Development of the M2M Service Platform

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Abstract

This paper introduces the component technologies of the CONNEXIVE M2M Service Platform, which supports the horizontally integrated M2M business model, which is expected to become the mainstream business platform of the future.

The NEC Group provides the M2M service platform to support its M2M business by adopting a non-coding technology using data models and workflows, while promoting efforts for a large-scale speed increase for withstanding the heavy traffic of M2M and also applying measures for supporting various standardizations.

Keywords

M2M, service platform, horizontal integration, data model, workflow

1. Introduction

The previous mainstream approach to the M2M field was to develop specifically optimized systems based on vertical integration. However, in cases of the introduction of integrated solutions in user environments or of implementation of independent cloud-based business at NEC, it is required to use a horizontally integrated platform. This will provide various service and device interfaces flexibly and easily rather than requiring development of a specifically optimized system (**Fig. 1**).

NEC has developed the M2M service platform (hereinafter referred to as M2M PF) as a horizontally integrated product.

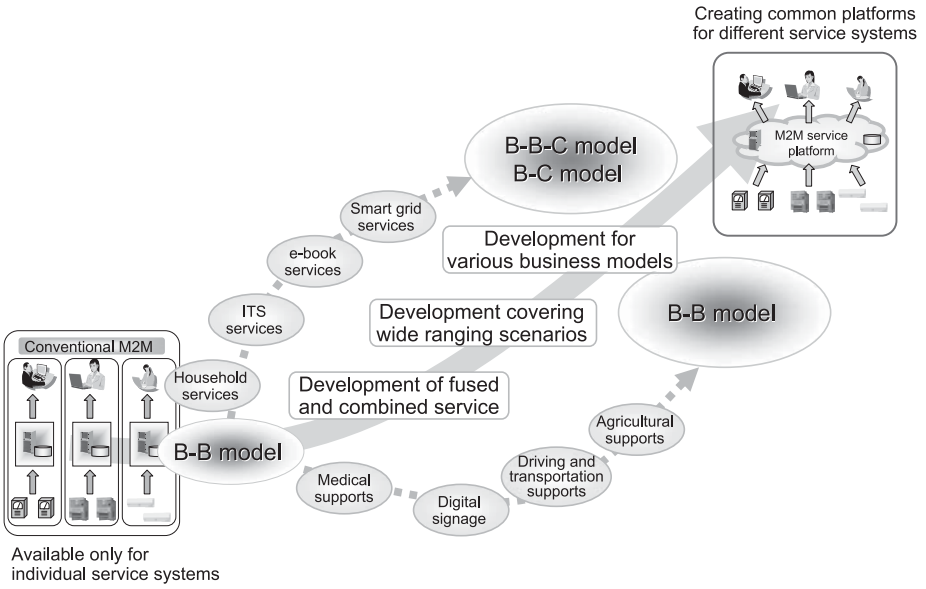

Fig. 1 From vertical integration to horizontal integration.

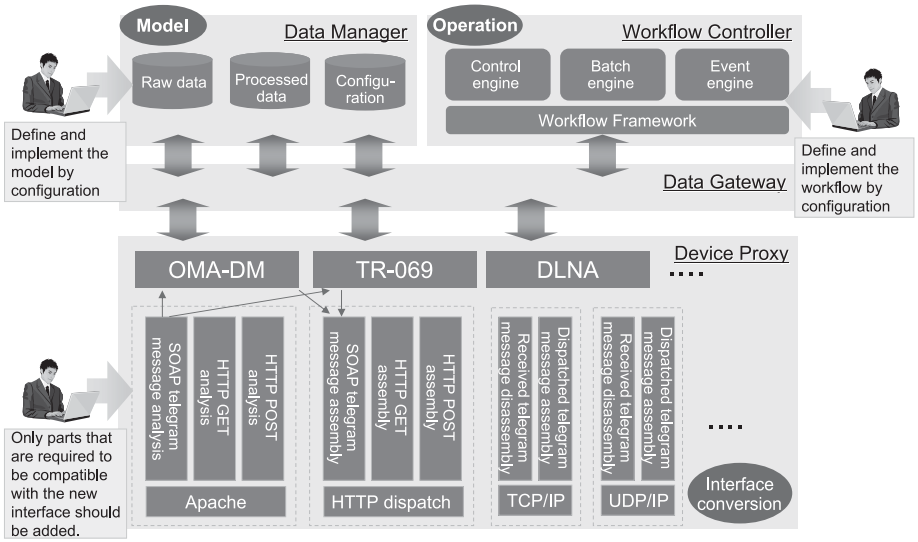

Fig. 2 Operation definitions by workflow.

