Project 3

This project is to be completed individually.

In this project, you are asked to implement a simulator of either the Stop-and-Wait (for undergraduate students) or the Go-back-N (for graduate students) protocol we discussed in the class.

The assumptions are:

* There is a sender A with unlimited data to send to the receiver B.
* Each data frame is 1 ms long.
* The delay between A and B is 3 ms.
* The time to send the ACK is negligible, that is, 0.
* The timeout used by A is 7 ms, where, as we discussed in the class, the timeout timer starts after the last bit of the data frame is sent.
* There are losses in the link, both for the data frame and ACK. Two files are given under files, namely Pj3\_DATA\_GOOD and Pj3\_ACK\_GOOD, where, in both files, each line is either ‘1’ or ‘0’, representing if the data frame or ACK is received correctly or lost, respectively.
  + For example, if the 10th line in DATA\_GOOD is ‘1’, the 10th data frame transmitted by A is received correctly; otherwise it is lost.
  + Please note that it is the 10th data frame transmitted by A, and may or may not be data frame with sequence number 10, because, for example, the 10th data frame transmitted by A may be a retransmission of data frame with sequence number 9.

You can use any language you like in this project.

The sample output for Stop-and-Wait:

time 0: sender got ACK0, window [0, 0]

time 0: sender window [0, 0], transmitting new frame 0, good transmission

time 4: receiver got frame 0, transmitting ACK1, good transmission

time 7: sender got ACK1, window [1, 1]

time 7: sender window [1, 1], transmitting new frame 1, good transmission

time 11: receiver got frame 1, transmitting ACK2, good transmission

time 14: sender got ACK2, window [2, 2]

time 14: sender window [2, 2], transmitting new frame 2, bad transmission

time 22: sender window [2, 2], retransmitting old frame 2, good transmission

time 26: receiver got frame 2, transmitting ACK3, good transmission

time 29: sender got ACK3, window [3, 3]

time 29: sender window [3, 3], transmitting new frame 3, good transmission

time 33: receiver got frame 3, transmitting ACK4, good transmission

time 36: sender got ACK4, window [4, 4]

time 36: sender window [4, 4], transmitting new frame 4, good transmission

time 40: receiver got frame 4, transmitting ACK5, good transmission

time 43: sender got ACK5, window [5, 5]

time 43: sender window [5, 5], transmitting new frame 5, good transmission

time 47: receiver got frame 5, transmitting ACK6, good transmission

time 50: sender got ACK6, window [6, 6]

time 50: sender window [6, 6], transmitting new frame 6, good transmission

time 54: receiver got frame 6, transmitting ACK7, bad transmission

time 58: sender window [6, 6], retransmitting old frame 6, good transmission

time 62: receiver got frame 6, transmitting ACK7, good transmission

time 65: sender got ACK7, window [7, 7]

time 65: sender window [7, 7], transmitting new frame 7, bad transmission

time 73: sender window [7, 7], retransmitting old frame 7, good transmission

time 77: receiver got frame 7, transmitting ACK8, good transmission

time 80: sender got ACK8, window [8, 8]

time 80: sender window [8, 8], transmitting new frame 8, good transmission

time 84: receiver got frame 8, transmitting ACK9, good transmission

time 87: sender got ACK9, window [9, 9]

time 87: sender window [9, 9], transmitting new frame 9, good transmission

time 91: receiver got frame 9, transmitting ACK10, good transmission

time 94: sender got ACK10, window [10, 10]

time 94: sender window [10, 10], transmitting new frame 10, good transmission

time 98: receiver got frame 10, transmitting ACK11, good transmission

time 101: sender got ACK11, window [11, 11]

time 101: sender window [11, 11], transmitting new frame 11, good transmission

time 105: receiver got frame 11, transmitting ACK12, good transmission

time 108: sender got ACK12, window [12, 12]

time 108: sender window [12, 12], transmitting new frame 12, good transmission

time 112: receiver got frame 12, transmitting ACK13, bad transmission

time 116: sender window [12, 12], retransmitting old frame 12, good transmission

time 120: receiver got frame 12, transmitting ACK13, good transmission

time 123: sender got ACK13, window [13, 13]

