

An ARQ scheme for IEEE 802.16j multihop relay networks

IEEE 802.16 Presentation Submission Template (Rev. 8.3)

Document Number:

S80216j-06_213.pdf

Date Submitted:

2006-11-14

Source:

Peng-Yong Kong, Derek Leong, Haiguang Wang, Yu Ge,
Chen-Khong Tham, and Wai-Choong Wong
Institute for Infocomm Research
21 Heng Mui Keng Terrace, 119613 Singapore

Voice: +65-6874.8530

Fax: +65-6776.8109

E-mail: kongpy@i2r.a-star.edu.sg

Venue:

IEEE 802.16 Session #46, Dallas, Texas, USA.

Base Document:

None.

Purpose:

Propose a cooperative ARQ scheme to be considered for Section 6.3.4.6 ARQ Operation.

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.

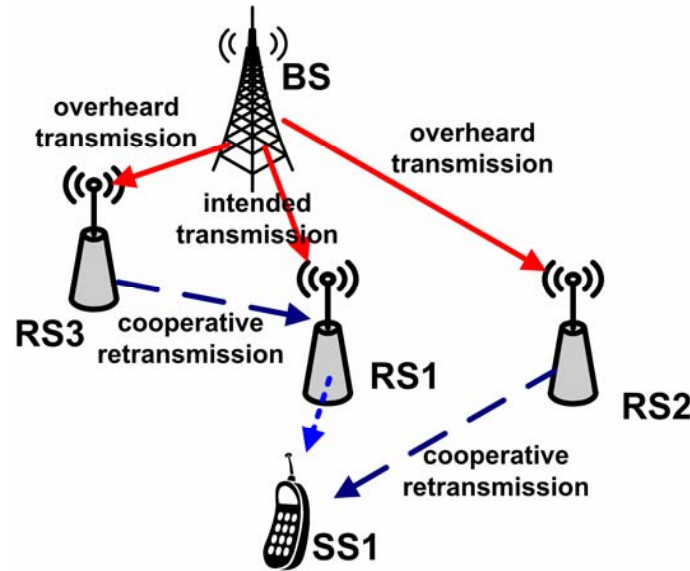
Release:

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.

IEEE 802.16 Patent Policy:

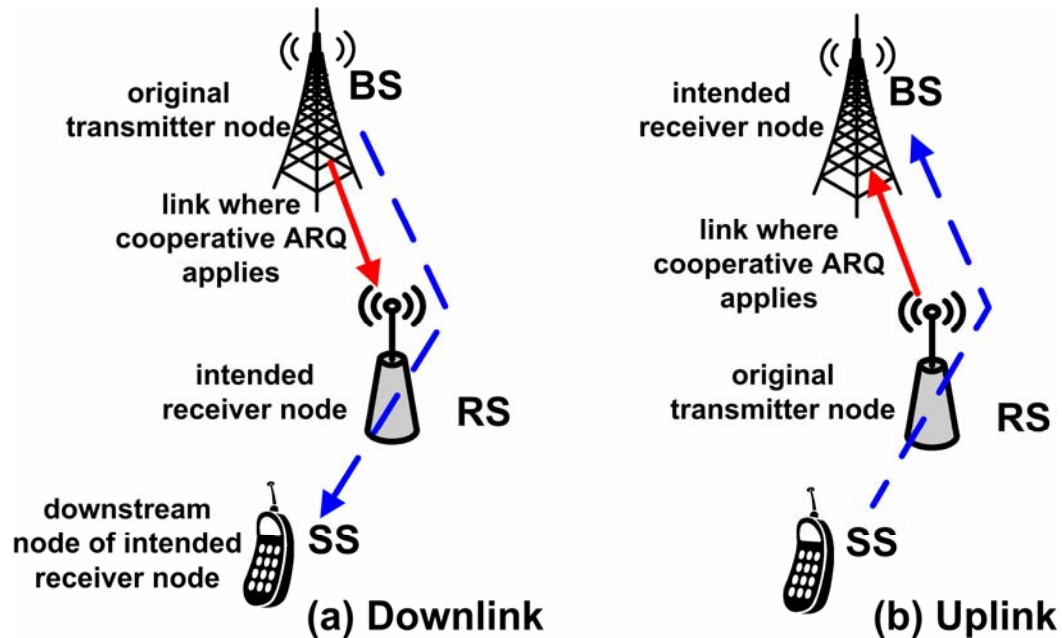
The contributor is familiar with the IEEE 802.16 Patent Policy and Procedures <<http://ieee802.org/16/ipr/patents/policy.html>>, including the statement "IEEE standards may include the known use of patent(s), including patent applications, provided the IEEE receives assurance from the patent holder or 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>>.

