Security and Privacy Considerations for Advancing Technology

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IEEE Advancing Technology for Humanity

All your kernel are belong to us...
CORNCON
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ISSA EDUCATION FOUNDATION

Who Am I?

DOCENT institute

security advisor alliance

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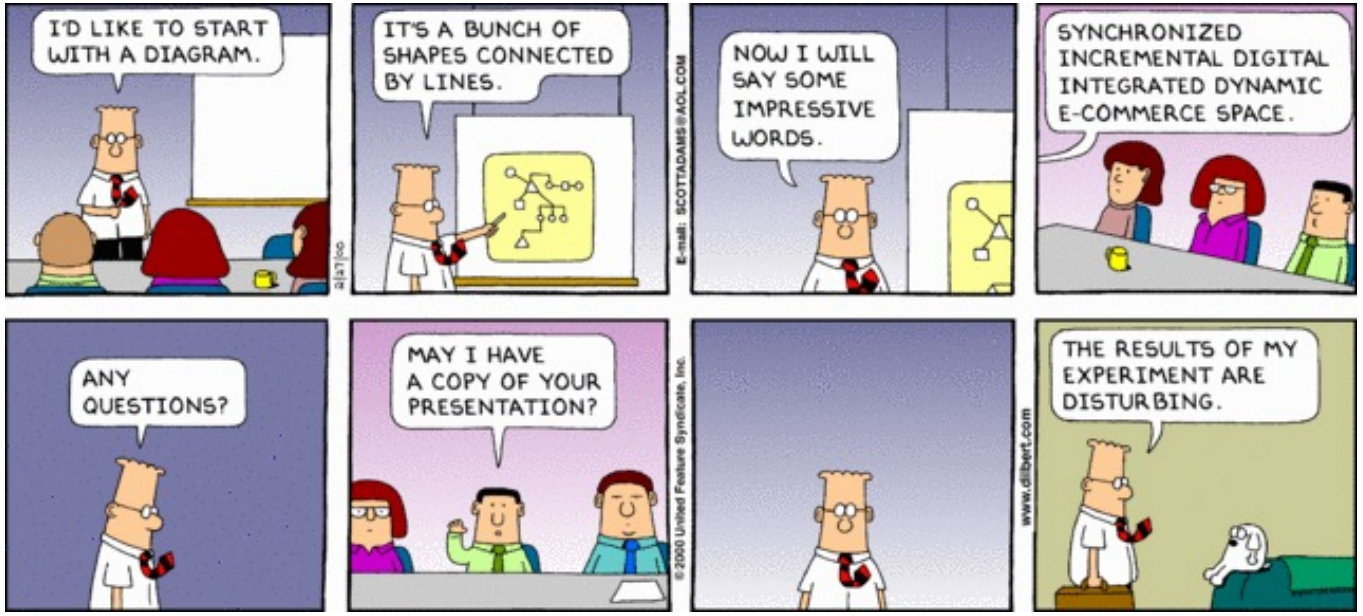
@johndjohnson

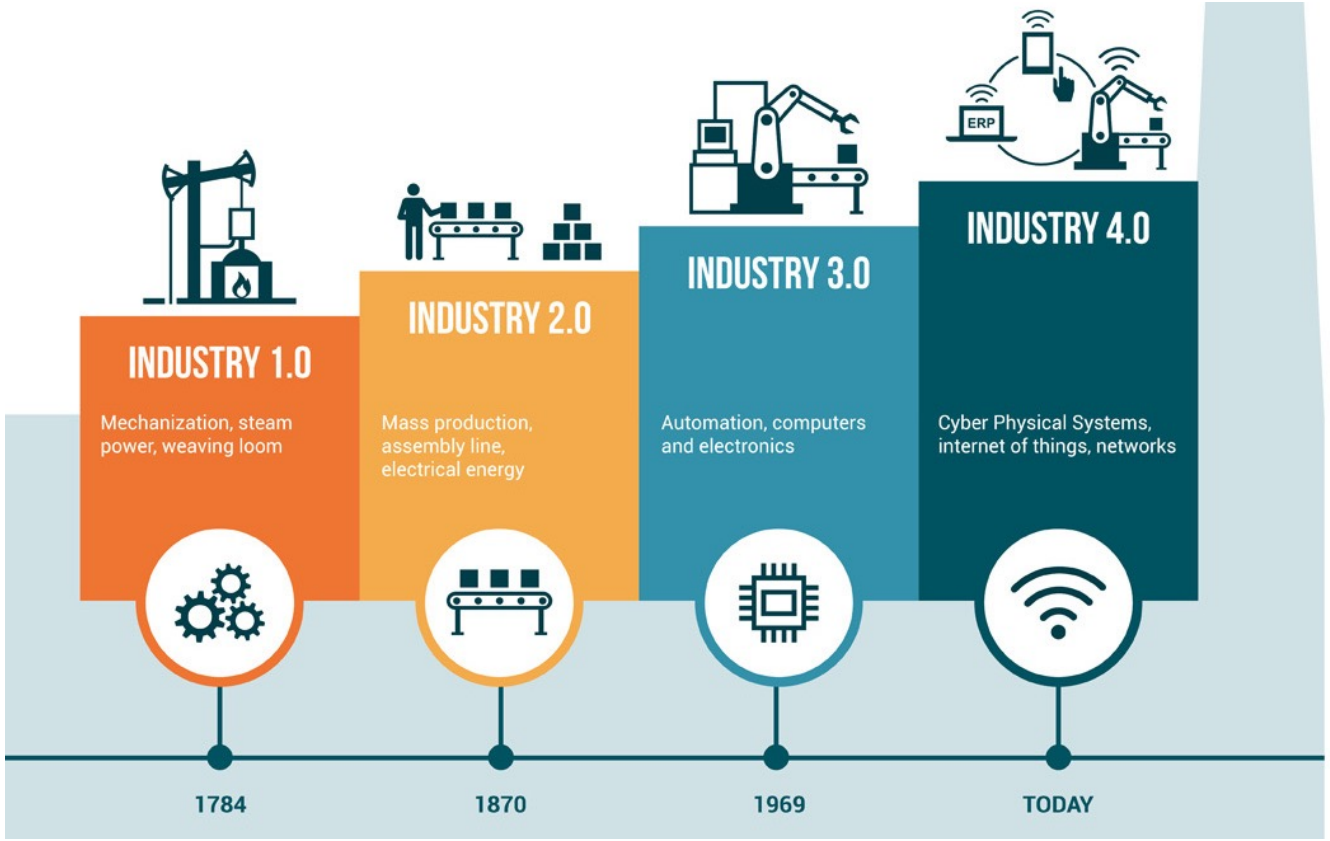
black hat DEFCON

RSA Conference

Preface

- I will try to avoid Death by PowerPoint. You all signed the disclaimer when you registered?
- I'm sure that you will look back afterwards and wonder how we covered 467 slides so quickly!





A new industrial revolution

”In the next decade, we will experience more progress than in the past 100 years.”
- Peter Diamandis, Co-Founder of Singularity University

100 Years Ago

The first “selfie” taken in 1920


Mid-1900s
IBM
System 360

Advancing Technology – Today or near future

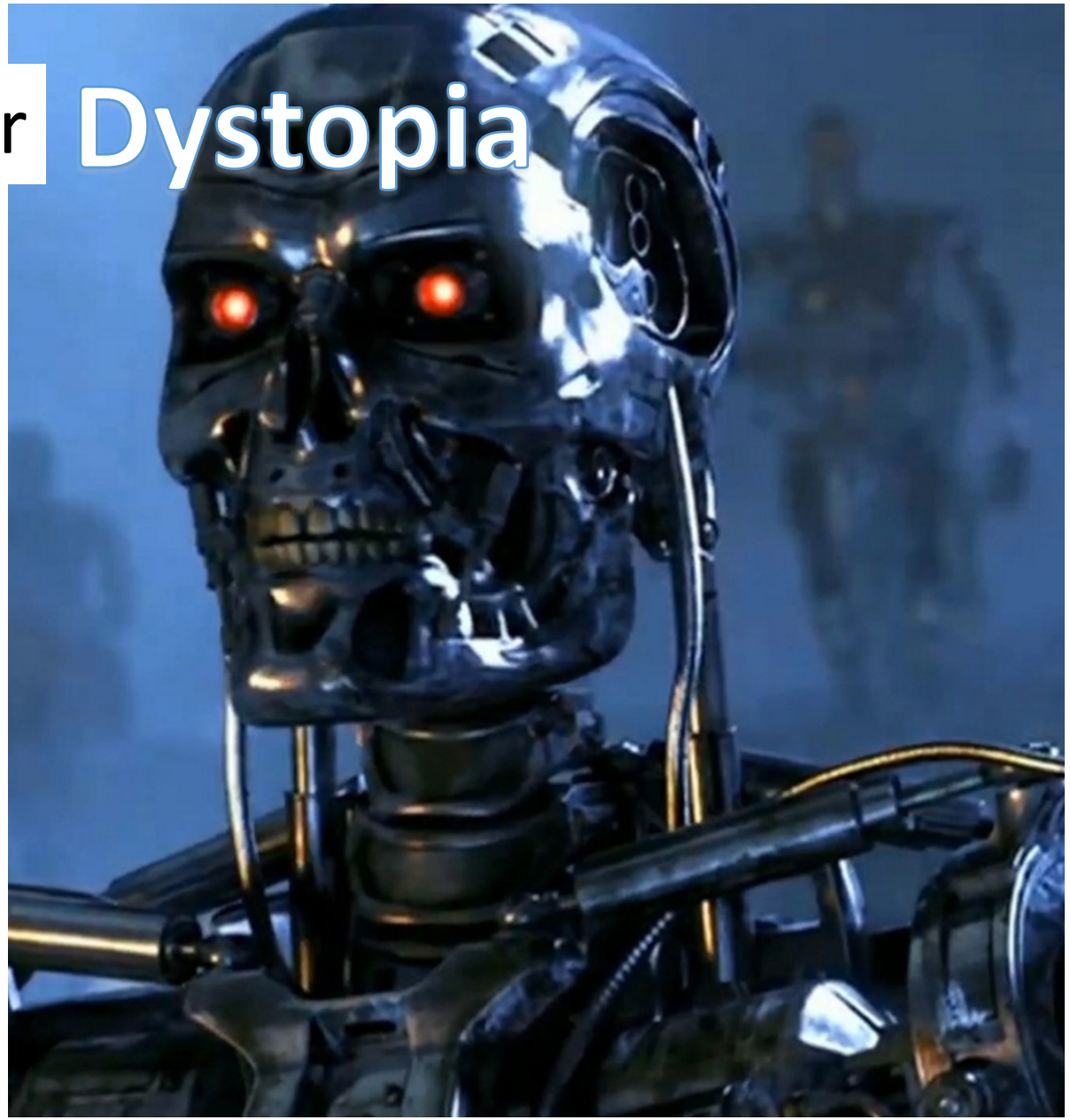
The pace of advancing technology is increasing

1. 5G – Faster communications
2. AI/ML – Machines can take over some human decision-making (e.g., cars)
3. VR/AR/Metaverse
4. Blockchain – Adds integrity and traceability and more with Web 3.0
5. Smart Things- IoT, Industrial IoT, Industrial Control Systems, Sensors
6. Distributed computing
    1. Fog: *push cloud computing to the edge (decentralize)*
    2. Mist: *push analytics & decision making to edge device*
    3. Rain: *computing is fully distributed, resilient and scalable, and integrated into the world around us*
7. Ubiquitous computing; Serverless Computing
8. Quantum computing & entanglement (cryptography)
9. 3-D Printing; Additive Manufacturing
10. Robotics/Automation (RPA)

Disclaimer: John's wild guesses may have involved alcohol and a dart board.

Will the future bring…

Utopia or Dystopia

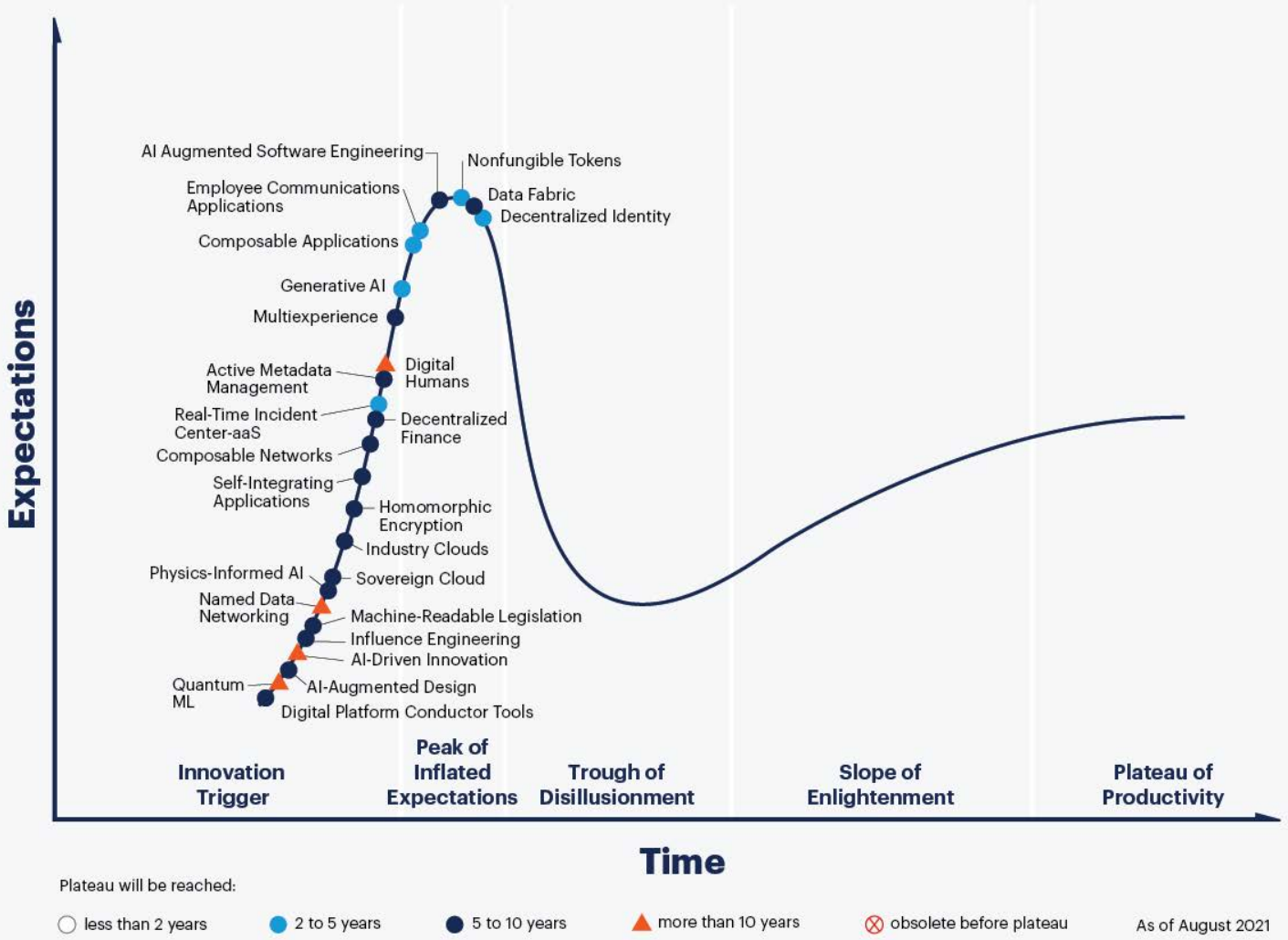


It is up to us to use technology ethically and to consider security & privacy.

Technology Trends

What are the advanced technology trends?

