Indian Institute of Technology Kanpur

National Programme on Technology Enhanced Learning (NPTEL)

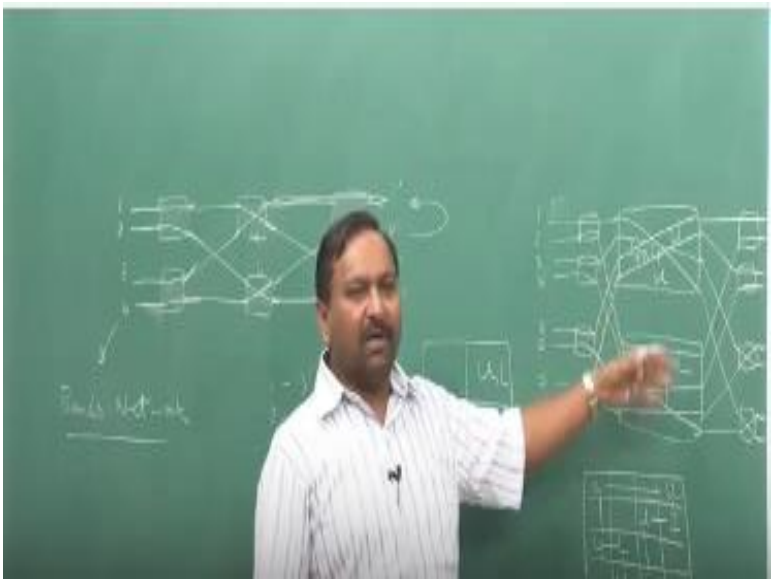
Course Title
Digital Switching

Lecture – 17

by
Prof. Y. N. Singh
Dept. of Electrical Engineering
IIT Kanpur

Okay in this video now we will be looking at a very simple switch because before I move on to rearrange lean on blockings witch I would like to do this so we would like to build the switch with which is a 4/4.

(Refer Slide Time: 00:29)



This is a simplest switch which we can get and I want to build up a clos network so I am not going to big build a strictly non blocking switch here this time but this will be a rear-engine a non-blocking switch and I will give the connection setup algorithm in this case so this is the way it is built you can appreciate that this is very strictly this is a clos Network.

In fact this kind of configuration becomes the Benes network I can actually this is has been a 4/4 switch okay but remember this is a blocking switch so I can show you how the blocking happens and how this can actually be resolved and then we look into how will recursively construct so this in fact is a subclass of clos network we call it Benes okay so this is on the in honor of E Benes so this 4/4 so first of all I have to give you the algorithm by which I will be able to set up any kind of connection within this switch so far we do it that way okay.

So let us try to set up a connection so I can take an arbitrary map okay so how we will do it so we can try it out so one I can set up to upper route 4 to 1 for example like 3 to 4' I can set it up in this fashion okay so I have said this one up I have done it intentionally in a certain sequence so that you can actually see the blocking is happening okay so now can I set it up to 2to 3 I try it out so 2 to 3 only way I can connect through this route but I have no path to 3 I can actually set up only 2 to 1' prime or I can set up only from 4 to 3'

So connection is not possible so what to do in this case this is a blocking system but if I would have been intelligent enough to actually switch it to do it in a different way I would have set up a still a 3 to 4' and then I could have done 2 to 3 also and 4 to 1 so all 4connections are through now okay but then how not to make this kind of mistake which I did so in this kind of network the logic is very simple.

I can create a loop the way I should actually set up the connection we call it a looping algorithm so I will start with a fresh and use my looping algorithm, looping algorithm says that I should so these two belongs to same switch these two belongs to same switch, these two belongs to the same switch, okay. So I will start with one I will set up the connection I can do it the way I want does not matter, okay.

This is a first one, so if I set it up like this time I am doing it indifferent ways so 1 to 2 prime and I setup the connection, so the next connection should be set up from one prime so one prime has to connect to four so 1prime to 4 I should set up the connection, okay. So one prime to 4 or four

to one prime when I do it I can actually use when I am going forward I should either use bottom switch or the upper switch.

But while coming on the reverse direction I should use the other one, okay. So since from one to two I have used the upper one so from one prime to 4 I should use the lower one I have used the lower ones over here I should use the upper one in now, so I have to use this option in fact I cannot use the lower one it was not possible even if I would have tried so it has to be from the upper one.

So I have come to the four so for the corresponding switch then input in the same switch is 3, so I should set up three to four since I am going in forward direction now, I should use the lower switch now, okay. So I will be using lower one and connect to the four prime and now I should connect to three prime I am coming back two to three prime has to be from the upper one, so 2 to 3 prime will be through upper one.

I will be always be able to set up the path in this 4 by 4, I can actually now do create even larger dimensional switch, how to do that? I have already four by four and if I follow this algorithm I will be able to set up the path, whatever be the connection whatever map you take I will always be able to set up the path, we can try out some other arbitrary example also, so to satisfy to verify this thing is.

So we will now set up another connection so I can take a different map and I will use the same logic so I can again try out this, okay. So 1, 2, 3 Prime and this time I am going to go from upper actually so this time I will try first upper so 1, 2, 3 prime goes here. So correspond to three prime there is a 4 prime so I need to create 2 to 4 so 2 to 4 but I will be using lower one, okay. 2 to 4 is a lower one.

So in fact the loop is started from here goes went and came back here, so loop actually is complete so but I can actually then choose three and four again following the same logic three two one if I am taking I am going to take one because the loop is complete so this time I can I start from any one of these so I can take either this as upper and then keep on doing the loop then

can be multiple loops which can exist so we will now do it for a larger dimensional switch also so three two one I will take upper and then for 22 I have to take lower one connection is set up okay so you take any combination this will be feasible now can I make a bigger switch by using same thing.

