Module 5: Examples of Architectures
(Linux and Chrome)
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Linux as a Case Study: Its Extracted Software Architecture

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Outline

- Terminology
- Conceptual Architecture
- Concrete Architecture
- Conclusions
Terminology

- **Conceptual Architecture**
  - How developers think of a system; Relations meaningful to developers
  - Analogy: Blue Print of the House
  - By Reviewing Existing Documentation
  - Essential Relations

- **Concrete Architecture**
  - Relations that exists in a system
  - Analogy: Actual Architecture of the House
  - By Examining the Source Code
  - Implementation Specific Knowledge
The Linux Kernel

- Responsible for process, memory, and hardware device management
  - Different from the Linux System
- Linux System: 10 KLOC in 1991 to 1.5 MLOC in 1998
- The studied Linux Kernel is 800 KLOC
- Open Source
Conceptual Architecture – Top Level
Concrete Architecture

Extraction Methodology

Control Flow

Data Flow

Manually

- Group Directory to Subsystems

- Naming Conventions

Feedback

Legend:

Subsystem

contained subsystems

omitted subsystems
Concrete Architecture – Top Level

Legend:
- Subsystem
- depends on
- extracted dependency

Diagram showing the relationships between different components such as File System, Memory Manager, Network Interface, Process Scheduler, Inter-Process Communication, Initialization, and Library.
Concrete Architecture – File System
Concrete Architecture – File System
Concrete Architecture – Logical File System
Why Conceptual Architecture and Concrete Architecture Not Match?

- Missing Relations in Conceptual Architecture
- More Functionalities
  - For example, Process Scheduler
- Use Different Mechanisms
- Improve Efficiency by Bypassing Existing Interfaces
- Exist for Developer Expediency
  - “The read-only stuff doesn’t really belong here, but any other place is probably as bad and I don’t want to create yet another include file.”
What To Do Next?

- Restructure to Remove Unexpected Dependencies
  - Header Files
  - Lower Coupling
- Refine Conceptual Architecture
  - Not Hinder System Understanding
Conclusions

- Conceptual and Concrete Architecture for the Linux Kernel
- Similar Work Needs to Be Done for the Firefox Report
- Sample Reports:
  - Conceptual Architecture: http://plg.uwaterloo.ca/~itbowman/CS746G/a1/
  - Concrete Architecture: http://plg.uwaterloo.ca/~itbowman/CS746G/a2/