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Study on resource encapsulation and information integration in service-oriented grid for aiot

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Abstract. This paper has a discussion and study on resource encapsulation and information integration based on grid technology for AIoT (Agricultural Internet of things). It proposes a new solution for AIoT via service-oriented grid to organize and manage the existing resources used in agricultural engineering. It makes all kinds of agricultural resources be encapsulated by the standard XML interface, which makes them be easily visited by customers via web application. Firstly the paper briefly introduces the AIoT ecosystem and describes the abstract model of AIoT. Secondly, based on the abstract model, the service-oriented semantic grid description and encapsulation method are proposed, which define the classification of agricultural device resource and WSRF (Web Service Resource Framework)-Based resource capsulation method. Thirdly, the implementation of service interface of device resources is put forward and further discussed in details. It primarily includes registration process of device resources, access and scheduling of device resources. The agricultural services are geographically distributed, dynamic and across different domains which are owned by different organizations. After the information is encapsulated, integrated and distributed in grid, the service-oriented capsulation and scheduling will be defined as a process of mapping the service demands for the concrete agricultural resources based on the semantic grid in an optimal manner, the various services will be implemented seamlessly and without distinction.

Key words. Agricultural grid, iot, wisdom agriculture.

1. Introduction

In the International Telecommunications Union (ITU) report of 2005, it suggested that the "Internet of Things will connect the world's objects in both a sensory and

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intelligent manner". By combining various technological developments, the ITU has described four dimensions in IoT[1]: item identification ("tagging things"), sensors and wireless sensor networks ("feeling things"), embedded systems ("thinking things") and nano-technology ("shrinking things"). The definition of "things" in the IoT vision is very wide and includes a variety of physical elements. These include personal objects we carry around such as smart phones, tablets and digital cameras. It also includes elements in our environments (be it home, vehicle or work) as well as things fitted with tags (RFID or other) which become connected via a gateway device (e.g. a smart phone).[2] Based on the above view of "things", an enormous number of devices and things will be connected to the Internet, each providing data and information and some, even services. In this paper we will have a discussion and study on resource encapsulation and information integration based on service-oriented grid technology for AIoT (Agricultural Internet of things).

2. AIoT Ecosystem based on Service-oriented Grid

In IoT, things could be tagged, and through scanners, identified, and the relevant location information could be communicated. Similarly, networked things with sensors of monitoring weather and environment become smaller, weaving themselves into our daily agricultural tasks[3], while sensor and actuator networks act on the local environment, communicating status and events to a higher level service. Smart things sense activity and status are linking to the IoT[4]. Figure 1 provides the view of the AIoT ecosystem based on service-oriented grid. In service-oriented architecture, middleware and frameworks enable application and service development are combined to offer services which utilize data as received from (or about) things, most often living in the cloud provides the capability to add intelligence resulting in better services, which ultimately impact on the ecosystem environment. The customers, e.g. farmers, can perform agricultural tasks via application service in AIoT. Agricultural expert can optimize the configuration of parameters of agricultural process via application service. Administrator will do maintenance, technical support and security management for AIoT ecosystem also via application service.

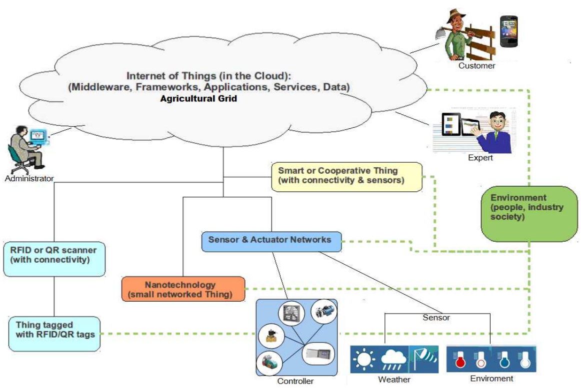

Fig. 1. Aiot ecosystem based on service-oriented grid

3. Semantic Analysis for Service-oriented Grid

In grid, all tasks are organized and performed with service format.[5] It is service-oriented. To realize the services described as above in the agricultural resource grid, we design the implementation architecture of semantic grid portal as figure 2. In

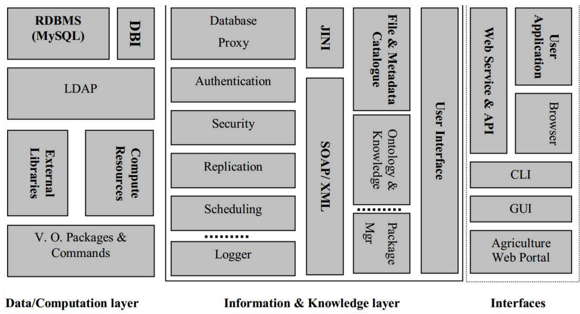

Fig. 2. The architecture of agricultural semantic grid

this architecture, the service owners and the service consumers are as autonomous agents. We use the agent developed in agricultural intelligent systems as that agent.[6] The relationship between service owner and service consumer is codified through a service contract. This contract specifies the terms and conditions under which the owner agrees to provide the service to the consumer. The service owners and service producers interact with one another in a particular environmental context. This environment may be common to all entities in the grid, which means that all agricultural entities offer their services in an entirely open marketplace. In other cases, however, the environment may be closed and entrance may be controlled.[7] So how to abstract resources to be the elements of agricultural semantic grid is important for implementation for these services.

