Technology Radar

2024

An LTIMindtree Crystal Report

Foreword

Innovation in technology is happening at a rapid pace, changing the world in unprecedented ways. The desire to foresee the future was never so strongly expressed.

In the modern era, where speed and efficiency are paramount, cutting-edge technological advancements have taken the forefront. The march of Generative AI is resulting in unbelievable and unimaginable inferences through a plethora of new-age algorithms. Leveraging complex AI models and superior computing capabilities, it is paving the way to a very futuristic outlook. Artificial Intelligence (AI), the Internet of Things (IoT), Decentralization, and Augmented Reality (AR) are leading the way in transforming industries. Automating tasks, predicting patterns, and building new ways of user experience and security are collectively pushing us towards a more innovative and connected world. Furthermore, we are witnessing concerted investments and efforts to integrate AI with the emerging paradigm of Quantum Computing. Enterprises are also becoming increasingly purpose-driven by prioritizing their commitments to environmental, social, and governance (ESG) principles, where a lot of investments are flowing in.

Aan S. Chauhan

Chief Technology Officer,
LTIMindtree

In 2023, AI assistance for application development, automation, data analysis, customer services, and other AI-related topics were the most common subjects of conversation. For example, GitHub Copilot, AWS CodeWhisperer, Jasper, and others are driving the change in how we use tools with the help of Large Language Models. We are all excited about the possibility of using them to write user stories, create test cases, and even carry out deployments. Considering ethics, privacy, security, trust, sustainability, decentralization, task specialization, propriety, and regulation, we have a strong case for developing smaller, bespoke, explainable, and concise Large Language Models.

The recent trend of combining Augmented Reality and Spatial Technologies has revived and reiterated the potential of bringing together virtual and physical to a mixed world. It has provided abundant possibilities and opportunities for humans to interact with the physical world virtually. The allure of the cloud is fueling the adoption of composable architecture principles for agility, technology ROI, and TTM, bringing in a renewed focus on platform engineering at the forefront.

So, what will 2024 look like? What emerging technologies will shape our lives, societies, and business ways and influence entire economies? It is a world where AI, computing power, smarter devices, security, and data all come together to create today's engines to enable the technologies of tomorrow.

This edition of the LTIMindtree Crystal Technology Radar 2024 provides a peek into the world of tomorrow. This perspective shows how disruptive factors that we call "trends" are changing the future, highlighting their technology maturity, interdependence across segments, and market potential.

As a community, we are committed to spreading awareness on how these technologies can help us prepare for the opportunities and challenges ahead and create a bright, green, and sustainable future.

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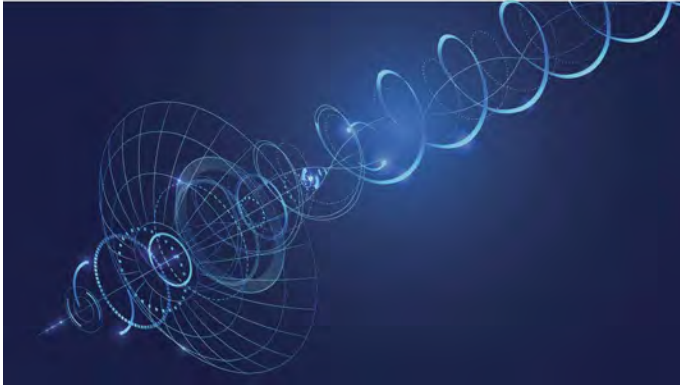
LTIM Crystal Technology Radar 2024

A comprehensive perspective on the latest trends driving transformation through evolving technologies

Navigating The Radar

66 technology trends highlighting Use Cases, Featured Stories, and Key Takeaways. Spanning across 4 technology segments namely: Interactive Tech, Data & AI, Cloud, Infra & Security and Digital Platforms & Operations
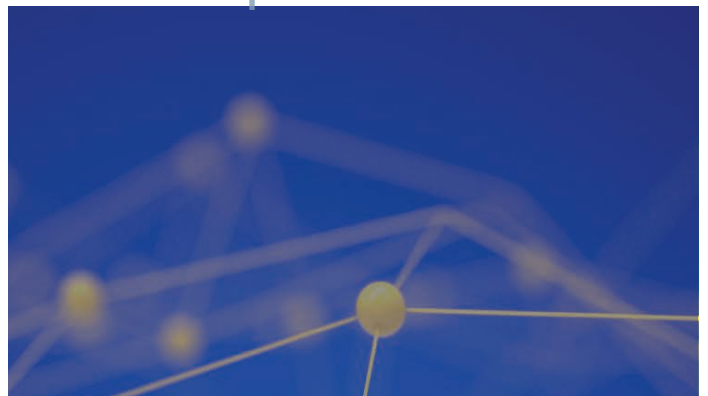
About LTIMindtree Crystal

A look into the LTIMindtree's Technology Council, next-gen technology experts and our meticulous rating mechanism

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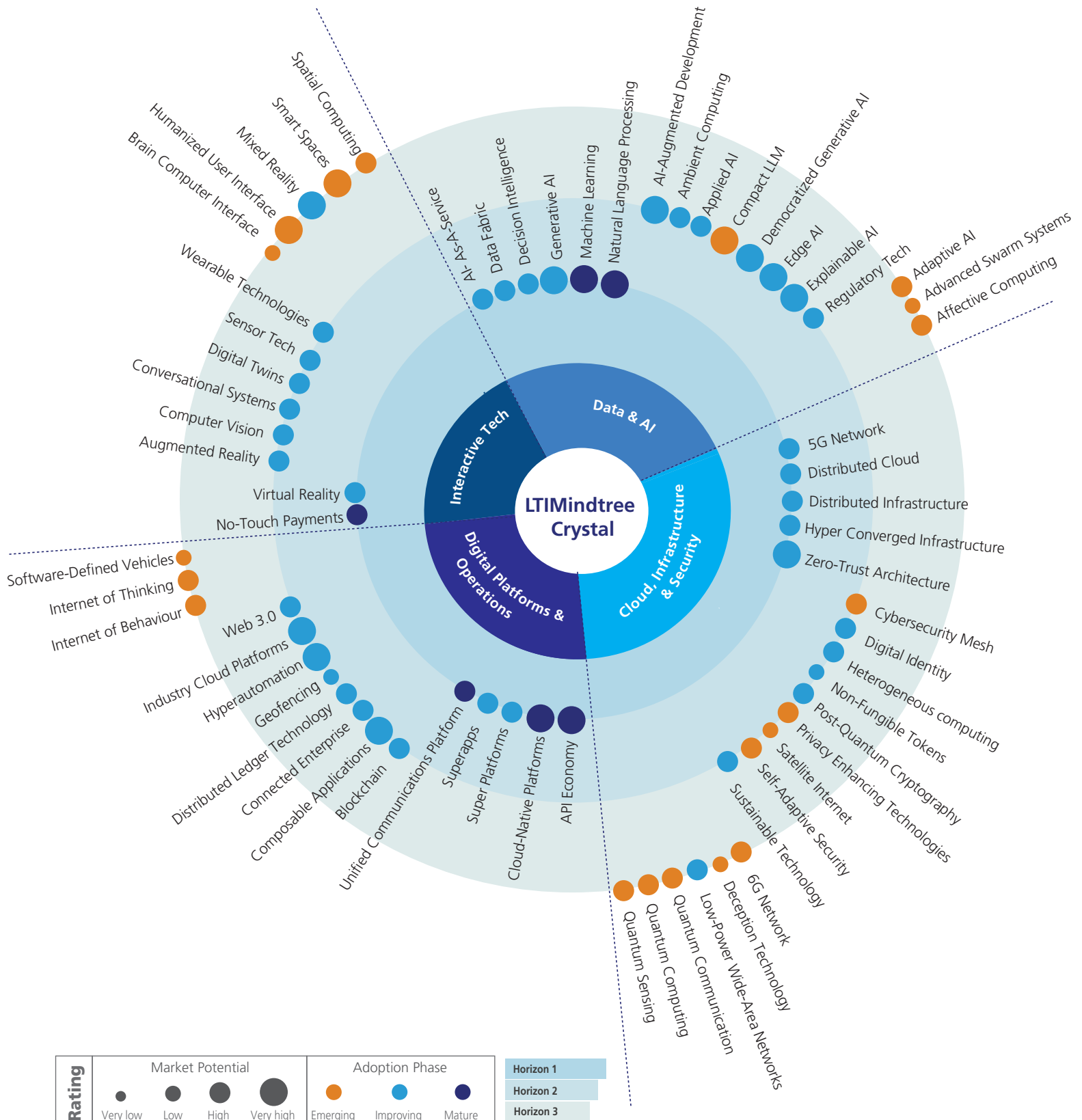
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Interactive Tech
- Spatial Computing
- Smart Spaces
- Mixed Reality
- Humanized User Interface
- Brain Computer Interface
- Wearable Technologies
- Sensor Tech
- Digital Twins
- Conversational Systems
- Computer Vision
- Augmented Reality
- Virtual Reality
- No-Touch Payments

Data & AI
- AI- As-A-Service
- Data Fabric
- Decision Intelligence
- Generative AI
- Machine Learning
- Natural Language Processing
- AI-Augmented Development
- Ambient Computing
- Applied AI
- Compact LLM
- Democratized Generative AI
- Edge AI
- Explainable AI
- Regulatory Tech
- Adaptive AI
- Advanced Swarm Systems
- Affective Computing

Cloud, Infrastructure & Security
- 5G Network
- Distributed Cloud
- Distributed Infrastructure
- Hyper Converged Infrastructure
- Zero-Trust Architecture
- Cybersecurity Mesh
- Digital Identity
- Heterogeneous computing
- Non-Fungible Tokens
- Post-Quantum Cryptography
- Privacy Enhancing Technologies
- Satellite Internet
- Self-Adaptive Security
- Sustainable Technology
- 6G Network
- Deception Technology
- Low-Power Wide-Area Networks
- Quantum Communication
- Quantum Computing
- Quantum Sensing

Digital Platforms & Operations
- Software-Defined Vehicles
- Internet of Thinking
- Internet of Behaviour
- Web 3.0
- Industry Cloud Platforms
- Hyperautomation
- Geofencing
- Distributed Ledger Technology
- Connected Enterprise
- Composable Applications
- Blockchain
- Unified Communications Platform
- Superapps
- Super Platforms
- Cloud-Native Platforms
- API Economy

Rating

Market Potential
- Very low
- Low
- High
- Very high

Adoption Phase
- Emerging
- Improving
- Mature

- Horizon 1
- Horizon 2
- Horizon 3

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Ratings Scale

Horizon	Horizon refers to the timeframe between the inception of a new technology trend and its adoption by the mainstream

Horizon 1

Relevant industry players are scaling the technology use cases

Horizon 2

Relevant industry players have started incubating the technology, to assess the potential, risk implications and benefits

Horizon 3

Emerging technologies in research with potential for transformational change

Adoption Phase	Adoption maturity of the technology trend in the market

Emerging

Technology is at its initial stages of adoption, with innovators and early adopters exploring its potential.

Improving

Technology adoption is increasing with proven potential to improve efficiency and effectiveness.

Mature

Technology has achieved widespread acceptance and usage among the general population or targeted audience

Market Potential	The likelihood of the technology trend to generate value across multiple functions

Very Low　　　**Low**　　　**High**　　　**Very High**

Navigating The **Radar**

The technology trends listed below are arranged according to their corresponding horizon and grouped by their technology segment

	Horizon 1	Horizon 2	Horizon 3
Interactive Tech	• No-Touch Payments • Virtual Reality	• Augmented Reality • Computer Vision • Conversational Systems • Digital Twins • Sensor Tech • Wearable Technologies	• Brain Computer Interface • Humanized User Interface • Mixed Reality • Smart Spaces • Spatial Computing
Data & AI	• AI As-A-Service • Data Fabric • Decision Intelligence • Generative AI • Machine Learning • Natural Language Processing	• AI-Augmented Development • Ambient Computing • Applied AI • Compact LLM • Democratized Generative AI • Edge AI • Explainable AI • Regulatory Tech	• Adaptive AI • Advanced Swarm Systems • Affective Computing
Cloud, Infrastructure & Security	• 5G Network • Distributed Cloud • Distributed Infrastructure • Hyper Converged Infrastructure • Zero-Trust Architecture	• Cybersecurity Mesh • Digital Identity • Heterogeneous computing • Non-Fungible Tokens • Post-Quantum Cryptography • Privacy Enhancing Technologies • Satellite Internet • Self-Adaptive Security • Sustainable Technology	• 6G Network • Deception Technology • Low-Power Wide-Area Networks • Quantum Communication • Quantum Computing • Quantum Sensing
Digital Platforms & Operations	• API Economy • Cloud-Native Platforms • Super Platforms • Superapps • Unified Communications Platform	• Blockchain • Composable Applications • Connected Enterprise • Distributed Ledger Technology • Geofencing • Hyperautomation • Industry Cloud Platforms • Web 3.0	• Internet of Behaviour • Internet of Thinking • Software-Defined Vehicles

Horizon 1

Relevant industry players are scaling the technology use cases

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No-Touch Payments

No-touch payments are made by transferring money electronically through debit or credit cards. This form now includes virtual payment methods such as online and mobile transfers. AI, machine learning, and blockchain are advancing the field of no-touch payments by enabling more secure and faster transactions. However, the risk of cybercrime remains, especially when dealing with high-value transactions.

⚑ Highlights

The global contactless payments market is expected to grow at a CAGR of 15.4% between 2023 and 2032. It is projected to reach USD 90.6 billion, up from USD 22.4 billion in 2022. The rapid growth can be attributed to the evolution of new payment technologies like Host Card Emulation (HCE) and Near Field Communication (NFC). These technologies use embedded chips in wearables, payment cards, tags, key fobs, and mobile phones to facilitate contactless payment transactions. The technologies further enable machine-to-machine communication, including RFID. The value generated by contactless payment would depend on market penetration, consumer adoption, infrastructure availability, and regulatory environment.

📝 Featured Story

With over two decades of experience, a leading financial software expert aimed to replace outdated hardware systems and introduce digitization for quicker payment processing. The vendor effectively created an app using the ReactNative framework, featuring automated mobile image capture technology and instant check processing. The new mobile app empowered the client to receive payments, deposits, and donations from members and branches seamlessly and securely.

◎ Radar View & Related Technologies

Rating	Market Potential				Adoption Phase		
	Very low	Low	**High**	Very High	Emerging	Improving	**Mature**
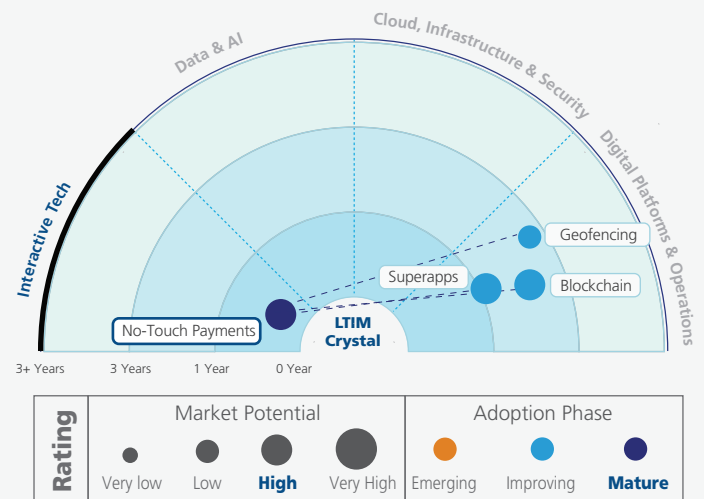
✧ Key Takeaway

Contactless payments offer numerous advantages to businesses and consumers, such as convenience and enhanced security. This method minimizes virus transmission and brings about operational efficiency and financial inclusion.

Key Use Cases

Retail and CPG
- Contactless cards, mobile wallets, wearable devices, contactless ATMs, and in-app payments

Media & Entertainment
- Purchase tickets, food, and beverages by tapping contactless-enabled devices at the designated payment points

BFS
- Contactless cards, mobile wallets, wearable devices, contactless ATMs, and in-app payments

Telecommunication
- Personalized content
- Recommendation engines

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Virtual Reality

Virtual reality (VR) is a technology that uses computer modeling and simulation. This allows a person to interact and communicate with his artificial three-dimensional (3-D) visual or other sensory environment. VR has made it possible for people to exist in multiple different realities. Recognizing the growth potential, investors have accelerated their interest in the AR/VR industry, even amid a global pandemic and subsequent economic uncertainty.
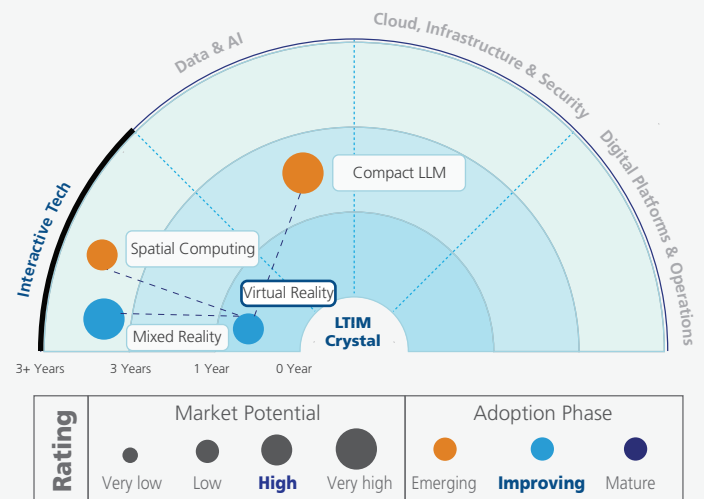
⚑ Highlights

Advancements in technology and increasing usage have resulted in notable progress in the VR sector over the past few years. Other factors driving its growth include the rise in content production, the widening range of industries adopting it, and growing demand from consumers seeking immersive experiences. Furthermore, continuous enhancements in technology, reduced costs, and the increasing use of virtual reality devices contribute to the expansion of the industry. VR extends its influence across various sectors, such as gaming, entertainment, healthcare, and education.

📝 Featured Story

In November 2021, the U.S. Food and Drug Administration (FDA) approved the prescription-use immersive VR system for pain relief in adults. This approach includes cognitive behavioral therapy and a variety of behavioral strategies, such as deep relaxation, redirection of concentration, and cultivating awareness of internal sensations to reduce persistent pain. Medical practitioners can use VR to plan for work in the operating room.

◎ Radar View & Related Technologies

Rating	Market Potential				Adoption Phase		
	Very low	Low	**High**	Very high	Emerging	**Improving**	Mature

✧ Key Takeaway

Multi-sensory experiences are becoming the dominant focus of future development in VR. Companies need to prioritize adaptability as a crucial factor in VR. Utilizing VR technology is already facilitating learning and advancement in professional fields.

Key Use Cases

Manufacturing
◦ Aid designers and engineers in creating and testing prototypes in a virtual environment, reducing development time and costs

Life Sciences
◦ Distract patients from pain and provide immersive therapeutic experiences like VR-exposure therapy

Media & Entertainment
◦ VR for sports in a 360-degree format
◦ VR in live concerts with simulations of 3D images of artists and surroundings

Energy & Utilities
◦ Train for dangerous or complex tasks in a safe VR environment

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Beyond the Horizon: Insights from LTIM Tech Innovators

*Embark on a journey where reality blurs and imagination takes flight, within the boundless realms of **virtual reality's** embrace.*

Jinto Varghese
Associate Vice President
Global Technology Office

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AI-As-A-Service

Artificial Intelligence- As-a-Service (AIaaS) refers to using external providers to outsource AI capabilities. AIaaS offers a pre-built platform that can be accessed readily and set up effortlessly. It facilitates the testing of diverse public cloud platforms, services, and ML algorithms. This grants businesses the opportunity to explore artificial intelligence for different objectives without having to make significant upfront investments and minimize the associated risks.

⚑ Highlights

AIaaS enables businesses to utilize advanced AI technologies without significant initial investments, ensuring affordability and accessibility. In addition, it promotes innovation by making advanced AI capabilities easily accessible and inspiring the exploration and creation of novel applications. Furthermore, it offers a versatile structure that enables businesses to swiftly adjust to emerging AI trends while disregarding the challenges associated with overseeing AI infrastructure. AIaaS is becoming increasingly popular in various sectors, with retailers utilizing chatbots in several aspects of their businesses.

📝 Featured Story

A US-based consumer goods company utilizes AIaaS provided by Google Cloud to enhance and personalize customer interactions. By providing AIaaS, businesses can provide customers with an extensive selection of merchandise available at local stores and conveniently facilitate delivery through preferred methods. Google Cloud's AIaaS empowers intelligent supply chains, intelligent factories, sustainability, enhanced system flexibility, and increased productivity.

◎ Radar View & Related Technologies

	Cloud, Infrastructure & Security
Data & AI	

AI-Augmented Development

Applied AI

Self Adaptive Security

AI-as-a-Service

Interactive Tech

Digital Platforms & Operations

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3+ Years — 3 Years — 1 Year — 0 Year

Rating	Market Potential				Adoption Phase		
	Very low	Low	**High**	Very high	Emerging	**Improving**	Mature
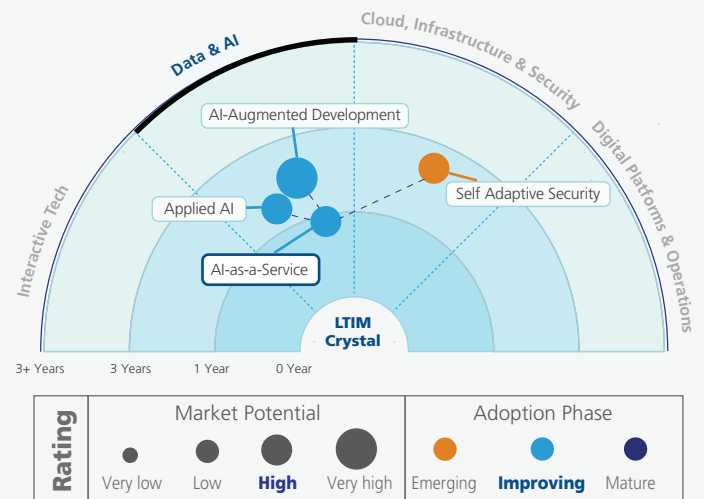
✦ Key Takeaway

One of the biggest challenges for AIaaS is ensuring privacy and security. If companies can overcome this hurdle, they can leverage and benefit from advanced AI capabilities without requiring significant upfront investments in infrastructure or expertise.

Key Use Cases

Insurance
◦ Risk assessment and underwriting automation
◦ Customer support through virtual assistants

Retail and CPG
◦ Demand forecasting and inventory optimization
◦ Customer behavior analysis for personalized marketing

Manufacturing
◦ Supply chain optimization and demand forecasting
◦ Predictive maintenance for machinery and equipment

Healthcare
◦ Drug discovery
◦ Personalized medicine services

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Data Fabric

Data fabric, an approved architectural framework, and a suite of technologies, facilitates breaking down data silos and streamlining data access within an organization. It enables the ingestion, integration, and sharing of data across the enterprise in a regulated manner, irrespective of location – whether within on-premises systems or various public cloud environments.
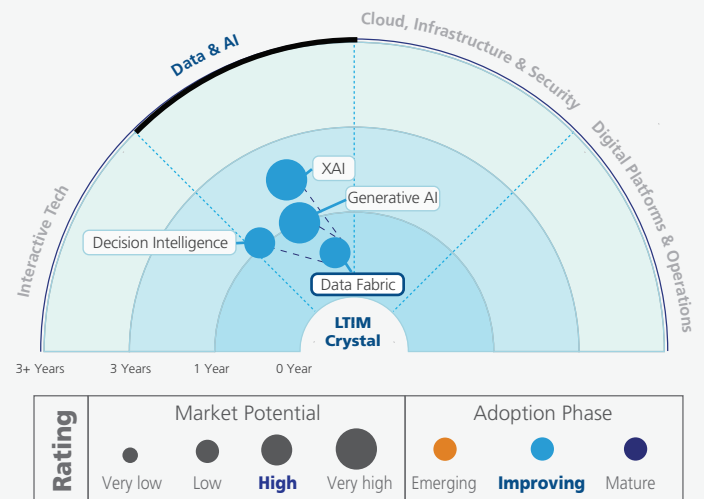
⚑ Highlights

Data fabric helps in reliable and quick decision-making by arranging data into warehouses and pipelines effectively. Today, a Global organization's data source can be multiple due to several stakeholders. These stakeholders can have their data staged at various locations connected to the internet. This massive trunk of data needs to be exploited to gain meaningful insights. By combining multiple data management processes such as data orchestration, data governance, data pipelining, integration, etc., organizations can reap benefits such as comprehensive data administration, optimized cost of ownership, enhanced security, better business insights, etc.

📝 Featured Story

One of the largest banks in India implemented a data fabric solution to create a mobile financial marketplace for its customer base of over 450 million. It integrated 22,500 branches worldwide and 2,60,000 employees. The platform helped alleviate the bank's digital journey, increased Insurance sales, improved customer experience, and brought data from across the world on a single platform.

◎ Radar View & Related Technologies

| 3+ Years | 3 Years | 1 Year | 0 Year |

Rating	Market Potential				Adoption Phase		
	● Very low	● Low	● **High**	● Very high	● Emerging	● **Improving**	● Mature

✧ Key Takeaway

In the current digital revolution, it becomes imperative that data flows smoothly in real-time. By implementing Data fabric, larger organizations can effectively manage contrasting environments, complex systems, and new micro-services-based applications.

Key Use Cases

Retail and CPG	**Manufacturing**	**Communication**	**BFS**
◦ Integrate in-store, e-commerce, and website sales data for meaningful insights.	◦ Analyze customer feedback, factory output, and supply-chain data to plan for upcoming manufacturing outputs.	◦ Analyze the market's pulse by leveraging customer behavior, network requirements, and billing information.	◦ Design customized and personalized solutions for clients based on their financial history and goals.

Decision Intelligence

Decision intelligence is making informed and effective choices by analyzing data and available information. Leveraging analytical techniques such as predictive analytics, machine learning, and collaborative tools facilitates identifying patterns. This, in turn, enables users to pose inquiries about unaggregated data, leading to a streamlined process and a more efficient approach to making strategic, tactical, and operational decisions.
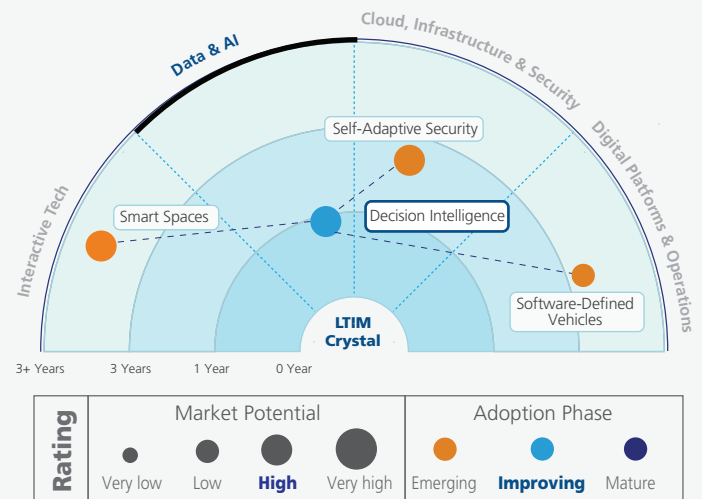
⚑ Highlights

Organizations today have a lot of staggered data; however, they struggle to turn it into insights. By leveraging decision intelligence, organizations can comprehensively view all the data, automate time-consuming processes, minimize biased analysis, and ensure collaborative and seamless information sharing. It can detect anomalies and make data-driven decisions. Decision intelligence is anticipated to emerge as a crucial competitive advantage for data-driven enterprises across diverse sectors, including financial services, healthcare, supply chain, e-commerce, retail, and manufacturing. It is poised to address the intricate "last mile of analytics challenge."

📝 Featured Story

An Australian govt department has been using decision intelligence since 2021 to improve efficiency and detect fraud. It successfully detected more than 50 instances where institutions defrauded more than AUD 15 million from the government's Covid loan schemes. It ensured more than AUD 1 million in savings on the implementation front.

◎ Radar View & Related Technologies

	Market Potential				Adoption Phase		
Rating	Very low	Low	**High**	Very high	Emerging	**Improving**	Mature

✧ Key Takeaway

AI-assisted decision intelligence can improve decisions by considering a wider range of variables, risks, and uncertainties. Businesses possess the ability to align decisions with both ethical considerations and the foundations of data-driven practices.

