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Introduction

Academia

PhD – UPC BarcelonaTech Spain

Microsoft Cambridge, IBM, Barcelona Supercomputing Center, PLDA Italia

Proven successful record of academic management as Professor and Dean.

Enhanced Quality of academic **outcomes** into **applied and sustainable projects.**

Research

Developed Labs Supercomputing, Distributed Artificial Intelligence, Computer Vision, Software Defined Radio, Parallel programming and Embedded Systems;

80+ publications and **PKR 60+ Million research funding** during the last 5 years.

Introduction

Experience

16+ years' versatile experience of **supercomputing, artificial intelligence and IT** domain in **national** and **international academia**, **industry** and **government**

Development and Commercialization

Developed systems for industrial problems. Transform ideas into applied product, **innovation and commercialization, sustainability and capacity building.** Completed multiple industrial projects having worth of PKR 30+ Million.

Recent Projects (worth 0.6 Million US $)

Development of a patient monitor system

Indigenous Ventilator

High Performance Software Defined Radio System

Scalable Heterogeneous Supercomputing System

BLDC Motor Controller

Tiers

Hardware Architecture (Trillion $)

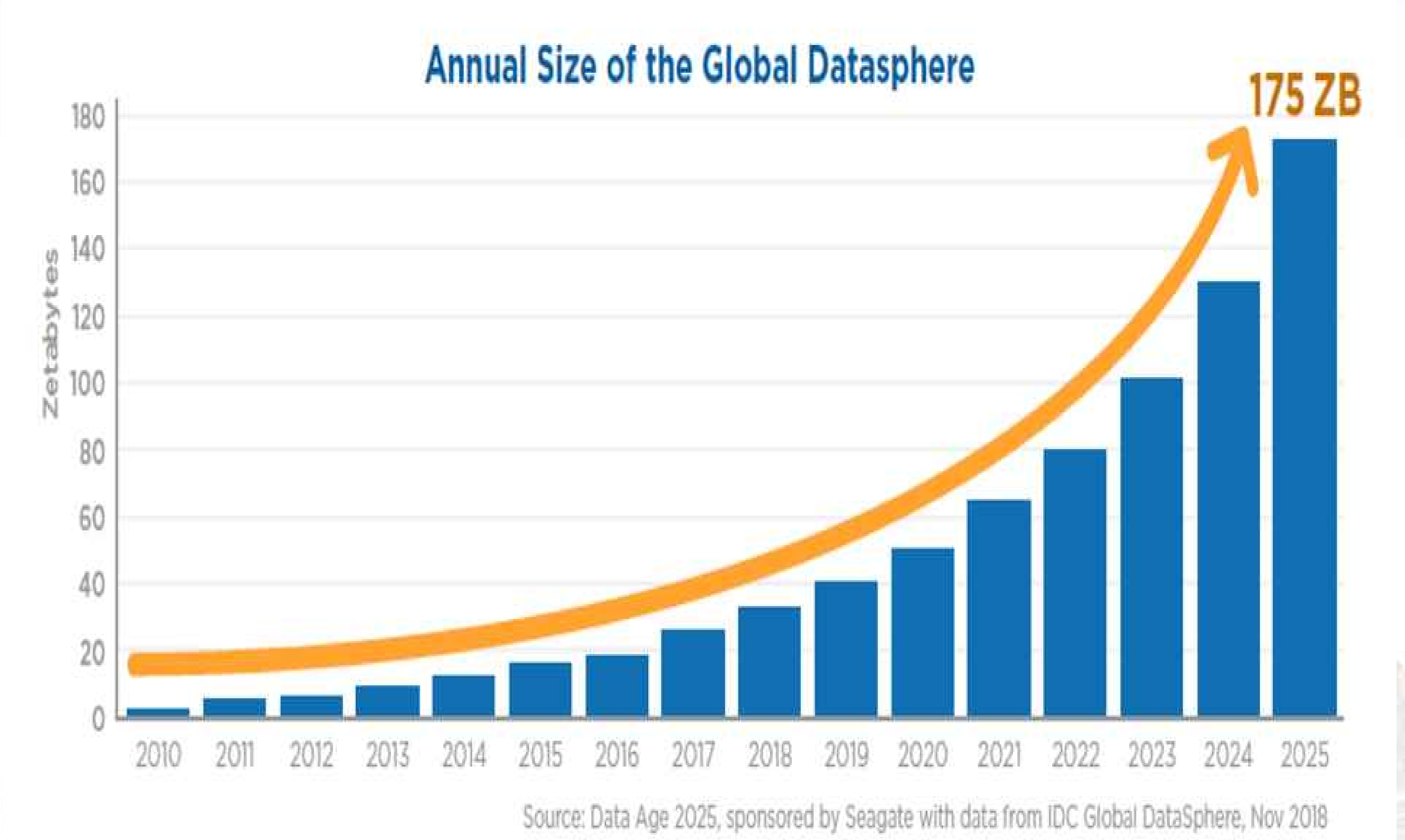
Software Architecture (Multi-Billion $)

Data Architecture (Billion $)

Front-End / Visualization (Million $)

- **Big Data**
- Artificial Intelligence
- Requirements
- Supercomputing
- Pakistan Status
- Expertise and Support

