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Performance Analysis of MANET Routing Protocols using Application Based Scenarios

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Abstract: **-- The Mobile Ad-hoc NETwork (MANET) is a collection of mobile nodes, and they communicate with one another without using any infrastructure support. The mobile nodes in MANET move arbitrarily and create a dynamic network topology. The routing protocols play a key role in communications that contain a set of rules for instructing the mobile nodes in the network. The performance evaluation in various simulation scenarios encounters many complexities due to the unpredictable and dynamic nature. For obtaining the accurate performance of protocols in simulation as equal to the realistic scenario, the comparative analysis significantly determines the robustness of the protocols under different scenarios. The proactive, reactive and hybrid protocols establish their routing behavior in a distinct manner based on their routing characteristics. This paper evaluates seven prominent routing protocols, and compare the several parameters in network scenarios using various kinds of application types such as CBR, FTP, audio, and video. These network scenarios create a considerable impact on the performance, and the performance of the protocols is not stable at all times. The simulation results reveals various performance issues and comparative analysis of proactive, reactive and hybrid routing protocols under different performance metrics. Thus, many significant factors are evaluated for clearly understanding the distinct characteristics of a routing protocol and estimating its relationship with others.**

Index Terms— **AODV, CBR, DSDV,DSR,FSR,FTP,LAR ,MANET,ns2, OLSR,,ZRP.**

I. INTRODUCTION

Nowadays, the Mobile Ad-hoc NETworks (MANETs) have been growing quickly according to the availability of current generation mobile devices [1]. The nodes are free to move without any specific network topology. The design of routing protocols to retain the communication among mobile nodes is a tough issue for MANETs [2]. The protocols have different and unique characteristics that they reveal such characteristics during routing behavior. The performance comparison of routing protocols is essential to determine the best one among them.

The protocols are classified as proactive, reactive and hybrid based on their topology updation [3]. The protocols under such categories expose their performances according to the different network scenarios as well as they reveal their characteristics in several routing parameters such as a packet delivery ratio, delay, overhead, and throughput. For example, in the high mobility scenario, the proactive type protocols such as Destination-Sequenced Distance-Vector (DSDV) attain high control overhead due to their continuous routing table updation. Instead, the reactive type protocols such as Ad hoc On-Demand Distance Vector (AODV), Dynamic Source Routing (DSR) achieve comparatively less overhead due to their on-demand updation. The hybrid protocols such as Zone Routing Protocol (ZRP) have less delay and communication overhead due to the usage of both proactive and reactive approaches in inter-zone and intra-zone respectively. Besides, the unheeded, as well as very crucial network scenarios are MAC (Multiple Access Control) standards and different application based scenarios. They play a significant part in the protocol performance evaluation due to their channel acquisition characteristics and varying file size respectively [4]. They certainly impact the protocol implementation. To get the accurate performance of each protocol, the scenarios mentioned above are to be considered at the time of implementation. The comparative performance analysis can provide the answer to which is the best one among other protocol performances.

The key contributions are listed as follows:

The comparative performance analysis of routing protocols ensures the simulation to predict the accurate and best protocol that is suitable for the applications in realistic scenario analysis.

The application scenario based protocol comparison assures which protocol perfectly suits for a specific application such as CBR, FTP, audio, video.

The performance evaluation of the proposed method is simulated using the extensive NS-2 simulator. The simulation result proves the fair performance of the proposed method. Section 2 surveys the works related to scenarios based protocol analysis. Section 3 describes the scenarios based protocol evaluation. Section 4 defines the simulation settings and scenarios based routing protocol implementation and comparison. Section 5 concludes this paper.

II. RELATED WORKS

The wireless nature creates a severe impact on the protocol design. Several routing protocols have been suggested in recent years with a greater ability [5]. Many researchers have been working to evaluate the routing performance of such protocols in various simulation scenarios [6]. The scenarios are analyzed based on the different performance metrics such as packet delivery, throughput, delay, and overhead.

