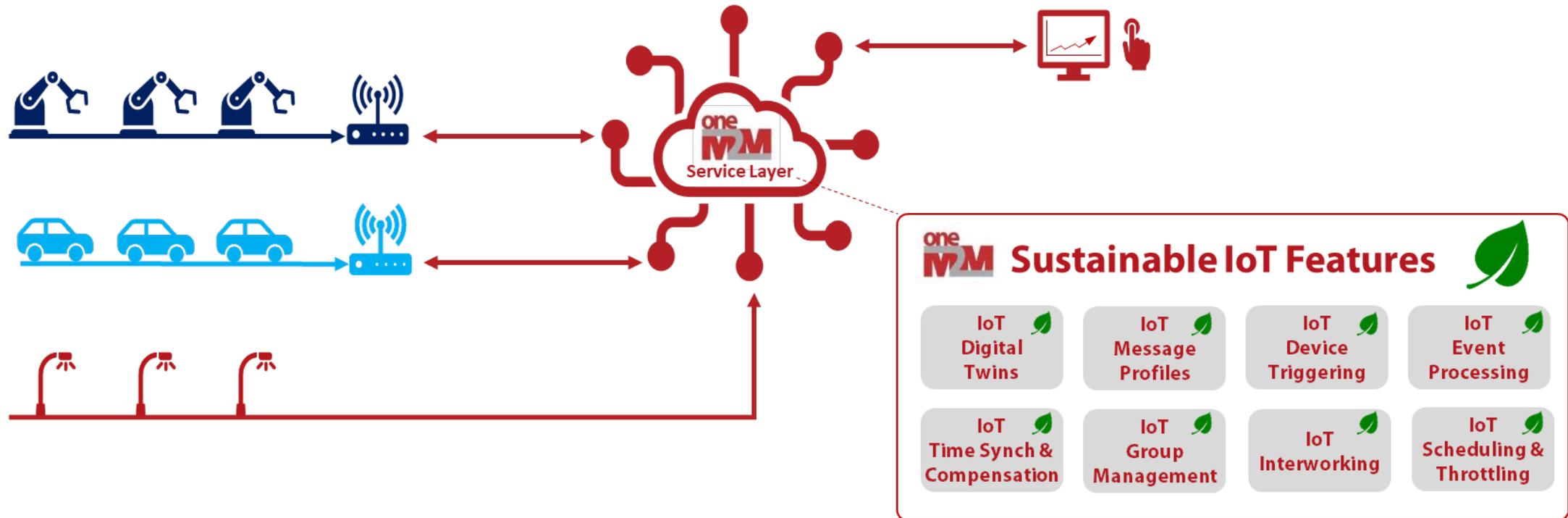# The Importance of IoT

IoT is a very important and well positioned technology to help reduce environmental impact and inefficiencies for many use cases.

E.g., smart farming, smart energy production, smart supply chain management, etc.

However, what's often overlooked is IoT technologies have their own carbon footprint which can undermine their benefits if not deployed responsibly.

oneM2M Sustainable IoT Features

The oneM2M standard provides several key features enabling more sustainable IoT deployments

Sustainable IoT Features

| IoT Digital Twins | IoT Message Profiles | IoT Device Triggering | IoT Event Processing |
| IoT Time Synch & Compensation | IoT Group Management | IoT Interworking | IoT Scheduling & Throttling |

