Behavioral Contracts and Service Substitutability:

A Contribution to Dependable SOA

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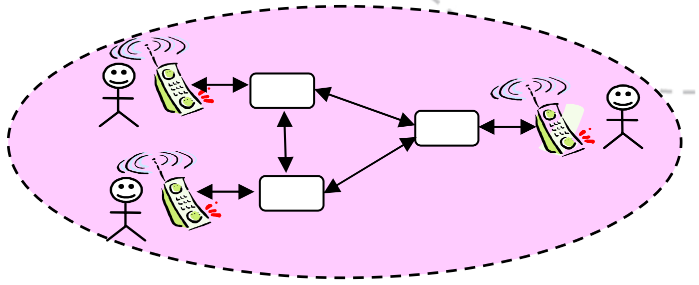
What is a service?

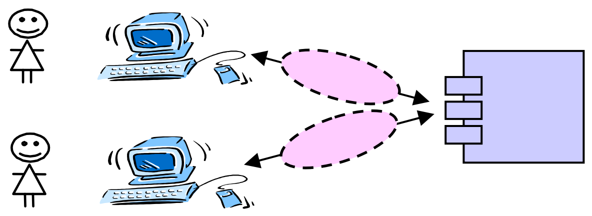
A service is:

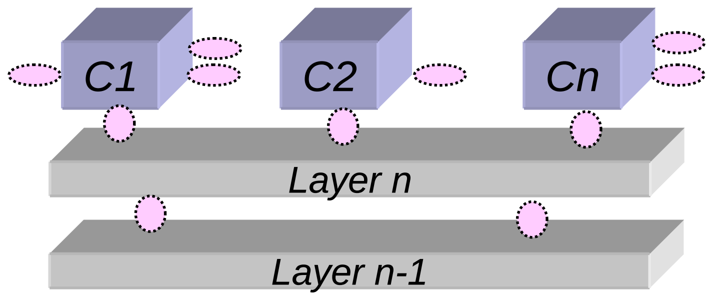
an identified functionality aiming to establish some goals/effects among collaborating entities.

Captures:

- end user services
- active services
- passive services
- component interfaces (Web Services, CORBA, JINI, …)
- layered functionality (ISO OSI)



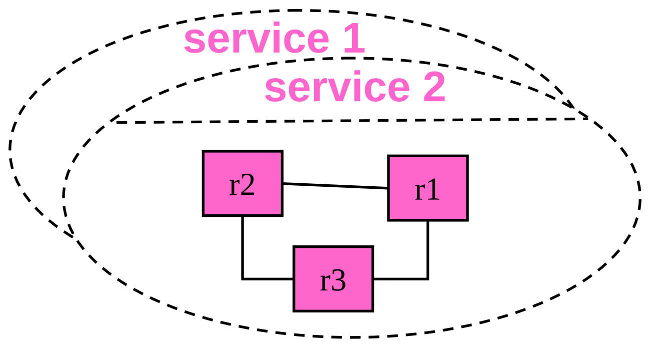


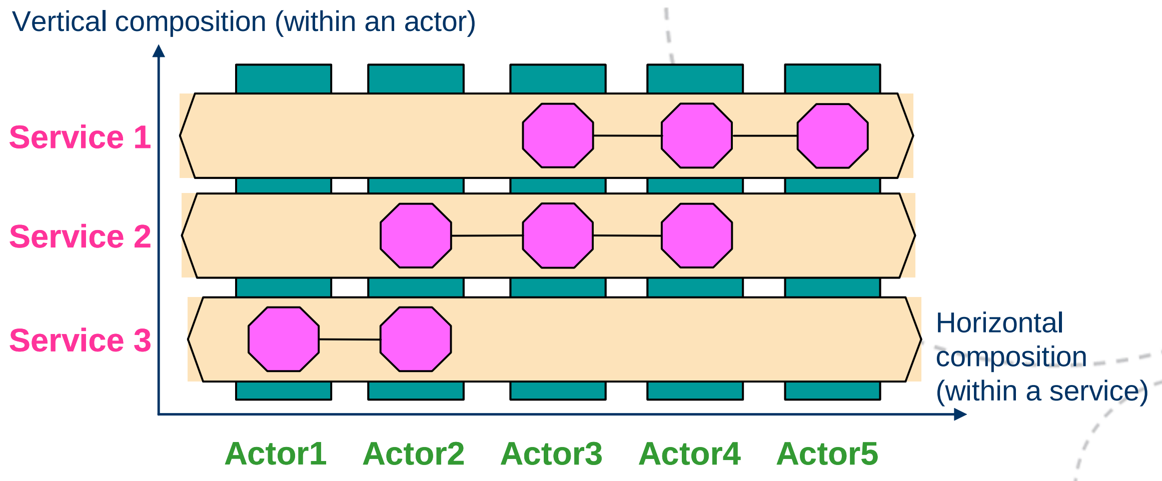


Service fundamentals:

- Service is *functionality*; it is behavior performed by entities.
- Service imply *collaboration;* it makes no sense to talk about service unless at least two entities collaborate.
- Service behavior is *cross-cutting*; it imply coordination of two or more entity behaviors
- Service behavior is *partial*; it is to be composed with other services

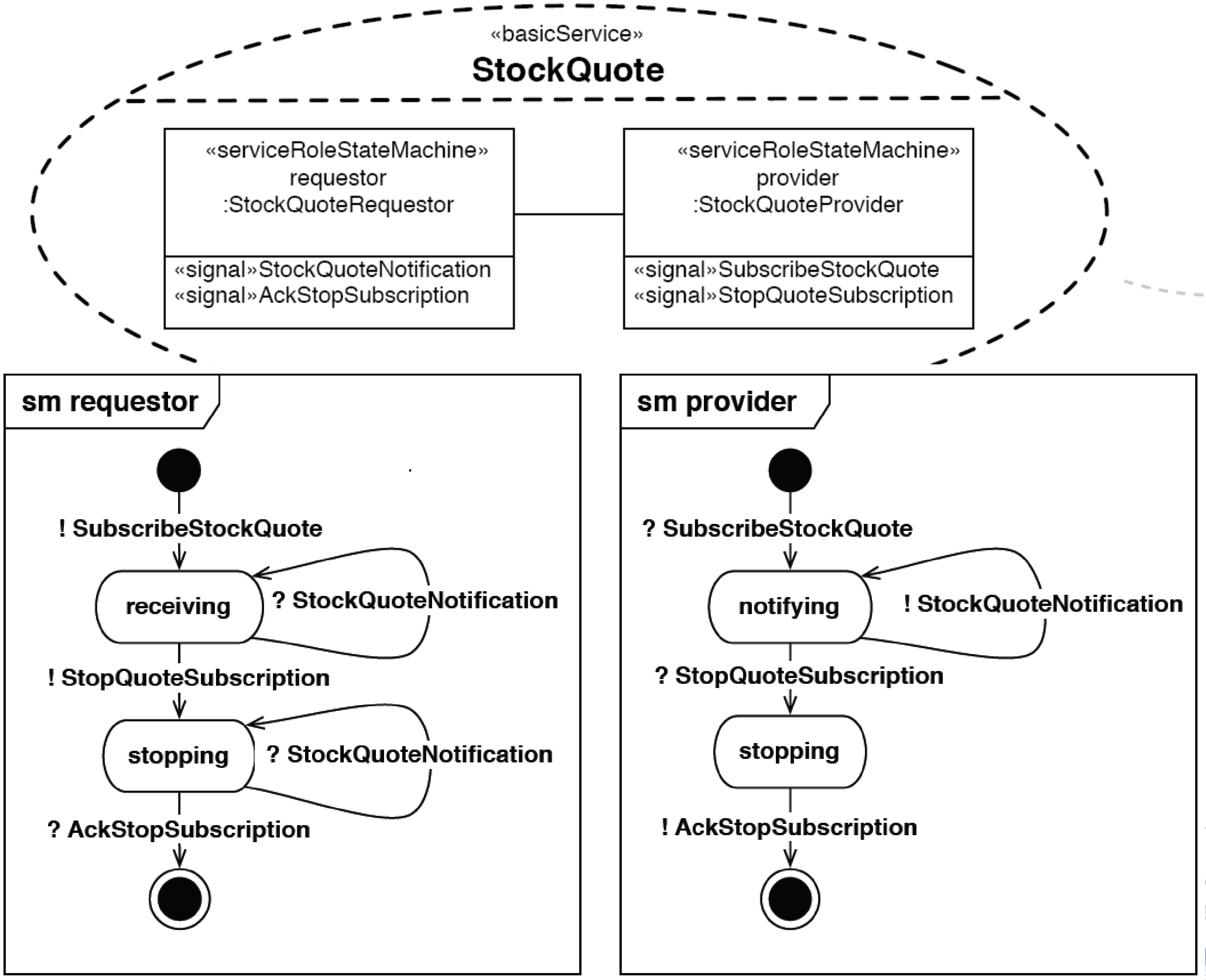
Service modeling using UML 2 collaborations



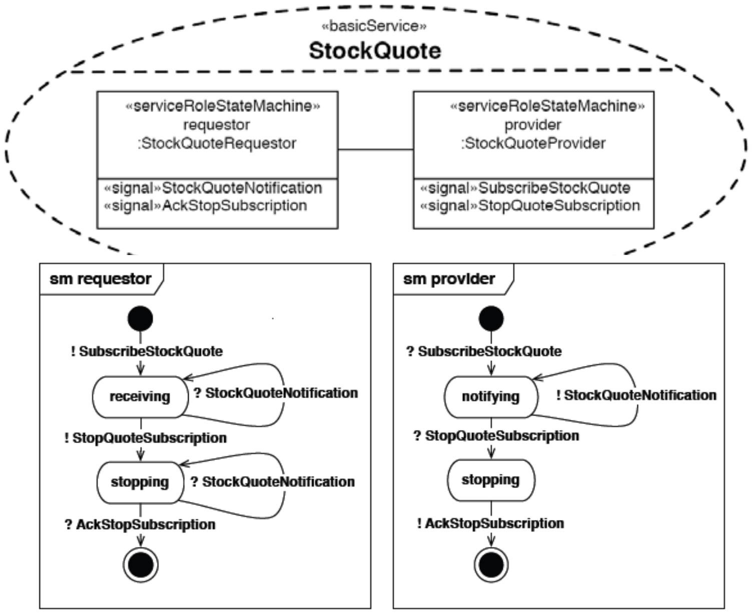

Vertical composition (within an actor)
Service 1
Service 2
Service 3
Horizontal composition (within a service)
Actor1
Actor2
Actor3
Actor4
Actor5

