Simulation assignment 4

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1. Single-cell case

- M Mobile stations are taken in the reference cell (M varied from 10 to 100). A 1000 length BPSK message is generated randomly for each user. A 512 length PN sequence is also generated for each user. Each user message is multiplied by its PN sequence and sent across the channel.
- At the receiver, the signal from each user gets added up. A 512 bit Gaussian noise is also added at the receiver.
- For, decoding the message from user i, the received signal is multiplied (dot product) by the PN sequence (assumed to be known at the receiver) of user i. Then a threshold detector at 0 is used.
- Pe is calculated for all users for each message bit and is averaged across the 1000 bits of message.
- The Pe vs No. of MSs graph can be seen below. As the no. of MSs increase, the Pe increases as the interference due to other users increase.
- SINR is calculated by first calculating the signal power of user i = mean square value of the User i signal*PN seq of user i. Then the interference+ noise power is calculating the mean square value of (Received signal –user i signal*PN seq of user i). SINR is computed using these values for all the users and an average is taken.

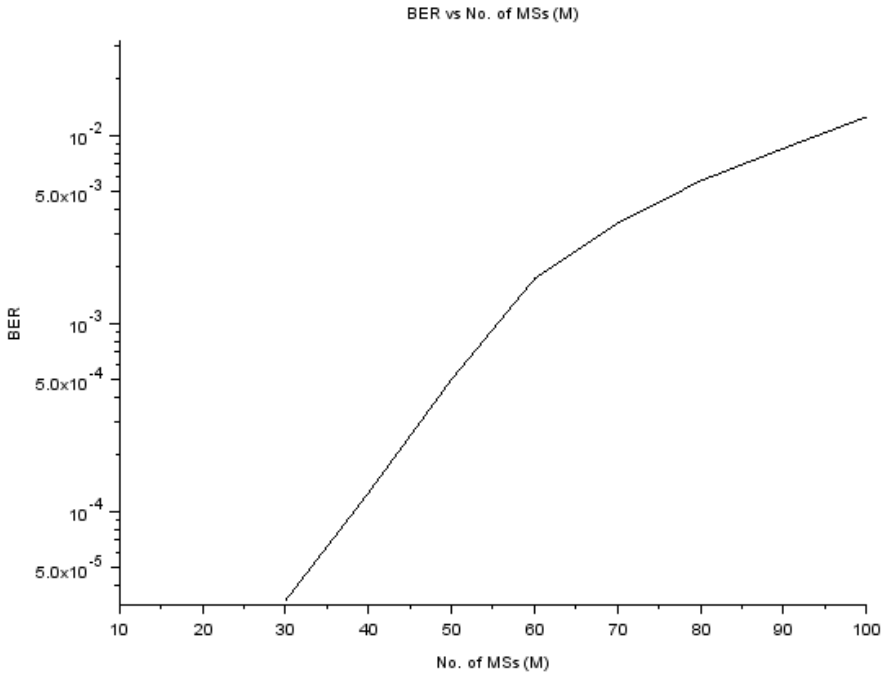

Fig: BER vs No. of MSs (M) for no single-cell case

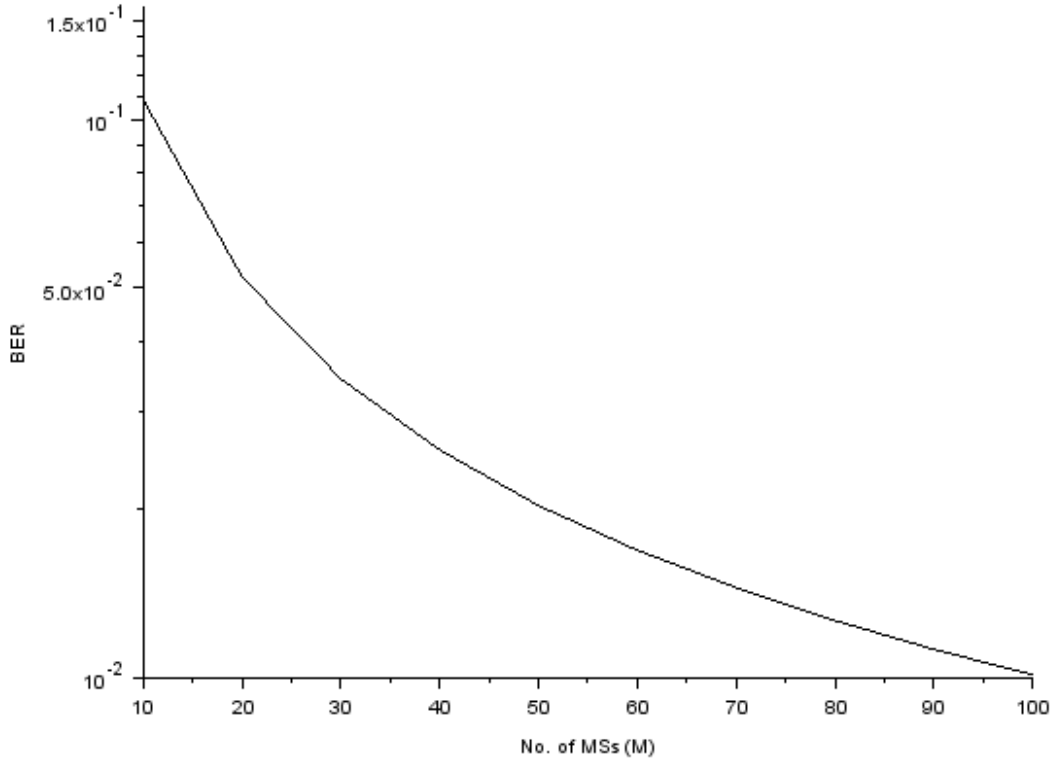

Fig: SINR vs No. of MSs (M) for no single-cell case

2. Multi-cell case

- For the multi cell case, M users each are uniformly generated in all the cells (reference cell + the neighboring cells). For each of the user in the neighboring cell, its received power at the BS of reference cell is calculated. Then its message (1000 bit with appropriate power as calculated) multiplied by its PN sequence is added to the received signal at the BS station of reference cell. This contributed to additional interference. This interference term is added for all the users in all the neighboring cells.
- Decoding of the message is same as in part 1.
- As there is additional interference due to neighboring cells, BER increases and SINR reduced as compared to part 1 which can be seen in the comparison plot at the end.
- It should however be noted then, the reduction in SINR or increase in Pe is by a very small factor, i.e by 1.47 (theoretical value – 1.6) which indicates the advantage of using a CDMA communication scheme in a multi cell scenario.

