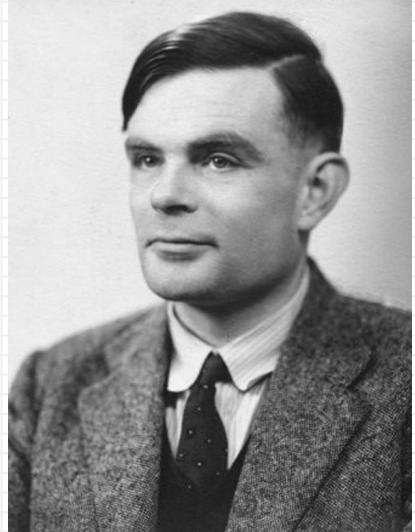


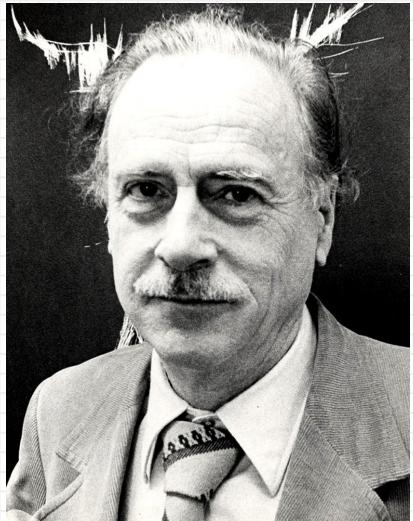
"When wireless* is perfectly applied the whole earth will be converted into a huge brain, which in fact it is, all things being particles of a real and rhythmic whole..... and the instruments through which we shall be able to do this will be amazingly simple compared with our present telephone. A man will be able to carry one in his vest pocket."

1926 – Nikola Tesla



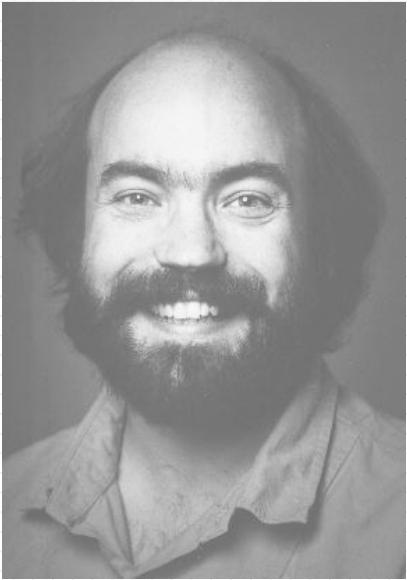
"...It can also be maintained that it is best to provide the machine with the best sense organs that money can buy, and then teach it to understand and speak English. This process could follow the normal teaching of a child."

1950 – Alan Turing



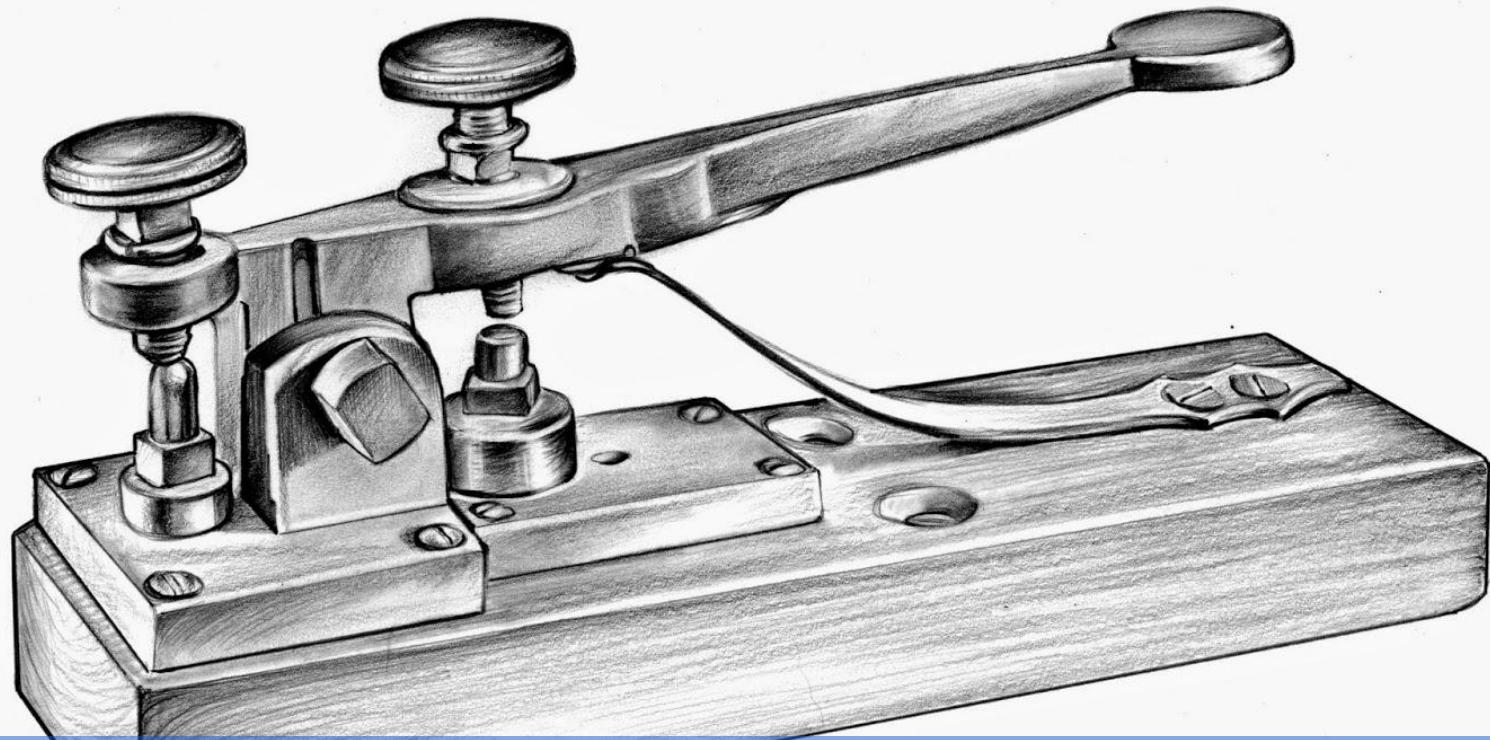
"....by means of electric media, we set up a dynamic by which all previous technologies -- including cities -- will be translated into information systems"

1964 - Marshall McLuhan



“The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it”.

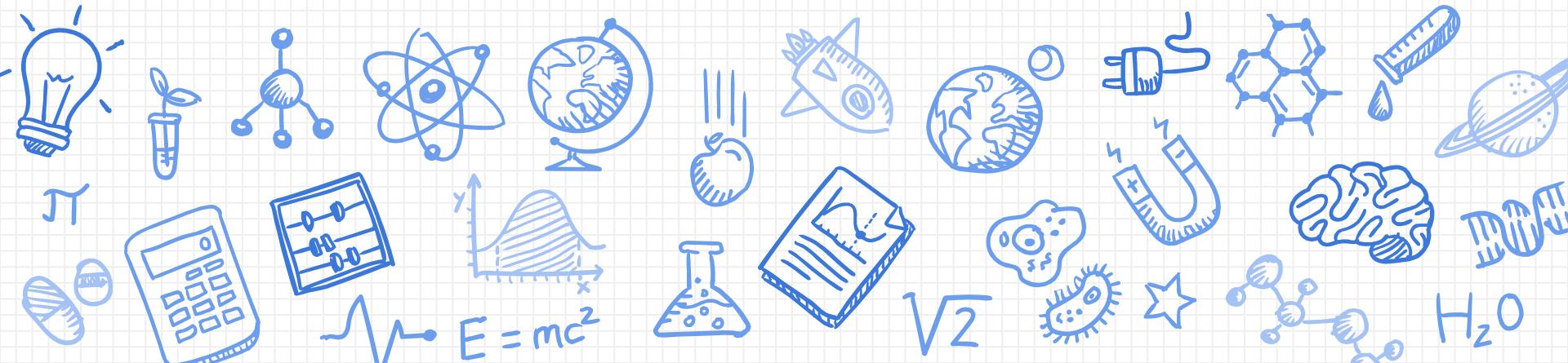
1991 – Mark Weiser



1844 – Samuel Morse sends the first public telegraph message. It said...

What hath God wrought?

Developing for the Internet of Things





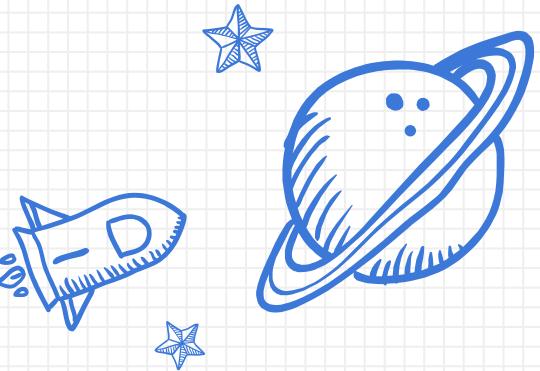
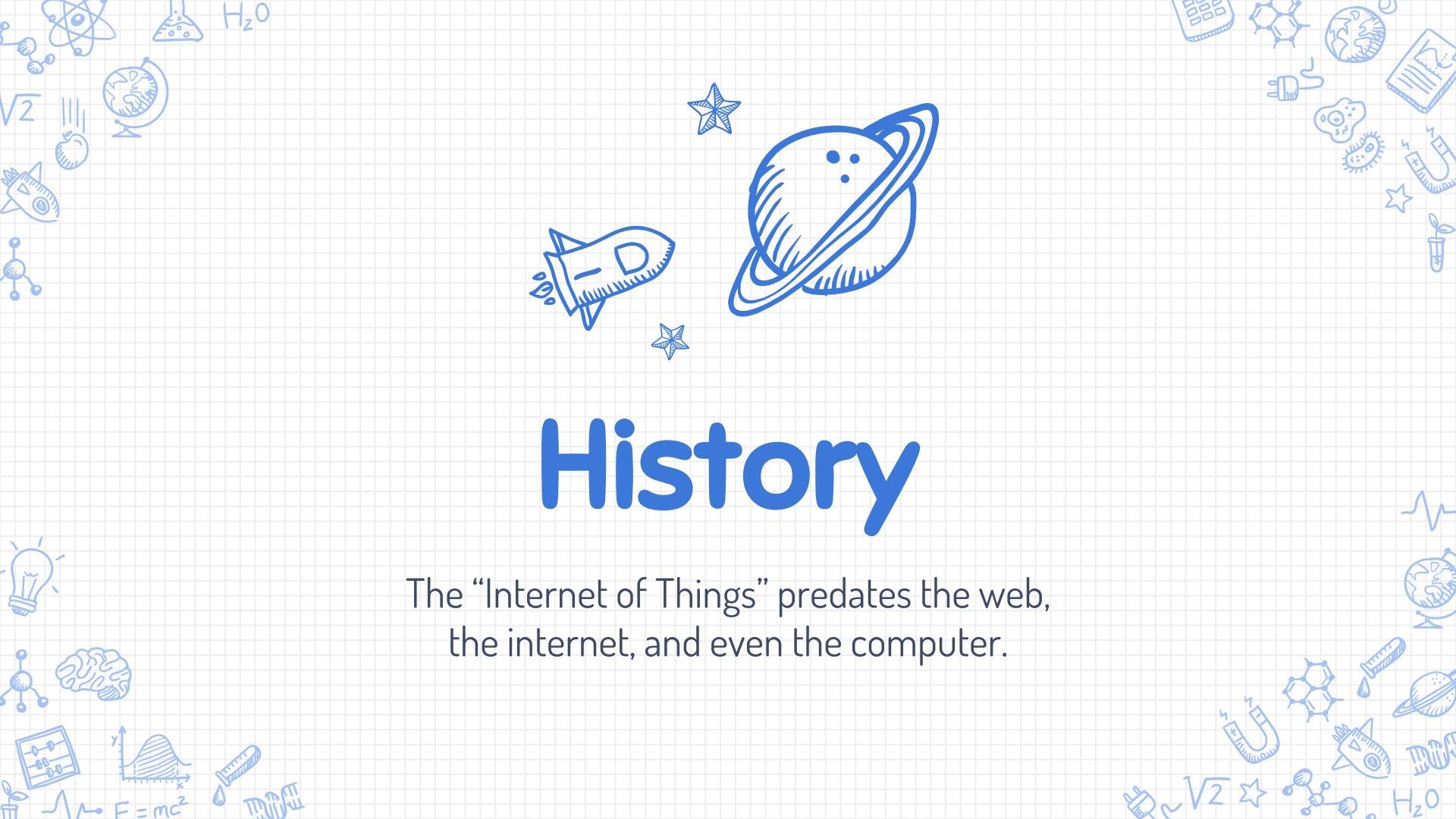
Mark Robert Henderson

