# EVSE Network Interoperability Standards
## (An Overview)

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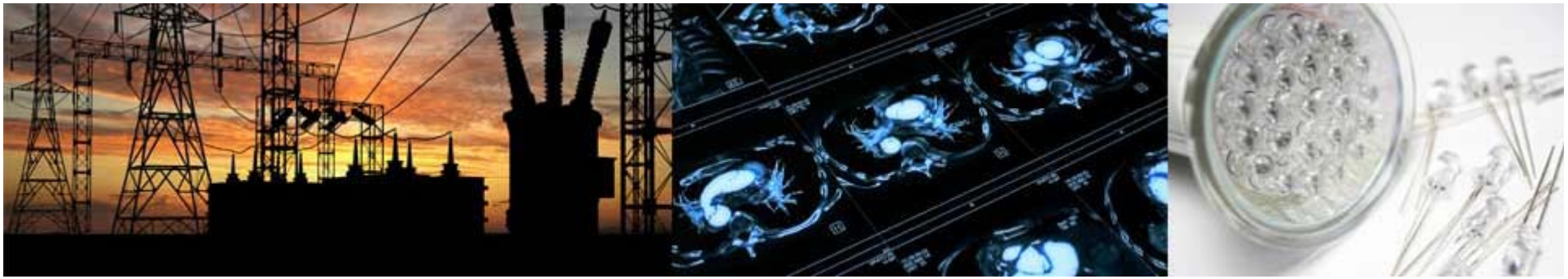
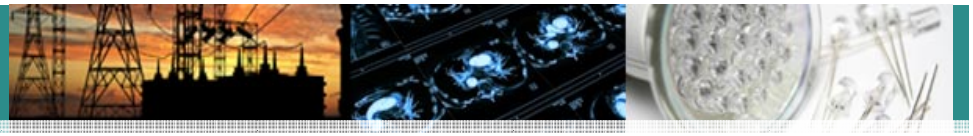
The Association of Electrical and Medical Imaging Equipment Manufacturers





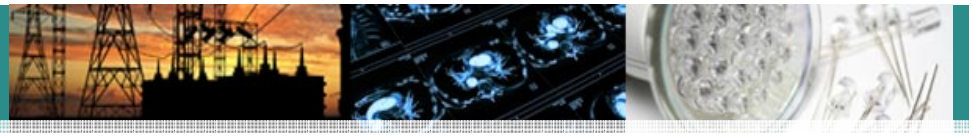
# What is NEMA?

## NEMA – National Electrical Manufacturers Association

- A Trade Association Founded in 1926
- 450 Member Companies Who Manufacture Products in the Generation, Transmission & Distribution, Control, and End-Use of Electricity
- An ANSI Accredited Standards Organization
- Holds over 20 ANSI groups Secretariats managing over 260 ANSI Standards including C12 Electrical Meters, and EVSEs
- Holds over 60 IEC/ISO TAG Secretariats and 6 IEC committee Secretariats
- Heavily invested in the safety of the national infrastructure via participation in NFPA's NEC, UL standards and others.
- Strategic interests in the Smart Grid, Energy Storage and High Performance Buildings codes, standards and regulations

## Other Functions Beyond Standards Development

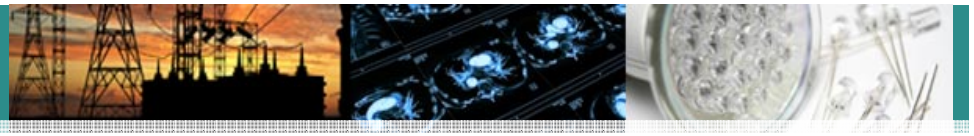
- Industry Advocacy
- Governmental Policy Positions



# What is NEMA?

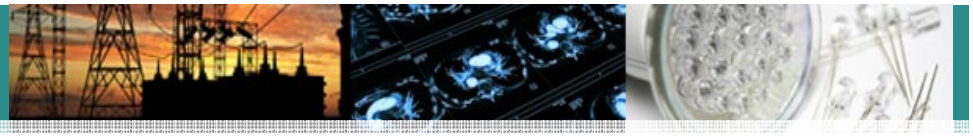
## 5EVSE Section

- Develops Standards for EVSE Components, Systems, and Services
  - EVSE Safety, Wire and Cables
  - EVSE Submeters
  - EV Charging Network Interoperability for Service Roaming
- Directly involved in code & standards developed by others:
  - Tri-national Canada-Mexico-US harmonized EVSE certification standards (ANCE, CSA, and UL)
  - Article 625 on EVSEs rewrite for NEC® 2014
  - ANSI EVSP Standardization Mapping
- Develop EVSE national infrastructure:
  - LEED
  - DOE's Clean Cities
  - ICC codes
  - CPUC- pilot program and EVSE deployment
  - SGIP PAP22 submetering