- Matches the concept of service: *Collaborative*; *Cross-cutting*; *Partial*; *Functionality*
- Can model services separately in terms of role structures and behaviours
- Allows flexibility in binding roles to classes
- Require conformance between roles and classes
- Can model interfaces and contracts as two-party collaborations

Collaboration as behavior contract: example



Collaboration as behavior contract:



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<rolesm rolename="StockQuote.provider"
            type="StockQuoteProvider">
 <state id="initial">
   <receive signal="SubscribeStock" nextState="notifying"/>
 </state>
 <state id="notifying">
    <send signal="StockQuoteNotification" nextState="notifying"/>
    <receive signal="StopSubscription" nextState="stopping"/>
 </state>
 <state id="stopping">
    <send signal="AckStopSubscription" nextState="final"/>
 </state>
</rolesm>
```

- Two connected roles with
  - Static interfaces
  - Interface behaviors
- Connector properties
  - Asynchronous or synchronous
  - Bidirectional or unidirectional
- Modelchecked to ensure compatibility between roles
- Publishable using WSDL

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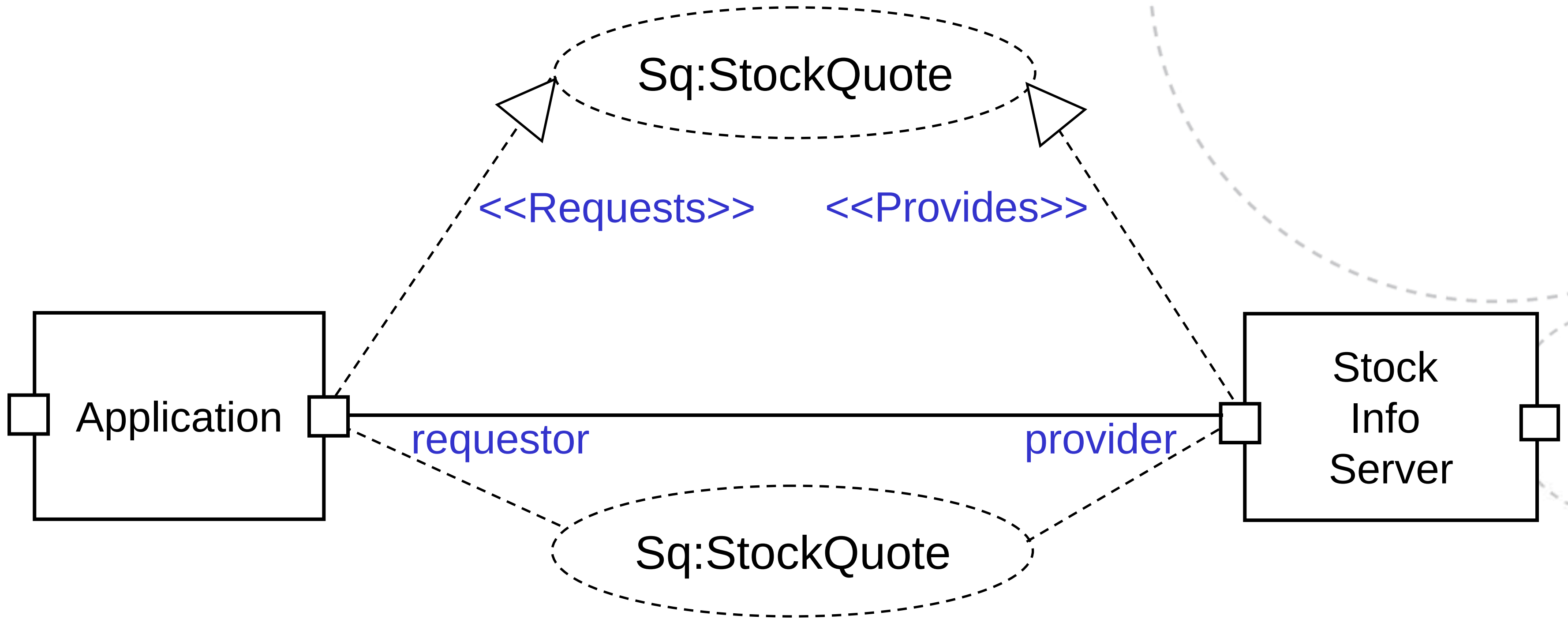
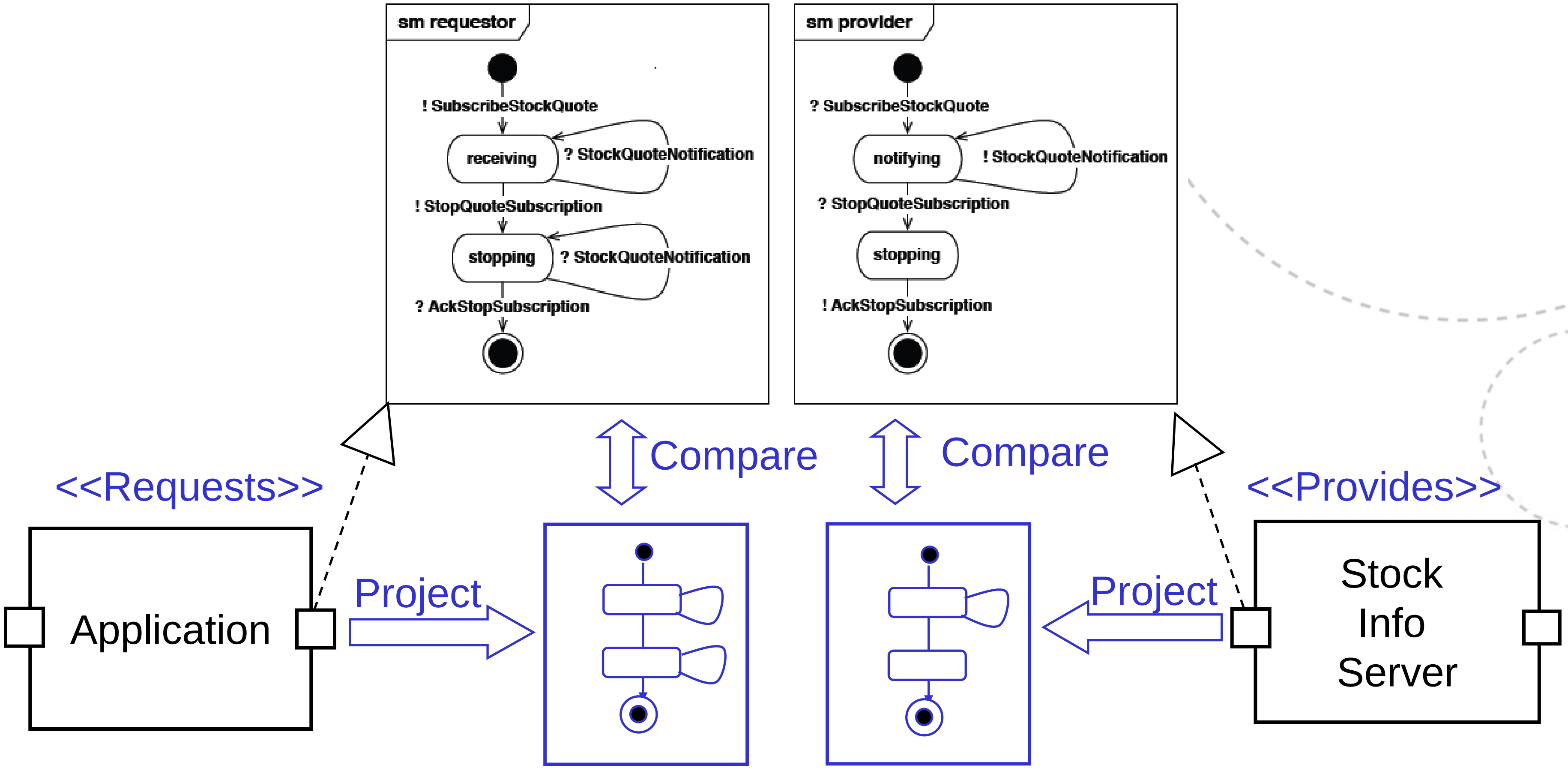
Using contract roles to type interfaces



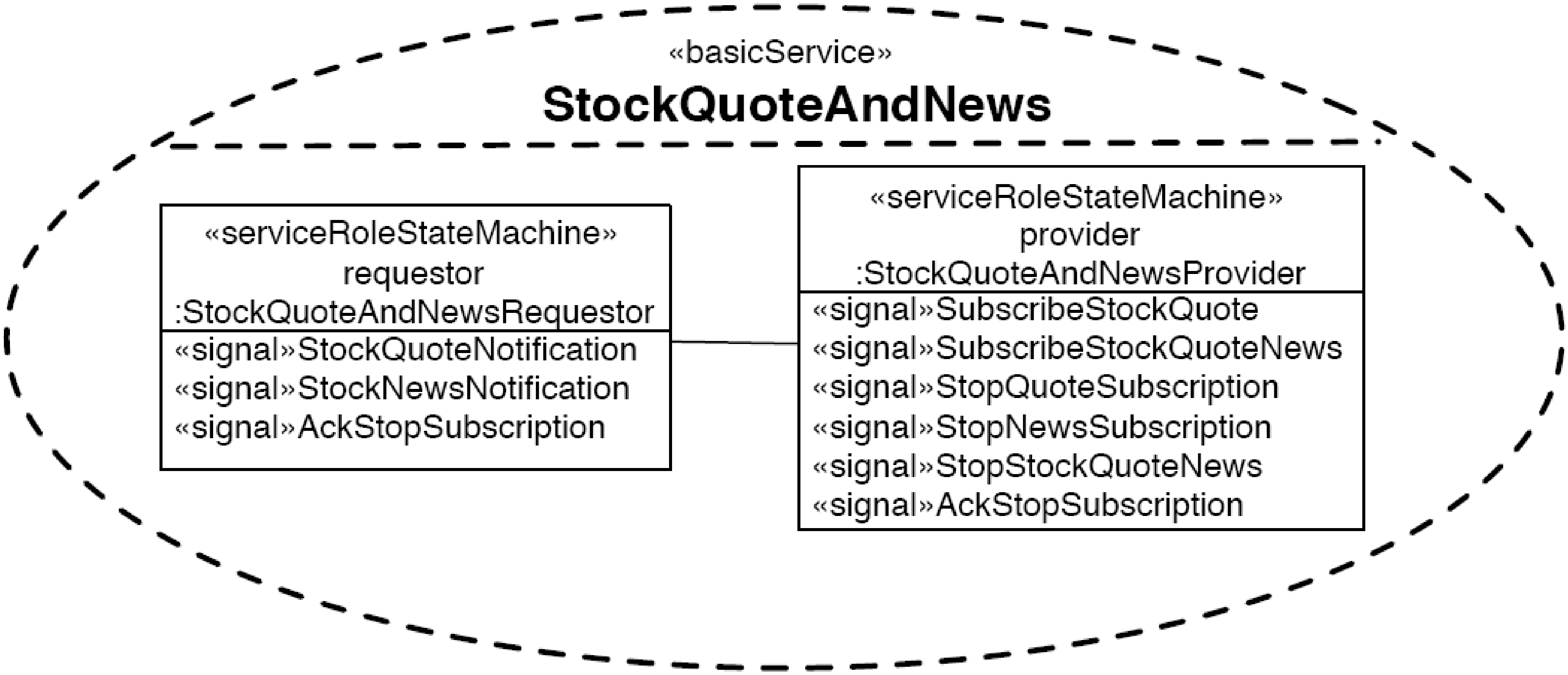
- Compatibility of contract roles modelchecked at design time
- Conformance with contract checked for each interface at design time
