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Abstract

The aim of this paper is to develop an analytical framework and model for understanding motivation and effort among members of Community-based WLANs. Wireless communities represent a stimulating area for research due to their organizational uniqueness as loosely-knit communities of wireless enthusiasts who cooperate to set up and operate a wireless communications infrastructure; in other words, they represent an example of collective action. Thus, two research issues are critical in understanding the mechanics behind the sustained existence of wireless communities: motivation *– why individuals become community members – and* coordination *– how individuals within a community interact with each other. Focusing on the first issue, the paper provides a theoretical explanation of motivation which, in turn, informs the design of a conceptual model. According to this explanation, an individual decides to participate in a wireless community because of intrinsic as well as extrinsic motives. These motives are balanced against the perceived effort to join and participate in the community to jointly determine a suitable participation level for each community member. The resulting model adopts a cost-benefit (utility) perspective that is being empirically tested through a large-scale questionnaire survey.*

Keywords: community-based WLANs, collective action, self-determination theory, intrinsic and extrinsic motives

1 INTRODUCTION

Community-based WLANs (or wireless communities) have recently emerged as an alternative to commercial models for the provision of public WLAN access. Their key features are the creation and operation of a wireless communications infrastructure through the voluntary contributions of their members' private resources (such as knowledge, expertise, equipment, and time) as well as the offering of free access to the resulting network and services. In other words, the community network is a network created by users and for users that is scalable enough to cover the connectivity needs of a metropolitan area (e.g. NYC Wireless, Athens Wireless Metropolitan Network). Hence, wireless community networks extend the scope of traditional computer-mediated communities (wireless community members build their own communication infrastructure), while opportunities for knowledge creation, exchange and innovation underline a resemblance to communities of practice.

There are many factors contributing to the emergence and success of the wireless community phenomenon. First of all, WLANs operate at an unlicensed frequency, eliminating the need for up-front investment for license purchases (Lehr & McKnight 2003). Second, tech-savvy users find it challenging to operate a network access point on their own using low-cost equipment and create a home-made *hotspot* which, in turn, can be connected to another hotspot on a grassroots and decentralized manner (Schmidt & Townsend 2003). Third, sharing appears as a natural idea for bandwidth since, depending on the allocation of its owner's requirements over time, bandwidth exhibits some form of excess capacity that can be harnessed through sharing relations (Benkler 2004). This reasoning is also adopted by Damsgaard, Parikh and Rao (2004) who speak of wireless commons.

A common theme in the aforementioned descriptions is their picturing of wireless communities as the result of the coordinated behavior of a highly motivated group of individuals who contribute private resources for the purposes of a common cause. Similar courses of action - common in everyday life (eg. voluntary organizations, community projects, etc.) - have been a research issue for a number of scholars within the broad area of social sciences (economics included) and have given rise to theories such as collective action (Olson 1965) and private provision of public goods (Cornes & Sandler 1996). These frameworks have been widely applied for explaining individuals' behavior within various forms of community organizations (e.g. Wasko, Faraj and Teigland 2004, Fulk et al. 2004). In accordance with these theories, a deeper understanding of the mechanics defining the evolution path of wireless communities cannot be accomplished without answering the following questions:

- Why do people voluntarily *participate* and put up *effort* in community-based WLANs when there is no promise for a concrete payback? (the *motivation* issue)
- How do participants' interactions with each other impact on communities' governance mechanisms, growth patterns, and, finally on their future sustainability? (the *coordination* issue)

These questions can be thought of as guidelines for further research in the area of community-based WLANs. This paper focuses on the first question – the motivation issue – by organizing a research design for tackling with it. Particularly, it reviews how the issue has already been treated in wireless and non-wireless community literature (Section 2) and analyzes three key concepts - motivation, effort and participation (Sections 3 and 4, and 5 respectively) - to formulate an explanatory conceptual framework (Section 6).

