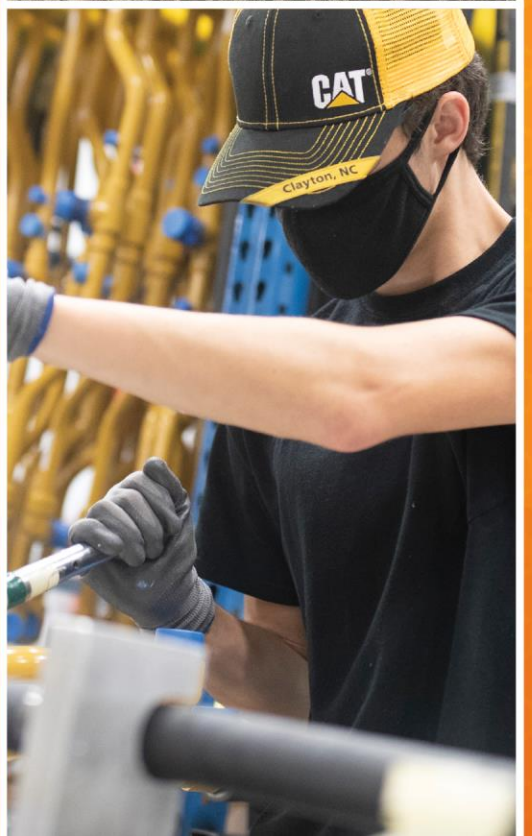
CATERPILLAR®



CATERPILLAR INC.
OVERVIEW

Caterpillar Nonconfidential

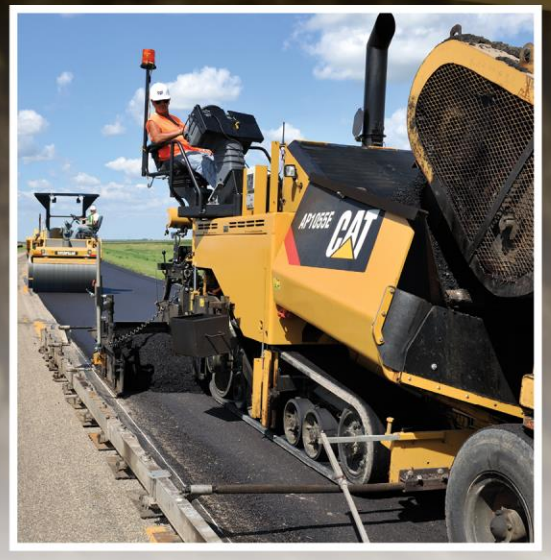
Based on year-end 2020

Forward Looking Statement

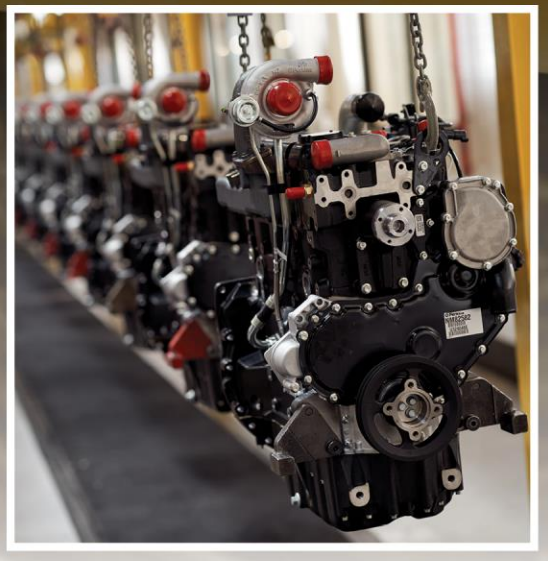
Certain statements in this financial review relate to future events and expectations and are forward-looking statements within the meaning of the Private Securities Litigation Reform Act of 1995. Words such as "believe," "estimate," "will be," "will," "would," "expect," "anticipate," "plan," "forecast," "target," "guide," "project," "intend," "could," "should" or other similar words or expressions often identify forward-looking statements. All statements other than statements of historical fact are forward-looking statements, including, without limitation, statements regarding our outlook, projections, forecasts or trend descriptions. These statements do not guarantee future performance and speak only as of the date they are made, and we do not undertake to update our forward-looking statements.

