Improved Elastic Timer Technique for Clock Synchronization in IoT

Karamvir Singh[1], Guneet Kaur[2]
[1]*Research Scholar, Amritsar College of Engineering and Technology, Amritsar, Punjab*
[2]*Associate Professor, ECE Department, Amritsar College of Engineering and Technology, Amritsar, Punjab*

Abstract - The IoT is the decentralized type of network in which sensor nodes can join or leave the network when they want. The channel sensing is the major issues of the internet of things.. The elastic time is the technique which is used to sense the channel and sensed information will be transmitted to the base station. The clocks of the sensor nodes are not synchronized due to which elastic timer donot work well which reduce efficiency of the network. In this research work, elastic timer technique will be improved for clock synchronization using time lay technique. The proposed improvement leads to improve network throughput, reduce delay and packetloss.

Keywords - Time lay, Clock Synchronization. Elastic Timer

I. INTRODUCTION

A system can be facilitated with higher level of automation, analysis as well as integration with the help of Internet of Things (IoT). The accessibility to such areas is eased along with accuracy of results through this approach. For being applied within the several sensing, networking as well as robotics applications, the existing and emerging techniques are used by IoT. The latest technological advancements with respect to several aspects are exploited by IoT. Within the delivering of products, goods and services, several modifications have been made with the help of such advancements. The IoT applications provide several advanced software and communication services. Amongst networks or other external things, the objects are linked [1]. It is possible to access the media available within these networks. Communication amongst other objects is also possible here. There is a need to provide small computer for each scenario in which an object or thing is involved. Several forecasts are made using the connection provided here to the microchip in which the data is stored. For providing the substructure of IoT environments, the processing power is maximized here. In the small sized devices, power is provided such that a computing network can be generated. RFID and sensors are present in several technologies which help in generating a real-time scenario for various IoT network devices. In real time, the object-to-object applications are examined in these systems. The IoT is a broad term alluding to applications as various as Internet-connected vehicles, consumer gadgets and smart phones. In any case, the edge of the IoT network will consist of simpler sensors and wireless devices that give, in addition to other things, the identification of objects, sensing, control and automation [2]. The least complex, inactive RF devices, with relatively short range, will potentially be the highest volume of all devices and come in at the lowest price points. Adding power to RF devices with relatively short range enables more functionality, for example, sensing, mesh networking and automated control. IoT alludes not just to personal computers and mobile phones connected through the Internet, additionally to the wireless interconnection of the greater part of the billions of "things" and devices through the internet or local area networks that is done to increase efficient utilization. With these billions of things come billions of batteries that must be purchased, maintained, and disposed of. Energy harvesting presents a straightforward solution for easily powering these remote devices by utilizing clean energy. A key requirement for IoT is the ability to place wireless sensor nodes in various locations in order to collect data [3]. Be that as it may, there is one substantial obstacle: the installation of power-distribution wires (or on account of battery use, the battery life or the time between battery replacements). Energy harvesting gives a solution to this challenging problem. Energy harvesting technologies use power generating components, for example, solar cells, piezoelectric components, and thermoelectric features to convert light, vibration, and heat energy into electricity and after that use that electricity efficiently. In any case, the amount of harvested energy is at present limited and energy storage is small. Subsequently, energy harvesting technologies require a solution for efficiently managing the harvested energy. In the internet of things (IoT) it is required to have the access in the restricted devices for which it is necessary to analyze the access requirements. The availability of these large numbers of access requirements is not present in the applications of real world due its use in large scale. Therefore, in this huge amount of essential data is present in it. In the condition of higher numbers of access restricted devices, there is expansion in applications fields of IoT, which can easily access the IoT [4]. Therefore, all the followed procedure makes the system more robust and intellectual. In the access restricted devices, there are two types of requirements such as functional as well as non-functional. The essential role is played by the time in the embedded wireless systems and networks. Every network device maintains its own clock. The clocks present in different devices locally are asynchronous as there is difference among individual oscillators and inherent diversity of hardware. In order to synchronize different devices to a shared global clock is done by the clock synchronization known as a key function in those networks. There is false identification and even mismatching in the condition if obtained sensor readings from different are not aligned in the temporal dimension [5]. This is in the case of event-driven application such as environmental surveillance and safeguard. Therefore, an essential role is played by the clock synchronization for the getting accurate information about network protocols and management. There is large number of wireless devices has been deployed in surroundings due to the development in the IoT applications. The heterogeneous devices are present in the IoT systems followed by different wireless standards such as WiFi, ZigBee, and BlueTooth. In order to enable the collaboration and inter-operation among those devices, an essential role is played by the clock synchronization. It is required to control the pipeline with accurate timing having different manufacturing units and sensors in an industrial IoT system. There are various faults and errors in the pipeline leading to inefficient results without clock synchronization of those units and sensors [6]. In order to synchronize the clocks of heterogeneous wireless devices the Cross-technology clock synchronization (CTCS) has been utilized which is considered as major challenge. It provides the direct communication to devices following different wireless standards. Therefore, to forward timestamps this above mention designed is used on the shared gateway. There can be seen additional synchronization error due to uncertain end-to-end delay in transmitting timestamps using gateway. The advancement in the cross-technology communication (CTC) also shows the advantages of direct data transmission across technologies. In order to modulate the data from WiFi to ZigBee, there is development of time modulation and energy modulation. In the enhanced CTCS method, the conventional synchronization protocols cannot be implemented even if CTC is present. This happens due to some following reasons such as low throughput of CTC, and more channel noise in CTC transmission. The channel is occupied for the longer period of time, as it is required to modulate timestamp using multiple wireless packets [7]. Therefore, this leads to delays and uncertainty in local processing and network propagation. The CTCS signal is corrupted by the noise due to which the calibration of clocks gives incorrect results. Therefore, noise in this signal is still a major issue.