Lead Engineer, No Pilots No Demos

@aphelionz

@npnd

Slides available at <http://npnd.us/iot-dev>



History

The “Internet of Things” predates the web,
the internet, and even the computer.

DICK TRACY WRIST RADIO

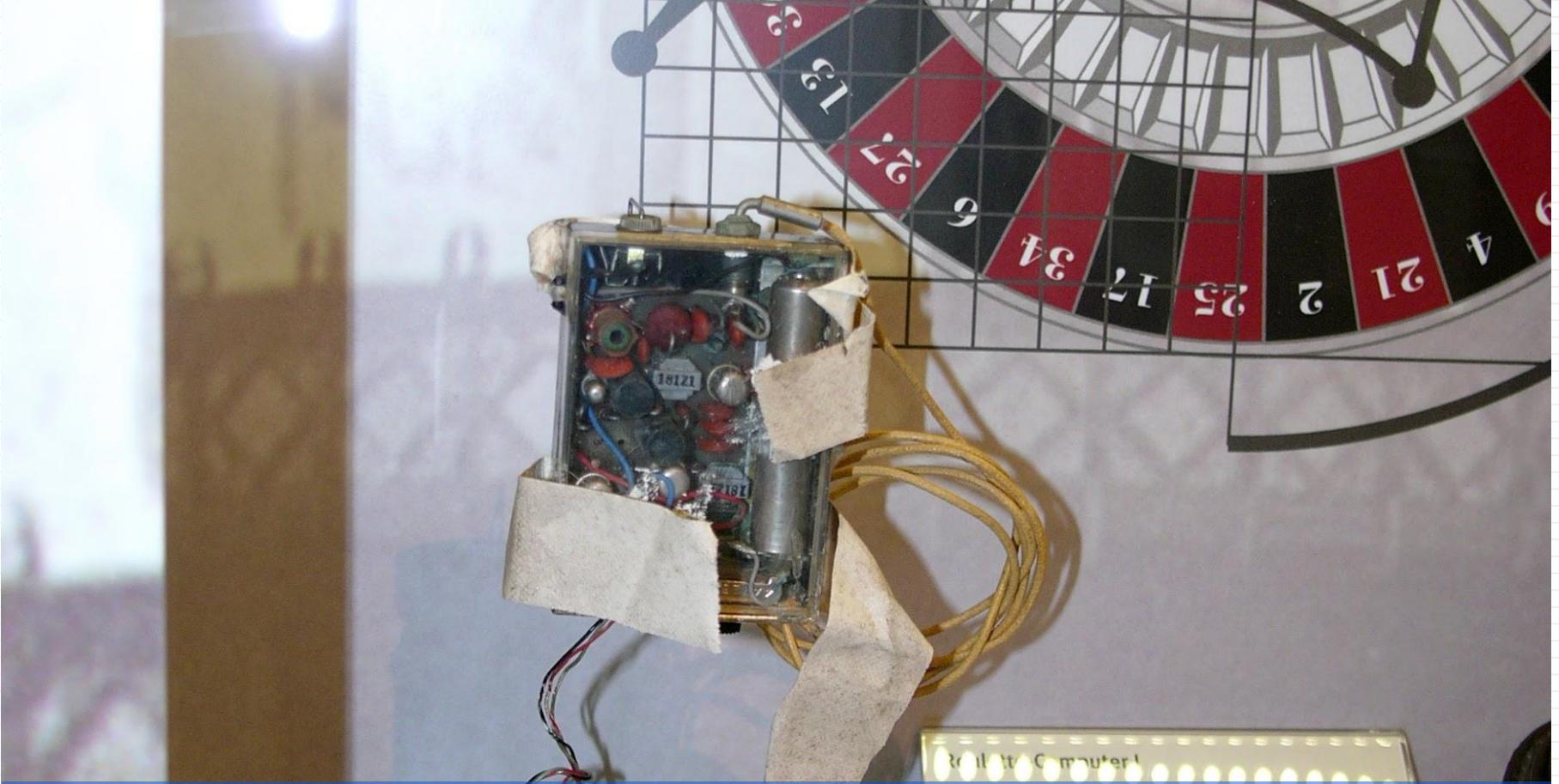
... for Kids from 6 to 60
WEAR IT LIKE A WATCH
USE IT AS A RADIO!
SHOCKPROOF—SAFE!

One of the
most comp-
act sets
you've ever
seen!

No Batteries
Electricity
Tubes

It really works. You've seen it in comic strips—now it's available for gift giving. Uses Radar Crystal Detector as developed by U. S. Air Forces. Receives regular AM radio broadcasts. Can be connected with wire for use as telephone system or as extra personal speaker for your home radio. Nothing to wear out or re-

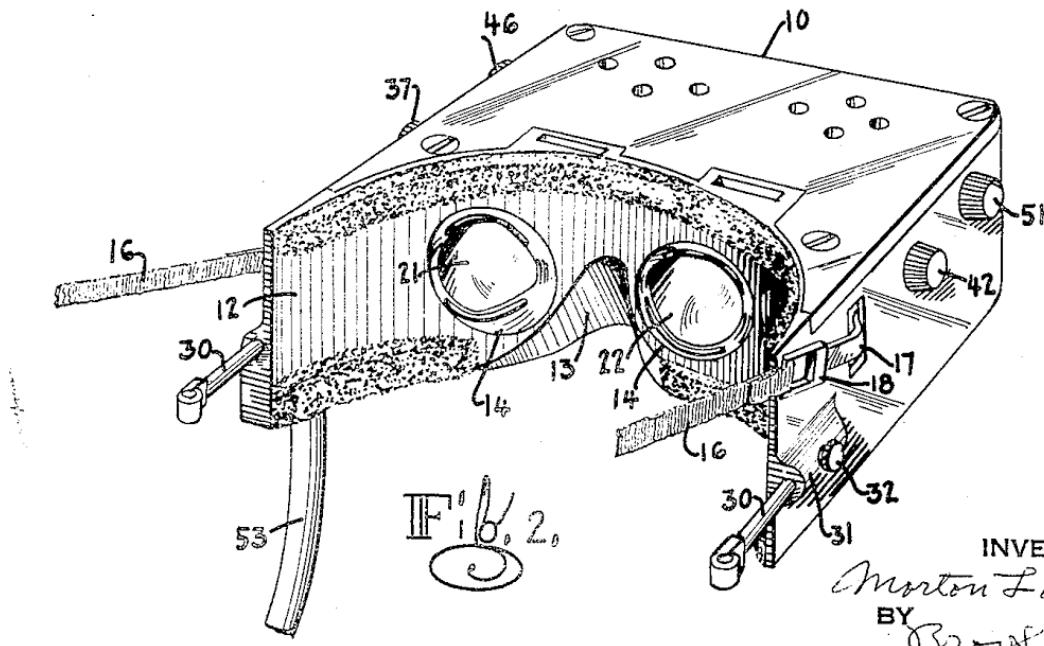
1946 – Dick Tracy's two-way wristwatch radio



1950 – Edward Thorp makes a wearable analog computer to cheat at roulette

Analogschaltung und Handskizze, 1960/61

Der Mathematiker Ed Thorp entwarf 1956 einen Analogrechner, um Roulettezahlen vorauszusagen. Gemeinsam mit Claude Shannon entstand daraus der erste Wearable Computer, der versteckt am Körper getragen wurde. 1961 erfolgte der Praxistest in Las Vegas. Erst ein Kabelbruch beendete ihre Glückssträhne...



