IEEE RFID 2023

Tutorial: **Context-aware physical spaces**

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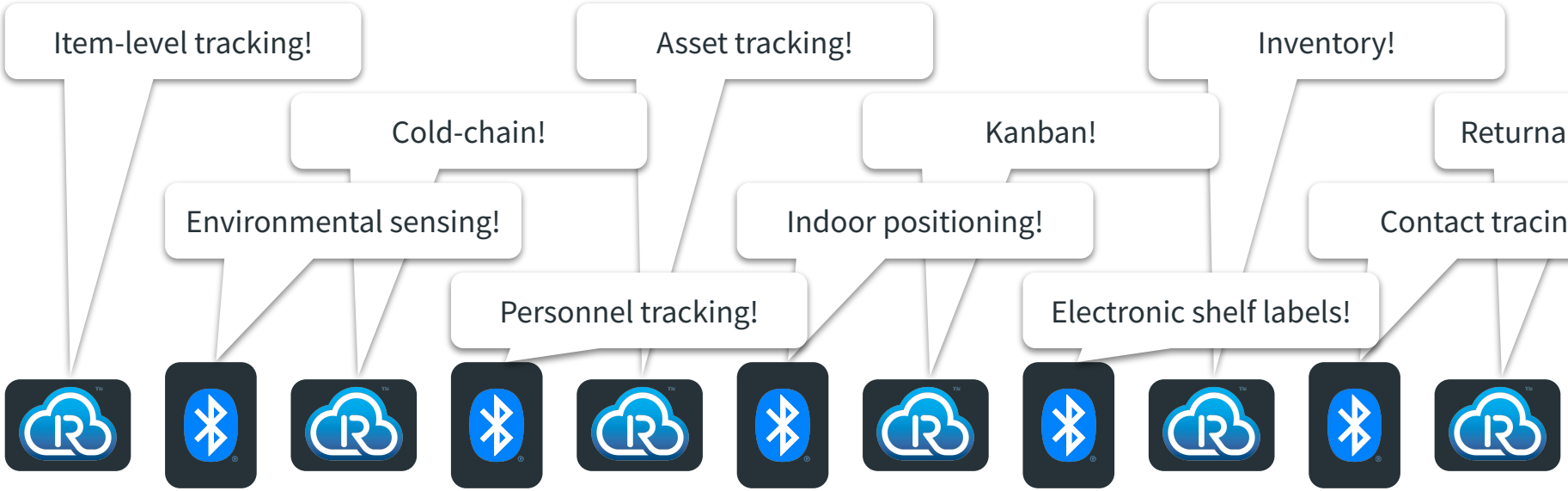
Context-aware physical spaces

As the **AIDC** industry celebrates its 50th anniversary this year, the technology has evolved such that today, **almost anything can be radio-identified**, using standard passive and active tags, at a range of several metres or more. As such, contextual awareness at the scale of a physical space becomes a possibility through the **identification**, **location** and **sensor data capture** of everything present.

This tutorial will cover how this data is captured, processed, represented and distributed to enable context-aware physical spaces, with a focus on **RAIN RFID** and **Bluetooth Low Energy** technologies, **off-the-shelf** hardware, and **open source** middleware. Current and emerging use cases will be presented, as well as a live, interactive demonstration.

The motivation?



Increasing co-existence of technologies, use cases and data consumers.

