Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**Discussion Base for 802.16 Mobile Multi-hop Replay Study Group Draft PAR and Five Criteria**
Date Submitted	**2005-12-16**
Source(s)	Mitsuo Nohara Mobile Multi-hop Relay SG Chair KDDI Corporation 10-10, Iidabashi 3-chome, Chiyoda-ku Tokyo 102-8460, Japan Acknowledgments: The author would like to thank Mr. Kenji Saito of KDDI R&D Labs. And Dr. JaeWeon Cho of Samsung Electronics for their kind support in preparation of this document.	Voice: +81 3 6678 3599 Fax: +81 3 6678 0279 mailto: mi-nohara@kddi.com
Re:	
Abstract	
Purpose	For comment by 802.16 MMR SG
Notice	This document has been prepared to assist IEEE 802.16. It is offered as a basis for discussion and is not binding on the contributing individual(s) or organization(s). The material in this document is subject to change in form and content after further study. The contributor(s) reserve(s) the right to add, amend or withdraw material contained herein.
Release	The contributor grants a free, irrevocable license to the IEEE to incorporate material contained in this contribution, and any modifications thereof, in the creation of an IEEE Standards publication; to copyright in the IEEE's name any IEEE Standards publication even though it may include portions of this contribution; and at the IEEE's sole discretion to permit others to reproduce in whole or in part the resulting IEEE Standards publication. The contributor also acknowledges and accepts that this contribution may be made public by IEEE 802.16.
Patent Policy and Procedures	The contributor is familiar with the IEEE 802.16 Patent Policy and Procedures <http://ieee802.org/16/ipr/patents/policy.html>, including the statement "IEEE standards may include the known use of patent(s), including patent applications, provided the IEEE receives assurance from the patent holder or applicant with respect to patents essential for compliance with both mandatory and optional portions of the standard." Early disclosure to the Working Group of patent information that might be relevant to the standard is essential to reduce the possibility for delays in the development process and increase the likelihood that the draft publication will be approved for publication. Please notify the Chair <mailto:chair@wirelessman.org> as early as possible, in written or electronic form, if patented technology (or technology under patent application) might be incorporated into a draft standard being developed within the IEEE 802.16 Working Group. The Chair will disclose this notification via the IEEE 802.16 web site <http://ieee802.org/16/ipr/patents/notices>.

IEEE-SA STANDARDS BOARD

PROJECT AUTHORIZATION REQUEST (PAR) FORM - 2005

The submittal deadlines are available at http://standards.ieee.org/board/nes/index.html.
(See NesCom Convention - Item #14)

Prior to submitting your PAR, please review the NesCom Conventions.

1. ASSIGNED PROJECT NUMBER

P _**802.16j**_ (Please leave blank if not available)
(see NesCom Convention – Item #19)

2. SPONSOR DATE OF REQUEST

Day: _**17**_ Month: _**02**_ Year: _**2006**_

3. TYPE OF DOCUMENT

(Please check one.)

☉ Standard for {document stressing the verb "shall"}

☐ Recommended Practice for {document stressing the verb "should"}

☐ Guide for {document in which good practices are suggested, stressing the verb "may"}

4. TITLE OF DOCUMENT

(See NesCom Conventions – Item #5, Item #7)

Draft

**Amendment to IEEE Standard for Local and Metropolitan Area Networks – Part 16: Air Interface for Fixed and Mobile Broadband Wireless Access Systems – Amendment for Physical and Medium Access Control Layers for Mobile Multihop Relay**

5. LIFE CYCLE

☉ Full-Use

☐ Trial-Use

6. TYPE OF PROJECT

☐ New document

☐ Revision of an existing document (indicate number and year existing document was approved in box to the right):

☉ Amendment to an existing document (indicate number and year existing document was approved in box to the right): _**IEEE Std 802.16-2004(as subsequently amended)**_ (####-YYYY)

☐ Corrigendum to an existing document (indicate number and year existing document was approved in box to the right):

☐   Modified PAR (indicate PAR Number and Approval Date here: P___ Day: ___ Month: ___ Year: ___)

Is this project in ballot now? ☐ Yes   ☑ No

State reason for modifying the PAR in Item #21.

