

Goal-Oriented Specification of Adaptation Semantics in Adaptive Systems

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Presented by Ji Zhang

This work was supported in part by the U.S. Department of the Navy, Office of Naval Research under Grant No. N00014-01-1-0744, and in part by National Science Foundation grants CCR-9901017, EIA-0000433, EIA-0130724, CCF-0541131, and CNS-0551622, and ITR-0313142, and by Siemens Cooperate Research, and a Michigan State University Quality Fund Concept Grant.

Need for Dynamic Adaptation

- Pervasive Computing.
 - Promises anywhere, anytime access to data and computing.
- Autonomic Computing.
 - Promises self-managed and long-running systems that require only limited human guidance.

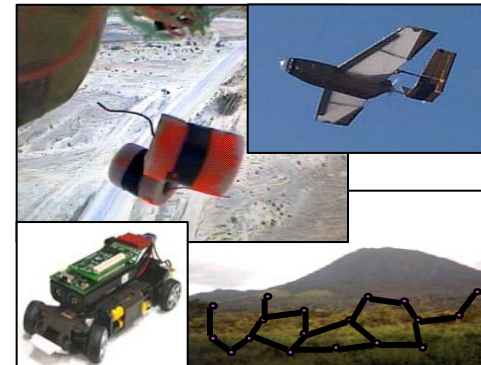
Handheld/Wearable Computing



Military Applications



Sensor Networks



Tasks in Dynamic Adaptation



Proposed Approach

- Goal-oriented specifications can aid in correct design of adaptive systems
 - Representation of adaptation semantics [JSS06]
 - Graphical wrapper for formal definition
- Existing goal-oriented models
 - KAOS
 - Feather, van Lamsweerde, Fickas [Feather98]
 - Tropos/i* mixture
 - Lapouchnian, Mylopoulos [Yu05]
 - Either could have been used for graphically representing these adaptation semantics

Agenda

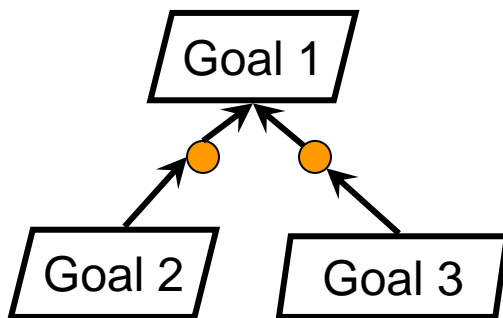
- KAOS Goal-Oriented Notation
- Adaptation Semantics Models
- Summary and Future Work

KAOS – Goal Models

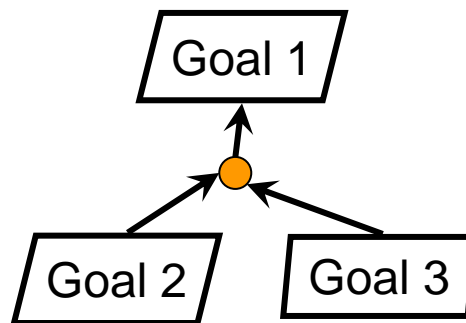
- Use graphical objects to model system requirements [Dardenne93]
 - Goals
 - OR-refinement
 - AND-refinement
 - Sequential annotation [Yu05]