2 LITERATURE BACKGROUND

Motivation has appeared on the research agenda of only a limited number of community-based WLAN researchers. In particular, Herslow, Navarro and Scholander (2002) draw on similarities of the wireless

community phenomenon to the Open Source Software (OSS) movement and accentuate on feelings of self-reliance and independence created through joining a wireless community; Auray et al. (2003) point to three motivations - willingness to break free from telecommunications companies, a spirit of sharing between community members, and learning benefits - based on a series of semi-structured interviews with wireless community leaders across Europe; Schmidt and Townsend (2003) also support the OSS parallelism by focusing on the prestige and the mutual cooperation enjoyed among community members as well as on their shared "utopian dream" to undermine telecommunications companies; finally, Sandvig (2004) applies a communication network development framing where sharing and innovation are key drivers for early community network developers. Nevertheless, none of the above studies has dealt exclusively with motivation nor has sought to collect large-scale empirical, hence also generalizable, data capable of explaining the phenomenon to its full capacity.

Originating from the motives already identified, our work aims at a more formal introduction of the role of motivation in community-based WLANs. In doing so, it capitalizes on previous studies of motivation in various community forms within Management, Organization and IS sciences literature: communities of practice (e.g. Wasko & Faraj 2005), virtual or online communities (e.g. Tedjamulia et al 2005), volunteers' or non-profit institutions (e.g. Clary & Snyder 1999, Rose-Ackerman 1996), peer-to-peer networks (e.g. Lui, Lang and Kwok 2002), and OSS communities (e.g Lakhani & Wolf 2005).

Following the previous review, it can be deduced that individuals are driven to participation in a community-based WLAN for a number of reasons related to social, psychological, hedonic, or utilitarian motives, while they also incur private costs due to their contributions. The motivation issue can, thus, be reformulated to the following proposition: *if motives imply that benefits from participation are stronger than the costs associated with the effort to participate, then an individual is moved to a certain participation level*. Individual behavior towards community-based WLANs is, thus, guided by a utility decision-making process at the micro (individual) level pinpointing to an economic framing of the phenomenon inspired by the collective action paradigm. So, our study of motivation and effort in community-based WLANs settles to uncovering how pecuniary or explicit gains and psychological or social benefits combine with costs to result to a given participation level including the possibility for non-participation.

3 MOTIVATION

Motivation is a horizontal theme for all scientists entailed in understanding human behavior. An explicit definition of motivation can be found in Ryan and Deci (2000): "*to be motivated means to be moved to do something; a person who feels no impetus or inspiration to act is thus characterized as unmotivated, whereas someone who is energized or activated towards an end is considered motivated*". Deci and Ryan's work on motivation is summarized in *Self-Determination Theory* (SDT) (1985), a macro-theory of human motivation concerned with the development and functioning of personality within social contexts. According to SDT, individuals are motivated in their goal pursuits as a result of their effort to satisfy three essential psychological needs: *competence*, *autonomy*, and *relatedness* (i.e. belongingness). SDT makes an ideal framework for understanding motivation in wireless communities where we need to place importance not only on individuals' inherent inclinations but also on their dialectic with the context of their behavior – the community.

One of the most useful contributions of SDT is its distinction between *intrinsic* and *extrinsic* motivation that is posited by the development of two sub-theories within SDT investigating the sources as well as the conditions that foster or undermine them: Cognitive Evaluation Theory (CET) and Organismic Integration Theory (OIT) respectively. Hence, it is argued that *motivation to participate in a Community-based WLAN is of two flavors, extrinsic and intrinsic*.

3.1 Extrinsic Motivation

Extrinsic Motivation occurs when an activity is performed for its instrumental value or as a means to attain some separable outcome (Ryan & Deci 2000). Extrinsic motivation has long been considered to lie within the traditional economic theory paradigm when it comes to explaining human behavior (Frey 1997) and the effect of incentives (sanctions or rewards) as motivators is extensively studied by economists (e.g. Frey 1993). Thus, extrinsic motivation is thought of as having the least effect on promoting human autonomy.

