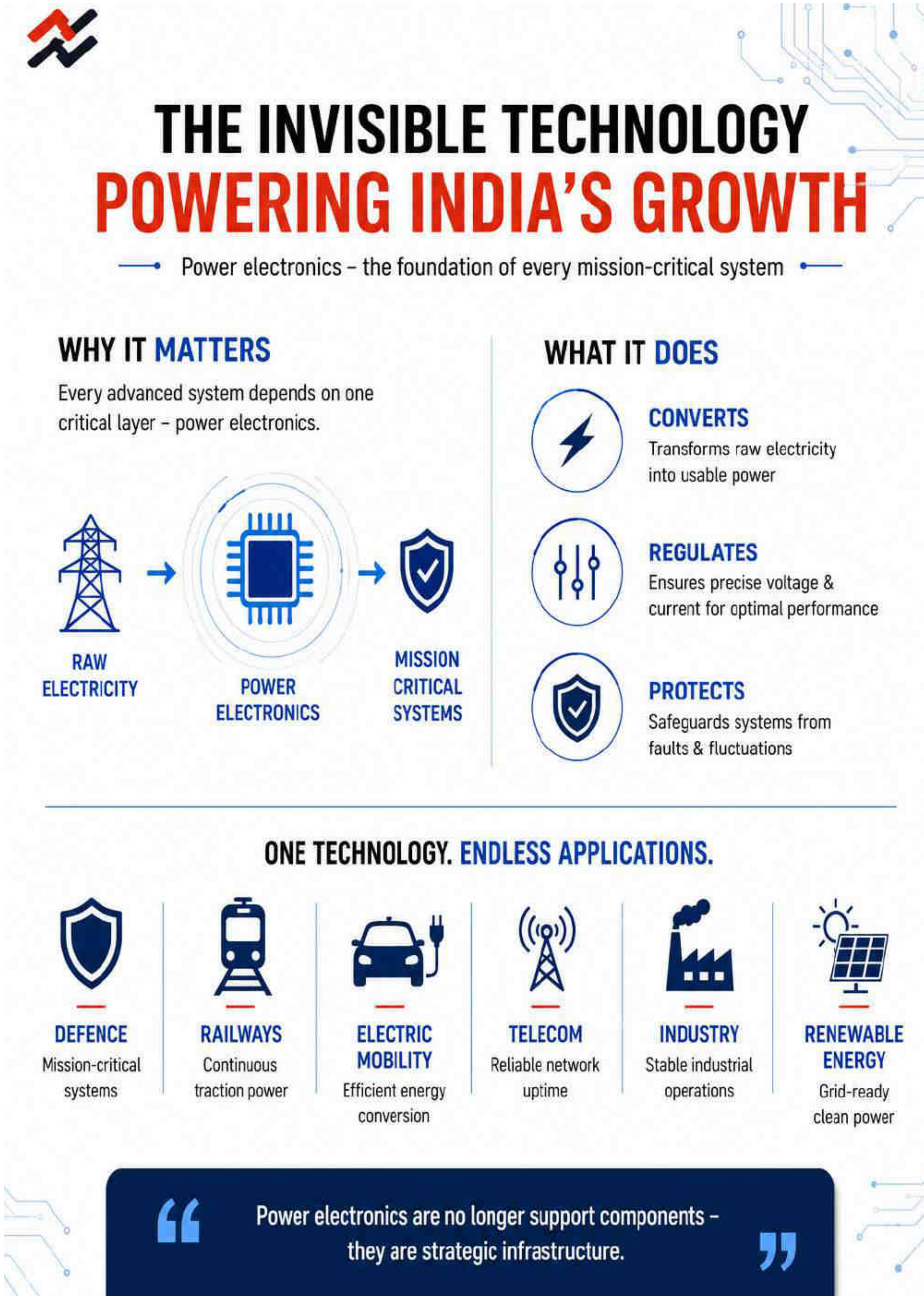
Discussions of electric mobility tend to focus almost exclusively on battery chemistry and motor design, yet every component of that ecosystem depends on power electronics to function as intended. Onboard chargers, DC-DC converters, and traction inverters determine how efficiently a vehicle utilises the energy stored within its battery. Charging infrastructure, in turn, depends on AC-DC and DC-DC power conversion systems capable of managing variable loads, grid fluctuations, and a wide range of outdoor operating conditions across India's diverse climatic zones.

Rail electrification introduces a comparable set of engineering demands. Traction power systems for electrified corridors and metro networks require converters engineered for continuous operation under heavy and fluctuating load conditions, a materially different design challenge from that faced by consumer or general industrial power supplies. As India expands its electric vehicle charging network and its electrified rail infrastructure, manufacturers with a direct, first-hand understanding of domestic grid characteristics and environmental operating conditions are better positioned than those adapting designs developed originally for markets with different power infrastructure and climate profiles.

Critical Infrastructure Depends on What Remains Unseen

Sagar P. Brahmbhatt, CEO, Powertec Supplies

> *"We have long regarded our role as building the component of the system that receives no attention until it ceases to function. That was once considered an unremarkable position within the industry. It no longer is. Defence programmes, electric vehicle deployment, and infrastructure projects are all being developed on the assumption that the underlying power layer will perform reliably."*


THE INVISIBLE TECHNOLOGY
POWERING INDIA'S GROWTH
Power electronics – the foundation of every mission-critical system
WHY IT MATTERS
Every advanced system depends on one critical layer – power electronics.
RAW ELECTRICITY
POWER ELECTRONICS
MISSION CRITICAL SYSTEMS
WHAT IT DOES
CONVERTS
Transforms raw electricity into usable power
REGULATES
Ensures precise voltage & current for optimal performance
PROTECTS
Safeguards systems from faults & fluctuations
ONE TECHNOLOGY. ENDLESS APPLICATIONS.
DEFENCE
Mission-critical systems
RAILWAYS
Continuous traction power
ELECTRIC MOBILITY
Efficient energy conversion
TELECOM
Reliable network uptime
INDUSTRY
Stable industrial operations
RENEWABLE ENERGY
Grid-ready clean power
Power electronics are no longer support components – they are strategic infrastructure.

Beyond defence and mobility, power electronics underpins nearly every category of infrastructure that India is expanding. Telecommunications networks and data centres require power systems engineered for near-continuous uptime, given that even brief interruptions can disrupt service for a substantial user base. Grid modernisation, particularly the transition toward a greater proportion of renewable generation, depends on inverters and converters capable of managing the inherent intermittency of solar and wind power without compromising grid stability.

This is an area in which newer semiconductor materials are becoming increasingly relevant for Indian manufacturers. Devices built on these materials permit faster switching, lower operating temperatures, and higher voltage tolerances than conventional silicon-based components, characteristics that are directly relevant to electric vehicle powertrains, solar inverters, and industrial motor drives as these applications scale. Domestic manufacturing capability in this area remains at an early stage, but it represents the direction in which the broader industry is moving, and it will materially influence the competitiveness of Indian-manufactured power electronics over the coming decade.

Engineering talent represents a further constraint that receives comparatively little attention. Power electronics design sits at the intersection of analog engineering, control systems, thermal management, and manufacturing expertise, a combination that has not traditionally been treated as a distinct specialisation within engineering education. As defence and infrastructure demand continues to outpace the supply of engineers trained specifically in this discipline, manufacturers are increasingly required to invest in structured, in-house training programmes rather than depending on the market to supply this expertise independently.

Testing and Reliability Infrastructure as a Source of Competitive Differentiation

A less visible but consequential shift is occurring within manufacturing facilities themselves: the expansion of internal testing capability among Indian power electronics manufacturers.

Environmental and reliability testing for power supplies intended for defence or rail applications was, until recently, frequently outsourced, which extended delivery timelines and placed smaller domestic manufacturers at a competitive disadvantage. This is changing as manufacturers build in-house capability for thermal cycling, vibration testing, electromagnetic compatibility verification, and accelerated life testing.

The significance of this development extends beyond compliance. Procurement authorities increasingly expect manufacturers to substantiate reliability performance in advance, rather than establishing it retroactively following a field failure. Manufacturers that invest in dedicated testing infrastructure can iterate on designs more rapidly and respond to defence and infrastructure requirements with considerably shorter lead times than those still dependent on external testing facilities. This represents one of the less apparent mechanisms through which domestic manufacturing capability compounds over time: enhanced testing infrastructure enables faster design cycles, which in turn strengthen competitive positioning and justify continued investment in testing capacity.

There is also a broader strategic consideration worth noting. As Indian manufacturers develop power electronics to standards suitable for domestic defence and infrastructure requirements, these same products are frequently well-suited to other markets characterised by comparable operating conditions, particularly regions where heat, particulate contamination, and inconsistent power supply present design constraints that Indian engineers already address as standard practice.

A power supply engineered to withstand extreme domestic climatic conditions and an unstable rural power supply connection is, in practical terms, already engineered to a more demanding standard than many other markets require. This represents a competitive advantage that Indian manufacturers have not yet fully realised, though it is likely to gain relevance as domestic production capacity extends beyond what the local market alone can absorb.

Implications for Manufacturers Operating in This Sector

Power electronics manufacturing does not present an easy commercial proposition. Margins remain narrower than in more prominently discussed sectors, certification cycles for defence and rail applications are lengthy, and the cost associated with a design failure — field replacements, recalls, and reputational consequences — is disproportionately high relative to the scale of individual contracts. Nonetheless, the strategic importance of the sector is no longer in question, and the trajectory of national industrial priorities indicates that this is not a transient period of attention.

“We have long regarded our role as building the component of the system that receives no attention until it ceases to function,” Brahmbhatt stated. “That was once considered an unremarkable position within the industry. It no longer is. Defence programmes, electric vehicle deployment, and infrastructure projects are all being developed on the assumption that the underlying power layer will perform reliably.”

A Foundational Requirement, Not a Peripheral Consideration

India's Make in India objectives were never intended to be measured solely in terms of manufacturing output, but the capability to design and produce technologies on which the nation's security and growth depend. Power electronics is one of the most direct tests of whether that objective is being met in substance — reflected in whether a radar system stays powered under field conditions, whether EV charging infrastructure withstands seasonal extremes, and whether a data centre operates through grid instability.

The manufacturers who invest in ruggedised design, deeper component sourcing, and engineering talent — rather than assembly alone — will determine how far India's defence, mobility, and infrastructure ambitions can go. Power electronics now sits at the centre of that undertaking, not at its margins.

Rethinking Edge Intelligence: How Brain-Inspired Computing is Rewriting Physical AI

Sumeet Kumar
Co-founder & CEO, Innatera

"The question is no longer whether neuromorphic computing has a role to play, but how quickly its myriad of features become part of the standard toolkit for building intelligent products. The ecosystem is continuing to mature, and we're bound to see more companies move confidently from experimentation to deployment, bringing always-on intelligence into everyday devices."

In a recent interaction with **Rashmi Verma**, **Sumeet Kumar**, Co-founder and CEO of **Innatera**, discussed how neuromorphic computing is transforming sensor-edge intelligence from a theoretical research concept into a deployable commercial reality. As Physical AI expands into everyday applications, traditional cloud-centric processing faces insurmountable limits around energy consumption, latency, and data bandwidth. Kumar highlighted why true decision-making must begin at the very first layer of data capture, shifting sensors from passive data collectors into intelligent, context-aware decision-makers.

Central to this transformation is Innatera's event-driven architecture, embodied in its Pulsar microcontroller. Inspired by Spiking Neural Networks (SNNs) in the human brain, the chip processes only "meaningful events" rather than wasting energy on continuous streams of redundant data. By triggering computation solely when significant patterns occur, this approach drastically slashes power requirements and delivers sub-millisecond responsiveness for always-on edge devices. Kumar detailed how this enables high-impact real-world applications—ranging from contactless human presence detection using mmWave radar and contextual audio classification in consumer electronics to predictive vibration monitoring in industrial environments.

Moving forward, scaling Physical AI requires co-designing hardware, sensing, and compute paradigms together from day one rather than relying solely on larger software models. As developer ecosystems and tools mature, brain-inspired processors are set to become a foundational capability for the next generation of wearables, robotics, and intelligent infrastructure.

It's been noted that real-time sensor perception is becoming just as critical as high-level reasoning for Physical AI. In practical terms, why must intelligent decision-making begin at the very first layer of data capture, and how does this change our traditional understanding of the AI pipeline?

For years, AI innovation has largely focused on reasoning, building models that can analyze information and make more sophisticated decisions. But in the physical world, reasoning is only one part of the equation. Before a system can decide what to do, it first has to understand what's happening around it.

That's where perception becomes critical. Whether it's interpreting radar signals, vibration data from industrial equipment, or contextual audio, the challenge isn't simply collecting sensor data; it comes down to recognizing which signals actually matter. If the perception layer can't distinguish significant information from background noise, even the most advanced reasoning model works with incomplete context.

That's what really alters the traditional AI pipeline. Sensing stops functioning as a passive first step and becomes an intelligent process in its own right. Devices need to interpret information as it's captured so that higher-level decision-making draws on relevant context and not raw data. Physical AI will continue to evolve, and much of its impact will depend on the ability to intelligently sense, reason, and predict the physical world.

Traditional cloud-centric AI architectures struggle under the strict energy and latency

constraints of edge devices. How does brain-inspired, neuromorphic computing fundamentally rewrite the rules of AI hardware design to deliver intelligence within these real-world limits?

Traditional processors weren't designed to operate in an always-on manner, certainly not in devices that are constrained by energy. The conventional compute paradigm aims to maximize operations per second, using dense, discrete computing elements. This approach is inherently power-intensive, and not intrinsically suited for processing continuous streams of sensor data.
The naive solution to this was to put the main compute core to sleep, and wake it up only when a relevant pattern is detected in the sensor data - this defeats the purpose of always-on sensing applications.

Neuromorphic computing, on the other hand, is inspired by how the brain processes sensory data – with Spiking Neural Networks. The neurons of the brain don't activate (spike) continuously when stimulated with sensory input. Instead, groups of neurons selectively spike in a clustered and time-bound manner, according to the features they've been sensitized to respond to. The method natively supports time-series processing; event-driven activation minimizes the energy cost of processing continuous data streams, and the energy cost of each operation is negligible due to the simplicity of the compute function and data representation. The result is extreme energy efficiency with short response latency.

At Innatera, we've designed our architecture around that reality. Our Pulsar chip combines multiple compute engines, including spiking neural network processing, conventional AI acceleration, and a RISC-V CPU, within a single heterogeneous microcontroller, and this lets developers run different parts of a workload where they make the most sense. What this ultimately yields is an architecture built specifically for always-on intelligence at the sensor edge, not one adapted from traditional computing paradigms.

Continuous data processing is incredibly resource-heavy. Can you explain the concept of event-driven intelligence? How does shifting the focus to processing only 'meaningful events' change the efficiency and speed of an AI system?

Traditional processors continuously process incoming sensor data, whether or not anything meaningful is occurring. That means energy gets spent analyzing every sound, movement, or signal, even when most of that information doesn't require a response.
With brain-inspired processing, however, computation in the neural network's nodes gets triggered only when important events occur, and data isn't processed continuously by default. Eliminating that unnecessary processing lets the system use significantly less energy while directing compute resources toward the moments that actually matter. That also improves responsiveness because the processor isn't occupied with redundant computation and can react immediately when it detects an important event.

We've demonstrated this through our collaboration with Joya Design, for example, where our neuromorphic technology powers their EdgeCore module for contextual audio intelligence. In one application, the system performs real-time, on-device classification of different baby cries, including hunger, tiredness, or discomfort, and can trigger appropriate responses without sending audio data to the cloud. The device performs intelligent analysis locally and only acts when it identifies audio events, instead of continuously streaming and processing every sound.

Sensors continue to become more capable and generate richer data, and event-driven intelligence offers an efficient way to extract information without continuously growing compute requirements. That's a big change from traditional AI architectures, and one we believe will prove essential for the next generation of always-on Physical AI.

There is a growing push to move AI processing right next to the sensor rather than relying on the cloud. Beyond saving bandwidth, what unique, next-generation use cases in wearables, robotics, or industrial sensing does this immediate responsiveness unlock?

Moving intelligence to the sensor does far more than reduce bandwidth; it enables products to understand and respond to the physical world in real time.

We're already seeing that across a range of applications. One of our hottest applications enables accurate human detection in context-driven environments. Pulsar, in combination with an ultra-low power mmWave radar, is able to accurately identify the presence of humans in a scene, even when they are completely motionless. The applications of this are numerous - smoke detectors that recognize if a person is asleep in bed during an evacuation, smart lights that don't switch off when you're seated motionless at your desk, or TVs that play content only when a human is seated on a couch (and ignore your roaming cat). In industrial monitoring, for example, we're working with partners to detect subtle vibration patterns that can indicate equipment wear before failures occur, helping move maintenance from reactive to predictive. In consumer electronics, we're enabling contextual audio intelligence that allows devices to recognize important sounds locally, without relying on cloud connectivity. The same principle extends to applications such as intelligent smoke detection in our collaboration with Aaroh Labs, where identifying an alarm immediately at the sensor enables faster responses while operating within the tight power constraints of battery-powered devices.

The applications are very different, but the underlying challenge stays remarkably consistent. Devices need to continuously interpret rich sensor data while operating within extremely tight power budgets and responding immediately when meaningful events occur. That's what sensor-edge intelligence makes possible, and it's why we believe it will become a foundational capability for Physical AI systems.

Engineers often face a harsh reality check when moving models from a lab simulation to a physical environment. What is the biggest misconception engineering teams have about scaling Physical AI, and why must hardware, sensing, and compute be co-designed from day one?

One of the biggest misconceptions we've seen is that scaling Physical AI comes down mainly to choosing the right AI model. In reality, it's about designing the right system.

Moving from a successful demonstration to a commercial product introduces an entirely different set of hurdles. Power budgets become fixed, memory is limited, sensing conditions vary, and products need to operate reliably for years, not just perform well in controlled testing.

That's why hardware, sensing, compute, and software all need consideration together from the beginning. We've seen this firsthand as customers move from evaluating neuromorphic technology toward deployable products through collaborations with partners like 42 Technology and Byte Lab, where the focus extends beyond AI performance to building complete, production-ready systems. Benchmark performance alone doesn't determine success. What truly determines it is whether the entire system can deliver reliable intelligence within the practical constraints of a real embedded device.