2. Outline of M2M PF

2.1 Issues to be Solved for the M2M PF

In the development study for the M2M PF, we have extracted the following five issues and have decided to develop functions for their solution.

(1) A huge man-hour input would be required because a very large variety of data and number of interfaces have to be collected and it is therefore difficult to predict the effects of rewriting a part of a program.

(2) High costs would be involved in implementing a large amount of statistical processing, control and event processing operations if they were coded individually using fixed logic.

(3) If unique inter-system interfaces were defined for the service AP as for previous developments, much labor would be required for their coordination. In addition, interfaces should be rigid enough to ensure security when data is shared by multiple services.

(4) There is insecurity in the database related performance because a large number of articles are connected in the developed system.

(5) Even when devices are developed, mechanisms for ensuring connections with servers are necessary because there are large amounts of standard and original interfaces.

2.2 Mechanisms Implemented by M2M PF

To resolve the issues summarized above, we have implemented the following functions for M2M PF.

(1) Logical division between operations, models and interface conversions

The device proxy function is the function for direct communication with devices. This function makes it possible to absorb the differences in communication protocols between device specifications (from the "HTTP: Hyper-Text Transfer Protocol" in the application layer to the "ICMP: Internet Control Message Protocol" in the network layer) as well as differences in the telegram message sequences.

The data gateway function analyzes the device data received from the device proxy function, normalizes the data formats to be easy to handle in the system, and stores data in a database.

The device data is analyzed by following the XML-format data models called device templates. When the device templates are loaded, the database schemas are also generated automatically.

After being processed by the above function, the data added to the database is used for defining operations by the workflow function (**Fig. 2**). The workflow is described in detail below.

(2) Operation definitions by workflow

The raw data stored by the M2M PF is used to generate pro-

cessed data according to the requirements of the service application (hereinafter referred to as service AP). The workflow is used to define this processing operation. There are three kinds of workflow; those executed upon request from a service AP (control type workflows), those executed upon reception of an event from a device (event workflows) and those executed at constant intervals (batch workflows).

The M2M PF provides diverse processing operations, from simple ones such as data inquiry, insertion and updating to complicated ones including totaling and averaging, as workflow components. They are combined by each workflow so that data can be processed. For this purpose, M2M PF adopts the Spring Framework (hereinafter referred to as Spring) as the DI (Dependency Injection) container for use in enabling scalability and customization.

Spring describes the relationships between components in an XML file called the Bean definition file so that, at the time of execution, instances can be generated based on the definition file. The components are implemented using a common interface, thus even when components are added or their combinations are modified, M2M PF can implement new workflow without coding them.

(3) Flexible but secure interface to service AP

The interface with the service AP uses the NC7000-WG, which is an existing product. It is platform software being made public in web service that easily and safely enables various services for the market by using an open, web-based API.

User convenience can be improved by marking public the API provided by the M2M PF in forms matching user needs (SOAP, REST, JSON). The M2M PF allows the administrator to make services public safely by providing authentication, authorization and SLA interfaces and security functions. It also provides a service management screen to facilitate publication and management of services.

(4) Handling of huge amounts of data

The M2M PF is compatible with the minimum configuration in which several function blocks coexist in a single server to large-scale configurations in which each function block scales out for inter-server communications. It employs PostgreSQL for the present, but we are planning to make it also compatible with data stores such as Apache Hadoop in the future.

The traditional program implementation method was to provide interfaces between function blocks by means of RMI (Remote Method Invocation) for the large-scale configuration, and communications using RMI that require processing costs have also been used even when several function blocks are operated on a single server. However, Spring can also be applied in this domain; holding communications by means of method calls between function blocks in the case of minimum configuration or by means of the RMI function provided by Spring in the case of large-scale configuration.

(5) Provision of device agent

The universal device agent is provided as an open-source library called from an AP running on a device to facilitate communication with the M2M PF. It is for the present available in the Java and C++ versions. As the communications are always held from a device to the M2M PF, it is not subjected to complicated restrictions like the NAT (Network Address Translation).

In addition, we are also developing other standardization-compliant agents such as one that is compliant to the DM (Device Management) of the OMA (Open Mobile Alliance) and one that is compliant to TR-069 of the Broadband Forum.

