



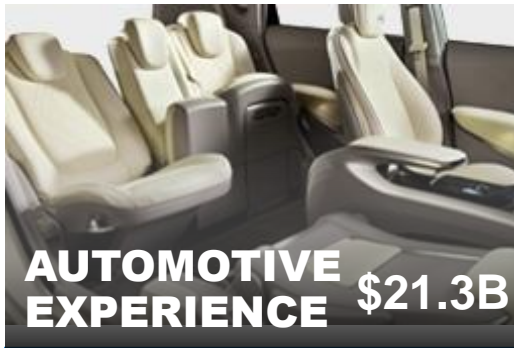
Towards Self-Conscious Buildings through connected products

Oct. 27th 2015



Building Efficiency

Part of a \$42B world-class organization – Johnson Controls



Supplying interiors to more than 30 million cars per year



Producing 130 million vehicle batteries annually



Optimizing building environments for more than 1 million customers

You may know us for ...

Part of a \$42B world-class organization – Johnson Controls

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Controls**



**Johnson
Controls**

**Johnson
Controls**

Including nearly 90% of the world's tallest buildings

Burj Khalifa
Dubai

Taipei 101
Taipei

International Commerce Center
Hong Kong

Greenland Financial Complex
Nanjing, China

International Finance Center
Guangzhou, China

Princess Tower
Dubai

Two International Finance Centre
Hong Kong

Makkah Royal Clock Tower
Saudi Arabia

Shanghai World Financial Center
Shanghai

Petronas Towers
Kuala Lumpur

Willis Tower
Chicago

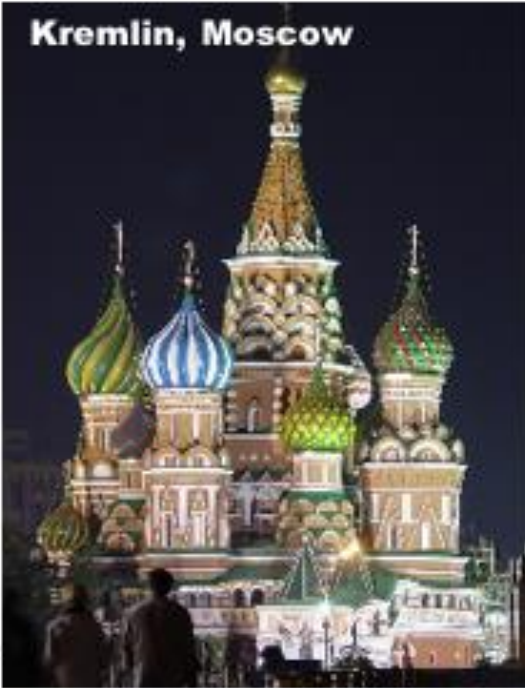
Trump Tower
Chicago

Al Hamra Tower
Kuwait



