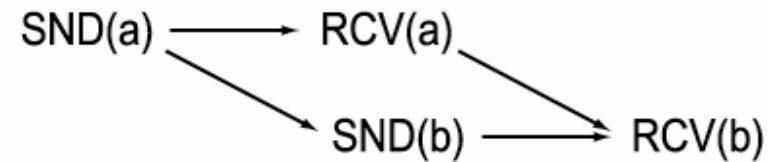
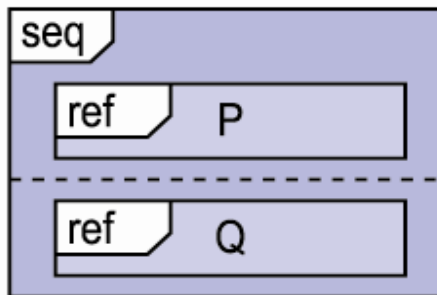
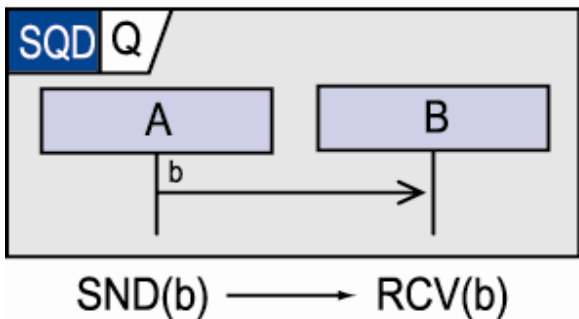
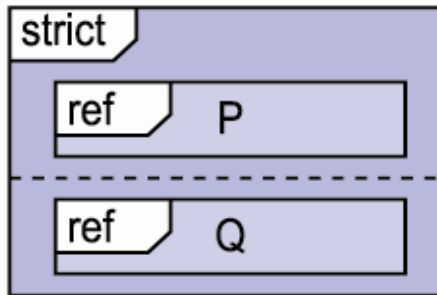
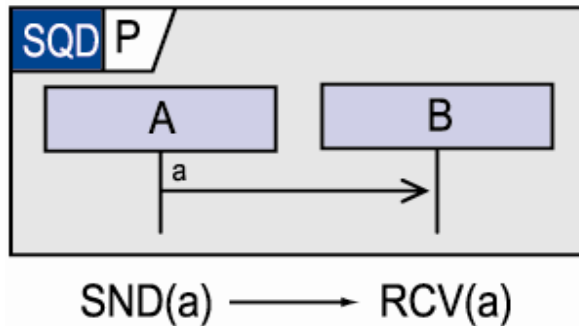


Interaction operators seq & strict

- **seq**
 - compose two interactions sequentially lifeline-wise (default!)
- **strict**
 - compose two interactions sequentially diagram-wise



