CompTIA aitp Lehigh Valley Chapter Association of Information Technology Professionals

Critical Trends- A Perfect Storm and What it Means for IT Professionals

AITP Virtual Meeting

May 19, 2021

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CompTIA aitp Lehigh Valley Chapter
Association of Information Technology Professionals

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- Member Benefits Include
  - C-Level Presentations at Chapter Meetings
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2020 – 2021 A Perfect Storm of IT Change

What can you do to Manage the Changes?

AITP Meeting – May 19, 2020 – v1.0

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Goals for tonight's talk

- **Increase your awareness of some of the major recent changes**
- **Increase your awareness of some of challenges they created**
- **Increase your awareness of the amount of marketing & hype**
- **Provide you with ideas to help you cope with these changes**

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2020- 2021 was a year of Major Changes / Disrupters

- Covid-19 and Working From Home
- Big Data and Analytics
- Cloud Edge Computing & Multi-cloud solutions
- Robotics, Automation and RPA (Robotic Process Automation)
- IoT & Sensors
- Artificial Intelligence, Machine Learning, Deep Learning& Autonomous Vehicles
- 3D Printing
- 5G
- Quantum Computing
- Bitcoin & Blockchain
- Security, Hacks & , Deep Fakes
- Virtual & Augmented Reality
- And overlap and integration among the disrupters

There were so many significant changes in a such short time accompanied by marketing hype that if felt like a Storm of Change. A Perfect Storm of Change. Let's focus on the following changes:

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2020 – 2021 A Perfect Storm of IT Changes

Covid-19

Photo by Ray Harrington on Unsplash

AI & Machine Learning

Photo by NOAA on Unsplash

Security & Privacy

Photo by Brandon Molitwenik on Unsplash

Cloud Computing

Photo by Bethany Laird on Unsplash

Blockchain

Photo by Fábio Hanashiro on Unsplash

A perfect storm is an event in which a rare combination of circumstances drastically aggravates the event.

From: Wikipedia

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Before First Storm: IT and Work

- **Most everyone working at organization's locations**
- **Most apps running behind org firewall or in the Cloud**
- **IT Key activities**
  - Learning Containers and Kubernetes
  - Implementing Micro-Services
  - Migrating to Agile Development
  - Building and enhancing Web based applications
  - Piloting new technologies like Blockchain and Machine Learning
- **Organizations were continuing to migrate apps to the Cloud**
  - Migrate legacy apps to the Cloud
  - Building new apps in the Cloud
  - Replacing existing legacy apps with Cloud Apps

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First Storm: Covid-19 Changed IT and Work

- **Massive Healthcare Challenges like never seen before**
- **Globally Economies Start to Shut Down**
  - Business Closures
  - Job Losses
  - Companies ask workers to Work From Home (WFH)
  - Schools went to Remote Learning
- **IT Responded**
  - Flexibility and resilience Internet & World Wide Web services handled the load
  - Firewalls were beefed up and existing apps were modified to support WFH
  - Agile Development and Micro-Services enabled quick app development
  - New apps were developed to help manage the Pandemic
- **World-wide IT**
  - Saved Millions of Jobs
  - Saved Billions of $$$ of GDP by enabling Working Form Home

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After First Storm: IT and Work Challenges

- **Work is Changing – Maybe forever**
  - Many individuals and organizations expect to continue WFH
  - Automation is taking over existing jobs and new jobs are being created
- **How to get back to the Office / School?**
  - How to organize the workplace
  - Who comes in, who continues to WFH, and hybrid?
  - How do we handle security as employees & students work outside the corporate firewall
  - Working from home pluses and minuses
- **How to Handle Social Disparities?**
  - Not everyone has a computer, broadband access or a place to work / learn from home
- **New Tools are needed to support Working from Home and Hybrid Work**
  - Virtual Reality
  - Telepresence
  - PORTL – Holographic solution

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Before Second Storm: Cloud Computing

Cloud: Internet Accessible, IT Services, Elastic, Virtually Limitless, Self-provisioned and can be paid for Pay-As-You-Go

- **Went from a novelty in 2010 to a mature IT Production Tool by 2020**
- **Cloud vendors were working on:**
  - **Reducing Latency**
    - » Today Cloud Latency approx. 75 msec
    - » Goal < 10 msec latency – needed for numerous applications – like autonomous car, IoT, Sensors, Controllers and Cameras
    - » Need to handle 5G
  - **Faster Processing**
    - » Massive data analysis
    - » Machine Learning
  - **Increasing capacity to handle growth**
  - **Adding services**