And some of the most iconic spaces and places

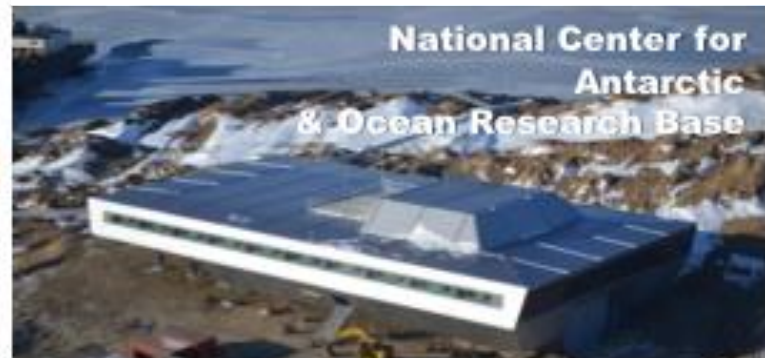
Kremlin, Moscow



**Holy Mosque
In Makkah**



**National Center for
Antarctic
& Ocean Research Base**



**The
Empire
State
Building**



**The National Stadium,
Beijing "Bird's Nest"**



**US,
French
& British Naval
Vessels**



**England/France
Trans-Channel Tunnel**



We create efficiency for the life of buildings



A historical note on the IoT

1999 - A big year for the IoT and MIT

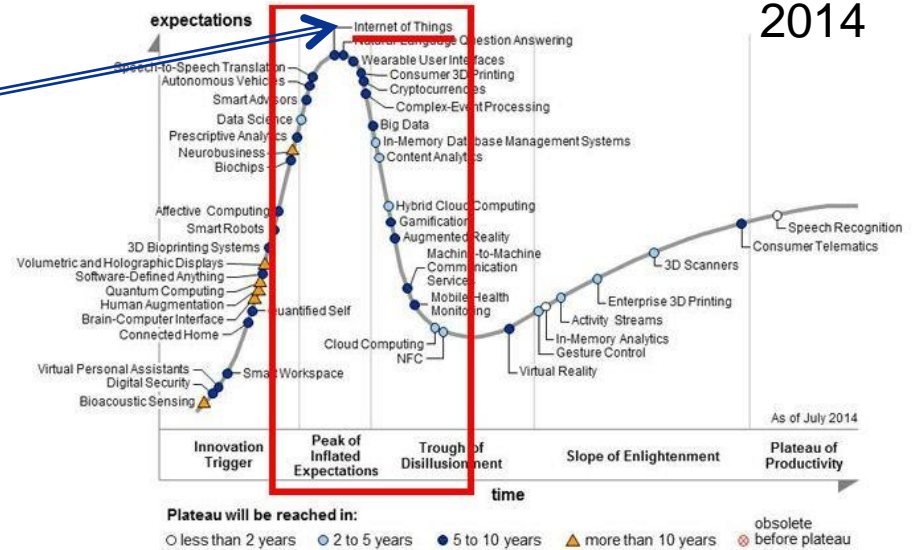
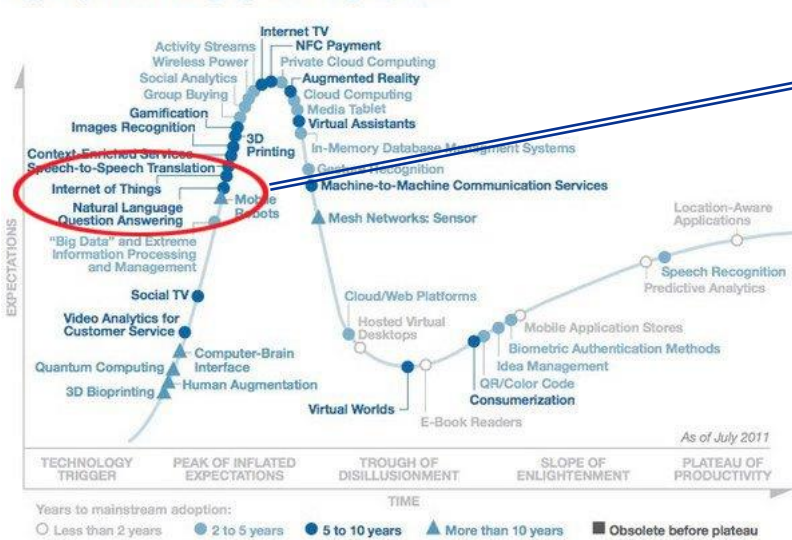


Credit: RFID Journal

The Internet of Things term is coined by **Kevin Ashton** executive director of the **Auto-ID Center**:

"I could be wrong, but I'm fairly sure the phrase "Internet of Things" started life as the title of a presentation I made at Procter & Gamble (P&G) in 1999. Linking the new idea of RFID in P&G's supply chain to the then-red-hot topic of the Internet was more than just a good way to get executive attention. It summed up an important insight which is still often misunderstood." - [Full article](#)