7. WORKING GROUP INFORMATION:

Name of Working Group (WG) : _**IEEE 802.16 Working Group on Broadband Wireless Access**_

Approximate Number of Expected Working Group Members: _**200**_

8. CONTACT INFORMATION FOR WORKING GROUP CHAIR

(must be an IEEE-SA member as well as an IEEE and/or Affiliate Member)
(See NesCom Convention Item #3, Item #4)

Name of Working Group Chair: First Name: _**Roger**_ Last Name: _**Marks**_
Telephone: _**+1 303 497 7837**_ FAX: ___ E-mail: _**r.b.marks@ieee.org**_

9. CONTACT INFORMATION FOR CO-CHAIR/OFFICIAL REPORTER,

Project Editor or Document Custodian if different from the Working Group Chair (must be an IEEE-SA member as well as an IEEE and/or Affiliate Member)
(See NesCom Convention Item #3)

Name of Co-Chair/Official Reporter (if different than Working Group Chair): First Name: ___ Last Name: ___
Telephone: ___ FAX: ___ E-mail:___

10. CONTACT INFORMATION FOR SPONSORING SOCIETY OR STANDARDS COORDINATING COMMITTEE

(See NesCom Convention Item #1, Item #3)

Sponsoring Society and Committee: _**C/LM**_
(Please choose the correct acronym for your Sponsor Society/Technical Committee or SCC. For an acronym list, please click here.)
Sponsor Committee Chair: First Name: _**Paul**_ Last Name: _**Nikolich**_
Telephone: _**+1 857 205 0050**_ FAX: ___ E-mail: _**p.nikolich@ieee,org**_

Standards Coordinator (Power Engineering Society Only):
Standards Coordinator: First Name: ___ Last Name: ___
Telephone: ___ FAX: ___ E-mail: ___

IF THIS PROJECT IS BEING SPONSORED BY TWO SPONSORS, PLEASE COMPLETE THE INFORMATION BELOW
Sponsoring Society and Committee: _**MTT**_
(Please choose the correct acronym for your Sponsor Society/Technical Committee or SCC. For an acronym list, please click here.)
Sponsor Committee Chair: First Name: _**Richard**_ Last Name: _**Snyder**_
Telephone: _**+ 1 973 492 1207, ext 23**_
FAX: ___ E-mail: _**r.snyder@ieee.org**_

Standards Coordinator (Power Engineering Society Only):
Standards Coordinator: First Name: ___ Last Name: ___

Telephone: ___ FAX: ___ E-mail: ___

11. SPONSOR BALLOTING INFORMATION

(Please choose one of the following):

◉ Individual Balloting

☐ Entity Balloting

☐ Mixed Balloting (combination of Individual and Entity Balloting)

Expected Date of Submission for Initial Sponsor Ballot: Month: _3_ Year: **_2007_**

Please review the PAR form three months prior to submitting your draft for ballot to ensure that the title, scope, and purpose on the PAR form match the title, scope, and purpose of the draft. If they do not match, you will probably need to submit a modified PAR.

Additional communication and input from other organizations or other IEEE Standards Sponsors should be encouraged through participation in the working group or the invitation pool.

(See NesCom Conventions - Item #20)

12. PROJECTED COMPLETION DATE FOR SUBMITTAL TO REVCOM:

Month: _9_ Year: **_2007_**

If this is a MODIFIED PAR and the completion date is being extended past the original four-year life of the PAR, please answer the following questions. If this is not a modified PAR, please go to Question #13.
(See NesCom Conventions - Item #18)

a. Statement of why the extension is required: ___
b. How many working group members are working on the project? ___
c. How many times a year does the working group meet: ___
      1. In person? ___
      2. Via teleconference? ___
d. How many times a year is a draft version circulated to the working group via electronic means? ___
e. What percentage of the Draft is stable? ___%
f. How many significant working revisions has the Draft been through? ___
g. Balloting History - If the draft has gone to ballot, please provide a history of all IEEE Sponsor ballots under this project in the box to the right. Please include the: ___

