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Re:	IEEE P802.16 MMR SG
Abstract	This contribution proposes wording for some sections of the PAR and Five Criteria. The contribution builds upon previous contributions and is submitted for clarification.
Purpose	Discussion
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Recommendations for the PAR and Five Criteria
Mobile Multihop Relay Task Group

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1   Introduction

The Study Group on Mobile Multihop Relay (MMR) for 802.16 was created on 22 July 2005 by the IEEE 802 Executive Committee. This document proposes text for certain sections of the MMR PAR and Five Criteria that is being finalized at the IEEE 802.16 Session 41 in January 2006. This document is in response to call for contributions IEEE 802.16mmr-05/026 [1] dated 2005-12-16 with contributions due 2006-01-06. This document considers previous contributions [2] through [6] which also address the PAR and Five Criteria. Suggested text is provided below for Section 13 (Scope), Section 14 (Purpose), and Section 15 (Reason) of the PAR and all Five Criteria.

2   Recommendation for "Scope of Proposed Project"

The following text is suggested for Section 13 of the PAR:

This project will create an amendment to IEEE 802.16-2004 as modified by IEEE 802.16e-2005 that defines mobile multi-hop relay (MMR) functionality. All relayed paths shall begin/end at a subscriber or mobile station and end/begin at a base station. Minimally modified legacy subscriber and mobile stations shall have relay support when operating in OFDM and OFDMA PMP modes. Relay Stations (RS) may be fixed, nomadic, or mobile and may be installed by a service provider or by a service-provider-approved subscriber. All RS shall be controlled by the relay-enhanced base station and associated system controller. Communications between a BS and an RS may utilize any viable communications medium including but not limited to licensed and license-exempt spectrum. Support for the relay function from communications protocol stack layers above layer 2 may be considered. The creation of a new class of subscriber and mobile stations having relay station functionality may be considered as a system option.

This amendment also enhances IEEE 802.16-2004 as modified by IEEE 802.16e-2005 by defining multi-hop relay functionality for wireless backhaul between base stations and a central controller where physical connection to wired infrastructure is achieved.

3   Recommendation for "Purpose of the Proposed Project"

The following text is suggested for Section 14 of the PAR:

The purpose of the proposed project is to create an amendment to the IEEE 802.16 WirelessMAN standard that defines mobile multi-hop relay functionality compatible with the IEEE 802.16e-2005 amendment. The previously defined mesh mode of IEEE 802.16-2004 is not compatible with IEEE 802.16e-2005. The proposed amendment also defines multi-hop relay functionality for wireless backhaul between base stations and a central controller that is connected to the wired infrastructure. Wireless multi-hop backhaul is not currently defined for IEEE 802.16 WirelessMAN.

4   Recommendation for "Reason for the Proposed Project"

The following text is suggested for Section 15 of the PAR:

The public technical literature contains numerous analyses showing that multi-hop relay technology may improve the coverage & throughput and possibly the capacity of wireless networks. One reason for this project is therefore to enable IEEE 802.16 WirelessMAN systems to experience the gains described in this literature. It is expected that the complexity of relay stations will be considerably less than the complexity of legacy IEEE 802.16 base stations. Therefore, the gains in coverage & throughput can be leveraged to reduce total system cost for a given system performance requirement and thereby improve the economic viability of IEEE 802.16 systems. Further, it is also known that a significant component of the cost of wireless networks is the cost of backhaul. The application of wireless relayed backhaul to IEEE 802.16 WirelessMAN

systems will further reduce the total system costs. Wireless relayed backhaul may also result in improved overall system reliability by allowing backhaul path selection diversity.

5   Recommendations for the Five Criteria

5.1   Broad Market Potential

5.1.1   Broad sets of applicability.

The following text is suggested:

> *IEEE 802.16-2004 WirelessMAN standard provides a wireless alternative to xDSL, Cable, and TDM DS1/DS3 level services. IEEE 802.16e-2005 provides a high data rate alternative to 3G cellular services for mobile data applications. These WirelessMAN standards are broadly accepted as evidenced by intense development activities worldwide. The enhancement of these WirelessMAN standards using relay technology is applicable to IEEE 802.16 standards and is therefore as broadly applicable as the baseline standards themselves. The enhancement of these standards using relay will improve coverage & throughput and/or reduce cost of these systems and will therefore increase the market for these standards.*

5.1.2   Multiple vendors and numerous users

The following text is suggested:

> *The July 2005 request for a Mobile Multi-hop Relay Study Group within the IEEE 802.16 Working Group was endorsed by 77 individuals. During the first two meetings of the SG, forty-three contributions from more than fifteen organizations were received. The baseline standard which will be enhanced by this amendment is supported by a large number of corporations many of which can be identified in the membership list of WiMAX forum as well as the current list of organizations represented by the current IEEE 802.16 individual members. 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.*

5.1.3   Balanced costs (LAN versus attached stations)

The following text is suggested:

> *Support for relay technology is expected to reduce overall system cost due to a reduction in the number of base stations required in a service area. Networks in compliance with the original IEEE 802.16-2004 and IEEE 802.16e-2005 may continue to be manufactured and used where relay technology is not appropriate. Relay enhanced systems will be manufactured and installed only after it has been proven that they result in an overall reduction in system cost and improved availability relative to legacy systems.*

5.2   Compatibility

The following text is suggested:

