Introduction to Electrical and Computer Engineering (ECE)

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Department of Electrical and Computer Engineering

Greatest Engineering Achievements of the 20th Century
National Academy of Engineering
(www.greatachievements.org)

1. Electrification
2. Automobile
3. Airplane
4. Water supply and distribution
5. Electronics
6. Radio and TV
7. Agriculture mechanization
8. Computers
9. Telephone
10. Air conditioning and refrigeration
11. Highways
12. Spacecraft
13. Internet
14. Imaging
15. Household appliances
16. Health technologies
17. Petroleum and petrochemical technologies
18. Laser and fiber optics
19. Nuclear technologies
20. High-performance materials

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ECE – Who are we?

High Performance Computing

Nanotechnology & Light

Clean Energy & Smart-Grid

Communications & Networking

Gyroscopes

(microelectromechanical system - MEMS)

Camera (=Photodetector)

(Photonics)

Battery

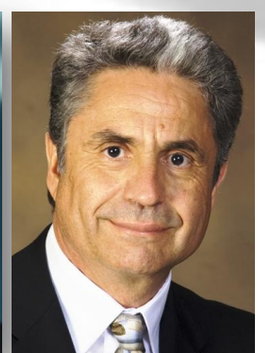
(Energy & Power)

Snapdragon

(Multi Core CPU)

Chipset

(Circuits, Memory)

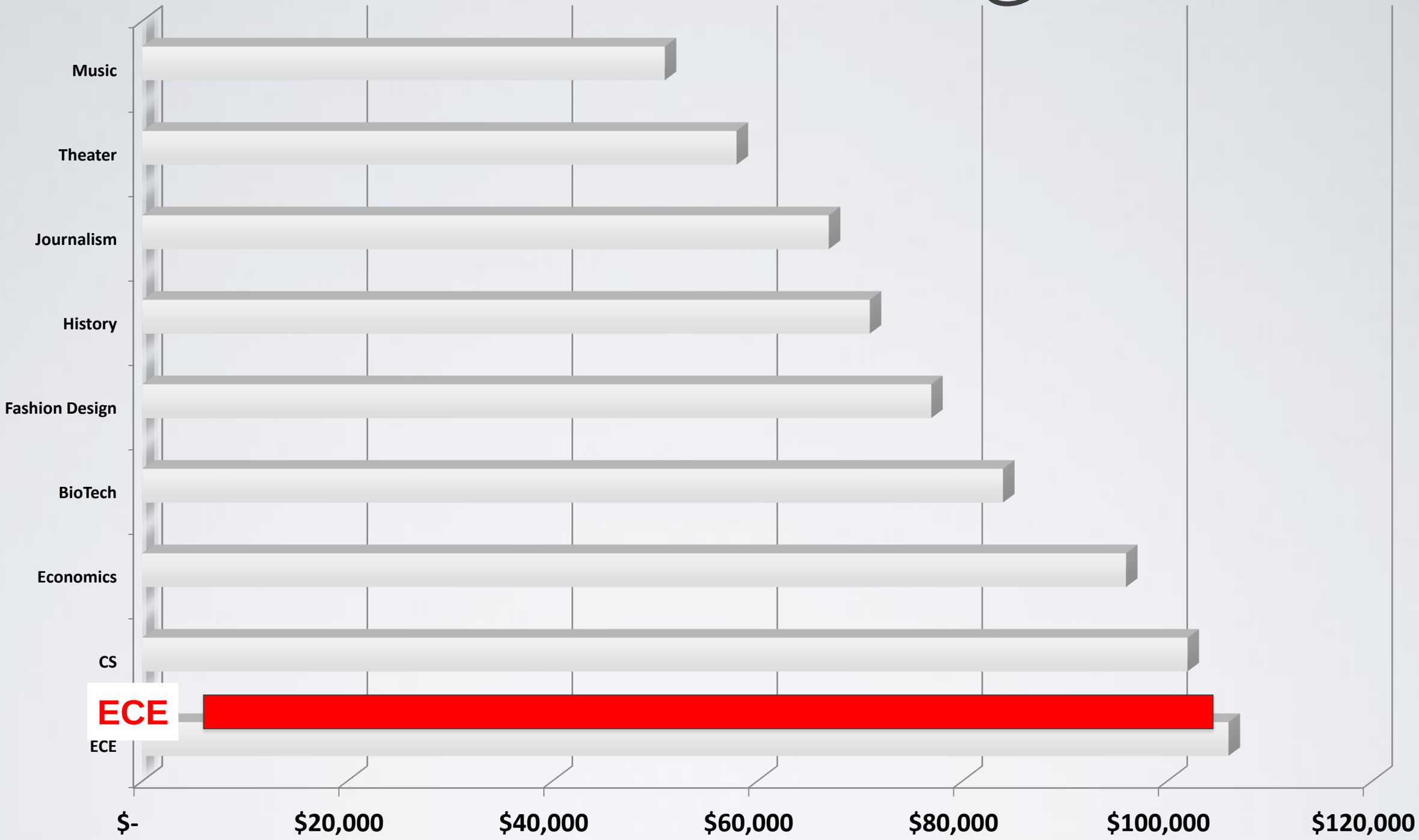


Communications

(RF, Communications, Networking)

ECE’s Making Good…

@ Mid Career



Q: Who makes more than ECE's? : Petroleum Engineers → Energy

That's ECE again! ☺

High Performance Computing & Computer Architecture

Technical Operations Manager, AV Engineering Events
Google ★★★★☆ 368 reviews - New York, NY
Google isn't just a software company. The Hardware Operations team is responsible for monitoring the state-of-the-art physical infrastructure behind Google's...
13 days ago - save job - email - more...

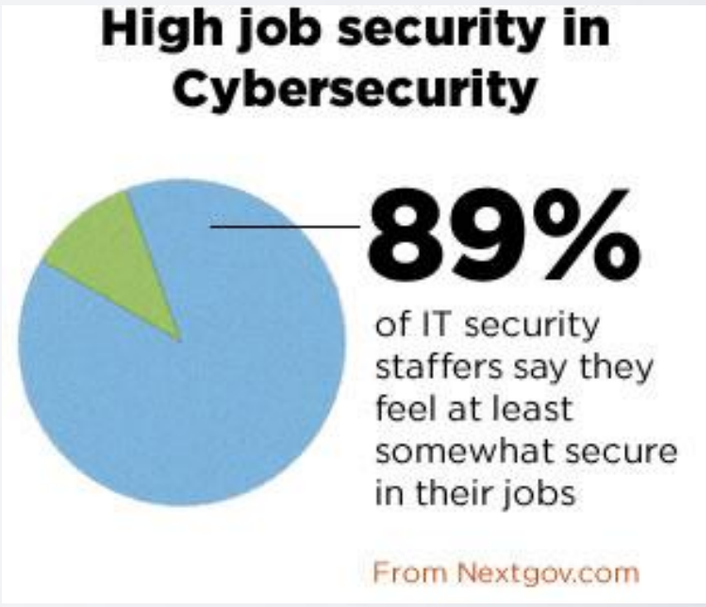
Get email updates for the latest **Google Data Center Technician $110,000 jobs**