Hype Cycle for Emerging Technologies, 2011





Marc Andreessen ✓
@pmarca

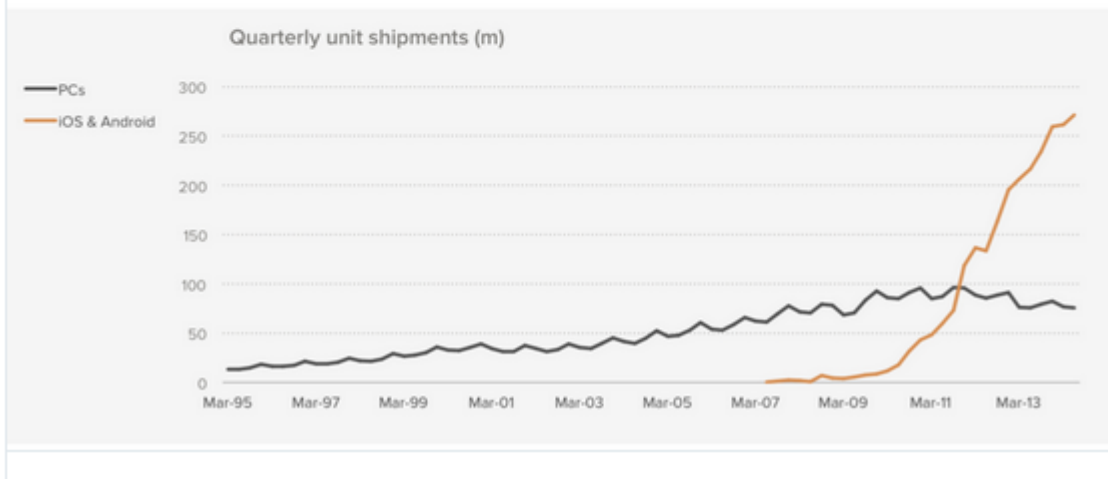


Following

The peace dividend from the smartphone wars = amazing sledgehammer impact on hardware supply chain: [ben-evans.com/benedictevans/...](http://ben-evans.com/benedictevans/)

The smartphone industry dwarfs PCs

4bn people buying phones every 2 years instead of 1.6bn buying PCs every 5 years



Connectivity is table-stakes now, but is it a box to be checked or a way to create value?

<https://twitter.com/pmarca/status/562149152948113408>

Role of Connectivity in Enabling New Business Models

- Provide product differentiation as we know more on how customers use products
- Broaden the value proposition beyond the physical product – include valuable data and value-added services
- Allow us to develop closer relationships with customers and contractors
- Accelerate adoption of customer support and merchant services

Products connect to ???

- Product to Infrastructure
 - Building structure integrity data aggregator (e.g., a gateway) talks to infrastructure
- Product to Environment
- Product to Human
 - Adjust airflow for person X
 - Thermostat talks to occupant
- Product to OEM and/or service provider
- Product to Enterprise
- Product to Product (within the same industry)
 - E.g., BAS Controller talks to other BAS controller
- Product to other internet connected products from X (across industries)
 - A building automation gateway offers data brokerage service to personal health insurance industry, assisted living care provider, and remote security monitoring service provider.

