

	ACOUSTIC	ELECTROMAGNETIC	OPTICAL
Frequency range	500hz (Long range) 50khz (Medium range)	100hz (Up to 100m) 100khz (A few m)	Blue-green visible 1014hz Generally not frequency agile
Interference sources	Rain / Marine life / Thrusters Electronic preamp noise	Motor / Lighting / Pumps / Solenoid EM noise / Electronic preamp noise	Sunlight Detector 'shot'+preamp noise
Latency	High latency 1450-1550m/S	Frequency dependent latency 1500m/S (1Hz) 1e6m/s (1Mhz)	Fixed lowlatency 2.25e8 m/s
Absorption loss	Low-frequency fependent 0.05db/m (150Khz) 0.0001db/M (1.5Khz)	High frequency dependent 5.4db/M@25khz 1.1db/M @ 1khz	Medium-high turbidity dependent 0.1db/M (Deep ocean) 10db/M+ (Shallow coastal)
Bandwidth (data rate)	10's Bps - 10's Kbps Transduction + Multipath limited	10's Bps - 100kbps+ Range-dispersion limited	100's Kbps to a several 10's Mbps Not dispersion limited
Signal processing complexity	Medium-high Doppler estimation/compensation, Equalisation, Beamforming, Complex modulation	Medium No doppler estimation/compensation, Equalisation at high rate, complex modulation at high rate	Medium-low No dispersion, Simple modulation High performance FPGA
Efficiency	Medium (Non-multipath)	Medium (Short range)	Highest (Non-turbid)
Antenna size	cm's (Medium range) Few 10's cm's (Long range)	Few 10's cm to several meters	Typically 10-30cm
Practical ranges	10's Km @ kbps Up to 100's Km @ 10's bps	<10m @ kbps, <100m @ bps	cm's - 100m (Turbidity dependent)
Aspect dependency	Scalar field, Omnidirectional/Directional	Vector field Requires appropriate antenna orientation	Scalar field directional, Narrower beam=better
Communication across media	Limited	Yes	No
Vector field sensing	No	Yes (Subject to local field distortion)	No
NLOS/kinetic environments	Limited	Yes	No
Bio-fouling tolerance	Medium	Good	Poor
Application examples	Long range communication	Short range comms Turbia, Kinetic environments (ie. surf zone)	Short range high bandwidth data uplift
	Precision navigation	Short range cross media and NLOS communication (Air-water, Water-bottom)	Real time video and command control
	Long range sensor networks	Short range sensor networks	Covert ops
	Integrated nav-comms	Covert ops	