Dynamic Evolution of .NET Systems

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The Dynamic Reconfiguration Premise

- Systems evolve over time.
  - System mission changes.
  - Improved implementations are developed.
  - Defects are discovered.
- Evolutionary paths cannot be predicted.

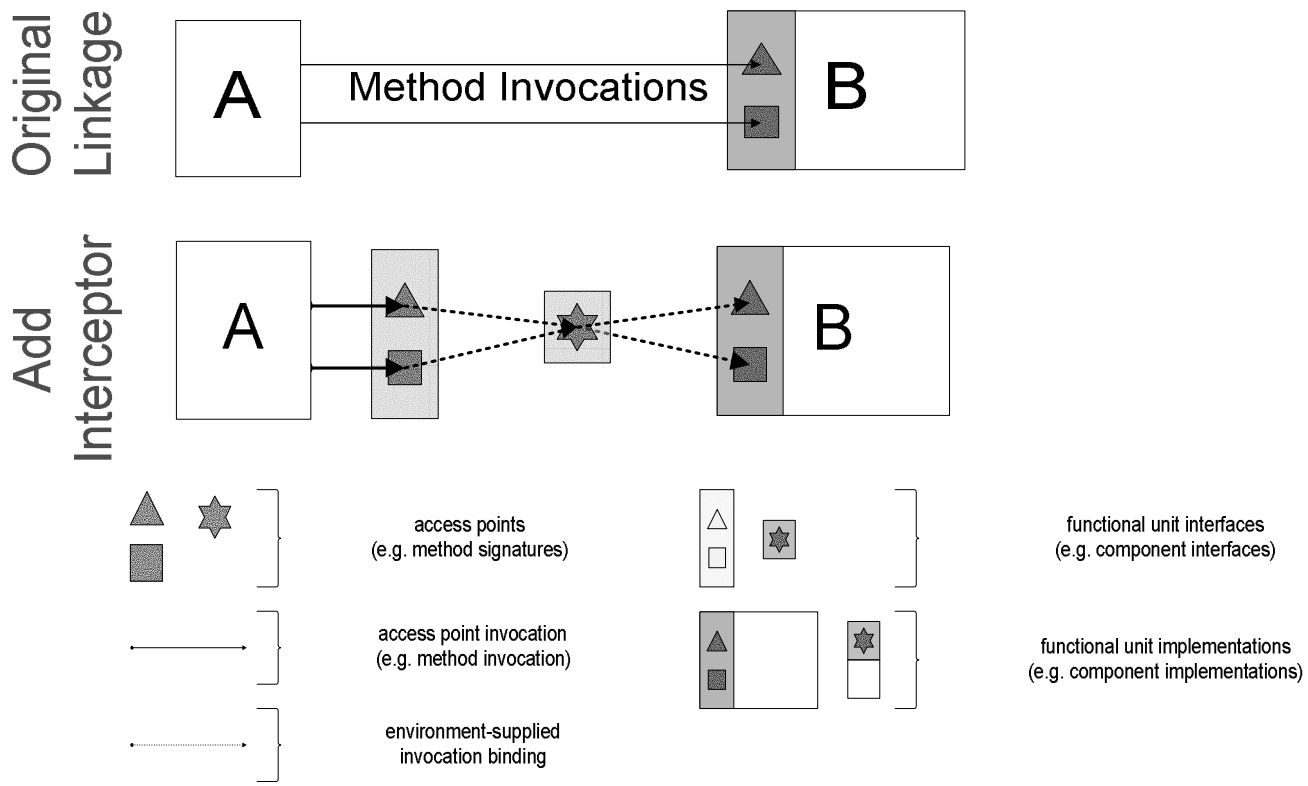
- Long-running systems must be evolved dynamically.
  - Difficult/expensive/unsafe to shut system down.
  - Make changes while system is running.