II. LITERATURE REVIEW

Li, et.al (2018) presented the major issue of security and the distributions of the data are considered as the major issue in this paper [8]. They proposed an OT method which is widely utilized in various applications such as providing privacy to data and data aggregation in smart grids. In order to process anonymous communications and group signatures, the proposed method can also be utilized to design crypto protocols. They proposed first algorithm in this paper for implementing the $n \times 1$-out-of-n OT effectively. Therefore, in the O (lg(n)) time to assign n secrets to n clients by the server, they construct hidden permutation circuits. They investigated security strength and performance of the protocol for the analysis of proposed method.

Qin, et.al (2018) presented the applications of industrial Internet of Things (IIoT) in this paper and associated challenges with the estimating communication latency considered as major task [9]. For the process of communication, the essential role is played by the path duration in end-to-end delay. They proposed a probabilistic model in this paper for mobile converge cast and for the evaluation of duration time for the path capturing. This model utilizes some parameters such as network models, sensor network scope, and mobility patterns of network elements. On the basis of performed simulations, it is concluded that proposed method has various application in industrial networks and to provide feasible of end-to-end delays for implementing converge cast.

Yu, et.al (2017) presented there are various advanced application in this emerging technology has been utilized as the major named as internet of things which is widely utilized in various major areas [10]. They proposed a cluster-based data analysis framework in this paper in which method of recursive principal component analysis (R-PCA) has been utilized. The abnormal squared prediction error (SPE) score has been utilized for the identification of potential data outliers, after the extractions of PCs, it is also termed as square of residual value. Therefore, IoT changes are adaptive to the done changes by updating the parameters of PCA model using R-PCA. On the basis of performed experiments, it is analyzed that proposed method provides effective and efficient results for the aggregation of sensor data provide high accuracy. It is also analyzed there is improvement in the detection of data outlier with accuracy as compared to other methods.

Bhandari, et.al (2017) presented the widespread applications of internet of things in this paper has been widely utilized in almost every application. At the Cluster Head (CH) they proposed a priority-based channel access and data aggregation scheme in this paper that cause reduction in channel access and queuing delays in a clustered industrial IoT network. Therefore, they followed some procedures such as developed a prioritized channel access mechanism in which to the packets assign different Medium Access Control (MAC) layer attributes coming from the two different types of IoT nodes [11]. Prior sending the data to the cloud, they implemented the separate low-priority and high-priority queues for which they used preemptive M/G/1 queuing model. They made comparison between the proposed method and the non-prioritized scheme using their results the effectiveness of proposed method is proved in terms of reliability and latency.