time 123: sender window [13, 13], transmitting new frame 13, good transmission

time 127: receiver got frame 13, transmitting ACK14, bad transmission

time 131: sender window [13, 13], retransmitting old frame 13, good transmission

time 135: receiver got frame 13, transmitting ACK14, good transmission

time 138: sender got ACK14, window [14, 14]

time 138: sender window [14, 14], transmitting new frame 14, good transmission

time 142: receiver got frame 14, transmitting ACK15, good transmission

time 145: sender got ACK15, window [15, 15]

time 145: sender window [15, 15], transmitting new frame 15, good transmission

time 149: receiver got frame 15, transmitting ACK16, good transmission

time 152: sender got ACK16, window [16, 16]

time 152: sender window [16, 16], transmitting new frame 16, good transmission

time 156: receiver got frame 16, transmitting ACK17, good transmission

time 159: sender got ACK17, window [17, 17]

time 159: sender window [17, 17], transmitting new frame 17, good transmission

time 163: receiver got frame 17, transmitting ACK18, good transmission

time 166: sender got ACK18, window [18, 18]

time 166: sender window [18, 18], transmitting new frame 18, good transmission

time 170: receiver got frame 18, transmitting ACK19, good transmission

time 173: sender got ACK19, window [19, 19]

time 173: sender window [19, 19], transmitting new frame 19, good transmission

time 177: receiver got frame 19, transmitting ACK20, good transmission

time 180: sender got ACK20, window [20, 20]

time 180: sender window [20, 20], transmitting new frame 20, good transmission

time 184: receiver got frame 20, transmitting ACK21, good transmission

time 187: sender got ACK21, window [21, 21]

time 187: sender window [21, 21], transmitting new frame 21, bad transmission

time 195: sender window [21, 21], retransmitting old frame 21, good transmission

time 199: receiver got frame 21, transmitting ACK22, good transmission

time 202: sender got ACK22, window [22, 22]

The sample output for Go-back-N:

time 0: sender got ACK0, window [0, 6]

time 0: sender window [0, 6], transmitting new frame 0, good transmission

time 1: sender window [0, 6], transmitting new frame 1, good transmission

time 2: sender window [0, 6], transmitting new frame 2, bad transmission

time 3: sender window [0, 6], transmitting new frame 3, good transmission

time 4: receiver got frame 0, transmitting ACK1, good transmission

time 4: sender window [0, 6], transmitting new frame 4, good transmission

time 5: receiver got frame 1, transmitting ACK2, good transmission

time 5: sender window [0, 6], transmitting new frame 5, good transmission

time 6: sender window [0, 6], transmitting new frame 6, good transmission

time 7: receiver got frame 3, transmitting ACK2, good transmission

time 7: sender got ACK1, window [1, 7]

time 7: sender window [1, 7], transmitting new frame 7, good transmission

time 8: receiver got frame 4, transmitting ACK2, good transmission

time 8: sender got ACK2, window [2, 8]

time 8: sender window [2, 8], transmitting new frame 8, good transmission

time 9: receiver got frame 5, transmitting ACK2, good transmission

time 10: receiver got frame 6, transmitting ACK2, good transmission

time 10: sender got ACK2, window [2, 8]

time 10: sender window [2, 8], retransmitting old frame 2, bad transmission

time 11: receiver got frame 7, transmitting ACK2, bad transmission

time 11: sender got ACK2, window [2, 8]

time 11: sender window [2, 8], retransmitting old frame 3, good transmission

time 12: receiver got frame 8, transmitting ACK2, good transmission

time 12: sender got ACK2, window [2, 8]

time 12: sender window [2, 8], retransmitting old frame 4, good transmission

time 13: sender got ACK2, window [2, 8]

time 13: sender window [2, 8], retransmitting old frame 5, good transmission

time 14: sender window [2, 8], retransmitting old frame 6, good transmission

time 15: sender got ACK2, window [2, 8]

time 15: receiver got frame 3, transmitting ACK2, good transmission

time 15: sender window [2, 8], retransmitting old frame 7, good transmission

time 16: receiver got frame 4, transmitting ACK2, good transmission

time 16: sender window [2, 8], retransmitting old frame 8, good transmission

time 17: receiver got frame 5, transmitting ACK2, good transmission

time 18: receiver got frame 6, transmitting ACK2, good transmission

time 18: sender got ACK2, window [2, 8]

time 18: sender window [2, 8], retransmitting old frame 2, good transmission

time 19: receiver got frame 7, transmitting ACK2, good transmission

time 19: sender got ACK2, window [2, 8]

