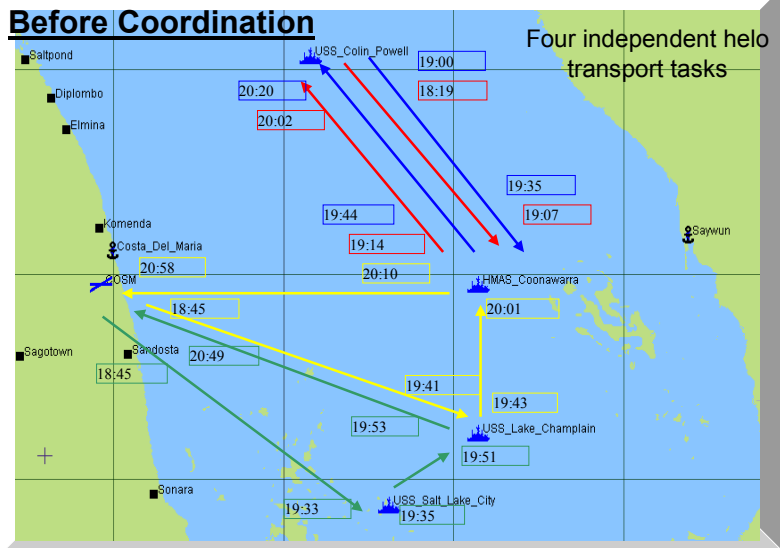


# Multilevel Mission Coordination for Coalition Operations

Edmund H. Durfee • University of Michigan  
<http://ai.eecs.umich.edu/people/durfee/COABS>

## Before Coordination



### Description:

Joint mission with objectives/responsibilities distributed among multiple functional teams comprised of human and computer agents

Operational choices by a functional team can unintentionally (infrequently) interact with what others can or should do

- ◆ Negative interactions: conflict over coalition assets, friendly fire
- ◆ Positive interactions: piggybacking tasks

Multilevel Coordination Agent is a grid-aware service to ensure that these interactions are efficiently predicted and effectively resolved

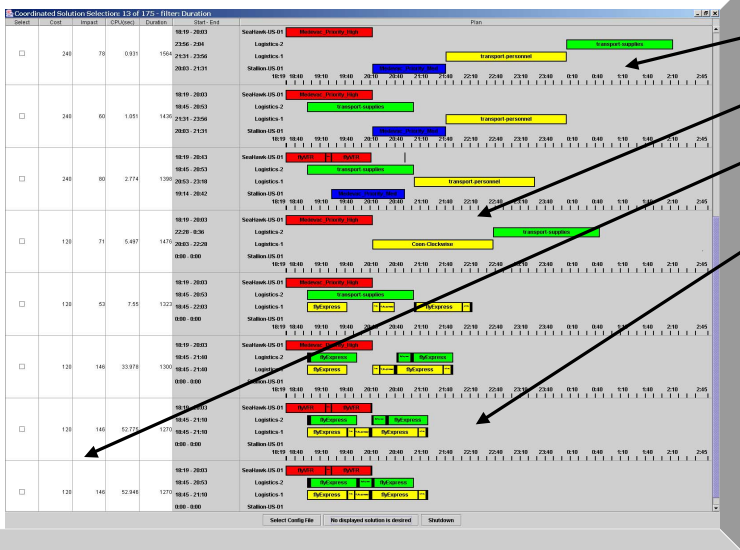
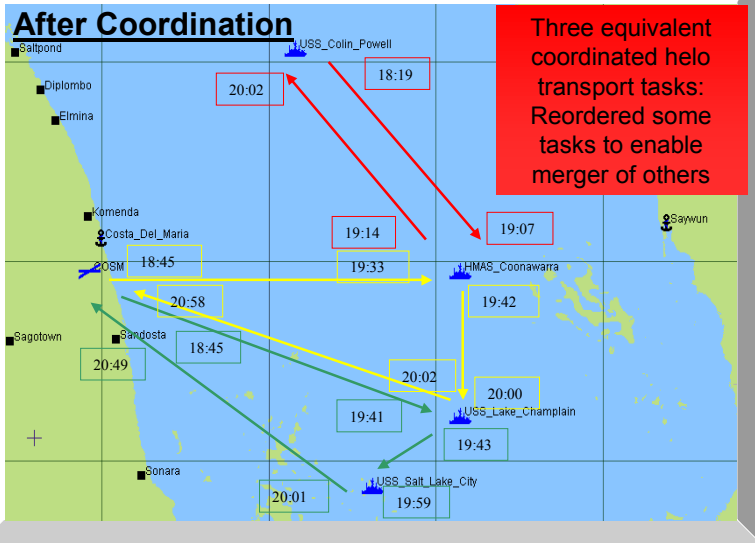
### Resulting joint plan balances:

- ◆ Efficient (fast, parallel) execution
- ◆ Flexibility for local run-time improvisation
- ◆ Avoidance of unnecessary or costly actions
- ◆ Realistic runtime messaging load
- ◆ Minimal disruption to prior commitments

### Results:

- ◆ Analyzes the alternative plan spaces of coalition functional teams that plan independently and act asynchronously
- ◆ Works top-down with plans chosen by teams to predict unintended interactions.
- ◆ Identifies candidate resolutions (merging steps that duplicate effort, inserting timing or action constraints to deconflict plans).
- ◆ Notifies operator of possible plan conflicts and synergies, and computed resolutions.
- ◆ Estimates quality of alternative resolutions, including action costs, parallelization, and disruption to prior commitments
- ◆ Operationalizes/enforces coordination decisions selected.
- ◆ Given more time, isolates and resolves interactions more precisely and efficiently.
- ◆ Allows postponing coordination decisions until runtime conditions are better known.
- ◆ Packaged as a Grid-aware component that supports coalition commanders.

## After Coordination



### Prototype capabilities:

- ◆ Finds serialization constraints to avoid conflicts (e.g., collisions over helipads),
- ◆ Discovers opportunities for having one plan accomplish (part of) mission for another.
- ◆ Estimates costs, overall time needs, and expected impact on prior commitments for informed command decisions.
- ◆ Given more time, explores at more detailed levels to find more parallelism.

### Future directions:

- ◆ More complicated kinds of plan merging to maximize utilization of assets.
- ◆ Modeling and coordinating interactions among agent teams.
- ◆ Caching and reuse of coordination decisions.
- ◆ Distribution of coordinator functionality leading to efficient parallel implementations.