4. Resource Information Abstraction and Integration

In order to facilitate enterprises to obtain the required components efficiently in a grid environment, set up a bridge between the vendors and enterprise or between enterprises and enterprises, it is necessary to encapsulate agricultural resources to form a grid service, which can make resource be easily accessed, called and processed in a wide range of environments of open, well-maintained and integrating heterogeneous equipment systems and applications.[8] In order to rationalize and standardize the information of resource, the resources must be classified firstly. We use the semantic features to describe the devices[9]. All devices will be explained with the characteristics of specific pieces. According to resource used in different levels, we establish a relatively simple agricultural hierarchy category in the resource library. It is divided as product great type, product class, as it shown in figure 3. The hierarchical classification catalogue can be extended for the extension of actual range of project. And table 1 is an example of WSRF[10] (Web Service Resource Framework)-based

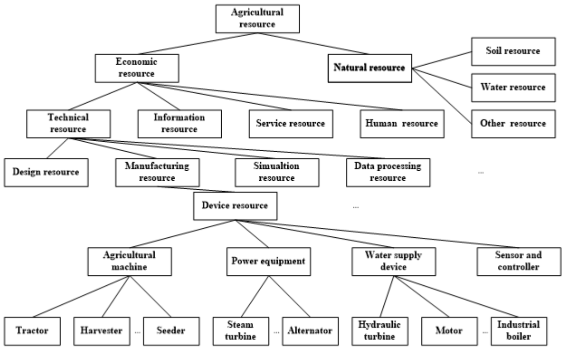

Fig. 3. Agricultural device classification

attribute structure of resource definition.

Table 1. The wsrf-based attribute structure of resource

Attribute information			Attribute Expression
Basic Attribute	Basic Description	Resource Identification	Bd_id
		Resource Name	Bd_name
		Resource Number	Bd_num
	...	...	...
processing Attribute	Working Attribute	Material Information	W_material_Info
		Max Load	W_load_limit
	Temporal Attribute	Season Factor	Tm_season_factor
		Starting Time	Tm_start_time
		...	...
Task Attribute	Task Description	Processing Output	Td_processcing_Output
		Batch Information	Td_batch_Info
	...	...	...

5. Service Implementation in AIoT

5.1. Registration of resources

If a service owner want to make a resource be used in a AIoT environment, he needs to register the attribute information based on a rapid prototype, and inputs the attribute information in the registration interface.

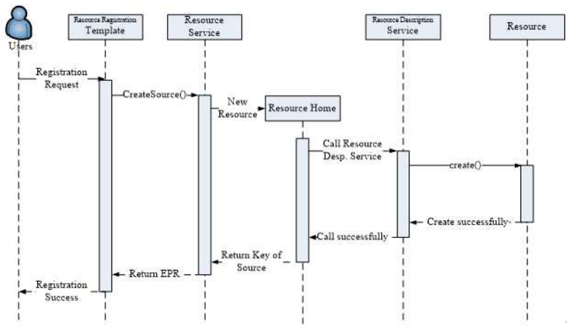

Fig. 4. Time sequence chart of resources registration

As shown in figure 4, firstly users need to register resource information on the web page, i.e. enter attribute information in web interface. When a JSP page of registration implementation is completed, the client will let FactoryService send a resource creation message. ResourceHome is the class of resources management. When receiving creation message, it will call description service by using WSDL format to create a resource file, and deploy it in the grid container. After the completion of resources deployment, it is automatically added to ResourceHome class, and returns the endpoint reference of resource, which is used to return the successful registration information that you can see through the grid portal. Then the registration of resources is completed in a grid environment.

5.2. Access and scheduling of resources

Through the registration interface, Device resources are registered with the device attribute information resources and become the grid service through grid capsulation. Then, they are published in the UDDI (Universal Description, Discovery and Integration) center, so that the users of outside world can access to the service. So now the capsulation of device resources is completed. Then users can use an existing entity object to hold the state information generated when the grid service is interacted with Web. Thus it shields the heterogeneity of resources so that the resources and web services are bundled together. Through transparently operating JAVA object of Web services, it makes resources state be changed, and then completes the corresponding agricultural production tasks.

As shown in figure 5, firstly, the users select the appropriate resource according to actual needs in the grid portal, enter the service information, and specify service requirements in the request. Secondly discovery service will do analysis in conjunc-

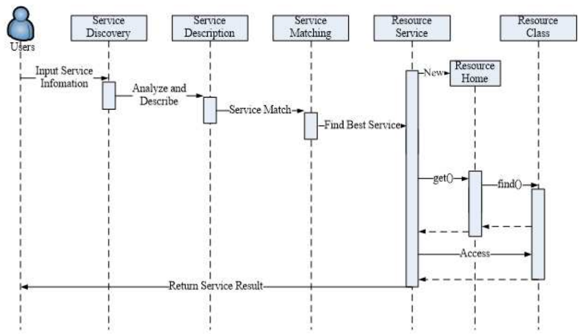

Fig. 5. Time sequence chart of resources access and scheduling

tion with description service. Combined with the task solutions, service is divided into different logical services.

Logical services can be found with a set of priorities in physical services by using a service matching algorithm, and then best physical services can be found. Resources services will find the corresponding resource implementation class and returns through ResourceHome. Resources services can operate class implementation to resources through an operation interface, thus realize to access and call resources. Finally resource service returned results to the user, so the user knows the visit is successfully completed.

6. Conclusions and Prospect

This paper has a discussion and stuqdy on resource encapsulation and information integration based on grid technology for AIoT. It proposes a new solution for AIoT via service-oriented grid to organize and manage the existing resources used in agricultural engineering. After the information is encapsulated, integrated and distributed in grid, the service-oriented capsulation and scheduling will be defined as a process of mapping the service demands for the concrete agricultural resources based on the semantic grid in an optimal manner. The AIoT application will be implemented as services seamlessly and without distinction.

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