DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE – RAIGAD -402 103

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Branch:M.Tech (ELECTRONICS & COMM. ENGG.) **Sem.:- I**

Subject with Subject Code:- Advanced Communication Engg. **Marks: 20**

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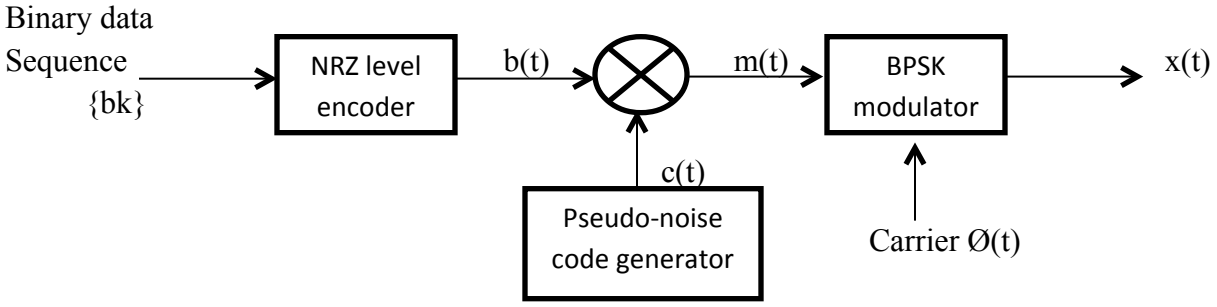
MODEL ANSWER SHEET

Q.No.1.A) With the help of suitable figures, explain Direct Sequence Spread BPK transmitter & receiver in detail. State applications of Direct Sequence Spread Spectrum. **8 marks**

Answer : i) DS-SS BPSK Transmitter : Figure shows the transmitter of Direct Sequence Spread Spectrum with BPSK.



As shown in the above figure , the binary data sequence is given to NRZ level encoder. This encoder converts b_k into bipolar NRZ waveform.

The Pseudo-noise sequence generator generates an encodes this sequence in bipolar NRZ signal. The multiplier multiplies the two signals b(t) and c(t). The optput of multiplier is direct sequence spread signal m(t). This signal is given as modulating signal to BPSK transmitter. The direct sequence BPSK(or DS/BPSK) signal is generated at the output (i.e.x(t)). Let's say that the carrier is represented as,

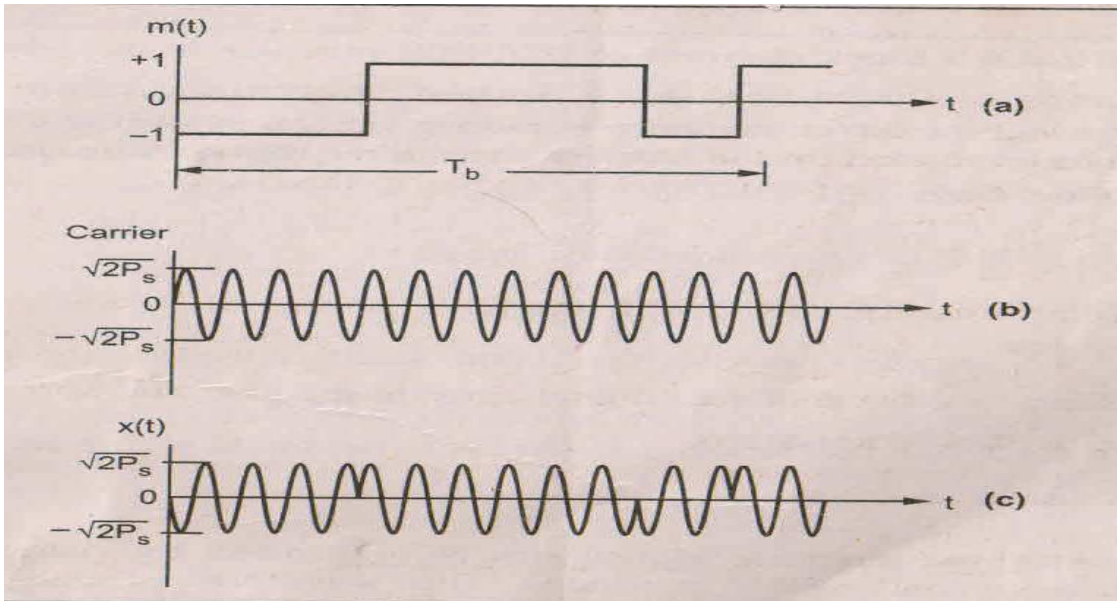
t)

