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Comparison & Packet Level Analysis of Routing Protocol for Video Streaming Traffic Over Mobile Adhoc Network

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Abstract— Mobile Ad-hoc networks are formed dynamically by an autonomous system of mobile nodes that are connected via wireless links without using an existing network infrastructure or centralized administration. The challenging factor in Mobile Ad hoc Networks (MANET) is to implement efficient and scalable multicast multipath transmission technique. In this paper, packet level analysis of video streaming is analyzed in probabilistic manner. To analyze video streaming traffic, the packet level performance of multipath transmission scheme is taken into account, which sends video traffic bursts over multiple available channels by means of comparative analysis of AOMDV and EGMP. Packet level performance in-terms of delay, outage probability and control overhead is evaluated using multipath multicast transmission scheme. Simulation result indicates that delay have been decreased by an amount of 17.3% for EGMP than the AOMDV protocol. It is also found that EGMP has shown a better performance in-terms of the overhead and outage probability which has been decreased by an amount of 0.15% and 0.12% respectively. The simulation results demonstrate the effective analysis frame work and performance gain of multipath multicast transmission.

Index Terms— **Minimum** 7 keywords are mandatory, Keywords should closely reflect the topic and should optimally characterize the paper. Use about four key words or phrases in alphabetical order, separated by commas.

1 INTRODUCTION

In wireless networks computers are connected and communicate with each other not by a visible medium, but by emissions of electromagnetic energy in the air. As the importance of computer in daily life increases it also sets new demands for connectivity. Wired solution have been for a long time but there is increasing demand on working wireless solution for connecting to internet, sending E-mail etc. One of the solution to these need is Adhoc network.

A mobile adhoc network (MANET) is an autonomous system of mobile routes connected by wireless links- the union of which forms an arbitrary graph. The routers are free to move randomly and organise themselves arbitrarily, thus the networks wide topology may change rapidly and unpredictably. Such a network may operate in standalone fashion, or may be connected to large internet.

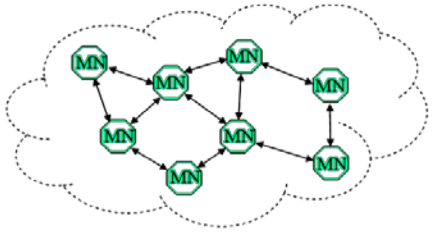

Figure 1 Infrastructureless Network

Adhoc networks are not connected to any static infrastructure. Figure 1 shows an adhoc network is a LAN or other small network, especially one with wireless connections, in which some of network devices are part of the network only for the duration of a communication session.

Mahesh K. Marina et al. (2006) [5] proposed an on-demand multipath protocol called AOMDV that extends the single path AODV protocol to compute multiple paths. AOMDV guaranteed loop freedom and disjointness of alternate paths. Performance comparison of AOMDV with AODV using ns-2 simulations shows that AOMDV is able to effectively cope with mobility-induced route failures. In particular, it reduces the packet loss by up to 40% and achieves a remarkable improvement in the end-to-end delay. AOMDV also reduces routing overhead by about 30% by reducing the frequency of route discovery operations. Shiwen Mao et al. (2005) [7] described a framework for multipath video transport over wireless ad-hoc network. He found that the multipath transport was an efficient technique for video communications over ad-hoc networks. However, this approach of using multipath transport for video communication caused an additional delay and channel coding redundancy and it is also not efficient in combating burst losses. S. R. Biradar et al. (2010) [2] compared and evaluated the performance of two types of On-demand routing protocols. AODV routing protocol, which is unipath and AOMDV routing protocol. He found that on comparing the performance of AODV and AOMDV, AOMDV incurs more routing overhead and packet delay than AODV but it had a better efficiency when it comes to number of packets dropped and packet delivery. When network load tolerance is of no consequence, AOMDV is a better on-demand routing protocol than AODV. X. Xiang et al.

