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Survey on Clustering Schemes for Transparency Reduction in MANET

D. Gayathri[1], Dr. S. Veni[2]

[1]Research Scholar, Department of Computer Science, Karpagam Academy of Higher Education

[2]Research Supervisor, Department of Computer Science, Karpagam Academy of Higher Education

Abstract: ***Mobile ad-hoc networks (MANETs) are a form of wireless networks which do not require a base station for providing network connectivity. As MANETs have some limitations, Cluster based routing is one of the routing schemes for MANETs in which various clusters of mobile nodes are formed with each cluster having its own Cluster head which is responsible for routing among clusters. Clustering in Mobile Ad Hoc Networks (MANETs) has many advantages compared to the traditional networks. Clustering in mobile ad hoc networks plays a very important role in improving resource management and network performance (routing delay, bandwidth consumption and throughput). This paper, presents a comprehensive survey of recently proposed clustering algorithms, which we classify as: Identifier Neighbor based clustering, Topology based clustering, Mobility based clustering, Energy based clustering, and Weight based clustering. We also include clustering definition, review existing clustering approaches, evaluate their performance and cost, discuss their advantages, disadvantages, features and suggest a best clustering approach.***

Keywords: MANET, VANET, DARPA, DDCA, Clustering, Overhead reduction

1. Introduction

In a wireless connection, the mobile nodes of independent system are connected without any infrastructure, and can communicate via radio waves is called MANET [1]. Since network resource accessibility continues to change with traffic dynamics, preserving correct network state information for stipulation of acceptable service quality necessitates frequent exchange of information in the network [2]. Main features of ad hoc network:

- Decentralized
- Pre existing infrastructure is meaningless for new communication
- Each node act as a router by forwarding data to neighbor nodes
- Fast network topology does change due to nodes movement.

A Mobile Ad Hoc Network is an infrastructure less, self-organized network with hastily changing topology causing the wireless links to be broken and a new path will available. A key issue is the necessity that the Routing Protocol should be able to respond quickly to the topological changes in the network [3]. In ad-hoc networks, each node must be capable of acting as a router. Due to the availability of limited bandwidth of the nodes, the source and destination node used to communicate via intermediate nodes. The main problems in routing are Routing Overhead, Interference Asymmetric links and Dynamic Topology [4].

MANET, now a topic of commercial research, was initially used in military projects, including in tactical networks and Defense Advanced Research Projects Agency (DARPA) projects [5]. Some uses 4G network and other wireless systems as examples of a potential topology for a mobile ad-hoc network (MANET), while others refer to a (VANET) vehicular ad-hoc network, where the free network nodes are installed in cars and other vehicles [6]. The research area of MANETs has to face a lot of challenges: like limited bandwidth, dynamic topology, routing expense, hidden terminal problem, packet loss, and route change due to mobility, battery constraints and security threats.

Routing in a network is the process of selecting paths to send network traffic. Routing can be done by two ways either in a flat structure or in a hierarchical structure. Protection switching is faster than rerouting but cannot handle simultaneous faults in the active and the recovery path. On the other hand, rerouting is generally slow and cannot offer QoS guaranties upon failure, but can use resources in a more efficient way [7]. In a flat structure use all the nodes have the same role as they are in the same hierarchy level. Although this approach is beneficial for small networks as scalability is the major issue, when the number of nodes in the network is more. In large networks, the flat routing structure can create a problem in the network as it produces excessive information flow in the network [8]. Hierarchical routing protocols remove this problem by making a cluster of some of the nodes of network.

2. Clustering in Manet

The process that divides the network into interconnected substructures, called clusters [9]. Each cluster has a particular node elected as cluster head (CH) based on a specific metric or a combination of metrics such as identity, degree, mobility, weight, density, etc. The cluster head plays the role of coordinator within its substructure [10]. Each CH acts as a temporary base station within its cluster and communicates with other CHs.

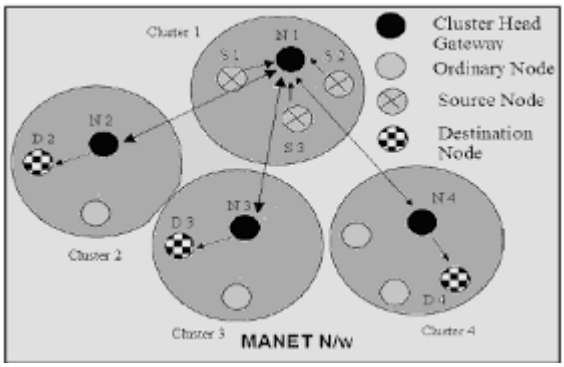

Figure 1: Mobile Ad Hoc Network

A cluster is there-fore composed of a cluster head, gateways and members node.

