

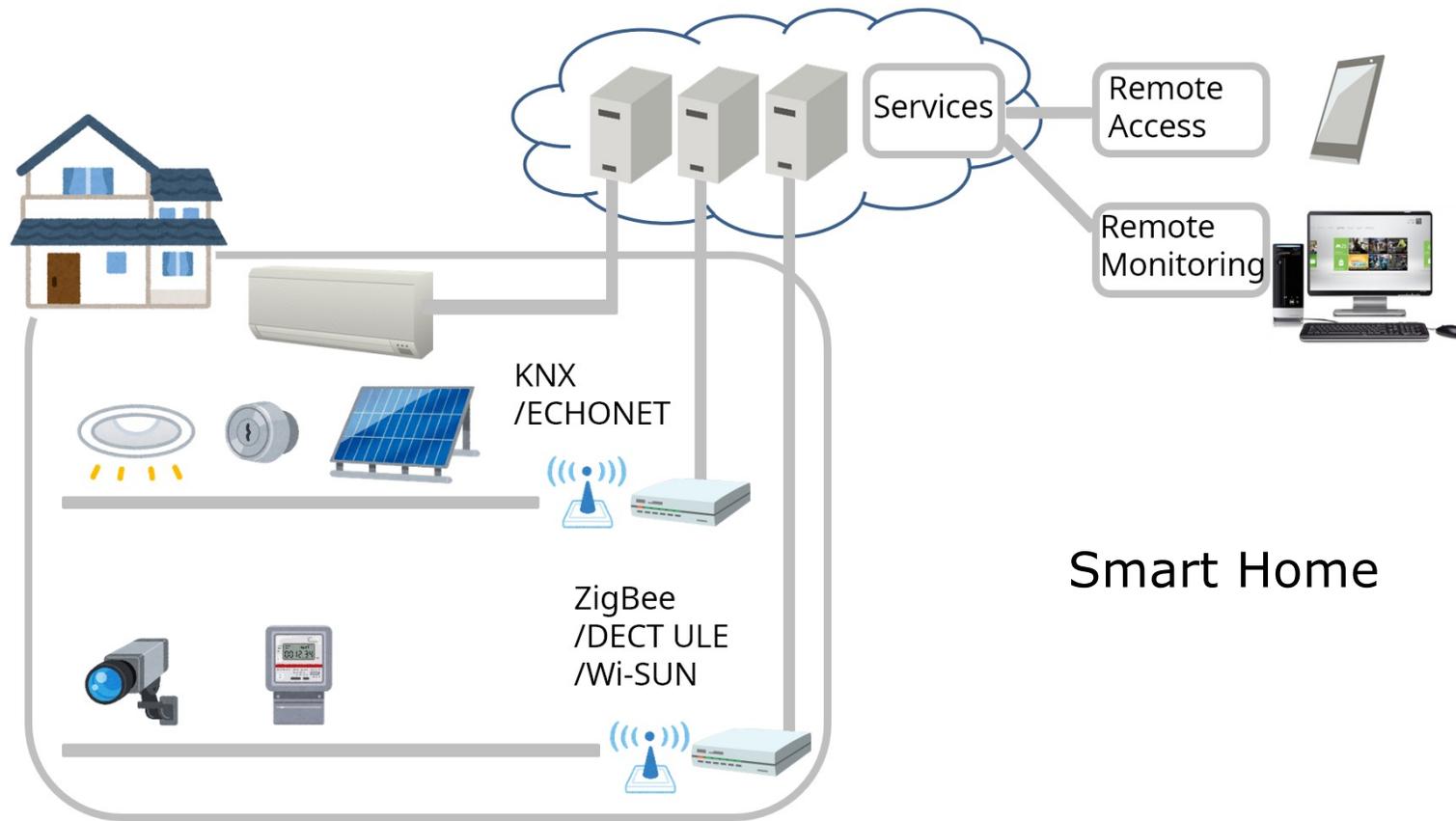
# 95-733 Internet of Things W3C Architecture

“When digital transformation is done right, it’s like a caterpillar turning into a butterfly, but when done wrong, all you have is a really fast caterpillar.”

