EMERGING TRENDS IN COMPUTER ENGINEERING

ROBOTICS

ARTIFICIAL INTELLIGENCE

NETWORK SECURITY

IOT

5G NETWORKS

BIG DATA

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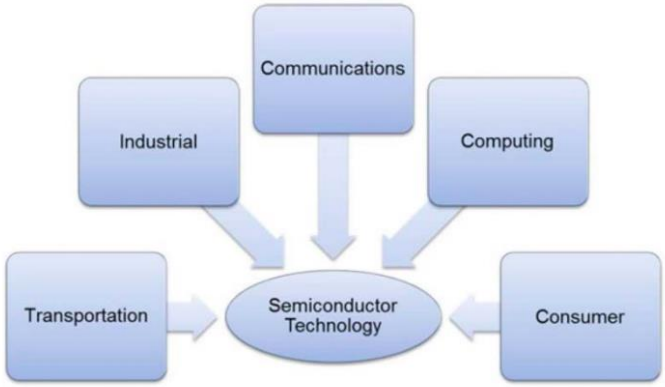

.1 Semiconductor technology and some of its applications

Miniaturization

Miniaturization is the trend to manufacture ever smaller mechanical, optical and electronic products and devices. Examples include miniaturization of mobile phones, computers and vehicle engine downsizing. In electronics, the exponential scaling and miniaturization of silicon MOSFETs (MOS transistors) leads to the average number of transistors on an integrated circuit chip doubling every two years, an observation known as Moore's law. This leads to MOS integrated circuits such as microprocessors and memory chips being built with increasing transistor density, faster performance, and lower power consumption, enabling the miniaturization of electronic devices. An example is IBM 2nm Chip. The process used to make computer chips is measured in nanometres (nm) - with a lower number usually signifying a leap forward. IBM claims its test chip can improve performance by 45% over current 7nm commercially available products. It is also more energy efficient - using 75% less energy to match current performance, IBM said. It claims the tech could "quadruple" mobile phone battery life, and phones might only need to be charged every four days. The computer chip industry used to use nanometres - one billionth of a metre - to measure the physical size of transistors. Today, a lower "nm" number is widely seen as a marketing term to describe new generations of the technology, leading to better performance and lower power.

IBM says its 2nm process can cram 50 billion transistors into "a chip the size of a fingernail" - up from 30 billion when it announced its 5nm breakthrough in 2017.

The end result should be another performance bump for computers in the coming years.

Industry growth

2019 proved grisly after the surging growth of the previous two years. The main problems are best understood in the context of uncertainty caused by the US-China trade war. Additionally, there is

overcapacity in the memory sector, lacklustre demand for processors at the world's data centres, and flattening smartphone sales.

Overall, the industry will do well to grow by more than 4% in 2020. The outlook for advanced processors is not encouraging as data centre spending is only likely to show modest growth. Moreover, smartphone makers are likely to experience sluggish sales growth of 3% in 2020.

AI and algorithmic chips

AI systems need to process massive amounts of data quickly. The performance of general-purpose chips has improved sufficiently to kick-start a new generation of AI technology. However, they cannot keep up with the exponential increase in the volume of data that AI systems process. This has given rise to the advent of hardware-based acceleration via algorithmic-specific chips such as field-programmable gate arrays (FPGAs) and graphics processing units (GPUs).

There is a high degree of specialisation among acceleration chip architectures. This specialisation and the popularity of AI itself have led to an arms race among chip manufacturers. They are seeking to solve AI problems on mobile devices, at the network edge, in the data centre, and on the public cloud platform.

IoT

The tsunami of real time data that will be spewed out by the IoT is driving significant research into new chip architectures, and materials, along with areas like silicon photonics. An increasing number of IoT devices will be armed with their own microcontrollers and analytics to make them less vulnerable. Cybersecurity will be vital to autonomous vehicles, factory and consumer robots, and drones..

Autonomous vehicles (AVs)

Modern vehicles with advanced driver-assistance systems features are networked supercomputers on wheels. Semiconductors will deliver 80% of the innovation required to move the industry to fully autonomous Level 5 vehicles. Given that most original equipment manufacturers (OEMs) have already decided on the main partners, the next couple of years will see competition intensify for design wins with the key OEMs.

RISC-V

The RISC-V Foundation now has over 300 active members, which are exploring the scope for developing open-source, license fee and royalty payment-free RISC processor templates for a wide range of applications. RISC-V is gathering momentum, but still has a long way to go.

The next two years will see the brisk adoption of RISCV. In 2020 it will probably be determined whether RISCV, can be fully exploited in China. Alibaba's RISC-V based developments in IoT and inferential chips were accomplished before the block on US exports to Huawei.

Chip security

The deployment of IoT devices significantly expands the potential attack surface for increasingly sophisticated state and private cyber attackers. The Meltdown and Spectre scandals of 2018 exposed chips' weaknesses to cyberattack. Telecom companies could benefit from the association of 5G and VR. Telecom players are already investing in VR/AR, either through partnerships or in-house initiatives.

Over the next two years we expect only marginal progress. The industry must tighten security across the supply chain, including testing and packaging services, foundries, equipment makers and electronic design automation (EDA) suppliers.

In-house chip design

The tech giants are under increasing pressure to differentiate themselves. Consequently, they are abandoning traditional suppliers such as Intel and Qualcomm in favour of their own proprietary designs. The world will continue to move from general purpose processors to specific, precisely tailored hardware focused on software and algorithm optimisation. The tech giants will increasingly design chips in-house, as they seek to control the computational architecture of their different services.

Foundries

Independent foundries will receive a boost from the profusion of design-only companies and from the tech giants designing their own chips. There is a big question mark over what China can achieve in advanced chip making over the next five years.

The world is expected to spend $50bn on new foundry projects over the next couple of years, with half earmarked for China. Foundries will continue to be challenged by the shrinking size of transistors, the increasing height of 3D stacked architectures deployed beyond Flash memories, and standard functional chiplets being designed into application-specific chip sets.

Digital Logic Design

Digital system is deals with the different types of elements such as hardware, software and network and their applications. Their combination forms a system as an application that is nothing but digital system design. There are many different components that designs a one system. For example, desktop computer contains central processing unit, hard disk, keyboard, mouse, screen etc. Peripheral device is a digital component connected to the digital system for digital camera or printer. Memory, microprocessor, and logic devices play a vital role for any digital system design.

Programmable logic devices are available in many different types. The current range of devices span from small devices capable of implementing only a handful of logic equations to huge FPGAs that can hold an entire processor core and peripherals. In addition to this incredible difference in size, there are many variations in the architecture.

Achronix Speedster SPD60 is a 1.5GHz asynchronous FPGA which includes 10.3Gbit/s serialiser/deserialisers (serdes). Within each device the repeating logic block has eight four-input look-up tables, storage elements and 128 bits of RAM. These logic blocks are surrounded by interconnect and asynchronous data routing blocks. The chip supports memory interface speeds of up to 1.066Gbit/s.

Actel's nano versions of its Igloo FPGAs are characterized by their sub-$1 price tag as much as their power and performance specifications. Power consumption is as low as 2µW and package size 3x3mm. The Igloo nano FPGAs range in densities from 10k to 250k system gates. The devices support 1.2V to 1.5V core and I/O operation. I/O features include hot-swapping and Schmitt trigger inputs.

Altera Stratix IV GT and Arria II GX 40nm FPGAs feature transceiver speeds from 155Mbit/s to 11.3Gbit/s. Stratix IV GT has 24 transceivers operating at 11.3Gbit/s, and up to 530K LEs, 20.3Mbit internal RAM and 1,288 18 x 18 multipliers.

Arria II GX devices are for lower-power applications using protocols such as PCI Express and Gigabit Ethernet. They feature up to 16 3.75Gbit/s transceivers, 256K LEs, and 8.5Mbit of internal RAM.

Atmel's AT91CAP7L customizable ARM7 microcontroller is intended for 12-week design turnarounds. It has 200k gates of metal programmable cell fabric that can be used to implement customer IP, hardware accelerators, additional processor cores, or other peripherals in a classic SoC configuration.

Cypress Semiconductor's programmable system-on-chip (PSoC) family has moved in to its second generation. A major redesign from the first generation PSoC, the programmable element now has the look of a PLD, with 20k density. The on-chip analogue circuits, which are also configurable, have been

given 20-bit resolution. Most significantly, Cypress has replaced its proprietary 8-bit processor core with an 8051-core in the 8-bit devices and an ARM Cortex-M3 processor in the 32-bit chips.

Lattice Semiconductor's ECP3 mid-range FPGA family features a DSP capacity of 320 18×18 multipliers, 6.8Mbit of memory and up to sixteen 3.2Gbit/s serdes channels. There are five devices that offer standards-compliant multi-protocol 3G serdes, DDR1/2/3 memory interfaces and cascadable DSP slices.Toggling at 1Gbit/s, the LatticeECP3 FPGAs also feature LVDS I/O as well as embedded memory of up to 6.8Mbit.Logic density varies from 17K LUTs to 149K LUTs with up to 586 user **Xilinx Virtex 6** and Spartan 6 differ from previous generations of the firm's FPGAs in that they are also being offered in application specific reference designs. Using 40nm for Virtex 6 and 45nm for Spartan 6, the FPGAs use voltage scaling to cut power consumption by up to 50% compared with previous generations. There are up to 760k logic elements, more than 38Mbit of Block RAM and 2,000 DSP slices available. Four I/O 64 transceivers run up to 11.2Gbit/s and there are PCI Express-compliant hard blocks and dedicated DDR3 memory controllers I/O.

Lime Microsystems' LMS6002 is a multi-band multi-standard RF transceiver IC designed for femtocells and small wireless base stations. The transceiver operates at user-selectable frequencies between 375MHz and 4GHz. It can be digitally configured with 16 user-selectable bandwidths of up to 28MHz.It is programmed via a standard Serial Port Interface (SPI) and is packaged in a 9x9mm 116-pin DQFN package.

Silicon Blue Technologies has designed a range of low-power SRAM-based FPGAs based around the traditional four-input look-up table (LUT) logic cell. Essentially, it is a 16-bit RAM with a register on its output which can be bypassed. The first product, iCE65L04, has 4,000 logic cells. Its core consumes under 25µA running at 32.768kHz, and benchmarking at 32MHz.The company has recently introduced a high-speed version with a 65% speed boost due to process optimization.

Xmos Semiconductor L series is the UK-based start-up's multi-threaded configurable processor. A single core version, the XS1-L1, which is made on a 65nm process, will run eight threads, it performs 400MIPS and has 64kbyte of SRAM. Power consumption is under 500µA in sleep mode and 15mA in standby. A dual-core version, the XS1-L2, will run 16 threads.

Circuit Analysis

The electrical engineering industry is under a significant paradigm shift. Ambitious research and development departments all around the globe are working towards better ways to obtain, store, and use electrical energy. Despite significant strides in the past year, the electrical engineering industry is not showing any signs of slowing down. Below are some of the most noteworthy industry trends you should watch out for in 2020.

Smart Grids

Unlike in the past, whereby consumers solely depended on a local electrical power company, today, they have many options. With the ability to even generate their own power, some consumers also now want to sell their surplus. As a result, the electricity delivery infrastructure has to change.

In response to these demands, most Energy Departments around the world are placing smart devices throughout their networks, right up to customers' homes, offices, and factories. The smart grid collects valuable data to allow both consumers and suppliers a higher degree of control over multiple power sources. It also enables them to predict surges in usage and instantly detect outages.

By allowing end-to-end communication between distribution sites, power plants, and the end user's electrical point-of-presence, smart grids significantly raise efficiency and reduce costs.

Soon, it's inevitable that electrical engineers will frequently come across smart grids and or be asked to help develop one.

Soon, electrical Vehicles would be the standard de facto

Tesla recently hit the $100 billion milestone, making itself the first publicly listed US carmaker in history to do so. This is a good sign that electric vehicles have come to stay.

