Wireless communication
Assignment no: 3

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T.
a. Adaptive Equalizer:

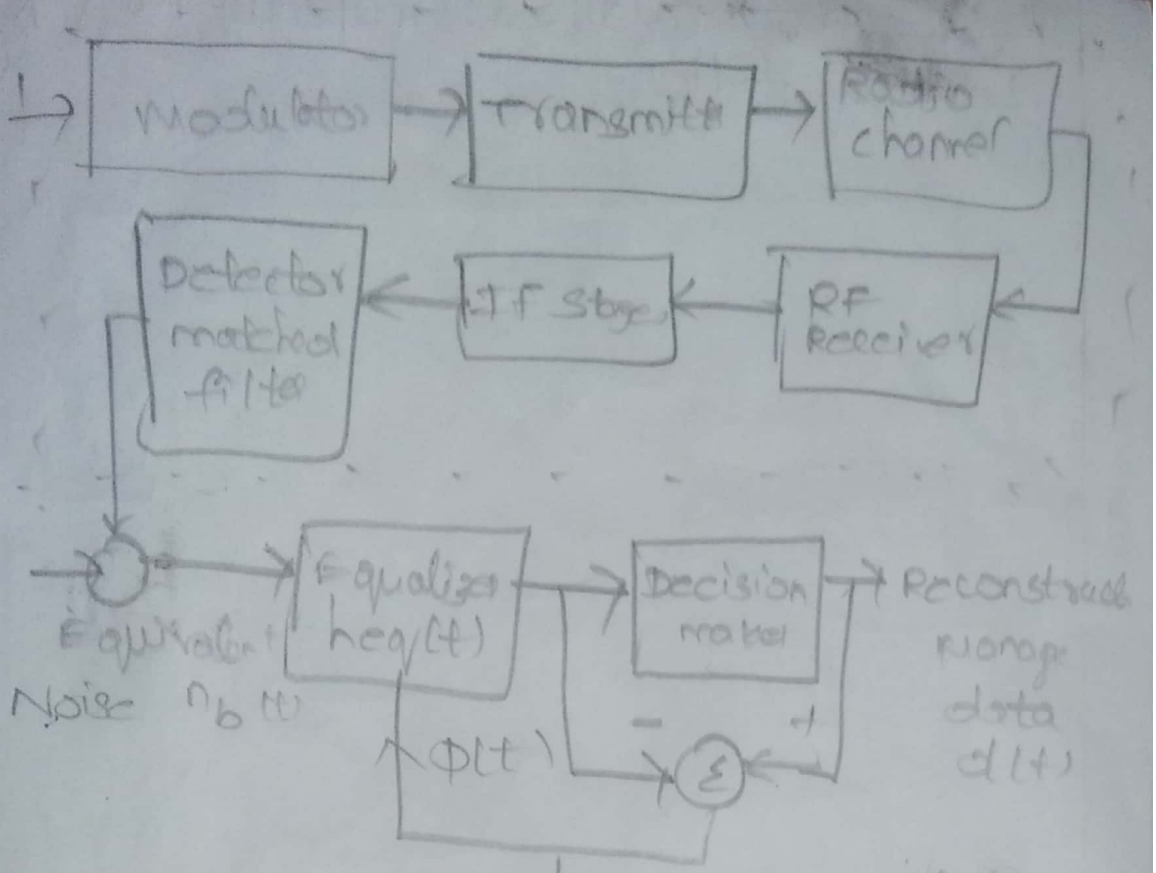
* As the mobile fading channels are random and time varying, equalizers must track the time varying characteristics of the mobile channel, & thus are called adaptive equalizers.

Operation modes
(i) training (ii) tracking

* the training sequence is a pseudorandom binary signal or a fixed prescribed bit pattern.
* As userdata are received the adaptive algorithm of the equalizier tracks the changing channel.

communication system with an Adaptive Equalizier:

f(t) = combined IR of transmitter multipath radio channel & receiver RF/IF.

