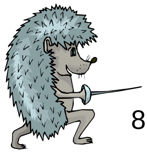
Sequence Diagrams

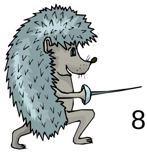
Version 050909

INF 5150



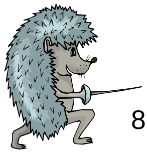
Sequence Diagrams

- Sequence Diagrams are
  - simple
  - powerful
  - readable
  - used to describe interaction sequences
- History
  - Has been used for a number of years informally
  - Standardized in 1992 in Z.120 (Message Sequence Charts - MSC)
  - Last major revision of MSC is from 1999 (called MSC-2000)
  - Formal semantics of MSC-96 is given in Z.120 Annex B
  - Included in UML from 1999, but in a rather simple variant
  - UML 2.0 http://www.uml.org/



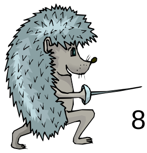
Purpose

- Emphasizes the interaction between objects indicating that the interplay is the most important aspect
  - Often only a small portion of the total variety of behavior is described improve the individual understanding of an interaction problem
- Sequence Diagrams are used to ...
  - document protocol situations,
  - illustrate behavior situations,
  - verify interaction properties relative to a specification,
  - describe test cases,
  - document simulation traces.

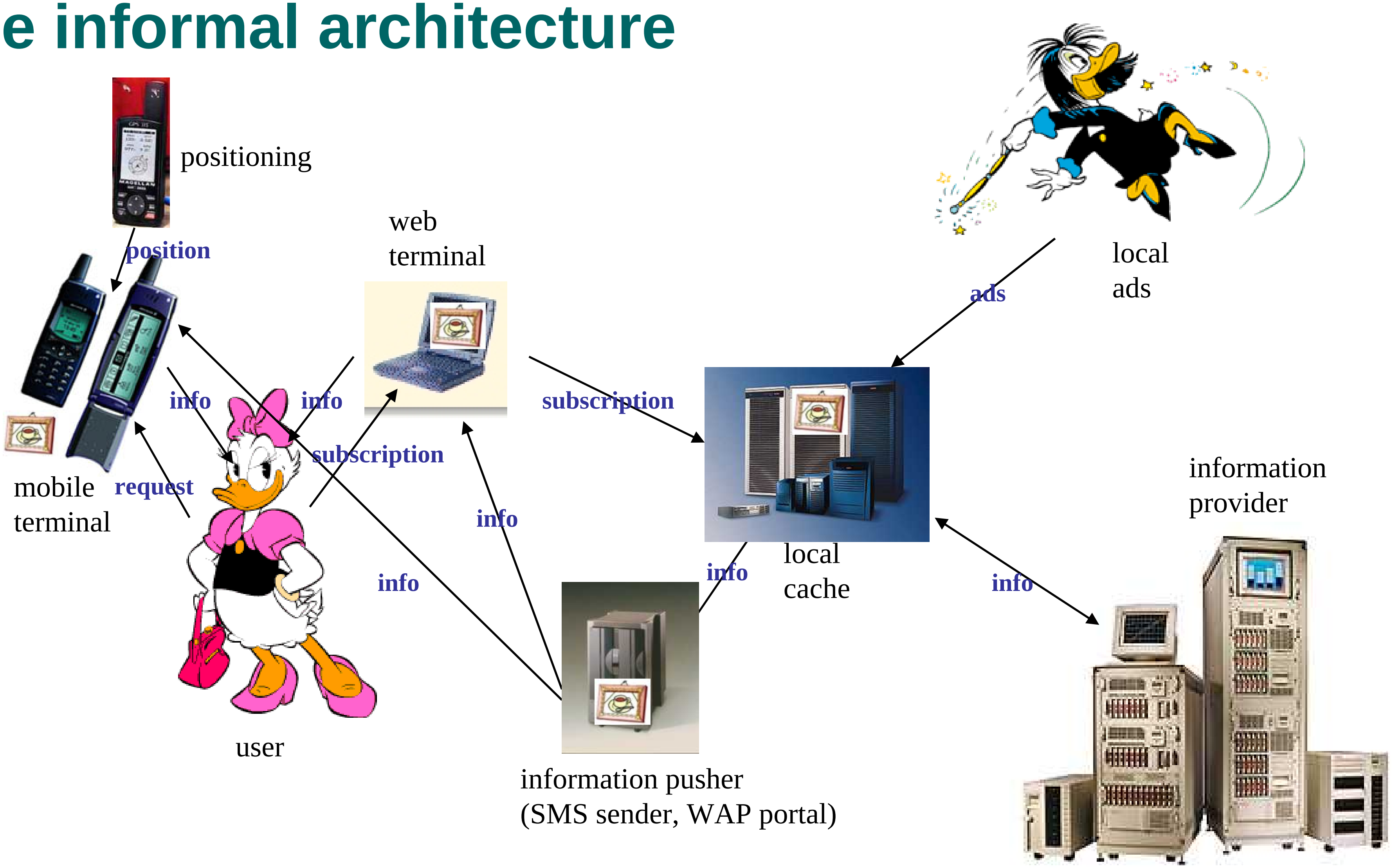


The example context: Dolly Goes To Town

- Dolly is going to town and
  - wants to subscribe for bus schedules back home
  - given her current position
  - and the time of day.
  - The service should not come in effect until a given time in the evening



The informal architecture



positioning

position

web
terminal

local
ads

ads

info

info

subscription

subscription

mobile
terminal

request

info

info

information
provider

local
cache

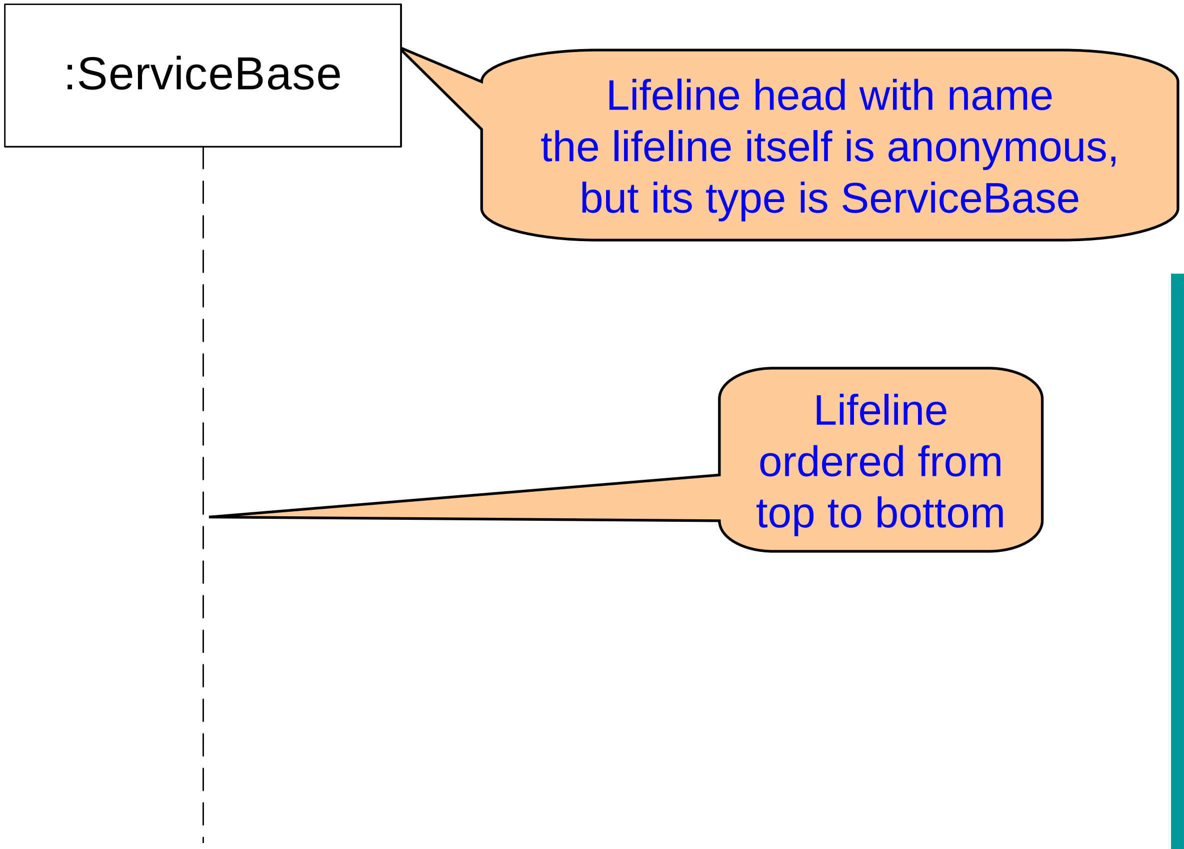
info

info

user

information pusher
(SMS sender, WAP portal)

