

An ARQ scheme for IEEE 802.16j multihop relay networks

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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

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None.

Purpose:

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

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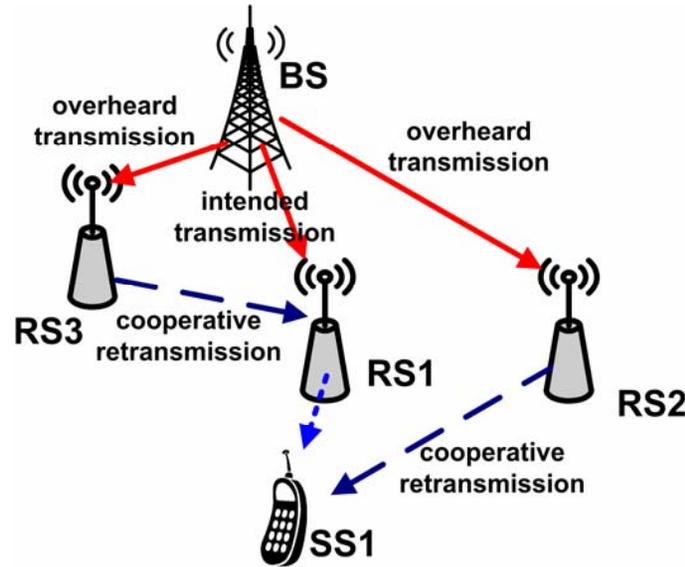
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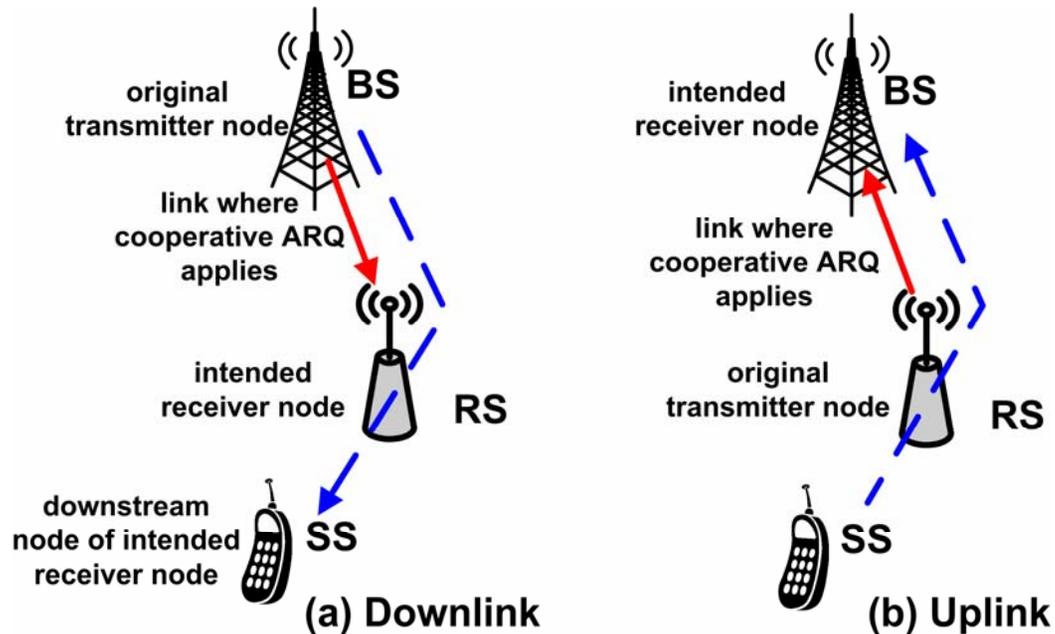
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Cooperative Retransmission