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Second Storm: Cloud Computing Changes

- **Pace of changed increased dramatically as workers went to WFH**
  - Ex. Zoom In 4 months went from 10,000 to 300,000 meeting participants/day
- **Clouds – Moving processing closer to users with Edge Computing**
  - AWS Wavelength – Reduce latency via Cloudlets at telecom vendors 5G sites
- **Clouds – Providing specialized devices to speed up processing**
  - Graphic Processing Units (GPUs)
  - Custom Chips like Google TPU to speed up processing
- **Developing Multi-Cloud Solutions**
  - National Institute of Standards & Technology (NIST) is developing Cloud Federation Standards to make it easier to implement Multi-Cloud solutions
- **Cloud Vendors continue to develop new services**
  - Development Tools
  - Data analysis, Machine Learning, Specialized Data Bases & Hardware Security Monitoring and Management Tools

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After Second Storm: Cloud Computing Challenges

- **How to implement Edge Computing?**
  - When to use edge computing?
  - How to parallelize apps?
  - How to organize the data?
- **Multi-Cloud & Cloud Federations Issues**
  - Complete NIST's Cloud Federation Standards & APIs efforts
  - Cloud Vendors need to agree to the Multi-Cloud Standards
- **Power – How to make Cloud Computing Greener?**
- **Continue to Improve Cloud Security Issues – More Later**

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Before Third Storm: Artificial Intelligence (AI) & Machine Learning (ML)

- **Artificial Intelligence (AI)**
  - Research in computer-based intelligence began in 1950's
  - In 1980's Expert Systems were developed to mimic human experts using languages like LISP, Closure or Prolog
  - Mixed history – successes and failure – often narrowly focused successes
    - 1996 IBM's Deep Blue defeated reigning world chess champion, Garry Kasparov
    - 2011 IBM's Watson defeated Jeopardy! Champions, Brad Rutter & Ken Jennings
    - Japan's Fifth Generation Computer Project
    - AI not very good at General Intelligence
- **Machine Learning (ML) – Subset of Artificial Intelligence**
  - Uses Neural Nets to analyze data to determine underline patterns
  - Became viable as computer power increased
  - Requires large amounts of data often combining Public & Private Data from multiple sources
  - Lot of pilots underway in numerous areas

Cloud Computing made ML relatively inexpensive and accessible.

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Third Storm: AI & ML Changes

- **Around 2015 interest in AI and ML increased and so did successes**
- **AI & ML quickly went from pilot to production**
- **Everyone started doing AI / ML**
- **Many different models**
  - Statistical Models
  - Supervised & Unsupervised Learning and reinforcement feedback Learning
- **Numerous new use**
  - Autonomous vehicles
  - Genetics
  - Medical Diagnosis
  - Computer Vision
  - Many, many, many other areas
  - Pattern recognition
  - Analyzing X-Rays
  - Speech Recognition
  - Face Recognition

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After Third Storm: More AI & ML Challenges

- **How to handle enormous data and processing requirements?**
  - Thousands of specialized processors and Terabytes of often multi-cloud data
  - Power Requirements – ML uses enormous power – Goal Greener AI
- **How to handle Data and Privacy?**
  - How to setup data and how to handle Outliers?
  - Who owns and can use Personal Information; where to store it, and delete it per European Union (EU) General Data Protection Regulation (GDPR)?
- **How to operationalize and explain results?**
  - How do you test and validate models in an operational environment?
  - How do you explain results?– new area of Explainable AI
- **How to handle Unintentional and Intentional Bias?**
- **Deep / High-Quality Fakes**
  - It is getting easier to develop Deep Fakes which are so good they fool some experts
  - How do we handle Deep Fakes?
- **Ethical Issues**
- **Legal Liability Issues**
- **Social Acceptance**

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Third Storm: Example of AI & ML Challenges

- **Autonomous Vehicle Industry is Consoldating**
- **Autonomous Vehicles (AV) Ethical & Legal Challenges**
  - Ethical Challenge – Autonomous Vehicle suddenly determines situation where:
    - A) It can crash vehicle and potentially kill or injure driver and passengers
    - B) It can take evasive action and potentially kill or injure pedestrians or passengers in another vehicle
    - Which action should it take: A or B
  - Legal Challenge – who would be responsible for damages

- **Autonomous Vehicle Social Acceptance Challenges**
  - There is no national standard like FAA or FDA for Autonomous Vehicles
  - Most vendors are looking at self-certification
  - Vendor's goal: Vehicle must be at least as good as the average human driver
  - In US that would mean: 36,500 auto deaths in 2019 or 100 deaths per day

Is 100 deaths per day by Autonomous Vehicles acceptable?
How about 50 per day? Or 25 per day?

