RAIDE: Engineering Architecture-Based Self-Adaptive Systems

Rainbow

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Motivation

- Systems are required to self-adapt in response to
  - Variable resources, system errors, changing priorities
  - Maintaining user goals and properties
  - With minimal human oversight
- Today self-adaptation is costly to build
  - Many man-months to develop or retrofit capabilities
  - Once added, difficult and costly to modify

Vision: an engineer could

- Take an existing system and specify objectives, conditions for change, strategies for adaptation
- Make system self-adaptive where it wasn't before
- Achieve this in *days*, rather than months
- Maintain business goals
- Reuse and share adaptation expertise

Rainbow is a framework for self-adaptation empowering engineers to

- Define adaptation policies that are global in nature
  - *Architecture model* reflects states of executing system
- Incorporate business goals and quality attributes
  - *Utility theory* used to inform trade-offs
- Augment legacy systems, not rewrite from scratch
- Reuse adaptation policies across similar systems
- Combine multiple sources of expertise
- Support maintainability, evolution, and analysis

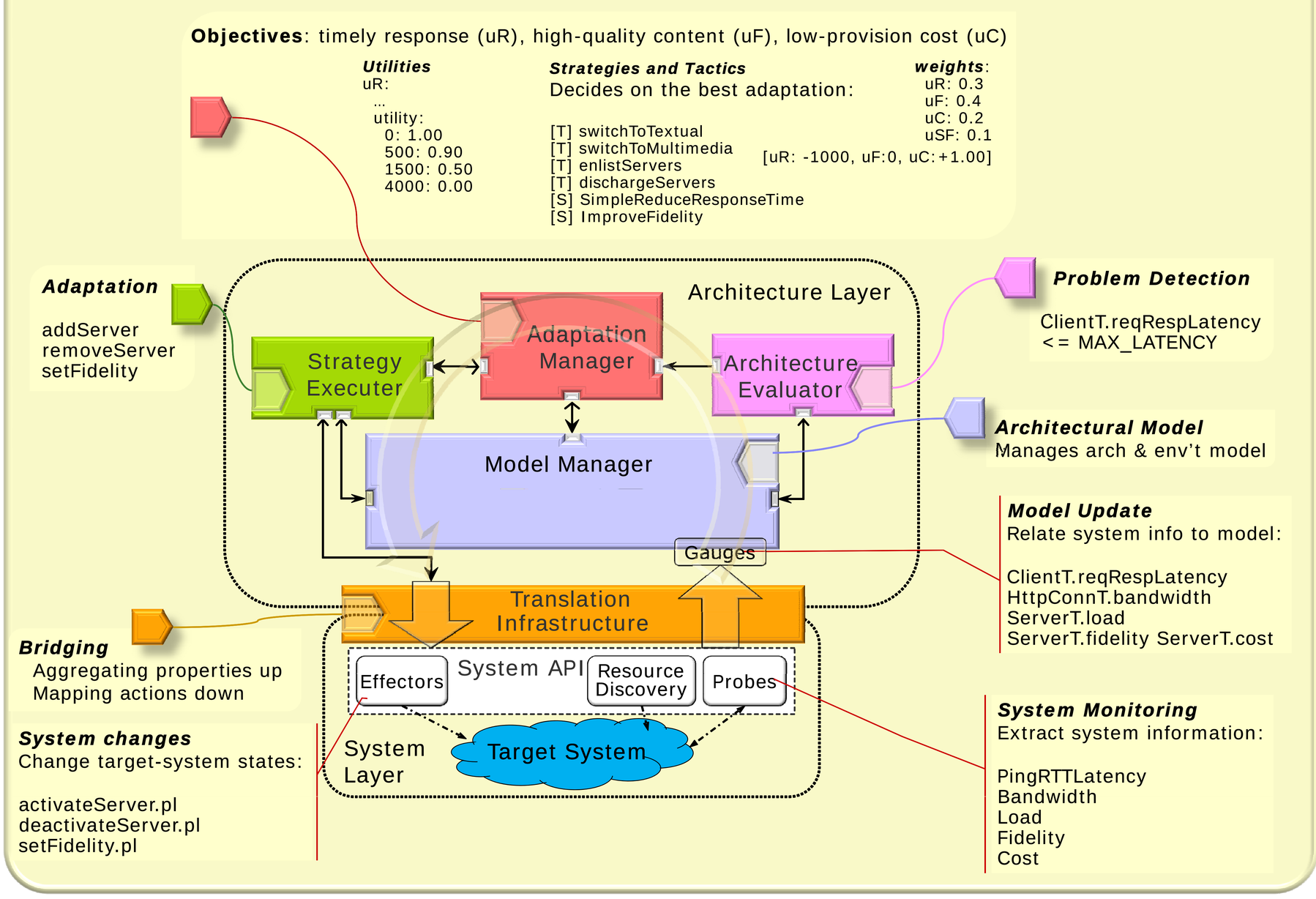
RAIDE:

- *An integrated development environment for customizing Rainbow*
- *Allows engineers to customize, test, and deploy Rainbow*

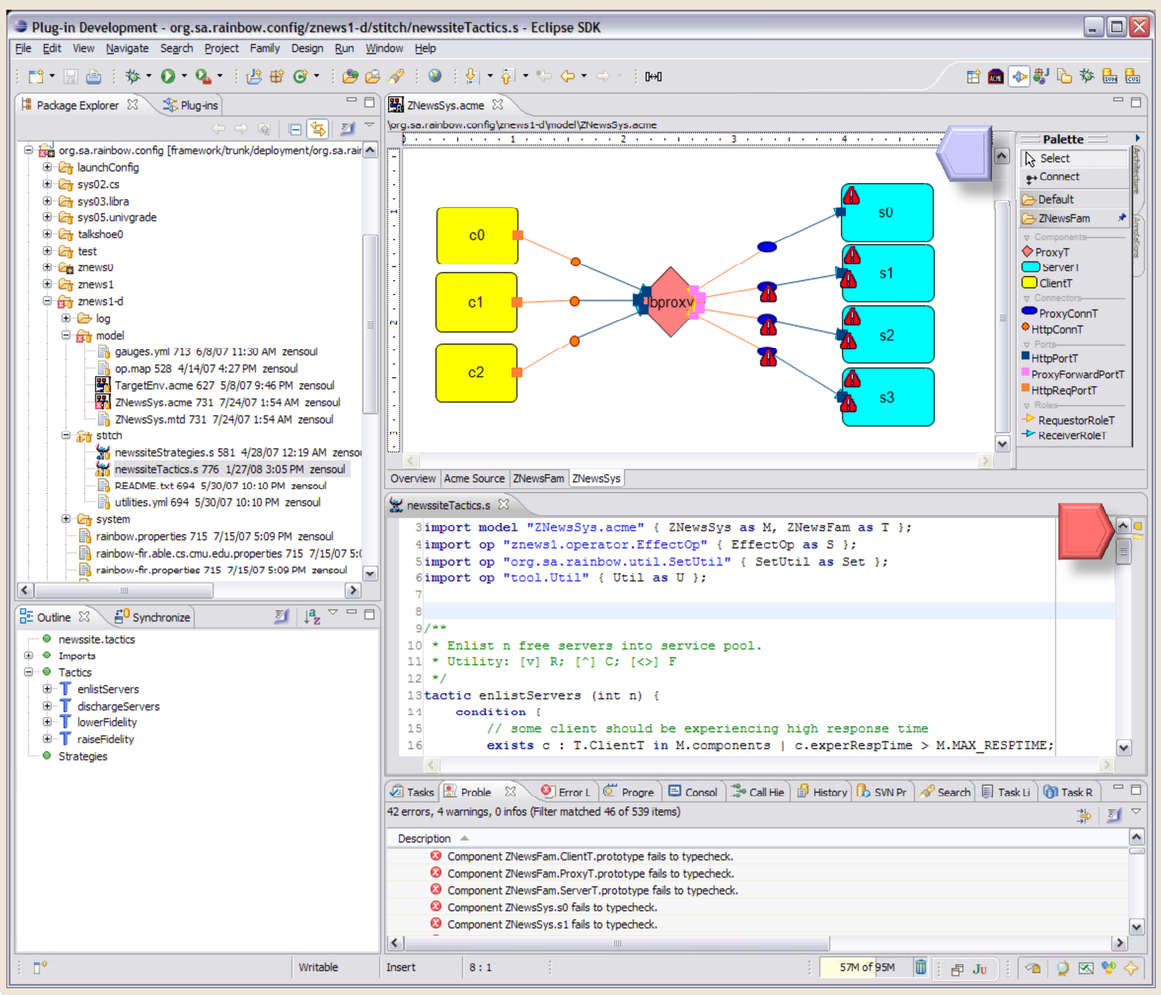
RAIDE components

- *Workbench explorer*: manage artifacts of customization project
- *AcmeStudio* plug-in: visualize and edit architecture model
  - System properties to monitor
  - Constraints to evaluate
- *YaML* plug-in: edit specifications of probes, gauges, effectors
- *Stitch Editor*: create adaptation strategies and tactics
  - Syntax highlighting
  - Simple code completion
  - On-save parsing
  - Outline view