Cooperative Retransmission

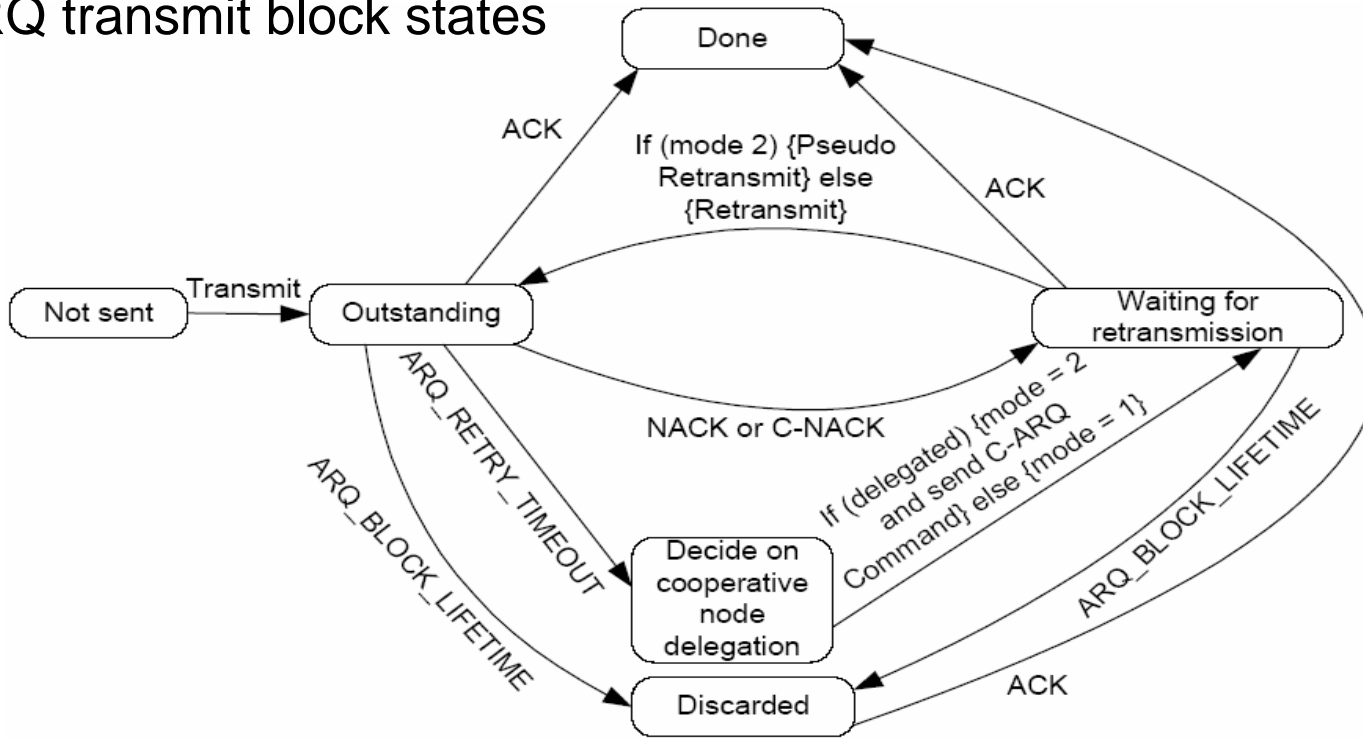


- BS transmit to SS1 in two hops via RS1. In the first hop, transmission from BS to RS1 is overheard by RS2 and RS3.
- Traditionally, a failed transmission is retransmitted by the original transmitter (BS in this case).
- Not effective: (1) the original link could suffer from extended fading, (2) other overhearing nodes have better links.
