

7 Billion People... all creating data

1.00 Engineering Computation
& Data Science

John R. Williams, Abel Sanchez
Lecture: MWF 9:30-11 (1-390)



Computation
Data Science
Devices
Machine Learning

Web to Cloud

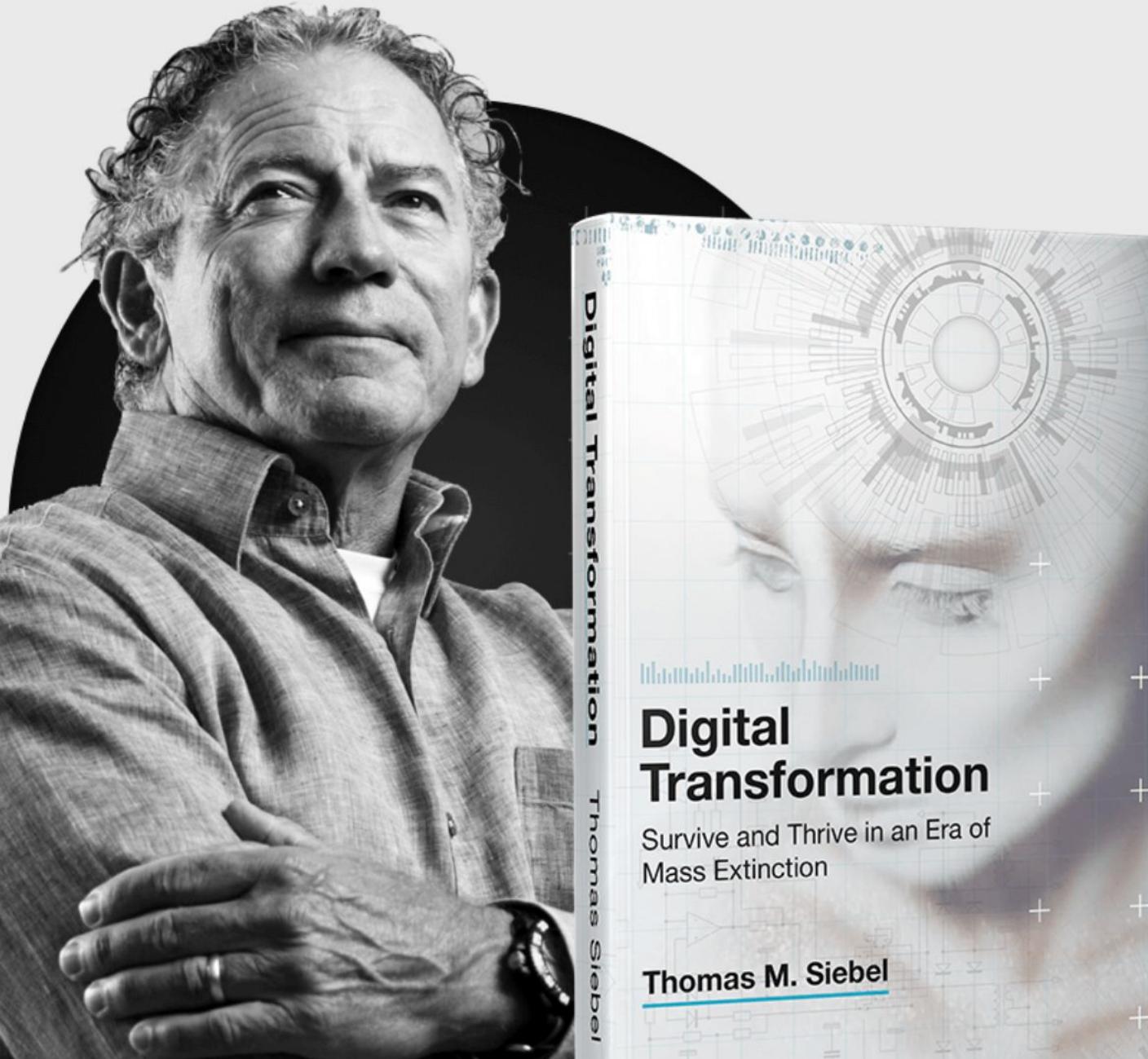
Web □ IoT □ Big Data □ ML □ Cloud

John R Williams, MIT

Digital is the main reason just over half of the **companies** on the Fortune 500 have **disappeared** since the year 2000

Pierre Nanterme
CEO of Accenture





Digital Transformation

Survive and Thrive in an Era of Mass Extinction

Order Now

amazon

BARNES&NOBLE

BAM!
BOOKS-A-MILLION

INDIE
BOUND.org

All author royalties will be donated to charity.



Change is not
necessary. Survival
is not mandatory. –
Edward Demming

Education is being Disrupted





How can
we survive
and thrive?

A Gemba Walk Around the Technologies



- Internet and Web 1970-2000
- Internet of Things 2001
- Smart Phone 2007
- Big Data ~2009
- Machine Learning ~2012
- Rise of the Robots ~2012
- Cloud Native / DevOps ~present

Any New Field Produces an Arbitrary, Annoying Language. Immersion course

JavaScript
Dublin Core
Integrated library system
Metadata Object Description Standard

XML RubyArchive
METS Digital library
Project management

MySQL HTML

PHP DSpace SQL Management
Drupal Perl

XSL Transformations Python

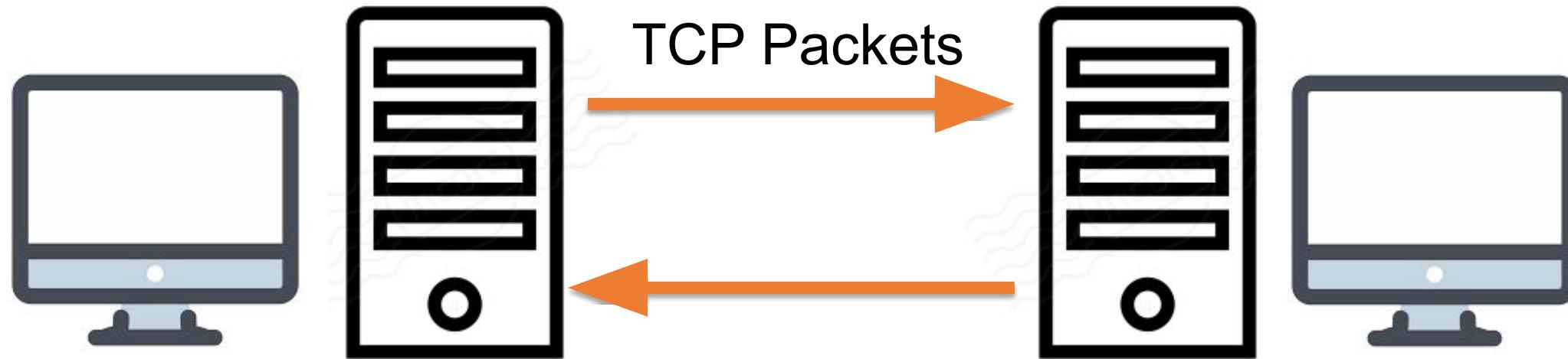
Digital repository Java World Wide Web
Digital preservation GNU/Linux

Cascading Style Sheets

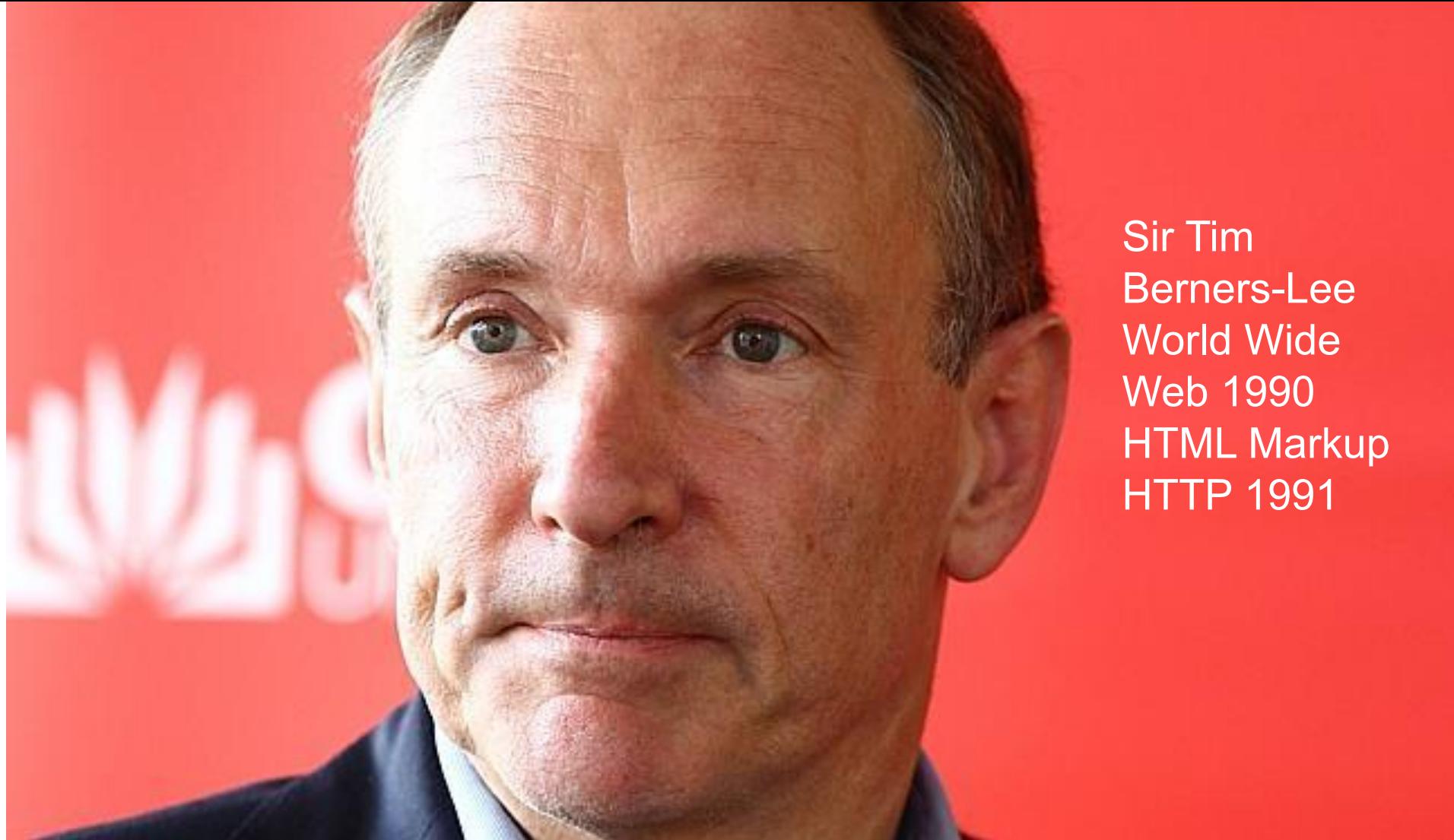
Encoded Archival Description
Resource Description and Access
Data management
MARC standards