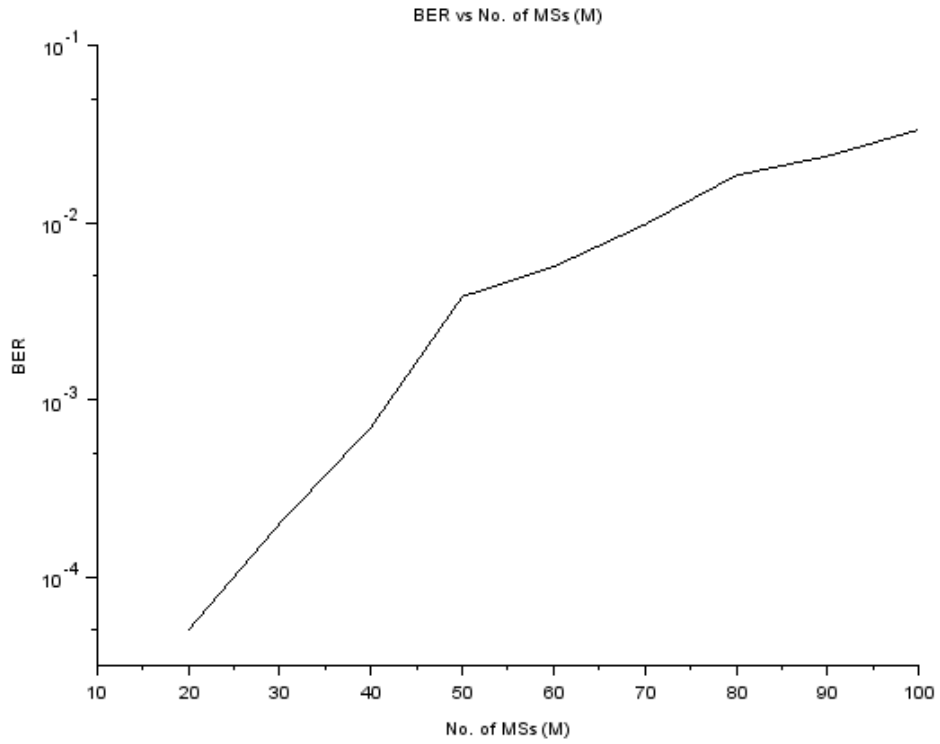

Fig: BER vs No. of MSs (M) for no multi-cell case

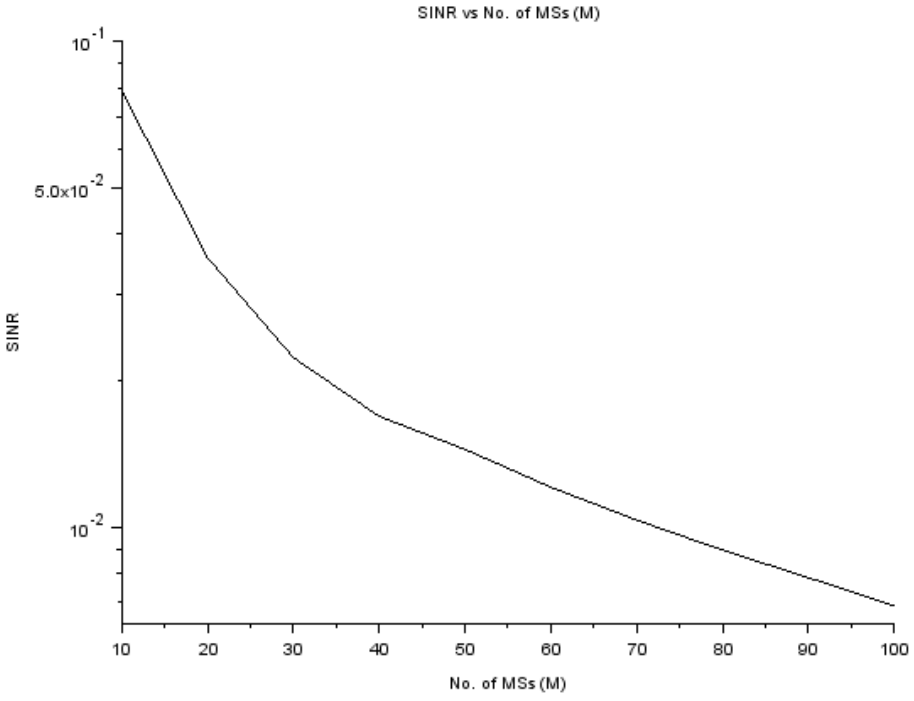

Fig: SINR vs No. of MSs (M) for no multi-cell case

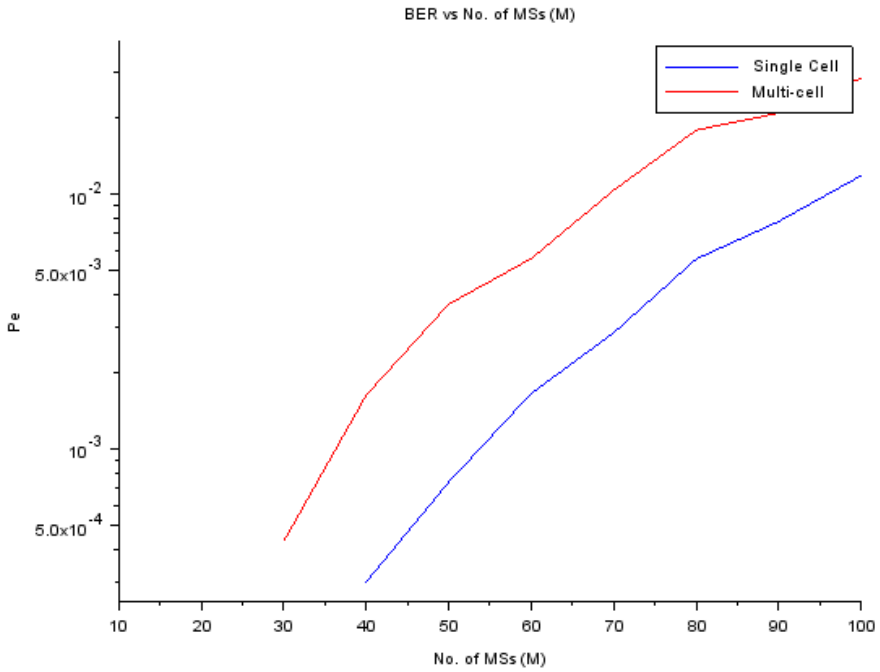

Fig: Comparison Plots, BER vs No. of MSs (M)

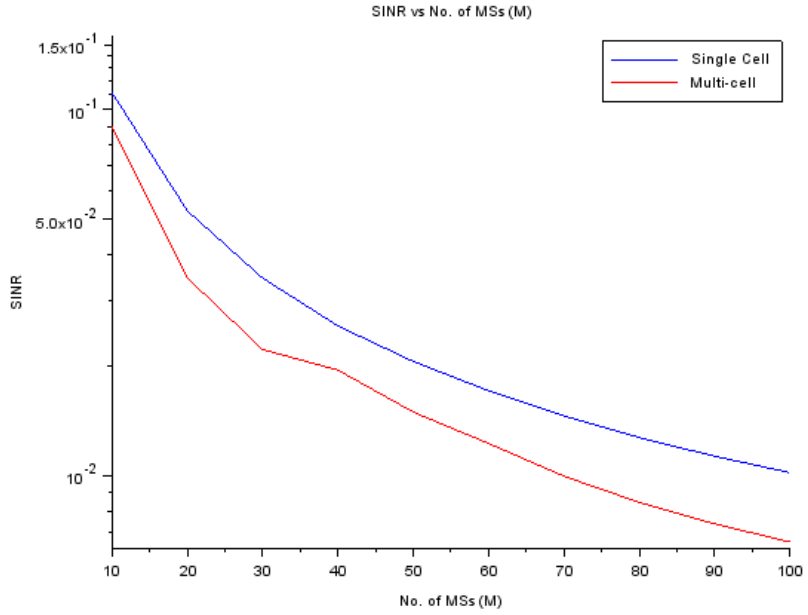

Fig: Comparison Plots, SINR vs No. of MSs (M)

For a BER of 10^-3, the capacity of a single cell system is 56, and a multi- cell system is 38*7 = 280. (Note the ratio of increase in interference in a cell is around 56/40 = 1.47 which is close to the expected value of 1.6 {which occurs when infinite neighboring tiers are considered}).