Lifeline (MSC: Instance) – the “doers”

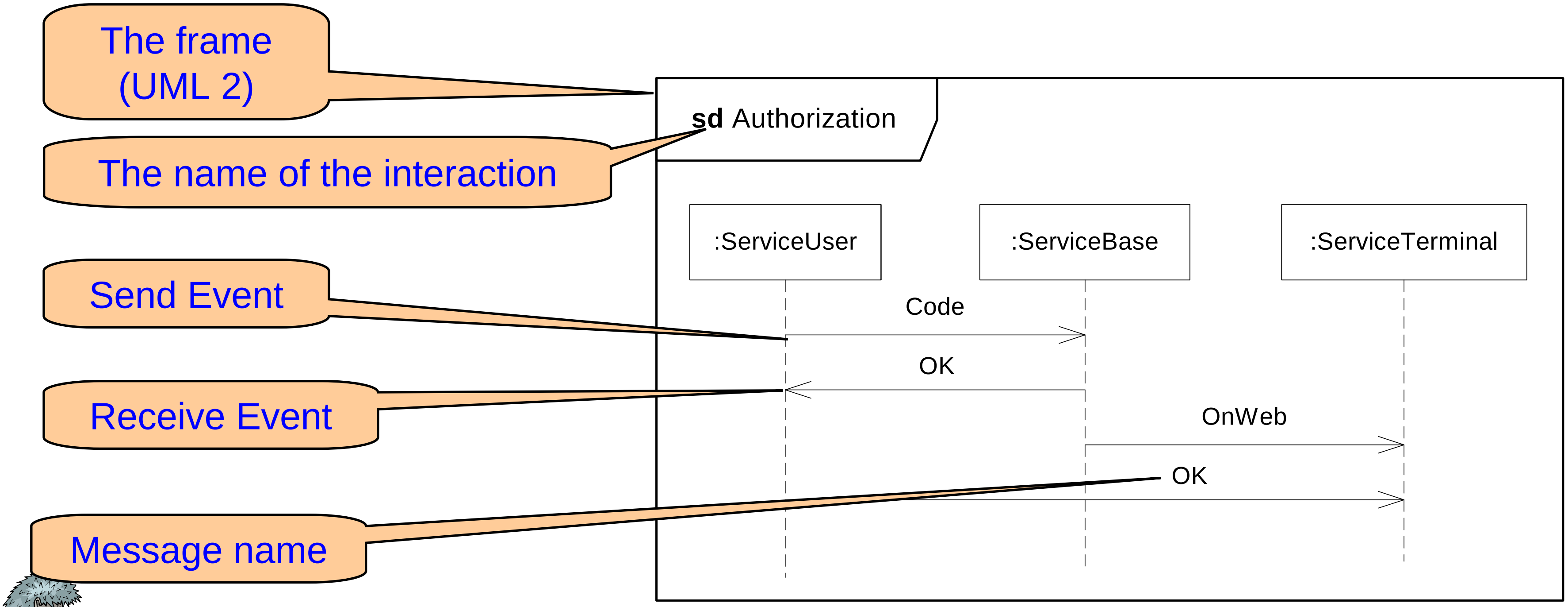


Lifeline head with name
the lifeline itself is anonymous,
but its type is ServiceBase

Lifeline
ordered from
top to bottom

(Simple) Sequence Diagram

- Messages have one send event, and one receive event.
  - The send event must occur before the receive event.
  - The send event is the result of an Action
- Events are strictly ordered along a lifeline from top to bottom

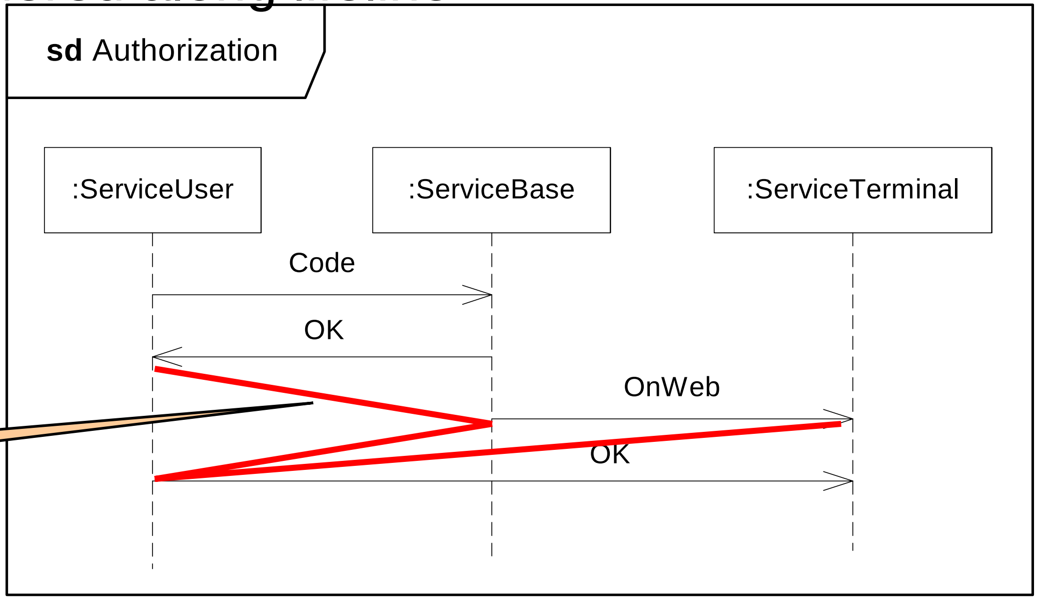


How many global traces are there in this diagram?

- The only invariants:
  - Messages have one send event, and one receive event. The send event must occur before the receive event.
  - Events are strictly ordered along lifeline

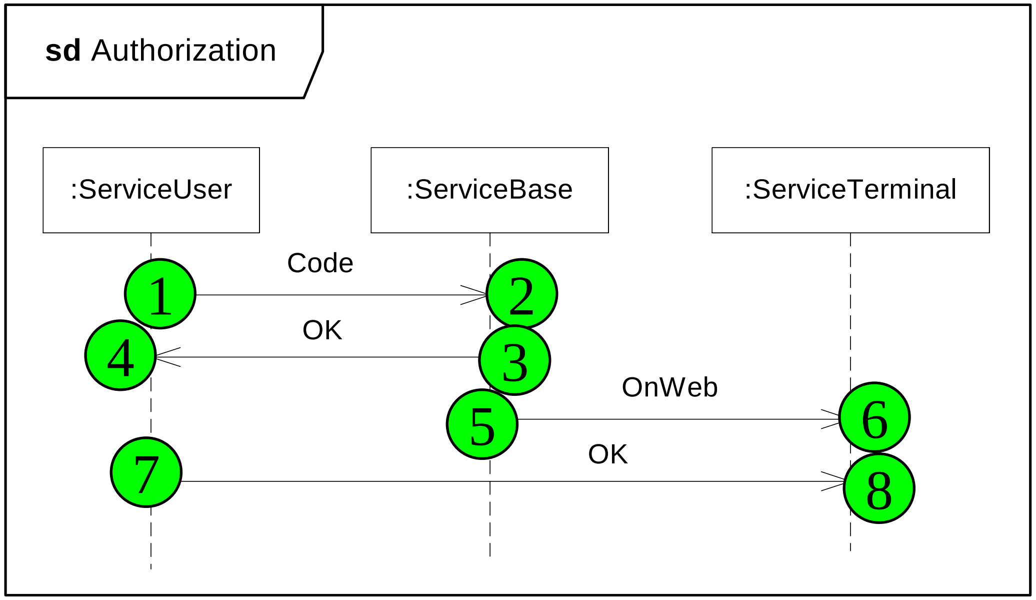
How many?

