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TOWARDS CAPACITY AND TRAFFIC IN SERVICES WITH MULTIPLE CONTENT PROVIDERS

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ABSTRACT

Anatomize incentive structures in peer assisted services with multiple content providers and focus on stability issues from two different angles: stability at equilibrium of Shapley value and convergence to the equilibrium. We first define a coalition game in a peer assisted service with multiple content providers by classifying the types of coalition structures as separated, where a coalition includes only one provider, and coalescent, where a coalition is allowed to include more than one provider. We present three examples stating the problems of the non-cooperative peer-assisted service: the peers are underpaid compared to their Shapley payoffs; a provider paying the highest dividend to peers monopolizes all peers and Shapley value for each coalition gives rise to an oscillatory behavior of coalition structures. Our objective in this paper is to analyze the incentive structure of peer-assisted services when the worth of coalition is feasible and super additive.

Key Words— Coalition game, peer-to-peer network, Shapley value, incentive

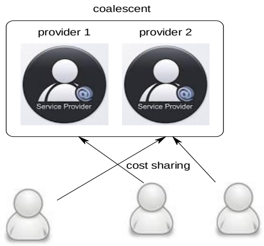
1. INTRODUCTION

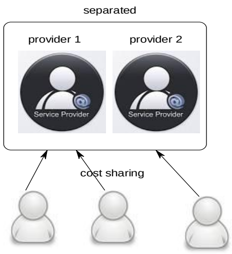
Peer to peer networks (P2P) have long been demonstrated to be technically superior to client-server architectures in terms of scalability. With the widespread adoption of broad-band access at the residential level, P2P networks promise even larger scalability while maintaining the same quality of service as dedicated data-centers or content delivery networks In order to reduce infrastructure, maintenance, and service costs, and provide more reliable services, the content providers often implement their services using P2P network. The details of the Bit Torrent protocol will be discussed in Section 3. Recently, media delivery and streaming services over the Internet such as YouTube, PP Live, and Internet video have emerged. These services have become very popular, as they can deliver video to a large number of receivers simultaneously at any given time.

However, a key disadvantage of this resource reciprocation strategy is that peers decide how to determine their resource reciprocation based on only the current upload rates that it receives from its associated peers, and does not consider how this reciprocation will impact their upload rates in the future.

2. ARCHITECTURE

However, it is still questionable whether peers are willing to stay in the grand coalition and thus the consequent Shapley value- based payoff mechanism is desirable in the multi provider setting. In this paper, we anatomize incentive structures in peer assisted services with multiple content providers and focus on stability issues from two different angles: stability at equilibrium of Shapley value and convergence to the equilibrium. We show that the Shapley payoff schememay lead to unstable coalition structure and propose a different notion of payoff distribution scheme, value, under which peers and providers stay in the stable coalition as well as better fairness is guaranteed



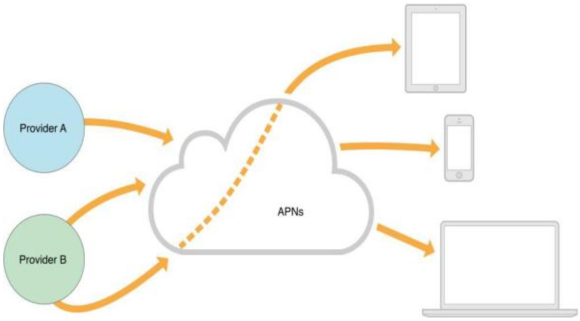


3. RELATED WORK

The research on incentive structure in the P2P systems has been studied extensively. To incapacitate free riders in P2P systems, which only download contents but upload nothing, from behaving selfishly, a number of incentive mechanisms suitable for distribution of copy-free contents have been proposed, using game-theoretic approaches. Alternative approaches to exploit the potential of the P2P systems for reducing the distribution costs of the copyrighted contents have been recently adopted the best of our knowledge, the work

Main Contributions and Organization

We summarize our main contributions as follows. Following the preliminaries in we describe and propose the cooperative game-theoretic framework of the peer-assisted service with multiple providers. After defining a worth function that is probably the unique feasible worth function satisfying two essential properties, i.e., feasibility and superadditivity of a coalition game, we provide a closed-form formula of the Shapley value for a general coalition with multiple providers and peers, where we take a fluid-limit approximation for mathematical tractability. This is a nontrivial generalization of the Shapley value for the single-provider case in [4]. In fact, our formula in Theorem 1 establishes the general Shapley value for distinguished *multiple* atomic players and infinitesimal players in the context of the Aumann–Shapley (A-S) prices [11] in coalition game theory.