# A Collaborative EV Infrastructure Industry Activity

- ChargePoint (WG Chair – Dan Lee)
- Car Charging Group / Blink Network
- GE Energy
- Schneider Electric
- Eaton
- Leviton
- Siemens
- ABB
- Greenlots
- Fuji Electric
- … and Growing



# Standards Development Organization Liaisons

- SAE
- eMI3
- ANSI
- IEC/ISO

# Motivation: ANSI EV Standards Panel Identified Standards Gaps

***Gap 1*: Charging of roaming EVs**. There is a need to permit roaming EVs to charge at spots affiliated with a different EVSP.
***Recommendation***: Develop communications standards that support roaming EVs that require charging services from an EVSP other than the EV users Home EVSP.
***Priority***: Near-term.
***Potential Developer***: ~~SAE, ISO/IEC, Zigbee Alliance, OpenSG, NAESB~~, **NEMA**, ~~others?~~

***Gap 2***: **Locating and reserving a public charging station**. There is a need for a standardized communication method to permit EV drivers to locate a public charging spot and reserve its use in advance.
***Recommendation***: Develop a communication and messaging standard to permit EV drivers to universally locate and reserve a public charging spot.
***Priority***: Near-term.
***Potential Developer***: ~~SAE, ISO/IEC, Zigbee Alliance, OpenSG~~, **NEMA**, ~~others?~~

***Gap 3***: **Offline access control at charging stations**. It would be beneficial to standardize offline access control at charging stations where a vehicle or driver may be denied access to charging.
***Recommendation***: Develop communication standards for offline access control at charging stations.
***Priority***: Near-term.
***Potential Developer***: ~~SAE, ISO/IEC, Zigbee Alliance, OpenSG, NAESB~~, **NEMA**, ~~others?~~

# EV Charging

## Residential

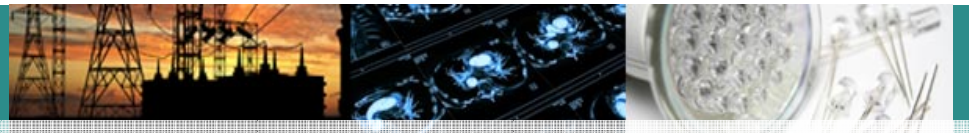
- Single Family Residences
- Apt/Condo Common Space
- Student and Shared Housing
- Friends' Homes

## Workplace

- Work Locations
- Customer Sites
- Universities and Schools
- Fleet Vehicle Depots

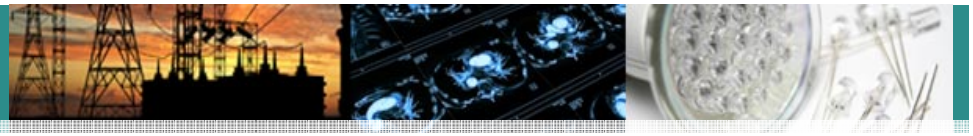
## Public/Commercial

- Stores and Malls
- Inter-State Fueling Stations
- Airports and Hotels
- Downtown Workplaces



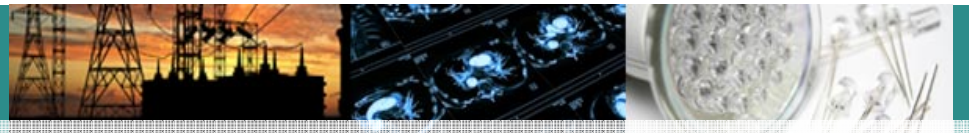
# EV Charging Service Transaction Methods (1/2)

| Transaction Method | Advantages | Disadvantages |
|---|---|---|
| **Cash** | • Universal | • High Cost to Operate EVSE Due to Manual Money Collection<br>• Increased Cost Due to Need for "Hardened" EVSE and/or Service Kiosk (& Need to Provide Change)<br>• Inconvenient to Use from Drivers' Perspectives<br>• Relatively Few EVSEs With Cash Acceptance Capability<br>• No Support for Mobile App Activation Methods |
| **Payment Cards** (Common Credit & Debit) | • Widely Available to General Public<br>• Convenient & Fast | • High Per Transaction Friction Costs and Payment Card Industry Compliance Costs<br>• Unable to Track Other Values Like Carbon Credits and Green House Gas Savings<br>• Difficult to Support New and Evolving EV Charging Plans<br>• No Visibility into Charging Service State or Remote Control Capability |



