Integrating EU Market Place with Market Player Platforms using lightweight web-based APIs

FLEXICIENCY EU Market Place

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***Abstract*— This paper presents the integration architecture implemented in the FLEXICIENCY project. The integration architecture defines how Market Players can integrate their platforms with a central EU Market Place in order to provide interfaces enabling the automated exchange of data. RESTful APIs with standardized interfaces are acting as a facilitator of the interoperability between the integrating parties. APIs enable EU Market Place to initiate the B2B integration process between Service Provider and Service Requester that agreed on service subscription via EU Market Place. The benefits of EU Market Place and integrations are demonstrated on the case of flexibility offers exchange. The FLEXICIENCY project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement n° 646482.**

Keywords—flexibility offers, integration architecture; REST API; OpenAPI; reliable message delivery;

I. INTRODUCTION

FLEXICIENCY project is aiming to demonstrate that the deployment of novel services in the electricity retail markets can be accelerated with an open European (EU) Market Place (MP) for standardized interactions among existing and joining market players. The EU Market Place is acting as a catalyzer for the interactions between all the relevant stakeholders in an open and standardized way to encourage a cross-country and cross-player access to innovative energy services. The EU MP provides a central register of data services that can be discovered by any Market Players wishing to integrate and provide novel services such as advanced monitoring, local energy control, flexibility aggregation and others [1]. In this paper, it is explained how the integration enabling data exchange between Market Players is automatically initiated and orchestrated by the EU MP [2,3]. Architectural components, which simplify and speed up the integration process between the EU MP and Market Player platforms (MPPs) to enable fast delivery of the B2B data service to the stakeholders, are described.

In this paper, the use and benefits of the EU MP is described on the case of exchange of flexibility offers. The main role in the case of flexibility is acted by a pan-European Aggregator. In order to provide flexibility offers across EU, the pan-EU Aggregator first needs to obtain near-real time data from Demand Response (DR) and Distributed Generation (DRES) units that will allow them to calculate forecasting trends for particular geospatial area. The EU MP presents a central point where providers of data can be easily found. The EU MP can help Aggregator to discover API services providing the data necessary for generation of flexibility offers. The Aggregator plays two roles on the EU MP: the first one is as Service requester that subscribes services of provision of individual and aggregated meter readings from various data providers, duly implementing data privacy measures; the second one is the role of Service provider, where the Aggregator publishes service to the EU MP and accordingly allows the exchange of flexibility offers to DSOs (e.g. for local grid management), TSOs (e.g. for balancing services), and retailers (e.g. for correcting the balance group deviations).

The integration between the EU MP and the MPPs plays an important role in this scenario because it optimizes the process for the data and service exchange between participating partners' platforms. This scenario also describes the cooperation between Regulated and Unregulated players over the EU MP.

II. B2B INTEGRATION PROCESS

The main purpose of the EU MP is to provide a central register of data services, called B2B data services, provided by different energy Market Players. The EU MP allows in particular Service Providers to publish a detailed description of their B2B services with usage details and basic information for the integration. Service Requesters, on the other hand, can negotiate B2B data service subscription and once the subscription is finalized the B2B integration process is initiated.

One of the project goals is to provide tools that enable quick integration between the Market Players. This includes automation of the B2B integration process, which consists of the following steps:

1) **Service discovery and requesting the B2B data service**: the Service Requester sends a request to the Service Provider on the EU Market Place;

2) **Service offer creation**: the Service Provider sends a service offer to the Service Requester with terms and conditions

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for service usage;

3) **Completing the service subscription**: (3.1) the Service Requester accepts the Service offer; (3.2) the EU MP sends a message with service offer details to both MPPs via the EU MP API;

4) **B2B integration set-up**: based on the data from the EU MP, the Service requester sets up a service client that integrates with the B2B service of the Service Provider;

5) **Initiating the customer consent process**: (5.1) the Service Requester sends a request with the list of Points of Delivery (PoDs) he wishes data for. (5.2) The Service Provider asks for customer consent. (5.3) The Service Provider notifies the EU Market Place when customer consent is obtained (however, customer consent is not managed at EU MP level);

6) **Service activation**: the Service Provider activates the service for the PoD with the necessary customer consent. The Service Provider notifies the EU Market Place when service is activated for the PoD;

7) **Data exchange**: once the service is activated, the Service Requester can ask for data for the activated PoD. The B2B data exchange APIs use standard data model based on CIM IEC 62325 [4] and it is performed direclty between the B2B platforms (i.e. data transfer or storage is not implemented on the EU MP);

8) **Service execution monitoring**: the Service Provider periodically notifies the EU Market Place with the status messages of the service execution.

