

TECH BEACON

THE TECHNOLOGY HARBINGER



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About TECH BEACON

THE TECHNOLOGY HARBINGER

Technology is core to Mindtree. It is extremely important in building capability and capacity for us to keep a sharp focus on emerging technologies. We also make it a point to understand the application of these technologies in the context of our customers. In this effort, we constantly explore and experiment with emerging technologies and gauge their maturity levels for consumption by enterprises. We do this by comparing and contrasting them with similar tools already in use. Tech Beacon is an initiative to compile outcomes of our experimentation and technology adoption guidance for enterprises. We group technologies under three categories: Invest, Experiment and Watch. We explain these categories in detail in this report.



Mindtree has been publishing Tech Beacon since 2015. Tech Beacon is a technology harbinger that provides directions on emerging technologies based on our experience. With the Covid-19 pandemic, 2020 has been a very difficult year so far for all forms of businesses and livelihood. A new normal seems to be emerging and it is quite likely that we may never go back to the old normal. There is a tremendous opportunity to leverage technology to create new possibilities in the new normal.

Almost every industry has been hit by Covid-19; some more and some less. Retail industry has seen significant YoY revenue growth from e-commerce channel across the globe. E-commerce will be reimagined using emerging technologies like AI/ML, IoT, AR/VR and Blockchain. Future of E-commerce will be Visual commerce, Conversational commerce, AR commerce, IoT enabled commerce, Semantic search along with the Supply chain industry to be reimagined using Blockchain ; especially to understand the provenance of perishable food items and the temperature at which the items were maintained through the chain. Visual commerce & AR commerce will augment the experience consumers are comfortable with in brick & mortar stores.

As Insurance companies introduce innovative, time bound insurance policies related to Covid-19, they will have to make these available online for self-service making the customer experience seamless for purchasing the insurance policy, remote consultation and for claims.

ICT (Information & Communication Technology) industry has been the most benefited from the lockdown situation during the Covid-19 pandemic. With more than 90% of workforce working from home and using various cloud tools for collaboration. With no sight on full workforce coming back to offices, the need for speed and stability in connectivity and various services on cloud will only increase. Even the enterprises will accelerate cloud adoption moving towards enabling contactless business where possible, Remote working, Remote/Virtual operations. All of these will place an increased demand on the ICT industry.

As the cities & offices open up slowly, technologies are being deployed with innovative solutions. Countries like Africa, China & Chile are using Drones for delivering PPE (Personal Protective Equipment), Coronavirus test samples and medicine. Drones are also being used for surveillance to monitor physical distance in different corners of the city, spraying disinfectants. Computer vision will be used to monitor physical distance, people wearing mask, people using hand sanitizers before entering lift, monitoring temperature of employees entering office and similar use-cases. All of these will be done leveraging the existing CCTV cameras in various parts of city and commercial buildings.

Compared to all industries, Travel industry is the most affected one during Covid-19 and recovery will also take time for this industry. According to IATA, annual loss is expected to be close to \$250 billion for the airline industry. As the economies open up, Airline cargo business would pick up before the passenger travel business. Tourism will look inwards with more of domestic travel than international. Even then, passengers would use web/mobile for booking, pay via mobile wallets and expect contact-less check-in & boarding process using biometrics. We could also expect gesture based self-service kiosks in airports & hotels.

In summary, as the world comes out slowly from the lockdown situation, technologies will play a huge role in getting every industry adjust to the new normal. Enterprises that proactively define the new normal instead of waiting it to unfold would deploy these technologies and become more resilient & successful.

Tech Beacon 2020 covers multiple emerging technologies and our recommendations to invest/experiment/watch based on their maturity.



Madhusudhan KM
Chief Technology Officer

Every major disruption has resulted in accelerating the trends that were already underway. As the days of social distancing continue, it is important to look at some of the immediate and near-term outlook for the technology industry.

In the immediate term, a few things are quite apparent

- Remote working and its associated needs of remote work infrastructure
- The shift away from Capex will continue to accelerate the adoption of cloud computing
- Data driven decisions will continue to increase. Decision makers will want to visualize more data, do what if analysis, look at historical analysis leading to more self-service analytics.

However, a larger aspect is to cast a look at changing behaviors. Everything around is going low touch. The touch-screen era is likely to see a shift towards machine vision and voice technologies, leading to higher prevalence of autonomous devices. This will be expected not only in consumer environments, but also remote working environments as well, leading all the way to smart-cities.

How would these intelligent devices look like? One example of this is the Covid-19 detection glasses from Rokid, a Chinese start up. Rokid's T1 thermal glasses use an infrared sensor to detect the temperatures of up to 200 people within two minutes from as far as three meters. The devices carry a Qualcomm CPU, 12 megapixel camera and offer augmented reality features — for hands free voice controls — to record live photos and videos. These glasses do all the processing and store the data measurement locally. They have inbuilt AI algorithms to infer objects, voice and do image enhancements.

While this is one example, it is equally true of aircraft boarding through face detection, enforcing social distancing in cities through video cameras as well. From a technology perspective, this is about distributed computing power at decentralized devices, which can also apply machine learning algorithms on the device as well. This mode of computing is also referred to as "Edge Computing". It is a perfect combination of low touch, cloud computing and data processing and prediction technologies. Additionally, data locality is one of the key aspects. E.g. A face detection system cannot be storing images in the cloud, it has to be processed locally.

Let us look at how ready we are for this technology. When we speak of deep learning and machine learning, we require a lot of computing power to train the models. However, once they are trained, applying the model, for e.g. to detect a face requires less computing power. This is also known as "inferencing" a model. This is what makes algorithms to run on these local devices/edge. E.g. Rokid was able to build these glasses in two months and the object detection algorithm runs on the device.

This is possible because, today we have the silicon chips specifically designed for this need. Typical chip manufacturers like Intel and ARM, have increased investment and sale in chips for the data-center and the edge. At the edge, we have an increasing class of chips called the application specific integrated circuits or ASIC for short. These chips are designed specifically to handle AI/deep learning training or inferencing at the edge. Sales of these chips are expected to grow at the rate of 25-35% over the next four years.

These chips are no longer the domain of traditional players though. Cloud service providers from AWS, Microsoft, Google and Huawei are also investing in their own chips. AWS has Inferentia line of chips, Huawei has Da Vinci and Ascend, Google is in the third generation of its TPU chips and Microsoft has partnerships like the one with Graphcore.

The edge however, need not be only the device. For example, if one wants to monitor traffic patterns in a mall or an airport, it requires one to collate events from different cameras and then apply the intelligence. Since many of the actions are event based which require low latency, going to the cloud or a remote data center is not practical. Could we have the processing power available to us at that place? And can one really manage this infrastructure effectively?

Innovations in cloud computing make this possible. Today it is possible for us to have cloud in a box as shown by AWS Outpost, Azure Edge and Google Anthos. As AWS puts it "AWS Outposts is a fully managed service that extends AWS infrastructure, AWS services, APIs, and tools to virtually any datacenter, co-location space, or on-premises facility for a truly consistent hybrid experience. AWS Outposts is ideal for workloads that require low latency access to on-premises systems, local

data processing, or local data storage". The customer provides the network connection and power and all other services, akin to public cloud, are taken care by AWS. This is largely true of Azure Edge and Google Anthos as well.

In summary we are talking about a consistent application platform whether it is the edge or the cloud. This has to have the guardrails of holistic security, identity, deployment and monitoring built into it.

The edge computing scenarios require low latencies which effectively is the network. These use cases require latencies mirroring wire line connections. This is where 5G makes a difference. 5G provides this low latency connectivity. On full implementation, 5G promises latencies of less than one millisecond, mirroring wireline connections, while providing the flexibility of wireless connections.

This has brought the telecom providers like AT&T & Verizon and the Cloud providers together. The basic idea is to place "cloud in a box" technology at the cell tower/network edge. Cloud providers have tweaked this technology for telecom and we now have AWS Wavelength, Azure Network Edge and Google Anthos for telecom in order to take the computing power to the network edge. Therefore, by extension, the edge could lie anywhere from the actual device to the first network termination point before hitting the internet.

How ready are we for 5G rollout? What use cases are possible? For one, the standards are yet to catch up and currently only enhanced mobile broadband use cases are possible e.g. applications which make augmented and virtual reality possible, increased video calling and autonomous machine to machine communication possible. To get the truly working smart cities and autonomous devices into reality, the standards will come out only by the end of 2020 with a subsequent release expected next year.

However, that doesn't change the fact that we are looking at building an autonomous low touch technology ecosystem which bring together the already proven technologies in chip design, cloud computing, data processing and network connectivity. We are likely to see some of these use cases across industries

- Communication providers across telecom and the ecosystem will have increased use of platforms and infrastructure to make edge intelligence possible

- In high end retail like jewellery and fashion, we are likely to see more adoption of augmented reality-based fitment mirrors which can help customers try out styles without touching them. This will be available both in-store and online including mobile applications
- For retail stores, usage of current video feeds to understand the amount of time that people spend in stores is likely to increase for both regulatory and commercial purposes
- In the insurance space, more remote working, digital forms and digital processing of forms through machine vision interfaces are likely to increase due to the low-touch requirements
- In Hospitality segment, we are likely to see changes in the check-in processes accelerating the movement towards mobile check-in and mobile contactless keys increasing the demand for edge intelligence as well.
- In restaurants, we are likely to move towards more contactless payments and menus, probably through QR codes. In the absence of smart-phones we are likely to use voice enabled menus as well.
- Self-checkout and contactless payments will continue to increase across the board

Applying these technologies would mean that the ways of working in an autonomous, low touch world will be different. This will require the processes to be re-engineered. Most visible is the supply chain process, but every process will undergo a change. The true power of AI is not in individual use cases, but in how we can re-imagine business processes so that human intelligence and machine intelligence can be used in the right mix. This can also be referred as Collaborative Intelligence.

In summary, we are working towards a paradigm where we act in the real world through autonomous machines, decide at the edge and learn in the cloud. Technologies which already have high demand, whether it is interactive process design, cloud computing, data processing and predictive intelligence, will see further fillip in a continuously connected low touch world.



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The recent events of COVID-19, the lockdown, and the adaptation that we've all had to go through - just to keep civilization and a bare-bones economy going - have highlighted the relevance that AI/ML has played in countries surviving through these critical times, what is possible today, and in the importance/focus that needs to be given to the relevance of artificial intelligence and machine learning for any organization.

While the industry/general population has mostly had a skeptical view towards machine autonomy, the situation around COVID-19 has largely demonstrated otherwise.

Let's take a few areas where AI has been a helper to mankind, the technology behind that made it possible, and its implications towards the 'new normal':

1. The role of data

The old norm was filled with silo organizations grappling with the problem of 'data not being readily available' and significant initiatives to consolidate available information in order to deliver decision-enabling insight.

Efforts around suppressing/fighting COVID-19 showed us a few things:

- The unprecedented level of collaboration across the scientific community in sharing data
- Publishing the results of efforts from multiple teams in many central sources so that others tackling a different aspect of the problem can build on research/observations already found/disproved
- The true power/potential that insights from data can bring – whether it is looking back and understanding what happened, to more predictive/prescriptive models or its capability in determining the to-be strategy for organizations, or countries as a whole

As we enter the new normal, here are the key lessons that organizations could leverage in their evolution:

- A clear data acquisition and/or consolidation strategy is critical for any organization, and has to be given the highest priority/focus
- Collaboration over silos will be a defining characteristic of the new norm – whether within or across organizations, and
- An increase in transparency of strategic and critical decisions for enterprises – made possible by data

2. Natural language and the challenge of finding relevant research

The collaborative efforts to combat COVID-19 also brought a different technology challenge to the forefront: When thousands of papers are being published by different research groups working on various aspects of combating the virus, how do you find relevant information in a knowledge-base of about 59,000 articles, and visually investigate associations between concepts appearing in the literature? Machines excel at handling large volumes of structured data, but the spoken word has invariably had a human being as the target reader.

As part of ongoing efforts to combat the virus, the working group created COVID-19 - a consolidated knowledge base of research papers and literature that could then be searched by NLP-enabled programs to find relevant pieces of information.

