



THE IOT GUIDE

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liveworx.com | [#LIVEWORX](https://twitter.com/LIVEWORX)





INTERNET
OF THINGS

- 
- Where did IoT come from?
 - What will it look like in the future?
 - Is the technology ready?
 - How to get going, today?

***BACK TO THE
FUTURE***

1985 · 2016 · 2045



PC WORLD

The Personal Computer Magazine
For Second-Generation IBM PCs and Compatibles

Premier Issue \$3.00

How Compatible is Compatible?

20 New PC "Lookalikes"

The Battle for Software Supremacy

Lotus 1-2-3 and Connect MBA



Do-It-
How

▪ MAKE BELIEVE NUCLEAR BLASTS ▪ ARTIFICIAL SKIN COMES ALIVE ▪

Technology Review

EDITED AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

JANUARY 1985

\$3.00

FACING UP TO AUTOMATION

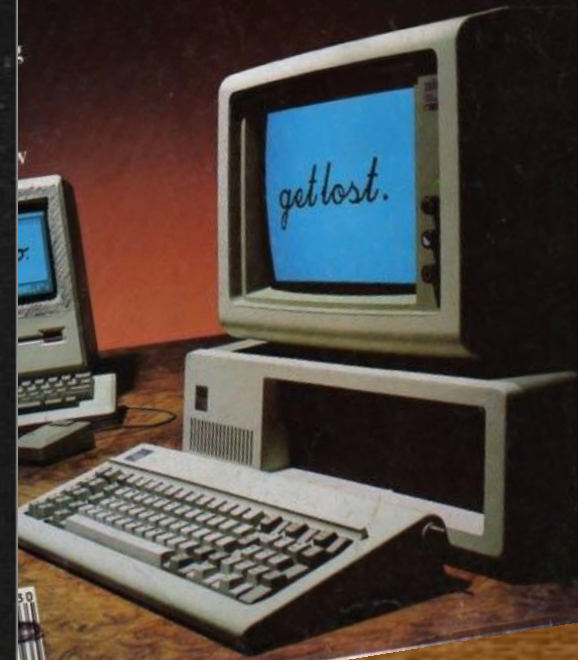


TO IBM PERSONAL COMPUTERS

BM vs. Apple

Is Mac Ready For Business?

DATA SECURITY SCANDAL



Another Price Breakthrough from Radio Shack!

FINALLY...A HIGH-PERFORMANCE 1200-BAUD MODEM FOR UNDER \$400

Save money on long-distance telephone service and on information network connect time with our high-performance DC-2212 Modem.

Superior Performance for Less than Lesser Modems

You can find other modems with only some of the same features as the DC-2212 selling elsewhere for \$500, \$600 and more. But why pay that much? The DC-2212 (26-1176) is just \$399.95 and includes the features you need to save time and money. And the DC-2212 is compatible with any personal computer equipped with an RS-232C

communications interface (just add appropriate software and cable).

Advanced Features for Convenient, High-Speed Data Communications

The DC-2212 is easy to use and will automatically dial or answer telephone calls, receive and transmit data and then hang up. Just connect the DC-2212 to a modular telephone jack for menu-driven, Bell 212A-compatible asynchronous or synchronous operation. The DC-2212 automatically selects 300 or 1200 baud operation to match incoming calls and lets you download

at 1200 baud to save time and money. The DC-2212 is fully compatible with Xenix systems and is perfect for use with any of our Videotex telecommunications software packages.

See It Today

Step up to high-speed data communications with the DC-2212.

Available at over 1200 Radio Shack Computer Centers and at participating Radio Shack stores and dealers.

Radio Shack
COMPUTER CENTERS
A DIVISION OF TANDY CORPORATION

Heavy 111



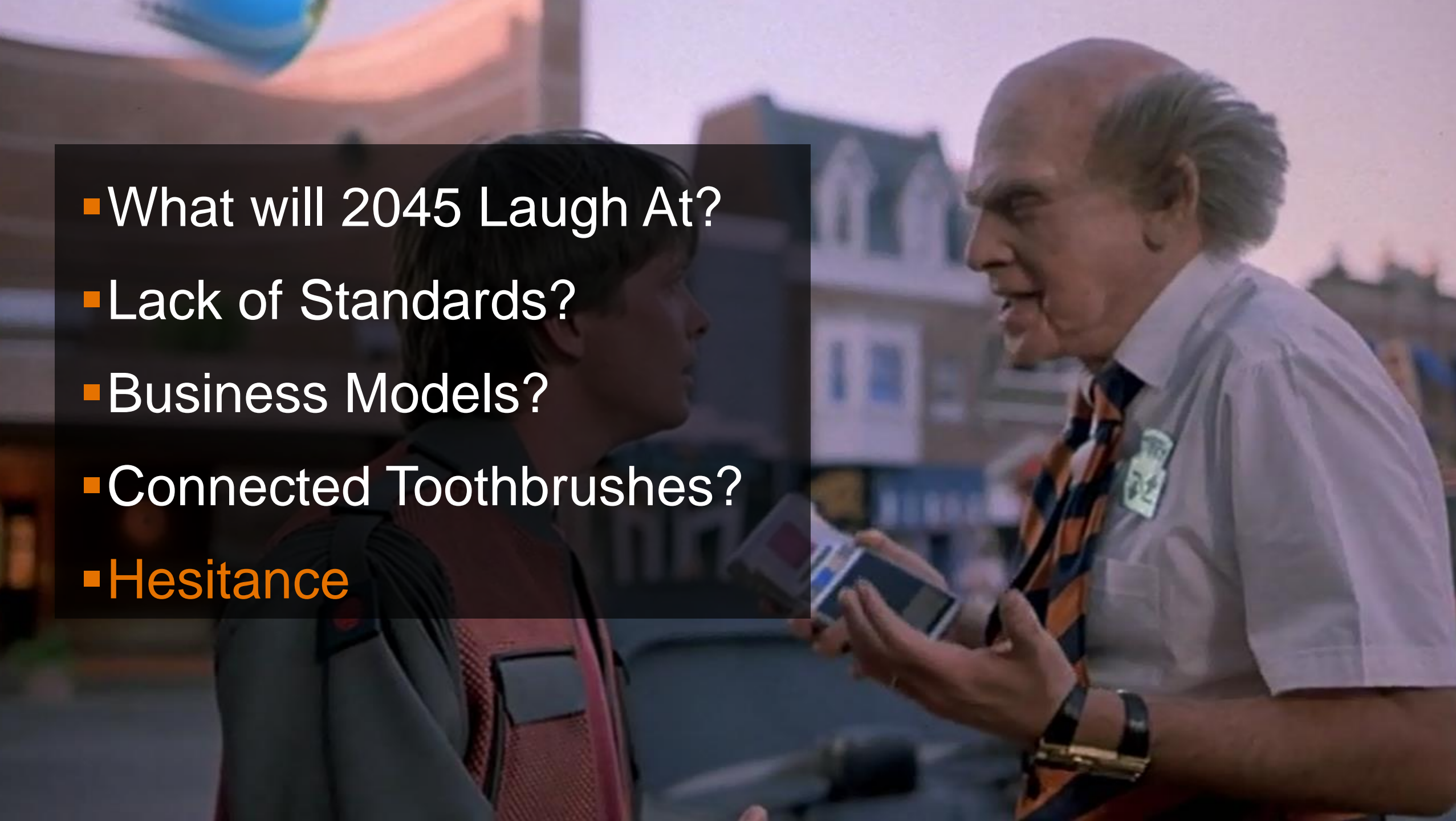
Prices apply at Radio Shack Computer Centers and at participating Radio Shack stores and dealers. FCC registered. Use only with Bell-compatible equipment. Not for multi-line use without optional extra controller. XENIX is a trademark of Microsoft.

