TOWARDS A P2P WORLD: PEERED TAXATION

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KEYWORDS: Peer-to-Peer, Client-Server, Taxation, Participation

1. INTRODUCTION

We are moving towards a globally formed information society, where easy access to knowledge is a one-way road towards feature cultures. Technology advantages have offered us the path for easy, on time access to a diversity of information and tools for improved productivity and communication. This has come under knowledge of today's government and organizations, who constantly try to increase the technological service level of their offerings via various ways.

It is a fact that today more than 30% of government and commercial information, in countries across Western Europe, is available online, offering online services, some advanced and some not, to citizens and customers ([9],[2]). Via this newly defined route, alternative paths of information are made available to individuals, offering seemliness, 24/7 on demand services.

All this effort is based on the current social and organizational model of government. This model can be though of as a pyramid of authority. In this pyramid each layer is controlled by its upper level having a relationship which can only be described as a one-way unequal relationship, using principles similar to the Client-Server model.

The limitations of such a system are many in terms of performance and stability ([5]), and at the same time its philosophy does not facilitate participation and equitability, two fundamental principles of our next generation societies. This, combined with the vast increase of resources and the need for on-time and stable information flow, has introduced the creation of a new architectural approach known as the Peer-to-Peer (P2P) paradigm. Based on this architecture participants, within a specific network, form equivalent two-way relationships, acting both as servers and clients, offering performance gain, stability, scalability and on-time delivery.

Although the performance advantages are significant, the focus of our research is not on them, but on its more social perspectives concentrating on participation. This paper presents a different approach towards taxation, which comforts citizen participation. Taking a P2P-like approach to network organization, the overall philosophy of the current taxation scheme transforms into a uniform bilateral approach towards tax assessment.

In the next section of this paper we are going to briefly compare the two models: the current Client-Server model and the next generation Peer-to-Peer one. We will then have a deeper look on the P2P model architecture and its offerings and use our findings in order to design a newly conceived e-taxation system.

2. EXISTING MODELS' ANALYSIS

2.1 The Client-Server model

The Client - Server model has become a status quo for both technical and organizational or socio-technical systems. It is characterized by the

existence of a supernode known as a server which serves, and often also controls and orchestrates, one or more clients via one-to-one relationships. "A Client–Server network is a distributed network which consists of one higher performance system and several mostly lower performance systems" ([2]).

The Client-Server model has been intended to provide a scalable architecture, whereby each computer or process on the network is either a client or a server. In this relationship the server can be described as passive, waiting for requests, which are served and returned, while the client can be described as active, sending messages and receiving replies. The decision and orchestration process is fully assigned to the server, the results of which are forwarded to the clients.
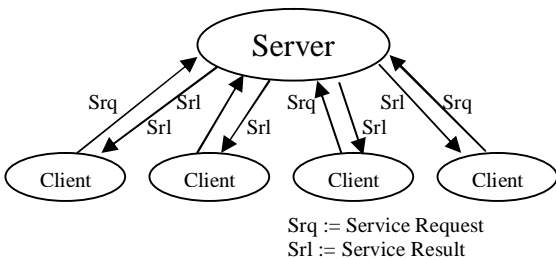

Srq := Service Request
Srl := Service Result

Fig. 1.   The Client - Server architecture

Although the name "Client-Server" has been introduced and used mainly on the technological field to describe computer networks' architecture, the very concept of that model has being used for ages on humans' societies as the main organizational principle. In full, it can be though of as a pyramid of authority. In this pyramid each level of "bricks" (nodes) is controlled by the upper level (Server) having a relationship which can be only described as a one-way unequal relationship:
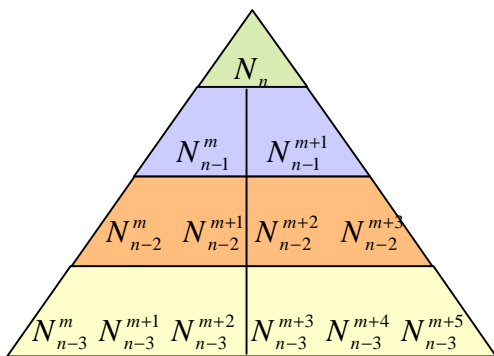

Fig. 2.   The Client - Server pyramid

The use of such an architecture in the early stages of network development was necessary, as a result of the limited capabilities of computer terminals used by the clients and the high total cost of owning central servers. Such a structure seemed fairly efficient for the amount of information flowing on computer networks and the clients available, bringing certain advantages such as scalability, security and availability.

