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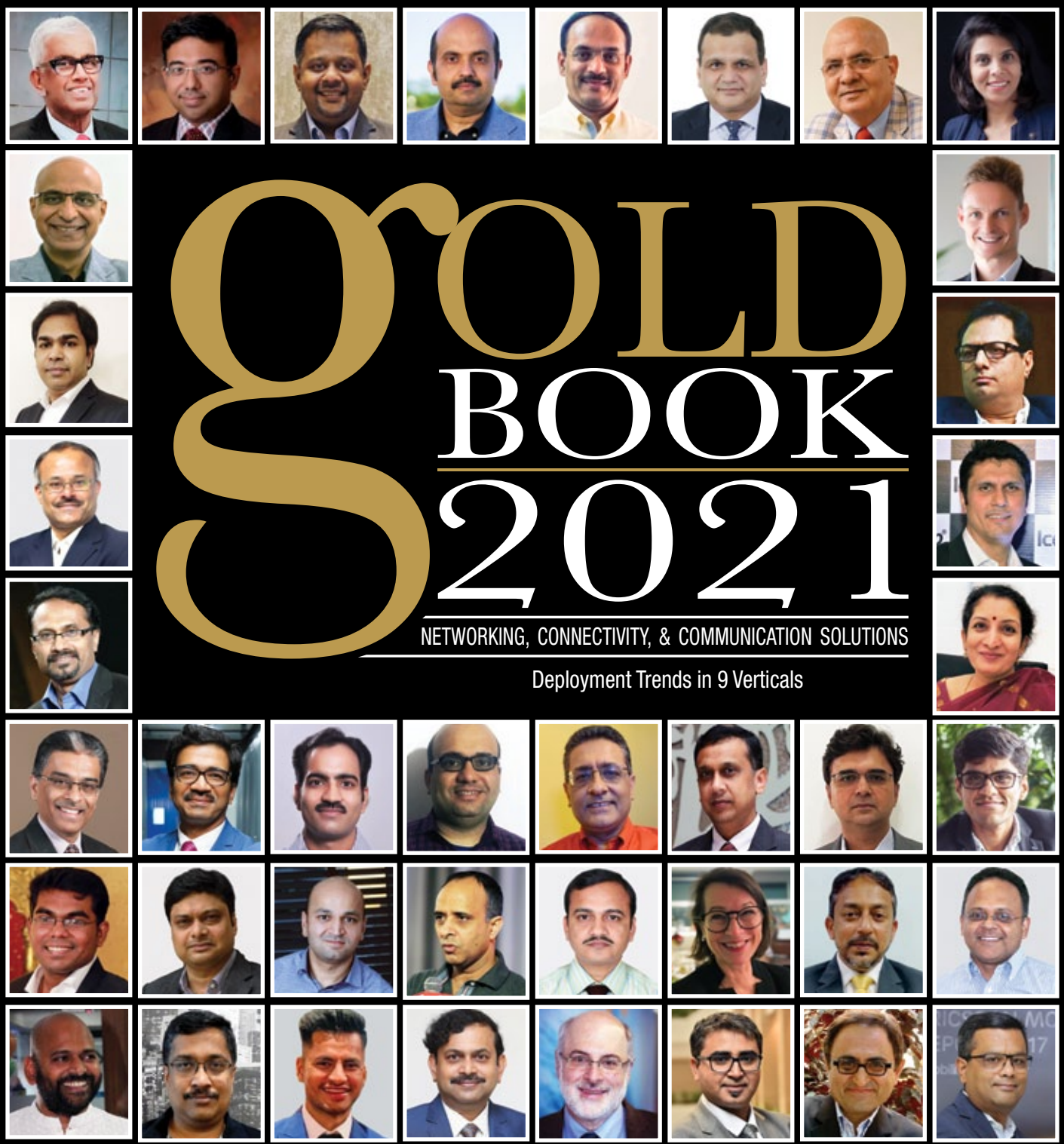

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SHUBHENDU PARTH

[OPENING NOTE]

The elephant is on the drawing board

This issue of Voice&Data is special in many ways. We not only extended the editorial prowess with experts from across nine sectors joining the advisory panel, we also democratized the content development process. The V&D Gold Book 2021 in that sense is truly an edition written by the experts, for the experts, and of the experts.

This also brings us to an interesting observation. In normal conditions, the answers to our five primary questions – technology trends driving the vertical, challenges and solutions, opportunities, and the future technology outlook – could have been different, depending on where the sector stands on the technology adoption curve. However, the pandemic and the recovery to new normal brought in a single-sense of purpose across all the verticals that we reached out to. This was beautifully articulated by our Contributing Editor Pratima Harigunani, and I quote her: "It is both shocking and strange then to find the inverse of a Rashomon Effect converging on a random day."

We did not expect this at all!

What transpired was an elephant in the room that everyone sketched together and clearly on the drawing board. Inputs from the experts clearly indicates that if there is anything that is going to accentuate and accelerate in the post-pandemic world, it is the bear-hug to more intelligence, more agility, more efficiency, more automation, more edge, more precision and more personalization.

And how will this happen?

Experts across the verticals also strongly agree that organizations could not have managed to effectively handle the crisis driven by the pandemic without the essential communication network riding on top of the robust telecom infrastructure that the country has built. Credit also goes to the ecosystem that helped strengthen the infrastructure, networks, cloud, connectivity, and data solutions.

No matter where you pick a sample – in the back-end pipe or the front-end fibre – the networks and communication landscape that we know are going to be defined by two key adjectives – soft and clever. Yes, they are becoming malleable, intelligent and laser-sharp, and permanently changing the way business is done, services are delivered and consumed, and creating new channels of distribution.

Experts also point out that the one year since March 2020 has produced more digital transformation than the change put together during the last decade, with enterprises scaling up all digitalization efforts that were already underway, and exploring newer options driven by artificial intelligence, machine learning, sensors of things (IoT, IIoT, IoMT, etc.), blockchain, AR/VR, and more. Security has been the other top gainer, and though the incidence of cyberattack did increase during the pandemic, it brought in a sense of urgency for leveraging new-age solutions to automate and strengthen the security framework.

This issue provides a quick helicopter-view of different industries, the trends and the driving forces, the networking, connectivity, and communication technologies making a difference and innovations with potential to disrupt the sector.

Watch out for the big neon signs.

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Fintech leads the race

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While the BFSI sector has undergone significant upheaval in times of the COVID-19 pandemic, the industry has displayed significant inherent strength to tide over the challenges. It looks set to emerge stronger through these tough times, especially by leveraging new-age solutions to automate, strengthen its security framework, and offer innovative products. The sector has also got a helping hand from fintech players and together they can grasp the rise in new business opportunities.

Expertspeak

"Connected India is vital for the BFSI sector growth"

RAJDEEP SAHA
Managing Director, Financial Services – Technology Consulting Practice, Protiviti India

The technology trends across customer and data interactions have been disrupted by the pandemic and the new normal, and like in many other sectors we are seeing an accelerated pace in adoption of next generation technologies in the banking, financial services and insurance (BFSI) space.

In India, these interactions are driven by the "voice, vernacular and video" paradigm. This makes it necessary for organizations to ensure seamless and faster provision of communication services through these "3Vs", both in urban and rural areas.

The COVID-era has seen demand from customers and service providers change in the financial services sector. Both are now looking for access and work from anywhere environment over the internet. There is a demand to embed artificial intelligence (AI) and internet of things (IoT) in processes for connected ecosystem, efficiency and speed, as also for less-touch operations. Expectation has also increased for data on the go – secured and through the 3Vs, and multi-channel unified customer experience.

The technology drivers to address these needs and newer demands have also evolved. The key trends that will impact the sector over the next 2-3 years include the following.

Technology advancement in connectivity and communication: In addition to deployment of next-generation wireless networks, in the mobile networking arena, it is the 5G standard that's expected to disrupt mobile network and communication. Two large local mobile operators have started 5G trials, and we should see early adoption in 2022. Also, for provision of internet to rural areas, low earth orbit (LEO) satellites will also gain traction.

Software-defined networking: To address the need of establishing a variety of network connections consisting of assets in the cloud, data centres, and branch offices that function like a single, seamless system, SD-WAN will become mainstay and replace traditional hardware-based onsite networking approaches.

Increased public cloud adoption: AI and IoT led interactions and remote collaboration will lead to increased public cloud adoption. The need for efficiency, on-the go services, customer experience and business continuity in remote operations have accelerated public cloud adoption in the BFSI sector.

Focus on security: With remote working and collaboration and digital transactions, cybersecurity has become one of the main concerns for the BFSI sector during the COVID-19 outbreak. This is where Service Access Security Edge (SASE) and Zero Trust model can help to create a single cloud-native security service, coupled with other enablers.

Autonomous networks: AI and machine learning (ML) will be baked into network platforms. ML can make predictions based on network data, while AI can take intelligent action based on those predictions and thereby evolve into validation mechanisms and the beginnings of a self-operating network.

Remote operations and hyper-automation: Devices, clients, applications, IoT... it is all trending to be more distributed. Tomorrow's networks can automatically secure and optimize workloads that are dynamically changing at an accelerating pace. Automation will get infused across endpoint management, SaaS platforms, self-service, and zero-touch provisioning.

BFSI sector challenges

A networked and connected India is vital for the growth of

> Upgrading ATMs and kiosks to 5G will deliver faster service, giving people access to more interactive and digital services.

the BFSI sector and provision of digital financial services. However, there are several challenges in the adoption of the technologies that can help the sector become truly ready for the digital normal.

Availability: Accessibility in rural India is less than half compared to its urban peers. This digital divide prevents provision of digital financial services in rural India. Though the BharatNet and National Broadband Mission are accelerating the rural adoption, we still have a lot of ground to cover.

Accessibility: With smartphone penetration still low in rural parts of the country, accessibility of network, computing equipments, and new age devices is an issue. Hence, last mile connectivity for financial services dissemination still continues to impact the sector.

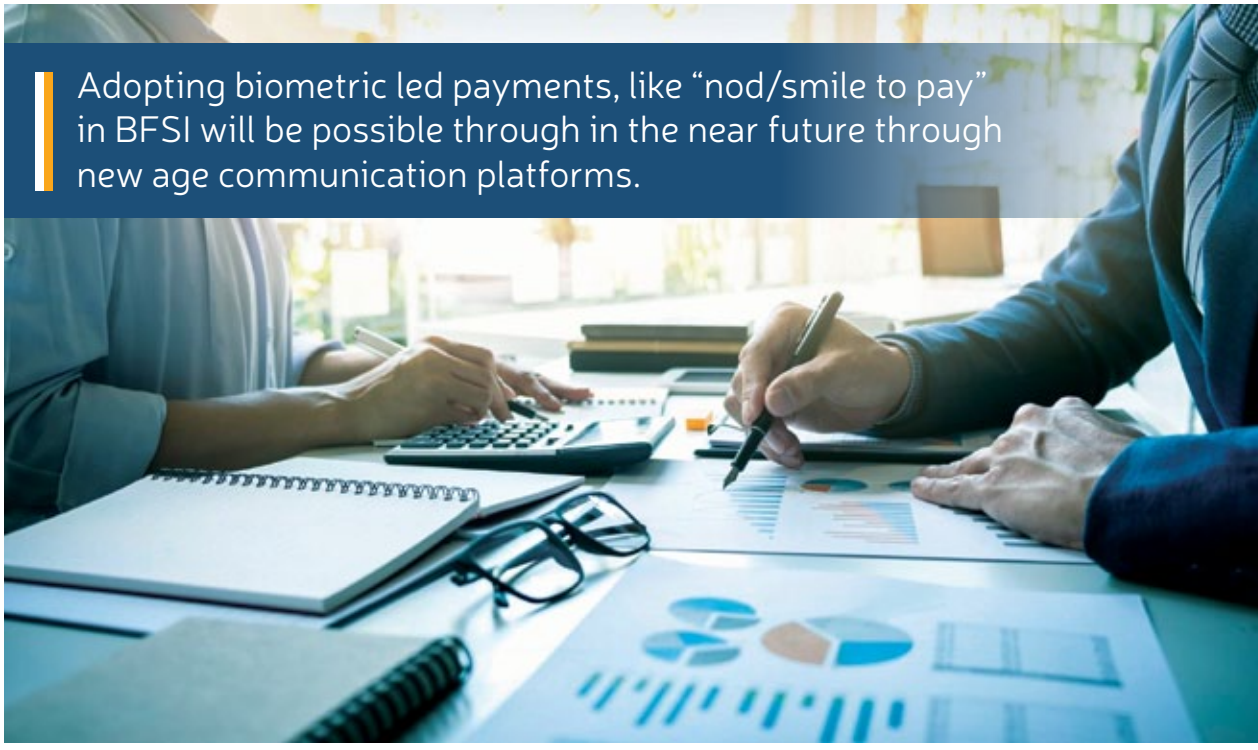
Usability: User convenience and experience will need to be balanced using "3Vs" in the applications for users, across rural and urban regions. For instance, vKYC for customer onboarding in rural areas could be challenging due to lack of internet connectivity and device compatibility. Similarly functionalities like "smile to pay" using facial recognition through mobile app will have to wait.

IT talent: As BFSI entities build next-generation networks, talent models will need to evolve as IT talent upskill and retrains to address the new normal. In the context of advanced connectivity, expertise for SDN and 5G is not widely available across regional and industry talent pools.

Investments: This change to next generation technology adoption for the network and connectivity platforms is an immediate and business critical need. Provision of adequate investments midst this the pandemic could be a challenge.

The opportunities

A 'connected economy' has immense potential for



As BFSI entities build next-generation networks, talent models will need to evolve as IT talent upskill and retrains to address the new normal.

BFSI and as India adopts next generation network and communication technologies there will be significant opportunities in customer acquisition, product innovation and servicing. While 5G will bring in high-speed internet, it will also usher in multiple opportunities for the sector.

- Micro-products in insurance, wealth management and advisory can be rolled out with collaboration of fintech, all using mobile app.
- The ongoing growth in mobile and internet penetration will pave way for a bigger and more sophisticated digital payments market.
- The sector can also benefit by rolling out quick and efficient performance of more complex processes, minimizing waiting time for things such as ID verification for new customer onboarding and loan tracking.
- Upgrading ATMs and kiosks to 5G will deliver faster service, giving people access to more interactive and digital services.
- It will help in providing effective fraud detection and prevention tools, chatbot, and voice-bots for customer support.
- Enable provision of better security and compliance.

Similarly, SD-WAN is an imperative today for remote collaboration and operations. It provides for WAN optimization, centralized management, reporting, and application steering, thereby managing costs and enhancing communication efficiency.

The solutions

All stakeholders – government, industry bodies, IT entities and BFSI sector will need to work cohesively to expand internet adoption and new technologies. At overall ecosystem level there is an urgent need for faster rollout of broadband services to connect every gram panchayat. Hence, there is a need to expedite the National Broadband mission rollout. A lot can be achieved through PPP for investments in network and communications, and private-state partnership is needed to expand network connectivity and broadband through fiber and other modes.

At telecom and IT sector level there is a need for faster adoption and rollout of 5G, SD-WAN, and cloud. The telecom and IT industry will have to work closely to drive broadband penetration and introduction of new technologies to grow the ecosystem. This is vital to facilitate usage and foster innovation to make India self-reliant.

Technology too has solutions in hand and there is a need to infuse AI, automation in network products and services. We have seen how AIops and CloudOps are being gradually used in remote operations to drive faster/self-remediation and efficiency. The related analytics will enhance the quality of usage and end customer experience.

Overall, the BFSI sector needs to adopt next generation network and connectivity platforms. With Industry 4.0 and the digital opportunity (with IoT, Analytics, AI etc.) never before has the potential been so transformative. There is need to define clear phased timeline-led approach in weaving in new products, services (like beyond banking for MSME segment) and agile operations, underpinned on next generation network and connectivity platform.

Networking and connectivity platforms can also have significant impact on AI and biometric-led payments. In India, UPI has simplified the entire payment's experience and created the road-rails for innovation. Adopting biometric led payments, like "nod/smile to pay" in BFSI will be possible through in the near future through new age communication platforms.

India has experienced a significant growth in recent years, enabled by encouraging financial inclusion, government policies and initiatives. As we outline the growth narrative for the future, the network and connectivity infrastructure will need to transform and accelerate Industry 4.0. This will lay a strong foundation for financial services to roll out innovative products for the bottom of the pyramid and expedite last mile digitisation.

Expertspeak

"AI will help banks move beyond traditional credit scores"

SHIVAJI CHATTERJEE
Sr. Vice President, Enterprise & Government Business,
Hughes Communications India

This year gone by has seen the BFSI sector picking up many new trends. This has resulted in a significant shift in evolution of technologies and their consumption. Besides, there has been a high adaptability for digital and contactless payments in the sector. A good example is the rise of the neo banks, digital on-line entities leveraging mobile-first technologies and being extremely user friendly with minimum operating cost.

Fintech firms are collaborating with brick and mortar conventional banks to offer web and mobile platform as white label solutions. Of course large, conventional banks have pushed their digital initiatives to the next level.

Security: With accelerated growth of operating remotely, cybersecurity and access management is going to play a major role. From the network perspective, blockchain technology is emerging as a key enabler of information security. Besides, with more applications on the cloud and emergence of SD-WAN, security at the branch/edge of the network is becoming more critical than ever.

Ever more bandwidth: Despite limited working hours and attendance in the BFSI sector, there has been no significant let up of the bandwidth utilization. With more applications, cloud hosting, centralised operations – the need for branch bandwidth has gone up with a minimum of 2 Mbps per branch as a standard. Technologies like broadband fibre and HTS VSATs that ensures speed of 5-10 Mbps would begin replacing MPLS and RF links.

Cloud and SD-WAN: With the entry of global cloud companies and the burgeoning applications that supplement the core banking portfolio, there is a huge emphasis on cloud hosting and direct access to cloud applications from the edge. Hence, traditional network architectures are lending way to SD-WAN with local breakout to the cloud in a secure, managed manner. It also brings in broadband, LTE access technologies into the branch, and WAN as compared to incumbent MPLS and VSAT options.

SD-WAN has evolved the router, network management, security and network architecture in one go and made it more cloud-friendly. This helps in keeping the network elements aligned to user and banks needs.

While banking-as-a-service (BaaS) is likely to emerge enabling third parties to directly connect with the banks' systems, there is a growing need to use artificial intelligence (AI) for smart lending. This will help banks and FIs use deeper insights beyond traditional methods of credit scores.

The challenges

The year 2020 saw the BFSI sector hit the reset button for everyday business by accelerating digital initiatives and adopting technology to make them more flexible and efficient. This also brought to forth concerns and issues that did exist but were not high on the radar.

> While banking-as-a-service is likely to emerge enabling third parties to directly connect with the banks' systems, there is a need to use AI for smart lending.

> With the entry of global cloud companies and applications that supplement core banking portfolio, there is a huge emphasis on direct access to cloud applications from the edge.

Competition: BFSI has seen a high degree of competition. The pandemic exposed inefficiencies of current financial services processes while disruptors have been gaining ground as more and more financial services consumption is going digital. To compete actively at the customer touch points, the BFSI industry, present in the brick and mortar form, have to enhance their telecom and networking infrastructure at the branch touch point levels to provide a similar or better level of services. The digital transformation due to smart phones and smart platforms has happened very rapidly to give faster, cheaper services under business models that are fast changing the competitive landscape.

Data and security issues: These are big obstacles for digital transformation. Legacy systems need upgrade while ensuring 100% data integrity. The upgraded ecosystem has to handle effectively the training needs of literally tens of thousands of bank staff, much high telecom bandwidth needs, enhanced data center resources, effective failover systems at branch, and data center levels etc. These fundamental needs, wrapped around the inherent fear of setbacks and getting stuck in planning stages is proving to be a challenge.

The sector also acknowledges that managing security in digital transformation is a continuous story. Almost all BFSI organisations have set up independent security departments with strong vetoing powers on which technology adoption meets the security compliances. These systems and processes laid down, at times, leads to institute adopting existing incremental technology much faster than new technologies.

Business priority change due to pandemic: While digital transformation is being pushed ahead the current focus is more on short term goals and initiatives of reducing cost, revenue growth, improving existing product and services, and innovation within the existing realm.

Bridging urban-rural divide: While smartphones have led to digital transformation in urban areas, majority of rural India still uses feature phones. Besides, there are several black spots – unserved and underserved by mobile phone connectivity. For the BFSI sector this creates a big challenge in terms of providing uniform quality of service on a pan India basis. The sector resorts to a store and forward non-online mode of communication via business correspondence and for on-line communication the VSAT technology can prove to be a secure and reliable connectivity service.

Telecom has the solution for BFSI woes

Cleary the benchmark is set very high for the BFSI sector in India. The sector needs enhanced bandwidth and highest level of availability at every touch point – branch, kiosk, or ATM. It also needs to be abreast with the latest security best practices and adoption of newest technologies for better cost optimization and to ensure high availability and reliability.

BFSI players have always been early adopter of technologies and communication solutions have evolved to become lifeline of the sector.

SD-WAN and virtualisation: SD-WAN is clearly the most sought after networking solution by the BFSI sector as it provides a complete networking framework and a modernization of the wide area network in keeping with evolution of the banking applications, cloud architecture, virtualized appliances, centralized control and management, higher visibility and decentralized security.

4G/LTE-based solutions: 4G and LTE penetration has reached far and deep into the country. The networks have got augmented with much more spectrum allocation and hence bandwidth. These solutions have gained very good acceptance in several areas of the financial services sector. There are good solutions available that bond multiple LTE links and service providers to provide speeds of 2-6 Mbps per site and give SLAs of 99.5% with high levels of security.

High throughput satellite: The HVSAT solutions provide the BFSI sector very high bandwidth of 2/4/6/8/10 Mbps at a fraction of the cost of the

> Fintech firms are collaborating with brick and mortar conventional banks to offer web and mobile platforms as white label solutions.

conventional satellite solutions and VSAT that were restrictive in providing bandwidth higher than 2 Mbps. This technology jump from VSAT to HVSAT is being very ably supported by ISRO with several satellites having been already commissioned in the geostationary orbit to offer these solutions. In addition, LEO satellites from internet majors like OneWeb, SpaceX, and Amazon offer low-latency connectivity.

Opportunity galore

Digitization has propelled a significant change in the BFSI sector with the introduction of new-age banking solutions. Besides, the pandemic has increased the demand for easy access to financial products, services, and information and the need for stress-free banking. We see this change as an opportunity. The percentage of clients using digital channels for bank transactions has considerably increased. Customers of a younger generation are more willing to trust digital banking and learn how to use it. India is now on its way to becoming one of the world's largest digital economies, and banking will indeed ride this wave of innovation.

The Indian government has taken several actions and strategies to make banking more accessible and better. With the economy on an upswing, banks in India, both private and public, see the value of digital technology like robotic process automation, AI, and machine learning. These innovations provide great possibilities.

Emergence of BaaS will allow non-banking businesses to connect directly to banking system and embed financial services into their products. In addition, AI for smart lending will enable banks and financial institutions to employ deeper insights than traditional credit scores. Financial organizations, such as banks would have to rethink their digital strategies to see if they can satisfy future demands.

The pandemic has also emphasized the necessity for digital delivery options. However, given the current situation and challenges, it will be intriguing to see how neo banks handle regulatory and compliance, data and cybersecurity, seamless API integration, and product expansion.

Expertspeak

"More banks are adopting the BaaS business model"

SUDHIR PAI
CTIO, Global Financial Services, Capgemini

COVID-19 has pushed cost transformation into overdrive, with companies looking at technology as a major lever to save their bottom-line. The important technological trends in the industry include rise in adoption of distributed ledger technology (DLT), while there are clear indications of hyper-personalization gaining ground. We see that DLT is gaining momentum, with prominent use cases such as CBDC and Asset Tokenization being picked up in multiple markets across the globe. Similarly, technology-driven hyper-personalization is increasingly becoming critical for loyalty and growth, especially in the wealth management industry.

The rising demand for embedded finance means more banks are adopting banking-as-a-servicer (BaaS) business model, pushing themselves to create a 'new-age cloud-native, API-driven tech stack' to cater to the demand. Also, data-driven offerings are becoming the latest winning propositions for payment firms. Access to alternate data and real-time data is enabling companies to offer contextual value-added services to customers.

The other trends that are picking up include use of cognitive technologies for better prediction, technology for healthcare, and uptake of intelligent automation in the insurance sector. In fact, more banks are now using cognitive technologies to strengthen credit risk management; these technologies enable banks to improve their predictive accuracy throughout the value chain of credit risk management to servicing.

Since data inter-operability is expected to become a key to enable seamless coordinated delivery of healthcare, insurers are developing digital healthcare tools to allow patients to access and share their healthcare data. Insurance companies are also increasingly adopting intelligent automation to reduce operational costs and are turning to artificial intelligence- (AI) based models to accelerate their back-end processes.

Challenges, solutions, opportunities

While the BFSI industry has undergone significant upheaval in times of the COVID-19 pandemic, the industry has displayed significant inherent strength to tide over the challenges. It looks set to emerge strongly from these tough times, especially by leveraging new-age solutions and grasping the rise in new business opportunities.

Operate like a tech company: Every enterprise is on the path to become a tech company – digital to the core and agile in operations. Without this vision, companies run the risk of becoming obsolete in the near future. Hence, greater investment in efforts to anticipate and assess newer technologies is critical to ensure you are not left behind. Financial customers expect their services providers to offer experiences similar to what Google and Facebook have provided them. Banks, insurers, and

> Financial customers expect their services providers to offer experiences similar to what Google and Facebook have provided them.

> Insurance companies are adopting intelligent automation to reduce operational costs and are turning to AI-based models to accelerate their back-end processes.

other financial institutions are striving to live up to their expectation through reimagined customer journeys and hyper-personalized products. For banks and insurers, this also implies significant investments in talent and new ways of working.

Adapting to, and thriving on, regulatory reforms: Regulatory reforms in the near future will focus on two major aspects: ensuring real-time compliance, and stimulating innovation within the industry. The ability of organizations to adapt to these reforms will determine their success to a large extent, especially in markets with a proactive regulatory regime. Cryptocurrency is a good example. With multiple markets accepting the value it holds, players in the field can expect to see far-reaching reforms from regulators. Pioneers in this domain have the scope to set a precedent with regulators and gain a massive first-mover advantage.

Remodeling FS value chain: As-a-Service partnerships are gaining momentum within the industry, BaaS being the latest and most prominent of them. Financial institutions will continue to experiment and, in certain cases, win big with this business model, with focus shifting to possible collaborations with BigTech companies. This will almost invariably imply that organizations move to a more 'platform-driven' operating model enabling unconventional partnerships, as well as driving production and distribution layers. While customer-facing platforms are already omnipresent, more organizations are expected to build internal platforms as well, with greater collaboration between business and technology functions within them.

Decentralized finance (DeFi): Rather than being viewed as a standalone technology trend, 'decentralized future' should be treated as a combined and powerful evolution of distributed technology that will manifest through currencies (Crypto), applications (dApps) and consensus, cloud, security, data portability and open-source practices.

However, the world of DeFi is not one that will replace traditional finance. The intrinsic nature of DeFi implies that it will coexist with traditional finance, driving innovation and improvement in a specific set of use cases. This is evidenced by the rise of CeDeFi, which combines the elements of traditional financial organizations with mature DeFi applications. For instance, Stablecoins is an effort to improve upon one of the pain points of cryptocurrencies, the price volatility.

Sustainable economy: Sustainability and its operationalization is becoming a mainstream agenda for BFSI. Banks and insurers are now planning their journey for a comprehensive transition to sustainable business operations. In addition to the climate debate, several emerging economies are burdened with issues ranging from inadequate infrastructure to underequipped social and healthcare systems. Over and above ensuring sustainable IT practices, financial institutions can serve as a key player by establishing sustainable offers, finance mechanisms, and investment principles, thereby establishing sustainability as a business opportunity.

Impact of intelligent industry: Intelligent industry will unleash waves of innovation across every industry through intelligent products and systems, intelligent operations, and intelligent support and services. New digital and disruptive technologies like 5G, AI, edge computing, internet of things (IoT), big data, and blockchain, etc., are enabling financial services companies to adapt in a digital and intelligent way for sustainable business success and competitive advantage.