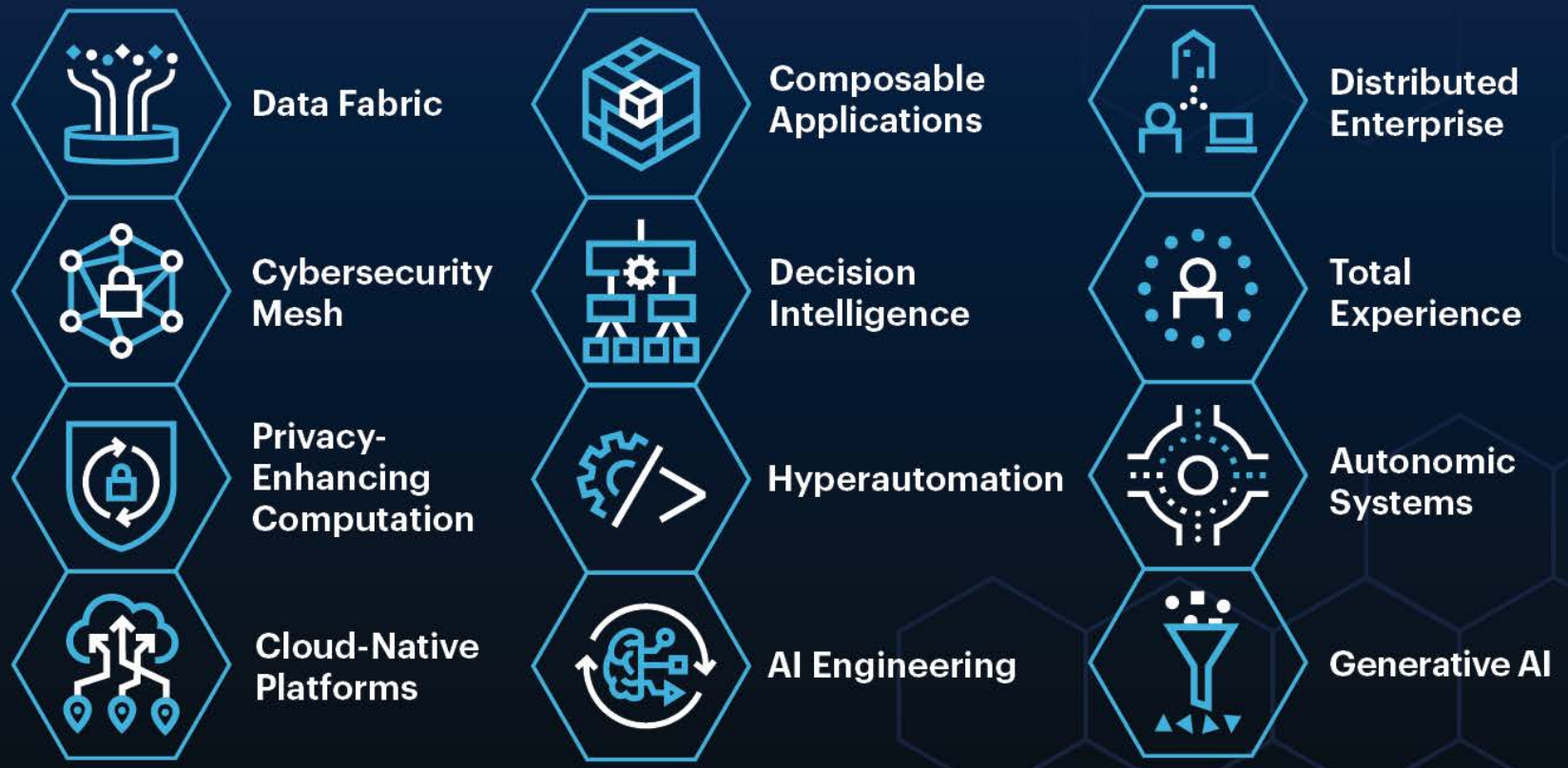
Hype Cycle for Emerging Technologies, 2021



gartner.com

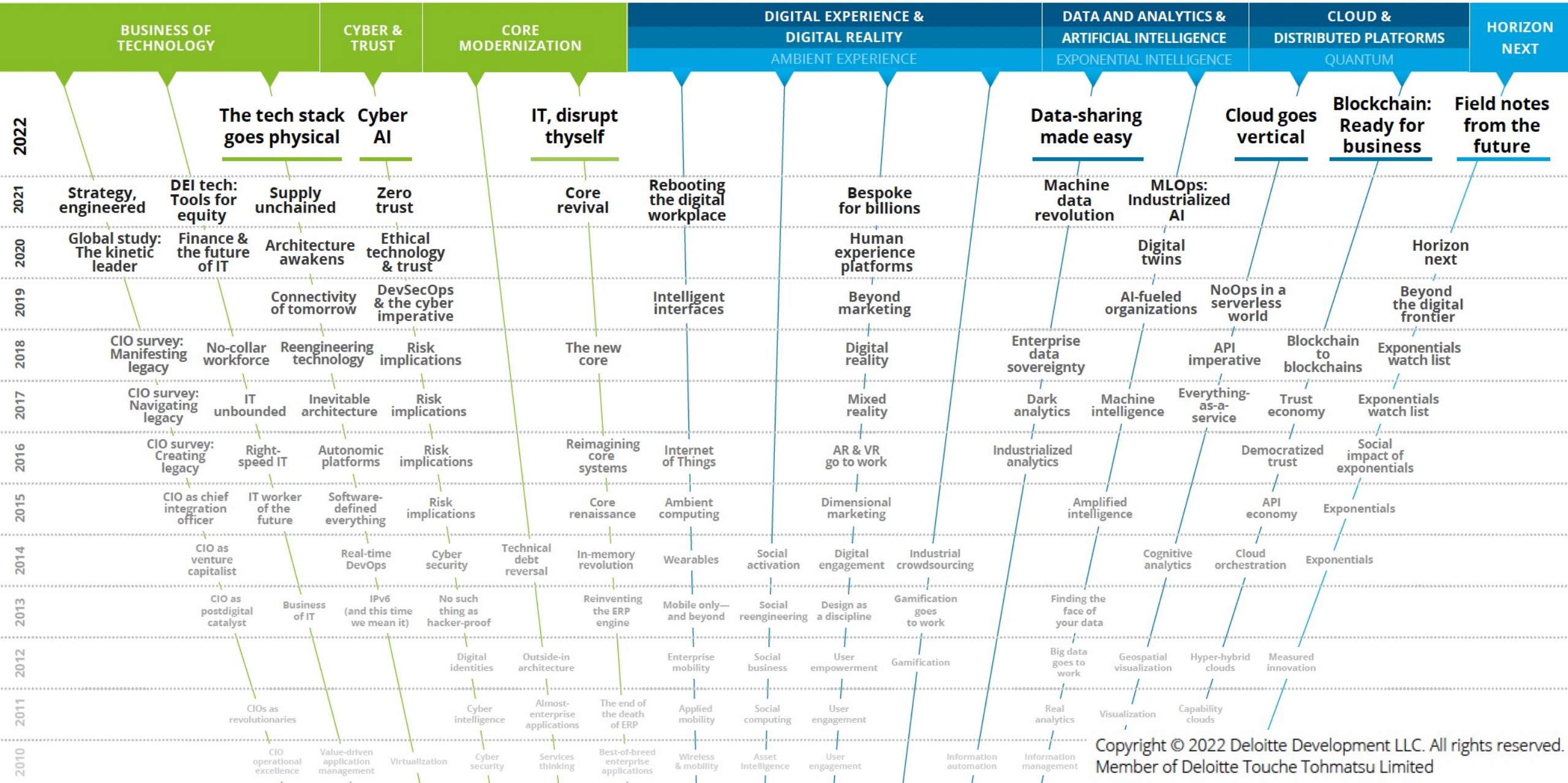
Gartner

Top Strategic Technology Trends for 2022



Gartner®

Trending the trends: Thirteen years of research



seven cross-industry and three industry-specific trends based on prioritized technologies…

Technology trends and underlying technologies

Industry-agnostic trends

1 Next-level process automation…

Industrial IoT[1]

Robots/cobots[2]/RPA[3]

… and process virtualization

Digital twins

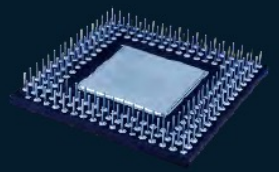
3-D/4-D printing

2 Future of connectivity

5G and IoT connectivity

3 Distributed infrastructure

Cloud and edge computing



4 Next-generation computing

Quantum computing

Neuromorphic chips (ASICs[4])

5 Applied AI

Computer vision, natural-language processing, and speech technology

6 Future of programming

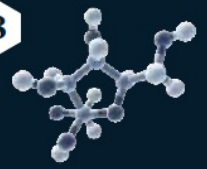
Software 2.0

7 Trust architecture

Zero-trust security

Blockchain

Industry-specific trends



8 Bio Revolution

Biomolecules/"-omics"/ biosystems

Biomachines/biocomputing/augmentation

9 Next-generation materials

Nanomaterials, graphene and 2-D materials, molybdenum disulfide nanoparticles

10 Future of clean technologies

Nuclear fusion

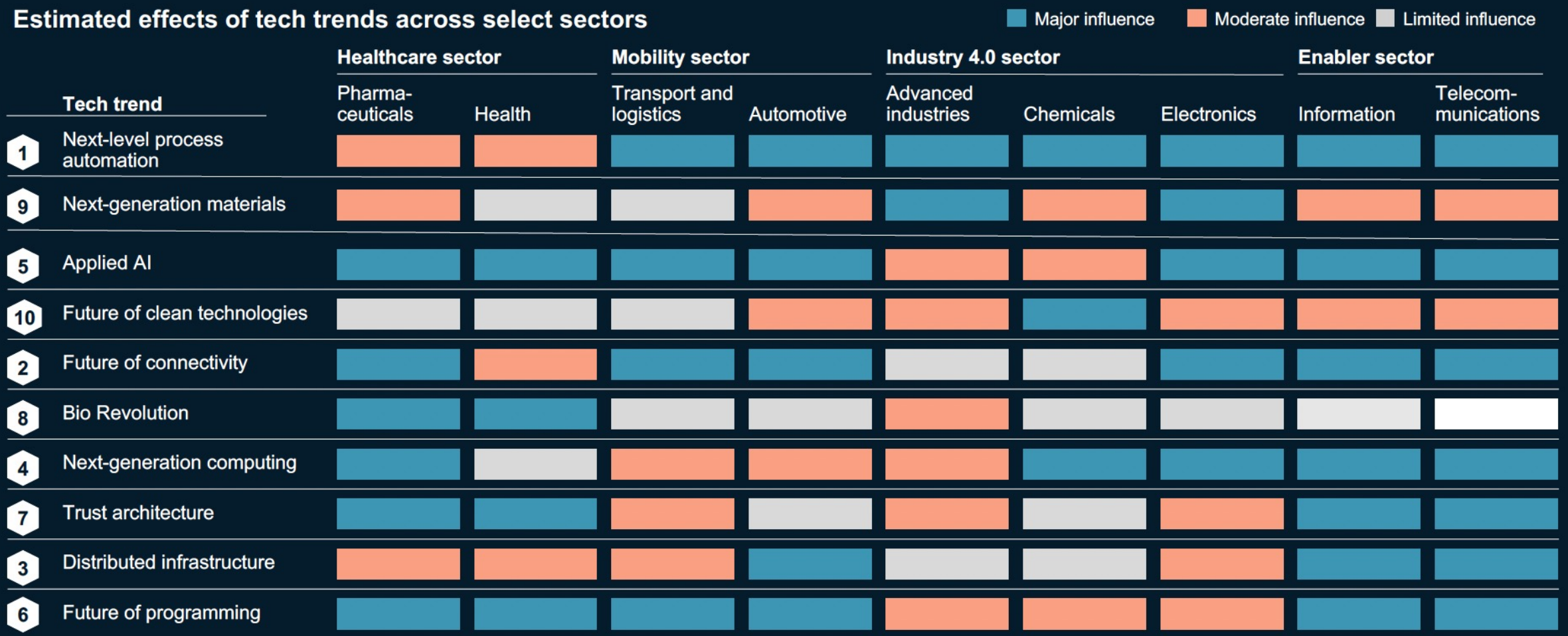
Smart distribution/metering

Battery/battery storage

Carbon-neutral energy generation

1. Internet of things. 2. Collaborative robots. 3. Robotic process automation. 4. Application-specific integrated circuits.

Tech trends affect all sectors, but their impact varies by industry.



1. Based on the average impact across different industries.
Source: Expert interviews; McKinsey analysis

McKinsey & Company

20 Metatrends for the 2020s

(1) Continued increase in global abundance: The number of individuals in extreme poverty continues to drop, as the middle-income population continues to rise.

(2) Global gigabit connectivity will connect everyone and everything, everywhere, at ultra-low cost: The deployment of both licensed and unlicensed 5G, plus the launch of a multitude of global satellite networks (OneWeb, Starlink, etc.), allow for ubiquitous, low-cost communications for everyone, everywhere, not to mention the connection of *trillions* of devices.

(3) The average human health span will increase by 10+ years

(4) An age of capital abundance will see increasing access to capital everywhere: This metatrend is driven by the convergence of global connectivity, dematerialization, demonetization, and democratization.

(5) Augmented reality and the spatial web will achieve ubiquitous deployment: The combination of augmented reality (yielding Web 3.0, or the spatial web) and 5G networks (offering 100Mb/s – 10Gb/s connection speeds) will transform how we live our everyday lives, impacting every industry from retail and advertising to education and entertainment.

(6) Everything is smart, embedded with intelligence: The price of specialized machine learning chips is dropping rapidly with a rise in global demand. Combined with the explosion of low-cost microscopic sensors and the deployment of high-bandwidth networks, we're heading into a decade wherein every device becomes intelligent. Your child's toy remembers her face and name. Your kids' drone safely and diligently follows and videos all the children at the birthday party. Appliances respond to voice commands and anticipate your needs.

(7) AI will achieve human-level intelligence

(8) AI-human collaboration will skyrocket across all professions: The rise of "AI as a Service" (AIaaS) platforms will enable humans to partner with AI in every aspect of their work, at every level, in every industry. AIs will become entrenched in everyday business operations, serving as cognitive collaborators to employees—supporting creative tasks, generating new ideas, and tackling previously unattainable innovations.

https://singularityhub.com/2020/01/10/20-tech-metatrends-to-look-out-for-in-the-2020s/

20 Metatrends for the 2020s

(9) Most individuals adapt a *JARVIS*-like "software shell" to improve their quality of life: Imagine a secure JARVIS-like software shell that you give permission to listen to all your conversations, read your email, monitor your blood chemistry, etc. With access to such data, these AI-enabled software shells will learn your preferences, anticipate your needs and behavior, shop for you, monitor your health, and help you problem-solve in support of your mid- and long-term goals.

(10) Globally abundant, cheap renewable energy: Continued advancements in solar, wind, geothermal, hydroelectric, nuclear, and localized grids will drive humanity towards cheap, abundant, and ubiquitous renewable energy.

(11) The insurance industry transforms from "recovery after risk" to "prevention of risk"

(12) Autonomous vehicles and flying cars will redefine human travel (soon to be far faster and cheaper)

(13) On-demand production and on-demand delivery will birth an "instant economy of things": Urban dwellers will learn to expect "instant fulfillment" of their retail orders as drone and robotic last-mile delivery services carry products from local supply depots directly to your doorstep.

(14) Ability to sense and know anything, anytime, anywhere: We're rapidly approaching the era wherein 100 billion sensors (the Internet of Everything) is monitoring and sensing (imaging, listening, measuring) every facet of our environments, all the time.

(15) Disruption of advertising: As AI becomes increasingly embedded in everyday life, your custom AI will soon understand what you want better than you do. In turn, we will begin to both trust and rely upon our AIs to make most of our buying decisions, turning over shopping to AI-enabled personal assistants. Your AI might make purchases based upon your past desires, current shortages, conversations you've allowed your AI to listen to, or by tracking where your pupils focus on a virtual interface (i.e., what catches your attention).

(16) Cellular agriculture moves from the lab into inner cities, providing high-quality protein that is cheaper and healthier

(17) High-bandwidth brain-computer interfaces (BCIs) will come online for public use

(18) High-resolution VR will transform both retail and real estate shopping

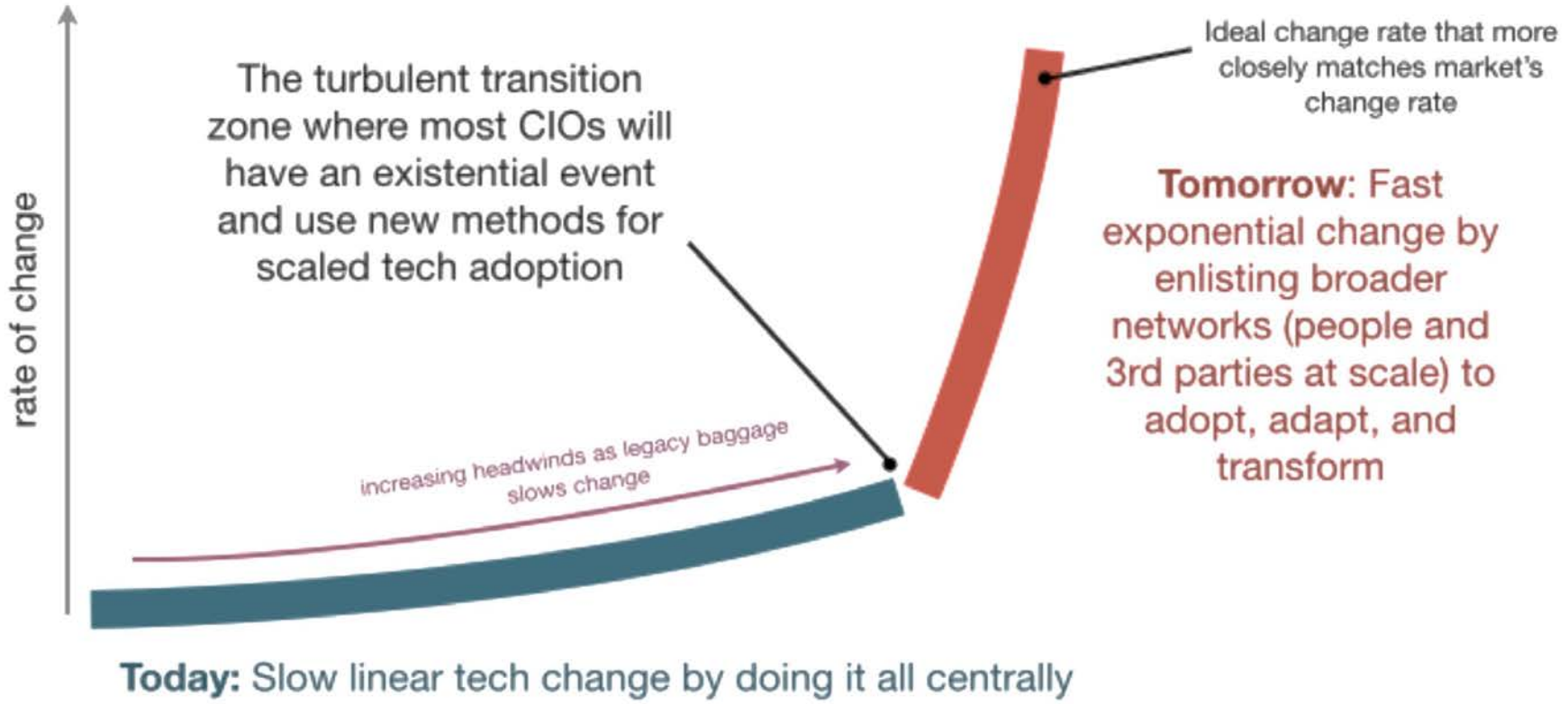
(19) Increased focus on sustainability and the environment