time 19: sender window [2, 8], retransmitting old frame 3, good transmission

time 20: receiver got frame 8, transmitting ACK2, bad transmission

time 20: sender got ACK2, window [2, 8]

time 20: sender window [2, 8], retransmitting old frame 4, good transmission

time 21: sender got ACK2, window [2, 8]

time 21: sender window [2, 8], retransmitting old frame 5, good transmission

time 22: sender got ACK2, window [2, 8]

time 22: receiver got frame 2, transmitting ACK3, good transmission

time 22: sender window [2, 8], retransmitting old frame 6, good transmission

time 23: receiver got frame 3, transmitting ACK4, bad transmission

time 23: sender window [2, 8], retransmitting old frame 7, good transmission

time 24: receiver got frame 4, transmitting ACK5, good transmission

time 24: sender window [2, 8], retransmitting old frame 8, good transmission

time 25: receiver got frame 5, transmitting ACK6, good transmission

time 25: sender got ACK3, window [3, 9]

time 25: sender window [3, 9], transmitting new frame 9, good transmission

time 26: receiver got frame 6, transmitting ACK7, good transmission

time 27: receiver got frame 7, transmitting ACK8, good transmission

time 27: sender got ACK5, window [5, 11]

time 27: sender window [5, 11], transmitting new frame 10, good transmission

time 28: receiver got frame 8, transmitting ACK9, good transmission

time 28: sender got ACK6, window [6, 12]

time 28: sender window [6, 12], transmitting new frame 11, good transmission

time 29: receiver got frame 9, transmitting ACK10, good transmission

time 29: sender got ACK7, window [7, 13]

time 29: sender window [7, 13], transmitting new frame 12, bad transmission

time 30: sender got ACK8, window [8, 14]

time 30: sender window [8, 14], transmitting new frame 13, good transmission

time 31: sender got ACK9, window [9, 15]

time 31: receiver got frame 10, transmitting ACK11, good transmission

time 31: sender window [9, 15], transmitting new frame 14, good transmission

time 32: sender got ACK10, window [10, 16]

time 32: receiver got frame 11, transmitting ACK12, good transmission

time 32: sender window [10, 16], transmitting new frame 15, good transmission

time 33: sender window [10, 16], transmitting new frame 16, good transmission

time 34: receiver got frame 13, transmitting ACK12, good transmission

time 34: sender got ACK11, window [11, 17]

time 34: sender window [11, 17], transmitting new frame 17, good transmission

time 35: receiver got frame 14, transmitting ACK12, bad transmission

time 35: sender got ACK12, window [12, 18]

time 35: sender window [12, 18], transmitting new frame 18, good transmission

time 36: receiver got frame 15, transmitting ACK12, good transmission

time 37: receiver got frame 16, transmitting ACK12, good transmission

time 37: sender got ACK12, window [12, 18]

time 37: sender window [12, 18], retransmitting old frame 12, bad transmission

time 38: receiver got frame 17, transmitting ACK12, good transmission

time 38: sender window [12, 18], retransmitting old frame 13, bad transmission

time 39: receiver got frame 18, transmitting ACK12, good transmission

time 39: sender got ACK12, window [12, 18]

time 39: sender window [12, 18], retransmitting old frame 14, good transmission

time 40: sender got ACK12, window [12, 18]

time 40: sender window [12, 18], retransmitting old frame 15, good transmission

time 41: sender got ACK12, window [12, 18]

time 41: sender window [12, 18], retransmitting old frame 16, good transmission

time 42: sender got ACK12, window [12, 18]

time 42: sender window [12, 18], retransmitting old frame 17, good transmission

time 43: receiver got frame 14, transmitting ACK12, good transmission

time 43: sender window [12, 18], retransmitting old frame 18, good transmission

time 44: receiver got frame 15, transmitting ACK12, good transmission

time 45: receiver got frame 16, transmitting ACK12, bad transmission

time 45: sender window [12, 18], retransmitting old frame 12, good transmission

time 46: receiver got frame 17, transmitting ACK12, good transmission

time 46: sender got ACK12, window [12, 18]

time 46: sender window [12, 18], retransmitting old frame 13, good transmission

time 47: receiver got frame 18, transmitting ACK12, good transmission

time 47: sender got ACK12, window [12, 18]

