

CHOREOS

Large Scale Choreographies for the Future Internet

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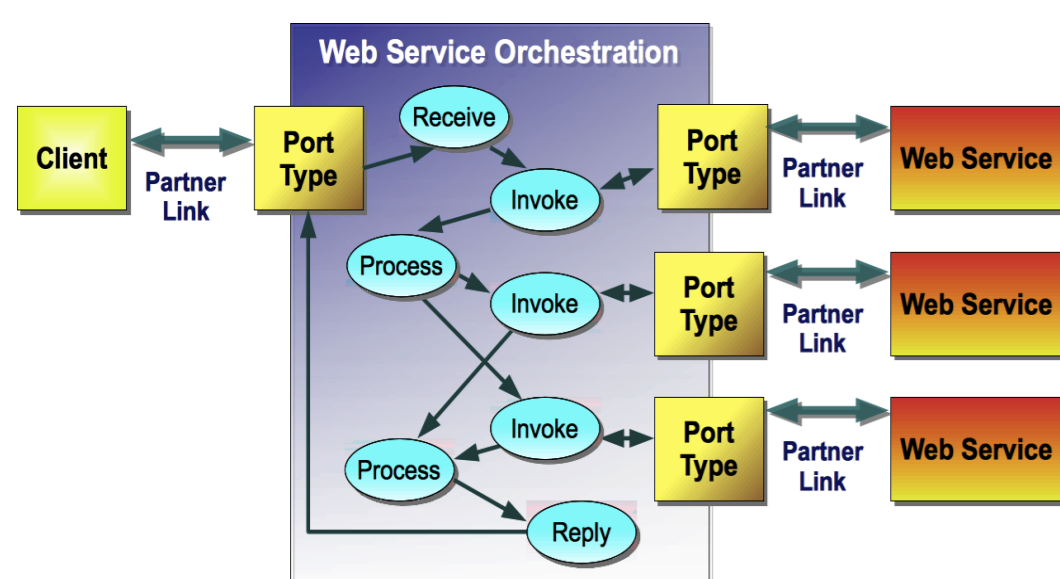
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Summary

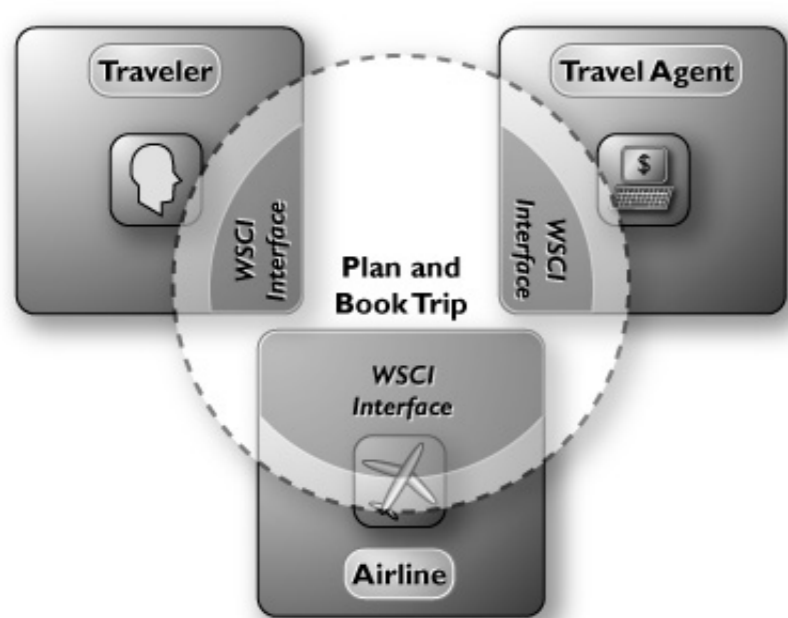
The Internet has been growing at an impressive rate in many aspects such as size, heterogeneity, and usage. This growth forces the continuous improvement of Internet infrastructure technologies. The Future Internet concept magnifies the required shift for Internet technologies, which shall allow supporting the continuously growing scale of the converging networking world together with new generations of services made available to and brought by the broad mass of end users. The CHOREOS project positions itself in this vision of the Future Internet, whilst focusing on the Future Internet of Services. This research project aims at assisting the engineering of software service compositions in this novel networking environment by devising a dynamic development process, and associated methods, tools and middleware, to sustain the composition of services in the form of large-scale choreographies for the Internet of the future.



