probability of a transition from the waiting (0) to the transmission (1) during a time(τ and

$$\sigma_d = (\tau / L_b / R_s) \quad (5)$$

is the inverse transition.

3. Protocol description

In the studied protocol, the time is divided in frames where several users can send at the same time but on different codes. A user, who sees a gust, must choose a code then to send his packets over. The code can be chosen uncertainly or partner either to the user at the time of his entry in the system after have been accepted by the CAC (Connexion Admission Control) function (Shinsuke and Ramjee, 2003). A user sends on this code when he has packets to transmit. If the number of codes used simultaneously is very elevated, the error probability increases considerably. It is necessary to limit the maximal number of codes used simultaneously. For this reason, in the beginning of every frame, a probability of permission is distributed to the different users to limit the access of users to codes. This probability is a function of number of codes used in the previous frame. The function of permission depends on the quality of service (QoS) asked by the user and must be different for the voice subsystem and the data subsystem. In the context of satellite it is necessary to define the appropriate permission function for each subsystem in order to get the best performance.

DS/CDMA Channel model

As in (Mohsen and Evaggelos, 1995; Mori *et al*., 1998), it is assumed that the performance of CDMA system is dominated by the bit error ratio (BER) performance and any problems related to packet acquisition, although not completely insignificant, are ignored. To the bit error rate on DS/CDMA channels, the standard Gaussian approximation is widely used. Assuming that the multiple access interference (MAI) is Gaussien and perfect power control is employed, the probability of bit error P_e in the case of neglecting additive white Gaussian noise (AWGN) can be obtained from:

$$P_e = Q(\overline{SNR}) \quad (6)$$

where

$$Q(x) = \frac{1}{\sqrt{2\pi}} \int_x^{\infty} e^{-u^2/2} du \quad (7)$$

When considering random direct sequences (Pr{xj = 1 } = Pr{xj = -1} = 0.5) where xj is a chip of the direct sequence with a spreading factor *sf*, the average signal-to-noise ratio (SNR) for the ith packet in the case of unequal power reception can be written as

$$\overline{SNR} = \sqrt{\frac{P_i}{(3sf)^{-1} \sum_{k=1,\, k\neq i}^{K} P_k + \frac{N_0}{2T}}} \quad (8)$$

where a system with K simultaneous transmitters is considered with received power levels Pj $(j=1..K)$, data bit duration T, and tow- sided spectral density of additive white Gaussian noise $N_0/2$. Consider a cellular environment with R+1 equally loaded cells and K active transmitters in each cell. Assume that perfect power control is employed such that all the packets transmitted by terminals within a given cell can be received by its base station at equal power level P_0 . In this case, (4) yields for a test cell.

$$\overline{SNR} = \sqrt{\frac{3sfP_0}{(K-1)P_0 + \sum_{k=1,k\neq i}^{K} \sum_{i=1}^{R} P_{(k,j)0}}} \quad (9)$$

We disregard the white noise and one supposes that the signal of the k user in the *i* cell is received by the base station 0 with a power of $P(k,i)_0$. Now take the case where interference received by the other cells is proportional to the total interference in the cell considered with a factor of *f*.

$$\overline{SNR} = \sqrt{\frac{3sfP_0}{(K-1)P_0 + (K-1)fP_0}} = \sqrt{\frac{3sf}{(K-1)(1+f)}} \quad (10)$$

Assuming that packets of length L bit are transmitted over a memoryless binary symmetric communication channel with average probability of data bit success $Q_e = 1 - P_e$ and employed a block code, witch can correct up to t errors, the packet success probability Q_E can be derived from

$$Q_E(K) = \sum_{i=0}^{t} C_L^i \, (1-Q_e)^i \, (Q_e)^{L-i} \quad (11)$$