The protocols are commonly categorized into table driven (proactive) and on-demand (reactive) protocols. The several protocols under such categories are implemented under various network scenarios [7]. The most preferred routing protocols such as DSDV, DSR, OLSR (Optimized Link State Routing), TORA (Temporally Ordered Routing Algorithm) are analyzed in [8] [9] [10]. The proactive protocols such as DSDV exposes routes to all nodes in advance since the routing table is updated in the fixed time interval which is independent of topology changes. This topology change increases the control overhead along the network. Consequently, the throughput becomes low in DSDV. Another proactive protocol is FSR (Fisheye State Routing) which reduces the large size of update messages by broadcasting the information at high frequency for closer nodes than remote nodes. This process is more suitable for large size networks than other protocols [11]. The DSR and AODV get high throughput and packet delivery for any node density due to their source routing mechanism. The DSDV attains increased packet delivery in the number of network scenarios [12]. Principally, the disruption occurs due to the random movement of the intermediate nodes or the end nodes [13]. The mobility scenario considers the speed and pause time of nodes at different mobility patterns. In [14], the AODV, DSR, DSDV are compared with OLSR with varying pause time. The DSR exhibits excellent performance in terms of the packet delivery ratio and control overhead at low to high pause time. When comparing LAR (Location-Aided Routing) with ZRP and FSR protocols, the LAR outperforms other two protocols in the number of nodes scenario due to its multi-level scope technique and reduced overhead [15].
The traffic is also an important factor in MANET environment. In [16], CBR and VBR traffic are varied with different scenarios such as the number of nodes and speed. For CBR traffic, DSDV protocol exhibits reasonable energy consumption in low and medium node density due to the capability of building the routing table with low energy. However, the packet delivery fraction of DSDV has reduced while comparing with AODV and DSR protocols. In [17], the AODV is compared with Mobility and Load-aware Routing (MLR) protocol with different CBR connections. The MLR scheme has a less overhead than AODV since the MLR supports to reduce the control packets by allowing only the nodes with low load and speed to broadcast their packets. Instead, the AODV exploits blind flooding. The MLR performs well in all metrics even if there are maximum CBR connections. With the ability to ensure the packet delivery of TCP, the AODV is perfectly suitable for real-time applications. The poor performance of DSR is due to the high overhead, and spending a high processing time for processing the heavy overhead information [18] [19]. The long time that has been availed by DSR enables the nodes in both processing the packet forwarding and overhead information. Due to this more spending time, the DSR has a high end-to-end delay than AODV. The routing overhead of DSDV under TCP traffic is less than both the OLSR and AODV under all conditions. The packet loss of AODV is high as compared to other considered routing protocols [20]. The OLSR gives better throughput than DSDV and AODV under low and high network load and speeds using TCP traffic sources.

III. OVERVIEW OF SCENARIO-BASED ANALYSIS

The routing protocols exploit their unique characteristics under some set of rules for instructing the

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elements in the wireless networks. All the routing protocols have strengths and weaknesses. Over a period, the routing protocols have been developed and adapted to the requirements of complex networks. The comparative analysis of several protocol parameters assists in determining the robustness of the each protocol. To demonstrate the different scenarios on the same network, the protocols are simulated and compared which reveals the best performance of one over the others and proves the efficiency of comparing protocols. The comparative results of protocols under any one factor is not capable of ensuring the definite performance of such protocols as equal to the realistic scenarios. Since, the realistic scenarios have more disruptions during routing such as node density, unpredictable speed, traffic, bandwidth insufficiency, and so on. In addition to the comparison, the different applications are accounted for estimating which protocol performs well under specific application. In this estimation, many factors have to be taken into consideration for clearly understanding the unique characteristics of a routing protocol and its contact with others. Thus, the consideration of these factors helps to identify the most appropriate routing protocol for the specific network and goal. The following table 1 exposes the basic characteristics of protocols. The protocols shown in Table 1 are taken from the comparative analysis of this work.

