

PTC® Live Global

PTC322 Understanding the Internet of Things (IoT) Solution Stack

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VP IoT Technology

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INTERNET
OF THINGS



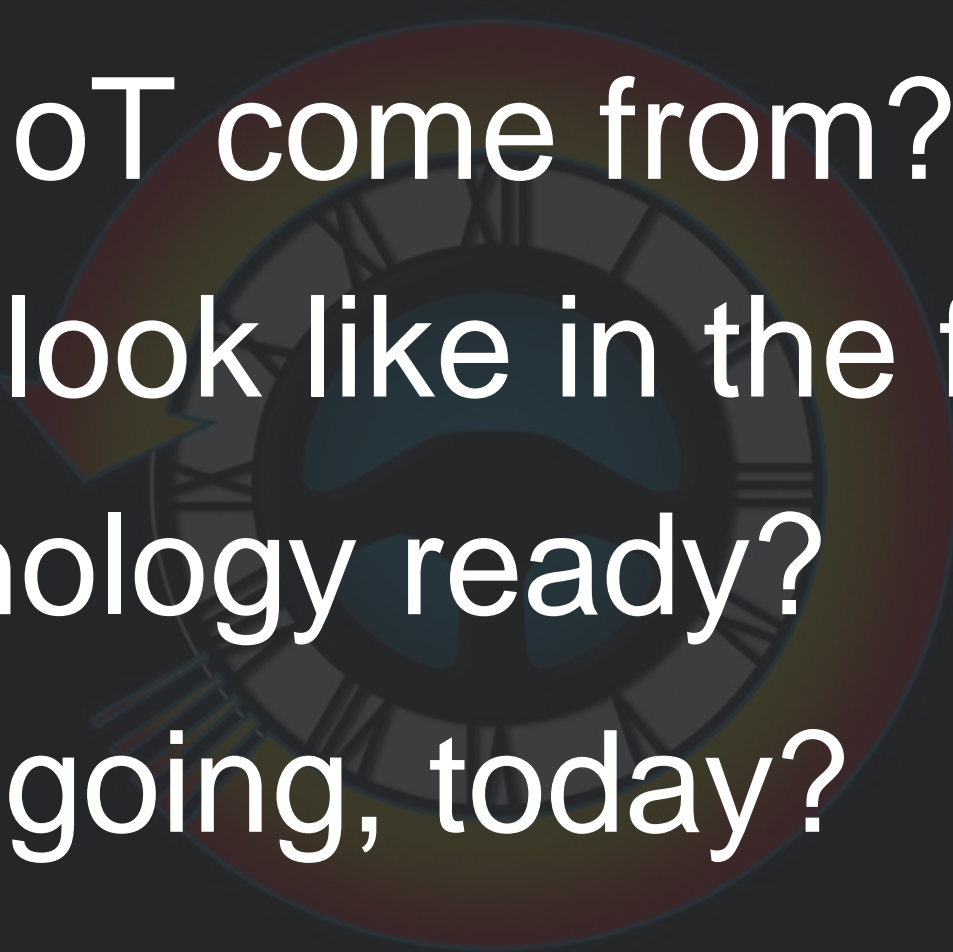
**NO BS
NO HYPE**

NO BS NO HYPE

NO BS NO HYPE

NO BS NO HYPE

NO BS NO HYPE

- 
- 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 · 2015 · 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 Context-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

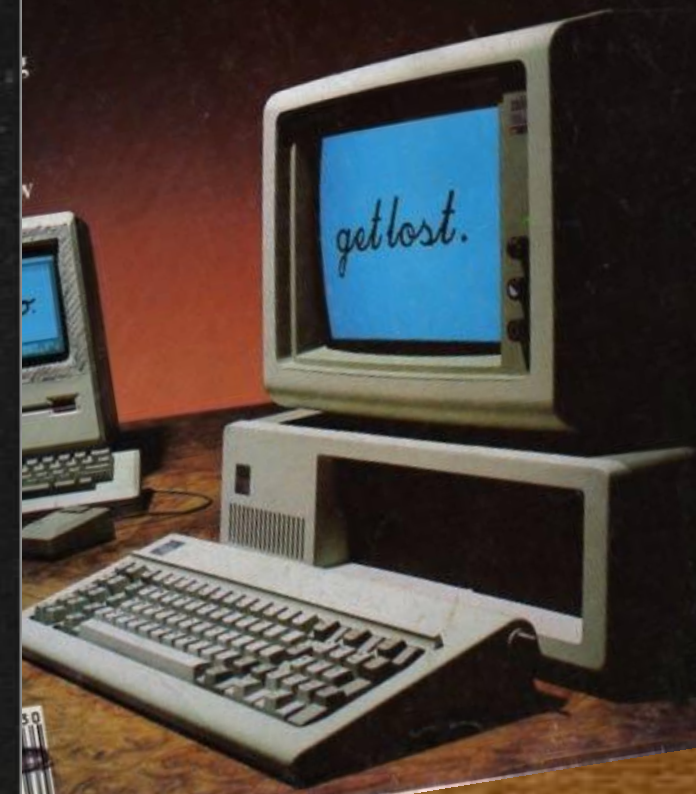
FACING UP TO AUTOMATION



TO IBM PERSONAL COMPUTERS

DATA
SECURITY
SCANDAL

BM vs. Apple
Is Mac Ready
For Business?



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 (28-1176) 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 101

