Charging in Peer-to-Peer Systems Based on a Token Accounting System

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Abstract. Today, Peer-to-Peer applications are predominant on the internet when considered in terms of its traffic consumption. However apart from Skype, their commercial success is still very limited. This is due to the difficulties faced when trying to implement crucial functionality such as accounting and charging without violating the Peer-to-Peer paradigm. A fully decentralized accounting scheme based on tokens was presented by the authors last year. In this paper we analyse the interactions between token-based accounting and charging in order to enable peers to charge for their services. We present three different charging schemes using tokens as (1) pure receipts, as (2) Micropayment, and as (3) bill of exchange. These schemes are evaluated based on the provided security and the overhead traffic introduced into a Peer-to-Peer system.

1 Motivation

Apart from Skype, the commercial success of Peer-to-Peer (P2P) applications is negligible. Internet Service Providers believe that the future of P2P is very promising in the combination with Triple Play \([1]\), due to the strong interest of customers today in private content, which can be delivered efficiently using P2P. Besides this, other P2P applications have been envisioned whereby peers have to pay for services which they receive. However, it is still an open question for service providers how to charge for the services within a P2P system. A basic requirement for P2P business applications is a P2P architecture which supports commercial services. Often such an architecture is provided by the manufacturer \([2,3]\). In this paper, we do not consider payment models used by the manufacturer to charge the peers using his P2P platform. Instead, we focus on the P2P business applications whereby peers charge for their services delivered.

The requirements for an architecture suitable in supporting such business applications and related work about charging systems are summarized in Sect. 2. A core requirement is a reliable, trustworthy accounting mechanism that complies with the P2P paradigm \([4]\). We have developed a token-based accounting mechanism which fulfils these requirements (see \([5]\)). A short overview is given in Sect. 3. In this paper, we present and analyse three charging alternatives which can be added to our token-based accounting scheme. These alternatives are
presented in Sect. 4. In Sect. 5 we compare the different alternatives in terms of the transaction costs born by the peers. In Sect. 6 we draw the conclusions.

2 Requirements for P2P Business Applications

Peer-to-Peer business applications that offer service providers the possibility to charge money for their services have to fulfill several requirements. The fundamental mechanism needs to be able to determine supply and demand, both of which can be determined using the search functionality in P2P. Further requirements include pricing, metering and accounting, charging, billing and payment [6,7,8,9,10]. We will now present the process from pricing to the final payment together with the related work.

Pricing. Before peer A requests a service from peer B, first, both peer A and B must agree on the service and its price. This price will be expressed in the form of a tariff. There are several options for determining a price, e.g. negotiations or auctions [11,12,13]. For a fair market the availability of price information is important. Price or tariff distribution is discussed e.g. in [14].

When A and B agreed on both service and price, the service will be delivered (e.g. the file will be uploaded by B to A). This period is called service session. During the service session, other functions mentioned above are also required. Several integrated frameworks in different fields of the Internet have been presented [15,16].

Metering. Metering is the process of objectively observing events happening within the P2P system and communicating them to the accounting system. In P2P systems metering is limited to local observation.

Accounting. By using information from metering, accounting creates receipts and may distribute these within the system for storage. Thus, receipts contain information about the events which the peers claim to have happened. It is the most objective information about service sessions available. Examples of accounting mechanisms for P2P systems are [17,18,5], see also next section.

Charging. Charging combines the accounting information provided, with the tariff which the transaction partners agreed upon and calculates the charge, the actual amount of money the service requestor has to pay to the service provider. Charging can be an ongoing process during the service session, an once only process at the end of the service session, or even an aggregating process over several service sessions. Examples for P2P based systems are [19,18]. The charging information is fed into a billing and payment system.

Billing and Payment. The billing functionality creates a bill which states, among with other information, the amount that the requestor has to pay to the provider. As money is something external to the P2P application, we also assume that the