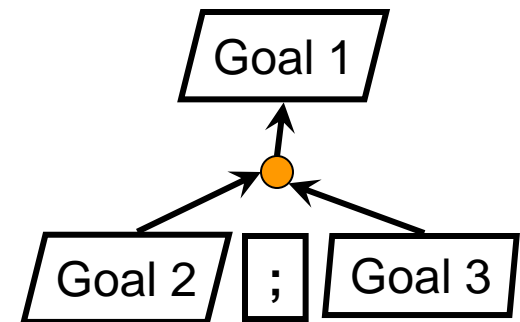
OR-refinement



AND-refinement

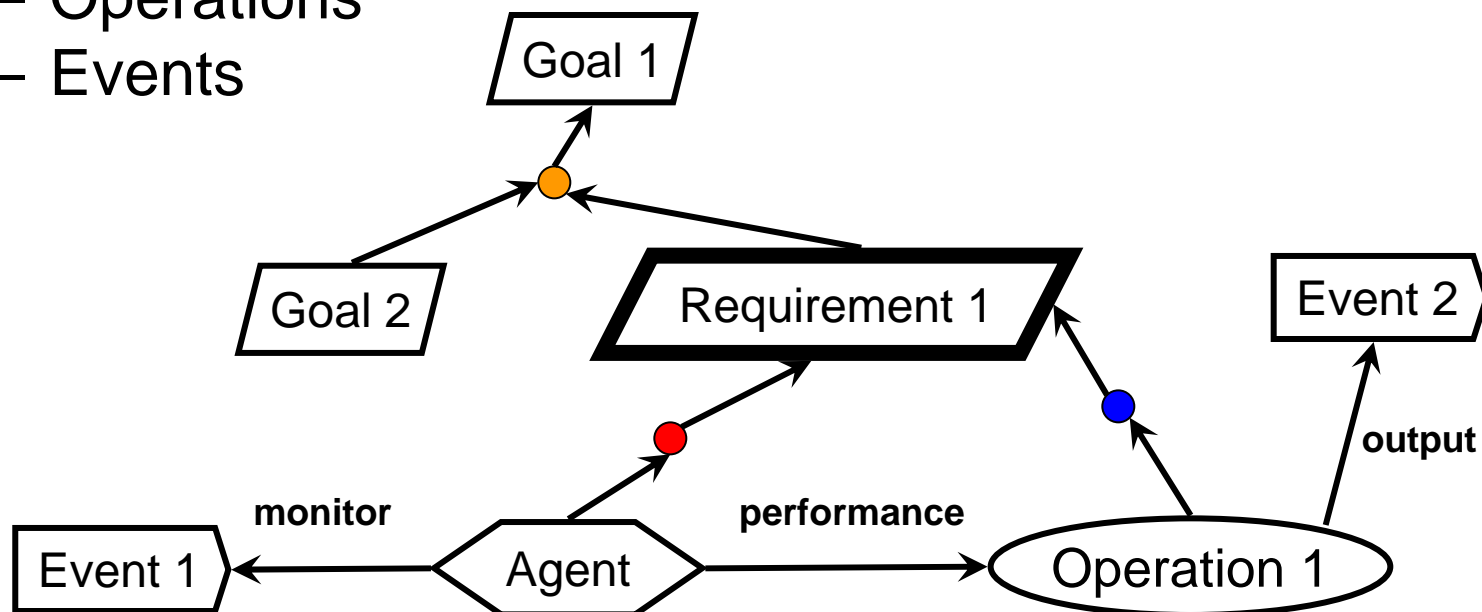


Sequential-refinement



Operationalization

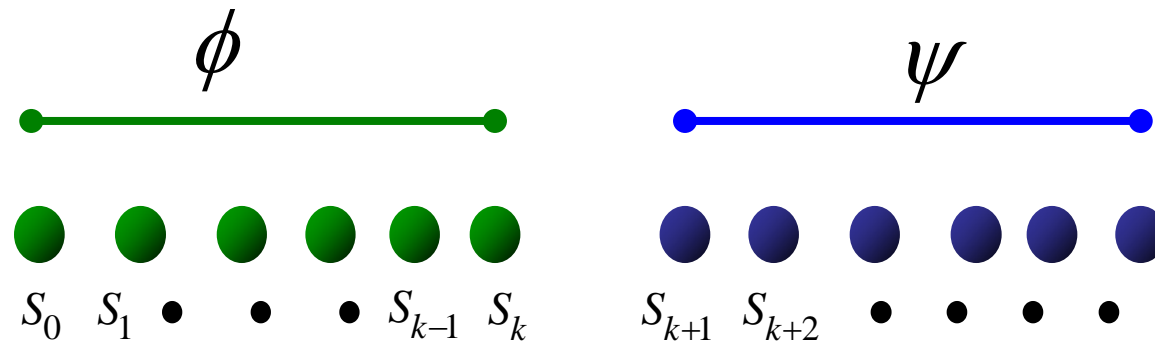
- Requirements are modeled in terms of system goals
 - Requirements
 - Agents
 - Operations
 - Events