We knew we'd get here…

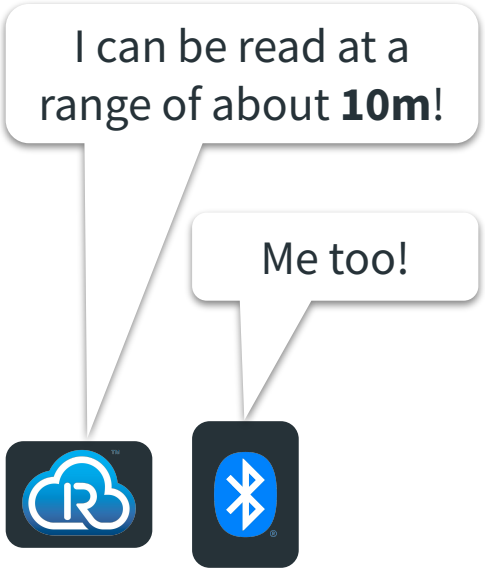
2017

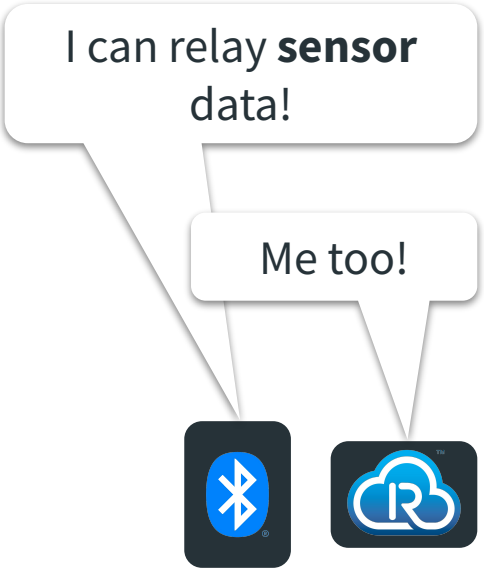
2019

2022

2023: There's no mention of RFID in the title of my tutorial… 🤔

Complementary co-existence





Ubiquitous human-scale AIDC?

Ambient data—*everywhere*

5 Billion

of us will ship in 2023!

ABI Research, 2023

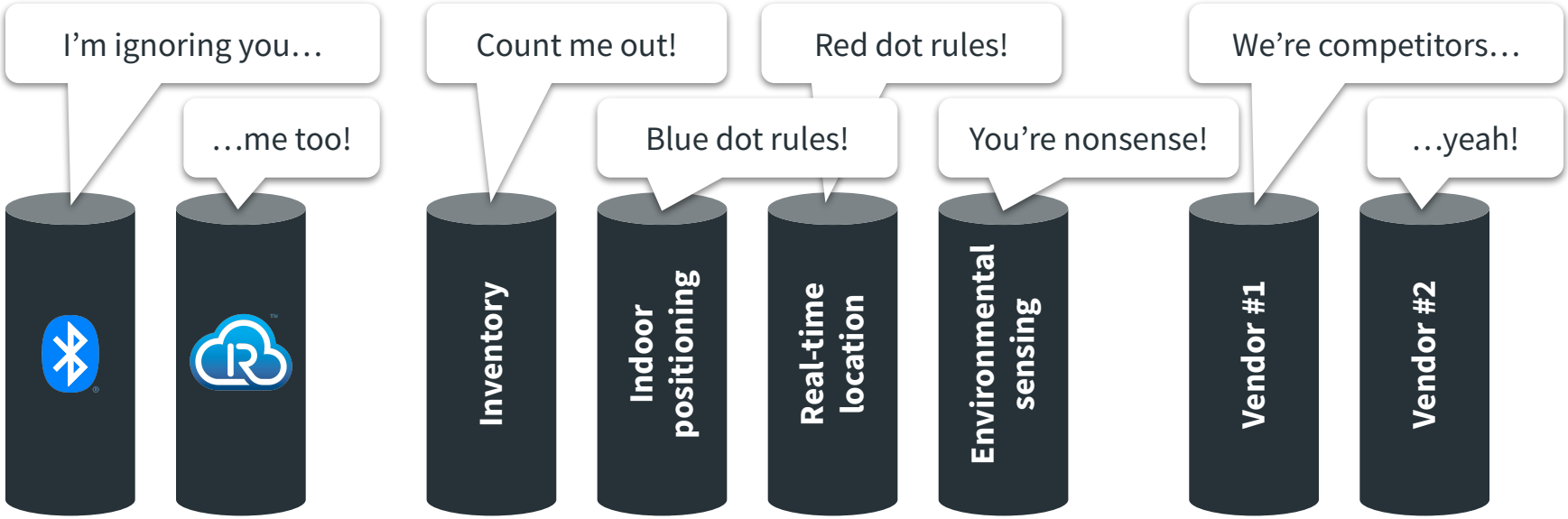
28 Billion

of us shipped in 2021!

RAIN Alliance, 2022

Nearly 200 billion “things” have shipped in the past decade!