Key Use Cases

Communication
- Enhances capacity planning
- Preventive maintenance
- Network optimization, and forecasting.

Retail and CPG
- Simplifies supply chain and customer analysis to send appropriate promotional marketing campaigns

Insurance
- Study market data for policy underwriting
- Fraud detection
- Risk modeling studies

Life Sciences
- Monitor inefficiency of resources
- Reduce operational costs in hospital operations

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Generative AI

Generative AI, a subset of AI, creates digital images, videos, audio, text, or code using unsupervised learning algorithms. While traditional AI is trained for specific outputs, generative AI innovates independently, learning digital representations from sample data to generate unique, realistic artifacts. This distinctive approach positions generative AI as a catalyst for rapid innovation in enterprises.
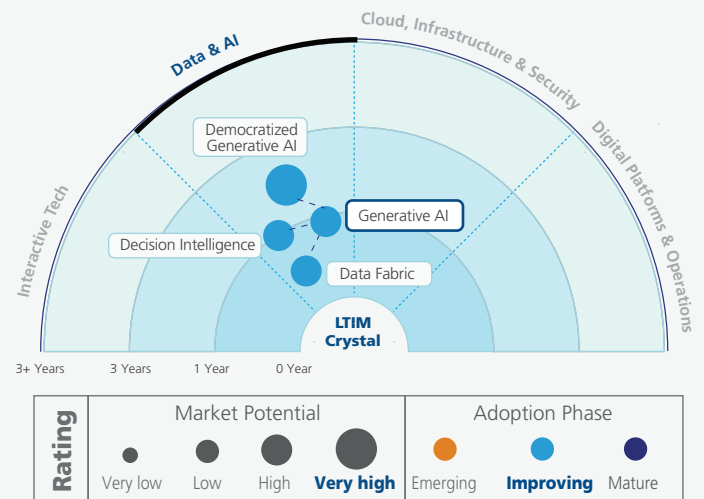
⚑ Highlights

Generative AI is designed to amplify product development and content creation, enhance team productivity, and augment customer experience. It is highly compatible with existing technologies such as big data, IoT, cloud, etc., making its integration easier, and can be applied extensively across many areas of the business. It can be easily personalized to provide strategic information for a competitive edge. Automation capabilities enable organizations to focus their resources and time on important strategic goals, resulting in lower costs and greater efficiency.

📝 Featured Story

A global payment processing corporation leveraged Generative AI to provide personalized product recommendations based on users' product searches, purchase history, demographic profile, etc. The tool can answer conversational questions and provide recommendations as a result. Their algorithm uses image recognition to help with relevant products from the product catalog, providing a personalized customer experience.

◎ Radar View & Related Technologies

Rating	Market Potential				Adoption Phase		
	Very low	Low	High	**Very high**	Emerging	**Improving**	Mature

✧ Key Takeaway

With its immense power, generative AI is changing many facets of human existence, propelling innovation in various sectors. It is developing new applications for consumers and businesses and boosting profits.

Key Use Cases	**BFS**	**Life Sciences**	**TTH**	**Retail and CPG**
	◦ Analyze market data and scenarios to generate personalized investment decisions	◦ Fast-track R&D processes by gathering and testing information on millions of molecules	◦ Helps with facial recognition and verification at airports to ensure the correct traveler's identity	◦ Deliver personalized and contextual sales-driven communications

Machine Learning

Machine Learning is a part of AI centered around imitating human intelligence by enabling systems to learn and continuously improve themselves using data rather than explicit instructions. Its algorithms can address challenges that exceed the computational capabilities of traditional algorithms. They achieve this by deriving conclusions from data and autonomously establishing their own set of rules.

⚑ Highlights

Machine learning can perform manual tasks beyond a human's ability to execute at scale, such as processing huge quantities of data generated by digital devices. It has a competitive differentiator by extracting patterns and insights from vast data sets in various industries such as e-commerce, retail, scientific discovery, etc. The ability to process enormous volumes and a variety of data, high-speed internet, and accessibility of computational powers are driving the adoption of machine learning. Its applications independently learn, unlearn, and adapt from the data fed onto them, making them autonomous.

📝 Featured Story

A global household care corporation utilized machine learning and other cutting-edge technologies to digitize and consolidate data from over a hundred manufacturing sites worldwide. This implementation enabled them to analyze production data and make real-time data-driven decisions. They improved their overall energy usage and pre-determined predictive maintenance in their machines, saving costs.

◎ Radar View & Related Technologies
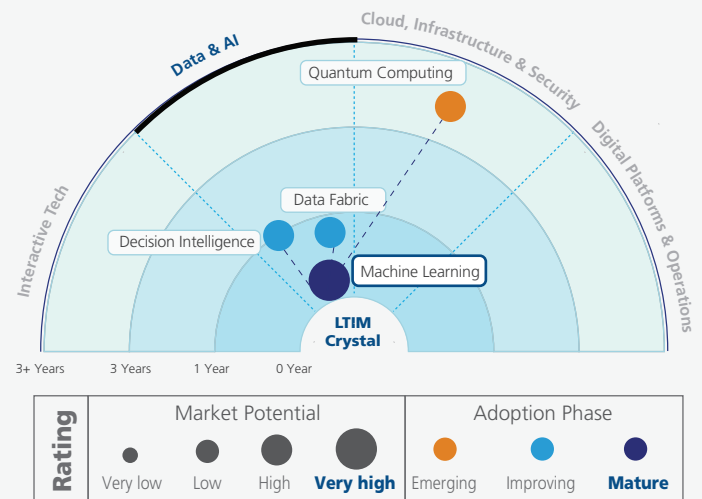
✧ Key Takeaway

Machine learning holds paramount significance, USP through high-value predictions. This capability facilitates improved real-time decision-making and intelligent actions without human intervention.

Key Use Cases

BFS
◦ Analysis and behavioral pattern detection of past transactions for potential credit and fraud detection

Media & Entertainment
◦ Adaptive narratives responding to viewer choices for personalized and immersive experiences

Healthcare
◦ Analysis of patient history with external data points such as X-ray and ultrasound to improve diagnosis and detection

Retail and CPG
◦ Optimize and streamline inventory, thereby preventing stock-outs or overstocking

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Natural Language Processing

Natural Language Processing (NLP) is a subset of Artificial Intelligence (AI) that uses computational techniques and algorithms to read, analyze, and extract complex information from human language inputs. This technology processes unstructured data to derive meaning and can be used to conduct sentiment analysis. NLP applications include seamless chatbot interactions and nuanced text translation.
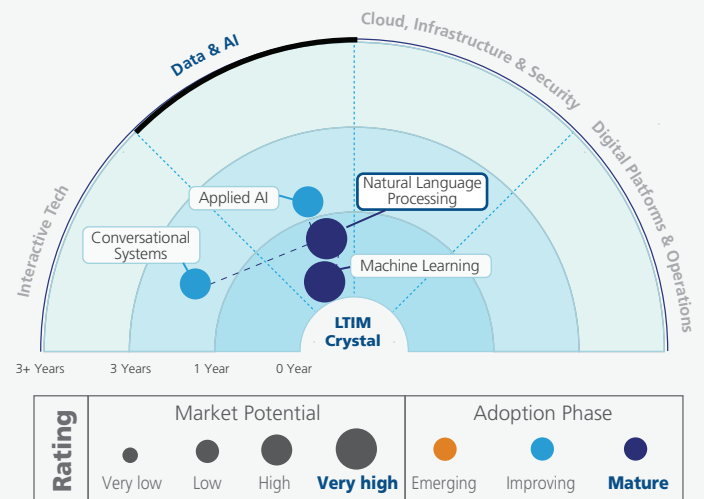
⚐ Highlights

NLP is expected to reach USD 49.4 billion by 2027, growing at a CAGR of 25.7% between 2022 - 2027. There is a growing demand for cloud-based NLP solutions to reduce costs and improve scalability, streamline business operations, and offer better CX. Predictive analytics is also in demand to lower risks and recognize growth opportunities. All these factors are expected to drive the adoption of NLP. The market is projected to be 14 times larger in 2025. NLP can enable businesses to automate content creation, translation, and localization processes, saving time and money. Besides this, it can enhance business intelligence and aid in decision-making by analyzing customer feedback.

📝 Featured Story

A US-based healthcare provider signed a ten-year agreement with an AI company to improve its revenue cycle management processes through natural language processing. The company offers over 100 medical specialties to two million people across New York. It is now leveraging AI to automate its revenue cycle activities and speed up document processing, and initial chart reviews. Through the deal, the healthcare provider aims to improve its revenue, cycle management accuracy and, meet patient needs.

◎ Radar View & Related Technologies

Rating	Market Potential				Adoption Phase		
	Very low	Low	High	**Very high**	Emerging	Improving	**Mature**

✧ Key Takeaway

NLP is a rapidly evolving field. Efforts are in progress for creating algorithms to enable computers to decipher and generate human language. Deep learning through neural networks such as recurrent neural network (RNN) models has significantly impacted NLP.

Key Use Cases

Insurance
◦ Extract and analyze information from claim documents, speed the claim process

Retail and CPG
◦ Product review analysis, recommendations systems, and chatbots for customer queries

Healthcare
◦ Analyze health records to identify patterns and trends in patient care

BFS
◦ Identify anomalies in transactions or detect patterns that indicate a potential threat
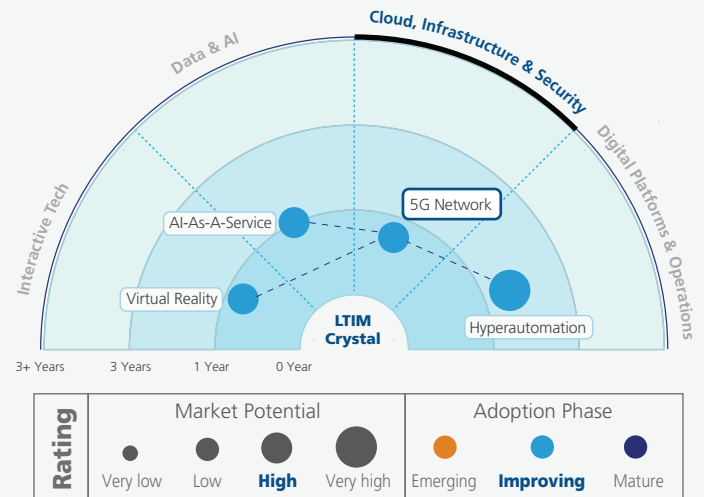
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5G Network

The 5th Generation Network (5G) is the latest global wireless standard after 1G, 2G, 3G, and 4G, which promises to connect virtually with everyone and everything. The 5G network is designed to facilitate higher, multi-GBPS peak data speeds, low latency, increased reliability, enlarged network capacity, and a better user experience.

⚑ Highlights

A 5G network is built to take connectivity to the next level by leveraging technologies like the cloud. Its dense and distributed architecture helps to move data processing closer to the edge, enabling edge computing at a much faster speed. The network augments synchronization across different systems. For efficient performance of business operations virtually, high-speed data storage and transfer capabilities are essential. The widespread deployment of 5G will support the adoption and advancement of technologies like telemedicine, AI-enabled customer service, precision agriculture, autonomous vehicles, etc.

📝 Featured Story

The world's leading electronics appliances manufacturer faced challenges monitoring real-time production phases for anomaly detection. The company then created a digital twin of the production line and augmented it through 5G networking. The resultant integration of 5G and digital twin helped the company to identify anomalies quickly and address issues.

◎ Radar View & Related Technologies

	Market Potential				Adoption Phase		
Rating	Very low	Low	**High**	Very high	Emerging	**Improving**	Mature

✧ Key Takeaway

5G is evolving as a comprehensive package in communication and network space. It can catalyze the adoption of new-age technologies like cloud, edge computing, Internet of Things (IoT), AR/VR, etc.

Key Use Cases

Communications
◦ Mobile Edge Computing
◦ Network Slicing

Media & Entertainment
◦ Delivering immersive and interactive experiences with faster download speeds and low latency

Healthcare
◦ Connected ambulances
◦ AR/VR assistance for visually impaired

Manufacturing
◦ Smart factories and logistics
◦ Remote monitoring of production assets

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Distributed Cloud

Distributed cloud refers to the next generation of cloud computing, in which resources like computing power, storage, and microservices are accessed on-demand instead of being managed by the user. This technology leverages various cloud "locations," including public, private, and on-premises infrastructure. This means organizations have greater flexibility in deploying software, optimizing performance, regulatory compliance, data security, and more.
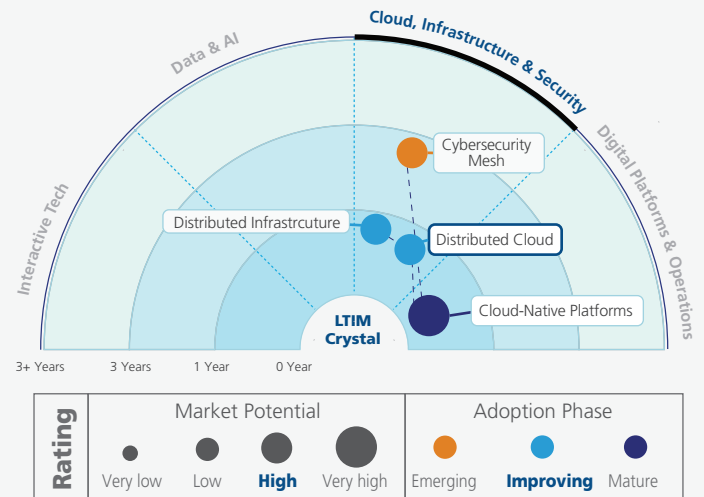
⚐ Highlights

Distributed cloud leverages geographically distributed and centrally managed cloud services optimized for performance, compliance, and edge computing. It is supported by decentralized strategies such as Secure Access Service Edge (SASE) and is expected to help drive the growth ofas a business strategy. Moreover, with the growing implementation of IoT and other data-intensive systems, distributed cloud will enable efficient end-to-end management, optimizing data management, computing speeds, and network connectivity. It will also be significant in determining how 5G networks are designed and deployed.

📝 Featured Story

A U.S.-based government contractor, providing strategic IT and engineering solutions to the U.S. armed forces, aspired to migrate its emergency notification system to the cloud. A renowned cloud services provider in the U.S. implemented Microsoft Azure-based distributed cloud, leveraging Secure Azure Computing Architecture (SACA). As a result, the designed distributed system surpassed U.S. government standards and supported millions of users under the U.S. defense ministry.

◎ Radar View & Related Technologies

Rating	Market Potential				Adoption Phase		
	Very low	Low	**High**	Very high	Emerging	**Improving**	Mature

✧ Key Takeaway

The distributed cloud undoubtedly forms the next generation of cloud platforms and is expected to reach the mainstream market in the next few years. A rise in endorsement of IoT and data-intensive systems can speed up its adoption.

Key Use Cases

Hi-Tech
◦ Building and managing distributed applications across multiple clouds
◦ Edge locations for increased flexibility and scalability

Media & Entertainment
◦ Ensuring low-latency, high-quality live-streamed events with distributed cloud

Healthcare
◦ Facilitating secure collaboration and data sharing among healthcare providers and researchers

BFS
◦ Ensuring compliance with financial regulations and data security via distributed cloud across cross-channel banking

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Beyond the Horizon: Insights from LTIM Tech Innovators

***Distributed cloud** emerges as a transformative leap forward from traditional cloud computing, strategically dispersing infrastructure to optimize performance, cost, and compliance. It offers unmatched agility and resilience in complex digital ecosystems, serving as an indispensable solution amid evolving regulatory landscapes.*

A distributed cloud is a true multi-cloud and will fulfill the promise of cloudifying the edge.

Anup Karade
Associate Vice President,
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LTIMindtree

Distributed Infrastructure

Distributed Infrastructure is how IT organizations ensure applications are deployed to provide the best performance and scalability. It spans applications over on-premises data centers, the public cloud, and edge locations.

⚑ Highlights

These days, flexibility and scalability have gained a lot of importance in infrastructure planning. Distributed infrastructure fulfills these needs by leveraging distributed programs without needing each layer to comprehend underlying mechanics. Moreover, distributed file systems are designed to be deployed in low-cost hardware and have high fault tolerance. These systems are widely used in data mining, log analysis, advertising computing, and web search. Distributed infrastructure is gaining popularity in open-source projects as these projects focus on distributed assets. Technology giants like Google, Amazon, and IBM have recognized the significance of distributed infrastructure and have started using it in their ecosystems.

📝 Featured Story

The world's leading technology giant uses distributed infrastructure for its applications and middleware infrastructure. The company leverages the MapReduce distribution platform for data storage, retrieval, and processing. This cost-effective and high-performance platform has successfully provided low latency in networking and higher reliability in the services offered.

◎ Radar View & Related Technologies

	Market Potential				Adoption Phase		
Rating	● Very low	● Low	● **High**	● Very high	● Emerging	● **Improving**	● Mature
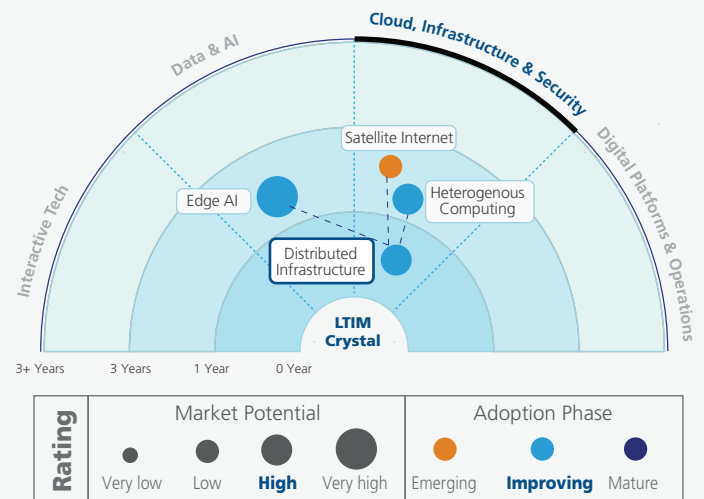
✧ Key Takeaway

Distributed infrastructure has started gaining attention recently and is expected to reach the mainstream market in the next few years.

Key Use Cases

Hi-Tech
◦ Adopting serverless computing models for deploying and running applications without the need for managing servers

Media & Entertainment
◦ Optimizing content delivery through geographically distributed infrastructure for improved latency and user experience

Retail and CPG
◦ Utilizing services from numerous public cloud providers to prevent vendor lock-in, optimize costs, and enhance redundancy

BFS
◦ Leveraging a blend of on-premises data centers and public cloud services for a flexible and scalable IT infrastructure

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Hyper Converged Infrastructure

Hyperconverged Infrastructure (HCI) is an IT framework combining various infrastructure layers like storage, computing, and networking into a single, unified data center solution. It enables an IT infrastructure to run on standard, off-the-shelf servers by virtualizing all the hardware elements of a conventional data center environment. The technology aims to reduce infrastructure complexity, thereby increasing scalability and agility.
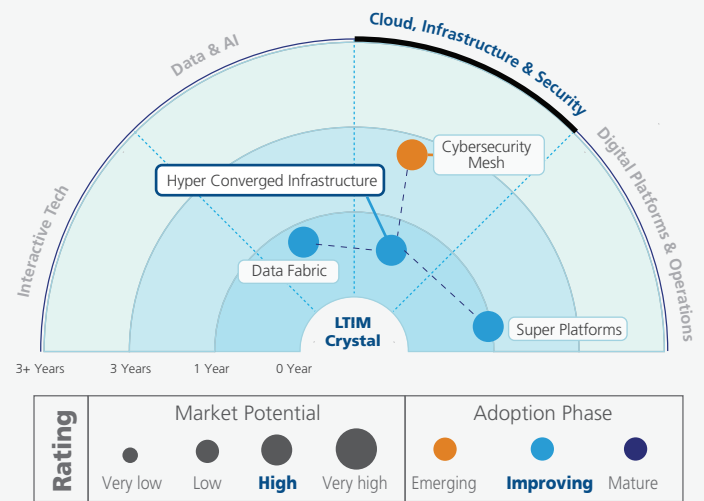
⚑ Highlights

HCI enhances converged infrastructure by introducing increased levels of abstraction and elevated automation, going beyond its initial simplicity. In an HCI environment, the components are coupled to seamlessly integrate storage, computing, and networking, giving an edge to organizations in expanding capacity. Organizations can begin with a modest scale and expand as required. The growing popularity of Infrastructure-as-a-service can drive the growth of this technology as it ensures reduced ownership costs and infrastructure virtualization. Also, new-age technologies like AI and ML disrupt legacy data infrastructure, making companies more agile, flexible, and responsive.

📝 Featured Story

A well-known Indian bank faced challenges stemming from underutilized IT infrastructure. A new HCI platform was adopted to address this, seamlessly integrating hybrid and multi-cloud strategies. This platform ensures unified management and operations with intelligent automation, whether on-premises or in the cloud. This reduced the need for manual infrastructure management and established a robust architecture supporting the banks' operations.

◎ Radar View & Related Technologies

Rating	Market Potential				Adoption Phase		
	Very low	Low	**High**	Very high	Emerging	**Improving**	Mature

✧ Key Takeaway

HCI empowers organizations with faster and more reliable IT infrastructure. Its adoption is fueled by the growing implementation of the cloud and distributed technologies.

Key Use Cases

Retail and CPG
◦ Virtual desktop infrastructure
◦ Data 'In-Transit' analytics

Media & Entertainment
◦ High-density media streaming and Content disaster recovery

Life Sciences
◦ Low-latency health monitoring equipment

BFS
◦ Real-time transaction data analytics
◦ Flexible compute and storage scaling for financial analytics

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Zero-Trust Architecture

Zero-Trust Architecture (ZTA) is a cybersecurity approach that prioritizes users, assets, and resources over network-based perimeters. Zero-trust principles are used to plan industrial and enterprise infrastructure and workflows. They assume no implicit trust is granted to assets or user accounts due to their location or ownership. Authentication and authorization functions are done before starting a session with an enterprise resource.
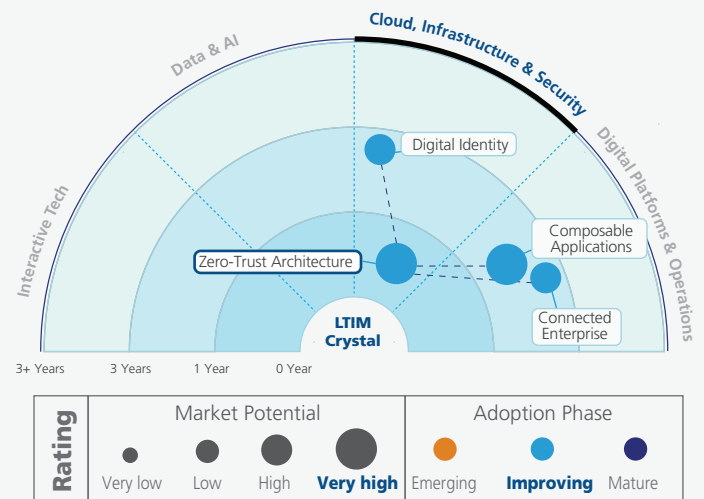
⚐ Highlights

ZTA will be increasingly adopted as security needs grow. Remote work and cloud services will boost its adoption. This approach will be crucial as organizations seek improved security solutions for modern enterprises. By 2026, Gartner forecasts that 10% of big organizations will have an experienced and measurable ZTA program, a significant increase from less than 1% in 2022. ZTA revolutionizes security strategy for modern enterprises, where perimeter defense alone is inadequate due to cloud computing, mobile devices, and remote workforces. It will tackle security challenges through a granular approach based on user and device identity and trust.

📝 Featured Story

A notable case study of a ZTA implementation comes from an American multinational technology company. The company switched from a traditional security model to ZTA that focused on device and user authentication, no matter their location. This method exemplifies how ZTA efficiently mitigates cybersecurity risks in a dynamic landscape, enhancing safety in the industry.

◎ Radar View & Related Technologies

Rating	Market Potential				Adoption Phase		
	Very low	Low	High	**Very high**	Emerging	**Improving**	Mature

✦ Key Takeaway

ZTA is set to grow as organizations prioritize adaptive cybersecurity. With evolving threats and increased remote work, this technology will likely become a standard, focusing on continuous monitoring, identity-centric security, and dynamic access controls.

Key Use Cases

Manufacturing
◦ Protect critical systems such as Supervisory Control and Data Acquisition (SCADA)

Communication
◦ Securing access to applications and resources regardless of location, replacing outdated VPNs with granular access control

Healthcare
◦ Securing sensitive patient data in compliance with HIPAA and other healthcare regulations

Energy & Utilities
◦ Protecting data from distributed energy resources like solar panels and wind turbines

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Beyond the Horizon: Insights from LTIM Tech Innovators

Zero-Trust is one of the fool-proof security frameworks that can secure all attack surfaces within an organization and provide a proactive and modern approach to organizational security. The zero-trust framework validates every access at every layer and ensures that the right data is available and protected from cyber threats.

**Senthil Kumar Arumugam**
Associate Principal, CyberSecurity

API Economy

The API economy is a business model built around the use of APIs in the digital economy. APIs refer to application programming interfaces made available to third-party data and services. They work as a bridge to connect data extracted from one software application to the next application securely and accurately so that the two can communicate and share data seamlessly. The API economy is vital because it creates new business models and allows companies to profit by selling their features as SaaS products.

⚑ Highlights

API is prime in organizational practices, aligning with market demands and customer preferences. Embracing an API-first approach underscores their value in system design, fostering flexibility and agility to meet market needs. This trend gains traction due to organizations' access to hybrid multi-cloud systems, blending cloud service adaptability with existing infrastructure for enhanced performance, security, and cost efficiency. Companies persist in API investments for diverse reasons, notably to bridge isolated applications in an ecosystem where 70% of over 1,000 applications operate independently. APIs serve as the linchpin, forging connections and justifying the investment.
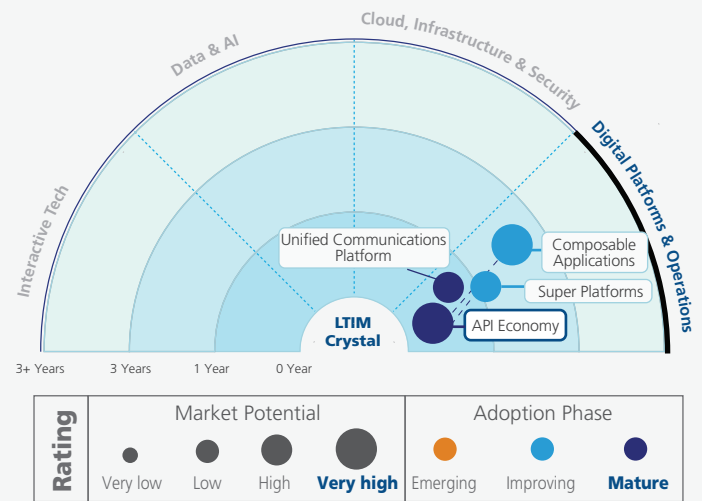
📝 Featured Story

A US-based life insurance company partnered with Human API, a health data platform, to merge expertise and technologies to revolutionize life insurance purchases and provide an unparalleled experience. Human API's specialized data normalization engine broadens the uses of digital health data, offering deeper insights and new opportunities. This partnership will help insurance providers to deliver the best experiences to their members.

◎ Radar View & Related Technologies

Rating	Market Potential				Adoption Phase		
	Very low	Low	High	**Very high**	Emerging	Improving	**Mature**

✬ Key Takeaway

API economy fosters seamless data sharing, enhances services across sectors, enables innovation, streamlines processes, and empowers collaboration, spurring growth and efficiency in diverse industries worldwide.

