802.1 Time Sensitive Networking (TSN)

Overview of IEEE 802 opportunities in
AFV (EV and H$_2$V) Fueling*

Craig Rodine

Renewable and Distributed Systems Integration

Sandia National Laboratories
Albuquerque, NM, USA

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*** Alternative Fuel Vehicle**

Agenda

- ## Summary of 802.24 discussion (began Sept 2022)
  - Survey of opportunities for IEEE 802
  - Example use cases for EV charging (depot, parking)
  - A brief look at Hydrogen Surface Vehicle fueling
- ## IEEE 802.1 and 802.3 opportunities
- ## Concrete, near-term ETH opportunity
- ## Potential relevance of TSN
- ## Discussion and next steps

802.24: Opportunity for IEEE 802 vertical application

- Explore a 'Secure L2 EV charging comms fabric'
  - Develop LAN architecture supporting site-level (depot, public fueling) operations
  - Towards a secure, cohesive, extensible '*AFV fueling edge*'
  - Draw on existing and emerging 802.1/.3/.11 standards

- Explore how 802 services for e.g. TSN, location, and privacy could enhance site operations and systems integration

- Example next-generation (esp. fleet) AFV charging uses cases
  - Site-level comms fabric under 802.1 security and management framework
  - Wi-Fi for charging, transactions, robotics, Autonomous Vehicle (AV) control
  - SPE for control and management of high-power EV charging, integrating building/site DERs and the electrical utility edge
  - TSN features (e.g. time synchronization) for power systems controls
  - VLANs for security, QOS of high-data-volume applications, e.g. GIS data, route and schedule optimization, media services, trusted SW updates for vehicle ECU/DCU
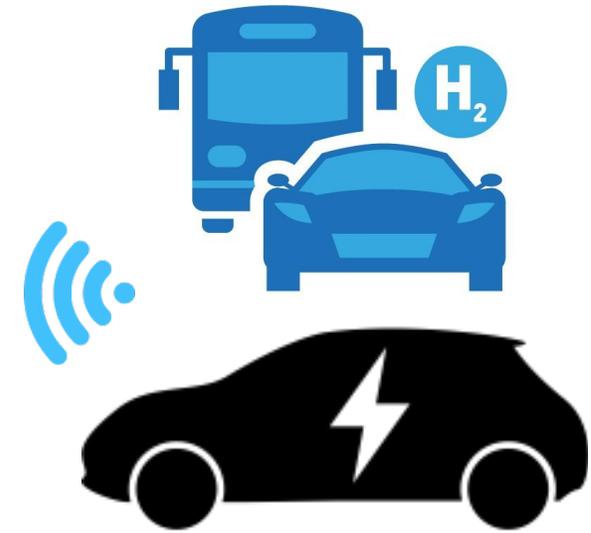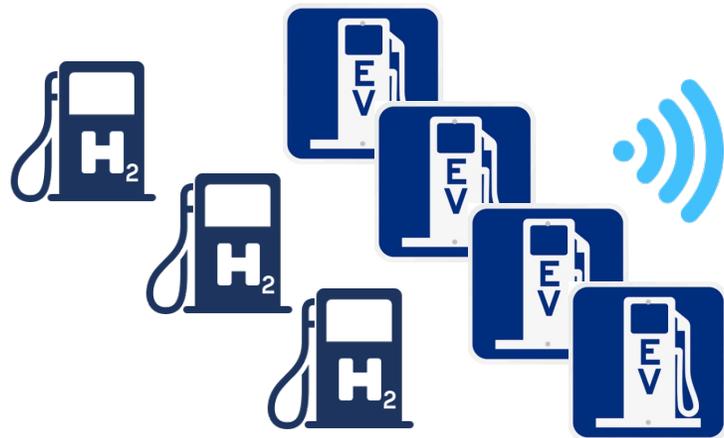
"Anchor" near-term use case #1

Use Wi-Fi® for large-scale EV (AC) charging

- 800 parking spots, 400 AC charging stations (6.6 kW)

- Medium/long dwell (4-10 hour) charging

- Obvious opportunities

  – Replace PLC (L1/L2)

  – Managed charging

  – Data (logistics & tracking)

  – EV (ECU) maintenance

"Anchor" near-term use case #2

Use Wi-Fi for "over-the-top" transaction services

- EV joins site Wi-Fi network, negotiates fueling service parameters
- On-site edge (+cloud) services platform directs AFV to fueling bay
- Coupling to fueling device could be robotic, controlled via Wi-Fi
- Fueling control could be via Wi-Fi as well

