Chapter 6
Conclusions

6.1 Conclusions

The demand for mobile communications is rapidly increasing in the last one decade, especially in urban areas. The efficient use of the spectrum is of paramount importance in the quest to meet this demand, since new spectrum is unlikely to be allocated to this service, and the cost of base station sites increase as the system becomes more dense. Spectral efficiency depends on two interdependent technologies; on one hand, the modulation technique used must permit many channels per MHz to be defined; and on the other hand, the method used to assign channels to mobiles must make efficient use of
the channel resource. In order to solve the channel allocation problem, FCA, DCA, and HCA channel allocation algorithms are in use, but their performance needs much to be desired.

In this thesis, it has been shown that with combined use of the existing FCA and DCA schemes, a distinct new algorithm, Optimized Blocking Dropping Load Balancing (OBDLB) algorithm, is proposed that optimizes blocked and dropped calls to provide efficient management of wireless channels for giving maximum throughput under different traffic conditions. This new strategy is based on multi-agent architecture for channel allocation. Instead of changing hardware connections between base stations and MSC, the blocked calls are placed in a waiting queue for a limited amount of time so as to decrease the blocking probabilities of the cellular system. To develop OBDLB algorithm, an agent approach has been used to make dynamic decision and do the computation in the remote destination, in order to reduce the network traffic load and improve the efficiency of resource allocation.

Results of the OBDLB algorithm show that when the network size is of 49 cells and 45 radio channels are available to the network, HCA(S) gives better results under all types of loads as only 12% of new calls get blocked under light load when channel holding time is 100 seconds, whereas new call blockings in existing schemes i.e. FCA and DCA is 20% and 22% respectively. Similar results are also seen under heavy load where 30% new calls are blocked in HCA(S) as compared to 45% and 42% in FCA and DCA. The dropping of handoff calls in the HCA(S) is 0.1% under light load and 28% in heavy load when channel holding time is 100 seconds, which is very much lower than the already existing schemes FCA and DCA, in which dropping percentage is 21% and 29% under light load, 45% and 42% under heavy load.

If network size is increased to 100 cells, then the new call blocking percentage in this scenario under light load for HCA(S) is only 14%, whereas in FCA and DCA it is 25% and 30% respectively, with channel holding time of 100 seconds. In heavy loads, percentage call blocking in HCA(S) is 38% and FCA and DCA show higher call blocking percentages with 58% and 55% respectively. Less percentage of calls get dropped in both
HCA and HCA(S) with dropping percentages of around 0.1% and 0.6% respectively, whereas both FCA and DCA show higher dropping percentage of 25% and 29% respectively, with channel holding time of 100 seconds under light load. On the other hand, when traffic is high, call dropping percentage in HCA is 49% and in HCA(S), it is 44%, which is lower than the existing schemes FCA and DCA showing 55% and 54% calls get dropped under the channel holding time of 100 seconds.

When the network size is further increased to 225 cells, and the total number of radio channels available to the network is 45, as used in the previous scenarios, in this case under light load, only 14% calls are blocked in HCA(S). On the other hand, 25% and 35% new calls are blocked in FCA and DCA respectively, when average channel holding time is 100 seconds. Under heavy traffic loads, call blocking percentage in case of HCA(S) is 42%, which is lower than the FCA and DCA having a call blocking percentage of 58% and 56% respectively, under the same channel holding time of 100 seconds. It is seen that only 1.9% and 1.4% of handoff calls get dropped in HCA and HCA(S) respectively, which is lower than FCA and DCA, in which 29% and 36% of handoff calls are dropped under light load with 100 seconds of channel holding time. But when heavy traffic flows in the network, both HCA and HCA(S) show lower call dropping percentage of 52% and 37% respectively, whereas 63% and 61% of handoff calls are dropped in FCA and DCA respectively, under the same channel holding time.

By increasing the total number of frequencies available in the system from 45 to 70, and the network having 49 cells, only 3% of new calls are blocked in the system when HCA(S) scheme is used under light load, but FCA and DCA are showing higher call blocking of 4% and 6% respectively. When the traffic load on the network is increased, even then, the HCA(S) shows lower call blocking with only 2.3% of new calls getting blocked in the system, whereas both FCA and DCA show almost same call blockings i.e. 36% under heavy load with average channel holding of 100 seconds. But 0% handoff call dropping is witnessed in both HCA and HCA(S) under light load having 100 seconds channel holding time, whereas 9% and 12% handoff calls are dropped in both FCA and DCA respectively, under same load. The performance of the proposed schemes do not
degrade when the network traffic is increased as 23% and 9% of handoff call get dropped in HCA and HCA(S) respectively, which is quite low as compared to FCA and DCA, which are showing 37% and 36% droppings.

When network has 100 cells and rest of the parameters remain the same as that of previous scenario, the percentage of new calls blocked in this scenario under light load with channel holding time of 100 seconds is around 4% when HCA(S) is used, whereas both FCA and DCA witness 8% and 13% call blockings respectively. New call blockings under heavy load for HCA(S) is around 22%, whereas for FCA and DCA, it is around 40% and 30% respectively. For HCA and HCA(S), the percentage of handoff calls dropped under light load is around 1% and 0.3% respectively, when channel holding time is 100 seconds, which is very less as compared to the 8% and 13% in case of FCA and DCA. The increase in the traffic load does not affect the performance of HCA and HCA(S) as 30% and 22% calls are dropped in case of HCA and HCA(S), but higher dropping percentages i.e. 42% and 41% are seen in FCA and DCA.

When the network size remains the same as that of previous case i.e. 100 cells, and 70 radio channels are available to the system, and if nominal channels present in the cluster are doubled, then system experiences 24% and 44% new call blockings for HCA(S) and HCA respectively, which is slightly higher as compared to 39% and 22% for HCA and HCA(S), when nominal channels are not doubled. Only 23% and 14% handoff calls are rejected for HCA and HCA(S) when nominal channels are doubled, when heavy traffic flows in the network and the channel holding time is 100 seconds.

The results prove that both HCA and HCA(S) perform better than the other schemes by showing low handoff call rejection rates under different channel holding times. Whereas HCA(S) shows lowest call blocking rates than all the other schemes, and HCA slightly underperforms in this case.

The results (Appendix A) confirm that the Hybrid Channel Allocation, using OBDLB algorithm, has maximized the communication sessions by minimizing both call blocking and dropping rates under different types of loads.
6.2 Future Work

The following recommendations are suggested for future improvements and further developments of proposed algorithm:

- Data loss was assumed to be non-existent. However, this is not the case in real networks. Data loss can occur by many means such as channel fading, errors, and collisions. Future work may accommodate this.

- The propagation delay is included as part of the duration of each cell of the matrix. Future work may include modifying the matrix to account for both the propagation delay and processing time. Most importantly, it should be modified to support flow control mechanisms other than just Stop-and-Wait. Also, it may include congestion control.

- The algorithm could consider the priority of incoming calls. As in the proposed scheme, handoff calls are given higher priority than the new calls. But some realistic scenarios require that few incoming calls (e.g. emergency calls) must be given higher priority than the other calls.

- The co-operative planning layer has been performing well in the proposed scheme, as this layer is involved in the load balancing task i.e. moving the calls from the heavily loaded cells to the less loaded cells. So, better optimization techniques should be developed for this layer in order to reduce the complexity of calculations.