Silos fail at scale



Technology silos

Application silos

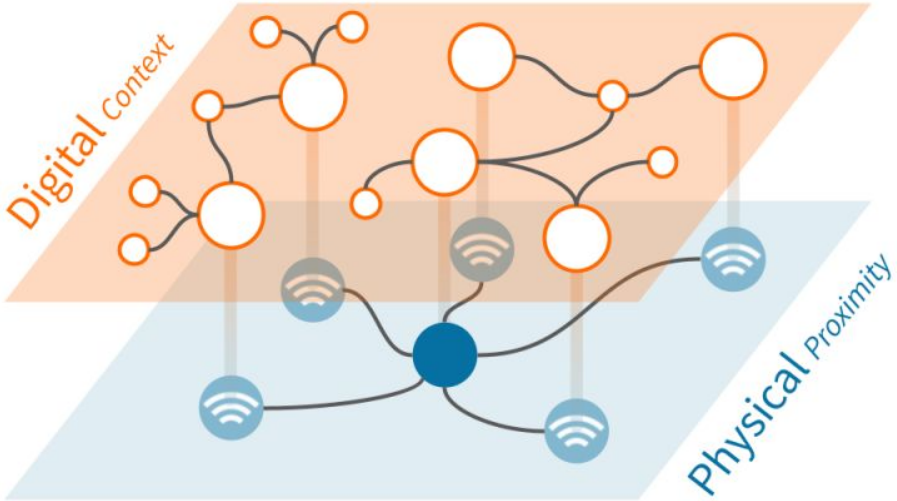
Vertical lock-in silos

A new paradigm?

How do we combine and distribute the data
of *all* the radio-identifiable things
in range of one another,
at the human scale of a physical space,
to enable *any* current and future application,
in an opt-in, privacy-preserving way,
that facilitates access for *all* participants?

Spoiler alert!

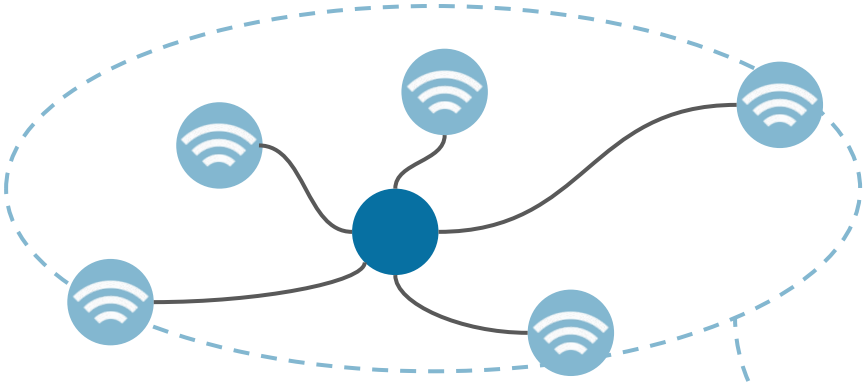
Imagine the Web

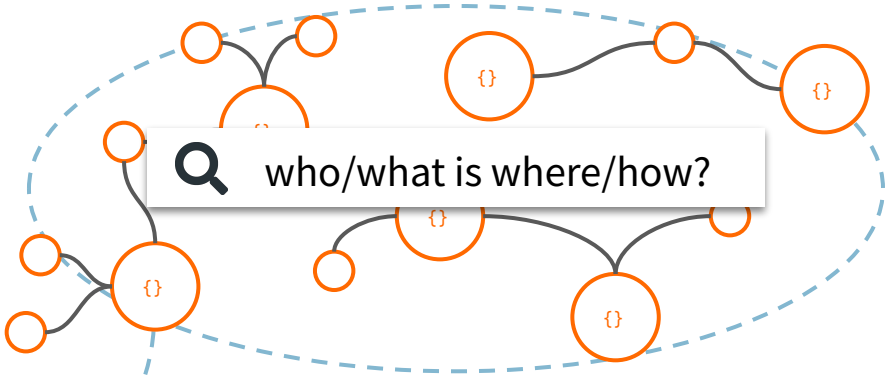


at human scale.

That pretty much sums up what this tutorial is about!

