Green Enterprise Patterns

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To provide services and goods, enterprises are consuming and using various types of resources. The use of resources, especially the use of non-renewable resources or resources that originate certain pollution or waste, has an intrinsic impact to our environment. However, the health of our environment is crucial for life on earth. The patterns in this work, namely Integrated Green Business, Green Resource Providing, Green Service Communication and Green Service Selection, address different aspects of sustainability that may be considered when building enterprises with sustainability in mind.

Categories and Subject Descriptors: I.5.0 [Pattern Recognition], I.5.2 [Pattern Recognition]: Pattern Analysis

General Terms: Management, Documentation, Design, Standardization.

Additional Key Words and Phrases: Environment, Business, Enterprise, Health of Environment, Business Design, Sustainability

1. INTRODUCTION

Enterprises are primarily built to gain profit by offering specific products or services that serve a particular demand. Each enterprise tries to maximize its profit by selling as many products or services as possible. However, the creation of products and services has an immense impact on our environment. We consider the responsible selection and use of resources as one of the meanings of the term “green”.

Each creation process consumes a certain amount of resources. This can typically either be direct or indirect resources. Direct resources are used in the form of raw materials or supplementary goods, for example, and are processed within or for an enterprise. Indirect resources are resources where the changes of the state of the environment have been induced before the organization uses them, like electricity.

The selection of proper resources as well as the proper and efficient usage of those resources is crucial to reduce the environmental impact of enterprises to a minimum. The patterns of this work are intended to help people in building sustainable enterprises considering the harmony and the health of the environment. Especially, they focus on how to integrate the different services that are implemented to build up the value stream(s) of an enterprise.

2. THE BEGINNING OF A GREEN BUSINESS PATTERN LANGUAGE

When talking about a “language of patterns” we stick to the interpretation of Hanmer (Hanmer 2012) who describes a language as a set of patterns that are used to solve a problem of a particular domain. The patterns comprised in a language are structured in such a way that stakeholders can navigate through the complete set of patterns, selecting suitable patterns, and recognize the relations between the patterns in order to solve even bigger problems. Depending on different use case scenarios, a different set of suitable patterns may be selected. This aspect is also reflected by the abstract description of solutions which explicitly does not provide final and concrete solutions for a very specific use case.

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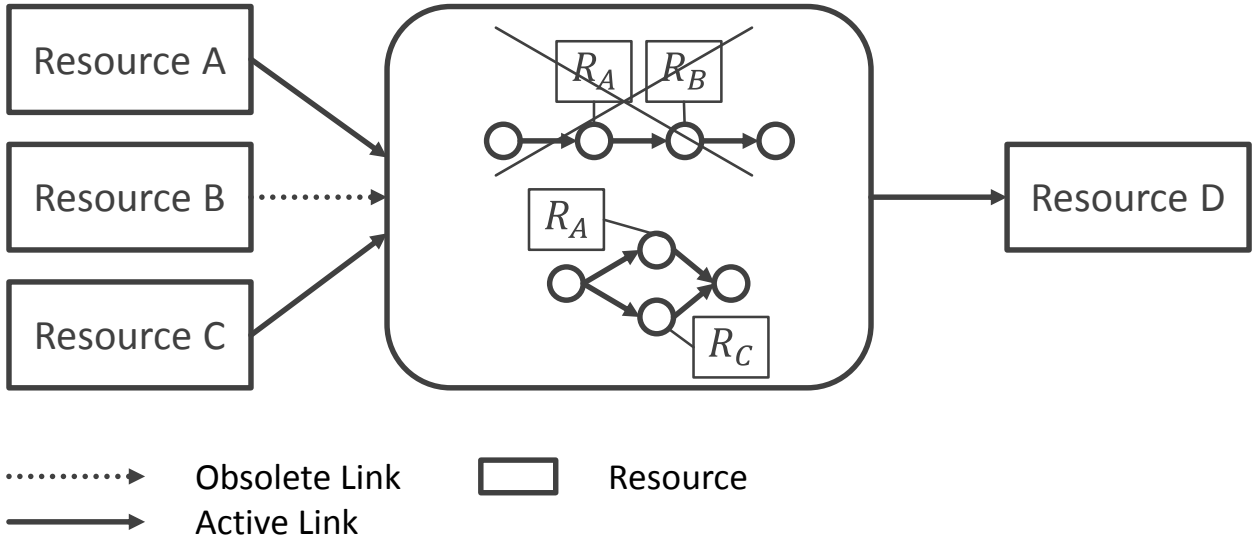
Based on this definition we are seeing this work as “the beginning” of a pattern language. This work does not provide a complete pattern language as much more patterns than presented in this work may apply and be valid. However, we intend to provide a first starting point and encourage the stepwise completion of the language. The target audience for both extending and using that language are represented by various stakeholders, like managers, process engineers, environmental officers and process owners.