(20) CRISPR and gene therapies will minimize disease

Pace of technology change

The technology landscape is rapidly evolving, bringing with it business opportunities

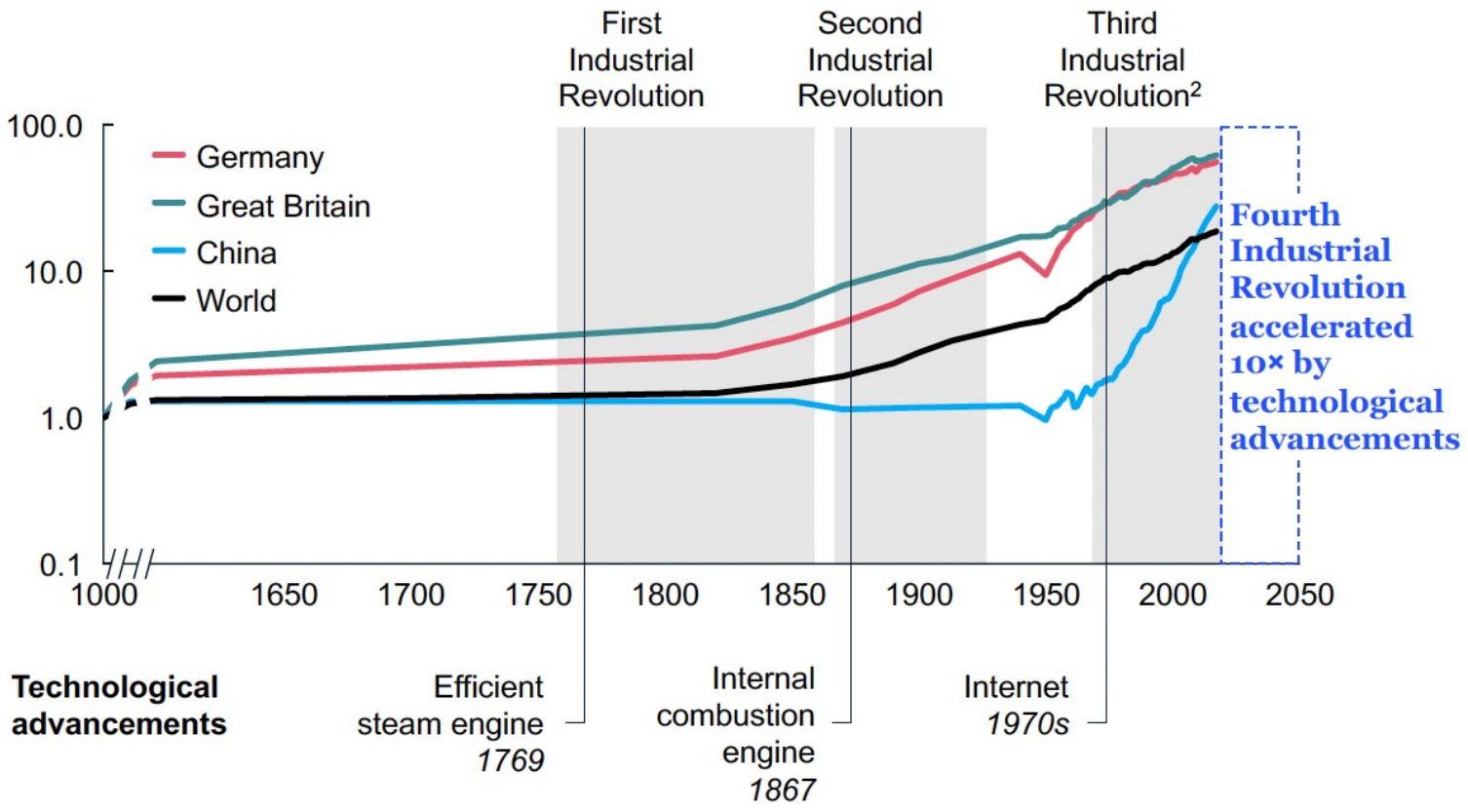
Increasing pace of technology change



By Dion Hinchcliffe, ZDNet

Advancing technology has always spurred economic development, and now it's accelerating even faster.

Changes in GDP per capita brought about by technological investments, 1000–2000 AD, by country, indexed[1]



1. Estimated global GDP per capita in USD, adjusted to GDP in 1000 AD = 1; not exhaustive; 2. Includes Industry 4.0 (debate exists as to whether Industry 4.0 is seen as the Fourth Industrial Revolution or simply as the second phase of the Third Industrial Revolution).
Source: Angus Maddison, "Statistics on World Population, GDP & Per Capita GDP, 1-2008 AD," Maddison Project Database; UBS Asset Management; OECD

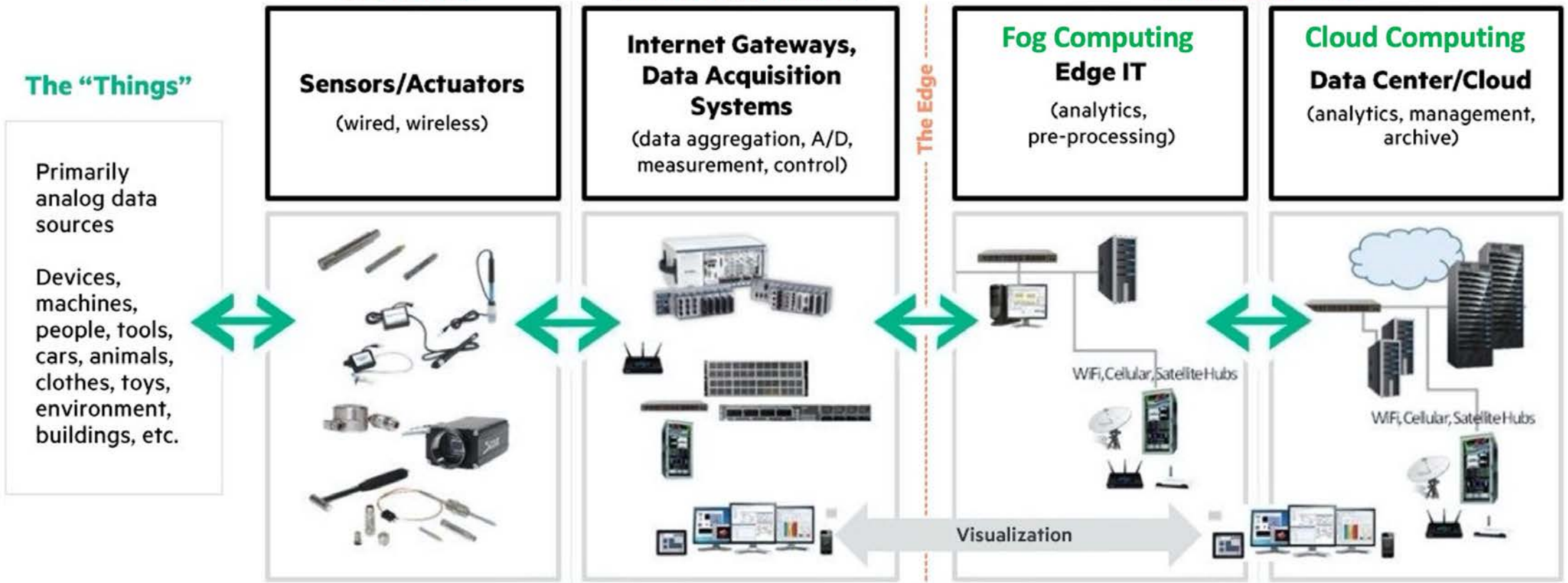
"In the next decade, we will experience more progress than in the past 100 years."

–Peter Diamandis,
Cofounder of Singularity University

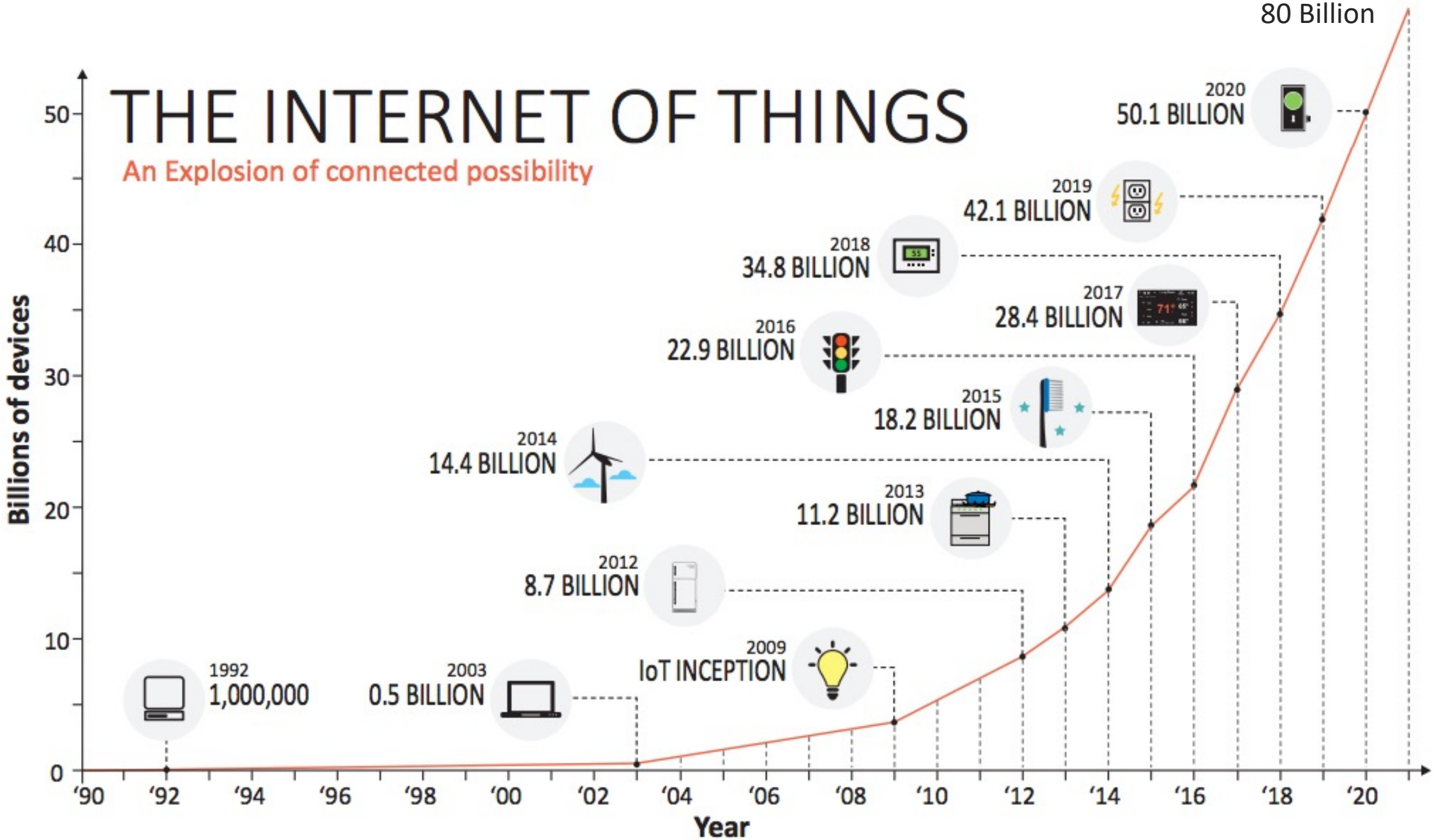
Everything is connected

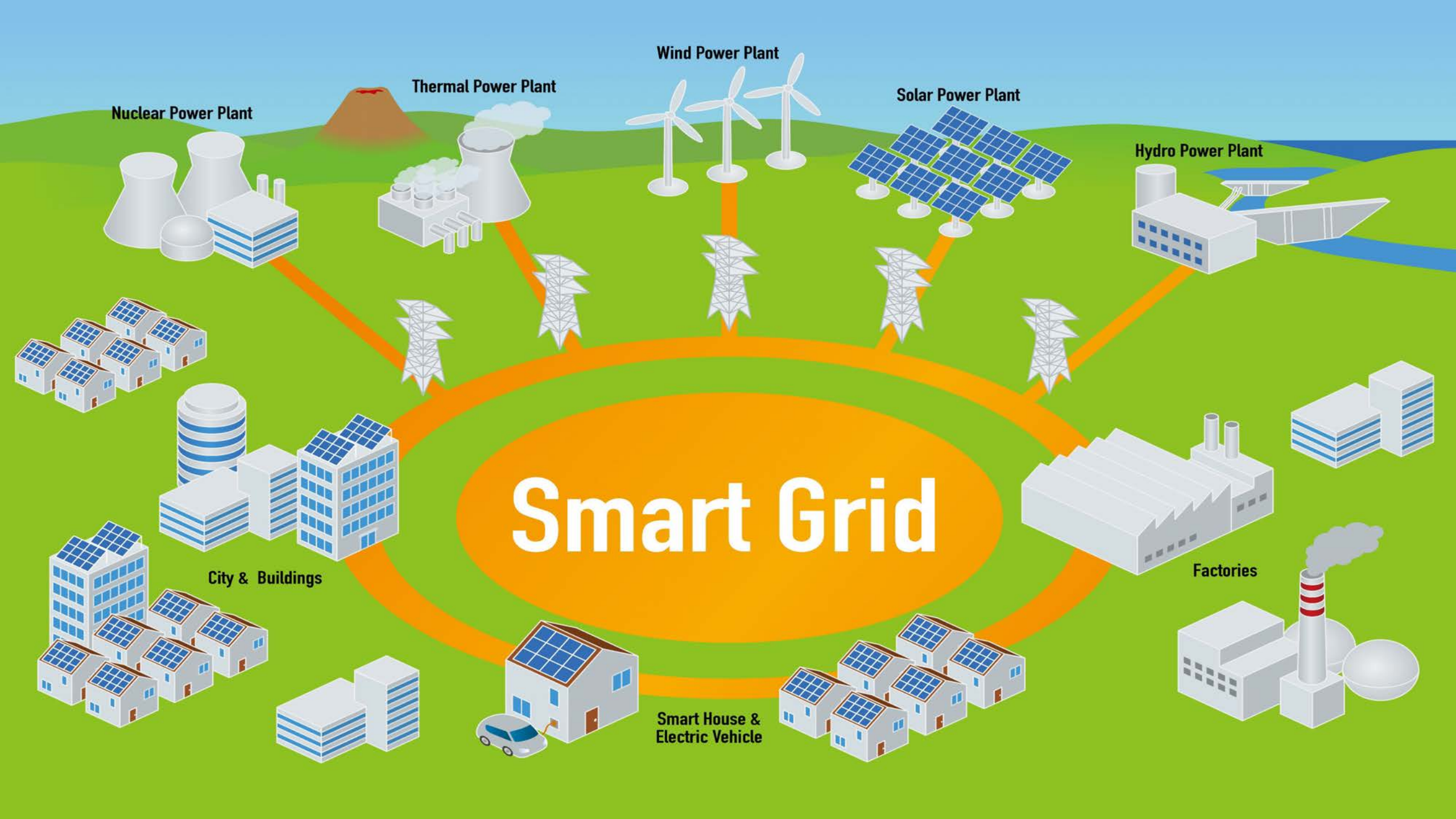
We are heading toward a Smart Future where trillions of sensors and devices will be connected to the Internet

The Internet of Things definition: “**Sensors and actuators embedded in physical objects are linked through wired and wireless networks**”

