

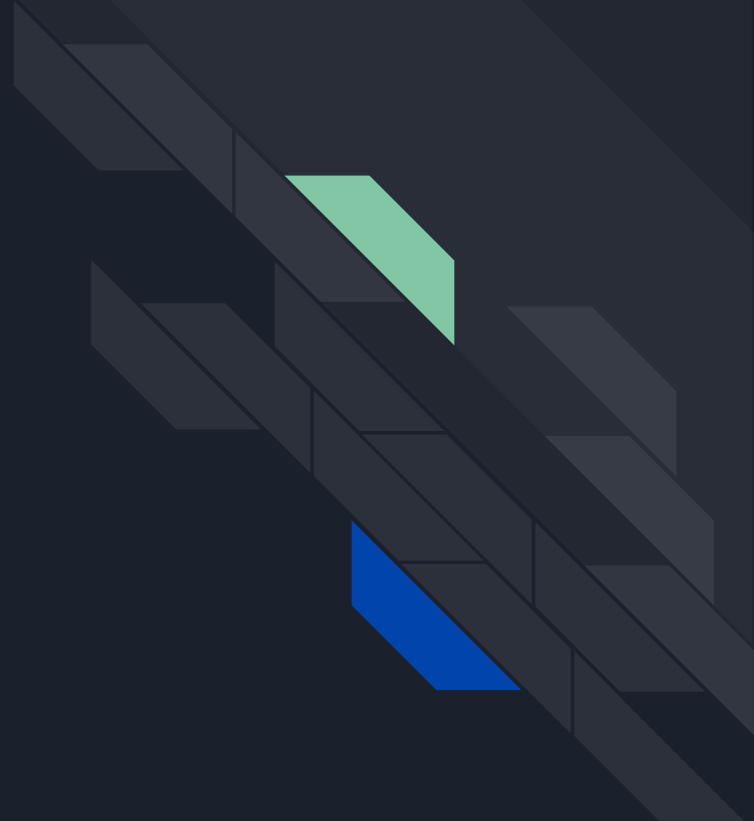
A decorative graphic on the left side of the slide consisting of two overlapping parallelograms. The front one is blue and the back one is a light green. They are positioned diagonally, with the blue one partially covering the green one.

Internet of Things (IoT) Introduction

January 29th- IOT Class

The Internet of Things (IOT) is the extension of internet connectivity to physical devices (sensors, controls, home appliances,...).

Such “smart connected” devices communicate over the internet and can be remotely monitored and controlled.

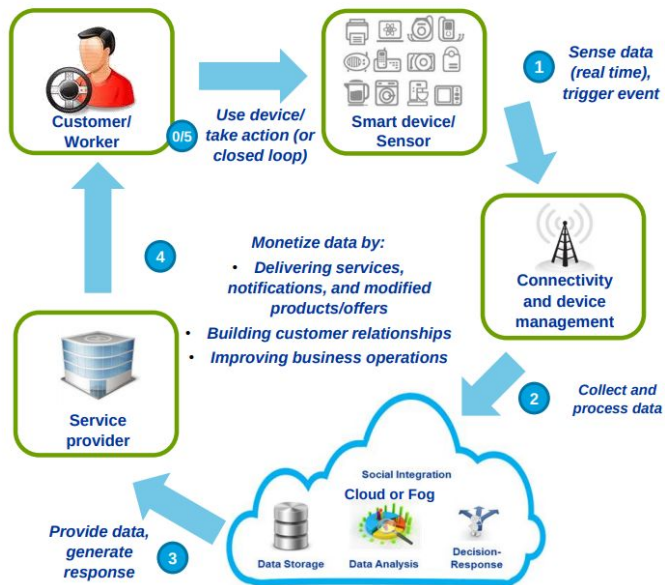


IoT enables companies to turn data into insight, action, and new business models through ubiquitous connectivity.



Advances in a number of related technologies, including sensors, analytics, network, cloud, security, and M2M management platforms, are allowing companies across industries to illuminate their dark assets. They can collect, analyze, share, and act on the data to drive operational efficiencies or new growth models in new ways.

Value is created by analyzing context-specific data to drive action serving a specific purpose.



