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# EXPLORE



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COVER STORY
FUTURE TRENDS

# Top tech trends that business can't look away from in 2022

# EXPLORE

**Sunil Rajguru**
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# TikTok right on top

In 2014, the Chinese Musical.ly burst into the scene. With it you could create 15-60 second music videos. You could lip sync those music videos,record them in slow motion, speed them up or do a time lapse. There were special effects and filters. You could use hashtags and browse through other Musical.ly users and create a community. When this sensation crossed 200 million users, ByteDance realized its potential and merged it into its social media video app TikTok and the rest is history.

It became a sensation among Chinese teenagers and the youth of the world's two largest democracies–America and India–were hooked. 2020 should have been the Year of TikTok. That's when US President Donald Trump and Indian Prime Minister Narendra Modi cracked down on Chinese companies including TikTok. Instead of a rise, TikTok saw a great fall and some analysts wrote it off altogether.

> **Rules China, India & America**

But what is it about the short video format in general and TikTok in particular, that caught the fancy of the youth of the world? If today belongs to Facebook, then it seemed that tomorrow would belong to TikTok. All the Silicon Valley giants thought they could fill the vacuum created by TikTok's fall. We had YouTube Shorts. Instagram Reels. This even as Facebook tried to push short videos on its own.

But none of them could really replace TikTok as it rose from the ashes like a phoenix in 2021. While it did touch a billion users, that's still way behind in the billion users club which boasts of Facebook, Messenger and WhatsApp (all Meta); Gmail and YouTube (both Alphabet) and even the Chinese WeChat, which was also targeted by Trump.

But it's a real achievement and disruption has come to light in the Cloudflare global traffic rankings of 2021.TikTok has displaced Google Search which has held onto that crown for goodness knows how long. From No. 7 in 2020, it is No. 1 in 2021. This has great significance because this is the first time a Chinese company has beaten an American company at the global level. Chinese giants dominate China and American giants the rest of the world.

Here's another fun fact. TikTok has been released as Douyin in China and that has also crossed 500 million users. So TikTok-Douyin combo is right now Facebook's biggest challenger. It is the first cross border platform that has stormed the three largest populated countries of the world: China, India and America. Are other Chinese giants watching and will they want to adopt the TikTok strategy?

TikTok wasn't the first product that was dismissed for being flippant and just a fad among teenagers.It definitely won't be the last.

*Sunil Rajguru*

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## Which one is better, M1 seems faster than previous generation Intel processors?

■ *Abhinav Choudhury*

When you compare them side-by-side for their performance, the 11th Gen Intel processor seems faster than Apple's M1 chip, whether it's work or play. Apple M1 has its own benefits, as it's based on a completely different architecture, OS, and applications eco-system.

Apple intends to gradually replace Intel CPUs with its own Arm-based silicon. The Apple M1 is the first chip in this effort, powering the latest MacBook Air, Pro, and the Mac Mini. The M1 boasts some impressive performance.

## What will be a good choice of laptop for deep learning purpose for a beginner?

■ *Robert Ian*

For deep learning and Artificial Intelligence kind of operations, you require a lot of processing power and RAM because you'll be dealing with large data sets. If you want to learn deep learning and are a beginner, then a laptop powered with Intel Core i5 11th gen processor, 16 GB RAM, 512 GB SSD and 1 TB HDD

for doing quick reads/writes of your data and 4 GB or higher dedicated GPU.

## Why does the entire battery charge of my Lenovo laptop drain in about 30 minutes? How can it be fixed?

■ *Rohan Giri*

There could be two reasons - the most probable reason is that it's an old laptop and the battery's life cycle must have ended. You should replace the battery. Another thing that you can consider, is if you are performing some intensive tasks on a low powered machine. In this situation, CPU works with 100 per cent utilisation and consume a lot of battery, leading to poor battery performance.

## Why does a PC need a graphics card if it's not for gaming?

■ *Vikas Mundra*

The graphics card is not only for gaming. If you work on graphics applications, then also you need a graphics card. Professionals who're into video and graphics editing need a separate graphics card for their job. If you don't need to do any of this in your profession, then you can rely on inbuilt graphics. For instance, the latest 11th Gen Intel CPUs come with Intel Iris $X^e$ Graphics.

### Which one is more powerful, the Snapdragon 888 or the Intel i7 processor?

■ *Divyansh Srivastava*

Let's have a look at some technical details of both CPUs - *Qualcomm Snapdragon 888:* Kryo 680 - Architecture, 8 - Cores, 8 - Threads, 1.80 GHz – Frequency, 2.40 GHz – Turbo (All Cores), Qualcomm Adreno 660 – GPU, 0.84 GHz – GPU frequency, 5 nm – Technology

*Intel Core i7-1165G7:* Tiger Lake U - Architecture, 4 - Cores, 8 - Threads, 2.80 GHz - Frequency, 4.10 GHz - Turbo (All Cores), Intel Iris Xe Graphics 96 (Tiger Lake G7) - GPU, 0.40 GHz - GPU frequency, 1.30 GHz - GPU (Turbo), 10 nm - Technology

When you compare them side-by-side, Intel is a better choice over Qualcomm. The CPU is not only better in terms of specs, in the real world performance as well it performs better than the Snapdragon. So, I would recommend you choose Intel CPU when you consider your next machine. Also, with Intel, you would get numerous options to choose from.

### My gaming laptop heat reaches to 100degree Celsius while playing game?

■ *Prakash Reddy*

Gaming machines are designed to handle higher temperatures, but CPU performance will be gradually impacted as soon as it reaches 100 degCelcius. First, if your gaming machine is new, then it's better to put it on a flat surface for better ventilation. While playing the game, only run the game and close all other applications to reduce the load. If that isn't work, then you need to reduce turbo power limits, or in the case of TCC, you can set the thermal throttling to kick in at a lower temp, i.e. 90C. but remember in both options, the PC performance will be compromised. Try to add external fans to cool it down. The better option would be to get a new gaming laptop with greater cooling capabilities.

### Is integrated graphics can be used for gaming?

■ *Lukesh Patel*

Integrated graphics are not really meant for gaming, but to run routine productivity applications. They can however, handle some light games, but if you intend to do high-end gaming, then you need a dedicated GPU. Here also, you should choose the right one as per your gaming interest, as all GPUs can't handle high-end games. For instance, you can rely on NVIDIA GeForce RTX 3070 Max-Q (8 GB GDDR6 dedicated) GPU to play high-end games. While choosing your laptop, you should prefer to choose the right machine for the job. A home or business laptop can also let you play games, but the performance won't be up to the mark. To get the maximum out of your machine you should choose a gaming laptop.

### I've been thinking of buying a Windows laptop to use in tandem with my Mac mini, mostly for schoolwork and Gmod/YouTube projects. How is Acer Aspire 7 (16 GB RAM and 6-core intel i7)?

■ *Surya Dewaan*

Acer laptops are good. The company has a wide array of products for every need and budget. There are some good options for students as well. The configuration you mentioned is capable of handling various applications, but it's better to have dedicated graphics as well to enhance the overall performance and smooth graphics.

### Which is a better option, an i5 10 gen with Nvidia MX330 2GB GPU or i5 11th gen with integrated graphics Intel Iris Xe?

■ *Ritesh Agarwal*

In this comparison, the i5 11th Gen with integrated Intel Iris graphics is better than the entry-level MX330 GPU. You need to understand your computing requirement first. The integrated Iris graphics is enough for most of the daily productivity apps and some light games. If you are a hard-core gamer or coder then you might require a dedicated GPU but not the entry-level one, the recommended one would be 4 GB Nvidia GTX graphics.

# Top tech trends that business can't look away from in 2022

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**W**elcome to 2022. No one knows what the future has in its store. But every new year brings new possibilities with it- a new ray of hope. In the December 2021 edition of PCQuest, we prepared and brought you a technology wishlist for 2022 encompassing the A to Z of future technology trends. This time we bring you the technology experts and industry leaders who have unique insights and foresights about their respective sectors.

In this edition and the next, we will bring you the enterprise technology trends (Cloud, AI, Analytics, Blockchain, Automation, Web 3.0, Security) and some interesting and emerging industry-wise tech trends (RetailTech, ManufacturingTech, AutomotiveTech, AdTech, EdTech, HealthTech, FinTech and more) specific to each of those sectors and a sneak-peek into the way businesses are planning to align those tech with their strategic priorities and overall business goals.

Throughout the year, we will track these technologies along with the other emerging technologies to see how they shape the future of businesses across industries and keep you updated on all the latest technology trends and innovations.

# Micro data centers will accelerate Edge computing innovations

▼ **Sachin Bhalla,** VP & Country GM- Secure Power Division, Schneider Electric India & SAARC

Today, we want everything instantly and at the click of a button. Micro Data Centers are the answer to this need as they bring computing and storage closer to end-users. We are witnessing an unprecedented demand for low latency access to data processing and data storage, owing to the rise in the IoT-based applications, content delivery, and 5G. Also, a few years ago, edge computing was a nascent development that was gaining momentum in the enterprise technology sector. Now, it is a force to reckon with. Micro data centers are accelerating the innovations that we are making in edge computing. With these technologies projected to grow through 2022, the proliferation in the market size of micro data centers is going to be indomitable. Moreover, a plethora of products and services will reap benefits with an increase in micro data centers, like satellite navigation systems, online banking, shopping and retail services, as well as streaming and content platforms. In the near future, the ability of Micro Data Centers to provide local availability in the event of network outages will be a major driving force behind their adoption.

# Demand for Data Center-as-a-Service (DCaaS) will rise

▼ **Sunil Gupta,** Co-founder & CEO, Yotta

A large growing internet user base and the explosion in data consumption along with a favorable push from the government's Digital India mission will see India continue its growth as an upcoming data center hub. Developments like the Personal Data Protection Bill and 5G adoption will cascade and crystallize across 2022. Data protection and localization will give a massive boost to the Indian data center industry as enterprises will embrace local service providers.

Edge computing and 5G will co-evolve to harness the best of each other, with data centers serving as a bridge between the two. Underpinned by a robust Edge data center network, enterprises, telecom companies and cloud service providers will invest in edge computing for applications like faster video streaming, factory automation, telemedicine, autonomous vehicles and augmented and virtual reality (AR/VR).

As companies hasten migration from captive to multi-tenant data centers, the data center industry will witness adoption of 'as-a-service solutions' from enterprises, with high scalability and high-quality infrastructure being the primary drivers of this adoption. Lastly, data center interconnect (DCI) technology which can connect two or more data centers over short, medium or long distances, will continue to grow as it brings lower operational costs and flexibility.

# Efficiency and utilization of data centers will remain critical

▼ **Nitin Gavade,** Director- Global Edge, Racks & ITMS, Vertiv, India

With more people relying on technology to stay connected in a hybrid working environment, we anticipate that efficiency and utilization of data centers will become critical, along with a more aggressive and comprehensive focus on sustainability. Cloud computing is becoming more mainstream in India, and hybrid cloud models, including enterprise, public-private cloud, colocation and edge are increasingly becoming common. These compute models offer enterprises more flexibility, increased efficiency, higher security and reduced energy consumption, enabling organizations to rapidly scale their businesses. As technology and operator focus evolves, the infrastructure that supports it will need to evolve to also be more efficient, sustainable, flexible and secure. While data centers continue to innovate and enhance their tech capabilities, they will also increasingly focus on adopting a more sustainable eco-centric approach. Fuel cells, renewable assets, and long-duration energy storage systems, including battery energy storage systems (BESS) and lithium-ion batteries, will play a vital role in providing sustainable, resilient, and reliable outcomes. Additionally, the edge will continue to be a focus. While availability will remain top priority, lower latency will become crucial to support healthy buildings, smart cities, and distributed energy resources. 2022 will see increased investment in the edge to support this new normal and the anticipated rollout of 5G.

## Investments in smart infrastructure will see an uptick

▼ **Vinod Ganesan,** Country Manager- India, Cloudera

While some organizations might have deployed cloud to tackle specific issues, we will likely see the focus shift towards an all-inclusive approach centered on enterprise-wide cloud migration. A large number of organizations will increasingly look to house their data and performance analytics on hybrid and/or multi-cloud architectures. Investments in smart infrastructure are also expected to witness an uptick in 2022. With the anticipated roll-out of 5G, businesses will embrace newer technologies. Enterprises in the region will look to smart edge computing to help quickly analyze data, while reducing latency and costs. In the manufacturing industry, for example, this means shifting from corrective maintenance to preventive maintenance, made possible by real-time decision-making.

## Focus will be on optimizing Day 2 operations with intent-based capabilities

▼ **Rajesh Kumar,** Technology Head- Enterprise & Government, India & SAARC, Juniper Networks

While speed has been one of the major goals in advancing operations, today, organizations are focusing more on reliability and rolling out services faster. With IT infrastructure generating more data than ever before, especially in the manufacturing sector that's experiencing IT and OT convergence, 2022 will witness the workings of a reliable network in accelerating data center operations. In addition to this, as initial operations and processes become more and more streamlined, the focus will shift to optimizing Day 2 operations with intent-based capabilities in 2022. Gradually, multi-domain observability will take the stage and basic workflow composers will become a thing from the past. Having said that, the impact of long-anticipated technologies like AI, automation and intent-based networking that leverages deep analytics will be more visible than ever for large enterprises.

## Adopting zero touch operations to improve operational efficiency

▼ **Samit Banerjee,** Division President, Amdocs

With exponential growth in digitalization, industries are adapting to virtual methods for running their business. Service providers are proactively developing zero touch operations to improve their operational efficiency and customer experience by reducing human interaction. For Cloud Service Providers (CSP), Zero Touch Operations means automating each phase of operations and usage of AI to predict patterns of anomaly and implement auto healing as per different operational scenarios. The fully automated system would significantly reduce the OSS and BSS operational cost and improve time to market, service quality and customer satisfaction.

## Modernizing apps with cloud-native approach

▼ **Gaurav Agarwal,** Senior Director- Enterprise & Government Sales, VMware India

Over the last two years, we have helped organizations across verticals in India, accelerate the delivery of modern services and thrive in a multi-cloud world. Going forward, enterprises will increasingly focus on modernizing applications to ensure agility, resilience, and scale to serve their end customers better. To develop modern apps using containers and microservices, they will need fundamental skills and a cloud-native approach in place to enable highly automated cloud platforms that improve the overall quality of application development.

We also foresee increased adoption of Multi-Cloud that will help enterprises to leverage AI, ML and data capabilities. On average, organizations run hundreds of apps across many different clouds, and it has never been more important for enterprises to have consistent visibility and control across the full spectrum of application architectures and infrastructure resources. Organizations need to relook at their security architectures and deploy cloud-native endpoint security that leverages behavioral analytics to identify and stop emerging threats before a potential cyberattack affects the organization's business.

## Adoption of Hybrid Multi Cloud, AI-powered automation will rise

▼ **Faiz Shakir,** MD- Sales, India & SAARC, Nutanix

Flexibility and resiliency will continue to be top priorities for India's enterprises as they look to unlock every opportunity for growth in a post-covid, digital reality. As businesses increase their cloud adoption, costly lock-ins will become more of a concern. Organizations will lean further towards hybrid multi cloud strategies that enable flexibility and avoiding cloud lock-in. This will give them the best cloud mix the market has to offer, with freedom and choice for their applications and data.

AI will become an even important tool to power IT operations and automation. Between advancements in technology and shortage of skilled labor in a number of areas, AI can help organizations tackle multiple challenges. While AI implementations may not always succeed in the first attempt, those who leverage existing models developed by leading research or company projects will be ahead of the pack.

## Preference of Hybrid Multi Cloud over single cloud stack

▼ **Nandini Sabanayagam,** VP, Client Engagement, ANSR

In the pandemic's wake, cloud-based technologies and services have helped organizations effectively support the distributed workforces, improve collaboration, stay connected with customers, and drive innovation. One of the key cloud trends for 2022 will be an increased adoption of hybrid cloud or multi-cloud architectures. Not too long ago, most enterprises believed public cloud was the future and everything would eventually move there. But they are now realizing the benefits of hybrid models that utilize the best qualities of public and private clouds. Hybrid cloud allows you to keep sensitive data off the public cloud, while still taking advantage of the cloud for data that doesn't have the same kinds of risk associated with it. Also, limiting yourself to a single cloud stack can come at a significant cost. Instead of taking advantage of the unique capabilities of every cloud, you face the limitations of proprietary systems. Hence, hybrid cloud not only opens the doors to a wide range of valuable opportunities, but delivers value for money, enabling companies to operate more effectively and efficiently.

## Growing interest in bringing cloud-native apps to the Edge

▼ **Sudhir Nair,** Global Head, Infrastructure and Cloud Services, Tech Mahindra

During the pandemic, businesses embraced a digital first approach and focused on enhancing service delivery leveraging digital technologies. World experienced a 'Digital Downpour'! Today,

cloud computing infrastructure is the backbone of just about every digital service. Cloud technology essentially integrates all stakeholders in real-time. It drives other technologies to get faster and more accessible from the users' point of view and is set to take the lead among technologies for addressing critical business challenges. Evolution and adoption of digital technologies, powered by cloud, AI and analytics is reshaping the way businesses serve, compete, and grow. We strongly believe that cloud computing will remain a key technology trend in 2022 and beyond. With enterprises expressing growing interest in bringing cloud-native apps to the edge, it is likely that we will see the adoption of more holistic strategies centered on enterprise-wide cloud migration.

## Charting cloud migration strategy to fast-track 5G and Edge deployments

▼ **Mahesh Zurale,** Senior MD, Lead- Advanced Technology Centers in India, Accenture

The pandemic has accelerated the adoption of digital technologies, compressing a decade of digital transformation into just a few months and igniting a new era of exponential transformation. As technologies like AI, automation and low code platforms gain traction in the workplace, organizations need to reinvent their strategies and work style to successfully navigate the road ahead. First, cloud will continue to be a key growth enabler and organizations will need to prioritize managing and optimizing hybrid cloud environments, and charting the right cloud migration strategy to fast-track 5G and Edge deployments. With technology becoming more accessible to people across the organization, it will enable better synchronization between IT and business departments to build better solutions aligned to business needs. This will help companies to gain an innovation advantage that best positions them for future success. We also foresee the emergence of network-effect, with platforms that will help create new business models and build strategic partnerships between large companies in the ecosystem.

## Intelligent cost optimization with automated management of hybrid cloud

▼ **Pandurang Kamat,** CTO, Persistent Systems

Enterprise modernization journeys already have major cloud migration and cloud-native architecture components. The key sub-trends on the uptick are hybrid and edge cloud architectures and management through a single pane. Even as the cost per compute decreases, the total cost of the cloud is a focus because the usage and nature of workloads is changing. Intelligent cost optimization and automated management of hybrid cloud will be a key focus in 2022.