Metadata

The Internet



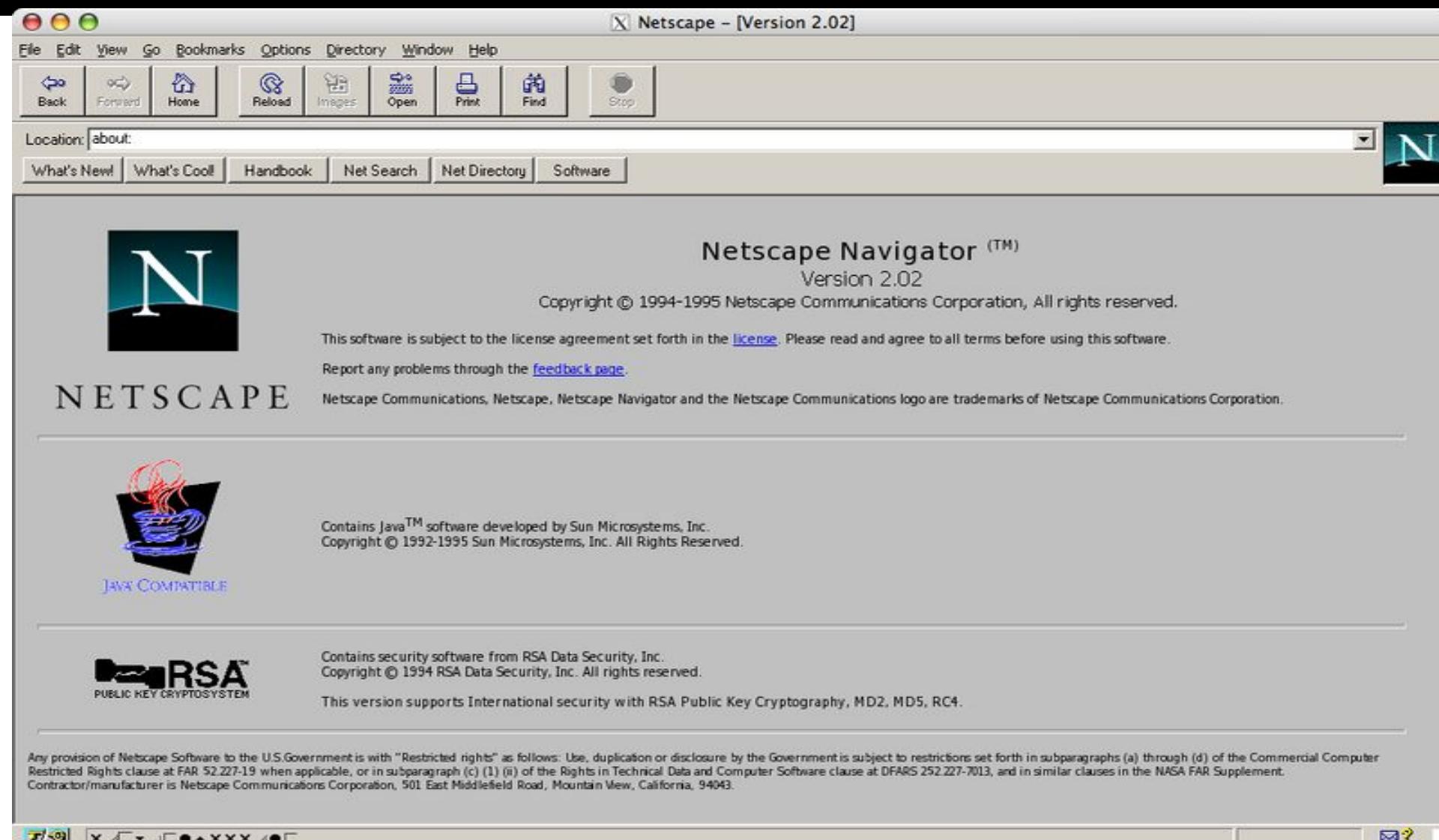
The Digital Revolution was started by him – Who is he?



Sir Tim
Berners-Lee
World Wide
Web 1990
HTML Markup
HTTP 1991

- 1983 DNS servers map URLs to IP
<http://www.mit.edu> □ 18.58.1.131
- 1990 HTML layout
- Invented URIs (Universal Resource Identifiers)
- In 1991 HTTP 0.9 : GET, POST
- 1995 Browser - Netscape Browser

