# Electric Revolution in India and Proposed Solution using Technology

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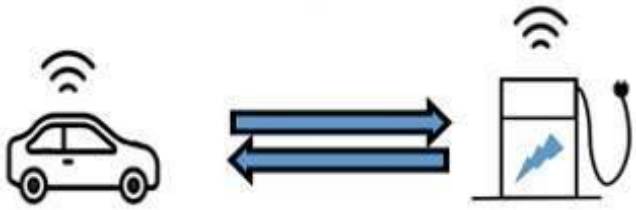
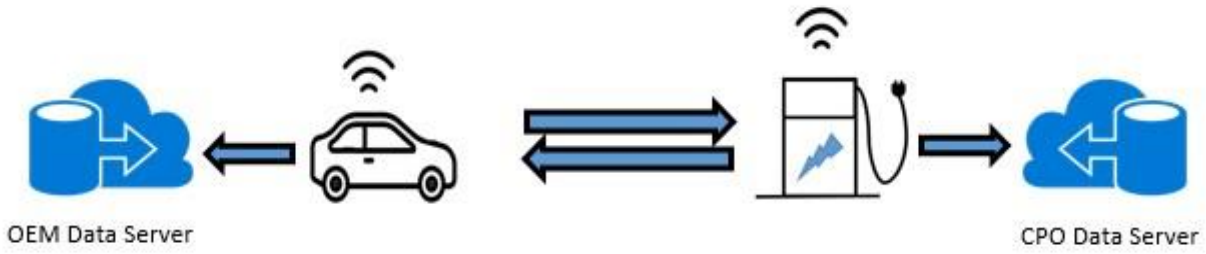


- Identify any one of the Urban city in India (e.g. Delhi) to setup the proposed connected infrastructure of public charging station.
- This infrastructure will be initially setup for the fleet owners. (Ola, Uber etc.) and public transport.
- Section of existing petrol pumps, parking areas, malls etc. to be used to setup infrastructure of public charging station.
- **Connected Charging Stations**
  - Connected via network of IoT(Internet of things) devices.
  - Ability to Smart Charge
  - Health monitoring of the charging points on the charging station
  - Support Geo-Location and Ledger for the day to day transactions.

- **Connected Electric Vehicle (EV)**
  - Connected via network of IoT(Internet of things) devices.
  - Ability to schedule charging or send start/stop command for charging.
  - Health monitoring of the EVs battery.
  - Support Geo-Location

On success of the initial proposed solution, it can be replicated to various cities simultaneously. This approach will result in laying the public charging stations as foundation to enable easy adaption by commercial and private vehicles owner.




OEM – Original Equipment Manufacturer

CPO – Charging Point Operator

# IoT driven Charging Station

**Abstract** – Shifting to EV's depends on available fast charging Infrastructure. The AC charging station, also known as slow charging station, are suitable for home or office charging, however, DC charging station which offer fast charging are appropriate for public charging. The DC charging station significantly reduce time to charge the EV compared to AC charging. For instance, depending upon the maximum power supply the charging station can offer, electric vehicle's battery size and maximum power battery can accept, DC charging process can fully charge an electric vehicle in 15 to 30 minutes.

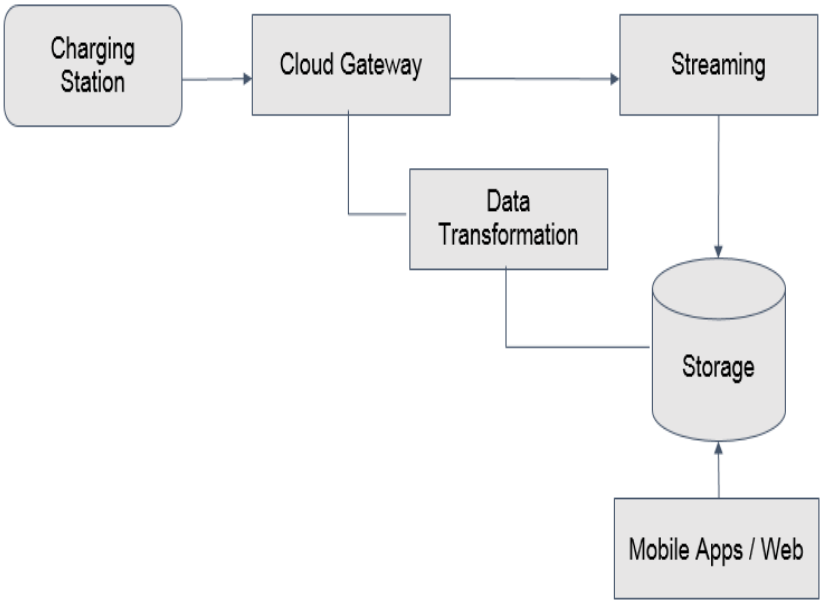
**Prerequisite**

- Energy utility supplier to provide energy supply and energy price feed to Charge Point Operators (CPO) (out of scope for this solution).
- CPOs provides charging station, data services and are responsible for infrastructure.
- IOT enabled Charging Stations.