- Simple compatibility assurance at runtime

Conformance with contract

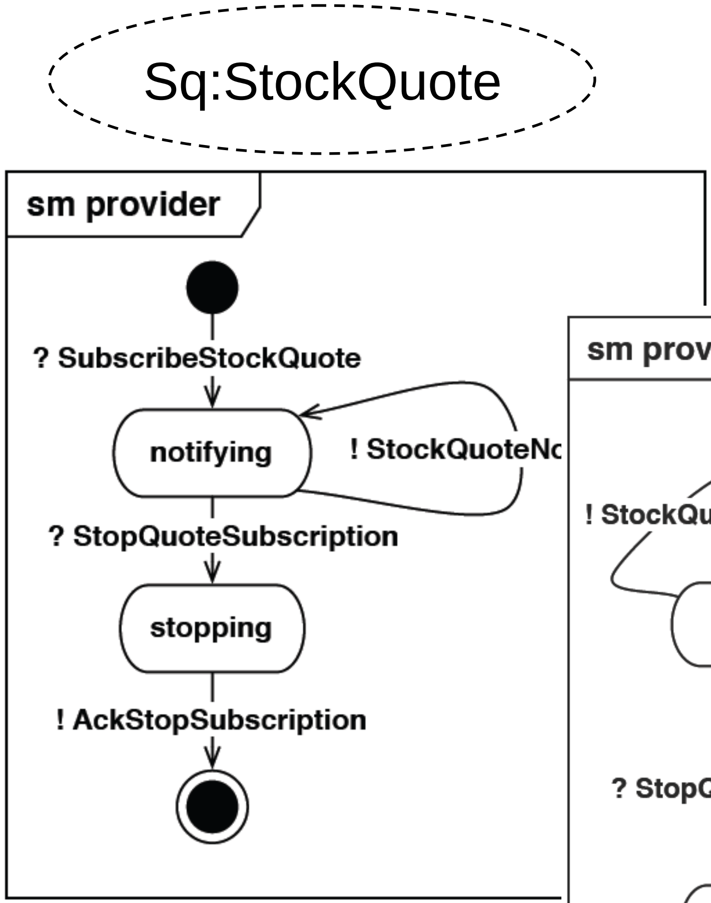


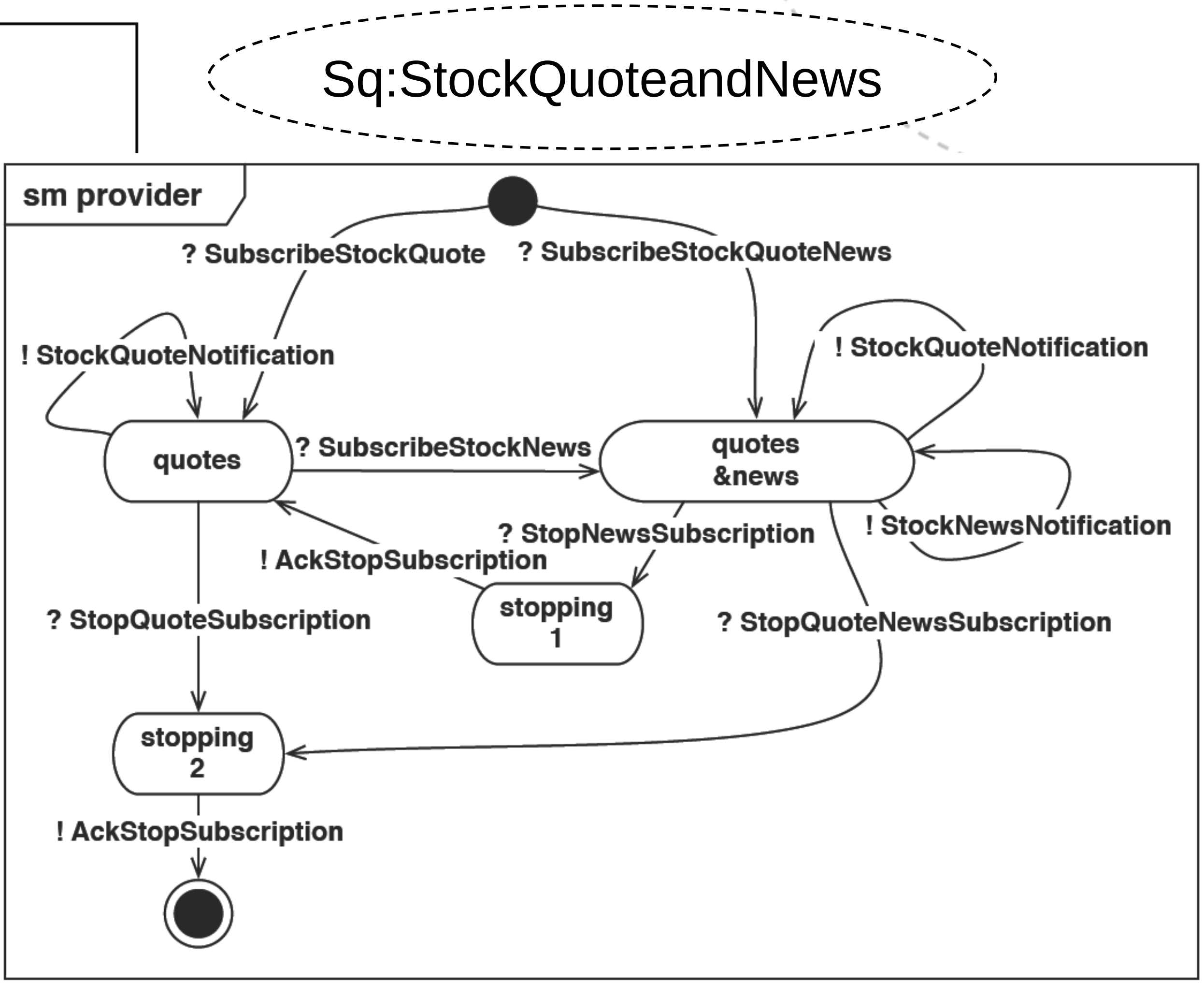
1. Project component behavior to interface behavior
2. Compare interface behavior with contract role behavior: are they equivalent or substitutable?

An extended contract

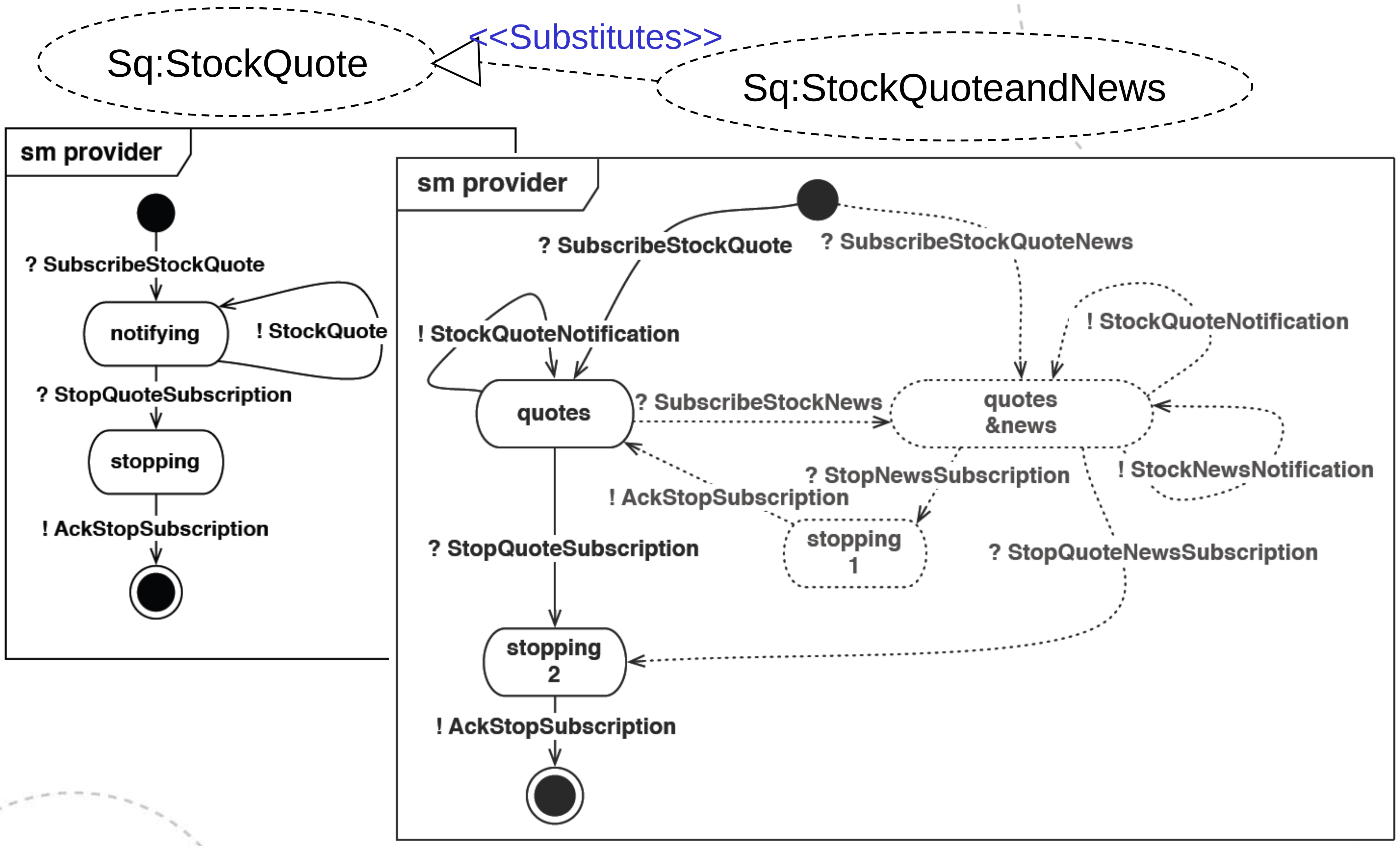

«basicService»
StockQuoteAndNews
«serviceRoleStateMachine»
requestor
:StockQuoteAndNewsRequestor