Protocol	Route Repository	Route Discovery	Route Reconfiguration	Advantages	Disadvantages
DSDV	Routing tables	Periodic and as required	Notify Source	Loop-free	High overhead
OLSR	Routing tables	Periodic	Notify Source	Reduced control overhead and connection	It requires 2-hop neighbor knowledge
FSR	Routing tables	Periodic, local	Notify Source	Reduced control overhead	Reduced accuracy and high memory overhead
AODV	Routing tables	Request broadcasting when needed, hop-by-hop	Erase route then source notification or local route repair	Low overhead and adaptive to highly, dynamic network topologies	Large delays, scalability problems, Hello messages
DSR	Route Cache	From cache memory, source routing	Erase route then notify source	Loop-Free, multiple routes, and promiscuous overhead	Large delays, and scalability issues
LAR	Request Zone & Expected Zone	Flooding location information of nodes, cache complete route	Notify Source	Saving of resources, reduces routing overhead, and loop-free	Requirement of GPS device at every host
ZRP	Inter-zone, intra-zone tables	Periodic in inter-zone, as required in intra-zone	Start repair at the failure point	Scalability, up-to-date information inside zone	More resources for large zones, inter-zone routing delay

Table 1: Basic Comparison of Routing Protocols

(A). Scenario-Based Analysis of Routing Protocols

Considering the different characteristics of routing protocols in the evaluation ensures accurate and efficient results. The routing protocols are mainly classified into proactive-reactive and hybrid types according to their individual updating behavior. Such classification based comparison helps the designers and researchers to find the appropriate protocol which performs well under various scenarios.

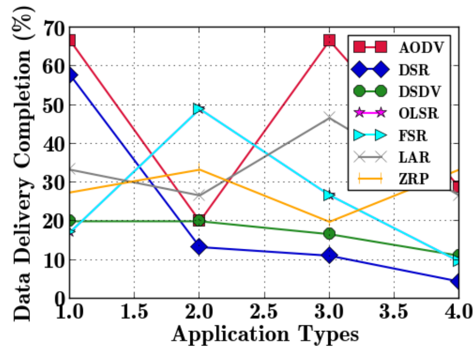
Scenarios	Descriptions
CBR	The CBR is attached to a UDP agent which is attached to a transport agent in sender side, and the connection is established to NULL agent attached to the receiver. The NULL agent just frees the received packets. The file size of CBR is set at 512bytes.
FTP	The FTP traffic generator is attached to a TCP agent. A TCP agent is attached with the sender and establishes a connection to TCPSink which is attached as a transport agent on the receiver side. A TCPSink generates and sends back ACKs to the TCP agent (sender) and frees the received packets.
Audio	The RealAudio is an application agent for transmitting audio files in a streaming format. It is a proprietary audio format which exploits a variety of audio codecs. A UDP and NULL agents are exploited as a transport agent in the sender and receiver side respectively.
Video	To support multimedia file transmission, new agents are added into NS-2 namely MyTrafficTrace, MyUDP, MyUDPSink. The video format is YUV QCIF or YUV CIF which is considered as an input source. The MPEG 4 codec format is exploited to compress such video files. Such compressed file can be fragmented into several segments using MyTrafficTrace. MyUDPSink is exploited at the receiver side to receive the video.

Table 2 : Application Based Simulation Scenario Descriptions

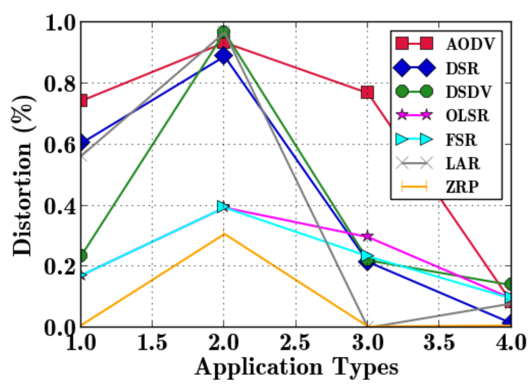
The proactive protocols (Ex. DSDV, OLSR, FSR) always try to retain the recent routes at each node to all the possible destinations in the network. Conversely, the reactive type protocols (Ex. AODV, DSR, LAR) commence the route discovery procedure only when the data packet has to be sent. The hybrid protocols (Ex. ZRP) have the combined process of proactive and reactive type. Due to the continuous topology dissemination and updation of the routing table in proactive type, the routing paths are available at all the times. However, greater control overhead develops along the network, even when reducing the route searching burden during routing. At most scenarios, the reactive protocols have divulged good performance than proactive types. However, in some case such as delay performance, the proactive type proves its best by providing impressive results. Also, the hybrid protocols retain strong network connectivity and determine the distant route faster. In order not to miss such more advantages in protocols and to get the proper comparative results, more scenarios are taken into the comparison.