On the AI front, the biggest limiting factor in AI adoption today is lack of sufficient data science and engineering expertise. So end-to-end automation in the AI lifecycle will be a dominant trend in scaling enterprise AI, helping to do more with fewer people. Responsible, ethical, and transparent AI will be the other major AI sub-trend, driven by the realization that AI is not infallible and can pick up and propagate biases from the data it learns from.
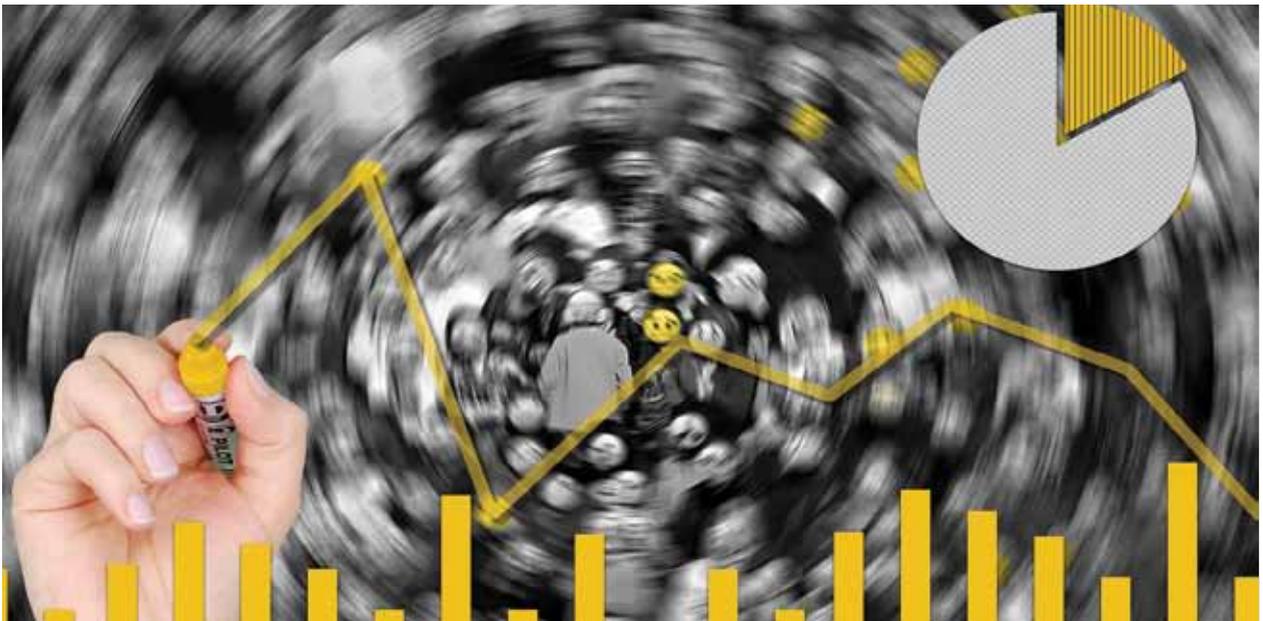
## Data literacy will be high on the leaders' priority list

▼ **Prashant Momaya,** Director, Solution Engineering, Tableau India

Data literacy will be high on leaders' priority lists as the demand for skilled talent continues to rise. More than technical proficiency with software, data literacy encompasses the critical thinking skills required to interpret data and communicate its significance to others. The use of data and analytics needs to permeate everyday business scenarios - it should no longer be a skill of the few, but a muscle of the many.

At the same time, understanding that everyone interacts with data differently is also key. Analytics needs to be collaborative and accessible for everyone, so anyone can interact with data in the flow of business. Think of data and analytics as a trusted teammate who proactively tells you when there is a problem, instantly answers your questions, and helps you automate business processes to close the loop from insight to action.

But to make great decisions with data, people need access to data they can trust. It is important for data governance to be top-of-mind for businesses as it provides visibility into data while also enabling discoverability so people can consume and create content with confidence.

## Adoption of DPaaS, data governance will grow

▼ **Pradeep Seshadri,** Director, Sales Engineering, Commvault India & SAARC

With the world moving towards a hybrid model of work, there is an avalanche of data, and organizations are doubling down with renewed aggressiveness to protect their most valuable

asset. To cater to this, especially the SMBs and mid-market segment, we expect subscription-based data management and protection services to reign the market with its agility, flexibility, and efficiency. Larger enterprises will continue to adopt the 'as-a-service' by outsourcing various backup and recovery solutions.

Predictive analytics will continue to play a crucial role in data protection and management. The increasing utilization of technologies like AI, ML and DevOps practices will not only propel data growth but will also aid in insightful analysis of threats and pattern matching leading to prevent data breaches and ensure recoverability. Additionally, Data Governance will remain key. We will witness more accountability in terms of data ownership.

## Get data-ready with Data Fabric

▼ **Sreenath AV,** VP & GM- Global Applications & Analytics Service Line Head, DXC Technology

Modern Enterprises are data-driven entities, functioning with data as the core asset for monetization. As enterprises become more data-reliant, they are bound to face a myriad of challenges with numerous data sources, data types, and formats leading to long and complex data processing cycles while maintaining security, compliance, active metadata, and data governance. In 2022, Data Fabric will be a critical component in helping enterprises get data-ready for the future. Data Fabric can be understood as a data management architecture that acts as a connective tissue along the data-to-insights pipeline. It provides users access to the right data in the right place at the right time across hybrid cloud and multi-cloud environments, geographies, even processes, and workflows. With the 360 Degree Data Fabric that is self-service enabled, data management is simplified and business users, IT stakeholders, data engineers, and data scientists.

## Successful cloud data lakes will prioritize unstructured data analysis

▼ **Prateek Kansal,** Head of Operations & Engineering India, Komprise

Data analytics is growing quickly in the cloud and with the popularity of technologies such as Snowflake, Redshift, and Databricks, it is natural to predict that the cloud will become the penultimate platform for data lakes in the future. Cloud-based data lakes don't require the heavy upfront infrastructure investments of on-premise data warehouses. Another advantage of cloud-based analytics and data lake solutions is rapid innovation. Fueled by the accelerated R&D engines of the three largest cloud providers, data lakes are getting smarter and more automated, democratizing this technology for most organizations which five years ago could have never afforded the compute power nor the know-how to conduct real-time analysis of massive, distributed data sets. Yet there remain many hurdles to overcome in making cloud data lakes successful due to the fact that 60-80pc of data is unstructured and does not work well (if at all) within data lakes

and warehouses. The merging of unstructured data into the world of structured and semi-structured analytics tools and practices will be an area ripe for innovation.

## Dedicated product analytics will be essential

▼ **Scott Pugh,** Regional VP & General Manager- APAC, Mixpanel

In 2022, more companies will realize that it is critical to understand how their customers interact with their digital properties. As Product, Engineering and Design teams become the key driver in business innovation and growth, they need the right data and tools to enable them to make validated product decisions. Shoehorning marketing analytics or business intelligence tools to build their products will no longer be acceptable. Dedicated product analytics will be essential. You don't want to step up to a gunfight with a swiss army knife. Many companies will review their existing data stack to find the best way to modernize it or fit product analytics into the stack. More companies will adopt a 'hub-and-spoke' approach with data from various tools being ingested into a central data repository, be it a CDP or data warehouse, to create a single source of truth. This will help companies to enrich user behavior data with additional data sources for even deeper insights.

## Responsible AI will gain precedence

▼ **Suman Reddy,** MD & Country Head, Pegasystems India

As businesses are leaning heavily on evidence centric and data driven strategies, the pervasive and ubiquitous presence of AI will dominate all customer interactions and/or business processes. The use of AI is moving into the realm of data savvy businesspeople who will be able to use it to drive better agility, understand their customers more, and drive better outcomes. By replicating and/or exploring the human condition through the AI lens, businesses can become more cognizant of the customer's emotional state, allowing them to interact more naturally and emphatically in chatbots and other channels, therefore providing better customer experience.

Ethical/Responsible AI will also evolve from a business 'vision' to something that's embedded in actual law and regulation. As responsible AI gains precedence for most businesses, attention will also turn to eliminating 'evil' apps, in which the AI has been deliberately manipulated to provide nefarious outcomes, such as ransomware. And as customers are becoming more conscious of their privacy, it will lead to ultimate transparency appearing within the app development space where the spotlight will be on what developers are doing with the AI.
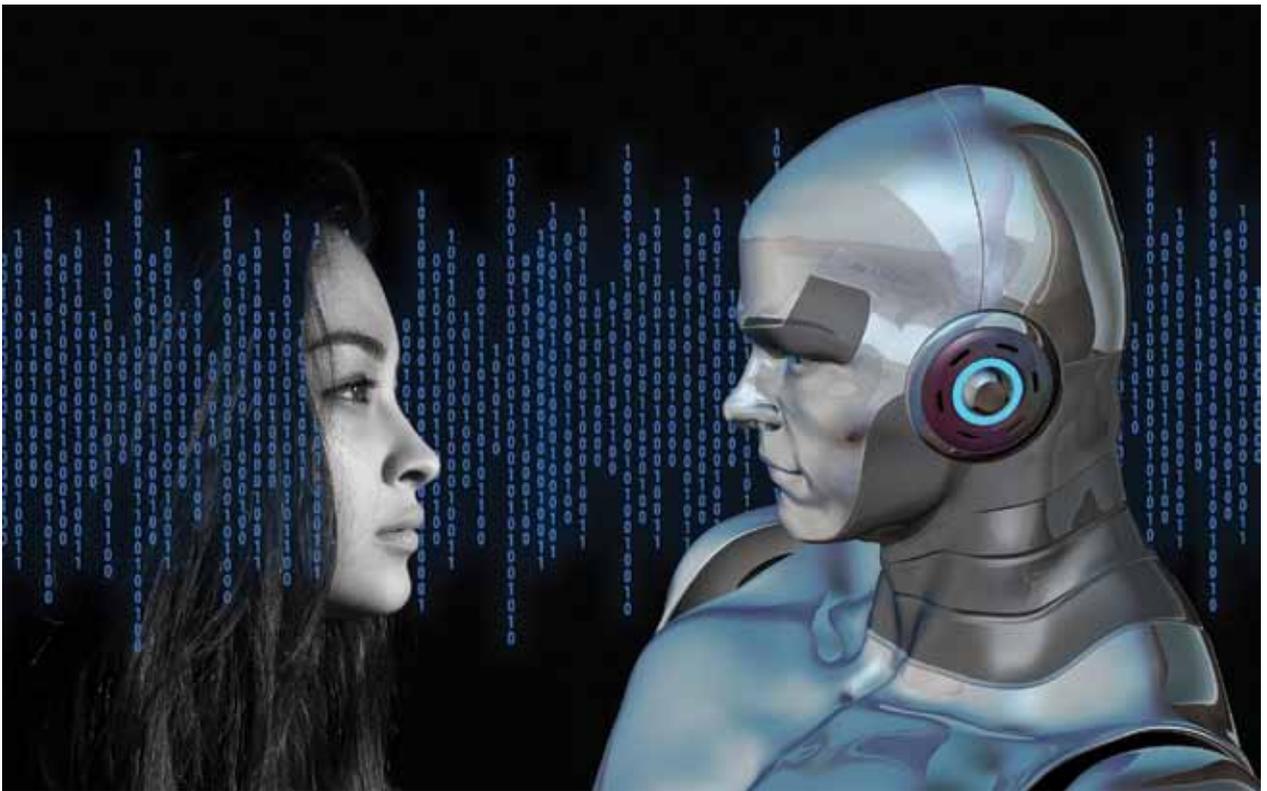
## ML innovations for embedded Edge will speed up

▼ **Krishna Rangasayee,** Founder & CEO, SiMa.ai

As we move into 2022, the challenge facing many industries is data management and leveraging that data for the best decisions. This is especially true at the embedded edge. ML is now being used as the technology of choice in many markets in order to manage data in a more efficient way. While it's still early in the process, ML will soon be the de facto technology that changes and reshapes how we manage data for better and quicker decisions at the embedded edge. Every system in the world will have some element of ML in them over the next decade. This includes aerospace and defense, industrial, manufacturing, video surveillance, autonomous vehicles, smart vision, robotics and autonomous systems, medical, and enterprise systems, just to name a few. ML will reshape architectures, hardware and software systems and also reshape how we build, deploy, and manage these systems.

## More organizations will have bias bounties in place

▼ **Rahul Joshi,** CTO, CSS Corp

As AI inside will be embedded at the core of everything from architecture to operations

to bridge the business-to-customer divide, in 2022, we will witness a high demand for responsible AI solutions in the market. If we look at the industry today, most tech or non-tech organizations generate consumer benefits and business value by leveraging 70-80pc AI-led operations and creating AI-infused products and applications. While AI can be a helpful tool to increase productivity and reduce the need for people to perform repetitive tasks, it can also give rise to a host of significant unintended (or maliciously intended) consequences for individuals, organizations, and society. For instance, there are well-known examples where the algorithms cause problems by replicating the (often unconscious) biases of the developers/ programmers who built them. So, it's crucial to ensure that comprehensive datasets are used. Most organizations have bias bounties in place, and this trend will run rampant in the coming years. To ensure that no company is marred with data or AI ethics enrages that can impact its reputation and revenue, it's imperative to build an ethical and responsible AI. Some best practices to navigate dilemmas concerning AI are inculcating transparency, ethical data mining, inclusivity, accountability, and explainability.

## Location tech will get better with Data and AI

▼ **Ankush Chatterjee,** Senior Director & Head- Product Management, APAC, HERE Technologies

In 2022, we're likely to see a deeper omnipresence of data resulting in a convergence between our physical and digital worlds when it comes to mapping. Through AI and the combination of varied datasets, we connect aspects of the physical world beyond the road network in a semantic relational network called 'location graph', and ensure its availability across platforms. This allows objects in the physical world to become relatable to one another, enabling those relationships to be mapped and queried. As a result, every dataset will become referenceable to a unifying map schema.

The map will serve as a giant, contextual canvas through which OEMs can connect their vehicles to other aspects of the mobility ecosystem, such as public transit, search for places, optimal routing and parking facilities. Mapping will also simulate and predict movement and predict future traffic flow to aid the overall planning and efficiency of the broader mobility network. With location graphs, we can start to ask more complex questions and get better answers. For example, "Find me a fast-charging station along my route where I can also grab a coffee." Finally, hyper automation will also assist in how quickly we can ask and receive such responses.

## Leveraging AI-powered intelligent workflows for operational efficiencies

▼ **Kamal Singhani,** Country Managing Partner, IBM Consulting, IBM India/South Asia

The disruptions of the past year have made it necessary for organizations to have the ability to rapidly scale up or down, pause operations or quickly restart while maintaining flexibility to react to market trends in real time. This is possible only by leveraging technologies such as cloud, AI, and automation  which can open up capabilities that were

previously inaccessible. To develop these capabilities, companies must innately understand core processes, including barriers, and reinvent themselves. In the coming year, we will see enterprises increasingly leveraging AI-powered intelligent workflows in order to transform the business and boost operational efficiencies. The current trend of embracing the hybrid cloud as the technology backbone will see significant uptick. It will enable organizations to enhance adoption of AI models, foster innovation and boost agility - all of which are essential to meet current and future challenges.

## Humanizing data and analytics with NLP

▼ **Rajasekaran Panchatcharam,** CPO, Bahwan CyberTek

In 2022, future-fit enterprises will turn to AI for value creation. AI-powered predictive analytics will give customer-centric enterprises a definite edge. Data-rich sectors will unlock hidden revenue streams and leverage data in a connected and converged environment to sense disruptions, predict performance, and achieve business goals. Key industries like healthcare, supply chain, energy, oil and gas, retail and telecom will continue to increase their investments in AI-powered technologies. Taking AI up a notch, Natural Language Processing (NLP) capabilities will humanize data and analytics. It will dig into the complex syntax and semantics of the human language and help machines understand and interpret it. With these trends that we will see through 2022, the IT sector will continue to invest in AI competency, and institutions will feed this need by creating learning programs in AI.

## 'Intelligent Products' will take over

▼ **Mayur Purandar,** VP – Enterprise Architecture, Lowe's India

Even though AI & ML have gained popularity recently, moving beyond just buzzwords, they are still being treated in silos. However, it is essential to understand that any capability

treated in isolation and disconnected from the rest of the technology or business ecosystem cannot yield consistent and measurable results. Hence with the need to expand technology for the benefit of business, it is imperative to move to an agile and product mindset, where we put customers at the front and think about 'Intelligent Products.' Enabling the organization to harness the promise of AI/ML more effectively, Intelligent Products furthers the agenda of product thinking. By embedding relevant AI/ Ml capabilities in-context to enhance the product, it aids the organization in creating ever-improving products in sync with hyper-evolving consumer demands. While there has been a lot of progress made on the core capabilities of AI/ML, I firmly believe 2022 will be our movement from 'Powered by AI' to 'Intelligent Products'.

## Using AI for human performance development

▼ **Hariraj Vijayakumar,** Founder & CEO, NWorx

Use of AI in Human performance development is today limited to mission critical areas such as aviation or medical procedures and areas such as sports performance. This will broaden and we will see AI in professional development at the workplace. Performance of teams and their managers at the workplace is a rich data stream that combines market triggers, strategic choices, goal-setting decisions, behavioral events and cognitive responses. This data stream offers enormous opportunities to generate intelligent machine responses as well as automate workflows for professional development use cases. Next stage of application of AI is in the embedding of professional development in the flow of everyday work. This will mark the emergence of far more effective workforce development solutions than the limited content-oriented solutions that exist today. Finally, widespread application of conversational AI using GPT-3 means sophisticated and natural interfaces for humans to access these technologies.

## Using AI to drive compliance

▼ **Anil Paranjape,** Director, Avalara India

AI-backed software is likely to be leading business functions and replace how some functions operate - especially those with a high scope for human error and repetitive manual tasks. This is an exciting time for businesses that have to deal with legal compliance - because the augmented workforce is steadily becoming a reality. Compliance functions that involve a massive amount of paperwork are actively looking to incorporate AI-based operations that eliminate manual processes. As a result, the establishment of augmented workforces is definitely expected to be an essential part of our future. The government uses AI/ML to help taxpayers file their taxes. It also uses AI to detect patterns and zero in on any activity done with nefarious intentions. Seeing any suspicious fraudulent activity in the initial phases will help nip tax fraud in the bud. It will be excellent if a system starting as a pattern detection activity will eventually develop into a decision-based AI system- one that will issue notices and penalties against those conducting fraudulent activity.

## Use of ML, NLP in CRM will bring tangible benefits to the BFSIs



▼ **Indraneel Fuke,** Founder & CEO, SimpleCRM

We see the growing use of ML, especially Natural Language Processing (NLP), to automate processes and deliver better-personalized experiences to customers in the BFSI sector. We expect these organizations to adopt solutions like automated email triaging, sentiment analysis of customer interactions, document classification, credit risk assessment, analyzing unstructured information, omnichannel customer engagement through bots, and others. The use of NLP models, especially in conjunction with a consolidated customer-data repository like a CRM, can result in a tremendous improvement in the operations of BFSIs. For example, an automated email triaging solution can tag the incoming email to a specific customer record and capture the customer sentiment and intent to trigger a workflow for creating an opportunity, service request, or complaint ticket. Similarly, NLP-powered virtual agents can increasingly engage customers in meaningful conversations, respond to frequently asked questions, as well as answer their account-specific information, can even allow customers to carry out financial transactions without the need for a live agent. Other benefits of NLP models include: Better personalized experience to customers, Improved operational efficiency, Better compliance with policy norms, New analytical insights and Innovative product offerings.

