SPECIFICATION OF NEIGHBOR DETECTION PROTOCOL: A SIMULATION APPROACH FOR CPN

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Abstract

Wireless devices in MANET (Mobile Ad Hoc Network) go freely while left over accessible to each other. With flat topology group, a connectivity intercellular substance may be give to describe the connectivity among the devices. Conversely, for MANET the making of connectivity intercellular substance, wherever the regular updating is needed to reproduce the modify in the network topology, is really unmanageable. The nodes enable by proposing the Neighbor Detection Protocol to discover the 1-hop neighbors in the network. The protocol is framework by using CPN tools and validated through model. In this Paper, a NDP has been projected that active the devices to locate their 1-hop neighbors in the network. The protocol is framework with the familiar CPN tools with justify during imitation.

Keywords*: CPNs, Network Topology, MANET*

1.1 Introduction

Through the beginning in radio communication and decrease in cost of individual communiqué nodes, the internet services have get to each place of the global. The need of minute networking services has been extremely growth within the region of learning, amusement, business centre and urgent situation services. Ad hoc network assembles these strains rapidly and economically because it does not require some time for its exploitation. In the multihop network data communication is likely by furtherance the packets during immediate neighbors. Therefore, degree of connectivity along with the nodes plays a major function in packet furtherance in the network. In the network device mobility change their location and so as change the connectivity to their neighbors.

1.2 CPN Tool

1.2.1- Petri Nets

Presentation is frequently an essential matter in the innovation, developing and pattern of systems. It is not forever sufficient to be familiar with that system effort accurately; they should also work in effect. There are several surveys, e.g. in the field of computer and telecommunication systems, manufacturing, military, health care and transportation that have revealed that time, money and still lives can be preserve if the functioning of a system is enhanced. Functioning analytic survey are conducted to assess existent or proposed system, to equate substitute confirmation or to locate an optimum conformation of a system. We propose the three methods for analyzing the system functioning fist one is simulation models and second and third one is respectively analytical models and measurements.

Simulation based investigation of industrial-sized system done by using of CPN.Use of the CPN mainly large complex system modeling and analyzing for few reasons: to facilitate the setup

hierarchical models: they have an perceptive in writing illustration; they are workable; it is probable to model that used by dissimilar behavior in a structure; grown-up and time tested tools subsist for make imitation, and examine colored Petri net models. [CPN TOOL 10]

CPN is a modeling instrument that aggregates the potency of Petri Nets of through the intensity of proper modeling language. Petri Nets are too known as Placed Transition nets wherever a set of positions and transition create obtainable the primitive for identify synchronization of simultaneous action. The prescribed modeling Language (ML) allows the essential for explanation of character varying and exploitation of their character values.

As the engineering point of view, it is first check and then confirms the attributes of the system to abolish some probable plan misplay previous to the tangible execution or exploitation system happen. CPN tools also known as Colored Petri nets that make available a in writing atmosphere to editing and imitate any planned structure to investigate it for necessary stream of the operation. CPN is a prescribed way which is appropriate for molding study compound structure where picking order be able to formed, assess data can be incorporated and multipart data preserve managed with using simple tokens [1]. Modeling a system using colored Petri nets is useful in which communication, synchronization and resource sharing plays vital role. This is because, CPNs supports concurrency, non-determinism and distributive which are inherent to most of the system models.

Petri Nets are hopeful for writing and arithmetical modeling tools for telling and perusing data giving out systems. The conception of Petri Nets occur keen on survival in the year 1962 by C.A Petri while commencing the year 1970 to 1975 working out formation set at MIT conducted several place related investigator and formed a lot of information and research on Petri Nets might be used to representation one given system that can be described diagrammatically similar to graphical representation and desires some means of on behalf of parallel or concurrent activities. [2]

Only some of the function fields comprise the communication protocols, fault-tolerant systems distinct-event systems, multiprocessor memory systems and distributed database systems.

The concept of Petri Nets might be with no trouble unstated by a reserve allocation system as shown in figure 1.1.

