Complex Applications over Peer-to-Peer Networks

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Existing Peer-to-Peer (P2P) applications are designed to provide file sharing. We envision more complex applications on P2P systems, e.g., P2P virtual-worlds. We have developed a layered software architecture called Open P2P Network (OPeN) architecture to enable such applications. In particular, the objective of our OPeN architecture is to allow application developers to focus on their tasks, rather than the details of the underlying P2P protocol, for a complex application and to allow P2P applications to be developed independently from specific P2P protocols.

The OPeN architecture consists of three layers: Connectivity layer, Core Services layer, and Application layer. The Connectivity layer is responsible for P2P object management and message routing where different protocols can be utilized. We enable P2P protocols to be developed transparently to the higher levels of the architecture. Core Services layer uses objects that are extended from the Connectivity layer. The use of objects allows the delegation of data processing to be seamlessly distributed over the peers in the P2P network. Applications make use of the standard interfaces provided by Core Services. Core Services consist of a variety of generic services, these currently include (but are not limited to): Peer Management, Database, and Virtual Machine. For example, a Core Service can query, insert, delete, and modify objects in/into/from/in a P2P network.

Using the OPeN architecture, we have developed a P2P 3D virtual-world application. P2P systems scale well in comparison to centralized systems, so a massive amount of participants in this world is achievable. We partition the space into regions and assign the responsibilities of regions to peers. We developed this serverless virtual-world on top of our Database Core Service without much difficulty or considering details about dividing the virtual space to peers at the application level. The underlying P2P protocol can now easily be replaced with other upcoming more efficient protocols too.

A neural network grid is also under development, making use of the Virtual Machine Core Service; that allows applications to allocate resources such as processors under a single distributed structure. Artificial neural network scientists can run and share learning algorithms via this application. Scientists can choose an algorithm and execute multiple copies of it with parameters generated from a range. The results can be monitored by all involved. In this case, the software design defines a farming application and a monitoring application for interactive use by the scientists.

One additional advantage of our architecture is the ability to allow application, Core Service, and P2P protocol developers to test and experiment with their work independently of other layers. We are currently developing wrappers around our sample services and will test them on a large scale simulated network.

We are planning to develop other Core Services as our future work, e.g., Security Core Service. Our initial experience with the OPeN architecture is very positive and we believe it can be extended and used for other highly distributed dynamic environments.

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