**IEEE P802.15**

**Wireless Personal Area Networks**

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| Project | IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs) |
| Title | Positive Train Control Five Criteria |
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| Re: |  |
| Abstract | [Five Criteria for the SG PTC.] |
| Purpose | [Working document for the 5 Criteria to the P802.15 PTC Group] |
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**Five Criteria - 802.15 PTC, Amendment to 802.15.4 current revision**

**1. BROAD MARKET POTENTIAL**

 **a) Broad sets of applicability**

Positive Train Control systems are intended to: prevent train-to-train collisions; enforce train speed restrictions; provide safety for road and rail workers; and prevent movement through misaligned switches.

Development of an amendment to IEEE 802.15.4 which may be used to support US federally mandated Positive Train Control will not only have immediate applicability on interoperable systems that must begin to be in operation by end of 2015. As well, the establishment of a 802.15.4 PTC amendment may be of use in existing and future communications-based train control (CBTC) systems, and may encourage use of other existing IEEE 802.15 standards for low data rate command and control applications, expanded monitoring and control, and information exchange systems for transportation uses.

 **b) Multiple vendors and numerous users**

The PTC system performance requirement is specified in Section 20157.(i).(3) of US Public Law 110-432, also known at the **US Rail Safety Improvement Act of 2008**, signed into law on 16 October 2008 ([http://www.gpo.gov/fdsys/pkg/PLAW-110publ432/pdf/PLAW-110publ432.pdf](http://www.gpo.gov/fdsys/pkg/PLAW-110publ432/pdf/PLAW-110publ432.pdf%22%20%5Ct%20%22_blank)).

This requirements was codified in Title 49 of the Code of Federal Regulations Section 236 Subpart I, “Positive Train Control Systems”, 10 CFR 236.1005, “**Requirements for Positive Train Control systems**” ([http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&sid=e170244e549d82349c62a88fe7b2ec7a&rgn=div5&view=text&node=49:4.1.1.1.30&idno=49](http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&sid=e170244e549d82349c62a88fe7b2ec7a&rgn=div5&view=text&node=49:4.1.1.1.30&idno=49" \t "_blank)) The Federal Railroad Administration of the US Department of Transportation has been tasked with oversight of the implementation of this law by industry.

The number of participants and the breadth of participation in the PTC Study and Interest Groups demonstrate the level of interest in this class of networks. Participants include US Federal agencies (including DOT, FRA, FTA), foreign government rail agencies, systems integrators, equipment manufacturers, silicon manufacturers, transportation engineering consultancies, academic researchers, telecommunications service providers, and rail and transit system operators.

Stakeholders include: Communication device manufacturers and users; Passenger Rail Entities; Freight Rail Entities; State, Regional, Municipal and Private Rail Transit Entities; Device, Component, and Systems Integrators; US Regulatory and Government Agencies; and Spectrum Licensees.

 **c) Balanced costs**

Based upon the known costs of existing and planned IEEE 802.15.4-compliant devices, the proposed amendment must be developed with the aim that the connectivity costs will be reasonably small as compared to the cost of devices or the value of the applications served.

**2. COMPATIBILITY**

IEEE 802 defines a family of standards. All standards shall be in conformance with the IEEE 802.1 Architecture, Management, and Interworking documents as follows: 802 Overview and Architecture,

802.1D, 802.1Q, and parts of 802.1f. If any variances in conformance emerge, they shall be thoroughly disclosed and reviewed with 802.1.

Each standard in the IEEE 802 family of standards shall include a definition of managed objects which are compatible with systems management standards.

This standard will be compatible with the IEEE 802 requirements of Architecture, Management, and Inter-networking documents as required. There is no specific technology feature anticipated in the standard that could preclude this compliance.

**3. DISTINCT IDENTITY**

1. **Substantially different from other IEEE 802 standards**

There are no other IEEE 802 wireless projects specifically addressing narrow channel width, high reliability operation in high-mobility (600 km/h) information exchange, sensor, command and control applications.

 **b) One unique solution per problem (not two solutions to a problem)**

The proposed amendment will add to the existing 802.15.4 standard the ability to operate and meet performance requirements in high mobility environments, and to operate in bands not considered in the current standard. Consequently, this is the only optimized solution to this particular problem.

 **c) Easy for the document reader to select the relevant specification**

The proposed standard will produce a clearly distinguishable amendment to the IEEE 802.15.4 specification.

**4. TECHNICAL FEASIBILITY**

 **a) Demonstrated system feasibility**

Existing train communications and control protocols (including ITCS, ACSES, and ETMS) have been implemented and are operational. Testing in the 220 MHz band is ongoing at the American Association of Railroads (AAR) Transportation Technology Center (TTC). Operation of ITCS (Incremental Train Control System) at 220 MHz in the Michigan MDOT/Amtrak corridor has been authorized to 160km/h (100 mph). Operations in 44 MHz spectrum for EMTS/HLCS have demonstrated some aspects of the required functionality, at speeds up to 50 mph (80km/h). Advanced Train Control Systems have been in operation for upwards of 20 years in the 160-161 band and the 896-897/935-936MHz paired band. In Europe, GSM-R (GSM for Railroad) has been designed for speeds up to 500 km/h and is tested and proven to 350 km/h in revenue service.

 **b) Proven technology, reasonable testing**

The technologies and uses mentioned in the previous paragraph demonstrate that standards-based systems can be designed and fabricated.

 **c) Confidence in reliability**

The proposed functionality will be designed to meet relevant reliability standards.

**5. ECONOMIC FEASIBILITY**

 **a) Known cost factors, reliable data**

As the proposed amendment is largely the addition of a new frequency band, there are existing IEEE 802.15.4-class silicon devices that operate near these frequencies. These devices are manufactured in large volume and these volumes are expected to increase dramatically as other industries, including Smart Utility Networks, begin to scale up.

 **b) Reasonable cost for performance**

Based on existing systems deployed for rail communications applications, and upon similar devices being deployed today for systems like Smart Utility Networks, it is expected that the wireless connectivity components will meet the expected cost, size and power requirements.

 **c) Consideration of installation costs**

Devices compliant to a future IEEE 802.15.4 PTC specification are intended to reduce operator installation and maintenance costs through improved equipment availability and interoperability.