# EV Charging Service Transaction Methods (2/2)

| Transaction Method | Advantages | Disadvantages |
|---|---|---|
| **EV Charging Network Subscriber Card or Mobile App** (First Generation –Stand alone network) | • Convenient & Fast<br>• Single Bill for Monitoring EV Charging Usage<br>• Track Carbon Credits & Green House Gas Savings<br>• Low Transaction Friction Costs<br>• Visibility and Remote Control of Charging Process<br>• Mobile Phone App Integration<br>• Provide Other Ways To Subsidize Charging Costs (e.g., Loyalty Programs and Ads)<br>• Integrates Well with Workplaces | • Not As Widely Available as Payment Cards<br>• Incompatible - No Common Industry Standard<br>• Lack of Data Interchange and Communication Standards Between EV Charging Networks<br>• Limited to “In-Network” Operation |
| **EV Charging Network Subscriber Card or Mobile App** (Second Generation - NEMA Network Interoperability Standards) | • All of the Advantages of First Generation<br>• Interoperable Across Many EV Charging Networks<br>• Enable New Integrated EV Charging Plans Spanning Multiple EV Charging Networks | • Not Universal Like Cash<br>• Need to Re-Issue New Cards and Upgrade EVSEs<br>• Require Network Inter-Connection Among Providers |



# NEMA Network Interoperability Objectives

- Enable EV Drivers to Receive Service on Any Inter-Connected EV Charging Network
  - Multiple Standardized Activation Methods:  RFID, Mobile App, Web, Support …
  - Standardized Inter-Connection Protocols
- Help Drivers Locate Nearby EVSEs, Determine Their Availability, and Assess Their Service Characteristics
  - Common Data Model for Describing EVSEs
  - Standardize Protocols for Sharing and Accessing Station Directories
- Allow the EV Drivers' "Home Network" to Serve As the Primary Interface When Receiving Service on Foreign Networks
  - Monitoring and Remote Control of EV Charging Sessions
  - Single Bill and Account for Collecting All EV Usage
  - Payment Reconciliation for Services Provided by Foreign EV Charging Networks

