# Smart Connected Design with A360 Web Service and Internet of Things

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@tenmoos

# Class summary

- Making connected design, product and service
- Internet of Things and its impact
- Introducing Autodesk 360 Web Services and Open Source tools
- Connecting design and product with Internet of Things
- Building interaction-on-demand design and product
- Wiring all up without writing any code

# Key learning objectives

At the end of this class, you will be able to:

- Explore new ways of making smart connected design and data
- Understand Autodesk 360 Web Service, View and Data API and functionalities
- Learn step by step how to connect design with Internet of Things using Autodesk Web Service and open source APIs
- Learn how to turn a design into an interaction-on-demand system that interacts with any device at any time

# Making Connected Design, Product and Service

# Disconnected world

- Disconnected silos and people
- Different applications and tools
- Different processes and workflows
- High cost and waste
- Low productivity and efficiency

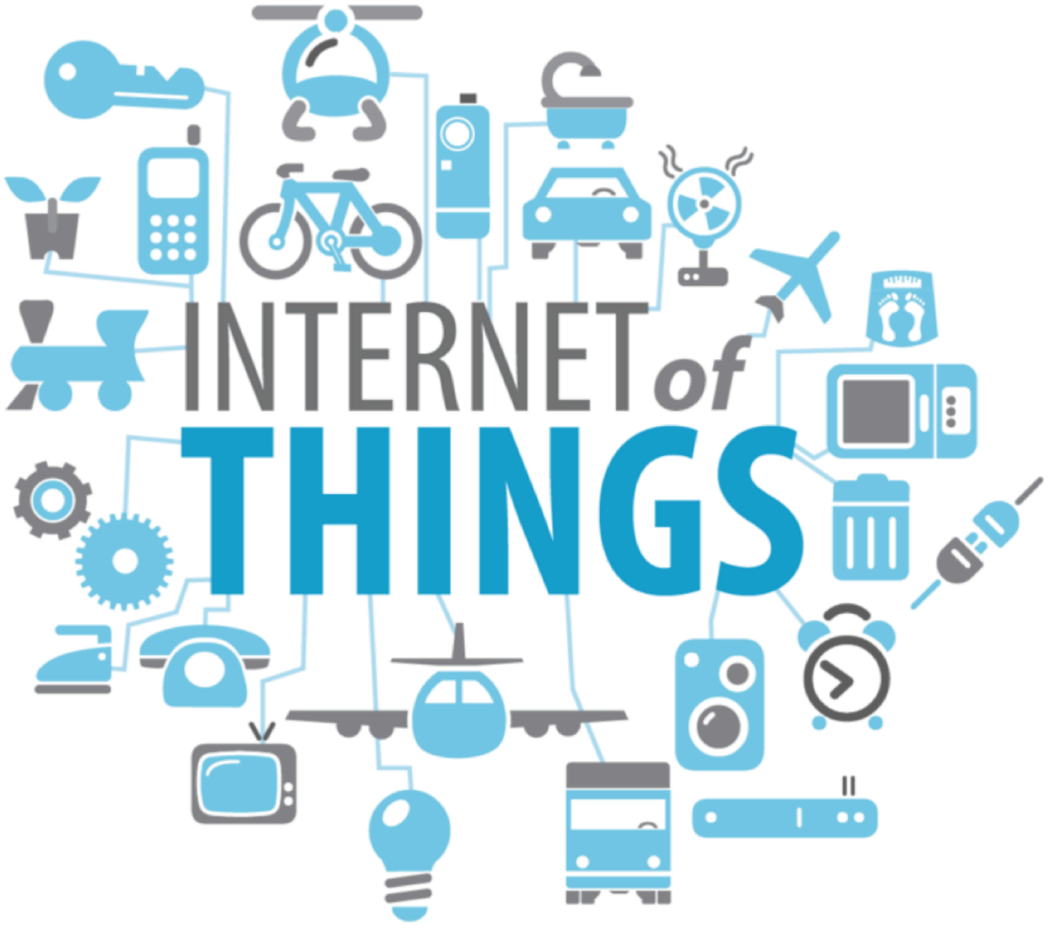
# Disconnected product

- Know little about design after leaving our hands
- Know little about product after leaving the factory
- Know nothing about how well our product performs in real world

# Questions:

- How can we reduce the gaps in the entire process?
- What can we do to make design more accessible to everyone involved in the project?
- How can we make better design decision and respond more rapidly to customer needs?

