

operation to S_provider (e.g., 34) that changes the Submitted field in Orders database table (Table 12) to “True” for selected rows corresponding to OrderId={2, 3}.

[0125] Getting (184) customer address, included in process 150, from Addresses database table (Table 8) is defined by the standard Select By Relation action on A_Customer aspect. For example, the front end application program 12 sends a Select By Relation action on A_Customer aspect specifying relation R_Customer_To_Address and Customer_Key={2} to service manager 16. Service manager 16 checks the request against repository 18 and passes the request to service provider S_provider (e.g., 34) that looks up foreign key AddressId matching CustomerId={2} and navigates to Addresses table 8. S_provider (e.g., 34) returns a record set containing {Louisville, Willow Avenue} from Addresses database table (Table 8) to application 12 via service manager 16.

[0126] The techniques described above can be implemented in digital electronic circuitry, or in computer hardware, firmware, software, or in combinations of them. The techniques also can be implemented as a computer program product, i.e., a computer program tangibly embodied in an information carrier, e.g., in a machine-readable storage device or in a propagated signal, for execution by, or to control the operation of; data processing apparatus, e.g., a programmable processor, a computer, or multiple computers. A computer program can be written in any form of programming language, including compiled or interpreted languages, and it can be deployed in any form, including as a stand-alone program or as a module, component, subroutine, or other unit suitable for use in a computing environment. A computer program can be deployed to be executed on one computer or on multiple computers at one site or distributed across multiple sites and interconnected by a communication network.

[0127] Method steps of the techniques can be performed by one or more programmable processors executing a computer program to perform functions of the invention by operating on input data and generating output. Method steps can also be performed by, and apparatus of the invention can be implemented as, special purpose logic circuitry, e.g., an FPGA (field programmable gate array) or an ASIC (application-specific integrated circuit). The method steps may also be performed in other orders than those described above.

[0128] Processors suitable for the execution of a computer program include, by way of example, both general and special purpose microprocessors, and any one or more processors of any kind of digital computer. Generally, a processor will receive instructions and data from a read-only memory or a random access memory or both. The essential elements of a computer are a processor for executing instructions and one or more memory devices for storing instructions and data. Generally, a computer will also include, or be operatively coupled to receive data from or transfer data to, or both, one or more mass storage devices for storing data, e.g., magnetic, magneto-optical disks, or optical disks. Information carriers suitable for embodying computer program instructions and data include all forms of non-volatile memory, including by way of example semiconductor memory devices, e.g., EPROM, EEPROM, and flash memory devices; magnetic disks, e.g., internal hard

disks or removable disks; magneto-optical disks; and CD-ROM and DVD-ROM disks. The processor and the memory can be supplemented by, or incorporated in special purpose logic circuitry.

[0129] The techniques can be implemented using a computing system that includes a back-end component, e.g., as a data server, or that includes a middleware component, e.g., an application server, or that includes a front-end component, e.g., a client computer having a graphical user interface or a Web browser through which a user can interact with an implementation of the techniques, or any combination of such back-end, middleware, or front-end components.

[0130] The invention has been described in terms of particular embodiments. Other embodiments are within the scope of the following claims.

What is claimed is:

1. A method comprising:

representing, in a repository, services from a server, the services comprising interacting with one or more collections of data elements using a set of operations on the data elements in the collections, the repository comprising descriptions of the collections and common attributes for each collection, the repository organized according to a meta model;

enabling a software entity to request a service represented in the repository, the service representing a first operation on one or more data elements in a first collection from the collections; and

executing the first operation on the one or more data elements in the first collection.

2. The method of claim 1 wherein the repository further comprises descriptions of specialized actions on a collection of data elements from the collections.

3. The method of claim 2 wherein a description of a specialized action comprises:

a name of the specialized action;

a name of a data structure for input data for the specialized action;

a name of the collection of data elements.

4. The method of claim 1 wherein the set of operations correspond to methods of a service provider class.

5. The method of claim 4 wherein the set of operations comprise select, delete, select by relation, and update operations.

6. The method of claim 1 wherein the repository further comprises descriptions of relations between pairs of collections of data elements.

7. The method of claim 1 wherein the first collection has a relation with a second collection of data elements, a description of the relation is stored in the repository, and the relation enables the software entity to request the retrieval of data elements of the second collection by specifying data elements of the first collection.

8. The method of claim 1 wherein the repository is a database.

9. The method of claim 1 wherein executing the first operation comprises reading the one or more of the attributes of the first collection of data elements from memory storage and sending the attributes to the software entity.