Integration of Software Intensive Systems

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Agenda

- Introduce the Problem
- Integration Definitions
- Integration throughout a Development Lifecycle
- Integration: Techniques, Methods
- Integration Support Activities
- Wrap-Up

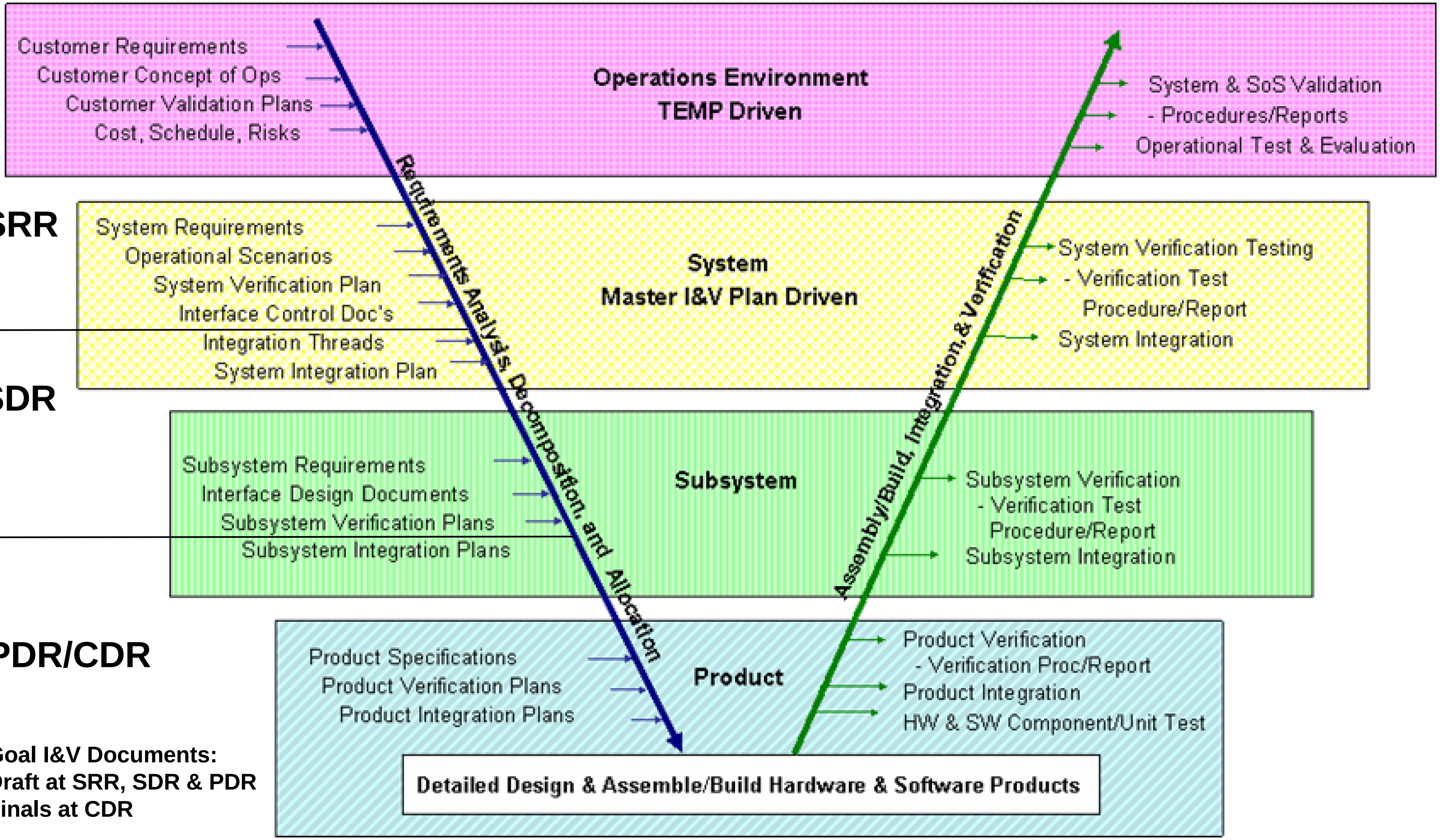
Introduce the Problem

- No consistent definition & process:
  - Results of a Web Search "System Integration is the successful integration of a new technology into the system by analyzing the technology's system effects and resolving any negative impacts that might result from its broader use."
  - From the International Council on System Engineering (INCOSE) web site – "Integrate: . . . Systems, businesses and people must be integrated so that they interact with one another. Integration means bringing things together so they work as a whole. . ."