- 1985
- 1200 bits per second
- \$400 USD
- TTY
- Kermit
- BBS



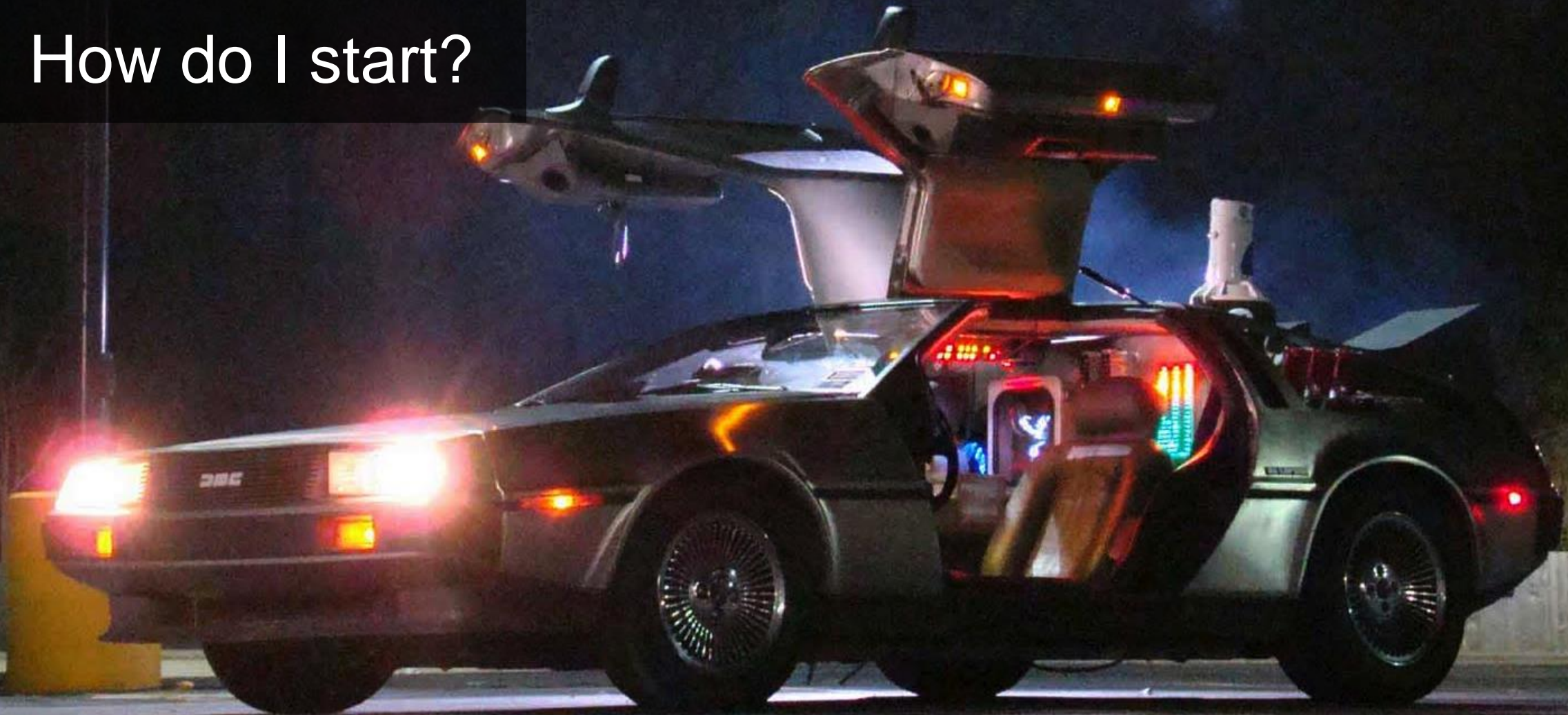


- Ambient Computing
- Nano-Connectivity
- Ubiquitous Wireless
- “Free” Smart Products
- Connected by default

- 
- What will 2045 Laugh At?
 - Lack of Standards?
 - Business Models?
 - Connected Toothbrushes?
 - Hesitance



How do I start?





How do I design
an IoT solution?

alliance allseen analytics
azure big-data cassandra cloud
coap control data edge
embedded gateway
governance hadoop iaas identity iic
industry internet ipso
management modbus module mqtt
obd-ii oic plane privacy serial smart-home
things wifi yocto z-wave zigbee