Sample use cases

Condition-based maintenance
e.g., aircraft engines

Optimization
e.g., HVAC

Marketing
e.g., proximity marketing

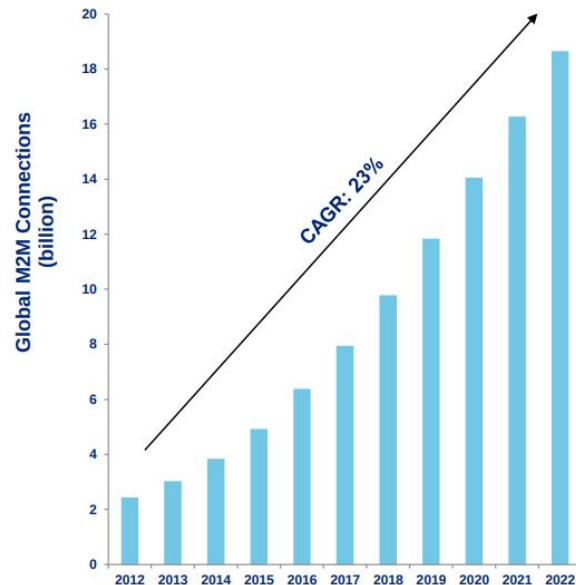
Inventory management
e.g., retail

Innovation
e.g., product, service

The global IoT market is expected to reach \$1.9 trillion by 2020.

- **\$1.9 trillion** global economic value creation by 2020
- **26 billion** embedded devices and intelligent systems by 2020
- **4 billion** connected people
- **50 trillion** GBs of data
- **25+ million** apps
- **75%** of executives exploring/adopting IoT

Global M2M Connections 2012–2022



Source: Machina Research (2013); Pyramid Research (2012); Gartner, Nov. 2013; IDC, Oct. 2013; *The Economist*, Oct. 2013; Deutsche Bank May 2014

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Interesting Smart Phone Statistics

2020



Out Of This World Smartphone Statistics

- In 2020, there are 3.5 billion smartphone users around the world
- 77% of Americans have smartphones
- 47% of US smartphone users say they couldn't live without their devices
- 62% of smartphone users have made a purchase on the device
- There were 204 billion apps downloads in 2019 worldwide
- Smartphone users worldwide will reach 3.8 billion in 2021
- The top 10 vendors contribute almost 77% of the global smartphone market
- Mobile apps are projected to generate 188.9 billion US dollars in revenues in 2020



Additional Statistics

In 2018, there were around 1.56 billion smartphones sales worldwide. *(Source: Statista)* With the world's population at over 7.691 billion, these smartphone numbers show approximately 20% of all people got a new smartphone in 2018.

In 2019, 56% of all website traffic worldwide was generated through mobile phones. *(Source: Digital 2019)* That amount will continue to grow, especially with the adoption of 5G networks.



Additional Statistic

- **66% of smartphone users are addicted to their phones.** (Source: TechJury)
- **In 2018, there were 7.9 billion mobile broadband subscriptions worldwide.** (Source: Ericsson Mobility Report 2018)
- **Almost 10 billion mobile devices are currently in use.** (Source: Outerboxdesign)
- **By December 2017, 97.5% of Chinese netizens accessed the Internet via their mobile phones.** (Source: China Internet Network Information Center)
- **South Korea, the leader in smartphone ownership.** (Source: Pew Research Center) 94% of adults own a smartphone, and 6% own a non-smart mobile phone.
- **In 2019, 81% of American adults owned a smartphone.**
- (Source: Statista, Pew Research Center)
- **67% of internet users worldwide visit the Web on a mobile device.** (Source: Stone Temple)
- **We spend 90% of media time on mobile devices in apps and 10% on the mobile web.** (Source: Aum)



Additional Statistic

- **Google produced 96% of US mobile organic search visits.** *(Source: Merkle Digital Marketing Report: Q4 2018)*
- **The most popular smartphone brand in the world is Samsung.** *(Source: Counterpoint)*
- **75% of smartphone owners turn to search first to address their immediate needs.** *(Source: ThinkWithGoogle)*
- **Apple iPhone shipments declined by 4% during 2018, but overall revenues for iPhone grew by 6%** *(Source: CounterPoint Research)*
- **Apple continued to dominate the US market in 2019, with a 42% share.** *(Source: Statista)*
- **Huawei and Xiaomi were among the fastest growing brands.** *(Source: IDC)*
- **Smartphones with Android operating system have 81.7% share of the global market.**



App Winners

YouTube was America's' favorite mobile app in 2018. *(Source: Statista)*

This is a particularly interesting stat. Smartphone usage statistics define Youtube as the most used app with 81.9%, followed by Facebook with 75.7%. Next in line are Google search, FB messenger, Google maps, Gmail, and Google Play.