Experts predict that by 2030, there would be over 125 million electric vehicles on the road. Considering the millions of EVs that are already roaming the streets, this is not so much of a long-short. Many EV manufacturers are investing hard into the tech, and consumers can expect better batteries, improved charging tech, more accurate autonomous driving, solar-powered EVs, and even electric planes.

Wireless Power Transfer

Wireless power transfer is in its primitive stages, but the future is bright. In 2020, we expect better wireless charging for laptops, smartphones, earphones, and other smart devices.

Shortly, however, we expect much more. Soon, wireless charging will also become the standard for electric cars. Instead of the large charging docks, drivers will be able to park on a charging spot without

needing to plug in. Expects predict that a few years from now, it will also be possible to charge your electric vehicle while it's moving!

Wireless Wearable Tech

Last year, at the recent Apple event, Tim Cook shared a couple of videos he had received from several apple watch users. These customers appreciated how the apple watch had detected their health conditions (such as Atrial Fibrillation) and encouraged them to visit a doctor—ultimately saving their lives.

Well, this is the same case with wearables in electrical engineering: they are literally lifesavers as well. An excellent example is Proxxi bracelets for electrical engineers with a sensor that vibrates if it gets too close to high-voltage electricity. SolePower also developed boots that are built with temperature sensing, lighting, cloud connectivity, and GPS to provide a warning for overheating, proximity to danger, and falls.

Furthermore, wearable devices are being developed to authenticate access to electrical machinery, provide communications information without the use of mobile phones. This significantly improves the overall safety of electrical engineers.

Artificial intelligence

If artificial intelligence has penetrated large industries like armaments and medicine, surely the electrical engineering landscape cannot be an exception. Electrical engineers are expected to do much better with AI. By blending their prowess and skill with the know-how of AI and machine learning, electrical engineers are contributing the following:

1. Create complex algorithms for data interpretation
2. Generate new codes or revamping existing codes
3. Build massive AI and machine learning platforms
4. Develop comprehensive strategies in the field of electronics

Most notably, artificial intelligence is going to help electrical engineers with image processing. Leveraging AI, engineers can invent complex image processing algorithms to help machines detect electrical or structural abnormalities on a framework and quickly send feedback or suggest rectifications.

Ultimately, this helps to improve the workplace safety of electrical engineers who are often involved in hazardous and massive electronic production lines.

Prefabricated products

The use of prefabricated and preassembled electrical components is increasing. While they significantly bring substantial cost savings, it seems electricians are not happy with the trend.

Electrical engineers are concerned that this threatens their role. “Prefab products?” grunted one union electrician. “They don’t need us for that. A monkey can do that work “. Some also argue that prefab increases the safety of electrical engineers, their efficiency and ultimately compensates for the industry’s labor shortage.

Energy-saving lighting technologies

Gone are the days when LED bulbs were only for those willing to pay the top dollar. LED lamps are becoming the standard de facto light bulb. Today, with prices as low as $2 per bulb or even less, LED bulbs are now a possibility for the average consumer.

Due to their energy-saving capabilities, the bulbs pay for themselves in a matter of months. On average, they can save each household $50-$100 per year in utility bills. With more advances in smart technology, these lights are expected to become even more efficient and easy to install in the near future.

Automated client relationship and project management

Generally, electrical engineers are not enthusiasts of paperwork. However, as much as they love their practical work, there are instances when paperwork is necessary. Fortunately, now there is software that electrical engineers can use to organize scheduling and billing, track customer interactions, and ultimately spend less time on paperwork.

The Internet of Things (IoT)

IoT impacts many different areas of the electrical engineering landscape. From smart grids to smart lighting and Visible Light Communication (VLC), among many others, IoT is now intertangled with the electrical engineering industry. As a result, it’s now imperative that every electrical engineer becomes “IoT literate.”

Apart from the smart grid benefits like monitoring, distribution and automation implemented in electrical utilities, IoT applications in the field of electrical energy also include smart inverters, advanced metering infrastructure (AMI), remote control operation of energy-consuming devices and SCADA (supervisory control and data acquisition.)

Increased use of Drones

When you think of drones, often you probably think of the entertainment industry, shooting music videos and movies.

Well, the application of drones goes far beyond the entertainment industry. A recent survey on seven business sectors has shown that the engineering and construction industries use drones the most. Did you know that leveraging drones can increase safety on a construction site by 55%.

Electrical engineers are using drones to examine certain hazardous electrical zones without putting themselves at risk. This provides much-needed safety in the electrical engineering industry. Furthermore, drones are now helping to record, collect, and analyze data at the job site, thus increasing productivity and efficiency.

A boost in the implementation of sustainable energy

With Greta Thunberg making her firm stand for intense action towards climatic change, it's certainly not the best time for the energy sector to rely on fossil fuels and other environmentally unfriendly energy sources.

The drive for sustainable energy sources is at its peak. The implementation of utility-scale renewable fuels such as solar, wind, and hydropower is, at its peak increase all around the world.

Energy storage and better batteries

While wind and solar power are excellent sources of sustainable energy, they are not always there. Therefore, consumers can only "make hay when the sun shines." They have to do their best to save energy from the wind, the sun, or any other renewable sources for later use.

To meet this demand, electrical engineers all around the world are working towards better batteries and energy storage. Distributed Energy Resource (DER), grid parity, AI and sustainable energy, blockchain, and cyber security.

Generally, 2020 is an exciting year for the electrical engineering landscape. Companies like Tesla, Eos, Sonnen, and Vivint Solar are some to keep an eye on for the latest innovations.

Robotics

While robotics-based technologies are often ridiculed for stealing people's jobs in most industries, it's a different case in electrical engineering. Robotics significantly help to improve safety. For instance, remotely controlled, wireless underground cable cutters can be used instead of putting humans at life-threatening risk.

Wrap Up

Electrical engineers have a lot on their deck, and we can't wait for all these awesome innovations to reach their full potential. These trends will lead us toward the future. Where the lights never go out unexpectedly, a world whereby everything is more comfortable, efficient, and affordable.

Computer Programming

Technology is constantly updating at such a rapid pace that it seems it might be faster than light! A technology or a programming language that is making the rounds this week may be obsolete by the next few days! As more and more funds are invested in research and development, computer scientists and professionals are constantly tweaking and improving existing technologies to get the most out of them. As a result, a new programming language, library, patch, or plug-in gets released almost every hour. To keep up with this crazy pace of development, you have to keep learning the latest technology concepts. The type of software you want to develop is one consideration for which programming languages to learn. While there are no concrete rules for what language is used to write what software, a few trends offer some guidance:

- Web-based startups are more likely to be programming in Python and JavaScript.
- Larger companies tend to develop their internal software applications using C# or Java and their Web applications using PHP.
- Programs for data analytics typically use the R and MATLAB programming languages.
- Embedded devices, such as those in the automotive and healthcare industries, run software written in C, C++, or Rust.
- Applications that run on the cloud are increasingly written in Go or Scala.
- Mobile applications are increasingly written in Swift or Kotlin.

Latest software development tools:

Best recommended software development (developer) tools

RAD Studio

RAD Studio is a Powerful IDE for Building Native Apps on Windows, Android, iOS, macOS and Linux. It enables you to design Beautiful Desktop and Mobile App UIs with less coding effort. Write once, compile everywhere.

Embold

Embold is a software analytics platform that analyses source code and uncovers issues that impact stability, robustness, security, and maintainability.

Scratch:

Scratch is a free application for Windows that lets you easily generate your own graphic animations (aka, cartoons). Its controls are so easy-to-use and adaptable that kids love creating their own cartoon designs.

Animations are generated based on different visual elements (backgrounds, images, and graphics generated from within the program), which you'll program to perform any moves you want. Programming these actions is not at all complicated, thanks to the full-featured graphic editor you get in Scratch. It has all the functions you need to create your design and make it perform any way you want. Its simplified format greatly reduces the difficulties you'd otherwise normally encounter when it comes to programming movements, playing sounds and modifying how characters behave. Create as many objects as you want, tailor any of the available backgrounds to match and get started making your characters come to life.

Collaborator

Collaborator is a peer code and document review tool for development teams that take quality seriously.

Linx

Linx is a low code IDE and server. IT pros use Linx to quickly create custom automated business processes, integrate applications, expose web services and to efficiently handle high workloads.

Studio 3T

Studio 3T for MongoDB helps you to build queries fast, generate instant code, import/export in multiple formats, and much more.

GeneXus

GeneXus provides a unique platform that captures the needs of users and generates applications for present and future technologies, without the need to learn new technology. Allows pragmatic developers to evolve quickly, responding to market and technological changes in an agile way.

Access Rights Manager

Access Rights Manager is a tool that can manage your audit access rights across IT infrastructure. This application helps you to detect compliance by detecting changes. It enables you to generate audit-ready reports instantly.

DbSchema

DbSchema is a visual database designer & manager for any SQL, NoSQL, or Cloud database. The tool enables you to visually design & interact with the database schema, design the schema in a team and deploy it on multiple databases, generate HTML5 diagram documentation, visually explore the data and build queries, and so much more.

NetBeans

NetBeans is a popular, Free, open-source IDE. It is one of the best application development tools that allows developing desktop, mobile and web applications.

Cloud9 IDE

Cloud9 IDE is an online integrated software development environment. It is one of the best software design tools that supports many programming languages like C, C++, PHP, Ruby, Perl, Python and JavaScript.

Zend Studio

Zend Studio allows software developers to code faster, debug more easily. It is next-generation PHP IDE designed to create apps for boosting developers' productivity. It is one of the best developer tools which scales according to the DPI settings of the underlying operating system.

Atom

Atom is a solid all-around text-editor. It is fully free and open source. This software development tool can be customized to do anything but without a need of modifying the config file.

Spiralogics Application Architecture

Spiralogics Application Architecture (SAA) is a cloud-based software development tool. It is one of the best software engineering tools which allows users to build and customize their applications online and deploy them. It also allows users to choose from a set of prebuilt applications or customize them it from scratch.

CodeLobster

Codelobster streamlines and simplifies PHP software development. process. It supports CMS like Wordpress, Drupal, Joomla, and Magento.

CodeCharge Studio

CodeCharge Studio offers the fastest way to build applications. This tool helps to develop data-driven Web sites or enterprise Internet and Intranet systems.

Bootstrap

Bootstrap is a responsive framework for developing with HTML, CSS, and JS. It is one of the best software programming tools that has many in-builds components, which you can easily drag and drop to assemble responsive web pages.

Expression Studio

Expression Studio is a set of a family of tools for professional designer's developers. It is a robust professional design tool which gives creative freedom to developers.

HTML5 Builder

HTML5 Builder is a software solution for building the web and mobile apps. It can develop an app using a single HTML5, CSS3, JavaScript and PHP codebase. It helps to target multiple mobile operating systems, devices and Web browsers.

Visual Online

Visual Studio Online is a collection of services. It is fast and easy to plan, build and ship software across a variety of platforms. It is one of the best tools for software developers that allows organizations to create the perfect development environment.

Kwatee

Kwatee Agile Deployment is a software development tool. It is one of the best software developer tools that automates applications or micro services to any number of servers. It fully automates deployments of text and binary files from any number of target servers.

Azure

Microsoft Azure is widely used by developers to build, deploy and manage web applications.

Data studio

Dataiku DSS is a collaborative data science software platform. It is used by data scientists, data analysts, and engineers to explore, prototype, build and deliver their data products.

Github

GitHub allows developers to review code, manage projects, and build software. It offers right tool for different development jobs.

BitBucket

Bitbucket is a version control tool. It facilitates easy collaboration amongst software development team. It integrates very well with JIRA, a famous project and issue-managing app.

Cloudforge

CloudForge is a software-as-a-service product for application development. It Integrates and manages various development tools.