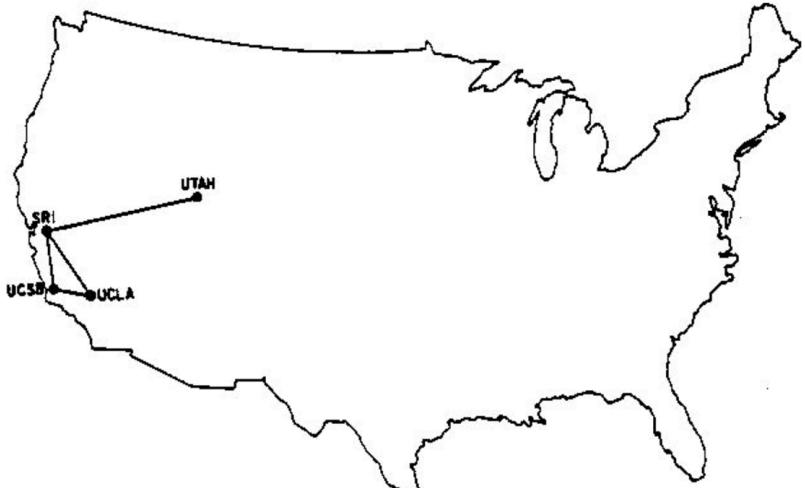
INVENTOR
Morton L. Heilig
BY
Brookhaven
His ATTORNEYS

1960 – Morton Heilig patents the first head-mounted display

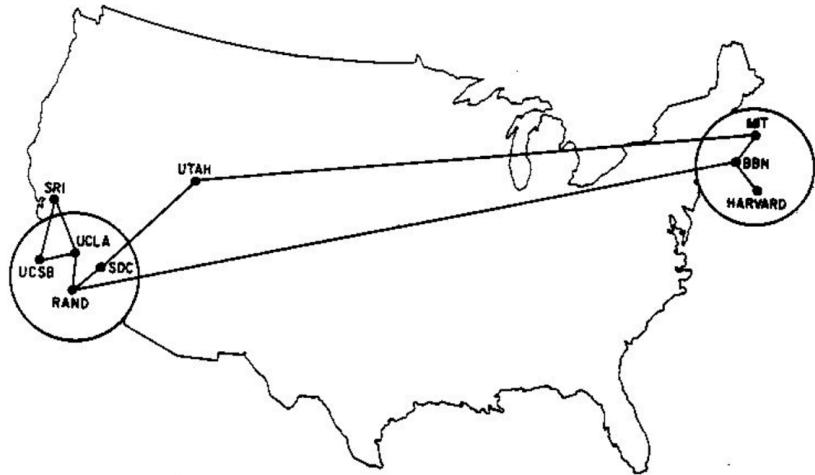
NEIMAN-MARCUS
PRESENTS ...