These features can help reduce the energy consumption and carbon footprint of IoT deployments
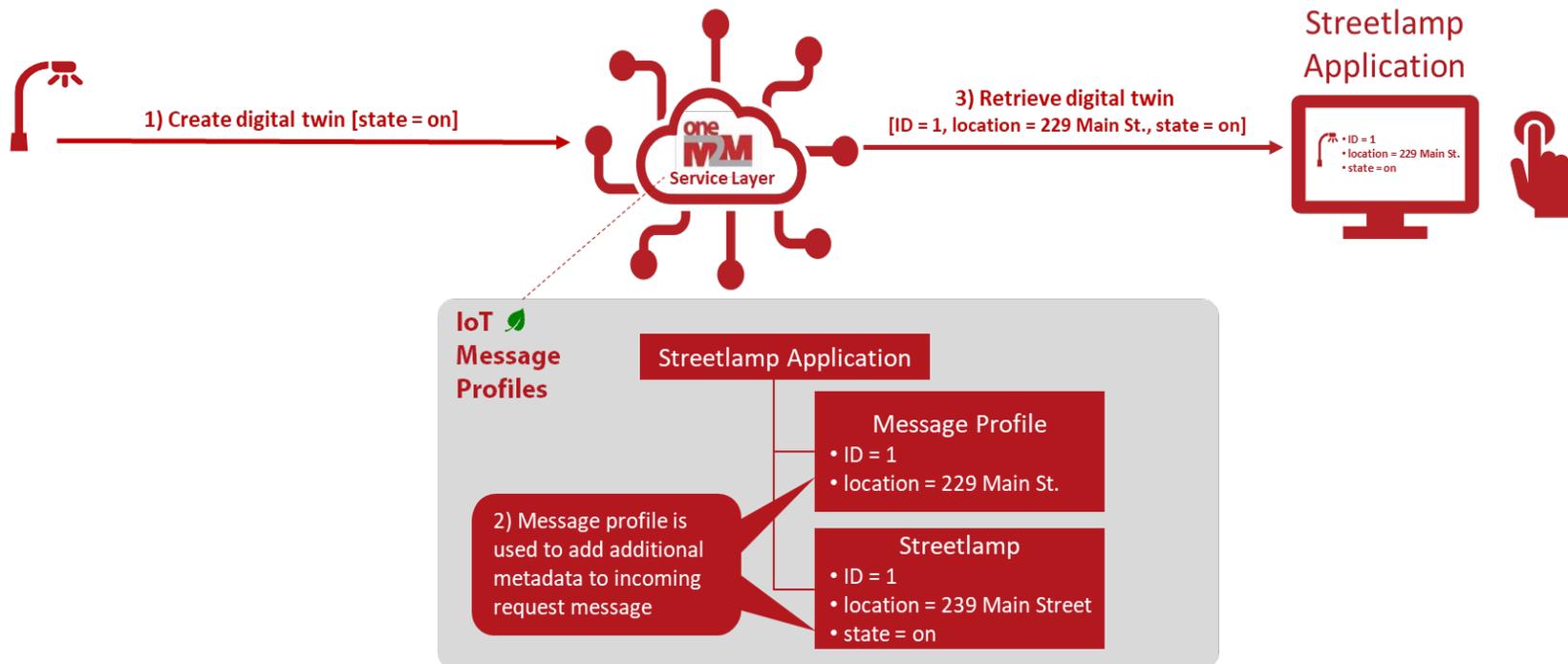
IoT Digital Twins
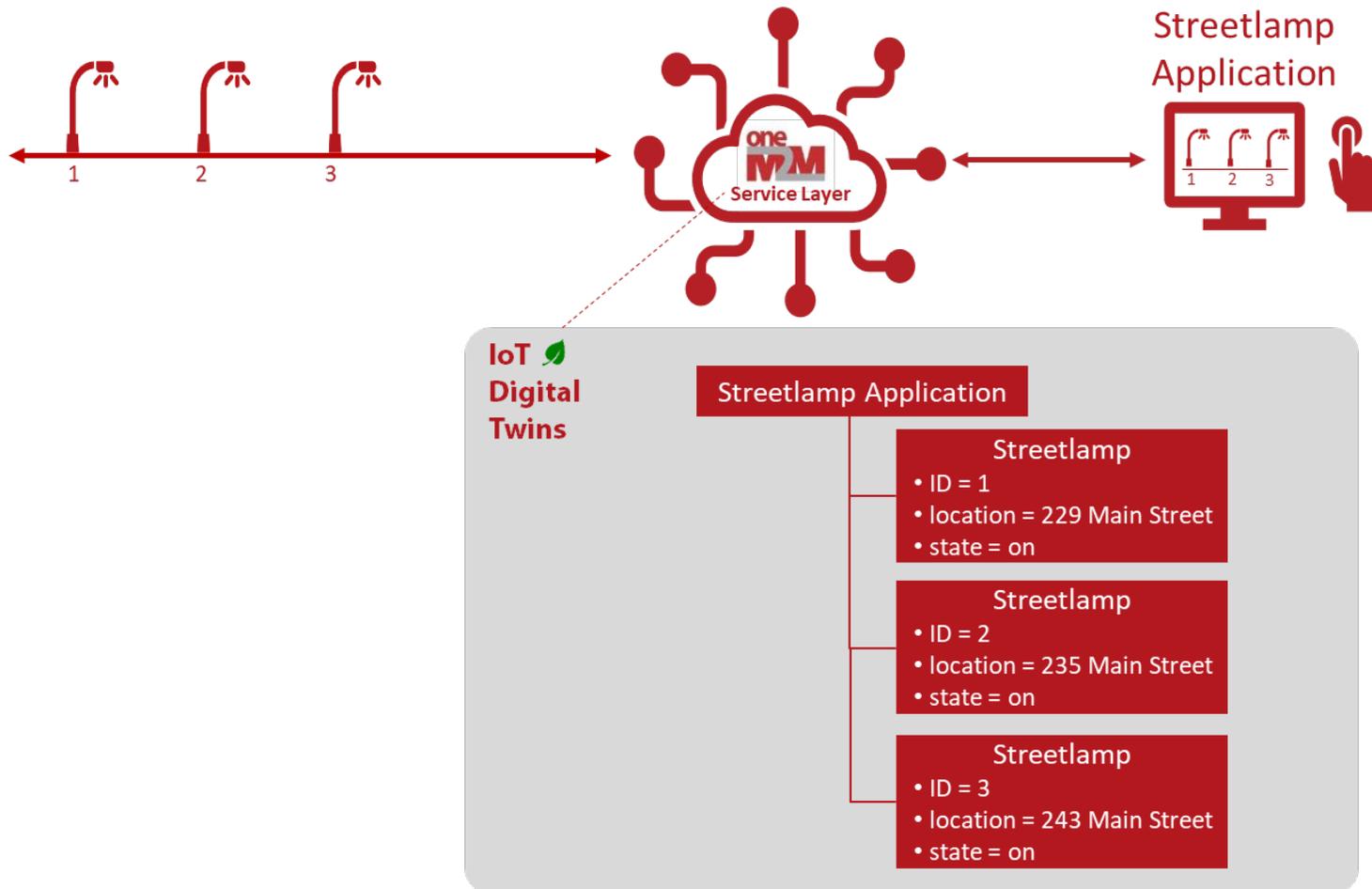
Use of IoT digital twin technology provides a huge power consumption benefit for IoT devices:
- Allows IoT devices to disconnect, power down and sleep for longer durations of time,
- Allows network applications to access device data while IoT devices are sleeping,
- Reduces load on devices – devices only need to interact with their digital twins and not all the applications interested in their data.