Then the transmitted signal is

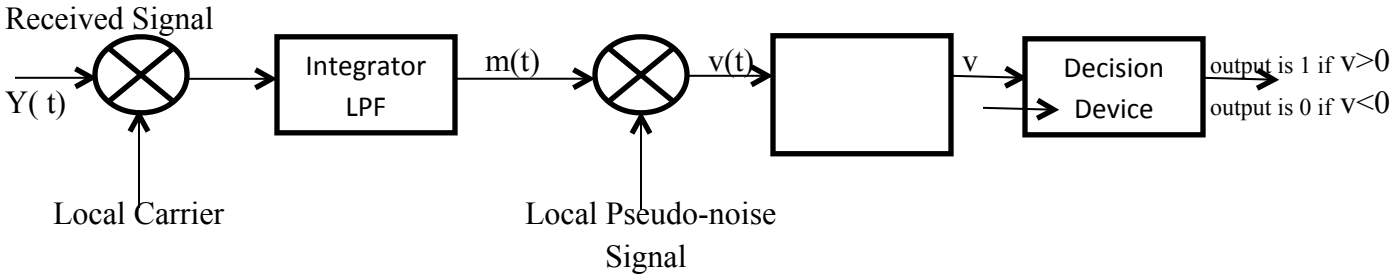
x

Thus when m(t) is positive , there is phase shift of '0' and if it is negative, there is phase shift of 180.

Following figure shows the waveform of message signal m(t), carrier signal and modulated signal x(t). These waveforms are shown for one bit period T_b of the waveforms. That is in following figure the message signal m(t) is taken from the one bit period T_b.



ii) DS-SS BPSK Receiver : Figure shows the block diagram of DS/BPSK receiver. There two stages demodulation. The received signal y(t) is applied to the multiplier which is also supplied with locally generated coherent carrier. The output of the multiplier is then applied to the low pass filter (integrator). The babdwidth of these low pass filter is equal to m(t). This stage is BPSK detector. This signal m(t) is applied to the second demodulator which dispreads the signals.The local pseudo noise signal is exact replica of that used in the transmitter. The integrator integrates the product of detected message signal and pseudo noise signal over one bit period. The decision is then taken depending upon the polarity of output of the integrator.



DS.BPSK RECEIVER

Application :

Anti-jamming with the help of DS-SS Signal.

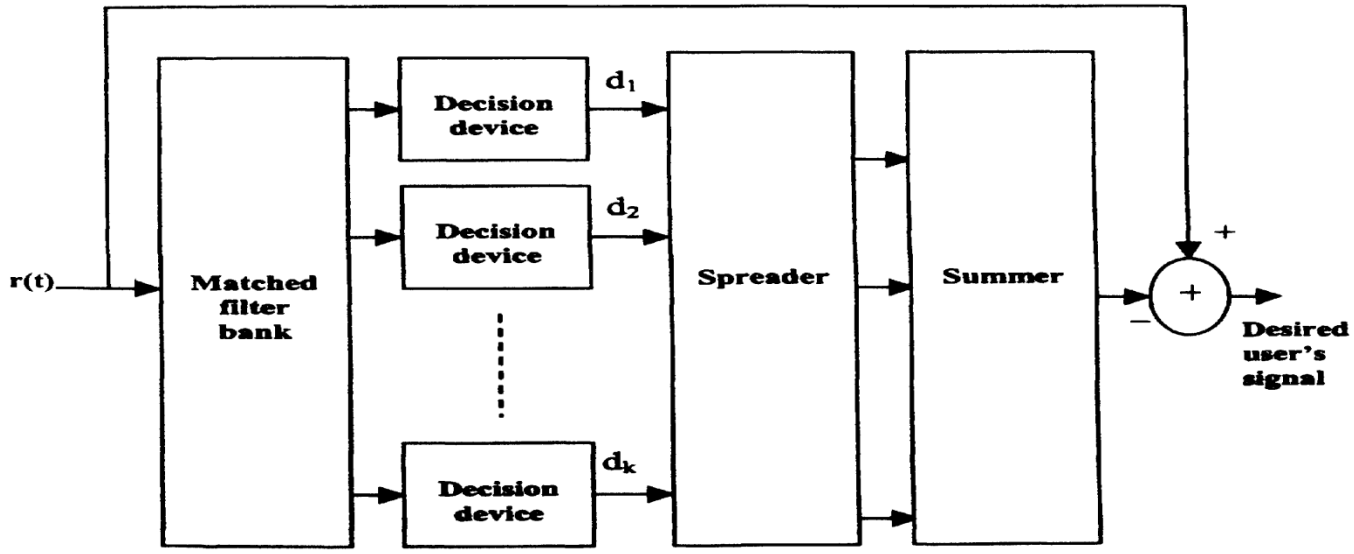
Low detectability signal transmission.