To automate the B2B integration process, integration components that allow reliable integration between the EU Market Place and Market Player platforms have been put in place. This eventually allows the exchange of the data that is required by the Market Player platforms to initiate internal processes, which take care of the B2B data exchange. Fig. 1 illustrates the interactions that take place during the B2B integration process.

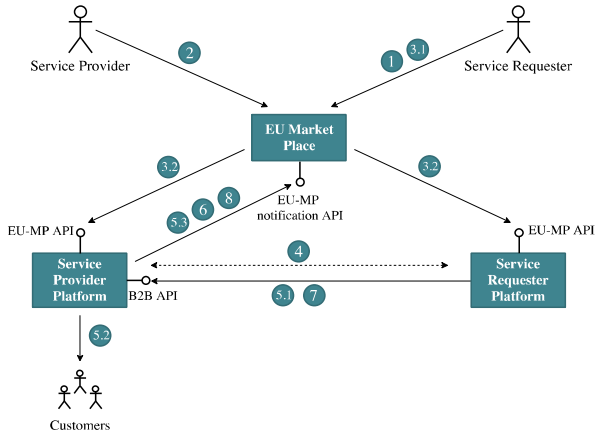

Fig. 1 Interactions between EU Market Place and Market Players

The automation of the B2B integration process is achieved by the EU-MP API implemented as RESTful web service. The interface is specified using OpenAPI specification [6] and it is obligatory for every Market Player to provide EU MP API that complies with the API specification. This allows the EU MP to integrate with the Market Player platforms with generic API client. On the other side, the EU MP exposes API that allows any Market Player platform to send notifications to the EU MP enabling monitoring and orchestration of the services under the execution. It is important that implementation and the set-up of the APIs on the MPPs is simple so the Market Players can engage with the EU MP as fast as possible. In the following chapter, the architecture and components enabling quick integration between parties are described.

III. EU Market Place Integration Architecture

The integration between the EU Market Place and the Market Player platforms is bidirectional. For each direction, the initiating party implements REST client that triggers the requests towards the REST API exposed by the opposite party acting as a server as illustrated in Fig. 2. The communication is based on HTTP protocol, which means that the server will always provide response to the request. The EU Market Place and the Market Player platforms exchange roles of the client and the server. The role of the client is always taken by the party that is the source of the notification. Notification is created based on the event or the action performed on the EU Market Place or on the Market Player platform. The EU Market Place triggers the notification in the following events: (1) the Market Player initiates the integration set-up test; (2) the service subscription is completed; (3) the service subscription is canceled. The Market Player platform initiates the notification when: (1) the consent from the customer is obtained; (2) the service is activated; (3) the periodic service status message is triggered. Each MPP tracks the status of the consents and the status of service activation, whenever a change in status happened, the MPP sends update towards the EU Market Place.

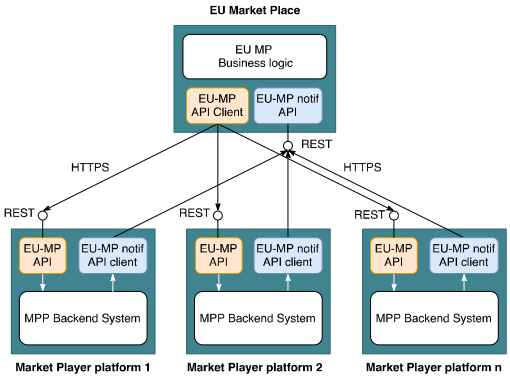

Fig. 2 EU Market Place integration components

Automation of the B2B integration process is enabled by the following APIs and API clients:

1) **EU-MP API**: RESTful API exposed by the MPPs;

2) **EU-MP notifications API**: RESTful API exposed by the EU MP to receive notifications for service execution monitoring;

3) **EU-MP API Client**: generic API client integrated into EU Market Place business logic;

4) **EU-MP notifications API Client**: API client implemented into the Market Player Platform.