Defining the *infrastructure* of computing

Cloud Computing & Cyber Security



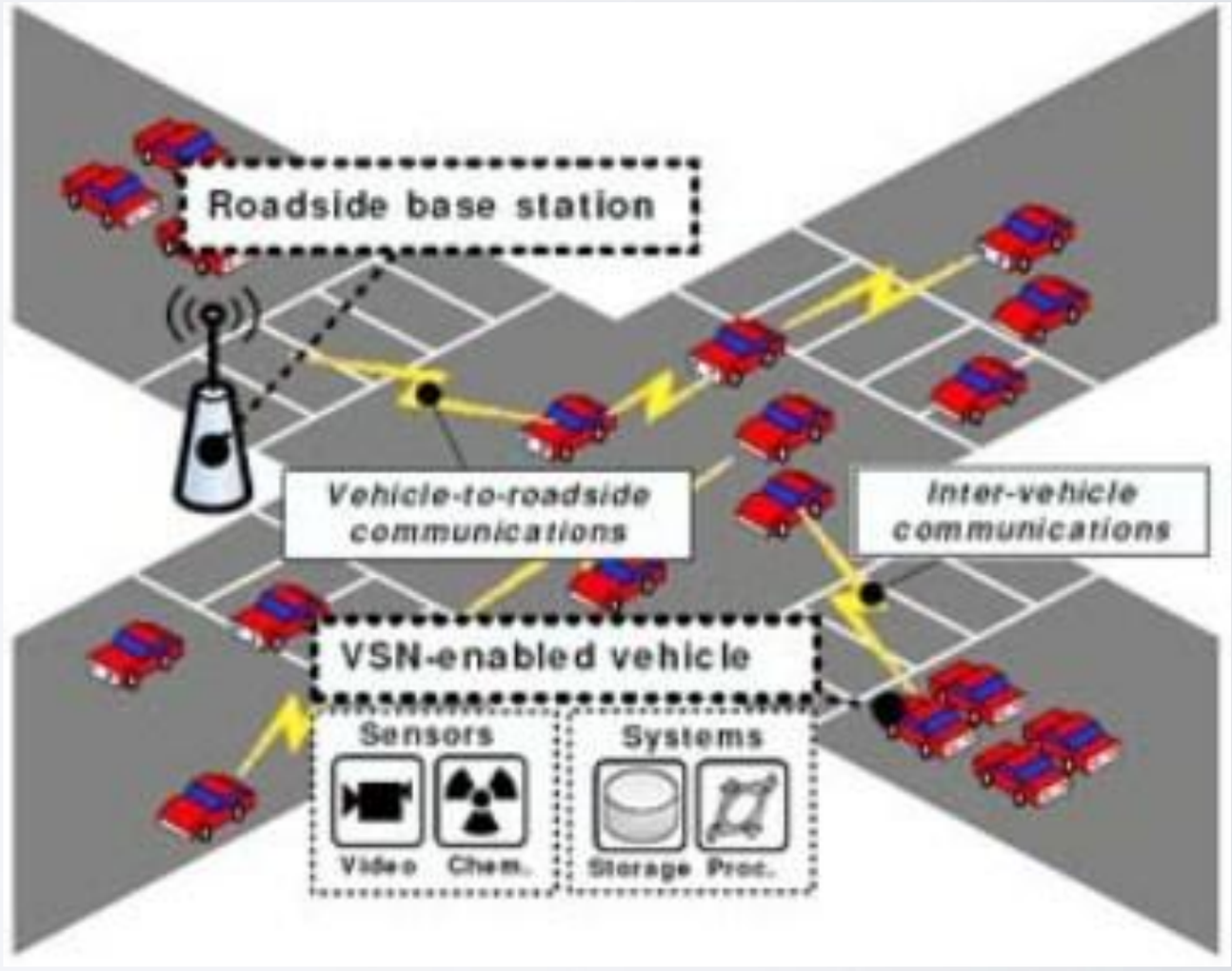
Making IT *secure* and *efficient*



Communications and Networking




Wireless
everywhere



Green Power & Energy

Defining the *Energy* of a Clean Future

EU green jobs boom forecast

By Christopher Hopson in London Tuesday, September 09 2014

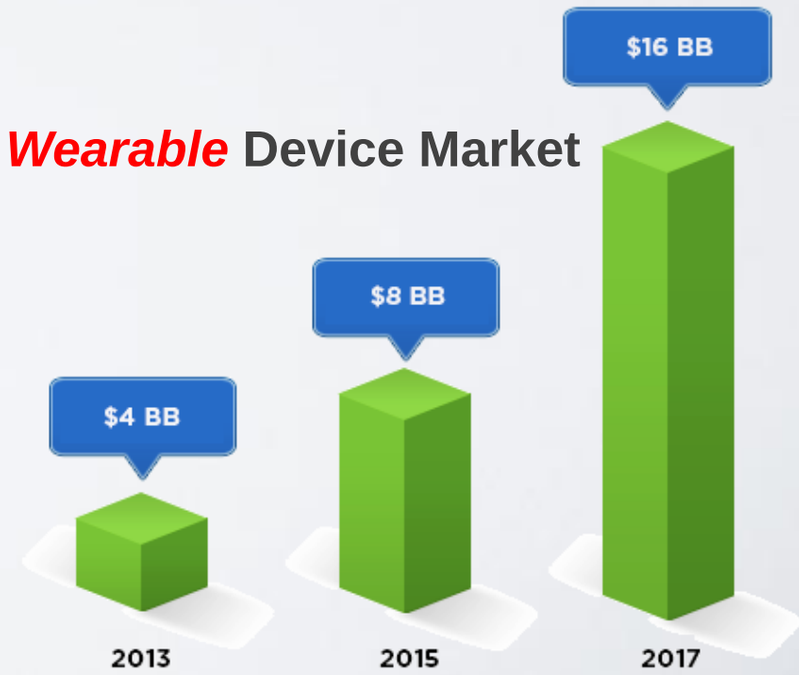
Updated: Tuesday, September 09 2014

European renewables contractors expect a steady rise in the number of new jobs as countries rush to achieve their 2020 renewables targets.

Professional services consultancy Procorre says the European Commission estimates that reaching the 20% renewables target would create more than 400,000 jobs between 2011 and 2020.

Microelectromechanical devices (MEMS), Electronics & Photonics

Inventing *Smart* devices for the 21st century



ECEs have a …

The Impact of ELECTRICAL ENGINEERING

ON 21ST CENTURY INNOVATION

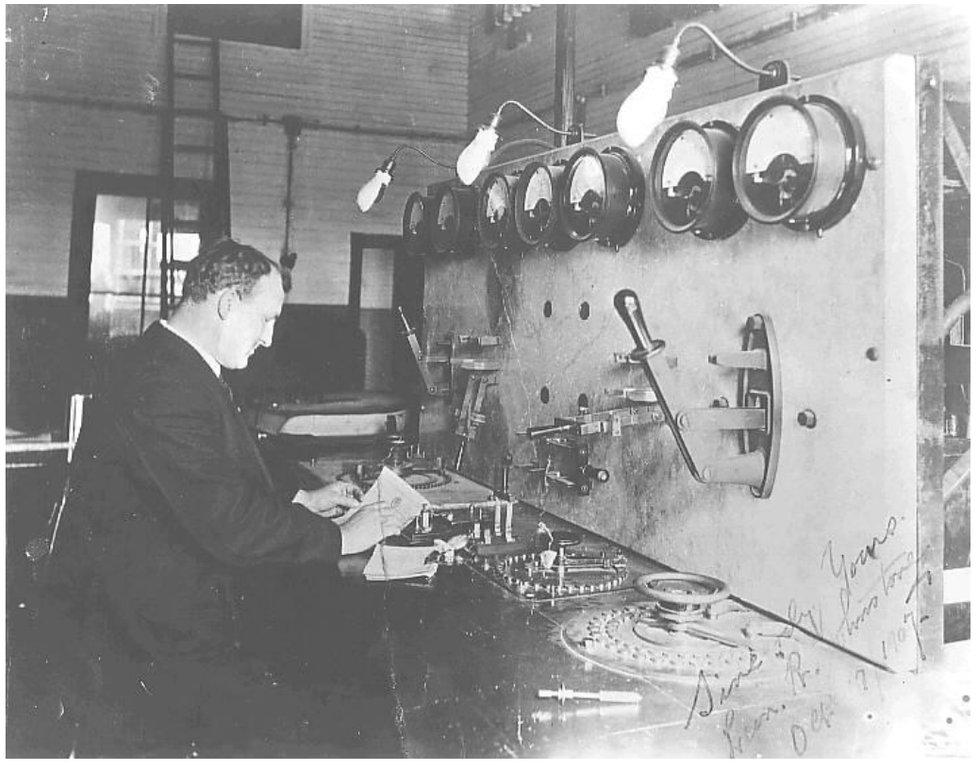
Q: How do various wireless devices communicate with each other?

