Designing Convivial Digital Cities

A Normative Multi-Agent Systems Approach
Using Dependence Networks
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1. INTRODUCTION

Concepts, models and theories from the social sciences are studied in multi-agent systems to regulate or control interactions among agents. Examples of social concepts studied in multi-agent systems are societies, coalitions, organizations, institutions, norms, power, and trust [4]. We argue in our thesis that this list should be extended with a social-cognitive concept concerned with agent interaction which is used frequently in the social sciences, and has been discussed in applications of multi-agent systems where artificial and human agents interact like ambient intelligence, social intelligence design, digital cities and virtual communities. This concept is called *conviviality*.

Conviviality is concerned with user-friendliness, and it is often reduced to it. For example, one of the four themes of the European Community Fifth Framework Program was titled the "Societe de l'Information conviviale" (1998-2002) [11], which was translated as the "User-friendly information society". This translation refers to a popular definition of a convivial place or group as one in which "individuals are welcome and feel at ease" [3], but it ignores the scientific literature on tools for conviviality [8] defining mechanisms to achieve user friendly user interaction.

We believe that multiagent systems can be used as the technology for the tools for conviviality, and the aim of this paper is therefore to bridge the gap between tools for conviviality and multiagent systems. Our research question is *How can social conviviality models based on dependencies and power be used in multiagent systems?*, which breaks down in the following sub-questions:

1. What is the role of conviviality in multiagent systems?
2. How to model conviviality as personal freedom realized in personal interdependence using goal directed agents?
3. How to define conviviality masks for the power relationships and the social structures that govern multiagent systems?
4. How to use social mechanisms like social laws or normative systems to define conviviality masks?

We illustrate the role of conviviality in multi-agent systems, with the use of examples from digital cities, particularly because we work together with the city of Luxembourg on the elaboration of conviviality for their digital city which provides us with use cases from Luxembourg. As a first running example, we refer in this thesis to the newborn baby declaration in the digital city, which consists of a number of processes (13 in Luxembourg) and establishes one of the most important documents in a persons life: the act of birth that identifies the child by name, and establishes the childs citizenship and filiation, these regulations also include requirements for services such as financial assistance, insurance, parental leave and child care.

It may, first, seem that the gap between tools for conviviality and multi-agent systems is much too large to be bridged in a single thesis, but we can build on a large body of work on social-cognitive concepts. To model conviviality, we use power structures and dependence networks developed by Castelfranchi, Sichman, Conte and colleagues. Social structures in these models, for example based on reciprocity, are groups and coalitions, or institutions when we add a normative system, and relate the various models to each other. To define conviviality masks as a mechanism for user friendly agent interaction, we filter out goals and add new goals with their power relations.Finally, we consider role based organizations to model conviviality masks.

Many definitions of conviviality have been proposed. There is no consensus on the definition of conviviality in the social science literature, and neither in computer science, using concepts referring to qualities such as trust, privacy and community identity. In particular, in this thesis we consider Polany's notion of empathy, which needs trust, shared commitments and mutual efforts to build up and maintain conviviality, dynamic aspects of conviviality, such as the emergence of conviviality from the sharing of properties or behaviors whereby each member's perception is that their personal needs are taken care of, and Ashby's observation that enforcing conviviality for the majority re-inforces non-conviviality for minority.

Layout of this thesis. First, we discuss the role of conviviality in multi-agent systems, and second we introduce our running example of multi-agent systems for the newborn baby declaration in digital city. Third, we model conviviality as personal freedom in interpersonal dependence using dependence networks, fourth, we consider the role of masks of power relations and social structures. Fifth, we introduce dynamic dependence networks to model conviviality masks for the creation of conviviality. Finally, we plan to do simulations to test our model.

2. CONVIVIALITY AS AGENT CONCEPT

The Grand Dictionnaire Terminologique [1] defines conviviality as follows.

> "Conviviality is the set of positive relations between the people and the groups that form a society, with an emphasis on community life and equality rather than hierarchical functions."

