Fundamentals of Electric Vehicles
Technology and Economics
Professor Prabhjot Kaur
Indian Institute of Technology, Madras
Lecture 70
Public Charges Part-2

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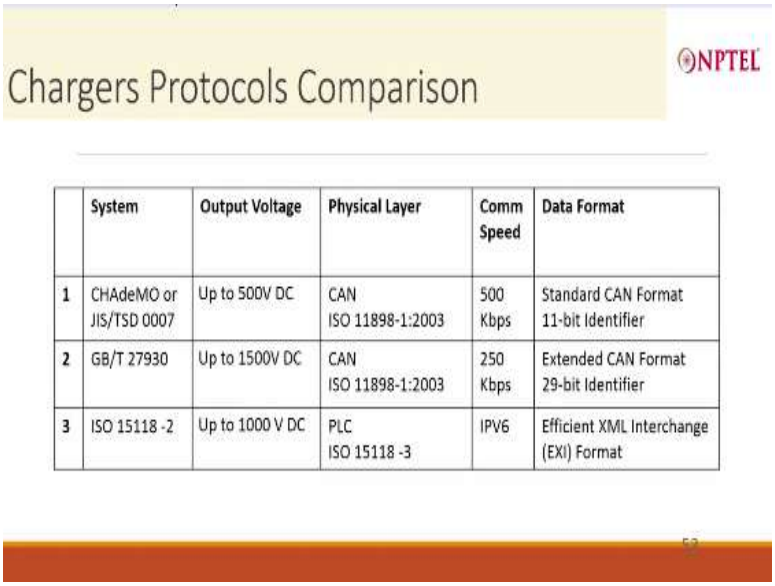

	System	Output Voltage	Physical Layer	Comm Speed	Data Format
1	CHAdeMO or JIS/TSD 0007	Up to 500V DC	CAN ISO 11898-1:2003	500 Kbps	Standard CAN Format 11-bit Identifier
2	GB/T 27930	Up to 1500V DC	CAN ISO 11898-1:2003	250 Kbps	Extended CAN Format 29-bit Identifier
3	ISO 15118 -2	Up to 1000 V DC	PLC ISO 15118 -3	IPV6	Efficient XML Interchange (EXI) Format

Overall, if we look at these standards we talked about their voltage differences, we talked have about their CAN physical layer, the speed that we have in GB by T is 250 kbps in Chademo 500 kbps and ISO actually works on IPV6. So it is the most advanced version, but again whenever we talked upon what is the version, what is the speed, what is the thing that you specify on the communication layer or other layers there is a tradeoff.

Do you need IPV6 or do you need 500 kbps or 250 is good enough to communicate between an EV and EVSE after all there is no intelligence that you are going to share, there is no I mean regular transactions that are happening that have to be very secure between these two link it is a physical link that is there. So, what is sufficient versus what is required so one has to pick and choose based upon that.

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These are the few connectors that we use if you look at the first one that is the blue connector. This connector is used in AC charger its number is IEC60309 if you look at this 3 pin much similar to what we use as our domestic plugs, but it is t3 pin we call it as an industrial connector. So, industrial connector is something that is chosen for Bharat AC-001. So this is actually Bharat charger.

And if you talk about Bharat DC-001 this is something that we use. So, this part is used on the charger side and this is used on the vehicles (sorry), this is used on the charger side, this is gun which is actually hooked on to the charger and whenever there is a vehicle coming so this is much like you can view it like the petrol plugs that are open to fuel it. So if you see that it is much similar to that and once the car comes you take out your gun and put it in the fuel so this is much like that.

And this is the GB by T connector, so if we talk about Bharat DC-001 this also is derived from GB by T standards and follows GB by T connector. Other connectors that exists the CCS-01, CCS-02 and Chidemo I am not giving here details and the pin configuration. If you want all those pin configuration you can actually search them and look at IEC61851 and take that reference from there and find it out, but not needed out of scope (from) for at this point in time.

So these are the different standards and we talked about Indian standard that BIS recommends. As per BIS these are the two standards that are actually recommended for the connectors.

