

# An Exploration of Behavior and Challenges of Clustered Sensor Network

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## ABSTRACT

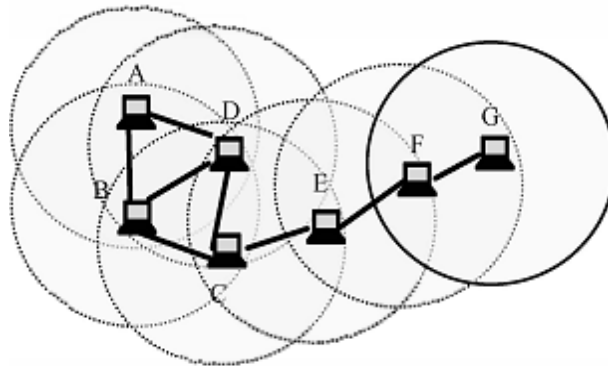
The Clustered Sensor Network is the dynamic network, which provides the cooperative route formation without any administrative control. The dynamic nature add on the communication level criticalities which can result the degradation in QoS. In this paper, the communication behavior and dynamic nature of Clustered Sensor Network is described. The characterization of Clustered Sensor Network along with communication behavior specification is provided. The paper also defined various challenges to the Clustered Sensor Network. These challenges are relative to design time, routing time, protocol or the environment related. These challenges have the impact on network communication and affect the network QoS in terms of lesser throughput or higher delay.

**Keywords:** Communication Challenges, QoS, Dynamic Nature, Routing,

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## 1. INTRODUCTION

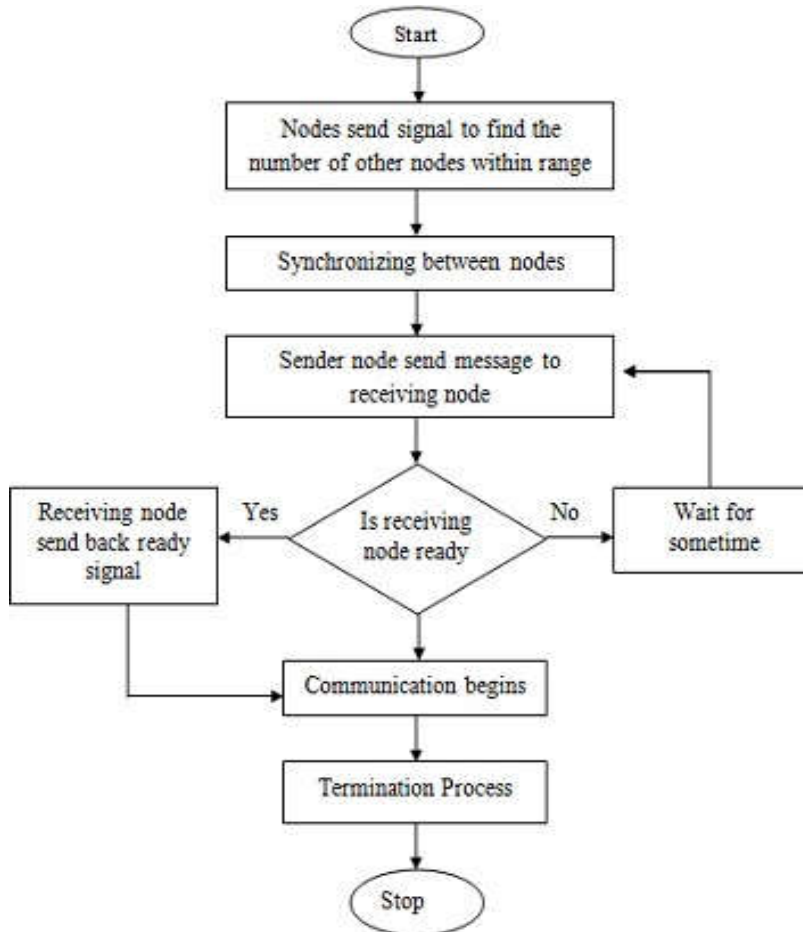
Clustered Sensor Network[1][4][5][12][13] is most common, dynamic and challenging networking paradigm. The versatility, dynamism and the variation in terms of environment, scenarios and communication behavior also increases the communication criticality of this network. The network is having various communication technologies, environmental configuration which also changes in daily life. The network is having the potential to provide the effective communication and momentum gained method to provide effective and reliable communication. The network supports different forms of communication including textual data, voice communication, video data and other multimedia communication. Because of all these responsibilities, the Clustered Sensor Network suffers from various kinds of attacks and failures. Each of the network layer, protocol, architectural behavior and communication characterization are affected by such issues. In this paper some of these issues are discussed and explored.