The COVID-19 initiative was largely successful in providing a consolidated knowledge-base for the distributed teams working on combating the virus.

However it has also highlighted a few challenges:

- Individual areas of research within the space of natural language - have all been specific, narrow applications focusing on a specific problem domain [something that was designed for an n-gram based search index does exactly that, but cannot stitch together relevant paragraphs from multiple articles into an associative graph unless trained to do so]
- The need for creating documents in both human-readable and machine-readable forms so that programs can extract meaningful links between the information that a human might miss or overlook

Natural Language techniques also played another essential role in the efforts to combat the virus: identifying vaccines already existing in the market that could help combat the virus's symptoms. The technique that made this possible is called Literature-based analysis – a method of combining drug industry data with information gleaned from scientific research papers. Now let's look at the relevance of both the challenges and the potential of the solution for organizations.

In the old norm, for most organizations, the problem of managing relevant, text-based and up-to-date

information is probably much worse than the structured method made possible by COVID-19. Most organizations that have evolved over the past few decades will have a few challenges with managing their own verbal information: multiple technologies used, incomplete/incorrect details within this documentation, no single way to query/extract relevant information, and/or siloed sources that always require manual curation, and always take a long time to search.

In the new normal – characterized by remote working and floating workforces – where information is key, let's assume that streamlining available knowledge and standardizing information management within the organization is given the necessary focus. Now let's look at the potential that linking structured and unstructured data brings:

- Retail organizations would now be able to link structured purchase order information to invoices from suppliers and query information seamlessly across both – what used to be a manual, time-intensive process in the old norm
- Insurance companies would be finding themselves populating their structured data stores automatically from hand-written claims forms – with a high degree of accuracy – and
- Hotels could now be correlating/linking bills from multiple outlets at the location to each identified customer – without the manual effort that the old norm needed

And so on.

3. Optimization and Re-purposing Supply Chains

When the lockdown was initiated, governments all around the world varied in both in their strategy and the structure of their responses. Organizations were left with the stark reality of optimizing the bottom line in order to account for dips in incoming. While underpaid hospital and retail staff bravely went out into potentially infected areas, shortages of essential equipment for these brave workers highlighted a different type of gap - a disconnect between those with a 'need' for items (ventilators/masks), those who could provide the needed items (manufacturers, or people/organizations with a surplus), and those who could move these to the location of need.

Organizations with the assets to help address a specific need were not able to get connected to those in need - even if they were willing to re-design/re-purpose assets to help fight the crisis. Generative AI could play a critical role in addressing this gap - using techniques like Genetic and Adversarial networks - to reposition/repurpose/re-balance supply chains to keep communities and businesses running.

However, there are two main challenges in achieving this:

- Imagine that the economy of a country is composed of a collection of supply chains, each in turn composed of a collection of business processes. If these core services had been modeled at a community, locality, or country level as a hierarchical collection of components, re-purposing them towards critical objectives such as these would have been easy
- The second main challenge would be the algorithm itself, and defining what constitutes an objective, or to be more specific - what constitutes a 'good' solution

Generative AI like Genetic Algorithms or Adversarial networks can help with the second challenge above: finding the most optimum solution given a list of shortages, 'component processes', and surplus providers/makers. In the new norm, as enterprises start exploring new ways to leverage assets and or re-purpose the essence of their businesses, generative solutions can play a key role in designing – and optimizing – how these new models work.

In summary, various capabilities offered by Artificial Intelligence and Machine Learning will definitely help enable organizations to adapt to the 'new normal' - whether it is with finding new areas of efficiency during lockdown, or to evolve into the new era.



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Emerging Solution Patterns

Enterprises continue to embark on legacy modernization and digital transformation exercises, and the output is expected to be a leaner application landscape with intelligent processes, high degree of automation and lower total cost of ownership. Technologies like AI, IoT, and Blockchain are slowly becoming mainstream and we are recognizing the significance of data and Cloud.

Amidst this business trend and progress, we have been hit by an unexpected and unprecedented crisis. 2020 is a year that most of us will not forget, it will be infamously remembered for COVID-19 and its impact on humanity. However, COVID-19 has also brought to light many factors that will have to be considered when designing solutions in the future. This incident has changed the way people will work, support, and interact with systems in the future. Collaboration, Automation and Self-service will take center stage in every system that is being designed.

As enterprises will be more complex, distributed with more moving parts, we have listed a set of patterns that must be considered while designing solutions for the future.



Shared Workspace

The need to build collaborative experiences for users in different locations has become vital. The shared workspace pattern allows users to share their workspace with multiple users, collaborate, and resolve issues. It allows multiple logged in users to work on a common workspace, view and edit information in real time.

When implementing this pattern, it is important to decide the type of workspace elements that need to be shared with a specific user, and the portion of shared data that needs to be persisted. This is important for security and performance. The implementation should have intelligent algorithms to resolve conflicts as multiple users are able to make updates.

Some common implementations of the pattern are:

1. Shared AR to help sales folks to collaborate with customers and customize products being sold. We could have an automobile salesperson; a specialist in accessories and a customer all of them located in different locations use a Shared AR to customize a car based on customer needs.
2. The same concept of Shared AR along with Digital twins can be used to collaborate and debug issues in mission critical systems in a remote area; an expert located elsewhere can get a view of the system at fault and jointly work with the maintenance team onsite to fix the issue at short notice.



Closed Loop Automation

Solutions that are deployed today involve provisioning resources on the cloud, on premise, the edge including networks and devices that have to be plugged on to a network.

The closed loop automation pattern allows automated setup and maintenance of enterprise applications using a combination of

- Frameworks that automate provisioning of resources on the cloud, on-premise or edge. including resources required for monitoring/alerts and self-correction based on service assurance policies (Ex: 99.99% availability).

- Frameworks that provision networks defined by user-configured models using software defined networks and network function virtualization along with the means to take care of service assurance on the network and link them to resources available on cloud/on premise.
- Integrate with device manufacturers to send them endpoint and security information to enable zero-touch onboarding of devices, and connect to provisioned networks and cloud services.
- A single management console to manage all resources.

This pattern will be immensely useful when building solutions for smart cities, enabling drones or onboarding multiple devices to an IOT platform.

This trend is already being implemented in the telecom industry for 5G services given the scale of operation of the telco's and adherence to stringent SLAs.

Frameworks like Intel SDO along with frameworks like ONAP and OMS and cloud services like Azure Arc/ Google Anthos are powering closed loop automation.



Act on the Edge

Inflating compute costs of large data centers, need for ultra-low latency, increased security and compliance with regulations in various geographies are forcing enterprises across industry verticals to move workloads closer to the users. This can be achieved by creating Edge Zones, which serve as mini data centers located closer to users instead of distant data centers.

Edge zones offer low-latency compute and take care of local regulations. They will continue to send data that can be used for monitoring, analytics, or audit to a hub data center and they will not have the entire suite of offerings provided by a data center (Ex: Data Lake, BI).

Designing Edge zones is a complex exercise that involves designing self-service capabilities, hyper automation (deployments, upgrades, and maintenance), security, high availability, and resiliency.

Pattern like Edge zones will be powered by advancements in cloud and communication technologies

led by the advent of 5G. These technologies will power ambitious projects like

- Smart cities, smart factories (a Boeing plant that manufactures 787s), smart airports, etc.
- Self-driving vehicles and drone as a service, impacting multiple industry verticals

Cloud solutions like AWS Outposts, Local Zone, Wavelength and Azure Edge Zones are some of the leading implementations.



Shared Data, Shared Processes, Shared Truth

The current COVID-19 crisis has brought to light the need to Correlate data in disparate systems (hospitals, governments, research organizations)

Ensure suppliers are verified/onboarded quickly to build resilient supply chains that enable provenance, real time tracing and tracking.

Provide financial benefits directly to consumers
This will need the ability to not only share data in real time but also provide the ability to all involved parties to validate and approve processes that modify data. Traditional integration patterns like API's, messaging or file sharing falls short when addressing requirements listed above paving the way for technologies like Blockchain and distributed ledgers.

The peer-peer network, immutability of the distributed ledger, support for pluggable consensus mechanisms and smart contracts that provide complete visibility into processes which operate on data enable higher security, increased resilience, high levels of automation, disintermediation and ease of dispute management.

Blockchain solutions have come a long way in addressing issues around scalability, performance, operations, integration with existing ERP or external interfaces and handling large volumes of data.

We have public blockchains that power use cases to easily onboard suppliers or share digital identities. Likewise, there are live implementations of permissioned blockchains that ease cross border payments, provide

provenance of food products, power connected devices and connected supply chains.



A touchless and virtual experience using AI

Artificial Intelligence and especially Deep Learning using Vision and natural language has found a strong place in Retail, Manufacturing, Banking, Insurance and travel. It is changing the consumer behavior and patterns which results in delightful customer experience.

In Retail, a user sitting at home can use the mobile phone take a selfie, get the skin analyzed and have the most appropriate skin care products recommended. Here deep learning is used to recognize the face and the key features to make the process efficient. In manufacturing, quality inspection is a key process area and computer vision is a valuable technique. High resolution pictures of products on the manufacturing line can be analyzed for minute defects which may not be easily detected by a human and also it is a laborious and intensive task for a human to do it at scale.

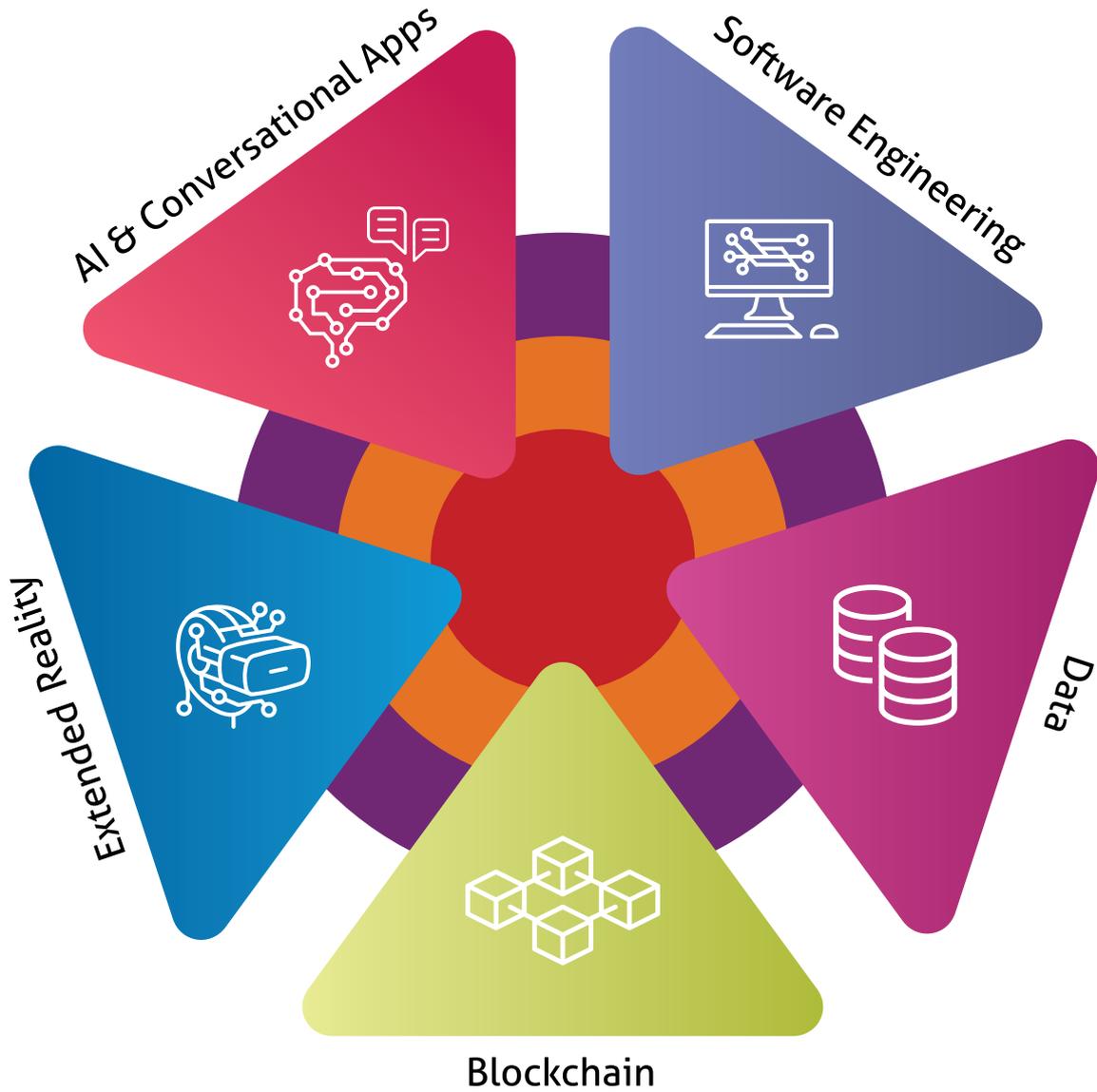
Banks and Insurance companies are also using AI to improve experience of customers in newer ways. Selfie based authentication is becoming the primary way to open bank accounts or do a KYC process instead of visiting a bank. Visual inspection of managed properties or automobiles using computer vision is also gaining lot of traction that reduces touch points and makes the process faster and efficient.