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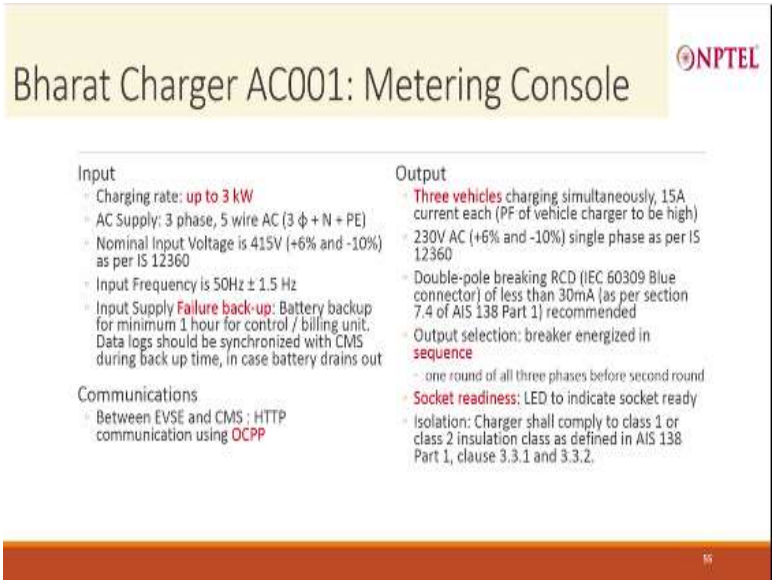

Since we are not talking details on IEC standards for all these 2-3 things and in India what is important is Bharat AC standard and Bharat DC standard so that is what you would see in most of the tenders that government is floating. So number of tenders that you would seen from DHI or ESL that people are procuring and on the electric vehicles that is something happening. So they comply to Bharat charger AC-001 and DC-001.

So just to have a quick recap of what is happening in AC-001 where we said that this is nothing, but simply a plug point, but what happens here is that incorporated material into that is the metering and some intelligence and what is that intelligence to understand who is the user who is coming to me for charging. Should I charge the user or not charge the user if I charge the user how much should I bill him?

So it is a small box wherein you plug in your connector and it starts billing you. So it is a common AC plug point wherein it can actually give you a charging rate of about 3 kilowatt much like what we use at our domestic plugs. It comes with the 3-phase power supply and the nominal input voltage since it is 3-phase we specify it as 415 volt as we do it at our I mean as per the Indian standard.

What it also provides you is the failure backup wherein it has a localized battery backup also such that if there is no power coming in the data can be actually transmitted to the server. So that if the user was getting charged and in between the connection gets lost. It should not be that he runs away with the vehicle the server should know or the operator should know that how much is the bill I have to charge him.

And he should have sufficient time with him to make the payment before he takes the vehicle away. For communication, the communication between EVSE and CMS is over OCPP and what is not mentioned here is the communication between EV and EVSE that is actually Bharat charging protocol residing over GB byT standard. So on to the EV to EVSE one side of it follows Bharat charging protocol on to the interface that we have from EVSE to the cloud it follows OCPP open charging point protocol.

The output side whatever actually we specify based upon the Indian standard. So there conditions, their protections their safety, the RCD that we need to use added on to that as soon as we put in our connector it should actually indicate whether the socket is ready or not or it is healthy or not. So, there has to be some intelligence added on to the charger where it can tell you whether the charger is good to go or not good to go.

And also this charger comes with three power supplies. So with one charger we can actually charge three vehicles simultaneously.

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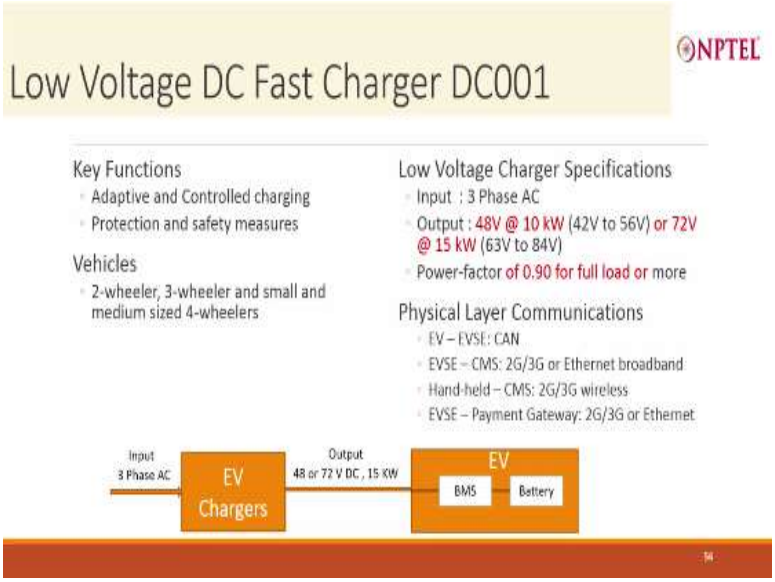

One slide on low voltage DC charger or what we call as Bharat DC-001. The key function is adaptive and control charging wherein it can actually adapt to any kind of vehicle that falls under LEV category. Has inbuilt protection and safety measures and that is where our whole of the big segment of vehicles actually comply to so that means two wheelers, three wheelers and small EVs that we have been talking about.

