Software Engineering

Vikas Bajpai

Software Architecture:

- The software architecture of a program or computing system is a depiction of the system that aids in the understanding of how the system will behave.
- Software architecture serves as the blueprint for both the system and the project developing it, defining the work assignments that must be carried out by design and implementation teams.
- The architecture is the primary carrier of system qualities such as performance, modifiability, and security, none of which can be achieved without a unifying architectural vision. Architecture is an artefact for early analysis to make sure that a design approach will yield an acceptable system.

Software Architecture:

The software architecture of a program or a computing system is the structure or structures of the system, which comprises software elements, the externally visible properties of those elements, and the relationships among them

--Software Architecture in Practice 2nd Edition by Bass, Clements and Kazman

Architecture is about:

- What is visible externally, not the internals.
- The implementation details of a component are not architecture.

Software Architecture:

The Software architecture of a system is the set of structures needed to reason about the system, structures needed to reason about the system, which comprise software elements, relations among them, and properties of both

--Software Architecture in Practice 3rd Edition by Bass, Clements and Kazman

Software Architecture:

Fundamental concepts or properties of a system in its environment embodied in its elements, relationships, and in the principles of its design and evolution.

-- ISO/IEC 42010

What is a software architecture?

- An architecture defines structure.
- An architecture defines behaviour.
- An architecture focuses on significant elements.
- An architecture balances stakeholders need.
- An architecture embodies decisions based on rationale.
- An architecture may confirm to an architectural style.

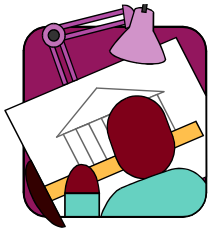
What is a software architecture?

- An architecture is influenced by its environment.
- An architecture influences team structure.
- An architecture is present in every system.
- An architecture has a particular scope.

The Role of the Architect:

client, users

requirements



architect

solutions

developers

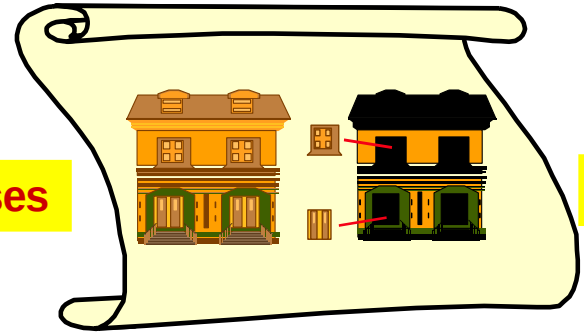
assess

creates

assess

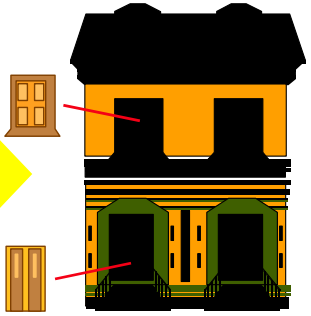
appearance, behaviour

visualises



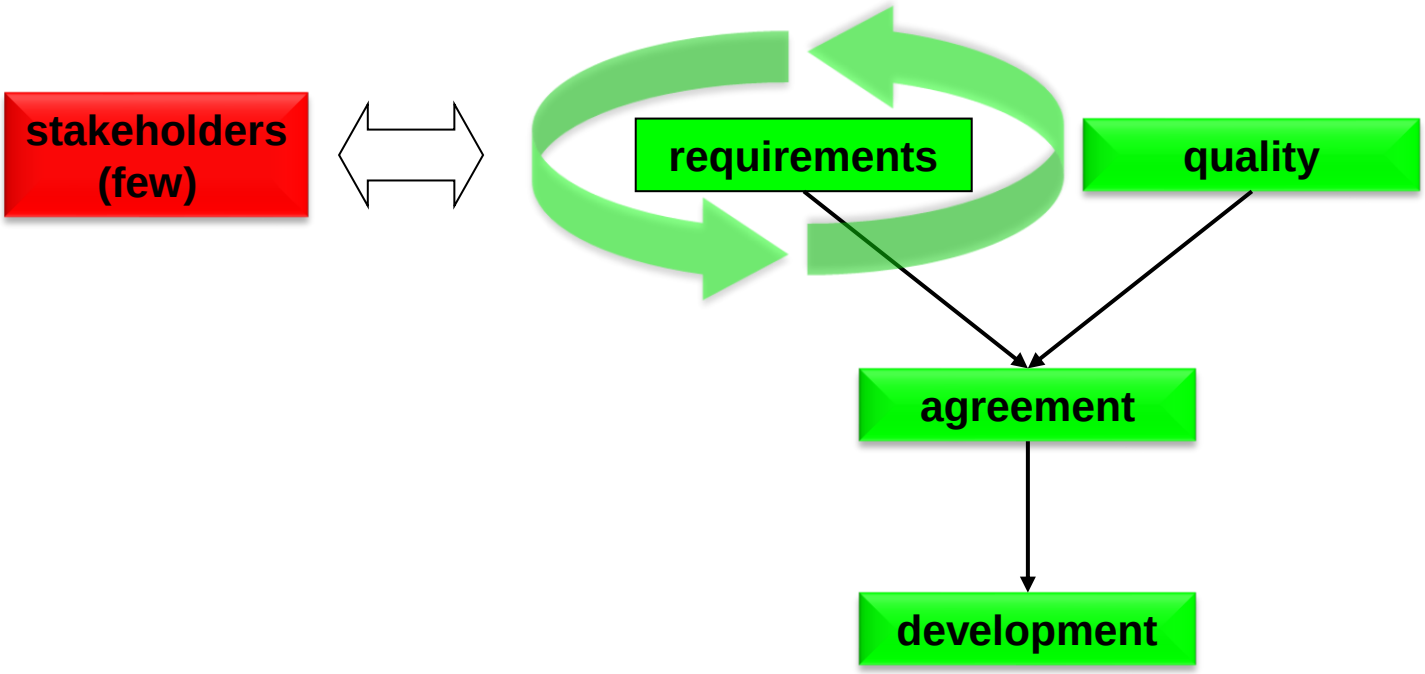
architectural design

prescribes

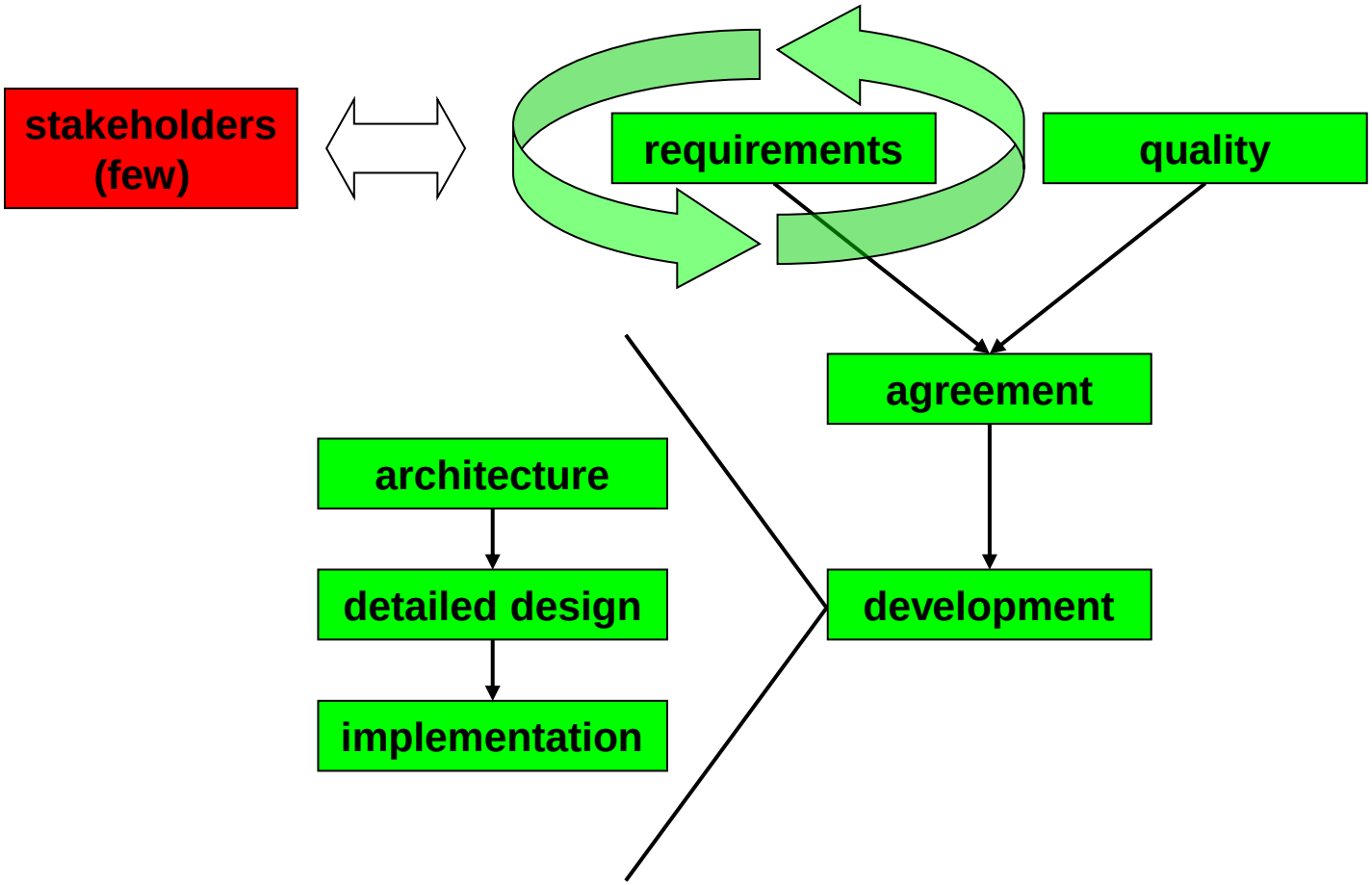


