Interview Questions

1. X1, X2 are iid RVs, and we know the CDF. Find the CDF of min(X1,X2).
2. P(H) = p, we toss until we get a head. Find expected number of tails.
3. a) BPSK signal x = +-1, with equal probability, y = x + n,
   n ~ Uniform(-2,2). Find the optimal detector and Pe.
   b) What will be the Pe when the threshold is 0.5 instead of 0 (ans of previous 3.a)?
   c) Find the optimal detector when we have complex normal noise with individual variance as 1/2.
   d) Instead of +-1, now we have symbols at [1/sqrt(2), 1j*1/sqrt(2)] and [-1/sqrt(2),-1/sqrt(2)] and complex normal noise as previous. Find the optimal detector. What will be the Pe ?
   e) If we rotate y clockwise by 45 degrees, will the effect of noise be same ?
4. QPSK symbols at [+1,+1j], [-1,+1j],[-1,-1j],[1,-1j], how to calculate the symbol error probability from the probability of error of BPSK.
5. MISO system. Total power at Tx = P. Channels are independent and are known at Tx. What is the best way to transmit x ? What is the SNR at Rx ? What will be the SNR when we transmit only in the best channel ?
6. x = [x_1 x_2 .... x_n] has DFT X. Find the DFT of [x_1 0 x_3 0 ....x_(n-1) 0] in terms of X.

1. Bpsk with equal probability. Noise ~ U(-2,2). y=x+n. Find optimal decoder with Ber.
2. Tone at 99khz. Fs =10k. LPF Fc=15k. Output?
3. Y=max(X1, X2,... Xn). Xi iid U(0,1). Find E(Y).
4. Capacity of BSC. What is the capacity when two BSCs are cascaded?
5. Compare between Bpsk and Qpsk. When to use which?
6. A square is cut out from within a larger square. How to equally divide the remaining area?
7. explain Viterbi decoding

1. Communication system with 1 antenna at the Tx and 2 antennas at the Rx. Channel gain is h1 for one channel and h2 for another channel.
Channel gains h1 and h2 are known.

$$y1 = h1\,x + n1$$
$$y2 = h2\,x + n2 \quad ; n1, n2 \sim N(0, \sigma^2)$$

a) What is the best estimate of x ? (equal noise variance case)
b) If the noise variance is not equal, then what is the best estimate of x ? How will you combine the two observations?
c) If noise in the channel is coloured, then optimal estimator of x?
d) If n1 and n2 are perfectly correlated, then what is the estimator of x ?

2. transmission of uncoded binary bits over a binary symmetric channel with prob of correct transmission =p. A frame consists of n bits. After a CRC check, if all the bits in a frame are correct then, there is no error in the frame.
a) Probability of error in the frame ?
b) If we use some encoding that can correct upto 1 error in a frame, then what is the new probability of error?
3. Rate is 1but per channel use. For transmission, the bit 0 is mapped to x=0 and the bit 1 is mapped to x=1 and x=-1 , each with probability half. What is the optimal detector?

4. Y is the DFT of a n-length sequence x. x=[x1 x2 x3 x4.. xn]. Consider another n-sequence, x' = [x2 x3 x4 .. xn 0]. What is the DFT of x' in terms of Y?
5. y=hx + n .. there are pilot symbols x and h is unknown.

1. N*1 antenna system. all the channels are i.i.d in space but correlated in time . Your CSIT is delayed. Rate goes to zero as CSIT delay is infinite. If you have correlation in space, does your rate vs delay curve become better or worse?
Ans: it can become good. Eg: assume all antennas have correlation 1 in space and some correlation in time. Then your beam forming vector is same across time and space [1 1].
2. Nt transmit and Nr received antennas. Nr tends to infinity. Single Eigen mode transmission. Does the rate improve?
Ans: Yes because of channel hardening.
3. 2 sinusoids at 99 and 101 Hz.. What is sampling rate?
4. You have a sorting algorithm. what is minimum sorting complexity
5. Schmidl cox: if u have sub-band each of 10 kHz and frequency offset of 5 kHz and noise variance is 0 , what is the impact on snr, BER?
Ans: snr roughly be 0 dB .. because half of your signal power has gone into next band and half of before band has come into yours. So the signal power and noise power you have is same
6. Sum of three angles of a triangle is 180.. what is the minimum value of sin A + sin B + sin C ?
Ans: problem is jointly convex in A and B.. substitute C as 180-A-B and solve this 2 dimensional problem

Questions were on receiver structure, coherence bandwidth, coherence time, doppler spread etc. and many usual questions that are in
above list one interesting question was about receiver used in a phone which is on a high speed travelling train... how to estimate doppler spread, frequency offset and compensate for this. Few coding theory questions I have missed but they were pretty easy and direct. Swapping two numbers in a single line of code.
And some questions on pointers and basic C operators.
Decision regions for Bpsk and additive exponential noise.

Qualcomm: campus (firmware team)-easy interview

1. log likelihood ratios and decision region for bpsk in AWGN
2. difference between jump and call instructions:
You have to answer this from how the variables are stored, it is a difference similar to call by value and reference.
3. code for factorial
Primary focus is DSP, Probability. In addition to that there are good number of questions on Digi comm, and concepts of MIMO and OFDM.

First round:

1. Draw the pulse shape of BPSK and Differential BPSK
2. You have a signal y(t)= cos(2*pi*(1.1)t) + cos(2*pi*(0.9)*t). What will happen if sample exactly at Nyquist rate. Draw the pulse in Fourier domain. What is the resulting x[n] after sampling.
3. Explain about types of fading. Like large scale, small scale. What is the difference between them.

4. What is coherence bandwidth?

Second round:

1. In a village, a family keeps getting children till they get a boy. What is the average number of children for a family. Ans: Geometric distribution: So Expected value is 1/p =2.
2. You have N Guassian random variables with different variances and zero mean. They might be correlated random variables too. Now we want to linearly combine these Guassians with some weights. What should be the weights that maximize the variance of the resultant Guassian variance.
3. What is the probability that birthday of at least two people is same in a party of N people.
4. What is MAP, what is ML. what is the difference between them.

Third round (On skype to Pune)

1. Draw the constellation of BPSK anti-modal and BPSK-orthogonal. If we have AWGN, what scheme is better. (I told the first one. They asked to give a proof.)
2. X,Y are iid. What is P(X<Y)? Ans: 0.5. Then they asked to prove.
3. You are given a LTI system y[n]= y[n-1]- y[n-2] + x[n]. Is this system stable? Is it causal. What are the poles. What is the ROC. what is the criteria for stability in terms of poles in Z transform.

Fourth Round(On Skype to Pune)

1. I was shown a signal in Fourier transform domain. Its magnitude had only one sided non-zero value from f1 to f2. Was first asked if it was a real or complex signal.
2. How much Bandwidth is required to sample that. Draw the sampled version Fourier transform.
3. Can CDF be viewed as a transformation of the given random variable. What is the CDF of the CDF (when viewed as a random variable.
Ans: It is a uniform distribution . Prove that its uniform.
4. How to sample from a distribution if we know the CDF.
Ans: Sample from Uniform and use F^-1.
5. You have a sample of a random variable X. How do you transform that to a random variable Y. We know the cdf of both.
6. How to convert a received band pass signal to baseband. What filters to use. Draw the resulting pulses.
7. What happens when there is a slight frequency off set in the lowpass filter that you use to recover the Analog signal from sampled signal.
Ans: Aliasing occurs
8. You are given a series of two amplifiers with gain G1 and G2 and noise amplifiers with Noise factors N1 and N2. What is the equivalent gain and noise factor of the total system.
9. y[n]=x[n] conv h[n]. Write the formula and represent it in matrix form.

Fifth round (On Skype to USA)

1. Write the formula for DTFT. What is the complexity of computing it. What is FFT main idea. How much does the complexity reduce to? Ans : O(N^2) to O(N log N).
2. In an OFDM, given a fixed Bandwith, is it good to use 64 frequencies or 128 frequencies under the ideal assumption of fully flat channel. Which will give more data rate.
3. In a component there is a maximum voltage limit of -1 to +1. It gets capped at the extreme values if it goes beyond these limits. What happens if we give a sine wave as input for this

device. What will the output signal look like in the frequency domain.
4. In MIMO, if there is one transmitter, and two receivers with the corresponding channel variances being \sigma_1 and \sigma_2, how do you combine them optimally? Can you derive the best weights for combining?

TI phone interview questions :

1) For a sequence if we take the FFT twice what sequence will we get?

2)For a 1.26 GHz signal with 100Mhz BW sampled at 2 Gbps what will the spectrum look like?
3)BPSK transmitter and receiver signal chain description-what are the issues you might face in detection - how will you take care of the phase offset? Why is it am issue and how to take care of it? What will the receive constellation look like?

4) There are 25 horses in a race track. What is the minimum number of races required to decide the fastest 3 candidates? only 5 horses can race at a time and you only know the relative finishing time of the horses in any given race.

5) What is complex baseband and why is it necessary for baseband signal processing of real time signals? Why does the signal become complex in baseband?

Questions -off campus:

1. Explain the entire communication structure
Ans: Tx: Message source to Source encoder to Channel encoder to Modulator. Modulator converts bits to symbols. Modulator to Pulse shaper to ADC to up converter to power amplifier to antenna Rx: Rx. antenna to low noise amplifier along with a filter to capture desired freq. to down converter to DAC to correlator/match filter to demodulator to error correcting code to decoder

2. Why source encoder:?
Ans: To compress using Huffman or lempel ziv or any such algorithm so that avg. codeword length is close to entropy

3 Why channel encoder? Ans- to add redundancy so that errors can be corrected at output using Linear block code, convolutional code or simple repetition code... and also channel encoding helps us achieve rates closer to Shannon limit ..

4. If source encoding compresses and channel encoding adds redundant bits, why do this ? cant we just transmit
Ans: Redundant bits are added in a systematic manner so that error correction can be done in receiver, so both are not same

5. What is the Nyquist criteria of pulse shaping and what does it achieve ?
Ans: let T be symbol duration. assuming ideal channel, in frequency domain the pulse shaping spectrum must be such that when u take shifted copies of the spectrum by 1/T and add them u must get a constant. eg: rectangular spectrum from -W/2 to W/2.. shifting it by

1/T and adding all the shifted copies to get a constant gives the condition that 1/T =W i.e. data rate is twice the one sided bandwidth

6. What is the disadvantage and advantage of using sinc pulse i.e rectangular shape in freq. domain when compared to rrc
Ans: sinc gives max spectral efficiency of 2bps/Hz. RRC will give only 2/(1+beta) sinc in freq. domain is an ideal filter whereas rrc is realizable and sinc has a slow roll off .. when sampled at ideal symbol time instants u wont have ISI which is true for rrc too but even when there is a small offset, effect of ISI will be predominant due to slow roll off in sinc when compared to rrc Rx:

7. How many errors can be corrected? You can correct upto approximately d/2 errors or floor of (d-1)/2 errors where d is hamming distance
8. how do u do this correlation at rx matched filter
9. What is the simple method to decode and when is it optimal? nearest neighbour .. gets simple decision regions optimal when noise is gaussian and all symbols are equi probable i.e. MAP is same as ML .. performs good esp. when noise is low

Campus TI interview

1. 1.25 GHz centre frequency, 100 MHz bandwidth. 2 Gbps.. what happens.
Ans draw the spectrum.. no aliasing will happen .. but if u use 2.5 Gbps aliasing will happen due to folding..
2. An interpolator of 2 and a decimator of 3.. what is the relation between FS and one sided bandwidth b originally to recover the signal back .
Ans : FS should be at least 6 times b .. use time domain to see this immediately. frequency domain could be slightly confusing as we do not use LPF before decimator or after interpolator..
3. Usual bpsk with a rect function from 0 to T of amplitude 1 for s0 and amplitude -1 for s1. and another one of same s0 but s1 is positive from 0 to T/2 and negative from T/2 to T. Which of these two schemes have better prob. Of error
Ans : first one .. second one requires twice power . Must draw constellation points and derive. many ways to do this.. one way is Eg: take 0 to T/2 rectangular as basis... so in first one s0 is represented by (1,1) and s1 by (-1,-1)... in second one s0 by (1,1) and s1 by (1,-1)... hence the answer..
4. DFT of (1,-1,1,-1...)
Ans : delta(omega-pi) this is a high frequency signal... unit step gives delta... and (-1)^n x(n) gives X(omega-pi)

Qualcomm:

1. y= x + n, where n is exponential noise. Find the optimal receiver. problem was when x=-1 and n is mean 1...is y expo. RV of lambda = infinity ?
2. Square wave of freq. f0... notch at f0... what is the output .. can u plot
Ans: Square wave is periodic... so by Fourier series, has all sinusoid components at f0 and harmonics .. and hence this removes sine at f0
3. As vehicle travels in free space, what happens to signal.. power reduces due to path loss but no fading as we have considered free space and then about thesis ...not able to recollect more...

Intel campus:

1. What does antenna do.. what is the difference between an antenna and a metallic object.. what makes it special?
2. What is beamforming?
3. What is diversity in SIMO?
4. What is the minimum distance between antennas to get maximum receiver diversity
5. Why MIMO instead of SIMO?
Ans: As I can play with both diversity and spatial multiplexing diversity gain is (m-r)(n-r) where r is spatial mux no. and related to thesis...

Qualcomm

1). IQ imbalances and the spectrum of signals in the presence of IQ imbalanced data.
2). Given error probabilities in each transmission, how many number of re-transmissions are needed.
3). What is a bi-linear transformation?
>>This transformation is used to map continuous time filters to discrete time filters.
4). What will happen when the signal is up sampled or down sampled.
5). Given y= hx+ w, x=+-1, h and sigma^2 not known, how to find x. Its a very difficult problem and you can use EM algorithm to solve this.
6). Give a particular spectrum, what should be sampling rate.
7). What will happen when the clock in your down converter and your ADC are both erroneous.
8). Is cyclic prefix necessary when impulse response have only one tap? Ans). No. What can you do once impulse response length is larger than the CP duration? Use a channel shortening filter. Can be designed using MMSE.
9). What is the IDFT of [1 0 1 0 1 0 1 0].

