

Relay Frame Structure for IEEE 802.16m

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Source:

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LG Electronics Mobile Research

Re:

TGm Call for Contributions, IEEE 802.16m-07/047, specifically on “16m Frame Structure with special attention to legacy support”

Abstract:

Discussion on the 16m frame structure for enhanced relay support

Purpose:

To discuss the frame structure in the 802.16m SDD

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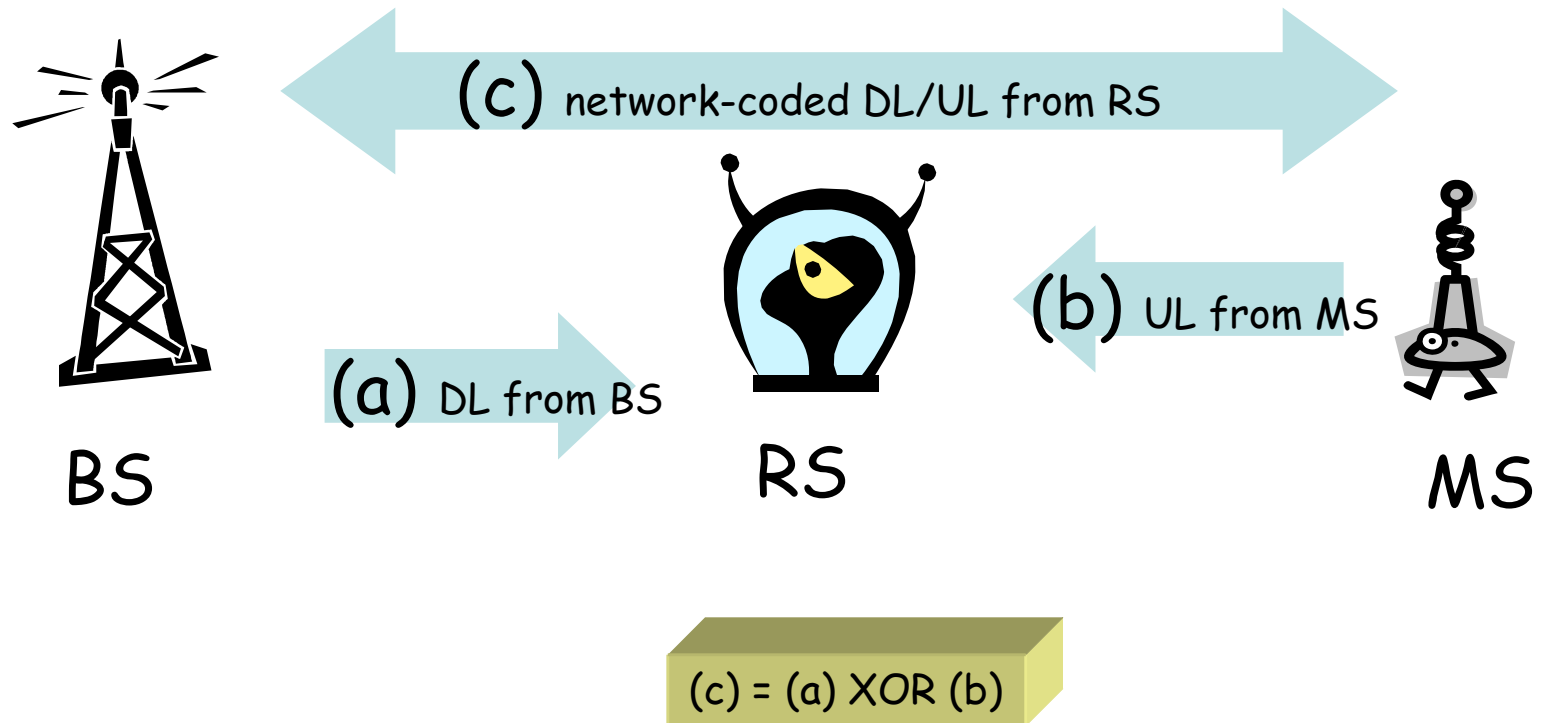
Patent Policy:

The contributor is familiar with the IEEE-SA Patent Policy and Procedures:

<http://standards.ieee.org/guides/bylaws/sect6-7.html#6> and <http://standards.ieee.org/guides/opman/sect6.html#6.3>.

Further information is located at <http://standards.ieee.org/board/pat/pat-material.html> and <http://standards.ieee.org/board/pat>.