George Westerman, MIT Sloan Initiative on the Digital Economy

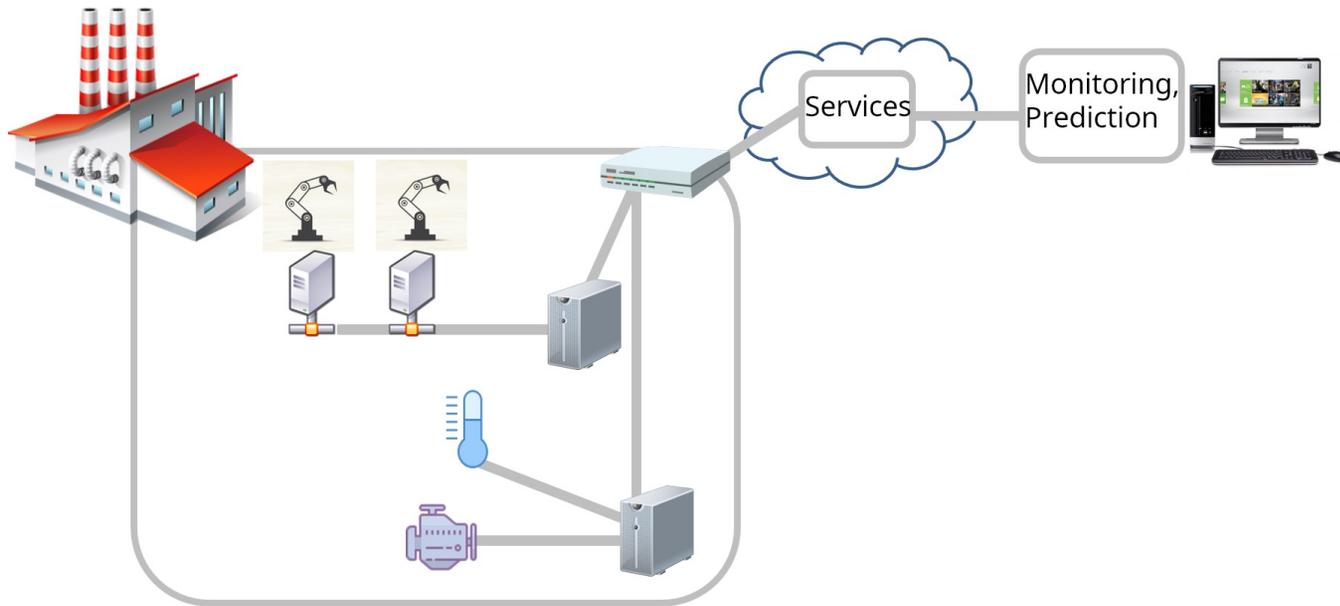
From Industry of Things World Conference 2023

# Architecture Patterns



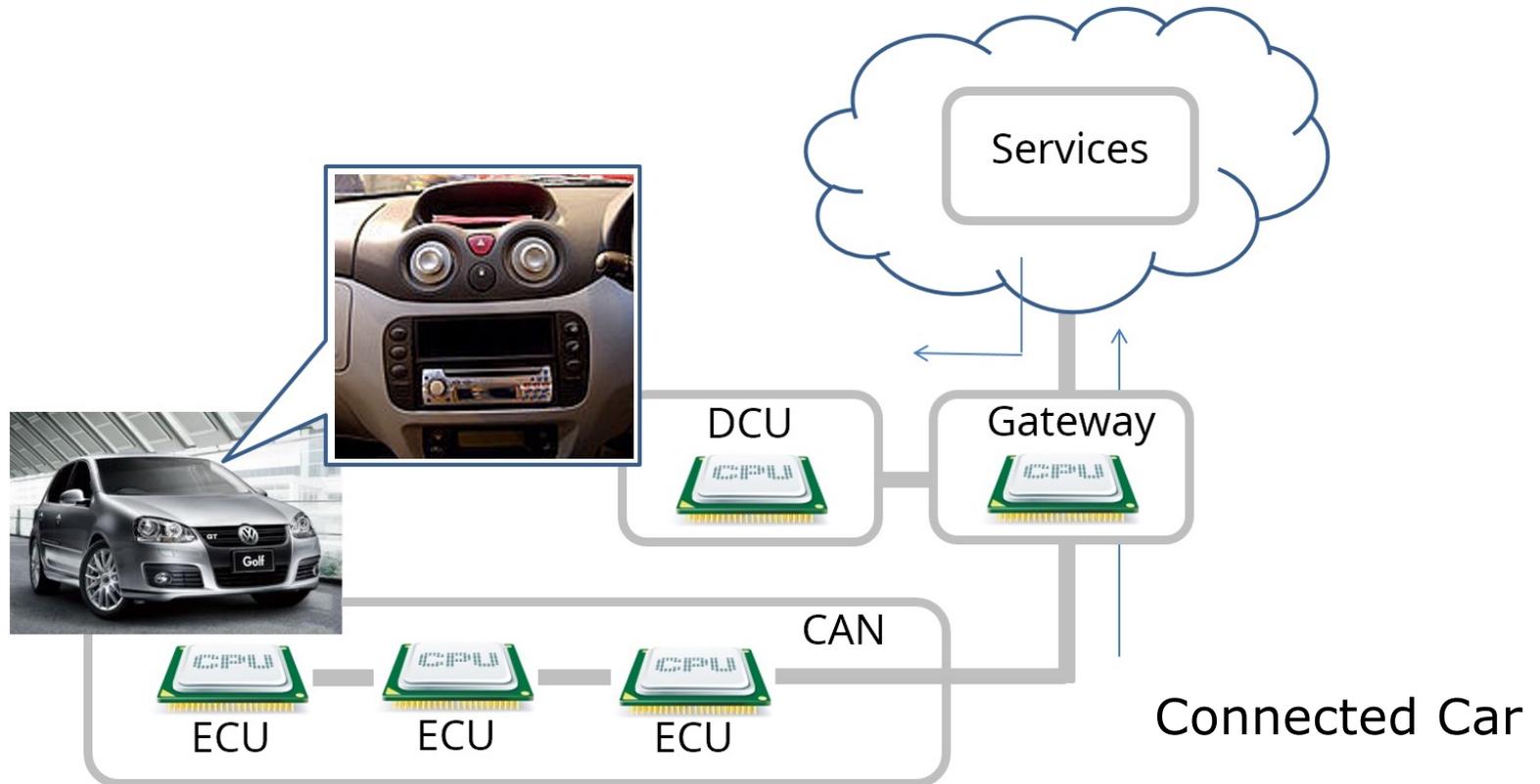
DECT ULE (Digital Enhanced Cordless Ultra low energy sensing and actuation)  
KNX/ECHONET standards for home energy management