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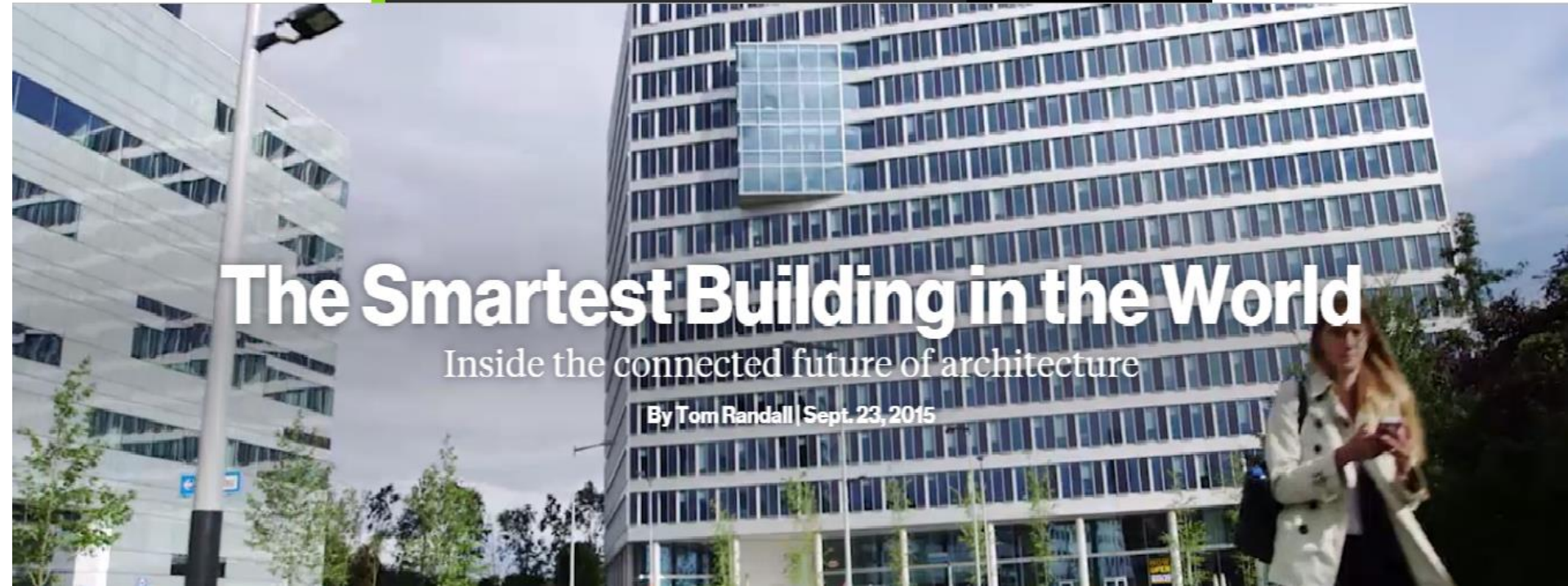
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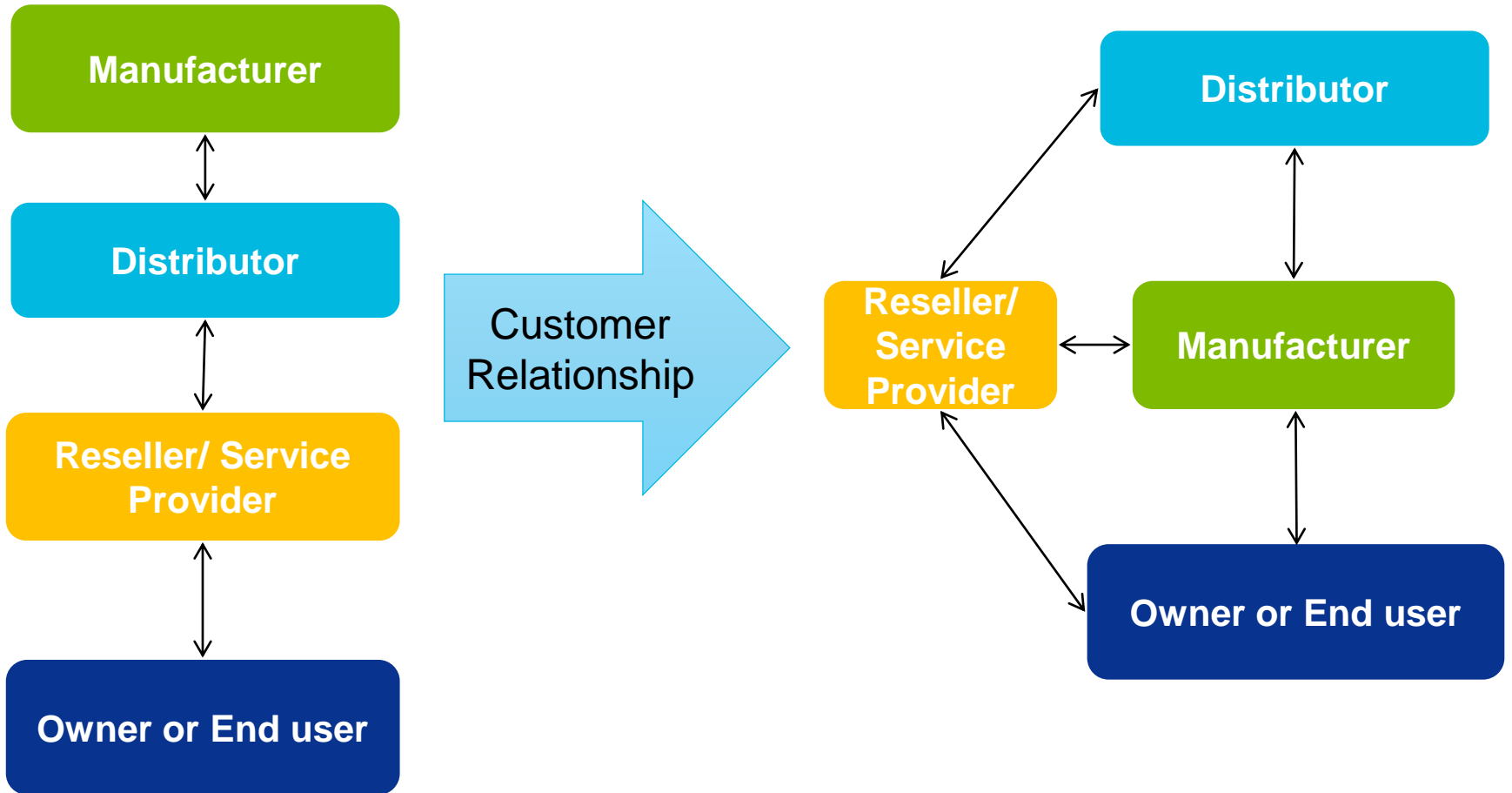
The Smartest Building in the World

