```
no_duplicate_send_layer  THM

⊢  ∀E:EventStruct. layerR(E)^-1 preserves No-dup-send(E)
| by Auto THEN Unfold `layer_rel` 0
THEN Assert ((asyncR(E)
|    ∨ delayableR(E))
|    ∨ send-enabledR(E)^-1)^* preserves No-dup-send(E)
|
|
|
|\
| .....assertion .....
| 1. E : EventStruct
| ⊢  ((asyncR(E) ∨ delayableR(E))
| |  ∨ send-enabledR(E)^-1)^* preserves No-dup-send(E)
| | by BackThruLemma `preserved_by_star` THENA Auto
| |
| 1. E : EventStruct
| ⊢  (asyncR(E) ∨ delayableR(E))
| |  ∨ send-enabledR(E)^-1 preserves No-dup-send(E)
| | by Repeat (BackThruLemma `preserved_by_or` THEN Auto)
|
| |    THEN Try (BackThruLemma `no_duplicate_send_async` THEN Auto)
|
| |    ...
| |
| 1. E : EventStruct
| ⊢  send-enabledR(E)^-1 preserves No-dup-send(E)
| | by InstLemma `no_duplicate_send_safety` [E] THENA Auto
|
| |    THEN BackThruLemma' `preserved_by_monotone` THEN Auto
| |
| 1. E : EventStruct
| 2. x : |E| List
| 3. y : |E| List
| 4. x send-enabledR(E)^-1 y
| ⊢  x safetyR(E) y
| | by ...
| THEN ExRepD THEN SubstFor x 0 THEN Auto'
| |
| 1. E : EventStruct
| 2. x : |E| List
| 3. y : |E| List
| 4. x@0 : |E|
| 5. is-send(E)(x@0)
| 6. x = (y @ [x@0])
| ⊢  y ≤ y @ [x@0]
|   by BackThruLemma `iseg_append` THEN Auto THEN Easy
|
.\
. 1. E : EventStruct
. 2. ((asyncR(E) ∨ delayableR(E))
. |  ∨ send-enabledR(E)^-1)^* preserves No-dup-send(E)
. ⊢  ((asyncR(E) ∨ delayableR(E))
. |  ∨ send-enabledR(E))^*^-1 preserves No-dup-send(E)
```

```
. | by BackThruLemma' `preserved_by_monotone` THEN Auto
. |
. 1. E : EventStruct
. 2. x : |E| List
. 3. y : |E| List
. 4. x ((asyncR(E) ∨ delayableR(E)) ∨ send-enabledR(E))^*^-1 y
. ⊢  x (((asyncR(E) ∨ delayableR(E)) ∨ send-enabledR(E)^-1)^*) y
. | by RWO "rel_inverse_star" (-1) THENA Auto
.
. |    THEN BackThruLemma' `rel_star_monotonic` THENA Auto
. |
. 1. E : EventStruct
. 2. |E| List
. 3. |E| List
. ⊢  (asyncR(E) ∨ delayableR(E)) ∨ send-enabledR(E)^-1 => (asyncR(E)
.    ∨ delayableR(E))
.    ∨ send-enabledR(E)^-1
.   by ...
. THEN Repeat (ParallelOp (-1))
.
.      THEN Try (BackThruLemma `R_async_symmetric` THEN Auto)
.
.      THEN Try (BackThruLemma `R_delayable_symmetric` THEN Auto)
END
```