10) In wiener filter , weights c are found as c=R^{-1} p..if correlation matrix R is square matrix and not full rank, what to do ? do not use pseudo inverse ..
Hint: something to do with the correlation among elements guess could be like using a whitening filter
11) Why is soft decoding preferred over hard decoding ?
12. another question on ARQ and HARQ protocol and comparing their average throughput ..

Qualcomm

1. Let there be a random number generator of distribution Gaussian 0 mean, unit variance. What should be there in black box so that output has discrete uniform distribution over 1 to 5. Ans : find the value of [x1 x2 x3 x4 x5] in the cdf of gaussian that gives 1/5, 2/5, 3/5, 4/5 and 1. If the number generated is between -infinity and x1, map it to 1 and so on.

2. A question on log likelihood ratio in QPSK.

3. What is the Diversity order if u use MMSE or ML in MIMO

4. Let there be 2 kids in a house. Prob. of girl= boy. Prob. of the child u pick is boy given at least 1 boy at home

5. Tones : If u have freq. tones at 98 and 101 Hz, what is the minimum frequency you can sample at ?
Ans : 2 Hz as the harmonics are at odd and even.. 202 Hz is Nyquist freq. but its too big..6 Hz is band pass sampling freq.. but as these are just tones, it is enough as long as 98 and 101 do not interfere with any periodic repetitions of themselves after aliasing..

6. if there is a tone at 99, then after aliasing at 10 Hz, u have tones at 1 Hz and -1 Hz... where do these come from? Ans : -1 Hz is one of the tones u get after aliasing from the tone at 99 Hz and 1 Hz comes from -99 Hz..

7. y1 = ax1 + bx2 +n1
y2 = bx2+ n2
How do u detect ? Ans: joint detection

8. What is single carrier freq. domain equalization. Why is OFDM advantageous over it..

9. Let x be 0, plus or -1 with prob. 1/2, 1/4, 1/4. How will the decision region be?

10. In the above problem, let 0 be affected by noise of variance 2 sigma^2 and plus or -1 by noise of sigma^2 .. so if the received symbol is 100, What will u decode it to?
Ans : 0 as the pdf p(y/x=0) will dominate over p(y/x=1) as the tail of noise of 2 sigma^2 is big.

11.Write a code to find the second maximum no. What is the order of number of steps required?
Ans: O(log N)

12. Find x that maximizes |x^H A x|^2 subject to norm being 1.

13. If there are N uniform random variables, what is the expected difference between max and second max of these RVs.

14. If Y is the product of N uniform random variables, what is the distribution of Y asymptotically. Ans : Y = X1 X2...XNlog(Y) is asymptotically gaussian distributed.. and hence Y is log normal..

15. what are the weights in MRC if the noises are correlated..

16. If X(f) is the Fourier transform of x= xI+jxQ, what is the fourier transform of xQ + jxI..
Ans : X*(-f) is the FT of x^* so it is the FT of xI-j xQ.. and hence jX^*(f) is the FT of xQ +j xI..

17. In a board, u can move only in horizontal direction by rolling a dice. Dice is numbered from 1 to 6... interested in the prob. of reaching 25 in 5 steps.. qn. is how do u frame this mathematically..
Soln: Use state transition matrix .. if there are total of 100 points in the board... then have 100 indices in X and Y axis... and each row will have 6 elements of prob. 1/6... for eg. from first position u can jump to anyone of 2 to 7.. and hence in first row each of these columns will have 1/6..so on and so forth...

18. If there is a sequence x(0) x(1) x(2).. x(N),whose Fourier transform is X(f) whose diagram was drawn on board. What is the Fourier transform of x(0) 0 x(2) 0 ...
Solution: So first a down-sampling is done and then a up-sampling ..accordingly draw the spectrum

19. Probability of 2 cords intersecting ..
Hint: Draw a cord.. for another cord to intersect with this, the 2 points must be on either side of the cord .Probability a point is above a cord is arc length/ 2Pi R= R theta/ 2 pi R = theta/2 pi and then take expectation with respect to theta assuming its uniform in 0 to pi..

20.Relation between H(X+Y) and H(X) + H(Y).
soln: function of a RV has lesser entropy so H(X, Y) \leq H(X,Y)= H(X)+H(Y/X) \leq H(X) + H(Y).
21. y1=x h1+n1,
y2=n2 where n1 and n2 are correlated .What is the optimal detector?
22. Find I(Z;X) where Z=max(X,Y)
23. y1= h1x+n1
y2= h2x+n2
Ans : If n1 and n2 are fully correlated, y1-y2= h1 x1 -h2 x2 (as n1=n2) so noise goes off and snr is infinity. If h1=h2, then y1-y2 wont work out as y1- y2=0..

24. y1= h11x1 + h12 x2 +n1
y2= h21x1 + h22 x2+n2 n1 and n2 are correlated, find the optimal detection?

25.Prob.of error of QPSK from BPSK.

26. y = hx + n1 there are pilot symbols x .How to find snr?

27. If bit 1 is mapped to (1+j) of probability 0.5 and 0 is mapped to (-1-j) , (-1+j), (+1-j) with each probability 1/6. what is the boundary decision ?

28. Similarly if bit 1 is mapped to (1+j) of probability 0.5 and 0 is mapped to (-1-j) , (-1+j) with each probability 1/4. what is the boundary decision ?

29. is y = ax + b linear ? Ans: no, as b is not 0.

30. You have a bandpass signal whose centre freq. is fc.. and the down-convertor is offset by a frequency delta f. Now sample this signal with a frequency fs + delta f.. the output

spectrum has multiple copies. Will the other copies just be a shifted version of the baseband signal or will there be a stretching too ?

31. MRC if noise variances are different....
soln: weights are channel gain/ sqrt(noise variance)..

Qualcomm(Hyderabad)

1. Complete structure of comm. Tx and Rx. and some basic questions in that.

2. If in a wired channel, receiver sees a low power in received training symbol, it could be either due to low RF power or some problem with pulse shaping or channel coding or modulator . How to identify?
Soln: Use a spectrum analyzer. If the problem is with raw power, then one wont see much power at all. If there is good power seen in the band of interest, then the problem must be in one of the other 3.If there is no problem with pulse shaping (guess the entire band will be seen ..not sure about how it is different with raw power explanation , then have to debug between channel coder and modulator. One shuts down one of the 2 blocks alternately and finds where the problem is.

3. Basic info theory questions as it is an optional subject:relation between H(X+Y) and H(X,Y).. must think in terms of relation between H(X) and H(g(X)). and the easy one, relation between H(X,Y) and H(X)+H(Y).

4.Multirate is important .. is downsampling by 2 followed by upsampling by 2 same as upsampling by 2 followed by downsampling by 2. under what condition is downsampling by L followed by upsampling by M same as downsampling by M followed by upsampling by L. guess they must be relatively prime..

5. Quantization..derive the trade off between no.of bits and sampling frequency..
Soln: let delta be interval length. max error is delta/2. min error is 0.error is uniformily distibuted in this range. So derive var. If total voltage span is 2A and number of levels L. substitute delta=2A/L and if b are no. of bits substitute L=2^b in the derived variance now PSD is var/f_s. From this talk about whether to increase fs or bits to reduce variance.

6. Coding:in a chess board, i want to go from left most point at bottom to right most point at top with only one horizontal and one vertical movement allowed. How many ways possible. write a pseudocode to compute this. Find mathematically no. of ways ..
soln: let (x,y) denote (horizontal, vertical) movement. Whichever way u take, only 14 steps are required and in that 7 will be horizontal and 7 vertical ..So 7 (1,0) and 7 (0,1). so total no. = 14!/(2*7!) ...due to repetition, denominator comes..

7. explain timing sync in OFDM, schmidl cox...

8. If u have finite and less no.of samples how will u compute the spectral density in matlab .
Soln: periodogram or look upto pwelch in matlab

9. y(i) = h + v(i) .How do u find SNR?
Soln.. estimate h as (sum of y)/N and find signal power... for noise power, as h is constant ,var(y) is var of noise.. so just find power of y using law of large nos.

10. Intersting qn: y(i) = h x(i) + v(i)..now u dont know both h and x(i) but x(i) is BPSK + or -1 How to find SNR.. signal power is h^2 and noise power is sigma^2..
soln: use moment matching..E(y^2) can be express in terms of h and sigma .. E(y^4) can also be expressed in terms of h and sigma... so 2 equations and 2 unknowns.. find E(y^2) and E(y^4) from samples assuming large no. of samples and solve..

11. Bertand paradox.. derive the different probabilities..

12. y(n) = alpha x(n) +(1-alpha) y(n-1). find variance of y if variance of x is known and x is white..

13. OFDM let a channel have no multipaths..so just 1 tap h(0).. let the number of carriers be 1200.. there are 200 equi spaced pilots.. at output take these 200 points and take a 256 point idft.How many non zero samples will be there?
soln : As only one tap, H(k)= h(0) for all k=0,1..,1199. So the channel corresponding to 200 equi spaced pilots in frequency domain is h(0). as u are taking a 256 point idft,pad with zeros so this is like a rectangular pulse.. and idft is sinc ,hence all the samples are non zero..

14. y = ha convolve with x + hb convolve with conj(x).. how do u remove conjugate ?
soln:] Y(f) = Ha(f) X(f)+ Hb(f) X^{*}(-f).
Y*(-f)= Ha*(f) X*(-f) + Hb*(-f)
X(f).. scale appropriately and add with above to get rid of conugate..

15. Let a circle be of radius r.,let 2 vechicles start from a point with velocities v and 3v... when do they meet for the first time.. they meet at the same starting point when 3v would have completed 3 rounds.. but they would have met before that also in 3v's 2nd round.. when and where is that..

16. Let there be an infinite length y(n) with freq response Y(omega) .let it be sampled at 2pi k /N .. from this dft obtain a N sample length x(n) thru idft... what is the relation between x(n) and y(n)..

17. What is the motivation for path loss exponent being 2 in free space

18. Derive Doppler freq shift and what is Doppler spread..

19. If there is a BPSK which is pulshaped by a rectangular pulse of duration T and another pulshape which is a high frequency signal of same duration,which has low BER?

Qualcomm questions from glassdoor:

1.Difference between LMMSE and MMSE.
2.What is the similarity between correlation and convolution"?
3.What's the negative frequency? where can you find it?
4. How would you estimate the time of arrival of a waveform?
-A desirable answer might be to say "apply correlator".
5.How negative numbers are stored and how to calculate the 2's complement
coherent bandwidth, coherent time, pilot pollution, degree of uptilt down tilt, which is better qpsk or qam?
6. Draw the block diagram of a wireless system as detailed as possible. Solve PA nonlinearity precompensation

7. A coin weighing problem with faulty coins. You have N coins out of which one is heavier. How many uses of the scale do you need to find it? The second part, now you don't know if it is heavier or lighter. How many uses of the scale do you now need to do?Then you need to relate this to a problem in information and coding theory. capacity of parallel Gaussian channels

8.What is the assumption of RLS algorithm MIMO Systems-explain the benefits of 2Tx/1RX vs 1Tx/2Rx

1. OFDM
2. Cycle Prefix
3. Source and
channel coding
4. Ideas for low throughput
why SCFDMA in uplink, PHFICH channel frequencies, what happens in MRC, LTE call procedure.

1.Uplink LTE
2.Cyclic prefix
3.Peak to average power ratio

Qualcomm Bangalore phone interview

1. If u get head in kth toss where prob. of head is k, what is the expected no. of tails..
2. y = x + n. If x is BPSK +1, -1 if noise is gaussian (0,1) what is the ML decision region ? What is the probability of error?
3. if y=hx+n and u do not know h at receiver, what is the prob. of error? h is complex gaussian. Ans: if u keep 0 as a decision region, Pe is 0.5 as h can be both positive and negative and flip the bits.
4.If h is known at tx., then what is the best way to transmit?
5. In a MISO Nt*1 system, what would be the best way to transmit if vector h is known. and how would you compare this with transmitting only in the dominant channel.
6. If you have a power constraint at the transmitter, how do you allocate power?

7. OFDM qns: cyclic prefix. What is the advantage. Why not 0s instead of CP if avoiding inter OFDM symbols is the goal. What are the disadvantages with CP?
8. y=x+n. If x and n are gaussian,what is the mmse estimate of x.

1) Basic digital communication questions: Digital Modulations especially a comparison of various schemes.knowledge of bers at specific snrs Coding schemes and why it helps increase throughput in spite of introducing redundancy.(linear block codes and coding with memory)Timing synchronization and carrier recovery-why is it necessary and how to accomplish this. how to mitigate ISI.comparison between ofdm and equalizers. which one to prefer and why? eye diagram-its significance.capacity of channels, sphere packing ,etc.

2) Wireless and estimation:ML, MAP, cramer rao bound and its significance channel parameters like delay spread, coherence bw, doppler spread and coherence time diversity, simple space time codes, mrc, cdma-advantages and disadvantages, pn sequences.

1.What is stationary process
2.What is white process
3.what is wide sense stationary process BPSK sigma1 and sigma2 decision region with sigma1 greater than sigma2
4.Variance of a white process passed through an FIR filter.
5.OFDM
6.Timing synchronisation offset, frequency offset

1.Derive power spectral density from autocorrelation function.
2.Derive signal to noise ratio for ADC.
3.MAP rule
4.ML rule
5.Maximum Likelihood sequence detection
6.Viterbi decoding of ISI
7.OFDM frequency offset
8.OFDM timing synchronisation
9.MRC combining with different noise variances.

1.Taylor series
2.sin x taylor series
3.cos x taylor series
4.intuition behind taylor series
5.Fading
6.Effect of Doppler when two objects move
7.Square wave passed through a notch filter of the same time period
8.BPSK corrupted by uniform noise
9.OFDM
10.Frequency offset
11.Timing synchronisation
12.This guy made me derive the motivation for Schmidl cox (Awesome!!)

13.MIMO Interpolation
14.Decimation
15.How does the spectrum change?
16.2*1 CSIT needed or no?
17.2*1 ZF Beamforming needed or not?
18.All of them asked me about my project but I guess that was just to get things comfortable I guess.

