# Seastar underwater acoustic local-area network

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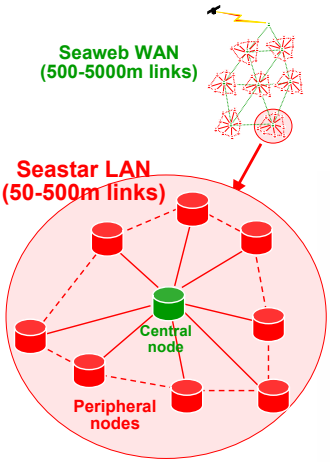



## Objective

**Asymmetric links**: high-BW links from peripheral nodes to central node; low-BW links from central node to peripherals and peer-to-peer

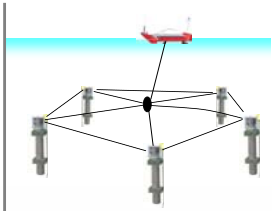
**Short range** point-to point communications (50 to 500 m) employ the 30-100 kHz band

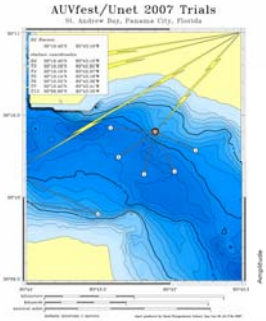
**Data are fused/beamformed** at the central node

Central node **reports compressed information** through the Seaweb wide-area network

Seastar LAN increases the **information carrying capacity** of the undersea environment by an order of magnitude

**Applications** include sensor arrays, sensor clusters, unmanned undersea vehicle formations, and dive teams

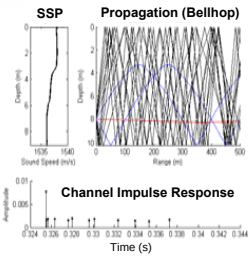


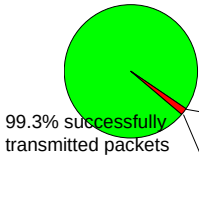


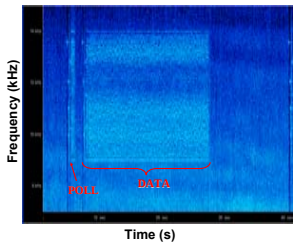

## Seastar prototype at AUVfest/Unet 2007 sea trials

### Set-up

- Teledyne Benthos ATM-885 modems, 9-14 kHz
- 5 peripheral nodes
- Poll at 140 bit/s, data at 800 bit/s
- 1850 byte test message
- Seaweb link layer: SRQ enabled



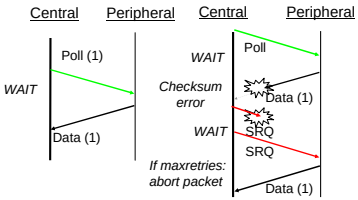

### Results

- 26 hrs of operation
- 2031 successful transmissions
- 53 subpkt. corrupted, 3 pkt. abort, 12 range abort, 3 pkt. out of sequence
- 3 network self-recoveries
- Average Latency ~ 3 minutes/cycle

## Candidate protocols

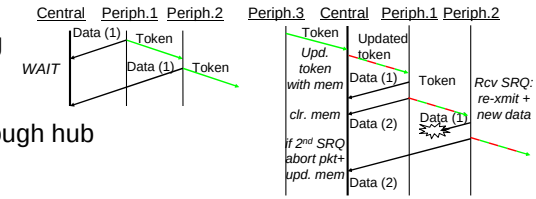
### Polling

- No SRQ
- SRQ




### Token ring

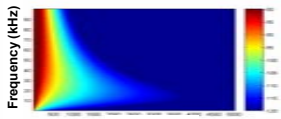
- No SRQ
- SRQ, through hub



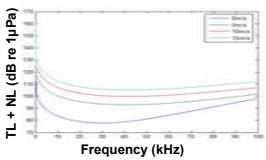

## Design optimization metrics

### Physical layer

Identifying operating frequencies and spectral bandwidth with link margin modeling



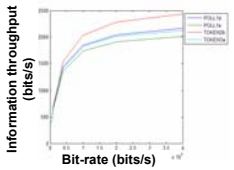

*TL + NL (wind = 5m/s) for range vs. frequency*



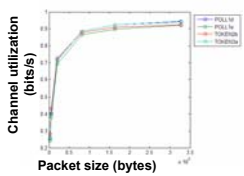

*Optimum frequency for different wind speeds @ range = 500m*

### Link layer

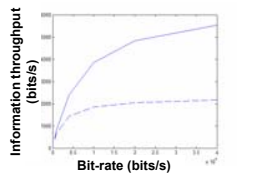
Comparing protocol performance with network simulations



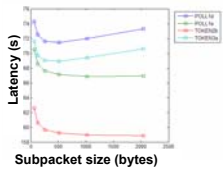

*Limiting effect of increasing bit rate on information throughput*



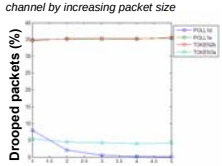

*Improving efficient use of communications channel by increasing packet size*



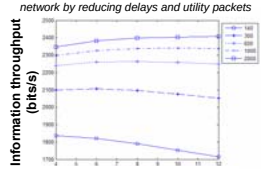

*Improving information throughput for polling network by reducing delays and utility packets*




*Influence of sub-packet size on latency in noise environment for various network types*




*Advantage of using SRQ in noisy environment for different network types*




*Negative effect of longer token inverted by relative gain of increased node density*