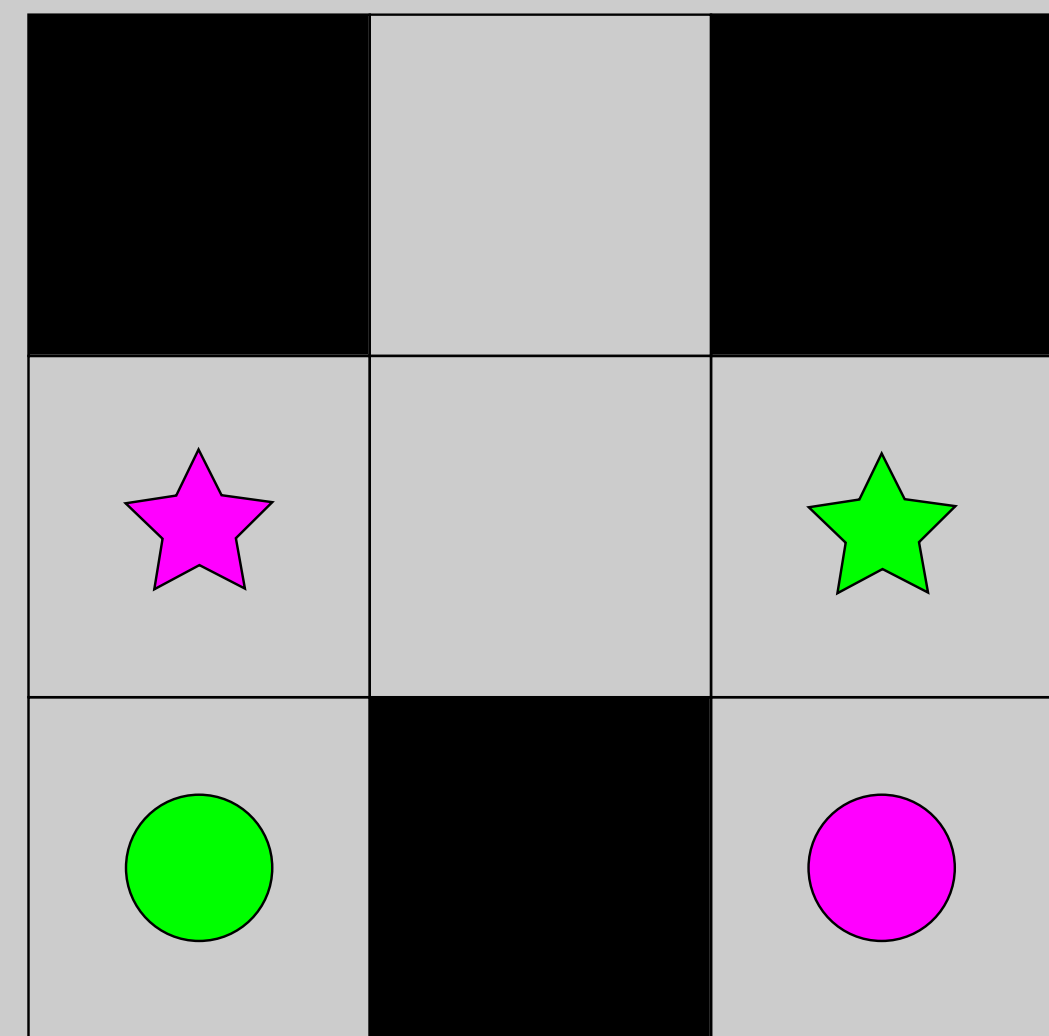


### The Problem

How can we efficiently route multiple robots to their destinations with no collisions?