    ・Ballot Close Date (or scheduled Close Date)

    ・Ballot Draft Number

    ・Ballot Results (% affirmative, % negative, % abstain)

h. Is this the first request for an extension? ☐ Yes ☐ No
If no, when was the previous extension approved? ___ (DD-MMM-YYYY)

13. SCOPE OF PROPOSED PROJECT

(See NesCom Conventions – Item #6, Item #16, Item #17)

Briefly detail the projected output including technical boundaries.
FOR MODIFIED PROJECTS/REVISION DOCUMENTS - Only detail the projected output including the
scope of the project or last published document to be modified and any amendments and/or additions.

- *Merged draft*

***This document provides enhancements to IEEE Std. 802.16 by employing mobile multi-hop relay techniques
between base station and subscriber mobile station, and the subscriber mobile station operating according to
the existing standard shall be capable of operating with mobile multi-hop relay enabled base station with no
modification and with an relay station with little or no modification.***

- *Baseline example (Session #40)*

C802.16mmr-05/039 (Mitsuo Nohara, et al.)

*This document provides enhancements to IEEE Std. 802.16 by employing mobile multi-hop relay techniques
between base station and mobile subscriber station, and thereby specifies a system and functions on PHY and
MAC layers to support the multi-hop relay.*

- *Proposed drafts (Session #40)*

C802.16mmr-05/035 (David Steer, et al.)

*The proposed project seeks to create extensions to the IEEE 802.16 to provide, as appropriate, interoperable
support for Relay Stations for 'Multi-hop" operation. The extensions will support transport of data, video, and
voice services. It is anticipated that the Relay Stations may be of two types, stations that are notionally fixed in
location and relays stations that are mobile.*

C802.16mmr-05/043r1 (Mike Hart, et al.)

*This document provides enhancements to the MAC, OFDM PHY and OFDMA PHY of the IEEE Std 802.16
such that a fixed, nomadic and mobile relay station (RS) are defined and their operation enabled in a manner
such that they are interoperable with existing IEEE Std 802.16 systems.*

 Is the completion of this document contingent upon the completion of another document?

☐ Yes (with detailed explanation below)   ☑ No

14. PURPOSE OF PROPOSED PROJECT

Briefly, clearly and concisely explain "why" the document is being created.
(See NesCom Conventions - Item #16)

FOR MODIFIED PROJECTS/REVISION DOCUMENTS - Only include the purpose of the project or last
published document and any amendments and/or additions.

- *Merged draft*

***This amendment provides specifications of the multi-hop relay function enhancing coverage, system capacity
and/or user throughput and flexibility of 802.16 networks through the use of interoperable relay stations,
while being compatible with IEEE Std. 802.16.***

- *Baseline example (Session #40)*

C802.16mmr-05/039 (Mitsuo Nohara, et al.)

This amendment provides specifications of the multi-hop relay function enhancing coverage, capacity and flexibility, while being compatible with IEEE Std. 802.16.

- *Proposed drafts (Session #40)*

C802.16mmr-05/035 (David Steer, et al.)

The purpose of the extensions is to improve the coverage and capacity of 802.16 networks through the use of interoperable relay stations.

C802.16mmr-05/043r1 (Mike Hart, et al.)

The purpose of this project is to define the various RS types and the required amendment to the IEEE802.16 standard to enable the RS operation such that they will enable coverage augmentation, throughput enhancement and/or increase in system capacity of an existing deployment.

15. REASON FOR THE PROPOSED PROJECT

Give the specific reason for the standardization project. Focus on explaining the problem being addressed, the benefit to be provided and the stakeholders for the project.

