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A slotted floor acquisition multiple access based MAC protocol for underwater acoustic networks with RTS competition

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Key words: Underwater acoustic networks, Medium access control (MAC), Request-to-send (RTS) competition, Throughput, Energy consumption

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Introduction

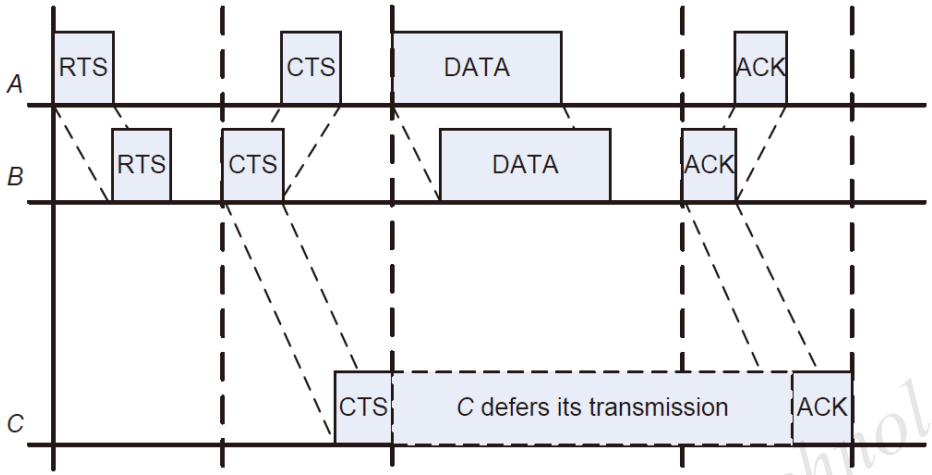
- Long propagation delay, limited bandwidth, and high bit error rate pose great challenges in media access control (MAC) protocol design for underwater acoustic networks.

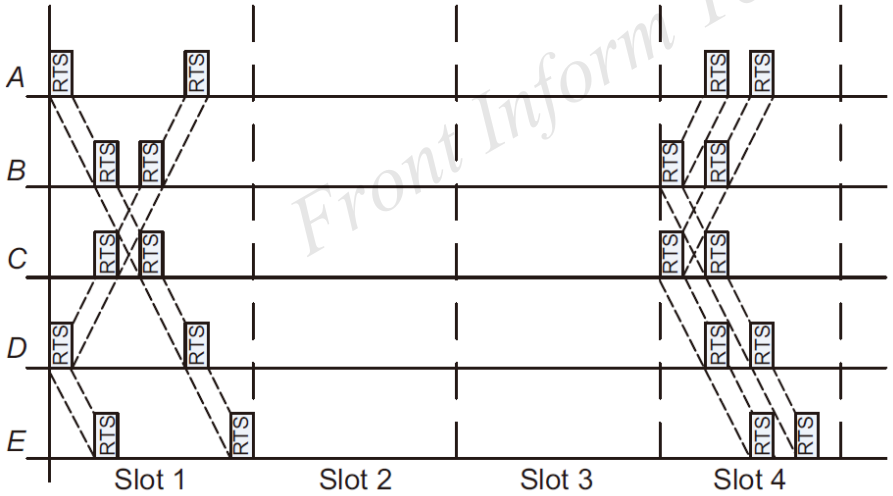
- A MAC protocol called slotted-FAMA suitable for underwater acoustic networks is proposed and analyzed. However, it is not suitable for dense networks since the multiple request-to-send (RTS) attempts problem in dense networks is serious and greatly limits the network throughput.

- We propose a slotted-FAMA based MAC protocol with RTS competition to solve this problem.

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Original slotted-FAMA and its limitation





Slotted-FAMA adds time slot mechanism to avoid DATA packet collisions. However, Slotted-FAMA is not suitable for dense networks since the multiple RTS attempts problem in dense networks is serious and greatly limits the network throughput.

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RC-SFAMA description

RC-SFAMA introduces RTS competition mechanism to keep the network from high frequency of backoff caused by the multiple RTS attempts problem. Via the RTS competition mechanism, useful data transmission can be completed successfully when the situation of multiple RTS attempts occurs.