Axure

Axure provides the capability to produce wireframes, prototypes, and create documentation. This tool is used by business analysts, product managers, and IT consultants around the world.

Codenvy

Codenvy automates applications or micro services to any number of servers. It is one of the best software developing tools which fully automates deployments of text and binary files from any number of target servers.

SendBird

Sendbird is used as a messaging and Chat API for Mobile Apps and Websites. It offers scalability for a massive audience. It also prevents spam flooding of chat rooms.

Enterprise Architect

Enterprise Architect is a requirement management tool. It integrates seamlessly with other development tools by creating requirements in the model.

Computer Organization and Architecture

Big data and fast data applications are transforming enterprise environments and driving changes in the fundamental basic technologies that make up the data centre. In storage, new technologies like SMR and low-latency NAND flash are driving the need for different storage interfaces and in the system software stack. Emerging non-volatile memories likewise require new interfaces and new software mechanisms. The RISC-V open instruction set architecture, and associated trend towards open-source cores, will enable a new set of architectural opportunities, including options for large-scale in-memory, compute, for heterogeneous memory (using different types of memory in the same system), and for heterogeneous compute (combining general purpose and accelerator compute engines, sometimes within the same memory coherency domain). These fundamental changes in the core technologies of the data centre promise to unleash a new set of innovations in system architecture and in how difficult computational problems are solved at scale in a data-centric world.

Emerging memory technology:

The goal for some people interested in emerging memory technology is a single memory type for both storage and computing, in which any amount of memory attached to the system can be used for either purpose. New technologies such as PCM (phase-change memory) promise to bring that goal to reality within the next decade. PCM is new emerging memory technology and its first commercial product is3D XPoint. With PCM products such as 3D XPoint, the writing of a bit from a 1 to a 0 is handled by electronically flipping the resistance of the individual cell. This makes it potentially much faster than even NAND flash, bordering on the speeds of DRAM.

Processor with integrated graphics:

Intel shows where the journey is going in the future with its current processors (Sandy Bridge): namely toward processors that integrate an ever-increasing number of functions on one chip and intelligently adapt their performance and power consumption depending on the requirements of the application. The second generation of the Intel® Core™ processors combines visual and 3D graphic technology with high-performance microprocessors on a single piece of silicon. This integration improves the graphic performance through an even closer coupling of GPU and CPU. The graphic engine is connected directly to the cache of the processor. Therefore, this is no longer called L3-Cache, but Last-Level-Cache.

Intelligent performance:

A further factor that increases performance is Intel® hyper-threading technology. Four processor cores of the second generation of the Intel® Core™ processor can process up to eight threads at the same time

together using this technology. In addition to that there is the new version 2.0 of the Intel® turbo-boost technology. It is optimized for the new micro-architecture and accelerates every application, regardless of whether it is based on one or eight threads. Intel has also extended its turbo-boost technology to the graphic cores in the new processors. Depending on the workload, Turbo Boost 2.0 automatically selects whether the processor cores or the graphics should be accelerated and always makes the optimum performance available depending on the individual requirements.

Discrete Structures/Mathematics

Everyday Applications of Discrete Structures / Mathematics

Networks: are, at base, discrete structures. The routers that run the internet are connected by long cables. People are connected to each other by social media ("following" on Twitter, "friending" on Facebook, etc.). The US highway system connects cities with roads.

Computers: run software and store files. The software and files are both stored as huge strings of 1s and 0s. Binary math is discrete mathematics.

Online Shopping: Encryption and decryption are part of cryptography, which is part of discrete mathematics. For example, secure internet shopping uses public-key cryptography.

Computer Graphics: Computer graphics (such as in video games) use linear algebra in order to transform (move, scale, change perspective) objects. That's true for both applications like game development, and for operating systems.

Google Maps: uses discrete mathematics to determine fastest driving routes and times. There is a simpler version that works with small maps and technicalities involved in adapting to large maps.

Smarter Phones for All: Cell Phone Communications: Making efficient use of the broadcast spectrum for mobile phones uses linear algebra and information theory. Assigning frequencies so that there is no interference with nearby phones can use graph theory or can use discrete optimization.

Power grids: Graph theory is used in finding the most vulnerable aspects of an electric grid. Graph theory and linear algebra are used in power grid simulations.

Finding Friends on Facebook: Graph theory and linear algebra can be used in speeding up Facebook performance.

DNA Fragment Assembly: Graph theory is used in DNA sequencing.

Theoretical computer science: Theoretical computer science includes areas of discrete mathematics relevant to computing. It draws heavily on graph theory and mathematical logic. Included within theoretical computer science is the study of algorithms and data structures. Computability studies what can be computed in principle, and has close ties to logic, while complexity studies the time, space, and other resources taken by computations. Automata theory and formal language theory are closely related to computability. Petri nets and process algebras are used to model computer systems, and methods from discrete mathematics are used in analyzing VLSI electronic circuits. Computational geometry applies algorithms to geometrical problems, while computer image analysis applies them to representations of images. Theoretical computer science also includes the study of various continuous computational topics.

Discrete Tomography in Medical Imaging: We can model a crystal structure based on a set of electron microscope images using discrete tomography. Linear programming can be used in discrete tomography. Discrete tomography can also be used in medical imaging, to reconstruct an image of an organ from just a few x-ray images.

Modeling traffic: Determining the effect of regulation on network traffic flow---whether that's cars on roads or packets across the internet---is a matter of game theory and graph theory together. Optimizing traffic-light cycles uses both discrete and continuous mathematics.

Research & corporate applications that use Discrete Structures / Mathematics.

SARS-CoV-2: Graph theory, and in particular rooted tree diagrams of a genome, is used in the evolution of SARS-CoV-2.

There are two major ways in which mathematics has contributed to our understanding of the disease CoVid-19 and the coronavirus SARS-Cov-2 that causes it. One that is very prominent is through mathematical modelling, which attempts to predict the development of the epidemic in various circumstances. With the appearance of the extremely dangerous CoVid-19, mathematical modelling has become even more important.

Another relevant application of mathematics attempts to track the evolution of the virus responsible. The core of every virus is a small string of replicating genetic material, either DNA or RNA, which sits enclosed in a structure of some kind. The structure serves to keep the virus in one piece, but also, and most crucially, facilitates the insertion of the genetic material into target cells. (It is in this respect that SARS-Cov-2 outdoes SARS-Cov-1.) The genetic material then takes over the machinery of the invaded cell to reproduce itself. It's a remarkable process and, if it weren't so dangerous to humanity, would be deserving of admiration.

Operations research: Operations research provides techniques for solving practical problems in engineering, business, and other fields — problems such as allocating resources to maximize profit, and scheduling project activities to minimize risk. Operations research techniques include linear programming and other areas of optimization, queuing theory, scheduling theory, and network theory. Operations research also includes continuous topics such as continuous-time Markov process, continuous-time martingales, process optimization, and continuous and hybrid control theory.

Detecting deepfakes (fake videos): uses linear algebra and related discrete mathematics.

Determining voting districts: a process known as redistricting, is rife with problems and influenced by politics. Many researchers in various fields work on methods for fair redistricting, and some use lots of discrete math.

Matching medical-school graduates: to hospital residencies is solved using an algorithm that is provably optimal. Here are two articles that describe the discrete mathematics involved and what happens when this is extended to the problem of matching middle-school students to high schools.

Producing Rankings: Many ways of producing rankings use both linear algebra and graph theory. Specific examples include ranking relevance of search results using Google, ranking teams for tournaments or chicken pecking orders, and ranking sports team performances or restaurant preferences that include apparent paraoxon.

Chemistry: Balancing chemical equations uses linear algebra, and understanding molecular structure uses graph theory.

Operating Systems

Distributed Operating System:

A distributed operating system is system software over a collection of independent, networked, communicating, and physically separate computational nodes. They handle jobs which are serviced by multiple CPUs.

Recently, there have been several observations indicating that operating systems for very large scale systems are broken. Full featured operating systems have been shown to limit application scalability. The alternative approach, the lightweight operating systems deployed on IBM's Blue Gene/L and Cray's XT3 do not provide many of the features that application developers have come to expect.

In the current environment, companies developing the largest systems face an unappealing dilemma: they can adopt a full-featured operating system at the risk of hindering application scalability, or they can adopt a lightweight operating system that does not support the broader application community. The possibility of supporting both a full-featured operating system and supporting a lightweight operating system is financially infeasible.

Operating Systems for Embedded Devices:

Embedded system refers to the use of electronics and software within a product that has a specific function or set of functions, as opposed to a general- purpose computer, such as a laptop or desktop system. Today, many, perhaps most devices that use electric power have an embedded computing system. It is likely in the near future, virtually all such devices will have embedded computing systems.

Types of devices with embedded systems are almost too numerous to list. Examples include cell phones, digital cameras, video cameras, calculators, microwave ovens, home security systems, washing machines, lighting systems, thermostats, printers, various automotive systems (e.g., transmission control, cruise control, fuel injection, anti-lock brakes, and suspension systems), tennis rackets, toothbrushes, and numerous types of sensors and actuators in automated systems.

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Virtualization:

Virtualization encompasses a variety of technologies for managing computing resources by providing a software translation layer, known as an abstraction layer, between the software and the physical hardware. Virtualization turns physical resources into logical, or virtual, resources. Virtualization enables users, applications, and management software operating above the abstraction layer to manage and use resources without needing to be aware of the physical details of the underlying resources.

Virtualization technology enables a single PC or server to simultaneously run multiple operating systems or multiple sessions of a single OS. In essence, the host operating system can support a number of virtual machines (VM), each of which has the characteristics of a particular OS and, in some versions of virtualization, the characteristics of a particular hardware platform.

A common virtual machine technology makes use of a virtual machine monitor (VMM), or hypervisor, which is at a lower level than the VM and supports VMs. There are two types of hypervisors, distinguished by whether there is another operating system between the hypervisor and the host. A Type 1 hypervisor executes directly on the machine hardware, and a Type 2 hypervisor operates on top of the host operating system.

A very different approach to implementing a VM environment is exemplified by the Java VM. The goal of a Java VM is to provide a runtime space for a set of Java code to run on any operating system staged on any hardware platform, without needing to make code changes to accommodate the different operating systems or hardware.

Data Management:

Users spend most of their time on mobile devices in apps, but the OS today has no visibility into the content users consume within them. OS is in a unique position to shoulder the responsibility of extracting behavioral analytics from a user's activity within her apps. There are proposals for behavioral analytics service (BAS) hosted entirely in the OS, which promises to work with zero- developer effort and which, at least from a design point of view, does not compromise user privacy. The BAS allows for scalable sharing of behavioral analytics data among apps, makes it easy for developers to personalize their apps, and helps emerging digital assistants to be- come truly "personal".

Cloud Operating System:

The term *cloud operating system* refers to a distributed operating system that is designed to run in the cloud service provider's datacenter and is used to manage high-performance servers, network, and storage resources and provide those services to cloud service users. In essence, the cloud OS is the software that implements IaaS.

It is important to note the distinction between a cloud OS and *Platform as a Service* (PaaS). PaaS is a platform for executing customer applications. PaaS enables the customer to deploy onto the cloud infrastructure customer-created or acquired applications. It provides useful software building blocks, plus a number of development tools, such as programming language tools, run-time environments, and other tools that assist in deploying new applications. In effect, PaaS is a user-visible operating system in the cloud. In contrast, a cloud OS is distinct from the operating system run by the cloud service user on cloud virtual machines. Because the provider provides an IaaS, the user's OS runs on the cloud infrastructure. The cloud OS man- ages the provision of these services and may provide some tools to the user but is otherwise transparent to the cloud service user.