Orchestrations are a centralized approach to Web Service composition. Although their implementations are usually governed by open standards like WS-BPEL, their centralized approach to composition, although straightforward and simple, has scalability and single point of failure problems.

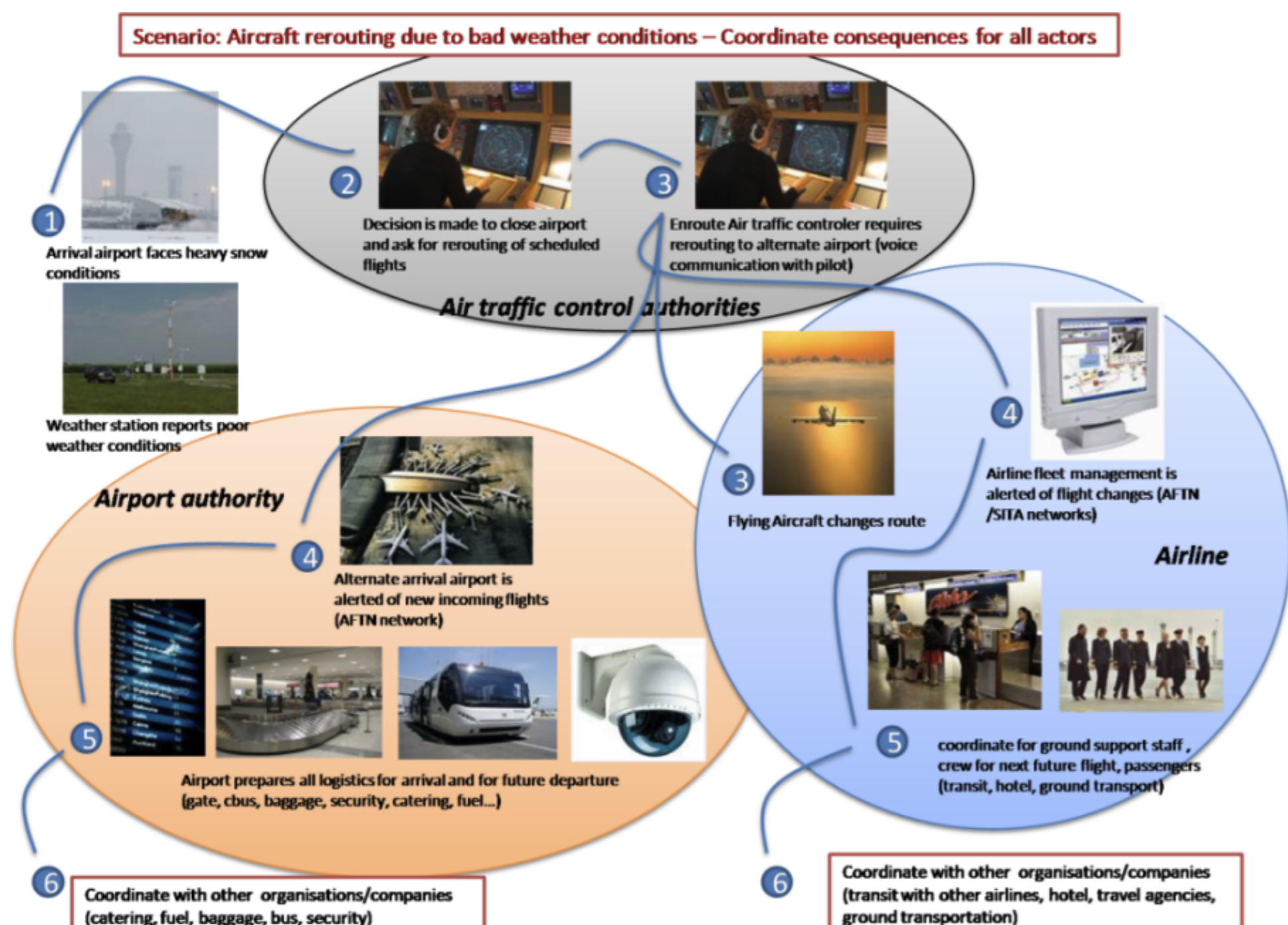