oneM2M defines a standardized and extensible framework for IoT digital twins. It provides developers with flexible options for representing their devices and applications as digital counterparts in the oneM2M service layer.

IoT Message Profiles

Streetlamp Application

1) Create digital twin [state = on]

Service Layer

3) Retrieve digital twin
[ID = 1, location = 229 Main St., state = on]

- ID = 1
- location = 229 Main St.
- state = on

IoT 🍃 Message Profiles

Streetlamp Application

Message Profile
- ID = 1
- location = 229 Main St.

2) Message profile is used to add additional metadata to incoming request message

Streetlamp
- ID = 1
- location = 239 Main Street
- state = on

The number of bytes included within each message a device sends or receives has a major impact on its battery life and the amount of congestion and overhead introduced into the network.
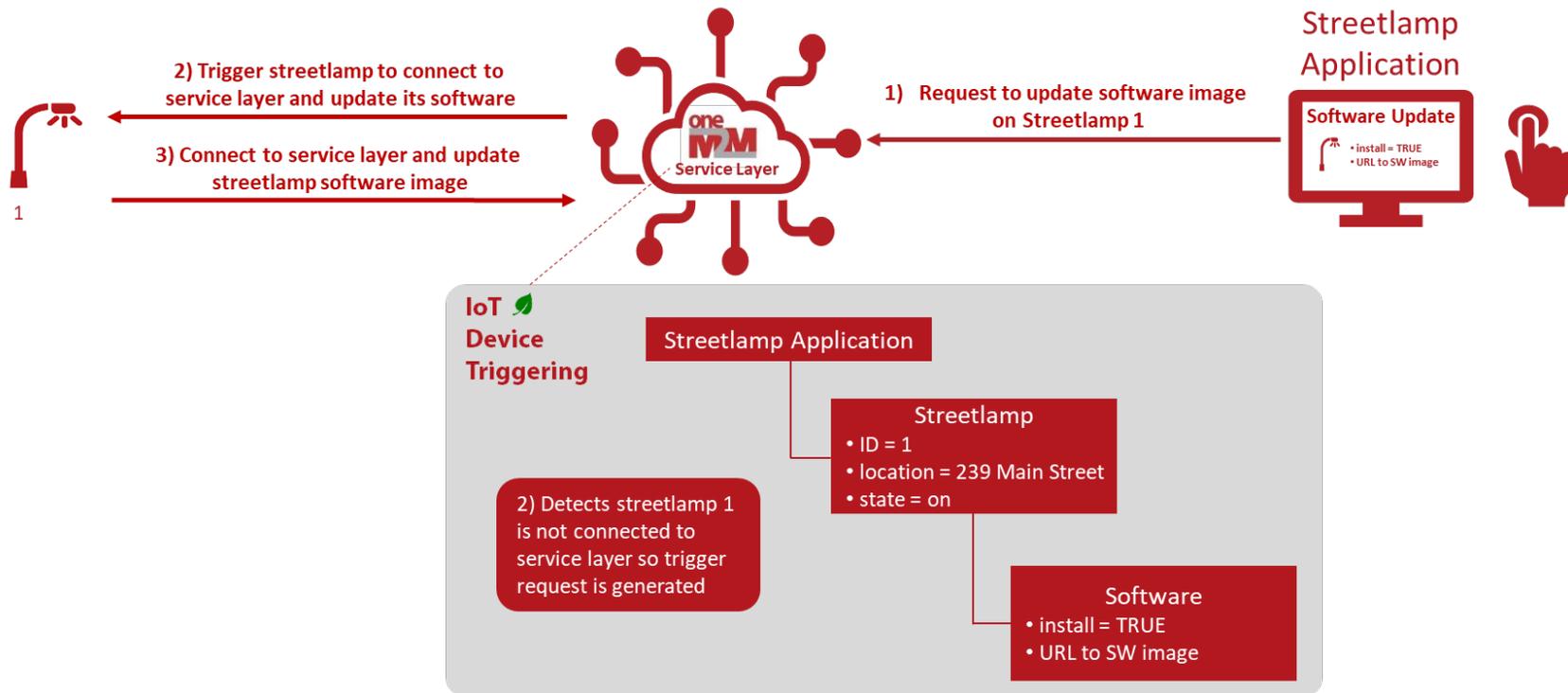
In many IoT use cases, there is a certain amount of static and repetitive data present in sensor readings (e.g., device description or location).