Key Use Cases

TTH
◦ Integrating flights, hotels, and car rental services for seamless reservation

Media & Entertainment
◦ Providing access to streaming platforms, gaming APIs, or media content

Healthcare
◦ Enabling seamless data sharing among healthcare systems for telemedicine

BFS
◦ Enabling banking, stock data, and payment processing access

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Cloud-Native Platforms

The term "cloud-native" means developing and running applications to take advantage of the distributed computing given by the cloud delivery model. They allow enterprises to build new application architectures that are elastic and scalable. Cloud-native platforms take up the core elasticity and scalability of cloud computing to serve faster time to value.
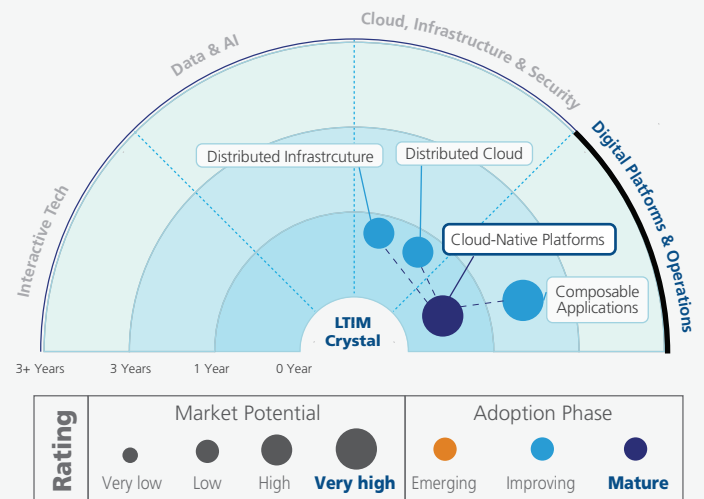
⚑ Highlights

Cloud-native platforms are designed using new-generation methodologies like DevOps, continuous integration, microservices, etc. This enables enterprises to deploy and scale components independently without any service interruptions. Cloud-native platforms bring quality, integrity, and consistency to critical areas and enhance the velocity of software production. It allows delivery teams to dedicate time to developing advanced product/application features that boost competitive differentiation. This supports organizational goals, which may vary in scope between companies; however, generally, the focus is on meeting customers' evolving needs securely, and cost-effectively.

📝 Featured Story

A travel conglomerate in China struggled to scale up the software performance and related hardware issues in network devices. The company was unable to keep up with the market growth. Cilium was identified as the best fit after evaluating multiple options. The cohesive technology stack and reliability of Cilium addressed the scalability issues of their previous setup. It has also significantly reduced operational costs, even as their clusters grow.

◎ Radar View & Related Technologies

	Market Potential				Adoption Phase		
Rating	● Very low	● Low	● High	● **Very high**	● Emerging	● Improving	● **Mature**

✧ Key Takeaway

Cloud-native platforms play a crucial role in data aspects of the digital transformation journey of enterprises, offering higher agility, scalability, and resilience.

Key Use Cases

BFS
◦ Elastic scaling and financial grade reliability of custom-built applications

Media & Entertainment
◦ Improved scalability, performance, and availability for digital media platforms

Healthcare
◦ Centralizing medical data on secure cloud-native platforms for enhanced access, analysis, and interoperability

Retail and CPG
◦ Utilizing real-time data and analytics on cloud-native platforms to optimize inventory levels

Super Platforms

Super platforms represent the evolution of DevOps practices designed to assist larger organizations in establishing standardized support and reusable configurations and providing systems engineering as an internal product capability. It enables developers to create a stable environment for software development teams to build and run their applications.

⚑ Highlights

Super platforms are an emerging methodology focused on modernizing software delivery. It escalates software teams' delivery in operations as well as developer experience.
 Leveraging super platforms is considered more advanced than DevOps because it enables organizations to create a reliable, standard, and technical foundation. Software developers can focus more on their core competencies without distractions like infrastructure. Super platforms facilitate enhanced communication and collaboration amongst team members and automate many processes. It also allows greater consistency amongst teams and enables the reuse of shared components rather than building and customizing them all over again.

📝 Featured Story

An American streaming service provider unified its developer experience by leveraging platform engineering. The organization learned from day-to-day operations that its microservices-based architecture was increasingly becoming fragmented as the platform tooling grew. Post implementation, the platform provided a common front door to developers who could access the project status at any time.

◎ Radar View & Related Technologies
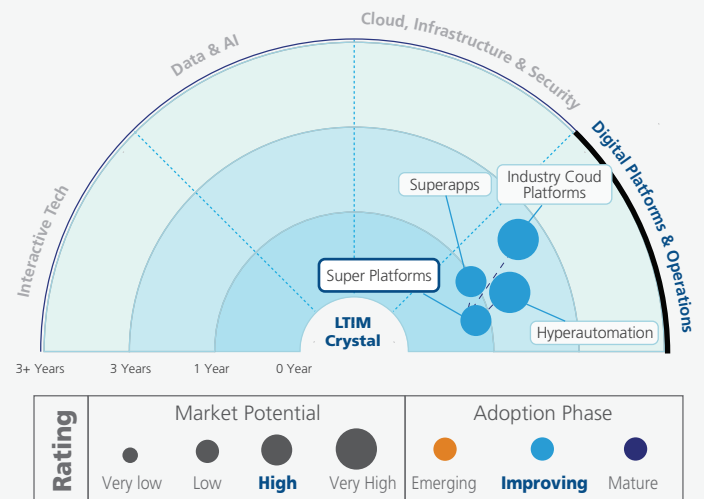
✧ Key Takeaway

Super platforms are vital in creating a faster, more efficient, and robust foundation for software development teams. By 2026, large IT organizations are expected to establish super platform teams to resolve cooperation issues between operators and software developers.

Key Use Cases

BFS	Insurance	Communication	Hi-Tech
◦ Enables swift creation and deployment of tailored financial products, utilizing real-time customer data and preferences	◦ Analyzes real-time data on risk factors ◦ Adjusting insurance premiums for personalized coverage	◦ Optimizes diverse communication channels, dynamically routing traffic based on real-time network conditions and user requirements	◦ Manage a city's infrastructure, coordinating traffic flow, optimizing energy usage ◦ Tailoring public services to individual needs

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Superapps

A superapp is a single application accessible on a mobile device or web browser and offers multiple diversified services for personal or commercial life. It relies on a common financial transaction platform and leverages intra-app data to tailor offerings. The app provides services such as messaging, payments, ride-hailing, food delivery, and shopping in a single app to provide a seamless user experience.
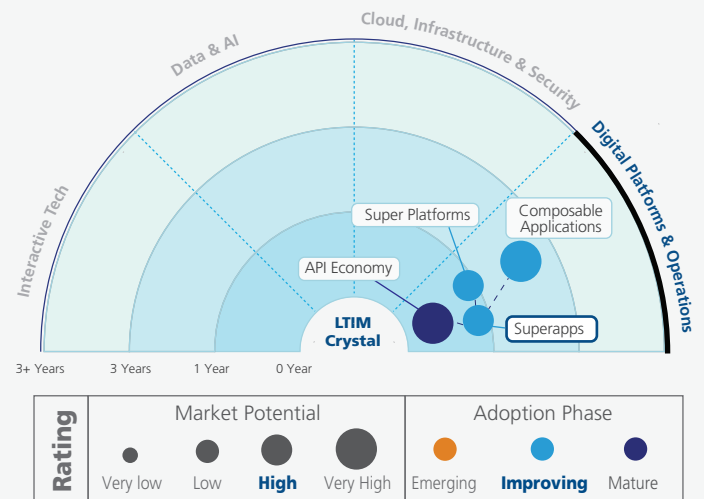
⚑ Highlights

Superapp is a growing market, especially in Asia, where most Superapps have been developing. As companies work to provide personalized experiences, and seamless integration, the future scope of superapps has enormous potential. As per Gartner, it is a frontend platform where internal developers and third parties can release micro apps, which users can activate. Superapps are expected to witness the integration of financial services like lending, digital wallets, and insurance. Superaapps for banking services are also an attractive sector for manufacturers to scale over the upcoming years. As cybersecurity threats are consistently rising, the installation rate of superaapps is likely to surge.

📝 Featured Story

A messaging app developed by a Chinese multinational conglomerate evolved into a superapp. It provides a wide range of services such as social networking, mobile payments, ride-hailing, food delivery, e-commerce, etc. It allows users to send messages, make voice and video calls, and make in-store and online payments. Additionally, users can manage their finances, including personal banking, investments, and wealth management within the app.

◎ Radar View & Related Technologies

Rating	Market Potential				Adoption Phase		
	Very low	Low	**High**	Very High	Emerging	**Improving**	Mature

✧ Key Takeaway

A superapp is a single application that integrates multiple services like messaging, social media, e-commerce, ride-hailing, food delivery, and financial services. Through this platform, superapps help businesses to expand their service offerings.

Key Use Cases

BFS
◦ Mobile payment capabilities, digital wallet features, loans, and credit service

Media & Entertainment
◦ Integrate multiple streaming platforms into a single interface

Retail and CPG
◦ Product recommendations, integration of mobile wallet features
◦ Real-time order tracking features

TTH
◦ Compare ride prices, book in your preferred language across provider services

Unified Communications Platform

Unified Communications Platforms are cloud-based and serve as collaboration and communication hubs for organizations. They can support enterprise telephony, unified messaging, meetings (audio/video/web conferencing), and mobility and communications-enabled business processes. It helps employees stay better connected with organisations gaining more control over their workflows and processes.
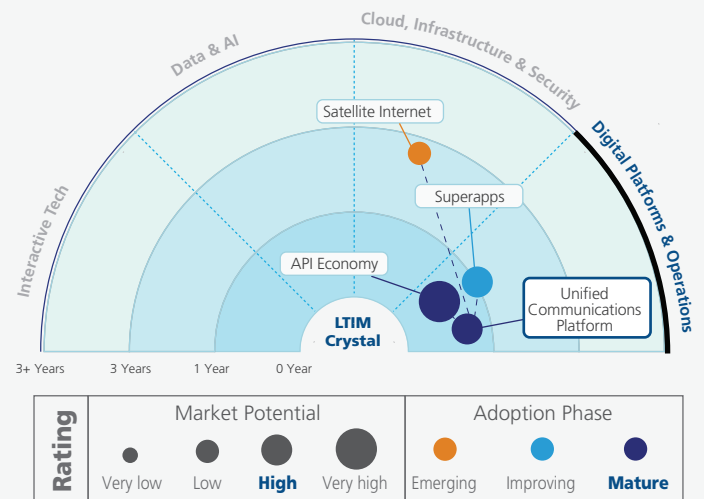
⚑ Highlights

Leveraging Unified Communications Platforms helps organizations avoid CAPEX & OPEX associated with deploying unified communication. It enhances business continuity, supports in engaging a hybrid workforce, and streamlines internal communication within the workforce. These platforms are very flexible and allow adding and removing employees quickly. They also eliminate the need to switch between multiple communication tools, boosting efficiency, productivity and workplace organization. Unified Communications solutions are securely hosted over the cloud, eliminating the need for on-site maintenance and technical support, making it faster and cheaper to deploy.

📝 Featured Story

A South Korean telecom provider implemented a secure Unified communication tool, capable of streamlining work processes for its distributed internal teams. The solution could create a collaborative and engaging culture amongst its employees offering excellent integration with the provider's existing tools resulting in a secure and compliant process.

◎ Radar View & Related Technologies

Rating	Market Potential				Adoption Phase		
	Very low	Low	**High**	Very high	Emerging	Improving	**Mature**

✧ Key Takeaway

Unified communications enables effective communication in a secure and collaborative. It eliminates multiple mediums of communication and allows organizations to exercise greater control & security over their processes. The growth of a hybrid workforce is expected to drive the adoption.

Key Use Cases

Transport & Hospitality
◦ Allows easier connection with guests and internal teams to ensure enhanced customer experience.

Healthcare
◦ Consolidates phone systems thereby providing staff flexibility, expanding incident reporting and improving patient experience.

Manufacturing
◦ Allows one-stop place for all documentation, alerts, and notifications

BFS
◦ Ensures financial teams document correct information securely

Horizon 2

Relevant industry players have started
incubating the technology, to assess the
potential, risk implications and benefits

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Augmented Reality

Augmented reality (AR) creates an interactive experience in the real world, enriching physical objects. It uses computer-generated perceptual information across visual, auditory, haptic, somatosensory, and olfactory senses. In contrast to virtual reality, AR seamlessly integrates digital elements into your surroundings rather than constructing a wholly artificial environment.
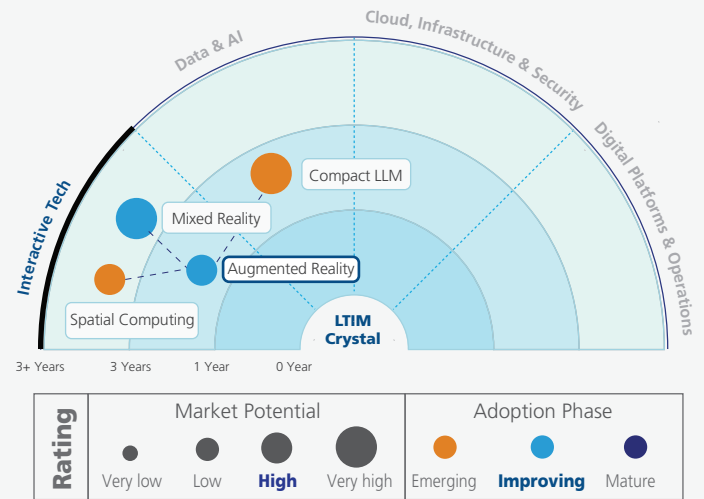
⚐ Highlights

Integrating Depth APIs, LiDAR sensors, and Cloud anchors reshapes the landscape as AR evolves. Depth APIs bring realism to object interactions, allowing dinosaurs to navigate behind tangible trees seamlessly. LiDAR sensors ensure instant AR placement, eliminating lag and intensifying the immersive experience. With the imminent arrival of 5G and innovations like contact lenses, the increasing convergence of AR and AI enables more immersive and interactive experiences with real-time data overlays. AR is on an exciting trajectory towards unprecedented possibilities and shows an upward trend in consumer AR adoption, driven by gaming, shopping experiences, and educational applications.

📝 Featured Story

A German remote access and remote-control computer software provider revolutionized warehouse operations in the US. Smart glasses with vision-picking software guide workers, boosting efficiency and accuracy. Employees see real-time order information, shelf locations, and instant feedback, reducing training time and errors. Hands-free picking improves ergonomics and productivity, while seamless integration with warehouse management systems creates a fully connected end-to-end process.

◎ Radar View & Related Technologies

	Market Potential				Adoption Phase		
Rating	Very low	Low	**High**	Very high	Emerging	**Improving**	Mature

✧ Key Takeaway

Sophisticated AR tools with enhanced spatial mapping, object recognition, and AI capabilities will unlock new possibilities. Enterprises must leverage AR for training, remote collaboration, product design, and field service.

Key Use Cases

Retail and CPG
◦ Virtual try-on experiences for clothing and furniture
◦ Interactive product demonstrations

Communications
◦ Overlaying contextual information and improving collaboration
◦ Visual prompts to enhance virtual meetings

Healthcare
◦ AR glasses for doctors with real-time instructions and schematics overlaid on equipment

Insurance
◦ Overlaying relevant data onto physical scenes to assist in evaluating damages

Computer Vision

AI has a branch named computer vision, which enables computers to obtain relevant information from videos, digital images, and other visual inputs to interpret information, much like humans. Like how AI empowers computers to think, computer vision empowers them to observe and comprehend. Computer vision encompasses identifying objects, processing, tracking, and understanding images.
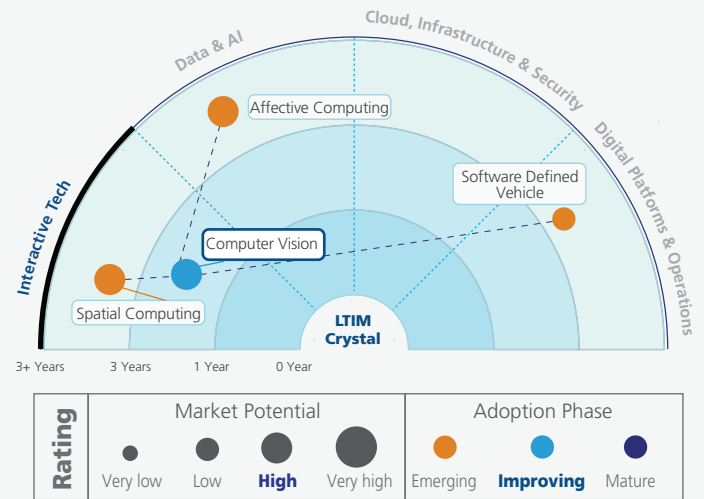
⚑ Highlights

Computer vision's shift to deep learning, notably with Convolutional Neural Networks (CNNs), is transformative. ResNet-50, using innovative residual blocks, enhances accuracy in image classification. YOLO sets a benchmark for real-time object detection, evolving through versions like YOLOv5 and YOLOv8, impacting applications such as traffic management. Stable Diffusion V2 advances image generation with text-to-image models and super-resolution upscaling. Early adoption in the BFS and Insurance sectors is evident, while retail, manufacturing, sports, and automotive sectors are experimenting with applications across in-store engagement, quality control, and connected car safety.

📝 Featured Story

India's top construction organization aims to achieve zero incidents by enforcing strict Personal Protective Equipment (PPE) compliance. A global tech consulting firm created an edge-based computer vision solution, swiftly identifying and alerting non-compliance with safety guidelines in authorized work zones. The system's low latency ensures quick detection, issuing alerts and video clips to supervisors. This innovative solution supports achieving 100% safety compliance at construction sites.

◎ Radar View & Related Technologies

Rating	Market Potential				Adoption Phase		
	Very low	Low	**High**	Very high	Emerging	**Improving**	Mature

✕ Key Takeaway

Real-world computer vision applications demand the synergy of cloud and ultra-low latency. To address critical business challenges and opportunities, an architecture with local (edge) computing capabilities and cloud scale ensures optimal real-time performance.

Key Use Cases

BFS
◦ Data extraction from trade documents

Life Sciences
◦ Analysis of CT scans and MRI

Manufacturing
◦ Identifying macro and micro level defects in the production line

TTH
◦ Traffic management and surveillance systems

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Conversational Systems

Conversational systems are smart technologies that can communicate with humans through text and speech. They automate consumer interactions in multiple languages through text and voice queries. Companies use conversational systems to enhance consumer interactions and create personalized products using consumer segmentation data. The capability of this technology to comprehend human emotion and tone is limited.
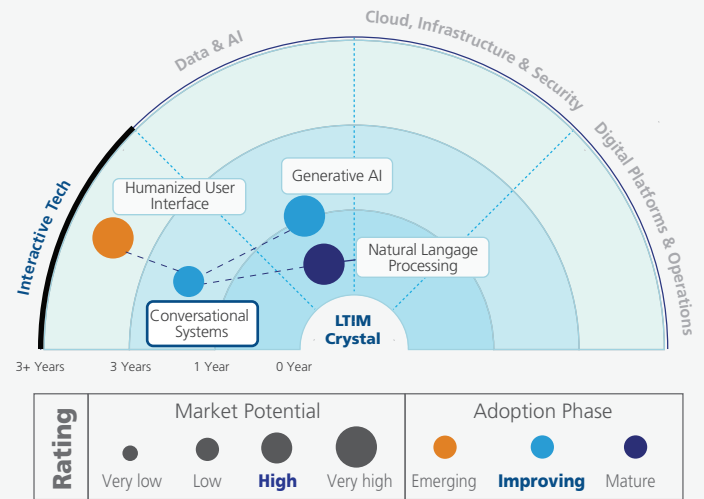
⚑ Highlights

Incorporating conversation systems technology is crucial for enhancing users' engagement with digital platforms. This technology fosters improved and effective interaction between humans and machines, influencing customer service, healthcare, and education sectors. With the continuous development of technology, conversational systems play a critical role in improving user satisfaction, accessibility, and optimizing the retrieval of information and execution of tasks. Consumers' adoption of conversational system technology is strongly influenced by their perception of **intelligence, user-friendliness, and usefulness.** Small and large businesses can expect enhanced consumer experiences as conversational systems advance and evolve.

📝 Featured Story

A US-based company that provides pharmacovigilance solutions was looking for a tailored and convenient way to collect information about adverse drug reactions in patients. A UK-based hyper-personalized systems company has launched a solution that offers a customized conversation generator and engine. The solution helped the pharmacovigilance company customize the language to their users' preferences. It also helped provide personalized web chat with a user-friendly interface and integrate it seamlessly into the customer's product suite.

◎ Radar View & Related Technologies

Data & AI · Cloud, Infrastructure & Security · Digital Platforms & Operations · Interactive Tech

- Humanized User Interface
- Generative AI
- Natural Langage Processing
- Conversational Systems
- LTIM Crystal

3+ Years · 3 Years · 1 Year · 0 Year

Rating	Market Potential				Adoption Phase		
	Very low	Low	**High**	Very high	Emerging	**Improving**	Mature

✧ Key Takeaway

This technology can significantly enhance language comprehension, situational awareness, and smooth integration into various business and operational contexts. As technology progresses, these systems can become more accessible and enhance meaningful interactions.

Key Use Cases

BFS
- Customer support and query resolution through chatbots
- Transactional support for fund transfers, and account management

Insurance
- Policy information and coverage queries handled by chatbots
- Claims processing assistance, and status updates

Healthcare
- Medication adherence support through conversational interfaces
- Virtual health assistants for symptom checking and initial consultation

Hi-Tech
- Technical support and troubleshooting for hi-tech products
- Product information and feature demonstrations

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Digital Twins

A digital twin is a virtual replica enabling simulations to predict real-life performance. It facilitates ongoing optimization, reducing operational costs and enhancing efficiency across industries. Digital twins are based on real-world data and provide a dynamic approach to monitoring and optimization. However, their effectiveness requires comprehensive implementation throughout the value chain.
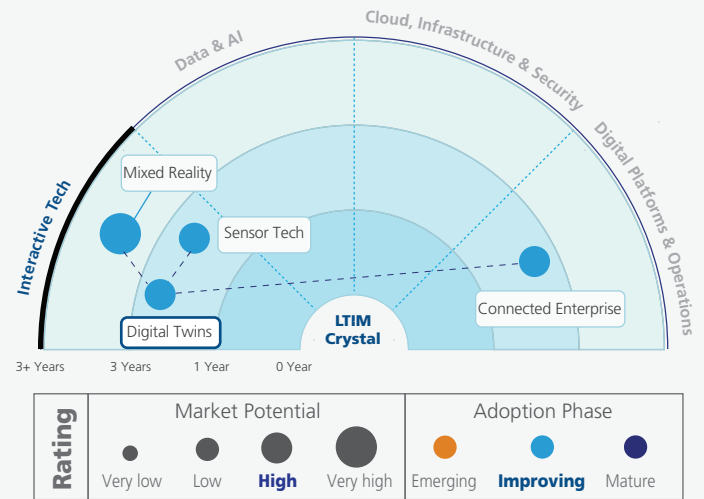
⚑ Highlights

Digital twins are pivotal for enterprises, offering visualization, prediction, and optimization of asset operations, constituting the convergence of the physical and digital realms. They facilitate rapid ROI, allowing the creation of critical components or entire assets, promising improved design, faster development, and enhanced after-sales service. As the tech landscape evolves, digital twins revolutionize manufacturing, logistics, and retailers' operations, serving as virtual representations to simulate real-world conditions. In supply chain, they optimize production, enhance logistics, and cut costs. The USD 73.5 billion digital twin market foreseen by 2027 attests to their accelerated adoption and transformative impact.

📝 Featured Story

A North American healthcare provider successfully revitalized its outdated data centers with this technology. It resolved issues such as stranded capacity, power, cooling, and space limitations posed by high-density sy stems. Leveraging digital twin capabilities, the provider engaged in scenario analyses predicted failure issues and planned future IT deployments. By transitioning systems and services from colocation back to their data centers, the healthcare enterprise realized an approximate annual saving of USD 300,000.

◎ Radar View & Related Technologies

Rating	Market Potential				Adoption Phase		
	Very low	Low	**High**	Very high	Emerging	**Improving**	Mature

✧ Key Takeaway

The data deluge from IoT necessitates efficient processing, with digital twins providing a contextualized framework. This enables proactive management, ensuring positive work experiences and responsive decision-making for a safer, customer-centric environment.

Key Use Cases

Hi-Tech
◦ Prototyping environment for complex process

Retail and CPG
◦ Real-time tracking of inventory
◦ Optimizing efficiency & utilization

Healthcare
◦ Remote patient monitoring, diagnosis and treatment

TTH
◦ Fuel consumption tracking, digging & idle hours per day
◦ Location tracking

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Sensor Technology

Sensor technology captures data by detecting physical, chemical, or biological factors and translating them into readable signals. These sensors are crucial in generating added value for signal processing and the respective businesses.
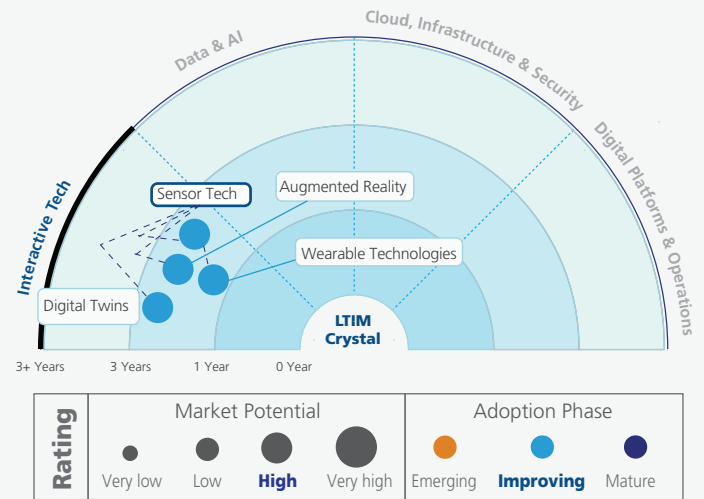
⚑ Highlights

From the simple beginning to detecting physical parameters like temperature and pressure, sensor technologies have exploded into a vast field, impacting almost every industry. Smart sensors are shaping the future of sensor technologies. Their ability to process and analyze data locally minimizes delays, enhances efficiency, and empowers instantaneous decision-making. AR sensors integrate digital information with the real world, enriching user experiences by overlaying contextual information onto the physical environment. Rather than a sole sensor technology, combining two or more sensing technologies provides great insights, making applications more intelligent and efficient.

📝 Featured Story

A major airframe manufacturer faced issues with the pressure switches on flights that involved high humidity, coupled with extremely low temperatures and high altitudes. The appointed vendor designed innovative switches by leveraging AI and ML in the venting operation. The newly built switches could withstand higher temperatures and pressure sensitivity, resulting in a seamless performance in extreme weather conditions.

◎ Radar View & Related Technologies

| | 3+ Years | 3 Years | 1 Year | 0 Year |

Rating	Market Potential				Adoption Phase		
	● Very low	● Low	● **High**	● Very high	● Emerging	● **Improving**	● Mature

✧ Key Takeaway

Sensor technologies are key enablers for IoT, edge computing, automation, and other new-age technologies. Organizations must first carefully build these foundations and then shape up the structure for digitalization.

Key Use Cases

Hi-Tech
◦ BCIs with sensors enable direct communication between users and devices

Media & Entertainment
◦ Gesture recognition and eye-tracking in wearable devices make for an enhanced interactive experience

Life Sciences
◦ Continuous health monitoring with implantable sensors detects diseases early, enabling personalized treatment

BFS
◦ ATMs with biometric sensors detect emotions for heightened security and personalized interactions

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Wearable Technologies

Wearable technology leverages intelligent, connected and purpose-specific devices worn on users' bodies. These devices can take different forms, including jewelry, accessories like watches, bands, medical devices, implants, sensors and clothing elements. The most sophisticated examples of wearable technology include AI hearing aids, VR/AR headsets, etc.
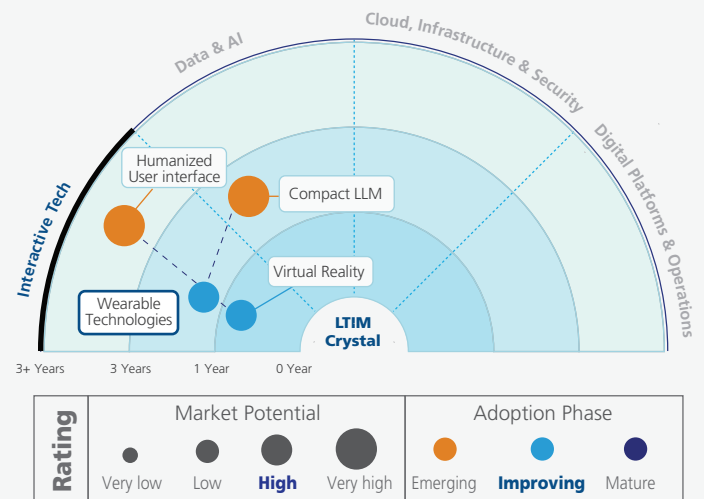
⚐ Highlights

Wearable technology is revolutionizing the healthcare industry by providing real-time health data. It can monitor patients remotely reducing the need for hospital visits. According to IDC, global shipment of wearable devices rose by 2.6% year-on-year in the third quarter of 2023 (3Q23), reaching a record high of 148.4 million units for that quarter. The growth is largely attributed to smaller brands and emerging categories. The IoT and smart home systems are integrating wearable fitness devices, which can be seamlessly integrated with other smart devices, such as home exercise equipment, smart scales, or virtual assistants. This market also incorporates gamification elements such as virtual badges, rewards, and challenges.