1. Mismatch in gain and phase offset.
2. What will you do if poles in the filter dont match ?
3. Solution for aliasing?
4. How to deal with non linear distortions ? - WSD course
5. Channel estimation
6. Timing misalignment ? my clock freq does not match BS clock
7. communication problems in high speed trains.

1.What are the Eigenvalues of a linear transformation representing differentiation.

2.Interpolation at input of DFT, how will the output look like.

3. How to sort numbers, what is the complexity of the optimal algorithm.

4. one transmit antenna with 2 receive antenna (or) 2 transmit antenna with one receive antenna: which is better and why.

5. Some aptitude question..
6. There were two questions on the concept of upsampling and downsampling.

7.Prove the Nyquist Shannon theorem

8.You have my parallel lines and no other parallel lines. What is the number of parallelograms you can form?

9.One question on the topic of aliasing. Very specific question though.

10.The interviewer made a diagram on the board and all/And other general questions about future plans and a simple question on Bayes rule in probability.

11.questions from Probability, ITC, linear algebra, basic wireless, C sorting, time complexity, code snippets debugging DSP -FFT

12. Linear algebra- eigenvalues orthogonality

13.Entropy and capacity in ITC capacity - when bandwidth is 0 or infinity

4.Viterbi coding as Viterbi is the founder of Qualcomm

15.Probability- cdf of max , min, sum of random variables.

16.Some basic questions related to finding pdf and error probability

17.Estimation: deriving likelihood ratio for different cases where variance is different or H is a vector or H and X are matrices. Like all combinations and which decision rule is used in each case. Also error properties like error variance in each case

1) $y = h + n$ where n follows Gaussian with mean **zero** and variance $\boldsymbol{\sigma^2}$. What is the ML Estimate of h?
2) What is MLE if n follows **Uniform distribution**?
3) $Y = X_1.X_2.X_3 \ldots X_N$. What is the distribution of Y if $N \to \infty$?
4) If u have freq. tones at 98 and 101 HZ, what is the minimum frequency u can sample at?
5) Let $X(k)$ be the DFT of $[x_1, x_2, .., x_N]$ then what is the DFT of $[x_1, 0, x_2, 0, \ldots, x_N, 0]$?
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7) Let $X(k)$ be the DFT of $[x_1, x_2, .., x_N]$ then what is the DFT of $[x_1, -x_2, x_3, -x_4 \ldots, x_N]$?
8) How to choose CP length wrt Delay spread?
9) What is the relation between $H(X,Y),\ H(X) + H(Y),\ H(X+Y)$?
10) Find the maximum value of $\boldsymbol{x}^H \mathbf{A} \boldsymbol{x}$ when $\mathbf{A}$ is Hermitian matrix? What if $\mathbf{A}$ if not Hermitian?
11) Prove that n^{th} order polynomial (n= odd) will have at least one **Real root**.
12) There are some chocolates each with a ticket inside it (Total 5 different Tickets). What is the expected number of chocolates one needs to buy to collect all 5 tickets?

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Tanumay Datta

(1) Find the maximum value of $x^H A x$ when A is hermition matrix. What if A is not hermition?

(2) Given that $X \sim U([0,1])$, find $E[\min(x, 1-x)]$

(3) If $[x_1, x_2, x_3, \ldots x_n]$ has DFT X, find DFT of $[x_1, 0, x_2, 0, \ldots x_n, 0]$.

(4) We transmit ± 1 BPSK symbols through a MIMO channel. How will you detect the symbols at the reciever?

(5) (a) What is the capacity for MIMO channel?

(b) What is diversity? What will be the diversity of 4x1 and 1x4 channels?

(c) Which is better, 4x1 or 1x4 when you have (i) CSIT (ii) CSIR?

(6) We have a n^{th} order polynomial (n = odd)

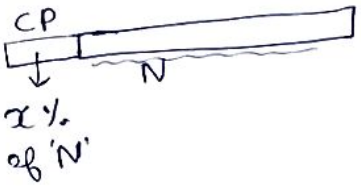
$a_n x^n + a_{n-1} x^{n-1} + \ldots a_1 x + a_0 = 0$.

Prove that the equation will have at least one real root.

Gowrisankar Somichetty

(1) OFDM System (A)

BW = B



x % of 'N'

OFDM System (B)

BW = B

$\frac{x}{2}$ % of 2N

Which system will be better in terms of capacity ? What will happen if for system (B), we ~~use~~ have the OFDM symbol length to be 'MN' and CP as $\frac{x}{M}$ % of MN ? (large M)

(2) We know $[x_1, x_2, x_3, \cdots x_N] \xrightarrow{DFT} X$, what will be the DFT of $[x_1, x_2, x_3, \cdots x_N, \underbrace{0, 0, \cdots 0}_{N \text{ zeros}}]$ in terms of X ?

(3) There are N players. We can ~~play~~ compete between 2 players at a time, and we want to find the winner of the tournament. Find the minimum number of games we need to organize.

(4) Derive the capacity of Binary erasure channel.

(5) $y_i = x + n_i$; $i = 1$ to N, $n_i \sim N(0, \sigma^2)$ $\forall i$, independent

Find $\frac{1}{N} E\left[\sum_i |y_i - \tilde{y}|^2 \right]$, where

$$\tilde{y} = \frac{1}{N} \sum_i y_i$$

[* check the answer for N=1]

Arul Durai Murugan

(1) We transmit uncoded binary bits over a Binary symmetric channel with probability of incorrect transmission as 'p'. There are total 'N' bits in a frame. If all the bits in a frame are correct, then there is no error.

(a) Find the probability of error in the frame.

(b) If we can correct upto 1 bit in a frame, what will be the probability of error?

(2) We have a system with one antenna at T_x and 2 antennas at R_x. Channel gains are h_1, h_2 (known)

$$y_1 = h_1 x + n_1$$
$$y_2 = h_2 x + n_2$$

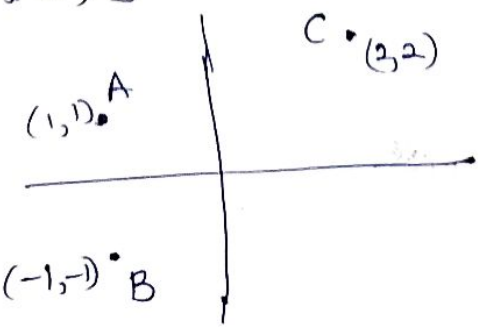
(a) what is the estimate of 'x' when $n_1, n_2 \sim N(0, \sigma^2)$

(b) How will you combine y_1, y_2 when n_1, n_2 are correlated & with unequal noise variance?

(3) $y = x + n$, $n \sim N(0, \sigma^2)$, Rate = 1 bit / channel use

$x = 0/1$, '0' is mapped to points 'A' and 'B' with equal probability. '1' is mapped to point 'C'

$[P_r(x=0) = P_r(x=1)]$. Find the decision regions.



④ We have a tone at ~~11KHz~~ 11 KHz. First, we do sampling ~~by~~ at 10 KHz and then pass the signal through a low pass filter of cut off frequency 10 KHz. What will be the output? Why do we get multiple copies of the original spectrum when we do sampling?

⑤ $[x_1, x_2, \ldots x_N] \xrightarrow{DFT} Y$

Find DFT of $[x_2, x_3, \ldots x_N, 0]$ in terms of 'Y'.

⑥ We have an array of ~~inte~~ numbers. Write an efficient pseudo code to find the 2nd maximum number of the above array.

Kapil Bhattad

① R.V. $Y \sim \mathcal{U}([0,1])$, another R.V $X = g(Y)$ find 'g' the function 'g' such that X ~~is~~ has Gaussian distribution. Prove it.

② Find the maximum value of $\frac{x^H A x}{x^H B x}$, $A, B \rightarrow$ PSD

③ $[x_1, x_2, x_3, x_4, \ldots x_N] \xrightarrow{DFT} X$

$[x_1, -x_2, x_3, -x_4 \ldots] \xrightarrow{DFT}$? in terms of 'X'

④ Find the probability of 2 chords intersecting each other.

⑤ $y(n) = h(0)\,x(n) + h(1)\,x(n-1) + h(2)\,x(n-2) + w(n)$ ← Noise

How to detect $x(n)$'s ?

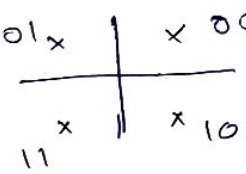
⑥ $y_1 = x_1 + z + n_1$
$y_2 = x_2 + n_2$

x_1, x_2, z, n_1, n_2 all are independent.

Find the estimate of x_1, x_2

Raj Kumar

① We have QPSK symbols mapped to $\{\pm 1 \pm j\}$.



, bits "$b_0 b_1$", passed through a scalar fading channel ; $y = hx + n$, $n \sim CN(0, \sigma^2)$

(a) Find the value of $\log\left[\frac{Pr[y \mid b_0 = 0]}{Pr[y \mid b_0 = 1]}\right] \triangleq LLR(b_0)$

(b) Now, we send a series of N (independent) QPSK symbols like $b_0 b_1\ b_0 b_1\ b_0 b_1 \cdots$ N times, through the same channel and receive $y_1, y_2 \cdots y_N$.

Find the equivalent value of $LLR(b_0)$

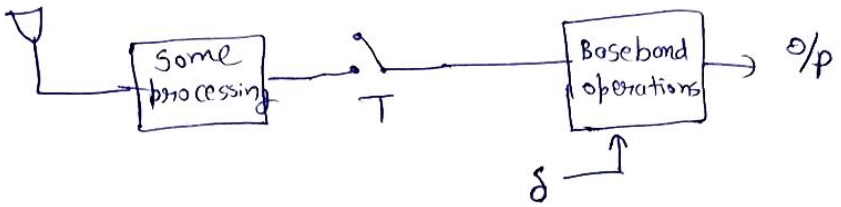
(c) Now, we use some scrambling codes on the symbols like $c_0 = b_0 \oplus s_0$, $c_1 = b_1 \oplus s_1$ where $\oplus$ denotes modulo 2 addition,

s_0, s_1 are known ; Find value of $LLR(c_0)$

(2) $y = hx + n$, $n \sim N(0, \sigma^2)$

h, σ^2 are unknown. Find SNR.

(3) Receiver Structure



The actual samples are $y(0), y(T), y(2T) \ldots$.

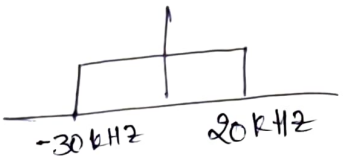
Due to some error, we in processing, we collect the samples $y(\delta), y(T+\delta), y(2T+\delta), \ldots$.

By some means, we know the value of 'δ'.

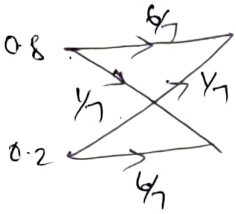
How to recover the original samples from the observed samples $y(\delta), y(T+\delta), y(2T+\delta), \ldots$?

Qualcomm

① find Sampling rate



②



find $P\left[\frac{x=1}{y=0}\right]$ & $P\left[\frac{x=0}{y=1}\right]$

③ Consider Signal $x(n)$ & it is upsampled by 2, you will get $x'(n)$. In $x'(n)$ One Sample is falsly decoded, then How you will recover (get) $x(n)$ from $x'(n)$

Hint : use Sinc (ideal) interpolation

④ $P(A) = 0.5$, $P(B) = 0.7$, $P(C) = 0.9$ find the range of probabilities $P\left[\frac{A \cup B}{C}\right]$ if they are independent & if they are dependent

5) what is the probability $x_3 > \max(x_1, x_2)$ if all x_1, x_2, x_3 follow uniform R.V

6) What is F.T of (i) $\text{rect}(t/T)$

(ii) $\text{Tri}(t)$

(iii)  (trapezoid)

7) $y = x + \eta$ where x follows Bipsk $\in \{-1, 1\}$

η is R.V which follows exponential distribution with mean 1. what is the ~~probability~~ decision region to detect x.

(assume BPSK symbol equal probability)

(8)

00	01
11	10

option A

00	01
10	11

option B

(assume) if we know 2nd bit in qpsk, in which of the option will give minimum probability of detecting 1st bit. & why?

(9) $y_1 = h_1 x + n_1$ $\quad n_1 \sim (0, \sigma_1^2)$

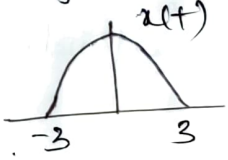
$y_2 = h_2 x + n_2$ $\quad n_2 \sim (0, \sigma_2^2)$

} if n_1, n_2 are i.i.d how you will decode x?

(10) if these correlated with Covariance matrix R_{nn} how will you decode x

11) question Converting Coloured noise to white noise.

12) $x(t)$ is Gaussian R.V distributed btw $[-3, 3]$ with variance of 1. how would you sample that



Hint: non uniform sampling.

13) OFDM Basics

option1	option 2
N subcarriers	N subcarriers
BW = B Hertz	B Hertz

Which option will have good Coherance B.W, Delay spread. Subcarries Spacing, Which system better for CFO.

14) $y_1 = x + n_1$ if n_1 & n_2 are correlated how

$y_2 = n_2$ will you detect

15) R_x is able to detect one bit error per frame only, Suppose frame contains n bits Total probability error for Receiving frame as error.

16) Basics on mmse, LS, ML estimates.

17) Why cp is needed for OFDM. if Zero padding is done in the place of cp, how OFDM subcarrier will you detect. [explanation in time domain with example]

$x_1 = x_4\ x_1\ x_2\ x_3\ x_4$

$x_1 = 0\ x_1\ x_2\ x_3\ x_4$

$h = h_0 h_1$

} you have explain by taking this example.

18) Basics on matched filter.

which is better matched filter for ML detection to estimate $y_1 = x + n_1$, $n \sim (0, \sigma^2)$

$y_{1000} = x + n_{1000}$

19) SISO system Diversity ?

2x2 MIMO system Diversity ? → if we apply ML, MMSE ? What is difference in diversity order ? how will improve 2x2 diversity

20) Expected no. of tosses to get first head.

$p(\text{head}) = p \qquad p(\text{tail}) = 1-p$.

21) Expected no. of tosses to get 3 consecutive heads $p(H) = 2/3, \; p(T) = 1/3$.