Caterpillar's actual results may differ materially from those described or implied in our forward-looking statements based on a number of factors, including, but not limited to: (i) global and regional economic conditions and economic conditions in the industries we serve; (ii) commodity price changes, material price increases, fluctuations in demand for our products or significant shortages of material; (iii) government monetary or fiscal policies; (iv) political and economic risks, commercial instability and events beyond our control in the countries in which we operate; (v) international trade policies and their impact on demand for our products and our competitive position, including the imposition of new tariffs or changes in existing tariff rates; (vi) our ability to develop, produce and market quality products that meet our customers' needs; (vii) the impact of the highly competitive environment in which we operate on our sales and pricing; (viii) information technology security threats and computer crime; (ix) inventory management decisions and sourcing practices of our dealers and our OEM customers; (x) a failure to realize, or a delay in realizing, all of the anticipated benefits of our acquisitions, joint ventures or divestitures; (xi) union disputes or other employee relations issues; (xii) adverse effects of unexpected events; (xiii) disruptions or volatility in global financial markets limiting our sources of liquidity or the liquidity of our customers, dealers and suppliers; (xiv) failure to maintain our credit ratings and potential resulting increases to our cost of borrowing and adverse effects on our cost of funds, liquidity, competitive position and access to capital markets; (xv) our Financial Products segment's risks associated with the financial services industry; (xvi) changes in interest rates or market liquidity conditions; (xvii) an increase in delinquencies, repossessions or net losses of Cat Financial's customers; (xviii) currency fluctuations; (xix) our or Cat Financial's compliance with financial and other restrictive covenants in debt agreements; (xx) increased pension plan funding obligations; (xxi) alleged or actual violations of trade or anti-corruption laws and regulations; (xxii) additional tax expense or exposure, including the impact of U.S. tax reform; (xxiii) significant legal proceedings, claims, lawsuits or government investigations; (xxiv) new regulations or changes in financial services regulations; (xxv) compliance with environmental laws and regulations; (xxvi) the duration and geographic spread of, business disruptions caused by, and the overall global economic impact of, the COVID-19 pandemic; and (xxvii) other factors described in more detail in Caterpillar's Forms 10-Q, 10-K and other filings with the Securities and Exchange Commission.

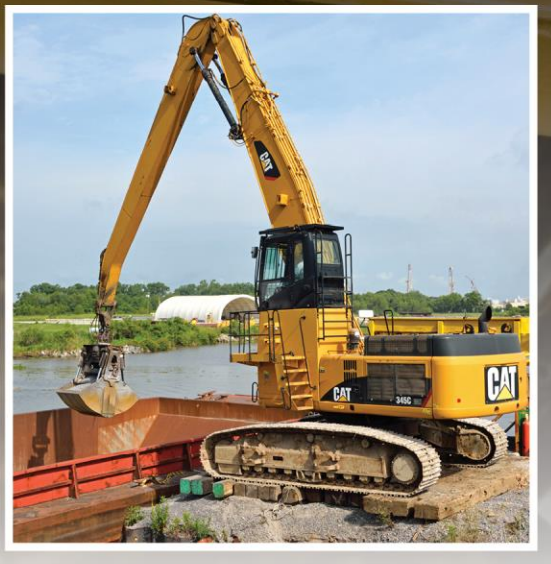
OUR SOLUTIONS HELP OUR CUSTOMERS BUILD A BETTER WORLD.