Physical proximity meets Web





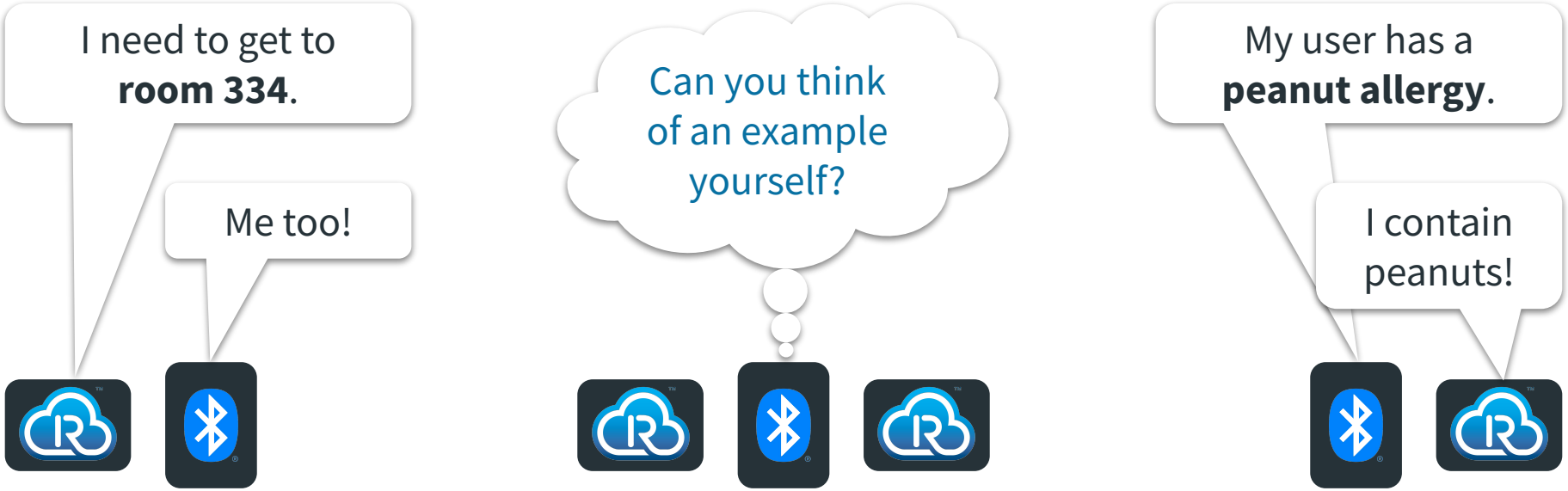
Physical proximity

Collectively represent all the radio-identifiable “things” as a graph:

what is close to what?

Use the established features of the Internet to facilitate the **discovery**, **exchange** and **search** of this data.

Next-level efficiency

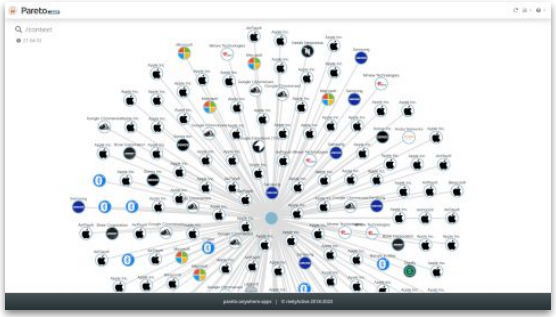


An Internet-like platform for information exchange at the level of physical things.

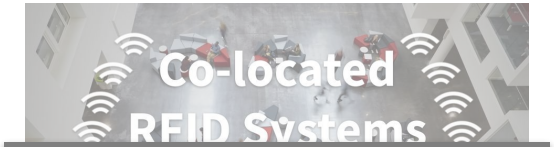
Let’s put things in context

1 Discovery Demo

Pareto –ANYWHERE by reelyActive



2 raddec Review



A standardised radio decoding

Transmitter ID	RSSI Signature	Payloads	Time
11:22:33:44:55:66	[{ bb:bb:bb:bb:bb:bb, -72dBm, 7 }, ...	[02ab1234..., 9143ce2f...]	12:34:56
What?	Where?	How?	When?
An iPhone Clothing item	In or near Aisle 7 In or near Aisle 7	AirPlay, AirDrop SKU: 123456	Now Now

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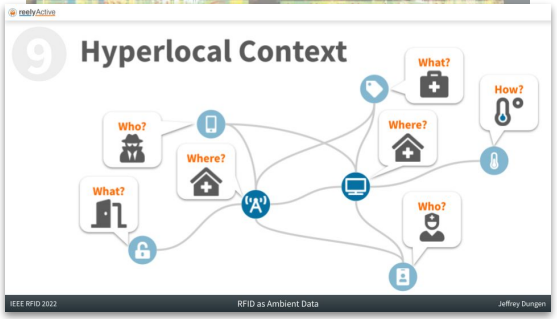
3 HLC Review



Theory meets reality?

At reelyActive, we've been pioneering **hyperlocal context** since 2012,
so shouldn't **context-aware physical spaces** be a reality by now?

Live Demo!

SSID: Hyperlocal Context
Password: ambientdata

http://pareto.local/context/
(http://10.0.50.100/context/)

Middleware

Ambient data

Pareto -ANYWHERE by reelyActive

Run *anywhere:* edge/local/cloud

Who/what is **where/how**

JSON

Hyperlocal Context
for
context-aware
physical spaces

https://www.reelyactive.com/pareto/anywhere/
https://github.com/reelyactive/pareto-anywhere/

Do it yourself!

