IEEE P802.11  
Wireless LANs

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| Proposed Dynamic Mobility Use Cases for TGai | | | | |
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Abstract

There are several brand new application areas that are being researched for Intelligent Transportation Systems. These include Dynamic Mobility Applications (DMA), and Applications for the Environment Real-Time Information Synthesis (AERIS). Although both programs are in a research phase, DMA has high level use case descriptions available. The following DMA use cases are being proposed to IEEE 802.11TGai and represent anticipated advancements and the latest terminology for emerging transportation applications.

There are several brand new application areas that are being researched for Intelligent Transportation Systems. These include Dynamic Mobility Applications (DMA), and Applications for the Environment Real-Time Information Synthesis (AERIS). Although both programs are in a research phase, DMA has high level use case descriptions available. The following DMA use cases are being proposed to IEEE 802.11TGai because they are emerging applications from a transportation domain expert’s workshop that are being supported by various government agencies and stakeholders. Although many transportation use cases already appear in various IEEE 802 wireless use case documents, the following use cases represent anticipated advancements and the latest terminology for these applications.

**Assumptions:**

1. There were over 30 new Dynamic Mobility Applications (DMA) discussed at a Connected Vehicle Mobility and Environmental Transportation Workshop held November 30-December 1, 2010 at George Mason University in Arlington, Virginia. These applications are being researched and only high level descriptions are currently available.
2. Only applications with wireless mobile device to infrastructure needs were considered for this submission. Vehicle to vehicle high mobility applications are assumed to use IEEE 802.11p.
3. Precise requirements for these applications may not be available from the DMA program in the time frame needed by IEEE 802.11TGai. Requirements will have to be estimated by the TG for any use case that is accepted. Those requirements can be revised when the appropriate information becomes available.

**Description of Applications (use cases):**

**Public Transit:**

1. *Connection Protection*

Many public transportation trips require multiple transfers which may be between different modes, such as buses, subways, and commuter rails, and are often across multiple agencies. Any segments of a trip can be delayed and passengers wishing to transfer may miss their connection. Travelers are often uncertain about whether they will actually miss the planned connection due to lack of information and means of spontaneous communications. The proposed application will allow travelers to initiate a connection protection request using personal mobile devices, or through drivers using onboard mobile devices, and receive a confirmation based on a set of criteria, indicating whether the request is accepted. IEEE 802.11ai can be one of several means used by travelers to make requests and receive confirmations prior to, or during a trip. For public transit riders experiencing delays, a high volume of requests may be attempted at a single AP necessitating quick authentication and association. Travelers attempting to submit a request may be en-route (moving).

Use Case Categories: Stationary (at home), Pedestrian, vehicle (transit), switchover.

1. *Dynamic Transit Operations*

The proposed application will use GPS and mapping capabilities of mobile devices to enable a traveler to input a desired destination and time of departure along with their current location. This information will be sent to a central system that dynamically schedules and dispatches or modifies the route of an in-service vehicle by matching compatible trips together. Travelers at rail, subway, or bus transfer stations and depots may present a large volume of requests in a short period of time to a limited number of APs. Travelers may also alter plans or plan a return trip while en-route. Fast secure authentication and association will enable IEEE 802.11ai APs to serve this classification of request in areas where high density use is anticipated.

Use Case Categories: Stationary (at home), Pedestrian, vehicle (transit), switchover.

Special notes for Public Transit:

Transit vehicles may be light rail, heavy rail, bus rapid transit, fixed route transit and non-fixed route transit. Busses may be single unit or articulated (two rigid sections linked by a pivoting joint). The type of transit vehicle has implications both in the maximum speed at which it is allowed to travel, and the maximum number of passengers it is expected to carry. This will affect the number of associations and volume of data that may be presented to a fixed AP en-route, and subsequently will affect the technical requirements derived from the use case.

**Advanced Traveler Information Systems**

1. *Curbside Parking Availability System*

The application is used to inform travelers of available parking spaces in real time via the Internet as well as via navigation devices (handheld devices, in-vehicle systems). Parking information will include the location, rate, type, and hours. The application incorporates monitoring curbside parking availability by different means such as fixed sensors installed in parking meters or the road surface, or by vehicles equipped with ultrasonic rangefinders and GPS. The information on available spaces will be sent from the fixed sensors or the vehicles to a central server for processing. The data received needs to be in near real time and should include sufficient information for the application to predict the availability of spaces in a given area. Travelers can access the real time parking information via an IEEE 802ai AP wherever coverage is available either prior to or during a trip and can receive updates en-route. APs can be strategically placed in the vicinity of the parking areas to assists motorists finding spaces.

Use Case Categories: Stationary (at home), vehicle, switchover.