# Architecture Patterns



Smart Factory

# Architecture Patterns



Domain Control Unit (DCU)

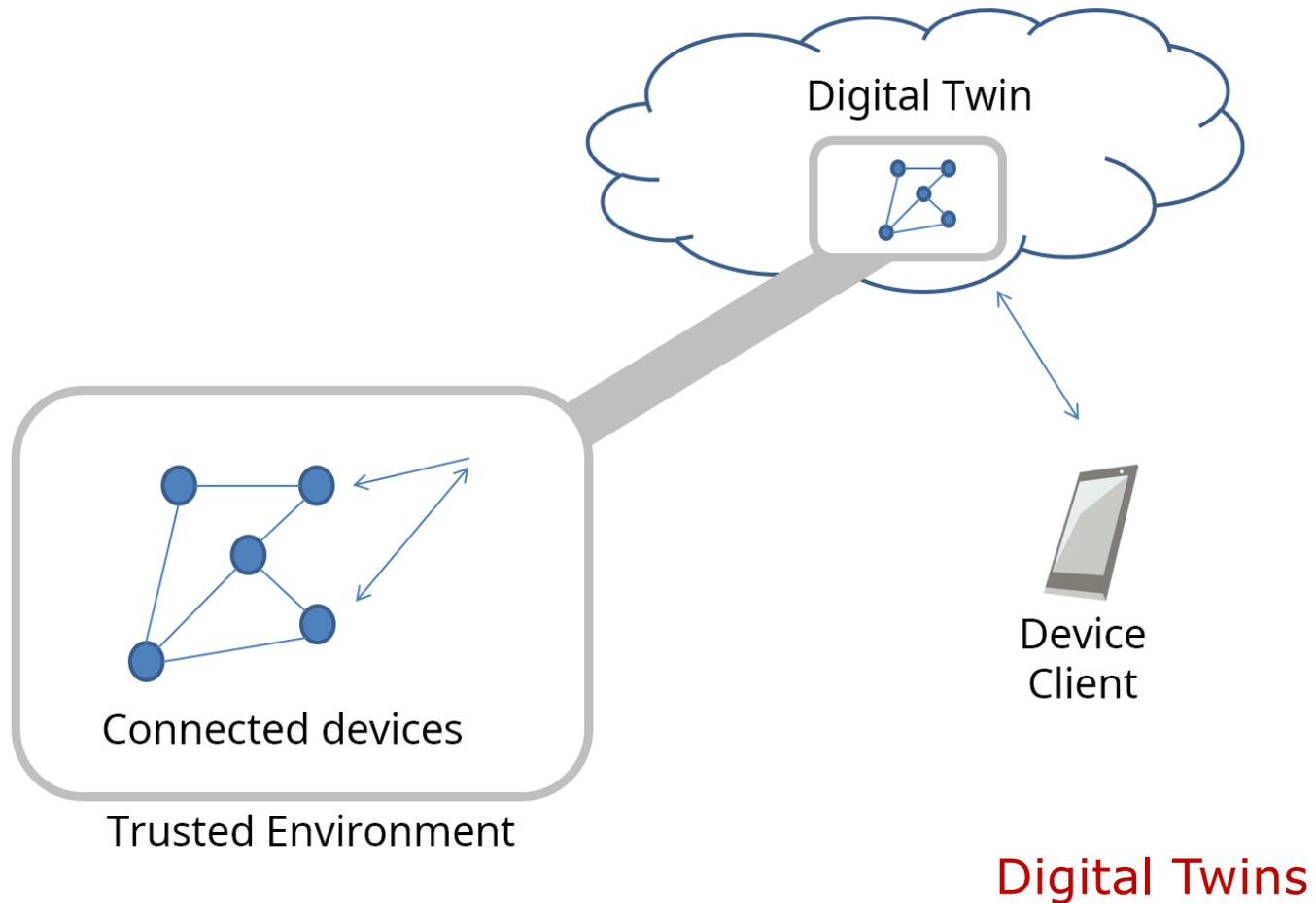
Engine Control Unit (ECU) sensors and actuators

