Modelling Self-Led Trust Value Management in Grid and Service Oriented Infrastructures: A Graph Theoretic Social Network Mediated Approach

Antony Brown, University of Bedfordshire, UK
Paul Sant, University of Bedfordshire, UK
Nik Bessis, University of Bedfordshire, UK
Tim French, University of Reading and University of Bedfordshire, UK
Carsten Maple, University of Bedfordshire, UK

ABSTRACT

Current developments in grid and service oriented technologies involve fluid and dynamic, ad hoc based interactions between delegates, which in turn, serves to challenge conventional centralised structured trust and security assurance approaches. Delegates ranging from individuals to large-scale VO (Virtual Organisations) require the establishment of trust across all parties as a prerequisite for trusted and meaningful e-collaboration. In this paper, a notable obstacle, namely how such delegates (modelled as nodes) operating within complex collaborative environment spaces can best evaluate in context to optimally and dynamically select the most trustworthy ad hoc based resource/service for e-consumption. A number of aggregated service case scenarios are herein employed in order to consider the manner in which virtual consumers and provider ad hoc based communities converge. In this paper, the authors take the view that the use of graph-theoretic modelling naturally leads to a self-led trust management decision based approach in which delegates are continuously informed of relevant up-to-date trust levels. This will lead to an increased confidence level, which trustful service delegation can occur. The key notion is of a self-led trust model that is suited to an inherently low latency, decentralised trust security paradigm.

Keywords: Ad Hoc Services, Graph Theory, Grid Technology, Self-Led Trust Management, Service Oriented Architecture, Social Network Mediated Approach

INTRODUCTION

The main motivation of this work is to provide a trust-based model that brings together ideas from previous research, and consolidates these in a graph-theoretic framework. The model proposed is simple and computationally lightweight meaning that it has practical applications. The model describes a self-led trust approach, giving a level of autonomy to trust
calculations, not simply being dependant on previous scores from a trust chain/neighbourhood, leading to more accurate trust levels. The trust scores should also be mediated, not just dependant on one trust score but allowing some level of control by enabling individuals to weight the available information in favour of more trusted sources and to better reflect the individuals own trust strategies. The extant trust related research literature is vast and highly diverse. Trust has been studied from each and every angle: in the philosophical, sociological, psychological, computer scientific, economic, and legal sense – just to name a few (Karvonen, 2007). One perennial barrier to synthesising a definitive e-service trust model and theory of trust from this work is the lack of agreement as to definitions of trust (Grabner-Krauter et al., 2005; Grabner-Krauter & Kaluschia, 2003). Thus, inadequate trust conceptualisations and a lack of a unifying viewpoint or paradigm have frequently lead to weak theoretical rationale for empirical studies and a consequent inability to develop coherent and efficient theories. Indeed, one of the central difficulties is that the notion of trust is closely related to other concepts such as reliance, competence, trustworthiness and credibility. Nevertheless, within the vast extant trust literature it is possible to identify a core body of classic work. Further, we have chosen to focus on the notion that trust as a definite measurable confidence level, mediated by inherent risk. Classic trust studies have firmly established the notion that trust and distrust are threshold points on a continuum of probability assessment (Gambetta, 1988). Thus, we trust an entity to perform a particular task if and only if the likelihood that the entity will fulfil its obligation lies above a particular threshold value. This notion is central to the consumer and provider e-service model that is presented later in this paper. A concise review of the relevant literature now follows so as to partially contextualise the model.

### Classic Trust Models and Definitions

Deutsch (1958) was one of the first modern writers to seek to build a formal model of trust. Deutsch defined trust in terms of an individual confronted with an ambiguous path. Further, the path may lead to either an event leading to a beneficial outcome (V+) to that individual or to an event perceived as being harmful (V-). This individual perceives that the occurrence of V+ or V- is dependent on the behaviour of another human agent. Finally, the strength of V- is greater than the strength of V+. Essentially, his view of trust is of a trust relationship in which events are linked to other events, each of which has beneficial or non-beneficial paths. For a trust relationship to occur, the harmful path is more significant than the beneficial path. Deutsch goes on to explain that risk is an essential property of the environment within which a choice of paths occurs. The notion that trust building between individuals takes place within information spaces that are both potentially risky to the participants and where incomplete information is available to the human actors has been widely accepted and developed by many subsequent researchers (Corritore, Krasher, & Wiedenbeck, 2003; Mayer, Davis, & Schoorman, 1995). Within this information space the notion of expectation is central to many writers. For example, Gambetta (2000) provides us with a rich and potentially computationally useful definition that encapsulates the notion of trust as expectation:

*Trust (or symmetrically, distrust) is a particular level of subjective probability with which an agent assesses that another agent or group of agents will perform a particular action, both before he can monitor such action (or independently of his capacity ever to be able to monitor it) and in a context in which it affects his own action. (Gambetta, 2000, p. 217)*
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