A-LTL: Adapt Operator Extended LTL

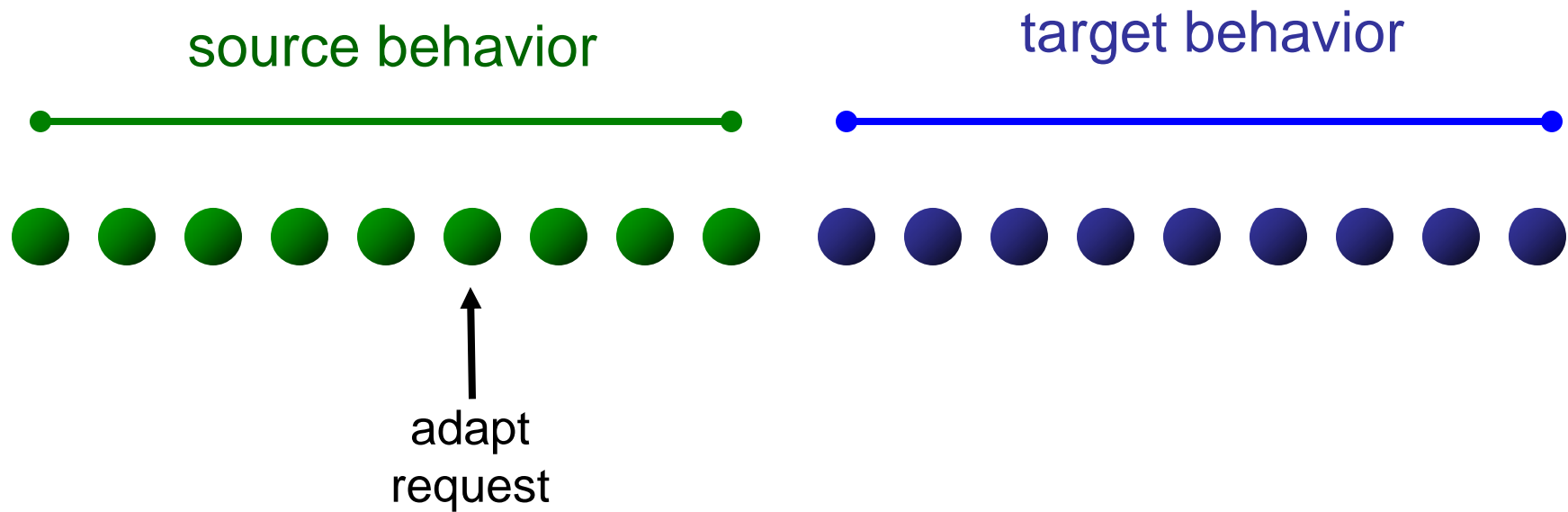
- Extends the Linear Temporal Logic with an adapt operator [JSS06].

$\phi \xrightarrow{\Omega} \psi$ read as ϕ adapts to ψ with constraint Ω .