- *Merged draft*

The multi-hop relay is a promising solution to expand coverage, enhance system capacity and/or user throughput, and provide flexibility to IEEE 802.16 systems. In addition, it enables a rapid deployment and also reduces the cost of deploying and operating the systems. Those will expand the market opportunity for Broadband Wireless Access.

This project aims to enable exploitation of such advantages by adding appropriate relaying functionality to IEEE Std 802.16 through the proposed amendment.

- *Baseline example (Session #40)*

C802.16mmr-05/039 (Mitsuo Nohara, et al.)

The multi-hop relay is a promising solution to expand coverage, enhance capacity, and provide flexibility to IEEE 802.16 systems. In addition, it enables a rapid deployment and also reduces the cost of deploying and operating the systems. Those will expand the market opportunity for Broadband Wireless Access.

- *Proposed drafts (Session #40)*

C802.16mmr-05/035 (David Steer, et al.)

The current IEEE 802.16 standard supports only two classes of devices, mobile stations (MSS) and network base stations (BS) and traffic flows between these two station classes. The coverage and performance of a network may be enhanced if traffic may also be relayed through intermediate relay stations (RS). These relay

stations may be in locations that provide advantageous radio coverage to both the network base station and the mobile station, and hence provide improved performance and coverage for mobile stations.

The work envisioned in this project will extend the protocols of 802.16 to support relay nodes for multi-hop traffic forwarding.

C802.16mmr-05/043r1 (Mike Hart, et al.)

It is well known that the use of an RS in an existing network can improve coverage; simple RS are in use today that achieve such an objective. However, it is also known, through considerable research, that an RS can also provide a cost effective method for improving throughput and system capacity in an existing deployment as well as reducing transmit powers and consequently the level of interference. This project aims to enable exploitation of such advantages by adding appropriate relaying functionality to the existing IEEE Std 802.16 through the proposed amendment.

16. INTELLECTUAL PROPERTY

(Please answer each of the questions below)

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 ☐ No

> If yes, state date: Day: ___ Month: ___ Year: ___
> If no, please explain: ___

b. Is the Sponsor aware of copyright permissions needed for this project? ☐ Yes ☒ No

> If yes, please explain: ___

c. Is the Sponsor aware of trademarks that apply to this project? ☐ Yes ☒ No

> If yes, please explain: ___

d. Is the Sponsor aware of possible registration activity related to this project? ☐ Yes ☒ No

> If yes, please explain: ___

17. ARE THERE OTHER DOCUMENTS OR PROJECTS WITH A SIMILAR SCOPE?

☒ Yes (with detailed explanation below) ☐ No

(a) The existing IEEE 802.16-2004 has optional Mesh mode in which traffic can be routed through other subscriber stations and it can also occur directly between subscriber stations. No mobility support and incompatible with mendatory point-to-multipoint (PMP) mode.

(b) IEEE 802.11s project is currently developing an extension to the IEEE 802.11 MAC for providing an IEEE 802.11 Extended Service Set (ESS) Mesh. While the IEEE 802.11 standard addresses primarily short range WLAN applications, this amendment specifically directed toward longer-range wireless point to multipoint MAN systems with mobile multi-hop relay function.

If Yes, please answer the following:
Sponsor Organization: *(a) IEEE 802, (b) IEEE 802*
Project/Document Number: *(a) IEEE Std 802.16-2004, (b) IEEE P802.11s*
Project/Document Date: *(a) 01-OCT-2004 (b) ??* (DD-MMM-YYYY)
Project/Document Title: *(a) IEEE Standard for Local and metropolitan area networks Part 16: Air*
                          Interface for Fixed Broadband Wireless Access Systems
                          (b) ESS Mesh Networking

18. FUTURE ADOPTIONS

Is there potential for this document (in part or in whole) to be adopted by another national, regional or international organization? *Yes*
   If Yes, the following questions must be answered:
   Technical Committee Name and Number: *ITU* TC __ SC __ WG __
   Other Organization Contact Information:
   Contact Name - First Name: *Jose* Contact Name - Last Name: *Costa*
   Contact Telephone Number: *+1 613 763 7574*
   Contact FAX Number: *+1 613 765 1225*
   Contact Email address: *j.costa@ieee.org*

19. WILL THIS PROJECT RESULT IN ANY HEALTH, SAFETY, OR ENVIRONMENTAL GUIDANCE THAT AFFECTS OR APPLIES TO HUMAN HEALTH OR SAFETY?