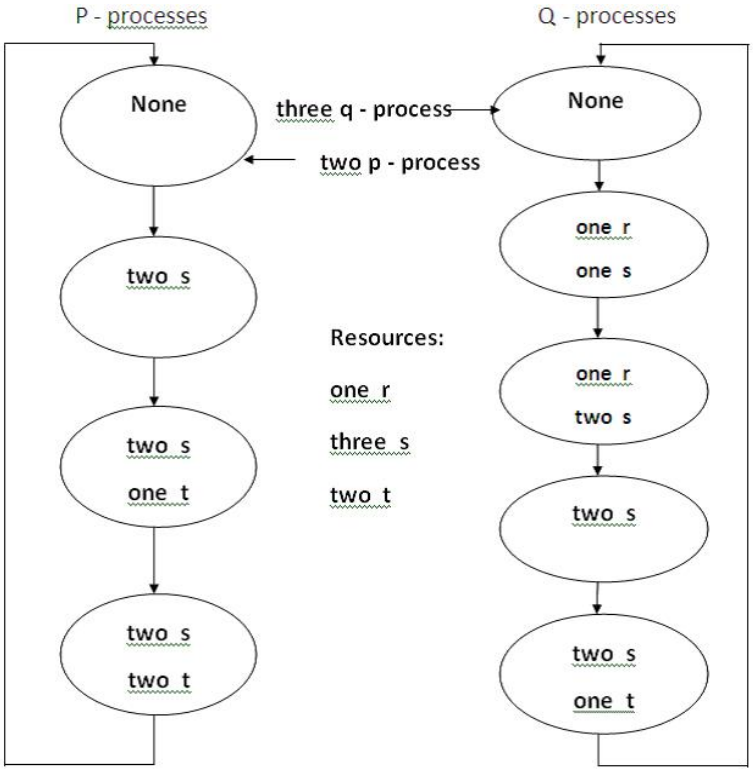

Fig 1.1: State of the processes in the Resource Allocation System

Let us assume that we have a set of physical processes which could be dissimilar set of instructions called programs and contain a set of resources which might be the amenities common by the programs. As look in the above figure we contain two set of procedure i.e. the P-Process and the Q-processes. The procedure is recurring and throughout the entity parts of its series the procedure wants to have restricted right to use to an unreliable quantity of the resources. It is shown in given figure the P-processes can be in four dissimilar states. In the same way the Q-Process has five dissimilar states and for each one of these states the necessary quantity of resources is precise. Overall, we have two-two P-process and Q-process as exposed by the arrow in the fig 3.1. Here it specifies the strain of the process by recounting the probable states. So, we say that it is a state-oriented system. However, the stress is able to also be explicating as act leaning as shown in figure 3.2 wherever it provides the comprehensive explanation of the likely actions [2] .