oneM2M defines message profiles to help streamline message sizes.

Devices send only the bare minimum amount of data that is dynamically changing.

oneM2M then enriches messages with static information using message profiles.

IoT Device Triggering

2) Trigger streetlamp to connect to service layer and update its software

1) Request to update software image on Streetlamp 1

3) Connect to service layer and update streetlamp software image

Streetlamp Application

Software Update
- install = TRUE
- URL to SW image

oneM2M Service Layer

IoT Device Triggering

Streetlamp Application

2) Detects streetlamp 1 is not connected to service layer so trigger request is generated

Streetlamp
- ID = 1
- location = 239 Main Street
- state = on

Software
- install = TRUE
- URL to SW image

oneM2M device triggering enables an IoT device to "sleep" for long periods of time when not in use, and intelligently "wake up" when applications need to interact with the device.

oneM2M triggers devices in an on-demand fashion via control plane of underlying communication network (e.g., 3GPP).

When device receives trigger, it fully powers-up, re-connects to the network and receives application messages.
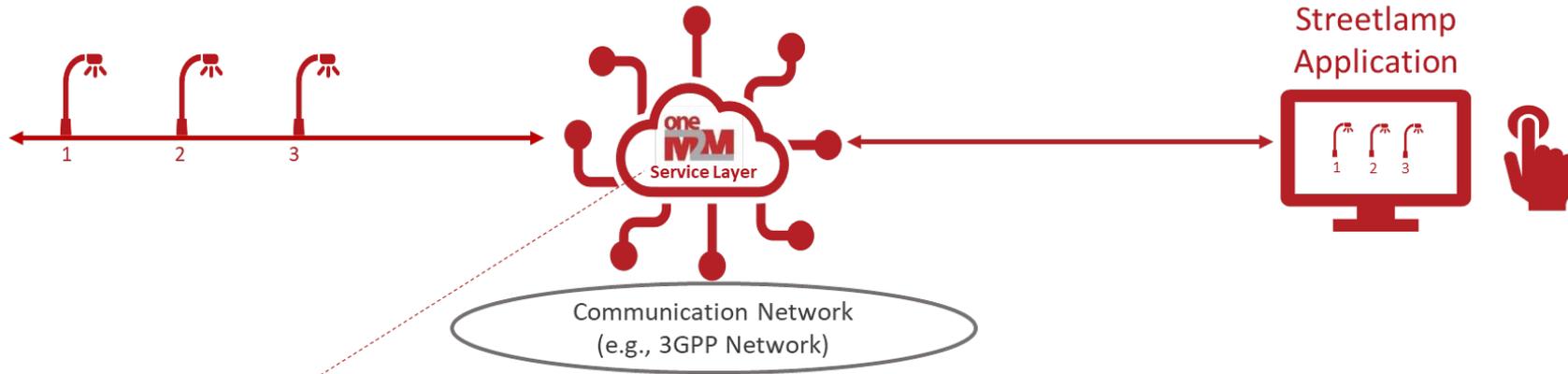
IoT Event Processing
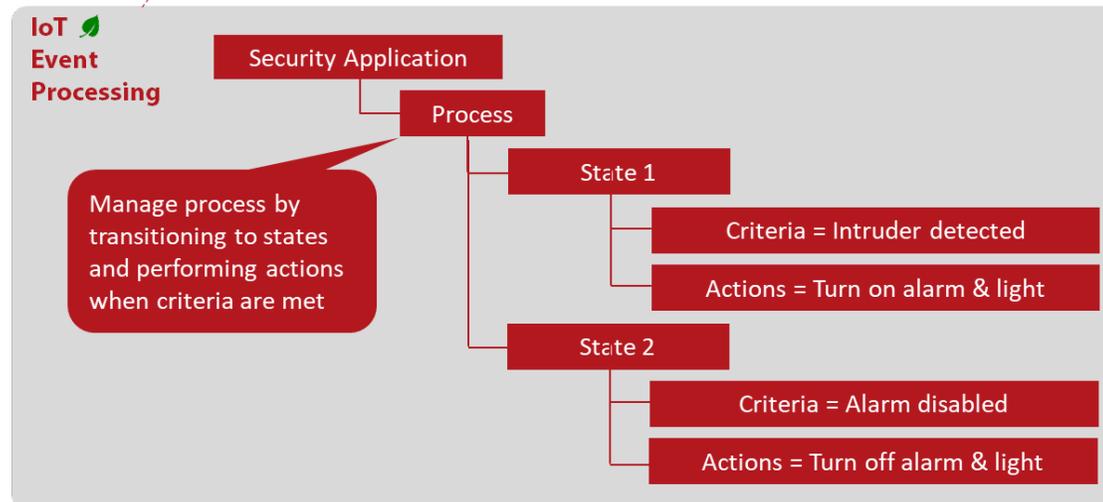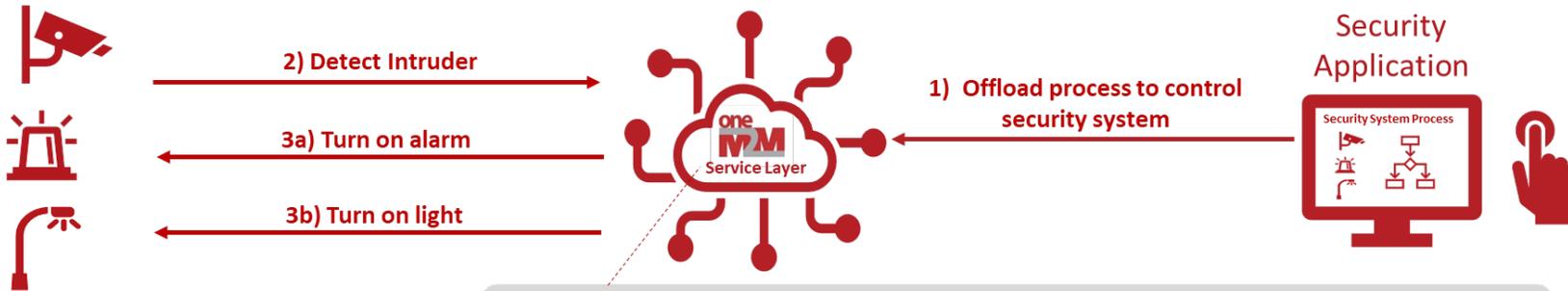
oneM2M supports offloading event detection and processing from devices and applications to the oneM2M service layer.

