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1  |----- MODULE CSComm -----|
   | Specification of communication in a Client-Server system model.
5  | EXTENDS Integers, Naturals, AdditionalSequenceOperators
6  |-----|
7  | CONSTANTS
8  |   Client,      the set of clients
9  |   Server,      the (unique) server
10 |   Msg
11 |-----|
12 | VARIABLES
13 |   cincoming,   cincoming[c]: incoming channel at the client c ∈ Client
14 |   sincoming    incoming channel at the Server
16 |   vars ≜ ⟨cincoming, sincoming⟩
17 |-----|
18 |   TypeOK ≜
19 |     ∧ cincoming ∈ [Client → Seq(Msg)]
20 |     ∧ sincoming ∈ Seq(Msg)
21 |-----|
   | The initial predicate.
25 | Init ≜
26 |   ∧ cincoming = [c ∈ Client ↦ ⟨⟩]
27 |   ∧ sincoming = ⟨⟩
28 |-----|
   | A client sends a message msg to the Server.
32 | CSend(msg) ≜
33 |   ∧ sincoming' = Append(sincoming, msg)
34 |   ∧ UNCHANGED cincoming
   | A client receives a message from the Server.
38 | CRev(c) ≜
39 |   ∧ cincoming[c] ≠ ⟨⟩   there are messages to handle with
40 |   ∧ cincoming' = [cincoming EXCEPT ![c] = Tail(@)]   consume a message
41 |   ∧ UNCHANGED sincoming
42 |-----|
   | SRev and SSend below will be used together in one subaction. Therefore, there are no UNCHANGED
   | sub-formulas in their definitions.
   | The Server receives a message from some client c ∈ Client.
51 | SRev ≜
52 |   ∧ sincoming ≠ ⟨⟩   there are messages for the Server to handle with
53 |   ∧ sincoming' = Tail(sincoming)   consume a message
   | The Server sends a message to each client other than c ∈ Client.
57 | SSend(c, cmsg) ≜
58 |   ∧ cincoming' = [cl ∈ Client ↦
59 |     IF cl = c

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60             THEN cincoming[cl]
61             ELSE Append(cincoming[cl], cmsg[cl]))
    The Server broadcasts the same message to all the Clients other than  $c \in Client$ .
66 SSendSame(c, msg)  $\triangleq$ 
67      $\wedge$  SSend(c, [cl  $\in$  Client  $\mapsto$  msg])
68 |-----|
    Properties of communication.
72 EmptyChannel  $\triangleq$  Init
73 |-----|
    \ * Modification History
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