Efficiency matters – each robot must commit to each move in bounded time (in real-time)

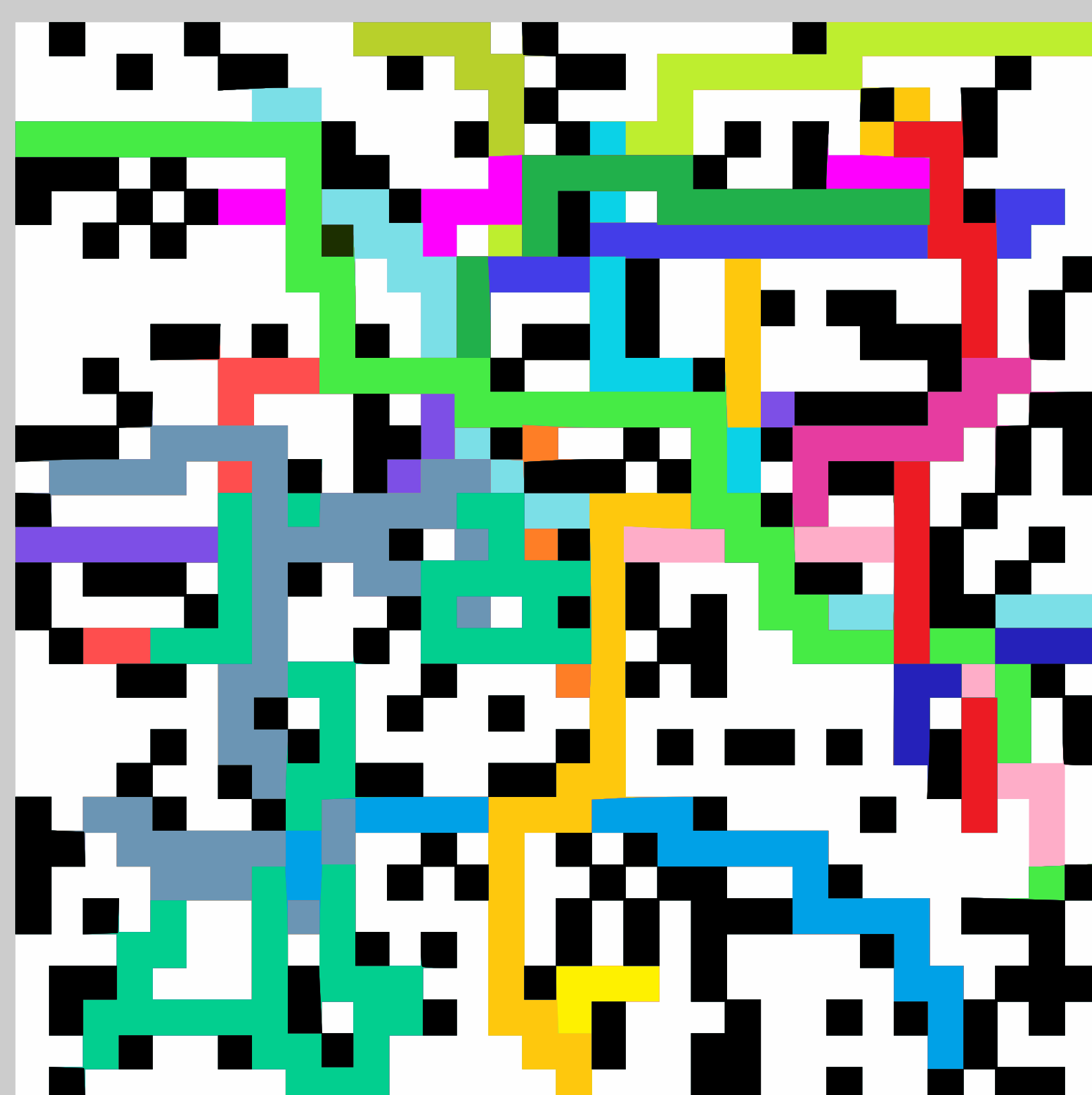
Complete algorithms are guaranteed to find a solution if one exists

Decentralized algorithms allow each agent to plan for themselves, where centralized ones plan for all agents at once