So Benes Network actually is built by two by two these are two by two crossbar okay class is a more generalized form so this is subclass of a clause so I can now take I can create this four by four and I have two by two so this becomes eight by eight switch so one goes up one down one goes up one down one goes up down we have got a eight by eight switch and we can do a similar exercise here also later on when we like you do as sleep and do good theorem we will understand why this thing is working.

So we just have to just bother about the looping so far we to the loop incorrectly we will be always be able to set up the path okay and there will not be any blocking scenario okay so you can take arbitrary and if any connection so I have done something arbitrary here okay, so 128 I want to create so if I go in forward direction I have to either decide that it will be upper or lower okay so this can be apart or this can be lower so if I decide it is going to the upper one in the forward direction.

So128 so I will be switching here and this can now switch over to the fourth one and I can connect to it internally this 4/ 4 can be built using this technique and I can use a looping algorithm here which I had used here in truly within this which block and I can set up all kinds of maps every possible map can be done but remember this is not a strictly non blocking switch okay the mapping from inputs to output will only be possible for in certain states in certain states it can become blocking I have shown with an example in the beginning okay.

So once it goes to it so corresponding is 7 so which means for 27 has to be happen from the bottom one so I will take the bottom one for 27 and connection has been done so I have done 1 to 8, 8 the corresponding was seven so I finish this so once I have come here the corresponding to 4 I had three.

So there is this three to six prime this has to go from the upper 1326 prime it has to comehere326 prime it goes connected six prime the corresponding number is five so 825 has to go from bottom so remember this is the forward direction this is the reverse this is the forward this is the reverse 825 has to go from bottom 825 has to go from bottom done.

Corresponding 87 this has to happen in the reverse forward direction from the upper 17 to three prime so connection is through corresponding three there is a force 0624 has to happen in the backward direction from the bottom one so 6 24 I will do it through bottom one so this is done corresponding 6 there is a 5 so 5to 1 prime has to happen in there from through upper in the forward directions of 5 through upper it goes to 1 so this is done correspond one there is a 22 has to be connected to two prime but through a bottom root so too will be connected by a bottom route.

I have set up all possible connections I can actually keep on doing it I can make now using this eight by eight block to eight by eight and I can put force which is here force which is here similar kind of thing on this side it becomes a 16 by 16 bins network okay bins Network basically I have to replace this by here I am showing 4 by 4block but actually bins network will be requiring three stages of two by two here ok so again I can use this looping algorithm and set up the paths there and there will not be any blocking so far you follow this procedure .

Ok the looping thing is taken care of ok so but we have I have also told you about pulse matrix let us see what happens in the pulse matrix when I am doing all this so let us draw the pulse matrix for this one so I have how many switches here there are only two switches it is a two by two matrix so when I create it from one to three so I am creating one two three so this two switches so first row second column which is this one I have used I will define this as upper and lower so I have used the lower one sorry upper 1.

So1 2 3 and then prefer to 24 I have used the lower one okay this also comes here then 3 to 1. I have used upper and 4 to 2 I have used lower the condition is satisfied build up a Paull’s matrix for this one so I will be requiring in this case 4 by 4 only 2 switches are their upper and lower. So

from 1when I am connecting to 8’ so this is going from Row 1 2 column for this is going where upper.

Okay so 1 to 8’ and when I am actually connecting from 4 to 7’ this is going from bottom which is this switch 4 to 7’. So I am going here 4 will be here so I am actually putting up a lower here 4 to 7’okay. And then I am doing 3 to 6’so 3 stands here 6 comes here I am using the upper part so remember this is the way I am going and then I am using 5 or 5’ being connected 8 to 5’.

So 5 stands here and it comes here so I am putting a lower here 8 to 5 prime that is a bottom part and then 7 to 3’ so 7 comes here 3 comes here I am using upper so I am you see I can I am actually making a chain that’s what the loop is so 7 to 3’ then sorry, yeah 7 to 3’ then comes the 6 to 4 prime so 6 will come here 4’ here so lower line coming here and then 5 to 1’ so 5 comes here and 1’ comes here so upper.

And then 2’ to 2’ so two comes here two comes here so I will make lower I started from here I came here and these two are also not conflicting. So I have built up the complete loop there is one single loop which has been done. So that is what is happening in the pulse matrix same will be true if I make it for a 16 by 16 and so on.

So in the next video will actually firmly look how to prove this particular thing for two by two life is very simple I can actually show it. So far I am doing this, this is okay, but if I am not using two by two is there are generalized number of switches how do what will be the condition for rarrangebly non-blocking system, these are rearranged every non blocking system actually this is not a strictly non-blocking because blocking states do exist.

But if you set up the connections or you can rearrange the connections as some existing connections can be moved but how they should be moved that I have not discussed here okay. So the rearrangement strategy as well as the proof for a generalized system we will do it in the next video.

Acknowledgement

Ministry of Human Resources & Development

Prof. Satyaki Roy

Co-ordinator, NPTEL, IIT Kanpur

NPTEL Team

Sanjay Pal

Ashish Singh

Badal Pradhan

Tapobrata Das

Ram Chandra

Dilip Tripathi

Manoj Shrivastava

Padam Shukla

Sanjay Mishra

Shubham Rawat

Shikha Gupta

K. K. Mishra

Aradhana Singh

Sweta

Ashutosh Gairola

Dilip Katiyar

Sharwan

Hari Ram

Bhadra Rao

Puneet Kumar Bajpai

Lalty Dutta

Ajay Kanaujia

Shivendra Kumar Tiwari

an IIT Kanpur Production