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First, we believe that the ambiguity and vagueness of conviviality is not a valid reason to discard it together with its associated social science literature, because this ambiguity and vagueness holds for most other social-cognitive concepts studied in multi-agent systems. Moreover, the existence of various definitions makes it possible to choose one which fits best the interests on the multi-agent systems community, and, as we show in this paper, it is possible to make the vague definitions much more precise.

Second, the concept of conviviality and the associated social science literature is not technical. However, the concept can be related to other non-technical concepts used in multi-agent systems, which have got a more technical interpretation. For example, the concept of conviviality was popularized by a book of Illich in 1973 called "tools for conviviality", in which he defines conviviality as follows:

> Conviviality means "individual freedom realized in personal interdependence"

Dependencies have been related to goals of agents and the abilities of other agents to see to these goals.

Third, the aim of social scientists is not to define the concept, but to create conviviality by creating the desired conditions for social interaction. This coincides with the aim of designers of multi-agent systems applications in ambient intelligence, digital cities or virtual communities. For example, Illich defines a convivial learning experience in which the teacher and the student switch roles, such that the teacher becomes the student and the student becomes the teacher. This role swapping emphasizes reciprocity as a key component for conviviality. Such role swapping scenarios can directly be used in multi-agent systems, and it has been emphasized here that conviviality is based on reciprocity [6].

2.1 Role of conviviality

There are several reasons to add conviviality as a social-cognitive concept to multi-agent systems models and theories.

First, requirements for multi-agent systems expressed by politicians and managers say that systems must be convivial, whereas multi-agent system researchers and developers use other concepts. As an analogy, consider a manager requiring of her system developers to have a convivial attitude during a meeting, in order for example to make it more efficient. Conviviality during the meeting is used as a tool to achieve the goals of the meeting, and when the employees leave the meeting room, they go back to their conflicted relations with each other. The developers, however, may not understand the notion of a "convivial attitude." To model the requirement, the developers may interpret the conviviality requirement as being autonomous to make suggestions, being reactive to react the discussion in the meeting to reach their goals, being pro-active to take the initiative and being goal-directed, and most importantly being social by interact with others to reach their goals.

Second, the use of conviviality as an agent concept ensures that considerations on the user-friendliness of multi-agent systems get

the same importance and considerations on the functionality of the system. For example, our experience with the development of a digital city in Europe is that computer engineers are focussed on filling in forms and developing menu structures and other interface issues, and do not take into account that a digital city should be a meeting place for human and artificial agents. In other words, they forget the metaphor of a real city which should be underlying the digital city. In particular, using conviviality in multi-agent system models ensures that user friendliness is incorporated in the specification and design of multi-agent systems. There is a widespread belief that user friendliness is something which can be added to a multi-agent system once it has been developed. However, it is much more difficult to turn a non-convivial system into a convivial one, than developing a convivial system from scratch. Thus conviviality should be incorporated from the first design of the system.

Third, it is a useful high level modeling concept for organizations and communities, emphasizing the social side of them rather than the legal side. Erickson and Kellogg [5] say: "In socially translucent systems, we believe it will be easier for users to carry on coherent discussions; to observe and imitate others' actions; to engage in peer pressure; to create, notice, and conform to social conventions. We see social translucence as a fundamental requirement for supporting all types of communication and collaboration". Taylor studies conviviality in British pantomime and observes that: "conviviality masks the power relationships and social structures that govern societies." This social perspective gives new way to look at normative systems. Norms are not just for static bureaucratic systems, but can also be used for dynamic systems. Social norms versus legal norms.

Fourth, when developing user friendly multi-agent systems, it is crucial to understand the inherent threads of conviviality. Whereas conviviality was put forward by Illich as a positive concept, also negative aspects were discussed. Agents are often not rational and cooperative to achieve conviviality [9] and unity through diversity [7] may lead to suppression of minorities. Taylor explores the contradiction that conviviality cannot exist outside institutions: i.e., the question "whether it is possible for convivial institutions to exist other than by simply creating another set of power relationships and social orders that, during the moment of involvement, appear to allow free rein to individual expression. Community members may experience a sense of conviviality which is deceptive and which disappears as soon as the members return to the alienation of their fragmented lives."