### First Approach: Incomplete

#### WHCA\* (Silver, 2005)

Maintain global "reservation table" and plan each route separately

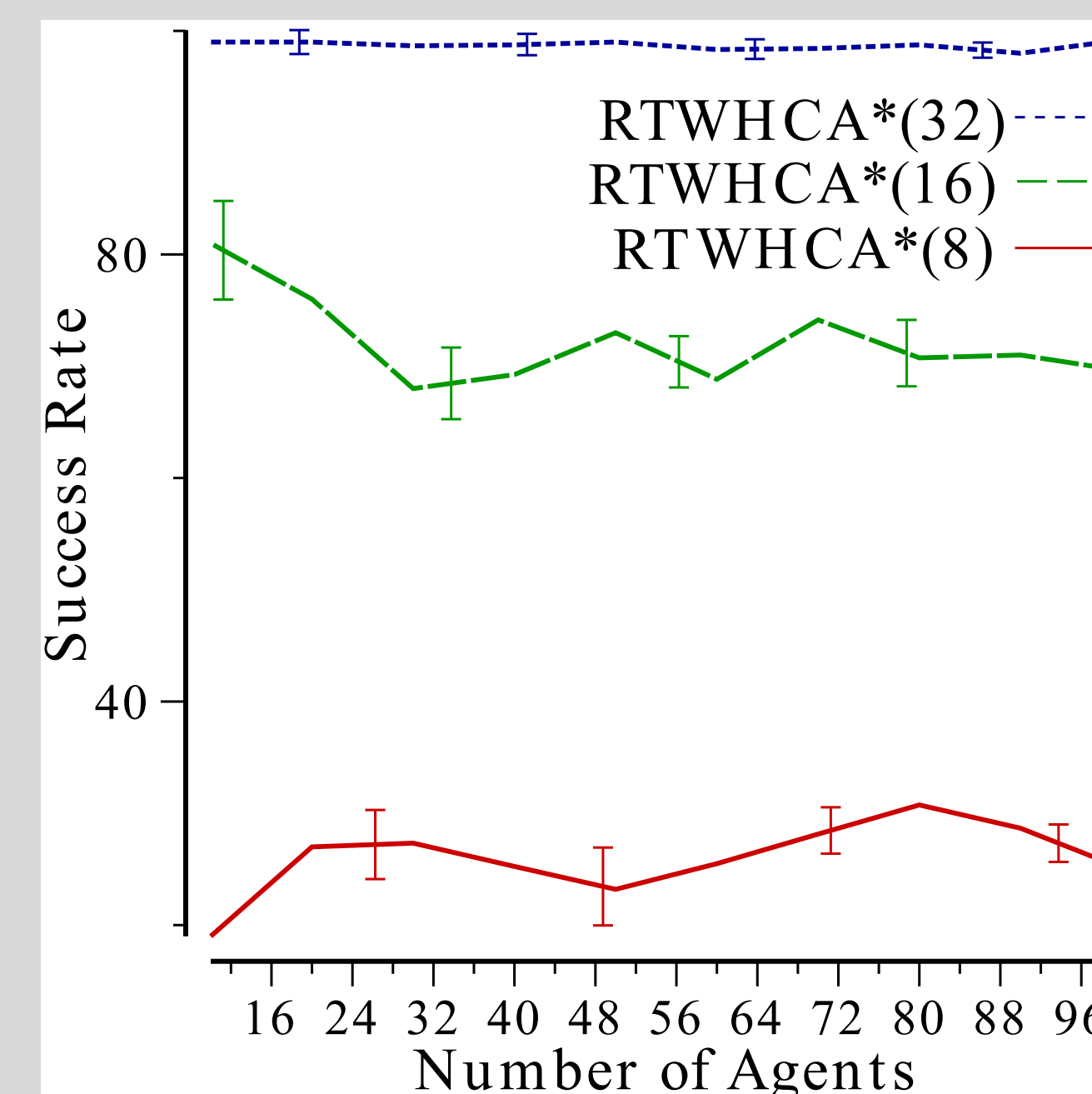
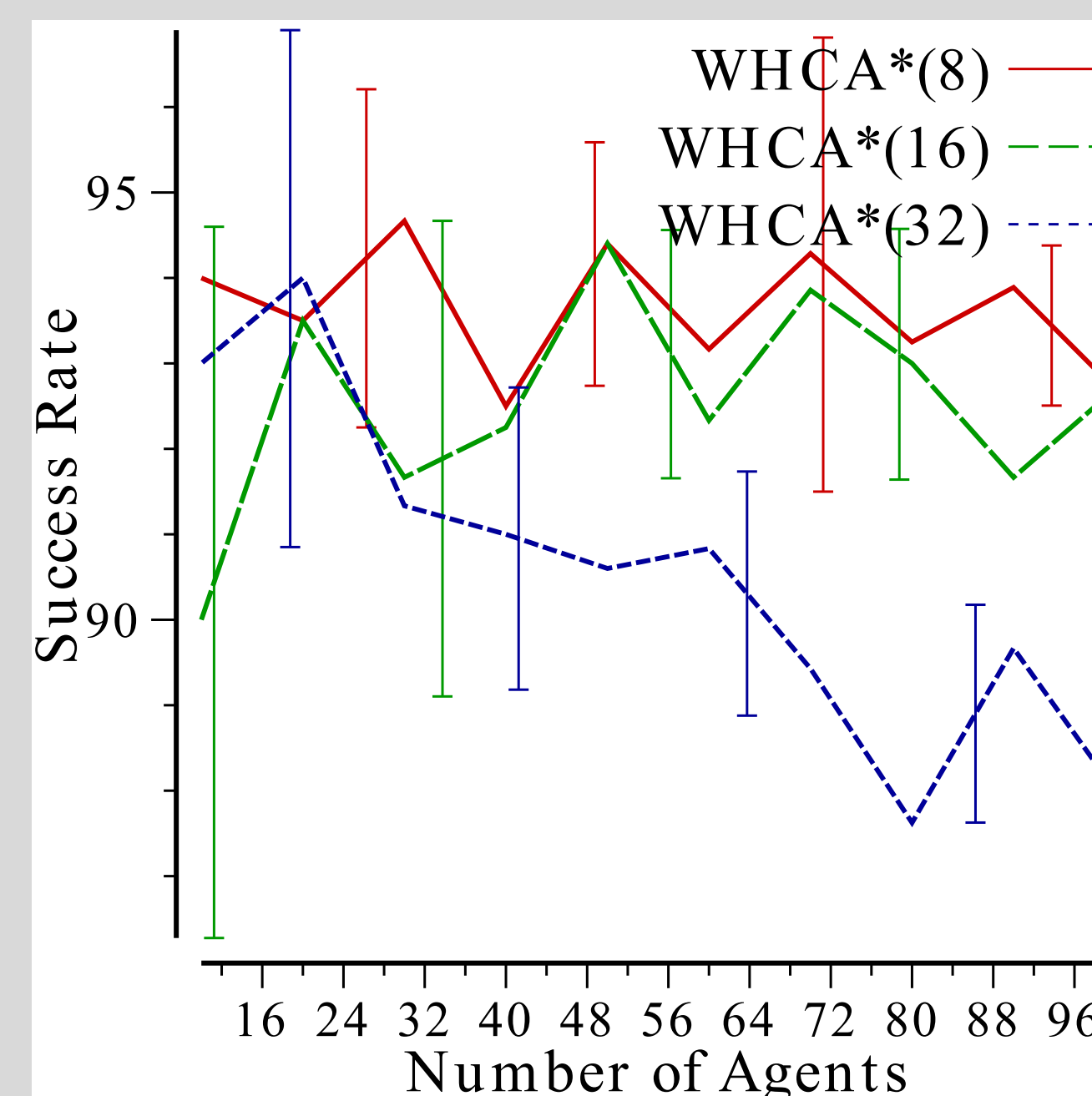