Introduce the Problem (cont’d)

- My favorite published definition:
  - Integration is defined as the act of mating hardware and/or software components, subsystems, systems or elements at their respective interfaces and verifying the compatibility and proper operation of the integrated units.
    - From a paper entitled “Integration Challenges of Complex Systems” written by Bill Haskins and Jack Striegel for the 16th Annual INCOSE International Symposium,
- No complete guidance on how to do Integration

Integration throughout the Lifecycle



Customer Requirements
Customer Concept of Ops
Customer Validation Plans
Cost, Schedule, Risks

Operations Environment
TEMP Driven

System & SoS Validation
- Procedures/Reports
Operational Test & Evaluation

SRR

System Requirements
Operational Scenarios
System Verification Plan
Interface Control Doc's
Integration Threads
System Integration Plan

System
Master I&V Plan Driven

System Verification Testing
- Verification Test
Procedure/Report
System Integration

SDR

Subsystem Requirements
Interface Design Documents
Subsystem Verification Plans
Subsystem Integration Plans

Subsystem

Subsystem Verification
- Verification Test
Procedure/Report
Subsystem Integration

PDR/CDR

Product Specifications
Product Verification Plans
Product Integration Plans

Product

Product Verification
- Verification Proc/Report
Product Integration
HW & SW Component/Unit Test

Detailed Design & Assemble/Build Hardware & Software Products

Requirements Analysis, Decomposition, and Allocation
Assembly/Build, Integration,& Verification

Goal I&V Documents:
Draft at SRR, SDR & PDR
Finals at CDR

Integration: Techniques, Methods & Tools

Two Techniques:

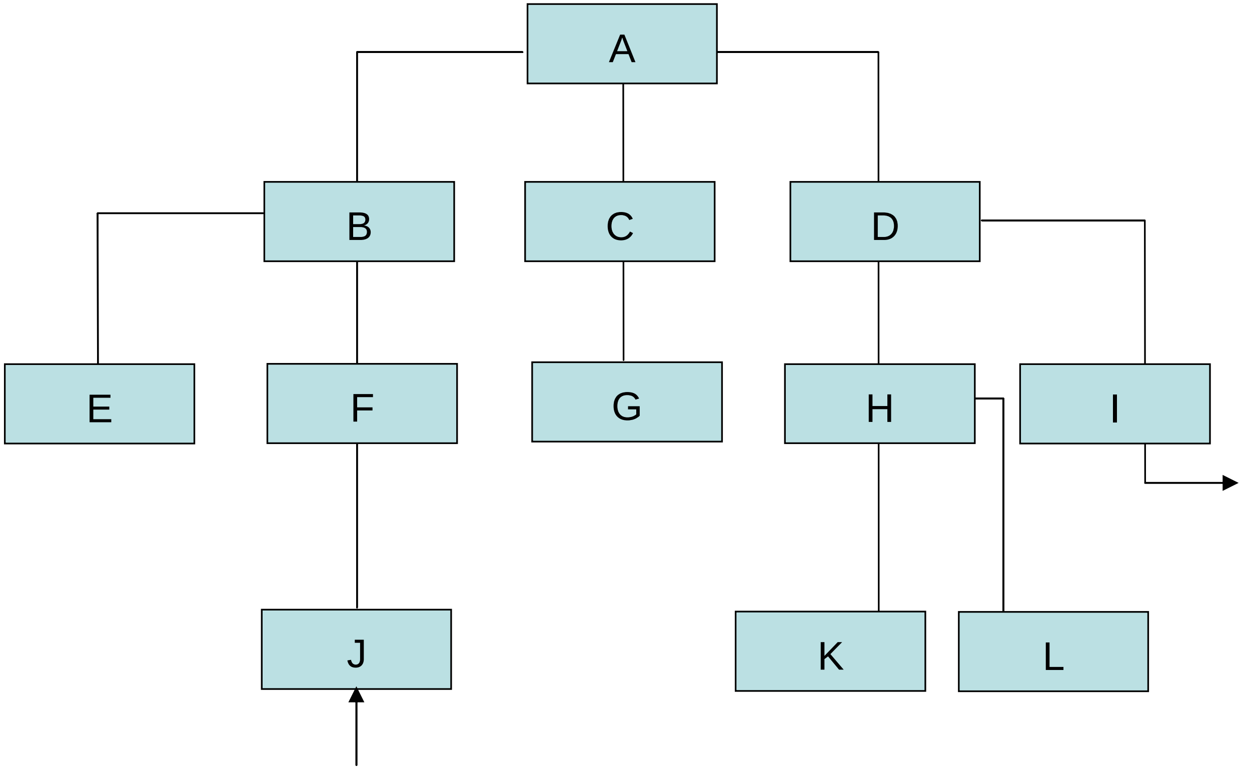
- Non-Incremental* (Big Bang) vs Incremental*
  - Incremental is the way to go for most systems and large applications
  - Integrate/Build-Up – starting small and continually increasing capability/complexity