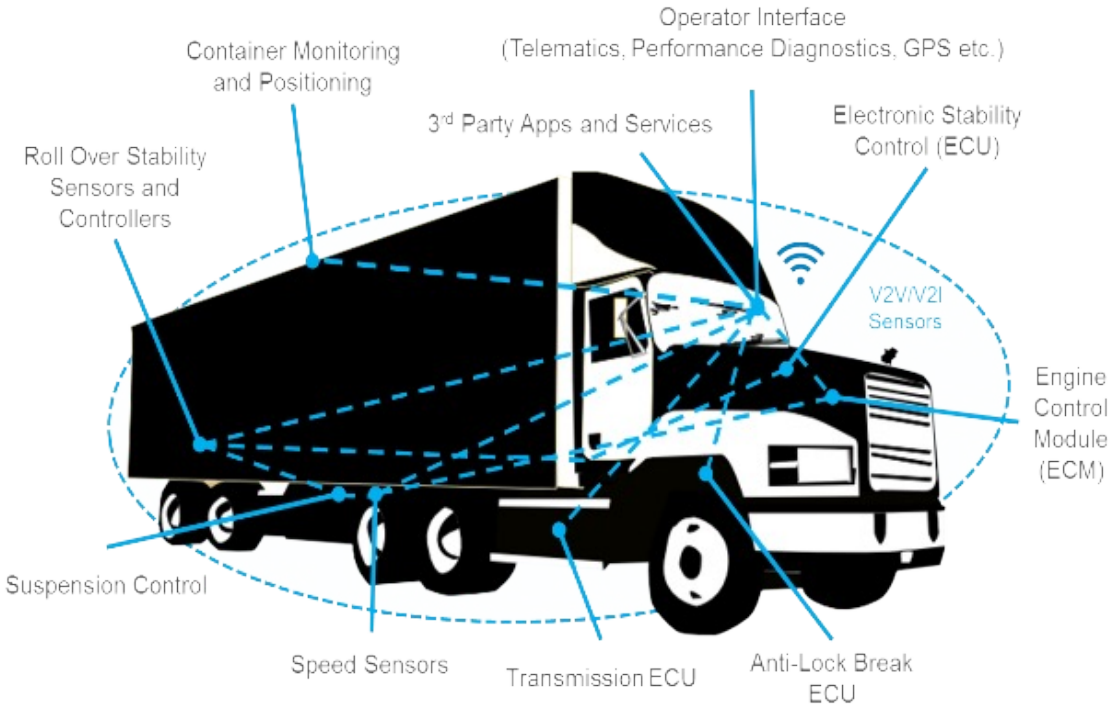

The "Things"
Primarily analog data sources
Devices, machines, people, tools, cars, animals, clothes, toys, environment, buildings, etc.
Sensors/Actuators
(wired, wireless)
Internet Gateways, Data Acquisition Systems
(data aggregation, A/D, measurement, control)
The Edge
Fog Computing
Edge IT
(analytics, pre-processing)
Cloud Computing
Data Center/Cloud
(analytics, management, archive)
WiFi, Cellular, Satellite Hubs
WiFi, Cellular, Satellite Hubs
Visualization

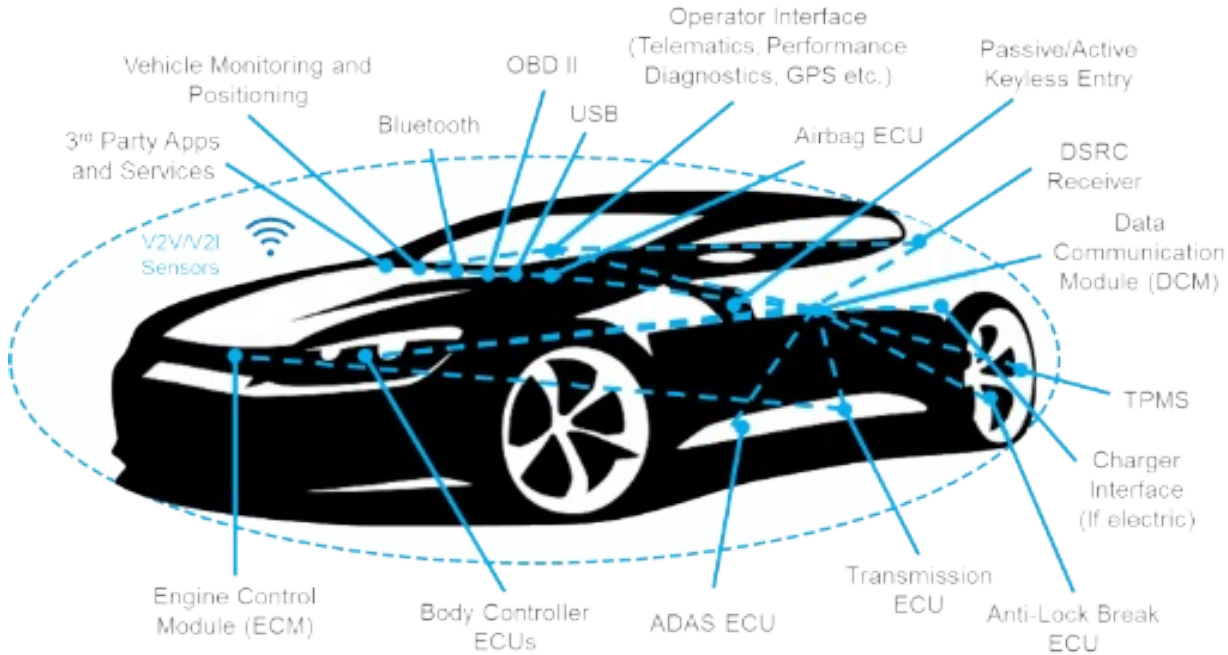
80 Billion


THE INTERNET OF THINGS
An Explosion of connected possibility
Billions of devices
50
40
30
20
10
0
'90
'92
'94
'96
'98
'00
'02
'04
'06
'08
'10
'12
'14
'16
'18
'20
Year
1992
1,000,000
2003
0.5 BILLION
2009
IoT INCEPTION
2012
8.7 BILLION
2013
11.2 BILLION
2014
14.4 BILLION
2015
18.2 BILLION
2016
22.9 BILLION
2017
28.4 BILLION
2018
34.8 BILLION
2019
42.1 BILLION
2020
50.1 BILLION

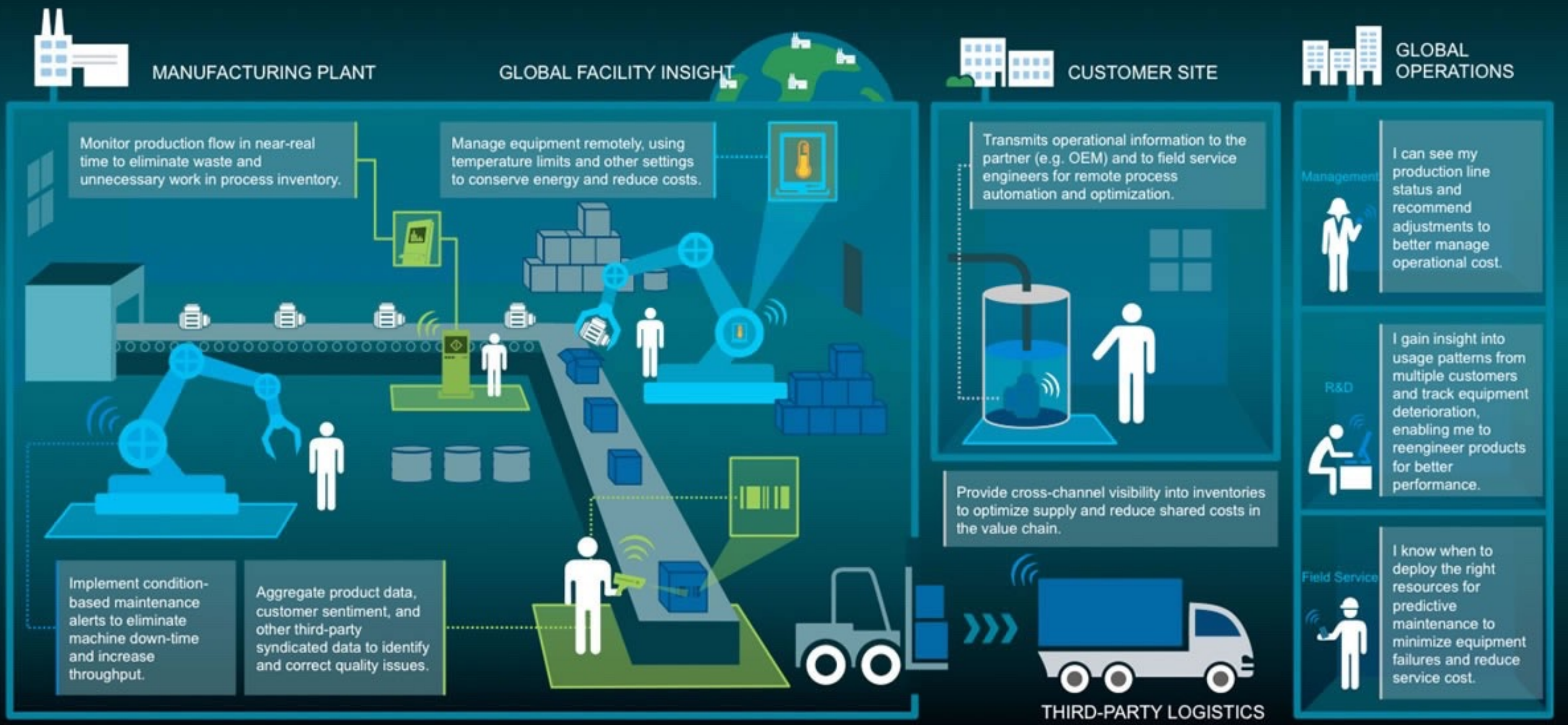

Wind Power Plant
Thermal Power Plant
Nuclear Power Plant
Solar Power Plant
Hydro Power Plant
Smart Grid
City & Buildings
Factories
Smart House &
Electric Vehicle

Smart & Autonomous Vehicles





Internet of Things in Manufacturing



FUTURE FARMS
small and smart

SURVEY DRONES

Aerial drones survey the fields, mapping weeds, yield and soil variation. This enables precise application of inputs, mapping spread of pernicious weed blackgrass could increasing Wheat yields by 2-5%.

FLEET OF AGRIBOTS

A herd of specialised agribots tend to crops, weeding, fertilising and harvesting. Robots capable of microdot application of fertiliser reduce fertiliser cost by 99.9%.

FARMING DATA

The farm generates vast quantities of rich and varied data. This is stored in the cloud. Data can be used as digital evidence reducing time spent completing grant applications or carrying out farm inspections saving on average £5,500 per farm per year.

TEXTING COWS

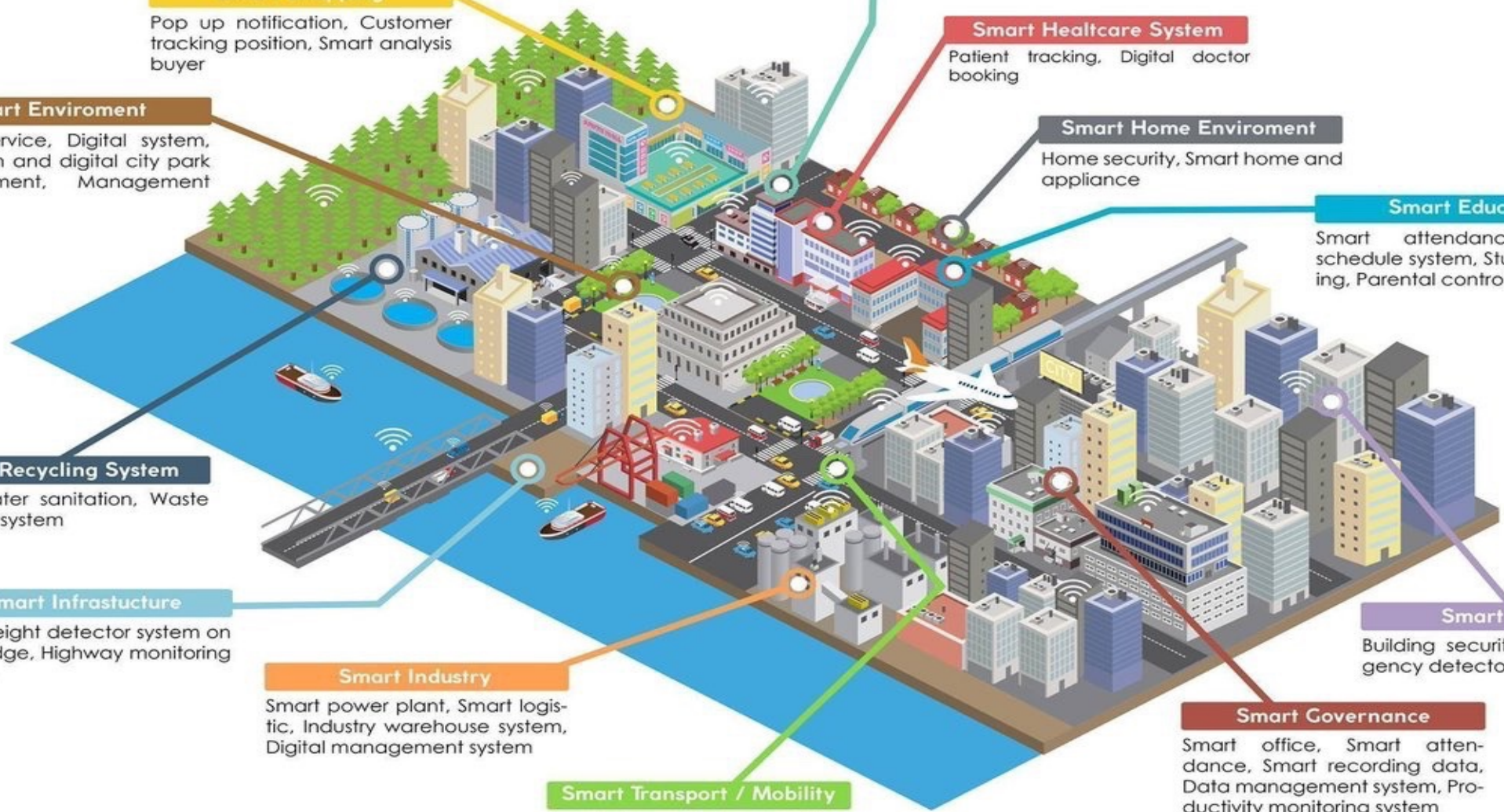
Sensors attached to livestock allowing monitoring of animal health and wellbeing. They can send texts to alert farmers when a cow goes into labour or develops infection increasing herd survival and increasing milk yields by 10%.

SMART TRACTORS

GPS controlled steering and optimised route planning reduces soil erosion, saving fuel costs by 10%.


SMART
CITY
SMART MEDICINE
SMART RETAIL
SMART HOME
SMART AGRICULTURE
CONNECTED CAR
SMART INDUSTRY
SMART ENERGY
INTERNET OF THINGS

SMART DIGITAL LIFE



Smart Security
Smart security city, security checkpoint

Smart Shopping
Pop up notification, Customer tracking position, Smart analysis buyer

Smart Healtcare System
Patient tracking, Digital doctor booking

Smart Enviroment
Public service, Digital system, Plantation and digital city park management, Management tourism

Smart Home Enviroment
Home security, Smart home and appliance

Smart Education
Smart attendance, Digital schedule system, Student tracking, Parental control system

Smart Recycling System
Smart water sanitation, Waste recycling system

Smart Infrastucture
Overweight detector system on the bridge, Highway monitoring system

Smart Industry
Smart power plant, Smart logistic, Industry warehouse system, Digital management system

Smart Transport / Mobility
Smart transportation tracking, Smart parking, Traffic monitoring, System and updates, Connected airpod system

Smart Building
Building security system, Emergency detector system

Smart Governance
Smart office, Smart attendance, Smart recording data, Data management system, Productivity monitoring system