And again on the charger specs on the AC side that is a 3-phase AC works till about 10 kilowatt for 48 volt vehicle and 15 kilowatt for 72 volt vehicle and how do we say that 10 kilowatt or 15 kilowatt is that it is limited to 200 amps current. So the current that it can supplies about 200 amps and that is how we specify ratings and the communication EV to EVSE physical interface is CAN.

Protocol is GB by T the interface with the cloud is OCPP and the physical interfaces that is specified is it is left to the choice of the operator or the users you can use 2G you can use 3G you should also add 4G here. So there is an option 2G, 3G, 4G or any Ethernet broadband that is available.

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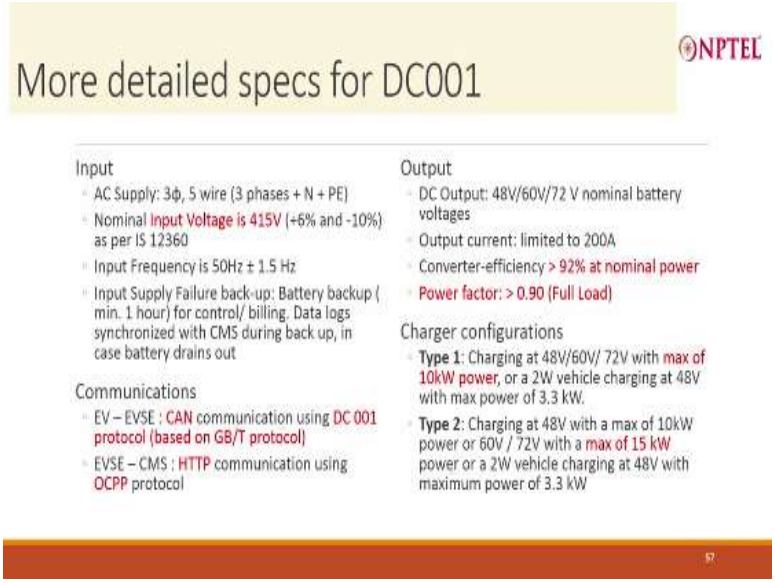

So more on that the input side supply is actually the same that are there for AC charger we use AC 3-phase and all the conditions that we apply on it for the threshold tolerances etcetera are followed as per IS standards that we have and extra things that we have is the battery backup for billing purposes like we have it in AC charger and OCPP is what we follow from EV to EVSE.

The CAN the protocol is derived from GB by T I mentioned for AC there is please note that AC there is no communication between EVSE and EV. So the only protocol that is specified for EVSE for Bharat AC-001 is only OCPP whereas the difference here for DC is that it follows two different protocols one with the EV to EVSE and another between EVSE to the cloud and the power factor it tells is greater than 0.9 with the conversion efficiency of 92 percent.

So why these are specified is that not that you have to specify or comply to the functionality behaviors only, but one has to give a good product as such as well to deliver and to be called as Bharat charger. So that is why some good threshold specified on to the efficiency in the power factor as well. Two different configurations that you can run in; one that we say that up to 10 kilowatt and another that we say at a max of about 15 kilowatt.

Now what different configurations you want to make? You can have I mean 2-wheelers or 3-wheelers getting charged simultaneously or you have one vehicle, one bigger vehicle let us say a car coming in and charging so depends upon that what different configurations you can have and what is expected.

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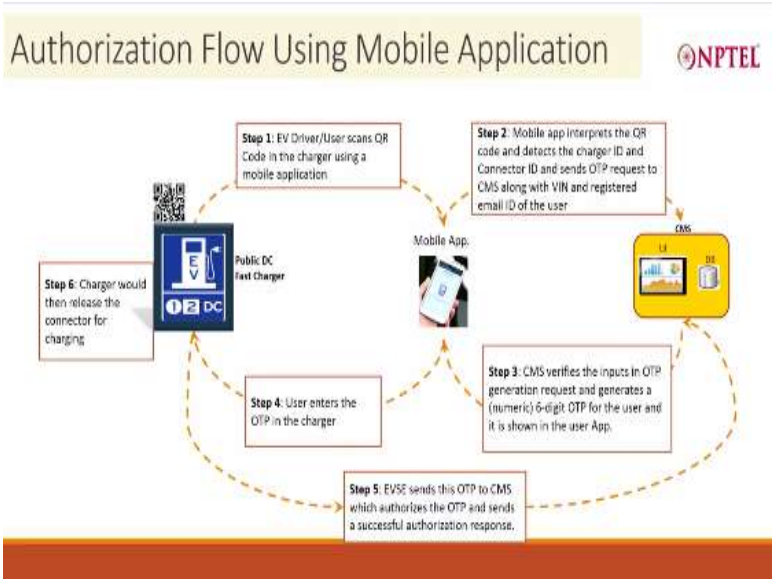

