Communication Switch for Seismic Active Area

V. Skorpil and P. Zednicek

Abstract - *Communication network in the field of geology, for the seismic active areas must have, given the difficulty of the environment, the advanced controlled switches, the earthquake epicentres with specific fault zones must be serviced. We propose a model of the switch, which would be for its advanced properties for an active seismic territory very suitable in this paper. Part of the research were described previously, in this contribution we focused to yet non-published conclusions. Switch suitable for the seismic active area is controlled progressively using artificial intelligence, such as neural networks or evolutionary algorithms and not classical sequential circuits. Switching is more reliable, faster and better meets the demands of the environment. Switches the main role of the processing of a received data according to the results of the processing units and the direction of these data to the relevant networks. It is important to maintain the quality of service, therefore questions of the packet delay, jitter, priority processing, etc. In the seismic areas are the services sensitive primarily to the delay, jitter, error rates and sensitive nondeterministic behaviour, for example random delay.*

Keywords – *Seismic, Network Element, Neural Network, Model, Simulation*

1. INTRODUCTION

A network element is controlled using a neural network and is described in [1] and [3]. The initial idea comes from [2]. We can see it in Fig 1, taken from [1] and [3]. Part of the research have been described previously in this contribution we have new, yet non-published conclusions. The earthquake epicentre with specific fault zones are studied [5]. The entry queues are divided into as many parts as there are outputs (two here) and for each packet is given its priorities. The highest priority is 10 (VoIP) and the lowest 1 (FTP). Packets without information have zero priorities. From the priorities of packets that will be switched as the

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first and the priorities of the vector is created. The neural network recalculates this priority vector and vector configuration, which then controls the switching area. The elements of the configuration of a vector are either one (he) or zero (off) [2]. When we test the functionality of the network in the Hopfield Neural Network Toolbox, it is necessary to set a fixed number of recurrences, after which the calculation stops. The test function contains an algorithm for finding the smallest number of recurrences.
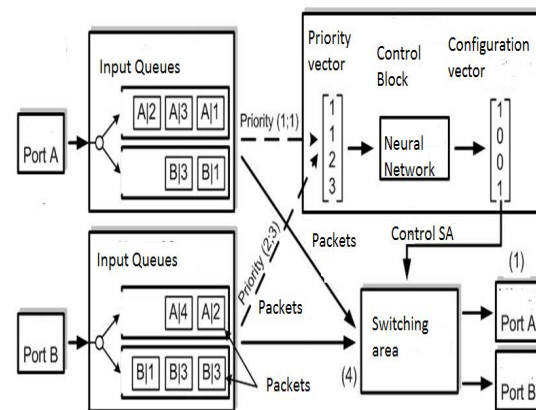

Fig 1 Network element

The classic methods of processing may be based on one of the Central Evaluation Unit, the speed depends on the speed and effectiveness of the unit. Such a solution becomes ineffective with increasing bit rate, because extending the period of processing one data unit. Possible way is to use a parallel sorting of these units. Unfortunately, this solution does not provide a significant increase in efficiency, so important in the seismic areas [7]. The reason for this is the problem of control, synchronization and collaboration of all of these units. There is, therefore, the question of how to solve this problem. The answer may be artificial neural networks, which have the character of simple functional systems with extended memory. Neural networks can solve complex parallel tasks with greater efficiency than the classical sequential method [8]. By linking a large number of small and simple elementary blocks involved in specific architecture can achieve interesting results [2] [4].

All the blocks of network element are in Fig. 1. Some have been described in [1] [3], the rest are dedicated to this paper.

2 INPUT QUEUES

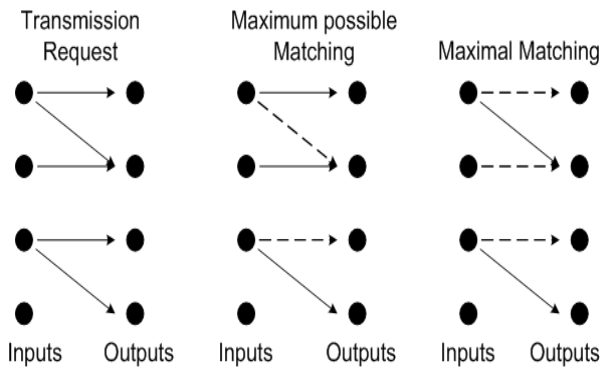An Input queues are shown in Fig. 2.

