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EPIC 5 CurrentWays proposals

EPIC 5 Research Concept Proposal 1
Title: Software Stack Implementation for Grid-Interactive OBCs (CWUBIC-V2G)
EPIC 5 Research Concept Proposal 2
Title: Low-Cost DC Fast Charger with Parallel OBC Integration and Bidirectional Communication Stack

Additional submitted attachment is included below.

EPIC 5 Research Concept Proposal 1

Title: Software Stack Implementation for Grid-Interactive OBCs (CWUBIC-V2G)

1. Contact Information

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2. Organization or Affiliation

Current Ways, Inc.

3. Brief Concept Description

This project proposes a software-focused extension of Current Ways' high-power onboard charger (CWUBIC) to enable full grid interoperability via bidirectional power flow, using industry-standard protocols and California-specific grid requirements. The project will:
- Upgrade CWUBIC's smart controller with DIN SPEC 70121 and IEC 15118 stacks for V2G handshake and encrypted communication.
- Integrate UL 1741-SA certification and CA Rule 21 grid interconnection requirements at the software level.
- Validate secure firmware stacks in simulated and real grid events using utility-provided test environments.

This work is critical to transition CWUBIC from being just V2G-capable in hardware to being fully deployable on the California grid, with verified, standards-compliant behavior.

4. How It Advances Technology (SB 96)

While the previous CWUBIC project focused on hardware development and low-rate initial production (LRIP), this project targets the key remaining barrier to real-world deployment: grid interconnection compliance and secure bidirectional communication.

Key barriers addressed:
- Absence of validated protocol stack in most EV on-board chargers for grid interoperability.
- Lack of modular, drop-in firmware architecture for Rule 21 compliance.
- Grid operators' inability to trust EVs as DERs without predictable behavior under grid commands.

This project fills that protocol and compliance gap, providing:
- Secure, low-latency software handshake (<2s)
- Firmware support for Plug & Charge, scheduled discharge, and grid ride-through behavior
- Demonstration of DER capabilities across 3 different EVSE/grid conditions

Target end-users: automotive OEMs, DER aggregators, utilities

5. Anticipated Outcomes

- Validated CWUBIC firmware image meeting UL 1741-SA, CA Rule 21, DIN SPEC 70121, and IEC 15118
- Demonstration of controlled bidirectional power flow and revenue-grade data logging
- Interoperability with at least 3 EVSE brands and 2 grid-in-the-loop simulation platforms
- Deployment-ready OBC software for V2G programs (PG&E ELRP, SCE DR, SDG&E VGI)

Ratepayer Benefits:
- Increased participation in grid services (lower peak load, higher renewable use)
- Enhanced grid reliability and flexibility from EVs-as-DERs
- Lower total cost of ownership for EV users with demand response/V2G revenue

6. Evaluation Metrics

- Time-to-V2G handshake success rate
- Interoperability test matrix pass rate (% across multiple EVSEs)
- Successful grid event simulation response compliance (load shed, frequency ride-through)
- Firmware validation coverage (unit and integration tests)
- Utility pilot participation and feedback

7. Supporting References

- CA Rule 21 guidelines
- IEEE 2030.5, IEC 61850 interoperability studies
- Existing CEC-funded hardware development under GFO-21-304
- CharIN certification path for ISO 15118

8. Strategic Goal Alignment

a. Transportation Electrification – Enables bidirectional EVs to become active grid participants, beyond just charge-only roles.

b. DER Integration – CWUBIC acts as a mobile DER, supporting grid balancing, frequency response, and backup power.

d. Net-Zero Emissions – Empowers better use of solar and renewable surplus via controlled EV charging/discharging.

e. Climate Adaptation – Adds resiliency via V2H/V2B capabilities during outages and grid instability.

EPIC 5 Research Concept Proposal 2

Title: **Low-Cost DC Fast Charger with Parallel OBC Integration and Bidirectional Communication Stack**

1. Contact Information

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2. Organization or Affiliation

Current Ways, Inc.

3. Brief Concept Description

This project proposes the development and demonstration of a DC fast charging system with integrated, parallel On-Board Chargers (OBCs) capable of providing high-current DC output using modular AC-to-DC building blocks. Key components include:

- Electro-mechanical demonstration of parallelized OBCs for AC-to-DC conversion, enabling scalable, cost-effective DC fast charging
- Implementation of IEC 15118 (transmit side) to support secure, high-level communication from charger to vehicle
- Integration of DIN SPEC 70121 (transmit side) to ensure interoperability with existing EVs and support fast DC charging sessions

This modular charger concept enables DC fast charging capabilities without requiring centralized, high-cost rectification hardware, reducing infrastructure barriers while aligning with open communication standards.

4. How It Advances Technology (SB 96)

This project addresses technical and market barriers in EVSE scalability, cost, and interoperability, including:
- High cost and limited modularity of traditional DC fast chargers
- Lack of interoperability due to nonstandard or proprietary communication stacks
- Incompatibility with next-generation bidirectional EVs

By using parallel OBCs in an electro-mechanical configuration to build DC output from modular AC feeds, the charger becomes:
- More cost-effective, especially for rural or commercial applications
- Highly maintainable, as modules can be added or replaced independently
- Capable of V2G-compatible communication via 15118 and 70121 transmit functionality

Cost/performance targets:
- Target charger cost < $0.12/W installed
- Interoperability across ≥90% of EVs with ISO 15118
- Communication initiation time < 2 seconds

End users: Site hosts, utilities, fleet operators, distributed infrastructure installers

5. Anticipated Outcomes

- Demonstration unit of a modular, scalable DC fast charger using parallel OBCs
- Validated 15118 and 70121 transmit stack supporting Plug & Charge, secure session start
- Field-tested communication with at least 3 vehicle models
- Lower installed cost and increased deployment speed in underserved areas

Ratepayer Benefits:
- Reduces infrastructure costs, especially in multifamily, rural, and commercial fleet settings
- Improves charging access and reliability, especially in disadvantaged communities
- Aligns with grid-friendly charging protocols, preparing the foundation for V2G from charger side

6. Evaluation Metrics

- Successful DC charging session initiation rate
- Communication stack compliance test results
- Number of vehicles tested successfully
- Field uptime of modular OBC array
- Cost and installation time benchmarking

7. Supporting References

- Modular power electronics studies (NREL, IEEE)
- DIN SPEC 70121 and IEC 15118 stack integration guides
- EPIC reports on distributed EVSE deployment
- Comparative cost breakdown of centralized vs modular chargers

8. Strategic Goal Alignment

a. Transportation Electrification – Supports high-power EV adoption by reducing infrastructure costs and enabling plug-and-play DC fast charging.

b. DER Integration – Charger system is capable of supporting bi-directional interactions with DERs or managed grid charging.

e. Climate Adaptation – More distributed and modular charging hardware improves resilience during grid emergencies and enables flexible deployment.