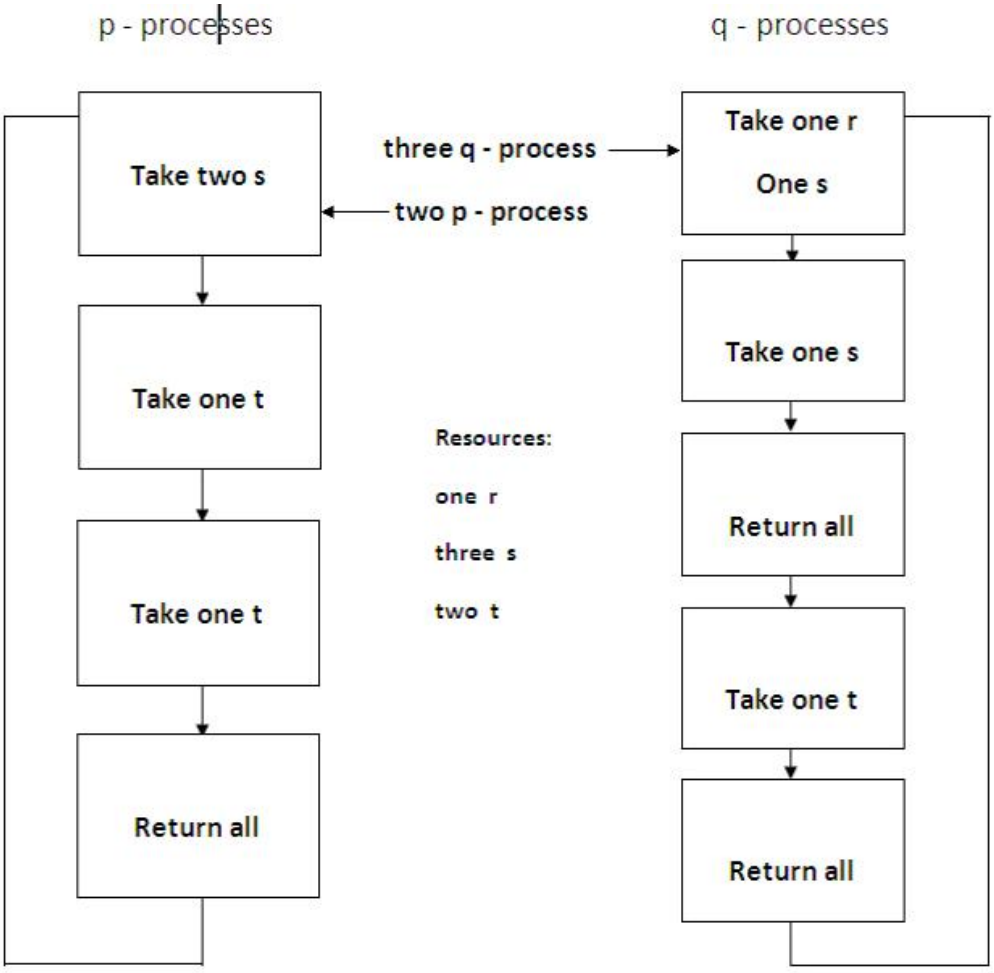

Fig 1.2: Proceeding of the Process in the Resources Allotment System [2]

In dissimilarity to the over conversation, Petri Nets stipulation of the resource allotment difficulty is together condition-oriented and achievement-oriented at the similar time. Transition is indicated by the rectangle in the process of resource allocation system and the circle indicate the place in the resource allotment system.

A Simple Petri Nets framework is revealed in the fig 1.3 [3] position and transition are linked by arrows or arcs. Arcs specify stream from the point to transition or from transition to the point.

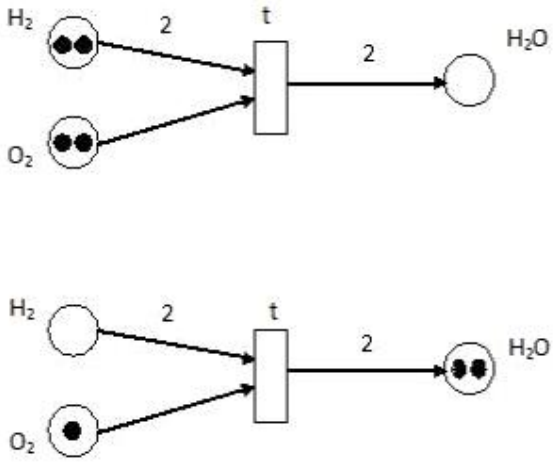

Fig 1.3: Sample Petri Nets model [3]

From time to time the arcs are tagged with a optimistic (positive) integer called the heaviness of that exacting arc For example, a k-weighted arc can be interpreted as the set of k parallel arcs. The initial state of a Petri Net graph is called the initial marking M0. A marking assigns to each place a non-negative integer called the token or resource of the place. If t tokens are assigned to a place, then it is marked with t number of black dots inside it in the graphical representation. In a Petri Net model, the transition that represents the action of a system can have certain number of input and output places representing the pre-condition and post-condition of the action. An action can occur or a transition can fire [3]:

- Weight of arc beginning p to t is w (p, t), all the input position p of changeover t is denoted with at smallest amount w (p, t) tokens.
- If every input position p of changeover t is noticeable with at smallest amount w (p, t) tokens, wherever w (p, t) is the heaviness of the arc beginning p to t. A passionate change t move out w(p,t) tokens as of all input position P of t and adds w(t, p) token to every output position P of t, where w(t, P) is the mass of arc beginning t to P.
- Look on whether or not the happening really takes place, the transition may well or may not fire.