Fig.2 The input queues

This is the memory type VOQ (Virtual Output Queuning), although the involvement of fulfilling the function of the input buffers. They can be understood and implemented as a FIFO queue. Their principle is that an allocation of memory for each input port on the virtual queues, with N, where N is the number of ports, and each queue contains only data that is specified for the port. You can implement a queue for each priority class. In our case, the total number of queues will be always the quadrate number of ports. In Fig. 1 are displayed in the queues for packets whose formal registration is in the form [Y Z|] ", where Y is the direction of the packet. For a simpler proposal is intended to only the number of the output port. The value of is the priority of the packet. In practice, priority may be obtained in different ways. For example, from the destination port field or the TOS header of TCP protocol [9]. It may also be included in the frameworks of higher protocols, which wraps the data into their frames, or just swept along with the packet as a separate item. The second option is used in this work. VOQ is further divided into two groups. Maximum possible matching-links the largest possible number of input and output ports. In the basic build can link to only one input, one output. Maximal matching-the result is a situation in which other possible assignment is no longer possible to add an existing assignment without modification. Maximum possible and maximal matching on Figure 2. Maximum matching assigns to three paths. VOQ queue for each port are compared to one separate queue for one port from an advantage in the Suppression of the blocking queue. In Fig. 3 shows the case block. Output port 3 it he occupied by packet from the first input port. Packets in the queue the fourth input port must wait until the next cycle, even if the port is free and it could link to 4 port. A similar situation can occur even in the case of the blocking of the coupling of the field [11].
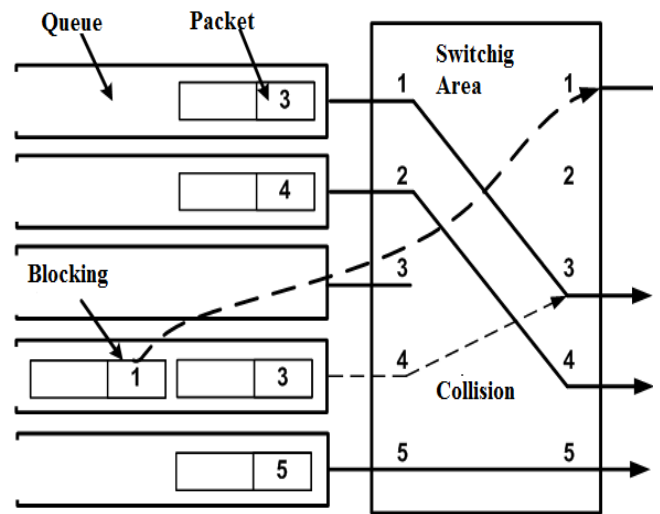

Fig.3 Sample of blocking queue. A packet with a request to port 1 is blocked.

3 CONTROL BLOCK

The role of a control member is free to choose the queue from which the packet will be switched to the output port. The input queue, provide a priority value for packets. Which are in a given time in the queues as first. Of these values shall be drawn up. priority vector, which is the entry for the network of neuronal control [12]. The output of these blocks is the configuration vector. We can fix the terms port and entry. In connection with the managing member and neural networks is always understood to mean the one with the term port I/O path and entry input path neural networks.

4 SWITCHING AREA

A switching area provides the physical connection and the transfer of packets between the input and output. The link is controlled by the configuration of the vector. There are several types of connecting fields, we'll only deal with the one-way field [13]. For one-way field is characterised by a single path between the link just one entry and exit. For a router with four ports can be a maximum of four independent links. One of the most popular areas is the switch crossbar switching. Number of switching nodes is equal to the N^2, where N is the number of ports. It is shown on Fig. 4.
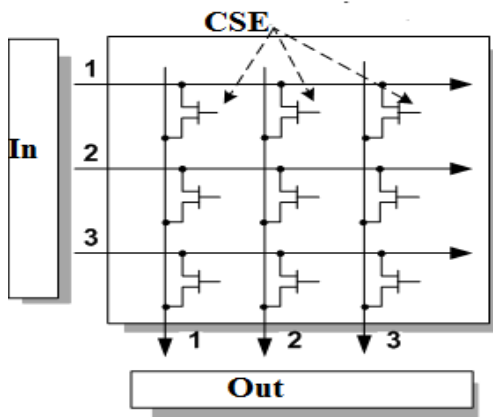
Fig.4 Switching Area – CrossBar Switch
CSE – Control and Switching Element

The connection between the input port (i) and output port (j) is an indication of the switching element (i, j) in the connection state. Placing to the connection state of the element for each switch element can be run automatically by the advent of the cell with the corresponding address of output. This process can take place entirely independently of the other cells. Using this solution for the control of coupling field is considerably simplified the problem and the connecting field becomes self-routing, i.e.. control functions are distributed between the switching elements [2]. The advantage and the reason for the election of this structure is that there is no internal locking, structure is simple and works on the high frequency switching is easy and the modularity of the possibility of parallel sorting multiple fields.