This is very interesting actually, so if we talk about chargers and standards this is the key difference between what has been specified in India with respect to what is there globally available. And this kind of an interface for authentication is actually not specified anywhere in the world, this is very unique to what India is specifying. So, the requirement could also be because we do not want the people come, use the chargers and they do not pay.

So, as far as the infrastructure is concerned if the government lays puts down some infrastructure or there are private companies, PSUs or anyone who is putting up their money they do not want that it goes for a waste and at the same time if I and you go to a parking station and put our vehicle of the charge on that charging station they are on a parking lot. We would want that unless I want or unless my vehicle is charged fully there should not be a second person who comes in and starts charging the vehicle.

So how do I avoid that and it should not be that someone tampers with the whole flow of what is happening between my vehicle and the charger. So, in order to avoid that there is a authorization flow that is specified in the Bharat chargers which is both they are common to Bharat AC-001 and Bharat DC-001. How it works is you have given an app in the app you have a QR scanner.

So as we go to the charging station we scan the QR code of the charger that tells my app that this is the charging station I am at and I connect to the CMS. So I connect to the CMS and the CMS tells me that this is your OTP. I get that OTP enters that OTP into the charger. The charger now knows the charger also gets the OTP from the server. So now there are two OTP; one OTP that I receive as a user from the server one that he receives the charger receives from the server.

And I put in that OTP into that charger if the two matches that means you are an authorized user. If it does not matches there is a mismatch you are trying to vandalize the machine or trying to get an illegal access to that charger. Once it start, once it matches the charging cycle starts and now we want that one should not be able to take out. So, what we do is that there is a locking mechanism that is actually specified in the guidelines.

Where you say that you plug in the socket your connector as soon as you plug in there is a lock. Now locking could be any kind of locking, but it gets locked and then you have to make payment. Once you have made that payment only then it will actually release the lock or it will unlock. So once we make the payment the charger gets the notification from the Central Management Server that this has been unlocked so you can now take out your charger.

So it has actually prevented that nobody else can come and take out your vehicle and put in their vehicle for charging unless the payment is made. So, this is how the whole flow actually is made mandatory for the chargers.

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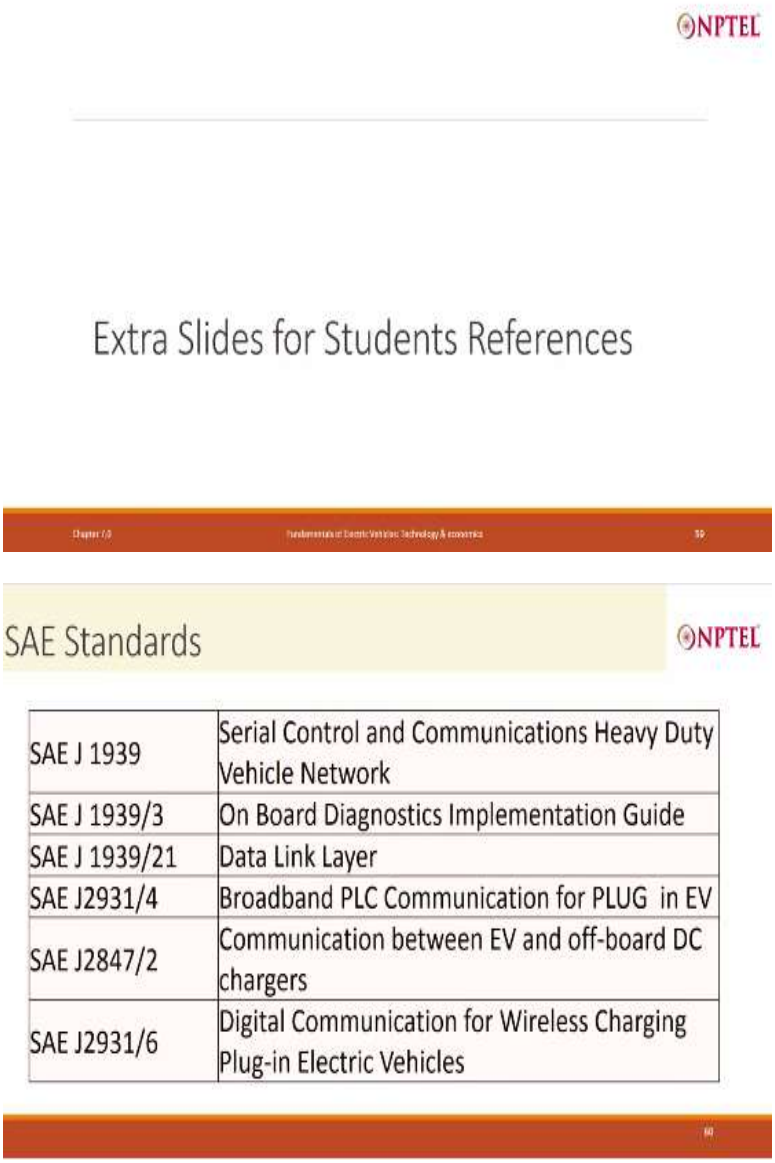

