On the Performance of Unsynchronized Distributed MAC Protocols in Deep Water Acoustic Networks

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Objectives

To compare MAC protocols employing asynchronous channel access in deep water networks

- Throughput
- Packet delivery ratio

To compare the results against those obtained in a shallow water scenario and understand if a sort of «winner» can be identified among the considered schemes

Results at a glance

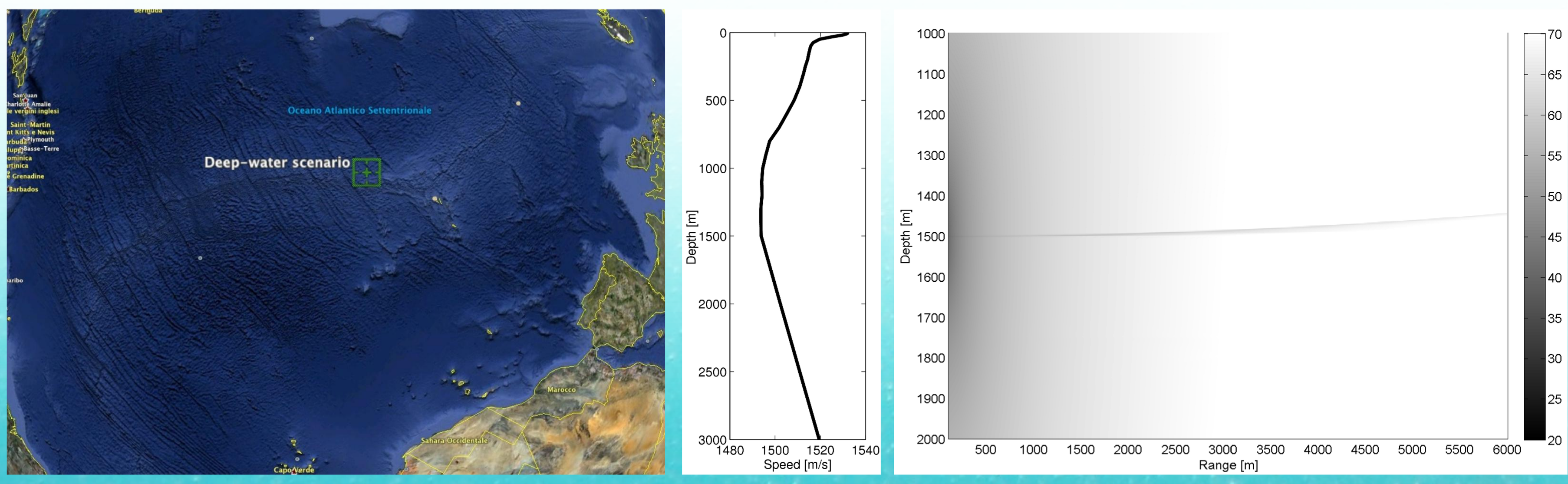
Three random access MAC schemes

- CSMA-ALOHA (short channel sensing)
- DACAP (RTS/CTS + warning)
- Tone-Lohi (transmitter-driven tone-based contention)