The first version of this (incomplete) pattern language consists of the following patterns:

- P-1: Integrated Green Business
- P-2: Green Resource Providing
- P-3: Green Service Communication
- P-4: Green Service Selection

P-1: Integrated Green Business



Context

An organization wants to create an Enterprise that is contributing to harmony and health of the environment.

Problem

To provide services or goods an enterprise needs to integrate different business services into a value stream. Each of these services consumes resources that can either preserve or destroy ecosystems. However, responsibly selecting suitable resources and assuring their efficient and effective use is not trivial.

Forces

Using resources that best fit certain tasks can obviously optimize functional consumer requirements. While the use of best-fit resources is beneficial from a functional point of view it is not always a good choice from an environmental point of view. Using chemicals, for example, may have a much bigger impact to the harmony of the environment than natural resources.
Using alternative resources may also lead to worse results than using the best-in-place resources. The way how those alternative resources are processed may change – especially when they have a mutual impact. This in turn influences the way business services are interacting.

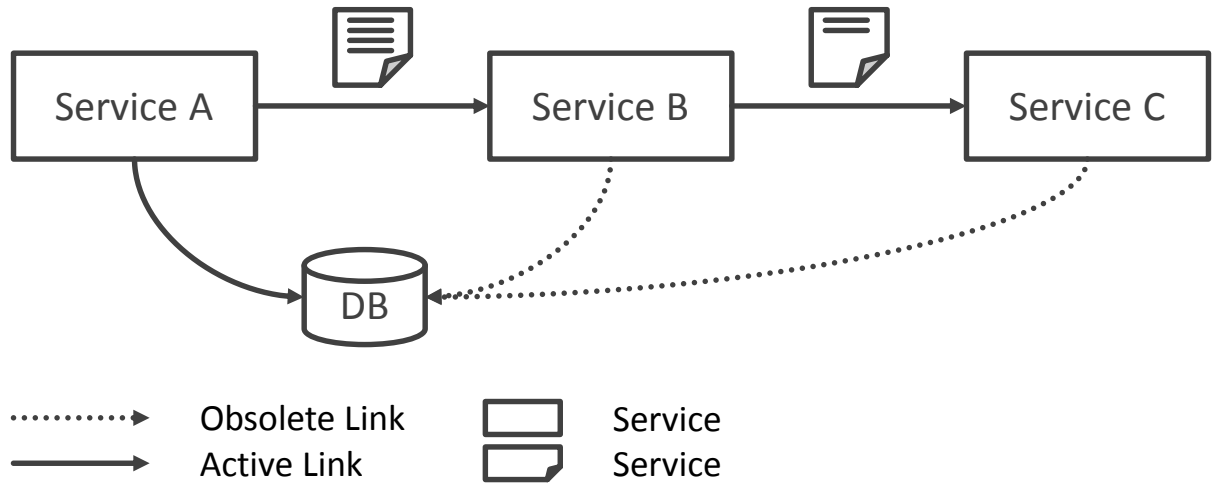
Solution

Create and choose services for each domain based on optimizing overall benefit, including both functional consumer requirements and environmental aspects. As services consume and use resources the selection of those resources is crucial with respect to the harmony and health of the environment. The way enterprises use those resources is another important aspect. Therefore, integrate those business services in a loosely coupled fashion, using principles of a service-oriented architecture, for example. This makes them interchangeable and allows to flexibly react to changes of requirements. For example, new business services, even for external partners, may be put in place that lessens the negative impact on the environment.
The integration of the individual business services must be coordinated outside of those services on an integrated business level, considering the business goals to be achieved with the designed value stream.

Known Uses

Different enterprises have started to introduce various alternative resources or have changed complete production processes. DHL (Deutsche Post AG 2013), for example, introduces their *Green Logistics* program that compensates parts of their induced pollution by using alternative resources in shipping and working together with climate protection projects. The Tchibo direct GmbH (Tchibo 2013) changed their electricity producers and increasingly uses electricity from renewable resources. Another example is Fjällraven (Fjällraven 2013) which manufactures outdoor equipment. They changed their production process and resources needed to create their shell material. They no longer use fluorocarbons but use natural impregnation, organic cotton, recycled polyester, and they compensate climate impacts by various climate protection projects.

P-2: Green Resource Providing



Context

An Enterprise created a multi-service value stream and wants to contribute to the harmony and health of the environment.

Problem

Providing all relevant resources at the right time at the right place is complex.

Forces

Providing services with all resources that are possibly needed will ensure the correct processing of the service. The identification, retrieval, and transportation of resources, like information, however, may require a lot of effort and even cause resource wasting. Providing fewer resources saves those resource efforts but

may result in failure of a service if there are too few resources available. Consequently, the identification of the relevant resources is crucial but tricky.