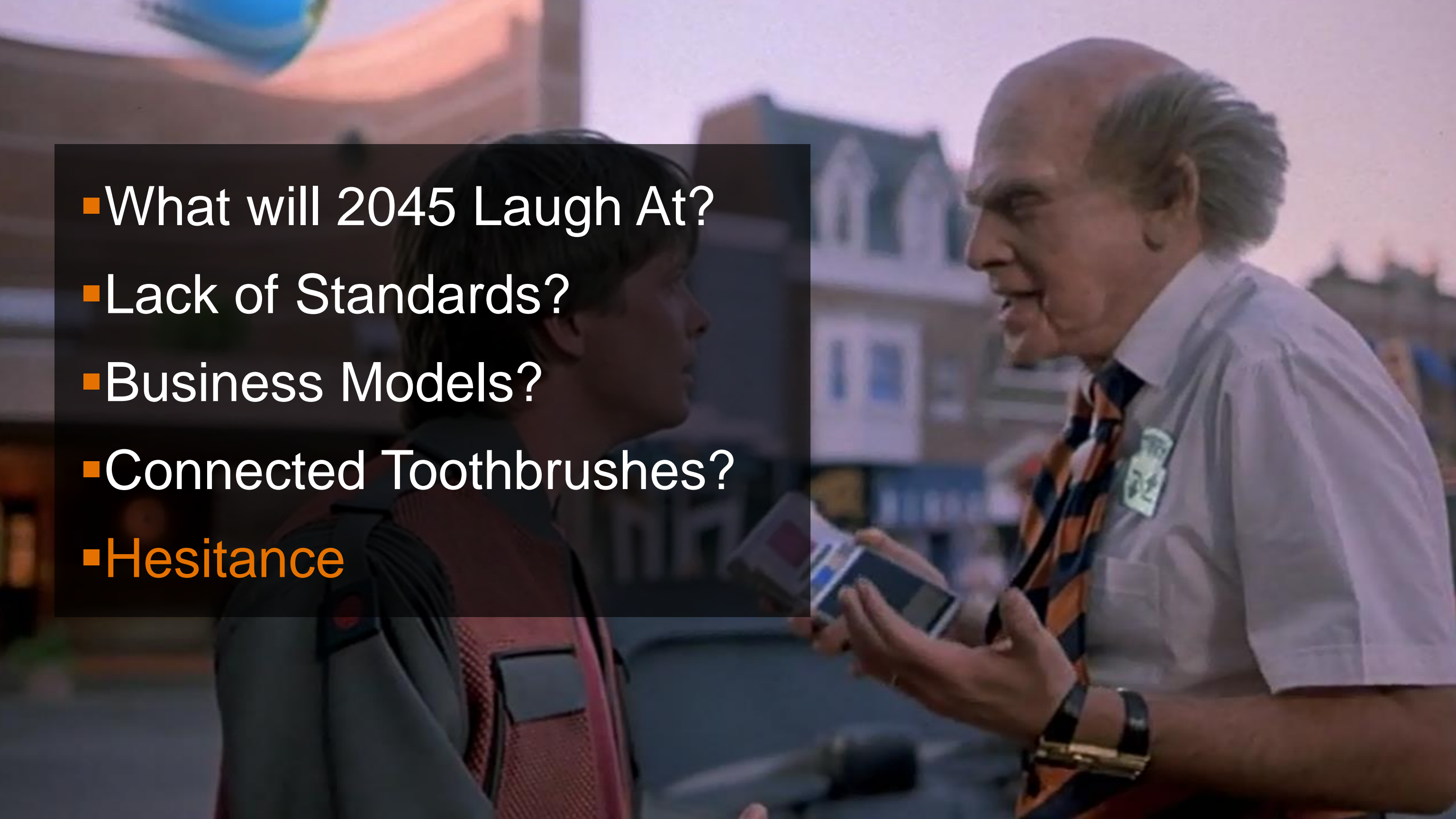


- 1985
- 1200 bits per second
- \$400 USD
- TTY
- Kermit
- BBS





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

- 
- A man in a white short-sleeved shirt and a striped tie is holding a smartphone and looking at it. He is wearing a name tag and a watch. He is talking to a woman in a red vest who is looking at the phone. The background is a blurred outdoor setting with buildings and a blue sky.
- 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