Q: How does traffic get through the internet?

A typical online, networked life.

A Brief History of Telecommunications

Samuel Morse and his telegraph machine



Guglielmo Marconi and wireless telegraphy

A few bits/sec

First Telephone in 1876

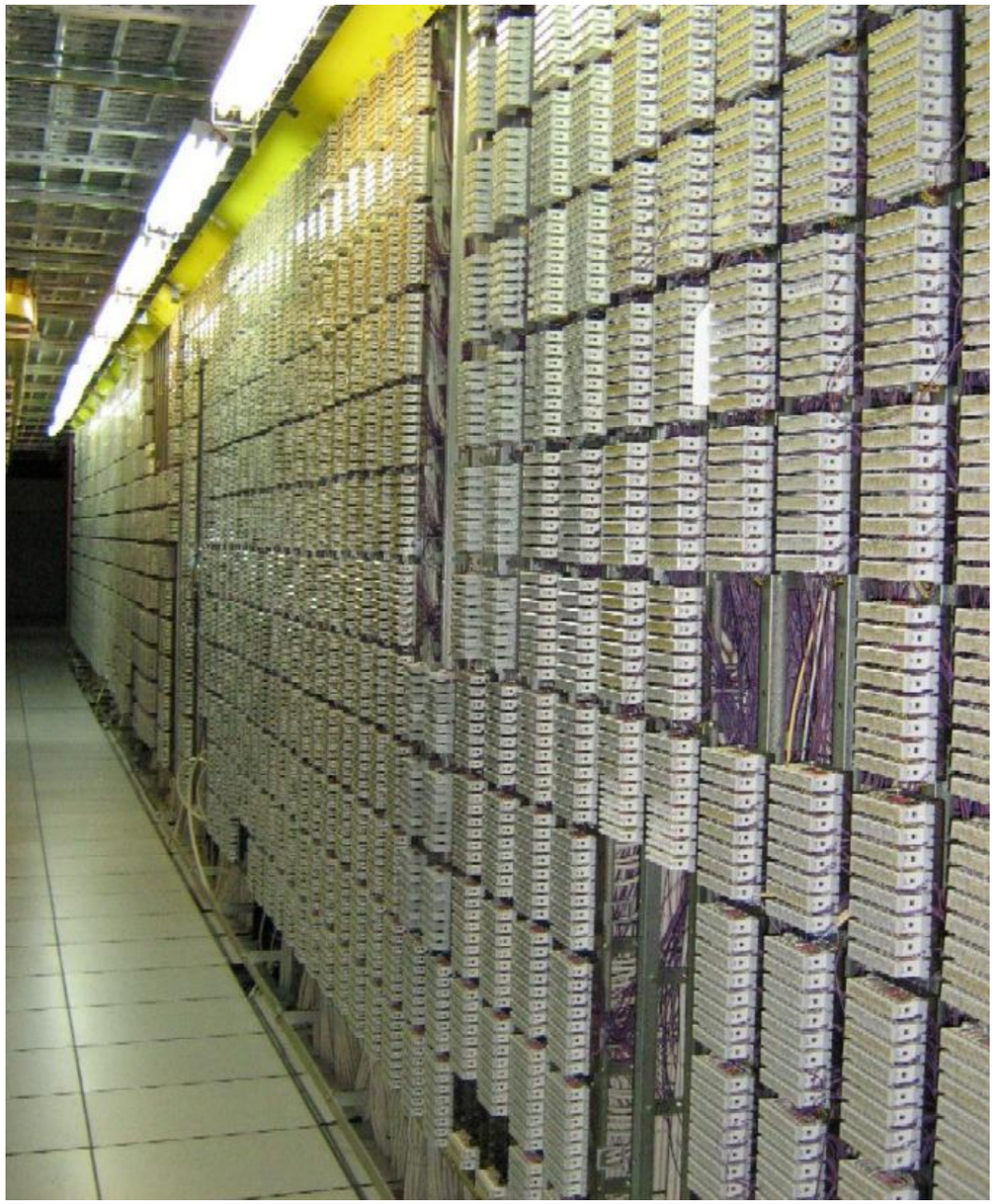
Photo : Cassell & Co., Ltd

Manual telephone switching

Then

Manual telephone switching

Now



Electronic telephone exchange

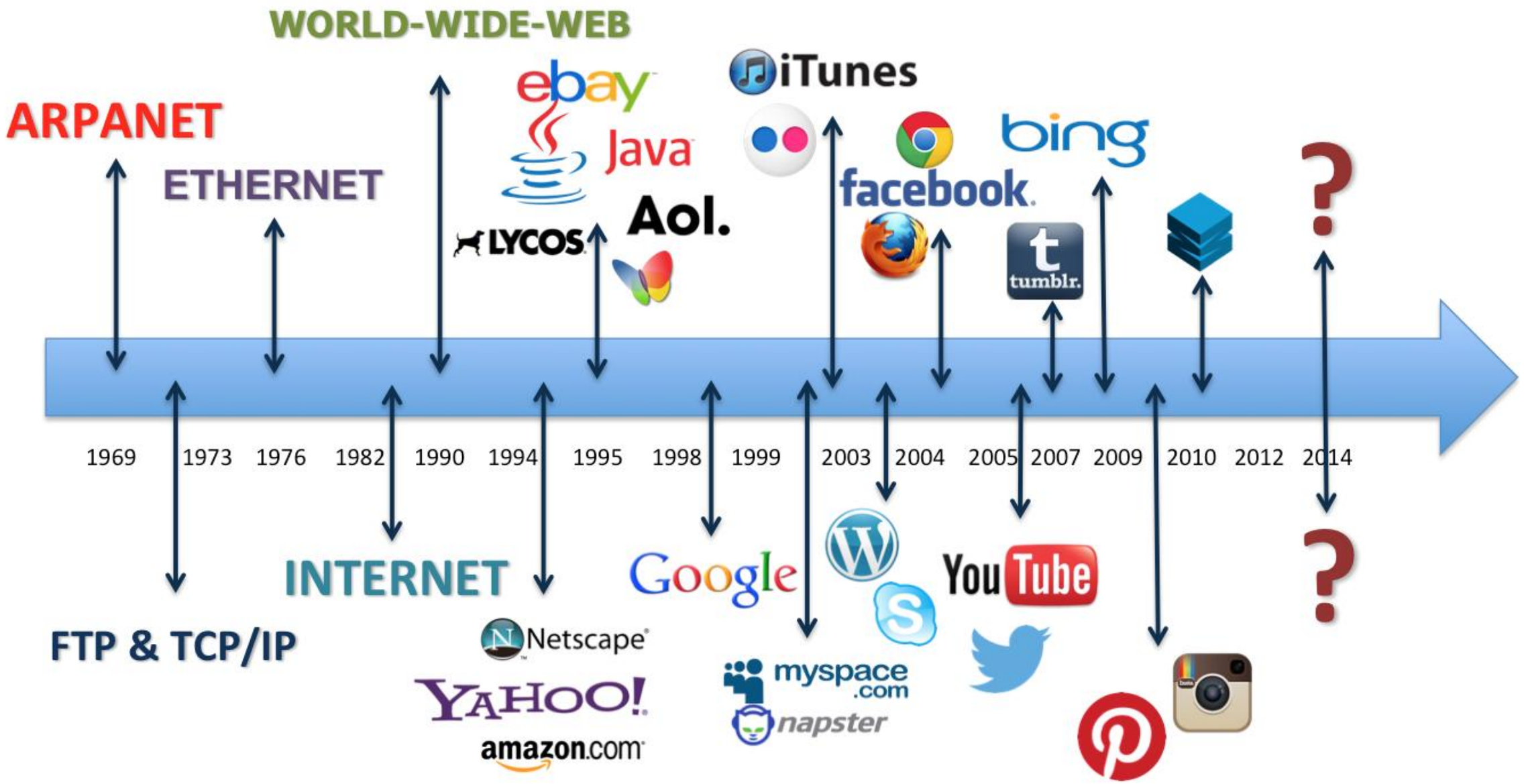
Then

Cray-2, a supercomputer released in 1985

Now

iPhone 4’s in 2010

World optical backbone

