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TELESCAN 2K19

Editorial Committee

We, the students of Electronics & Telecommunication feel the privilege to present the Technical Departmental Magazine of Academic year- TELESCAN 2019 in front of you the magazine provides a platform for the students to express their technical knowledge and enhance their own technical knowledge. We would like to thank Dr.M.P.Sardey (HOD) and Prof. Santosh H Lavate for their constant support and encouraging us throughout the semester to make the magazine great hit.

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VISION OF E&TC DEPARTMENT

To provide quality education in Electronics & Telecommunication Engineering with professional ethics

MISSION OF E&TC DEPATMENT

To develop technical competency, ethics for professional growth and sense of social responsibility among students

INDEX

3 Dimensional Integrated Circuit

A three-dimensional integrated circuit (3D IC) is a MOS (metal-oxide semiconductor) integrated circuit (IC) manufactured by stacking silicon wafers or dies and interconnecting them vertically using, for instance, through-silicon vias (TSVs) or Cu-Cu connections, so that they behave as a single device to achieve performance improvements at reduced power and smaller footprint than conventional two dimensional processes. The 3D IC is one of several 3D integration schemes that exploit the z-direction to achieve electrical performance benefits, in microelectronics and nano electronics.

3D integrated circuits can be classified by their level of interconnect hierarchy at the global (package), intermediate (bond pad) and local (transistor) level. In general, 3D integration is a broad term that includes such technologies as 3D wafer-level packaging (3DWLP); 2.5D and 3D interposer-based integration; 3D stacked ICs (3D-SICs), monolithic 3D ICs; 3D heterogeneous integration; and 3D systems integration.

International organizations such as the Jisso Technology Roadmap Committee (JIC) and the International Technology Roadmap for Semiconductors (ITRS) have worked to classify the various 3D integration technologies to further the establishment of standards and roadmaps of 3D integration. As of the 2010s, 3D ICs are widely used for NAND flash memory in mobile devices.
3D Packaging refers to 3D integration schemes that rely on traditional methods of interconnect such as wire bonding and flip chip to achieve vertical stacks. 3D packaging can be disseminated further into 3D system in package (3D SiP) and 3D wafer level package (3D WLP). Stacked memory die interconnected with wire bonds, and package on package (PoP) configurations interconnected with either wire bonds, or flip chips are 3D SiPs that have been in mainstream manufacturing for some time and have a well established infrastructure. PoP is used for vertically integrating disparate technologies such as 3D WLP uses wafer level processes such as redistribution layers (RDL) and wafer bumping processes to form interconnects.

2.5D interposer is also a 3D WLP that interconnects die side-side on a silicon, glass or organic interposer using TSVs and RDL. In all types of 3D Packaging, chips in the package communicate using off-chip signaling, much as if they were mounted in separate packages on a normal circuit board.

3D ICs can be divided into 3D Stacked ICs (3D SIC), which refers to stacking IC chips using TSV interconnects, and monolithic 3D ICs, which use fab processes to realize 3D interconnects at the local levels of the on-chip wiring hierarchy as set forth by the ITRS, this results in direct vertical interconnects between device layers. The first examples of a monolithic approach are seen in Samsung's 3D V-NAND devices.

As of the 2010s, 3D IC packages are widely used for NAND flash memory in mobile devices.

One master die and three slave dies

3D SiCs

The digital electronics market requires a higher density semiconductor memory chip to cater to recently released CPU components, and the multiple die stacking technique has been suggested as a solution to this problem. JEDEC disclosed the upcoming DRAM technology includes the "3D SiC" die stacking plan at "Server Memory Forum", November 1–2, 2011, Santa Clara, CA. In August 2014, Samsung Electronics started producing 64 GB SDRAM modules for servers based on emerging DDR4 (double-data rate 4) memory using 3D TSV package technology. Newer proposed standards for 3D stacked DRAM include Wide I/O, Wide I/O 2, Hybrid Memory Cube, High Bandwidth Memory.

Monolithic 3D ICs

Monolithic 3D ICs are built in layers on a single semiconductor wafer, which is then diced into 3D ICs. There is only one substrate, hence no need for aligning, thinning, bonding, or through-silicon vias. Process temperature limitations are addressed by partitioning the transistor fabrication to two phases. A high temperature phase which is done before layer transfer follow by a layer transfer use ion-cut, also known as layer transfer, which has been used to produce Silicon on Insulator (SOI) wafers for the past two decades. Multiple thin (10s–100s nanometer scale) layers of virtually defect-free Silicon can be created by utilizing low temperature (<400°C) bond and cleave techniques, and placed on top of active transistor circuitry. Follow by finalizing the transistors using etch and deposition processes. This monolithic 3D IC technology has been researched at Stanford University under a DARPA-sponsored grant.

(CNT) structures vs. silicon using a wafer-scale low temperature CNT transfer processes that can be done at 120°C.

In general, monolithic 3D ICs are still a developing technology and are considered by most to be several years away from production

Manufacturing technologies for 3D SiCs

There are several methods for 3D IC design, including re crystallization and wafer bonding methods. There are two major types of wafer bonding, Cu-Cu connections (copper-to-copper connections)[10] and through-silicon via (TSV). As of 2014, a number of memory products such as High Bandwidth Memory (HBM) and the Hybrid Memory Cube have been launched that implement 3D IC stacking with TSVs. There are a number of key stacking approaches being implemented and explored. These include die-to-die, die-to-wafer, and wafer-to-wafer.

Die-to-Die

Electronic components are built on multiple die, which are then aligned and bonded. Thinning and TSV creation may be done before or after bonding. One advantage of die-to-die is that each component die can be tested first, so that one bad die does not ruin an entire stack.[11] Moreover, each die in the 3D IC can be binned beforehand, so that they can be mixed and matched to optimize power consumption and performance (e.g. matching multiple dice from the low power process corner for a mobile application).

Die-to-Wafer

Electronic components are built on two semiconductor wafers. One wafer is diced; the singulated dice are aligned and bonded onto die sites of the second wafer. As in the wafer-on-wafer method, thinning and TSV creation are performed either before or after bonding. Additional die may be added to the stacks before dicing.

Wafer-to-Wafer

Electronic components are built on two or more semiconductor wafers, which are then aligned, bonded, and diced into 3D Ics. Each wafer may be thinned before or after bonding. Vertical connections are either built into the wafers before bonding or else created in the stack after bonding. These ―through-silicon vias‖ (TSVs) pass through the silicon substrate(s) between active layers and/or between an active layer and an external bond pad. Wafer-to-wafer bonding can reduce yields, since if any 1 of N chips in a 3D IC are defective, the entire 3D IC will be defective. Moreover, the wafers must be the same size, but many exotic materials (e.g. III-Vs) are manufactured on much smaller wafers than CMOS logic or DRAM (typically 300 mm), complicating heterogeneous integration.

Tushar Ghati
TE A

4D Printer

3D printing has captured the imagination of everyone from industry experts to at-home hobbyists. Media attention has helped to promote this technology beyond all expectations. The major arguments in favor of 3D printing and Additive Manufacturing are often cited as free complexity, mass-customization and minimizing weight/volume while maximizing strength in components (Lipson 2012). However, there are significant challenges that need to be addressed in order for 3D printing to have widespread adoption in production and manufacturing, including; print speed/time, build volume, material quality and new software capabilities (Hayes 2013). These hurdles have relegated printing to a space of tentative implementation but not yet unanimous adoption across industries. A new category of printing has recently been introduced, called 4D printing, which describes the ability for a material system or object to change form and/or function after printing (Tibbits 2013). This technique expands current processes to include the fourth dimension, time, whereby parts can transform themselves in shape or property. 4D printing offers a number of unique advantages over 3D printing that may prove to be the critical capability needed to catalyze widespread implementation. More specifically, 4D printing offers actuation, sensing and programmability embedded directly into a material, without the reliance on external devices and electromechanical systems. This has a number of unprecedented advantages: a) minimizing the number of components in a product or system b) minimizing assembly time as compared to traditional processes where motors, sensors and electronics are assembled post-fabrication c) minimizing cost as compared to expensive components d) minimizing failure-prone devices that have become common in electronics and robotics

In order to create ‒smart‖ products, materials and architectural systems once previously required additional components that were expensive, failure-prone and difficult to assemble. However, 4D printing now allows smart materials to be programmed with linear actuators, folding mechanisms, curling/ bending surfaces and material sensors. In essence, printing can now become a Materials Science chamber where the designer is able to customize the deposition of materials, anisotropic behaviors and active sensing based on the surrounding environment.

