Detailed computation of probabilities of occurrence

Ranwa Al Mallah

LiTrans, Ryerson University, Ontario, Canada

David López

GiiTraL, Universidad Nacional Autónoma de México, Mexico City, Mexico

Bilal Farooq

LiTrans, Ryerson University, Ontario, Canada

1. Detailed computation of probabilities of occurrence

The un-normalized probability of occurrence is the sum of the three actors attributes: capacity (c), opportunity (o) and motivation (m). The c, o, m values vary from 1 to 4, with 4 corresponding to a higher likelihood. The un-normalized probability of occurrence $P(G_i, S_j, A_k)$ as follows:

$$P(G_i, S_j, A_k) = c(G_i, S_j, A_k) + o(G_i, S_j, A_k) + m(G_i, S_j, A_k)$$

such that:

$$\begin{aligned} f : S_j \mapsto G_i \ : \ & f \text{ is given by Table 1} \\ c(G_i, S_j, A_k) \in & \{1,2,3,4\} \\ o(G_i, S_j, A_k) \in & \{1,2,3,4\} \\ m(G_i, S_j, A_k) \in & \{1,2,3,4\} \\ i \in & \{1,2\ldots,5\} \\ j \in & \{1,2\ldots,22\} \\ k \in & \{1,2,3,4,5\} \end{aligned}$$

The Tables 2 to 6 show the rates assigned to $c(G_i, S_j, A_k)$, $o(G_i, S_j, A_k)$, $c(G_i, S_j, A_k)$ for a given attack goal, G_i, scenario, S_j, and actor A_k

Email addresses: ranwa.almallah@ryerson.ca (Ranwa Al Mallah), dlopezfl@iingen.unam.mx (David López), bilal.farooq@ryerson.ca (Bilal Farooq)

Table 1: Possible scenarios per attack goal

Attack goal	**Label**	**Scenarios**
Gain knowledge about the data-market	G_1	$S_1, S_3, S_4, S_7, S_8, S_{10}, S_{12}, S_{20}$
Access sensitive data on the nodes of the network	G_2	$S_1, S_3, S_4, S_7, S_8, S_{10}, S_{12}, S_{20}$
Manipulate and modify blockchain information	G_3	$S_1, S_{10}, S_{11}, S_{14}, S_{15}, S_{16}, S_{17}, S_{18}, S_{19}, S_{21}$
Sabotage activities	G_4	$S_1, S_2, S_5, S_6, S_7, S_8, S_9, S_{10}. S_{11}, S_{12}, S_{13}, S_{14}, S_{15}. S_{16}, S_{17}\, S_{18}, S_{19}, S_{21}, S_{22}$
Induce participants in the blockchain network to make errors	G_5	$S_1, S_2, S_5, S_6, S_7, S_8, S_9, S_{10}. S_{11}, S_{12}, S_{13}, S_{14}, S_{15}. S_{16}, S_{17}\, S_{18}, S_{19}, S_{21}, S_{22}$

Table 2: Probability of occurrence of identified threats for G_1 - Gain knowledge about the data-market

S_j	A_k	c	o	m	P
S_1	A_1	3	3	2	8
	A_2	2	3	4	9
	A_3	2	3	3	8
	A_4	1	2	3	6
S_3	A_1	1	2	1	4
	A_2	2	2	3	7
	A_3	2	2	2	6
	A_4	2	1	2	5
S_4	A_1	1	1	2	4
	A_2	2	2	4	8
	A_3	2	2	3	7
	A_4	2	2	3	7
S_7	A_1	2	2	1	5
	A_2	2	2	2	6
	A_3	1	2	1	4
	A_4	2	2	1	5
S_8	A_1	3	2	2	7
	A_2	2	2	2	6
	A_3	2	1	1	4
	A_4	2	1	1	4
S_{10}	A_1	2	1	1	4
	A_2	1	1	2	4
	A_3	1	1	1	3
	A_4	1	1	1	3
S_{12}	A_1	2	1	1	4
	A_2	2	1	2	5
	A_3	1	1	1	3
	A_4	1	1	1	3
S_{20}	A_1	2	2	1	5
	A_2	2	2	2	6
	A_3	2	2	1	5
	A_4	1	2	1	4

