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With the advent of high-speed internet access, high data-rate, low latency of service and minimum loss of data when travelling over the internet in the form of packets have become the most desirable characteristics of wireless networks. Wireless systems span almost all industries aimed at providing everything to everything connectivity (Internet of Things or *IoT*). Besides, the competition in the wireless industry is increasing by the day with the introduction of various communication standards such as WiMAX and LTE and the near approaching 5G that shall connect everything over the internet. To meet these challenges, one of the majorly important aspects of network design considered by the network designers is the Quality of Service (QoS).

The users connected to a wireless network demand different quality of treatments based on the requested service over the radio interface. The QoS for such networks deals with the allotment of radio resource among its users with respect to the requesting application's requirements. The process of measurement of QoS can be sub-categorized as design of resource allocation strategies and design of metrics measuring network performance parameters. The work in this thesis is aimed at providing optimal solutions for design of metrics measuring performance parameters that determine the QoS. The performance parameter for which measurement methods are designed in this work is the 'fairness of allocation' that is determined from the amount of allocation made to a user and also the extent to which the QoS requirements of a user are fulfilled.

A novel QoS measurement and analysis framework has been proposed in this work that determines the fairness of allocation made to users of a wireless network. In order to determine performance of a wireless network in terms of resource allocations made to its users, both fairness and unfairness must be considered. The proposed

intra-class fairness measure determines the index of unfairness for an allocation scenario. The proposed measure when used along with the widely deployed Jain's fairness index can determine the intra-class fairness of allocation. Though it provides an index of equality of allocation, the intra-class fairness cannot determine the index for different traffic classes of a network. For this purpose, the inter-class fairness is determined which measures fairness relative to all users of the wireless network that belong to one or more traffic classes. The proposed inter-class fairness measure determines fairness as utility of satisfaction of QoS requirements. The ability of the proposed framework to determine both intra-class as well as inter-class fairness of allocation shall make it usable for measuring fairness of allocation in wireless networks such as Long Term Evolution or LTE.

The inherent characteristic of fuzzy logic systems is to generate outputs as imprecise and indistinct values. This motivates the proposed QoS analysis framework to be designed using fuzzy logic to make it suitable for use in wireless networks where the radio communication link poses the properties of time-variation and unpredictability. In the proposed QoS analysis framework, fuzzy logic models are designed for measuring both intra-class fairness and inter-class fairness.

The observed QoS parameters are analyzed using the LTE-*sim* simulator. Fairness of allocation is computed for the observed values of QoS parameters and compared with the fairness values obtained from the widely used methods. The proposed 'Biphasic Growth Curve BGC' are exploited for the analysis of network performance parameters such as fairness of allocation for a given allocation scenario.