1. The source nodes start to send RTS packets
2. More than one RTS is received and the multiple RTS attempts problem occurs
3. RTS competition
4. The winner continues finishing its transmission and other nodes go to the backoff state

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RC-SFAMA description

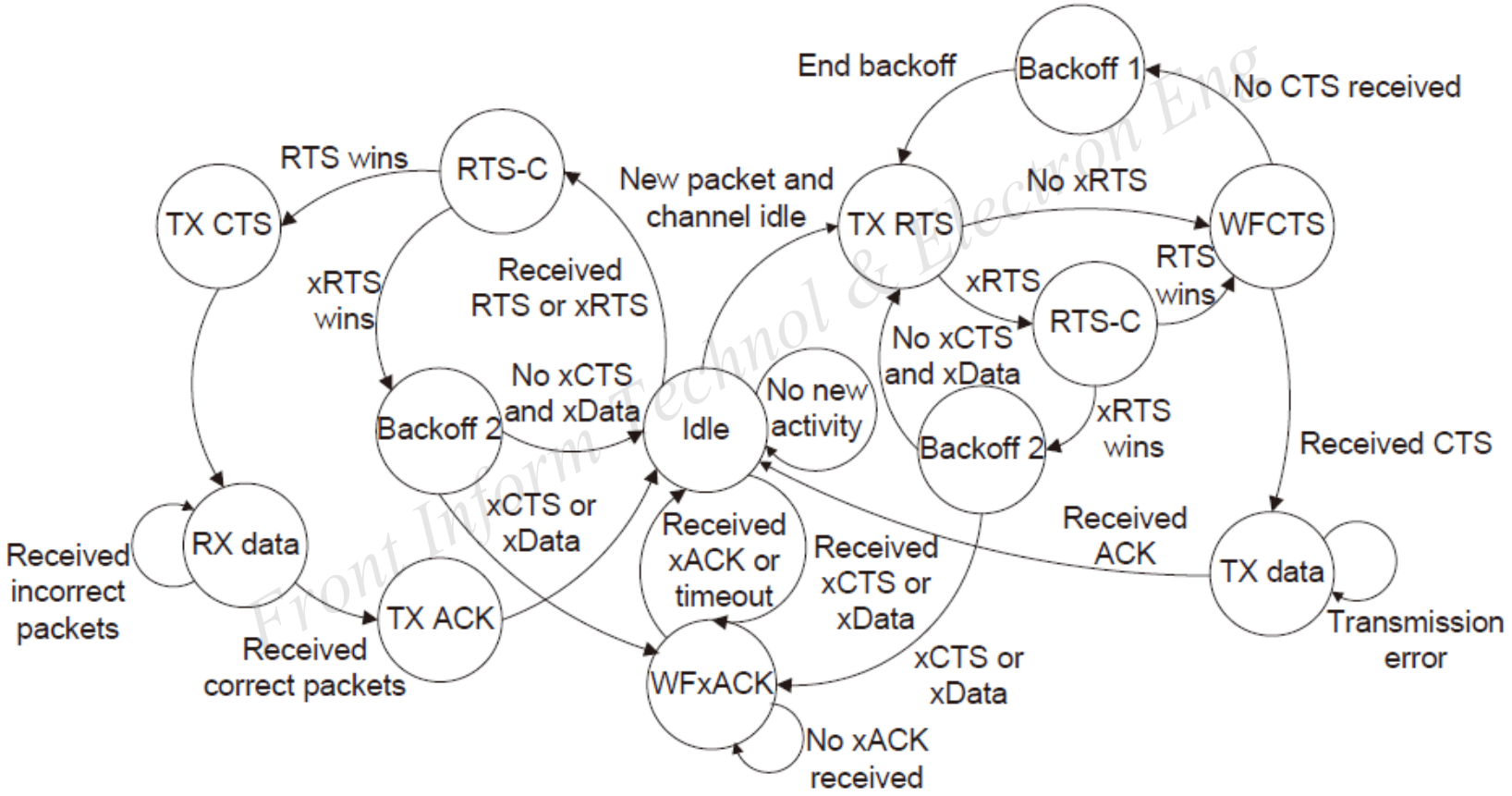


Fig. 3 State-transition diagram for RC-SFAMA

Simulation for throughput

RC-SFAMA performs better in network throughput than slotted-FAMA in dense networks. And the improvement becomes higher when the network becomes denser.

