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CS 4643
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LoRa Network Design

Roles of the LoRa devices:

Node: Device of varying function, connects to network and does something. Nodes can send to other Nodes if they share the same prefix and can send to Beacon's.
Beacons: Devices that are responsible for communication between beacons. Beacons can send to both Nodes and other Beacons.
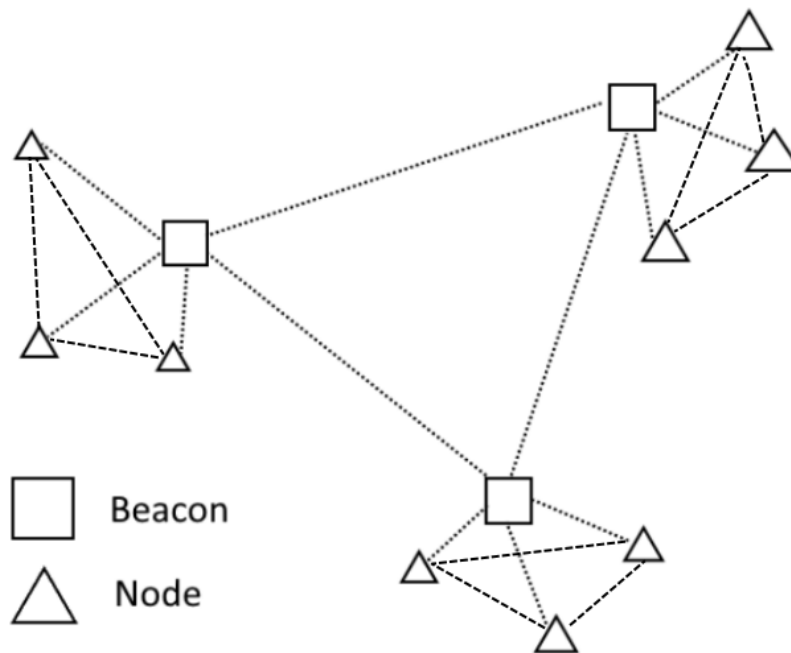
Example network diagram

Messages:

Node advertisement message (NAM): Node advertises itself to nearby Beacons.
Beacon purchase message (BPM): Beacon sends a message back to the Node saying that it can be connected to this beacon.
Node handshake message (NHM): Node agrees to establish communication
Node refund message (NRM): Node disagrees to join the network (such as if it's already connected to another Beacon).

<u>Beacon-2-Beacon Message (B2B):</u> Data packet sent between Beacon's with the "outbound data" flag turned on.

<u>Node-2-Node Message (N2N):</u> Data packet sent between two Nodes that are within the same prefix.

<u>Connection check message (CC):</u> Send periodically, set by the beacon, to see if Node is still on and communicating. Node responds if it is still alive

Device Configuration:

- ❖ Connection-oriented communication; Nodes connect to Beacons, Beacons connect to other Beacons. Established connections between Nodes and Beacons, but not between Nodes and other Nodes. Nodes can communicate directly to other nodes that have the same prefix. Beacons are used for inner-prefix communication (similar to subnets in IP).
- ❖ All devices in the network are transceivers.
- ❖ Upstream and Downstream communication will be separated and used on two separate fixed ISM channels. Uplink: 125kHz, Downlink: 500kHz. A coding rate of ⅘ will be used. Uplink channel will be used when communicating from Node and Beacon and Node to Node, Downlink channel will be used when communicating from Beacon to Node.

Addressing Schemes:

- Addressing will be done through a Beacon prefix value and a Unique Node ID given to each Node by the Beacon. Each beacon has a unique prefix of 8 bit length called a Beacon Prefix (BP) which will differentiate it from other Beacons.
  - When a Node connects to a Beacon, the Beacon will assign the Node with an 8 bit number from 1-255 called a Node ID (NI). This unique id with the BP will give the address for each Node.
- When a Beacon receives a NAM, it will check if there is availability for the node, if there is it will reserve a number for the Node and send back a BPM. BPMs are sent every 1,2,4,8 seconds and if there is no response, the Beacon will unreserve the id number and act as if the Node is not alive.

Message delivery:

Message delivery will be unreliable. There will not be any checksum or ack equivalent.

Testing:

- To test the addressing, I will set up two of the Pis as Nodes and one as a Beacon. The Nodes will send NAMs and connect to the Beacon, and then the Nodes will send data packets to each other directly.
- To test beacon communication, I will set up two of the Pis as Beacons and one as a Node. I will send a packet from the Node to a node that does not exist on a different prefix, and see if the other Beacon receives the data packet and transmits it.

Assumptions you make about the environment of LoRa:

The transmitting of data will be done through its unique LoRa modulation that I will not have to program, and receiving data will be the same.

Constraints:

Limited number of Nodes per beacon (255). Communication is designed to be within close range and use with sensors that communicate with nearby hosts, but it also allows for data to be sent outside of the network.

Any other salient points that will be used to support the use of layer-2 protocols:

Beacon's will ask nearby beacons for their prefixes and choose one randomly that is not the same as a nearby beacon. This protocol should encapsulate into other protocols such as IP by using their unique IDs and prefixes as the subnet and address.