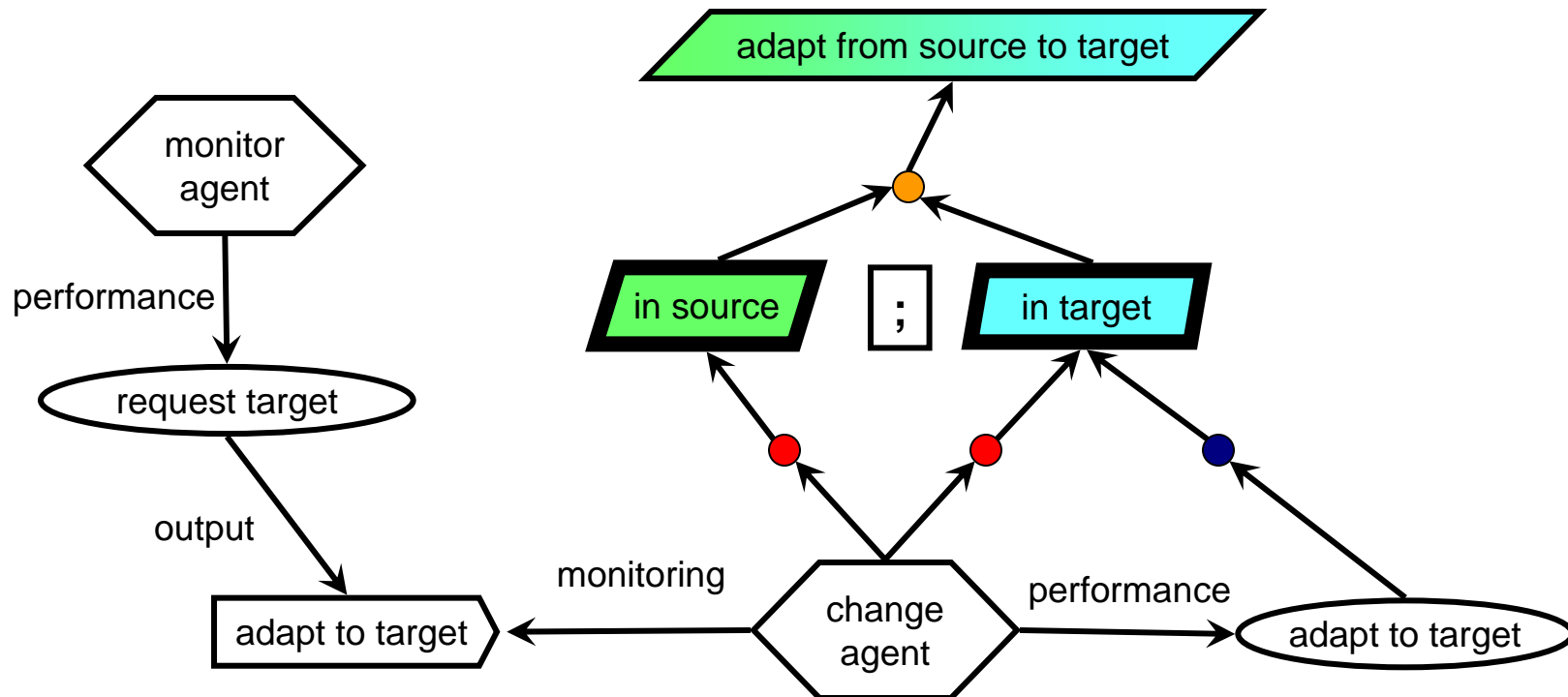
– Used to specify adaptation semantics

One-Point Adaptation

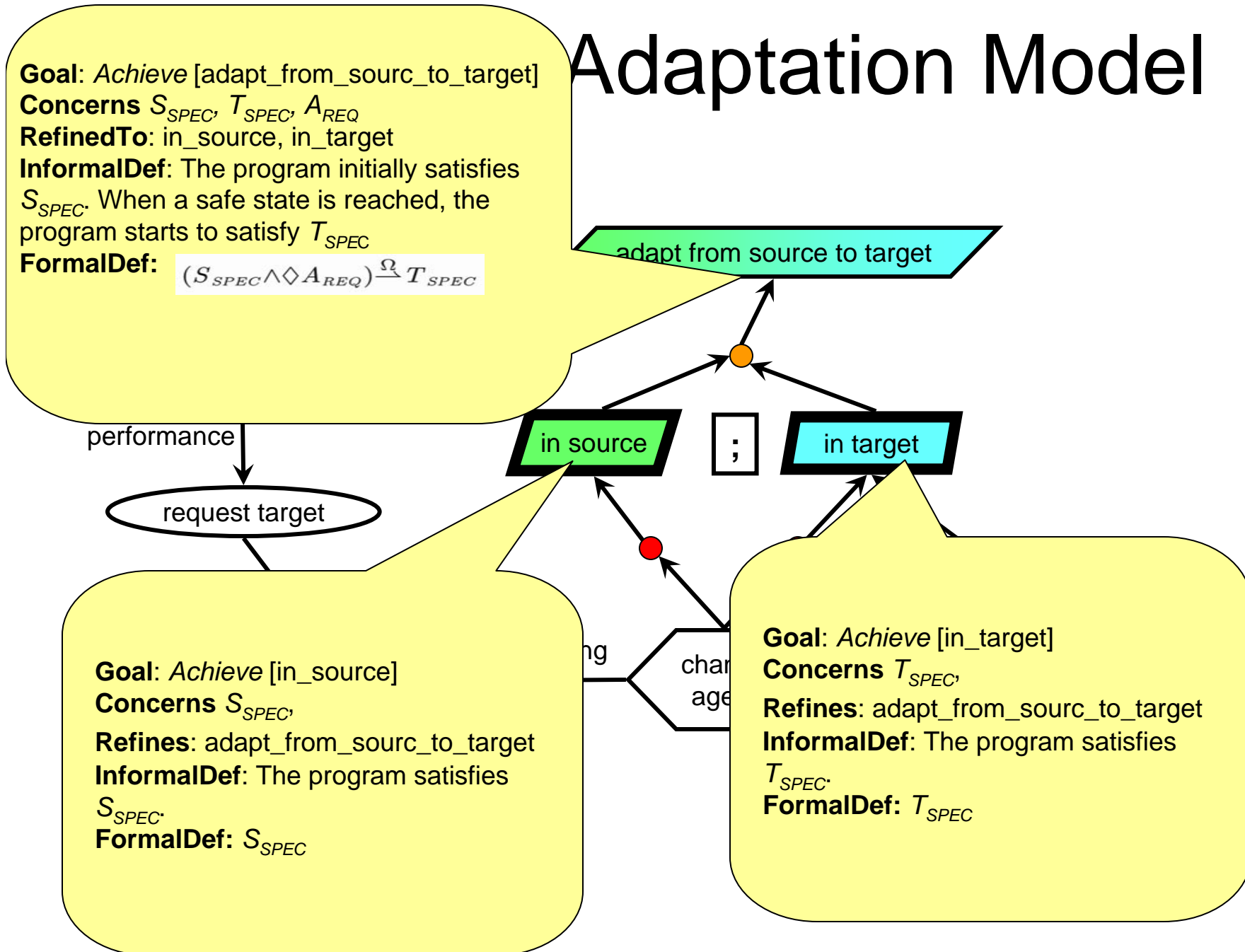


- Initially behaves as **source**.
- At one point after “adapt request”, starts to behave as **target**.