A changeover with no one input position is known as a source changeover and one with no one output position is known as a sink changeover. A source conversion is categorically enabled, and the dismissal of a sink conversion ingests tokens but do not create one. In diagram 3.3 the model symbolizes the well-recognized chemical reaction: 2H2 + O2 → 2H2O. More than one token in each input place illustrate that two units of H2 and O2 are obtainable, and the conversion t is enabled. After dismissal t, the condition that occurs is revealed in fig 3.3, wherever the conversion t is no longer enabled. Subsequent to attractive 2 tokens beginning the H2 position, it is missing without additional tokens through in it. Wherever as the position O2 is missing through single token as the happening of conversion withdraw single one token from it. The dedication on the arc designates the numeral of tokens to facilitate be able to pass during it .

Nevertheless, the restrictions by the customary Petri nets are that, it does not sustain to plan big compound framework wherever modular arrangement is necessary. In the same way, the information types handled by the representation are very incomplete for which the framework go without need large yet although modeling minute system. Moreover, it is not probable to engage the

time conception did not addict to it nor does it carry to verify for the accessibility of zero tokens in a position. Each one these restrictions led to the plan of elevated Petri nets known as the CPNs.

1.2.2 Colored Petri Nets

Colored Petri Nets [4] offer an outline effort for the creation and examination of dispersed and simultaneous systems [5]. A CPN tool identifies the position that are system might get and the probable conversion in connecting them. The potency of CPNs over customary Petri Nets is that, it reinforcement chain of command, color and time in the model.

Chain of command in the CPNs indicates that the model can be prearranged into number of associated tools. This perception is based on the concept of hierarchical structuring of the programming language that support the bottom-up or top down style. Module formed can be reprocessing in various parts of CPN tool and further sub-module can be formed from it. The Part of the CPNs is called pages. A multifaceted representation can have as many as hundreds of pages comparable to an extended and multifaceted program that is divided into several modules. In Hierarchical CPNs, a conversion and its connected components make a link to other CPNs given that a more accurate and detailed explanation of the movement is represented by the conversion. Such transitions are called the substitution transitions. The hierarchical dedication in the substitution conversion defines the facts of the substitution in disconnect modules called the sub-pages. The position in a subpage are noticeable with an enter tag-in-tag, output tag or input/output tag. These positions are called the port position. They comprise the crossing point throughout which is the subpage communicates with its surroundings. Fig 3.4 shows a port position, where the position is assigned with Input/output-tag. The subpage gets tokens from its surroundings through the input port".

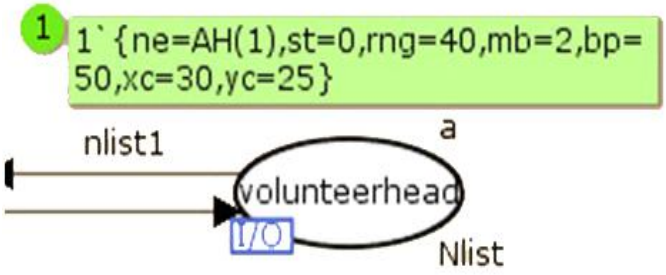

Fig 1.4: Section Position in CPN

"It presents tokens to its surrounding through the output ports and the Input/output port announcement to its environment both ways. The positions connected with a replacement conversion are called the socket position. The Port position of the subpages are linked to the socket position of the replacement conversion by given that the port assignments. When a port position is assigned to the socket position, the two positions become identical. The port and socket position are two different representations of a single conceptual position i.e. the port and the socket have for all time the same markings. While an enter socket obtain a token from the environment of the replacement conversion that tokens also becomes accessible at the input port of the sub-page and therefore the token can be used by the conversion on the subpage. Similarly, the subpage may generate token on an output port. Such tokens are also accessible at the matching output socket and hence they can be used by the surrounding of the replacement conversion".