- *Utility Editor*: manage biz objective profiles and preferences
- *Rainbow SDK*:
  - Rainbow runtime API
  - Communication event API
  - Basic target system simulation
  - Integration and testing

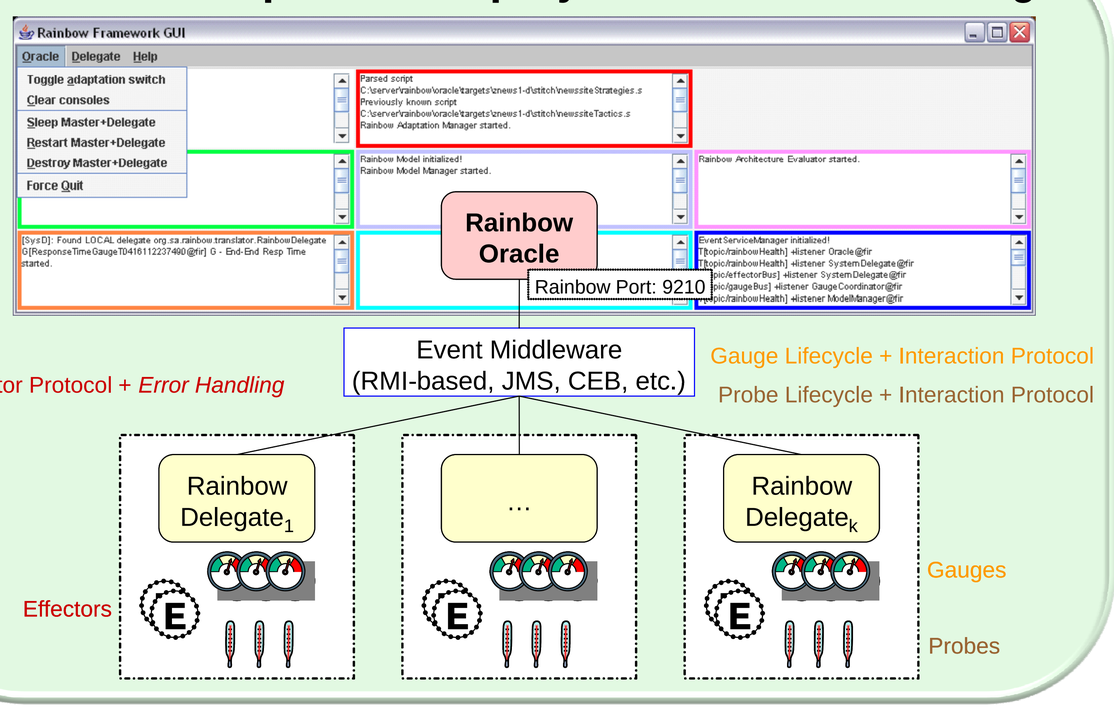
Rainbow Adaptation Loop



RAIDE: Adaptation Development



RAIDE: Adaptation Deployment and Monitoring



Rainbow Customization Effort Data		Duration	
No	Customization Task	Znn.com	TalkShoe
1	Target system monitors and effectors	12.9	56.1
2	Model capture	4.4	13.3
3	Stitch script	8.5	21.3
4	Roundtrip integration + modification (small)	8.2	2.7
	Total customization time (man-hrs):	~34 h (56)	~93 h