Power System Protection
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Lecture 32
Communication Assisted Relaying Scheme

Welcome to NPTEL course on power system protection. We are continuing with the distance relaying on model 5, this lecture is on communication assisted relaying scheme.

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So, we will see how with the use of communication system, we can enhance the protection with the distance relaying schemes will have the advantages. We will explore, explore and explored the advantages of how we can speed up the decision process using the communication system and how the decision can be also made more secure.

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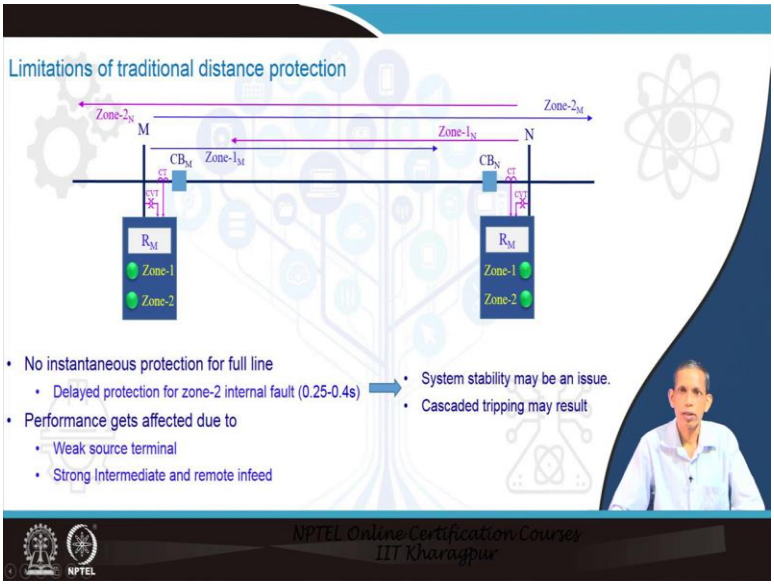

Now, let us see the issues with the traditional distance protection. So, we know we can say that, in an interconnected system a set of relays that to the bus M and another set of relays at bus N will be there to activate the circuit breaker as N, when required. So, here we have sown zone 1 from this side and zone 1 and zone 2 from M side and also zone 1 and zone 2 from this side.

So, blue lines are the land coverage from the M side and the from N side also we are showing for the zone 1 and zone 2. Now, what you see here that from one side when the relay takes the decision let us say it covers through zone 1, 80 %, and the rest of the portion is taken care of by the zone 2. Now, that means that for the whole section of the line, we have we do not have instantaneous protection and that leads to the fault persist for 15 cycles and so, with the zone 2 that may not be acceptable for a high voltage line on system stability point of view and so.

So, that leads to a scope that can you improve the protection in terms of speed? And so, that is what we consider, we will see. Now, furthermore, what happens that if the fault persist in the subsequent portion gets from this side, even the fault appears to be here, then these are considered side relay we will see in zone 1 and it may go for instantaneous tripping. From this side however, it will continue now that leads to consider it because of the delay tripping and so and it goes to

instability kind of situation that may lead to cascaded tripping and eventually at a large scale disturbance into the system also or a very high voltage system that may be a situation.

Now, the other things which we have seen that in the distance and the performance also that when the we have removed infeed in earlier classes you have seen and also when you consider we have intermediated T connection or so in that case also you can say that the zones, zone 1 limitation and the infeed amount limits the performance of the distance relay schemes. So, the question here is that is there any scope to improve the speed of operation of a distance relay and the reliability of you can say that more reliability of the decision of the relay, distance relay.

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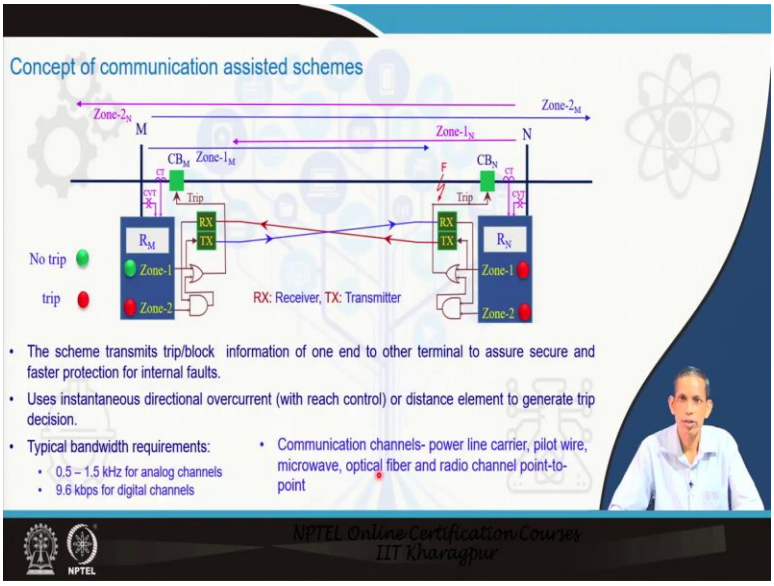

So, how the communication system can be useful and that may enhance the you can say that the performance of the distance relay we like to see that in this slide. So, have these relay at M bus and we have the relay and the distance relay set at N bus. Now, let us say you consider here assuming a communication medium is available and, and what you see here, let us you can say fault happens to be here in this line towards the bus N.

So, this is in zone 2 from this side and from this side zone 1 overlap in here. So, this will see zone 1 and this will see zone 2 so with this side you can say that decision will be delayed and where this side you can say decision will be quick. That means that if this fault is considered in zone 1.

So, this relay ensures that you can say that the fault inside this line and if we can communicate to you can say that to the other side the trip decision taken by RN relay and if you can get this side you can say that can get that information through the communication medium, then we can have you can say that an accelerated trip decision by this communication. Communication medium through which the corresponding decision of the other relay can be sent to the remote end relay and we can make the decision faster, not waiting for the delay to you can say time delay like 15 cycles or so, by the zone 2.

So, these kinds of information which is being transferred to the to the other remote end you can say that it is of importance and then you can say that we will see how this communication medium can be also of importance in terms of that. But note that you can say that we are exploring here how only the decision of trip or block you can say that can be transferred to other end they are called the communication medium which is being required, it is not you can say that very large you can say that bandwidth also. Typically, between the digital you can say that, channels it can be 9.6 kbps kind of thing and or more and for analog channels, you can say that it can be in the range of 0.5 to 1.5 kilohertz analog channels.