Financial services also stand to gain through innovative offerings to address the needs of the new 'intelligent industries.' Use cases such as UBI that leverages telematics in auto industry and embedded finance leveraging IoT in retail industry are set to explode over the next 2-3 years.

Expertspeak

"Communication on the 5G network can bring newer attacks"

VAIBHAV TARE
Chief Information Security Officer, Fulcrum Digital

In the world of the internet, implementing cybersecurity has become a necessity, and organizations are taking steps to improve their security system and make sure their network, programmes, data, and devices are well protected. Cyberattacks can lead to a massive blow to the financial sector players and it can become a challenge if undetected or not well taken care of. Cyberattacks can be led by an individual or a group trying to target a system for financial gain, politically motivated for information gathering, or to cause panic or fear. Preventing a cyber-attack from not occurring requires implementation of a well-structured cybersecurity system.

Cybersecurity uses a unique architecture and other reliable technologies to protect organization from cyber-attacks. Cybersecurity is very helpful to an organization when it transmits sensitive data from one device to another or from one location to another. This sensitive data needs to be protected by all means; so, it doesn't get into the hand of an unauthorized user. A good cybersecurity system also uses enhanced cryptographic protocol that not only protects critical data in transit, but also shields them from theft.

Trends driving BFSI in 2021

As technology develops, organizations in the BFSI sector face new threats and risks. In the year 2020, there was a significant 273% increase in data breaches, which also means the threat grew both in quantity and complexity compared to previous years. The increase was also reported to be far more than the breaches estimated in the previous year, and it could be alarming. Understanding technology trends can help organization create an up-to-date structure for fighting cyber threats.

Cloud services: Financial institutions including banks, NBFCs, rating agencies, local governments, and credit card processing companies, etc. are increasingly using cloud services to offer more scalable and efficient operation. Its introduction has also significantly reduced the cost of setting up physical workstation and allows organizations to divert these funds to other areas of development. However, this also exposes them to the risk of data breaches if the cloud environment is poorly secured.

Human error such as disclosing access details, connecting to an exposed network service, or incomplete data deletion can cause data breaches. The more popular cloud services become, the more organizations experience growing cloud-related threats. There are few stringent regulatory and compliance requirement like PCI-DSS compliance for all financial institutions. However, it may be interesting to see how these organizations have implemented the compliance and how they are maintaining; there are many areas like databases, artificial intelligence (AI), machine learning (ML) integrations, and new encryptions levels that need to be assessed correctly. Most of the time an auditor has very low visibility on these new emerging technologies and that may lead to slip in some of the critical areas.

> Financial institutions are increasingly using cloud services to offer more scalable and efficient operation. It also exposes them to the risk of data breach.

> While PCI-DSS compliance is mandated for all FIs, there are areas like databases, AI, ML integrations, and new encryptions levels that need to be assessed correctly.

AI integration: AI and ML are beginning to impact the technology space. Recently, we have seen the introduction of automated security systems, self-driving cars, disease mapping, proactive healthcare management, social media monitoring, and more to influence the way people live. AI has also offered massive benefits to the organization that is under-resourced and provides efficient structure to analyze data at a faster pace. The introduction of AI with cybersecurity can detect a new threat and notify the admin when there are breaches.

Data privacy: Protection of data will continue to be a major issue. Organizations will always need cybersecurity to prevent their data from getting into the hands of unauthorized users. Several measures have been taken internationally to prevent data breaches, for example, General Data Protection Regulation (GDPR), which was introduced by the European Union to provide data protection and privacy. Data privacy, when implemented, impacts an organization tremendously and they need to have well-equipped officers to strengthen their data system.

5G network: 5G network is also one of the cybersecurity trends for 2021. It is best known for lower latency, faster speed, and improved reliability. 5G's global presence has delivered a new era of connectivity and efficiency. Communication between two devices on the 5G network can bring new attacks that organizations aren't aware of. Due to its nature, there can be loopholes that will require advanced research to make any system connected to the network secure from external attacks.

State-sponsored attacks: Showcasing superiority will always be common among world leaders. Most leaders often use state-sponsored attacks to spy on other nations. Some result in elections manipulating to have things in their favor. As we progress into 2021, we should expect more state-sponsored attacks.

New-age challenges

Cyber threat has become more evident, and its challenges have caused organizations a lot of losses. These losses can be the amount of money spent on fixing the damage that occurred, loss of sensitive data, and fixing a new architecture to the network system. Here is a look at the challenges cybersecurity faced in 2021.

IoT attacks: Advancing into internet of things (IoT) has become a challenge for cybersecurity professionals. Over 11.6 billion IoT devices have been introduced into the market in 2021 and more enhanced devices will be made available in the later years according to IoT Analytics. These devices such as smart security devices,

> It is important to stay up to date with the ever-changing nature of cyberattacks to successfully forecast, prevent, and remediate them.

laptops, mobile phones, and more can be problematic to cybersecurity personnel. Recent AI devices come with new architectures that will take a while to implement on the security system.

Ransomware attacks: Ransomware attacks are one of the most popular forms of attack. In India, ransomware attacks have become one of the major security challenges and reports indicate that 82% of India's organizations have been taken down by such attacks in the last six months. This form of attack is unique from the others as it stops the operations of the organization and further causes more loss to the organization.

Phishing attacks: It is a unique type of social engineering and involves using an advanced method to collect user details such as credit card numbers and login credentials. Compared to ransomware attacks or other forms of attacks, the hacker performing a phishing attack uses the user's information to shop for goods on the internet or perform illegal money transfers.

Software and application vulnerability: Software vulnerabilities are also a cybersecurity challenge. Installation of software doesn't completely solve the issues of threat but ensuring that software is updated frequently. Having the latest version of software reduces security vulnerabilities that help to prevent sophisticated cyber threats. Installation of unpatched software, one that has not verified by a reliable source, is another vulnerability that could be very harmful.

Bring-your-own-device: BYOD was adopted to reduce the cost of distributing or maintaining a new device. Most organizations have begun implementing the BYOD policy for their employees, and this implementation offers several challenges to cybersecurity personnel. If the device operating system version is out of date it becomes a medium for attacks. The device is also prone to insider attacks where an employee leaks confidential data to outside individuals.

The action points

Staff training is very essential for efficient cybersecurity. With this, the staff is equipped with basic training to prevent cyber threats. The training also creates awareness on how important it is for data to be secured and how threats are implemented.

Many financial organizations have legacy systems and applications which are greater threats for customers and data. Hence it is important to stay up to date with the ever-changing nature of cyberattacks to successfully forecast, prevent, and remediate them. It is also in your best interests to have a comprehensive understanding of the industry and the typical risks to which your firm may be exposed.

It is also important to implement the right cybersecurity framework. Besides complying with PCI-DSS, organizations also need to meet the requirements of ISO 27001, SOX, Bank Secrecy Act (BSA), HIPPA, GDPR, and CCPA, particularly while working with global partners.

End-to-end risk management: Implementation of risk management along with CISO and CCO is a must for all financial institutions.

Ensure endpoint protection: There are so many sophisticated threats that creating endpoint protection and an optimized firewall to secure the data is a good idea. Also, the endpoint helps to protect the network that is connected to devices.

Threat modelling: This method involves optimizing systems and applications by identifying objectives and vulnerabilities, creating a well-defined plan to prevent any threat to the system. Threat modelling involves concepts like stride methodology, process for attack simulation and threat analysis or PASTA, Trike methodology, and Meta attack language.

Security automation: Investing in security automation will benefit any organization because of the growing rate of data breaches occurring. A research conducted by IBM in 2020 found an USD3.58 million difference in the average total cost of a data breach for any organization without security automation compared to those with security automation. Organizations should also consider having automated tools to collect and analyze data efficiently. This will save the organization more money in the process.

Expertspeak

"Legacy platforms are a big challenge for the BFSI industry"

VIVEK KULSHRESTHA
Director – Technology, Synechron

The transformations and tales of the BFSI industry are in abundance and the bird-eye view poses a plethora of ifs and buts. This dynamic yet essential industry is the backbone of global economies and has passed the baton of progress to the fintech players. What is interesting is that the trends and possibilities for the BFSI have amplified because of the pandemic.

The technology trends

Organizations are increasingly transitioning towards adapting a cloud-agnostic system by moving towards hybrid cloud services and are largely trying to make their applications a part of a cloud-neutral solution by spreading critical functionality across cloud providers. This primarily helps in mitigating the risk from outages on a particular cloud. It also allows flexibility in dealing with providers and the ability to switch business volumes across the cloud options.

Another key trend is that BFSI businesses are more interested in buying platforms, rather than building them. This is to keep technology debts and the high maintenance costs at bay. These debts result in higher future cost due to adoption of complex platforms. Additionally, banks are also strategically working with multiple fintech vendors to optimize productivity by segregating tasks between them and acquiring the ability to switch business volumes between vendors for managing redundancy and resiliency.

We're also aware of the global data abundancy, which needs to be sourced, stored, and analysed. The ability to shift through this huge amount of data and gain intuitive insights is a massive task. This incorporating automation for data-driven decision-making is the trend supported by an event-based architecture, and this will continue to be a crucial milestone for the BFSI world.

Containerization of applications is another key trend to transform legacy platforms. It involves decomposing platforms into loosely coupled isolated modules. By encapsulating a unique functionality in a microservices based 'container', enterprises will save cost, reduce application dependencies, and improve time to market. Containerized application modules can be migrated across platforms, retired, and have their functionality outsourced without impacting the rest of the applications ecosystem.

The latest and the hottest trend relates to the impact of COVID-19. It has not only accelerated adoption of innovation but also created an urgency to leverage fintech, review infrastructure deficiencies, and augment the capabilities of cloud and data center providers. Additionally, the work-from-home system has proven that skilled and innovative talent can operate from any corner of the world. Hence, future leaders of the industry will choose to work with organizations that are flexible, and have an inclusive work culture.

The fintech challenges

Stickiness towards legacy platforms is a big challenge for the BFSI industry. Several businesses still operate on legacy platforms because their replacement comes

Containerized application modules can be migrated across platforms, retired, and have their functionality outsourced without impacting the rest of the applications ecosystem.

> BFSI businesses are more interested in buying platforms, rather than building them. This is to keep technology debts and the high maintenance costs at bay.

at a high cost; this is a key reason why stakeholders keep postponing the due transformation. It is a vicious cycle as the delay causes more technology debt to pile on. Unfortunately, only emergencies are prioritized, such as fixing a bug, responding to security breaches or adding new business functionalities. The transformations are also borderline tricky because the existing legacy platforms were erected by dedicated leaders, and these platforms have served the business well, hence getting the buy-in and cooperation of such leadership can be challenging

Another challenge is the organization's lack of confidence in the outcome of adopting new technology. This attitude makes some businesses adopt a "wait and watch approach". Unless there is a commitment from the highest level, tech leaders are hesitant to experiment. This is especially true when the limited funding available is often prioritized for immediate business functions. It is perhaps correct to say that banks will only adopt proven technology and are usually not in the business of helping technology evolve.

The evolving fintech market also poses another key challenge as it expands. There are many innovative vendors, offering similar functionality with different underlying technologies. The analysis and research required to find the optimum fit for one's platforms is challenging. Banks are wary of partnering with newcomers and need to put their money on the right vendor and technology stack. There is expected to be consolidation among the fintech players and not all will survive.

As the BFSI industry progresses, we're also looking at a probable pool of digital fraudulency due to the reduction in physical verification of people and documents, and the introduction of faceless endpoints and gateways, which collectively increases the risk of fraud and digital theft.

Get smart: Incubate innovation

A smart way of dealing with the fear of transformation is by incubating innovation labs for gaining confidence. Most banks want to "feel the water before taking the plunge". Small, modular functionality provided by fintech companies allow them to test the feasibility of new modules without fully investing in their development and infrastructure, such as fintech labs and accelerators allow research and validation at a quicker pace with little upfront cost.

Firms need to migrate to cloud-based applications and reduce their infrastructure and environmental expenses. This will also enable faster roll-out of business functionality. Having the cloud privately hosted gives organizations control over their data and reduces down time due to vendor issues. Besides, on-premises solutions are certainly recommended for organizations that are willing to bear the cost and need total control over their data.

As banks develop more and more on the new technology, there is also a possibility of them being threatened by fintech firms taking their market share and disrupting their business model. However, the budgets in which banks function provide multiple options to combat this probable issue. They could sponsor start-ups and integrate with them as they expand and prove themselves. Alternatively, they can also partner with existing fintech players or outsource functionality. In either case, banks can leverage the nimbleness of fintechs to create pilot platforms and scale up after concepts are proved.

Additionally, the industry as a whole would benefit from targeted innovation with prototypes. In the pursuit of winning the trust of stakeholders, solutions should provide tangible benefits and focus on what pain points are addressed and what result is expected. In other words, innovations should not look like solutions in search of a problem.

New economy, newer options

It's known how enterprises are stuck with monolithic platforms but at the same time, there are never enough funds to replace them. Fintech innovation offers the middle path. Innovation can carve out the monolithic platforms, one piece at a time. Digital capabilities enable enterprises to work on pain points, containerize functionality, leverage fintech vendors, introduce data-driven decision making, automate, and streamline data flow.

> Most banks want to "feel the water before taking the plunge". Small, modular functionality provided by fintech companies allow them to test the feasibility of new modules.

The industry is experiencing a surge in new opportunities to transform banking tasks. This comes as a result of the high penetration of smart devices in the hands of customers. Starting from biometric authentication, elimination of plastic cards, AI supported chatbots, and KYC verification, all contribute to reducing queries and cost savings in customer service. The sector is also looking at digital authentication, verifications, e-signatures, self-serving features becoming pivotal for banks and their vendors for large-scale adoption.

It's also exciting how open banking will continue serving as an opportunity for start-ups to level the playing fields with established banking institutions. Additionally, access to customers' data along with third party service providers, also offers tremendous opportunity for banks to cross-sell their products to customers and get an aggregated view of customers' assets and liquidity.

The work-from-home model might have been viewed as a temporary happening, but it's clear that it is there to stay even after the pandemic. This provides an opportunity to facilitate employees and ensure enterprises are equipped with the appropriate tools and services.

Future outlook for the BFSI sector

The period starting 2020 to 2022 will experience some losses, although short-term, in the lending business. This would especially materialize in categories of consumer loans, credit cards, commercial loans, and small business loans. This will also impact the return on equity (ROE) negatively. However, after 2022 recoveries will fall in place.

The pandemic has changed a lot about how we function and has been an accelerating force for digitization. To catch up, traditional banks will be forced to urgently partner with fintechs and adopt cloud and disruptive technologies faster than they planned to. The BFSI industry will continue to experience an increase in the virtualization of the workforce, which will further cause to enhance cybersecurity, fraud prevention measures and surveillance.

Enterprises will also strengthen their environmental, social, and governance (ESG) commitments to leverage their growing influence. ESG impacts an enterprise's reputation and is being increasingly considered as a metric for stability and reliability. Regulators in the US and EU have already proposed new frameworks to set expectations in ESG. India can expect more funding and focus as well.

Digital banking sales existed even before the pandemic; however, it never took off due to customer preferences and ever-evolving solutions. Its adoption has been accelerated by the pandemic. Mobile banking apps, payment wallets, and the participation of non-bank players will see new business models and tools supported by mobile platforms.

Remote business models would certainly increase customer retention risks, as switching banks will become effortless and paperless. Banks will therefore need to retain clients by customized offers and inducements. To aid this, big data will play a huge role in providing tailored solutions to customers based on their history and profile. AI-based intelligent chatbot, banking assistants and virtual reality experiences will be used for engaging customers.

By how the ecosystem has adapted to the new normal, it is a given that there will be an increased acceptance of flexible shifts, hybrid work models, reduced working hours, and remote working models. On the flip side, we could expect reduced compensations, need-based hours, freeze on bonuses and promotions, reduction in generic roles like people management, application of a flat organizational structure, to name a few.

The waves of opportunities and drawbacks would be the only constant for the BFSI against the gigantic and mammoth sized changes that are yet to come. The combination of being nimble yet apprehensive makes it tricky but also adventurous. It's certain that the pandemic has played a pivotal role in fast-forwarding a bunch of transformations and it'd be a journey worth watching.

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On track, but miles to go

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The pandemic has led to swift adoption of communication solutions by the academic fraternity and students, and online learning has emerged as the only way to keep the education system running. Coupled with real time engagement, virtual education has been able to replace in-person classes. Also, edtech companies are exploring use of artificial intelligence (AI) and machine learning (ML) for personalized learning recommendations, AI-based coaching and mentoring, and virtual proctoring among others.

Expertspeak

"Mobile screens are not suitable for long hours of study"

ARVIND BALI
CEO, Telecom Sector Skill Council

Education and skill development are a key focus for the Government of India. The education budget was Rs 93,224 crore for 2021, with Rs 54,873 crore for school education and literacy and Rs 38,350 crore for the higher education sector. As a young nation with an average age of 28.4 years, this investment will go towards the education and vocational skill training of the youth. Education and skill development are crucial in eradicating unemployment and utilising our human resource. The entire nation was transformed into a digitally empowered society and knowledge economy through the Digital India campaign. The transformation of the education and skilling sector is also happening through the use of futuristic technologies to aid the mission of a successful and self-reliant India.

The New Education Policy (NEP) 2020 replaced the earlier policy introduced 34 years ago, with major reforms in the education system. It focuses a great deal on the use of technology and its integration. The NEP was drafted considering India's position as a global leader in information and communication tech and other cutting-edge domains. Education will play a critical role in this transformation and technology plays an important role to improve educational processes and outcomes; making the relationship between them bi-directional.

There are seven key technologies that are growth driers across industries, and education and skilling are no exception. These include 5G, cloud computing, artificial intelligence (AI), machine learning (ML), big data, robotic automation, drone, and blockchain. Each of these key technologies can be leveraged to increase operational, structural, administrative efficiency of the process of education and skilling.

Challenges and solutions

There is a clear gender gap when it comes to access to education in India. This means we lose out on a large section of our human resource capacity. It has been shown that women are better suited for vocational skill development with lower attrition rates in jobs. Awareness drives carried out to create a stronger, more lasting impact on importance of education for all.

A land of many languages, India needs a comprehensive system in place to provide education and skill development in regional languages while upholding the national standards of teaching. Not everyone speaks English to compensate for the lack of a national language. Standardized content is still far from perfect and collating open-source content will require tremendous effort on part of the government not to mention magnify the costs. The syllabus needs to be re-evaluated from an amalgamated learning approach.

The teachers need to know how to operate digital platforms more effectively. Short, inadequate training of teachers can lead to inefficient teaching methodology at the basic level. Additionally, single teacher schools are another major issue in the rural areas with 97,273 single teacher schools in the country which account for ~8.8% of schools in India. We need comprehensive skill-

> Data plans increase tariff with increased data usage. To address this, telecom companies can subsidize learning data plans to aid the existing gap.

> Blockchain will be used in many areas of education including examination management, student credentials verification, and certificate verification.

gap analysis at a district level which can aid industry and academia to come together and fulfil the needs of the industry.

The other key challenge we face today is the disproportionate distribution of human resource across the nation. The global pandemic also highlighted this aspect with disruption in the economy due to large scale migration of frontline workforce. This stems from the fact that there are certain jobs preferred or endemic to certain regions, sections of society or industries.

Urban centres see large densities of youth leading to high competition for selective courses and skills. This creates selective skill training in those regions and leaves a gap for other or less preferred roles leading to scarcity in that sector. Conversely in rural areas, the lack of competition invokes less funding for specialization skills leading to lack of high-skilled manpower in those regions. Labour migration patterns need to be studied to understand local requirements which will lead to more effective use of skill development funds.

Smart devices for low-cost education

Online education is a cost effective and scalable way to provide remote areas with access to high quality standardized education. This means that access to devices is imperative in remote or far-reaching sections of our country. Only 21.3% people have access to desktops in rural areas, while internet penetration is another key challenge. This affects availability of quality education in rural areas.

Mobile screens, although portable, are small and not very suitable for long hours of study. Data plans also increase tariff with increased data usage, making it difficult for locals to fund these initiatives out of their own pockets. To address this situation, telecom companies can subsidize learning data plans to aid the existing gap. Government rollout of digitization and fibreization drives are the key in tackling these problems effectively through rigorous survey and follow-ups.

However, a large percentage of the rural population lack adequate literacy to acknowledge these equipment and digital terminologies. An important concern includes the shortage of infrastructural support facilities like electricity and high-speed internet connections.

One of the easiest ways to sensitize the population is to collaborate with 'influencers' on digital platforms. These are not only high-visibility individuals but also ambassadors for digital outreach and its transformational capacity. Identifying suitable individuals can help expedite this process while incurring minimal cost and maximum engagement among the youth.

The future outlook

Digital education has frequently been regarded as a feasible solution to bridge the prevailing gaps in education delivery for the rural India. People often consider it to overcome the problems associated with high dropout rates, insufficiency of school teachers in rural areas, delivery of quality education, and lack of innovative teaching-learning techniques, and inadequate standard of the learning materials.

The National Education Policy (NEP) 2020 stresses on digital learning as an alternative to the conventionally accepted classroom model as a communication medium between teachers and students. This shows tremendous opportunity to install digital education infrastructure using government institutions helping standardize the courses and trainers.

Going ahead there seems to be some clear choices; e-learning and LMS platforms will take over conventional model of learning to create a blended learning environment. Industry-ready students will also become commonplace with introduction of vocational skill development courses into the K-12 curriculum, while digitization through the BharatNet will result in increased last mile connectivity in rural areas. This along with development of smart cities will create jobs for high-skilled individuals resulting in demand for higher education and skill training.

The use of AI to personalize learning experience will help us allocate human resource more efficiently and online certification will make getting jobs faster and more reliable. Blockchain will be used in many areas of education including examination management, student credentials verification, and certificate verification.

Expertspeak

"Edtech is tapping AI for personalized learning recommendations"

MINAXI INDRA
President & Head, upGrad for Business

The pandemic has led to an increased acceptance of online learning by both students as well as the industry and there is an overall recognition of the value of anytime, anywhere online learning that is accessible across devices.

Technology is disrupting all sectors and education is not an exception. However, most higher education institutions in India are not technologically advanced and hence they cannot stay relevant and updated with the evolving technology. Neither does it make our youth workforce ready. This is where edtech companies have an important role to play. This has led to creation of an entire digital ecosystem. Let's look at some of the technology trends that are influencing the education sector today.

Data analytics: While this is crucial to almost every industry, the education sector is using data analytics for better outcomes. Learner behaviour analytics today helps perpetuate a thriving learning culture and having a healthy learning culture has a direct correlation with employee engagement and retention.

Artificial intelligence and machine learning: Edtech is tapping the power of artificial intelligence (AI) and machine learning (ML) for personalized learning recommendations, AI-based coaching and mentoring, and virtual proctoring among others. The huge data bank

> In digital learning, the learner participates in a very engaging and interactive learning process that holds the learner's cognitive ability to learn.

enabled with AI can also be used to create customized assessments for students across subjects and grades.

Virtual education: With the pandemic, virtualization of office space has become a necessity for many organizations and learning is no exception – moving from classroom to virtual; be it for lab practice or lectures.

Augmented reality and virtual reality: AR and VR are playing a big role in simulation-based learning, especially in domains like manufacturing, logistics, medico, and pharmaceutical sectors. Edtech companies are partnering with AR and VR technology companies to provide an AR-driven immersive learning experience.

Blockchain: Universities are seeking to tap into the potential of blockchain for authentication and authorization of certificates and credentials. This will provide authenticity of their certification and students can rely on a digital immutable authentic copy of their certifications and degrees, etc.

Learning challenges and solutions

A major challenge of any virtual learning environment is how to ensure that it continues to engage the learners and hold their attention. Edtech companies are constantly trying to tackle these challenges through various engaging programs and initiatives. Also, while education sector can invest in technologies that can help in better learner engagement, the total cost of ownership and return on investment in such technology infrastructure is still very high.

Gamified learning and gamification in learning: The former is learning embedded in a game and the latter is gamification elements like points, and leaderboards, etc. in a learning experience. Both have their advantages whether you decide to implement a learning game to teach a specific skill or gamify the entire learning process, the learner will be more engaged and motivated. Both help increase engagement of the learner and in extending their attention span.

Online platforms: Through an online learning platform, one can have access to some of the best professors and universities from around the world including, multilingual content, blended learning with an online and offline learning experience, and personalized learning experience without any geographical barriers at a fraction of the cost. In digital learning, the learner participates in a very engaging and interactive learning process that holds the learner's cognitive ability to learn.

Going ahead, higher education and degree market is going to be the next big thing in the digital and online learning space with the New Education Policy 2020 emphasizing on online degree courses. Digital universities will be the way forward and will pave the way for new opportunities and boost India's future giving its youth a strong foundation.

Expertspeak

"The switch to online has made curriculum accessible from anywhere"

RANGANATH JAGANNATH
Director – Growth, Agora

The edech sector was one of the first to adopt a digital model at the onset of the pandemic last year. Teachers and students collaborated to troubleshoot technical problems as they arose, while educational institutions adopted remote learning software to provide the best experiences.

Some of the technology trends that paved way during the pandemic included web-based curriculum and supporting artefacts; a switch to online textbooks. While this helped reduce the cost to students, it also made the curriculum accessible from anywhere.

Better, faster accessibility: With the roll-out of better, faster, and less expensive data plans, we should expect higher adoption of digital literacy and education in geographies and populations that were not connected as well earlier.

Real-time engagement: Easy and scalable access to technology and tools that allow multi-way engagement with teachers and students will become a minimum requirement.

XR-based learning: A logical step forward is the inclusion of XR-based learning tools for a more immersive real-time teaching and learning experience.

Increase in video calling apps: The pandemic steered the adoption of video calling applications. It became a prominent mode of communication for teachers and students, as well as parents. Digitization led the way from online classes to exams, and meetings.

> Implementation and adoption of real-time engagement will be driven by accessibility and affordability, both for small cohorts as well as for very large classrooms.

Technology is there, and challenges too

While great strides have been made in amalgamating technology into education, there still remain a host of challenges to be addressed.

Lack of real-time feedback loop: Since these are relatively early days of edtech-at-scale, there isn't much by way of providing real-time feedback to students and teachers. One of the hallmarks of an in-class experience was the scope for interpersonal interactions and one-on-one tutoring. As much there has been development in this sphere, it acts as a barrier for many.

How much is too much: While it is tempting to pack a lot of features in a platform, app developers and product managers need to assess if they are overloading platforms with so many features that its users might get intimidated.

Gamification: There are early attempts to gamify the teaching-learning experience but are devices ready to render this gamification effectively, is yet to be known.

Costs and monetization: This is still an evolving model and it is up for discussion as to what are the right cost and price points so that all stakeholders come away happy given that the technological growth bought with it additional costs like cost of gadget, cost of data and others.

Lack of resources: With the pandemic, came the need for digitization and technological advancements. However, not everyone can afford this advancement. For a large number of students, parents, and teachers procuring resources like devices, Wi-Fi and data connectivity is a big challenge.

Online keeps it going

Currently live online learning is the only way to keep the education system up and running. Coupled with real time engagement, virtual education is doing a tremendous job of replacing in-person classes. Amidst the pandemic, with students and teachers spread across the country, interactive voice- and video-led software has helped retain the essence of a classroom by emulating the student-teacher connect. With real time engagement, there have been a couple of new and engaging ways of delivering education with the help of an integrated approach like live video, a virtual interactive whiteboard, screen share and full-length recordings backed by multilayer security for data protection.

A successful example of this could be upGrad, an online higher education provider platform. Its new platform replicates a real-time classroom learning experience by providing greater interactivity, real-time doubt resolution, in-class concept check, and session analytics. To summarize, real time engagement platforms help revamp and re-strategize the learning modules for students as well as teachers.

Good times ahead

For those looking at building edtech solutions, there are still a lot of areas that are under-served. Apart from aspects like immersive learning (XR-based), gamification, extra-curricular learning, adult learning, skills training, language learning, there is the whole domain of how to make all this truly interactive and engaging, at scale.