Data Forecast



The Big Business of Big Data

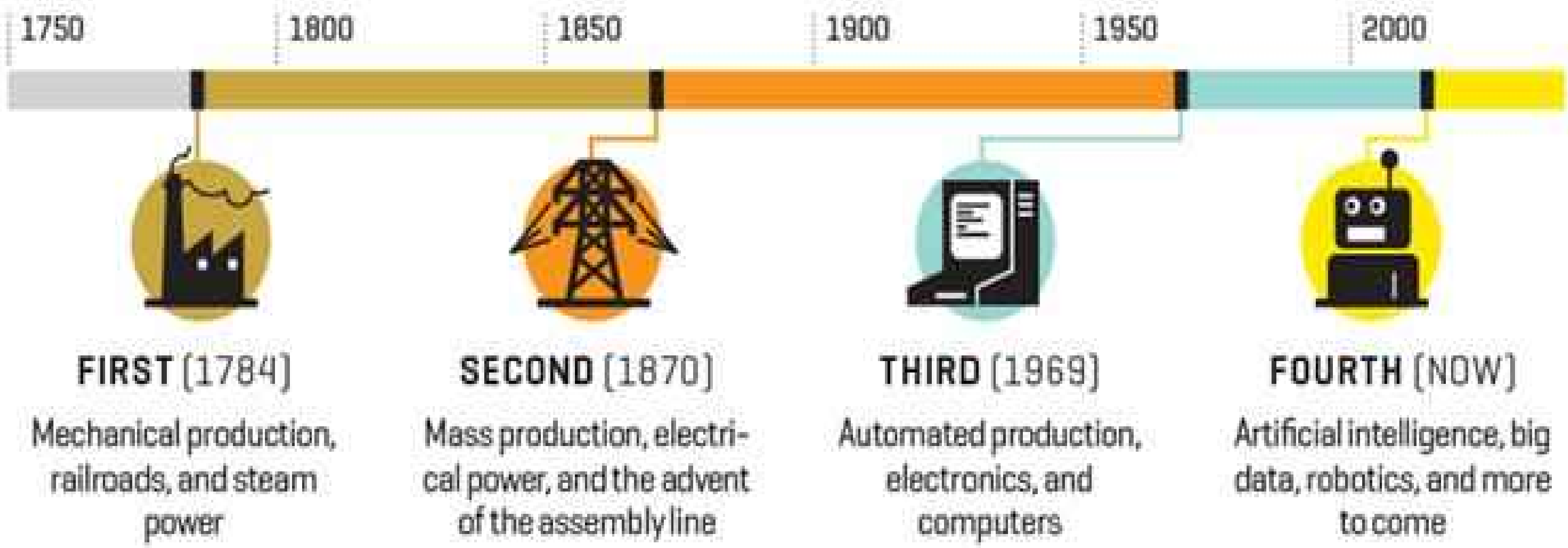
Global big data and business analytics revenue, 2015-2022

* Forecast. Survey time period worldwide between 2015 to 2019.

Source: IDC

- Big Data
- **Artificial Intelligence**
- Requirements
- IoT

Industrial Revolution



Intelligent Algorithms

- Senors Inputs (x) = Algorithm = Decisions Outputs (y)
- Inputs (x) = Program = Outputs (y)
- (Labeled) Outputs (y) = F (x) (computation) => **Program**
- F (x) = Training Models
  - Accuracy
  - Performance