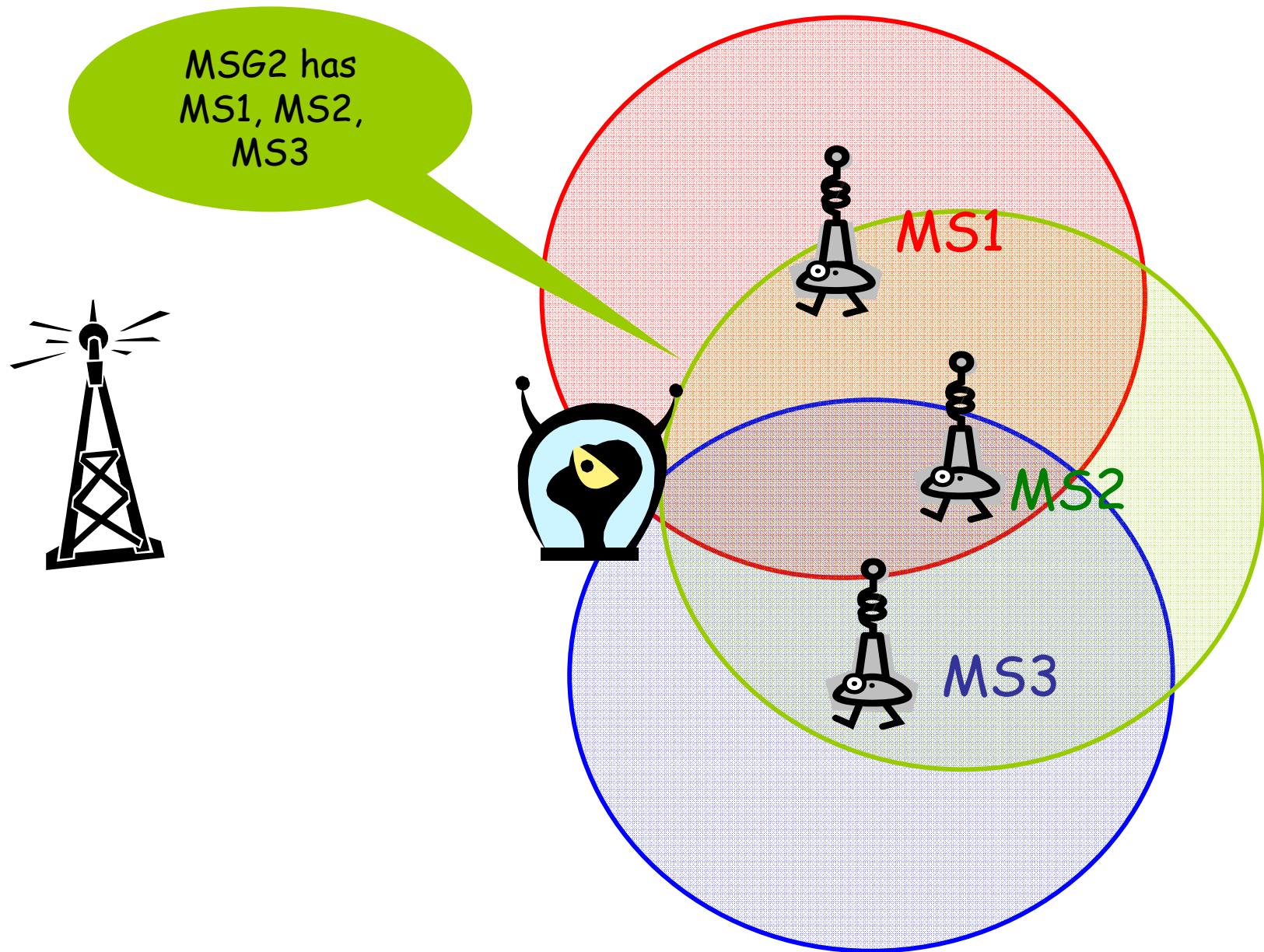
Relay in a cellular network using combined transmission