DRSS
Dynamic Reconfiguration SubSystem

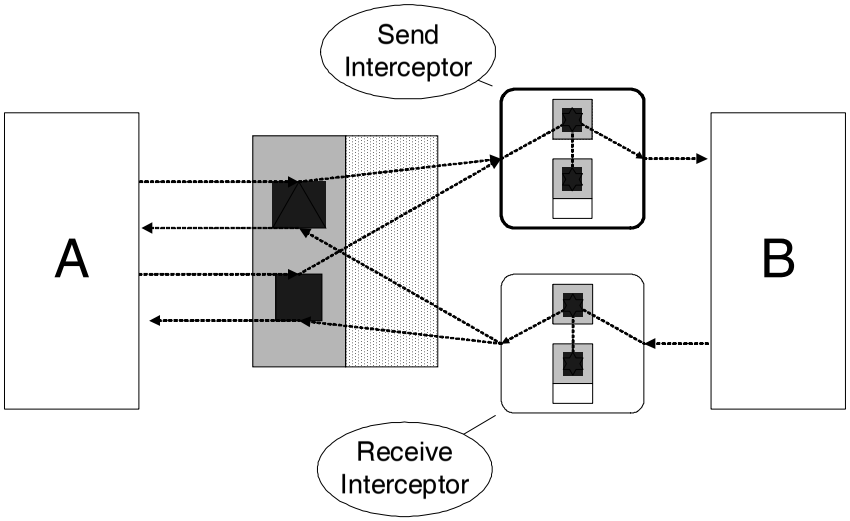
- Support for cross-cutting concerns
  - Example: add encryption/decryption to all component communication
- Scalable
  - Example: add encryption/decryption to many components, or to just one.
- Incremental evolution
  - Example: add encryption/decryption to a component, later add visualization.
- Accessible to practitioners
  - Not require major change in development methodology

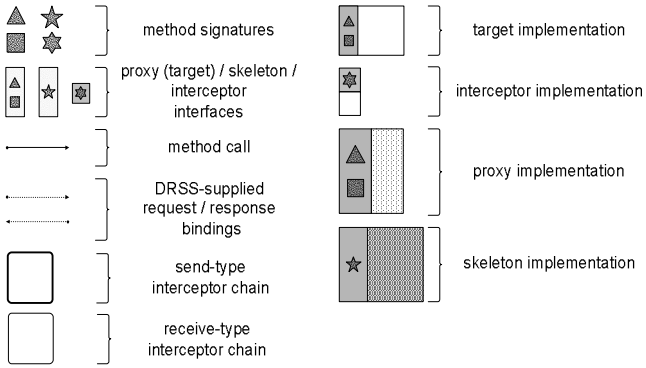
www.cis.ohio-state.edu/siefast/msr-cont-self-maint/

