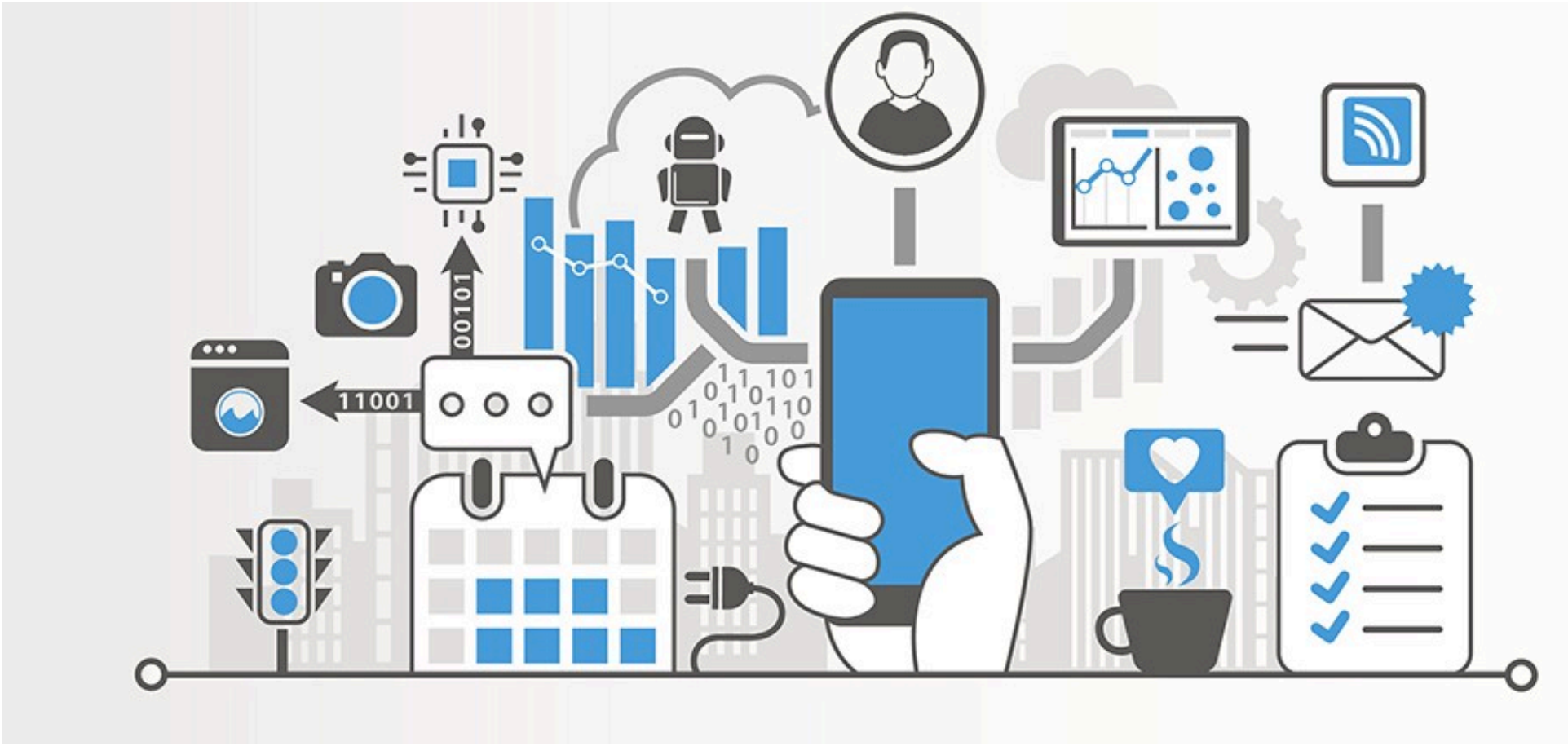
Programming for IoT Applications

Edoardo Patti

Lecture 11



PLATFORMS FOR INTERNET OF THINGS APPLICATIONS

What is Middleware?

Middleware *is computer software that provides services to software applications beyond those available from the operating system. It can be described as "software glue". Middleware makes it easier for software developers to perform communication and input/output, so they can focus on the specific purpose of their application.*

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Middleware is the software that connects software components or enterprise applications. Middleware is the software layer that lies between the operating system and the applications on each side of a distributed computer network. Typically, it supports complex, distributed business software applications.

What is a peer-to-peer communication?

The **peer-to-peer (P2P) communication** paradigm is a *self-organizing of equal, autonomous entities (peers), which aims to shared usage of distributed resources in a networked environment avoiding central services.*

Each peer acts simultaneously as supplier and consumer of resources enabling the communication directly with another peer.

LinkSmart Middleware

LinkSmart is a middleware for heterogeneous IoT devices in a distributed architecture:

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- It helps on **registering, discovering and exploiting services and devices** from LinkSmart application. This overcomes the common problem of incompatibility between proprietary protocols and devices.
- It **delivers development tools** for ambient intelligent applications using such IoT device.
- It **abstracts IoT devices** as a web services to provide a uniform access to their resources.

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It consists of two main distributed components:

- LocalConnect
- GlobalConnect

Some definitions

- **Device** is a physical IoT device with communication capabilities providing a “native” communication protocol or an API and exposes various Resources (sensors, actuators) over it.

- **Resource** is an abstraction of a “real” resource (sensors, actuators) hosted by a Device, which has a state that can be obtained and/or manipulated. The access to this state is provided and managed by the hosting Device

LinkSmart LocalConnect

In its core, the LocalConnect is a software components done by:

- Service Catalog
- Resource Catalog
- Device Connector

LinkSmart LocalConnect – Service Catalog

The **Service Catalog** is a **service registry system**. It registers and provides the services available in the network exposing JSON-based RESTful API.

The Service Catalog can be considered as the entry point for applications and other components (e.g. Device Connector), mainly to discover registered services in the network (e.g. Resource Catalog).

Service Catalog contains entries of everything that is meant to be discovered by applications and other services, which can be called a “service” (not just a physical device or a “virtual sensor”).

LinkSmart LocalConnect – Resource Catalog

The **Resource Catalog** is a **device registry system**. It registers and provides a registry of available IoT devices and the resources they expose. It exposes a simple **JSON-based RESTful API**, which is intended to be used by:

- Device Connectors to register the available devices and their resources
- Applications to discover these devices and learn how to talk with them

