Verifiable Billing in Electric Vehicle charging infrastructure using blockchain

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Outline:

- An overview of EV charging landscape
- What is the need of solving this problem?
- What is the problem?
- Proposed solution
- Why do you need blockchain for it?
- Our solution
- EV charging infrastructure
- Demo
- Implementation detail
- Future Work
EV charging Landscape

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Electric Boom

Sales of electric vehicles rose 63 percent globally year on year

350K vehicles sold

Source: Bloomberg New Energy Finance
Ionity launches its first ‘ultra-fast’ electric car charging station and makes it free for a limited time

Global Electric Car Sales Jump 63 Percent

Ola Wants a Million Electric Rides on India's Roads by 2021

China made more than half of EV purchases in the third quarter

Bloomberg New Energy Finance expects 1 million sold this year
All electric cars by 2030? Nitin Gadkari inaugurates EV charging points at Niti Aayog

In a bid to go green, the government is targeting the year 2030 by which it plans to go all-electric in terms on new car sales across India. In a step towards its mission, Union Minister Nitin Gadkari inaugurated Electronic Vehicle (EV) charging points today.
In a bid to go green, the government is targeting the year 2030 by which it plans to go all-electric in terms of new car sales in the country.

In its National Electric Mobility Mission Plan, the government hopes to get at least six to seven million electric vehicles on the road by 2020.
Problem
What about the charging infrastructure?

- With the constant rise in the number of electric vehicles, we need a widespread and seamless charging infrastructure which supports seamless charging and billing.
- One of the very prominent problems presently existing with any of the billing systems is lack of transparency, where the service provider can overcharge the customer.
How can blockchain solve the problem?

- Immutability
- Decentralized model
- Non-repudiation
- Public verifiability
- Trusted record-keeping
- Privacy
- Access Control
- Auditability: through proper key-distribution at
  - System level, User level & Contract level
Our Solution
Users

Charging Stations
Charging Stations

Energy Providers
Let's have a Demo
The proposed solution

- A modular charging infrastructure.
- Components:
  - PEVs
  - Users (car users)
  - Smart meters installed on charging poles.
  - Public charging parking spaces
  - Micro-payment transactions
Key Features

- A user can use the charging facility by any provider, seamlessly, without subscribing to any particular provider.
- Fraud at user level is minimized.
- A user cannot be overcharged. If he is overcharged, he has the power of challenging against the seller by the log of transactions.
- Exchange of money and energy between any two parties facilitated with micro-payments.
- Predestined for the coming future of smart cities
- Very limited info is revealed about a user is revealed at the charging station.
Implementation

HYPERLEDGER

COMPOSER

HYPERLEDGER

FABRIC
Key Features:

- **Assets** - Asset definitions enable the exchange of almost anything with monetary value over the network, from whole foods to antique cars to currency futures.

- **Chaincode** - Chaincode execution is partitioned from transaction ordering, limiting the required levels of trust and verification across node types, and optimizing network scalability and performance.

- **Ledger Features** - The immutable, shared ledger encodes the entire transaction history for each channel, and includes SQL-like query capability for efficient auditing and dispute resolution.

- **Privacy through Channels** - Channels enable multi-lateral transactions with the high degrees of privacy and confidentiality required by competing businesses and regulated industries that exchange assets on a common network.

- **Security & Membership Services** - Permissioned membership provides a trusted blockchain network, where participants know that all transactions can be detected and traced by authorized regulators and auditors.

- **Consensus** - a unique approach to consensus enables the flexibility and scalability needed for the enterprise.
Future Work

- The concept of prosumers
- Public and Private parking spaces
- Dynamic tariff
Billing Issues:

- Consumer might be overcharged.
- In the existing systems, one can also not challenge the authority. (not at least in the post-paid model)
Various Components of the Project

1. Authentication of user
2. Micro-payment transactions
3. Push the final transaction on the blockchain

1. Generate the bill for electricity consumption (monthly)
2. Pay the bill to the Infrastructure provider

Fig: The infrastructure provider gives the service provider their share of money.

Fig: Various stages during the implementation
Post-paid Vs Pre-paid

Postpaid
- Ease of payment as the bill comes at the end of month.
- The user need not worry about carrying cards/wallet all the times. He can freely charge at any place without the need of paying instantly.

Prepaid
- Instant payment prevents some possibilities of overcharging the customer.
- The seller can be challenged then and there itself.
EV charging with post-paid and pre-paid model

- **Pre-paid model:**
  - Similar to a Delhi Metro Smart Card. You buy a card, recharge it with money and use wherever and whenever you want.
    - Pros: Anonymity
    - Cons: Keep refilling the card at regular intervals. Need to carry the card/wallet all the time.

- **Post-paid model:**
  - Care-freely charge anywhere anytime you want. You will receive the bill right at your doorsteps at the end of the month.
    - Pros: No need to carry card/wallet all the time. No need to worry about paying instantly.
    - Cons: Possibility of getting overcharged by the seller.
References:

- https://evobsession.com/electric-car-charging-101-types-of-charging-apps-more/
- https://www.zap-map.com/charge-points/
- https://economictimes.indiatimes.com/industry/auto/news/no-licence-needed-for-electric-vehicle-charging-station/articleshow/63777789.cms
- https://www.express.co.uk/life-style/cars/898493/electric-car-sales-global-million
- https://www.bloomberg.com/hyperdrive

Images:

- http://www04.abb.com/global/seitp/seitp202.nsf/e308f3e92d9c8fc5c1257c9f00349c99/19c9d73d5fd7ba42c12578c0002a148b/$FILE/100922+Terra+50_2+in+front+of+restaurant_highres.jpg
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