Inside the connected future of architecture

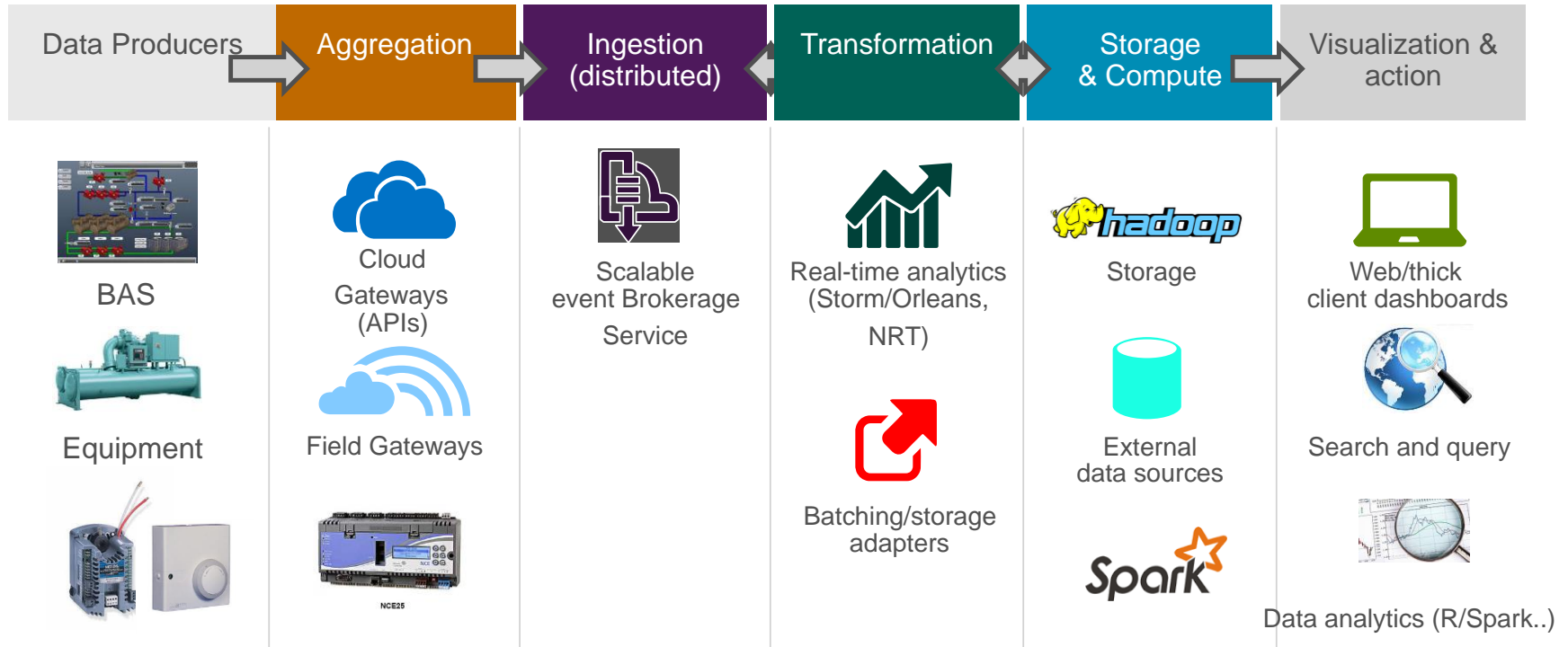
By Tom Randall | Sept. 23, 2015