📝 Featured Story

A U.S.-based smart wearable device manufacturer recently launched its compact wearable spatial computing device revolutionizing work, collaboration, connection, and entertainment. It seamlessly integrates digital and physical realms, offering an immersive experience through vision OS controlled effortlessly by users' eyes, hands, and voice.

◎ Radar View & Related Technologies

Rating	Market Potential				Adoption Phase		
	Very low	Low	**High**	Very high	Emerging	**Improving**	Mature

✧ Key Takeaway

The wearable technology industry has expanded beyond tracking individual fitness and helps with activity tracking, heart rate monitoring, and posture correction. AI-powered wearables provide personalized fitness, nutrition, and stress management recommendations.

Key Use Cases

Manufacturing	Life Sciences	Healthcare
◦ Ergonomic monitoring ◦ Fatigue and stress management ◦ Wellness and health promotions	◦ Diagnosis and administer medication to treat health disorders ◦ Capture a diverse of medical data remotely	◦ Respiratory disease detection ◦ Depression monitoring through an app, tracking vitals, sleep quality, and medication ◦ Monitor chronic health condition

LTIMindtree

AI-Augmented Development

AI-augmented development leverages generative AI and Machine Learning (ML) to enhance E2E software development processes. AI automates repetitive tasks and provides real-time feedback. Automation accelerates development cycles and suggests improvements for faster and more efficient software development. This approach applies to various software development projects, offering benefits from small applications to complex systems.
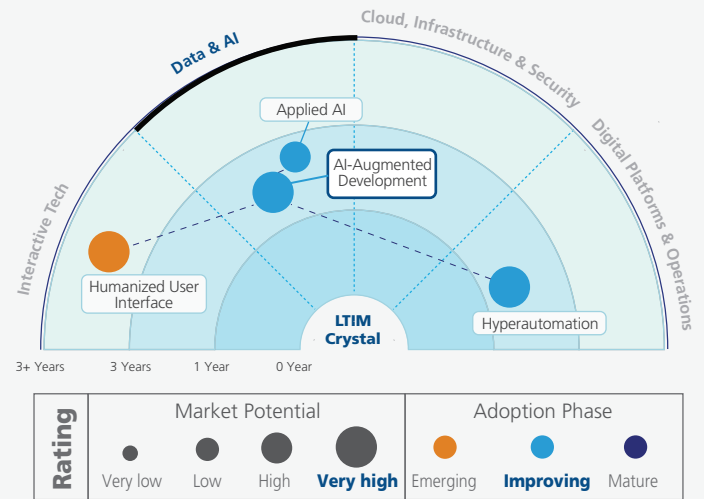
⚑ Highlights

The potential of AI-augmented development technology to revolutionize software development processes is significant. Gartner's prediction that by 2028, 75% of enterprise software engineers will use AI coding assistants reflects a growing trend in technology adoption. This demand arises from a dedicated developer community and the need for efficient AI solutions to meet the increasing demand for business software. AI tools also allow engineers to concentrate on higher-level tasks such as application design. At the same time, AI-infused development streamlines code production, facilitates legacy code translation, and enhances productivity and quality of service.

📝 Featured Story

A multinational technology conglomerate faced challenges with a critical application with a large regression suite. Automated and manual testing scripts in the suite took significant time to execute, impacting speed-to-market and revenue. A global insights technology consulting and digital solutions company implemented its insights tool to enable deterministic correlation between test cases and code. Establishing the correlation for microservices-based applications helped achieve a 65% reduction in regressing testing efforts.

◎ Radar View & Related Technologies

	Market Potential				Adoption Phase		
Rating	Very low	Low	High	**Very high**	Emerging	**Improving**	Mature

✕ Key Takeaway

Leadership must actively facilitate the widespread adoption of AI coding assistants by enterprise software engineers while balancing AI use with human innovation and creativity.

Key Use Cases

Hi-Tech
◦ Automated application testing
◦ Design-to-code transformations

Media & Entertainment
◦ Personalized content recommendation engines

Healthcare
◦ Medical imaging analysis and diagnosis tools

"

Beyond the Horizon: Insights from LTIM Tech Innovators

*Developers today need not focus on repeatable and mundane tasks, thanks to accelerators like GitHub Co-pilot, AWS CodeWhisperer, and similar tools that can bring up to 40% productivity improvements. Besides bringing superior developer experience, they also reduce the learning curve while picking up new technology areas. Over time, **AI-Augmented Development** can greatly reduce the need for overspecialized and underutilized teams, leading to efficient delivery.*

Ragupathi KP
AVP, Chief Architect, UK & Europe

LTIMindtree

Ambient Computing

Ambient computing, or ubiquitous computing, seamlessly integrates smart devices, AI, and human activity in daily life without direct commands. This involves endpoint hardware, software, and human-machine interaction, creating an intelligent ecosystem. By analyzing movements, voice patterns, and biometrics, it customizes user experiences without requiring conscious intervention for using computers or internet-enabled devices.
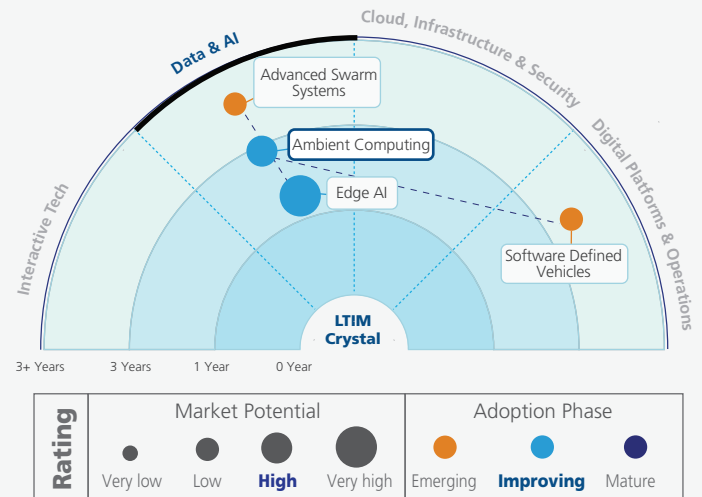
⚑ Highlights

The adoption of ambient computing is set to transform branding and marketing by providing interactive product placement opportunities. Fueled by data from transactions and external sources, intelligent applications deliver insights seamlessly within existing business apps, eliminating the need for separate business intelligence tools. This advancement promises heightened convenience, personalized experiences, enhanced efficiency, and improved resource management. The global ambient computing market is driven by consumer demand for smart homes, connected cities, and intelligent workplaces. It is an indication of a future where ambient spaces enable real-world digital applications shaped by evolving AI models.

📝 Featured Story

A chain of convenience stores in the United States and the United Kingdom revolutionizes grocery shopping through AI-powered sensors and digital billing. There are no cashiers, just a seamless selection. Cameras, weight-sensitive shelves, and an intricate network of sensors track chosen items, automatically charging linked accounts as customers leave. This ambient intelligence streamlines shopping, saving time and enhancing convenience, offering a glimpse into the future of checkout-free retail.

◎ Radar View & Related Technologies

Rating	Market Potential				Adoption Phase		
	Very low	Low	**High**	Very high	Emerging	**Improving**	Mature

✩ Key Takeaway

Ambient computing reduces energy consumption through resource optimization but still requires a robust network of sensors and data centers with their energy footprint. Balancing efficiency gains with infrastructure costs is essential.

Key Use Cases

Hi-Tech
◦ Energy-efficient environments

TTH
◦ Seamless check-in processes
◦ Personalized room adjustments
◦ Automated baggage handling

Healthcare
◦ Proactive health care
◦ Early detection of health issues

Retail and CPG
◦ Personalized dynamic advertising
◦ Product recommendations

"

Beyond the Horizon: Insights from LTIM Tech Innovators

Ambient Computing is pivotal as technology universally transitions towards it. Today, Ambient Computing is omnipresent and integrated into our daily tools. Tech developers aim to craft technology that not only enhances daily tasks but also harmonizes effortlessly.

Anand Hariharan
Associate Vice President
Global Technology office

LTIMindtree

Applied AI

Applied AI is the field of AI focusing on real-world applications that resolve problems related to classification, prediction, and mitigation. This helps automate, add, or augment real-world business use cases. Applied AI helps solve real-world problems using ML, deep learning, software engineering, and domain expertise.
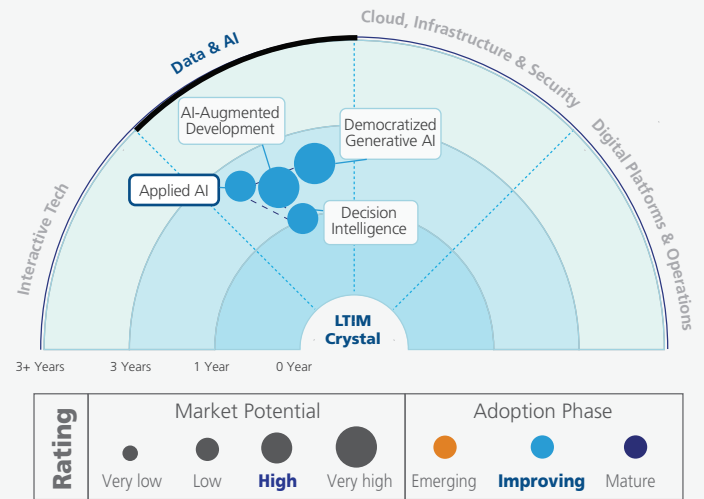
⚑ Highlights

Applied AI creates intelligent systems that can learn from surrounding data, make predictions, and take actions that improve efficiency, accuracy, and productivity. Lately, there have been tremendous developments in many applied AI areas. No-code ML platforms, API-based ML as a service (MLaaS), easy-to-use ML programming libraries, and dedicated hardware for training and running ML models continue to mature and be adopted. At the same time, the underlying data storage technology for ML services has become more flexible, interoperable, and scalable. Some enterprise AI companies have also started offering ML solutions for financial services, oil and gas, and retail sectors.

📝 Featured Story

The diagnosis tool was developed by one of the world's largest tech firms in collaboration with an eye hospital in London. It uses deep learning algorithms to check retinal scans and look for signs of diabetic retinopathy. A study published in the journal Nature Medicine claims that the AI algorithm could detect diabetic retinopathy equivalent to that of human ophthalmologists, with an accuracy of 94%.

◎ Radar View & Related Technologies

Rating	Market Potential				Adoption Phase		
	Very low	Low	**High**	Very high	Emerging	**Improving**	Mature

✕ Key Takeaway

As LLMs, Generative AI, XAI, and federated learning continue to upgrade and gain wide acceptance, we can expect the emergence of even more revolutionary applications of applied AI.

Key Use Cases

Hi-Tech
◦ Develop personalized learning experiences

TTH
◦ Optimize traffic flow and improve public transportation systems
◦ Develop self-driving vehicles

Healthcare
◦ Assess medical images, diagnose diseases
◦ Create personalized treatment plans

Manufacturing
◦ Optimize production processes
◦ Improve quality control

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Compact LLM

Large language models (LLMs) are a form of AI system trained on extensive text datasets. This equips them with the ability to perform tasks such as generating text, summarizing documents, translating languages, and responding to queries effectively. LLMs with parameters under 100 million are considered compact large language models (Compact LLMs).
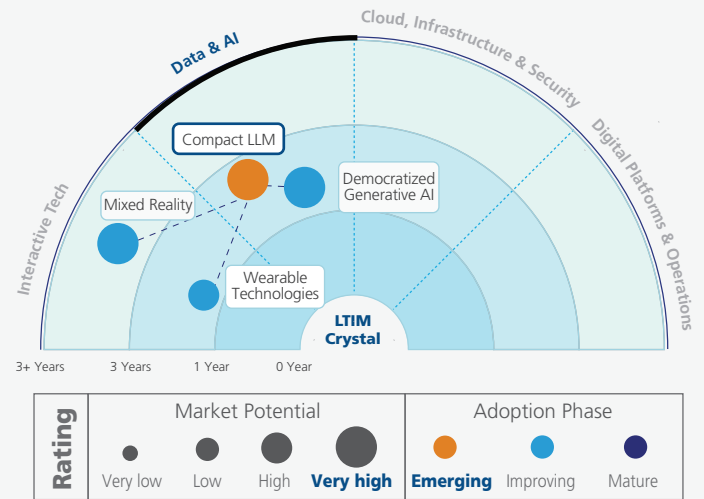
⚑ Highlights

Due to the smaller number of parameters, compact LLMs are significantly more efficient than large ones like Chat GPT. They can be easily fitted into sensors and IoT devices as they require less memory and storage space. Due to their modest resource requirements, these models find application in edge computing, enabling them to operate offline on lower-power devices. They offer quicker iteration cycles, making them more practical for architecture modification. The training of LLMs frequently involves self-supervised objectives, wherein models acquire fundamental language skills by predicting corrupted segments within input text sequences.

📝 Featured Story

One of the largest technology giants launched a compact LLM to optimize LLM inference efficiency for edge computing. This model gives low-latency and memory-bound workload patterns. Additionally, it offers effective implementation for weight-quantized kernels, a feature not supported by libraries from other vendors. This has increased the speed three times compared with other models and twice the DRAM traffic of the processor.

◎ Radar View & Related Technologies

	Rating	Market Potential				Adoption Phase		
		Very low	Low	High	**Very high**	**Emerging**	Improving	Mature

✧ Key Takeaway

In today's world, where AI is shaping our future, compact LLMs can make advanced AI capabilities accessible to everyone. Hence, compact LLM capabilities are strongly recommended for digitalization and customer-centric organization.

Key Use Cases

BFS
◦ Protection against leakage of sensitive individual information
◦ Secure multi-party computation

Media & Entertainment
◦ Natural language generation for animations
◦ Dialogue models for gaming

TTH
◦ Provide access to information and translation in areas with limited internet connectivity, bridging digital divides

Hi-Tech
◦ Collaboration without sharing sensitive data and ensuring data privacy & security

"

Beyond the Horizon: Insights from LTIM Tech Innovators

Compact LLMs *will have more specialized capabilities with the emergence of Open AI Stores transforming access to language models across diverse applications and platforms. Their compact design and robust performance will redefine accessibility and efficacy in natural language processing.*

Sunil Agrawal
Global Head of Enterprise
Architecture Group,
Global Technology Office

LTIMindtree

Democratized Generative AI

Democratized generative AI epitomizes the inclusive accessibility of AI technologies, empowering users from all backgrounds. It transforms AI from an exclusive tool to a widely available resource, fostering creativity and problem-solving. This technology, poised to revolutionize various sectors, aids small businesses in marketing, educators in personalized learning, artists in unique creations, scientists in data analysis, and individuals in diverse everyday tasks, transcending technical barriers.
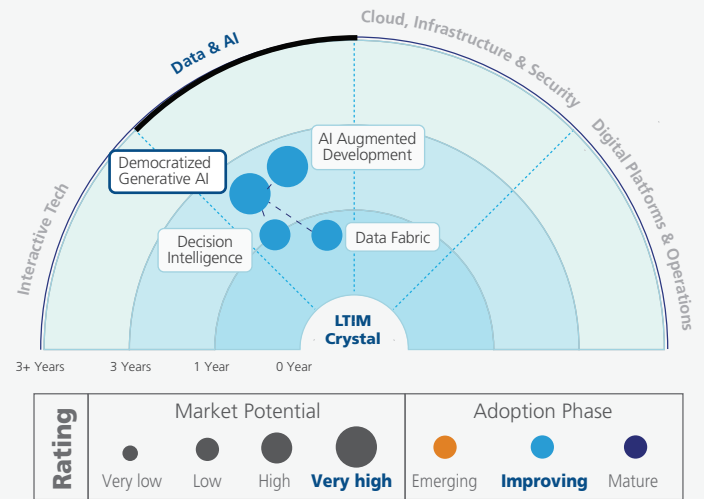
⚑ Highlights

Democratized Gen AI aids marketing, education, art, scientific analysis, and non-tech users in daily tasks and hobbies. According to Gartner, by 2026, over 80% of enterprises will adopt Gen AI APIs, a sharp rise from 5% in 2023. Since the year generative AI was introduced, democratized generative AI has revealed myriad benefits. Gen AI sparks innovation by breaking barriers in art and design, enabling rapid ideation and quicker product launches. Gen AI can shorten tasks from hours to minutes, amplify productivity, and automate diverse activities like coding and writing, saving time and costs.

📝 Featured Story

A US-based communication automation company introduced a generative AI solution for substantial customer savings in IT, HR, and operations. The company's communication automation platform harnesses top-tier generative AI, empowering users to create an integrated workflow. Central to this platform is the AI Hub, a unified space facilitating rapid ingestion of customer data.

◎ Radar View & Related Technologies

Rating	Market Potential				Adoption Phase		
	Very low	Low	High	**Very high**	Emerging	**Improving**	Mature

✧ Key Takeaway

Democratized generative AI empowers a democratic workplace, equipping employees for growth. IT leaders should leverage its potential for productivity, cost reduction, development, and risk management.

Key Use Cases

Education
◦ Personalized learning experiences
◦ Adaptive teaching tools
◦ Content creation

Media & Entertainment
◦ Content generation
◦ Virtual world creation
◦ Enhancing user experiences in gaming and media

Healthcare
◦ Diagnosis assistance
◦ Drug discovery
◦ Personalized treatment plans

Manufacturing
◦ Design optimization
◦ Predictive maintenance
◦ Quality control

"

Beyond the Horizon: Insights from LTIM Tech Innovators

Democratized Generative AI will transform AI from a sophisticated technology to a more inclusive and pervasive capability, unlocking boundless potential in creativity, innovation, and problem-solving. With accessibility to all, Gen AI heralds a decade of unprecedented productivity, efficiency, and innovation.

Chandi Prasad Ojha
Chief Technology Officer, Insurance

LTIMindtree

Edge AI

Edge AI merges artificial intelligence with edge computing, allowing AI algorithms to run on local devices with computing capabilities. Edge AI operates without constant connectivity, unlike cloud-based AI, enabling real-time data processing on devices. Integrating AI processes into edge devices circumvents network issues, ensuring uninterrupted service and faster data aggregation, serving users without reliance on external physical locations.
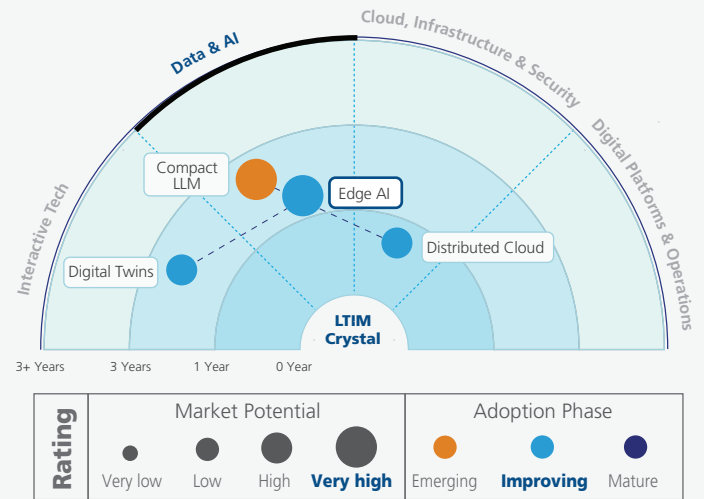
⚑ Highlights

Enabled by 5G, it thrives in fields like autonomous driving and healthcare, leveraging high bandwidth and low latency for data processing. Advancements in edge AI chips enable complex models, fuelling applications in video analytics and natural language processing. The evolving, sophisticated edge AI software simplifies development and deployment, widening its reach across industries. With its expansion, attention shifts to cybersecurity; the internet-connected nature of edge devices prompts providers to fortify against cyber threats. In addition, as this technology evolves, companies need to grasp its capabilities to integrate multiple AI models for commercial use.

📝 Featured Story

A US-based network solutions provider implemented edge AI technology in Las Vegas. The company's Kinetic Grid Platform brings AI to the edge to reduce latency for real-time response in the city. It also integrated computer vision to enable video analysis for crowd monitoring and predictive maintenance. Its private 5G network will ensure secure, high-speed connectivity for advanced services.

◎ Radar View & Related Technologies

Rating	Market Potential				Adoption Phase		
	Very low	Low	High	**Very high**	Emerging	**Improving**	Mature

✧ Key Takeaway

As Edge AI technology advances, we can expect wider usage, better performance, enhanced compatibility, more AI devices, heightened security focus, a remarkable progress in innovative business models.

Key Use Cases

TTH
◦ Fuels autonomous vehicle sensors, aiding navigation and obstacle avoidance

Manufacturing
◦ Optimizes manufacturing, boosting efficiency, productivity, and waste reduction

Healthcare
◦ Aids real-time medical image analysis for quicker diagnoses

Hi-Tech
◦ Analyze smart city sensor data for traffic and security management

LTIMindtree

Explainable AI

Explainable AI (XAI) is an approach to developing AI systems designed to be transparent and understandable to humans. The aim of XAI is to create AI systems that can clarify their decision-making processes and provide transparent, easily understandable rationales for the decisions they generate.
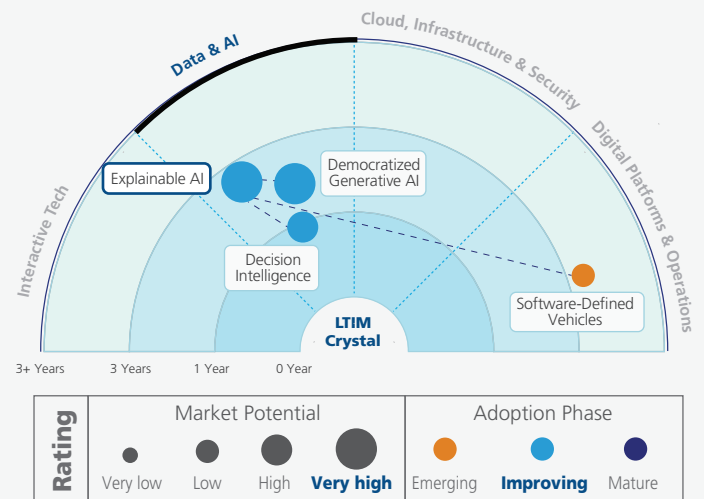
⚑ Highlights

One of the challenges of traditional machine learning algorithms is that they can often be black boxes where the inputs and outputs are well understood. Still, the internal processes that lead to those outputs are opaque and difficult to interpret. XAI seeks to address such issues by explaining their rationale, characterizing their strengths and weaknesses, and conveying an understanding of how they will behave in the future. XAI enhances the precision and efficiency of AI systems and contributes to their improvement. Through explaining decisions, AI systems can undergo more accessible audits and testing, facilitating the identification and correction of errors within the system.

📝 Featured Story

A Japanese multinational IT equipment and services provider deployed XAI at an information provider for processing and analyzing large volumes of data, categorizing it, and providing accurate predictions with full transparency and visibility. The implementation built trust with its users, greater alignment with ethical and regulatory European standards, and addressed risk and fraud issues.

◎ Radar View & Related Technologies

Rating	Market Potential				Adoption Phase		
	Very low	Low	High	**Very high**	Emerging	**Improving**	Mature

✧ Key Takeaway

Through enhancing the transparency and interpretability of AI systems, XAI plays a pivotal role in fostering trust and confidence, consequently expanding its broader applicability.

Key Use Cases

Manufacturing
- Show multiple potential options of repair guidance recommendations with continuous and improved recommendations

BFS
- Automating credit risk
- Detecting fraudulent activities
- Portfolio management

Healthcare
- Save medical practitioners time by giving patient recommendations and explaining how the conclusion was reached

Telecommunication
- Network optimization
- Customer support chatbots
- Predictive maintenance of infrastructure

"

Beyond the Horizon: Insights from LTIM Tech Innovators

With **Explainable AI (XAI),** it's not just about what machines do; it's about machines explaining why they do it. It promotes transparency and accountability in the realm of artificial intelligence.

Jitendra Putcha
Executive Vice President
Data, Analytics & AI

LTIMindtree

Regulatory Tech

Regulatory technology, or RegTech, refers to the use of technology, particularly software and data analytics, to help organizations comply with regulatory requirements. RegTech solutions are designed to streamline and automate compliance processes and lower the risk of non-compliance and the cost of compliance.

⚑ Highlights

RegTech solutions help businesses automate compliance processes, provide real-time monitoring and reporting, and leverage data analytics to identify potential risks. This allows corporations to mitigate the risk of non-compliance, avoid costly fines, and improve their overall compliance posture. RegTech automates many compliance processes that were previously done manually, saving companies time and money. These solutions leverage data analytics and other technologies to help companies identify and mitigate prospective risks before they become obstacles.
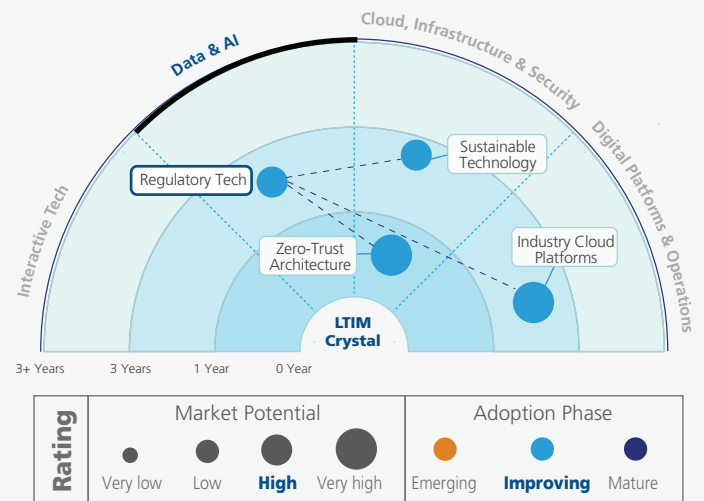
📝 Featured Story

An Italian company specializing in banking outsourcing services has integrated a RegTech application into various banking operations. A data management system has been developed to guarantee the dependability and capability to monitor information. Clients who opt for this service can take advantage of a database that can analyze customer patterns and predict future outcomes.

◎ Radar View & Related Technologies

	3+ Years	3 Years	1 Year	0 Year

Rating	Market Potential				Adoption Phase		
	Very low	Low	**High**	Very high	Emerging	**Improving**	Mature

✩ Key Takeaway

The RegTech industry is forecasted to experience substantial growth in the coming years. As regulations get more complex, organizations will rely more on advanced technologies for efficient compliance. AI, ML, and automation will greatly enhance regulatory efficiency.

Key Use Cases

Insurance
◦ Automate compliance processes
◦ Monitor policyholder data

Media & Entertainment
◦ Automatically detecting and filtering spam, phishing, and other malicious content, content moderation and censorship compliance

Healthcare
◦ Ensure compliance with regulations related to patient data privacy
◦ Electronic health records, billing and coding

Energy and Utilities
◦ Automate compliance processes
◦ Monitor energy usage and emissions
◦ Generate required reports

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Cybersecurity Mesh

Conventional security methods around the enterprise perimeter expose organizations to potential breaches. A cybersecurity mesh architecture adopts a composable approach centered on identity, ensuring a scalable and interoperable security service. An integrated structure safeguards assets universally, supporting a security approach spanning IT services. It forms a zero-trust foundation, providing secure access to devices, data, and applications.

