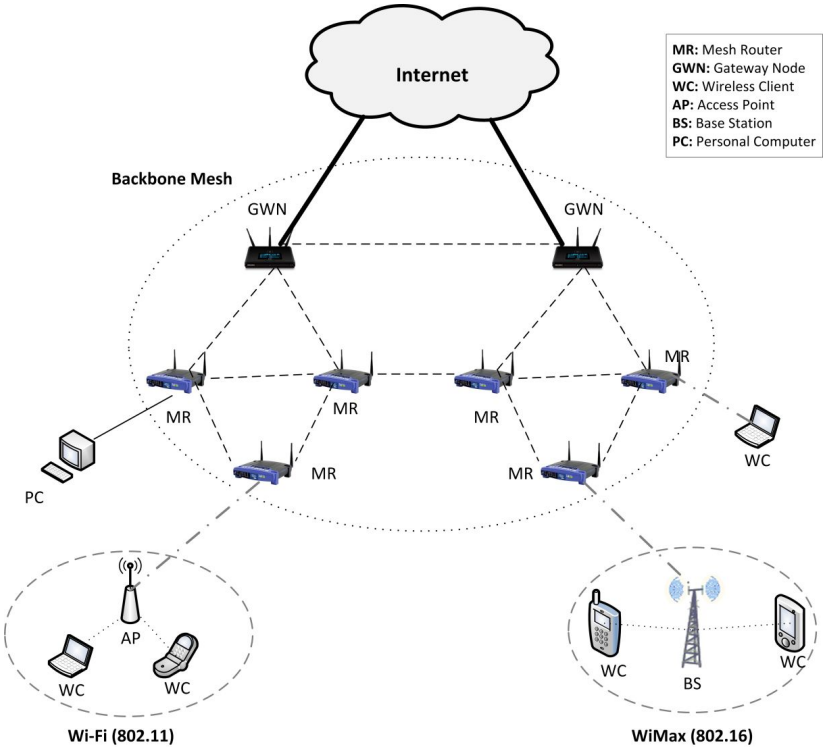
Mesh Networks and Routing

Mesh Networks

- Characteristics:
  - Not centralized (form of Ad Hoc Network)
  - Can be strongly connected, not required (partially connected)
  - Self-configuring/Self-healing
  - Need a gateway to facilitate client to mesh communication

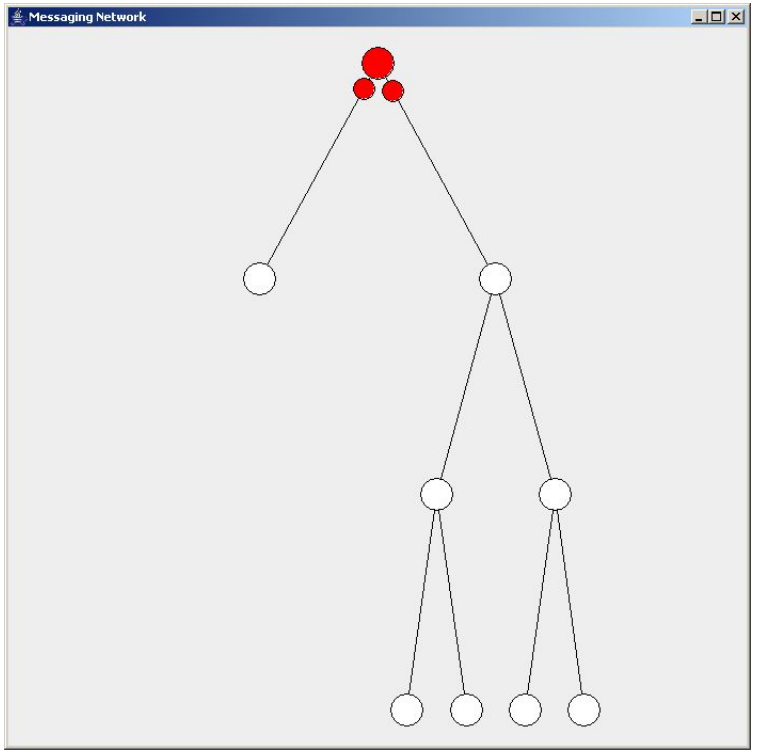


Mesh Networks (con.)