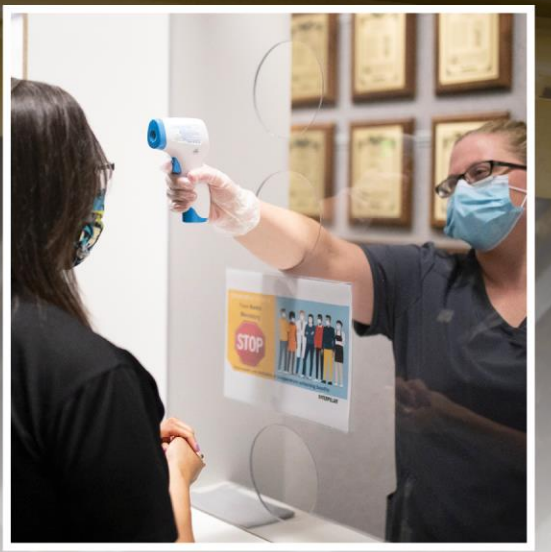
IMPROVING



POWERING



RESTORING



INSPIRING

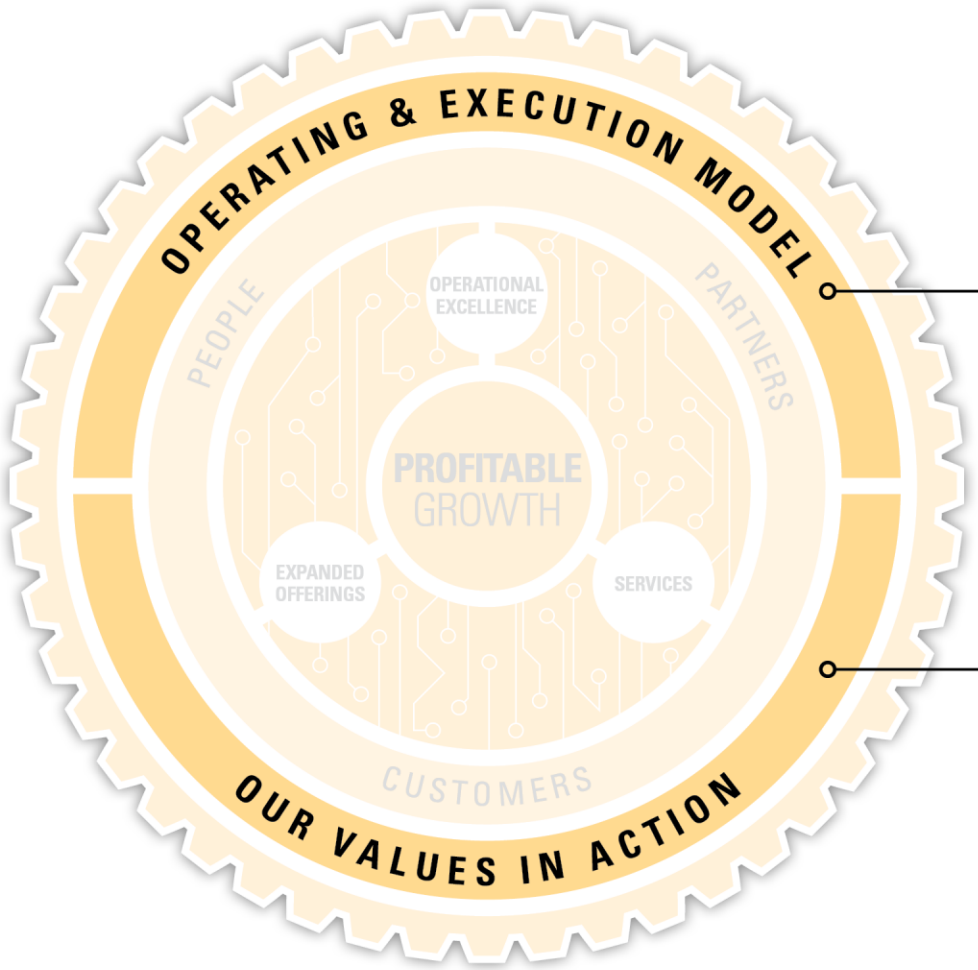
CATERPILLAR®

Our Strategy

With our Values as a foundation and the Operating & Execution Model as a guide, we develop a deep understanding of our customers needs, and along with our partners deliver outstanding products and services.