E.g., checking if sensor readings have crossed a certain threshold and performing actions such as switching an actuator on/off.
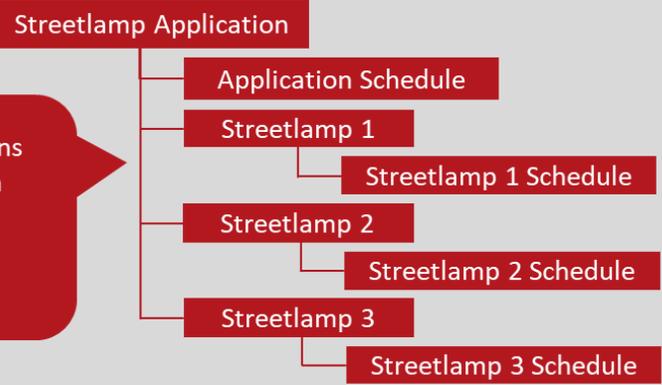
This offloading to the oneM2M service layer greatly reduces the amount of messaging and data exchanged in the system.

IoT Scheduling and Throttling

Streetlamp Application

By managing peak demands on communication networks, network operators can optimize the amount of network equipment (e.g., switches, routers, servers, cell towers and base stations) required to meet their customer demands. This can significantly reduce the energy consumption and carbon footprints of their networks.

oneM2M supports several scheduling and throttling features to help network operators minimize the peak demand on their communication networks.