LinkSmart LocalConnect – Device Gateway

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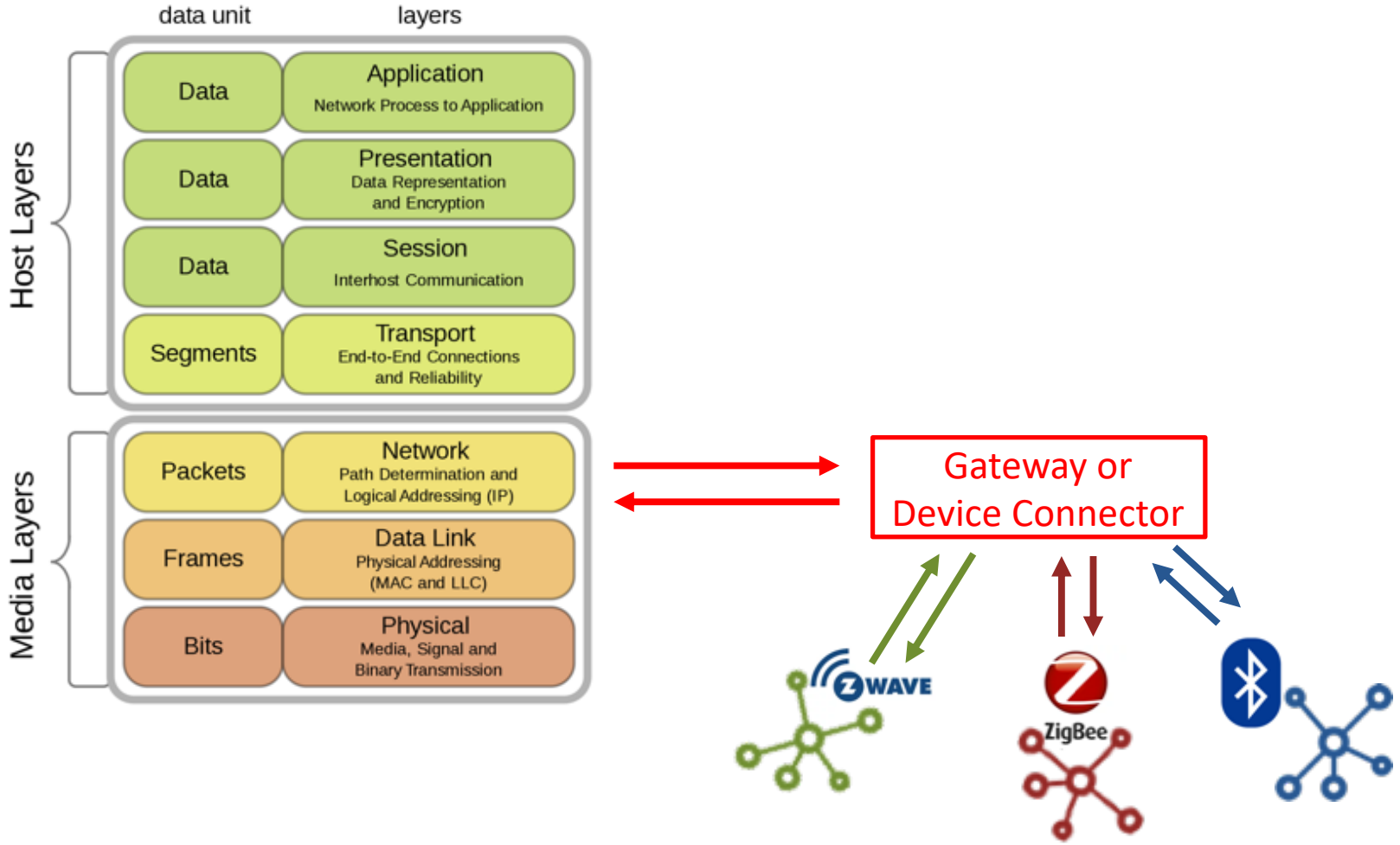

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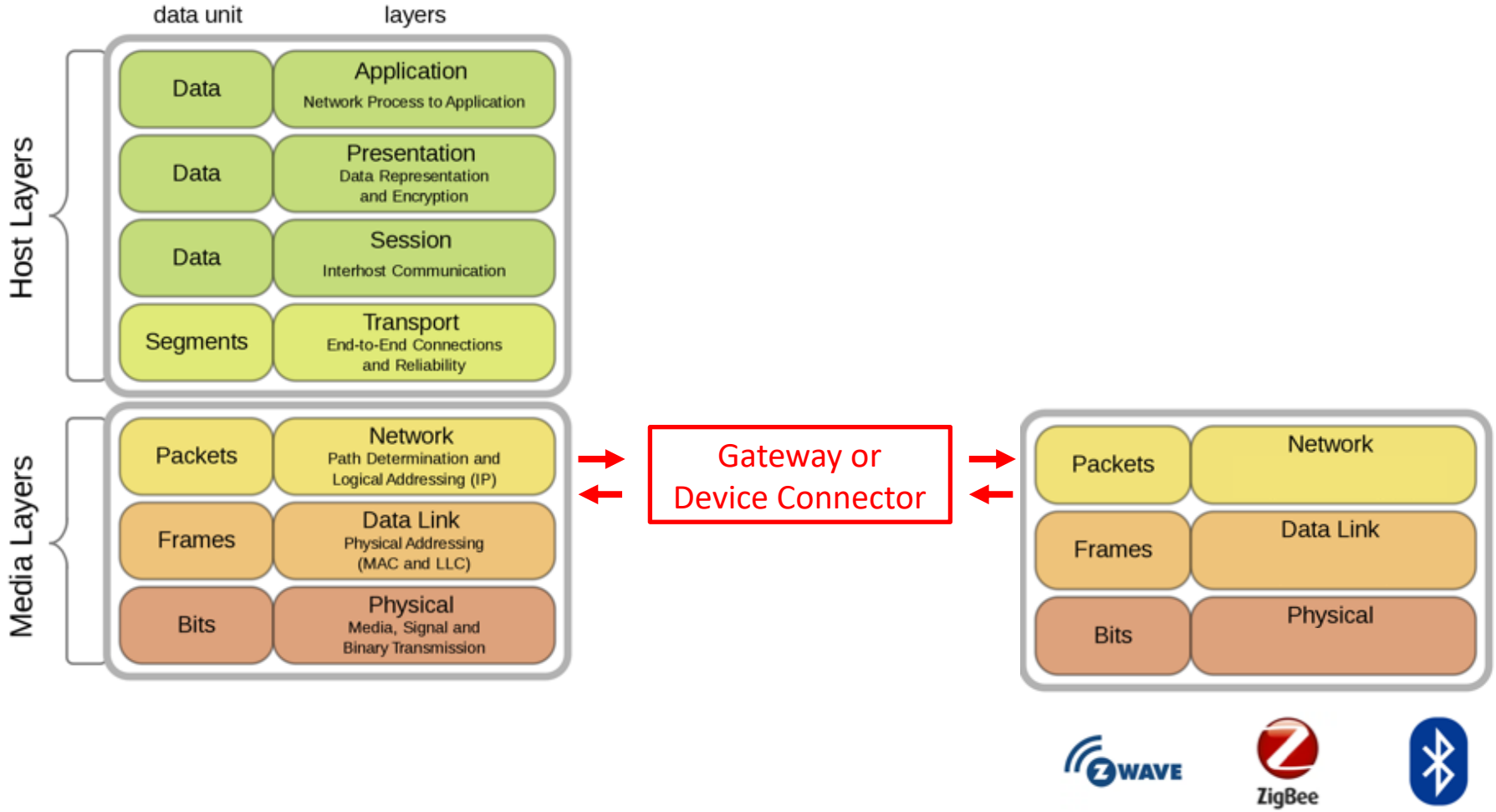