## Rising CX expectations will push business towards unified tech platforms

▼ **Prashanth Krishnaswami,** Head- Market Strategy & Thought Leadership, CX, Zoho Corp



The pandemic and the resulting uptick in digital adoption have changed

the fundamental nature of markets and redefined customer preferences. Trust-by-design will become a strong expectation from customers and the ultimate goal for brands. Customers will switch to brands that offer more privacy and take data security extra seriously. They would even pay a premium for these offerings. This is already starting to be true and will only get stronger as a trend.

The rising demand for digital-first experiences will also push businesses towards unified technology platforms, as opposed to a landscape of integrated best-of-breed applications, in order to enable every internal stakeholder (marketing, sales, service, operations, etc.) to collaborate seamlessly and deliver exceptional experiences. Regardless of functional alignment internally, everyone in the organization needs to come together to make the customer successful. And the CX technology platform must enable this by making the employee experience frictionless and cross-functional.

## Experience, privacy will be the key differentiators in the connected world

▼ **Nabendu Das,** Head-Engineering, Tally Solutions

Most businesses are connected, but the right experience will bring the best of the connected world. For example, you can send an email to somebody, and if you are offline, you can rest assured that when you come online the email will get sent. Can you expect the same from your business application? Also, can you stay connected with your ecosystem of businesses, and exchange business documents by just clicking a button? An integrated solution that either incorporates multiple aspects of the business in the same solution, or has super-easy integration with other software solutions, is going to make a big difference.

Privacy and security of data continues to be of paramount importance for businesses in 2022, especially as they increasingly get connected. Enabling customers to choose a solution or application that allows them to have control on the level of privacy and security is crucial. For example, can customers have a choice to make a decision regarding their business data, which can be managed within their own premise or on their device or on the cloud platform with the support of technology/ application?

## One-size-fits-all ERP solutions will be obsolete

▼ **Kaushik Mitra,** Senior Director, Cloud ERP, Oracle India

Data will continue to be the lifeblood of organizations, being the source driving insight and innovation. But with ever more quantities of data being produced, gaining value will continue to challenge organizations of all sizes. Businesses are relying on AI-embedded ERP solutions. Although ERP systems have been in the business space for a while now, they are not evolving from legacy systems to modern systems. We believe that one-size-fits-all ERP solutions will be obsolete by 2022, as trends shift toward more personalized solutions

for organizations. As new technologies such as AI advance, ERP solutions will be able to seamlessly connect with these breakthroughs in the coming years, potentially changing the ERP landscape by introducing new processes. Furthermore, mobile support and user-friendly systems will become core components of modern ERP solutions, supplanting the days when a solution was tethered to a single workstation. Similarly, as these systems evolve, a larger emphasis will be placed on real-time data insights to assist organizations in making informed decisions. Furthermore, as part of the digital-first approach, organizations will use technologies such as data visualization, integrated analytics, and real-time performance insights to generate, consolidate, and effectively use data to make data-driven decisions and forecast future trends.



## Making automation a strategic priority

▼ **Peter Gartenberg,** MD & President, Blue Prism India

The pandemic has slowly changed the perception of automation – from one that brought fear, to a more positive outlook, where automation is an enabler for positive change. We anticipate a sharpened focus on various forms of process automation such as Intelligent Document Processing, Rules-based and AI-based Decision engines, etc. that will drive greater efficiencies and improve customer journeys. Companies need to focus on

developing an operating model that enables scaling, making automation a strategic priority. To enable this transition, companies need to develop internal expertise across the automation landscape. Hybrid working has already driven a change in how Digital Workers are used. This can result in a greater focus on the interaction between human and digital workers, with a focus on human-like traits of the Digital Worker – for example, a greater reliance on Natural Language Understanding. AI & ML skills will continue to add value to the capabilities of digital workers, helping enterprises unlock new scenarios to adapt as you go.

## Rise of composable enterprise

▼ **Deepak Pargaonkar,** VP, Solution Engineering, Salesforce

The last 12 months have been a story of organizations finding their feet again as they encounter new challenges and opportunities, such as hyper automation, hybrid experiences, distributed environments, and an explosion of data. In the coming year, business and IT teams will need to embrace the challenges of this reality by finding new and more sustainable ways to deliver the rapid change that organizations, employees, and customers have come to expect. To drive collaborative innovation, companies should look to a strategy that combines integration, API management, and automation to enable the composable business and increase the speed of work.

2022 will be a year of composability, where organizations increasingly shift to agile architectures that enable both business and IT teams to harness digital capabilities more effectively and accelerate customer and employee experiences to a whole new level. Empower IT teams to deliver composable services, API products, and bots at scale for the entire organization. Empower business teams to automate integrations to common systems without code, by leveraging IT's reusable assets, support, and governance. Automate repetitive and manual tasks with reusable and composable bots that can intelligently process documents, enter data, or take action on the user's behalf, all without code.

## Low-code platforms are effective bulwarks against business disruption

▼ **Sumeet Mathur,** VP & Head- India Development Center, ServiceNow

The adoption and development of low-code platforms will meet demands for hybrid workstyles and allow teams to operate smarter and faster. This is better for employees and better for business. In this experience-focused era of work, employees' natural desire for low-friction experiences will empower them to build and adopt low-code apps that simplify and streamline their work lives. Low-code platforms put the tools of process innovation in the hands of the people closest to the problems. With the power of low code development, organizations can launch formalized citizen developer programs to heighten productivity and give employees the space to experiment. We will also see more firms introduce low-code development guardrails such as platform-level security and access controls that combine enterprise-level scalability with enterprise-level security and compliance.

## No-code platforms will be crucial for Composability, Hyper Automation

▼ **Gautam Nimmagadda,** Founder & CEO, Quixy

In turbulent times, businesses that are prepared for digital disruption hold strategic advantage over their competitors. Composability is integral to this preparation and demands democratization of technology by adopting no-code platforms and building business-IT fusion teams - to shift focus from technical APIs to business capabilities. Organizations must look to optimize their use of AI also. For example - using AI-powered no-code platforms to build decision engines, omni-channel chatbots and intelligent document processing solutions.

Increased emphasis on growth, digitization, and operational excellence have highlighted the critical need for more advanced, widespread automation. Hyper Automation is a business-driven methodology for identifying, validating, and automating as many business and information technology processes as possible. It necessitates the coordinated use of a variety of technologies such as no-code. There are cutting-edge no-code solutions that can hyper automate help desk support, CRM, travel & expense management, loan management, organizational training management, to name a few.

## Web 3.0 will upend the application development approach approach

▼ **Sri Viswanath,** CTO, Atlassian

Over the next 5 years, Web 3.0 will upend the way we think about application development. Where Web 1.0 was the era of internet protocols, Web 2.0 is our current state of applications and generated content. Web 3.0 will rise as a result of the cracks in the current system, which puts user data in the hands of social media giants. Powered by blockchain technology, this new version of the web will usher in a decentralized internet and put data ownership back in the hands of the user. For the industry, it will completely change the way we approach application development and privacy.

## Usage of Blockchain and ML applications will grow across industries

▼ **Raman Sharma,** VP- Product & Programs Marketing, DigitalOcean

Distributed applications enabled by technologies like blockchain and ML are still pretty niche scenarios, limited only to people with deep expertise in these areas. Going forward, we will see more growth in applications like supply chain, healthcare, financial services, and digital commerce taking advantage of these cloud-powered technologies. Storage and PaaS are perfect candidates to take advantage of distributed architectures like blockchain. Similarly, many aspects of cloud management, such as diagnostics, analytics, alerting, or cost optimization can benefit from ML.

## Gear up for Blockchain-as-a-service (BaaS)

▼ **Edul Patel,** Co-founder & CEO, Mudrex

Blockchain technology is constantly evolving and with tech giants such as Microsoft, Facebook, and Amazon delving deep into the blockchain space, this sector is bound to witness a massive growth in coming times. Blockchain-as-a-service (BaaS) is a type of cloud-based service that enables users to develop their own digital products by working with blockchain. These are smart contract applications being developed by Microsoft and Amazon. Several hedge funds and financial institutions are awaiting the development of infrastructure from these tech giants to transact from one blockchain network to another. In other words, blockchain interoperability is the ability to share data and other information across multiple blockchain systems as well as networks. It is known as blockchain interoperability that allows users to see and access the data across different blockchain networks.

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## Satellite internet networks, crypto wallets will be potential targets of exploits

▼ **Rajesh Maurya,** Regional VP- India & SAARC, Fortinet

Attacks will continue to span the entire attack surface, leaving IT teams scrambling to cover every possible avenue of attack. This will be incredibly challenging because the attack surface will simultaneously be expanding as organizations transition to more hybrid environments and workspaces, adopt more AI and ML-based technologies, develop new connectivity options, and deploy additional business-critical applications and devices into the cloud.

We expect to see new exploits targeting satellite internet networks over the next year. Satellite base stations serve as the entry point to the satellite network, essentially connecting everyone, everywhere—including cybercriminals to their targets—so this is where a lot of threats will be lurking. At the smaller end of the scale, we also expect to see an increase in digital theft by attackers targeting crypto wallets. While banks have largely been able to fend off attacks targeting wire transfers using encryption and multi-factor authentication, many digital wallets sit unprotected on laptops and smartphones.

## Business of data exfiltration and extortion will grow

▼ **Mike Sentonas,** CTO, CrowdStrike

We're seeing an entire underground economy being built around the business of data exfiltration and extortion. Data-shaming websites are popping up like street-corner storefronts, providing a hub for ransomware groups to post and auction stolen data that's being held ransom. These ransomware groups are revamping their entire infrastructure of tactics, techniques and procedures

to hone in on more effectively exfiltrating and selling stolen data. Even if the threat actors can't get their ransomware to execute past the encryption stage, they'll pivot and find other ways to gain access to the data to sell for a profit anyway. This year we spoke about the rise of the double extortion ransomware model where adversaries demand one ransom for the return of data and another to ensure that data is not leaked or sold. This double extortion ransom model will grow in sophistication in 2022.

Numerous high profile software supply chain attacks have brought this low-hanging attack vector to greater prominence this year. They've exposed supply chain vulnerabilities and presented opportunities for adversaries to exploit. Greater focus needs to be placed on vetting the security posture of suppliers otherwise these attacks will continue to grow in 2022.

## APIs will be the biggest attack surface targeted by criminals

▼ **Dr Robert Blumofe,** Executive VP & CTO, Akamai Technologies

The growth of APIs in all aspects of business, coupled with a lack of visibility into the attacks they face means that criminals can compromise organizations far easier and for far longer than better understood targets. Far too many organizations lack anything but the most basic visibility into their own APIs. In 2022, we will see criminals target this attack surface more regularly, and organizations will need to adjust their security posture to reduce these vulnerabilities.

Ransomware is the new face of organized crime, and in 2022 we will see these types of attacks get worse before they get better. Previously, cyber crime was dominated by two types of criminals: the hacktivists, who were fairly unsophisticated and easy to protect against; and the nation states, who were very sophisticated and pretty much impossible to defend against. Now we've moved into an era dominated by financial motivation. While law enforcement is accelerating their efforts to combat ransomware, it is a problem that can't be solved overnight.

## API security will be a top priority for the digital banks

▼ **Sean Duca,** VP & Regional CSO, APAC & Japan, Palo Alto Networks

The APAC region is in the midst of a digital banking revolution, with at least two new digital banks expected to emerge in every market by 2025. While digital banking brings greater convenience and accessibility, it is not without potential risks. With the rise of open banking and fintech growth in the region, poor programming done at the Application Programming Interface (API) level can have serious repercussions as APIs are the glue that holds most digital apps and software together. Any security misconfigurations in APIs can be exploited as an entryway for cybercriminals to gain access to personal data, manipulate transactions, or shut down a key service.

Financial institutions need to integrate security into all stages of the software delivery process and ensure they have visibility on their entire API ecosystem. This approach, also known as DevSecOps or 'shift left' security, ensures that software is tested for security problems before it goes public, allowing IT teams to plan for any security issues that might

appear after deployment. In addition, organizations should implement API security to their inventory and assess the security of external-facing APIs. Monitoring and addressing any anomalous activities within API interactions is also vital.

## Zero Trust and Micro-Segmentation adoption will grow

▼ **Shakeel Khan,** Regional Director, India & SAARC, ColorTokens

2022 will compel security teams to plug the security gaps left behind by the accelerated pace of digital. While 2020 gave a major impetus to the need for a Zero Trust security model, large-scale ransomware attacks across 2021 led to businesses starting to consider implementation.

As security needs become complex and InfoSec teams work towards implementing a new security model while balancing daily operations – micro-segmentation will come in handy. Micro-segmentation aims to make security as granular as possible. By isolating segments within a network and creating 'trust zones', it helps monitor end-to-end traffic and deploy specific policies for sensitive environments. Most importantly, micro-segmentation can help overworked IT teams, bringing more security with less effort. Micro-segmentation can be applied not just to networks, but also to applications, and even individual servers, devices, endpoints, and workloads.

## Passwords are passé; gear up for identity-based authentication

▼ **Mike Engle,** CSO, 1Kosmos

There are several emerging trends regarding digital identity and how it applies to secure, trusted services. Individuals (both employees and consumers) will be able to enroll their citizen, bank and telco identity attributes into their own digital wallet, allowing for a trusted way to engage with third parties without usernames and passwords. This is happening both globally and locally. Consortiums are forming to create these trust networks and governments are moving much faster than they typically do to work with technology providers to enable these new services. The net result will be a reduction in fraud, a better user experience, and a more decentralized layer that breaks our dependencies on the technology incumbents.

## Nation-State threat actors will be quieter in 2022

▼ **Daniel Spicer,** CSO, Ivanti

While nation state-backed threat actors won't stop their operations, we should expect 2022 to be a quieter year. A lot of tools and techniques have been exposed in the past year- many operations by espionage organizations that prefer to remain quiet and in the shadows were brought into the spotlight in 2020-21. So nation-state threat actors will spend additional time

updating kits and refining techniques. Changes in cybersecurity policies and requirements will require nation-state operators to further adjust their toolkits to evade new minimum requirements. Plus, most of the world does not have a major election cycle next year. However, by the end of 2022 or early in 2023, we should expect to see a continuation of larger scale operations targeting the weakest links in the chain. And we likely will see more attacks targeting managed service providers (who provide IT and security services to companies) as opposed to going after companies directly.

Ultimately, most attacks are the result of poor cyber hygiene. Finding ways to automate cyber hygiene will become increasingly important, especially as environments continue to get more complicated. This includes leveraging a combination of risk-based vulnerability prioritization and automated patch intelligence to identify and prioritize vulnerability weaknesses and then accelerate remediation. If an organization can automate all the processes that constitute cyber hygiene, then the security team can deal with bigger issues.

## Zero Trust will drive further innovation in security tech

▼ **Gautam Rege,** Co-founder & Director, Josh Software

2022 will focus towards zero trust security, which adds an additional layer of authentication and authorization over existing security protocols. It is critical that the concept of BYOD be implemented across industries so that access to sensitive information from microservices based applications in orchestrated environments is not only authenticated but also authorized. SSL, short lived certificates, MTLS continue to be a key part of the security puzzle to ensure secure access from authenticated devices by authorized personnel. In fact, there are solutions in the market that allow mobiles and tablets to register for zero trust security to ensure a VPN free but completely secure access to critical systems. The next wave of security tech is already here, and innovations like these are what will propel it forward!

## SOAR is set to emerge as a great equalizer

▼ **Akshat Jain,** Co-founder & CTO, Cyware

Cybersecurity has become a board-level concern for organizations as the number and sophistication of security breaches is rising every year. As cyber threats continue to pose greater operational challenges and cybersecurity teams tend to mature their SecOps workflows, they will also focus on streamlining and decluttering their internal processes. Security Orchestration, Automation, and Response (SOAR) will emerge as a great equalizer in the coming year for organizations to further boost the integration of their security stack and the pace of their SecOps to respond to threats proactively.

As the expanse of the technology infrastructure of organizations keeps growing, the entities

which are part of the hardware and software supply chains behind it are also becoming a prominent gateway for cybercriminals to launch destructive attacks. This threat of supply chain attacks is poised to grow further in 2022. The coming year will witness a continuation of some of the prominent cybercrime trends as well as a spur in the adoption of new technological and operational approaches to curb critical threats.

## Audio deepfakes will be utilized in spear-phishing assaults

▼ **Jakub Kroustek,** Malware Research Director, Avast

In 2021, frequency of ransomware assaults and the amount of ransom demanded have progressively increased. It is likely that instances of worldwide ransomware attacks will continue to increase in 2022 as more assaults on essential infrastructure, such as aviation will occur. According to Avast researchers, cybercriminals delivering ransomware as a service (RaaS) will strengthen affiliate models to better target enterprises, including adding Linux-specific ransomware, greater rewards and extending extortion layers. We also foresee continued use of crypto-mining malware, cryptocurrency-related frauds and malware targeting cryptocurrency wallets, and thefts from exchanges in 2022, as Bitcoin reaches a new all-time high.  With network security setups being inadequately implemented and the continuing work from home trend will leave the company's doors exposed to cybercriminals. Companies are particularly vulnerable to cybercrime when their VPNs are poorly configured, especially if they lack two-factor authentication. Audio deepfakes will be utilized in spear-phishing assaults, going as far as being used by criminals to impersonate a senior executive or other employee to persuade someone to allow them access to sensitive data or a company network.

## Adoption of Predictive AI in cyber security is likely to grow

▼ **Apu Pavithran,** CEO & founder of Hexnode (Mitsogo)

Increased adoption of Zero Trust Network Access (ZTNA) is something we could expect, slowly moving away from VPNs to a more tunneled approach for accessing sensitive information. They help secure private and cloud resources and help minimize third-party risks. The rising popularity of IoT and the connectivity across all systems and devices requires us to look more into IoT security. The device security in most of these systems is still in its infancy and requires better management to protect against threats. The interconnectivity of devices and the number of IoT devices will reach much higher once the 5G network is in everyday use. With increased innovations in AI and automation over the years, we can witness higher adoption of Predictive AI in cyber security. As a result, many more organizations utilize pattern recognizing AI to monitor and detect threats in the traffic, compare anomalous network behavior and even detect Zero-day threats in real-time, helping reduce response time against bad actors. With innovations like these coming along, we will be able to pave a much more secure and safe way in the world of device security and enterprise security.

## Attackers will look for new ways to compromise open source libraries

▼ **Rohan Vaidya,** Regional Director- India, CyberArk

In 2021, we have observed early glimpses of evolving attacker innovation, each with the potential to significantly alter the cybersecurity landscape over the next 12 months. Digital economy runs on open source software (OSS) - it's flexible, scalable and harnesses collective community power to spark new innovations. But countless open and free OSS libraries also mean a dramatically expanded attack surface and a way for threat actors to automate their efforts, sidestep detection and do more harm. In 2022 we can expect attackers to continue looking for new ways to compromise open source libraries. Organizations, therefore must remain observant, as these subtle attacks will rarely send up signals, making them extremely difficult to spot- especially because such libraries are deployed into the pipeline as part of legitimate day-to-day operations, and in many cases, may look benign as the malicious code is downloaded as a dependency. Since these automated attacks are easy and quick to execute with a very limited signature, they will become even more frequent, sudden and damaging.

