

“Catalactic” Resource Allocation in Application Layer Networks

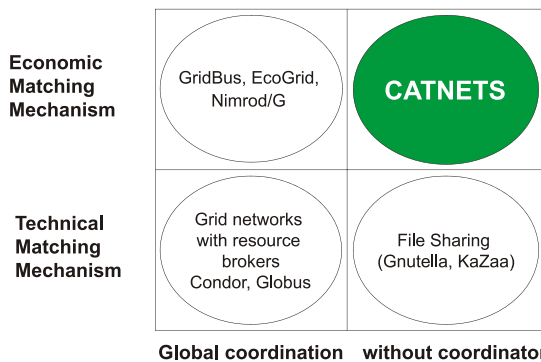
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Utility or on-demand computing offers vast capacities for varying computational tasks in order to absorb capacity peaks in enterprises and reduce costs („pay as you go“). This will result in business service networks (BSN), where enterprises source out software components and buy these as web services. At the same time, large, dynamic networks make optimal resource allocation difficult.

Thus, one of the main challenges of future on-demand network technology is the efficient provisioning of services to clients. The CATNETS project investigates a "free market" economic self-organization approach, the concept of "Catalaxy" by F.A. von Hayek, as the basis for realising a scalable and dynamic resource allocation (matching) mechanism.

Existing approaches in service location and selection



In the context of on-demand networks, existing systems such as Globus, Condor and Nimrod/G already employ a centralised auctioneer instance –a resource broker– somewhere in the network for service control and resource allocation. The broker generates a list of possible allocations and ranks the items using technical or economic parameters. This process relies on a constant feed of updated request information from all clients.

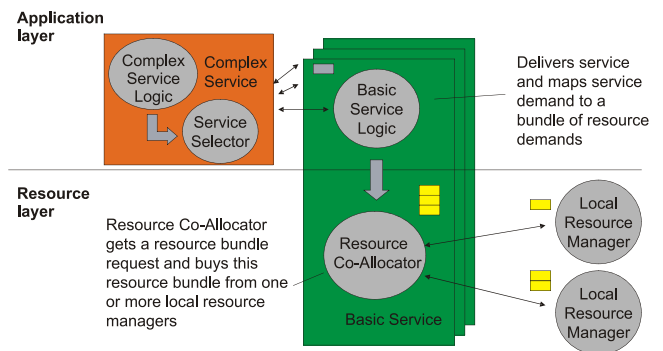
Where current approaches fail

We consider a two-stage market, one for services and another for resource co-allocation. This enables flexible, location-independent service provisioning.

The centralisation implemented in current approaches has several fundamental drawbacks. The most severe is scalability. The broker always requires global knowledge of a network. The status of the network must not change during the matchmaking process; otherwise information might be outdated by the time a result has been found. As soon as the network grows and becomes dynamic, misallocations result from the changing availability of services.

Introducing economic utility allows ranking the different possible matchmaking policies according to an optimal gain which can comprise different technical or subjective parameters. Economic principles serve as a basis for a value-oriented view of the network and its resources. For the ranking process of possible service or resource candidates, economic utility is applied.

The CATNETS approach



F.A. von Hayek's Catalaxy describes an economic coordination mechanism for information systems consisting of autonomous network elements, based on constant negotiation and price signalling. In the CATNETS architecture, the respective clients gather and evaluate information on the availability of services within the network on their own (decentralisation), applying the forementioned mechanism. This principle is probably best known from peer-to-peer networking.

Preliminary results of CATNETS simulations

The first simulations within the test infrastructure show the impact of service selection mechanisms (centralised/decentralised) on the performance of BSNs. The parameter allocation efficiency presents the ratio of launched and satisfied requests. In addition, using the economic principle of catalaxy has proven to be a reliable and effective algorithm for the coordination of service oriented networks.

Possible areas for the application of the developed concepts in real-world environments include hospital or factory logistics, and adaptive supply chain management.

