FACTA UNIVERSITATIS (NIŠ)
Series: Electronics and Energetics vol. 12, No.1(1999), 55-60

UDC 621.395

ROULETTE SIMULATION OF TRAFFIC PROCESS ON THE CCS NO 7 LINK

Žarko Markov and Dragan Mitić

Abstract. The use of roulette or Monte Carlo traffic simulation method for the traffic simulation of CCS no 7 signaling link is considered. It is shown that simulation may be simple but with great degree of fidelity if the time between two successive random numbers is equal to FISU emission time.

1. Introduction

Simulation is a good way to test the traffic properties of the CCS (*Common channel signaling*) no 7 signaling link. The main difference between telephone traffic models and CCS no 7 signaling link traffic model is permanent traffic on the link. This traffic consists of priority MSUs (*Message signal unit*) and FISUs (*Fill in signal unit*), [1]. As it is well known, servicing of MSUs is with non–preemptive priority over FISUs. An other difference is two kind of signal units: FISUs with constant duration and MSUs with variable duration.

On the other hand, in the Monte Carlo or roulette simulation, process is performed by basic events. In the telephone traffic roulette simulation basic events are new call appearance and call ceasing. In the case of CCS no 7 simulation the basic event would be appearance and ceasing of signaling bit, signaling octet or signaling message. A way to simulate CCS no 7 signaling link if the time between two successive basic events is not shorter than duration of one FISU is shown in this letter.

Manuscript received July 1, 1998.
Manuscript revised January 26, 1999.
The authors are with Institute IRITEL, Batajnički put 23, 11080 Zemun, Yugoslavia.

2. Roulette simulation

Roulette simulation is the continuous time traffic process imitation by the means of discrete time process of events. Any change of simulated process is possible only in discrete instants of time, Fig. 1. In the telephone traffic simulation, appearance of new calls and ceasing of calls are possible only in instants nt_0, Fig. 1. These instants are the instants of (pseudo) random numbers (RNs) production by means of (pseudo) random generator (RNG). The values of RN are uniformly distributed, defining the events caused by RN. One interval of the telephone traffic simulation by roulette consisting of four telephone calls is shown in Fig. 1.

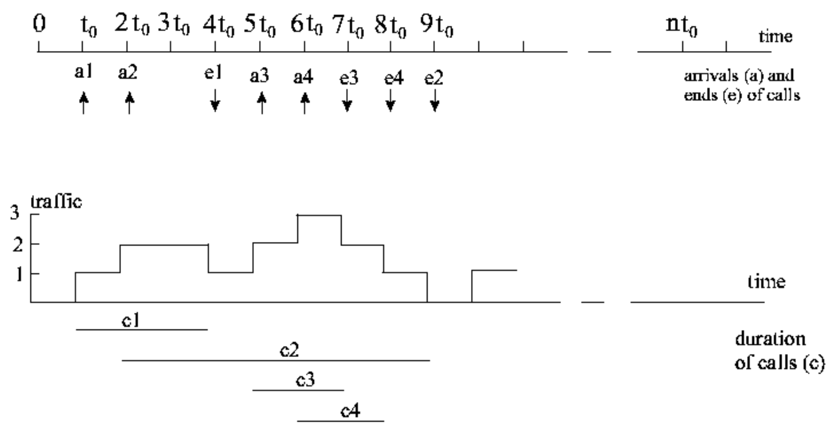

Fig. 1. Roulette simulation of telephone traffic.

It is clear that the time unit in simulation is t_0. This time unit is used for all time measurements during simulation process.

The RNs obtained from RNG belong to three intervals:

- the interval proportional to the call intensity, λ. The random numbers $RN1$, $RN2$, $RN5$, $RN6$ in Fig. 1 belong to this interval and they cause the new calls;
- the interval proportional to the number of channels. The random numbers $RN4$, $RN7$, $RN8$, $RN9$ belong to this interval and they cause the call ceasing;
- interval of empty events, G. The random number $RN3$, Fig. 1, belongs to this interval. If the random number obtained from RNG belongs to interval G, no change happens in the system.