construction, co-operation

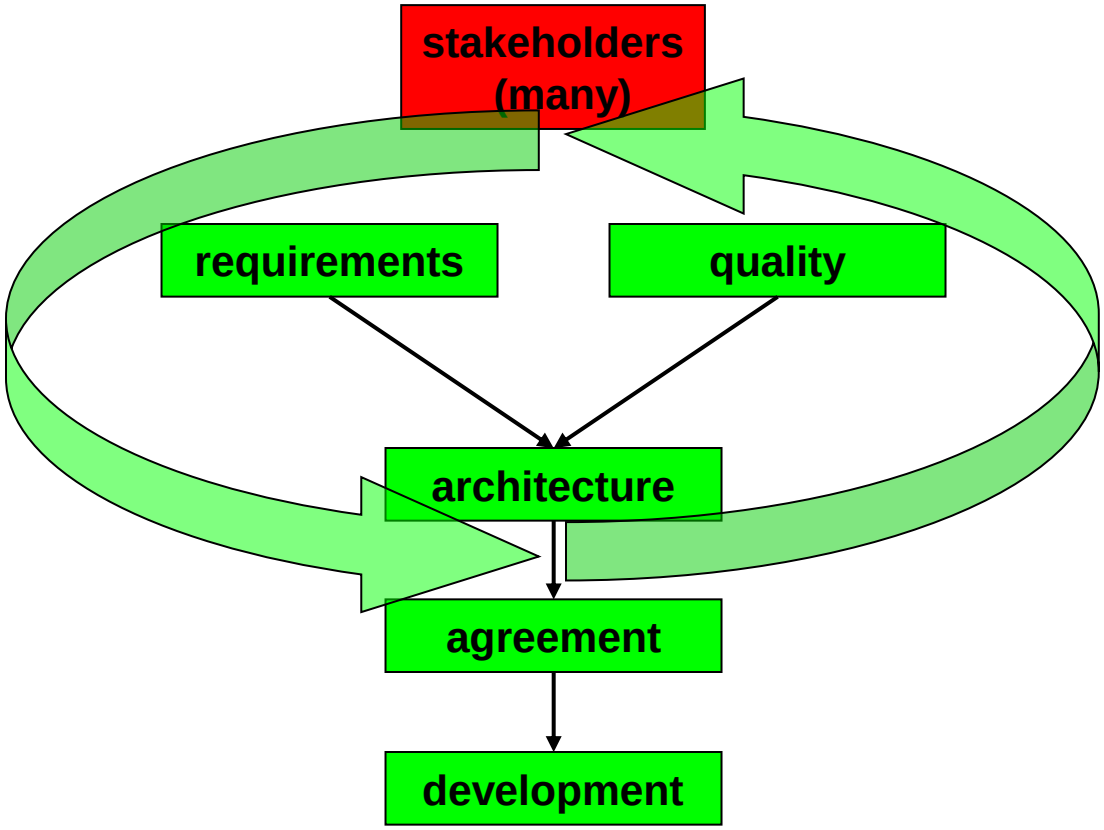
Pre-architecture life cycle:



Adding architecture, the easy way



Architecture in the life cycle



Importance of Software Architecture:

- Understand the System
  - Handling complexity
- Organize the development process