The domain of knowledge, application and usage of most systems enabled the adaptation of such a model. Applications such as e-mail systems, databases, expert systems, etc, had a philosophy compliant to the Client–Server one and therefore the model was widely adopted. However IT has moved beyond this once pioneering, but now primitive, usage area, reaching a more advanced one, where the information load has vastly increased, and so has the range of use.

To sum up, client-server continues to be the dominant paradigm in network architecture. Although it is highly dependent on centralised points, it offers great interoperability and scalability, within a certain threshold, at endurable cost.

2.2 Current Client-Server Taxation Scheme

The taxation scheme used in most countries across the E.U uses the Client–Server pyramid architecture. In bulk, we could say that it consists of three main elements: the central authority, the revenue services and the tax payers, plus an e-service wherever available:

- Central authority: The central authority, (i.e. the government) is responsible for the settlement of the revenue services and the collection / allocation of the tax funds.
- Revenue services: The revenue services constitute the central part of the taxation network and operate as a link between the central authority and the taxpayers. Their basic responsibilities involve tax collections from the taxpayers, to be then forwarded to the central authority.
- Taxpayers: The lower layer of this taxation pyramid is formed by the taxpayers. Their participation in this scheme can be only described as passive, being limited to tax payment.
- E-service: The e-service entity, when it exists, acts as a parallel information channel. In some more advanced e-services it operates as a

secondary online revenue service with e-transaction capabilities.

The participants of each layer form one-way relationships with the participants of their upper level. The communication attributes are limited to standard financial transactions, neglecting equally important subjective data derived from the taxpayers.
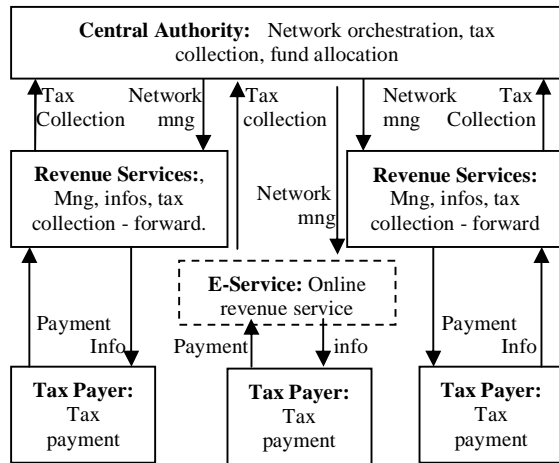

Fig. 3. Current Taxation Scheme

Such a "commercial" approach towards tax management often leads to some unwanted results. Governments often draw away from the true citizens needs, increasing the gap formed between the two edges of the pyramid. The strategic investments of the taxpayers money are based on raw statistics and not on actual needs.

At the same time transactions seem to lack transparency. Citizens have no clear saying or view of the sink-point of their tax payments and therefore lack the means to track the use of their contributions, a weakness that can encourage corruption and intentional fund misplacement.

In terms of citizen psychology, the current taxation scheme could increase taxpayers' discomfort. Taxation nestles in a basket of activities that trigger a degree of societal discomfort. The taxing procedure is from its nature an unsatisfying experience. It becomes even more unsatisfying when participation in the procedure is limited to tax payment. Taxpayers often feel disregarded and deflated as a result of this unilateral relationship. Their discomfort is often expressed by an unacceptable social behaviour, which sometimes

includes tax evasion. Studies by Pommerhence and Weck ([6]) show that the stronger political participation rights are, in the sense of direct democratic decision making, the lower tax evasion is. In other words, tax morale appears to be higher when taxpayers can influence decision making. Taxpayers perceive their civic duty more strongly if they are directly involved in political decisions of content instead of solely electing representatives on a periodic basis.

3. THE P2P REVOLUTION

3.1 The P2P model

It has become obvious that the traditional Client–Server model lacks in terms of performance and dependability. The number of clients vastly increases, and so does the load generated per client. Nowadays the benefit of scalability rarely exists in the Client–Server architecture, since the thresholds per server can be easily reached. Once reached, the potential for load capability increase demands high-cost investments that will hardly attenuate. Along with that, socio-technical Client–Server systems also lack social capital between clients. These have motivated the quest for alternative, lowcost architectures, capable to provide the means for a high performance communication, unaffected by a vast increase of clients and load.

This quest introduced the P2P architecture on network design. It can be described as the extension of the Marxian ideology on today's human networks ([1]), technology-based or not. Concisely speaking the term "P2P network" refers to networks where its participants can be described as equivalent. In such a network every participant can operate both as a client and a server, in order to serve the common goals, forming bidirectional relationships.