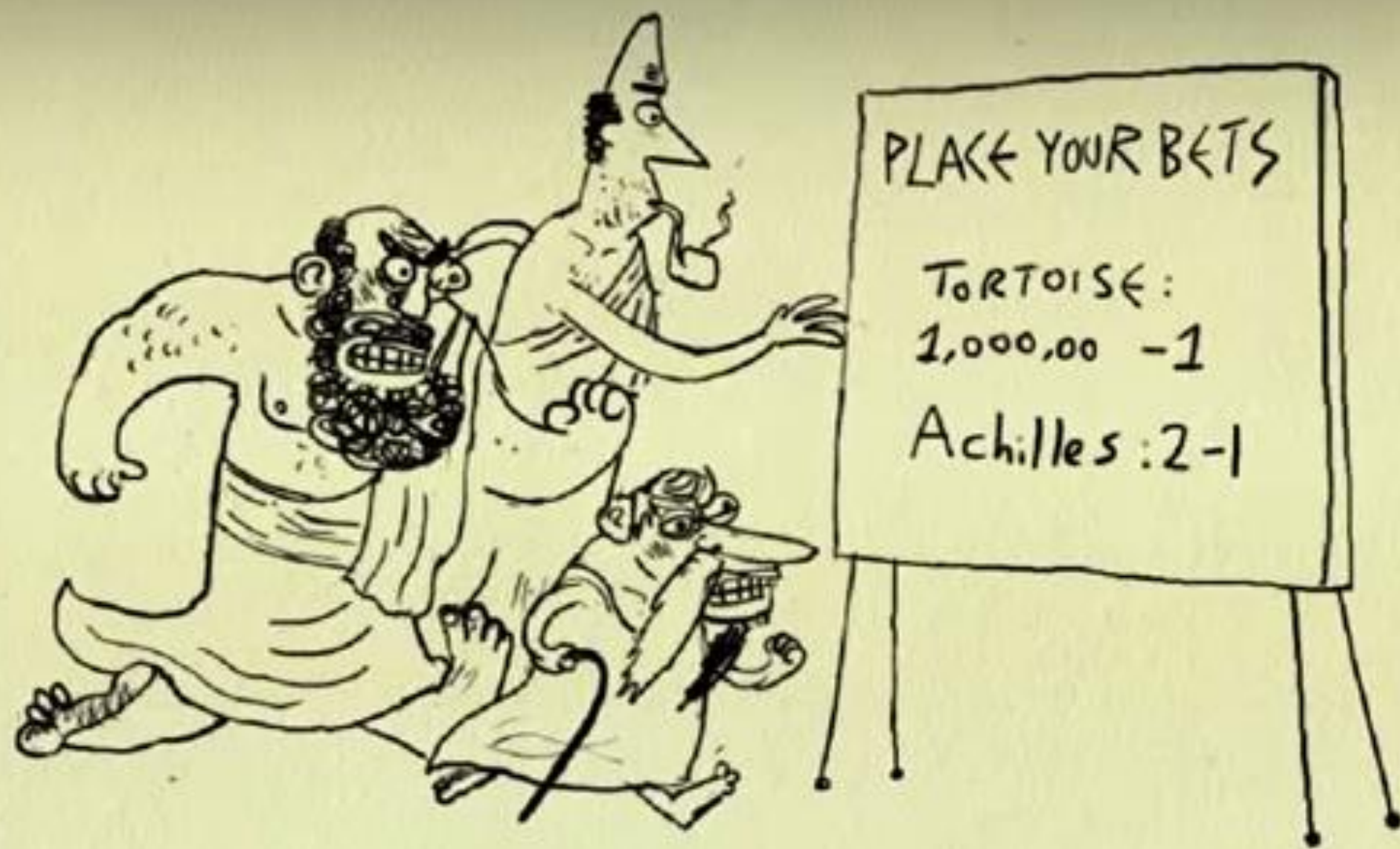
1. AACHILLE
& THE
TORTOISE



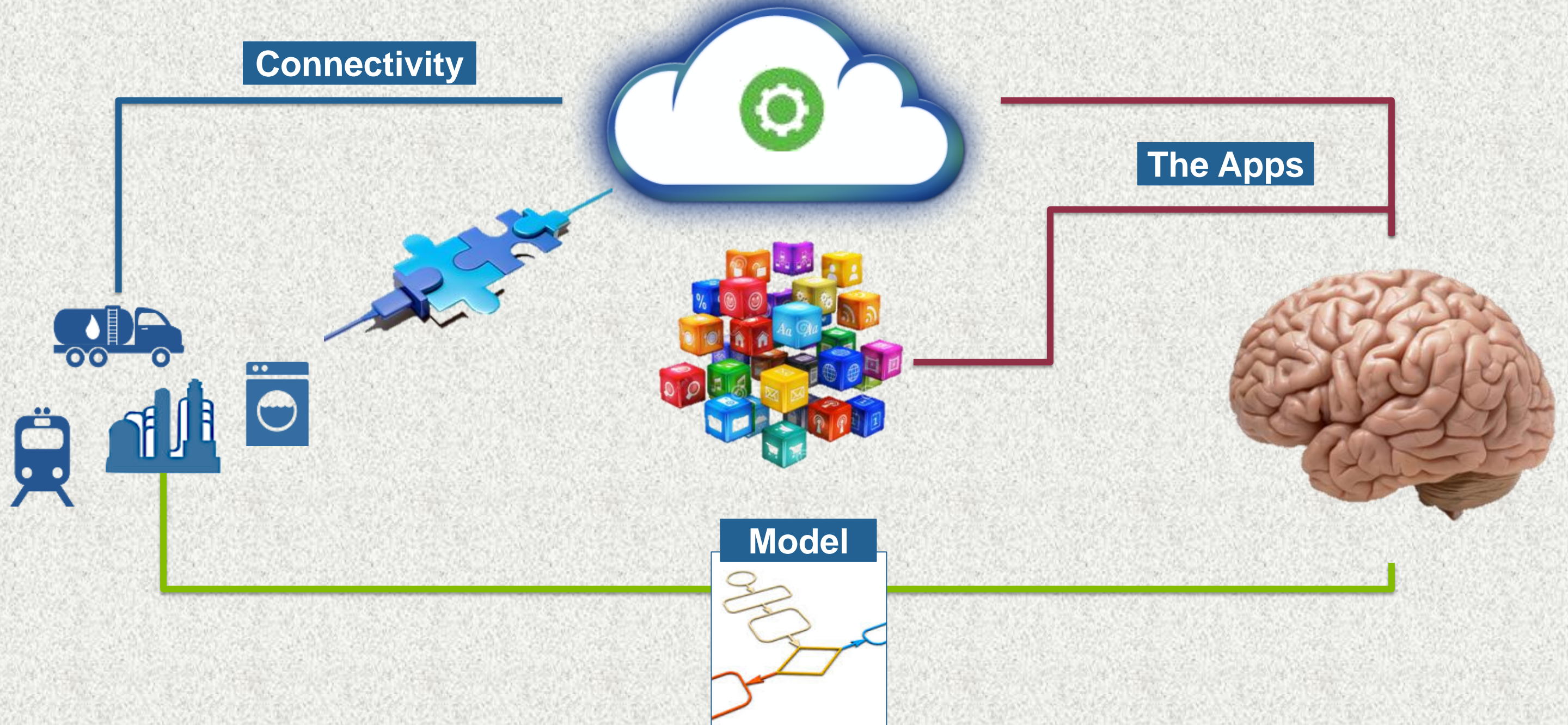


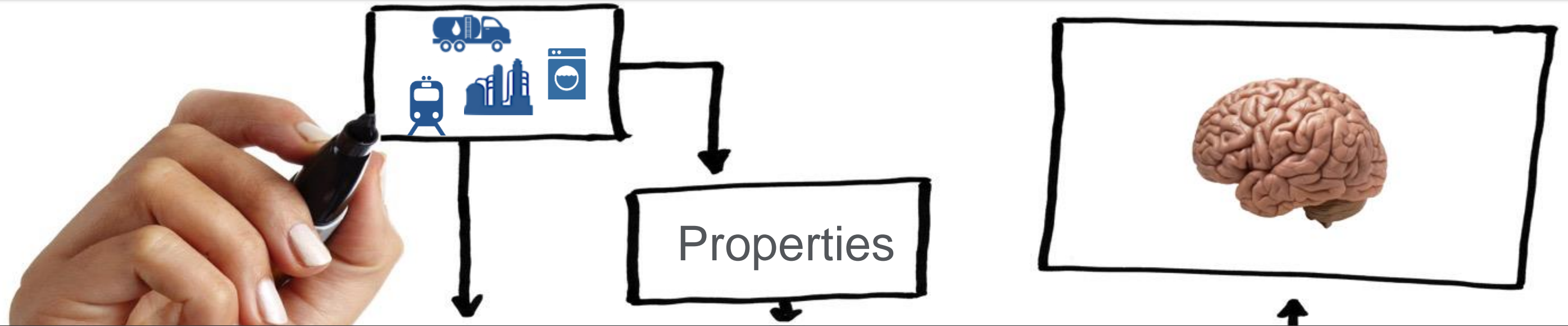
PLACE YOUR BETS
Tortoise: 2,000,00 - 1
Achilles: 2-1