* References for Techniques and Methods
Kit, Edward. 1995. *Software Testing in the Real World*, Addison-Wesley
Myers, Glenford. 1979. *The Art of Software Testing*, John Wiley & Sons, Inc.

Integration: Techniques, Methods & Tools

Three Methodologies:

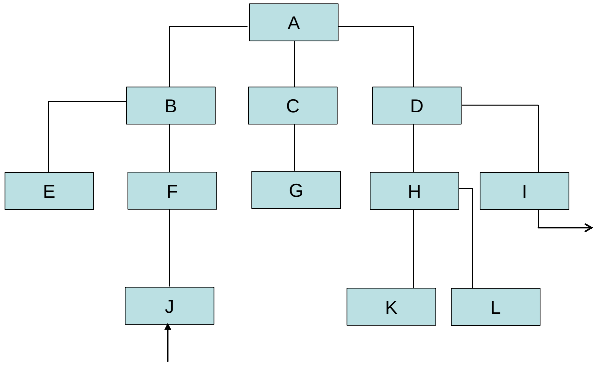
- Top-Down*, Bottoms-Up* & Thread-Based

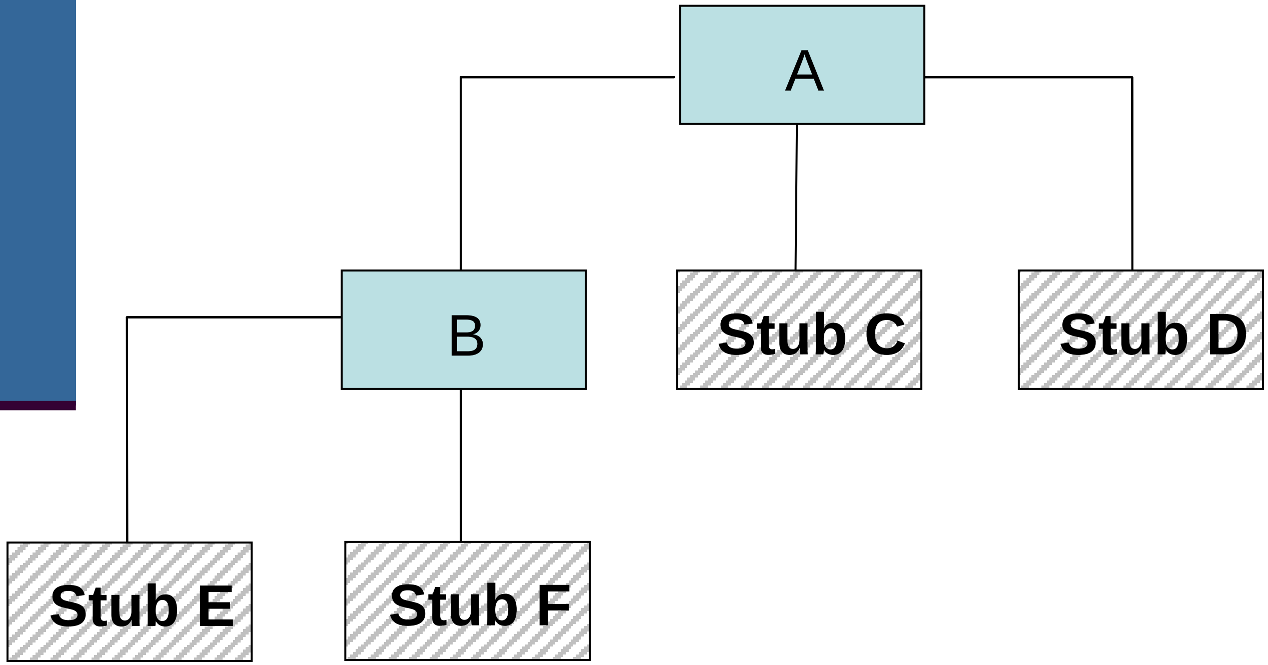


Integration: Techniques, Methods & Tools

Three Methodologies:

- Top-Down

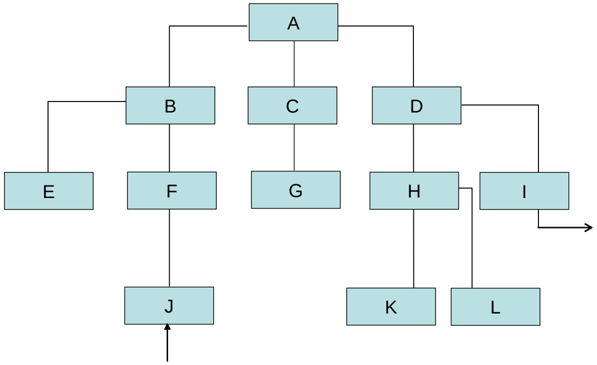


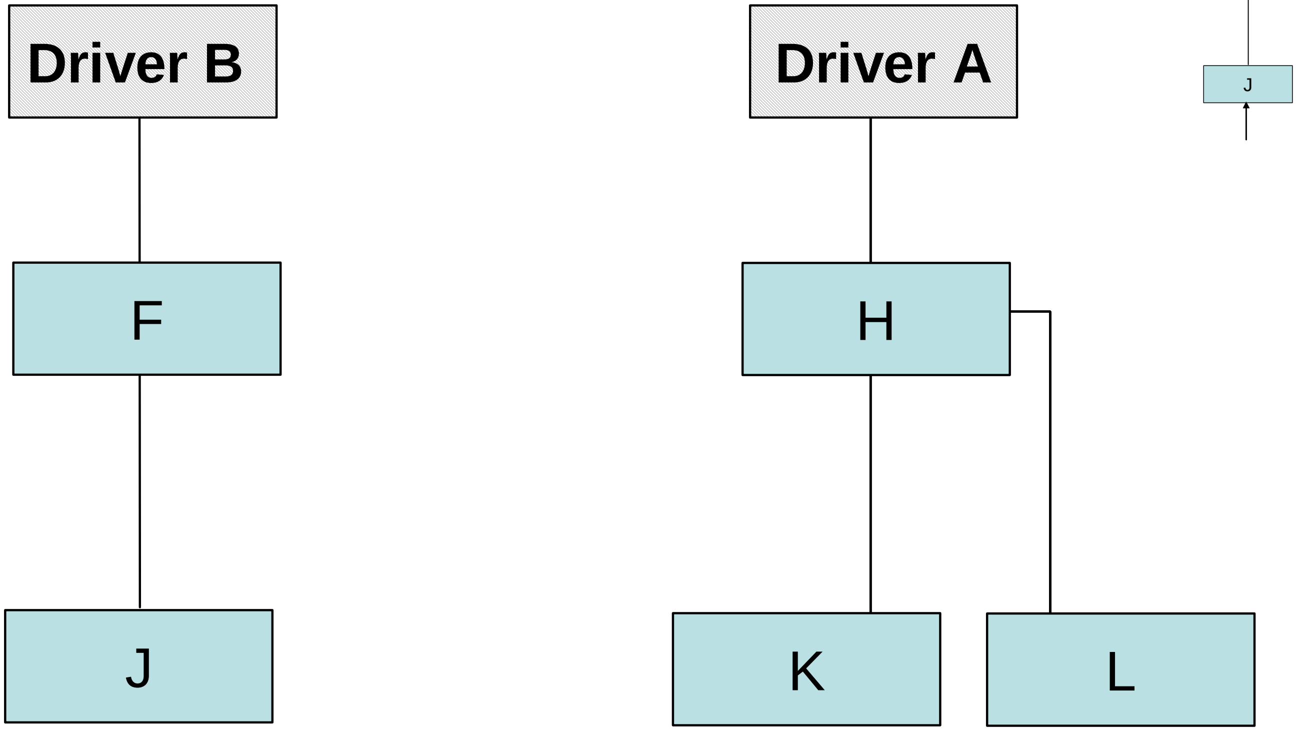


Integration: Techniques, Methods & Tools

Three Methodologies:

- Bottom-Up

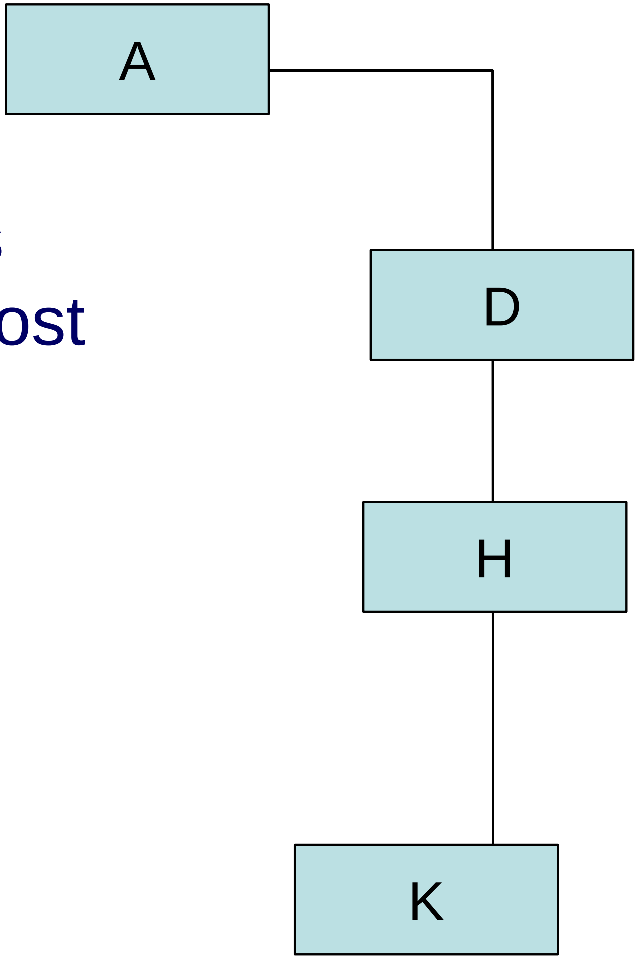


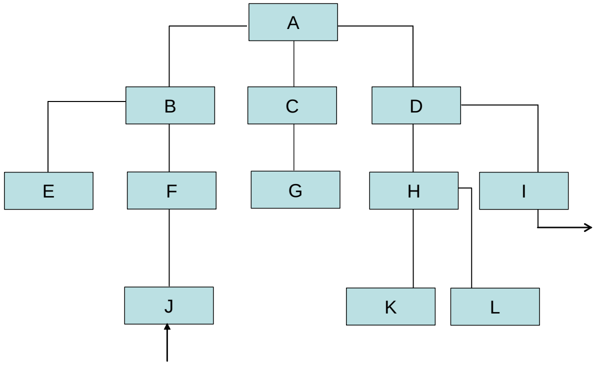


Integration: Techniques, Methods & Tools

Three Methodologies:

- Thread-Based
  - Experience indicates this is the preferred method for most large complex applications and or systems





Integration Support Activities

- Interface Matrices (Interface Coverage)
  - Account for all internal & external interfaces
- Hardware/Software/System Build Plan
  - Thread based and negotiated with the developers
- Dedicated Integration Laboratories
  - Separate from Test Laboratories
- Early "ilities" Checkout during integration phases
  - Stability
  - Reliability
  - Performance
  - Capacity

Wrap-Up

- Integration requires a different skill set than Testing.
- Lessons learned have shown that Integration is a key weakness on most medium to large software intensive projects
- Perform the Top Ten Integration steps and you will have a robust Integration process

Top Ten Integration Steps

1. Document the Integration and Test process
2. Hire and train the right staff for the role of Integrator
3. Review and analyze requirements to ensure testability and included requirements to ensure visibility into system data while it is operating
4. Ensure all interfaces at all levels of the architecture have been identified and are implemented, tested, tracked, and statused
5. Identify & plan other testing activities to start during the integration test conduct phase (i.e. stability, performance, reliability, etc)
6. Develop and maintain a Project "Build Plan"
7. Define and ensure sufficient Integration and Test laboratories available
8. Design integration tests and test data for all levels of the architecture
9. Ensure functional testing is also being conducted at each level of he architecture
10. Ensure sufficient simulation/stimulation capabilities are available