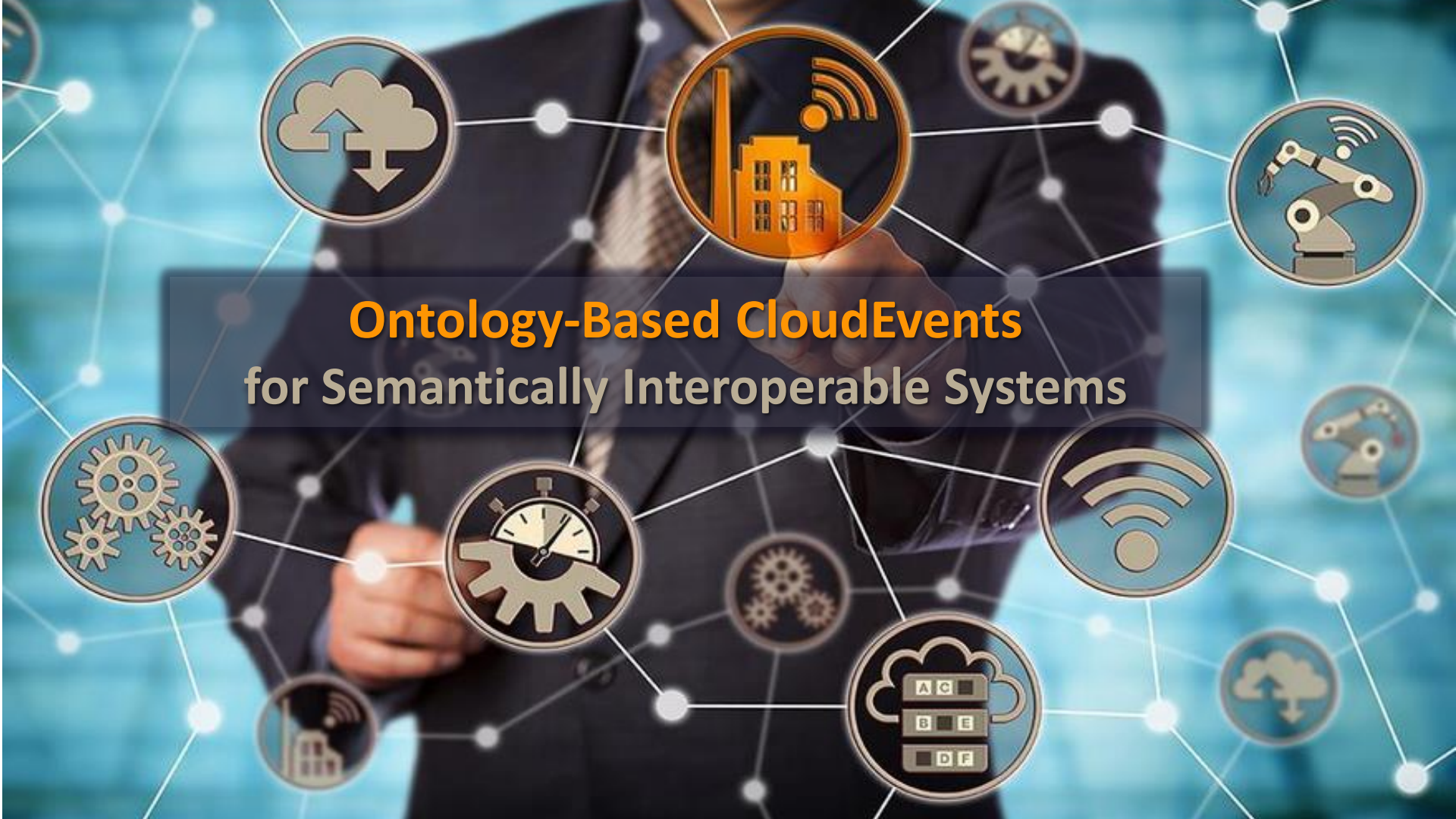

Ontology-Based CloudEvents
for Semantically Interoperable Systems

Ontology-Based CloudEvents for Semantic Interoperability

In the emerging digital world, billions of people, systems, and devices will interact and **react in real-time**, requiring new and disruptive approaches to distributed data/state management, interoperability, and rule-based event processing.