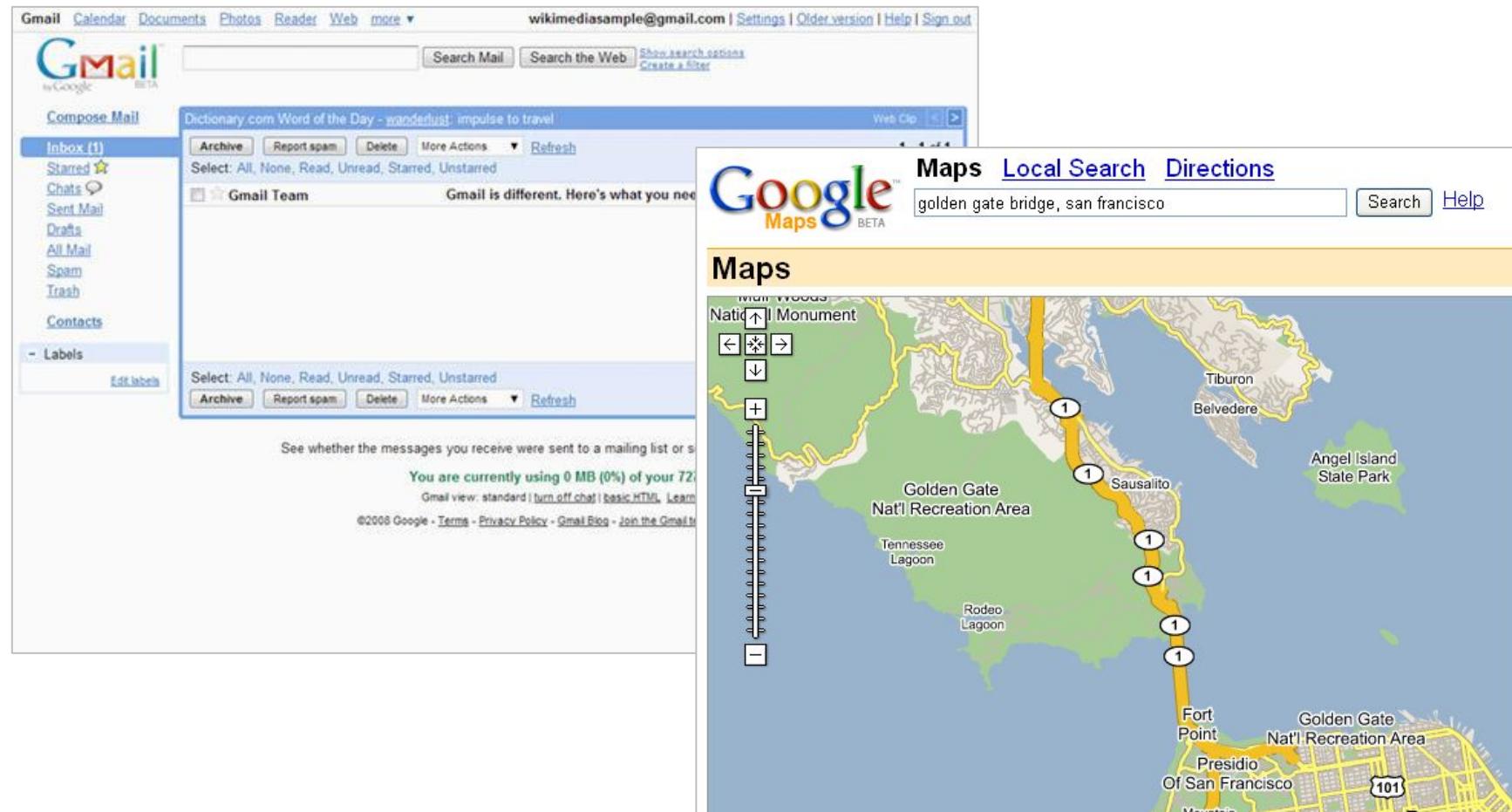
Netscape Browser



1995 Brenden Eich Invents JavaScript in 10 days



2004 First Web Apps - HTML 5



2004 Ian Hickson – HTML5







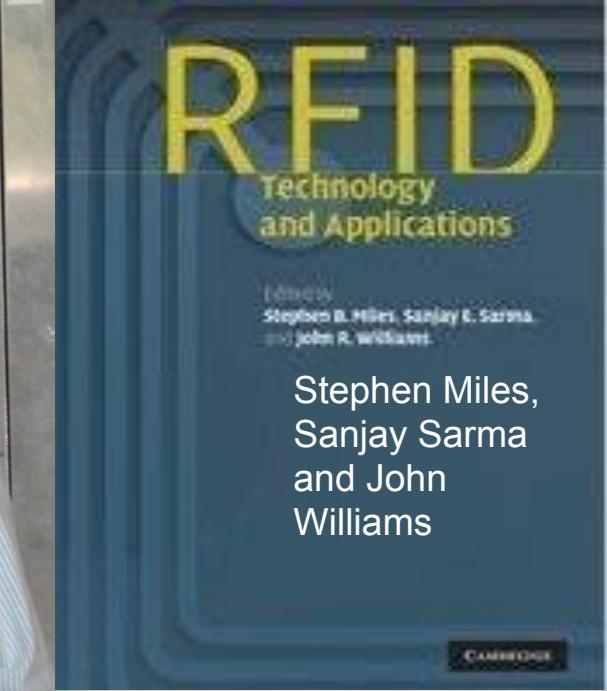
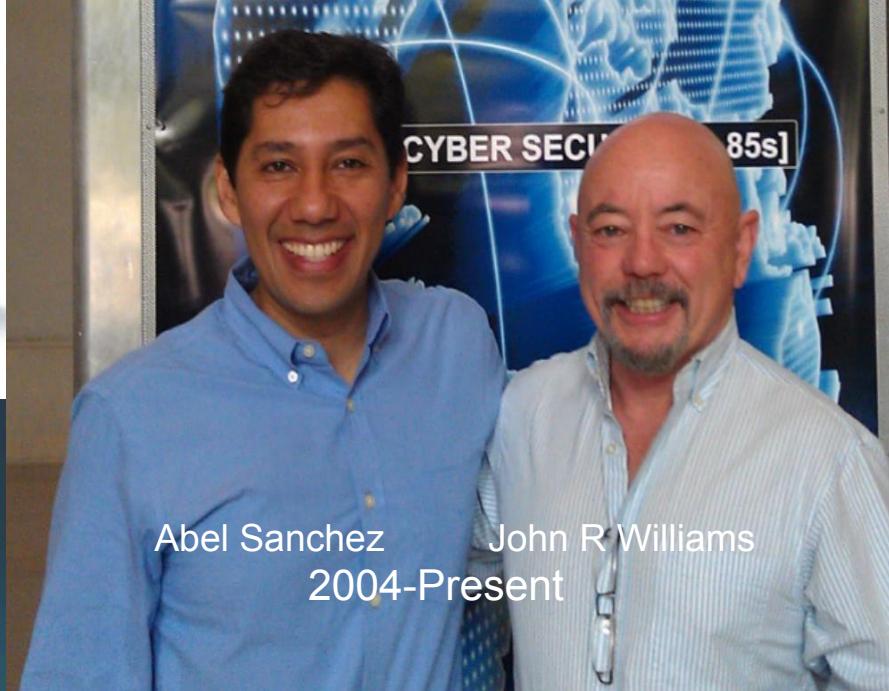
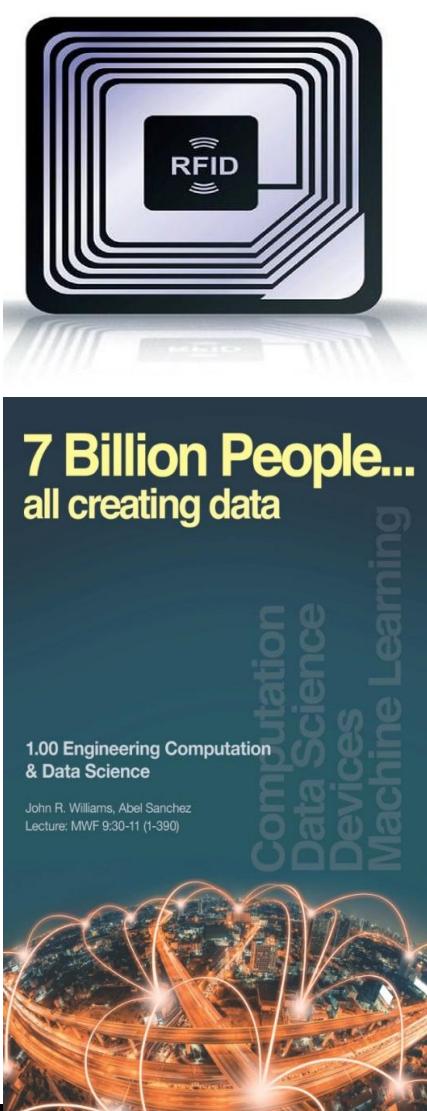
IoT - Big Data Explosion