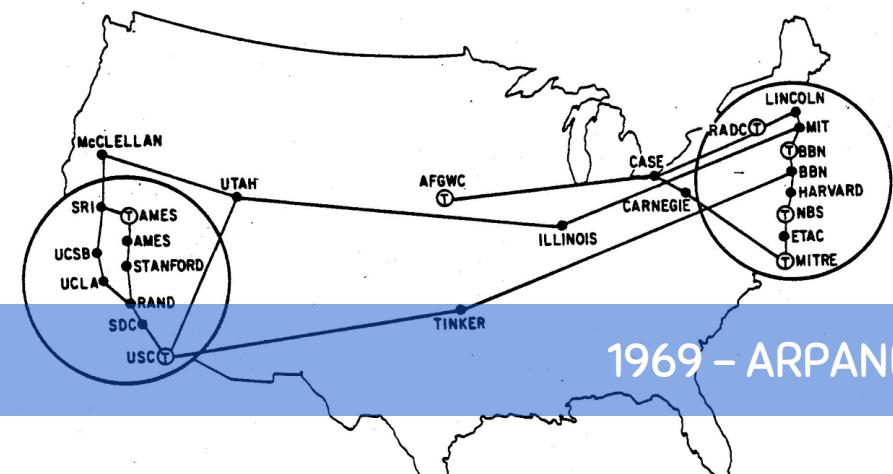
1969 - Honeywell Kitchen Computer



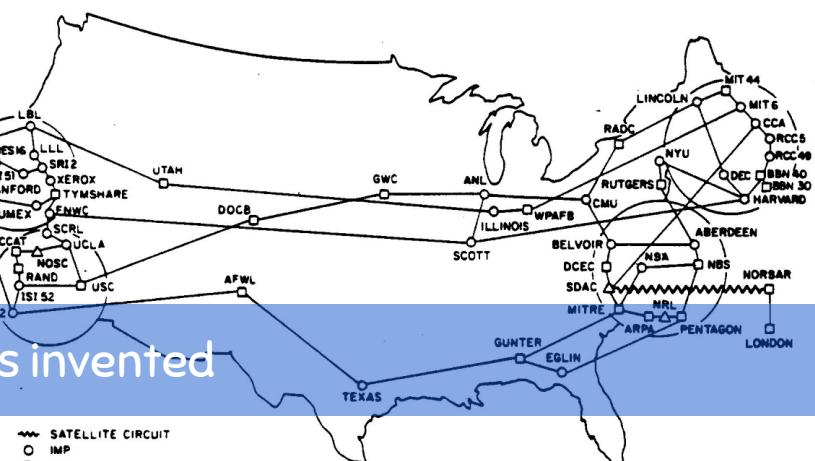
Dezember 1969



Juni 1970



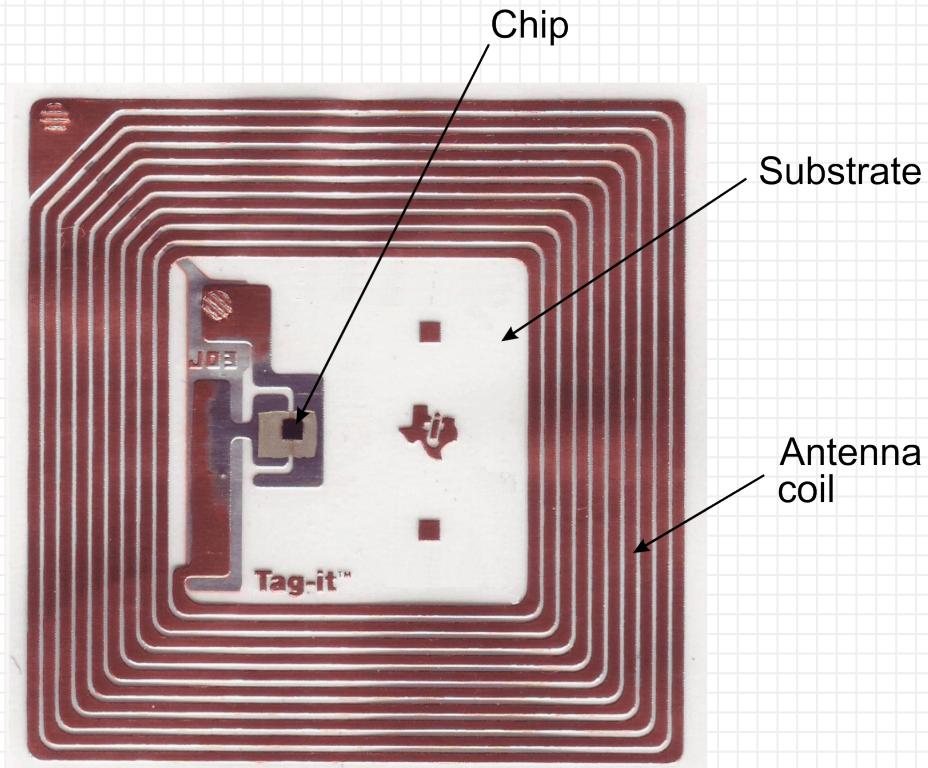
1969 – ARPANET is invented



*** SATELLITE CIRCUIT
○ IMP
□ TIP

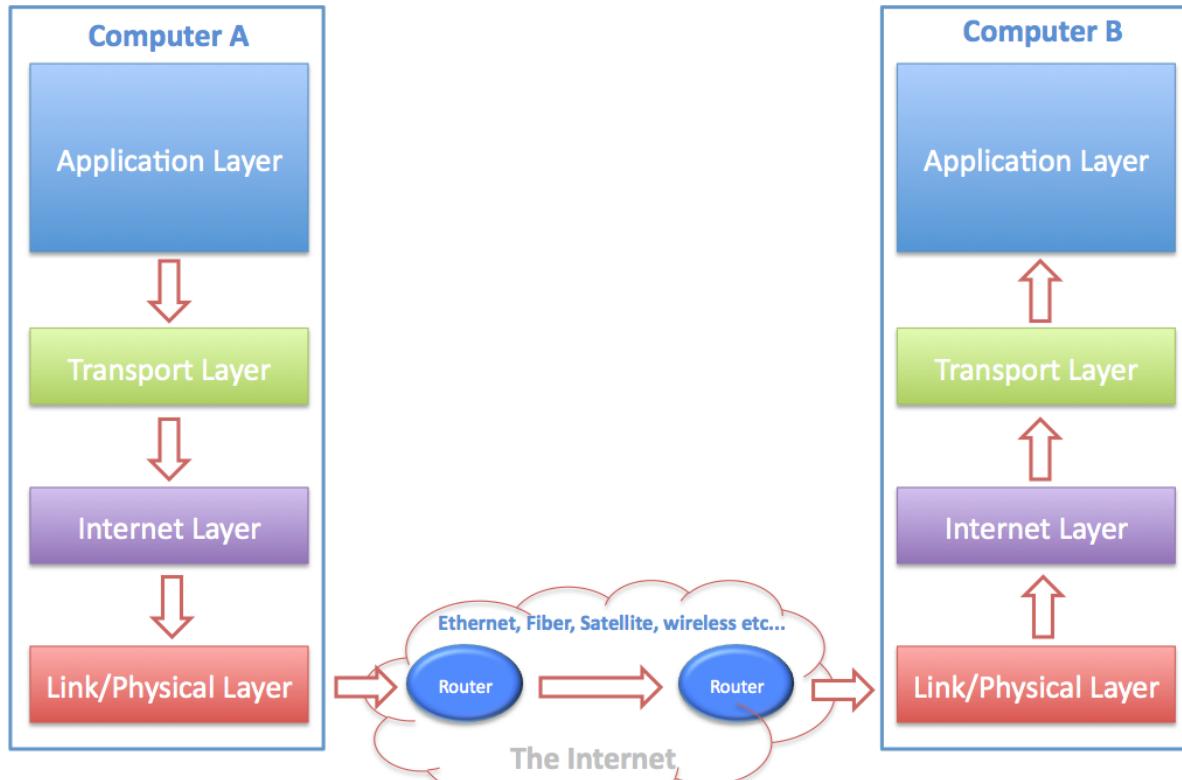
Topología de ALOHAnet

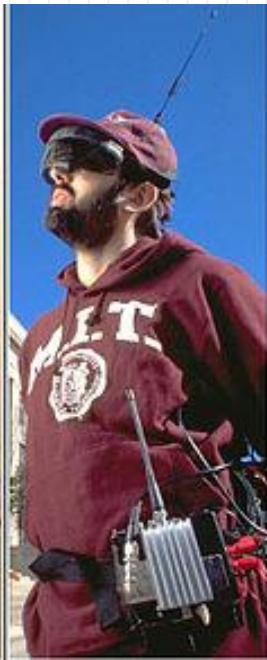




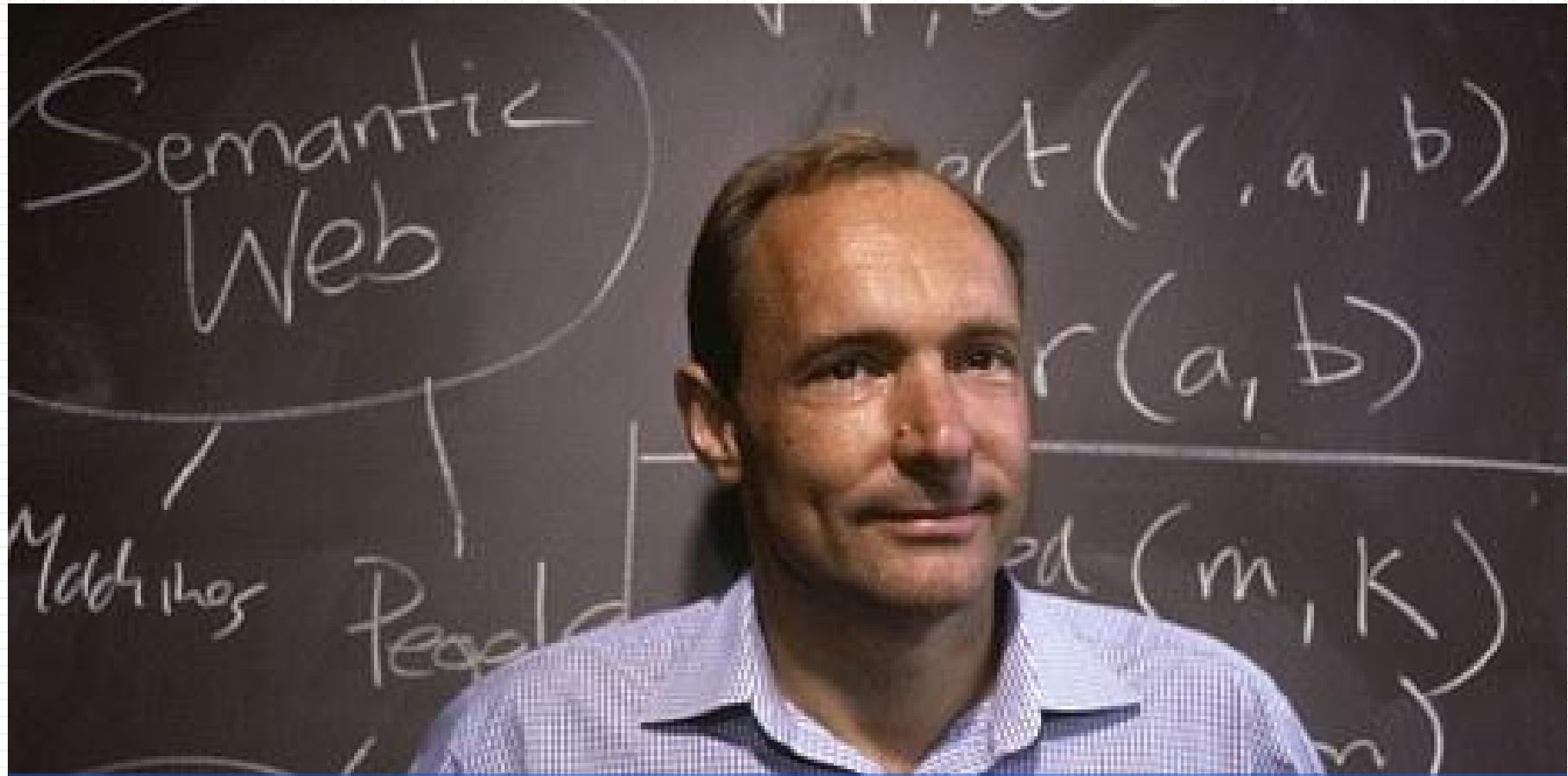
1973 – RFID is patented

Data Transmission over the Internet through TCP/IP





1981 – Steve Mann, the first wearable computer (eventually becomes WearCam)



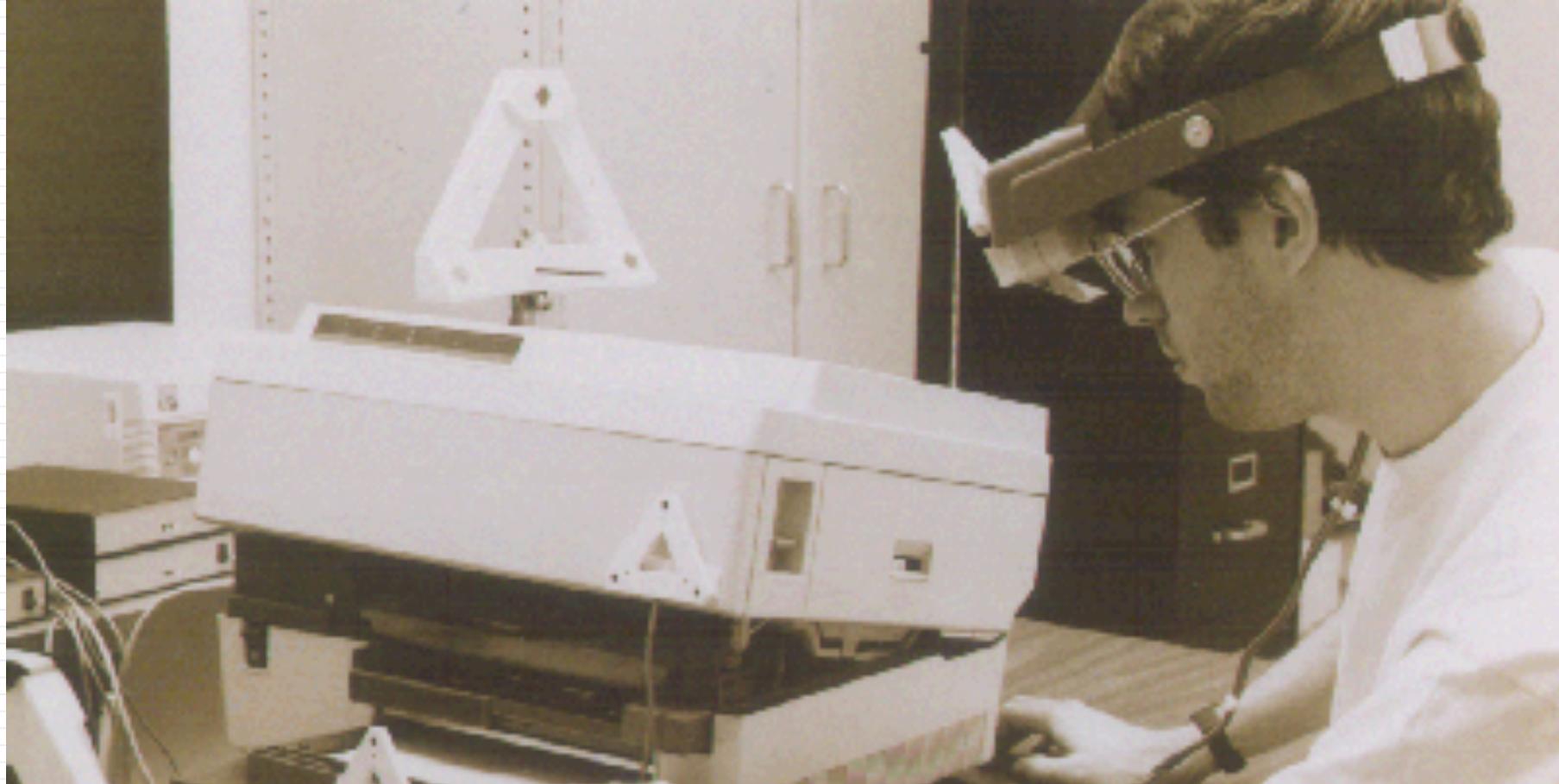
1989 – Tim Berners-Lee proposes the World Wide Web



1990 – John Romkey's Toaster



1991 – Precursor to 802.11



1991 – Knowledge-based Augmented Reality for Maintenance Assistance

25/1/94

14:35

14:35

[500]

14:41

14:41

14:41

[500]

14:41

14:41

14:41

[500]

14:42

14:42

14:42

[500]

14:45

14:45

14:45

[500]

14:49

14:49

14:49

[500]