- *Cluster Head (CH):* it is the coordinator of the cluster.
- *Gateway:* is a common node between two or more clusters.
- *Member Node (Ordinary nodes):* is a node that is neither a CH nor gateway node.

Each node belongs exclusively to a cluster independently of its neighbors that might reside in a different cluster.

3. Clustering Approaches

- **DS-based clustering**: - Finding a (weakly) connected dominating set to reduce the number of nodes participating in route search or routing table maintenance. Ex - Connected DS, Weak CDS
- **Low-maintenance clustering**: - Providing a cluster infrastructure for upper layer applications with minimized clustering-related maintenance cost. Ex- LCC (Least Cluster Change), 3hBAC (3-hop Between Adjacent Cluster heads), PC (Passive Clustering)
- **Mobility-aware clustering**: - Utilizing mobile nodes' mobility behavior for cluster construction, maintenance and assigning mobile nodes with low relative speed to the same cluster to tighten the connection in such a cluster. Ex - MOBIC, DDCA (Distributed Dynamic Clustering Algorithm)
- **Energy-efficient clustering**: - Avoiding unnecessary energy consumption or balancing energy consumption for mobile nodes in order to prolong the lifetime of mobile terminals and a network. Ex - IDLBC , Energy based DS
- **Load-balancing clustering**: - Distributing the workload of a network more evenly into clusters by limiting the number of mobile nodes in each cluster in a defined range. Ex - DLBC (Degree-Load-Balancing Clustering)
- **Combined-metrics-based clustering**: - Considering multiple metrics in cluster configuration, including node degree, mobility, battery energy, cluster size, etc., and adjusting their weighting factors for different application scenarios. Ex - WCA, On-Demand WCA (Weighted Clustering Algorithm

4. Comparison of Clustering Schemes

They are many clustering schemes for MANETs avail-able in the literature. To evaluate these schemes, we have to decide about the metrics to use for the evaluation. Based on our review and the work presented in, we summarize the comparison in the following tables. We can ob-serve in the following tables, the total overheads increase when clusters number is high and CHs change frequently. The weight based clustering scheme performs better than ID-Neighbor based, topology based, mobility based and energy based clustering. The weight based clustering scheme is the most used technique for CH election that uses combined weight metrics such the node degree, remaining battery power, transmission power, and node mobility etc. It achieves several goals of clustering: minimizing the number of clusters, maximizing lifespan of mobile nodes in the network, decreasing the total overhead, minimizing the CHs change, decreasing the number of re-affiliation, improving the stability of the cluster structure and ensuring a good resources management (minimize the band-width consumption)

Table 1: Comparison modal based on ID-Neighbor

Comparison Model/ Features	LCA	LCC	ACA	Max-Min D-Cluster
CHs Election	Lowest ID	Lowest ID	Lowest ID	Node ID
Cluster Radius	One-Hop	One-Hop	One-Hop	K-Hop
Overlapping Clusters	Possible	Possible	No	No
Clusters Number	High	High	High	High
CH Change	Very High	High	Moderate	Moderate
Cluster Stability	Very Low	Low	Low	Low
Total Over head	High	High	High	Very High

Table 2: Comparison model based on Topology (Low Maintenance)

Comparison Model/ Features	HCC	3hBAC	α-SSCA	Associability-based Cluster
CHs Election	Highest degree	Highest degree	Node Degree	Associatively and node degree
Cluster Radius	One-Hop	One-Hop	One-Hop	K-Hop
Overlapping Clusters	No	No	No	Yes
Clusters Number	High	Moderate	Moderate	Moderate
CH Change	Very High	Relatively High	Relatively low	Relatively low
Cluster Stability	Very Low	Low	High	High
Total Overhead	High	Very High	Low	Relatively High