The duration of the calculation of the configuration of the vector
In MATLAB [6], [10] , the process time can be measured by using the tic and toc. Functions work at a lower application level and the resulting values are counted and the time when processor solve other tasks than ours. This fact is revealed as the high peak time of the collision, which is fine, e.g.. average or restrictions [14]. The function stores the start time for the tuples of the process. After the end of the function calculates the neural network and vector configuration function returns the toc equation of time

$$t = tact - tic \qquad (1)$$

where tact is the current time. The resulting time gets the arithmetic average of all the measured values. The measured value is taken as relative, and may serve only as evaluative dependencies between them.
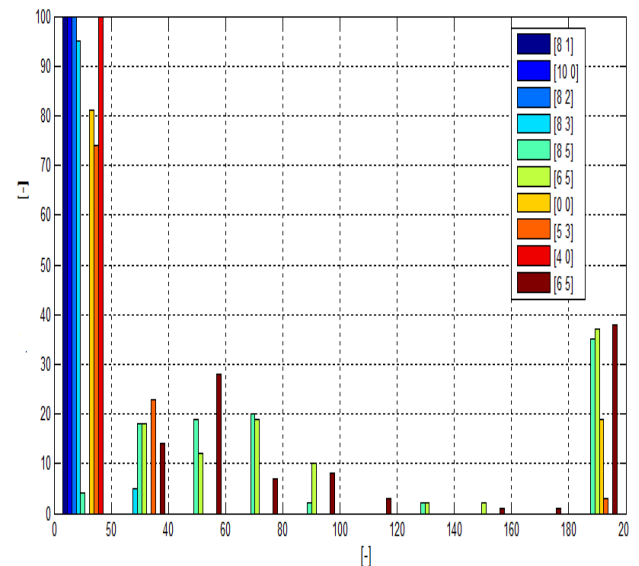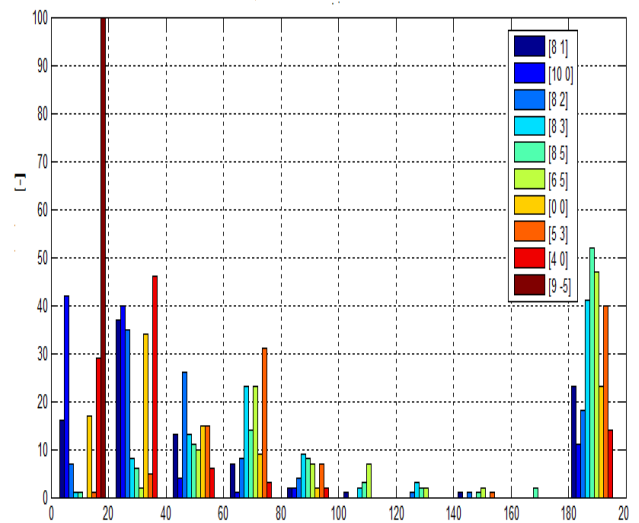

Fig.5 The Hopfield Network Histogram

Fig. 5 shows two histograms, both show the number of the occurrence of recurrences in each of the vector test set. They show the number of recurrences for a network of 7 ports and the maximum number of recurrences 200. The colour indicates the individual test distribution.
Test vector sets are separated by different colour. The top chart shows the layout for the network, which has been tested with bipolar (hop) format for entry of priority vectors [15]. The bottom chart shows the testing with the unipolar (som) format of input data. Ideal result is a situation in which the entire set of test vectors would be included in the area from 0 to 50 recurrence. It is apparent that the more this definition corresponds to the bottom of the chart, and thus the network is the best coach gate bipolar values and test unipolar. Very similar to the layout of the histogram

was even in the event of error and time depending of the configuration of the vector.

If the network of trains with unipolar values are the results of the simulations very bad. In finding suitable sites for this job we tested also other types of neural networks. Tested the network with radial networks were base functions and multi-layer network. We have noted that both types of networks are not suited for the solution of our job. The reason is insufficient, and in the framework of the technical options for the troubled Assembly trained sets and training of the network. The result was a large amount of error in the configuration of vectors.