These communication channels can be the powerline conductor itself the powerline carrier or it can be pilot wire or through dedicated communication wire for that one. It can be microwave, it can be optical fiber or radio channel you consider from point to point, point to point perspective or so. So, these kinds of communication channels are being used in for the high voltage line protections in power grid aspects which supplements the decision process by the relay.

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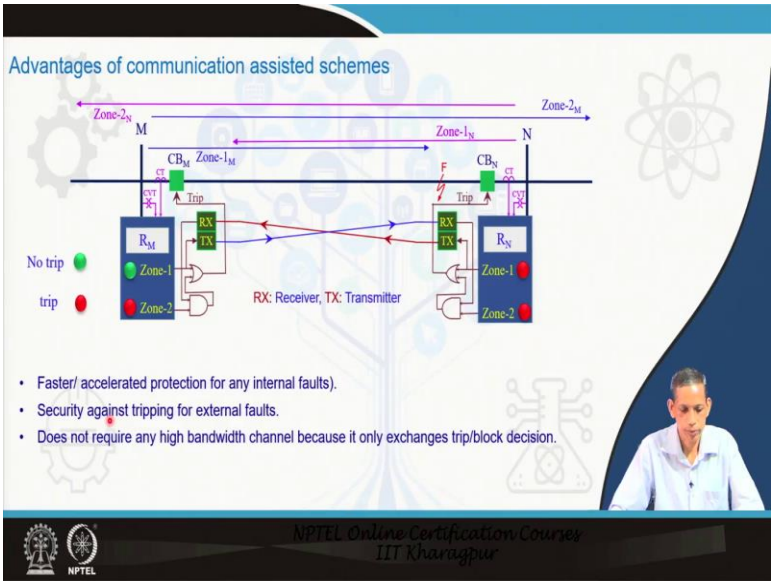

Now, through this the advantages of you can say that such an arrangement is that it gives us faster or accelerated protection, which is an essential requirement of you can say that very high voltage system from stability point and possible damage point of view and then you can say that it also leads to you can say we will see how it leads to secure decision process also during the external fault situation and so, in that perspective. And we see that you can say that in such a case, such an arrangement, we do not require high bandwidth you can say that communication, even the power line in communication can be also used.

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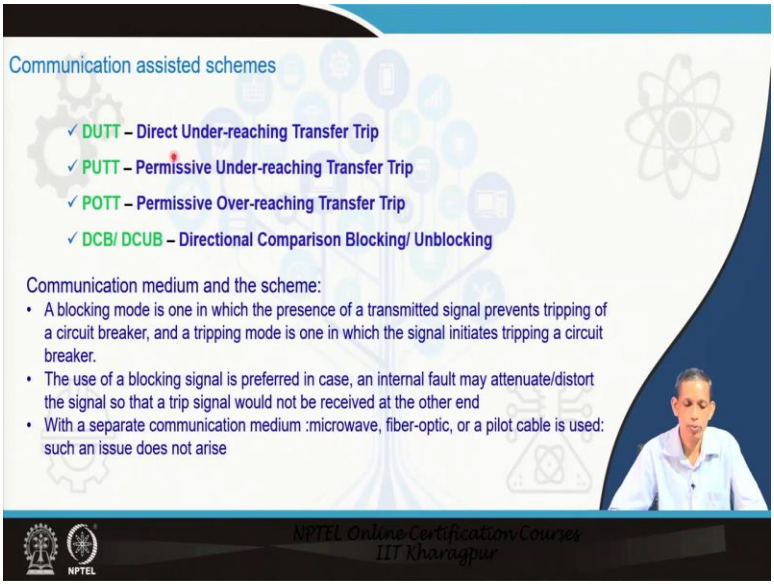

They are important you can say that 5 we can say that basic communication assistant skills which are being used for high voltage system with their distance relay schemes, DUTT direct under reaching transfer trip, PUTT permissive under reaching transfer trip, and POTT permissive overreaching transfer trip, and directional compression blocking and unblocking it is DCB and DCUB.

Now, if you see this terminology, which we will discuss in details, immediately after this slide is you see here direct under reaching. So, under reaching you consider we know by this one this zone 1 and the overreaching here we mean zone 2 or so that we have already answered aware of. Direct means it is without any other checking. Permissive means with permission. So, it has to go for an AND operation kind of thing. Here it is OR operation kind of thing.

So, those are the distinction we can say in terms of that. The other distinction from this terminology you can see here trip you can see that and this is a block. So, whether you are transferring the trip signal or you are transferring the block signal that is also important in terms of that. Now these you can see that all these options of the schemes, communication assistance schemes with that distance relay, which we will be discussing requires, they may require you can see that communication medium, and based on the communication available communication medium, the corresponding schemes can be selected.

Two important points we will discuss here. A blocking mode a blocking mode that what we are told here a blocking mode, is one in which the presence of a transmitted signal prevents tripping of a circuit breaker at one end. Say blocking you can see that signal will be received from the remote end and it will block the circuit breaker you can see that at one end that is to consider a blocking mode operation.

And a tripping mode is one in which the signal initial tripping is circuit, circuit breaker. So, a tripping signal is in transfer to initiate the you can see that trip of the circuit breaker. That is the

clear distinction we can block mode and tripping mode. The use of a blocking signal is preferred in case an internal fault attenuate or distort the signal so, the trip signal would not be received at the other end.

Suppose, we are using the powerline communication and a fault internal fault happens to be there, then in that can kind of situation you can see that the corresponding signals may be distorted. And in that case we can say that the trip signal you can see that to transfer a trip signal we got internal fault maybe difficult or maybe leading to inaccuracies. However, blocking signal means the fault is not there in the line.

So, for a secure decision we are transforming the blocking signal. So, it means that the blocking signal maybe preferred for now, for in that kind of situations if the corresponding line the communication medium is all powerline or. So, but however, with the separate communication medium like microwave, fiber optic or any pilot where dedicated communication system is available, then you can see that use both the options in terms of that. So, however, if you are having a dedicated communication system it has associated economics also. So, that leads to the choice of that which one will be there the important factor is the availability of the communication medium.