(B). Simulation Results of Application Scenario

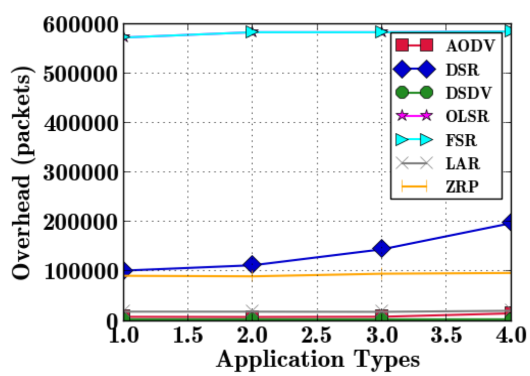
The AODV, DSR, LAR, DSDV, OLSR, FSR, and ZRP routing protocols are assessed under an application based scenario on the escalation of file size. The relative performance evaluation of such routing protocols under varying file size is illustrated in figure 1. In this scenario, the various application types such as CBR, FTP, audio, and video are represented as 1, 2, 3, and 4 respectively. In figure 1(a), the DSDV and DSR exhibit comparable DDC than AODV in FTP, audio, and video due to their poor performance with a wide range of flows. The AODV efficiently completes full data transmission within short and medium flows under UDP traffic rates. Thus it maintains 66.6% DDC from CBR to audio file size (point 1 and 3). Note that, in FTP (point 2); the AODV obtains poor DDC relatively more equal to DSDV and DSR as the TCP is likely to create the packet loss when the traffic load is escalated during merge path selection. Furthermore, the videos have a large file size as well as the video transmission unsuitable for the process in a MANET environment that requires additional compression formats as shown in Table 3.



(a)



(b)



(c)

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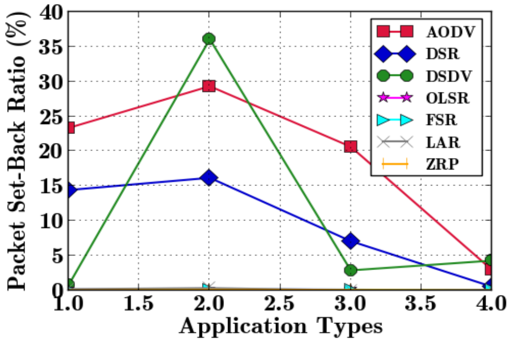

(d)

Figure 1: Performance Comparison With Application Types

Comparing OLSR, LAR, ZRP and FSR in FTP, the OLSR and FSR protocols attain 49% of data delivery. This is because such protocols select the reliable routers with the help of updating link state information resulting in considerable collision and loss. In figure 1(b), the CBR completes its transmission within short duration at minimum flows. In case, when the path optimality within such short duration is poor, the data is likely to be dropped. Instead of short flows, the large duration of video file transmission can discover the great paths. Thus, it executes the large file transmission without much dropping. For instance, the dropped packet count in CBR is 5/10= 0.5, the count in the video is 25/50=0.5. If there is a better path optimality on the escalation in file size, CBR attains 5/10=0.5% dropping, and video achieves 15/50=0.3% dropping. Therefore, the audio and video files show less distortion as compared with CBR. In CBR, the ZRP accomplishes 39.2% less distortion than AODV due to the path maintenance among intra and inter-zones. All compared protocols have almost same and high distortion in TCP due to the auto-adjustment depending on available bandwidth.

As depicted in figure 1(c), the FSR and OLSR reveal much similar and high overhead, since the distance between source and destination is a prime factor in both. If the distance is large, zones are increased which makes high traffic in ZRP, as well as the more distance impacts the scope level in FSR. By following these, the DSR has high overhead since; it selects the routing path in their cache memory which stores more routes. Conversely, the DSDV, LAR and AODV protocols attain less and comparable overhead even in large file transmissions such as audio and video.