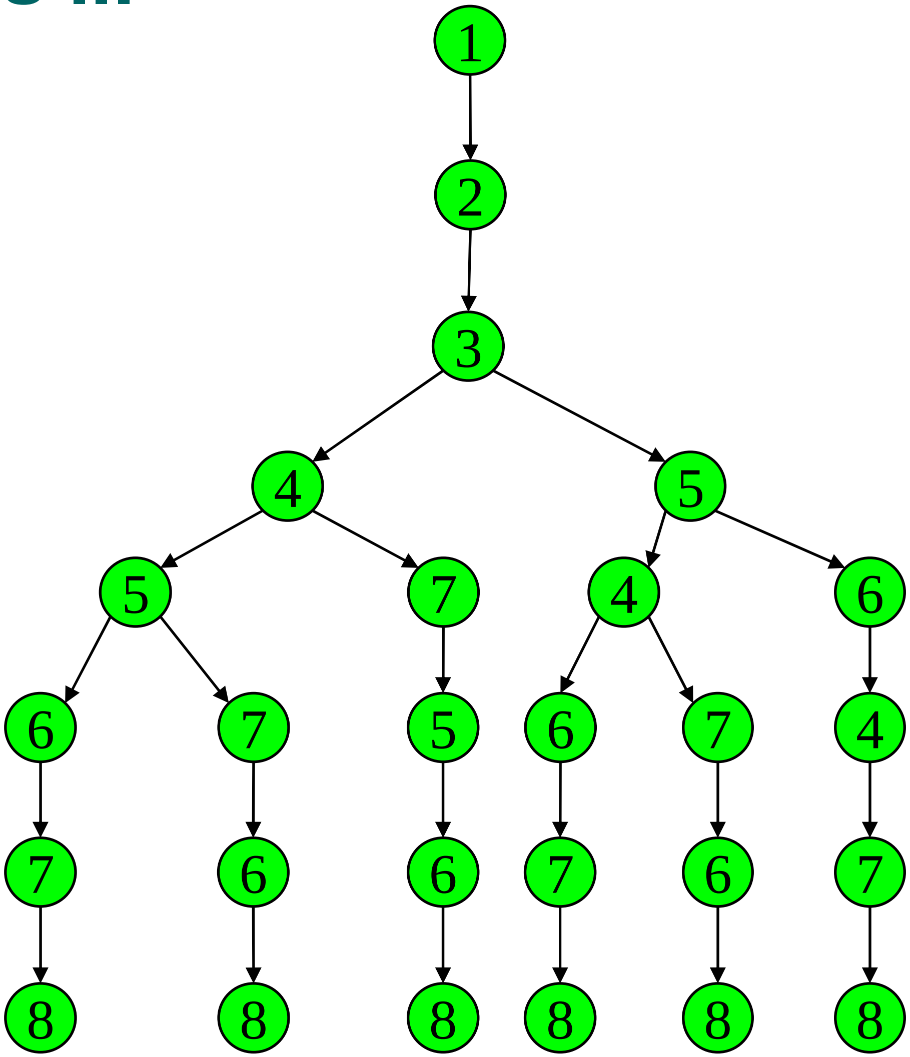
- 1, 2, 3, 4, 5, 6,..?

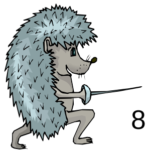


independent!

Really counting the traces ...

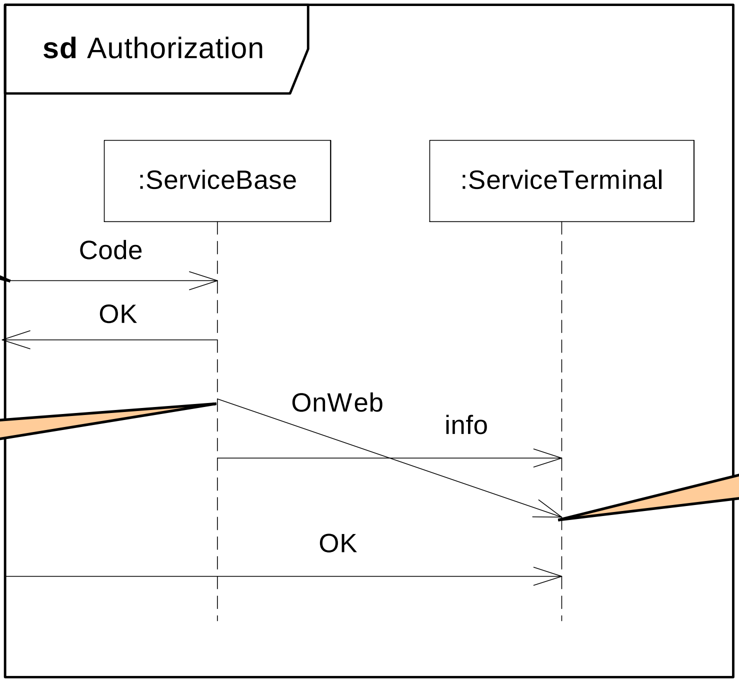






Asynchronous messages: Message Overtaking

- asynchronous communication = when the sender does not wait for the reply of the message sent
- Reception is normally interpreted as consumption of the message.
- When messages are asynchronous, it is important to be able to describe message overtaking.



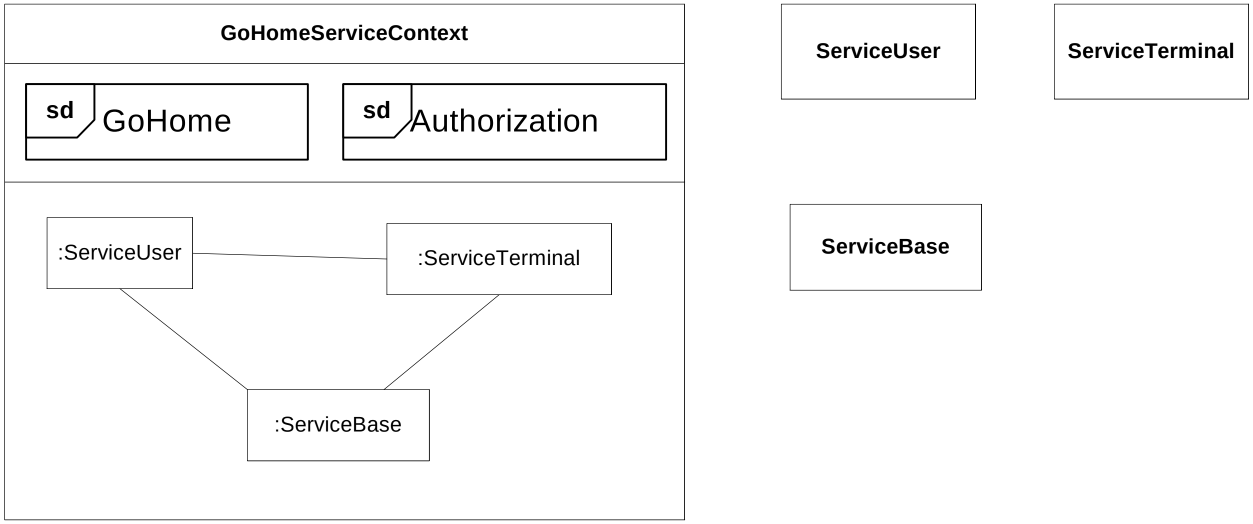
notice message to/from environment

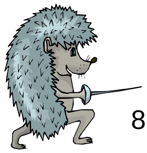
sending OnWeb before sending Info

receiving OnWeb after receiving Info

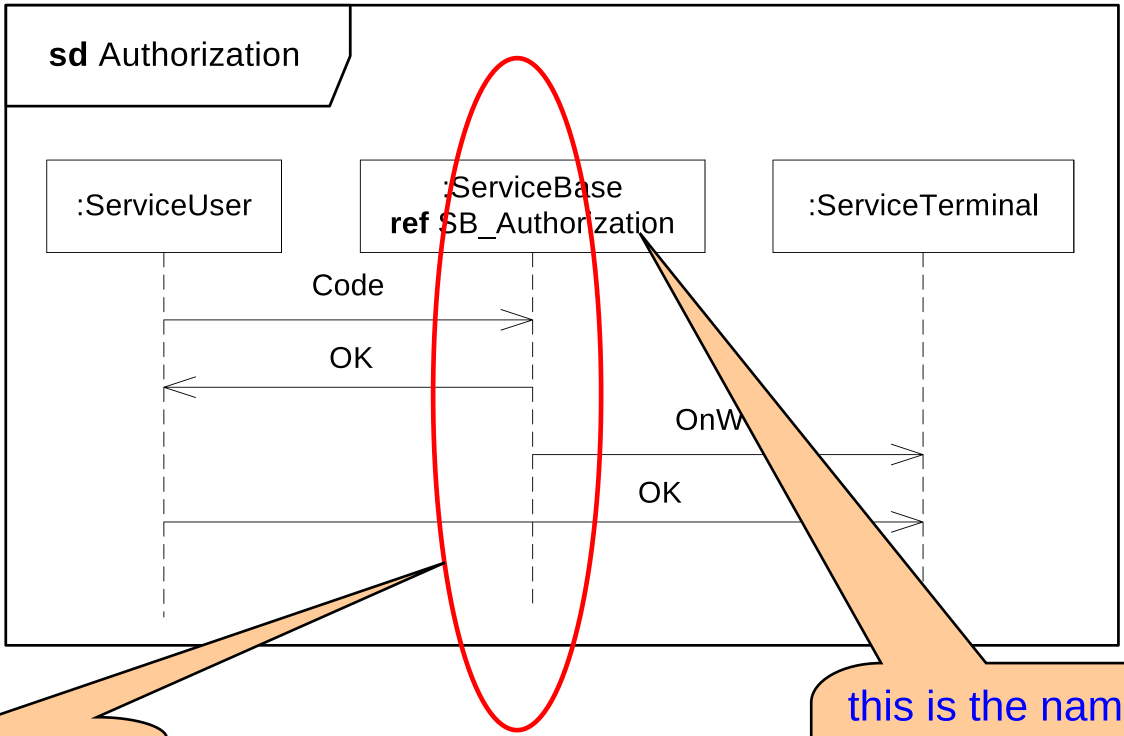
The context of a Sequence Diagram

- The context is a Classifier with Composite Structure (of properties)
  - Properties (parts) are represented by Lifelines
  - Generic Parts of Collaborations must be bound to concrete Parts
  - Concrete Parts of Classes can be Lifelines directly
- In MSC (Message Sequence Charts) context is an “MSC document”
- The concept of a context with internal structure leads to an aggregate hierarchy of entities (parts)
  - We exploit this through the concept of Decomposition