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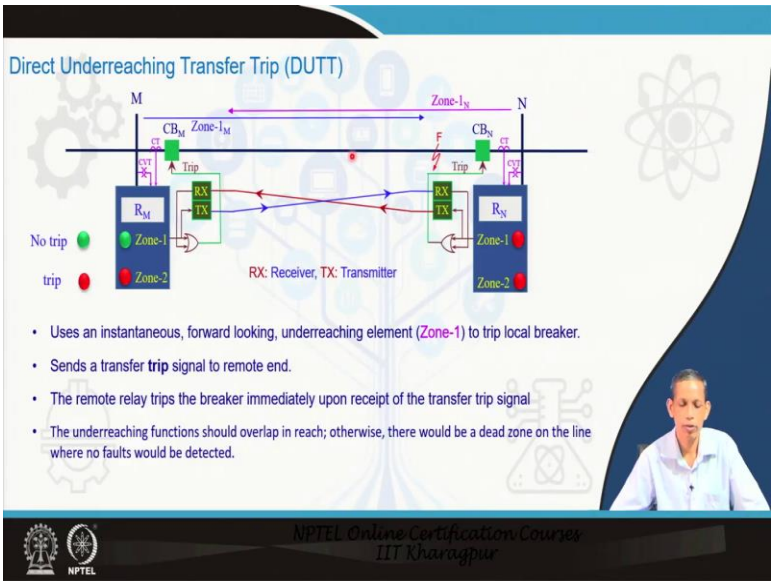

We will go with one by one you can say that this the techniques available you can say that techniques you can see that what we have seen first one is direct under reaching transfer trip, direct, this without any permission from this one. So, without any waiting for the permission, we will see what is that concept under reaching means, the zone 1 perspective and is a transferred trip, agree? So, this is what scheme. So, these you can say that are the M and N bus and we have the transmitter line and we have you can say that the corresponding relay block here and relay will occur at the other end distance relay block and then you can say that the associated breaker which are connected to this 1.

We will see you can say that that these let us see we have this had this relay you can say that to have a zone 1, zone 2 and zone 3 and so, other zones maybe also there. And similarly, here also, but for these you can say that direct under reaching transfer trip scheme, we require only the zone 1 decision process. And see here you can say that we are you can say that the zone 1 here.

So, for this you can say that this side let us consider fault happens to be this side this end then we see it and so, that that will we can say that the zone 1 will not pick up from this side, but zone 1 will pick up from the side close by this fault. So, we have you are using this red dots you can say that your main trip and green dots you can say that is no trip throughout this discussion. So, that means that this will pick up and what we will see you can say that you will see here the this will

you can say that from this one we have OR you can say that OR option and here also an OR options both are having similar structure.

So, once the zone 1 you can say picks up this one it will transfer see here this is a transfer you can say that transfer the corresponding signal to the remote end. And the remote end receives the RX is the receiver, TX is the transmitter. So, RX receives and then you can say that, that also you can say that giving an input to the OR circuit.

Now what happens here if the local one you can say that has not picked up, but initially we can say that from the remote end to you can say that there is a you can say that a zone 1 fault as picked up by the RN relay and this is OR operation. So, it will you can say that go for the tip of the circuit breaker M also. Once again, that zone 1 you can say that at M end does not pick up so the fault will continue from this side till zone 2 picks up and makes a decision like 15 cycles or so. From this side this is close waveforms so zone 1 will pick up so a red frequency flag here.

And that you can say that it means that what will happen there these you can say that information that it has picked up where by the zone 1 will be transmitted to you can say that to this one and this you can say that relay at this end will receive that signal and with an OR gate of local you can say that zone 1 and the remote end you can say that zone 1 that is what under reaching element will be you can say that to make a decision that this relay will also trip.

So, what will happen that from the side also you can say that without any wait for the zone 2 decision it will go for the trip. So, we can we are exploiting the advantage of a faster protection, accelerated protection. So, that is why it sends trip signal to the remote end and that is what the wording direct under reaching transfer trip and these I am sure that this uses instantaneous forward looking under reaching element.

So, the decision of the under reaching element in zone 1 in being transferred to the other one and locally also as usual you can say that we will go for the trip basis instantaneously. The remote relay trips the record immediately open receiving the transfer tip signal from the remote end. So, if the remote and chance the transfer trip signal, the local you can say that this relay also does not wait for of its own you can say that and zone 1 also with the OR gate concept.

Now, 1 thing here is you can say that the point is that the no sections in this you can say that line that should be left out by you can say that either by this or this. What do you mean by here that there must be an overlapping of you can say that zone 1 from M bus side and also N bus side. Otherwise if a fault happens to be in that zone, it will continue without notice of this one, that will be picked up by the zone 2 perspective, so that you can say the difficulty of this.

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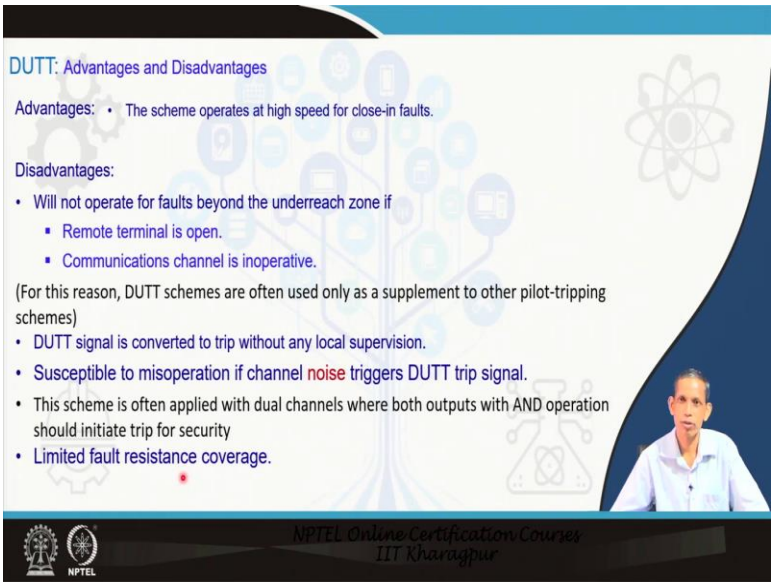

The advantages you can say that of this direct under reach transfer trip scheme is that the schemes operate very fast for the close-in faults. And it also clear you can see from the other end also but it has associated disadvantages, it will not operate for faults beyond the under reach zone. If it means that if the corresponding fault from M bus side as you have seen earlier.