2013



MIT AutoID Laboratory 2001-present



MIT Auto-ID Laboratory IoT and Supply Chains

<http://geospatial.mit.edu>

One Goal of IoT was Visibility into the Supply Chain

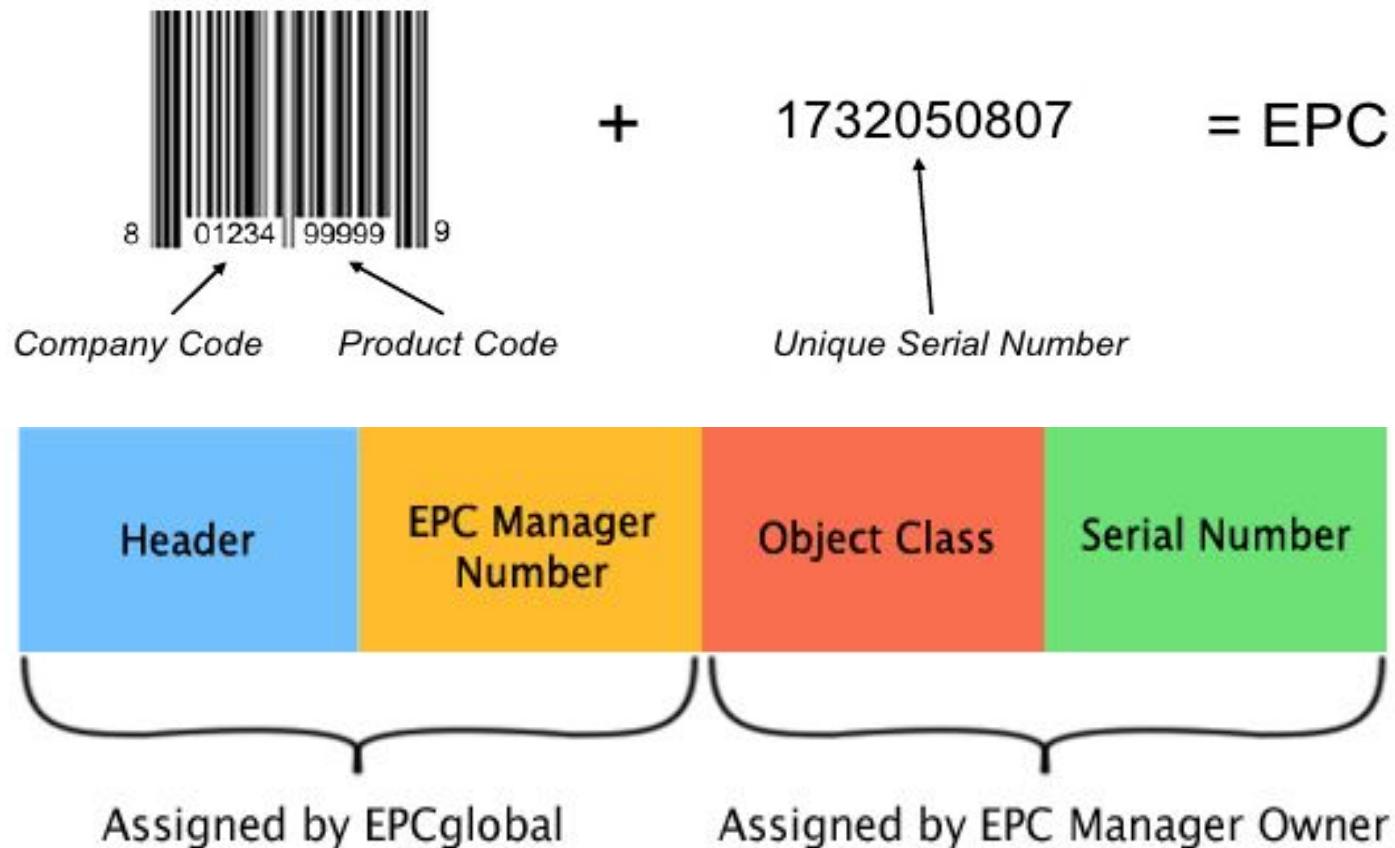


Barcode = Manufacturer No. + SKU



Visibility into the Supply Chain

Electronic Product Code

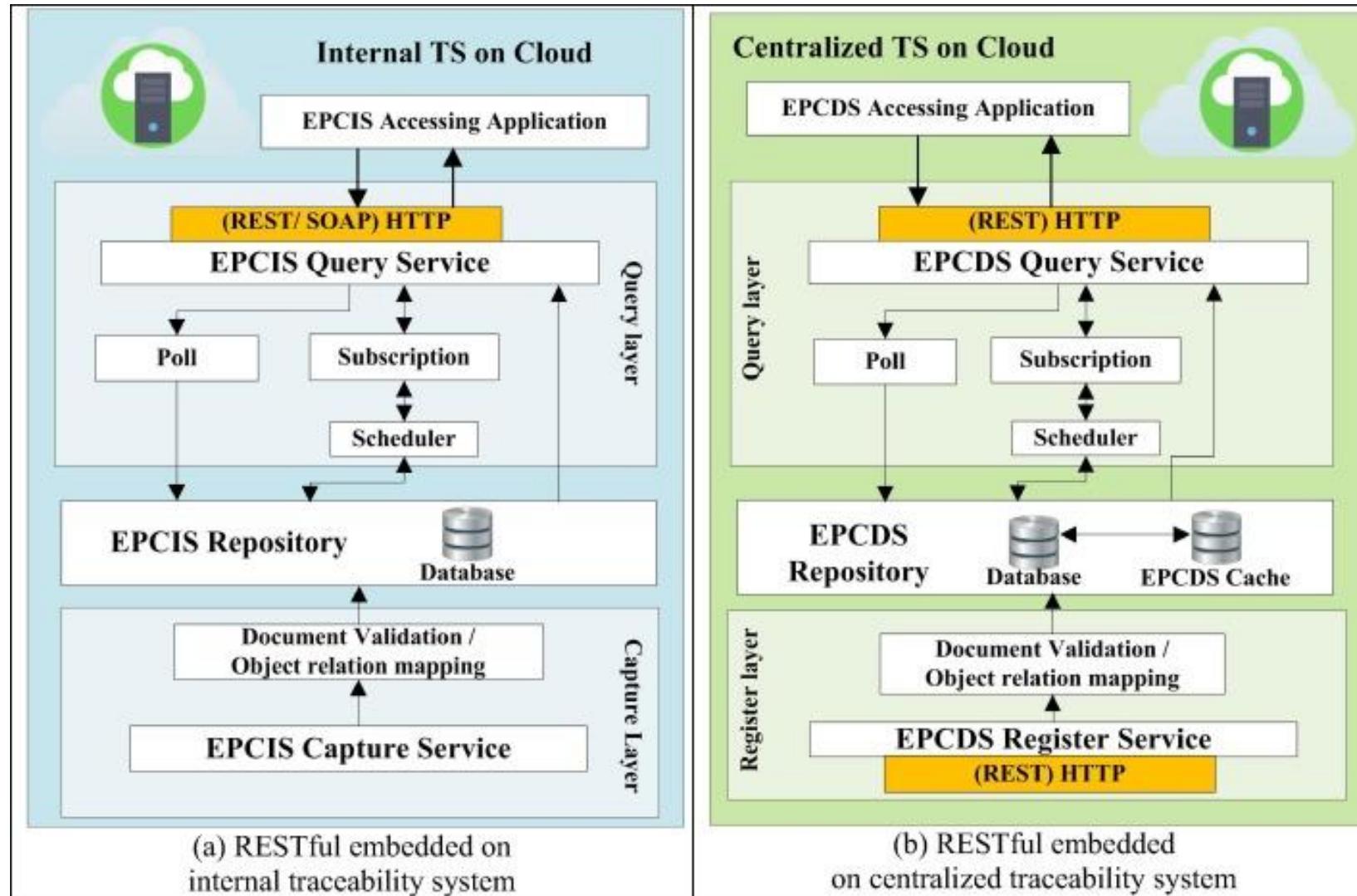


Link to the Web



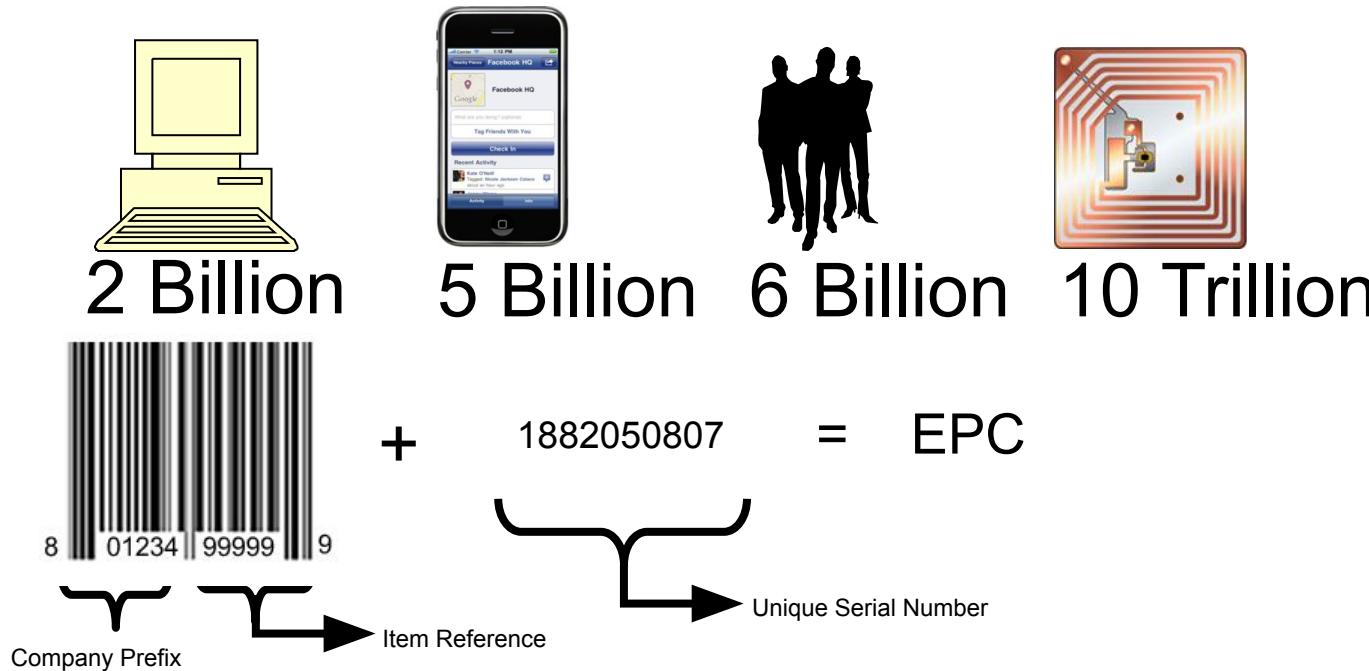
- URI which specifies the Name is URN
- URI which specifies the Location is URL
- URI which specifies both Location and name is URI

EPCIS = Electronic Product Code Information System



The Internet of Things Rough Numbers

The Electronic Product Code issued globally by GS1



Item identification- epc code...

What, When, Where, Why (4W)

IoT
devices
everywher
e

30 BILLION
Sensor enabled objects
connected to networks
by 2020



Gartner Inc. forecast that 6.4B connected things will be in use worldwide in 2016, up 30 percent from 2015, and will reach 20.8B by 2020. In 2016, 5.5M new things will get connected each day, Gartner estimates