Other thought of hierarchical CPNs is the fusion position fig 3.5.This designates that a number of entity drained position can be measured to be similar i.e. they all symbolize a single intangible position.

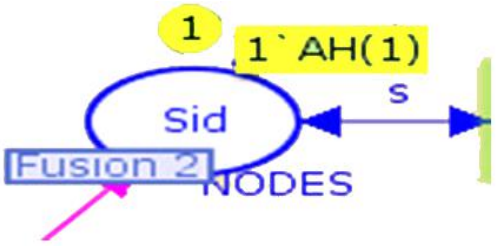

Figure 1.5: Fusion position in CPN

In the fusion set matching token will added and remove from all position but single token will be added or remove from one of the positions. Relationship between two positions which are allotted to each other with a port assignment is alike to association among elements of fusion set. A single page contains the all the member of merger that page only one-page instance, to avoid too crossing arc in the structure fusion set nothing more than a drawing convenience. In the difficult and motivating condition, the member of fusion set is fit into numerous dissimilar subpages or the page that has numerous page instances. Fusion set, sheet fusion set, illustration fusion set are the different type of worldwide fusion set. Page and illustrate fusion only accessed the member from single page whereas worldwide merger set preserve has members from many pages.

Colors-Position in the CPNs is associates to find out the type of data it may handle. Types in the programming language are similar to the types of the position. Records can be complex type it may contain the different type data value.

colset No =int”

Whereas “=int” show that this colset have essential numerals as token and color set no is declare by the keyboard “colset”. Every token convey a value that go to the type of the position on which tokens resides. The tokens there on an exacting position indicate the grading of that position. The preliminary condition of a position is defined as the preliminary making of it. It is generally on paper in the higher left or right side of the position as given away in fig 1.4 and fig 1.5.

Thought of time into the Color Petri Nets is redefines as timed Color Petri Nets. This encloses Time conception into CPNs is redefines as timed CPNs. This preface the conception of worldwide timer. The timer worth whichever is either distinct or unbroken corresponds to the framework time. In the Times CPNs, each token convey a time value known the time stamp. [5]

The grading of a position wherever the tokens convey a time stamp become a timed multi-set assign the members in the multi-set collectively with their numeral of visual aspect and their time stamp. The timed color set are declared as:

“Colset No =int timed”;

And the probable grading of a position by way of timed indication is as:

2’ (1 “colour”) @ [19, 45]

Here designate the marking contains two indications (token) by value (1, “colour”) and time stamp 19 and 45 consequently the @ sign can be study as “at” and the sign [ ] is used to denote the time stamp.

1.2.3-In MANET Modernistic on CPNs

It was already proved that the CPN is knocking-down in the imitation and examine non-deterministic, suitability, dissimilar layer of generalization of any communiqué set of rules. Zhou et al. have proven the potency of CPN for imitating and analyzing TCP protocol [6]. Advance to enhanced the TCP presentation more than MANET Xiong et al. [Xiong, Yim, Leigh and Murata] have planned a responsive access TCP-MEOX to identify the cases of packet loss.

As movement of nodes is the big confront in mobile ad hoc network the one-shot trip time is interchange through a regular transmission interruption for representing overcrowding. The author declares that the TCP-MEDX method is capable to identify small package loss much precisely Xiong et al. have produced a formed Color Petri Net (CPN) tool of the very well identified routing set of rules for mobile ad hoc network the AODV to analyze its precision in examine [7]. To meet confront of enthusiasm of the devices the writers have projected a TA mechanism. The Topology Approximation method works with assured statement. They are

- Everyone device in the MANET has the same broadcast range.
- In MANET every node has the similar numeral of neighbors which is the same to normal amount of the MANET chart.

Now the second statement is not a practical feeler. Since in Mobile Ad Hoc Network the device motility regularly modifies the level of connectivity between the devices and also the network topology. In such a non-deterministic situation the method of topology estimate might not be achievable.