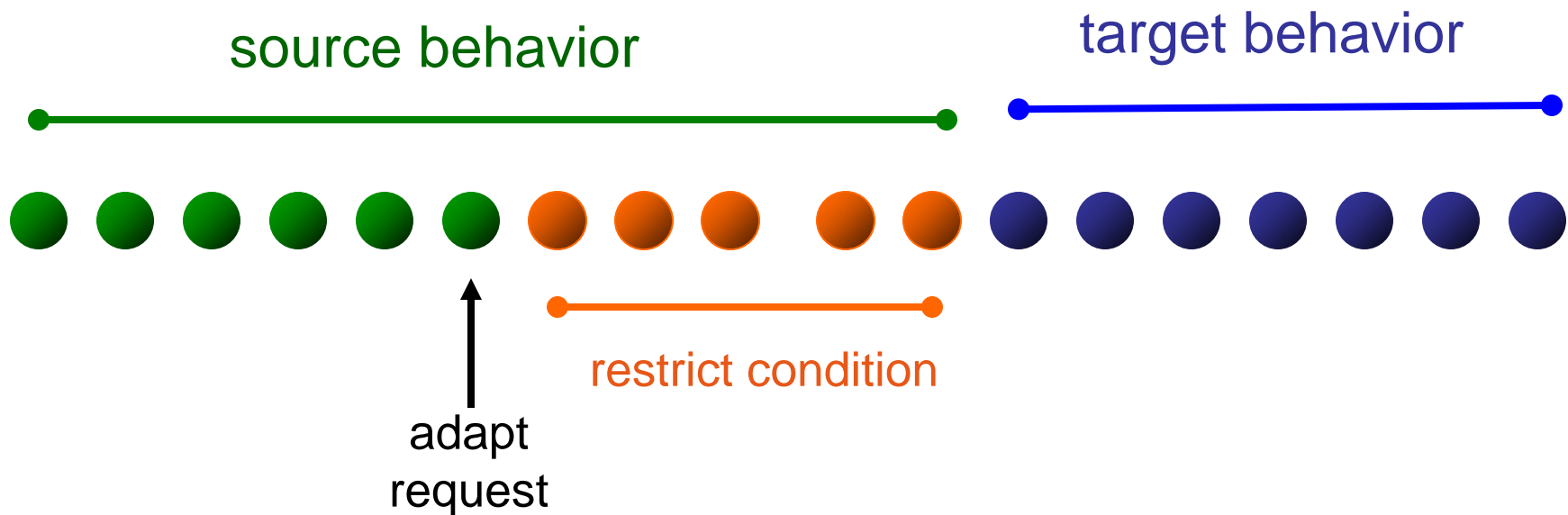
One-Point Adaptation Model



Adaptation Model

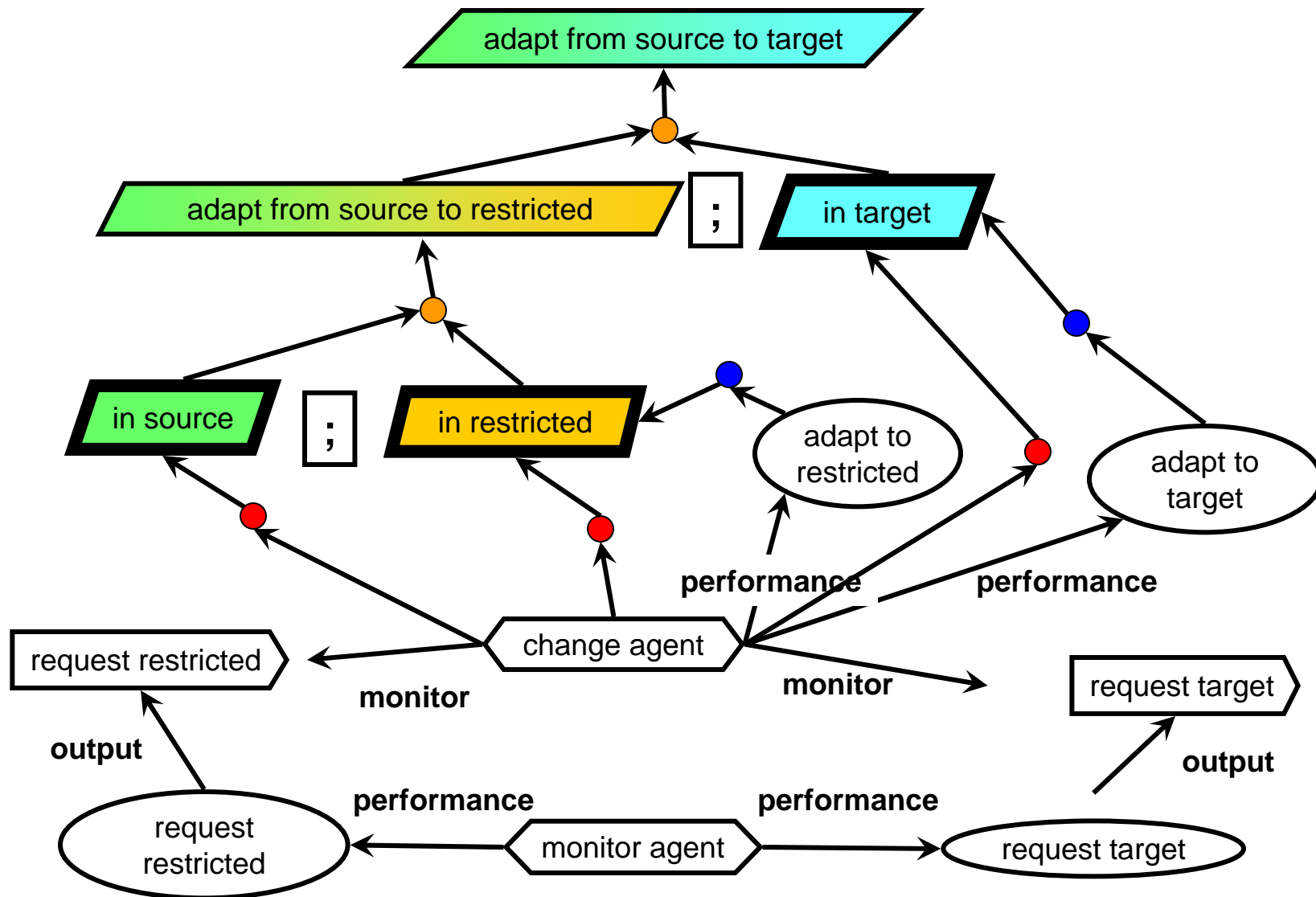


Guided Adaptation

