Collaboration among Agents in Logical Network of Peer-To-Peer Services

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Abstract

Mobile devices will have enough power to provide various kinds of services on themselves in the Internet. In these services, users buy and sell products by peer-to-peer contact on streets and shops. In order to realize the peer-to-peer services, we need a platform that satisfies the following requirements: describing a service independent of its location, and providing a service under dynamically changing network environment. This paper proposes a new framework, called Virtual Private Community (VPC), for such services. VPC provides flexible collaboration and a new computation framework for the flexible collaboration, in order to realize such services.

1 Introduction

In the near future, every mobile device is expected to have a capability to provide a variety of different services. Individuals are going to provide these services on a large, distributed scale in an environment encompassing the real world and cyberspace. We define “P2P service” a service which individuals provide each other with their mobile devices under temporal contact. P2P services have two important features; P2P services are not specified by location, but some dynamically changing place in the network. Services do not fix its own location statically, since several peers provide the same services at various locations. Peers also do not provide services all over the time. Services are provided only when peers get contact with each other. P2P services are also performed by activities of roles in commercial transactions. Roles, such as seller and customer, change according to commercial transactions. A role, which a peer plays in a P2P service, is also dynamically determined. Hence, a service in P2P services is completely separated from location. Therefore, in order to realize P2P services, we need a new framework, in which services are defined and performed independently of their location. The framework for P2P services should support flexible collaboration among roles in commercial transactions under ad hoc and temporal contact.

We propose Virtual Private Community (VPC) as a new framework to realize P2P services. VPC also supports collaboration among roles without addresses of roles under temporal connection. VPC platform works on user’s mobile device, and several VPC platforms construct network, called P2P network, by connecting each other. P2P network is ad hoc and temporal network. A virtual community is created on P2P network for each service. Necessary roles for a service reside in the virtual community. A service is offered by collaboration among roles. The virtual community is destroyed when the service is closed. VPC provides flexible collaboration method, and a new computation framework to realize P2P services.

2 P2P service: Ad hoc computation

A P2P service is based on computation in temporal contact that is ad hoc network. A P2P service is provided by collaboration among roles under ad hoc network. In order to execute collaboration among roles, a computation framework under ad hoc network is needed. We define “ad hoc computation” as computation in ad hoc network here. We call a ”computation entity” as an entity executing calculation. Computation entities are roles in P2P services. Execution environment for ad hoc computation is constructed temporally at beginning of the computation, and is released when computation finishes. There are two phases, setup phase and execution phase, to carry out ad hoc computation. Ad hoc computation must be set up according to setup definition and executed according to execution definition.
setup phase, computation entities are spread to corresponding platforms according to definition. Then, the spread computation entities perform computation by collaboration with each other according to the definition. Setup definition defines deployment of computation entities. Computation entities are put onto distributed platforms according to the definition. Setup definition should not include addresses of platforms to allocate computation entities to platforms. The question in setup definition is how to distribute computation entities to appropriate platforms. Execution definition defines computation among computation entities. The definition also should allow computation without addresses of computation entities. Addresses of the entities are dynamically determined according to setup definition at execution. The question in execution definition is how to describe collaboration among computation entities without addresses of computation entities. The platform to realize P2P services must answer the two questions: how to distribute computation entities and how to describe collaboration among computation entities without addresses.

3 Virtual Private Community (VPC)

Virtual Private Community (VPC) is a framework to realize P2P services. Service such as commerce in VPC is performed in a virtual community consisting of roles, and the virtual community is specified by a policy that defines assignment of appropriate roles for users according to users’ attributes, called a policy package. A policy package consists of a set of assignment rules of roles, role definition, and contents definition. An assignment rule consists of a pair of condition and role names. The condition is combination of attributes. Role definition is a set of a role name, a program code name, and description for initialization.

Users who accept a policy package pertaining to the community create a virtual community in VPC. Each user has its own VPC platform (VPC-P). VPC-Ps construct P2P network created by connecting each other. P2P network is a temporal and ad hoc network. Virtual communities are created on P2P network for each service when the services begin. A virtual community is withdrawn when corresponding service is finished. VPC-P manages owner’s attributes. The attributes may include name, age, and certificates published by an authority (e.g. PKI [1]). Each VPC-P determines roles to its owner according to user’s attributes and the policy package. Services are provided by collaboration among the assigned roles on VPC-Ps in communities.

Collaboration in a community among roles is performed with type match invocation. The type match invocation has been developed as Field Reactor Model [2] based on data-driven coordination model [3]. The type match invocation provides a collaboration way, in which methods of objects are invoked when the same type of messages as an argument of the methods are put in the communities, without addresses of objects. Collaboration among roles is defined by declaration of methods for collaboration in a community. Declaration of a method to collaboration is same as normal method declaration consisting of an argument type, body, and a return message type.

4 Ad hoc computation in VPC

VPC provides ad hoc computation. A policy package in VPC is setup definition. Execution definition is defined as a set of declaration of methods in roles. An assignment rule in policy package is setup definition in ad hoc computation. Computation entities (roles) are allocated according to users’ attributes. Assignment rules as the setup definition do not use addresses of VPC-Ps for deployment of computation entities. Execution definition in ad hoc computation is defined as a set of declared methods of role objects. Computation is executed with logical connection between argument types and return value types of methods by type match invocation. The type match invocation provides a collaboration method without addresses of computation entities.

5 Conclusion

We have proposed in this paper a new framework called Virtual Private Community (VPC) for P2P services, in which individuals can buy and sell products by peer-to-peer contact. VPC enables services to perform by implementing a simple method called policy packages. Policy packages contain an assignment rule for roles utilizing user attributes and/or certificates, definition of roles, and contents such as role programs. In addition, by transferring policy packages, VPC provides services a means to expand their application range on the Internet, and communities are created by linking VPC platforms (VPC-Ps), VPC provides a new computation model for P2P services.

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References