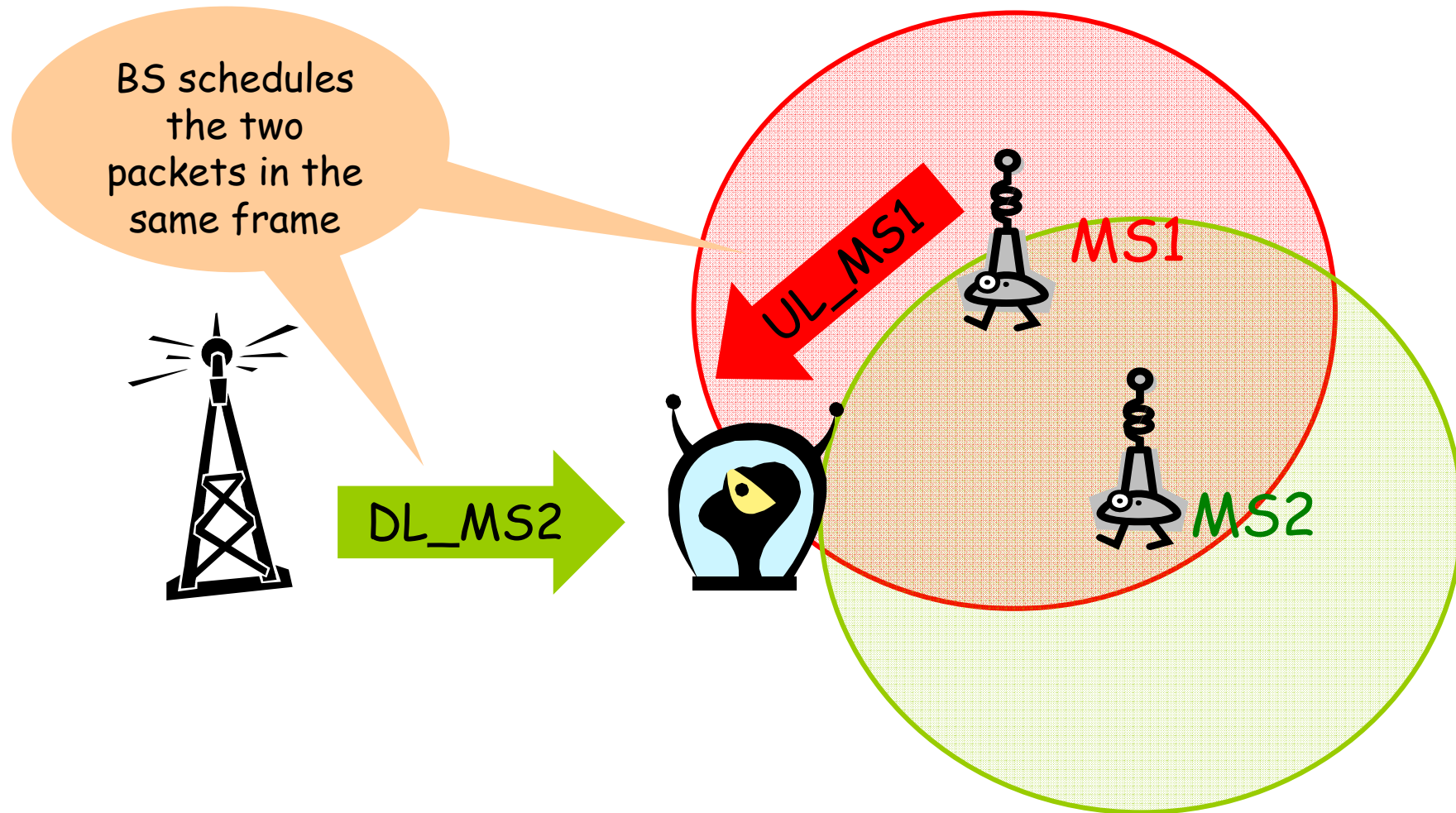
MSG & BS Scheduling

- Each MS maintains a MS Group (MSG) consisting of the neighboring MSs whose MSG report is decodable during UL sub-frame
- MS reports its MSG to BS periodically
- BS scheduler pairs the transmissions of a DL packet to MS2 and an UL packet from MS1, with MS1 in MS2's MSG, to maximize the possibility that combined transmission can be used if there is a retransmissions by relay
- MS1 & MS2 can be the same MS

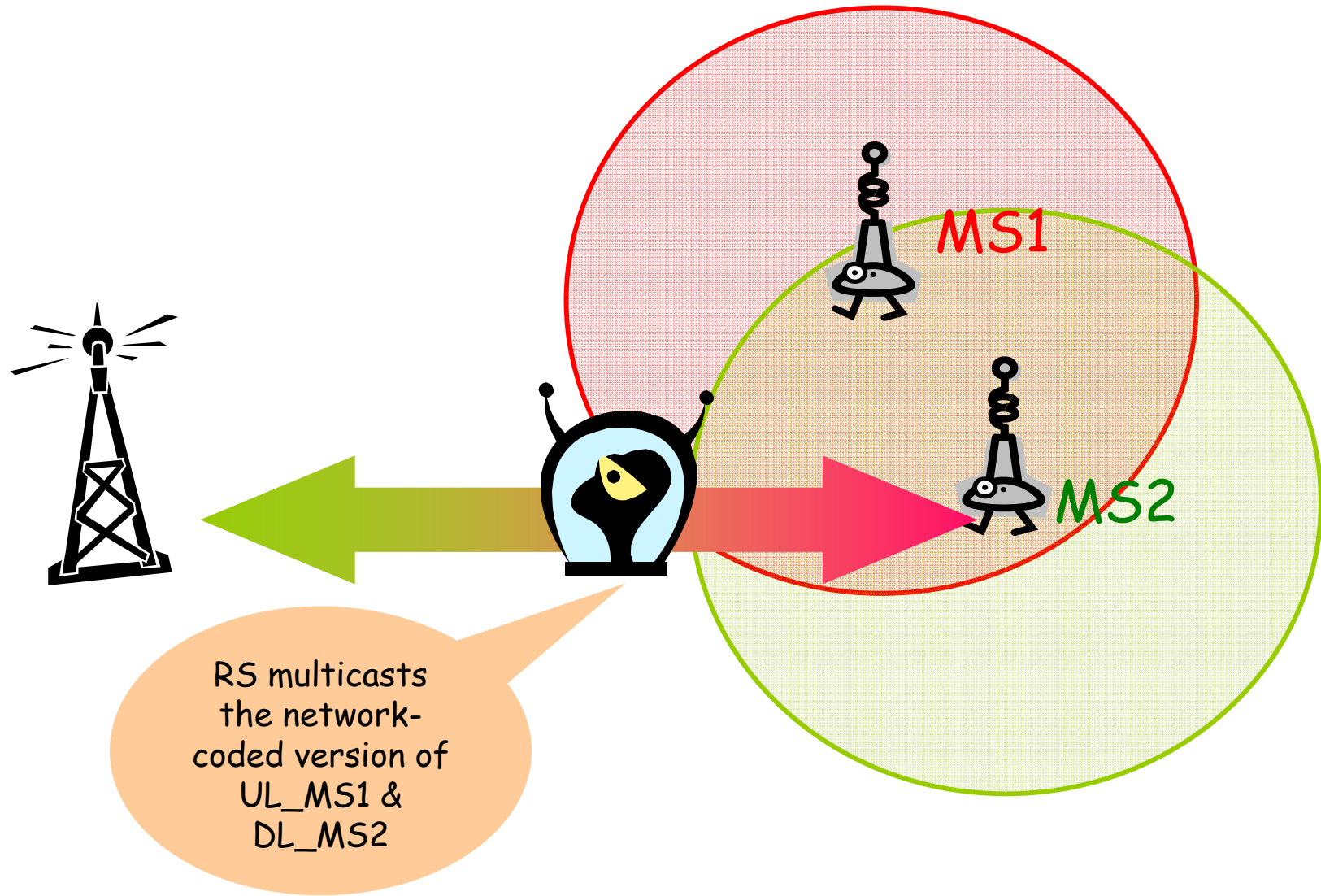
MS Group (MSG)