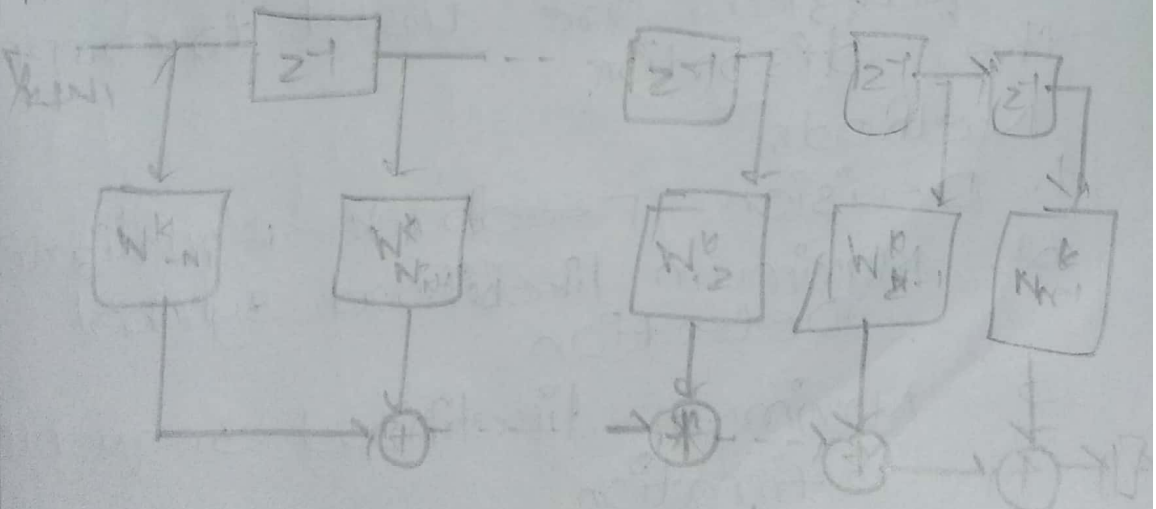


Techniques:

* Linear Equalizer
* Non-Linear Equalizer

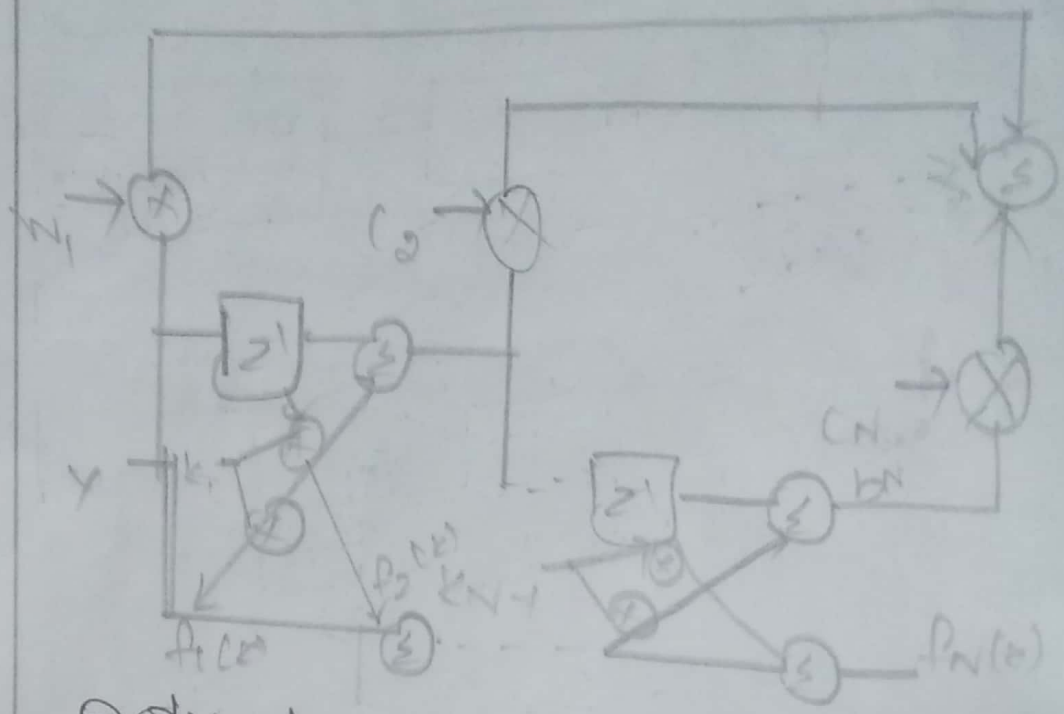
Linear Equalizer:

If the output d(t) is not used in the feedback path to adopt the equalizier then the type of equalization is called linear equalization.