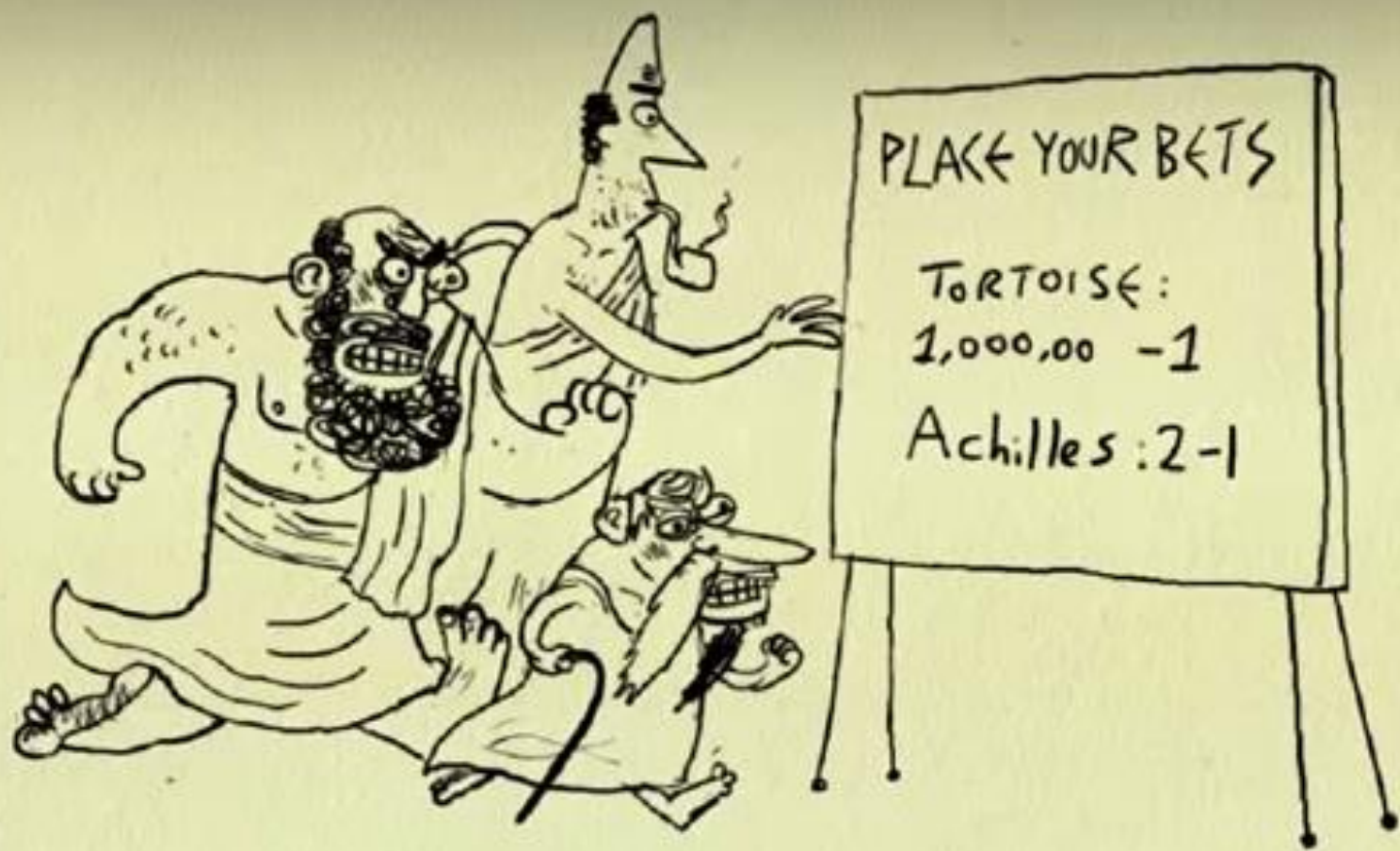
ZENO'S PARADOXES



1. ACHILLES
& THE
TORTOISE

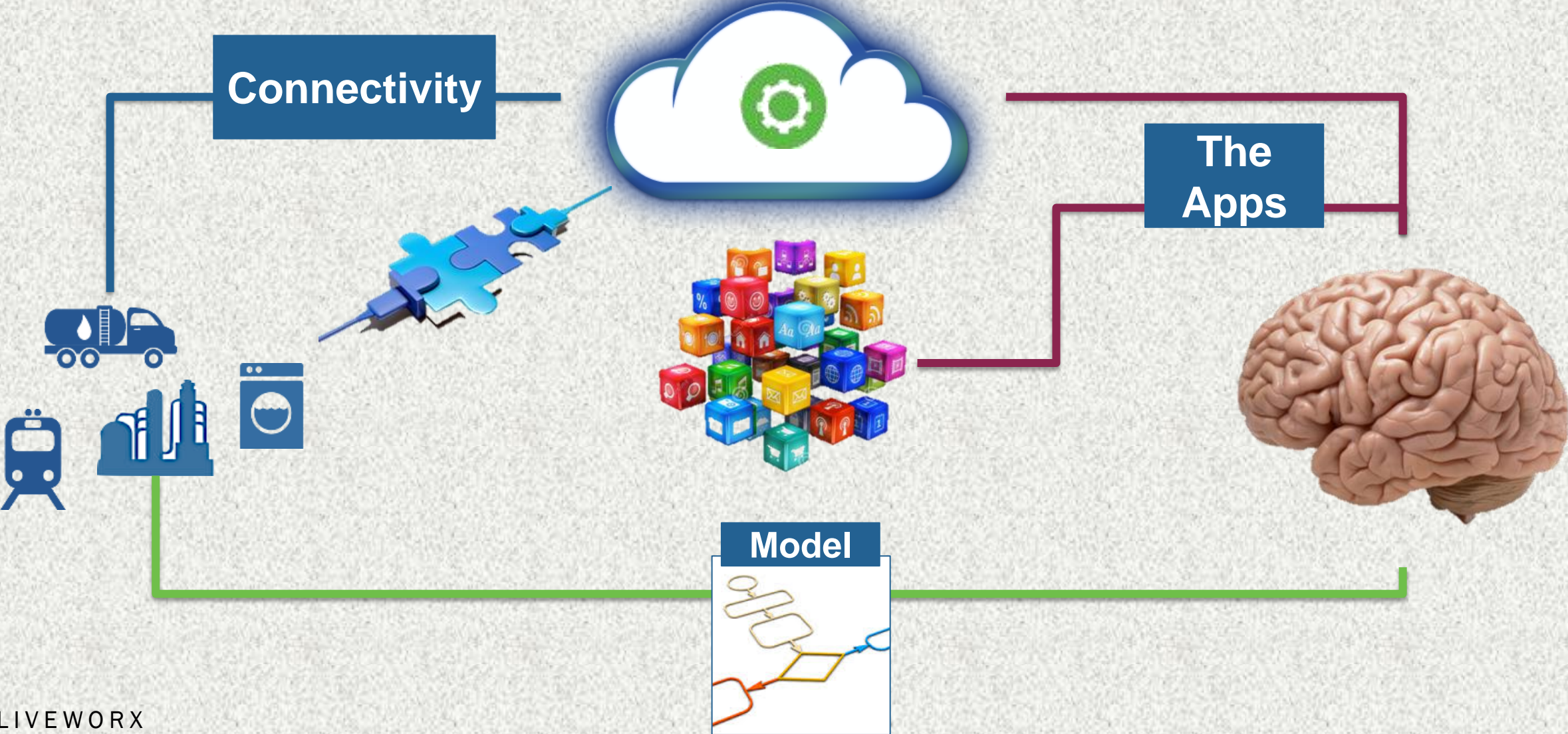


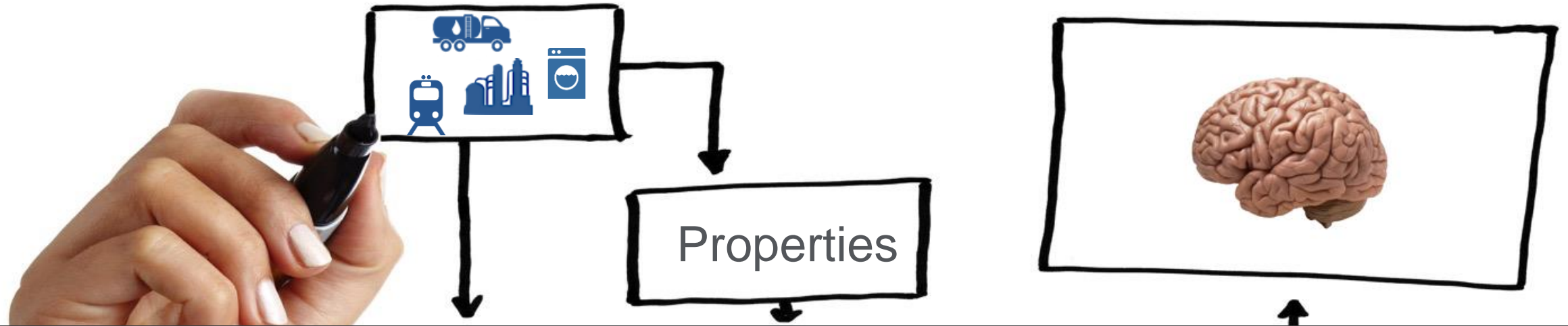




NB: movement IS possible

HOW TO THINK ABOUT AN IOT SOLUTION






What do I want to learn?

What do I want to do?

What's my thing's API?



How to optimize maintenance
Fuel efficiency
Manage farm with less overhead

- Properties



ThingWorx A PTC Business

Type to search system

ConnectedTractor.Tractor x DemoLaunch x

ConnectedTractor.Tractor ThingTemplate ? Save Cancel Edit To Do

ENTITY INFORMATION

- General Information
- Properties**
- Services
- Events
- Subscriptions

PERMISSIONS

- Visibility
- Visibility Instance
- Design Time
- Design Time Instance
- Run Time
- Run Time Instance

CHANGE HISTORY

- Change History


DEPENDENCIES

Properties ?