LinkSmart LocalConnect – Device Gateway

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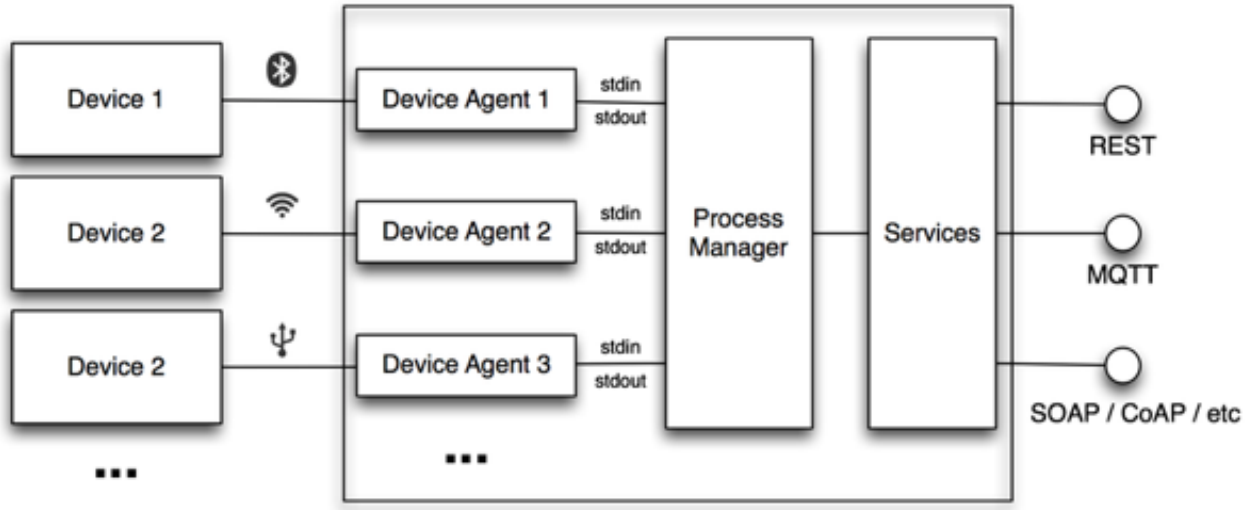
A Device Connector implements the following functionality:

- Manage devices and their resources in the Resource Catalog:
  - Publish registrations to Resource Catalog
  - Continuously update these registrations
  - Remove the registrations on devices failures and graceful shutdown of the Device Connector
- Provide communication with devices over the network via standardized protocols (E.G. HTTP/REST, MQTT, etc.)

LinkSmart LocalConnect – Device Gateway

The **Device Connector** is a ready to use software component offering a simple integration of various IoT devices in LinkSmart and rapid prototyping.
It acts as a gateway between the low-level hardware access protocol and a TCP/IP network.



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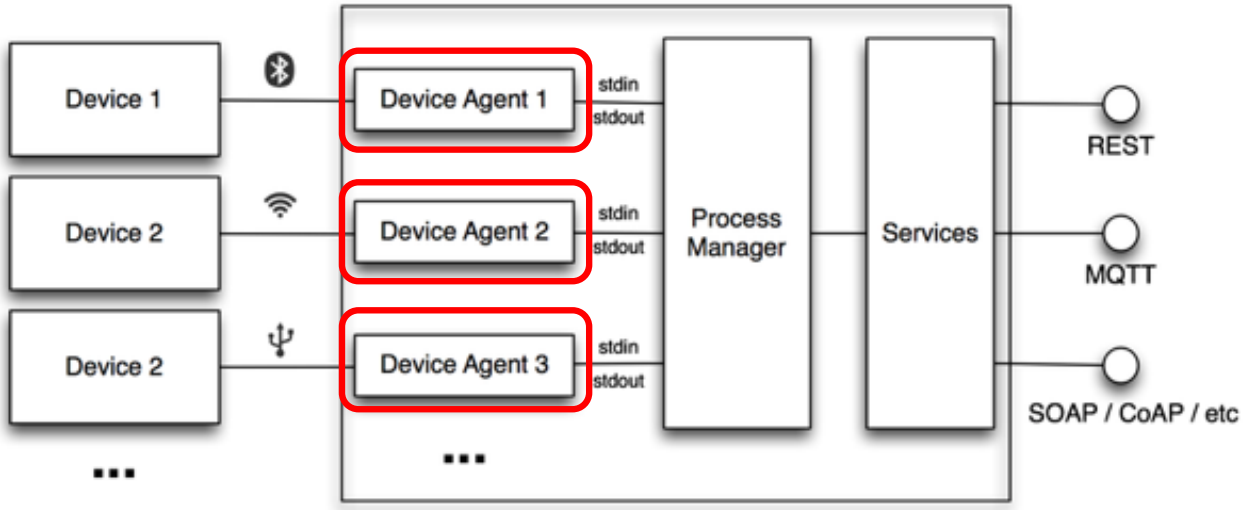
- **Device Agent:** it implements the low-level communication with actual devices using its interface and protocol



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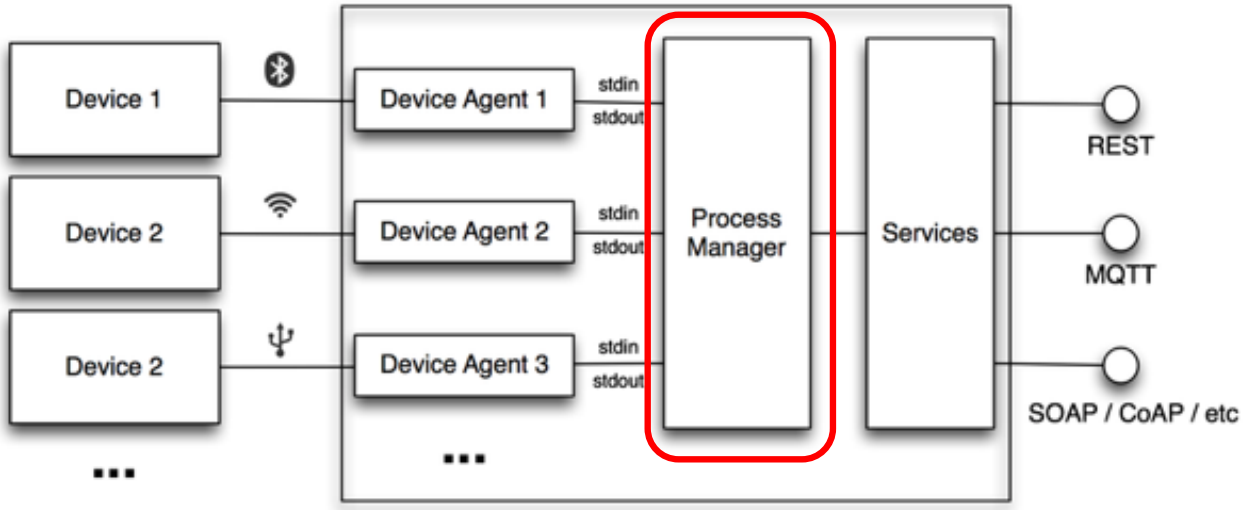