**Figure 1 : Multihop Communication in Clustered Sensor Network [13]**

One of major characterization [12] [13] of the Clustered Sensor Network is the communication without any central authority. It provides the peer-to-peer communication without any base station control. Such communication is shown in figure 1. The figure shows that each of the nodes is having its own coverage area and it can communicate within the coverage area directly. If the destination node is not in coverage, then multihop communication can be performed. Each of the mobile node work as an intermediate forwarder to provide effective data delivery. The time varying communication management under mobility and topology control is also a critical requirement of the Clustered Sensor Network. Because of this dynamic nature, the organized and quick method is required to identify the next cooperative

node. In real time application in which VoIP communication or video conference is performed, the time sensitivity is the major requirement. There is the requirement to maintain the data integrity and effectiveness to achieve the reliable communication. The QoS in such communication is defined based on packet loss, throughput and latency parameters. The data flow analysis and the relative communication characterization are required to achieve the effective and reliable communication in Clustered Sensor Networks. The communication behavior in Clustered Sensor Network is shown in figure 2.



**Figure 2 : Communication behavior in Clustered Sensor Network**

Here the figure is showing the complete communication process applied while generating the communication route over the network. The figure shows that as the communication initialize between two nodes, the sender node sends a signal to the neighbor nodes and obtain the number of next level feasible nodes. As the nodes are identified, the synchronization is performed between these nodes. After setting up the synchronization, the message communication is performed. On the receiver side, it checks whether the message received correctly. If it is received, the ready signal is generated to start the communication otherwise wait till the packet not received.

This kind of adhoc communication suffers from various associated challenges. In this paper, these all challenges to the network and communication are discussed. In this section, the basic architectural and behavioral characterization of the Clustered Sensor Network is provided. The dynamic and the adhoc nature is described along with communication behavior. In section II, the study work provided by earlier researchers to identify the issues and challenges on different layers, different applications and different forms of Clustered Sensor Network is discussed. In section III, the challenges identified in this work are listed and explored. In section IV, the conclusion of work is provided.

## 2. RELATED WORK

The Clustered Sensor Network is real time network applied in open area for global communication. Different forms of data can be transferred with continuous and uninterrupted communication requirements. The dynamic and real time nature of network arises various kinds of network challenges. These challenges are associated with architecture, environment and communication. In this section, the work defined by earlier researchers to identify these challenges in the network and to provide the relative associated solution. In this section, the work contribution of earlier researchers

