

# Self-organized Routing for Radial Underwater Networks

PAPER ID: 2326

AUTHORS: WAHEEDUDDIN HYDER

JAVIER PONCELA

PABLO OTERO

# Problem Statement

- ▶ Localization is difficult in UWSN
- ▶ Most of the existing routing protocols are based on location.
- ▶ Few location free protocols are proposed which are based on additional resources like AUVs or some kind of measuring device.
- ▶ A self-organized location free protocol is needed which does not require any additional resources like pressure measuring devices or AUVs or time synchronization.

# Literature Survey

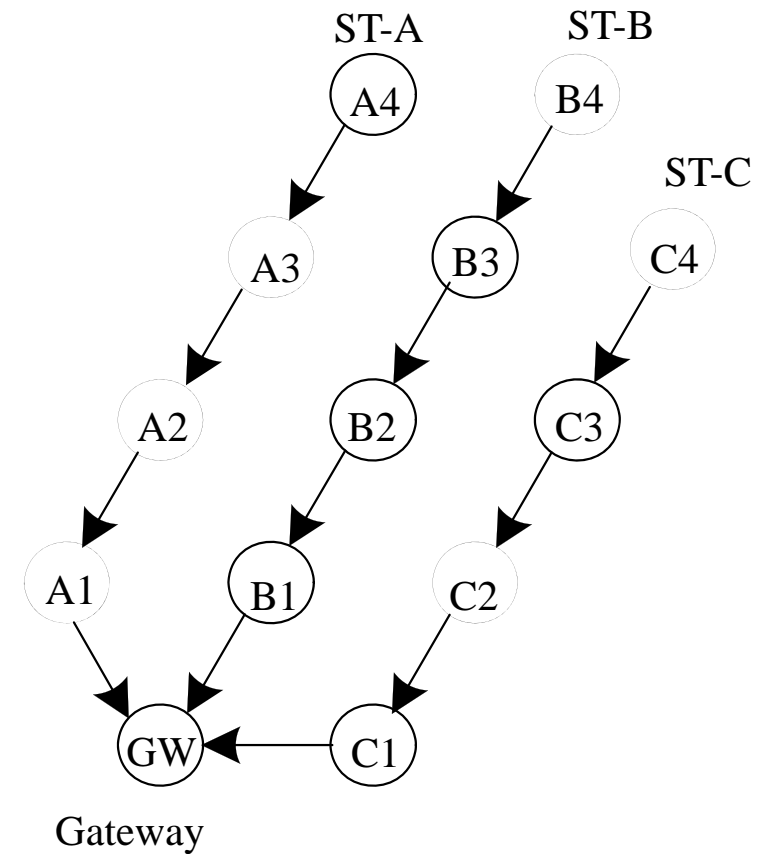
- ▶ Location based routing based protocols are not suitable for UWSN.
- ▶ Location based routing protocols which depend on Time of Arrival (ToA) or Angle of Arrival (AoA) require time synchronization and measuring equipment. [1, 2]
- ▶ Some location based protocols use AUVs [3 – 7].
- ▶ DBR [8] is a location free routing protocol and uses pressure sensors to estimate depth.
- ▶ LFLR [9] is also a location free protocol and it also uses pressure sensors to estimate depth.

# Research Objectives

- ▶ Design a routing protocol having the following characteristics:
  1. Self-organized
  2. Location-free
  3. Energy Efficient
  4. Support real time Multimedia traffic
  5. Fast Converging