One can also safely say that hybrid learning models – a mix of offline and online – are here to stay. Just like workplace, a hybrid form of education system is to be seen in the near future. To enable this, real-time engagement and gamification of the teaching-learning process will continue to evolve and will take center-stage.

Edutainmemt (like co-watching in the OTT space) is emerging as a trend to allow students to learn at their own pace with friends. As fancy as it sounds, it will be interesting to see, how this shapes the educational fraternity. We will also witness 360-degree involvement of teachers, students and parents or employees in the case of adult education for better teaching and learning outcomes.

Lastly, the implementation and adoption of real-time engagement will be driven by accessibility and affordability, both for small cohorts as well as for very large classrooms. As a natural extension, XR-based learning tools will ride on top of real-time engagement capabilities to deliver much superior outcomes. The future is ripe for possibilities in education.

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Powering the network

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The energy sector is going through a massive digital transformation. The advent of 5G is expected to help it meet not just the operational challenges – managing the intermittency and variability of generation, maintaining grid stability, and responding to new and surging demands, but also sustainability commitments. The power sector in India has also started to embrace internet-of-things and is looking forward to IT-OT integration involving ERP, GIS, and SCADA, as well as use of AI/ML.

Expertspeak

"Automation will be imperative for managing grid operations"

MARTIN HAUSKE
Energy Segment Leader (Asia Pacific & Japan),
Nokia Solutions & Networks

The energy sector landscape is changing globally with an increasing adoption of renewable energy, battery storage, distributed grid edge generation (prosumers), and rise of electric vehicles. India is very much in the forefront of this transformation. Aligning to its Paris agreement commitments, the country has set an ambitious target of RE generation of 450GW by 2030, a substantial reduction in fossil fuel dependence by 2030, a "Go-Electric campaign", and incentives for faster EV adoption.

Compared to many nations, the power supply system in India is one of the largest and includes complex grid systems with its diversity of supply/demand positions across regions, and many market players – central generation and transmission utilities, state gencos, transcos and discoms, private power utilities, IPPs, power exchanges, traders, central and state regulators, and system operators.

Radical changes in the energy mix is leading to several challenges for utilities, central transmission grids and the state transmission/distribution grids – from managing the intermittency and variability of generation, to maintaining grid stability, and responding to new and surging demands from moving electric loads(EVs). Potential revenue erosion with growing prosumer generation and energy aware and energy efficient consumers, is forcing many utilities to redefine their business models for survival and growth.

> Higher levels of instrumentation through IIoT enablement of distribution grids provides utilities with the ability to sense, respond, and react in real time.

As a result, higher levels of instrumentation (industrial IoT or IIoT enablement) of primarily distribution grids are being deployed. This provides utilities with the ability to sense, respond, and react in real time to manage the supply/demand balance and stability challenges of the future grid. Digitalization and automation will be an essential imperative in managing grid operations and market transactions among grid participants.

There are several players that are engaged with utilities globally in enabling their future grid transformation with end-to-end communication network technologies like private LTE, 5G, optical; IIoT platforms; and digital automation cloud. Besides, there are also technologies that helps utilities plot a path to Industry 4.0, by providing a framework for controlling and managing assets and field resources everywhere, and the adoption of digital value platforms to manage and control the generation, distribution, and operation of energy services.

Going ahead, private LTE and 5G can play a major role in management of future grids by enabling grid edge automation, real time asset management through Drone based line inspection, VR/AR, and teleprotection.

Ultimately higher visibility of energy grid endpoints behind the meter coupled with data analytics will render better choices for consumers and minimize the gaps between energy have's and have-nots in large countries such as India. These technologies enable energy companies to transform into a distribution service operator (DSO) with multiple types of energy service (and potentially adjacent types of smart city services) offerings to consumers, and helps build smarter communities.

Expertspeak

"Indian power sector is opening up to embrace IoT"

BRAGADESH DAMODARAN
Director, Energy & Utility IndustryHub, Capgemini

The Energy sector is undergoing global transformation to fulfil its net zero and sustainability commitments. The Indian power sector is seen to be responding positively to this global phenomenon. Indian markets too are responding to the opportunities in the power sector, as major business drivers are in place for the absorption of new technologies and solutions to achieve the sustainability goals to keep carbon emissions in check. Here are some of the developments and technology trends with huge transformational potential in the Indian energy markets.

New and clean energy alternatives: Exploring new energy sources and fuel alternatives are high on the agenda for Indian markets. This includes solar-thermal, solar-wind hybrid, smart battery storage, green hydrogen and carbon sequestration. Use of artificial intelligence (AI) and machine learning (ML) to manage the distributed energy resources to optimize generation is the new norm.

Innovations in utility asset management: Indian utilities are facing an enormous burden of ageing infrastructure and have started exploring solutions which can provide better overview of the diverse assets, "retain or retire" decisions and use of technology to measure asset performance and enhance its life.

The markets are aligning to the needs of the Indian power sector, with a growing demand of smart asset monitoring, visualization and analytics. These needs will push the adoption of cloud-based services on software-as-a-service (SaaS) model in the Indian power sector. The solution will spur the demand for enabling technologies like 5G, edge analytics, cloud computing and cybersecurity. Use of AR/ VR and digital twins are other technologies which will dominate the Indian market space in the future.

Smart metering: This has a huge potential in the Indian market. It is not just about the meter-reading device, but about solutions built around it, e.g. load management, energy efficiency management, network health monitoring, predictive analytics and customer services.

There is a growing future market in India to add more intelligence and improve communication and security in the humongous rollout of smart metering in India. There is a huge opportunity in the Indian markets for the creation of robust and secure communications (e.g. 5G), smart bots and energy data analytics (using AI/ ML).

The age of internet-of-things: The Indian power sector is now opening up to embrace internet-of-things (IoT) as a technology of choice in a big way. There is a fast-emerging market for IoT in the Indian power sector – for applications like planning and forecasting, utility asset monitoring, predictive maintenance, energy efficiency and performance improvement. The appetite for IoT-based solutions in the Indian power sector is growing fast and there is a huge market for enabling technologies

> There is a fast-emerging market for IoT in the Indian power sector – for applications like planning and forecasting, utility asset monitoring and predictive maintenance.

> A growing market is foreseen in India for hyper-personalization solutions, using real-time communication systems and RPA to enhance the user experience.

for IT-OT integration involving ERP, geographical information system (GIS) and Supervisory Control and Data Acquisition System (SCADA). IoT-based solutions are also opening the market for Secured cloud computing, data communication using 5G and AI/ ML.

EV charging infrastructure and vehicle-to-grid solution: The demand for EV infrastructure is growing in the Indian market, including the use of vehicle-to-grid (V2G). There is a growing scope to exploit this market segment to use EV battery energy of stationary vehicles to power the grid. Many leading Indian power distribution companies are setting up the infrastructure to develop EVs as potential source of clean energy powering the grid.

A huge market demand is predicted for EV infrastructure solution which tracks grid parameters, energy demand, pricing and weather predictions, using AI/ML, to enable EV owners to take informed decisions on charging their vehicles and exporting power to the grid.

Defining energy-sector challenges

The roadmap to achieve carbon neutrality by 2050 is also fraught with numerous challenges.

Community participation: Involve community at large to participate in energy saving programs such as demand side management (DSM). This entails creating awareness among energy consumers on adopting energy efficient practices, thereby reducing their energy bills.

Creation of charging infrastructure: Manufacturing of EVs in large numbers and gradual phase-out of petrol and diesel vehicles will spur the demand of charging infrastructure, which is essential for a healthy growth of EVs in the Indian market.

IT-OT integration: Since many utilities still use legacy applications with proprietary standards, it becomes a challenge to enforce integration of different solution components. This has to be addressed by upgrading certain solutions to conform to open standards.

Cybersecurity compliance: The cybersecurity compliance has to be ensured at various levels – devices, network, data and cloud, which could be challenging. This can be resolved by doing vulnerability assessment and penetration testing.

Standards and interoperability: There is a need to ensure adoption of industry standards for smooth migration to new platform on cloud, 5G compatibility and IoT-based systems.

Solutions at hand

Indian power sector is contemplating different solutions to meet the energy demands in the most sustainable way, with focus on long-term energy security and sustainability. The following initiatives by the Indian power sector are likely to create a huge market impact, offering a huge opportunity for bespoke solutions.

Supply-side (generation side) initiatives

- **Renewable energy (RE) generation:** Distributed Energy Resources Management System (DERMS), Automated Demand Response (ADR) and intelligent Battery Energy Storage System (BESS), targeted to maximise operations and efficiency of the Indian utility's RE portfolio. Technologies that will drive the above solutions are 5G, Edge analytics and AI/ ML.

- **New energy network technologies:** Indian power sector will require proven solutions to enable grid resiliency, self-healing and adaptive energy networks. This is likely to see a huge growth potential in the Indian markets for remote monitoring and visualization, smart asset analytics and predictive maintenance, with demand for IoT-based and data-driven cloud technologies, and faster communication networks using 5G.

- **Community microgrids:** Grid-connected community microgrids are gaining acceptance in India. Powered by renewable energy, these are self-sustained energy networks supplying power to the local community. There is a huge market potential in India to develop an intelligent microgrid, to export excess energy to the

Opportunities are emerging in mobile computing front to enhance digital experience, workforce management, SaaS, and technology-on-the-go.

main grid, with attractive revenue model, using AI/ ML and IoT-based energy data monetization. Virtual power plant (VPP) solution using AI/ ML is a huge future market prospect for India.

Demand-side (load side) initiatives

- **Demand side management:** There is a demand in the Indian power sector to develop solution to track energy consumption of end-use customers, and send them automated alerts on their smartphone to promote energy efficiency and save precious resources. This is called demand side management (DSM) which will see a future market push of developing smart solutions using edge intelligence to communicate with energy customers in real-time to bring down their energy bills, thus avoiding wastage of energy and resources.

- **Smart metering and hyper-personalization:** Smart metering with in-home displays will help residential and commercial energy consumers keep a tab on their energy consumption rate. The projected growth in the smart metering segment in India is creating a demand for intuitive interactions with the energy customers using AI/ML. A growing market is foreseen in India for hyper-personalization solutions, using real-time communication systems and robotic process automation (RPA) to enhance the user experience.

There is a growing list of opportunities in the power sector in India. New technology adoption, focussed on sustainability and IT-OT integration are creating opportunities in diverse areas such as SCADA, GIS, ERP, smart grids, predictive maintenance, smart asset analytics, remote monitoring and visualization, cloud computing, cybersecurity, big data, industrial IoT and AI/ ML.

In fact, RE proliferation will encourage sustainable technologies of the future like automated demand response (ADR), distributed energy resources management system (DERMS), digital twins, AR/ VR technology, AI-based modelling and forecasting to name a few.

Another huge opportunity is ERP migration to cloud-based platform. Since many Indian utilities are using SAP ISU, there is a growing future market on SAP ISU migration on S4HANA platform and cloud-computing technologies. The need for bandwidth to support these technologies and real-time systems will spur the demand for 5G in India. Opportunities are emerging in mobile computing front to enhance digital experience, workforce management, SaaS, and technology-on-the-go.

A positive future outlook

Indian market is looking up positively to far-reaching transformation in the energy sector, and progress the sustainability agenda to achieve near net-zero targets by 2050. The future outlook for the power sector in India is expected to transform in the many ways. As the country continues to adopt clean technologies, there will be a growing penetration of renewable energy into the grid, and more independent microgrids – solar, wind, biomass, battery energy storage, waste-to-energy – will continue to power communities. It is estimated that by the middle of the century, India can expect four times as much of renewable energy generation than what the country has today.

By 2050, more bioenergy will be added to the energy landscape. It is estimated that liquid biofuels will surpass petroleum products in fuelling the industry and transport sector, before mid-century. Also, there will be big push for green hydrogen as fuel for the industry and transport, and n carbon sequestration technologies

While the future looks promising for the Indian power sector markets, to achieve its target the country will need to rely heavily on solutions based on IoT, AI/ ML, cloud, data integration and 5G. Driven by actions to reverse climate change, India will continue to invest in processes, technologies, end-use energy efficiency, and carbon footprint reduction. Besides, market-driven mechanisms, such as peer-to-peer energy trading, carbon pricing, congestion-based pricing and green certificate trading will become more innovative with AI/ML technology, which will stimulate reallocation of capital and resources to fund these opportunities.

Expertspeak

"The role of digital technology is getting redefined for renewable"

DR. PRAMOD PALIWAL
Professor & Dean, School of Petroleum Management, PDEU

The indicators are obvious that world is getting impatient for a low-carbon future in numerous ways. Investors are now seeking for more than just returns; they want reliable returns, i.e., returns that have a significant environmental, social, and governance impact on the sector as a whole. COVID-19 emergence that saw collapse in oil demand and transition that is generally expected in years took only a few months.

The renewable energy technologies that were considered threat to conventional oil and gas (O&G) companies have now become a part of their own portfolio. Industry as a whole is refocused on carbon management, making the goal of decarbonization part of their fundamental strategy, and also making them public. As traditional energy companies add renewable to their portfolio, network and communication technologies will need to keep pace with the phenomenon. If digital technologies were earlier crucial for modernizing extractive industries, their role is now getting redefined for above-the-ground energy production, transmission and distribution.

Moreover trend towards electric cars and subsequent recharging infrastructure creation accentuates the need for network technologies aligning with smart grid and EV info ecosystem.

The industry challenges

Let us look at them under different categories – the need to refocus and redefine portfolio strategy, improving competitiveness, and becoming technology ready for the green digital era.

Focus: Companies in the O&G sector have built their business models around the assets they own, and resources they can pull from ground. They have to renew their focus on society and customer instead. It is about delivering solutions that meet customers need and address societal concerns.

Portfolio: So far O&G companies managed massive portfolios of assets that were largely rigid. Operating successfully in 2021 and beyond will require companies to take a much more strategic look at their holdings and build the agility and improvise asset classes as conditions dictate. Role of data analytics and subsequently that of ICT in bringing about operational efficiency will be important. The challenge of course is the speed as well as willingness to spend.

Competitiveness: I a world of shrinking demand, mastery of oilfield technologies are no longer an advantage. Much more valuable is mastery of digital technologies that connect the organization and optimize the end-to-end value chain. Gaining edge in digital technologies is quite a challenge in its own ways.

Technology readiness: With energy companies moving towards adopting Industry 4.0, the role of

> As traditional energy companies add renewable to their portfolio, network and communication technologies will need to keep pace with the phenomenon.

With energy companies moving towards adopting Industry 4.0, the role of network and communication technologies has become more important.

network and communication technologies has become more important. The challenge here would be to take quick moves with earmarking of adequate investments and building competent teams.

The future outlook

While oil and gas will continue to be important sources of energy, the way these resources will be consumed and the expectations for how these resources will be extracted, refined and commercialized will be completely different. To retain their mandate – both commercial as well as moral – to operate, companies need to embrace the structural shifts and meet above challenges head-on. Energy efficiency continues to be a focus for energy companies and hence the role of ICT in sharing real time information, analyzing and taking corrective actions becomes crucial. Emerging Hydrogen ecosystem too presents opportunities for players in the network and communications sector.

The scenario in India presents a very interesting case-study. As the world strives towards cleaner energy, India's hunger for energy is set to overtake EU by 2030, making it third largest energy consumer of world. The country will continue to see three times increase in import by 2040. It is fair to argue that India finds itself in an unusual position of having to pioneer a new low-carbon economy while also striving for growth. If India is able to achieve this, it will be a role model for other developing economies, especially in the African continent. Moreover with solar energy poised to play a major role in decarbonizing the electricity sector, owing to optimization needs, network and communications technologies aptly synergize with this thrust.

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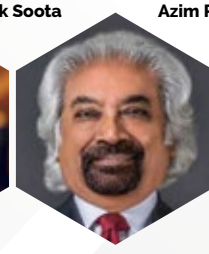

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Riding high on digital backbone

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The pandemic has brought to forth the need to integrate digital technologies across healthcare – from patient tracking and disease surveillance to patient care and research for development of vaccine. Despite being digitally unprepared, the sector quickly adopted not just collaborative and communication tools but also open source hardware, personal medical devices, mobile phone applications for creation of unique medical devices and individualized care. The sector has also started to explore upcoming technologies like blockchain, AR/VR, and NB-IoT.

Expertspeak

"Health tech standards are slower than advent of new technologies"

GURUPRASAD S
Vice President, Robert Bosch Engineering & Business Solutions

There has been a tremendous increase in the number of interconnected devices that generate, collect, analyze or transmit health data. Augmenting this data with a layer of artificial intelligence and machine learning will generate timely insights resulting in faster and more accurate diagnosis and treatments.

Upcoming technologies like blockchain have the potential to re-instate trust in the digital healthcare space by addressing issues of data security and privacy. Features like smart contracts enable fast and secure micro-transactions that enable seamless transfer of patient medical records where it is needed to advance the medical science.

Even the most experienced clinical surgeons face surprises on the operating table. New technologies like AR/VR reduce the likelihood of such surprises, allowing for digital rehearsals of high-risk and complex cases. These technologies could be further leveraged to educate patients prior to planned procedures, improve caregiver trainings and even help patients express their complex symptoms more effectively.

Narrowband Internet of Things (NB-IoT) is another promising new-technology that delivers connectivity at low data transmission rates. This would enable sensors with limited device processing capabilities and limited battery lifetime to handle high-intensity and short-lived demands of new generation IoT applications. This is an important need for continuously monitoring patient's physiological parameters for reliable remote healthcare monitoring systems.

Patient engagement is another area that healthcare organizations desire to address effectively since it helps to deliver realizable business value and superior patient care at affordable costs. Intelligent healthcare automation enhances patient experience and increases compliance by automating patient pre-authorizing, claims processing, operational analytics, medical record management and other necessary but mundane tasks.

Patient data and other challenges

Using digital technologies can enhance the efficiency of healthcare businesses and provide tailored individual care. However, this could lead to a potential system design paradox for the providers: "which is more important?", "why put effort into standardizing care pathways when the goal is to shift towards personalized care?"

The healthcare system is burdened with caring for a growing patient volume and ageing population. It is already in a crisis with insufficient physicians, nurses, and technicians to diagnose and treat patients – global deficit of 9.9 million healthcare professionals is expected by 2030.

Additionally, according to the World Economic Forum Global Risk Report, chronic or non-communicable diseases (NCDs) have already surpassed infectious diseases as the leading threats to global health. Because of the complex and often-lifelong treatment for these chronic illnesses, as well as increased longevity, managing NCDs has put healthcare systems under tremendous strain. When considered collectively, these issues have the potential to increase overall healthcare costs while increasing caregiver fatigue.

Data is something that healthcare companies have dealt with over a long time. The challenge however, is making this data accessible and interoperable so that meaningful insight is drawn while ensuring sensitive personal data protection.

Patients and caregivers agree that health-care systems require more access to diagnostic technologies. Diagnostics has become important generators of value

> Open source hardware, personal medical devices, and mobile phone applications are allowing for the creation of unique medical devices and individualized care.

for patients and health systems, but this promise has not been realized in all contexts, notably in low and middle-income economies. It is rather well known that diagnostic development has been stalled for a number of diseases and that even when appropriate tests are available, they are not always accessible or affordable to those who require them the most.

Open source hardware, personal medical devices, and mobile phone applications are allowing for the creation of unique medical devices and individualized care. They, however, create new issues in blending the need for regulation with the need to innovate quickly and effectively. Health technology standards and regulations reform are much slower in comparison to advent of new technologies, making it challenging to adapt existing standards to the most promising advances. While regulatory guidelines have been revised to reflect proliferation of health-related mobile applications, determining whether and where these guidelines apply can be challenging.

Connectivity, interoperability is need of the hour

One of the industry's most important breakthroughs is remote health care. People stay at home while receiving their treatment, and caregivers treat more patients consuming less time. Physicians have access to higher quality and continuous clinical data than those gained during physical visits because wearables, biosensors, and smart medical gadgets provide them directly from the user, including statistical views and reports.

By utilizing these digital medical solutions, patients will be able to discover impending issues faster, prevent deterioration and better manage their conditions. On the other hand, healthcare providers can improve care outcomes while saving precious time and resources. Technology can boost efficiencies across the patient journey and alleviate resource constraints.

The healthcare system's design contradiction, which forces providers to choose between standardization and personalization, presents a unique opportunity to create solutions that strike a balance between the two while also leveraging digital for collective societal goals. Standardization, at its least, can provide efficiencies that allow more time for complex and tailored treatments. Similarly, customization helps those working within a system to cater to the requirements, needs, and preferences of individuals and local communities they serve. The conflict between the two is minimized by preserving the values of individual agency, professional autonomy, and a relationship-based care.

Interoperable platforms aid healthcare players in ingesting, managing, storing, viewing, sharing, and exchanging medical data irrespective of geographies. It also facilitates sharing of electronic health records (EHR) allowing doctors to have a better picture of their patient cohorts. Integrated health systems (IHS) have enabled the secure transmission of medical images, making data transfer faster, cheaper, and more dependable. They are, at their core, vital connectors that lead to better patient outcomes and at the same time provide a secure single repository for health data in order to prevent data leaks and vulnerabilities from unauthorized devices or individuals.

As artificial intelligence (AI) clearly demonstrates its ability to tackle many of the most time-consuming and variable aspects of diagnostic medicine, hospitals will be able to address the imbalance between available expertise and growing patient volume by incorporating this technology as a central component in routine patient management. Medical Image analysis coupled with machine learning and AI holds the promise of addressing diagnostic efficiency concerns as well as the potential to drive value-based treatment with insights that go beyond what modern medicine can now provide.

Solutions to the regulatory problems could be publishing documentation and making it openly available for review, increasing transparency to cover people's everyday use of personal health technology. Allowing patient groups to review mobile applications, create their own guidelines and collaborate with one another can accelerate evolution of regulations at par with the pace of digital technologies.

Reaping benefits of big data

The focus of healthcare data analytics will change from "big data" to "valuable small data." Globally, increasing digitization of healthcare workflows is resulting in a data explosion throughout the care cycle. In comparison to other emerging technologies, this makes extracting insights from existing healthcare data for specific use cases a

> Interoperable platforms aid healthcare players in ingesting, managing, storing, viewing, sharing, and exchanging medical data irrespective of geographies.

comparatively low-hanging fruit. Furthermore, because health data is the "holy grail," analytics solutions are seen as the first step towards catalyzing complementary technological promises based on healthcare data (example: AI, cloud computing, and blockchain).

Current technologies are frequently portrayed as building barriers between patients and caregivers. In order to eliminate these barriers, focus must shift from conversations surrounding digital transformation to digital clinical outcomes. Population health management, financial performance improvement, and operational automation by patients, payers, physicians, and procedures are all significant themes driving this potential opportunity. Furthermore, the rise of value-based care and outcome-based reimbursement programs will fuel demand for customized analytics solutions.

Digital therapeutics is on the verge of becoming a viable medical alternative, utilizing communication-based technology, applications, and software to improve patient outcomes while also lowering healthcare costs. By obviating the need for a drug or supplementing a standard of care, digital therapies can enhance patient outcomes. Digital therapies will grow in popularity as a promising healthcare solution that adds a curative component to technology. Aside from diagnosis and treatment, prevention and recovery are becoming new priority areas as the breadth of care for these chronic conditions expands. To properly stratify at-risk patients for a preventive and targeted treatment paradigm, opportunity lies in creating a holistic perspective of individual health, lifestyle, and environmental data beyond clinical health records.

Businesses are over-burdened with data from varied sources – both internal and external. This is leading to increased societal focus onto the topic of who actually is the owner of such acquired data. Bernard Marr, author of the bestseller "Big Data in Practice" describes "Data Democratization" as everybody having access to data with no aggregator acting as a gatekeeper thereby creating bottleneck to its access. Data Democratization is being aided by emerging technologies like Blockchain, which create numerous prospects to enable secure collaboration among multiple parties who may have no trust amongst themselves.

5G: The new healthcare driver

The emerging telecommunication revolution in the form of high bandwidth 5G networks will further propel the growth of Artificial Intelligence of Medical Things (AIoMT). AIoMT is a fertile bed for data (both what it generates and what it transmits). Hence, pipelines that handle data become an equally important factor and enabler so the overall system does not get clogged leading to under-performance. 5G networks will also act as a clear enabler in higher adoption of Edge-Computing within AIoMT systems due to their low-network latencies and higher response times. Today's raw data byte driven AIoMT systems will mature towards Voice and Video based systems providing closer to human behaviors and outcomes.

The future will be focused on primary care modernization. Advanced primary care services with larger and more varied care teams are expected in the future. Social workers, nutritionists, health coaches, and physicians are among those who will deliver a more comprehensive range of services aimed at improving health and well-being.

Infrastructure and platforms that can service highly empowered and engaged individuals in real time will be required in this new world of digital-health. The pipes will have to be laid by someone. Builders of data and platform infrastructure will create and administer site-less health infrastructure to connect consumers and other healthcare stakeholders, as well as establish platform component standards.

Benefits from pharmacies and present mass-produced drug programs will also change. Not only has pharmaceutical research enhanced the development of specialty medications and biosimilar, but it has also advanced the development of treatments tailored to an individual's genetic makeup (DNA). Precision medicines based on genetics will be developed to target specific cancerous tumors. Combining the two disciplines of 3-D printing and nanotechnology has the potential to drastically alter how existing components are made as well as create a gamut of whole new materials with wider applications in medicine. Pharmaceutical corporations will almost certainly morph into actual life sciences firms. The utilization of one's biometrics for ongoing pharmaceutical treatments will require data once again.

Expertspeak

"The sector needs to adopt technologies with an open mind"

PRAMOD SHARDA
CEO, India & Middle East, IceWarp

In the healthcare industry, the adoption of digital tools has been a bit slow as compared to the other industries. However, this slow adoption witnessed an immense surge during the COVID-19 pandemic in order to brace the recovery and to reconcile the damage incurred due to the deadly virus. Notably, in a very less time, COVID-19 became a reason for disruption for most of the industries including the healthcare industry, be it hospitals, pharmaceuticals, medical devices and equipment manufacturers, etc. Using technology, the healthcare industry especially in India completely changed the way in which they used to operate.

In a bid to bring down the number of COVID-19 cases or simply controlling the spread of the contagious virus, collaborative and communication tools played a pivotal role. In these tough times, while the industry has been putting in their heart and soul working day in and out to support and match the pace with their unwavering spirit, without collaborative communication the situation could have been devastating. COVID-19 has certainly transformed and made the nation aware of the importance of digitization even when we all are bound to stay inside our homes.

Overall collaborative solutions have been a big help to the healthcare industry. These include unified communication solution that connect the healthcare teams inside and out, improves access to medical information and data, enables quick decision making due

Collaborative solutions have been a big help to the healthcare industry. These include unified communication solutions that connect the healthcare teams inside and out.

> Innovation in healthcare is very broad – from delivery of preventative healthcare to new forms of personalized and remote contact with patients.

to the smooth flow of information between health care teams, better healthcare updates, and higher security of patient records and personal information.

Data and information challenges

The healthcare industry is one of the largest industries in the world that requires handling of a large amount of crucial data and information and a huge workforce that needs to be managed securely. Some of the major challenges of healthcare and pharmaceutical industry can be listed below.

- Managing users – creation and deletion – regularly due to the high attrition rate
- Making available data on mobile for sales team and MR
- Data security on mobile
- Migration of data despite limited strength of IT team
- Archival of data as per healthcare industry guidelines (HIPAA)

The pharma industry has lately realized the importance of the same and hence, has started investing in digital transformation technologies. To operate and communicate in a secured way, an effective and end-to-end encrypted communication tool becomes a key differentiator in the industry. There is also a need for seamless integration of technology into the healthcare sector to empower the industry to negate cyber risks and has opened up new avenues of progress with a very personalized and an innovative way of collaboration.

Collaboration all the way

Collaborative tools like- video conferencing, team messaging, and business suites provide great opportunities for improving communication experience between the industry and their stakeholders especially when the COVID-19 pandemic hit the industry which was not much prepared earlier. Initially, from supply chain, safety measures, to workforce distribution, the industry suffered to deliver services at its best. However, as the complete healthcare vertical started leveraging digital transformation and adopted modern communications and collaboration technologies, delivering quality care and achieving seamless collaboration, improving operational efficiencies and enhancing patient care became way easy.