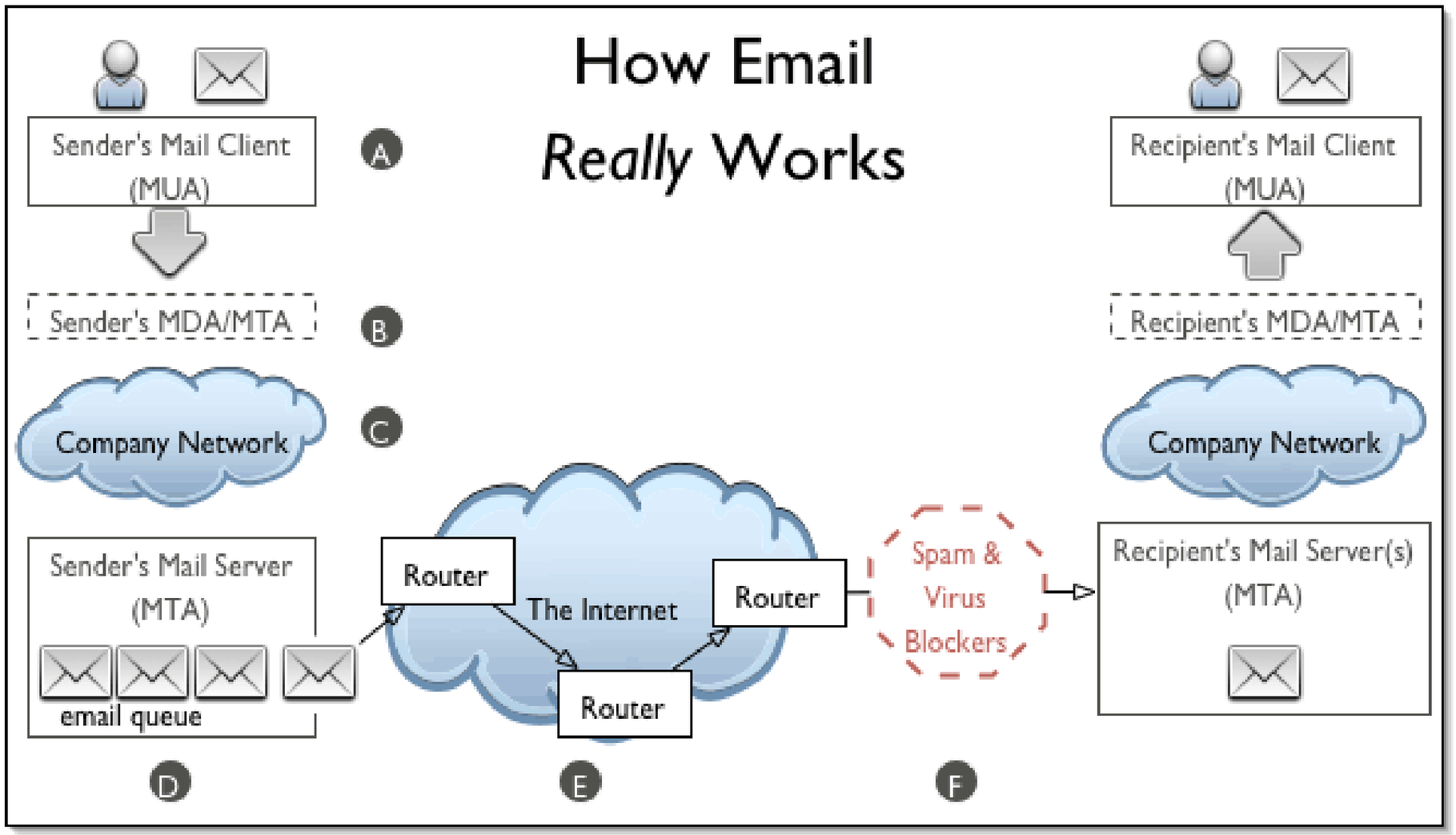


Internet History

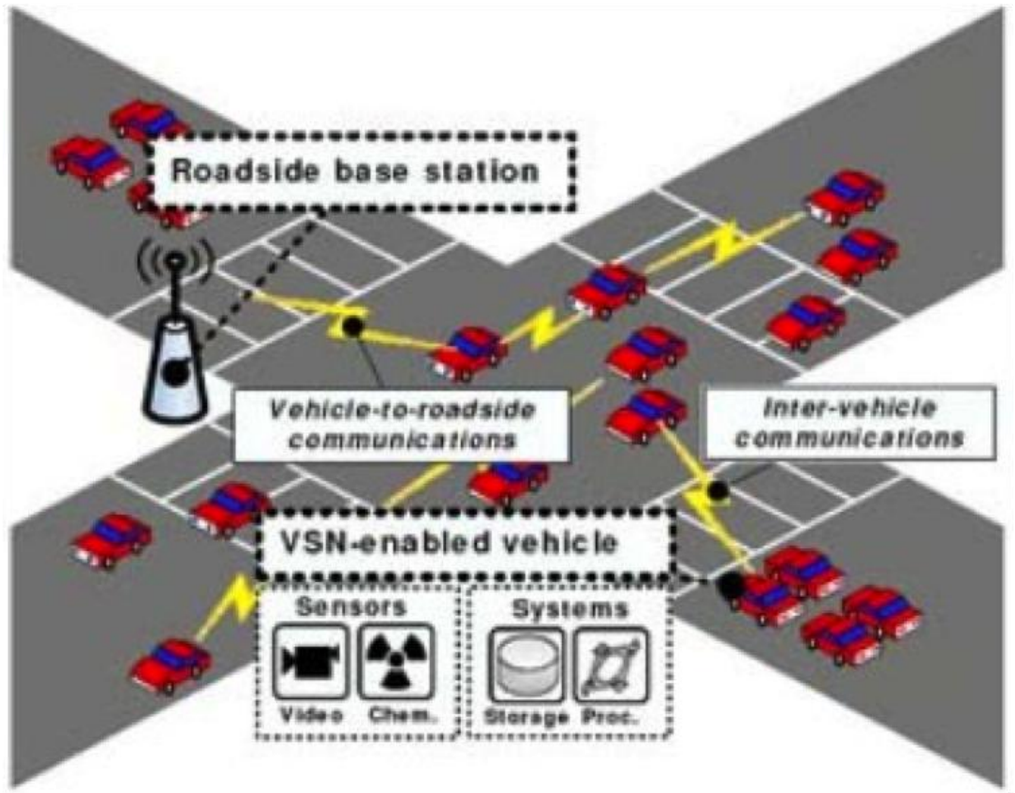
2020 This Is What Happens In An Internet Minute

2021 This Is What Happens In An Internet Minute


How Email *Appears* to Work
Sender's Outbox
Recipient's Inbox


How Email
Really Works
Sender's Mail Client
(MUA)
A
Sender's MDA/MTA
B
Company Network
C
Sender's Mail Server
(MTA)
email queue
D
Router
The Internet
Router
Router
E
Spam &
Virus
Blockers
F
Recipient's Mail Client
(MUA)
Recipient's MDA/MTA
Company Network
Recipient's Mail Server(s)
(MTA)

