2 CALL MINIMIZATION TECHNIQUES

2.1 Guard Channels

The guard channels are used to prioritize handover calls over new calls. Assume an isolated node in an isolated cell having n channels. Handover calls can be prioritized by reserving g channels while the remaining n-g channels are made available to both new and handover calls [15]. A handover call can be dropped or retried when all the channels are occupied. A schematic showing the guard channels is given in figure 1.

2.2 Handover Queue

The handover queue is established on the assumption that adjacent cells in a mobile cellular system are overlaid. Thus there is a considerable area (i.e. handover area) where a call can be handled by base station (BS) in adjacent cells. In this scheme, it is assumed that the same channel sharing method is used as that of a priority scheme except that provision is made for the queuing of handover requests. If a BS finds all channels in the target cell occupied, a handover request is put in the queue. If a channel is released when the queue for handover requests is not empty, the channel is assigned to the request at the head of the queue. If the received signal strength from the current BS falls below the receiver threshold level prior to the mobile being assigned a channel in the target cell, the call is forced to terminate [1[illegible] In this scheme, the first-in-first-out (FIFO) queuing strategy is used and a finite queue size, **R**, is assumed. This means that if a handover call finds the queue fully occupied it will fail and be dropped by the system.The duration of a MS in the handover area depends on system parameters such as moving speed, the direction of the MS and the cell size. This duration is defined as the dwell time of a mobile in the handover area and it is denoted by T_Q. The dwell time is assumed to be exponentially distributed with the mean dwell time, $1/\mu_Q$.

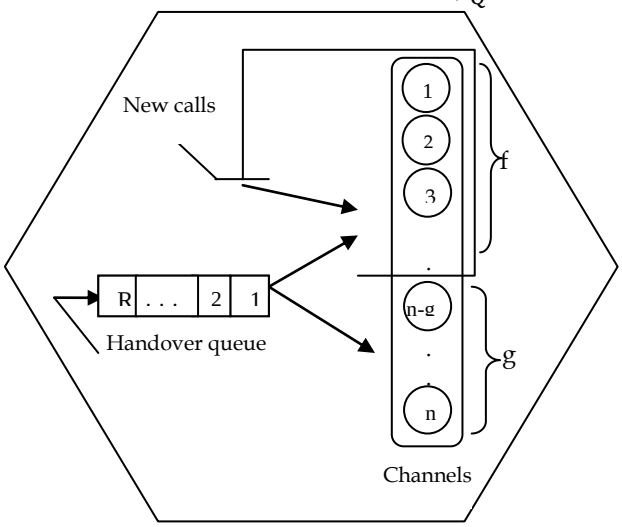

Figure 1: Schematic of the Guard channel; n-g to n are the guard channels reserved for handover calls when the free channels are all occupied while f are the free channels for all calls.

Analytical model

To develop the analytical model for figure 1, a markov chain representation was developed in figure 2. The total call arrival rate is denoted as λ while the handover call arrival rate is λ_H. All calls (both new and handover) that are served have a service rate of μ.

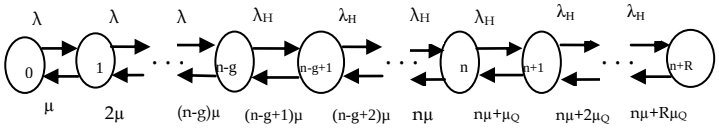

Figure 2: Markov chain representation

The steady state probabilities for a network with guard channels and handover queue will be determined as follows:

States

[0] $\lambda P(0) = \mu P_1$ (1)

[1] $\lambda P(0) + 2\mu P_2 = \lambda P_1 + \mu P_1$ (2)

[n-g] $\lambda P_{n-g-1} + (n-g+1)\mu P_{n-g+1} = \lambda_H P_{n-g} + (n-g)\mu P_{n-g}$ (3)

[n-g+1] $\lambda_H P_{n-g} + (n-g+2)\mu P_{n-g+2} = \lambda_H P_{n-g+1} + (n-g+1)\mu P_{n-g+1}$ (4)

[n] $\lambda_H P_{n-1} + (n\mu + \mu_Q)P_{n+1} = n\mu P_n + \lambda_H P_n$ (5)

[n+1] $\lambda_H P_n + (n\mu + 2\mu_Q)P_{n+2} = \lambda_H P_{n+1} + (n\mu + \mu_Q)P_{n+1}$ (6)

[n[illegible]] [illegible] (7)

Further analysis of equations (1) – (7) gives the steady state conditional probability as

$$P(i) = \begin{cases} \frac{(\lambda)^i}{i!\mu^i}(\,), & 0 \le i \le n-g \\ \frac{(\lambda)^{n-g}}{i!\mu^i}\frac{\lambda_H{}^{i-(n-g)}}{}P(0), & n-g < i \le n \\ \frac{(\lambda)^{n-g}}{n!\mu^n}\frac{\lambda_H{}^{i-(n-g)}}{\prod_{j=1}^{i-n}[n\mu+j(\mu+\mu_Q)]}P(0), & n < i \le R \end{cases} \quad (8)$$

where $P(0)$ is the initial steady state probability. This implies that all the channel resources are free at that instant.

$$P(0) = \left[\sum_{i=0}^{n-g}\frac{(\lambda)^i}{i!\,\mu^i} + \sum_{i=n-g+1}^{n}\frac{(\lambda)^{n-g}}{i!\,\mu^i}\frac{\lambda_H{}^{i-(n-g)}}{} + \sum_{i=n+1}^{n+R}\frac{(\lambda)^{n-g}}{n!\,\mu^n}\frac{\lambda_H{}^{i-(n-g)}}{\prod_{j=1}^{i-n}[n\mu+j(\mu+\mu_Q)]}\right]^{-1} \quad (9)$$

2.3 The Retrial Queue

When a call is blocked, it retries for access to a free channel. Since more than one call may retry at any given time interval, it is necessary to introduce a queuing system for the retrying calls. This queue allows calls that are retrying to wait for a given time based on a particular queuing discipline. The FIFO queuing discipline is assumed. The retrial probability for all