We will not consider to go for a decision. If the remote terminal is open. If the end, end you can say breaker is open and a fault is you can say there in that line. In that case, you can say that the M side will be observing it in zone 2 not in zone 1. So it cannot expect the advantages of the high speed protection or accelerated protection. If the communication channel is inoperative the communication channel is not available, if the breaker is open you can say that and so then they and or for any reason you can say that if the communication is not available.

Then you can say that also there will no information from the other end. So we cannot expect this. For this region, the duty schemes are often you can say that only a supplement to the other piloted pilot schemes, which we will be discussing subsequently. The other thing is that the DUTT signal is converted to trip without any local supervision. So, without any local supervision, the relay takes a decision once he receives a trip signal.

So, if the trip signal is corrupted by noise or so you can say that then it becomes the detrimental decision that is you consider the disadvantage of this 1. This case is 1 applied with dual channels, it means that what is being that 2-communication channel being used and at the end of the AND operation to be there to make that to get there yes, it is not a corrupted signal or incorrect signal by this you can say that AND operation we can mix.

There we considered the decision process can be more secure. The other thing is that if the fault resistance becomes higher, then what happens is that the relay may find it in zone 2 and we will find in zone 2 even though fault is in the zone 1. Then the advantages you can say that cannot be exploited in that perspective. So that is why is a limited you can say that the resistance coverage aspects.

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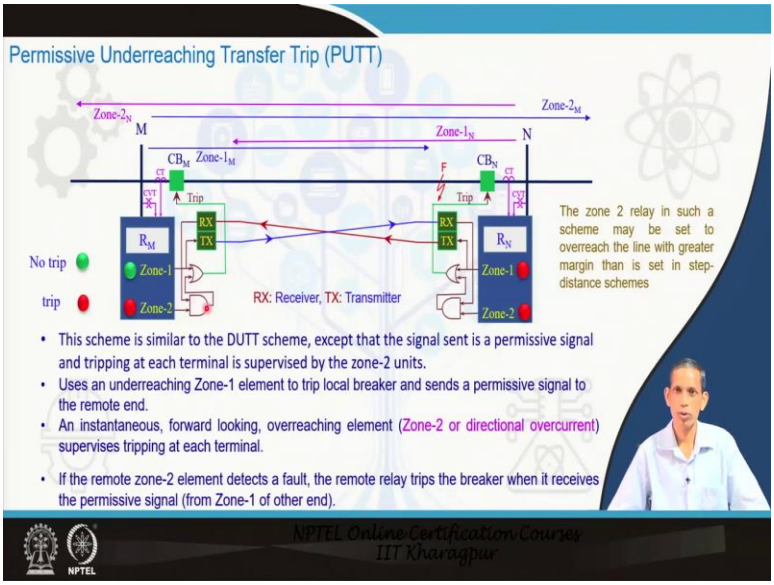

We will go to the second 1 the permissive under reaching transfer trip, permissive. So, with permission only you can say that the remote end will operate, it is not like the direct under reaching transfer trip and under reaching transfer trip. So, the word under reaching means again the zone 1 is the information platform which is PUTT transfer, which has to be transferred to the other end.

So, we will say you can say that again same 2 bus system and then we have the relay the RM relay and RN relay. And we have this communication arrangement, the RX and TX receiver and transmitter you can say that. That means are both ends it is available. Now you can say that the circuit arrangement is you can say that the decision process change. We will see what is the difference.

The schemes is similar to the DUTT what we have discussed, except that the signal sent is a permissive signal and tripping at each terminal is supervise the zone 2 units. Yes, it sends signals from both ends. If the zone 1 finds the fault, finds the fault in zone 1. But the remote end it takes that signal and checks you can say that through zone 2. Yes, it sees in the zone 2 or not and then takes a decision.

Let us say voltage here close to bus N. So, the corresponding zone 1 will pick up from the side. So, it will trip immediately up its local breaker and then you can say that it will consider a sense you can say that the signal to the other end. So, this receiver same gets the you can say that signal that there is a trip decision by zone 1 from this side. Now it goes you can say that to this to this block of you can say that this block you will say region AND block and it compares with zone 2, right.

What you see that from this end is the corresponding relay able to say in zone 2 and not? Agree. So, that you can say that it received it in zone 2. So, that the zone 2 is also trip here. Now, this you can say zone 2 sees and from that remote end also it is you can say that a trip decision. So, this AND operation does not say that now, this is 1. So, it goes to the 1 it 1 and this OR you can say that is already you have seen in DUTT.

So either if the zone 1 is zone 1 you can say that these the zone 1 has taken decision or a decision from you can say that the taken by the zone 2 and the remote information if that is you can say that also trip then either of these can say trip is the breaker will be open. So, what we said that as usual zone 1 trip instantaneously that is 1 perspective. The other is that if the zone 2 picks up from the side and you can say that it gets information from the other end from that zone 1 has picked up then the relay also takes a decision process for the you can say that at the this end also and that you can say that the faster protection can be achieved even though the fault is close to the remote bus.

So, similarly, you can say that fault happens to this end you can say that the this end you can say that will also pick up in a faster decision. And so, what do we say you can say that the zone 2 here can be also you can say that like a directional overcurrent also. Can we use instead of we can say that the normal zone 2 But in addition to that, these zone 2 which we are talking about here for this business, can be also you can say that an extended you can say that a greater margin.

Then what we do generally you can say that setting stepped distance schemes. Because you can say that is here this is permissive you can say that case. So the zone 2 also see and you can say that from these side zone 1 also see. So, that you can say that AND operation makes it you can say that the decision process most secure and therefore, you can extend the zone 2 to a larger area also.