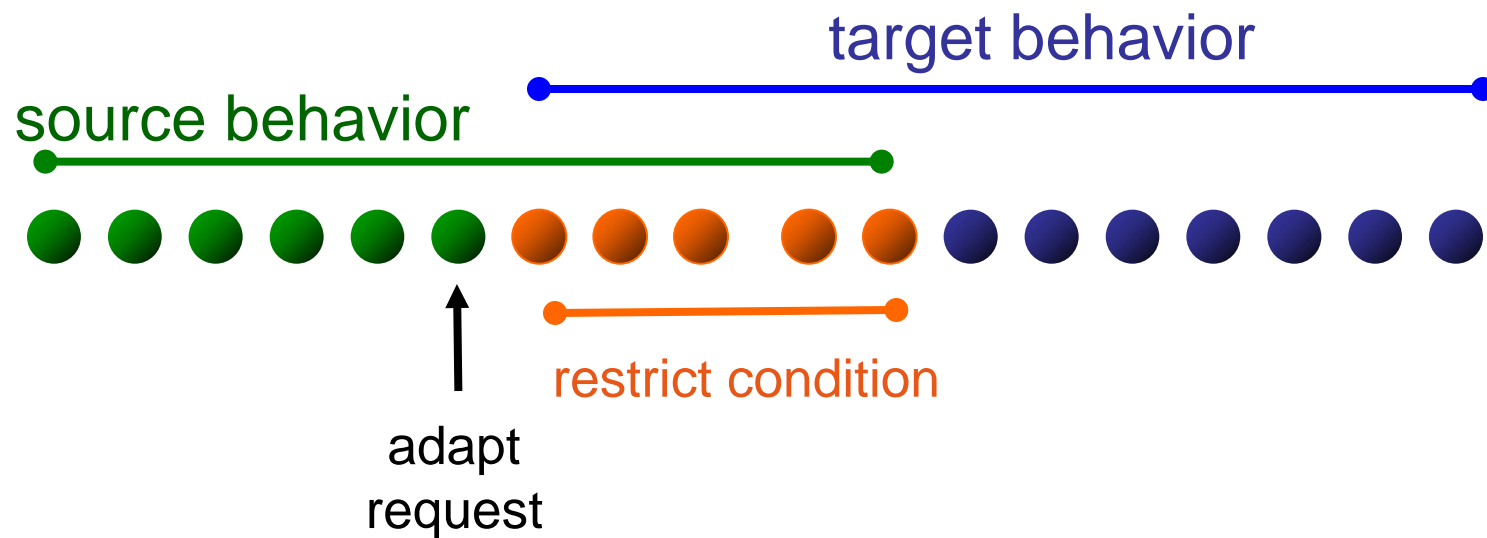


- Initially behaves as **source**.
- A condition **restrict** the program to reach a safe state.
- Finally, the program behaves as **target**.