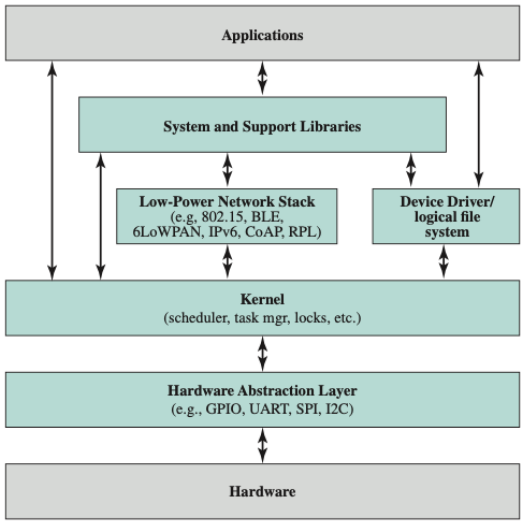
Infrastructure as a Service

IaaS represents the infrastructure layer composed mostly of virtualized environments providing computing, storage, and network resources. Hypervisors run a collection of virtual machines on real IT resources and provide virtualized versions of these resources to cloud service users. The users are free to install any OS and application environment they want on these virtualized resources. The provider is responsible for enabling access to the virtualized resources, provisioning the quantity of resources needed, and managing the resources. The CSC does not manage or control the under- lying cloud infrastructure but has control over operating systems, storage, deployed applications, and possibly limited control of select networking components (e.g., host firewalls).

Note IaaS is not simply another name for a virtualized environment. Although virtualization is a key enabling technology for cloud computing, it is only when the basic environment is extended to incorporate advanced management tools (for moving virtual machines, for monitoring and managing availability, recovery, lifecycle management, self-service, chargeback, etc.) that a virtualized environment becomes capable of satisfying the essential IaaS characteristics.

Operating Systems for IoTs:

IoT devices are embedded devices, and so have an embedded OS. However, the vast majority of IoT devices have very limited resources including limited RAM and ROM, low-power requirements, no memory management unit, and limited processor performance. Thus, while some embedded OSs, such as TinyOS, are appropriate for IoT devices, many are simply too big and require too many resources to be used. Another popular open-source IoT OS is RIOT.


Applications
System and Support Libraries
Low-Power Network Stack
(e.g., 802.15, BLE,
6LoWPAN, IPv6, CoAP, RPL)
Device Driver/
logical file
system
Kernel
(scheduler, task mgr, locks, etc.)
Hardware Abstraction Layer
(e.g., GPIO, UART, SPI, I2C)
Hardware

Computer Communication & Networks

Next-Generation Wireless Technology

Without a doubt, the biggest networking technology development of the 2020s is one that's going to be all around us very soon – the deployment of next-generation wireless networks. In the mobile networking arena, it's the 5G standard that's going to rewrite the rules of what's possible for technology on-the-go. It's these new cellular networks that are going to unleash the true potential of things like augmented reality and the IoT, as well as bringing us closer to a world filled with "smart everything".

Indoors, the wireless revolution's going to be led by Wi-Fi 6, the soon-to-go-mainstream standard that's making its way into devices right now. It will not only triple the theoretical maximum throughput of its immediate predecessor, but will deliver better indoor signal penetration and support greater device density. In a world where every electrical device is gaining networking capabilities, the effects of Wi-Fi 6 can't be overstated.

Internet traffic is increasing

As the COVID-19 pandemic was spreading globally and forcing governments to introduce hard lockdowns, people became more online-dependent —for work, school, communication and entertainment. This caused a massive surge in Internet traffic and raised concerns as to whether our network infrastructure could handle it.

At the very beginning of the pandemic in Europe, five major Spanish telecommunications operators, including Orange and Vodafone, warned that a roughly 40% spike in traffic had flooded IP networks together with a 50% jump in voice calls due to the rapid expansion of coronavirus. They urged users to use the Internet responsibly to avoid collapsing their networks.

The increased Internet traffic was slowing the networks' speed. In mid-February 2020, users in Spain, Italy and Germany, badly hit by the first wave of the pandemic, noted that the speed of their Internet connection had deteriorated. In March, Ookla, a company behind Speedtest—a tool for measuring Internet connection speed—said it had observed the same flagging speed in the US. Ookla had started tracking the COVID-19 impact on global internet performance.

Streaming services are indeed on the rise. According to the COVID-19 Global Internet Phenomena Report published by Sandivne in May 2020, video streaming is responsible for 57.64% of global Internet traffic—a 2.20% increase over the 2019 figure. During the worldwide stay-at-home orders, YouTube was the undisputed leader, commanding over 15% of global application traffic, while Netflix was responsible for

11%. To avoid network congestion, YouTube and Netflix, following appeals from UE officials, reduced their streaming quality.

Even if the Speedtest Global Index shows that Internet speed has now returned in most countries to pre-COVID-19 levels, Internet traffic is set to rise even more in 2021, as enterprises and consumers become more and more network-dependent.

SD-WAN Becoming Common

Over the course of the last decade, cloud providers, SaaS and IaaS solutions, and mobile computing have come to challenge the traditional notion of boundary-driven networking. In the past, corporate and other private networks were animated by the concept of fenced-off access using firewalls and other location-centric controls. Now, as business computing assets have started to spread to remote data centers and mobile systems, a new concept has emerged – software-defined wide area networks (SD-WAN).

This new paradigm in networking makes it possible to use a variety of network interconnections to create a private business LAN analog consisting of assets in the cloud, data centers, and branch offices that function like a single, seamless system. More than anything, this is made possible by continued improvements in WAN link bandwidth, which now allow geographically disbursed resources to move data at or near LAN speeds across vast distances. As the 2020s wear on, SD-WAN will come to replace traditional hardware-based onsite networking approaches.

UCaaS Displacing VoIP, OTT Messaging

One of the biggest results of the explosion of networking technology over the past 40 years is that it has revolutionized the way that we communicate. The internet began by displacing switched telephone networks as the primary means of real-time communication around the globe, and in the years since has spawned myriad ways for people to talk to one another.

The result has been a fragmented communications environment that networked systems often struggle to keep up with. Between traffic shaping and prioritization to support VoIP protocols and managing the traffic generated by innumerable over-the-top messaging platforms on computers, tablets, and smartphones, the lack of standardization has been tough to navigate. In the 2020s, though, a trend toward Unified Communications as a Service (UCaaS) solutions aims to reset the landscape and allow network hardware developers to move away from supporting multiple application-specific protocols and specifications.

Remote work becomes the standard

Growing Internet traffic and concerns about network infrastructure are affecting our everyday lives, but coronavirus also has a profound impact on our businesses. The main challenge the companies are facing

now is the need to work remotely. To make a smooth transition from on-site to remote work, an organization needs to have in place clear procedures, competent IT staff and proper networking technology. Here the technology itself plays a vital role, as it ensures the traffic in the company's network is properly secured.

VPN or Virtual Private Network has become a keyword. Unfortunately, not every company had used a VPN before the pandemic so many needed to make an effort to catch up. Even if a company had a properly configured VPN, most of its employees didn't use it, as they mostly worked onsite in the office. But with the pandemic scattering everyone into home-office mode, bandwidth suddenly became an issue. When the entire company moved online, it was hard to scale it up to cover the surge in traffic. In fact, the Sandvine's COVID-19 GlobalInternet Phenomena Report notes that VPN applications together with video conferencing applications (e.g. Zoom or WebEx) have driven Internet traffic growth during the pandemic.

Database Management Systems

Databases that bridge SQL/NoSQL

The latest trends in database products are those that don't simply embrace a single database structure. Instead, the databases bridge SQL and NoSQL, giving users the best capabilities offered by both. This includes products that allow users to access a NoSQL database in the same way as a relational database, for example.

Databases in the cloud/Platform as a Service

As developers continue pushing their enterprises to the cloud, organizations are carefully weighing the trade-offs associated with public versus private. Developers are also determining how to combine cloud services with existing applications and infrastructure. Providers of cloud service offer many options to database administrators. Making the move towards the cloud doesn't mean changing organizational priorities, but finding products and services that help your group meet its goals.

Automated management

Automating database management is another emerging trend. The set of such techniques and tools intend to simplify maintenance, patching, provisioning, updates and upgrades — even project workflow. However, the trend may have limited usefulness since database management frequently needs human intervention.

An increased focus on security

While not exactly a trend given the constant focus on data security, recent ongoing retail database breaches among US-based organizations show with ample clarity the importance for database administrators to work hand-in-hand with their IT security colleagues to ensure all enterprise data remains safe. Any organization that stores data is vulnerable. Database administrators must also work with the security team to eliminate potential internal weaknesses that could make data vulnerable. These could include issues related to network privileges, even hardware or software misconfigurations that could be misused, resulting in data leaks.

In-memory databases

Within the data warehousing community there are similar questions about columnar versus row-based relational tables; the rise of in-memory databases, the use of flash or solid-state disks (which also applies within transaction processing), clustered versus no-clustered solutions and so on.

Big Data

To be clear, big data does not necessarily mean lots of data. What it really refers to is the ability to process any type of data: what is typically referred to as semi-structured and unstructured data as well as structured data. Current thinking is that these will typically live alongside conventional solutions as separate technologies, at least in large organizations, but this will not always be the case.

Integrating Trends

Projects involving databases should not be viewed and appreciated solely on how they adhere to these trends. Ideally, each tool or process available should merge in some meaningful way with existing operations. It is important to look of these trends as items that can coincide: enhancing security and moving to the cloud coexist.

Professional Ethics

Environmental, social and governance

Environment, social and governance (ESG) issues are at the top of the agendas of companies and investors, and for good reason. A sufficient amount of funds is being allocated for ESG. ESG is also focusing on social issues, most notably equity and social justice. Organizations are setting goals for racial equality and inclusion.

Ethical culture and employee wellbeing

Ethical culture has always been important and was even more so in 2020, with remote working and disruption putting a strain on controls, training and in-person management. Employees have also been stretched on the home front. As a result, ethics and compliance teams have had to regroup and step in to address a full range of new concerns. Companies will also continue to conduct ethical culture surveys to identify risk areas and know how to prioritize training and other wellbeing activities. The coming year will also feature more virtual training and communications that are short, focused on key messages, and easy to access.

Data analytics and digital innovation

With compliance, investigations, and audit teams working remotely due to Covid-19, and with the uncertainty of when in-person compliance reviews and audits will resume, data analytics technology that continuously and remotely monitors 100% of spend for fraud, corruption, sanctions violations and conflicts of interest will be a priority for ethics and compliance professionals in 2021. Companies will continue to evaluate how data analytics technology can drive more efficient and more effective compliance reviews, investigations, and risk assessments.

Remote and hybrid working:

During the initial months of the pandemic, companies had to focus on business continuity, and many relaxed data protection policies to help employees quickly and efficiently shift to remote work. 2020 also saw an enormous increase in ransomware attacks as hackers took advantage of the disruption.

In 2021, it is time to make sure that data protection policies are updated for the hybrid remote/office workplace. Most important will be to build a culture of cybersecurity and data protection by helping the people to develop good habits regardless of where they are working.

Digital Systems Design

Field Programmable Gate Array (FPGA) based design has the following benefits:

- Performance

– exploiting hardware parallelism

– can do more per clock cycle

• Time to Market

– flexibility and rapid prototyping

capabilities

• Cost

– low cost compared to ASIC

– (But) higher compared to microprocessor

• Power

– Parallel operation with lower clock rates can reduce power

Some of the case studies to exploit these benefits are listed below: -

FPGA-Based Implementation in a Wireless Sensor Node for IoT Street Lighting Applications

Smart lighting systems based on the Digital Addressable Lighting Interface (DALI) protocol are the most suitable for street lighting systems, allowing digital lighting control operations. Unfortunately, the microcontrollers, which are commonly used in the Wireless Sensor Network nodes to control the lamps, do not implement this protocol. The DALI protocol implemented by software in the microcontroller consumes hardware resources (timers), processing time and requires a precise temporal analysis of the application, due to the strict bit times and the Manchester coding that it uses. The design of a bridge can be used to free the microcontroller from the implementation of the DALI protocol. The results of the synthesis show that a minimum amount of logical and routing resources would be used, that the power consumption is in the order of tens of mW, that it has a very small latency time and that it supports a high operating frequency, which allows adding new functions. Its operation can be verified by implementing a wireless sensor node using an FPGA.

