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Subterranean Decibal Networks of AUVs by Adopting Location Conscious Source Routing

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Abstract: Acoustic networks of autonomous underwater vehicles cannot typically rely on protocols intended for terrestrial radio networks. Therefore a new location-aware source routing (LASR) protocol is shown to provide superior network performance over two commonly used network protocols = flooding and dynamic source routing (DSR). LASR includes an improved link/route metric and a node tracking system. LASR greatly increases performance compared to DSR.LASR includes a tracking system that predicts node locations, so that LASR can proactively respond totopology changes. LASR delivers 2-3 times as many messages as flooding in 72% of the simulated missions and delivers 2–4 times as many messages as DSR in 100% of the missions. In 67% of the simulated missions, LASR delivers messages requiring multiple hops to cross the network with 2–5 times greater reliability than flooding or DSR.

Keywords: AUVs, MANET, LASR, DSR, FER.

I.INTRODUCTION

As autonomous underwater vehicles (AUVs) continue to become less expensive and more capable, they are being deployed in larger groups. As a result, the need to communicate between multiple, mobile underwater systems is growing as well. Underwater communication is best accomplished through the use of acoustic links, and interconnecting multiple underwater vehicles is best accomplished through the use of an acoustic network. Such a network, one using a shared medium and comprising mobile nodes, is called a mobile ad hoc network (MANET). It is difficult to efficiently forward data across a MANET because node mobility means network topology—the overall set of connections between nodes—changes over time. The network must spontaneously organize, learn the topology, and begin routing with a minimum of overhead traffic for route discovery and maintenance. There has been a great deal of attention paid to this problem, but almost exclusively as it applies to wireless radio networks.A message may have to be forwarded across one or more links to intermediate nodes before reaching its intended destination. Routing is the process of choosing the links that will comprise the route the message will follow across the network. A routing protocol is responsible for selecting the route. Most routing protocols collect, manage, and disseminate information about the network in order to function, for example, by monitoring network topology, specifying the next hop of a message, queuing messages awaiting routes, and tracking which messages have already been processed. Unlike in a traditional, wired network, routing in a mobile ad hoc network (MANET) is complicated by the possibly rapid and unpredictable topological changes caused by movement of the nodes.

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II. PROPOSED WORK

The new LASR protocol has been specifically designed to address the problems of routing in low-bandwidth, high-latency underwater acoustic networks of mobile nodes. It is loosely based on the DSR protocol. Like DSR, LASR is a self-organizing, infrastructure-less, distributed protocol. It learns and maintains only those routes that are in use.LASR uses the source route principally as a means to communicate topology information. Each inter-mediate node updates the source route in every message it forwards, applying the route most likely to require the fewest transmissions (which does not necessarily correspond to the fewest hops) to reach the destination. Every message transmission is therefore routed according to the most current topological knowledge, rather than DSR's approach which routes according to the topological knowledge at the time the message was originated.

The LASR protocol is designed for small underwater networks using low-speed acoustic links. This network size limitation is due in lesser part to the source route header overhead in each message. The size of the source route grows linearly with the length of the longest path through the network. In greater part, this assumption is due to LASR's required use of TDMA, which does not scale well into large networks.

Nodes may move at any time and in any direction. The only restriction on node motion is that speeds should be in the range 0–3 m/s; this speed range is typical for most current AUVs. This assumption is necessary to limit the rate at which node motion can change the network topology.

All nodes must use identical LASR algorithms, and all must fully participate in the protocol, including forwarding the messages of others.Every node must have accurate timekeeping, for example, by means of a low-drift clock. No two node clocks may differ by more than 50 milliseconds throughout a mission, although this network time may differ from true time by any amount. This is necessary for TDMA window timing. Equipped with the optional time synchronization feature, the FAU Dual Purpose Acoustic Modem (DPAM) fits this requirement over 8 hours using low-drift clocks. Also, prior work has shown that for LASR, this is the minimum timekeeping precision necessary to preserve the accuracy of the time-of-flight range estimates based on TDMA window timing.The communication link endpoints should be identical acoustic modems, and these modems should be effectively omnidirectional. They must support overhearing—the reception of messages not specifically addressed to them. Overhearing is an important source of topology information.

To allow the tracking system to function, each modem must report the time at which any incoming transmission is detected, regardless of whether or not the transmission can be successfully decoded. The detection time reporting must be accurate to within 30 milliseconds. As with the timekeeping precision, this reporting precision has been shown to be the minimum necessary for time-of-flight range estimate accuracy. LASR's implementation of ETX assumes that network links are bidirectional (acoustic modem links are traditionally bidirectional, albeit half-duplex) and symmetrical, meaning packets can cross the link between any pair of nodes in either direction with equal probability of success. In practice, the links are not perfectly symmetrical, but symmetry is a fair assumption so long as the transducer is assumed omnidirectional and the environmental conditions (and range between nodes) do not change significantly between two transmissions. The development of a nonsymmetrical and unidirectional version of LASR is beyond the scope of this article, but constitutes a future key for development of LASR. The links are assumed to be through a shared medium. The network must use TDMA as the

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MAC protocol so that implicit time-of-flight range estimate is possible.The ETX implementation also assumes that a medium model exists for the modem, which can provide a reasonably accurate estimate of the frame-error rate (FER) between two modems given the distance between them. The FER is the probability that a given transmission (a frame) on the link will be received in error. All nodes must use identical medium models and the FER estimate must be deterministic: every use of the model at every node must return the same FER for a given range. Note that the FER model includes other input parameters (sea state, ambient noise, water depth, bottom type etc…). A complete list is provided in. The FER model used in the simulation was developed from field data. For simplicity, the study assumes that every input parameter is constant, with the exception of range. These other parameters impact the FER, thus the LASR performance. At fixed range, the authors showed in that the LASR performance drops with ambient noise and sea state, as the FER increases with these two parameters.