5 EXPORT OF NEURAL NETWORKS INTO SIMULINK

This part of the work does not allow direct training and the creation of neural networks, though in Simulink can be of elementary blocks provide a neuronal network. Here is the fact that we will use the trained network of theoretical part, which are only disable to Simulink [16]. The fastest way to create a block from the MATLAB neural networks is to use the gensim subroutine library NNT (Neural Network Toolbox). The command to create a model is:

gensim (name of neural networks in MATLAB).

Fig. 6 shows the generated network, using the function gensim. Fig. A shows the block of the Hopfield network) and Fig. B) SOM (Self-organizing Map) neural networks. Thus the generated models of networks should be subsequently edit, and delete the parts that are unnecessary. In the case of the Hopfield network is necessary to open the block of Neural Network and cut block Layer 1. The remains of the circuit is feedback and output circuit. The generated model network SOM (also true for the perceptron network) is enough to delete only the input and output circuits.
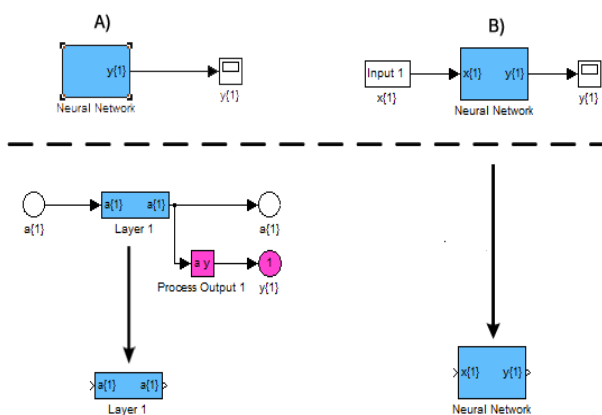

Fig. 6 Example of the generated models
A) Hopfield neural network)
B) SOM neural network

6 CROSSBAR

This entire block is written as a function, so in itself does not contain any of the other blocks (Fig. 7). The name of the function that takes care of the operation is Crossbar and takes a parameter of the number of ports. The minimum number of ports is 3. Block amended numbers of ports dynamically, depending on the number of ports. The first input port is the control port, where comes the configuration model. From this section of the configuration of the model first and converted all of the Quartet, as in the vector section of the configuration of the converter. Well-known port numbers, create a link between the input and output.
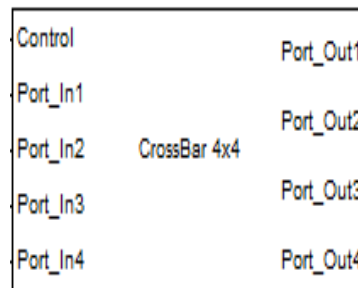

Fig. 7 CrossBar Block

7 THE EVALUATION OF MEASURED DATA

All data shall be entered into the variables in the Matlab Workspace [10]. The names of the variables for the outputs of the coupling fields are port_outX, where X is the port number. The input stream can be recorded in the variable port_inX. For the purposes of the evaluation of the application was written by m. interpreter (interpreter .fig), which displays basic information about the service [17]. This application will start after the double click of the buttons Show Statistic. This is a graphical menu, after selecting input variables and election data and evaluate the measured dependency report and results.

Available depending
Packets received — the number of the selected variables summed up all the pacts, which come complete and that have the same destination address as selected output port. The packets in an inbound port.
Wrong packets received – in the selected variables are summed to packets that have been incorrectly sended to a port with a different address.
Packets sent-the function finds and adds in all the stored data flows, packets that have the same destination port number X as the chosen variable. Displays results separately for each port. These results include both packets that have already reached the target, so the packets, which remained in the input queues.
Jitter-size of jitter gives the delay of the incoming packets. For each priority class, which came to an output port X, it is displayed in the chart, a separate dependency. Furthermore,

it is displayed in the eye of the decision, with the average jitter of each priority group.

Delay — specifies the difference between outbound and inbound packet in time. as with the jitter chart is displayed with a delay of the individual priority classes and is calculated using the average delay of each priority class.

All of the above dependencies are automatically sent to the Matlab Workspace, where you can continue to work with them.