In Section IV, we discuss in various ways that the Shapley Payoff regime cannot incentivize rational players to form the grand coalition, implying that *fair* profit sharing and *opportunism* of players cannot stand together. First, we prove that the Shapley value for the multiple-provider case is not in the core under mild conditions, e.g., each provider's cost function is concave. This is in stark contrast to the single provider case where the concave cost function stabilizes the equilibrium. Second, we study the dynamic formation of coalitions in peer-assisted services by introducing the notion of stability defined by the seminal work of Hart and Kurz [8]. Finally, we show that, if we adopt a Shapley-like payoff mechanism, called Aumann–Drèze value, irrespective of stability of the grand coalition, there always exist initial states that do not converge to the grand coalition. 3) In Section V, we present three examples stating the problems of the non cooperative peer-assisted service the peers are underpaid compared to their Shapley payoffs a provider paying the highest dividend to peers monopolizes all peers

Problem Definition

The problems of the non cooperative peer-assisted service: 1) the peers are underpaid compared to their Shapley payoffs; 2) a provider paying the highest dividend to peers monopolizes all peers; and 3) Shapley value for each coalition gives rise to an oscillatory behavior of coalition structures. The system with the separated providers may be even unstable as well as unfair in a peer-assisted service market. In particular, for the non concave cost functions, it is unclear if the Shapley value is not in the core, which is still an open problem.

We describe and propose the cooperative game-theoretic framework of the peer-assisted service with multiple providers. After defining a worth function that is probably the unique feasible worth function satisfying two Essential properties, i.e., feasibility and superadditivity of a coalition game, we provide a closed-form formula of The Shapley value for a general coalition with multiple providers and peers. First, we prove that the Shapley value for the multiple-provider case is not in the core under mild conditions, e.g., each provider's cost function is concave. Second, we study the dynamic formation of coalitions in peer-assisted services. This payoff mechanism is relatively fairin the sense that players, at the least, apportion the difference between the coalition worth and the sum of their fair shares, i.e., Shapley payoffs, and it stabilizesthe whole system. It is also practical in the sense that providers are granted a limited right of bargaining.

Stable coalition structures were proposed by effrosynidiamantoudi and the concept of investigates how rational individuals partition themselves into different coalitions. We proposed a notion that determines simultaneously the coalition structures that are likely to prevail in a game, as well as the feasible payoff configuration associated with the. Our solution concept is built in the spirit of stability, but it overcomes the overoptimistic associated with it when employed in our context.

4. IMPLEMENTATION

Implementation is the stage of the project when the theoretical design is turned out into a working system. Thus it can be considered to be the most critical stage in achieving a successful new system and in giving the user, confidence that the new system will work and be effective.

The implementation stage involves careful planning, investigation of the existing system and it's constraints on implementation, designing of methods to achieve changeover and evaluation of changeover methods.

Algorithm:

COALITION GAME THEORY:

Given the current overview of the information security and intrusion detection there is definitely a need for a decision and control framework to address issues likeattack modeling, analysis of detected threats, and decision onresponse actions. A rich set of tools havebeen developedwithin the game theory to address problems, where multiple players with different objectives compete and interact with each other on the same system, and they are successfully used in many disciplines including economics, decision theory, and control. Therefore, game theory may provide the much needed mathematical framework for analysis, modeling, decision, and control processes for information security and intrusion detection

Application of Game Theory to Intrusion Detection

Each of the basic network tradeoffs mentioned in the can be posed as resource allocation problems. It is difficult, however, to quantify and solve these problems using classical optimization methods. Another issue is the interpretation of the incoming data from various detection mechanisms in the network. A significant shortcoming of the current IDSs is the lack of a unifying mathematical framework to put the pieces into a perspective. Game theory can provide a basis for development of formal decision and control mechanisms for intrusion detection. Specifically, game theoretic models can be used to address issues like How to interpret and efficiently use huge amounts of input data from various detection mechanisms containing a significant percentage of false alarms. Modeling and estimation of the real intent and the target of an attacker in a large system using additional information like context, history etc. Reconfiguration of the security system given the severity of attacks and making decisions on tradeoffs like increasing security versus increasing system overhead or decreasing efficiency.