{ : dev }

Create context-aware physical spaces with a Raspberry Pi

Our step-by-step guide to create #CAPSpaces with a Pi using open source technologies.

https://reelyactive.github.io/diy/capspaces-pi/

{ : dev }

Configure an Aruba Instant AP

Our step-by-step guide to configure the access point(s) to forward data for processing by Pareto Anywhere.

https://reelyactive.github.io/diy/aruba-instant-config/

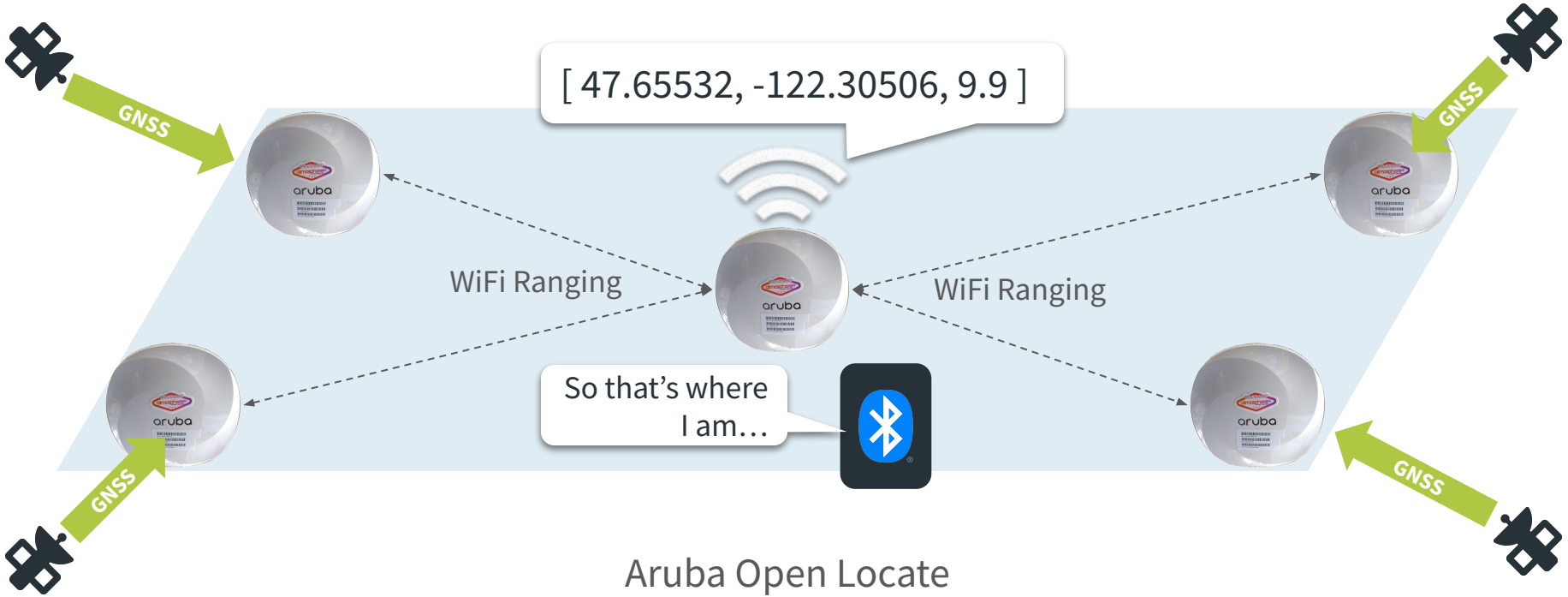
Ubiquitous infrastructure?

Where *isn't* there a **WiFi access point** these days?

Tens of millions of my peers have **BLE radios**.