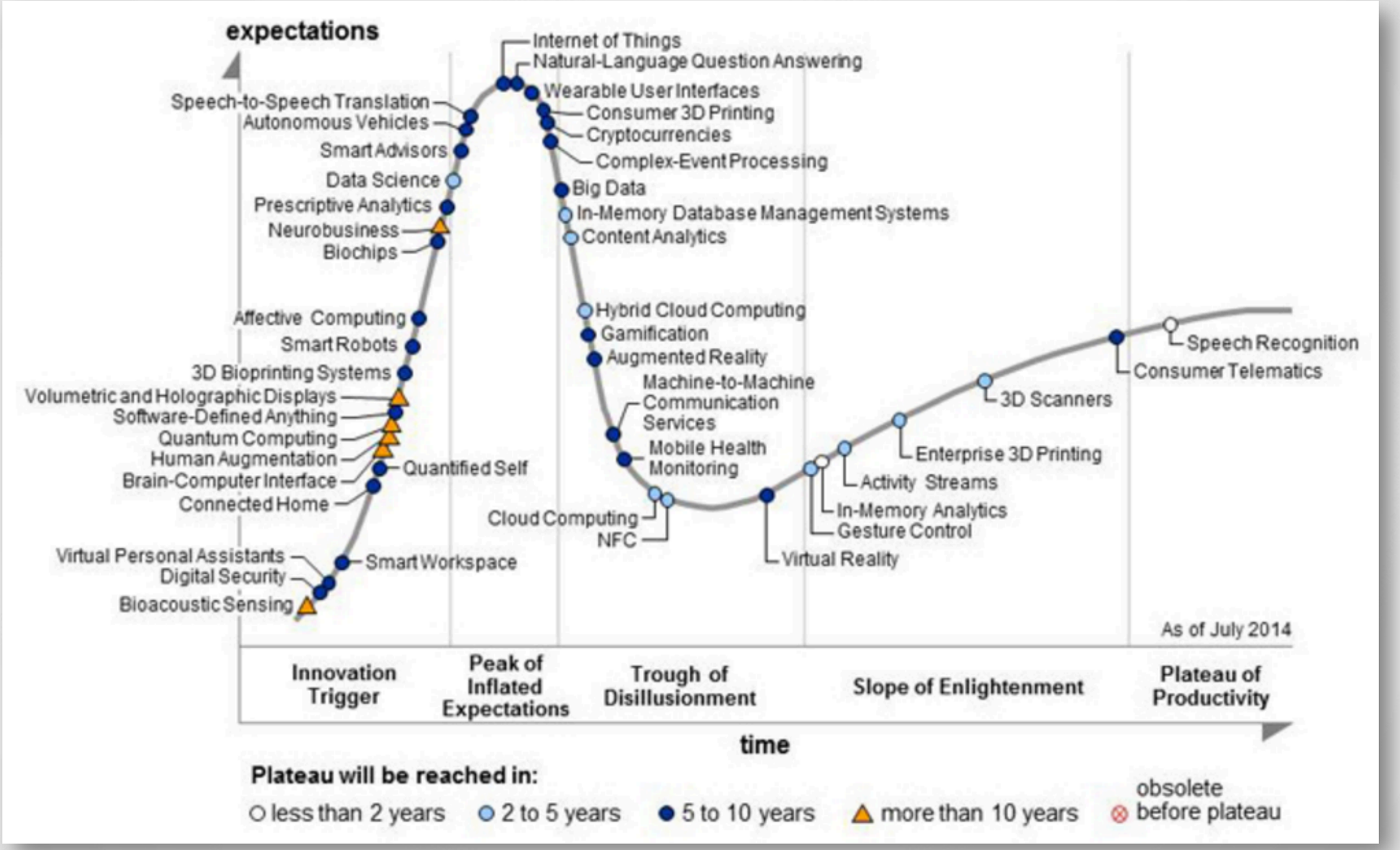
# Internet of Things and its Impact



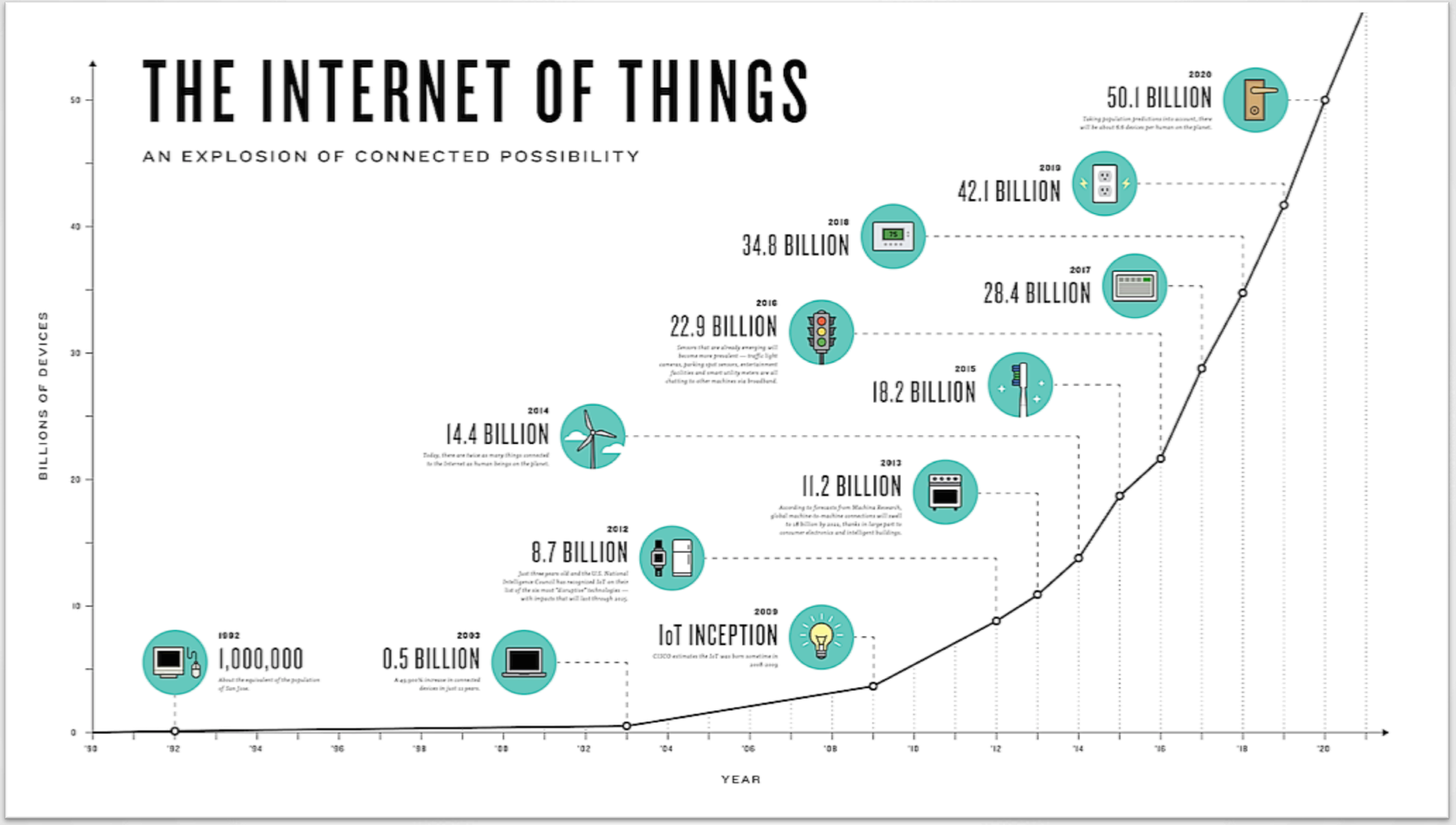

# Internet of Things

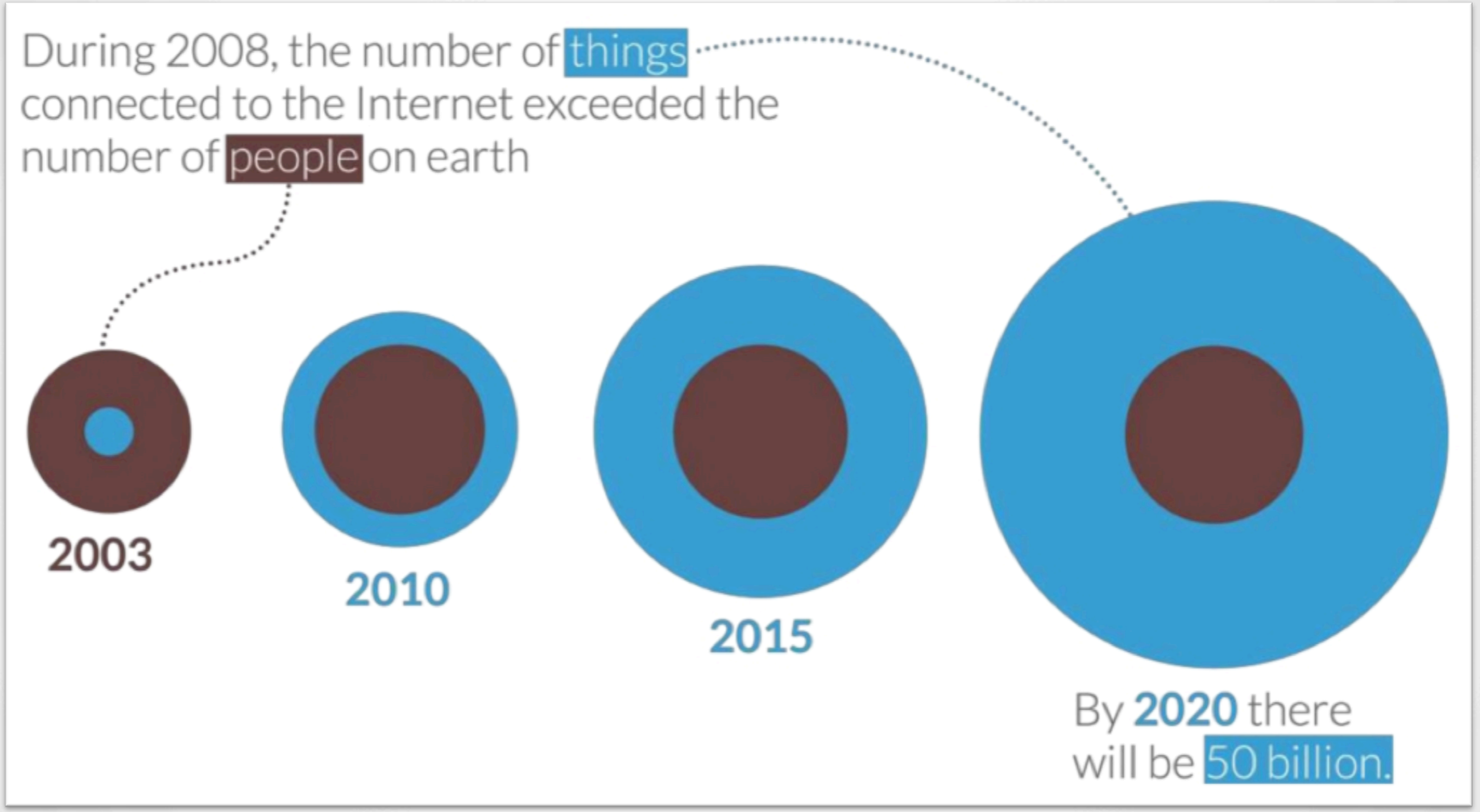
From Wikipedia, the free encyclopedia

The **Internet of Things** (**IoT**) is the network of physical objects or "things" embedded with electronics, software, sensors, and network connectivity, which enables these objects to collect and exchange data.[1] The Internet of Things allows objects to be sensed and controlled remotely across existing network infrastructure,[2] creating opportunities for more direct integration between the physical world and computer-based systems, and resulting in improved efficiency, accuracy and economic benefit.[3][4][5][6][7][8] Each thing is uniquely identifiable through its embedded computing system but is able to interoperate within the existing Internet infrastructure. Experts estimate that the IoT will consist of almost 50 billion objects by 2020.[9]




Garner's Hype Cycle for Emerging Technologies 2014


THE INTERNET OF THINGS
AN EXPLOSION OF CONNECTED POSSIBILITY
BILLIONS OF DEVICES
YEAR
1992
1,000,000
About the equivalent of the population of San Jose.
2003
0.5 BILLION
A 49,900% increase in connected devices in just 11 years.
2009
IoT INCEPTION
CISCO estimates the IoT was born sometime in 2008-2009.
2012
8.7 BILLION
Just three years old and the U.S. National Intelligence Council has recognized IoT on their list of the six most "disruptive" technologies — with impacts that will last through 2025.
2013
11.2 BILLION
According to forecasts from Machina Research, global machine-to-machine connections will swell to 18 billion by 2022, thanks in large part to consumer electronics and intelligent buildings.
2014
14.4 BILLION
Today, there are twice as many things connected to the Internet as human beings on the planet.