Application Types (X-axis)	Y-axis						
	Data Delivery Completion (%)						
	AODV	DSR	DSDV	OLSR	FSR	LAR	ZRP
CBR	**66.667**	57.78	20	17.21	17.21	33.33	27.46
FTP	20	13.33	20	**49**	**49**	26.67	33.33
Audio	**66.667**	11.11	16.66	26.75	26.75	46.67	19.86
Video	28.89	4.44	11.11	9.66	9.66	26.67	**33.3**
Application Types (X-axis)	Y-axis						
	Distortion (%)						
	AODV	DSR	DSDV	OLSR	FSR	LAR	ZRP
CBR	0.74	0.60	0.24	0.17	0.17	0.56	**0.009**
FTP	0.93	0.89	0.97	0.39	0.39	0.97	**0.31**
Audio	0.77	0.22	0.22	0.29	0.23	0.0006	**0.005**
Video	0.085	0.016	0.14	0.097	0.097	0.0794	**0.0074**
Application Types (X-axis)	Y-axis						
	Overhead (packets)						
	AODV	DSR	DSDV	OLSR	FSR	LAR	ZRP
CBR	8401	101992	**3356**	573855	573855	18892	91422
FTP	8057	112875	**3340**	584508	584508	18828	90425
Audio	8550	145130	**3285**	584493	584493	18492	95679
Video	15375	198036	**3427**	585814	585814	20654	97188
Application Types (X-axis)	Y-axis						
	Packet Set-Back Ratio (%)						
	AODV	DSR	DSDV	OLSR	FSR	LAR	ZRP
CBR	23.34	14.41	0.81	0.11	0.11	0.16	**0.0022**
FTP	29.32	16.16	36.08	0.15	0.15	0.31	**0.077**
Audio	20.63	7.063	2.86	0.09	0.09	**0.0002**	0.057
Video	2.97	0.53	4.26	0.032	0.032	0.034	**0.0034**

Table 3 : Result analysis of Application Based Scenario

Moreover, the file transmission is likely to be delayed for some time before reaching the receiver due to some distortion in MANET. The sufficient path availability makes the large flow of file transmission reliable without delay as exposed in figure 1(d). The ACK nature and data rate adjustment in TCP leads to packet collision and latency. As well as, due to the periodic routing table updation of DSDV, it achieves more PSBR by 6.75% and 19.9% than AODV and DSR. In this, the LAR, ZRP, FSR, and OLSR have very low and comparable set back rates and these achieve almost 0.002% to 0.3% of PSBR from CBR to video files transmission. The Result analysis of Application Based Scenario is as shown in the Table 3. The protocols which show the better performance of various applications is discussed in Table 4.

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Application Types	Suitability			Descriptions
	Reliability	Energy Sensitive	Delay Sensitive	
CBR	AODV	DSDV	ZRP	The CBR completes its transmission within short duration at minimum flows. The protocols such as ZRP execute the large file transmission without much dropping due to the possibility of selecting the optimal paths at large flows.
FTP	FSR, OLSR	DSDV	ZRP	
Audio	AODV	DSDV	LAR	
Video	ZRP	DSDV	ZRP	

Table 4: Performance of Protocols

IV. CONCLUSION

This work has proposed a comparative analysis of routing protocols such as AODV, DSR, LAR, DSDV, OLSR, FSR, and ZRP for correctly estimating the protocol characteristics under various applications oriented network scenarios. By taking different network scenarios into comparison, the appropriate and suitable protocol can be predicted among the various protocols according to their adaptability with scenarios used in the simulation. The application scenario based comparison ensures the protocol characteristics under specific application. The performance analysis utilizes NS-2 simulator tool to evaluate the individual performance of each protocol under such various scenarios in a realistic manner. The simulation results show the individual performance of AODV, DSR, LAR, DSDV, OLSR, FSR, and ZRP routing protocols.

REFERENCES

[1] de Morais Cordeiro, Carlos, and Dharma P. Agrawal, "Mobile ad hoc networking", Center for Distributed and Mobile Computing, ECECS, pp. 1-63, 2002.

[2] Pathan, Al-Sakib Khan, and Choong Seon Hong, "Routing in mobile ad hoc networks", Springer, Guide to Wireless Ad Hoc Networks, pp. 59-96. 2009.

[3] Saeed, Nagham H., Maysam F. Abbod, and Hamed S. Al-Raweshidy, "MANET routing protocols taxonomy", IEEE International Conference on Future Communication Networks (ICFCN), pp. 123-128, 2012.