## The new world of work will usher in a new era of social engineering

▼ **Nathan Wenzler,** Chief Security Strategist, Tenable

While threat actors have historically leveraged large-scale events like the Super Bowl or Tax Day to launch attacks on unsuspecting, distracted users, 2021 has changed the playing field. Now, remote work has become the perfect ongoing distraction for attackers to build social engineering attack campaigns around. After all, only one-third of remote workers strictly follow their organization's security guidelines, and remote workers have an average of eight devices connecting to their home network, creating plenty of targets of opportunity for attackers to take advantage of. As we look ahead to 2022, threat actors will continue to take advantage of the opportunities that lie within this new world of work, setting their sights on compromising any device in the home network to get to the crown jewels on the corporate network. All it takes is one employee falling victim to a single, well-crafted social engineering stunt, which makes end users the perfect target for today's adversaries who are aiming for access to corporate networks, databases and other valuable assets.

## Increased focus will be on securing the Edge

▼ **Dhananjay Ganjoo,** MD, F5, India

As digitization continues to take the center stage, processing of the data generated is being pushed closer to the users and to the edge network. As organizations use the edge to play a more significant role in their application architecture, we will see an increased risk with expanded attack

surface. In the coming years, attackers will capitalize on seams in the edge by targeting a) Quantum of sites and devices, b) Gaps introduced in application and network security controls with manual implementation across sites, c) Lack of observability and central management.

There needs to be an increased focus on addressing the edge security challenges proactively. The tenets for securing this transformed compute must include secured communications with sites, uniform security policy enforcement, automation and cross site observability. Uniform enforcement of adaptive controls from the edge, to the cloud and at the data centres will help solve challenges the distributed applications face.

## Cloud-native threats will continue to grow further

▼ **Sanjay Manohar,** MD, McAfee Enterprise India

As remote work models shift to 'hybrid work' models, organizations have stepped up the use of cloud-based collaborative tools for enhanced flexibility, but often with inadequate protection measures. This has vastly increased the risk of sensitive data getting compromised. As organizations build cyber resilience in an increasingly sophisticated threat landscape, cloud compliance and security will rise in prominence. Having said that, the coming year will still remain challenging in terms of cloud security. According to recent research by McAfee Enterprise and FireEye, the top three cyber risks of 2022 that are the most threatening to businesses in India will continue to be malware attacks, data breaches, and cloud jacking.

As an increasing number of corporate operations move to Cloud, it will be imperative for them to not only dedicate resources to advanced cloud security technology but also adopt a zero-trust approach to their cyber defenses, which will provide an effective cover against wide-ranging cloud-native threats while ensuring organizational security and a consistent user experience.

## AI, video analytics will transform security and surveillance systems

▼ **Sandesh Kaup,** Country Manager, Milestone Systems, India & SAARC

Video security is essentially a combination of camera audio feeds, sensor data with intelligent video analytics, that can initiate immediate responses in case of emergencies. AI can significantly improve surveillance and monitoring while reducing the amount of raw data generated in the process. From anomaly detection and alert generation to facial recognition and real-time search of objects in specific time, AI integrated video solutions have been a boon to the security industry. It can also be used in many ways; from automatic vehicle detection and license plate recognition to people counting, all made available on an open, unified video management platform. This technology drastically impacts automating real-time analytics and decision making, enabling security systems to operate with higher efficiencies. We expect more comprehensive use cases for AI integrated video management systems to surface in the future such as facial recognition, real-time search and even behavior calculations that can provide early warning alerts to potential incidents.

# 35 Years of Technology

March 2022 - Collector's Edition

Visionaries, Industry leaders & influencers coming together to write about the nostalgic view & expert's insights of 35 years of IT landscape in India.

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# Connected Operations will bring in B2C level standards in B2B operations

▼ **Dev Ramchandani,** Sr. Director- Management Consulting, Smart Manufacturing, Hitachi Vantara

The Indian Manufacturing sector is a key growth driver and with the thrust on 'Make in India', it is expected to create 100 million jobs by 2022 along with establishing India as a 'Global Manufacturing Hub'. With on-going focus on operational excellence, manufacturers are always looking for innovative solutions to disrupt the status-quo.

In the existing Industry 4.0 era, some of the key trends which will help manufacturers in this journey will be: a) A continued shift towards 'Connected Operations' to bring in B2C level standards (e.g. status visibility, quality traceability, customer experience, dynamic supply chain management) in B2B operations; b) Leveraging AI/ML for handling inherent 4M (Man, Machine, Material & Method) variability and taking operational excellence to the next level (e.g. SKU-wise line speed optimization, cost optimization); c) Increasing the leverage of video analytics and using it in tandem with IoT and system data for better addressal of use cases across safety, quality and delivery; d) Shift towards low code/no code solutions to enhance direct involvement of functional team members to drive operational excellence enabled by digital; e) Thrust on end-to-end data monetization through innovative business models and ecosystem partnerships.

## The future of Industry is Intelligent and it is here now

▼ **Vikas Kumar,** VP, Capgemini Invent India

The COVID-19 pandemic has exposed vulnerabilities within organizations, putting pressure not only on production and distribution of products and services but also on design and engineering. Products, processes, services, operating models, and even business models are all undergoing a transformation. We call this new era of transformation 'Intelligent Industry': The next generation of digital transformation. It is about fostering synergies between the digital and engineering spheres to help companies build intelligent products, operations, and services, at scale. Intelligent Industry is helping organizations improve their operations and unleash innovation, thereby crafting a profitable and sustainable path forward. From the pipette to the airplane engine, anything can become 'intelligent'. Using state-of-the-art sensors that facilitate augmented control and data acquisition, robots on a production line will be able to communicate with each other and adapt the production process in real time, depending on maintenance requirements, market developments, or customer demand. While climate-change concerns and regulatory pressures are forcing organizations to change, the rise of digital technologies is bringing the physical and digital worlds together, creating an ocean of opportunity.

## Emerging tech poised to take on a much larger role in manufacturing

▼ **Sekaran Letchumanan,** VP- Operations, Flex India

Emerging technologies have completely reimagined the factory floors in the manufacturing industry. They improve quality, lower risks, and reduce costs while adopting sustainable practices. As a global manufacturing and supply chain solutions company, we deploy and use advanced manufacturing systems and technologies and have ensured that we have in place a solid digital foundation. We have deployed the Digital Twin model which has advanced simulation capabilities and uses 3D modeling as well as AR/VR to build real-time, digital models of processes and physical entities. Using Digital Twin applications, we can build a digital representation of a proposed production line to experiment with different processes and configurations to make sure it works as planned before installing it physically.

Bringing in 3D printing during manufacturing could help in the effortless customization of products and reduce the production cost. The fabrication of parts on demand minimizes lead times and reduces the need for a large inventory. Over the coming years, we will witness emerging technologies take on a much larger role in manufacturing.

## Adoption of IoT-backed comprehensive solutions will become more feasible

▼ **Rushendra Babu,** CTO, Utthunga Technologies

Manufacturing has been implementing IoT as an integral part of digital transformation in recent years, and this trend will continue. IoT-backed comprehensive solutions for Asset Performance Management, Reliability Centered Management, etc. are becoming more and more feasible, enabling increased adoption of secure and open standards based systems integration, digitization of logbooks, edge device management, digital twins deployment, ML models deployment and system simulation.

The demand for Systems Integration and Digitization will continue to grow based on technologies like OPC and MQTT, but will not be limited to them. Edges are invariably part of these solutions. Consequently, edge device management solutions will become imperative to handle the provisioning and maintenance of edge devices, enabling data flow in a reliable and secure manner to upstream value-add systems.

On the other hand, the understanding of capabilities and limitations of Digital Twins and ML Models is maturing, and consequently, deployment strategies and expectations are being recalibrated. The adoption of Digital Twins and ML Models will naturally lead to an increased popularity of system simulation as it becomes essential for comprehensive validation of the Digital Twins and Machine Learning Models.

## Embracing industry 4.0 for greater resilience and agility

▼ **Shashank Agarwal,** MD, Salasar Techno Engineering

Over the past year, manufacturing firms have faced unprecedented disruption. The COVID-19 crisis has resulted in disruption of supply chain and transformed consumer behavior. For manufacturers, the pandemic has revealed weaknesses across their end-to-end activities—and highlighted the need for greater resilience and agility which can be addressed by embracing industry 4.0.

I think manufacturing is in the midst of another Industrial revolution being brought about by the advent of new age technologies such as AI, 5G, edge to cloud computing and more. With this transformation we expect the automation and decentralization of production processes. The next digitalization era is here. It unleashes infinite new possibilities for industries and governments that dream of building a more agile, resilient and sustainable future. The possibilities are endless, imagine being able to re-design your physical operations in real time, optimizing for efficiency, productivity and safety, then put it all into action with the click of a button.

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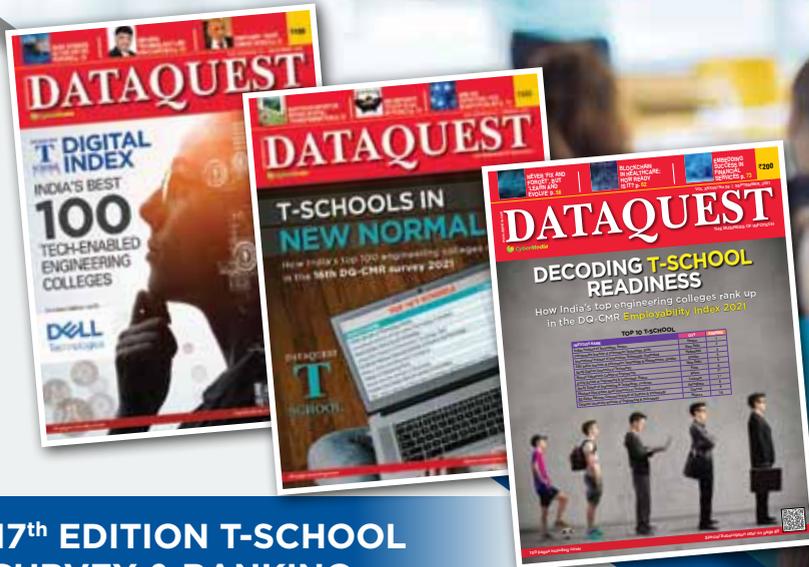


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## Get ready for Internet of Vehicles

▼ **Dr Rishi Mohan Bhatnagar,** President, Aeris Communications

IoT has emerged as a key technology that has changed the model of interaction between intelligent solutions and other objects, including the way we travel. Moving forward, the Internet of Vehicles (IoV) is expected to become the future of the EV industry with a network of vehicles communicating with each other and other intelligent devices like the mobile phones, traffic systems for real-time updates and more.

With the integration of IoT, users will have the ability to remotely monitor and even access their vehicles. IoT can help users show real-time updates of vehicle location, secure park, stolen vehicle detection, remote door locking, etc. Service and fleet operators will be able to leverage IoT solutions and embrace proactive management and operational efficiencies, while maintaining an edge over competitors.

IoT-enabled servers at EV charging stations will help EV charging operators understand real-time load, forecast details on their charging stations to further manage and minimize the overall time taken to charge the vehicles. It will guide drivers to quickly find nearby charging point operators leading to shorter search time for charging stations and higher customer satisfaction.

## Integrated Modeling, Simulation will transform EV manufacturing

▼ **Shree Harsha,** Director- India Marketing & Communications and Strategic Planning, Dassault Systèmes

The Indian automotive market is seeing a shift towards greener energy especially with EV and fuel cells; but it faces three major challenges i.e. improve battery performance and safety, get new batteries quickly to market and address sustainability. For India to become self-reliant in EV, the entire value chain needs to collaborate to meet the changing performance and form-factor requirements, which is possible only with technology!

Model Based Systems Engineering and Integrated Modeling and Simulation can revolutionize how EVs are made here and Frugal engineering practices like Virtual Twin can reduce the overall cost of the battery development. Digital simulations can help companies test new ideas in collaboration with stakeholders and regulators, and validate battery pack design against critical performance and safety requirements, creating realistic test conditions by modeling the pack as part of the vehicle's architecture. Predictive models of electric current densities and Li-ion diffusion can optimize performance across different cell designs and in-service performance can be improved by modeling and assessing the impact of manufacturing techniques on residual stresses and strains.

## EVs will be enabled with smart and connected technology

▼ **Jyotiranjan,** Co-founder, REVOS

EV Adoption in India has taken a boost in recent years with more new players entering the market and the government defining the right policies to support the adoption. The next decade will see EVs being enabled with smart, safe and connected technology and with charging infrastructure expanding rapidly it will further boost the adoption-making battery swapping solutions obsolete in the coming future and adding to demand for fast-charging solutions for 2 and 3-wheelers EVs.

## Digital cores will be key to thriving in the new normal

▼ **Dr Yogesh Bhatia,** CEO, LML

Undeniably, 2021 was a challenging year for manufacturers, OEMs, and suppliers. As we look ahead to 2022 to absorb and react to the various COVID-related strikes, some projections appear to be fair bets. While 2022 is expected to offer more of the issues that have plagued automakers in the last year, there will also be some new surprises. The new coins of the

realm are resilience, agility, adaptability, and collaboration. Digital 'cores' that are highly agile and versatile can provide a solid platform for thriving in a continually disturbed world.

## Digital Twins poised to bring radical change in the automotive industry

▼ **Neil Unadkat,** CTO, Intangles Lab

The automobile landscape is adapting to constricting emissions regulations by virtue of advanced mechatronics. The serviceability and performance of the drive-by-wire automobile entails real-time tracking of data from sensors integrated in the powertrain. With this kind of complexity, the need of the hour is a technology that aggregates, processes, and analyzes all vehicular data in real-time to bring in the right kind of insights into its performance, as well as possible failures. In this regard, the Digital Twin emerges as the technology to watch for in 2022 and beyond.

Through the seamless convergence of physical and virtual versions of vehicular components, the digital twin has the power to bring a radical change in the automotive industry. Early adopters of this technology will definitely reap superior long-term gains. Through data and feedback, both simulated and real, a digital twin can develop autonomy to learn from and reason about its environment, thereby helping businesses make informed decisions. Digital twins also enable operators in the automotive industry to understand potential sources of failure, thus allowing them to conduct preventive and proactive maintenance of their vehicles.

## Innovations and investment in eco-friendly solutions for EVs will increase

▼ **Mayur Misra,** Director & CEO, Corrit Electric

2022 is anticipated to be huge for the EV sector. We expect increased adoption of EVs backed by innovation and technology, especially with the Government pushing for cleaner alternatives in the auto sector. From an industry standpoint, we hope to see an acceleration in the installation of charging stations in public places and parking lots all over the country. Furthermore, this could have a domino effect on financial institutes to extend support for consumers and brands with upfront payments and easy loan terms. The Indian Government has been advocating reduced dependence on fossil fuels. We expect the government to further extend the current subsidies schemes and a new policy to register low speed EVs. Taking into account the recent announcements made by the government, charging stations infrastructure is expected to see a huge up-curve with multiple swapping stations in metro cities to begin with. Thus, we hope to see an increased chunk of next year's budget being allocated towards encouraging brands to innovate and invest in eco-friendly solutions, especially in industries that generate the most harmful waste and impact overall environmental goals. India will be resilient in 2022, and I expect the registration of electric vehicles, especially 2-wheelers, to increase many folds with buy-back and leasing options coming into foray as well.

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# The future is in offering customers a truly personalized shopping experience

▼ **Utkarsh B,** Chief Architect, Flipkart

e-commerce has changed the way customers shop and technology has played an imperative role in transforming users' online shopping experiences. The past year saw an increased dependence of customers on online shopping channels as they opted for safer and convenient delivery options. The future is in offering customers a truly personalized shopping experience in the entire value chain, from search to after-sales support. AI-based personalization will enable users to have the most relevant and fulfilling e-commerce journey by tailoring their experience based on their preferences.

India is a heterogeneous market, and one solution doesn't fit all. Also, Bharat or the next 500 million users who are coming online have varied preferences and showcase unique needs. We need technology that is scalable, affordable and inclusive to solve for the real Bharat. Part of this is innovating in the voice and vernacular spaces, allowing online shoppers to interact with the platform in their own language and enabling voice commands across languages. While data science is playing a critical role in shaping the user journey and transforming merchandising itself, a combination of tech innovations including the high-end computer processing, AI/ML, natural language processing is also solving for connecting India's remotest places with seamless delivery.

These innovations will take e-commerce deeper to more customers. We believe that the year 2022 will see a continuation of this trend to make e-commerce more inclusive and accessible for Indian consumers.

# Empowering retail workforce with technology, mobility, and real-time data

## ▼ Rohit Kaila, VP- Engineering, Walmart Global Tech India

The idea of 'digital' has provided retailers with a better and deeper understanding of customer wants, desires, and priorities, which has helped pivot the paradigm of retail from product-centricity to customer-centricity. A key trend that is impacting the retail industry is empowering the workforce with technology and real-time data. Using new technology and mobile apps, store associates will be able to better assist customers and make dynamic decisions based on information about the store, products and offers in real-time. They can reply to customers at any time or any location in the store, thanks to the mobility, which eliminates the need for them to return to their kiosks for every request. It also allows them to cross-sell new products, keep track of store layouts, and upsell fast-moving items to keep customers interested. For example, Walmart has a new app for retail associates called that lets associates perform everything from digitally logging in, to assisting customers with product searches and answering queries in real-time. In addition our associates have access to Voice Assistant, which was designed using ML techniques, to save time from performing accounting and backroom activities.

# Delivering seamless Phygital Shopping experiences

## ▼ Rajnish Gupta, VP & Head- India & Subcontinent Business, Zebra Technologies

A new era of retail innovation has arrived. Millennial and Gen X shoppers today live in a reality where the physical and digital retail domains are merged, and they expect seamless 'phygital' experiences. And COVID-19 has only accelerated this trend towards a seamless omnichannel experience. Shoppers are constantly looking for alternatives to in-store shopping or simply wanting to make the experience more convenient and intuitive. Retailers need to be equipped with the right technology to cope with such heightened shoppers' expectations, as they are being propelled into a new reality.

According to a Zebra study, 70pc of the shoppers agree they have a better shopping experience when store associates assist them with the latest technology. Yet, the shopping experience extends far beyond the four walls of the retail store. Channels have converged as shoppers begin their journeys online, in-store or both. Up to 92pc of the retailers agree that more shoppers are using more mobile ordering today. Shoppers now go to e-commerce or mobile platforms to purchase almost everything and pick it up or have it delivered within hours.

## Enabling Live Commerce, Co-shopping and RTE will be top priorities

▼ **Ranga Jagannath,** Director-Growth, Agora

While retailers have transitioned to online platforms, the priority in 2022 will be to elevate the online experience to avoid customer loss and enhance brand loyalty. With the right engagement platforms, live video capabilities, and personalized experiences, online retailers can create meaningful experiences that increase engagement, brand awareness, customer loyalty, and sales. As technology evolves and more people look at meaningful interactions, marketers will have to focus on bridging the gap between real and virtual worlds to create innovative engagement and enhance customer experiences.