⚑ Highlights

After the COVID-19 pandemic, numerous organizations have embraced remote work setups to comply with regulations. They aim to sustain these models or adopt hybrid ones for cost reduction. Simultaneously, there's a migration from on-premises infrastructure to cloud-based systems, altering the way employees access company assets. Consequently, cybersecurity strategies must evolve to safeguard assets accessed beyond traditional security perimeters. Cybersecurity mesh is gaining attention across banking, healthcare, IT, and manufacturing sectors.
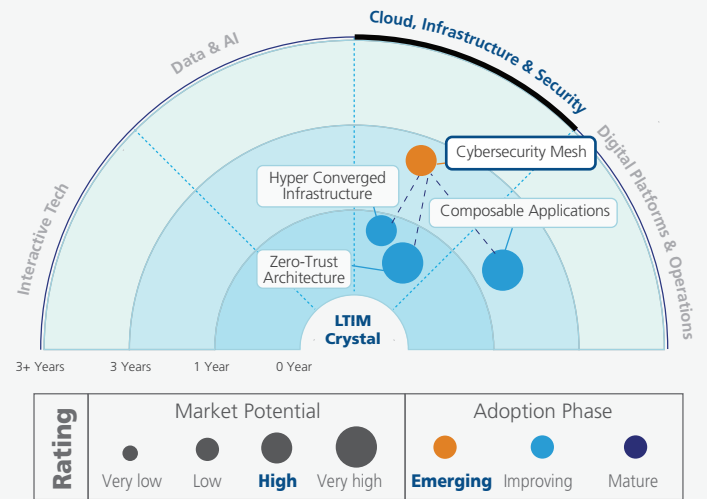
📝 Featured Story

A US-based managed IT service provider partnered with a security services provider to introduce its secure managed LAN. They integrated wired and wireless LAN portfolios, offering fully managed security and connectivity services. Moreover, these managed services seamlessly combine with the security fabric of a cybersecurity mesh platform supported by the security provider's specialized OS. It safeguards devices, data, and applications across the expensive attack surface.

◎ Radar View & Related Technologies

Cloud, Infrastructure & Security

Data & AI

Digital Platforms & Operations

Interactive Tech

Cybersecurity Mesh

Hyper Converged Infrastructure

Composable Applications

Zero-Trust Architecture

LTIM Crystal

| 3+ Years | 3 Years | 1 Year | 0 Year |

	Market Potential				Adoption Phase		
Rating	Very low	Low	**High**	Very high	**Emerging**	Improving	Mature

✧ Key Takeaway

Cybersecurity meshes become crucial for securing IT advancements from cyber threats and supporting business continuity. Adopting them offers real-time attack detection and prevention, facilitating seamless digital operations while fortifying IT security.

Key Use Cases

BFS
- Identity and access management of staff and customers

Manufacturing
- Secure sensitive machinery data and ensure uninterrupted operations

Healthcare
- Identity and access management of patients
- Safeguarding patient records, medical devices, etc.

Energy and Utilities
- Secure critical infrastructure, such as power grid distribution systems against cyber attack

LTIMindtree

Digital Identity

Digital identity is a digital mechanism that provides complete information to identify and distinguish individuals, systems, and organizations in the digital space. It is a personal and reusable proof of identification that is non-transferable and convenient for online use. Each entity possesses a single unique digital ID, ensuring trustless interactions and transactions in a virtual realm.
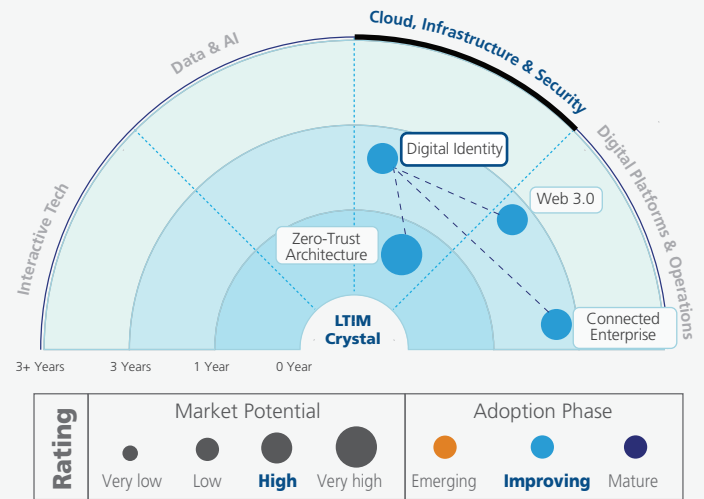
⚐ Highlights

The increasing importance of data privacy and control for digital systems has led to the development of digital identity solutions. They are designed to ensure a comprehensive defense against unauthorized access and alterations. Digital identity analytics and orchestration platforms can unlock tangible business benefits such as increased efficiency, security, compliance, and satisfaction. Digital ID can potentially enable economic and non-economic value creation but carries associated risks, like unauthorized credential use and exclusion of individuals. It can help reduce these risks by minimizing the opportunity for manual error or conduct breaches.

📝 Featured Story

A payment processing company and a healthcare technology company offered a digital innovation, enabling patients to confirm their identity via mobile phones. This ID verification service provides a secure, streamlined method for accessing healthcare, utilizing password-less authentication through smart biometrics. It simplifies and secures online and in-person identity verification, moving beyond traditional username and password authentication methods.

◎ Radar View & Related Technologies

Rating	Market Potential				Adoption Phase		
	Very low	Low	**High**	Very high	Emerging	**Improving**	Mature

✧ Key Takeaway

Digital trust oversees data, AI, cloud, and culture risk. Organizations build and maintain stakeholders' trust in digital services by employing tools like digital identity.

Key Use Cases

BFS
◦ Enables DeFi applications

Communication
◦ Establish digital identity services leveraging next-generation networks

Healthcare
◦ Set up a "single source of truth" for medical records and better coordination

TTH
◦ Streamline check-ins, enhancing security at airports or hotels

Interactive Tech   Data & AI   **Cloud, Infrastructure & Security** Digital Platforms & Operations

LTIMindtree

Heterogeneous Computing

Heterogeneous computing means a system that uses various varieties of computing cores, like CPUs, GPUs, ASICs, FPGAs, and NPUs. The term "heterogeneous compute" also refers to the use of processors based on diverse computer architectures. It is a common practice when a specific architecture is better suited for a particular task due to power efficiency, compatibility, or number of available cores.
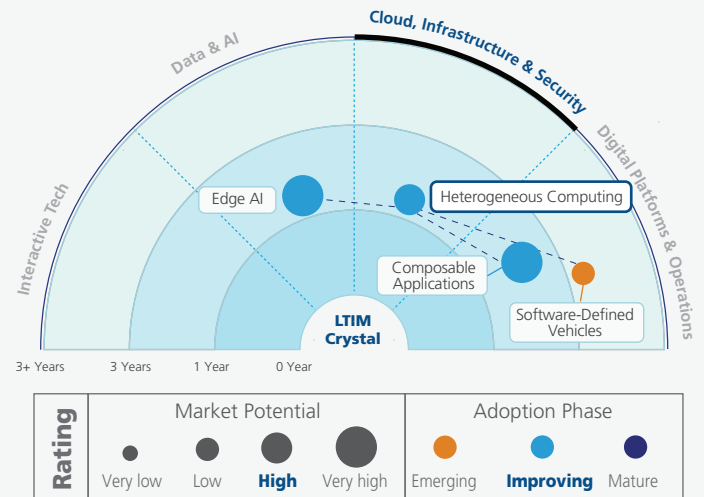
⚑ Highlights

Heterogeneous computing improves performance by processing diverse tasks, such as advanced calculation and image processing, in parallel. Specialized hardware is used for parallel processing instead of adding more raw processing power. The global heterogeneous mobile processing and computing market revenues totaled USD 87.8 billion in 2022. The overall demand in the market is projected to rise at a CAGR of 15.8% between 2022 and 2032. Accordingly, by the end of 2032, the total market size will reach around USD 382 billion. It is crucial in developing AI and ML workloads, where large volumes of data must be processed and converted for a seamless user experience.

📝 Featured Story

A leading multinational semiconductor company and search giant developed a GPU-based accelerator for edge devices, which can integrate with Raspberry Pi or other devices. Thus, more heterogeneous edge devices are deployed to build an edge computing environment for deep learning applications. However, building and maintaining a cluster edge environment with numerous edge devices is a challenge due to the heterogeneity of these devices.

◎ Radar View & Related Technologies

Rating	Market Potential				Adoption Phase		
	Very low	Low	**High**	Very high	Emerging	**Improving**	Mature

✧ Key Takeaway

It has the potential to elevate the computing power of the software exponentially. However, building and maintaining numerous heterogeneous devices in one ecosystem remains challenging. LTIMindtree believes that the rapidly evolving technology distribution can surpass it very soon.

Key Use Cases

Hi-Tech
◦ Optimizing AI and ML workloads for enhanced system performance
◦ Reduced energy consumption

Media & Entertainment
◦ Deploying diverse processors for low-latency delivery of VR/AR based Interactive content

Manufacturing
◦ Deploying low-latency FPGAs for swift control of robots
◦ Enhancing factory efficiency and accuracy

Communication
◦ Utilizing diverse processing units for efficient virtualized network function orchestration
◦ Enhancing flexibility and scalability

LTIMindtree

Non-Fungible Tokens

Non-fungible tokens (NFTs) are unique cryptographic tokens on a blockchain with unique identification codes and metadata that cannot be duplicated. It can be traded and exchanged for money, cryptocurrencies, etc. In practice, NFTs represent digital items that someone might own, such as a piece of music, a painting, or a unique collectible card.

⚑ Highlights

The global NFT market is expected to reach USD 14228.29 million by 2031, growing at a CAGR of 24.4% from 2023 to 2031. As per McKinsey, the NFT marketplace will allow brands to extend the consumer journey beyond virtual worlds and provide more monetization opportunities. The increased demand for NFTs can be attributed to their diverse use cases across various industries, such as games, music, film, and sports. The increasing use cases of NFT in retail, fashion, and supply chain management, the efforts to make Metaverse a reality, and the personalization of NFT would provide lucrative opportunities. Industry experts believe that NFT will become the revenue model for Metaverse.

📝 Featured Story

In 2023, a major multinational chain of coffeehouses headquartered in Seattle introduced NFT-based loyalty programs. Customers could collect digital tokens that represent points or rewards. These NFTs could be redeemed for special discounts, exclusive merchandise, or personalized experiences.

◎ Radar View & Related Technologies

| Data & AI | Cloud, Infrastructure & Security | Digital Platforms & Operations |

Post-Quantum Cryptography

Non-Fungible Tokens

Web 3.0

Blockchain

LTIM Crystal

Interactive Tech

3+ Years   3 Years   1 Year   0 Year

Rating	Market Potential				Adoption Phase		
	Very low	**Low**	High	Very high	Emerging	**Improving**	Mature
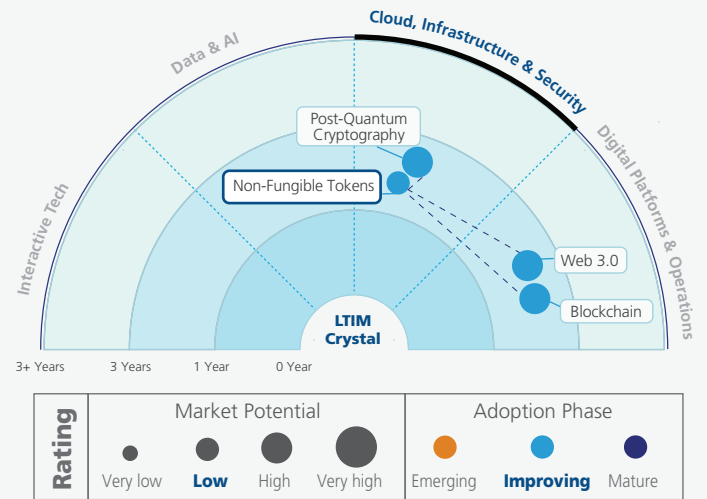
✦ Key Takeaway

NFTs have gained significant popularity in digital art, collectibles, etc. While their adoption and integration are still evolving, NFTs present a novel way to establish ownership, prove authenticity, and create value in the digital realm.

Key Use Cases

BFS	**Retail and CPG**	**Healthcare**	**Manufacturing**
◦ Authenticate digital assets ◦ Validate ownership ◦ Verify digital identities securely	◦ Enhance loyalty programs and reward systems ◦ Track the warranty status	◦ Verifying the identities of healthcare professionals during telemedicine consultation	◦ Supply chain traceability ◦ Managing and tracking equipment and assets

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Post-Quantum Cryptography

Post-quantum cryptography is a field that aims to develop and implement cryptographic methods that are resistant to attacks from both classical as well as quantum computers. They are based on computationally hard mathematical problems, the most common being lattice-based problems such as shortest vector and closest vector problems, that are difficult to solve even with quantum computers.

⚑ Highlights

Post-quantum cryptography takes advantage of mathematical properties that are expected to be difficult to compute on both classical and quantum computers. The most common approaches include lattice-based encryption, multivariate encryption, hash-based signatures, code-based encryption, hypersingular homogeneous encryption, and symmetric key encryption. Quantum computers could have a sizable impact on the security and reliability of digital communications on the internet and elsewhere. Post-quantum cryptography is a modern encryption alternative and cutting-edge technology to protect sensitive data from quantum hacking.

📝 Featured Story

A US-based multinational financial company was among the first to embrace quantum-safe cryptography as a precaution. The company recognized that existing cryptographic methods were becoming more susceptible to quantum attacks and began implementing a strategy for post-quantum cryptography. Adopting this technology early gave the company a competitive edge in data security.

◎ Radar View & Related Technologies

	Market Potential				Adoption Phase		
Rating	Very low	Low	**High**	Very high	Emerging	**Improving**	Mature
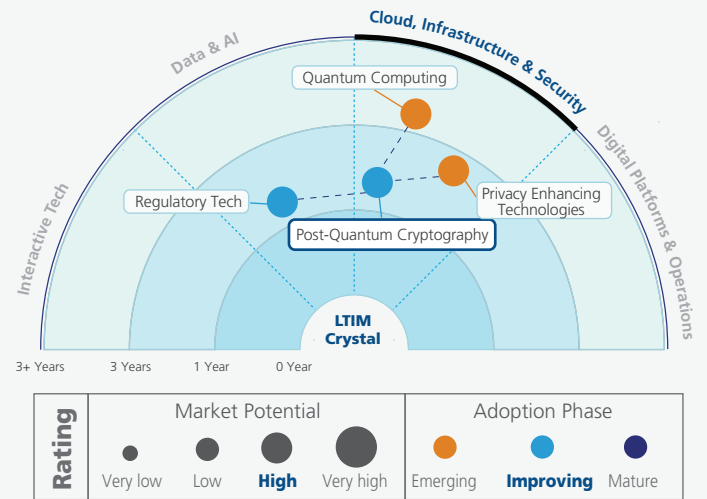
✧ Key Takeaway

Its adoption is increasing due to the threat from quantum computers. Finance, healthcare, and government sectors are embracing this technology. Quantum technologies have made traditional encryption ineffective and led to the development of secure algorithms.

Key Use Cases

BFS	**Communication**	**Energy and Utilities**	**Manufacturing**
◦ Implementing quantum-resistant algorithms for secure financial transactions ◦ Quantum-safe payment cards	◦ Quantum-resistant encryption for secure B2B and IoT communication	◦ Securing communication and data in smart energy grids ◦ Critical infrastructure protection	◦ Secure vehicle-to-everything (V2X) communications

Pilot Phase

"

Beyond the Horizon: Insights from LTIM Tech Innovators

While quantum computing has the potential to solve challenges that surpass the capabilities of today's most advanced high-performance computers, it also threatens to undermine current cryptographic systems that are based on very complex mathematical problems.

*Embracing **Post-Quantum Cryptography (PQC)** and crypto-agility becomes essential for enterprises to safeguard their critical data from such quantum threats.*

Amogh Apsingekar
Principal Director
Quantum Technology Incubation Group,
Global Technology Office

Interactive Tech   Data & AI   **Cloud, Infrastructure & Security**   Digital Platforms & Operations

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Privacy Enhancing Technologies

Privacy-Enhancing Technologies (PETs) help users safeguard their privacy, including encryption, masking, computation, and privacy. PETs and related technologies enable safe data sharing between companies and regulatory bodies without compromising individual identity. Methods like federated analysis and homomorphic encryption protect source data while enabling insight generation.
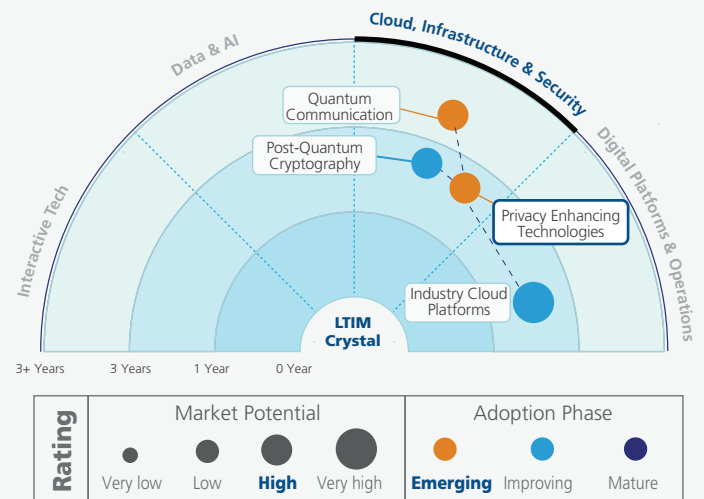
⚑ Highlights

PETs enable businesses to comply with strict privacy and security regulations while realizing the value of collaborative data analytics. It offers a promising opportunity to protect privacy amidst the growing use of digital technologies. It can be beneficial as organizations and governments leverage AI and ML for advanced analytics and decision-making. These technologies are employed in the medical field to facilitate secure cooperation on patient information for research objectives while guaranteeing the safeguarding of private medical data. As per a Gartner report, by 2025, 60% of major corporations will utilize PETs for multiparty data analytics applications.

📝 Featured Story

A Singapore-based pharmaceutical firm launched a Digital Health Exchange platform (DHEX). The platform enables the safe exchange of sensitive healthcare information, fostering innovation and new products/services. DHEX is the first Privacy Enhancing Technology (PET) implemented in the Infocomm Media Development Authority's (IMDA's) sandbox initiative. The data analysis head at a pharma company said that the PET framework was key in securing data privacy.

◎ Radar View & Related Technologies

Rating	Market Potential				Adoption Phase		
	Very low	Low	**High**	Very high	**Emerging**	Improving	Mature

✧ Key Takeaway

Privacy-enhancing technologies are becoming more prevalent. Data ethics and ownership are becoming increasingly important as risks to digital identity and data protection become increasingly recognized. Companies are given priority when incorporating PET into their operations.

Key Use Cases

Hi-Tech
◦ Secure multi-party computation
◦ Differential privacy

Media & Entertainment
◦ Secure content exchange
◦ Real-time strategy to classify sensitive content

Life Sciences
◦ Safeguard sensitive patient information
◦ Automate the discovery of patient data and identities

BFS
◦ Secure large-scale multi-party financial transactions with Zero-knowledge proofs (ZKP)

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Satellite Internet

Satellite internet is a service that utilizes satellite technology to provide internet access. It involves communication between ground stations and satellites orbiting the earth. The service enables users in remote or underserved areas to connect to the internet without needing traditional land-based infrastructure. While it is available globally, factors like latency and potential weather interference can affect performance compared to other broadband options.
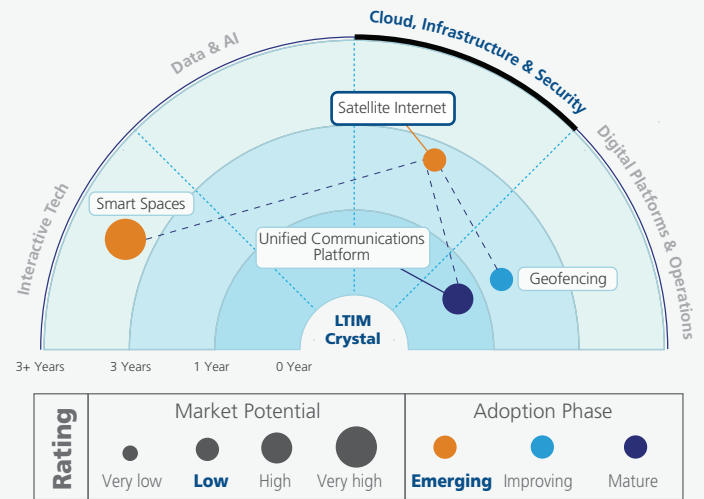
⚑ Highlights

Satellite technology for the internet is crucial in offering internet connectivity to remote and underserved regions where establishing conventional infrastructure is not feasible. This allows for worldwide connection, aids in times of crisis, and assists with communication in challenging landscapes and regions that have restricted resources. In 5G networks, using modern technology like satellite internet will substantially increase data speeds. The military can utilize satellite internet for remote operations. According to Globaldata, the space economy industry was valued at USD 450 billion in 2022, with a projected CAGR between 6% and 10% from 2022 to 2030.

📝 Featured Story

The American government is seeking satellite-based internet services specifically for its military division. They required a dependable and consistent wireless Internet connection to effectively coordinate operations in Africa. The technology company offered satellite-based internet services, comprising a solution that fulfilled the army's requirements for this venture.

◎ Radar View & Related Technologies

3+ Years	3 Years	1 Year	0 Year

Rating	Market Potential				Adoption Phase		
	Very low	**Low**	High	Very high	**Emerging**	Improving	Mature

✧ Key Takeaway

Its future is promising, with rising demand for connectivity in distant and underserved areas. As technology advances, the future of internet connection will likely combine satellite broadband with land-based networks, creating a more connected and accessible global community.

Key Use Cases

TTH	**Media & Entertainment**	**Healthcare**	**Energy and Utilities**
◦ In-flight Wi-Fi for airlines ◦ Improved maritime transport	◦ News outlets to broadcast high-quality live content remotely	◦ Remote patient monitoring for chronic diseases globally	◦ Enhanced communication for smart grid applications

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Self-Adaptive Security

Self-adaptive security is a framework that continuously adapts itself in real time to secure an organization's network infrastructure from advanced cyber threats. This architecture creates a feedback loop to identify, prevent, and respond to threats. Self-adaptive security relies on machine learning, multi-factor authentication, biometrics, mobile security, and risk analytics.
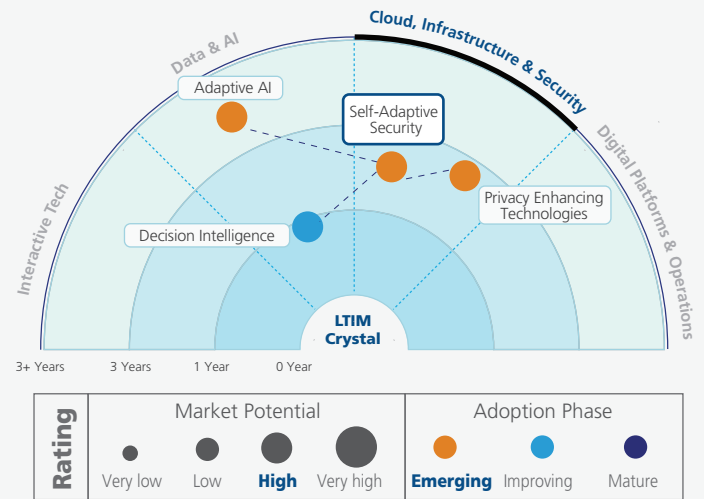
⚐ Highlights

With enterprises facing continuous attacks from advanced persistent threats (APTs), zero-day malware, and other targeted assaults, the adaptive security market will experience a burgeoning demand. Harnessing AI, ML, automation, and self-adaptive security solutions can remarkably enhance threat detection, incident response, access controls, etc. As organizations rapidly adopt cloud computing and edge computing architectures, self-adaptive security will extend its capabilities to protect these environments effectively. Self-adaptive security will be extended to edge devices and the IoT ecosystem to provide real-time threat detection and response.

📝 Featured Story

In July 2023, a data security company based in the UK launched adaptive security for its intelligent email security platform. It became the first cloud email security platform to implement an adaptive security model, delivering automated and personalized protection to its customers. The design enables personalized security measures based on the identified risk level, improving protection tailored to each user's needs.

◎ Radar View & Related Technologies

	Cloud, Infrastructure & Security		
Data & AI			Digital Platforms & Operations
Adaptive AI		Self-Adaptive Security	
Interactive Tech			Privacy Enhancing Technologies
	Decision Intelligence		
	LTIM Crystal		

3+ Years   3 Years   1 Year   0 Year

Rating	Market Potential				Adoption Phase		
	Very low	Low	**High**	Very high	**Emerging**	Improving	Mature

✧ Key Takeaway

Self-adaptive security aims to enhance the effectiveness of cybersecurity. It automates mundane tasks, detects threats in real time, adapts to the evolving threat landscape, and minimizes the impact of security incidents.

Key Use Cases

Insurance
◦ Data protection
◦ Fraud detection and prevention
◦ Identity and access management

Manufacturing
◦ Industrial control system security
◦ IP protection

Healthcare
◦ Patient data protection
◦ Medical device security

BFS
◦ Real-time fraud detection
◦ Threat monitoring and response
◦ Security incident response

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Sustainable Technology

Sustainable technology constitutes a set of digital solutions designed to facilitate environmental, social, and governance objectives, ensuring long-term ecological harmony and upholding human rights. It is a crucial tool for safeguarding individual machines at a micro level, promoting energy efficiency, and fostering enhanced coordination among systems and software for resource optimization.
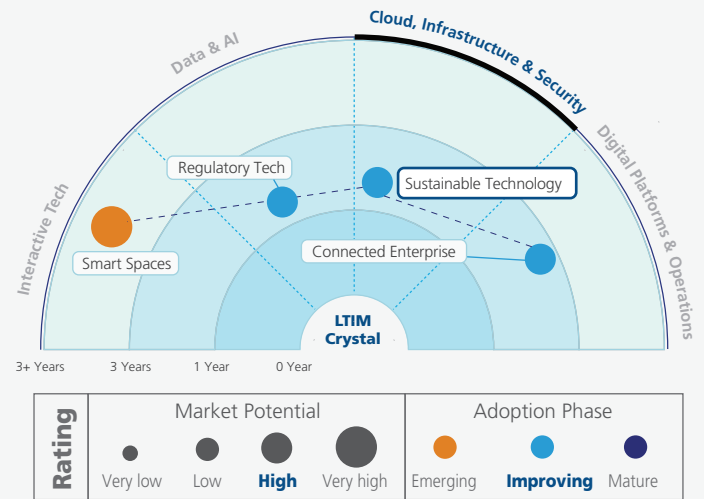
⚑ Highlights

Organizations that have a sustainable focus in mind usually tend to perform better than their competitors. New-age consumers are driven by consuming more transparent, sustainable products aligned with their core values. Consumers are also being mindful of their purchases and their environmental impact. 90% of consumers were ready to pay a premium if it met their sustainability criteria, according to a Survey from 2022. Gartner predicts that by 2026, 75% of clients may change their IT vendors if they cannot demonstrate sustainability-driven products and services. Managing and reducing energy costs and measuring sustainability goals remain top drivers for adopting sustainability trends.

📝 Featured Story

A software and consulting firm in India implemented sustainable practices to reduce carbon footprints at their data center. They leveraged AI to optimize and automatically allocate resources for flexibility and optimizing resource allocation. Data center infrastructure management (DCIM) tools allow us to automate and increase efficiency. AI-based bots have helped reduce power consumption by up to 40% in cooling the data centers.

◎ Radar View & Related Technologies

Rating	Market Potential				Adoption Phase		
	Very low	Low	**High**	Very high	Emerging	**Improving**	Mature

✦ Key Takeaway

Green technology products and practices advocate for sustainable product life cycles, aiming to minimize environmental impact. Therefore, technology sustainability will continue gaining traction as stakeholders recognize it as an important area of investment.