Connected product will change



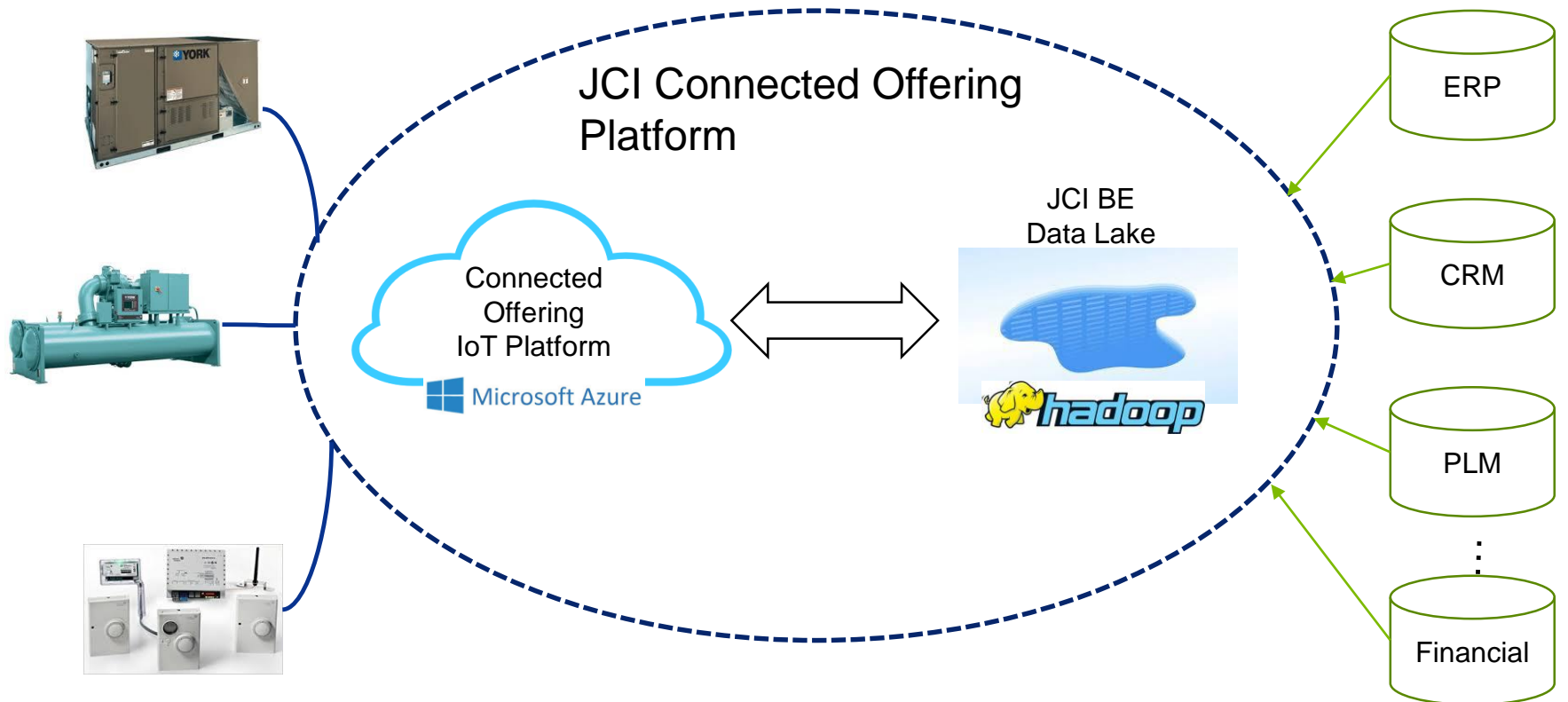
Architecture (Current JCI's IoB technology stack)