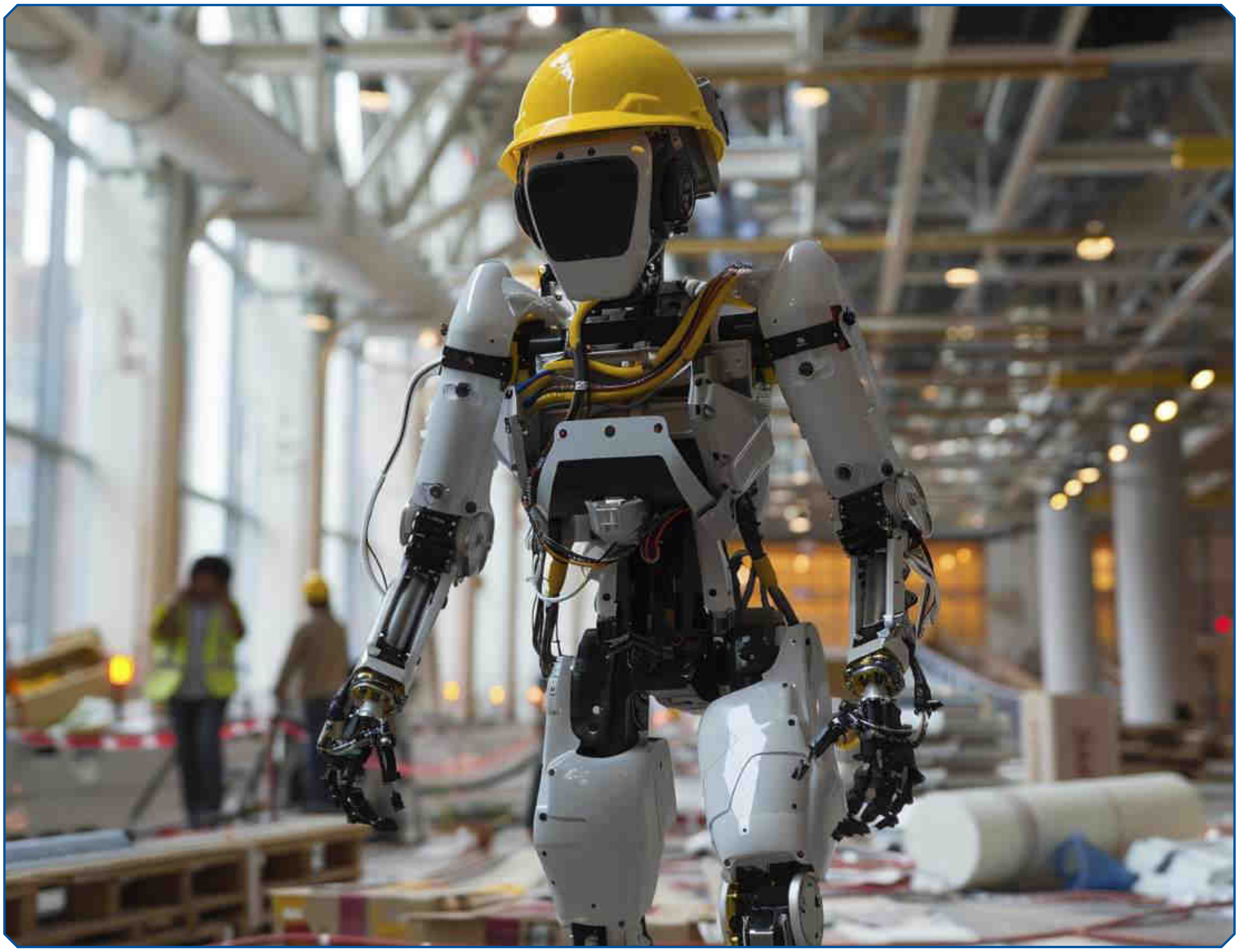
Neuromorphic computing has long been viewed as a fascinating research concept. As it matures into a practical commercial technology, where do you see brain-inspired processors having the most disruptive impact over the next three to five years?

I think we're reaching an important inflection point. For many years, neuromorphic computing was primarily discussed in research environments. Today, the conversation focuses much more on deployment.

Over the next three to five years, I expect we'll see the greatest impact in products that continuously interact with the physical world: robotics and industrial sensing, wearables, and intelligent infrastructure. These systems all need to process richer sensor data while operating within strict power, size, and cost constraints, which makes them well suited to brain-inspired architectures.

The surrounding ecosystem matters just as much, and it's maturing alongside the hardware. Better developer tools, more standardized deployment workflows, and greater collaboration across the industry are converging to make neuromorphic computing far more accessible than it was only a few years ago. Initiatives like Synfire, our open platform for sharing and deploying neuromorphic models, help reduce friction for developers while encouraging greater collaboration across the ecosystem.

The question is no longer whether neuromorphic computing has a role to play, but how quickly its myriad of features become part of the standard toolkit for building intelligent products. The ecosystem is continuing to mature, and we're bound to see more companies move confidently from experimentation to deployment, bringing always-on intelligence into everyday devices.



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Radiation Characterization and Performance Evaluation of the LX2160 Space Processor

TELEDYNE | e2v Semiconductors

“By integrating advanced semiconductor technology with effective architectural and software-based mitigation approaches, the LX2160-Space processor represents a highly capable solution for next-generation space systems.”

INTRODUCTION

A Comprehensive Analysis of Total Ionizing Dose, Single Event Effects, and System-Level Robustness.

Spaceborne electronic systems are evolving rapidly, driven by increasing demands for onboard processing, autonomy, and real-time data exploitation. Modern missions—including Earth observation, telecommunications, navigation, and deep-space exploration—require processors capable of handling large volumes of data directly in orbit. This shift reduces dependence on ground infrastructure while enabling faster decision-making and more flexible mission architectures.

At the same time, these systems must operate reliably in harsh radiation environments. High-energy particles can induce both cumulative degradation and transient disturbances in semiconductor devices, potentially affecting system functionality and long-term reliability. As a result, comprehensive radiation characterization is essential to ensure predictable behavior and mission assurance.

The LX2160-Space processor, based on NXP’s QorIQ® Layerscape architecture and enhanced through Teledyne e2v’s space-grade manufacturing and qualification flow, has been developed to address these dual challenges. Integrating up to sixteen Arm® Cortex-A72 cores alongside high-speed memory and communication interfaces, the device targets next-generation space systems requiring both computational performance and robustness.

To validate its suitability for space environments, an extensive radiation test campaign has been conducted. This campaign includes Total Ionizing Dose (TID), Single Event Latch-up (SEL), and Single Event Effects (SEE) evaluations across cores, memory subsystems, and peripheral interfaces. The present paper consolidates these results and provides a system-level interpretation of the processor’s behavior under radiation exposure.

LX2160-SPACE PROCESSOR ARCHITECTURE OVERVIEW

The LX2160-Space processor is a highly integrated System-on-Chip designed to balance performance, flexibility, and resilience. Its architecture includes multiple processing cores, an advanced cache hierarchy, and a wide range of high-speed interfaces, enabling it to support complex and data-intensive applications.

A key aspect of this architecture lies in its use of Error Correction Code (ECC) across critical memory elements, which allows the detection and correction of transient errors. In addition, the processor is structured around multiple independent power and clock domains, enabling localized fault isolation and improved robustness. The integration of interfaces such as DDR4, PCIe, Ethernet, SATA, SPI, I2C, and eMMC further supports a broad range of mission profiles.

Equally important is the processor’s reliance on software-driven mitigation

strategies. Built-in reset mechanisms and system-level recovery capabilities enable rapid restoration of functionality following transient disturbances. This combination of hardware protection and software flexibility provides an effective approach to managing radiation-induced effects without requiring fully hardened design techniques.

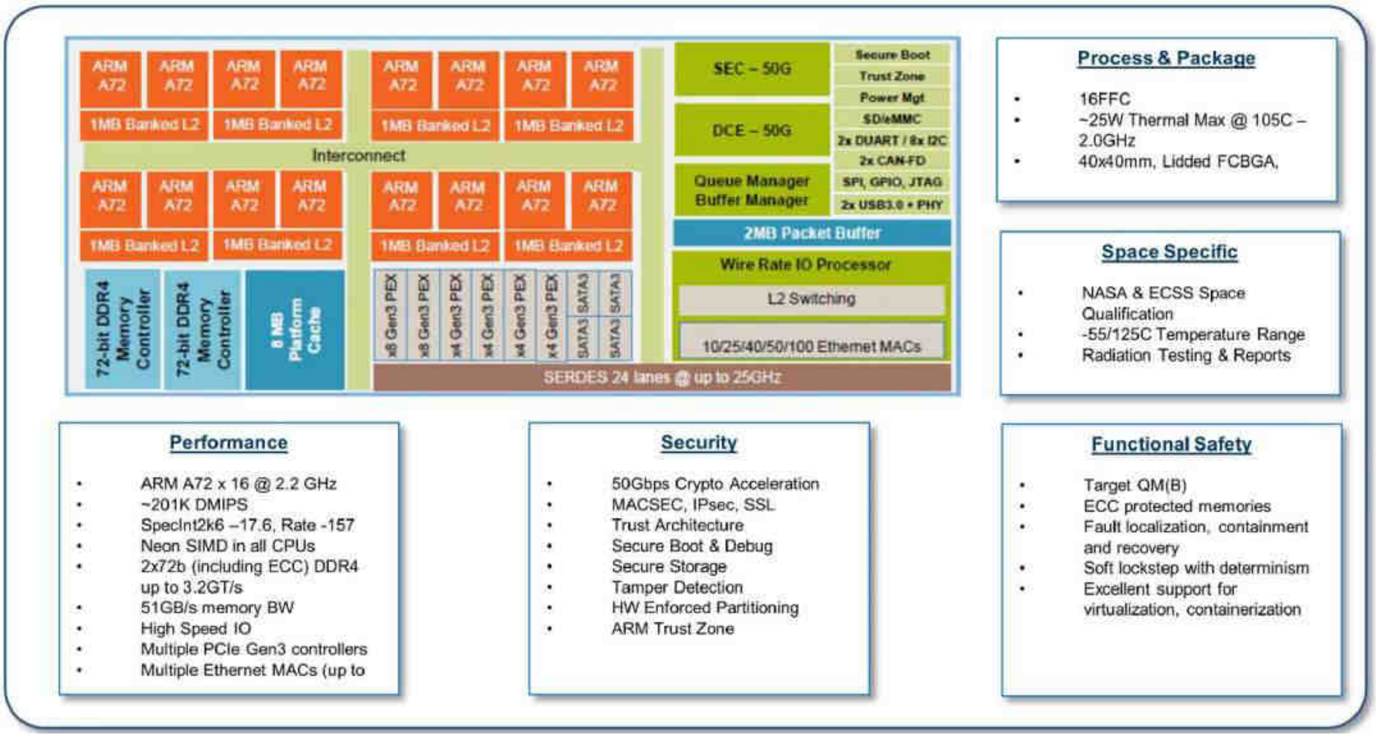


Figure 1 – LX2160 Space Processor Functional Block Diagram

RADIATION EFFECTS IN SPACE ENVIRONMENTS

Radiation effects in semiconductor devices can be broadly categorized into cumulative and single-event phenomena. Each type has distinct physical mechanisms and implications for system design.
Total Ionizing Dose represents the long-term accumulation of ionizing radiation in device materials. This leads to progressive changes in transistor characteristics, including threshold voltage shifts and increased leakage currents. Over time, these effects can alter circuit behavior and degrade performance, particularly in analog and mixed-signal blocks.

Single Event Latch-up is a more severe phenomenon, involving the activation of parasitic structures within CMOS devices. When triggered, it can result in a high-current state that may lead to permanent damage if not quickly mitigated. Ensuring immunity to this effect is therefore critical for any space-qualified component.

Single Event Effects encompass a range of transient disturbances caused by individual particle strikes. These include bit flips in memory elements, temporary functional interruptions, and more complex multi-bit errors. Although non-destructive, such events can disrupt system operation and must be carefully characterized to define appropriate mitigation strategies.

Table 1 summarizes the radiation test conditions and measurements performed on the LX2160 as part of the overall characterization campaign. The device was evaluated under representative operating conditions during both cumulative and single-event irradiation tests, including TID and heavy-ion exposures. Key electrical and functional parameters were continuously monitored to capture the processor's response across cores, memory subsystems, and interfaces, ensuring a comprehensive assessment of its behavior and robustness in realistic space radiation environments.

Test Group	Description
Open/Short	Open/Short circuits
CRES	Contact resistivity
Trip	Leakage between supply and ground
Fuse	Internal register fused during final test at NXP
Leakage	Leakage on I/Os
Sidd	Static power Consumption
DC Scan	Stuck-at fault detection
DC Spec	VOL and VOH test
DDR4	Memory controller test
EMI	Peripheral interface test
1588	Peripheral interface test
HSSI	High speed serial interface test
Slowbus (GPIO, I2C...)	Low speed serial interface test
USB	Peripheral interface test
SNVS	Security Engine
Lynx test guide (LTG)	High speed serial interface test
AC Scan	Transition fault detection
RGMII	Ethernet interface test
SPI	Serial peripheral interface test
CRES	Contact resistivity

Table 1: Parameters measured during electrical testing

TOTAL IONIZING DOSE CHARACTERIZATION

The TID performance of the LX2160-Space processor was evaluated through irradiation up to 100 krad(Si), using a Cobalt-60 gamma source under representative operating conditions. Throughout the exposure, key electrical parameters such as power consumption, leakage currents, frequency margins, and operating voltages were continuously monitored, both during irradiation and during post-irradiation annealing phases.

The results demonstrate that the processor maintains stable functional behavior across the entire dose range. No significant degradation or drift in critical parameters was observed, and all variations remained within expected limits for advanced semiconductor technologies, including 16 nm FinFET processes.

From a system perspective, this level of robustness ensures that the device can operate reliably over long mission durations without requiring derating or complex compensation mechanisms. The demonstrated tolerance is compatible with a wide range of orbital environments, from Low Earth Orbit to more demanding Geostationary missions where cumulative radiation effects are more pronounced.

SINGLE EVENT LATCH-UP IMMUNITY

The susceptibility of the LX2160-Space processor to Single Event Latch-up was evaluated through heavy-ion irradiation testing under conservative worst-case conditions. These conditions included high Linear Energy Transfer (LET) levels exceeding 93 MeV·cm²/mg, elevated temperatures, and maximum operating voltages, ensuring a rigorous assessment of device robustness. Throughout the test campaign, all power domains were closely monitored for abnormal current behavior. No destructive latch-up events were observed. While some high-current events were detected, these were found to correspond to gradual and reversible current increases rather than true latch-up phenomena.

These events were fully recoverable through standard power cycling and did not result in any permanent degradation. Their behavior is consistent with transient charge effects rather than the activation of parasitic thyristor structures. The absence of destructive latch-up under such stringent conditions confirms the processor's strong intrinsic immunity. This greatly simplifies system design by eliminating the need for complex protection circuitry and significantly reduces the risk of catastrophic failure in orbit.

SINGLE EVENT EFFECTS CHARACTERIZATION

A comprehensive SEE evaluation was performed across the processor cores, memory subsystems, and peripheral interfaces to assess the impact of transient radiation-induced events on system operation.

At the processor core level, Single Event Functional Interrupts were observed, indicating sensitivity to particle-induced disturbances. However, the recovery mechanisms proved highly effective. The vast majority of events were resolved through simple reset procedures, while only a very small fraction required more extensive reinitialization. Importantly, no events necessitated a complete power cycle, demonstrating the efficiency of built-in mitigation strategies.

Memory subsystem testing revealed the occurrence of transient errors in cache structures at moderate LET levels. These errors exhibited complex behavior influenced by both LET and particle fluence. Despite this, integrated ECC mechanisms and architectural design features ensured effective error management. System-level analysis further indicated that the probability of such events occurring in orbit remains extremely low, even under pessimistic conditions.

The evaluation of peripheral interfaces highlighted varying levels of sensitivity depending on controller architecture. Transient disturbances were observed in communication interfaces such as DDR4, Ethernet, and SATA, as well as in storage and control interfaces including eMMC and I2C. These disturbances manifested as temporary communication errors or data corruption events, often occurring in clusters associated with particle interactions.

Crucially, all observed SEE events were non-destructive and could be resolved using standard reset mechanisms. The associated cross-sections remained low, confirming limited susceptibility to radiation-induced disruptions. Furthermore, the ability to recover both core and peripheral functionality using uniform mitigation strategies greatly simplifies system-level fault management.

SYSTEM-LEVEL IMPLICATIONS

The combined results of the radiation characterization program demonstrate that the LX2160-Space processor exhibits a high degree of robustness across all examined domains. It maintains stable operation under cumulative radiation exposure, shows complete immunity to destructive latch-up, and demonstrates predictable and recoverable behavior in response to single-event effects.

These characteristics enable the implementation of modern mitigation strategies based on software supervision and system-level resilience. Rather than relying exclusively on radiation-hardened hardware, designers can take advantage of reset-based recovery techniques and redundancy schemes to ensure reliable operation.

Orbit-level modeling further confirms that the expected rate of radiation-induced events remains compatible with mission reliability requirements across a wide range of environments. Even in worst-case scenarios, the impact of transient effects on system availability is minimal.

CONCLUSION

The radiation characterization of the LX2160-Space processor provides a comprehensive understanding of its behavior in space environments. The device demonstrates strong tolerance to cumulative radiation effects, complete immunity to destructive latch-up, and robust resilience to transient disturbances. Although single-event effects may occasionally disrupt operation, they remain non-destructive and can be efficiently mitigated using well-established recovery mechanisms. This combination of performance, robustness, and recoverability ensures that the processor meets the stringent requirements of modern space missions.

By integrating advanced semiconductor technology with effective architectural and software-based mitigation approaches, the LX2160-Space processor represents a highly capable solution for next-generation space systems. It enables the deployment of high-performance onboard processing capabilities while maintaining the level of reliability required for operation in harsh radiation environments.

