1 INTRODUCTION

E-communities are dependent on on-line entertainment, trade and communication, which is spread over Internet services. E-commerce sites such as Amazon [1], eBay [2], information and social web portals (Flickr, My Space, I Google, Wikipedia, Face book) incorporate advanced Web 2.0 mechanisms [3] for customizable content presentation, sharing and delivery. A versatile mechanism for usage of applications and computing resources as a service, called cloud computing [4] has moved the margin of the computer user experience from the ordinary simple desktop applications to enriched, any-where and any-time, widely portable web applications.

A significant component of contemporary web applications is a mutual user interaction which drives the development of flexible and customizable web applications. To some extent, especially for social web applications, a middleware part is operated by a provider, whilst the value added content is delivered by service users. The Web 2.0 paradigm [3] introduces a certain level of complexity to the service design and imposes new challenges for Application and Internet Service Providers (ASPs and ISPs). They are forced to ensure attributes demanded by the market in terms of (network-centric) Quality of Service (QoS), application-specific security as well as ergonomics that fit human needs. These attributes are composed of a mix of objective and subjective metrics of service quality which require appropriate evaluation methods. It has to be realized that the development described above entails an increasingly hazy distinction between service and user, which may lead to the inevitable loss of manageability on the provider’s side, resulting in service quality degradation or even failure of users’ business. In the growing jungle of self-service, users as consumers of services need to be able to assess whether a particular (web) service matches their needs in an aesthetic, functional, timely and financial manner. Quality of Experience (QoE) – is, according to ITU-T Rec. P.10/G.100 Amendment “the overall acceptability of an application or service, as perceived subjectively by the end user” – and this has recently replaced classic QoS parameters
(such as loss and delay) when it comes to assess the quality of a service. Thinking of all kinds of potential impact factors such as user expectations, user experience, context of use and technical parameters such as QoS, determining the QoE of a particular service is not necessarily a trivial issue.

A potential approach to the given challenge is the use of reputation systems [5], [6], [7]. Apart from the defined service logic and their security assurance, the reputation systems perform a continuous monitoring of user or user agents’ activities and stimulate the associated community to behave appropriately. They also support accountability for malicious attitudes, which is often reflected as lowering of service quality. The reputation systems evolved with a mechanism of sharing a reputation scoring on a particular entity among all interested users and corresponding service providers [8], [9]. This approach introduces a role of a third trust party who observes and propagates the scoring that stimulates the increase of collaborative attitude across a population. Applying this feature into Future Internet services, we may expect to keep the reputation fairly balanced over the users’ and web applications’ communities.

Reputation scoring usually reflects an aggregated subjective opinion on a party and depends on the user’s activity, time scale and service context [7]. These certain key attributes of the service are represented by a number of parameters and evaluated by the reputation system. The result of such an analysis forms a reputation-based user experience which is expressed with a set of QoE metrics of the service [10]. The way of building reputation distinguishes between its subjective and objective nature. For instance, in Mobile Ad Hoc Networks (MANET) [11] a locally created reputation [5], [12] reflects a generalized opinion on the truthfulness of peers in the network, but still remains a subjective measure of the service in a local neighborhood. This is a characteristic property of distributed reputation systems. In contrast, a centralized reputation repository yields objective scoring [13], by means of performing a global generalization and assuming that parties of subjective opinions are not related. A diversity of contemporary Web applications may impose a need to adapt reputation
metrics with use of collaborative filtering in order to get an accurate and context-aware subjective measure, the subjective reputation [14]. Collaborative filtering shapes the reputation in order to emphasize and share the characteristic features of subjective metrics and allows the interpretation of a particular reputation to be distinguished, for example user reputation and network reputation. Operators, for example, might be interested in both subjective and objective network reputation. Subjective reputation reflects the individual customer’s view on the quality and value of a service and is strongly related to the risk for churn, i.e., the risk of leaving the operator because of dissatisfaction. However, the operator has to treat the potential risk from single unhappy customers against the overall service quality, which is typically limited by the margin between income and investments. In this context, even the reputation of the (complaining) user might be of interest; a reasonable user’s judgment might be weighted higher than that of a well-known grouch.

Electronic commerce (eCommerce) communities can be seen as truly distributed computing applications in which peers (members) communicate directly with one another to exchange information, distribute tasks, or execute transactions. Such communities can be implemented either on top of a P2P network [15], [16], [17] or using a conventional client-server platform. Gnutella is an example of P2P eCommerce communities that are built on top of a P2P computing platform. Person-to-person online auction sites such as eBay and many business-to-business (B2B) services such as supply-chain-management networks are examples of P2P communities built on top of a client-server computing architecture.

In eCommerce settings P2P communities are often established dynamically with peers that are unrelated and unknown to each other. Peers of such communities have to manage the risk involved with the transactions without prior experience and knowledge about each other’s reputation. One way to address this uncertainty is to develop strategies for establishing community-based trust through reputations. In a buyer-seller market, buyers are vulnerable to risks because of potential incomplete or distorted information
provided by sellers. Trust is critical in such electronic markets as it can provide buyers with high expectations of satisfying exchange relationships. A recent study [18] reported results from both an online experiment and an online auction market, which confirmed that trust can mitigate information asymmetry (the difference between the amounts of information the two transacting parties possess) by reducing transaction-specific risks, therefore generating price premiums for reputable sellers.