- Applications:
  - IoT: Internet of Things - GoogleNest
  - Drone Swarms:
    - Creates wireless infrastructure (Google Loon)
    - Catastrophe recovery (connectedness)
  - Balloon Mesh for Navy

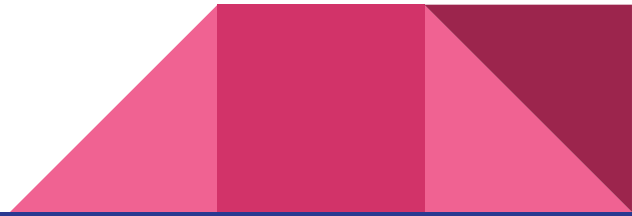
Mesh Networks (con.)

- Failure Tolerance
  - No single point of failure
  - Redundant: i.e. Flooding (broadcast)
  - Highly dependent on Routing
  - Gateways are important as points of failures



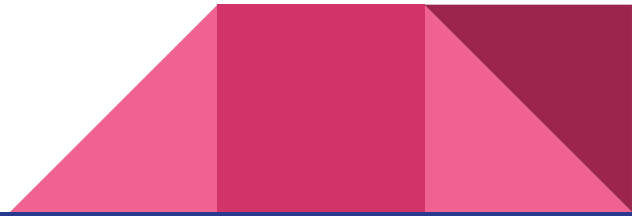
Mesh Networks (con.)

- Efficiency
  - Minimal infrastructure (low hardware components)
  - Nodes entering and leaving have a big effect on overhead
  - Larger bandwidth: if you load/split (too many hops can lead of higher transmission delay which leads to a decrease in throughput)
  - Designated routing algorithm has a huge effect on efficiency



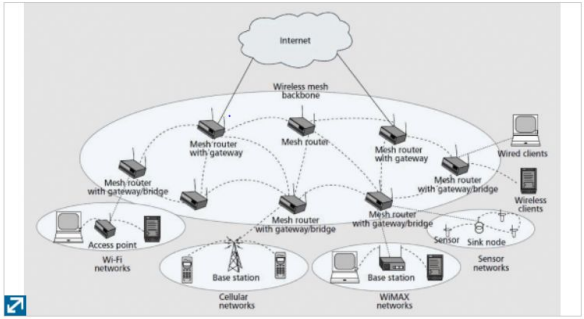
Mesh Networks (con.)

- Limit of Usability:
  - Capacity (bandwidth of each node)
  - Memory of each node for routing/forwarding
  - Protocol overhead (existing messages)
  - Requires a minimum # of nodes

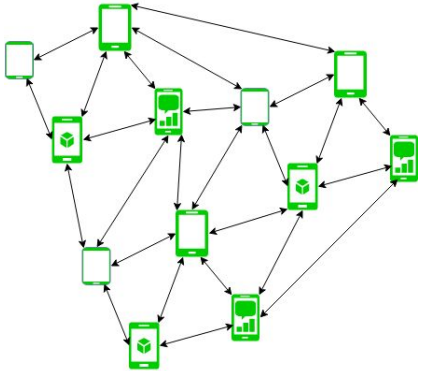


Mesh Network Architecture

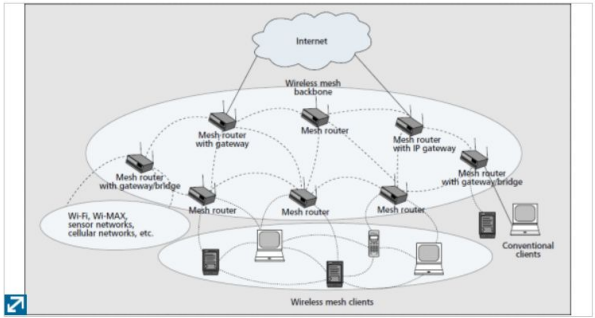
Infrastructure:



Client:

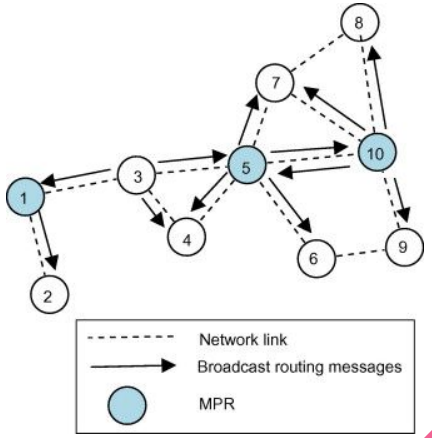


Hybrid:



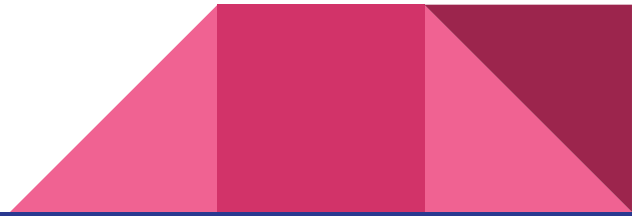
Mesh Routing

- Proactive Routing:
  - Every node maintains one or more tables representing entire topology network
  - Topology info needs to be exchanged between node on a regular basis
  - Routes will always be available on request
  - Ex. Optimized Link State Routing Protocol (OLSR)



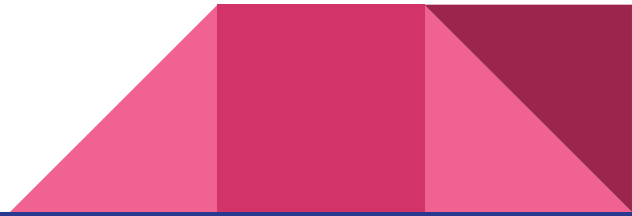
Mesh Routing (con.)

- Reactive Routing
  - Route discovery process initiated until a route is required/requested
  - Higher latency but lower overhead
  - Ex. Ad Hoc On-Demand Distance Vector routing protocol (AODV)



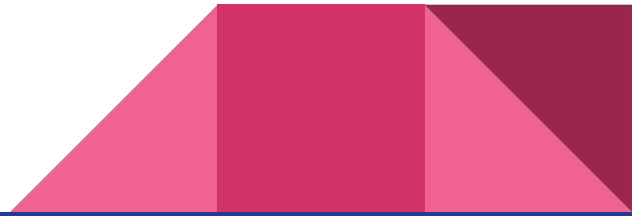
B.A.T.M.A.N. Routing Protocol

- B.A.T.M.A.N adv Characteristics
  - Proactive routing protocol
  - Distance - vector approach and routing metric that incorporates reliability of radio links
  - Each node maintains a routing table containing potential next hops to all other nodes
  - Layer 2 routing instead of Layer 3
  - Decentralized knowledge of applications



B.A.T.M.A.N Routing (con.)

- Failure Tolerance:
  - Relatively consistent, may take more time than other protocols because of rapid changes in Traffic Quality (TQ) values
- Efficiency
  - Transmission quality metric based on Expected Transmission Count to find tradeoff between low hop count and stable links



B.A.T.M.A.N Routing (con.)

- How it Works:
  - Every node broadcasts hello messages (OGMs) in fixed intervals to neighbors
  - Nodes measure the fraction of hello messages they receive from a given neighbor (Receive Quality, RQ)
  - Neighbors rebroadcast received OGMs, so nodes more than one hop away are aware of node's existence
  - Nodes measure fraction of their own OGMs that are retransmitted by neighbors (Echo Quality)