Akash Chauhan
BE-A

5 Nanometer Semiconductor

In semiconductor manufacturing, the International Roadmap for Devices and Systems defines the nanometer (5 nm) node as the technology node following the 7 nm node. As of 2019, Samsung Electronics and TSMC have begun commercial production of 5 nm nodes. They are based on multi-gate field-effect transistor (MuGFET) technology, an evolution of MOSFET (metal-oxide-semiconductor field-effect transistor) technology.

Background

The 5 nm node was once assumed by some experts to be the end of Moore's law.[Transistors smaller than 7 nm will experience quantum tunnelling through the gate oxide layer Beyond 7 nm, it was initially claimed that major technological advances would have to be made to produce chips at this small scale. In particular, it is believed that 5 nm may usher in the successor to the FinFET, such as a gate-all-around architecture.[citation needed] In 2009, Intel's roadmap projected an end-user release by approximately 2020, though Intel has not yet revealed any specific plans to manufacturers or retailers.

Technology demos

Single transistor 7 nm scale devices were first produced by researchers in the early 2000s, with IBM releasing one in 2002, followed by NEC in 2003. In 2015, IMEC and Cadence had fabricated 5 nm test chips. The fabricated test chips are not fully functional devices but rather are to evaluate patterning of interconnect layers.

In 2015, Intel described a lateral nanowire (or gate-all-around) FET concept for the 5 nm node. In 2017, IBM revealed that they had created 5 nm silicon chips, using silicon nanosheets in a gate-all-around configuration (GAAFET), a break from the usual FinFET design.

Commercialization

In early 2018, TSMC announced production of a 5 nm node by 2020 on its new Feb 18. In April 2019, Samsung Electronics announced they had been offering their 5nm process (5LPE) tools to their customers since 2018 . The N5 process can use EUVL on up to 14 layers, compared to only 5 or 4 layers in N6 and N7++.

5 nm process nodes

Samsung TSMC IRDS roadmap 2017

Process name (nm) 5LPE N5 7 5

SRAM bit-cell size (µm2) 0.0262 0.017-0.019 0.02690.0202

Transistor gate pitch (nm) 57 48 48 42

Interconnect pitch (nm) 36 30 28 24

† Based on a 6T SRAM 111 cell

Transistor gate pitch is also referred to as CPP (contacted poly pitch) and interconnect pitch is also referred to as MMP (minimum metal pitch).

Beyond 5 nm

Main article: 3 nanometer

–3 nml (3 nanometer) is the usual term for the next node after 5 nm. As of 2019 Samsung and TSMC have plans to commercialize the 3 nm node.

3.5 nm has also been given as a name for the first node beyond 5 nm.

Atharva Ekad
BE B

AI: Changing The Face of Defence

The US, China, Russia and the UK are among a growing number of countries that are turning to artificial intelligence (AI) and machine learning as they look to develop a new generation of advanced weapons system.

The Pentagon, in the US, has made a commitment to spend $2 billion over the next five years through the Defense Advanced Research Projects Agency (DARPA). Its OFFSET programmed, for example, is looking to develop drone swarms comprising of up to 250 unmanned aircraft systems (UASs) and/or unmanned ground systems (UGSs) for deployment across a number of diverse and complex environments. In China, there are a growing number of collaborations between defense and academic institutions in the development of AI and machine learning and Tsinghua University has launched the Military-Civil Fusion National Defense Peak Technologies Laboratory to create ―a platform for the pursuit of dual-use applications of emerging technologies, particularly artificial intelligence.‖
Russia has gone one step further and is creating a new city named Era, which is devoted entirely to military innovation.
Currently under construction, the main goal of the research and development planned for the technopolis is, ―the creation of military artificial intelligence systems and supporting technologies,‖ according to the Kremlin.
―What we are seeing is a renaissance in interest in AI and machine learning (ML),‖ says Dr Andrew Rogoyski, Innovation Director at Roke Manor, a contract research and development business owned by Chemring.
―The initial surge in AI came in the 1940s and 50s and then again in the 1980s. Today, in what can be described as a ‗third renaissance' we have the computing power and enough data to deliver on the promises made for the technology in the past. It's a really exciting time in terms of what is possible.‖
According to Dr Rogoyski, ―When we talk about AI we tend to mean machine learning. You have to remember that AI is a vast subject and includes areas such as natural language processing, robotics, machine vision and data analytics.
―While the media tends to focus on ‗killer robotics' the use of ML in the military space takes in areas as diverse as logistics, surveillance targeting and reconnaissance. Healthcare is one of the biggest costs for the military as it needs to keep service personnel fit and ready for deployment. ML can be used to optimize and tailor individual training schedules. As such, the application and use of AI and ML is extremely broad.‖
The UK's Ministry of Defence (MoD), sees autonomy and evolving human/machine interfaces as enabling the military to carry out its functions with much greater precision and efficiency.

A 2018 Ministry of Defence report said that the MoD would be pursuing modernisation in areas like, ―artificial, machine-learning, man-machine teaming, and automation to deliver the disruptive effects we need in this regard.‖

The MoD has various programmes related to AI and autonomy, including the Autonomy programme, which is looking at algorithm development, artificial intelligence, machine learning, as well as ‒developing underpinning technologies to enable next generation autonomous military-systems.‖ Its research arm, the Defense Science and Technology Laboratory (Dstl), unveiled an AI Lab last year.
‒The MoD is focused on a variety of AI techniques such as machine vision and robotics across a number of different use cases,‖ explains Dr Rogoyski. ―These range from threat intelligence to data science, and the ministry is now having to operate in much the same way as it would if it was in the commercial world. That means it needs to be able to deploy these technologies fast enough to match deployments in the commercial space. Keeping up is a real challenge, you are looking at getting technology into operational use without taking 5-10 years to procure it and go through the long drawn out cycles of the past.
‒Ultimately, it will mean changing procurement strategies.‖
In terms of weaponry, one of the best-known examples of autonomous technology currently under development is the Taranis armed drone, the ‒most technically advanced demonstration aircraft ever built in the UK,‖ according to the MoD.
‒Whether it‘s drones or autonomous vehicles, there‘s a big push to develop technologies that protect servicemen,‖ explains Dr Rogoyski. ―Whether that‘s drones or route clearance vehicles, the aim is to move servicemen away from the front line and to allow technology to take their place.‖
The Royal Air Force and Royal Navy are ten per cent short of their annual recruitment targets, while the Army is more than 30 per cent short, so the MoD also sees automation as a possible solution to this manpower shortage.
‒Another area of interest, and which is becoming increasingly important, is where ML is being used in psychological operations,‖ explains Dr Rogoyski. ‒It may not have anything to do with _killer robots‘ or drones but these types of operations, via social media or through the use of fake news, are transforming the way we can influence the political will behind the use of military force.‖
According to Dr Rogoyski, psychological management is just one of a number of new _fronts‘ that need to be addressed.
‒Another is the security of a nation‘s critical and increasingly connected infrastructure and the role of AI in protecting it. How can we project military power overseas when our entire infrastructure could be at risk from a cyber-attack, not just from other nation states but from non-government organisations?‖
The MoD has a cross-government organisation called the Defense and Security Accelerator (DASA), that looks to find and then fund exploitable innovation to support UK defence and security quickly and effectively.
Advances in AI and automation offer real opportunities but will require a fundamental shift in how they are viewed and treated. Instead of being seen as something confined solely to research labs, the MoD has been urged to adopt a much nimbler and more ambitious approach in terms of how they are used to transform defence programmes, using experimentation to try, fail, learn and succeed, while at the same time developing procurement processes that allow for a more agile adoption.