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Before Fourth Storm: Blockchain

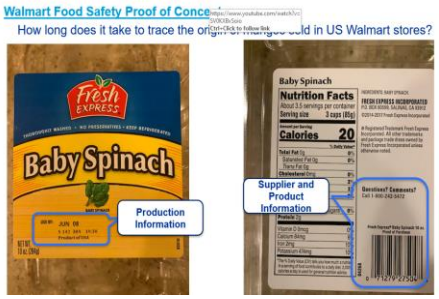
Blockchain History

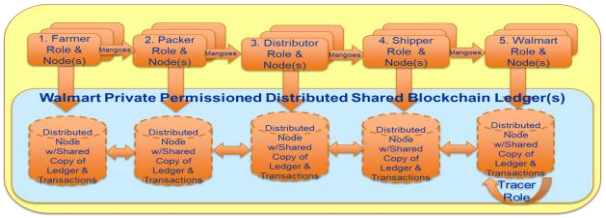
- Blockchain concept developed by Satoshi Nakamoto in 2008
- In 2009, Satoshi announced first implementation of Blockchain – Bitcoin, the first cryptocurrency implemented using Blockchain Technology
- Includes Smart Contracts – Automated transactions
- **Key Takeaway – Blockchain is not Bitcoin**
- **Key Takeaway – Bitcoin is just one Use-Case of Blockchain**
- **Cryptocurrencies are Speculative Devices (like Gold) not Currencies**

Blockchain Pilots

Ex. Walmart / IBM Food Safety Blockchain Pilot
Goal: Trace products from grower to consumer

- Traditional DB Pilot in early 2000's failed
- Manual approach takes 7 days
- 2017 Blockchain Pilot took 2.2 seconds
  (But used different tools than Traditional pilot)





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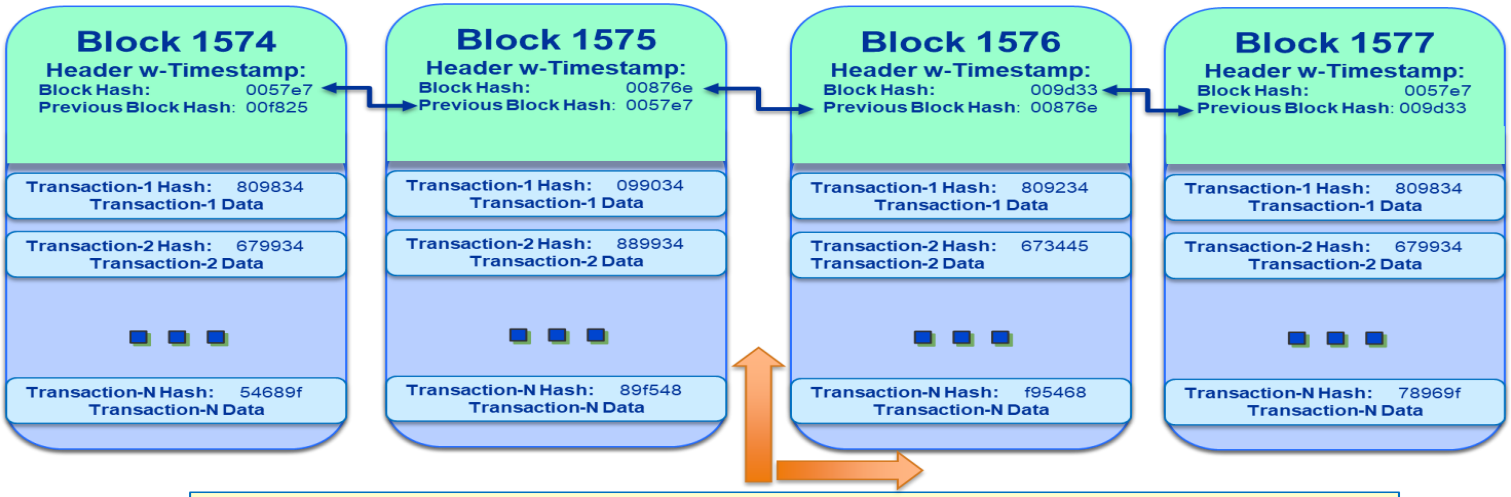
Fourth Storm: Blockchain Changes