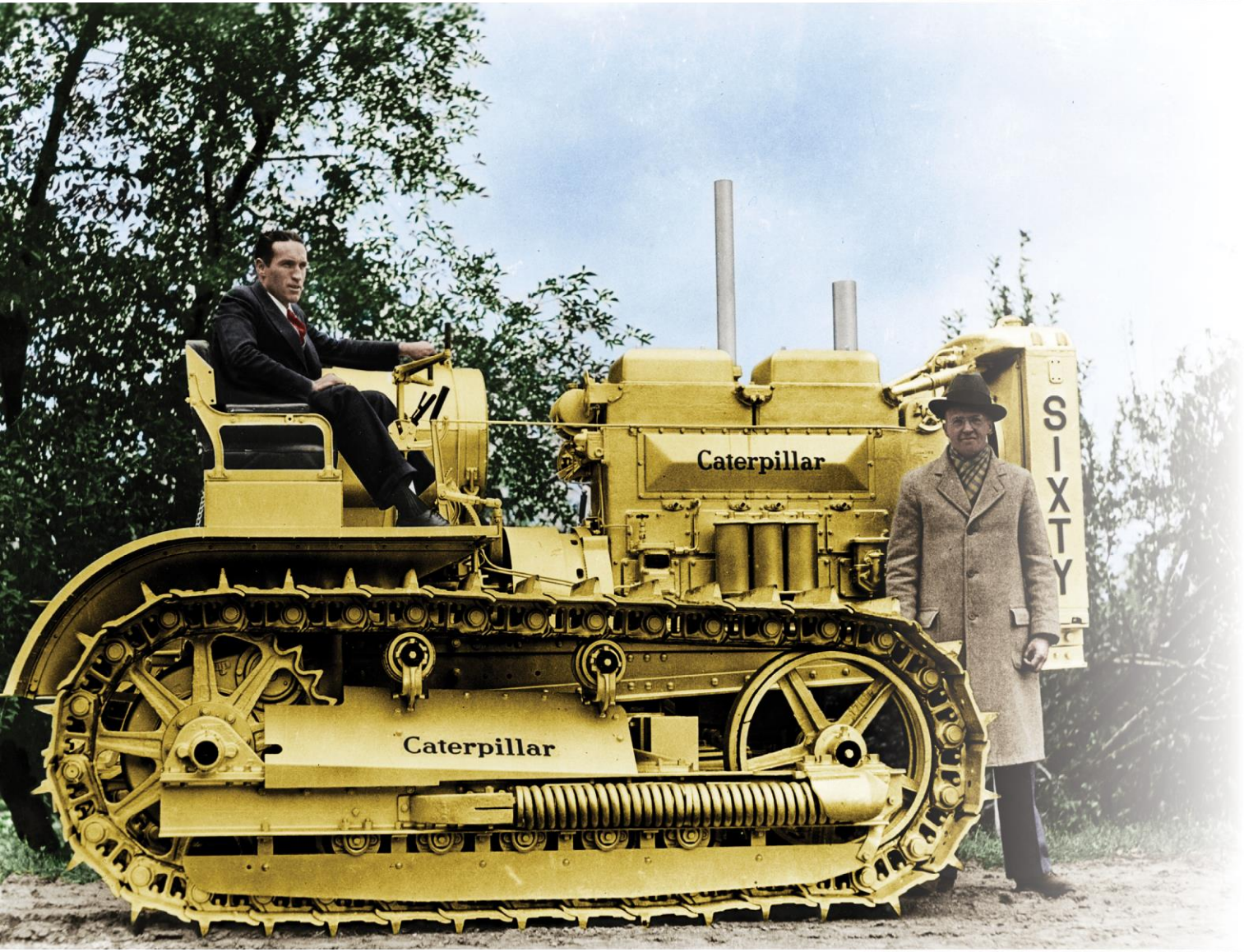
This focus allows us to develop **solutions to help our customers build a better world** and deliver profitable growth for our stakeholders.

How we act and manage



Operating & Execution Model
The Operating & Execution Model is our guide to understanding where and why we are profitable, which leads to smart and quick decisions, strategic resource allocation and profitable growth.

Our Values in Action
Our Values in Action define what we stand for and how we conduct ourselves with our customers, partners and one another.



