**IEEE P802.15**

**Wireless Personal Area Networks**

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| Project | IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs) | |
| Title | **<PAR for IEEE 802.15.13>** | |
| Date Submitted | [17 March 2016] | |
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| Re: |  | |
| Abstract | [Drafting preliminary PAR application for Dependable Automotive Wireless(DAW) communications] | |
| Purpose | [PAR for Dependable Automotive Wireless(DAW) communications] | |
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**P802.15.13**

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**Type of Project:** New IEEE Standard

**PAR Request Date:** 17-Mar-2016

**PAR Approval Date:**

# PAR Expiration Date:

**Status:** Unapproved PAR, PAR for a New IEEE Standard

* 1. **Project Number:** P802.15.13
  2. **Type of Document:** Standard
  3. **Life Cycle:** Full Use

**2.1 Title:** Dependable Automotive Wireless (DAW)

* 1. **Working Group:** Wireless Personal Area Network (WPAN) Working Group (C/LM/WG802.15)

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* 1. **Sponsoring Society and Committee:** IEEE Computer Society/LAN/MAN Standards Committee (C/LM)

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* 1. **Type of Ballot:** Individual

# Expected Date of submission of draft to the IEEE-SA for Initial Sponsor Ballot: 03/2018

* 1. **Projected Completion Date for Submittal to RevCom:** 11/2018
  2. **Approximate number of people expected to be actively involved in the development of this project:** 30
  3. **Scope:** This new standard defines Dependable Automotive Wireless (DAW) communications for automotive industry sensing and control. Here automotive consists of three sub-categories: intra-vehicular, inter-vehicular, and factory line. In the project scope intra-vehicular refers to piconetwork(s) inside or on a vehicular body such as wireless harness. Inter-vehicular refers to communications between two vehicular bodies, such as adjacent or modular vehicles. Factory line refers to piconetworks in or on assembly line equipment and modules in production. Dependability stands for reliable, secure and predictable communications network operations satisfying the performance criteria defined in Section 8.1. The DAW provides physical (PHY) and Media Access Control (MAC) specifications for extended star and inter-connected star network communications to conform to dependability criteria. The DAW defines specific features to ensure dependability, such as inter-piconetwork coordinator communications, feedback loop provisioning, piconetwork health monitoring and link extension to ensure connectivity within a piconetwork. In addition, DAW provides a limited set of options for implementation with the aim of increasing coexistence and interoperability between devices from multiple vendors.

# Is the completion of this standard dependent upon the completion of another standard: No

* 1. **Purpose:** This new standard focuses on DAW communications for automotive industry. The set of specifications provided by this project enables automotive equipment and manufacturers to adopt wireless solutions within a vehicular body and assembly line that complement and/or partially replace existing wired solutions. To enable partial wire replacement tight reliability, security and predictability requirements need to be met that are lacking in existing wirless standards. Inter-vehicular communications are required to ensure reliable interconnectivity to exchange vehicle control information between multiple vehicles or parts of a modular vehicle, such as a semi-trailer truck.
  2. **Need for the Project:** Automotive equipment and manufacturers need dependable wireless sensing and control piconetworks, i.e. DAW in intra-vehicle, inter-vehicle and factory line. This Project covers new capabilities and functionalities different from existing IEEE802 standards while keeping interoperability with or extension of vehicle and factory network standards e.g. CAN and LIN. The DAW enables intra and inter-piconetwork communications. Current IEEE802 standards lack clear definition of reliable, secure and predictable inter-piconetwork communications at L2. Although a number of standards enable feedback loop communications from channel time allocation point of view, there is no deterministic mechanism to adaptively carry out such actions and they need to be defined. Piconetwork health monitoring provides more dependable automotive equipment management and features for collecting such information and adapting to current L1 and L2 environment lack standardization at link level. Although IEEE802.15.4-2015 defines time-slot relaying based link extensionfor time slot based PANs, the specifications are not clear and apply on for time-slot based operations. Link extension is required for moving machine bodies such as robot arms in factory line and also as a means to satisfy the dependability criteria. This standard covers adaption to variable and unpredictable heavy communications channel noise, interference and reflections radiated from machines, such as inside engine compartments and over manufacturing lines.

The DAW is needed to enable:

* Dependable (reliable, secure and predictable) communications between DAW devices.
* Interaction of DAW piconetworks.
* Harmonize the operation principles of such piconetworks.

* 1. **Stakeholders for the Standard:** The stakeholders include automotive equipment and manufacturers, silicon manufacturers and users of equipment involving the use of wireless sensor, actuator and control networks.

**Intellectual Property**

* + 1. **Is the Sponsor aware of any copyright permissions needed for this project?:** No
    2. **Is the Sponsor aware of possible registration activity related to this project?:** No
  1. **Are there other standards or projects with a similar scope?:** No
  2. **Joint Development** **Is it the intent to develop this document jointly with another organization?:** No

**8.1 Additional Explanatory Notes (Item Number and Explanation):**

**5.2 Scope:**

**1)** Criteria for DAW:

General requirements:

* Number of sensors: few tens per piconet,
* Support for multiple piconets co-existence & interoperability: few tens of piconets,
* Types of topologies: extended star, inter-connected piconets coordinator nodes,
* Data rate requirement: up to 2 Mbps per sensor,
* Aggregate data rate per piconet: 50 Mbps,
* Latency: 250 ms to 1 s,
* Fraction of MLME requests successfully delivered: >99.9 %
  + Inter-piconet success rate > 99 %
* Jitter: < 50 ms in regular case, 5 % outliers acceptable.

Application-specific requirements:

* Data packet sizes (typical, maximum),
  + Automotive: (10 bytes, 300 bytes),
    - ~4 – 68 bytes for extended CAN frame format
    - 5 – 11 bytes for LIN
    - 8 – 264 bytes for FlexRay
    - Compatibility with CAN and LIN buses for intra-vehicle communications,
  + Factory line: (100 bytes, 1000 bytes)
* Feedback loop response time
  + Collision avoidance radar: 10 ms
  + Factory line: less than 1 s
* Handover capability: seamless between piconets, factory line speed,
* Security considerations: Handover peers need to have trust relationship (in factory line).
  + Factory line: pre-shared key
  + Vehicle: pre-shared key
  + Modular vehicles (trucks, trailers, etc.): key exchange
* Factory line sensor lifetime: minimum 1 year, up to equipment lifetime,
  + Batteries may be recharged/replaced once per month.
* Coverage range:
  + Factory line: 20 m.
  + Intra-vehicle: 20 m.
    - Inside enclosed objects line engine compartment 2 m.
  + Inter-vehicle:
    - Modular vehicle: 30 m.
    - Adjacent vehicles 100 m.