Communication Network
(e.g., 3GPP Network)
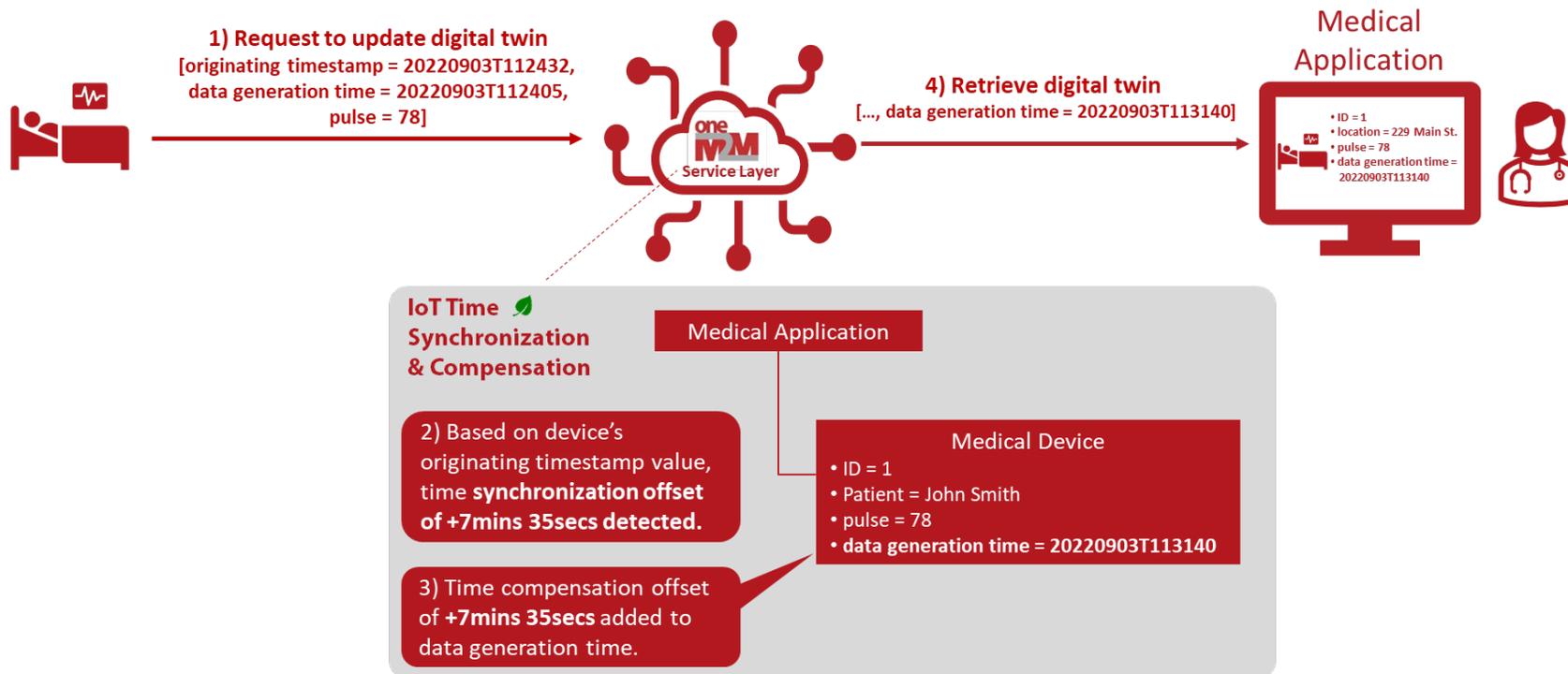
**IoT 🍃
Scheduling & Throttling**

- Schedule message exchanges between devices and applications
- Interwork with communication networks to detect congestion
- Adjust schedules to alleviate network congestion
- Throttle messages to alleviate network congestion
- Batch messages to increase efficiency of message exchanges

Streetlamp Application

Application Schedule

Streetlamp 1

Streetlamp 1 Schedule

Streetlamp 2

Streetlamp 2 Schedule

Streetlamp 3

Streetlamp 3 Schedule

IoT Time Synchronization & Compensation

1) Request to update digital twin
[originating timestamp = 20220903T112432,
data generation time = 20220903T112405,
pulse = 78]

4) Retrieve digital twin
[..., data generation time = 20220903T113140]

oneM2M
Service Layer

Medical Application

- ID = 1
- location = 229 Main St.
- pulse = 78
- data generation time = 20220903T113140

IoT Time 🍃 Synchronization & Compensation

Medical Application

2) Based on device's originating timestamp value, time synchronization offset of +7mins 35secs detected.

3) Time compensation offset of +7mins 35secs added to data generation time.