Controller Area Network (CAN)

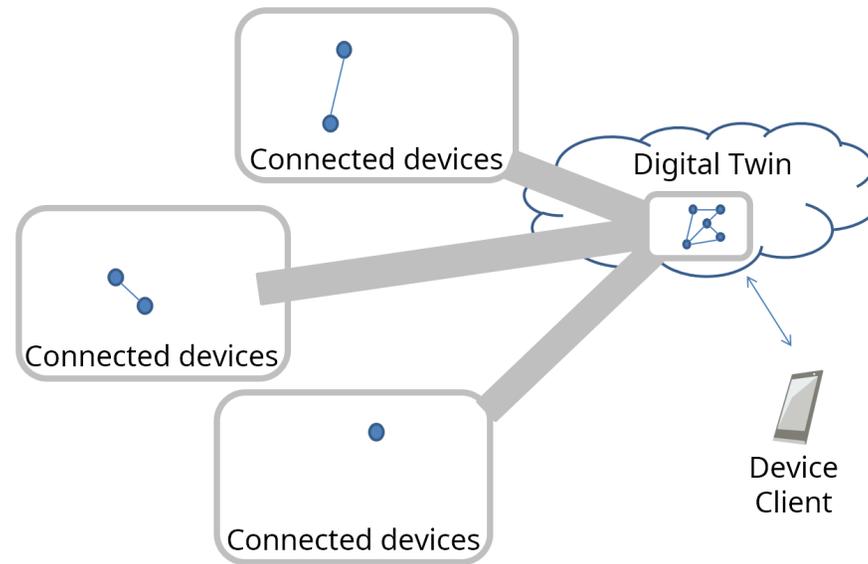
95-733 Internet of Things

Carnegie Mellon University

# Architecture Patterns

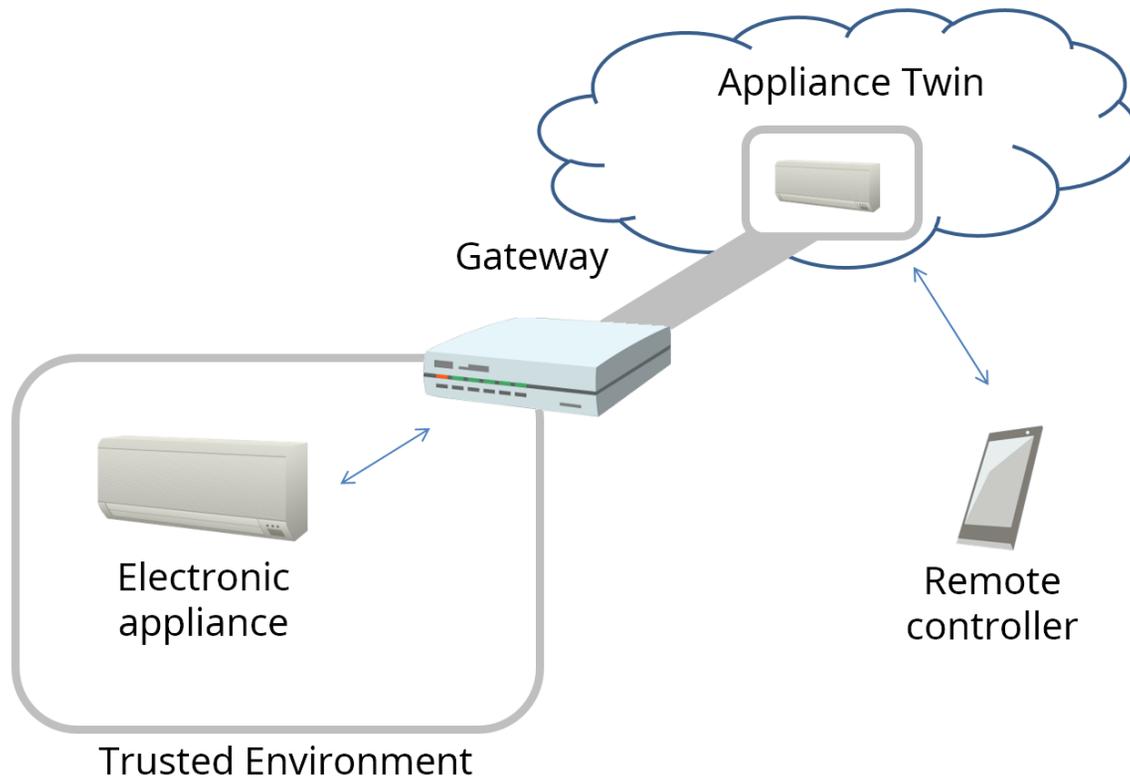


# Architecture Patterns



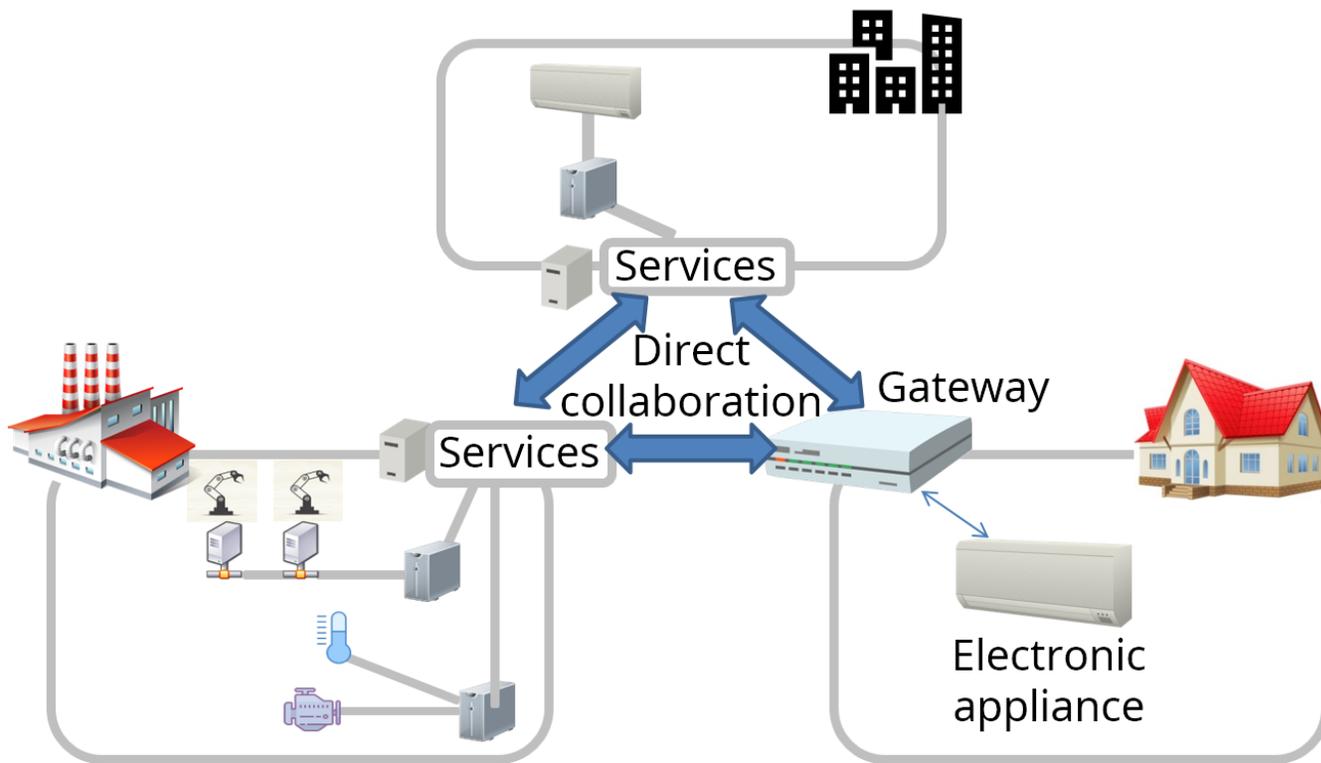
**Digital Twin** for Multiple Devices

# Architecture Patterns



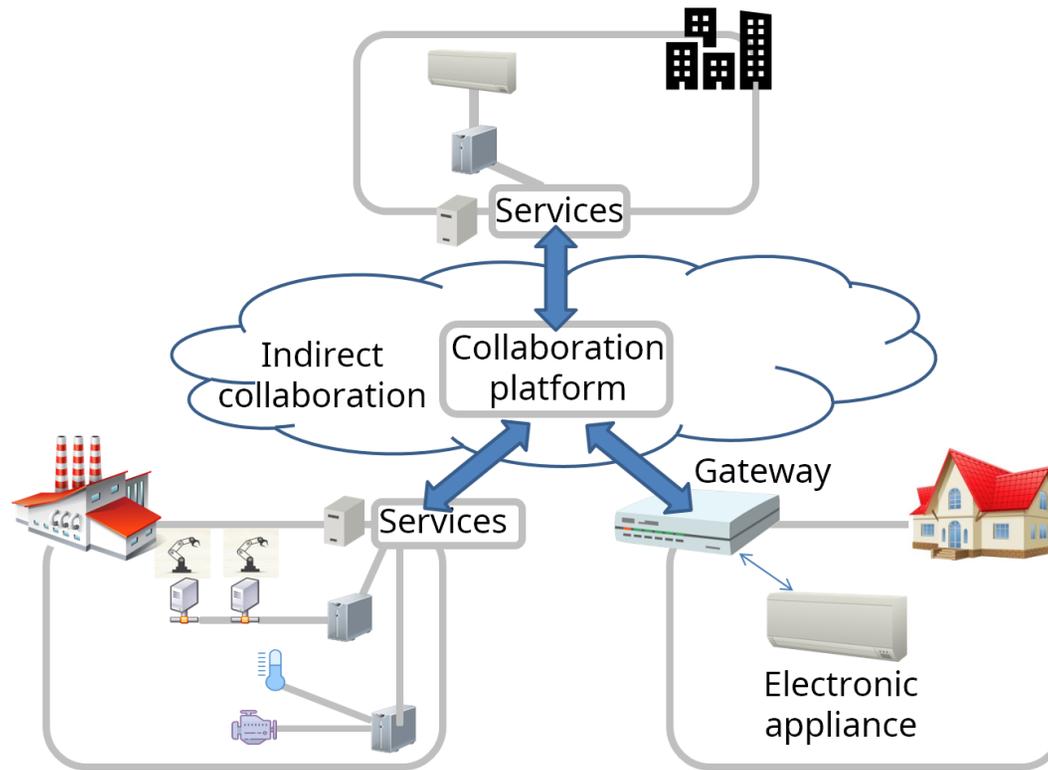