Advance the actively process of MANET using Color Petri Net tools are illustrated by Yaun et al. in [3][8]. The writers have modeled the long familiar Mobile ad Hoc Network routing protocol named DSDV whichever is practical with opinion. The Color Petri Nets (CPNs) tools are used by the writers for the graceful and easy modeling of protocol with no using any hypothesis or estimate. With using the prescribed measurement and confirmation technique of modeling tool the writer might be capable to locate the errors accessible in the protocol and recommend the amendment to get rid of those mistakes.

1.3 The Planned Neighbor Detection Protocol

“Mobile ad hoc network can be modeled as unidirectional graph G=(V,L) where V is a finite set of nodes and L is a finite set of links that exist between the nodes .We assume that there exists a bidirectional link Lij between the node i and j when the distance between the nodes dij<trange (Transmission range) of the nodes .In the dynamic network the cardinality of the nodes |V| remains constant but the cardinality of links |L| changes due to the mobility of the nodes .Each node v€V is uniquely identified by an Integer Identifier ID along with a wireless transmission range Vtrange. When a node v1 is within the transmission range of v2 it is assumed to be connected by unidirectional link l12 €L such that whenever v1 broadcasts a message it is received by v2 via l12. Similarly when v2 is within the transmission range of v1 range it is assumed to be connected by an unidirectional link l21€L such that whenever v2 broadcasts a message it is received by v1 via L21. Thus we say there exists a bidirectional link between v1 and v2. The graph representing the ad hoc network is assumed to be a simple graph. That is an un-weighted, un-directed graph containing no self-loops or no parallel links (when their ends points are same).

In the Ad Hoc network a mechanism is used to detect the 1-hop neighbours of the devices which provided by the designed Neighbours Detection Protocol. At this time a special packet used by the nodes is called NDPAK to appreciate neighbours.

As a device u desires recognize the concerning accessible neighbors and it broadcast Neighbors Detection Packet. The senders designate it as a Neighbors Request type Packet and keep Receiver Identification field the same as X. The nodes that are inside the communication range of the transmitter u pick up the packet and transmit reverse acknowledgment packet has kind of small package as Neighbour acknowledgment and create a unicast broadcast and to the sources. Therefore, the Request Identifier field comprises the classification number of the font node that initially sent the Neighbors Detection Packet request. The WT region is a positive digit i.e. deliberate with allowing for few node arguments to identify its ability to be preferred as a group head. The STATUS part of the device shows its present node in the network. In the present effort it is understood that the node can have either position of group head or group member or an

undetermined condition. In the beginning the position of all nodes is undetermined inside a STATUS value of 0 previous to the cluster is really shaped. Consequently, as the device is preferred as cluster head or cluster member this field is filled with suitable value. The method of the NDP is as keep.

Step I: device u broadcast the NDPAK to the network

STATUS	RTR/STR	RID	SID	NAC/NRQ	WT

Where the subject field of the packet are given below:

STATUS: Position of packet sending node
2: Cluster Head
1: Cluster Constituent
0: Exposed (Uncover)

RTR: Receiver Transmission Range
SRT: Source transmission
RID: Receiver Identification
SID: Source Identification
X: Each node (Used by the broadcast message)
NUM: identifier NUM Node (useful in unicast message)

WT: Weight of the packet sending node
NRQ/NAC: NRQ: Neighbors Request Packet
NAC: Neighbors Acknowledgement

Step II: Node v received a packet which is also belong to the range of. Other node u receives a NAC Packet along with all information similar to ID, scope, status and mass of packet.

Step III: Node u update its NTAB (Neighbours Table) by adding v as its instant neighbours beside with its data, after getting the acknowledgement NAC packet from the node v.

Step IV: Node v update its own Neighbours Table and bidirectional link is fixed among nodes when node u sends back a Neighbors Confirmation Message. Set of rules can be making a clear in the given below fig 3.6 it comprises of five hubs.