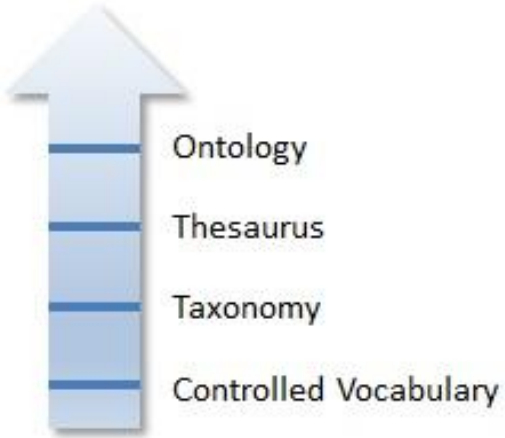
A key challenge to digital transformation is the ability to enable **end-to-end interoperability** across different industries, each having its own environments and interdependent use cases. A McKinsey report estimates that achieving interoperability in **IoT** would unlock an **additional 40 percent value** in the total available market.

An **Ontology-Based CloudEvent format** can provide a degree of abstraction necessary for highly distributed, interoperable digital systems. This common event format can break down data silos, eliminate complex system integrations, and unify information spaces – in a way that is **simple**, **scalable**, and **sustainable**.

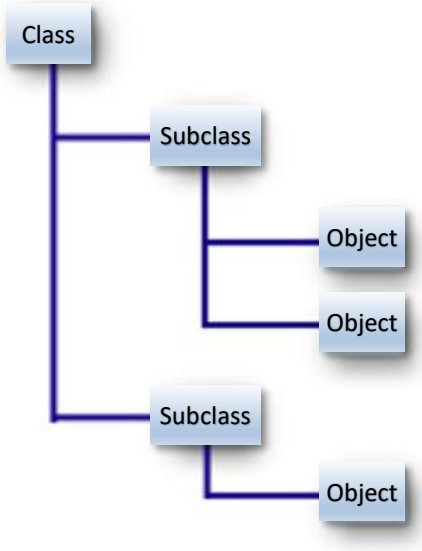
Common Ontology

- An **ontology** can provide a standardized classification of domain concepts through a collection of classes.
- Each **class** (concept) can represent a category of like **objects** (things) which can be uniquely identified.
- A class is defined to reflect the **attributes**, restrictions, and **relationships** unique to its objects (instances).