**Digital Twin** for Legacy Devices

# Architecture Patterns



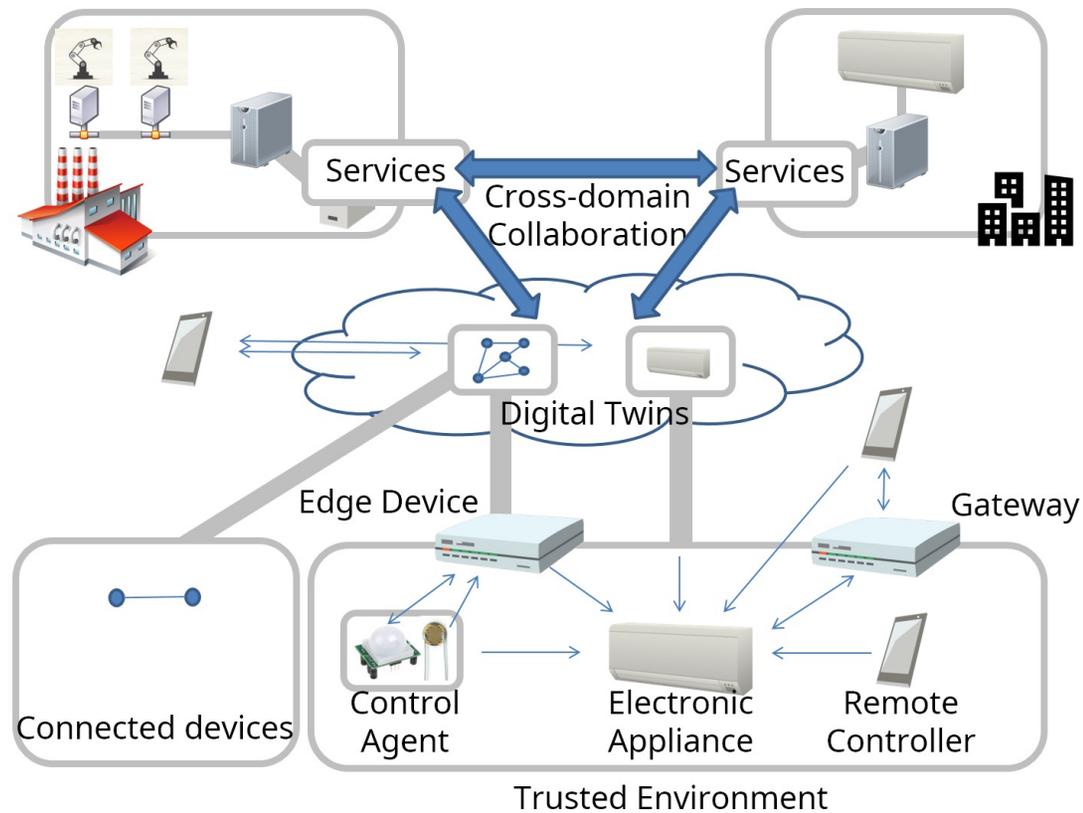
Cross domain collaboration: **Direct** peer to peer collaboration

# Architecture Patterns



Cross-domain collaboration: **Indirect collaboration** uses orchestration by a collaboration platform.

# Architecture Patterns



## Use case overview

# Defining an Interface

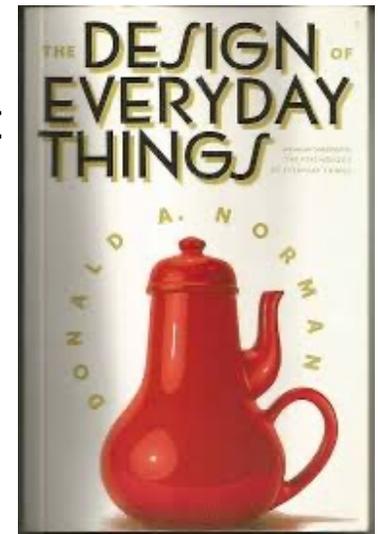


- **Interface Definition Language (IDL)**
- IDL's are an old and powerful idea.
- Compare with WSDL or CORBA IDL or Sun RPC or Protocol buffers IDL for gRPC.
- Promote interoperability with diverse languages.