BS schedules based on MSG



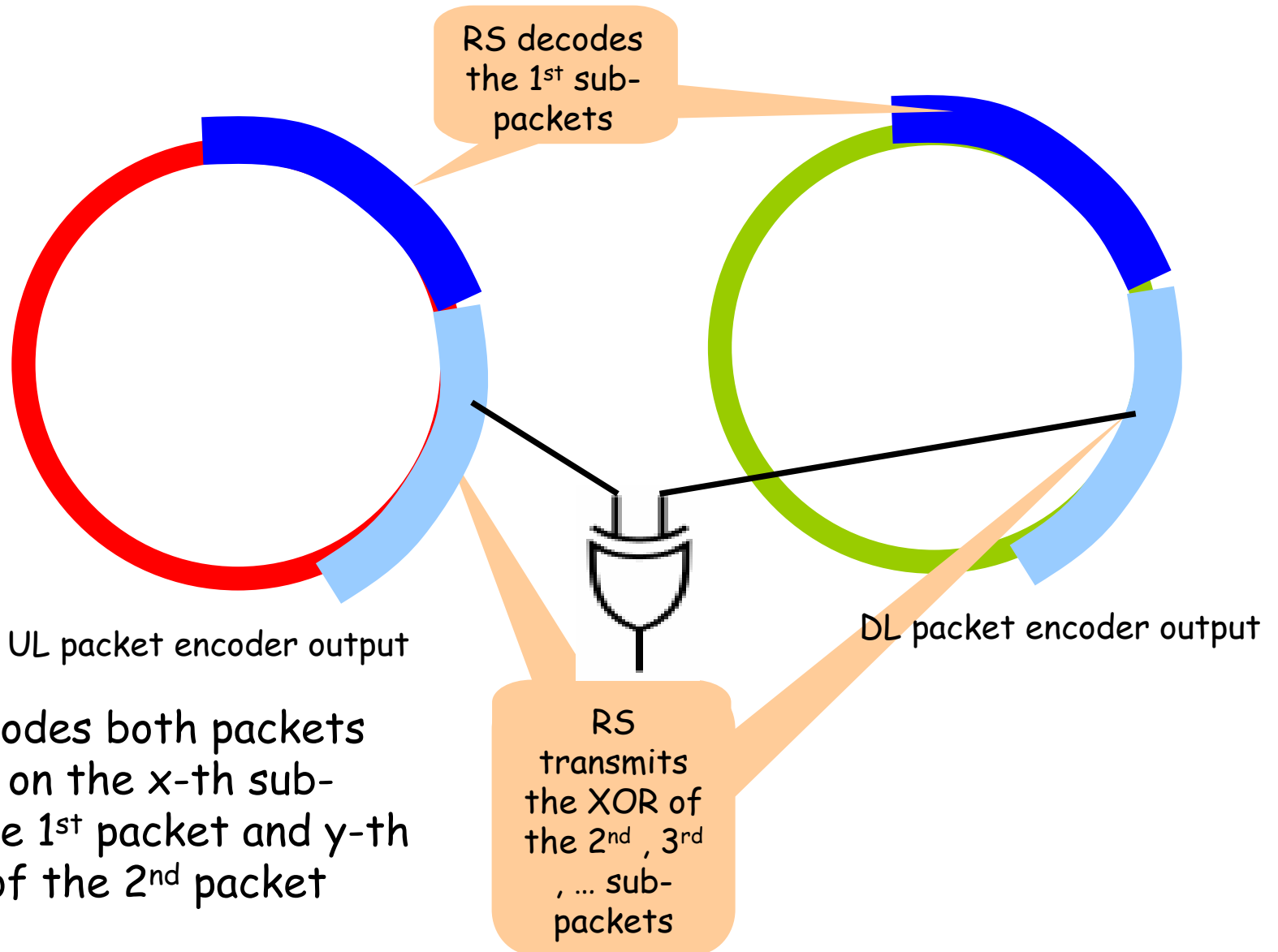
Relay sub-frame



Co-operative relay support

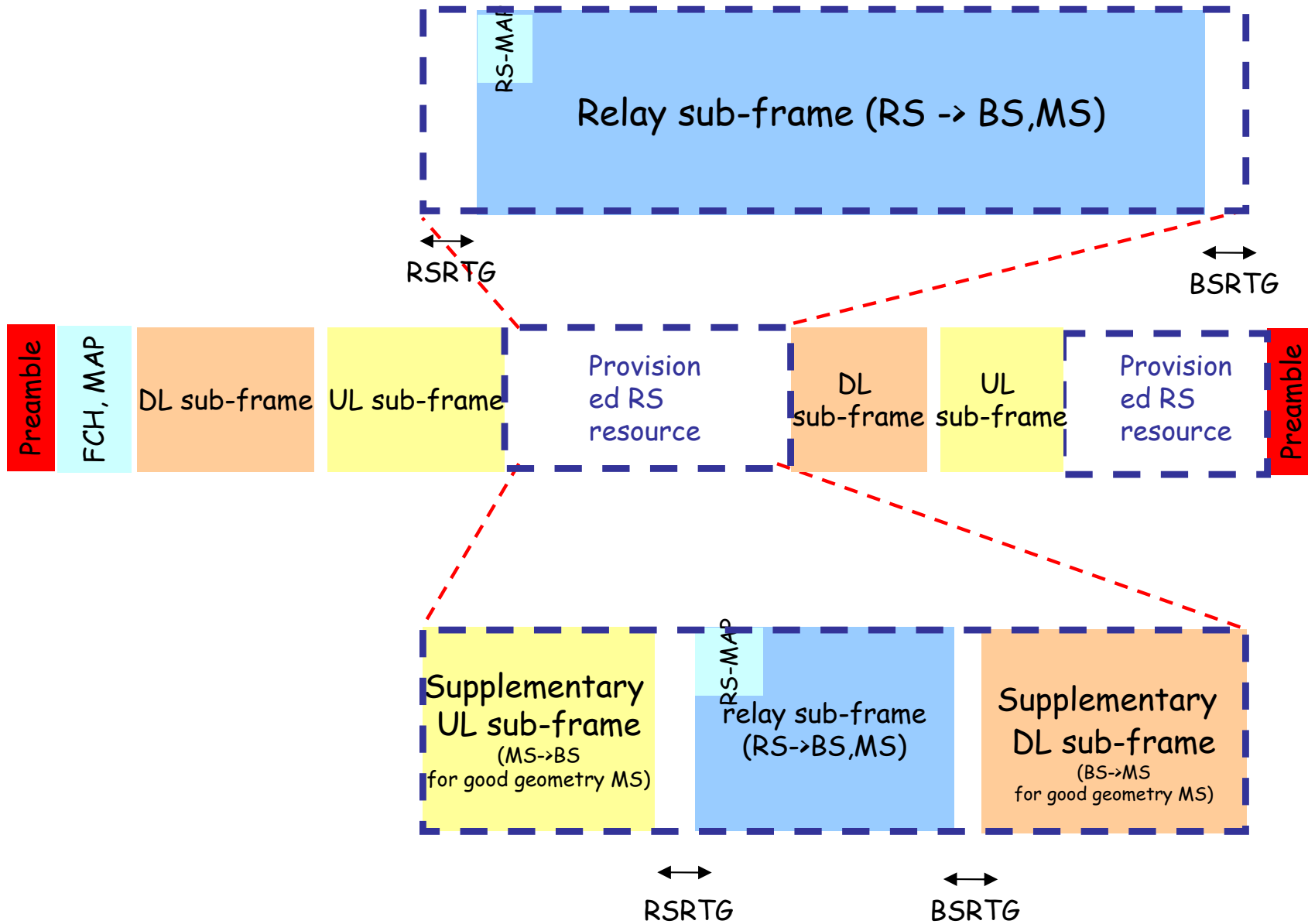
- To support co-operative relay, the RS does not transmit a separated coded PHY packet
 - Instead, RS re-encodes the UL and DL packets and sends the XOR of the parity bits
 - BS/MS uses its own parity bits (not transmitted) to descramble the received parity bits, and decode the packets
- Receiver combines the information from both the source and RS (after de-scrambling) to decode the packet
- Co-operative relay with reduced RS BW consumption