3. Construction Procedure Using M2M PF

This section describes how the construction has been simplified by actual use of our M2M PF. **Fig. 3** shows the main operations required for preparation of the M2M PF.

3.1 Interface Definitions to Go with Devices

The first action to be taken is to decide the interface to go with devices. For the device interface pattern, it is required to select the optimum one from the following three patterns; one using a standardization-compliant protocol, one using the distributed universal device agent and one to be customized according to an original interface. When newly creating the device, connections can be facilitated by using a standardization-compliant protocol or by the universal device agent.

3.2 Data Model Definition

Define the data models of the raw data sent from devices and the processed data to be shown to the service AP. For example, the temperature data sent every minute can be defined as raw data and the average temperature over an hour can be defined as processed data. These definitions are made on the

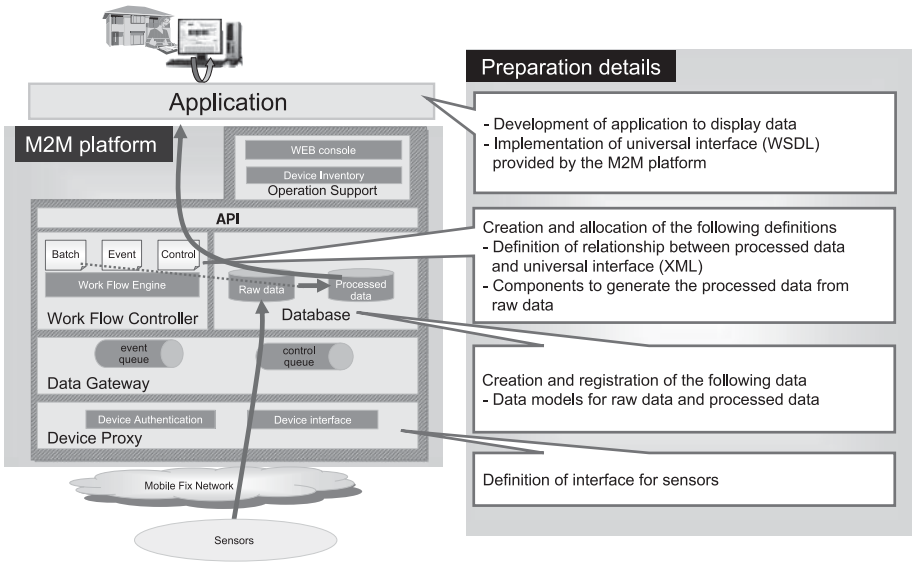

Fig. 3 Preparation of M2M.

XML basis and do not need complex coding.

3.3 Workflow Definition

Create the file for defining the workflow for generating processed data from raw data. This can be implemented by configuration based on the components provided by the M2M PF without need of coding.

3.4 Service AP Interface Definition

The M2M PF provides the SOAP, REST and JSON interfaces as the interfaces to service AP. This makes it possible to collect the data stored in the M2M PF easily without being concerned about the interface used by each device.

4. Roadmap of M2M PF

We started the demonstration experiment of the β-version in June 2011. Based on the experience obtained in this experiment, we added workflow components and devices/protocols that would be used in many situations, and eventually released the commercial version V1.0 in September 2011.

Following the above, we are planning to upgrade the version quarterly, in December 2011 and March 2012. The upgrading will include increased data access speed and capacity, compatibility measures with the MVNO (Mobile Virtual Network Operator), compatibility with the report builder for enhanced support, automation of constructions of data and workflow definitions via the GUI, and easy advancement of operations via the GUI. We will also enhance the functions to make the M2M PF a more convenient platform.

With regard to the compatible protocols, we will prepare protocols compliant to Continua, Z-Wave and ZigBee, etc., in order to enable connection of various devices. The increases in the types of compatible protocols and connected devices will bring the increase in the applications types. Under such a trend, we will aim to provide a platform that can be used optimally and easily in various usage situations.

5. Conclusion

For M2M business where eco-systems should be constructed via integrated management of information and convergence of interfaces, the M2M PF is one of the fundamental products supporting the M2M cloud-based business of NEC. This is due to the possibility of early, low-cost, easily undertaken construction of M2M systems.

In the future, we will invest new technologies by feeding back opinions from users so that the M2M PF will become an even easier-to-use product.

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