Live commerce enhances e-commerce with live streaming video events, combining the personal help of in-store shopping experiences with online convenience. Globally, live e-commerce has taken over and is on route to becoming mainstream.

Real-Time Engagement (RTE) is leveraging voice and video capabilities to build connections and enhance experiences in the virtual world. Retailers can personalize the experience for their audience by offering direct purchase channels, enabling comments, using one-on-one video chat, and more. The application of AI for data anonymization will be a key next step towards the future of online shopping.

Co-shopping is an evolving concept but offers fascinating possibilities for group shopping experiences. It will enable multiple users to conduct real-time online shopping collaboratively from different locations. Shoppers and collaborators can view the same product online and offer comments and suggestions as if they are shopping together in real-time.

## e-commerce will spend big on immersive and interactive shopping

▼ **Kanav Singla,** Founder & CEO, Adloid

According to recent studies conducted globally, personalized AR experiences on e-commerce significantly impact the complete sales funnel, reducing the bounce rates by 30-40pc, increasing the purchasing propensity of customers by 51pc, and boosting conversion by 2-3x. With higher engagement and conversion possibilities on their platforms through AR, e-commerce brands are now looking to spend big on digital technologies and advertisement to add value to their businesses and therefore, AR will be a tech trend to watch in 2022. Through AR, customers can now augment a virtual replica of the real-sized product in their physical space.

With metaverse gaining popularity, retail and e-commerce brands are increasingly looking to move from digital to virtual, in order to provide immersive and interactive shopping experiences to their customers. The companies are implementing new digital tools such as virtual showrooms, virtual try-on, and 3D configurator to drive better engagement and conversions, as they help boost customer's confidence on the product before buying.

## Democratization of retail intelligence will benefit mid-size companies

▼ **Rohit Khetan,** Head- Marketing & Strategy, Ginesys

The retail landscape will continue to evolve at a rapid pace in 2022. Post pandemic challenges and opportunities will be technology-driven with a deeper and real-time understanding of consumer trends and demand.

Digitization has led to an increase in demand for integration of offline retail stores, online web stores and channels for a better omnichannel experience. Another trend we foresee is the gradual democratization of retail intelligence to benefit mid-size companies. Businesses are using AI to drive customer behavior at scale leveraging digital footprints. This includes using interest and social media footprints to subtly push customers to try certain products/webstores. Industry data suggests that marketers will see an average increase of 10-20pc in sales when using personalized experiences. Self-checkout is also going to be a much-implemented feature across mid to large stores as costs to deploy this technology gradually reduce. Digital payments across retail formats like UPI are now at around 10pc of retail transactions and only growing. Combined with credit cards, this is set to eclipse cash as the payment system of choice.

## Live video shopping, dark stores are shaping future of retail

▼ **Dilli Babu Nandarapu,** Founder & CEO, ShopConnect

The retail landscape in India has seen a major transformation in the last one year and it will continue to evolve. Retailers that succeed in bridging the gap between offline and online commerce will have an added advantage to sell to the consumers. The future will clearly be more digitalized, personalized, and connected, hence agility, personalization, innovation, and a viable business model will be crucial for any retailer. Moreover, retail leaders should watch out for key technology trends that will shape the future of retail in 2022.

Video-enabled commerce, for example, has a lot of potential to influence choices and attract next generation consumers. It will play a key role to personalize the shopping experiences of consumers. Most importantly, through dark stores, shopping will become a consumable activity like for instance, live video shopping from home, video shop parties, live streaming shopping, AR/VR experience to replace touch-and-feel, etc.

Stores of the future that use disruptive technologies like smart applications, video analytics and robotics, AR/VR, drone delivery, etc. will require adequate network capability or bandwidth and 5G can act as a game changer, if used effectively.

## Making customers' online journey smoother will be a key priority

▼ **Vimal Sharma,** Founder & CEO, Smoor

As a retail D2C organization, we see a lot of innovations and trends on UI/UX for websites to make the customer online journey smoother. New features and add-ons that help online retailers like us get improved conversion and bill size. At the backend, newer sophisticated tools to measure and improve our performance too.

Tools that deploy data science and AI that help our back-end production and logistics team to meet the customers needs. Supply chain and logistics also play a very important role as it helps us ensure products reach customers in the right state (our products being chocolates and cakes which are not just temperature sensitive but also delicate).

Further ensuring timely auto updates to make the customer experience superlative. An ERP system helps with our production team to meet the demand while our logistics team is supported with technology that helps us optimize our fleet and share live rider location updates with the customer at the time of delivery.

## Powering predictive shopping with AI, ML, and predictive analytics

▼ **Anjna Bhati,** Director, Data Analytics & AI, BluePi

The Retail sector has been quite successful in leveraging new age technologies. Free deliveries, multiple payment modes, unlimited catalogs, easy returns, same day delivery, rural outreach and omni-channel platforms are driving the new trends in retail with technology playing a key role.

Many young shoppers value an experience and do a thorough research before making a purchase.  In 2022, the demand for immersive experiences will grow significantly. VR, AR and XR technologies will provide virtual trial rooms, try-on clothes besides other customization options to provide the best possible customer experience.

Predictive analytics, besides AI and ML technologies that deliver customer insights to enable retailers to understand and cater to the former's needs, will be used for Predictive Shopping. Customer Data Platforms will be sought after by brands to get a single-360-degree view of prospective customers.  These platforms will provide enhanced visibility of the customer journey which can be leveraged to develop targeted marketing campaigns and messaging that helps to in future gain customer loyalty as well. Hyper-personalization, where every customer is made to feel special, will become the marketing mantra of retail brands. AI, Big Data, ML and Analytics will support in creating personalized experiences.

## Tapping women and non-urban consumers will be key focus for brands

▼ **Vasuta Agarwal,** MD, APAC, InMobi

As we see the Great India mobile economy exponentially grow, there are a few key consumer and marketing trends that brands need to look out for.

Since the pandemic, one of the most critical shifts has been how women have emerged as the new mobile gamer (accounting for 43pc of all mobile gamers) and online video viewer demographic. Brands must take note of this and invest in mobile gaming/ video advertising as one of the primary channels for reaching connected women consumers in India.

India, with 799 million internet users is home to the second largest internet user base in the world, preceded only by China. From a 15pc internet penetration in 2015, to 32pc in 2020, non-urban Indians are coming online fast. The mobile-led penetration and adoption of the internet in rural areas will blur the divide between urban and rural areas in almost all aspects. And as this ever-growing Indian digitalization story unfolds, all eyes will be on the non-urban connected consumer.

Brands that do not build mobile marketing maturity will be left behind competition and more importantly, will fail to keep pace with the connected consumer. Brands will focus on leveraging programmatic buying, video, gaming advertising, and data-driven personalization on mobile in 2022.

## Hyper-personalization will be a game changer for AdTech

▼ **Charles Yong Jien Foong,** Architect & Technology Officer, Affle

2020-21 was a defining period for mobile advertising. As the world goes back to normalcy,

one thing is for certain: mobile user engagements are on an accelerated growth momentum.

Hyper-personalization is the game changer within the AdTech industry. This marketing trend will aid in providing targeted experiences with the help of technologies including data analytics, AI and ML. Algorithmic advances in AI like deep-learning came at the right time for mobile advertising and are immensely capable of capturing complex non-intuitive patterns across numerous touchpoints.

The future of AdTech has moved towards making the spends consumer-focused rather than media-focused. The consumer is present across multiple channels and what the advertiser wants is to reach out to the consumer across online and offline channels to drive incremental engagements at the right time, right channel, right content and the right price.

## Data privacy will be the top priority for mobile marketing community

▼ **Aditya Maheshwari,** Head- Customer Success, AppsFlyer

Apple's App Tracking Transparency (ATT) update in 2021 has brought a considerable shift in the app marketing ecosystem, resulting in the revaluation of strategies by the mobile marketing community to make data privacy the topmost priority. With limited access to granular, user-level data, marketers are now leveraging aggregated data for the decision-making of their campaigns. Further, this aggregated data coupled with a top-down approach can help extract intuitive and comprehensive insights more straightforwardly. Another way to address the challenges of the ATT update will be ML-led probabilistic modeling. It will help measure in-app campaign performances without compromising on privacy. Hence, only organizations that aim to adapt to a privacy-by-design architecture built on consumer choice, transparency, and control, will be able to seamlessly establish themselves in the evolved mobile marketing ecosystem, while the rest will perish.

## First-party data becoming crucial for marketers

▼ **Taranjeet Singh,** MD, SEA & India, Criteo

2022 would be the year for marketers to further focus on audience-first advertising and utilize customary advertising solutions while achieving the addressable media future. Brands and marketers have continuously observed over the previous two years that consumers have been more responsive to increasing ad consumption on various apps and platforms, particularly in the video format. The pandemic has significantly altered consumer behavior in terms of streaming videos across all age groups. The same behavior will prevail in 2022 due to the escalation in screen time and will likewise influence how consumers receive and engage with the advertisement. We can anticipate

that video advertising will continue to evolve and be a substantial and efficient medium for audience-first advertising, targeting and engaging the right audience for delivering brand key messaging while providing measurable results.

With respect to the future of addressability, marketers and media owners are becoming increasingly aware that first-party data is more crucial than ever, and there is also tech tax which is the data and revenue loss from working with several partners whose methodologies don't always align. Technologies that help them connect, enrich, and activate first-party data using privacy-by-design measures will continue to attract the interest of the market.

## Embracing first-party data strategy for the cookieless future

▼ **Projjol Banerjea,** Co-founder & CPO, Zeotap

For many marketers, the unification of multiple data sources into a single customer view or 'golden record' remains a challenge. However, Zeotap research revealed that, of the 20pc of marketers who currently lack such a record, 99pc of them will have achieved it by the end of 2022. This acceleration comes in part as a result of Google's deprecation of third-party cookies in 2023- with the removal of this key pillar of addressability, marketers have been forced to quickly compensate with a strong first-party data strategy, of which a single customer view is the foundation. More successful marketers have already begun making the shift to Customer Data Platforms (CDPs). Meanwhile, Data Management Platform (DMP) usage decreases as marketing success increases. This shows that successful  marketers have already started migrating toward solutions that enable them to leverage their first-party datasets ahead of a cookieless future.

## MarTech investments will grow significantly

▼ **Mihir Karkare,** EVP, Mirum India

Mirum India report throws up some interesting trends in the area of MarTech, in the coming year. One key insight is the rise of a group of organizations we are calling MarTech Heroes – these organizations are already heavily invested in MarTech and will continue to significantly increase their investments in 2022 and beyond. In the next 12 months, organizations say, that they will invest in the technologies like 'Marketing Analytics, Performance and Attribution' (53pc of respondents say they will invest), 'CDP' (47pc say they will invest) and 'Ecommerce platforms' (47pc say they will invest). What will they expect to get out of these investments? Brand Building, Brand Loyalty and Lead Generation top the list of objectives that these organizations have.

We believe that this surge in investments into MarTech is a trend that everybody needs to watch out for – including the organizations themselves, service providers who can help these organizations as well as professionals – who need to upskill themselves rapidly to adapt to this changing landscape.
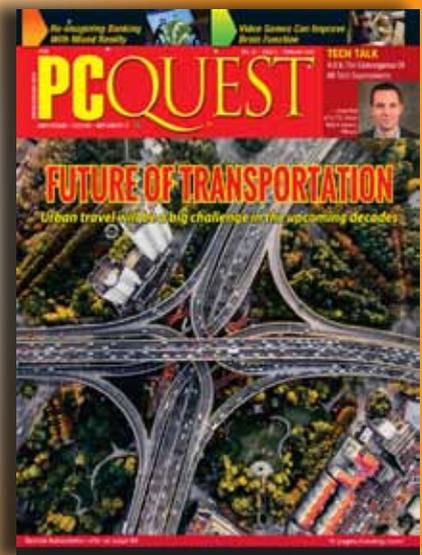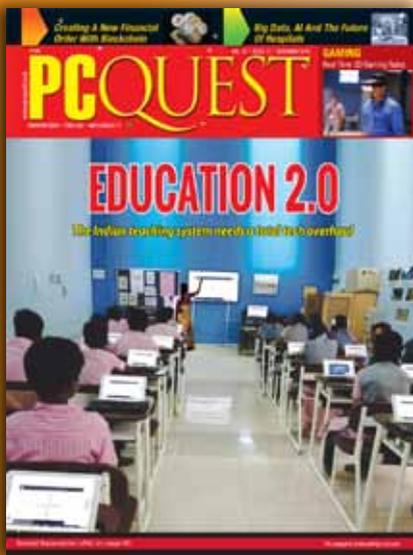
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## Focus will be on continuous learning and upskilling

▼ **Krishna Kumar,** Co-founder & CEO, Simplilearn

The edtech space has been fast evolving with continuous developments, especially over the past year and a half. This shall continue in the months to come, given the parallel advancement of technology and digital integration in business transformation. Some of the factors that will change the future of learning in 2022 include the growth of outcome-based learning, increased investment in continuous learning, increased gamification providing high quality e-learning content and micro-learning with the use of bite-sized learning molecules with small, specific bursts of content.

These evolved learning patterns will be complemented by changing workplace trends, driving advancement in the edtech space. Some trends that will further boom with the Workforce 2.0 include employee interests in short-term, contractual and part-time employment; growth of the youth workforce as the leadership landscape continues to undergo a revolution. Flexibility and hybrid workplaces will be the new normal leading to increased use of technology and design on a regular basis by both businesses and employees. Most importantly, continuous learning and location agnostic upskilling will see increased interest among learners, as aspirants look to improve their skill sets and adapt to the rapidly growing digital landscape.

## Tech skills have become the new currency

▼ **Irwin Anand,** MD, Udemy India

The pandemic proved to be a game-changer for all of us. Businesses have seen a lot of changes in the way they work and function. Owing to the physical restrictions brought forth by COVID-19, the use of technology in our day-to-day lives has become dominant. Be it studying online, working remotely, or even having birthday parties, everything has shifted towards digitization. Fast-forward 20 months and, today, tech skills have become the new currency. As many workplaces continue to be remote or hybrid and agility dominates our new world of work, it is becoming increasingly significant to upskill oneself in new-age technology to keep at par with others. As per Ranga Karanam, one of our top-rated technology instructors, we expect an increased pace in adoption of AI, data engineering and the cloud in 2022. Also, since many offices will continue a remote or hybrid model of work, there will also be a continued reliance on tools like Teams and Zoom across sectors.

## Adapting skills and learning to a VUCA world

▼ **Om Narayan Rai,** Head- Enterprise Business Solutions & Academia Relations, Mytat

The ongoing pandemic has accelerated not only the need to identify technology-based innovative products and solutions to tide over disruptions and create a relevant system to weather similar challenges going forward. It has also forced the human race to look at technology not as a mere enabler, but as an extension of their being. However, this understanding's implications have gone beyond the efficiencies, as its impact is at social, mental, physical and even relationship levels, of course, business is not at all in this picture. Some of the insights that have emerged out of this need-gap situation include a focus on understanding the human ecosystem in this VUCA world, along with future skills, critical thinking, collaborative, interpersonal and problem-solving skill sets. Today data-driven solutions and digitization across India's education landscape are ensuring that the workforce is equipped with the requisite skill sets of tomorrow. Technologies like AI, ML, AR, VR enable a more immersive learning experience and assist them in becoming aware of the HOST (Human Oriented Strategy of Technology) and industry-ready. I believe that the HOST mindset with technology will play a critical role in developing new learning methods, innovative thinking and promoting an entrepreneurial mindset in the post pandemic classroom.

## Virtual admissions, virtual internships will be the new norm

▼ **Shashank Shwet,** Founder & CEO, ImaginXP

Tech has enabled work from home, now virtual internship would be the new norm in 2022. Students from across colleges will use the work from home phenomenon to do virtual internships across product companies. With the lack of trained talent this would be a new norm.

Admissions is the first traditional process that will get disrupted in 2022. A virtual tour of the university, a walkthrough of classrooms, hostels and labs and a combined virtual admission process will be the stepping stone towards metaverse. A virtual education counseling mela hosted by us saw 50K students and parents participating.

Blockchain and NFT will play an important role in edtech. Content creators will be able to mine blockchain cryptocurrency by listing down expert videos for NFTs. In fact a marketplace of professional experts, uploading videos and images in return for NFT would be a new thought process. Content creators will be paid on the number of content that they create. Welcome to education in the metaverse!

## Transformation of education in Tier-2 and 3 cities will be a key focus

▼ **Anil Nagar,** Founder & CEO, Adda247

The online education sector has grown tremendously during the COVID pandemic. The lockdown has enabled various educational institutions, professionals, students and parents to embrace technology to advance the learning process. There has also been a considerable shift in the mindset of people that has led to an increased acceptance of online mode of learning. At present, We see a rise in students, parents and educators inclination towards online education instead of traditional school-bound education.

In the next few months, the rise of digitized training, AI/ML-based tools, gamification of education along with tools customized for India's Tier-2 and 3 cities is set to invite further investment at a global scale. By leveraging the AI technology, digital assistants can help manage entire classrooms in an optimum manner. AI-powered chatbots can also help in improving the overall communication and tutoring through the infusion of next-gen technologies.

## Tech will be key in collaborative content creation

▼ **Pawas Tyagi,** Co-founder, Edustoke

Offline education delivery, which was forced to go online because of a pandemic, would see hybrid learning as the new normal. Most institutions, after having invested time,

effort, and resources in online models, and having seen efficiencies from it, would strive to find use cases to exploit this to enhance learner experience. Schools and educational bodies conducting tests and assessments would look at ways of enhancing tech integration to increase efficiency, ensure transparency and speed of delivery.

New education policy will begin to disrupt current curriculum practices and classrooms would see enhanced tech integration. SaaS products for education providers shall continue to see robust demand. VR and AR would start to embed themselves in mainstream education content. We see increased opportunities for tech to make School and K-12 specific applications to displace force-fitted video platforms like Google Meet, Zoom, and MS Teams. Edtech/Schooltech would enhance its reach to encapsulate safety, security as well as help and hygiene aspects of learning and learning spaces.

We would also begin to see more substantive tech-enabled collaborative content creation and democratization of delivery. Individual teachers would have the opportunity to overshadow large institutions. Home schooling options will show green shoots.

## Hybrid campus model will be preferred

▼ **Sabari Girish Parampoor,** CTO, CollPoll

In 2022, most institutions strategically would not want to go back to a 100pc offline mode, and will continue to support online services for at least some of the modules like admissions, classes, examinations etc. Institutions will look to use technology to simplify and automate campus operations, in addition to optimizing the running costs. In these uncertain times, the focus will be on supporting a hybrid campus model while being fully prepared to run and manage a 100pc digital campus, should such a situation arise.

