Social Computational Trust Model (SCTM): A Framework to Facilitate the Selection of Partners

Ameneh Deljoo1, Tom van Engers1, Leon Gommans1,2, Cees de Laat4
1 Systems and Network Lab, University of Amsterdam
2, AirFrance-KLM, Amsterdam, The Netherlands

Context

A Social Computational Trust Model (SCTM), that helps alliance members to select the right partner to collaborate with and perform collective tasks, and encourages the sharing of incident data and intelligence.

Research Question

How can the alliance members evaluate and select the most trustworthy partner for a particular situation at hand while keeping the risk of interaction at minimum?

SCTM

- Identify two distinctive trustworthiness factors (Benevolence and Competence)
- Evaluate Trust in a dynamic way
- Gather the direct and indirect evidence on a trustee
- Update Trust value
- Evaluate the interaction Risk

Direct and Indirect Evidence

Direct Evidence

A trustor looks at its Kb to collect the evidence on a trustee based on past interactions.

\[ val_d() \rightarrow [0,1] \]

\[ Ed(x, y, s_1; k_b) = \{d_0(x, y, s_1) \in k_b\} \]

\[ val_d(Ed(x, y, s_1; k_b)) = \frac{1}{\#d_0} \sum d_0(x, y, s_1) \in Ed(x, y, s_1; k_b) \]

Indirect Evidence

A trustor asks a trustee’s direct neighbors to send him their evidence on a given trustee.

\[ val_e() \rightarrow [0,1] \]

\[ Ec(nbr_\gamma, y, s_1) = \{ Ed(u, y, s_1; k_b) \mid u \in nbr_\gamma \} \]

\[ val_e(Ec(x, y, s_1)) = \frac{1}{\# nbr_\gamma} \sum_{Ed(u, y, s_1; k_b) \in Ec(nbr_\gamma, y, s_1)} val_d(Ed(u, y, s_1; k_b)) \]

Functions

- Competence Function

\[ \text{Com}(nbr_\gamma, y, s_1) = val_e(Ec(nbr_\gamma, y, s_1)), nbr_\gamma = nb \setminus \{x\} \]

- Benevolence Function

\[ \text{Ben}(x, y, s_1) = val_d(Ed(x, y, s_1; k_b)) \]

- Interaction Risk

\[ R_{i}(x, y, s_1) = \alpha (1 - \text{Com}(nbr_\gamma, y, s_1)) + (1 - \alpha) (1 - \text{Ben}(x, y, s_1)), 0 \leq \alpha \leq 1 \]

Experiment

- A collaborative network implemented with BDI-Agent.
- Selecting a ‘right’ partner with the maximum competence and benevolence value while the interaction risk is minimal.

Scenario:

Domain “N” wants to choose ideal domains for collaboration in order to mitigate and defend against a certain attack.

Sub-Tasks

\[ T_{e1}: \text{provide resources within a certain time window}, \]

\[ T_{e2}: \text{monitor a certain traffic}, \]

\[ T_{e3}: \text{block a certain link}, \]

\[ T_{e4}: \text{implement a certain counter measurement}. \]

Main Results

- The interaction risk estimated through the SCTM by combining benevolence and competence.
- We have shown that the stability of the alliance is dependent on the value of benevolence that led to a lower interaction risk.
- We demonstrated that the SCTM is able to obtain comparable results to the other trust models that we evaluated.