Structure of linear equalizer

Linear Equalizer implemented by Lattice filter



Advantages:

* Numerical stability
* Faster coverages

Disadvantages:

It is more complicated than a linear transversal equalizer.

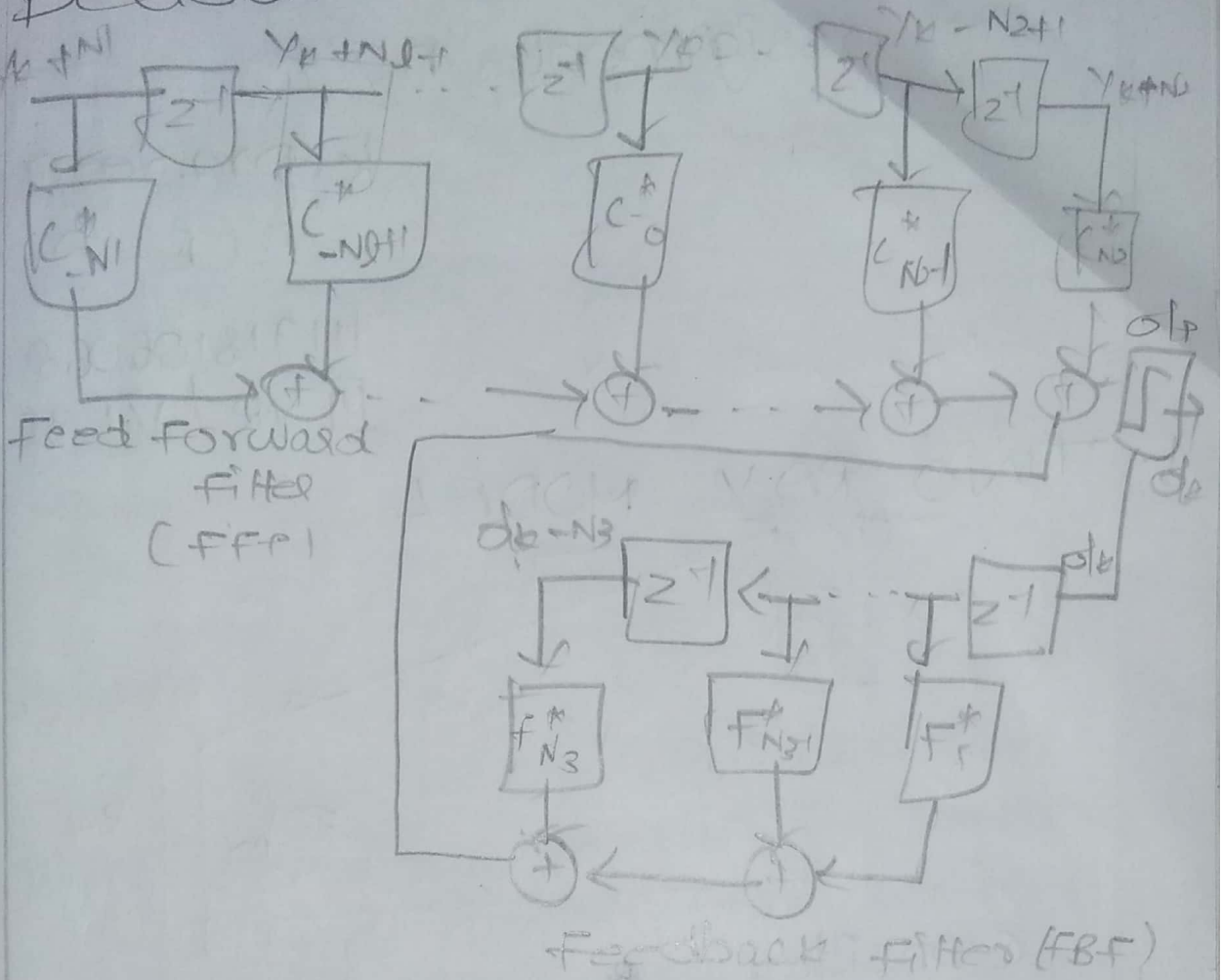
Non-linear Equalization:

If the channel distortion is too severe in linear equalizer to handle then the non-linear equalizers are used to compensate the disortion.