☐ Yes ☐ No
If yes, please explain: __

20. SPONSOR INFORMATION

a. Is the scope of this project within the approved scope/definition of the Sponsor's Charter? ☒ Yes ☐ No

   If no, please explain: __

b. Have the Sponsor's procedures been accepted by the IEEE-SA Standards Board Audit Committee? ☒ Yes
☐ No
(See NesCom Convention Item #2)

21. ADDITIONAL EXPLANATORY NOTES

(Item Number and Explanation)

__

☒ 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 by FAX to +1 732-875-0695 to the NesCom Administrator before this PAR will be forwarded to NesCom and the Standards Board for approval.

(See NesCom Conventions - Item #8, Item #9, Item #10

FIVE CRITERIA FOR IEEE 802.16 MOBILE MULTI-HOP RELAY PAR

IEEE P802.16mmr Five Criteria, Draft 0
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).

- *Merged draft*

a) IEEE802.16 wireless standard, will take place of xDSL, Cable, T1 level services and fiber optic broadband technologies. Also the one with mobility support will 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 Multi-hop Relay)-SG by 77 members including various manufacturers and telecom operators, signifies the possibility of multiple vendors.
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, the 802.16 with relay stations may be used for 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, MMR system is cost effective to accommodate many mobile subscribers and establish the wide area and the higher data rate.

- *Baseline example (Session #40)*

C802.16mmr-05/039 (Mitsuo Nohara, et al.)

a) IEEE802.16 wireless standard, will take place of xDSL, Cable, T1 level services and fiber optic broadband technologies. Also the one with mobility support will provide wireless access at a higher rate compared with conventional cellular services. The throughput enhancement and coverage extension through relay stations will expand such market potential.

b) IEEE802.16's high transmission speed and wide coverage for Wireless MAN, attract many commerce leaders. The approval of MMR (Mobile Multi-hop Relay)-SG by 77 members including various manufacturers and telecom operators, signifies the possibility of multiple vendors.
When we provide a higher transmission rate access to a user, the service coverage can be reduced in reverse proportion. The relay capabilities will be able to overcome this issue, and increase the possible number of users.

c) The relay stations with the PMP (Point-to-Multipoint) mode can provide wireless packet forwarding functions with simpler and more compact station configuration, thus at low cost. Thus, MMR system is cost effective to accommodate many mobile subscriber stations and establish the wide area and the higher data rate.

- ***Proposed drafts (Session #40)***

C802.16mmr-05/035 (David Steer, et al.)

a) The extension of the 802.16 to support relay stations is applicable to all 802.16 networks and enhances their coverage and operation for multi-media traffic. The relay stations may be applied to existing or new-build networks. The principles of the enhancements may be applied to other radio communications networks.

b) The 802.16 support for relay stations may be used for 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 does not change the costs for existing stations or networks, and enables improved performance capacity and coverage through their addition to existing or future networks.

C802.16mmr-05/043r1 (Mike Hart, et al.)

a) The amendment will be applicable to the already existing IEEE Std 802.16 which itself already has a broad set of applicability, and through this amendment the applications of this standard will be further broadened due to the amendment enabling lower cost deployments and improved performance. This is because the amendment will provide a cost effective way to either improve throughput in a non-coverage limited scenario or considerable increase in range in a coverage limited scenario, thus increasing the performance and reach of the existing standard.

b) Refer to cosignatories.

c) The relay station (RS) which will be introduced through the amendment will be of reduced complexity when compared to the basestation (BS). It is well known that it is possible to use cheaper RS's to improve coverage, throughput and system capacity as an alternative to using more costly BS's.