time 47: sender window [12, 18], retransmitting old frame 14, good transmission

time 48: sender window [12, 18], retransmitting old frame 15, good transmission

time 49: sender got ACK12, window [12, 18]

time 49: receiver got frame 12, transmitting ACK13, bad transmission

time 49: sender window [12, 18], retransmitting old frame 16, good transmission

time 50: sender got ACK12, window [12, 18]

time 50: receiver got frame 13, transmitting ACK14, good transmission

time 50: sender window [12, 18], retransmitting old frame 17, good transmission

time 51: receiver got frame 14, transmitting ACK15, good transmission

time 51: sender window [12, 18], retransmitting old frame 18, good transmission

time 52: receiver got frame 15, transmitting ACK16, good transmission

time 53: receiver got frame 16, transmitting ACK17, good transmission

time 53: sender got ACK14, window [14, 20]

time 53: sender window [14, 20], transmitting new frame 19, good transmission

time 54: receiver got frame 17, transmitting ACK18, good transmission

time 54: sender got ACK15, window [15, 21]

time 54: sender window [15, 21], transmitting new frame 20, good transmission

time 55: receiver got frame 18, transmitting ACK19, good transmission

time 55: sender got ACK16, window [16, 22]

time 55: sender window [16, 22], transmitting new frame 21, good transmission

time 56: sender got ACK17, window [17, 23]

time 56: sender window [17, 23], transmitting new frame 22, good transmission

time 57: sender got ACK18, window [18, 24]

time 57: receiver got frame 19, transmitting ACK20, bad transmission

time 57: sender window [18, 24], transmitting new frame 23, good transmission

time 58: sender got ACK19, window [19, 25]

time 58: receiver got frame 20, transmitting ACK21, good transmission

time 58: sender window [19, 25], transmitting new frame 24, good transmission

time 59: receiver got frame 21, transmitting ACK22, good transmission

time 59: sender window [19, 25], transmitting new frame 25, good transmission

time 60: receiver got frame 22, transmitting ACK23, good transmission

time 61: receiver got frame 23, transmitting ACK24, bad transmission

time 61: sender got ACK21, window [21, 27]

time 61: sender window [21, 27], transmitting new frame 26, good transmission

time 62: receiver got frame 24, transmitting ACK25, good transmission

time 62: sender got ACK22, window [22, 28]

time 62: sender window [22, 28], transmitting new frame 27, bad transmission

time 63: receiver got frame 25, transmitting ACK26, bad transmission

time 63: sender got ACK23, window [23, 29]

time 63: sender window [23, 29], transmitting new frame 28, good transmission

time 64: sender window [23, 29], transmitting new frame 29, good transmission

time 65: sender got ACK25, window [25, 31]

time 65: receiver got frame 26, transmitting ACK27, good transmission

time 65: sender window [25, 31], transmitting new frame 30, bad transmission

time 66: sender window [25, 31], transmitting new frame 31, good transmission

time 67: receiver got frame 28, transmitting ACK27, good transmission

time 67: sender window [25, 31], retransmitting old frame 25, good transmission

time 68: receiver got frame 29, transmitting ACK27, good transmission

time 68: sender got ACK27, window [27, 33]

time 68: sender window [27, 33], transmitting new frame 32, good transmission

time 69: sender window [27, 33], transmitting new frame 33, bad transmission

time 70: receiver got frame 31, transmitting ACK27, bad transmission

time 70: sender got ACK27, window [27, 33]

time 70: sender window [27, 33], retransmitting old frame 27, good transmission

time 71: receiver got frame 25, transmitting ACK27, bad transmission

time 71: sender got ACK27, window [27, 33]

time 71: sender window [27, 33], retransmitting old frame 28, good transmission

time 72: receiver got frame 32, transmitting ACK27, good transmission

time 72: sender window [27, 33], retransmitting old frame 29, good transmission

time 73: sender window [27, 33], retransmitting old frame 30, good transmission

time 74: receiver got frame 27, transmitting ACK28, good transmission

time 74: sender window [27, 33], retransmitting old frame 31, good transmission

time 75: receiver got frame 28, transmitting ACK29, good transmission

time 75: sender got ACK27, window [27, 33]