A brief look at H_2 (HSV) fueling

- Current system uses IrDA standards for one-way communication
  - SAE J2799/J2600/J2601
  - Vehicle sends fixed fueling parameters (V, T, p)
  - Dispenser performs accordingly ("parameter-driven")
  - Overly large margins for physical and functional safety
  - Doesn't support higher fill rates, tank temp ranges
  - IrDA not very reliable (sunlight, fogging); easily damaged
- Opening for standards-based w/less comms
  - 2-way: tank characteristics; pre-cooling; dynamic control
  - Needed for higher-speed fueling (larger tank HSVs)
  - EU Project Prhyde -> ISO 19885-2/-3 (TC 297)
  - Contemplating transactional services (e.g. payment, loyalty points) and fleet management (fueling logs, maintenance)
  - Developing requirements for trust and security (PKI)
  - Interested in using Secure Layer 2 (802.1/802.11)
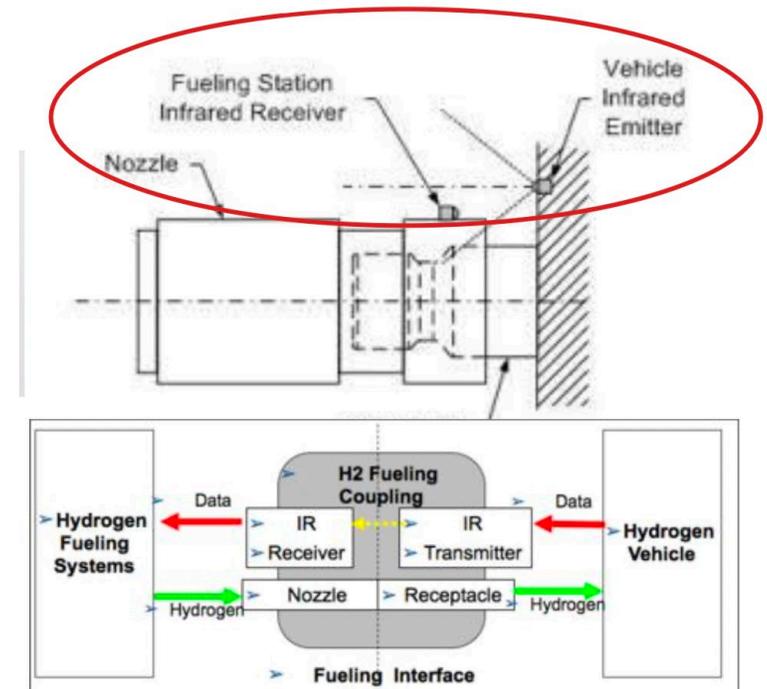
802.1/.3 opportunities

- How could 802.1 and 802.3 standards support AFV fueling?
  - Convergence/concentration of energy & data for transportation
  - Support for fueling, power/energy distribution, logistics, operations
  - Sites/locale: depots, 'truck stops', public transport hubs (LAN/MAN)
- Architecture
  - Distributed energy, computing, control
  - Coordinated security contexts
    - Fueling: vehicle, dispenser, energy sources and sinks; safety-critical?
    - Data: public/private, site/region, cooperating entities; trust domains
  - Orchestration of workloads between edge/cloud
- Applications:
  - SPE in EV charging cables/couplers, for sensors (situational awareness)
  - Power system controls (e.g. protection, UPS, load management)
  - Data services (Internet/media, goods tracking, mobility services)
- Inspiration: 802 Nendica Reports (Flex Factory IOT, Intelligent LDCN)
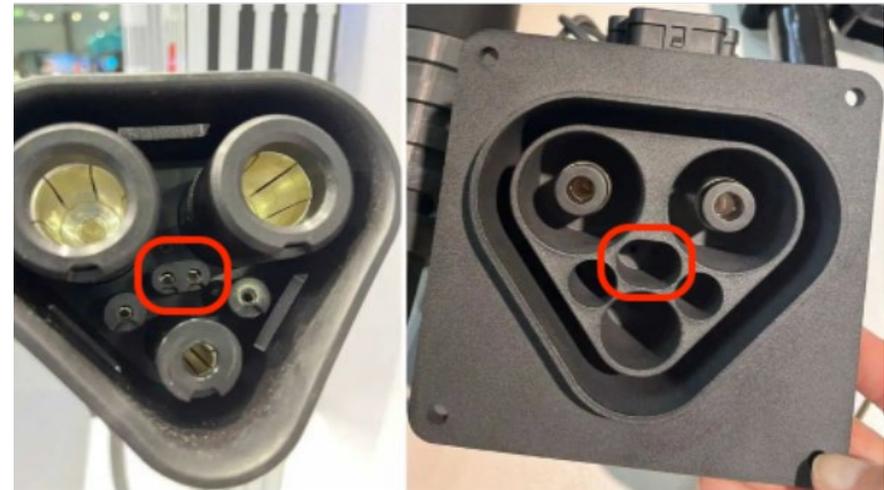
Concrete, near-term use case