# Benefits of NEMA Network Interoperability

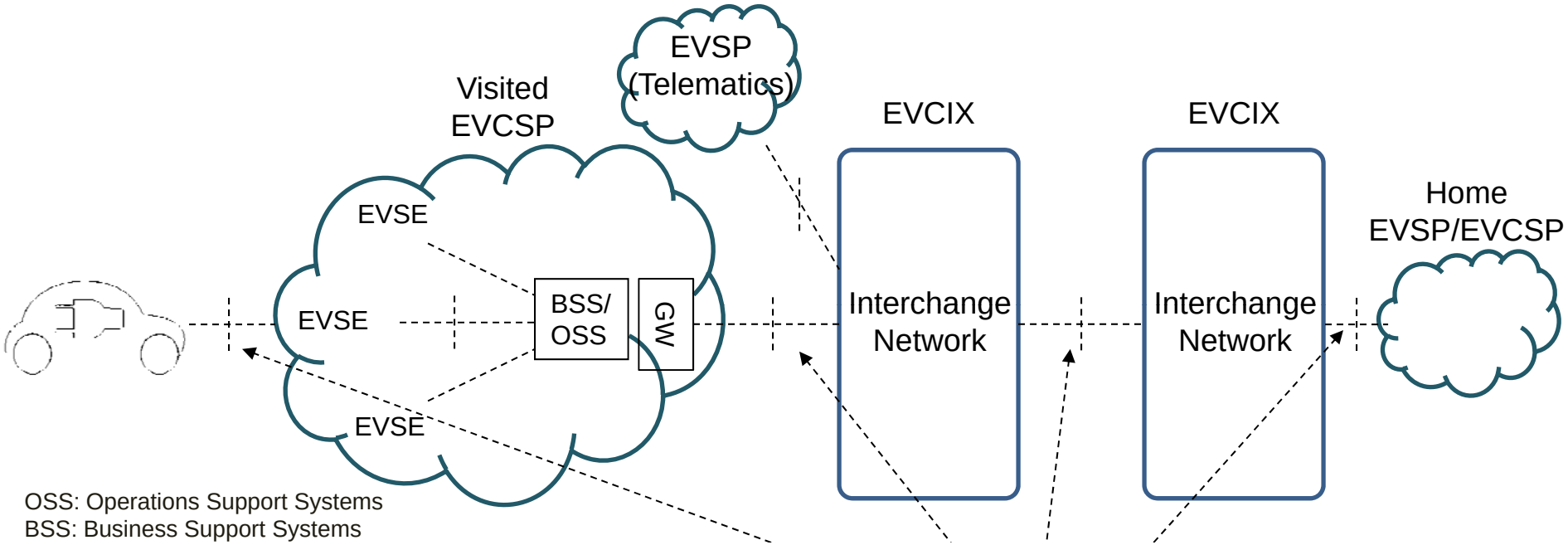
## Benefits to Drivers

- Greater Choice of EV Charging Stations Near Driving Destinations
- Improved Availability and Driving Range for EV Drivers
- More Economical EV Fueling from Product Standardization and "Co-opetition"
- Much Needed Convenience to Drivers
  - Reduced Need to Sign Up for Multiple Charging Service Plans
  - Fewer Service Access Credentials To Be Carried Around
  - Fewer Mobile-Apps and Web-Sites to Visit to Find Available Charging Stations
- Lower Cost Compared to Cash or Payment Cards
- New Service Plans - Single Bill Electricity Service Plans Covering Home, Work, and Public Charging
- Commercial Fleet Management Services
  - Cost and Greenhouse Credit Management

## Benefits to EV CSPs

- Increase Revenue From Your EV Charging Stations
- Drive More Consumers (with Long Shopping Times) to Host Store Locations
- Market an Expanded Service Foot Print to your Drivers and Hosts
- Enable Business Relationships Not Otherwise Possible with a Small Service Foot Print
- Encourage Smaller Businesses to Host EV Charging Services and Leverage "Network Effects"
- Retain Drivers/Subscribers by Providing a Better Driving Experience

# Inter- & Intra- Network Protocols




## Defined by Others

Intra-Network Protocols
- + Internal ICT
  - - OCPP, etc.
  - - Proprietary
  - - etc.
- + Subscriber ICT