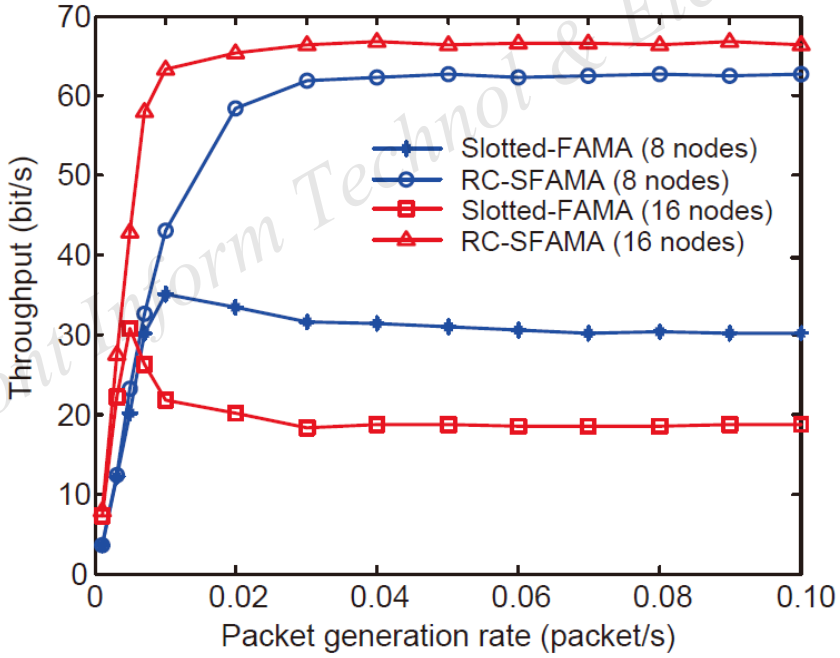


Fig. 4 One-hop throughput

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Simulation for energy consumption

Within the same period of time, RC-SFAMA can complete more data transmissions than SFAMA, without wasting time to re-send RTS over and over. Thus, RC-SFAMA can be more energy efficient.

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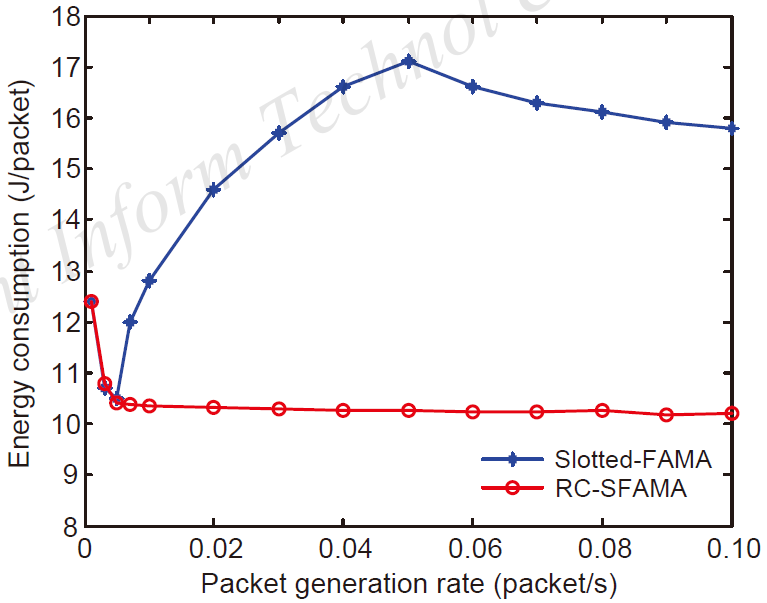


Fig. 9 Energy consumption comparison

Conclusions

- We present the multiple RTS attempts problem of slotted-FAMA in dense networks and show how this problem limits network throughput.

- The proposed RC-SFAMA introduces an RTS competition mechanism to choose a winning node when the multiple RTS attempts occur, and then makes the winning node continue completing its data transmission.

- Simulation results show that RC-SFAMA increases the network throughput efficiency compared with slotted-FAMA, and minimizes the energy consumption.

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