Methods:

1. Decision Feedback Equalization
2. Maximum likelihood symbol Detection
3. Maximum likelihood sequence estimation

Decision feedback :



This equalizer consists of a feedforward filter as in the convenion DFE. The FBF is called a Noise predictor because it predict the NOISE & the residue ISI contained in the signal at the FFF olp & subtract from it the detector olp after some feedback delay

Diversity Techniques

* It is a powerful technique which is used in the receiver to improve the efficiency the wireless link with relatively low cost.

* In this type of reception the received s/g is selected from many paths among those the strongest s/g is predicted.

Types

- Macro [provides a method to mitigat the effects of shadowing]
  - Space Diversity
  - Polarization Diversity
  - Frequency Diversity
  - Time Diversity
- Micro [provides a method to mitigat the effects of multi-path]
  - Large scale
  - Long term Fading

Polarization Diversity:

principle:

* It relies on the de-correlation of the two receive ports to achieve diversity gain. The two receiver ports must remain cross polarized.

* In this diversity the transmitted s/g with horizontal or vertical polarization is received.

* One element is used for horizontal polarization & the other is used for vertical polarization. Wireless communication systems usually use vertical polarization because this is more convenient for use with portable & mobile Antenna.

* A vertically polarized signal may be transformed into horizontal polarization due to multipath propagation the s/g received in any polarization will be interupted.

Advantage:

* It reduces the multipath delay spread.

Time Diversity:

* the signal representing the same information are sent over the same channel at different time.
* time diversity repeatly transmit information at that time spatings that exceeds the coherence time of the channel.

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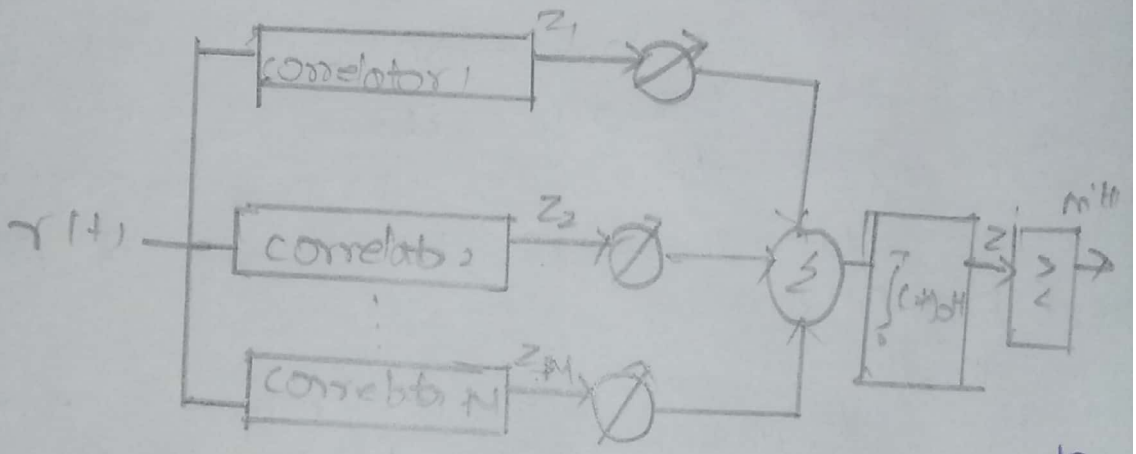


* Multipath component appears like uncorrelated noise at a CDMA receiver and equalization is not required.
* the output of each correlator are weighted to provide better estimate of transmitted s/g than is provided by a single component.
* the weighting coefficients are based on the power or the SNR from each correlator output.

