## 1. Name and contact information

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## 2. Descriptive (under ten-word) project title

Development of a Total Cooperative Adaptive Cruise Control (TCACC)

## 3. Location of project:

Implementation along Interstate highways I-880, I-580 and I-680, from/to Port of Oakland throughout the central valley.

## 4. Concise two paragraph executive summary of project.

We propose is to develop a **Total Cooperative Adaptive Cruise Control (TCACC)** system to enable trucks to cooperate not only with each other, but also with surrounding traffic conditions and environment. TCACC is conceptualized to address issues in commercial vehicle mobility, emissions and fuel economy over all operating conditions and environments, up to and including congested and arterial travel, where significant energy is consumed by truck braking and stop-and-go activity. TCACC will operate in different modes, including Adaptive Cruise Control (ACC) mode, CACC mode or full platoon operation, with safe operation taken as a very serious constraint. TCACC in its initial forms is therefore a safe partial automation solution, transcending but still building upon previous work within the California PATH program, which makes TCACC more than an idea; the innovation is that there is a solid foundation, a solid set of objectives and a true consideration of safe commercial vehicle operation. The TCACC offers an attractive, innovative concept to integrate existing ACC technologies with Vehicle to Vehicle (V2V) and Vehicle to Infrastructure (V2I) technologies to form a system that will be cost effective, and practical to implement.

We propose to implement the TCACC system using a fleet of 15-20 vehicles and conduct field operational tests to demonstrate its effectiveness in saving energy and reducing emmisions. We will work with truck manufacturers to incorporate TCACC technologies in future production vehicles as well as retrofit options for existing vehicles. We will also work with port authorities (i.e., Port of Oakland in this proposed work), regional MPOs (e.g., MTC), and local transportation authorities (i.e., Contra Costa

Transportation Authority and Alameda CMA) to develop policies and deployment strategies to encourage adaptation of TCACC.

## 5. Detailed description of how the pilot project idea components will incorporate advanced technologies, alternative fuels, freight and fuel infrastructure, and local economic development; and advance goals of improving freight efficiency, transitioning to zero-emission technologies, and increasing competitiveness of California's freight system.

TCACC addresses a core value of technology advancements and what vehicle automation may bring about for improving truck operation efficiency. First, consider a heavily loaded truck in typical freeway operations. It is operated with near-maximum engine efficiency when in free-flow traffic. About 20% of the energy is utilized to overcome aerodynamic road forces. On the other hand, the energy used in applying brakes is about 2% while its brake-specific fuel consumption (fuel consumption to power ratio) is 5%. Also consider a vehicle being operated on the urban highway and roads where traffic is often stop-and-go and where brakes are applied more frequently. For such typical conditions, energy wasted by application of brakes increases to about 60% to 65% of the total energy consumed by the truck during this mode of driving.

We believe that both long haul operation and operation in congested areas ***must*** be considered within the framework of the evolutionary, partial automation strategy of vehicle-highway automation, and TCACC is specifically designed to cover the complete spectrum of operation modes. The proposed TCACC operating strategy will appropriately adjust speed and spacing between vehicles based on the data received through V2V and V2I communication, with the mindset to maximize environmental and safety benefits.

The expected impacts of TCACC are significant. TCACC will:

- Deliver smoother operation, gentle deceleration and avoid unnecessary accelerations when operated in congested roads and arterial corridors. The expected fuel savings will be up to 40% and subsequent emission reduction.
- Enable trucks in shorter headways; therefore, it can offer greater truck throughput when operated in the dedicated truck lanes or even in mixed traffic.
- Reduce truck related crashes, which will not only increase safety for trucks and surrounding vehicles, but also reduce the likelihood of secondary collisions and crash induced congestion.
- The benefits of TCACC can be extended to zero emission vehicles.

## 6. Estimated cost for implementation and existing funding commitments (include any funding limitations or constraints) by stakeholder and amount.

The proposed project budget is $5M. Cost share is expected in the form of in-kind from truck manufacturers and local transportation agencies.

## 7. Timeline.

Two (2) years for project implementation and one (1) year for field operational tests. Additional deployment cycle is expected to be 2-3 years.

**8. Means for measuring progress toward meeting goals over time.**

We plan to implement a fleet of 10-15 drayage trucks that operate in/out of Port of Oakland along I-880, I-580, I-80 and I-680. Progress toward meeting the goals will be demonstrated through extended field operational tests by comparing before-and-after fuel saving and emission reduction.

**9. Description of the potential roles each of the interagency partners could provide to support the project's implementation.**

Transportation agencies from local to state, including Contra Costa Transportation Authority, Alameda CMA, MTC, and Caltrans will be invited to participate in this project. Truck manufacturers (e.g., Daimler Truck) has expressed strong interest and will be invited to join the project.