Connected Offering Platform, 1.0

OT (Operational Technology)

IT (Information Technology)



Things I'm not going to talk about

- Use of IoT in our manufacturing enterprise
- “IT” data ingestion – streaming data of database changes
- In-depth algorithms we use for fault detection on mechanical systems
- Security – especially authorization
- HVAC
- **Too** much about our business models

Typical Streaming Data Analytics

- “Cleaning” data
 - Bad sensor readings, meter rollovers or resets, missing data
- Online Modeling
 - Based on regression model, predict next few hours of energy spend
 - Update model with new data
- Signal extraction
 - Transform data streams onto a new basis to better describe features
- Anomaly and Fault Detection

More Streaming Data Use Cases

- **Aggregation**
 - More independent than many Time Series databases assume, less server-farm focused
 - Rollup of a single series rather than vertical slices across all
- **General algebra on streams**
 - “Virtual” meters - Meter C is the sum of Meter A and Meter B
 - Incorporate external data sources, e.g. weather, schedules

Things that keep me up at night: Deployment



Sometimes we can't get the cloud!



Where's the SQLite of Streaming?

What the hell have you built.

- Did you just pick things at random?
- Why is Redis talking to MongoDB?
- Why do you even *use* MongoDB?

Goddamnit

Nevermind

FREE



<https://twitter.com/codinghorror/status/347070841059692545>

More things that keep me up at night: Transactional Handoff

- Updates either need to be idempotent or coordinated
 - If my Actor Model is pushing to a stream and crashes, how do I recover?
- One missing link and we have to build a whole workaround ourselves

Things that we really like: Python + Pandas

- What's Good?
 - We're a big MATLAB shop and will continue to be, but easy to pickup
 - Rich library to talk about timeseries – especially dates and times
 - General purpose programming language with great ecosystem
 - Fast, but expressive.
- What's the worry?
 - Not so good with streaming.
 - Maybe Ibis will fix? Spark Streaming/PySpark?

Things that we really like: Portable Format for Analytics

- What's Good?
 - Declarative/intermediate representation of computation
 - Useful functions, abstract representation of computation that seems reasonable
 - “Compiles”/has runtimes for multiple systems, from single node to big clusters
- What's the worry?
 - Not clear that it's efficient.
 - Very Early Days
- <http://dmg.org/pfa/index.html>

Things that we really like: Google Cloud Dataflow

- What's Good?
 - Rich windowing
 - Restatements
- What's the worry?
 - Embedded in a language and hard to reason about outside of system
 - Early days

Things that we really like: Streaming Storage Systems & Platforms

- What's Good?
 - Kinesis, Cloud PubSub, Azure Event Hub: solve a real problem
 - Amazon IoT, Azure IoT Hub: one level up, also solving real problems
- What's the worry?
 - For non-cloud, Kafka it is, I guess?
 - IoT platforms, build out our own?

Thank You!

Burj Khalifa
Dubai

Taipei 101
Taipei

International Commerce Center
Hong Kong

Greenland Financial Complex
Nanjing, China

International Finance Center
Guangzhou, China

Princess Tower
Dubai

Two International Finance Centre
Hong Kong

Makkah Royal Clock Tower
Saudi Arabia

Shanghai World Financial Center
Shanghai

Petronas Towers
Kuala Lumpur

Willis Tower
Chicago

Trump Tower
Chicago

Al Hamra Tower
Kuwait