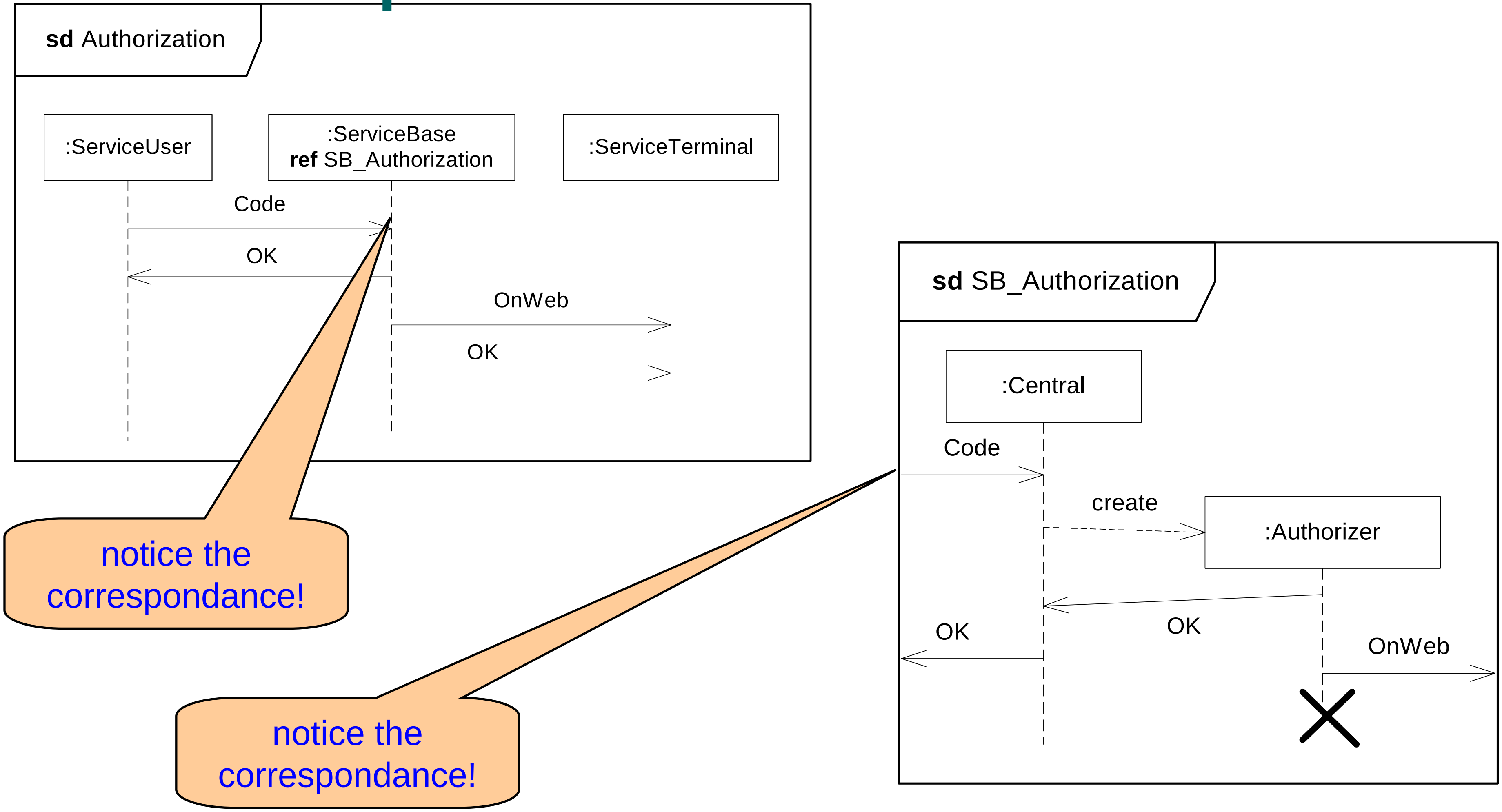
Decomposing a Lifeline relative to an Interaction



we want to look into this lifeline

this is the name of the diagram where we find the decomposition

The Decomposition



sd Authorization

:ServiceUser

:ServiceBase
ref SB_Authorization

:ServiceTerminal

Code

OK

OnWeb

OK

sd SB_Authorization

:Central

Code

create

:Authorizer

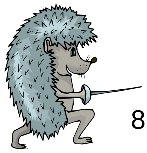
OK

OK

OnWeb

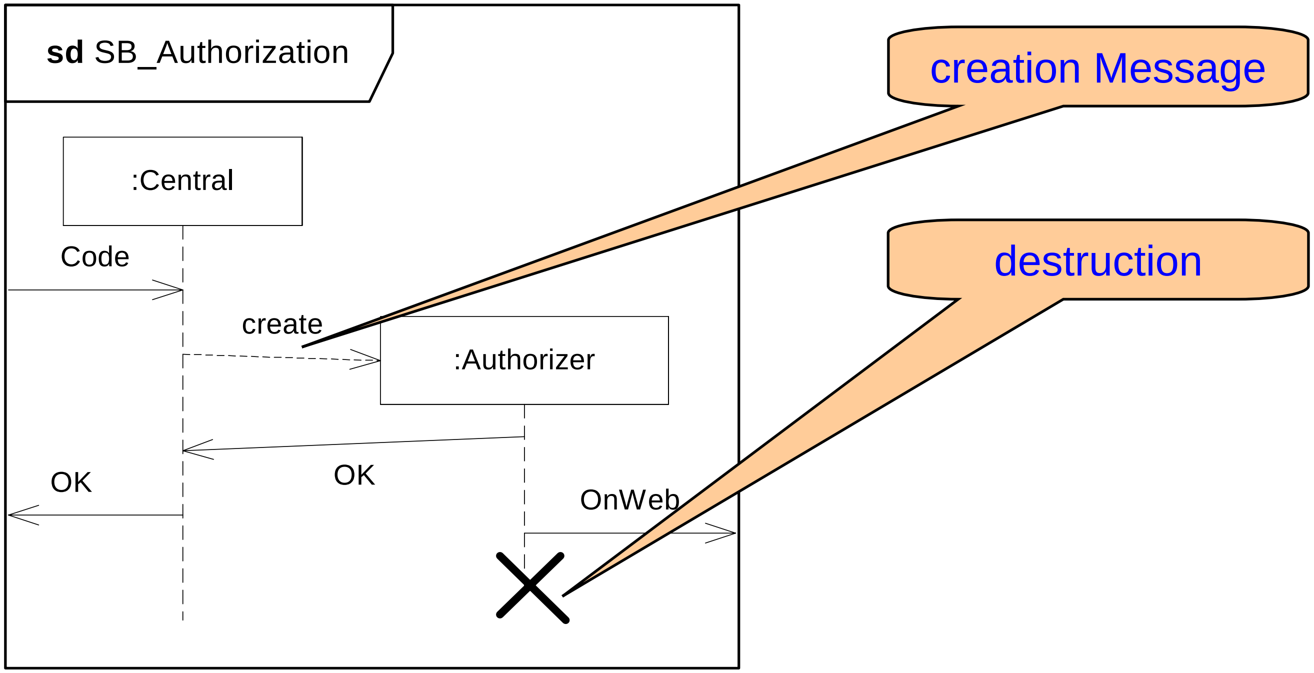
notice the correspondance!

notice the correspondance!