Key Use Cases

BFS
◦ Facilitating green investments and transparent tracking of impact

Retail and CPG
◦ Use of AI to optimize the use of power in retail stores and outlets

Communication
◦ AI-driven network management optimizes data routing
◦ Cutting energy consumption in communication networks

TTH
◦ Reducing emissions in delivery trucks by optimizing routes

Beyond the Horizon: Insights from LTIM Tech Innovators

*The EU Sustainability Directive promotes environmental sustainability by reducing carbon emissions, minimizing waste, and optimizing resource usage in the supply chain. This can lead to a cleaner and greener operation, aligning with EU **sustainability** goals. However, it also has the potential to enhance brand reputation and customer loyalty.*

Tom Christensen
Head of Thought Leadership,
Nordics

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Blockchain

Blockchain functions as a decentralized, distributed ledger, simplifying the recording of transactions and tracking sets across a network. It gathers information into unalterable blocks, disrupting industries such as payments, cybersecurity, and healthcare by ensuring secure, transparent tracking and trading, reducing risks and costs.
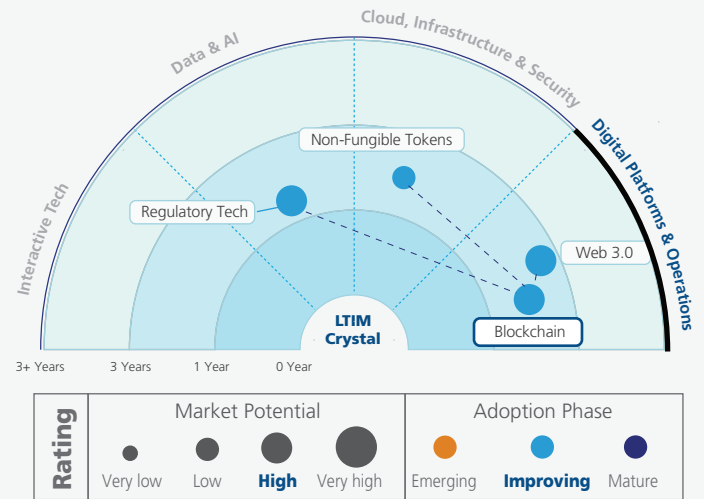
⚑ Highlights

The economic impact of blockchain is vast. According to Gartner, the technology will generate over USD 3 trillion by 2030. It enables seamless supply chain traceability through decentralized ledgers, ensuring product authenticity globally. Smart contracts streamline documentation, reducing costs and reliance on intermediaries and boosting trade accuracy and speed. Decentralized Finance (DeFi) revolutionizes finance by securing funds via smart contracts, bypassing traditional banking fees. Blockchain-based payment systems cut costs, enhance security, and drive demand for faster transaction systems. In the future, enterprises will focus more on security and transparency to increase their reliance on the blockchain.

📝 Featured Story

A leading US-based financial services provider partnered with major Indian banks, including Axis Bank, HDFC, Yes Bank, IndusInd Bank, and ICICI. The banks collaboratively seek to harness blockchain's potential for 24x7 USD settlement services in India. This initiative aims to bypass swift messaging and Nostro account limitations, enabling continuous transactions and addressing weekend payment hurdles prevalent in the current system.

◎ Radar View & Related Technologies

	Data & AI	Cloud, Infrastructure & Security	Digital Platforms & Operations

Non-Fungible Tokens
Regulatory Tech
Web 3.0
LTIM Crystal
Blockchain
Interactive Tech

3+ Years   3 Years   1 Year   0 Year

Rating	Market Potential				Adoption Phase		
	Very low	Low	**High**	Very high	Emerging	**Improving**	Mature

✧ Key Takeaway

Blockchain's promising future will impact businesses and individuals. It will fuel the creation of new cryptocurrencies and exchanges, merging with other technologies to propel innovation to unforeseen levels.

Key Use Cases

Hi-Tech	BFS	Healthcare	Energy and Utilities
◦ Property ownership verification ◦ Transparent transactions ◦ Smart contracts for leases	◦ DeFi ◦ Smart contracts for loans ◦ Secure fast cross-border transactions	◦ Secure patient data sharing ◦ Medical record management ◦ Drug traceability	◦ Decentralized energy trading ◦ Tracking renewable energy credits ◦ Managing grids efficiently

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Composable Applications

Composable applications comprise packaged business capabilities (PBCs) or software-defined business objects. Patient- or digital twins-based PBCs serve as reusable modules, allowing teams to assemble applications and swiftly reducing time to market. This collaborative architecture, connecting through APIs, enables businesses to proactively build, deploy, and adapt to evolving requirements, fostering greater resilience.
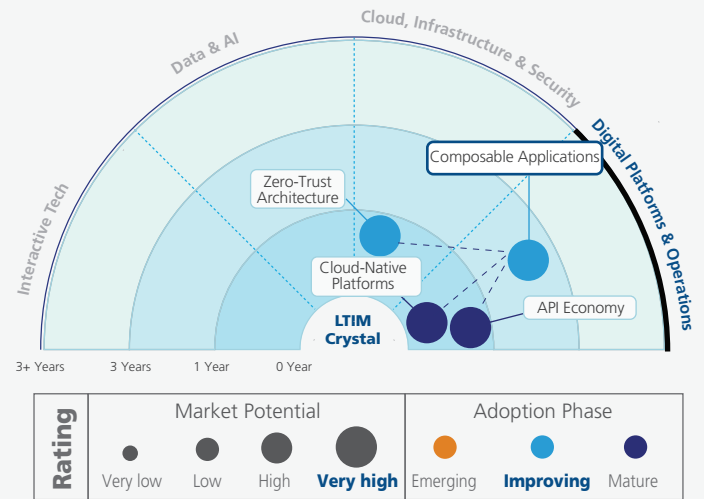
⚑ Highlights

Composable application drives business agility by expediting development, deployment, and market entry. They empower citizen development, enabling non-technical users to craft software. Embracing composable applications becomes vital for businesses seeking agility amidst rapid market shifts. Unlike traditional monolithic systems, these applications offer reconfigurability, scalability, and faster development, essential for a dynamic business landscape aiming for a composable enterprise model. Gartner anticipates that by 2026, leading cloud providers will offer component marketplaces for compostable strategies, distinguishing themselves through quality, convenience, and security.

📝 Featured Story

A US-based fintech company introduced enhanced deployment choices for its Universal Online Banker platform. This empowers banks to deliver top-notch digital business banking services at scale, competing effectively with FinTech counterparts. The platform stands out as the sole composable solution tailored to contemporary digital and integrated business banking demands. It offers unparalleled flexibility and agility to match varying bank sizes and corporate client needs.

◎ Radar View & Related Technologies

Rating	Market Potential				Adoption Phase		
	Very low	Low	High	**Very high**	Emerging	**Improving**	Mature

✧ Key Takeaway

Composable strategies incrementally facilitate rapid adaptation, fostering agility and responsiveness across global industries. Surviving amid market upheavals demands prioritizing valuable efforts and shedding outdated practices swiftly.

Key Use Cases

Hi-Tech
◦ Composable modules enable robots for construction, self-repair, and autonomous learning

Manufacturing
◦ Streamlined production by integrating diverse systems for real-time monitoring

Healthcare
◦ Adaptable solutions for linking patient data across platforms

BFS
◦ Financial service providers leveraging composability for agile customer-centric app development

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Beyond the Horizon: Insights from LTIM Tech Innovators

The cloud unlocks incredible possibilities for people when they understand how it can boost their business performance, and they start seeing it as not just a tech option but rather a wholesome business strategy. These are conditions in which the business becomes incentivized to adopt **composable architecture** *principles, which will inevitably drive significant improvements in technology ROI and TTM.*

Antony Panteli

Associate Vice President
Consulting

LTIMindtree

Connected Enterprise

Technologies such as 5G, edge computing, AI, and the cloud make new value chains and digital touchpoints. Together, these technologies make a connected enterprise. Value stream Mapping (VSM) is crucial for keeping the process transparent and identifying the pain points. Data integration and harmonization through a data lakehouse lead to contextualized decision-making.

⚑ Highlights

An interconnected enterprise transcends IoT, encompassing all facets of operations. While companies heavily invest in cloud tech, data lakehouses offer superior connectivity, speed, and efficiencies, elevating ROI. Analytical tools leverage this for real-time insights, aiding credit assessment and fostering socially conscious partnerships. Centralizing data in lakehouses reduced multiple reduces multiple system transfers, simplifying business demands and enhancing data oversight. This supports diverse analytics and streaming operations, driving innovation and yielding positive societal impacts within the connected enterprise realm.
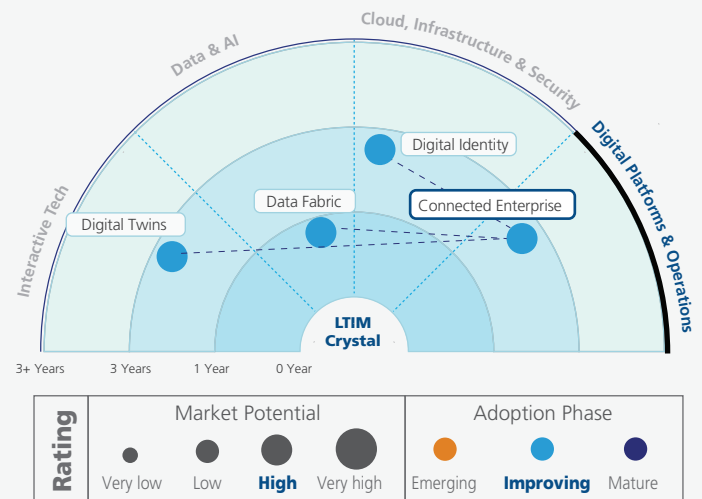
📝 Featured Story

A US-based multinational conglomerate evolved into a software leader via its connected enterprise offerings, aiming for robust growth in connected software sales. The company's connected enterprise solution, bolstered by the debut of extensive IIoT software, drives its software-focused trajectory. Targeting various sectors, the company aims to address shared operational challenges for customers' solutions.

◎ Radar View & Related Technologies

Data & AI

Cloud, Infrastructure & Security

Interactive Tech

Digital Platforms & Operations

Digital Identity

Data Fabric

Digital Twins

Connected Enterprise

LTIM Crystal

| 3+ Years | 3 Years | 1 Year | 0 Year |

Rating	Market Potential				Adoption Phase		
	Very low	Low	**High**	Very high	Emerging	**Improving**	Mature

✧ Key Takeaway

Data lakehouses fuel connected enterprises, enhancing insights, simplifying data management, and supporting innovation. A holistic approach integrating from edge to office drives agility, human-centricity, and innovation for future goals.

Key Use Cases

BFS	**Manufacturing**	**Healthcare**	**Retail and CPG**
◦ Analyze data from financial transactions to make better investment decisions	◦ Connected sensors and AI guide robots ◦ Optimizing production in real-time for efficiency and waste reduction	◦ Study the data extracted from medical devices, electrical health records, and other mediums	◦ AR-based globally connected retail stores

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Beyond the Horizon: Insights from LTIM Tech Innovators

Connected enterprises are at the forefront of digital transformation, bridging the gap between physical and virtual kingdoms. With sensors, smart devices, and 5G connectivity, they harness the power of data to drive informed decision-making and optimize processes.

Tarun Gupta
Chief Technology Officer,
Emerging Markets

LTIMindtree

Distributed Ledger Technology

Distributed Ledger Technology (DLT) involves storing data across multiple ledgers using a network of computer servers (nodes). Each ledger holds identical records, accessed, validated, and updated simultaneously via cryptographic protocols. This fosters a secure, decentralized, and unchangeable digital database. DLT is used extensively in the financial industry and finds applications in supply chain management, education, etc.
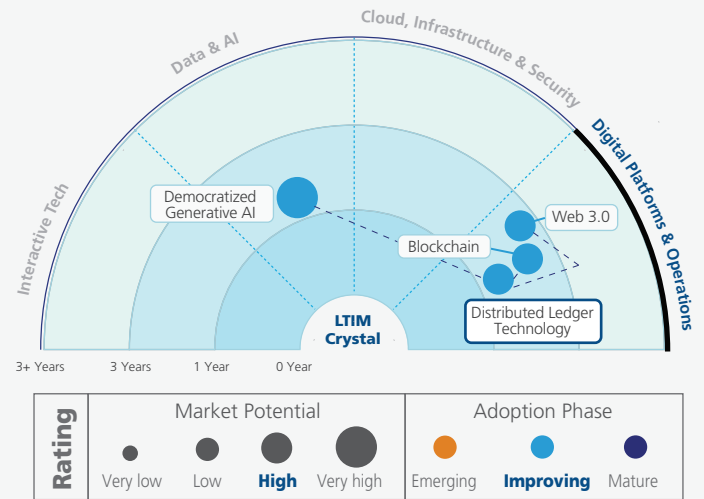
⚑ Highlights

DLT is well-known for enabling cryptocurrencies, like Bitcoin and Ether. Its applications span capital markets, facilitating native securities issuance, asset tokenization, and the development of Central Bank Digital Currencies (CBDC). DLT's integration into capital markets marks a natural progression in decentralization, offering efficiency advancements in trading, settlement, and currencies like CBDC or stablecoins. Major banks explore cash-on-ledger solutions, and blockchain-based account platforms highlight this shift in financial architecture. The tokenization of traditional assets has gained traction, with initiatives exploring real estate, art, and various asset classes.

📝 Featured Story

The European Central Bank seeks interest from financial market participants for trials involving new settlement technologies for wholesale central bank money settlement and mock settlement using three platforms provided by Deutsch Bundesbank, Banca d'Italia, and Banque De France. It encompasses DLT-based digital asset settlements in euros and various operations in securities lifecycle management.

◎ Radar View & Related Technologies

Rating	Market Potential				Adoption Phase		
	Very low	Low	**High**	Very high	Emerging	**Improving**	Mature

✧ Key Takeaway

Exploring future trends in DLT reveals its impact on governance, transparency, and interoperability. With its evolution, key trends emerge, such as DLT integration in corporate ecosystems, enhancing processes, traceability, transparency, supply chains, and AI integration.

Key Use Cases

BFS
◦ Facilitating faster, cost-effective, and secure cross-border transactions

Education
◦ Securing academic credentials ensuring authenticity simplifying the verification process

Healthcare
◦ Ensuring transparency in the drug supply chain
◦ Improving interoperability between healthcare providers

Energy and Utilities
◦ Managing energy grids efficiently
◦ Tracking energy trading
◦ Enabling peer-to-peer energy transactions

> ## *Beyond the Horizon: Insights from LTIM Tech Innovators*

*With the tokenization of data and assets gaining momentum, **Distributed Ledger Technology** would have a major role in making Decentralized AI applications fully transparent, auditable, and compliant. This means no hidden, unethical algorithms can be implemented without the knowledge of the majority of stakeholders.*

Mainak Mojumdar

Vice President
Global Technology Office

LTIMindtree

Geofencing

Geofencing refers to a feature in software programs that uses Global Positioning System (GPS) and Radio Frequency Identification (RFID) to establish a virtual geographic boundary. Entering or exiting this area can trigger various pre-programmed responses or actions. Geofencing can be configured to prompt push notifications on mobile devices, send text messages and alerts, deliver location-based marketing data, and monitor activity in secure areas.
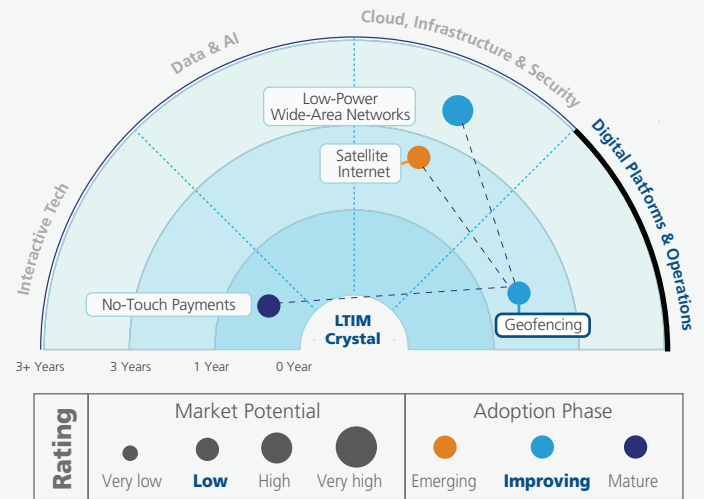
⚑ Highlights

As IoT integration expands and mobile technology advances, industries like retail and logistics increasingly embrace geofencing for targeted engagement and operational efficiency. Geofencing is commonly used for advertising to deliver app-based ads and offer promotions, sales, or reminders. Marketers employ geofences around competitors' locations, known as geo-conquesting, to target customers nearing rival stores. Utilizing past location data enables precise message customization. For example, targeting concert attendees with special deals amplifies customer satisfaction through hyper-targeted geofencing ads, fostering higher loyalty.

📝 Featured Story

A US-based multinational retailer introduced geo-fencing technology to send push notifications of its special offers to customers' mobile phones inside the store. The retailer introduced a "Map Your Deals" feature in their app, accessible via a button in the Black Friday ad. Geo-fencing technology triggered its display on the main page when customers were in the store, aiding easy access to product maps.

◎ Radar View & Related Technologies

	Market Potential				Adoption Phase		
Rating	● Very low	● **Low**	● High	● Very high	● Emerging	● **Improving**	● Mature

✧ Key Takeaway

Geofencing presents immense potential for businesses and individuals but demands thoughtful, ethical applications. Its evolution promises innovative solutions, shaping our mobile app experiences and addressing intricate challenges ahead.

Key Use Cases

Hi-Tech
◦ Protect access to government devices used by staff working remotely

Retail and CPG
◦ Send push notifications, alerts, and coupons, allowing real-time interaction with customers

TTH
◦ Send alerts of reroutes or delays, inform drivers of traffic and climatic conditions

Energy and Utilities
◦ Control household lighting, door locks, cameras, fire and life safety devices

Hyperautomation

Hyperautomation is a business-driven approach to identifying, evaluating, and automating as many businesses and IT processes as possible. It involves orchestrating multiple technology tools and platforms, including RPA, low-code platforms, and process mining tools. The bots designed by hyper-automation will improve the accuracy and productivity of the business processes. An increased focus on digitalization and operational excellence has highlighted a need for better automation.
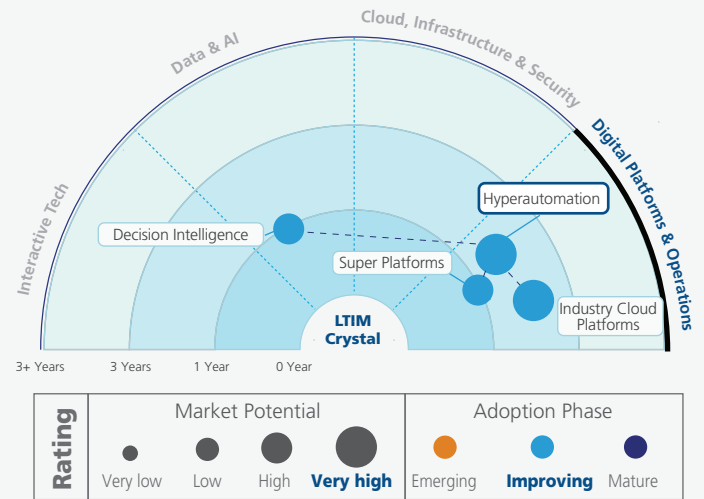
⚐ Highlights

Hyperautomation goes beyond traditional process automation and combines various technologies and tools for automating the process. It is a holistic approach for enhanced organizational efficiency, agility, and innovation. Furthermore, evolution in AI, ML, and RPA are improving the capabilities of hyperautomation and expanding its applications across industries. According to Gartner, companies using hyperautomation can reduce operational costs by 30% within four years. A study conducted by McKinsey revealed that companies were able to adapt to digitization 25 times faster with hyper-automation-enabled processes.

📝 Featured Story

An insurance company was facing challenges in the manual underwriting process. It was a time-consuming and non-standardized decision-making process. A leading automation provider in India implemented automation and created an end-to-end process flow. The solution included an analytics platform for debt exposure across the company's products. As a result of this implementation, there was a 45% reduction in underwriting efforts and a 90% reduction in error and data integrity issues across systems.

◎ Radar View & Related Technologies

	Market Potential				Adoption Phase		
Rating	Very low	Low	High	**Very high**	Emerging	**Improving**	Mature

✑ Key Takeaway

Hyperautomation is a powerful combination of automation technologies leading to enhanced operational efficiency and agility. Organizations must carefully choose the relevant technologies based on their end goals of the automation journey.

Key Use Cases

Hi-Tech
◦ Automating software development tasks to accelerate code generation, testing, and deployment, ensuring efficient delivery

Manufacturing
◦ Utilizing AI-powered visual inspection for automated defect detection and Improved product quality

Insurance
◦ Automating customer onboarding and KYC/AML checks to speed up account opening

Energy & Utilities
◦ Optimize grid integration of solar and wind energy

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Beyond the Horizon: Insights from LTIM Tech Innovators

__Hyperautomation__ drives IT transformation, streamlining operations and uncovering cost-saving opportunities while enhancing agility. Its integration with AIOps revolutionizes IT management, offering real-time insights and optimizing performance across digital landscapes.

Balaji Seshadri
Associate Vice President,
Global Technology Office

Industry Cloud Platforms

Industry Cloud Platforms (ICPs) are customized cloud solutions tailored to specific industries, offering adaptable and industry-relevant capabilities. It combines the underlying building blocks of cloud services as a platform with composable capabilities. This enables organizations to enhance existing processes and embark on differentiated transformation and innovation initiatives, addressing mission-critical priorities.
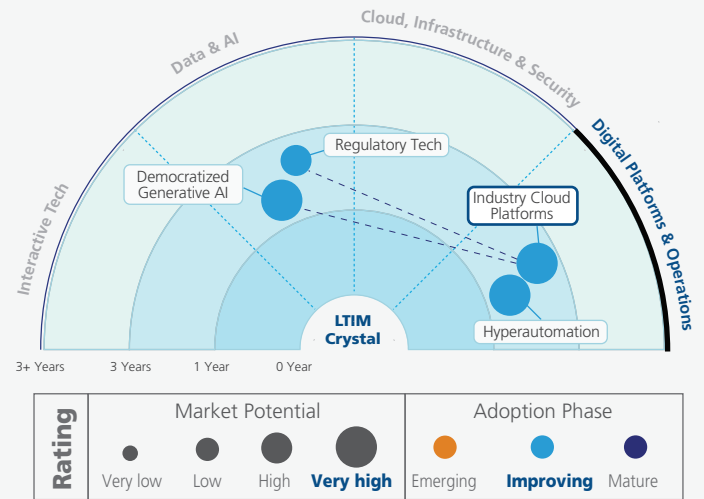
⚑ Highlights

ICPs are becoming popular because of the composability of these platforms and the industry trend of product specification. Industry clouds are quickly gaining adoption as hyperscale and niche players embrace business-as-a-service models. According to Gartner, the adoption of ICPs is projected to skyrocket, with over 50% of enterprises utilizing ICPs to expedite their business initiatives by 2027, a substantial increase from less than 15% recorded in 2023. Successful SaaS service providers like Salesforce have their solutions built for health cloud, financial services cloud, media cloud, etc., and SAP solutions for oil, gas, energy, and retail.

📝 Featured Story

A global technology consulting and digital solutions company's insights platform is equipped with pre-trained analytical models that address problems specific to manufacturing and construction industries. Platform was envisioned based on the experience of working closely with and solving challenges faced in their parent company's manufacturing and construction business.

◎ Radar View & Related Technologies

	3+ Years	3 Years	1 Year	0 Year

Rating	Market Potential				Adoption Phase		
	Very low	Low	High	**Very high**	Emerging	**Improving**	Mature

✧ Key Takeaway

Integrators need to take a closer look at the verticals with deep roots for common, industry-specific challenges and focus their time, energy, and resources on co-creating the industry solution differentiators.

Key Use Cases

Energy and Utilities
◦ Energy production and distribution platforms

Insurance
◦ Policy administration and claims management platform

Healthcare
◦ Electronic health record (EHR) management platform

Life Sciences
◦ Clinical trial management platform with in-built drug safety monitoring

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Beyond the Horizon: Insights from LTIM Tech Innovators

*Businesses keen on innovation & faster growth have prioritized **industry cloud platforms** driven by their abilities of scalability, customization, security, & cost savings.*

Pradeep K. Mishra
Chief Technology Officer,
Banking & Financial Services

LTIMindtree

Web 3.0

Web 3.0 is the next phase of the internet, bringing disruptive changes and a major paradigm shift. It is based on decentralization, openness, and increased user utility and offers users more than just social media, streaming, and online shopping. The core capabilities of Web 3.0, Semantic Web, AI, and ML can revolutionize application diversity and enhance user interaction.
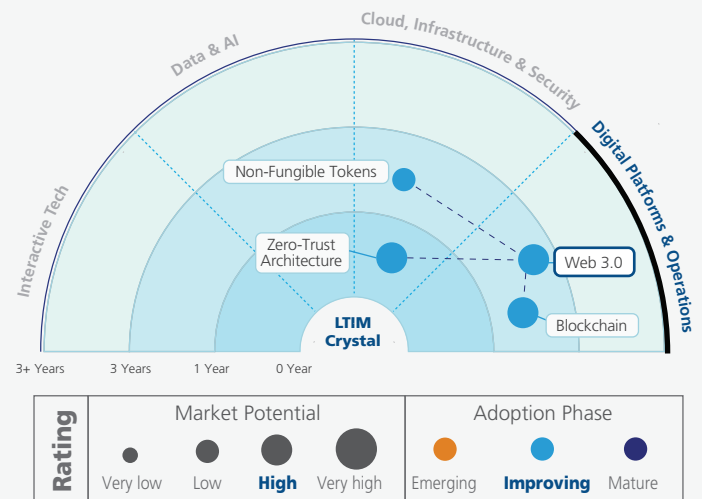
⚑ Highlights

Web 3.0 is a powerful new technology that has the potential to transform the future of the Internet and traditional businesses into the digital realm, LTIMindtree executives say. The developments in this technology help companies reach their target audience and customers online by improving user experience. It will interpret user data and become smarter to improve the digital experience. Additionally, a centralized network encourages censorship and deplatforming. Web 3.0 gives users control over data and storage. This user-focused web version's websites can run on blockchain networks, replacing centralized servers with distributed computers.

📝 Featured Story

The Hong Kong government has expedited the advancement and adoption of Web 3.0. In the 2023-2024 budget, the finance minister assigned funds to support the development of Web 3.0 and create a specialized team to promote the advancement of virtual assets. A Web 3.0 hub was established in January 2023 at Cyberport in Hong Kong. Its purpose was to support local innovators and attract global enterprises.

◎ Radar View & Related Technologies

	Market Potential				Adoption Phase		
Rating	Very low	Low	**High**	Very high	Emerging	**Improving**	Mature

✧ Key Takeaway

Web 3.0 signifies a paradigm shift towards a decentralized and user-focused internet. Blockchain technology enhances privacy, enables trustless interactions, and gives users control over their online experiences. Web 3.0 will make it more transparent, secure, and collaborative.

Key Use Cases

Hi-Tech	Media & Entertainment	Life Sciences	BFS
◦ Building and integrating immersive virtual worlds powered by web 3.0 technologies like tokens and DAOs	◦ Tokenizing digital assets like music, artwork, and video games for ownership, licensing, and trading	◦ Interoperable electronic health records	◦ Implementing blockchain-based data solutions for secure data storage, ownership, and usage tracking ◦ Open banking in Web 3.0

Horizon 3

Emerging technologies in research with potential for transformational change

LTIMindtree

Brain Computer Interface

A Brain-computer Interface (BCI) is a technology that captures brain activity and converts it into signals or commands for controlling external devices such as a prosthetic limb, a computer, or a robotic system. It can have applications for treating neurological disorders, enhancing human abilities, or providing new forms of communication and entertainment.
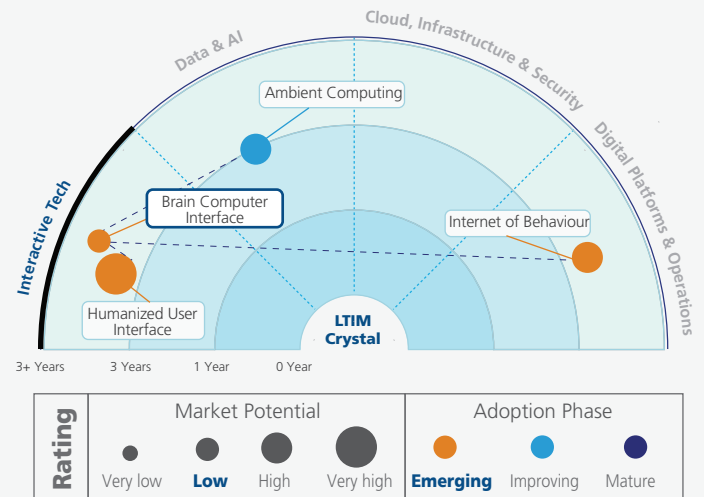
⚐ Highlights

BCIs connect the brain to external devices, like computers or robotic limbs, allowing control through thoughts. They allow users to control objects using brain signals instead of muscles. These interfaces can enhance the lives of individuals with brain, spine, limb, and sensory disorders through direct interface with the nervous system. BCIs can revolutionize the lives of people with paralysis. BCI technologies in homes are a game changer for users and part of a gradual adoption curve. In BCI gaming, subjects wear an EEG headset to control virtual objects in VR games. For movement-based actions like "push," "pull," or "jump," they use mental commands instead of a traditional game controller.