is provided. Dötting et. al. [1] has provided a steady work to recognize the operational challenging in the self organizing Clustered Sensor Network maintenance, operational behavior and recovery methods are defined for a Clustered Sensor Network. The parameter specific use cases and interrelation are explored in this work. The convergence, stability and overhead analysis are provided by the researcher. Liyanage et. al. [2] has defined a study on the legacy adaptive Clustered Sensor Network under dynamic ecosystems. The architectural integration to the software define network and its functionality is provided. The control and data plane specific challenges were recognized by the author. The security architecture exploration and various challenges associated to the secure communication were observed by the author to provide secure communication. Kadadha et. al. [3] has provided a survey on various network challenges to the mobile social network for smart campus integration. The user centric network was defined under the domain and environment specification. The social characteristic based network profile specification was provided by the author. The content level, application level and communication level challenges are provided by the author. Richerzhagen et. al.[4] has defined an adaptive method to monitor the Clustered Sensor Network under more challenging constraints and environmental factors. The observations are defined at node level to identify the dynamic behavior, node failure, efficiency and reliability constraints. The component based evaluation at the scenario specification was analyzed to generate more effective evaluation. Liotou et. al.[6] has defined a method to recognize the design challenges that affect the quality of communication in mobile cellular networks. The conceptual framework was provided to improve Quality of Experience provisioning in Clustered Sensor Network. The functional services are adopted to reduce the quality damage to the Clustered Sensor Network. The criteria and relative functional mapping are provided by the author.

Han et. Al. [8] has defined a work to recognize the framework specific, design specific and optimization challenges for Clustered Sensor Network. The converged methods are defined to analyze the interference and provided the performance solution. The flexibility method is provided to achieve the frequency allocation and infrastructure deployment in Clustered Sensor Network. The traffic demand analysis and convergence is provided to improve the communication. Pushparaj et. al.[9] has identified the routing issues in energy restricted sensor network. The energy aware metrics are defined by the author with scenario specification. The routing behavior, requirement and relative routing method was provided to optimize the communication in Clustered Sensor Network. Hawilo et. al.[10] has defined an analysis on the requirements and the traffic performance observations for Clustered Sensor Network. The group communication control method is defined to observe the infrastructure characterization. The target specific communication analysis also provided to improve the communication efforts. The operational and functional behaviour are also analyzed by the author. Wang et. al.[11] has defined an analysis on various characterization on Clustered Sensor Network architecture and applications. The context context based analysis is provided to generate the potential characterization. The attention specific, mobile specific and trust specific observation is defined. The large scale featured analysis with multimedia sharing was provided by the author. Conti et. al.[12] has defined a work on opportunistic analysis with pragmatic application specific. The triggered and data centric methods are defined to improve the communication efforts so that the reliable communication will be drawn over the network. The momentum specific communication observation is provided for Clustered Sensor Network. Saeed et. al.[13] has defined a protocol driven method to improve the communication solution to achieve QoS provisioning. The dynamic topology and ondemand routing method was provided by author to improve the communication in Clustered Sensor Network.

Security is another critical challenge in Clustered Sensor Network. The network suffers from various kind of internal and external attacks. These attacks increases the communication loss and communication delay. Researchers also identified various kind of criticalities under security concerns. Raj et. al.[5] has identified various security issues, features for mobile communication. Author identified the attack impact on routing in distributed environment. The attack pattern and its relational observation for various protocols is provided in this work. Another work to identify the safety challenges and relative solution was provided by Najafloo et. al.[7] for mobile social network. The security solution including the privacy, trust method, security methods were provided by the author. The concern is defined to maintain the communication integrity for Clustered Sensor Network. Ghosh et. al.[14] has defined a work on various security challenges for Clustered Sensor Network. The parameter specific secure routing, key specific constraints and trust management methods are defined by the author. The attack detection and prevention behaviour is also provided by the author. Djahel et. al.[15] has defined a work to explore the challenges associated to packet dropping method. The malicious node analysis with forwarding function is defined to improve the detection and reaction schemes. A comprehensive survey is defined to recognize the misbehaving nodes and to generate the safe communication in Clustered Sensor Network. Dhurandher et. al.[16] has identify the secure routing challenges for Clustered Sensor Network. The parameter specific trust requirement and feature exploration is provided by the author.