ChatGPT

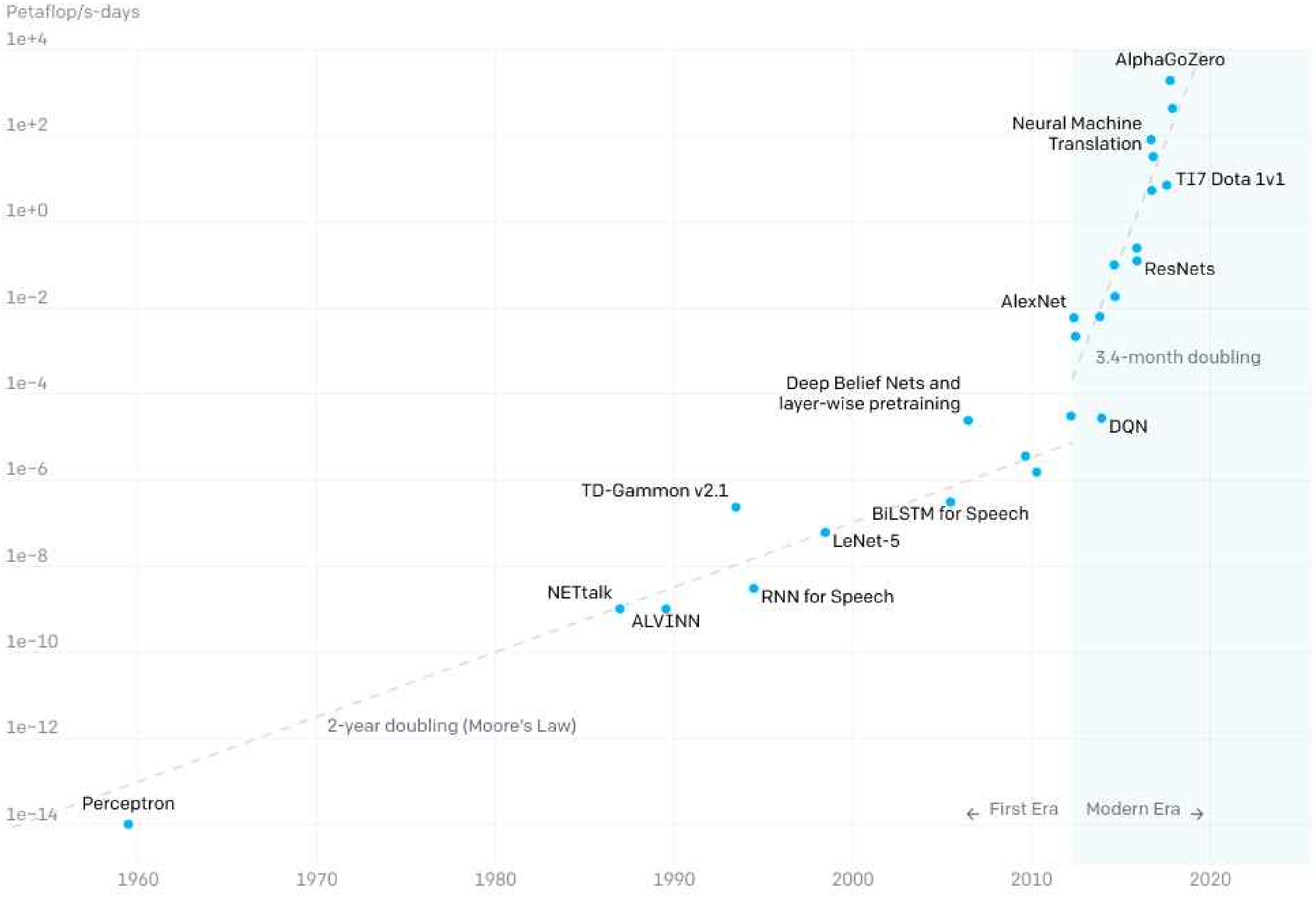
$29 billion

45 Tbyte Training Data

175 billion parameters

Training Cost $12 million

- Big Data
- Artificial Intelligence
- **Requirements**
- IoT



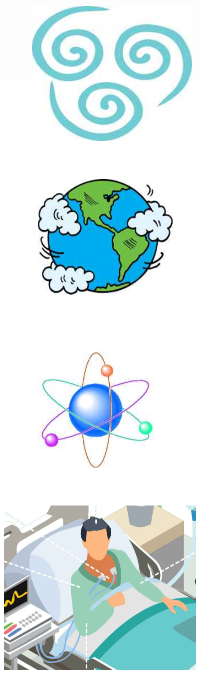
Total amount of calculations, in Petaflop per day, that have been used to train neural networks that have their own name and are referents in the Deep Learning community

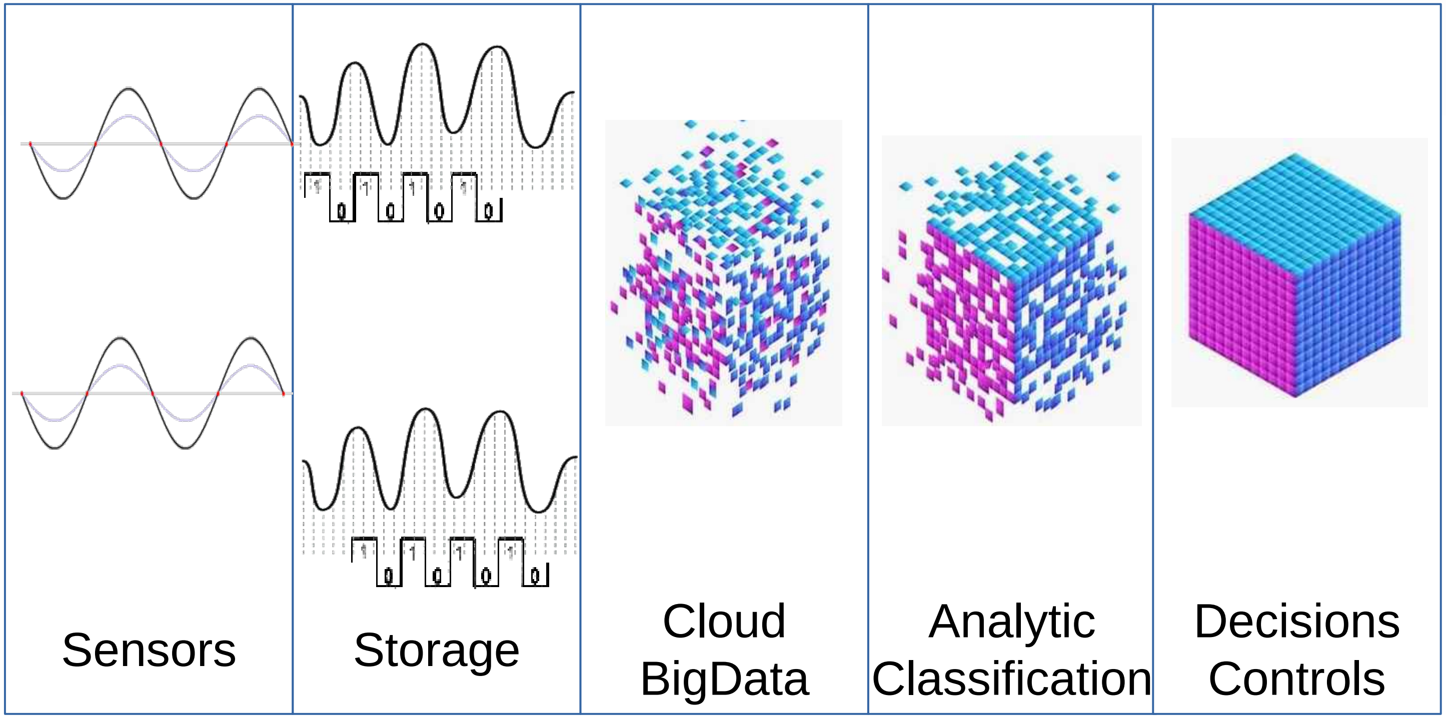
Performance metrics

The term performance for AI has a double interpretation.