📝 Featured Story

A French research institute for computer science and applied mathematics has developed BCI systems for immersive virtual reality experiences. In the experiment, people were asked to control the launch of a simulated spacecraft using either real or mental leg movements. This system was based on a simple but asynchronous BCI.

◎ Radar View & Related Technologies

Rating	Market Potential				Adoption Phase		
	Very low	Low	High	Very high	Emerging	Improving	Mature

✧ Key Takeaway

BCIs are at the forefront of technological advancement, helping disabled individuals and revolutionizing entertainment and education. As research and development continue, we can expect to see more remarkable applications of this technology.

Key Use Cases

| Hi-Tech	Media & Entertainment	Healthcare	Communication
◦ Training programs for complex manufacturing processes ◦ Brainwave-driven music and art creation	◦ Enhance immersion experiences in virtual reality driven by user's emotions	◦ Neurorehabilitation for patients with motor disabilities ◦ Brain-controlled prosthetics for amputees	◦ Brainwave-based authentication for secure access ◦ Thought-to-text or thought-to-speech communication

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Humanized User Interface

A humanized and intuitive UI considers human tendencies and expectations. This is achieved using plain language, visual cues such as colors and icons, and helpful prompts. The goal is to make the experience less mechanical and more natural, increasing engagement and satisfaction and decreasing frustration and errors.

⚑ Highlights

A humanized UI is essential for effective and engaging products/services. Organizations can improve interface usability, satisfaction, and loyalty by understanding human users. Natural language is crucial in humanized UI design as it encourages user interaction using plain language and avoiding technical jargon. Using visually appealing cues such as icons, colors, and animations can improve interface navigation and user confidence. Prioritizing language and visuals boosts user satisfaction, loyalty, and organizational success. A humanized UI prioritizes user needs, increasing engagement and loyalty in businesses.
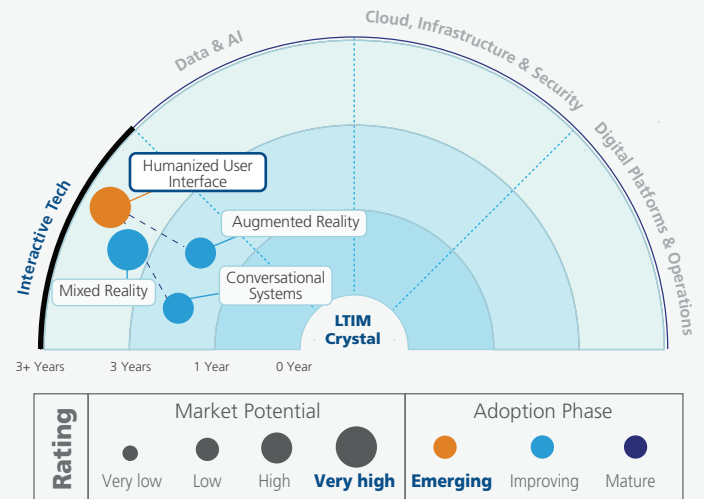
📝 Featured Story

A customer engagement and fintech company enhanced the user experience for a Japanese insurance and reinsurance firm. The team collaborated with the insurance firm's product manager to acquire a broad understanding, including its specifications and constraints. The broker management portal was revamped with enhancements in user experience by humanizing the interface to boost brokers' efficiency.

◎ Radar View & Related Technologies

	3+ Years	3 Years	1 Year	0 Year

Rating	Market Potential				Adoption Phase		
	Very low	Low	High	**Very high**	**Emerging**	Improving	Mature

✧ Key Takeaway

Companies will prioritize user-friendly interfaces to ease the cognitive load and comprehend user environments and communication styles. UI designers will prioritize user-specific experiences, ethical design, and privacy-conscious products and services.

Key Use Cases

Hi-Tech
○ Humanized interfaces for programming and coding
○ Hands-free communication

Retail and CPG
○ Purchases through natural language voice commands, assist customers with product information and ordering

Healthcare
○ Human-like chatbots for patient interaction and emotional support

TTH
○ In-flight or in-hotel entertainment adapting to passenger emotions

"

Beyond the Horizon: Insights from LTIM Tech Innovators

Humanized user interfaces are one of the most strategically invested areas, trying to implement the paradigm of computing everywhere and for everyone. The constant miniaturization of digital components, emerging compute capabilities, and decreasing network latency are naturally going to revolutionize the way devices are designed and how humans interact with them in natural and intuitive ways.

Sushil Ajgaonkar
Managing Principal - Architecture
Global Technology Office

LTIMindtree

Mixed Reality

Mixed reality (MR) refers to the merging of the physical and digital worlds, creating a hybrid environment where virtual and augmented reality elements coexist with the real world. This technology blends aspects of both virtual reality (VR) and augmented reality (AR) to provide users with immersive experiences that integrate digital content seamlessly into their surroundings.
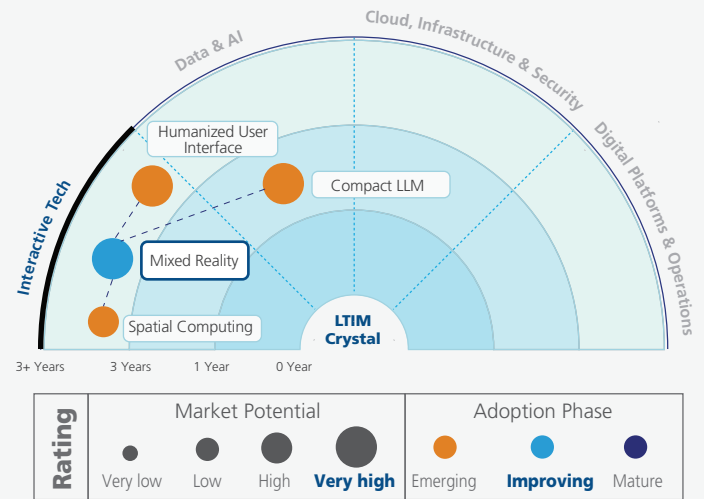
⚑ Highlights

MR devices use sensors and cameras to understand the user's environment, providing a more immersive experience by joining virtual objects into the real world. It can also use holographic displays, projecting virtual content into user's vision, creating a more realistic and immersive experience. Mixed reality finds applications in several fields, from gaming and entertainment to healthcare, education, and business, providing innovative solutions for training, visualization, and community. The growth of the developer ecosystem greatly contributes to the creation of diverse MR content and applications, thereby driving continuous innovation in the mixed reality space.

📝 Featured Story

A Japanese car maker rapidly adopted 3D data in digital design and subsequently integrated real-time 3D technology. This entails employing real-time 3D development platforms throughout the vehicle's lifecycle. Introducing this virtual pipeline begins by bringing vehicle data into unity using Pixyz. This process quickly transforms large computer-aided design (CAD) assemblies into compact data suitable for immediate 3D application.

◎ Radar View & Related Technologies

Rating	Market Potential				Adoption Phase		
	Very low	Low	High	**Very high**	Emerging	**Improving**	Mature

✧ Key Takeaway

Mixed reality will arrive sooner than expected due to advancing technology becoming more compact, efficient, and affordable. Some challenges, such as hardware technology, privacy and security, user acceptance, etc., must be acknowledged for the success of mixed reality.

Key Use Cases

Manufacturing
◦ Collaborative design and prototyping
◦ Providing assembly instructions through MR overlays

Healthcare
◦ Surgical simulations and training
◦ Patient education for explaining medical conditions

Retail and CPG
◦ MR displays for interactive product information
◦ Virtual fitting rooms and product try-on

TTH
◦ Overlay real-time information such as directions, speed, and traffic data

"

Beyond the Horizon: Insights from LTIM Tech Innovators

The seamless integration of digital and physical realms, empowered by cutting-edge technologies like computer vision, AI, and ML, revolutionizes quality and production control for our clients. **Mixed reality** *promises significant cost savings and productivity enhancements, showcasing a future brimming with remarkable possibilities on the horizon.*

Kapil Jain
Chief Technology Officer,
Media and Entertainment

LTIMindtree

Smart Spaces

A smart space enriched with technology offers interactive environments where people and technology seamlessly communicate in physical and digital realms. This fosters heightened interactivity, immersion, and automation for specific audiences and industries. Emerging from Industry 4.0, smart spaces are pivotal in reshaping the built environment and promoting sustainability, addressing crucial aspects across various industry segments.
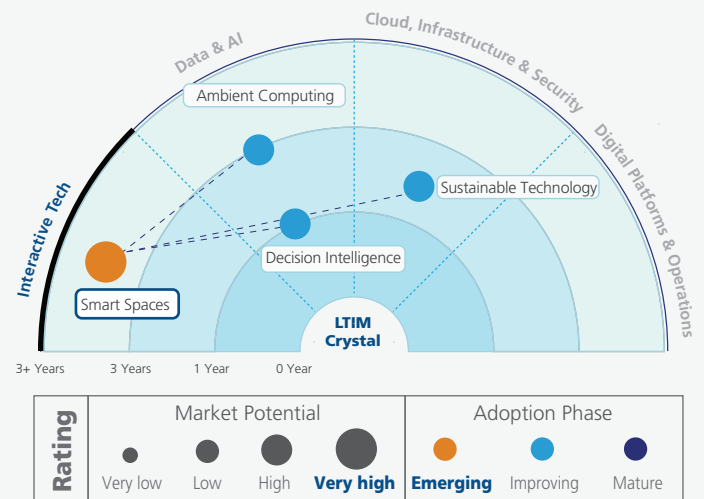
⚑ Highlights

Smart spaces thrive on the pillars of intelligent edge, connectivity, PropTech, and sustainable urban planning. With sustainability taking center stage across industries, nations are embracing Greenfield plans to ease challenges in established cities. Organizations are driven to convert diverse environments into intelligent, secure, and resource-efficient spaces in cities, buildings, factories, or business estates. This transformative vision underscores the pivotal role of these technologies in shaping the future, fostering connectivity, efficiency, and sustainability across various environments on a global scale. It marks a shift towards "invisible interfaces" that seamlessly blend into the environment, providing intuitive control without disrupting user flow.

📝 Featured Story

India's top construction organization aimed to achieve zero incidents by enforcing strict Personal Protective Equipment (PPE) compliance. A global tech consulting firm created an edge-based computer vision solution, swiftly identifying and alerting non-compliance with safety guidelines in authorized work zones. The system's low latency ensures quick detection, issuing alerts and video clips to supervisors. This innovative solution supports achieving 100% safety compliance at construction sites.

◎ Radar View & Related Technologies

Rating	Market Potential				Adoption Phase		
	Very low	Low	High	**Very high**	**Emerging**	Improving	Mature

✧ Key Takeaway

Organizations should prioritize constructing accelerators to integrate diverse devices, facilitating the creation of smart applications and seamless interweaving of different data classes within smart spaces.

Key Use Cases

Hi-Tech
◦ Central view of connected building ecosystems across the globe

Energy and Utilities
◦ Energy command center for optimized energy usage and cost savings

Healthcare
◦ Clinical process automation using clinical care procedures and AI technologies

Manufacturing
◦ Predictive maintenance
◦ Operation management

"

Beyond the Horizon: Insights from LTIM Tech Innovators

*The fusion of technology with physical environments in **smart spaces** is revolutionizing experiences in homes, workplaces, retail, and cities, elevating personalized interactions, and pushing the boundaries of UX to new heights.*

Bharat Trivedi

Principal - Architecture,
Global Technology Office

LTIMindtree

Spatial Computing

Spatial computing redefines how humans interact with machines within real-world spaces. It goes beyond traditional computing interfaces, leveraging AI and sensors to blend digital elements into physical environments seamlessly. This allows users to interact with objects in a virtual world using hands and gestures. This unique capability opens doors for new experiences and applications across industries.
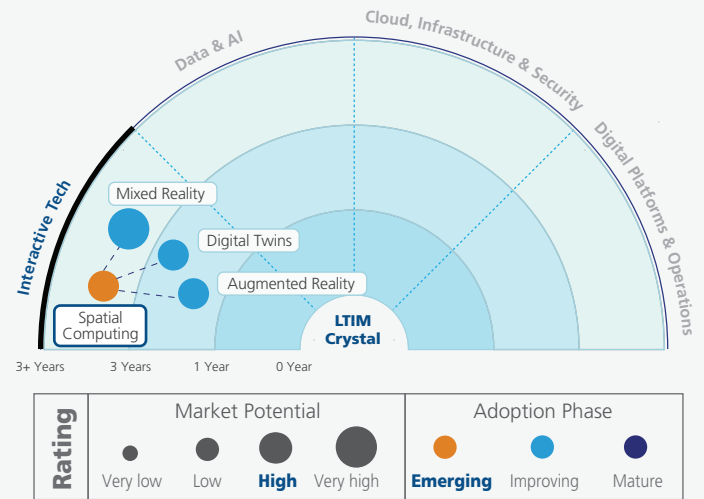
⚑ Highlights

While still in its early stages, spatial computing has already found practical applications in areas like GPS navigation, wearable devices, and transportation. As the penetration of AR/VR and 5G technologies reaches the masses, we can expect the potential of spatial computing to expand significantly. This technology enables dynamic 3D visualization within prisons, capturing real-time product, industrial space, and worker interactions. Spatial computing offers unparalleled visualization and interaction capabilities, boosting efficiency and innovation in manufacturing and beyond.

📝 Featured Story

A food giant wanted to optimize production processes and reduce downtime in geographically dispersed manufacturing facilities to support their global clients. A leading IT solutions provider embraced spatial computing and virtual tours to enable remote inspection, equipment installation simulations, and immersive training for employees. This reduced in-person site visits by 50%, improved equipment installation accuracy, and enhanced training effectiveness.

◎ Radar View & Related Technologies

Rating	Market Potential				Adoption Phase		
	● Very low	● Low	● **High**	● Very high	● **Emerging**	● Improving	● Mature

✧ Key Takeaway

As the ecosystem matures and collaboration strengthens, the true potential of spatial computing will become clearer. Expect technological advancements in remote collaboration, prototyping, and hyper-realistic virtual worlds.

Key Use Cases

Retail and CPG
- Virtual try-on experiences for clothing and furniture
- Interactive product demonstrations

TTH
- Interactive wayfinding tools in airports and museums, personalized in-room experiences controlled through spatial gestures

Healthcare
- Accurate immersive experiences for surgeons to practice complex procedures

Communication
- Holographic video conferencing and enhanced accessibility tools for individuals with disabilities

"

Beyond the Horizon: Insights from LTIM Tech Innovators

*From pixels to realities, **spatial computing** is driving forward a paradigm shift in innovation. With the integration of map intelligence and automated workflows, it transforms industry operations and redefines the way we work, create, and engage in the digital realm.*

Dr. Pari Y
Associate Vice President,
Geospatial

LTIMindtree

Adaptive AI

Adaptive AI is a form of AI that works on the principles of continuous learning and improves itself over time. Adaptive AI is the right mix of ML, agent-based modeling, evolutionary algorithms, neural networks, and reinforcement learning. Adaptive AI is regularly fed with new data to provide more accurate and improved insights as output. It can change its code in real time based on its previous interactions.

⚐ Highlights

Adaptive AI substantially improves a range of processes across multiple sectors to provide personalized experiences and enhance user engagement. Implementing adaptive AI in a complex and ever-changing situation brings out its best since it is not trained on historical or static data but operates on techniques like neural architecture search, reinforcement learning, transfer learning, etc. Traditional AI systems were designed with fixed inputs, such as responses and instructions, while adaptive AI can respond and accommodate an endless stream of data. It can also analyze self-performance, identify weak areas, and improvise its code autonomously.
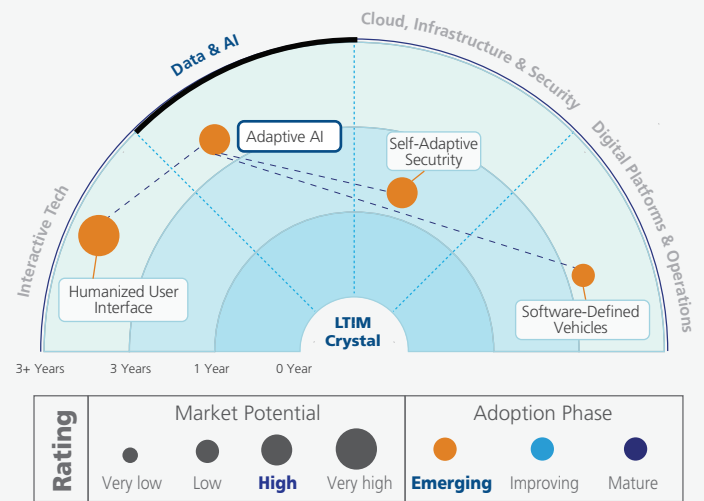
📝 Featured Story

An American streaming service uses adaptive AI algorithms to analyze user data, including past viewing history, search queries, and ratings, to make personalized content recommendations for each user. The adaptive AI recommendation engine improves user engagement and retention, helping the company keep users engaged and interested in the platform, reducing the likelihood of churn, and improving the quality of content recommendations.

◎ Radar View & Related Technologies

Rating	Market Potential				Adoption Phase		
	Very low	Low	**High**	Very high	**Emerging**	Improving	Mature

✧ Key Takeaway

Traditional AI systems were designed with fixed inputs such as responses and instructions, while adaptive AI can change its codes without human intervention, producing better results.

Key Use Cases

Hi-Tech
- React to unpredictable and ever-changing dynamics for navigating driverless cars

Retail and CPG
- Analyze competitor pricing, market conditions, and customer behavior to optimize real-time pricing

Healthcare
- Real-time patient health monitoring
- Timely interventions to improve patient outcomes

Manufacturing
- Optimizes production, leading to better quality control and improved resource utilization

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Advanced Swarm Systems

Advanced swarm systems arise from swarm intelligence, which refers to the collective intelligence of a group of self-organized, decentralized systems. Swarm systems are used in fields ranging from troubleshooting manufacturing errors and designing precision drug delivery systems to deploying tiny spacecraft for space exploration. Deep learning, cloud computing, robotics, and data analytics support advanced swarm systems.

⚑ Highlights

Advanced swarm systems can solve complex problems with unprecedented accuracy compared to isolated or standalone systems, which use a single data source to draw inferences. These systems are designed to work together seamlessly and can process vast amounts of data in parallel, improving performance and accuracy. While standalone systems may use a single data source to draw inferences, Swarm systems can use data from multiple sources and work together to provide more accurate and reliable results.
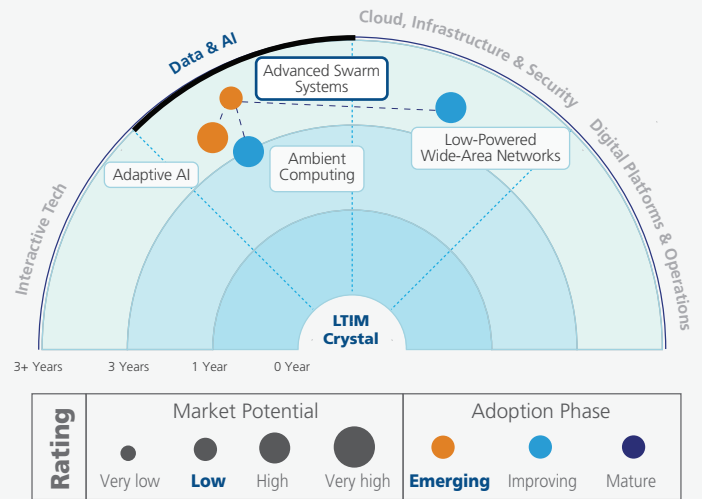
📝 Featured Story

The army of the world's largest democracy deployed a heterogeneous offensive swarm drone system for military applications. It is a system of 100 drones that can target bunkers and armored territories up to 50 km into the enemy territory with weight-specific bombs. The system can attack individual drones in case of closely contested airspace.

◎ Radar View & Related Technologies

	Market Potential				Adoption Phase		
Rating	Very low	**Low**	High	Very high	**Emerging**	Improving	Mature

✧ Key Takeaway

Advanced swarm systems are inspired by the natural behavior of swarms such as bees or birds. They offer numerous benefits over traditional centralized systems. It efficiently helps optimize and collect data from multiple sources.

Key Use Cases

BFS
◦ Assesses creditworthiness, providing financial access in underserved communities without traditional credit scores

TTH
◦ Optimizing fleet operations, resulting in efficient utilization and reduced travel time.

Manufacturing
◦ Robo-swarm systems dynamically reconfigure production

Telecommunication
◦ Swarm drones with self-deploying and self-healing capabilities

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Affective Computing

Affective computing, a swiftly advancing field in computer science, focuses on detecting, interpreting, and simulation of human emotions. With applications in healthcare, retail, marketing, and customer service, this interdisciplinary domain, also known as emotion AI, integrates computer science, psychology, and cognitive science. Affective computing promises to revolutionize human-machine interactions by responding to human feelings.

⚐ Highlights

By reading your emotions, machines can personalize responses, creating engaging and meaningful experiences. Our appetite for tailored solutions, AI advancements, and improved sensor technology has fueled this demand. HR, for instance, can benefit from emotion-aware tools for employee engagement and support. While some companies specialize in areas like marketing optimization, most offer APIs for seamless integration, bringing the power of emotional intelligence to diverse applications. However, challenges remain. Improved databases and solutions for handling obscured emotions and detecting deception are crucial to ensure accurate, ethical use of this powerful technology.

📝 Featured Story

India's leading multinational footwear retailer implemented an AI-powered video analytics solution for improved in-store sales, operations, and customer satisfaction. Developed by a top AI video analytics company, the platform utilizes the store's video infrastructure for smart data collection and insights on conversion and audience segmentation. It uses 'Emotions Charts, to assess customer interest and reactions, enabling the store to identify products and categories that evoke positive or satisfied emotions.

◎ Radar View & Related Technologies
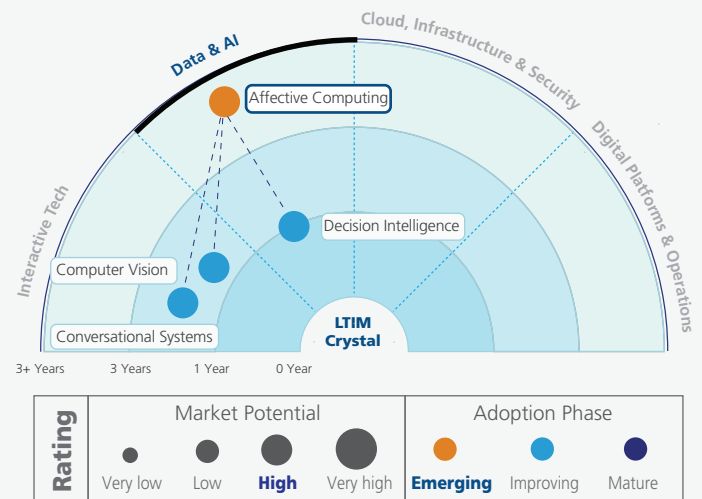
✧ Key Takeaway

The future of affective computing lies in responsible development, addressing ethical concerns, and ensuring user privacy. As the technology matures, it will continue to shape how we interact with machines.

Key Use Cases

Hi-Tech
◦ Personalizing learning styles
◦ Detecting student engagement
◦ Providing real-time feedback

Retail and CPG
◦ Monitoring customer's satisfaction level during shopping experience

Healthcare
◦ Observing mood changes, customizing therapy
◦ Aiding pain relief in patients

Energy and Utilities
◦ Analyze employee stress levels to prevent burnout and improve safety in high-pressure environments

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6G Network

6G is the successor to 5G cellular technology, likely 100 times faster than 5G. With an ability to deliver omnipresent wireless intelligence, this technology is expected to become available in the early 2030s. One of the goals of the 6G internet is to support one-microsecond latency communications. This is 1,000 times faster than one millisecond throughput.
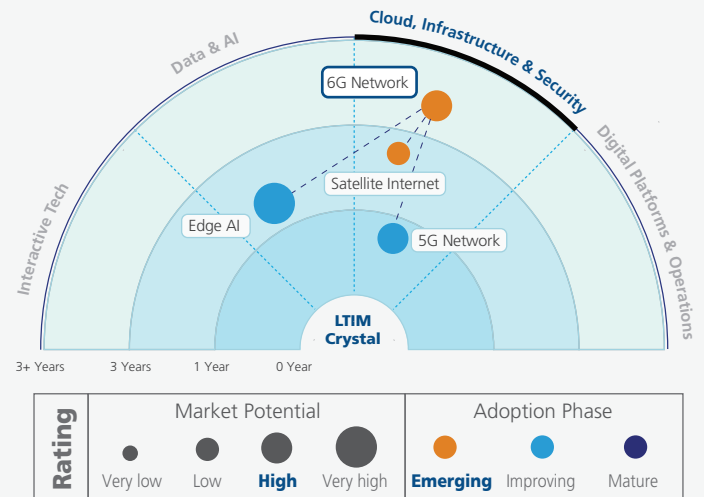
⚐ Highlights

6G is being designed to create a seamless reality between the digital and physical worlds. The merged reality will provide newer ways of interacting with people. In 6G, countless sensors will be embedded into the physical world to send real-time data and digital representation. The market size for 6G is estimated to be around USD 129 billion by 2030, with a 4.8% CAGR. Type and application segmentation is expected to be crucial in its growth and gain significant momentum in the coming years. Overall, 6G is expected to be a fully unified system that enables fast communications between devices, consumers, and the neighboring environment.

📝 Featured Story

6G is still a decade from reality. However, several countries have started innovating to develop and patent 6G, which could be the next big industrial revolution. Meanwhile, China has successfully released "the world's first 6G satellite" into space to test the technology. The telecoms industry is still several years away from agreeing on 6G's specifications. Whether it will make it into the final standard is yet to be determined.

◎ Radar View & Related Technologies

Rating	Market Potential				Adoption Phase		
	Very low	Low	**High**	Very high	**Emerging**	Improving	Mature

✧ Key Takeaway

6G will surely evolve as a revolutionary technology and become a key enabler for businesses to operate in the new digital and smart environment. However, it is still in the nascent stage and should be on the top of the watchlist of technology companies.

Key Use Cases

Hi-Tech
◦ Advanced AR/VR/MR
◦ experiences with high-resolution visuals and haptic feedback

TTH
◦ Empowering autonomous vehicles, connected transportation with seamless navigation and dynamic service adjustments

Healthcare
◦ Accurate diagnoses through high-resolution medical image analysis and data sharing

Communication
◦ Ultra-reliable and low-latency networks

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Deception Technology

Deception technology refers to a set of tools designed to deceive hackers and prevent them from inflicting significant damage once they have infiltrated a network. Deception technologies improve on traditional "honeypots" in that they are more dynamic and act as more intelligent alert systems. It may become a cornerstone of legislation governing how businesses safeguard consumers' data privacy rights.

⚑ Highlights

Deception technology can benefit sectors like manufacturing, transportation, and healthcare, which rely heavily on OT/IoT technologies lacking security agents. By mimicking these devices, authentic production units are shielded. This technology collaborates seamlessly with detection engineering. Generative AI might craft both deception components and corresponding detection protocols concurrently. Referencing the MITRE ATT framework, deception technology aligns with MITRE Engage, a cyber-deception framework and community. Collaboration between vendors and MITRE seems probable for engagement and its commercial adoption.

📝 Featured Story

A US-based deception solutions provider partnered with a government IT solutions provider to deliver advanced cyber deception technology to the public sector. This collaboration in the public sector aims to offer US government agencies advanced security against zero-day attacks and advanced threats. Their integrated solutions use AI to automate deception and tailor it for each endpoint of vulnerability.