–A key issue with both AI and ML that will ensure their successful adoption is that they need to be explainable and come with a level of assurance,‖ says Dr Rogoyski. –Both are fundamental and are not solely confined to the military.

–If you supply a black box system and the user has no idea how or why it makes a decision, how can they trust it if, and when, it makes a mistake? Trust in weapons systems is critical, but then would you put your trust in a robotic surgeon or a banking system that made arbitrary decisions about your savings?

–AI needs disciplined thinking and the systems will need to operate in the way you expect, under specific circumstances. If they make a mistake you want to be able to understand why, so there's an important link with post analysis and how a system has made a particular decision.‖

In fact, by gathering and analyzing multiple limited implementations it could provide the MoD with a clearer sense of direction and an ability to rapidly exploit AI developments in the commercial sector, leading the way for further military development.

Vaibhav Jagtap
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Artificial Intelligence

Artificial Intelligence is a term, which consists of two words.

Artificial: Artificial is something that is not real and which is kind of fake because it is simulated.

Intelligence: Intelligence is are very complex term. It can be defined in many different ways like logic, understanding, self-awareness, learning, emotional knowledge, planning, creativity and of course problem solving.

From SIRI to self-driving cars, artificial intelligence (AI) is progressing rapidly. While science fiction often portrays AI as robots with human-like characteristics, AI can encompass anything from Google‘s search algorithms to IBM‘s Watson to autonomous weapons. Artificial intelligence today is properly known as narrow_AI (or weak AI), in that it is designed to perform a narrow task (e.g. only facial recognition or only internet searches or only driving a car). However, the long-term goal of many researchers is to create general AI (AGI or strong AI), While narrow AI may outperform humans at whatever its specific task is, like playing chess or solving equations, AGI would outperform humans at nearly every cognitive task.

We call us, humans, intelligent, because we all do these mentioned things. We perceive our environment, learn from it and take action based on what we discovered. The same applies to animals. The interesting point about intelligence on animals is, that there are many different species and because of that we can compare intelligence on between species. In both cases (human intelligence and animal intelligence) we talk about natural intelligence (NI).

Current Uses of AI:

Although artificial intelligence evokes thoughts of science fiction, artificial intelligence already has many uses today, for example

- **Email filtering**: Email services use artificial intelligence to filter incoming emails. Users can train their spam filters by marking emails as ―spam‖.
- **Personalization**: Online services use artificial intelligence to personalize your experience. Services, like Amazon or Netflix, ―learn‖ from your previous purchases and the purchases of other users in order to recommend relevant content for you.
- **Fraud detection**: Banks use artificial intelligence to determine if there is strange activity on your account. Unexpected activity, such as foreign transactions, could be flagged by the algorithm.
- **Speech recognition**: Applications use artificial intelligence to optimize speech recognition functions. Examples include intelligent personal assistants, e.g. Amazon‘s ―Alexa‖ or Apple‘s ―Siri‖.

Aniket Bhor
BE A

Artificial Intelligence :A Boon Or a Bane

From getting up in the morning and having your breakfasts ready, till sleeping at the night ,all the spheres of life has been taken over by the most hottest technology on the planet. Undisputedly it is "The Artificial Intelligence".

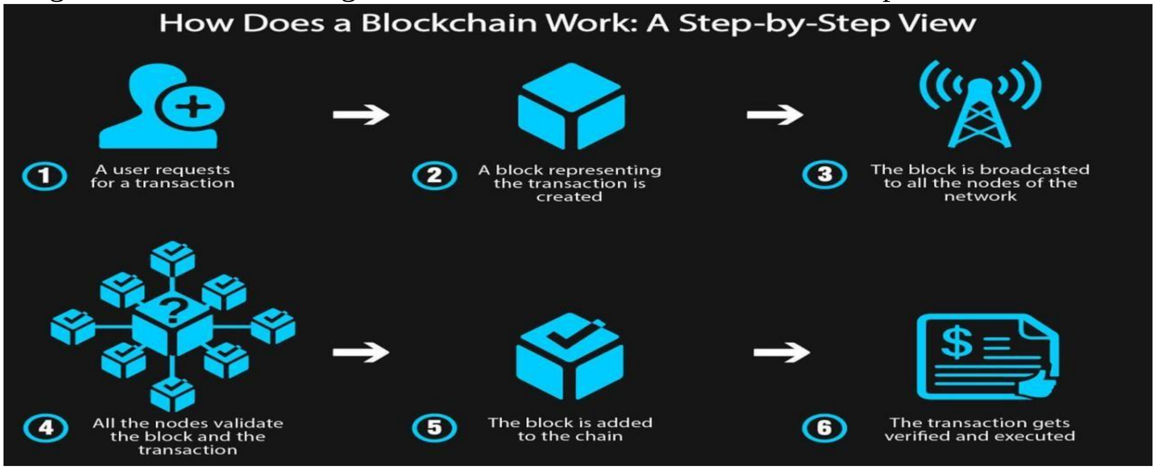
Day by day, more and more intelligent machines are being designed mimicking human brain. Be it responding to human texts or identifying objects, machines have not left any page unturned in showing superiority over humans. But, the question still lingering around everybody's mind stays- "Can AI replace humans ?" The huge data we produce everyday is processed and given to our devices with the collaborated use of machine learning models that gives most of our control to gadgets. These services may certainly be felt as free, but they come to us at the cost of our precious time and attention. Google maps is becoming the most popular app amongst everyone. Just by feeding the current location and destination it gives us the best route 95% times. Certainly it does save our time and energy, but it's very true rather, that we have given up on our thinking and decision making abilities. Not to argue on any fact but, humans are different than any other species because of their decision making capabilities. China on other side has developed autonomous cars that gave better results than human driven cars. Be it our airplanes ,our autopilots are getting better with time. In the US, robots are carrying out surgeries quicker and better than human doctors. Artificial Intelligence certainly has brought a large positive impact on our lives. The arguments continues when complex human emotions still do not find a place to be replicated. It is nearly impossible to mimic human emotions ,be it out of uncertainty or complexities of socio-psychological behavior. Seeing the rise of psychological and mental problems, it is obvious that humans are preferring isolation in the form of chatting ,Web series, social media etc ,rather than getting out and interacting with humans. Artificial Intelligence is certainly not a matter of few years, but it is evolving day by day. It will still take a large time for AI to take a more significant position in our lives when ALEXAS and SIRIS would be

our personal advisors and we wouldn't have to worry about being late to our offices. We may expect in the next 200 years as the true world of AI ,provided the world does not come to an end which, certainly won't. "Behind the new faces of Automation, Human mind still remains the best inventions of all time"

Revati Deshmukh
SE A

Block Chain

In simple terms, block chain is a digital ledger.
Ledger is a book containing accounts to which debits and credits are posted from books of original entry.



The block chain is an **incorruptible digital ledger** of transactions that can be programmed to record virtually everything of value. Each list of record in a block chain is called block. So a block chain is a continuously growing list of records called blocks, which are linked and secured.
Bitcoin and Block chain:
Bitcoin also known as _Virtual Gold' or _Cryptocurrency', is the first decentralized form of virtual currency system that allows online money trading without any bank or a single administration. All these transactions are registered in a ledger that is publicly available, to ensure security and authenticity. The technology that keeps this process functioning without any requirement of an intermediate is the block chain. Although, these two words
been used in the same context and are connected, they refer to two completely different things.
Depending on the need of the application, Block chain can be divided into 3 types:

1. Public Block chain - Public Block chain is publicly accessible and has no restriction on who can participate or be a Validator. In Public block chains, no one has complete control over the network. This ensures data security and helps immutability because a single person cannot manipulate the Block chain. The authority on the Block chain is equally divided among each node in the network, and due to this, Public block chains are known to be fully distributed.