**Standards** (Following points are proposed to be regulatory framework) Communication and Data exposed by Charging Infrastructure needs to be standardized irrespective of its manufacturer. We highly recommend adapting proven technology i.e. Open Charge Point Interface. The Open Charge Point Interface (OCPI) allows for a scalable, automated roaming setup between Charge Point Operators and e-Mobility Service Providers. It supports authorization, charge point information exchange (including transaction events), charge detail record exchange and finally, the exchange of smart-charging commands between parties.

**High Level Architecture**

1. Charging Station that has ability to securely register with the cloud, and connectivity options for sending and receiving data with the cloud.
2. Cloud gateway service to securely accept that data and provide device management capabilities.
3. Streaming and Data Transformation that consume that data, integrate with business processes, and place the data into storage.



4. User Interface for device management and visualize data.

**Security** - Authentication can be done through Tokenization. The data in Transit and at Rest are to be encrypted.

**Communication** - REST/HTTPS using JSON though binary protocols.

## Solution for IoT driven Charging Station using Azure Services

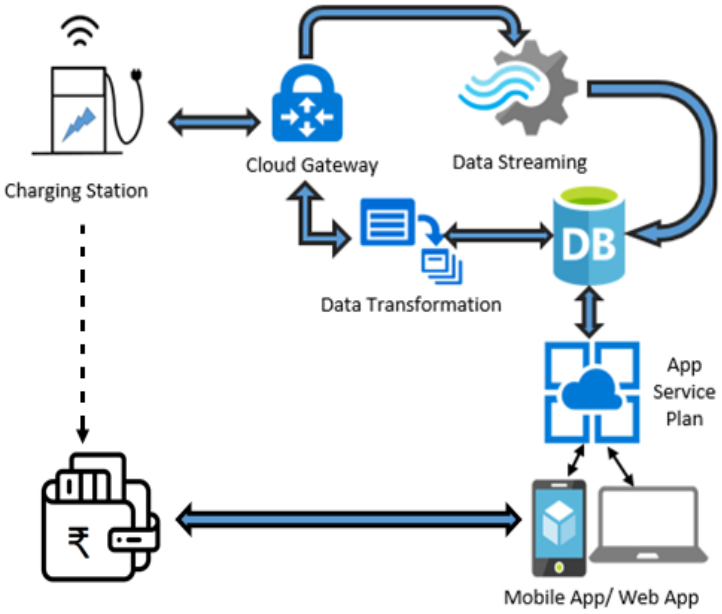
**Process Flow / Solution**

- An App (downloadable) / Charging Card will be made available by the Charging Station company to the EV users.
- The app / charging card will handle user and payment information that will be used at the Charging Station.
- An EV user drives into the charging station. From the mobile application installed in the EV user device, a secure communication channel with the IoT cloud service is established and authenticated with the cloud service.
- The user's location will be determined using GPS. After plug-in the connection point from the charging station to the EV, the user can scan the charging station QR code or may enter the charging station ID via the user device application that helps in identifying the User, charging station and start charging.
- The "Start Charging" action transmits a command to the IoT hub in EV Charging Station to authorize the connected EV. After the EV is authorized, the charging starts and bidirectional communication between EV and EV Charging Station is achieved.
- Once the user finish the charging the user will action "Stop Charging" / auto action on "Full Charge" on the app, thereafter a payment service on the cloud initiates a payment transaction with an external payment service such as PayPal, a credit card company, or the user's bank account as preferred in the App.
- The IoT hub at the charging station will transmit the cost of the electrical power to the IoT cloud service which will forward a message to the payment service to complete the transaction and pay for the electricity consumed. If the payment service is a bank account, then the amount will be deducted from the user's account. The communication between the charging station and the IoT service occur via the user's mobile phone.

Note – The above steps could also be done using Charging Card

**Details on the Solution using Azure Services**

- Azure IoT Hub collects data from charging station and pass on telemetry information for further processing.
- Azure stream analytics monitors IoT Hub and transforms collected data into database.
- Mobile App / Web apps to help users to know their battery status and time to full battery charge based on current battery status and power delivered by charging station based on telemetry information of charging station.




