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1. ASSIGNED PROJECT NUMBER: 802.16j

2. SPONSOR DATE OF REQUEST: 7-Feb-2006

3. TYPE OF DOCUMENT: Standard

4. TITLE OF DOCUMENT: Amendment to IEEE Standard for Local and Metropolitan Area Networks – Part 16: Air Interface for Fixed and Mobile Broadband Wireless Access Systems – ~~Physical and Medium Access Control Layers for Mobile~~ Multihop Relay Specification

5. LIFE CYCLE: Full-Use

6. TYPE OF PROJECT: Amendment 802.16

Modified PAR?

No

7. WORKING GROUP INFORMATION

Name of Working Group: [IEEE 802.16 Working Group on Broadband Wireless Access](#)

Approximate Number of Expected Working Group Members: 300

8. CONTACT INFO FOR WORKING GROUP CHAIR

Name of Working Group Chair: [Roger Marks](#)

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9. CONTACT INFO OF CO-CHAIR/OFFICIAL REPORTER

Name of Co-Chair/Official Reporter:

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10. CONTACT INFO OF SPONSOR

Sponsor: [C/LM](#)

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CO-SPONSOR INFORMATION (THIS IS BEING SPONSORED BY TWO SPONSORS):

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Name of Cosponsor Chair: [Richard Snyder](#)

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11. TYPE OF SPONSOR BALLOT: Individual

Expected Date of Submission for Initial Sponsor Ballot: Mar-2007

12. PROJECTED COMPLETION DATE FOR SUBMITTAL TO REVCOM: Sep-2007

13. SCOPE: This document specifies OFDMA physical layer and medium access control layer enhancements to IEEE Std 802.16 for licensed bands to enable the operation of relay stations. Subscriber station specifications are not changed.

Completion of this document contingent upon another document? No

14. PURPOSE: ~~This amendment provides specifications for mobile multihop relay features, functions and To enhance coverage, interoperable relay stations to enhance coverage,~~ throughput and system capacity of 802.16 ~~networks.~~

networks by specifying 802.16 multihop relay capabilities and functionalities of interoperable relay stations and base stations.

15. REASON: This project aims to enable exploitation of such advantages by adding appropriate relay functionality to IEEE Std 802.16 through the proposed amendment." type="hidden"> The multihop relay is a promising solution to expand coverage and to enhance throughput and system capacity for IEEE 802.16 systems. It is expected that the complexity of relay stations will be considerably less than the complexity of legacy IEEE 802.16 base stations. The gains in coverage and throughput can be leveraged to reduce total deployment cost for a given system performance requirement and thereby improve the economic viability of IEEE 802.16 systems. Relay functionality enables rapid deployment and reduces the cost of system operation. These advantages will expand the market opportunity for broadband wireless access. This project aims to enable exploitation of such advantages by adding appropriate relay functionality to IEEE Std 802.16 through the proposed amendment.

16. INTELLECTUAL PROPERTY:

IEEE-SA Policy on Intellectual Property Presented: Yes 9-Jan-2006
Copyrights: No
Trademarks: No
Registration of Object: No

17. SIMILAR SCOPE: No

18. FUTURE ADOPTION: Yes

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19. Health, Safety or Environmental Issues: No

Explanation:

20. SPONSOR INFORMATION:

- a. Is the scope of this project within the approved scope/definition of the Sponsor's Charter? **Yes**
- b. Sponsor's procedures accepted by AudCom: **Yes**

21. ADDITIONAL NOTES: Item 13. ~~The relay station is controlled by the base station.~~ Control functions may be centralized at the base station or distributed among the relay stations with central coordination from the base station.

I acknowledge having read and understood the IEEE Code of Ethics I agree to conduct myself in a manner which adheres to the IEEE Code of Ethics when engaged in official IEEE business.

The PAR Copyright Release and Signature Page must be submitted either by FAX to 732-875-0695 or as e-mail attachment in .pdf format to the NesCom Administrator before this PAR will be sent on for NesCom and Standards Board approval.

FIVE CRITERIA FOR IEEE 802.16 MOBILE MULTI-HOP RELAY PAR

IEEE P802.16mmr Five Criteria
CRITERIA FOR STANDARDS DEVELOPMENT (FIVE CRITERIA)

Broad Market Potential

A standards project authorized by IEEE 802 shall have a broad market potential. Specifically, it shall have the potential for:

- a) Broad sets of applicability.
- b) Multiple vendors and numerous users.
- c) Balanced costs (LAN versus attached stations).

a) IEEE Std. 802.16 will compete with, and provide alternative services to, xDSL, Cable, T1 and fiber optic broadband technologies. It will also provide wireless access at a higher data rate compared with conventional cellular services. The amendment through relay stations will be applicable to the already existing IEEE Std 802.16 which itself already has a broad set of applicability as stated above, and through this amendment the applications of this standard will be further broadened due to the amendment enabling lower cost deployments. This is because the amendment will provide a cost effective way for multi-media traffic to considerably increase in range. In addition, this amendment will most likely improve throughput,

b) IEEE802.16's higher data rate and wide coverage for Wireless MAN, attract many commerce leaders. The approval of MMR (Mobile Multihop Relay)-SG by 77 members including various manufacturers and telecom operators, signifies the possibility of multiple vendors. Furthermore, during the first two meetings of the SG, forty-three contributions from more than fifteen organizations were received.