Company History

The history of Caterpillar is all about doing: creating, building, problem solving, innovating, testing, servicing and improving. We're proud of the ingenious machines that are part of our rich heritage. And more importantly, we are proud of the people who founded and built the company one breakthrough at a time. Beginning with Benjamin Holt and C. L. Best, the people of Caterpillar have always been—and continue to be—extraordinary.

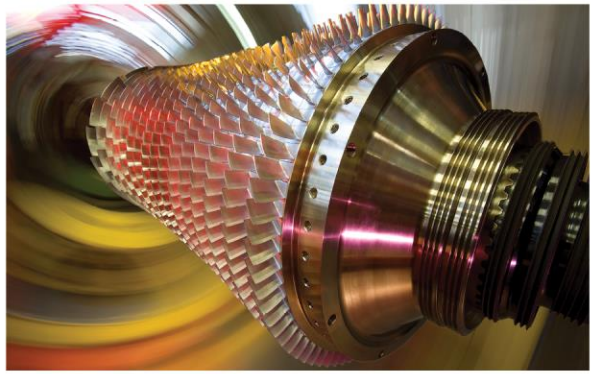
Construction Industries

HELPING OUR CUSTOMERS BUILD WHAT THE WORLD NEEDS.

MAKING IT POSSIBLE FOR CUSTOMERS TO PROFITABLY MINE AND HARVEST NATURAL RESOURCES.

Energy & Transportation

DELIVERING SOLUTIONS FOR OUR CUSTOMERS' GROWING ENERGY AND TRANSPORTATION NEEDS.



CATERPILLAR®

Services, Distribution & Digital

BUILDING LONG-LASTING RELATIONSHIPS WITH CUSTOMERS BY PROVIDING VALUE-ADDED SERVICES THROUGHOUT THE PRODUCT LIFE CYCLE, ENABLED BY DIGITAL SOLUTIONS AND DELIVERED BY THE STRENGTH OF THE GLOBAL CAT DEALER NETWORK.

Financial Products

HELPING OUR CUSTOMERS AND DEALERS SUCCEED THROUGH FINANCIAL SERVICES SOLUTIONS.

CATERPILLAR®

61%

SALES & REVENUES OUTSIDE OF THE UNITED STATES*

*Sales and revenues outside the United States were 61% of consolidated sales and revenues for 2020.

CATERPILLAR®

CONSTRUCTION INDUSTRIES

1.8M

active construction machines globally

RESOURCE INDUSTRIES

3B+*

metric tonnes moved autonomously with zero lost time injuries

ENERGY & TRANSPORTATION

>20M

engines built

SERVICES, DISTRIBUTION & DIGITAL

~1M

connected assets

*As of May 2021

CATERPILLAR®

161 CAT® DEALERS

SERVING 192 COUNTRIES

CATERPILLAR®

~27,000

SUPPLIERS

The Caterpillar Family of 21 Brands*

CAT®
CAT Financial
CAT Lift Trucks
CAT Reman
CAT THE Rental STORE
ANCHOR®
ASIATRAK
FG WILSON
HINDUSTAN
HYPAC™
KEMPER VALVE & FITTINGS CORP. A Caterpillar Company
MAK
MWM Energy. Efficiency. Environment.
m2m DATA CORPORATION A Caterpillar Company
OLYMPIAN™
Perkins®
Progress Rail A Caterpillar Company
SEM™ A Caterpillar Brand
Solar® Turbines A Caterpillar Company
SPM™ Oil & Gas A Caterpillar Company
TURNER POWERTRAIN SYSTEMS

Enhancing Brand Awareness through Cat Merchandise

* As of February 2021

CATERPILLAR®

Caterpillar is ranked

#62

in the **Fortune 500**

Caterpillar is

#101

amongst **Fortune's World's Most Admired Companies**

#84

Caterpillar's rank amongst **Interbrand's Top 100** global brands

21x

Caterpillar named to the **2020 Dow Jones Sustainability Indices**

Ranked amongst Wall Street Journal's

100 most sustainably managed companies

in the world

Learn more on **caterpillar.com/awards**

CATERPILLAR®

The Value of Sustainability

We are comitted to building a better world.

