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A TPN MODEL OF HALF DUPLEX PROTOCOL IN WIRELESS SECURITY SYSTEMS

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Abstract: *This paper concerns the problems about modeling radio protocols in wireless security systems. The parameters of the link are: length of packages; number of repetitions of packages, number of transmitters, repeater and receivers, parameters of channel. A Timed Petri Net model of wireless half duplex protocol is presented.*

1. Introduction

This investigation is oriented to connection between wireless unit (as detector, siren) and control panel. Specifically for wireless security unit (WSU) is the fact, that they are battery powered and protocols have to save the energy. The WSU sends specific signals, correspond to the change of status of his status.

One control panel serves up to **N** wireless units (N ordinary is between 16 to 128). If happens a common ccause, several WSU transmits the signals at the same moment. The receiver (SMC) will receive only one signal at the highest level, another signal will be loss (as an message). This may have dangerous result, if any signal is alarm or personal attack.

Another problem is an ether noise might be casual or made by a tamper.

We are searching for methods to suspend of loses of the signal.

There are two possibilities:

•One possibility method is the duplex link, but it makes the equipment too complex and dear.

•Another approach is the repetition of the signals. Every signal will be transmitted several (n-) times in to ether, for a casual interval of time.

Wireless protocols are comparatively complex. It is needed to use of a formal method for specification and verification these protocols. The idea is the errors themselves to be found in the process of the designing.

Timed Petri Nets (PN) are most appropriate techniques as compared with the approaches existing so far. This fact is conditional by the presence of a set of asynchronous parallel processes, the usage of exchange protocols, the solving of coordinate tasks and the realization of alternate transitions.

2. Half Duplex Protocol Model

In this case wireless unit (detector) sends the signals until receiver talks him to stop, because information is received [1]. The intervals between packages are approx. 5s. After every transmission, detector turns on listen (receive) mode. In this mode detector tries to get acknowledge form receiver. If this acknowledge is not received, detector sends encore one time the signal. In other case communication will be cancelled.

Marker in t1 (SEND) correspond to the change of detector status. This means that detector will send a signal. The signals are:

- alarm / restore of alarm;
- low battery / restore battery;
- tamper / restore of tamper;
- system test - emits every 12 hours.

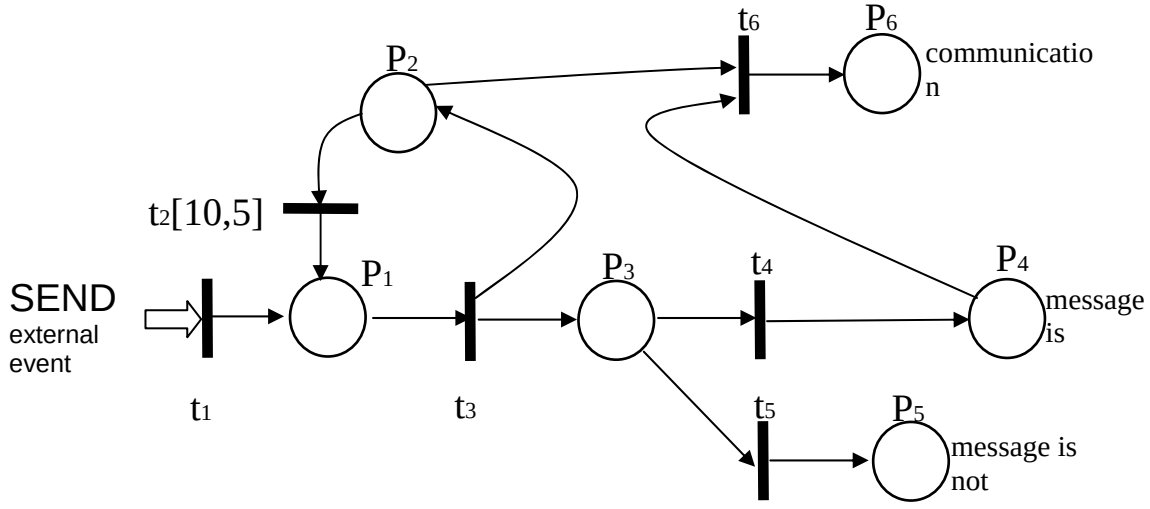

Fig.1.A TPN model of half duplex protocol.

Position P1 is generation place. If a marker persists in this position, a generation will make. P2 is subsidiary place. Marker in this place means, that after 10s a new generation will be made. Position P3 and transaction t4 and t5 model ether. If transaction t5 is fired, the message is lost. In this case after approx. 10s t2 will fire and new generation will be made.

Otherwise, if t4 is fired, the message will receive successfully. Then receiver sends the signal “OK”. Transaction t7 is fired and communication is canceled (the marker inhibits from position P2. A marker in Position P6 means that communication has been made successfully.

Tab.1 Places

P1	Main state – generation place
P2	Subsidiary place – new generation after approx. 10s.
P3	The message passes though ether. It might be received or lost
P4	The message is received
P5	The message is not received
P6	Communication is canceled successfully.

Tab.2 Transitions

T1	An event is occurred
T2	Generation will make after 5-15s
T3	Signal is sent trough ether
T4	The message is received
T5	The message is received
T6	Inhibition of generation marker.

3. Experimental Results

Two models have been created. First model is simplex communication and it includes five repetitions of the signal [2,3]. Every time the message is received, but there are occasions of particularly signal loss.

Second model is similar to described above. It is seen that he is too complex as first, but he is too economical with battery energy. If it is placed possibility to t3 and t4 it will be possible to model noise in ether. At Fig.2 is shown dependability between signal repetition and noise. If it is associated 100mW energy with every transmition (generation), battery life will be saved with 30% by using half duplex protocol.

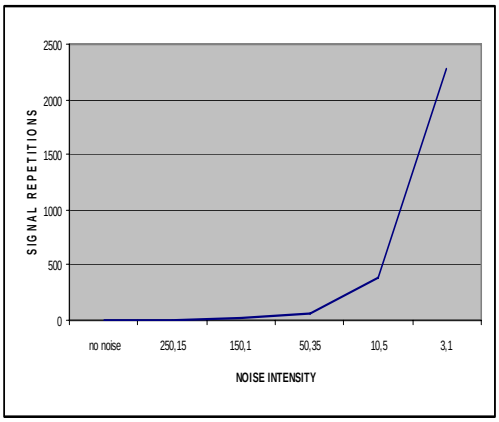

Fig.2 Dependability between noise and signal repetitions in half duplex protocol

The presented solutions are analyzed, simulated and tested using created in TU-Sofia program product “Petsym”. During verification procedure are investigated and demonstrated the following properties: safeness, boundless, liveness etc.

4. Conclusions

A comparative analysis between two security wireless protocols has been made. Second protocol saves battery life, but it makes electronic too complex. An additional receiver must be incorporated in detector, and one additional transmitter in receiver (control unit).

Half duplex link has additional advantages, as possibility to program each detector by control unit. Otherwise, installer must set every detector with DIP switch and potentiometer. Another advantage is possibility to upgrade protocol with polling by control unit.

The presented model with Time-out Petri Nets solves the problems in protocol designing. The suggested formalism gives opportunity for automatization. This formalism would be used to simplify the designer’s work in the new system creation.

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