High density of base stations to enhance coverage in shadowed or underserved area is not a feasible solution, resulting in considerably higher deployment costs. The relay capabilities will be able to overcome this issue, and increase the possible number of users.

Consequently, given that the multi-hop relay technology meets at least part of the current expectations, it is likely that these same companies will support this enhancement of the existing standard.

The IEEE Std. 802.16 with relay stations may be used in products manufactured by existing and future vendors and support a wide range of network users including individual mobile subscribers and broadcast groups,

c) The support for relay stations enables extended coverage through their addition to existing or future networks, and the relay stations with the point-to-multipoint (PMP) mode can provide wireless relay function with simpler and more compact station configuration when compared to the base station, thus at lower cost. It is well known that it is possible to use cost effective relay stations to improve coverage, and probably increase throughput as an alternative to using more costly base stations. Thus, an MMR system is a more cost effective solution to accommodating many mobile subscribers, establishing wide area coverage and providing higher data rates.

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.

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

The amendment will conform to the IEEE 802 family of standards as required.

IEEE802.16 recognizes that relay function provides potential to interfere with bridging, spanning tree and other IEEE802.1 bridging and routing conventions. IEEE802.16 will take special precaution, including close interactions with IEEE802.1 working group, to ensure continuing compatibility with IEEE802.1 family of architectural features.

Distinct Identity

Each IEEE 802 standard shall have a distinct identity. To achieve this, each authorized project shall be:

- a) Substantially different from other IEEE 802 standards.
 - b) One unique solution per problem (not two solutions to a problem).
 - c) Easy for the document reader to select the relevant specification.
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- a) *There is no other standard for defining an IEEE Std. 802.16 compatible relay station,*
 - b) *The MMR extension to the standard will provide a unique solution to increase coverage areas along with a possible throughput enhancement in an easy to manage and cost effective manner,*
 - c) *The project will produce an interoperable and distinguishable extension to the IEEE Std 802.16 so that users can easily distinguish the amendment from the original standard.*

Technical Feasibility

For a project to be authorized, it shall be able to show its technical feasibility. At a minimum, the proposed project shall show:

- a) Demonstrated system feasibility.
- b) Proven technology, reasonable testing.
- c) Confidence in reliability
- d) Coexistence of 802 wireless standards specifying devices for unlicensed operation

a) One purpose of some wireless relay or mesh systems such as IEEE 802.11 TGs, which is being developed, is to extend coverage areas. Furthermore, the performance of wireless relay systems has been examined and revealed by theoretical analyses and computer simulations. In addition, wireless networks employing MMR are already operational albeit using other physical layer technologies. Wireless ad-hoc networks have been

- under development by the military for more than two decades. Consequently, the feasibility of potential improvements that are offered by the use of relaying has been clearly demonstrated,*
- b) MMR technology is an extension of the existing standard which is already a proven and tested technology. The fundamental concepts of MMR technology have been proven in analytical studies and simulations and also proven in operational systems. The application of MMR to IEEE802.16 while not a completely proven technology, is considered to have a high likelihood of success,*
 - c) MMR technology leverages IEEE Std 802.16 technologies and signaling,*
 - d) not applicable since the project is only for licensed operation.*

Economic Feasibility

For a project to be authorized, it shall be able to show economic feasibility (so far as can reasonably be estimated), for its intended applications. At a minimum, the proposed project shall show:

- a) Known cost factors, reliable data.
- b) Reasonable cost for performance.
- c) Consideration of installation costs.

a) The economic viability of IEEE 802.16 systems has been analyzed within the industry and a number of development efforts are ongoing. The existence of these development efforts indicates that IEEE 802.16 systems are expected to have a cost that is consistent with reasonable business strategies. The proposed application of MMR will reduce overall system costs thereby enhancing the economic viability of IEEE 802.16 systems. The deployment costs of IEEE Std 802.16, such as radio and base-band architecture, are well known and the addition of a relay station class is a low risk extension,

b) MMR technology provides a more cost effective solution to extending a service area than deploying more base stations because relay stations will be of lower cost than base stations due to their lesser complexity and they do not need the backhaul communication cabling cost for themselves,

c) Relay stations will be installed more easily than base stations due to their smaller size, lower power consumption and elimination of backhaul communication cable. Furthermore, antenna structures for relay stations are expected to be less costly than antenna structures for conventional base stations, and as they can incorporate intelligent algorithms such that once deployed they self-configure, the cost associated with planning a deployment of base stations and relay stations is significantly reduced compared to an all base stations deployment.