(2011) [9] proposed an efficient and scalable geographic multicast protocol, EGMP, for MANET. He found that by means of simulation EGMP could achieve much higher delivery ratio in all Circumstances. A.E Gamal et al. (2006) [4] determined the optimal throughput-delay trade-off for random wireless networks. Wei Song et al. (2012) [8] proposed packet level and call level performance of multipath transmission scheme to analyse video streaming traffic in multi-radio devices. Pengbo Si et al. (2009) [6] proposed an optimal distributed network selection scheme in heterogeneous wireless networks considering multimedia application layer QoS. J.G.Apostolopoulos et al. (2002) [1] reviewed about video compression and video compression standards and also found that the three fundamental challenges in video streaming: unknown and time-varying bandwidth, delay jitter, and loss.

2 Routing Protocol & Transmission Mechanism

A routing protocol is a protocol that specifies the way in which routers communicate with each other, disseminating information that enables them to select routers between any two nodes or a computer network, the choice of route being done by routing algorithm.

2.1 Ad-hoc On-demand Multipath Distance Vector Routing (AOMDV)

AOMDV has numerous features. AOMDV discovers routes on demand using route discovery method. The most important variation is the amount of routes found in each route discovery. In AOMDV, RREQ transmission from source to the target establishes multiple reverse paths both at intermediate node in addition to the destination. Multiple reverse paths at intermediate nodes in addition to the destination. Multiple RREP's navigate this reverse route back to form multiple routes to target at the source and intermediate nodes. The AOMDV uses the basic AODV route construction process. In this case, however, some extensions are made to create multiple loop-free, link-disjoint paths.The main idea in AOMDV is to compute multiple paths during route discovery. It consists of two components: 1) A route update rule to establish and maintain multiple loop-free paths at each node. 2) A distributed protocol to find link-disjoint paths.

In AOMDV this is used at the intermediate nodes. Duplicate copies of a RREQ are not immediately discarded. Each packet is examined to see if it provides a node-disjoint path to the source. For node-disjoint paths all RREQs need to arrive via different neighbors of the source. This is verified with the first hop field in the RREQ packet and the first hop list for the RREQ packets at the node. the destination a slightly different approach is used, the paths determined there are link-disjoint, not node-disjoint. In order to do this, the destination replies up to k copies of the RREQ, regardless of the first hops.

ALGORITHM

Step1: Send request from source to the selected destinations.

Step2: Shortest multipath selection is done and transmission takes place.

Step3: Destination will send reply consisting hop count of route.

Step4: Multipath route selection is done and is updated in the routing table.

Step5: Divide the traffic on available routes as less hop count routes will assign more traffic.

Step6: Now transmit data according to the above division ratio through discovered routes.

2.2 Multipath Schemes

Routing is responsible to establish and maintain possible end-to-end paths from source to destination. The main challenge in video streams is to classify the routes that ensure the video delivery with a satisfying quality. In general, Multipath routing can improve QoS by providing the following:

Accumulation of bandwidth and delay: breaking the capacity of more than one route.

Route load balancing: balance the traffic load in higher number of nodes.

Fault tolerance: by adding redundancy, to reduce the effect of network failures onto affected video quality, it is important that the paths are disjoint. In case the Multipath routing protocol offers multiple paths with sufficient path diversity, it is less probable that a link failure affecting one of the paths simultaneously affects one of the other paths. This is especially beneficial in real-time streaming, where information is useful in checking the disjointness of alternate paths.

Destination	Sequence number	Hop count	Next hop	Timeout

(a)

Destination	Sequence No.	Advt Hop count	Route list			
			Next hop 1 Next hop 2	Last hop 1 Next hop 2	Hop count 1 Hop count 2	Time out 1 Time out 2

(b)

Figure 2 (a) AODV Routing table,
(b) AOMDV Routing table

including: next hop, last hop, hop count, and expiration timeout.

AOMDV relies as much as possible on the routing information already available in the underlying AODV protocol, thereby limiting the overhead incurred in discovering multiple paths.

Figure 2 shows the difference in the routing table entry structure between AODV and AOMDV. AOMDV route table entry has a new field for the advertised hop count. Besides a route list is used in AOMDV to store additional information for each alternate path.

2.3 Efficient Geographic Multicast Protocol

EGMP uses a two-tier structure. The whole network is divided into square zones. In each zone, a leader is elected and serves as a representative of its local zone on the upper tier. The leader collects the local zone's group membership information and represents its associated zone to join or leave the multicast sessions as required. As a result, a network-range core-zone-based multicast tree is built on the upper tier to connect the member zones. The source sends the multicast packets directly onto the tree. And then the multicast packets will flow along the multicast tree at the upper tier. When an on-tree zone leader receives the packets, it will send the multicast packets to the group members in its local zone.

