Section 1: Introduction and Objective

This is the second document in the series of documents we have written to help build a unified energy transfer facilitator network. The goal of this document is to help folks at FIDE understand the current EV charging topologies, the built in functionalities offered in both AC and DC charging, and how payment flows work in both systems. Once this understanding is established, we will use this document to outline how each of the intended functionalities will work using Beckn protocol.

The facilitator network we build on Beckn is going to be called **Unified Energy Interface (UEI)**. The name signifies that it;s a network that's meant to unify India's energy transaction needs going into the future. Any mobile app service will be able to plug into UEI in order to access multiple CPO networks that India has today and will have in the future.

Section 2: Charging Topologies (AC vs DC)

There are two types of charging topologies in India. AC charging software is non standard and implemented as closed loop systems with proprietary communication protocols. DC charging software is standardized and available with multiple charger management solutions today.

2.1. AC charging (Low Cost EV charging or Slow Charging)

AC charging is predominantly slow charging and utilized by 2W and 3W EV vehicles today in India. There are three types of AC chargers available in India today

2.1.1. Bluetooth enabled AC chargers (15A chargers): These are chargers that require a mobile app to be brought to close proximity to a charger in order to start charging. Once a connection is established, the charger communicates with the mobile device to confirm if the incoming mobile device can use the charger or not (to ensure the charger is available for a booked user if that's the case), if they are allowed to proceed, then the start command is sent to the charger post payment processing done within the app. The charger simply does a time based expiry charging session, which tends to be very unreliable at times due to frequent power cuts or load shedding in various parts of the country.

Example vendors include: Bolt Earth
Vehicle type charged: 2W (as primary and backup) and 3W (as backup)

2.1.2 MQTT enabled AC chargers (15A chargers): These are chargers that are connected to a backend server using a 2G or a 4G LTE modem. They communicate with the server over MQTT. Messages are often proprietary and not disclosed as they operate closed looped systems. Chargers often have the CPO's own firmware.

Example vendors include: Kazam, ElectricPe, Uzna, ElectriVa, Ather, Ola Electric
Vehicle type charged: 2W (as primary and backup) and 3W (as backup)

2.1.3 OCPP enabled AC chargers (Type 2 connector chargers): These are chargers connected to a backend server using a 4G LTE modem. They communicate with the server over websockets. Messages follow a standard messaging protocol called OCPP (Open Charge Point Protocol). Majority of charger OEMs procure OCPP controllers from china to build this into their chargers or flash OCPP messaging format as their firmware.

Example vendors include: Exicom, Tata Power, Jio BP, Zeon, Statiq, Chargezone
Vehicle type charged: 4W that has Type 2 connectors

2.2 DC Charging (Fast Charging)

DC chargers are fast chargers and predominately used for 4W+ EV vehicle charging. The charger messaging protocol to the backend is standardized using OCPP across 95% of Charge Point Operators with the exception of Ather and Ola

2.2.1 OCPP enabled DC chargers (CCS2, DC001 connectors): These are chargers that have a fixed messaging format between the charger and the backend server. They run these messages as websocket messages over a persistent HTTP or HTTPs connection.

Example vendors include: Tata Power, Jio BP, Zeon, Statiq, ChargeZone, Log9 30+ CPOs
Vehicle Type charged: 4W Cars, Buses and 2W and 3W EV with Log9 and Exponent Energy batteries.

2.2.2 MQTT enabled DC chargers (Ather connector and Ola Connector): These are chargers that have a proprietary messaging format between charger and backend server.

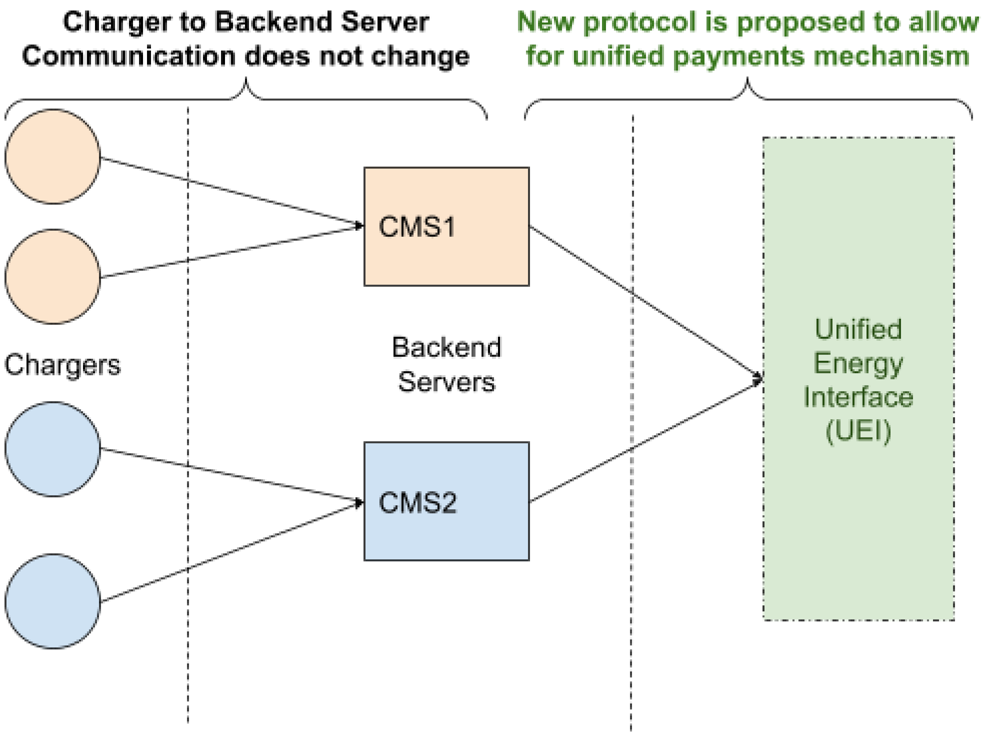
Example vendors include: Ather and Ola
Vehicle Type charged: 2W EVs with fast charging