IoT Platform by :
mesosfer

created by : cubeacon & mesosfer
cubeacon

Enabling Technologies

The Smart Future is accelerated by enabling technologies

5G enables IoT

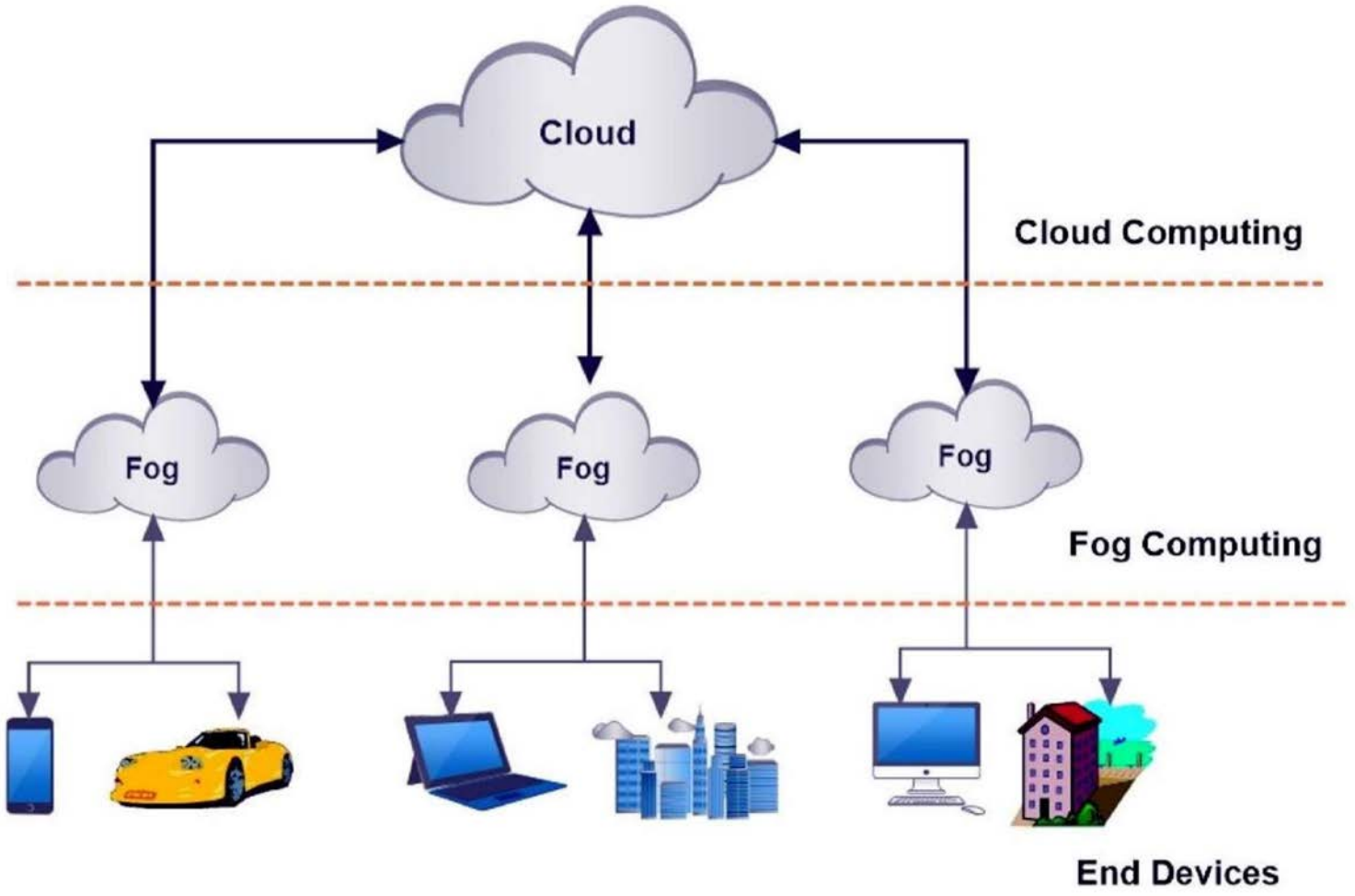
- 100x faster than 4G
- 1/50 the latency of 4G
- Much more scalable: 100x more devices than there are people
- Good for time sensitive applications (e.g. factory robotics, robotic surgery)
- How do you get billions of devices to talk to each other?
- Security & Privacy are key
- Connected assets can be used to extract productivity

Big Data enables IoT

Sensors on Boeing jet engines can produce 10 terabytes of operational information for every 30 minutes they turn. A four engine jumbo jet can create 640 terabytes of data on just one Atlantic crossing. Now, multiply that by the more than 25,000 flights flown each day…"

COMMON DETECTION SENSOR TECHNIQUES:
Optical spectrum. Electromagnetic - DC to 300+ PetaHertz (gamma rays, 3 X 10^21 Hz). Sonic: from almost 0 Hz to ~250KHz at sea level air. Pressure. Viscosity. Phase relationships (time). Vibration (intensity/time). Velocity (time). Acceleration (time^2). Tuned to specific Chemical Signatures. Echoing & Doppler. Temperature (time & time^2). Proximity. Weight/Mass. Flow (time).

Fog (Edge) Computing enables IoT



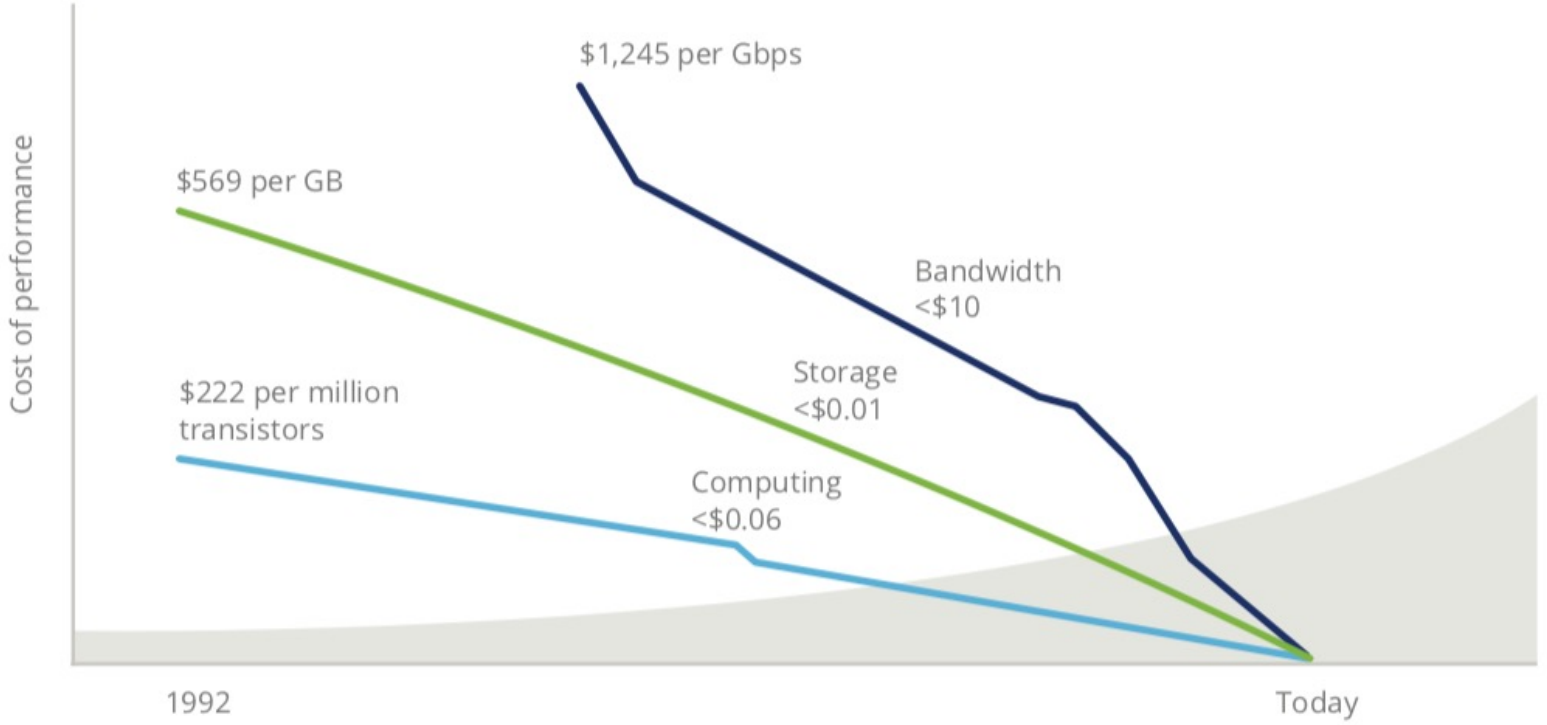
Serverless computing

From Wikipedia, the free encyclopedia

Serverless computing is a cloud computing execution model in which the cloud provider allocates machine resources on demand, taking care of the servers on behalf of their customers. "Serverless" is a misnomer in the sense that servers are still used by cloud service providers to execute code for developers. However, developers of serverless applications are not concerned with capacity planning, configuration, management, maintenance, fault tolerance, or scaling of containers, VMs, or physical servers. Serverless computing does not hold resources in volatile memory; computing is rather done in short bursts with the results persisted to storage. When an app is not in use, there are no computing resources allocated to the app. Pricing is based on the actual amount of resources consumed by an application.[1] It can be a form of utility computing.

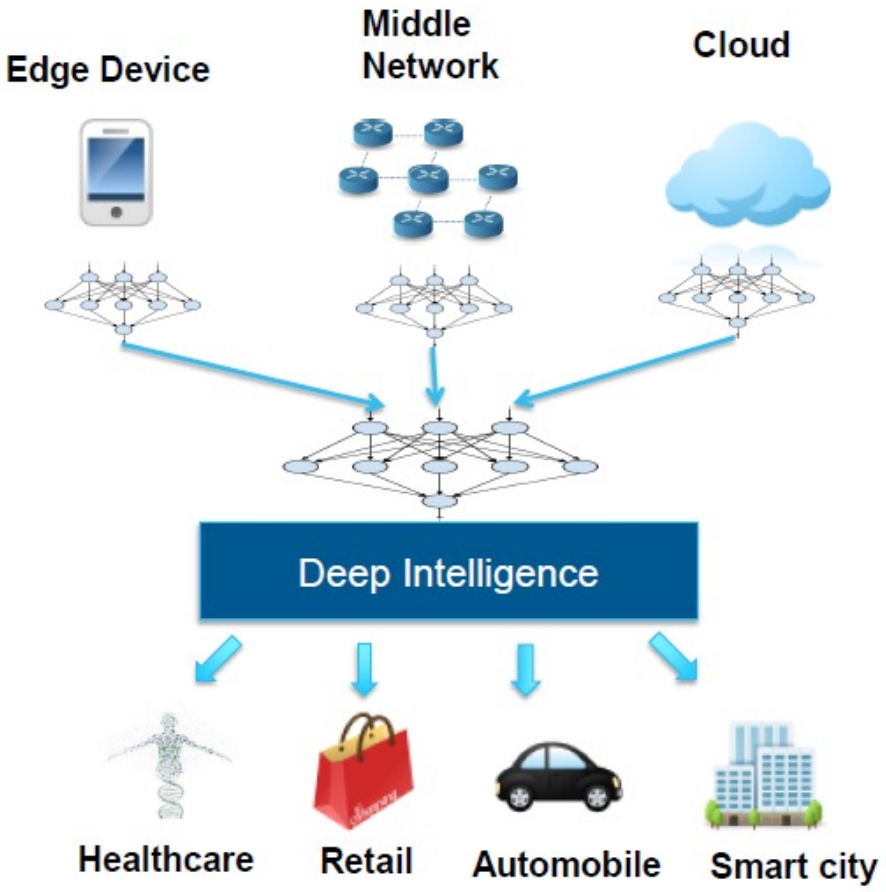
Heading toward ubiquitous computing

Figure 3. Bandwidth, storage, and computing prices (1992–2016)



Source: Adam Mussomeli, Doug Gish, Stephen Laaper, *The rise of the digital supply network*, Deloitte University Press, December 1, 2016.

AI and Machine Learning Enable IoT



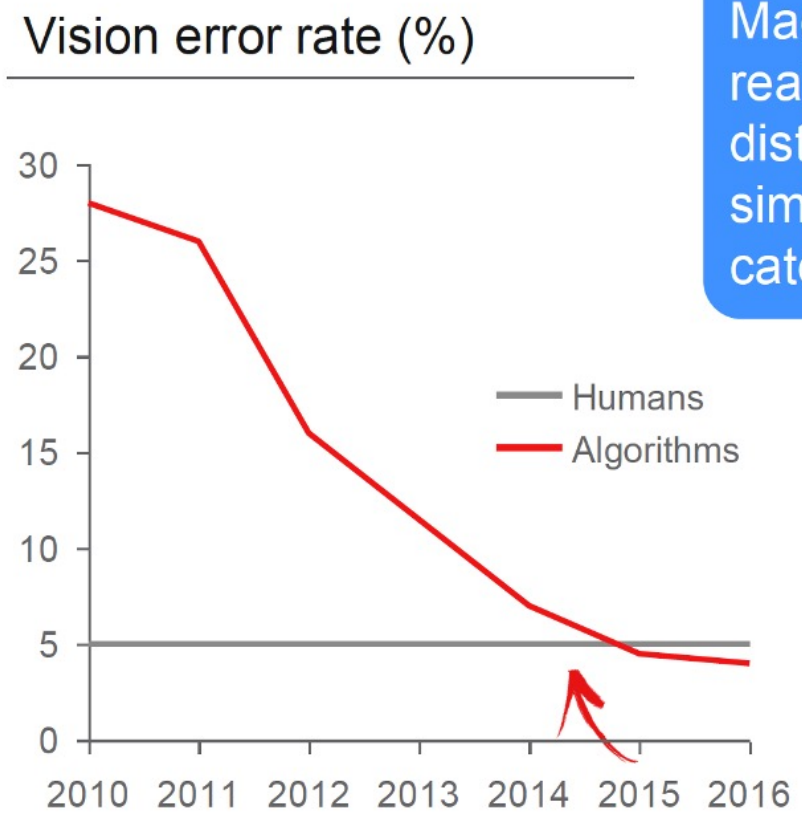
- Training AI can be hit or miss – need sufficient training data for possible scenarios
- Need to eliminate unwanted biases
- Lightweight blockchain for IoT applications
- Privacy protecting federated ML
- P2P model and environmental data sharing

ARTIFICIAL INTELLIGENCE
57 YEARS LATER

'A Cambrian Explosion that will disrupt virtually all sectors.'

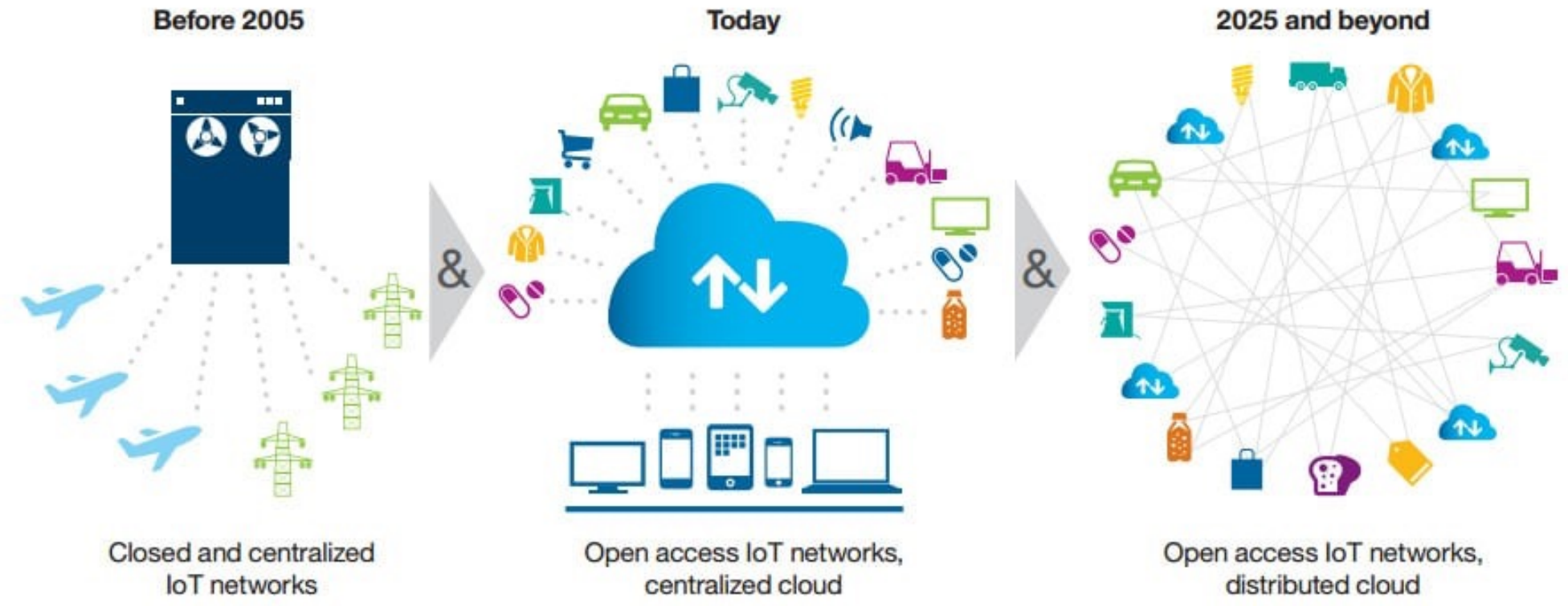
Puppy or Muffin?

Machines have made real strides in distinguishing among similar-looking categories of images



Speech to text translation rates are now > 95% accurate.

Blockchain (Distributed Ledger) Adds Integrity to IoT and Security to M2M Communications



Theme Article: Special Section on Distributed Ledger Technologies

BPAF: Blockchain-Enabled Reliable and Privacy-Preserving Authentication for Fog-Based IoT Devices

Can Zhang, Liehuang Zhu, and Chang Xu
Beijing Institute of Technology

***Abstract*—The development of IoT and fog computing promotes various kinds of authentication mechanisms for IoT devices. Traditional IoT authentication schemes are based on Public Key Infrastructure (PKI) where a centralized certificate authority is introduced. To mitigate the security, privacy, and reliability issues bring from the centralization, some blockchain-based authentication schemes have been presented to achieve decentralized authentication. Unfortunately, they cannot be directly used under the fog-based IoT environment, which consists of resource-constrained IoT devices. To mitigate these issues, we present a Blockchain-enabled reliable, and Privacy-preserving Authentication for Fog-based IoT devices, named BPAF. BPAF achieves reliable authentication of fog nodes without violating the privacy of authenticated users during the authentication process. Security analysis and experimental evaluations show that BPAF achieves privacy-preserving and reliable authentication with high efficiency for both the fog nodes and full nodes participating in the authentication process.**

Digital Object Identifier 10.1109/MCE.2021.3061808
Date of publication 24 February 2021; date of current version 28 February 2022.