1994 - Forget Me Not



1998 - MIT's InTouch



1998 – Mark Weiser's Stock Fountain



1999 – “Internet of Things” is coined by Kevin Ashton



2000 - LG's Internet Refrigerator



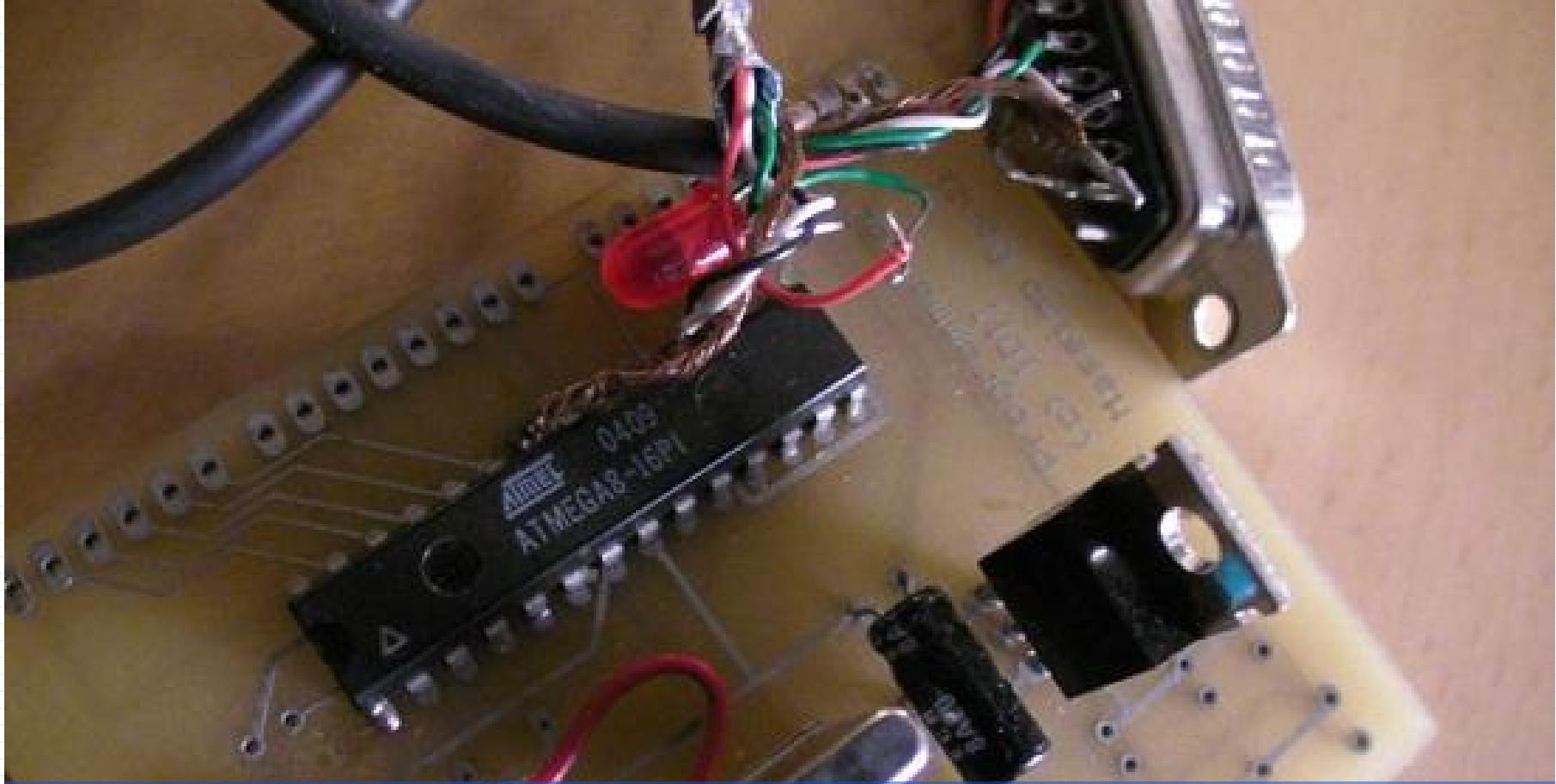
2002 – Ambient Orb



2005 – Nabaztag



2010 – Google's Self Driving Cars



2011 - Arduino launched, “maker” revolution begins



2014 – Gartner hype cycle

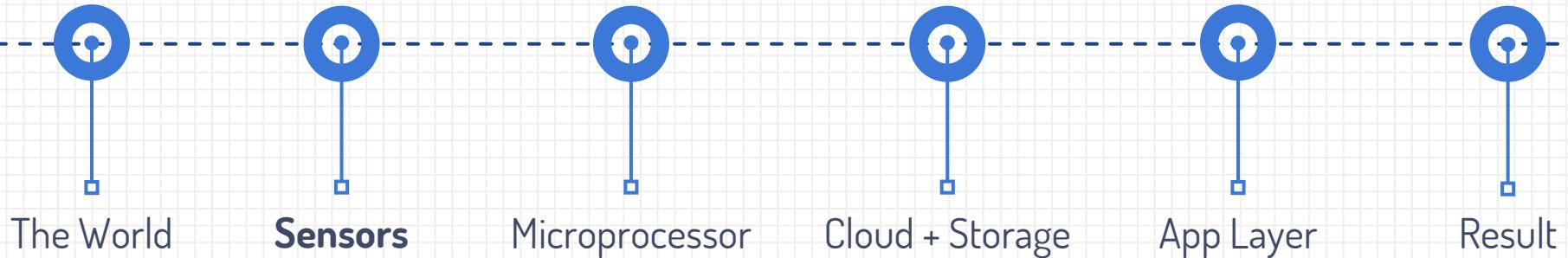
What was recently a joke about getting your toaster on the internet, and has now evolved into an industry buzzword, is in fact the continuation of a very simple human endeavor to transcend our physical limitations and create a worldwide extension of our very nervous systems.



End-to-End

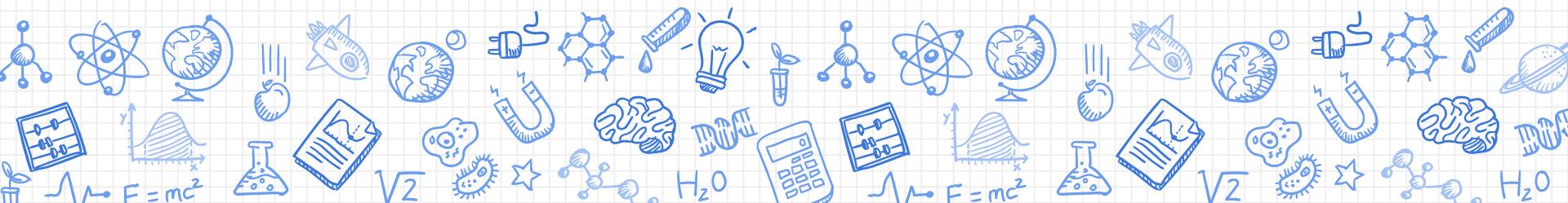
The background features a light blue grid pattern with various hand-drawn science-related icons in blue ink, including a globe, a brain, a lightbulb, a magnet, a DNA helix, a test tube, a graph, a rocket, a star, and a planet.

So, here's what you're going to do.



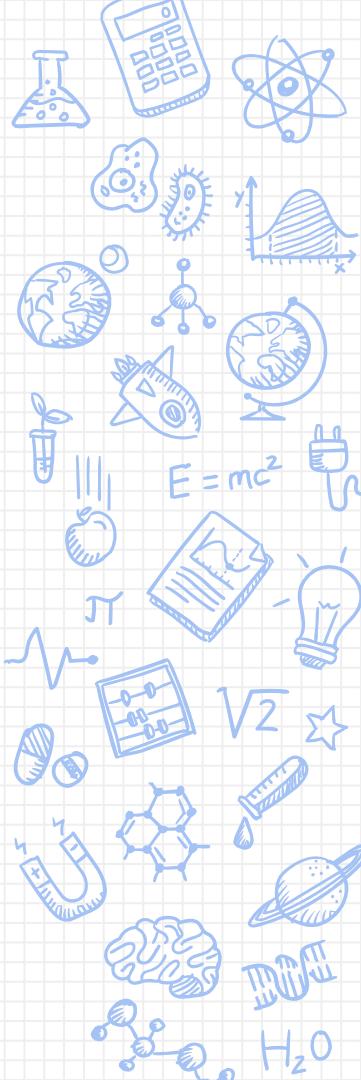
Sensors

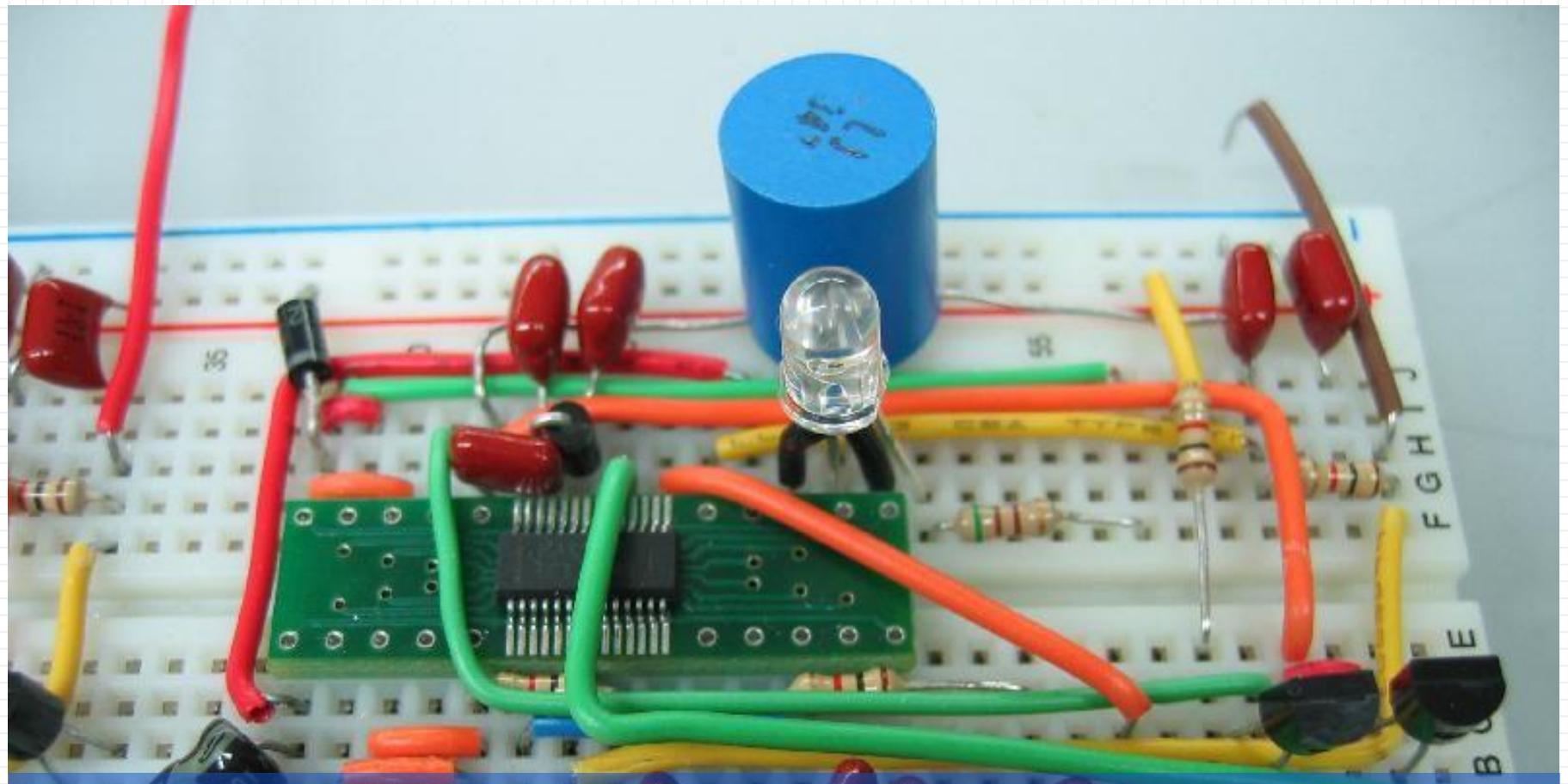
How to get information from the ether.