- Mobile App / Web apps will provide nearest charging station location to EV user using maps.
- Optional, Azure Power BI is a convenient tool for system integrators because it aids developing user-friendly dashboards for various devices which have different display formats.

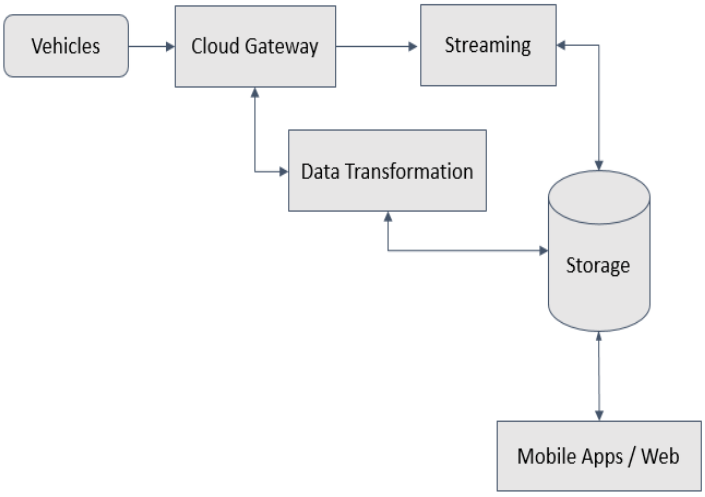
**Design considerations for Charging Station in context of charging**

| | |
|---|---|
| Universal charging socket i.e. Combination Plugs (Combined Charging System, or CCS) supports AC and DC charging power levels (alternating and direct current charging power levels). | Charge point operator should provide information about charging station like whether fast charging is possible. |
| EVSE ID (Electric vehicle supply equipment ID) unique number across CPO to identify charging stations. | Fast charging stations expected to be delivering at least 22kW per hour. |
| Internet based charging station to communicate with Charge Point Operator's (CPO) data server. | Charging station geo-location in terms of latitude and longitude. |

# Solution for Charging of Connected Electric Vehicle

**Electric Vehicle -** The important aspect of the solution is "Charging" of electric vehicles which forms the subset of Connected Electric Vehicle Platform. The below Architecture is cloud native and emphasizes on use of Azure IOT Services to process and store relevant data in terms of "Charging" an Electric Vehicle.

## High Level Architecture




1. Vehicles that have ability to securely register with the cloud, and connectivity options for sending and receiving data with the cloud.
2. Cloud gateway service to securely accept that data and provide device management capabilities.
3. Streaming and Data Transformation that consume that data, integrate with business processes, and place the data into storage.
4. User Interface for device management and visualize data.

**Security** - Authentication can be done through Tokenization. The data in Transit and at Rest are to be encrypted.

**Communication** - REST/HTTPS using JSON through binary protocols.
**The scalable and secure Microsoft azure services serves solution for both worlds i.e. connected Charging Station and connected Electric Vehicles.*

## Details on the Solution using Azure Services

- Azure IoT Hub is an easy-to-use, secure, and reliable tool for connecting edge devices to the cloud. It is particularly useful for larger networks with many client devices because it assigns a unique IP address to each connected device, thus ensuring complete data traceability.

Azure IoT Hub collects data from vehicle and pass on vehicle telemetry information for further processing.

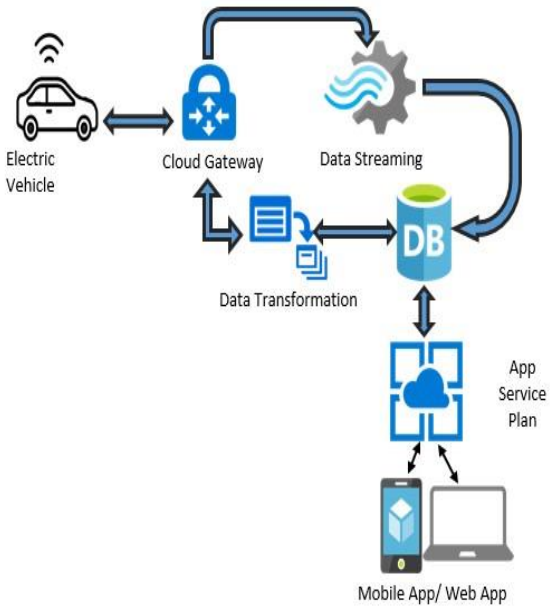
- Azure Stream Analytics can then be used to evaluate data, streamline the dataflow, and forward data packets to a cloud database, intelligent

dashboard, or management reporting system. The main benefit of this is a potentially marked improvement in bandwidth utilization, which can also reduce costs.