B. EU-MP API

The interface is standardized for every Market Player platform. OpenAPI specification allows automatic generation of the RESTful web service skeleton for most popular programming languages (Java, C#, Python etc.) [5]. This reduces the implementation efforts needed for the integration between REST interface that is taking care of the communication with the EU MP and the MPP Backend System. In the majority of cases, this includes a transformation of the received data, storing data into MPP Backend System database and triggering the B2B client to initiate the exchange of the B2B data with the MPP of the Service Provider.

The EU-MP API exposes the following API endpoints to the EU Market Place:

- /service-offer/confirmed/{platformRole}[POST] receives service offer details;
- /service-offer/canceled/{platformRole}[POST] receives service offer cancelation request;
- /apikey [POST] allows EU Market Place to periodically refresh the authentication key;
- /test [GET] allows EU Market Place to check the availability of the EU-MP API.

C. EU-MP notifications API

The EU Market Place gathers notifications from each MPP to provide monitoring of the service subscription under the execution. Each MPP must implement REST API Client based on the OpenAPI specification of the EU-MP notifications API. Formatted OpenAPI specification of the API again allows automatic generation of the API Client for the most popular programming languages. Generated API Client takes care of the communication with the EU Market Place while developers still have to integrate the client with the MPP Backend Systems which is the source of the notifications.

The EU-MP notifications API exposes the following API endpoints to MPPs:

- /service/consent [POST] receives information when the state of the customer consents changes on the side of the service provider (only if consent is required);
- /service/activation [POST] receives information when activation state of the service changes;
- /service/interim [POST] receives interim notification to validate that service is being offered;
- /apikey [POST] allows MPP to periodically refresh the authentication key;
- /test [GET] allows MPP to validate the availability of the EU-MP notifications API.

D. EU-MP API Client

To integrate with the Market Player platforms, the EU Market Place must implement a client. Because the interface exposed by all MPPs is standard, all of them expose endpoints with the same path, and all of them receive and respond with the same messages. The EU Market Place needs only one implementation of the client to integrate with all the MPPs. However, the EU MP needs connection information for each of the MPPs. These configuration is provided by the Market Players on the EU Market Place web site.

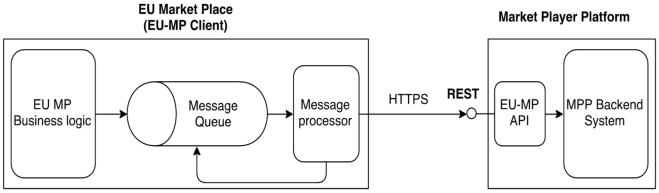

Fig. 3 EU-MP Client architecture

One of the challenges EU Market Place needs to deal with is the potential unavailability of the MPP. If the MPP is not available in the time notification is sent from the EU Market Place, the message could be lost. To overcome this, message queue was incorporated into the EU-MP API Client architecture. Each notification is inserted into the message queue that is listened by the message processor. The message processor takes the notification from the queue and tries to send notification via REST API client to the MPP. If the MPP is not responding, notification is put back into the message queue with a time delay for redelivery. The architecture of the REST API client is illustrated in Fig. 3.

E. EU-MP notifications API Client

Each Market Player platform implements EU-MP notifications Client that is integrated with the MPP Backend System. The integration logic of the client is specific for each MPP because backend systems are custom. The reliable delivery of the notifications for monitoring can be achieved by the same approach as in the case of EU-MP API Client, but the architecture of the client is left to the MPP developers.

IV. EU MARKET PLACE – FLEXIBILITY OFFERS

The purpose and the use of the EU Market Place in FLEXICIENCY project are nicely demonstrated with flexibility offers exchange. In the project, cyberGRID is emulating a Pan-EU Aggregator, making flexibility offers based on forecasting trends from DR and DRES units. This can work only if:

- an Aggregator is able to obtain data from local operators, with the necessary data privacy measures implemented;
- an Aggregator is able to access procedures to actuate offered flexibility;
- DSO/TSO is able to acquire flexibility offers from the Aggregator;
- DSO/TSO is able to activate flexibility offers.

To achieve this, the Aggregator needs to establish B2B integrations with local operators to obtain data required for flexibility offer generation. In the scenario where the Aggregator wants to participate in a new balancing market (e.g. in another EU country) and the EU Market Place is not in place, the Aggregator will first need to consider a variety of regulatory and technical barriers, which can prolong new business implementations. The EU Market Place helps to remove these barriers and defines standardized interfaces. It also provides an Aggregator with faster and cheaper integration with the balancing markets.