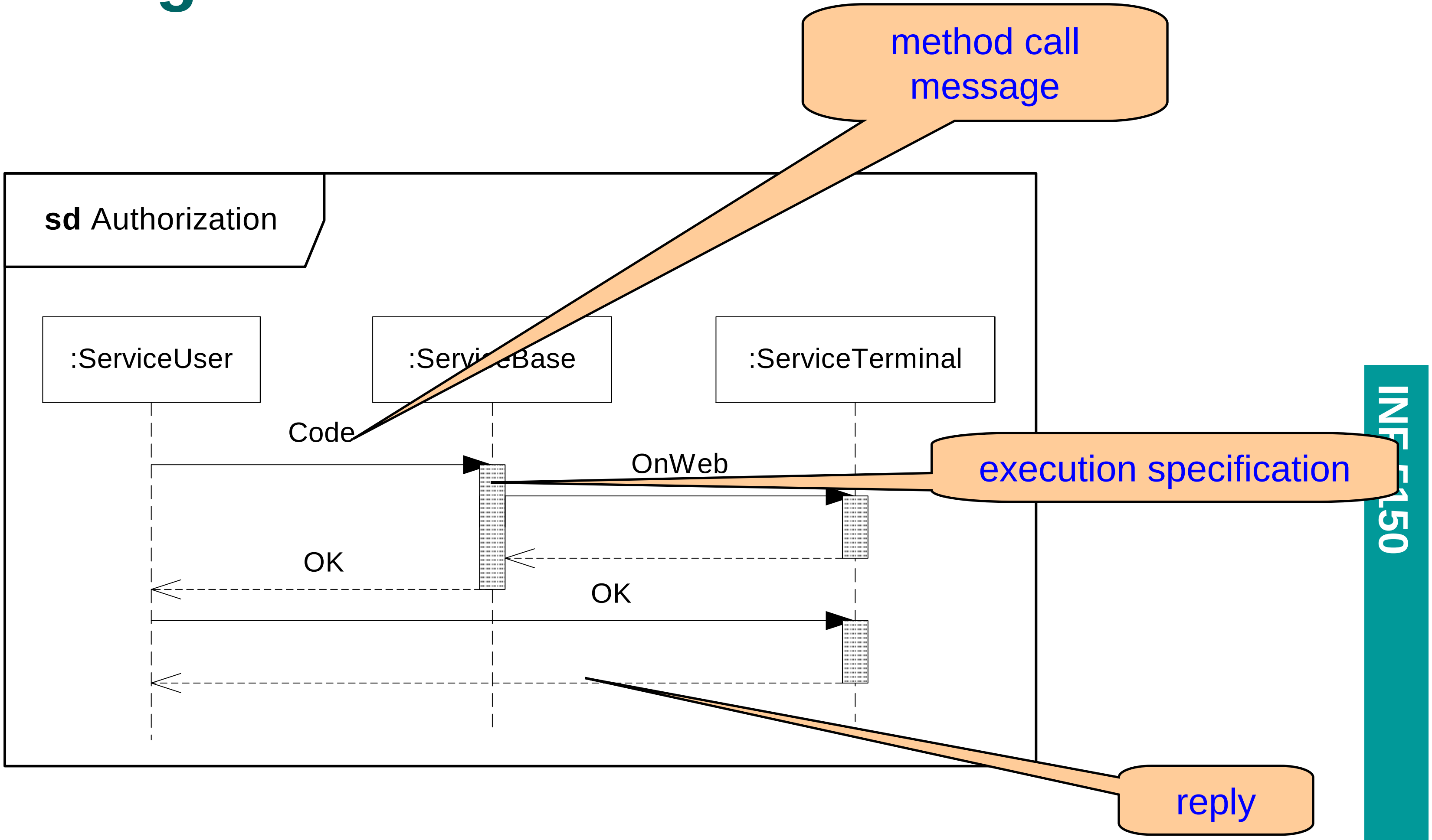


Lifeline creation and destruction

- We would like to describe Lifeline creation and destruction
- The idea here (though rather far fetched) is that the *ServiceBase* needs to create a new process in the big mainframe computer to perform the task of authorizing the received *Code*. We see a situation where several *Authorizers* work in parallel

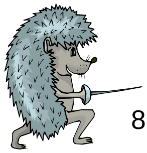


Synchronizing interaction



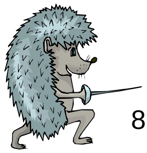
Basic Sequence Diagrams Summary

- We consider mostly messages that are asynchronous, the sending of one message must come before the corresponding reception
- UML has traditionally described synchronizing method calls rather than asynchronous communication
- The events on a lifeline are strictly ordered
- The distance between events is not significant.
- The context of Interactions are classifiers
- A lifeline (within an interaction) may be detailed in a decomposition
- Dynamic creation and destruction of lifelines

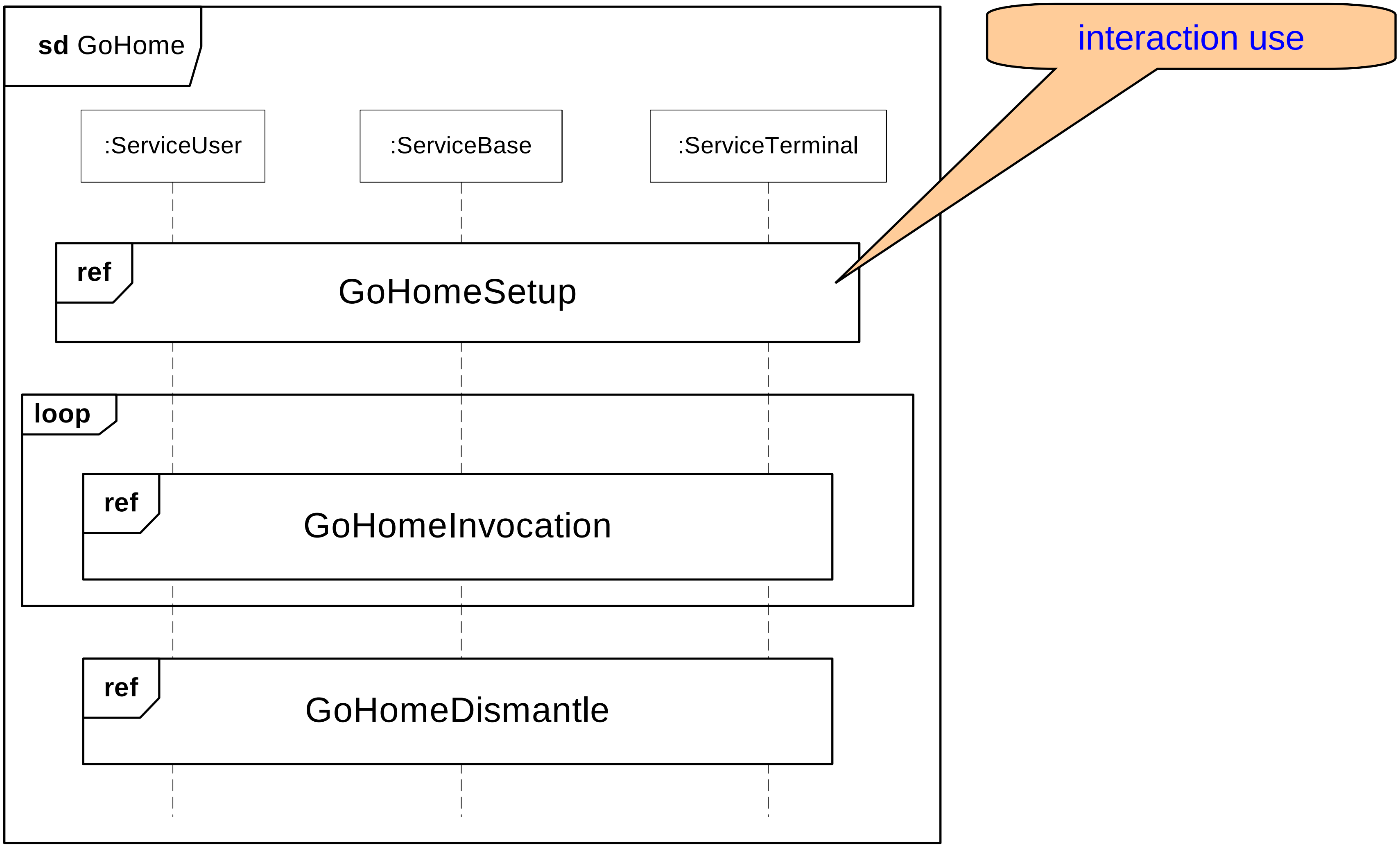


More structure (UML 2.0 from MSC-96)