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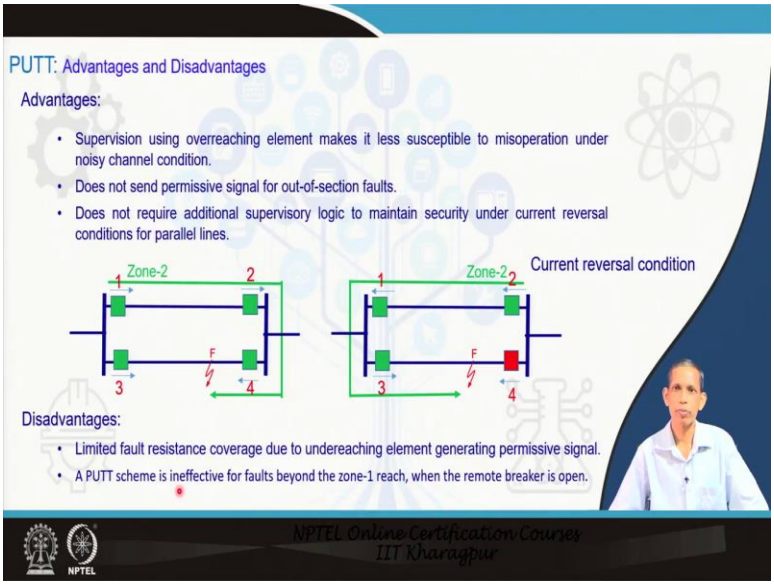

The PUTT has advantages the supervision using overreaching element makes it less susceptible to misoperations, even to the noisy signal channels also, agree. Because at the AND operation does not stand you can say permissive signal for out of section faults. So, that say that AND operation advantages does not require additional supervisory look to maintain security under current reversal condition for parallel lines.

See this parallel condition. So, first note that the transfer trip signal is from the zone 1, agree? That zone 1 only sends the information. And zone 2 makes the AND operation. So, if your fault happens to be for this parallel line at F. So, the current path in the 1 and 2 block which does not have a fault which should be should be retained you can say that for this case. We will have you can say that fault path like this.

Now, consider what happens there this 4 not trips, breaker is tripped. So, the corresponding because the interconnected system the fault you can say that will continue from you can say that fault path current becomes this. So, suddenly the reversal of current suddenly there is a current reversal in this kind, in this system. So, what is happening here we say this 1 and 2.

In both the cases the current is being reversed. So, they will again say a reversal of thing. Now, what happens that in the first case because this is for what fault, these forward fault, this fault you can say that why these you can say the relay at this condition will be observed not to you will not be observed in zone 1 and will not be either it may be observed in zone 2 or zone 3. So, this one relay for this fault will not transfer any signal to this 1.

And a 2 you can say that does not say you consider at any forward fault. So, it will not transfer to these sides. So, there no exchange of any information from either end you can say that for this line. Now at this condition, if we see you can say that, then because this, this will see in zone 2 or so and this will this will not see you can say that any forward fault. So, there is no transfer of any information or transfer trip in addition for the first line.

Because, because the fault is in second line. So, absolutely these you can say that that arrangement, PUTT arrangement has not a problem you can say that for the current reversal for the parallel line. The disadvantage you can say that of these PUTT scheme is limited fault resistance coverage, because already mentioned for the DUTT scheme, that is the fault resistance becomes high the zone 1 may not pick up from both the ends also and then you can say that the fault clearance may be delayed you can say that which may be tripped by zone 2 or zone 3.

A PUTT scheme is ineffective for faults beyond the zone 1 is when the remote breaker is open as I already mentioned if the remote breaker is open and then you can say fault is continue from 1 side because they know communication from the other end you can say that other end will not detect the zone 1. So, this the advantage of PUTT cannot be exploited in such a condition.

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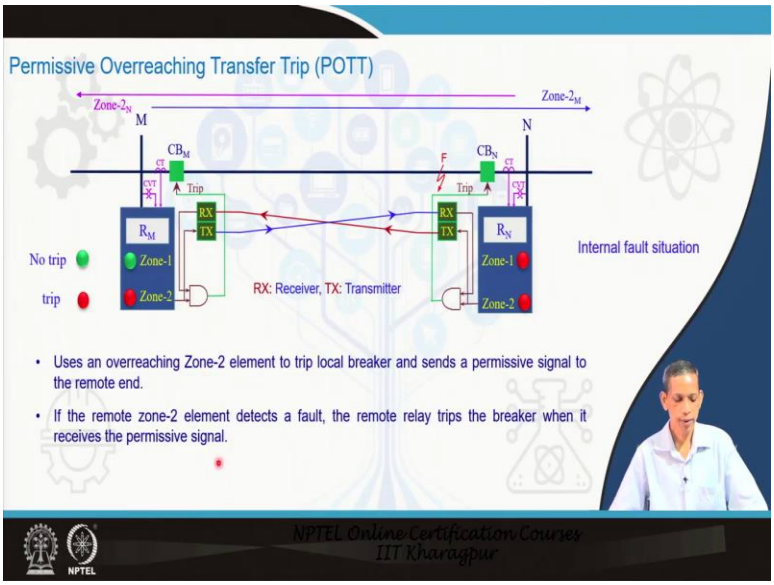

The next one on permissive overreaching transfer trip, permissive and it is overreaching earlier we are telling about under reaching that is the difference. Now, what is you can say that how this, this scheme functions we will see first. So, we have you can say that same 2 bus systems and the corresponding RN relay and RM relay and there you can say that communication medium to exchange the corresponding the transfer trip here. So, it is the signal transfer is transfer trip. What it does here there is as an overreaching zone 2 element to trip local breaker and sends a permissive signal to the remote end.

So, what is you can say that here that it uses an overreaching zone 2 element to trip local breaker so this you can say that we will say if the remote zone 2 element detects if all the remote you can say that trips the breaker when it will say receive the permissive. So, we see you can say that now here that suppose the fault is here in at this position. And you can say that a fault you can say that at this, this position you see here you can say that zone 1 you can say that will not pick up but zone 2 may pick up for this 1 very likely.

In this case, you can say that the zone 1 will pick up, zone 1 will pick up and zone 1 as usual you can say will open this breaker, but here also you can say that the corresponding zone 2 will also pick up. So, what you can say that we see here that the corresponding zone 2 now sends the

corresponding signal not zone 1 now, note. This zone 2 you can say picks up send in the information and it goes to you can say that to this side and it comes you can say this 1.

Now, see here in zone 1 is not picking up because the fault is in the remote end, but the zone 2 is observing that fault. So, this is the AND operation from the remote signal. It also sent is coming from the zone 2. So, the both the zone twos of these you can say that both side's relays and this AND operation will make the corresponding breaker to be open that you can study the scheme you can say that or permissive over reaching transfer trip.

In this case for internal fault these corresponding zone 2 you can say that elements which is having the AND operation a from the remote end also it receives signals from these zone 2 and that is where the overreaching transfer trip scheme is not the underreaching. Now for an external fault if you see here what happens here, this permissive overreaching transfer trip schemes.