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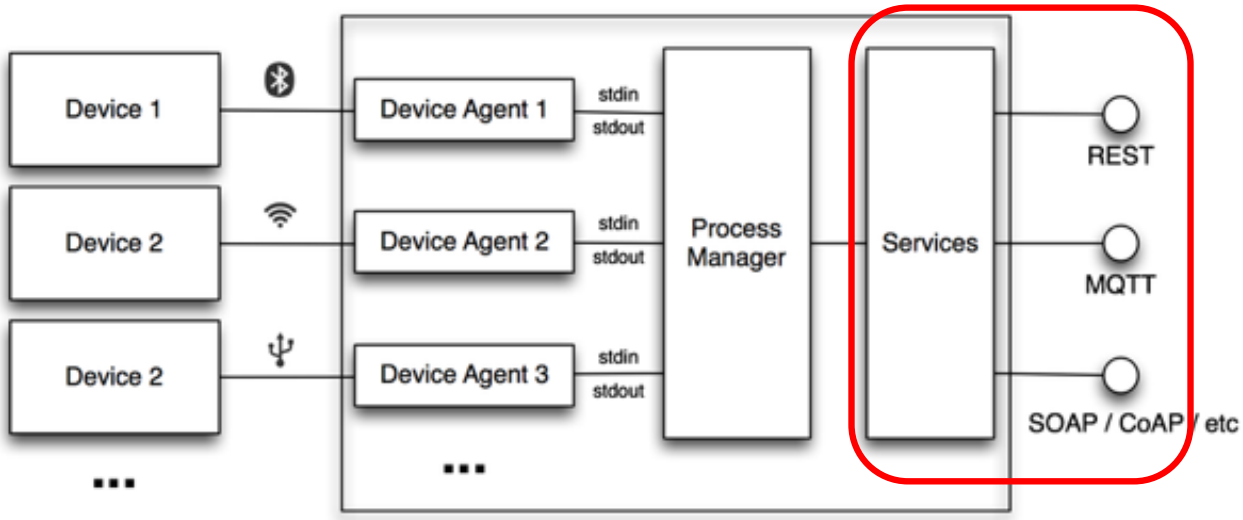
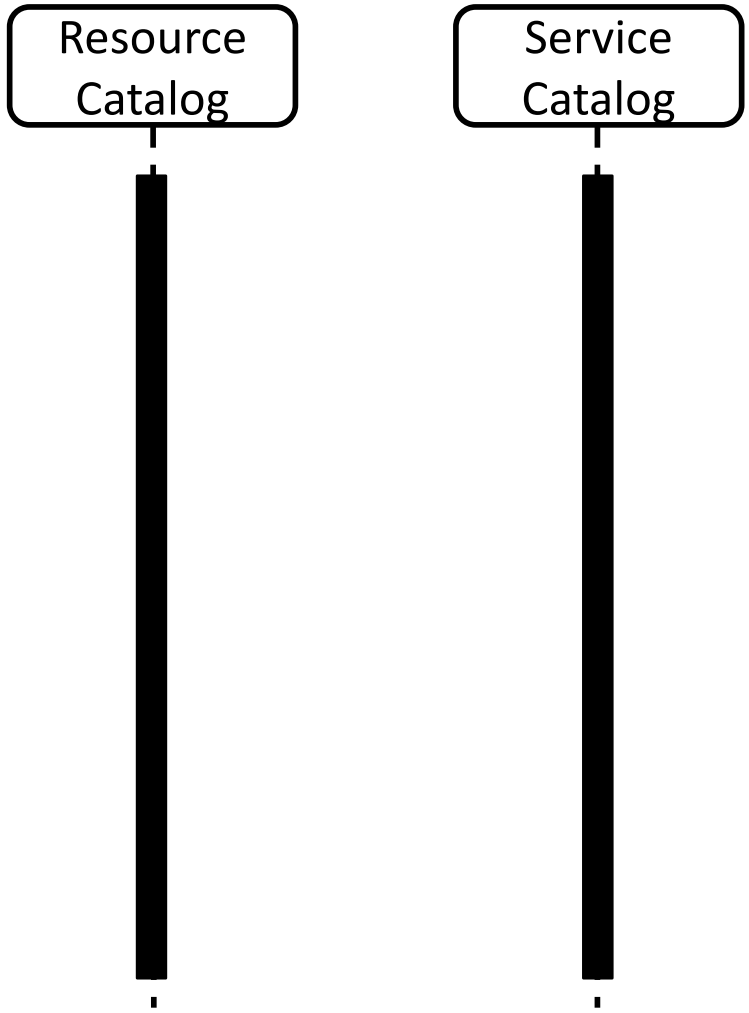
- **Process Manager:** it executes the right device agents, depending on user settings
- **Services component:** it is responsible for establishing communication with the connected devices trough standard internet protocols (e.g. REST and/or MQTT).



LinkSmart LocalConnect – Communication Flow



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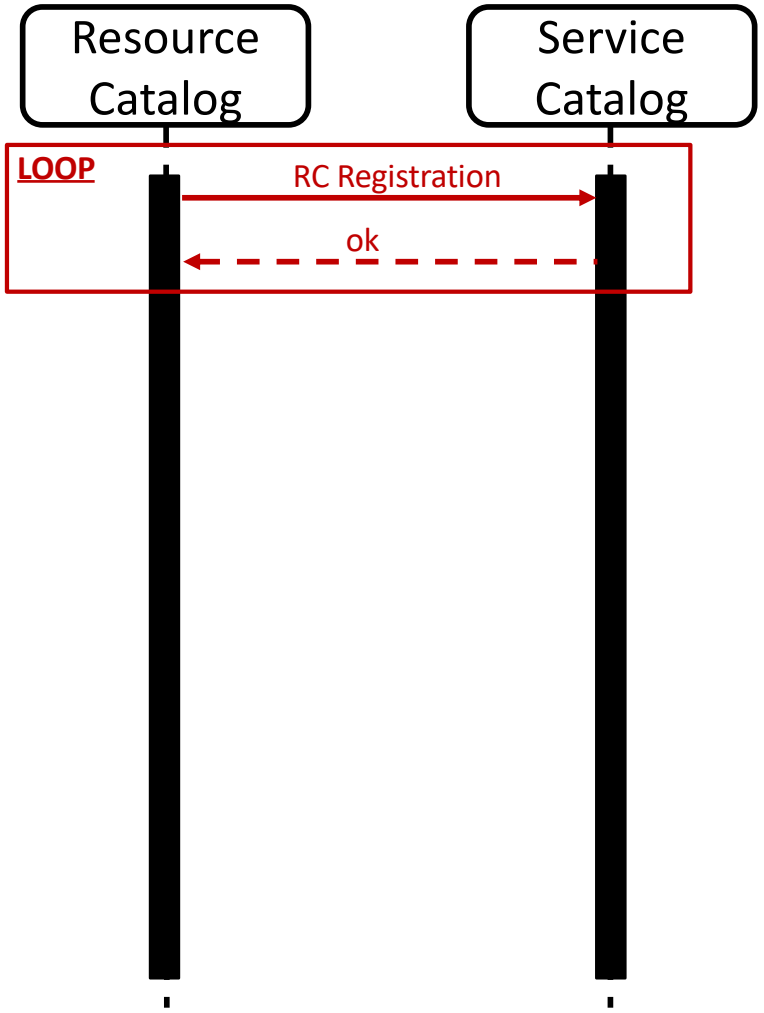

