

Achieving System Qualities Through Software Architecture

What is “software architecture?”
Role in determining system qualities

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Working Definition

“The software architecture of a program or computing system is the structure or structures of the system, which comprise software components, the externally visible properties of those components, and the relationships among them.”

From *Software Architecture in Practice*, Bass, Clements, Kazman

Remember as: **Components, Interfaces, and Relations**

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Examples

- An architecture comprises a set of
 - Software components
 - Component interfaces
 - Relationships among them
- Examples

Structure	Components	Interfaces	Relationships
Calls Structure	Programs	Program interface and parameter declarations.	Invokes with parameters (A calls B)
Data Flow	Functional tasks	Data types or structures	Sends-data-to
Process	Sequential program (process, thread, task)	Scheduling and synchronization constraints	Runs-concurrently-with, excludes, precedes

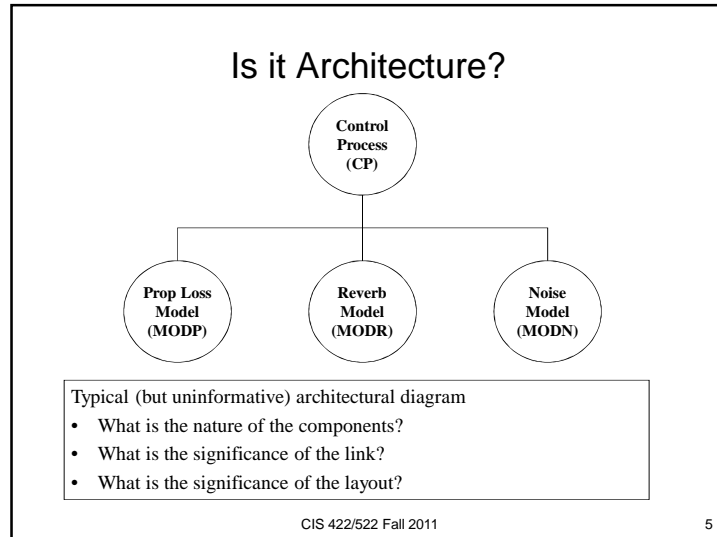
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Implications of the Definition

“The software architecture of a program or computing system is the structure or structures of the system, which comprise software components, the externally visible properties of those components, and the relationships among them.” - Bass, Clements, Kazman

- Systems typically comprise more than one architecture
 - There is more than one useful decomposition into components and relationships
 - Each addresses different system properties or design goals
- It exists whether any thought goes into it or not!
 - Decisions are necessarily made if only implicitly
 - Issue is who makes them and when
- Many “architectural specifications” aren’t

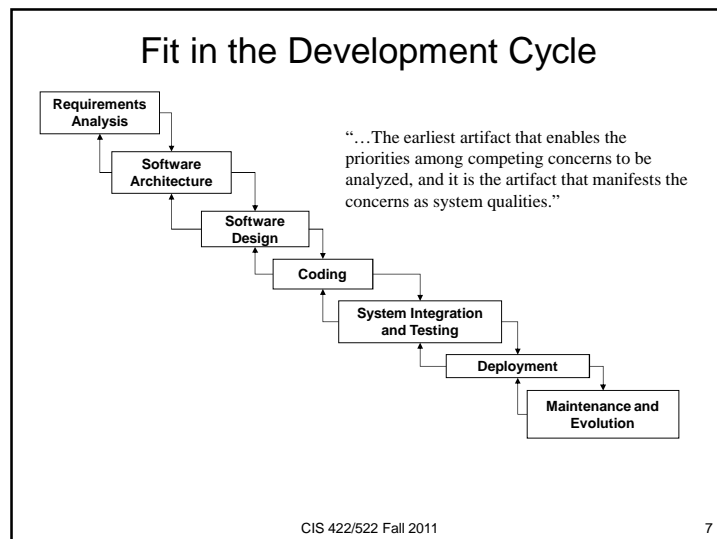
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The Role of Architecture

Which system or development characteristics are determined by architecture?
What is the source of requirements?

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Effects of Architectural Decisions

- What kinds of system and development properties are and are not affected by architecture?
- System run-time properties
 - Performance, Security, Availability, Usability
- System static properties
 - Modifiability, Portability, Reusability, Testability
- Production properties? (effects on project)
 - Work Breakdown Structure, Scheduling, time to market
- Business/Organizational properties?
 - Lifespan, Versioning, Interoperability

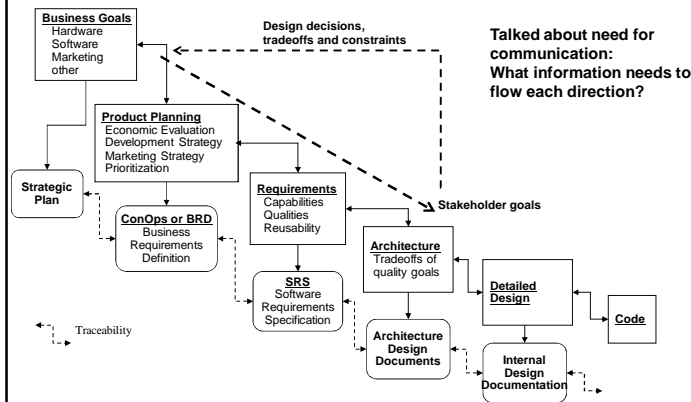
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Importance to Stakeholders

- Which stakeholders have a vested interest in the architectural design?
 - Management, marketing, end users
 - Maintenance organization, IV&V, Customers
 - Regulatory agencies (e.g., FAA)
- There are many interested parties (stakeholders) with many diverse and often conflicting interests
- Important because their interests defy mutual satisfaction
 - There are inherently tradeoffs in most architectural choices
 - E.g. Performance vs. security, initial cost vs. maintainability
- Making successful tradeoffs requires understanding the nature, source and priority of these constraints

Role of Architecture in Disciplined Development

Product Development Cycle and Architecture



SW Engineering of Software Architecture

- What are we trying to gain/maintain control of in the Architectural Design phase?
 - Profoundly effect system and business qualities
 - Requires making tradeoffs
- Control implies achieving system qualities by choice not chance
 - Understanding what the tradeoffs are
 - Understanding the consequences of each choice
 - Making appropriate choices at appropriate times

Implications for the Development Process

Implies need to address architectural concerns in the development process:

- Understanding the “business case” for the system
- Understanding the quality requirements
- Designing the architecture
- Representing and communicating the architecture
- Analyzing or evaluating the architecture
- Implementing the system based on the architecture
- Ensuring the implementation conforms to the architecture

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Related Design Questions

- Create business case for the system
 - What is the “business” rationale or goal?
- Understanding the requirements
 - What is the design goal?
- Creating or selecting the architecture
 - What are appropriate components and relations?
 - What are the decomposition principles?
- Representing and communicating the architecture
 - How are the components and relations represented?
- Analyzing or evaluating the architecture
 - How do we decide if the architecture is any good?

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Summary

- Earliest set of design decisions – hence, most influential and hardest to change
- Determines a wide range of critical system, production, and business properties
- A product of tradeoffs between conflicting demands by different stakeholders
- Requirements come from product/business goals and subsequently affect them
- Implication: good design is a balance of technical, business and social influences
 - Must understand the context
 - Must communicate effectively
 - Must negotiate the requirements
 - Must think strategically about the effects of decisions

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Assignments

- Read Ch. 11 on Architecture
- Project 2 proposals

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Questions