22) ~~Two~~ players is using ~~biased~~ coin for game show.

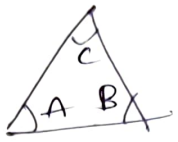
22) Suppose $x(n)$ is stored in 7 bit register, and sent from transmitter, but when receive that $x(n)$ is received as $x(n)+1$ in decimal

Ex:- If 11 is transmitted it is decoded as 12. Expected no. of bits in error at receiver ?

23) Two players are playing tosses with biased coin with $p(H) = 2/3, \; p(T) = 1/3$. How can you make equal Their winning Chances. (what is your approach to make equal winning chances)

24) $x(n)$ is wss with mean $(0, \sigma^2)$ passed through FIR filter with $y(n) = ax(n) + bx(n-1)$ such that $a+b=1$. what is the max o/p varience you can get ?

26) Code for to calculate max run length in CDMA.

27) 

A, B, C are angles of triangle.

max value $\sin A + \sin B + \sin C$ [Use convex approach]

28) $\max x^H A x \quad \forall \|x\| = 1$, (i) if A is hermitian, and (ii) if A is not hermitian.

29) derive mrc when noise variance are correlated.

30) are polynomial follows linear mapping? give matrix representation for $T(f(x)) = f'(x)$ with degree of polynomial is 10.

31) $y_1 = 2a + b + n_1$
$y_2 = a + b + n_2$
} a, b are R.V.
$n_1, n_2 \sim (0, \sigma^2)$

How will you detect a, b.

32) $y_1 = hx + hy + n_1$
$y_2 = hx + hy + n_2$
$n_1, n_2 \sim (0, \sigma^2)$
if h is unknown scalar. how will you decoded h.

33) $y_1 = h_1 x + h_2 y + n_1$

$y_2 = h_1 x + h_2 y + n_2$

if n_1 & n_2 are

Correlated how will you decode H?

(Hint moment matching)

Qualcomm :-

1st round :-

Q.1) Given three discrete different equations and asked about the causality of the system.

a) $y(n) = x(n) + x(n-1)$

b) $y(n-1) = y(n) - x(n)$

c) $y(n) = x(n) * x(n+1)$

Q.2) $x(n) = A\cos(5n)$ periodic or aperiodic ? If periodic why ? If aperiodic why ?

Q.3) A square matrix is given whose Trace is 'T' and determinant is 'D'. what do you comment about it's Eigen value.

Q. 4) Three vectors $v_1 = [1 \ 1 \ 1 \ 1]$

$v_2 = [1 \ -1 \ 1 \ -1]$

$v_3 = [1 \ 1 \ -1 \ -1]$

check for orthogonality and are they Linearly dependent or independent?

Q.5) Two signals $x_1(t) = \sin(2\pi f_1 t)$ and $x_2(t) = \sin(2\pi f_2 t)$. Both signals are sampled at frequency $F_s = 100Hz$ After sampling, the two signals equations are same in digital domain Relation between f_1 and f_2?

Q.6) $a^2 + b^2 + c^2 = 10$ find $\max(3a + 4b + 5c)$?

Q.7) X_1, X_2 IID R.V's Find PDF of $\max(X_1, X_2)$?

Q.8) two dices are rolled and the sum of the number on two dices is 10.

a) what is the prob. that the no on first dice is '1'

similarly asked for 2, 3, 4, 5, 6

Q.9) Given a stick. You have to cut the stick at 2 points which gives 3 pieces. what is the probability that these 3 pieces form a triangle?

Q.10) You have 'N' floors building, and you have certain number of eggs with you. The k^{th} floor is a critical floor. If you drop the egg from k^{th} floor or from the floors above the k^{th} floor, the egg breaks. If you drop the egg from below k^{th} floor, the egg doesn't break. How many minimum no.

of eggs you required to find out the k^{th} floor.

2nd round :-

Q.1) Given $f_{XY}(x,y) = x+y \quad 0 \le x \le 1, \; 0 \le y \le 1$

$= 0$ otherwise

find the $P(X+Y \le 1)$?

Q.2) OFDM :- 1201 subcarriers.

frequency offset is 500Hz.

subcarrier Bandwidth is 15KHz.

what is signal to inter carrier interference ratio on 601 carrier.

Q.3) X_1, X_2 are IID Gaussian Random variables. Find the Pdf of $X_1 + X_2$?

Q 4) $x = [x_1 \; x_2 \; \dots \; x_N]$ N point sequence

$y = [y_1 \; y_2 \; \dots \; y_N]$ N point sequence

$z = [x_1 \; y_1 \; x_2 \; y_2 \; \dots \; x_n \; y_n]$

X :- DFT of 'x'

Y :- DFT of 'y'

DFT of z in terms of X and Y?

Q 5) what is Doppler spread?

[change in frequency due to relative motion of transmitter and Received is not the answer].

Q 6) MIMO :- MIMO can give you spatial multiplexing and diversity. when do you prefer using spatial multiplexing when do you use diversity?

3rd Round :-

Q.1) $y = x + n$ $\quad x = \pm 1$

$P[x=1] = P[x=-1] = 1/2$

'n' is gaussian. what is the Pdf of y?

Sol:- not Gaussian.

$f_{Y/X}(y/x)$ is Gaussian.

But $f_Y(y)$ is convolution of $f_X(x)$ and $f_N(n)$.

Q.2) Hypotheses $H_0 :- y_0 = n_0$

$n_0 \sim N(0, \sigma^2)$

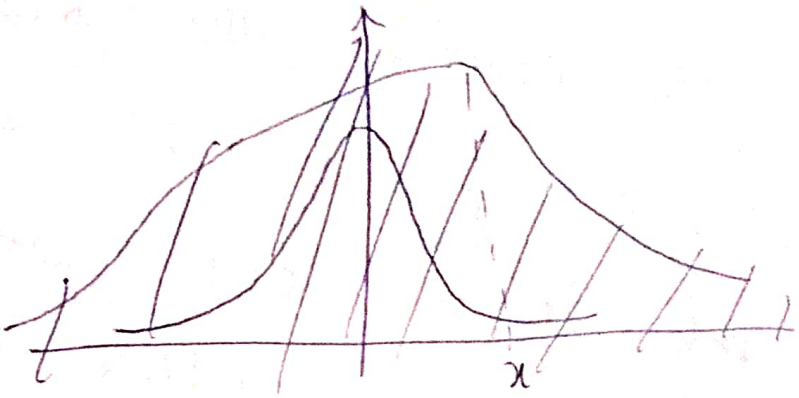
Hypotheses $H_1 :- y_1 = 1 + n_1$

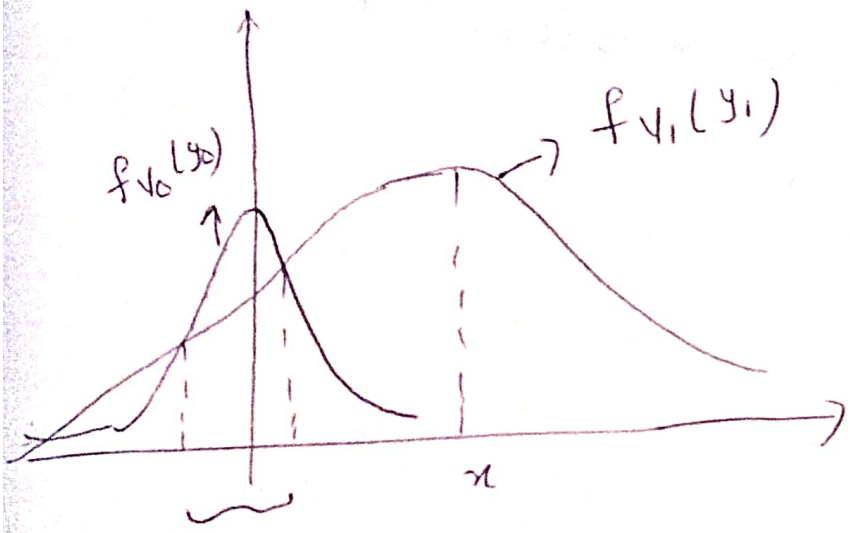
$n_1 \sim N(0, 10\sigma^2)$

find out the decision regions?

Sol:- If we solve it by doing LLR we get a quadratic equation

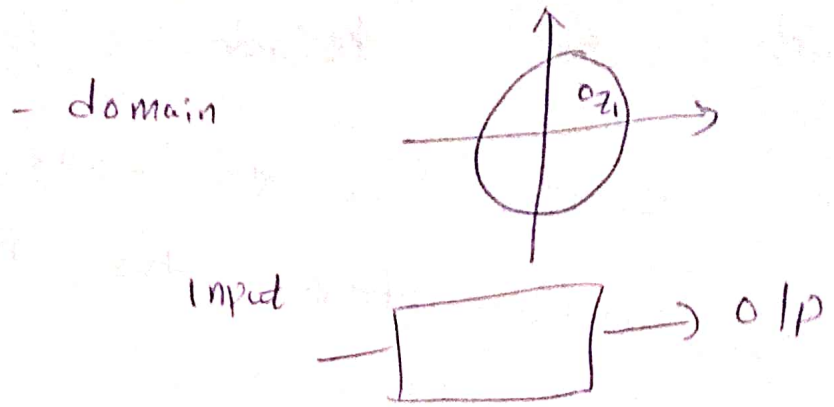
But he wants us to say the approximate regions from the Pdf's $f_{y_0}(y_0)$ and $f_{y_1}(y_1)$.





this region $P(y_0)$ is more, so right side and left side of these regions we can say that decision regions of '1'.

Q.3)

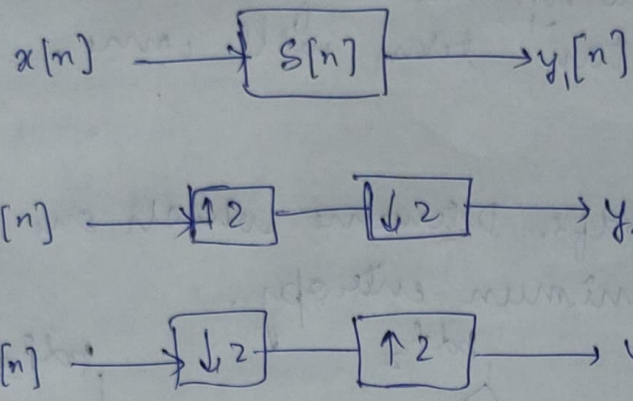


You have to equalize the o/p symbols so we will use a filter which has a pole at z_1. But we have to design an FIR filter. This discussion lasted for 15 - 20 minutes. I don't know the answer.

1st Round

Interviewer: Niranjan Vadlamudi

Q Given three systems.



Output of which of the above systems ~~give~~ is same as the input $x[n]$.

Ans ~~For the~~ $y_1[n] = x[n]$, $y_2[n] = x[n]$

But $y_3[n] \neq x[n]$

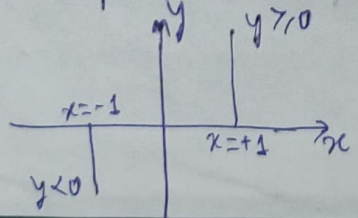
Q Then they asked how can we make sure that $y_3[n] = x[n]$. ~~He~~ He was asking about what should be the frequency range ~~of~~ of $x[n]$ such that o/p $y_3[n] = x[n]$.

Q Given: $y = x + w$

$w \rightarrow$ white Gaussian noise

$\mathcal{N}(0, \sigma^2)$

and, $x \in (+1, -1)$. What ~~is~~ should be the equiprobable. threshold for detection?



Ans

$y = 0$

For $y > 0$ $\hat{x} = +1$

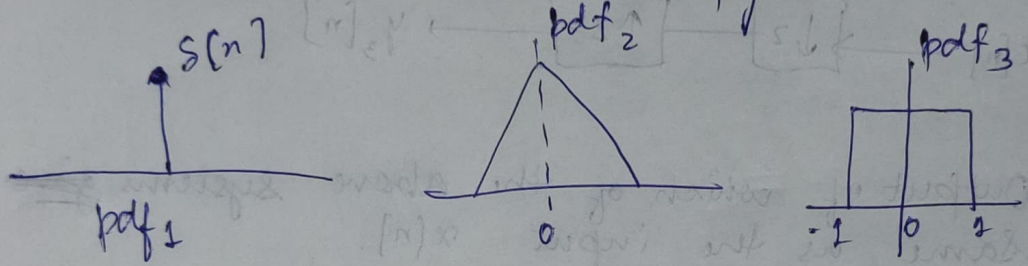
$y < 0$ $\hat{x} = -1$

Q For the above system, compute MMSE estimate for x given y.

Ans $E[x/y]$

It comes some non-linear function
some $\tan^{-1}$ term will come.

Q Given three pdfs. Determine which one has maximum & minimum entropy.



Ans max^m entropy: pdf_3
min^m entropy: pdf_1.

2nd Round

Initially asked about the current thesis work.

Q Given QAM and PAM. ~~which performs better~~ which has less BER and comparison of energy required.

Q How OFDM converts wideband channel to flat band channel? Then about cyclic prefix.

Q Given $y = x + n$, $n \sim N(0,1)$

probability of $+1 \Rightarrow p_1$

probability of $-1 \Rightarrow p_2$

Give their ML estimate, MAP estimate (derive) Among ML and MAP, which gives better estimate.

Ans ML estimate, $y \gtrless 0 \Rightarrow \hat{x} = +1$

MAP estimate, $y \gtrless \frac{1}{2} \log \frac{p_2}{p_1} \Rightarrow \hat{x} = +1$

MAP is better than ML since when either p_1 or $p_2 = 0$ then MAP estimate neither BER $= 0$ but ML estimate gives BER $= 1/2$.

Q Monte-Hall Problem of three gate

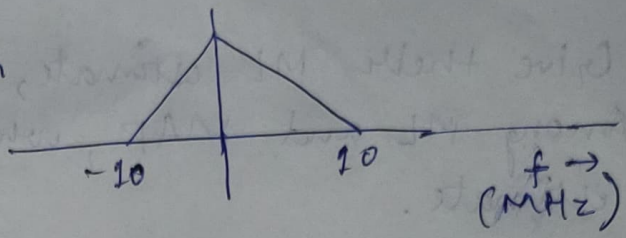
Extension of Monte-Hall Problem for 10 gate. 9 gates have goats behind them. Only 1 gate has car behind. Give the probability that by switching the gate participant can win the car.