2015
18.2 BILLION
2016
22.9 BILLION
Sensors that are already emerging will become more prevalent — traffic light cameras, parking spot sensors, entertainment facilities and smart utility meters are all chatting to other machines via broadband.
2017
28.4 BILLION
2018
34.8 BILLION
2019
42.1 BILLION
2020
50.1 BILLION
Taking population predictions into account, there will be about 6.6 devices per human on the planet.


During 2008, the number of things connected to the Internet exceeded the number of people on earth
2003
2010
2015
By 2020 there will be 50 billion.

# Economic Impact

McKinsey Global Institute

By 2025, Internet of things applications could have $11 trillion impact

**GE: “Industrial Internet” can add $15 trillion to global GDP**

Cisco’s analysis indicates that IoE is poised to generate $4.6 trillion in Value at Stake for the public sector over the next decade (compared with $14.4 trillion for the private sector over the same period).

# Biggest Impact and Opportunity?

# Rethink Our Industry

- Tim O'Reilly

# Challenges?

# Security and Privacy

...

# Autodesk 360 Web Services (Forge)

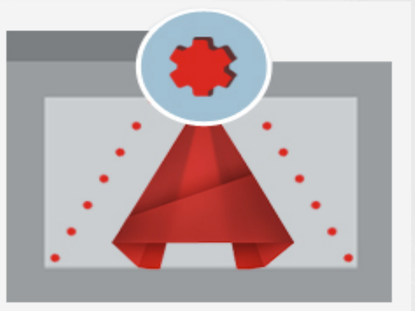
# Autodesk 360 Web Services (Forge)

A centralized, unified and simplified platform for you to:

- Discover, learn and experiment with Autodesk platform APIs
- Access docs, samples, SDK and source code
- Create and manage your apps easily
- Utilize all Autodesk APIs with one single consumer key and secret for each environment

# AutoCAD I/O

AutoCAD I/O web service allows you to run AutoCAD scripts remotely and enable them to process DWG files at cloud scale. You can create an AutoCAD script or use built-in script and have AutoCAD I/O web service run your script on the DWG files you designated and save the output to your specified web storage or location.