The zone-based tree is shared for all the multicast sources of a group. To further reduce the packet forwarding overhead and delay, EGMP supports bi-directional packet forwarding along the tree structure. That is, instead of sending the packets to the root of the tree first, a source forwards the multicast packets directly along the tree. At the upper layer, the multicast packets will flow along the multicast tree both upstream to the root zone and downstream to the leaf zones of the tree. At the lower layer, when an on-tree zone leader receives the packets, it will send them to the group members in its local zone.

ALGORITHM

Step 1: Network is divided into square zone and in each zone a leader is elected. Zone leader (zLdr) maintains a multicast table.

Step 2: When a zone leader receives the NEW SESSION message, it will record the group ID and the root-zone ID in its multicast table.

Step 3: The leader will send JOIN REQ message towards root zone, on receiving it destination will sent back JOIN REPLY message back to source.

Step 4: The leader will send a JOIN REQ message to the zone to refresh cluster information.

Step 5: Multipath selection is done in the cluster using Dijikstras algorithm.

Step 6: Video is split and transmitted in the selected multipath to multiple selected destinations.

Step 7: When a zone leader receives END SESSION message, the node will remove all the information and stops the transmission.

Video Streaming Traffic

A video streaming flow can be split into multiple sub-streams and delivered through different network simultaneously. Based on video transmitted, each video traffic burst is generated over fixed intervals and consist of an I or P frame and number of B frame.

To remove temporal redundancy, intra-coded (I) frame are interleaved with predicted (P) frames and bi-directionally code (B) frames. I frames are compressed versions of raw frames independent of other frames, whereas P frames only refer preceding I/P frames and B frames can refer both preceding and succeeding frames. A sequence of video frames from I frame to next I frame comprises group of picture (GoP). Because P and B frames are encoded with reference to preceding and/or succeeding I/P frames, traffic transmission follows the batch arrival.

3 PROPOSED WORK

3.1 Multipath Routing

Multipath routing [11] is the routing technique of leveraging multiple alternative paths through a network, which can yield a variety of benefits such as fault tolerance, increased bandwidth, improved delay, increased throughput or improved security. The ability of creating multiple routes from a source to a destination is used to provide a backup route. When the primary route fails to deliver the packets in some way, the backup is used.

3.2 Multicast Routing

Multicast communication [10] is an efficient solution for group applications in the Internet. Multicast conserves the network bandwidth by constructing a spanning tree between sources and receivers. A single copy of the data is sent to all the receivers through the multicast tree. Applications such as videoconferencing, distant learning or network games use video, audio and data traffic.

3.3 Multipath Multicasting

Multipath Multicasting is based on three aspects:

1. Multipath selection and establishment
2. Multipath route maintenance
3. Load distribution for distributing traffic among multiple paths

MULTIPATH SELECTION AND ESTABLISHMENT

In AODV, when a node broadcasts a RREQ message, it is often likely to receive more than one response message since any node in the multicast tree can respond to the message. If the source node receives one or more RREP messages in this time, it queries the multicast table and check if the route is activated to confirm which one is the first arrival.

The source node unicasts a MACT (Multicast Activation) to the node which RREP is the first arrival for activating the route and sends packets through the path due to the first path has the shortest latency. The intermediate nodes, which received MACT, activate the related entry in multicast table, and then forward the MACT to next hop until one group member receives MACT. Multiple paths are selected to reduce resource consumption and improve calculation efficiency.

MULTIPATH ROUTE MAINTENANCE

The wireless link is easy to break because of nodes mobility or other reasons. When a node doesn't receive any message from the adjacent node or can't send any packet to the next hop, it thinks the link is broken. When the intermediate nodes in this path receive RERR, they delete the entry in the route table, and continue to forwarding RERR until the source node receives RERR message.

When the source node receives the RERR, it deletes the related entry in the route table, searches backup route table [11] and checks whether both paths are invalid. If the two paths are broken at the same time, the source node broadcasts RREQ to initiate a new route discovery.