Guided Adaptation Model

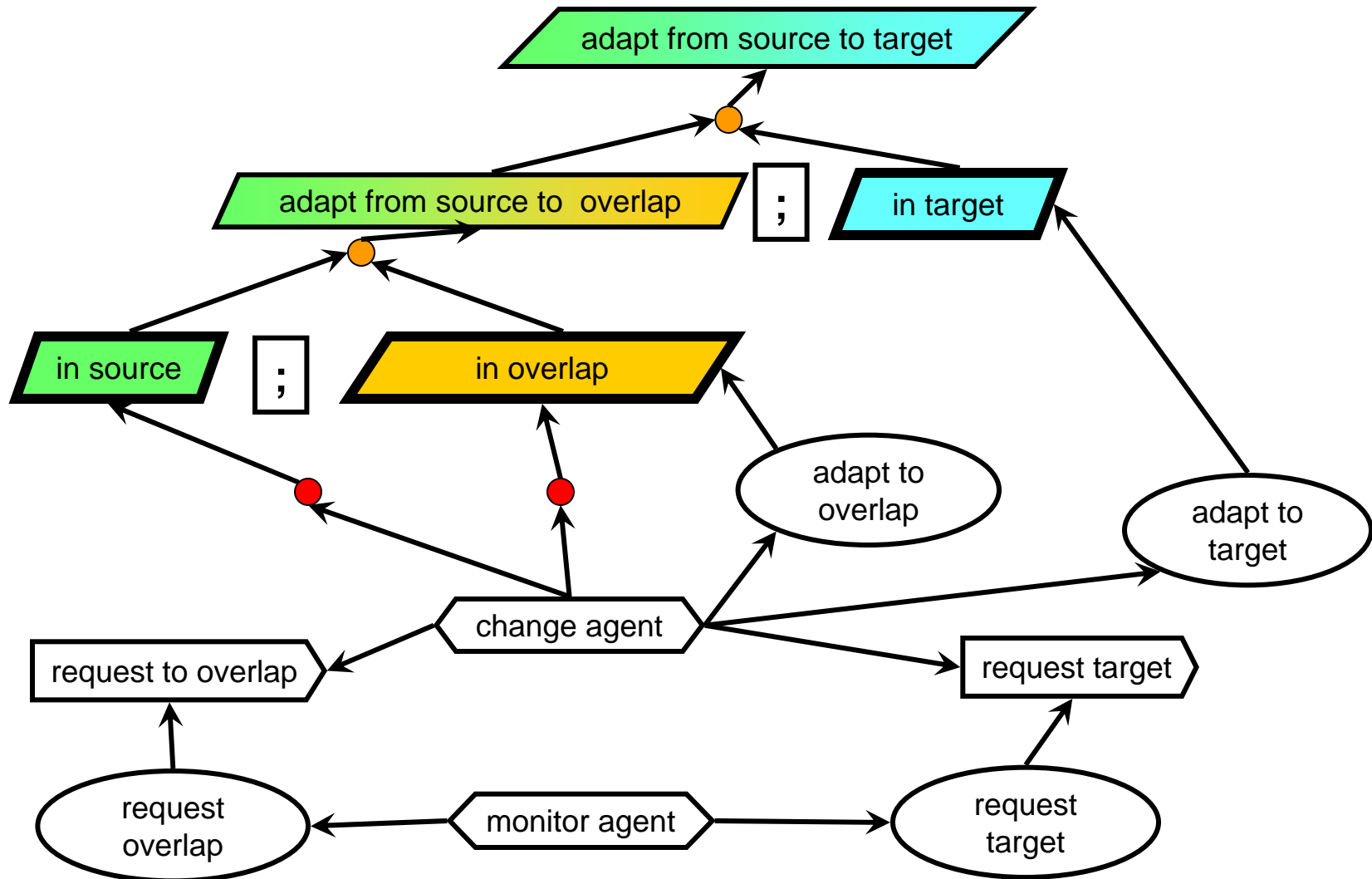


Overlap Adaptation



- The **source** and **target** behavior may overlap.
- A condition **guides** the program to reach a safe state.

Overlap adaptation model



Summary

- Goal-oriented specification of common adaptation semantics in KAOS notation
- Graphical wrapper to formal A-LTL adaptation semantics
- Benefits of formal specification as well as those of graphical representation
 - Ease of understanding
 - Tool support
 - Analyses

Future Work

- Use of adaptation semantics in different application domains.
- Goal-oriented decision-making
- Goal-oriented modeling in the context of model-driven development of adaptive systems [ICSE06]

Acknowledgements

- Members in the Software Engineering and Network Systems Laboratory at Michigan State University
- SEAMS reviewers
- Grants: This work was supported in part by the U.S. Department of the Navy, Office of Naval Research under Grant No. N00014-01-1-0744, and in part by National Science Foundation grants CCR-9901017, EIA-0000433, EIA-0130724, CCF-0541131, and CNS-0551622, and ITR-0313142, and by Siemens Cooperate Research, and a Michigan State University Quality Fund Concept Grant.