Sustainability is part of who we are and what we do every single day. We recognize progress involves a balance of **environmental stewardship, social responsibility** and **economic growth.**

CATERPILLAR®

A Proactive Community Member

Caterpillar Foundation: building resilient communities that thrive in a rapidly changing world through investments in the workforce of the future and strong sustainable infrastructure that protects communities and empowers them to thrive.

Historical Performance – A Look at 2020

SALES AND REVENUES

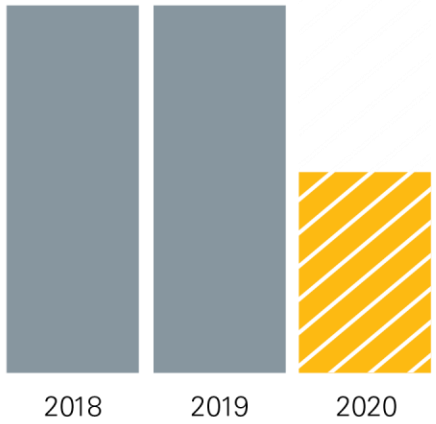
($ IN BILLIONS)

$54.7 $53.8 $41.7

OPERATING PROFIT

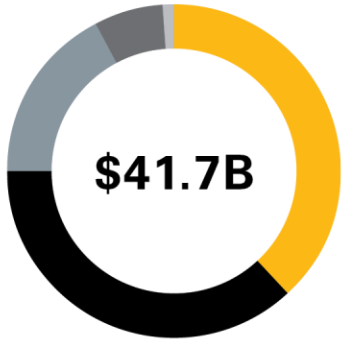
($ IN BILLIONS)

$8.3 $8.3 $4.6



2020 TOTAL SALES AND REVENUES BY SEGMENT*

($ IN BILLIONS)



- Energy & Transportation | $17.5
- Construction Industries | $16.9
- Resource Industries | $7.9
- Financial Products | $3.0
- All Other/Eliminations | ($3.6B)

*Includes Inter-Segment Sales

CATERPILLAR®

For more Caterpillar information, visit

CATERPILLAR®

Internet of Things Research Roadmap

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RI RESOURCE INDUSTRIES
WHEN OUR CUSTOMERS WIN, WE WIN

CATERPILLAR®

Caterpillar Overview

- Caterpillar is the world's largest construction equipment manufacturer
- Headquarters located in Deerfield Illinois
- Factories all around the world: USA, UK, Europe, China, India, Brazil and more
- Sensing and components engineering is located basically in Peoria, Illinois but have teams around the globe
- Our team works on advanced sensing technology with new technologies and products introduction

THE FUTURE STARTS HERE

Battery Powered Mining Trucks to Support Customer Goals

State of the Art of IoT Research

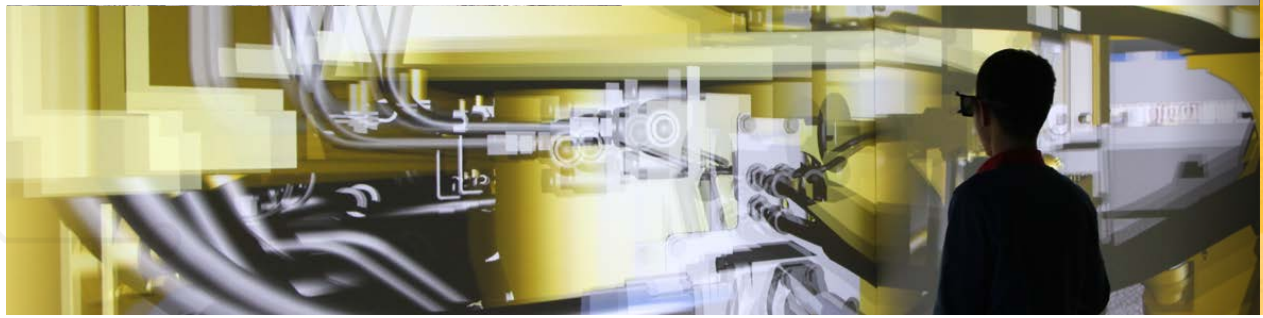
Communication Protocols
IoT Applications
Challenges

