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THE MODELLING OF DATA LINK LAYER RECEIVER WITH GENERALIZED NET – A LIFETIME VALUE RESTRICTION

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1. Introduction

Open systems interconnection (OSI) conception [1] of International Standard Organization (ISO) is used by developers at the field of telecommunications as a base for realization, investigation and development of the systems of information exchange. Parallelism and asynchrony, and their structure characterize the processes in such systems - by a hierarchy.

Petri nets (PN) [2] are used for such tasks because of us possibilities to model as the structure of the investigated object, as the dynamics of the flowing in it processes. The Generalized nets (GN) [3] are contemporary their development, suggesting detail reflection of the structure and time relation in parallel processes.

In this paper we shall use GN apparatus for modelling of one of the basic elements in OSI – receiver, for data link layer LLC type 3 Protocol.

2. Logical Link Protocol

The reference model of OSI order to divide the architecture of each communication system into seven layers on the principle of stratified hierarchy. Data link layer (second layer) must ensure orderly and correct delivery of packets between its interconnecting protocol objects. The LLC (logical link control) [4] is a protocol having been developed for this purpose.

The LLC sublayer can provide either connectionless (called type 1) or connection-oriented (type 2) service. It also provides acknowledged connectionless (type 3) service, which is useful in factory automation environment.

The LLC type 3 protocol adopts the stop-and-wait scheme for the error control and the flow control. The proper operation of the protocol requires that the logical link parameters be set appropriately. For the single link they are an acknowledgement time value (T1), maximum number of transmissions (N4), transmit lifetime value (T3) – for sender, and receive lifetime value (T2) – for receiver components.

Modelling of a single link by Timed PN [2] (with inhibitor arcs) have been considered by Moon [5]. If the transmission lines is unreliable, and transmission delay is assumed to be bounded by Td (>0), the parameter region for the proper operation is:

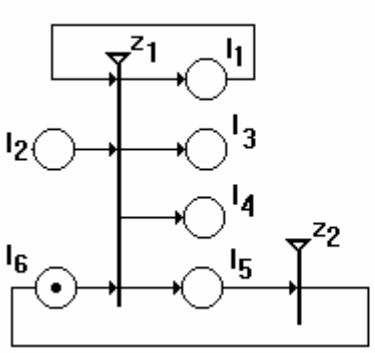
$$T1 > 2Td\ ; \qquad T2 < T3\ ;. \qquad T2 > (N4-1)T1 + Td\ .$$

It is obvious, that by given Td and N4 the choice of T1 is not a problem. But for the value of T2 there is no upper limit, but on it depends the value of T3. I.e. for the receiver is have to search more limits. Since the possibilities of Timed PN are overused, we will construct a model of LLC type 3 receiver by means of Generalized Nets.

3. GN-model of a receiver

Our aim is to obtain of model of a receiver in the GN-view, saving source model [5]. All used notations are given in [3]. The graphical view of synthesized GN model is presented on Fig.1.

Initially, token α will be in place l_6 with input characteristic "wait new packet".



r_1 =

	l_1	l_3	l_4	l_5
l_1	True	false	false	$\neg W1 \wedge W_2$
l_2	false	True	$W_1 \vee W_2$	false
l_6	W_3	false	false	True

r_2 =

	l_6
l_5	W_4

Fig.1 GN model

Token β enters place l_2 with initial characteristic "packet with number RSSV", where RSSV∈ {0,1}. If token α enters place l_1, it obtains characteristic "state of receiver VS", where VS∈ {0,1}.

The token β has higher priority.

$$Z_1 = <\{ l_1, l_2 , l_6\}, \{ l_1, l_3\ l_4, l_5\}, r1, \wedge(v(l_1, l_6), l_2)>$$
$$Z_2 = <\{l_5\}, \{l_6\}, r2, \wedge(l_5)>$$

The predicates W_1, W_2, W_3 and W_4 have the following forms

W_1 ="there is a token in position l_6" ;

W_2="RSSV ⊕ VS=1" ;

W_3 ="there is no token in position l_1" ;

W_4 =" TIME > Time_start + T2"

The characteristic functions are :

Φ_1="VS := RSSV" ;

Φ_3=" RSSV ⊕ 1" ;

Φ_4="new packet received" ;.

Φ_5=" Time_start := TIME" ;

Φ_6="wait new packet"

4. Properties of the constructed GN-model

The capacities of all arcs are equal to one. The capacities of all places, excluding l_3 and l_4, are equal to one. The number of the token's characteristics is equal to one. The priorities of the transitions satisfy the condition: Z_2 is higher than Z_1; and the priorities of the places are not necessarily for the model.

The GN E does not have local and global temporal components. Therefore, the constructed GN is a reduced GN (see [3]).

The desribed GN can be applied in design of the other communication processes, based on the Open systems interconnection (OSI) conception [1].

5. Conclusion

Analysis of functioning of suggested GN-model acknowledged validity of assumed in [5] parameter region for proper operations. And more, we discovered the expected "upper" limit for T2 : $T2 < 2 [(N4-1)T1 + Td]$

It is necessary not to loose the packet in the receiver by loosing of all acknowledgements in case of maximum loading of the sender.

This result showed necessity of modelling by GN of other communication protocols.

References

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