Travel and hospitality has been a high touch experience starting from airports to hotels. Gesture based visual recognition can be used at kiosks to print boarding passes without touching the screen. Instead of physically inspecting travel and identity documents, we can rely on vision techniques to scan documents and identify a person with a good degree of accuracy.

The trend of touchless and virtual experience is going to grow and become a norm especially with pandemics like COVID - 19 affecting humanity and AI is at the sweet spot to enable such experiences.

Focus Areas

Mindtree presents a point of view on each of the following broad areas of focus in the technology domain.



INVEST



EXPERIMENT



WATCH

Direction

The Mindtree Tech Beacon provides direction to enterprises on various technologies by categorizing them as Invest, Experiment or Watch technologies.



Invest

These technologies have a high potential for generating business value in the near future. Mindtree intends to build capability internally or identify a partner who can help our project teams learn to bootstrap these technologies. We arrive at these technologies by observing customer demands, industry trends, opportunities and open source community support. Most of these technologies were either implemented in production-grade applications for customers, or in internal reference implementations.



Experiment

These technologies have not yet seen mainstream adoption but show huge promise for the near future. We arrive at these technologies by listening to our customers' interests, following industry buzz, and noting indications of increased activity in various forums and analyst reports. We need to experiment and build capability in these technologies to have an early adopter edge.



Watch

The technologies in this category show promise through their architecture, the business cases they support, and a community push for adoption. These technologies are not yet adopted by enterprises, but are being evaluated by enterprises for their adoption benefits. While we do not have to invest much in them yet, we need to keep a close watch on these technologies and move them to the 'Experiment' category as they mature or become more relevant to enterprises.



AI & Conversational Apps

How can AI/ML help enterprises during the COVID – 19 pandemic?

COVID – 19 pandemic has presented unique challenges to enterprises and organizations across the world. As people and industries are adapting to the new normal way of life and business, AI/ML technologies have shown that they can help people and businesses to return to usual activities with a certain degree of confidence amid the pandemic. The low touch or zero touch economy has gained a lot of importance now than ever before.

Banks and financial institutions are adopting new processes like selfie-based authentication using Deep Learning based face detection for opening accounts. Insurance companies can handle claims remotely and the claimants need not visit the spot of incident.. Whether it is a car accident or property damage, claimants can upload photos of the incident and an Object detection algorithm detects the damage and makes decisions remotely.

Physical retail has always been a high-touch business across the globe. Virtual trial rooms on mobile phones using AR/VR and Vision intelligence is an advantage for retailers to reduce store visits, but still keep the business going. In manufacturing, where workforce presence on the shop floor is mandatory, Vision intelligence can help monitor social distance and compliance of wearing facemasks and PPEs.

Air travel, which has lot of touch points at the airport can also benefit from Vision intelligence. For example, to avoid public touch surfaces like kiosks, gesture based operations can be easily implemented to reduce touch. Finally, AI/ML also has been a great help in crunching large amounts of molecular and chemical compound data to produce a possible vaccine for COVID – 19. Remdesivir is one such vaccine candidate identified through an ML competition that crunched about 4 million molecule combination data.

AI & Conversational Apps

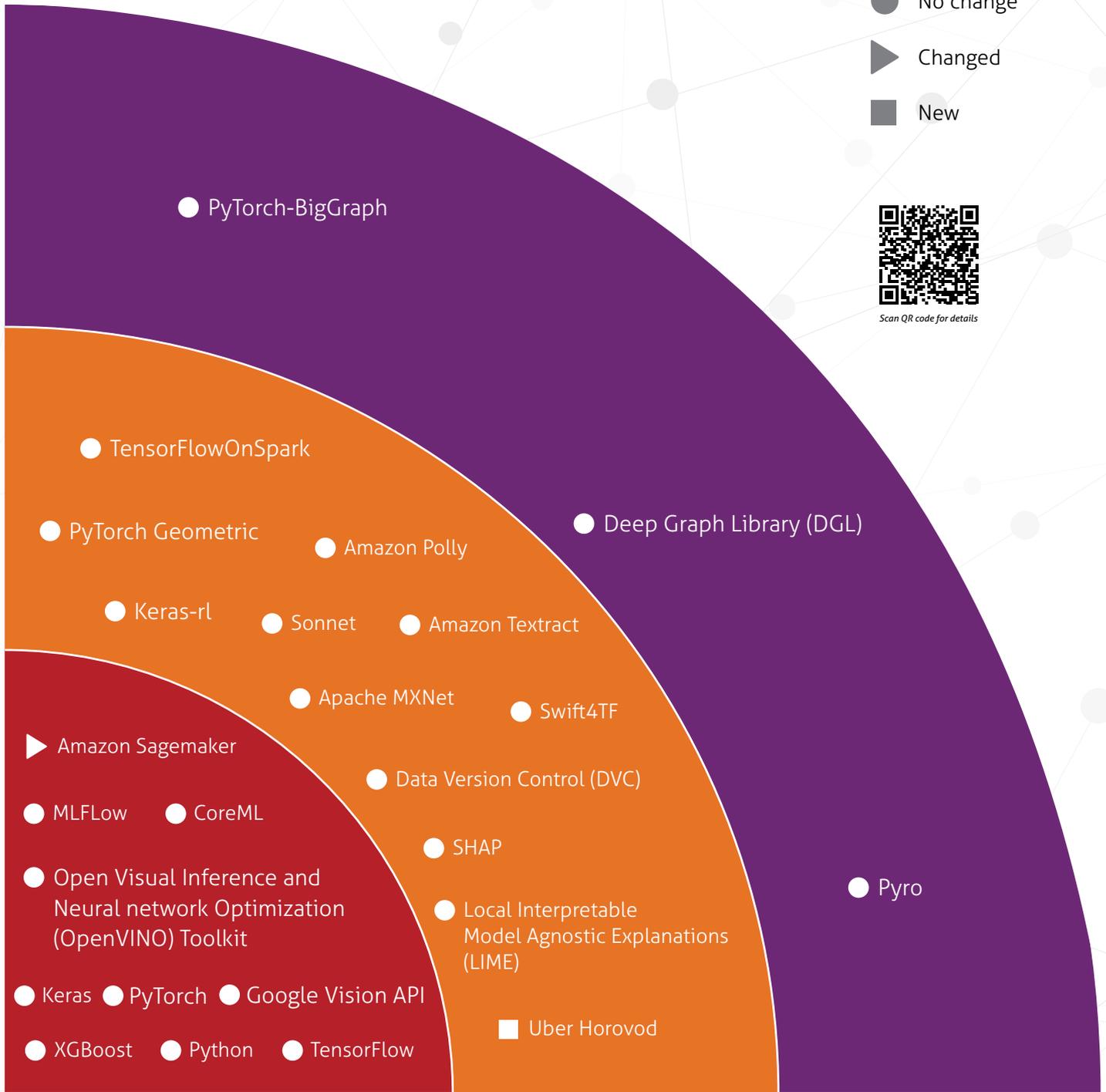
● No change

▶ Changed

■ New



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 INVEST

 EXPERIMENT

 WATCH



INVEST

XGBoost

XGBoost is a machine library that uses gradient-boosted decision trees designed for speed and performance. It supports regression, classification, ranking and user-defined objectives. It is scalable, supports parallel and distributed execution, and provides interfaces for multiple programming languages. XGBoost is very effective for prediction tasks on tabular or structured data sets. XGBoost library is used in many data science and machine learning challenges.

Python

Python is an interpreted, high-level, general-purpose programming language. Created by Guido van Rossum and first released in 1991. Python is the most popular programming language used for coding Deep Learning models and algorithms.

TensorFlow

TensorFlow is a free and open-source software library for data flow and differentiable programming across a range of tasks. It is the most popular library for implementing Deep Learning models.

Keras

Keras is an open-source neural-network library written in Python. It is capable of running on top of TensorFlow, Microsoft Cognitive Toolkit, R, Theano, or PlaidML. Designed to enable fast experimentation with deep neural networks, it focuses on being user-friendly, modular, and extensible.

PyTorch

An open source machine learning framework that accelerates the path from research prototyping to production deployment. It supports distributed training which is a useful feature required for many projects.

Google Vision API

A cloud based API to implement a range of Vision based solutions. It is one of the best among the cloud Vision APIs in terms of accuracy for a range of tasks. This helps in quick implementation and deployment.

Open Visual Inference and Neural network Optimization (OpenVINO) Toolkit

OpenVINO toolkit is a free toolkit that facilitates the optimization of a Deep Learning model from a framework and deployment using an inference engine onto Intel hardware.

MLFlow

MLFlow is an open source platform for end-to-end machine learning lifecycle management.

CoreML

Core ML is the machine learning framework used across Apple products (macOS, iOS, watchOS, and tvOS) to perform fast prediction or inference with easy integration of pre-trained machine learning models on the edge, which allows you to perform real-time predictions of live images or video on the device.

Amazon Sagemaker

Sagemaker aids every developer and data scientist to build, train, and deploy models quickly. It is a fully managed service that covers the entire machine learning workflow to label and prepare data, choose an algorithm, train the algorithm, tune and optimize it for deployment, make predictions, and take action.



EXPERIMENT

PyTorch Geometric

Most existing deep learning techniques deal with Euclidean data. However, many real world data like graphs is non-Euclidean and irregular in structure. Geometric Deep Learning deals with the extension of Deep Learning techniques to graph/manifold structured data. PyTorch Geometric consists of various methods for deep learning on graphs and other irregular structures. These methods include graph convolution, graph embedding and graph attention based networks.

TensorFlowOnSpark

TensorFlowOnSpark enables merging of deep learning with big data platforms. TensorFlowOnSpark enables distributed TensorFlow training and inference on Apache Spark clusters. TensorFlowOnSpark enables distributed deep learning on a cluster of GPU and CPU servers. It was developed at Yahoo and then contributed to the open-source community. It minimizes the amount of code changes required to run existing TensorFlow programs on a shared grid. Its Spark-compatible API manages the TensorFlow cluster.

Keras-rl

Keras-rl implements advanced deep reinforcement learning algorithms in Python and seamlessly integrates with the deep learning library Keras. Keras-rl uses Keras and supports Theano or TensorFlow back-end. Hence, algorithms can efficiently be trained on either CPU or GPU. It works with OpenAI Gym out of the box as well and makes evaluating and experimenting with different algorithms relatively easy. Keras-rl is extendable and helps implement your own environments and algorithms by extending some simple abstract classes.

Amazon Polly

Amazon Polly is a service that turns text into life like speech. It allows to create applications that talk and build entirely new categories of speech-enabled products. It uses advanced deep learning technologies to synthesize speech that sounds like a human voice.

Amazon Textract

The API automatically extracts text and data from scanned documents. It goes beyond simple optical character recognition (OCR); identifies the contents of

fields in forms and information stored in tables and gives a meaningful output in various formats. It can be used to quickly automate document workflows, enabling the user to process millions of document pages.

Sonnet

Sonnet a deep learning library from DeepMind. It is useful to train and learn from DeepMind's open sourced models. It is a good tool for experimentation.