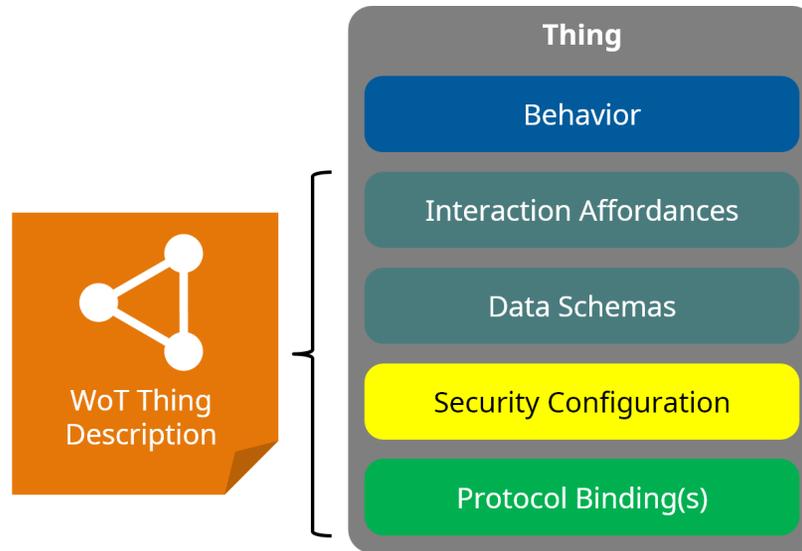
# Interface has a new name

Donald Norman: **Affordance** refers to the perceived and actual properties of the thing, primarily those fundamental properties that determine just how the thing could possibly be used.”

An example for this is a door with a handle. The door handle is an affordance, which suggests that the door can be opened. For humans, a door handle usually also suggests *how* the door can be opened; an American knob suggests twisting, a European lever handle suggests pressing down.