time 76: receiver got frame 29, transmitting ACK30, good transmission

time 76: sender window [27, 33], retransmitting old frame 32, good transmission

time 77: receiver got frame 30, transmitting ACK31, good transmission

time 77: sender got ACK28, window [28, 34]

time 77: sender window [28, 34], retransmitting old frame 33, good transmission

time 78: receiver got frame 31, transmitting ACK32, good transmission

time 78: sender got ACK29, window [29, 35]

time 78: sender window [29, 35], transmitting new frame 34, good transmission

time 79: sender got ACK30, window [30, 36]

time 79: sender window [30, 36], transmitting new frame 35, good transmission

time 80: sender got ACK31, window [31, 37]

time 80: receiver got frame 32, transmitting ACK33, good transmission

time 80: sender window [31, 37], transmitting new frame 36, bad transmission

time 81: sender got ACK32, window [32, 38]

time 81: receiver got frame 33, transmitting ACK34, good transmission

time 81: sender window [32, 38], transmitting new frame 37, good transmission

time 82: receiver got frame 34, transmitting ACK35, good transmission

time 82: sender window [32, 38], transmitting new frame 38, good transmission

time 83: receiver got frame 35, transmitting ACK36, good transmission

time 83: sender got ACK33, window [33, 39]

time 83: sender window [33, 39], transmitting new frame 39, good transmission

time 84: sender got ACK34, window [34, 40]

time 84: sender window [34, 40], transmitting new frame 40, good transmission

time 85: receiver got frame 37, transmitting ACK36, bad transmission

time 85: sender got ACK35, window [35, 41]

time 85: sender window [35, 41], transmitting new frame 41, good transmission

time 86: receiver got frame 38, transmitting ACK36, bad transmission

time 86: sender got ACK36, window [36, 42]

time 86: sender window [36, 42], transmitting new frame 42, good transmission

time 87: receiver got frame 39, transmitting ACK36, good transmission

time 88: receiver got frame 40, transmitting ACK36, good transmission

time 88: sender window [36, 42], retransmitting old frame 36, bad transmission

time 89: receiver got frame 41, transmitting ACK36, good transmission

time 89: sender window [36, 42], retransmitting old frame 37, good transmission

time 90: receiver got frame 42, transmitting ACK36, good transmission

time 90: sender got ACK36, window [36, 42]

time 90: sender window [36, 42], retransmitting old frame 38, good transmission

time 91: sender got ACK36, window [36, 42]

time 91: sender window [36, 42], retransmitting old frame 39, bad transmission

time 92: sender got ACK36, window [36, 42]

time 92: sender window [36, 42], retransmitting old frame 40, good transmission

time 93: sender got ACK36, window [36, 42]

time 93: receiver got frame 37, transmitting ACK36, good transmission

time 93: sender window [36, 42], retransmitting old frame 41, good transmission

time 94: receiver got frame 38, transmitting ACK36, good transmission

time 94: sender window [36, 42], retransmitting old frame 42, bad transmission

time 96: receiver got frame 40, transmitting ACK36, good transmission

time 96: sender got ACK36, window [36, 42]

time 96: sender window [36, 42], retransmitting old frame 36, bad transmission

time 97: receiver got frame 41, transmitting ACK36, bad transmission

time 97: sender got ACK36, window [36, 42]

time 97: sender window [36, 42], retransmitting old frame 37, good transmission

time 98: sender window [36, 42], retransmitting old frame 38, good transmission

time 99: sender got ACK36, window [36, 42]

time 99: sender window [36, 42], retransmitting old frame 39, good transmission

time 100: sender window [36, 42], retransmitting old frame 40, good transmission

time 101: receiver got frame 37, transmitting ACK36, good transmission

time 101: sender window [36, 42], retransmitting old frame 41, good transmission

time 102: receiver got frame 38, transmitting ACK36, good transmission

time 102: sender window [36, 42], retransmitting old frame 42, good transmission

time 103: receiver got frame 39, transmitting ACK36, good transmission

time 104: receiver got frame 40, transmitting ACK36, good transmission

time 104: sender got ACK36, window [36, 42]

time 104: sender window [36, 42], retransmitting old frame 36, bad transmission

time 105: receiver got frame 41, transmitting ACK36, good transmission

time 105: sender got ACK36, window [36, 42]

time 105: sender window [36, 42], retransmitting old frame 37, bad transmission

time 106: receiver got frame 42, transmitting ACK36, good transmission

time 106: sender got ACK36, window [36, 42]