- Early Design Decisions
- SA is a transferable, reusable model

Architectures:

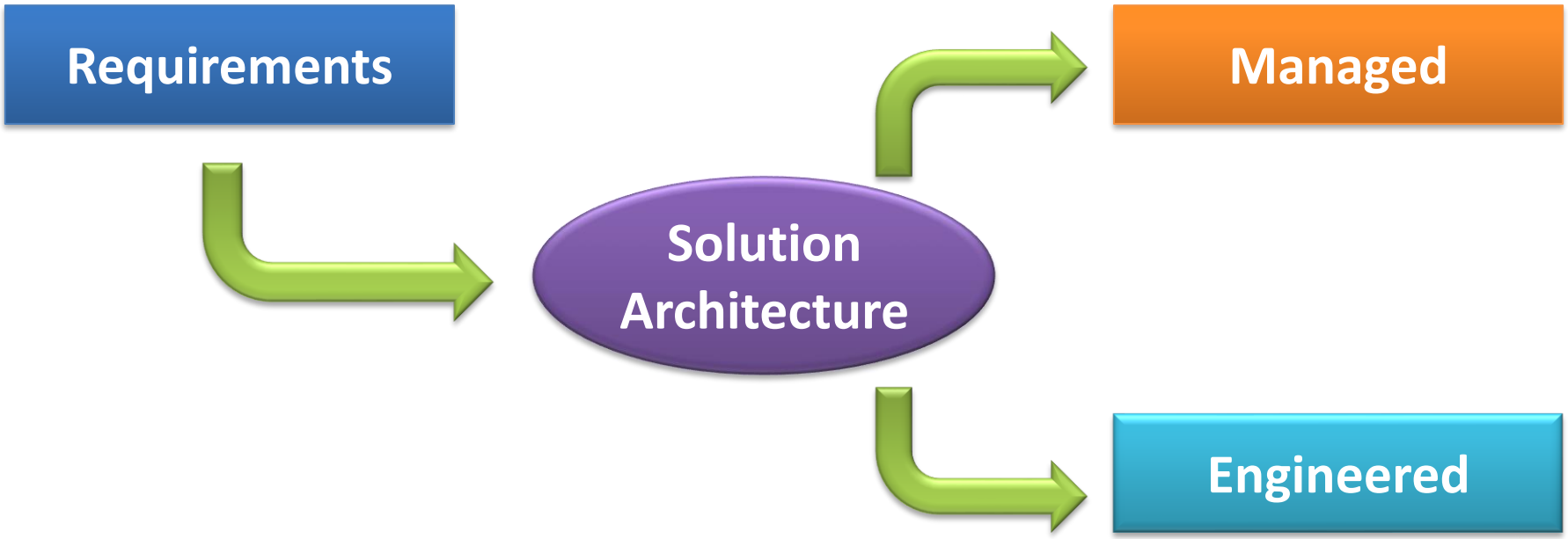
1. Software Architecture
2. Solution Architecture
3. Logical Architecture
4. Technology Architecture
5. Information Architecture
6. Platform Architecture
7. Technical Architecture