Co-operative relay support

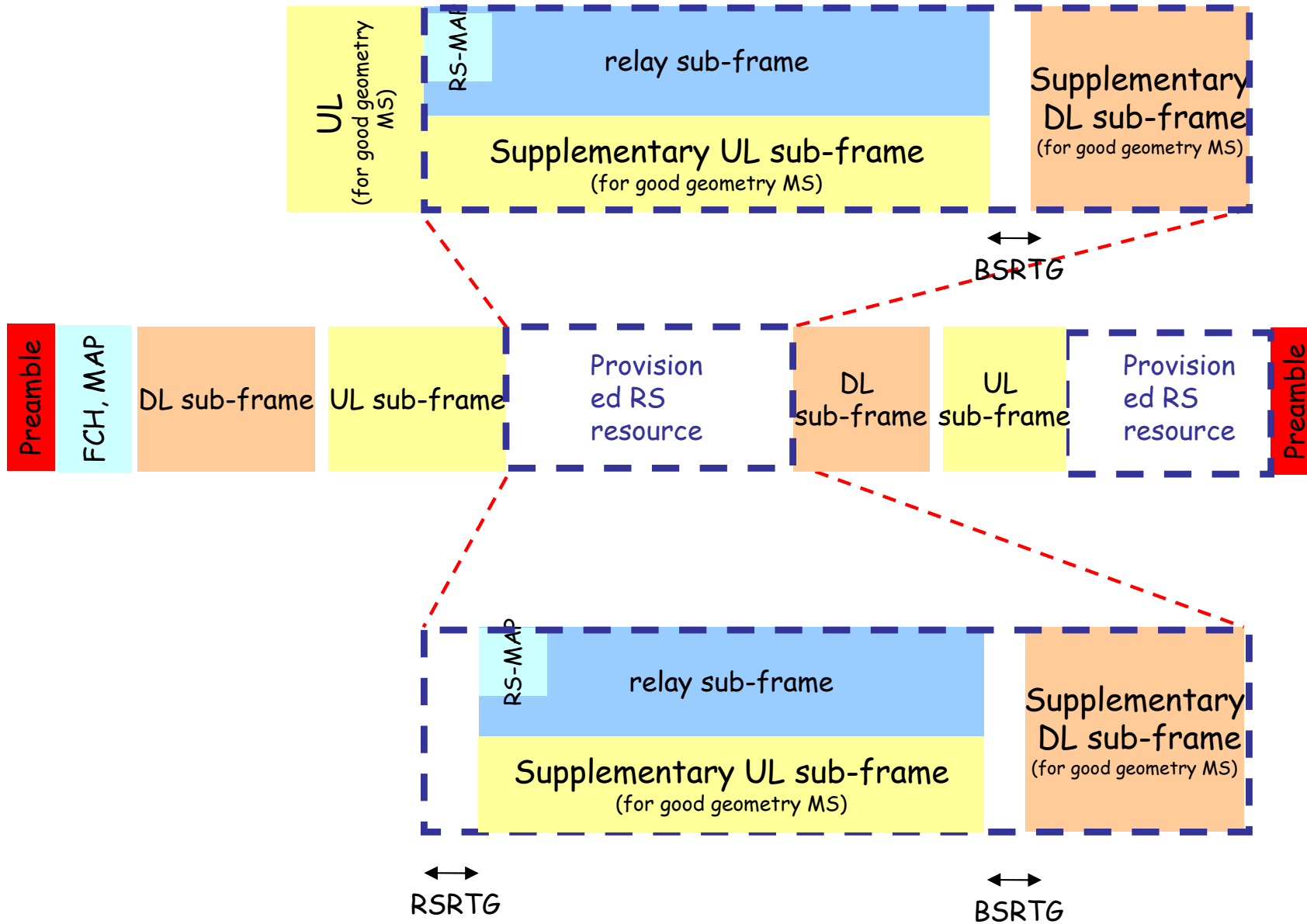


- Relay re-encodes both packets
- XOR is done on the x-th sub-packet of the 1st packet and y-th sub-packet of the 2nd packet