Table 3: Probability of occurrence of identified threats for G_2 - Access sensitive data on the nodes of the network

S_j	A_k	c	o	m	P
S_1	A_1	3	3	3	9
	A_2	2	3	3	8
	A_3	2	3	3	8
	A_4	1	2	4	7
S_3	A_1	1	1	2	4
	A_2	2	2	2	6
	A_3	2	2	3	7
	A_4	2	1	4	7
S_4	A_1	1	2	1	4
	A_2	3	2	2	7
	A_3	3	2	2	7
	A_4	2	1	3	6
S_7	A_1	2	3	1	6
	A_2	2	2	1	5
	A_3	2	2	2	6
	A_4	2	1	2	5
S_8	A_1	3	2	2	7
	A_2	1	1	2	4
	A_3	2	2	2	6
	A_4	2	2	2	6
S_{10}	A_1	2	2	1	5
	A_2	2	1	1	4
	A_3	2	1	2	5
	A_4	1	1	2	4
S_{12}	A_1	2	1	2	5
	A_2	1	1	2	4
	A_3	1	1	2	4
	A_4	1	1	2	4
S_{20}	A_1	2	1	2	5
	A_2	1	2	2	5
	A_3	1	2	3	6
	A_4	1	1	3	5

Table 4: Probability of occurrence of identified threats for G_3 - Manipulate and modify blockchain information

S_j	A_k	c	o	m	P
S_1	A_1	2	3	3	8
	A_2	1	2	3	6
	A_3	1	2	3	6
	A_4	2	2	4	8
S_{10}	A_1	3	1	1	5
	A_2	1	1	2	4
	A_3	1	1	1	3
	A_4	3	3	2	8
S_{11}	A_1	1	1	2	4
	A_2	1	2	3	6
	A_3	1	1	2	4
	A_4	4	3	4	11
S_{14}	A_1	1	1	1	3
	A_2	1	1	1	3
	A_3	1	1	1	3
	A_4	3	2	2	7
S_{15}	A_1	1	1	1	3
	A_2	1	1	1	3
	A_3	1	1	1	3
	A_4	2	1	2	5
S_{16}	A_1	1	1	1	3
	A_2	1	1	1	3
	A_3	1	1	1	3
	A_4	1	1	3	5
S_{17}	A_1	1	1	1	3
	A_2	1	1	2	4
	A_3	1	1	1	3
	A_4	2	2	2	6
S_{18}	A_1	3	1	2	6
	A_2	2	2	2	6
	A_3	1	1	2	4
	A_4	3	2	2	7
S_{19}	A_1	1	1	1	3
	A_2	1	1	1	3
	A_3	1	1	1	3
	A_4	2	2	2	6
S_{21}	A_1	2	1	2	5
	A_2	1	1	1	3
	A_3	1	1	1	3
	A_4	4	2	2	8