Do you notice anything? Two companies own the top 7 apps.

Smartphone Sensor Capabilities





Smartphone Sensor Capabilities

1. **Microphone** (Decibel, Frequency, Noise cancellation)
2. **Camera/Image sensor** (Scanner, Barcode , Colour temperature-Kelvin)
3. **Proximity sensor** (Object detection/Like Laser Mouse Operation-Infrared)
4. **Ambient light sensor** (Light Intensity-Luminance/lux)
5. **Motion sensor**(Can be used by Accelerometer)
6. **Gyroscope**(orientation, Constellation degree-Google sky map)
7. **Accelerometer sensor** (Acceleration, Gravity, Speed)
8. **Digital compass / Magnetometer**
9. **Magnetic field sensor**(xyz wise-micro tesla)



Smartphone Sensor Capabilities (continued)

10. Hall sensor

11. Temperature

12. Humidity

13. Barometer(Air pressure , Altimeter)

14. Battery temperature

15. Fingerprint scanner(Ultrasonic or Optical Scanner)

16. Iris Scanner(Retina scanner-can be used by front camera)

17. Pedometer or Step counter(mostly used by Accelerometer)

18. Heart rate Monitor (Samsung Galaxy S5, Lenovo ZUK Z2 Pro)



Smartphone Sensor Capability (continued)

- 19. **Pulse oximeter** (Samsung Galaxy S5, Lenovo ZUK Z2 Pro)
- 20. **Geiger Counter**(Harmful Radiation level detector-Sharp Pantone 5 in japan)
- 21. **NFC** (Type of radio frequency tag scanner, Connectivity)
- 22. **Infrared Blaster**(For using TV remote data connection etc)
- 23. **Laser**(Auto focus,Distance Measurement, Also one type of laser bar-code scanner available-Panasonic Toughpad FZ-F1 Mobile)
- 24. **Touch screen** (Conductivity or by pressure)
- 25. **Air Gesture**(by using front camera)
- 26. **3D Air gesture & 3D scanning**(use multiple camera 2 to 5- Takee 3D mobile)



Smartphone Sensor Capability (continued)

27. GNSS (Global Navigation Satellite System- GPS, GLONASS, BeiDuo-BDS, IRNSS-Indian Navigation Satellite system- Global position , Elevation or altitude, Speed, Time measurement, Distance measurement, Satellite scanning)

28. Other signal receiver spectrum and bandwidth(1G,2G,3G,4G,5G,WiFi,Bluetooth,FM radio,Television)

30. Clock(Normal and Atomic clock-Distance measurement and Satellite positioning)

31. Molecular/ Material sensing(SCiO sensor based on Near Infrared or FTIR type Raman Spectroscopy detector to identify material like Mango Fruit,Gold,Body fat or anything- Changhong H2 Mobile)

Portable bluetooth SCiO Sensor and Changhong H2 Mobile scan any possible matter in our world. Like quantum laboratory in your phone.

Use many sensor device by USB or 3.5mm port ; Like - Anemometer(Air Speed), Blood Glucose , sphygmomanometer(Blood pressure) Etc....



Smart Phone Data Content

- Contact list
- Mailing lists
- Pictures
- Emails
- Browsers
- Browser history
- Network information
- ?

Combine with sensor data for compounded value.



Think About the Following

Imagine Harnessing sensors, connectivity, people/processes, and data of smartphones



The following is my example

- Track people's locations
- Figure out social grouping as a result
- Target what they get access to based on past activity
- Control sensor alert based on individuals state
- Keep track of individual's activities
- Suggest new activities based on location, time, and past activities
-?