2. A Private Block chain (also known as Permission Block chain) has restrictions on who can access it and participate in transaction and validation. Only pre-chosen entities have permissions to access the Block chain. These entities are chosen by the respective authority and are given permission by the Block chain developers while building the Block chain application. Suppose there is a need to

give permissions to new users or revoke permissions from an existing user, the Network Administrator can take care of it.

3. In Consortium Block chain, some nodes control the consensus process, and some other nodes may be allowed to participate in the transactions. Consortium Block chain is like a hybrid of Public and Private Block chain. It is public because the Block chain is being shared by different nodes, and it is private because the nodes that can access the Block chain is restricted. Hence, it is partly public and partly private.

Basic Features of Block chain Technology:

- Cannot be Corrupted
- Decentralized Technology
- Enhanced Security
- Distributed Ledgers
- Faster Settlement.

U**ses** of Block chain applications that are transforming society-Asset Management: Trade Processing and Settlement, Insurance: Claims processing, Payments: Cross-Border Payments, Block chain Internet-of-Things (IOT).

Prajakta Jakate
BE A

Blue Brain

The Blue Brain project is the first comprehensive attempt to reverse-engineer the mammalian brain, in order to understand brain function and dysfunction through detailed super computer-based reconstructions and simulations. The project aims to build comprehensive digital reconstructions of the brain which can be used to study the nature of the brain. This, in turn, helps in understanding how human beings process emotions, thoughts, and gives us deeper insight into the decision making power of the human brain.

Introduction to the blue brain project

The blue brain project (BPP) makes use of the Blue Gene supercomputer developed by IBM to carry out simulations Today scientists are carrying out research to create an artificial brain that can think, respond, take decisions and store information. The main aim is to upload a human brain into the computer, so that it can think, and make decisions without the presence of a human body. After death, this virtual brain can act as the man. So, even after the death of a person, we will not lose the knowledge, intelligence, emotions, and memories of a person and this can be used for various situations like to continue the pending work, to decide on something based on his/her area of expertise etc.

The human brain is a complex system consisting of recursive connectors. It is more complex than any circuitry in the world. The human brain is a multi-level system with 100 billion neurons (nerve cells) and 100 trillion synapses.

A neuron is a cell designed to transmit information to other nerve cells, muscle, or gland cells whereas synapses help neurons to communicate with each other. So, the question may arise, is it really possible to create a human brain? The answer is yes. Today it is possible because of advancement in technology. The world of technology has expanded in areas like humanoid robots, computing, virtual reality, wearable devices, Artificial Intelligence, Digital jewellery, Blue Eyes Technology, Brain Gate Technology and so much more at a rapid rate. A full human brain simulation (100 billion neurons) is planned to be completed by 2023 if everything goes well. If so, this would be the first virtual brain of the world.

What is a Virtual Brain?

A virtual brain is an artificial brain. It can think like the natural brain, take decisions based on the past experience, and respond as the natural brain can. It is possible to do so by using supercomputers, with a huge amount of storage capacity, processing power and an interface between the human brain and this artificial one. Through this interface, the data stored in the natural brain can be uploaded into the computer. So the brain and the knowledge, intelligence of anyone can be preserved and used forever, even after the death of the person.

Why do we need a virtual brain?

Today we are developed because of our intelligence. Intelligence is the inborn quality that cannot be created. Some people have this quality so that they can think to such an extent where others cannot reach. Human society would always need such intelligence and such an intelligent brain. But the intelligence is lost along with the person after death. Virtual brain is a solution to it. The brain and its intelligence can be alive even after death.

We often face difficulties in remembering things such as people‘s names, their birthdays, and the spellings of words, proper grammar, important dates, history facts, and etcetera. A virtual brain can take away the extra stress we all face to remember things. It is a perfect technical solution to a very common human problem.

How does the natural brain work?

The human ability to feel, interpret and even see is controlled, in computer-like calculations, by the magical nervous system. Yes, the nervous system is quite like a magic because we can‘t see it, but it is working through electric impulses through your body.

The human brain is a multi-level complex system with 100 billion neurons and 100 trillion synapses. Not even engineers have come close to making circuit boards and computers as delicate and precise as the nervous system. To understand this system, one has to know following three simple functions.

Sensory input: When our eyes see something or when our hands touch a warm surface, the sensory cells, also known as Neurons, send a message straight to our brain. This is called sensory input because we are putting things into our brain by way of senses.

1. **Integration:** Integration is best known as the interpretation of things like taste, touch, and sense which is possible because of our sensory cells, known as neurons. Billions of neurons work together to understand the change around us.
2. **Motor Output:** Once our brain understands the change, either by touching, tasting or via any other medium, then our brain sends a message through neurons to effectors cells, muscles or gland cells, which actually work to perform our requests and act upon our environment. The word motor output is easily remembered if one should think that our putting something out into the environment through the use of a motor, like a muscle which does the work for our body.

Suraj Kumbhar
BE A

The Cobra Effect

The Cobra Effect is a term in economics. It refers to a situation when an attempted solution to a problem makes the problem worse. This name was coined based on an incident in old colonial India.

By some reasons, there were too many venomous cobra snakes in Delhi. People were dying due to snake-bites and it became scary for almost everyone to step out of their houses. The government of the day had to get into action to stop this menace and it offered a silver coin for every dead cobra. The results were great, a large number of snakes were killed for the reward.
Eventually, however, it led to some serious unwanted consequences. After a short-term dip in cobra population, it started going up.

The unintended consequence for a well-intention-ed idea led to making the problem worst.
Trying a new solution? Or Planning to tackle an existing problem with a new idea?
Well, it‘s time to pause and think about how people would respond to the new idea that may sound great on paper!

Specially the solutions that try to affect how people behave. There‘s always a certain group of people who have a tendency to game the system -intentionally or otherwise.
They have a tendency to take short-term advantage of any situation though that may lead to harm to them & society-at-large only in the long run. Every solution has consequences and those consequences may lead to certain situations where rather than solving a current problem, you may end up with more complex problems.

Few more examples:
A similar type of incident like increasing cobra-population occurred in Vietnam. The rulers realized that there were too many rats in Hanoi and spread of plague was imminent They created a reward program that paid a prize for each rat killed. To obtain the bounty, people would provide the severed rat tail. After initial success, the officials, however, started noticing rats with no tails. The rat catchers would capture rats, cut off their tails, and then release them back into the sewers so that they could breed and produce more rats, thereby increasing the rat catchers' profits.

As they say the road to hell is paved with good intentions, the similar mistakes are happening around us every day when the decision -makers fail to take a 360 degree view of all the possible outcomes of an action before implementation.

Nearly 2 years ago, city of Philadelphia in USA passed a "soda tax" -- a US $1 tax on a typical 2-liter bottle of soft-drink- as a "sin tax" in the national war on obesity. But the natives didn‘t cut calories as a result of the tax on sweetened drinks, nor there was a shift towards any healthier option. Instead, most of them just drove outside the city to buy the same colas , from stores where they didn‘t have to pay the tax.

But the poorest paid more as they could not find it affordable to drive out of the city to buy their drinks. In the end , city suffered loss of revenue due to lower sales whereas the lower section society paid more .

The unintended consequence for a well-intentioned idea led to making the problem worst.
Even big & brilliant companies do the same mistake! It is not that mistakes happen only with the government run programs, there're n numbers of examples in great private companies too where the best & brilliant people lose sight of certain negative outcomes due to the initial magic of seemingly great looking ideas .

Apple turning sour!
In 2017 Apple admitted that it was slowing down the speed of old iPhones as the batteries of those old phones were degrading with the passage of time. To make up on loss of brand image and to satisfy its erstwhile customers, it offered to cut its US $79 battery replacement feed down to US $29 as a way of apologizing. This lower fee led to more people in 2018 ended up swapping their batteries — instead of upgrading to the latest iPhone models thus affecting new iPhone sales. As iPhone batteries became cheaper and easier to replace, fewer people are shelling out for new iPhones that can now cost up to US $1,449.

On January 2nd this year, Apple revealed that it was expecting a $9 billion loss in revenue due to weak iPhone demand that‘s partly caused by more people replacing their batteries, according to a letter issued by CEO Tim Cook addressed to investors.

