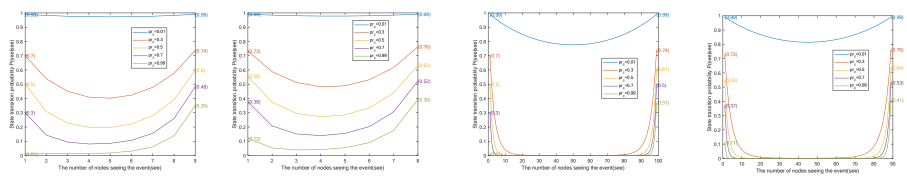
APPENDIX A

The results for the evaluation of $P(see|see)$ in (1), where n varies from 10 to 200, λ varies from 0 to 0.3, and pr_c varies from 0.01 to 0.99, are presented in Fig.1 and Fig.2. It can be found that $P(see|see)$ has the maximum value when $see = n(1-\lambda) - 1$.

$$P(see|see) = (1 - pr_c + pr_c \cdot \frac{n \cdot \lambda + see - 1}{n-1})^{see} \tag{1}$$



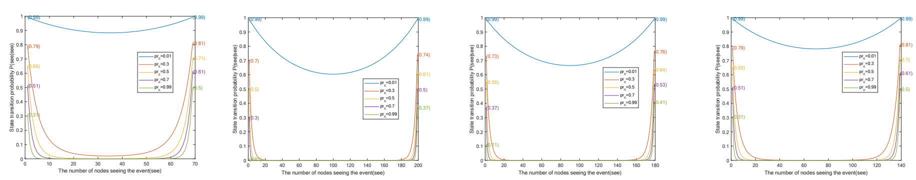
(a)Given n=10 and λ=0, with the increase of the number of nodes seeing the event, the changes of P(see|see) where pr_c varies from 0.01 to 0.99

(b)Given n=10 and λ=0.1, with the increase of the number of nodes seeing the event, the changes of P(see|see) where pr_c varies from 0.01 to 0.99

(c)Given n=100 and λ=0, with the increase of the number of nodes seeing the event, the changes of P(see|see) where pr_c varies from 0.01 to 0.99

(d)Given n=100 and λ=0.1, with the increase of the number of nodes seeing the event, the changes of P(see|see) where pr_c varies from 0.01 to 0.99

Fig. 1. With the increase of the number of nodes seeing the event, the changes of $P(see|see)$ in (1) where n varies from 10 to 100, λ varies from 0.1 to 0.3, and pr_c varies from 0.01 to 0.99



(a)Given n=100 and λ=0.3, with the increase of the number of nodes seeing the event, the changes of P(see|see) where pr_c varies from 0.01 to 0.99

(b)Given n=200 and λ=0, with the increase of the number of nodes seeing the event, the changes of P(see|see) where pr_c varies from 0.01 to 0.99

(c)Given n=200 and λ=0.1, with the increase of the number of nodes seeing the event, the changes of P(see|see) where pr_c varies from 0.01 to 0.99

(d)Given n=200 and λ=0.3, with the increase of the number of nodes seeing the event, the changes of P(see|see) where pr_c varies from 0.01 to 0.99

Fig. 2. With the increase of the number of nodes seeing the event, the changes of $P(see|see)$ in (1) where n varies from 100 to 200, λ varies from 0 to 0.3, and pr_c varies from 0.01 to 0.99

APPENDIX B

$\{rs(t), ns(t)\}$ is formulated as a discrete-time markov chain in Fig.3.

For the one-step transitions from state $\{0, j\}$, the corresponding probabilities are given by (2). In (2), $1 - pr_r$ is the probability that a nod_x does not contact

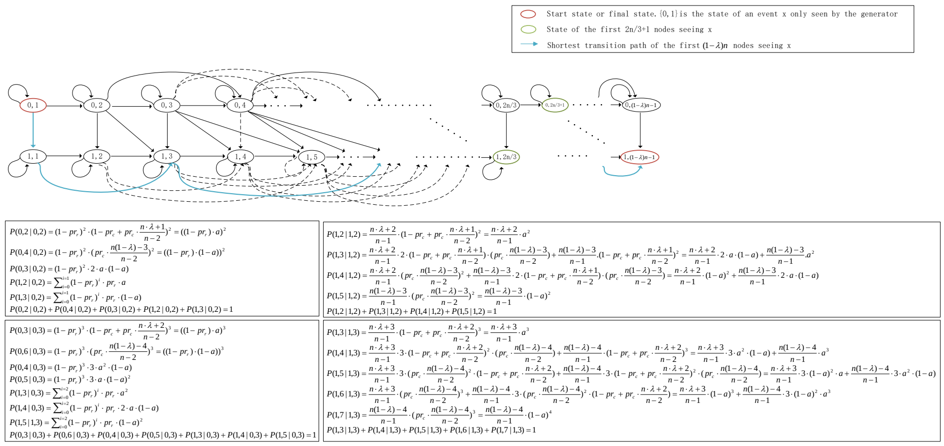


Fig. 3. Markov Chain for the process of event x being seen by the first $n(1-\lambda)$ nodes