Interaction operator loop

- **loop**

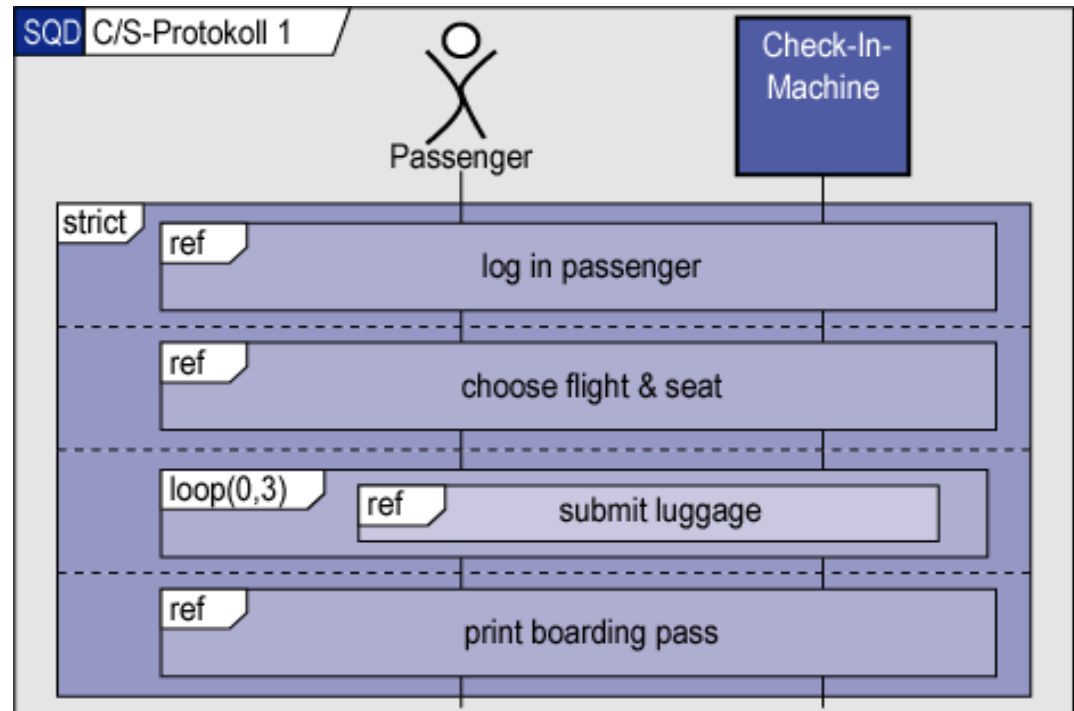
- repeated application of seq

$\text{loop}(P, \text{min}, \text{max}) = \text{seq}(P, \text{loop}(P, \text{min}-1, \text{max}-1))$

$\text{loop}(P, 0, \text{max}) = \text{seq}(\text{opt}(P), \text{loop}(P, 0, \text{max}-1))$

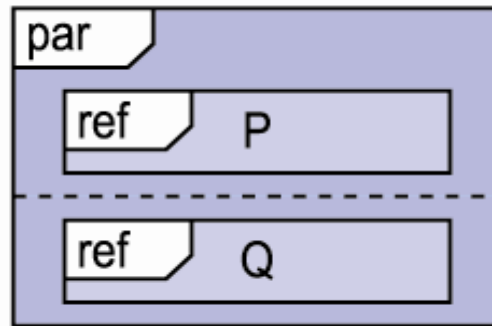
$\text{loop}(P, *) = \text{seq}(\text{opt}(P), \text{loop}(P, *))$

for some interaction fragment P



Interaction operators: interleaving

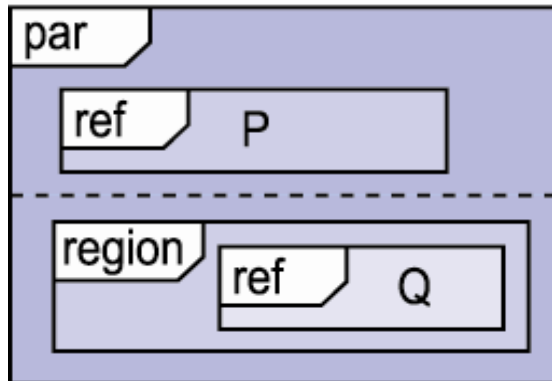
- **par**
 - shuffle arguments
- **region**
 - execute argument atomically, i.e. disallow interleaving



SND(a) → RCV(a)

SND(b) → RCV(b)

SND(a).RCV(a).SND(b).RCV(b)
 SND(a).SND(b).RCV(a).RCV(b)
 SND(a).SND(b).RCV(b).RCV(a)
 SND(b).SND(a).RCV(a).RCV(b)
 SND(b).SND(a).RCV(b).RCV(a)
 SND(b).RCV(b).SND(a).RCV(a)



SND(a).RCV(a).SND(b).RCV(b)
 SND(a).SND(b).RCV(b).RCV(a)
 SND(b).RCV(b).SND(a).RCV(a)

Interaction operators alt, opt, brk: choice

- **alt**
 - alternative complete execution of one of two interaction fragments
- **opt**
 - optional complete execution of interaction fragment:
 $\text{opt}(P) = \text{alt}(P, \text{nop})$
- **break**
 - execute interaction fragment partially, skip rest, and jump to surrounding fragment

Interaction operators: abstraction

- **ignore, consider**

- dual way of expressing:

- allow the ignorable messages (!) anywhere
- present only those messages that are to be considered
- $\llbracket \text{ignore}(P,Z) \rrbracket = \text{shuffle}(\llbracket P \rrbracket, Z^*)$