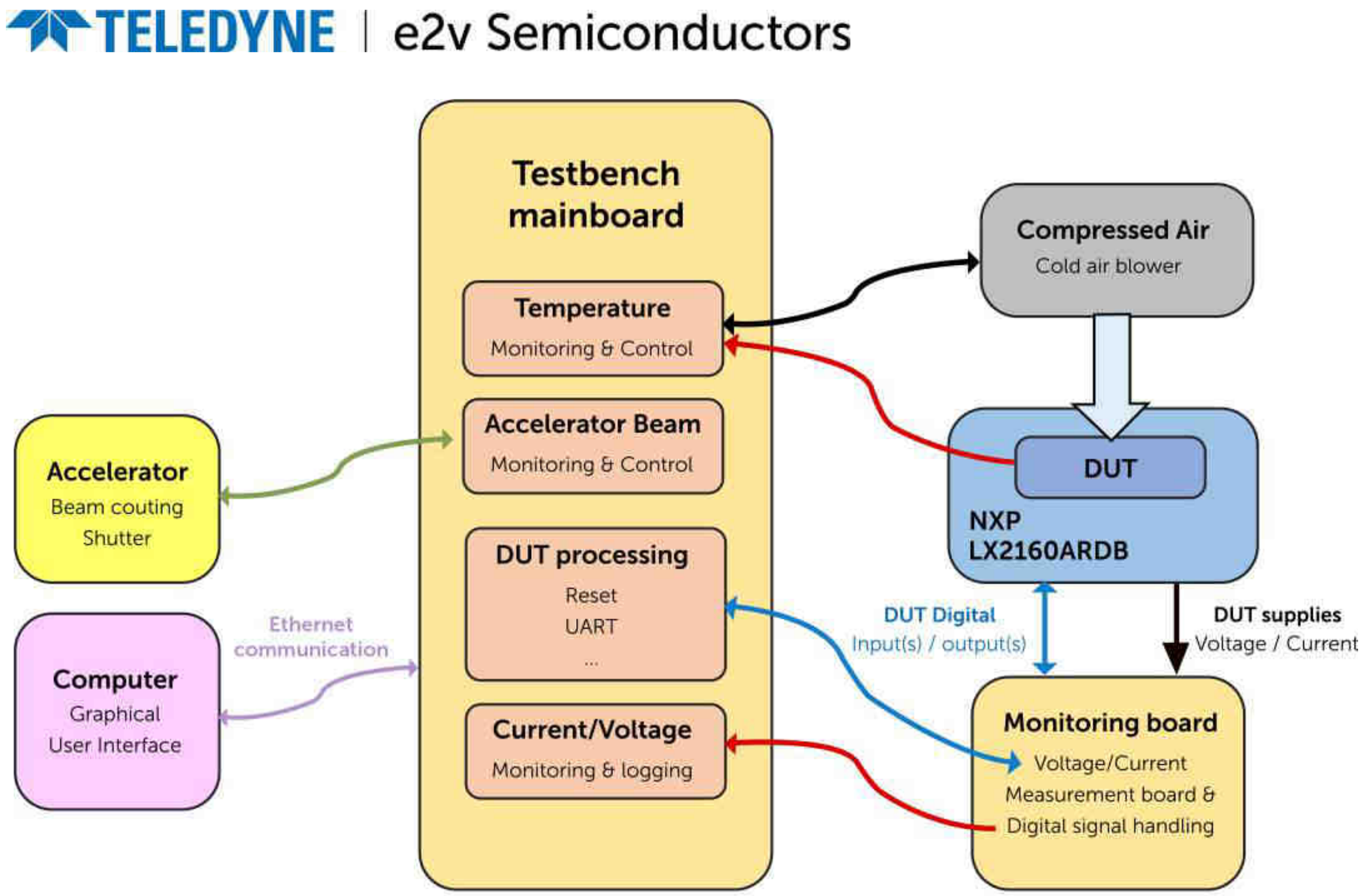
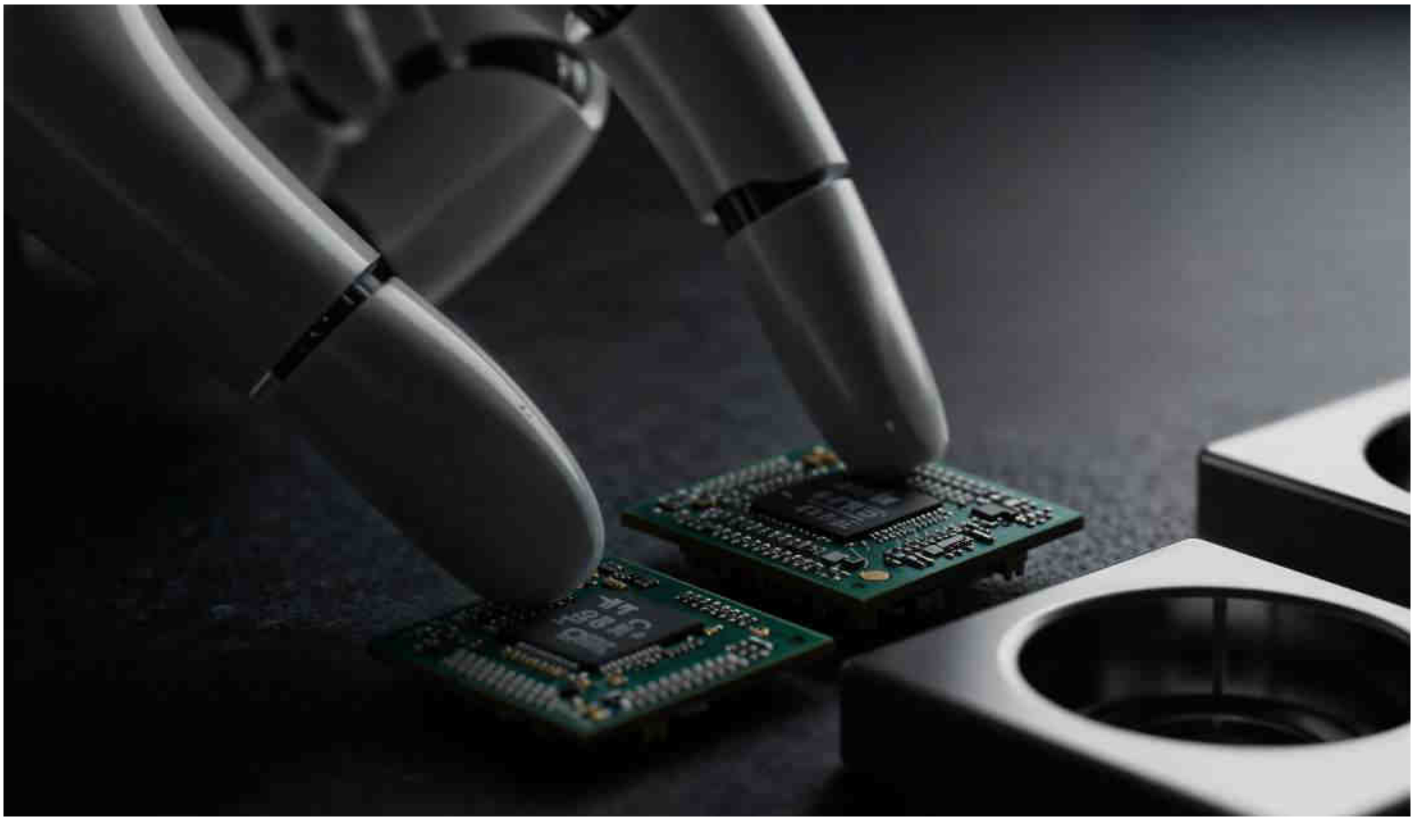


Figure 2 – SEE Test setup



Building a Globally Integrated Semiconductor Ecosystem: The Polymatech Blueprint

"Semiconductor talent cannot be developed only through classroom education. Engineers and technicians must receive sustained exposure to equipment, processes, materials, quality systems, yield improvement and actual production conditions."

Eswara Rao Nandam
Managing Director and Chief Executive Officer
Polymatech Electronics Limited

In a recent interaction with **Rashmi Verma**, **Eswara Rao Nandam**, Managing Director and Chief Executive Officer of **Polymatech Electronics Limited**, discussed the company's strategic trajectory as it enters its 20th year of operation. Moving beyond simple expansion, Polymatech is actively executing a blueprint for deep vertical integration and international scale. From establishing India's newly notified Semiconductor and Electronic Components SEZ in Nava Raipur, Chhattisgarh, to expanding upstream capabilities with sapphire ingot crystal-growth pullers at its Oragadam campus, the company is securing control over critical material stages to ensure uncompromised device performance and supply chain resilience.

Highlighting the operational strategy behind Polymatech's new manufacturing facility in Singapore under AEIM Pte Ltd, Mr. Nandam detailed how this hub seamlessly bridges Indian manufacturing scale with global technology corridors across France, Estonia, and the United States. Rather than operating isolated units, Polymatech is building a tightly coordinated semiconductor ecosystem—combining material innovation, specialized packaging, and advanced workforce development to position an Indian enterprise as a formidable global semiconductor player.

As Polymatech enters its 20th year of operations since its founding in Chennai in 2007, how do you reflect on the evolution of the Indian semiconductor ecosystem, and what has been your biggest anchor for growth over these two decades?

India's semiconductor ecosystem has moved from discussion and import dependence towards policy-led investment and actual manufacturing. There is now much greater recognition that semiconductor capability requires not only fabrication and packaging plants, but also reliable power, speciality gases, materials, equipment support, logistics, technical institutions and a strong domestic customer base. However, the ecosystem is still developing, and India must continue building this supporting industrial infrastructure if it wants semiconductor manufacturing to become globally competitive.

Polymatech was founded in Chennai on 29 May 2007 and has completed 19 years of operations. Our biggest anchor throughout this journey has been execution discipline: building real manufacturing capability, developing products, serving customers and continuously reinvesting in technology and capacity. We have remained focused on manufacturing rather than announcements, and that approach has allowed us to progress from an individual production facility into an internationally integrated semiconductor and advanced-electronics group.

The Government of India has formally notified Polymatech's SEZ at Mandir Hasaud, Nava Raipur. What does this strategic milestone mean for your capacity scaling, and what role will Chhattisgarh play in your electronics manufacturing roadmap?

The formal notification converts our Nava Raipur project from an expansion proposal into a long-term industrial platform. The notified Semiconductor and Electronic Components SEZ covers 10.13 hectares at Mandir Hasaud and gives us the regulatory framework required to establish globally oriented manufacturing capacity with an integrated ecosystem of suppliers, processors and supporting operations.

Chhattisgarh will be Polymatech's principal scale-up location for advanced semiconductor materials, compound-semiconductor products and electronic components. Oragadam will continue to function as an important technology, manufacturing and product-development centre, while Nava Raipur will enable us to install capacity at a significantly larger scale, including additional sapphire crystal-growth systems and associated downstream processes.

The location also gives us the opportunity to create a new semiconductor manufacturing cluster rather than merely establish an isolated factory. Our objective is to develop the surrounding vendor base, train local technical personnel and attract complementary manufacturing activities into the SEZ. Chhattisgarh will therefore play a central role in our next phase of growth and in broadening India's semiconductor manufacturing geography beyond the traditional industrial corridors.

You recently commissioned a sapphire ingot crystal-growth puller at your Oragadam campus. How does this advance your goals for upstream vertical integration, and how critical is control over the crystal-growth and wafer-preparation stages to your finished devices?

The commissioning of the sapphire ingot crystal-growth puller is an important step upstream in our manufacturing value chain. Instead of depending entirely on externally sourced substrates, we are developing control from crystal growth and ingot formation through wafer preparation, semiconductor packaging and finished devices.

Crystal growth is not simply a raw-material operation. Parameters such as purity, crystal orientation, defect density, thermal stability and dimensional consistency directly influence wafer yield, process repeatability and the performance of the final semiconductor device. Control over wafer cutting, orientation, lapping, polishing and surface preparation is equally important because any variation introduced at these stages is carried into the subsequent device and packaging processes.

Vertical integration therefore gives us greater traceability, supply-chain security, quality control and the ability to develop materials for specific customer and application requirements. The Oragadam installation also provides the operating knowledge required for the planned deployment of additional crystal-growth systems at Nava Raipur. Our objective is not merely to produce sapphire ingots, but to establish an industrial capability extending from engineered semiconductor materials to finished products.

With AEIM Pte Ltd opening its new manufacturing facility at Mapletree Hi-Tech Park in Singapore, how does this hub strengthen your international supply chain and customer delivery?

Singapore gives Polymatech a strategically located Asia-Pacific manufacturing and supply-chain hub. Through AEIM Pte Ltd, our wholly owned subsidiary, the Mapletree Hi-Tech Park facility supports commercial-scale LED Chip-on-Board packaging and advanced memory-module assembly while providing close access to customers, technology partners, equipment suppliers and logistics networks across Asia.

The facility enables us to shorten delivery cycles, respond more quickly to customer requirements and manage regional product qualification, sourcing and technical support from a globally recognised semiconductor and advanced-manufacturing centre. It also provides customers with supply-chain flexibility by linking our manufacturing capabilities in India with our material, substrate, equipment and engineering operations in France, Estonia and the United States.

Singapore is not intended to duplicate or replace our Indian operations. It performs a complementary role: India provides manufacturing depth and scale, while Singapore strengthens regional integration, customer access, supply-chain coordination and delivery reliability. This combination gives Polymatech greater resilience and allows us to serve international customers through multiple, coordinated manufacturing locations.

Your new Singapore facility is expected to create specialised engineering and manufacturing roles over the next five years. What is your broader strategy for developing and retaining highly technical talent across your global locations?

Semiconductor talent cannot be developed only through classroom education. Engineers and technicians must receive sustained exposure to equipment, processes, materials, quality systems, yield improvement and actual production conditions. Our approach is therefore to combine structured technical training with direct responsibility on operating manufacturing lines.

In Singapore, the facility is expected to create approximately 50 specialised engineering and manufacturing roles over five years. We intend to build this talent pipeline through local recruitment and engagement with Singapore's universities and technical institutions, supported by practical training from our equipment and technology partners. Across our global locations, employees will also benefit from exposure to different parts of the semiconductor value chain—from crystal growth and wafer preparation to substrates, packaging, memory assembly, equipment engineering and reliability analysis. This cross-functional and cross-border experience is essential for developing future technical leaders.

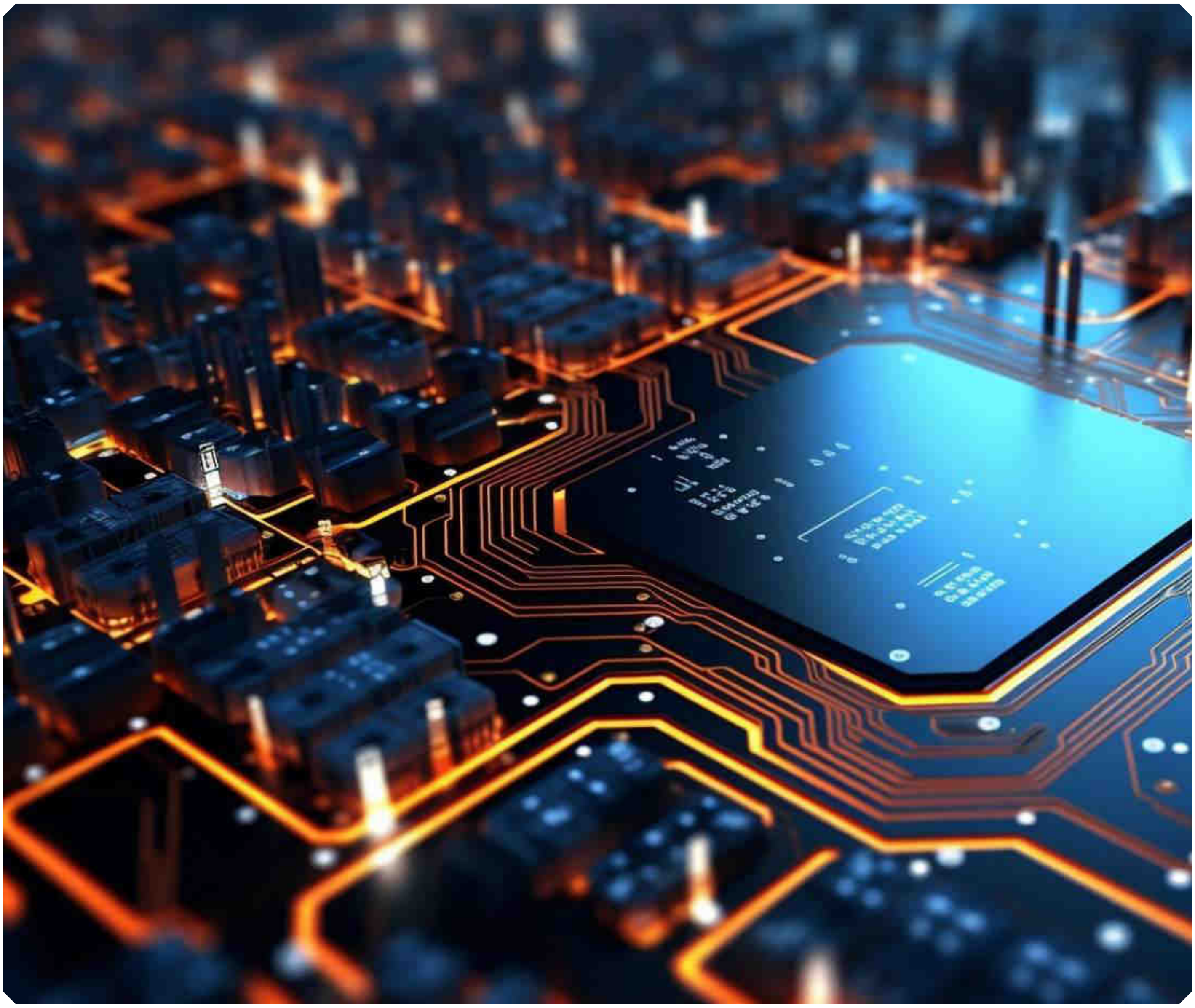
Retention ultimately depends on providing meaningful technical careers. Highly skilled people remain with an organisation when they are given advanced equipment, continuous learning, responsibility for measurable outcomes and a clear opportunity to participate in the creation of new manufacturing capabilities.