NB: movement IS possible






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 DemoLaunch

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

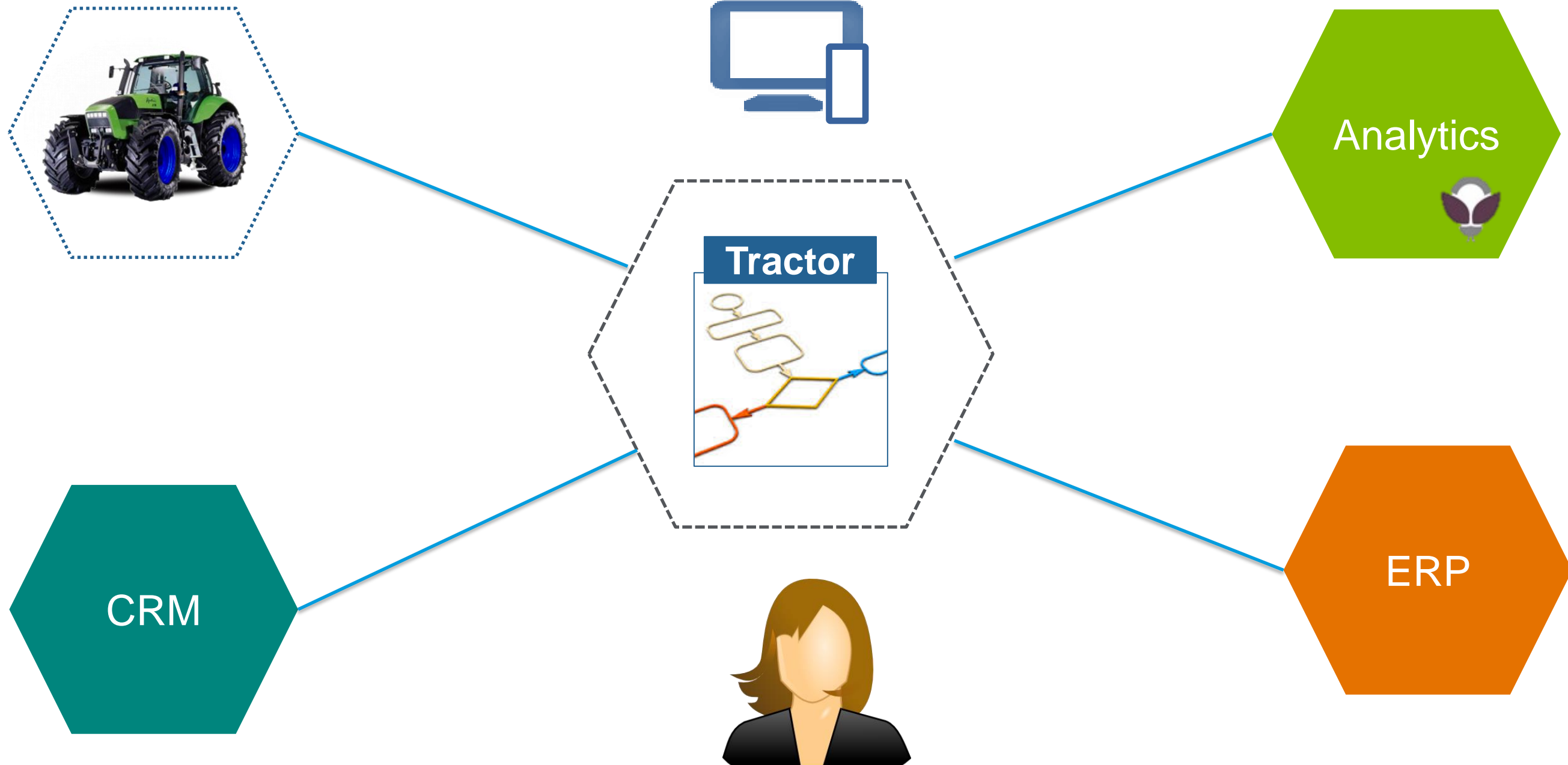
Properties Add My Property Edit Delete

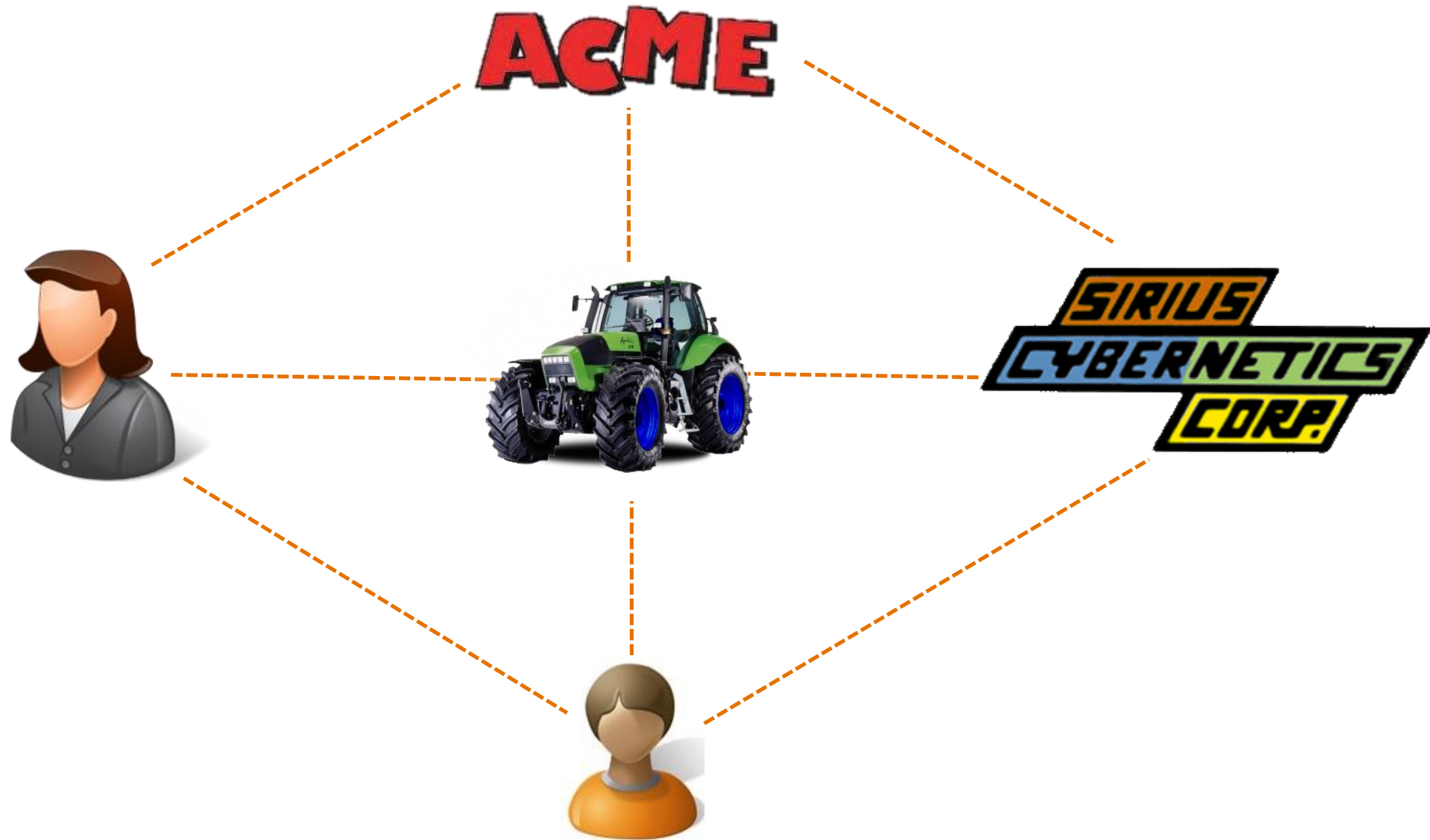
My Properties

<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 user interface for configuring a service. The top navigation bar includes the ThingWorx logo, a search bar, and menu items for 'New Entity', 'Import/Export', 'Monitoring', 'Help', and the user 'JoeB'. Below the navigation bar, there are tabs for 'ConnectedTractor.Tractor' and 'DemoLaunch'. The main content area is titled 'Services' and features a table of 'My Services'. The selected service is 'GetMaintenanceBlogEntries', which is a 'Local (JavaScript)' service with inputs for '-T- Search', '-T- Blog', and '# MaxBlogEntries', and an output named 'result'. The configuration panel for this service is open, showing the 'Inputs/Outputs' tab. The 'Inputs' section lists the three input parameters with their names and actions. The 'Outputs' section shows the output name 'result'. To the right, the 'Script' editor contains 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