Slowing down of iPhones sales can be attributed to many external reasons too (better Chines phones, better Apps on Android phones etc), but strategy of battery-replacement was an internal idea. It would have been handled better if people at top would have thought more about it , if they would have filtered this program from Cobra effect

What's in it for you ?
Next time if you or your team has some brilliant idea , get your brilliant guys together in a room and think about the Cobra- effects before implementing that idea.

You can always fine-tune the idea to minimize the negative implications by spending few extra hours/days before rushing to announce it. Don‘t implement while you‘re under the awe of the brilliance of a never - tested, nice-looking solution or idea, think about the Cobra-effects first.

Prof. Supriya Lohar
Assistant Professor
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A New Era In Industrial Production

The next era of industrial production, Industry 4.0, is now upon us, fuelled by advancements in technology such as the rise of big data, automation and cyber physical systems. One particularly significant opportunity for growth within this revolution is the Industrial Internet of Things (IIOT), which covers a variety of applications used in everything from manufacturing, to container ports and power plants. The processes and operating models that make up the IIOT can be elevated to the next level with the high-performance, ultra-low latency connectivity offered by 5G wireless networks.

Different use cases

Let us consider the ‗factory of the future'; a wireless environment in which everything is monitored and optimized. By enabling high-performance wireless communications, 5G offers considerable potential for use cases such as assembly line automation, automated guided vehicles (AGV) decision-making, and the collection of data from sensors to inform machine learning solutions, and AR and VR applications.

What's more, although each of these use cases may have different requirements in terms of speed, latency or bandwidth, 5G is able to handle them as part of a single network.

Depending on their requirements, some use cases can be more challenging and demanding than others. Motion control systems, for example, responsible for controlling the well-defined movements of machines, have very strict requirements regarding latency, reliability, and determinism, while the constant transmission of data within the massive IOT requires high capacity, and the transmission of high-definition video streams to and from augmented reality (AR) devices is heavily dependent on high data rates. The needs of process automation, on the other hand, which employs a variety of different sensors and actuators to monitor and control processes within a plant, sit somewhere between the two. These use cases require Ultra Reliable Low Latency Communication (URLLC), a key element of 5G-enabled wireless connectivity capable of delivering six nines of reliability at less than 1ms latency, meeting all their needs within a single network.

The factory floor can be a tough environment for wireless communications, however. Blockages and reflections caused by fast-moving metal objects such as cranes and conveyor belts can lead to sudden drops in RF signal strength, and rapidly time-varying interference from the small cells deployed throughout the facility.

COMP for URLCC

Coordinated transmission of signals from multiple antennas in different locations, COMP (co-ordinate multi point), when enabled by a dense deployment of small cells with high bandwidth backhaul, can provide the spatial diversity and high capacity needed to deliver URLLC's six nines reliability.

By using spatial dimensions to multiplex many data streams, COMP allows multiple transmissions to be made to multiple locations simultaneously, without interfering with each other, thereby increasing the capacity of a 5G network. In addition, it can allow adjacent networks to share spectrum more effectively.

Finally, spatial diversity can overcome the radio shadowing that occurs in challenging environments such as the modern factory floor, significantly reducing error rates and delivering the URLLC reliability required by IIOT applications.

COMP requires coordination across several different transmission/reception points (TRPs) for which functions such as scheduling, and resource management may need to be performed by a centralized unit. Trade-offs can be made though. The physical layer functions could all be moved to a central unit for example, which would support coherent joint transmission COMP for greater capacity, but this requires high-performance backhaul such as fiber.

Alternatively, splitting the physical layer between a centralized and a distributed unit would support non-coherent COMP, with less stringent backhaul requirements, such as GbE.

Ultimately, the form that a facility's COMP network architecture takes will be largely dependent on factors such as its existing network infrastructure, cost and capacity requirements.

Abhishek Parte
BE B

Radiometry

Why Radiometry??

What is Radiometry ??

Where do we use it??

These are some of the questions that strikes our mind regulary. But we donot have its proper explanation. Right from seeing through our eyes to sensing any signal by brain , everything is based on this radiometry process.

So Radiometry is basically a set of techniques for measuring electromagnetic radiation, including visible light. *Radiometric* techniques in optics characterize the distribution of the radiation's power in space, as opposed to photometric techniques, which characterize the light's interaction with the human eye. The *use* of radiometers to determine the temperature of objects and gasses by measuring radiation flux is called pyrometry. **EMF meters** detect fields emitted by moving electrically charged objects. Electromagnetic fields are created using alternating current and direct current. There is a huge difference between radiometry pyrometry and photometry .they relate to same category but signify different aspect. A **photometry is** an technique that measures the strength of electromagnetic radiation in the range from ultraviolet to infrared and including the visible spectrum. **Pyrometry is** the technique for measurement of surface temperature by the characteristics of the radiation that **is** emitted. The **units** of all **radiometric quantities** are based on watts (W). **Radiometry** is important in astronomy, especially radio astronomy plays a significant role in Earth **remote sensing** . Radio astronomy is a subfield of Radiometry that studies celestial objects at radio frequencies.

Radio waves are a type of **electromagnetic** radiation with wavelengths in the **electromagnetic spectrum** longer than infrared light. **Radio waves** have **frequencies** as high as 300 gigahertz (GHz) to as low as 30 hertz (**Hz**). At 300 GHz, the corresponding wavelength is 1 mm, and at 30 **Hz** is 10,000 km. Radiometry is critically important for various environmental research works and can be applied for developing illumination sources for industrial and commercial *use*. Hence Radiometry is being utilized everywhere in our day to day life but is still remained unknown to us.

Nehal Gholse
TE B

The Growing Need For Large Bank Of Test Items

The principles and practices that guide the design and development of test items are changing because tests are changing. Interdisciplinary forces rooted in areas such as mathematical statistics, the learning sciences, medical education, educational psychology, computing science, and educational technology are now exerting a strong influence on educational measurement theory and practice resulting in different kinds of tests and testing tasks. The first and, probably, most obvious example is in the area of computer-based testing. Educational visionary Randy Bennett (**2001**) anticipated, more than decade ago, that computers and the Internet would become two of the most powerful forces of change in educational measurement. It is fair to say that his prediction was accurate. Computer-based testing is dramatically changing educational measurement because test administration procedures combined with the growing popularity of digital media and the explosion in Internet use have created the foundation for new types of tests and testing tasks. As a result, many educational tests that were once given in a paper format are now administered by computer using the Internet. Many common and well-known exams can be cited as examples including the Graduate Management Achievement Test (GMAT), the Graduate Record Exam (GRE), the Test of English as a Foreign Language (TOEFL iBT), the American Institute of Certified Public Accountants Uniform CPA examination (CBT-e), the Medical Council of Canada Qualifying Exam Part I (MCCQE I), the National Council Licensure Examination for Registered Nurses (NCLEX-RN), and the National Council Licensure Examination for Practical Nurses (NCLEX-PN). Internet-based computerized testing offers many advantages to examinees and examiners compared to more traditional paper-based tests.

But the advent of computer-based Internet testing has also raised new challenges, particularly in the area of test and item development. Large numbers of items are needed to support the banks necessary for computerized testing because items are continuously administered and exposed. As a result, these banks must be frequently replenished to minimize item exposure and maintain test security. Breithaupt, Ariel, and Hare (**2010**) claimed that a high-stakes 40-item computer adaptive test with two administrations per year would require, at minimum, a 2,000-item bank. The costs associated with developing these large banks are severe. For instance, Rudner (**2010**) estimated that the cost of developing one operational item using the traditional approach where content experts use test specifications to individually author each item can range from $1,500 to $2,500. If we combine the Breithaupt et al. (**2010**) bank size estimate with Rudner's cost per item estimate, then we can project that it would cost between $3,000,000 to $5,000,000 alone just to develop the item bank for a computer-based test. Clearly, alternative item development methods are needed.