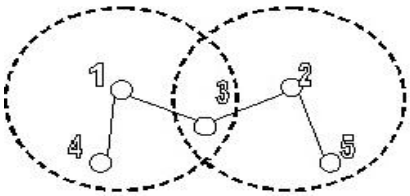

Fig 1.6-Geometric configuration of Protocol

In the Network topology dotted circle indicate the transmission range for the node 1 and 2.In this configuration integer number from 1 to 5 recognized the node. It is clear from the fig. that hub 3 is in the range of transmission together with the hub 1 and 2 while small circle 4 and 5 are completely in the range of hub 1 and 2 correspondingly. The node 1 sent NDPAK comprise of following value.

0	1_{RANGE}	X	1	NRQ	WT(1)

Now 1_{Range} in the STR part representing the communication scop of hub 1 and the value 0 in the STATUS part represent to the condition of the device 1 is not so far determined. The hub 3 and 4 receive the packet and they sent back NAC packet to hub 1 as Ack. to NDPAK. Acknowledgement Packet contents sent back by device 3 to device 1 can be scripted as:

0	3_{RANGE}	3	1	WT(3)	NAC

For the protocol revealed in fig 3.6 where the device 1 and 2 send the NRQ packet to node 3 and it sent back NAC packet consequently together senders and turn into the neighbors of the both.

The reaching of NAC packet intimates the sender regarding the existence of its 1-hop neighbours, and it modify its have NTAB. NTAB may be written as:

NS	DIS	NID	NTR	NWT

Specification of field is given below as:

NS : Neighbors Status
DIS : Neighbors Distance
NID : Neighbors ID
NTR : Neighbors Transmission Range
NWT : Neighbors Weight

The neighbor distance DIST can be considered from signal strength of the received signal [9]. On the other hand, for the present effort the devices are pretended to be ready with Global Position System (GPS) that gives the place data of nodes. Thus, here are the Euclidian distance among two devices is measured as exact length between the two devices. While an Acknowledgement Packet is received by the source device, it modifies its NTAB and sends an NC message to verify its connectivity by the later so that a two-way link recognized between both of them.

1.4 Substantiation of Neighbors Detection Protocol by Colored Petri Nets

Into this part we will focused on justification of NDP (Neighbors Detection Protocol) using Colored Petri Nets (CPN) tools. The substantiation during imitation is going through with six points called hubs in the network. As long as the intention of substantiation the hubs are considered to be non-mobile throughout the implementation of the protocol. The upper stage of CPN model for the Neighbors Detection Protocol is revealed in the fig. 3.7. This model interprets a conceptual view of whole NDP. The replacement transition NODE 1 TO NODE 6 has their mine subpages related with it.