A game with coalition structure is a triple where is a player set and(is the set of all subsets of) is a worth function, is called the worth of a coalition

. is called a *coalition structure* for ; it is a partition of where denotes the coalition containing player . For your reference, a coalition structure can be regarded as a set of disjoint coalitions. The *grand coalition* is the partition. For instance, a partition of is, and the grand coalition is. Is the set of all partitions of? For notational simplicity, a game *without* coalition structure is denoted by. A value of player is an operator that assigns a payoff to player. We define for all. To conduct the equilibrium analysis of coalition games, the notion of *core* has been extensively used to study the stability of grand coalition.

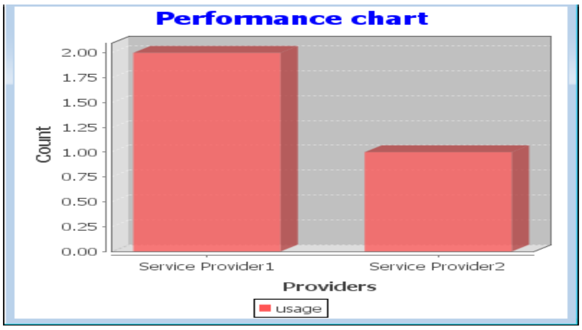
A Game Theoretic Framework

We construct two game theoretic schemes to address some of the issues in Section While the foremost goal of the first scheme is simplicity and ease-of implementation, the second one models and analyzes attacker and IDS behavior within a two-person, nonzero-sum, non-cooperative game framework. We also note that both schemes are flexible and can be implemented regardless of the underlying architecture S := fs1; s2; : : : ; sP g, where the sensor is defined as an autonomous software (agent) that monitors and reports possible intrusions or anomalies occurring in a subsystem of a large network using a specific technique like signature comparison, pattern detection, statistical analysis etc. The system monitored by the IDS can be represented as a set of subsystems, T = ft1; t2: tMg, which may be targeted by an attacker. We note that these subsystems can be actual computer programs or parts of the network as well as abstract (business) processes distributed over multiple hosts. Define I = fI1; I2; IKg as the set of documented threats and detectable anomalies, which may indicate a possible intrusion. The properties of an element of I can be further described by assigning it to one or more function classes among fF1; F2: g, where each function class, F, represents a common property of its members. For example, F1 _ I may represent web services, and if I 2 F1 then it means that I is an intrusion signature or anomaly related to web services. A sensor can possibly detect more than one anomaly or possible intrusion. Let us define, using a one-to-many mapping from the set S to the set I [f0g, the output vector of the network of sensors, d: = [d1; d2; dN], where N _ P. The ith element of the output vector associated with the sensor sj 2 S, di (sj), is equal to an Ik 2 I if the sensor has detected the possible intrusion or anomaly Ik. Otherwise, di (sj) = 0. We note that each sensor can report at most one of each type of possible intrusions. Hence, di(sk) 6= dj(sk) 8i; j of a given sk 2 S, unless di(sk) = dj(sk) = 0. Finally, we define the system matrix, A, describing the relationship between the sensor output vector and subsystems as Ai;j =(1; if sensor j monitors subsystem i0; if sensor j does not monitor subsystem i; where i 2 T and j 2 d.

COALITION GAME IN PEER-ASSISTED SERVICES:

In this section, we first define a coalition game in a peer assisted service with multiple content providers by classifying the types of coalition structures as separated, where a coalition includes only one provider, and coalescent, where a coalition is allowed to include more than one providers define the coalition game, we will define a worth function of an arbitrary coalition for such two cases.

Peer-Assisted Services: Assume that players are divided into two sets, the set of content providers, and the set of peers. We also assume that the peers are homogeneous, e.g., the same computing powers, disk cache sizes, and upload bandwidths. Later, we discuss that our results can be readily extended to non-homogeneous peers. The set of peers assisting providers is denoted by where i.e., the fraction of assisting peers. We define the worth of a coalition to be the amount of cost reduction due to cooperative distribution of the contents by the players in both separated and coalescent cases.



Assumption: is none increasing in for all. Note that from the homogeneity assumption of peers, the cost function depends only on the fraction of assisting peers. Then, we define the worth function for a coalition having a single provider as: where corresponds to the cost when there are no assisting peers. For a coalition with no provider, we simply have. For notational simplicity, is henceforth denoted by, unless confusion arises.