Apache MXNet

Apache MXNet is an open-source deep learning software framework to train, and deploy deep neural networks. It is worth experimenting, as it is a top-level Apache project.

Swift4TF

Swift for TensorFlow is a next generation system for deep learning and differentiable computing on Apple systems. Integrated into Swift programming language this may soon become the framework of choice for DL development on iOS.

Data Version Control (DVC)

DVC is an open-source version control system for machine learning projects. A must watch tool from an engineering perspective.

SHAP

SHapley Additive exPlanations (SHAP) is a tool to explain the behavior of a Machine Learning model. It uses a game theoretic approach to explain the output of any machine learning model. It connects optimal credit allocation with local explanations using the classic Shapley values from game theory and their related extensions.

Local Interpretable Model Agnostic Explanations (LIME)

LIME (Local Interpretable Model Agnostic Explanations) is a model explanation technique. It can predict classifications on text and images. LIME uses a technique to interpret model locally around a prediction.

Uber Horovod

Horovod provides an OpenMPI based distributed training framework



WATCH

PyTorch-BigGraph

PyTorch-BigGraph is a distributed system to learn graph embedding for large graphs, particularly big web interaction graphs with up to billions of entities and trillions of edges.

Deep Graph Library (DGL)

DGL is an implementation of graph neural network model family, on top of existing DL frameworks (e.g. PyTorch, MXNet, Gluon etc.). DGL is designed to be compatible

and agnostic to the existing tensor frameworks.

Pyro

Pyro is a universal probabilistic programming language (PPL) written in Python and supported by PyTorch on the back end. Pyro enables flexible and expressive deep probabilistic modeling, unifying the best of modern deep learning and Bayesian modeling. With support of variational inference techniques, Pyro addresses the key challenge of non-scalability of inferring probabilistic systems.





Software Engineering

During this crisis, all software engineering functions are being executed by remote work force and the necessity to rapidly transition into this 100% remote working has pushed systems and processes to its limits. Organizations have adopted Technologies like Cloud, DevOps, and Collaboration tools effectively for business continuity.

The crisis has highlighted the need for enabling developers to work from anywhere and anytime. This has been possible because of Collaboration tools like MS Team and Slack, conferencing tools like Skype, WebEx, and independent developer environments such as Visual Studio, Eclipse, etc.

The new norm also has shown the criticality of reliability and adaptability of software applications. It emphasized the ability to scale down or scale up. Application architecture and software development practices have to be reimagined and adapted to the new normal. Trends such as Global work force, Cloud IDEs and adoption of more aggressive automation will be the norm and tools now adopted will continue to evolve, providing greater flexibility and influence the future of software engineering.

Software Engineering

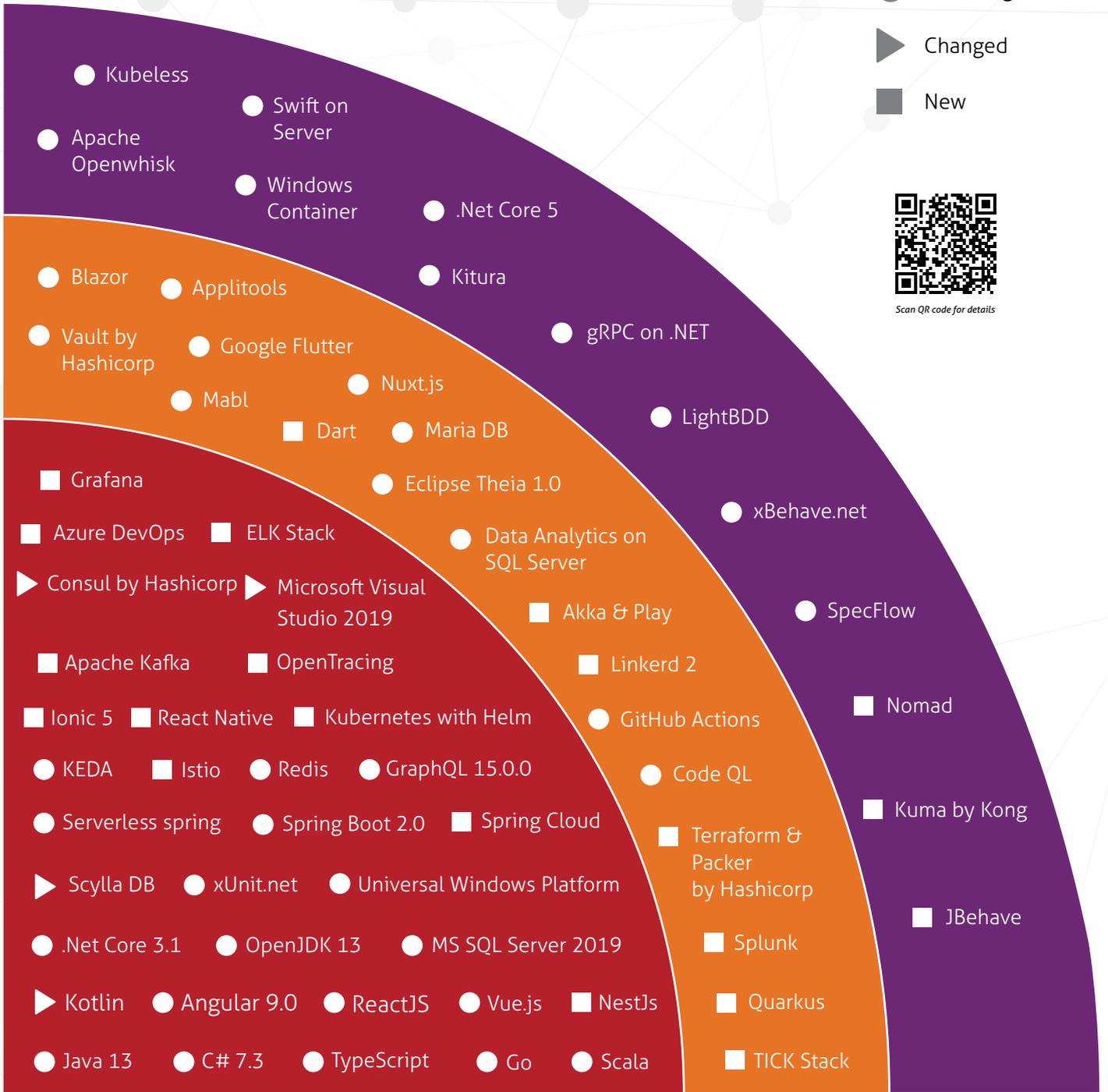
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INVEST

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 **INVEST****Java 13**

Java Development Kit (JDK) 13, the latest version of standard Java, is now available as a production release. It includes enhancements on Z Garbage Collector, improved startup performance for enhanced application class-data sharing, previews of switch expressions and text blocks.

C# 7.3

C# 7.3 is the latest point release in the 7.0 family and it continues themes of performance-focused safe code, as well as bringing some "quality of life" improvements such as improvements for unsafe code, syntax to easily and safely initialize stack allocated buffers. Improvements also include removal of some constraints to System.Enum, System.Delegate types, and a new unmanaged constraint that allows a pointer to a generic type parameter.

TypeScript

TypeScript is a language for application-scale JavaScript. It adds optional types, classes, and modules to JavaScript and supports tools for large-scale JavaScript applications for any browser, host, or OS. TypeScript compiles to readable, standards-based JavaScript.

Go

Go is an expressive, concise, clean, and efficient general-purpose programming language. It compiles quickly to machine code and yet has the convenience of garbage collection and the power of runtime reflection. A fast, statically typed, compiled language that feels like a dynamically typed, interpreted language. It has recently gained significant prominence in server software design and construction.

Scala

Scala is a popular object-oriented and functional programming language that has seen good adoption, especially for developing reactive applications. Also, Scala is the programming language of choice for analytics applications that leverage Apache Spark ecosystem.

Kotlin

Kotlin is a cross-platform, general purpose, free, open source, statically typed "pragmatic" programming language initially designed for Java Virtual Machine (JVM) and Android that combines object-oriented and functional programming features. Kotlin can also compile to JavaScript or native code. It introduces many improvements such as null-pointer safety, extension function and infix notation.

Angular 9.0

Angular 9.0 is a major release with several improvements over its previous versions. It spans the entire platform, including the framework, angular material, and CLI. This release switches applications to the Ivy compiler and runtime by default, which reduces bundle sizes, and introduces improved ways of testing components and enabled Ahead-of-time-compilation by default. Angular has also introduced more stringent checking. It now supports Typescript 3.8. Angular 9 comes with better internationalization support.

ReactJS

ReactJS is an open source JavaScript library that provides a view for data rendered as HTML. React views are typically rendered using components that contain additional components specified as custom HTML tags. React Virtual DOM is a core feature of React that creates fast, scalable web apps. It is SEO-friendly, fast, easy to create UI test cases can be created easily, and components can be reused.

Vue.js

Vue.JS is a progressive open source JavaScript framework used to develop interactive web interfaces, and one of the popular frameworks used to simplify web development. It focuses on the view layer and uses virtual DOM. It is designed from the ground up to be incrementally adaptable, and can easily scale between a library and a framework depending on different use cases. It consists of an approachable core library that focuses on the view layer only, and an ecosystem of supporting libraries that helps tackle complexity in large single-page applications.

NestJs

NestJs is a Node.js framework that mainly focuses on developing progressive server-side applications by using cumulative JavaScript. NestJs uses TypeScript, as it is the only programming language that includes FP, OOP, and FRP components. NestJs offers a modular structure, and arranges codes systematically in different modules making using external libraries easier. NestJs utilizes Express.js features. Developers can build highly scalable, loosely linked, testable, and easily manageable applications.

.Net Core 3.1

.Net core is an open source, general purpose and cross-platform development platform for building applications that need to run on Windows, Linux, and MacOS. In .Net core 3.1, performance is greatly improved and it supports hardware intrinsic. Frameworks and APIs are provided for cloud, IoT, client UI, and machine learning.

OpenJDK 13

Open JDK 13 is the open-source reference implementation of version 13 of the Java SE Platform as specified by JSR 388 in the Java community process. This version includes the following features: Dynamic CDS Archives, ZGC: Uncommit Unused Memory, Re implement the Legacy Socket API, Switch Expressions (Preview), Text Blocks (Preview)

MS SQL Server 2019

SQL server 2019 introduces big data cluster for SQL server. It also provides additional capability and improvements for the SQL Server database engine, SQL Server Analysis Services, SQL Server Machine Learning Services, SQL Server on Linux, and SQL Server Master Data Services. It enables us to manage both structured and unstructured data in SQL server. It also comes with tempdb performance improvements.

Scylla DB

Scylla is a drop-in Apache Cassandra alternative big data database that powers your applications with ultra-low latency and extremely high throughput. Scylla re-implemented Apache Cassandra from scratch using C++ instead of Java to increase the raw performance and utilization of modern multi-core servers and, through

self-tuning and improved uptime, minimize the overhead to DevOps. Scylla provides applications with NoSQL database platform to scale out and up linearly.

xUnit.net

XUnit.net is a free, open-source, community-focused unit-testing tool for the .NET Framework. Written by the original inventor of NUnit, xUnit.net is the latest technology for unit testing C#, F#, VB.NET and other .NET languages. xUnit.net works with ReSharper, CodeRush, TestDriven.NET and Xamarin. It is also a part of the .NET Foundation, and operates within their code of conduct.

Universal Windows Platform

Windows 10 introduced the Universal Windows Platform (UWP), which enables the Windows Runtime model to evolve and bring it into the Windows 10 unified core. As part of the core, the UWP now provides a common app platform that is available for every device that runs Windows 10. This package can be installed on a wide range of devices.

Serverless spring

Serverless architecture has gained a lot of traction over the last two years. However, until now enterprises had to depend on companies like AWS for their AWS lambda service. Now with Spring framework taking the jump into server-less architecture model, we expect more organizations to experiment with this style. Serverless Spring with its framework, is emerging as a strong contender in the enterprise application development space

Spring Boot 2.0

Spring Boot enables developers to build spring applications quickly by taking a conventional over configuration approach. The Spring Boot ecosystem is vibrant and can be used to realize a micro-services-based architecture. Spring Boot 2.0 supports Spring Framework 5.0, reactive web programming with Spring WebFlux/ WebFlux.fn, HTTP/2 for Tomcat, Undertow and Jetty. It is a brand new actuator architecture and Micrometer based metric with exporters.