With the proliferation of consumer of Things (IoT), privacy issues have more and more nonnegligible.[1] Effective tications should be implemented to prev tem violations from unauthorized adve

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IEEE Consumer Electronics M

Theme Article: Special Section on Distributed Ledger Technologies

Blockchain-Enabled Data-Sharing Scheme for Consumer IoT Applications

Bowen Hu, Yingwen Chen, Hujie Yu, Linghang Meng, and Zhimin Duan
National University of Defense Technology

***Abstract*—A staggering number of consumer Internet-of-Things devices are being deployed in various application scenarios, and massive data will be generated per day. How to achieve a secure and efficient data-sharing scheme for the consumer IoT applications is a huge challenge for us. The traditional cloud-based IoT has the dilemma of prolonged communication delay and privacy leakage. With the application of 5G technology, edge computing can effectively alleviate these problems. However, it cannot meet the higher security requirements for the data sources' authenticity and information reliability. By combining the blockchain and smart contracts technology, this article proposes a distributed, efficient, and secure data-sharing scheme centered on consumer IoT devices. This architecture consists of four layers: 1) IoT devices layer, 2) edge storage layer, 3) blockchain network layer, and 4) application services layer. We design smart contracts based on the attributed based access control and the searchable encryption algorithm, including device retrieval contract, policy management contract, and authorization verification contract. Through the implementation of simulated experiments, we prove that our proposed architecture can satisfy the large-scale data access requests and bring a tolerable level of communication overhead. The proposed framework is one of the few attempts to leverage the edge computing and blockchain**

Theme Article: Special Section on Distributed Ledger Technologies

Cryptocurrency Solutions to Enable Micropayments in Consumer IoT

Suat Mercan
Florida International University
Ahmet Kurt
Florida International University
Kemal Akkaya
Florida International University
Enes Erdin
University of Central Arkansas

***Abstract*—The successful amalgamation of cryptocurrency and consumer Internet-of-Things (IoT) devices can pave the way for novel applications in machine-to-machine economy. However, the lack of scalability and heavy resource requirements of initial blockchain designs hinder the integration, and it is unclear how consumer devices will be adopting cryptocurrency. Therefore, in this article, we critically review the existing integration approaches and cryptocurrency designs that strive to enable micropayments among consumer devices. We identify and discuss solutions under three main categories; *direct integration*, *payment channel network*, and *new cryptocurrency design*. The first approach utilizes a full node to interact with the payment system. Offline channel payment is suggested as a second-layer solution to solve the scalability issue and enable instant payment with low fee. New designs converge to semicentralized scheme and focus on lightweight consensus protocol that does not require high computation power. We evaluate the pros and cons of each of these approaches and then point out future research challenges. Our goal is to help researchers and practitioners to better focus their efforts to facilitate micropayment adoptions.**

Internet of things (IoT) from tiny sensors to rs are becoming an indispensable part of life. To create an effective IoT ecosystem, it is significant to enable data and service sharing among objects.[1] Since this ecosystem will be dependent on financial microtransactions among digital devices, a *reliable* payment system without *human intervention* is desirable for a seamless experience. As IoT evolves over time, cryptocurrency

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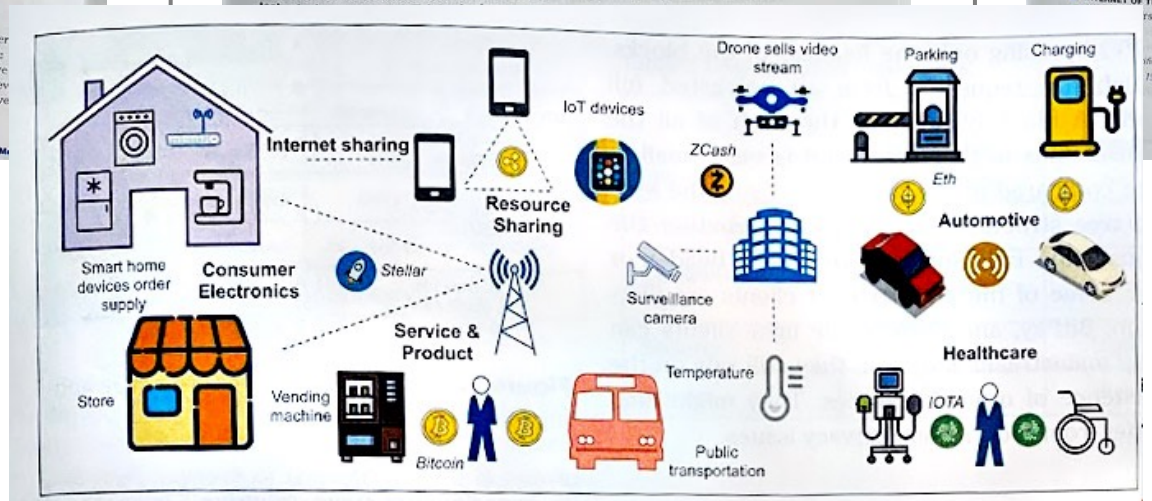


Figure 1. M2M economy requires payment among entities.

Web 3.0, the Metaverse and beyond

By Jaeson Schultz.

Internet technology evolves rapidly, and the World Wide Web (WWW or Web) is currently experiencing a transition into what many are calling "Web 3.0". Web 3.0 is a nebulous term. If you spend enough time Googling it, you'll find many interpretations regarding what Web 3.0 actually is. However, most people tend to agree that Web 3.0 is being driven by cryptocurrency, blockchain technology, decentralized applications and decentralized file storage.

Risk

Advancing technology brings risk and opportunity

- Since IT is critical for all business processes today, IT **Risk affects all enterprise risk**
- **Risk is calculated**:
  - Threats & Vulnerabilities
  - Likelihood & Frequency of Loss Event
  - Impact of Event
- **Risk is difficult to calculate**, especially for new technologies and use cases
- **Threats are increasing**
  - Adversaries
  - Misconfigurations
- **Why?**
  - More devices
  - Increased complexity
  - Increased connectivity
  - Technologies that don't integrate well
  - More data to process
  - Speed of data
  - Automation/AI

Risk associated with advanced technology

- Not well understood, may require training
  - Most drivers have no idea how their car works, and that's OK
- May not follow standards or be interoperable
- May be regulated
- The impact of an exploit may be more far reaching
- "We didn't know someone would try to use it that way."
- Rush to adopt new technology without fully understanding consequences
- Connected technology may impact more people when attacked

Everything connected. Everything at risk.

- More connected devices means a **greatly expanded attack surface**.
- The bottom line is the more that all of our things are **connected** together, and the more we rely on them, the more vulnerable we are to having **disastrous disruptions** to our **business processes, personal lives, and to society as a whole**.

Greater complexity leads to increased risk

"The following is my rule of thumb. For every 1,000 lines of code, on average, at least one code-level bug exists. For every 20 code-level bugs, at least one is a security vulnerability. For every 10 vulns, at least one is exploitable."

- J. Wolfgang Goerlich, VP of Strategic Programs, CBI

Supply Chain Security

- Whether intentionally, or accidentally, insiders can cause security breaches *(employees, contractors, suppliers)*
- Supply Chain attacks tripled in 2021
- Widely adopted software packages can be exploited: SolarWinds, Log4j…
- Open-source software, Internet code repositories, and common libraries with vulnerabilities can lead to widespread incidents

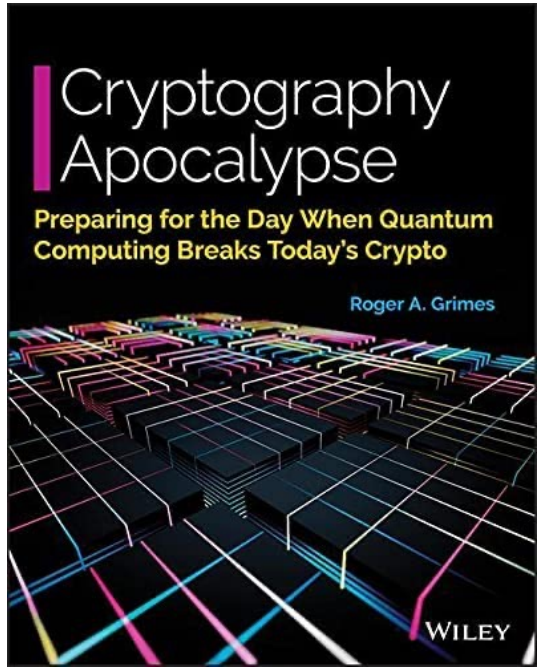
Schneier on Security

Developer Sabotages Open-Source Software Package

This is a big deal:

> A developer has been caught adding malicious code to a popular open-source package that wiped files on computers located in Russia and Belarus as part of a protest that has enraged many users and raised concerns about the safety of free and open source software.
>
> The application, node-ipc, adds remote interprocess communication and neural networking capabilities to other open source code libraries. As a dependency, node-ipc is automatically downloaded and incorporated into other libraries, including ones like Vue.js CLI, which has more than 1 million weekly downloads.
>
> […]
>
> The node-ipc update is just one example of what some researchers are calling protestware. Experts have begun tracking other open source projects that are also releasing updates calling out the brutality of Russia's war. This spreadsheet lists 21 separate packages that are affected.
>
> One such package is es5-ext, which provides code for the ECMAScript 6 scripting language specification. A new dependency named postinstall.js, which the developer

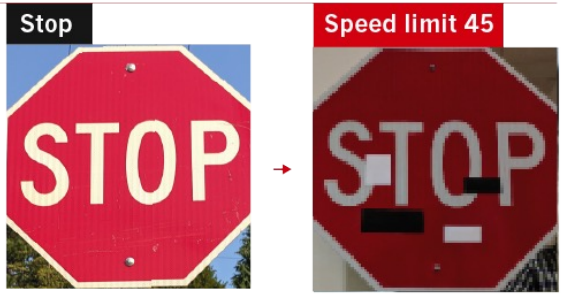
Technology concerns



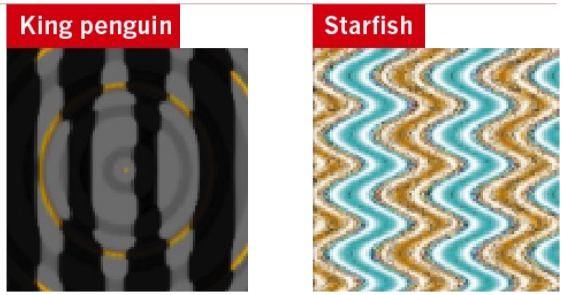
FOOLING THE AI

Deep neural networks (DNNs) are brilliant at image recognition — but they can be easily hacked.

These stickers made an artificial-intelligence system read this stop sign as 'speed limit 45'.



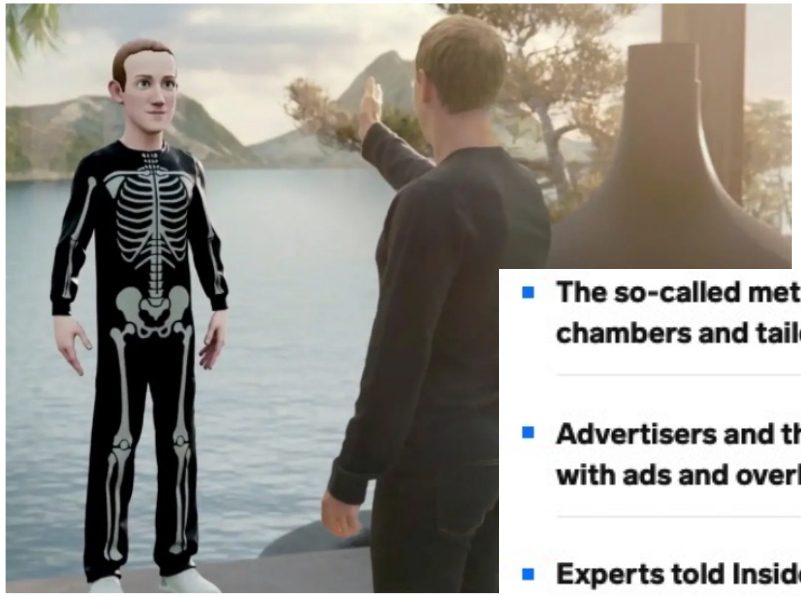
Scientists have evolved images that look like abstract patterns — but which DNNs see as familiar objects.



©nature

Mark Zuckerberg's metaverse could fracture the world as we know it — letting people 'reality block' things they disagree with and making polarization even worse

Katie Canales Nov 20, 2021, 6:55 AM



Facebook CEO Mark Zuckerberg shows off his vision for the metaverse during Faceb
2021. Facebook/Handout via REUTERS

- **The so-called metaverse could give us our own virtual echo chambers and tailored realities.**
- **Advertisers and third parties could inject someone's virtual world with ads and overlays unique to them.**
- **Experts told Insider the result could be a fractured reality where we all exist in different worlds.**

Threats

Threat Actors

- Threat actors include humans/groups that intentionally or unintentionally cause a loss event (security incident). This can include the employee who clicks on malicious email or the contractor who shares their password with a co-worker. It can include misconfigurations or mistakes.
- In addition to the unintended consequences that come with advancing technology, we have specific groups of adversaries that are motivated by **M**oney, **I**deology, **C**oercion, **E**go **(M.I.C.E.)**
- Asymmetric warfare – Adversary just needs one vuln to exploit, Defender must defend all
- Experts commoditize exploits which can later be used & rented by n00bs

Criminal Enterprises

- Broad-based and targeted attacks
- Financially motivated
- Getting more sophisticated

Hactivists

- Targeted and destructive attacks
- Unpredictable motivations
- Generally less sophisticated

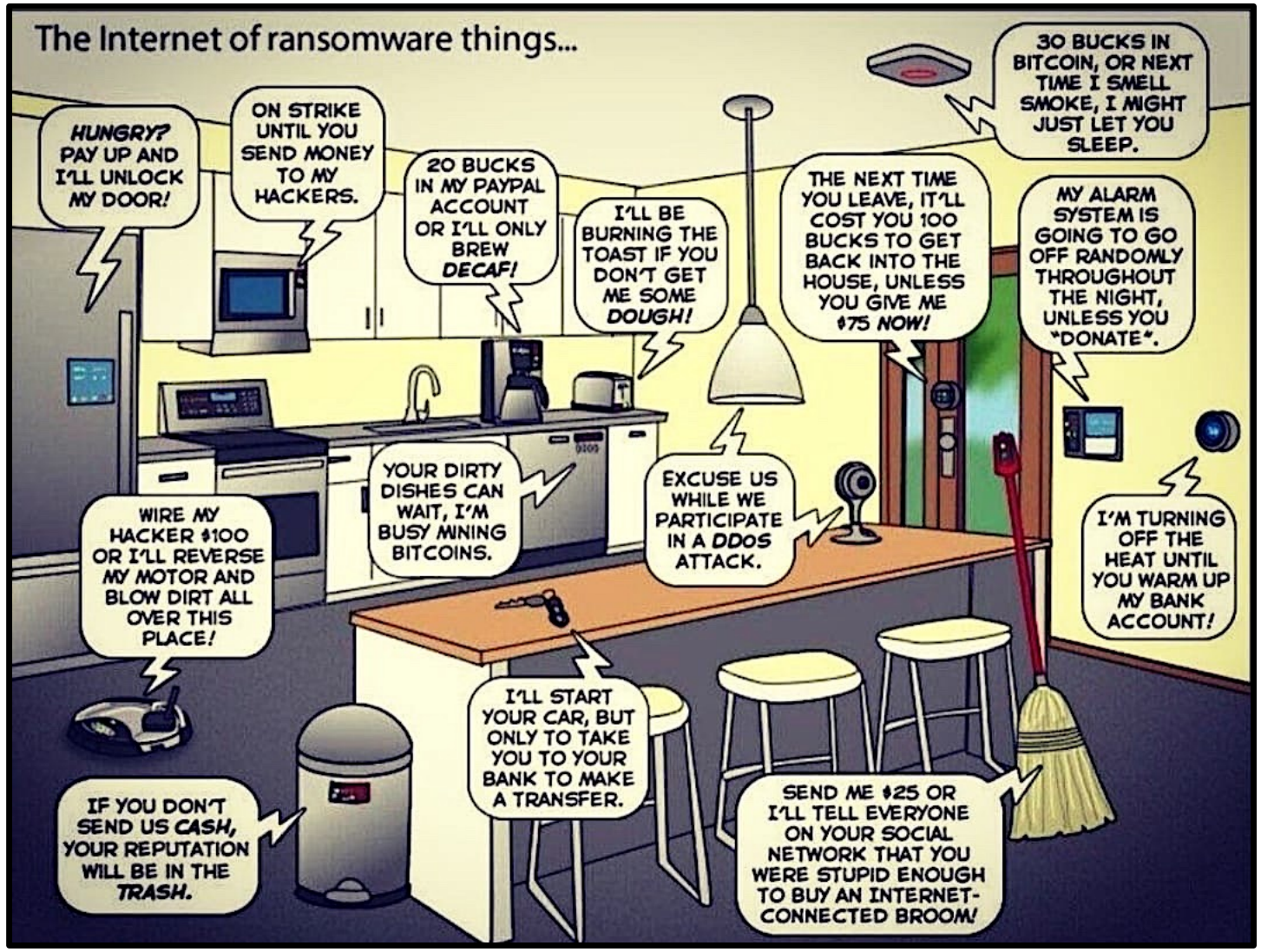
Nation-States

- Targeted and multi-stage attacks
- Motivated by information and IP
- Highly sophisticated, endless resources


The risk is not being chased by one bear…
Running faster than your friend isn't enough.
The Internet is full of bears.