- **Bitcoin made the news! As the price of Bitcoin went up and down, there were stories of cryptocurrencies fortunes made / lost**
- **Countless videos and articles describing the "magic" of blockchain**
- **Blockchain became Mainstream by 2020 – Pilot to Production**
- **Articles describing Blockchain generally do so in glowing terms:**
- **The implementation details are often another story**



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After Fourth Storm: Blockchain Challenges

- **When should you use Blockchain? Blockchain Strengths?**
  - Prevenance – keep track of history of a series of events
  - Security – Cryptographic techniques & Open Source
  - Trust among untrusted parties – 3rd party not available or too costly
  - Distributed for redundancy
- **How to integrate with real world objects?**
- **How do you test Smart Contracts?**
- **How to validate "identities" and transactions?**
- **How to speed up? Extremely Slow (5 TPS vs. Visa 1,700)?**
- **How to handle network propagation delays? Approx. 14sec**
- **How to manage enormous power requirements?**
- **How to protect from Hackers? – Had to fix Heartbleed Vulnerability**
- **Decentralized? – 5 Mining pools control 50% of Bitcoin**
- **"Experts" will install (whether it is a good fit or not for $$$$)**
- **Overhyped – 5% of CIOs felt that Blockchain was a game changer**

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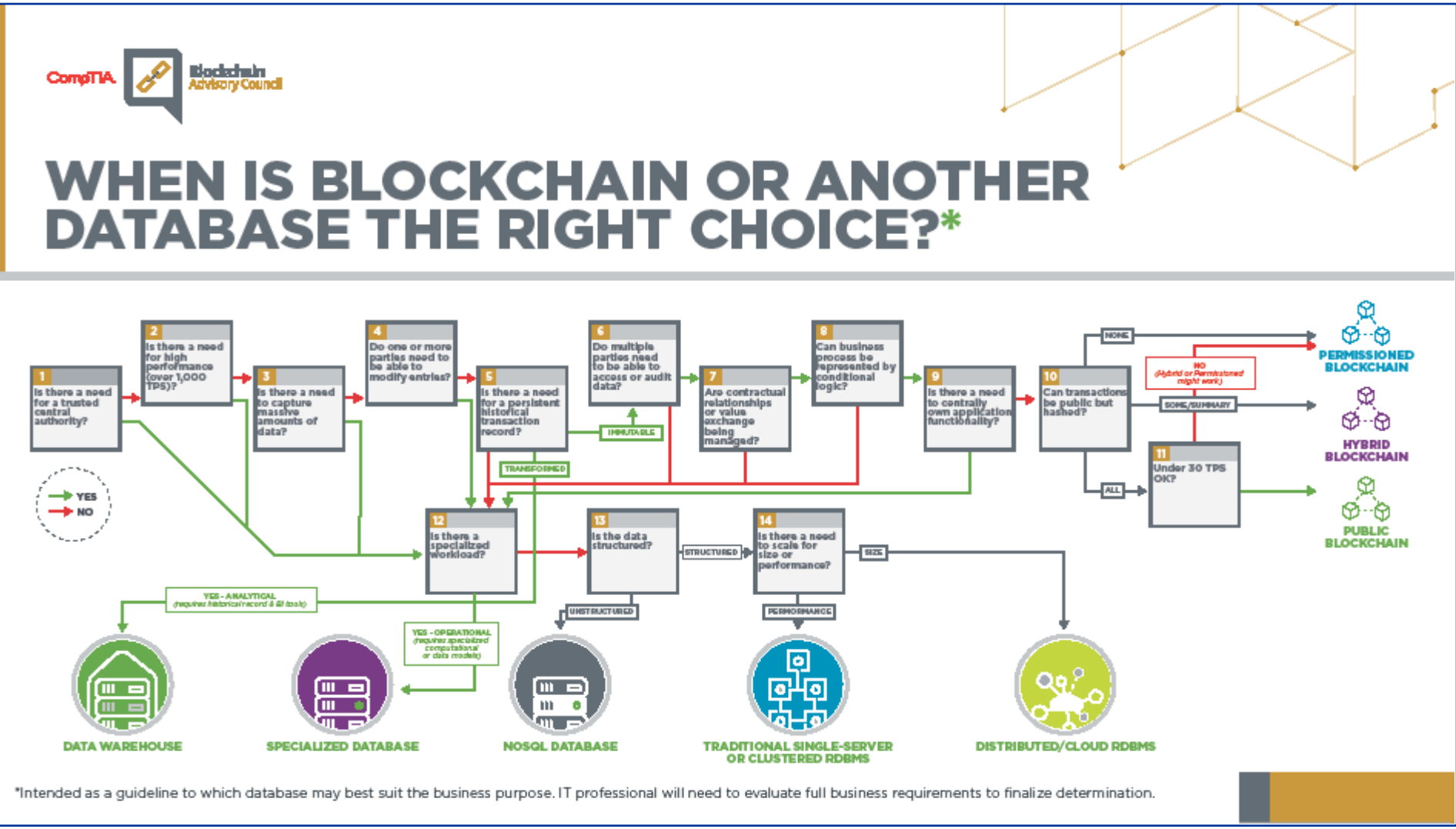
After Fourth Storm: Should you use a Blockchain?