Exchanging data for generating the flexibility offers is only one side of the medal. TSOs and DSOs are facing very similar story with the providers of flexibility offers. Without the EU Market Place, they are challenged with the discovery of Aggregators able to provide flexibility offers for some areas or country. With the EU Market Place, the discovery of providers and services would be simplified as all the information, including for the B2B integration, is provided in a central place.

The added value of the EU Market Place also comes with the integration to the Market Player platforms. The process of the B2B integration starts with the approved service subscription on the EU Market Place, but it is not useful if the operators of the Market Player platforms need to manually obtain the subscription data from the EU Market Place and manually enter it into their platforms. This approach not only takes a lot of time, it is also prone to mistakes.

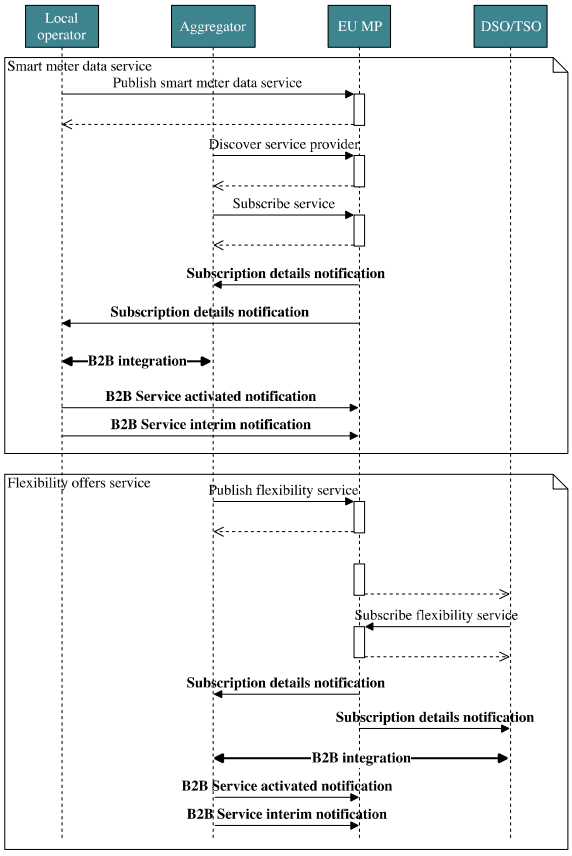

Fig. 4 Flexibility offer generation and exchange sequence diagram

Fig. 4 illustrates the complete sequence diagram with actors and steps involved in the flexibility offer generation, including the EU MP and the B2B integration steps. The sequence diagram is divided into two parts: first, it shows the process for the subscription to the Smart meter data service provided by the local operator to the Aggregator (provided that data privacy measures have been duly implemented); second, it shows how the Aggregator becomes a provider of the flexibility offers service and how DSO, TSO or retailer can subscribe to such service. As in the sequence diagram, whenever a service is subscribed, the EU Market Place dispatches notification with the subscription details to both involved parties. Data from service subscription allows the service provider to initiate the process for the activation of the B2B service for the service requestor and provides the service requestor with the details required to establish and implement the B2B integration.

The Aggregators providing flexibility offers nicely demonstrate how the EU Market Place can be used to obtain data from service providers, with duly implemented privacy measures, and build new services with added value upon provided data, back to other Market Players.

CONCLUSIONS

The architectural design and components used to integrate the EU Market Place and the MPPs showed that lightweight web-based APIs with an interface specified by OpenAPI specification significantly reduce the implementation efforts. The integration between the EU Market Place and the MPPs enables automation of the B2B integration process as the data needed for setting up the B2B data exchange is automatically transferred to the parties participating in the B2B integration. With bilateral integration between the EU Market Place and the MPPs, transparency of the B2B data exchange is also addressed as monitoring is provided by gathering notifications from the MPPs. The use and benefits of the EU Market Place and the integration with the MPPs are nicely demonstrated with the flexibility offers generation use case.

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Disclaimer: This paper reflects the FLEXICIENCY consortium view and the European Commission (or its delegated Agency INEA) is not responsible for any use that may be made of the information it contains.

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