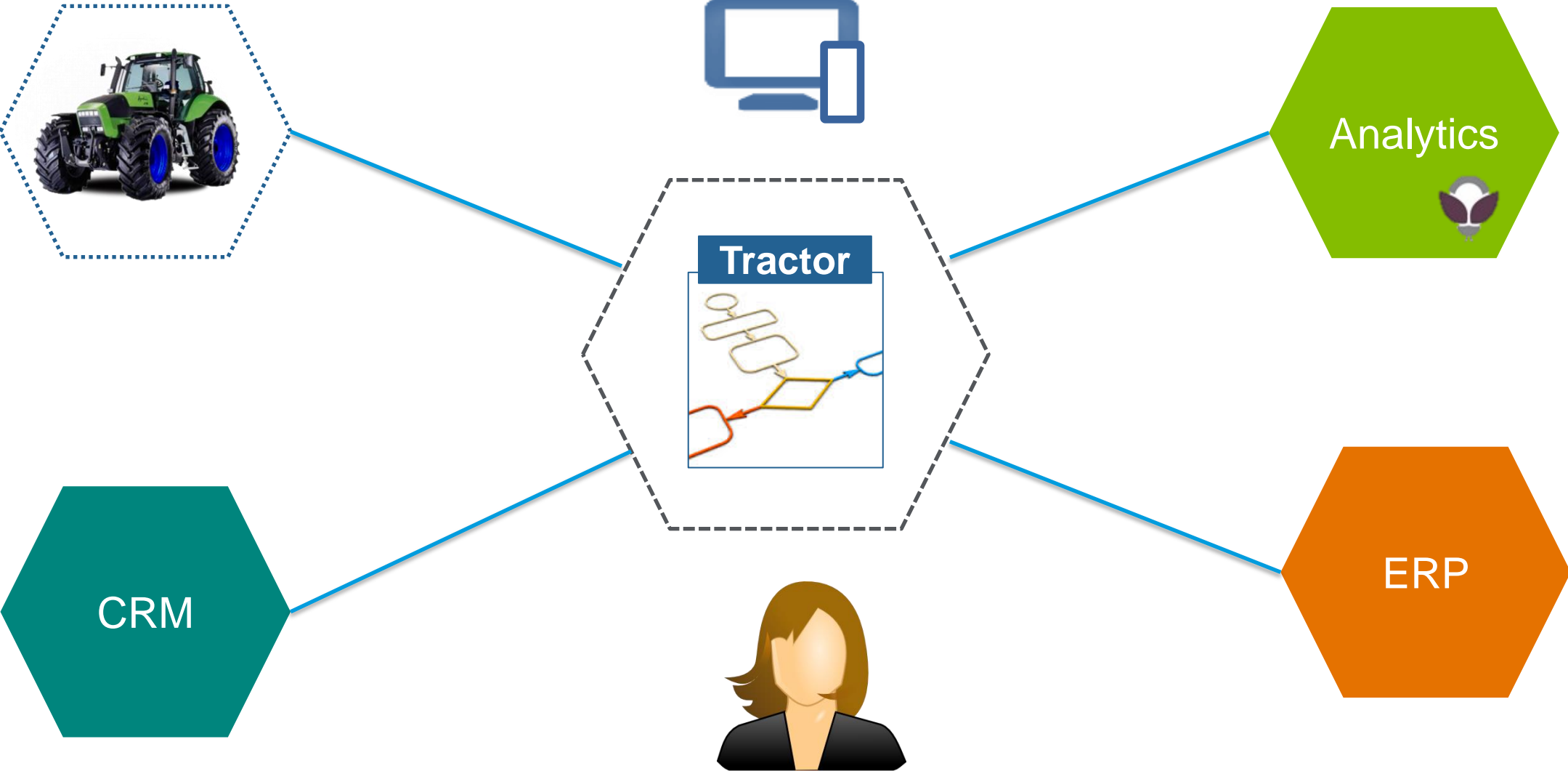
+ Add My Property Edit Delete

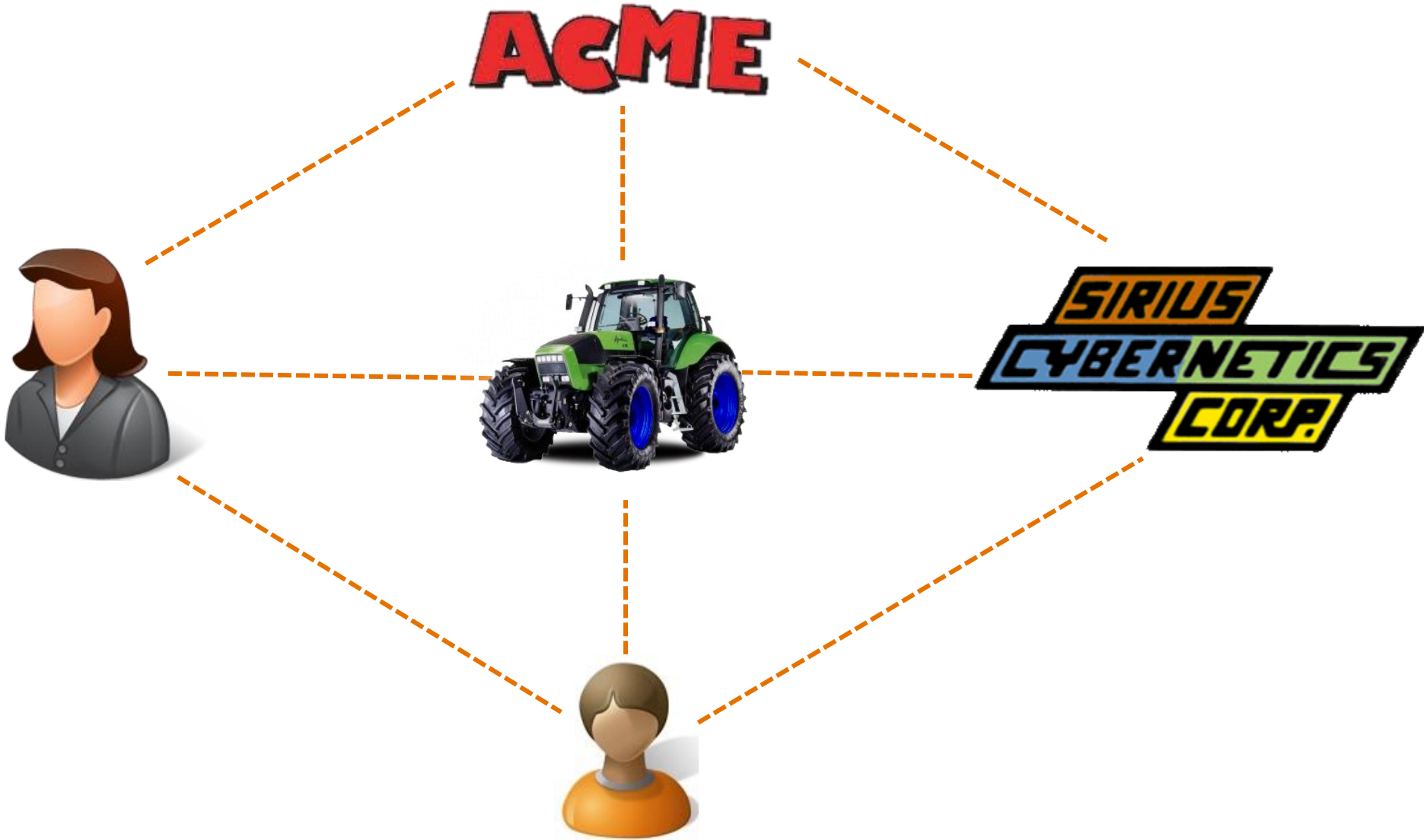
My Properties

<input type="checkbox"/>	Edit	Name	Type	Alert
<input type="checkbox"/>		-T- SerialNumber		0 Ale
<input type="checkbox"/>		-T- ModelNumber		0 Ale
<input type="checkbox"/>		-T- Factory		0 Ale
<input type="checkbox"/>		# OriginalPrice		0 Ale
<input type="checkbox"/>		-T- Engine		0 Ale
<input type="checkbox"/>		# FuelCapacity		0 Ale
<input type="checkbox"/>		# WheelBase		0 Ale
<input type="checkbox"/>		# Weight		0 Ale
<input type="checkbox"/>		# HydraulicCapacity		0 Ale
<input type="checkbox"/>		-T- HydraulicType		0 Ale



Business Logic and Analytics
Other Systems
User Experience and Identity





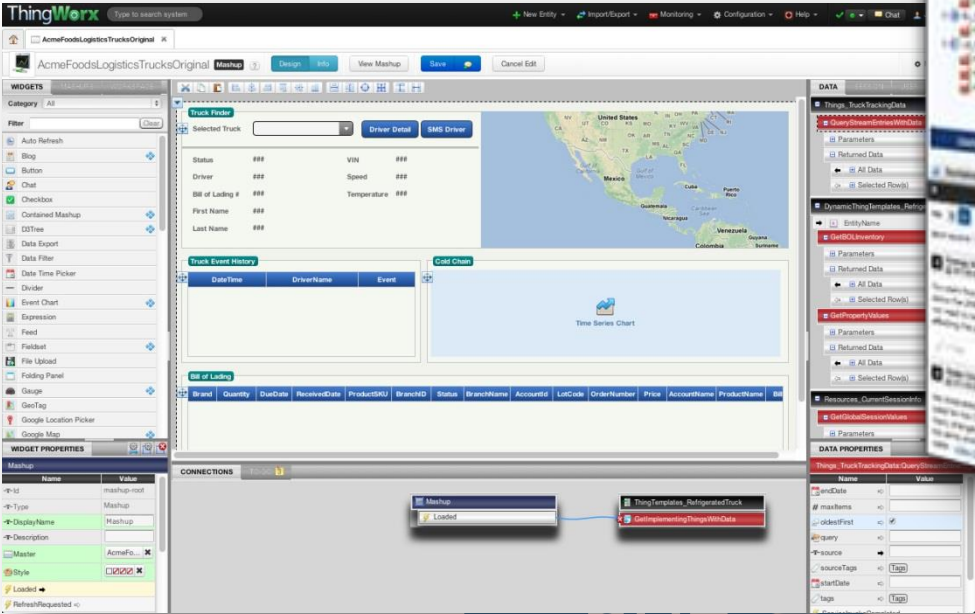
The screenshot displays the ThingWorx IDE interface. At the top, the title bar shows 'ThingWorx A PTC Business' and a search bar. The main workspace is titled 'Services' and shows a table of 'My Services'. The selected service is 'GetMaintenanceBlogEntries', which is a 'Local (JavaScript)' service. The 'Inputs' column lists '-T- Search', '-T- Blog', and '# MaxBlogEntries'. The 'Output' column shows 'result'.

Below the table, the configuration for 'GetMaintenanceBlogEntries' is shown. The 'Inputs/Outputs' tab is active, displaying a list of inputs with their names and actions (edit, delete, add). The 'Script' tab is also active, showing the following JavaScript code:

```
7 var blog = Blog;
8 if(Blog == undefined)
9     blog = "ConnectedTractor.MaintenanceMonitor";
10
11 // result: INFOTABLE dataShape: BlogEntry
12 var blogEntries = Things[blog].SearchBlogEntries(params);
13
14 var params = {
15     dataShapeName: "BlogEntrywithAvatar" /* STRING */,
16     infoTableName: "BlogEntrywithAvatar" /* STRING */
17 };
18
19 // result: INFOTABLE
20 var BlogEntrywithAvatar = Resources["InfoTableFunctions"].CreateInfoTableFromDataShape(params);
21
22 for each (var row in blogEntries.rows){
23
24
```

The 'Outputs' section shows a single output named 'result' with an empty description field. At the bottom right, there are buttons for 'Cancel', 'Done', and 'Save Entity'.