- **Speedup.**
- **Accuracy.**
- **Scalability**
  - Data parallelism
  - Model parallelism

- Big Data
- Artificial Intelligence
- Requirements
- **IoT**




Sensors
Storage
Cloud
BigData
Analytic
Classification
Decisions
Controls


FUTURE SCOPE OF
COMPUTING

Definition

“The Internet of things describes physical objects with sensors, processing ability, software and other technologies that connect and exchange data with other devices and systems over the Internet or other communications networks. “ Wikipedia

Things

- **Physical things** exist in the physical world and are capable of being sensed, actuated and connected. Examples of physical things include the surrounding environment, industrial robots, goods and electrical equipment.
- **Virtual things** exist in the information world and are capable of being stored, processed and accessed. Examples of virtual things include multimedia content and application software.

ITU Definition

A device is a piece of equipment with the mandatory capabilities of **communication** and **optional capabilities of sensing**, **actuation**, **data capture**, **data storage** and **data processing**.

The devices collect various kinds of **information** and provide it to the information and **communication networks** for **further processing**.

Some devices also **execute operations** based on information received from the information and communication networks.

Interconnectivity: With regard to the IoT, anything can be interconnected with the global information and communication infrastructure.

Heterogeneity: The devices in the IoT are heterogeneous as based on different hardware platforms and networks. They can interact with other devices or service platforms through different networks.

Dynamic changes: The state of devices change dynamically, e.g., sleeping and waking up, connected and/or disconnected as well as the context of devices including location and speed. Moreover, the number of devices can change dynamically.

Enormous scale: The number of devices that need to be managed and that communicate with each other will be at least an order of magnitude larger than the devices connected to the current Internet. The ratio of communication triggered by devices as compared to communication triggered by humans will noticeably shift towards device-triggered communication.

Microsoft CEO (2007) laughed at the **price tag** and the fact that the **iphone** didnt **have** a **keyboard** and so had no appeal for business users.

“

This telephone has too many shortcomings to be seriously considered as a means of communication. The device is inherently of no value to us.

Western Union internal memo
1876

”

“I think there is a world market for maybe five computers.”