The collaborative technology platforms have been now considered a crucial tool because of the nature of this industry. Moreover, innovation in healthcare is very broad when delivery of preventative healthcare, new healthcare products, new forms of personalized and remote contact with patients is concerned. Hence, even when the time comes, technology will have numerous opportunities for improving and transforming healthcare sector by reducing human errors, improving coordination, uplifting practice efficiencies, and securing data simultaneously.

Healthcare workers, as well as their stakeholders, have to embrace emerging healthcare technologies in a bid to stay pertinent in the coming years. The sector needs to work hand-in-hand with technology, adopting technologies with an open mind and preparing for the changing world as much as possible is the only way forward looking into the current scenario. The future is in front of us and digital is certainly the future as well. Digital technology like collaborative tools could help transform healthcare systems balancing the relationship between medical professionals and patients.

To some extent, COVID-19 has also enrooted the benefits of collaborative technology, now there is more awareness in the healthcare industry about the role of collaboration.

The future of collaborative technology not only depends on the healthcare practitioners but also on the human factor that requires more focus towards the usability of prevailing technology and future technology. The process could start by transforming end-users psychology and pushing them to think differently regarding the end goal of collaboration tools, defining the aim; clarify what technological collaboration means and their key purposes

Expertspeak

"Blockchain and big data can help streamline healthcare processes"

SHAJAN GEORGE
Sr. Director Sales – Private Network, R&M India

Post pandemic many nations including India are looking forward to strengthen the healthcare sector in their regions. Now, more than ever technology and healthcare go hand-in-hand. Implementing electronic-medical records (EMR), blockchain systems, artificial intelligence- (AI) driven natural language processing, augmented and virtual reality integration, telehealth/telemedicine, internet of medical things (IoMT), and 3D printing are just few of the technology trends that are playing a major role in expanding the sector.

But healthcare is not just about serving the patients. Research, pharmaceutical, analytics of health related topics, and biotechnology are part of the healthcare ecosystem. Japan, for example is investing more and more on robotics to take care of the increasing number of senior citizens in their country. This is also a current trend attracting investment and considered by healthcare industry and tech moguls. Investment is also needed to make healthcare infrastructure safe in terms of patient room and treatment room cabling. Besides the need for reliable LAN products, the healthcare environment needs the ability to identify and separate different networks, antimicrobial treatment, and overvoltage protection.

Today, the industry can offer solutions for treatment and patient rooms to ensure that specific electromagnetic, galvanic separation and hygiene requirements in these special environments are supported. These functionalities can directly help improve the care process, positively affecting the health of patient and staff.

Healthcare sector ills

Just like challenges in any vertical, even the healthcare sector has been challenged by many of the external factors in terms of technology. Security, data privacy and regulations, simple user experience, blind spots, keeping up with old technology, the non-availability of right resources for data scientists, and data analytics engineers are all challenges that the healthcare industry is facing.

Lack of right manpower often affects the capacity to face challenges. Security and data privacy are one of the supreme requirements of healthcare as the records of a patient and their health history is utmost importance and recently cybersecurity breaches have put hospitals, their functioning and patients' privacy at threat. Medical technology is advancing by leaps and bounds. Yet one thing left in the dark ages is user interface. These devices might change the world, but it won't matter if they're too difficult to use.

Various solutions can be implemented to help the healthcare vertical overcome the challenges it faces on a day to day basis, including the use of deep tech like AI in healthcare for cost effective treatments and personalized decision making. Clinical trial can be made easy with strong DC support. Blockchain and big data can be utilized to further consolidate and streamline healthcare processes.

Newer technologies with DCs and strong infrastructure as a backup, drug development, patient healthcare prediction, stronger research, healthcare trackers, wearable and sensors, nanotechnology, gene sequencing, recommending treatments and identifying high risk patients, health chatbots are few of the many healthcare opportunities that can be looked at. Smart building is another factor that can be considered, including data security. This is a priority in terms of securing the perimeter and building, and applies to all levels of the IT infrastructure.

With AI, data analytics and immense data being generated, the future of healthcare industry is set to evolve in a gigantic scale. Real-time health prediction and analysis, 3D printing technology for a better understanding, smart infrastructure to enhance the performance of the unit and helps swifter performance which also leads o faster diagnosis. As healthcare vertical sheds the old skin of outdated technology and infrastructure and embraces the newer technology there will be no stopping the advancement in this field which would eventually benefit us all.

Expertspeak

"Buffering methods on local microcontrollers need to become robust"

DR. SHARADA RAO
Head, Life Sciences Business Delivery, Birlasoft

The medical device industry is witnessing high levels of growth due to increasing demand at hospitals, medical and surgical centers. Rapid adoption of high-end medical devices across hospitals is driving the global medical devices market. Fortune Business Insights predicts that hospitals, medical and surgical centers will remain dominant and find greater use in the coming years.

Increasing expenditure on healthcare and expansion of healthcare infrastructure, especially in emerging nations are anticipated to drive this segment during 2021-2025. The medical device market is projected to expand at a CAGR of > 5.4% by 2025 and is likely to reach USD612.7 billion by 2025.

In-vitro diagnostics help in the testing of diseases such as malaria, diabetes, cancer, STDs, and AIDS/HIV. These devices provide accurate information, a key factor fueling their demand worldwide. In-vitro diagnostics has piqued in interest and has potential to dominate the medical devices market.

Trends in medical devices industry

Telehealth: COVID-19 has greatly accelerated the use of telehealth resources. In April of 2020, 43.5% of medicare primary care visits in the United States, utilized telehealth methods rather than in-person visits. One of the major benefits of telehealth over in-person alternatives is that it reduces contact between patients, healthcare workers, and other patients. Wearable devices enable healthcare workers to have real-time information on patient data while they remain at home.

More importantly, the growth of telehealth appears likely to continue even after the pandemic is over. Over 71% of patients in the United States considered telemedicine at the beginning of the pandemic, and 50% had already utilized virtual appointments. With telehealth already rising in popularity in the previous year, the pandemic was a major boost to the industry's development. With this boom, telehealth is likely to touch to USD185.6 billion by 2026.

The growth and evolution of voice, data, and communications technologies have impacted telemedicine in a big way and telehealth solution clearly has a strong future. The most robust telehealth services are provided through telemedicine apps. Apps on devices with feature rich pathways, ease of user experience and versatility in communication management are core to patient adoption. This can enable useful features like text and video chat, screen sharing, and file transfer.

Electronic health records (EHR) are important to integrate into your telemedicine app. This allows patients and healthcare providers to see patient medical records in the app. Interactive voice response (IVR) is useful for the app to relay communication to patients through digital speech. Google fit and Apple HealthKit integration also presents valuable opportunities for allowing the app to access existing health information available on a patient's own smartphone. Cloud-based server solutions are also critical for all of the above processes to function.

> Apps on devices with feature rich pathways, ease of user experience and versatility in communication management are core to patient adoption.

> When building a telemedicine app, it's critical to plan for security, location services, and wireless testing, etc. through wearable integration.

When building a telemedicine app, it's critical to plan for security, location services, appointment management, video/audio communication, secure messaging, healthcare provider reviews, visit history, and wireless testing through wearable integration. From security to accessibility, these features are essential when considering the needs of a telemedicine app.

Vaccine discovery, AI, and data: Vaccine development underwent a massive transformation in terms of industry collaboration in R&D, time to discover target molecule, rapid prototyping, pre-clinical and clinical trials using artificial intelligence (AI) and launch within a year's This was totally the Pearl Harbor of drug discovery, wherein necessity introduced a whole new model of rapid drug discovery; and every entity including the regulatory bodies complied with the need to overcome the pandemic.

AI also plays a critical role in the fight against COVID-19, including areas like pandemic detection, vaccine development, thermal screening, facial recognition with masks, and analyzing CT scans. Data management, AI, and machine learning (ML) algorithms scan over 100,000 media sources worldwide in over 65 different languages daily to ascertain dangerous outbreaks in nearly real time.

To predict the risk of a disease becoming a pandemic, several threat vectors are analyzed. These include insect and animal populations, global and regional climate conditions, flight data and itineraries worldwide, capacity of health systems, and vaccine development.

When developing new vaccines, the goal is to include strongly immunogenic viral components that cause a response from the immune system. Machine learning has enabled great strides in immunology. AI can help identify viral fragments that have the properties needed to accomplish these goals, while ML enables advancements that humans would not be able to achieve otherwise.

The precision, efficiency, and speed of these developments cannot be achieved with human work alone. With machine assistance, immunologists have identified over one million fragments of proteins on a cell's surface that are discoverable by T-cells. Thanks to ML, COVID-19 vaccine development has been implemented worldwide

The internet of medical things (IoMT): Various devices and mobile apps have come to play a critical role in tracking and preventing chronic illnesses for many patients and their doctors. By combining internet of things (IoT) development with telemedicine and telehealth technologies, a new internet of medical things (IoMT) has emerged. This approach includes the use of several wearables, including ECG and EKG monitors. Many other common medical measurements can also be taken, such as skin temperature, glucose level, and blood pressure readings.

By 2025, the IoT industry will be worth USD6.2 trillion. The healthcare industry has become so reliant on IoT technology in 2020 that 30% of the market share of these devices is expected to come from healthcare. With the arrival of new delivery methods, such as the first smart pill approved in 2017 by the FDA, practitioners will have many interesting options for providing care in a more effective manner.

AR/VR/MR in healthcare

Augmented and virtual realities (AR/VR) are important technologies with great potential to enhance the quality of telehealth during the COVID-19 pandemic. From enhancing patient and provider visits to helping educate medical students in procedure simulations, this technology is turning science fiction into reality. AR and VR technology shows promise for helping stroke victims overcome motor deficiencies. These patients must be put in a robust environment to help regain motor control. However, simulated environments provide more flexibility that physical therapy may not be able to offer. These controlled simulations can be used to gather data to help therapists tailor care plans for their patients.

There are new products such as VR headsets to work with individuals who have concerns ranging from dementia to cognitive impairments. They have access to activities and experiences that are otherwise unavailable in their current environments. This may allow patients to unlock memories and improve their emotional well-being.

Providing consistent and effective communication with numerous medical IoT devices is one of the biggest challenges that the sector faces.

Augmented reality can greatly assist healthcare providers in providing service. Since information can be provided in 3D space in a surgeon or doctor's vision, they can have real-time access to information that can benefit their procedures. This can allow students to learn more about procedures through overlays, and doctors can quickly compare data to help them make diagnoses. Another aspect of AR technology that is useful for the healthcare market is advancements in robotic surgeries. The future of AR will be strongly influenced by its use in healthcare settings.

Challenges ahead

Providing consistent and effective communication with numerous medical IoT devices is one of the biggest challenges that the sector faces. Manufacturers still regularly utilize their own proprietary protocols for talking to devices. This can present problems, especially when trying to collect large amounts of data by servers.

Connectivity issues are also still common, as the collection of data by microcontrollers and smartphones can be disrupted by several factors in the environment. Buffering methods on local microcontrollers need to become more robust to maintain better connections.

Potential security concerns also need to be addressed, as indicated by a report from the Ponemon Institute's Sixth Annual Benchmark Study on Privacy and Security of Healthcare Data, which showed that 89% of healthcare operations had been the subjects of at least one data breach.

The privacy Issues

Privacy is an extremely important issue in health technology, especially with regards to HIPAA compliance in 2020. Although cloud computing can make storing and retrieving data more efficient, regulations to secure electronic protected health information (ePHI) are very strict and complying with them can be very difficult.

Remote communication with patients is especially important during the COVID-19 public health emergency. Some telehealth technologies are not fully compliant with HIPAA which can raise challenges for patient privacy. Healthcare providers should ensure that they are still following the regulations as best as they can, only missing the bar where they have to.

Future outlook post COVID

As the world completes a year of the pandemic, many countries have resumed daily life and a lot of them have forced down lockdowns to combat the rising number of cases. Despite vaccines being rolled out, it a stark reality that the pandemic has impacted several industries, and the livelihoods associated with it. The move towards digital has found many takers and has posed a challenge to brick-and-mortar alternatives.

The speed at which technological changes have been inspired by COVID-19 has led to accelerated trends like – industrial automation and contactless payments. AR/VR, 3D printing, telehealth has given many industries a fresh lease of life during these testing times, enabling them to continue providing value to consumers and helping keep the economies running. Everything from doctors' appointments, medical consultation to regular life went online. People were forced to indoors yet made digital an indispensable part of their lives.

The future will witness healthcare adopting digital technologies in heaps; helping make it affordable and accessible to all. Wearables, AR/VR, appropriate use of clinical and consumer data, telehealth apps, remote diagnostics, virtual fitness, and therapy will find many more takers, as COVID-19 become a blur and the world finds its feet in the new normal.

Expertspeak

"Surveillance has played a pivotal role in the healthcare sector"

SUDHINDRA HOLLA
Director, Axis Communications, India & SAARC

Percolating to a catastrophic level, the pandemic continues to disrupt multiple facets of the healthcare sector. Technological innovation can change the dynamics of the healthcare industry to fight the pandemic and make the system more efficient.

The shift towards IP-based network video solutions with integrated solutions like artificial intelligence (AI), machine learning (ML), infrared LED (IR LED), wide dynamic range (WDR), and analytics in CCTV cameras is a primary technology driver to support the healthcare industry. This hugely contributes to the digital transformation of the industry and support frontline workers.

Another technology trend in the healthcare sector will be the demand for more cybersecurity solutions.

Remote monitoring technology can help healthcare workers reduce patient contact which will help in mitigating disease transmission and limit the use of PPE kits.

> Cameras enabled with audio and video analytics can be used to monitor a patient and detect early signs of distress in real-time and accordingly alert the staff.

The pandemic has put a lot of pressure on the healthcare industry in terms of data storage, thus increasing the risk to potential cyber-attacks that might lead to the leakage of sensitive patient information and lead to system downtime in hospitals. A strong cybersecurity solution will not only help in countering cyber-threats but also provide critical care.

The healthcare industry is additionally looking at workforce management with the help of smart technology that can monitor patients and act as the eyes and ears for the administration. It is also looking to embrace cloud-based solutions to improve accessibility through telemedicine and teleconsultation while meeting the challenges of reduced staff in a cost-effective way.

New-age challenges

Surveillance has played a pivotal role in the healthcare sector, owing to the inherent vulnerabilities faced by the doctors and healthcare workers. In India, it has hit this segment with a tremendous pressure to efficiently run their operations while monitoring patients and reinforce hygiene management.

With the task of establishing COVID care units to give special care to the virus affected patients with limited workforce, hospitals are currently facing a challenge in effectively ensuring proper adherence to government issued norms including social distancing, and crowd gathering in the premises. Acute pressure on the hospitals increases the chance of human errors or patient neglect. The lack of automated solutions for attendance and mask violations are other obstacles faced by hospitals. Additionally, perimeter security has also posed a major challenge with 24*7 services provided by them.

Cybersecurity is another major threat to the healthcare sector as hospitals grapple to protect their databases, especially at this moment. With increasing cases this year too, it is highly critical to maintain an error free and a secured database as it contains a lot of sensitive information making it a hotspot for hackers leading to severe reputation loss.

Opportunities and drivers

Technology-driven innovation has secured a wide pool of opportunities across industries including healthcare. The healthcare system around the world has struggled to keep pace with the increasing number of patients since the onset of the pandemic. It is now time to tap into these opportunities and explore them for better care of the patients. Remote monitoring technology can help healthcare workers reduce patient contact which will help in mitigating disease transmission and limit the use of personal protective equipment (PPE) kits.

Cameras enabled with audio and video analytics can be used to monitor a patient and detect early signs of distress in real-time and accordingly alert the staff, while healthcare facilities with the help of intelligent video surveillance technology and remote monitoring solutions can function better and provide faster patient care.

With the subsequent waves of the pandemic affecting the country, mitigating infections is the need of the hour. This can be ensured by remote monitoring of hand hygiene, PPE compliance and sterilization processes. Cameras can automatically notify cleaning teams on high visitor traffic to sanitize a particular area. Such use of connected technologies will be able to ensure compliance to the highest levels of quality in the healthcare facility. Real time location technology can also help officials find patients, beds, staffs, family members or equipment even in the most difficult situation.

The separation with a newborn baby for neonatal care can be extremely stressful for a parent. Virtual connection round the clock with the baby can comfort worried parents. High-definition video solutions with two-way audio feature can also help parents bond with their children especially when it is needed the most. This helps in contagion mitigation and also in making sure that the doctors and nurses are providing the best care to the children.

Time to go agile

EDITORIAL ADVISORY PANEL

- **Sunil Gupta,** Co-founder & CEO, Yotta Infrastructure
- **Dr. Nityesh Bhatt,** Professor & Chairperson, Information Management Area, Institute of Management, Nirma University
- **Neil Harwani,** Founder-Director – Harwani Systems

As enterprises fast-track their digital transformation journey to gain competitive advantage, building a robust network infrastructure is becoming critical. The pandemic also brought the IT & ITES sector to the centre stage, up against the challenge to bring the entire workforce online by scaling up cloud, virtual training, and increased use of VPN to strengthen the company's communication infrastructure. It is also driving use of DevOps tools and network technologies to facilitate concurrent development by multiple teams across time zones and locations.

Expertspeak

"Connectivity and automation are critical for innovation"

SUNIL GUPTA
Co-founder & CEO, Yotta Infrastructure

Industries worldwide, shaken up by the pandemic, leaned on connectivity like never before as employees were confined in their homes and office grounds were off-limits. The world relied on the IT sector to facilitate businesses with an uninterrupted working environment for their distributed workforce. Indian IT industry stood as one of the key drivers in country's accelerated digital transformation. Undoubtedly, cloud adoption became a necessity for business continuity from being a choice for cost optimization or scalability.

Emerging technologies such as artificial intelligence (AI) and internet of things (IoT) are being widely adopted and increasing business opportunities via data collection and analysis. There is already an impressive surge in customer data platforms (CDP) in order to collect well-curated data to operate optimally.

The technology industry has been bracing itself for 5G for couple of years and the focus now is on providing high-performance connectivity solutions to enterprises and end-users. Another significant trend alongside of 5G, edge computing has grown immensely in the COVID world as it is an efficient solution that optimizes technological interactions and reduces latency at the origin to enable real-time data consumption effectively. According to a report by International Data Corporation (IDC), the worldwide edge computing market will reach USD250.6 billion in 2024 with a CAGR of 12.5% over 2019 – 2024.

The industry concerns

Connectivity and automation are critical to bring innovation in the digital world. Under current circumstances, demand for IT services such as cloud migration, data analytics, applied intelligence, etc. are on the rise. Hence, the technology industry has been working under immense pressure to ensure seamless connectivity, stay accessible to the customers, maintain regulatory standards, and address evolving security threats.

The pandemic brought IT sector to the centre stage, and up against the challenge to bring the entire workforce online by scaling up cloud, virtual training of the staff, and increased use of VPN to strengthen the company's communication infrastructure. Security has been one of the biggest challenges faced by IT sector as unsecured remote devices connected to the server are prone to cyberattacks.

With the increase in demand for cloud services, integrating these services with different applications is on a priority list for technology services providers. By 2025, Gartner estimates that 75% of enterprise data will be generated and utilized outside of the data centers. To deploy storage capabilities and power source at the edge of the network will also emerge as challenge for technology team.

India is in dire need to grow its data center capacity due to pandemic's push towards cloud adoption and data migration to co-located data centers. Having said that, growth of data centres is hindered by challenges around land costs, power availability, and sustainability.

The XaaS solution

Due to the rapid shift in cloud computing and spurred complexities in technology over the past couple of years, managed services providers have become a one stop solution for tech enterprises to optimise and manage their entire IT infrastructure from managing CSPs to backups, network connectivity, disaster recovery, and security. The need to shift to a more flexible model has become critical for businesses. With XaaS, all cloud services are available at pay-per-use model allowing enterprises to avail

these offerings at zero Capex investment and zero Opex commitment. The pandemic and the government's push towards digitisation have accelerated the penetration of XaaS across Indian companies and the world.

A research reports by IMARC suggests that the global XaaS market is expected to reach $344.3 billion by 2024, expanding at a CAGR of 24 percent during 2019-2024. The IT industry has also been working on security technologies to protect data such as hardware authentication for IoT devices, user behaviour analytics (UBA) with the help of big data analytics, data loss prevention techniques like encryption, deep learning using AI/ML, and virtual security using cloud.

The pandemic forced the enterprises to accelerate digital transformation and deviate from the traditional workplace to innovate their operations and communication with employees and customers. To address these concerns, companies required work-from-anywhere services with secured connectivity and access to data and applications. Thus, it inevitably magnified the demand for cloud-based solutions like desktop-as-a-service. Virtual and graphics workstations also began to gain popularity. Simultaneously, it increased the demand for tech skilled resources.

The future outlook

As enterprises fast-track their digital transformation journey to gain competitive advantage, building a robust network infrastructure will be even more critical. Remote working will be the standard in the future and instead of temporary new normal, there will be a rise in demand for cloud services and security solutions. Even emerging use cases around AI, ML, and IoT will accelerate the demand for robust digital infrastructure. To drive innovative and profitable business models, enterprises will continue to align their business transformation efforts with adopting the public cloud platform. Everything-as-a-service will gradually become an imperative for a truly digital-native enterprise.

It is believed that 5G is the key towards a strong, digital India. There is going to be massive propulsion behind 5G in the coming years with large companies already investing significantly to build their own 5G ecosystem. Riding on the 5G and IoT wave, edge computing is booming in India. Organizations will need to keep data closer to the origin for low latency, better connectivity, and real-time data consumption. These compact and self-operating data centers will support more unique use cases of digital transformation in the future.

There will also be an increase in the demand for data centers like never before. While India is currently home to 80+ third party data centers, investments in the space have also grown exponentially with at least 10 new projects coming up on an annual basis. These investments are estimated to grow at 5% CAGR and reach USD4.6 billion per annum by 2025. Additionally, the JLL report predicts that in terms of power capacity (MW), the India data center capacity is expected to grow about three times to 1,078 MW by 2025. Currently, it stands at 375MW.

Expertspeak

"DevOps tools and network technologies enable concurrent development"

DR. NITYESH BHATT
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NEIL HARWANI
Founder-Director –
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The modern era or the twenty-first century belongs to science and technology as human lives revolve around state-of-the-art technology systems, specifically information and communication technology (ICT). Every sphere of human life – e-banking, e-health, e-government, and e-commerce, etc. is enabled by ICT systems.

The backbone of the continuously-evolving technology world is the tech community including developers, who regularly develop, deploy, manage and upgrade the software programmes to suit the changing end-user requirements. This process known as software project management, has evolved from waterfall model of software development lifecycle (SDLC) and has got new feathers with other approached like pair programming, iterative development, and hybrid approaches over the last six decades.

Programming styles like structured and object oriented ones also developed along these methods. Overtime, the older methodologies became inefficient and ineffective at delivering complex and time-bound products that changed frequently, resulting in development of Agile and subsequently, DevOps over the last two decades.

As per agilealliance.org, agile is the ability to create and respond to change. It is a way of dealing with, and ultimately succeeding in, an uncertain and turbulent environment. It is a methodology where product specifications evolve over time and development happens in small one to two week sprints, customers are shown demos at the end of each sprint and sometimes every day. It gives developers, product owners and management a flexible approach to build software products which evolve and are aligned to customer needs with course-corrections possible at any point of time during the project lifecycle.

Despite numerous benefits, certain limitations were observed in Agile approach too, which required weekly or fortnightly demos and deliveries. Therefore, continuous and concurrent light-weight design, development, testing, documentation, packaging, and release became sine qua non for sustenance. This necessitated the development of DevOps tools to improve the culture, deliverables and cycle time of project and product delivery. This shift was largely due to a large number of failures in software projects, cost and time overruns, and product non-conformance.

DevOps (in conjunction with Agile software processes) is a seamless methodology where the development team takes responsibility both for development as well as operations (therefore the term DevOps) which significantly increases the throughput. It has its origin in thought-provoking discussion between Andrew Clay and Patrick Debois (considered as the father of DevOps) in 2008.

Researches reveal that learning and assimilating the DevOps and Agile methodology are relatively difficult for the development teams, but it produces significant benefits to all stakeholders, both in quantitative and qualitative measures. With integration of Agile and DevOps, ownership, overall structure of technology products and their life cycle have seen a quantum shift.

The DevOps market size is expected to grow from USD2.90 billion in 2017 to USD10.31 billion by 2023, at a CAGR of 24.7$ during the forecast period, according to MarketsandMarkets. The IMARC Group also expects the

global DevOps market to grow at a CAGR of around 21% during 2021-2026.

DevOps and related tools: DevOps spans across coding, building, testing, packaging, releasing, configuring, and monitoring with cross-functional teams working on these areas. A lot of innovation in terms of processes and tools is happening in the DevOps world (including Scaled Agile). DevSecOps combines development, security, and operation. MLOps integrates machine learning pipelines and operations. DataOps and ArchOps are related tools in the domains of data management and software architecture.

Use cases for DevOps: DevOps gets leveraged across a wide spectrum for software development. Smart cars are example where car apps and navigation (integrated with IoT and embedded systems) need rapid upgrades and security patches from the vendor. In banking and financial applications, loan and insurance processes regularly change, which necessitate DevOps usage.

In smartphones, operating systems and applications are upgraded continuously due to regulatory, legal and other macro- and micro-environmental reasons. Digital manufacturing and 3D manufacturing require changes in assembly and production lines to cater to large numbers of products making these ideal candidates for DevOps usage. The nature of online education also required continuous changes in courses, delivery, and methodologies, which is facilitated by Agile and DevOps tools. Similarly, applications of DevOps can be found in many other industries like telecom, online retail, e-commerce, social media, pharmaceuticals, petrochemical, hospitality etc.

DevOps in networked technology infused world

We live in a technology infused world where rapid changes can be witnessed across domains and where pace of obsolescence is very fast. Technology space is the best example for VUCA (volatility, uncertainty, complexity, and ambiguity) world. In just two decades, world has witnessed shift from 2G telephony to 4G telephony and 5G is knocking the door soon.

Changes in apps and billing ecosystem, frequent security updates, software defined networks for optimising network performance, software defined storage, paradigm shift of in-premise systems to cloud to hybrid cloud (SAAS, PAAS, IAAS etc.), wide-spread adoption of analytics technologies (including big-data), virtualization, high-speed broadband are some of the other trends. These technologies are reshaping the business models across industries, geographies and size of the businesses.

The Agile approach or development originally started with business and product team, architects, developers etc. sitting together in a close office workspace or co-located for frequent interactions to deliver desired value to the customers. However, in the last one or two decades, these teams had to be located across places for several reasons including cost advantage and faster delivery. DevOps tools (for faster development) and network technologies (for team collaboration) facilitate concurrent development (along with monitoring and management) by multiple teams across time-zones, geographies, SBUs and sometimes organisations too. Thanks to DevOps tools and faster telecom and information networks, most of agile teams have become distributed agile teams or location-agnostic, without compromising quality and speed.

Following are other reasons for DevOps in contemporary networked environment.

- Availability and need of virtual instances which can be scaled up and scaled down in seconds/minutes to meet varying demands of customers from different domains using Cloud environment.
- Dynamic internet, cloud, analytics, and 4G/5G driven world where streaming, changes, and integrations are common place.
- Containerization and orchestration of containers in the cloud ecosystem provide the facility for dynamic changes and this, in turn enables DevOps to work at speed.
- Developers don't need to wait for multiple team members to setup their environment or applications. Containerized environments and build tools with CI/CD pipelines allow them to do this seamlessly.
- Requirements and design are discussed over calls and stored in tools like JIRA with development happening in DevOps way via containers.
- The same concept applies to all the network upgrades in the 4G/5G world, applications over networks, software defined radios/networks and so on. These necessitate rapid development infused with seamless operations for managing environments.

Disruptive technologies like Agile, DevOps, SMAC and 5G will keep coming. While individually these innovations will add value, together these will bring a significant advantage for the community.