Pipelined Implementation of Encryption-Decryption Algorithm up to 28 Gbit/s Real Throughput by Xilinx Zynq UltraScale+ MPSoC ZCU102 Platform

The security of communication and computer systems is an increasingly important issue, nowadays pervading all areas of human activity (e.g., credit cards, website encryption, medical data, etc.). Furthermore, the development of high-speed and light-weight implementations of the encryption

algorithms is fundamental to improve and widespread their application in low-cost, low-power and portable systems. A high-speed implementation of the AES-128 algorithm can be achieved for a short-range and high-frequency communication system, called Wireless Connector; a Xilinx ZCU102 Field Programmable Gate Array (FPGA) platform.

High-Level Synthesis Design for Stencil Computations on FPGA with High Bandwidth Memory

Due to performance and energy requirements, FPGA-based accelerators have become a promising solution for high-performance computations. Meanwhile, with the help of high-level synthesis (HLS) compilers, FPGA can be programmed using common programming languages such as C, C++, or OpenCL, thereby improving design efficiency and portability. Stencil computations are significant kernels in various scientific applications which can be implemented by considering both the spatial and temporal parallelism of the stencil kernel.

Mobile Application Development

The mobile app development industry is continuously evolving. Technology advancements, consumer demands, and a wide range of other factors have a direct impact on mobile app trends. Staying up to date with the latest trends is arguably the most crucial aspect of success in this space. As a member of the Forbes Technology Council, I'm constantly researching patterns and communicating with other tech leaders about gaining an edge. Mobile app resellers need to keep up with new trends to better serve their clients. The same goes for content creators and producers ready to take their brands to the next level with mobile development. Are you prepared for the mobile app development changes in the coming year? The list below is more than just a hunch or my personal opinion. I've used fact-based research to come up with the top app development trends that will dominate 2021.

Internet of Things (IoT) App Integration

The IoT is far from a new concept. But the rise in mobile penetration across a broad range of sectors and categories has created seemingly endless opportunities for the Internet of Things. People have grown accustomed to using technology to improve their everyday life. The IoT describes the growing network of devices connected to the Internet, providing convenience and automated control to consumers. Smart home technology is a perfect example of the rise in IoT and mobile app development. Mobile apps can be used to adjust the thermostat in a house from a remote location, lock or unlock a front door, and connect to home security systems. Refrigerators and other household appliances can also be connected to mobile apps. The global Internet of Things market is expected to reach $222 billion in 2021. $161 billion of that estimate will come from software, like mobile apps.

Apps for Foldable Devices

It feels like a lifetime ago, but one of my first cell phones was a flip phone. Phones have clearly changed over the last decade. Touch screens with one or no buttons have taken over the market. But over the last couple of years, foldable devices have begun making a comeback. 2019 saw the release of foldable devices like the Samsung Galaxy Fold, the Huawei Mate X, and the new Motorola Razr. These smartphones fold to compress or expand the screen size based on user preferences. For example, a user might make a call with the device closed, but watch a video on a larger screen by unfolding the device. From an app development perspective, resellers and content creators need to account for these devices when building or updating an app. The idea is that an app should seamlessly adjust its display as the screen folds or unfolds. Right now, foldable devices are just a sliver of the overall smartphone market share. But this will change in the coming years. According to a 2019 study by USA Today, 17% of iPhone users and 19% of

Android users are excited about buying a phone with a foldable design. According to Statista, roughly 3.2 million foldable phones were shipped in 2019. This forecast is expected to reach 50 million units by 2022. For that growth to happen, 2021 will be a big year for foldables, which means app developers must plan accordingly.

5G Technology

The rollout of 5G will have a major impact on 2021 app trends. For developers, resellers, and creators, this technology is poised to change the way apps are used and created. Take a look at the expected growth of 5G smartphone connections over the next four year.

Development for Wearable Devices

Wearable technology has been trending upward for years now as well. This isn't necessarily a breakthrough in the market. We've seen smartwatches, trackers, and fitness bands for a while now. But wearable devices have yet to reach their full potential.

Mobile Commerce

I can't make a list of 2021 app trends without mentioning mobile commerce. This trend has been dominating 2019, 2020, and will continue to thrive in 2021. It seems like everyone is leveraging mobile apps to increase revenue. From large retailers to individual content creators and personal brands, there is plenty of money to be made in this space.

Mobile ecommerce functionality is a top feature for mobile app resellers to showcase during client pitches. It seems like every day another business is launching an app to drive sales. We're not quite at this point yet, but we're almost reaching the age where you need a mobile commerce app to stay competitive. Every single person and business selling online is competing with giants like Amazon. To keep pace, you need to replicate what makes those brands so successful; an app is at the top of that list. By the end of 2021, more than 72.9% of total ecommerce sales will come from mobile devices. Apps play a significant role in the current and future success of mobile commerce.

System Programming

Linux: Ever since its invention, the Linux platform, provided its open-sourced character, has featured a huge selection of innovative minds that are determined to deliver world-changing thoughts in reality. Due to its wide developer user base, Linux has grown into one of the secure and well-known operating systems together with several different implementations.

Together with the evolution and progress in each technological age, Linux is also making significant advancements year annually. The professionals together with all the upgraded knowledge of their Linux tendencies and also a Linux certificate for its recognition of the abilities are considered more notable in this competitive age. Now, as we have stepped to 2021, it is the ideal time to check into the approaching Linux tendencies which are going to be understood in 2021.

As a tribute to the revolutionary platform, we have compiled a thorough list of those Linux tendencies that are likely to observe a increase in popularity in the upcoming year.

New Linux-based Hardware

The Linux platform was in highlights since Chromebooks and Rasberry Pi gained the attention of quite a particular domain of viewers. Given the minimum form factor and abilities to do regular tasks effortlessly, these Linux-based components are getting new ground as the days pass by. Linux also observed various advanced implementations throughout the prior calendar year, among which being the Purism Librem 5 --a fairly innovative spin on smartphones with privacy and information isolating being the only attention behind its production.

Taking a look at the new-found realm of viewers these innovative hardware options have resorted to, Linux will likely find various additional hardware devices to market during the course of the following calendar year.

With innovative alternatives like Samsungs' Linux on Dex being in the beta stage, this tendency of emerging and new Linux-based hardware is likely to continue through the following calendar year. Therefore, the tendency of creating and innovating with Linux inside the hardware area is going to be among those recent Linux trends this season.

Linux in Supercomputing

Since Sierra is defined to take its position as the second-fastest supercomputer using 125 petaflops of processing power, it's likely to spark substantial interest from the improvements inside the supercomputing field. Each supercomputer that now exists runs on some kind of Linux platform, and Sierra is no exception because it runs on Red Hats' Enterprise Linux (RHEL).

The development and installation of Linux-powered supercomputers is a fad that will not be resting anytime within the following calendar year. Given the flexible nature of the Linux system as well as the capacities it is embedded with, the tendency of Linux being used as the system for supercomputers is certain to continue to become among the significant Linux tendencies of 2021.

The Great Ubuntu Revival

After undergoing minor setbacks in popularity throughout the last ten years, Ubuntu is decided to make a significant comeback. It'll innovate and provide customers with a safe working environment. What started with Ubuntu 18.04 is bound to keep using the forthcoming 19.04 launch of this operating system that is due this April.

Ubuntu 19.04 innovates on its prior models on many distinct grounds making it one of the greatest Linux tendencies. A number of those planned inclusions for attributes include quicker Snap applications, easy integration with Android apparatus, fractional screen scaling service, multitasking alterations, plus a fresh installer for simplifying the Ubuntu operating system inside machines. In addition to that, another version of Ubuntu is forecast to experience various graphical adjustments to make it attractive and productive.

Accounting for those modifications and improvements which are intended for your operating platform, these amounts are sure to increase throughout the course of the following calendar year. Hence, considering all of the advice and the improvements which are intended for the operating platform, Ubuntu's excellent revival is going to be among the greatest Linux tendencies in 2021.

Linux and the Cloud

Although Linux is currently well-known in the technical community, it is going to continue to expand in popularity in line with the open-minded tendencies of 2021. Gartner says that 80 percent of those internally developed apps are using cloud computing or are cloud-native. Inside the cloud-based computing area, Linux is regarded as the most popular operating system that's used by businesses.

Given the interdependency between cloud-based technologies as well as the Linux system, the Linux system is thought to expand proportionally to the prevalence of cloud-based alternatives. Because cloud computing is virtually guaranteed to be the focus of growth throughout the following calendar year, Linux is becoming more popular as a stage too. This tendency is guaranteed to last during the following year and is sure to be among the greatest Linux tendencies of 2021.

Chrome OS and Chromebooks

Chrome OS has been becoming among the most flexible operating systems which are presently on the market. With the capability to supply consumers with one of the most bizarre web-centric adventures, Chrome OS lately gained the capacity to link to Google's Play Store and operate just about any Android

program. As customers we are adapting to the entire slew of attributes that opened to these, Google incorporated minor support for Linux-based programs and reported to be analyzing GPU service integration with these programs.

Considering that the improvements coming into this operating system's way, it is going to be on a quick rise towards possibly becoming the most flexible platform capable of running Linux and Android software. It's anticipated that at the end of this forthcoming year, Chrome OS will be amenable to running Linux applications natively in a secure state.

Since Chrome OS expands its viewers using all the Android user base and Linux-based customers, Chromebooks will unavoidably become popular by the conclusion of the following calendar year. This tendency of Chrome OS becoming better will make its way to become among those Linux tendencies that grace the following calendar year.

Wireless & Mobile Networks

Mobile Backhauling provides an interface between radio controller and base stations, mostly realized with a physical medium such as optical fibers or microwave radio links. With the huge mobile traffic due to an increase in mobile subscribers as well as deployment of 4G and 5G cellular network technologies, better solutions for capacity and coverage should be provided in order to enhance spectral efficiency. For 4G cellular networks, mobile backhaul networks deal with capacity, availability, deployment cost, and long-distance reaches. In addition, mobile backhaul networks based on the 5G network incurs additional challenges that include 1 ms or less ultralow latency time requirements and ultra-dense nature of the network capabilities. Therefore, for 5G technologies, latency delay, QoS, packet efficiency, noise suppression, and mitigation techniques, efficient modulation schemes, and packet network timing synchronization are some aspects that are to be dealt with while designing efficient backhaul approaches (wired/wireless). Current backhaul systems typically use cost-effective solutions (e.g, -Wi-Fi and WiMAX)-based packet-switched technologies, especially Ethernet/Internet technologies and high-speed optical fiber links. Following are the latest emerging trends in advance wireless and mobile networks.

Convergence of Control: Communications and Computing (3C), Localization, and Sensing (3CLS): However, evolution of enables a convergence of various functions such as control, communications, computing sensing, and localization. Example of jointly providing sensing function is 3D mapping of the radio environment across various frequencies supported to the subscribers. 6G built a multi-purpose system to deliver a number of 3CLS services for applications such as DLT, XR, and CRAS.

Cyber Robots and Autonomous Systems: The 6G system will offer large-scale deployment of autonomous systems, (e.g., unmanned aerial vehicles mail delivery systems, drones), network robots as well as application of self-driving cars.

New Smart City: Millions of sensors have been equipped into roads, houses, vehicles, buildings, factories, and other facilities to build a smart city. To complete data-oriented activities, 6G will be the reliable wireless high-speed communication which will support applications that will collaborate and integrate with each other.

High Speed Internet Access in the Air: Air network services have two modes: satellite transmission and ground base stations. In case of ground base station mode, the air network suffers issues such as Doppler frequency shift due to the rapid movement of the aircraft, large cross-border range, high maneuverability, frequent handovers, and narrow base station coverage.