A second example of the need for large numbers of items can be found in the growing body of research on cognitive diagnostic assessment (CDA). A CDA contains items designed to measure the knowledge and skills required to solve specific problems in a particular content area for the purpose of providing examinees with detailed feedback on their problem-solving strengths and weaknesses. Often, a cognitive model is developed so that examinees' problem-solving skills can be included in the interpretations of their test performance. A cognitive model also guides item development so testing tasks that measure

these specific skills can be created. A cognitive model in educational measurement refers to a simplified description of human problem solving on standardized tasks at some convenient grain size or level of detail in order to facilitate explanation and prediction of students' performance, including their strengths and weaknesses (Leighton & Gierl,(**2007**). Typically, the cognitive models used to develop CDAs contain large numbers of skills specified at a fine grain size because these skills must magnify the knowledge, skills, and processes that underlie test performance. Because large numbers of skills are specified in the cognitive models, large numbers of items must be developed to measure these skills.
Recently, Gierl, Alves, Roberts, and Gotzmann (**2009**) created cognitive models for diagnosing skills in mathematics for the Preliminary SAT/National Merit Scholarship Qualifying Test (PSAT). The PSAT is a standardized test created by the College Board that permits students to practice for the SAT Reasoning Test as well as enter the National Merit Scholarship Corporation programs. Three test development specialists created cognitive models in four mathematics content area. In total, 39 cognitive models containing 134 diagnostic skills were required. In other words, to measure PSAT mathematics skills for cognitive diagnosis, 134 items, at minimum, would be needed if the diagnostic test contained one item per skill. Gierl, Alves et al. (**2009**) recommended that at least three items per skill be created, meaning the PSAT diagnostic assessment would require at least 402 items, to increase the score reliability for each measured skill (see Gierl, Cui, & Zhou, **2009**). Hence, as with the computer-based testing example described earlier, we are faced with an enormous and daunting challenge of creating thousands of new test items.

One way to address the challenge of creating more items is to hire a large numbers of developers who can scale up the traditional, one-item-at-a-time content specialists approach to ensure more items are available. But we know this option is costly. An alternative method for item development that may help address the growing need to produce large numbers of new test items is through the use of AIG. In the next section we describe and illustrate a three-step process for AIG that could prove useful in producing new items to support the evolution and development of our new testing procedures and practices.

Sanmay Kamble
BE B

The Project Loon

Introduction

Loon LLC is an Alphabet Inc. subsidiary working on providing Internet access to rural and remote areas. The company uses high-altitude balloons placed in the stratosphere at an altitude of about 18 km (11 mi) to create an aerial wireless network with up to 4G-LTE speeds. It was named Project Loon, since even Google itself found the idea of providing Internet access to the remaining 5 billion population unprecedented and ―loony‖. It may also be a reference to the balloons used. Loon began as a research and development project by X (formerly Google X), but was spun out into a separate company in July 2018.

The balloons are manoeuvred by adjusting their altitude in the stratosphere to float to a wind layer after identifying the wind layer with the desired speed and direction using wind data from the National Oceanic and Atmospheric Administration (NOAA). Users of the service connect to the balloon network using a special Internet antenna attached to their building. The signal travels through the balloon network from balloon to balloon, then to a ground-based station connected to an Internet service provider (ISP), then onto the global Internet. The system aims to bring Internet access to remote and rural areas poorly served by existing provisions, and to improve communication during natural disasters to affected regions. Key people involved in the project include Rich DeVaul, chief technical architect, who is also an expert on wearable technology; Mike Cassidy, a project leader; and Cyrus Behroozi, a networking and telecommunication lead.

The balloons use patch antennas – which are directional antennas – to transmit signals to ground stations or LTE users. Some smart phones with Google SIM cards can use Google Internet services. The whole infrastructure is based on LTE; the eNodeB component (the equivalent of the ―base station‖ that talks directly to handsets) is carried in the balloon.

Technology

Loon deploys its high-altitude balloon network into the stratosphere, between altitudes of 18km and 25km. The company states that the particular altitude and layer of the stratosphere is advantageous for the balloons because of its low wind speeds, which are usually recorded between 5mph to 20mph (10km/h to 30 km/h). The layer is also an area of minimal turbulence. The company says it‗s able to model the seasonal, longitudinal and latitudinal wind speed variations, allowing them to adjust the placements of their balloons.

Loon claims it can control the latitudinal and longitudinal position of its high-altitude balloons by changing their altitude. They do this by adjusting the volume and density of internal gas (which is composed of either helium, hydrogen or another lighter-than-air-compound), which allows the balloon‗s variable buoyancy system to control the altitude. Additionally, Google has indicated that the balloons are possibly constructed from materials like metalized Mylar, BoPET, or a highly flexible latex or rubber material, like chloroprene.

Initially, the balloons communicated using unlicensed 2.4 and 5.8 GHz ISM bands, and Google claims that the setup allows it to deliver ―speeds comparable to 3G‖ to users, but they then switched to LTE with cellular spectrum by cooperating with local telecommunication operators. It is unclear how technologies that rely on short communications times (low latency pings), such as VoIP, might need to be modified to work in an environment similar to mobile phones where the signal may have to relay through multiple balloons before reaching the wider Internet. Google also experimented with laser communication technology to interconnect balloons at high altitude and achieved a data rate of 155 Mbps over a distance of 62 miles (100 km).

The first person to connect to receive internet access from one of the Loon balloons was Charles Nimmo, a farmer and entrepreneur in Leeston, New Zealand. Nimmo was one of 50 people in the area around Christchurch who agreed to be a pilot tester for Loon. The New Zealand farmer lived in a rural location that was unable to get broadband access to the Internet. The town‗s residents used a satellite Internet service in 2009, but found that the service could reach costs of up to $1000 per month.

Locals who were not participating in the testing were not made aware of the details, other than that it had potential ability to deliver Internet connectivity, but allowed project workers to attach a basketball-sized receiver resembling a giant bright-red party balloon to an outside wall of their property in order to connect to the network.

The technology designed in the project could allow countries to avoid using expensive fiber cable that would have to be installed underground to allow users to connect to the Internet. Alphabet feels this will greatly increase Internet usage in developing countries in regions such as Africa and Southeast Asia that can‗t afford to lay underground fibre cable.

Equipment

The balloon envelopes used in the project are made by Raven Aero star, and are composed of polyethylene plastic about 0.076 mm (0.0030 in) thick. The balloons are super pressure balloons filled with helium, standing 15 m (49 ft) across and 12 m (39 ft) tall when fully inflated. They carry a custom air pump system dubbed the ―Croce‖ that pumps in or releases air to ballast the balloon and control its elevation. A small box weighing 10 kg (22 lb) containing each balloon‗s electronic equipment hangs underneath the inflated envelope. This box contains circuit boards that control the system, radio antennas and a Ubiquiti Networks ‗Rocket M2‗ to communicate with other balloons and with Internet antennas on the ground, and batteries to store solar power so the balloons can operate during the night. Each balloon‗s electronics are powered by an array of solar panels that sit between the envelope and the hardware. In full sun, the panels produce 100 watts of power, which is sufficient to keep the unit running while also charging a battery for use at night. A parachute attached to the top of the envelope allows for a controlled descent and landing when a balloon is ready to be taken out of service. In the case of an unexpected failure, the parachute deploys automatically. When taken out of service, the balloon is guided to an easily reached location, and the helium is vented into the atmosphere. The balloons typically have a maximum life of about 100 days, although Google claims that its tweaked design can enable them to stay aloft for closer to 200 days.

The prototype ground stations use a Ubiquiti Networks ‗Rocket M5‘ radio and a custom patch antenna to connect to the balloons at a height of 20 km (12 mi). Some reports have called Google‘s project the Google Balloon Internet.