Shen, et.al (2017) presented the emerging technology used in day to day life and various major areas where things are required to control through system, known as Internet of Things. They proposed a generic architecture for IoT in this paper on the basis of internet architecture over which various different devices can be operated easily and different number of applications can be run easily [12]. Therefore, there are two DIY areas that are supported by this network such as network DIY used for data aggregation and second is application DIY used for service cooperation. Therefore, they designed a centralized controller in order to connect these two DIYs that provide the interfaces for the following data acquisition, organization, and storage, and to support elastic and supportive computing.

Dong, et.al (2017) presented the internet of things (IoT) in this paper has been widely utilized nowadays due to its widespread applications in day to day life. The commonly used IoT applications are subscription and notification communication pattern with the help of which consumers are notified about their interested information or searched query. Therefore, for the information centric networking (ICN), they proposed a network aggregation and distribution of conditional IoT subscription solution (INADS) in this paper [13]. There seen a reduction in the number of notifications both in single and multiple producer scenarios due to this proposed method hence, the limited power issues in IoT devices is minimized by this method. While, there is reduction in the bandwidth used for transmitting subscription messages and minimization in the notification messages.

III. RESEARCH METHODOLOGY

In the infinite sensor nodes, the sensor network is deployed initially. In the clusters all the sensor nodes are grouped together. These clusters are formed on the basis of the sensor nodes. A cluster head is present within each cluster and for the selection of these cluster heads an election algorithm is used. The node with more resources and energy is selected within the cluster for cluster head. All these nodes transfer their data to cluster heads after which the data is further forwarded to their destinations by the cluster head. AODV routing protocol discovered the route for transmission and also establish the path between source and destination. The virtual paths and dynamic paths have been discovered by the AODV routing protocol.

The synchronization of sensor nodes is necessary with cluster head so that packet collision remains minimum in the network. There is a sink available at the network. After that, there are clusters having cluster head and node in it. First of all, the message is send by the one cluster head to the sink. After receiving message sink will minus transmission delay from the message and calculate its current time. At the end, to the same cluster head message is send by the sink. Now again this cluster head will minus transmission delay from the message and calculate its time. Now we have final delay that is transmission delay of sink– transmission delay of cluster head.

Finally, cluster head will set its clock according to the current timing after delay. This process will continue until all the cluster head gets the similar clock. Same process will be applicable to the clock synchronization between cluster head and node in a cluster. After receiving message from sink cluster head will minus its delay from the message. For the final clock timing cluster head will calculate final delay and deduct it from the timing. The remaining time will the final time for clock setting. All the other nodes also set their clock by sending message to the cluster head first. Cluster head will calculate time by deducting transmission delay and send message back to node. Now node will calculate time by deducting transmission delay from the message. Again calculate final delay and minus it from the current time. The remaining time will be final time and node sets its clock according to it. As illustrated in the figure 4.6, two steps have been taken to synchronize entire network

IV. EXPERIMENTAL RESULTS

The proposed work has been implemented in NS2 and the results have been analyzed by making comparisons of proposed and existing work in terms of delay, packet loss, throughput, energy, packet delivery ratio and lifetime parameters.