Internet of Things



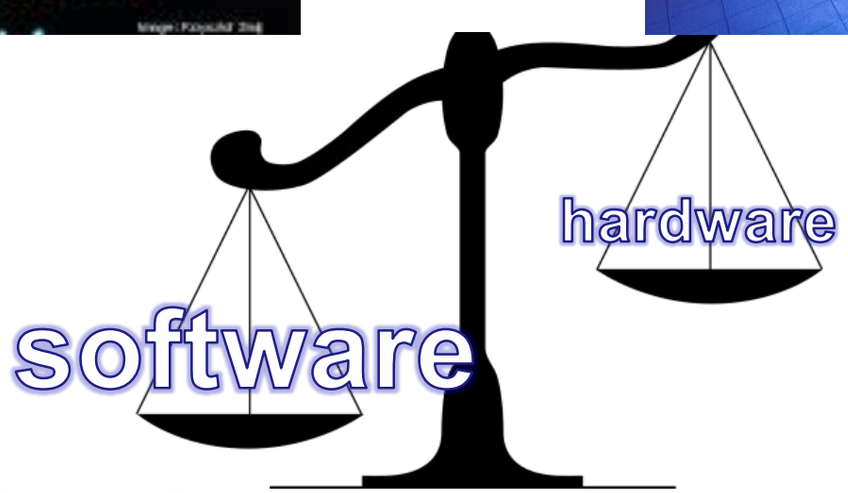
Wireless everywhere

Artificial intelligence

Driven by algorithms

+

and server farms

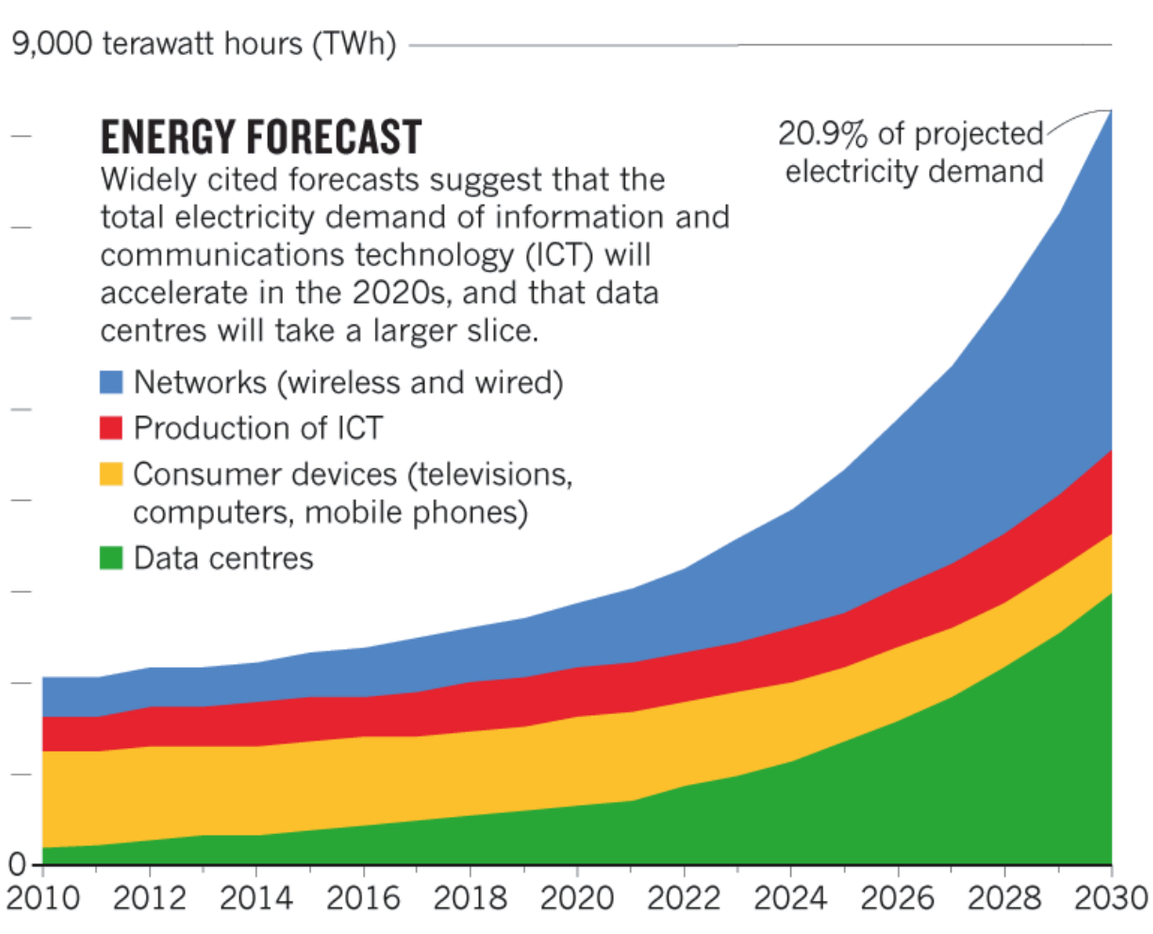


current
AI innovation

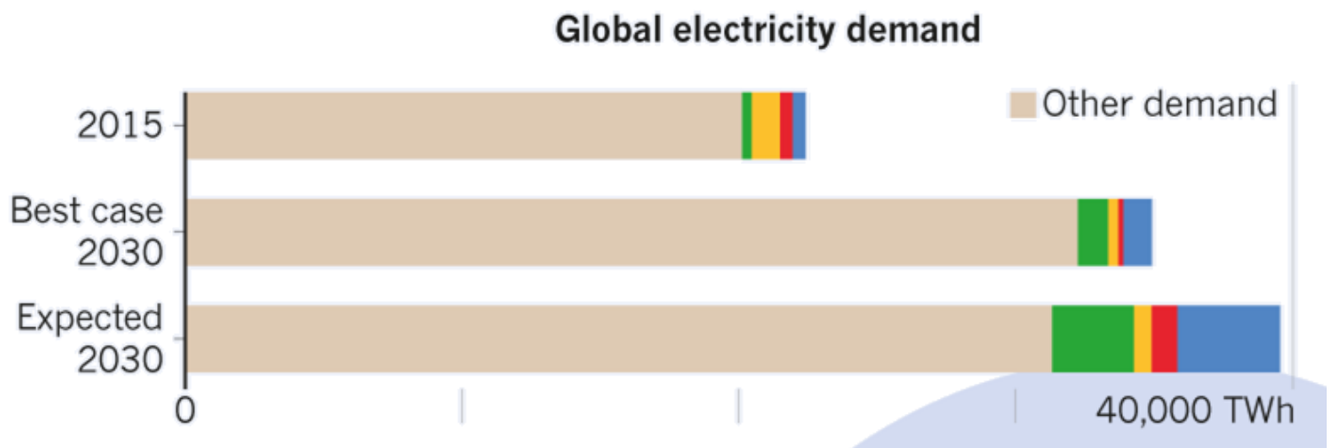
???