Ans $\frac{9}{10} \times \frac{1}{8}$

3rd Round

Interviewer: Sashankar Pulliyakode

Q1 Given spectrum



Spectrum is to be sampled with freq resolution of 30KHz.

How many samples would be there (Ans $\frac{20 \times 10^6}{30 \times 10^3} = 666$)

What will be the f_s (Ans $f_s = 20$MHz)

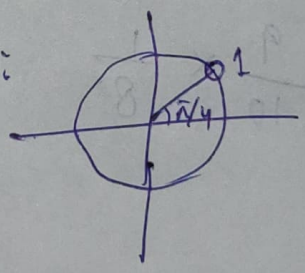
Time duration of signal $s(t)$. (Ans no. of frames $\times T_s$) $= 33.3$ ms

If lets say we want 2000 samples $f_s = 20 \times 10^6$ resolution we still want = 30KHz. What should be done for this.

Ans In freq domain drop some samples.

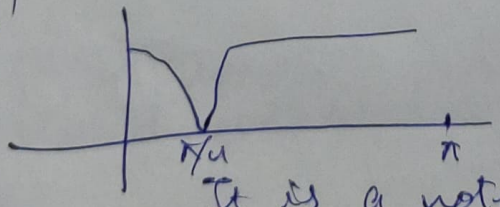
Only keep 1 out of every 3 samples by averaging those 3 samples.

Q2 Given pole-zero plot:



How will its spectrum look like,

Ans



It is a notch filter.

What will be its transfer function Ans $H(z) = z - e^{j\pi/4}$

How can we sharpen the notch filter at $\pi/4$?

Ans First add a pole at $\pi/4$. And then ~~add~~ by adding zero ~~at~~ near $\pi/4$ (Not sure).

Naveen Kumar Bellamkonda Round 1

Q① How do you convert passband to baseband if you are given
(a) passband signal $x(m)\cos 2\pi f_c t$?

(b) Now consider you have $x(m)\cos 2\pi f_c t + \alpha \cos 2\pi f_c t$ instead of $x(m)\cos 2\pi f_c t$. How will you recover the baseband signal?

(c) What is the estimate of α in previous question?

(d) you are using LPF in (a) How do you convert FIR to IIR lowpass filter? Draw pole zero in Z-plane

(e) What happens if passband signal is $x(m)\cos 2\pi(f_c+\Delta f)t$ i.e phase offset? what happens in the baseband?

Q2- What is Doppler Shift? If we have some freq shift due to Doppler, what does it looks like in time domain?

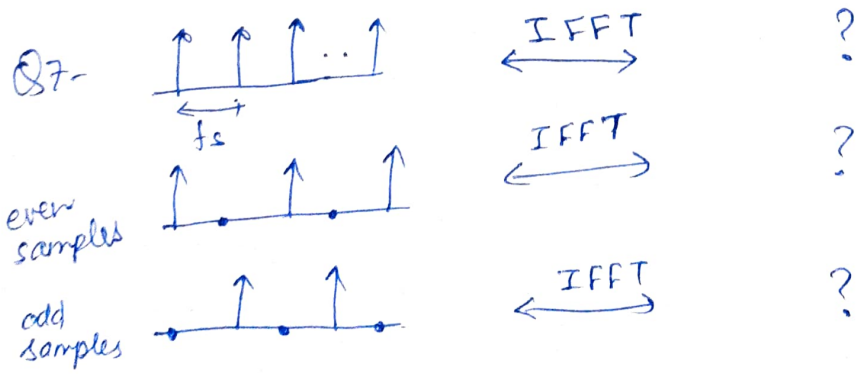
Q3- Doppler Spread, Coherence Time discussion

Q4- Delay Spread, Coherence Bandwidth discussion

Q5- Types of fading

Q6- Channel estimation needs pilot transmission.
When do we need more/less pilots → flat fading/freq selective fading. and why?
When do we need more/less pilots → fast/slow fading

Q7-



Q8- $x(n) = a(n) + jb(n)$ has F.T $X(\omega)$

What is F.T of $b(n) + ja(n) = y(n)$?

How does the magnitude spectrum & phase plot look like ? Can you identify / differentiate $x(n)$ & $y(n)$ only using magnitude plot ?

Round 2

Q1 (a) X, Y are IID R.V

what is probability $P(X > Y)$?

using intution.

(b) X, Y, Z are IID R.V

what is probability that X is largest among the three ?

(c) What is probability $X > Y$ given $X > Z$?

Why does this conflict with our earlier intution ?

Q2- When do we use Matched Filter, ZF Receiver and MMSE Receiver ? When is LMMSE = MMSE ?

Q3- Given $y_1 = x + n_1$ $\quad n_1 \sim N(0, \sigma_1^2)$

$y_2 = x + n_2$ $\quad n_2 \sim N(0, \sigma_2^2)$

what is MMSE and LMMSE estimate of x ?

Q4- (a) $y_1 = x + n_1$ $\quad n_1, n_2 \rightarrow$ independent

$y_2 = n_2$ should we include y_2 in estimating x ? Why ? Why not ?

(b) $y_1 = x + n_1$ $\quad n_1, n_2 \rightarrow$ correlated with correlation coefficient ρ

$y_2 = n_2$

Should we include y_2 in estimation of x?
Why / Why not?
What is the MMSE estimate of x?

Q5- $x(n) \rightarrow [\delta(n)] \rightarrow y_1(n)$

$x(n) \rightarrow [\text{up sampler } \uparrow 2] \rightarrow [\downarrow 2] \rightarrow y_2(n)$

$x(n) \rightarrow [\downarrow 2] \rightarrow [\uparrow 2] \rightarrow y_3(n)$

When can you recover $x(n)$ from $y_1(n)$, $y_2(n)$ and $y_3(n)$?

For 3rd case what can you do to recover $x(n)$ back? Is Interpolator a Low Pass / High Pass filter?

Q6- Can you always recover $x(n)$ back from down sampled version? (Given no filtering is done prior to down sampling)
Why / Why not?
What is the condition to avoid this aliasing and recovering $x(n)$ correctly?

Round 3 Ravinder Kumar

Q1- Why do we need cyclic prefix in OFDM?
Q2- What causes ISI in OFDM?
Q3- How will you prove that time limited in time will result in infinite bandwidth in frequency domain?
Q4- We have some samples at $0, T, 2T \ldots$
We need those samples to be at $a, T+a, 2T+a, \ldots$
How can you achieve it?

Q5- Discussion on Interpolator and Decimator.

Q6- Given $y_1 = h_1 x + n_1$ $\quad n_1 \sim N(0, \sigma_1^2)$

$y_2 = h_2 x + n_2$ $\quad n_2 \sim N(0, \sigma_2^2)$

Estimate of x ? what will be the weights, How to combining the two observations ?

Q7 Observation $r \sim N(1, \sigma_1^2)$ if $x = 1$ is Tx.

$\sim N(-1, \sigma_2^2)$ if $x = -1$ is Tx

What will be decision regions corresponding to $x = \pm 1$?

QUALCOMM INTERVIEW QUESTIONS

ROUND-1

Q1. Describe the complete communication block diagram. Had to start from concept of sampling then source encoding, channel encoding and finally transmission of signal. Follow up questions regarding band pass sampling, what is source encoding, channel encoding and then regarding probability of error of BPSK with different probability of inputs. Also had to draw the distribution of received signal in case of above BPSK arrangement. Also was asked regarding basics of noise. Where we usually add noise, concept of thermal noise and dependence with respect to temperature. (If 2 cities one with comparatively more temperature what will be the noise variance of that city as compared to the other city).

Q2. Designing of OFDM system. How will we design OFDM when given a particular value of N. What parameters we have to keep in mind? Value of N depends on the delay spread, coherence bandwidth. Was required to think in this particular direction. Also keep in mind regarding coherence time for estimation and doppler spread for movement of receivers.

Q3. Rank of covariance matrix and rank when the vectors are orthonormal.

Q4. Question of Probability. Given a Poisson distribution for a server which accepts request with $\lambda = \frac{5}{3} /s$. The server has a limit to take only 120 requests/min (If more than 120 server will crash). What is the probability that server will crash?

ROUND-2

Q1. We have an unsorted array. We need to find the 5^{th} smallest element of the array. Write an algorithm for the problem and find its complexity order.

Q2. We have 2 coins C1 and C2 where the probability of getting heads in C1 is p and in C2 is q. Both the coins are independent of each other. In a trial we are tossing the two coins together and we continue doing the trial until we get heads in any of the coin. Find the probability of the above experiment at the nth trial.

Q3. Find the relation (greater than or less than or equal to) between H(X1+X2) and H(X1,X2) given that both X1 and X2 are i.i.d.

Q4. Relation between Rank(AB) and Rank(A),Rank(B).

ROUND-3

Q1. Standard Geeks for Geeks Puzzle (81 Horses Puzzle).

Q2.FFT Decimation in time. Explain completely. Follow up question of a DFT sequence $x(n) = \{1, -1, 1, -1, 1, -1, 1, -1\}$. What be will its DFT?

Q3. Standard down-sampling question and then given a sequence we sample it at more than 4 times the maximum freq. and then compute its N = 1024 pt. DFT. Again the same sequence is sampled at more than 2 times the maximum freq. and we compute its N = 512 pt. DFT. Relation between the 2 DFTs?

Q4. Explain Linear Block Codes and what are the parameters of LBC. Then explain Convolutional Codes, Code Tree, Trellis Diagram and concept of d_free in Convolutional Codes. Finally explain Viterbi decoding of convolutional codes.

Q5. Combination of Log Likelihood Ratio Test and Viterbi Decoding.

Round - 1

Q1)

$$y_1 = h_1 + n_1$$
$$\vdots \quad \vdots \quad \vdots$$
$$y_K = h_K + n_K$$

$n_i \sim (0, \sigma_i^2)$

find ML estimate of h.

$$\bar{n} = \begin{bmatrix} n_1 \\ \vdots \\ n_K \end{bmatrix} \sim (0, R)$$

i.e., 0 mean vector

R covariance matrix

Q2) Given IIR filter,

$$y(n) = \alpha\, x(n) + (1-\alpha)\, y(n-1)$$

find mean & variance of $y(n)$.

Q3) RV $X = \underbrace{A_0 A_1 \cdots A_N}$

product of IID uniform RV's from $[0,1]$

find the distribution of X.

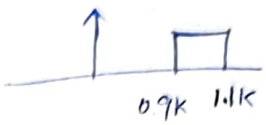
Q4) what is cyclic prefix, frequency selective fading, what if CP is replaced by zeros.

Q5) OFDM SE loss if we increase N indefinitely. Also can we increase N as much

as we want ?

Round - 2

Q1) what is Sampling frequency ? Signal present at 0.9k & 1.1k also.



Q2) Using only FFT blackbox, how to find IFFT of a sequence.

Q3) $Ax = b$

A, b - known

how to find approximate x ?

Q4) A - Hermitian matrix

max, min values of $x^H Ax$ given $\|x\|_2 = 1$

Round - 3

Q1) what is OFDM vs FDM

can we increase guard bands in FDM to achieve orthogonality and if achieves orthogonality will there be any other issue?

Q2) what is CFO (Carrier frequency offset) ?

causes of CFO ?

Q3) M-QAM vs M-PSK

which is better ?

Q4) Monk Carlo problem. (Google the qtn)

↓

(Two goats, 1 car qtn)

Q5) Same question Q4 with 9 goats & 1 car

Q6) A train arrives every 15 mins to a station. What is Expected waiting time for a person if he arrives everyday uniformly between 1 PM and 2 PM.

Q7) $x_0, x_1, x_2, \ldots, x_7 \xrightarrow{FFT} X[0], X[1], \ldots, X[7]$

what is, $X[0], 0, X[1], 0, \ldots, X[7], 0 \xrightarrow{IFFT}$?

Q8) MMSE (vs) ZF

which is better ?

Q9) $y = hx + n$ n-known

x is either 0, 1. $n \sim (0, 1)$

write likelihood function & find the decision boundary to detect 0/1 ?

— x —

Qualcomm Interview Tanu Bharti

Interleaver's purpose-Polar codes, channel coding

Questions from thesis

Focus on DSP, resolution, no of samples -basically have a good understanding of DSP concepts

Sampling- which frequency is better- excatly at Nyquist or more than that

Diversity vs MIMO

Estimation for different noise varinace

some questions from dft similar to one in question set

difference between source and channel coding, pro cons

coding-how to check if 3rd bit of a number is set, union structure difference

OFDM, its benefits

MISO vs SIMO, which is better, precoding

Alamouti codep

Subject: Fwd: Qualcomm campus test questions
From: "vikas sharma" <vikassharmamp9@gmail.com>
Date: Wed, May 19, 2021 3:22 am
To: manish20@iitk.ac.in
Priority: Normal
Options: View Full Header | View Printable Version | Download this as a file | Add to Address Book | View Message Details

---------- Forwarded message ---------
From: **Anand Maurya** <anand.ec10n@gmail.com>
Date: Fri, Nov 13, 2020, 9:27 PM
Subject: Fwd: Qualcomm campus test questions
To: <vikassharmamp9@gmail.com>

---------- Forwarded message ---------
From: **Anand Maurya** <anand.ec10n@gmail.com>
Date: Wed, May 13, 2020, 14:57
Subject: Fwd: Qualcomm campus test questions
To: <jaiswal.ashish502@gmail.com>

---------- Forwarded message ---------
From: **Anand Maurya** <anand.ec10n@gmail.com>
Date: Mon, 27 Apr 2020, 09:10
Subject: Fwd: Qualcomm campus test questions
To: <hsaxena@iitk.ac.in>

---------- Forwarded message ---------
From: **Anand Maurya** <anand.ec10n@gmail.com>
Date: Sat, 7 Mar 2020, 16:08
Subject: Fwd: Qualcomm campus test questions
To: himanshu gautam <himanshugautam.0562@gmail.com>

---------- Forwarded message ---------
From: **Kanchan Chaurasia** <kanchan13mit@gmail.com>
Date: Fri, Nov 29, 2019 at 10:41 PM
Subject: Fwd: Qualcomm campus test questions
To: <Anand.ec10n@gmail.com>

---------- Forwarded message ---------
From: **Ankita Anvi** <ankita231095@gmail.com>
Date: Wed, 27 Nov, 2019, 6:32 PM
Subject: Fwd: Qualcomm campus test questions
To: Kanchan Chaurasia <kanchan13mit@gmail.com>

---------- Forwarded message ---------
From: **Ayushi Parwar** <ayushiparwar001@gmail.com>
Date: Wed, Nov 27, 2019, 3:15 AM
Subject: Fwd: Qualcomm campus test questions
To: <ankita231095@gmail.com>

---------- Forwarded message ---------
From: **vidushi** <vidushi@iitk.ac.in>
Date: Wed, 24 Jul, 2019, 5:50 PM
Subject: Fwd: Qualcomm campus test questions
To: <singhrk@iitk.ac.in>, <prajain@iitk.ac.in>, <ayuship@iitk.ac.in>, <18104071@iitk.ac.in>

-------- Original Message --------

Subject: Qualcomm campus test questions
Date:09-11-2018 22:20
From:manojps <manojps@iitk.ac.in>
To: Nehachau <nehachau@iitk.ac.in>, Nehag <nehag@iitk.ac.in>, Mfaisal <mfaisal@iitk.ac.in>, Vidushi <vidushi@iitk.ac.in>, Sarath <sarath@iitk.ac.in>

Here are some Questions from seniors asked in Qualcomm interview ..... Enjoy.....