- interaction uses – such that Interactions may be referenced within other Interactions
- combined fragments – combining Interaction fragments to express alternatives, parallel merge and loops
- better overview of combinations – High level Interactions where Lifelines and individual Messages are hidden
- gates – flexible connection points between references/expressions and their surroundings

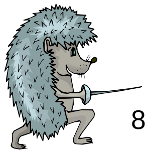


References

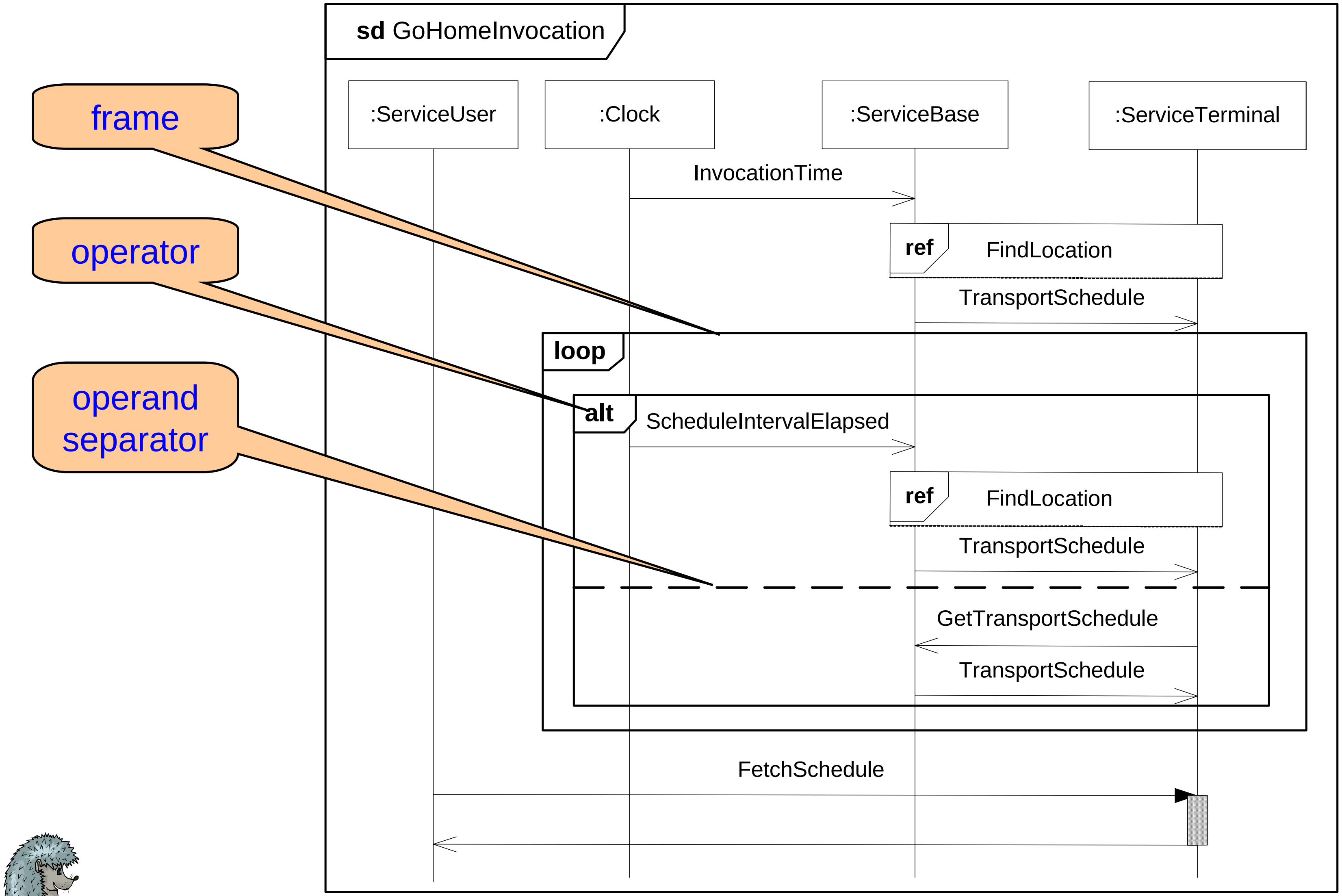

sd GoHome
:ServiceUser
:ServiceBase
:ServiceTerminal
ref
GoHomeSetup
loop
ref
GoHomeInvocation
ref
GoHomeDismantle
interaction use

Combined fragments of Interaction

- MSC-96: “inline expressions”
- UML 2.0: “combined fragments”
- We want to express
  - choices: alternative, option, break
  - parallel merge
  - loops
- We also want to add other operators
  - negation
  - critical region
  - assertion
- Other suggested operators that will not come in UML 2.0
  - interrupt
  - disrupt