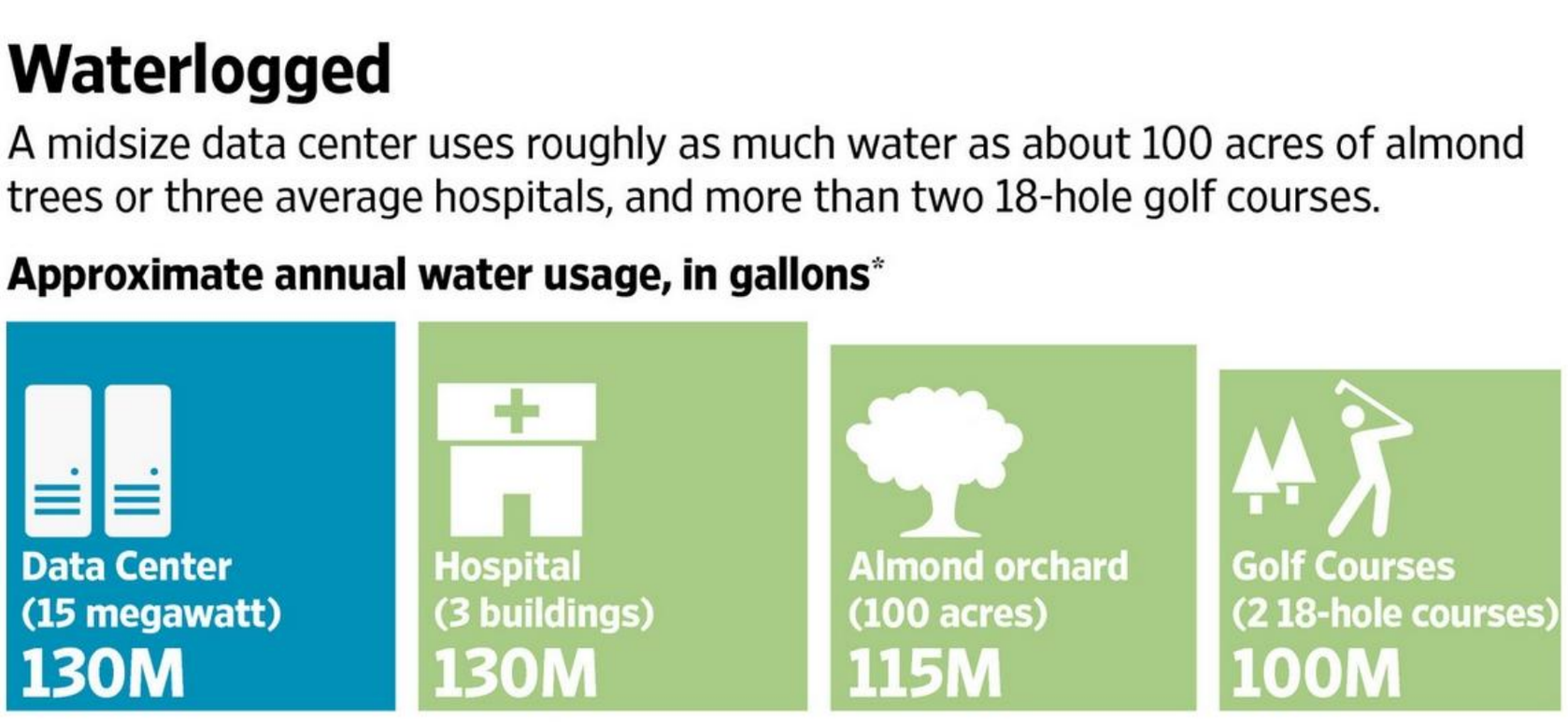
Google's AI Can Dream, and Here's What it Looks Like

258 SHARES Share on Facebook Share on Twitter +

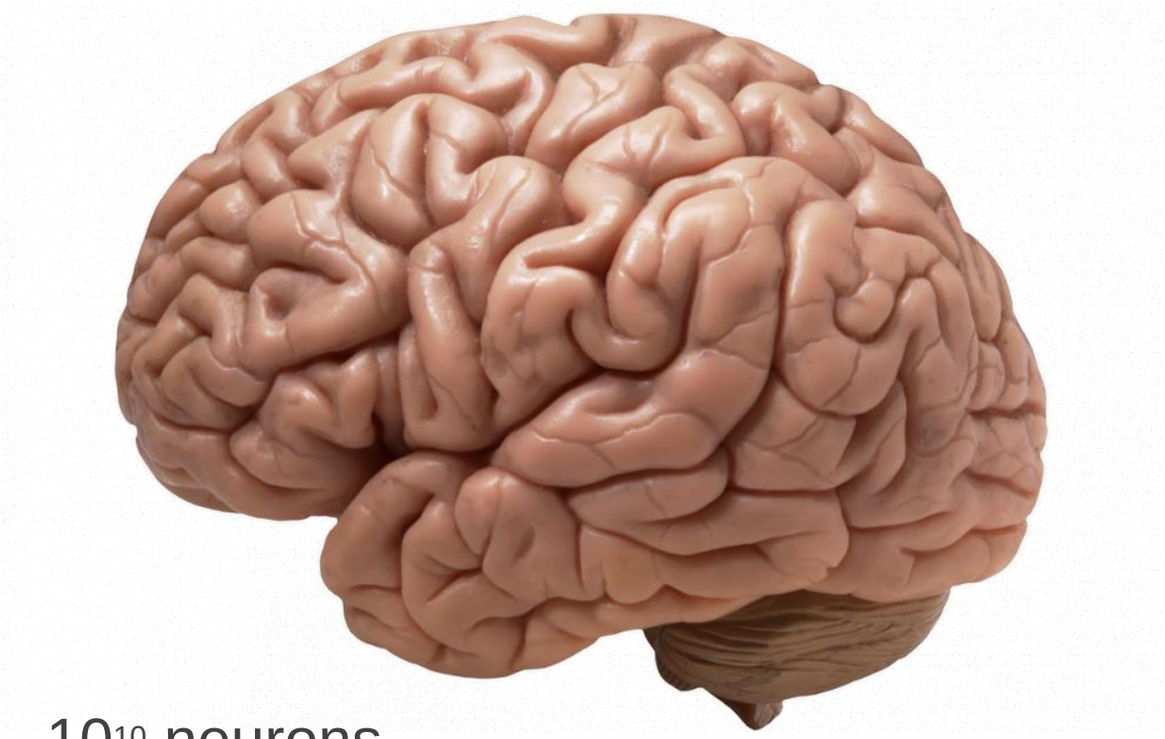


Problem: Server farms and data centers are resource intensive (electricity and water for cooling)





Goal: Build AI hardware that has the performance and efficiency of the brain



10^{10} neurons
10^{14} synapses

~ 20 W of power
(~10 fJ/synaptic event)

Continuously learns from unlabeled data

Drives actions, predicts consequences of actions and plans ahead to reach goals

IBM TrueNorth
(made of transistors)

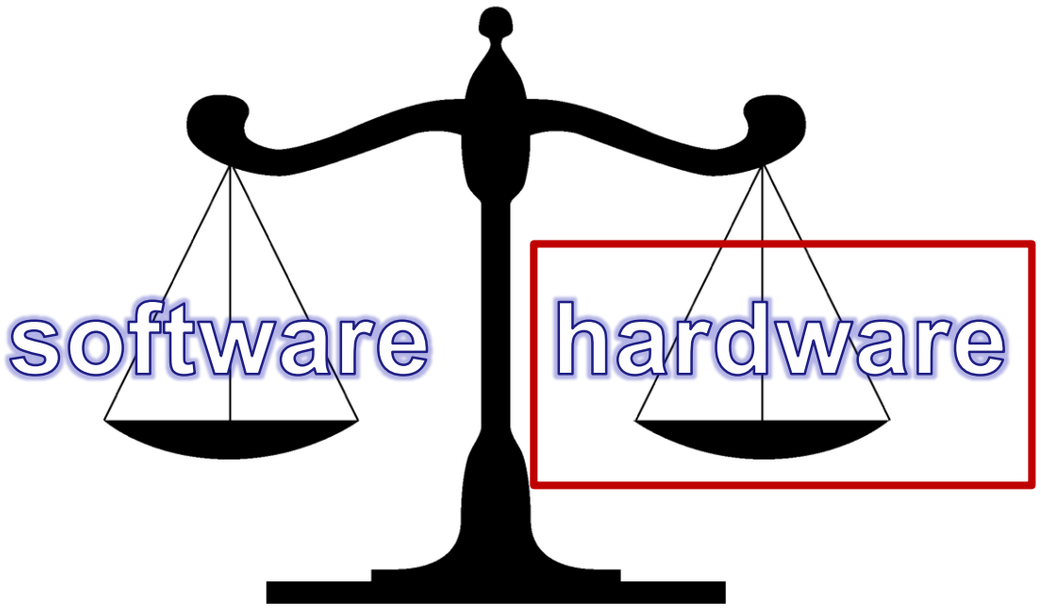
10^{6} artificial neurons
256 *10^{6} artificial synapses