Spring Cloud

Spring Cloud provides tools for developers to quickly build some of the common patterns in distributed

systems (e.g. configuration management, service discovery, circuit breakers, intelligent routing, micro-proxy, control bus, one-time tokens, global locks, leadership election, distributed sessions, cluster state).

Kubernetes Event Driven Auto Scaling (KEDA)

A large number of applications being developed today are event based. However, until now, only CPU or memory was used to scale a containerized application listening to events. KEDA changes this mode by giving containerized applications the ability to scale by the number of events being processed.

Istio

Istio is a Service mesh that addresses the challenges of monolithic applications transition to distributed Microservice architecture. Istio makes it easy to create a network of deployed services with load balancing, service-to-service authentication, monitoring, and more, with few or no code changes in service code. Istio provides behavioral insights and operational control over the service mesh as a whole, offering a complete solution to satisfy the diverse requirements of Microservice applications.

Redis

Redis is an open-source, in-memory data structure store that can be used as a database, cache, or message broker. It supports data structures such as strings, hashes, lists, sets, sorted sets with range queries, bitmaps, hyperlog logs and geospatial indexes with radius queries. Redis has built-in replication, Lua scripting, LRU eviction, transactions, different levels of on-disk persistence and provides high availability via Redis Sentinel and automatic partitioning with Redis Cluster.

GraphQL 15.0.0

GraphQL is a query language for APIs and a runtime for fulfilling those queries with your existing data. GraphQL provides a complete and understandable description of the data in your API, gives clients the power to ask for exactly what they need and nothing more, makes it easier to evolve APIs over time, and enables powerful developer tools.

Ionic 5

Ionic is the open-source mobile app development framework that makes it easy to build top quality native

and progressive web apps with web technologies. Ionic 5 enables to build out-of-the-box blazing fast apps with a small footprint and built-in best practices like hardware accelerated transitions, touch-optimized gestures, pre-rendering and AOT compiling. Ionic 5 supports various popular web frameworks like Angular, ReactJS, Vue JS, and Native Script.

React Native

React Native combines the best parts of native development with React, a best-in-class JavaScript library for building user interfaces. It is used to develop applications for Android, iOS, Web and UWP by enabling developers to use react along with native platform capabilities. Written in JavaScript-rendered with native code, it provides a core set of platform agnostic native components like View, Text and Image that map directly to platform's native UI building blocks.

Kubernetes with Helm

Kubernetes is an open-source container-orchestration platform. It helps manage containers, scale, and automate deployment. With applications moving to cloud and using containers as a basic deployment unit, Kubernetes comes in handy to manage the deployment of containers and leverage cloud resources efficiently. Helm is package manager for Kubernetes. Helm Charts help you define, install, and upgrade even the most complex Kubernetes application.

Apache Kafka

Apache Kafka is an open-source stream-processing software platform developed by LinkedIn, written in Scala and Java, and donated to the Apache Software Foundation. It provides a unified, high-throughput, low-latency platform to handle real-time data feeds. Kafka can connect to external systems (for data import/export) via Kafka Connect and provides Kafka Streams, a Java stream processing library. Kafka uses a binary TCP-based protocol optimized for efficiency and relies on a "message set" abstraction that naturally groups messages together and reduces the overhead of network roundtrip.

OpenTracing

The OpenTracing API provides a standard, vendor neutral framework for instrumentation. OpenTracing is

a framework that helps developers trace calls across services in a distributed environment. OpenTracing allows developers of application code, OSS packages, and OSS services to instrument their own code without binding to any tracing vendor. Every component of a distributed system can be instrumented in isolation, and the distributed application maintainer can choose, switch, or multiplex a downstream tracing technology with a configuration change.

Consul by Hashicorp

Consul is a versatile toolkit for discovering and configuring services within your infrastructure. It provides several key capabilities like service-discovery, health-checks, and key value store. Consul is designed to be friendly to both traditional application developers and the DevOps community, making it perfect for modern, elastic, and highly available applications.

Microsoft Visual Studio 2019

Enhancements to code navigation, IntelliSense, refactoring, code fixes, and debugging, save time and effort on everyday tasks regardless of language or platform. For teams embracing DevOps, Visual Studio 2019 streamlines the inner loop and speeds up code flow with brand new real-time features such as live unit testing and real-time architectural dependency validation.

Azure DevOps

It provides version control (with either TFVC or git), reporting, requirement management, project

management (for both agile software development and waterfall teams), automated builds, and lab management, testing, and release management capabilities. It covers the entire application lifecycle and enables DevOps capabilities. Each Azure DevOps service is open and extensible. With Azure Pipelines, you get cloud-hosted pipelines for Linux, Windows and macOS. You can build, test, and deploy any language or platform to any cloud.

ELK Stack

"ELK" is the acronym for three open source projects: Elasticsearch, Logstash, and Kibana. Elasticsearch is a search and analytics engine. Logstash is a server-side data processing pipeline that ingests data from multiple sources simultaneously, transforms it, and then sends it to a "stash" like Elasticsearch. Kibana allows users visualize data with charts and graphs in Elasticsearch.

Grafana

Grafana is the open source analytics and monitoring solution. Grafana allows query, visualization, and alert on data and enables understanding metrics visually. Grapha also allow custom dashboard creation, data exploration, and sharing of dashboards. Grafana supports over 30 open source and commercial data sources such as Graphite, Influx, Prometheus, Elastic Search, and others.



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Vault by Hashicorp

Vault is a tool used to access secrets in a secured manner. A secret is anything that you want to tightly control access to, such as API keys, passwords, certificates, and more. Vault provides a unified interface to any secret, while providing tight access control and recording a detailed audit log.

Blazor

Blazor is a single-page app framework for building interactive client-side Web apps with .NET. Blazor uses open web standards without plugins or code transpilation. Blazor works in all modern web browsers, including mobile browsers. The .NET code runs inside the context of WebAssembly. Blazor decouples component rendering logic when UI updates are applied. Blazor Server provides support for hosting Razor components on the server in an ASP.NET Core app. UI updates are handled over a SignalR connection. Blazor MobileBindings, currently an experimental feature, can be used to build native apps on Android and iOS.

Mabl

Mabl is testing tool that focuses on using AI and ML to help with testing efforts. It will crawl web screen and run default tests common to all applications. Mabl uses ML to improve test execution and defect detection. Mabl provides many useful functionalities such as Auto heal that corrects test cases and not break for typical changes in web UI. It can be integrated with any CI/CD pipeline and can version test cases. Mabl can perform visual testing and selenium test cases can be imported directly to Mabl.

Applitools

Applitools is an end-to-end testing platform powered by Visual AI. It can be useful to find defects that are missed out by manual functional testing. It supports Auto maintenance of test cases.

Dart

Dart is a client-optimized language for fast apps on multiple platforms. Mature and complete Async-await for user interfaces containing event-driven code, paired with isolate-based concurrency. Dart has the Ahead of time compiler (AOT) that compiles the code to fast, native machine code. With AOT optimized code generation almost all of Flutter is developed using Dart.

Google Flutter

Flutter is Google's portable UI toolkit used to develop natively compiled applications for mobile, web, and desktop from a single codebase. Organizations across the world use Flutter as it works with existing code, and is a free and open source toolkit. Flutter is for developers who want a faster way to build beautiful mobile apps, or a way to reach more users with a single investment.

Maria DB

MariaDB Server is one of the most popular open source relational databases. It is part of most cloud offerings and the default in most Linux distributions. Recent new functionality includes advanced clustering with Galera Cluster 4, compatibility features with Oracle Database and Temporal Data Tables, allowing one to query the data as it was at any point in the past. MariaDB turns data into structured information in a wide array of applications, ranging from banking to websites. It is an enhanced, drop-in replacement for MySQL. MariaDB is used because it is fast, scalable, and robust, with a rich ecosystem of storage engines, plugins and many other tools make it very versatile for a wide variety of use cases. MariaDB is developed as an open source software. As a relational database, it provides an SQL interface for accessing data. The latest versions of MariaDB also include GIS and JSON features.

Nuxt.js

Nuxt is a progressive framework based on Vue.js to create modern web applications. It is based on Vue.js official libraries (vue, vue-router and vuex) and powerful development tools (Webpack, Babel and PostCSS). Nuxt's goal is to make web development powerful and performant with a great developer experience in mind. Incrementally adaptable, it can be used to create from static landing pages to complex enterprise ready web applications.

Data Analytics on SQL Server

Built on top of Kubernetes containers, Big Data Clusters have a built-in management system on any infrastructure. Managing all the services that run relational and big data workloads in a secure, efficient, and scalable way are challenging. With Big Data Clusters, management and data engineering tasks can be optimized in an integrated and consistent way with modern, container-based architecture built on top of Kubernetes. At the center of this platform is the SQL Server master instance that stores relational data

and serves as an entry point to other data sources within or outside the cluster.

Eclipse Theia 1.0

Eclipse Theia 1.0 is an open source alternative to VS Code. Supports multiple languages and combines some of the best features of IDEs into one extensible platform, designed to run on both cloud and desktop, flexible, draggable dock layouts and more modular than VS Code, vendor neutral and truly open source.

Akka & Play

Akka is a runtime simplifying the construction of concurrent and distributed applications on the JVM. Akka supports multiple programming models for concurrency, but it emphasizes actor-based concurrency. For fault-tolerance Akka adopts production hardened self-healing model for building always-on applications. Play Framework is a web application framework that follows the model–view–controller architectural pattern. It is written in Scala and usable from other programming languages that are compiled to JVM Bytecode.

Linkerd 2

Linkerd 2 is a service mesh for Kubernetes and other frameworks. It makes running services easier and safer by runtime debugging, observability, reliability, and security—all without the need for any code changes. Built in Rust, Linkerd 2 data plane proxies are incredibly small and blazing fast. It gives comprehensive suite of diagnostic tools, including automatic service dependency maps and live traffic samples.

GitHub Actions

GitHub Actions is an end-to-end continuous integration (CI) and continuous deployment (CD) tool that automates software development workflows in the same place that store code and collaborate on pull requests and issues. Actions are individual tasks can be written and combined to create custom workflows. Workflows automate processes that can be set up in repository to build, test, package, release, or deploy any code project on GitHub.

Code QL

CodeQL is the code analysis platform used by security researchers to automate variant analysis. CodeQL queries

can be used to explore code and quickly find variants of security vulnerabilities and bugs.

Terraform & Packer by Hashicorp

Terraform is an open source tool for building, changing, and versioning infrastructure safely and efficiently. Packer is a tool for creating identical machine images for multiple platforms from a single source configuration file. It can build images for multiple cloud hosting platforms, including Scaleway.

Splunk

Splunk provides easy way of analyzing, aggregating, and getting insights from machine data. It can analyze, monitor, and search any kind of data in near real time. Splunk has the capability to ingest, manage, and move any data to and from Splunk. It can be used to investigate and explore data across a broader set of functions spanning from IT and security to business analytics.

TICK Stack

TICK stack is the open source component that includes Telegraf, InfluxDB, Chronograf, and Kapacitor. The TICK Stack is a loosely coupled yet tightly integrated set of open source projects designed to handle massive amounts of time-stamped information to support metrics analysis and visualization.

Quarkus

Quarkus is a Container First Kubernetes Native Java framework tailored for GraalVM and HotSpot, Quarkus offers a unified reactive and imperative programming model to optimally address a wide range of distributed application architectures. Quarkus provides an effective solution for running Java in serverless, microservices, containers, Kubernetes, FaaS, and cloud environments.



WATCH

Apache Openwhisk

Apache Openwhisk is suitable for enterprises with a strong affinity to develop applications using open-source frameworks. Apache OpenWhisk is a good option for developing server-less apps on the cloud. Apache OpenWhisk offers many features but is still in the incubating stage. But, it is worth to watch out as several server-less frameworks are available in the market.

Kubeless

Kubeless is a native server-less framework to build Function as Service applications. Kubernetes have established itself as a standard for container orchestration for web-scale applications.