Medical Device
- ID = 1
- Patient = John Smith
- pulse = 78
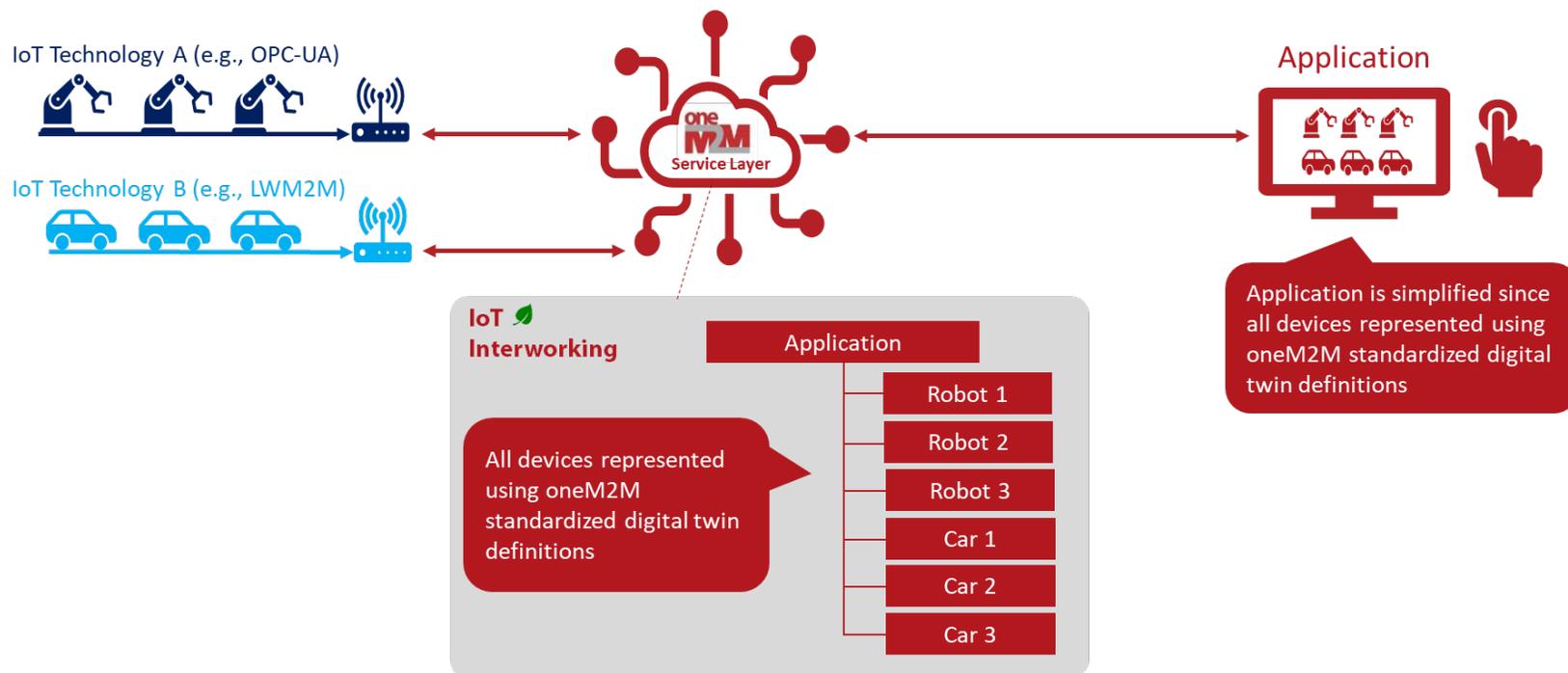- **data generation time = 20220903T113140**

Many resource constrained devices lack the capability to keep their local time synchronized with other devices in the network using traditional technologies such as GPS and Network Time Protocol (NTP).

oneM2M supports low-overhead time synchronization capabilities for IoT devices.

E.g., when messages containing timestamp information are received from devices, the oneM2M service layer can adjust the timestamps to compensate for any detected time offsets.

IoT Interworking

IoT Technology A (e.g., OPC-UA)

IoT Technology B (e.g., LWM2M)

oneM2M
Service Layer

IoT 🌿 Interworking

Application

All devices represented using oneM2M standardized digital twin definitions

Robot 1
Robot 2
Robot 3
Car 1
Car 2
Car 3

Application

Application is simplified since all devices represented using oneM2M standardized digital twin definitions

Interworking different IoT platforms together with one another can be challenging, especially newer and older platforms.

This typically requires developing complex and costly custom over-the-top application code to glue these platforms together.

This can lead to frustration and frequent swapping out and replacing of older platforms with new ones.

This is problematic from a sustainability perspective since frequent refreshing of older platforms with newer ones generates a significant amount of e-waste

oneM2M can help extend the life of IoT deployments by standardizing and simplifying how IoT platforms are interworked with one another.