However OIT offers reconciliation between extrinsically motivated behaviors and the need for feeling autonomous. It argues that not all extrinsic motives are associated with tangible rewards and classifies them based on their degree of autonomy support along the ends of a continuum. It also describes how less autonomous extrinsic motives can be transformed to socially sanctioned mores or requests and to personally endorsed values or self-regulations through the process of internalization (Ryan & Deci 2000). Following the aforementioned taxonomy, extrinsically motivated behaviors towards community-based WLANs result from the motivations described in Table 1:

EXTRINSIC MOTIVATION FORM IN OIT	WIRELESS COMMUNITY CONTEXT
External Regulation The least autonomous motivation by which an individual satisfies an external demand or obtains an externally imposed reward.	Participation is driven by an expectation for an *explicit reward* (such as payment) or because of an *external pressure* (for example, it is part of one's job).
Introjected Regulation Actions are performed in order to enhance or maintain feelings of worth, to avoid guilt or anxiety, or to boost individuals' egos.	Participation is urged in order to feel better about one's self (*self-esteem*) or in order to receive credit by significant others (*ego involvement*).
Identified Regulation The individual has identified himself with the personal importance of a behavior or has self-endorsed its goals; however, the activity is still performed for its instrumentality and not for itself.	Participation in the community is important because it satisfies a *personal need* for broadband connectivity and services, while learning and interacting with others enhances one's *human capital* and augments his *career prospects*.
Integrated Regulation (synonymous to intrinsic motivation) When the action has been fully assimilated to other aspects of the self by becoming an integral part of one's values and identity; then, it emanates from one's sense of self.	*Altruism* or other *ideological aspirations* (such as promoting the use of Wi-Fi, undermining telecommunications companies, or believing in the community spirit of sharing) when they represent personal inclinations can urge participation in a wireless community.

Table 1 Extrinsic Motivation Taxonomy

3.2 Intrinsic Motivation

According to Deci & Ryan (2000), there are two strands to the definition of intrinsic motivation. The first refers to doing an interesting activity for its inherent satisfaction, for the fun or challenge entailed in it, while the second states that intrinsically motivated behaviors are a function of the basic psychological needs of competence, autonomy, and relatedness. Thus, individuals are intrinsically motivated towards activities with the appeal of novelty and challenge, and such behaviors are catalyzed in a social context that fosters the satisfaction of the three innate human needs. In a wireless community context, intrinsic motives emanate when the act of participating is perceived as having the appeal of *interest* or *enjoyment* and are sustained when participation satisfies individuals' needs for *competence* – that is, involvement with the community makes them feel self-efficient, *autonomy* – that is, they are allowed to self-organize

their behavior and activity within the community, and *relatedness* – that is, they experience feelings of connectedness and belongingness to others inside the community.

3.3 Obligation-based Intrinsic Motivation

Continuous research studying motivation in social contexts has offered new perspectives in the classic distinction between intrinsic and extrinsic motivation. In particular, Frey (1997) and Lindenberg (2001) promote an aspect of intrinsic motivation*, obligation-based intrinsic motivation,* which they consider rather under-researched in Deci and Ryan's work.

For Deci and Ryan, self-determined actions are induced out of choice rather than obligation or coercion (Deci & Ryan 1985); issues of moral (standard- or principle-induced) behavior are neglected since there could not possibly be a conflict between realizing values and enjoyment. Nevertheless, Frey (1997) has empirically shown that individual behavior can also be based on the feeling that one must follow a particular rule, norm of principle. Lindenberg (2001) states that obligation-based behavior emanates from the goal, acquired through socialization, to act appropriately, thus resulting in strong solidarity and a sense of community.

Therefore, it is argued that this sort of motivation, which is induced by a sense of community attachment and a tendency to conform to social norms like reciprocity and fairness, is quite relevant to the wireless community context. The most obvious link is the fact that these behaviors arise due to the socialization procedures in groups whose members cooperate and interact for a certain task. Thus, obligation-based intrinsic motivation in wireless communities stems from a desire to enforce or build one's identity by attaching to the community with which individuals share common beliefs (*collective identification*) and to reinforce norms of *reciprocity* in the exchanges between community members.