Looking at both the newly notified SEZ in Chhattisgarh and your existing hubs, how do these individual expansions tie together into your long-term vision of positioning Polymatech as a globally integrated semiconductor platform?

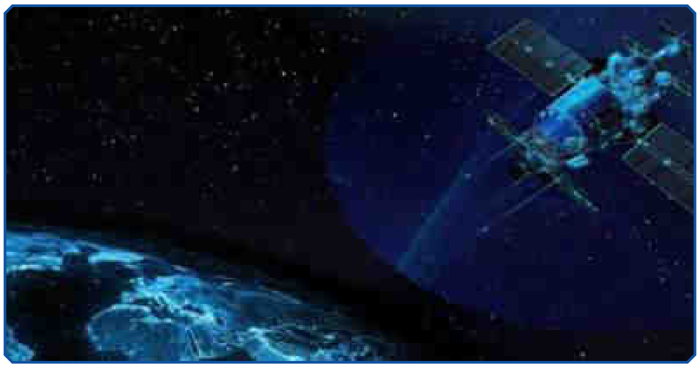
Our international facilities have been developed with defined and complementary responsibilities; they are not a collection of unrelated expansions. India provides our primary manufacturing base for semiconductor packaging, opto-electronics, advanced materials and large-scale expansion. Singapore serves as our Asia-Pacific advanced-manufacturing, supply-chain and customer-delivery hub. France strengthens sapphire crystal-growth and wafer-processing capability, Estonia contributes advanced PCB and substrate manufacturing, and the United States provides semiconductor equipment, reliability engineering and access to important end markets.

Together, these locations allow us to participate across a much broader section of the value chain—from engineered materials, ingots, wafers and substrates to packaging, modules, finished devices and reliability support. This structure reduces concentration risk, improves supply-chain resilience and enables each location to operate within the industrial ecosystem where it has the strongest comparative advantage.

Our long-term vision is to build Polymatech into a globally integrated semiconductor and advanced-electronics platform headquartered in India. The goal is not expansion for its own sake, but the creation of a coordinated manufacturing network capable of controlling critical technologies, serving international customers and building globally competitive semiconductor products from India.



UMS Launches Ka-Band High-Power RF Amplifier for Communications



United Monolithic Semiconductors (UMS) has expanded its RF product portfolio with the launch of the CHA8265-98F, a three-stage high-power amplifier designed for Ka-band satellite communications, 5G infrastructure, and microwave communication systems. Operating across the 27.5 GHz to 31 GHz frequency range, the amplifier addresses growing demand for higher data rates while maintaining power efficiency. At a 25 V drain voltage, the amplifier delivers 25 W saturated output power with 30% power-added efficiency (PAE), helping reduce energy consumption and heat generation in high-frequency applications. For linear operation, it provides 10 W output power with IMD3 of -25 dBc while maintaining over 25% PAE, ensuring high signal integrity for data transmission.

Iridium Completes Aireon Acquisition to Strengthen Aviation Services

Iridium Communications Inc. has completed its acquisition of Aireon LLC, the operator of the world's only space-based Automatic Dependent Surveillance-Broadcast (ADS-B) air traffic surveillance system. The acquisition strengthens Iridium's position in the aviation sector by combining Aireon's real-time air traffic surveillance and aviation intelligence services with Iridium's global satellite communications and positioning, navigation, and timing (PNT) capabilities. Aireon will continue operating as a wholly owned subsidiary, with Don Thoma remaining Chief Executive Officer and reporting to Iridium CEO Matt Desch, ensuring leadership continuity and strategic alignment. The integration creates a comprehensive platform that provides aviation stakeholders with real-time aircraft visibility, resilient connectivity.

Europe Accelerates Optical Communications for Sovereign Space

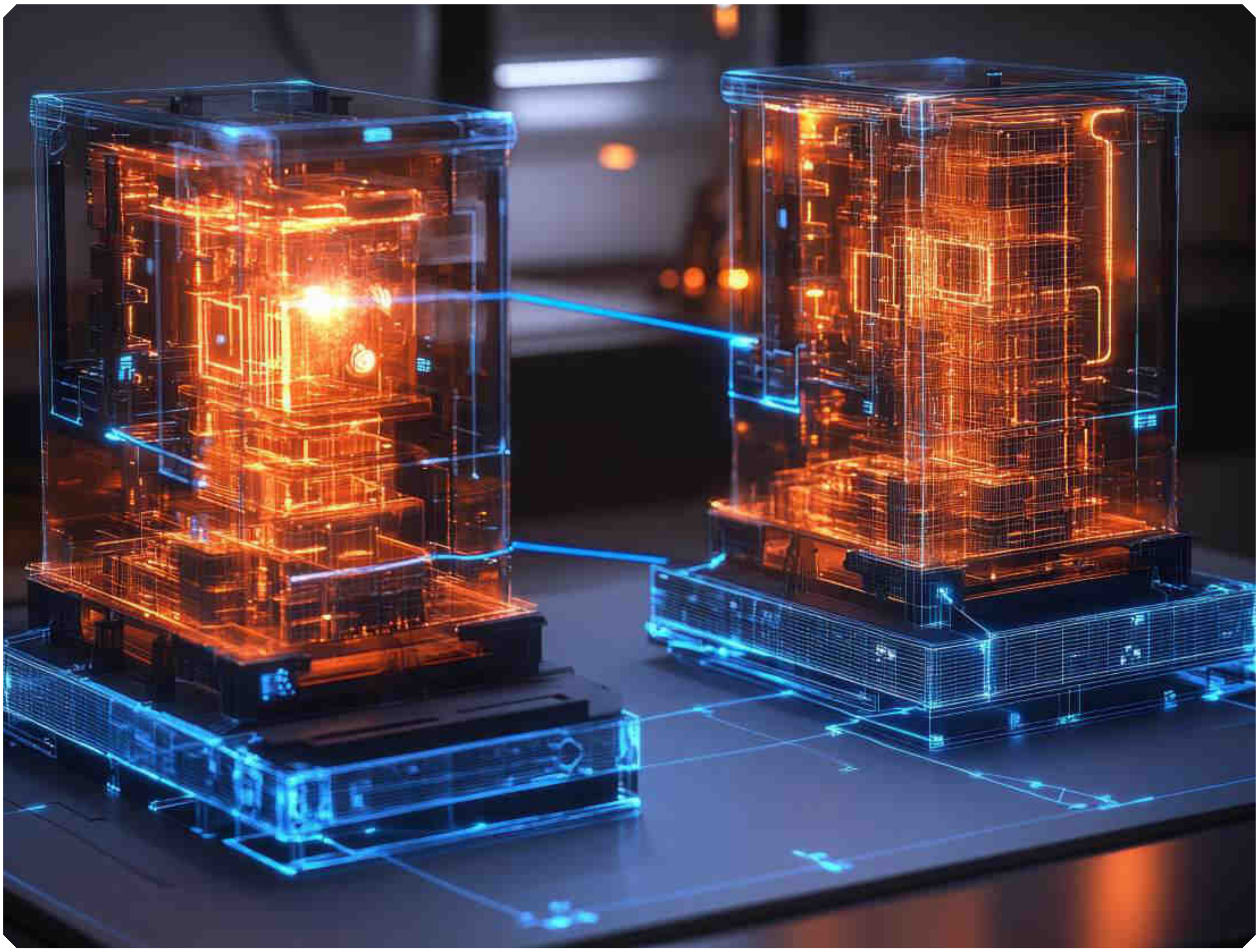
Europe is accelerating the adoption of optical communication technologies as part of its strategy to strengthen sovereign space infrastructure and reduce dependence on foreign satellite services. Recent initiatives, including the European Commission's focus on spectrum allocation for direct-to-device connectivity, the development of the IRIS² satellite constellation, and Germany's planned €35 billion investment in defence space capabilities, highlight this push. Unlike conventional radio frequency systems, optical communication uses laser-based links that can deliver up to 100 times higher data transmission rates while offering greater resistance to jamming, interception, and spectrum congestion. As satellite connectivity demand is projected to increase more than 11-fold between 2024 and 2034, according to Novaspace, optical links are expected to play a critical role in overcoming bandwidth limitations.

ESA Selects Keysight for Secure 5G Satellite Network Development

Keysight Technologies has been selected by the European Space Agency (ESA) to lead a three-year program aimed at developing secure, blockchain-enabled anomaly detection for 5G non-terrestrial networks (NTN). As the prime contractor, Keysight will collaborate with Sateliot to support technical development and satellite mission integration. Supported by ESA's Space for 5G/6G & Sustainable Connectivity program under the ARTES initiative, the project seeks to establish a secure and verifiable trust framework for satellite-based communication networks. The initiative addresses growing challenges in network security, anomaly detection, quality of service, and operational reliability as satellite constellations become more complex and increasingly integrated with terrestrial 5G infrastructure. Keysight will apply its expertise in design, test.

Your Digital Twin Should Be a Super-forecaster

"At Decimal Point Analytics, my analytics firm, we run the same assembly line on economic series such as India's wholesale price index — decompose, forecast, score, update. The domain changes; the discipline does not."



Walk into a modern factory and ask to see the digital twin. You will be shown something impressive: a photorealistic replica of the line, bearings glowing amber where vibration is trending up, a dashboard announcing that pump seven will fail in eleven days. Now ask a second question. When was this twin last wrong — and where is that written down? I have asked that question in boardrooms and on shop floors for years. The answer is almost always silence. And the silence is the diagnosis. A system whose errors nobody records is not a predictive instrument. It is decoration.

Manufacturing has paid for this confusion before. In the middle of the last decade, General Electric poured billions of dollars and its institutional prestige into Predix, a platform meant to become the operating system of the industrial internet. By 2018 the ambition had been broken up and scaled back. The episode was read as a lesson about software execution. The deeper lesson went unlearned: prediction is a discipline, and GE had bought a technology.

A Twin From First Principles

Strip away the vendor language and a digital twin does exactly two things. It estimates the present state of a physical system from incomplete, noisy sensor data. And it predicts the future states of that system under alternative actions: run on, slow down, intervene now, wait until Sunday. That is the whole machine. The three-dimensional render is packaging.

Seen from first principles, then, a digital twin is a forecasting engine, and its entire economic value is the value of the decisions its forecasts change. A model pays rent in predictions. If the predictions change no decisions, the twin's value is not zero but negative: it consumes capital and manufactures false confidence, which is worse than ignorance because it gets acted upon. The test is falsifiability: a forecast that cannot be graded is an opinion wearing a lab coat.

And once you accept that the twin is a forecaster, the only question left is impolite: how good a forecaster is it? Forecasting quality is not a matter of taste. It is a measurable science — one that was born, fittingly, on a factory floor.

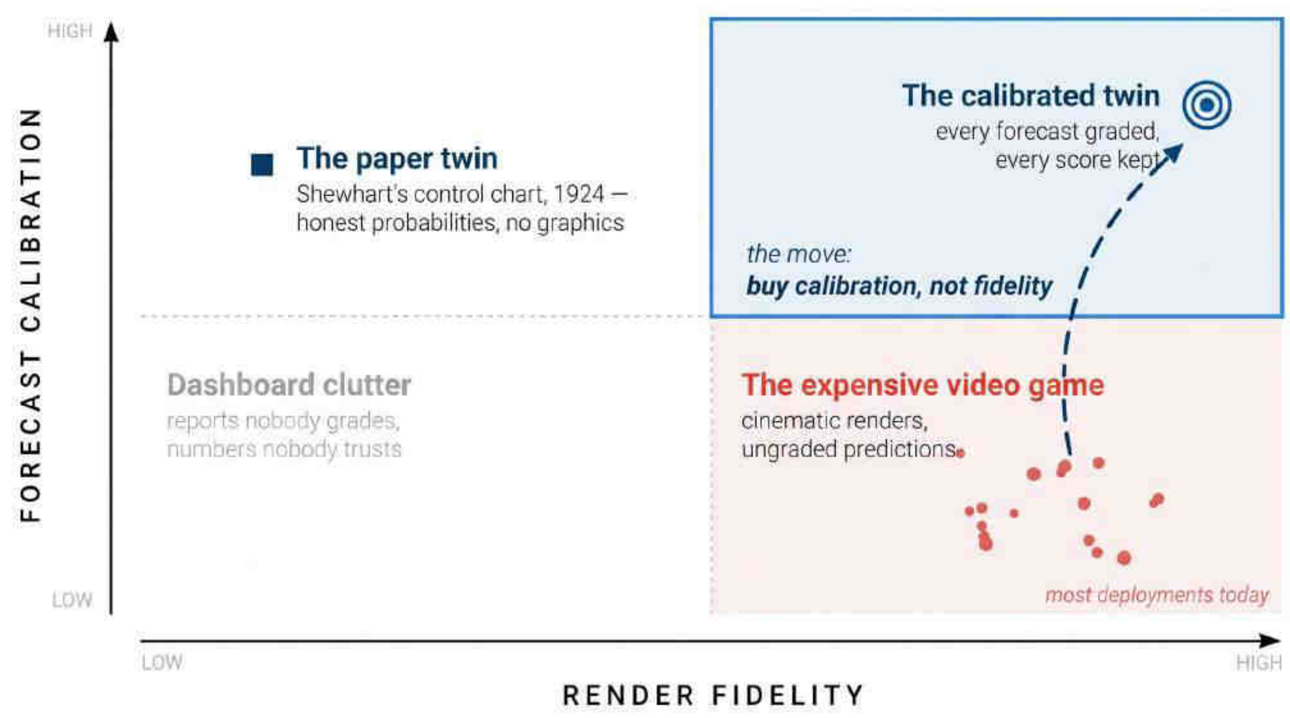
The Paper Twin of 1924

On 16 May 1924, Walter Shewhart, a physicist at Western Electric, handed his boss a one-page memo containing a small diagram. It was the first control chart and, properly understood, the first digital twin — executed on paper. The chart made a probabilistic forecast: this process, left undisturbed, will produce within these limits; a point outside them signals an assignable cause

EXHIBIT 1 — THE TWIN QUADRANT

Fidelity is not calibration — most digital twins occupy the wrong quadrant

Ways of building a twin, placed by what they render and what they can honestly predict



Source: Author's analysis. Positions are illustrative; the axes are the argument.

worth hunting down. Its power was not computational. It was epistemological. It forced the factory to separate signal from noise, and to predict before reacting.
W. Edwards Deming carried the idea to Japan in 1950, and Japan carried it to dominance in global quality. A century later, we have inherited Shewhart's computing power in unimaginable abundance and, in too many deployments, abandoned his epistemology. We upgraded the graphics and downgraded the statistics. We traded statistical thinking for cinematic rendering (Exhibit 1).

WHAT THE SUPERFORECASTERS KNOW

While manufacturers were perfecting the render, forecasting itself went through a quiet revolution. Beginning in 2011, IARPA — the research agency of the American intelligence community — ran a series of geopolitical forecasting tournaments. The winning team, Philip Tetlock's Good Judgment Project, was built not from credentialed experts but from ordinary volunteers — retired programmers, pharmacists, homemakers — trained in a handful of habits. By published accounts, its best forecasters outperformed professional analysts who had access to classified information.

The habits are almost embarrassingly unglamorous. Keep score: every forecast is a probability with a deadline, settled against reality and graded, typically with the Brier score, a measure weather forecasters have used since 1950. Decompose: break unanswerable questions into estimable parts, the way Fermi estimated piano tuners. Take the outside view first: before asking what is special about this case, ask what usually happens in cases like this. Update in small increments, and often; dramatic revisions usually reveal that the original number was theatre. Hunt disconfirmation, including through the pre-mortem: assume the forecast has failed, and write the story of why. And work in teams structured to disagree.

Now audit your digital twin programme against those six habits. Does every prediction it makes carry an explicit probability and horizon? Is there a ledger where its predictions are settled and scored? Are its calibration curves — when it says eighty per cent, does the event occur eight times in ten? — reviewed with the seriousness reserved for cash? Does anyone decompose its headline forecasts into auditable parts, check them against fleet-wide base rates, or run a pre-mortem on its advice before acting? Across most deployments I have seen, the honest score is zero out of six (Exhibit 2). Procurement documents specify sensor counts, integration standards and render fidelity; I have yet to see one specify calibration. Hence an uncomfortable aphorism: a digital twin without a Brier score is an expensive video game.

EXHIBIT 2 — THE SIX-HABIT AUDIT

Audited against the six habits of super-forecasting, the typical twin scores zero

The habits that beat professional analysts — and their absence on the shop floor

	THE HABIT	TOURNAMENT PRACTICE	TYPICAL DEPLOYMENT
01	**Keep score**	Every forecast a probability with a deadline; Brier score tracked	No prediction ledger — errors vanish unrecorded
02	**Decompose**	Big questions broken into small, estimable parts	Headline forecasts arrive whole and unauditable
03	**Outside view first**	Base rates across the reference class before case details	Every machine treated as unique; fleet data unused
04	**Update often**	Small, frequent revisions as evidence arrives	Set-and-forget models, revised only after failures
05	**Hunt disconfirmation**	Pre-mortems: assume failure, write the story of why	The twin's advice acted upon unchallenged
06	**Team of rivals**	Forecasts stress-tested by structured disagreement	Single vendor, single model, single view

Every habit is procurable; none is procured.

TYPICAL PROGRAMME AUDIT SCORE

0 / 6

Source: Author's analysis; habits adapted from Philip E. Tetlock and Dan Gardner, *Superforecasting* (2015)

EXHIBIT 3 — ARCHITECTURE OF THE CALIBRATED TWIN

Scoring underneath, machines in the middle, judgment at the boundary

Judgment frames the questions; machines compute the answers; the ledger keeps everyone honest.

HUMAN JUDGMENT *— at the boundary*

Chooses the questions worth answering · Owns the interventions · Runs the pre-mortems before acting

MACHINE INTELLIGENCE *— in the middle*

Physics simulation · Machine learning · LLM agents that decompose, fetch base rates and red-team scenarios

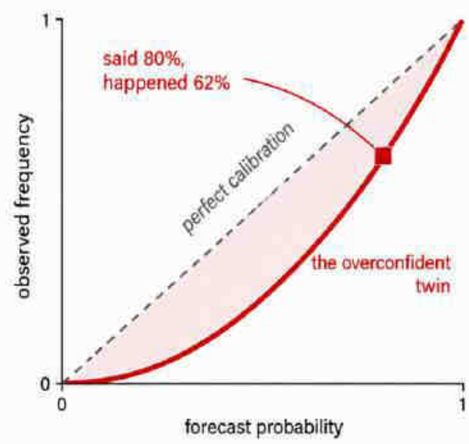
STATISTICAL SCORING *— underneath*

Prediction ledger · Brier scores · Calibration curves reviewed monthly, like working capital

Forecasts flow up; questions and decisions flow down; the ledger grades everything in between.