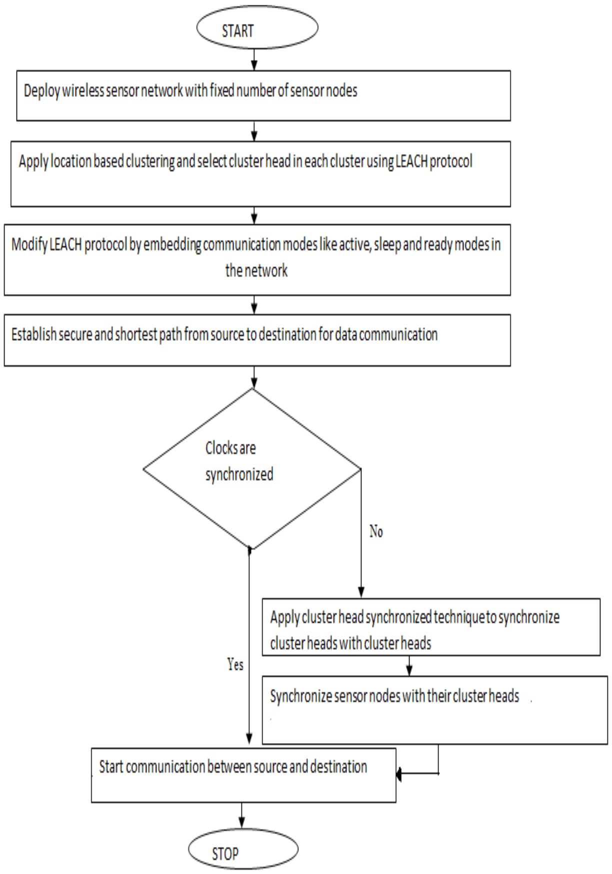

Figure 1: Proposed Flowchart

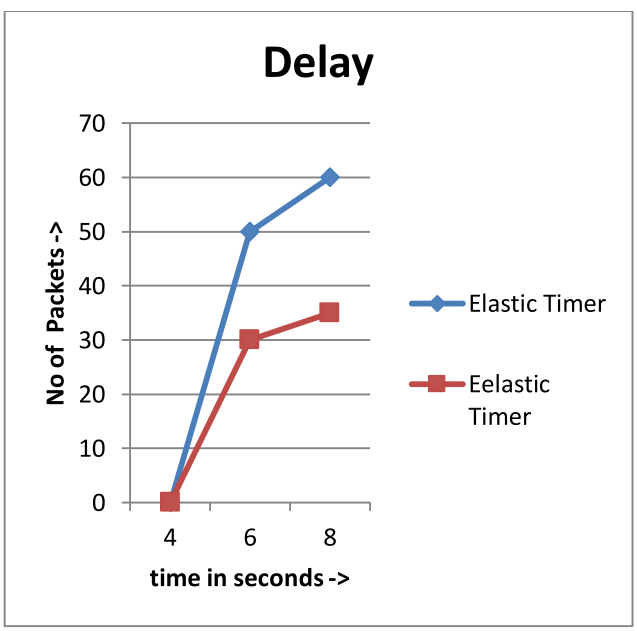

Figure 2: Delay Comparison

The delay of the existing Elastic based scheme is compared with the proposed EElastictimer scheme is compared for the performance analysis. It is analyzed that EElastic Timerbased scheme has less delay as compared to Elastic Timer Scheme.

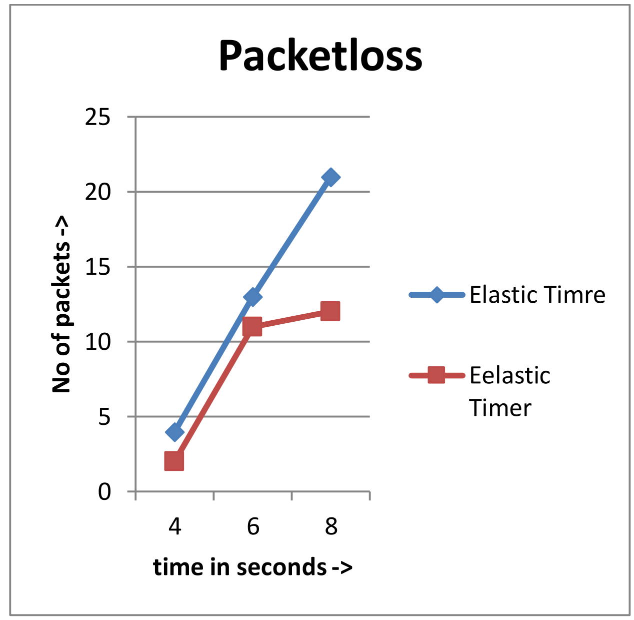

Figure 3: Packetloss Comparison

The packetloss of the existing Elastic based scheme is compared with the proposed EElastic timer scheme is compared for the performance analysis. It is analyzed that EElastic Timer based scheme has less packet loss as compared to Elastic Timer Scheme.