```

At the bottom of the configuration panel, there are buttons for 'Cancel', 'Done', and 'Save Entity'.

Unlocking the Value in the Internet of Things



1B

2015




2020

2045

The screenshot displays the ThingWorx RPA interface for a 'TrackTrace.Plant' mashup. The interface includes a top navigation bar with 'New Entity', 'Import/Export', 'Monitoring', and 'Help' options. The main workspace is divided into several sections:

- Left Panel:** A 'Widgets' sidebar with a search bar and a list of widget categories including 'Auto Refresh', 'Blog', 'Button', 'Carousel', 'Checkbox', 'Contained Mashup', 'D3Network', 'D3Tree', 'Dashboard', and 'Data Export'. Below this is a 'Mashup' properties table.
- Top Bar:** Contains 'Design', 'Info', 'View Mashup', 'Save', and 'Cancel Edit' buttons, along with 'Preview', 'Available Space', and 'Default Language' options.
- Main Dashboard:** Features a map of North America, a 'Plant Address' (4362 Mainland Blvd, Cincinnati, OH 38921), 'Plant Manager' contact info, and four 'Gauge' widgets. It also includes a 'Spotlight Line' with a 'Pause' button and a 'Next Refresh Now' button. At the bottom, there are progress bars for 'Shift Progress: 0' and 'Uptime: 0', and a 'Time Series Chart'.