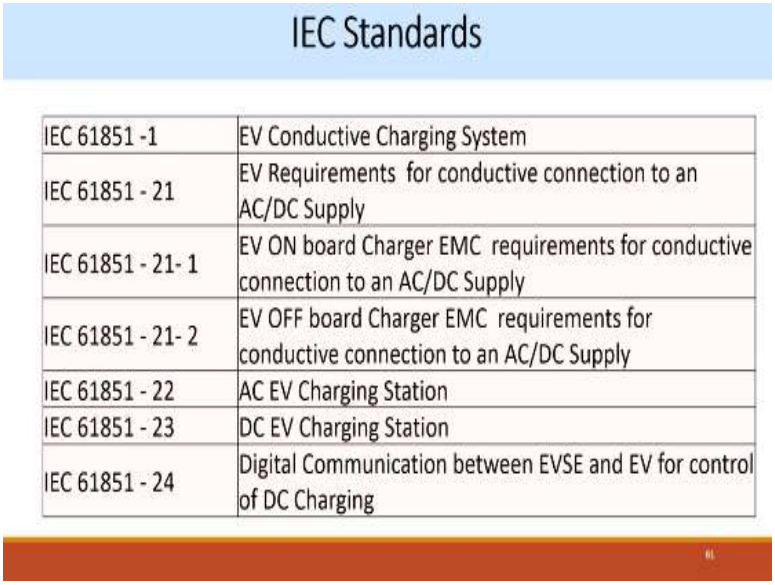

Given some extra slides for the references where it is just giving what are different standards that are available wherein all different specifications on protocols etcetera are specified. You can refer to them later on for any further details that you would require. So this was actually on the public chargers.

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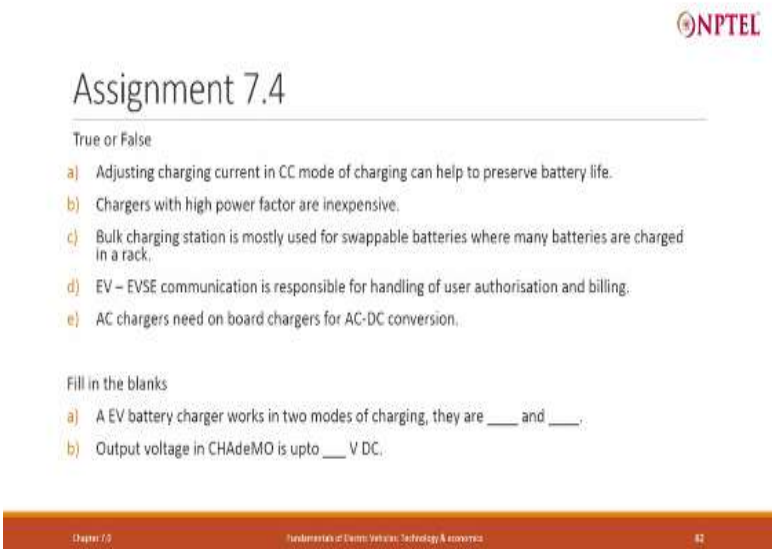

We have a second section I leave on to the assignment side. Second section where it is actually we are talking about bulk charger, but before that if you have any questions anything that you want to ask on public chargers please go ahead.