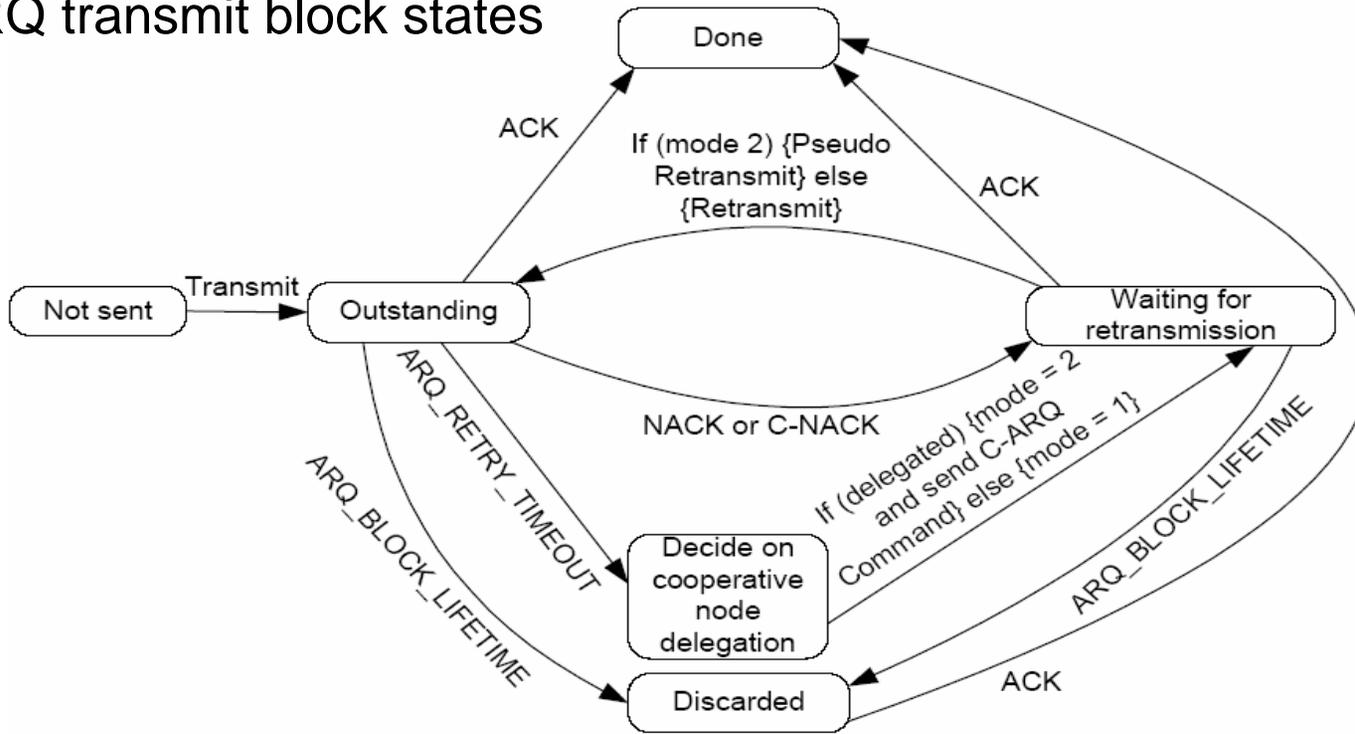


- BS transmit to SS1 in two hops via RS1. In the first hop, transmission from BS to RS1 is overheard by RS2 and RS3.
- Traditionally, a failed transmission is retransmitted by the original transmitter (BS in this case).
- Not effective: (1) the original link could suffer from extended fading, (2) other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

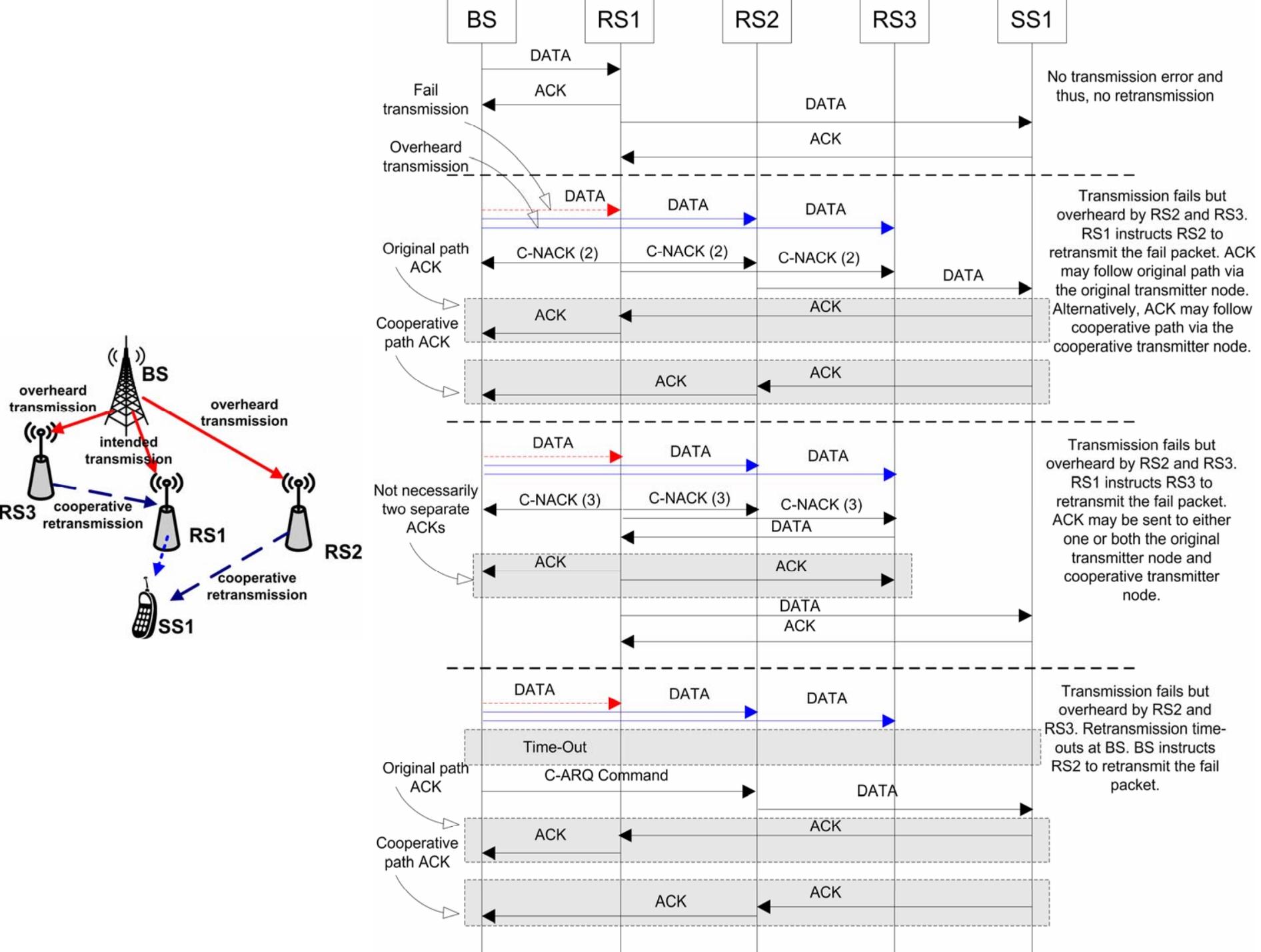
- To be implemented where there is at least one non-SS hop, so that there is not change required at SS.
- Non-SS hop = a hop with no SS node at both its end points



- 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