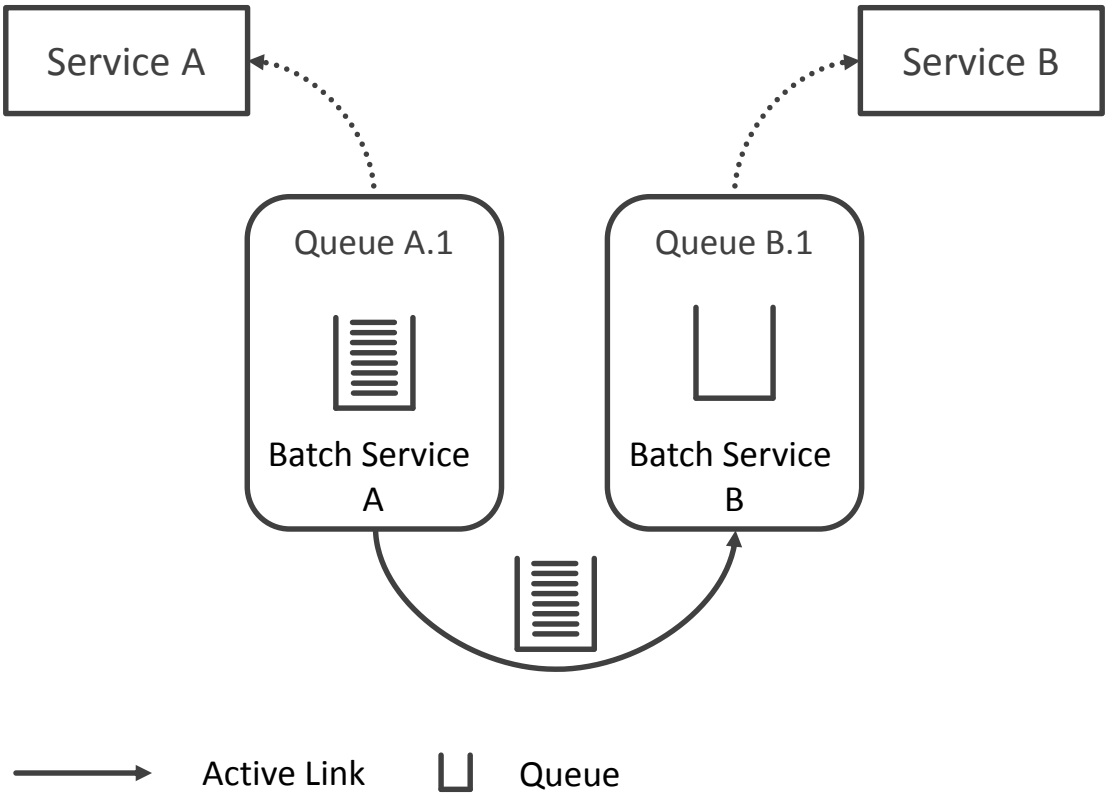
Solution

For each service that needs certain resources for processing create a resource object that comprises all resources. Each resource object should contain those types of resources that will most likely be used by the corresponding service. Moreover, it should contain proper references where further resource that might be required by the service can be found. If such resource will be required the service is able to directly retrieve it from the given source.

Known Uses

There are different known uses for this pattern trying to reduce the total amount of resources spent. A first example is the Amazon online store (Amazon 2013). If users review their last orders Amazon only provides an overview in a first step. If the user wants more Information regarding a specific order, information will be reloaded. Another example is Kanban (Ohno 1988) as a method to design manufacturing processes. Using Kanban, resources are only provided in a pull or request principle and are provided only at the amount that is needed to fulfill a specific task. There are also some other patterns that follow the idea of this pattern, like the Half Object Plus Protocol. This pattern divides information into two objects and links them in order to exchange information whenever needed (Meszaros 1995). A more arcane use is the secure communication over a public network following the approach described at (Cohen and Rolls 2008). To authenticate a user she or he needs to provide only a set of basic information in first place. Whenever the system needs additional information or wants to double-check the identity of the user, it generates a request for more information.

P-3: Green Service Communication



Context:

Enterprise created different services that communicate with each other and cover different tasks of that enterprise. The enterprise wants to contribute to the health of the environment.

Problem:

Coordinating the communication between different services is complex. Interfaces must be well defined and timely communication and transport must be ensured based on business needs.

Forces:

Just-in-time delivery of resources decreases the latency of services as those resources are processed immediately by the service. However, system power consumption is proportional to the number of communications. The cost and waste of frequent message communication can be measured in increased pollution, as all services must be available all time. This always-on mode leads to an increased number of resources that must be provided; even in times of no/low utilization or at non time-critical communication. If using a batch mode communication between services an appropriate buffer needs to be defined. This is important from two perspectives: (1) to provide resources at the right time, i.e. find a solution for the trade-off between the number of communications and the time of processing, and (2) to process tasks in an appropriate time, i.e. ensure a service throughput that fulfills business objectives.