THE FOUNDATION'S TEST

When the twin says 80 per cent, does it happen eight times in ten?



Source: Author's framework

The irony is that manufacturing is the friendliest terrain the forecasting sciences have ever been offered. Outcomes arrive quickly, repeat endlessly, and are settled by instruments rather than by argument. A geopolitical forecaster waits years for one resolution; a plant settles hundreds of wagers a week. If calibration can be built anywhere, it can be built here.

The Architecture of The Calibrated Twin

What would the alternative look like? Call it the calibrated twin. From first principles its architecture has three layers: statistical scoring underneath, machine intelligence in the middle, human judgment at the boundary (Exhibit 3).

Underneath sits the prediction ledger. Every forecast the twin issues — failure probabilities, quality drift, throughput under a proposed schedule — is logged with its probability, its horizon and, eventually, its outcome. Calibration is computed monthly and reviewed like working capital. This inverts the usual ontology: the ledger, not the model, is the asset; the model is merely this month's method of making entries. Shewhart would recognise the move at once — it is a control chart drawn around the forecaster itself. And it changes behaviour the way scoreboards always do. The render is the demo; the ledger is the product.

In the middle, the machinery has become genuinely formidable. Physics-based simulation encodes what must be true; machine learning captures what tends to recur; and large language model agents can now do what once required scarce analysts — decompose a downtime question into sub-forecasts, retrieve base rates across a fleet of similar machines, generate scenario ensembles, and argue against their own conclusions before a human ever reads them. The middle layer should be promiscuous about techniques and monogamous about scoring: let any method compete, and let the ledger decide.

At the boundary stand people, doing the two things machines must not do alone. They choose the questions, because a forecast is worth making only if some decision changes with the answer; a twin predicting everything is a twin predicting nothing that matters. And they own the interventions — including the discipline of a pre-mortem before any consequential action the twin recommends. The future of manufacturing intelligence is not the machine replacing the engineer. It is the centaur: judgment at the edges, computation in the middle, arithmetic underneath keeping both honest.

The View From The ShopFloor

None of this is theoretical for me. At Empyreal Galaxy's plant in Nashik we build tethered aerostats — helium-filled systems that must hold station for weeks, in real weather, carrying sensitive payloads for demanding customers, including the armed forces. Our survival questions are forecasting questions. Will this Seems to survive months of cyclic load? At what rate will this envelope shed helium

Shailesh Dhuri
Co-founder & CEO,
Decimal Point Analytics

> *"At Decimal Point Analytics, my analytics firm, we run the same assembly line on economic series such as India's wholesale price index — decompose, forecast, score, update. The domain changes; the discipline does not."*

through a Deccan summer? Is Thursday's launch window real?

We could answer with simulation alone. We choose to answer with wagers. Material predictions are written down with a probability and a settlement date; when reality arrives, the ledger is updated before the next forecast is issued. The habit costs almost nothing — it is a spreadsheet discipline long before it is a software purchase. What it buys is the one thing a young manufacturer cannot otherwise acquire: the earned right to trust its own numbers. At Decimal Point Analytics, my analytics firm, we run the same assembly line on economic series such as India's wholesale price index — decompose, forecast, score, update. The domain changes; the discipline does not.

The economics compound quietly. A calibrated seventy per cent is worth more than an overconfident ninety-five, because everything downstream of the twin — maintenance scheduling, spares inventory, warranty reserves, insurance pricing — consumes probabilities, not pictures. Rolls-Royce grasped this decades ago: once you sell engine hours rather than engines, the calibration of your predictions is your margin. As Indian manufacturers climb into outcome contracts and uptime guarantees, forecast calibration stops being an engineering nicety and becomes a line in the P&L.

Five Moves For The Operations Leader

For the leader who accepts the argument, the programme is five moves, in ascending order of difficulty and descending order of excuse.

First, give the twin a scorecard. Log every material prediction with probability, horizon and outcome; compute Brier scores and calibration curves; give ten minutes of the monthly operations review to the twin's accuracy. What is inspected improves — the forecaster included.

Second, buy calibration, not fidelity. Rewrite the request for proposal. Ask vendors for their prediction track record on comparable assets, and tie a portion of payment to demonstrated accuracy gains on yours. Watch the market reprice overnight.

Third, decompose before you simulate. Insist that headline forecasts arrive as auditable sub-forecasts, so that when the twin is wrong you learn which belief failed, not merely that one did. Error you can localise is tuition; error you cannot is loss.

Fourth, import the outside view. Before believing your machine is special, ask how machines like it usually behave — across your fleet, your industry, your suppliers' installed base. A machine is a member of a population before it is an individual.

Fifth, keep judgment at the boundary. People select the questions and own the interventions, with a pre-mortem before every consequential act. The twin advises; the ledger grades; humans decide.

India's Open Lane

For Indian manufacturing, this argument arrives at a convenient hour. The capacity now being poured into electronics, semiconductors, electric vehicles and defence is overwhelmingly greenfield, and greenfield is precisely where the calibrated twin is cheapest to build — poured into the foundation rather than retrofitted onto decoration. The decorative-twin decade was a rich economy's detour; there is no law that says we must repeat it.

The current wave of incentive-led capacity gives us hundreds of new plants to instrument correctly the first time. Discipline scales cheaper than graphics. Japan built a quality empire on Shewhart's paper twin. India can build a prediction empire on its digital descendant.

The Only Question That Matters

Deming, Shewhart's greatest student, is remembered for a warning: in God we trust; all others must bring data. The 2026 revision writes itself: all twins must bring calibration curves.

So the next time someone demonstrates a digital twin — cinematic, confident, glowing amber — ask the only question that matters. When was it last wrong, and who wrote it down? If there is an answer, you are looking at a forecaster earning trust, one settled wager at a time. If there is silence, you are looking at a mirror. Mirrors are lovely. But mirrors only show the present. The future belongs to the factories that keep score.

Tata Communications Strengthens Leadership Across Network, Cloud and Cybersecurity

Tata Communications has announced two key leadership appointments to strengthen its network infrastructure, cloud, and cybersecurity businesses. The company has named Rupesh Chokshi as Executive Vice President and Global Business Head – Network Services and Chief Technology Officer, while Vivek Srivastava has been appointed Executive Vice President and Business Head – Cloud and Cyber Security Services. Both executives will join the company's Global Management Committee. Rupesh Chokshi brings over 25 years of experience in networking, cloud connectivity, cybersecurity, and software-defined infrastructure. Previously Senior Vice President and General Manager of Application Security at Akamai Technologies, he also held senior roles at AT&T. At Tata Communications, he will lead the Network Services business, focusing on product strategy, AI-driven network innovation, and strengthening global digital infrastructure.

Aziro Technologies Appoints Suraj Sehgal as Chief Strategy Officer

Aziro Technologies, a provider of digital transformation and product engineering services, has appointed Suraj Sehgal as its Chief Strategy Officer (CSO) to support its global expansion and strengthen its artificial intelligence (AI) initiatives. The appointment comes as the company scales its presence in international markets and enhances its portfolio of AI-driven solutions. With enterprises increasingly seeking AI-focused technology partners, Aziro is investing in strategic partnerships and expanding its agentic AI offerings for software development, business operations, and consumer applications. In his new role, Sehgal will lead the company's strategic growth agenda, focusing on strengthening customer value, expanding market reach, and driving innovation across global enterprise engagements. The appointment is part of a broader leadership restructuring at Aziro Technologies. The company has also named Anand JK Jain as Deputy Chief Technology Officer.

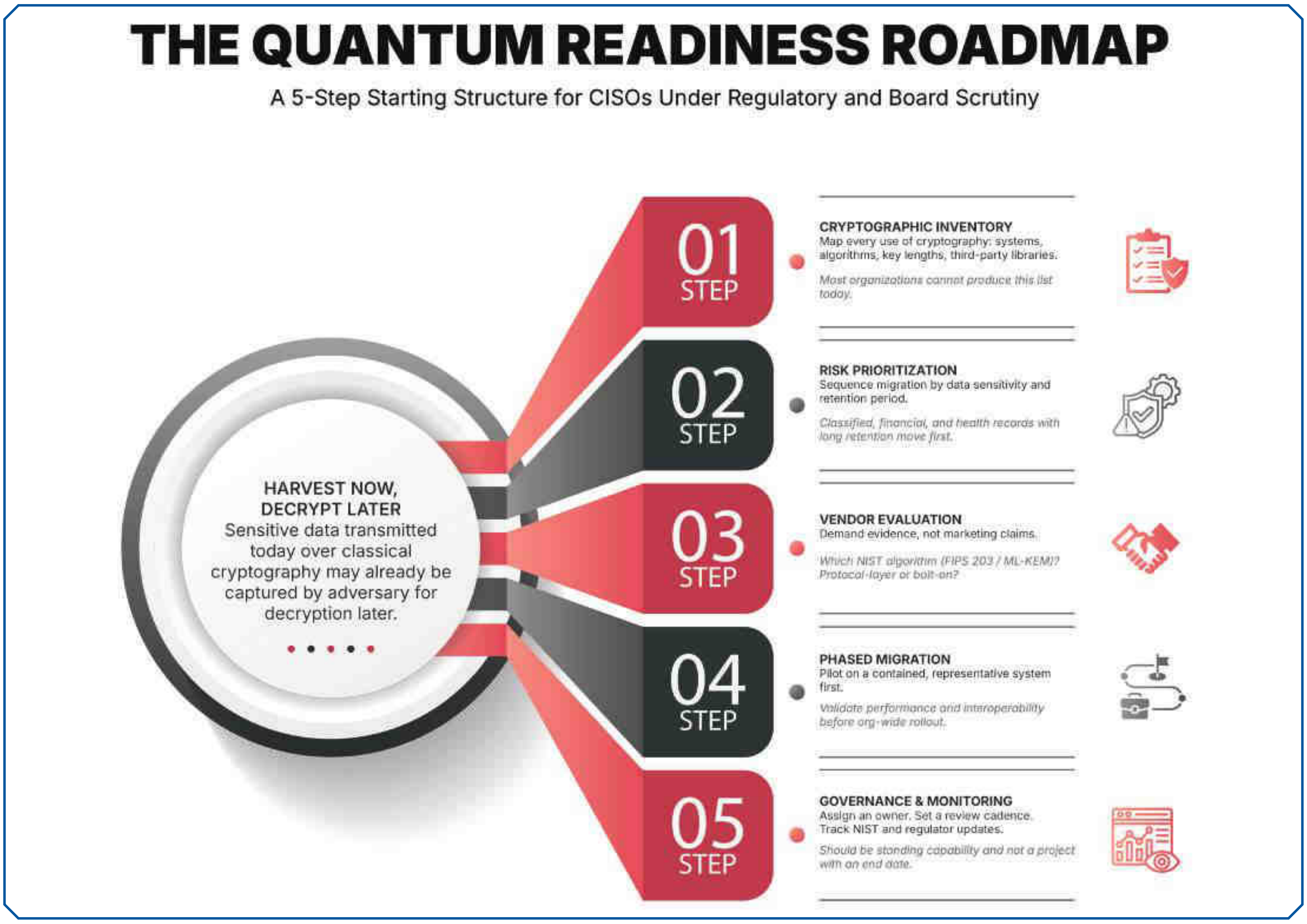
Rapidise Appoints Hardik Shah to Lead Solution Engineering

Rapidise, an India-based deep-tech Original Design Manufacturer (ODM), has appointed Hardik Shah as Senior Director – Solution Engineering to strengthen its IoT ODM business. Based in Ahmedabad, Shah will lead solution engineering, pre-sales, customer engagement, and go-to-market execution, supporting business growth across multiple industry sectors. The appointment comes as Rapidise expands its end-to-end ODM platform to address increasing demand for integrated product development and electronics manufacturing services. In his new role, Shah will collaborate with customers as well as the company's engineering and manufacturing teams to develop scalable product solutions, enabling OEMs to accelerate the journey from concept to commercial deployment.

Vertiv Promotes Raghavendra Kale to Lead India Channel Strategy

Vertiv, a global provider of critical digital infrastructure solutions, has promoted Raghavendra Kale as Channel Leader for India. In his new role, he will oversee the company's channel sales strategy, with a focus on expanding partner reach, accelerating market penetration, and strengthening engagement across key channel segments. Kale brings nearly three decades of industry experience and has built strong expertise in channel management and partner development. Most recently, he served as Director, West Zone, Channel, where he played a significant role in streamlining operations, strengthening the partner ecosystem, and driving sustained business growth across the region. He will now lead the development of a scalable partner framework to support strategic accounts and reinforce Vertiv's channel-led growth strategy in India.

Preparing for the Quantum Era: A Practical Roadmap for India's Government, BFSI, and Critical Infrastructure Sectors



For most of the last four decades, the security of digital communication has rested on a simple mathematical bet: that certain problems are too hard for any classical computer to crack in a useful timeframe. RSA, Diffie-Hellman, and elliptic-curve cryptography, the algorithms that secure everything from banking transactions to classified government communications, all depend on this bet holding.

Quantum computing is the development that breaks it. A sufficiently powerful, fault-tolerant quantum computer running Shor's algorithm could factor the large numbers underlying RSA encryption in hours rather than the billions of years a classical supercomputer would need. When that day arrives (often called as Q-Day) every message, transaction, and record ever encrypted with today's public-key cryptography becomes retroactively readable, unless it has already been re-secured with quantum-resistant methods. For regulated sectors, that uncertainty is beside the point. The threat that matters today isn't a future decryption event, it's a present-day exfiltration one.

The "Harvest Now, Decrypt Later" Problem

Nation-state actors and sophisticated threat groups do not need a working quantum computer today to benefit from one tomorrow. They only need to capture and store encrypted traffic now, and wait. This "harvest now, decrypt later" pattern is already a documented concern among national security agencies, and it fundamentally changes the risk calculus for any organization whose data needs to remain confidential for years, not months.

That single fact explains why government, financial services, and critical infrastructure operators are the sectors under the most immediate pressure to act. Classified government communications are frequently required to remain protected for decades. Financial institutions retain customer records, transaction histories, and trading data under regulatory mandates that stretch for seven, ten, sometimes twenty years or more. Critical infrastructure like transport, energy grids, water systems, industrial control networks often runs on hardware and communication protocols with operational lifespans measured in decades. If any of that data or infrastructure is protected only by classical cryptography, it is already, in a meaningful sense, on borrowed time.

The Regulatory Signal Is No Longer Subtle

India's own policy apparatus has moved on this faster than many enterprises operating here have registered. The Union Cabinet approved the National Quantum Mission in April 2023* with an outlay of roughly ₹6,000 crore through 2030-31, funding thematic hubs across IISc and the IITs covering quantum computing, communication, sensing, and materials including satellite-based secure quantum communication and inter-city quantum key distribution networks, with C-DOT already developing indigenous capability in this space.

More directly relevant for enterprise security leaders: a task force constituted under the Mission, chaired by C-DOT's chief executive with IIT Kanpur's Manindra Agrawal* as co-chair, released a report earlier this year on implementing a quantum-safe ecosystem in India. Its central recommendation is a phased migration to post-quantum cryptography across the country's most critical sectors which is government, defence, power, telecom, transport, and banking and financial services with full adoption targeted for Critical Information Infrastructure (CII)* by 2029 and broader adoption across non-CII systems by 2033. The report also proposes a tiered, risk-based national testing and certification framework, developed with input from the Telecommunication Engineering Centre, the Bureau of Indian Standards, and MeitY, with the highest assurance tier reserved for sovereign and critical national infrastructure and pointing toward indigenous cryptographic implementations rather than reliance on foreign-validated products alone. RBI, SEBI, and CERC (Central Electricity Regulatory Commission) are all named participants in shaping how this plays out sector by sector, which means Indian banks, insurers, and financial infrastructure providers should expect quantum readiness to surface in supervisory conversations well before 2029, not right at the deadline.

This is not happening in isolation from the rest of the world. NIST(National Institute of Standards and Technology) finalized its first three post-quantum cryptography standards in 2024, including FIPS 203*, which specifies the Module-Lattice-Based Key-Encapsulation Mechanism (ML-KEM) is steadily tightening its expectations around demonstrable quantum-readiness for vendors. The EU's NIS2 Directive and DORA* impose comparable pressure across Europe, and Singapore's MAS* has embedded similar expectations into its TRM (Monetary Authority of Singapore Technology Risk Management) guidelines for financial institutions.

India's own CII (Critical Information Infrastructure) timeline sitting alongside NIST's finalized standards: organizations handling sensitive, long-lived, or systemically important data need a credible, demonstrable plan for cryptographic resilience, on a timeline measured in single-digit years, not a comfortable multi-decade horizon.

Critical infrastructure operators face a particular version of this pressure. Power, telecom, and transport systems often run on operational technology with refresh cycles measured in decades, which means cryptographic decisions made today, or deferred today, will still be in production well past 2029. Phased CII timeline has been assigned to force inventory and planning work to start now, years ahead of when migration actually needs to be complete.

What "Quantum-Ready" Actually Means

This is where many organizations get the strategy wrong. Quantum readiness is not a single product purchase or a one-time algorithm swap. It is an architectural property, usually described as crypto-agility: the ability to change cryptographic algorithms, key sizes, and protocols across an organization's systems without re-architecting those systems from scratch.

This distinction matters because the current generation of NIST-standardized algorithms will not be the last word. Cryptographic standards evolve, vulnerabilities are occasionally found even in newly standardized algorithms, and migration is rarely a single event, it's a capability an organization needs to sustain indefinitely. An organization that hard-codes a specific post-quantum algorithm into its infrastructure without building in the ability to rotate or upgrade that algorithm later has solved today's problem while quietly recreating tomorrow's.

