CHAPTER 6

CONCLUSIONS

The emerging wireless networks envisage to cater to high speed data applications through the use of mobile phones. This initiative has opened up new avenues for cellular mobile networks. Inspite of heavy constraint on available spectrum, the mobile data applications are growing at a rapid pace. Hence, there arises a strong need for maximizing spectral efficiency. Further, these applications also expect the underlying networks to offer sufficient QoS assurances under diverse traffic conditions. The emerging systems, besides satisfying these requirements will have to be carefully designed to handle the performance limiting factors like dynamically varying mobile channels and MAI. The consistent usage of TDMA phones by most of the wireless subscribers has motivated investigations on quality improvement using spectral efficient techniques in TDMA and the emerging CDMA access technologies. Thus, an attempt has been made to improve connection level quality in terms of minimum blocking rates and increased throughputs using spectrally efficient mechanisms. This objective is accomplished by properly tailoring the radio resource management tools. The following are the conclusions arrived during the investigations.

6.1 CONCLUSIONS

As a first step, an admission policy that strongly affects the radio blocking probabilities has been explored. An attempt has been made to propose mobility predictive CAC scheme using mobile positioning techniques for offering class based QoS in a high resource contention environment. It is interesting to note that this predictive approach could be practically implemented with location aware GPS activated mobile phones. The simulation results prove that, the proposed
technique maintain the handoff dropping rate at or below a target dropping probability of 0.1 for group I services and 0.15 for group II services without penalizing the new calls. Further, the resource utilisation rates are greater for position based CAC scheme when compared with other conventional approaches.

The proposed predictive CAC scheme can potentially offer a high level of active link protection in a CDMA environment by preserving the outage probability within a bound of 0.001. Above all, it is interesting to note that, the proposed CAC logic satisfies most of the requirements of a good admission controller.

An opportunistic scheduler that can improve spectrum efficiency by exploiting the time-varying channel conditions has been used for making resource scheduling next to the user's admission process. However, this kind of approach requires a channel prediction mechanism for making appropriate scheduling decisions. To cater to this need, a novel channel predictor based on neural network has been designed to enable the scheduler to take optimal decisions based on channel state estimates. By virtue of artificial intelligence, the neural network offers a good degree of prediction accuracy and speed.

The opportunistic scheduler differs from other wireless schedulers, as it exploits the channel fluctuations to enhance system throughputs to as high as 95%. However, selecting the best channel users for transmission maximizes the system performance at the expense of user fairness criteria. An attempt has also been made to incorporate user fairness by suitably modifying the scheduling mechanism. The results show that there is a slight reduction in system throughput, if user fairness is accounted.

Link adaptation is another powerful tool to meet the target error rates besides achieving higher throughputs by exploiting channel conditions. Link adaptation has been performed by altering both transmitted powers and modulation levels adaptively according to the application needs. The adaptive modulation has been observed to play a passive role while the power control plays an active role in preserving the link quality.
Both predictive and non-predictive power control schemes have been suggested for satisfying the minimum power requirements to minimize interference. The non-predictive PC technique neglects the loop delay, while it is accounted in the predictive approach by employing a Kalman filter for making the interference predictions. The Kalman filter based prediction offers the benefit of an iteration free power convergence with different power requirements depending upon the QoS guarantees. The results obtained shows that, for a case of eight users time sharing a single channel, an average transmit power requirement of 17 dBm, 18.2 dBm and 27.35 dBm are required to meet the error rates of $10^{-2}$, $10^{-3}$ and $10^{-4}$ respectively.

The results reveal that a tradeoff always exists between the system throughputs and the required quality guarantees. However, systems incorporating both benefits are generally attractive. Therefore, an attempt to synthesize the adaptive modulation with power control for enhancing the obtained throughputs subject to resource and error constraints is envisioned. The spectral efficiency obtained through this combined approach was observed to be higher by 0.2 bps/Hz to 1.2 bps/Hz than adaptive modulation technique and up to 4.6 bps/Hz when compared with fixed modulation technique.

An integration of the various adaptive mechanisms is finally made to realize an integrated QoS framework. The basic idea is to enable both link adaptation and scheduling policy to co-exist in wireless networks in order to achieve a substantial improvement in throughput besides achieving spectral usage. The flexibility offered by the opportunistic scheduler permits the link adaptation mechanism to work in unison with it. This proposal overrides the hidden problem of short-term performance violations of opportunistic schedulers. The integrated QoS framework promotes commendable improvement in quality and spectral efficiency. The simulation results explain that the integrated QoS algorithm can quickly adapt itself to channel states and improve the system performance.

This dissertation has made several investigations for promoting the obtained quality using adaptive elements in cellular mobile networks. The reported proposals have been shown to be effective. The objective of satisfying
both quality guarantees and spectral efficiency has been accomplished. It is firmly believed that the research findings are certain to offer a profound improvement in quality and go a long way in serving the innovative needs of future generation networks.

6.2 SCOPE FOR FUTURE WORK

In this work, a number of spectral efficient techniques that can simultaneously satisfy the quality assurances have been proposed and analysed for cellular mobile systems. However, there are many interesting problems yet to be resolved in this area. This work can also be extended to MIMO technology, another emerging and attractive field.

The emerging systems are likely to incorporate orthogonal frequency division multiplexing (OFDM) based multi-carrier CDMA (MC–CDMA) systems for want of capacity. Hence, applicability of these QoS solutions for systems incorporating OFDM needs to be examined. One of the visions of UMTS is to provide seamless connectivity, irrespective of the nature of the networking architecture, in which the mobile user is currently associated with. This necessitates end-to-end QoS guarantees in heterogeneous internetworking architecture, which can be explored as a future scope for study.