# View and Data API

A web service that allows you to create custom web application to interactively visualize your design data in a web browser (with no plug-ins required) and on mobile device.

# View and Data API

- REST and Javascript API to create applications easily
- Upload your model via REST API and let web service create the viewing stream for you
- Access the model and components data in your web app
- Visualize 2D and 3D models in your browser with detailed textures, smooth navigation and in-depth design data

# View and Data API

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- Upload your model via REST API and let web service create the viewing stream for you
- Access the model and components data in your web app
- Visualize 2D and 3D models in your browser with detailed textures, smooth navigation and in-depth design data

# View and Data API

- Browser compatibility with Chrome, Safari and Firefox
- Visualize and interact with more than 50 design file formats in your web app such as Autodesk Fusion 360, Inventor, Revit, 3ds Max, Navisworks, DWG, CATIA, SolidWorks, STEP, NX, JT and many more.

# View and Data API

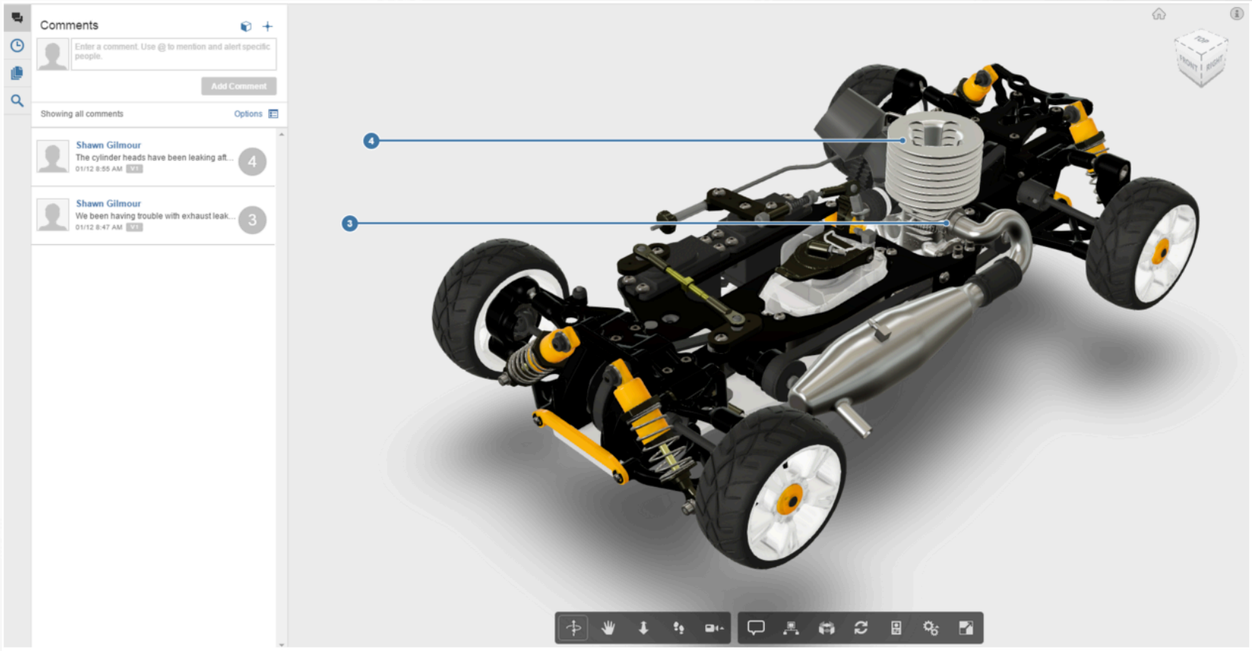
***Sharing Data Centric Design***

View and Data API lets you share your design with any stakeholder of your project from anywhere, anytime. You don’t need to install any software or tool to view the design.

# View and Data API

***Navigate, Search and Review***

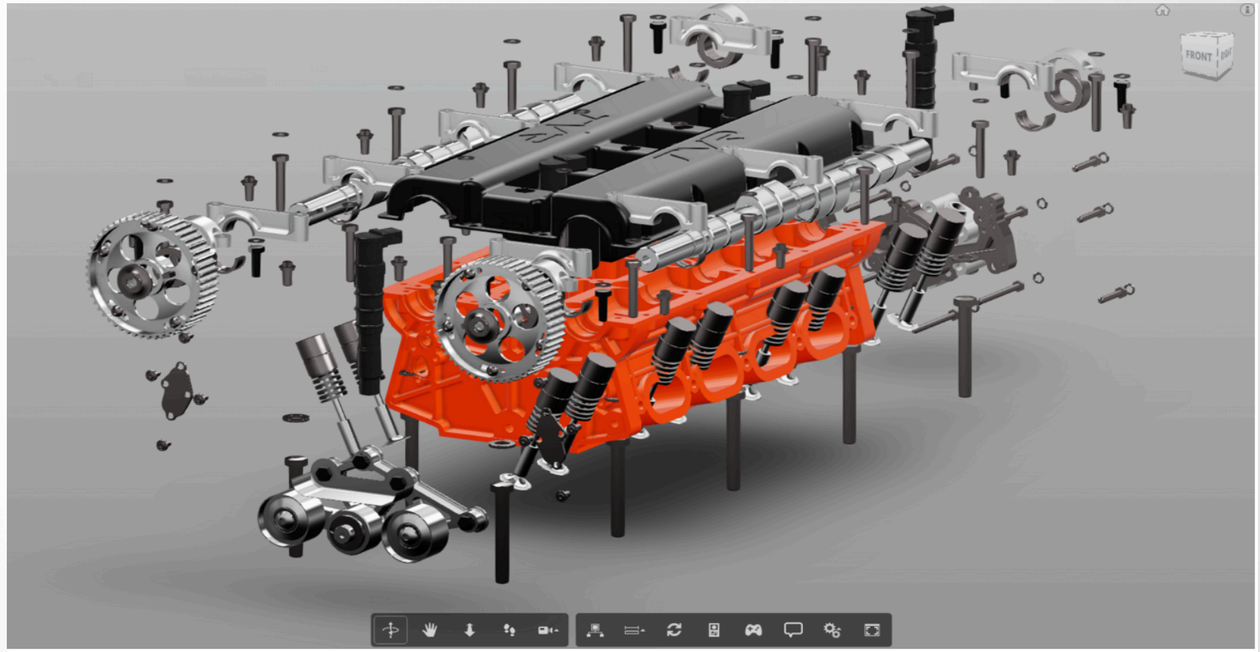
View and Data API lets you easily navigate your design in 2D and 3D space, examine and search for specific parts. You can also add comments and navigate through comments on a model or drawing



# View and Data API

***Large Model Capacity***

View and Data API is able to load large models incrementally and in parallel. The progressive rendering allows you to view and navigate large model at interactive frame rate.