Combined fragment example



Interaction Overview

similar to activity diagram

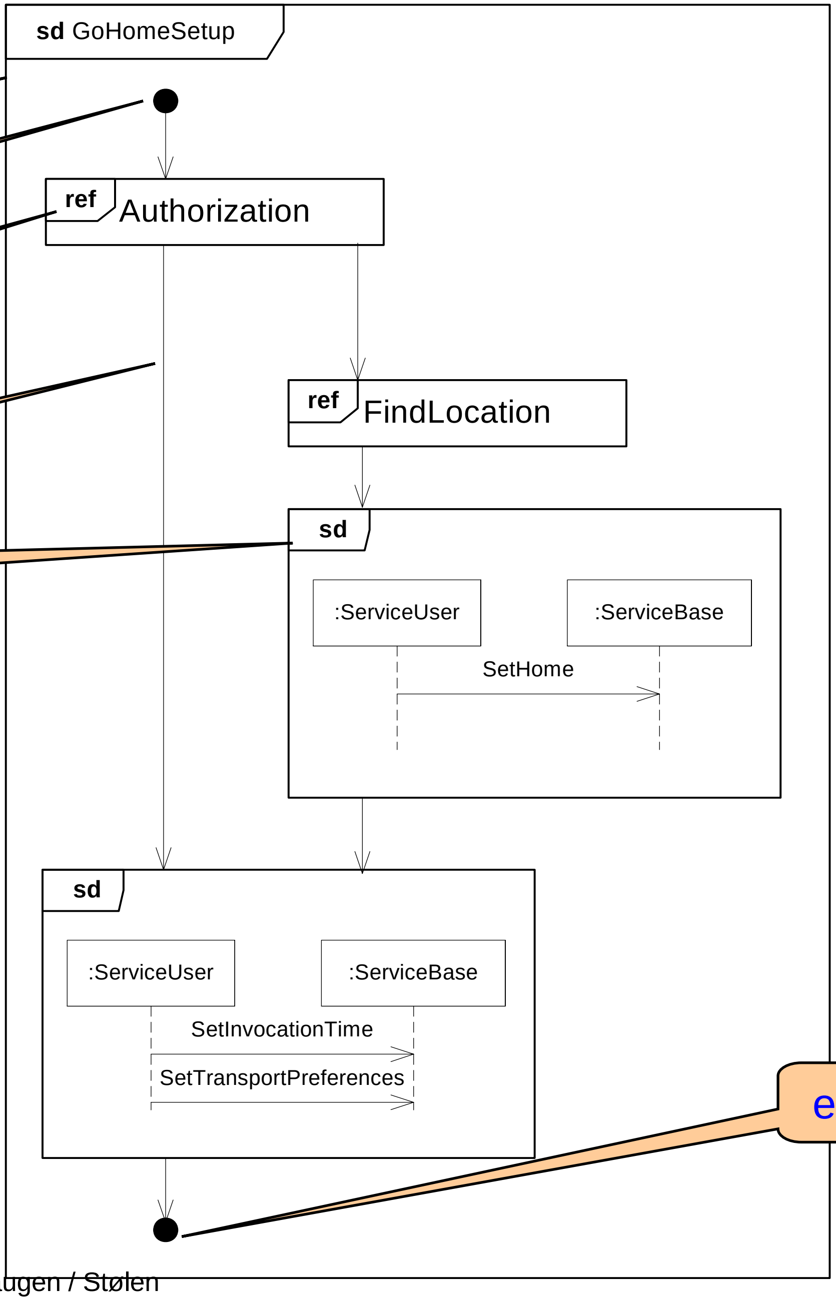
start

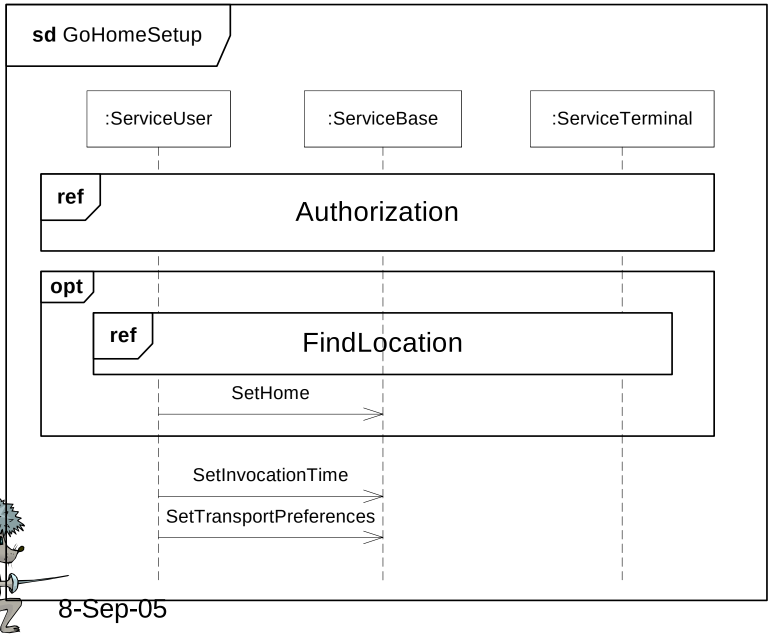
references

flow line

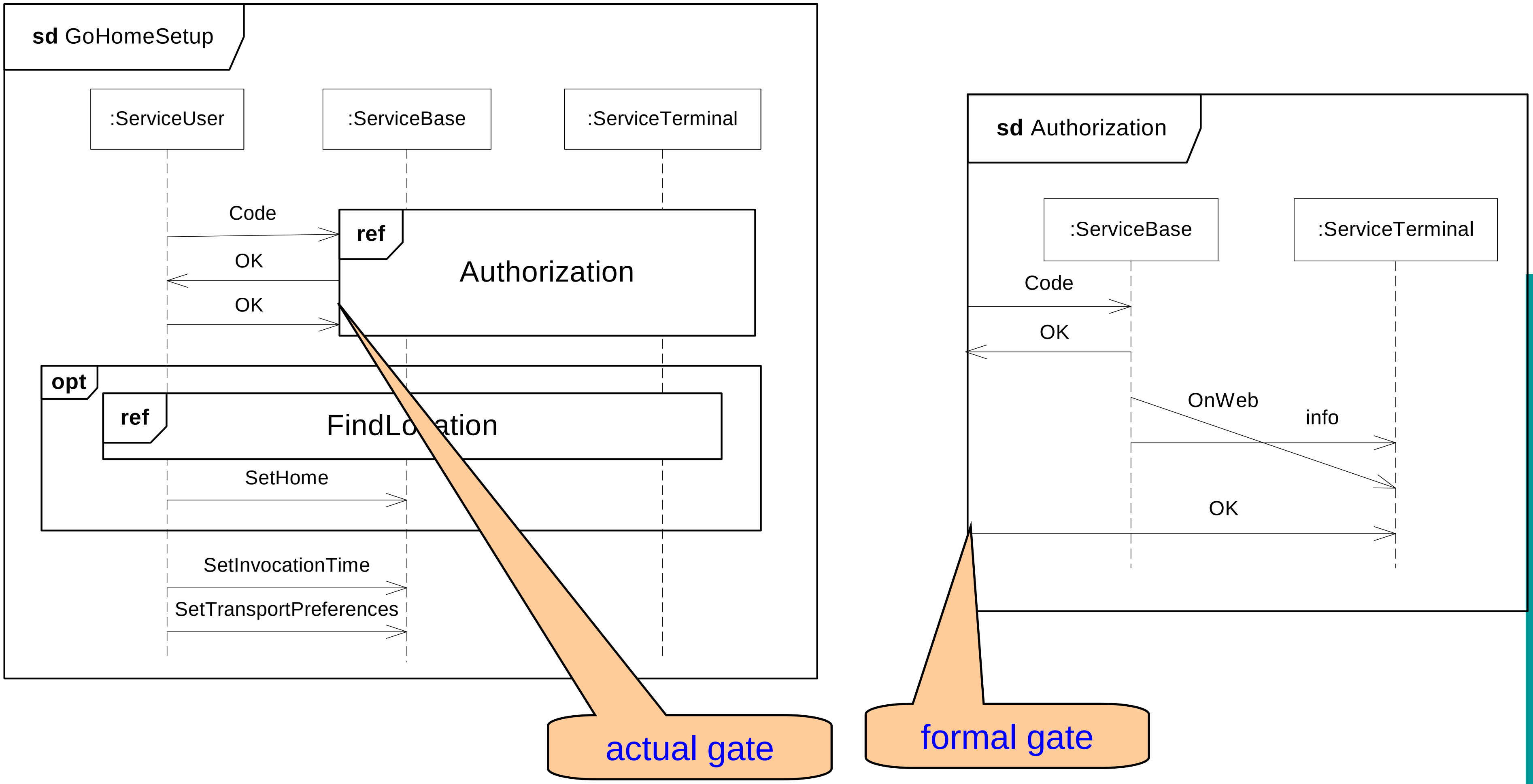
inline diagram

end

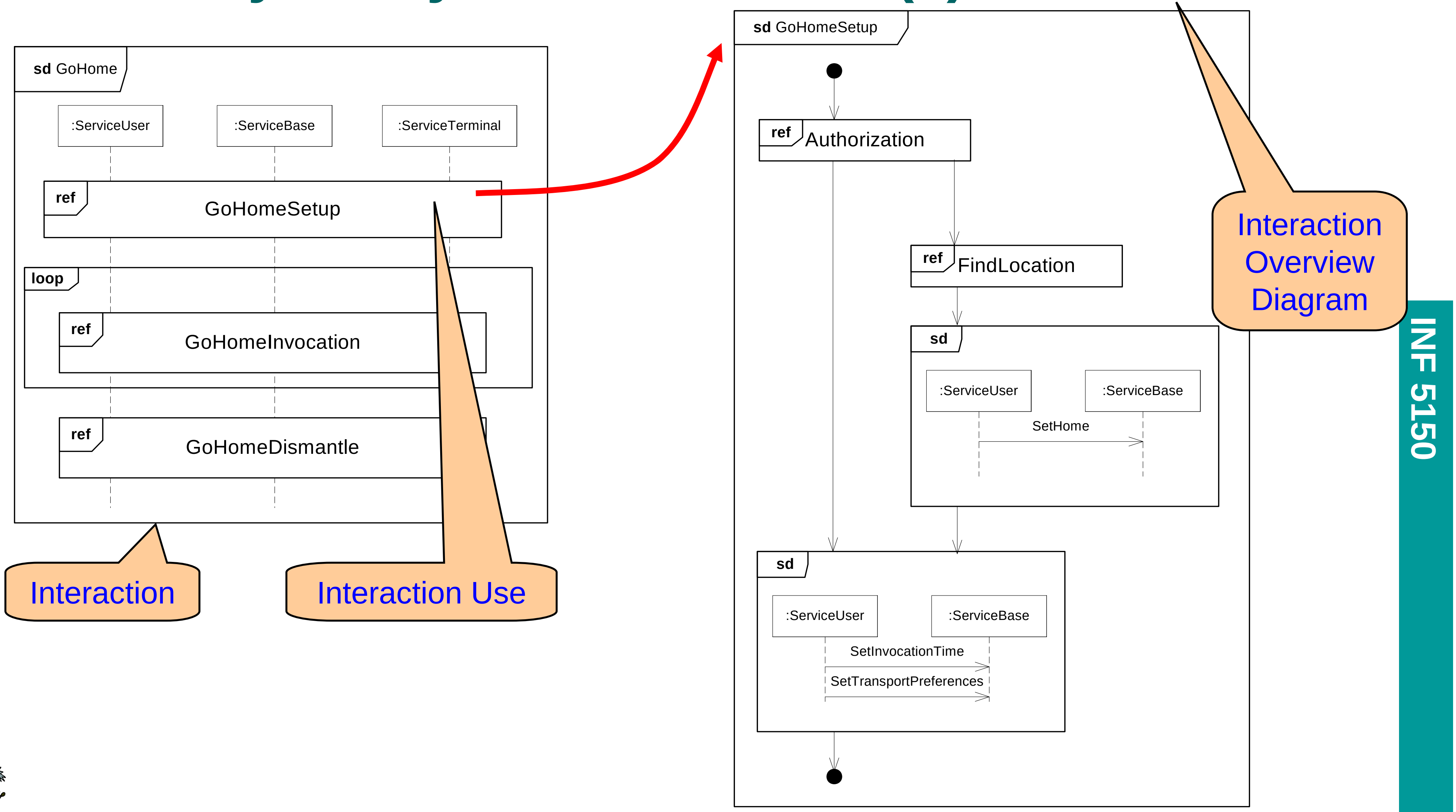




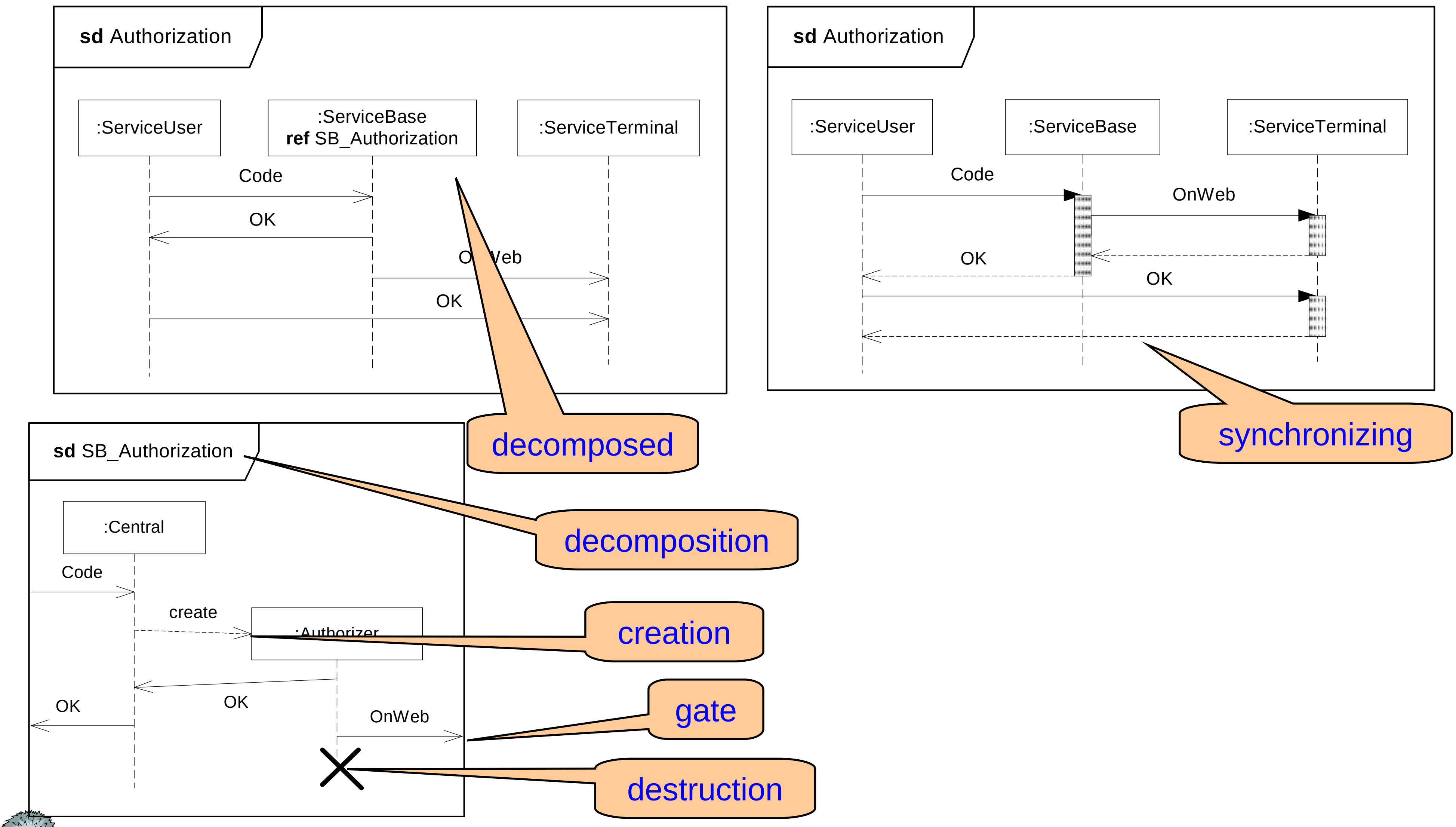
Gates


sd GoHomeSetup
:ServiceUser
:ServiceBase
:ServiceTerminal
Code
OK
OK
ref
Authorization
opt
ref
FindLocation
SetHome
SetInvocationTime
SetTransportPreferences
sd Authorization