Table 3: Comparison model based on mobility

Comparison Model/ Features	MOBIC	MPBC	Mob Hop	Cross-CBRP
CHs Election	Lowest Mobility	Lowest Mobility	Lowest Mobility	Node ID and Mobility
Cluster Radius	One-Hop	One-Hop	K-Hop	One-Hop
Overlapping Clusters	Possible	Yes	No	Yes
Clusters Number	Relatively High	Relatively Low	Low	Relatively High
CH Change	Very High	Relatively High	Relatively low	Relatively low
Cluster Stability	Low	Low	Low	Relatively low
Total Overhead	High	Low	Low	Low

Table 4: Comparison model based on energy

Comparison Model/ Features	MPGC	FWCABP	ECEC
CHs Election	Highest energy	Lowest Energy	Highest Energy
Cluster Radius	One-Hop	One-Hop	One-Hop
Overlapping Clusters	Yes	Possible	Yes
Clusters Number	Moderate	Low	Moderate
CH Change	Relatively low	Low	Low
Cluster Stability	Relatively High	High	Relatively high
Total Overhead	Relatively High	Relatively Low	Relatively Low

Table 5: Comparison model based on Weight

Comparison Model/ Features	FWCA	SBCA	EWBCA
CHs Election	A combined weight metric	A combined weight metric	A combined weight metric
Cluster Radius	One-Hop	One-Hop	One-Hop
Overlapping Clusters	Possible	No	No
Clusters Number	Low	Low	Low
CH Change	Low	Low	Low
Cluster Stability	High	High	Very High
Total Overhead	High	Relatively high	Relatively Low

5. Conclusion

In this survey, we first presented fundamental concepts about clustering, including the definition of clustering, design goals and objectives of clustering schemes, advantages and disadvantages of clustering, and cost of network clustering. Then we classified clustering schemes into five categories based on their distinguishing features and their objectives as: Identifier Neighbor based clustering, Topology based clustering, Mobility based clustering, Energy based clustering, and Weight based clustering. We reviewed several clustering schemes which help organize MANETs in a hierarchical manner and presented some of their main characteristics, objective, mechanism, and performance. We also identified the most relevant metrics for evaluating the performance of existing clustering schemes. Most of the presented clustering schemes focus on important issues such as cluster structure stability, the total control overhead of cluster formation and maintenance, etc. In addition, the different categories of clustering schemes have different characteristics and objectives.

References

[1] A. K. Gupta, H. Sadawarti, and A. K. Verma "Review of Various Routing Protocols for MANETs" in International Journal of Information and Electronics Engineering, Vol. 1, No. 3, November 2011.
[2] S.Veni, Dr.G.M.Kadhar Nawaz, "Localized Multi Path Selection With Shamir's Secret Scheme For Qos Routing", International Journal Of Emerging Trends In Engineering And Development, vol.1(3),pages : 65-71,2013.
[3] A. Bentaleb, A. Boubetra, and S. Harous, " Survey of Clustering Schemes in Mobile Ad-hoc Networks," Commun.Netw., vol. 05, no. 02, pp 8-14, May 2013.
[4] M. Anupama and B. Sathyanarayana "Survey of Cluster Based Routing Protocols in Mobile Ad hoc Networks," International Journal of Computer Theory and Engi-neering, Vol. 3, No. 6, 2011.
[5] B. Guizani, B. Ayeb and A. Koukam., "Impact of Stabil-ity in Cluster Based Link State Routing Protocol for Self-Organizing Networks," 7th ICWMC, 2011.
[6] S. J. Francis and E. B. Rajsingh, "Performance Analysis of Clustering Protocols in Mobile Ad hoc Networks," Journal of Computer Science, 2008, pp. 192-204.
[7] S.Veni, Dr.G.M.Kadhar Nawaz, "Protection Switching and Rerouting in MPLS" International Journal Of computer technology & Applications(IJCTA), 2012 , Vol 3(1),216-220
[8] M. Ni, Z. Zhong and D. Zhao. "MPBC: A Mobility Pre-diction-Based Clustering Scheme for Ad Hoc Networks," *IEEE TVT*, Vol. 60, No. 9, 2011.
[9] G. Chen, F. G. Nocetti, J. S. Gonzalez and I. Stojmenovic. "Connectivity Based k-Hop Clustering in Wireless Net-works," 5th HICSS, 2002.
[10] O. Flauzac, B. S. Haggar and F. Nolot, "Self-stabilizing Clustering Algorithm for Ad Hoc Networks," *ICWMC*, No. 24-29, 2009.