This sounds like something we know

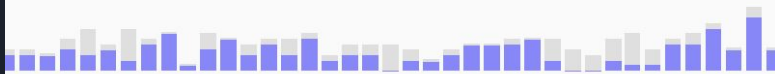
Google?



YEAR

MONTH

DAY



229 places

See your most visited places and all the places you've been based on your Location History

Westford and Worcester

Jan 26 – 28, 2020

MORE TRIPS



Location History is on

Your location is reported by your mobile device and only you can see it.

MANAGE LOCATION HISTORY

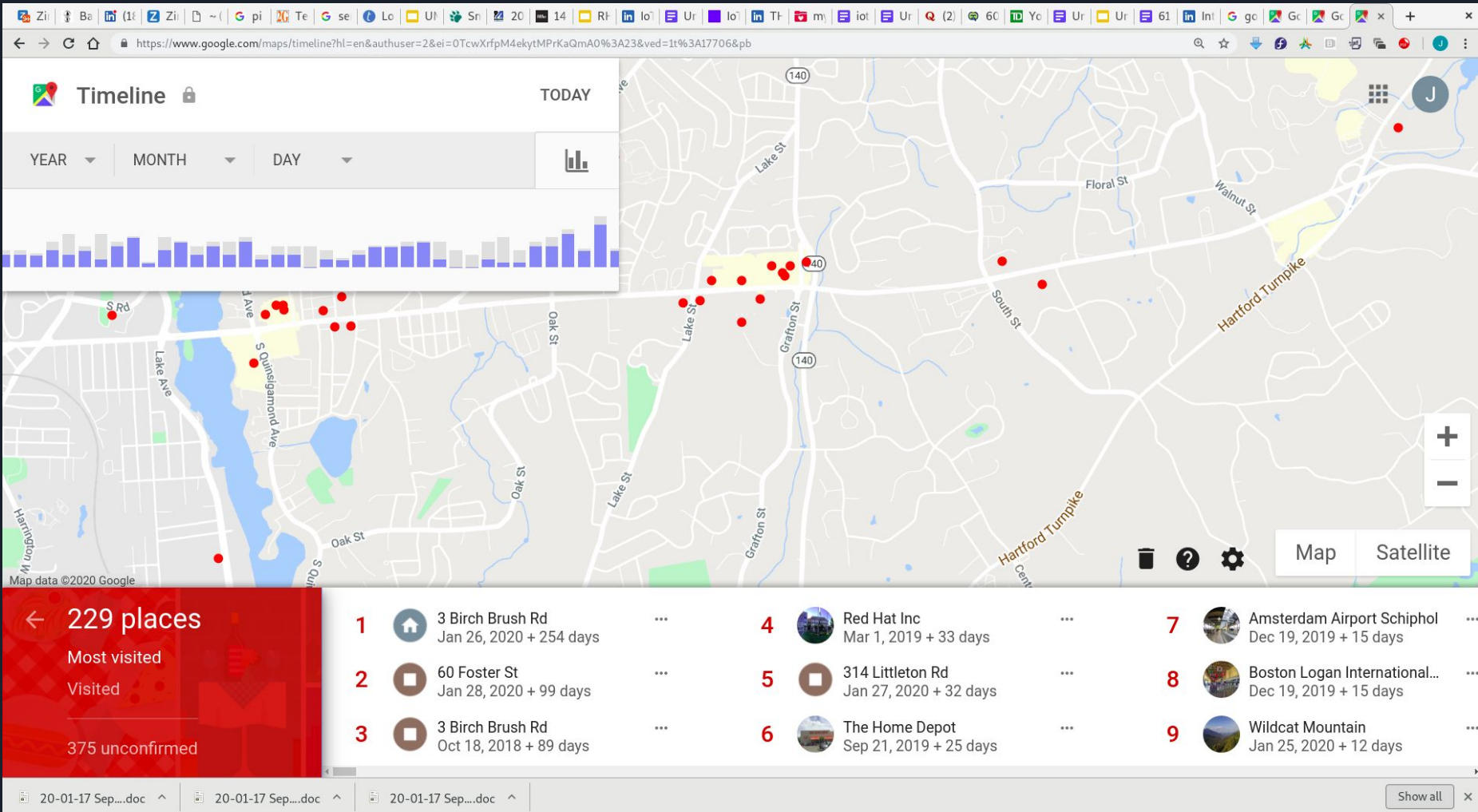
Home and work



Shrewsbury, MA 01545





Massachusetts



← Activity controls

The data saved in your account helps give you more personalized experiences across all Google services. Choose which settings will save data in your Google Account.