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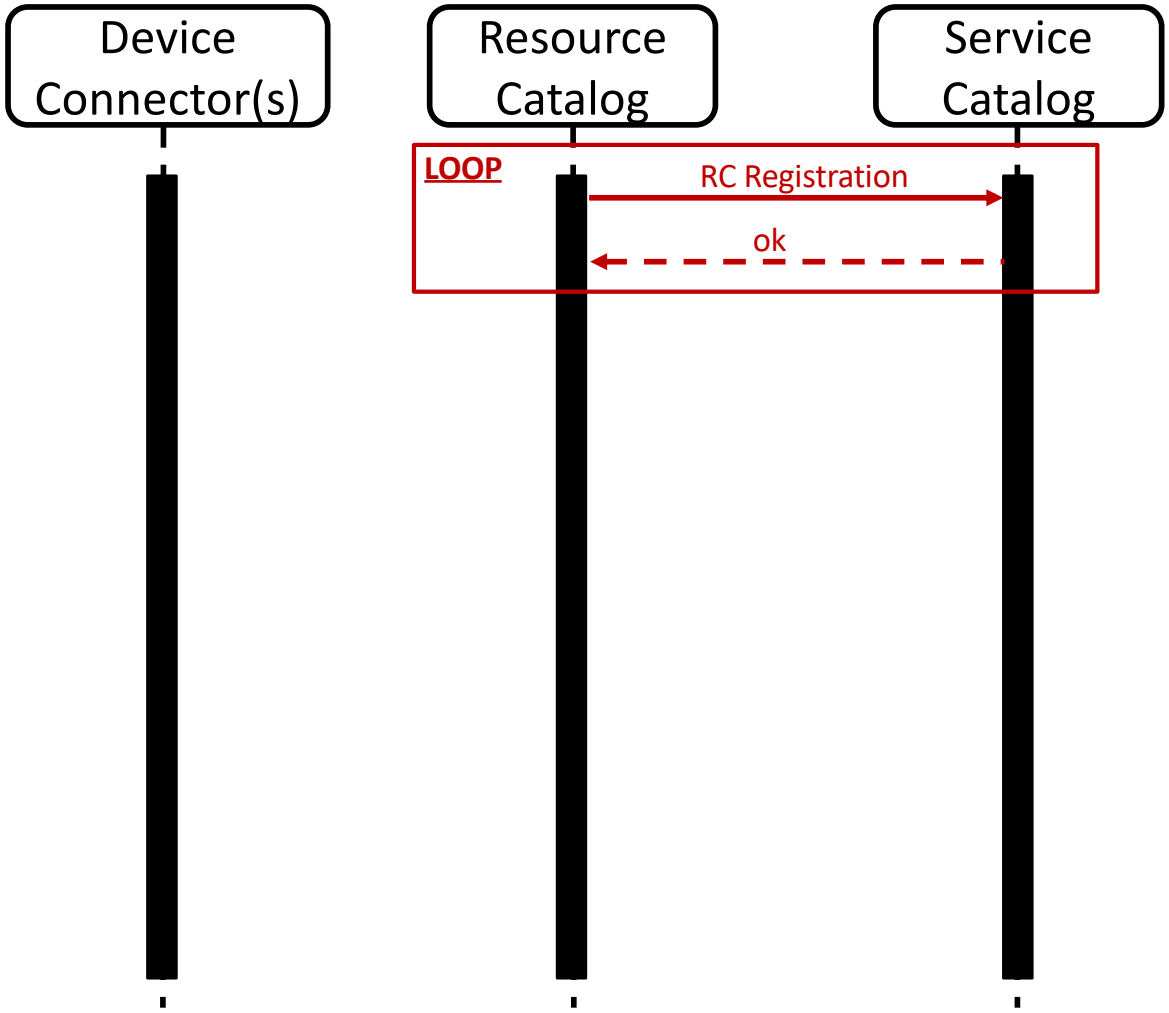

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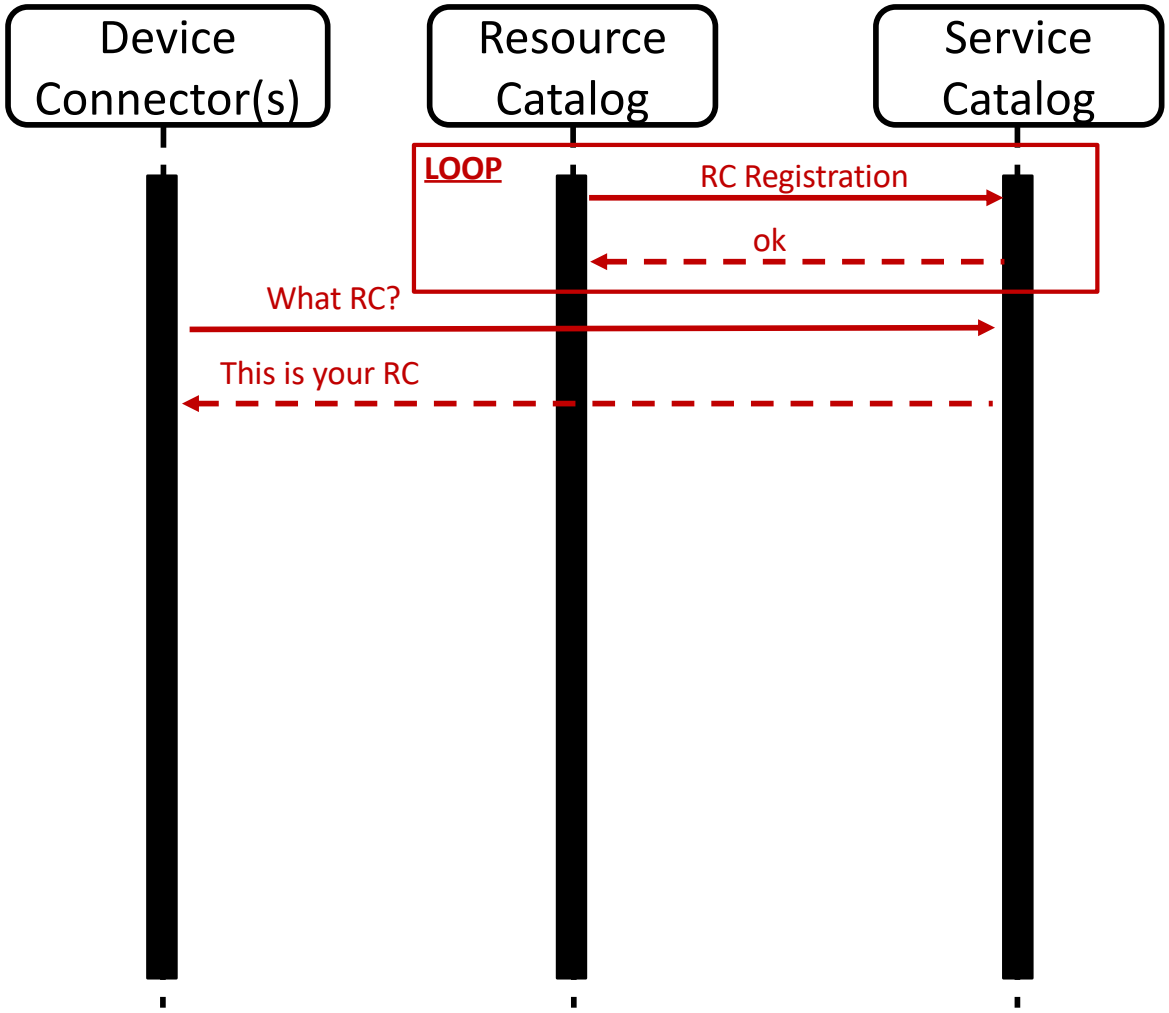