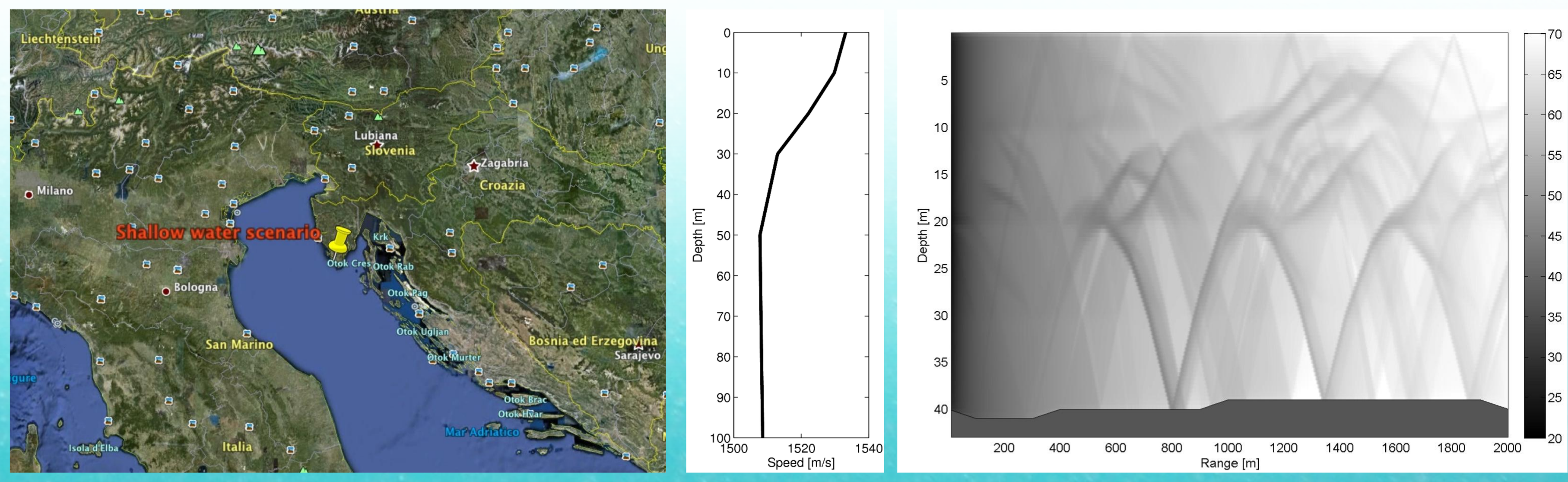
CSMA-ALOHA performs better

- Higher throughput because of more persistent access attempts
- The performance of DACAP and Tone-Lohi is unfavorably affected by the duration of the handshakes

Scenarios



Deep water scenario: location, SSP from WOD 2009 and attenuation from Bellhop (5 kHz, "incoherent" mode, darker = stronger signal)



Shallow water scenario: location, SSP from WOD 2009 and attenuation from Bellhop (11.5 kHz, "incoherent" mode, darker = stronger signal)

Protocols

CSMA-ALOHA

Sense the channel for a short, *random* time (much less than τ_{prop}), transmit if the channel is clear, otherwise repeat sensing until the channel is found free

DACAP

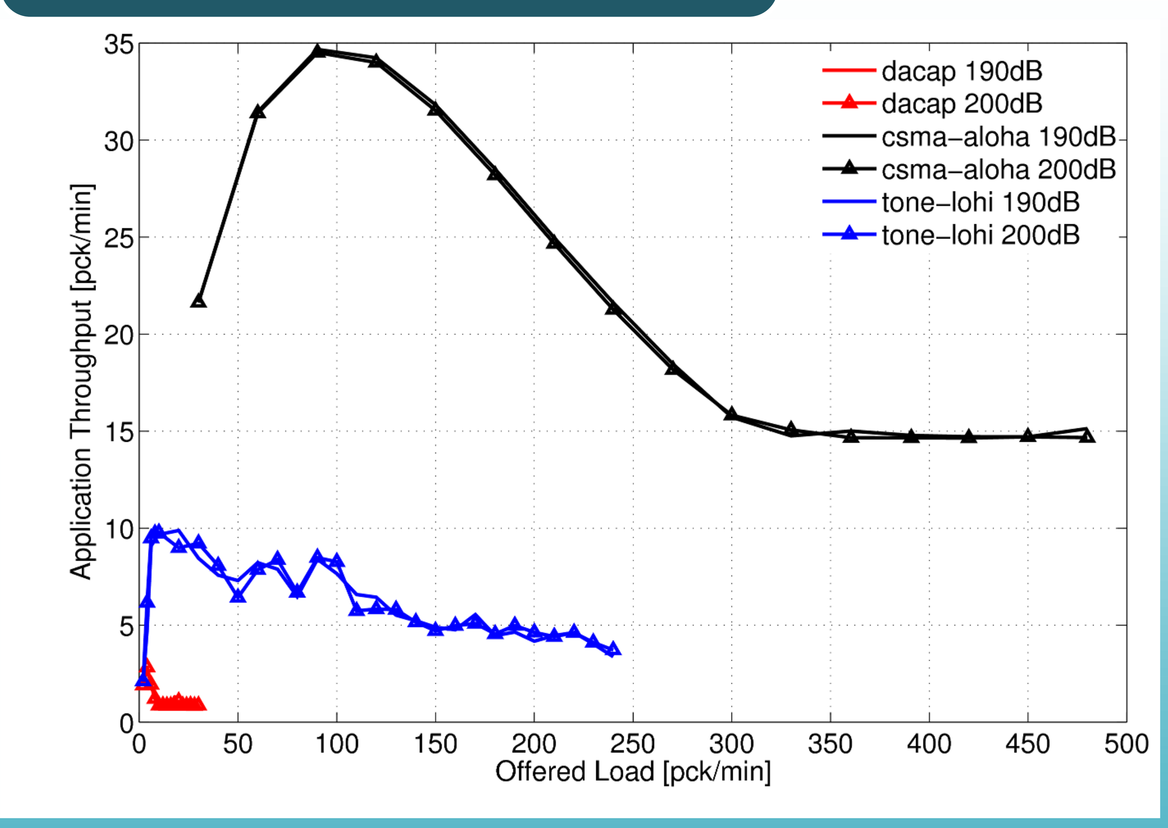
Transmit RTS, wait for CTS, defer DATA transmission to detect ongoing handshakes, back off (or warn the transmitter to back off) if a likely collision is detected.