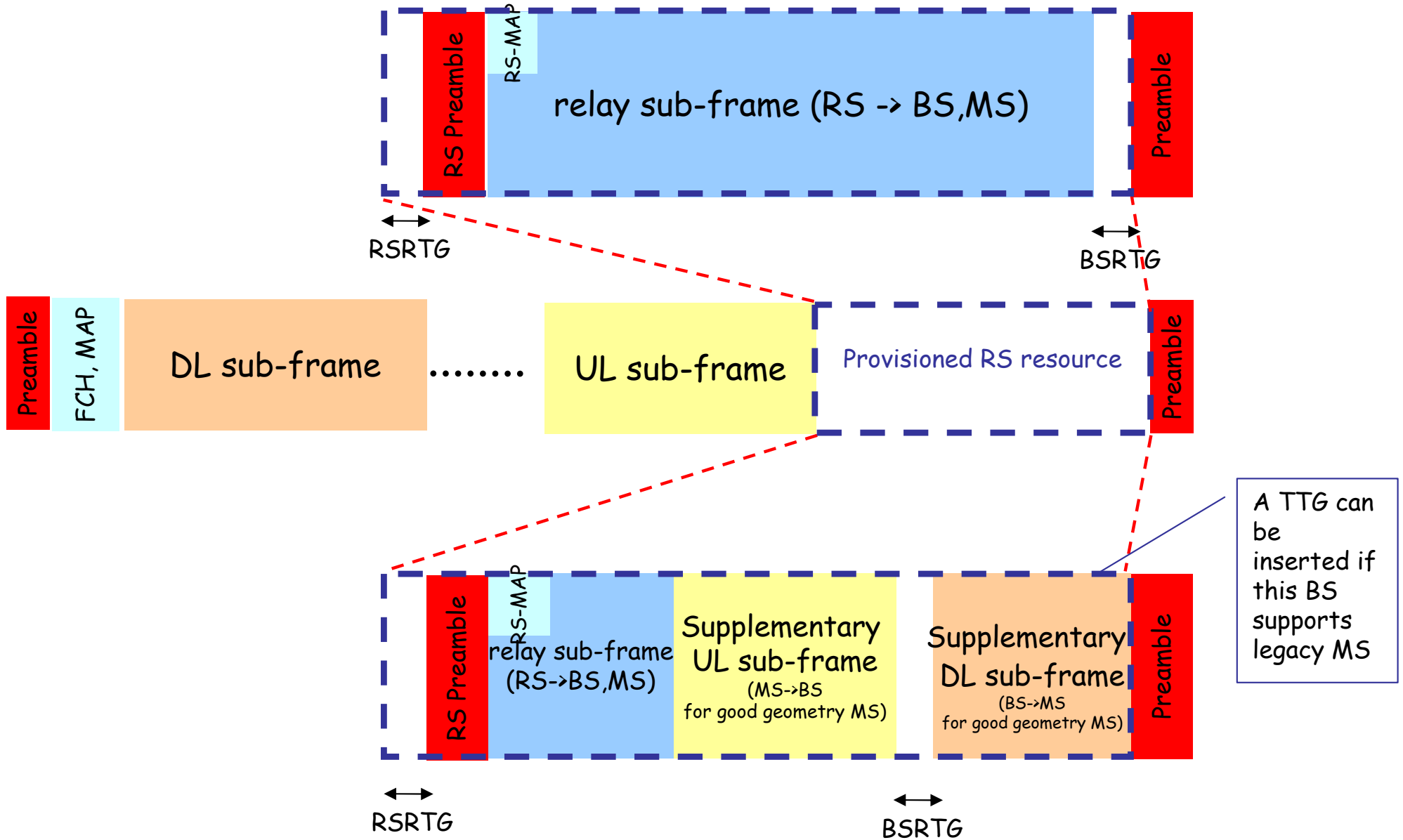
Proposed relay-sub-frame type A



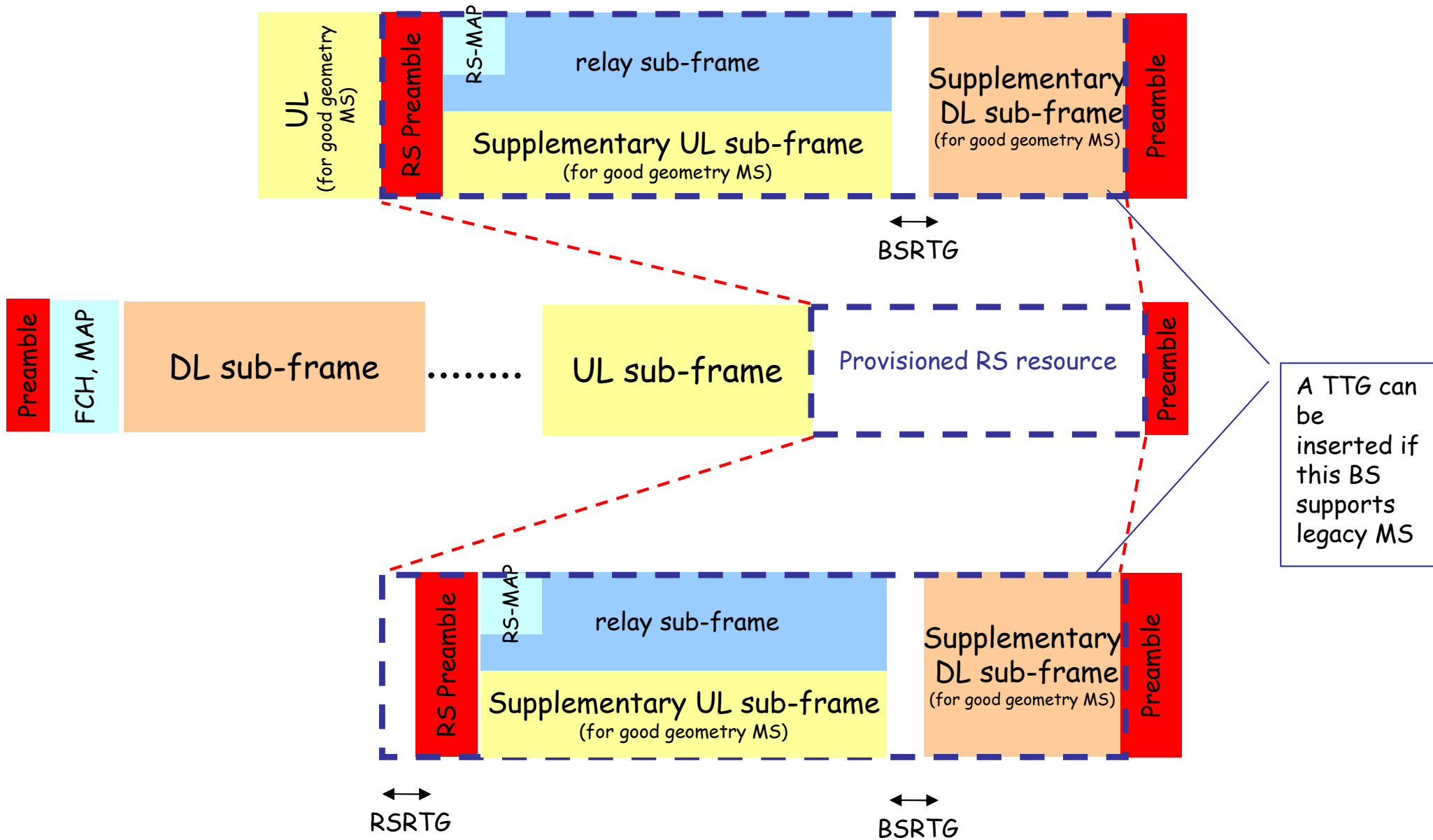
Proposed relay-sub-frame type A



Proposed relay-sub-frame type B



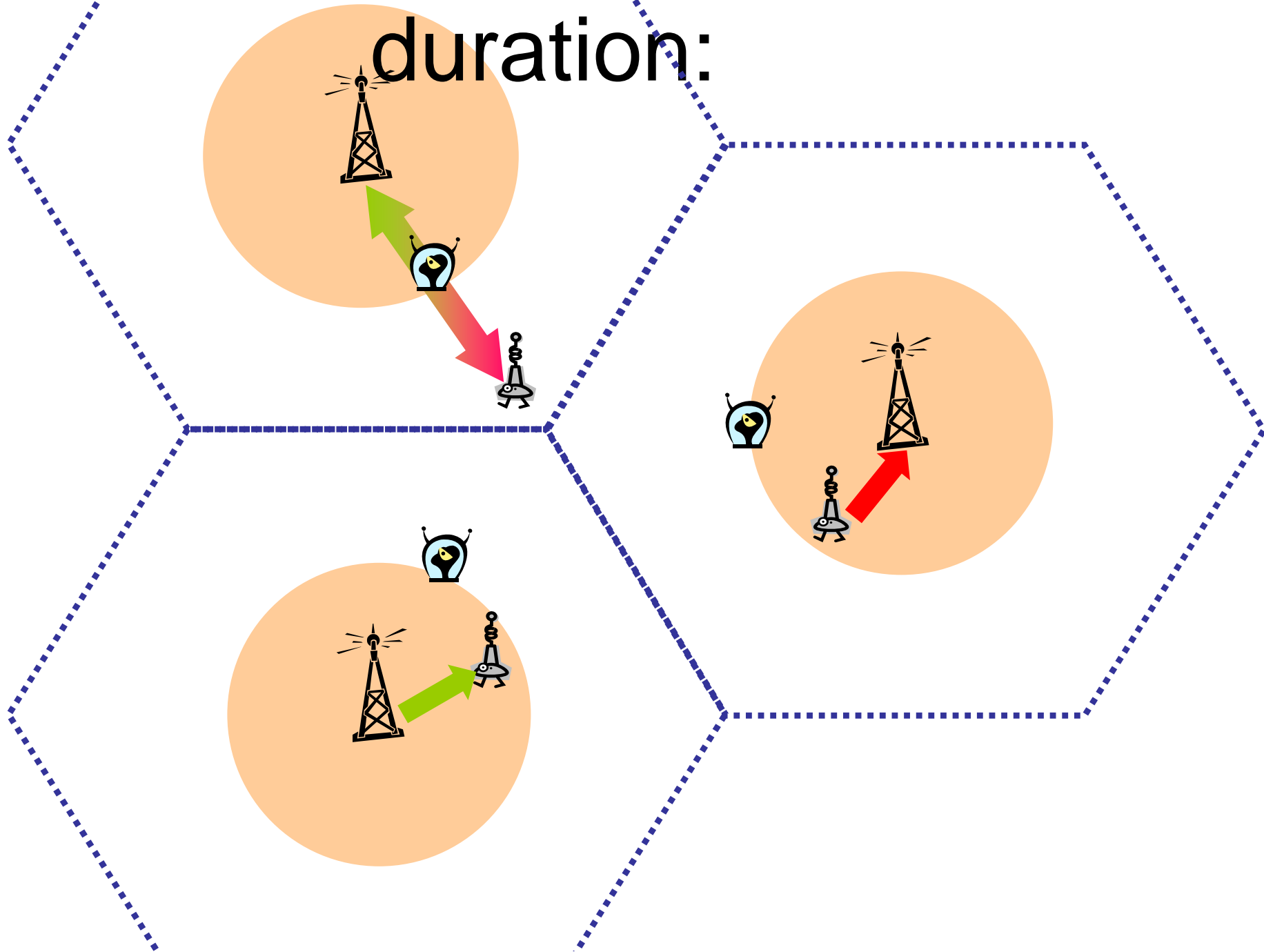
Proposed relay-sub-frame type B



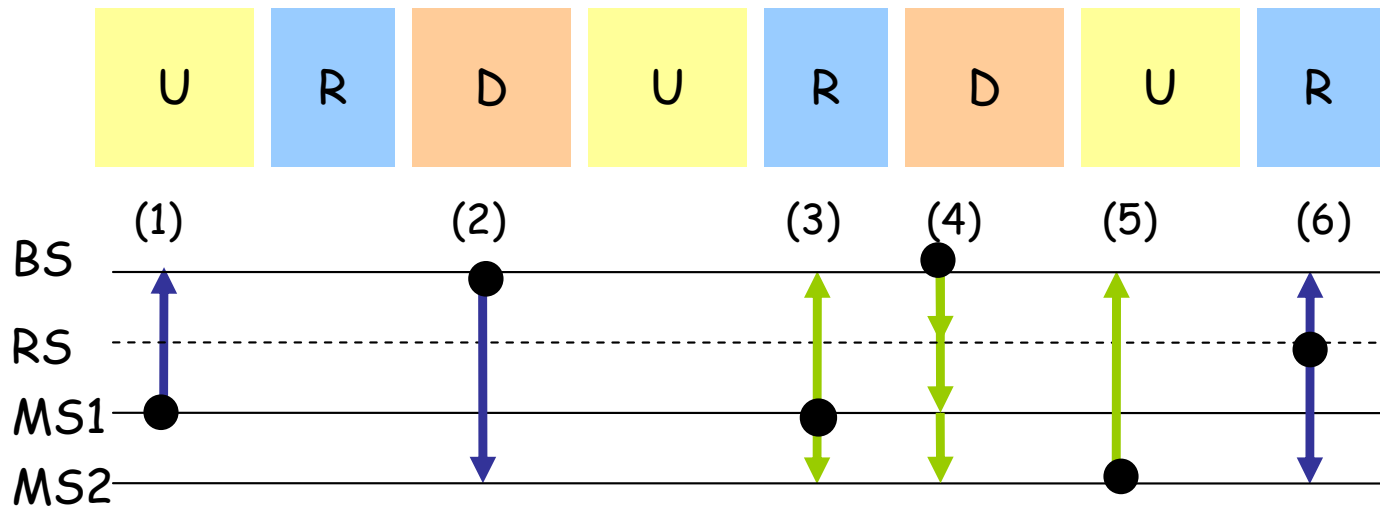
Proposed relay-sub-frame

- Relay sub-frame from RS may contain:
 - RS-MAP
 - Combined HARQ retransmissions to BS, MS
 - DL HARQ retransmissions to MS
 - UL HARQ retransmissions to BS
 - RS HARQ ack/nak to BS, MS
- The need for relay may vary from time to time based on BS, MS HARQ ack/nak
 - Fixed RS resource is provisioned per frame
 - Provisioned RS resource can be used for
 - relay sub-frame
 - DL/UL transmission for good geometry MS's if relayed traffic is small

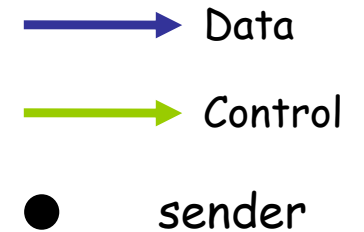
In the provisioned RS time duration:



Example HARQ time line



- (1) UL burst from MS1 to BS