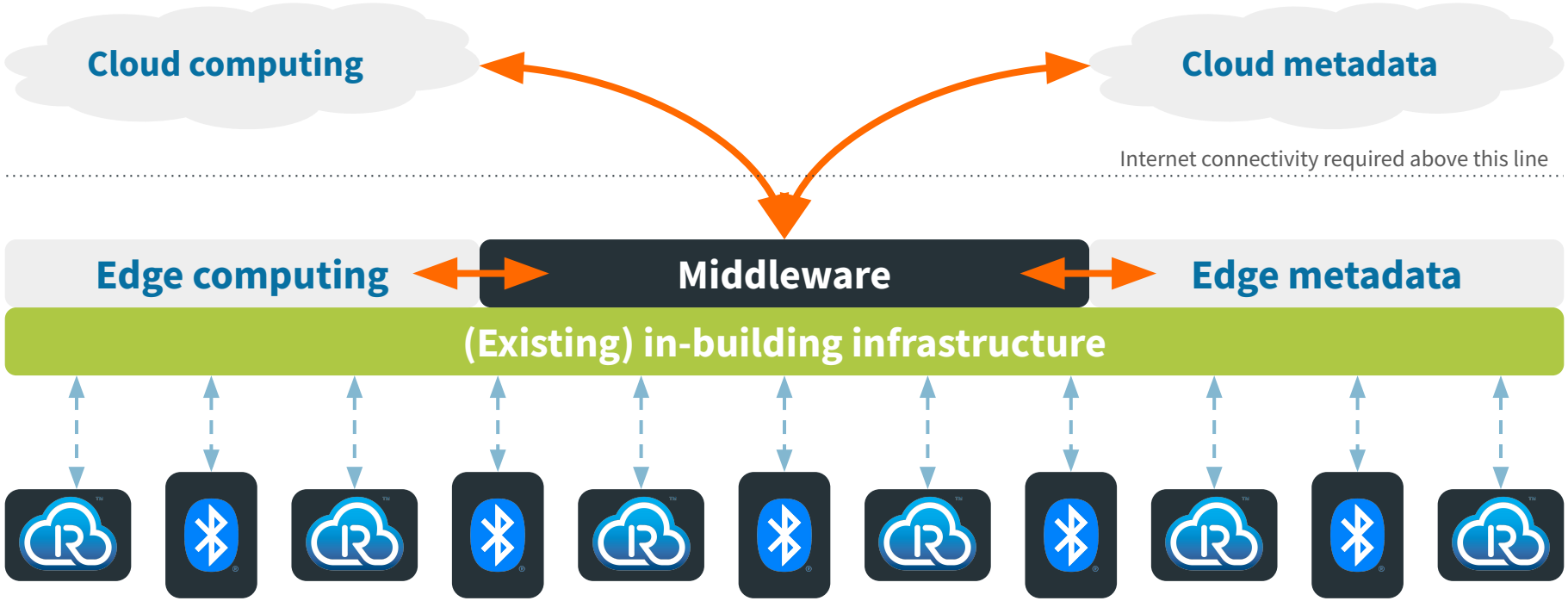
Is there an equivalent for RAIN RFID?

(Geo)location, location, location



Aruba Open Locate

Data flow


Cloud computing
Cloud metadata
Internet connectivity required above this line
Edge computing
Middleware
Edge metadata
(Existing) in-building infrastructure

Tag & reader evolution?

This is **IEEE RFID**—*and we love to talk RFID tech*—so how might tags & readers evolve to leverage the affordances of context-aware physical spaces?

- ➔ (geo)location-awareness
- ➔ digital twins
- ➔ environmental sensing
- ➔ …

Human interaction evolution?

DTPR

How do we inform occupants (human & digital) of the technologies used in the physical space?

Digital Trust for Places & Routines: dtpr.io

Outstanding questions

- ➔ Which standard(s) for **digital twins**?
- ➔ **GeoJSON** and/or semantic location?
- ➔ **Web3** and decentralised architectures?

Do you believe there's a breakthrough use case? Or this will remain theory?

Context-aware physical spaces

…combine and distribute the data
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If evolving Internet best practices are observed…

Room for improvement…

Whereas the Internet & the Web *erased* the constraints of physical distance to facilitate information exchange on a global scale…

Context-aware physical spaces *embrace* the constraints of physical distance to facilitate information exchange at a human scale.

Whereas the Internet & the Web foster countless applications by enabling computers to make sense of the digital world in which *computers* themselves operate and interconnect…

Context-aware physical spaces foster countless novel applications by enabling computers to make sense of the physical world in which we *humans* live, work and play.

Whereas the Internet & the Web rose to ubiquity as a decentralised open architecture buoyed by open source community initiatives…

***Ubiquitous* context-aware physical spaces** will almost certainly replicate the proven success of a decentralised open architecture employing open source technologies.

Context-aware physical spaces

Presented by Jeffrey Dungen
Co-founder & CEO of reelyActive
at IEEE RFID 2023 in Seattle

www.reelyactive.com | reelyactive.github.io