Semantic Levels

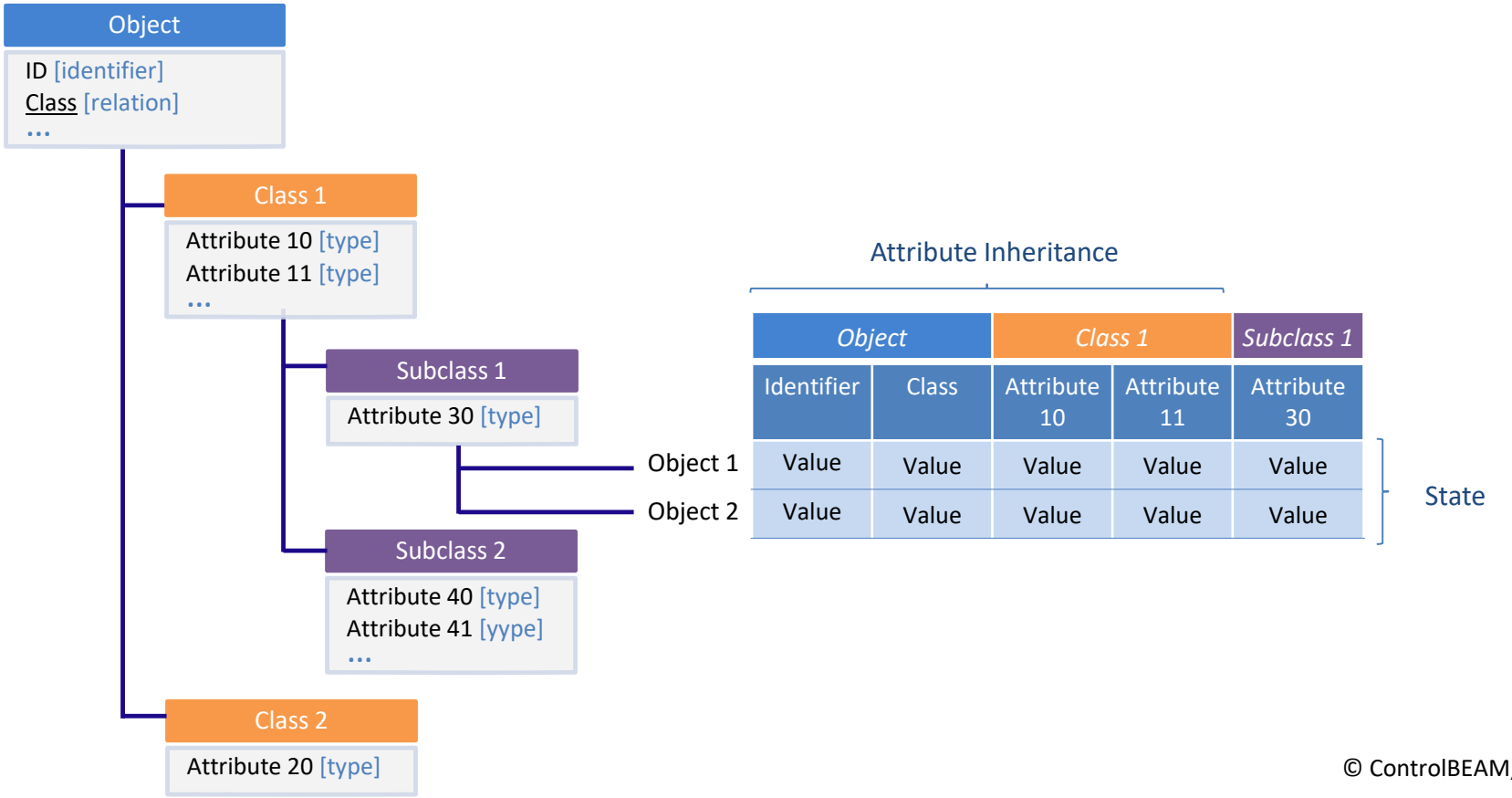


Hierarchical Classes



- A **class** (such as Sensor or Actuator) can be a subclass (type) of another class (Device).
- All **subclasses** inherit the attributes of its class.
- An **attribute** is attached at the most general class applicable to all of its objects, including subclasses.
- Similar to, but **metadata abstraction** from object-oriented programming