Windows Container

Windows Container is a logical isolation where an application can run without affecting the rest of the system, and vice versa. Containers are the next evolution in virtualization. If you were inside a container, it would look very much like you were inside a newly installed physical computer or a virtual machine. To Docker, a Windows Container can be managed in the same way as any other container.

Swift on Server

Swift is a high-performance system programming language. It has a clean and modern syntax, offers seamless access to existing C and Objective-C code and frameworks, and is memory-safe by default. Although inspired by Objective-C and many other languages, Swift is not itself a C-derived language. As a complete and independent language, Swift packages core features like flow control, data structures, and functions, with high-level constructs like objects, protocols, closures, and generics. Swift embraces modules, eliminating the need for headers and the code duplication they entail.

Kitura

Kitura is a new, modular, package-based web framework written in the Swift language. It is a high-performance and simple-to-use web framework for building modern Swift applications.

.Net Core 5

.NET Core 5 provides a unified .NET SDK experience, with a single base class library (BCL) across all platforms and support for native and web applications across multiple operating systems for developing Desktop, Web and Mobile applications.

gRPC on .NET

gRPC is a language agnostic, high-performance Remote Procedure Call (RPC) framework. gRPC services can be hosted on ASP.NET Core. It uses contract-first approach to API development. Services have full integration with popular ASP.NET Core features such as logging, dependency injection (DI), authentication, and authorization.

LightBDD

LightBDD is an open source Behavior-Driven Development test framework that enables to write tests that are easy to read, easy to track during execution and summarize the test results in user-friendly report, while allowing developers to use all of the standard development tools to maintain them. It integrates with NUnit, xUnit and MsTest.TestFramework frameworks and provides cross-platform support (.NET Framework / .NET Standard / .NET Core / UWP).

xBehave.net

xBehave.net is xUnit.net extension for describing your .NET tests using natural language. Ideally suited for a variety of testing styles (e.g. BDD, TDD, ATDD, etc.), xBehave.net can be used for acceptance tests, integration tests, unit tests or any other ad-hoc testing scenarios. You can mix and match standard xUnit.net tests and xBehave.net scenarios in the same assembly or even in the same class. Use xBehave.net unobtrusively along with other frameworks (e.g. NUnit, MSpec, etc.) in the same solution.

SpecFlow

SpecFlow is an open source .NET testing tool that is part of the Cucumber family. It uses the official Gherkin parser and supports the .NET framework, Xamarin and Mono. You can use SpecFlow to define, manage, and automatically execute human-readable acceptance tests in .NET projects. Writing easily understandable tests are a cornerstone of the BDD paradigm. It helps build a living

documentation of your system. SpecFlow integrates with Visual Studio, but can be also used from the command line (e.g. on a build server). SpecFlow supports popular testing frameworks: MSTest, NUnit, xUnit 2, and MbUnit.

Nomad

Nomad by Hashicorp is a workload orchestrator to deploy and manage applications on any cloud, or on on-premise infrastructure. Nomad can deploy containerized as well as non-containerized applications.

Kuma by Kong

Kuma is based on Envoy, is a powerful proxy designed for cloud native applications. Service Meshes are becoming an important part of cloud native architectures for invocation, monitoring, security, and reliability of micro service applications at scale.



JBehave

JBehave is a framework for Behavior-Driven Development (BDD) and acceptance-test driven design and is intended to make these practices more accessible and intuitive to newcomers and experts alike. It shifts the vocabulary from being test-based to behavior-based and positions itself as a design philosophy.





Data

One of the experts in data called Insights and Data as Janus technologies. In good times, one uses data and insights to expand market opportunities, and during times of sustenance and recovery, data and insights are required to identify spend analytics, adjacent market opportunities, indicators for market revival and behavior to name just a few.

However, in line with the larger trends, we are likely to see accelerated shift to cloud based integrated data architectures. This helps one get free from the high license and running costs from traditional data technologies, while allowing more freedom to experiment and take data driven decisions. Therefore, we expect an increase in object storage-based data lakes, cloud data-warehouses, multi-cloud choices, and new age visualization techniques to identify opportunities. Predictive analytics may take a slight backseat due to the large variance in recent data.

Data

● No change

▶ Changed

■ New



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● Uber Cadence

● Molecula

● Dask

● Azure Synapse

● GNU Parallel

● Julia

● Ceph

● Apache Pulsar

● Amazon FSx for Lustre

● Collibra

● Denodo

● Apache Hudi

● Tableau

● Domo

● Apache Pinot

● MongoDB Atlas

● PowerBI

● ksqlDB

● Jupyter notebooks

● Snowflake

● Looker

● Apache Airflow

● PySpark

● Databricks

● Apache Atlas

● Alluxio



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Apache Airflow

Apache Airflow is an open-source workflow management platform. Airflow programmatically authors, schedules and monitors workflows. Airflow has a modular architecture and uses a message queue to organize an arbitrary number of workers. It allows dynamic instantiation of pipelines by configuring pipelines configuration as code. Airflow pipelines are lean and explicit. Parametrizing script is built into its core using the powerful Jinja templating engine.

PySpark

PySpark has become the choice of application development for leveraging scalable Spark clusters. Using PySpark, you can work with RDDs in Python programming language. PySpark offers PySpark Shell, which links the Python API to the spark core and initializes the Spark context. Majority of data scientists and analytics experts today use Python because of its rich library set. Integrating Python with Spark has several benefits.

Databricks

Databricks is a unified Data Analytics Platform for massive scale data engineering and collaborative data science on the cloud. It is a commercial technology made available from the inventors of Spark. The pace of innovation has continued with the release of technologies like delta and MLFlow. This year, we are looking at the release of fast query engine to close the gap with cloud data-warehouses to make this a complete unified platform.

Jupyter notebooks

The Jupyter Notebook is an open source web application to create and share documents that contain live code, equations, visualizations, and text.

Snowflake

Snowflake's unique architecture empowers data analysts, data engineers, data scientists, and data application developers to work on any data without the performance, concurrency or scale limitations of other solutions. Snowflake is built on a patented, multi-cluster, shared data architecture created for the cloud to revolutionize data warehousing, data lakes, data analytics and a host of other use cases. Snowflake is also a powerful query processing back-end platform for developers creating

modern data-driven applications. Metadata processing within Snowflake is automatic and does not compete with the compute resources running your queries.

MongoDB Atlas

MongoDB Atlas is the global cloud database service that is flexible and scalable for modern applications.. It is available as a fully managed service. MongoDB with its on-cloud offering is now seen as a replacement for several on-prem NoSQL databases.

PowerBI

Microsoft Power BI is a collection of online services and features to find and visualize data, share discoveries and collaborate in intuitive new ways.

Tableau

Tableau is an integrated business intelligence (BI) and analytics solution to analyze key business data and generate meaningful insights with live visual analytics and interactive dashboard that allow slicing and dicing datasets for generating relevant insights.

Domo

Domo is a self-service business intelligence (BI) tool that offers the widest data set and connectors, with collaboration across users. It has an appealing visualization with dashboard widgets, mobile first experience. It has an exposed programmatic API that enables developers to build apps and host on marketplace.

Collibra

Data governance solution that links data sources, applications, metadata, and other data management stacks into a single responsive system where updates and policies can be applied automatically. With open API, Collibra provides extensibility to integrate and build applications around data catalogs, data glossary and data metrics.

Denodo

Denodo quickly connects disparate structured and unstructured sources, and catalogs your entire data ecosystem. Data stays in the sources, it is accessed on demand with no additional need for another copy. You can build data models that suit consumer needs, even across multiple sources. The virtual model can be secured and consumed using standard SQL and other formats like REST, SOAP, and OData.



EXPERIMENT

Azure Synapse

Azure Synapse is a limitless analytics service that brings together enterprise data warehousing and Big Data analytics. Synapse helps deliver insights from all your data, across data warehouses and big data analytics systems, with tremendous speed, and you can apply machine-learning models to all your intelligent apps.

Dask

Dask is open source and freely available. It is developed in coordination with other community projects like Numpy, Pandas, and Scikit-Learn. Dask's schedulers scale to thousand-node clusters and its algorithms have been tested on some of the largest supercomputers in the world. Dask exposes lower-level APIs allowing you to build custom systems for in-house applications.

GNU Parallel

GNU Parallel is a shell tool for executing job in parallel using more computers. A job can be a single command or a small script that has to be run for each line in the input.

Julia

Julia is new open-source language with batteries included. It is seen as a replacement for Python, and is used for s at data engineering and data science community. Julia programs compile to efficient native code for multiple platforms via LLVM. Julia is dynamically typed, feels like a scripting language, and has good support for interactive use.

Amazon FSx for Lustre

AWS brings LustreFS storage to cloud. Lustre file system is designed for applications that require fast storage to keep up with your compute. Amazon FSx for Lustre makes it easy and cost effective to launch and run the world's most popular high-performance file system. Amazon FSx enables you to use Lustre file systems for any workload where storage speed matters. FSx for Lustre integrates with Amazon S3, making it easy to process data sets with the Lustre file system.

Ceph

Ceph is an open-source software storage platform, implements object storage on a single distributed

computer cluster, and provides 3in1 interfaces for -object, block, and file level storage. Ceph and blob stores are fast replacing HDFS clusters as the backbone for next generation big data stores.

Apache Hudi

Apache Hudi ingests and manages storage of large analytical datasets over DFS. It provides common data storage services across batch and stream with atomic publish and rollback support and timeline metadata.

Apache Pinot

Apache Pinot is a real-time distributed OLAP datastore, designed to answer OLAP queries with low latency. Apache Pinot enables in-memory cubes that form the backend for visualization. Cubes are managed in memory and provide sub-second response for interactive visualization user experiences. It is horizontally scalable and fault tolerant. Run ML Algorithms to detect Anomalies on the data stored in Pinot. Use ThirdEye with Pinot for Anomaly Detection and Root Cause Analysis.

ksqlDB

ksqlDB enables you to build event streaming applications with the same ease and familiarity of building traditional applications on a relational database. It also simplifies the underlying architecture for these applications so you can build powerful, real-time systems with just a few SQL statements.

Looker

Looker, now a part of Google, is new generation Visualization and BI platform, with revolutionary Blocks concept as a strong contender. Serve up real-time dashboards for more in-depth analysis. Easy access to trustworthy data enables fresh results for better reporting. Looker helps to enhance the tools you're already using by infusing new, relevant data. It provides a purpose-built tool that users need, while creating data experiences that people love.

Apache Atlas

Atlas provides open metadata management and governance capabilities for organizations to build a catalog of their data assets, classify and govern these assets and provide collaboration capabilities around these data assets for data scientists, analysts and the data governance team.



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Uber Cadence

Cadence is a distributed, scalable, durable, and highly available orchestration engine to execute asynchronous long-running business logic in a scalable and resilient way. Cadence fault-oblivious code platform preserves complete multithreaded application state including thread stacks with local variables across hardware and software failures. It greatly simplifies coding of complex and stateful distributed applications.

Molecula

Enterprise Data Virtualization (EDV) platform creates an entity-focused data representation that is optimized for analytical workloads with low latency joins across data stores.

Apache Pulsar

Apache Pulsar is an open-source distributed pub-sub messaging system alternative to Kafka. It can easily deploy lightweight compute logic using developer-friendly APIs without having to run your own stream processing engine. Pulsar seamlessly expands capacity to hundreds of nodes. Designed for low publish latency at scale with strong durability guarantees.

Alluxio

Alluxio, a data orchestration platform that processes data without data copies and makes data accessible regardless of location. It enables your data local to compute workloads for Spark caching, Presto caching, Hive caching and more, whether it is on-prem or on cloud, HDFS or S3. Alluxio enables your files and objects accessible in several ways. With Alluxio orchestrate your data effortlessly for compute in any cloud, even if data is spread across multiple clouds.





Blockchain

As nations try to reboot the economic recovery process, it is imperative that they have the means to provide safe working environments, build resilient supply chains, guarantee safe travel across nations, and ensure relief funds reach the beneficiaries on time. This will lead to:

- Sharing digital identities and health certificates across various entities like employers, border control, etc.
- Enable provenance of the food supply chain
- Governments, citizens and NGOs trace disbursement of relief funds

All these use cases demand a high degree of trust, immutability of data, decentralization, transparency, and integrity which are the corner stones of any blockchain based solution. Hence, Blockchain will play a vital role in helping organizations and governments flourish in the new normal and be better prepared if we encounter a similar situation in the future.