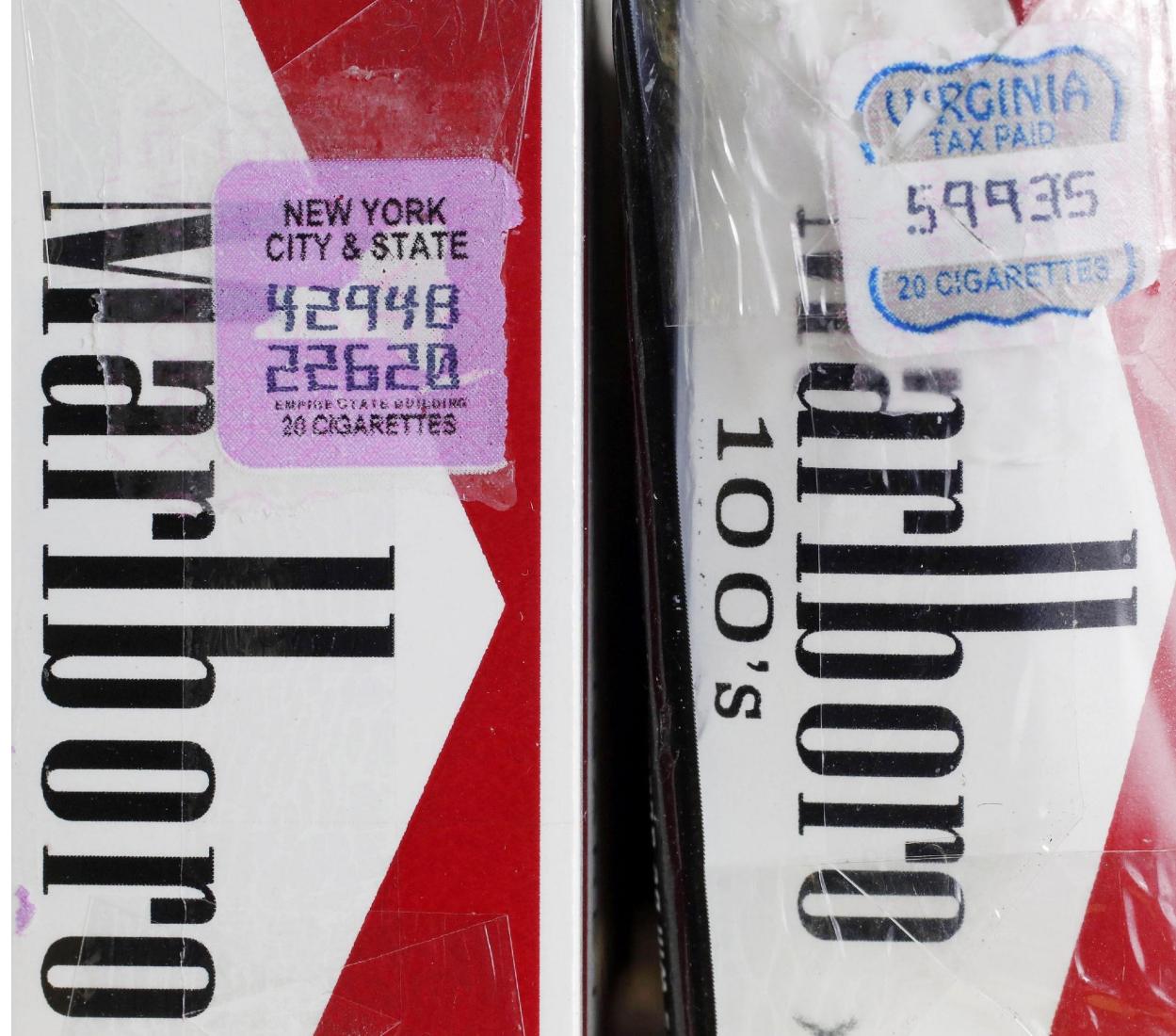
212 BILLION

Total number of
available sensor
enabled objects by
2020

212B is **28x** the
total population of
the world



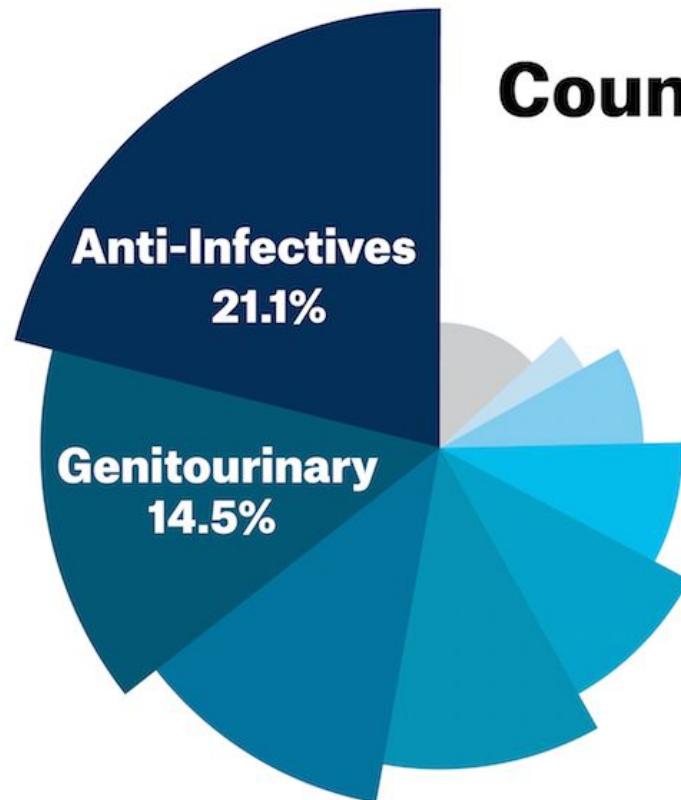
Use Case – Tax on Cigarettes



2 trillion sold per year

©MIT GeoSpatial Data Center, Feb. 2018

Counterfeit Drugs



Source: Pharmaceutical Security Institute Counterfeit Incident System

Counterfeit Drugs, by Category

| | |
|--------------------------|-------|
| ■ Cardiovascular | 11.6% |
| ■ Central Nervous System | 11% |
| ■ Alimentary | 9.1% |
| ■ Musculoskeletal | 8.1% |
| ■ Metabolism | 7.7% |
| ■ Respiratory | 3.8% |

NEW REPUBLIC

Tamiflu Drug Counterfeiting

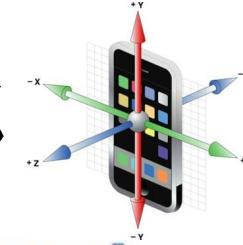


IoT Video Huawei Vision



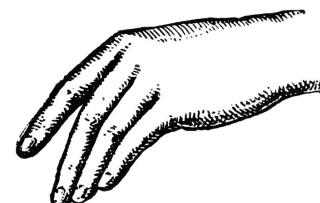
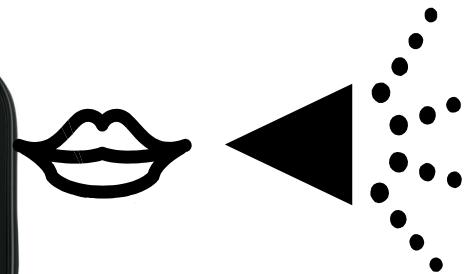
One Device Producing Big Data

Smart Phone Platform



NFC

GPS



Your phone knows who you are, where you are, who you contact, what you say, what you buy, the money you have in the bank, how many steps you take in a day, whether you are sick, how you sleep – it better be your best friend!!!