- Use 802.3 (SPE) for control and management of high-power EV charging systems
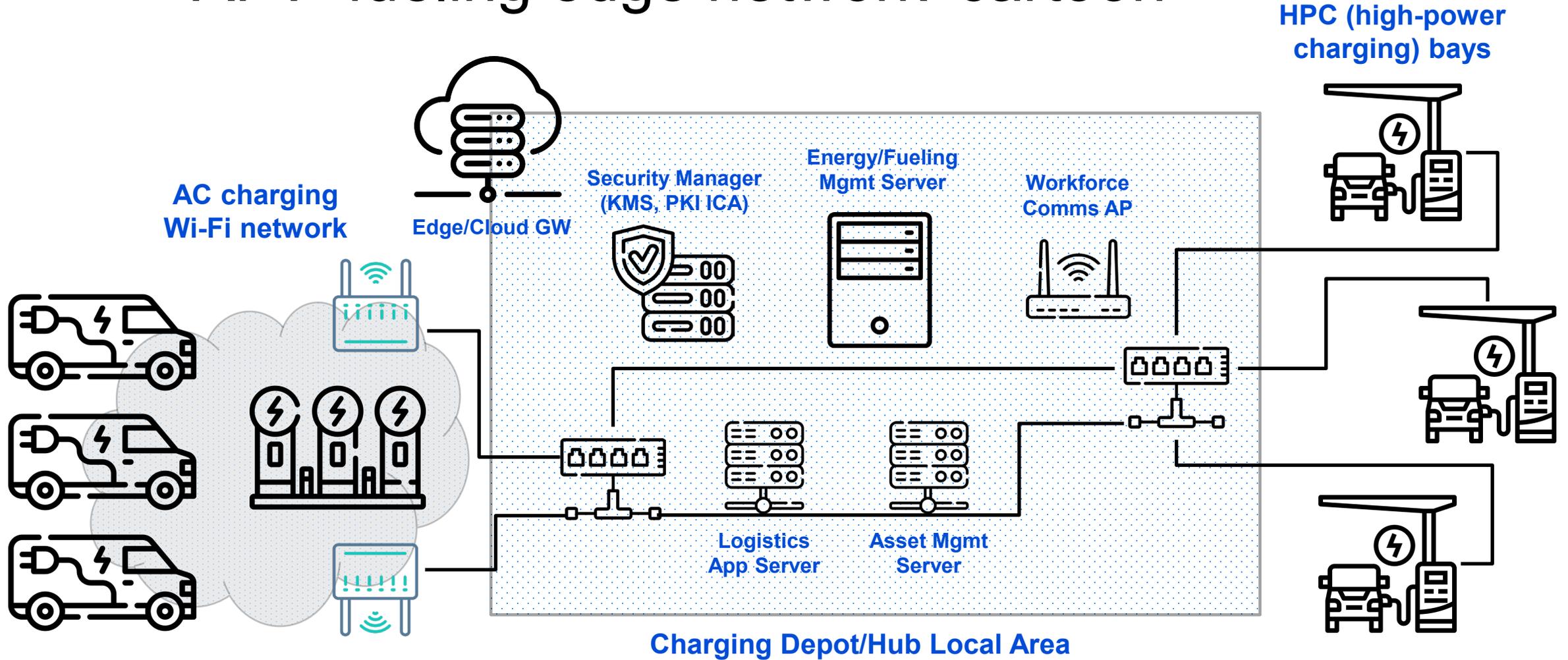
CHAdeMO 3.0 aka ChaoJi   **Megawatt Charging System (MCS)**

- Both couplers have 2x pins with ~8mm spacing for comms
- CHAdeMO/ChaoJi are now testing "Two-wire Ethernet" over these pins
- MCS group is exploring alternatives to BPLC (CAN bus, 10Base-T1S)
- ISO 15118-10 launched (req'ts for Ethernet PHY/MAC for EV charging)

AFV 'fueling edge network' cartoon

Potential relevance of TSN for AFV Fueling

- Critical transportation hubs must be robust and reliable
  - In normal and emergency operational conditions
  - Applies to charging, cybersecurity, data services
- Time Synchronization for power system control
  - Protection (AC: "sub-cycle" reaction times)
  - Coordination of distributed (local) sources and sinks
  - Next-gen switchgear; integration with utility grid

Discussion, next steps

- Ask: 802.1 & 802.3 work with 802.24 on AFV Fueling Vertical Opportunity

- Ask: 802 reach out to CHAdeMO Association and ISO (TC22, SC37, JWG1): ETH use in EV cables/couplers

- Discussion

Discussion, next steps

Thank you very much!

c.rodine@ieee.org

crrodin@sandia.gov