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.

- ***Merged draft***

The proposed amendment will conform to IEEE Std 802.16e (P-MP mode), excluding the MMR extension.

- *Baseline example (Session #40)*

C802.16mmr-05/039 (Mitsuo Nohara, et al.)

The proposed standards will conform to IEEE Standard 802.16 and 802.16e (P-MP mode), excluding the MMR extension.

- *Proposed draft (Session #40)*

C802.16mmr-05/035 (David Steer, et al.)

The proposed amendment will be compatible with the 802.16 architecture and standards.

C802.16mmr-05/043r1 (Mike Hart, et al.)

Compatible with the IEEE Std. 802.16.

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.

- *Merged draft*

a) The only similar standards purposing to expand the single hop connectivity are the amendment being developed by TGs of the IEEE 802.11 Working Group and the already existing Mesh mode in the IEEE Std 802.16. However, these are limited only to mesh architecture and this amendment will develop a distinctly different, yet cost and performance-effective extension for the point to multi-point mode of the IEEE Std 802.16 to achieve the coverage extension from a BS and the possible throughput enhancement in shadowed or underserved coverage regions.
It should be noted that this project is targeted to amend the current standards without changing the operational frequency band, i.e. the co-frequency scheme with the current single-hop connections.

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 extension to the IEEE Std 802.16 so that users can easily distinguish the amendment from the original standard.

- *Baseline example (Session #40)*

C802.16mmr-05/039 (Mitsuo Nohara, et al.)

a) The current standards aim to provide a single hop connectivity for user terminals. The modification to the existing standards for the purpose for MMR includes:
    Coverage extension from a BS;
    Throughput enhancement in specific areas;
    MAC for MMR support;
    Route selection via relay stations.

11

It should be noted that this project is targeted to extend the current standards without changing the operational frequency band, i.e. the co-frequency scheme with the current single-hop connections.

b) By modifying the existing IEEE Standard 802.16 and 802.16e (P-MP mode), a unique solution will be developed. The MMR extension to the standard will provide wider coverage areas and higher throughput without increasing the transmission power of user terminals.

c) It is anticipated that the document will be easily selectable by the user.

- *Proposed draft (Session #40)*

C802.16mmr-05/035 (David Steer, et al.)

a) There are no other IEEE 802 projects working to develop support of relay stations for 802.16 networks.

b) The support of relay stations to enhance coverage in shadowed or underserved coverage regions is a unique solution applicable to 802.16 networks.

c) The project will produce an interoperable extension to the IEEE 802.16 standard.

C802.16mmr-05/043r1 (Mike Hart, et al.)

a) The only similar standards are the amendment being developed by TGs of the IEEE 802.11 Working Group and the already existing Mesh mode in the IEEE Std 802.16. However, these are limited only to mesh architecture and this amendment will develop a distinctly different, yet cost and performance-effective extension for the point to multi-point mode of the IEEE Std 802.16.

b) The amendment will provide a unique solution to the problem of increasing coverage and improving throughput in an easy to manage and cost effective manner.

c)

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

- *Merged draft*

a) One purpose of some wireless relay systems such as IEEE 802.11 TGs, which are already developed, is to extend coverage areas. Furthermore, the performance of wireless relay systems have been examined and revealed by theoretical analyses and computer simulations. 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.

c) MMR technology leverages IEEE Std 802.16 technologies and signaling.

d) The working group proposing a wireless project is required to demonstrate coexistence through the preparation of a Coexistence Assurance (CA) document unless it is not applicable.

The project will create a CA document for those aspects of the 802.16 relay station operation that may occur in unlicensed spectrum to assure compatibility with other 802 wireless standards that may be sharing the same spectrum band.