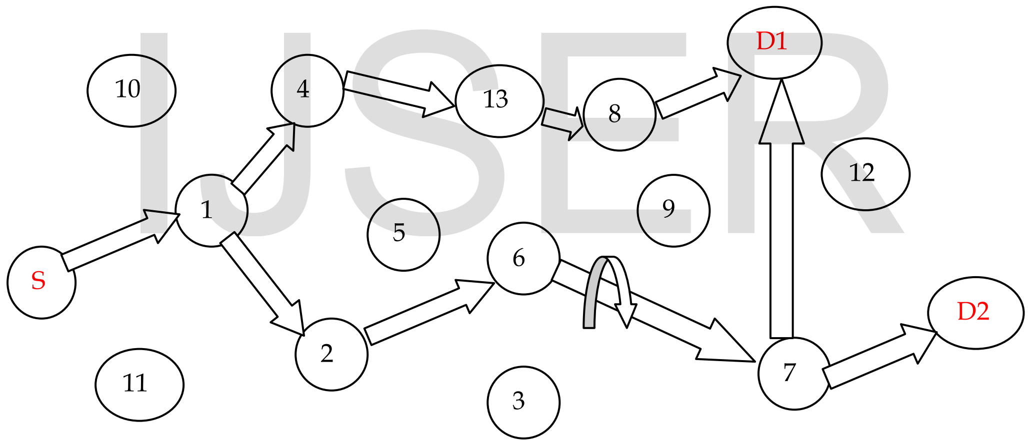

Figure 3 : Link Failure

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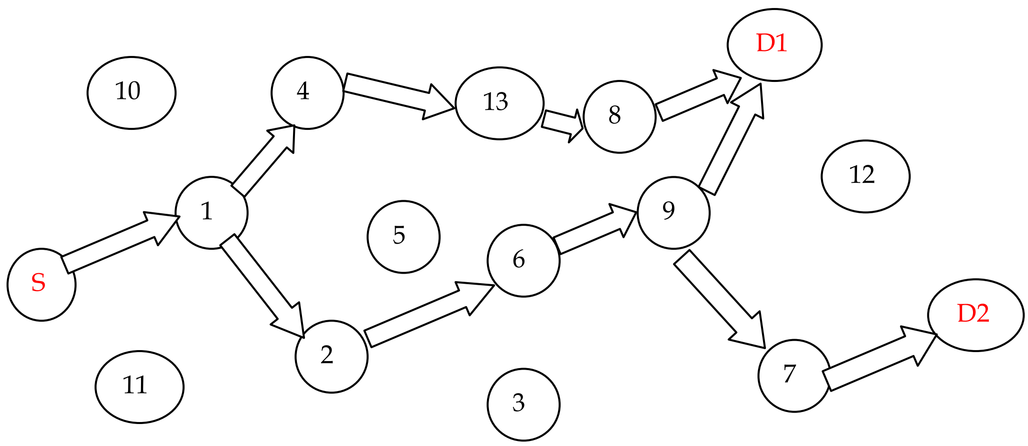

Figure 4: Choosing an alternate path

4 RESULTS AND DISCUSSIONS

4.1 SIMULATION SCENARIO

To evaluate the performance of the Modified-AOMDV routing protocol, NS2 is used. The Monarch research group in CMU has extended the NS-2 network simulator to include physical layer, link layer and MAC layer models to support multi-hop wireless network simulations.

4.2 PERFORMANCE EVALUATION

PERFOMANCE MTRICS

DELAY

It is defined as the average time taken by the packet to reach the server node from the client node. The lower value of delay means the better performance of the protocol. Delay differs depending on location of specific pair of communicating nodes.

Delay = (Inter-arrival of 1st and 2nd packet) / (Total packet delivered Time)

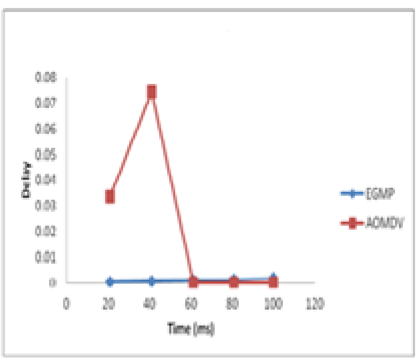

Figure 5 Time Vs. Delay

Delay is calculated for both AOMDV and EGMP algorithm. From the Figure 5 it is inferred that the delay has been decreased by about 17.2896% than the AOMDV algorithm.