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Moving towards Industry 4.0

EDITORIAL ADVISORY PANEL

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- **Vikas Kumar,** Vice-President, Capgemini Invent India

For manufacturers, the top challenges across their IT and OT includes reducing unplanned downtime, improving operational efficiency, replacing ageing infrastructure, increasing capacity, and improving security and workplace safety. As the sector moves towards digitalization, it is important that they build a robust network infrastructure and invest on setting up their 5G ecosystem. Organizations will also need to keep data closer to the origin for low latency, better connectivity, and real-time data consumption.

Expertspeak

"COVID-19 increased the rate of digital communications by six years"

SANDEEP SEHGAL
Head, Enterprise Business, Nokia India

The Industry 4.0 digital transformation in the manufacturing is being driven by the need to collect more data and to collaborate in real-time to quickly access, analyze to gain insight, and take action in order to adapt and adjust to changing market forces in order to remain competitive. Manufacturing OT organizations are looking to replace legacy TETRA land mobile radio and SCADA systems with more advanced, next generation wireless technology that is more reliable, provides increase scalability and bandwidth to support their operations.

Manufacturing operations are also looking to make their production lines and processes more agile and flexible through the addition of mobile robots and industrial internet of things (IIoT) to wirelessly connect devices. This gives them the ability to quickly reconfigure their lines to meet new requirements. Manufacturing IT organizations want next generation wireless technology that is standards based, secure and is future-proof. This has led manufacturers to investigate and initiate the deployment of 4G/5G cellular technology within their facilities operations.

The challenges

For manufacturers, the top challenges across their IT and OT organizations according to a survey done of 600+ manufacturers by Nokia and ABI Research in early 2020 (pre-COVID) are: reducing unplanned downtime; improving operational efficiency; replacing ageing infrastructure; increasing capacity; and improving security and workplace safety.

While some manufacturing sectors saw a drop in demand during the pandemic, others saw a significant increase in demand driven by the explosion of e-commerce for their products. But nearly all felt the impact of a supply chain that couldn't meet demands for materials or parts that were often sourced from far off geographies due to the lean supply chains strategies adopted to drive lower costs and increase efficiencies. This has led manufacturers to rethink their supply chains and make them more robust by increasing the number of suppliers with local or near shoring to shorten the distances between them.

It has also affected the pace of digital transformation. A survey done by Bell Labs Consulting of 2,500 companies across industries world-wide found that COVID-19 increased the rate of digital communications by six years. The research also indicated that industries that have invested in digital infrastructure came out of the pandemic in far better shape than those that did not make this investment. Going ahead, to become better prepared for future pandemics and major disruptions physical industries such as manufacturing will need to digitalize their infrastructure through the adoption of technologies closely tied to 5G.

Solutions and opportunities

For manufacturers that are starting on their digital transformation journey, a fundamental component is to provide reliable, scalable, high-performance network connectivity for their wireless equipment, IIoT sensors and devices. With industrial-grade private wireless

> Manufacturing OT organizations are looking to replace legacy TETRA land mobile radio and SCADA systems with more advanced wireless technologies.

To become better prepared for future pandemics, manufacturing will need to digitalize their infrastructure through the adoption of technologies closely tied to 5G.

solution, manufacturers can deploy their own bespoke, dedicated network that is specifically designed to meet their requirements. It can operate in unlicensed, shared, licensed 4G or 5G spectrum and can be wholly managed by their own IT organization, through a third party as a managed network service.

The deployment of 4G/5G private wireless as the networking infrastructure for digitalization and automation plans will also help identify new use cases and applications that were not possible with existing networks. The use of high-definition AR/VR with wireless headsets will improve factory worker training enabling them to learn more quickly and reduce the ramp up time to greater throughput and efficiency.

Real-time processing of critical operational data provides greater insights and help in monitoring performance of assets. This enables predictive maintenance and digital twins to create digital representations of machines and factory layouts to identify issues before they occur. It also helps model new lines and to simulate their performance before they are implemented. Intra-logistics can be greatly improved with the addition of autonomous mobile robots to efficiently move parts and materials from the warehouse to the factory floor and between assembly operations. These use cases can be implemented today using existing 4G/LTE technology that support a broad eco-system of devices and industrial automation system providers.

Future outlook

As the standards for industrial 5G are defined in releases 16, 17 and 18, there will be new applications for manufacturing that can take advantage of the new features and capabilities that are not possible with 4G. Increase in uplink and downlink speeds (10 Gbps), increase in scalability and connectivity (1m IoT devices/sq km), ultra-low network latency (1 ms) and high-reliability (6 9s) will give manufacturers the performance, security and reliability of today's wired industrial Ethernet network along with untethered freedom, mobility, and coverage. This will help support precision assembly and control of cobots with time sensitive networking (TSN) and precise location of assets (down to centimeters), which will further automate operations. Besides, it will improve productivity and efficiency while making them safer and more secure.

Expertspeak

"Build robust digital supply networks instead of linear models"

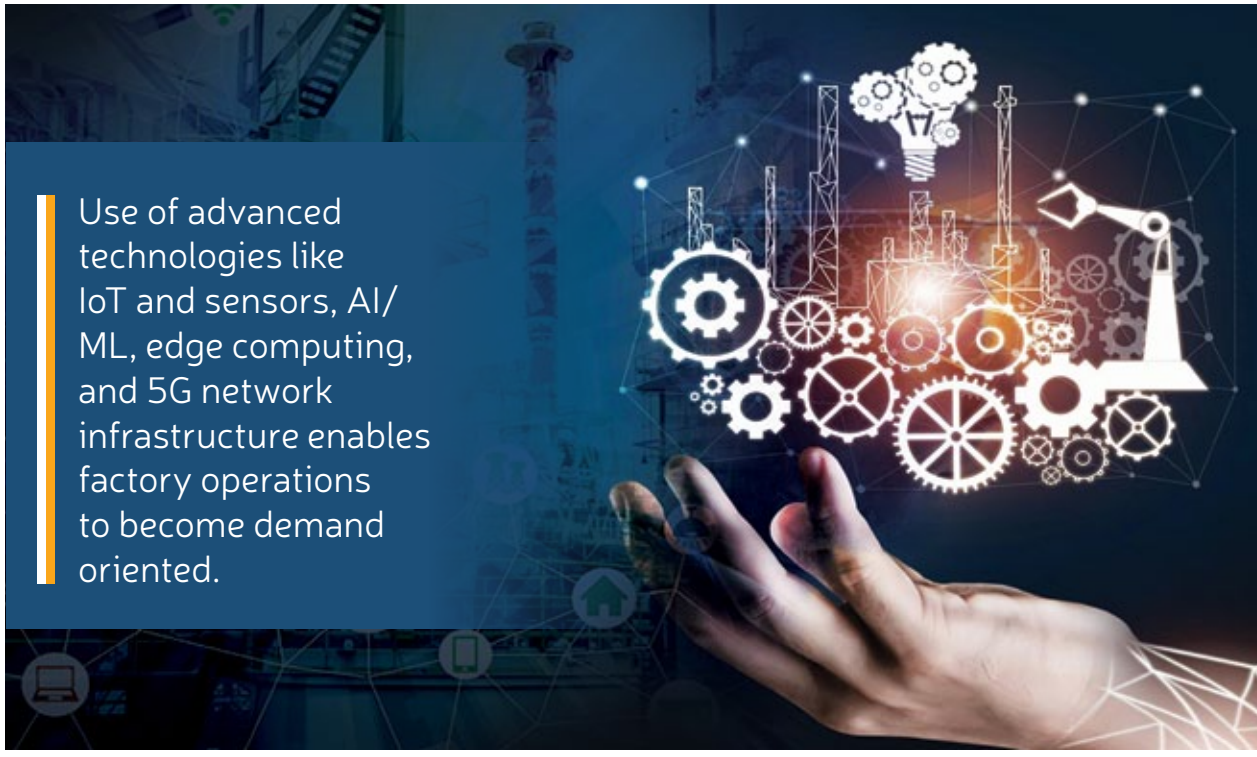
VIKAS KUMAR
Vice-President, Capgemini Invent India

The manufacturing industry is currently facing multi-pronged challenges. The pandemic has caused a severe disruption in supply chains. In fact the disruption in supply chain is the stress test that caught most organizations by surprise, and offered very little time to prepare.

Overall there has been a decline business and organizations have had to contend with sharp spikes and declines in consumer demand, production downtime, and supply and transportation delays. This, coupled with the threat of global trade wars, is keeping large organizations on their toes. The sub-sectors that have experienced a major impact include consumer durables, pharmaceuticals, telecom, power, chemicals, and agro-chemicals sector.

Rising fuel and energy prices are also impacting the sector in multiple ways – increasing the manufacturing and logistics costs and impacting sales in sectors such as automotive. This is in turn is leading to a ripple effect on the components industry as well.

The pandemic-induced repatriation of the workforce from industrial hubs to the hometowns in the interiors of India is also impacting manufacturing productivity and output. For specific industries such as electronics appliances and automotive, the ongoing global shortages of products such as semiconductors is further impacting production output and p roduct prices. Worse, traditional sales and distribution models are limiting the reach and market addressability.



> Use of advanced technologies like IoT and sensors, AI/ ML, edge computing, and 5G network infrastructure enables factory operations to become demand oriented.

> Companies need to invest in omnichannel sales and distribution to maximize their reach and minimize the impact of disruptions due to situations like the ongoing pandemic.

The technology trends

- **Advanced analytics and AI-enabled supplier risk forecasting:** Predicting risks in advance and use machine intelligence to identify and implement mitigation plans like new supplier recommendation, alternative material recommendation, etc.
- **Digital transformation on factory floor to become more resilient:** Wide prevalence of advanced technologies like IoT and sensors, AI, machine learning, computer vision, robotics, advanced analytics, augmented and virtual reality, cloud computing, edge computing and 5G network infrastructure, etc. This enables factory operations to become demand oriented, data driven, and digitally executed.
- **Focus on smarter products to provide alternate revenue models:** Use of IoT, cloud computing, and advanced analytics to gather and process large volumes of data and information from products. This provides ample opportunity for manufacturers to devise new subscription models that deliver recurring revenue (and data). For example, use of sensor data from appliances for designing customized warranty packages.
- **Digital (Amazon-like) brand experience for customers:** Seamless experience across digital and real touchpoints like digital catalogue with 3D DMUs (Digital MockUps), chatbot, AI-enabled product guide and recommendation, AR/VR virtual experience with infinitely many customizations, etc. This is especially applicable in industries like automotive, electrical appliances, machinery and equipment, etc.

From a different perspective, however, 'revenge buying' or 'revenge spending' in some aspirational product segments like appliances, electronics, and automobiles are likely to bolster sales in the near to medium term.

The solution

It is important that organizations de-risk the supply chain through decentralization. It also needs to identify alternate sourcing channels and build robust digital supply networks instead of the traditional linear models. A Capgemini research reveals that 68% of organizations are actively investing in diversifying their supplier base and 62% are diversifying their manufacturing base.

There is also a need for organizations to focus on new-age technologies, as well as rebuild and revamp the focus on centralized decision making and process automations along with technologies such as cloud, internet of things (IoT), big data and analytics (BDA), artificial intelligence (AI), and cybersecurity that are pivotal to enabling value chain visibility.

Philip Morris International (PMI), for example, has developed a digital twin of its entire global manufacturing footprint. This allows the company to assess the impact of changes in regulation, changes in product portfolio, or even business disruption on a monthly basis versus only on a yearly basis

Manufacturing organizations will also need to embed sustainability in the DNA rather than considering it as an option – prudent energy monitoring and management mechanisms and increased usage of alternate sources of fuel and energy. Unilever has identified that the seven brands with the highest turnover in the company are all Sustainable Living Brands and they grew 69% faster than the rest of the business

Companies need to invest in omnichannel sales and distribution models to maximize their reach and to minimize the impact of disruptions caused due to situations like the ongoing pandemic. PepsiCo launched two direct-to-consumer websites – PantryShop.com and snacks.com – to meet customer demand. The websites, built from ground-up in less than a month, offer consumers direct access to some of Pepsi's top-selling SKUs.

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Going strong on digital pathway

EDITORIAL ADVISORY PANEL

- **Amit Joshi,** Director, Capgemini Invent India
- **Nishant Rathi,** CEO & Founder, NeoSOFT Technologies

The sector that was already high on digital adoption saw new distribution models and monetization strategies evolve across both large and small screens. Learning content through mobile and gaming have also emerged as big new opportunities driving shift in models for monetization of content. The sector is also harnessing new technologies such as artificial intelligence (AI), big data, and smart algorithms to identify and deliver content based on user choices.

Expertspeak

"IoT is instrumental to future expansion of media industry"

AMIT JOSHI
Director, Capgemini Invent India

The COVID pandemic has forced the media and entertainment (M&E) business across markets to accelerate some of the transformational changes they had already been initiated. The industry has had to relook at some of their customer engagement models with the emergence of new demand-side. This is born from the new reality of understanding the importance of consumer behaviour and to better engage with them.

The diverse nature of India's consumer base, coupled with the demand for hyper-personalization, continue to fuel growth of traditional media. This is accompanied with new opportunities for M&E businesses.

New distribution models and monetization strategies are evolving across both large and small screens. Learning content through mobile and gaming have emerged as big new opportunities. These changes are driving a shift in monetization of content, leading to organizations experimenting with several models.

The future of the M&E industry in India continues to gravitate towards digital advances for entertainment, news and business, which translates to major opportunities for all players in the value chain.

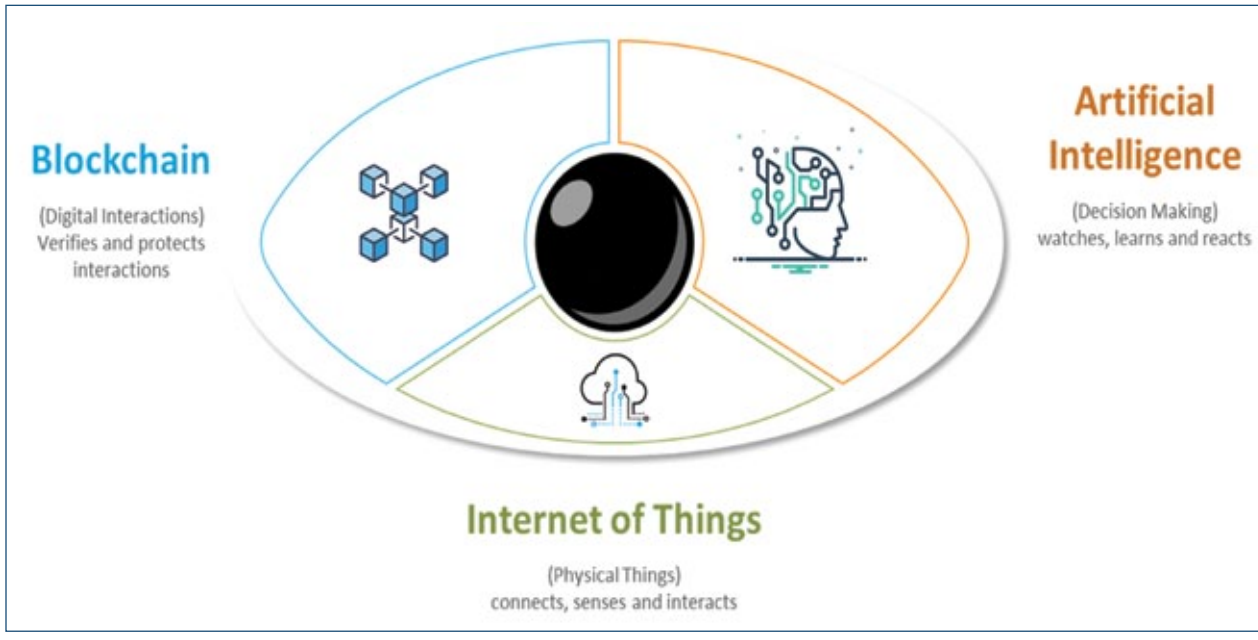
Technologies driving M&E

The combination of internet of things (IoT), blockchain and artificial intelligence (AI) presents a tremendous potential to improve efficiency and drive new opportunities across media and entertainment businesses, right from creation.

With growth of IoT, content providers can deliver and monetize their content on a multitude of new devices, and create engaging experiences adapted to

With growth of IoT, content providers can deliver and monetize the content on multiple new devices, and create engaging experiences adapted to IoT platforms.

> Building a plug-and-play interactivity stack, which is easily deployable across channels, content genres and media, can bring increased engagement for audiences.



IoT platforms. The rise of IoT helps organizations track a variety of physical parameters including a user's location, movement, and interests, thereby helping M&E companies enhance their understanding of customers and potentially point the direction in which they can drive ad revenues by delivering personalized content.

Concerns and way forward

The future and success of M&E companies largely depend on their ability to capitalize on the data at their disposal to create personalized content, advertisements, and offers for customers. They must figure out how to identify a business and the operating model that balances the development of IoT and management costs with the incremental revenue per user and investment returns. One of the biggest challenges for deploying IoT in M&E is the issue of companies not being able to scale up their digital transformation initiatives in a cost-effective manner.

As the choice of video, audio and textual products keep growing with the advent of newer players and products, the need to differentiate product design and the customer experience (CX) becomes more important. Integrating sustainable and genuine experiential aspects such as interactivity, AR, and VR can help differentiate the product and build a loyal fan base.

Building a plug-and-play interactivity stack, which is easily deployable across channels, content genres and media, can bring increased engagement for audiences and add to time spent.

Acquiring skillsets for the Fourth Industrial Revolution will be a necessity. The revolution around IoT and personal consumption will trigger a massive opportunity for automated decision making, across all customer touchpoints. Knowledge of wearables, interactivity, AI, machine learning (ML), social media, and location-based services will become essential for M&E industry leaders.

The plethora of regulation around data privacy, complaints management, content, advertising, data storage, age limits, and access to adult content can be daunting when dealing with millions of customers. Automating these aspects will be critical to scale efficiently while still complying with regulations.

The combination of IoT, blockchain and AI presents a huge potential to improve efficiency and drive new opportunities across media and entertainment businesses.

When IoT becomes part of consumer's life and media habits...

Discovery

Personalized recommendations and curation of movies to watch

Interactive theatre lobby

Purchase tickets, concessions, interaction with favourite characters, and personal artwork

Connected home

Can you play Jungle Book on my TV and set the ambience to "Jungle" at my home?

Immersive in-theatre

Experience instrumented seats and connected 3D glasses providing an out-of-the-world, immersive experience

Additional content

Alexa, can you take me behind the scenes of the final Friends season?

IoT is instrumental to future expansion of the media industry. This is because IoT allows M&E organizations to predict and understand consumer behaviour. Using this information, media companies can understand the emerging needs of customers they are targeting and tailor their ads for them.

As M&E solutions become high on digital, devices can read and understand consumers in real-time. This presents several interesting benefits that can propel M&E companies towards better business opportunities.

The future outlook

Given the growing consolidation in the M&E industry, it will likely lead to the emergence of a limited set of players that could dominate large chunks of the TV and video market. These players will have local and global content partnerships, underpinned by an all-IP device ecosystem. The shift to all-IP will also help in providing a much more enhanced experience to consumers, including custom recommendations and targeted advertising.

Large content owners have the upper hand in the present and upcoming scenario. They have started vertical integration by directly distributing content to the consumers, bypassing platform players. Content is a key differentiator in the video market. Large production houses will be serving global markets and gain from economies of scale, while smaller production houses may find it hard to survive the competition. Content owners will begin to directly negotiate with advertisers, and a global advertising business model is set to evolve.

A key defining aspect of the future is everyone doing everything. The rich content will serve the consumer through a variety of digital platform players. Media houses will look to have a strategic partnership with digital platform players, broadcasters, and telecommunication companies that have established their networks for seamless content aggregation and distribution to the consumer. Advertising agencies will become more crucial and relevant in this complex ecosystem.

Expertspeak

"The M&E market for physically challenged is unexplored"

NISHANT RATHI
CEO & Founder, NeoSOFT Technologies

Surviving the pandemic has not been easy for anyone. Fighting it out bravely, be it indoors or outdoors, has been tedious. The only way to keep ourselves pepped up and deviate attention from the pandemic blues was resorting to digital media and entertainment platforms offering diverse, meaningful, and quality video content. Not that these platforms were unpopular earlier, but now the responsibility had grown much bigger.

Harnessing the latest technologies such as artificial intelligence (AI), big data, and smart algorithms, this

Blockchain, AR/VR, voice search technology, facial recognition, AI, and cloud security are the key technologies that are transforming this sector at a larger scale.

> There is a complete niche of unexplored market for media targeted to the physically challenged or disabled. Technology can easily help bridge this access gap.

sector today has evolved to identify and deliver content based on user choices. Technology has been playing a dynamic role here. It has three major expectations to meet: to keep renewing the focus on customers' need, to converge and remix the benchmarks of entertainment, and to monetize wireless networks.

Blockchain, AR/VR, voice search technology, facial recognition, AI, and cloud security are the key technologies that are transforming this sector at a larger scale. It will not be a surprise if this vertical curve keeps going beyond its threshold while in pursuit of digital transformation.

M&E challenges and solutions

Content privacy, muddled analytics, and data privacy seem to be the core challenges at the present moment. The most crucial challenge for this industry is content privacy because that's the single most valuable commodity that they harp upon. A single leak and the loss can be tremendous. Muddled analytics is another arising issue because of multiple users sharing a single account. It makes it tough for the algorithms to make accurate content predictions and recommendations, thus affecting the overall experience of their service.

As with any digital-based service, maintaining users' data privacy is a concern in this sector as well. Moreover, users prefer to divulge the least amount of personal data which again affects the algorithms working on user profiling and recommending.

With the technology advancements that are being witnessed, the challenges can be overcome with creativity and innovation. With interfaces that are built to be aesthetic and intuitive, backed with algorithms powered by AI and machine learning (ML), the service providers stand a greater chance to keep their viewers engaged and not lose them to slow-loading web portals or hard-to-spot CTAs.

Personalization can become easy through innovation for provision of supporting multiple user profiles within a single account, much like Netflix, and harnessing deep learning to analyse usage history and offer recommendations that are the closest match like Spotify. Tackling content piracy has also been possible by restricting capturing of content via screenshots and screen recordings while using these platforms or apps.

Opportunities and future outlook

With every provider having access to the same technology and same real-time updates and more or less the same facilities, it takes much more than quality to make a mark. However, that is not to say that there aren't any opportunities. User patterns are drastically shifting, much more quickly due to pandemic than ever. However, there is still a dearth of services that are universally accessible.

There is a complete niche of unexplored market for media and entertainment targeted to the physically challenged or disabled. Technology can easily help bridge this access gap with intelligent closed-captioning, text-to-speech facilities, and disabled-friendly haptic output.

With AI already creating ripples, the future is already near. The forthcoming years will see the presently nascent data analytics technology progressing and being realised to its complete potential. What holds exciting prospects from the technology point of view in the field of media and entertainment is AR/VR and the avenues that are barely opened in this realm. It stands to embark on what can be aptly called the entertainment of the senses. With games like Pokémon Go already setting the precedent, it won't be long before we will have immersive role-play based games that can be played out in the real world.

As and how our medium of communication changes – from voice to multimedia to rich, engaging visuals, to whatever the future holds – similarly will the media of entertainment and gaming evolve. We only know that it will be unseen and it will be immensely exciting from the tech point of view.

Cashing on the technology boom

EDITORIAL ADVISORY PANEL

- **Arun Kumar,** Senior Architect, Cloud Engineering Studio, Brillio
- **Alok Nayak,** Senior Director, Head – CPRD Sector Hub, Capgemini
- **Rajiv Kumar,** CEO & Founder, StoreHippo

World's second-largest consumer base India has emerged as one of the most digital-savvy retail market, adopting cutting edge technology in a big way. Reports indicate that retail and ecommerce segment has seen a significant transformation in customer demands and experiences during the pandemic, and retailers are now looking at using deep tech to offer personalized immersive shopping experience. Technology is also helping streamline inventory management and warehouse operations and 5G is expected to drive it further.

Expertspeak

"Internet and 5G will be the common factor for all disruptions"

ARUN KUMAR
Senior Architect, Cloud Engineering Studio, Brillio

India's retail sector, according to a NASSCOM report, has emerged as one of the most dynamically-evolving, rapidly digitizing sectors, with the second-largest consumer base in the world. In 2020, the sector emerged as the world's 5th largest market undergoing rapid digital transformation. The report also estimates that India's retail sector is likely to become the second largest consumer base in the world, and touch up to USD1.5 trillion by FY2030.

This reflects the power of digital adaptability of the industry while overcoming the economic slowdown and pandemic. In the days to come, internet and 5G will be the common factor for all technological disruptions – from offering ultra-low latency, low power internet of things (IoT) features, and broad device connectivity, to delivering an integrated and personalized omnichannel and immersive experience, digital signage, video, and pattern recognition. Edge computing is another trend to look out for. The shift towards phygital world (the convergence of physical and digital space) through AR/VR unification supported by IoT will provide an enriched experience to the customers. Intent based networking will deploy artificial intelligence (AI) and machine learning (ML) to run workflows rendering superior intelligence for a faster and more agile network with error reduction.

The other foundational catalyst to Retail 4.0 will be the cloud. Moving to a multi- and hybrid- cloud environment has become a business imperative for attaining seamless experience and scaling up operations. With the shift to cloud from on-premises, there will be a need for redeveloping cybersecurity in the areas of omnichannel retail, mobile, mobility, and IoT ecosystem. This will help build an interconnected world. Involving a 'Zero Trust Network' model to protect business from ever-growing cyber breaches and threats such as phishing, password attacks will become a top priority.

The challenges

Digital advancements coupled with the integration of emerging technologies such as Edge AI, ML, mixed

Retail and ecommerce companies should focus on private 5G with intent based networking to bring infrastructure stability and improve productivity of the engineering team.

> Digital advancements coupled with the integration of emerging technologies such as Edge AI, ML, mixed reality have transformed the dynamics of retail industry.

reality have transformed the dynamics of retail industry. Brands have moved to omnichannel retail with customer experience being the utmost priority. The face of ecommerce has been elevated with enhanced experiences such as smart fitting rooms, in-store navigations, and chatbots being introduced to the customers. Such features require high connectivity and ultra-low latency to provide a seamless experience. Here, the adoption of 5G will allow integration of next generation technology innovations with low to zero latency and bring in key enhancements to cloud computing.

With increased traffic and tonnes of privileged data on the cloud, ensuring a resilient and secured network across geographies is critical to defending the organization from any potential security breach. Data thefts being at an all time high since the onset of the pandemic, cybersecurity and reliability have become an important sector to be focused on for any cloud solutions provider. To ensure data protection standards are met, expert committees consisting of representatives of all applications integrated with a cloud hosted application can be formed by CIOs. Utility CIOs have robust security teams to confirm adhering to Critical Infrastructure Protection (CIP) reliability standards.

Managing the complexities

With technology disruption in the retail sector, businesses have been exposed to a wide pool of opportunities to tap and explore. The potential opportunity for technology providers lies in enabling a framework that can be customized and brings abstraction layer for the enterprise to manage the complex network environment.

Application programming interfaces or APIs connects "things" and enables enterprises to collaborate and share information with other enterprises at a large scale with the help of digitization and the increased usage of software in our lives. APIs allow the abstraction of functionality between two systems and play an integral role in digital transformation.

APIs are growing in popularity and being adopted across sectors – retail, financial services, manufacturing, and healthcare. The need for data-driven, real-time, and seamless customer interaction is important to accelerate growth in the retail sector. APIs also offer vast opportunitiesto foster new business through ecosystems and newer ways to restructure an organization's framework with the help of microservices. It can be used to build middle layers from multiple vendors and create customized solutions to enable seamless customer communication. This new capability introduces a potential business model and revenue stream which can be utilized by vendors and customers.