Common Ontology | Root, Top-Level, and Subclass Attributes

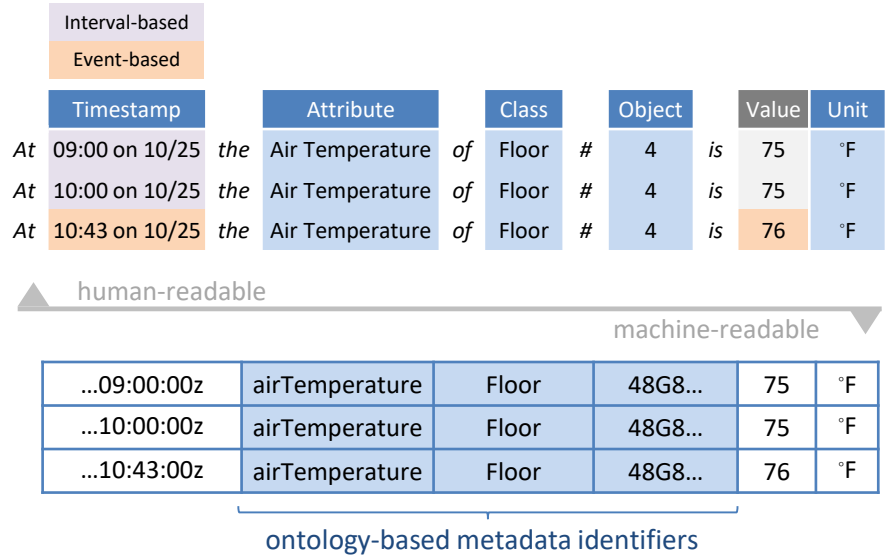


Ontology-Coupled Common Event Format

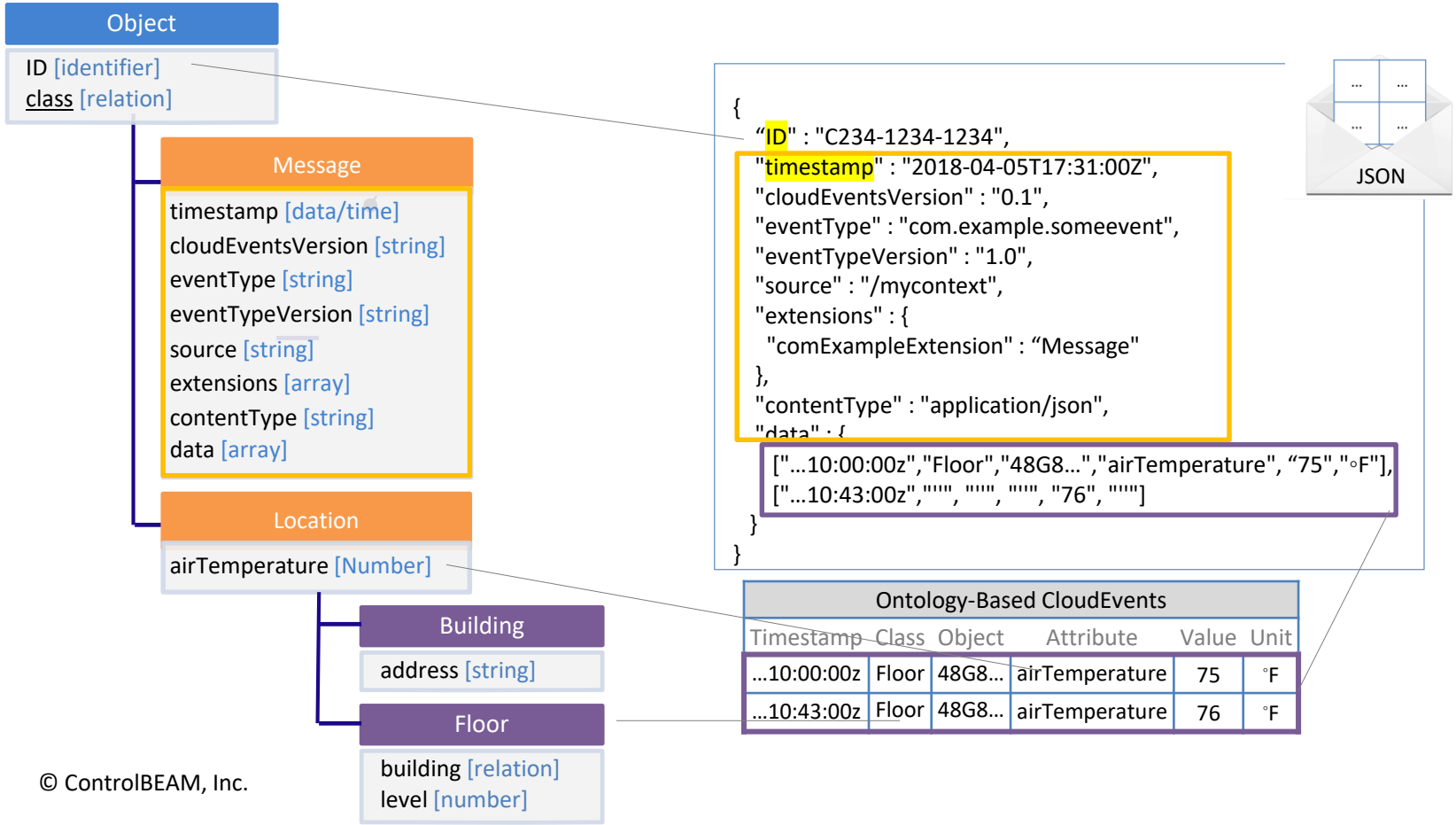
Event-defined architecture (EDA) needs a consistent view of contextual events based on a clearly defined, standardized, and tightly-coupled ontology.

A **common event format** can provide a "lowest common denominator" for distribution of object state changes, where an object represents an instance of an ontology class (e.g. Message, Location, Floor).