time 106: sender window [36, 42], retransmitting old frame 38, good transmission

time 107: sender got ACK36, window [36, 42]

time 107: sender window [36, 42], retransmitting old frame 39, bad transmission

time 108: sender got ACK36, window [36, 42]

time 108: sender window [36, 42], retransmitting old frame 40, good transmission

time 109: sender got ACK36, window [36, 42]

time 109: sender window [36, 42], retransmitting old frame 41, good transmission

time 110: receiver got frame 38, transmitting ACK36, good transmission

time 110: sender window [36, 42], retransmitting old frame 42, good transmission

time 112: receiver got frame 40, transmitting ACK36, bad transmission

time 112: sender window [36, 42], retransmitting old frame 36, bad transmission

time 113: receiver got frame 41, transmitting ACK36, good transmission

time 113: sender got ACK36, window [36, 42]

time 113: sender window [36, 42], retransmitting old frame 37, bad transmission

time 114: receiver got frame 42, transmitting ACK36, good transmission

time 114: sender window [36, 42], retransmitting old frame 38, bad transmission

time 115: sender window [36, 42], retransmitting old frame 39, good transmission

time 116: sender got ACK36, window [36, 42]

time 116: sender window [36, 42], retransmitting old frame 40, good transmission

time 117: sender got ACK36, window [36, 42]

time 117: sender window [36, 42], retransmitting old frame 41, good transmission

time 118: sender window [36, 42], retransmitting old frame 42, good transmission

time 119: receiver got frame 39, transmitting ACK36, good transmission

time 120: receiver got frame 40, transmitting ACK36, good transmission

time 120: sender window [36, 42], retransmitting old frame 36, good transmission

time 121: receiver got frame 41, transmitting ACK36, bad transmission

time 121: sender window [36, 42], retransmitting old frame 37, good transmission

time 122: receiver got frame 42, transmitting ACK36, good transmission

time 122: sender got ACK36, window [36, 42]

time 122: sender window [36, 42], retransmitting old frame 38, good transmission

time 123: sender got ACK36, window [36, 42]

time 123: sender window [36, 42], retransmitting old frame 39, good transmission

time 124: receiver got frame 36, transmitting ACK37, bad transmission

time 124: sender window [36, 42], retransmitting old frame 40, good transmission

time 125: sender got ACK36, window [36, 42]

time 125: receiver got frame 37, transmitting ACK38, good transmission

time 125: sender window [36, 42], retransmitting old frame 41, good transmission

time 126: receiver got frame 38, transmitting ACK39, good transmission

time 126: sender window [36, 42], retransmitting old frame 42, good transmission

time 127: receiver got frame 39, transmitting ACK40, bad transmission

time 128: receiver got frame 40, transmitting ACK41, good transmission

time 128: sender got ACK38, window [38, 44]

time 128: sender window [38, 44], transmitting new frame 43, good transmission

time 129: receiver got frame 41, transmitting ACK42, good transmission

time 129: sender got ACK39, window [39, 45]

time 129: sender window [39, 45], transmitting new frame 44, good transmission

time 130: receiver got frame 42, transmitting ACK43, good transmission

time 130: sender window [39, 45], transmitting new frame 45, bad transmission

time 131: sender got ACK41, window [41, 47]

time 131: sender window [41, 47], transmitting new frame 46, bad transmission

time 132: sender got ACK42, window [42, 48]

time 132: receiver got frame 43, transmitting ACK44, good transmission

time 132: sender window [42, 48], transmitting new frame 47, good transmission

time 133: sender got ACK43, window [43, 49]

time 133: receiver got frame 44, transmitting ACK45, good transmission

time 133: sender window [43, 49], transmitting new frame 48, good transmission

time 134: sender window [43, 49], transmitting new frame 49, good transmission

time 135: sender got ACK44, window [44, 50]

time 135: sender window [44, 50], transmitting new frame 50, bad transmission

time 136: receiver got frame 47, transmitting ACK45, good transmission

time 136: sender got ACK45, window [45, 51]

time 136: sender window [45, 51], transmitting new frame 51, good transmission

time 137: receiver got frame 48, transmitting ACK45, good transmission

time 138: receiver got frame 49, transmitting ACK45, good transmission

time 138: sender window [45, 51], retransmitting old frame 45, good transmission

time 139: sender got ACK45, window [45, 51]