Log on to intent-based networking

Intent-based networking (IBN) is a form of network administration that incorporates AI, network orchestration, and ML to automate administrative tasks across a network. The goal of IBN is to reduce the complexity of creating, managing and enforcing network policies and reduce the manual effort associated with traditional configuration management. For example, an IBN command may look like this: "Allow accounting applications to access server ABC, but do not allow manufacturing applications to access" *(see IBN solution workflow).*

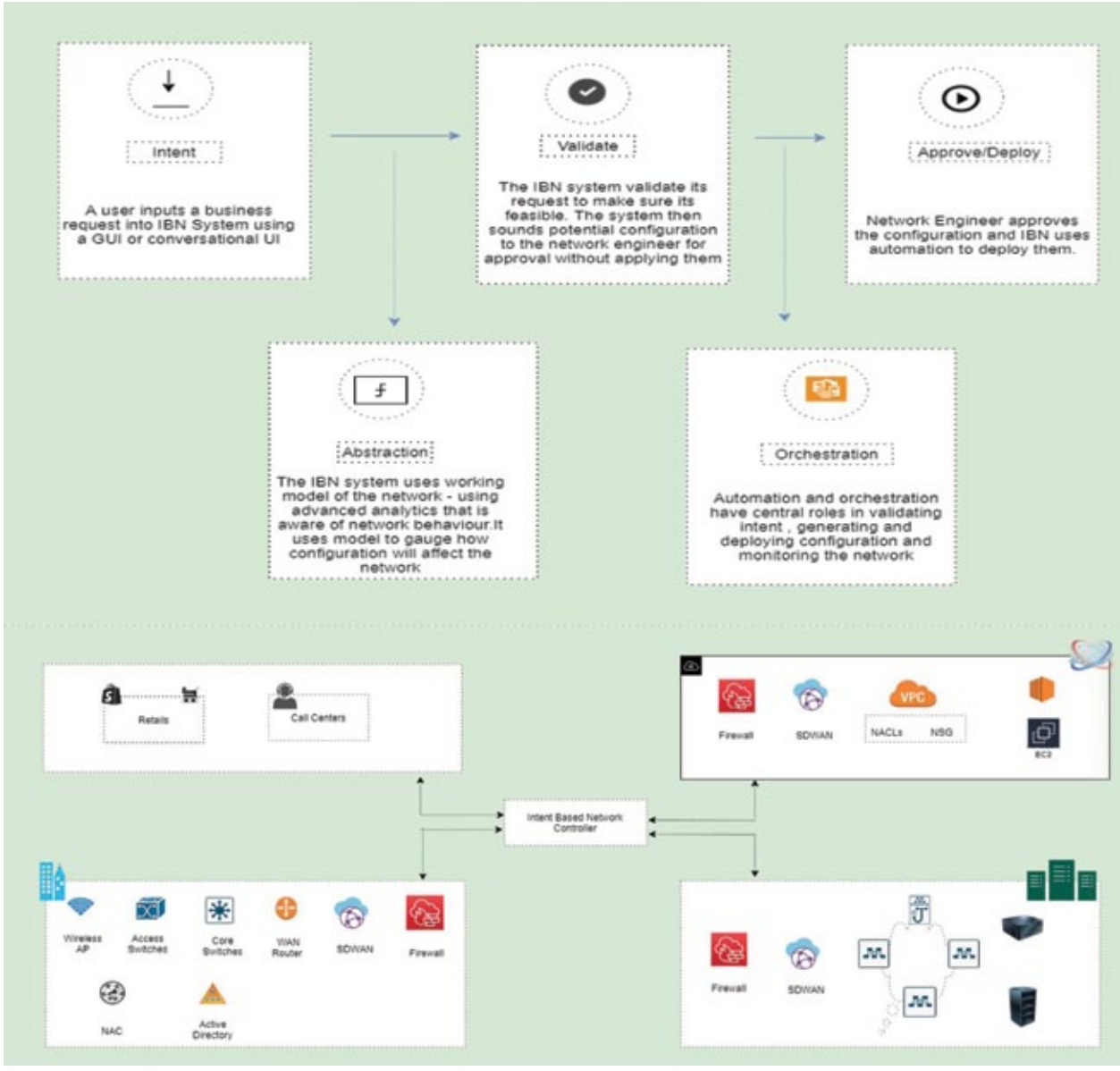
IBN enables converged network infrastructure where all the distributed environments can be managed at the central location. Key pillars of the system include end to end topological view, intent-based orchestration, root cause analysis for service assurance, self-remediation, and closed loop configuration.

This enables infrastructure team to automate all their standard operating procedures for L1 and L2 tickets, as out of box feature or customized change config approval workflow hence forth reduces the operation overhead, scalability and enhances end user experience. In fact, IBN is essential for IoT systems, environment that uses AR/VR where ultra resiliency and reliability are the essential components. Retail and ecommerce companies should focus on private 5G with intent based networking to bring infrastructure stability and improve productivity of the engineering team.

5G to drive the future

With the advent of next generation satellites, which will be built and integrated from 5G architecture, satellite communication will no longer work in silos. In future, on-ground 5G infrastructure will be boosted and supported

IBN solution workflow



by satellites to offer seamless and wireless customer experience not only connecting big cities but tier 3 town as well.

The retail and ecommerce segment has seen a significant transformation in customer demands and experiences over the last year. Shifting bases online has pushed 5G and the internet at the forefront of the technology disruption. According to recent reports, during the lockdown citizens spent 39% more time on their phones and India is expected to have 966 million mobile users by 2023.

It may be apt to state that mobile and internet has evolved to become left and right arms of an individual. With this, retailers are now looking at offering a personalized immersive experience, while making inventory management and warehouse operations more efficient with the use of the internet and 5G connection. Low Earth Orbit (LEO) satellites ensure seamless, wide-scale coverage over a pre-defined geographical area due to low orbit that allows reducing latency. Companies are now moving towards replacing traditional fiber networks with all the satellites to deliver high-speed 5G network connections globally.

Expertspeak

"Ecommerce platforms will evolve into Super Apps"

ALOK NAYAK
Senior Director, Head – CPRD Sector Hub, Capgemini

Indian consumers are increasingly taking to online channels for purchases and the pandemic saw many new consumers enter the online channel. In urban India, the share of online shoppers among active internet users nearly doubled, from 22% before the pandemic to 42% during the pandemic. According to India Brand Equity Foundation (IBEF), the order volume in ecommerce jumped 36% in Q4 2020 in the country.

Online growth is expanding across categories: By Q4 2020, personal care, beauty, and wellness showed the fastest growth by order volume. Grocery and epharmacy are expected to see bulk of growth in 2021 with large business groups entering these areas. Single-brand category champions like Decathlon and IKEA too have started a strong push towards ecommerce.

Indian consumers prefer healthier baskets: With a significant increase in the number of COVID cases, the Indian consumer is approaching the future cautiously by prioritizing health, thereby preferring online channels for purchases while choosing to delay large purchases. For example, Dabur's healthcare vertical contributed about 40% to its overall sales in the second quarter of FY21, compared with about 32% in the comparable quarter last year.

Data is increasingly used as a tool to drive online growth: Data-powered consumer product and retail (CPR) organizations, especially large organizations, are able to turn data into new growth engines. They launch new products and services, drive new business models and build a competitive edge using data. This is gaining increasing traction in India. For instance, Unilever, through the social business analytics platform of its global 'People Data Centers', has launched an AI-powered insights service that uses consumer data from social media, searches, and online reviews across all its business lines.

Most consumer product and retail organizations see the need for a significant shift in their supply chain strategies in response to the crisis.

> CPR companies need to invest in AI, ML, and other tools to manage consumer experience and glean insights from shopping behavior and transactions.

These capabilities helped Hindustan Unilever Ltd to identify matcha tea as a product that was gaining traction among increasingly health-conscious Indian consumers.

Indian CPR firms are sprucing up supply chains for online fulfillment: A case in the point is the decision by India's hypermarkets chain DMart to convert some of its stores to dark stores and fulfillment centers to meet ecommerce orders.

Localization and regionalization are gaining traction: While the consumption habits in the COVID-19 era have gone through some distinct change, the average Indian consumer has become more cautious about spend. The desire to buy brands and products that are good for the society and environment are at an all-time high. According to a Capgemini Research Institute report on supply chain, 73% of organizations in India are actively investing in regionalizing and localizing their supplier base; with 55% of organizations actively investing in regionalizing and localizing their manufacturing base.

Direct-to-consumer (D2C) growth in India: D2C brands in India may be looking at a USD100 billion addressable consumer opportunity in the country by 2025. Since 2016, more than 600 D2C brands have entered India market. Growth in such brands is driven by the evolving consumer who seeks niche and customized products previously underserved by traditional retail.

During the nationwide lockdown in India, which led to closure of non-essential stores for many weeks, Nivea, which usually sells its products through retailers and distributors across different store formats, collaborated with Swiggy and Zomato to offer its service through the DTC channel.

What worries the sector?

To make important strategic decisions based on data, organizations need to trust their data. A Capgemini research on data-powered organizations points out that only 3% of executives in India trust the data they get. Data mastery is still an evolving concept among Indian retailers.

Most consumer product and retail organizations see the need for a significant shift in their supply chain strategies in response to the crisis. Reports indicate that 73% of organizations in India had difficulties in demand planning due to lack of data on fluctuating demand, while over 60% of organizations lost sales due to stockouts.

On the regulatory front CCI has an ongoing probe against large ecommerce players allegedly for unduly preferring select sellers in their marketplaces. Also, mandatory display of country of origin and safeguards against deep discounting are part of the draft ecommerce policy.

The future outlook

India's ecommerce growth story will not be written by the digitally-savvy, upper middle class in Tier 1 cities who contribute to 10% of modern trade. Like Shopify in the US and Tmall in China, a comprehensive ecosystem is emerging to tech-enable the distributive trade sector. With large players like Metro Cash & Carry, JioMart, and Unilever, as well as startups like StoreKing, Khatabook, iPay Tech showing interest in innovating, this is work in progress.

In the next five years, we can expect a marked improvement in timely inventory, record keeping, credit tracking, along with analytics support for Kirana shops.

A period of retail apps: Ecommerce platforms will evolve into Super Apps, with other services plugged in from partners and group companies. The trajectory will be similar to WeChat in China where payment, ecommerce, food ordering, and cab hailing are all available on the same platform.

Need for strategic decisions: In these uncertain times, success hinges on business resilience and the ability to readily adapt to changing conditions. Companies in India need to accelerate their strategic ambition, acquire capabilities that set them apart, and place growth bets at a time when others are retrenching and recovering at different rates.

> From an operating model perspective, the whole adoption of digital model has to be reimagined and rearchitected to suit the new business models.

The opportunity

- **Growth in online pie:** The share of ecommerce is estimated to be USD200 billion, of which organized retailing (i.e., modern trade) in India makes up 3% or USD6.4 billion. This clearly indicates the potential for growth of the market.
- **Increasing buying options for online consumers:** Offering 'Buy Online, Pick-Up in Store' (BOPIS) options will help organizations offer more buying options for consumers.
- **Tools up in online channels:** Offering try-and-buy solutions with augmented and virtual reality will offer attractive propositions to consumers. For example, Nike is using an AR application to help its customers find shoes of the correct size. The company's app helps scan a consumer's foot and tells them the right size for their footwear. Also, the customer information is stored in the app so that they don't have to recheck their size the next time they wish to purchase.
- **Adoption of ecommerce by distributive trade:** Over 92% of India's retail market is unorganized and dominated by local shops owned by individuals. COVID-19 has established the importance of these shops. However, to be available to local and nearby customers, a virtual webshop and digital payment is a must. Sensing that 13 million Kiranas are waiting to be tech enabled, a host of VCs are open to fund new-age startups. KiranaTech could well be India's next big driver for ecommerce.

Traditionally, supply chains were designed for efficiency. Now there's a need to redesign them to balance efficiency and resilience. CPR companies need to have purpose-led intelligent supply chains that operate fast, with more agility to fuel sustainable future growth.

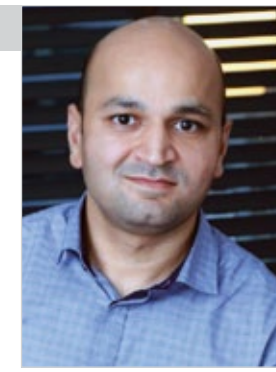
Prevalence of new-age technologies: CPR companies need to invest in artificial intelligence (AI), machine learning (ML) and other tools to manage consumer experience and glean insights from shopping behavior and transactions. This will help them provide frontline staff with the insights they need to drive elevated personalized experience. For example, AI can be integrated as a tech enabler in interpreting demand signals and to proactively deal with fluctuating demands across supply chain operations.

Data analytics to drive business: Business model flexibility will be more important than ever, as well as having ecosystem partners that allow for experimentation. With the shift to omnichannel services likely to be permanent and as new business structural industry shifts to direct-to-consumer model, there is need for a stronger and integrated digital commerce strategy, aligned to new ways of shopping and fulfillment. This needs to be bolstered by intelligence and insights, driven by data emanating from across the ecommerce value chain. From an operating model perspective, the whole adoption of digital model has to be reimagined and rearchitected to suit the new business models.

New workforce for specialized needs: The type of skills and roles PR organizations need since the onset of COVID-19 are different from what was needed earlier; also, the way these roles will be sourced is becoming more innovative and agile. The rise of the gig economy and work-from-anywhere policies will require talent, and sourcing this talent will increasingly become geography agnostic, thereby giving both the service provider and the consuming organization more choices. The concept of the "workforce" will transgress beyond traditional organizational boundaries and will be further supplemented by the drive toward increased automation, as well as contactless and digitally driven processes.

Expertspeak

"Inbuilt mobile-ready solutions like PWA are a must for mobile commerce"

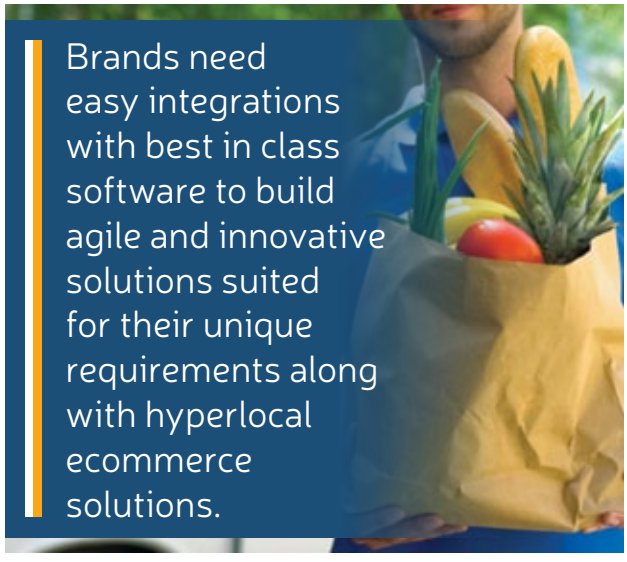


RAJIV KUMAR
CEO & Founder, StoreHippo

The ecommerce industry, which has been demonstrating unprecedented growth since the past few years has been subject to many new trends. With technology being an active participant in almost every business including the retail and ecommerce industry, businesses are also witnessing numerous technological advancements.

The ongoing digital wave is giving rise to trends like agile payment gateways, integration of technologies to meet the deliveries, personalization and shift towards D2C amongst others. To meet the ever-evolving demands of the customers, brands are also offering easy payment and fast shipping options to their customers by deploying innovative technologies into their business operations.

Furthermore, the industry is also observing the entry of new sectors like agritech, edutech, and healthtech that are looking for multi channel commerce solutions to reach the maximum number of customers which is eventually possible with the help of an idiosyncratic technological approach.



The right solution mix

Be it any business, one has to swim through a pool of challenges to attain a niche position for itself in the market. Companies in the retail and ecommerce segment also undergo various challenges with the changing customer preference and market requirements.

To stay ahead, it is quintessential for the brands to offer solutions that are in sync with the current market scenario as well as future ready in every sense of speaking. However, building solutions from scratch is time and resource-intensive. Moreover, negotiating with multiple providers for end to end solutions can be tricky and time taking. Hence, right digital solutions critical for the success of business.

Though the industry faces various challenges, these also come along with certain solutions that can ease the operations of the brands. The need of the hour, specifically in the retail and ecommerce space is the turnkey and customizable ecommerce solutions that can help businesses go to market in the shortest possible time.

Additionally, the solutions offered by the industry players should be based on headless architecture to allow brands to add as many customer touchpoints as they wish and facilitate easy omnichannel selling. Furthermore, inbuilt mobile ready solutions like PWA and mobile apps builder are also a must to leverage mobile commerce. Apart from this, brands need easy integrations with best in class software to build agile and innovative solutions suited for their unique requirements along with hyperlocal ecommerce solutions to ensure faster delivery and better brand presence in local markets.

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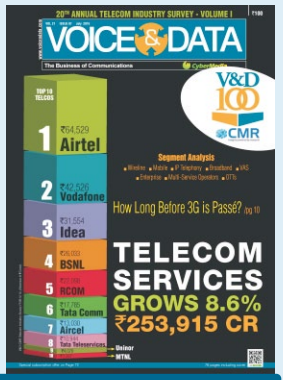

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Enabling the new normal

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This is one sector that stood rock-solid, despite odds, to keep the world connected and working. Thanks to its massive investment in technology the sector did not falter once despite massive surge and pressure on its infrastructure. However, with the 5G roll out on the card, it's time for the telecom sector to reinvent itself and build robust and flexible infrastructure by integrating technologies like AI, ML, and blockchain into their core network infrastructure.

Expertspeak

"Telcos need to reinvent their processes for the digital age"

AJAY CHITKARA
Director & CEO – Airtel Business

The telecom industry has been a constant pillar of support in India's growth story. The onset of COVID-19 set the world on course to a paradigm change resulting in telcos emerging as key enablers of the global remote work model.

As the world switched to radically new ways of functioning, certain trends indicating what the future holds appeared soon and have been shaping the business landscape. 5G is set to create a much bigger and broader landscape of business opportunities. Realizing the radical opportunities being created in the B2B space and 5G rollout calls for a strong vision. Monetizing the investments necessary to make that world, and especially 5G, a reality will largely come from scaling new business models and creating new opportunities in the B2B sphere.

Another key trend going forward will be the adoption of cloud based communication solutions by enterprises as they embrace digital platforms to deliver omni-channel experiences to customers.

With the Indian economy going digital, demand for services like content and social media, ecommerce, elearning, and more is going through the roof. Secure data centres will be the heart of managing this massive surge. And not just large data centres but also Edge data centres that will take applications and experiences closer to customers in small towns and villages. In the coming decade, the one-two punch of 5G's faster speed and superior performance and the decentralized processing power of edge could produce a steady stream of business and consumer innovations.

Remote working and hybrid workplace models have transformed the way businesses operate and then there is automation. This has made online security one of the biggest requirements of businesses and is getting more and more attention from top managements. Secure networks and applications that ensure customer privacy and zero downtime will differentiate brands and services.

The COVID-19 pandemic has tested the resilience of companies that majorly depend on the physical presence of employees. However, the others who have smartly shifted to intelligent factories and connected IoT devices are well placed to sustain longer. Harnessing the internet of things (IoT), 2021 has laid the foundation of a future where telcos will depend on devices to interact and connect people, data and processes using the power of technologies like 5G.

Avenues of opportunities

Seeing the glass as half-filled rather than half empty is the prerequisite to emerge not just as a survivor but a saviour during crises. The post-pandemic global village that we live in has gone through its SWOT analysis in the last year and a half, laying bare scopes of opportunities that are waiting to be tapped by enterprises that heed the writing on the wall. For telcos, emerging opportunities lie in software-defined network (SDN), moving beyond the pipe, and meeting the needs of the growing the micro, small, and medium enterprises (MSME) sector.

Virtualization and abstraction of the physical hardware layer promise to change the basis of future service differentiation by creating networks that will be self-aware, self-optimizing, self-healing and self-secure. The increased digitization also presents important opportunities to extend revenue streams beyond connectivity – through IoT, cloud, cybersecurity, edge computing, machine to machine (M2M), AR/VR and more – reimagining models of digital communication.

> Secure networks and applications that ensure customer privacy and zero downtime will help differentiate brands and services.

MSMEs are a big opportunity that will play out during the current decade as these small businesses embrace digital technologies to become more efficient.

Hurdles along the way

No change has ever come without its own set of formidable challenges. However, things that are hurdlesin a path, if put in the right place, can serve as stepping stones. To turn the tables over in this manner, in-depth understanding of the existing and potential challenges is crucial. That said, the telecom industry needs to primarily focus on striking a balance between the legacy and new business streams, making a portfolio mix based on customer segments, and rising customer expectations

Conquering the hurdles

Where there's will there's a way. Telcos have proven their mettle by standing tall in the face of a crisis that does not have precedence in recent history. They have not only managed to surf the tides of change well but also enabled organisations across sectors to keep their lights on. The challenges stated above are, by any scale, not insurmountable.

Telcos must tap into every scope of enriching their portfolio with IT products and services, either organically or through acquisitions or partnerships. This will help them transition from being telecom providers to integrated ICT companies. They also need to create clean and centralized customer personas by integrating data sets collected from all touchpoints and apply real-time analytics to develop exhaustive understanding of customers and customer segments, thereby getting a 360-degree view of customers.

In terms of operations, telcos need to reinvent their processes for the digital age to substantially improve both customer and employee experience while reducing operating costs. To streamline the E2E digital operations, telcos need to have the right technology and data foundations in place.

Being future-ready

The remote work model is now a permanent phenomenon as many large, medium-sized and small enterprises have confirmed a hybrid approach. Therefore, the one-dimensional customer relationship approach is no longer going to be effective. Customer relationship in the new normal is about delivering 360-degree, omnichannel experience. It involves changingsystems, processes, data policies, skills and culture throughout the organisation. In this regard, making customers self-reliant by providing self-service solutions will go a long way in earning accolades from them. The platforms supporting customers should support the development of both internal services and third-partyservices. This will facilitate the development of more comprehensive and relevant solutions, which, for telcos, is the key to being future-ready.

Expertspeak

"Telecom players need robust and flexible infrastructure"

DINESH DHUT
Senior Director, DC Telecom Engineering, Vertiv India

While talking about the telecom sector and what to expect, the biggest and most awaited shift is in the emergence of the fifth generation or 5G technology. A report by GSMA suggested that over the period of 2023-2040, 5G technologies will make an overall contribution of approximately USD450 billion to the Indian economy. That's 0.6% of GDP by 2040, and sectors across the board will benefit from the transformation 5G will bring in. Another important trend we foresee is that of internet of things (IoT). With remote working, governments and organizations alike are automating several business processes. They're exploring ways to create unmanned factories, have chatbots address grievances, and digitize processes across various functions. Communication between devices, vehicle-to-vehicle, vehicle-to-machine, and humans to machines will increase dramatically.

Additionally, technologies like artificial intelligence (AI), machine learning (ML), cloud and edge computing will come to the forefront. Given the creation of data from multiple locations, AI needs to move closer to the source or edge of networks. Edge computing will help speed up the processing of data real-time and with the help of AI/ML, businesses will be able to gain insights into the customers' requirements on-the-go. And for all this to operate smoothly, the telecom sector will play a huge role in the efficient transaction of data and ensuring uninterrupted communication between businesses.

Time to strengthen infrastructure

With both public and private sector companies moving to the cloud and away from traditional systems for communications, storage, and transfer of data, it has increased the loads on telecommunications companies. The need for robust infrastructure has never been more critical than in current times. Telecom companies need to ensure they are geared-up to support the processing of massive amounts of data and increased video and audio requirement of organizations. Additionally, with emerging technologies like 5G, AI, ML, and IoT etc. coming to the forefront, providing good internet speeds and sufficient bandwidth will be crucial.

Another major concern will be privacy and cybersecurity of the company's and customer's data. With the volume of data being generated from multiple locations, organizations need to ensure they have the right kind of infrastructure to keep this data safe. The surge in digitization in the past year or so has forced technology companies to come out with more advanced and innovative systems to protect all the data being generated. Telecom companies will need to be equipped with the right systems to keep track of the information flow from the beginning till the end. All data needs to be stored according to industry guidelines.

Searching for viable answers

Digital infrastructure is one of the key components to solve the above issues. Telecom players need to ensure they have a robust and flexible infrastructure to support the increased load, function in multiple environments, and enable uninterrupted operations. While addressing data security concerns during remote working, adoption

> Telecom companies need to be equipped with the right systems to keep track of the information flow from the beginning till the end.

of technologies like cybersecurity mesh will allow companies to place a security wall around an individual rather than an organization.

With emerging technologies becoming part of the mainstream, organizations will need intelligent systems for data analytics, reporting, and data management. And it is the telecom industry that now acts as a backbone in this regard.

Today, every business needs telecom infrastructure that is highly efficient and capable of handling high power density with lower footprint, both indoors and outdoors. The projected massive increase in deployments makes it more important than ever that solution have lower capital costs with lower operational costs, and can be easily deployedon site.

Prospects and future outlook

With 5G at the cusp of transformation, healthy prospects are anticipated in the Indian market in the near future. The boom in data storage due to remote working has increased the load on datacenters to manage and compute large amounts of data on a daily basis. Today's edge is more critical and more complex, functionally an extension of the data center rather than the glorified IT closet of the past. As a result, we anticipate a continued focus on bringing hyperscale and enterprise-level capabilities to these edge sites. This includes greater intelligence and control, an increased emphasis on availability and thermal management, and more attention to energy efficiency across systems. A drastic rise in the power and processing requirements for 5G infrastructure requires solutions that are highly efficient and reliable enough to support these challenges.

Ever since the world has shifted to a remote working model, there's been an increase in the need for connectivity. As per a recent Hootsuite study, there are 5.27 billion unique mobile users around the world, which means that more than two-thirds of all the people on earth now have a mobile phone. Among these, internet users have grown by more than 330 million over the past year, reaching a total of more than 4.7 billion which equates to more than 60% of the total world population. The increase in mobile and internet users will only continue to rise, which is rather promising for the telecom sector in India and globally. This, combined with the importance of emerging technologies, will propel the telecom sector on a path to increased growth and innovation.

With exponentially enhanced network availability and faster downloads, the efficiency and reliability of DC power systems, and the importance of an infrastructure partner that is constantly innovating to keep pace with the technology they are supporting, are vital to 5G infrastructure's success.

Expertspeak

"Communication service providers cannot remain static"

HILARY MAINE
VP CX Strategy & Technology, Nokia

Communication services have never been more critical or more vulnerable. In the first weeks of lockdown, most communication service providers experienced a year's worth of traffic growth in just a few weeks. The global pandemic has prompted a new normal of network demands. In the US, pre-pandemic, 17% of employees worked from home five days per week or more. That number now stands at 44% which means that thousands of employers are dependent on the quality and reliability of telecommunications infrastructure.

Traffic patterns have changed as well, impacted by videoconferencing, streaming and gaming. With millions visiting family and friends, and conducting business over video every day, the upstream bandwidth on networks has increased on average 30-35% and demand for reliable home broadband has exploded. Waves of lockdown, bursts of unemployment and disruption of traditional education have accelerated the consumption of streaming video and online games, which were already growing fast.

At the same time, cybercrime is exploding. The FBI reported a 300% increase in cybersecurity complaints just in the first three months of lockdown. The DDoS attacks too are growing at around 25% per year, creating terabit traffic storms.

All of this puts pressure on communication service providers who typically operate on thin margins and have to continually introduce new services to compete while maintaining legacy services to support existing customers or devices, such as elevator alarm mechanisms.

Fortunately, the IT and telecom industries have been coming together to develop more efficient and service rich networks, leveraging cloud to enable elasticity and resilience of services, and introducing architectures that support rapid innovation via ecosystems. With the introduction of 5G, the industry is enabling operators to deliver up to 100 times the capacity they deliver today; to provide greater security, and to reduce power consumption per bit. By leveraging artificial intelligence (AI) and machine learning (ML) built into network elements, service providers can become more proactive and predictive.

Wireless and fiber networks are the heartbeat of a connected community because they link the layers of physical devices and systems, data, and sensing to make a connected community possible. Communication service providers cannot remain static, simply providing the pipes for information that moves from cool smart devices to even cooler smarter devices. Rather, they should be pursuing what is called a smart enabler strategy, using their telecommunications assets to promote innovation, integrate industry ecosystems, and foster change in consumer behavior and tap the enterprise connectivity and use case potential. Communication service providers are in a strong position to execute this growth play. Although a smart enabler strategy will require new skills, we see it as a natural progression of what communication service providers do best: pioneer connectivity.