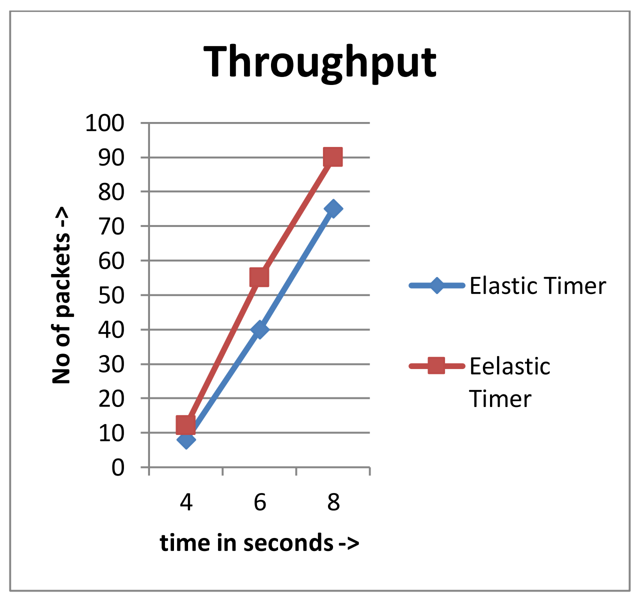

Figure 4: Throughput Comparison

The throughput of the existing Elastic based scheme is compared with the proposed EElastic timer scheme is compared for the performance analysis. It is analyzed that EElastic Timer based scheme has high throughput as compared to Elastic Timer Scheme.

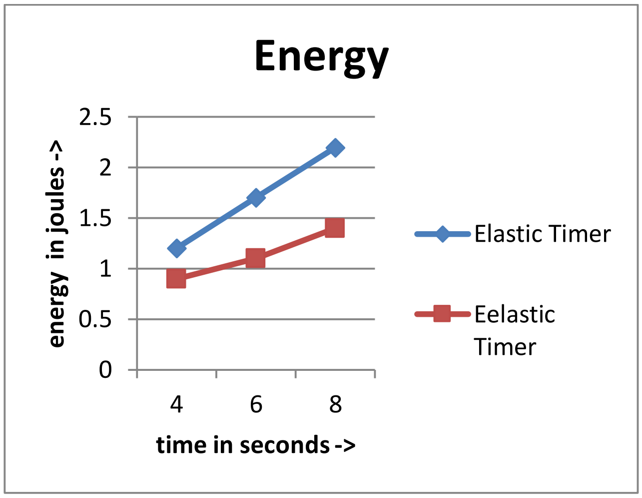

Figure 5: Energy Comparison

The energy of the existing Elastic based scheme is compared with the proposed EElastic timer scheme is compared for the performance analysis. It is analyzed that EElastic Timer based scheme has less energy as compared to Elastic Timer Scheme.

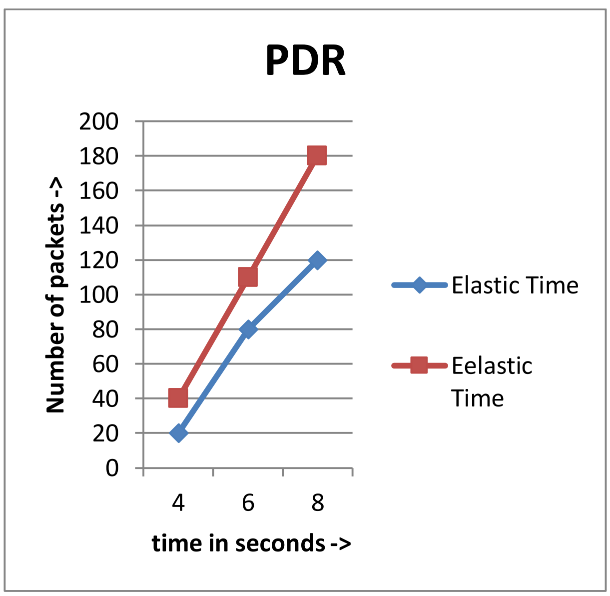

Figure 6: PDR Comparison

The PDR of the existing Elastic based scheme is compared with the proposed EElastic timer scheme is compared for the performance analysis. It is analyzed that EElastic Timer based scheme has highPDR as compared to Elastic Timer Scheme.

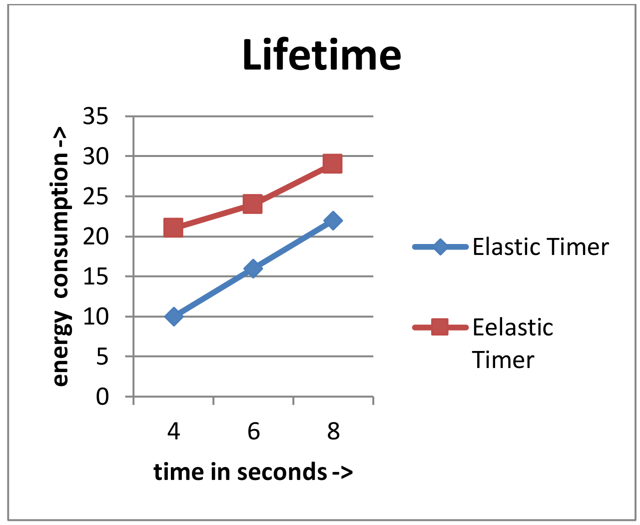

Figure 7: Lifetime Comparison

The lifetime of the existing Elastic based scheme is compared with the proposed EElastic timer scheme is compared for the performance analysis. It is analyzed that EElastic Timer based scheme has high lifetime as compared to Elastic Timer Scheme.