A second architectural question that regulated organizations should press their vendors on is where quantum-resistant cryptography actually lives in the technology stack. Some vendors add post-quantum protection as a bolt-on layer, a VPN(Virtual Private Network) tunnel or gateway-level encryption wrapped around an otherwise unchanged application. Others build the resistance into the communication protocol itself, so that every message, call, and file transfer is quantum-resistant by default, rather than dependent on a separate layer being correctly configured and maintained. Protocol-layer implementation is generally more resilient because it removes a category of misconfiguration risk and doesn't depend on every endpoint and network path being wrapped correctly.

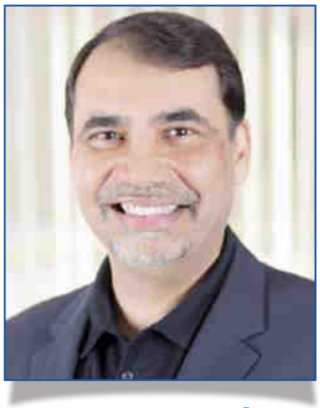
A third, more immediate consideration is the transition period itself. Because we are in the early years of post-quantum deployment, most credible implementations today use hybrid approaches which is combining a classical algorithm like elliptic-curve cryptography with a NIST-standardized post-quantum algorithm such as ML-KEM, so that a system remains secure even if unexpected weaknesses are later found in the newer algorithm. This hybrid posture, not a wholesale and immediate rip-and-replace of classical cryptography, reflects current best practice guidance from standards bodies and reflects the pragmatic reality that migration will be gradual.

A Practical Five-Step Roadmap

For CISOs and technology leaders in government, financial services, and critical infrastructure sectors who are being asked by regulators, boards, or auditors about the organization's quantum plan actually is, the following sequence offers a workable starting structure.

Conduct a Cryptographic Inventory

- Identify where cryptography is used across your organization.
- Document algorithms, key lengths, systems, applications, and third-party libraries.
- Prioritize systems handling sensitive or long-lived data.



Anurag Lal
President & CEO, NetSfere

> *"With India's own Critical Information Infrastructure timeline now pointing to 2029, the regulatory and standards landscape has moved from research question to operational expectation faster than many enterprise security roadmaps have kept pace with."*

Prioritize Risk

- Classify data based on sensitivity and retention period.
- Focus first on data that must remain confidential for years, such as healthcare, financial, government, and critical infrastructure information.
- Factor in the "Harvest Now, Decrypt Later" threat when planning migration.

Evaluate Technology and Vendors

- Look beyond marketing claims.
- Verify support for NIST-standardized post-quantum algorithms (such as FIPS 203 / ML-KEM).
- Assess whether implementations are production-ready, crypto-agile, and independently verifiable.

Adopt a Phased Migration Approach

- Begin with pilot deployments on representative systems.
- Validate interoperability, performance, and operational impact before wider rollout.
- Build internal expertise during the transition.

Establish Continuous Governance

- Treat quantum readiness as an ongoing security program, not a one-time project.
- Assign ownership and regularly review evolving guidance from NIST, regulators, and cybersecurity agencies.
- Continuously monitor and update cryptographic strategies as standards evolve.

CII buyers should additionally ask where a vendor's solution is likely to sit once the national testing and certification framework proposed under the Quantum Mission task force is finalized, since the highest assurance tier is expected to favour demonstrable, independently verifiable cryptographic implementations over self-attested claims.

Lessons from Early Movers

We've had the opportunity to work through several of these questions directly, having built quantum-resistant encryption into NetSfere's enterprise communication platform using ML-KEM 1024 at the protocol layer, applied uniformly across messaging, voice, and video rather than as an optional add-on. NetSfere, a global leader in next-generation secure and compliant messaging and mobility solutions, unveils the industry's first Quantum-Proof Secure Communication Platform. Powered by ML-KEM 1024 (Module-Lattice-Based Key-Encapsulation Mechanism) quantum-safe encryption, this platform sets a new standard in secure messaging. NetSfere's crypto-agile architecture ensures a seamless transition to quantum-safe cryptography while maintaining backward compatibility for existing encrypted data. This advanced quantum-proof encryption ensures that NetSfere's security remains resilient and robust, even in the era of quantum computing, safeguarding enterprise data against the complex threats of tomorrow.

Conclusion

The quantum threat to classical cryptography is not speculative, and for government, BFSI, and critical infrastructure organizations specifically, it is not a distant one either, given how long the data these sectors handle needs to remain confidential. With India's own Critical Information Infrastructure timeline now pointing to 2029, the regulatory and standards landscape has moved from research question to operational expectation faster than many enterprise security roadmaps have kept pace with. The organizations that will be best positioned when that deadline or Q-Day itself, whenever it arrives comes due are not the ones waiting for certainty about the timeline, but the ones already building the inventory, the prioritization discipline, and the crypto-agile architecture that quantum readiness actually requires.

About NetSfere

NetSfere is a next-generation secure enterprise communication platform, delivering AI-powered, quantum-proof encryption to safeguard mission-critical communications in an era of evolving cyber threats. A product of Infinite Convergence Solutions, Inc., NetSfere's global, cloud-based service offers end-to-end encrypted messaging, real-time collaboration, compliance-driven security features, location-based controls, and comprehensive IT administrative oversight and control. The platform is backed by strategic partnerships with Deutsche Telekom GmbH and NTT Ltd., enabling organizations worldwide to deploy secure, compliant, and AI-driven communication solutions. Leveraging Infinite Convergence's legacy of delivering carrier-grade mobility solutions, NetSfere's technology supports over 500 million subscribers and processes more than a trillion messages annually. The platform is fully compliant with global regulatory standards, including GDPR, HIPAA, SOC 2, FedRAMP, Sarbanes-Oxley, ISO 27001, and more.

Infinite Convergence Solutions has offices in the United States, United Kingdom, Germany, India, and Singapore. Learn more at www.netsfere.com.

Why standardized OTA is a fit for every power train

The software-defined vehicle conversation has, almost by default, become an electric vehicle conversation. Ask an automotive engineer to picture an SDV and the image that forms is predictable: a battery-electric platform with a clean-sheet electronic architecture, centralized compute, and a software stack designed without the challenges of legacy hardware. The logic is understandable. EVs arrive without decades of accumulated ECU sprawl, so they present the path of least resistance for continuous software management.

But that logic contains a significant blind spot and it is not simply that most vehicles on the road still run on internal combustion engines, although they do. It is that the coming decade belongs to mixed fleets. Every volume manufacturer will spend the next ten to fifteen years selling gasoline, hybrid and battery-electric vehicles side by side in large, cost-sensitive markets. An over-the-air update strategy that only works for one of those powertrains leaves an OEM with an unattractive choice: run parallel software-management systems for each platform generation or postpone software-defined capability until the portfolio has finished a transition that will take a generation to complete.

A production program now running in India points to a third option. The new Tata Sierra, engineered by Tata Motors Passenger Vehicles with over-the-air infrastructure delivered by eSync Alliance member Excelfore, is a gasoline-powered vehicle designed from inception as a software-defined platform. It is the first production deployment of eSync Alliance specifications on a software-defined internal combustion engine vehicle in India. But the real lesson of the program is not that OTA can be made to work on a gasoline vehicle. It is that the architecture updating a gasoline Sierra is the same architecture that could update a hybrid or an EV, which means an OEM can deploy it today, on the vehicles it sells today, and carry it forward as the powertrain mix evolves.

Designed in, not bolted on

What distinguishes the Sierra program is not simply that the vehicle can receive software updates. Plenty of vehicles can, through proprietary systems of varying sophistication. The distinction is architectural: OTA update capability and remote diagnostics were embedded as core elements of the vehicle's electronic architecture from the earliest stages of development, rather than retrofitted onto a finished design.

That decision changes everything downstream. When update capability is an afterthought, it sometimes reaches only the head unit or telematics controller, leaving most of the vehicle's software estate - powertrain controllers, body electronics, ADAS modules - frozen at the point of manufacture. When it is designed in, the entire distributed electronic architecture becomes addressable, manageable and improvable across the vehicle's operational life.

The Sierra's update infrastructure is an implementation of eSync Alliance specifications, which define a multi-company framework for secure, bi-directional data exchange between cloud infrastructure and in-vehicle devices. Its remote diagnostics capability is enabled through an implementation of Service-Oriented Vehicle Diagnostics (SOVD), the specification published by ASAM, the Association for Standardization of Automation and Measuring Systems. It is worth being precise about what was deployed here: not a powertrain-specific variant of the eSync specification, because no such variant exists. These are the same specifications proven in vehicle programs worldwide, applied to a gasoline platform because the specifications themselves are indifferent to what turns the wheels.

Two standards, one operating model

The eSync specification addresses the delivery problem: how software and firmware move securely from cloud to vehicle, how they are distributed to the correct end devices within the vehicle, and how data flows back in the opposite direction. It defines a server-client-agent pipeline in which a cloud-side server communicates with an in-vehicle client, which in turn manages agents attached to individual ECUs and smart devices. Because the interfaces between these elements are standardized, components from different suppliers can interoperate within the same pipeline, the property that distinguishes a standards-based deployment from a proprietary one.

SOVD addresses a different problem: how diagnostic services are exposed and accessed in vehicles whose architectures no longer resemble the ECU topologies that classical diagnostic protocols were designed around. By abstracting diagnostics away from transport-level constraints and legacy protocol dependencies, SOVD allows diagnostic functions to be reached consistently whether the requester is a workshop tester, a cloud service or an in-vehicle application.

Note what neither specification mentions: powertrain. The pipeline addresses ECUs and software images; the diagnostics layer addresses services and data. An engine control module, a hybrid supervisory controller and a battery management system are, from the pipeline's perspective, simply end devices with agents attached. Deployed together, as they are on the Sierra, the two specifications form a standards-based operating model for the whole software lifecycle, one that transfers unchanged across every powertrain an OEM builds.

The harder engineering problem

Delivering this on an internal combustion engine platform is, if anything, the harder version of the engineering problem. A clean-sheet EV architecture typically concentrates software into a small number of high-performance compute nodes, simplifying update orchestration considerably. A gasoline-derived architecture distributes software across a larger population of heterogeneous ECUs, each with its own memory constraints, boot behavior, bus position and update characteristics. Updating one module in isolation is straightforward. Updating many interdependent modules coherently, on a vehicle owned by a customer who expects it to start every morning, is not.

The Sierra implementation answers this through intelligent orchestration of the distributed ECU population. Campaign management coordinates updates across multiple ECUs so that interdependent software versions move together rather than drifting apart. Differential delta delivery transmits only the changed portions of a software image, which matters enormously in markets where cellular bandwidth carries a real cost and connectivity cannot be assumed to be continuous. Rollback and recovery mechanisms ensure that a failed or interrupted update returns the vehicle to a known-good state rather than leaving a module inoperable. And bi-directional cloud-to-vehicle communication closes the loop, enabling continuous monitoring of fleet software health and informing the next update cycle.

This is also why the Sierra matters so much for what comes next. If the distributed-ECU problem has been solved on a gasoline platform, other powertrain technologies are already within reach.

One pipeline for a mixed fleet

Step back from the single vehicle and the fleet-level argument comes into focus. An OEM's fleet over the next fifteen years could contain gasoline vehicles, diesels, hybrids and battery-electric models, often built on different platform generations. Under a proprietary, per-platform approach to OTA, each of those may bring its own cloud backend, its own campaign tooling, its own security audit surface and its own engineering team. The cost multiplies, and so does the risk.

A standards-based architecture collapses that multiplication. One cloud infrastructure, one campaign management system and one security model serve the entire fleet; what changes from vehicle to vehicle is the population of agents matched to that vehicle's ECUs. The investment Tata Motors has made in the Sierra program is therefore not stranded in a single model or a single powertrain. When electric derivatives arrive, they could plug into the same server, the same client model and the same operational processes - new agents, same architecture. No OEM needs to wait for a powertrain transition, or for a rearchitected vehicle, to begin managing software across its fleet. The infrastructure deployed today is the infrastructure the transition itself will run on.

For an OEM, this reframes the build-versus-standards decision as a decision about the next fifteen years rather than the next program milestone. Tata Motors' adoption of eSync specifications reflected a recognition that standards-based OTA and diagnostics deliver transparency, interoperability and long-term sustainability: Tier-1 suppliers and internal engineering teams can manage, extend and maintain the platform across its lifecycle without vendor lock-in, integration friction falls when suppliers change, and the architecture is insulated against technology shifts, including the biggest shift of all, the one happening under the hood.

The practical consequence is a different relationship between manufacturer and product. A conventionally engineered car is, in software terms, finished on the day it leaves the plant. A vehicle built on this architecture evolves continuously instead: functional refinements, efficiency improvements, security patches and diagnostic enhancements reach the fleet within days of validation, while diagnostic data flowing back lets engineering teams observe software behavior across millions of real operating hours. Multiply that across a mixed fleet on a single pipeline, and the OEM gains one coherent view of software health across every powertrain it sells.

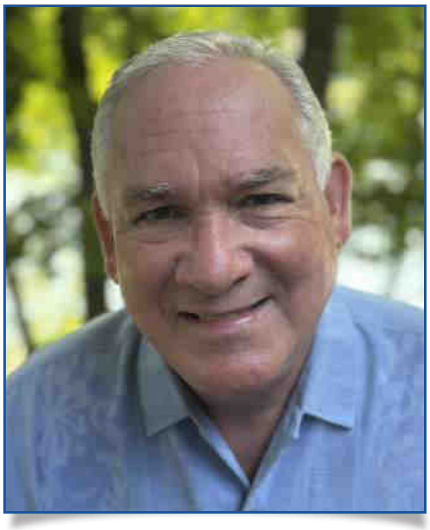
It takes an ecosystem

Innovation at this scale is expensive, and little of it can be accomplished by any single company. The Sierra deployment drew on Tata Motors as the OEM, Excelfore as the eSync-based technology provider, cloud infrastructure running on AWS, and the specification work of two trade associations, the eSync Alliance and ASAM, whose collaboration made the combined OTA-plus-SOVD model deployable. Standards organizations exist to distribute the cost of innovation, accelerate shared technology and guarantee interoperability that no bilateral agreement can; because they evolve through structured collaboration among OEMs, Tier-1s, tool vendors and cloud providers, the platforms built on them remain current and secure over decades.

The market signal

India is the world's third-largest automotive market, one where gasoline vehicles will remain a substantial share of sales for years and where the electrification journey has already begun. It is also a market that imposes real discipline: cost sensitivity is high, connectivity is variable, and engineering budgets do not stretch to speculative architecture programs. When an OEM of Tata Motors' scale selects a standards-based approach for a production vehicle in that environment, the signal reaches well beyond India - open, interoperable OTA is commercially viable for volume manufacturers today, on the powertrains they sell today.

The eSync Alliance's specifications are indifferent to what sits under the hood. They are concerned with interoperability, auditability and scalability; qualities that matter as much in a combine harvester or an excavator as in a connected passenger car, which is why the Alliance continues to extend its specifications across passenger, commercial and off-highway segments. The vehicles that need continuous software management are not only the next generation powered by batteries; they are the ones already on the road. The infrastructure to support all of them exists, it is standardized, and it is in production. The Sierra is the proof and the point is that nothing about it needs to change when the powertrain does.



Mike Gardner
Executive Director
the eSync Alliance

What industry can expect from ISM 2.0 and the key priorities that will determine its long-term success

When the Union Budget 2026-27 announced India Semiconductor Mission 2.0, it marked something more significant than a policy continuation. It marked a strategic inflection point, the moment India moved from building a semiconductor ecosystem to deliberately engineering one that can compete, and contribute, on a global scale.

ISM 2.0 represents a decisive shift from ecosystem creation to ecosystem consolidation and global integration. Having observed India's technology trajectory closely over the past decade, I believe this distinction matters enormously. ISM 1.0 was, in many ways, India's entry statement, a commitment that the country was serious about semiconductors. ISM 2.0 is something different. It is an execution mandate, and the industry needs to read it as such.

The scale of the commitment reinforces that seriousness. With an allocation of ₹1.25 lakh crore, approximately $13.21 billion, ISM 2.0 represents a near-doubling of the funding committed under ISM 1.0, which had an outlay

Chandrakant Agrawal
Co-Founder & CEO
AppSquadz

> *"The industry needs to engage directly with this agenda rather than treating it as the government's problem alone."*

of ₹76,000 crore. But the more consequential shift is not in the quantum of investment, it is in the scope of what that investment is designed to accomplish.

From manufacturing incentives to full-stack value chain thinking

ISM 1.0 was principally structured around attracting capital into wafer fabrication facilities and assembly and test infrastructure through fiscal incentives. That model served its purpose, it established India's credibility as a semiconductor investment destination and laid the physical and regulatory groundwork for what follows. As of December 2025, ten projects with investments of ₹1.60 lakh crore have been approved across six states, covering silicon fabs, compound semiconductors, and advanced packaging.

ISM 2.0 widens that lens considerably. The program focuses on six key pillars: chip design, semiconductor equipment and materials, new fabrication plants, strengthening the ATMP/OSAT industry, research and development, and talent development. This breadth is deliberate and, in my view, correct. A semiconductor ecosystem that can only assemble and test, but cannot design, cannot produce its own equipment, and cannot develop the materials its fabs require, remains structurally dependent on external players at precisely the points that matter most. ISM 2.0 is designed to address that dependency systematically rather than incrementally.

The Chip Design Opportunity, India's Most Underutilized Advantage

Of all the pillars within ISM 2.0, chip design is where India's existing strength is most visible and most underexploited simultaneously. India already contributes meaningfully to global semiconductor design, a significant volume of chip design work for global semiconductor companies happens out of Indian engineering centers, even when fabrication occurs elsewhere. That capability exists. What has been missing is the infrastructure to convert that capability into owned intellectual property, commercializable products, and globally competitive fabless companies.

ISM 2.0 introduces product development grants, EDA tool funding, foundry access support, and market linkage programs to help Indian startups move from chip design to commercial production and customer engagements. Twenty-four semiconductor design startups have already been supported under the DLI scheme, attracting nearly ₹430 crore in venture capital funding, and ISM 2.0 aims to scale that cohort to over 100 companies.