CDMA with direct sequence SS.

Q.No.1.B) Explain Parallel Interference Cancellation Receiver with the help of suitable block diagram.

Answer : Parallel Interference Cancellation Receiver:

In contrast to the SIC receiver, the Parallel interference cancellation (PIC) receiver estimates and subtracts out all of the MA1 for each user in parallel.



The basic block diagram of a single stage PIC receiver is shown in Figure. The first block is that of a matched filter bank, which is used to achieve at the initial bit estimates for each user. These bits are then rescaled by the amplitude estimates and re-spread by the individual PN codes to produce an estimate of the received signals of those users. The summer sums up all the estimated signals of various users and these are in turn subtracted from the total received signal. Hence a partially error free signal with less effect of MAI is obtained.

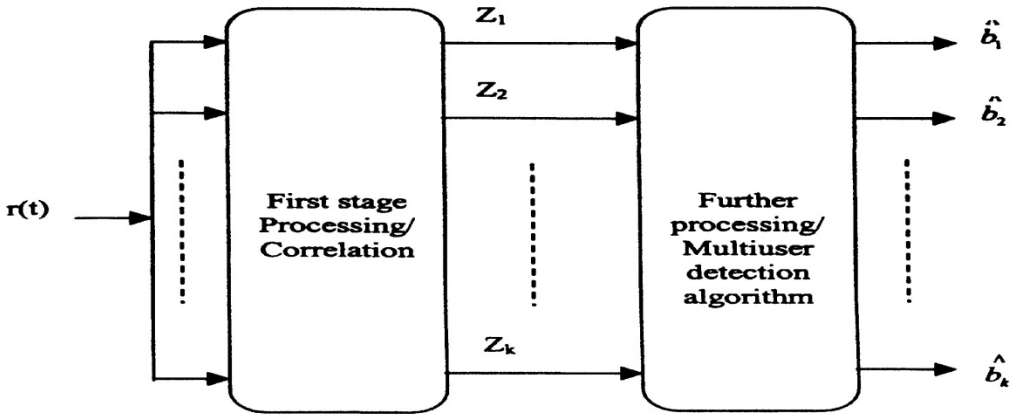
The advantage of the PIC receiver is that the process of cancellation is quite fast and there is no delay incorporated at the receiver. But the problem with this type of receiver is that the receiver complexity is quite large. Also the performance of the receiver is not reliable for there is a possibility of improper cancellation. The PIC receiver is faster than the SIC receiver, but at the same time, is more complex than the SIC receiver. Hence in order to obtain an optimal receiver performance, a trade-off between the computational time and receiver complexity is necessary [158]. This trade-off is incorporated in the proposed SINR driven Hybrid Interference Cancellation (HIC) receiver, presented in the next section.

Q.No.2. Solve any three:

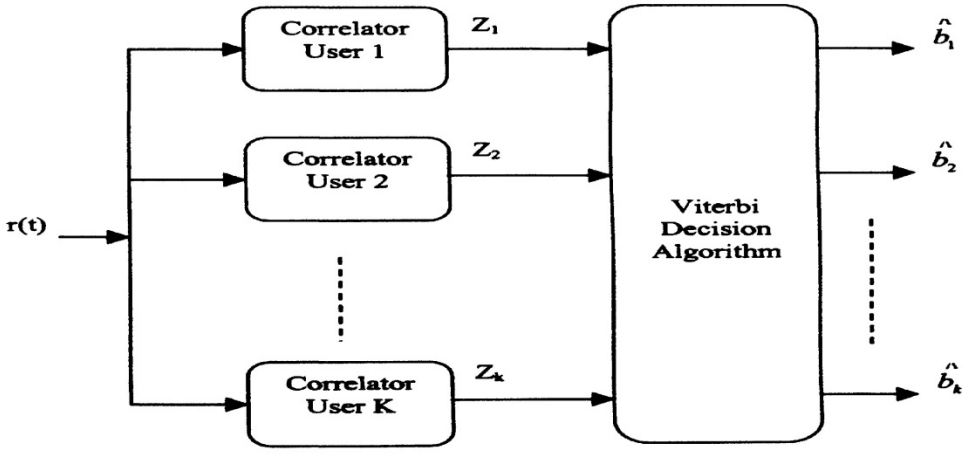
A) Discuss general multi user receiver structure with neat block diagram. 4marks