As it is known, [2], mean time of at least one channel occupancy i. e. mean time of conversation in simulated process is $t_m = t_0(\lambda + N + G)$.

3. The CCS no 7 link operation

If the emission time of one FISU is denoted by t, the operation of CCS no 7 link may be shown by Fig. 2. The MSU sending can not begin immediately at the instant of its arrival. The new MSU must wait for the end of current sending of FISU or previously arrived MSU(s). The start of a new MSU sending may happen only in "discrete" instants (after FISU or MSU). This is very similar to discrete time roulette simulation process. We adopt the following assumption that is very close to reality: the shortest time interval between two successive events may be emission time of FISU, t. This assumption leads to the following conclusion: The duration of every MSU, t_{MSU}, is $t_{MSU} = kt$, $k = 2, 3, 4, ...46$. This quantization of time enables very simple simulation of CCS no 7 link.

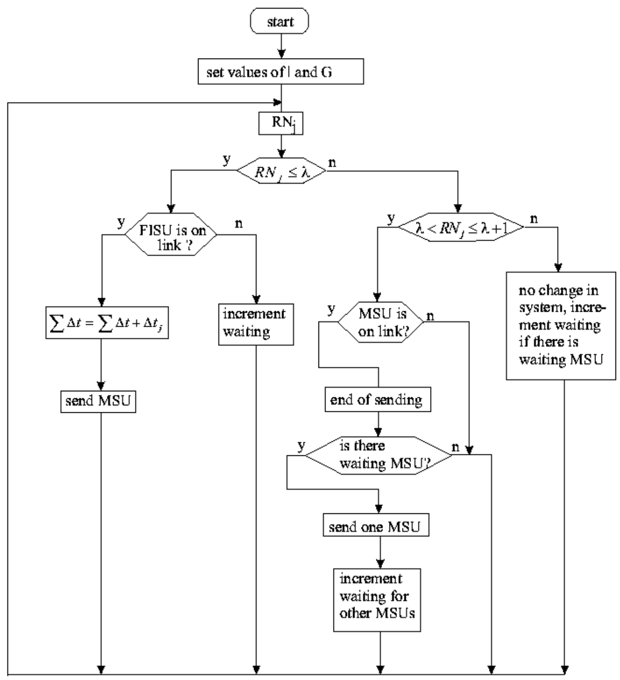

Fig. 2. Roulette simulation of signaling traffic on CCS no 7 link.

4. Traffic simulation of CCS no 7 link operation

Combining the characteristics of roulette simulation and CCS no 7 link, the traffic simulation of CCS no 7 link may be performed as follows.

The RNG produces uniformly distributed RNs in interval $\lambda+N+G$, where $N=1$, λ is MSU intensity and G serves to determine mean MSU length. The time interval between two successive RNs, t_0 , is equal to the FISU emission time, and may be taken as time unit, $t_0 = t_{FISU} = 1$. According to RN taken in j-th trial, RNj, j-th event is simulated as one of three possible events:

- the arrival of new MSU if $0 < RNj \leq \lambda$;
- the end of sending MSU if $\lambda < RNj \leq \lambda + 1$;
- the empty event if $\lambda + 1 < RNj \leq \lambda + 1 + G$.

The traffic properties of CCS no 7 link may be estimated by this simulation, but the waiting for current FISU sending (time interval $t - t_1$ in Fig.2.) can not be simulated because $t - t_1$ is smaller than the basic time unit $t - t_1 < t_0$. This problem may be solved in the following way. We observe the CCS no 7 channel sending FISU, time interval $t - t_s$ in Fig. 2. The arrival of a new MSU in t_1 is a random event so the time interval $t_1 - t_s$ is the random variable with uniform distribution. This means that the waiting time interval $t - t_1$ is, also, random variable with uniform distribution. All RNs causing the new MSUs are uniformly distributed over interval $(0, \lambda)$. We assume that the waiting time of j-th MSU caused by sending FISU is proportional to $\lambda - RNj$:

$$\frac{t - t_1}{t - t_s} = \frac{\lambda - RNj}{\lambda} = \frac{\Delta t_j}{t_0} = \Delta t_j, \qquad t_0 = 1$$

If N MSUs are produced in simulation, the mean waiting time caused by FISU sending is

$$E(t_{wf}) = \frac{1}{N} \sum_{j=1}^{N} \Delta t_j$$

The flow chart of simulation is shown in Fig. 3.

