

# From Requirements to Architectures

“It was the best of times, it was the worst of times”

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# Software Architectures

- “it was the best of times...”
- Tremendous advances in software-architecture research and practice
  - Three-tier, n-tier, and the layered-architecture pattern
  - Enterprise and Service-Oriented Architecture
  - Architectural models and Description Languages (ADLs)
  - Architectural style
  - Components, connectors, and interface specifications
  - Alternative architectural approaches and design choices

# The Requirements-Architecture Gap

- “it was the worst of times...”
- A stubborn gap persists...
- Lack of significant progress in
  - Mapping software requirements to software architectures
  - Verifying and validating said architectures against said requirements

# Software Requirements

- “it was the best of times...”
- Useful advances in requirements engineering
  - Functional/behavioral requirements
    - Use cases
    - Scenarios
    - State-based models, etc.
  - Non-functional
    - The “NFR Framework”
    - Methods and models for specific NFRs
      - Safety, security, reliability, availability, performance, etc.

# Why the Gap Exists

- “it was the worst of times...”
- Traditional problems
  - Traditional software process/lifecycle models
    - Waterfall, phased development, “over the fence”
  - Isolation of requirements and architecture
    - Different tools, methods, “over the fence”
- New problems
  - Software architects ignoring or incorporating requirements
  - Requirements engineers ignoring or incorporating architectures
    - “from use cases to code”

# Spanning the Requirements- Architecture Gap

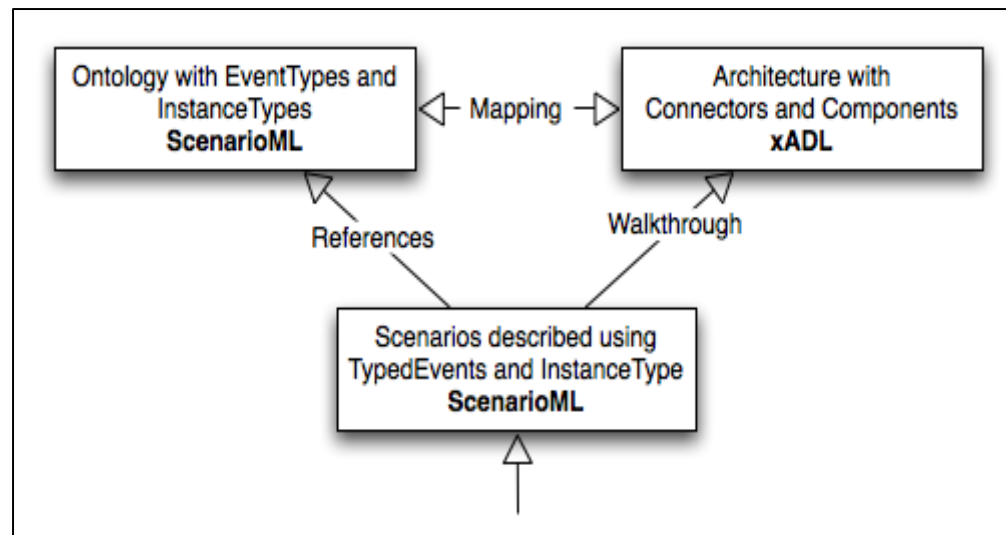
- “it was the best of times...”
- Work on architecture-generation methods based on refinement of requirements
  - ATAM (Architecture Trade-off Analysis Method)
  - CBSP (Component-Bus-System-Property)
- Work on architecture analysis and evaluation methods based on requirements
  - SAAM (Scenario-based Architecture Analysis Method)
  - PASA (Performance Assessment of Software Architecture)
- Must all be evaluated against subject systems!

# Looking for Subject Systems

- 17 candidate subject systems
  - Varying sources
  - Different characteristics (domain, size, etc.)
- All 17 were incomplete!
- 4 types of incompleteness
  - Detailed requirements and sketchy architecture
  - Detailed architecture and sketchy requirements
  - Sketchy requirements and architecture
  - Toy systems with detailed requirements and architecture
- ***“Case Study, Interrupted: The Paucity of Subject Systems that Span the Requirements-Architecture Gap”***
  - *Diallo, Sim, Alspaugh, 2007*

# A Requirements-based Architecture-evaluation Approach

- **Step 1:** Requirements specification using scenarios and ontology
  - *typedEvents* (scenarios)  $\longrightarrow$  *eventTypes* (ontology)
- **Step 2:** Mapping ontology elements to architectural components
  - *eventTypes* (ontology)  $\longrightarrow$  *components* (architecture)
- **Step 3:** Architecture evaluation against scenarios – ***Walkthrough***
- **“Evaluating Software Architectures Against Requirements-level Scenarios”**
  - *Diallo, Naslavsky, Ziv, Alspaugh, Richardson, 2007 & 2008*





# Summary

- ***Mind your Requirements***
  - ***Much of software-architecture today***
    - ***Ignores requirements***
    - ***Attempts to absorb or incorporate requirements***
- ***Mind your Architecture***
  - ***Much of requirements-engineering today***
    - ***Ignores (mapping to) architectures***
    - ***Attempts to absorb or circumvent architectures***
      - ***“from use cases to code”***
- ***Mind the Gap!***
  - ***Gap exists, persists***
    - ***Need “spanning” methods from requirements to architectures***
    - ***Need to analyze and evaluate, verify and validate architectures***



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