This is the right direction. India's fabless semiconductor opportunity is not theoretical, it is grounded in demonstrated engineering depth. The question has always been whether the ecosystem around that talent, EDA access, foundry relationships, IP support, go-to-market infrastructure, would develop at a pace that allows Indian chip design companies to reach commercial maturity rather than remaining perpetual proof-of-concept operations. ISM 2.0's design-focused provisions are a serious attempt to close that gap.

The Digital India RISC-V program deserves specific mention here. By promoting open-source processor development without licence costs, the program creates a pathway for Indian engineers and startups to develop processor architectures without the prohibitive IP licensing structures that have historically disadvantaged new entrants in the global semiconductor market. For a country building its design ecosystem from a position of scale rather than decades of incumbency, this is strategically significant.

The Equipment and Materials Gap, The Most Critical Frontier

If chip design represents India's most visible existing strength, semiconductor equipment and materials represent its most significant structural gap, and the one that will ultimately determine whether India's fabs and packaging facilities can achieve genuine operational independence.

India currently imports essentially all of its semiconductor equipment and most specialty materials. This dependency is not merely a cost concern, it is a supply chain vulnerability that sits at the base of every other semiconductor ambition. A fabrication facility that depends entirely on imported lithography systems, deposition equipment, and process chemicals is not sovereign in any meaningful sense, regardless of where its building sits.

ISM 2.0's explicit focus on domestic semiconductor equipment and materials manufacturing addresses this directly, and it is arguably the most strategically important, and most technically demanding, priority in the entire mission. Building competitive semiconductor equipment requires deep materials science capability, precision engineering infrastructure, and sustained R&D investment over timelines that extend well beyond a single budget cycle. The ₹8,000 crore allocation under the Modified Programme for Development of Semiconductor and Display Manufacturing Ecosystem for 2026-27 is a start, but the industry should expect that equipment and materials indigenization will be a multi-year, multi-cycle effort that requires consistent policy support across administrations.

Manufacturing: Consolidating the Foundation While Reaching for Advanced Nodes

ISM 2.0 introduces a rigorous technical roadmap with a timeline to achieve 3nm pilot production by 2032 and full-scale 2nm manufacturing by 2035.

This ambition is significant and should be understood in its proper context. India is not attempting to displace Taiwan or replicate the TSMC model in a compressed timeframe, that would be neither realistic nor the right strategic objective. What ISM 2.0's advanced node roadmap represents is a credible signal that India's semiconductor manufacturing aspirations are not confined to the legacy process technologies that the rest of the world is moving away from. Mature node manufacturing has commercial value and should be pursued, but positioning India as a destination for next-generation fabrication requires demonstrating the technical and infrastructural capability to get there.

The ATMP and OSAT segment merits particular attention here, because it represents the near-term area where India can build scale, generate employment, and develop the operational expertise that advanced manufacturing requires, while longer-gestation fabrication investments mature. India's packaging and testing capabilities are already growing, and ISM 2.0's continued emphasis on this segment is pragmatically sound.

Supply Chain Resilience, The Systemic Priority

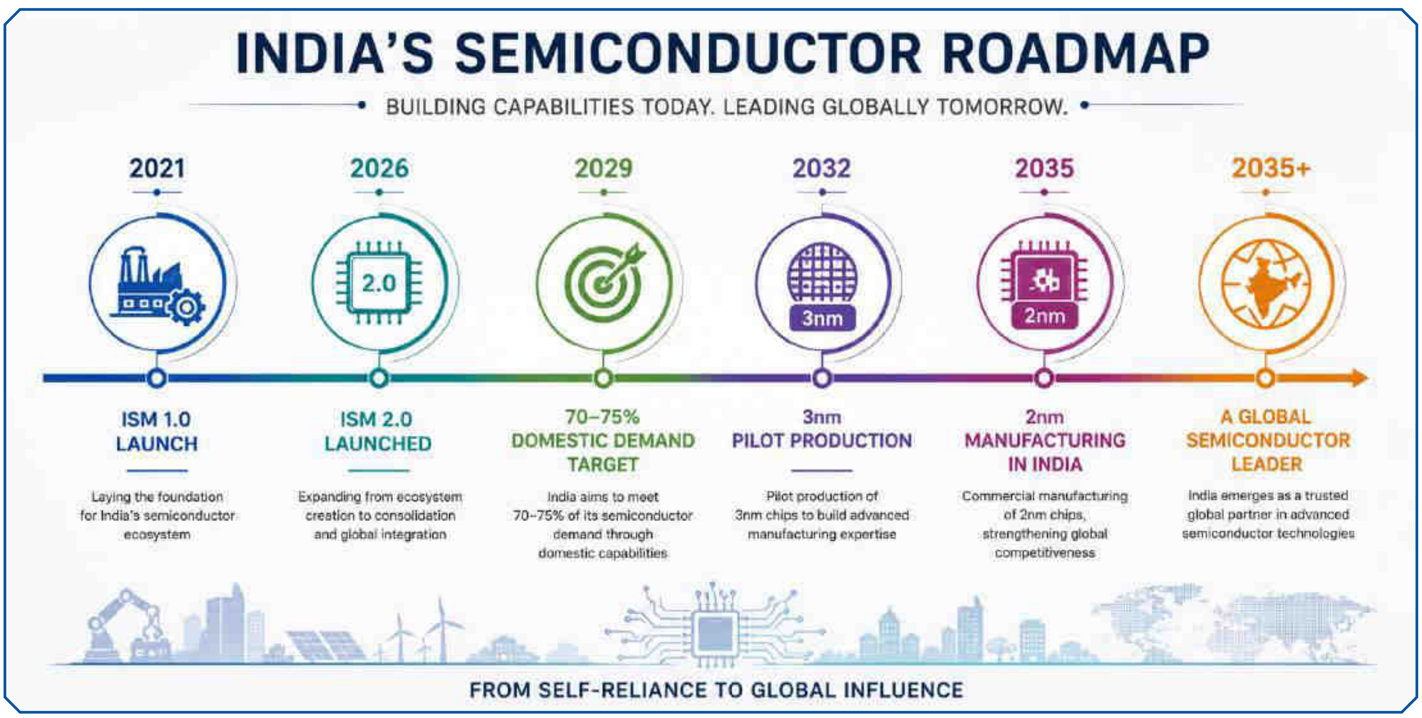
The global semiconductor industry learned something difficult during the pandemic disruptions of 2021-22: geographic concentration in supply chains is not just an economic inefficiency, it is a systemic risk. Taiwan produces over 60% of global chips and nearly 90% of advanced semiconductors, which limits diversification and keeps India dependent on external ecosystems for advanced components and technologies. ISM 2.0's supply chain provisions are designed to position India as a node of diversification within the global semiconductor value chain, not a replacement for existing hubs, but a trusted alternative that reduces the systemic fragility of a supply chain currently concentrated in too few geographies. The government has explicitly stated that ISM 2.0 will strengthen national security through enhanced supply chain resilience and help establish technological leadership in critical sectors.

For this to be realized, India needs to develop credibility not just as a manufacturing location, but as a reliable, quality-consistent, geopolitically stable semiconductor partner. That credibility is built through execution, on-time delivery, consistent yield, regulatory predictability, and the kind of long-term partnership behavior that global semiconductor customers require before they restructure supply chains of this strategic importance.

Talent Development, The Long-Cycle Investment That Cannot Be Deferred

Every other priority in ISM 2.0 is ultimately constrained by the availability of skilled human capital, and this is where the mission's emphasis on industry-led research and training centers is most important.

These initiatives span approximately 400 organizations, including 305 academic institutions under the Chips to Start-up (C2S) Programme and 95 startups under the Design Linked Incentive (DLI) Scheme enabling students and researchers to gain hands-on experience in chip design, with designers from more than 46 institutions having already designed and fabricated 56 chips at the Semiconductor



Laboratory in Mohali. This is meaningful progress, but the scale required to support a ₹1.25 lakh crore semiconductor mission demands a talent pipeline that is orders of magnitude larger. The industry needs to engage directly with this agenda rather than treating it as the government's problem alone. Semiconductor companies operating in India, global design centers, and technology providers all have a stake in the quality and scale of the engineering talent emerging from India's universities and technical institutions. Industry-academic collaboration, on curriculum, on access to real design environments, on internship and placement pipelines, is not optional at this stage. It is foundational.

By 2029 India is expected to achieve the capability to design and manufacture chips required for nearly 70–75% of domestic applications within a growing semiconductor market projected to reach \$100-\$110 billion. Achieving those targets without a commensurate investment in human capital development is not possible.

What Long-Term Success Actually Requires

ISM 2.0 is a well-structured mission with the right priorities and, for the first time, funding at a scale that matches the ambition. But the history of industrial policy is littered with well-funded missions that underdelivered because the conditions surrounding them were not aligned.

From where I sit, three factors will determine whether ISM 2.0 delivers on its promise over the long term.

The first is policy continuity. Semiconductor investments operate on capital cycles of ten to fifteen years. A fabrication facility approved today will not reach full production maturity for the better part of a decade. If the policy environment, the incentive structures, and the regulatory predictability that attracted that investment are subject to revision with each budget cycle, the risk calculus for investors changes, and capital flows elsewhere. India needs to demonstrate the kind of policy durability that Taiwan, South Korea, and increasingly the United States have built into their semiconductor strategies.

The second is private sector co-investment at scale. Government funding of ₹1.25 lakh crore is significant, but semiconductor ecosystems of genuine global scale require private investment that multiplies that public commitment. The early signals from ISM 1.0, where the Electronics Components Manufacturing Scheme received investment commitments double its original target, indicate that industry appetite is present when the policy framework is credible. ISM 2.0 needs to sustain and deepen that confidence.

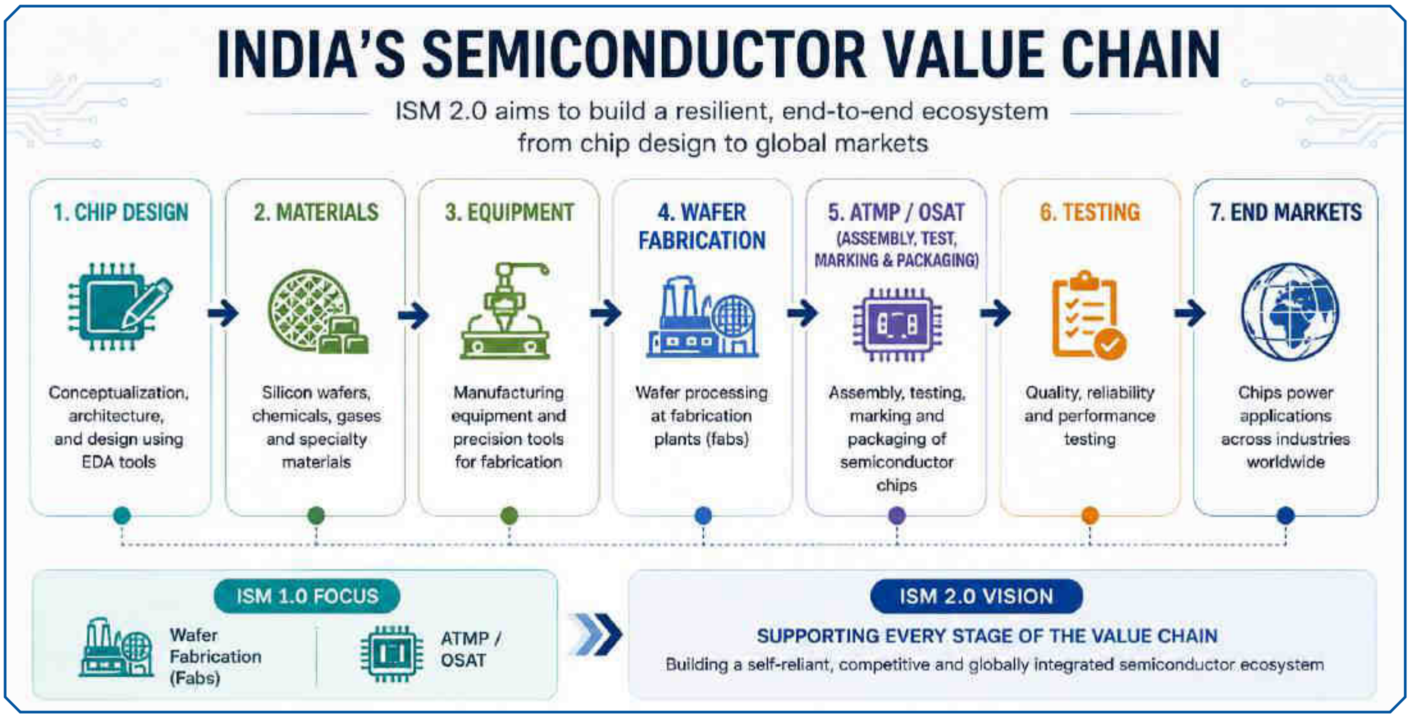
The third is the global partnership discipline. India cannot build a world-class semiconductor ecosystem in isolation, and ISM 2.0 does not attempt to. But technology transfer agreements, joint venture structures, and international research collaborations need to be structured in ways that build genuine indigenous capability rather than creating new forms of dependency with different counterparties. The goal is self-reliance over time, and every partnership should be evaluated against that long-term objective.

The Industry's Moment

India's semiconductor ambition has, for most of the past decade, been a story of stated intent waiting for structural follow-through. ISM 2.0 represents the most credible attempt yet to provide that follow-through, across the full value chain, at meaningful scale, with a policy architecture that addresses the ecosystem holistically rather than in isolated segments.

The opportunity ahead is real. The market trajectory is favorable. The engineering talent is present. What the next five years will test is whether India's semiconductor industry, government, private sector, academia, and global partners together, can execute with the consistency and discipline that this scale of ambition demands.

The foundation has been laid. What gets built on it will define India's position in the global technology landscape for a generation.



Microchip Makes MPLAB XC Pro Tools Free Worldwide

Microchip Technology has made its MPLAB XC Pro Compilers and MPLAB Machine Learning (ML) Development Suite available free of charge, giving developers unrestricted access to advanced embedded software development tools. The move removes previous licensing barriers and allows unlimited installations for individual developers and engineering teams. Previously offered under paid licensing tiers, the MPLAB XC Pro Compilers provide advanced code optimization features that reduce code size, lower memory usage, improve execution speed, and generate architecture-optimized code for embedded applications. The compilers support Microchip's complete portfolio of 8-, 16-, and 32-bit microcontrollers and microprocessors. The MPLAB Machine Learning Development Suite, including the Model Builder plug-in for MPLAB and Microsoft Visual Studio Code, is also now available at no cost.

Arrow Electronics Earns Microsoft Azure Virtual Desktop Specialization Recognition

Arrow Electronics has earned the Microsoft Azure Virtual Desktop specialization, recognizing its expertise in deploying, scaling, and securing virtual desktop infrastructure on Microsoft Azure. The achievement follows the company's Infrastructure and Database Migration to Microsoft Azure specialization, earned in 2025, further strengthening its cloud services portfolio. The Azure Virtual Desktop specialization is awarded only to Microsoft channel partners that meet strict requirements for customer success, technical expertise, employee certifications, and independent third-party audits. It validates Arrow's capability to help partners modernize workplace environments with secure, scalable, and cost-effective virtual desktop solutions. As organizations continue to embrace hybrid and remote work, Microsoft Azure Virtual Desktop enables seamless integration with Microsoft's ecosystem while simplifying deployment and licensing.

Avnet Schedules Fiscal 2026 Earnings and Shareholders Meeting

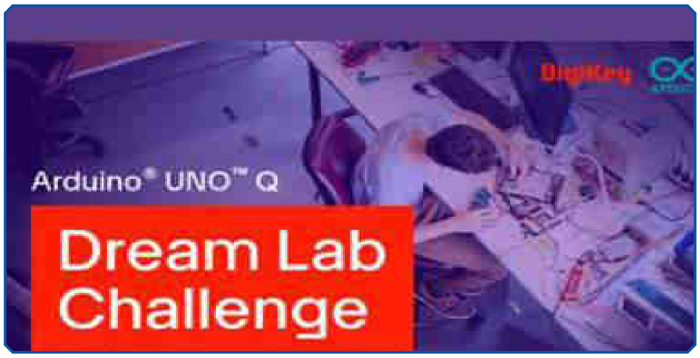
AVNET®

Avnet, Inc., a global technology distributor and solutions provider, has announced that it will release its financial results for the fourth quarter and full fiscal year 2026 before the market opens. Following the earnings announcement, Chief Executive Officer Phil Gallagher and Chief Financial Officer Ken Jacobson will host a webcast to discuss the company's financial performance and provide a corporate update. The company has also scheduled its Annual Meeting of Shareholders for November 20, 2026, at its corporate headquarters in Tempe, Arizona. Shareholders recorded as of the close of business on September 21, 2026, will be eligible to vote during the meeting. With more than a century of industry experience, Avnet supports customers and suppliers throughout the entire product lifecycle, offering electronic components, embedded solutions, software, and value-added services.

Mouser Stocks Renesas RX14T Motor Control Microcontrollers Worldwide

Mouser Electronics has added the Renesas RX14T motor control microcontrollers (MCUs) to its product portfolio, providing engineers with cost-effective solutions for motor control applications. Designed around a 48 MHz RXv2 core with a floating-point unit (FPU) and digital signal processing (DSP) support, the RX14T MCUs deliver an optimal balance of performance, functionality, and affordability. The entry-level MCUs are targeted at home appliances, power factor correction (PFC) systems, HVAC equipment, water pumps, power tools, and other small-motor applications. They support sensor-less field-oriented control (FOC) for a single motor at a 20 kHz carrier frequency while maintaining efficient CPU utilization. The RX14T MCU family integrates advanced features, including dual 12-bit analog-to-digital converters, programmable gain amplifiers, comparators, digital-to-analog converters,.

DigiKey, Arduino Launch Dream Lab Challenge for Innovators



DigiKey and Arduino have launched the Dream Lab Challenge, inviting makers and developers to showcase innovative projects using the new Arduino UNO Q single-board microcontroller. The competition offers four winners custom Dream Lab packages worth approximately $5,000 each, featuring professional-grade test equipment to support future innovation. Entries are open until September 30, 2026. Participants are encouraged to design projects ranging from robotics and AI vision systems to industrial automation or other creative applications that demonstrate the capabilities of the Arduino UNO Q. The challenge aims to highlight how the platform bridges hardware development with generative AI while encouraging originality, technical excellence, and real-world problem-solving. Winning projects will be evaluated based on creativity, technical execution, effective use of the UNO Q platform, quality of documentation, and overall innovation.