And then we have aligators.

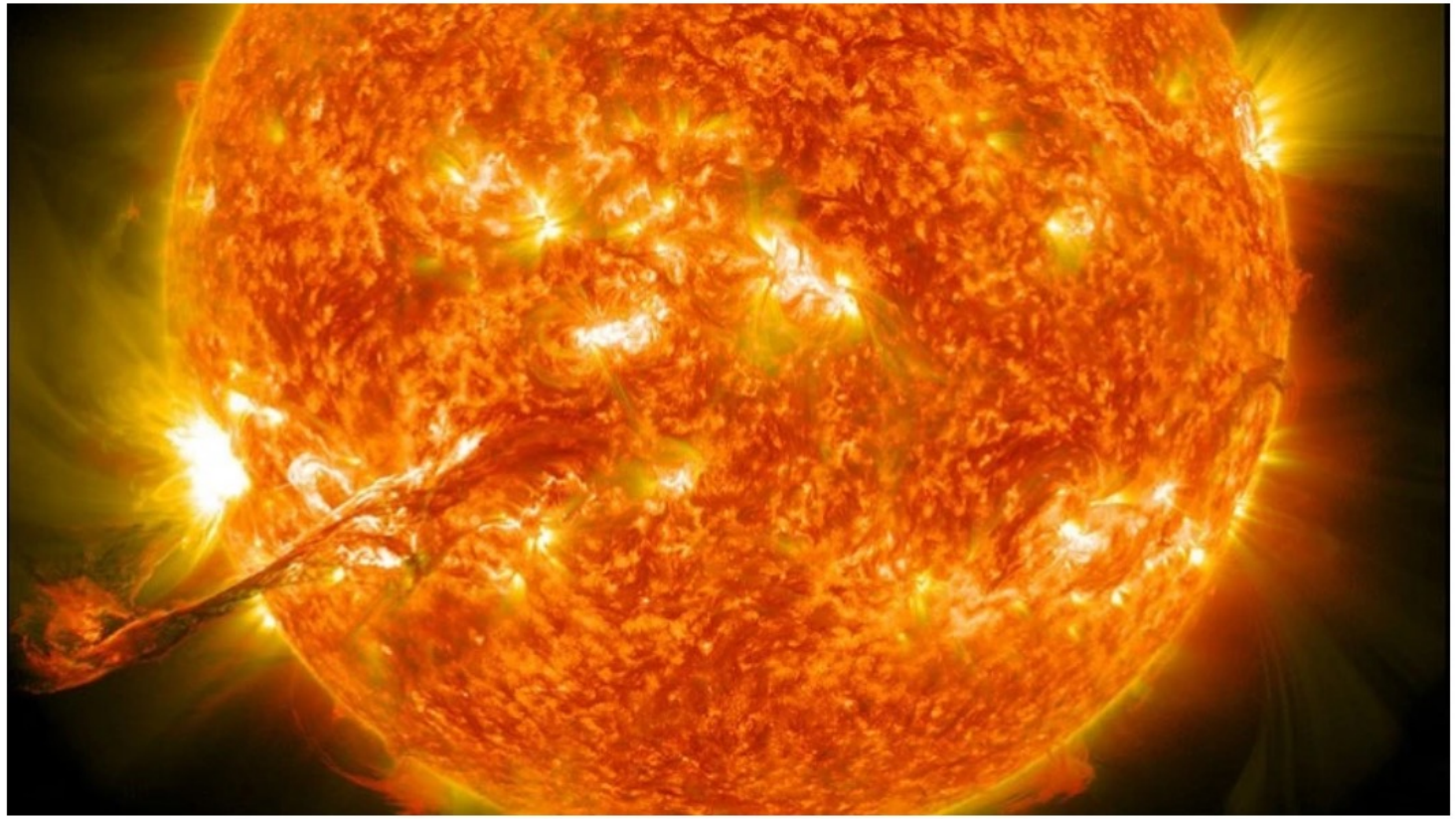
And toasters…



Environmental factors can affect technology

Solar storms can destroy satellites with ease – a space weather expert explains the science

Forty Starlink satellites were destroyed earlier this year in a geomagnetic storm.



NASA/GSFC/SDO / WikimediaCommons

How we use technology changes, based on age, culture, and other factors

1998

- Don’t get into strangers’ cars
- Don’t meet people from the Internet

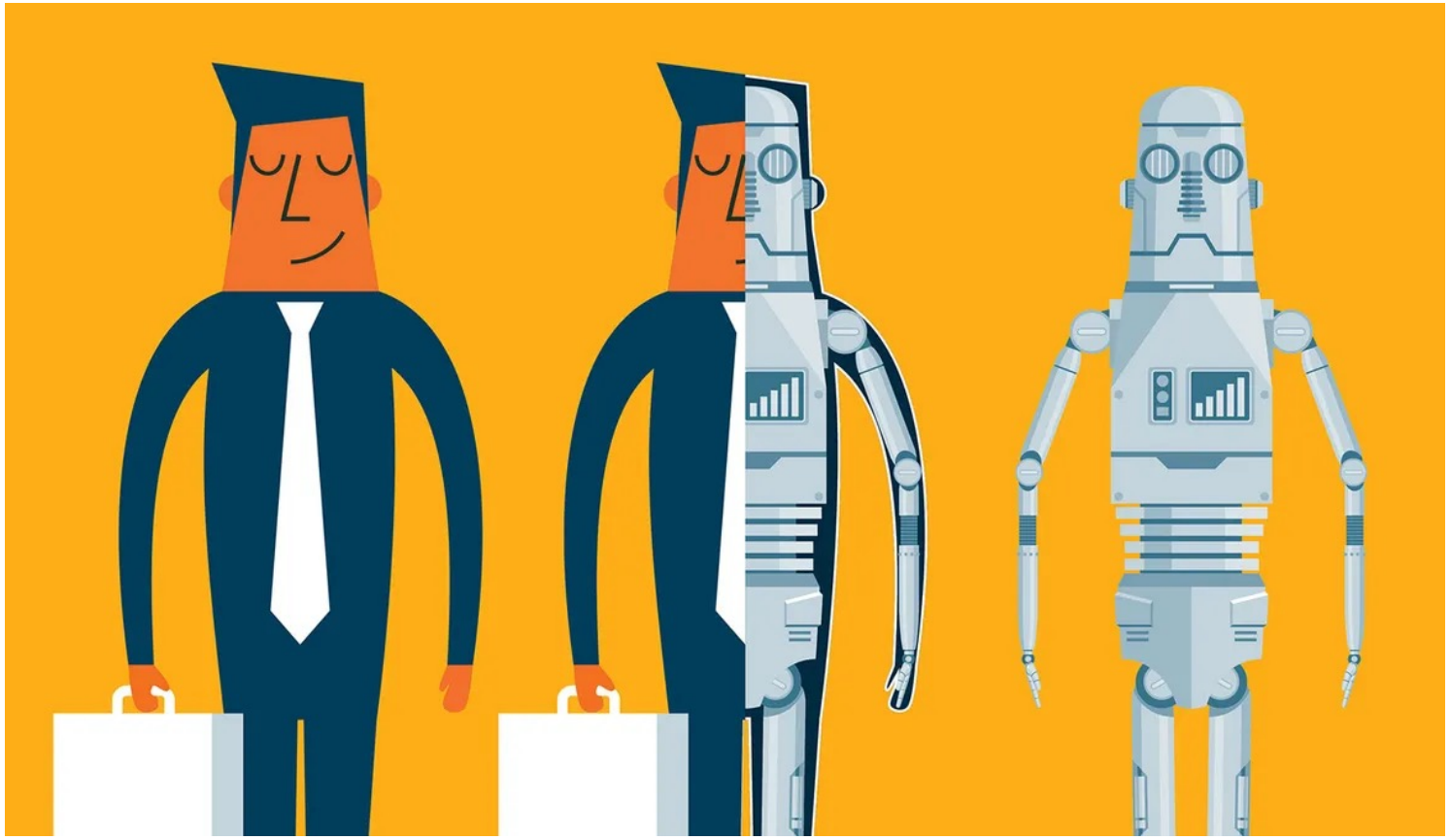
2017

- Literally summon strangers from the Internet so you can ride in their car

Original source unknown

Ethical Concerns

Ethical concerns



- Advanced technology without an ethical roadmap can lead to:
  - Loss of privacy
  - Abuse of personal information
  - Increased inequity between different groups
  - Workers replaced in many fields by AI and Robotic Process Automation
  - Health & safety concerns

Darrell M. West
Brookings Institution, Washington D. C., USA

Robotics displaces workers

https://www.bbvaopenmind.com/en/articles/technological-progress-and-potential-future-risks/

"Emerging technologies, such as industrial robots, artificial intelligence, and machine learning, are advancing at a rapid pace. These developments can improve the speed, quality, and cost of goods and services, but they also displace large numbers of workers. This possibility challenges the traditional benefits model of tying health care and retirement savings to jobs. In an economy that employs dramatically fewer workers, we need to think about how to deliver benefits to displaced workers. If automation makes jobs less secure in the future, there needs to be a way to deliver benefits outside of employment. "Flexicurity," or flexible security, is one idea for providing health care, education, and housing assistance, whether or not someone is formally employed. In addition, activity accounts can finance lifelong education and worker retraining. No matter how people choose to spend time, there needs to be ways for people to live fulfilling lives even if society needs fewer workers.

Alessandro Civati
CEO LutinX Inc. .|. Innovation 💡 .|. Writer 🖋️ .|. Influencer 📣 .|. Blockchain 🚀 .|. Cyber Security 🔐

75 articles

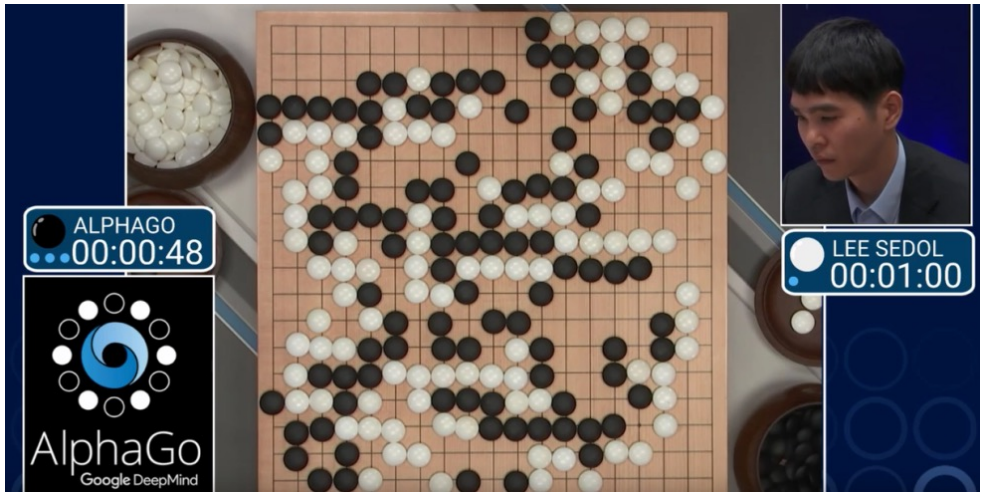
Over the past several years, artificial intelligence and machine learning have radically transformed society. Social networks are lauded for creating connections and bringing people together. However, a study published in the *Scientific Reports* journal indicates that algorithms worsen existing inequalities and discriminate against specific groups of people. Sociologists have always acknowledged the existence of inequalities in any domain of society and equally recognize that the benefits and harms of technology are not evenly distributed. The most pertinent questions have been directed at developers of new algorithmic technologies.

ACQUISITION

DHS seeks to automate video surveillance on 'soft targets' like transit systems, schools

Artificial intelligence (AI) has solved one of biology's grand challenges: **predicting how proteins fold from a chain of amino acids into 3D shapes that carry out life's tasks**. This week, organizers of a protein-folding competition announced the achievement by researchers at DeepMind, a U.K.-based AI company.

https://www.science.org › doi › science.370.6521.1144



INNOVATION

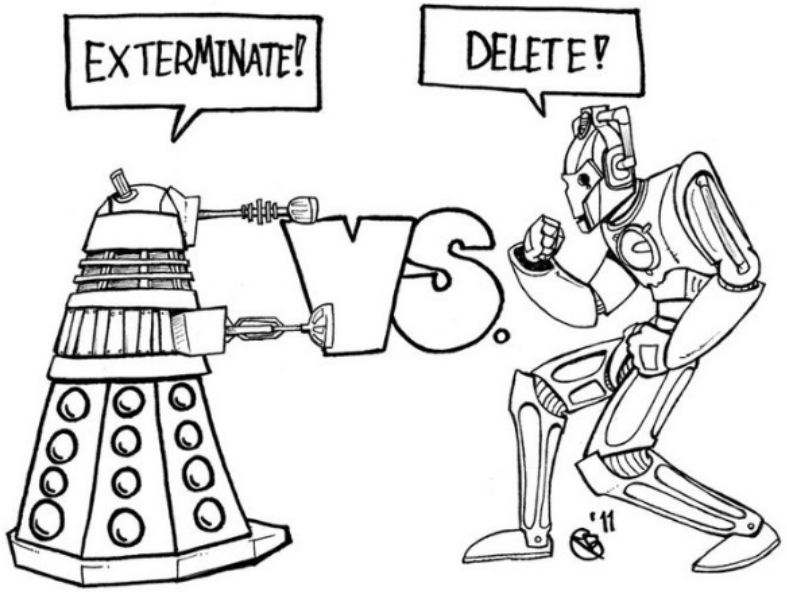
An artificial intelligence model invents 40,000 chemical weapons in just 6 hours

The model was built to search for helpful drugs.

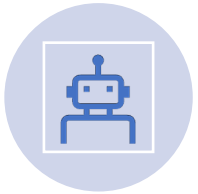
By Loukia Papadopoulos
Mar 21, 2022 (Updated: Mar 22, 2022 12:59 EDT)

A person in protective suits. Andrey Shalari/iStock

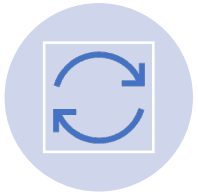
The truth behind Facebook AI inventing a new language *Hint: Not as bad as it sounds.*



Humane Technology



Respects human minds



Minimizes unintended harm

Centers human values

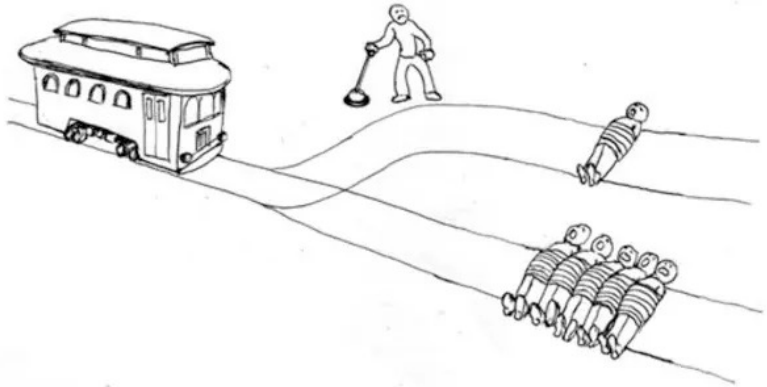
Creates shared understanding

Narrows gaps of inequity

Helps people thrive

Mitigation

- Consider ethical, security & privacy issues at onset, not after it is in use
- Define and follow (international) standards and protocols
- Ethical inspection and consensus on path forward with advanced technology (new can be better… not always)
- Threat modeling and risk-based security controls
- Regulations (*good, bad & ugly)* – not always best solution, but sometimes necessary – these can be global but are often local
- Architect for future state (what should it do and what will it need to integrate with?)
  - Security/Privacy by design
  - Leverage complementary technologies (such as Blockchain)
- Philosophy applied to technology: There isn't always a perfect solution. Seldom is. Think: Kobayashi Maru - or - Trolley Problem
- It is important to bring together people with different expertise and background to have varied points of view to reach an informed consensus



Respond with “Smarter” layered security

Once we have assessed our security risk, we identify controls to mitigate risk, or we transfer or accept risk. [Risk transfer includes cyber insurance.] Controls may be technical, but also involve people and processes. They may be “traditional” or leverage new technology, such as machine learning.

SECURITY SYNERGY

To determine the total effectiveness of one or more synergistic controls, use the following equation (E = effectiveness of a single control). As the chart indicates, using multiple ineffective controls together results in effective control overall.