EDA implementations have typically defined a custom event schema for each ontology class, with elements within the custom event schema reflecting multiple attributes of the ontology class. Each event within a **common event format** represents a state change of a single attribute, which enables one event format to be utilized across any ontology class.

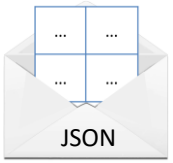


Ontology-Based Message object within CloudEvents



Correlations within Historic Ontology-Based CloudEvents

```
{
   “ID” : "C234-1234-1234",
  "timestamp" : "2018-04-05T17:31:00Z",
  "cloudEventsVersion" : "0.1",
  "eventType" : "com.example.someevent",
  "eventTypeVersion" : "1.0",
  "source" : "/mycontext",
  "extensions" : {
    "comExampleExtension" : “Message"
  },
  "contentType" : "application/json",
  "data" : {
     ["…10:00:00z","Floor","48G8…","airTemperature", “75","◦F"],
     ["…10:43:00z","""", """", """", "76", """"]   }
}
```



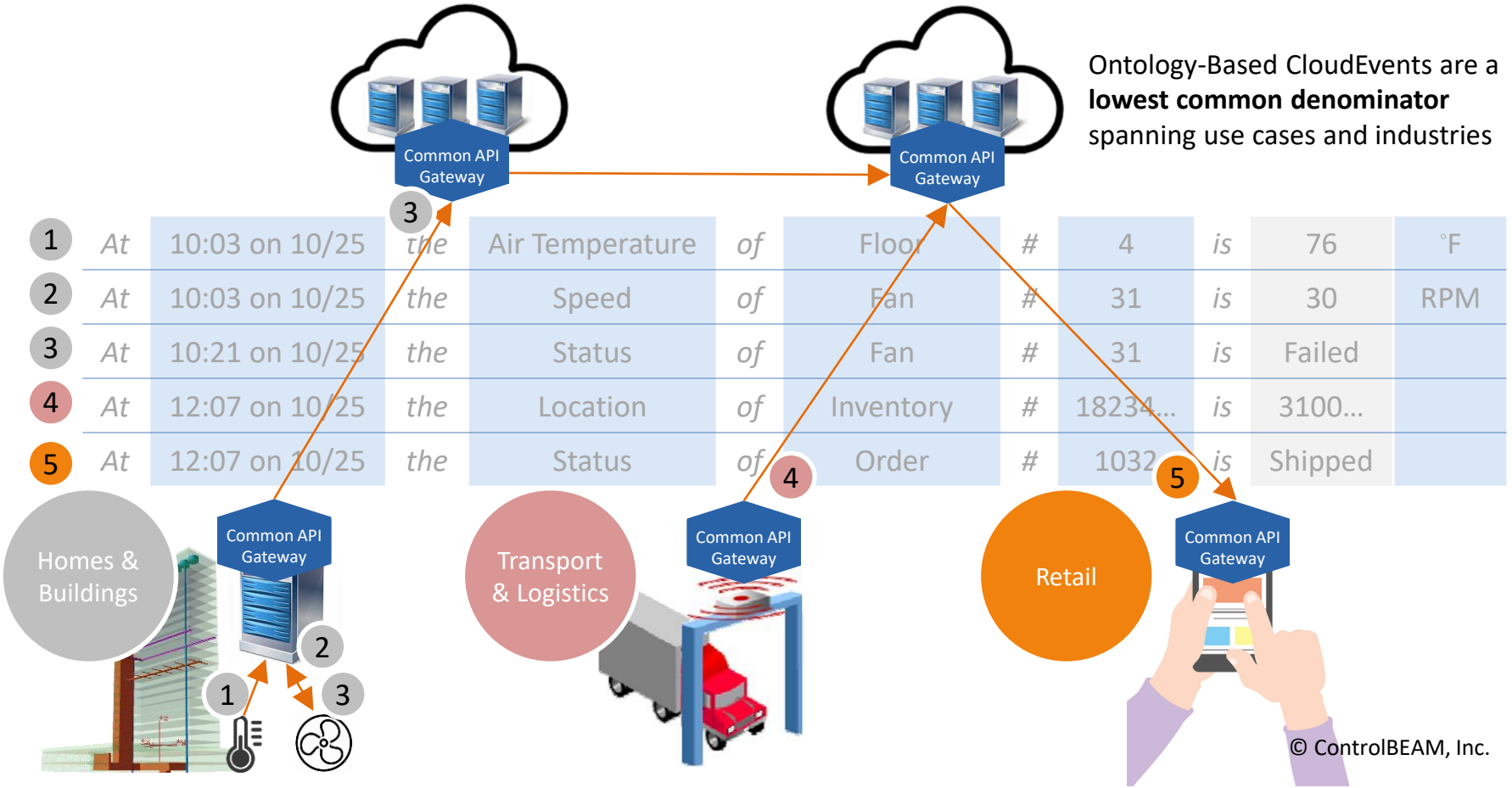
Historic Ontology-Based CloudEvents						Extensions
Timestamp	Class	Object	Attribute	Value	Unit	Message
…17:31:00z	Message	C234…	cloudEventsVersion	0.1		
…17:31:00z	Message	C234…	eventType	com.example…		
…17:31:00z	Message	C234…	eventTypeVersion	1.0		
…17:31:00z	Message	C234…	source	/mycontext		
…17:31:00z	Message	C234…	contentType	…/json		
…10:00:00z	Floor	48G8…	airTemperature	75	◦F	C234…
…10:43:00z	Floor	48G8…	airTemperature	76	◦F	C234…
…11:39:00z	Floor	48G8…	building	A025…		8603…
…11:39:00z	Floor	48G8…	level	4		8603…
…23:41:00z	Building	A025…	address	3100 Main St.		D820…