Investments in technology and transformation will continue, aimed towards modernizing education delivery and offering flexibility to students. Data and AI will play a key role in providing product differentiations, especially focused on student success, towards both personal and career goals. Personalized learning catering to specific needs of each student will be one of the use cases. The industry will see increased experimentation with AR, VR for creating engaging content, though more suitable for some disciplines (medicine, engineering, etc.) than others. As digital education gains wider acceptance, institutes will turn to solutions that help them stay compliant and protect their data.

## Cohort based classes, collaborative learning will grow popular

▼ **Himanshu Periwal,** Co-founder, unlu

In 2022, creative skills in edtech will see the highest growth rate as it addresses a huge latent gap of over 50M potential learners. More celebrities and industry experts will get into the learning domain as edtech platforms will start making it self-serve and easy for them to become instructors. The collaboration economy will see a hockey stick growth, where

learners will collaborate with each other on projects and content creation. In times to come, the entire ecosystem will power learning to collaborate to monetization for creators and will hold better chances to take pole position in the creator edtech space.

I feel cohort based classes will take over the one-to-one learning model as firstly it offers a sense of classroom and community based learning to the student, and secondly it offers economies of scale to edtech players too. AI-based personalization in learning will take the center stage, the learning requirement of every student is different, hence AI will make it possible to customize and personalize the learning for students. Lastly, VR and AR in learning will continue to grow and become more mainstream, especially getting a boost through the metaverse being built by top tech conglomerates.

## AI, Big Data, gamification will be used to improve learning curve analytics

▼ **Sumit Gupta,** Co-founder & CTO, GetWork

In this rapidly changing world, one has to learn every day both on a personal and professional front. Technology offers a plethora of applications that aid in education, learning and development, and many other aspects of the education sector. Edtech companies will emerge that help individuals to be updated with the latest trends and technologies.

As most of the classes are online, there is an undying need of learning management systems to automate, personalize, track the overall learning curve of a student/or a group. E-Learning is generating a huge amount of data about student interest, behavior, interactions. Valuable information can be extracted from these data which will improve the learning process of students. As the abundance of material/content available to study, AI will come into play to personalize and assist the users for relevant materials using automated processes, chatbots, voice assistants. In the traditional education system, students are always the passive observer. Introduction of AR/VR is changing the role of students from a mere observer to an active participant. To keep students focused and engaged during online classes, gamification is a must, leveraging storytelling, problem solving techniques.

## Focus will be on mobile and gamified learning

▼ **Janishar Ali,** CEO, Curious Jr

Mobile devices are going to be the next growth driver in the education sector. They provide accessibility, are highly portable, and access to the internet via cellular tower is much easier. The new generation is building behavior with the gaming industry or social media as the foundation of their experiences around mobile phones. Higher bandwidth and more stable connectivity will bring education to more remote areas.

People from all over the world will come together as creators of a

learning ecosystem. The four major stakeholders whose behavior would be re-learned would be the kids or the learners, the parents, the teachers, and the institutes. For kids, more practice-oriented learning that is gamified would be the norm or go-to strategy for any edtech product. Whatever theories or concepts they are taught must be applied in some sense, which would be triggered or delivered by the technology. Schools and institutions would need more practice frameworks and the gamification tools that would be working for the edtech industry to also be incorporated into the offline campus.

## Hybrid and AI-driven learnings are on the rise

▼ **Rajesh Bysani,** CPO, Brainly

The last 18 months have shed light on the numerous merits of virtual learning, and students have adapted seamlessly to online learning platforms. Online learning is here to stay even in the post-pandemic era. In such a scenario, as schools adopt hybrid learning models for the foreseeable future, they will also look at adopting online learning platforms, offering wider learning opportunities to children. The year 2022 will likely witness further progress in the AI-driven learning segment as more parents and students start looking for instant and technologically advanced solutions. For instance, we have seen an AI-powered 24/7 tool that assists users with finding solutions for the most complex mathematical problems has been gaining steady traction since its inception in early 2021.

## Innovative use of of tech will transform online learning and assessments

▼ **Puneet K,** President, The Narayana Group of Institutions

There has been rapid adoption of edtech applications and tools over the last two years. We will witness further innovation, refinement, and penetration of them in the edtech space.

We will see a rise in the use of online education materials to complement offline teaching. This will be in the form of additional practice, curated assignments that teachers can set their pupils to enhance their learning. Plug and play learning management systems will be adopted across the education spectrum to achieve the same. There is likely to be massive innovation in gamifying learning content especially in the K-5 space. Gamification will be used to reinforce concepts , provide immediate feedback and course correct from mistakes at a younger age. There will be increasing adoption of immersive content as these technologies become more accessible and affordable.

Online tests combined with data analytics can pinpoint gaps in students' conceptual learning and application. We are likely to see a rise in online exams at the level of class tests and formative assessments which will provide insightful analytics on a student's strengths and weaknesses. During the pandemic, there was rapid innovation in the exam proctoring space. AI-enabled facial recognition, movement recognition, authentication, auditing, and

other tools may lead to an increase in remote testing for a variety of entrance exams reducing logistical burdens for candidates to travel to exam centres far away from their home.

## Conventional counseling models are getting a digital makeover

▼ **Paridhi Khaitan,** MD, ProTeen

Today, career guidance platforms leverage cutting-edge technology and predictive algorithms backed by science to help students plan their career paths right from the comfort of their homes. Conventional counseling models are getting a digital makeover through online platforms and gamification techniques. Gamification offers a fresh approach to established assessment tests, and lifts career exploration to a new level. Standardized tests now leverage gamification elements to provide a fun, engaging and a more effective experience. With advancements in AI/ML, personalized reports are possible which leads to mapping skill sets, personalities, and capabilities to the wide range of careers now available. Using simulations of real 21st-century careers, and immersing themselves in fun role-plays and career demos, modern-day students have the privilege of previewing a career, and seeing their ideal career fit before choosing a path forward. These techniques have enabled digital career counseling by offering students immersive, textured, and comprehensive guidance in a virtual yet life-like setting.

## Higher education institutions will embrace Blockchain, chatbots

▼ **Brijesh Kohli,** Director, Xebia Academy

Higher education institutions should start focusing on the changing trends and start adapting to new technologies.

Till date, chatbots are only used as a part of customer care or for quick help. A higher education institution may get thousands of queries from prospective students. Chatbots can be used by these institutions to address the queries regarding scholarships, education loans, admission process, admission criteria-related queries, or fee-related queries, thus eliminating human intervention altogether.

Blockchain provides great collaboration and secure data exchange opportunities for organizations, as well as individuals. Sharing of student data between universities for a semester exchange, course exchange, student transfer, data exchange for scholarship with authority and student academic data sharing with companies for recruitment are instances where blockchain is useful. The security protocols followed in blockchain are unique and are difficult to hack. In the digital age, this has become one of the mandatory changes that should be adopted by all higher education institutions to avoid spamming of student data. Digital storage of academic information and accessibility to it for authenticated users would restrict its accessibility and, thus, maintain its safety with the help of blockchain technology.

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# 35 years of Data Storage:
# A peek into the evolution

**Ashok Pandey**
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The oldest known form of data storage is dated back to 1725 - the punch card, created by Basile Bouchon. The paper punch card was used to store patterns rather than actual data. And now we are storing digital data on various devices and virtual clouds.

## Types of storage:

**Direct Attached Storage (DAS)** – Storage devices that are physically connected to the PC, such as Hard Drives, Solid-State Drives (SSD), CD/DVD Drives, Flash Drives, etc.

**Network Attached Storage (NAS)** – Multiple machines sharing single storage over a network.

**Cloud Storage** – Complete cloud-based or online storage solutions that offer virtual data storage and convenient access from anywhere.

The first hard disk drive (HDD) was introduced in 1956 by IBM, as part of the IBM 305 RAMAC (Random Access Method of Accounting and Control) system



## 1987



*The Conner CP344 HDD, a later version of the CP340A*

The Conner CP340A was introduced in the 3$\frac{1}{2}$-inch HDD form factor



Digital Audio Tape (DAT or R-DAT) is a signal recording and playback medium introduced by Sony

## 1988



*RAID1 (1989) - Sun 4/280 WS,128 MB DRAM, 4 dual-string SCSI controllers, 28 5.25-inch SCSI disks with disk mirroring software*

David Patterson, Garth Gibson, and Randy Katz of U.C. Berkeley presented a paper claiming that an array of multiple inexpensive disks intended for PC applications could outperform single, large expensive mainframe drives



PrairieTek, founded by Terry Johnson, introduced the 20 MB 2.5-inch drive

## 1990

The Magneto-Optical Disc (MOD) introduced by IBM that used both magnetic and optical methods. A MOD disc can be 3.5 inches or 5.25 inches in size, and disk capacities are usually one of 128MB/230MB /540MB/640MB/1.3GB/2.6GB



*"Sawmill" disk drive cutaway*

## 1991



Sony and Hewlett Packard defined the Digital Data Storage (DDS) format for storing and backing up computer data on magnetic tape that evolved from Digital Audio Tape (DAT) technology, which was originally created for CD-quality audio recording

## 1992





*Sony MZ1- The first MiniDisc player with MiniDisc*

A prototype solid state disk (SSD) module is made for evaluation by IBM. SanDisk, which at time was known as SunDisk, manufactured the module which used non-volatile memory chips to replace the spinning disks of a hard disk drive

A MiniDisc (MD) is a disc-based data storage device for storing any kind of data, usually audio- was targeted as a replacement for analogue cassette tapes as the recording system for Hi-Fi equipment

## 1993



The Digital Equipment Corporation invented the Digital Linear Tape (DLT), purchased by Quantum Corporation in 1994. DLT is a de facto standard for magnetic tape technology used for computer data storage

## 1994





CompactFlash drive- a solid state device that uses flash memory is less susceptible to data corruption than disk drives because there are not any moving parts. It was quickly adopted and became the preferred memory storage option in many consumer as well as professional electronic devices

The Iomega Zip Disk introduced with the initial Zip system allowed 100 MB storage, but ramped up to 2GB in the later versions. Like hard disks but unlike other floppies, ZIP drives used a non-contact read/write head that 'flew' above the surface. The Zip system also introduced media access protection via a password

## 1995



The Digital Video Disc (DVD) format is introduced with huge storage capacity over the compact disc (CD). DVDs came in both read-only and read-write formats, and were widely adopted in the film industry for consumer releases of movies



SmartMedia is a flash memory card standard owned by Toshiba that was launched to compete with Intel's unsuccessful MiniCard and SanDisk's wildly successful CompactFlash format. SmartMedia cards were created for portable devices such as digital cameras

Matsushita Electric Industrial developed Phase-change Dual (or Phase-change Disc), a rewritable optical disc with a capacity of 650 MB on one side. The phase change recording technology using red laser light was adopted, and about 500,000 times of rewriting was possible



## 1997



The Compact Disc-ReWritable (CD-RW) was introduced that could be re-written roughly 1,000 times



The Multimedia Card (MMC), a flash memory memory card, unveiled by Siemens and SanDisk based on Toshiba's NAND-based flash memory

## 1998

A removable memory card format Memory Stick launched by Sony that is used as storage media for a portable device, in a form that can easily be removed for access by a PC

## 1999



IBM releases the Microdrive, 1-inch drive in 170 MB and 340 MB capacities. At the time of their introduction, they were the smallest hard drives in the world. Like all hard drives, Microdrives were mechanical and contained small, spinning disk platters. Hitachi purchased IBM's hard disk division in 2002

## 2000
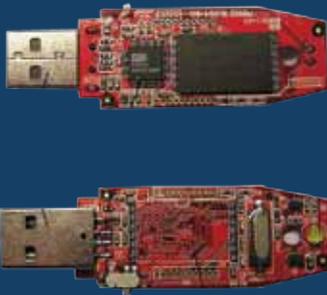


USB Flash drives consist of flash memory encased in a small form factor container with a USB interface

## 2003

Blu-ray Disc (BD) is a next-generation optical disc format meant for high definition video (HD) and high density data storage. One single-layer BD can hold about 25 GB or over two hours of HD video plus audio, and the dual-layer disc can hold approximately 50 GB



## 2006



The first all web-based data storage system was PersonaLink Services, launched by AT¢T in 1994. Amazon Web Services launched AWS S3 starting the new trend toward massive cloud data storage

## 2007

**Dropbox, founded by Arash Ferdowsi and Drew Houston, was designed as a cloud-based service used for convenient storage and access to files** ▶

**Dropbox**

☁ **OneDrive**
▲
Initially known as Windows Live Folders (codenamed as SkyDrive) was renamed later as Windows Live SkyDrive. In 2013, 'SkyDrive' was renamed as 'OneDrive'

▲
Hitachi Global Storage Technologies announces the first 1 TB hard disk drive (HDD) using five 3.5-inch 200 GB platters and rotated at 7,200 RPM

## 2009

Cloud-based network-attached storage solutions announced for online backup. They were designed for small and medium sized businesses in addition to general consumers ▶

## 2010

Google launched its second major cloud service, Cloud Storage, making its entry into the IaaS market

◀ **Microsoft Azure**

Microsoft first unveiled its plans to introduce Windows Azure in 2008, leading to its commercial launch in early 2010 to offer developers tools for simpler management of data and file storage. By early 2014, it was rebranded as Microsoft Azure

**2011**



## iCloud

Apple started iCloud storage. iCloud replaced Apple's MobileMe service, acting as a data syncing center for email, contacts, calendars, bookmarks, notes, reminders (to-do lists), iWork documents, photos, and other data

**2012**

**Google launched its new Drive feature-cloud-based storage workspace** ▶



## Google Drive

**2013**





To store huge amounts of digital data, HGST (now Western Digital) shipped the Ultrastar He6, a 3.5-inch, 7200 rpm drive offering 6 TB capacity. The drives are filled with Helium instead of air that greatly reduces the power consumed and heat generated and also improves track-following

The first NVMe drive, Samsung's XS1715 enterprise drive was announced supporting 3 GB/s read speeds

## 2015



Samsung announced mass production of the industry's first NVMe PCIe SSD with M.2 form factor

## 2019



HGST introduced 14 TB and 15 TB Shingled Magnetic Recording (SMR) drives



At the 2019 CES, Seagate showcased HAMR technology, demonstrating successful read/write tasks using an "Exos" drive

## DID YOU KNOW ?

## Superman Memory Crystal

Remember the memory crystals in the 'Superman' movies? Researchers in the UK have developed a way of storing digital data inside tiny structures contained in glass. In 2013, University of Southampton and Eindhoven University of Technology scientists developed something similar -the 5D optical storage technology, a nanostructured glass for permanently recording digital data using a femtosecond laser writing process.



*Image source: Arch Mission Foundation*

The memory crystal is capable of storing up to 360 TB worth of data for billions of years. Since 2018 the technology is in production use by the Arch Mission Foundation. The first and second discs were given to Elon Musk: one disc is in his personal library, and the other was placed aboard the Tesla Roadster in space.

# Top gadgets to look forward to in 2022

**Ashok Pandey**
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It's all about the galaxy of gadgets; 2022 is here, and with it comes a host of new gadgets. What are they? What cool features do they have? Check out our list of gadgets to expect in 2022

**P**ast two years, the pandemic has locked us inside our homes, but we are hoping for a great year ahead. We all are welcoming the new year 2022, and with the new year, a host of new gadgets are ready to hit the market. From Smartphones to VR glasses and from laptops to robots, all the gadgets are poised to make our lives healthier, more efficient, and more sustainable than ever.

# Smartphone



Without being too hyperbolic, I can say that since smartphones hit the market, we have seen humongous development in the industry. The smartphone companies keep developing exciting models and amazing camera capabilities and other features to keep the momentum going.

The pandemic impacted most of the industries, and the smartphone industry was no exception. Yet, we witnessed the launch of exciting smartphones like foldable display, 108MP camera, etc. The year 2022 is expected to have a more powerful phone to keep the momentum going.

We all are expecting new models from major manufacturers like Apple, Samsung, OnePlus, etc. and there are plenty of rumours already, here are some of the upcoming phones we're particularly excited about.

## Apple iPhone 14 Max

So till now, Apple is relying on its 12MP sensor, but if rumours are right then the next flagship would get a higher resolution 48MP camera. According to analyst Ming-Chi Kuo, Apple plans to add a 48MP camera lens to the next iPhone.

The 48MP sensors still output 12MP images after pixel-binning but allow more data to be gathered for computational photography. Apple might also introduce another widely used smartphone tech, the periscope lens. The iPhone 14 Pro and Pro Max models are also rumoured to have hole-punch displays and in-display fingerprint readers.

## Apple iPhone SE 5G

The affordable Apple iPhone SE is expected to get an update in 2022- a new design, camera, and chipset. According to a recent report from ITHome, the third generation of iPhone SE will be entering the trial production phase soon. It would look much like its predecessor featuring a

4.7-inch Retina HD LCD display, and the fingerprint sensor would be embedded inside the Home Button. The next iPhone SE would be powered by the A15 Bionic paired with an external X60M 5G baseband chip, bringing 5G support onboard.

## Google Pixel 6a

The upcoming phone from Google is the Pixel 6a. It is expected to hit the Indian market as well. A recent report claimed that the phone will be powered by the Google Tensor GS101 SoC. An alleged dummy unit of the Pixel 6a also leaked, revealing a design that shares the same design language as its elder brothers. The Pixel 6a will feature a 6.2-inch flat OLED display with a single centred punch-hole camera and an in-display fingerprint scanner.

## Samsung Galaxy S22 Ultra

LetsGoDigital leaked an official poster of the Galaxy S22 Ultra that shows that it will adopt a camera bump similar to the previous Galaxy S21 lineup. Also, the new device will be supporting the S Pen.

The flagship 'Ultra' series is expected to pack in the latest Snapdragon and Exynos hardware, some cool accessories and a new camera setup. And perhaps India might get the Qualcomm Snapdragon variants of the Galaxy S22 models.

## Samsung Galaxy S21 FE

Samsung is likely to launch its upcoming smartphone - Galaxy S21 FE - on January 11, 2022. The date on the image could be the launch date of the device, though no official confirmation. If we go with the rumours, and images, the smartphone will be supporting 5G and likely to come in 6GB RAM + 128GB storage and 8GB RAM + 256GB storage choices. It would house a 6.41-inch AMOLED FHD+ 120Hz display, a 32MP selfie camera and a 12MP (main with OIS) + 12MP (ultrawide) + 8MP (telephoto) triple camera unit. Depending on the region, the S21 FE will ship with the Snapdragon 888 or Exynos 2100.

## OnePlus 10 Pro

OnePlus founder Pete Lau has confirmed that its next OnePlus 10 Pro flagship smartphone will arrive in January. The next-gen phone will be powered with Qualcomm's new Snapdragon 8 Gen1 chipset. According to rumours, it will have an improved 32MP selfie camera, 6.7-inch LPTO QHD+ AMOLED display with 120Hz refresh rate and will feature 12GB of LPDDR5 Ram and either 128GB or 256GB of storage. The primary camera would have a triple camera system consisting of a similar setup as the 9 Pro with a 48MP main camera, 50MP ultrawide, and an 8MP 3.3X telephoto camera.

## Xiaomi 12

The Xiaomi 12 will be the next premium smartphone from the company. Xiaomi is planning to unveil the Xiaomi 12 series on December 28, consisting of vanilla and a Pro model. Xiaomi also released a teaser revealing centred punch hole displays on both smartphones.