### 3. CHALLENGES IN CLUSTERED SENSOR NETWORK

The dynamic nature and absence of centralized control increases the communication criticality. These challenges occur because of network architecture or the communication behavior. Some of the challenges associated with network architecture, behavior, resources and constraints are listed here under:

### A. Lack of Adaptation

Most of the available Clustered Sensor Network is based on reactive communication and security integration. These networks cannot take real time decisions collaboratively. The security policies are not adaptive to monitor and detect the abnormal behavior of nodes. The security policies are defined over the dynamic environment to observe the network parameters dynamically. The dynamic adjustment of the network to the security mechanism can be applied to provide service without any interruption.

### B. Interoperability

The Clustered Sensor Network provide the diverset set of security features to the dynamic Clustered Sensor Network. The cooperative secure communication can be provided by using firewall, tunneling etc. But if the network is wide and having multiple network configurations as the intermediate, then the interoperability is one critical challenge to the network. Different network technologies such as WiFi, WiMax network can exist on different intermedite nodes. The interoperability is required to provide the reliable and secure communication in such hybrid network.

### C. Visibility and Monitoring

The Clustered Sensor Network does not provide end to end visibility because of widely spread network. The security equipments also hide the information of the nodes. The monitoring of the node is not possible because of densed network architecture and the dynamic nature of network. The network traffic analysis and the communication observation is required to provide the network analysis. Such kind of network is difficult to manage, deploy and communicate. The network is intelligent and provided the secure communication in collaborative form.

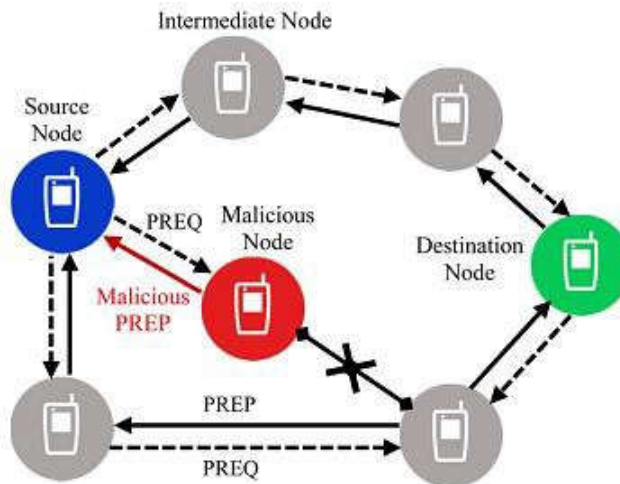


Figure 3: Malicious Node Behavior in Clustered Sensor Network

### D. Attacks

The open nature of network allow any new node to enter to the environment. The network suffers from various internal and external attacks. The internal attacks are performed some known nodes that captures the network communication and reveal or destroy the information. The external nodes are any outsider nodes that can destroy the communication. These attacks can be applied on different application, protocol or the layers. These attacks increase the communication loss and increase the communication delay. The attack behavior is shown in figure 3 which accept the data but does not allow it to forward to the next node. Because of which the communication loss increases.

## 4. CONCLUSION

In this paper, the characterization an Clustered Sensor Network is defined by exploring the various network features. These critical features include dynamic communication behavior, mobility and the hybrid network environment. In this paper, various network challenges and issues to the network are provided. The security concerns and communication concerns to the environment are provided in this paper.