<u>2.3 Table showing the different charger to backend server communication formats</u>

Charger to Backend Server communication format	AC Charging	DC Charging
2 Wheeler	**Messaging Forma**t: Proprietary **Network Transport Format**: BLE or MQTT	**Messaging Format:** Proprietary **Network Transport Format**: MQTT **<u>Except for Log9 battery enabled vehicles:</u>** **Messaging Format:** Open Standard (OCPP) **Network Transport Format**: Websockets
3 Wheeler	**Messaging Forma**t: Proprietary **Network Transport Format**: BLE or MQTT	**Messaging Format:** Proprietary **Network Transport Format**: MQTT **<u>Except for Log9 battery enabled vehicles:</u>** **Messaging Format:** Open Standard (OCPP) **Network Transport Format**: Websockets
4 Wheeler	**Messaging Format:** Open Standard (OCPP) **Network Transport Format**: Websockets	**Messaging Format:** Open Standard (OCPP) **Network Transport Format**: Websockets

2.4 Does bringing a unified energy transfer interface impact charger to backend server communication?

No, The table above outlines how current charger networks are built out using a 50:50 split of open and proprietary standards. It would be great if everyone followed the same charger to backend communication format, but that would stifle innovation. Also switching to an open standard now will require a huge investment in upgrading existing charger investments (25K+ chargers deployed). **Hence this proposal does not change the way charger to backend communications are being done today, they will remain as is and up to the Charge Point Operator.**



Section 3: Functionality chart

Below are the different functionalities that are available within the CPO world today and we intend to map it out to individual Beckn API/ functionality today. If there doesn't exist one we can consider creating one. These functionalities are offered to two kinds of users today. A) Regular User (a user that pays directly for the charging session), or B) A Fleet driver (a user that pays indirectly for the charging session via fleet admins). The table below calls out which functionalities get impacted by the kind of user.

Feature Theme	Sub Feature	CPO World	Beckn
Searching for a charger		A simple HTTP GET or POST request made by the mobile app to the backend charger server with the appropriate query filters. Search request parameters can be based on any of the following a) Lat Long of the user b) Radius of the user search field from the user's lat long. In kilometers c) Charger Type. Possible values include AC or DC d) Connector Type: Possible values include 15A, AC001, DC001, CCS2, Type 6(Ola),	

		Ather. e) Power Rating: This will be an integer. Possible values include greater than 3.3kW and less than 11kW. OR equals to 50kW f) Availability of a connector within a single charger: This will be a string. A single charger can contain multiple connectors and each connector can have four states : Available, Unavailable, Occupied, & Faulted (Which means someone has pressed the emergency button and it;s possible for you to go to the charger and release the emergency button) g) Tariff of the charger: This is also a float. Possible values can be less than 10Rs per unit OR less than 15Rs per unit. Response includes the following based on the user type (regular user or fleet driver) 1. Name & Address of the charger 2. Lat Long of the charger 3. Availability of the charger 4. Number of connectors available on the charger 5. Connector Type 6. Power Rating 7. AC or DC charger 8. Tariff of the charger (based on the user request - regular user or fleet user)	
Using a charger	Booking a charger	A user can reserve a charging station for a particular period of time. This is done via simple HTTP GET and optionally using a pre-payment request to the charger backend server	
	Starting a charger from a mobile app (vehicle must be connected to the charger to complete isolation tests)	A user can start a charger (i.e. a connector) by sending a start command from the mobile app to the charger server. The server does an Authorization check to see if the user exists within their system (known as ID Tags in the OCPP world) OR checks if they have any pending payment requests and only then accepts the request if both checks pass Once Authorization checks pass, the server now sends a remote start transaction request to the charger. If the charger is connected and the isolation test is successful (known as preparing), the charger starts charging the vehicle.	
	Starting a charger directly from a vehicle or using RFID card (called autocharging)	When the vehicle is connected to the charger, the charger captures the vehicle identifier (battery identifier or VIN or chassis number) and sends it to the charger server for authorization. The charger server checks if the vehicle identifier is associated with their ID tags or they have a pending payment. If both checks pass then it picks the default charging rate (fixed amount of charging or fixed rupee rate) and instructs the charger to start charging.	