Full plan for all agents

### RTWHCA\* New



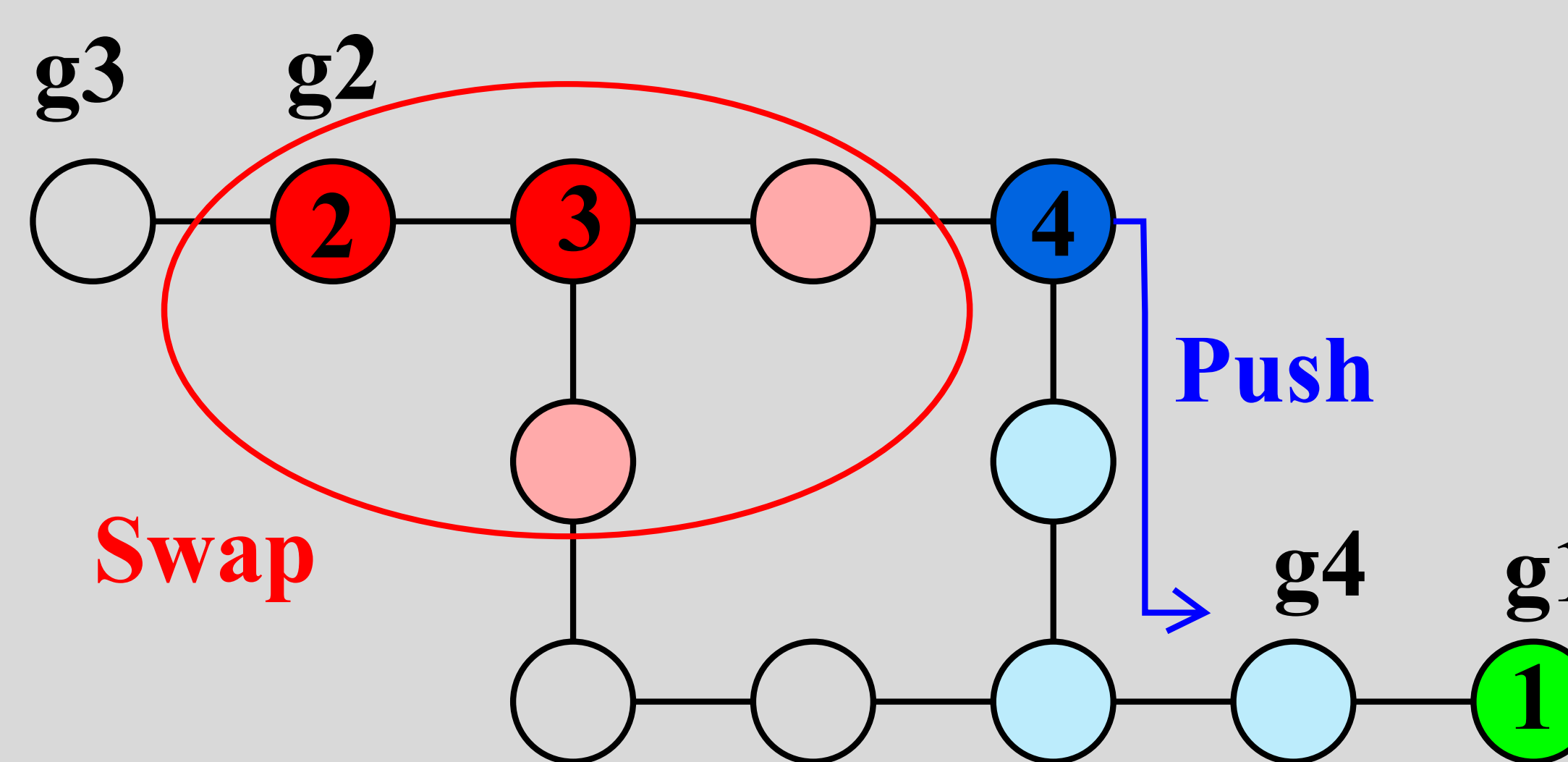
Use estimated distance to goal instead of actual distance to goal