- Right Panel:** A 'Data' table with columns for 'Name' and 'Value'. Above the table is a list of data services and properties, such as 'EntityName', 'GetProperties', 'TogglePlayButton', 'GetPlantManagerDetails', 'GetNextSpotLightProductionLine', 'GetEfficiencyNumbers', and 'DynamicThingTemplates_AcmeTractor...'. Below the table is a 'Connections' section showing a flow diagram with nodes like 'DynamicThingTemplates_AcmeTr...', 'AutoRefresh', 'Mashup', 'Loaded', 'TogglePlayButton', 'All Data', 'GetProperties', and 'DynamicThingTemplates_AcmeTr...'.

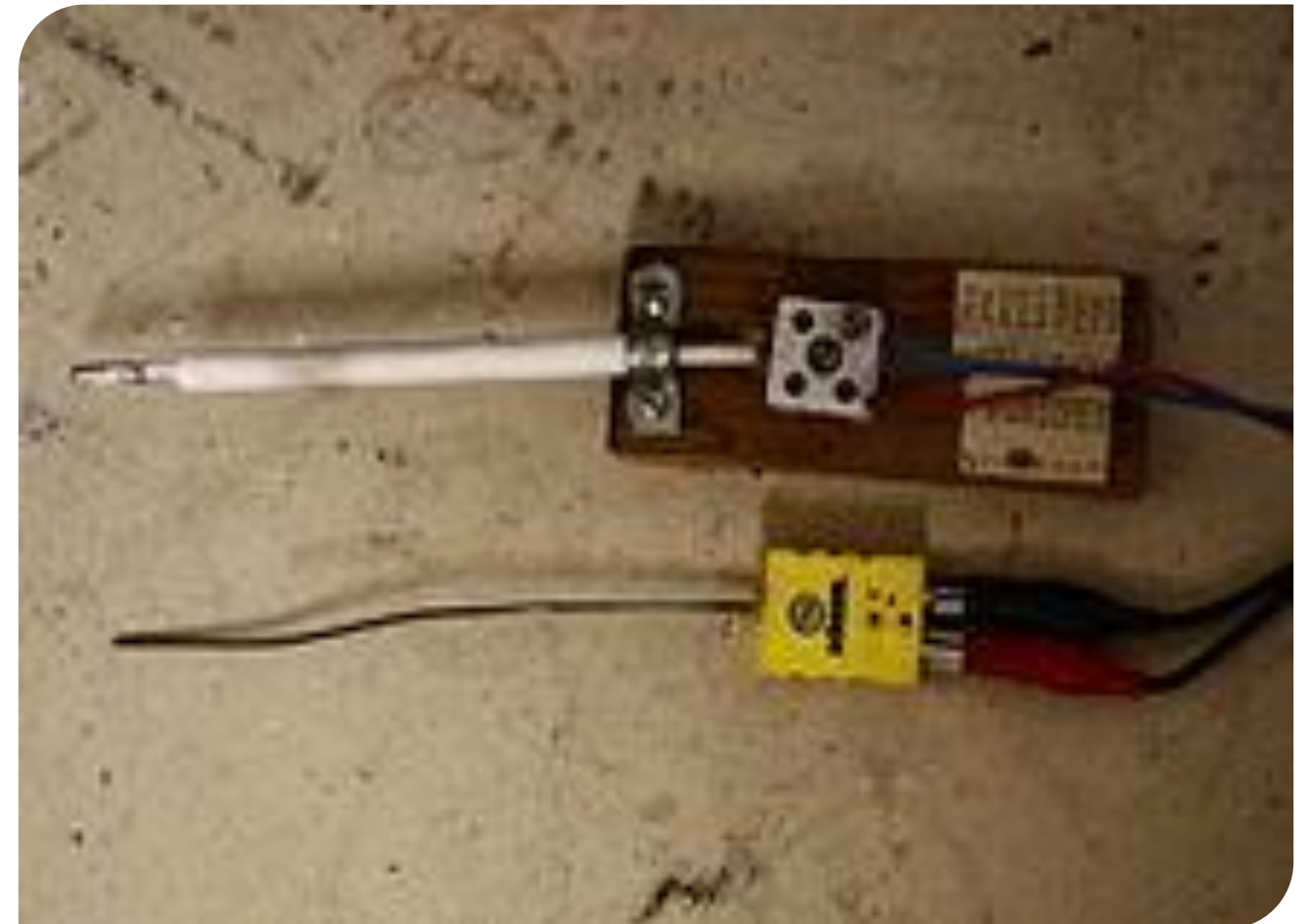


Edge Architecture The Network Cloud Services



Key Terms

- 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
- Files
- Firmware



Short Haul (southbound)

- Communication over short distances
- Things that are proximate
- Hardwired
- Serial / Modbus
- LAN cables
- Bluetooth
- Zigbee
- MQTT
- J19 bus, CAN bus, OBD
- NOT THE INTERNET. NOT CELLULAR.

Long Haul (northbound)

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



World Class Standards



OPEN
INTERCONNECT
CONSORTIUMSM



I E T F

nest[®]



HomeKit



oma
Open Mobile Alliance
For a Connected World



