AquaNetwork: Underwater wireless modem with networking capability

AquaNetwork modems are standard AquaComm modems with added networking capability. Today the need for deploying numerous underwater sensors in a network configuration is growing rapidly. Underwater network applications include:

1. Pipeline monitoring network, e.g. for subsea oil and gas production
2. Environmental monitoring
3. Oceanographic sensor network
4. Autonomous Underwater Vehicle (AUV) communications

In addition to the standard AquaComm features the AquaNetwork includes the following:

Features	Attributes	Benefits
Parallel-link capability	• Modem has true code division multiple access (CDMA) capability • Simultaneous links between nodes can co-exist due to CDMA • A million possible addresses set with six digit address field • Addresses can be set dynamically	• Parallel links can be set up easily • Simplifies networking algorithms • Since addresses can be set dynamically, simplifies setting up various network configurations, e.g. for node hopping
Broadcasting	• Ability to broadcast data and commands to several nodes simultaneously	• An essential feature to setup networks easily. A common broadcast channel can be allocated with an address.
Broadcast wake up	• Ability to broadcast wake up command to awaken sleeping nodes simultaneously. This is in addition to the unicast wake up command.	• For low power consumption, network nodes can be in a low power receive state until woken up by a broadcast • Reduce time to wake up sleeping nodes
Simple networking API	• A networking command set is included	• Allows third parties to interface and implement networking layer easily

Detailed technical specifications:

Parameter	Details
Data rates	100 or 480 bits per second depending on model
Bit Error Rate	10^{-6} bit error rate or better
Acoustic Doppler Tolerance	High immunity to noise and to multi-path and Doppler fading. Acoustic Doppler tolerance of +/- 5ms-1
Bandwidth	Broadband operation 16Khz to 30Khz
Range	Tested to 3km range. Longer ranges possible
Modulation	Direct sequence spread spectrum / OFDM
Error detection	CRC16 error detection
Through water communications protocol	Confirmed packet delivery with error detection. If the transmitting end does not receive an acknowledgement, it will resend the data two more times. Number of retries is configurable.
Addressing	Uniquely addressable. Six digit numeric address set through host command.
Receive sensitivity	Ability to set the receive sensitivity
Transmit power	Ability to set the transmit power level
Physical size	8cm x 7cm x 1.5cm (excluding transformer)
Electronics	Digital signal processor based
Power supply input voltage	DC 5V to 9V
Current consumption @ 6V DC	42mA (nominal) in normal wake operation 4.2mA in power save receive Less than 150uA in sleep model
External connections	10 pin KK header to connect power, host communications, reset line and wake up line 2 pin terminal to connect hydrophone transducer
Host communications	RS232 serial communications. 9600 baud (default),1 start bit, 1 stop bit, no parity 4800, 2400 or 1200 baud programmable Either TTL voltage levels (3.3V) or RS232 voltage levels selectable
Host command	Simple ASCII command set to configure and command the modem
Temperature range	-5 degC to +50 degC
Networking Features	
Parallel links	Code Division Multiple Access (CDMA). Parallel links can be setup for efficient networking. Each link looks like noise to the other.
Broadcast	Broadcast mode to communicate with several nodes simultaneously on a CDMA channel. Essential to set up networks.
Store and Forward	Store and forward of data packets for Networking
Broadcast wake up	Wakeup several sleeping nodes simultaneously on a CDMA channel. Essential for conserving power.
Unicast	In addition to the broadcast, unicast is used to talk privately between nodes on a CDMA channel