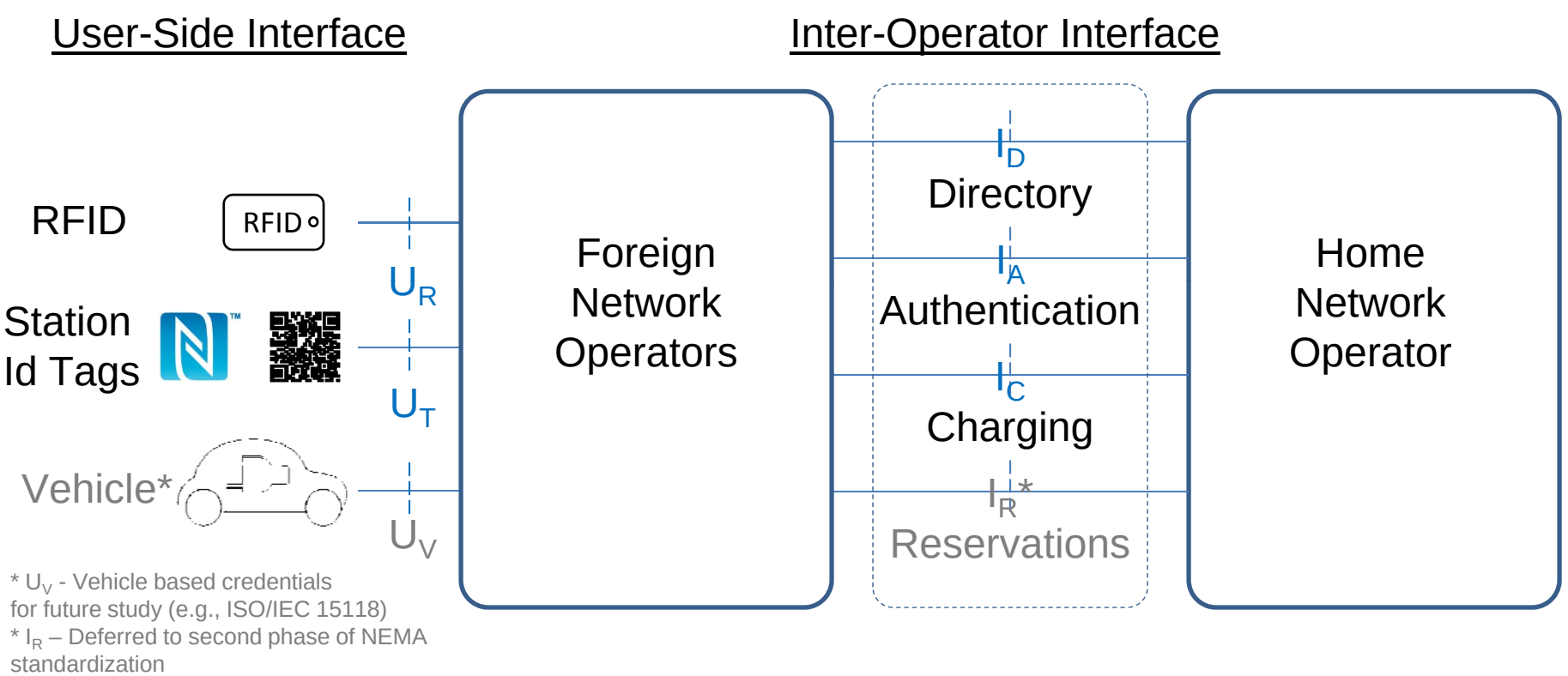
Payment Standards

## Areas of NEMA Standardization

Inter-Network Protocols
- - Directory ($I_D$)
- - Authentication/Authorization ($I_A$)
- - Charging Session ($I_C$)
- - Reservations ($I_R$)

Compatible Driver-Side Interfaces
- - RFID ($U_R$)
- - Station Identification Tags ($U_T$)

# Interface Standardization Reference Points

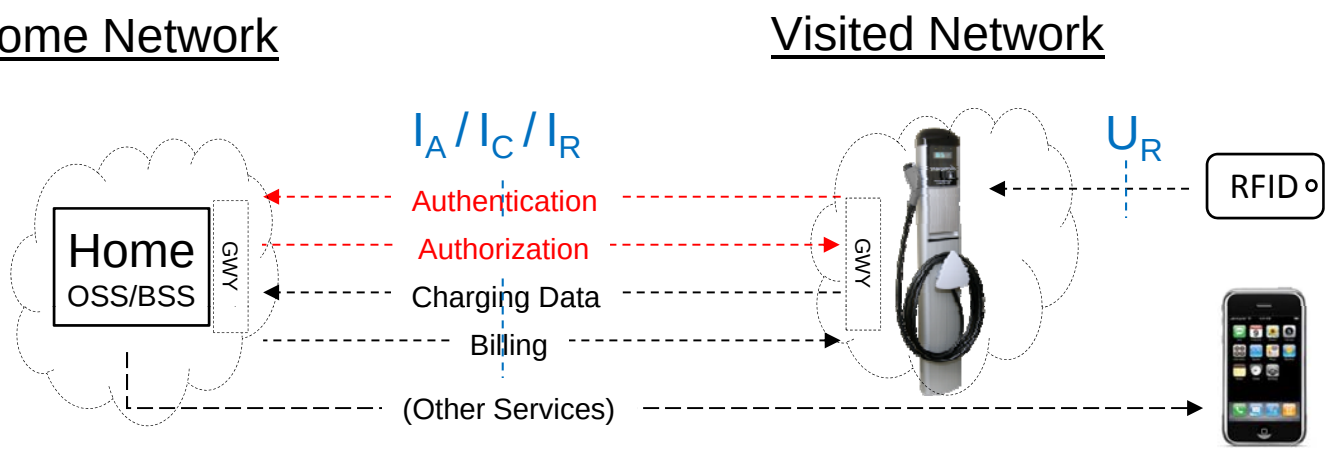



* $U_V$ - Vehicle based credentials for future study (e.g., ISO/IEC 15118)
* $I_R$ – Deferred to second phase of NEMA standardization

- Station Directory ($I_D$) Provides an Integrated View of Stations on Participating Networks Along with Real-Time Status
- Common Station Station Identification($U_T$), Subscriber RFID Credentials ($U_R$), and Authentication Protocols ($I_A$) Enable Service Activation Across Any Network
- Roaming Service with Charging Status and Billing Data Across Networks ($I_C$)