## REFERENCES

- [1]. M. Döttling and I. Viering, "Challenges in Clustered Sensor Network operation: Towards self-optimizing networks," 2009 IEEE International Conference on Acoustics, Speech and Signal Processing, Taipei, 2009, pp. 3609-3612.
- [2]. M. Liyanage, A. B. Abro, M. Ylianttila and A. Gurtov, "Opportunities and Challenges of Software-Defined Clustered Sensor Networks in Network Security," in IEEE Security & Privacy, vol. 14, no. 4, pp. 34-44, July-Aug. 2016.
- [3]. M. Kadadha, H. Al-Ali, M. A. Mufti, A. Al-Aamri and R. Mizouni, "Opportunistic mobile social networks: Challenges survey and application in smart campus," 2016 IEEE 12th International Conference on Wireless and Mobile Computing, Networking and Communications (WiMob), New York, NY, USA, 2016, pp. 1-8.
- [4]. N. Richerzhagen, D. Stingl, B. Richerzhagen, A. Mauthe and R. Steinmetz, "Adaptive Monitoring for Clustered Sensor Networks in Challenging Environments," 2015 24th International Conference on Computer Communication and Networks (ICCCN), Las Vegas, NV, 2015, pp. 1-8.
- [5]. N. Raj, P. Bharti and S. Thakur, "Vulnerabilities, Challenges and Threats in Securing Mobile Ad-Hoc Network," 2015 Fifth International Conference on Communication Systems and Network Technologies, Gwalior, 2015, pp. 771-775.
- [6]. E. Liotou, D. Tsolkas, N. Passas and L. Merakos, "Quality of experience management in mobile cellular networks: key issues and design challenges," in IEEE Communications Magazine, vol. 53, no. 7, pp. 145-153, July 2015.
- [7]. Y. Najaflou, B. Jedari, F. Xia, L. T. Yang and M. S. Obaidat, "Safety Challenges and Solutions in Mobile Social Networks," in IEEE Systems Journal, vol. 9, no. 3, pp. 834-854, Sept. 2015.
- [8]. T. Han, Y. Yang, X. Ge and G. Mao, "Mobile converged networks: framework, optimization, and challenges," in IEEE Wireless Communications, vol. 21, no. 6, pp. 34-40, December 2014.
- [9]. R. Pushparaj and M. Dinakaran, "Energy efficient routing issues and challenges in mobile Ad Hoc networks," Second International Conference on Current Trends In Engineering and Technology - ICCTET 2014, Coimbatore, 2014, pp. 26-31.
- [10]. H. Hawilo, A. Shami, M. Mirahmadi and R. Asal, "NFV: state of the art, challenges, and implementation in next generation Clustered Sensor Networks (vEPC)," in IEEE Network, vol. 28, no. 6, pp. 18-26, Nov.-Dec. 2014.
- [11]. Y. Wang, T. Jing, Q. Jin and J. Ma, "Overview Mobile Social Networking in Proximity (MSNP): Applications, Characteristics and Challenges," 2013 IEEE 10th International Conference on High Performance Computing and Communications & 2013 IEEE International Conference on Embedded and Ubiquitous Computing, Zhangjiajie, 2013, pp. 2112-2119.
- [12]. M. Conti and S. Giordano, "Mobile ad hoc networking: milestones, challenges, and new research directions," in IEEE Communications Magazine, vol. 52, no. 1, pp. 85-96, January 2014.
- [13]. S. Saeed, K. Jumari, M. Ismail and A. Al-hemyari, "Challenges and solutions of QoS provisioning for real time traffic in mobile ad hoc networks," 2012 International Conference on Computer & Information Science (ICCIIS), Kuala Lumpur, 2012, pp. 765-770.
- [14]. C. Ghosh, D. Jana and B. B. Bhaumik, "Security challenges in reactive Mobile Ad Hoc Network," 2011 Annual IEEE India Conference, Hyderabad, 2011, pp. 1-6.
- [15]. S. Djahel, F. Nait-abdesselam and Z. Zhang, "Mitigating Packet Dropping Problem in Mobile Ad Hoc Networks: Proposals and Challenges," in IEEE Communications Surveys & Tutorials, vol. 13, no. 4, pp. 658-672, Fourth Quarter 2011.
- [16]. S. K. Dhurandher, M. S. Obaidat, Karan Verma, Pushkar Gupta and Pravina Dhurandher, "Friend-based secure routing through challenges in mobile ad hoc networks," Performance Evaluation of Computer and Telecommunication Systems (SPECTS), 2010 International Symposium on, Ottawa, ON, 2010, pp. 280-286.