**IEEE P802.24**

**Vertical Applications Technical Advisory Group**

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| Project | IEEE P802.24 Vertical Applications Technical Advisory Group |
| Title | **Proposed an extended outline for adding use cases of ‘Integrated Charging Infrastructure with Distributed Energy Resources, Building and Grid-Level Energy Management Systems’** **in Clause 3 of the AFV draft outline (Doc. 24-24-0025-00-0000)** |
| Date Submitted | 2024-10-28 |
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| Re: | Additional content  |
| Abstract | This contribution proposes an extended outline for adding use cases of ‘Integrated Charging Infrastructure with Distributed Energy Resources, Building and Grid-Level Energy Management Systems’ in Clause 3 of the IEEE 802.24 AFV White Paper revised outline (Doc. 24-24-0025-00-0000). Based on the discussions, the text will be developed for inclusion as new sub-Clauses within Clause 3 of the AFV draft (Doc. 24-23-0007-06-0000).  |
| Of Purpose | To be added as Clause 3.f, 3.g, and 3.h of the AFV draft outline (Doc. 24-24-0025-00-0000-afv-whitepaper-revised-outline).  |
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IEEE 802.24 AFV WP
revised (final) outline

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1. Introduction
	1. Problem statement: AFV fueling protocols don’t use mainstream networking Layer 2 standards and technologies. Consequently, they are not as economical, secure, performant, or extensible as they could/should be.
	2. This whitepaper describes how IEEE 802 LAN/MAN standards and technologies are being introduced to extend and enhance the communications capabilities, and could be used to enhance the security, of AFV charging infrastructure.
2. A brief overview of current AFV fueling infrastructure communications and security at networking stack Layer 2.
	1. Electric Vehicle (EV) charging:
		1. AC charging control is done with analog control (1 KHz PWM baseband), there is no ISO-layered protocol stack.
		2. Some DC charging uses conventional automotive CAN bus. (CN, JP)
		3. Some DC charging uses PowerLine Carrier at Layer 1 and Ethernet at Layer 2 [per HomePlug Green PHY specification, peer-to-peer link]. (EU, KR, NA)
* TCP/IP is used at Layers 3-4 with compressed XML as payload (Layers 5-7)
* TLS (v1.2) is used to protect messaging in some charging sessions, not all.
* New standard requires mTLS (v1.3) but supports fallback to TCP/IP w/o TLS.
	1. Hydrogen Surface Vehicle (HSV) fueling:
		1. Currently, IrDA protocols are used by the vehicle only to indicate HSV fueling tank type (one-way, static info) per SAE J2799-2024.
		2. Weak physical security (easily thwarted), no data security.
		3. Next-generation HSV fueling protocols are being explored in ISO TC197.
	2. Conclusions:
		1. Almost all AFV fueling sessions use old, stale, not secure communications standards and technologies at the point of delivery (dispenser 🡨🡪vehicle).
		2. Security is almost exclusively physical; where digital security is required for EV charging, it currently relies on deprecated standards and often fails.
		3. There is plenty of room for improvement!
1. Use cases for IEEE 802 LAN/MAN standards in AFV fueling infrastructures.
	1. EV charging: depot and public charging sites – passenger/delivery EV charging.
		1. Wireless LAN (802.11, p2p) for robotic control of conductive coupler.
* Revise to use more recent 802.11 version/features, better architecture?
	+ 1. Wireless LAN (802.11, 802.15) for controlling inductive charging.
* Could replace current, proprietary communications methods.
	+ 1. Wireless LAN (802.11, 802.15) connecting EVSE/dispensers with site- or cloud-based energy/charging services management systems.
* Could support asset management, optimize energy use, enhance service delivery and fleet logistics.
* LAN configuration sketched in OPCC V2.x (Local Gateway, Local Proxy) but no technical specification or requirements [check draft OCPP 2.1]
	+ 1. Wireless LAN (802.11, 802.15) for valet parking/charging service