Azure stream analytics monitors IoT Hub and transforms collected data into database.

- Mobile App / Web apps to help users to know their battery status and time to full battery charge based on current battery status and power delivered by charging station based on telemetry information of vehicle and charging station. Mobile App / Web apps will provide nearest charging station location to EV user using maps.

- Optional, Azure Power BI is a convenient tool for system integrators because it aids developing user-friendly dashboards for various devices which have different display formats.

| **Details on the Solution using Azure Services** | **Design considerations for Electric Vehicle in context of charging** |
|---|---|
|  | • Internet based electric vehicle to communicate with Original Equipment Manufacturers (OEM) data server<br>• Vehicle Identification Number (VIN) - unique number across OEM to identify vehicle<br>• EV with battery capacity ranging from 40kW to 90kW. Current EV Market has vehicles ranging from 40kW of Renault Zoe to 100kW of Tesla having average 250 Kms mileage on full charge.<br>• Universal charging socket i.e. Combination Plugs (Combined Charging System, or CCS) supports AC and DC charging power levels (alternating and direct current charging power levels) of up to 170 kW. In practice, the value is usually around 50 kW.<br>• Vehicle geo-location in terms of latitude and longitude. |

# Proposal for Stake Holders (Conclusion)

Government and Regulatory

- For enabling successful transformation to E-Vehicles, it is important to have robust charging infrastructure. Currently, as per Government of India policy, it is not allowed for entity other than licensed Distributed Companies (Discoms) to sell power.
- Once charging is considered as a service rather than selling of power, this policy can no longer be a roadblock in creating robust power infrastructure.
- Government can sell power cheaper to EV recharge point entities as an incentive which can be another step towards powering India with Electric car revolution.
- Government should include / upgrade courses with respect to new technologies in field of engineering which would cater the proposed solution. (EVs Technology, Charging Infrastructure, Cloud computing, IoT etc.)

EV Manufacturer

- To build successful electric vehicle market like the Netherlands, government needs to provide several incentives for the manufacturers as well as end users of electric cars.
- In India, several incentives can be pushed; some of them for manufacturers could be, granting additional relief to manufacturers in GST (Goods & Services Tax).
- Employment opportunities in manufacturing sector can be created.
- Manufacture can provide battery pack on lease to users. This will reduce initial total cost of ownership and be recovered through installments over 3-5 years based on business model.

Battery Manufacturers

- Battery manufacturers can be provided similar waivers as described above and GST waivers to ensure healthy competition and growing market which benefits end user.
- Reuse of proven technology from various countries in order to increase the battery range, charging and life. Invest in setting up R&D centers across country for reusing and developing highly scalable solutions.
- This will boost manufacturing sector and in turn create employment.

Power

- For the revolution to take shape, charging points and power are central to the plan, and need to be made available at every few km's in pilot towns.
- Power needs to be differentiated as one which is used for e-car charging and the one that is used as electricity in day to day use.
- When power looked as a service, government can look at providing exemptions to those producing equipment for e-charging of vehicles.
- Under the Make In India scheme, several experienced firms outside of India, experts in e-car power and charging facilities, could be invited to make the charging points with several tax exemptions and low cost to user.

Digital Technologies

- Smart charging should be enabled so that, load on power grids when many e-cars are plugged in can be managed.
- To ensure, customers can be provided incentives and lower costs if they charge at nonpeak hours.
- Incentives also could be in form of waiver over card transactions, cashbacks and possibly tax waivers for using electric vehicles and charging of the same.
- This will create employment in IT sector.

End Users

- Fleet Transport can be first component in a process to move to electric transport. With government subsidy for charging as well as infrastructure it can be expanded across country.
- Since 2007, number of private cars in Mumbai have increased by 55%, which in turn means more polluted city. Waiver on road tax while purchasing electric Vehicle can help private car owners switch to e-vehicles and kick start revolution process.
- Ease of switching from fuel cars to e-vehicles is another important factor considered by private owners to switch to e-vehicles. Government incentives play a key role in the same.

Finance

- Finance options need to be made available to end users especially with waivers on taxes like those offered in European countries like Netherlands, Belgium and Norway.
- PSU banks could provide Loans on subsidized rates for electric car buyers on similar lines of Pradhan Mantri Aawas Yojana for home buyers.

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