Increased Bits, Increased spectrum, Higher Reliability: Most of the driving applications of 6G require higher bit rates than 5G. For applications such as XR (AR and VR) and brain computer interface (BCI), 6G will be able to support yet 1000 times increase in data rates with expected data rates of 1 Terabit/second.

Global Emergency Communication Rescue: It is expected that, by 2030, ubiquitous connectivity or huge seamless network coverage system in all regions such as deserts, blind spots, deeps seas will going to be the main functions of 6G networks. With integration of unmanned aerial networks, features such as wide coverage, flexible deployment, ultra-low power consumption, and high precision will be supported by 6G communication network.

Energy Efficiency and from Areal to Volumetric Spectral: Evolution regarding high spectral and energy efficiency (SEE) started from 2G (bps) to 3G (bps/Hz), then 4G (bps/Hz/m2) to 5G (bps/Hz/m/J). Therefore, an evolution towards XR/BCI devices occurs due to this 3D nature of 6G systems as well as 6G systems must provide SEE constraints which is measured in bps/Hz/m/J.

Emergence of Smart Surfaces and Environments: Utilization of environments for wireless communications incorporating smart large intelligent surfaces will carry forward the 6G architectural evolution. Cellular systems used base stations for transmission which are of various forms and sizes in current and existing scenarios.

XR Based on Holographic Communication: With evolution in 6G, potential trend can be noticed in development in AR/VR technology due to which freedom of users and their mobility (users will not be restricted by location) as well as holographic communication will be no longer be restricted by location and time.

Massive Availability of big data to Small Data: 6G systems must handle both small datasets as well as big data sets across their infrastructure to support new services and improve network functions. Various new machine learning tools will be developed due to this trend to go beyond big data analytics. Therefore, revolution in data will persist in the coming future and move from big data (centralized), small data (massively distributed).

Human Digital Twin: A digital twin is a virtual model or replicas of a products, processes, or any other physical devices and services in which sensors collects data which corresponds to physical asset. Due to the rapid growth in IoT, data analytics and AI digital twin technology has moved beyond manufacturing and provides enhanced network capacity.

From Self-Organizing Networks (SON) to Self-Sustaining Networks: SON has only been scarcely integrated into 4G/5G networks due to a lack of real-world need.

Wireless Tactile Network: The traditional Internet is only used for the interaction of data and information, but the tactile Internet will not only responsible for the remote transmission of information but will also contain remote control and response behavior that will correspond to the transmission of data and information.

End of the Smartphone span: In 6G, wearable devices incorporating applications such as BCI and XR will take place of Smartphones centered in 4G and 5G with enhanced functionalities. The new devices integrated with these applications will range from wearables to smart body implants and integrated headsets which can take signals from direct sensory inputs of human senses, results an end to smartphones and potentially driving a majority of 6G use cases.

Control Engineering

It has often been noted that not much has changed in the last few years in the way control engineers code PLCs, neither in coding for functionality nor for safety. But with the arrival of younger engineers with experience in technology and software, and the possibilities for using web and cloud-based tools, this may be on the verge of change.

As new ideas enter an old-fashioned discipline, they bring with them the advanced capabilities of a more computerized world. These capabilities are in fact aggressively working their way into industrial automation and industrial control systems. The spread of the 'Internet of Things' (IoT) concept and the 'Industrial Internet of Things' (IIoT) subset, has opened many new possibilities. Trends like the combination of traditional manufacturing practices with technology, such as Industry 4.0, and the creation of merged philosophies like DevOps– combining IT and OT functions–forcing the creation of the fully connected enterprise in traditional disciplines.

As industrial control systems become more connected, Systems Integrators are discovering the need to be open to new ideas and new methods:

Risk Assessment: Methodologies such as Hazard and Operability Analysis (HAZOP) can help identify potential hazards within a system. These hazards can be used in PLC coding to maximize safety based on systematic and documented risks.

Learning from Other Disciplines: System Integrators should include software considerations when considering the code needed as PLCs lend themselves more to software than electrical engineering. Taking lessons from the world of software engineers, an SI can build a safer system.

Choosing a process safety strategy, and implementing the solution, should follow some clear common-sense steps:

Follow a Methodology: Using a proven methodology forces programmers to work in repeatable and documented ways. The result will yield higher quality code and more predictable–and safer behaviour within the system.

Update Without Disruption: With a strongly enforced methodology in place, codes can easily be updated without "breaking" anything. Again, the result is a safer, repeatable process for updating code that doesn't disrupt the system with accidents or downtime.

Update Safely: Changes should be minimized, but to some extent they are inevitable. Traditionally, PLC coding has been "patch heavy", placing patches one upon another. Bad coding led to faults causing

downtime or waste, and in some cases, to safety incidents. Following established methodology for modular design allows isolated changes with a low chance of affecting other parts of the code.

Get the 'Big Picture': Another aspect is ensuring that programmers have a better understanding of the big picture. By allowing the programmer to face questions, answer them and even test them before getting to the site, helps to assure minimal changes onsite and make the change process quicker and safer.

Looking six years into the future for automation engineers, predicting the trends in 2020 will enlighten our next steps.

1. The Internet of things (IoT) now in full swing will enter a high-growth path by 2020. In a time when people and things are all connected by network, automation engineers and end users will care most about the stability and reliability of the industrial network. The intellectualization, collection, and detection of data will mostly be resolved. The harder part is the troubleshooting and reliability of the industrial network. If situations arise in the network, whether in the business network or in the network controlling production, the whole operation of the enterprise will confront difficulties and hinder decision making in real time because control engineers rely on the industrial network for assessment and indicators. The primary concern for engineers will be the stability and reliability of the networked automation.

2. Future automation engineers will no longer be limited to the field of production. Many automation projects, for example, will be implemented within the so-called Smart City. In transportation, buildings, and health care, future automation projects will have closer proximity to people's everyday lives. The engineers' expertise in automation will be applied in many non traditional fields. These innovations will drastically change people's lives, adding convenience. The automation system will become an important foundation for the future construction and operation of intellectualized and automated societies.

3. In new markets where changes are created continuously by new applications, the automated system and system integration will become a necessary part of the solution. The innovation and development of products and engineering services will become primary work for automation engineers. In some new applications, artificial intelligence will become the spotlight that reflects the core value of automation.

Artificial Intelligence

Artificial intelligence continues to be one of the new technology trends because it has significant effects on how we live, work and play. AI has already achieved success in image and speech recognition, navigation apps, smartphone personal assistants, ride-sharing apps and much more.

Companies are using AI to explore how they can use it to streamline their operations and to improve customer satisfaction. Google, Amazon and Microsoft provide platforms for developing AI applications.

Conversational AI

Conversational AI such as chatbots, virtual personal assistants, and virtual customer assistants are becoming the mainstream for businesses. With AI on the rise, organizations hope to expand their businesses effectively. The year 2021 is projected to be an energizing year as conversational AI proceeds to extensively boost client encounters.

Ethical AI

Ethical AI is chief among the list of emerging technology trends in 2021. But how do we define AI ethics and morals when it comes to machines and robots? This is one aspect computer scientists and AI engineers have been trying to figure out since the 1970s. AI ethics help determine right and wrong. In this case, it is the set of 'rules' or 'decision path' that is taken to determine AI's behavior.

The Fusion of AI and IoT (AIoT)

The Internet of Things has been a fast-growing area in recent years with market researcher Transforma Insights forecasting that the global IoT market will grow to 24.1 billion devices in 2030, generating $1.5 trillion in revenue. The use of AI/ML is increasingly intertwined with IoT. AI, machine learning and deep learning, for example, are already being employed to make IoT devices and services smarter and more secure. But the benefits flow both ways given that AI and ML require large volumes of data to operate successfully – exactly what networks of IoT sensors and devices provide. In an industrial setting, for example, IoT networks throughout a manufacturing plant can collect operational and performance data, which is then analyzed by AI systems to improve production system performance, boost efficiency and predict when machines will require maintenance.

AI in Cybersecurity

Artificial intelligence and machine learning technology is increasingly finding its way into cybersecurity systems for both corporate systems and home security. Developers of cybersecurity systems are in a never-ending race to update their technology to keep pace with constantly evolving threats from malware, ransomware, DDS attacks and more. AI and machine learning technology can be employed to

help identify threats, including variants of earlier threats. AI-powered cybersecurity tools also can collect data from a company's own transactional systems, communications networks, digital activity and websites, as well as from external public sources, and utilize AI algorithms to recognize patterns and identify threatening activity – such as detecting suspicious IP addresses and potential data breaches.

Quantum AI

Industry leaders in the quantum space such as IBM, Azure, Microsoft, and Google are making a breakthrough in 2021. While the opportunity in quantum computing seemed alluring, most organizations are willing to adopt quantum technology to solve multiple computational problems in various sectors like cloud security, finance, logistic, supply chain, and drug discovery.

The Growing Role of AI And Machine Learning In Hyper automation

Hyper automation, an IT mega-trend identified by market research firm Gartner, is the idea that most anything within an organization that can be automated – such as legacy business processes – should be automated. The pandemic has accelerated adoption of the concept, which is also known as "digital process automation" and "intelligent process automation." AI and machine learning are key components – and major drivers – of hyper automation (along with other technologies like robot process automation tools).

Internet-of-Things

Advancements in Edge Computing

The reduction in cost and the increased power of the devices used in the IoT makes it likely to use the enhanced computing power of the devices to process data collected on the edge and allow huge bandwidth profits. Besides, in many cases, it secures greater compliance with privacy laws.

5G Networks Across the Industries

5G networks in future will continue to be used across different industries around the world. This, in turn, will be a helpful factor prompting an increase in the number of IoT devices. The use of 5G will make it viable to control even a broader range of devices remotely via applications.

Together, IoT and 5G are setting infrastructure for smartphones and tablets, as well as wearables, medical devices, and vehicles. This evolution of a 5G-powered IoT system will fuel the development of the smart city, improve healthcare operational performance, and benefit the production industry.

Blockchain for IoT Security

Blockchain is one of the fundamental IoT technology trends as for today. The interchange of money and data between IoT devices in a secure way is becoming possible once the blockchain technology provides them with a mere infrastructure for doing so. Hence, the transactions performed on the blockchain are completely secured.

Blockchain technology has been applied by many financial & governmental organizations, entrepreneurs, customers, and manufacturers. This is one of the most famous IoT trends that will bring great variations in the field of technology and encourage its advanced application to build technical devices.

Augmented Reality (AR) and IoT

The bond between IoT and augmented reality (AR) keeps getting deeper. While IoT fills a gap between physical assets and digital infrastructure, AR drives digital components to real life. That's great teamwork. AR and IoT have a big future in healthcare. For example, surgeons can use an application composed to rebuild a body part in 3D along with devices measuring necessary stats in a real-time mode. All these could make complicated procedures easier for surgeons and more secure for patients.

IoT Security

Security stays a major matter for those developing and using IoT solutions today. It is visible that this will be an operation in which investment and the research of the required countermeasures will be a growing

trend this year and in the years to come. Many experts also witness how the use of blockchain could be a solution to gain higher security in the IoT.

IoT security will be a higher priority in order to create IoT based mobile app development safer and secure. By this year, the changes are the most expected thing to be made.

Global Connectivity

Despite the transmission technology used to gather data from sensors and then process them, solutions to promote processes of international or global reach such as asset tracking and management in food, manufacturing, or medical applications lack quick and always-on connectivity to assure consistency and process security. Something that network provider will have to deal with and resolve during the year that has just started.

Better Data Analytics

Increased selection of IoT solutions results in expanded data collection and transmission of all kinds of data. Better data analytics help to obtain essential and valuable insights.

Managing and analyzing this data serves the real added value that IoT can cause. Data analysis, Machine Learning, and Artificial Intelligence will hence play an increasingly significant and crucial role. These trends will not only provide effective processes to accomplish tasks but also support in making our lives easier and more convenient.