Table 5: Probability of identified threats for G_4 - Sabotage activities

S_j	A_k	c	o	m	P
S_1	A_1	3	3	4	10
	A_2	2	2	4	8
	A_3	2	2	4	8
	A_4	2	2	2	6
S_2	A_1	4	4	4	12
	A_2	4	4	4	12
	A_3	4	4	4	12
	A_4	4	4	2	10
S_5	A_1	3	1	3	7
	A_2	1	1	2	4
	A_3	1	1	2	4
	A_4	1	2	4	7
S_6	A_1	2	1	2	5
	A_2	1	1	2	4
	A_3	1	1	2	4
	A_4	1	2	2	5
S_7	A_1	4	1	2	7
	A_2	2	1	1	4
	A_3	2	1	1	4
	A_4	1	1	2	4
S_8	A_1	4	1	2	7
	A_2	3	1	2	6
	A_3	3	1	2	6
	A_4	1	2	2	5
S_9	A_1	2	1	3	6
	A_2	1	1	2	4
	A_3	1	1	2	4
	A_4	1	2	2	5
S_{10}	A_1	2	1	3	6
	A_2	1	1	2	4
	A_3	1	1	2	4
	A_4	2	2	3	7
S_{11}	A_1	1	1	3	5
	A_2	1	2	3	7
	A_3	1	1	4	6
	A_4	4	3	3	10
S_{12}	A_1	3	1	2	6
	A_2	2	1	2	5
	A_3	2	1	2	5
	A_4	1	2	1	4
S_{13}	A_1	2	2	2	6
	A_2	2	1	2	5
	A_3	2	1	2	5
	A_4	1	2	2	5
S_{14}	A_1	1	1	1	3
	A_2	1	2	1	4
	A_3	1	1	1	3
	A_4	2	2	3	7
S_{15}	A_1	1	1	1	3
	A_2	1	1	1	3
	A_3	1	1	1	3
	A_4	2	2	2	6
S_{16}	A_1	1	1	1	3
	A_2	1	1	2	4
	A_3	1	1	2	4
	A_4	1	1	3	5
S_{17}	A_1	1	1	2	4
	A_2	1	1	1	3
	A_3	1	1	1	3
	A_4	2	1	2	5
S_{18}	A_1	3	1	2	6
	A_2	2	2	2	6
	A_3	2	1	2	5
	A_4	4	3	2	9
S_{19}	A_1	1	1	1	3
	A_2	1	1	1	3
	A_3	1	1	1	3
	A_4	2	2	2	6
S_{21}	A_1	2	1	2	5
	A_2	1	1	1	3
	A_3	1	1	1	3
	A_4	4	2	2	8
S_{22}	A_1	4	4	3	11
	A_2	4	4	3	11
	A_3	4	4	3	11
	A_4	4	4	3	11

Table 6: Probabilities for G_5 - Induce participants in the blockchain network to make errors

S_j	A_k	c	o	m	P
S_1	A_1	4	3	3	10
	A_2	4	2	3	9
	A_3	4	2	3	9
	A_4	2	2	3	7
S_2	A_1	4	4	4	12
	A_2	4	4	4	12
	A_3	4	4	4	12
	A_4	4	4	3	11
S_5	A_1	2	1	2	5
	A_2	1	1	1	3
	A_3	1	1	1	3
	A_4	1	2	3	6
S_6	A_1	2	1	1	4
	A_2	1	1	1	3
	A_3	1	1	1	3
	A_4	1	2	2	5
S_7	A_1	3	1	3	7
	A_2	1	1	1	3
	A_3	1	1	1	3
	A_4	1	2	1	4
S_8	A_1	3	1	3	7
	A_2	2	2	2	6
	A_3	2	1	2	5
	A_4	1	2	2	5
S_9	A_1	2	1	2	5
	A_2	1	1	1	3
	A_3	1	1	1	3
	A_4	1	1	2	4
S_{10}	A_1	1	1	2	4
	A_2	1	1	1	3
	A_3	1	1	1	3
	A_4	2	1	1	4
S_{11}	A_1	1	1	2	4
	A_2	1	2	2	5
	A_3	1	1	2	4
	A_4	4	3	4	11
S_{12}	A_1	2	1	3	6
	A_2	1	1	3	5
	A_3	1	1	3	5
	A_4	1	1	1	3
S_{13}	A_1	2	1	2	5
	A_2	1	1	2	4
	A_3	1	1	2	4
	A_4	1	1	1	3
S_{14}	A_1	1	1	1	3
	A_2	1	1	2	4
	A_3	1	1	2	4
	A_4	2	2	4	8
S_{15}	A_1	1	1	1	3
	A_2	1	1	1	3
	A_3	1	1	1	3
	A_4	1	1	2	4
S_{16}	A_1	1	1	1	3
	A_2	1	1	1	3
	A_3	1	1	2	4
	A_4	1	1	2	4
S_{17}	A_1	1	1	2	4
	A_2	1	1	1	3
	A_3	1	1	1	3
	A_4	2	1	2	5
S_{18}	A_1	2	1	1	4
	A_2	1	1	2	4
	A_3	1	1	2	4
	A_4	3	2	3	8
S_{19}	A_1	1	1	1	3
	A_2	1	1	1	3
	A_3	1	1	1	3
	A_4	1	1	2	4
S_{21}	A_1	2	1	2	5
	A_2	1	1	1	3
	A_3	1	1	1	3
	A_4	3	2	2	7
S_{22}	A_1	4	4	4	12
	A_2	4	4	4	12
	A_3	4	4	4	12
	A_4	4	4	4	12