time 139: sender window [45, 51], retransmitting old frame 46, good transmission

time 140: receiver got frame 51, transmitting ACK45, bad transmission

time 140: sender got ACK45, window [45, 51]

time 140: sender window [45, 51], retransmitting old frame 47, good transmission

time 141: sender got ACK45, window [45, 51]

time 141: sender window [45, 51], retransmitting old frame 48, good transmission

time 142: receiver got frame 45, transmitting ACK46, bad transmission

time 142: sender window [45, 51], retransmitting old frame 49, good transmission

time 143: receiver got frame 46, transmitting ACK47, good transmission

time 143: sender window [45, 51], retransmitting old frame 50, good transmission

time 144: receiver got frame 47, transmitting ACK48, good transmission

time 144: sender window [45, 51], retransmitting old frame 51, good transmission

time 145: receiver got frame 48, transmitting ACK49, bad transmission

time 146: receiver got frame 49, transmitting ACK50, good transmission

time 146: sender got ACK47, window [47, 53]

time 146: sender window [47, 53], transmitting new frame 52, bad transmission

time 147: receiver got frame 50, transmitting ACK51, good transmission

time 147: sender got ACK48, window [48, 54]

time 147: sender window [48, 54], transmitting new frame 53, good transmission

time 148: receiver got frame 51, transmitting ACK52, good transmission

time 148: sender window [48, 54], transmitting new frame 54, bad transmission

time 149: sender got ACK50, window [50, 56]

time 149: sender window [50, 56], transmitting new frame 55, good transmission

time 150: sender got ACK51, window [51, 57]

time 150: sender window [51, 57], transmitting new frame 56, good transmission

time 151: sender got ACK52, window [52, 58]

time 151: receiver got frame 53, transmitting ACK52, bad transmission

time 151: sender window [52, 58], transmitting new frame 57, bad transmission

time 152: sender window [52, 58], transmitting new frame 58, good transmission

time 153: receiver got frame 55, transmitting ACK52, good transmission

time 154: receiver got frame 56, transmitting ACK52, good transmission

time 154: sender window [52, 58], retransmitting old frame 52, good transmission

time 155: sender window [52, 58], retransmitting old frame 53, bad transmission

time 156: receiver got frame 58, transmitting ACK52, good transmission

time 156: sender got ACK52, window [52, 58]

time 156: sender window [52, 58], retransmitting old frame 54, bad transmission

time 157: sender got ACK52, window [52, 58]

time 157: sender window [52, 58], retransmitting old frame 55, good transmission

time 158: receiver got frame 52, transmitting ACK53, good transmission

time 158: sender window [52, 58], retransmitting old frame 56, good transmission

time 159: sender got ACK52, window [52, 58]

time 159: sender window [52, 58], retransmitting old frame 57, good transmission

time 160: sender window [52, 58], retransmitting old frame 58, good transmission

time 161: receiver got frame 55, transmitting ACK53, good transmission

time 161: sender got ACK53, window [53, 59]

time 161: sender window [53, 59], transmitting new frame 59, good transmission

time 162: receiver got frame 56, transmitting ACK53, good transmission

time 163: receiver got frame 57, transmitting ACK53, good transmission

time 163: sender window [53, 59], retransmitting old frame 53, good transmission

time 164: receiver got frame 58, transmitting ACK53, good transmission

time 164: sender got ACK53, window [53, 59]

time 164: sender window [53, 59], retransmitting old frame 54, good transmission

time 165: receiver got frame 59, transmitting ACK53, good transmission

time 165: sender got ACK53, window [53, 59]

time 165: sender window [53, 59], retransmitting old frame 55, good transmission

time 166: sender got ACK53, window [53, 59]

time 166: sender window [53, 59], retransmitting old frame 56, bad transmission

time 167: sender got ACK53, window [53, 59]

time 167: receiver got frame 53, transmitting ACK54, good transmission

time 167: sender window [53, 59], retransmitting old frame 57, good transmission

time 168: sender got ACK53, window [53, 59]

time 168: receiver got frame 54, transmitting ACK55, good transmission

time 168: sender window [53, 59], retransmitting old frame 58, good transmission

time 169: receiver got frame 55, transmitting ACK56, good transmission

time 169: sender window [53, 59], retransmitting old frame 59, good transmission

time 170: sender got ACK54, window [54, 60]