# View and Data API

***High Qulaity Visualization***

The real-time high-quality 2D and 3D rendering is made possible with the state-of-the art computer graphics on a web browser and mobile device.

# View and Data API

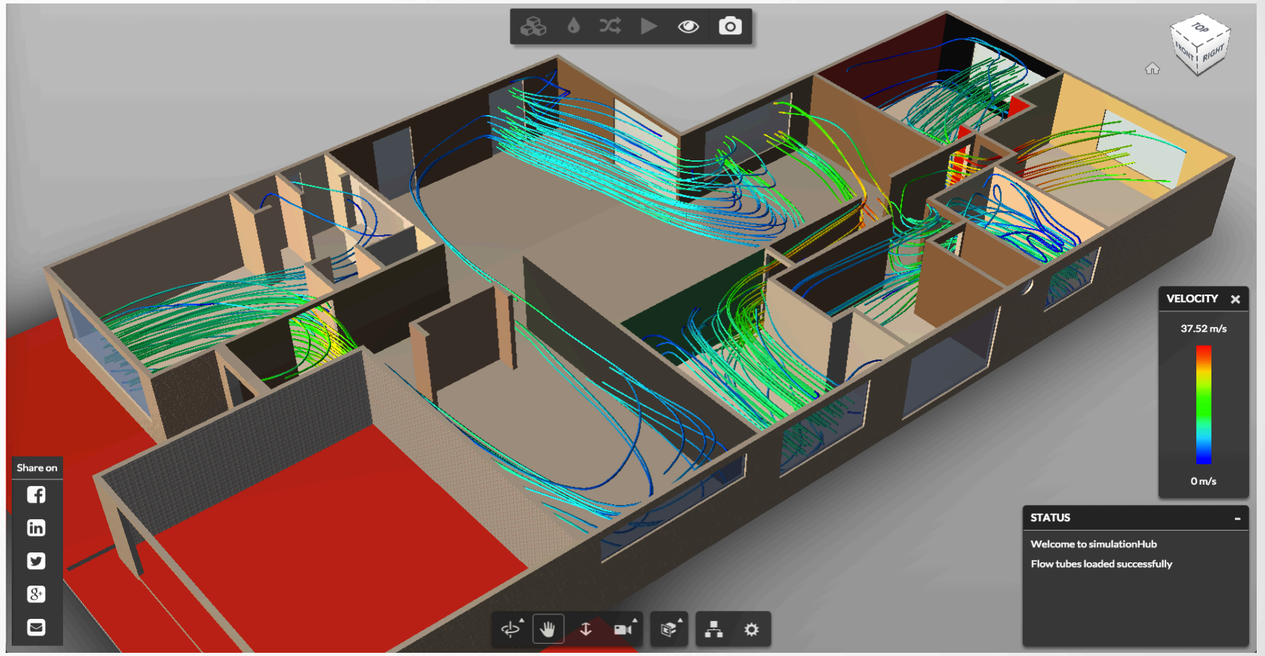
***Real-Time Collaboration***

You can collaborate your design with your team around the world in real time by messaging. You can even share your view controls and navigate to a specific view for detailed discussion.

# View and Data API

***Simulation and Animation***

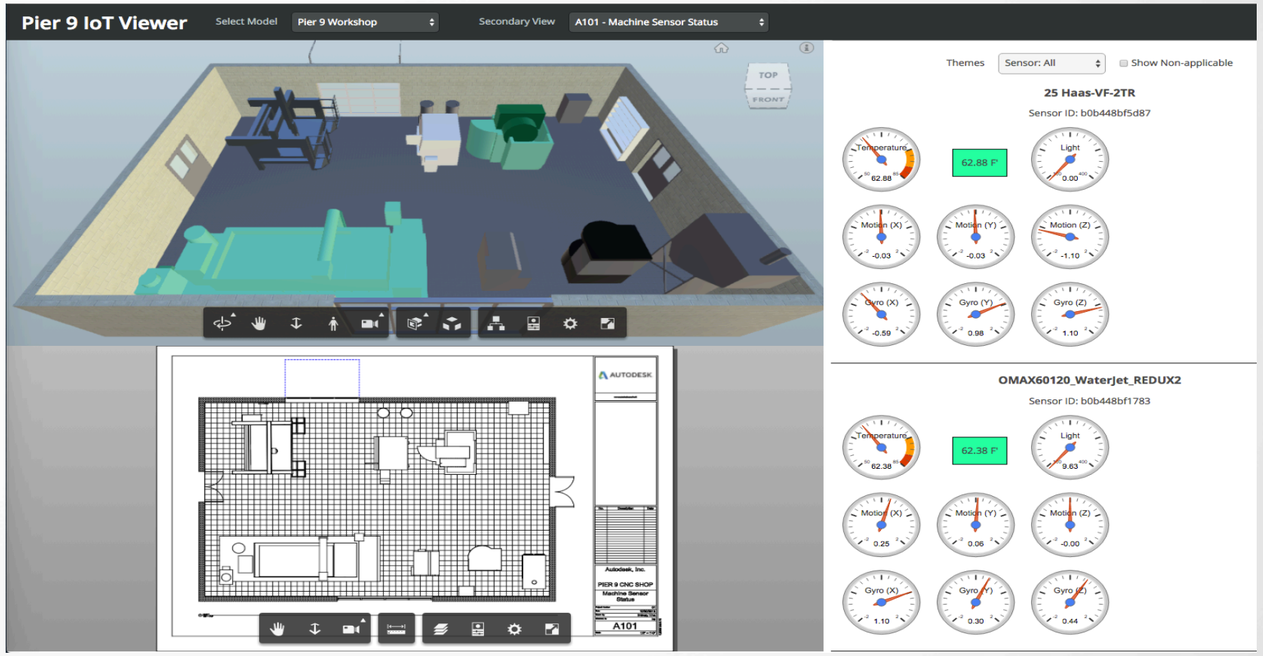
View and Data API allows you to create interactive animation with camera and object transformation, visibility and annotation .