Coalescent Case*:* In contrast to the separated case, where a coalition includes a single provider, the worth for the coalescent case is not clear yet since, depending on which peers assist which providers, the amount of cost reduction may differ. One of reasonable.

Assume that players are divided into two sets, the set of content providers, and the set of peers. We also assume that the peers are homogeneous, e.g., the same computing powers, disk cache sizes, and upload bandwidths. Later, we discuss that our results can be readily extended to non-homogeneous peers. The set of peers assisting providers is denoted by where i.e., the fraction of assisting peers. We define the worth of a coalition to be the amount of cost reduction due to cooperative distribution of the contents by the players in both separated and coalescent cases

5. INPUT DESIGN AND OUTPUT DESIGN

5.1. INPUT DESIGN

The input design is the link between the information system and the user. It comprises the developing specification and procedures for data preparation and those steps are necessary to put transaction data in to a usable form for processing can be achieved by inspecting the computer to read data from a written or printed document or it can occur by having people keying the data directly into the system. The design of input focuses on controlling the amount of input required, controlling the errors, avoiding delay, avoiding extra steps and keeping the process simple. The input is designed in such a way so that it provides security and ease of use with retaining the privacy. Input Design considered the following things:

- What data should be given as input?
- How the data should be arranged or coded?
- The dialog to guide the operating personnel in providing input.
- Methods for preparing input validations and steps to follow when error occur.

OBJECTIVES

In this paper, we anatomize incentive structures in peer assisted services with multiple content providers and focus on stability issues from two different angles: stability at equilibrium of Shapley value and convergence to the equilibrium. We first define a coalition game in a peer assisted service with multiple content providers by classifying the types of coalition structures as separated, where a coalition includes only one provider, and coalescent, where a coalition is allowed to include more than one provider. We show that the Shapley payoff scheme may lead to unstable coalition structure and propose a different notion of payoff distribution scheme, value, under which peers and providers stay in the stable coalition as well as better fairness, is guaranteed. In peer-assisted services, the “symbiosis” between providers and peers are sustained when: 1) the offered payoff scheme guarantees fair assessment of players’ contribution under a provider–peer coalition; and 2) each individual has no incentive to exit from the coalition. We present three examples stating the problems of the non-cooperative peer-assisted service: 1) the peers are underpaid compared to their Shapley payoffs; 2) a provider paying the highest dividend to peers monopolizes all peers; and 3) Shapley value for each coalition gives rise to an oscillatory behavior of coalition structures. Our objective in this paper is to analyze the incentive structure of peer-assisted services when the worth of coalition is feasible and super additive

5.2. OUTPUT DESIGN

A quality output is one, which meets the requirements of the end user and presents the information clearly. In any system results of processing are communicated to the users and to other system through outputs. In output design it is determined how the information is to be displaced for immediate need and also the hard copy output.

It is the most important and direct source information to the user. Efficient and intelligent output design improves the system's relationship to help user decision-making.

1. Designing computer output should proceed in an organized, well thought out manner; the right output must be developed while ensuring that each output element is designed so that people will find the system can use easily and effectively. When analysis design computer output, they should Identify the specific output that is needed to meet the requirements.
2. Select methods for presenting information.
3. Create document, report, or other formats that contain information produced by the system.

The output form of an information system should accomplish one or more of the following objectives.

- Convey information about past activities, current status or projections of the
- Future.
- Signal important events, opportunities, problems, or warnings.
- Trigger an action.
- Confirm an action.

6. FUTURE ENHANCEMENT

We surmise that providers in cooperation can make further expenses cut by pooling and optimizing their resources and traffic engineering, which will transform their cost functions. The question remains open how the ramifications of this type of cooperation can be quantified in peer-assisted services.

7. CONCLUSION

In this paper, we have first studied the incentive structure in peer-assisted services with multiple providers, where the popular Shapley-value-based scheme might be in conflict with the pursuit of profits by rational content providers and peers. The key messages from our analysis are summarized as follows. First, even though it is fair to pay peers more because they become relatively more useful as the number of peer-assisted services increases, the content providers will not admit that peers should receive their fair shares.

Moreover, the weights of value can serve as a flexible knob to enable providers to bargain with peers over the dividend rate at the same time as a preventive measure to avoid cutthroat or unfair competition between providers. However, we recognize the limitation of these results, which are based on the assumption that there is no additional cost reduction other than that achieved from the peer-partition optimization

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