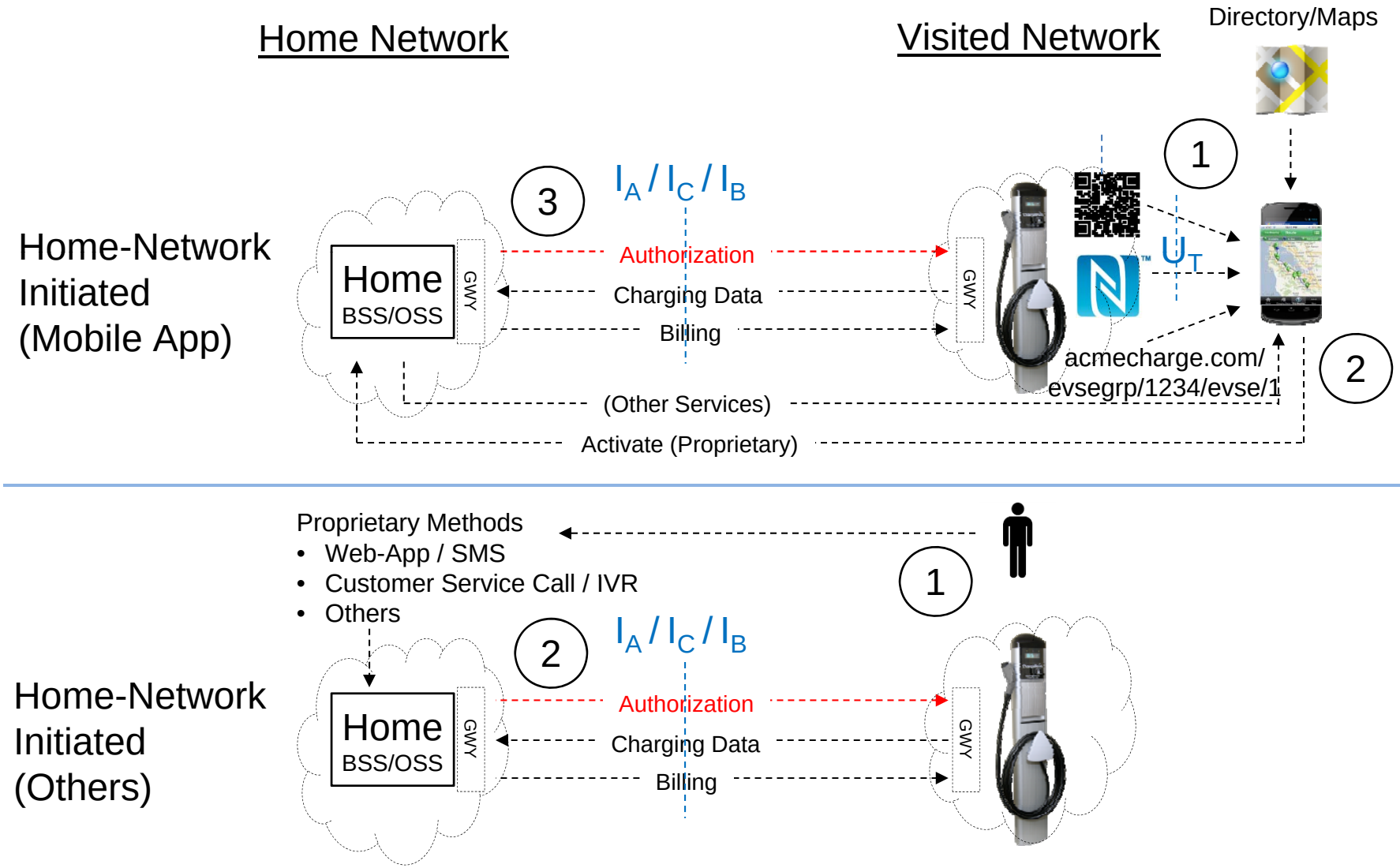
# EV Driver Roaming Use Cases (1/2)