For this analysis of motivation to be complete, we must question whether the motives that initialize participation in a wireless community also sustain it. Obviously, wireless communities prospects are driven to participation by an expectation of benefits not yet realized, while actual participants sustain, enhance, or diminish their level of involvement based on perceived, realized benefits. Thus, *it is expected that motivations vary depending on an individual's experience with the community*; some motives may only be significant prior to participation while others only after a certain time period of involvement.

4 EFFORT

Framing the wireless community phenomenon under a collective action context raises another important issue, besides motivation, identified earlier in this paper as the voluntary contribution of private resources. In fact, these resources are not uniform but rather heterogeneous ranging from contributions in terms of network equipment, time spent for and within the community, to knowledge and expertise sharing. This heterogeneity among contributable resources can have a positive effect on the sustained existence of the collective action according to Oliver, Marwell and Teixeira (1985). Moving a step beyond, our work is focused on the intertwinement between motivation and resource contribution that is translated to a relationship between motives – gains and effort – costs inquired from resource contribution.

Exploratory interviews with wireless communities' enthusiasts in Greece have indicated two cost components: *opportunity costs* in terms of time dedicated to the wireless community instead of alternative activities that may yield higher pecuniary or psychological compensation and *money expenditure* for the acquisition and maintenance of the wireless equipment. This cost composition reflects a tangible-intangible dichotomy that can affect contributors in different ways, while it is also heavily dependent upon the *ease or difficulty of making the respective contribution* (Fulk et al. 2004).

5 PARTICIPATION

Participation in a community-based WLAN involves a series of dilemmas regarding the orientation as well as the level of tangible and intangible resource contribution. The term orientation encompasses three distinct functions necessary for the community's operation: (1) infrastructure, (2) service, and (3) community participation.

Infrastructure participation is necessary for the community network's physical existence and, thus, more crucial than the other two functions. It includes all the activities for setting up and operating a network node and, then, offering open (or, maybe not so open) access to it. We can distinguish two different roles: individuals who operate their own *node* and follow an open or less open access policy for their hotspot and *clients* to other people's hotspots. In addition, *potential members* are in the process of connecting to the community network or are hindered by practical challenges; usually they are not located within the vicinity of a community network. Nodes are actual contributors to the community network and are required for its geographic extension, while clients rely on others' contributions to access the community infrastructure. Thus, a controversy is exhibited: while the presence of clients augments the value of the network, their concentration around nodes possibly degrades network performance in terms of quality of service which, in turn, can jeopardize the network's stability and prosperity.

Service participation is demanded from individuals through contributions in terms of content and services hosting (e.g. games, file sharing, web services, etc.), including the possibility for Internet access provision. In this role case, the dichotomy is between service contributors and service consumers. Finally, *community participation* refers to one's level of engagement to the community's social mechanisms such as online (forum) and offline communication tools (meetings), the possibility for peer co-operation as well as supporting activities (e.g. site maintenance, documentation, forum moderation, etc). Participants and actual contributors can be traced here as well.

The functions described above were deducted based on interviews with community members and studies of community websites. They illustrate a pragmatic view of a wireless community network and enforce its complex socio-technical nature. Its efficient operation depends upon the dynamics arising among the various roles that a participant may act within the community. Thus, it will be interesting to investigate whether the node-client structure dictated by network requirements creates a similar social structure that places wireless communities in the social networks' sphere (for example, Wellmann et al. 1996 studied computer networks as social networks).

6 THE MODEL

Figure 1 synthesizes motivation, effort and participation into a conceptual model for community-based WLANs members following a utility perspective: motives are perceived or anticipated benefits effort represents costs and participation is the outcome of weighing out benefits against costs.

