

A Definition of Peer-to-Peer Networking for the Classification of Peer-to-Peer Architectures and Applications

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Abstract

The main contribution of the poster, which is shortly outlined in the following, is to offer a definition for Peer-to-Peer networking and to make the differences to common so called Client/Server-architectures clear. With this definition we are able to classify currently existing networking concepts in the Internet either as "Pure" Peer-to-Peer, or "Hybrid" Peer-to-Peer or Client/Server architecture.

1 Introduction

Peer-to-Peer Networking is mostly known under the brand of Napster. Within this application the Peer-to-Peer networking concept is used to share files, i.e. the exchange of MPEG Layer3 (mp3) compressed audio files. However, Peer-to-Peer is not only about file sharing, it is also about establishing multimedia communication networks based on Peer-to-Peer concepts or resource sharing.

A basic problem we often encountered, is the multifaceted and confusing situation, concerning the terms related to Peer-to-Peer networking in publications and discussions. Often Peer-to-Peer is used without having clearly stated the meaning of Peer-to-Peer. Thus it may happen, that sometimes in discussions the term Peer-to-Peer is used with completely opposing meanings.

The central theme of this poster therefore is to bring in a clear definition of Peer-to-Peer networking and its different facets, like e.g. "Hybrid" Peer-to-Peer networking. Further on we also give a definition of the classical Client/Server architectural concept, to make a distinctive delimitation to Peer-to-Peer network architectures possible.

2 Definition of Peer-to-Peer and Client/Server networking

Peer-to-Peer networking is not new. Already a few years ago the advantages of Peer-to-Peer networking have been recognized and thus investigations into these architectures were made [You93] [Sim91]. Others like

e.g. [Met01] and [Wra94] define Peer-to-Peer networks just as a collection of heterogeneous distributed resources which are connected by a network. Some attempts to describe Peer-to-Peer networks more extensively, than in just an application specific way, define Peer-to-Peer simply as the opposite of Client/Server architectures [Sin01] [Tho98].

However, from our point of view, the most distinctive difference between Client/Server networking and Peer-to-Peer networking is the concept of an entity acting as a *Servent*, which is used in Peer-to-Peer networks. *Servent* is an artificial word which is derived from the first syllable of the term server ("Serv-") and the second syllable of the term client ("-ent"). Thus this term *Servent* shall represent the capability of the nodes of a Peer-to-Peer network of acting at the same time as server as well as a client. This is completely different to Client/Server networks, within which the participating nodes can either act as a Server or act as a client but cannot embrace both capabilities.

The above shortly outlined features of Peer-to-Peer networks can be concluded in Definition 1. Service in this context is understood as outlined in [Kel98].

A distributed network architecture may be called a Peer-to-Peer (P-to-P, P2P,...) network, if the participants share a part of their own hardware resources (processing power, storage capacity, network link capacity, printers,...). These shared resources are necessary to provide the Service and content offered by the network (e.g. file sharing or shared workspaces for collaboration): They are accessible by other peers directly, without passing intermediary entities. The participants of such a network are thus resource (Service and content) providers as well as resource (Service and content) requestors (Servent-concept).

Definition 1 The definition of Peer-to-Peer

To be able to distinguish Peer-to-Peer networks with a central entity from those without any central entities, it is general practice to split the Peer-to-Peer networking definition into two sub-definitions. They are generally known as the "Hybrid" Peer-to-Peer networking con-

cept, which allows the existence of central entities in its network, and the "Pure" Peer-to-Peer networking concepts within which *Servents* are the only entities allowed. These two concepts are defined in the following way:

A distributed network architecture has to be classified as a "Pure" Peer-to-Peer network, if it is firstly a Peer-to-Peer network according to Definition 1 and secondly if any single, arbitrary chosen Terminal Entity can be removed from the network without having the network suffering any loss of network service.

Definition 2 The definition of "Pure" Peer-to-Peer

The key distinction of "Hybrid" Peer-to-Peer compared to "Pure" Peer-to-Peer is the fact, that a "Hybrid" Peer-to-Peer network always includes a central entity, which is "forbidden" by definition in "Pure" Peer-to-Peer networks. On the other hand "Hybrid" Peer-to-Peer networks differ from Client/Server networks, because the feature of the nodes to share resources is substantial in "Hybrid" Peer-to-Peer networks.

A distributed network architecture has to be classified as a "Hybrid" Peer-to-Peer network, if it is firstly a Peer-to-Peer network according to Definition 1 and secondly a central entity is necessary to provide parts of the offered network services.

Definition 3 The definition of "Hybrid" Peer-to-Peer

One significant difference of Client/Server networking compared to Peer-to-Peer networking is that the clients do not share any of their resources (storage capacity, computing power, network connection, bandwidth, content). In the Client/Server concept exists only one central entity, which provides all the content and services which are offered in a certain network.

A Client/Server network is a distributed network which consists of one higher performance system, the Server, and several mostly lower performance systems, the Clients. The Server is the central registering unit as well as the only provider of content and service. A Client only requests content or the execution of services, without sharing any of its own resources.

Definition 4 The definition of Client/Server

3 Conclusion

The introduction of a profound and clear definition of the understanding of Peer-to-Peer -networking is a first step to understand and be able to estimate the impacts of

this new arising networking technology. We feel the need for such a basic work, because the main problem of today's discussions and publications in the field of Peer-to-Peer networking are, the different and often even opposing understandings of Peer-to-peer networking. Meaningful discussions were hardly possible until now, because of the vagueness about the terms used in Peer-to-Peer networking.

Nevertheless there is still a long way to go, until Peer-to-peer networking is going to become a real success story. A lot of problems still have to be solved and one of them is certainly the traffic engineering problem encountered especially in completely flat routing architectures. New, dynamic routing concepts have to be developed, as for example dynamic hierarchical routing topologies we envision as a solution for today's encountered traffic problems. Although there are still a of problems to be solved, this might finally lead to a Peer-to-Peer based third generation Internet.

4 References

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