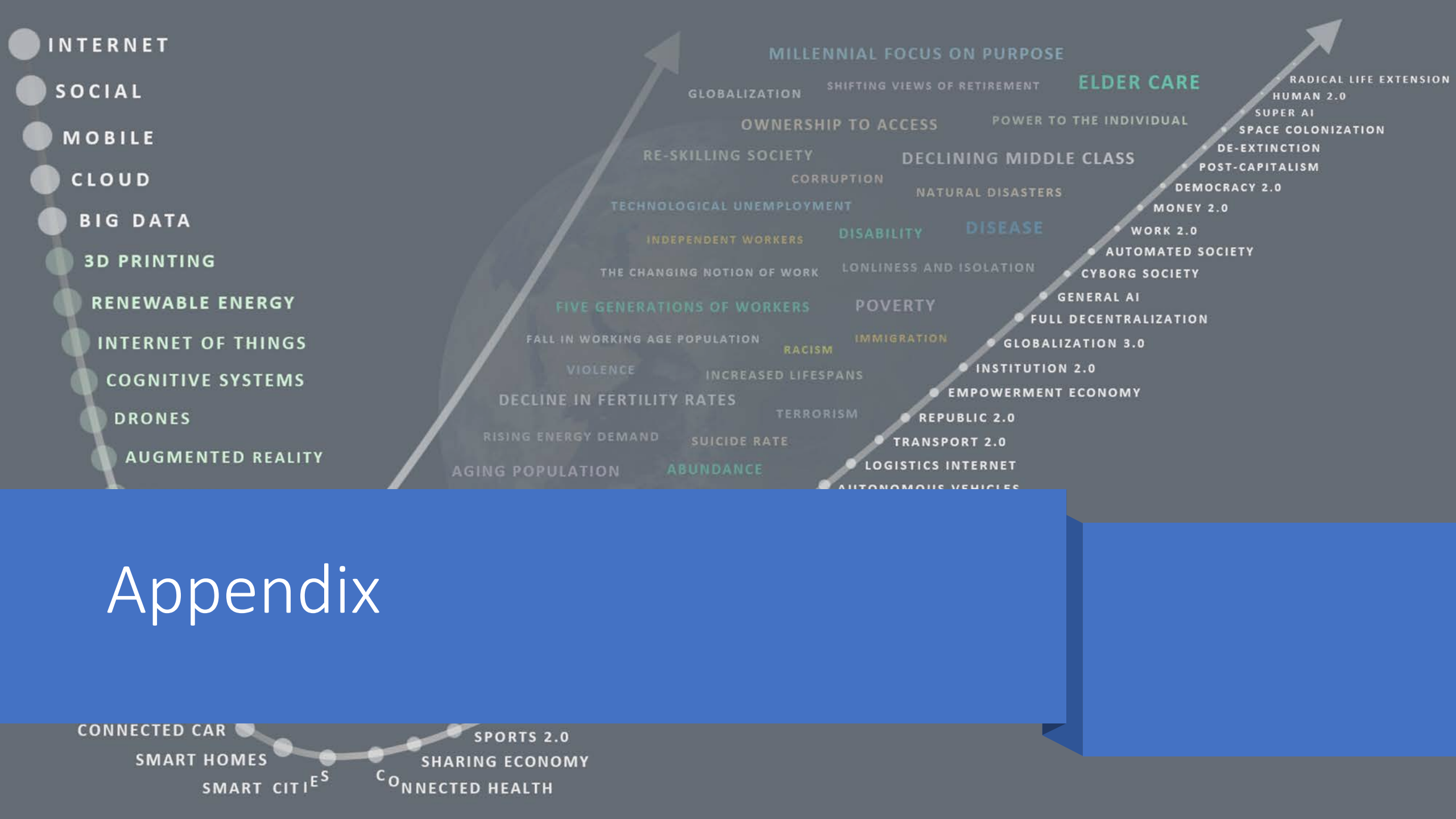
Baye's Theorem: $E_{total} = 1-((1-E1)*(1-E2)*(1-E3)...)$

# of Synergistic Controls	Efficacy of Each Control			
	60%	70%	80%	90%
1	60.0%	70.0%	80.0%	90.0%
2	84.0%	91.0%	96.0%	99.0%
3	93.6%	97.3%	99.2%	99.9%
4	94.7%	99.2%	99.8%	100.0%
5	99.0%	99.8%	100.0%	100.0%

- Risk can never be eliminated, but it can be mitigated (reduced to acceptable level). Layered security is the most effective way to do this.
- We must not rely on purely reactive, technical security controls.
- We must leverage advanced technology and consider ethical issues up front.
- We must prepare for failure and practice how we respond and recover.

Conclusion

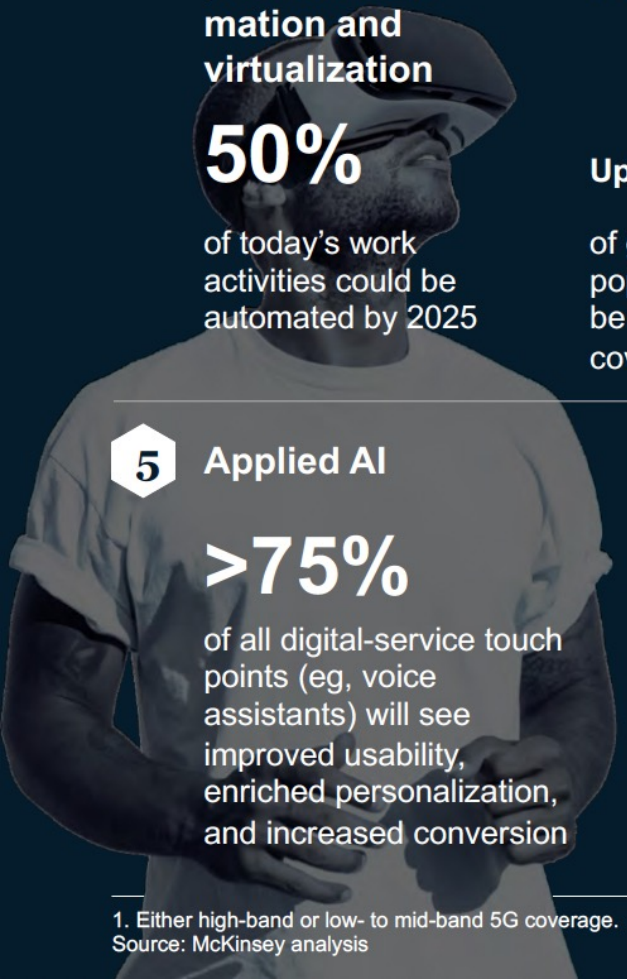
- We can’t continue to use failed models
- Leverage common standards and protocols
- Industry self-regulation (i.e., PCI) or government regulations may be needed
- We must consider the big picture and long-term implications
- Build resiliency in processes and architecture, and safe failure modes
- Stay on top of changes to technology and regulations
- The benefits of technology outweigh the negatives with due diligence
- The most disruptive technologies that will drive the 4th Industrial Revolution may not yet be invented
- The future will come fast, and we should hold on for the ride!


INTERNET
SOCIAL
MOBILE
CLOUD
BIG DATA
3D PRINTING
RENEWABLE ENERGY
INTERNET OF THINGS
COGNITIVE SYSTEMS
DRONES
AUGMENTED REALITY
MILLENNIAL FOCUS ON PURPOSE
GLOBALIZATION
SHIFTING VIEWS OF RETIREMENT
ELDER CARE
OWNERSHIP TO ACCESS
POWER TO THE INDIVIDUAL
RE-SKILLING SOCIETY
DECLINING MIDDLE CLASS
CORRUPTION
NATURAL DISASTERS
TECHNOLOGICAL UNEMPLOYMENT
DISABILITY
DISEASE
INDEPENDENT WORKERS
THE CHANGING NOTION OF WORK
LONLINESS AND ISOLATION
FIVE GENERATIONS OF WORKERS
POVERTY
FALL IN WORKING AGE POPULATION
IMMIGRATION
RACISM
VIOLENCE
INCREASED LIFESPANS
DECLINE IN FERTILITY RATES
TERRORISM
RISING ENERGY DEMAND
SUICIDE RATE
AGING POPULATION
ABUNDANCE
RADICAL LIFE EXTENSION
HUMAN 2.0
SUPER AI
SPACE COLONIZATION
DE-EXTINCTION
POST-CAPITALISM
DEMOCRACY 2.0
MONEY 2.0
WORK 2.0
AUTOMATED SOCIETY
CYBORG SOCIETY
GENERAL AI
FULL DECENTRALIZATION
GLOBALIZATION 3.0
INSTITUTION 2.0
EMPOWERMENT ECONOMY
REPUBLIC 2.0
TRANSPORT 2.0
LOGISTICS INTERNET
CONNECTED CAR
SMART HOMES
SMART CITIES
CONNECTED HEALTH
SHARING ECONOMY
SPORTS 2.0

Appendix

...that could reshape the future of markets and industries in the next few decades.

Effects of technology trends up to 2050



1 Next-level process auto-mation and virtualization

50%

of today's work activities could be automated by 2025

2 Future of connectivity

Up to 80%

of global population could be reached by 5G coverage[1] by 2030

3 Distributed infrastructure

>75%

of enterprise-generated data will be processed by edge or cloud computing by 2025

4 Next-generation computing

>$1 trillion

value potential of quantum-computing use cases at full scale by 2035

5 Applied AI

>75%

of all digital-service touch points (eg, voice assistants) will see improved usability, enriched personalization, and increased conversion

6 Future of programming

~30×

reduction in the working time required for software development and analytics

7 Trust architecture

~10%

of global GDP could be associated with blockchain by 2027

8 Bio Revolution

45×

cost reduction for sequencing the human genome has been achieved in the past 10 years

9 Next-generation materials

10×

growth in number of patents between 2008 and 2018

10 Future of clean technologies

>75%

of global energy will be produced by renewables in 2050

1. Either high-band or low- to mid-band 5G coverage.
Source: McKinsey analysis

Seven cross-industry technology trends will disrupt company strategy, organization, and operations…

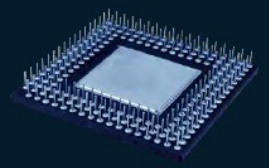
Disruptions across 7 cross-industry trends

Tech-trend clusters			Disruptions
1 **A. Next-level process automation**		Industrial IoT[1] Robots/cobots[2]/ RPA[3]	**Self-learning, reconfigurable robots** will drive automation of physical processes beyond routine activities to include less predictable ones, leading to fewer people working in these activities and a **reconfiguration of the workforce;** policy makers will be challenged to address labor displacement, even as organizations will need to rethink the future of work
B. Process virtualization		Digital twins 3-D/4-D printing	**Advanced simulations and 3-D/4-D printing** will virtualize and dematerialize processes, shortening development cycles as ever-shorter product and service life cycles continue to accelerate, further **pressuring profit pools and speeding strategic and operational practices** that tightly correlate with successful digital efforts
2 **Future of connectivity**		5G and IoT connectivity	With either high-band or low- to mid-band 5G reaching up to 80% of the global population by 2030, enhanced coverage and speed of connections across long and short distances will enable **new services** (eg, remote patient monitoring), **business models** (eg, connected services), and **next-generation customer experiences** (eg, live VR)
3 **Distributed infrastructure**		Cloud & edge computing	Wide availability of IT infrastructure and services through cloud computing could **shift demand for on-premise IT infrastructure and reduce the need for IT setup and maintenance**, while the democratization of infrastructure will help **shift competitive advantage** away from IT to software development and talent.

1. Internet of things. 2. Collaborative robots. 3. Robotic process automation.

Seven cross-industry technology trends will disrupt company strategy, organization, and operations... (continued)

Disruptions across 7 cross-industry trends

Tech-trend clusters			Disruptions
4 **Next-generation computing**		Quantum computing ASICs[4]	**High computational capabilities allow new use cases**, such as molecule-level simulation, reducing the empirical expertise and testing needed for a range of applications and leading to the following: disruption across industries such as materials, chemicals, and pharmaceuticals; highly **personalized product developments**, for instance in medicine; the ability to break the majority of **cryptographic security algorithms**, disrupting today's cybersecurity approaches; and the faster diffusion of **self-driving vehicles**
5 **Applied AI**		Computer vision, natural-language processing, and speech technology	As AI matures and continues to scale, it will enable **new applications** (eg, more rapid development cycles and detailed customer insights), **eliminate labor for repetitive tasks** (eg, filing, document preparation, and indexing), and support the **global reach of highly specialized services and talent** (eg, improved telemedicine and the ability of specialized engineers to work on oil rigs from the safety of land)
6 **Future of programming**		Software 2.0	Software 2.0 creates new ways of writing software and reduces complexity; however, as companies look to **scale their software-development capabilities**, they will need to **master DataOps and MLOps[5] practices** and technology to make the most of the future of programming
7 **Trust architecture**		Zero-trust security Blockchain	Trust architectures help commercial entities and individuals **establish trust and conduct business without need for intermediaries**, even as zero-trust-security measures address growing cyberattacks; countries and regulatory bodies may likely have to **rethink regulatory oversight;** distributed-ledger technologies will reduce cost and enable transformative business models

4. Application-specific integrated circuits.
5. DataOps supports and enables better data analytics; MLOps combines infrastructure, tools, and workflows to provide faster and more reliable machine-learning pipelines.

…and three industry-specific technology trends can help solve humanity's biggest challenges.

Disruptions across 3 cross-industry trends

Tech-trend clusters			Disruptions
8 **Bio Revolution**		Biomolecules/"-omics"/ Biosystems Biomachines/biocomputing/ augmentation	"-omics" enable **rapid analysis of genetic materials** and open up possibilities (eg, for rapid vaccine development, personalized medicine, and gene therapy) Using **biological material for computing purposes** can enable a vast expansion of data storage using DNA as the information medium
9 **Next-generation materials**		Nanomaterials, graphene and 2-D materials, and molybdenum disulfide nanoparticles	By changing the economics of a wide range of products and services, next-generation materials may change industry economics and reconfigure companies within them (eg, by allowing for the integration of **sustainable materials and renewable energy sources** into processes), even as innovations in materials science help create **smart materials with programmable properties** that respond to stimuli from external factors
10 **Future of clean technologies**		Nuclear fusion Smart distribution/metering Battery/battery storage Carbon-neutral energy generation	As clean technologies come down the cost curve, they become increasingly disruptive to traditional business models, creating new **business-building** opportunities, **operational-improvement** programs driven by clean technologies, and new **climate-change mandates** that could alter the balance sheet of carbon-intense sectors—all while providing the **green energy** needed to sustain exponential technology growth

The combinatorial effect of technology amplifies and accelerates new business models and innovation...

Mutually reinforcing technology leads to exponential growth.

Outcomes of 3 levels of combinatorial effects on cross-industry tech trends

Infrastructure and architecture

2 Future of connectivity

5G and IoT[1] connectivity

3 Distributed Infrastructure

Cloud and edge computing

7 Trust architecture

Zero-trust security

Blockchain

Enabler

6 Future of programming

Software 2.0 (including MLOps and DataOps)

4 Next-generation computing

Quantum computing

Neuromorphic computing (ASICs[2])

Application

1 Next-level process automation and virtualization

IIoT,[3] Robots/cobots[4]/ RPA,[5] Digital twins, 3-D/4-D printing

5 Applied AI

Computer vision, natural-language processing, and speech technology

New business models and innovation

New **programming modalities** to achieve robust models and build applications faster (eg, MLOps, federated learning)

Novel **architecture paradigms** focusing on orchestration of infrastructure, increasing resilience, flexibility, and speed (e.g., decoupled, microservice-based)

Dedicated hardware delivering **increased computing power**, diffused through new levels of connectivity (eg, edge-based processing or 5G)

1. Internet of things. 2. Application-specific integrated circuits. 3. Industrial Internet of Things. 4. Collaborative robots. 5. Robotic process automation.

5 areas of risk for new technology implementations

Business

Taking primary responsibility for soundness and application of data ethics and maintaining a data-driven culture

Developing appropriate processes and control

Adhering to regulatory and policy requirements

Fostering a culture of data-driven decision making and ethics as an enabler and not as an inhibitor of business-value creation

Society

Safeguarding of societal values from business actions and maintaining internal awareness about societal duty of organization

Engaging actively in societal development and local communities

Proactively waterproofing business actions to be in line with societal norms and promoting inclusion

Openly embracing diversity

Operational risk

Establish robustness of processes and control and mitigate operational risk

Monitoring of processes and controls to operationalize data-ethics codes

Measuring and prioritizing operational risks

Leading enterprise-wide activities to reduce risk through an appropriate data-driven culture (eg, avoid biases)

Compliance

Ensure compliance with a data-driven culture, regulations, and internal policies

Policy design in accordance with regulatory requirements

Information, education, and advice for business on regulatory and policy requirements

Continuous surveys and monitoring of activities and reporting/managing of incidents due to noncompliance

Legal

Proactively advise business lines and rest of organization with legal matters

Expert advice in transactions

External counsel

Advice on general internal-management issues requiring legal expertise, (eg, data-access restrictions)

Source: McKinsey analysis