For this external fault this side we will see in zone 2 or this side we will not see in zone 2. So, what will happen here? If you see you can say that this will not pick up and then it will say you can say that no signal will be received from this side. So, this AND operation means no signal from the side where local signal is there. So, this relay you can say that will not go for the block or not go for the breaker opening.

This means this is an external fault. So, no breaker opening will be there. So, that is you can say, that is the now the perspective or you can say that what we see from this 1. So, the decision is more secure in terms of that for external fault perspective. And what for internal fault as you have seen in earlier slide, this will go faster tripping.

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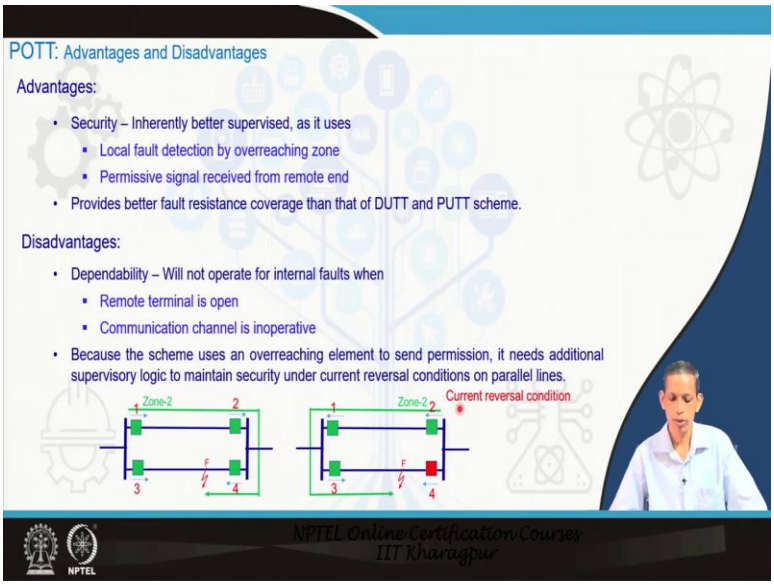

The PUTT has advantages in terms of security inherently better supervise at it uses you can say that local fault detection by overreaching zone, not by the underreaching zone. Permissive signal received from remote end, it is with permission so that is an AND operation so that is why it is more, better secure. Provides better fault resistance because it in zone 2 not in zone 1. That you can say that the advantages as compared to the DUTT or the PUTT schemes. DUTT and PUTT schemes they transfer the signal is being coming from the zone 1 not from zone 2.

The disadvantage is that dependability aspect will not operate for internal faults when remote terminal is open, remote terminal is open. So, from the remote end you can say that you will not find zone 2 so no signal will be coming. So, because it is with permission, with permissive, permissive 1. So therefore, the local you can say that whichever you can say that side this record is connected also will not be able to make a decision.

So, this way the faster or accelarated protections advantage cannot be exploited. In case of communication challenge inoperative also, the other end you can say will not receive any signal. So, then also you can say that we cannot exploit the advantage. Because this scheme uses an overreaching element to set permission, it needs additional supervisory logic to maintain security under current reversal condition on parallel lines.

So, earlier we have discussed the parallel lines. Now, you say this is I am saying 1 way we can explain here that fault is here. So, the fault path of current will be like this for sound circuit. Now, this breaker is open now, circuit 2 breaker, circuit 1 you can say that the corresponding current is having a reversal, note that what happen in this first case the 1 will you can say that it may see this fault in the zone 2 and 1 may send you can say that their signal to 2 side that it is in zone 2, agree.

But in this case, these you can say that relay associated with the 2 will not have a local you can say that zone 2 signal so, it will not go for the trip decision. So, neither this will trip nor this will trip, but in this case what will happen if you see here that in this case, this will seem this may seem zone 2 but this will not seem zone 2, agree. So, in generally you can say that they will not operate as you have seen in the PUTT schemes.

But in the first case zone 1 has already sent you can say that the communicated you can say that a zone 2 you can say that zone 2 you can say that detection. And if that signal will be used you can say that here and now 2 finds in zone 2 then there will be conflict of interest and that means that lead to maloperation. So, there you can say that so, additional supervision is required in this kind of situation.

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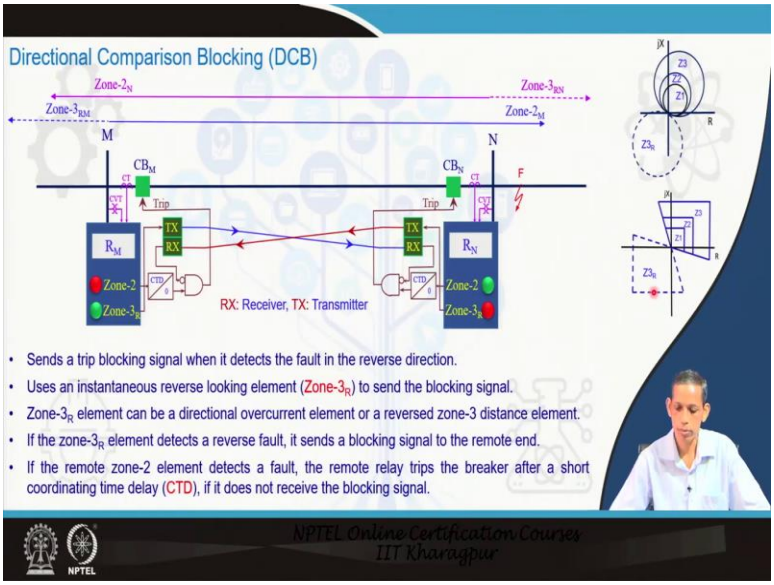

Now, we will go you can say that to the, the other you can say that scheme. Directional comparison blocking, DCB. Now you have your blocking signal not tripping signal. So, in our earlier cases, only tripping signals for being transfer whether it is underreaching from the or it is being from the overreaching means zone 2 or so. Now here you can say that we have directional comparison.

So, we are transmitting the direction information and how that direction information in there that we like to see here. And then you can say that how the blocking signal you can say that even transfer that we will have to see here. That is the difference. So, we have same considered bus M and N and then we have these corresponding RM and RM relay, and we will see you can say that what is being done.