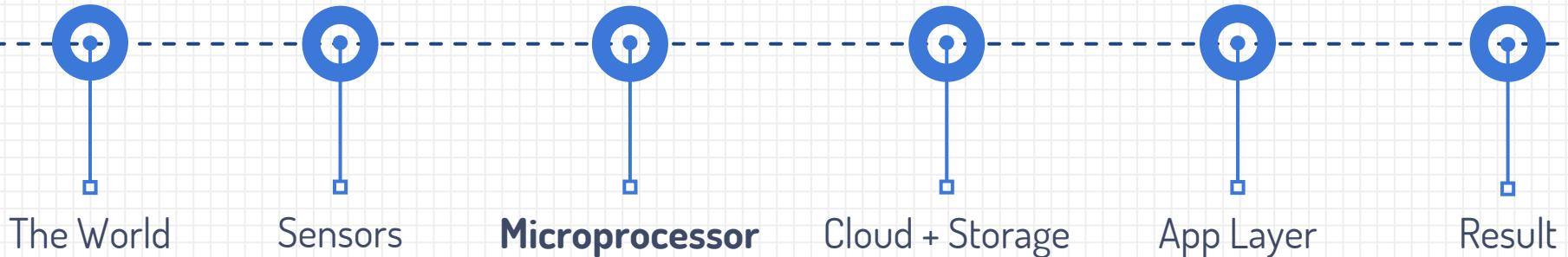
There are sensors available that read:

Ground movement, underwater sound, acoustic vibrations, air-fuel mixture, blind spots on cars, oxygen levels, alcohol content, magnetic fields, infrared, current, voltage, air pollution, bed wetting, humidity, snow, rain, soil moisture and composition, air flow, water flow, mass flow, radiation, temperature, geolocation, orientation, altitude, air speed, capacitance, fire, smoke, pressure, boost, level, force, strain



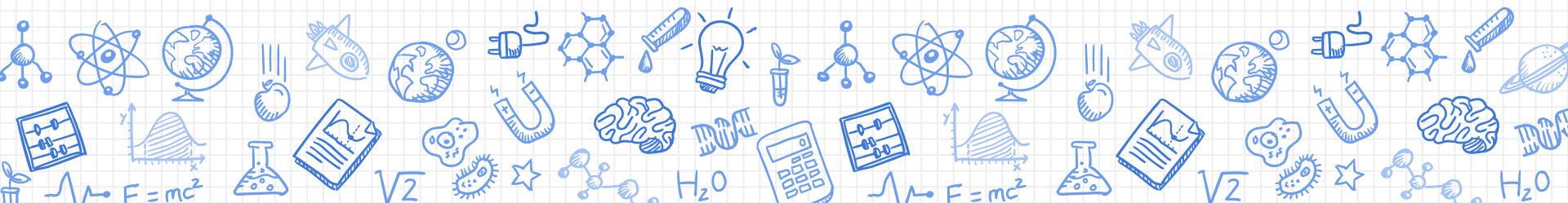


The breadboarding process – fun as heck



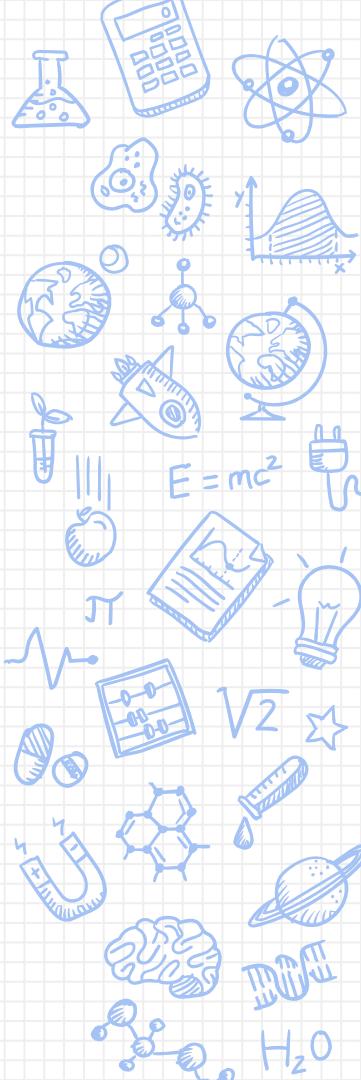
Microprocessor

Taking analog signals to the digital domain



Plenty of Options here

- ✗ Arduino
- ✗ BeagleBone
- ✗ Raspberry Pi
- ✗ Spark.io
- ✗ Linino One
- ✗ Tessel
- ✗ TI CC3200
- ✗ MSP430 LaunchPad





COM5

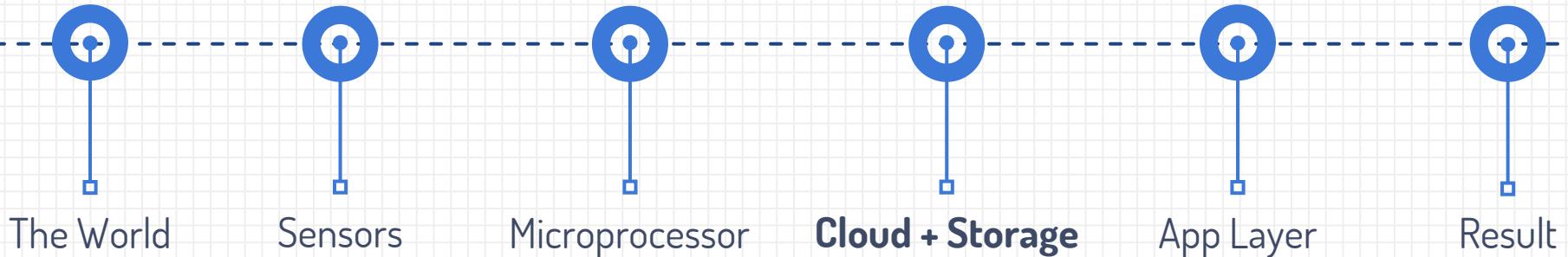


Send

```
-40 -287 220
46 -184 132
-6 -143 218
-63 -26 204
-44 55 154
-52 108 156
-54 141 141
-92 216 108
-69 179 86
-65 191 84
-71 231 54
-74 245 50
-99 269 52
-92 272 54
```

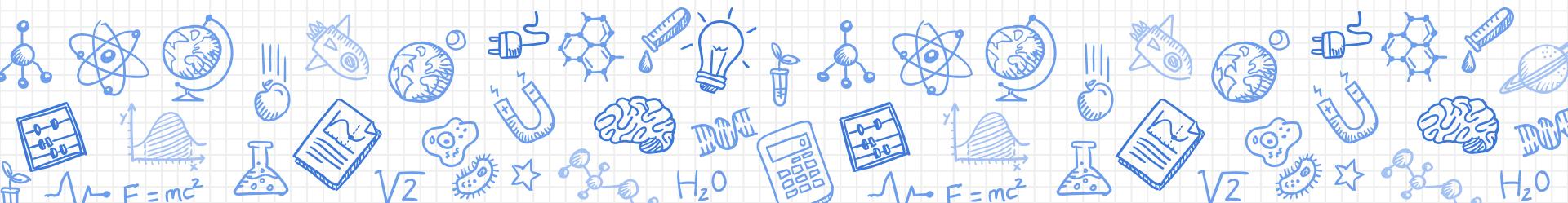


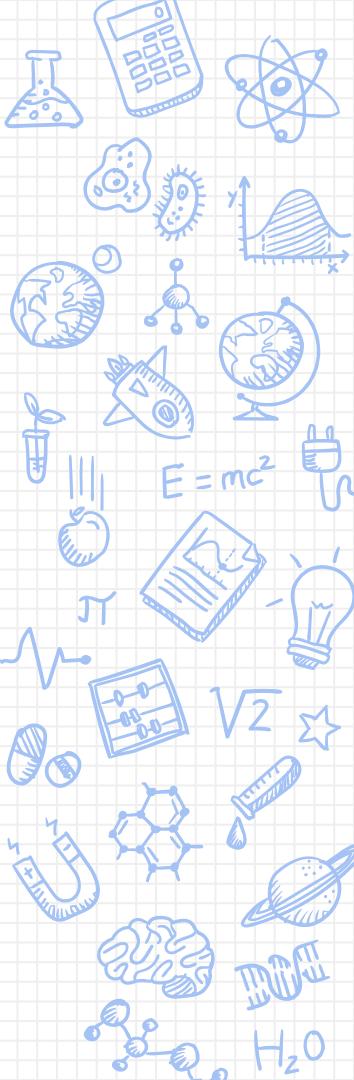
3 Axis Accelerometer Example (Serial Monitor)



Cloud Services

Where does the device transmit to?





You have two main options to send your packets

TCP

Data is sent via an established and verified connection to another device. As a result, slower.

Examples: HTTP, SMTP, FTP

UDP

Essentially “set it and forget it.” Sent connectionless* and orderless.

Examples: DNS, VOIP, Spark.
io’s Pub/Sub

*kinda

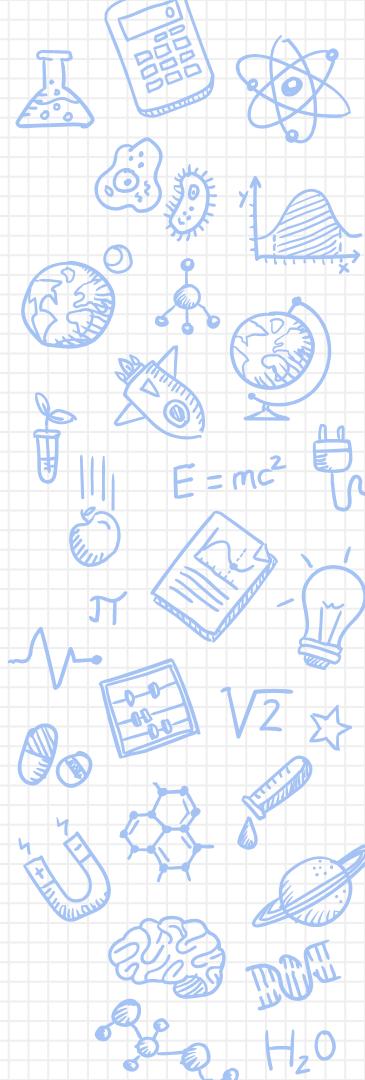
Two main ways of organizing your packets

REST/SOAP (HTTP)

Organized based on either HTTP verbs and resource nouns (REST) or HTTP calls to resource verbs (SOAP)

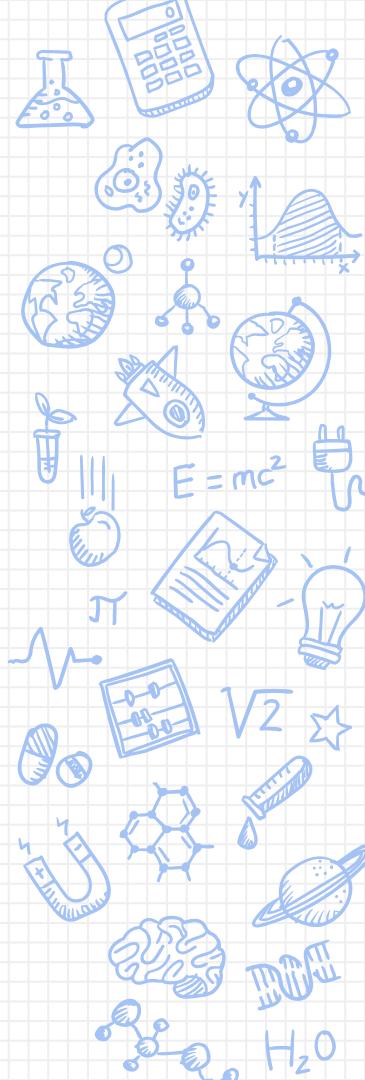
Pub/Sub (UDP)

Organized in terms of channels that devices ‘publish’ data to, where other channels would ‘subscribe’ to those channels and respond accordingly.