◎ Radar View & Related Technologies

Rating	Market Potential				Adoption Phase		
	Very low	Low	High	Very high	Emerging	Improving	Mature
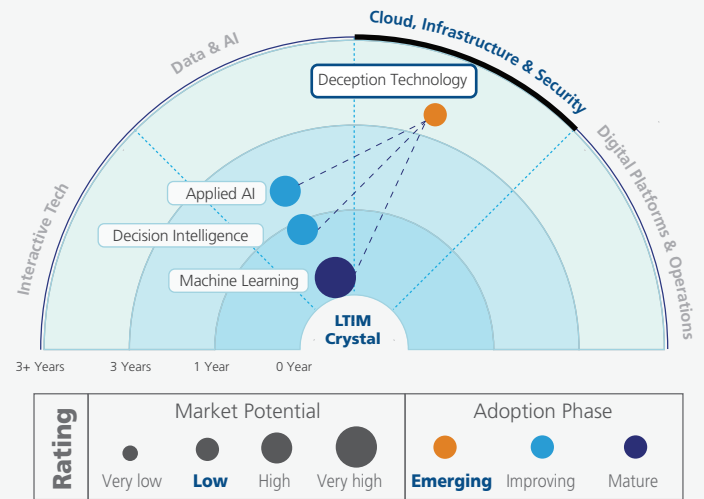
✦ Key Takeaway

Deception technology offers autonomous customized defenses leveraging AI integration for diverse endpoints. Its prevalence will rise, solidifying its status as a fundamental security operations component by 2025.

Key Use Cases

BFS
◦ Guarding the integrity of wire transfer services

Manufacturing
◦ Safeguard Information Technology (IT) and Operational Technology (OT) networks

Healthcare
◦ Meet HIPAA and HITECH patient data protection mandates

Energy and Utilities
◦ Deception for attack detection of distribution systems

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Low-Power Wide-Area Networks

LPWAN, a wireless wide-area network technology, connects low-bandwidth, battery-powered devices with low bit rates over extensive distances. Designed for Machine-to-Machine (M2M) and Internet of Things (IoT) networks, LPWANs operate at a lower cost and offer superior power efficiency compared to traditional mobile networks. It is important to note that LPWAN is not a single technology but a diverse group of low-power, wide-area network technologies, each taking different shapes and forms.

⚑ Highlights

The market's expansion is credited to the rising demand for LPWAN networks across diverse industries, including smart metering, asset tracking, and industrial automation. With reduced power needs, extended range, and lower costs compared to traditional mobile networks, LPWAN enables numerous machine-to-machine (M2M) and Internet of Things (IoT) applications. This unlocks possibilities for applications previously limited by budget and power constraints. Deployed in an unlicensed spectrum, LPWAN networks offer a cost-effective alternative to traditional cellular networks.
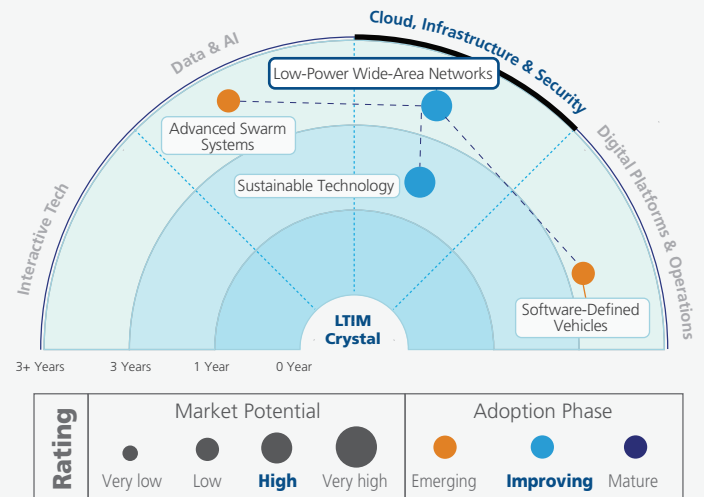
📝 Featured Story

A telecom operator based in Serbia has introduced a new NB-IoT network complementing its existing public LoRaWAN network. This expansion aims to cater to industrial firms, energy providers, cities, municipalities, and retail and facility operators across the country. The implementation will predominantly help in metering infrastructure and auxiliary smart-city applications, thereby digitally automating business processes and providing sustainable business.

◎ Radar View & Related Technologies

Rating	Market Potential				Adoption Phase		
	Very low	Low	**High**	Very high	Emerging	**Improving**	Mature

✧ Key Takeaway

LPWAN's increased adoption is driven by its ability for a wider number of devices to connect through the same area, making them more effective and economically sound than conventional cellular networks.

Key Use Cases

Manufacturing
◦ Continual monitoring aids in predicting machine maintenance, thereby minimizing downtime

TTH
◦ Improved fleet transportation fuel efficiency
◦ Visibility in maintenance concerns
◦ Improved operational efficiency

Healthcare
◦ Ideal for essential intelligent healthcare applications due to low-power, low-cost, and consistent performance

Energy and Utilities
◦ Provides updated, accurate, and periodic billing information to improve feasibility of deployment

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Quantum Communication

Quantum communication is a field of study that explores the use of quantum mechanics to transmit information. It leverages the principles of quantum superposition and entanglement to create communication systems. Use cases such as quantum internet that enables distributed computing paradigm in quantum computers and quantum key distribution that enables secure cryptographic key exchanges can be realized.
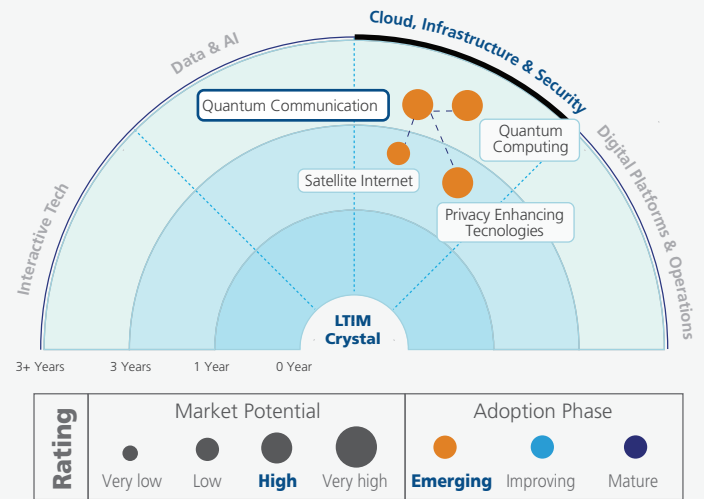
⚐ Highlights

The momentum in quantum communication research and investment is unprecedented. Governments, research institutions, and tech companies actively push quantum technologies toward practical implementation worldwide. This promises unbreakable security, swift data transfer, and potential synergies with quantum computing. Practical applications encompass secure communication, the quantum internet, progress in healthcare, and quantum cryptography. As projected by experts, quantum communication networks are expected to be globally available by 2030, ensuring secure communication channels worldwide.

✍ Featured Story

In November 2023, a Japanese multinational electronics company and a leading quantum communications technology company partnered to implement the National Quantum-Safe Networks+ (NQSN+) Project. The quantum communication technology leader will implement the project in the next few years. It will employ a suite of products, including Quantum Key Distribution (QKD) and Quantum Key Management System (Q-KMS).

◎ Radar View & Related Technologies

Rating	Market Potential				Adoption Phase		
	Very low	Low	**High**	Very high	**Emerging**	Improving	Mature

✧ Key Takeaway

Quantum communication leverages the principles of quantum mechanics to provide enhanced security and ultra-fast transmission of information. The outcome is expected to shape the way we communicate and collaborate in the years to come.

Key Use Cases

BFS
◦ Enhanced security of financial transactions
◦ Data protection

Retail and CPG
◦ Secure supply chain management

Healthcare
◦ Enhanced security of telemedicine services
◦ Remote healthcare systems

Insurance
◦ Fraud detection and prevention
◦ Data protection and privacy

LTIMindtree

Quantum Computing

Quantum computing leverages the principles of quantum mechanics to process large amounts of information faster. Unlike classical bits, which store only 1s and 0s, quantum bits (qubits) can be superposed and represent many states simultaneously. Quantum phenomena like superposition and entanglement enable quantum computers to tackle complex problems much faster, which are otherwise intractable on classical computers.
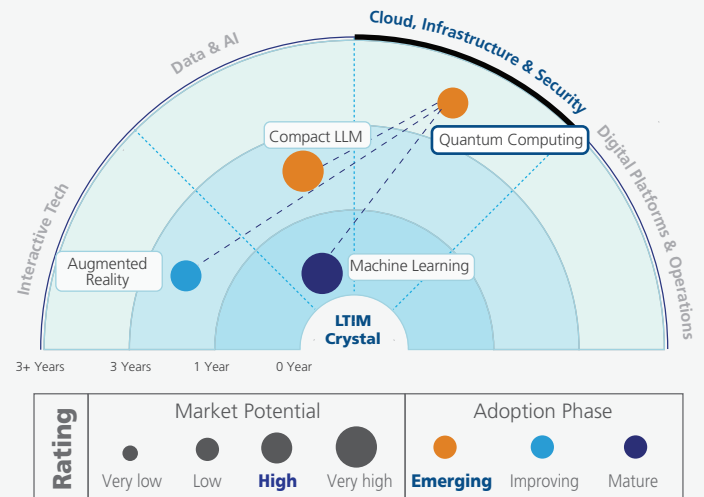
⚑ Highlights

IDC's analysis points to a substantial expansion in the quantum computing market. Customer spending is projected to surge from USD 1.1 billion in 2022 to USD 7.6 billion in 2027. This signifies an impressive five-year CAGR of 48.1%. Additionally, IDC anticipates consistent growth, forecasting an 11.5% CAGR in quantum computing investments from 2023 to 2027. This trajectory is expected to culminate in an estimated market value of around USD 16.4 billion by the end of 2027. Quantum technology has the potential to transform data processing, providing swifter computations, heightened encryption, and enhanced machine learning capabilities.

📝 Featured Story

The quantum AI sector of a major technology corporation headquartered in California collaborated with a UK-based healthcare company and a prestigious private research university in New York. Together, they explored the application of quantum computing to understand the intricate electronic structure of the cytochrome P450 enzyme family, a crucial player in drug metabolism.

◎ Radar View & Related Technologies

Rating	Market Potential				Adoption Phase		
	Very low	Low	**High**	Very high	**Emerging**	Improving	Mature

✧ Key Takeaway

Quantum computing has significant potential in addressing intricate issues like cryptography, material science, and drug discovery. Governments and industry leaders are actively formulating quantum algorithms and preparing for the upcoming quantum computing era.

Key Use Cases

BFS
◦ Risk analysis and portfolio optimization
◦ Financial modeling for improved risk management

Life Sciences
◦ Accelerates drug discovery and development processes
◦ Helps analyze large-scale genomic datasets more effectively

Healthcare
◦ Enhanced medical imaging techniques by improving image reconstruction and data analysis

Manufacturing
◦ Supply chain optimization, material design discovery with improved characteristics

"

Beyond the Horizon: Insights from LTIM Tech Innovators

Quantum Computing leverages quantum mechanics principles to enhance computational capabilities significantly for specialized tasks. This unlocks vast potential to tackle complex challenges in business and society. Business leaders should proactively explore and integrate quantum computing strategies to remain competitive and innovative in this rapidly evolving technological landscape.

Amit Modak
Research Lead,
Quantum Technology Incubation Group,
Global Technology Office

LTIMindtree

Quantum Sensing

Quantum sensing utilizes quantum systems or phenomena to measure physical quantities. Historical instances involve magnetometers using superconducting quantum interference devices and atomic vapors or clocks. The growth of quantum sensing is notable, with spin qubits, trapped ions, and flux qubits emerging as the primary platforms.
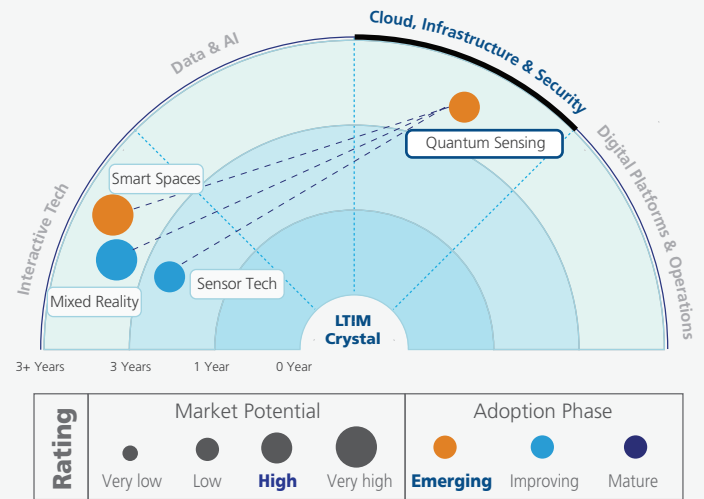
⚑ Highlights

The quantum sensors market size was USD 0.61 billion in 2023 and is expected to reach USD 1.12 billion by 2028, growing at a CAGR of 12.9% between 2023 and 2028. These sensors are in huge demand in the defense, healthcare, and aerospace sectors. The extensive application across various industries is propelled by the accurate measurement and sensing capabilities these technologies offer. They can detect and measure atomic and subatomic particles, enabling improvements in computing, communication, and metrology. IDtechEx's thorough research, extending until 2044, forecasts a projected value of USD 7.1 billion for deploying quantum sensors.

📝 Featured Story

In July 2023, an Australia-based quantum technologies company partnered with Australia's Department of Defence to provide disciplined control engineering solutions. It developed quantum sensors to deliver quantum-assured navigation capability for military platforms. The company is engaged in a multi-year collaboration to deploy and validate a miniaturized system on defense platforms.

◎ Radar View & Related Technologies

3+ Years	3 Years	1 Year	0 Year

Rating	Market Potential				Adoption Phase		
	Very low	Low	**High**	Very high	**Emerging**	Improving	Mature

✧ Key Takeaway

Quantum sensing offers a new paradigm for high-precision measurements across various domains. It can revolutionize scientific research and healthcare by providing unprecedented sensitivity and accuracy in detecting and measuring physical quantities.

Key Use Cases

Manufacturing
◦ Utilizing advanced quality controls to detect and address defects in real time

Retail and CPG
◦ Optimized inventory management
◦ Precision tracking
◦ Stock-level analysis

Healthcare
◦ High-precision medical imaging
◦ Enabling more accurate diagnostics
◦ Personalized treatment strategies

BFS
◦ Accuracy of financial transactions
◦ Safeguards against cyber threatschieves ultra-sensitive measurements

Internet of Behaviour

The Internet of Behavior (IoB) involves extracting essential consumer data from sensors and IoT-connected devices. It represents the convergence of data analytics and behavioral economics empowered by IoT capabilities. Analyzing consumers from a behavioral perspective helps businesses optimize their business processes and offer them greater value.
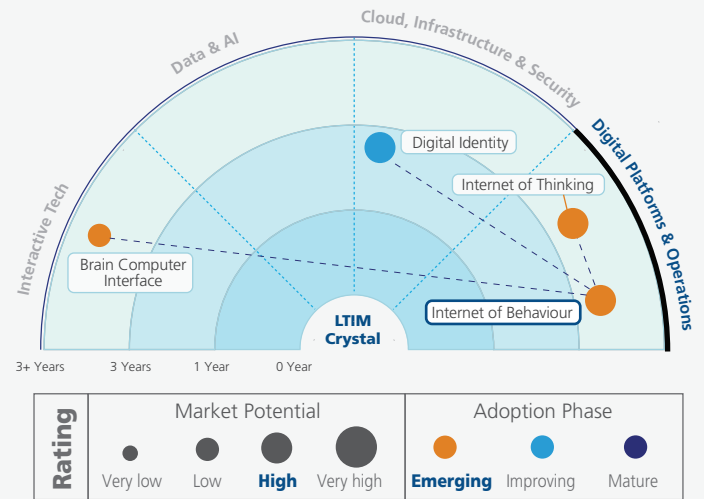
⚑ Highlights

IoB leverages IoT technology to analyze vast amounts of actionable data to understand human preferences and decision-making processes. It tracks customer journeys comprehensively and adds extra touchpoints for reinforcing or influencing purchase decisions. This approach strives to make each milestone engaging, gradually guiding customers towards favoring the product. Recognizing customers' shopping locations and times enables potential real-time interactions, potentially enhancing their shopping experience. The evolution of IoT technology sees emerging trends and notable AI-driven solutions for automated behavioral analysis.

📝 Featured Story

A Ukraine-based company built an IoT application that connects with sensors attached to a golf sleeve. The sensors catch the golfer's wrist and shoulder movements during the swing. This project embodies the IoB concept, aiming to enhance golfers' skills through a mobile app and wearable devices. It focuses on refining ball-striking techniques and introducing new ones.

◎ Radar View & Related Technologies

	Market Potential				Adoption Phase		
Rating	Very low	Low	**High**	Very high	**Emerging**	Improving	Mature

✧ Key Takeaway

IoB is an evolving protocol reshaping how we observe, manage, and understand human behavior. As this technology evolves, tech leaders must track its growth to maximize organizational advantages.

Key Use Cases

Hi-Tech
◦ Analyze data for channel use optimization

Retail and CPG
◦ Aids in-store consumer tracking, inventory management and store optimization

Healthcare
◦ Appropriate analysis and comprehension of behavioral data used for creating valuable services for treatment

BFS
◦ Enhanced KYC

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Internet of Thinking

The Internet of Thinking is a system that can process and analyze data collected by Internet of Things (IoT) devices closer to the origin of the data without relying on a central cloud server. This technology focuses on maximizing hardware's capabilities by harnessing a mixture of IoT and edge computing.
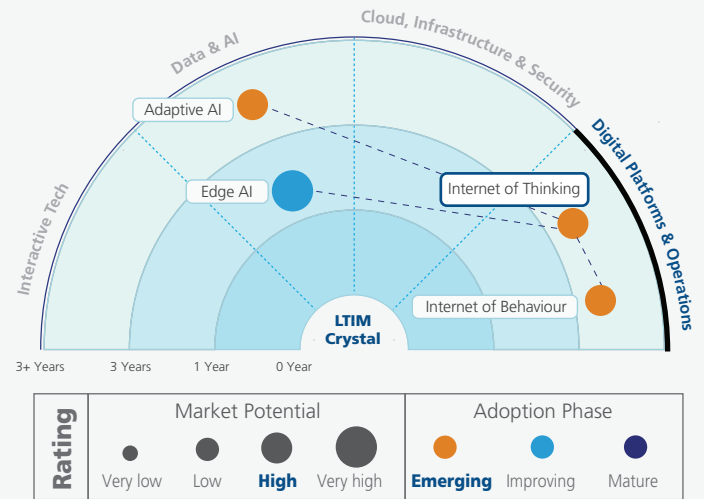
⚑ Highlights

A Cisco report predicts that the IoT device will create a value of USD 14.4 trillion across various industries. As per IDC, the IoT ecosystem investment is slated to surpass USD 1 Trillion in 2026 at a CAGR of 10.4% between 2023 and 2027. Western Europe and the United States have similar spending levels, but Western Europe is expected to expand its lead with an 11% CAGR between 2023-2027. It will be the biggest source of value of all disruptive technologies, ahead of knowledge-work automation, cloud computing, and advanced robotics. The rising need for real-time signals for proactive maintenance and business decision-making is expected to drive the demand for this technology.

📝 Featured Story

An American technology firm, providing energy and water resources management products and services, collaborated with an energy equipment and solutions company in Virginia. They deployed edge intelligence in the companies' smart electrical panels. DI-enabled (Distributed Intelligence) smart panels can help utilities manage load throughout the distribution network, including specific circuits within a home in strict coordination with distributed energy resources behind the meter.

◎ Radar View & Related Technologies

	Market Potential				Adoption Phase		
Rating	Very low	Low	**High**	Very high	**Emerging**	Improving	Mature

✧ Key Takeaway

The Internet of Thinking represents the integration of AI and IoT technologies, enabling intelligent devices to make autonomous decisions and process vast amounts of data. It can revolutionize industries, but ethical considerations and reliable connectivity are critical factors.

Key Use Cases

BFS
◦ Track customer footfall and waiting time
◦ Track cash levels in real time

Retail and CPG
◦ Real-time inventory tracking
◦ IoT-enabled smart displays to enhance product visibility

Healthcare
◦ Track vital signs and monitor movements of patients via smart beds

Manufacturing
◦ Improve supply chain visibility and real-time monitoring of equipment health

Software-Defined Vehicles

A Software-Defined Vehicle (SDV) manages its operations, adds functionality, and enables new features primarily or entirely through software. Autonomous Driving Technologies (ADTs) have advanced with sensors, processors, and deep learning to navigate autonomously. Deep learning enhances obstacle detection, signal interpretation, and decision-making. SDVs promise to revolutionize transportation, boosting safety, efficiency, and productivity.
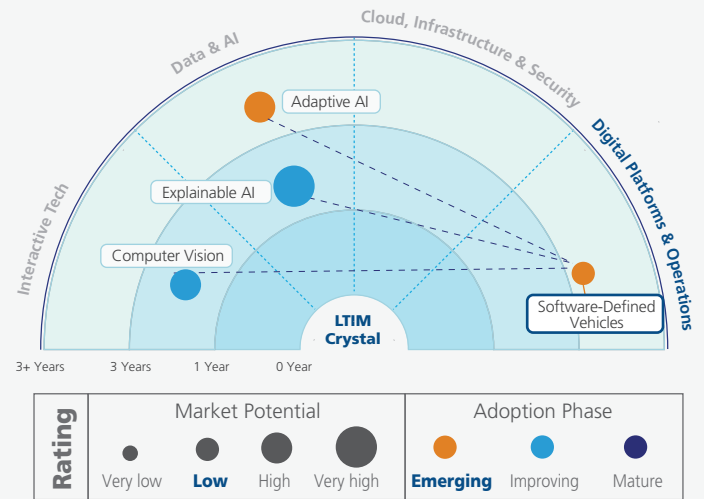
⚑ Highlights

While CASE principles (Connectivity, Autonomy, Shared, Electrification) drive the transformation in the automotive industry, it is experiencing a breakthrough driven by SDVs and electrification. SDVs can receive over-the-air (OTA) updates continuously, which improves your driving experience and keeps your car up-to-date with cutting edge technology. McKinsey predicts a significant USD 300-400 billion market impact of Advanced Driver Assistance Technologies (ADATs) in the passenger car market by 2035. Key industry trends include advanced connectivity, Vehicle-to-everything (V2X), smart sensors, intelligent driving support, vehicle quality control.

📝 Featured Story

A Swiss multinational committed to responsible consumerism collaborates with a Chinese ADT developer to address rising logistics costs. The partnership introduces advanced autonomous driving in road freight, reducing labor expenses by shifting from dual to single drivers. Achieving 95% autonomy on an 850 km route, the initiative yields substantial cost savings, 3-5% fuel efficiency gains, and enhanced safety. Plans involve developing L4 autonomous driving for continuous 24-hour operation to improve logistics efficiency and sustainability.

◎ Radar View & Related Technologies

3+ Years	3 Years	1 Year	0 Year

Rating	Market Potential				Adoption Phase		
	Very low	**Low**	High	Very high	**Emerging**	Improving	Mature

✧ Key Takeaway

SDVs expand the connectivity of the automotive supply chain to various avenues, including software development, testing automation, operations, and maintenance. This allows car manufacturers and service providers to expand their portfolio.

Key Use Cases

Retail and CPG
∘ Autonomous trucks handle long-distance freight
∘ Autonomous tractors and farming robots

Media & Entertainment
∘ Autonomous drones capture dynamic footage during the shoot

TTH
∘ Secure and on-demand autonomous public transport
∘ Mobility-as-a-Service

Energy and Utilities
∘ Autonomous drones inspect power lines and wind turbines

About LTIMindtree Crystal

LTIMindtree Crystal brings "Beyond-The-Horizon" technologies to cross-industry enterprises. It presents exciting opportunities in terms of foresight to future-ready businesses keen to make faster and smarter decisions on existing and emerging technology trends. The LTIMindtree Crystal is an output of rigorous research by our team of next-gen technology experts and meticulously rated by our Technology Council across a set of parameters.

We want to thank our Technology Council members for their passion and support in sharing their ratings and feedback. We hope you enjoyed reading the Technology Radar Report 2024!

For any queries and suggestions, please write to Crystal@LTIMindtree.com

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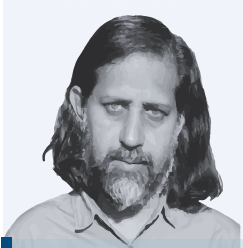
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Glossary

3D	Three-Dimensional
ADATs	Advanced Driver Assistance Technologies
ADT	Autonomous Driving Technologies
AI	Artificial Intelligence
AIaaS	Artificial Intelligences-As-A- Service
AML	Anti-Money Laundering
API	Application Programming Interface
APTs	Advanced Persistent Threats
AR	Augmented Reality
ASICs	Application-Specific Integrated Circuits
ATMs	Automated Teller Machines
ATT	Adversarial Tactic
AUD	Australian Dollar
B2B	Business-To-Business
BCI	Brain-Computer Interface
BYOD	Bring Your Own Device
CAD	Computer-Aided Design
CAGR	Compound Annual Growth Rate
CAPEX	Capital Expenses
CASE	Connectivity, Autonomy, Shared, Electrification
CBDC	Central Bank Digital Currencies
Chat GPT	Chat Generative Pre-trained Transformer
CNN	Convolutional Neural Networks
CPG	Consumer Packaged Goods

Glossary

CPUs	Central Processing Units
CX	Customer Experience
DAOs	Decentralized Autonomous Organizations
DCIM	Data Center Infrastructure Management
DeFi	Decentralized Finance
DevOps	Development And Operations
DHEX	Digital Health Exchange
DI	Distributed Intelligence
DLT	Distributed Ledger Technology
DRAM	Dynamic Random Access Memory
E2E	End-To-End
E-commerce	Electronic Commerce
EEG headset	Electroencephalography Headset
EHR	Electronic Health Record
ESG	Environmental, Social, and Corporate Governance
FDA	Food And Drug Administration
FIDO	Fast Identity Online
FPGAs	Field-Programmable Gate Arrays
GDPR	General Data Protection Regulation
GPS	Global Positioning System
GPUs	Graphics Processing Units
HCE	Host Card Emulation
HCI	Human Computer Interaction
HCI	Hyperconverged Infrastructure (HCI)

Glossary

HIPAA	Health Insurance Portability And Accountability Act
HMD	Head-Mounted Display
HR	Human Resources
ICP	Industry Cloud Platforms
IMDA	Infocomm Media Development Authority
IoB	Internet of Behavior
IoT	Internet of Things
IT	Information Technology
KYC	Know Your Customer
LAN	Local Area Network
LBS	Location-Based Services
LiDAR	Light Detection and Ranging
LLM	Large Language Model
LoRaWAN	Long Range Wide Area Network
LPWAN	Low-power Wide-Area Network
M2M	Machine-To-Machine
ML	Machine Learning
MLaaS	Machine Learning-As-A- Service
MoU	Memorandum Of Understanding
MR	Mixed Reality
NB-IoT	Narrowband Internet of Things
NFC	Near Field Communication
NFT	Non-Fungible tokens
NIST	National Institute of Standards and Technology

Glossary

NLP	Natural Language Processing
NPUs	Neural Processing Units
OPEX	Operating Expenses
OT	Operational Technology
OTA	Over-The-Air
PBC	Packaged Business Capabilities
PETs	Privacy-Enhancing Technologies
PPE	Personal Protective Equipment
QKD	Quantum Key Distribution
Q-KMS	Quantum Key Management System
RFID	Radio Frequency Identification
RNN	Recurrent Neural Network
ROI	Return On Investment
SaaS	Software-As-A-Service
SACA	Secure Azure Computing Architecture
SASE	Secure Access Service Edge
SDV	Software-Defined Vehicle
SOC	System-On-A-Chip
TTH	Travel, Transport and Hospitality
TTM	Time to Market
U.S.	United States
UCaaS	Unified Communications-As-A-Service
UI	User Interface
UK	United Kingdom

Glossary

USD	United States Dollar
V2X	Vehicle-To-Everything
VPNs	Virtual Private Networks
VR	Virtual Reality
VSM	Value Stream Mapping
XAI	Explainable Artificial Intelligence
ZKP	Zero-Knowledge Proofs
ZTA	Zero-Trust Architecture

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