RFID Credentials

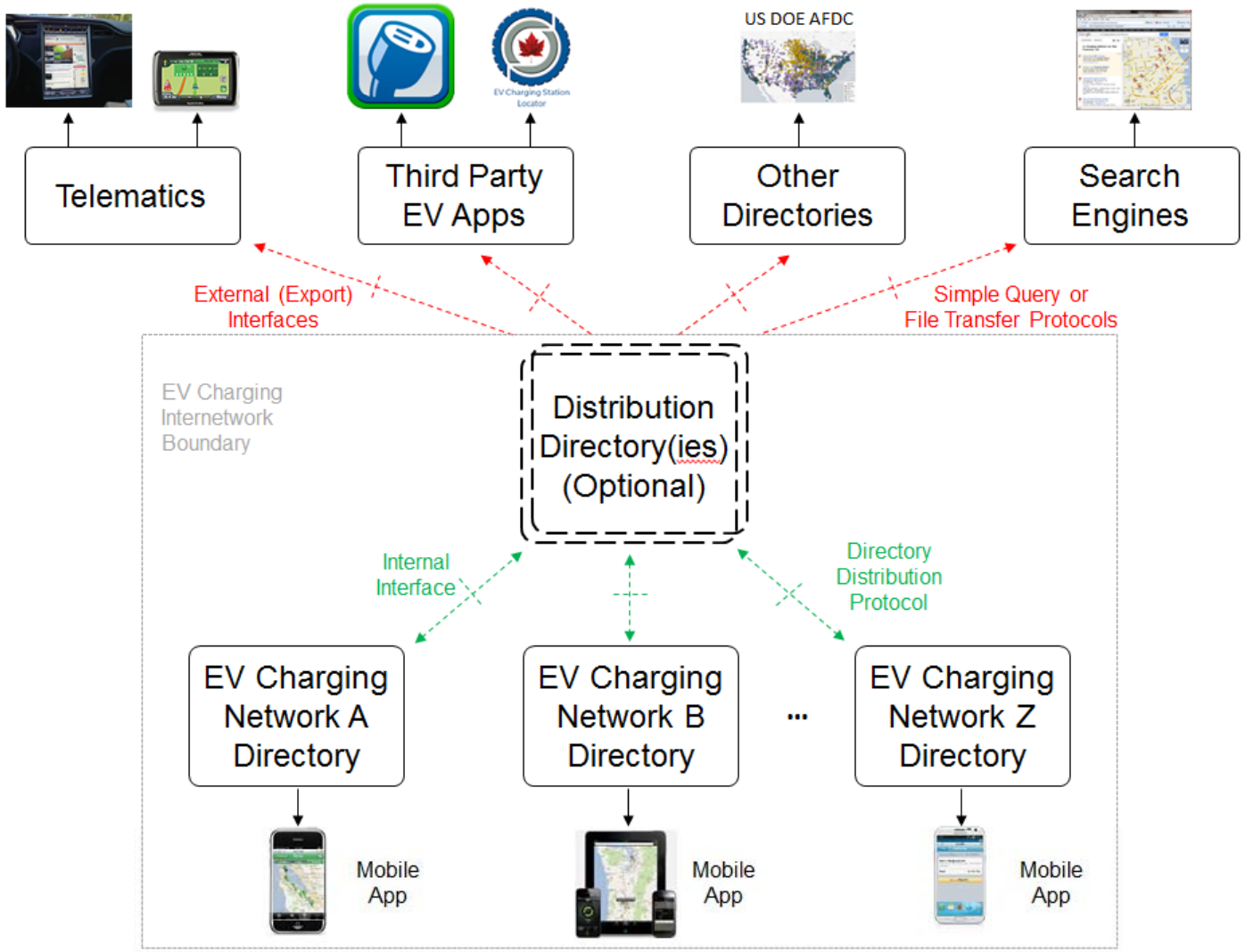


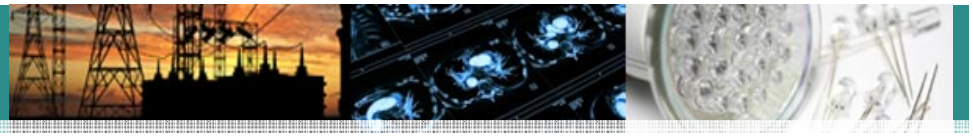

- Supports Subscription Based Service Plans or Per Session Transactions
  - Simple & Fast Service Activation
  - Low Transaction Overhead
- Enables Supplementary Services
  - Charging Status Notifications (EV Charging Done/Interrupted)
  - Usage Data and Receipts
  - Other Value Added Services May Help Subsidize Charging Costs