8 LIBRARY BLOCK

The involvement of the whole model was created, the [1], [3] and was created by the library of all of the above blocks. The basic breakdown is in Fig 8 -library functions, and blocks divided into categories.
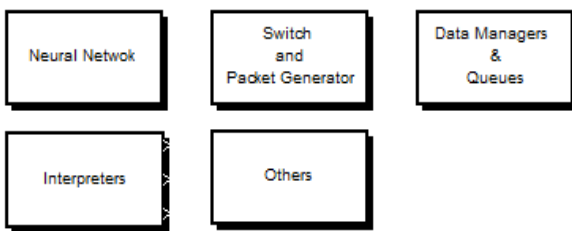

Fig. 8 Library functions and blocks

9 MEASUREMENT METHODOLOGY

Simulink is working on a different principle than MATLAB [6], [10], in which the real time calculation of the configuration of the vector neuronal networks depends on the complexity and performance of the processor unit. By contrast, blocks in Simulink are governed using the sample time. If the block does not contain the delay members, it cannot be measured in Simulink real speed. In the model used is the Hopfield network which, thanks to its recurrence needs to calculate the number of samples. The other networks would be under the same conditions to calculate only one sample, which does not correspond to reality. To calculate the size of the delay is not simple, and will always be compared with the Hopfield network inaccurate. The reason is that we need to include in the calculation of the result of a number of recurrence network, which was taken from a small set of priority vectors. The value of the delay therefore does not have the sense of a complicated control and better estimate of the results is in the theoretical part [1], [2] [3]. If we thought of Hopfield network, a solution would be relatively trivial, because the other networks have a constant period of calculation, which can be easily and accurately calculate an overdue. Table 1 contains recommended values of the delays for other network depending on the Hopfield network.

Ports	2	3	4	5	6	7
Hopfield max recurrences	6	8	15	20	30	50
SOM	9	9	10	10	13	-
SOM optimal	18	19	20	20	23	-
Serial computing	3	3	3	3	3	4

Tab. 1 Conversion table length of the delay for each neural network
Hop-Hopfield, SOM-Self-organizing Maps

Testing was done with this setting of the packet generator. The length of the simulation is 2000 samples. Block Packet Recorder we set the mode to save to the Workspace and we generate and store the data flows from the individual ports. Gradually we'll insert individual control blocks of neural networks, and we will evaluate the impact on communications. Compare the results between the ports of all algorithms. Furthermore we test two of the group setting the size of the delay and the number of recurrences. Setting up a packet generator for ports port-in1, 2, 3, 4 response to Tab 2.

Port	Service	Priority	Target	Interval	Source	Fill up
1	1	10	3	[5,10]	1	10
	2	5	[2,3]	[8,10]	1	5
	3	5	4	30	1	5
	4	1	[1,3]	1	1	1
2	1	10	1	[5,10]	2	10
	2	8	4	[10,15]	2	8
	3	3	3	12	2	3
3	1	1	2	[5,10]	3	10
	2	4	[1,3]	[10,15]	3	4
	3	5	2	12	3	10
	4	6	4	[5,30]	3	6
4	1	10	[1,2]	[10,15]	4	10
	2	9	[1,2]	[9,20]	4	9

Tab 2 Setting a Packet Generator for ports port_in 1, 2, 3, 4. Size 9.

The demand for ever higher capacity communication networks by using different types of communication services, particularly demanding video-conferencing

applications, data and multimedia services and network control leads to the problem of how these services on the active node routing elements to process efficiently. Each of the above services to the needs of the specific characteristics of the transmission. Particularly in audio-visual services in real time, such as VoIP or streaming video or audio puts high demands on active network elements, which must provide sufficient bandwidth, quality of connection and determine the correct routing. All of this, even to a greater extent for the area of geology, where we've been studying seismic waves, earthquakes and other events which require the robust systems.

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V. Skorpil (WSEAS 2002)

 He was born in Brno, Czech Republic, 1955. He attended the Brno University of Technology (BUT) for university education in 1980 and369.D. in 1989. From 1980 to 1982 he worked as a designer for the telecommunication design office. He again entered the Department of Telecommunications of BUT in 1982 as a university teacher and he has been working in this department since that time, now he is a vice-head of this department. He takes a keen interest in modern telecommunication systems. He has taught in courses on transmission systems from analogue through all categories of digital up to special applications. He is the author of about 103 international scientific   papers and some manuals. He has complemented his theoretical knowledge by co-operation with a lot of firms and institutions. He has co-operated on telecommunication projects such as digital transmission and switching systems, telecommunication broadband networks, data networks LAN and MAN, on structured cabling design, neural networks, wavelet transform, Quality of Service, data bit rate compression, etc. Assoc. Prof. Ing. Vladislav ŠKORPIL, Ph.D. He is a member of international organisations IEEE and WSEAS.

P. Zednicek

He was a student at Brno University of Technology. He is interesting about network elements controlled by artificial neural networks. His degree is a master. Ing. Petr Zednicek.