V. CONCLUSION

The IoT is the self configuring and decentralized type of network in which sensor nodes sense information and pass it to server. The sensor node transmits the data on the wireless channels and these channels are allocated to each sensor node with the elastic time technique. The clocks of the sensor nodes are not well synchronized due to which elastic time do not work well. In this research work, improvement in the elastic timer technique will be proposed for the channel sensing. To synchronize the clocks of the sensor nodes the time lay technique will be applied with the elastic timer technique. The proposed technique can synchronize the clocks of the sensor nodes and also increase lifetime of the networks, reduce delay and packetloss.

VI. REFERENCES

[1] F. Marcelloni and M. Vecchio, "Enabling energy-efficient and lossy aware data compression in wireless sensor networks by multi-objective evolutionary optimization," Information Sciences, vol. 180, no. 10, pp.1924-1941, 2010

[2] Y. Sun, H. Luo, and S. K. Das, "A Trust-based Framework for Fault Tolerant Data Aggregation in Wireless Multimedia Sensor Networks," IEEE Trans. Depend. Sec. Comput., vol. 9, no. 6, pp. 785–797, 2012.

[3] L. Xiang, J. Luo, and C. Rosenberg, “Compressed Data Aggregation: Energy-Efficient and High-Fidelity Data Collection,” IEEE/ACM Trans. Netw., vol. 21, no. 6, pp. 1722–1735, 2013.

[4] C. Castelluccia, E. Mykletun, and G. Tsudik, “Efficient Aggregation of Encrypted Data in Wireless Sensor Networks,” Mobiquitous, 2005.

[5] V. Pandey, "A Review on Data Aggregation Techniques in Wireless Sensor Network," .fournal of Electronic and Electrical Engineering, vol.I, no. 2, 2010.

[6] S. Sirsikar and S. Anavatti, "Issues of Data Aggregation Methods in Wireless Sensor Network: A Survey ;' Procedia Computer Science, vol. 49, pp. 194 - 201, 2015. Proceedings of 4th International Conference on Advances in Computing, Communication and Control(ICAC).

[7] A. Ray and D. De, "Data Aggregation Techniques in Wireless Sensor Network: A Survey," International Journal of Engineering Innovationand Research, vol. I, no. 2, pp. 81-92, 2012.

[8] RuinianLi, Carl Sturtivant, Jiguo Yu, and Xiuzhen Cheng, “A Novel Secure and Efficient Data Aggregation Scheme for IoT”, IEEE, 2018

[9] Zhijing Qin, Di Wu Member, IEEE, Zhu Xiao Member, IEEE, Bin Fu, and Zhijin Qin Member, IEEE, “Modeling and Analysis of Data Aggregation from Converge cast in Mobile Sensor Networks for Industrial IoT”, IEEE, 2018

[10] Tianqi Yu, Student Member, IEEE, Xianbin Wang, Fellow, IEEE, and AbdallahShami, Senior Member, IEEE, “Recursive Principal Component Analysis based Data Outlier Detection and Sensor Data Aggregation in IoT Systems”, IEEE, 2017

[11] Sabin Bhandari, Shree Krishna Sharma, Xianbin Wang, “Latency Minimization in Wireless IoT Using Prioritized Channel Access and Data Aggregation”, IEEE, 2017

[12] Yulong Shen, Tao Zhang, Yongzhi Wang, Hua Wang, and Xiaohong Jiang, “MicroThings: A Generic IoT Architecture for Flexible Data Aggregation and Scalable Service Cooperation”, IEEE, 2017

[13] Lijun Dong, Guoqiang Wang, “INADS: IN-NETWORK AGGREGATION AND DISTRIBUTION OF lOT DATA SUBSCRIPTION IN ICN”, Proceedings of the IEEE International Conference on Multimedia and Expo Workshops (ICMEW) 2017