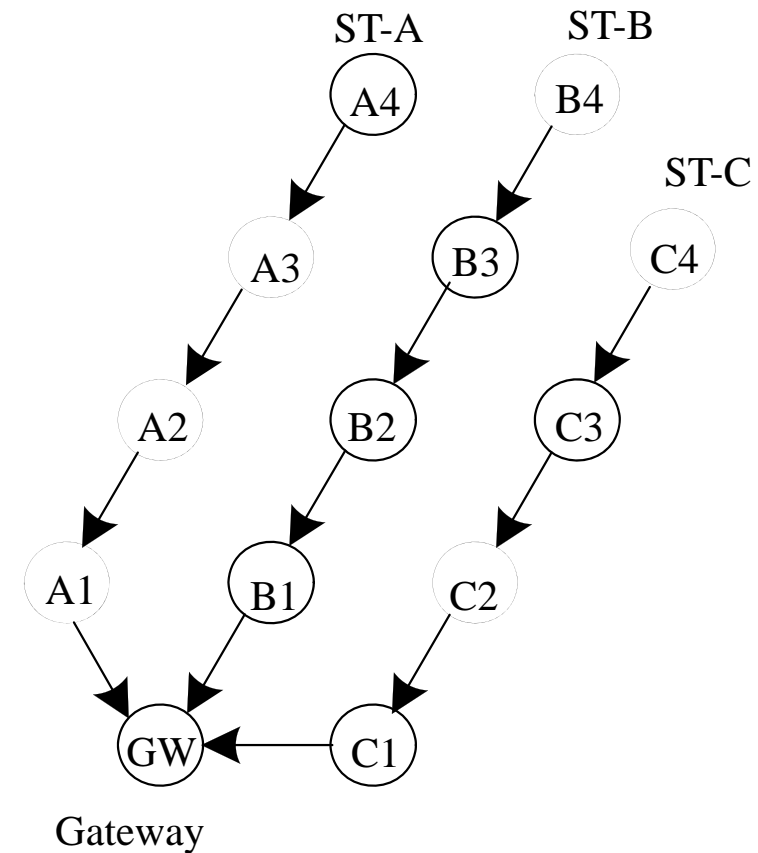
# Proposed Routing Protocol

- ▶ Forms straight routing paths called strings.
- ▶ Each node, in the straight path, forwards packets of the nodes above it towards the gateway (sink).
- ▶ Gateway initiates path formation by identifying its next hop neighbors.
- ▶ To identify the next hop neighbors the gateway broadcasts a request packet.
- ▶ After identifying the neighbors, the gateway initiates string formation process by broadcasting a route request packet.



# Proposed Routing Protocol

- ▶ The nodes forward the route request packet first.
- ▶ The nodes in the string (line) send back acknowledgment.
- ▶ When the last node in the string is reached a response packet is sent back to the gateway.
- ▶ This way all the nodes know their respective strings.
- ▶ The gateway also has complete knowledge of all the nodes and their respective strings.
- ▶ The middle node sends route request packet after the side node to avoid the collision.



# Conclusion

- ▶ The protocol does not require the location information to form the routing path.
- ▶ Since the routing path is predefined, the nodes takes minimum time to forward the packet.
- ▶ For a network of 24 nodes the complete period to form the routing paths is approximately 210 sec (3.5 mins).
- ▶ Keeping the high propagation delay in mind, this protocol considerably converges fast.
- ▶ Number of packets to form the path is not too large.
- ▶ It is energy efficient because it avoids collisions.

# References

- ▶ [1] Cheng X., Shu H., Liang Q., Du D.H.-C., "Silent positioning in underwater acoustic sensor networks", IEEE Transactions on Vehicular Technology, Vol. 57, pp. 1756–1766, May 2008
- ▶ [2] Syed A.A., Heidemann J., "Time Synchronization for High Latency Acoustic Networks", Proceedings of the 25th IEEE International Conference on Computer Communications, Barcelona, Spain, pp. 1–12, 23-29 April 2006
- ▶ [3] Zhou Y., He J., Chen K., Chen J., Liang A., "An area localization Scheme for large scale Underwater Wireless Sensor Networks", Proceedings of the WRI International Conference on Communications and Mobile Computing; Kunming, China, pp. 543–547, 6–8 January 2009
- ▶ [4] Erol M., Vieira L., Gerla M., "Localization with DiveNRise (DNR) Beacons for Underwater Acoustic Sensor Networks", Proceedings of the 2nd ACM International Workshop on UnderWater Networks, Montreal, QC, Canada, pp. 97–100, 14 September 2007
- ▶ [5] Erol M., Vieira L.F.M., Caruso A., Paparella F., Gerla M., Oktug S., "Multi Stage Underwater Sensor Localization Using Mobile Beacons", Proceedings of the 2nd International Conference on Sensor Technologies and Applications, Cap Esterel, France, pp. 710–714, 25–31 August 2008