Era of Mobile Computing

Mobility 101



More Data- Drone Lidar Data



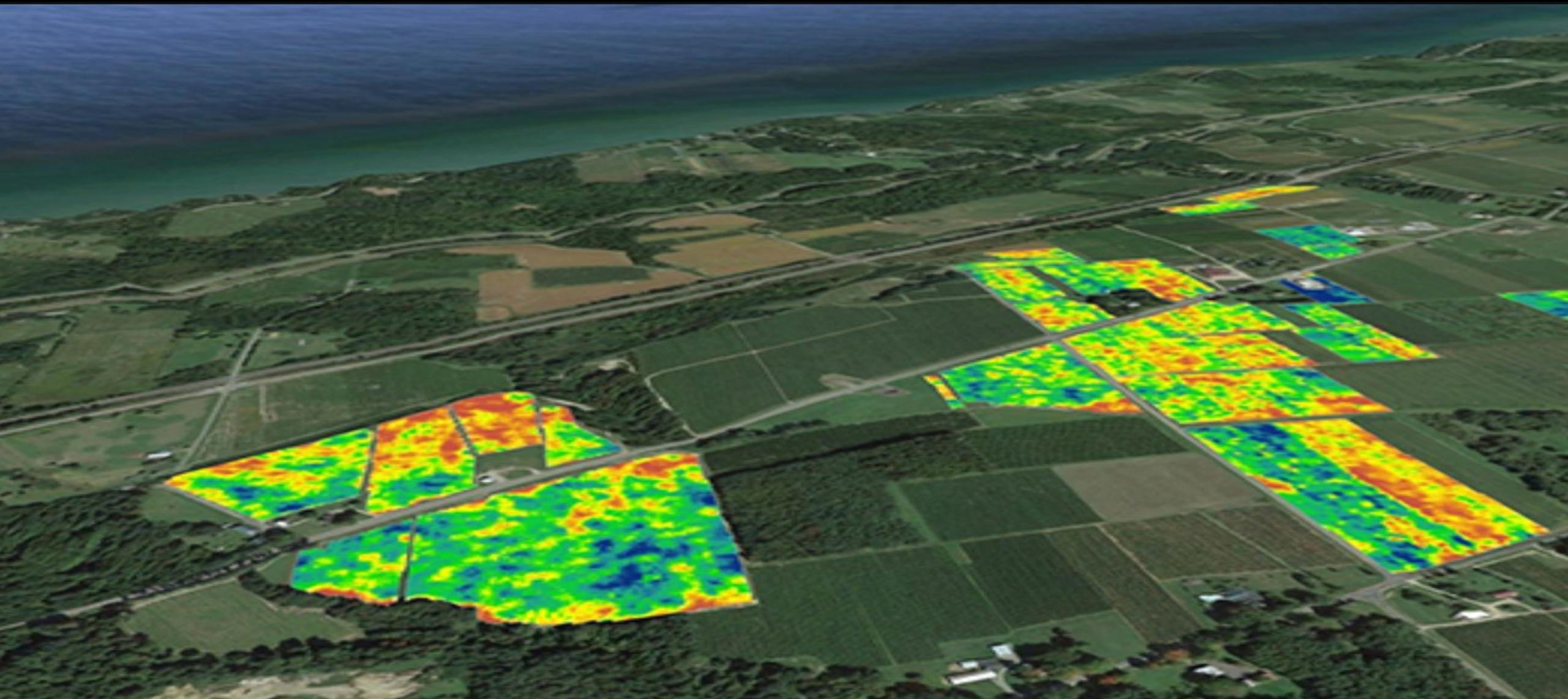
i

The Networked Farm

Digital Revolution: More Efficient Agriculture, More Reliable Harvests

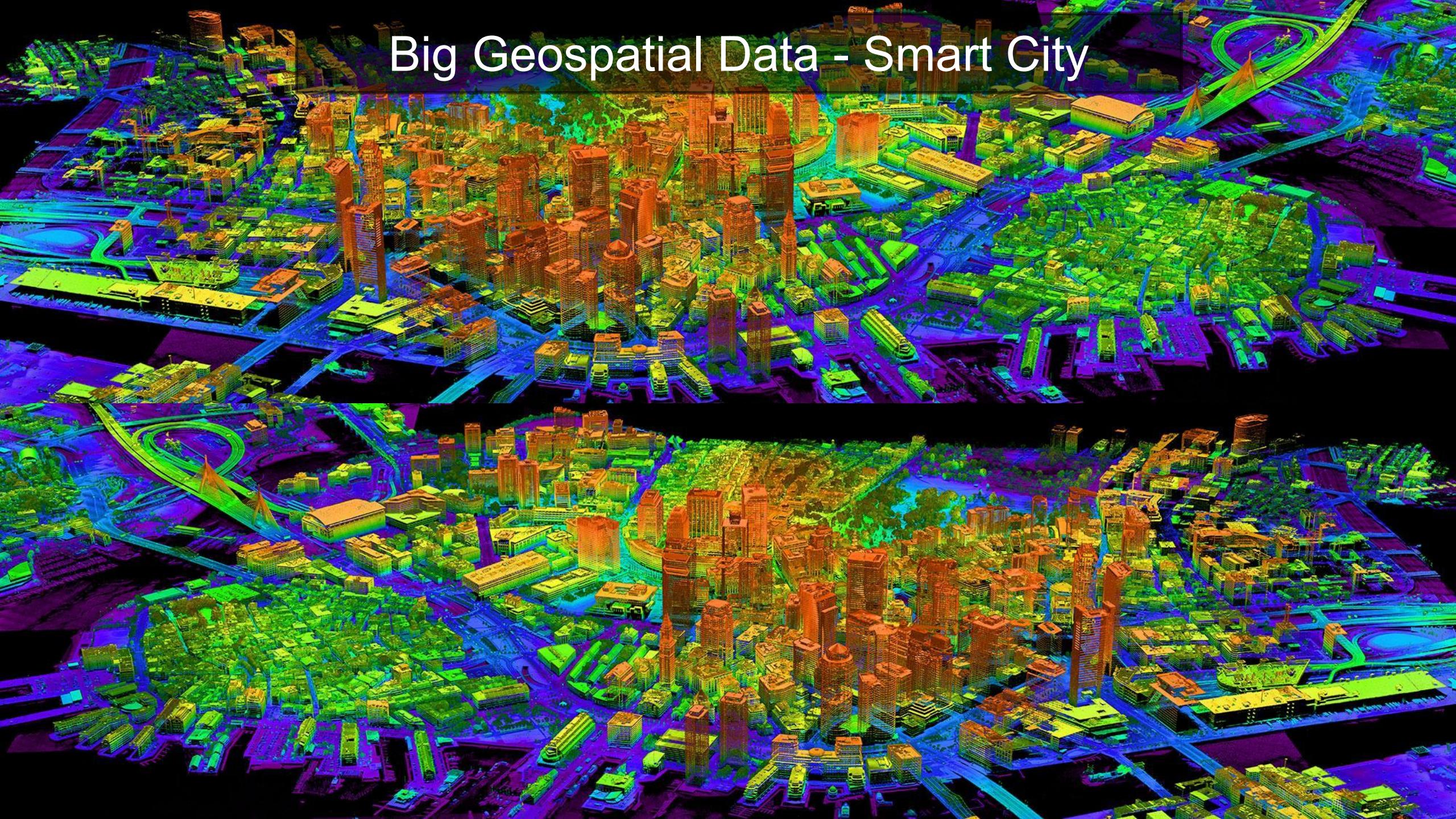


AgTech in California Wine Country

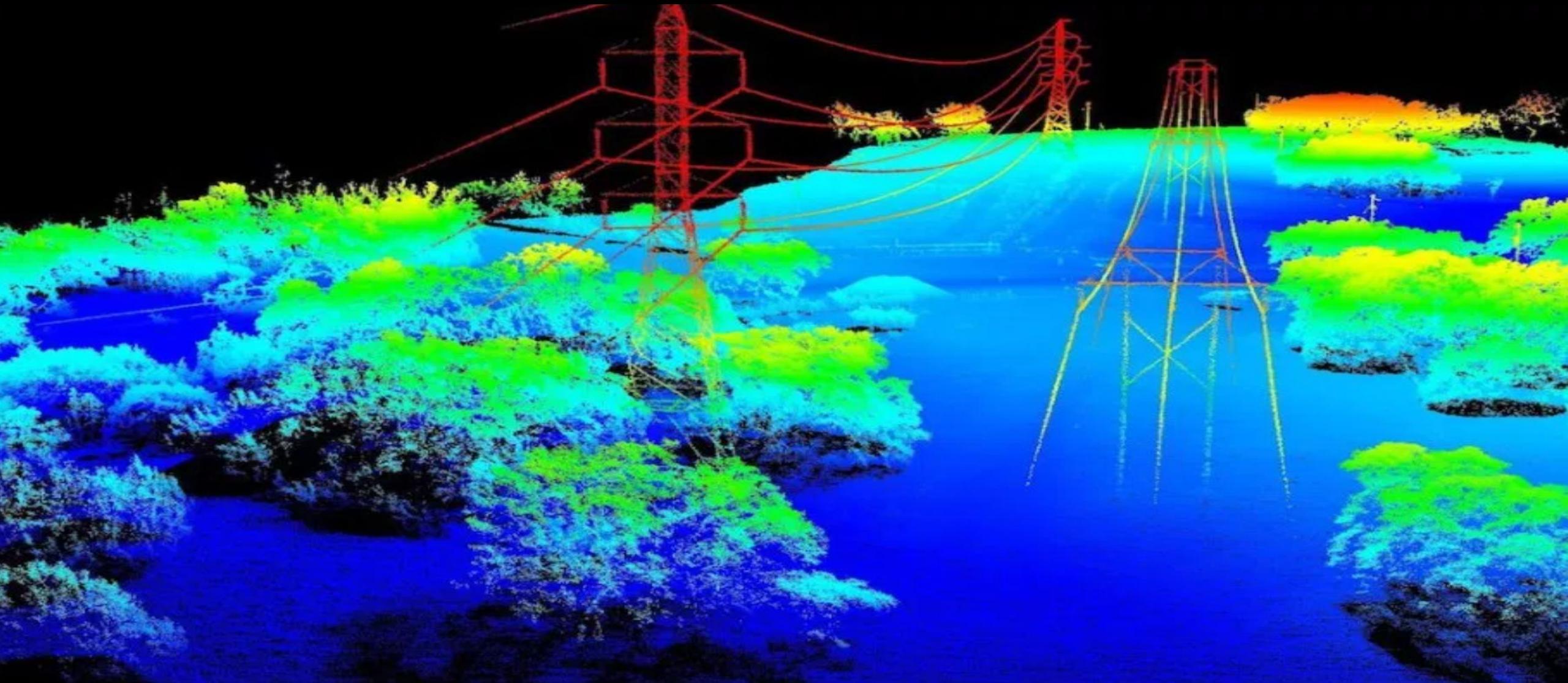


©MIT GeoSpatial Data Center, Feb. 2018

Big Geospatial Data - Smart City

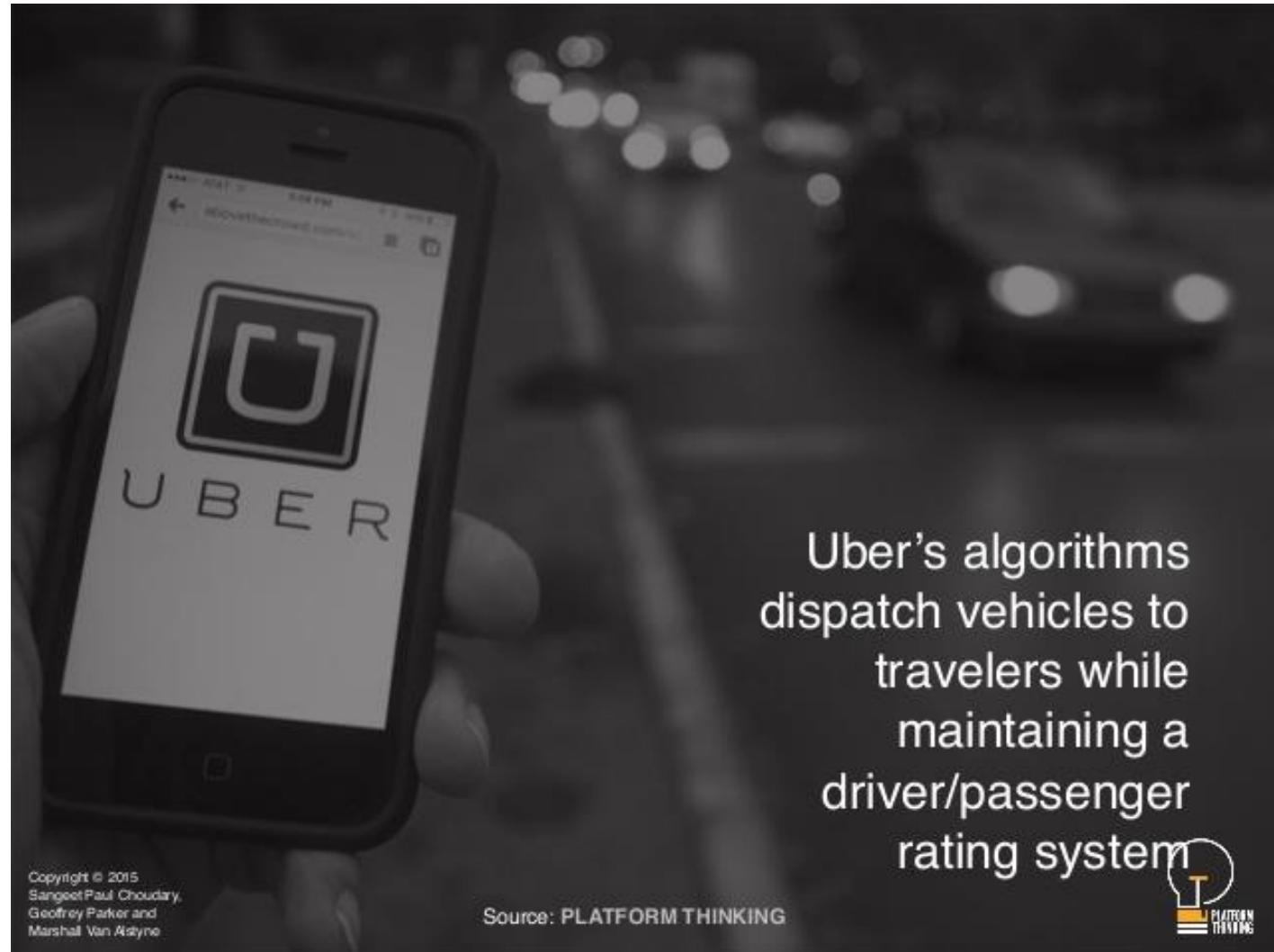


Drone Lidar Data – Electric Power Lines



Rise of the Cloud and Big Data Platforms

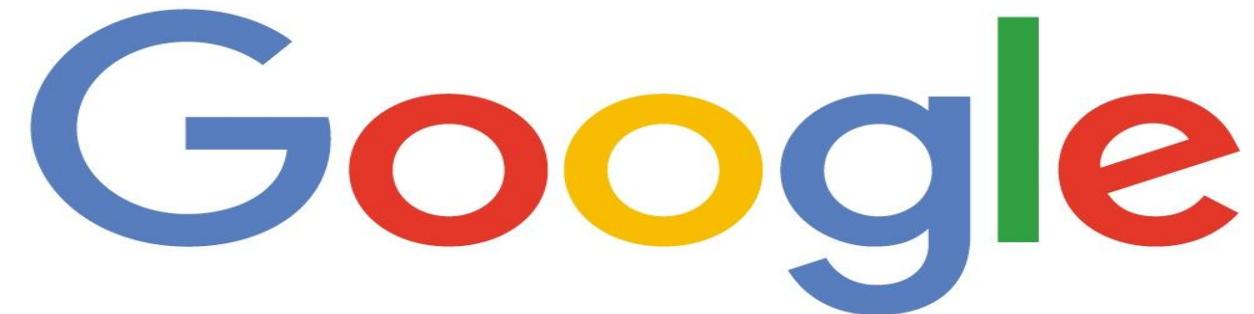
Coordination Platforms



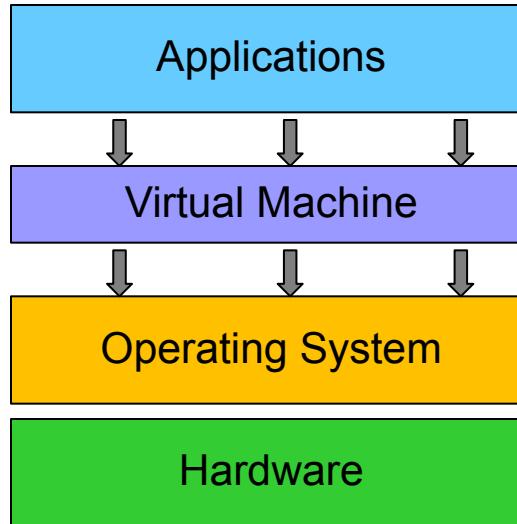
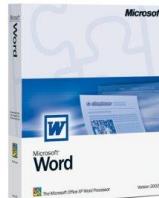
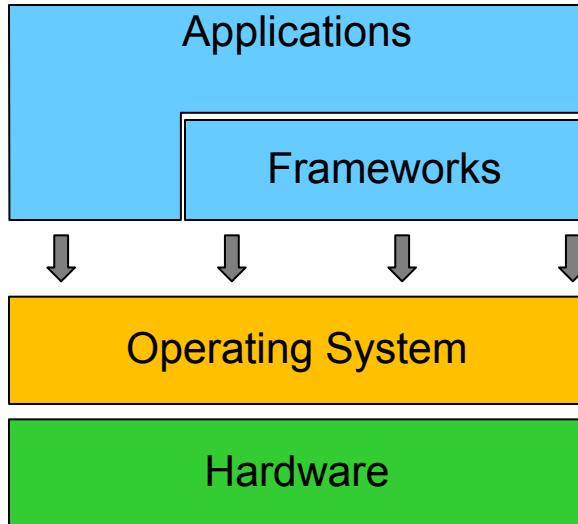
AgTech Platform – Monsanto tells Farmers What to Do



FANGs Know Their Customers

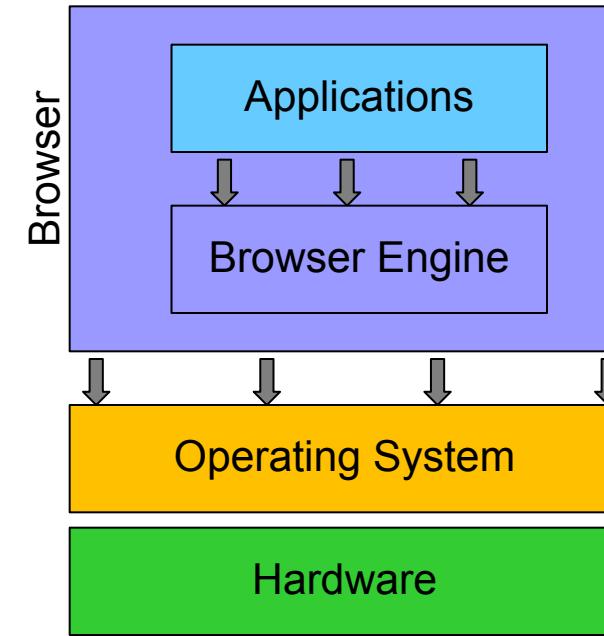


Evolution of Platforms – Move to the Browser



Microsoft
.net

Java



m e A

The MEAN
Stack



New Generation of Huge Web Apps

- Web apps are really really big
 - gmail ~500,000 loc JavaScript
 - amazon.com ~600,000 loc JavaScript
 - espn.com ~900,000 loc JavaScript
 - cnn.com ~1,500,000 loc JavaScript
 - Not uncommon to see 1 MB of JavaScript sent client (minified)



Node.js – Web Server

| processes | req/sec |
|-----------|----------|
| 1 | 6985.85 |
| 2 | 13420.92 |
| 3 | 19375.66 |
| 4 | 23868.80 |

*LinkedIn
Microsoft
Yahoo!
Github
Walmart
Uber
Voxer
Ebay*

Note: Linear Scalability

Over 1
million