Tone-Lohi

(aggressive version)

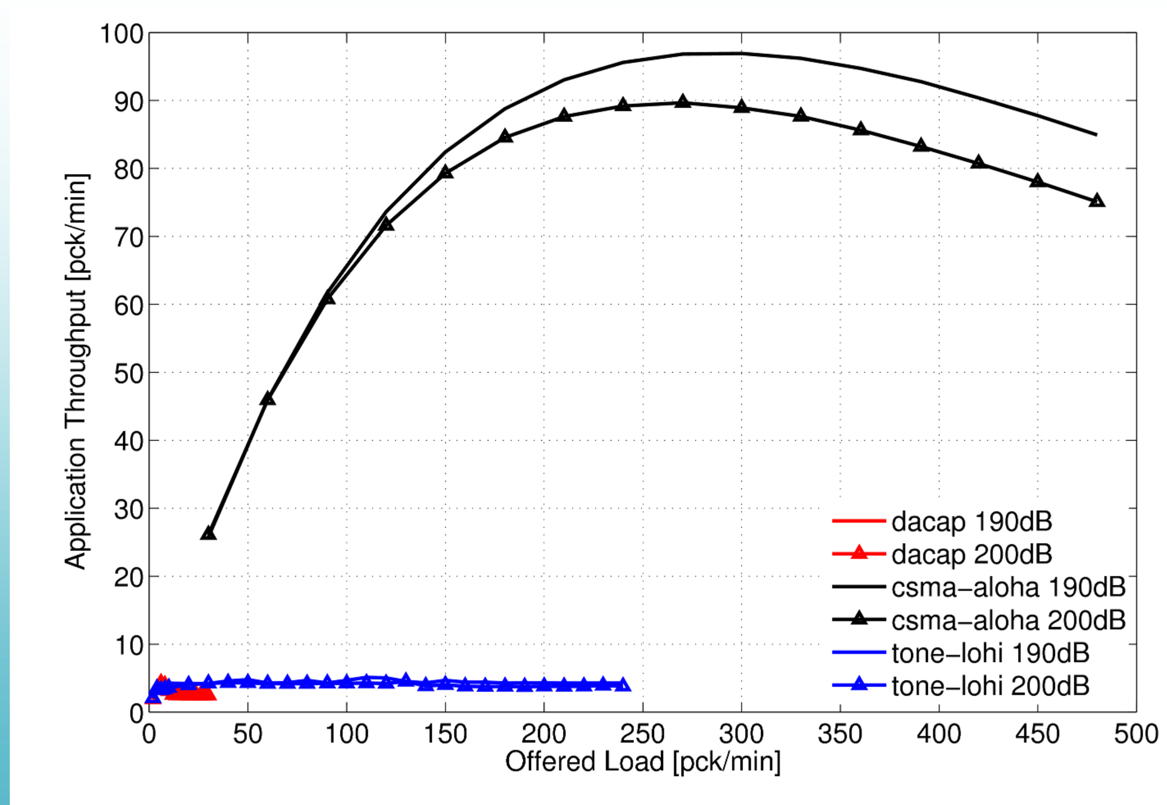
Transmit tone and contend, i.e., wait one τ_{prop}, transmit data if no other tone is heard; otherwise back off and repeat the tone transmission, or drop out of another tone is received