1. *Multi-modal Real-Time Traveler Information*

This multi-modal application uses real-time data and communications capabilities to empower travelers to make informed travel choices in real time, pre-trip and en-route. Based on real-time and historical travel conditions for the traveler’s trip (pre-specified origin, destination, and time of departure) the application will suggest potential routes and modes (e.g., auto, transit, bicycle, walk) with approximate travel times, travel time reliability, and costs for each alternative. If transit is included in one of the alternatives, locations of transit stations, arrival time of next bus or train, parking availability and cost, will be also be provided. The application will “predict” travel times based on existing and predicted traffic congestion, weather and pavement conditions, incident locations, work zone locations and timings, transit availability and schedule, parking availability, possible use of HOT and HOV lanes (depending on time of travel). Information may be provided via: personal mobile devices, transit stations on vehicle interactive screens, in-vehicle devices, internet, and 511. TGai APs can be used for Internet connections and communications with both in-vehicle and personal mobile devices.

Use Case Categories: Stationary (at home), Pedestrian, vehicle, switchover.

1. *Real-Time Route Specific Weather Information for Motorized and Non-Motorized Modes*

Knowledge of real-time weather conditions (rain, ice, snow, temperature) along an anticipated route can help a traveler (a potential motorist, transit user, pedestrian or bicyclist) determine whether to reschedule or postpone the trip, or take an alternate route or mode. This application includes continuously collecting weather-related probe data generated by probe vehicles, analyze, and integrate those observations with weather data from traditional weather information sources, and develop highly localized weather and pavement conditions for specific roadways, pathways, and bikeways. The role of 802.11ai is to provide a means of disbursing the current and forecasted information via the Internet and personal communication devices at high density user locations where devices will have relatively short dwell times such as rail/transit stations.

Use Case Categories: Stationary (at home), Pedestrian, vehicle, switchover.

**Emergency Response**

1. *Incident Scene Pre-Arrival Staging Guidance for Emergency Responders*

Staging/positioning of public safety vehicles arriving at an incident is typically handled ad hoc. However, task force and mutual aid response may involve pre-planned procedures and pre-deployment of assets. Pre-arrival situational awareness is critical to public safety responder vehicle routing, staging and secondary dispatch decision-making. Still or video images of an incident scene, surrounding terrain, and traffic conditions would be valuable input to responder and dispatcher decisions and actions. Incident status information relayed to both en route vehicles and vehicles at the incident command area could help in establishing safer, possibly less traffic-impeding incident response. Traffic camera images would be routed to moving vehicles via roadside infrastructure (still images or video depending on capabilities). Public safety dispatcher(s)/incident commander would make pre-arrival staging decision based on available data (initial responder reports; vehicle sensors; imagery). Staging plans (possibly graphic/map based) would be transmitted to emergency vehicles en route and upon arrival. Portable IEEE 802.11ai APs can be deployed at the incident management command location to disseminate the appropriate information to arriving vehicles and to responders with portable devices. APs deployed en-route may also provide the information prior to arrival.

Use Case Categories: Vehicle

**Transportation Management and Operations**

1. *Dynamic Speed Harmonization*

This application will be used to monitor real-time traffic and weather data to check if lane-specific speeds within a pre-specified zone indicate the onset of congestion or an increased risk of freeway breakdown conditions. If congestion precursors such as unstable flow patterns, are either detected (in the near-term) or predicted (in the longer-term), the application will calculate and communicate lane-specific target speeds within as well as upstream of the impending bottleneck to motorists via dynamic signs placed on overhead gantries, RSEs to vehicles with range; and from vehicle to vehicle. When RSEs are not available, IEEE 802.11ai APs may be a viable alternative.

Use Case Categories: vehicle

1. *Enhanced MDSS Communications*

In existing Maintenance Decision Support Systems (MDSS), there is a reliance on commercial wireless networks to communicate with snowplows or other maintenance vehicles.  In many rural areas, access to commercial networks is limited and/or expensive.  Using IEEE 802.11ai APs installed either specifically for this application or using an AP that offers multiple applications could be a better alternative. MDSS equipped maintenance vehicles would use the strategically placed APs to download treatment recommendations and upload recent maintenance activities.

Use Case Categories: vehicle, switchover.

1. *Mobile Accessible Pedestrian Signal System*

This application integrates information from sensors commonly available on a smart phone, and then wirelessly communicates with the traffic signal controllers to obtain real-time Signal Phasing and Timing (SPaT) information, which will then be used to inform visually impaired pedestrian as to when to cross and how to remain aligned with the crosswalk. The application will allow an “automated pedestrian call” to be sent to the traffic controller from the smart phone of registered blind users after confirming the direction and orientation of the roadway that the pedestrian is intending to cross. The traffic controller can hold or extend the walk signal until the visually impaired pedestrian has cleared the crosswalk. In addition, the application would also enable communications between vehicles and the pedestrian (V2P) at intersection crosswalks. Drivers attempting to make a turn will be alerted of the presence of a visually-impaired pedestrian waiting at the crosswalk. The application can also warn the pedestrian not to cross when an approaching vehicle is not likely to stop at the crosswalk while the light is transitioning to red for automobiles. The V2P concept can also be applied to alert drivers of the presence of non-visually impaired pedestrians and bicyclists, and vice versa, increasing safety of the non-motorized traveler. IEEE 802.11ai APs may be a cost effective alternative for intersections not equipped with public sector IEEE 802.11p RSEs.

Use Case Categories: Pedestrian, vehicle