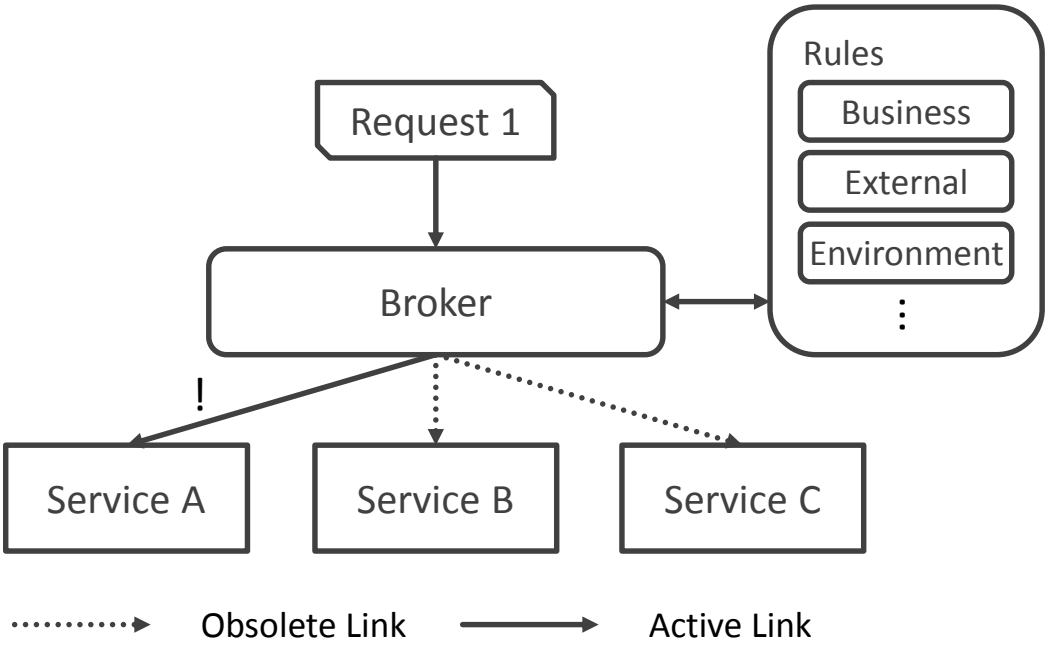
Solution:

Create a batch service for each service in place. Each of these batch services should provide a resource buffer, e.g. by using a database or a message queuing middleware, to store all communication requests. Based on predefined rules a stack of messages will be transferred at once. The rules of communication between services will be based on mechanisms outside the batch services, i.e., customer requests or business objectives. Those requirements are also helpful to determine a sufficient buffer size. To reduce resource consumption, for example, a service might be available only once a day.

Known Uses:

A common example for this pattern is the logistics area. Goods are transported and distributed in a batch way from one hub to another. Transporting single pieces would dramatically increase fuel usage, noise, pollution, etc. Moreover, batching lowers the costs per item significantly.

P-4: Green Service Selection



Context:

Enterprises are using different services that communicate with each other and cover different tasks of that enterprise. The enterprise wants to contribute to the health of the environment.

Problem:

Coordinating the selection of concrete services fulfilling certain business demands and managing their communication is complex. Different services may provide various QoS-levels or varying Interfaces requesting different information.

Forces:

Using pre-defined services ensures the proper execution of tasks with predictable results. However, the use of static services hinders the dynamic adaptation to external events or changes in business demands. For example, a service with a high QoS-level may perform a task very quickly. If the result, however, is not needed at that speed, a service with a lower QoS-level might be also sufficient, particularly when fewer resources may be used and, thus, the total resource consumption can be reduced.
The use of such varying services is complex and requires the definition of behavior rules and processing logic. The latter is particularly important if services are to be selected during runtime.

Solution:

Create a broker component that handles all communication requests between services. Each communication request is sent to this broker component and gets redirected to the service that adds the most value. Additionally, create a set of rules that express the strategic requirements. These rules may be very diverse. Decisions may, for instance, be based on the QoS ensured to the requestor, the number of pending requests, the available information, or the current environmental impact the enterprise accounts for. Parts of that functionality are, i.e., provided by an Enterprise Service Bus. The set of rules, however, needs to be defined based on business demands.

Known Uses:

Based on agreed QoS, like “regular”, “eco”, or “eco++”, different services are selected for execution. Services providing “eco++” induce less environmental impact than “regular” services. Another example can

be found in logistics industry. Depending on customer requests or company objectives different shipping partners may be selected.

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