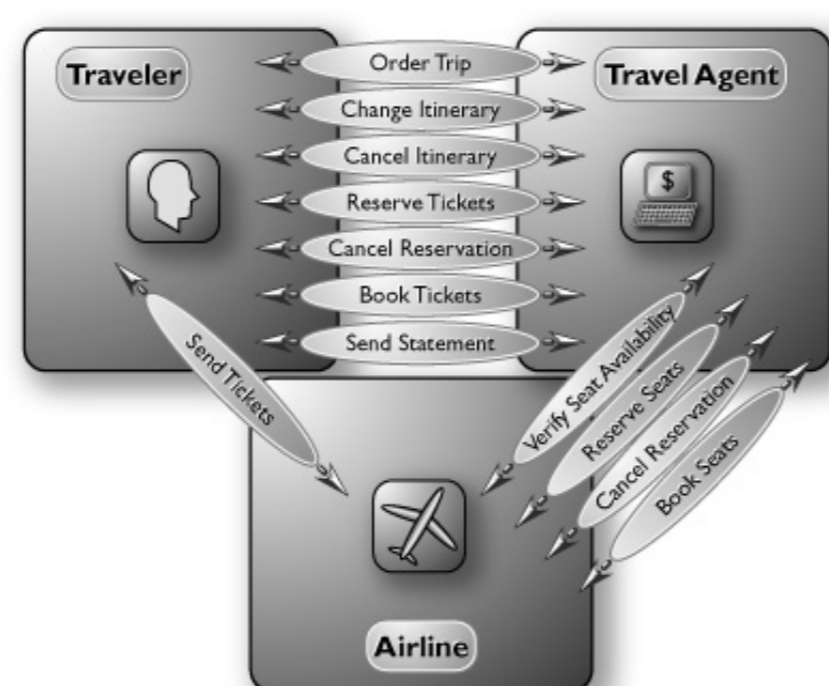
The next natural step is then to compose the web services in a non-centralized distributed way. Web services compositions organized in this fashion, i.e., in a decentralized, distributed manner, with no single point of failure are called Choreographies.

