

<p>Physical Layer</p> <p>radios, coaxial cable, optical fibers</p> <p>bits "on the wire"</p> <p>spread spectrum reduces narrowband interference by spreading a signal's frequency to create a wider bandwidth</p> <p>DSSS direct sequence spread spectrum</p> <p>FHSS frequency hopping spread spectrum</p> <p>DSSS and FHSS require time synchronization between sender and receiver.</p>	<p>Variables</p> <p>Signal sending signal</p> <p>Noise thermal noise, background radiation (aka AWGN - additive white gaussian noise)</p> <p>Interference signals from other transmitting sources</p> <p>SINR $S/(N + I)$ or SNR</p>	<p>Modulation</p> <p>AM, FM, PM</p> <p>amplitude modulation, frequency modulation, phase modulation</p> <p>TODO: pros/cons of each</p>	<p>Security</p> <p>TODO WEP insecure as heck</p>
<p>Maximum (Data) Bandwidth</p> <p>Shannon Channel Capacity</p> <p>data rate = $W \log_2(1 + S/N)$</p> <p>(theoretical) maximum number of bits that can be transmitted per second by a physical channel</p> <p>data rate = bps</p> <p>W = frequency range = bandwidth = Hz</p> <p>S/N = signal noise ratio = no unit</p>	<p>Path Loss Formulas</p> <p>free space model</p> <p>--</p> <p>two-ray ground reflection model</p> <p>--</p>	<p>Link Layer</p> <p>WiFi, Ethernet</p> <p>data transfer btwn neighboring network elements</p> <p>IEEE 802.11 DCF CSMA/CA</p> <p>CSMA/CA carrier sensing medium access / collision avoidance</p> <p>DCF distributed coordination function - appropriate for multi-hop ad hoc networks</p> <p>RTS/CTS request to send, clear to send</p> <p>hidden terminal problem A and C want to send to B but A and C cannot see each other. both send to B and msg collides. solved by RTS/CTS</p>	<p>Network Layer</p> <p>IP, routing protocols</p> <p>routing of datagrams from src to dest</p> <p>knows addresses, routes from src to dest, elems = hosts and routers</p> <p>LS link state</p> <p>DV distance vector</p> <p>types of networks MANET (mobile ad hoc network), mesh network, sensor network, DTN (delay tolerant network)</p>
	<p>Effects on Signal Propagation</p> <p>path loss, shadowing, reflection, refraction, scattering, diffraction, fading</p>		<p>MANET</p> <p>DSR destination source routing</p> <p>AODV ad hoc on-demand distance vector</p> <p>DSDV destination-sequenced distance vector</p> <p>DSR can be used for wireless mesh networks</p>
	<p>Multiplexing</p> <p>space, time, frequency, code</p> <p>TODO: pros/cons of each</p>		



Mesh Networks				DTN (cont)				Transport Layer	
ETX	expected transmission count			simple replication	src only	new contact	r first contacts	TCP, UDP	
	= $1/(df * dr)$... where df = fwd delivery rate, dr = rev delivery rate			history (r)	all nodes	new contact	r highest ranked	host-host data transfer	
ETT	estimated transmission time TODO: this is some combo of SETT and something right???			erasure coding (ec-r)	src only	new contact	kr (k >= 1) first contacts (k is related to coding algorithm)	UDP	user datagram protocol
Sensor Network								TCP (wired) transmission control protocol	
GPSR	greedy perimeter stateless routing							Mobile TCP	
BVR	beacon vector routing							TCP - not pipelined	
TODO: study implementation and write in chart in word or something				TODO: review history and erasure coding				Stop and wait	
DTN				Mobile IP				TCP - pipelined	
ALGORITHM	WHO	WHEN	TO WHOM	TO mobile system					
flood	all nodes	new contact	all new	CN -> HA -> FA -> MN					
direct	src only	dest	dest	FROM mobile node					
				MN -> FA -> CN					
				CN = correspondent node (aka FN = fixed node??)					
				HA = home agent					
				FA = foreign agent					
				MN = mobile node					
				Formulas					
				Transmission					
				$T = L/R$					
				Utilization - fraction of time sender is busy sending					
				$U = (L/R) / (RTT + L/R)$					
				Speed of light (to convert distance to propagation delay)					
				3E8 m/s					
				Don't forget to use proper units (convert)					
				T = transmission time in seconds					
				L = pack length in bits					
				R = transmission rate in bps					
				U = utilization no unit					
				RTT = round trip time seconds					
				= propagation delay * 2					
				Questions					
				Why can't we just use NACK?					