with the ranger. a indicates the probability that a nod_x does not contact with other nods in $1-pr_c$, contacts with Byzantine nodes in $pr_c \cdot \frac{n \cdot \lambda}{n-2}$, or contacts with other nod_xs in $pr_c \cdot \frac{j-1}{n-2}$ at time $t+1$. $ns(t+1)$ remains unchanged in a, or increases in $1-a$. Further, $P(0,u|0,j)$ is the probability related to a nod_x not contacting with the ranger which has not seen x. For the example of $P(0,1|0,1)$ with $u=j=1$, $P(0,1|0,1)$ is the transition probability that the generator does not contact with the ranger, and does not contact with nods or contacts with Byzantine nodes. It is $(1-pr_r)(1-pr_c+pr_c \cdot \frac{n \cdot \lambda}{n-2})$. Besides, $P(1,u'|0,j)$ is the probability related to a nod_x contacting with the ranger which has not seen x. For the example of $P(1,1|0,1)$ with $u=j=1$, $P(1,1|0,1)$ is the transition probability that the generator gossips with the ranger, and it is pr_r.

$$\begin{cases} P(0,u|0,j) = (1-pr_r)^j \cdot \binom{j}{u-j} \cdot a^{2j-u} \cdot (1-a)^{u-j} \\ P(1,u'|0,j) = \binom{j-1}{u'-j} \cdot pr_r \cdot a^{2j-u'-1} \cdot (1-a)^{u'-j} \cdot \sum\limits_{i=0}^{j-1} (1-pr_r)^i \\ \qquad s.t.\ a = 1-pr_c+pr_c \cdot \frac{n \cdot \lambda + j-1}{n-2}, \quad j \in [1, n(1-\lambda)-1], \\ \qquad\qquad u \in [j, \min(2j, n(1-\lambda)-1)], \quad u' \in [j, \min(2j-1, n(1-\lambda)-1)] \end{cases} \tag{2}$$

For the one-step transition from state $\{1,j\}$, the corresponding probabilities are given by (3). In (3), a indicates the probability that the ranger contacts with Byzantine nodes in $\frac{n \cdot \lambda}{n-1}$, or contacts with nod_xs in $\frac{j}{n-1}$ at time $t+1$. $ns(t+1)$ remains unchanged in a, or increases in $1-a$. b indicates a nod_x does not contact with nods in $1-pr_c$, contacts with Byzantine nodes in $pr_c \cdot \frac{n \cdot \lambda}{n-2}$, or contacts with other nod_xs in $pr_c \cdot \frac{j-1}{n-2}$ at time $t+1$. $ns(t+1)$ remains unchanged in b, or increases in $1-b$. For the example of $P(1,1|1,1)$ with $u=j=1$, $P(1,1|1,1)$ is the transition probability that the ranger contacts with Byzantine nodes or a nod_x, and a nod_x does not contact or contacts with Byzantine nodes. It is $\frac{n\cdot\lambda+1}{n-1}(1-pr_c+pr_c\frac{n\lambda}{n-2})$.

$$\begin{cases} P(1,u|1,j) = sgn(j,u-j)\cdot a\cdot b^{2j-u}\cdot(1-b)^{u-j} \\ \qquad + sgn(j,2j-u+1)\cdot(1-a)\cdot b^{2j-u+1}\cdot(1-b)^{u-j-1} \\ \qquad s.t.\ a=\frac{n\cdot\lambda+j}{n-1}, \quad b=1-pr_c+pr_c\cdot\frac{n\cdot\lambda+j-1}{n-2}, \\ \qquad\quad j\in[1,(1-\lambda)n-2], \quad u\in[j,\min(2j+1,(1-\lambda)n-1)], \\ \qquad\quad sgn(x,y)=\begin{cases}\binom{x}{y}, & x\geq y\\ 0, & x<y\end{cases} \end{cases} \tag{3}$$