:ServiceBase
:ServiceTerminal
Code
OK
OnWeb
info
OK
actual gate
formal gate

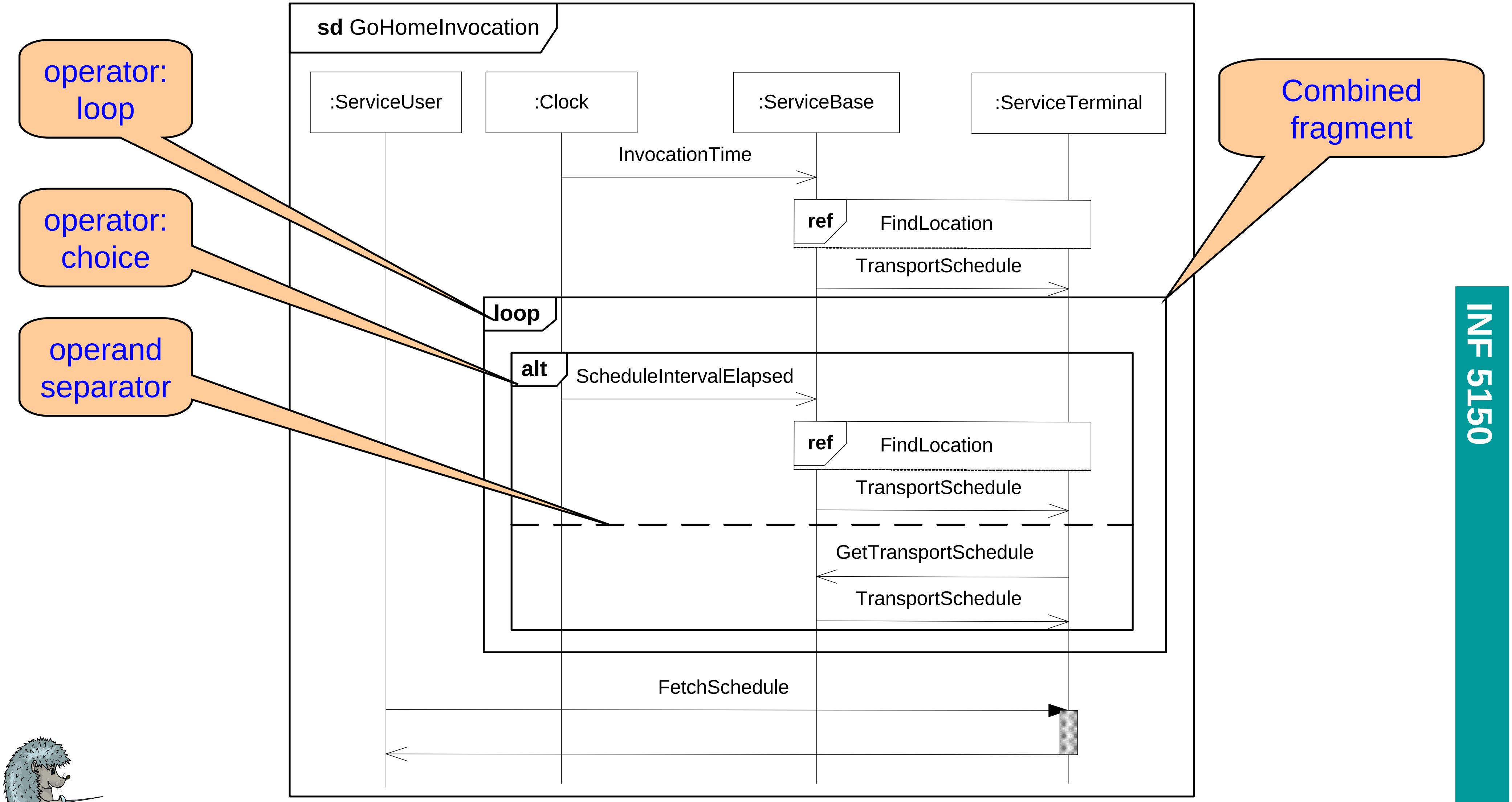
Summary: Dolly Goes To Town (1)



Dolly Goes To Town (2)



Dolly Goes To Town (3)


operator: loop
operator: choice
operand separator
sd GoHomeInvocation
:ServiceUser
:Clock
:ServiceBase
:ServiceTerminal
InvocationTime
ref FindLocation
TransportSchedule
loop
alt
ScheduleIntervalElapsed
ref FindLocation
TransportSchedule
GetTransportSchedule
TransportSchedule
FetchSchedule
Combined fragment