-------- Original Message --------

Subject: Fwd: qualcomm campus test questions
Date:09-11-2018 20:11

From: Aditi Jain <ee15s081@ee.iitm.ac.in>
To: manojps@iitk.ac.in

pranav's bangalore qcomm onsite qns attached

On Wed, Feb 28, 2018 at 7:26 PM, Sudharsan Parthasarathy <pras.1989@gmail.com> wrote:

> pranav's qualcomm bangalore phone interview questions:
>
> 1. X1, X2 are iid RVs, and we know the CDF. Find the CDF of min(X1,X2)
>
> 2. p(head) = p, we toss will we get a head. Find expected number of tails.
>
> 3. a) BPSK signal x = +-1, with equal probability, y = x+n, n~Uniform(-2,2). Find the optimal detector and Pe.
> b) What will be the Pe when the threshold is 0.5 instead of 0 (ans of previous 3.a)?
> c)Find the optimal detector when we have complex normal noise with individual variance as 1/2.
> d) Instead of +-1, now we have symbols at [1/sqrt(2),1/sqrt(2)] and [-1/sqrt(2),-1/sqrt(2)] and complex normal noise as previous. Find the optimal detector. What will be the Pe ?
> e) If we rotate y clockwise by 45 degrees, will the effect of noise be same ?
>
> 4. QPSK symbols at [+1,+1], [-1,+1],[-1,-1],[1,-1], how to calculate the symbol error probability from the probability of error of BPSK.
>
> 5. MISO system. Total power at Tx = P. Channels are independent and are known at Tx. What is the best way to transmit x ? What is the SNR at Rx ? What will be the SNR when we transmit only in the best channel ?
>
> 6. x = [x_1 x_2 .... x_n] has DFT X. Find the DFT of [x_1 0 x_3 0 .... x_(n-1) 0] in terms of X.
>
> On Thu, Jan 25, 2018 at 12:33 AM, Sudharsan Parthasarathy <pras.1989@gmail.com> wrote:
>
> > Qualcomm WLAN Bangalore on-site interview- qns. by aditi
> >
> > On Mon, Jan 8, 2018 at 6:06 PM, Sudharsan Parthasarathy <pras.1989@gmail.com> wrote:
> >
> > > arup bangalore phone qns:
> > >
> > > interviewer: ashutosh agarwal
> > >
> > > 1. Bpsk with equal probability. Noise ~ U(-2,2). y=x+n. Find optimal decoder with ber.
> > >
> > > 2. Tone at 99khz. Fs =10k. Lpf Fc=15k. Output?
> > >
> > > 3. Y=max(X1, X2,... Xn). Xi iid U(0,1). Find E(Y).
> > >
> > > 4. Capacity of BSC. What is the capacity when two BSCs are cascaded?
> > >
> > > 5. Compare between Bpsk and qpsk. When to use which?
> > >
> > > 6. A square is cut out from within a larger square. How to equally divide the remaining area?
> > >
> > > On Wed, Jan 3, 2018 at 11:50 PM, Sudharsan Parthasarathy <pras.1989@gmail.com> wrote:
> > >
> > > > thanks to aditi for the attached questions :)
> > > >
> > > > On Mon, Dec 18, 2017 at 9:24 PM, Sudharsan Parthasarathy <pras.1989@gmail.com> wrote:
> > > >
> > > > > 7. explain viterbi decoding

aditi jains qualcomm bangalore phone interview questions:

1. Communication system with 1 antenna at the Tx and 2 antennas at the Rx. Channel gain is h1 for one channel and h2 for another channel. Channel gains h1 and h2 are known.
y1=h1 x + n1
y2=h2 x + n2

n1 , n2 ~ N(0, sigma^2)

a) What is the best estimate of x ? (equal noise variance case)
b) If the noise variance is not equal, then what is the best estimate of x ? How will you combine the two observations?
c) If noise in the channel is coloured, then optimal estimator of x?
d) If n1 and n2 are perfectly correlated, then what is the estimator of x ?

2. transmission of uncoded binary bits over a binary symmetric channel with prob of correct transmission =p. A frame consists of n bits. After a CRC check, if all the bits in a frame are correct then, there is no error in the frame.

a) Probability of error in the frame ?
b) If we use some encoding that can correct upto 1 error in a frame, then what is the new probability of error?

3. Rate is 1but per channel use.
For transmission, the bit 0 is mapped to x=0 and the bit 1 is mapped to x=1 and x=-1 , each with probability half.

What is the optimal detector?

4. Y is the DFT of a n-length sequence x.
x=[x1 x2 x3 x4.. xn]. Consider another n-sequence, x'=[x2 x3 x4 .. xn 0]

What is the dft of x' in terms of Y?

5. y=hx + n .. there are pilot symbols x and h is unknown.

On Mon, Dec 18, 2017 at 6:27 PM, Sudharsan Parthasarathy <pras.1989@gmail.com> wrote:

> biswaji duttas qualcomm bangalore phone interview questions :
>
> 1. N*1 antenna system. all the channels are iid in space but correlated in time . Your CSIT is delayed. Rate goes to zero as CSIT delay is infinite. If you have correlation in space, does your rate vs delay curve become better or worse?
>
> Ans: it can become good. Eg: assume all antennas have correlation 1 in space and some correlation in time. Then your beam forming vector is same across time and space [1 1].
>
> 2. Nt transmit and Nr received antennas. Nr tends to infinity. Single Eigen mode transmission. Does the rate improve
>
> Ans: Yes because of channel hardening.
>
> 3. 2 sinusoids at 99 and 101 hz.. what is sampling rate
>
> ans: refer to sudharsans answer before.
>
> 4. u have a sorting algorithm. what is minimum sorting compelxity
>
> 5. schmidl cox: if u have subband each of 10 khz and frequency offset of 5 khz and noise variance is 0 , what is the impact on snr, ber?

ans: snr roughly be 0 db .. because half of ur signal power has gone into next band and half of before band has come into yours. So the signal power and noise power you have is same

6. sum of three angles of a triangle is 180.. what is the minimum value of sin A + sin B + sin C ?

ans: problem is jointly convex in A and B.. substitute C as 180-A-B and solve this 2 dimensional problem

On Fri, Dec 8, 2017 at 7:05 PM, Sudharsan Parthasarathy <pras.1989@gmail.com> wrote:

> intel- systems interview-phone
>
> questions were on receiver structure, coherence bandwidth, coherence time, doppler spread etc. and many usual questions that are in above list ...
>
> one interesting question was about receiver used in a phone which is on a high speed travelling train... how to estimate doppler spread, frequency offset and compensate for this....
>
> On Fri, Dec 8, 2017 at 1:58 AM, abhishek kulkarni <ee14s017@ee.iitm.ac.in> wrote:
>
> > Hi guys,
> >
> > Few coding theory questions I have missed but they were pretty easy and direct.
> >
> > On Thu, Dec 7, 2017 at 4:53 PM, Arijit Mondal <amondal29@yahoo.com> wrote:
> >
> > > Swapping two numbers in a single line of code.
> > > And some questions on pointers and basic C operators.
> > > Decision regions for bpsk and additive exponential noise.
> > >
> > > ---
> > > On Thu, 7/12/17, Sudharsan Parthasarathy <pras.1989@gmail.com> wrote:
> > >
> > > Subject: Re: qualcomm campus test questions
> > > To: "Sundaram R M" <sundaram.rm@gmail.com>
> > > Cc: "davis kachappilly neema" <kdneema@gmail.com>, "Sreejith K" <ee12d032@ee.iitm.ac.in>, "Sreelakshmi P.M" <sree15bangalore@gmail.com>, "Arjun Nadh" <arjunnadh@gmail.com>, "Ajay M" <ee12d030@ee.iitm.ac.in>, "Silpa S Nair" <ee14s049@ee.iitm.ac.in>, "Antony Mampilly" <ee13d202@ee.iitm.ac.in>, "Ragini Chaluvadi" <ee14d404@ee.iitm.ac.in>, "Aswin RC" <ee15s053@ee.iitm.ac.in>, "ASWATHYLAKSHMI P" <ee16d404@ee.iitm.ac.in>, "RENJITH KUMAR H" <ee16d021@ee.iitm.ac.in>, "Ramakrisnan S" <ee12d036@ee.iitm.ac.in>, "M.Gopal Krishna Kamath" <mgopalatin@gmail.com>, "Pawan Poojary" <ee15s025@ee.iitm.ac.in>, "RAVI kolla" <kolla.422@gmail.com>, "Sneha Konnur" <ee15s034@ee.iitm.ac.in>, "Sapana Chaudhary" <ee15s300@ee.iitm.ac.in>, "Debayani Ghosh" <ee12s052@ee.iitm.ac.in>, "Asit KUMAR PRADHAN" <ee13d021@ee.iitm.ac.in>, "Subrahmanya Swamy P" <swamy.iitmadras@gmail.com>, "Thulasi T" <ee15d410@ee.iitm.ac.in>, "Muralikrishnan S" <ee14d206@ee.iitm.ac.in>, "Aditi Jain" <ee15s081@ee.iitm.ac.in>, "Manoj A" <ee14d210@ee.iitm.ac.in>, "abhishek kulkarni" <ee14s017@ee.iitm.ac.in>, "Vishnu Raj" <ee14s014@ee.iitm.ac.in>, "Biswajit D" <ee15d027@ee.iitm.ac.in>, "Arup Kumar Das" <ee15s061@ee.iitm.ac.in>, "Gayathri R" <ee15d035@ee.iitm.ac.in>, "Pranav Bawane" <ee15s033@ee.iitm.ac.in>, "Arun B Aloshious" <aloshious.sp@gmail.com>, "Arijit Mondal" <amondal29@yahoo.com>
> > > Date: Thursday, 7 December, 2017, 10:47 AM
> > >
> > > qualcomm: campus (firmware team)-easy interview

1. log likelihoood ratios and decision
region for bpsk in awgn

2. difference between jump and call
instructions:

u
have to answer this from how the variables are stored... it
is a difference similar to call by value and reference ...

3. code for
factorial

@arijit: were there any more
questions ?

On Sun, Dec 3, 2017 at 1:00
PM, Sundaram R M <sundaram.rm@gmail.com>
wrote:
Superb
Sudharsan.
On Sunday,
December 3, 2017, davis kachappilly neema <kdneema@gmail.com>
wrote:
Macha, you are a gem! Thanks!

On Sun,
Dec 3, 2017 at 3:18 AM, Sudharsan Parthasarathy <pras.1989@gmail.com> wrote:
From Swamy: marvel,
pune... only person to get... dsp profile...

The interviewers were very
helpful. They were very patient and gave ample time for
every question. They helped with terminology and formulas,
when ever i got stuck.

Primary focus is DSP, Probability.
In additon to that there are good number of questions on
Digi comm, and concepts of MIMO and OFDM.

First round:
1. Draw the pulse shape of BPSK and
Differential BPSK

2. you
have a signal y(t)= cos(2*pi*(1.1)t) + cos(2*pi*(0.9)*t).
What will happen if sample exactly at Nyquist rate. Draw the
pulse in Fourier domain. What is the resulting x[n] after
sampling.
3. Explain
about types of fadings. Like large scale, small scale. what
is the difference between them.

4. What is coherence
bandwidth.
Second
round:1. In a

village, a family keeps getting children till they get a boy. What is the average number of children for a familyAns: Geometric distribution: So Expected value is 1/p =2.
2. You have N guassian randomm variables with different variances and zero mean. They might be correlated random varialbes too. Now we want to linearly combine these guassians with some weights. What should be the weights that maximize the variance of the resultant guasian variance.
3. What is the probability that birthday of atleast two people is same in a party of N people.
4. What is MAP, what is ML. what is the difference between them.

Third round (On skype to Pune)
1. Draw the constellation of BPSK anti-modal and BPSK-orthognal. If we have AWGN, what scheme is better.
I told the first one. They asked to give a proof.
2. X,Y are iid. what is P(X<Y).
Ans: 0.5. Then they asked to prove.
3. You are given a LTI system y[n]= y[n-1]- y[n-2] + x[n]. Is this system stable? Is it causal. What are the poles. What is the ROC. what is the criteria for stability in terms of poles in Z transform.

Fourth Round(On Skype to Pune)
1. I was shown a signal in fourier transform domain. Its magnitude had only one sided non-zero value from f1 to f2. Was first asked if it was a real or complex signal.
2. How much Bandwidth is required to sample that. Draw the sampled version fourier transform.
3.Can CDF be viewed as a transformation of the given random variable. What is the CDF of the CDF (when viewed as a random variable.
Ans: It is a uniform distribution.
Prove that its uniform.
4. How to sample from a distribution if we know the CDF.
Ans:
Sample from Uniform and use F^-1.
5. You have a sample of a random variable X. How do you trasform that to a random variable Y. We know the cdf of both.
6. How to convert a received band pass signal to baseband. What filters to use. Draw the resulting pulses.