time 170: sender window [54, 60], transmitting new frame 60, good transmission

time 171: receiver got frame 57, transmitting ACK56, good transmission

time 171: sender got ACK55, window [55, 61]

time 171: sender window [55, 61], transmitting new frame 61, good transmission

time 172: receiver got frame 58, transmitting ACK56, good transmission

time 172: sender got ACK56, window [56, 62]

time 172: sender window [56, 62], transmitting new frame 62, bad transmission

time 173: receiver got frame 59, transmitting ACK56, good transmission

time 174: receiver got frame 60, transmitting ACK56, good transmission

time 174: sender got ACK56, window [56, 62]

time 174: sender window [56, 62], retransmitting old frame 56, good transmission

time 175: receiver got frame 61, transmitting ACK56, good transmission

time 175: sender got ACK56, window [56, 62]

time 175: sender window [56, 62], retransmitting old frame 57, good transmission

time 176: sender got ACK56, window [56, 62]

time 176: sender window [56, 62], retransmitting old frame 58, bad transmission

time 177: sender got ACK56, window [56, 62]

time 177: sender window [56, 62], retransmitting old frame 59, bad transmission

time 178: sender got ACK56, window [56, 62]

time 178: receiver got frame 56, transmitting ACK57, good transmission

time 178: sender window [56, 62], retransmitting old frame 60, good transmission

time 179: receiver got frame 57, transmitting ACK58, good transmission

time 179: sender window [56, 62], retransmitting old frame 61, good transmission

time 180: sender window [56, 62], retransmitting old frame 62, good transmission

time 181: sender got ACK57, window [57, 63]

time 181: sender window [57, 63], transmitting new frame 63, bad transmission

time 182: receiver got frame 60, transmitting ACK58, good transmission

time 182: sender got ACK58, window [58, 64]

time 182: sender window [58, 64], transmitting new frame 64, good transmission

time 183: receiver got frame 61, transmitting ACK58, good transmission

time 184: receiver got frame 62, transmitting ACK58, good transmission

time 184: sender window [58, 64], retransmitting old frame 58, good transmission

time 185: sender got ACK58, window [58, 64]

time 185: sender window [58, 64], retransmitting old frame 59, good transmission

time 186: receiver got frame 64, transmitting ACK58, good transmission

time 186: sender got ACK58, window [58, 64]

time 186: sender window [58, 64], retransmitting old frame 60, good transmission

time 187: sender got ACK58, window [58, 64]

time 187: sender window [58, 64], retransmitting old frame 61, good transmission

time 188: receiver got frame 58, transmitting ACK59, bad transmission

time 188: sender window [58, 64], retransmitting old frame 62, good transmission

time 189: sender got ACK58, window [58, 64]

time 189: receiver got frame 59, transmitting ACK60, good transmission

time 189: sender window [58, 64], retransmitting old frame 63, good transmission

time 190: receiver got frame 60, transmitting ACK61, good transmission

time 190: sender window [58, 64], retransmitting old frame 64, bad transmission

time 191: receiver got frame 61, transmitting ACK62, good transmission

time 192: receiver got frame 62, transmitting ACK63, bad transmission

time 192: sender got ACK60, window [60, 66]

time 192: sender window [60, 66], transmitting new frame 65, good transmission

time 193: receiver got frame 63, transmitting ACK64, good transmission

time 193: sender got ACK61, window [61, 67]

time 193: sender window [61, 67], transmitting new frame 66, good transmission

time 194: sender got ACK62, window [62, 68]

time 194: sender window [62, 68], transmitting new frame 67, bad transmission

time 195: sender window [62, 68], transmitting new frame 68, good transmission

time 196: sender got ACK64, window [64, 70]

time 196: receiver got frame 65, transmitting ACK64, bad transmission

time 196: sender window [64, 70], transmitting new frame 69, good transmission

time 197: receiver got frame 66, transmitting ACK64, good transmission

time 197: sender window [64, 70], transmitting new frame 70, good transmission

time 198: sender window [64, 70], retransmitting old frame 64, good transmission

time 199: receiver got frame 68, transmitting ACK64, bad transmission

time 200: receiver got frame 69, transmitting ACK64, good transmission

time 200: sender got ACK64, window [64, 70]