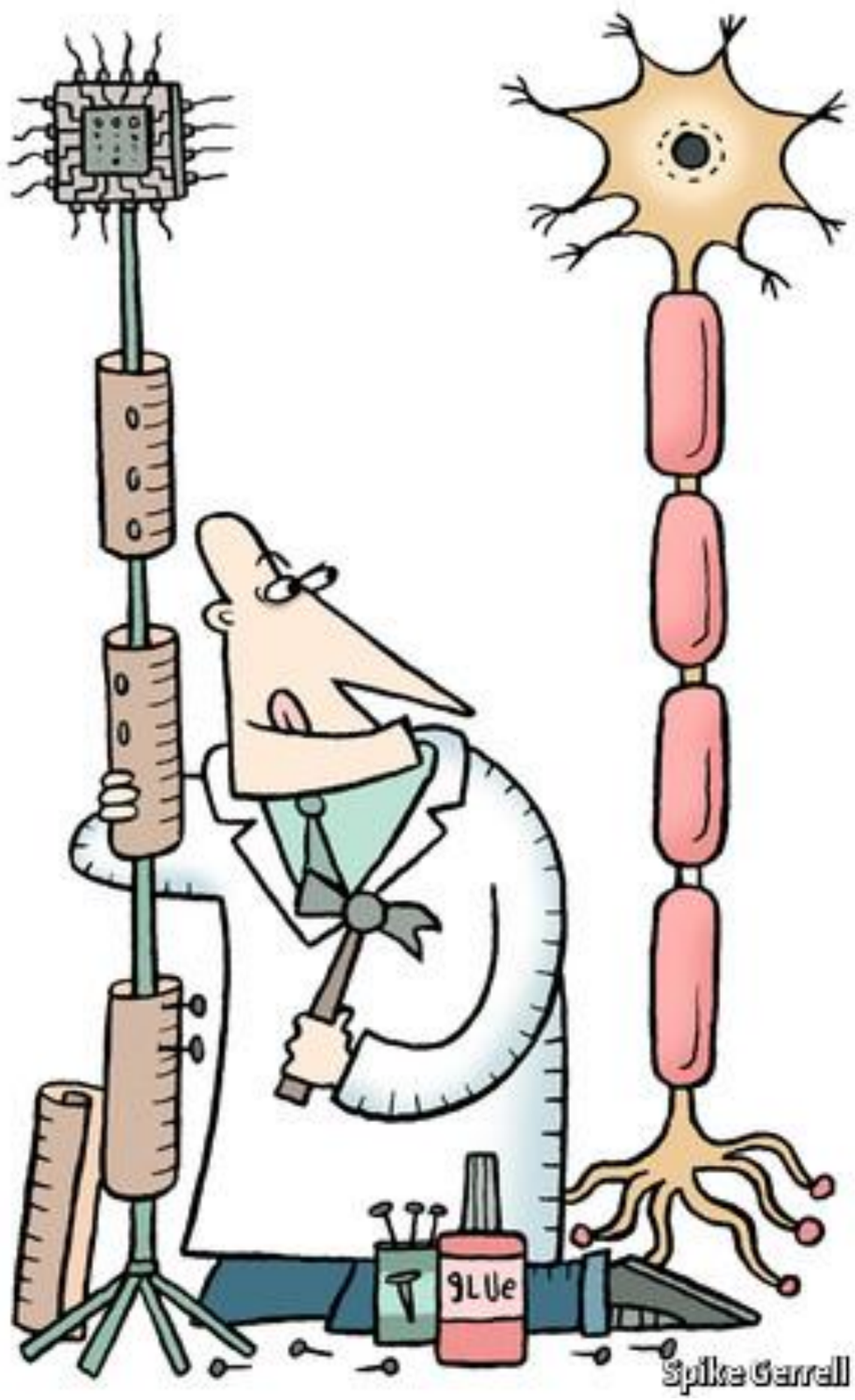
Simulating
10^{12} artificial synapses
~4kW

Analog-digital spiking architecture

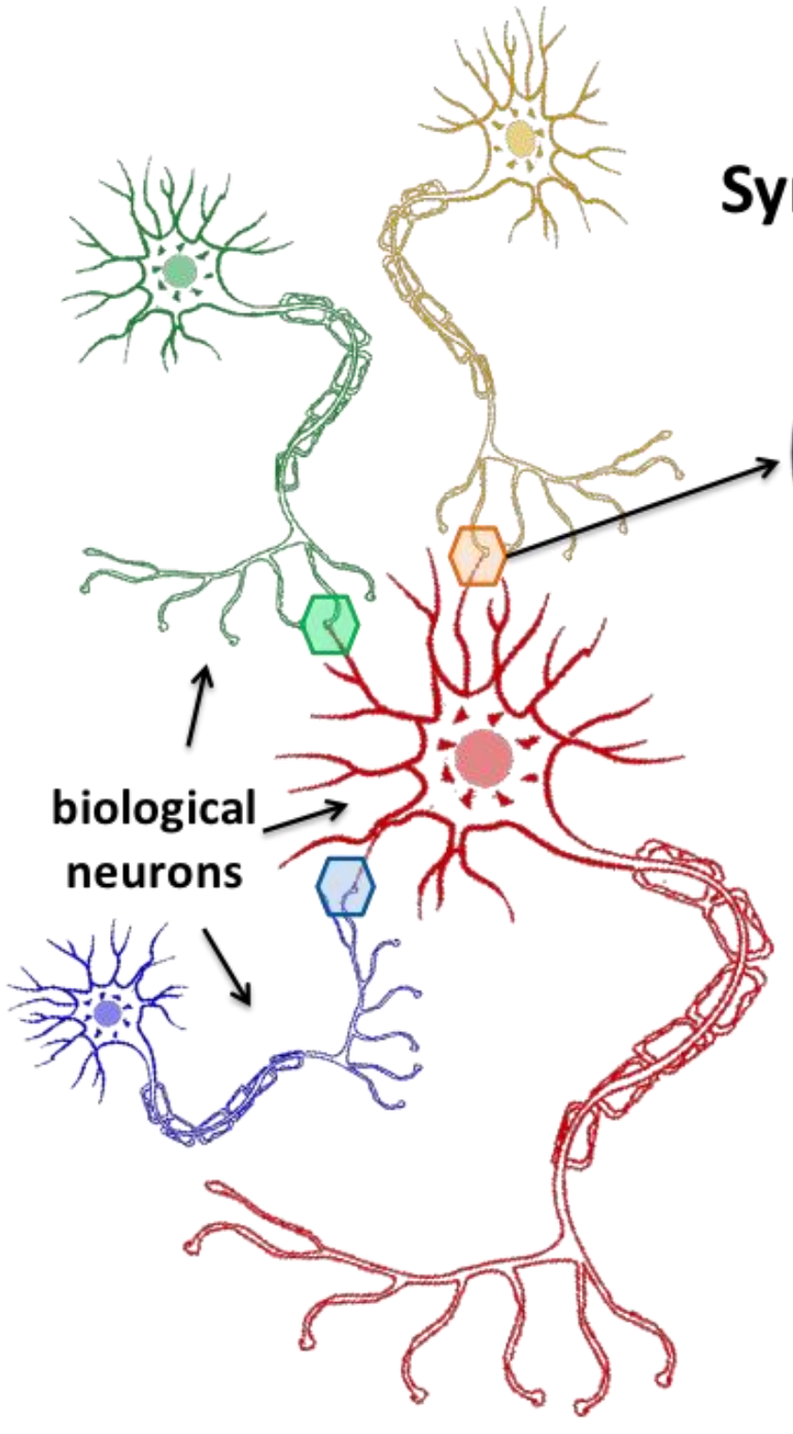
(**5.4 billion transistors | 4096 cores**)