Unlocking the Value in the Internet of Things



1B

2016




2020



2045

The screenshot displays the ThingWorx RPA interface for a project named 'TrackTrace.Plant'. The interface is divided into several key sections:

- Header:** Includes the ThingWorx logo, a search bar, and navigation options like 'New Entity', 'Import/Export', 'Monitoring', 'Help', and a user profile 'JoeB'.
- Project Bar:** Shows the current project 'TrackTrace.Plant' and tabs for 'Design', 'Info', 'View Mashup', 'Save', and 'Cancel Edit'.
- Left Panel (Widgets):** A list of available widgets categorized by type, including 'Auto Refresh', 'Blog', 'Button', 'Carousel', 'Checkbox', 'Contained Mashup', 'D3Network', 'D3Tree', 'Dashboard', and 'Data Export'. A 'Mashup' section below lists properties for the current mashup.
- Main Design Area:** A central workspace where a dashboard is being built. It features a map of the Gulf of Mexico region, a 'Plant Address' field (4362 Mainland Blvd, Cincinnati, OH 38921), a 'Plant Manager' section with masked text and a 'Send a Message' button, four 'Gauge' widgets, a 'Spotlight Line' with a 'Refresh Now' button, a 'Current Shift' progress bar (0/480), an 'Uptime' bar (0), and a 'Time Series Chart'.
- Right Panel (Data/Session/User):** A list of data sources and services, including 'EntityName', 'GetProperties', 'TogglePlayButton', 'GetPlantManagerDetails', 'GetNextSpotLightProductionLine', 'GetEfficiencyNumbers', and 'DynamicThingTemplates_AcmeTractor...'. Below this is a table with columns for 'Name' and 'Value'.
- Bottom Panel (Connections):** A visual flow diagram showing connections between various components like 'DynamicThingTemplates_AcmeTr...', 'AutoRefresh', 'Mashup', 'TogglePlayButton', 'All Data', 'Loaded', 'GetProperties', and 'DynamicThingTemplates_AcmeTr...'.



Edge Architecture

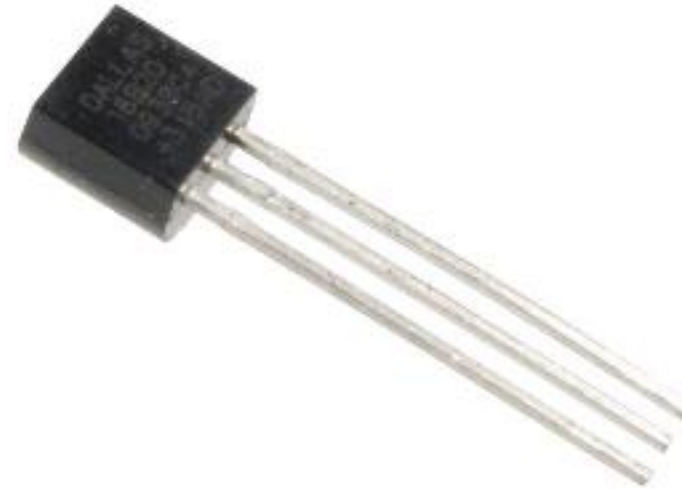
The Network

Cloud Services



KEY TERMS ON THE EDGE

- Anything that can “read” or “report” on the real-world status of the product or local environment
 - Temperature sensors and light sensors
 - GPS receivers
 - Vehicle on-board diagnostics (OBD)
 - Files
 - Stuff specific to the product
- Hardwired, plugged in, built-in, over BLE or Zigbee, or carrier pigeon delivered



Anything that can affect the product or environment

- Lights
- Valves
- Motors
- & Command
 - “Soft” Actions
 - File Distribution
 - Firmware Updates



Short Haul (southbound)

- Communication over short distances
- Things that are proximate
- Ethernet
- Serial / Modbus
- Bluetooth
- Zigbee/ZWave
- MQTT
- J19 bus, CAN bus, OBD
- OPC
- DDS



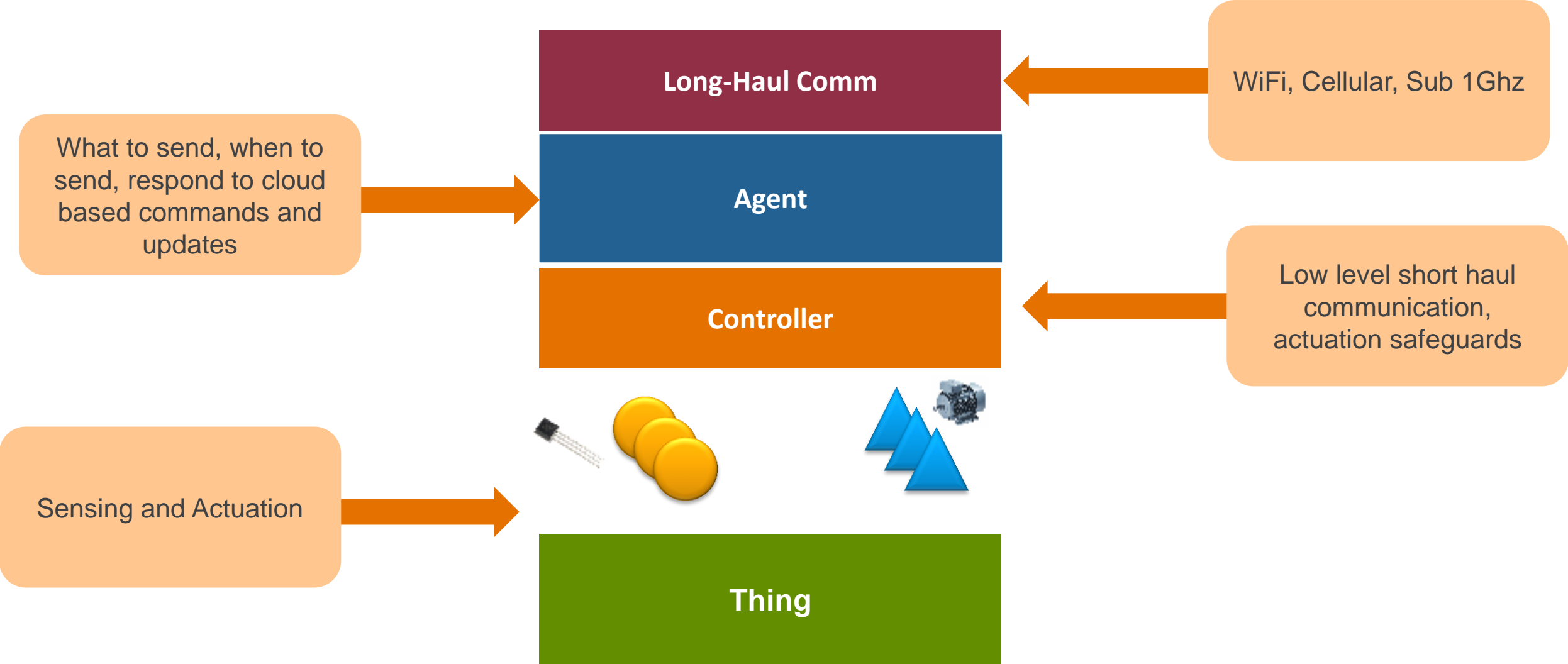
Long Haul (northbound)

- Communicating over long distances
- Transports
 - WiFi or Wired Ethernet
 - LoRa / Sub 1Ghz
 - Cellular
 - Satellite
- Networking Protocols
 - TCP
 - UDP
 - SMS
 - HTTP
 - COAP
- Messaging Protocols
 - AlwaysOn
 - OMA LWM2M