CONTROL OVERHEAD

Control overhead is obtained on number of control route request packet and number of route reply packet. Total control packet sent also included in overhead calculation. Overhead does not increase with number of routes being created.

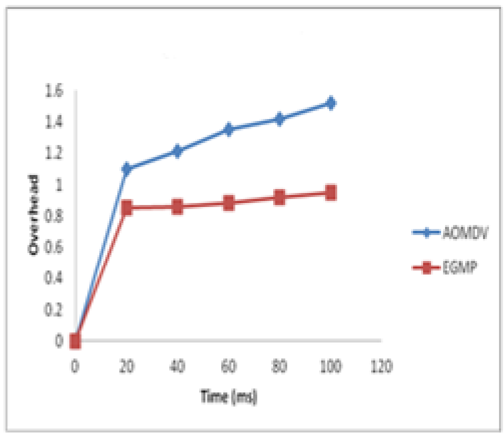

Figure 6 Time Vs. Overhead

Figure 6 shows the proposed method performs better than the existing method for different time intervals. Overhead is calculated and compared between EGMP and AOMDV algorithm.

Comparison result shows the overhead decreases by 0.15% for EGMP algorithm than AOMDV algorithm. This indicates number of control packet in transmission is reduced.

OUTAGE PROBABILITY

Each interfering signal is subject to multipath and shadow fading and it is necessary to incorporate these effects in assessing the performance of wireless systems. In such an environment, the link performance evaluation depends on many channel parameters. To assess the impact of these different parameters evaluation metric called outage probability is evaluated. The outage probability is an important performance measure of communication links operating over composite fading/shadowing channels. It is defined as the probability that the output SIR falls below a given threshold.

Outage probability is analyzed with respect to signal to interference ratioThe outage probability is high as the normalized distance between the node is less. As the normalized distance increases, the signal is prone to losses and outage probability reduces.

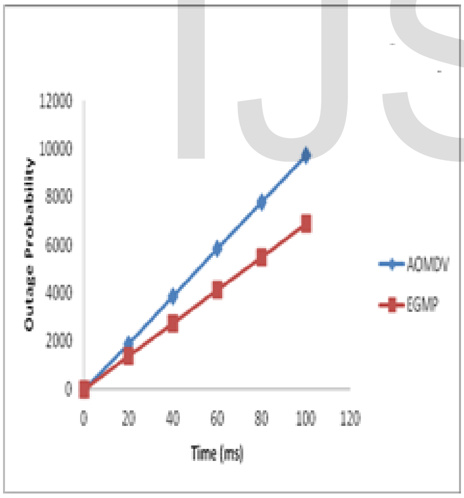

Figure 7 Time vs. Outage Probability

Figure 7 indicates the output Signal to Interference Ratio falls below a given threshold. As the normalized distance increases, the signal is prone to losses and outage probability reduces. It is observed that the outage probability has been decreased by 0.12% than the AOMDV.

CONCLUSION

In this paper, the packet level performance of video multipath multicast transmission over wireless ad-hoc networks has been analyzed. The effect of average network delay, routing overhead and outage probability are measured. From simulation result, it is found that the performance of EGMP protocol is much better during multipath multicast transmission than for AOMDV protocol.

Simulation result indicates that delay have been decreased by an amount of 17.3% than the AOMDV which implies that video quality is improved in the network, therefore interruption in video playback is reduced. It is also found that the overhead and outage probability has been decreased by an amount of 0.15% and 0.12% respectively.

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(a)

Applied Field (10^4 A/m)

Fig. 1. Magnetization as a function of applied field. Note that "Fig." is abbreviated. There is a period after the figure number, followed by one space. It is good practice to briefly explain the significance of the figure in the caption.

Figure axis labels are often a source of confusion. Use words rather than symbols. As an example, write the quantity "Magnetization," or "Magnetization *M*," not just "*M*." Put units in parentheses. Do not label axes only with units. As in Fig. 1, for example, write "Magnetization (A/m)" or "Magnetization ($A \cdot m^{-1}$)," not just "A/m." Do not label axes with a ratio of quantities and units. For example, write "Temperature (K)," not "Temperature/K." Table 1 shows some examples of units of measure.