"P2P networks are dynamic networks where peers can act as server and client indistinctly and peers might freely join and leave the network over the time" ([3]) and "they enable large numbers of computers to share information and resource directly without dedicated central servers" ([4]).
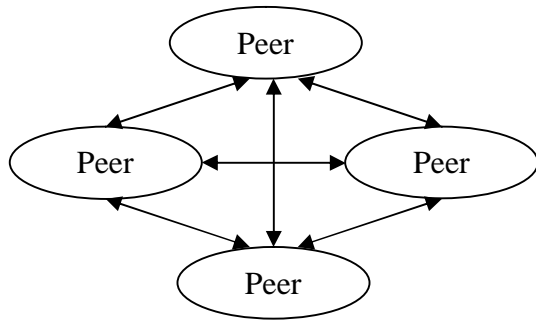
Fig. 4. The P2P model

Peer-to-Peer networks, contrary to the Client–Server ones, follow a de-centralized approach towards ad hoc network management, using end-to-end communication with shared ownership. They can dynamically evolve, in contrast to Client–Server networks which are server-dependent, offering high levels of scalability and reliability, proportional to the P2P network's size [5]. As a result, P2P is a well-suited off-spring of the Client – Server model, especially when there is lack of infrastructure for leveraging vast amounts of resources.

Basically the P2P structure manages to unburden the load from just one server, distributing it among all the participants. This offers great advantages, the two most important of which are:

- Stability: the network is no longer based on only one server; therefore if one machine goes offline, the network will not fail.
- Scalability: new peers can always join the network, without having to worry about the network load.

However from our point of view the most important attribute of the P2P model is participation. It transforms simple peers (clients) into active members of the system, involved both in system's operation and system's strategy planning. It uses altruistic principles compatible to the spirit and philosophy of ideal societies: "Everyone is equal and has the same abilities and liabilities" – "A world where every citizen is an active member of a social network". Lastly, its socio-technical architecture creates enriched social capital between the peer nodes due to mesh-like bi-directional relationships.

3.3 P2P Taxation scheme

As mentioned above, although this taxation model is described as P2P, the focus of our work was not to create a pure P2P model, whose members are fully equivalent but to adopt certain P2P principles on the current service client model. We have used the same structure as the one used on the pre-existing taxation scheme, but we have re-allocated the responsibilities and capabilities of the four participants.

The proposed system includes a new entity, namely the "domain list", a term used to describe the list of available departments that can be chosen for funding by taxpayers. This list is generated by the higher authority in coaction with each domain. Its validity will be audited by an external authority, to be then evaluated by taxpayers, and returned to the central authority. The domain list structure is simple: it contains a description of each funding domain, their past/undergoing works, their future works and the required funding.

Domain List		
Domain description	Health care	Road construction
Past/undergoing	Research on lung cancer, Construction of Rafinas General Hospital	Construction of Egnatia highway
Future plans	Establishment of chemotherapy clinics in 50% of hospitals in Attica,	Completion of Egnatia highway, Construction of Lamia highway
Required funding	12.000.000 Euros	85.000.000 Euros

Fig. 5. Structure of the Domain List

The newly defined responsibilities of the four participants include:

- Tax payers: Their primary responsibility will still be tax payment. However now, they will have the ability to denote the domains to which their taxes should be allocated. In order to facilitate the taxpayers' decision process on their tax allocation, access to detailed information concerning past performance of different funding domains, as well as their

future plans, will be made available to tax payers, from the revenue services. Lastly the means for communication and knowledge exchange with other taxpayers will be also provided by the Revenue Services and mostly by the E-service. This communication may serve multiple goals. A first "informed individual choice" scenario would be to have taxpayers communicate with each other with the objective of making informed individual decisions about how to allocate their tax contributions at different public domains, based at other taxpayers' preferences; this could in fact be a single- or multiple-round process, depending on taxpayers' interest. A second "collective deliberation" scenario could be to have taxpayers engage in a discussion among peers so that some uniform decisions about the allocation of tax contributions could be reached and proposed to all participants for their voluntary compliance. These options testify the fertile directions of future research that are opened up by the work reported in this paper.
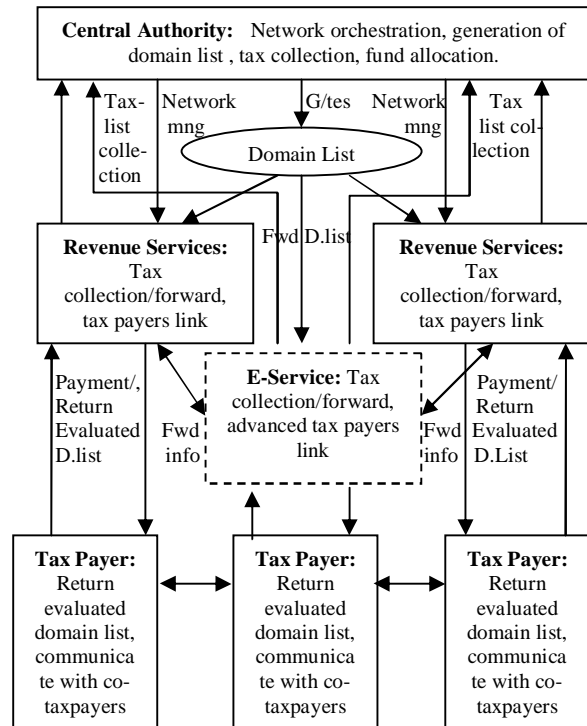
- E-service: the e-service will operate as a true revenue service. It will also take advantage of the communication capabilities offered by the Internet, in the form of forums, direct chat and e-mail between different taxpayers and revenue services.