RESOURCE INDUSTRIES
WHEN OUR CUSTOMERS WIN, WE WIN







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IoT Research Roadmap

- From 2008, more objects/things are connected to the internet than people
- IoT architecture
  - **Physical layer** : Devices and controllers, including sensors
  - **Communications and connectivity**: routers, switches, gateways
  - **Edge computing layer**: network data conversion
  - **Data accumulation**: multi device data storage layer
  - **Data abstraction**: process data to make it accessible to different IoT applications
  - **Application layer**: Interpretation of data by IoT applications (healthcare, smart home, industrial,…)
  - **Collaboration processes**: communication and collaboration between different IoT applications to exchange data

Cisco, “The Internet of Things Reference Model”, White Paper, pp. 1–12, 2014

Communication Protocols

- IoT is a heterogeneous network (electronic devices, mobile devices, industrial equipment…)
- Each device has different communication platform, networking, data processing, storage capacity, and transmission power
- Vital role of communication protocol in the IoT system to allow devices to exchange data over network
- Communication protocols provide sequence control, flow control, retransmission of lost packet…
- 3 type of communication protocols: short range, medium range, long range, wired

L. Da Xu, W. He, and S. Li, “Internet of things in industries: A survey”, IEEE Trans. Ind. Informatics, vol. 10, no. 4, pp. 2233–2243, 2014

Common Short Range Communication Protocols

- **ZigBee**: IEEE802.15.4, low cost, low data rate, longer battery life
- **Bluetooth Low Energy** (BLE): 2.4 GHz, low power mode, integration with mobile devices
- **Z-Wave**: mainly for home automation, low latency for small data packets
- **Near Field Communication** (NFC): very short-range wireless communication (< 4cm), safe two-way communication, contactless payment, connect electronic devices
- **IPv6 over Low Power Wireless Personal Area Net.** (6LoWPAN): most common comm. protocol for IoT, IEEE 802.15.4, ability to connect directly to another IP network
- Other short-range protocols: Li-Fi, Wi-Fi, RFID

L. Da Xu, W. He, and S. Li, "Internet of things in industries: A survey", IEEE Trans. Ind. Informatics, vol. 10, no. 4, pp. 2233–2243, 2014

Common Short Range Communication Protocols

Characteristics	ZigBee	Bluetooth	Z-Wave	NFC	6LoWPAN
Standard	IEEE 802.15.4	IEEE 802.15.1	Z-Wave	ISO/IEC 18000-3	IEEE 802.15.4
Network type	WPAN	WPAN	WPAN	P2P Network	WPAN
Frequency Band	2.4 GHz	2.4 GHz	900 MHz	13.56MHz	2.4 GHz
Range	Short Range 10-100 m	Short Range 15-30 m	Short Range 30 - 100 m	Short Range Up to 200 m	Short Range 10-100 m
Data Rate	250 kbps	1Mbps	100kbps	100 – 420kbps	250 kbps
Power	30 mA Low power	30 mA Low Power	2.5 mA Low power	50 mA low power	Very low power consumption
Supported Topology	Star, Mesh Network	Star and Bus Network	Mesh Network	P2P Network	Star Mesh Network
Security	AES	AES	AES	RSA and AES	AES
Common applications	Home control and monitoring	Wireless headsets and audio applications	Home control and monitoring	Payment and access	Monitor and control via internet

H.-F. Atlam, R.-J. Walters, G.-B. Wills, “Internet of Things: State-of-the-art, Challenges, Applications, and Open Issues”, International Journal of Intelligent Computing Research IJICR, Volume 9, no. 3, Sep. 2018

Mid Range, Long Range and Wired Protocols

- **LTE-Advanced**: High speed for mobile devices, extended coverage, higher throughput, low latency
- **5G**: high communication requirements of IoT, connect large number of devices even in motion
- **Low Power Wide Area Networking** (LPWAN): long range communication, low data rate
  - LoRaWan, Sigfoc, RPMA,…
- **VSAT**: Satellite communication, small dish antennas
- Wired Protocols:
  - **Ethernet**: twisted pair and fiber optic
  - **Power Line Communication** (PLC): communication over electrical wiring, carry power and data