Multipliers can be especially confusing. Write "Magnetization (kA/m)" or "Magnetization (103 A/m)." Do not write "Magnetization (A/m) × 1,000" because the reader would not know whether the top axis label in Fig. 1 meant 16,000 A/m or 0.016 A/m. Figure labels should be legible, approximately 8 to 12 point type. When creating your graphics, especially in complex graphs and charts, please ensure that line weights are thick enough that when reproduced at print size, they will still be legible. We suggest at least 1 point.

TABLE 1
UNITS FOR MAGENTIC PROPERTIES

Symbol	Quantity	Conversion from Gaussian and CGS EMU to SI [a]
Φ	magnetic flux	1 Mx $\rightarrow 10^{-8}$ Wb $= 10^{-8}$ V·s
B	magnetic flux density, magnetic induction	1 G $\rightarrow 10^{-4}$ T $= 10^{-4}$ Wb/m^2
H	magnetic field strength	1 Oe $\rightarrow 10^3/(4\pi)$ A/m
m	magnetic moment	1 erg/G = 1 emu $\rightarrow 10^{-3}$ A·m^2 $= 10^{-3}$ J/T
M	magnetization	1 erg/(G·cm^3) = 1 emu/cm^3 $\rightarrow 10^3$ A/m
$4\pi M$	magnetization	1 G $\rightarrow 10^3/(4\pi)$ A/m
σ	specific magnetization	1 erg/(G·g) = 1 emu/g $\rightarrow$ 1 A·m^2/kg
j	magnetic dipole moment	1 erg/G = 1 emu $\rightarrow 4\pi \times 10^{-10}$ Wb·m
J	magnetic polarization	1 erg/(G·cm^3) = 1 emu/cm^3 $\rightarrow 4\pi \times 10^{-4}$ T
χ, κ	susceptibility	$1 \rightarrow 4\pi$
χ_ρ	mass susceptibility	1 cm^3/g $\rightarrow 4\pi \times 10^{-3}$ m^3/kg
μ	permeability	$1 \rightarrow 4\pi \times 10^{-7}$ H/m $= 4\pi \times 10^{-7}$ Wb/(A·m)
μ_r	relative permeability	$\mu \rightarrow \mu_r$
w, W	energy density	1 erg/cm^3 $\rightarrow 10^{-1}$ J/m^3
N, D	demagnetizing factor	$1 \rightarrow 1/(4\pi)$

Statements that serve as captions for the entire table do not need footnote letters.
[a]Gaussian units are the same as cgs emu for magnetostatics; Mx = maxwell, G = gauss, Oe = oersted; Wb = weber, V = volt, s = second, T = tesla, m = meter, A = ampere, J = joule, kg = kilogram, H = henry.

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Number footnotes separately in superscripts (Insert | Footnote)[1]. Place the actual footnote at the bottom of the column in which it is cited; do not put footnotes in the reference list (endnotes). Use letters for table footnotes (see Table 1). Please do not include footnotes in the abstract and avoid using a footnote in the first column of the article. This will cause it to appear of the affiliation box, making the layout look confusing.

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1. Items will be set outside of the paragraphs.
2. Items will be punctuated as sentences where it is appropriate.
3. Items will be numbered, followed by a period.

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Theorems and related structures, such as axioms corollaries, and lemmas, are formatted using a hanging indent paragraph. They begin with a title and are followed by the text, in italics.

Theorem 1. *Theorems, corollaries, lemmas, and related structures follow this format. They do not need to be numbered, but are generally numbered sequentially.*

[1]It is recommended that footnotes be avoided (except for the unnumbered footnote with the receipt date on the first page). Instead, try to integrate the footnote information into the text.

Proofs are formatted using the same hanging indent format. However, they are not italicized.

Proof. The same format should be used for structures such as remarks, examples, and solutions (though these would not have a Q.E.D. box at the end as a proof does).

7 End Sections

7.1 Appendices

Appendixes, if needed, appear before the acknowledgment. In the event multiple appendices are required, they will be labeled "Appendix A," "Appendix B, " etc. If an article does not meet submission length requirements, authors are strongly encouraged to make their appendices supplemental material.

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Acknowledgment

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