Results



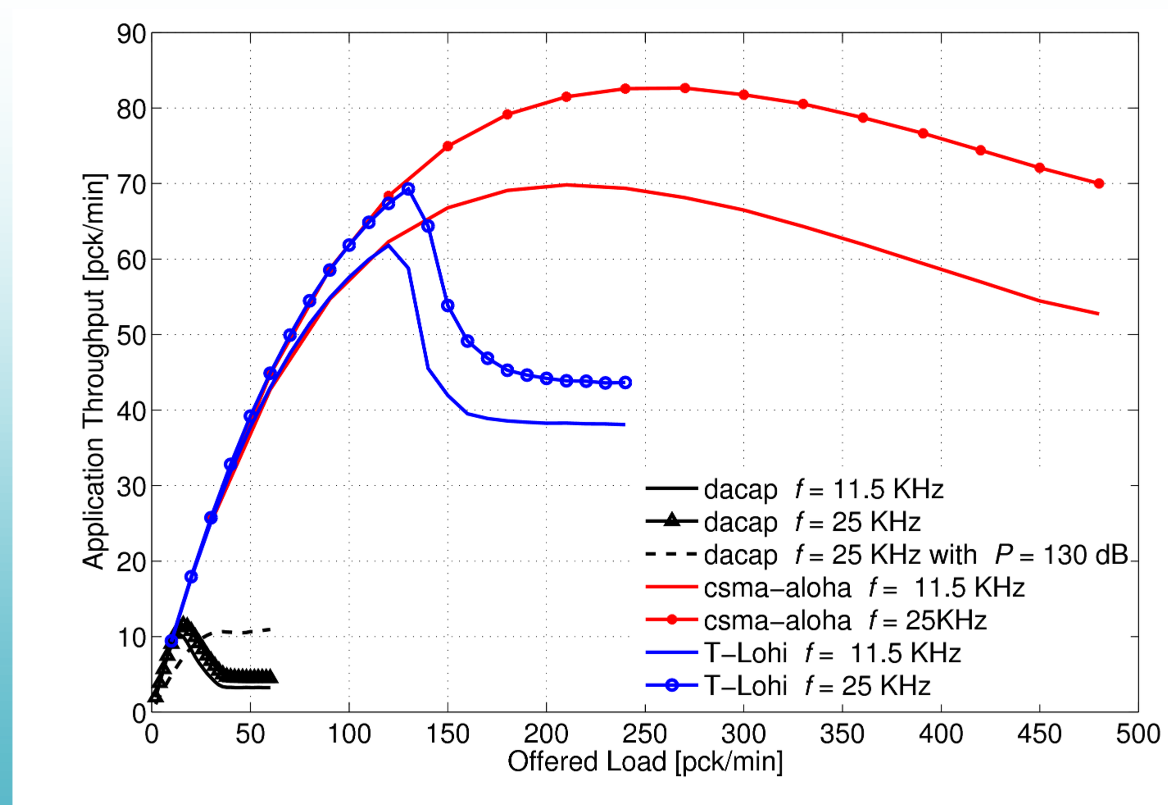
Deep water, carrier frequency of 5 kHz

CSMA-ALOHA's lighter access phase achieves better throughput than DACAP and T-Lohi



Deep water, carrier frequency of 25 kHz

Increased attenuation decreases interference, (CSMA-ALOHA's performance improves)



Shallow water, carrier fr. of 11.5 and 25 kHz

CSMA-ALOHA yields better throughput; DACAP benefits from a lower transmit power.

Conclusion: CSMA-ALOHA wins over more complicated asynchronous access schemes in the considered scenarios (main reasons: delay and interference)

This work was supported, in part, by Johns Hopkins University, Applied Physics Laboratory's internal research and development funds.