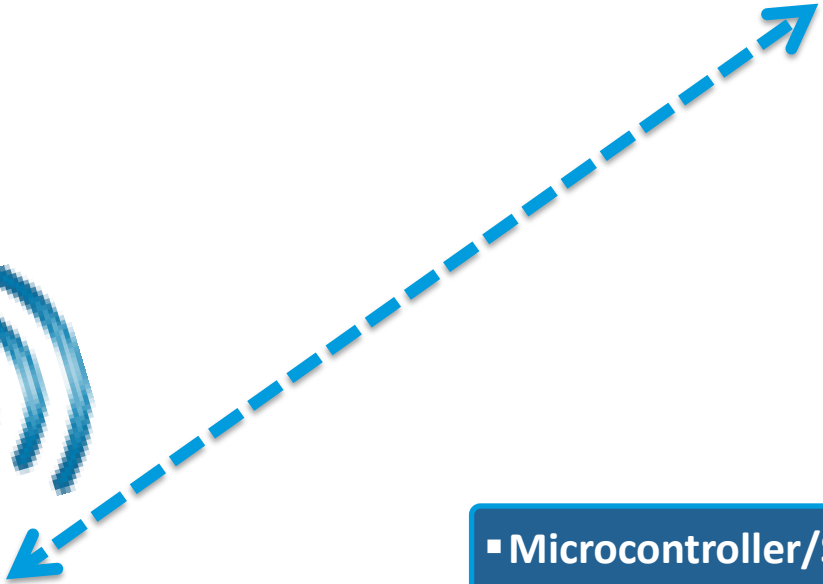




ABSTRACT IOT THING ANATOMY

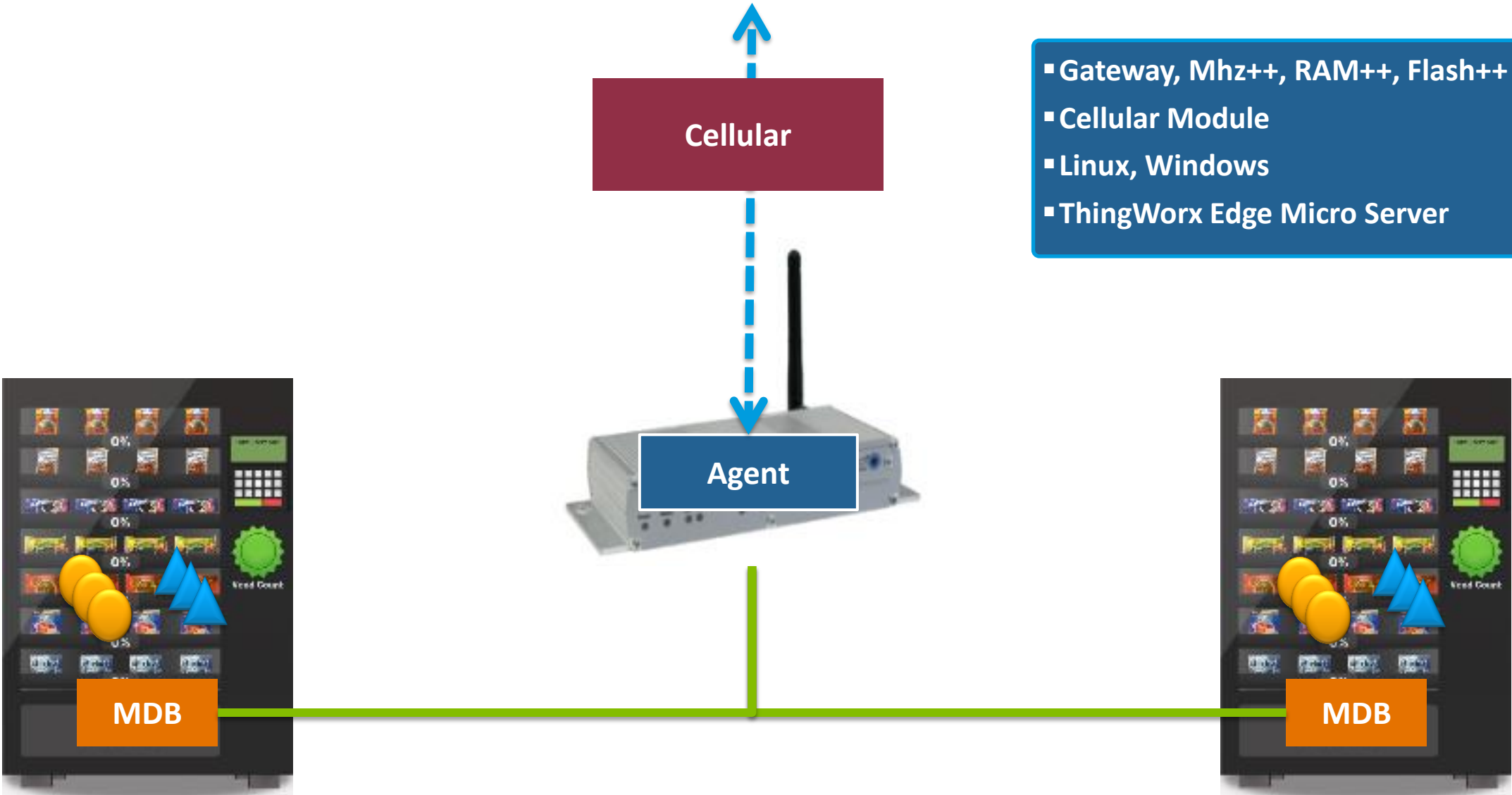


EMBEDDED EXAMPLE WITH WIFI



- Microcontroller/SOC (ARM, x86)
- WiFi Module (Broadcomm, Marvell)
- Embedded RTOS/No-OS/Skinny Linux
- ThingWorx AlwaysOn SDK

GATEWAY EXAMPLE WITH CELLULAR



- Gateway, Mhz++, RAM++, Flash++
- Cellular Module
- Linux, Windows
- ThingWorx Edge Micro Server





Serial #
MEID
UUID?

Token, user/pass,
X.509?

IDENTIFY YOURSELF



Cloud <-> Device Connectivity



Cloud Communication Client



Executive team

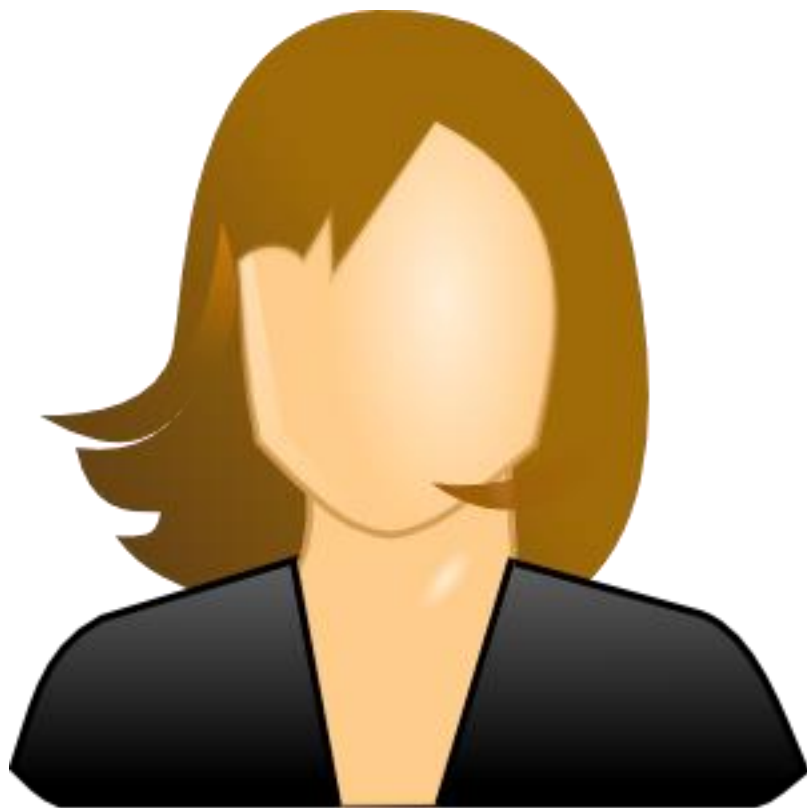
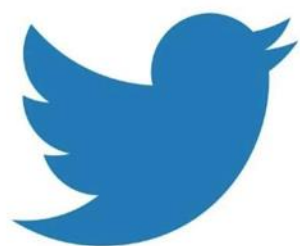
Milestones

Open Source

Our mission: To give everyone the power of information instantly, without barriers.