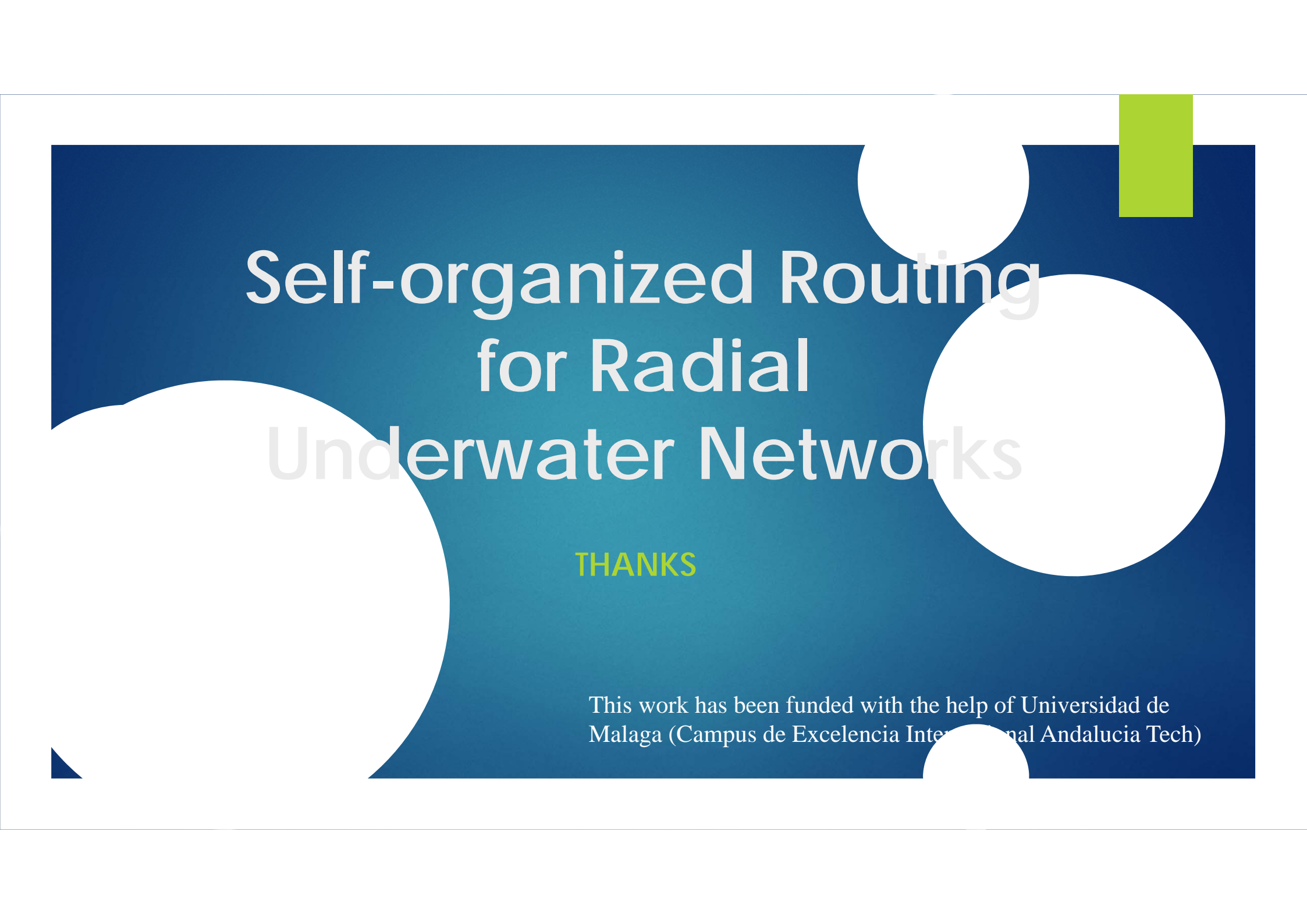


# References

- ▶ [6] Erol M., Vieira L., Gerla M., "AUV-Aided Localization for Underwater Sensor Networks", Proceedings of the International Conference on Wireless Algorithms, Systems and Applications; Chicago, IL, USA, pp. 44–54, 1–3 August 2007
- ▶ [7] Luo H., Guo Z., Dong W., Hong F., Zhao Y., "LDB: Localization with directional beacons for sparse 3D underwater acoustic sensor networks", Journal of Networks, Vol. 5, pp. 28–38, January 2010
- ▶ [8] H. Yan, Z.-J. Shi, and J.-H. Cui, "DBR: Depth-based routing for underwater sensor networks", in Proceedings of the 7th International, IFIP-TC6 Networking Conference on AdHoc and Sensor Networks, Wireless Networks, Next Generation Internet, NETWORKING'08, Berlin, Heidelberg, pp. 72–86, Springer-Verlag, 2008.
- ▶ [9] Michel Barbeau, Stephane Blouin, Gimer Cervera, Joaquin Garcia-Alfaro and Evangelos Kranakis, "Location-free Link State Routing for Underwater, Acoustic Sensor Networks", Proceeding of the IEEE 28<sup>th</sup> Canadian Conference on Electrical and Computer Engineering Halifax, Canada, pp. 1544-1549, 3-6 May 2015

# References

- ▶ [10] Xie P, Cui J-H, Lao L. "VBF: vector-based forwarding protocol for underwater sensor networks", NETWORKING'06 Proceedings of the 5th international IFIP-TC6 conference on Networking Technologies, Services, and Protocols; Performance of Computer and Communication Networks; Mobile and Wireless Communications Systems Berlin/Heidelberg, Springer, pp. 1216–21, 2006
- ▶ [11] Mari Carmen Domingo, Rui Prior, "A Distributed Energy-Aware Routing Protocol for Underwater Wireless Sensor Networks", Wireless Personal Communications, Vol. 57, pp. 607-627, April 2004
- ▶ [12] Zhang Senlin, Zhang Qiang, Liu Meiqin, Fan Zhen, Sheng Weihua, "A Multi-hop Reverse Localization Scheme for Underwater Wireless Sensor Networks", IEEE Control Conference, Xi'an, China, pp. 7383 – 7388, 26-28 July 2013
- ▶ [13] Yang K.W., Guo Y.B., Wei D.W., Jin Y.G. MFALM: An active localization method for dynamic underwater wireless sensor networks, Computer Science, Vol. 37, pp. 114–117, 2010



# Self-organized Routing for Radial Underwater Networks

THANKS

This work has been funded with the help of Universidad de  
Malaga (Campus de Excelencia Internacional Andalucia Tech)