# View and Data API

***Visual Report and Presentation***

View and Data API allows you to create interactive animation with camera and object transformation, visibility and annotation.

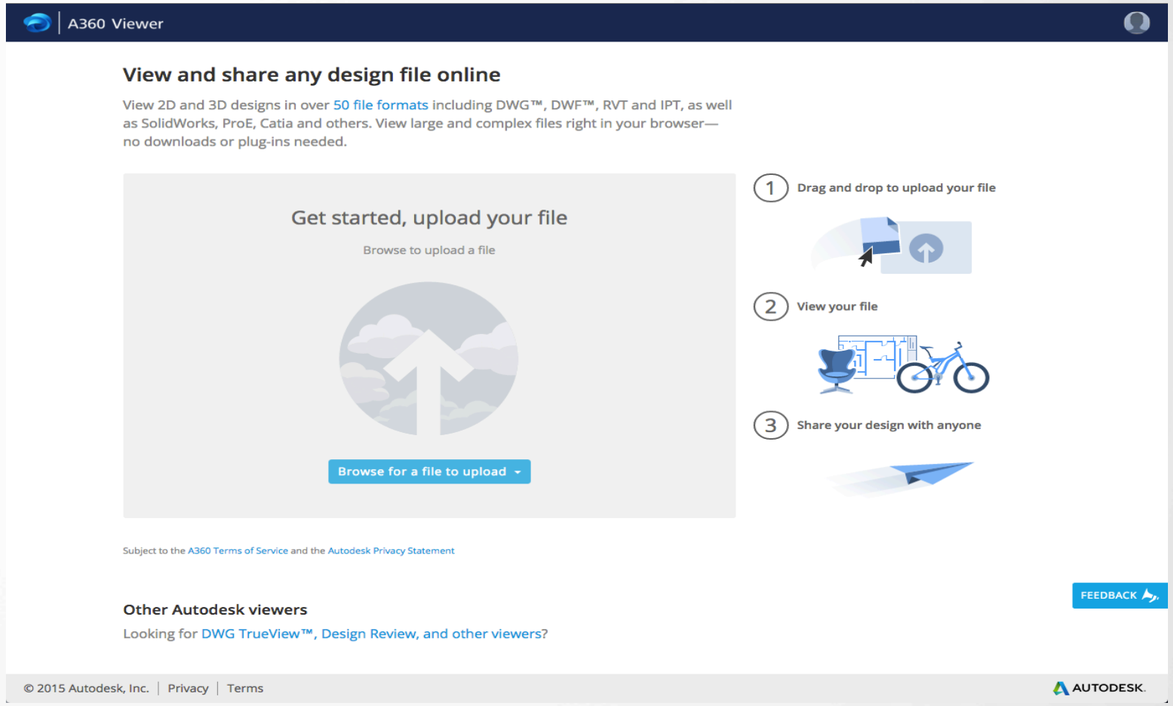


# Online A360 Viewer

**https://a360.autodesk.com/viewer**

You can try out (w/o sign up):

- Drag and drop to upload your file
- View your file
- Share your design with anyone



# Connecting Design with Internet of Things

# IoT Protocols

***Wi-Fi***

- Based on 802.11 standard
- 2.4 GHz and 5 GHz radio bands
- Universal compatibility but requires high power
- New 802.11ah standard that utilizes sub 1 GHz with low energy consumption and extended range (1km) for IoT is expected to be finalized in 2016 and chips and systems to hit the market soon

# IoT Protocols

***Bluetooth Low Energy (Bluetooth Smart)***

- Reduced power consumption
- Longer range (60 meters) compared to Classic Bluetooth (10 meters)
- Operates in 2.4 GHz radio frequency
- Low cost, small size
- Supported by most desktop and mobile operating systems
- No paring required like Bluetooth.

# IoT Protocols

***ZigBee***

- Based on 802.15.4 standard
- Operates in the 2.4 GHz frequency range with 250 kbps (worldwide), 915 MHz with 40 kbps (Americas and Australia) and 868 MHz with 20 kbps (Europe)
- Uses 128 bit AES encryption
- Low power consumptio
- Approximated physical range between 10 to 100 meters.

# IoT Protocols

***Thread***

- IPv6 based
- Uses 6LoWPAN, which is built on 802.15.4.
- Operates in 2.4 GHz radio frequency
- Launched by Google's Nest, Samsung, ARM, Freescale etc.

# IoT Protocols

***MQTT***

Message Queue Telemetry Transport

- Machine-to-machine protocol
- Lightweight publish/subscribe messaging transport for small code footprint and low network bandwidth
- Many-to-many protocol on top of TCP
- IBM submitted MQTT 3.1, OASIS standard.
- Facebook, Amazon, Xively, Evrything are also using MQTT.

# IoT Protocols

***CoAP***

Constrained Application Protocol

- Used with constrained nodes and constrained network
- Machine-to-machine protocol.
- One-to-one protocol between client and server running on top of UDP
- Designed to easily translate to HTTP for web integration.

# IoT Protocols

***DDS***

Data Distribution Service

- For real-time system targets devices that directly use device data
- Optimized for distributed processing
- Directly connecting sensors, devices and applications without any dependence on centralized IT infrastructure.
- Best for decentralized processing instead of routing through centralized broker like MQTT.

# IoT Protocols

***AMQP***

Advanced Message Queuing Protocol

- Queuing system designed to connect servers to each other
- Mostly used in business messaging and server-based analysis functions.

# IoT Protocols

***XMPP***

Extensible Messaging and Presence Protocol

- Original called Jabber
- Developed for instant messaging
- Uses XML format over TCP
- Offers easy way to address a device
- Ideal for consumer-oriented IoT application.