Choreographies can be more resilient than orchestrations, although not as easily manageable. As non-centralized distributed systems they have potential for improvements in terms of higher fault tolerance, adaptability, configurability, and freedom to grow. The joint operation and execution of several web services composing a choreography is called “enactment”.

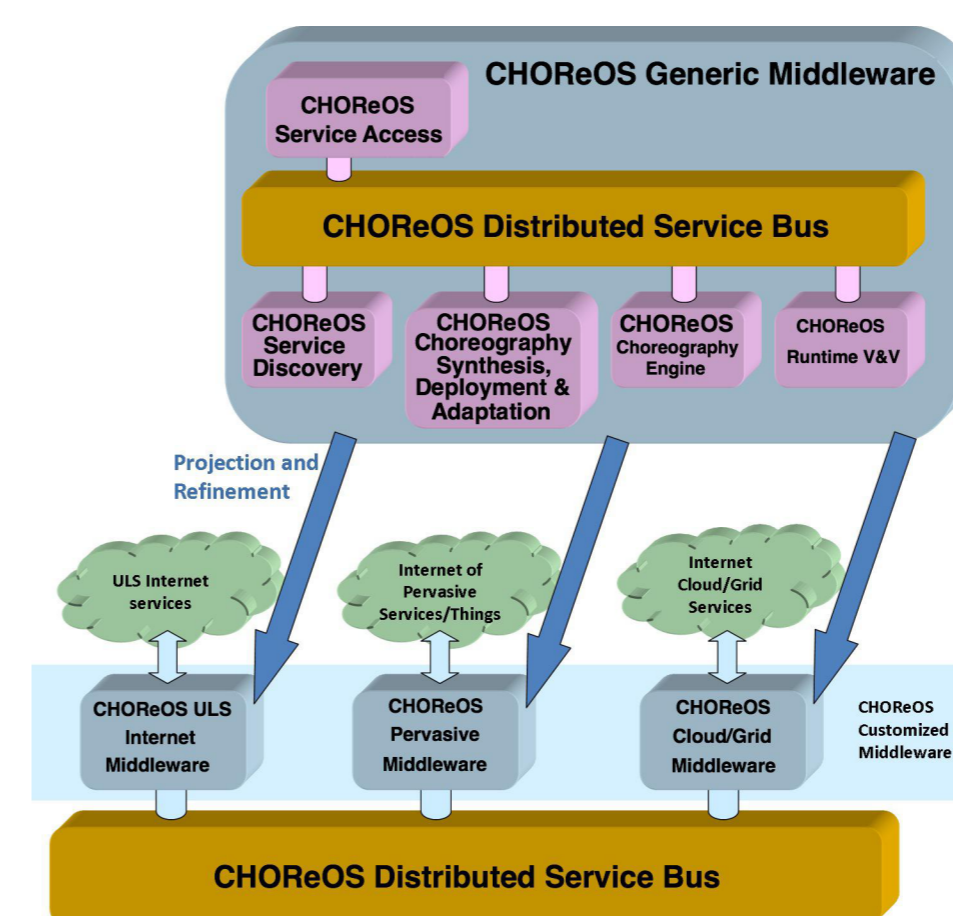


Even though some choreography standards (e.g., WSCI and WS-CDL) have been defined, to the best of our knowledge, none of them has been completely implemented, there are very few development tools available and there is still little research into the actual usage (deployment and enactment) of choreographies.

The example above (adapted from the W3C WSCI 1.0 specification) shows a use case of a traveler who is interested in buying a flight ticket. In order to do so, the traveler interfaces with a travel agent that, in its turn, communicates with the airline. When all the details are sorted out, the airline sends the tickets directly to the traveler, without the intervention of the travel agent. The whole communication process can be seen on the figure on the right.



The execution of large-scale choreographies within the Future Internet heavily relies on adequate middleware support. We will base the implementation of our middleware on three middleware technologies: distributed service bus, pervasive middleware technology and grid and cloud computing technologies. The figure below depicts the proposed CHOREOS middleware architecture.



The CHOREOS Distributed Service Bus, we will rely on the PETALS ESB-based middleware solution. PETALS is already further evolving towards a Distributed Service Bus (DSB) to scale to millions of services. The evolution of PETALS into a DSB relies on a federated architecture based on a P2P overlay network. The desired outcome will then be a highly scalable service bus that allows choreographing heterogeneous services, thanks to the service bus principle and its evolution to cope with the features of the Future Internet.

In the CHOREOS framework, the Internet of Things concept is that of a highly dynamic and heterogeneous networking environment integrating an ultra-large number of devices, including many with limited resources. The CHOREOS middleware needs to meet these requirements accounting for the resource-constraints of devices together with the environment’s high dynamics and heterogeneity. This will be done in a way that is compatible with the OASIS standard for Web services on resource-constrained devices.



We want also to provide CHOREOS with the high-performance computing power available in Grid and Cloud Computing infrastructures. Thus, the computationally intensive processes that will be required to serve millions of users issuing thousands of simultaneous service requests to thousands of services will be able to be processed by Grid and Cloud services. The task will involve efforts in (1) Software Architecture and Engineering to implement the interaction protocols and choreography engines onto the specific context of Grid and Cloud middleware infrastructures and (2) investigation of the CHOREOS methods for creating, managing, and processing choreographies so that its computation can be delegated to a high performance computing engine.



Existing ESB, Grid/Cloud, and pervasive middleware technologies emerged independently to cope with different scalability issues. Nevertheless, the Future Internet calls for an integrated solution. To this end, will refine individual solutions so that they meet the challenges of the Future Internet, and moreover will develop a unified middleware infrastructure that enables: (1) service provisioning for the ultra-large number of Future Internet users based on available Grid and Cloud technologies, (2) networking a large number of heterogeneous services via ESB-based middleware, and (3) networking services from the Internet of Things based on middleware for pervasive networks.