Dynamic Link Adaptation

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1.0 Current State of the Art

Link Adaptation is the process of adapting the wireless link parameters as a function of current channel conditions. Link parameters which can be adapted include the following: Modulation, Symbol Rate, Channel Coding, Retransmission Scheme etc. Commercially available point to multipoint broadband access equipment today allows the adaptation of the Modulation parameter.

2.0 Shortcomings of Current Art

- Current Art allows only the modulation to be adapted, which limits the flexibility of the system
- Adaptation decisions are carried out on a periodic basis, based on measurements of channel quality such as bit error rate (BER) statistics. Hence when link conditions change, the system is not able to react quickly enough because: 1) It takes some time before the change is reflected in the BER statistics, 2) The system can change link parameters only at at periodic intervals.

3.0 Description of Proposed Invention

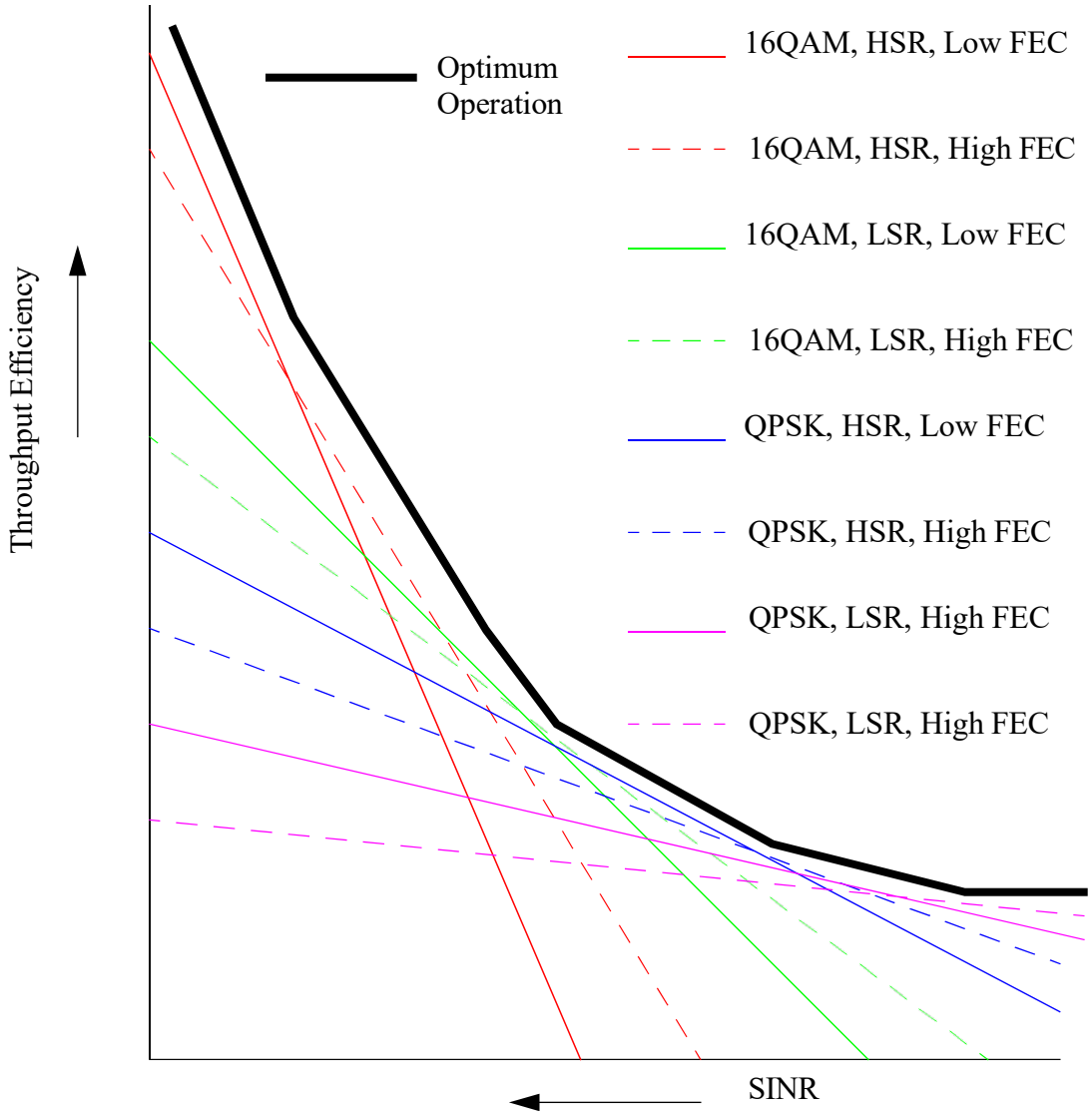

FIGURE 1.

Fig. 1 plots the Throughput Efficiency for various combinations of Link Parameters, as a function of the Signal to Interference+Noise Ratio at the receiver. In each case the Throughput decreases monotonically as the SINR decreases, since more and more re-transmissions are required to recover from errors. The optimum policy is to switch from one combination of Link Parameters to another, at the point at which the through efficiency lines for the two cross each other. This optimum policy is is indicated by the dark line in Fig 1.