# IoT sensors and microcontrollers

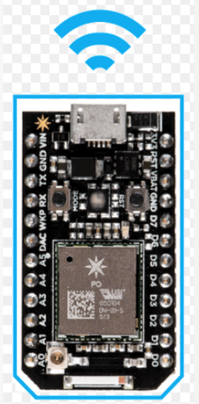
***TI SensorTag***

- Made by Texas Instrument
- Multi-standard: Bluetooth Low Energy, 6LoWPAN, ZigBee, Wi-Fi (coming soon)
- Temperature (infrared and ambient), humidity, pressure, light, 3-axis accelerometer, 3-axis gyroscope, 3-axis magnetometer sensors, microphone, buzzer and buttons

# IoT sensors and microcontrollers

***Photon***

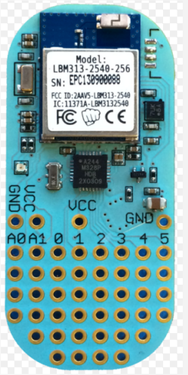
- From Particle (formerly Spark)
- Wi-Fi (802.11b/g/n) development kit
- Broadcom BCM43362 Wi-Fi chip
- ARM Cortex M3 (120MHz)
- 1 MB Flash, 128KB Ram
- 18 GPIO
- Open source hardware and software



# IoT sensors and microcontrollers

***LightBlue Bean***

- By Punch Through Design
- Bluetooth Low Energy
- Arduino compatible microcontroller
- 3-axis accelerometer and temperature sensor
- RGB LED
- GPIO



# IoT sensors and microcontrollers

***Tethercell***

- AA-battery adapter
- Bluetooth Low Energy
- Operates on low duty cycle
- Consumes small current (~20mA)
- Stays mostly in sleep mode

# IoT sensors and microcontrollers

***Chipolo***

- Small BLE enabled device
- Temperature sensor
- Locate device attached to lost or misplaced item

# IoT sensors and microcontrollers

***PIR Motion Sensor***

- Passive infrared motion sensor
- Detects motion from animal or human in range

***Vibration Motor***

- Coin-size permanent magnet DC motor
- Vibrates as input is logic high

***Light Sensor***

- Photo resistor (LG5528)
- Detects light intensity  of surrounding environment

# IoT sensors and microcontrollers

***Pebble Smartwatch***

- Bluetooth enabled
- Ambient light sensor
- 3-axis accelerometer
- Magnetometer
- SDK provides access to on-board sensor data

# IoT sensors and microcontrollers

***Wii Remote***

- Accelerometer
- Vibration motor

***Wii Nunchuk***

- Thumb stick
- Wired connection

# Open Source Tools

***Node.js***

- Asynchronous event-driven
- Non-blocking I/O API
- Designed to optimize performance and scalability for real-time web application
- Built on Chrome's V8 Javascript engine
- Fast application development
- More than 210,000 packages

# Open Source Tools

***Jonny-Five***

- Javascript Robotics programming framework
- IO plugins allow to communicate with any hardware in any language
- Supports more than 30 platforms

# Open Source Tools

***Cylon.js***

- Javascript Robotics programming framework
- Designed for controlling robots, embedded sensors and IoT devices
- Supports 36 different platforms
- Built on top Node.js

# Open Source Tools

***Mosca***

- MQTT broker (3.1, 3.1.1 compliant)
- Standalone and embedded options
- Supports AMQP, Mongo, Redis and MQTT as backends
- Supports websockets, offline
- Fast, 10k+ messages routed per second
- Scalable, 10k+ concurrent connections

# Open Source Tools

***Node-RED***

- Visual tool for wiring together devices, online service
- Browser-based flow editing
- Built on Node.js
- Shares flow with others (stored as JSON)
- Runs on desktop, Raspberry Pi, Beaglebone Black

# Open Source Tools

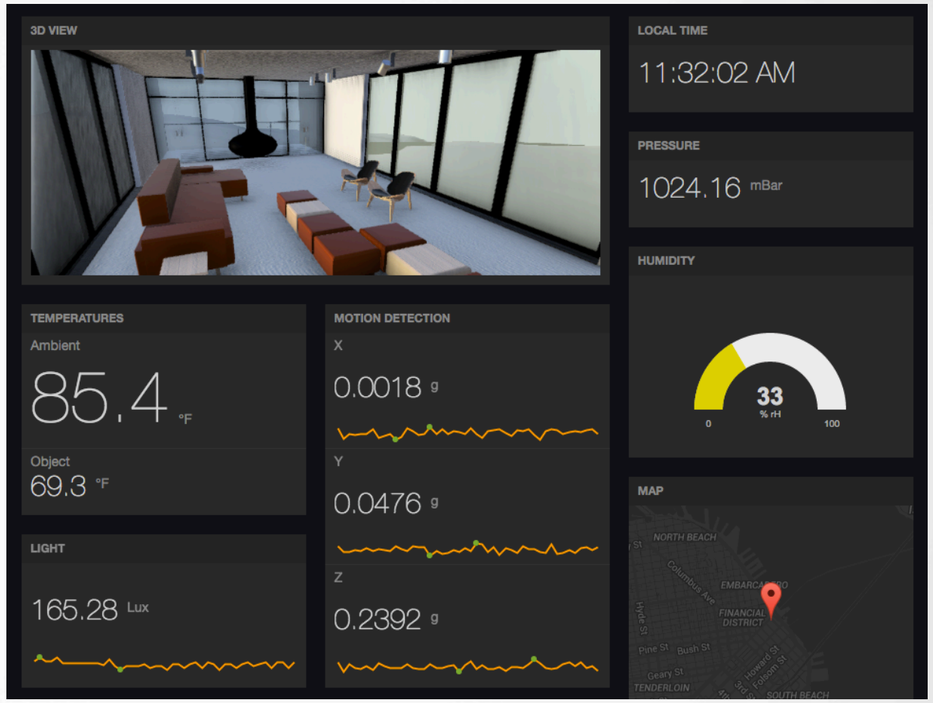
***freeboard.io***

- Real-time dashboard builder
- Designed for IoT and web mashups
- Open-source alternative to Geckoboard

# Building Interaction-On-Demand Design

# Real-time data mashup

- Mash up design with different data sources such as IoT sensor data, Google Map, Open Weather, clock etc.
- Each widget receives data from the different or same web or IoT service.
- 3D View (View and Data API) wrapped in a widget.
- Responsive layout changed dynamically based on the input of the sensor data or location of the viewer.
- Interactive content or configuration based on proximity or location



# Interactive car manual

- Replace car manual with a 3D interactive app on a tablet or mobile phone
- Connect with on-board diagnostics (OBD) and other sensors displaying real-time and historical sensor data of your car such as speed, mileage, tire pressure, impact, GPS location and engine status along with the 3D view.
- Given collected data, recommend best commute route that saves fuel
- Remind regular maintenance, advice road and traffic condition via email, text or twitter