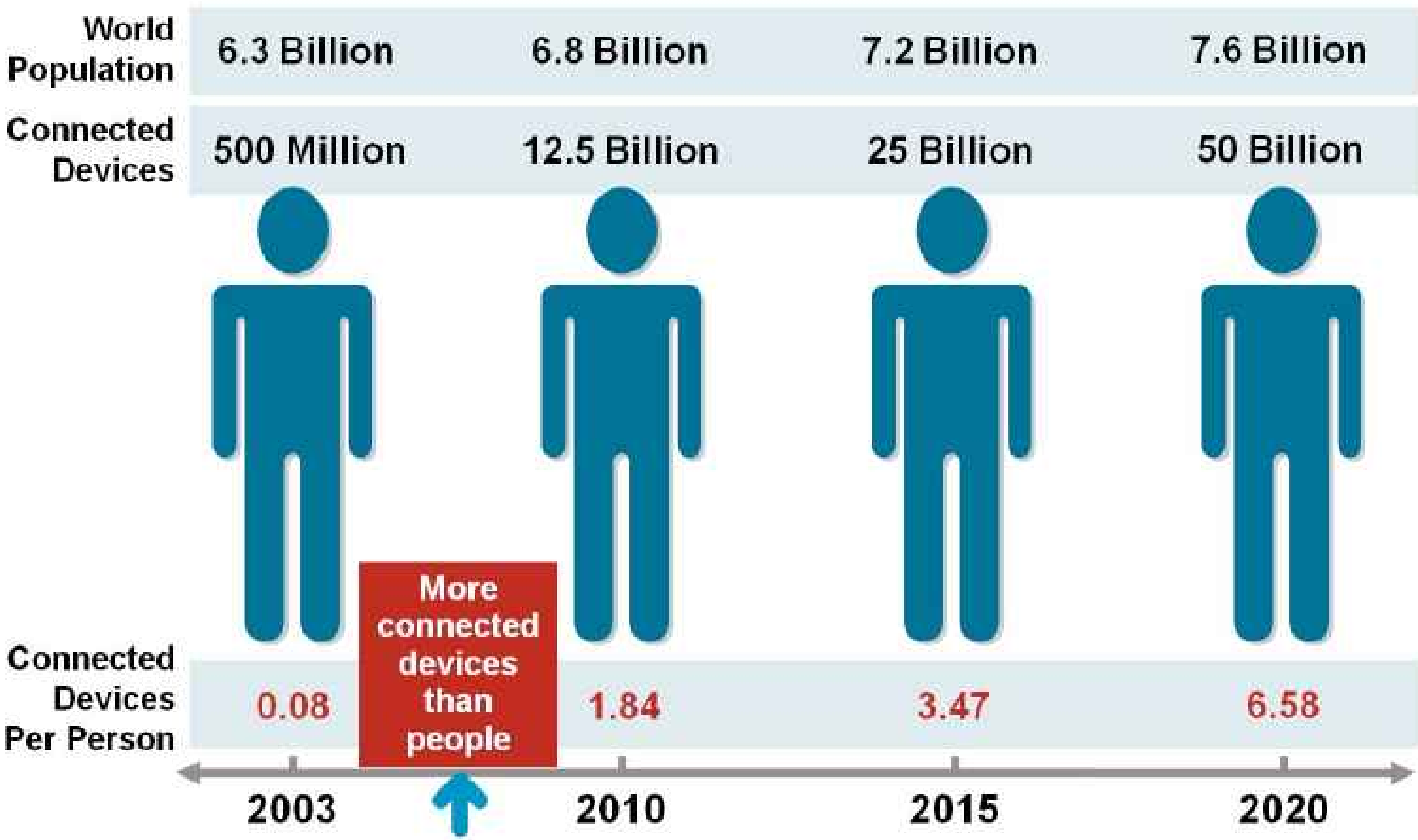
Thomas Watson
Chairman, IBM
1943

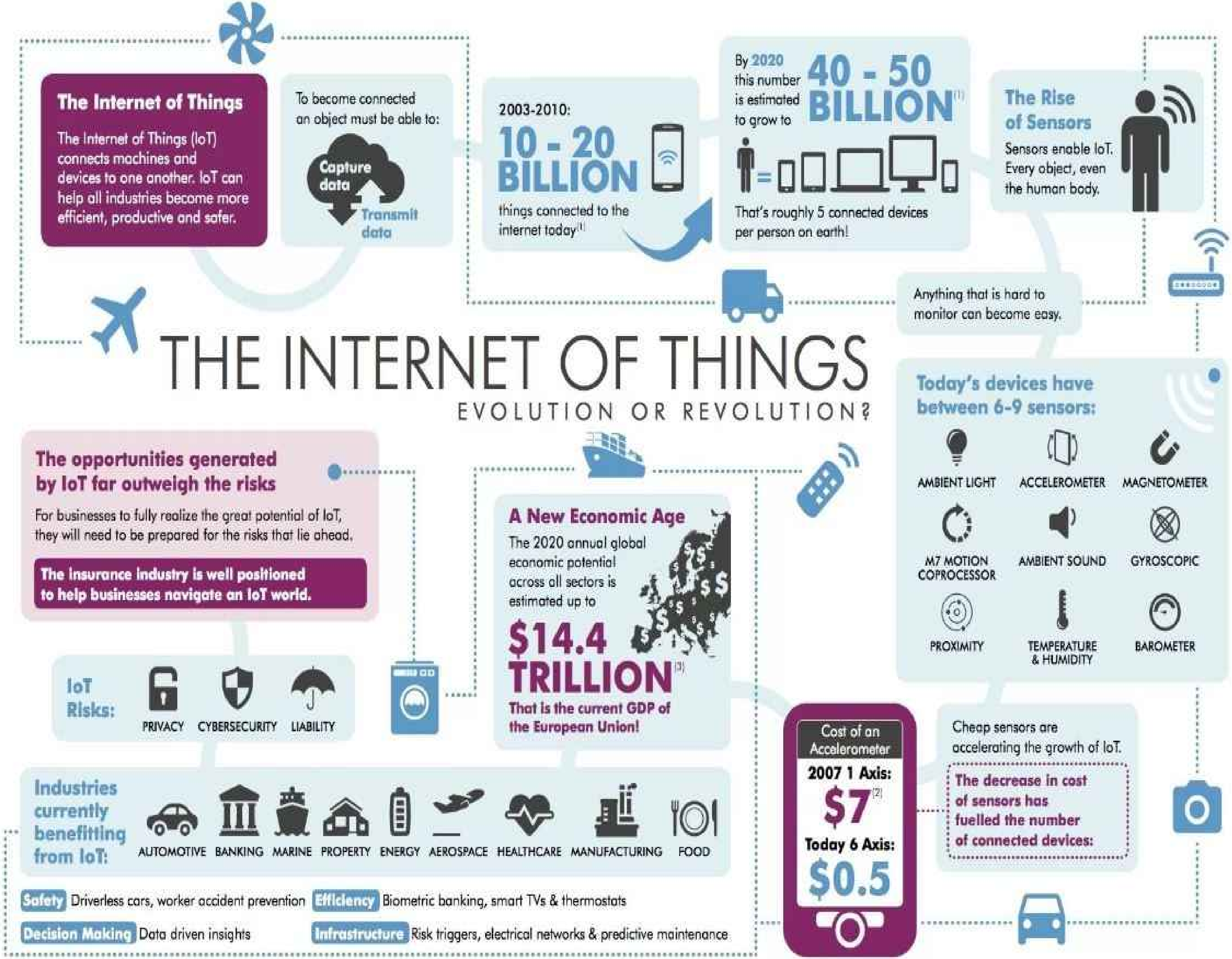
“

There is no reason why anyone would want a computer in their home.

Ken Olsen
Founder, Digital Equipment Corp.
1977

”


World Population
6.3 Billion
6.8 Billion
7.2 Billion
7.6 Billion
Connected Devices
500 Million
12.5 Billion
25 Billion
50 Billion
Connected Devices Per Person
0.08
More connected devices than people
1.84
3.47
6.58
2003
2010
2015
2020