Microchip Launches Free VectorBlox 3.0 AI Development SDK

Microchip Technology has introduced the VectorBlox™ 3.0 Accelerator Software Development Kit (SDK), a free tool designed to simplify FPGA-based artificial intelligence (AI) deployment and accelerate time-to-market for edge AI applications. The SDK, along with the CoreVectorBlox IP, provides an integrated development environment for optimizing, compiling, and deploying convolutional neural network (CNN) models on PolarFire® FPGA and SoC platforms. The latest SDK enables developers to consolidate multiple AI workloads, including vision and sensor-based applications, on a single low-power FPGA. Support for sparse neural networks improves inference performance by skipping zero-value operations, reducing power consumption while maintaining model accuracy. This makes the solution well suited for always-on edge AI applications in aerospace, defense, industrial automation, and other mission-critical environments.

Mouser Concludes Seventh India Technical Roadshow Across Three Cities

MOUSER ELECTRONICS

Mouser Electronics has successfully concluded the seventh edition of its India Technical Roadshow, bringing together engineers, product designers, developers, technology leaders, and industry experts across Pune, Bengaluru, and Chennai. The event highlighted the latest innovations in electronics and industrial automation while supporting India's growing role as a global electronics manufacturing and innovation hub. The roadshow was organized in collaboration with leading technology partners, including Analog Devices, Amphenol, Littelfuse, Molex, Phoenix Contact, Samtec, Silicon Labs, TE Connectivity, and TAIYO YUDEN. Participants attended expert-led technical sessions and live demonstrations covering artificial intelligence (AI), automotive electronics, embedded systems, industrial automation, and smart manufacturing.

Microchip Launches Industrial PoE Midspan for Harsh Environments

Microchip Technology has expanded its Power over Ethernet (PoE) portfolio with the launch of the PD-9601GCI Midspan, an industrial-grade solution designed to meet the IEEE 802.3bt standard for demanding industrial environments. The new device enables reliable power and high-speed data transmission over a single Ethernet cable, simplifying deployment while reducing installation complexity. The PD-9601GCI delivers up to 90 W of power alongside 10/100/1000 Mbps data rates, making it suitable for factory automation, outdoor installations, and remote industrial applications. Compared with the company's indoor PC-9601GC midspan, the new model is built for harsh conditions with an IP30-rated sealed metal enclosure, vibration resistance, an extended operating temperature range of -40°C to 75°C, and dual 20–60 V DC power inputs.

Infineon Launches SECORA ID Key S USB Authentication Solution

Infineon Technologies AG has introduced the SECORA ID Key S USB, a Java Card-based authentication solution featuring USB and NFC connectivity. Designed for passwordless authentication and secure digital signatures, it offers FIDO Level 3+ certification, flexible Java Card customization, and strong protection against phishing, software attacks, and hardware threats for enterprises.

Features :

- **FIDO Level 3+ Security:** Enables phishing-resistant, passwordless authentication with CTAP 2.1 compliance and protection against remote software and local hardware attacks.
- **Flexible Java Card Platform:** Supports custom applets alongside preloaded FIDO, PKI, and digital signature applications for multiple identity and security use cases.
- **Compact System-in-Package Design:** Integrates the security controller and USB bridge into a 4 × 4 × 0.85 mm package, reducing component count and simplifying OEM integration.

Availability:
Available Now

ROHM Expands 600V Super Junction MOSFET Portfolio with Surface Packages

ROHM has introduced new 600V Super Junction MOSFETs in the R60xxXNx and PrestoMOS™ R60xxWNx series to improve power efficiency, thermal performance, and power density. Featuring compact surface-mount packages, the devices support AI servers, industrial equipment, and other high-power applications while enabling easier integration and second-source compatibility.

Features

- **Compact Surface-Mount Packages:** Available in DFN8080-5L and TOLL packages for improved heat dissipation, higher power density, and space-saving designs.
- **Enhanced Electrical Performance:** Optimized gate threshold voltage and improved admittance characteristics reduce switching losses while supporting a wide range of drive conditions.
- **Broad Product Lineup:** Includes 21 high-speed switching models and 11 PrestoMOS™ models with class-leading reverse recovery performance for diverse applications.

Availability:
Available Now

Rambus Launches DDR5 9600 Server RDIMM Chipset for AI

Rambus has unveiled its DDR5 9600 Server RDIMM chipset, designed to meet the growing memory demands of AI, high-performance computing, and data centers. Featuring a sixth-generation Registering Clock Driver, the chipset delivers faster memory performance, improved bandwidth, and integrated power and thermal management for next-generation server platforms.

Features

- **DDR5 9600 Performance:** Supports RDIMM memory speeds up to 9,600 MT/s, delivering 20% higher performance than previous-generation solutions.
- **Integrated Chipset Platform:** Combines the RCD06 Registering Clock Driver, PMIC5030 power management IC, SPD Hub, and temperature sensors for synchronized operation.
- **Optimized for AI and HPC:** Designed to handle memory-intensive workloads such as AI inference, large language models, HPC, and modern data center applications.

Availability:
Available Now

Infineon Launches Radiation-Hardened GaN Driver for Space Power Applications

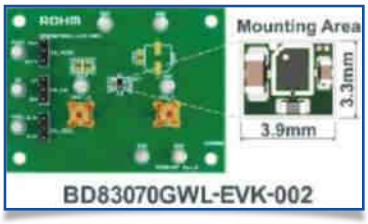
Infineon Technologies AG has introduced the RIC70115, a radiation-hardened GaN HEMT driver for satellite and high-reliability space applications. Supporting both silicon and GaN MOSFETs, the device enhances power conversion efficiency, simplifies system design, and delivers robust radiation tolerance for demanding New Space missions and advanced satellite power architectures.

Features

- **Flexible Power Design:** Supports both GaN and silicon MOSFETs in low-side and high-side configurations for versatile space power architectures.
- **Integrated Protection and Efficiency:** Features an independent Miller Clamp, Truly Differential Input (TDI), and integrated 4.8V LDO to improve switching performance, noise immunity, and reliability.

Availability:
Available Now

ROHM Unveils Ultra-Compact DC-DC Converter Evaluation Board for Wearables



ROHM has introduced the BD83070GWL-EVK-002 evaluation board to showcase its high-efficiency BD83070GWL buck-boost DC-DC converter. Designed for battery-powered wearables, IoT, and mobile devices, the board delivers up to 97% efficiency, ultra-low power consumption, and a compact reference design that simplifies development and accelerates product commercialization.

Features

- **High-Efficiency Power Conversion:** Demonstrates the BD83070GWL DC-DC converter with up to 97% efficiency and 2.8 µA ultra-low quiescent current for extended battery life.
- **Ultra-Compact Design:** Requires only five external components, achieving a mounting area of 12.87 mm² (3.3 × 3.9 mm) for space-constrained devices.
- **Reference Design Resources:** Includes publicly available circuit patterns and bill of materials (BOM) to simplify evaluation and speed mass-production design.

Availability:
Available Now

Toshiba Introduces Compact Stepper Motor Driver for Industrial Applications

Toshiba has launched the TB67S531FTG, a two-phase bipolar stepper motor driver designed for reliable operation under unstable power conditions. Featuring direct phase-input control, low heat generation, and integrated protection functions, the compact driver improves motor precision, simplifies circuit design, and enhances reliability in industrial and commercial equipment.

Features

- **Reliable Motor Control:** Direct phase-input interface minimizes the impact of electrical noise and voltage fluctuations, ensuring accurate positioning and smooth motor operation.
- **High Power, Low Heat:** Supports up to 40V output and 2.0A drive current, with 0.8 Ω RDS(ON) to reduce power loss and heat generation.
- **Compact, Integrated Design:** Housed in a 5 × 5 mm 32-pin QFN package with built-in current sensing and charge pump, reducing external components and board space.

Availability:
Available Now

Littelfuse Launches FlatSuppressX TVS Diodes for 48V Automotive Protection

Littelfuse has introduced the TP5.0SMD-FL and TP1KSMB-FL FlatSuppressX™ TVS Diodes to protect 48 V automotive electronics from transient overvoltage events. Featuring ultra-low, stable clamping voltage and high surge capability, the devices improve system reliability, reduce component stress, and support cost-effective designs compliant with ISO 21780 standards.

Features

- **FlatSuppressX™ Technology**: Delivers ultra-low, stable clamping voltage with advanced foldback/snapback characteristics, reducing stress on sensitive automotive ICs.
- **High Surge Protection:** Available in 5 kW (TP5.0SMD-FL) and 1 kW (TP1KSMB-FL) variants for robust transient suppression in 48 V systems.
- **Automotive-Grade Reliability:** AEC-Q101 qualified and designed to meet ISO 21780 requirements for next-generation 48 V automotive electronics.

Availability:
Available Now

TDK Introduces Automotive Motor Controller for Smart Actuator Applications

TDK Corporation has unveiled the Micronas HVC 5422C, an automotive-qualified embedded motor controller for BLDC and BDC motors. Combining advanced field-oriented control, increased memory, integrated connectivity, and cybersecurity, the device enables quieter motor operation, greater software flexibility, and simplified system integration for next-generation automotive actuators.

Features

- **Advanced Motor Control:** Supports FOC, along with sensored and sensorless BLDC/BDC motor control, enabling smooth, silent, and efficient operation.
- **Enhanced Processing Resources:** Integrates an Arm Cortex-M3 CPU, 64 KB Flash, and 4 KB EEPROM for advanced algorithms, diagnostics, and OTA software updates.
- **Integrated Connectivity:** Features an auto-addressing LIN transceiver, seven GPIOs, and a 3.3 V supply output for simplified system integration.

Availability:
Available Now

Keysight Launches APS-ONE-400 for High-Performance Network

Keysight Technologies has introduced the APS-ONE-400, a modular 4x100GE network cybersecurity test platform designed to help network equipment manufacturers, service providers, and data center operators validate increasingly complex network environments. Housed in a compact 1-rack-unit (1RU) chassis, the platform combines Layer 4-7 traffic generation, post-quantum cryptography (PQC)-encrypted Transport Layer Security (TLS) testing, Zero Trust Network Access (ZTNA) validation, and Elephant Flow traffic simulation in a single solution. The APS-ONE-400 addresses the growing demand for testing AI-driven workloads, large language model (LLM) traffic, encrypted communications, and advanced cyber threats without requiring multiple dedicated testing appliances.

Siglent Launches High-Speed Probe and Vector Signal Analysis Software

Siglent has expanded its test and measurement portfolio with the launch of the SAP8000D active differential probe and SigVSA vector signal analysis software, strengthening its solutions for high-speed digital and RF design validation. The new products support engineers across signal acquisition and advanced protocol analysis workflows. The SAP8000D active differential probe is designed to minimize probe loading, ensuring accurate measurements without significantly affecting the circuit under test. It features an 8 GHz bandwidth, ultra-low 300 fF input capacitance, dual-mode operation for differential and single-ended measurements, and high common-mode rejection ratio (CMRR) to reduce environmental noise. The probe supports applications including PCIe, DDR memory, USB 3.0, Gigabit Ethernet, and RF circuit testing, with multiple connectivity options.

VIAVI Secures Horizon Europe Funding for SHIELD-6G Security Project

VIAVI Solutions has secured $1.1 million in funding from the European Smart Networks and Services Joint Undertaking (SNS JU) and Horizon Europe to support the SHIELD-6G project, which aims to strengthen cybersecurity for next-generation 6G networks through artificial intelligence. As cyber threats grow more sophisticated and quantum-enabled attacks become an emerging concern, the project seeks to develop an AI-driven Cyber Threat Intelligence (CTI) platform with interoperable security, orchestration, and regulatory compliance capabilities. VIAVI will contribute by developing digital twins using its TeraVM AI RAN Scenario Generator (RSG), enabling AI-based security models to be tested and validated before commercial 6G deployments begin.

Marquistech Expands Noida Lab With Rohde & Schwarz Test Systems

Marquistech has partnered with Rohde & Schwarz to upgrade its conformance and EMI/EMC test laboratory in Noida with advanced certification testing systems, making it the first fully equipped conformance test house in India for both GCF and PTCRB certification programs. The investment includes the R&S TS8980FTA-3A RF/RRM full type approval system, CMX500 radio communication tester, R&S TS-LBS positioning test system, and R&S TS9982 and TS9975 EMI/EMC platforms. The upgraded facility supports testing for legacy 4G and advanced 5G technologies, including non-terrestrial networks (NTN) and mission-critical communications (MCX), while covering a broad range of validated test cases. Located in the Delhi-NCR region, the expanded lab is designed to serve mobile device, IoT, and wireless module manufacturers as India strengthens its position as an electronics manufacturing hub.

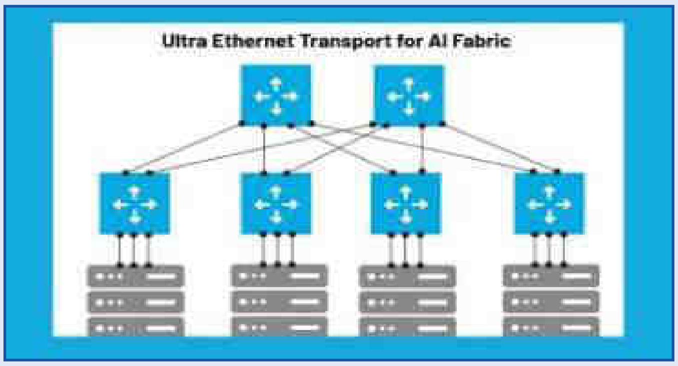
Emerson Launches Modular Automotive Vision Testing Platform for SDVs

Emerson has unveiled a modular automotive vision testing platform designed to simplify validation of advanced electronic systems in software-defined vehicles (SDVs). Built on National Instruments' (NI) PXI architecture, the solution aims to improve display and camera testing while reducing complexity for automotive engineers. At the core of the platform is the NI PXIe-1480 FlexRIO multiprotocol vision carrier module, which combines a high-performance FPGA with interchangeable serializer/deserializer (SerDes) interface devices. This modular approach enables engineers to replace interface modules instead of redesigning entire test systems when vehicle camera or display specifications change. The platform initially supports the FPD-Link IV automotive video interface used in advanced driver assistance systems (ADAS) and in-vehicle infotainment (IVI) applications.

Saelig Introduces MHO 6 High-Resolution Eight-Channel Oscilloscopes

Saelig Company has launched the MHO 6 Series 12-bit high-resolution oscilloscopes, offering 350 MHz, 500 MHz, and 1 GHz bandwidth options for advanced electronics testing. Manufactured by Micsig Technology, the new series combines an 8-channel architecture with a 6 GSa/s sampling rate and up to 1.8 Gpts memory depth for accurate capture of high-speed signals. The oscilloscopes feature a 16-inch touchscreen with 1920 × 1200 resolution, an ultra-slim 1.4-inch design, and a built-in 4½-digit digital multimeter. Running on the SigtestUI multitasking operating system, the instruments provide stable performance for complex testing applications. The MHO 6 Series supports automatic probe identification through Micsig's Mic-OPI interface and is compatible with passive, differential, current, optical isolation, and Rogowski coil probes.

VIAVI Launches First Ultra Ethernet Validation Solution for AI Fabrics



VIAVI Solutions has introduced the industry's first Ultra Ethernet Transport (UET) validation solution for AI fabrics, expanding the capabilities of its VIAVI TestCenter platform. The new GPU-free solution is designed to help hyperscalers, cloud and neocloud providers, and network equipment manufacturers validate next-generation AI networks using the Ultra Ethernet Consortium's (UEC) Ultra Ethernet Stack. Built for large-scale AI and high-performance computing (HPC) workloads, the UEC 1.0 Ultra Ethernet Stack introduces the UET protocol, enabling advanced congestion control, improved scalability, and multi-vendor interoperability for Ethernet-based AI infrastructure. VIAVI's validation solution emulates the UET transport layer to generate realistic, stateful AI traffic without requiring dedicated GPU hardware.

Pickering Launches PXI Analog Output Modules for HIL Testing

Pickering Interfaces has expanded its modular test portfolio with three new PXI/PXIe analog output modules designed for functional testing, hardware-in-the-loop (HIL) simulation, and sensor emulation. The new additions include precision DAC modules, multi-channel waveform generators, and high-density thermocouple simulators, enabling engineers to create realistic analog and sensor conditions within compact PXI test systems. The 41-770 PXI and 43-770 PXIe DAC modules provide up to four fully isolated analog output channels with programmable voltage outputs up to ±40 V and current outputs up to ±20 mA. They also support open-circuit simulation and hardware interlock protection for advanced fault-injection testing. The 41-625 PXI and 43-625 PXIe waveform generators offer up to 32 independent channels with waveform generation from DC to 300 kHz, supporting sine and standard.

UPCOMING EVENTS

August 21, 2026 to August 21, 2026	Data Centre Conclave 2026	Holiday Inn, Mumbai
Sept. 16, 2026 to Sept. 18, 2026	electronica India 2026 – South Edition	Bangalore International Exhibition Centre (BIEC), Bengaluru
Sept. 16, 2026 to Sept. 18, 2026	World Battery & Energy Industry Expo 2026	Area B, China Import & Export Fair Complex, Guangzhou, China
Sept. 16, 2026 to Sept. 18, 2026	InfoComm India 2026	Jio World Convention Centre, Mumbai
Sept. 17, 2026 to Sept. 19, 2026	SEMICON India 2026	Yashobhoomi (India International Convention & Expo Centre), ND
Oct. 22, 2026 to Oct. 24, 2026	The Battery Show India 2026	India Expo Mart & Centre, Greater Noida
Nov. 2, 2026 to Nov. 3, 2026	Li-ion Battery Europe 2026	Hilton Barcelona Spain
March 23, 2027 to March 25, 2027	Convergence India Expo 2027	Bharat Mandapam, New Delhi
June 22, 2027 to June 24, 2027	The Battery Show Europe 2027	Messe Stuttgart Stuttgart, Germany
July 22, 2027 to July 23, 2027	Strategic Electronics Summit 2027	BIEC, Bengaluru India