So, we have you can say that as you see from the you can say that diagram that we have you can say that zone 2 and zone 3 here. No zone 1 you can say that signal. Zone 1 is as such the local breaker will trip. But now how to speed up the process we will see that and make this distance secured that we will have to see. So, this, this blocking signal what happens here that at these events that bus we have a reverse looking zone 3; reverse, it says you can say that this side of the you can say that from the bus M line to be protected at bus M to N.

Here also like you can say reverse you can say that zone 3 is there, that is you can say that the 3 RN, this you can reverse looking 3 R, the R stands for here reverse looking to this side, agree? Any external fault happens to be there for this F let us say, then this zone 3, R we will see that fault in is in its forward direction. So, this fault is not this fault of this 1 internal fault. So, what will happen that, that signal will be transmitted to you can say that to the other end and it will block this you can say that relay this you can say that this relay.

Once again; this zone 3 R for this fault will find that, yes, it is the beyond the line and it will communicate you can say that the this you can that block signal to the other end and then you can say that this you can say that see here it is you can say that the corresponding operation here any operation. So local look into that one sees in zone 2, local one sees in zone 2, remote one you can say that sees in reverse zone 3 and that makes you can say that decision process so that this can be blocked at that time.

So therefore, a better security is achieved because the fault is external part. Similarly, a fault happens to in this also what happened here, this will find you can say that in the by this zone 3 are in reverse and then they will come in we will be communicating to this end. And then here that will find in zone 2 and the corresponding relay will be, corresponding breaker will be blocked at that time.

So that is why you can say that the blocking you can say that signal how that can be exploited for a secure decision for the system and that is what directional blocking. But what happens that the remote zone 2 element detects a fault, let us say for this fault in the remote element zone 2 detects a fault the remote relay trips the breaker after a short coordination time only. The remote you can say that trips you can say that short condition time delay only if it does not receive the block signal.

Suppose you can say that it sees in zone 2 and zone 2 operates in 15 cycles or so. So, that should operate. Now, this will operate in that after the 15 cycles or so, subject to the condition that it has not you can say that received any block signal from the remote end, agree? Otherwise zone 2 you can say that their fault at this point relay happen that they are internal fault then you can say that the zone 2 will trip even is delayed or you can say that it can use your other reconsider schemes for a better decision but this we can say that for any external fault the corresponding relays would not trip that they are you can say that advantage I can exploit.

But this you can say that this relay you can say that trips within coordination time delay. If there is no signal received from the remote end. So, if you that you can say that the characteristics in the more you can say that this is a about that they are reverse, you can say that zone 3 you can say that area and, in a quadrilateral, also. This is about the reverse zone 3 R area that you can understand from this plot, the diagram.

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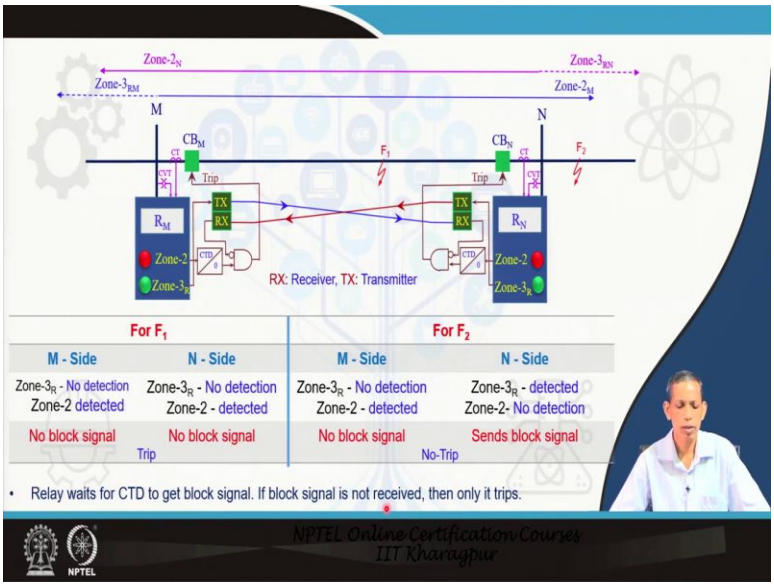

Now, consider that we are talking about earlier that suppose an internal fault happens to be here F1, agree. For this fault you see here the zone 2 has picked up and so also this zone 2 for F1 fault. Zone 2 from this side and zone 2 from this side pickup. Zone 3R will not see because this is the reverse here zone 3 R will not you can say that see in the reverse side fault we are talking about F1.

So, that means that for F1 these fault, internal fault to the line. Zone 3R, no detection. Zone 2 at M side detects that you have red we have put inside zone 3R, 3R does not detect and zone 2 detects agree? So, what will happen that no blocking signal is transmitted to other end, no blocking signal is transmitted to other end. So, zone 2 as usual will go for the trip decision. Zone 1 as such is always there. But independently zone 2 can take independent decision if we are talking about only DCB.

For faulted F2, external fault, see the situation M side this side zone 3 R will not pick up, will not detect, but zone 2 will detect. So, zone 2 detected, zone 3 not detected. No block signal is issued from this side. Come to this side N side zone 3 R detected this detects the F2. Now against the zone 2 at this end does not detect.

So, there you can say that the this will send a block signal to the side, agree. So, for this F2 it provides a block signal. So, block signal means this will not allow to operate this breaker at that moment. And that you can say that correct decision that will be the correct decision for this arrangement which I have already discussed in the earlier slides or so. So, the relay waits you can say that to get block signal.

If block signal is not detected in that CTD. CTD time then only it trips. So, it has to wait like some 40, 50 millisecond you can say that to get you can say that to till you can say that it does not get a block signal perspective.