- Central authority: The central authority is still responsible for the settlement of the revenue services and the collection of the tax funds. One additional task is assigned to it, that of the generation of the domain list. The allocation of the tax funds is still a responsibility of the central authority; however this responsibility is directly affected by the taxpayers' demands as illustrated on the evaluated domain list.
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- Revenue services: The revenue services continue to operate as a link between central authorities and taxpayers, being also responsible for forwarding the domain list. Moreover the revenue services will operate as a communication path between taxpayers.

Fig. 6. P2P taxation scheme

3.4 P2P Taxation scheme evaluation

The changes made to the existing model have managed to re-allocate in a more democratic manner the responsibilities among the members of the network. Still the central authority is the root of the network, but on the other hand the taxpayers assume a more active position in the scheme.

Such an meritocratic approach to tax funds-raising could affect positively the performance level of different domains. Funding will only take place if past performance exceeds a certain threshold and is apprehended by the citizens. Therefore fundees will constantly try to improve themselves in order to manage to convince citizens for the importance of their work, leading to less corruption, better performance and funding efficiency.

It should be noted that this merit system in some cases cannot be applied. Those cases involve services and domains whose deeds are not directly viewed by citizens (e.g. army, infrastructure work, etc) and in domains where maintenance funds are necessary (e.g. hospital maintenance on the health care domain). In such cases a basic level of funding could be applied, while any additional funding could be based on the taxpayers' evaluation.

4. CONCLUSIONS AND DIRECTIONS OF FUTURE WORK

This work is part of a greater effort that tries to migrate existing service infrastructures into the Peer-to-Peer paradigm. The P2P approach has already attracted great attention on the technological field and is soon expected to dominate it.

From a theoretical point of view, the P2P movement can be viewed as something more than a simple network architecture, but in fact as a philosophy. It can be described as a self-giving philosophy that allows every peer to equally participate, operating towards common good. It is a common fact that existing societies lack of true democracy, limiting their members to a passive participation on the social scheme. Such an approach to social culture is the very essence of pure democracy and is a one-way road towards future societies.

Guided by these needs, the research will continue to explore new ways towards citizen participation. Currently our focus is on the adjustment of the P2P taxation model to today's needs. Moreover our next steps are to fully define the relationship between the elements of the model, focusing on the taxpayer to taxpayer link, and to design an e-service that will successfully support the requirements, in terms of communication, knowledge exchange and transactions, of this taxation model. Lastly, we intent to examine ways to ascend potential issues that might occur, including a free-riding behaviour ([7], [8]), by the taxpayers towards tax placement and also tax payers' privacy issues.

References

[1] Bauwens M: *P2P and human evolution: Peer to Peer as the premise of a new mode of civilization, March 2005.*

[2] The Economist : *The 2006 e-readiness rankings – A white paper from the Economist Intelligence Unit, 2006.*

[3] Duval E, Vanderpitte P, Ternier S: LOMster: *Peer-to-Peer Learning Object Metadata*, World Conference on Educational Multimedia, Hypermedia and Telecommunications, 2002.

[4] Shiuhpyng S, Dan W: *Guest Editors' Introduction: Ad Hoc and P2P Security,* IEEE Internet Computing 2005.

[5] Milojici D, Kalogeraki V, Lukose R, Nagaraja K, Pruyne J, Richard B, Rollins S, Xu Z: *Peer-to-Peer Computing,* Technical Report HP Labs, 2002

[6] Pommerehne W, Weck H: Tax rates, tax administration and income tax evasion in Switzerland, 1996.

[7] Adar E, Huberman B: *Free riding in Gnutella*, 2000.

[8] Golle P, Leyton-Brown K, Mironov I: *Incentives for sharing in Peer-to-Peer* networks,2001.

[9] West D: *Global E-government 2006,* 2006