Prime focus Shift to Industrial IoT

The manufacturing industry has now recognized that predictive maintenance, energy, and resources management solutions are growing productivity, allowing greater optimization of devices and processes, diminishing operating costs, and enhancing operator safety.

With the center expense of using the technology falling, we may well see IoT being employed to resolve problems in farming, transport, telecommunication, and insurance.

The Popularity of Smart Home Devices

The growing grace of smart home devices using IoT is hard to refuse even by those who first rejected the technology of smart homes and later admitted them as a blessing.

The voice-recognition algorithms are now enough reliable and performing. So, the devices provided with voice user interface are spreading quickly, thanks to its affordable costs. Their common distribution serves an important operator in the selection of home automation and smart home solutions as these devices can become the access hub for loads of services suitable for any home environment

Unified Integration Framework

Lack of the unified IoT framework is something that IoT has faced as a challenge while interacting with the industries. To cause any project a success, it is important that the proper project management skills, systematic approach, and a great methodology are performed. For this, a basic shared platform to strategize plans and activities is needed by the companies.

The companies have received no central shared platform. All the IoT Trends we have mentioned before including a unified framework because this is the only way to keep the industries safe and secure.

Smart Cities to Become Mainstream

In the city environment, the services that people use can be significantly progressed, thanks to the IoT solutions now available on the market. Pioneer cities in this area are revealing how much value the Internet of Things is creating and many other cities are since following their example. Therefore, the smart city will surely become mainstream in future.

The integration of IoT with responsive cities will bring likable benefits for all. It will cover a track by providing ways for sustainable growth. It will also ensure reduced traffic obstruction and improved security within the city.

Healthcare Industry Enfolds IoT

Another interesting state of applying IoT devices is the digitization of healthcare. Healthcare devices well configured with IoT makes it more accessible to observe the health status of the patients. It as well helps doctors too.

With wearable devices, consultants can easily speak to patients and get doctors on your doorstep using some interactive mobile healthcare apps. Access to healthcare can be an easier and diverse process. The field of healthcare that encompasses IoT is highly encouraged.

Predictive Maintenance Boost Up by IoT

Another important among all the other IoT app trends in future, predictive maintenance will assist homeowners to know about the damages and leakages in their homes. This will prevent homes from disasters and aid in the maintenance of the same. IoT has not only reached its benchmark in the technological world but also has entered our house to fix our personal problems with smart solutions.

In the future, we would see home care offers as a contract service. They would take care of issues whether you are present or absent. Currently, various home insurance companies perform the services as they are conscious of the nature of smart sensors and various other connected devices that are affected by IoT trends.

Energy and Resource Management

Energy and resource management would also be affected by adding IoT. Energy management is reliable on the knowledge of the value of consumption. Integrating products and devices with IoT technology trends would benefit from saving energy and resources by notifying the consumption of data and its usage hours.

This would make the life of people more carefree and comfortable. Push-notifications can be attached for sending notifications with the smartphones when the energy threshold will exceed.

Cloud Computing

Data protection is going to be one of the most essential security trends. To have a device that is already a connection to the internet can be harmful in many ways, and the use of spyware can instantly get your personal information.

Infrastructures for smart homes, autonomous vehicles, and wearable devices are going to have the record of the hackers, robbers, etc. Also, private data is also sold for many purposes, and this is where cloud computing can serve to build up the future of IoT.

Cloud and Distributed Computing

The Rise of Containers

A container is a virtual software environment for running applications. Containers are the backbone of many cloud computing systems. Containers offer an effective way to distribute computing resources. Cloud systems that use containers are also easy to scale through the addition of additional containers.

According to 451 Research, the container market is set to achieve market worth of $2.7 billion this year. A survey by Cloud Foundry further confirms this trend, stating that 53% of surveyed companies are in the process of integrating containers in their tech stack.

Kubernetes is by far the most popular container solution on the market. What initially started as a Google project in 2014 grew to become the leading platform for container orchestration. Kubernetes is an example of Infrastructure-as-a-service (IaaS).

Serverless Computing

The basic building block of a computer network is the server. And since running a businesses without a computer network is impossible, companies had no other choice to rent or purchase servers to host their data and applications.

The problem with servers is that you can rarely tell in advance how much power and space you will need, and for how long. You could end up spending a hefty sum upfront, only to find out you're using 50% of its computing power.

Enter serverless computing. This new cloud computing service model eschews paying for servers on per unit basis. Instead, serverless computing providers offer a pay-as-you-go model for renting servers. Serverless computing is another trend towards increasing decentralization of IT infrastructure.

Hybrid Clouds

As cloud computing proliferates, we will see more and more enterprises starting to develop cloud infrastructure for internal use. Such clouds can be built on top of existing networks and resources. While setting up a private cloud can be a complex endeavor the benefits in terms of scaling, flexibility, and data safety make it a worthwhile choice.

Some companies are taking things a step further and adopting a hybrid cloud approach. In addition to using internal cloud networks, these companies are utilizing public cloud infrastructure as well. Such hybrid solutions allow companies to fully harness the power of the cloud.

Hybrid clouds are a sign that companies are looking for ways to prevent vendor lock-in. Relying on a single cloud provider is akin to putting all your eggs in a single basket, and hybrid clouds represent a way to avoid this.

Edge Computing

The main advantage of cloud computing over centralized computer networks is its distributed nature. Instead of relying on a single hub for computation, cloud networks are divided into nodes with a certain geographic distribution. The edges of such networks are used as an entry point for users wanting to interact with the cloud. This is edge computing.

Cloud providers are increasingly working on developing edge computing in an effort to give users data and computing power through a low-latency connection. Cloud devices located on the edge have their own computing, storage, and network modules. These devices operate as the gathering spot for processing information from other parts of the network. This information is then sent to the nearest data center based on pre-defined protocols.

Cloud for Mobile

The transition to a mobile-first environment has affected cloud computing as well. Mobile cloud computing is a model for developing applications for portable devices such as smartphones and tablets.

According to this model, on the user side of the application there is a light-weight client interface used for presenting data and querying inputs. As for the actual computation, it is performed entirely on the cloud. This allows for the development of feature-rich mobile apps that can run on any kind of device thanks to the cloud.

While mobile cloud computing is on the rise, there are still some pending issues. One of them is security, as mobile devices are notoriously prone to hacking attacks.

Cloud AI

The cloud is a natural environment for artificial intelligence. AIs hosted on the cloud gain direct access to massive amounts of data, which enables them to optimize their core competencies via machine learning.

AI is also being used to solve cloud-related problems. From determining trends in power usage in server clusters, to finding patterns of network failure, AIs are essential for the continued development of cloud infrastructure.

Conversely, the distributed nature of cloud computing gives AI the ability to manage its resources more effectively, allowing for faster computation, and therefore faster learning.

Cyber-security Within the Cloud

Ever since the Capital One data breach last year there is growing interest and concern for cloud security. The case of Capital One has shown that when cloud credential management systems go haywire, disastrous consequences soon follow. This has prompted cyber security vendors to focus their efforts on cloud security.

A cloud is a system with many moving parts, which makes implementing security measures more difficult than in the case of conventional computer networks. The cloud has numerous points of entry by design, which unfortunately makes it more vulnerable to attacks from hackers.

Cloud providers such as Amazon are increasingly using AI to automate their security efforts. They are also simplifying cloud access interfaces to limit potential venues of attack.

Software Engineering

Low-Code/No-Code Platforms

Low-code/no-code will only continue to rise in popularity. The history of computing is building higher-level abstractions away from the zeroes and ones—from yesterday's assembly languages and compiled software to today's modern low-code/no-code solutions. Through these solutions, businesses can move forward in their digital transformation without a technical resource at every step.

Machine Learning Operations

Machine learning operations are needed to advance to at least a modicum of operational excellence. MLOps includes elements such as automated concept-drift detection (i.e., how does production data differ from the data used to train the model), real-time feedback on key model KPIs in production, and pre-built support for continually updating models based on production success and integration with AutoML.

User Experience Design

User experience design matters more than ever before. Across every industry, companies are reimagining their customer engagement models to better adjust to the disruption created by the pandemic. User-experience-led software design is critical for redesigning customer-facing products and services in ways that allow companies to retain and recapture business in today's all-digital environment.

Near-Perfect Digital Experiences

In the blink of an eye, providing near-perfect digital experiences went from a novelty to table stakes. As the number of applications skyrockets and cloud infrastructure becomes ubiquitous, front-end development takes center stage. Developers will take on skills and responsibilities that resemble operations to improve efficiency, accelerate remediation and bring massive improvements to the customer experience.

Native Mobile-Development Languages

I expect trendy native mobile-development languages (Kotlin, Swift) and programming languages focused on improving product speed, memory safety and parallelism (such as Rust) to have a promising future. This expectation is associated with the growing demands of users for app quality, personalization and speed.

A 'Shift Left' Approach To Security And Compliance

To date, security and compliance practices have been mainly reactive, as teams scramble to remediate security issues after creation. By employing a "shift left" approach, developers and security teams work

together to proactively identify security issues before cloud resources are deployed. This approach improves developer productivity and stops security and compliance risks before runtime.

Mobile-Responsive Design

I think it's safe to say that mobile-responsive design is on the rise and will remain that way for years to come. We all use our smartphones for shopping, connecting with friends and reading content online. All of this is dependent on intuitive mobile-friendly design. I suspect we will continue to see more emphasis on mobile development and a decrease in desktop optimization.

Continuous Integration And Delivery

I predict the rapid adoption of continuous integration and delivery as part of a larger shift towards DevOps so organizations can fail fast and drive rapid digital transformation. CI/CD involves continuous testing to identify and resolve bugs before they lead to downtime and the use of automated pipelines for technology deployments so teams can continuously deliver value to the end customer.

Code-As-A-Service

Code-as-a-service will speed the pace of leveraging platform-as-a-service and infrastructure-as-a-service—and thus cloud computing. CaaS will aid in the ever-growing need for universal development (unlike single platforms such as iOS or Android) and will also provide built-in artificial intelligence, machine learning, Internet of Things and blockchain modules, allowing developers easy access to these top in-demand technologies.

E-Commerce Cloud Integration

Cloud integration will become a higher priority for e-commerce. Some cloud-based e-commerce platforms have seen that failure to integrate with outside services will mean that business owners will migrate to more suitable storefronts. Users want to have access to as many options as possible to optimize their cloud platforms.

Project Management

Greater Reliance on Digital and Remote Teams

Project management, like other industries, is no longer strictly bound to the confines of a typical office. Due to a number of factors—including greater connectivity, changing corporate values, and the rise of the gig economy—digital and remote teams are more common today than ever before.

While the prevalence of remote work was already on the climb, the onset of the Coronavirus (COVID-19) pandemic forced an unprecedented shift. In an effort to protect workers and slow the spread of the virus, organizations across the globe have adopted new work-from-home policies that favor digital communication over face-to-face interaction. It is estimated that up to half of U.S. workers are now telecommuting and that this trend will likely continue even after the pandemic subsides, which will present unique challenges for project managers.

A Closer Connection Between Projects and Strategy

Traditionally, project management is an organizational tool used to work toward and achieve discrete goals, which might include the launching of a single product or service or the pursuit of a particular outcome. In this sense, a project is a temporary endeavor with a finite start and end, and the role of the project manager is to shepherd the project through to successful completion.

In recent years, however, the role of project management in many organizations has begun to expand. Project management is more than just a tool for carrying out discrete goals; the framework is now also being applied to broader strategy and initiatives.

Project Management and Change Management

Each year, an organization can go through dozens—even hundreds—of organizational changes. These can range from small adjustments to internal processes to total overhauls of a company's products, services, supply chain, strategy, or structure. While this has always been true, the emergence of the novel coronavirus has forced many organizations to embrace substantial change initiatives while also completing previously existing projects.