* Use Next-Gen V2X communications (802.11bd) to connect EV to site-based auto-pilot server, direct EV to available and suitable EVSE
* On a separate WLAN or a VLAN on a multi-service WLAN (e.g. supporting use case 3.a.iii).
	1. EV charging: depot and public charging sites – Medium/Heavy Duty EV charging.
		1. L1-2 standard for the Megawatt Charging System (MCS)
* Replace HomePlug GP at Layer 1-2 with SPE (IEEE 802.3cg, 10BASE-T1S)
* Being standardized by ISO TC22/JWG1/WG4 as ISO/IEC 15118-10.
	+ 1. Site wired/wireless LAN connecting EV charging, DER, microgrid controllers.
* Supports next-gen EV charging energy resiliency requirements.
* Opportunity to use 802.1X and 802.1AE for industrial-strength security.
* Analogous to IEEE 802.1/IEC 60802 approach to evolving IACS comms.
	1. EV charging: integrated into Home and Building Energy Management Systems
		1. Opportunity for HEMS and BEMS systems to manage EV charging/BPT.
* EV charging is a new load category, growing in significance and impact.
* Potential for optimizing energy use via inter-device (source, load) micro-negotiations.
	+ 1. Potential for EVs to provide energy services to homes, building sites, and property portfolios.
* Back-up energy during outages, replacing petrol/diesel fueled generators.
* Energy shifting/flexibility (e.g. responding to dynamic utility energy pricing).
* Participation in utility Demand Response programs (e.g using predictive analytics for aggregated loads).
	1. EV charging: Wireless Battery Management System
* Potential for IEEE 802.15.4 to replace proprietary wireless comms for EV battery module/pack management
	1. HSV fueling: dynamic two-way communications between vehicle and dispenser.
* Potential for IEEE 802.11 or 802.15 to replace IrDA standards
* Advantages in performance, security, functionality and performance, cost, supply chain, etc.
	1. EV charging: integrated into Distributed Energy Resources Management System
* Potential for IEEE 80211 or 802.15 to replace proprietary wireless comms for optimizing energy use EV by integrating with Distributed Energy Resources Management Systems
	1. EV charging: integrated into Building Energy Management Systems
* Potential for IEEE 80211 or 802.15 to replace proprietary wireless comms for optimizing energy use EV by integrating with Building Energy Management Systems
	1. EV charging: integrated into Grid-Level Energy Management Systems
* Potential for IEEE 80211 or 802.15 to replace proprietary wireless comms for optimizing energy use EV by integrating with Grid-Level Energy Management Systems
1. IEEE 802 network and system considerations
	1. Medium flexibility and extensibility
		1. Support for wired and wireless endpoints
* E.g. IEEE 802.3 and IEEE 802.11 stations in controllers, actuators
* MAC (Layer 2): common architecture, addressing, bridging, VLANs, etc.
* WSNs (IEEE 802.15) less integrated but might be applicable
	1. IEEE 802.15 for sensors and IoT
* IEEE 802.24 IoT Whitepaper?
	1. Network security and management (802.1)
* Benefits from mainstream IT industry tools, techniques, insights, support
* YANG models, netconf
* “Belt and suspenders” approach: 802.1X+802.1AE (MACSEC) provides link security for any/all upper-layer protocols
* Being applied in other domains (IACS; aviation; automotive?; IoT?)
* Framework for EV charging/energy-edge domain-specific Layer 2 profiles
	1. Extensibility/innovation of standards and technologies
* Example: auto industry driving SPE for 10Mbps-10Gbps, copper and fiber
* Example: MAC address randomization (802.11bh) for enhanced privacy
* Example: IEC 60802 profile of TSN for IACS
1. Performance requirements
	1. A table of message length and duration per use case / link / network segment.
	2. Summary: 10-100-1000 Mbps will largely suffice in the near term.
2. Supply chain and ecosystem considerations
	1. AFV industry needs would probably be met by high-mix low-yield suppliers
	2. We’re in the early days of radio (horizontal integration is just beginning)
3. Conclusion