Shubham Awati

BE A

Management of IOT Data

- *Storing IOT data*
- *Applying IOT data*
- *Applying rules to act on IOT data*

As more and more things are connected to the Internet of Things, the volume of data associated with and generated by IOT devices, including device statuses, metadata, and sensor readings, is increasing exponentially. Managing and making sense of this data is essential if IOT solutions are to deliver value. Data analytics can be applied to IOT data to generate dashboards, reports, visualizations, and alerts, to monitor the health and status of connected devices, and to provide visibility for sensor readings. Analytics are used to identify patterns, detect anomalies, and predict outcomes from the data, as well to trigger actions through the application of rules. In this article, I'll describe some of the approaches for dealing with IOT data, including storing data, processing and analyzing data, and applying rules.

Storing data

IOT devices typically have limited data storage capabilities, so the bulk of the data acquired by IOT devices needs to be communicated using communication protocols such as MQTT or COAP, and then ingested by IOT services for further processing and storage. More data is being stored and accessed by IOT apps and services than ever before.

Dealing with the increased volume of data is not the only concern with managing stored IOT data. Other considerations include:

- Transforming, aggregating, and integrating data in order to prepare it for analytics while keeping track of data provenance
- Securing the data to maintain the integrity and privacy of the data
- Selecting storage technologies to ensure a balance between high performance, reliability, flexibility and scalability and cost.

Heterogeneous data

The data captured by IOT devices is produced in a mix of data formats, including structured, semi-structured, and unstructured data. This data might include discrete sensor readings, device health metadata, or large files for images or video. Because IOT data is not uniform, no one-size-fits-all approach exists for storing IOT data.

Transforming data

Data is usually transformed on the device or at device gateways to perform normalization. Events may need to be re-ordered if they have been received out of order, and if data is time sensitive, stale data might be dropped.

Provenance information about the sensor that captured the data, as well as location and timestamp for the data, is often attached at this point too. It is useful to store raw data for debugging and historical analytics

purposes, but storing the pre-processed data will avoid having to repeat expensive transformations if the data should need to be analyzed more than once.
Be sure to transform your data and then be selective about which data to transmit and store to save on bandwidth and storage costs.

Securing data
Data must be transmitted and stored securely in order to maintain data integrity and privacy, using secure protocols and encryption. Read more in –Securing IOT data over the network‖ on IBM developer Works.

Data storage Technologies
Because IOT solutions are complex, you'll need to use a combination of data storage strategies.
Data storage technologies that you use for data stored temporarily at the edge while it is being processed on devices and gateways will need to be physically robust (to withstand the often harsh operating environments in which devices are installed), but also fast and reliable so that pre-processing of data can be performed quickly and accurately before data is sent upstream. Device data storage can take advantage of next-generation non-volatile RAM (NVRAM) technologies such as 3D X Point and ReRAM, which are up to 1000 times faster than NAND flash but consume less power than DRAM. Once IOT data is transmitted from the device that generates it, it can be stored in the cloud, on premises, or a hybrid of the two. Data is likely destined for different purposes. Data that is intended for archival purposes rather than real-time analytics can be stored using different approaches that complement the analytics approach that will be adopted. Data access needs to be fast and support querying for discrete real-time data analytics. Storage technologies adopted for this data should support concurrent reads and writes, be highly available, and include indexes that can be configured to optimize data access and query performance.
High volume archival data can be stored on cloud storage that may be slower to access but it has the advantage of being lower cost and elastic so it will scale as the volume of data increases. Access to large file format data like video is usually sequential, so this data might be stored using object storage (such as OpenStack Object Storage known as Swift), or written directly to a distributed file system like Hadoop HDFS or IBM GPFS. Data warehouse tools like Apache Hive can assist with managing reading, writing, and accessing data that is stored on distributed storage.
Data storage technologies that are often adopted for IOT event data include No SQL databases and time series databases.

- **No SQL databases** are a popular choice for IOT data used for analytics because they support high throughput and low latency, and their schema-less approach is flexible, allowing new types of data to be added dynamically. Open source No SQL databases used for IOT data include Couch base, Apache Cassandra, Apache CouchDB, MongoDB and Apache HBase, which is the No SQL database for Hadoop. Hosted No SQL cloud storage solutions include IBM's Cloudant database and AWS DynamoDB.

- **Time series databases** can be relational or based on a No SQL approach. They are designed specifically for indexing and querying time-based data, which is ideal for most IOT sensor data, which is temporal in nature. Time series databases used for IOT data include Influx DB, Open TSB, Risk, Prometheus and Graphite.

Analyzing data

IOT data needs to be analyzed in order to make it useful, but manually processing the flood of data produced by IOT devices is not practical. So, most IOT solutions rely on automated analytics.

Analytics tools are applied to IOT data including device status data and sensor readings, to generate descriptive reports, to present data through dashboards and data visualizations, and to trigger alerts and actions.

Acting on the data by applying rules

Rule engines use the insights discovered from IOT data through analytics, and apply rules to produce accurate, repeatable decisions. There are a variety of approaches to implementing rules for IOT:

- Decision trees. Decision points are represented using a tree (that is, a hierarchical graph-based structure), to represent decision points. Each leaf in the tree structure corresponds with a decision.

Decision trees grow exponentially as the possible number of variable states being tracked increases.

- Data flow graphs. Data flow graphs (also known as pipes) are used to represent the data dependencies and flow between functions. An example of a framework that is built on data flow graphs is TensorFlow.
- Complex Event Processing (CEP). CEP is often used for processing time series data, and it is a good fit for applying rules to real-time sensor data.

Regardless of the engine‘s implementation, rules encode conditions that are used to trigger actions that autonomously make adjustments to a system to work around issues, maximize performance, or optimize costs.

Open source analytics and rules engines can be self-managed; however, many IOT platforms offer hosted analytics and rules solutions based around open source offerings, such as IBM‘s Analytics for Apache Spark. IOT Platforms also typically include custom integrated analytics solutions, incorporating both batch and real-time analytics as well as machine learning and rules. Some examples of IOT platforms that include these capabilities include:

- Oracle Edge Analytics and Stream Analytics
- Azure Stream Analytics
- AWS IOT
- Google Cloud Dataflow

Sandhya Onkar Ahire
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This Big Drone Takes Off Like a Helicopter, Flies Like A Biplane, And Can Carry 70 Pounds

A typical quad copter drone is a small gadget that uses four propellers to take off and land vertically, like a helicopter. And at first glance, a cargo-carrying drone from Bell called the APT 70 looks a little bit like one of those flying machines—until you learn that it stands 6 feet tall, spans 9 feet wide, and can carry a 70-pound payload a distance of 35 miles.

It‘s not the kind of drone designed to drop packages in your yard. Instead, Bell sees it as a machine that could carry military gear, medical supplies, industrial components, and tools, or help a delivery company like Japan‘s Yamato with logistics. This machine first flew late last year, but earlier this month conducted a flight that demonstrated its autonomous capabilities—executing maneuvers on its own like automatically converting to horizontal flight, then back to vertical flight, at the right times.

Besides its size, the APT 70 (which stands for ―autonomous pod transport‖ and notes the number of pounds it can schlep) has another capability that truly separates it from a regular drone: It‘s actually a biplane. When flying, it positions itself parallel to the ground, so the four propellers pull it through the air and the two wide main surfaces serve as wings. Those wings give it lift as the air passes over them, meaning that the propellers demand 50 percent less power when the drone is flying horizontally.

―The drone is what we call a tail-sitting biplane,‖ says Scott Drennen, vice president of innovation at Bell.

In short: This machine takes off and lands like a helicopter, flies like a plane at speeds of over 100 mph, and does so by shifting its entire position in space.

The white and black pod in the middle is where the cargo goes, and the aerodynamic shape of that compartment reduces drag while also giving the craft a little lift.

In the current configuration, that means that the cargo in the pod is going to change its orientation throughout the flight in a way that you wouldn‘t want to experience if you were a passenger. (In other words, don‘t ship a game of Jenga this way.) The pod starts off vertical, then becomes horizontal, then vertical again for landing. ―It‘s not the most ideal configuration for people transport,‖ Drennen says—but that‘s not the mission his company has in mind for this drone. Drennan adds that they do have a design that could keep the pod positioned with a consistent orientation, if needed.

