Tomorrow’s IoT Forecast: RAIN

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Suppose You Wanted to Connect Every Item in Your Everyday World
You’d Probably First Ask *Why?*

To connect people and businesses to items

- To identify, locate and authenticate those items
- To store and access each item’s ownership, history and services

Item’s physical life

Item’s digital life

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Then You’d Ask How?

You’d use a wireless technology suitable for connecting items

- No batteries
- Unlimited life
- Fast & long range
- Small & low cost
- Unique identifier on every item
- You’d call it RAdio IdentificatioN

Costs pennies
1000 tags/sec
10m range
Am I For Real?

A few of the billions of items (or things) already connected
Yes, I’m for Real

RAIN is Established

- RAIN Industry Alliance
- Worldwide Spectrum & Standards
- Global Tagging Ecosystem

Complementary and Expansive

<table>
<thead>
<tr>
<th>Items</th>
<th>Beacons</th>
<th>Internet</th>
<th>Payment</th>
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Market has Adopted (1)

RAIN Tags in Billions

<table>
<thead>
<tr>
<th>Year</th>
<th>Number</th>
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<tbody>
<tr>
<td>2009</td>
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<td>2010</td>
<td>2B</td>
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<td>10B</td>
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Blue Chips are Deploying

Blue Chips are Deploying

(1) Industry-wide volumes (a) for the years 2010 and 2011 are based on VDC Research: “Strategic Insights 2013: RFID, Contactless & RTLS Technology,” (b) for the year 2012 is based on IDTechEx: “RFID Forecasts, Players and Opportunities 2014—2024,” 2013, (c) for the years 2013 and 2014 are based on IDTechEx: “RFID Forecasts, Players and Opportunities 2016—2026,” 2015, (d) for the year 2015 is based on research conducted by IDTechEx subsequent to the publication of its most recent report, and (e) for the year 2016 is based on data presented by the RAIN RFID Alliance.
The True Internet of Things

- Increase Store Efficiency
- Improve Customer Experience

- Reduce Lost Baggage
- Speed Bag Offloading

- Identify / Track Vehicles
- Fast, Cashless Fueling

- Streamline Operations
- Ensure Quality

- Track Assets
- Enhance Security

- Automate Drug Tracking
- Improve Asset Utilization

(1) These RAIN programs may, but do not necessarily, use the Company’s products.
In the News

- “Delta Air Lines is investing $50 million to soothe one of air travel's biggest headaches: lost and delayed luggage
- Delta already has one of the airline industry's best luggage-handling records but hopes that by deploying a [RAIN] system globally it can improve further
- Ultimately the bag tag might be replaced with permanent [RAIN tags] in our suitcases”

And Touching People’s Lives

Little RAIN IC

Big Opportunity
An IoT Tale From the Future…

I need some new luggage

I visit a retailer web page and order a RAIN-enabled suitcase

The retailer transfers the bag’s electronic ID (EID) to me as owner
An IoT Tale from the Future...

My luggage arrives

The shipper uses the bag’s EID for delivery routing

The retailer linked the bag’s EID to my home address and granted the shipper access to that information
An IoT Tale from the Future…

My futuristic home automation device includes a RAIN reader

Alexa/Siri/Assistant asks me:

Q: Register the bag’s warranty?  A: Yes
Q: Alert your RAIN-enabled phone to your new luggage?  A: Yes
Q: Assign RAIN privacy protections appropriate for luggage?  A: Yes
Q: Register the EID with your airline frequent-flier numbers & TSA?  A: Yes
Today is my trip to Amsterdam

I pack my bag with my RAIN-enabled stuff

I use the RAIN reader in my futuristic phone to link the bag’s EID to my ticket, alert the airline, and alert TSA that my bag flies TSA pre-check

At the airport, I hand over my bag and head to security – no waiting in a check-in or bag-drop line
An IoT Tale from the Future…

The airline uses RAIN readers to track and route my bag

The airline verifies my bag’s destination using RAIN-enabled belt loaders

And sorts it using RAIN-enabled sorters

At the carousel, my futuristic phone beeps when its RAIN reader reads my bag coming my way
An IoT Tale from the Future…

My vacation is over; today I fly home

The airline alerts me about an issue as I board the plane – my bag will be delayed

I arrange delivery to my work and track progress with my phone

My phone RAIN-authenticates my bag, and vice versa, when the driver delivers my bag
An IoT Tale from the Future...

Alas, I realize my bag is too big – I want something smaller

I buy a new bag from the retailer and repeat the process

Alexa/Siri/Assistant, please transfer ownership of my old bag to my friend
Progress Towards the Vision

In Progress – Item Connectivity

Reading

Identification

Inevitable – Digital Life for Items

IoT Opportunities

1. Digital life for physical items
2. People engaging connected items
3. Developers innovating an IoT ecosystem

IoT Issues

1. Item identity has multiple numbering systems without name resolution
2. Item history isn’t accessible
3. Item data services aren’t defined
4. Item ownership isn’t an internet concept
History as a Guide

Internet Evolution

TODAY: Internet Era

PAST: Private Networks Era

IoT Expectation

FUTURE: Internet-of-Things

TODAY: Private Networks of Things
Proposal: IoT Architecture for Items

Items have digital lives that mirror their physical lives

An item’s physical life is its identity, location & authenticity

An item’s digital life is its ownership, history & services*

*A services registry points to services / data associated with an item
The item’s digital life is contained in a journal

The item’s digital identity resolves to the journal’s URI

Journals store
1. current and past item owners and their owner rights
2. item history {what, where, when}
3. a services registry for the item

*DNS is a metaphor for a discovery service that resolves item identities to URIs*
Proposal: IoT Architecture for Items

Applications access journals to
  1. access/update services and history
  2. read or assign/transfer item ownership
all subject to persistent owner rights

Services & history are atomic; ownership is chained

Services direct applications to item data

The virtual Electronic Product Code (EPC) is a journal entry, applicable to all items, and independent of the data carrier
Proposal: IoT Architecture for Items

Originator rights determine who can access item data

Journal entries must be authenticated/signed

Journals are cloud-based, open-source, replicable and enforce eventual consistency

This IoT architectural view is item-owner- centric
• An owner owns an item
• An owner owns their item data
• An owner benefits from the item’s digital life
Items have digital lives that mirror their physical lives

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Mission
To enable businesses and consumers to identify, locate, authenticate and engage items in our everyday world

Vision
A future where everyday things are part of a connected world … like raindrops to the sea
THANK YOU