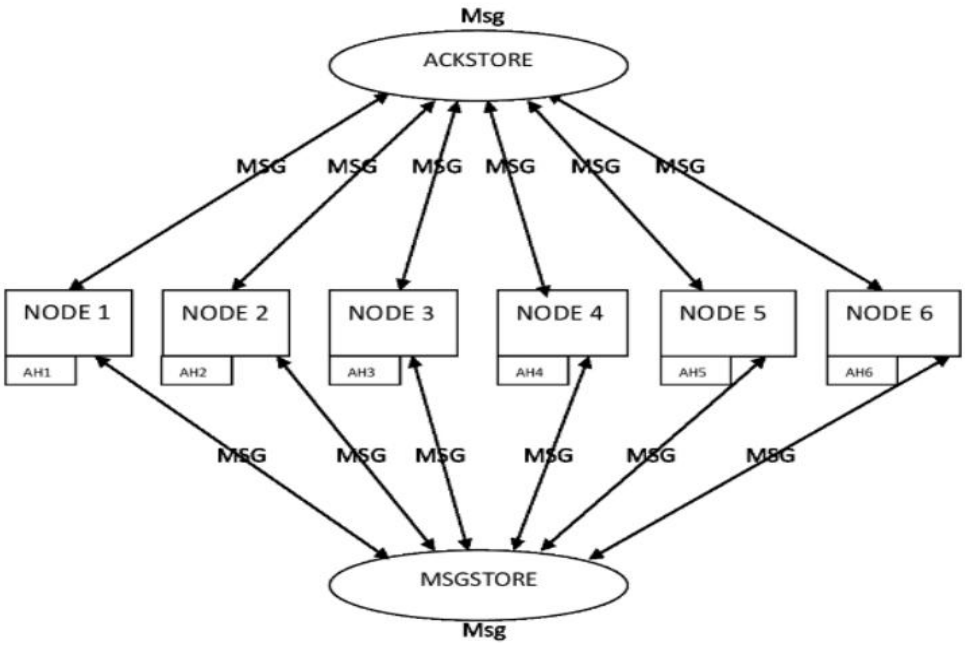

Fig 1.7: Top Level of Design

Two positions are retaining general for all the devices in the form. They have two types of places first for store message is MSGSTORE and second for Acknowledgement store is ACKSTORE. The MSGSTORE position contains the message transmitted by all the devices in it. Likewise, the entire acknowledgement transmitted by all the devices is stored in ACKSTORE. The MSG denoted the token type related with both the places which is record of different data types discussed later in this section. Through the bidirectional arc the nodes 1 to 6 are linked to the

positions. This refers that a device can store with retrieve its message from the places. The lettering connected with the arcs indicates the types of token it can pass through it. They are written in the CPN ML programming language.

1.5 Conclusion

In this section a conclusion of the paper has been explained. This section concludes the main use of CPN mock-up of NDP give new insights and opinion into the pattern of the structure. Furthermore, numerous intend troubles and fault can be revealed and concluded in the study and innovation segment kind of than completion or consumption phase. CPN tool investigate the system to validate that it has been considered correctly to meet the preferred properties and help in the enhanced understanding of the desired system. The analysis of existing work on the MANET using CPN tools has allow the inspiration to propose the needful protocol for the present effort and assert its operations using CPNs tools to make sure it accuracy earlier than execution. The validation of NDP start from the first grading of design M0 to reach its last grading wherever all the hub simplified with its one-hop neighbors in NTAB. The imitation of results ensures that a node able to detect its 1-hop neighbors in the network and setup a two-way connectivity by them with mutual replace of acknowledgement message and neighbors request.

References

[1] Cramer, C., Stanze, O., Weniger, K., & Zitterbart, M. (2004, June). Demand-Driven Clustering in MANETs. In *International Conference on Wireless Networks* (pp. 81-87).

[2] Ramanathan, R., & Redi, J. (2002). A brief overview of ad hoc networks: challenges and directions. *IEEE communications Magazine*, *40*(5), 20-22.

[3] Rezaee, M., & Yaghmaee, M. H. (2008, August). A new clustering protocol for Mobile Ad-Hoc networks. In *Telecommunications, 2008. IST 2008. International Symposium on* (pp. 376-381). IEEE.

[4] Renu, B., & Pranavi, T. (2013, January). Routing protocols in mobile ad-hoc network: a review. In *International Conference on Heterogeneous Networking for Quality, Reliability, Security and Robustness* (pp. 52-60). Springer, Berlin,Heidelberg.

[5] Shayeb, I. G., Hussein, A. H., & Nasoura, A. B. (2011). A survey of clustering schemes for Mobile Ad-Hoc Network (MANET). *American Journal of Scientific Research*, *20*(2011), 135-151.

[6] Chen, Y.P., & Liestman, A.L. (2002, June). Approximating minimum size weaklyconnected dominating sets for clustering mobile ad hoc networks. In *Proceedings of the 3rd ACM international symposium on Mobile ad hoc networking & computing* (pp. 165-172). ACM.

[7] Sahoo, N., Callan, J., Krishnan, R., Duncan, G., & Padman, R. (2006, November). Incremental hierarchical clustering of text documents. In *Proceedings of the 15th ACM international conference on Information and knowledge management* (pp. 357-366). ACM.

[8] Perkins, C.E. (2001). Ad hoc networking: an introduction. *Ad hoc networking*, *40*,20-22.

[9] Maji, A. (2010). *Load Balancing in Wireless Mobile Ad Hoc Networks* (Doctoral Dissertation) .

[10] Diwakar, S., Singhai, R., & Thakur, N. S. Power constant-based methods for dealing with missing values in knowledge discovery, GESJ: Computer Science and Telecommunications 2012|No.4(36) (PP. 31-41).