7. What happens when there is a slight frequency off set in the low pass filter that you use to recover the analog signal from sampled signal.
Ans:
Aliasing occurs
8. You are given a series of two amplifiers with gain G1 and G2 and noise amplifiers with Noise factors N1 and N2. What is the equaivalent gain and noise factor of the total system.
9.
y[n]=x[n] conv h[n]. Write the formula and represent it in matrix form.

Fifth round (On Skype to USA)
1. Write the formula for DTFT. What is the complexity of computing it. What is FFT main idea. How much does the complexity reduce to.Ans:O(N^2) to O(N log N).
2. In an OFDM, given a fixed bandwith, is it good to use 64 frequencies or 128 frequencies under the ideal assumption of fully flat channel. Which will give more data rate.
3. In a component there is a maximum voltage limit of -1 to +1. It gets capped at the extreme values if it goes beyond these limits. What happens if we give a sine wave as input for this device. What will the ouput signal look like in the frequency domain.
4. In MIMO, if there is one transmitter, and two recivers with the corresponding channel variances being \sigma_1 and \sigma_2, how do you combine them optimally? Can you derive the best weights for combining?
HR:
Will you relocate to pune?
On Sun, Dec 3, 2017 at 3:05 AM, Sudharsan Parthasarathy <pras.1989@gmail.com> wrote:
hi,
can people who attended campus interviews update questions in this thread before u forget... below are questions from last 2 days and recent past...

Ti phone interview questions -arijit :
1)For a sequence if we take the fft twice what sequence will we get? 2)For a 1.26 Ghz signal with 100Mhz bw sampled at 2 Gbps what will the spectrum look like?
3)BPSK transmitter and receiver signal chain description-what are the issues you might face in detection - how will you take care of the phase offset? Why is it am issue and how to take care of it? What will the receive constellation look

like? 4) there are 25
horses in a race track. What is the minimum number of races
required to decide the fastest 3 candidates?only 5 horses
can race at a time and you only know the relative finishing
time of the horses in any given race. 5) What is complex baseband and
why is it necessary for baseband signal processing of real
time signals? Why does the signal become complex in
baseband?
sudharsan - intel phone interview
questions -off campus : easy interview
1. Explain the entire
communication structure
Ans:
Tx: Message source to Source
encoder to Channel encoder to Modulator. Modulator converts
bits to symbols. Modulator to Pulse shaper to ADC to up
converter to power amplifier to antenna
Rx: Rx. antenna to low noise
amplifier along with a filter to capture desired freq. to
down converter to dac to correlator/match filter to
demodulator to error correcting code to decoder
2. why source encoder:?
ans:to compress using huffman or
lempel ziv or any such algorithm so that avg. codeword
length is close to entropy
3 why channel encoder?
to add redundancy so that errors
can be corrected at output using Linear block code,
convolutional code or simple repetition code... and also
channel encoding helps us achieve rates closer to shannon
limit ..
4. if
source encoding compresses and channel encoding adds
redundant bits, why do this ? cant we just
transmit
ans:
redundant bits are added in a systematic manner so that
error correction can be done in receiver..so both are not
same

5. what is
the nyquist criteria of pulse shaping and what does it
achieve
ans: let T
be symbol duration. assuming ideal channel, in frequency
domain the pulse shaping spectrum must be such that when u
take shifted copies of the spectrum by 1/T and add them u
must get a constant.
eg: rectangular spectrum from -W/2
to W/2.. shifting it by 1/T and adding all the shifted
copies to get a constant gives the condition that 1/T =W
 i.e. data rate is twice the one sided bandwidth

6. what is the disadvantage and
advantage of using sinc pulse i.e rectangular shape in
freq.domain when compared to rrc
ans: sinc gives max spectral
efficiency of 2bps/hz... rrc will give only
2/(1+beta)...
sinc in

freq. domain is an ideal filter whereas rrc is
realizable
and sinc
has a slow roll off .. when sampled at ideal symbol time
instants u wont have ISI which is true for rrc too.. but
even when there is a small offset, effect of ISI will be
predominant due to slow roll off in sinc when compared to
rrc
Rx:
7. how many errors can be
corrected:
u can
correct upto approximatly d/2 errors or floor of (d-1)/2
errors where d is hamming distance
8. how do u do this correlation at
rx:
match
filter
9. what is
the simple method to decode and when is it optimal
:
nearest
neighbour .. gets simple decision regions.. optimal when
noise is gaussian and all symbols are equi probable i.e. MAP
is same as ML .. performs good esp. when noise is
low
sudharsan
-campus TI interview
Qn
1. 1.25 GHz centre frequency, 100
MHz bandwidth. 2 Gbps.. what happens.
Ans draw the spectrum.. no
aliasing will happen .. but if u use 2.5 gbps aliasing will
happen due to folding..
2. An interpolator of 2 and a
decimator of 3.. what is the relation between FS and one
sided bandwidth b originally to recover the signal back .

Ans : FS
should be at least 6 times b .. use time domain to see this
immediately..frequency domain could be slightly confusing as
we dont use lpf before decimator or after
interpolator..
3. Usual
bpsk with a rect function from 0 to T of amplitude 1 for s0
and amplitude -1 for s1.
And another one of same s0.. but
s1 is positive from 0 to T/2 and negative from T/2 to T
..
Which of
these two schemes have better prob. Of error
Ans : first one .. second one
requires twice power . Must draw constellation points and
derive.

many ways
to do this.. one way is
Eg: take 0 to T/2 rectangular as
basis... so in first one s0 is represented by (1,1) and s1
by (-1,-1)... in second one s0 by (1,1) and s1 by
(1,-1)... hence the answer..

4. DFT of (1,-1,1,-1...)
ans : delta(omega-pi)
this is a high frequency signal...
unit step gives delta... and (-1)^n x(n) gives
X(omega-pi)

qualcomm:
1. y=x+n, where n is exponential
noise... find the optimal receiver.'
problem was when x=-1 and n is
mean 1...is y expo. rv of lambda=infinity ?
2. square wave of freq. f0...
notch at f0... waht is the output .. can u plot
ans: square wave is periodic... so
by fourier series, has all sinusoid components at f0 and
harmonics .. and hence this removes sine at f0
3. as vehicle travels in free
space, what happens to signal..
power reduces due to path loss
but no fading as we have considered free space

and then about thesis ...not able
to recollect more...

intel:
campus
1. what
does antenna do.. what is the difference between an antenna
and a metallic object.. what makes it special
2. what is beamforming
3. what is diversity in
SIMO

4. what is
the minimum distance between antennas to get maximum
receiver diversity
5. why
MIMO instead of SIMO
ans: as i
can play with both diversity and spatial
multiplexing..
diversity
gain is (m-r)(n-r) where r is spatial mux no.
and related to
thesis...
On Thu, Nov 2, 2017 at 5:45
PM, Sreejith K <ee12d032@ee.iitm.ac.in> wrote:
HI
all,

Below are some
of the questions my interviewers in Qualcom asked.

1). IQ imbalances and
the spectrum of signals in the presence of IQ imbalanced
data.

2). Given
error probabilities in each transmission, how many number of

retransmissions are needed.

3). What is a bi-linear transformation?
This transformation is used to map continuous time filters
to discrete time filters.

4). What will happen when the signal is
up sampled or down sampled.

5). Given y=hx+w, x=+-1, h and sigma^2
not known, how to find x. Its a very difficult problem and
you can use EM algorithm to solve this.

6). Give a particular spectrum, what
should be sampling rate.

7). What will happen when the clock in
your down converter and your ADC are both erroneous.

8). Is cyclic prefix
necessary when impulse response have only one tap? Ans).
No. What can you do once impulse response length is larger
than the CP duration? Use a channel shortening filter. Can
be designed using MMSE.

9). What is the IDFT of [1 0 1 0 1 0 1
0].

Regards

On Sat, Oct 28, 2017 at
3:16 PM, Sudharsan Parthasarathy <pras.1989@gmail.com> wrote:
29.
in wiener filter , weights c are found as c=R^{-1} p.. if
correlation matrix R is square matrix and not full rank,
what to do ? do not use pseudo inverse ..

hint: something to do
with the correlation among elements .. guess could be like
using a whitening filter

30.. why is soft decoding preferred over
hard decoding ..

31.
another question on ARQ and HARQ protocol and comparing
their average throughput ..

On Sat, Oct 28, 2017 at
12:49 AM, Sudharsan Parthasarathy <pras.1989@gmail.com> wrote:
Blr
qcom qns: to the best of memory

1. Let

there be a random
number generator of distribution Gaussian 0 mean, unit variance. What
should be there in black box so that output has discrete uniform
distribution over 1 to 5.

Ans : find the value of [x1 x2
x3 x4 x5] in the cdf of gaussian that gives 1/5, 2/5, 3/5, 4/5 and 1. If
the number generated is between -infinity and x1, map it to 1 and so
on.

2. a question on
log likelihood ratio in qpsk..

3. what is the diversity order if u use
MMSE or ML in MIMO

4.
let there be 2 kids in a house.prob. of girl=boy. prob.of the child u pick is boy given atleast 1 boy at home
'
5. tones : if u
have freq. tones at 98 and 101 hz, what is the minimum frequency u can sample at ?

ans
: 2 hz as the harmonics are at odd and even.. 202 hz is nyquist freq
but its too big..6 hz is band pass sampling freq.. but as these are just
tones, it is enough as long as 98 and 101 do not interfere with any
periodic repetitions of themselves after aliasing..

6. if there is a tone at
99, then after aliasing at 10 hz, u have tones at 1 hz and -1 hz... where do these come from?

ans : -1 hz is one of the tones u get
after aliasing from the tone at 99 hz and 1 hz comes from -99 hz..
7. y1= a x1 +
bx2 +n1
y2= bx2+
n2..
how do u detect
?
ans: joint detection
..
8. what is single
carrier freq domain equalization.. why is ofdm advantageous over it..
9. Let x be
0, plus or -1 with prob. 1/2, 1/4, 1/4.. how will the decision region be

10.
in the above problem, let 0 be affected by noise of

variance 2 sigma^2
and plus or -1 by noise of sigma^2 .. so if the received symbol is 100,
what will u decode it to?
ans : 0 as the pdf p(y/x=0) will
dominate over p(y/x=1) as the tail of noise of 2 sigma^2 is big.
11.write a code
to find the second maximum no. what is the order of number of steps required.
ans
: O(log N)
12. find x
that maximizes |x^H A x|^2subject to norm being 1.

13. if
there are N uniform random variables, what is the expected difference between max and second max of these
RVs.
14. If Y is the
product of N uniform random variables, what is the distribution of Y asymptotically.
ans : Y = X1
X2...XNlog(Y) is asymptotically gaussian
distributed.. and hence Y is log normal..
15. what are the weights in MRC if
the noises are correlated..
16. If X(f) is the fourier transform
of x= xI+jxQ, what is the fourier transform of xQ+j xI..
ans : X*(-f) is
the FT of x^* .. so it is the FT of xI-j xQ.. and hence j X^*(f) is the FT of xQ +j xI..
17.
In a board, u can move only in horizontal direction by rolling a dice.
dice is numbered from 1 to 6... interested in the prob. of reaching 25
in 5 steps.. qn. is how do u frame this mathematically..

soln:
use state transition matrix .. if there are total of 100 points in the
board... then have 100 indices in X and Y axis... and each row will have
6 elements of prob. 1/6... for eg. from first position u can jump to
anyone of 2 to 7.. and hence in first row each of these columns will
have 1/6..so on and so forth...
18. If there is
a sequence x(0) x(1) x(2).. x(N),whose fourier transform is X(f) whose
diagram was drawn on board.. what is the fourier transform of x(0) 0
x(2) 0 ...
soln:
so first a dowsampling is done and then a upsampling .. accordingly draw the spectrum
19. probability of 2 cords
intersecting ..

hint:
draw a cord.. for another cord to intersect with this, the 2 points
must be on either side of the cord .. probability a point is above a
cord is arc length/ 2Pi R= R theta/ 2 pi R = theta/2 pi and then take
expectation with respect to theta assuming its uniform in 0 to pi..
20.
relation between H(X+Y) and H(X) + H(Y)..
soln: function of a RV has lesser
entropy ..
so H(X, Y)
\leq H(X,Y)= H(X)+H(Y/X) \leq H(X) +
H(Y).
21. y1=x h1+n1,
y2=n2 where n1 and n2 are correlated .. what is the optimal detector..
22. find
I(Z;X) where Z=max(X,Y)
23. y1=h1 x+n1
y2= h2 x+n2
ans : if n1 and n2 are fully
correlated, y1-y2= h1 x1 -h2 x2 (as n1=n2) .... so noise goes off and snr is infinity...
if h1=h2, then y1-y2 wont work out
as y1-y2=0..
24.
y1=h11 x1 + h12 x2 +n1
y2=h21 x1 + h22 x2+n2

n1 and
n2 are correlated, find the optimal
detection..
25.
prob.of error of qpsk from bpsk
26. y=hx + n1 .. there are pilot
symbols x .. how to find snr ..
27.
if bit 1 is mapped to (1+j) of probability 0.5 and 0 is mapped to
(-1-j) , (-1+j), (+1-j) with each probability 1/6. what is the boundary
decision ?
28.
similarly if bit 1 is mapped to (1+j) of probability 0.5 and 0 is mapped to (-1-j)
, (-1+j) with each probability 1/4. what is the boundary
decision ?

On Tue, Oct 24, 2017 at
11:49 AM, Sreelakshmi P.M <sree15bangalore@gmail.com>
wrote:
Sincere appreciation for the effort Sudharsan. I
am sure it will be very helpful to those planning to give
the interview in the near future.

Sreelakshmi P M
Dept of Electrical Engineering
IIT Madras

On
Tue, Oct 24, 2017 at 11:47 AM, Sudharsan Parthasarathy <pras.1989@gmail.com>
wrote:
21. is y=ax+b
linear ?

ans: no, as
b is not 0.