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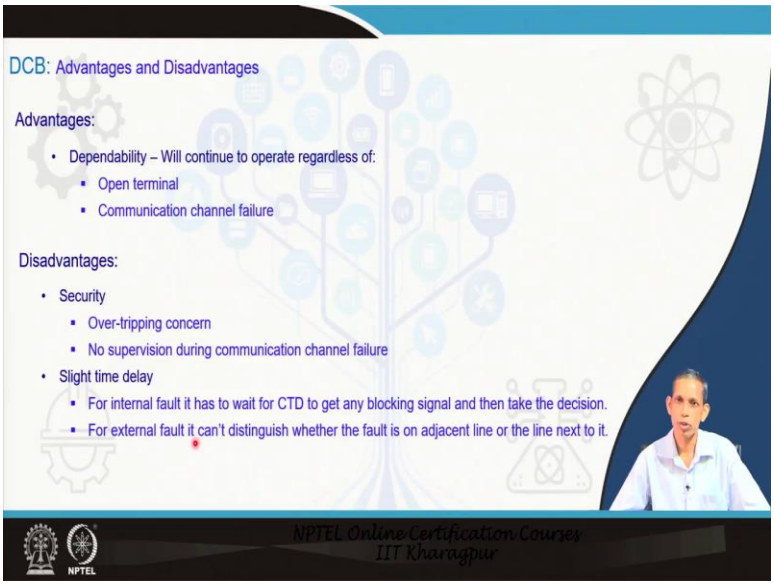

The advantages of the directional blocking you can say that aspect is that the dependability. We will continue to operate regardless of you can say that open terminal communication channel failure this is the advantages of you can say that the DCB scheme. That even for open terminal on the other end and also the communication channel failure also it can you can say that will be you know will be in operational. The disadvantage you can say that there that the over tripping concern and no supervision during communication channel failure you can say that the no supervision during communication channel failure. That is from the security perspective that is a compromise.

The delay you can say that we are talking about for internal fault it has to wait for CTD to get any block signal and then take the decision. If the does not come to consider it 50 millisecond also then only it will operate. For external fault it cannot distinguish whether the fault is adjacent line or in the line to the next 2 things. It means there for internal fault it has to wait because for internal fault you can say that the block signal will not come.

So, that is where these 30, 40, 50 milliseconds delay will be the CTD time delay will be there. For external fault the block signal will come but it does not distribute you can say that whether that is a with the adjacent line or you can say that the line next to it you can say that. If there is a next line you can say that it is it to the next line then you can say that the corresponding zone 2 or zone 3 operation should not be there.

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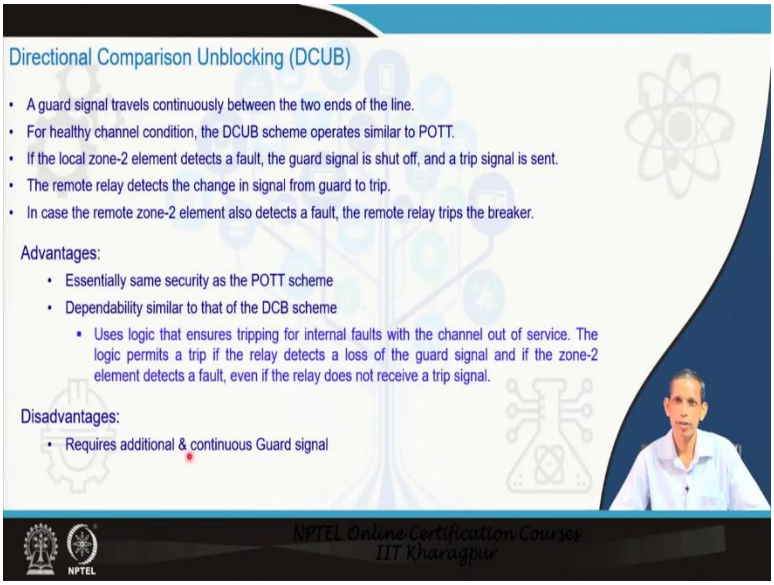

The last one on directional comparison unblocking. So, earlier we were talking about blocking, now it is unblocking, agree? So, unblocking means you can say that it is a trip kind of thing. What has been done here? A guard signal travels continuously between the 2 ends. What we have learned in DCB, that only a block signal is being issued from the remote terminal you can say that reverse third zone relay to have a secure decision when the fault happens to be the beyond the line.

What is being done here a guard signal travels continuously between the 2 ends of the line. A continuous is signal is being transmitted from both the sides that from the both the sides. For healthy channel condition, that this scheme operates similar to POTT; Permissive Overreach Transfer Trip, Permissive Overreach Transfer Trip that is zone 2, agree? Similar to that, if the local zone 2 element detects a fault, that is what POTT kind of thing, the guard signal is shut off, the guard signal is shut off and a trip signal is sent once again.

If the local zone 2 element picks up you can say that detects a fault so now they that continuous signal of guard signal is now you can say that the mode is changed to a trip signal. This remote you can say that relay detects that from the information coming from the remote side. The remote relay detects the change, what change? From guard to the trip and then you can say that incase the

remote zone 2 also you can say that finds it like in POTT we do then the, it makes a decision to trip one.

So, here what happens that it is that the trip signal you can say that like POTT you can say using transport to that one. And that way you can say that for internal fault we can exploit the advantage of faster tripping which was the demerit, you can say that disadvantage in case of simply you can say that with DCB scheme, right. The advantage of you can say that such scheme is essentially security as the POTT scheme, same level of POTT security scheme.

Dependability similar to you can say DCB scheme. So, as I said you can say that with the internal fault you can say that they know you can say that, that coordination time delay you can say will not be there here. Uses logic that ensures tripping for internal faults with the channel out of service. The logic permits a trip if the relay detects a loss of guard signal and if the zone 2 element detects a fault, even if the relay does not receive a trip signal that what we have narrated.

The disadvantage you can say is that it requires additional continuous guard signal. So, continuous guard signal is to be transmitted. This you can say that continuous signal is not required in earlier or you can say that schemes what we have discussed. That is the disadvantage you can say that of this scheme.

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So, you know, overall we see you can say that we saw different communication assisted schemes. How, communication facility you can say that can speed up the decision process that faster decision and also you can say that also they can be a secured decision DCB and so you can say that secure decision can be also obtained from that perspective. But note that you can say that the communication medium available decides whether is a block signal will be transmitted or whether is a trip signal will be transmitted and the all you can say that their own advantages and disadvantages.

In some of the schemes you can combine these also schemes also and numerous schemes are being used you can say that in different grids and depending upon the communication availability, depending of the practice you can say that in different things, depending on the short line and long line. For longline you can say that communication medium may be costly also and so and like that, agree.

So, all these factors decide which schemes will be can be used and so and then. So, to exploit the advantages of speed and you can say that and security aspects. Through this you can say that we complete the module on distance relay. One perspective which here you can say that we will address again in distance relay is that the sensors, current transformers and the capacitive voltage

transformer aspect their transient influence on the distance relay performance we will discuss you can say that in the subsequent lectures. Thank you.