WHCA\* solves some problems, but not others – RTWHCA\* fails way too often

### Second Approach: Complete

#### Parallel Push and Swap (Sajid et al., 2012)



Move to goal by "pushing" other agents away and "swap" when necessary

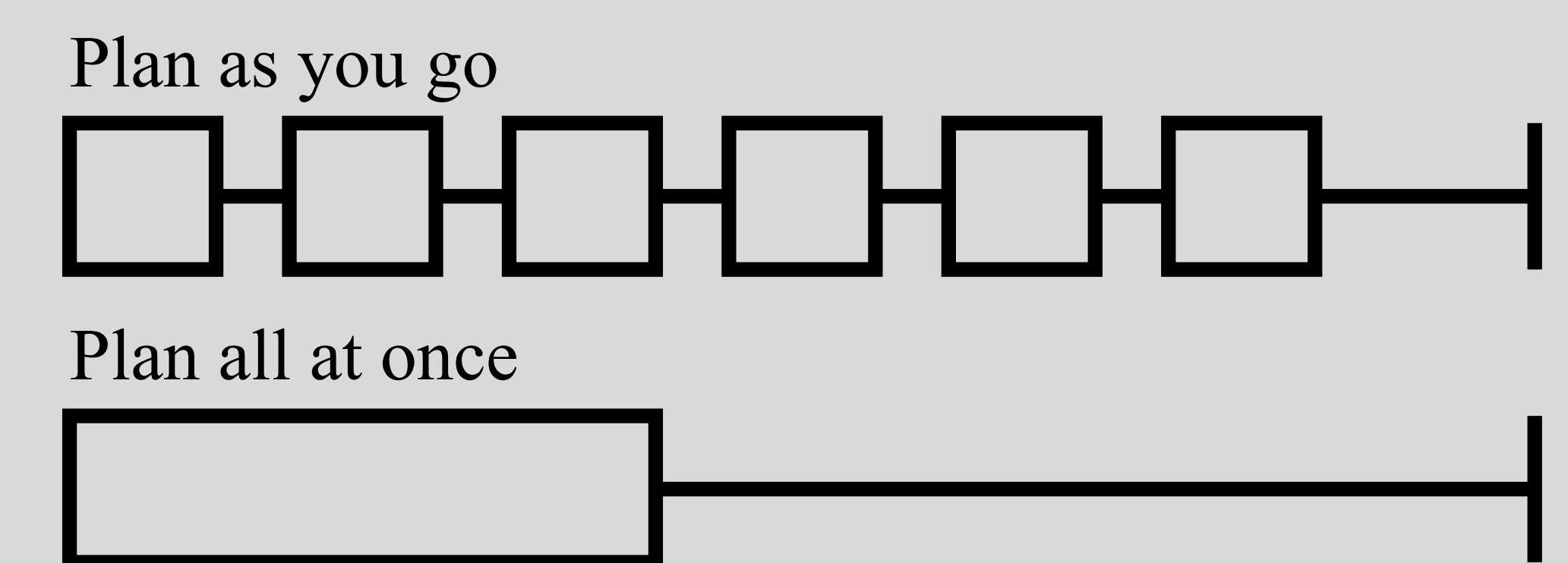
### Parallel Push and Swap Lite New

When swapping, make all other units wait. Otherwise push in parallel

Simplifies implementation immensely without compromising solution quality

### RT-Parallel Push and Swap Lite New

Bound the amount of time each unit receives to push or swap



The real-time version responds faster without compromising completeness

### Acknowledgements

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### References

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