3. DIGITAL CITIES

Digital cities are web portals using physical cities as a metaphor for information spaces. They present various combinations of political, economic and social activities. The following examples show the diversity of the combinations: First, eCities, eAdministrations and eGovernments, such as eLuxembourg and eEurope are the official portals of cities and countries used as tools to improve local democracy and participation; they provide local social information infrastructures over the real city with public and administrative services to citizens and visitors; the activities are predominantly political and to a lesser extend, economic and social. Second, eCommerce portals, such as MSN CitySearch and AOL Digital Cities offer commercial services, shopping, entertainment and more generally, local easy to find and search information; they provide practical resources for the organization of every day life and the support of local economic activities; the activities are predominantly economic and to a lesser extend social and political. Finally, social virtual worlds such as Second Life and the Habbo Hotel, provide a communication medium primarily to conduct social experiences through role playing while, at the same time, attracting advertisers and businesses by the size of their massive multi-player communities. "experiment with new forms of solving problems and coordinating social life" [**?**]. Activities are predominantly social and to a lesser extend economic and political.

Digital cities popular some time ago with proceedings of digital cities 2000, 2002 and 2005, then focus turned to eGovernment and eAdministration. Gap between the concepts studied in this research area (such as conviviality, the digital divide, eDemocracy) and the needs of system developers.

Existing models are organizational, functional, economic, games or artificial life. Multiagent systems are a promising methodology

to develop digital cities, because: first, they can bridge the gap between eGovernment concepts and system development; second, the autonomy of users is central in digital cities, and can be better modelled using the autonomy of agents; Third, interaction between human and artificial agents, and sometimes the distinction between them is unclear as the use of intelligent agents in some cities. Or the use of avatars in second life.

3.1 Multi-agent systems for Digital cities

Multi-agent systems are a promising technology for virtual worlds such as digital cities, because virtual worlds are about the interaction among agents, and such interactions are best represented, coordinated and controlled using an explicit representation of agents. For example, the explicit representation of social relations and dependencies between the agents facilitates the representation of social interactions, and electronic institutions [2] with explicit roles within organizations, powers, responsibilities and norms facilitate the coordination of these interactions. The real and institutional powers of agents lead to dependencies among them, in the sense that agents that have a goal depend on other agents that have the power to achieve the goal.

Moreover, there are two areas where masks are discussed in multi-agent systems. First, agent communication distinguishes between private beliefs and goals, and public opinions and intentions. Second, electronic institutions create a new social reality for agents by creating new powers, normative goals, and in general new social dependencies.

4. SUMMARY

In this thesis we argue that conviviality is a social-cognitive concept which must be used in agent theory to realize requirements on user-friendly systems, to ensures that considerations on the user-friendliness of multi-agent systems get the same importance and considerations on the functionality of the system, to model organizations and communities, emphasizing the social side of them as well as their legal side, and to take the inherent threads of conviviality into account when developing user friendly multi-agent systems.

We therefore show how the concept of conviviality can be related to existing social-cognitive concepts in agent theory such as dependence networks, power and coalitions. Moreover, we show how social mechanisms from artificial social systems like role-based institutions or organizations, social laws, and normative systems can be used to enforce conviviality. Finally, based on Taylor's idea that conviviality "masks the power relationships and social structures that govern societies" [10], we propose a minimal extension to dependence networks called dynamic dependence networks, that precisely captures the notion of a conviviality mask. We use a new born baby declaration use case for digital cities to illustrate conviviality masks, the role of institutions, and the dynamic dependence networks.

The measures introduced in this thesis are a first step to define such a methodology. Topics for further research are: To model a wide range of examples, we can extend the social models with trust, privacy and community identity to cover a wider range of notions of conviviality. In addition, we can use nested modalities representing agent profiles to model Polany's notion of empathy, which needs trust, shared commitments and mutual efforts to build up and maintain conviviality. Such models can be used, for example, for social simulation. We can use the abstract dynamic dependence networks to analyze the conditions for conviviality, such as the claim that enforcing conviviality for the majority re-inforces non-conviviality for minority. Moreover, we can model the creation of conviviality by creating the desired conditions for social interaction.

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