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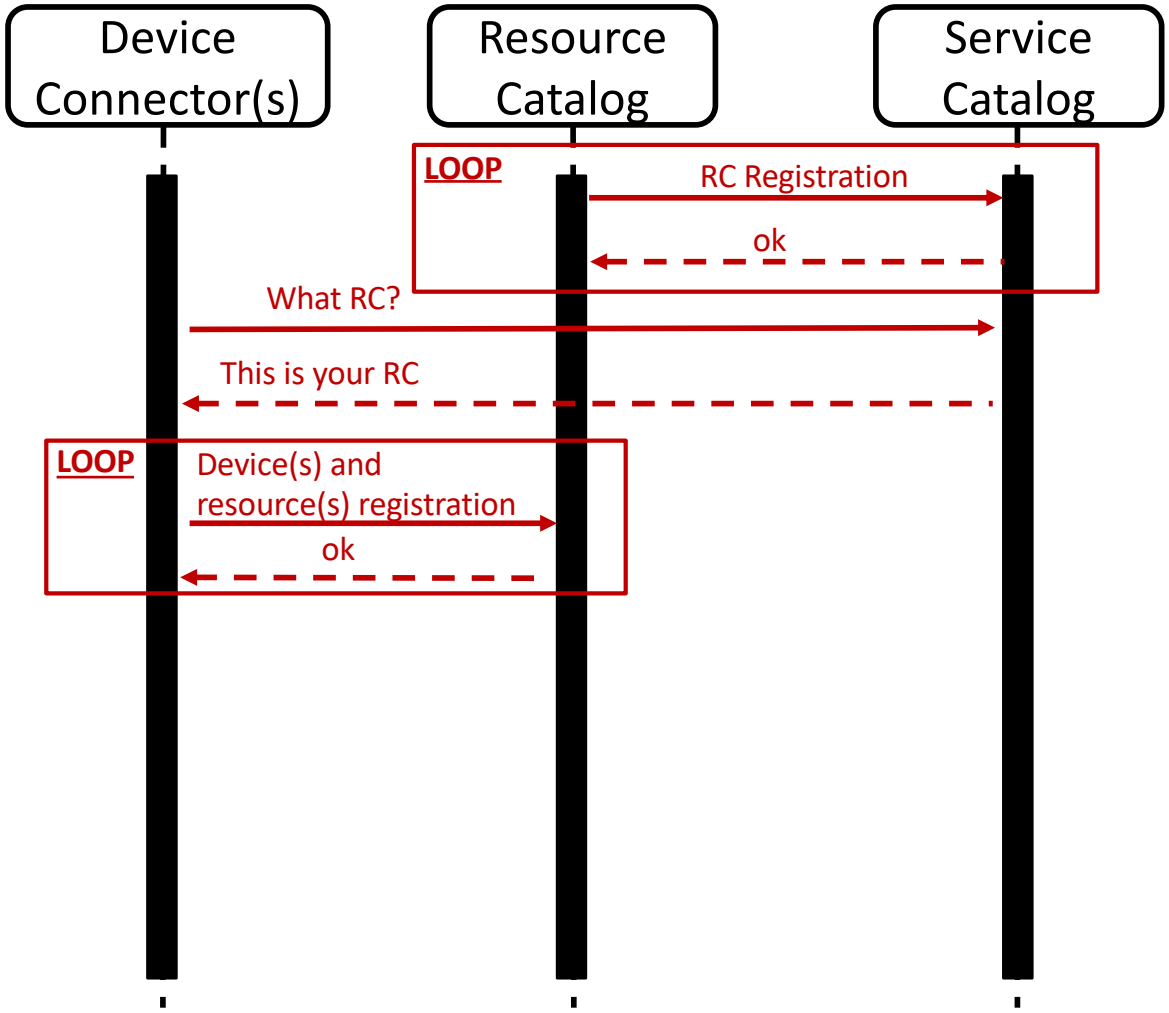

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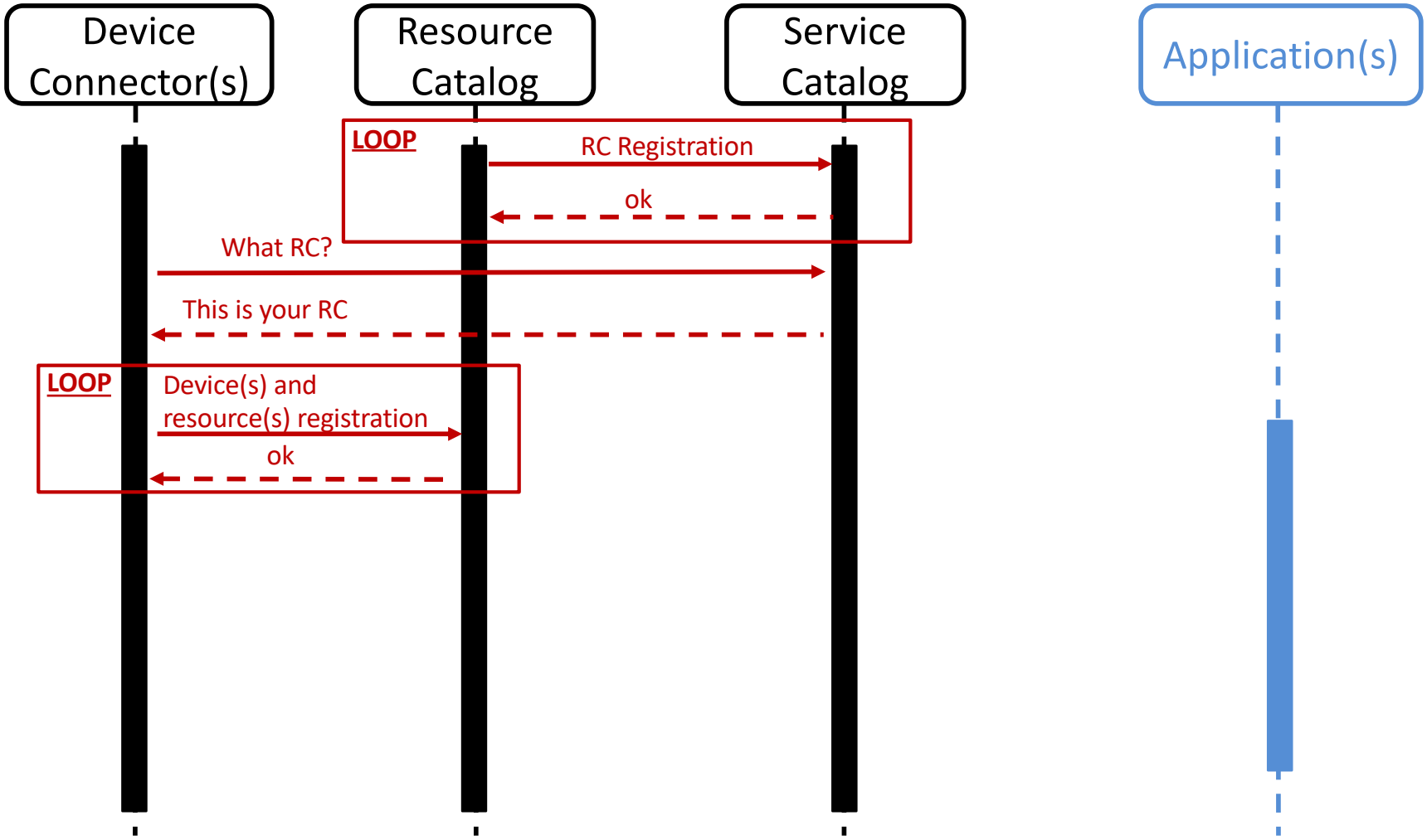

