

EE 6950 – Homework #2

Assigned: 10/06/03; Due: 10/13/03 before class

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1. Consider the following system made up of 150 MSC/VLRs. Each user receives 3 calls/hour, there are 320 users/sq. mile, users move at an average speed of 8 miles/hr. Each HLR in this system can support 25,000 users, and MSC covers a square region with perimeter of 30 miles. If HLRs can process 100 incoming operations/second maximum and VLR/MSCs can process 40 incoming operations/second, determine the delay to locate a user during incoming calls (hint: assume poisson arrivals and exponential service times). Ignore authentication and ciphering procedures and also assume SS7 and paging delays are negligible. Operations only include messages requesting an action, not responses. Determine the delay, assuming that a) subscriber information is downloaded to the VLR during call establishment and b) subscriber information is downloaded to the VLR during registration (60 pts).
2. Consider a CDMA system in which users A and B have Walsh codes  $(-1 \ 1 \ -1 \ 1 \ -1 \ 1 \ -1 \ 1)$  and  $(-1 \ -1 \ 1 \ 1 \ -1 \ -1 \ 1 \ 1)$  respectively. Show a) output at receiver of A if A transmits bit '1' and B does not transmit; b) output at receiver of A if A transmits bit '0' and B does not transmit; c) output at receiver of A if A and B both transmit a '1' bit assuming received power from both A and B are same; d) output at receiver of A if A transmits bit '0' and B transmits bit '1' assuming same received power; and e) output at receiver of A if A and B transmit bit '1' assuming received power from B is twice received power from A - this can be represented by showing received signal from A has magnitude 1 (+1,-1) and received signal from B has magnitude 2 (+2,-2). (20 pts).
3. Determine the maximum number of 9.6Kbps calls that can be supported in a single-cell IS-95 based CDMA system if the minimum  $E_b/N_0$  required is 6dB for a) omni-directional base station with no voice activity detection, b) omni-directional base station with voice activity detection ratio of 40% and c) three-sector base station with sector gain factor of 2.4 and voice activity detection ratio of 40%. Assume perfect power control. (20 pts).