Blockchain

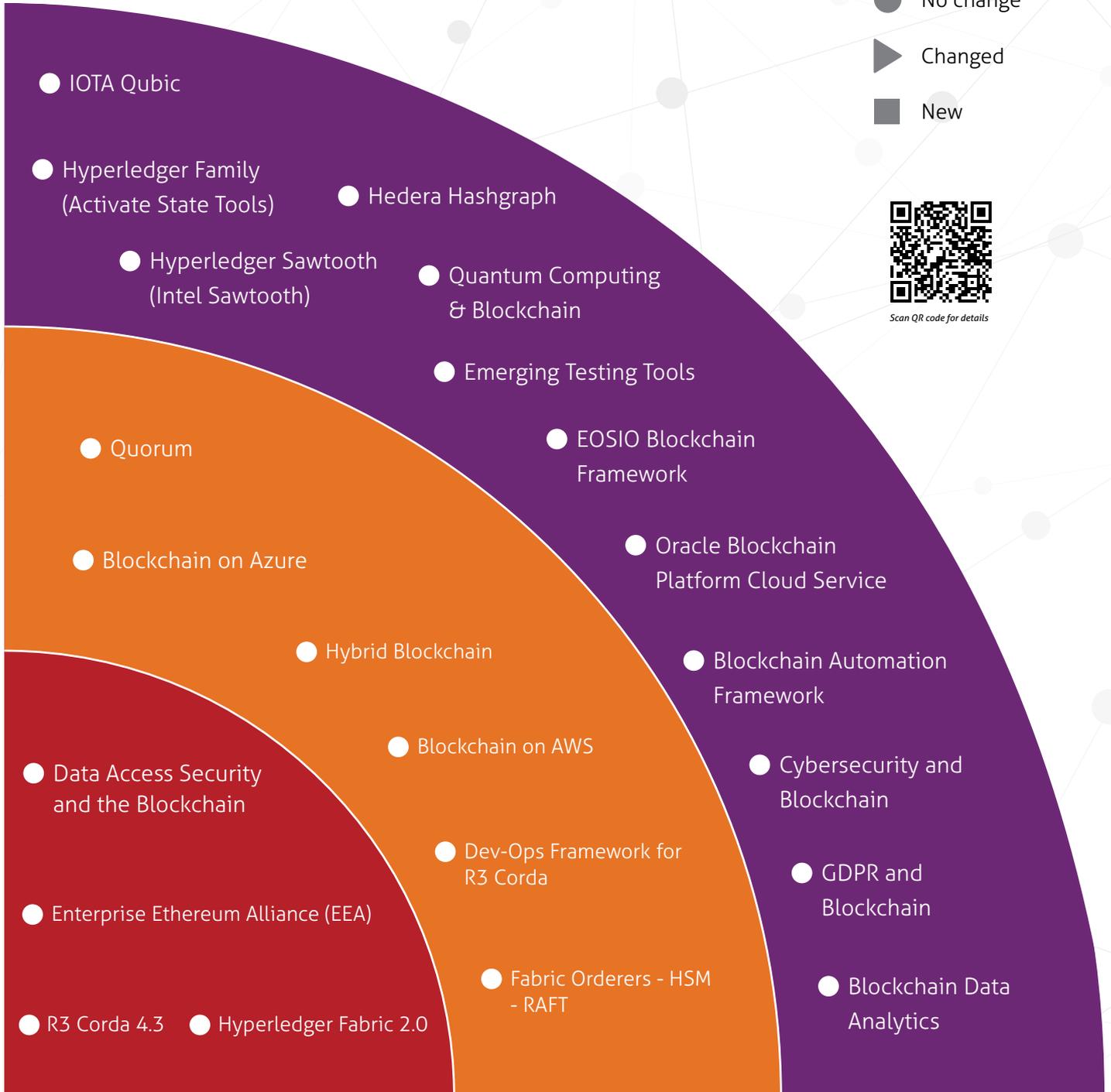
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R3 Corda 4.3

Corda is a framework specifically used by the Banking and Financial institutions to explore various use cases in blockchain. The latest version has features like Accounts, Corda Settler (for instant settlement and deferred settlement), Confidential Identities and security enhancements are required for any enterprise use cases.

Hyperledger Fabric 2.0

Hyperledger Fabric 2.0 was released with several new and important features and changes. It includes support for new application and privacy patterns, enhanced governance around smart contracts, and new options for operating nodes. Nevertheless, private data handling channels and its enhancements has provided Fabric as a booster.

Enterprise Ethereum Alliance (EEA)

EEA is a member-driven standard organization that provides a decentralized ecosystem, which is open-source, public, blockchain-based distributed computing platform, and operating system featuring smart contract (scripting) functionality. It supports a modified version of Nakamoto consensus via transaction-based state transitions.

Data Access Security and the Blockchain

Blockchain ecosystem handles lot of data every moment. With blockchain data churning, there were several issues associated like security, storage, access control, and ownership of data, amongst others. A framework based on Data Access and security can help eliminate these risks and provide an access management facility, offering the user absolute control over their data. This can be helpful for GDPR as well.



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Quorum

Quorum is an enterprise-ready distributed ledger and smart contract platform similar to Permissioned Ethereum ecosystem, founded by JP Morgan Chase. This platform is ideal for any application requiring high speed and high throughput processing of private transactions within a permissioned group of known participants. Quorum addresses specific challenges of adopting blockchain technology within the financial industry, and beyond.

Blockchain on Azure

With Blockchain technology gaining traction across industries, many enterprises want to explore use cases with less cost and quick turn-around for 'ready-to-market'. Microsoft Azure gives a jump-start with pre-built templates for Ethereum, Hyperledger Fabric, Corda, and Chain platforms. For new enterprises, this is a good option instead of setting up infrastructure.

Hybrid Blockchain

Hybrid Blockchain, by design, is a combination of different characteristics of public and private blockchains. It determines what information stays private

and what information is made public. Thus, any system can reap the benefits of both the approaches.

Blockchain on AWS

AWS provides a fully managed, scalable blockchain service. AWS blockchain service makes it easy to set up, deploy, and manage scalable blockchain networks, eliminating the need for you to rely on expensive consulting implementations.

Dev-Ops Framework for R3 Corda

Corda is a flexible and agile platform that can scale to meet the needs of any business. Enterprises are churning Corda for their requirements. The Dev-Ops framework with its available process and plugins will enable developers and stakeholders for quick turnaround in production.

Fabric Orderers - HSM - RAFT

Hyperledger Fabric introduced RAFT algorithm in 1.2 version for production releases. Creating a perfect model or combination of Orderers - HSM on different VMs is one of the propelling factors for Fabric based blockchain ecosystem in future.



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IOTA Qubic

IOTA is the first open-source non-permission based new distributed ledger technology, the Tangle, which overcomes the inefficiencies of current Blockchain designs and introduces a new way of reaching consensus in a decentralized peer-to-peer system. Qubic fundamentally differentiates from traditional smart contract layers because the contract is not subject to global consensus and need not be validated by the entire network but instead will only be processed by dynamically sized node clusters (called "assemblies"). This enables scalability and is the most important requirement for Tokenized Smart Contracts (TSC).

Hyperledger Family (Activate State Tools)

Hyperledger family has some of its projects in active state and are already live. These projects have some unique features that will lift blockchain technology to another level altogether. For e.g., 'Hyperledger Besu' is an Ethereum client that runs on the Ethereum public network, private networks, and test networks such as Rinkeby, Ropsten, and Görli. 'Hyperledger Indy' is a distributed ledger purpose-built for decentralized identity.

Hyperledger Sawtooth (Intel Sawtooth)

Hyperledger Sawtooth offers a flexible and modular architecture that separates the core system from the application domain. Hence, smart contracts can specify business rules for applications without having to know the underlying design of the core system. Hyperledger Sawtooth supports a variety of consensus algorithms, including Practical Byzantine Fault Tolerance (PBFT) and Proof of Elapsed Time (PoET)

Hedera Hashgraph

Hashgraph is a distributed ledger technology envisaged on asynchronous Byzantine Fault Tolerance (aBFT) consensus algorithm amalgamated with the concept of gossip protocol, capable of securing the platform against attacks. Hedera Hashgraph is a public distributed ledger based on the Hashgraph algorithm that uses DAG for time-sequencing.

Quantum Computing & Blockchain

In Quantum computing, data analysis is handled using quantum-mechanical components. This may be a threat to Blockchain as quantum computing calculates complex mathematical equations that will compromise Blockchain public key Cryptography, thus making Blockchain a highly vulnerable technology.

Emerging Testing Tools

Ethereum Tester is an open source testing library. The setup is easy with a manageable API support for various Testing requirements.

BitcoinJ is a Java-based framework built for Bitcoin-based apps to interact with the real BTC network and various testing activities. It is an open network available for assistance.

Truffle is a commonly referred tool for Ethereum developers, which brings in good testing features such as automated contract testing. The framework holds capabilities beyond just testing functionality within the blockchain application.

Ganache (previously TestRPC) tool is solely built to test Ethereum contracts locally. It creates a simulated blockchain to use various accounts for testing.

Hyperledger Composer lacks most of the blockchain testing features. Therefore, it is only useful for testing apps before they are launched. However, this tool excels in these areas: being interactive, automated system and automated unit testing.

EOSIO Blockchain Framework

The EOSIO is a blockchain platform designed to enable both vertical and horizontal scaling of decentralized application. It can be used to launch both public and private blockchain networks. It has the potential to scale to millions of transactions per second, eliminates user fees, and allows for quick and easy deployment of decentralized applications. EOSIO framework can be used in the fields such as Social Media, Finance, Healthcare, Government, Supply Chain, etc.

Oracle Blockchain Platform Cloud Service

Oracle Blockchain Platform Cloud is a comprehensive, distributed ledger cloud platform that enables us to provision blockchain networks, join other organizations' networks, deploy, and run smart contracts to update

and query the ledger. It allows to share data reliably and conduct trusted transactions with suppliers, banks, and other trade partners through integration with existing or new cloud-based or on-premise applications. Need to watch scalability, performance, and ease of upgrade to new releases of Fabric.

Blockchain Automation Framework

The Blockchain Automation Framework provides a consistent means by which developers can deploy production-ready distributed networks across public and private cloud providers. The deployment scripts can be reused across heterogeneous deployments in a multi-cloud, multi-owner model where each node is completely owned and managed by separate organizations.

Cybersecurity & Blockchain

Blockchain technology is still in nascent state but according to experts, there is promising innovation in blockchain towards helping enterprises tackle immutable Cyber-Risk challenges such as digital identities and maintaining data integrity. Blockchains could potentially help improve cyber defense as the platform can secure, prevent fraudulent activities through consensus mechanisms, and detect data tampering based on its

underlying characteristics of immutability, transparency, auditability, data encryption, and operational resilience (including no single point of failure).

GDPR & Blockchain

The GDPR allows individuals to place a request to erase their data that is no longer relevant. Due to the blockchain's nature of immutability, there are potential complications if an individual who earlier made transactions on the blockchain requests their data to be deleted. Once a block is verified on the blockchain, it is impossible to delete it. It would be an interesting game-changer in the future.

Blockchain Data Analytics

Each blockchain solution/framework utilizes a chain structure, but may also employ novel data structures. This information may be analyzed to provide novel insights about emerging trends that raises questions such as: 1) How to represent and model the data stored on blockchains 2) What are the novel analytical tools required for analyzing Blockchain data? 3) What insights could be gleaned from the transactions stored on public blockchain?





Extended Reality

eXtended Reality (XR) is a comprehensive term for a multitude of technologies used to create immersive experiences, encompassing a few state-of-art technologies, viz., Augmented Reality, Virtual Reality and Mixed Reality. In today's era of the 'New Normal' with business travels and office commutations being curtailed, the need for physical spaces and physical interactions is rapidly diminishing. 'Working from home' and collaboration through digital means has become the 'New Reality'. In these challenging times, it is highly imperative for enterprises to explore newer possibilities using XR to drive next-gen digital collaboration and sales to ensure business continuity.