Correlations

From a Message *at* 17:31 on 08/03/18:

At 10:43 on 08/03/18, *the* Air Temperature *of* Floor Level 4 *of* Building Address 3100 Main St. *is* 76 ◦F.

Exchanging CloudEvents within Device & Business Systems

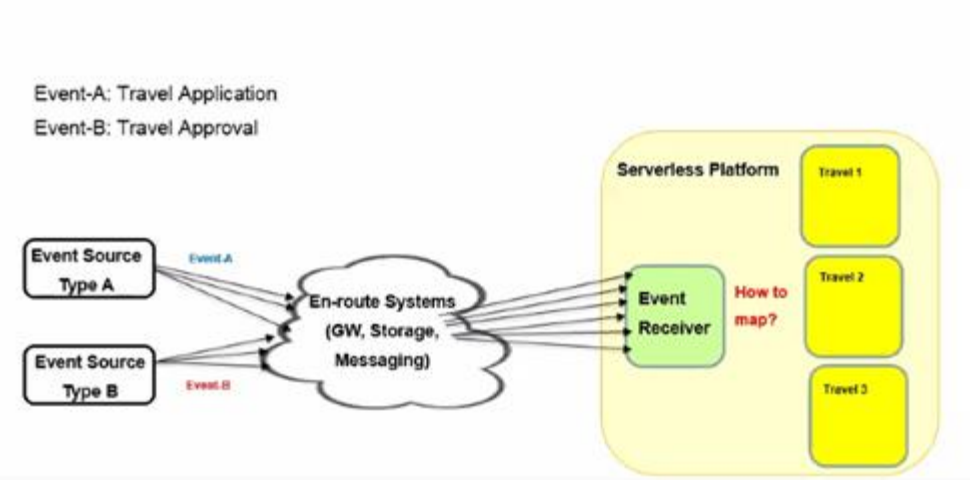


Ontology-Based CloudEvents are a **lowest common denominator** spanning use cases and industries

Use Case | Employee Travel Application

Ontology-Based CloudEvents					
Timestamp	Class	Object	Attribute	Value	…
…12:30:00z	Application	627D…	status	approved	

Historic Ontology-Based CloudEvents					
…	Class	Object	Attribute	Value	…
	Application	627D…	status	approved	
	Application	E841…	number	1	
	Application	E841…	Employee	B830…	
	Application	E841…	status	requested	
	Application	627D…	Employee	82H7…	
	Application	627D…	Number	2	
	Application	627D…	status	requested	
	Employee	82H7…	name	John Smith	



Source: Huawei

Correlations

At 12:30 on 08/03/18, *the* Status *of* Application Number 2 *of* Employee Name John Smith *is* Approved