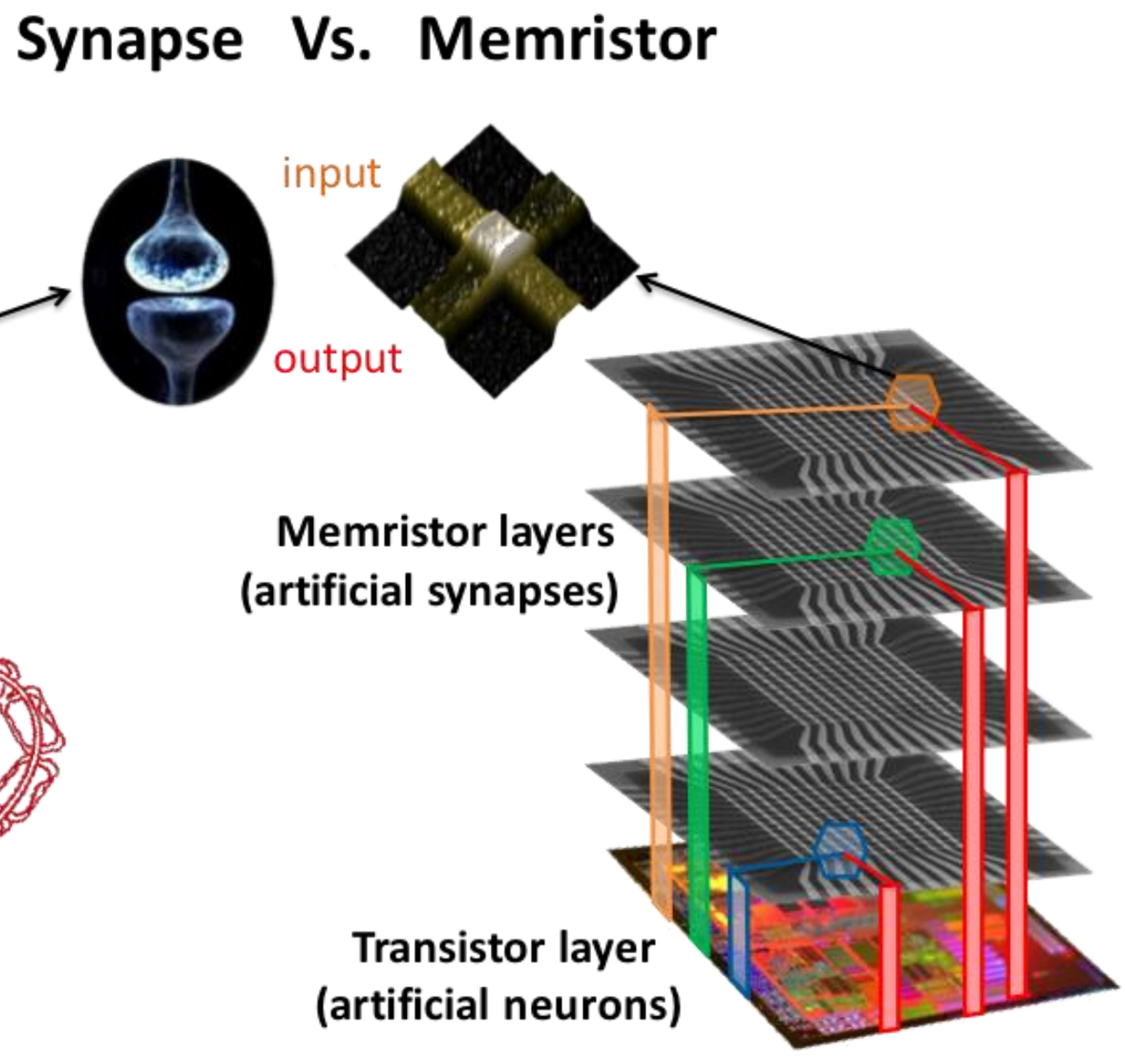
Goal: Draw inspiration from biology





Focus: Developing <u>compact</u> and <u>efficient</u> electronic devices that behave like artificial synapses

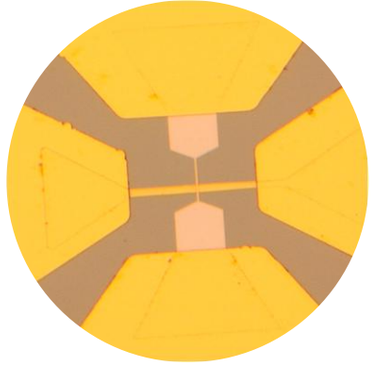




GW — ECE

Adaptive Devices And Microsystems

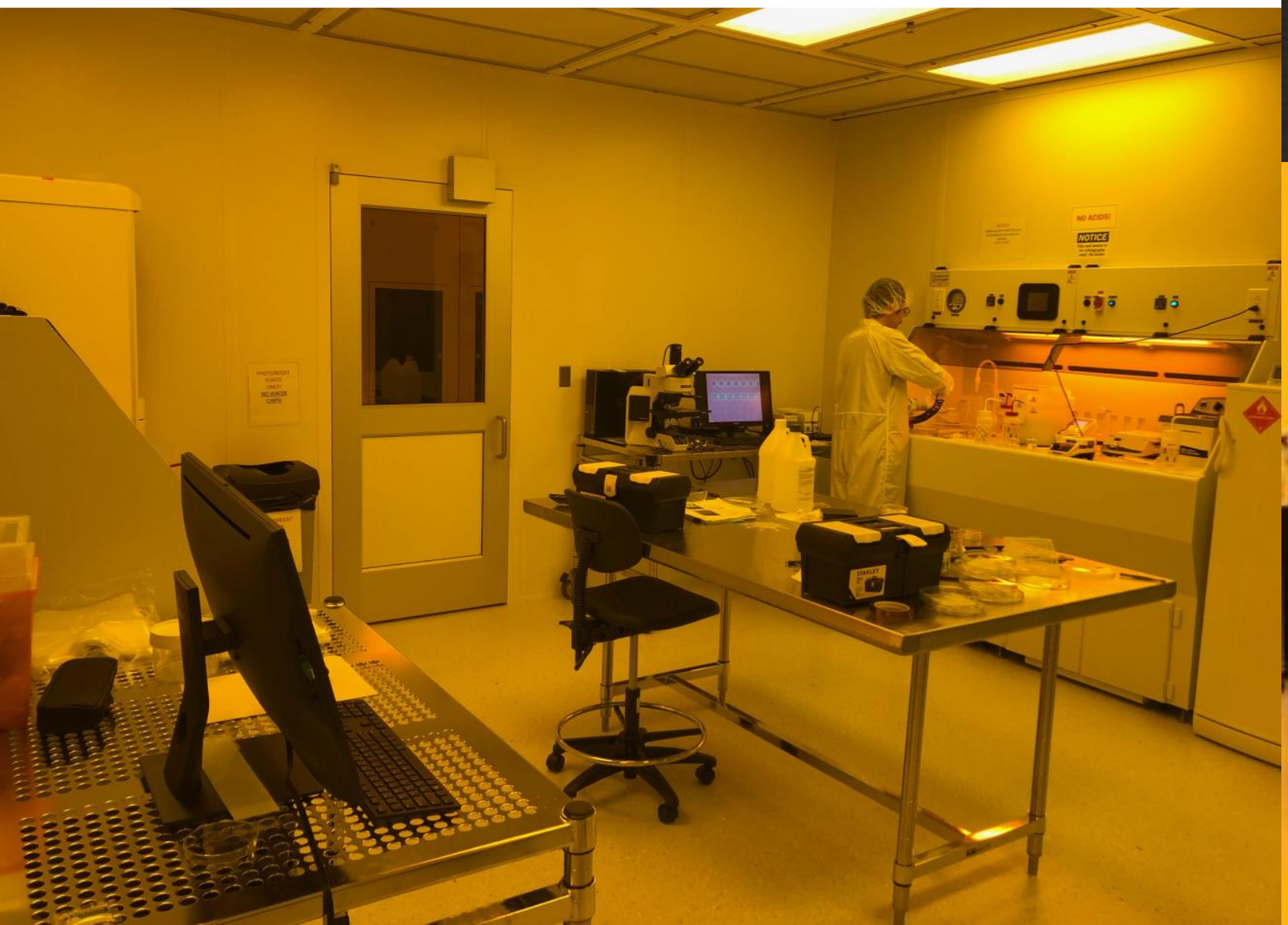
ADAM LAB



@ GWU: Use advanced equipment to manufacture memristors at the nanoscale

GW NANOFABRICATION AND IMAGING CENTER

https://nic.gwu.edu/



Questions ???

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https://www.ece.seas.gwu.edu/