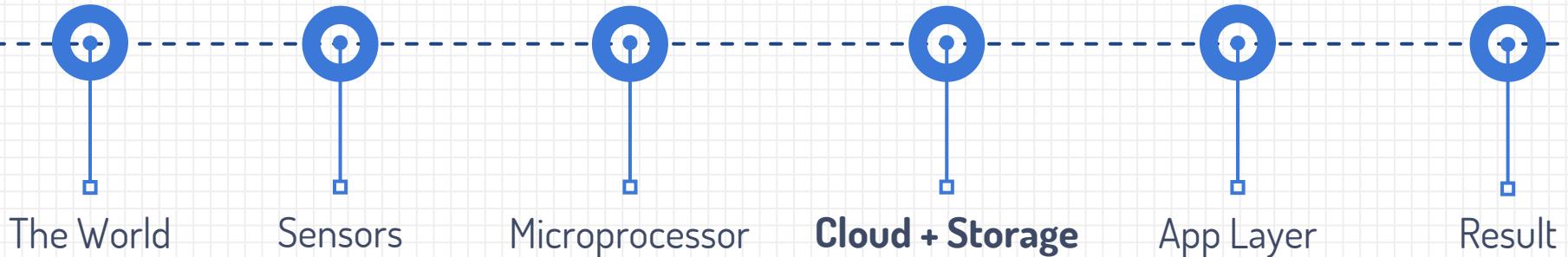
Asynchronous + Evented I/O is your friend

- ✗ Node.js
- ✗ Scala / Akka
- ✗ Python / Twisty
- ✗ libuv
- ✗ ...and more



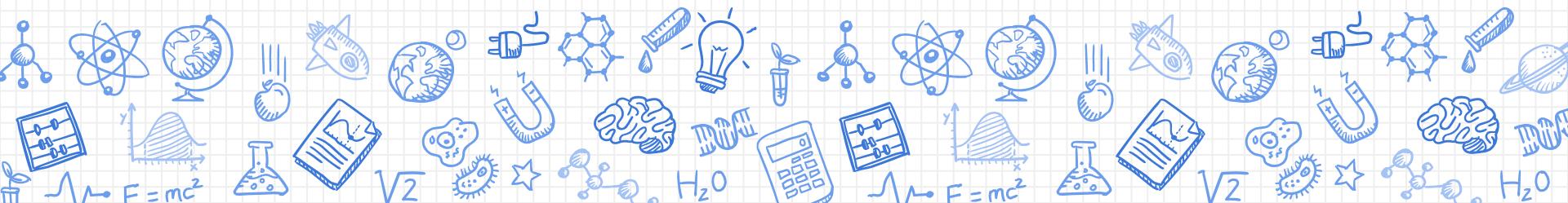
340,282,366,920,938,463,463,374,607,431,768,211,456

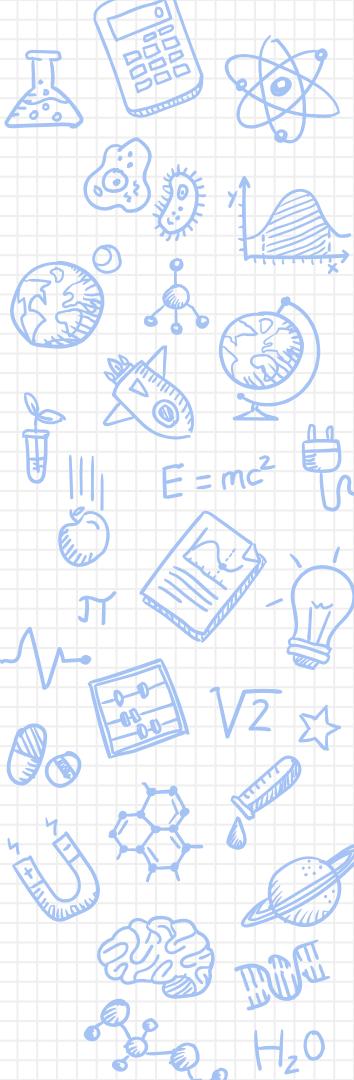
That's the (theoretical) number of IPv6
Addresses available, thus...



Storage

...FAST WRITES ARE IMPORTANT (reads too)



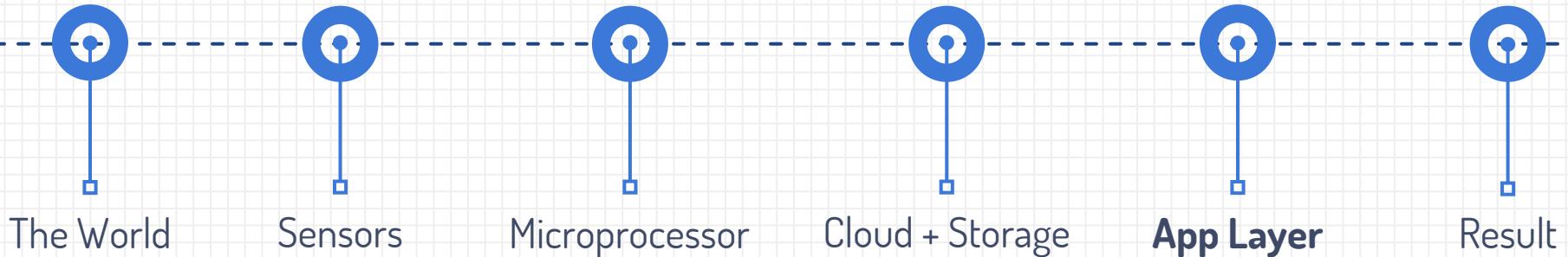


In-Memory Databases are key here

- ✗ Aerospike
- ✗ Cassandra
- ✗ Redis
- ✗ Mongo
- ✗ MemSQL

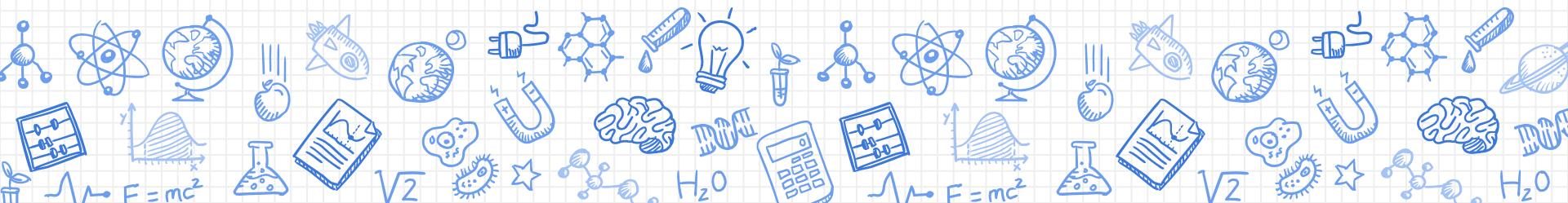
Of course, you can aggregate down to a traditional db...

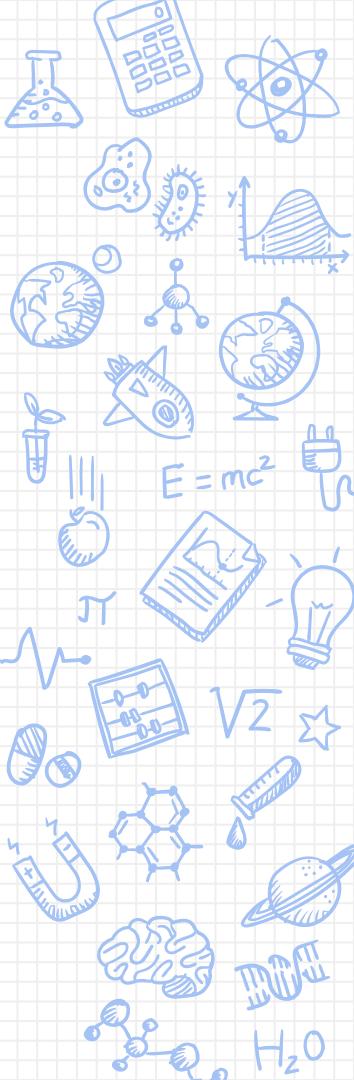
- ✗ PostgreSQL
- ✗ MySQL
- ✗ Oracle, etc



Application Layer

What the End User Sees





High-level options for application development

Native

iOS - Objective-C

Android - JVM

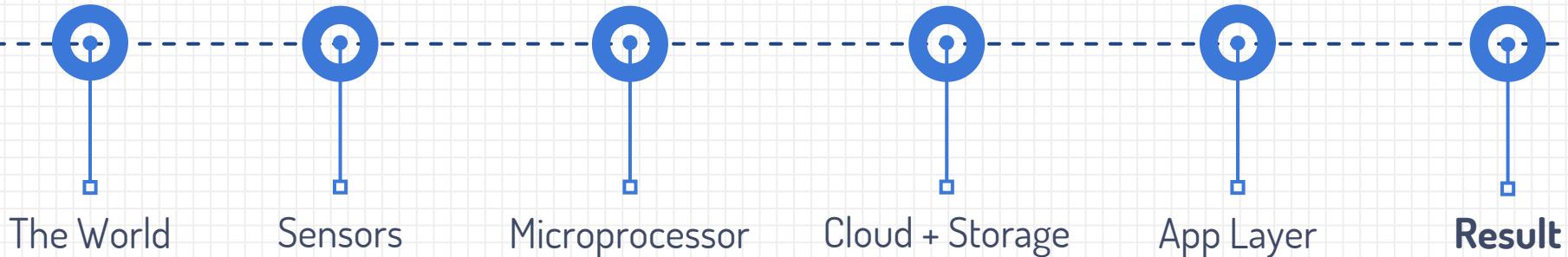
Desktop - various

Web - HTML/CSS/JS

Hybrid

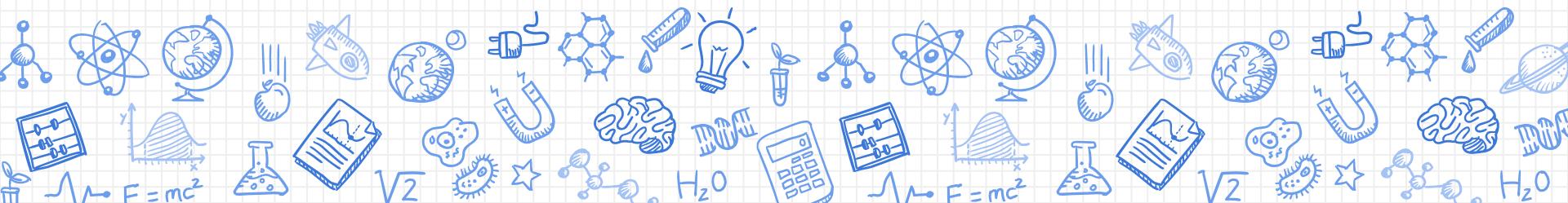
Web technologies
“wrapped” in various
frames for deployment
to different platforms.