Twitter usage

- **271 million monthly active users**
- **500 million Tweets are sent per day**
- **78% of Twitter active users are on mobile**
- **77% of accounts are outside the U.S.**
- **Twitter supports 35+ languages**
- **Vine: More than 40 million users**



IoT Device: updating status every 1 minute





700:1

387,142 == All of Twitter

2 Customers == Twitter * 10

	Coffee Pot	Industrial Robot
Connectivity	Home WiFi	Sub ghz private network
Physical Security	None	Lockbox
Transport Encryption	None	TLS 1.2
Device Authentication	Serial number	serial + x.509 certificate
Message integrity	MD5	SHA-2 (256)
OS	Windows 95	Wind River Linux
Secure boot?	No	Yes



	Coffee Pot	Industrial Robot
Connectivity	Home WiFi	Sub ghz private network
Physical Security	None	Lockbox
Transport Encryption	None	TLS 1.2
Device Authentication	Serial number	serial + x.509 certificate
Message integrity	MD5	SHA-2 (256)
OS	Windows 95	Wind River Linux
Secure boot?	No	Yes
Remote Update Capable?	Yes	No



THE NETWORK IS UNRELIABLE



BLUE MOON

Data Normalization

Protocol Translation

Device Ingress

Device Egress

Cloud <-> Device Connectivity

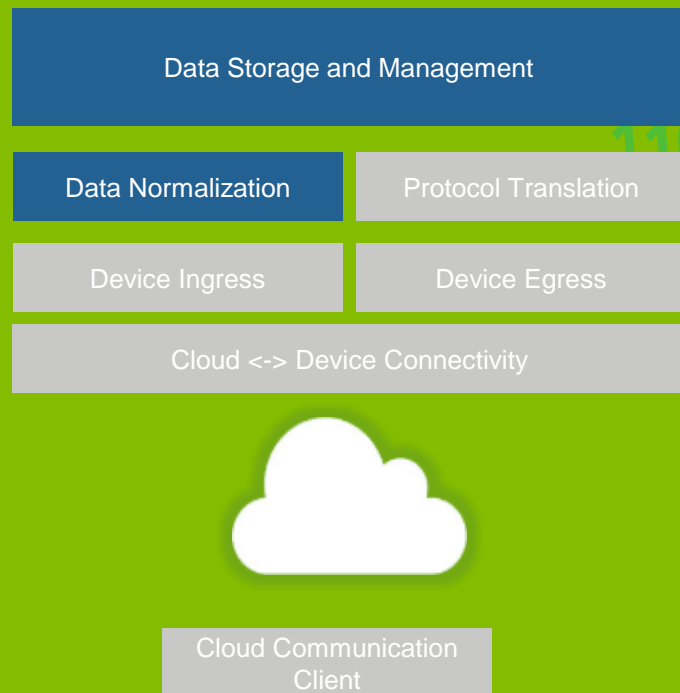


Cloud Communication Client

**STOP!
Actuate!
Update!**

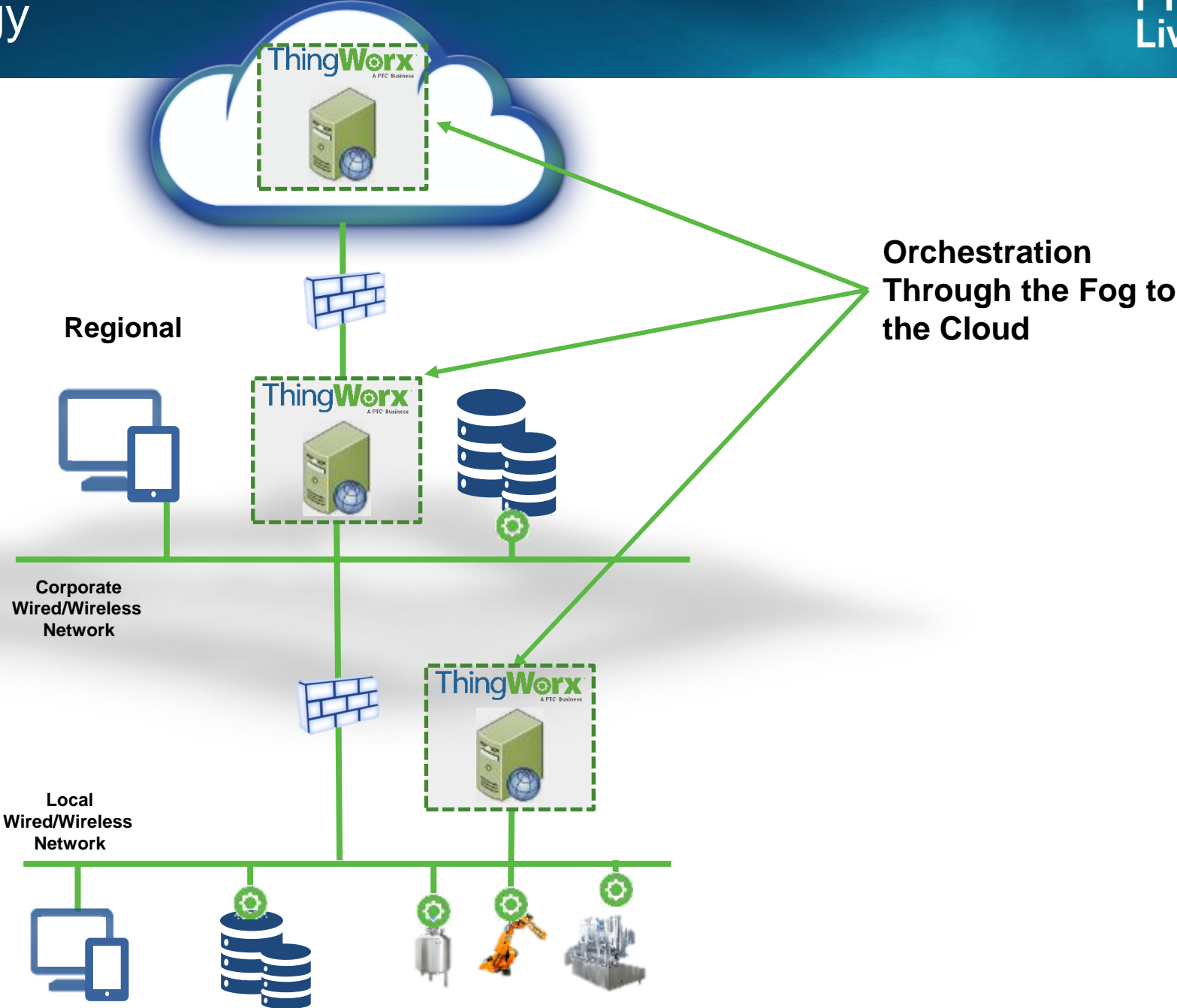


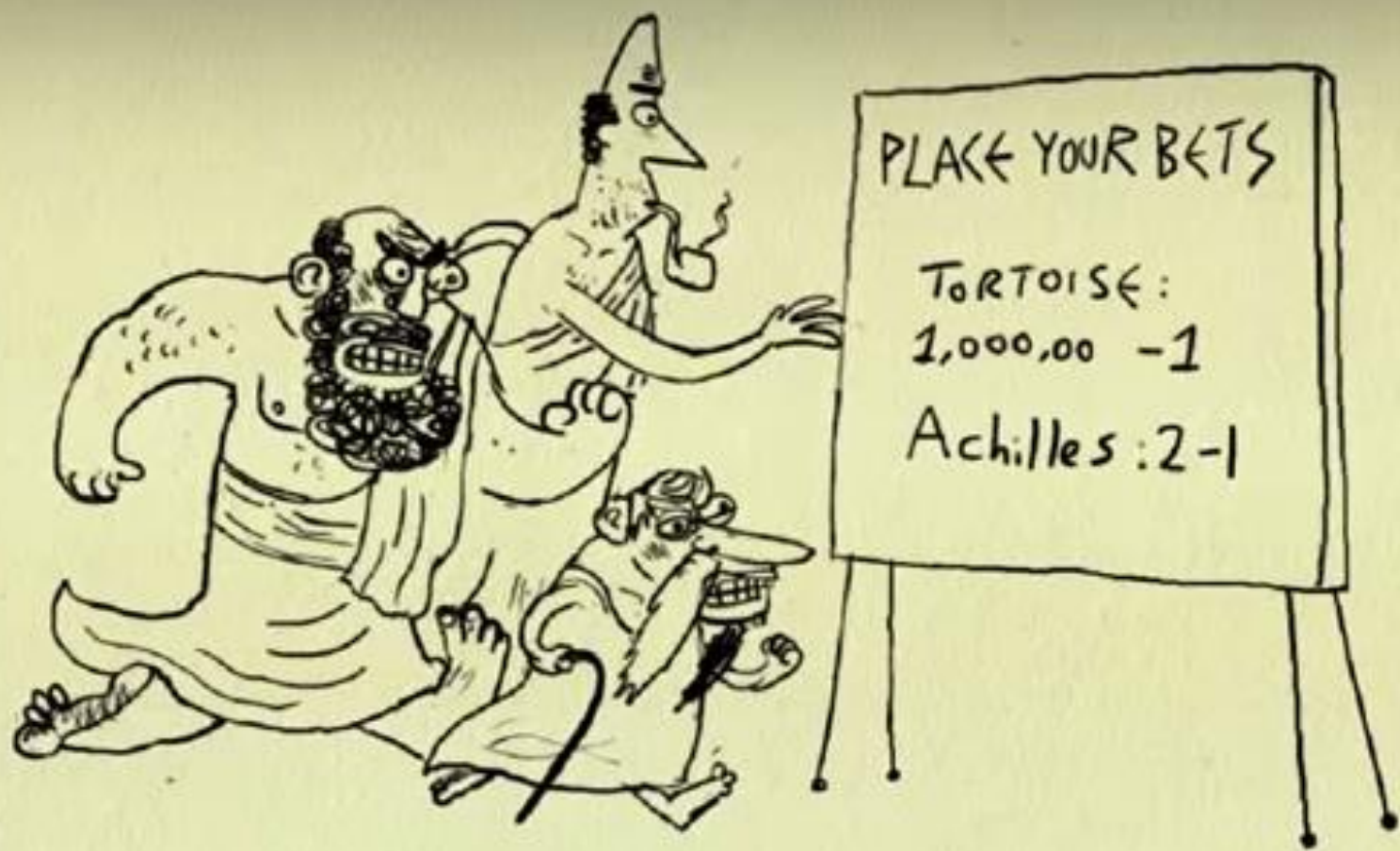
IOT DATA



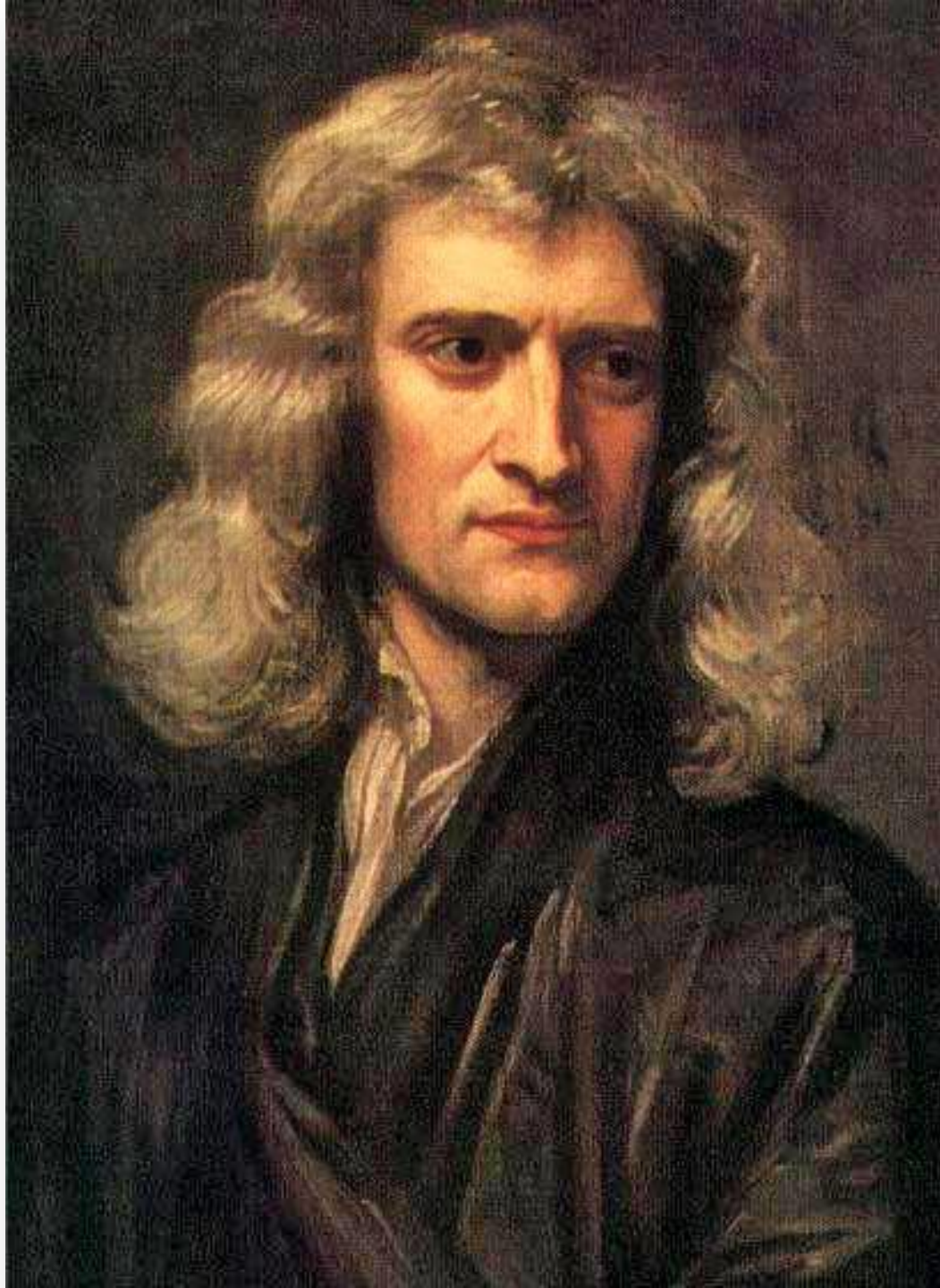
Fallacies

- It's Big
- It's Fast