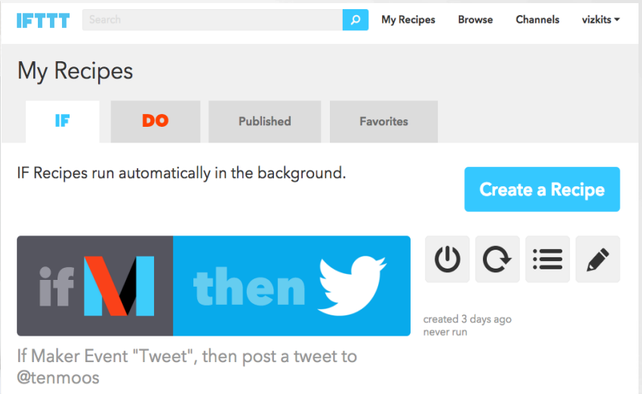
# Wiring Up Without Coding

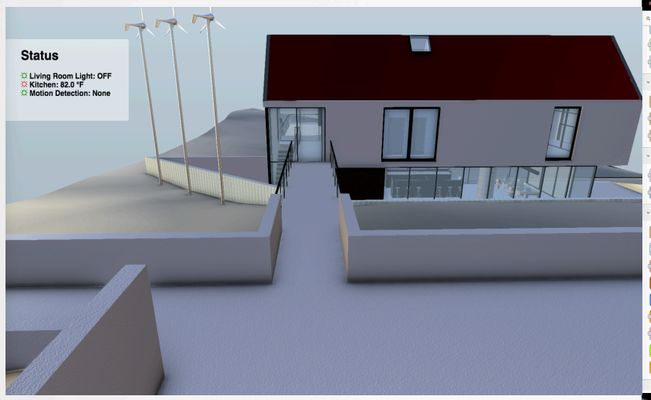

MQTT
ORG

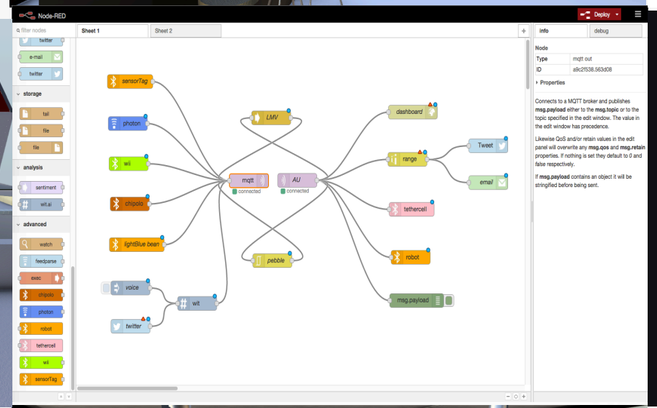

Bluetooth
SMART

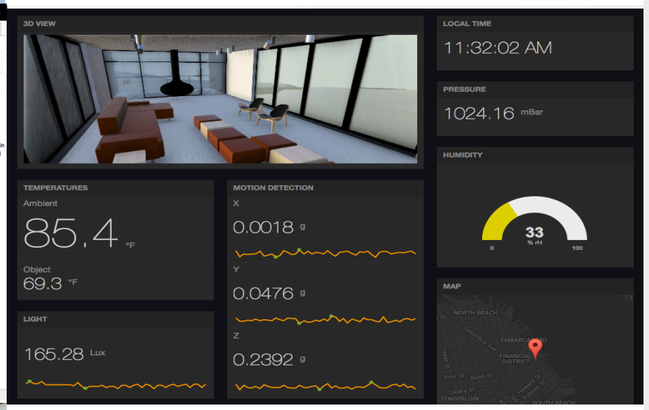

WiFi


Kitchen
Temperature:
85.3 °F


IFTTT
Search
My Recipes
Browse
Channels
vizkits
My Recipes
IF
DO
Published
Favorites
IF Recipes run automatically in the background.
Create a Recipe
if
then
created 3 days ago
never run
If Maker Event "Tweet", then post a tweet to @tenmoos


Status
Living Room Light: OFF
Kitchen: 82.0 °F
Motion Detection: None


Node-RED
Deploy
sensorTag
photon
wii
chipolo
lightblue bean
voice
twitter
mqtt
LMV
AU
pebble
wit
dashboard
range
tethercell
robot
msg.payload
Tweet
email

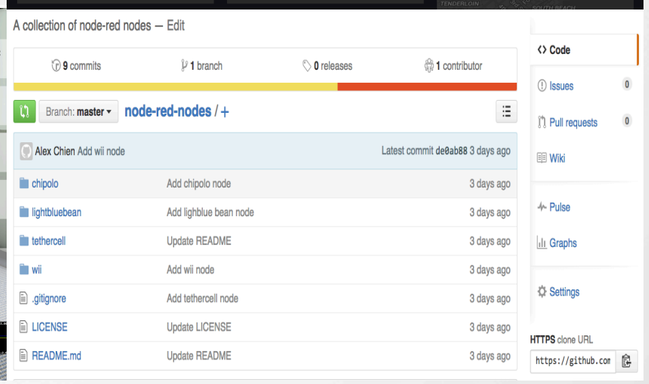

3D VIEW
LOCAL TIME
11:32:02 AM
PRESSURE
1024.16 mBar
HUMIDITY
33
TEMPERATURES
Ambient
85.4 °F
Object
69.3 °F
MOTION DETECTION
X
0.0018
Y
0.0476
Z
0.2392
LIGHT
165.28 Lux
MAP


Tethercell


CHIPOLO


Grove


Living Room
Temperature:
85.5 °F
Humidity:
32.0 % rH
Pressure:
1016.32 mBar
Light:
131.16 Lux
Magnet(μT):
x: -4.9480
y: 5.9976
z: 10.0459
Gyro(°/s):
x: 0.3967
y: -0.1221
z: 0.8240
Acc(g):
x: 0.0007
y: 0.0464
z: 0.2409


A collection of node-red nodes — Edit
9 commits
1 branch
0 releases
1 contributor
Branch: master
node-red-nodes / +
Alex Chien Add wii node
Latest commit de0ab88 3 days ago
chipolo Add chipolo node 3 days ago
lightbluebean Add lighblue bean node 3 days ago
tethercell Update README 3 days ago
wii Add wii node 3 days ago
.gitignore Add tethercell node 3 days ago
LICENSE Update LICENSE 3 days ago
README.md Update README 3 days ago
Code
Issues
Pull requests
Wiki
Pulse
Graphs
Settings
HTTPS clone URL
https://github.com

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Alex Chien
alex.chien@autodesk.com

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- Give instructors feedback in real-time.

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