The constructs presented in the model have been operationalized to a measurement instrument. Motivation items are measured based on questions used in prior studies with minor adaptations to fit the wireless community context. Additional questions for motivation, effort, and participation were developed based on literature review and the interviews with community members. All items are measured on a one-to-seven Likert scale, whereas infrastructure participation is measured with a multi-option question. The instrument was subject to a pre-test procedure where selected individuals - three university professors and twelve potential respondents - were invited to complete the questionnaire and provide comments for its refinement; consequently some of the items were dropped or further modified. The sampling frame originates from wireless enthusiasts all over Greece (email invitations were sent to all wireless

communities in Greece with the request to post the invitation on their sites and discussion forums as well as to selected members of the Greek research and business community known for their interest in wireless communities). To overcome the bias introduced by conducting the survey at a single site, two other countries (USA and Australia) have agreed to replicate the research design. Collection of empirical data for Greece took place in November 2005, while Australia conducted its part of the survey from January to February 2006 and USA plans to launch the questionnaire in summer 2006. Statistical analyses of the data collected are underway where the effect of motivation and effort on participation is investigated through the means of Logistic Regression Analysis. In addition, Cluster Analysis is employed to construct meaningful groupings of individuals representing different motivational structures.

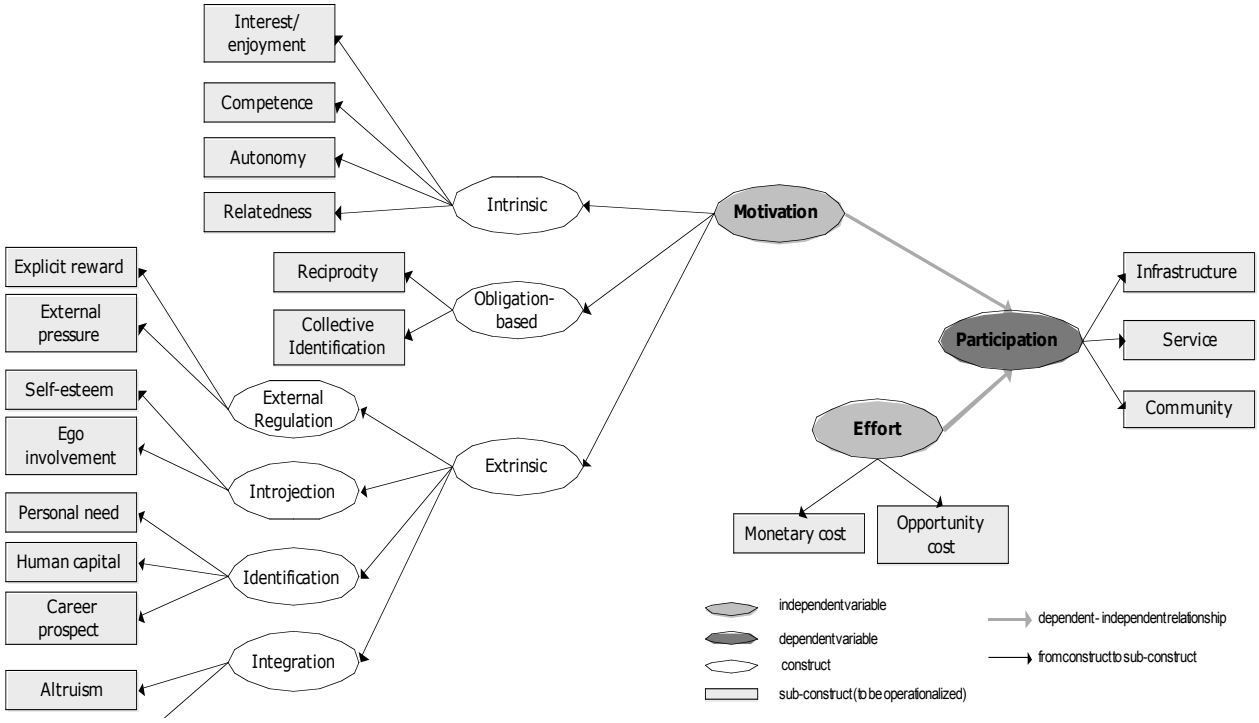

Figure 1. The Conceptual Model

Analytical results are expected to shed light on the first question postulated in Section 1. Moreover, the aforementioned course of thinking for understanding and analyzing motivation and effort in Community-based WLANs can be extended to answer the second question by moving from the individual to the collective as the unit of analysis where participants take into account others' utilities as well in their decision making process when choosing participation orientation and level as well as desired effort intensity.

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