- It's Time-Series
- It's Unstructured
- It's Write-heavy
- Consistency
- It's Mostly Useless





NB: movement IS possible



$$\begin{aligned}1 + r + r^2 + r^3 + \dots &= \lim_{n \rightarrow \infty} (1 + r + r^2 + \dots + r^n) \\ &= \lim_{n \rightarrow \infty} \frac{1 - r^{n+1}}{1 - r}\end{aligned}$$

Since $(1 + r + r^2 + \dots + r^n)(1 - r) = 1 - r^{n+1}$ and $r^{n+1} \rightarrow 0$ for $|r| < 1$.

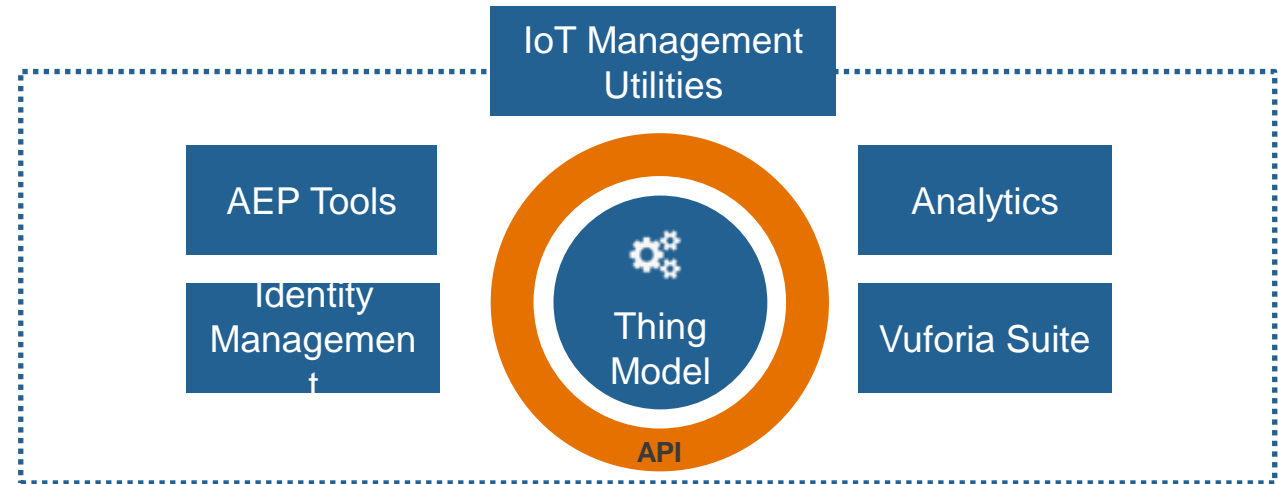
Our Customers



THE THINGWORX STACK



Customer Apps



ThingWorx Device Cloud

IaaS Device Cloud

Other Device Cloud



Edge Micro Server

AlwaysOn SDK

3rd Party Connectivity Libs

EDGE ANALYTICS

KepWare



I hope that clears things up.

- 1985 – still getting PCs to talk
- 2045 says “Get to work!”
- 2016 is the time to act!
- Model, Apps, Connectivity

O'REILLY®

Compliments of
ThingWorx

Foundational Elements of an IoT Solution

The Edge, The Cloud, and
Application Development



Joe Biron &
Jonathan Follett

BONUS TOPIC – BE LIKE JAMIE FROM MYTHBUSTERS



- How to use IoT Tools in a non-standard way



The image features several colorful geometric shapes, including triangles and lines in shades of blue, green, yellow, orange, pink, and purple, scattered across the background. A large, multi-colored geometric shape is prominent on the right side.

LIVE WORX 16™

TAKE A FRESH LOOK AT THINGS

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