We all hope that we will never experience another pandemic, but with the ongoing strengthening of our network infrastructures, we can certainly be better prepared. Pursuing a smart enabler strategy is an exciting opportunity. There is enough evidence to suggest that smart enablers are the wave of the future. Communication service providers that successfully pursue this strategy will benefit from distinct competitive assets and exploit their connectivity strengths to remain at the epicenter of the complex yet promising ecosystem.

Expertspeak

"The industry has one of the highest adoption rates for RPA"

MURTUZA KACHWALA
Managing Director, Protiviti India

During COVID-19 pandemic, on account of work-from-home, fixed broadband uptake has increased among households. More than 600 million people became internet users over the last six years and another 600 million internet users are expected to join the bandwagon in the next five to six years. Mobile subscriptions and fixed broadband subscribers will continue to grow.

Technology trends such as cloud computing, internet of things (IoT), that were once viewed as emerging technologies have become a necessity today.

Cloud computing: COVID-19 has been driving new ways of doing work, leading to a dramatic effect on the requirement of networks. Remote working is the new trend. Telecom players should examine and define their overall cloud computing strategy to get a sustainable play in the market.

Internet of things (IoT): Interconnection between devices, sensors, infrastructure and computing elements further enables new ways for management. The foundation for future has already been laid where not just the devices interact but also a complex, ever-connected network of people, processes, data, and things, aided by the power of seamless internet connectivity.

5G: It is the next big upgrade of telecommunication network and devices. Providing high speed of network, increased capacity and lowest latency. Massive machine-type communications (mMTC) that 5G networks provide will support in creating high-density IoT networks.

In conclusion, future of telecommunication industry in India is bright in the new normal. COVID-19 has proved that individuals and businesses are now in favor of digitization. In light of these changes, 2021 could prove to be a pivotal year for the telecom industry.

The telecommunication industry has one of the highest adoption rates for robotic process automation (RPA) technology, since it offers high levels of scalability and agility and can take over many tasks such as report generation, responding to customer questions, order processing, price tracking and more. Artificial intelligence (AI), machine learning (ML), intelligent automation, network virtualization, etc. are increasingly getting adopted by telecommunication operators.

Industry concerns

Increased digitization and addition of mobile subscribers have put tremendous pressure on operators to upgrade the existing telecommunication infrastructure and make it a more resilient network. Telecommunication operators are re-evaluating their network strategy and adapting the speed of automation and digital transformation programs.

Some of the top challenges faced by telecommunication operators are related to high spectrum pricing in upcoming 5G auctions, complex right of way (RoW) rules, adjusted gross revenue (AGR) issues i.e., successful bidders in the

> Telecom operators need to take a fresh look at the level of ICT innovation and adapt to digital transformation by creating strong cross-functional interfaces.

> Increased digitization and addition of mobile subscribers have put tremendous pressure on operators to upgrade existing infrastructure and make it more resilient.

upcoming auction of spectrum worth 3.92 lakh crore will also need to pay 3% AGR revenue and cell tower radiation speculations.

The variety and quality of services from telcos are increasing, profit margins are decreasing, and the lines between telecommunication operators and technology companies are blurring. Hence, they need to take a fresh look at the level of ICT innovation and adapt to digital transformation by creating strong cross-functional interfaces. Operational support services like service configuration, order fulfillment, customer care and billing have become increasingly complex requiring resources and different tools, thus, increasing the financial overhead.

The telecommunication industry faces several looming challenges in the form of network load and infrastructure optimization, effectively addressing subscriber grievances to reduce churn, provide data and voice services that are high quality, reliable and affordable and improving network security. Other challenges are associated with data privacy and cyber security.

The telecommunication industry also faces challenge of lack of skilled manpower in rural and semi-rural areas and extremely high level of competition for a limited spectrum, wherein, new players find it difficult to grab a fair share of the spectrum in the auctioning process. Spectrum allocation, therefore needs to be more efficient and transparent.

Key solutions

To ensure continuity in service and meet government regulation on quality service indicators, telcos require huge investment to upgrade and increase the capacity of their existing infrastructure. The telecom industry is now making increasing use of digital technologies that allows transmission integration, switching, processing, and retrieval of information and also provides opportunities to merge various service models into an integrated whole.

Even though digitalization and merging of communications and computation functions have caused substantial advances in device and material technology, concerns remain about the integrity and authenticity of the information to be provided, as well as privacy protection.

What's in store?

The telecommunication industry in India is the second largest in the world with a subscriber base of 1.17 billion. The broadband subscribers have reached 765.1 million in February 2021. Telecommunication industry witnessed an exponential growth primarily driven by affordable tariffs, rollout of mobile number portability (MNP) and increased coverage of 3G and 4G. This massive growth and upcoming 5G technology have opened the gates to numerous opportunities in India.

With the COVID crisis, there has been a huge demand of data. 5G technology promising high speed and huge capacity will be the next technology frontier in the telecommunication sector. Further, mobile and cloud value-added services (VAS) and EDGE computing have become a new revenue stream providing used cases opportunities in media processing, telemedicine, video surveillance, manufacturing, and a myriad of immersive applications such as augmented reality (AR), virtual reality (VR), and gaming.

Another opportunity that has emerged from demonetization coupled with the push on the digital economy is the widespread adoption on mobile wallets and mobile banking. During COVID crisis, contactless transactions are preferred. It is estimated that transactions done on a mobile wallet in Q2 2019 stood at Rs 1.08 billion and those via unified payment interface (UPI) was Rs 2.27 billion.

Tower sharing, green energy solutions, untapped rural market, industrial applications and cloud computing are few of the other opportunities that telcommunication operators should explore and invest. To summarize, the telecom market in India is lucrative enough for all kind of players, especially those who can achieve rolling out of 5G and related services.

Consolidation of telcos presents several opportunities for surviving operators as and when prices revive to levels in line with costs. Tele-density in rural areas remains one of the main areas of growth for the operators, considering it is still very low.

Expertspeak

"The shift toward open-source and disaggregation is visible"

RAJESH GANGADHAR
CTO - Access Solutions, STL

The telecom industry witnessed some major technology shifts in 2020-21. The year marked the start of an unparalleled decade of network creation. The pandemic has had a significant impact on network upgrades, expansion, and adoption of innovative technology and solutions by operators. Telecom companies around the world have stepped up their investments in broadband digital network infrastructure.

Digital infrastructure has emerged as the hero of the current times as it created a significant impact on all aspects of human life, across each demographic and every country. Additionally, digital infrastructure was the backbone for enterprises in ensuring business continuity going forward. Some technology trends shaping the digital infrastructure and telecom industry are as follows.

5G technology: With 113 operators launching 5G in 48 countries, roughly 229 million 5G connections were established at an adoption rate that was four times faster. While there have been 300 pre-commercial trials in 31 nations, India has initiated its own 5G trials. 5G is set to be a game-changer for the industry. For India specifically, 5G will create some of the best use cases like e-education, remote working, ehealthcare and industrial automation. In the near future, 5G will be proved as a means for humans and machines to collaborate seamlessly and work with data available in real-time.

Open and virtual networks leading to 5G: To unleash the full potential of 5G, the telecom service providers will need to adopt open networking architecture and build virtualized and open RAN. Some of the big telcos have already realised this notion and are taking big steps.

Optical fibre: Network creators are investing heavily in digital networks built on the back of optical fibre. Some global fibre to the home (FTTH) connectivity initiatives, include the UK Openreach program and the Rural Digital Opportunity Fund (RDOF) in the US. The optical fibre segment witnessed a growth momentum on the back of FTTH deployments.

Telco clouds: Telco cloud has now become a buzzword for telecom modernization as operators transform their networks to fully virtualized network functions (NFV), disaggregate software from hardware in a data centre model, provide them scale and agility to orchestrate various vendor-agnostic 5G services and applications. Service providers are now building a telco cloud environment that spans across multi-vendor and

The pandemic has had a significant impact on network upgrades, expansion, and adoption of innovative technology and solutions by operators.

> To unleash the full potential of 5G, the telecom service providers will need to adopt open networking architecture and build virtualized and open RAN.

multi-site cloud infrastructures, designed to meet the performance and scalability requirements that 5G will require. The Indian telco cloud market is estimated to grow approximately 20% annually.

Hyperscalers making a mark in telco edge space: While 5G networks are expected to provide virtually-unlimited-gigabit and ultra-reliable connections, anytime, anywhere, edge computing is a natural element of 5G, helping to satisfy its throughput, latency, scalability and automation targets. It also offers additional privacy and security. For telcos, edge computing offers an opportunity to generate new revenue streams from enterprise customers that will need to rely on their mobile and fixed networks; telcos will need to orchestrate a broader partner ecosystem to capitalize on the edge computing market.

There are also many collaborations happening between hyper-scale cloud service providers like Azure, AWS and telecom service providers, primarily aimed at bringing cloud computing capabilities to the network. The collaborations will help telcos develop applications that require significantly reduced latency, strengthen processing power and analytics capabilities.

Obstacles for the industry

The super-fast network modernization will be one of the major challenges for telecom networks. The faster legacy networks migrate to newer architecture, the faster digital transformation will be for everyone.

Capex allocations, 5G network architecture that seamlessly integrates with existing 4G LTE network, and network rollout and deployment time frames, all must be streamlined to transform India into the 5G ecosystem. Deep fibreization is another critical infrastructure investment required to achieve gigabit speeds at the network edge. With only about 30% of cell towers fibreized in India, this remains the single biggest challenge to surmount.

Remedies for telcos

India has the second-largest telecom market in the world, and we have come a long way. For the next phase of development, based on digital transformation, the telcos will need to opt for solutions such as making an ecosystem of skilled professionals who can take up the fibreization to the next level if the country needs to be fibreized at four times the current pace.

The focus needs to be on incentivising high tech local manufacturing, which will not only boost innovation but also create higher-paying jobs. There is also a need for innovative offerings like indoor small cells that offer a low cost and agile means for faster 5G readiness, improving the economics for digital service providers and enterprises. New network architectures with network slicing and agility are required. This will happen when programmable networks which are open source and disaggregated are deployed.

What more can the telcos do?

5G and FTTH present great opportunities for the Indian telecom sector to be at the forefront. Though implementation of 5G is slow compared to other nations, the ecosystem required is being created at a pace. Mammoth telecom infrastructure needs to be modernized and integrated with new technologies. The role of digital network integration becomes pivotal in this context. This is also the best time for India to not only adopt open networking technology but also create an ecosystem of components and solutions that are world-class and make adoption of 5G a breeze.

Future for technology

Building networks closer to the edge is getting a lot of attention because it provides low latency, high agility, and a terrific customer experience. Gartner predicts that by 2025, over 75% of enterprise-generated data will be created and processed at the edge, as against 10% in 2018. The shift toward open-source and disaggregation can also be seen.

Going forward, seamless convergence of wireless and wired networks will allow for extremely fast communication at a low cost. By combining connection, computing, and storage, new generation networks are becoming more intelligent. Going forward, a few critical factors will write India's 5G and digital story. How telecom networks of India will adapt to new architectures and how the government and private players will come together to build the next generation of digital infrastructure, the answers to these questions will shape the future for us.

Expertspeak

"Telecom players will have to adapt quicker than ever before"

SATYA YERAMSETTI
Founder & CEO, Telebu

Telecom and the communication industry at large are going through a major transformation. The on-going pandemic has not only disrupted the functioning of the sector but also accelerated the growth rate for the industry by a number of years. Besides, technologies like 5G, cloud computing, artificial intelligence (AI), and machine learning (ML) are driving and dominating the industry.

5G, which has already been introduced in several countries, is all set to transform the industry by allowing the telecom sector to enhance the way they operate and deliver their services. Another prominent, fast-growing trend is cloud computing, which is being actively driven by the demand of internet of things (IoT). Apart from this, AI and ML, which have made their way into almost every business, continue to enhance the network capabilities by predicting multiple things including peak traffic. Data science combined with good data analytics will allow the telecom industry to boost network performance and cut network cost.

Hurdles and answers

Challenges are a part and parcel of every business and the telecom industry is no exception. Right from infrastructural challenges to funds, policy changes, and audience acceptance of new service; the challenges are many. However, amidst the many; safety and security are becoming the biggest challenges for the industry. Furthermore, in order to stay abreast of the competition, the telecom players have to adapt to new technology changes quicker than ever before and this might pose certain challenge in the initial stages.

Technology will always keep evolving. To stay ahead of the game, the telecom industry needs to research, upgrade IT and connectivity infrastructure, and adapt to the new requirements in the markets. Moreover, the rise in the demand for IoT and the telecom industry at large can come with a certain number of security risks. To stay safe, companies in the telecom sector need to fortify their networks through network monitoring and deploy innovative technologies to avoid phishing attacks. They should also abide by the increased regulatory norms to stay safe and ahead of other counterparts.

The industry opportunity

The telecommunications industry has been recording a steady Y-o-Y growth for more than a decade now. Amidst this, the global pandemic and consequential lockdown has just accelerated the rate at which businesses across the country are adapting the virtual communication platforms. Undoubtedly, the number of inquiries in this segment has significantly increased by 100% week-on-week from March 2020 to July 2020, demonstrating a tremendous growth opportunity for the sector in India.

The accelerating technology trends including 5G and IoT will further provide the required impetus to the telecom players. 5G, which is currently the talk of the town, is going to transform several industries in the coming years. In fact, 5G is predicted to create a cumulative economic impact of USD one trillion in India by 2035. Additionally, the rising demand of IoT will also open the doors to a pool of opportunities. Telecom operators are likely to observe a significant rise in demand due to IoT as even the Indian Government is planning to develop 100 smart city projects with IoT at the core of the development.

Looking ahead

The telecom industry enables the transfer of crucial information, through the internet, phone, cables, airwaves, wire or wirelessly. In simpler terms, the industry facilitates the smooth functioning of businesses across the globe.

Therefore, all the advancements in the telecom sector will eventually shape the future by allowing companies to communicate and collaborate better with innovative technologies and offerings. Moreover, the future of the telecom industry is highly dependent on 5G, fast speed networking, and digitalization, which will further give the required impetus to the companies operating in this domain.

Expertspeak

"Telecom companies in mature markets will commoditize connectivity"

SHAMIK MISHRA
Vice President & CTO Connectivity, Capgemini Engineering

With the Government of India approving 5G trials, India is now one step closer to adopting the new standard and mobile networks in the country. The technology will revolutionize all industries and transform how they operate and deliver their services. Businesses will get real-time insights and total control over their products, services, and assets.

Intelligent industry: Telecom companies are today collecting incredible volumes of data from industrial devices and processes. Enterprises that can use this data to innovate in the creation of new products and services will dominate the race for survival through intelligent operations and support. Telecom companies can ensure that their networks can consume large amounts of data efficiently and continue to deliver on security, privacy and regulated data governance.

Connected devices: The demand for connected devices in the telecom sector and other industries will continue to grow in 2021. Coupled with implementation of 5G and data driven industries, it will make devices exchange data in real-time. Devices will leverage connectivity and compute, and this is an opportunity for industries to deliver innovation through cloud and edge.

Edge computing: With edge computing, we will see the drastic speed up of processing real-time data collected through connected devices.Edge computing means moving the computation away from devices to the edge of the network. This means that smart objects, mobile phones, or network gateways provide services on behalf of the cloud. Telecom operators are expected to be a key provider for such heavily distributed compute infrastructure as they own the real estate and connectivity, the beach front property needed to deliver such services.

Robotic process automation (RPA): With the deployment of RPA for tasks, error rates and costs are reduced while operational efficiencies are boosted. Telecom companies must be prepared to offer high levels of scalability and agility so that RPA can take over many tasks such as report generation, responding to customer questions, order processing, price tracking and more.

Challenges and solutions

Security and the threat of data breaches are some of the common challenges that the telecom industry will face. Moreover, the demand for better security will increase at perhaps a greater scalewith the advent of more devices and more distributed computing inside the telecom operator networks. According to some studies, the world has seen the biggest cyberthreats during the COVID-19 pandemic.

Apart from keeping data secure, telecom companies must also ensure that they are being transparent with their customers and clients about how they use the data. As there is more reliance on digital tools and artificial intelligence, telecom companies need to consider how they collect data from their customers. We have already seen the impact of regulations like GDPR on how companies manage information and we may see

> Telcos can combine their capabilities and distributed edge compute to deliver new experiences, drive new revenues, and help enterprises improve productivity.

Using data to deliver better experiences and outcome is key to telcos' strategy. This requires unifying the robust and resilient connectivity to different technologies.

many more regulations in the near future. Therefore, how telecom companies show that they have the right systems in place to track and analyze the flow and storage of information in the organization from end to end will become crucial. Telecom companies must be ready to show that they are committed to privacy.

Telecom operators can combine their connectivity capabilities and distributed edge compute to deliver new experiences, drive new revenues or improve productivity for consumers and enterprises. This requires adopting digital technologies, driving more automation, enabling AI and secured connectivity.

Today's telecom industry is competing on enhanced customer experience and searching for new revenues by leveraging connectivity. Using data to deliver better experiences and outcome would be key to their strategy. This requires unifying the robust and resilient connectivity to different technologies like AI, edge, intelligent devices and cloud will be critical. The industry is also looking for new revenue opportunities. This requires innovation across the target markets. Such unified digital architectures will enable telcos to offer customized, automated, trustworthy, and reliable "connectivity" based solutions as an innovation platform to their B2B clients.

Betting big on 5G opportunities

5G will bring in the most revolutionary changes in the telecom industry. Once the technology is fully rolled out, the opportunities and possibilities are endless. This is an opportune moment as the demand for 5G and IoT is now higher than ever. 5G will be the answer to effective communications on the move and will disrupt and empower the workforce for tomorrow.

Telecom companies in mature markets will commoditize connectivity, which will help connected devices and IoT open up new revenue streams. Digital IDs are the electronic equivalent of an individual identity card and can optimize operations like enhance the customer experience by utilizing data to improve targeting and personalization and forming partnerships with companies using artificial intelligence that generate a vast amount of user data that then be used to continuously improve products which in turn drive brand affinity and loyalty.

Intelligent Industry powered by data is the evolution of Industry 4.0, cloud data, 5G, edge computing and big technology converge together to completely transform entire value chains of industrial companies starting from research and development, designing a concept to engineering and manufacturing. With intelligent products, intelligent operations and intelligent support and services, everything a firm does will become digitized, leading to new platforms and portfolios and ultimately to a more profitable and sustainable business.

According to a Research and Markets report, more than 600 million people became internet users over the last six years and another 600 million more internet users are expected to come online over the next six years by 2025. This increase in mobile subscriptions and fixed broadband subscribers will continue to fuel the telecom sector growth till 2025.

TV RAMACHANDRAN

Broadcasting in India undergoes a quiet revolution

Progressive government policies and enabling regulations can further maximize customer benefits and drive the industry growth

Broadcasting is inarguably one of the most powerful modes of mass communication, especially in a large country like India with over 850 million people based in rural areas, a significant percentage of whom are unable to read or write. Understandably, therefore, it is extremely critical for both governments and the private sector. While there are perennial pushes and pulls in every nation, in the play of fundamental forces shaping this important sector, the overall directional trends in its trajectory are unmistakeable.

World-famous astrophysicist Meghnad Saha had once stated: "Most things of importance start without people noticing they have started." Indeed, this is true for broadcasting. Unlike other sectors, where there is a fair bit of noise and hype about technological disruptions and upheavals, broadcasting has been quietly undergoing a major transformation due to digitalisation and convergence of mediums of content delivery, as well as content consumption hardware. Traditional linear TV content is now available through handheld devices and personal computers, and online content can be viewed on connected TV sets. Co-axial cable, which delivers TV content when upgraded to fibre optic cable, can deliver converged services such as voice, video and data. Therefore, the lines between platforms for delivery of content are blurring.

One of the essential requirements of all emerging digital technologies is improved digital efficiency, use of improved modulation techniques to compress audio, video, messaging and data surfing on the same carrier/channel. What it leads to, is increased consumer benefit. With increase in digitalisation and adoption of digital technologies in all sectors, new technologies capable of doing multiple and dissimilar functions have emerged.

Entertainment and broadband services are two important applications, particularly in the far flung and remote areas where other modes of terrestrial communications are not viable to deploy. New convergent technologies like the new standard ATSC 3.0 enables mobile broadcasting and mobile communication service on the same device using the UHF frequency bands. India is yet to leverage this powerful instrument.

Indians' intrinsic love for online video content is almost insatiable. This has been sharply accentuated by the environmental restrictions caused by the pandemic. Over-the-Top (OTT) user consumption has boomed. With over 40 players, India is the world's fastest-growing OTT market, expected to hit over USD3 billion in the next five years. By 2023, India is expected to have over 500 million subscribers to OTT platforms. However, OTT Platforms need to innovate by using technology and performance metrics to ensure better customer experience and customer satisfaction – when it comes to both availability of content and seamless delivery of content to consumers without technical glitches. With the right metrics, these players can use advanced technology platforms to make suitable investments in the areas that need them most to win the maximum eyeballs of the increasingly savvy 500+ million Indian consumers who are likely to use OTT platforms for entertainment and watching TV.

As consumers become more driven to personalized experiences, platforms need to keep up with dynamic

> AI can provide rich end-user experiences with minimal manpower by creating more efficient operations. It can bring down cost by identifying viewership trends.

content. Artificial intelligence (AI) can provide rich end-user experiences with minimal manpower. This generates more viewership and reduced operating costs. AI-based solutions are creating more efficient operations and bring costs down by identifying viewership trends.

Global content delivery platforms like Netflix estimate that its use of AI would automate workflows and reduce customer churn, saving the company around USD1 billion annually. This not only increases the quality of experience and quality of service for users, but also reduces the number of bits required to achieve the same quality stream. Similarly, YouTube is also at the forefront of using AI to reduce overall video latency and encoding costs.

With the proliferation of smart devices, and extending internet bandwidth limits, broadcasters have a unique advantage of accessing their customers directly through OTT. Broadcasters and media houses that have launched their own portals or mobile applications can securely host their content on the cloud, as well as leverage benefits of OTT infrastructure that allows them to create video catalogues and distribute their content directly to the consumers through their own web portals.

A quick look at the table 'Growth trajectory of media sector in India' showing the growth of the media sector in the country over the past few years and one notices a sharp viewership shift from analog television to digital. The classical model of watching television, also known as Linear Television, is evolving rapidly. Transformation means shifting from serving a TV centric audience to serving a heterogeneous mix of audiences, using a number of mobile devices and platforms, and being capable of watching it anywhere and anytime. Both types of broadcasting will necessarily coexist and should be facilitated to grow healthily. This essentially means the smooth evolution from a TV broadcaster to an overall broadcaster.

Growth trajectory of media sector in India
(figures in INR in billion for calendar years)

Segment	2018	2019	2020	2021 (estimated)	Segmental growth 2019 v/s 2020
Television	594	660	740	815	12.1%
Print	296	303	306	317	0.7%
Filmed entertainment	122	156	175	194	12.2%
Digital media	92	119	169	223	41.9%
Radio	24	26	31	34	7.5%

Source: FICCI-EY report on India's Media and Entertainment Sector, March 2021

> A key trend that will separate relevant broadcasters from the fading ones, as the business continues to quickly evolve, is making connections for and with their users.

According to eMarketer, traditional TV viewing time in 2019 was declining with an average of 4 hours, 10 minutes per day. This trend shifted dramatically in early 2020, due to the unprecedented conditions brought on by the pandemic and the number of traditional TV viewers grew by 8.3 million to 287.3 million, the first positive growth since 2011. Similarly, Statista reported that the share of total gross hours viewed across major broadcast television channels increased from 25.7 to 30.4 percent during the pandemic-struck 2020. The trends suggest that a significant number of households are switching over from linear TV to watching content on the mobile phones and devices to fulfil their entertainment needs.

This is the age of the 'digital consumer'. India has over 750 million broadband subscriptions already and smartphone users expected to be about a billion by 2025. The humungous impact of this on total television viewership is mindboggling. Indian policy and regulation need to be ready for this quiet revolution. The average age of a new digital user is estimated to be more than two years younger than the typical digital user and so the viewership preferences are changing inexorably. TV companies and broadcasters need to innovate to improve their digital services and consumer experiences to stay relevant. A key trend that will separate relevant broadcasters from the fading ones, as the business continues to quickly evolve, is making connections for and with their users.

The fast changing and exciting times ahead in the broadcasting space remind me of Henry Ford when he said, "If I had asked my customers what they wanted, they'd have said -Don't change anything." However, driven by the all-powerful winds of Quality of Experience, the tide of change is engulfing broadcasting in India and customers are set to have a continuously rising wave of enriched choice and quality in broadcast content and programmes. Progressive policies and enabling regulation would catalyse these changes for maximising customer benefit as well as the healthy growth of the industry.

Indian Broadcasting's exciting 'Tryst with Destiny' is in the offing...

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Research inputs by Debashish Bhattacharya

(The views are personal)

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[COMMENTARY]
BLOCKCHAIN

Driving mass adoption of blockchain

To become 'palatable', blockchain solutions need to reach devices that are ubiquitous. The average smartphone can be the most viable vehicle for this mammoth task

BY ANIKET JINDAL

Technology has always evolved to become mainstream and publicly accessible, and the entry of smartphones stands as a testament to this fact. However, with emerging technologies such as distributed ledger technology, we're heading towards decentralization and free flow of information, resources, and assets.

Blockchain technology, as revolutionary as it is, is still nascent and being shaped to fit the needs of the masses. A great way to make blockchain solutions 'palatable', as it were, would be to take it to devices that are ubiquitously used; the average smartphone would be the most viable vehicle for this mammoth task.

State of smartphone usage

Smartphones are characterized by their signature capability to combine telephonic and computing functions in one portable device. One of the many factors in accelerating the ubiquity of smartphones has been user-friendly applications that provide a myriad of services with a single click.

While smartphone applications have seen great success, their biggest pitfalls have been with data security and privacy concerns. According to a NowSecure benchmark test of 250 popular Android apps, 92% of online retail apps, 67% of travel apps, and 50% of financial and insurance apps have leaked

> With innovation focused on interfacing with smartphones, dApps can break through the current ubiquity barrier and offer efficient, decentralized solutions

> Since dApps are based on a decentralized P2P technology with multiple distributed networks, there can be no unilateral changes or monopoly of any kind.

sensitive user data. This is where blockchain-based decentralized applications can help.

dApps for the win?

Since its debut in 2008 as the tech infrastructure for Bitcoin, blockchain technology has shown its relevance by growing into an industry valued at USD758.06 billion (2020). With innovation focused on interfacing with smartphones, dApps can break through the current ubiquity barrier and offer efficient, decentralized solutions. Furthermore, efforts towards mass adoption are underway with the web 3.0 wave consisting of decentralized finance (DeFi), decentralized apps (dApps), and non-fungible tokens (NFTs), etc. Web 3.0 is the new-age decentralized internet aimed at eliminating problems with data extraction, security breaches, and exclusivity of blockchain technology.

Web 3.0 is the natural evolution of the internet, as more devices and people get connected to the web. The key idea, apart from decentralization and trust minimization, is the involvement of machines – artificial intelligence (AI) systems and smart contracts, etc. – as intelligent agents in the decision making process.

Blockchain-based solutions built via decentralized apps can fit snugly in this space, making it a viable entry point to cater to the average Joe. To put that into perspective, dApps, if built the right way, can reach six billion smartphone users worldwide. In fact, dApps are looked upon as a solution due to its inherent strengths that helps bring in transparency, immutability, and decentralization, besides being accessible and economically feasible.

Transparency: Blockchain technology relies on its decentralized and transparent system. Thus, dApps, being based on a public blockchain or a peer-to-peer network (P2P), are secure and less prone to activities like data theft or data extraction by a central authority.

Immutability: Blockchain technology is immutable. Once added, information cannot be changed or modified on the chain. dApps provide the same immutability and permanent record-keeping, which means no data lost.

Decentralization: Since dApps are based on a decentralized peer-to-peer (P2P) technology with multiple distributed networks, there can be no unilateral changes or monopoly of any kind. To make any modification, one requires the participation of all the elements on the network.