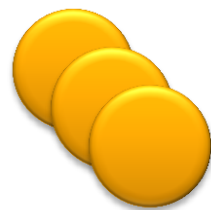
XMPP

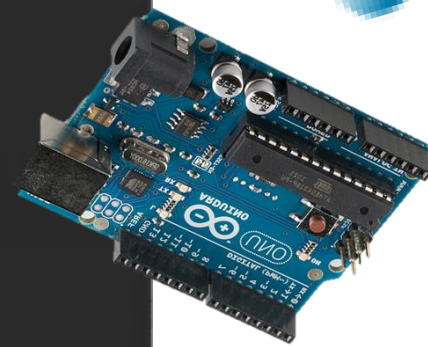
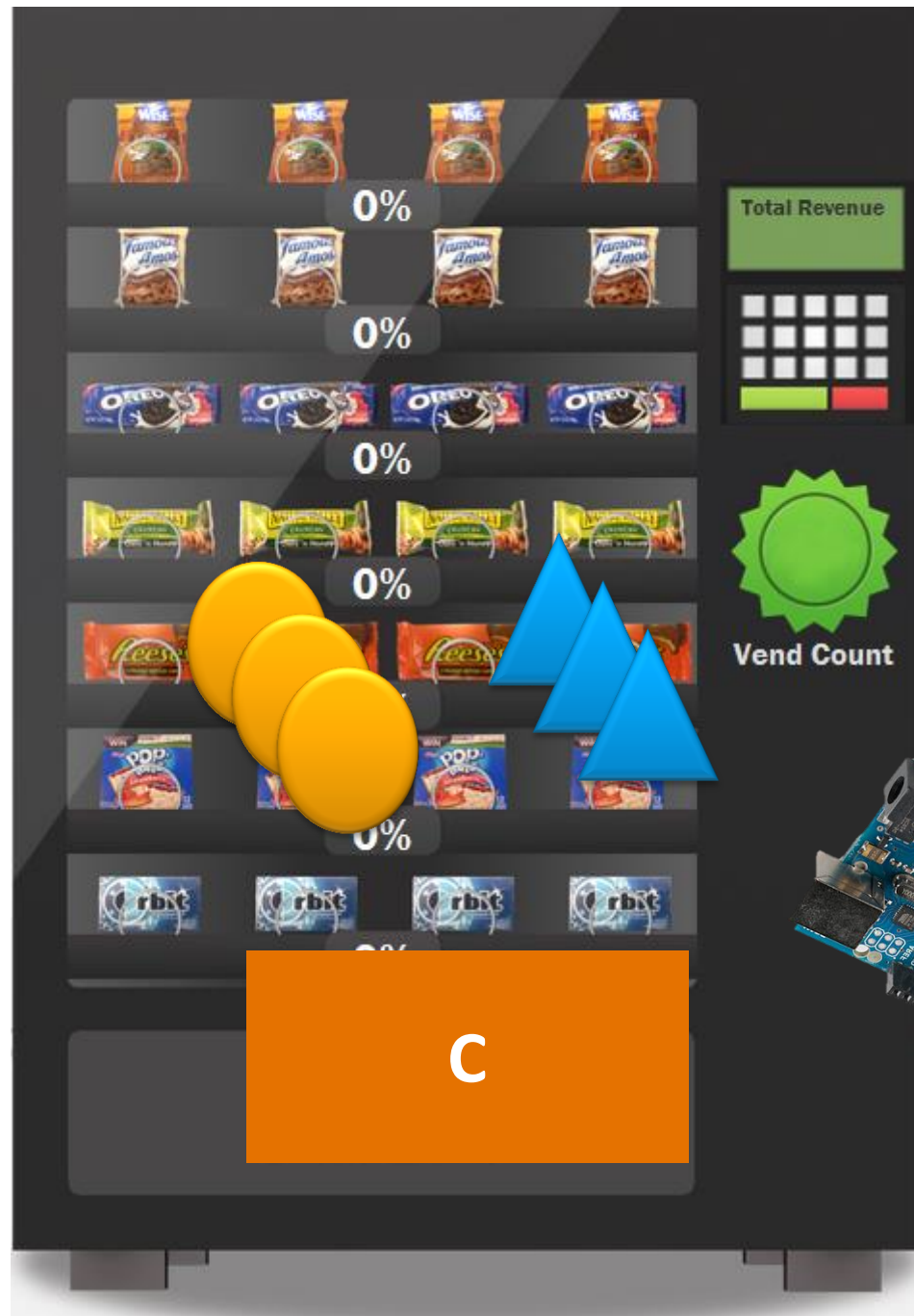
Long-Haul Comm

Agent

Controller

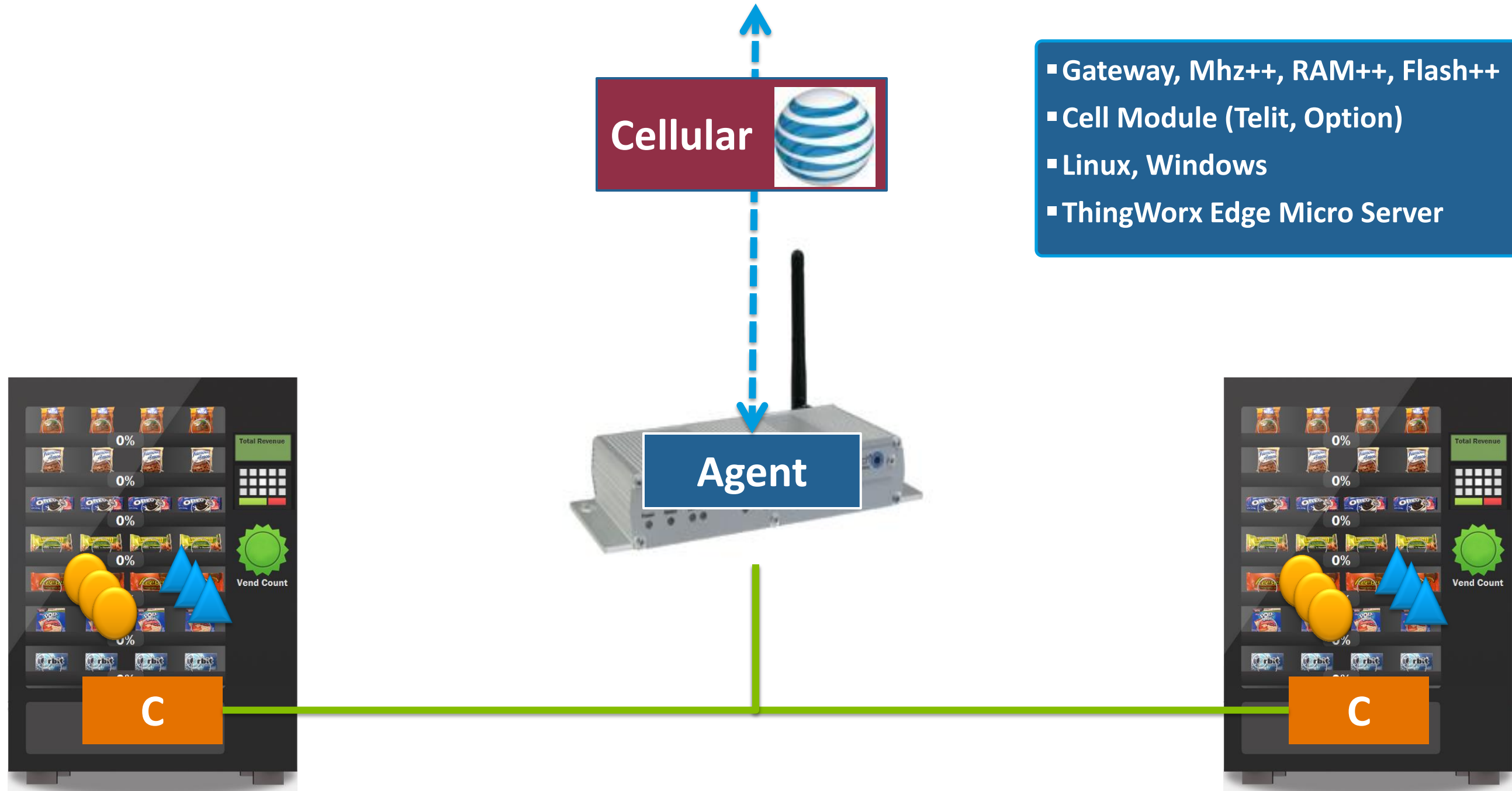
Thing





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

- Gateway, Mhz++, RAM++, Flash++
- Cell Module (Telit, Option)
- Linux, Windows
- ThingWorx Edge Micro Server





Executive team

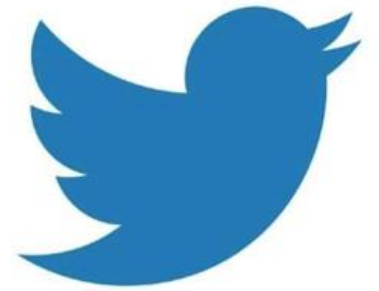
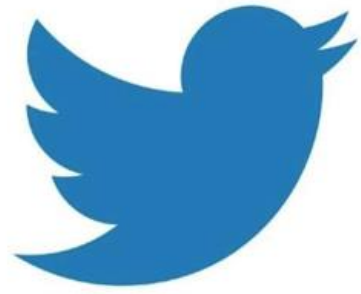
Milestones

Open Source

Our mission: To give everyone the power to share their ideas and 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



It's Not Just Web and Mobile Ingress/Egress

Not just users to authenticate!

Low Power Devices cannot forego transport encryption

Physically secure the honeypots

Use secure boot, root-of-trust, and TPM

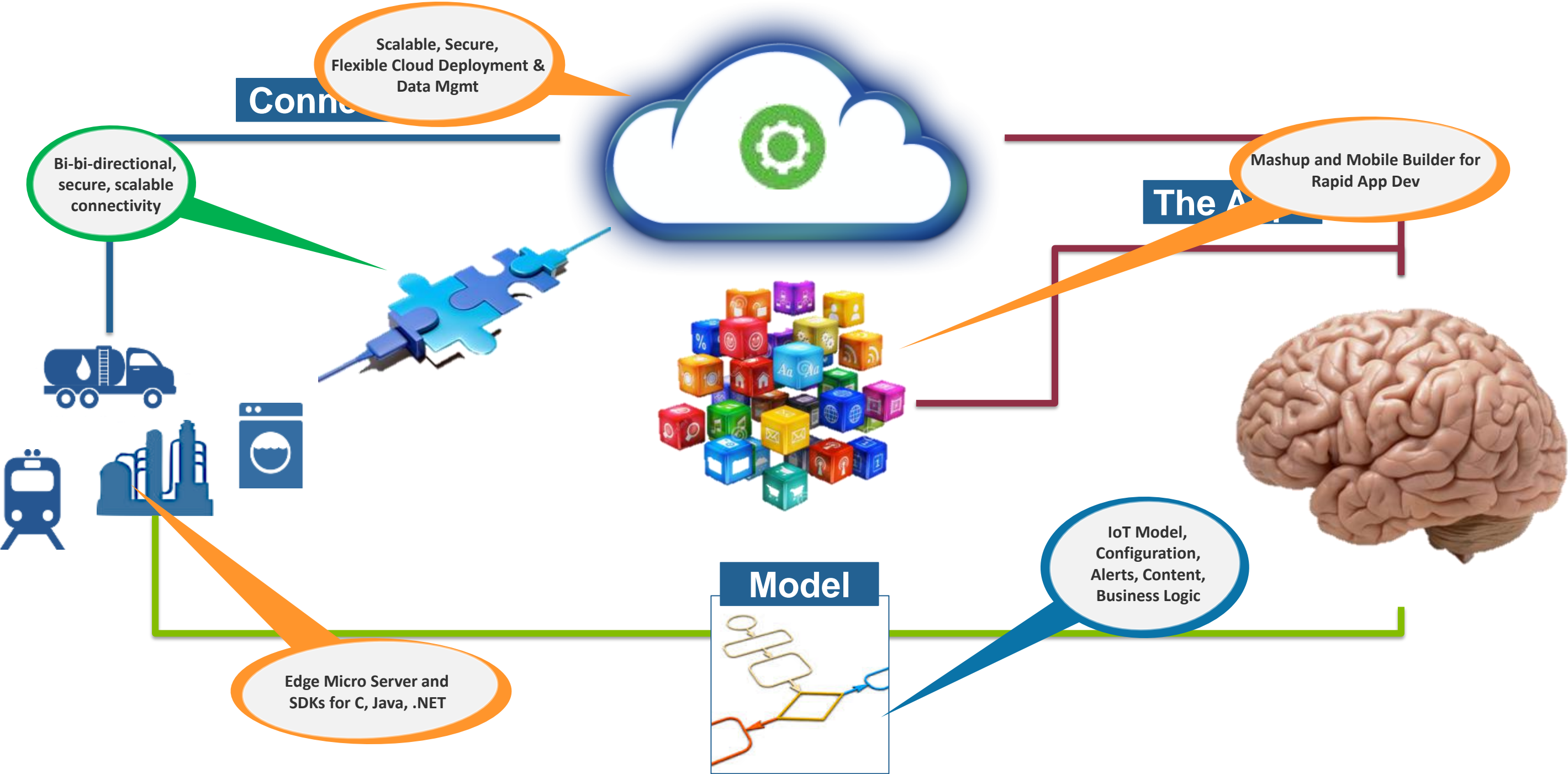
Data privacy and <gulp> governance

	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



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OS	Windows 95	Wind River Linux
Secure boot?	No	Yes
Remote Update Capable?	Yes	No





Applications



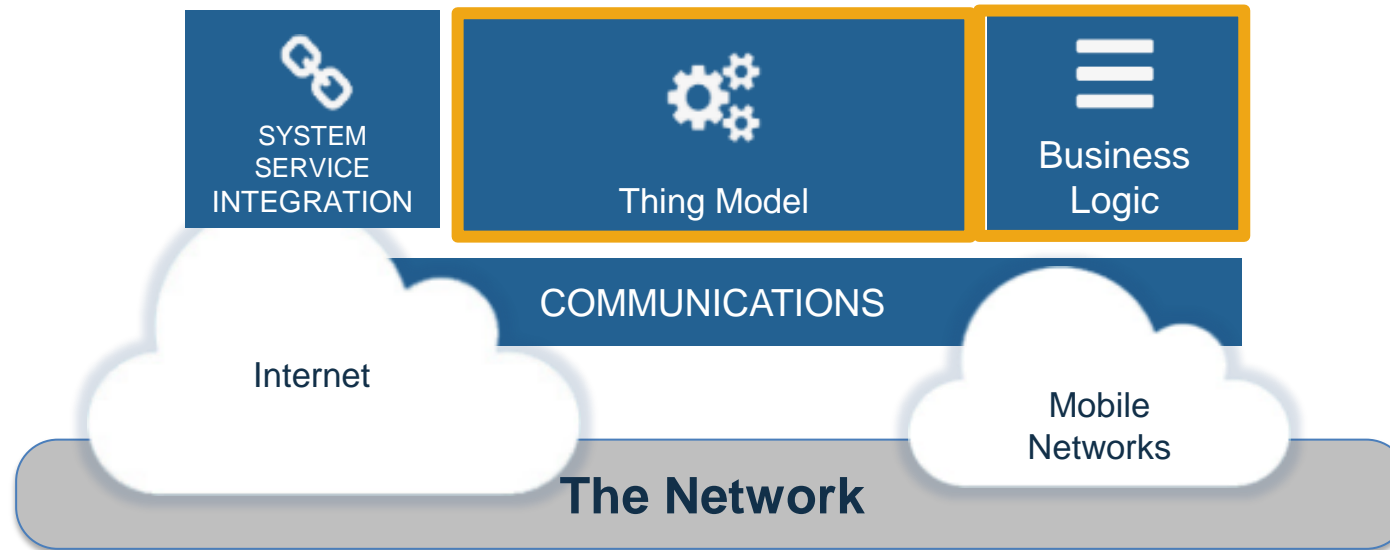
CLOUD SERVICES

Application Enablement