# Architectural aspects of a Thing

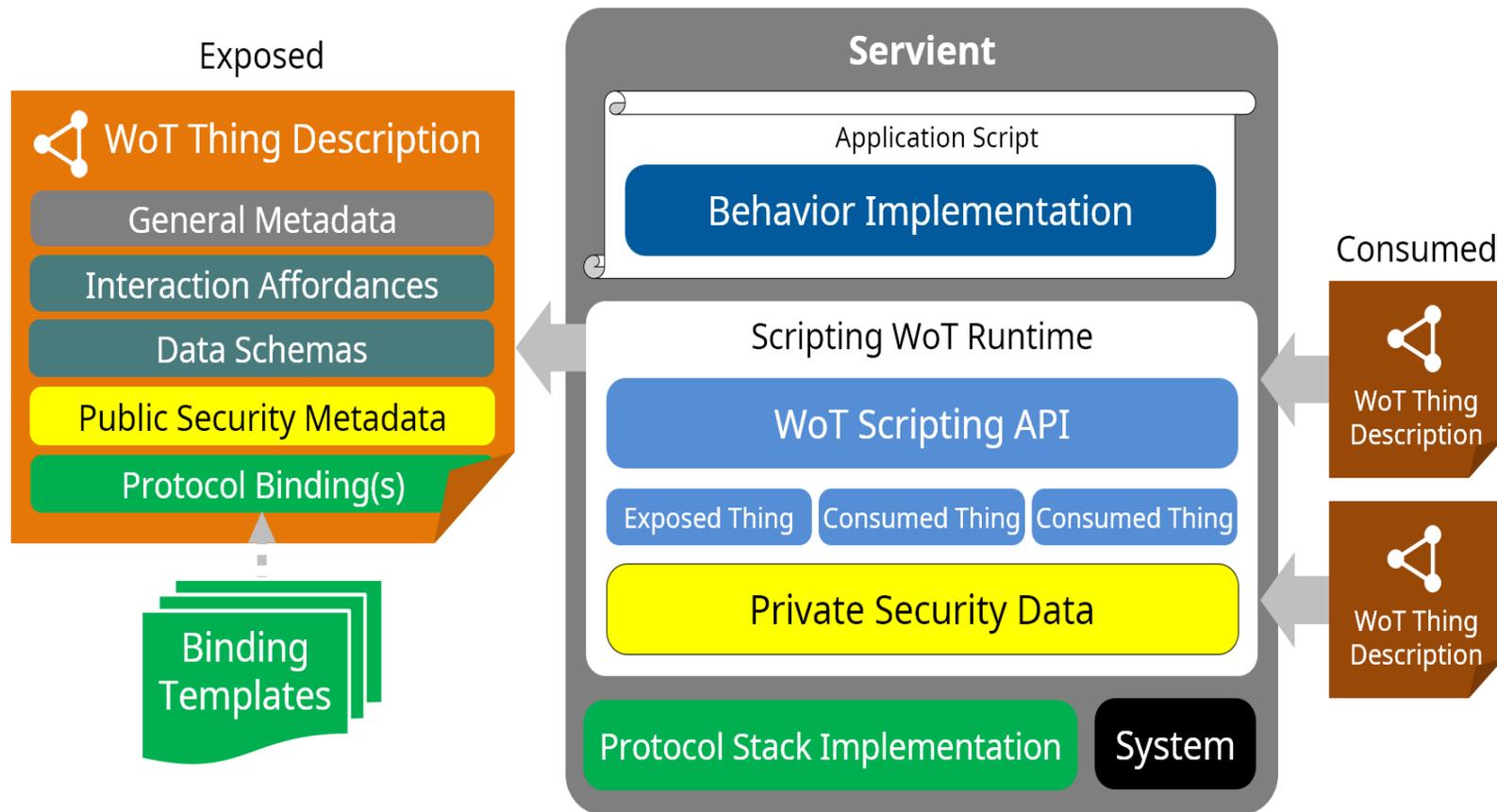


Interaction Affordances:

- Properties
- Actions
- Events

A **Protocol Binding** is the mapping from an interaction affordance to a concrete message of a specific protocol such as HTTP, CoAP, or MQTT.

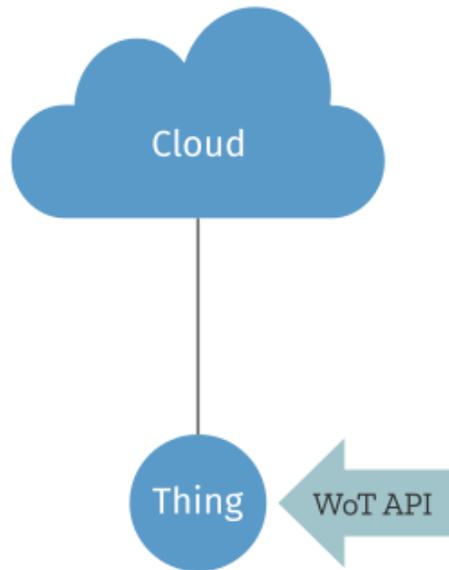
# A **servient** is programmed by interacting with its standard API.



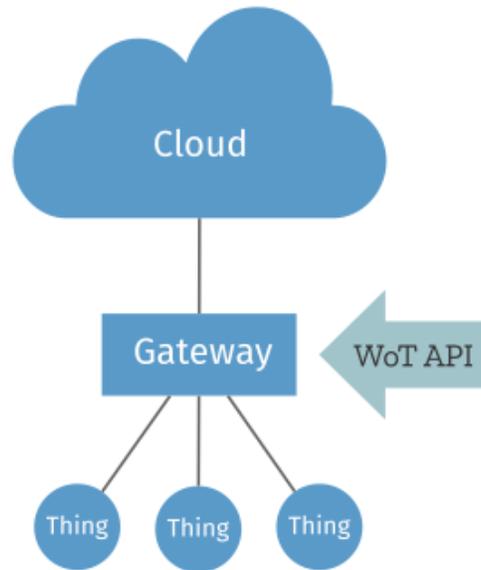
Implementation of a **Servient** using the WoT Scripting API. What has this approach done for browsers? Javascript code is downloaded and runs on diverse clients.

# Where will **servients** live?

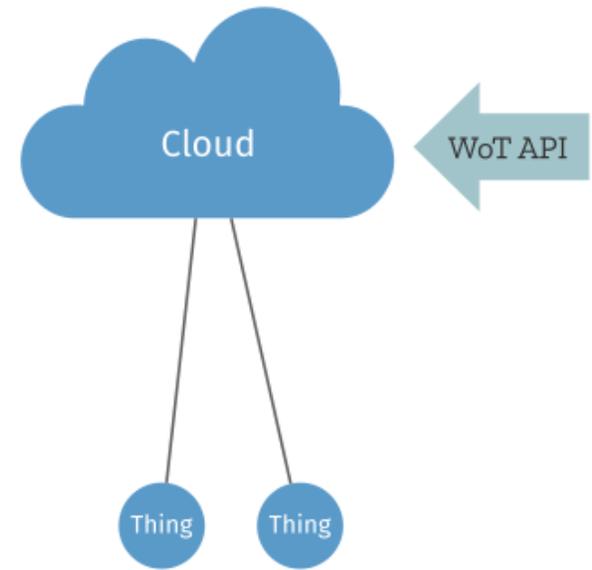
Direct Integration Pattern



Gateway Integration Pattern



Cloud Integration Pattern



A servient may live at any one of these locations.