THE INTERNET OF THINGS
EVOLUTION OR REVOLUTION?
The Internet of Things
The Internet of Things (IoT) connects machines and devices to one another. IoT can help all industries become more efficient, productive and safer.
To become connected an object must be able to:
Capture data
Transmit data
2003-2010:
10 - 20 BILLION
things connected to the internet today[1]
By 2020 this number is estimated to grow to
40 - 50 BILLION[1]
That's roughly 5 connected devices per person on earth!
The Rise of Sensors
Sensors enable IoT. Every object, even the human body.
Anything that is hard to monitor can become easy.
Today's devices have between 6-9 sensors:
AMBIENT LIGHT
ACCELEROMETER
MAGNETOMETER
M7 MOTION COPROCESSOR
AMBIENT SOUND
GYROSCOPIC
PROXIMITY
TEMPERATURE & HUMIDITY
BAROMETER
The opportunities generated by IoT far outweigh the risks
For businesses to fully realize the great potential of IoT, they will need to be prepared for the risks that lie ahead.
The insurance industry is well positioned to help businesses navigate an IoT world.
IoT Risks:
PRIVACY
CYBERSECURITY
LIABILITY
A New Economic Age
The 2020 annual global economic potential across all sectors is estimated up to
$14.4 TRILLION[3]
That is the current GDP of the European Union!
Cost of an Accelerometer
2007 1 Axis:
$7[2]
Today 6 Axis:
$0.5
Cheap sensors are accelerating the growth of IoT.
The decrease in cost of sensors has fuelled the number of connected devices:
Industries currently benefitting from IoT:
AUTOMOTIVE
BANKING
MARINE
PROPERTY
ENERGY
AEROSPACE
HEALTHCARE
MANUFACTURING
FOOD
Safety Driverless cars, worker accident prevention
Efficiency Biometric banking, smart TVs & thermostats
Decision Making Data driven insights
Infrastructure Risk triggers, electrical networks & predictive maintenance

26.66 Billion

Number of active IoT devices worldwide as of 2020

Source: Security Today, 2020

FinancesOnline
REVIEWS FOR BUSINESS

History of IoT

The first telemetry system was rolled out in Chicago way back in 1912. It is said to have used telephone lines to monitor data from power plants.

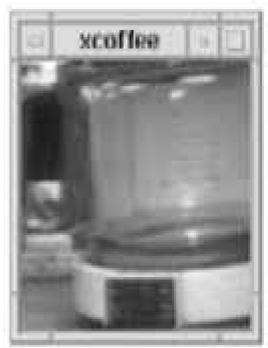
Telemetry expanded to weather monitoring in the 1930s, when a device known as a radiosonde became widely used to monitor weather conditions from balloons.

In 1957 the Soviet Union launched Sputnik, and with it the Space Race. This has been the entry of aerospace telemetry that created the basis of our global satellite communications today.

"Machine to Machine" (M2M)
(~1970s +)

Internet of Things Beginnings

Carnegie Mellon Internet
Coke Machine (1982, 1990)



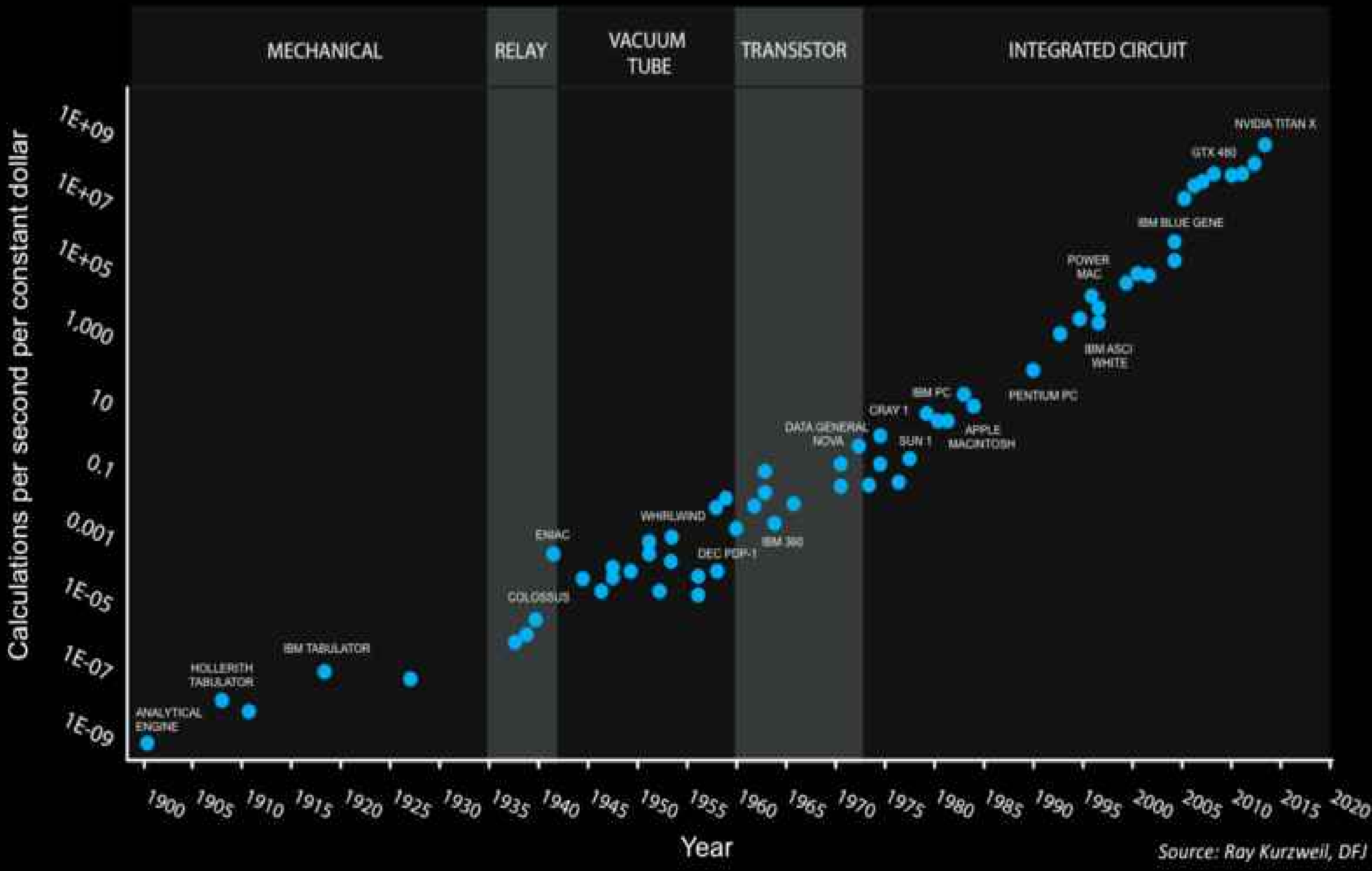
Trojan Room Coffee
Pot
(first webcam)
(1991)