- **There are multiple decision tables available like this one.**



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Before Fifth Storm: Security & Privacy

We have had security issues in the past

- **Security hacks**
- **Ransomware attacks**
- **Denial of Service Attacks using the Cloud**
- **Well known Security Hacks**
  - Yahoo – 2012-13
  - Target – 2013
  - eBay – 2014
  - Equifax – 2017
  - City of Atlanta - 2018
  - Note: Hackers reselling pirated goods on the Dark Web
    Hacked data from years ago may be used by hackers today!

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Fifth Storm: Security & Privacy Changes

- **Global Hacking increased dramatically**
- **State Sponsored Hacking – North Korea, China, Russia, and others**
- **Hacking Factories – India & Other Countries**
- **3rd Party Supply Chain Attacks**
- **Some of the 2020 – 2021 Security Hacks:**
  - 715% increase in Ransomware Attacks

    Source: Bitdefender Mid-Year Threat Landscape Report 2020
  - Solar Wind – US Gov. through 3rd Party – Damage still unknown
  - Outlook Exchange – Unmaintained servers – Damage unknown
  - IoT Cameras – 150,000 unsecured cameras hacked – including Tesla
  - State Unemployment Systems – US wide – 1 Million affected in Illinois alone
  - Sina Weibo – Chinese Facebook March 2020, Impact: 538 million account
  - Apple – through 3rd Party Quanta –$50 Million Ransom for Design Docs
  - Colonial Pipeline Ransomware – stopped gas shipments to the US East Coast

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After Fifth Storm: Security & Privacy Challenges

- **Threats are Changing**
  - Insider Threats / Risks
  - Open-Source or Private Code
  - Data Privacy and EU GDRP and how to obfuscating key data elements
  - Once hacked, data is easily portable
  - Rapidly changing and varied regulations
  - Gaps in Policy-Practice
- **Security Models are Changing**
  - Moving from “Trust but verify” to “Zero Trust” – Trust no one
  - Privacy by Design?
- **Quantum Threat**
  - Quantum computers may be able to “quickly” factor public/private keys
  - If true, a state sponsored quantum computer could in the future make existing public / private key techniques vulnerable
  - To handle Quantum Threat new cryptographic techniques are being designed

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2021 and Beyond

Arthur C. Clark once wrote:

"Any sufficiently advanced technology is indistinguishable from magic".

- **Changes we discussed are not "magic", but may feel that way**
- **Changes will continue, potentially at an accelerating pace**
- **New changes will emerge**
- **Marketing & hype will continue and accelerate**
- **Many key individuals will not understand changes, but need to:**
  - Business Leaders & Managers
  - Legislators
  - Regulators

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What can IT Professionals Do?