Project managers are now frequently left managing not only their own projects, but the organization's change initiatives as well.

The Emergence of Hybrid Project Management Approaches

In the not-so-distant past, project managers—and even entire organizations—typically pursued all projects according to a single project management methodology. While the specific methodology

embraced may have varied among project managers or organizations, a reliance on a *single* framework was generally the norm.

In recent years, however, project managers, and the organizations they work for, have become increasingly adaptable in their approaches. Some have even merged different methodologies into hybrid approaches that are unique to the needs of their specific project or industry. The increased adoption of alternative project management methodologies such as Kanban, Agile, and Scrum have contributed to this shift, along with changing corporate values that allow for increased flexibility.

An Emphasis on Soft Skills

Project managers need a certain level of analytical and organizational skills in order to be effective in their roles, but a project manager's job does not end with the completion of project scope and budget documents. At the core of their work lies an understanding of people and how to manage them in a way that will yield the best results. For this reason, possessing an effective array of "soft skills" can be equally as important as possessing the hard skills that are typically associated with the discipline.

Effective project managers must be able to anticipate the needs of their team, understand their hopes and motivations, and identify and remove roadblocks before they impact the progress of a project.

The Impact of Artificial Intelligence and Data Analytics

As with virtually every other industry, project management will be impacted by the rise of artificial intelligence (AI), machine learning, and proliferation of data collection and analysis that has characterized much of the 21st century. Exactly what this impact will look like is difficult to predict with certainty. However, most experts agree that some degree of disruption is unavoidable, a fact which the Association for Project Management discusses at length in their "Projecting the Future" report.

One impact of artificial intelligence, for example, will likely be the automation of many administration-focused tasks that currently fall to project managers, including resource allocation, project balancing, and schedule and budget updates, among others. Another example might include the automation of resource allocation—a task that has long included varying amounts of automation.

Blockchain and Applications

Blockchain technology has to be one of the biggest innovations of the past decade – it has had a ripple effect on several important sectors, from manufacturing to Fintech and education. Blockchain tech is poised to transform the nature of transactions and trade across the world, as well as transform several online services we use. We have tried to take a look at the top emerging blockchain development trends in 2021. From stable coins to interoperability, here are the latest blockchain trends that we're likely see this year.

An Expected Rise of Federated Blockchains

Federated Blockchain is in fact one of the best blockchain trends in the industry today. It is nothing but only an upgraded form of the basic blockchain model, which makes it perfect for many specific use cases. The federated blockchain functions under different authorities instead of following a single secure, trusted node.

Experts are of the opinion that in 2021 there will be an increase in the usage of federated blockchain as it provides private blockchain – a more customizable outlook. Conceptually federated blockchain is are quite similar to private blockchain, with a few added features.

Unlike private blockchain, which is controlled by one organization, multiple authorities can control the pre-selected nodes of federated blockchain. This selected group from various nodes can validate the block in order to process the transactions further.

Stable Coins Are Going to Dominate the Crypto Space

Cryptocurrencies are possible because of blockchain technology. Cryptocurrencies like Bitcoin run on top of their own blockchain platforms. Many cryptocurrency prices are subject to volatility than traditional asset prices. Though stable coins are in their initial phase and it is predicted that by 2019-20 blockchain stable coins will achieve their all-time high. This high value of the stable coin will make them the second most looked forward emerging tech trends in the industry.

As the name suggests, these high valued stable coins are more steady and don't fluctuate that often, preventing uses from worrying about frequent currency crashes. This stability factor allows users to invest in more cryptocurrencies.

Microsoft and Amazon Using Blockchain as a Service (BaaS)

Another emerging blockchain trend is BaaS or Blockchain As A Service. BaaS is a new blockchain trend that is currently integrated with a number of enterprises as well as startups.

BaaS is a type of cloud-based service that enables users to develop their own digital products by working with blockchain. Most of these digital products are smart contracts or applications that can work without any setup requirements of the complete blockchain-based infrastructure. Microsoft and Amazon are few of the known companies developing a blockchain applications that provide BaaS service.

Blockchain is Expected to Transform Social Networking

Social networking has become an integral part of our daily lives. According to Statista, it was estimated that in 2019, there will be more than 2.77 billion social media users worldwide.

The introduction of blockchain in social media will be able to solve inherent problems related to privacy violations, notorious scandals, data control and content relevance. Hence the blending of blockchain in the social media domain is another emerging technology trend.

Implementation of blockchain in social media will ensure that all the published data in the social media domain remain untraceable and cannot be duplicated, even after its deletion. Moreover, users will get to store data more securely and maintain their ownership. Blockchain technology ensures that the power of content relevance lies in the hands of those who created it, instead of the platform owners – thus making users feel more secure.

Interoperability Among Blockchain Networks

Blockchain interoperability makes it convenient for users to transact from one blockchain network to others. In other words, blockchain interoperability is the ability to share data and other information across multiple blockchain systems as well as networks. This function makes it simple for the users to see and access the data across different blockchain networks. For example, users can send their data from one EOS blockchain to another specific Ethereum blockchain. This function also offers a range of diverse functionalities, for example, cross-chain transactions and also enhances multi-token transactions.

The Rise of Ricardian Contracts

A Ricardian contract is actually a human-readable legal agreement that is also agreed and signed upon by both the parties involved in the contract. Thereafter, it gets converted into a machine-readable contract that clearly defines the listed intentions of both the involved parties.

The flow of this Ricardian contract can easily automate the operations on various blockchain applications that are based on this technology. Ricardian contract can be stated as a smart contract and is both machines and human-readable.

Hybrid Blockchains

Hybrid blockchain is an emerging concept in the blockchain domain. It can be defined as the blockchain that attempts to use the most appropriate part of the public as well as private blockchain solutions. Hybrid

blockchain operates in a closed ecosystem, hence every piece of information on the network remains secure.

Transaction costs are said to be much lower in hybrid blockchains as the influential nodes in the network make the process simple and quick to verify transactions. Another added advantage being, it protects from more than 50% of attacks as hackers are unable to gain access to the blockchain network.

Content Streaming to be More Secure With Blockchain

Content Streaming is one of the emerging blockchain technology trends of 2021 that will be highly popular in the near future. Popular movie streaming services like Netflix and Hulu can incorporate blockchain technology to store user data in a more secure and easily accessible manner.

Video, music and social media streaming companies can also opt for blockchain technology that will enable third parties to not only read, but even write information on the respective blockchain. The Blockchain promises to offer smart-contract technology, providing numerous benefits for video content to be stored and shared under a heavily encrypted and secure system.

Covid 19 Will Continue to Accelerate Enterprise Blockchain Adoption

Every business has been affected by the lockdowns and restrictions triggered by the Covid-19 pandemic. One benefit of the pandemic has been that it has forced organizations to revamp their processes and digitize their operations in order to continue their day to day functions. Managers have realized the value of adopting technologies and integrating them in their operations earlier, rather than lag behind and be late. Organizations have recognized the need for security, smart contracts, instant auditability and trust. Blockchain technology will help deliver solutions which will establish trust and transparency. Organizations will continue to use blockchain databases and features in the solutions they create.

NFT's will Revolutionize Digital Assets & Digital Art

Non-Fungible Tokens are on the rise and quickly gaining popularity across games, digital asset exchanges and blockchain platforms. NFTs enable digital scarcity. Meaning a single copy of a unique digital asset can be stored within an NFT and can't be replicated. NFTs were originally popularized by the game Crypto Kitties but since then several digital art projects and startups have established themselves online. In game assets can be digitized and exchanged using NFTs. Digital rights management is another space which is set for disruption using non fungible tokens.

Blockchains Will Establish Secure Digital Identity

We leave extensive digital footprints when we transact across the internet. Digital identiy solutions will help secure our online presence and drastically reduce online fraud and identity theft. Blockchain technology stores data in a decentralized, trusted and immutable manner. Blockchains can ensure that a

user's single digital identity is stored in a secure and incorruptible manner. This single digital identity can always be up-to-date with the latest user information. Several digital identity solutions are being developed and integrated by online platforms. This trend is set to grow this year.

Network Security

Mobile networks, VPNs and Roaming Users

Firewalls are increasingly porous as employees access services from devices such as iPads, Android phones, tablets, and PCs—all of which require security that mirrors but also improves upon PC solutions. Extending connectivity to small branch or home offices is also a focus for many organizations. Your network strategy needs to consider how to secure access across platforms over an expanding network perimeter.

Targeted Attacks and APTs

APTs (or advanced persistent threats) represent the next generation of Internet crimeware. For years network security capabilities such as web filtering or IPS played a key part in identifying such attacks (mostly after the initial compromise). As attackers grow bolder and employ more evasive techniques, network security must integrate with other security services to detect attacks. We'll need to evolve security capabilities in response to these threats in the coming years.

Consumerization and BYOD

Consumerization and the BYOD (bring your own device) movement means consumer devices like iPads, iPhones and Android phones are moving onto the corporate network. To deal with consumerization, your security strategy needs to focus on network security for devices where an endpoint agent may not have been deployed, or may not be functioning properly. For example, if a user connects with a Mac running malicious code, your network security layer should be able to identify that the device is attempting to retrieve malicious code updates or other suspicious activities—and be able to identify and remediate it. Otherwise you may not find out until you're already infected, and remediation can only happen after the fact. Consumerization and BYOD increase the importance of alignment between your various security layers.

Web Application and Web Server Protection

The threat of attacks on web applications to extract data or to distribute malicious code persists. Cybercriminals distribute their malicious code via legitimate web servers they've compromised. But data-stealing attacks, many of which get the attention of media, are also a big threat. Organizations used to focus security investment on PCs and preventing conventional malware from spreading to them and onto the network. Now, you need a greater emphasis on protecting web servers and web applications. Similar challenges lie ahead for emerging technologies such as HTML5. See our article HTML5 and Security on the New Web for more information on this trend.

IPv6

Major surgery for the Internet IPv6 is the new Internet protocol replacing IPv4, long the backbone of our networks in general and the Internet at large. Protecting IPv6 is not just a question of porting IPv4 capabilities. While IPv6 is a wholesale replacement in making more IP addresses available, there are some very fundamental changes to the protocol which need to be considered in security policy. Whether your organization adopts it later rather than sooner, make sure that IPv6 is on your network security agenda. For more on IPv6, check out our article Why Switch to IPv6.

Contending with Cloud Services

Small, medium, and large enterprises are beginning to adopt cloud services and SaaS at a greater rate. This trend presents a big challenge for network security, as traffic can go around traditional points of inspection. Additionally, as the number of applications available in the cloud grows, policy controls for web applications and cloud services will also need to evolve. For example, which users should be able to interface with which services? Who should be able to post data, and who should have read-only privileges? While cloud services are developing their own security models, they will still need to be harmonized with your own strategy to avoid multiplication of password, permissions, and other security infrastructure concerns. To be sure, the cloud represents a great opportunity. But as the cloud evolves, so too must network security.

More Encryption

Encryption at every level protects the privacy and integrity of data. We're increasingly deploying encryption at every layer. However, more use of encryption will bring more challenges for network security devices. For example, how will your network DLP (data loss prevention) inspect traffic which is encrypted end-to-end as it accesses a certain cloud service? Collaboration between the network and the endpoint to deliver complete security in scenarios like this will be critical. You need to have a network security strategy that integrates your network security with other layers of security such as endpoint, web protection and mobile devices.

The Elastic Network

The network perimeter is expanding like an elastic to include high-speed 4G and LTE networks, wireless access points, branch offices, home offices, roaming users, cloud services, and third parties accessing your applications and data to perform services. These changes to the size, scope and surface of your network can lead to misconfiguration or change control errors that could lead to security breaches. You'll need security solutions you can consistently deploy at each device or point of infrastructure. And you need

central management to keep on top of the dynamics of this elastic infrastructure and the various layers of security at each endpoint.