Internet Toaster
(1990)

Why now

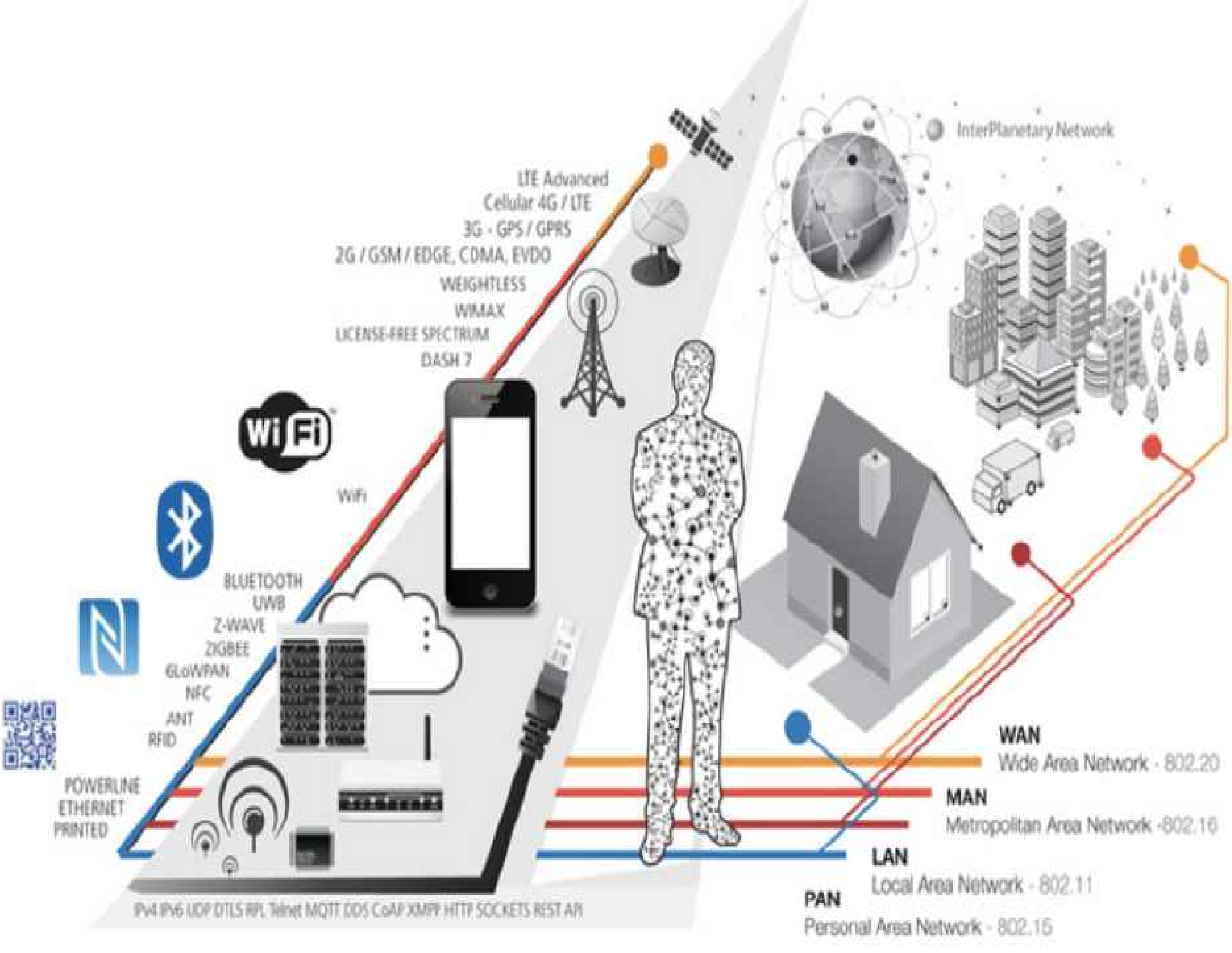
- Ubiquitous Connectivity
- Widespread Adoption of IP
- Computing Economics
- Miniaturization
- Advances in Data Analytics
- Rise of Cloud Computing