22. u have a bandpass signal whose
centre freq. is fc.. and the downconvertor is offset by a
frequency deltaf. Now sample this signal with a frequency
fs+deltaf.. the output spectrum has multiple copies.
Question is will the other copies just be a shifted version
of the baseband signal or will there be a stretching too
?

On Tue, Oct 24, 2017 at
1:31 AM, Sudharsan Parthasarathy <pras.1989@gmail.com> wrote:
20. mrc if noise
variances are different....
soln:
weights are channel gain/ sqrt(noise
variance)..

On Tue, Oct 24, 2017 at
1:00 AM, Sudharsan Parthasarathy <pras.1989@gmail.com> wrote:
hyd qualcomm
questions : to the extent i remember:
1. complete structure of comm. Tx
and Rx. and some basic questions in that.
2. If in a wired channel, receiver
sees a low power in received training symbol, it could be
either due to low RF power or some problem with pulse
shaping or channel coding or modulator . How to
identify.
Soln: use a
spectrum analyzer. If the problem is with raw power,then one
wont see much power at all. If there is good power seen in
the band of interest, then the problem must be in one of the
other 3. If there is no problem with pulse shaping
(guess the entire band will be seen ..not sure about how it
is different with raw power explanation , then have to
debug between channel coder and modulator. One shuts down
one of the 2 blocks alternately and finds where the problem
is.
3. Basic info
theory questions as it is an optional
subject:relation between H(X+Y) and H(X,Y).. must
think in terms of relation between H(X) and H(g(X)). and the
easy one, relation between H(X,Y) and
H(X)+H(Y).
4.
multirate is important .. is downsampling by 2 followed by
upsampling by 2 same as upsampling by 2 followed by
downsampling by 2. under what condition is downsampling by L
followed by upsampling by M same as downsampling by M

followed by upsampling by L. guess they must be relatively prime..
5.
quantization..derive the trade off between no.of bits and sampling frequency..
Soln: let delta be interval
length. max error is delta/2. min error is 0.error is uniformily distibuted in this range. So derive var. If total voltage span is 2A and number of levels L. substitute delta=2A/L and if b are no. of bits substitute L=2^b in the derived variance .
now PSD is var/f_s. From this talk
about whether to increase fs or bits to reduce variance.
6.
coding:in a chess board, i want to go from left most point at bottom to right most point at top with only one horizontal and one vertical movement allowed. How many ways possible. write a pseudocode to compute this. find mathematically no. of ways ..
soln: let (x,y) denote
 (horizontal, vertical) movement. Whichever way u take, only 14 steps are required and in that 7 will be horizontal and 7 vertical ..So 7 (1,0) and 7 (0,1).
so total no. = 14!/(2*7!) ...due to repetition, denominator comes..
7. explain timing sync.in OFDM, schmidl cox...
8. If u have
finite and less no.of samples how will u compute the spectral density in matlab .
Soln: periodogram or look upto
pwelch in matlab
9.
y(i)= h + v(i) .. how do u find snr...
soln.. estimate h as (sum of y)/N
and find signal power... for noise power, as h is constant , var(y) is var of noise.. so just find power of y using law of large nos.
10.
Intersting qn: y(i) = h x(i) + v(i)..now u dont know both h and x(i) but x(i) is BPSK + or -1 .. how to find snr.. signal power is h^2 and noise power is sigma^2..
soln: use
moment matching..
E(y^2) can be express in terms
of h and sigma .. E(y^4) can also be expressed in terms of h and sigma... so 2 equations and 2 unknowns.. find E(y^2) and E(y^4) from samples assuming large no. of samples and solve..

11. bertand paradox.. derive the
different probabilities..
12. y(n) = alpha x(n) +(1-alpha)
y(n-1). find variance of y if variance of x is known and x is white..
13. ofdm..
let a channel have no multipaths..so just 1 tap h(0).. let the number of carriers be 1200.. there are 200 equi spaced pilots.. at output take these 200 points and take a 256

point idft ... how many non zero samples will be there
?
soln : as only one
tap, H(k)= h(0) for all k=0,1..,1199. So the channel
corresponding to 200 equi spaced pilots in frequency domain
is h(0). as u are taking a 256 point idft,pad with zeros..
so this is like a rectangular pulse.. and idft is sinc..
hence all the samples are non zero..
14. y=ha convolve with x + hb
convolve with conj(x).. how do u remove conjugate
?
soln:]Y(f)=Ha(f) X(f)+
Hb(f) X^{*}(-f).
Y*(-f)= Ha*(f) X*(-f) + Hb*(-f)
X(f).. scale appropriately and add with above to get rid
of conugate..
15. Let
a circle be of radius r.. let 2 vechicles start from a point
with velocities v and 3v... when do they meet for the first
time.. they meet at the same starting point when 3v would
have completed 3 rounds.. but they would have met before
that also in 3v's 2nd round.. when and where is
that..
16. let there
be an infinite length y(n) with freq response Y(omega) ..
let it be sampled at 2pi k /N .. from this dft obtain a N
sample length x(n) thru idft... what is the relation between
x(n) and y(n)..
17.
what is the motivation for path loss exponent being 2 in
free space
18. derive
doppler freq shift and what is doppler
spread..
19. If there
is a BPSK which is pulshaped by a rectangular pulse of
duration T and another pulshape which is a high frequency
signal of same duration...which has low BER..

On Thu, Oct 12, 2017 at
9:34 AM, Sudharsan Parthasarathy <pras.1989@gmail.com> wrote:
qualcomm
questions from glassdoor:

Difference between LMMSE and MMSE.

"What is the
similarity between correlation and convolution"

what's negative frequency? where can
you find it?

How would you estimate the time of
arrival of a waveform.
A desirable answer
might be to say "apply correlator".

How negative numbers are stored and how
to calculate the 2's compliment

coherent bandwidth, coherent time,
pilot pollution, degree of uptilt downtilt, which is better
qpsk or qam?

Draw the block diagram of a wireless
system as detailed as possible. Solve PA nonlinearity
precompensation

a coin weighing problem with faulty coins. You have N coins
out of
which one is heavier. How many uses of the scale do you need
to find it?
The second part, now you don't know if it is heavier
or
lighter. How many uses of the scale do you now need to do?
Then you
need to relate this to a problem in information and coding
theory.

capacity of parallel Gaussian channels

What is the
assumption of RLS algorithm

MIMO Systems-
explain the benefits of 2Tx/1RX vs 1Tx/2Rx

1. OFDM
2. Cycle Prefix
3. Source and
channel coding
4. Ideas for low throughput

why SCFDMA in uplink, PHFICH channel
frequencies, what happens in MRC, LTE call procedure.

1.uplink lte
2.cyclic prefix
3.peak to
average power ratio

On Mon, Oct 9, 2017 at 3:17
PM, Sudharsan Parthasarathy <pras.1989@gmail.com> wrote:
below are a few
qualcomm interview questions i have collected from people
over time... i will keep adding if i get more..
---------- Forwarded
message ----------
From: Sudharsan
Parthasarathy <pras.1989@gmail.com>
Date: Mon, Oct 9, 2017 at 3:15
PM
Subject: Re: qualcomm campus test
questions
To: Subrahmanya Swamy P <swamy.iitmadras@gmail.com>, RAVI kolla
<kolla.422@gmail.com>, Asit KUMAR PRADHAN
<ee13d021@ee.iitm.ac.in>, Sneha Konnur
<ee15s034@ee.iitm.ac.in>, Sapana
Chaudhary <ee15s300@ee.iitm.ac.in>, Debayani Ghosh
<ee12s052@ee.iitm.ac.in>

qualcomm
bangalore phone interview qns:
1. if u get head in kth toss where
prob. of head is k, what is the expected no. of
tails..
2. y=x+n. If x
is BPSK +1, -1 if noise is gaussian (0,1) what is the ML
decision region ? what is the probability of
error.
3. if y=hx+n
and u do not know h at receiver, what is the prob. of error
? h is complex gaussian. Ans: if u keep 0 as decision
region, Pe is 0.5 as h can be both positive and negative and
flip the bits.
4.If h
is known at tx., then what is the best way to transmit
?
5. In a MISO Nt*1
system, what would be the best way to transmit if vector h
is known. and how would u compare this with transmitting
only in the dominant channel.
6. If you have a power constraint at
transmitter, how do you allocate power.
7. OFDM qns: cyclic prefix. what is
the advantage. why not 0s instead of CP if avoiding inter
ofdm symbol is the goal. what are the disadvantages with
CP.
8. y=x+n. If x
and n are gaussian,what is the mmse estimate of
x.

On Mon, Sep 11, 2017 at
11:44 AM, Sudharsan Parthasarathy <pras.1989@gmail.com> wrote:
questions from
arijit:

1) Basic
digital communication questions:Digital
Modulations especially a comparison of various
schemes.knowledge of bers at specific snrs
Coding
schemes and why it helps increase throughput in spite of
introducing
redundancy.(linear block codes and coding with
memory)
Timing
synchronization and carrier recovery-why is it necessary and
how to accomplish this.
how to mitigate ISI.
comparison between ofdm and equalizers. which one to prefer
and why?
eye diagram-its significance.
capacity of
channels, sphere packing ,etc.
2)Wireless and
estimation:ML, MAP, cramer rao bound
and its significance
channel parameters like
delay spread, coherence bw, doppler spread and coherence
time
diversity, simple space time codes, mrc,
cdma-advantages and disadvantages, pn
sequences
3)Your
project.

On Mon, Sep 11, 2017 at
10:51 AM, Sudharsan Parthasarathy <pras.1989@gmail.com> wrote:
arjuns interview
questions

What is stationary process
What is white process
what is wide sense stationary
process
BPSK sigma1
and sigma2 decision regionwith sigma1 greater
than sigma2
Variance
of a white process passed through an FIR filter.

OFDM
Timing synchronisation offset, frequency
offset

Gautham
Derive power spectral density from
autocorrelation function.
Derive signal to noise ratio for
ADC.
MAP
rule
ML
rule
Maximum
Likelihood sequence detection
Viterbi decoding of

ISI
OFDM frequency
offset

OFDM timing
synchronisation
MRC
combining with different noise variances.

Dhananjay
Taylor series
sin x taylor series
cos x taylor series
intuition behind taylor
series
Fading
Effect of Doppler when two objects
move
Square wave
passed through a notch filter of the same time
period
BPSK corrupted
by uniform noise
OFDM
Frequency offset
Timing
synchronisation
This
guy made me derive the motivation for Schmidl cox
(Awesome!!)
MIMO
Interpolation
Decimation
How does the spectrum
change?
2*1 CSIT
needed or no?
2*1 ZF
Beamforming needed or no?
All of them asked me about my
project but I guess that was just to get things comfortable
I guess.

On Mon, Sep 11, 2017 at
10:45 AM, Sudharsan Parthasarathy <pras.1989@gmail.com> wrote:
when qualcomm came
to ncc , this is what they told as sample questions:

1. mismatch in
gain and phase offset.

2. what will you do if poles in filter
dont match ?

3.
solution for aliasing?

4. how to deal with non linear
distortions ? - WSD course

5. channel estimation

6. timing misalignment ? my clock freq
does not match BS clok

7. communication problems in high speed
train.

On Mon, Sep 11, 2017 at
10:44 AM, Sudharsan Parthasarathy <pras.1989@gmail.com> wrote:
above one was
pranavs friends questions.. below is manojs

My questions were: 1)
what are the Eigen values of a linear
transformation representing differentiation. 2)
interpolation at input
of dft, how will the output look like. 3) how to sort
numbers, what is
the complexity of the optimal algorithm. 4) one transmit
antenna with 2
receive antenna (or) 2 transmit antenna with one receive
antenna: which
is better and why. 5) some aptitude question..

On Mon, Sep 11, 2017 at
10:43 AM, Sudharsan Parthasarathy <pras.1989@gmail.com> wrote:
There were
two questions on the concept of upsampling and
downsampling.Prove the Nyquist Shannon
theoremYou have m parallel lines and n other
parallel lines. What is the number of parallelograms you can
form?
One question on the topic
of aliasing. Very specific question though. The interviewer
made a diagram on the board and all/And other
general questions about future plans and a simple question
on Bayes rule in
probability.
On Mon, Sep 11, 2017 at
10:41 AM, Sudharsan Parthasarathy <pras.1989@gmail.com> wrote:
written test:

questions from
probability, ITC, linear algebra, basic wireless, C sorting,
time complexity, code snippets debugging

DSP -FFT... Linear algebra- eigen values
orthogonality

entropy
and capacity in ITC

capacity - when bandwidth is 0 or
infinity

viterbi
coding as viterbi is the founder of qualcomm

On Thu, Sep 7, 2017 at 9:59
PM, Sudharsan Parthasarathy <pras.1989@gmail.com> wrote:
https://www.pariksha.co/

On Thu, Sep 7, 2017 at 8:32
PM, Sudharsan Parthasarathy <pras.1989@gmail.com> wrote:
geeks4geeks,
indiabix, hackerrank --coding sites

On Thu, Sep 7, 2017 at 3:26
PM, Sudharsan Parthasarathy <pras.1989@gmail.com> wrote:
sample interview
qns:

Probability- cdf of max , min, sum
of random variables. Some basic questions related to finding
pdf and error probability

Estimation: deriving likelihood
ratio for different cases where variance is different or H
is a vector or H and X are matrices. Like all combinations
and which decision rule is used in each case. Also error
properties like error variance in each case

On Thu, Sep 7, 2017 at 2:42
PM, Sudharsan Parthasarathy <pras.1989@gmail.com> wrote:
got
these info from samriddhi

use 'test ur c skill' book to prepare
for C

In qualcomm they have 4
sections- 1. Aptitude- easy questions but speed needed.this
section if good can very easily qualify u
2. Digital electronics- very basic gate syllabus
3. C programming- if u read test ur c skills u will nail
this
4. Communication- it has dsp, wireless and filter design

In
wireless it will be very basic like just know the terms
related to each technology like power control in cdma .
Dsp will contain more questions from multi rate and sampling
and dft. Filter design will have basics of IIR and FIR .
Again just their properties

--
Kachappilly D Neema

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