The drone is also smart enough to take wind direction into account: For example, when transitioning into horizontal flight like a plane, it positions itself and its wings to face the wind, just like a regular airplane uses the breeze to maximize the lift its wings generate at takeoff and landing.

The drone is somewhat conceptually similar to the V-22 Osprey aircraft, also made by Bell (and Boeing), which takes off and lands like a helicopter and flies like a plane. But that aircraft has large pods on the ends of the wings that swivel around with rotors, so the fuselage itself (and the crew in it) stay level.

While the APT 70 isn't designed to carry people, of course, it is in a broader category of craft called eVTOLS (electrical vertical take-off and landing craft) that are, and could someday serve as air taxis that whisk people around cities. Many companies are working in this space—among them are Boeing and a vehicle called the PAV; Lilium and a small, futuristic-looking jet-like craft; Jaunt, which has plans for a helicopter-like vehicle; and Bell itself, whose air taxi concept is a hybrid called the Nexus. (And check out this weird-looking Volocopter flying around an airport!)

It‘s unclear just when people might be able to catch rides in eVTOLS, but Bell‘s new cargo carrier is a good demonstration of using the technology to transport non-living goods. Next year, Drennen says, they plan to add more sensors to the drone and take it on it on a more ambitious flight through the Dallas-Fort Worth area.

Prasad Padekar
BE B

Ultrasonic Finger Print Sensor

After a few years lurking in backroom prototypes and inside a few quickly forgotten handsets, ultrasonic fingerprint sensors are ready for prime time. The technology is built into Samsung‘s flagship Galaxy S10 and Galaxy S10 Plus, making the technology almost guaranteed to be securing millions of thumbprints by the year‘s end.

In December 2018, Qualcomm announced its 3D ultrasonic in-display fingerprint sensor. This technology is enabled in devices using the company‘s Snapdragon 855 platform as an option if the manufacturer wants to include the extra hardware. Ultrasonic fingerprint technology has its own pros and cons versus traditional capacitive scanners and even other in-display fingerprint designs. Here‘s everything you need to know.

How ultrasonic fingerprint scanners work

Qualcomm‘s 3D in-display ultrasonic fingerprint scanner is based on what used to be called Sense ID. Rather than existing photographic or capacitive-based fingerprint scanners, ultrasonic fingerprint scanners make use of very high-frequency ultrasonic sound. You can‘t hear it, but these waves are used to map out the details of the user‘s fingerprint. Fortunately, there‘s no need to swipe, just touch the finger to the sensor like the top of the line capacitive fingerprint scanners.

To actually capture the details of a fingerprint, the hardware consists of both a transmitter and a receiver. An ultrasonic pulse is transmitted against the finger that is placed over the scanner. Some of this pulse‘s pressure is absorbed and some of it is bounced back to the sensor, depending upon the ridges, pores and other details that are unique to each fingerprint.

There isn‘t a microphone listening out for these returning signals. Instead, a sensor that can detect mechanical stress is used to calculate the intensity of the returning ultrasonic pulse at different points on the scanner. Scanning for longer periods of time allows for additional depth data to be captured, resulting in a highly detailed 3D reproduction of the scanned fingerprint.

Qualcomm notes that there‘s about a 250-millisecond latency for unlocking, roughly equivalent to capacitive fingerprint scanners. The sensor has about a 1 percent error rate, which again is pretty comparable to other scanners.

Pros of ultrasonic fingerprint vs capacitive scanners

Ultrasonic fingerprint technology works very differently to capacitive fingerprint scanners, which are only able to reproduce 2D images. 3D details are much more difficult to forge or fool than a 2D image, making the ultrasonic system much more secure. It goes without saying that ultrasound is also much more secure than optical fingerprint scanners, which have all but fallen out of favor.

.Another added perk of this ultrasonic fingerprint scanner technology is that it allows the fingerprint scanner to still operate through thin materials, such as glass, aluminum, or plastic. The sensor is just 0.15 millimeters thick and can scan through up to 800 µm of glass and up to 650 µm of aluminum. Therefore, the scanner can be embedded under the case or under the display as we‘re seeing in the Samsung GalaxyS10, allowing for a more discrete look and thinner bezels.

Because the sensor uses ultrasonic waves, the sensor can also double up as a health tracker that can record heart rate and blood flow. Additionally, there‘s less chance of damaging the sensor or exposing it to external tampering, and sweat or moisture on the finger won‘t interfere with the scanning process either.

Sayali Kolte
BE C

VOIP: Voice Over Internet Protocol

Stands for "Voice Over Internet Protocol," and is often pronounced "voip." VoIP is basically a telephone connection over the Internet. The data is sent digitally, using the Internet Protocol (IP) instead of analog telephone lines. This allows people to talk to one another long-distance and around the world without having to pay long distance or international phone charges.

In order to use VoIP, you need a computer, an Internet connection, and VoIP software. You also need either a microphone, analog telephone adapter, or VoIP telephone. Many VoIP programs allow you to use a basic microphone and speaker setup. Others requires VoIP phones, which are like regular telephone handsets, but typically connect to your computer via USB. Analog telephone adapters allow you to use regular phones with your computer. IP phones are another option that connect directly to a router via Ethernet or wirelessly. These phones have all the necessary software for VoIP built in and therefore do not require a computer.
The largest provider of VoIP services is Vonage, but there are several other companies that offer similar services. While Vonage charges a monthly service fee, programs like Skype and PeerMe allow users to connect to each other and talk for free. However, these free services may offer fewer connections, lower audio quality, and may be less reliable than paid services like Vonage.
VoIP is also referred to as IP telephony, Internet telephony, and digital phone.

VoIP (voice over IP) is the transmission of voice and multimedia content over Internet Protocol (IP) networks. VoIP historically referred to using IP to connect private branch exchanges (PBXs), but the term is now used interchangeably with IP telephony.

VoIP is enabled by a group of technologies and methodologies used to deliver voice communications over the internet, enterprise local area networks or wide area networks. VoIP endpoints include dedicated desktop VoIP phones, soft phone applications running on PCs and mobile devices, and WebRTC-enabled browsers.

How does VoIP work?

VoIP uses codecs to encapsulate audio into data packets, transmit the packets across an IP network and unencapsulate the packets back into audio at the other end of the connection. By eliminating the use of circuit-switched networks for voice, VoIP reduces network infrastructure costs, enables providers to deliver voice services over their broadband and private networks, and allows enterprises to operate a single voice and data network.

VoIP also piggybacks on the resiliency of IP-based networks by enabling fast failover following outages and redundant communications between endpoints and networks.

VoIP protocols and standards

VoIP endpoints typically use International Telecommunication Union (ITU) standard codecs, such as G.711, which is the standard for transmitting uncompressed packets, or G.729, which is the standard for compressed packets.

Many equipment vendors also use their own proprietary codecs. Voice quality may suffer when compression is used, but compression reduces bandwidth requirements. VoIP typically supports non-voice communications via the ITU T.38 protocol to send faxes over a VoIP or IP network in real time.

Once voice is encapsulated onto IP, it is typically transmitted with the Real-Time Transport Protocol (RTP) or through its encrypted variant, the Secure Real-Time Transport protocol. The Session Initiation Protocol (SIP) is most often used to signal that it is necessary to create, maintain and end calls.

Within enterprise or private networks, quality of service (QoS) is typically used to prioritize voice traffic over non-latency-sensitive applications to ensure acceptable voice quality.

Additional components of a typical VoIP system include the following: an IP PBX to manage user telephone numbers; devices; features and clients; gateways to connect networks and provide failover or local survivability in the event of a network outage; and session border controllers to provide security, call policy management and network connections.

A VoIP system can also include location-tracking databases for E911 -- enhanced 911 -- call routing and management platforms to collect call performance statistics for reactive, and proactive voice-quality management.

VoIP telephones

The two main types of VoIP telephones are hardware-based and software-based.

A hardware-based VoIP phone looks like a traditional hard-wired or cordless telephone and includes similar features, such as a speaker or microphone, a touchpad, and a caller ID display. VoIP phones can also provide voicemail, call conferencing and call transfer.

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