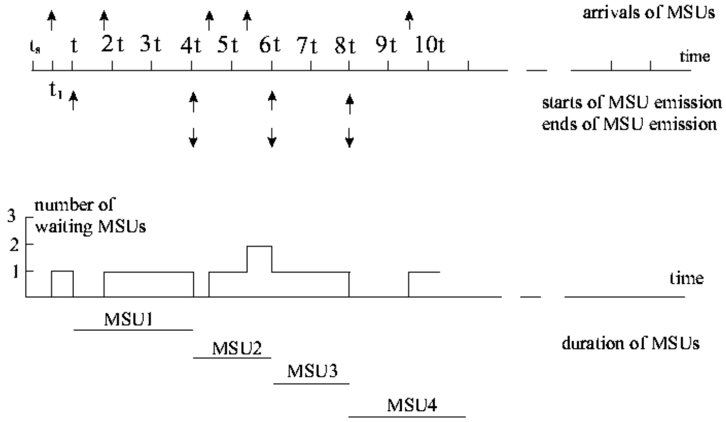

Fig. 3. Flow chart of traffic simulation on CCS no 7 link.

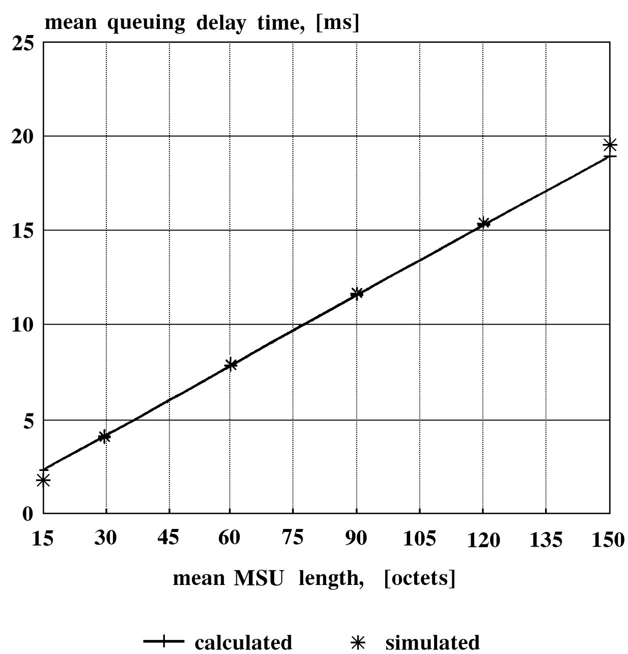

Fig. 4. Comparison of simulated and calculated mean queuing delay time for CCS no 7 vs mean MSU length, $a = 0.5erl$, FISU length 6 octets.

5. Example

We simulate traffic process on one CCS no 7 link. The signaling link is with 64kb/s rate, with basic error correction method, offered signaling traffic is $0.5erl$, FISU length is 6 octets and length of MSUs is exponentially distributed. We are interested to estimate the mean queueing delay time. Fig. 4. shows the comparison of the calculated results and 95% confidence area of simulated results. Mean queueing delay time is given as the function of the mean MSU length. The mean MSU length is determined by parameter G. Calculated values of mean queueing delay time are obtained by formula from Recommendation Q.706., [1].

6. Conclusion

Roulette or Monte Carlo simulation may be used for traffic simulation of CCS no 7 link if time interval between two successive random numbers is equal to emission time of one FISU. This simulation process enables the estimation of all traffic parameters. The adjustment of signaling traffic load and mean MSU length may be done in a very simple way.

REFERENCES

1. ITU–T Recommendations: *Q.7XX.* March 1993
2. Ž. Markov: *Roulette simulation of traffic process with call collision on both–way telecommunication channels.* Int. J. Electron. Commun. (AEU), vol. 50 (1996), pp. 391–394.