1.1 Problem Statement

The Internet is about scale. By virtually any metric, orders of magnitude more people are connected to each other, and communicate cheaply with each other, than at any time in history. However, many of these communications are among strangers, people who do not know each other before they receive a communication, learn little about each other from the communication, and do not encounter each other again. Where such encounters involve merely e-mail or chat room messages, such exchanges are not surprising. Risks are small so not much trust is required.

What is surprising is the vast shuttling of both new and second hand goods among distant strangers on the Internet, through such mechanisms as eBay and the Yahoo auction site. Buyers, who must pay before inspecting or receiving their items, must put considerable dollars at risk.

This new phenomenon of trust among strangers in Internet auction exchanges relies on a reputation system that is fundamentally different from those that human societies have evolved over thousands of years to create trust, particularly trust in economic transactions. Our focus is on transactions at the retail level, namely when the scale and dollar volume of transactions is limited.

How trust is traditionally created when goods are exchanged? We identify eight factors; readers would add more. (1) Most retail transactions are conducted locally, which gives individuals the opportunity to inspect them, as say with fruit in a rural market. If quality is discernible, no trust is needed. (2) Retail operations tend to be large relative to
their local market, be they vegetable sellers or the local department store. Buyers have frequent interaction with the same seller, and learn whom they can trust. (3) Even when one’s personal interactions are limited, given that a retailer’s sales are concentrated in a locale makes it easy to develop reputations so customers learn about retailers from their peers. (4) Retailer reputations are borrowed from other contexts. For example, retailers are likely to be pillars of the church and community, and would be highly reluctant to sacrifice the status that comes from such reputations.2 (5) Reputations are built over many years; witness the reputations of Sotheby’s and Christies, the leading auction houses, which are hundreds of years old. (6) Reputations are borrowed from others. Thus celebrities will attest to the quality of products. (7) New goods benefit from established brand names, and policing of quality by those who own them. The product, not the retailer, wins the reputation. (8) Significant expenditures – e.g., building a fancy store on Manhattan's Fifth Avenue3 -- indicates that one will be reliable, lest this expenditure be wasted, a form of signaling.

Internet auctions have none of these mechanisms available. Sellers are not met, and little or nothing is known about their characteristics, or even their location beyond its city. Customers rarely repeat, and they do not run into each other. Putting items on the Web is a cheap activity. Some goods that are traded are not brand name, and when they are there is a risk of being counterfeit. Measured in relation to the age of significant retail operations, all of the sellers are new. No one attests about the sellers. Firms like eBay do not stand behind their auctioneers. Yet millions of transactions have taken place.

What has substituted for the traditional mechanisms that establish trust? The argument we develop below is that the Internet substitutes a much better distribution of what information there is for the much more limited, but more reliable information of traditional retail markets. At least as judged by sales volume, the system appears to be working.

Though the system appears to be working, none of its participants know exactly how it is working or what its properties might be. For example, we found that just over
half of buyers provided feedback. Presumably, these buyers comprise an unrepresentative sample. If they are merely individuals who find it cheap to do so, the bias might not be severe. However, it may be that dissatisfied customers are substantially less likely to give feedback. If so, since the overwhelming majority of feedback is positive, the most important information is being lost. Similarly, there is no known correlation of feedback with the price of the transaction. Conceivably sellers are honest with small transactions, but deceive (cash in their reputations) with large ones.

Customer-scored reputation systems to date rely overwhelmingly on voluntarily provided information. This creates strong incentives to free ride, and quite possibly to Pollyanna (disproportionately positive) feedback. An alternative framework would pay individuals for providing evaluations, and would reward them if their assessments correlated with future experience. Hence, in the model proposed here in this this is significant.

1.2 Research Objective

Recognizing the importance of trust in such communities, an immediate question to ask is how to build trust. There is an extensive amount of research focused on building trust for electronic markets through trusted third parties or intermediaries [19]. However, it is not applicable to eCommerce communities where customers and sellers are independent entities, thus no peers can serve as trusted third parties or intermediaries.

Reputation systems [6] provide a way for building trust through social control without trusted third parties. Most research on reputation-based trust utilizes information such as community-based feedbacks about past experiences of peers to help making recommendation and judgment on quality and reliability of the transactions. Community based feedbacks are often simple aggregations of positive and negative feedbacks that peers have received for the transactions they have performed and cannot accurately capture the trustworthiness of peers. In addition, peers can misbehave in a number of ways, such as providing false feedbacks on other peers. The challenge of building a trust
mechanism is how to effectively cope with such malicious behavior of peers. Another challenge is that trust context varies from transactions to transactions and from communities to communities. It is important to build a reputation based system that is able to adapt to different communities and different situations.

With these research problems in mind, we develop Peer Trust, a peer-to-peer trust model for quantifying and assessing the trustworthiness of clients in eCommerce communities. Our goal is to build a general trust metric that provides an effective measure for capturing the trustworthiness of clients, addresses the fake or misleading feedbacks, and has the capability to adapt to different communities and situations.