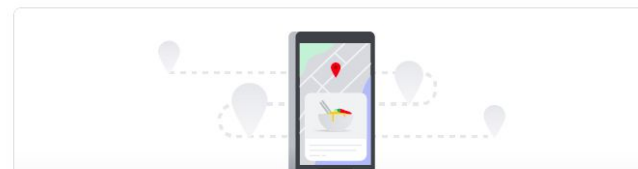
Web & App Activity 

Saves your activity on Google sites and apps, including associated info like location, to give you faster searches, better recommendations, and more personalized experiences in Maps, Search, and other Google services. [Learn more](#)

☐ Include Chrome history and activity from sites, apps, and devices that use Google services

☐ Include voice and audio recordings

[MANAGE ACTIVITY](#)



← Activity controls

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☐ Include voice and audio recordings

[MANAGE ACTIVITY](#)



Location History



Saves where you go with your devices, even when you aren't using a specific Google service, to give you personalized maps, recommendations based on places you've visited, and more. [Learn more](#)

Devices on this account



[MANAGE ACTIVITY](#)



Google Account

Options on this account

MANAGE ACTIVITY

← Activity controls



YouTube History



Saves the YouTube videos you watch and the things you search for on YouTube to give you better recommendations, remember where you left off, and more. [Learn more](#)

- ☒ Include the YouTube videos you watch
- ☒ Include your searches on YouTube

[MANAGE ACTIVITY](#)



Ad personalization


You can make ads more useful to you
Ad personalization is on ☒

[Go to Ad Settings](#)

Activity controls no longer include the Device Information setting

Why you're seeing an ad

When you see an ad from Google's network, you can see more details:

- **Google services**, like Google Search, YouTube, or Gmail: Click **Info** ⓘ ➤ **Why This Ad**.
- **Non-Google websites and apps** that partner with Google to show ads: Click **Ad Choices** ⓘ ➤.
- For some ads on Google's network, you can click  **Paid for by** to learn additional information about the advertiser.

Reasons you might see an ad

- **Your info:**
 - Info in your Google Account, like your age range and gender
 - Your general location
- **Your activity:**
 - Your current search query
 - Previous search activity
 - Your activity while you were signed in to Google
 - Your previous interactions with ads
 - Types of websites you visit
 - Types of mobile app activity on your device
 - Your activity on another device
- **Other info:**
 - The time of day
 - Info you gave to an advertiser, like if you signed up for a newsletter with your email address

Google can personalize ads so they're more useful to you.

Personalized ads aren't shown or hidden from you based on sensitive categories, like race, religion, sexual orientation, or health.

Types of ads you might see

- **Ads on Google services:** You might see ads with results on Google Search, or before you watch a video on

- Verify your Google Account
- Check for an existing account
- Change your Google Account name & other info
- Set up a recovery phone number or email address
- Change the phone number on your account & how it's used
- Change the email address for your account
- Get a summary of data in your Google Account
- Download your data
- Manage contact info from your devices
- Change who's saved & suggested as contacts
- Manage saved passwords in your Google Account
- Manage your online reputation
- Sync passwords across your devices
- Block or unblock people's accounts
- Create or change your Google Account PIN

Google Account Help

- Other info:

Google can personalize ads so they're more useful to you.

Types of ads you might see

How Google works with advertisers

As an ad network, Google connects:

Google doesn't sell your personal info to anyone, and doesn't let anyone read your emails to show you ads.

Learn more about [how Google ads work](#) ↗.

Google takes part in industry groups that create and follow standards in online advertising:

Paid for by

 Manage your online reputation

- Block or unblock people's accounts

- Find your purchases, reservations & subscriptions

-  Block certain ads

 Why you're seeing an ad

 Manage your Brand Account

- Manage business personalization for your Google Account

 Remove products

-  Delete your Gmail service

- Change who manages your Brand Account

 Manage your Google payment info

- Manage app info from your devices