IoT Group Management
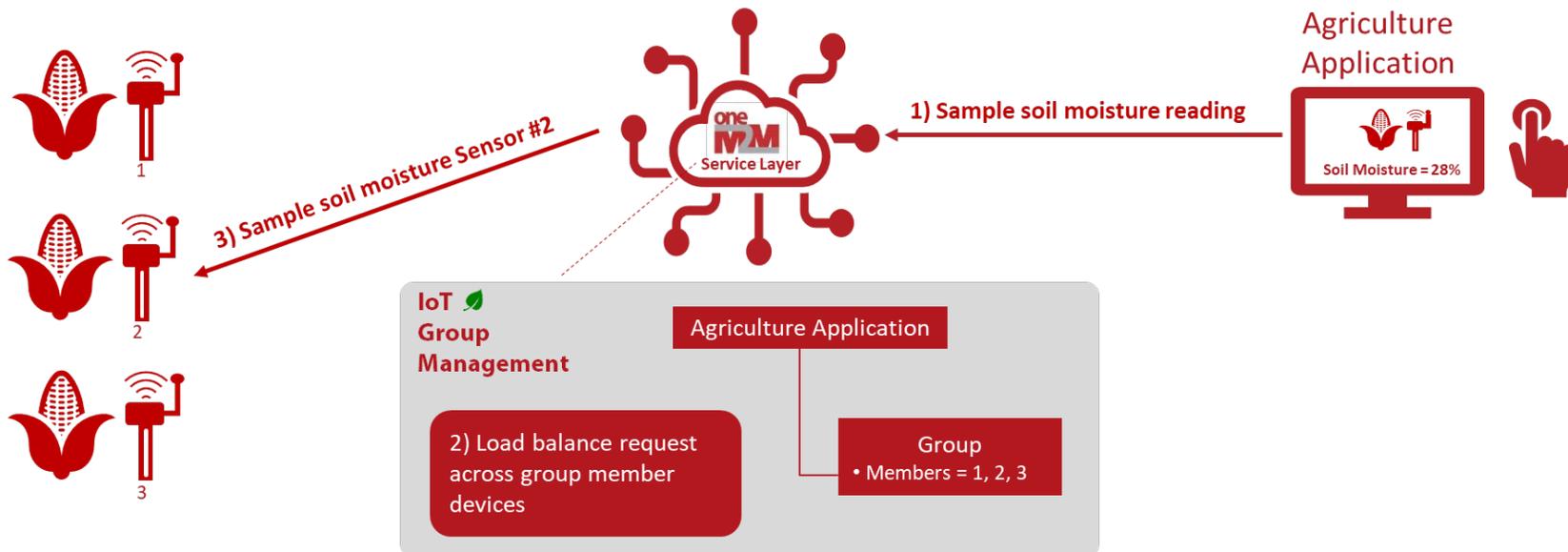
Deploying IoT devices in groups can extend overall lifetime of an IoT deployment and reduce its carbon footprint.

oneM2M supports load balancing requests across a group of functionally equivalent devices.

This can extend the battery lifetime of individual devices as well as extend the overall IoT system deployment lifetime.
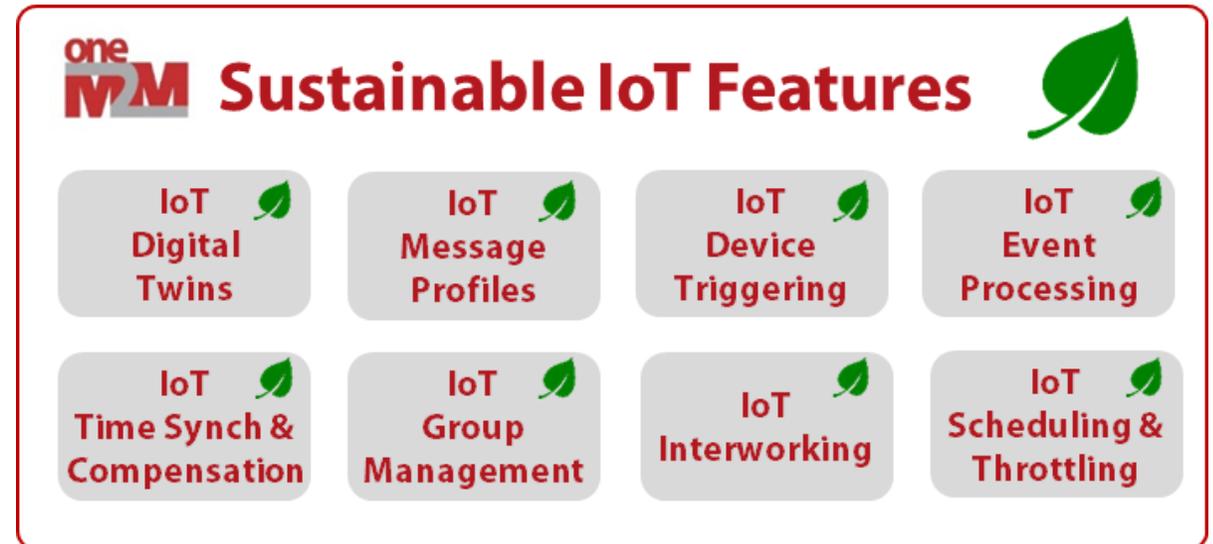
Takeaways

→ IoT deployments have their own carbon footprint which can undermine their sustainabilitybenefits.

→ oneM2M provides several key features that enable more sustainable IoT deployments

→ These feature can reduce energy consumption, increase system longevity, and minimize the amount of e-waste of IoT deployments

Link to oneM2M Sustainability White Paper

http://www.oneM2M.org

Thank You!

Dale Seed

oneM2M Technical Plenary Vice Chair

oneM2M Sustainability Sub Committee Convenor

Principal Engineer, InterDigital / Convida Wireless

dale.seed@interdigital.com