Spatial Diversity

Principle:

The basic principle of this diversity is selecting the best s/g among all the signals received from different branches at the receiving end.

Methods:

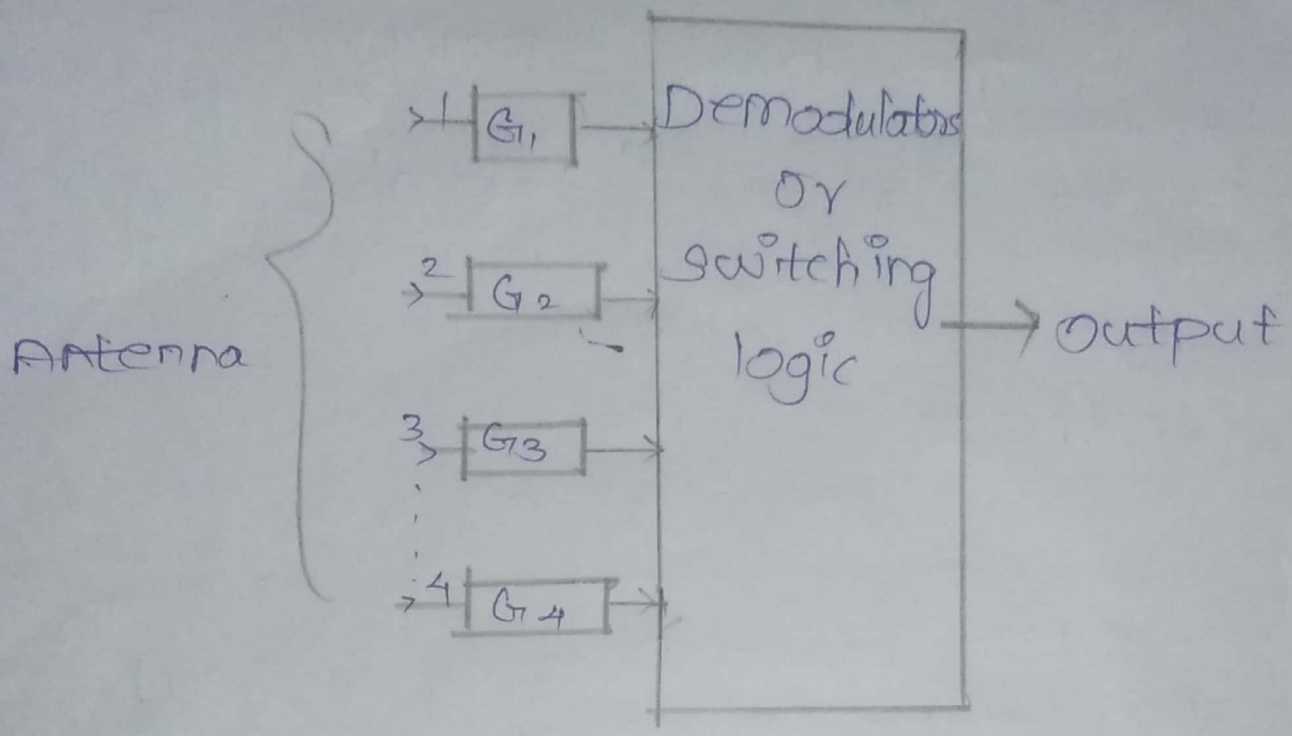
Spatial Diversity

- Selection based Diversity
  - * Selection Diversity
  - * Switched Diversity
  - * Feedback Diversity
- combining Diversity
  - * Maximal ratio combining
  - * Equal gain Diversity

→ one of the most popular forms of diversity used in the wireless system is space diversity also known as Antenna diversity.

→ this diversity technique is used in base station design

→ The base station Antenna are spread considerably far apart to achieve decorrelation.



Frequency diversity:

* Frequency diversity is implemented by transmitting same information on more than one carrier frequency

* our carrier frequency uncorrelated to each other ; so that they will not experience the same fades

* To make them least correlated these carrier frequencies are separated by more than the coherence bandwidth of channel.