Libraries

The screenshot shows the npmjs.com homepage with the following data:

- total packages:** 164,193
- downloads in the last day:** 70,660,995
- downloads in the last week:** 424,003,466
- downloads in the last month:** 1,751,344,174

Key packages listed include:

- browserify**: browser-side require() the node way. Version 9.0.3 published 5 months ago by substack.
- express**: Fast, unopinionated, minimalist web framework. Version 4.12.0 published 5 months ago by dougwilson.
- pm2**: Production process manager for Node.JS applications w... Version 0.12.6 published 5 months ago by jshkurti.
- node-inspector**: A browser-based debugger for Node.js. Version 0.12.1 published 5 months ago by node-inspector.
- istanbul**: Code coverage for node.js. Version 0.12.1 published 5 months ago by istanbul.

The URL at the bottom of the page is <https://www.npmjs.com/package/pm2>.



154,465

total packages



62,600,511

downloads in the last day



390,650,950

downloads in the last week



1,568,922,010

downloads in the last month

JavaScript Package Downloads

A photograph of a volcanic eruption. A massive, billowing column of grey smoke and ash rises from the volcano, filling the upper two-thirds of the frame. In the foreground, a row of palm trees stands on a grassy hillside. A blue vehicle is parked on a dirt road leading towards the volcano. The sky is overcast and hazy.

What are the steps
for Digital
Transformation and
how do we start?