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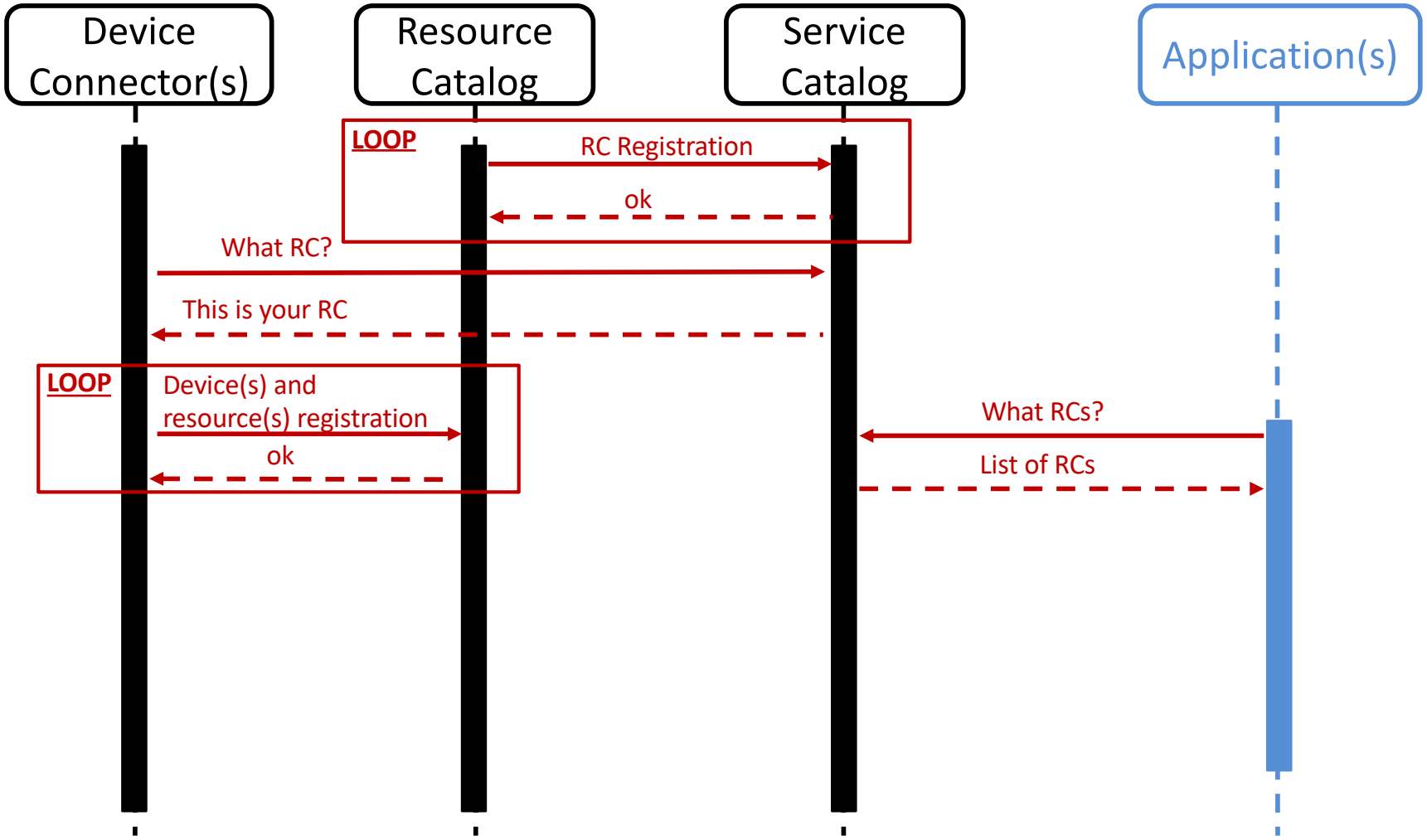

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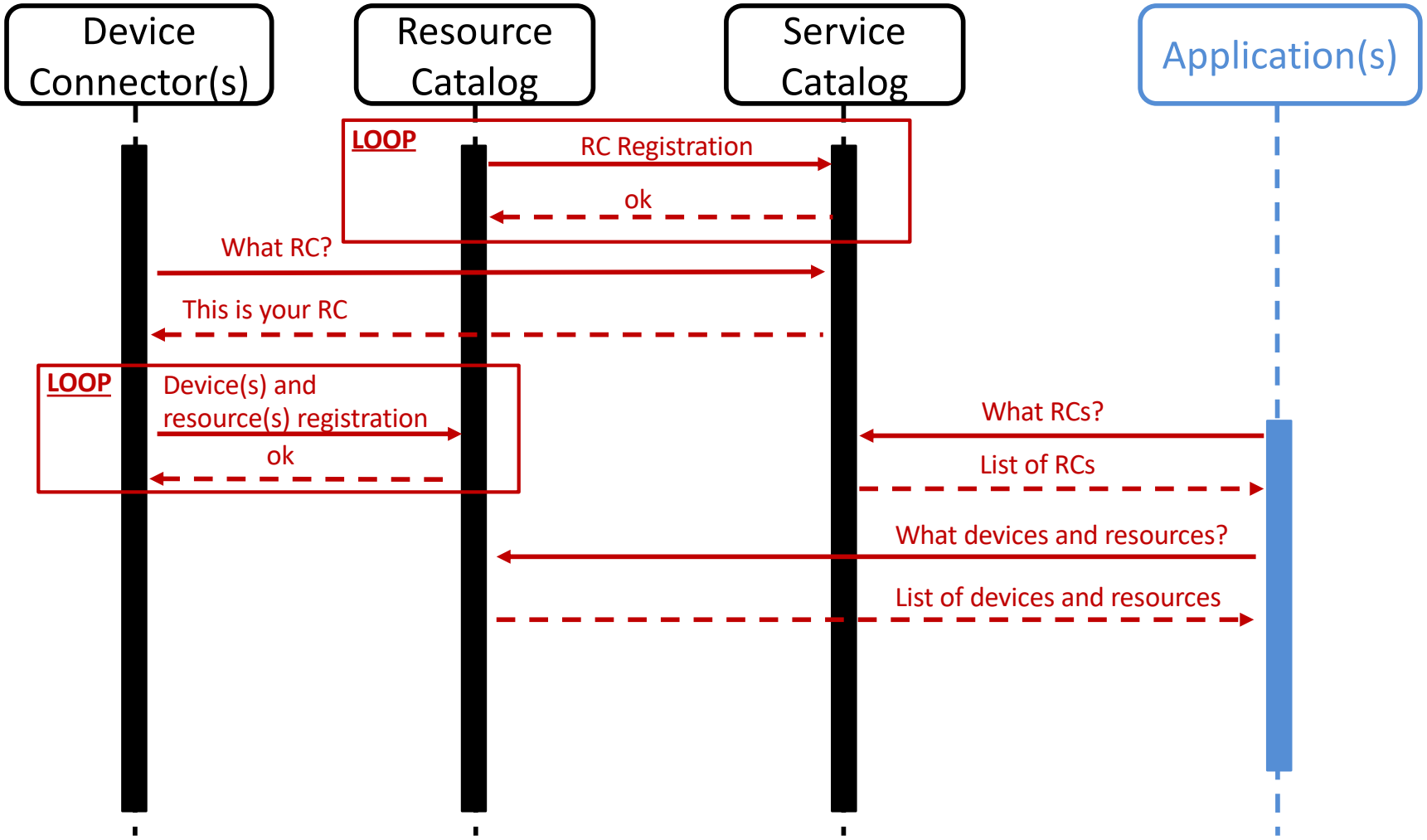