- We propose that a failed transmission to be retransmitted from overhearing nodes to SS1, or to RS1.

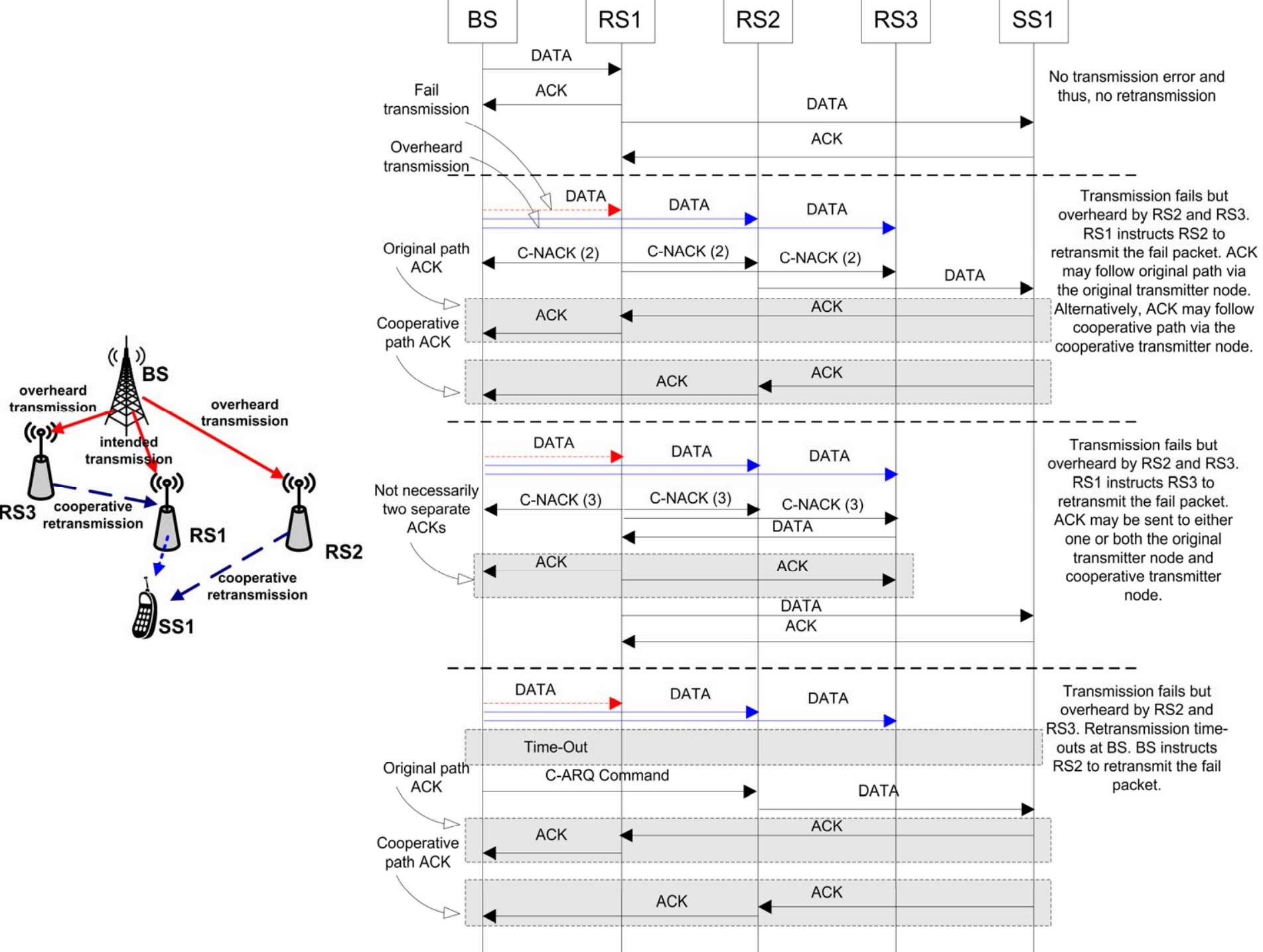
- To be implemented where there is at least one non-SS hop, so that there is not change required at SS.
- Non-SS hop = a hop with no SS node at both its end points