The objective of the proposed design are:

- To closely approximate the optimal policy
- To react to changes in link conditions quickly

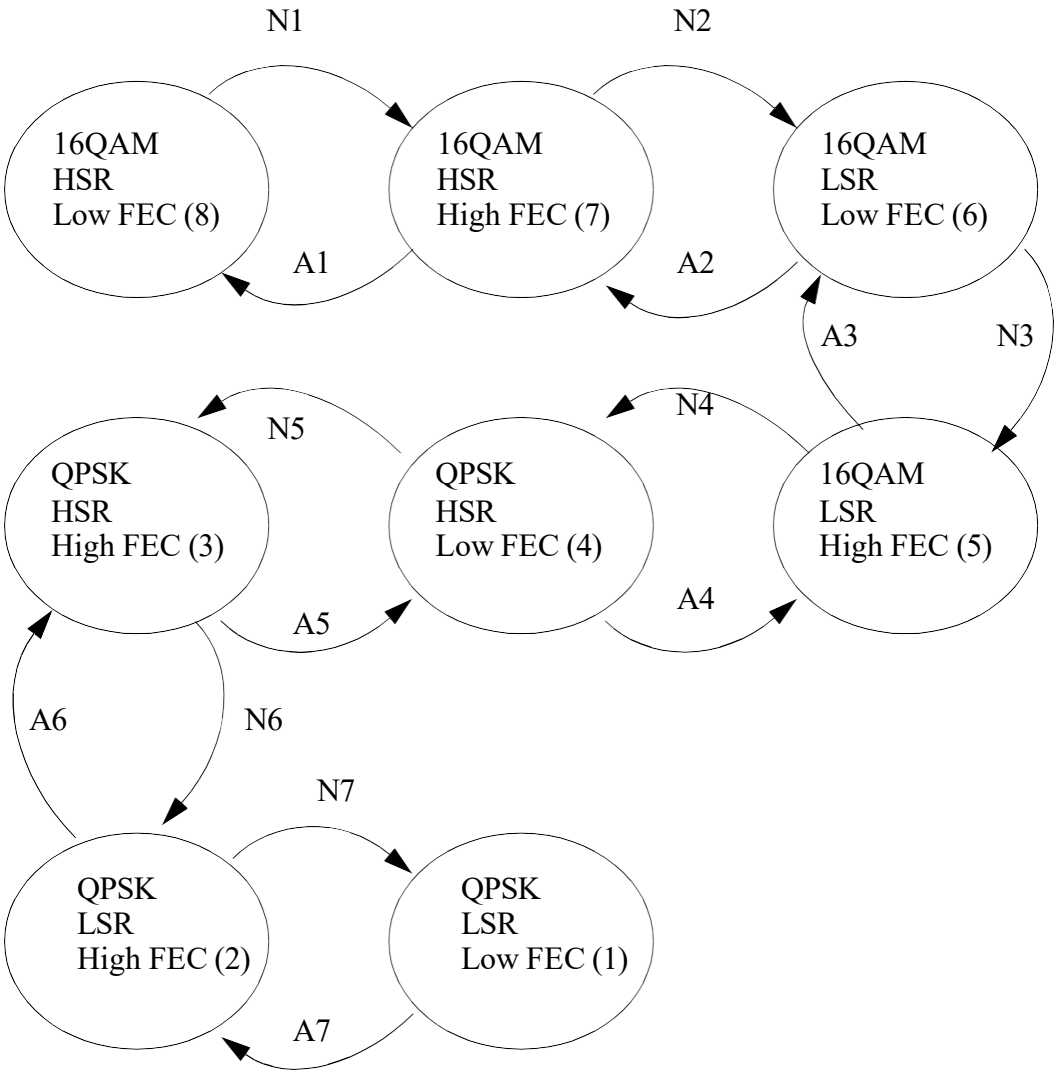

FIGURE 2.

- To be easy to implement.

The following algorithm achieves these objectives (Fig. 2):

Number the 8 possible combinations of the (Modulation, Symbol Rate, FEC) values from 1 to 8. Define seven pairs of integers (Ni, Ai), i = 1,...,7, such that:

- If the system is in State i , i = 1, ..., 7, and it receives Ni successive NACks, then it transitions to State (i + 1).

- If the system is in State i, i = 2, ... , 8 and it receives Ai successive ACKs, then it transitions to State (i - 1).

4.0 How the Proposed Invention Extends the Current Art

- The proposed system reacts dynamically to changes in link state, since it uses the number of ACKs/NACks to trigger state changes. As a result it is able to react faster. Existing systems use measured Packet Error Rate or SINR to trigger state changes, at periodic intervals. This is a sub-optimal, since it take time to collect enough measurements to be get a reliable estimate.
- The system is able to handle a much larger number of link parameters as compared to existing art.