IoT Applications

- Healthcare
- Smart City
- Smart Home
- Connected Industry
- Smart Retail
- Connected Car
- Smart Parking
- Smart Energy and Smart Grid
- Environmental Monitoring
- Smart Agriculture
- Wearables (smart watches, Fitbit, Jawbone,…)

Challenges of the IoT

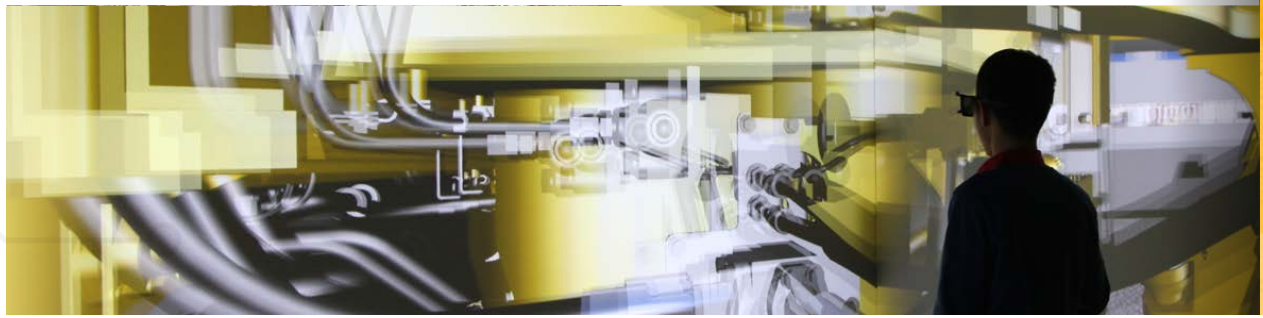
- Big Data: billions of devices generates huge amount of data, complex task to process and store it, cloud computing, data integrity
- Networking: network protocol should satisfy ease of use requirements, low cost, high performance
- Heterogeneity: service to work with multiple IoT applications, different features
- Interoperability: lack of interoperability between devices and networks, still a big issue of IoT, open research topic
- Scalability: handle specific needs as they arise, meet changing demand with people interest and environmental condition changes
- Security and privacy: sensors collect not only data but also habits, financial records, sensitive information ⇒ privacy is significant challenge, open research topic

Open Research Directions

- Standardization: improve interoperability, build industry specific guidelines, specify architectural standards
- Security: research should improve the security and privacy if IoT system
- Heterogeneity: research gap to optimize communication between different devices at architectural and protocol levels
- Fog Computing: How to integrate fog computing with IoT?
- Blockchain: decentralization platform, more research on this area is missing

Wireless Sensing

Earth Moving Machines Application



RESOURCE INDUSTRIES

WHEN OUR CUSTOMERS WIN, WE WIN

CATERPILLAR®

Motivation of Wireless Sensing

- Earth moving machines work 24/7 in most applications
- Improve quality of service, more sensors need to be installed
- Sensors on moving parts cannot be wired ⇒ Wireless Sensors
- Benefit from Wireless technology
- Self driving machines requires multiple wireless sensors

Challenges of Wireless Sensing in Industry

- Determine the technology to be used based on type of application
- Establish communication channels between sensor and Gateways
  - Poor channel status due to environmental conditions
  - Low power mode to preserve battery
  - Avoid interference with surrounding devices and preserve signal integrity
- Unlike cellular or rechargeable devices, wireless sensing in machine applications requires the battery to last for the life of the sensor and/or until machine rebuild
- Worldwide Machine distribution, the sensor should work all around the globe (from the hottest place to the coldest place)

Integration of Wireless Communication

- Integration of wireless communication with sensing technologies
  - Sensors may sense different media with different outputs
- Wireless sensors should fit the designed position: space challenge to fit sensing board, wireless board, antenna, and battery
- Using wireless technology requires certification from each country : financial challenge to import wireless technology to industry
- Industrial standards : new component much meet industrial standards (ISO, CISPR,…)
- R & D in progress to integrate sensing and wireless communication

QUESTIONS?