Accessibility: Irrespective of geographies and demographics, everyone can get the same access to every feature and benefit on a dApp.

Economic feasibility: On the feasibility front, dApps are economical as they require less processing time and less human capital due to no heavy machinery requirements.

Automation: At the backend, most dApps are smart contracts. This enables a lot of operations to be easily automated.

Catalyst for blockchain adoption: With its promise of a less tech-intensive and more end-user-focused format, dApps are a sure way to enter into and exploit the advantages of blockchain technology to its fullest potential.

Shaping a dApp-er future

Given the current barriers to entry in terms of user experience, KYC, and data immutability, dApps have not reached their peak yet, but industry leaders in the space are constantly working towards making it a viable alternative to current mobile applications.

Today, we have several functioning dApps and the space is expanding with third parties such as Biconomy, Covalent, and Radar Relay, etc. entering the space with their own simplifying solutions that encourage user adoption. Experts agree that dApps as an alternative to today's mobile applications are possible and smartphone adaptability would be a significant achievement towards this.

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[COMMENTARY]
ENTERPRISE COMMUNICATION

Gearing up for auto-pilot mode

Enterprise communications ensures seamless delivery of information to the end user. From emails to voice calls, this technology is all around us

BY DR. DEBABRATA DAS

The COVID-19 outbreak that the world faced last year accelerated the need to adapt to newer technologies like never before. Technological advancements in recent years combined with the 'work from home' situation that has become a functional mandate today, stands testimonies to the impact of enterprise communication technologies in business processes. With new technologies constantly replacing the existing IT landscape, it is critical for organizations to leverage enterprise communications and keep abreast of the latest advances in order to add value to their operations.

Fueling fast, reliable flow of communication

Going back to the basics, enterprise communications ensures seamless and flawless delivery of information to the end user. From emails to voice calls and video conferencing, this technology is all around us. Business organizations have adapted its IT infrastructure in day-to-day operations as it ensures accurate delivery of

> While it is important to keep up with technology, developers need to keep accessibility and applicability of their projects in mind.

> Organizations have realized the significance of enterprise communications. Automation in IT infrastructure is the next big leap they should prepare for.

information through a highly reliable, fast and flexible network. For the enterprise communications technology to function efficiently, the IT infrastructure and the applications platform that integrates communication requirements of the service are critical.

Rapid advancements and limitations

Sectors ranging from educational institutions to ecommerce ventures, agriculture, healthcare and banking, have all embraced enterprise communications. While this technology is able to meet the rapid advancements in business functions, it also brings an extremely short lifecycle for its supporting infrastructure.

Today, in order to keep abreast of new developments, corresponding hardware requirements have to be met and replaced at an increasing pace. Technological innovations have given us larger cloud storage size, computational speed and cloud computing capabilities, all of which enable organizations to augment their business processes. However, the bigger challenge, particularly for small and mid-sized organizations remains the question of feasibility to adapt to fast-changing technologies.

Another challenge that small and mid-sized organizations face is the complexity of setting up network and data centre systems as part of their IT infrastructure. The security required inside the data centers and the cost involved in running hardware and software licensing add to the challenge. While there is always the option of renting cloud technologies available in the market, to help reduce the cost of highly skilled manpower and the license cost, it comes with its own security concerns.

Embracing enterprise communication

Despite its challenges, we cannot deny the fact that it is enterprise communication technologies that are keeping business processes alive for several organizations especially with the COVID-19 outbreak. While it is important to keep up with technology, developers need to keep accessibility and applicability of their projects in mind, as the quality of experience (QOE) will define its end result.

Internet protocol is extremely elastic by nature to accommodate traffic by best effort service. However, applications need to be designed with simplified architectural design aspects that would ensure valuable customer experience. Businesses need to be more open minded to embrace technological improvements and also keep their IT team abreast of advancements.

Augment business processes with emerging technologies

Organizations have realized the significance of enterprise communications. Automation in IT infrastructure is the next big leap organizations should prepare themselves for. Research is underway to develop a level of automation with a good class of IT infrastructure. While chatbots are already being deployed by many organizations, we could expect an upgrade to high level robotic assistance through digital employees or digital assistants in the near future.

Internet of things (IoT) is also increasingly being deployed in enterprise communications. Autonomous cars, drones and remote patrolling are some of the upcoming technologies we could expect to see in this space. Virtual and augmented reality will also have a great impact on the business, along with security advancements like blockchain and zero- trust security architecture.

In that regard, robotics and automation is a critical advancement that organizations should be deploying to truly leverage the benefits of enterprise communications and IT infrastructure.

Today, most organizations are investing heavily on enterprise communications to outshine their competitors. Enterprise communications is a lot more than integrated communications in business. When deployed right, organizations could greatly benefit from greater accuracy, reliability and efficiency of business processes.

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[COMMENTARY]
INTERNET OF THINGS

Shaping up the new Cloud

The evolving IoT Edge cloud will ultimately surpass the one that gave us smartphones and tablets. It will also spur dramatic technology growth

BY KENNETH P. BIRMAN

The convergence of 5G networking with advances in artificial intelligence (AI), sensor technologies, robotics and mobility has created an immense business opportunity. It will not be long before we see a new form of cloud: an internet of things (IoT) Edge cloud that may ultimately surpass the one that gave us our smartphones and tablets. This IoT cloud revolution will also spur dramatic technology growth.

During the 1990's, the first web boom, I attended a small summit at which industry leaders debated the key factors that underlay technology disruption. One of the speakers asked why the internet had been so disruptive and offered the following hypothesis. In the 1980's Moore's Law enabled steady advances in computer hardware: displays grew in size, pixel density, and began to support color. DRAM capacity and speed increased, storage capacity and speeds climbed, and clock rates advanced. Inside our companies, we had Ethernet running at 1Mbps. Yet for all its technological wonders, this period of growth was remarkably balanced and not hugely disruptive. It gave us increasingly powerful computers and enabled very effective enterprise computing systems, but the experience wasn't radically different from a few years earlier.

What none of us was thinking about was the sense in which the wider networking options were limiting progress. In those days, there was no true public internet, so most communications remained sluggish. Even the most powerful computers used dial-up modems over telephone lines to communicate at geographic scale,

> Today, the uplink path from IoT sensors to the cloud is so slow that it blocks us from integrating those devices into the cloud in a direct, real-time manner.

> The intelligent IoT edge cloud will ignite the same sort of explosive growth that brought us modern data centers. Trillion-dollar industries will quickly follow.

and in fact this was also the WAN link technology for the nascent internet itself.

But then the communications sector experienced its own revolution. Enterprise networks upgraded to switched optical, and our routers could forward packets directly over a world-wide internet at lines speeds. Suddenly, all the ingredients for explosive growth fell into place. Overnight, a web revolution swept the planet. An immense disruption… and yet, even when viewed back in the 1990's, one that should have been completely predictable.

Today, we stand at the threshold of another such revolution. Of course, the bottled-up technologies are not identical. We possess a diverse collection of sensing devices, cameras, videos, microphones, and all the "things" in IoT and IIoT, a cost-effective cloud computing model, and powerful AI enabled by big data and massive hardware accelerators that run on that cloud. Yet much as in the 1990's, the true opportunity is limited by a daunting communication bottleneck: the uplink path from IoT sensors to the cloud is so slow that it blocks us from integrating those devices into the cloud in a direct, real-time manner.

Consider image-based intelligence, which is the key to many of the most exciting opportunities. The images are just too big to upload, and this is so even for photos – and far worse for high-resolution video. Industry is trying to do more and more computing on the sensors themselves. But even the smartest cameras are constrained by a lack of resources and electric power, and lack the situational perspective that can be achieved only by synthesizing data flows across thousands of sources. So, what is the bottom line? Without the big data capacity of the cloud and the hardware accelerators one simply cannot tap into the most exciting AI tools. Any application that involves dynamic machine learning (ML), in real-time, or coordinated reactions to unpredictable conditions, is limited by this communications barrier.

Dam up a huge river and the waters behind it will rise until they overtop the dam and wash it away in a massive flood. In the 1990's, that dam centered on dialup modems, and we tore it down by enabling a true high-speed, wide-area internet. Today's IoT and IIoT barrier involves networking at the edge, and this time, the disruptor will be 5G networking.

With 5G, we add two new elements to the mix. First, 5G networks are blazingly fast: once the 5G rollout gets serious traction, speeds of 10Gbps to 20Gbps should become commonplace. We'll suddenly be in a position to upload all of that sensory data. This leads to the second development: 5G networks situate small compute clusters on the access points, giving us a place to host a new kind of cloud. By treating these small cloudlets as a new form of cloud, with its own platform-as-a-service solutions and its own hosting options, developers can create applications to leverage that vast stream of edge information. Moreover, by keeping the data close to where we capture it and then discarding it promptly, we can even provide privacy guarantees. The intelligent IoT edge cloud will ignite the same sort of explosive growth that brought us modern data centers. Trillion-dollar industries will quickly follow.

Research efforts are also on to invent the software enabler for that next step and create new hosting platform that can help modern ML and AI solutions run close to the devices, connected over 5G. This will enable a true synthesis of IoT/IIoT with federated AI. The power of the cloud can expand to encompass the IoT edge.

An intelligent IoT Edge is also coming soon, and it will transform the world, giving us genuinely smart homes, smart power grids that can better leverage renewables, smart traffic intersections, roadways and cities, and even smart farms. AI will slash energy waste, reduce farm runoffs, and enable us to treat insect and other crop maladies with pinpoint precision, using far less pesticide to far greater effect. And the technology leaders who create this new infrastructure will lead in the transformation of today's communications industry into tomorrow's most vibrant and fastest-expanding cloud.

Birman is the N. Rama Rao Professor of Computer Science, Cornell University, where he leads the Derecho and Cascade projects, creating new technology for the IoT Edge Cloud

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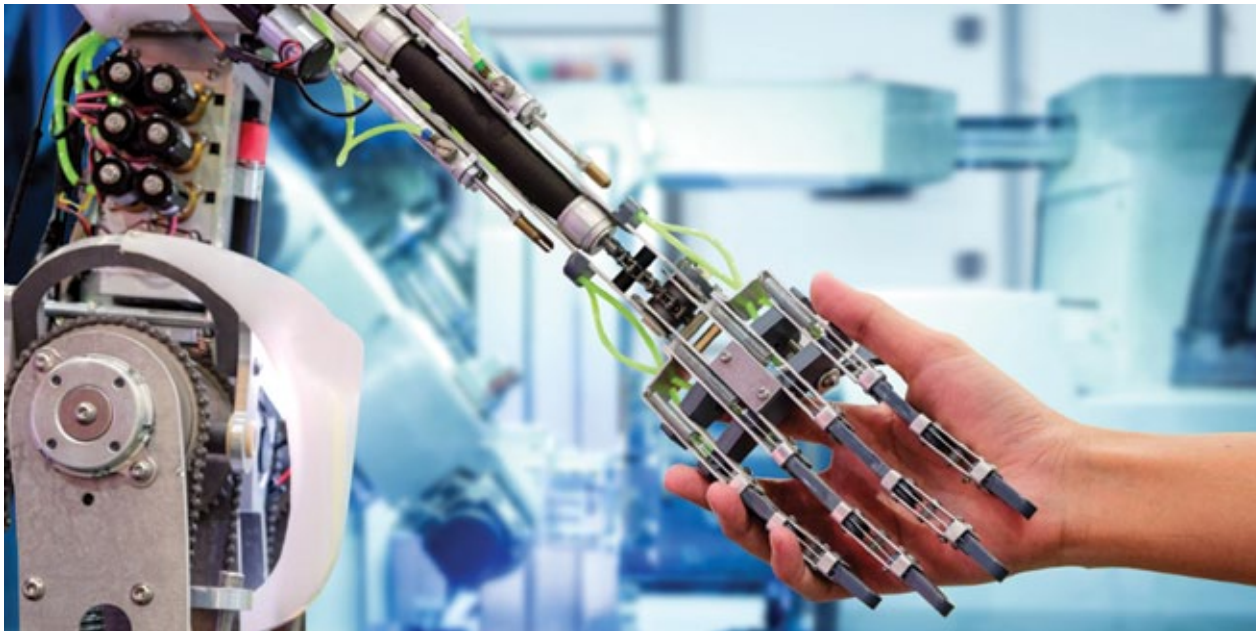
[COMMENTARY]
INTERNET OF THINGS

Looking beyond Industry 4.0

While Industry 4.0 is already popular in manufacturing, the concept of Society 5.0 offers untapped opportunities in blending technology with society



BY MANISH MISRA

It's a busy, sultry Monday morning traffic. In a hurry to reach office, you forget to turn off your room's AC. You don't fret; instead you reach out for your smartphone, while sitting in your car, and turn the AC off. Also, while browsing through your factory operations app, you receive an alert about machine maintenance for your workshop supervisor and control room. This is a LIVE scenario where the internet of things (IoT), artificial intelligence (AI), machine learning (ML), robotics, and other new-age technologies have become part of our connected world – both at home and in industry – and are now catalysed further, by the pandemic.

Industry 4.0, a decade-old concept, was first introduced by the government in Germany. Today, it has become a regular phenomenon. It entails building 'intelligent factories' where machines monitor and take decentralized production and maintenance decisions. This concept has now evolved further to'Society 5.0', which refers to a technology-based human-centered society. Society 5.0 was first conceptualized by Japan and aspires to go beyond industrial transformation and create a 'Super Smart Society', where people can resolve various social challenges by incorporating technologies such as IoT, AI/ML, robotics, and big data into society.

Society 5.0 looks at converging cyberspace (virtual space) and physical space (real space); Japanese companies such as Panasonic and Hitachi, to name a few, are already following this model. Overall, Society 5.0 can

> Society 5.0 aspires to create a 'Super Smart Society', where people can resolve social challenges by incorporating IoT, AI/ML, big data, etc. into society.

> Consumers are looking for IoT-based solutions that can connect all appliances and devices on single platform – light, fan, refrigerator, TV, AC, washing machines, etc.

be categorized under three broad areas: mobility, home and business.

Mobility includes autonomous driving and fleet systems that use obstacle detection, external environment recognition, and energy-saving technologies including next-generation power devices, lithium-ion battery systems, and contactless power supply systems.

Home includes home automation innovations such as smart appliances and lights, as well as sensing solutions such as facial recognition for entry control and detection of suspicious activities. It also includes technologies for lifestyle data analysis, and emotion recognition based on people's behaviour and activity information.

Lastly, business comprises solutions embedded with cutting-edge technologies, including IoT, AI/ML, cloud/edge computing, and blockchain. These are aimed at optimizing enterprise activities across sectors.

For India to achieve the trillion-dollar digital economy, the country needs to leverage these new-age technologies. According to a Zinnov report, India had 200-250 million connected devices by the end of 2019. The report estimates this number to jump tenfold and touch two billion devices in 2021. This signals the possibility of an exponential market growth in the years to come. Presently, the IoT adoption among large enterprises stands at 35%, with Industry 4.0 or Smart Manufacturing and Connected Assets as the two most prominent categories cornering 20-25% of the total investments.

The IoT ecosystem

While adoption of digital technologies has been on the agenda for many organizations, the pandemic has accelerated its pace across sectors. Digital transformation and adoption have gained speed while security has emerged as another top priority. Furthermore, change in consumer behaviour has created a demand for automation (home and office), contactless technologies and connected/IoT-enabled appliances. As a result, there's a rise in demand for smart manufacturing, smart lifestyle and smart societies.

With the advent of 5G, the demand for connected solutions is expected to rise further. Our syndicated research conducted in 2020 corroborates that nearly 81% of the consumers are comfortable spending extra on IoT-enabled products. Consumers are looking for IoT-based solutions that can connect all appliances and devices in the house on one single platform – lights, switches, fans, smart doors, refrigerators, TVs, air conditioners, washing machines, etc. Home automation as a service will enable businesses to provide a holistic smart living experience – comfortable (safe), convenient and connected – to consumers.

Similarly, industrial automation opens new avenues of growth for enterprises. Data generated through these IoT-based platforms will help businesses recognize consumer patterns/behaviour and share relevant information regarding predictive maintenance and warranty, to name a few. This, in turn, will optimise the overall supply chain, lower total cost of ownership and, thus, create economies of scale.

The new digital normal

Driven by the availability of enormous amount of data, rising smartphones adoption and connectivity, the country is well on its way towards 100% digitalization, faster than many developed and emerging economies. Progressive factors advancing this trend include the robust Indian IT/ITeS talent, diverse start-up ecosystem, Government of India's strong intent towards digitalization, development of digital infrastructure and IoT Centers of Excellence.

An integrated effort by the government and the industry will further play a critical role towards addressing the challenges of cybersecurity, standardization for IoT devices, high-speed connectivity, and skilled workforce, among others. At the same time, it will help create a sustainable and connected ecosystem that will take India a step closer to Society 5.0.

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[COMMENTARY]
CLOUD COMPUTING

Time for data to get the Edge

The big change in IT is where there is simply too much data; too much to be made sense of without mathematical models, too much to handle without automation

BY SHAHIN KHAN

There are three things that are hard to do: agree on what happened in the past, realize how things really are in the present, and predict the future. We will have to touch some of each in this article as we look at how cloud computing has evolved and how it is likely to change.

It seems too early to talk about a post-cloud era in computing. Cloud computing is growing rapidly. But the way organizations use information is changing, and with it, the role of cloud computing is changing too. Remember that the central concept behind cloud computing is 'Utility Computing', and that goes back several decades. Grid computing followed in the 1990s before morphing into cloud computing by mid 2000s. That was 15 years ago, before social media, before artificial intelligence (AI), before internet of things (IoT), cryptocurrencies, and 5G. A lot has happened since. So some change should not be too surprising.

Digitization is eating the world

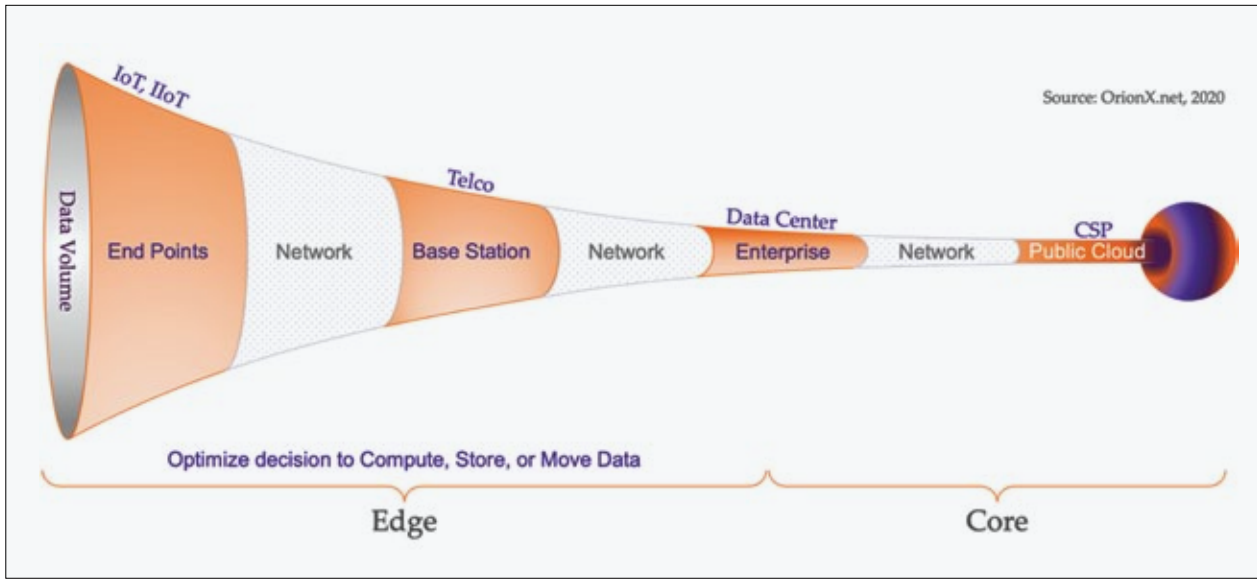
You could make a case that the four Vs of data – volume, variety, velocity, and value – have weaved together to form a common thread that change information processing. Data from big companies led to initial management information systems (MIS). Data from internet-connected organizations of all sizes helped create online search. Data from people was behind social media. And smart connected things serve as the fountain of data that is enabling AI.

While data volumes grow from all existing sources, it is new sources of data that accelerate change. New types and sizes of data enable new economically-viable applications which invigorate new infrastructure. Optimization efforts follow.

The big bang of IT

Computing started with a big mainframe accessed by a directly connected local terminal. It's been getting decentralized ever since. The monilithic terminal/mainframe model carries on but it gave way to the more distributed 2-tier or 3-tier client/server model. Cloud computing expanded the IT universe further. The end points moved further out and became mobile as servers became hyperscale. For a short while, it seemed like

Edge and core computing is the result of computational model, focused on end-to-end decentralized resources, and providing the optimal balance between data movement.



one could have a mobile phone on one end and a public cloud on the other end, and it would be done, nothing in between. But alas, that simplicity would not last.

Too much data (really!)

"Thing Data" is a new fountain of never-ending data. It is what is changing IT as it creates entirely new markets. Most "Things" are outside the cloud. That means most of the data will be created, and ultimately consumed, outside of the cloud.

If the data is small, the device can communicate directly with the cloud, and perhaps a mobile app can provide local and remote control – and IoT. But when the amount of data is too large, it becomes too costly to ship around the data willy-nilly. Rich data, such as 4K video, Lidar, telescope or satellite data can quickly complicate matters.

So the big change in IT is where there is simply too much data; too much to be made sense of without mathematical models, too much to handle without automation, and too much to send to the cloud. And the big realization in IT is that this scenario will be relatively common.

Edge and core computing

Edge and core computing is the resulting computational model, focused on end-to-end decentralized resources and providing the optimal balance between data movement, data storage, and data processing. The label edge works well since it covers the spectrum of devices, points of inception, and local in-situ processing. We can look at edges as the far edge (devices), mobile edge (mobile app for local control and tracking), and near edge (server-based apps and app components).

Edge computing is an emerging market segment with a device-to-cloud perspective, covering the area from the source of data towards the cloud. Core computing is the flip side of that picture: a cloud-to-device perspective that covers the area from the cloud towards the device. Edge/core combines the two halves and covers the end-to-end picture, including the part between IoT and cloud.

If cloud was Mainframe 2.0, then edge/core is client/server 2.0. More spread out, more flexible, and representing the complete digital fabric that represents an automated or autonomous organization.

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Nitin Bansal
Head, Ericsson India & Head, Network Solutions
Ericsson South East Asia, Oceania & India

"Our radio system hardware has been 5G-ready since 2015"

With the 5G trial underway in India, there is a lot of expectation, speculation, and apprehension about how the new telecom standard will change the shape of India's digital backbone and how it will create newer opportunities for both consumers and enterprises. As a technology provider Ericsson has been playing a key role in evolution of the 5G technology and standards. It has also been playing a critical role in developing use cases and demonstrating potential of commercial 5G network. Ericsson's Head of India and Head, Network Solutions, Ericsson South East Asia, Oceania & India ***Nitin Bansal*** *shared update on the company's 5G strategy, its partnership with Samsung and the spectrum policy matters in India. Excerpts from his interview with* ***Shubhendu Parth****:*

What is your strategy and portfolio for 5G rollouts in India?

Ericsson is a market leader when it comes to live 5G networks. Pioneering customers have chosen us as their 5G partner across the globe and we were the first ones to have deployed commercial live networks across four continents. As of now we have 138 commercial 5G agreements and 85 live 5G networks globally. We have the right 5G portfolio in place to enable our customers to deploy 5G networks in all main frequency bands and utilize their valuable spectrum assets in fastest and the most efficient way. This is proven in live networks with the best performance results, so our customers have every opportunity to be ahead with 5G.

So, from our perspective, we are ready for 5G rollouts. Ericsson's Radio System hardware has been 5G-ready since 2015, enabling operators to upgrade to 5G with a remote software installation. In fact, we manufacture telecom equipment, including 4G, 5G radios and microwave products at our Pune facility and it is worth highlighting that we were the first company to manufacture telecom equipment in India since 1994.

We have been working with our operator partners as well as the academia community to test and develop various 5G use cases that are relevant for the market. To that effect, Ericsson and Qualcomm successfully collaborated at the India Mobile Congress (IMC) 2019 to showcase India's first-ever live 5G video call using a 28 GHz spectrum. Ericsson took the lead at the India Mobile Congress 2019 to demonstrate the reliability, speed and low latency of 5G through the Connected Music use case apart from the use case it demonstrated with Qualcomm. Ericsson enabled the first ever 5G-powered Connected Music performance during the inauguration of the India Mobile Congress (IMC) 2019 in partnership with Airtel.

In January this year (2021), we partnered with Bharti Airtel to demonstrate 5G on a live network in Hyderabad. Leveraging Ericsson's dynamic spectrum sharing technology, Airtel gave India its first experience of 5G over a commercial network.

Tell us something about the role of standards and patents in 5G adoption, as well as about collaborations like the recent Samsung patent handshake and interoperability agreements with major chipmakers?

Open standards and patent licensing is the key to success

> We started to lead the industry discussions around 5G as early as 2011, scoping out 5G services and requirements, and researching and developing the 5G technical concept.

in the whole 5G ecosystem. They are important enablers of the growth in the 5G and IoT area. Ericsson is leading 5G standardization with most contributions for 4G and 5G and when counting declarations to ETSI, applying an essentiality filter, results in Ericsson being on top of 5G patent race.

We started to lead the industry discussions around 5G as early as 2011, scoping out 5G services and requirements, and researching and developing the 5G technical concept. During the development of 5G/NR between 2016 and 2020 we have had the biggest impact on technical specifications with 37% of the specification text coming from contributions co-authored by Ericsson. This is almost twice the additions by any other company.

Regarding the agreement with Samsung, we are pleased that we could reach a mutually fair and reasonable agreement which will allow us to focus on bringing new technology to the global market. The deal confirms the value of Ericsson's patent portfolio and further illustrates our commitment to FRAND principles.

Is pilot or phase-wise trial the right way to go forward with 5G? What is Ericsson doing on this front?

We are ready to switch on 5G for India as soon as the spectrum is made available. As mentioned earlier, our Radio System hardware has been 5G-ready since 2015 enabling operators to upgrade to 5G with a remote software installation. We will partner with our customers to develop 5G use cases in the coming months.

What is your take on the state of spectrum – bands, availability, pricing etc. from a 5G context?

We believe India is ready for 5G and affordable 5G needs to be made available to the Indian operators. Given the 'long-term benefits' that 5G technology will bring to India, it needs to be viewed as critical infrastructure and the foundation on which India can realize its Digital India vision. Having a good digital infrastructure is very impactful for the economy and we know that increased penetration of mobile broadband drives economic growth.

What does India lack and what are its unique strengths when we compare its 5G curve with other regions?

India is currently the world's second-largest telecommunications market and continues to register strong growth, which clearly shows the country's appetite for a faster next generation technology. We believe that 5G is the answer to unlock India's potential in reaching the next phase of growth and realizing the government's 'Digital India' vision.

While India remains the market with the highest usage per smartphone per month across the globe at 15.7GB/month (2020), it is expected to grow to 37 GB/month by 2026. 5G, in the initial phase, will be able to manage the increasing levels of data traffic. Enhanced Mobile Broadband, then, will be a way for service providers to manage the cost and the quality for end users. This will help improve the customer expectations and experience with faster speeds, better reliability and lower latency that 5G will bring. Over time, new and innovative 5G use cases will emerge in the areas of 5G for business and IoT.

Ericsson Consumer Lab study "5 ways to a better 5G" has revealed that there is a high interest for 5G in India among consumers and they are willing to pay extra for the new capabilities that 5G brings. The report estimates that one in three early adopters globally are willing to pay a 20-30% premium for 5G services whereas Indian consumers consumers have shown willingness to pay 50% more for 5G plans bundled with digital services and at least 40 million smartphone users in India could take up 5G in first year of the technology being made available. We believe India is ready for 5G and affordable 5G needs to be made available to the operators at the earliest.

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