120 Years of Moore's Law

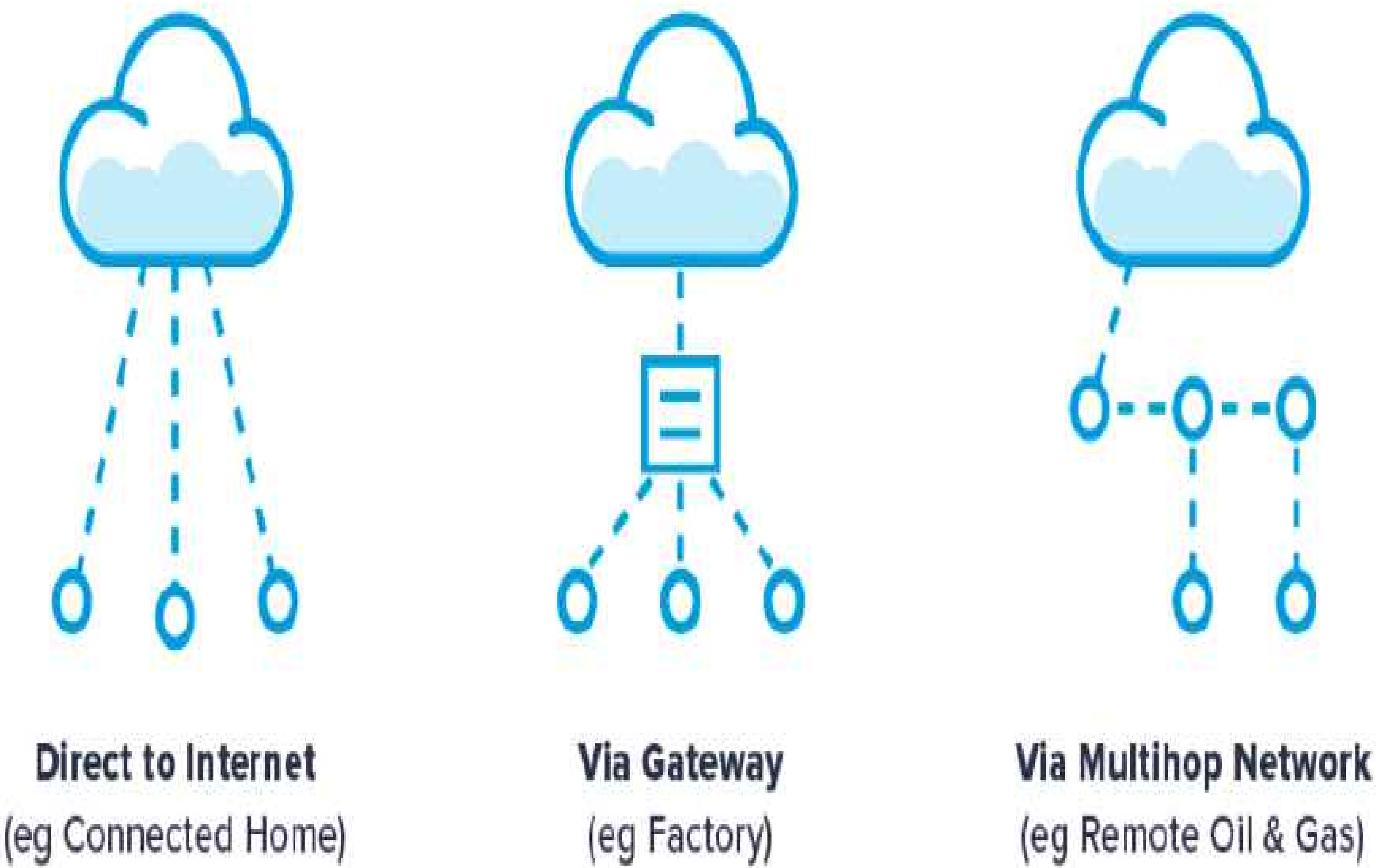


Network Connectivity

- Range - are you deploying to a single office floor or an entire city?
- Data Rate - how much bandwidth do you require? How often does your data change?
- Power - is your sensor running on mains or battery?
- Frequency - have you considered channel blocking and signal interference?
- Security - will your sensors be supporting mission critical applications?


InterPlanetary Network
LTE Advanced
Cellular 4G / LTE
3G - GPS / GPRS
2G / GSM / EDGE, CDMA, EVDO
WEIGHTLESS
WIMAX
LICENSE-FREE SPECTRUM
DASH 7
WiFi
BLUETOOTH
UWB
Z-WAVE
ZIGBEE
6LoWPAN
NFC
ANT
RFID
POWERLINE
ETHERNET
PRINTED
IPv4 IPv6 UDP DTLS RPL Telnet MQTT DDS CoAP XMPP HTTP SOCKETS REST API
WAN
Wide Area Network - 802.20
MAN
Metropolitan Area Network -802.16
LAN
Local Area Network - 802.11
PAN
Personal Area Network - 802.15

3 Possible Device Network Topologies



IPV6

Smart Objects will add tens of billions of additional devices

There is no scope for IPv4 to support Smart Object Networks

IPv6 is the only viable way forward

Solution to address exhaustion

Stateless Auto-configuration thanks to Neighbor

Discovery Protocol

Each embedded node can be individually addressed/accessed

Highest Cost

	Functionality	Sensor Type
$150-$1000+	• Long-term install/deployment • Industrial scale deployment • Extreme accuracy/precision • Typically large enterprises • Ease of solution interoperability	• Chemical/Gas • Electrical/Capacitive • Pressure/Load/Weight • Proximity/Position
$50-$150	• Residential/commercial • Advanced development kits • Consumer-based support • Cloud partnership capability • Fast deployment • Medium infrastructure required • Low-Medium accuracy/Precision	• Water Treatment/Flow • Weather/Temperature • Motion/Velocity • Acoustic/Sound/Vibration • Light/Imaging • Proximity/Position • Flex/Force/Strain
$0 - $50	• Single function • DIY/Prototyping often needed • Limited without other hardware • Requires basic equipment • Geared towards amateurs • Singular functionality • No infrastructure required	• Water Treatment/Flow • Weather/Temperature • Motion/Velocity • Acoustic/Sound/Vibration • Light/Imaging

Lowest Cost

What we will learn

Sensors

Data Acquisition System

Processing System

Communication System

Data Storage System

Data Analytic

Application Development Environment

Operating System and Libraries