- (2) DL burst from BS to MS2
- (3) UL/DL HARQ ack/nak from RS
- (4) UL HARQ ack/nak from BS, and the delivery of resource assignment of relay sub-frame (based on (3))
- (5) DL HARQ ack/nak from MS2, and UL HARQ ack/nak from MS2 (MS2 only acks those UL bursts nak by BS if MS2 cannot decode its own DL burst)
- (6) Combined HARQ retransmission from RS (based on (4), (5))



Numerical results

- Assumptions:
 - Each UL/DL packet uses the same amount of resource
 - 1 HARQ retransmission (from either source or RS)
 - $P_r=0.99$, probability of RS decodes a DL/UL packet in the 1st HARQ transmission
 - $P_m=0.1$, probability of BS/MS decodes a UL/DL packet in the 1st HARQ transmission
 - 2-bit Ack from a DL MS
 - 00: ack for its DL packet d0
 - 01: ack for an UL packet u1 and nak for d0
 - u1 paired/grouped with d0
 - 10: ack for an UL packet u2 and nak for d0
 - u2 grouped with d0
 - 11: none of the ack above

Effects from MSG reliability, DL/UL=1

MSG reliability	Saved BW/ RS BW	Saved BW/ Total BW
0.9	40.10%	18.80%
0.8	35.64%	16.71%
0.7	31.19%	14.62%
0.6	26.73%	12.53%
0.5	22.28%	10.45%

- MSG reliability: probability of MS2 decoding UL packets from MS1, given MS1 in the MSG of MS2
- BS pairs a DL MS2 with an UL MS1

Effects from BS scheduling decision, DL/UL=3

- When DL/UL ratio is high, BS may group multiple DL MSs with less number of UL MSs to improve MSG reliability
- Grouping applied to the case with low MSG reliability can perform better than the case with high MSG reliability and pairing

x DL MSs grouped with an UL MS based on MSG reports	y remaining DL MSs	MSG reliability	Saved BW/RS BW	Saved BW/Total BW
1	2	0.6	13.37%	6.27%
2	1	0.6	19.59%	9.18%
3	0	0.6	22.48%	10.54%
1	2	0.9	20.05%	9.40%

- BS schedules $x+y=3$ DL packets, and one UL packet (from MS0)
- MS0 is in the MSGs of x DL MSs
- MS0 is not in the MSG of y DL MSs