The next premium phone would get a high-precision screen with outstanding color accuracy, 16,000-level brightness adjustment, and Gorilla Glass Victus on top. Xiaomi has already confirmed that the Xiaomi 12 series will be powered by the Snapdragon 8 Gen 1 SoC. Xiaomi 12 is going to have a 50MP primary camera, an ultra-wide-angle camera and a telephoto camera.

# Laptop



Choosing a perfect companion that can handle all your computing needs isn't easy. The market is flooded with numerous options, yet one can easily get confused. To raise the challenge, laptop manufacturers have some plans to launch new lightweight, portable yet more powerful laptops.

But before we take a look at the expected future laptops, let me introduce you to the Framework laptops. This laptop could slot in whatever four ports you might need for the work or play, including microSD card reader, HDMI port, storage expansion and more. Depending upon the business need, the framework laptop offers a custom expansion. According to a Tom's Guide story, some enterprising fans have already designed custom expansion cards like an RFID reader.

Not only slot expansion, but Framework also has the DIY Edition laptop as well. The only high-end laptop that can be customized



**Image Source: Framework**

and assembled by yourself from a kit of modules. This only 15.85mm thin and 1.3kg lightweight laptop delivers the modularity of a desktop in the laptop's form factor.

If I go back in the past, there was a time when only selected configurations of laptops were available, and it was really hard to upgrade them. And now with laptops like Framework, we can think beyond an upgrade. Hope the future will introduce a few more innovations.

## Apple Mac

According to a report, Apple is all set to launch five new Macs in 2022. In these five devices, Apple can include– a high-end iMac, a MacBook Air, an updated Mac mini, an entry-level MacBook Pro and a Mac Pro with Apple silicon.

The new entry-level MacBook Pro could contain the same M2 chip as the next-generation MacBook Air, featuring the same number of CPU cores as the M1 chip, up to 10 graphics cores, and improved performance.

Details about the new machine are unclear, according to Bloomberg's Mark Gurman, Apple is developing a "thinner and lighter version of the MacBook Air". Plus a leak from Jon Prosser suggests that this new Mac laptop will come in a variety of colours - just like the 24in iMac.

## Microsoft Surface Laptop 5

Microsoft is going to add a new design element and features to its next Surface laptop. According to rumours, it would get a 120Hz display. Both the upgraded Surface Pro 8 and brand-new Surface Laptop Studio have 120Hz panels but can take advantage of Windows 11's 'Dynamic Refresh Rate' feature to manage battery life.

Surface Laptop 5 would be powered with the new processors, though 11th-gen Intel chips are the latest, but that will change soon as Intel has launched its 12th-gen Alder Lake CPUs for desktops, and is expected to launch laptop processors in the next few months.

## Dell Project Luna

**Image Source: Dell**

As I mentioned earlier about Framework laptops, Dell is also planning to introduce its modular devices. The Dell Project Luna is a concept laptop that lets the user shift the motherboard away from the unit's base and places it behind the display. Dell did this to improve thermals and make it easier to access the motherboard and heatsink for repairs.

This modular laptop gets a removable keyboard as well giving access to the IO board and the battery. Luna's modular parts are accessible by the two 'keystones', detachable panels that cover the screws that hold the keyboard and display in place.

## MSI gaming laptop

MSI is expected to announce upgraded versions of the GE66 and GE76 Raider, along with equivalent GS66 and GS76 Stealth machines at CES 2022. The four laptops will arrive with a choice of the Core i7-12700K and Core i9-12900HK, 14-core processors split between 6 performance and 8 efficiency cores. Hence, the Core i7-12700K and Core i9-12900HK should offer 20 threads, albeit with different CPU clock speeds.
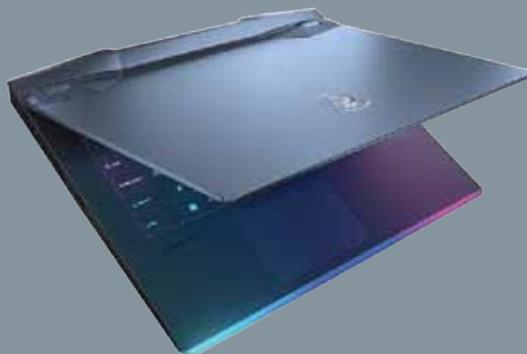
# Smart TV



Ever since smart TVs were announced, entertainment has gone to the next level. The next-gen smart TVs will come with abilities to control your home appliances as well. So you won't only watch TV, actually, it will help to create a connected home.

We are expecting to see some amazing tech innovations with CES 2022 just around the corner. The year 2022 is expected to witness the launch of a bunch of 4K and 8K TVs with some unique designs and display technology.

## Philips OLED 936 TV

Philips is also planning to introduce an OLED936 smart TV with 4K resolution. The TV would have a 4-sided Ambilight feature. The new flagship TV would be equipped with the most advanced technology from Philips.

**Image Source: Samsung**

## Sony QD-OLED TV

Sony is planning to launch QD-OLED TVs in 2022. According to a report from ChosunBiz, Samsung Display will start supplying OD-OLED panels to Sony that will be used for QD-OLED TVs.

No reports have yet mentioned that Sony will launch its QD-OLED models at CES 2022, but it's fair to assume QD-OLED will be a big technology talking point of the next 12 months.

## Samsung 8K TV

Samsung is planning to introduce its 8K TV line-up. According to a report the giant is planning to launch 8K MiniLED and 4K OLED TVs next year. The 8K TV will be the highest among the lineup.

Samsung will be using QD (quantum dot)-OLED manufactured by Samsung Display and W (white)-OLED made by LG Display for these TVs.

Samsung's premium 8K (7680x4320) MiniLED TV will carry the Neo QLED TV brand. Among the 'consumer premium' TVs, the 8K Neo QLED TV will be of the highest tier. This will be followed by 4K (3840x2140) OLED TVs, which will be the second-highest tier among consumer premium TVs.

## LG StanbyME and the LG Objet TVs

**Image Source: LG**

LG showcased its two new unconventional TVs ahead of CES 2022. The LG StanbyME is a 27-inch TV equipped with a battery, can be operated wirelessly and features a height-adjusted stand that you can move around on wheels. On a single charge, this TV can last for up to three hours.

The LG Objet TV is set to lean against a wall, with no stand or wall mount. It features a 65-inch OLED screen with a fabric cover underneath it. Using the remote, the user can raise or lower the cloth. Also, this fabric will come in three interchangeable colors. The TV has an 80W 4.2 channel sound output built-in.

# Top 10 titles releasing in 2022: Are you game?

**Ashok Pandey**
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Some of the biggest games launching in 2022 are the ones we were expecting last year. 2021 was one of the most delay-heavy years in gaming's history, but 2022 is going to witness the launch of numerous exciting games

**Inside: 250+ upcoming games in 2022**

Last year, we were not able to play some of the much-awaited games, which we were expecting to launch in 2021. But they will be available to play on our gaming devices soon. Huge games like Total War: Warhammer 3 and the Elden Ring are going to launch soon. Let's check out the top 10 upcoming games –

## God of War

Kratos now lives as a man and his son has joined him in the realm of Norse Gods and monsters. As a mentor and protector to Atreus, he is forced to deal with and control the rage that has long defined him while out in a very dangerous world with his son. Gamers can play this game on a gorgeous 4K, with all the power inside your PC.
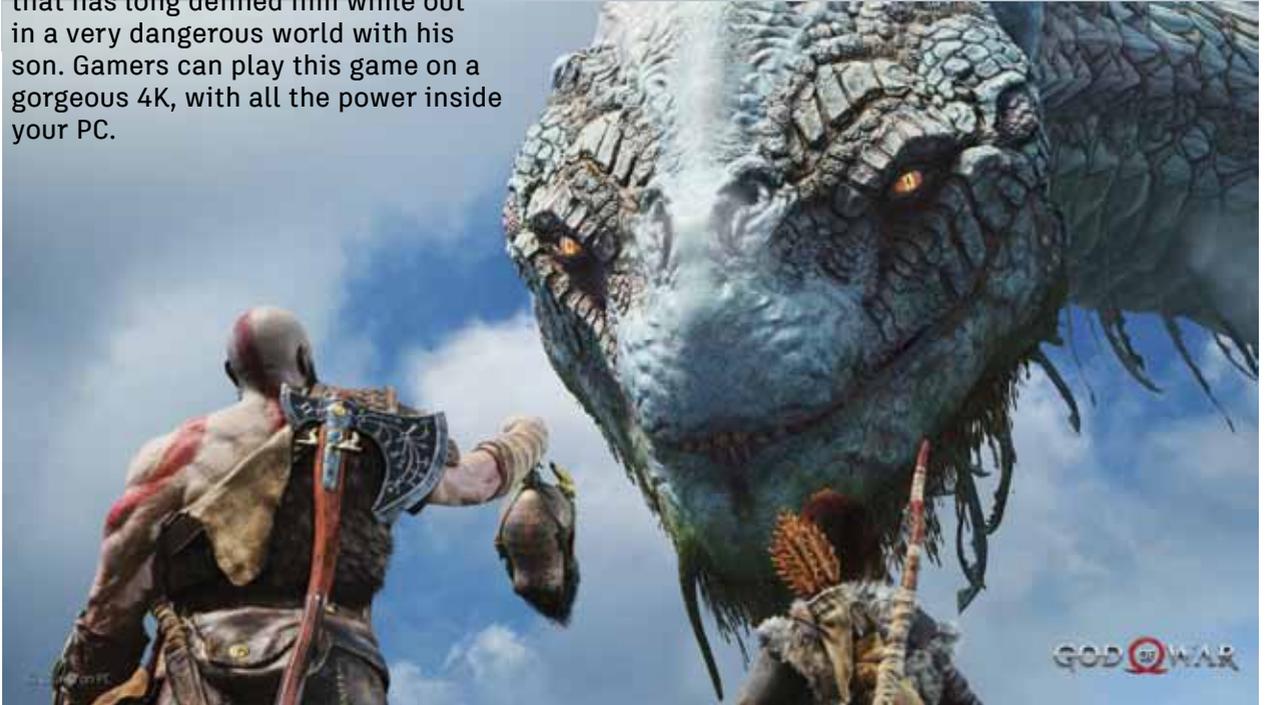


## Final Fantasy VI

The original FINAL FANTASY VI comes to life with completely new graphics and audio. The upcoming game is a remodelled 2D take on the sixth game in the world-renowned FINAL FANTASY series.

## Total War: Warhammer III

In this, the four Ruinous Powers rule over this place, Nurgle, the plague god; Slaanesh, the lord of excess; Tzeentch, the changer of ways; and Khorne, the god of blood and slaughter. Between the worlds, two mighty kingdoms stand sentinel, but each is beset by its own trials, and now both have cause to cross the threshold and send their armies into the Realm of Chaos.



## Elden Ring

In this war world, a variety of situations and huge dungeons with complex and three-dimensional designs are seamlessly connected. Discover the unknown and overwhelming threats. You can customize the appearance of your character, you can freely combine the weapons, armour, and magic that you equip. You can develop your character according to your play style, such as increasing your muscle strength to become a strong warrior, or mastering magic.

## Dying Light 2 Stay Human

After multiple delays, finally the sequel to Techland's zombies and parkour action game is arriving in 2022. To survive in the combat zone, you need skills, as to defeat your enemies and make allies, you'll need both fists and wits. But wherever your actions take you, there's one thing you can never forget—stay human.



## Saints Row

TThe wacky action series is about to reboot with four new young and witty protagonists. A new boss along with you and your four friends launch a criminal empire. Saints Row is set in the fictional city of Santo Ileso, based in the American southwest. The player-character, "The Boss", assembles a new gang from dissatisfied members of these gangs and to seize power from them.

## Starfield

The next generation role play game is set amongst the stars, create any character you want and explore with unparalleled freedom. Starfield is the first new universe in 25 years from Bethesda Game Studios, the award-winning creators of The Elder Scrolls V: Skyrim and Fallout 4.



## Gotham Knights

A new expansive, criminal underworld has swept the streets of Gotham City. Batman is dead, so the Batman Family; Batgirl, Nightwing, Red Hood, and Robin would protect Gotham. These four members of the Bat Family are watching over Gotham in Batman's absence.

https://**FUTURE GAMING**

## Vampire: The Masquerade – Bloodlines 2

You will enter the dark world and rise through vampire society. Choose to be brutal and unflinching or cultured and seductive. Experience Seattle - a city full of alluring, dangerous characters and factions.

## Company of Heroes 3

The game is the ultimate package of action, tactics and strategy. Take charge in the heat of real-time battle, then command as a General guiding the overall campaign where every decision matters.

# 250+ upcoming games in 2022

| Title | Platform(s) |
|---|---|
| .hack//G.U. Last Recode | NS |
| 13 Sentinels: Aegis Rim | NS |
| A Little to the Left | PC |
| A Plague Tale: Requiem | Win, NS, PS5, XSX |
| Abandoned | PS5 |
| Advance Wars 1+2: Re-Boot Camp | NS |
| Aftermath | PlayStation 5, Xbox Series X/S, PlayStation 4, PC |
| AI: The Somnium Files – Nirvana Initiative | Win, NS, PS4, XBO, XSX |
| Alfred Hitchcock – Vertigo | NS, PS4, PS5, XBO, XSX |
| Anno: Mutationem | PlayStation 4, PC |
| Anonymous;Code[b] | NS, PS4 |
| Apex Legends | iOS, Android |
| Arc Raiders | Win, PS5, XSX |
| Arcadegeddon | PlayStation 5, PC |
| Arctic Awakening | Win, Mac, PS4, PS5, XBO, XSX |
| Ark 2 | Win, XSX |
| Ashwalkers | Switch |
| Assetto Corsa Competizione | PS5, XSX |
| Asterigos | PlayStation 5, PlayStation 4, PC |
| Astroneer | NS |
| Atelier Sophie 2: The Alchemist of the Mysterious Dream | Win, NS, PS4 |
| Avatar: Frontiers of Pandora | Win, PS5, XSX, Stadia |
| Aztech Forgotten Gods | PlayStation 5, Xbox Series X/S, PlayStation 4, Xbox One, Switch, PC |
| Aztech: Forgotten Gods | Win, NS, PS4, PS5, XBO, XSX |
| Azure Striker Gunvolt 3 | NS |
| Baby Storm | Switch |
| Babylon's Fall | Win, PS4, PS5 |
| Baldur's Gate III | Win, Mac, Stadia |
| BattleCakes | Xbox One, PC |
| Bayonetta 3 | NS |
| Beacon Pines | Win, NS |
| Bear and Breakfast | Switch, PC |

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| Title | Platform(s) |
|---|---|
| Blazing Strike | Win, NS, PS4, PS5 |
| Blood Bowl 3 | Win, NS, PS4, PS5, XBO, XSX |
| Blossom Tales 2: The Minotaur Prince | Switch, PC |
| Bomb Rush Cyberfunk | Win, NS |
| Boundary | PlayStation 4, PC |
| Card Shark | Win, NS |
| Chaos;Child | NS |
| Chaos;Head Noah | NS |
| Chocobo GP | NS |
| Choo-Choo Charles | PC |
| Circuit Superstars | PlayStation 4 |
| Clash: Artifacts of Chaos | Win, PS4, PS5, XBO, XSX |
| Clive 'N' Wrench | Win, NS |
| Coffee Talk Episode 2: Hibiscus & Butterfly | PlayStation 4, Xbox One, Switch |
| Company of Heroes 3 | Win |
| Convergence: A League of Legends Story | Win, NS, PS4, PS5, XBO, XSX |
| Crossfire: Legion | PC |
| CrossfireX | XBO, XSX |
| Crystar | NS |
| Crystar | NS |
| Cult of the Lamb | PC |
| Cultic | Win, NS, PS4, PS5, XBO, XSX |
| Curse of the Sea Rats | Win, NS, PS4, XBO |
| Cursed to Golf | Switch, PC |
| Cyber Knights: Flashpoint | PC, Mac, Linux, iOS, Android |
| Cyberpunk 2077 | PS5, XSX |
| Dark Deity | NS |
| Dawn of the Monsters | Win, NS, PS4, PS5, XBO, XSX |
| Daymare: 1994 Sandcastle | Win, PS4, PS5, XBO, XSX |
| Dead Space | Win, PS5, XSX |
| Deathverse: Let It Die | PS4, PS5 |
| Deep Rock Galactic | PlayStation 5, PlayStation 4 |
| Demon Gaze Extra | NS, PS4 |
| Demon Throttle | Switch |
| Destiny 2: The Witch Queen | Win, PS4, PS5, XSX |

| Title | Platform(s) |
| --- | --- |
| Destroy All Humans 2: Reprobed | PlayStation 5, Xbox Series X/S, PC |
| Devolver Tumble Time | iOS, Android |
| Diablo Immortal | iOS, Android |
| Digimon Survive | Win, NS, PS4, XBO |
| Dinos Reborn | Win, PS4, PS5, XBO, XSX |
| DNF Duel | PS4, PS5, Win |
| Dolmen | Win, PS4, PS5, XBO, XSX |
| Don't Starve Together | NS |
| Dordogne | Switch, PC |
| Dragon Ball: The Breakers | Win, NS, PS4, XBO |
| Dragon Quest X Offline | Win, NS, PS4, PS5 |
| Dune: Spice Wars | Win |
| Dying Light 2 Stay Human | Win, NS, PS4, PS5, XBO, XSX |
| Dynasty Warriors 9 Empires | PlayStation 5, Xbox Series X/S, PlayStation 4, Xbox One, Switch, PC |
| Dynasty Warriors 9: Empires | Win, NS, PS4, PS5, XBO, XSX |
| EA Sports PGA Tour | Un¬known |
| Earth Defense Force 6 | PS4, PS5 |
| Earthlock 2 | PlayStation 5, Xbox Series X/S, PlayStation 4, Xbox One, PC |
| Earthlock 2 | Win, PS4, PS5, XBO, XSX |
| Echoes of Mana | iOS, Android |
| Edge of Eternity | PlayStation 5, Xbox Series X/S, PlayStation 4, Xbox One |
| eFootball 2022 | PlayStation 5, Xbox Series X/S, PlayStation 4, Xbox One, PC |
| Eiyuden Chronicle: Rising | Win, XSX |
| Elden Ring | Win, PS4, PS5, XBO, XSX |
| ELEX II | Win, PS4, PS5, XBO, XSX |
| Endling | PlayStation 4, Xbox One, Switch, PC |
| Evil Dead: The Game | Win, NS, PS4, PS5, XBO, XSX |
| Evil Dead: The Game | PlayStation 5, Xbox Series X/S, PlayStation 4, Xbox One, Switch, PC |
| Evil West | Win, PS4, PS5, XBO, XSX |
| Eville | PC |
| ExoMecha | Win, XBO, XSX |
| Fall Guys: Ultimate Knockout | Xbox Series X/S, Xbox One, Switch |
| Far: Changing Tides | PlayStation 5, Xbox Series X/S, PlayStation 4, Xbox One, Switch, PC |