[4] Walia, Manjul, and Rama Krishna Challa ,"Performance analysis of cross-layer MAC and routing protocols in MANETs", IEEE International Conference on Computer and Network Technology (ICCNT), pp. 53-59. , 2010.

[5] Habib, Shabana, Somaila Saleem, and Khawaja Muhammad Saqib, "Review on MANET routing protocols and challenges", IEEE Student Conference on Research and Development (SCOReD), pp. 529-533. 2013.

[6] Boukerche and Azzedine, "Performance evaluation of routing protocols for ad hoc wireless networks", Mobile Networks and Applications, Vol. 9, No. 4, pp. 333-342, 2004.

[7] Mohseni, Shima, Rosilah Hassan, Ahmed Patel, and Rozilawati Razali, "Comparative review study of reactive and proactive routing protocols in MANETs", IEEE International Conference on Digital Ecosystems and Technologies, pp. 304-309. 2010.

[8] Sandhu, Davinder Singh, and Sukesha Sharma, "Performance Evaluation of DSDV, DSR, OLSR, TORA Routing Protocols–A Review", Springer, Mobile Communication and Power Engineering, pp. 502-507, 2013.

[9] Misra, Rajiv, and C. R. Mandal, "Performance comparison of AODV/DSR on-demand routing protocols for ad hoc networks in constrained situation", IEEE International Conference on Personal Wireless Communications, pp. 86-89, 2005.

[10]Tuteja, Asma, Rajneesh Gujral, and Sunil Thalia, "Comparative performance analysis of DSDV, AODV and DSR routing protocols in MANET using NS2", IEEE International Conference on Advances in Computer Engineering (ACE), pp. 330-333, 2010.

[11] Jisha, G., and Philip Samuel, "Impact of node density on node connectivity in manet routing protocols", Springer International Conference on Advances in Computing and Communications, pp. 1-8, 2011.

[12] Maan, Fahim, and Nauman Mazhar, "MANET routing protocols vs mobility models: A performance evaluation", IEEE International Conference on

Ubiquitous and Future Networks (ICUFN), pp. 179-184, 2011.

[13] Mohapatra, S., and P. Kanungo, "Performance analysis of AODV, DSR, OLSR and DSDV routing protocols using NS2 Simulator", Elsevier, Procedia Engineering, Vol. 30, pp. 69-76, 2012.

[14] Razouqi, Qutaiba, Ahmed Boushehri, Mohamed Gaballah, and Lina Alsaleh, "Extensive simulation performance analysis for DSDV, DSR and AODV MANET routing protocols", IEEE International Conference on Advanced Information Networking and Applications Workshops (WAINA), pp. 335-342, 2013.

[15] Khamayseh, Yaser, Ghadeer Obiedat, and Munner Bani Yassin, "Mobility and Load aware Routing protocol for ad hoc networks", Elsevier, Journal of King Saud University-Computer and Information Sciences, Vol. 23, No. 2, pp. 105-113, 2011.

[16] Bakalis, Panos, and Bello Lawal, "Performance evaluation of CBR and TCP traffic models on manet using dsr routing protocol", IEEE International Conference on Communications and Mobile Computing (CMC), Vol. 3, pp. 318-322, 2010.

[17] Puri, Rajni, and Munish Rattan, "A Comprehensive Performance Analysis of MANET Protocols", Springer, International Conference on Research and Innovations in Mechanical Engineering, pp. 667-679, 2014.

[18] Kumar, Suresh, R. K. Rathy, and Diwakar Pandey, "Traffic pattern based performance comparison of two reactive routing protocols for ad hoc networks using NS2", IEEE International Conference on Computer Science and Information Technology, pp. 369-373, 2009.

[19] Basavaraju, T. G., Subir Kumar Sarkar, and C. Puttamadappa, "Impact of mac layer on the performance of routing protocols in mobile ad hoc networks", World Academy of Science, Vol. 3, No. 4, pp. 237-244, 2006.

[20] Gour, Devendra S., Rachit Jain, Rashmi Tikar, Rinkoo Bhatia, and Umesh Barahdiya, "Performance Analysis of MAC802.11 and MAC802.16 for AODV Routing Protocol in MANET", IEEE International Conference on Computational Intelligence and Communication Networks (CICN), pp. 129-133, 2013.