# *Achieving Comprehensive Mission Robustness*

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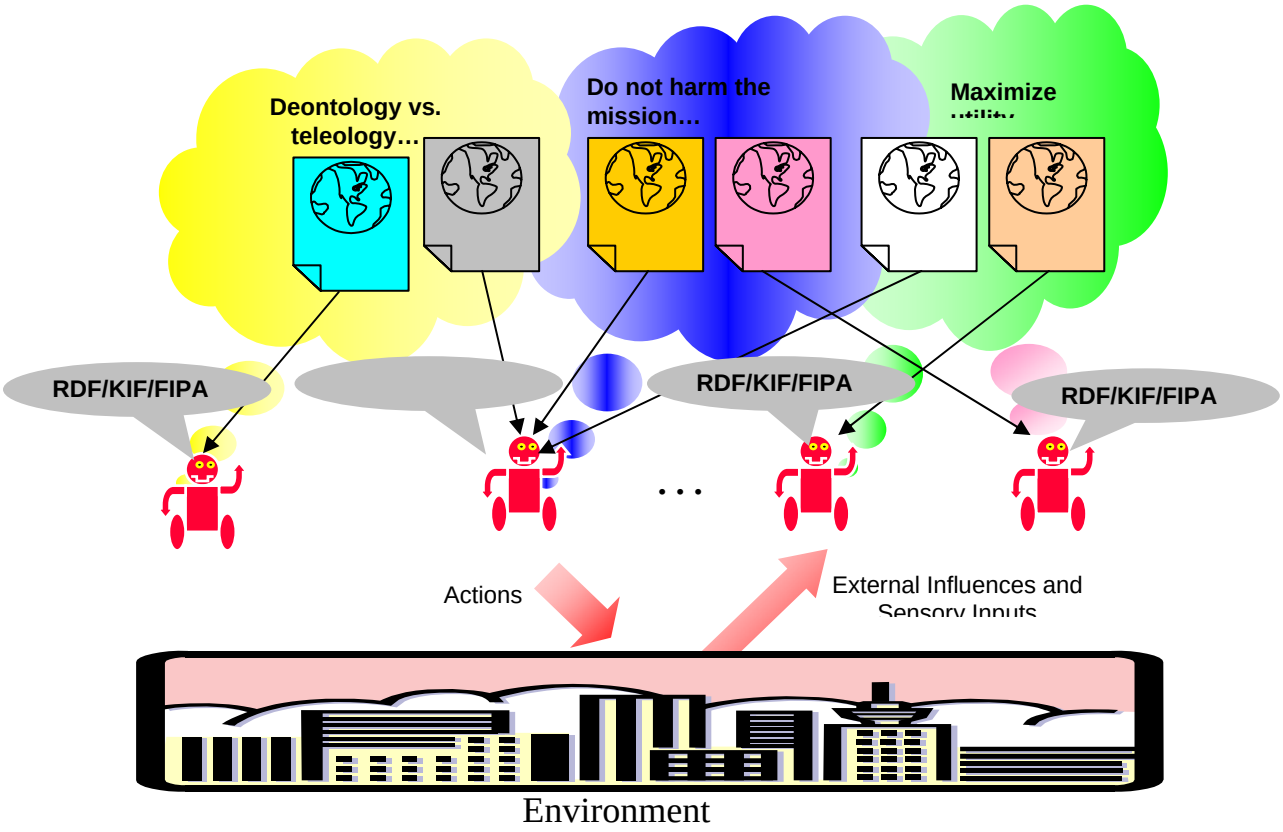
An architecture for achieving robust autonomous decision making and task execution is proposed. A key feature of the proposed architecture is that robustness is achieved through massive decentralization and redundancy in planning and execution. This revolutionary approach to achieving mission goals relies on interaction as a fundamental construct. Competing proposals for satisfying tasks or sets of tasks are developed by fluid collaborating groups of software agents vying for resources so that the failure of one approach does not jeopardize overall mission goals. Competing proposals can be acted on in parallel when they do not interfere significantly with each other, but are pruned as necessary to conserve resources. This approach to agent behavior will be constrained by sets of agent societal laws similar to Asimov's laws of robotics. In accordance with embedded philosophical principles, agents will use decision theory in their negotiations to evaluate the expected utility of proposed actions and use of resources. This will result in planning and task execution that is dynamic, rational, massively distributed, occurs at multiple levels of granularity, and can be trusted. The proposed architecture is a revolutionary departure, both from current monolithic approaches to planning and from distributed approaches to task execution. It takes advantage of the differences in local perspective that exist in a massively distributed environment to formulate and execute plans that, while not perfect, will not have identical flaws, producing robustness through redundancy and diversity of approach. The benefit of this architecture to future NASA planetary and deep space missions is fourfold: (1) it will support missions of much greater complexity than are possible under the current model of earth-based control, (2) it will reduce costs by minimizing the amount of earth-based support required for missions, (3) it will essentially eliminate communication time lag as a significant factor in local task execution, providing the ability to react to and take advantage of serendipitous events, and (4) it will significantly enhance mission robustness. The development of the proposed architecture builds on developments in decision theory, agent societies, trusted systems, and ubiquitous computing.