L. DAVID MARQUET

CAPTAIN, U.S. NAVY (RETired)

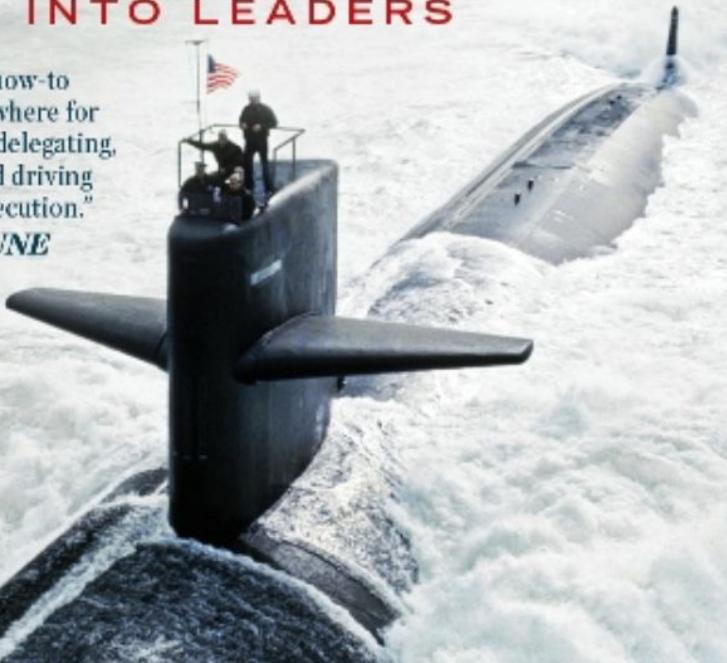
FOREWORD BY STEPHEN R. COVEY

Turn the Ship Around!

A TRUE STORY OF
TURNING FOLLOWERS
INTO LEADERS

"The best how-to manual anywhere for managers on delegating, training and driving flawless execution."

-FORTUNE



How do we design an agile organization ?

Can a small company compete?

AWS: Unblocking Innovation for Digital Transformation



Adrian Cockcroft

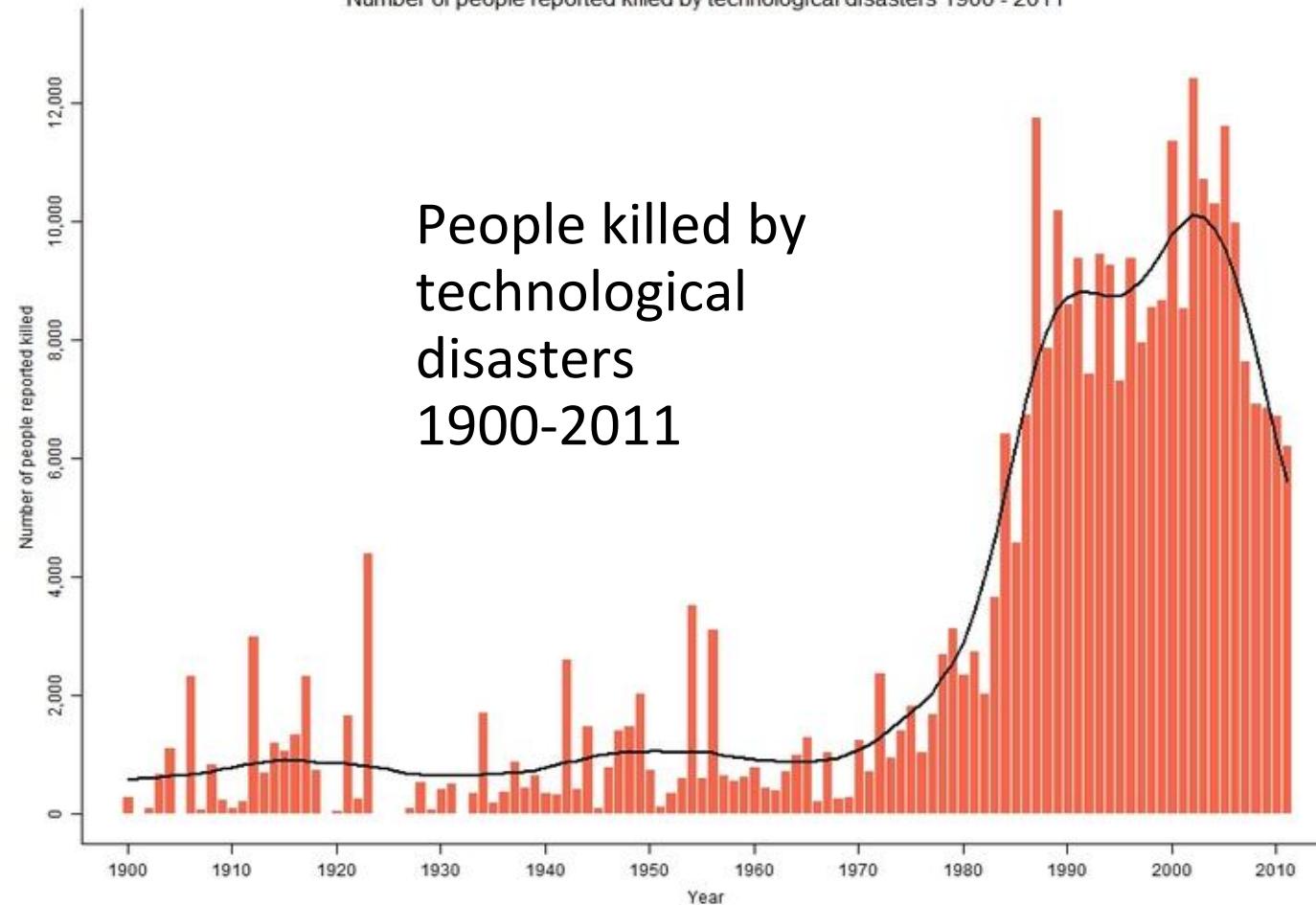
AWS VP Cloud Architecture Strategy
@adrianco



© 2018, Amazon Web Services, Inc. or its Affiliates. All rights reserved.



Number of people reported killed by technological disasters 1900 - 2011

EM-DAT: The OFDA/CRED International Disaster Database - www.emdat.be - Université Catholique de Louvain, Bruxelles - Belgium

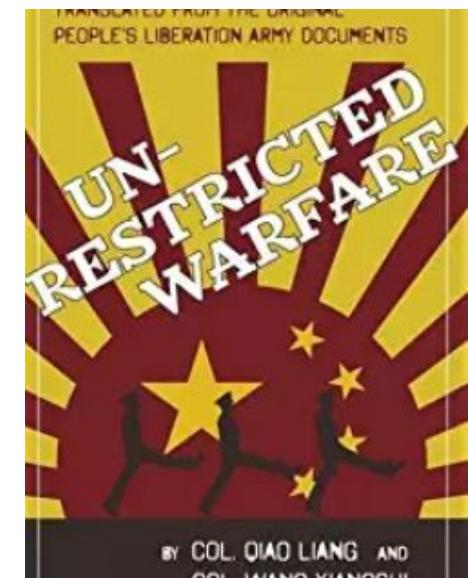
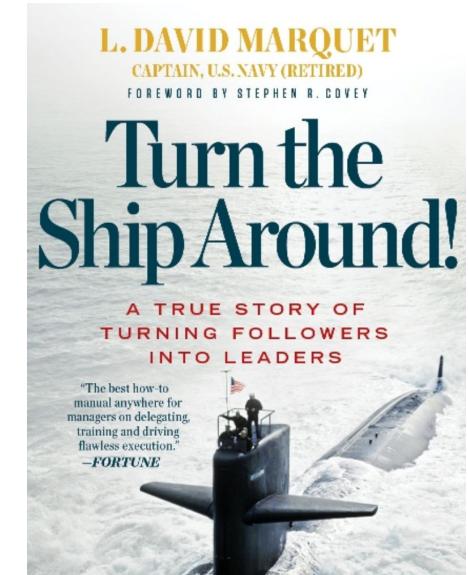
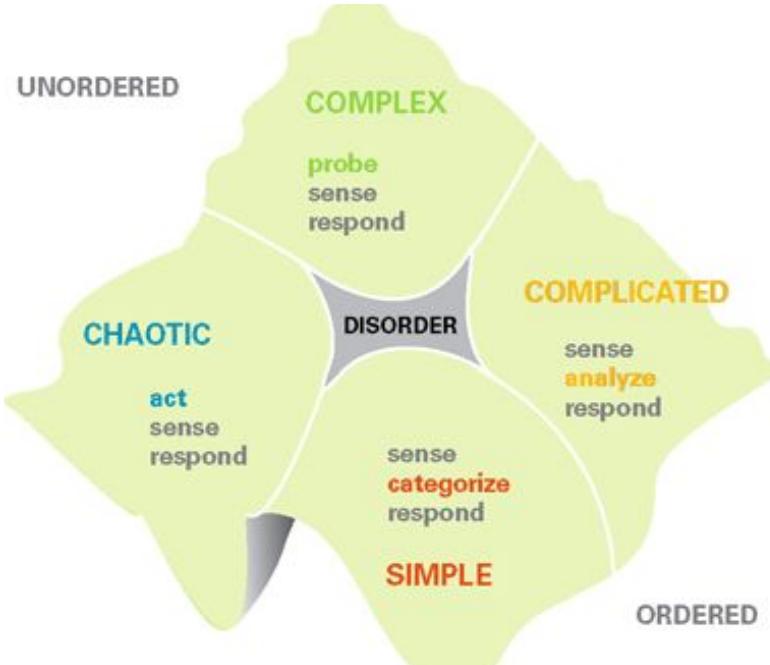
It's a VUCA world



V- Volatile
U- Uncertain
C - Complex
A -
Ambiguous

Strategic Thinking

- John Boyd - OODA
- David Snowden –Cynefin
- David Marquet - Leadership
- Qiao Liang - Warfare



John Boyd - OODA



A sepia-toned portrait of John Boyd, a man with short dark hair, wearing a flight suit and harness. He is looking slightly upwards and to his left with a thoughtful expression. A white helmet is resting on his right shoulder. The background is a plain, light color.

**How do
deal with
VUCA ?**

