Decentralized Coordination of Distributed Interdependent Services

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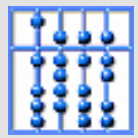
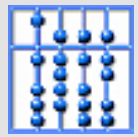


The DWARF Framework

- Mobile AR in ubiquitous computing environments
- Already built AR supported scenarios:
  - Navigation (Pathfinder)
  - Maintenance (TRAMP)
  - Multi-Player Game (SHEEP)
  - Collaborative Building Design (ARCHIE)

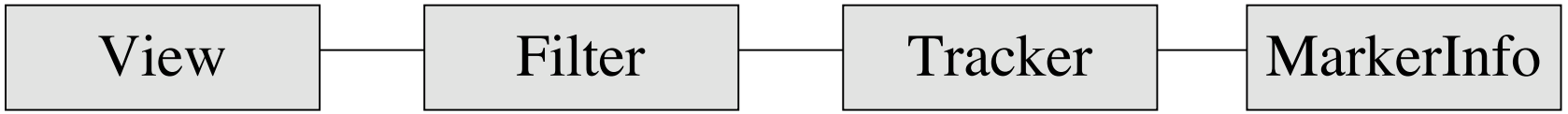
Problems

- Goal: Seamless integration of local and remote components
  - DWARF uses a distributed approach
  - No separation between local and remote component on architectural layer
- Components offer own services and need other services
  - > service interdependency
  - Applications are not simply star-shaped but build a service graph of interdependent services
- Services are distributed on several deployment units
  - > no centralized coordination and configuration possible
- Usually 10 to 50 services per application



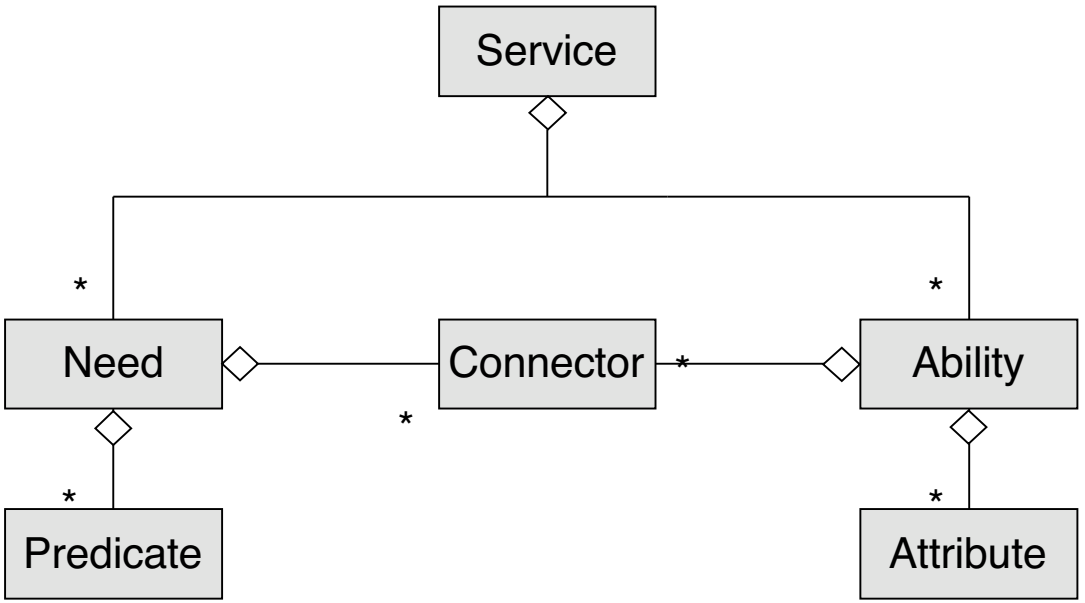
Example

- A View component needs position and orientation data
- A Tracker can provide orientation data in a particular format
- A Filter component must translate between Tracker and View
- The Tracker needs feature information for image processing



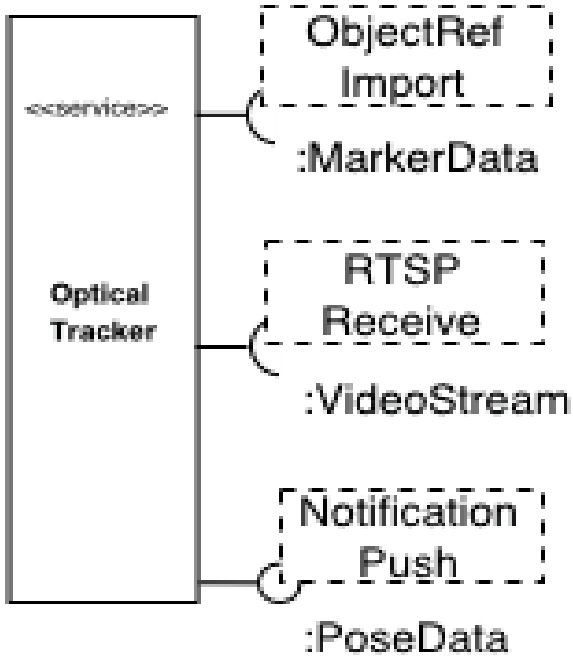
Approach

- Service model for interdependent services
  - Service have Attributes and Predicates.
  - They can be variables which are set at runtime.
- Runtime Infrastructure establishes connection between service automatically (management, lookup, connection)