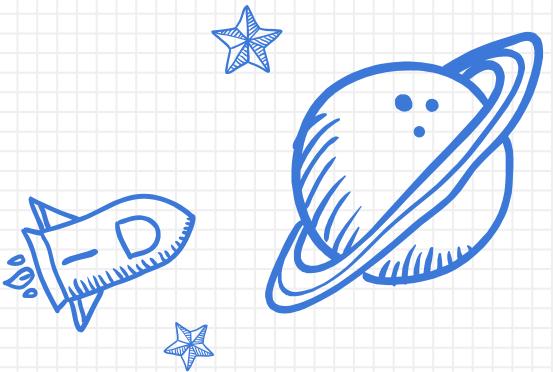
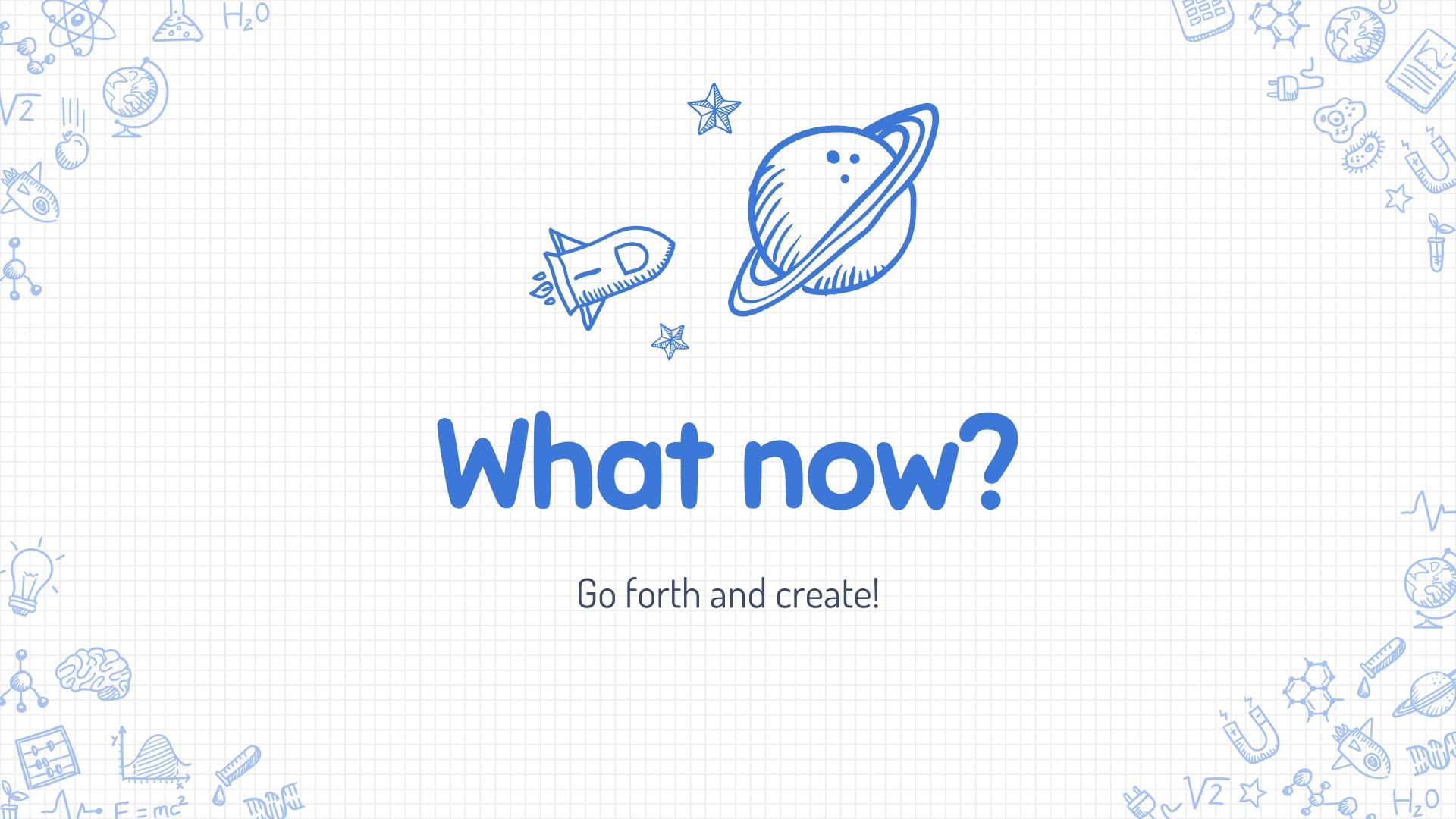
Cordova / Titanium /
etc.



The End Result

Servos, Automata, and Indicators



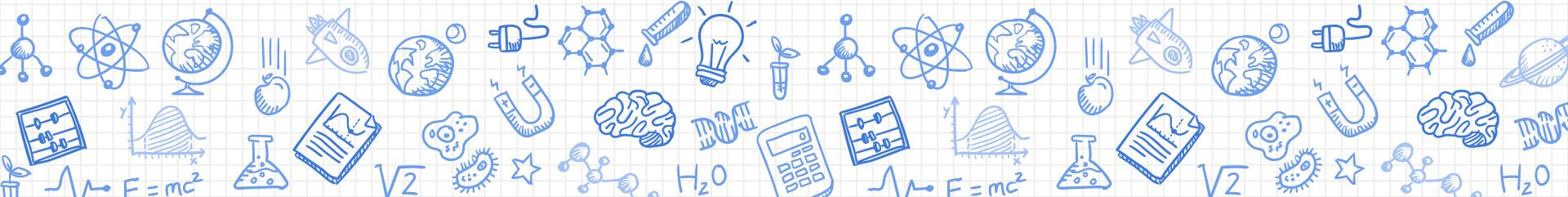


What now?

Go forth and create!

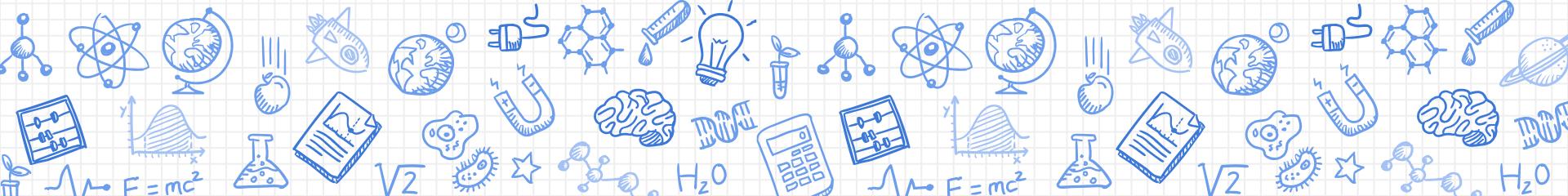
Wearables / Cybernetics

Becoming one with the machine.



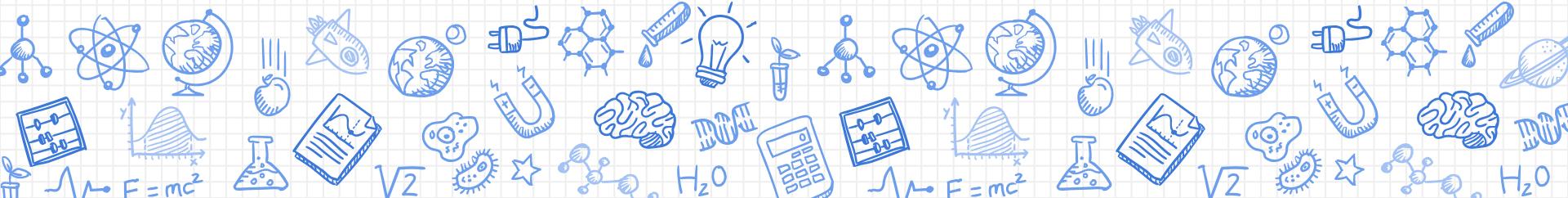
IRL Reductive Search

Looking for that Orange Ball



Extending the Neocortex

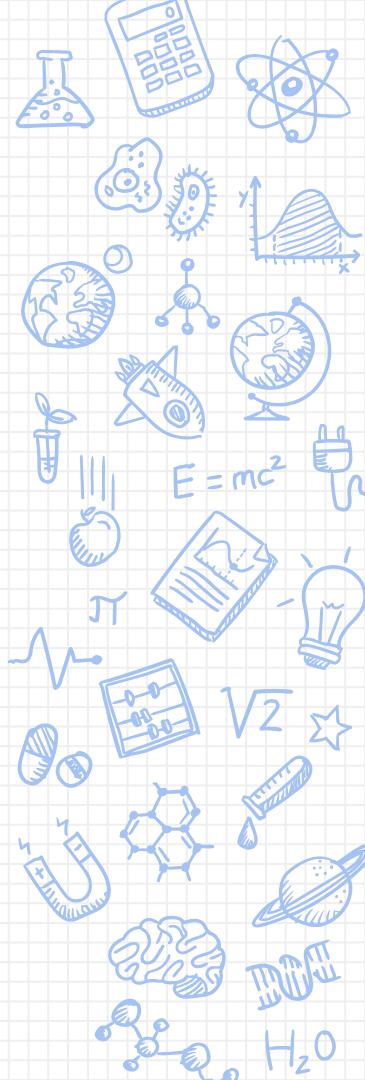
Expanding the predictive capability of the mammalian brain

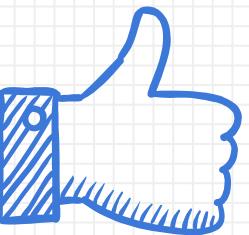


Credits

Special thanks to all the people who made and released these awesome resources for free:

- ✗ Presentation template by [SlidesCarnival](#)
- ✗ Photographs by [Unsplash](#)
- ✗ History of IoT appropriated from [Atmel](#) and [Postscapes](#)





THANKS!

Any questions?

You can find me at

- ✗ [@aphelionz](https://twitter.com/aphelionz)
- ✗ [@npnd](https://twitter.com/npnd)
- ✗ mark@npnd.com