«signal»StockQuoteNotification
«signal»StockNewsNotification
«signal»AckStopSubscription
«serviceRoleStateMachine»
provider
:StockQuoteAndNewsProvider
«signal»SubscribeStockQuote
«signal»SubscribeStockQuoteNews
«signal»StopQuoteSubscription
«signal»StopNewsSubscription
«signal»StopStockQuoteNews
«signal»AckStopSubscription

With additional behavior



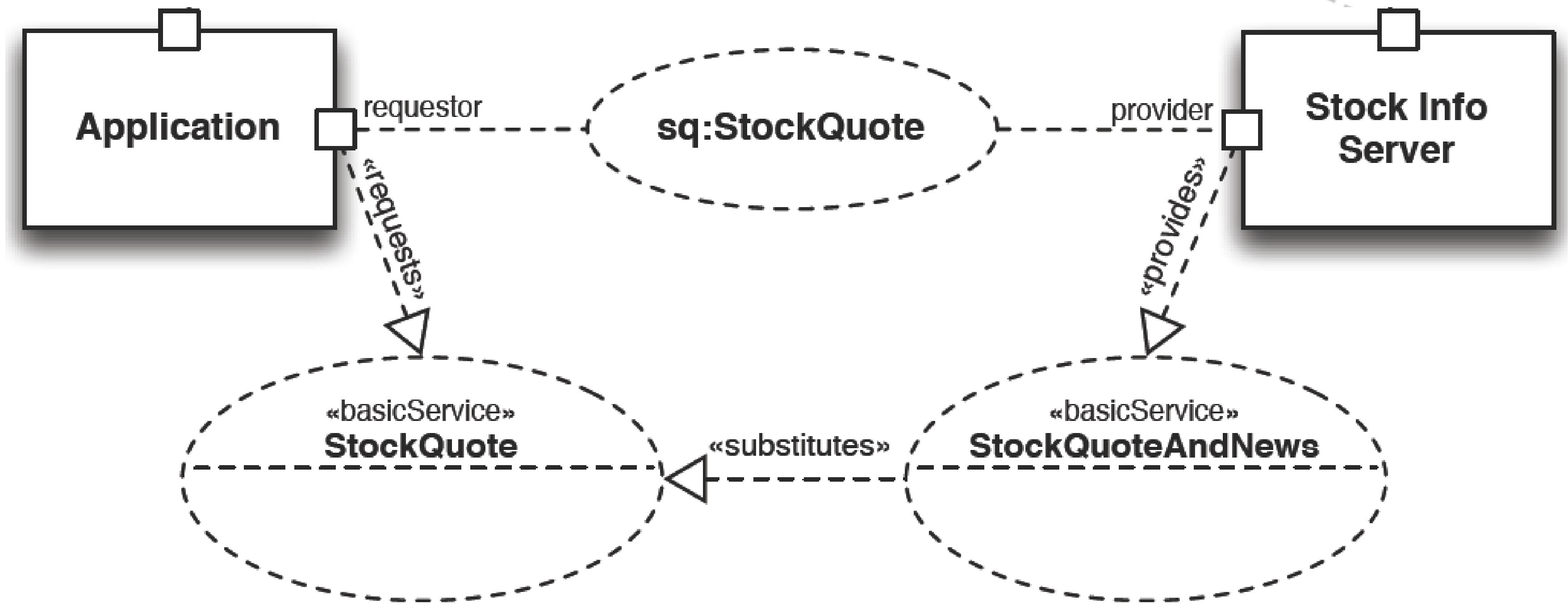


Safe substitution: equivalent reachable behavior



Safe substitution

- Verified once at design time