Basic Interception

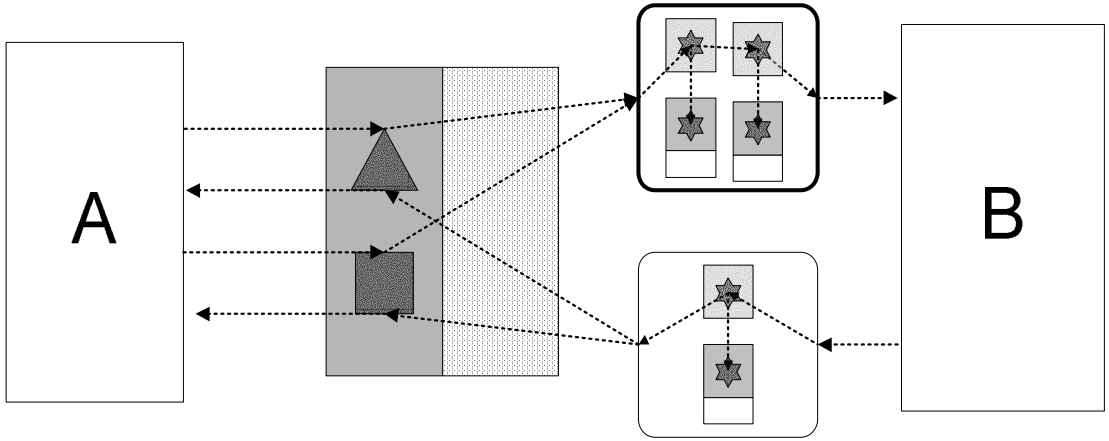


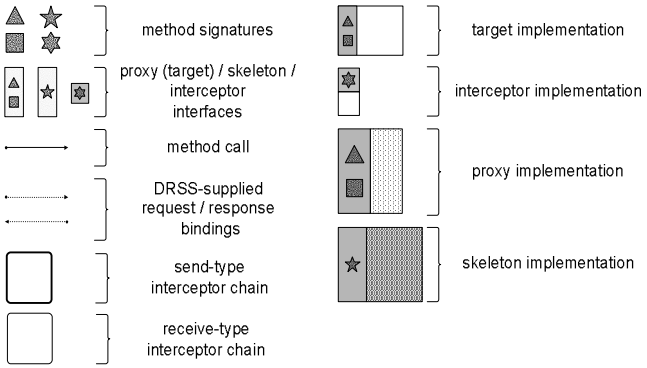
Send/Receive Interceptors



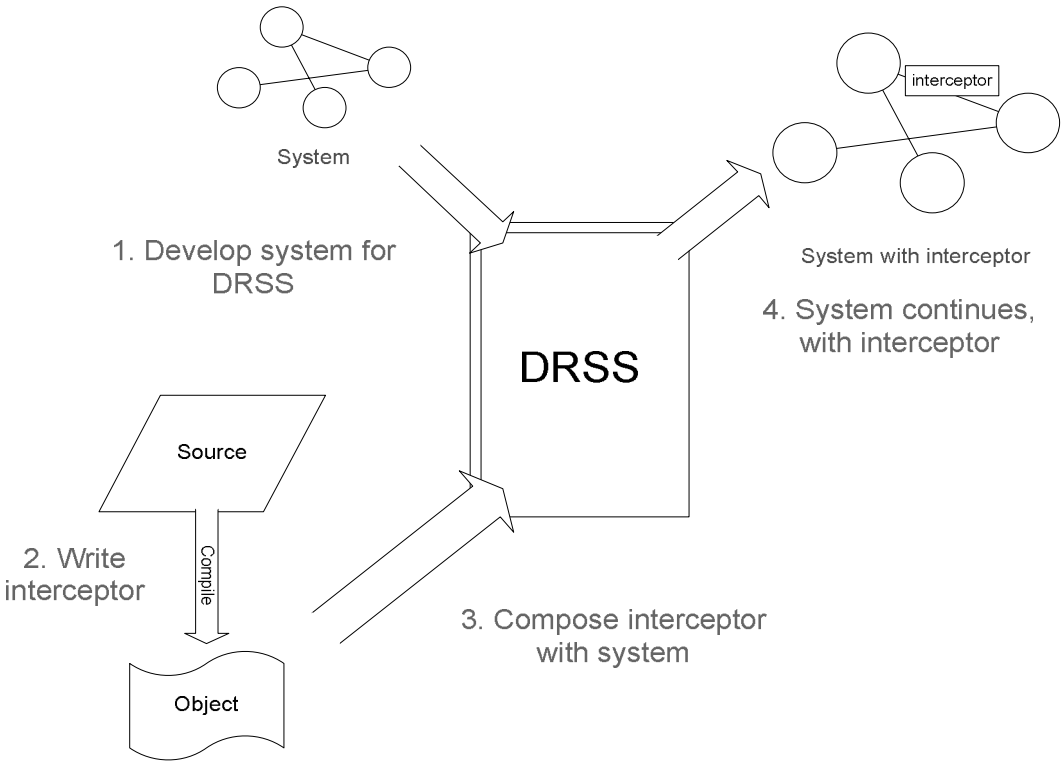


Interceptor Chains

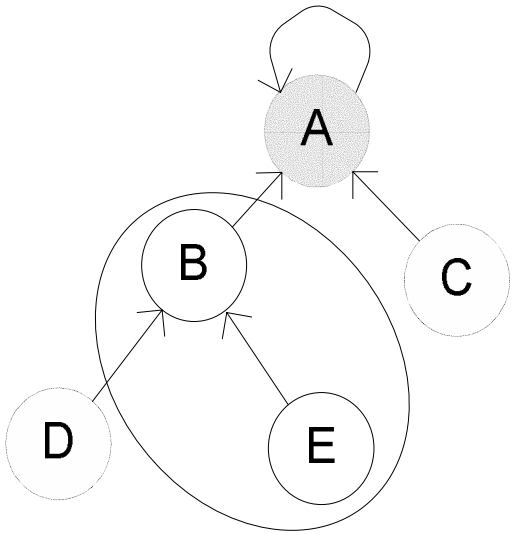


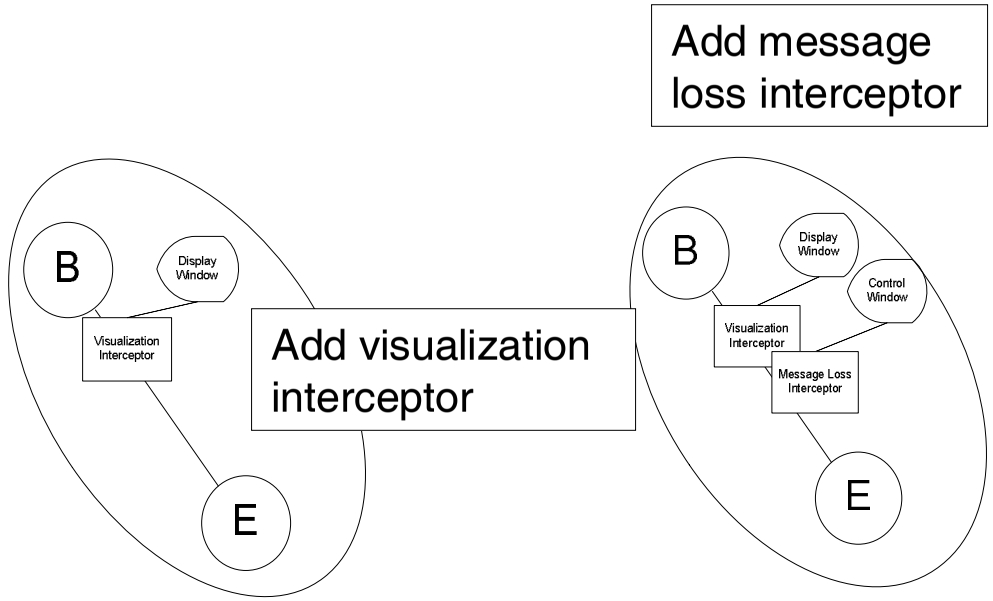


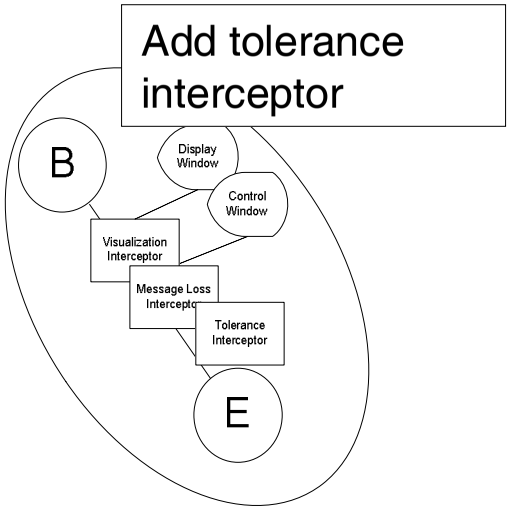
How to use DRSS



Example





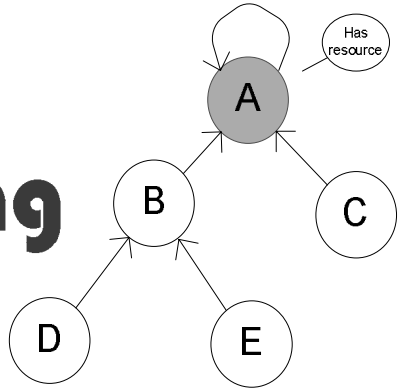


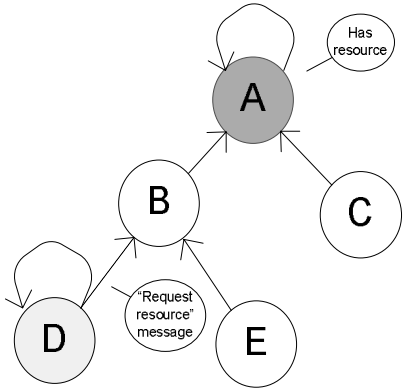
Note

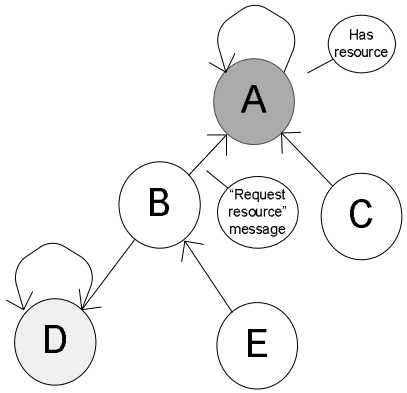
(1) Original system *not* changed.

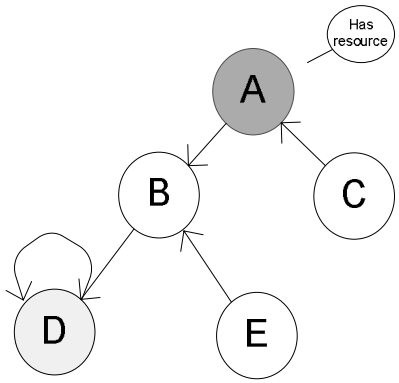
(2) Original system *not* designed for testing, visualization or tolerance.

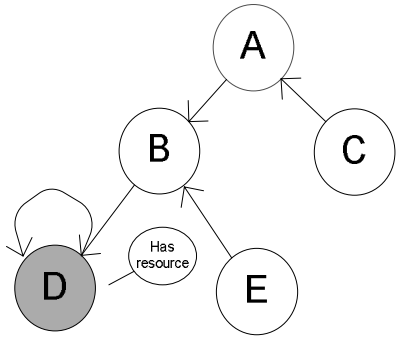
Arrow Protocol
Distributed Queuing











The Demo
Using the Arrow Protocol

- Dynamically add visualization and fault injectors
  - Start Arrow
  - Add visualization interceptors
  - Add message loss interceptors
  - Cause message loss, observe intolerance
- Dynamically add tolerance to Arrow
  - Start Arrow, add message loss, visualization interceptors
  - Add tolerance interceptors
  - Cause message loss, observe tolerance
- Demonstrate DVI toolkit

Demo Recap

- The Arrow protocol was *not* written with interception in mind.
- It was *not* written to enable testing, visualization or tolerance
- Fault injection, visualization, tolerance were all added after the fact.

- Summary: The system was evolved dynamically to provide capabilities not originally planned.

DRSS Summary

- DRSS supports cross cutting concerns
  - Example: visualization does not depend on system modularization.
- DRSS is scalable
  - Example: call tracking interceptor added to two components.
- DRSS supports incremental evolution
  - Example: added visualization, then fault injection.
- DRSS is easy to use
  - Does not require major change in approach to programming.

Tools

- DVI – Dynamic Visualization Infrastructure
  - Generic visualization to assist system development.
- CAT – Custom Adaptation Toolkit
  - Converts a .NET dll into a DRSS-compatible version.