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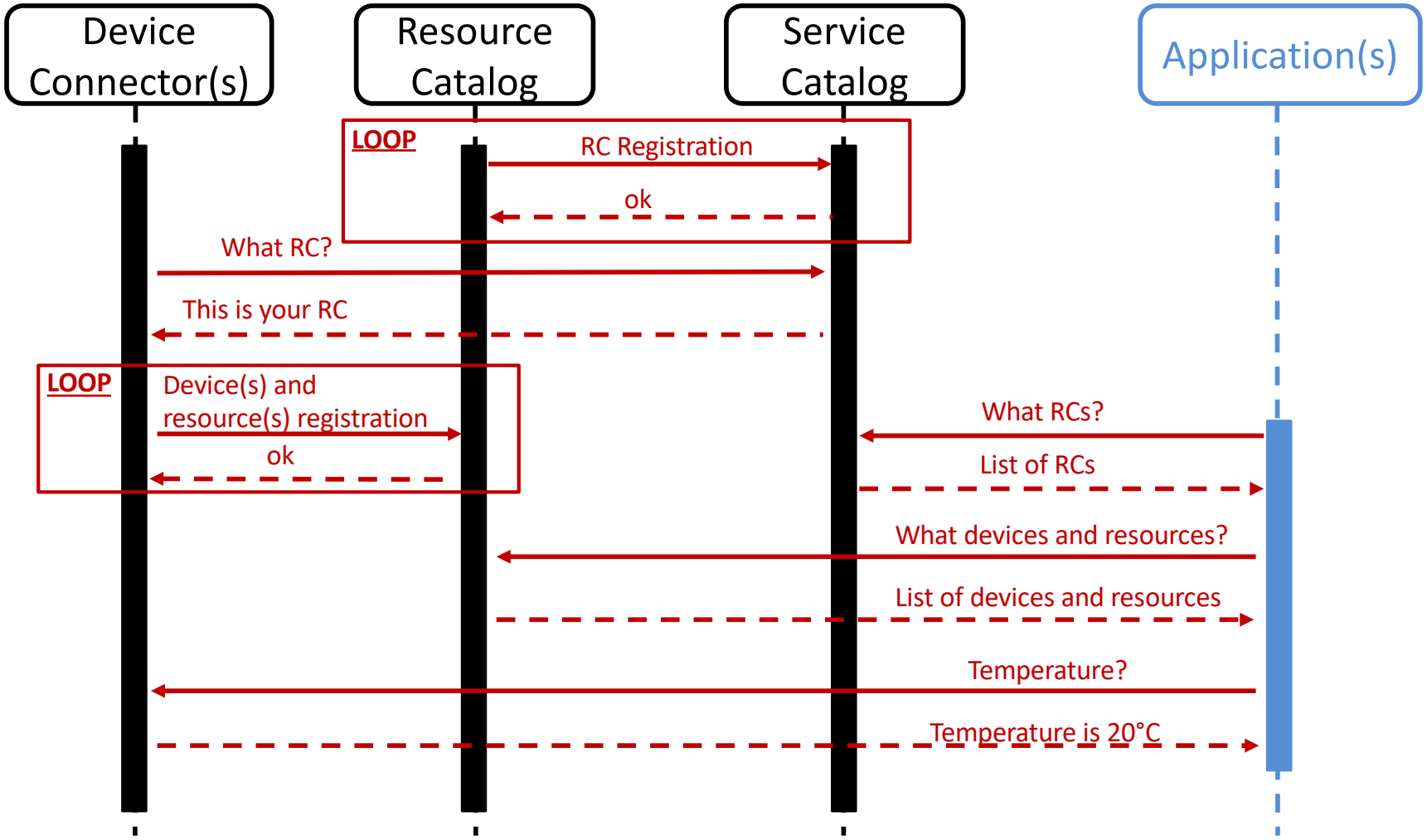
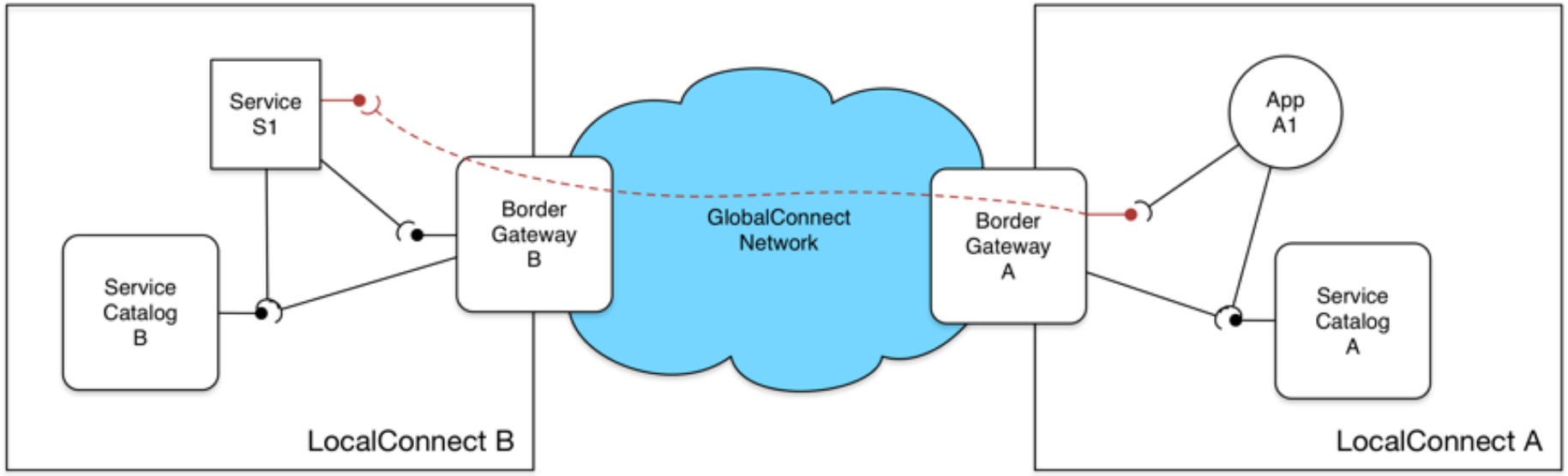


LinkSmart GlobalConnect

The main functionality of the GlobalConnect is to provide a **Tunnelling Service** that enables transparent communication of applications and services beyond the boundaries of a private (routable) network. It helps to connect remote LocalConnect environments over the Internet.



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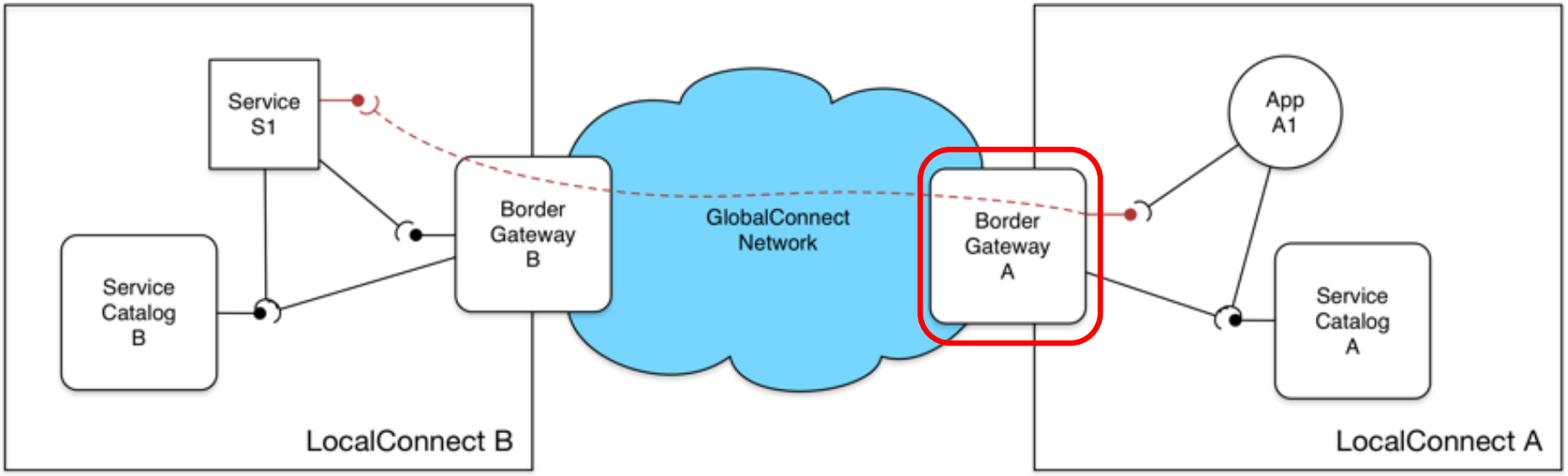
A **Border Gateway**, that provides **Tunnelling Service**, can be used to expose a local network. Different local networks communicate with a Tunnelled Service via Border Gateways service to a **GlobalConnect Network** (across the Internet). The Border Gateway connected to the GlobalConnect Network provides access to Tunnelled Services, so applications from other private networks.



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