Manufacturers are gradually experimenting with XR to highlight new products to their customers in an interactive manner. E-commerce giants are using the power of AR and are transforming the online shopping arena, blending the benefits of both physical stores and online experiences to create immersive virtual amalgamations. E-commerce is morphing into 'AR Commerce' allowing customers to immerse into virtual stores, interact, and experience products in real-time 3D, while enjoying the convenience of remote shopping.

Immersive technologies with its strong appeal and prominence, stands out to influence and transform industries across the value chain, from collaborative prototyping to simulated trainings, immersive sales to customizations, assembly instructions to quality assurance, service and operations to remote assistance.



Prototype



Sales & Marketing



Training



Services & Operations

Though the hardware market for immersive technologies is still evolving, enterprises are focusing on mobile-based solutions to cater to the needs of a larger audience.

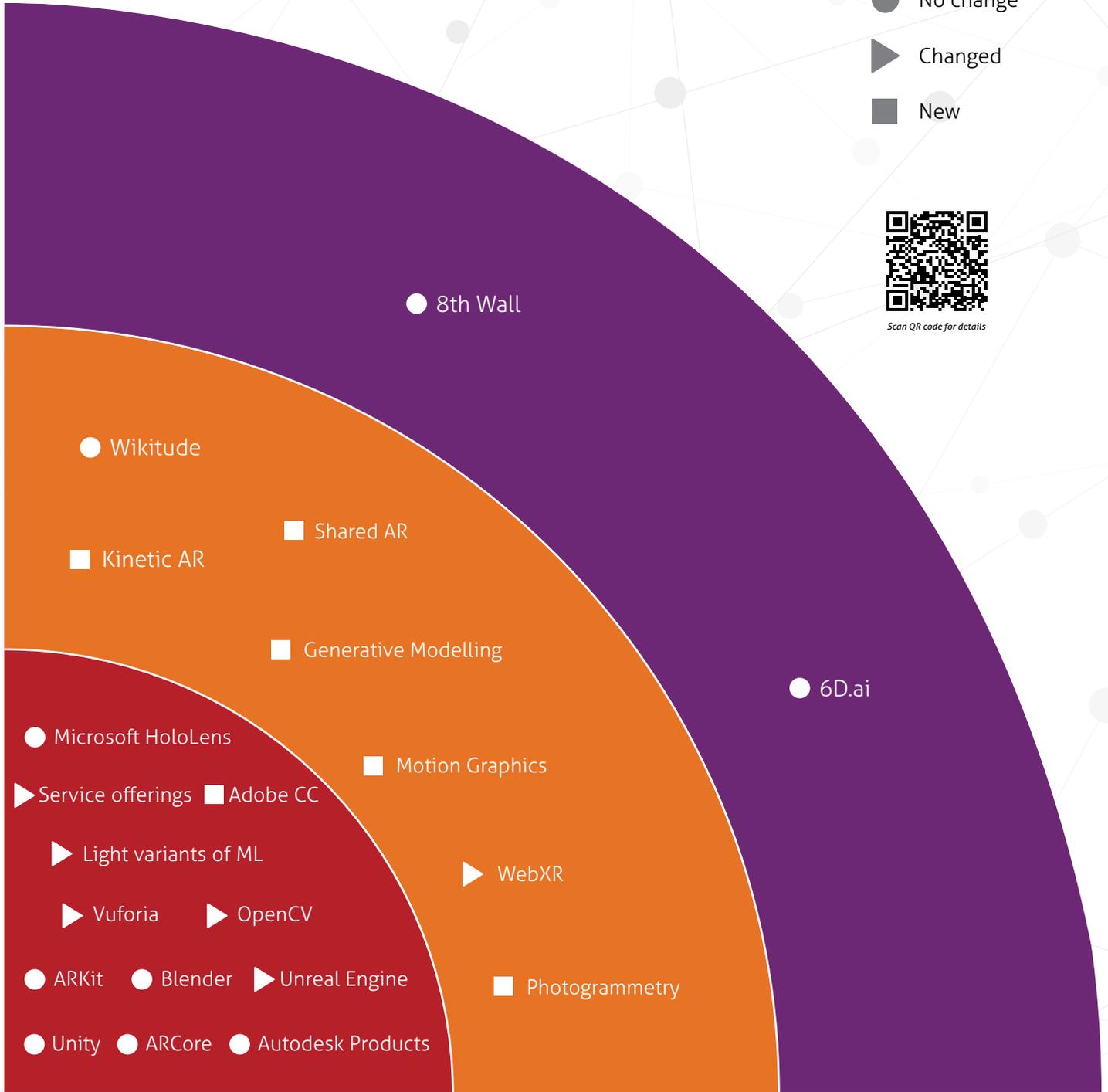
Enterprises can unleash the possibilities of immersive and interactive Experiences by combining XR with AI, CV, Voice and Gestures.

Extended Reality

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- New



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Unity

Unity is a cross-platform game engine developed by Unity Technologies that is used for creating 2D/3D applications, video games, animations for websites, gaming consoles, mobile devices, etc. Unity is notable for its ability to target games to multiple platforms. Within a project, developers have control over delivery to mobile devices, web browsers, desktops, and consoles. This tool is also used for creating content for extended Reality devices – Google VR, Microsoft HoloLens, HTC Vive, Oculus Rift, smartphones – Android, iOS etc.

ARCore

ARCore is a platform by Google to build augmented reality applications to integrate virtual content with the use of Motion Tracking, Light Estimation, and Estimation understanding techniques. ARCore enables your smartphone to understand the world and interact with information. Some of the features of ARCore are open for both Android and iOS to create shared AR experiences.

Autodesk Products

Autodesk has been a leader in the area of 3D content creation for years. Some of the popular products are Maya, AutoCAD, 3DS Max, Revit; which are used by many industrial designers, architects, real estate designers, game artists, many animation studios and more. Due to vast availability of the pre-curated content and artists, this is one of the popular choices to enable 3D content on eXtended Reality applications.

ARKit

Augmented reality (AR) describes user experiences that add 2D or 3D elements to the live view from a device's camera such that the elements appear to inhabit the real world. ARKit combines device motion tracking, camera scene capture, advanced scene processing, and display conveniences to simplify the task of building an AR experience. It integrates iOS device camera and motion features to produce augmented reality experiences in the application.

Blender

Blender is a free, open source 3D creation suite for

powering up the eXtended Reality applications. This application can handle full 3D pipeline – modeling, rigging, animation, simulation, rendering, compositing, and motion tracking, etc. It even supports python scripting for basic animation and rendering.

Unreal Engine

Epic Games have developed a complete suite of creation tools that serve ambitious artistic visions. Bringing photorealistic renders and content is a jewel in its crown. This tool can be used to develop eXtended Reality applications for HTC Vive, mobiles, PC, etc.

Vuforia

Vuforia is an Augmented Reality SDK for devices that create Augmented Reality applications. It uses Computer Vision technology to recognize and track Image Targets and simple 3D objects, such as boxes, in real time. This image registration capability enables developers to position and orient virtual objects, such as 3D models and other media, in relation to real-world images when these are viewed through the camera of a mobile device / HoloLens. The virtual object then tracks the position and orientation of the image in real time so that the viewer's perspective of the object corresponds with their perspective on the Image Target, so that it appears that the virtual object is a part of the real-world scene.

OpenCV

OpenCV is a library of functions targeting to resolve real-time computer vision problems. It is supported on many platforms such as Windows, Linux, MacOS, smartphones – iOS and Android. Being a BSD-licensed product, OpenCV makes it easy for businesses to utilize and modify the code. It has over 2500 optimized algorithms to detect and recognize faces, identify objects, classify human actions in videos, track camera movements, track moving objects, extract 3D models of objects, produce 3D point clouds from stereo cameras, stitch images together to produce a high resolution image of an entire scene, find similar images from an image database, remove red eyes from images taken using flash, follow eye movements, recognize scenery and establish markers to overlay it with augmented reality, etc.

Light variants of ML

Just having 3D models with basic functions is not sufficient for providing great experiences. Therefore, we use AI to power up the apps to behave naturally. Some frameworks involve TensorFlow, TensorFlow Lite, CoreML, ML Toolkit etc. They provide the necessary gesture/object/face/body detection and perform multiple analysis right on the user's palm

Service offerings

Many services provided by Microsoft Azure, Amazon Web Services and Google Cloud services are useful for eXtended Reality applications. These mainly constitute Cognitive services, which are Vision based and Speech, remote rendering, spatial anchors, etc., that enable applications perform heavy work off-load to cloud, and enable complex features to the devices which aren't capable enough.

Adobe CC

Creative Cloud is a set of applications and services developed by Adobe for graphic design, video editing, web development, photography, UX, 3D designs, and Cloud services. Adobe CC helps with texturing, physical based rendering of 3D content, Compositing, and Video editing.

Microsoft HoloLens

Microsoft HoloLens SDK helps create multiuser, interactive, and spatially aware applications. It provides the flexibility to use popular development platforms such as Unity, Unreal, and Vuforia to create mixed reality experiences.



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Wikitude

Wikitude is a mobile augmented reality based SDK, which is supported on iOS, Android, UWP. Just like Vuforia, this can also recognize and render based on markers/images. This also has a support for Geo based AR to power the applications.

Kinetic AR

Kinetic AR combines robotics with AR, where complex robotic instructions can be abstracted in the form of simple AR gesture based instructions. For example, a robotic cleaning drone for large windmills can be controlled with a set of simple AR-based instructions.

Shared AR

One of the rising trends across industries is Shared AR, where augmented information is shared with distributed teams across locations. For example, a car sales executive could connect with a customer in another location, share the 3D model of the car, and explain its specifications and features. Shared AR is highly effective for collaboration and remote assistance allowing multiple participants to view, modify, interact, and share AR experiences.

Generative Modelling

Generative modeling utilizes simple gestures/contours/commands to automatically generate complex 3D shapes. This is in contrast to manual modeling, which is time consuming. For example, a sport shoes manufacturer can utilize the power of generative modeling to design 3D models for their large inventory of shoes (instead of manually modeling each shoe).

Motion Graphics

Motion Graphics and Motion Tracking enable developers and designers to track and simulate realistic human body movements through a combination of CV, DL, and motion technologies (Inverse Kinematics, Skinning and Rigging).

This technology can be used to simulate lifelike avatars for live trainings and interactive sessions.

WebXR

We are entering a phase where JavaScript can pull out an eXtended Reality experience right on the website, where the user does not need to install any special apps. The computer/smartphone screens will be the portal for the end users to enter the world of eXtended Reality. Although the set of libraries in this space is not mature, you can still experience with this platform. It is currently supported on limited browsers and devices.

Photogrammetry

Photogrammetry is the science and technology of auto-generating photo-realistic 3D models with limited manual effort, helping 3D artists save significant amount of time that they would have otherwise encountered while manually modelling the same objects. Photogrammetry works by extracting 3D information about physical objects and the environment from photographs for generating 3D models. The process involves taking photographs of an object, structure, or space in different angles and using them to obtain information regarding the texture, shape, volume, and depth of the subject of interest. In recent years, 3D modelling of products is being used increasingly in large inventories and catalogues. For example, with WebXR seeing larger adoption rates in recent times, there is a compelling need for retailers to convert existing 2D product catalogues to 3D models for their websites and mobile applications.



WATCH

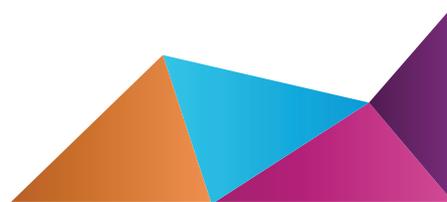
8th Wall

8th Wall is breaking the barriers between the digital and physical by bridging the development gap between iOS and Android, and even on web. Their platform enables the app to work seamlessly on any platform.

.....

6D.ai

Though it is just a startup, it has made everyone notice their product, which does faster SLAM. 6D Reality Platform AR with Depth, Occlusion and Physics, and all by using only a smartphone camera. The product is currently in beta and could be a game changer once it is launched.





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