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| Title | Platform(s) |
| --- | --- |
| Fashion Police Squad | Win |
| Final Fantasy VII Ever Crisis | iOS, Android |
| Final Fantasy VII: Ever Crisis | iOS, Android |
| Flashback 2 | Win, consoles |
| Forspoken | PS5, Win |
| Freedom Planet 2 | Win |
| Gal Gun: Double Peace | NS |
| Gerda: A Flame in Winter | Win, NS |
| Getsu Fūma Den: Undying Moon | Win, NS |
| GetsuFumaDen: Undying Moon | Switch, PC |
| Ghostwire: Tokyo | Win, PS5 |
| GigaBash | Win, PS4 |
| Gnosia | Win |
| God of War | Win |
| God of War Ragnarök | PS4, PS5 |
| God of War: Ragnarok | PlayStation 5, PlayStation 4 |
| Goodbye Volcano High | Win, PS4, PS5 |
| Gotham Knights | Win, PS4, PS5, XBO, XSX |
| Gran Turismo 7 | PS4, PS5 |
| Granblue Fantasy: Relink | Win, PS4, PS5 |
| Grand Theft Auto Online | PS5, XSX |
| Grand Theft Auto V | PS5, XSX |
| Grand Theft Auto: The Trilogy – The Definitive Edition | iOS, Android |
| Grand Theft Auto: The Trilogy - The Definitive Edition | iOS, Android |
| Graven | Win, NS, PS4, PS5, XBO, XSX |
| Grid Legends | Win, PS4, PS5, XBO, XSX |
| Grime | Switch |
| Grotto | PlayStation 5, Xbox Series X/S, PlayStation 4, Xbox One, Switch |
| Guild Wars 2: End of Dragons | Win |
| Gunfire Reborn | NS, PS4, PS5, XBO, XSX |
| Gungrave G.O.R.E. | Win, PS4, PS5, XBO, XSX |
| Gunvein | Win, NS, PS4, XBO |
| Gunvolt Chronicles: Luminous Avenger iX 2 | Win, NS, PS4, PS5, XBO, XSX |
| Hello Neighbor 2 | Win, XBO, XSX |

| Title | Platform(s) |
|---|---|
| Hindsight | Switch, PC, iOS |
| Hogwarts Legacy | Win, PS4, PS5, XBO, XSX |
| Homeworld 3 | Win |
| Horizon Forbidden West | PS4, PS5 |
| How to Say Goodbye | PC, Mac |
| I Am Jesus Christ | PC |
| In Sound Mind | Switch |
| Instinction | PlayStation 5, Xbox Series X/S, PlayStation 4, Xbox One, Stadia, PC |
| Jack Move | Switch, PC |
| Joe & Mac: Caveman Ninja | Win, consoles |
| KartRider: Drift | PS4 |
| Keo | PC |
| Kerbal Space Program 2 | Win, PS4, PS5, XBO, XSX |
| Kingdoms of the Dump | Win, Mac, Linux |
| Kirby and the Forgotten Land | NS |
| Know By Heart | PC |
| Lara Croft and the Guardian of Light | NS |
| Lara Croft and the Temple of Osiris | NS |
| Lego Star Wars: The Skywalker Saga | Win, NS, PS4, PS5, XBO, XSX |
| Life is Strange Remastered Collection | PlayStation 5, Xbox Series X/S, PlayStation 4, Xbox One, Switch, PC |
| Life Is Strange: Remastered Collection | Win, NS, PS4, PS5, XBO, XSX, Stadia |
| Little Devil Inside | Win, NS, PS4, PS5, XBO |
| Lost Ark | Win |
| Maglam Lord | NS, PS4 |
| Mario + Rabbids Sparks of Hope | NS |
| Martha Is Dead | PlayStation 5, Xbox Series X/S, PlayStation 4, Xbox One, PC |
| Marvel's Midnight Suns | Win, NS, PS4, PS5, XBO, XSX |
| Metal Max Xeno Reborn | Win, NS, PS4 |
| Metal Max: Wild West | NS, PS4 |
| Metal Slug Tactics | Win, NS |
| Metal: Hellsinger | Win, PS5, XSX |

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| Title | Platform(s) |
| --- | --- |
| Monark | Win, NS, PS4, PS5 |
| Monster Hunter Rise | Win |
| MultiVersus | Win, PS4, PS5, XBO, XSX |
| Nekojishi: Lin & Partners | Win, Mac, NS |
| Neon Beasts | Win, PS5, XSX |
| Nobody Saves the World | Win, XBO, XSX |
| Nobunaga's Ambition: Rebirth | Un¬known |
| OlliOlli World | Win, NS, PS4, PS5, XBO, XSX |
| Omori | NS |
| ONI | Un¬known |
| Oxenfree II: Lost Signals | Win, NS, PS4, PS5 |
| Park Beyond | Win, PS5, XSX |
| Pathfinder: Wrath of the Righteous | PlayStation 4, Xbox One |
| Persona 4 Arena Ultimax | Win, NS, PS4 |
| Phantom Breaker: Omnia | Win, NS, PS4, XBO |
| Pokémon Legends: Arceus | NS |
| Prince of Persia: The Sands of Time Remake | Win, PS4, XBO |
| Read Only Memories: Neurodiver | Win, Mac, NS, PS4, PS5, XBO, XSX |
| Redfall | Win, XSX |
| Redout 2 | Win, NS, PS4, PS5, XBO, XSX |
| Relayer | PS4, PS5 |
| Resident Evil Re:Verse | Win, PS4, PS5, XBO, XSX |
| River City Girls 2 | Win, NS, PS4, PS5, XBO, XSX |
| River City Girls Zero | NS |
| RPGolf Legends | Win, NS, PS4, XBO |
| RPGolf Legends | Win, NS, PS4, XBO |
| Rune Factory 5 | NS |
| RWBY: Arrowfell | Win, NS, PS4, PS5, XBO, XSX |
| S.T.A.L.K.E.R. 2: Heart of Chernobyl | Win, XSX |
| Salt and Sacrifice | Win, PS4, PS5 |
| Scorn | Win, XSX |
| Sea of Stars | Win, consoles |
| Shadow Warrior 3 | Win, PS4, XBO |
| Shinigami: Shibito Magire | NS, PS4 |
| Shredders | XSX |

| Title | Platform(s) |
|---|---|
| Sifu | Win, PS4, PS5 |
| Six Days in Fallujah | Win, PS4, PS5, XBO, XSX |
| Slime Rancher 2 | Win, XSX |
| Sniper Elite 5 | Win, PS4, PS5, XBO, XSX |
| Sol Cresta | Win, NS, PS4 |
| Somerville | Win, XBO, XSX |
| Song of Nunu: A League of Legends Story | Win, NS, PS4, PS5, XBO, XSX |
| Sonic Frontiers | Win, NS, PS4, PS5, XBO, XSX |
| Sons of the Forest | Win |
| Soulstice | Win, PS4, PS5, XBO, XSX |
| SpellForce 3 Reforced | PS4, PS5, XBO, XSX |
| SpellForce III Reforced | PlayStation 5, Xbox Series X/S, PlayStation 4, Xbox One, PC |
| Splatoon 3 | NS |
| Star Ocean: The Divine Force | Win, PS4, PS5, XBO, XSX |
| Star Wars: Hunters | NS, iOS, Android |
| Starfield | Win, XSX |
| Starship Troopers - Terran Command | PC |
| Steelrising | Win, PS5, XSX |
| Stranger Of Paradise Final Fantasy Origin | PlayStation 5, Xbox Series X/S, PlayStation 4, Xbox One, PC |
| Stranger of Paradise: Final Fantasy Origin | Win, PS4, PS5, XBO, XSX |
| Stray | Win, PS4, PS5 |
| Stray Blade | Win, PS5, XSX |
| Suicide Squad: Kill the Justice League | Win, PS5, XSX |
| Syberia: The World Before | Win |
| Tchia | Win, PS4, PS5 |
| Teenage Mutant Ninja Turtles: Shredder's Revenge | Win, NS |
| Test Drive Unlimited Solar Crown | Win, NS, PS4, PS5, XBO, XSX |
| The Callisto Protocol | Win, PS5, XSX |
| The Cruel King and the Great Hero | NS, PS4 |
| The Dark Pictures Anthology: The Devil in Me | Un¬known |
| The King of Fighters XV | Win, PS4, PS5, XSX |
| The Legend of Heroes: Trails from Zero | Win, NS, PS4 |

| Title | Platform(s) |
|---|---|
| The Lord of the Rings: Gollum | Win, NS, PS4, PS5, XBO, XSX |
| The Outlast Trials | Win |
| The Stanley Parable: Ultra Deluxe | Win, consoles |
| The Waylanders | PC |
| The Witcher 3: Wild Hunt Complete Edition | PS5, XSX |
| Tiny Tina's Wonderlands | Win, PS4, PS5, XBO, XSX |
| Tom Clancy's Rainbow Six Extraction | Win, PS4, PS5, XBO, XSX, Stadia |
| Tormented Souls | NS, PS4, XBO |
| Total War: Warhammer III | Win, Mac, Linux |
| Touken Ranbu Warriors | Win, NS |
| Touken Ranbu Warriors | NS |
| Trek to Yomi | Win, PS4, PS5, XBO, XSX |
| Triangle Strategy | NS |
| Trifox | Win, NS, PS4, PS5, XBO, XSX |
| Tunic | Mac, Win, XBO, XSX |
| Turbo Kid | Un¬known |
| Turbo Overkill | Win, NS, PS4, PS5, XBO, XSX |
| Two Point Campus | Win, NS, PS4, PS5, XBO, XSX |
| Uncharted: Legacy of Thieves Collection | PS5 |
| Undernauts: Labyrinth of Yomi | PS5 |
| Untitled Battlefield mobile game | iOS, Android |
| Untitled Need for Speed game | Un¬known |
| Untitled The Legend of Zelda: Breath of the Wild sequel | NS |
| Vampire: The Masquerade – Bloodhunt | Win, PS5 |
| Vampire: The Masquerade – Swansong | Win, NS, PS4, PS5, XBO, XSX |
| Vampire: The Masquerade - Swansong | PlayStation 5, Xbox Series X/S, PlayStation 4, Xbox One, Switch, PC |
| Voidtrain | Win |
| Warhammer 40,000: Darktide | Win, XSX |
| Warhammer 40,000: Shootas, Blood & Teef | Win, NS, PS4, PS5, XBO, XSX |
| Weird West | Win, PS4, XBO |
| Whisker Squadron | Win, consoles |
| Windjammers 2 | Win, NS, PS4, XBO, Stadia |
| Wizardry VA | iOS, Android |
| WWE 2K22 | Win, PS4, PS5, XBO, XSX |
| Yurukill: The Calumniation Game | NS, PS4, PS5 |
| Yurukill: The Calumniation Game | Win, NS, PS4, PS5 |

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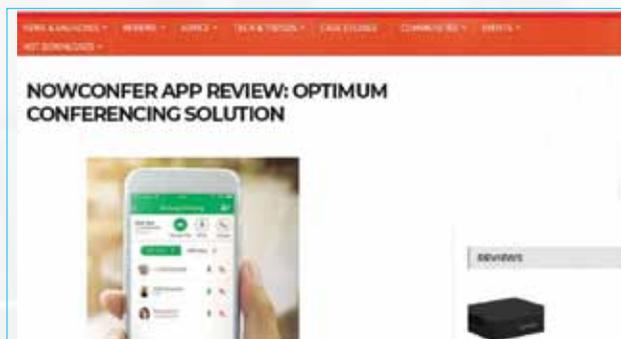








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# Can India challenge the Internet's Big MAC?

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While India was always way ahead in terms of IT Services, it might well be the startup explosion of 2021 that could propel it to the big league in terms of global tech products and giants

f you look at the Top 20 social media platforms of the world (note this is a dynamic list), then Meta absolutely dominates at the top: 1. Facebook. 3. WhatsApp. 4. Messenger. 5. Instagram. Together they have about 7.5 billion users as against the global population of 7.9 billion. Of course, there's an overlap with many using all four services. Meta seems unstoppable especially since it is heading for the first mover advantage when the metaverse takes off.

There is only one other entity that is there: Alphabet, with YouTube at No. 2. Alphabet is a giant in more ways. Gmail is a clear leader in its field with 1.7 billion users. Google Drive is becoming indispensable for those who want to work on the cloud. This is not even counting their biggest winner: Google Search. If you look at the global Alexa rankings: Their Search is at No. 1 and YouTube at No. 2.

The third entity is China. In the Alexa rankings, there are 12/20 Chinese companies. Basically, the Internet is dominated by America and China in general and just three entities in particular: Meta, Alphabet and the Chinese Closed Internet. Call it the Big MAC (Meta Alphabet China).

When you look at the tech giants, America still dominates. In terms of market capitalization, 6/7 top companies are American companies called the A3M3: Apple Amazon Alphabet Microsoft Meta Musk (he has Tesla among others). (The other company in the 7 is Saudi Aramco)

### ▼ The failure of the rest of the world

The biggest failure is that of Europe. It was one continent that always took the lead, especially after the Renaissance, with the Industrial Revolution being the prime example. Charles Babbage, the father of the computer, was English. So was Alan Turing, a pioneer in AI and known for the Turing Test.

The European Organization for Nuclear Research or CERN is not only known for the Large Hadron Collider but pioneering the Internet. Tim Berners Lee, the inventor of the World Wide Web is English. The UK lays claim to many of the foundation stones of the
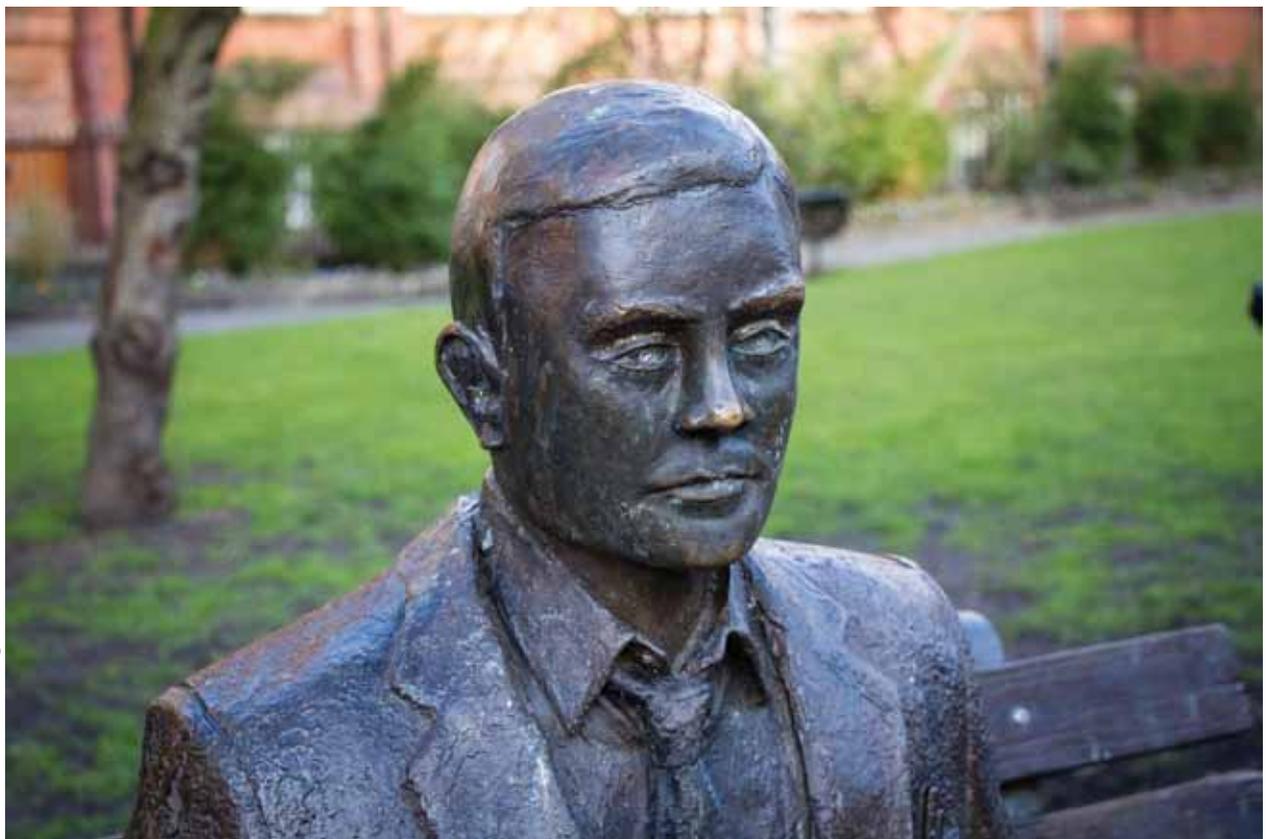
*A bust of Alan Turing*

Internet and modern-day cryptography.

But you won't find many British or European giants in the field of technology. While telecom companies are doing well in terms of revenue, Nokia is probably one of the biggest failures when it comes to what once could have been total global domination. SAP is 395th in the Fortune Global 500 list. In social networks, there's no-one in the Top 20.

Another biggie which didn't make it is Japan. There was a time when Japan took the lead in automobiles and electronics. In the world of technology we do have Sony, Hitachi and Fujitsu, but none of them are challenging A3M3. This despite the fact that Japan is still the third largest economy in the world.

If there are two countries which look like challengers of tomorrow, then one of them is South Korea with Samsung and LG. The second is Taiwan, the semiconductor giant. But though Taiwan is a virtually an independent country, it is "officially" part of China.

### ▼ The opportunity that is India

So, if the West is in decline and most other countries can't stand up, then can India shatter the Big MAC index and make its own giants? A big complaint against India is that while we are strong on IT services, overall manpower and Indian origin tech CEOs, we are quite weak on tech products and R&D. Can we finally change that?

For one, the government is finally serious. We are trying our best to change our policy and successive union budgets are showing this trend. We are launching a series of Performance Linked Schemes, trying to woo the tech giants of the world and coming out

## Some of the 2021 Unicorns

•BharatPe •Licious •CureFit
•Grofers •upGrad •Vedantu
•Mobile Premier League
•CoinSwitch •CoinDCX
•ShareChat •NoBroker •Meesho
•Cardekho •Rebel Foods

## Some of the high profile IPOs

• Zomato •FreshWorks •Nykaa
•Paytm

with things like the comprehensive drone policy. There are innovations like the Account Aggregator network.

Maybe the brightest ray of hope comes from the startup industry. In the pre-pandemic age the Indian one was a distant third behind America and China. Now things are quickly changing. While the Chinese one seems to be in decline, the Indian startup industry is on a huge upswing. Funding is pouring from all over the world as the ideas are mushrooming.

India's first unicorn came in 2011 and the end of 2020 saw the 37th. Well the tally for 2021 crossed 37 in November itself! This has been an unheard of growth. They are coming in diverse fields like ecommerce, gaming, SaaS, Social Media, FinTech & Crypto, HealthTech, EdTech, FoodTech, PropTech etc. The startups of today produce the tech products of tomorrow and become the giants of tomorrow. There is finally hope that there may be an Indian counter to Big MAC. ∎

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