Project Authorization Request (PAR)

Draft PAR Confirmation Number

Submittal Email: bheile@ieee.org

Type of Project: PAR for an amendment to existing Standard 802.15.4-2006

1.1 Project Number: P802.15.4g

1.2 Type of Document: Standard for

1.3 Life Cycle: Full

2.1 Title of Standard: IEEE Standard for Information Technology - Telecommunications and Information Exchange Between Systems - Local and Metropolitan Area Networks - Specific Requirements - Part 15.4: Wireless Medium Access Control (MAC) and Physical Layer (PHY) Specifications for Low Rate Wireless Personal Area Networks (WPANs) - Amendment: Physical Layer(PHY) Specifications for Low Data Rate Wireless Neighborhood Area Networks(WNAN)

3.1 Name of Working Group: Wireless Personal Area Network (WPAN) Working Group(C/LM/WG802.15)
Contact information for Working Group Chair
Robert F Heile
11 ROBERT TONER BLVD, SUITE 5-301
North Attleboro, MA 02763 USA
bheile@ieee.org

3.2 Sponsoring Society and Committee:IEEE Computer Society/Local and Metropolitan Area Networks(C/LM)
Contact information for Sponsor Chair:
Paul Nikolich
18 Bishops Lane Lynnfield, MA 01940 USA
p.nikolich@ieee.org

Contact information for Standards Representative:

4.1 Type of Ballot: Individual

4.2 Expected Date of Submission for Initial Sponsor Ballot: 2010-07

4.3 Projected Completion Date for Submittal to RevCom: 2010-11

5.1 Approximate number of people expected to work on this project: 150

5.2 Scope of Proposed Standard: (See explanatory notes in Secton 8.1)
This Standard defines an amendment to IEEE 802.15.4. It addresses outdoor Low Data Rate Wireless Neighborhood Area Networking (WNAN) requirements. It defines an alternate PHY and only those MAC modifications needed to support its implementation.

Specifically, the amendment supports all of the following:

- Operation in any of the regionally available license exempt frequency bands, such as 700MHz to 1GHz, and the 2.4 GHz band.
- Data rate of at least 40 kbits per second
- Line of Sight (LOS) range of 5 km using omni directional antennae
- Outdoor communications
- PHY frame sizes up to a minimum of 1500 octets
- Simultaneous operation for at least 3 co-located orthogonal networks
- Connectivity to at least one thousand direct neighbors characteristic of dense urban deployment

This amendment also addresses coexistence with other 802 wireless standards operating in the same bands.

Old Scope:

5.3 Is the completion of this standard is dependent upon the completion of another standard: No **If yes, please explain:**

5.4 Purpose of Proposed Standard: To provide a global standard that facilitates very large scale process control applications such as the utility smart-grid network (e.g., Wireless Neighborhood Area Networking). This amendment supports large, geographically diverse networks with minimal infrastructure. WNANs can potentially contain millions of fixed endpoints. The communication range, robustness, and coexistence characteristics required for this class of application have not been met with existing 802 standards (See explanatory notes in Section 8.1).

Old Purpose:

5.5 Need for the Project:
The need for a standard to promote orderly and quick evolution of smart-grid networks has been recognized in the recently passed energy legislation by the U.S. Congress (EISA 2007; Energy Independence & Security Act of 2007), which calls on National Institute of Standards and Technology (NIST) to work with standards bodies (such as IEEE) to develop protocols and standards for the smart-grid network. In the European community, the need is no less urgent and similar standardization mandates are in process worldwide.

The responses received by and presented to the NAN Study Group indicate an already large and rapidly growing market for WNAN applications that fit the objectives of 802.15, but are not satisfied by existing IEEE 802 standards. (See explanatory notes in Secton 8.1).

The NAN Study Group tutorial held in Denver in July 2008 was attended by well over 100 participants. More than 40 participants responded to the call for interest in participating in the NAN standardization activity.

Utility networking and very large scale industrial applications have requirements to keep infrastructure to a minimum, scale to millions of nodes across diverse geographical environments, and do so with carrier grade reliability. To reach every node in the network WNAN needs the capability to vary radio range from a few meters to 5 km LOS while providing for high spectral reuse (See explanatory notes in Secton 8.1).

5.6 Stakeholders for the Standard:
Utility (electricity, water, gas) industry, large scale industrial (thousands to millions of nodes), vendors supporting these industries (semiconductor, systems, integrators, service providers, technology providers), and energy consumers.

Intellectual Property
6.1.a. Has the IEEE-SA policy on intellectual property been presented to those responsible for preparing/submitting this PAR prior to the PAR submittal to the IEEE-SA Standards Board? Yes If yes, state date: 2008-09-08 If no, please explain:
6.1.b. Is the Sponsor aware of any copyright permissions needed for this project? No If yes, please explain:
6.1.c. Is the Sponsor aware of possible registration activity related to this project? No If yes, please explain:

7.1 Are there other standards or projects with a similar scope? No
Explanation:
Sponsor Organization:
Project/Standard Number:
Project/Standard Date: 0000-00-00
Project/Standard Title:

7.2 International Standards Activities
a. Adoptions Is there potential for this standard to be adopted by another organization? Do not know at this time
Organization:
Technical Committee Name:
Technical Committee Number:
Contact person Name:
Contact Phone:
Contact Email:
b. Joint Development Is it the intent to develop this document jointly with another organization? Do not know at this time Organization:
Technical Committee Name:
Technical Committee Number:
Contact person Name:
Contact Phone:
Contact Email:
c. Harmonization Are you aware of another organization that may be interested in portions of this document in their standardization development efforts? Do not know at this time
Organization:
Technical Committee Name:
Technical Committee Number:
Contact person Name:
Contact Phone: Contact Email:

8.1 Additional Explanatory Notes: (Item Number and Explanation)

5.2 Scope

a. To meet availability and reliability requirements, with the physical location constraints imposed by WNAN applications, WNAN needs the ability to use the maximum power available under applicable regulations (up to 1W in some regulatory domains). This need eliminates those PHYs from consideration that have transmit power limitations such as UWB PHYs. The WNAN devices are less constrained with respect to power consumption.

b. WNANs require adaptable, peer-to-peer multi-hop topologies. Acknowledging that meshing is out-of-scope in this amendment, the ability to provide long-range point-to-point circuits available for meshing increases the diameter of the unlicensed sub-GHz networks, thereby reducing total cost.

c. Existing and planned WNAN installations are required to cover geographically widespread communications to a large number of outdoor devices – e.g. electricity meters and other industrial control and monitoring equipment. LOS range, while explicitly listed in the scope because it is a quantifiable metric, is not a normal operational condition. In practice, NonLOS range is supremely important in diverse environments, such as urban or densely forested areas but is difficult to quantify. A 5km LOS range should assure nominal NLOS performance.

5.5 Need for the Project

Document numbers for IEEE posted Utility presentations regarding their WNAN experiences are:

a. 15-08-0245-00-wng0-utilities-view-of-smart-grid-network-needs.ppt – George Cosio/Phil Slack - FPL
b. 15-08-0297-00-0000-pg-e-smart-grid-discussion.ppt – Chris Knudsen – PG&E

These presentations document the experiences within each of the presenting utilities in their several pilots and trial installations. Discussed are a variety of technologies, wireless and wired, proprietary and standards-based. The requirements presented in the applications above are generally applicable and are not limited to the utilities that gave the presentations.

Utility networking and very large scale industrial applications have requirements to keep infrastructure to a minimum, scale to millions of nodes across diverse geographical environments, and do so with carrier grade reliability.

The 802.11 standards have been optimized for high data rates along with support for star network topologies with centralized control. Achieving maximum data rate in a given spectrum - as 802.11 does - is achieved at the expense of simultaneously achieving maximum range. WNAN requirements for complete ubiquity – communicating with all devices within a geographic territory – explicitly requires maximum range within existing local regulations.

Applications for WNAN further intensify the need for maximum range as many devices are located sub-optimally. An example is WNAN devices located in rural areas as at the end of electricity ‘feeders’ – where doubling range reduces cost by a factor of four as the area covered increases by the same factor.

802.16 standards are optimized for high data rate, point-to-point and point-to-multipoint network topologies. Achieving maximum data rate in a given spectrum - as 802.16 does - is achieved at the expense of simultaneously achieving maximum range. WNAN requirements for complete ubiquity – communicating with all devices within a geographic territory – explicitly requires maximum range within existing local regulations. While some flexibility exists for trading data rate for range, ranges that could be accomplished with a PHY optimized for the WNAN requirement (e.g., 40 kbps), with its corresponding on-air bandwidth, are not supported.

As mentioned before, the requirements of the WNAN further intensify the need for maximum range as many devices are located sub-optimally. An example is electricity meters located in highly obstructed, high multipath locations with inflexible antenna orientation. This makes it cost prohibitive to meet the WNAN requirement of 100% coverage with 802.16.

The cost of licensed spectrum is another factor affecting WNAN system costs. Existing WNAN installations occupy unlicensed spectrum. 802.16 standards support unlicensed operation in the microwave ISM spectrum at 5 – 6 GHz. Unlicensed use of this spectrum imposes regulatory transmitter power limits while physics imposes propagation limitations – both reducing range and thus reliability in the WNAN application.

An essential requirement of WNAN is the ability to support bursty, asynchronous upstream traffic. An example of this is the need for highly responsive outage detection. Typically, when an electric meter loses mains power, a ‘last gasp’ is emitted. This ‘last gasp’ is stored in a capacitor that can hold for 300ms. The connection-oriented, TDM-based 802.16 standard is not optimized for massively bursty, low duty cycle applications (i.e., does not maintain connections to idle nodes).

An important requirement of WNAN is the ability to support peer-to-peer distribution automation applications such as groups of switch reclosers or feedback loops for volt/VAr management. Star topologies are sub-optimal in supporting distributed peer-to-peer applications. The 802.15.4 standard does not meet all the WNAN requirements. It currently does not support frame sizes of 1500 bytes in length. Error detection in 802.15.4 is currently limited to a two byte CRC which is statistically likely to pass undetected errors given the large number of packets processed daily through the WNAN network.

WNAN device densities are variable and can be quite high; urban meter densities range upward of 5000 devices per square kilometer. Much WNAN traffic is event driven (e.g., a power outage report) and thus occurs simultaneously and at high priority. The WNAN requirement is thus for the largest number of orthogonal traffic carrying channels allowed per local regulations consistent with the simultaneous requirement to provide at least 40kbps.