Answer : Optimal Detector

The optimal structure shown in Figure consists of a bank of matched filters providing first order user amplitude estimates to a Viterbi decision algorithm. Verdu has shown that the optimal structure afforded significant performance improvement over the conventional structures and is insensitive to the near-far problem. The extraordinary performance enhancements however come at a price. The optimal receiver assumes apriori knowledge of the received signal amplitudes as well as delays; in practice, such ideals are usually not attainable. In addition to that the use of Viterbi decision algorithm makes the receiver complex and more burdensome.



General multi user receiver structure



BPSK based optimal CDMA receiver

The Viterbi decision algorithm performs maximal likelihood sequence estimation over the entire sequence of received message bits, thereby decoding the whole message sequence in a trellis with 2^k states. The computational complexity per bit decision then becomes exponential in the number of users, clearly rendering the optimal receiver impractical for implementation. Due to its prohibitively expensive complexity, the role of the optimal receiver has been relegated to that of a benchmark against which sub-optimal CDMA detectors exhibiting more reasonable computational complexity are compared. Some important sub-optimal multi-user receivers are discussed here.

B) Explain in short different telephone networks (past, present and future). 4marks

Answer : Telephony : Step by step, Digital

Communication satellite

Mobile radio & cellular

Internet and packet radio

Military wireless systems

Terrestrial

Satellite systems

Very short description of above points expected.

C) Write short note on soft hand off. 4marks

Answer :

Soft handover or **soft handoff** refers to a feature used by the CDMA and W-CDMA standards, where a cell phone is simultaneously connected to two or more cells (or cell sectors) during a call. If the sectors are from the same physical cell site (a sectorised site), it is referred to as **softer handoff**. This technique is a form of mobile-assisted handover, for IS-95/CDMA2000 CDMA cell phones continuously make power measurements of a list of neighboring cell sites, and determine whether or not to request or end soft handover with the cell sectors on the list.

Due to the properties of the CDMA signaling scheme, it is possible for a CDMA phone to simultaneously receive signals from two or more radio base stations that are transmitting the same bit stream (using different transmission codes) on the different physical channels in the same frequency bandwidth. If the signal power from two or more radio base stations is nearly the same, the phone receiver can combine the received signals in such a way that the bit stream is decoded much more reliably than if only one base station were transmitting to the subscriber station. If any one of these signals fades significantly, there will be a relatively high probability of having adequate signal strength from one of the other radio base stations.

On the uplink (phone-to-cell-site), all the cell site sectors that are actively supporting a call in **soft handover** send the bit stream that they receive back to the Radio Network Controller (RNC), along with information about the quality of the received bits. The RNC examines the quality of all these bit streams and dynamically chooses the bit stream with the highest quality. Again, if the signal degrades rapidly, the chance is still good that a strong signal will be available at one of the other cell sectors that is supporting the call in **soft**

D) Explain IS95 CDMA systems with appropriate information. 4marks

Answer:

The technology of code-division multiple access channels has long been known. In the Soviet Union (USSR), the first work devoted to this subject was published in 1935 by Dmitry Ageey. It was shown that through the use of linear methods, there are three types of signal separation: frequency, time and compensatory. The technology of CDMA was used in 1957, when the young military radio engineer Leonid Kupriyanovich in Moscow made an experimental model of a wearable automatic mobile phone, called LK-1 by him, with a base station. LK-1 has a weight of 3 kg, 20–30 km operating distance, and 20–30 hours of battery life.The base station, as described by the author, could serve several customers. In 1958, Kupriyanovich made the new experimental "pocket" model of mobile phone. This phone weighed 0.5 kg. To serve more customers, Kupriyanovich proposed the device, named by him as correllator.
In 1958, the USSR also started the development of the "Altai" national civil mobile phone service for cars, based on the Soviet MRT-1327 standard. The phone system weighed 11 kg (24 lb). It was placed in the trunk of the vehicles of high-ranking officials and used a standard handset in the passenger compartment. The main developers of the Altai system were VNIIS (Voronezh Science Research Institute of Communications) and GSPI (State Specialized Project Institute). In 1963 this service started in Moscow, and in 1970 Altai service was used in 30 USSR cities.