It has small form factor of the node.

Design Considerations of Transceiver

The design considerations which are considered while selecting transceivers architectures are,

(i) Energy Usage Profiles

The selection of energy consumption profile varies for different wireless devices. Some of the differences are described as follows, The radiated energy will be less on some order of dB. Such as 0 dBm whereas the tranşceiver will use the energy more than that of being used. The transceiver which works at the frequencies more than 1 GHz will consume 10 to 100 mW of power for radiating 1 mW.

The two modes transmit and receive will consume either less or more or even same for small transmit powers. In fact, the receiver needs more power than that of the transmitter. Power consumption of the idle mode might either be less or same to that of required for reception. This is based on the architecture of transceiver. For this reason, the transceiver must be switched to sleep mode rather than idle mode.

The third difference is the relative cost of required for communication and computation in sensor node. For comparing the costs of different types of communications we need to consider BER requirements, range, transceiver type etc. For comparing the computation on the processor we need to consider the instruction mix and so on. On the whole the communication is found to be costlier than the computation.

(ii) Choice of Modulation Scheme

Selection of relevant schemes of modulation needs the below factors to be balanced.

- Required data rate
- Implementation complexity
- Appropriate symbol rate
- Relationship between the radiated power and target BER
- Characteristics of expected channel.

The time spend by the transceiver in the sleep mode can be maximized by reducing the transmit times of it. An increase in the data rate of transceiver/modulation will decrease the transmit time and energy consumption for a given amount of data. The energy consumptions of a modulation scheme majorly depends on the symbol rate. Instead of data rate modulator schemes such as *m*-ary are called in order to fulfill the necessity of high data rates with low symbol rate. Here are some of the trade-fits unlike 2-ary modulation, *m*-ary modulation works on more sophisticated digital and analog circuitry. This is found during the parallelization of user bits into symbols.

Most of the *m*-ary modulation schemes are used for increasing m, E_b/N_o ratio and radiated power to attain the targeted bandwidth efficiency ratio.

Many of the packets in wireless sensor network are short in size i.e., applications on the order of tens to hundreds of bits.

Total energy is consumed at initialization time of the packet, leaving no energy which can be used to minimize the transmission time by selecting any of the *m*-ary modulation scheme.

(iii) Dynamic Modulation Scaling

An appropriate scheme for reaching the provided BER target of specific range and size can be identified. But that optimal scheme will be valid only for short time span because if any of the modification occurs in any of the constraints such as delay or to attain a much better scheme which can provide high throughput will surely lead to change in the choice of optimum scheme. So, it is important to consider certain methods for adapting the modulation scheme to the present situation. One of the method is dynamic modulation scaling.

For the case of m-ary QAM particularly and a target BER of 10^{-5}. Particularly, a model which makes use of symbol rate B and number of levels for every symbol m as parameters have been developed. It represents the required energy and obtained delay for each bit. It assumes that the higher modulation levels require the higher radiated energy in order to compensate for higher bit error rates.

Any additionals required for startup are not considered. The symbol rate B and number of levels m are increased by decreasing the bit delay. The energy and delay for each bit are reduced to increase the symbol rate for specific parameters.

By making use of modulation scaling, a packet can be appended to the delay constraint. This delay constraint is later on used to derive a minimum data rate directly. A minimum value for m must be chosen as per the requirement of data rate. This is because the symbol rate will be fixed at a point. It also reduces the energy needed for each bit. These delay constraints can be assigned implicitly or explicitly.

(iv) Considerations of Antenna

The size of number of antennas are restricted by the required form factor of all the sensor nodes.

Placement of two antennas with appropriate distance between them is difficult with small sensor node cases for achieving receive diversity.

Radio waves which are emitted from the antennas which are very near to the ground in certain applications will face a problem such as path-loss coefficients which are larger than that of the common value $\alpha = 2$ in order to allow communication in free-space.

Antennas need not be extended from the casing of a node for avoiding any occurrence of damage. Such restrictions will limit the quality that can be achieved and also the relative characteristics of antenna for wireless sensor nodes.

Nodes that are scattered on ground randomly will land in random orientations in which antennas will face the ground or will be obstructed. A non-isotropic propagation of radio wave will result from it. This will differentiate the strength of the signal that is emitted in different directions. Antenna design can also cause such type of effects.