	While charging via a mobile app or via RFID or via Vehicle ID.	Once charging starts, the charger sends over meters values of the charger to the charger server. Which is then massaged and sent down to the mobile app so a user knows what is the current battery level of the vehicle (this information helps the user know if the vehicle has been charged enough).	
	Edge Cases while charging: Power loss while charging Internet connectivity loss between charger and charger server	During a power loss the charger communicates to the charger server about it and stops the transaction. During an internet connectivity loss, the charger server does a timeout and declares the session as abandoned or pending to be settled. Some chargers communicate back when the session was stopped once the charger comes back online.	
	Stopping the charger using a mobile app	Mobile app communicates to the charger server to stop the transaction. The charger server sends a stop transaction request to the charger.	
	Stopping the charger using a reset button on the charger	Often times users press on the reset button on the charger when the charger does not stop (due to loss of connectivity with the charger server or their mobile app). In this case the charger stops and beams up the stop transaction request made within the charger to the charger server to settle the transaction.	
Paying for the charging session as a regular user.	Making a prepaid payment	User selects the type of charging session they need (by amount, by time, by units) before starting a charger. **UPI based payments (DST proposal)** Once the selection is made the charger server sends the UPI handle of the charger to the user to make the payment. In case of refunds due to charger server not responding OR power loss the charger server needs to refund the money back to the user's UPI Id **Current mechanism: (monthly CDR record settlement)** User is send them to a payment gateway of the mobile app to make the payment based on what the CPO has asked for. At the end of each month, the CPO sends an invoice to the mobile app provider asking them to pay for the charger transactions. (This is very inefficient and centralized by the mobile app provider) In case of refunds, the mobile app's payment gateway will settle the refund at the end of the month once the mobile app provider gets the transaction records from all the CPOs at the end of the month. The current mechanism is tedious and needs to be ended since it again revolves around centralized	

		mechanisms.	
	Making a post paid payment	**UPI based payment (DST proposal)** User is provided the charger transaction details and offered a UPI ID to make the transaction. **Current Mechanism (monthly CDR record settlement)** Similar to the workflow above.	
Paying for the charging session as a fleet driver	making a prepaid / postpaid payment	User does not pay, instead the mobile app provider does a UPI to UPI transfer from their fleet driver management systems to proceed with the transactions. Current mechanisms rely on a monthly settlement as well.	
Preventing abuse of chargers and charger data	Prevent scanning of chargers for availability data	Functionality does not exist today, but will need to be built in a facilitator network. Below are the use-cases of abuse reported today Competing CPOs grab the charger availability APIs from the CPO's mobile app and scan it periodically to see which chargers have higher utilization and which chargers don't. When they see a charger with high utilization, they go ahead and deploy their own charger near that location thereby cannibalizing that location.	
	Prevent users from using chargers due to lack payment	Functionality does not exist today, but will need to be built in a facilitator network. Below are the use-cases of abuse reported today CPOs that have gone to a post paid model have seen users register a new number (using OTP verification) each time, to try and avoid paying for charging session. Fortum has incurred a loss of 26L per year, while Zeon has a loss of 6.5L per year. In our facilitator network we should be able to avoid the same user from transacting with the network in case of non-payments.	
Future Looking Functionalities			
Discom Access	Configure time of day tariffs	Discoms in the future will need to broadcast in real time what the tariff should be for chargers in a particular lat long. All chargers in that lat long will want to opt in to adjust their tariffs. Current mechanism is using a protocol called OpenADR, where the discom publishes the time of day tariffs in the morning via an webhook call and the CPOs honor them.	
	Adding consumed units	Once discoms have access to the facilitator network, we could give users the option to add the units they	

	of a charger to the Discom's account	consumed as part of their home electricity bill. Once the units are attributed, the discom can issue credits to the CPO, while any extra premium the user needs to be paid will need to be paid to the UPI ID of the charger.	
	Planning grid capacity	Discoms will need to understand the consumption of energy by individual CPOs within a particular city. This helps them understand if they can do the following a) Provide a high load capacity / meter for a new CPO within that same grid. b) Understand if that grid needs to be upgraded with a transformer to withstand the increase in demand c) Forecast high demand charging areas and increase tariffs to normalize usage of the grid.	

Section 4: Contributors

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Usecase 1:		