Architectures:

8. System Architecture
9. Code Architecture
10. Deployment Architecture
11. Enterprise Architecture
12. Application Architecture
13. Conceptual Architecture

Enterprise Level Software ?

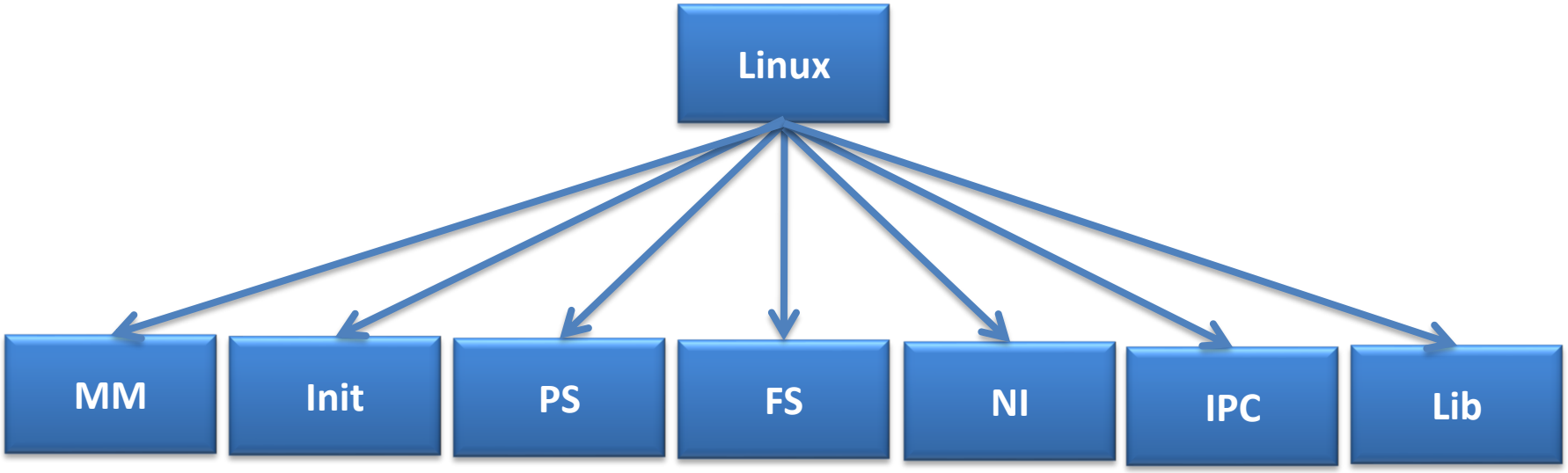
Solution Architecture:



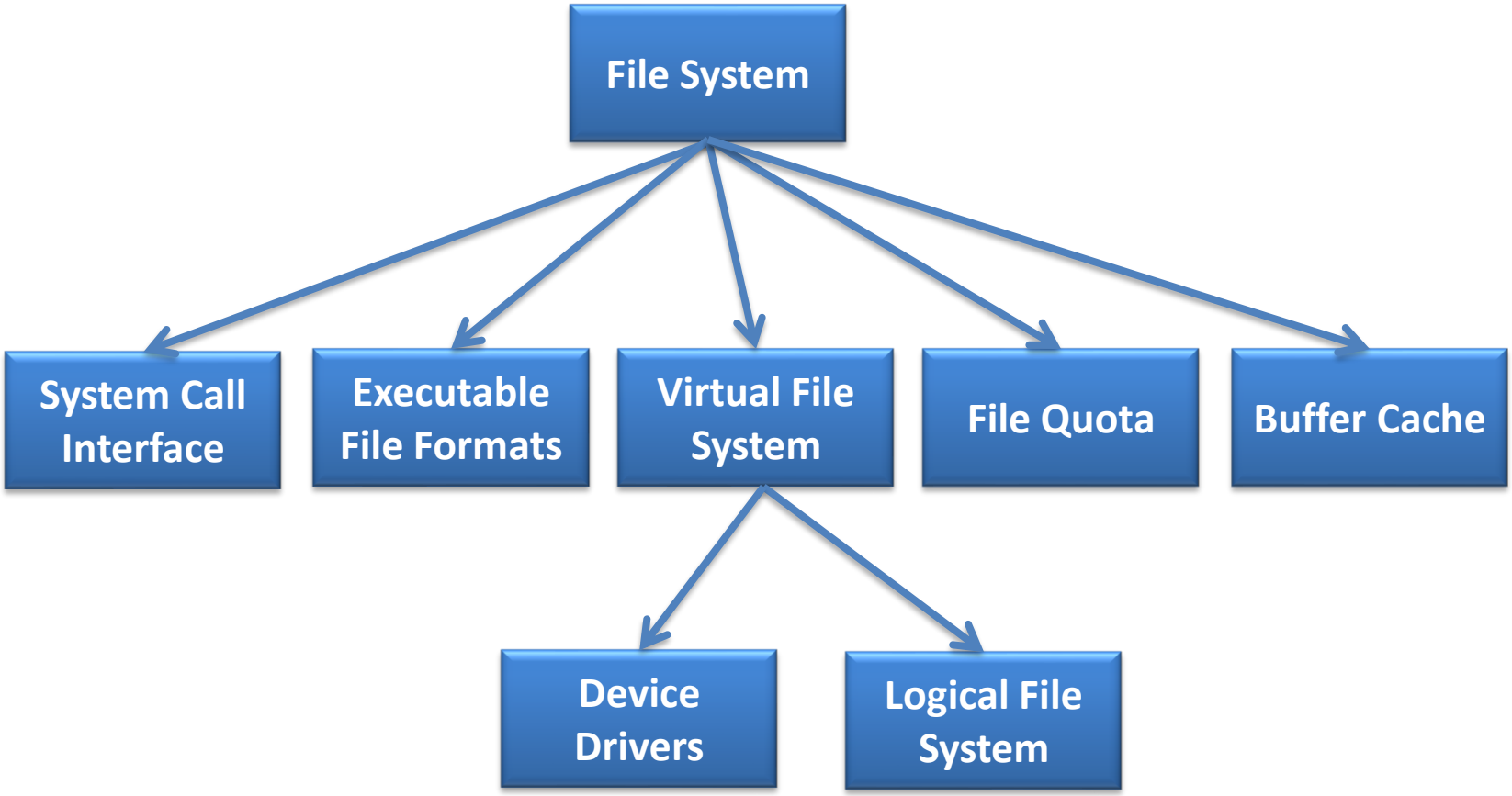
4+1 View Model of Architecture:

Architectural Blueprints – The “4+1” View Model of software Architecture *from IEEE Software (1995) by* ***Philippe Kruchten***