- ARQ transmit block states



- 5 possible states: Not-sent, Outstanding, Waiting-for-retransmission, Discard, Delegate.
- Mode 2 = Retransmission Delegated. Mode 1 = Retransmission Not Delegated.
- “Pseudo Retransmit” = following the original ARQ process which includes starting the ARQ_RETRY_TIMEOUT timer but not actually transmitting the packet.



Decision algorithm for cooperative retransmission

```
//Decision on performing actual or pseudo retransmission by the original transmitter node.
//Link quality is calculated as the ratio of total number of packets positively acknowledged
//over total number of packets transmitted. If the ratio is not more than 0.5, the link quality
//is consider bad.
if (link quality between original transmitter and intended receiver is bad)
mode = 2;
else
mode = 1;

//Decision on selecting cooperative node and receiver node.
//S1 is the set of nodes with good link quality, and are within the range of the original
//transmitter node, the intended receiver node and the downstream node of intended
//receiver.
//S2 is the set of nodes with good link quality, and are within the range of the original
//transmitter node and the intended receiver node.
// Q1,i is the link quality between i-th node in S1 and the downstream node of intended
//receiver.
// Q2,i is the link quality between i-th node in S2 and the intended receiver node.
// Wk,i is the willingness to cooperate as declared by the i-th node in Sk.
if (S1 is not empty) {
cooperative node = arg max  $i \in S_1$  {W1,i × Q1,i};
receiver node = downstream node of the intended receiver;
}
else if (S2 is not empty) {
cooperative node = arg max  $i \in S_2$  {W2,i × Q2,i};
receiver node = intended receiver;
}
else
original ARQ procedure;
```

Scheduling algorithm for cooperative retransmission

```
generate a random number  $x$  within the range and inclusive of 0 and 1
if ( $x \leq P_1$  and own packet queue is not empty)
    transmit own packet;
else if ( $x \leq P_1 + P_2$  and retransmission queue is not empty)
    retransmit own failed packet;
else if ( $x \leq P_1 + P_2 + P_3$  and identified as cooperative node and the failed packet is buffered)
    retransmit overheard failed packet;
```

// $P_1 + P_2 + P_3 = 1$

// $P_1 \geq P_2 + P_3$.

// Suggestion: $P_1 = 2 \times (P_2 + P_3)$ and $P_2 = P_3$

Syntax	Size	Notes
C-ARQ_IE(LAST) {	<i>variable</i>	
COOPERATIVE NODE	16 bits	The identified Cooperative Node
LAST	1 bit	0 = More C-ARQ IE in the list 1 = Last C-ARQ IE in the list
TYPE	2 bits	0x0 = C-ARQ Feedback (C-NACK) 0x1 = C-ARQ Command 0x2 = reserved 0x3 = reserved
CID	16 bits	The ID of the connection being referenced
BSN	11 bits	Block Sequence Number
MODE	2 bits	0x0 = reserved 0x1 = Not Pseudo Retransmission 0x2 = Pseudo Retransmission 0x3 = reserved
RECEIVER NODE	16 bits	The identified Receiver node
}		

C-ARQ IE