# EV Driver Roaming Use Cases (2/2)



# Station Directory ($I_D$) Model

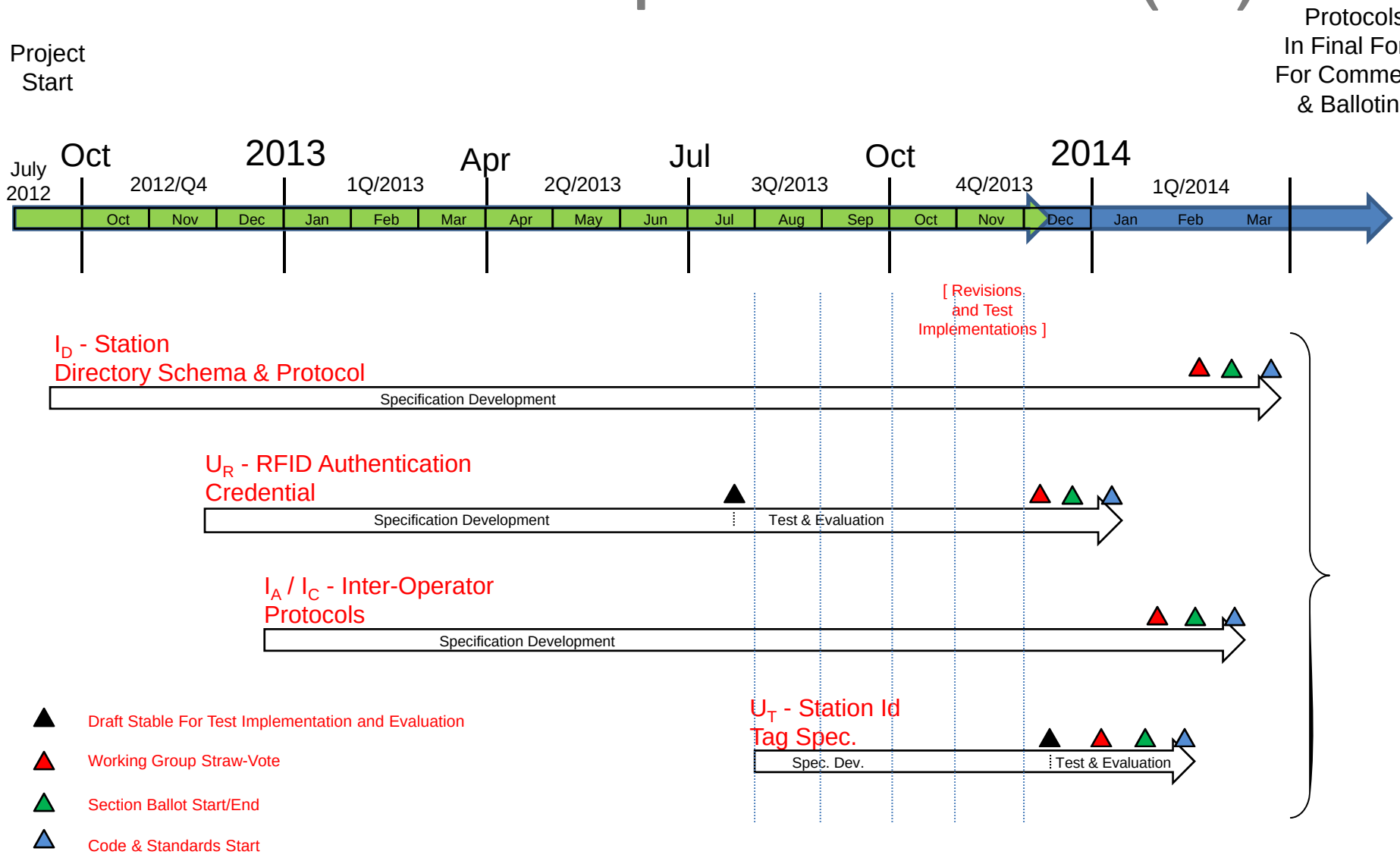




# Station Directory Data Schema & Protocol ($I_D$)

- Standardize Data Model & Exchange Protocol, But Not Presentation of Data
  - Each EVCSP To Differentiate Its User (Mobile) Apps
- Give Consumers Information To Choose According to Their Needs
  - Proximity & Real-time Availability of Charging Service
    - Location and Site Picture Information
    - Potential for Electricity Delivery Curtailments
  - Type of Charging Service
    - Number of Ports / Per-Port Charging Level Types / Total Power Delivery Capability
    - Parking Characteristics (with Possibility of Conveying Parking Sensor State Information)
  - Price of Service
    - Time-Based Parking Fees / Electricity Usage Fees / Session Fees
    - Payment Types (Network-Specific Credentials, Payment Cards, Cash, etc.)
- Give Charging Stations Operators/Owners Flexibility To Design Their Service Offering
  - Allow Hosts/Owners to Respond to Different Market Conditions

# Standards Development Timeline (v5)



# Summary

## Critical Issues Affecting EV Usability

- Difficult to Locate Charging Stations Across Various EV Charging Service Providers
- Inconsistent and Incompatible Credentials and Activation Methods Prevents Drivers from Using Available EV Chargers
- Disparate and Non-Interoperable Charging Service Networks Prevent Drivers from Using Their Existing Charging Service Plans

## Approach

- Create a Common Data Schema and Protocol to Enable Sharing EVSE Attributes, Location, and Status Between Networks
- Define Standard Credentials and Service Activation Protocols To Enable Roaming and Receiving Charging Service On Any Standards Compliant Network
- Develop Communication Protocol Standards to Enable Authentication/Authorization, Conveyance of Charging Status, and Reconciliation of Customer Transactions

## Proposed Solution

- ISO14443a/b RFID Credentials with ISO7816-4/8 APDU Messaging Layer
- Common EVSE Identification and Naming
- Charging Service Interworking Via Gateways to Adapt Internal Networks to a NEMA-Defined Internetwork Protocol
- Peer-to-Peer or Clearinghouse Connectivity
- HTTPS SOAP Based Protocol for Directory Data Sharing, Authentication/Authorization, Charging Status, and Billing Reconciliation
- XML Data Schemas and WSDL Specifications

## Collaborative Effort Among Many EV Industry Stakeholders

- National Standards Development Organizations (NEMA & ANSI) Promoting Comprehensive National Solutions
- EVSE Manufacturers Building Compatible Equipment
- EV Charging Service Providers Interworking Their Networks to Enable Interoperable Charging Services Nationwide
- Local, State and National Governmental Input