A range-only tracking system is assumed to be available at each node. Regular measurements of the distance from the local node to each of the various other nodes within detection range will be available from a combination of the modem's transmission detection and TDMA window timing. The tracking system must use those time-of-flight based range measurements to predict the current location of those nodes relative to the local node. Prior work has shown that the tracking system must predict relative node position to within 200 m of the true relative node position. If the estimated prediction error exceeds this amount for a given node, the tracking system must cease reporting the predicted position of that node.

*A. LASR Packet Structure*Each LASR packet contains one or more messages. A message can contain user data or protocol data. A user-data message contains a source-route in addition to the user data.

Packets are small in a typical acoustic network, typically on the order of tens to hundreds of bytes only. This makes header overhead very expensive as even a small header can represent a large fraction of a packet. LASR uses a different header structure than DSR in order to reduce the size of the header as much as possible. The number of bits added to the header by a given layer can change from message to message.

To accommodate this, the header is implemented as a stack of bits. A source route is structured as a series of triples followed by an end marker. Each triple is a hop in the route starting at the originator and ending one hop before the destination. A triple comprises the address of the node, the best-available estimate of the range from the node to the next hop (or the destination) and the timestamp of the range estimate. Both the range and its timestamp are quantized to conserve space in the header. The route end is the special network address zero, which is never a valid address. The network addresses are represented as the smallest number of bits that can represent the number of nodes in the network, plus one for the special zero address. For example, a 16 node network would require 17 unique addresses and would therefore require 5-bit addresses.

IV. CONCLUSION

The new location-aware source routing (LASR) is a reactive, link-state MANET routing protocol specifically designed to the constraints of an underwater acoustic network. It was intended for small underwater networks using low-bandwidth, high-latency acoustic links. Nodes were assumed to be mobile, moving at any time (including continuously) and in any direction with node speeds in the range of 0–3 m/s. LASR used the implicit information drawn from incoming transmissions to estimate ranges to neighboring nodes; these ranges were continuously fed into a tracking system which estimated local network topology. Other improvements included the addition of

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the ETX route metric to replace minimum hop-count, the use o an acknowledgment guarantee and aggressive, preemptiv rerouting.Simulated missions showed that the flooding protoc and DSR performed poorly in an underwater acoustic networ The flooding protocol provided reliable delivery at the cost o decreased message delivery counts. The DSR protocol regular delivered the fewest messages with the least reliability.

The simulations showed the new LASR protocol to be superi to the DSR and blind-flooding routing protocols. In many of th simulated missions, LASR delivered more messages tha flooding. In all of the simulated missions, LASR delivered mo messages than DSR. Under fair or marginal communicatio conditions, LASR delivered messages requiring multiple hops cross the network with greater reliability than flooding or DS in more than half of the missions.

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REFERENCES

[1] M. Chitre, S. Shahabudeen, and M. Stojanovic, "Underwat acoustic communications and networking: recent advances ar future challenges," Marine Technology Society Journal, vol. 4 no. 1, pp. 103–116, 2008.

[2] J. Heidemann, W. Ye, J. Wills, A. Syed, and Y. Li, "Researc challenges and applications for underwater sensor networking," in Proceedings of the IEEE Wireless Communications and Networking Conference (WCNC '06), vol. 1, pp. 228–235, April 2006.

[3] [3] D. Pompili and I. Akyildiz, "Overview of networking protocols for underwater wireless communications," Communications Magazine, IEEE, vol. 47, no. 1, pp. 97–102, 2009.

[4] [4] E. P. C. Jones and P. A. S. Ward, "Routing strategies for delay-tolerant networks," in ACM Computer Communication Review, 2006.

[5] [5] I. Cardei, C. Liu, J. Wu, and Q. Yuan, "DTN routing with probabilistic trajectory prediction," inProceedings of the Wireless Algorithms, Systems, and Applications (WASA '08), vol. 5258 ofLecture Notes in Computer Science, pp. 40–51, 2008.

[6] [6] M. Stojanovic, L. Freitag, J. Leonard, and P. Newman, "A network protocol for multiple AUV localization," in Proceedings of the MTS/IEEE Oceans Conference, vol. 1, pp. 604–611, Biloxi, Miss, USA, October 2002.

[7] [7] R. Bachmayer, J. A. Rice, R. Crebert, and C. Fletcher, "Navigation and control of multiple gliders in an underwater acoustic network," in Proceedings of the IEEE/OES Autonomous Underwater Vehicles, pp. 54–58, June 2004.

[8] [8] O. Normand, Synchronous spatial array processing for underwater vehicle tracking [M.S. thesis], Florida Atlantic University, 2002.

[9] [9] E. A. Carlson, P. P. Beaujean, and E. An, "An improved location-aware routing protocol for mobile underwater acoustic networks," in Proceedings of the MTS/IEEE Oceans Conference, Vancouver, Canada, October 2007. P. P. J. Beaujean and E. P. Bernault, "A new multi-channel spatial diversity technique for long range acoustic communications in shallow water," in Proceedings of the MTS/IEEE Oceans Conference, pp. 1533–1538, September 2003.

[10] E. A. Carlson, P. - Beaujean, and E. An, "An Ad Hoc wireless acoustic network simulator applied to multiple underwater vehicle operations in shallow waters using high-frequency acoustic modems," U.S. Navy Journal of Underwater Acoustics, vol. 56, pp. 113–139, 2006.

[11] E. A. Carlson, Simulator and location-aware routing protocol for mobile Ad Hoc acoustic networks of AUVs [Ph.D. dissertation], Florida Atlantic University, 2009.