> *The amendment shall conform to the IEEE 802 family of standards as required. Equipment meeting the specification of this amendment shall also be backward compatible with IEEE 802.16-2004 as modified by IEEE 802.16e-2005. "Backward compatible" means that subscriber and mobile stations manufactured according to the 802.16 standard shall function within the relay-enhanced systems possibly without experiencing the full benefit of the relay enhancement.*

5.3   Distinct Identity

5.3.1   Substantially different from other IEEE 802 standards.

> *The current IEEE 802.16-2004 standard includes a multi-hop mesh (i.e. SS to SS) mode of operation. The current mesh mode is not compatible with the OFDM and OFDMA PMP modes and applies only to fixed subscriber stations.. The mobile multi-hop relay mode proposed in this amendment will be compatible with the OFDM and OFDMA PMP (i.e. BS to SS or BS to MS) full-*

mobility modes and is thereby distinct from the current fixed wireless mesh mode. The IEEE 802.11 Task Group s has also defined mesh modes of operation compatible with the 802.11 medium access and physical layers. Much of the mesh technology of IEEE 802.11 TGs is specific to the 802.11 physical layer and is therefore distinct from the proposed mobile multi-hop relay amendment to IEEE 802.16.

5.3.2   One unique solution per problem (not two solutions to a problem).

The following text is suggested

A single mobile multi-hop relay solution for IEEE 802.16e-2005 will be developed within the proposed Task Group.

5.3.3 Easy for the document reader to select the relevant specification.

The following text is suggested:

The amendment will be written in a manner that the mobile multi-hop relay components of the standard are clearly distinguishable from the baseline standard.

5.4   Technical Feasibility

5.4.1 Demonstrated system feasibility

The following text is suggested:

Numerous publicly available technical analyses and simulations have been done to demonstrate the feasibility of relay technology. In addition, wireless networks employing multi-hop relay 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. Thus, the fundamental concepts of MMR technology have been proven leaving only the specific application to IEEE 802.16 to be proven. Contributions to the Mobile Multi-hop Relay Study Group have already demonstrated a number of options for implementations of MMR for IEEE 802.16.

5.4.2 Proven technology, reasonable testing

The following text is suggested:

MMR technology is an extension of already proven IEEE 802.16-2004 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 IEEE 802.16, while not a completely proven technology, is considered to have a high likelihood of success.

5.4.3 Confidence in reliability

No text is being recommended.

5.4.4 Coexistence of 802 wireless standards specifying devices for unlicensed operation

No text is being recommended.

5.5   Economic Feasibility

5.5.1 Known cost factors, reliable data.

The following text is suggested:

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 have a cost that is consistent with reasonable business strategies. The proposed application of mobile multi-hop relay will reduce overall system costs thereby enhancing the economic viability of IEEE 802.16 systems.

5.5.2 *Reasonable cost for performance.*

The following text is suggested:

> *Because relay stations will be considerably less complex than base stations, their cost is assumed to be considerably less than a base station. A fundamental principle being applied in this MMR amendment to IEEE 802.16 is the use of low-cost relay stations in place of some higher-cost base stations in initial system designs. Thus, reasonable cost for performance is achieved by achieving the same performance as existing systems at reduced cost.*

5.5.3 *Consideration of installation costs.*

The following text is suggested:

> *Relay stations, because they are less complex than base stations, will consume less mains power than a base station so that installation and operational costs are further reduced. Finally, antenna structures for relay stations are expected to be less costly than antenna structures for conventional base stations. For these reasons, it is expected that overall installation costs for a relay-enhanced system will be less than the comparable cost of a non-relay-enhanced system.*

6   Conclusions

The text suggested above was, for the most part, derived from the text in the "Discussion Base for 802.16 Mobile Multi-hop Relay" [2]. Most details are the same, however, wording has been considerably revised to achieve enhanced readability. Some detail has, however, been modified and these details are discussion point for IEEE 802.16 Session 41. The authors credit many of the details above to the authors of [2] and the references therein.

7   References

[1] M. Nohara, "Call for Comments and Contributions: IEEE 802.16's Study Group on Mobile Multi-hop Relay", document IEEE 802.16mmr-05/26, 16 December 2005.

[2] M. Nohara, "Discussion Base for 802.16 Mobile Multi-hop Relay Study Group Draft PAR and Five Criteria", document IEEE 802.16mmr-05/25, 16 December 2005.

[3] M. Hart and S. Vadgama, "Input Text to the PAR and Five Criteria", document IEEE C802.16mmr-05/043, 14 November 2005.

[4] M. Asa, R. Peterson, S. Ramanchandran, D. T. Chen, N. Natarajan, "Recommendations for the Scope and Purpose of the Mobile Multihop Relay Study Group", document IEEE C802.16mmr-05/032, 11 November 2005.

[5] D. Steer, W. Tong, P. Zhu, M. Fong, H. Zhang, D. Paranchych, "MMR PAR and Five Criteria Draft", document IEEE C802.16mmr-05/035, 11 November 2005.

[6] M. Nohara and J. Cho, "PAR and Five Criteria for 802.16 Mobile Multihop Relay", document IEEE C802.16mmr-05/039, 11 November 2005.

8   Revision History

Version No.	Date	Remarks		Author
1.0	2006.01.06	Initial submission for MMR Study Group in Session 41 of IEEE 802.16		all authors