- *Baseline example (Session #40)*

C802.16mmr-05/039 (Mitsuo Nohara, et al.)

a) Some wireless systems such as IEEE 802.11 TGs and mesh FWA (Fixed Wireless Access) are already studied and developed. Relaying data between wireless stations is one of the most popular solutions to extend a wireless coverage area.

b) The MMR protocol is an extension of P-MP mode in both IEEE Standard 802.16 and 802.16e.

c) Most of the technology of the new protocols leverages the technology of IEEE Standard 802.16 and 802.16e. Furthermore, some FWA systems use such technology to establish wireless backhaul network.

d)

- *Proposed draft (Session #40)*

C802.16mmr-05/035 (David Steer, et al.)

a) The practical feasibility of supporting relay stations with 802.16 equipment has not yet been demonstrated, although technical studies have indicated its feasibility and value.

b) The main components of 802.16 technology and signalling are in use today and are readily extended to support relay nodes.

c) There are outdoor IEEE 802.16 systems in operation today, and they have demostarted reliability for the services offered.

d) The working group proposing a wireless project is required to demonstrate coexistence through the preparation of a Coexistence Assurance (CA) document unless it is not applicable.

The project will create a CA document for those aspects of the 802.16 relay station operation that may occur in unlicensed spectrum to assure compatibility with other 802 wireless standards that may be sharing the same spectrum band.

C802.16mmr-05/043r1 (Mike Hart, et al.)

a) The use of very basic relaying is already employed in many current deployments in order to provide coverage in areas that are otherwise uncovered. The fundamental theoretical benefits of relaying are well known and researched. Moreover, coverage-capacity performance of advanced relay systems, such as those proposed in this project, have been verified by means of system level computer simulation. Consequently, the feasibility of potential improvements that are offered by the use of relaying has been clearly demonstrated.

b) The existing standard itself is already a proven and tested technology. The technology associated with the amendment is in use in a very basic and limited way today. This provides a practical foundation for the defining the proposed relay functionality.

c) See above.

d)

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.

- *Merged draft*

a) 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 enable to provide a more cost effective solution to extend a service area than deploying more base stations because relay station will be of lower cost than base station due to its lesser complexity than base station and it does not need the communication cabling cost for itself.

c) Relay station will be installed more easily than base station due to their smaller size, lower power consumption and elimination of communication cable. As they can incorporate intelligent algorithms such that once deployed they self-configure, the cost associated with planning a deployment of base station and/or relay station is significantly reduced compared to an all base station deployment.

- *Baseline example (Session #40)*

C802.16mmr-05/039 (Mitsuo Nohara, et al.)

a) Relay technology enable to extend a service area at low cost since it does not need at least communication cabling cost for the RS since it can be provided in wireless manner.

b) The new protocol is based thus can highly depend on and P-MP mode in both IEEE Standard 802.16 and 802.16e, which is to be widely developed. Additionally, the new technology will minimize the installation cost to extend a service area than setting of a new BS (Base Station).

c) To install the relay function discussed in MMR SG, a few requires are needed and most of the technology of the new protocol can leverages the technology of IEEE 802.16 standard.
* This sentence may be deleted as it looks duplicated with the first part of comment (b) above.

- *Proposed drafts (Session #40)*

C802.16mmr-05/035 (David Steer, et al.)

a) The fundamental radio and base-band architecture of the 802.16 radios and networks is well known, and the addition of a relay station class is a low risk extension.

b) The extension of IEEE 802.16 products and/or chipsets to cover relay station operation is incremental to basic operation and is only applicable to those networks that opt to use the capability.

c) The installation cost 802.16 networks with relay stations do not affect existing network costs and is anticipated to reduce cost for improved coverage and performance for new networks.

C802.16mmr-05/043r1 (Mike Hart, et al.)

a)

b) RS stations will be of lower cost than a BS due to their lower complexity, however it is known that they will provide improved system performance and consequently can provide a more cost effective solution to improving system performance compared with deploying more base stations.

c) RS stations will be much simpler to install than BS due to their smaller size, power consumption and the fact that they do not require separate backhauling. As they can incorporate intelligent algorithms such that once deployed they self-configure, the cost associated with planning a deployment of BS and/or RS is significantly reduced compared to an all BS deployment.