- Question Everything – If it sounds too good to be true, maybe it isn't!
- Constant be learning – Keep yourself & your career relevant
- Be agile and flexible and follow you own style
- Educate Yourself Broadly but Shallow in many, many areas
  … and go Narrow and Deep when needed
- Delegate to others – you can't learn / know everything
- Give your team time to learn
- Where possible work with Universities and Researchers
- Split work across groups so that they solve problems together
- Offer to give a presentation on something you don't know & do research
- Learn how to educate others so that they ask right questions
  - Business Leaders
  - Legislators
  - Regulators

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Another Perspective: Continuing to Learn in a World of Change

From Michael Milutis's talk at 15th Regional Symposium by PMI Singapore Chapter

Michael works for Computer Aid and is Director of THE GREAT IT PROFESSIONAL – a great IT Education Site

1. **Own your Own Career**
   - Be Pro-active not Re-active
   - Create a Vision & Brand of you – your Brand is more important than resume
   - Think: What do you want to be known for?
   - Learn continuously and Network strategically
   - Be Agile – Your Goals will change & that's OK
2. **Start Where You Are**
   - Know your industry, your market and your competitors
   - Think "Business Value"
3. **Focus on Soft Skills and EQ – Become More Human**
   - Humans have EQ - Emotional Intelligence – AI does not do this today and may not for years
   - Humans are Multi-domain Experts – AI & ML are not
4. **Become a Continuous Learner – 20-minute learning segments**
   - Learn to delegate – you can't be an expert in all things
   - How much do you need to know – enough be fluent and ask good questions
   - Know enough and know when you need to know – you need to know enough be provide value
   - Use Online sources – ex. YouTube, Google, Wikipedia, and others – Google Scholar

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Takeaways, Questions, Ideas???

- **Increased your awareness of some of the major recent changes**
- **Increased your awareness of some of challenges they created**
- **Increased your awareness of the amount of marketing & hype**
- **Provided you with ideas to help you cope with these changes**

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For More Information: Some References

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What can you do to Manage the Changes?

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Extra Slides

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What is Blockchain?

- **Secure tamper evident and tamper resistant distributed digital ledger implemented without a central repository (or authority)**
  - Ledger – append only
  - Secure – using cryptographic techniques to provide evidence of tampering
  - Shared – among multiple users
  - Distributed – making it difficult (not impossible) for bad actors to attach
- **Provenance – provides a proven history of transactions**
- **Come in two main flavors**
  - Permissionless – Ex. Bitcoin & other cryptocurrency – unrestricted user access
  - Permissioned – typical business blockchains – restricted user access
- **Implemented through use of complex cryptographic technology**
  - Hashing mechanism
  - Public / Private Keys
  - Encryption
  - Validation mechanisms – ex. Bitcoin Proof-Of-Work

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Bitcoin Challenges

- **Bitcoin Validation (Proof-of-Work) requires enormous processing**
  - Peer-2-Peer Network of 10,000 Miners – most in China near cheap energy
  - Specialized ASIC hardware
  - Slow – 4.6 transactions per second vs. Visa avg of 1,700 TPS
  - Long Latency – Bitcoin Proof-of-Work Validation long propagation time – 14+ sec
  - Large distributed 330GB – Updating at 1 MB Block every 10 minutes
- **Expensive but potentially lucrative to become a Miner (Validate Blocks)**
  - 6.25 new Bitcoins added with every Block added ever 10 minutes
  - Miner Reward 6.25 Bitcoins @BTC $50,263 as of 4/24/21 =$314,143
  - Reward haves every 4 years to keep Bitcoin hashing rate approx. constant
- **Can't control Supply – Maximum number of Bitcoins set at 21 million**
- **Bitcoin is Volatile**
  - $28,990 as of Dec. 31, 2020, and $48,881 as of Apr. 24, 2021
  - Down 25% in 5 days last week while the US $ stayed the same
- **Bitcoin's volatility & fixed supply means not useful as reserve currency**
- **New Use-Case: NFTs & Collectibles – Similar to Bitcoin**
  - NFT stands for Non-Fungible Token – Fractional Ownership
  - Like Bitcoin – great for speculation

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NFTs & Collectibles – New Use Case

- **Like Crypto-currency and Blockchain – great for speculation**
- **NFT stands for Non-Fungible Token – Fractional Ownership**
  - If something is non-fungible it means it has unique properties so it cannot be interchanged with something else
  - It could be a house, or a painting such as the Mona Lisa,
- **NFTs are "one-of-a-kind" assets that have digital tokens in the digital world that can be bought and sold like any other piece of property, but they have no tangible form of their own.**
- **The digital tokens can be thought of as certificates of ownership or percentage of ownership for a virtual or physical assets like**
  - A Picture
  - Music portfolio
  - Property
  - Any collectable – fractional ownership
  - ….

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