- Simple checks at run time



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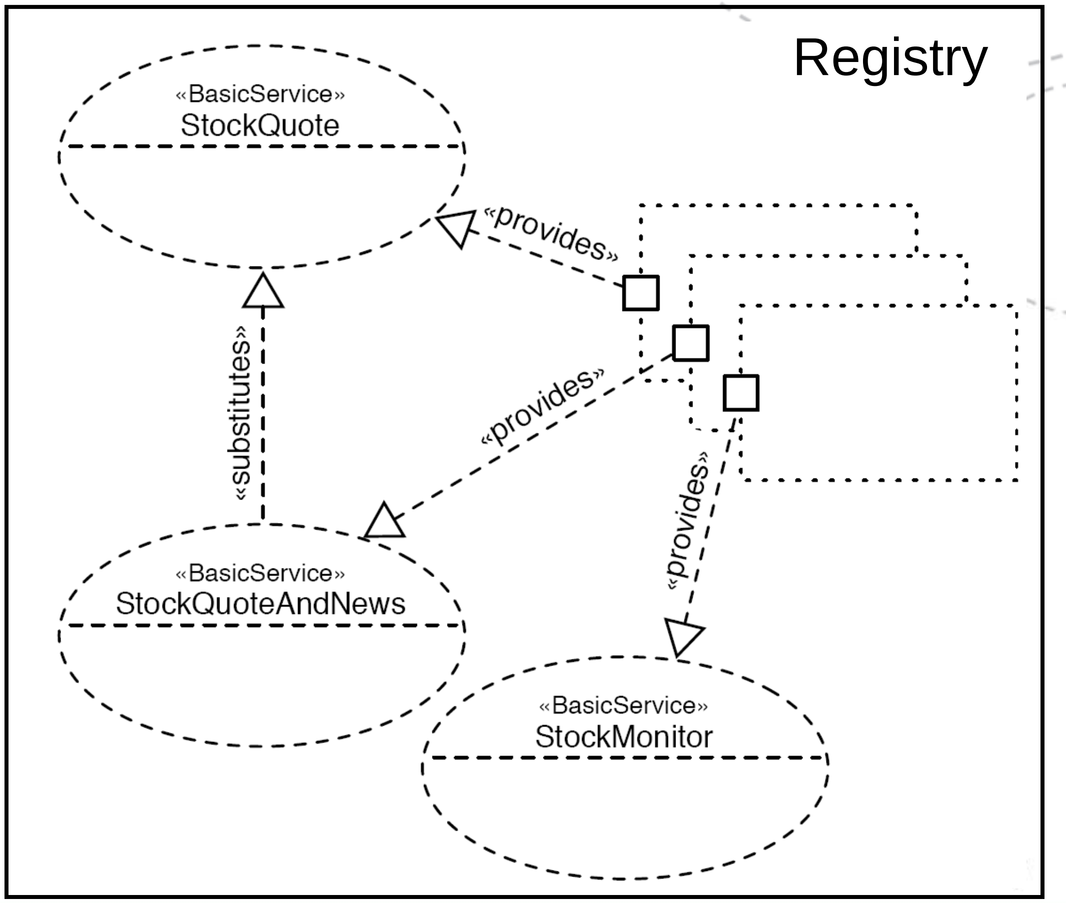
Summing up

- Contracts are modelchecked collaborations
- Conformance ensured by projection and role comparison
- Run-time efficient compatibility assurance
- For active and passive services
- A basis for meaningful lookup


Registry
«BasicService»
StockQuote
«provides»
«substitutes»
«provides»
«BasicService»
StockQuoteAndNews
«provides»
«BasicService»
StockMonitor