BUSINESS ENTERPRISE SYSTEMS

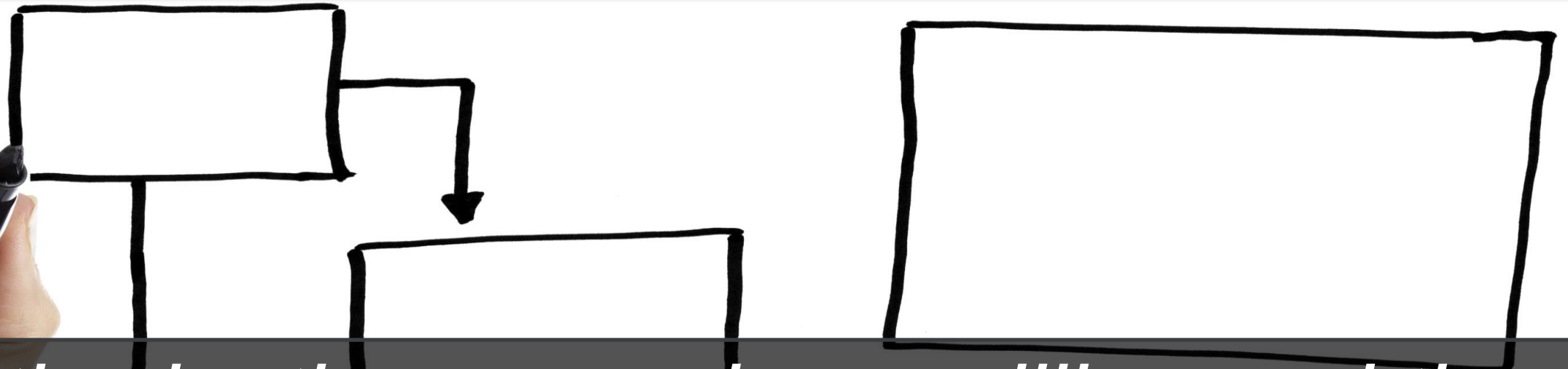
Communications Elements



BIG DATA ANALYTICS

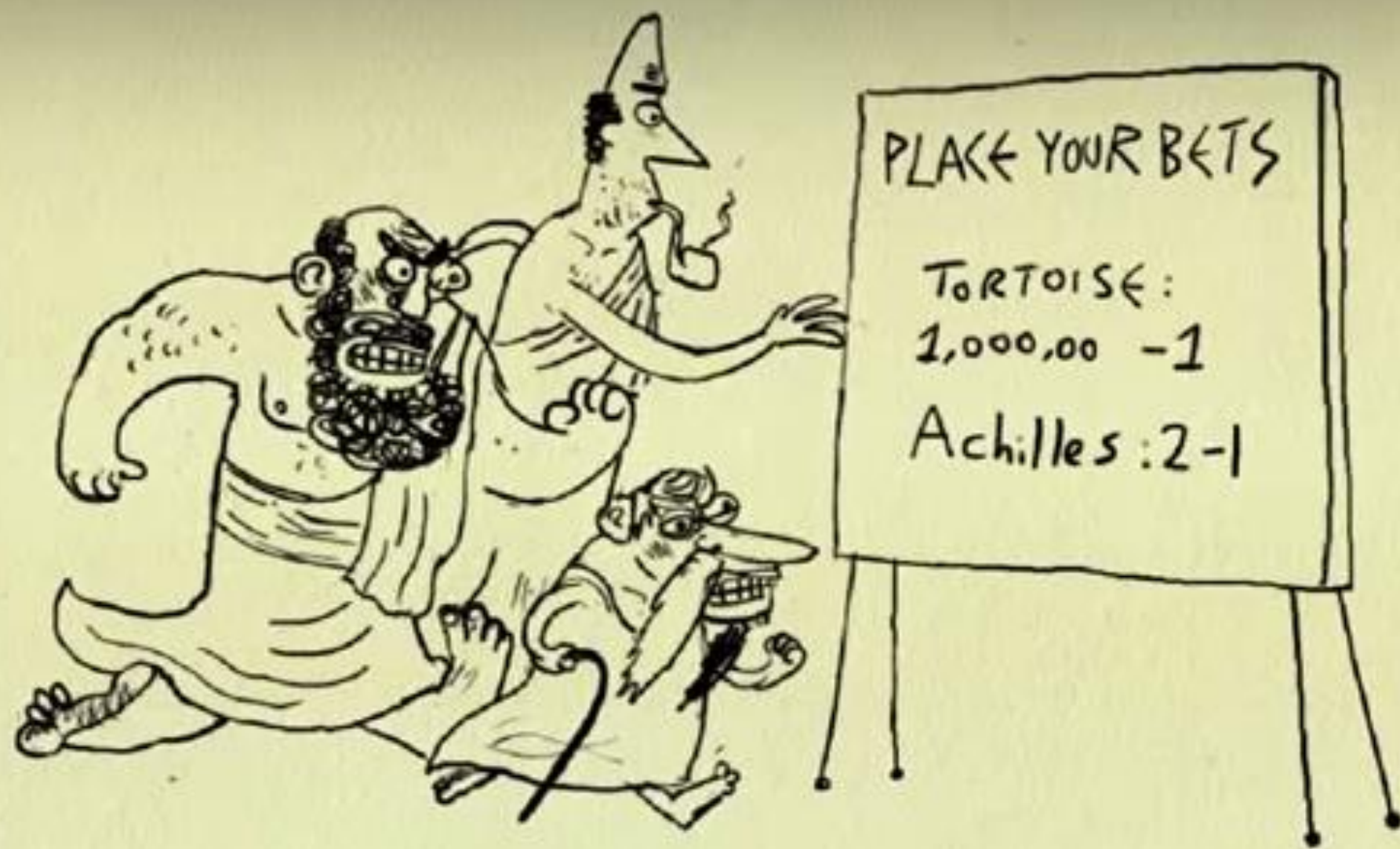
Sensors, Devices & Equipment



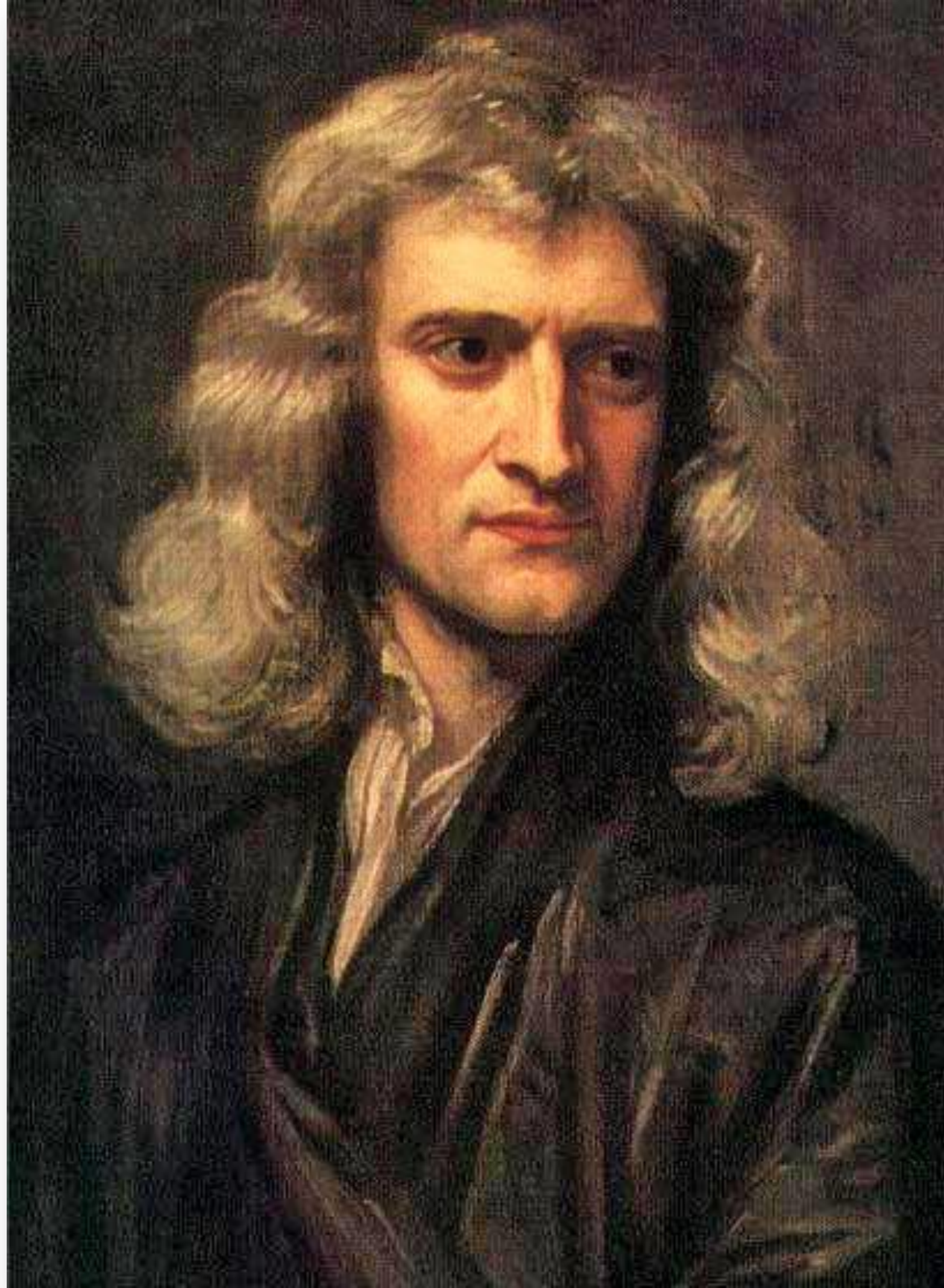


As to the methods, there may be a million and then some, but principles are few. The man who grasps principles can select his own methods. The man who tries methods, ignoring principles, is sure to have trouble.

-- RALPH WALDO EMERSON



NB: movement IS possible



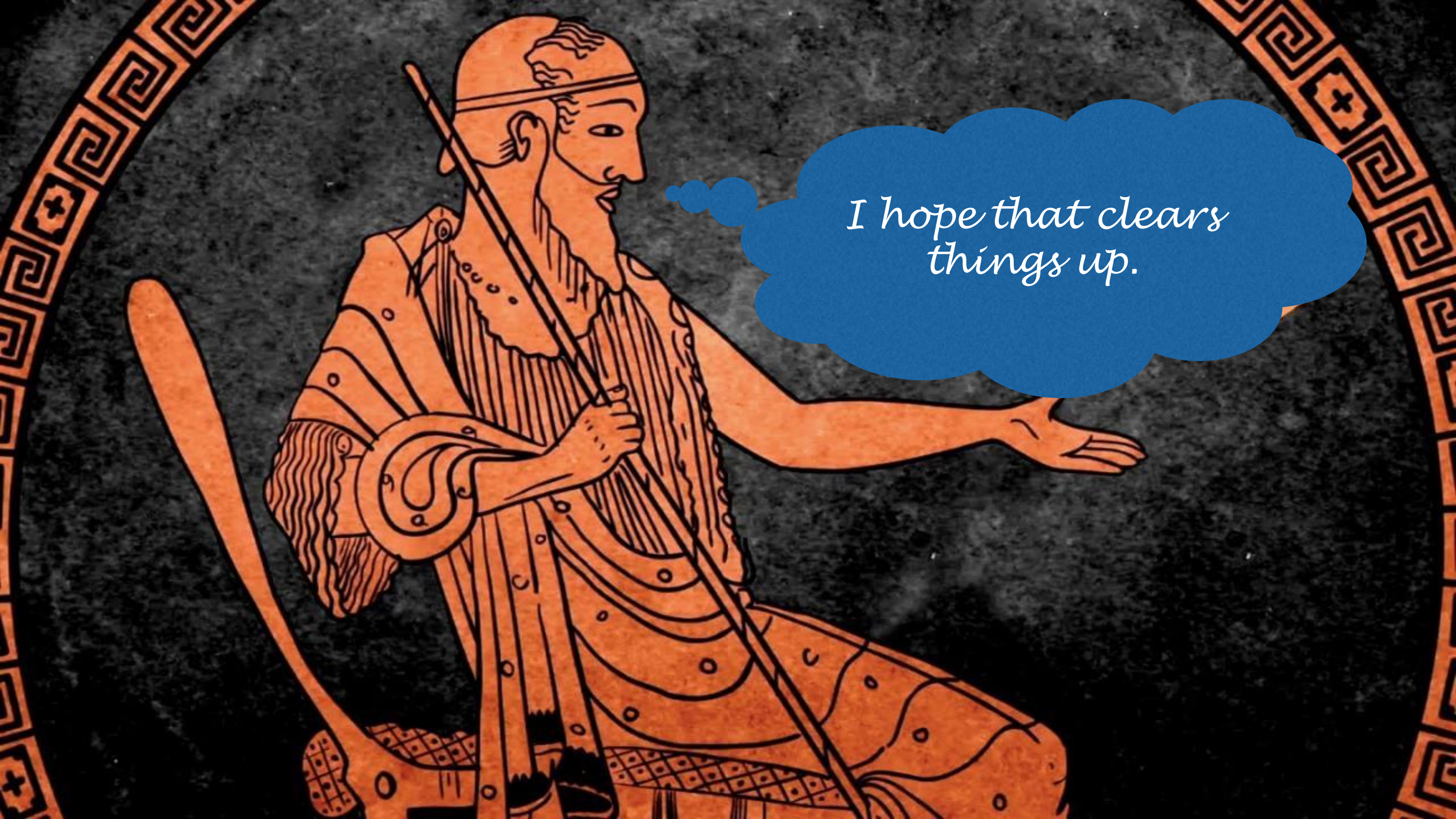
$$\begin{aligned}1 + r + r^2 + r^3 + \dots &= \lim_{n \rightarrow \infty} (1 + r + r^2 + \dots + r^n) \\ &= \lim_{n \rightarrow \infty} \frac{1 - r^{n+1}}{1 - r}\end{aligned}$$

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

They all overtook the tortoise





I hope that clears things up.

- 1985 – still getting PCs to talk
- 2045 says “Get to work!”
- 2015 is the time to act!
- Model, Apps, Connectivity

Joe Biron
VP IoT Technology

Thank You!

- Your feedback is valuable
- Don't miss out on the chance to provide your feedback
- Gain a chance to win an instant prize!
- Complete your session evaluation now



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