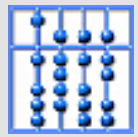
Example Service: Optical Tracker

```
<service name="OpticalTracker">
    <attribute name="Room" value="Studio"/>
    <attribute name="Lag" value="0.01"/>
    <attribute name="Accuracy" value="0.001"/>
    <need name="markerData" type="MarkerData"
        predicate="(&(Thing=*)(User=*))">
        <connector protocol="ObjrefImport"/>
    </need>
    <need name="videoStream" type="VideoStream">
        <connector protocol="RTSPReceive"/>
    </need>
    <ability name="poseData" type="PoseData"
       isTemplate="true">
        <attribute name="Thing"
            value="$(markerData.Thing)">
        <attribute name="User"
            value="$(markerData.User)">
        <connector protocol="NotificationPush"/>
    </ability>
</service>
```

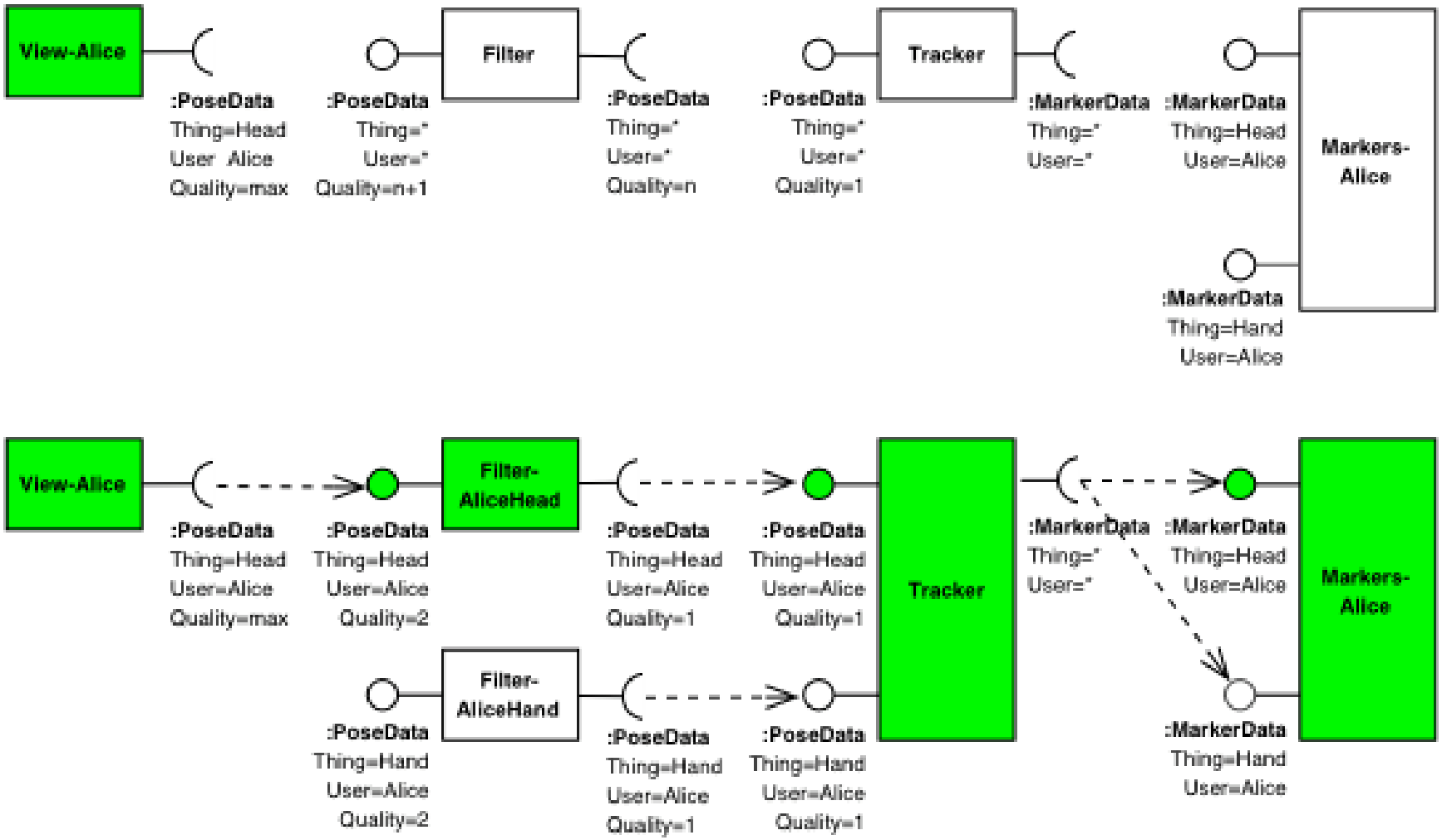


Service Chains

- Service instantiation
  - *Singleton Services* exist only once
  - *Template Services* have multiple instances and can be started on demand by the runtime environment
- Formation of chains of services
  - Services are connected automatically based on *context* and *service-specific attributes*
  - Attribute values are *handed over* from Abilities to Needs
- Services for configuration
  - Service are configured through *Configuration Services*
  - Selection of the correct one over context attributes
  - *Selector Service* for user defined connection



Setup of a Service Chain



Conclusion

- Service model used for several AR applications
- Configuration Service and Selector Service are being tested
- Hops of Attribute values from Abilities to Needs work. Particularly needed for selection of correct Configuration Service instance
- There are use cases for the opposite way, from Need to Ability
- Simulations and tests needed to find best set of context attributes for clear service selection