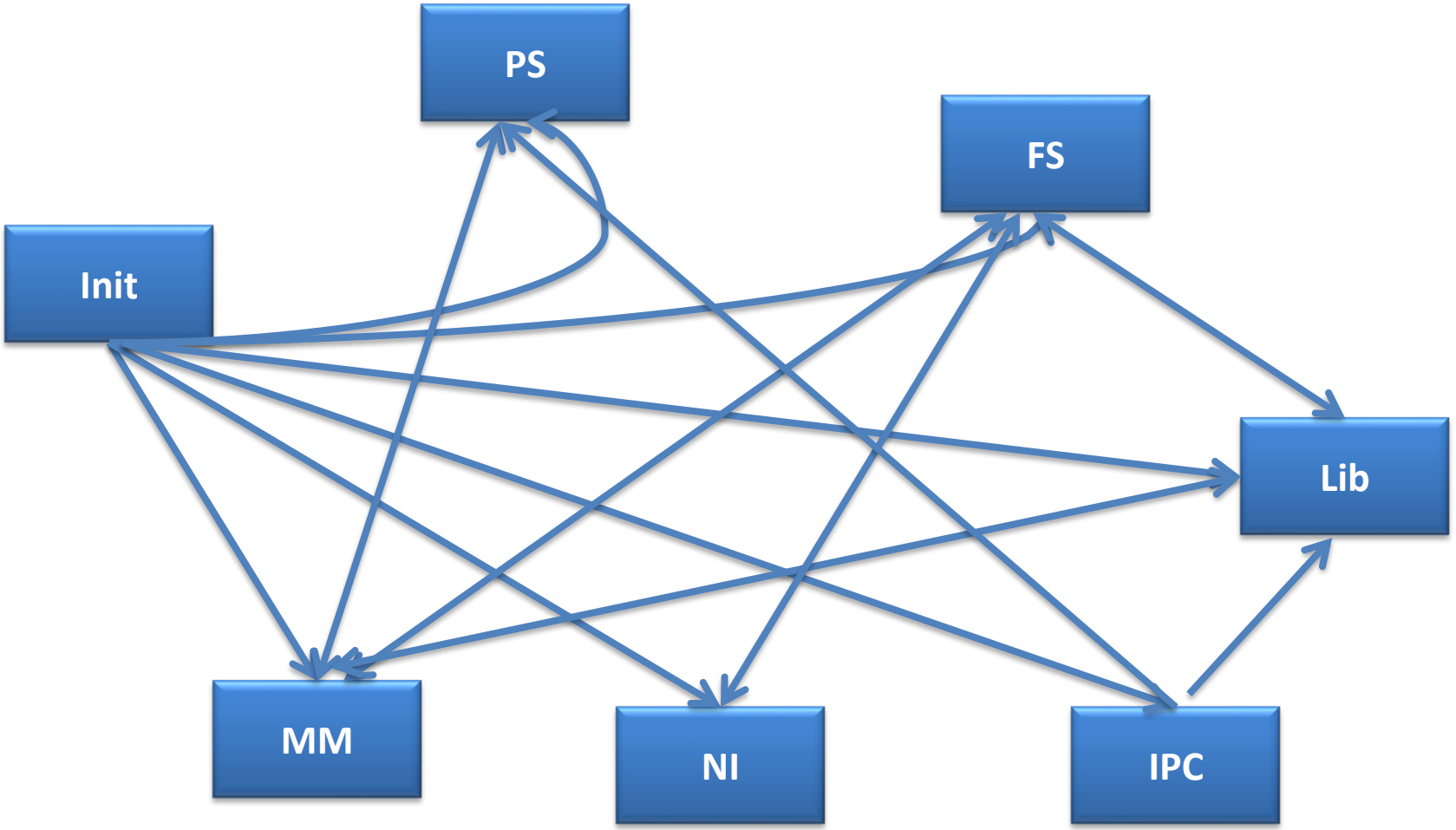
Linux:



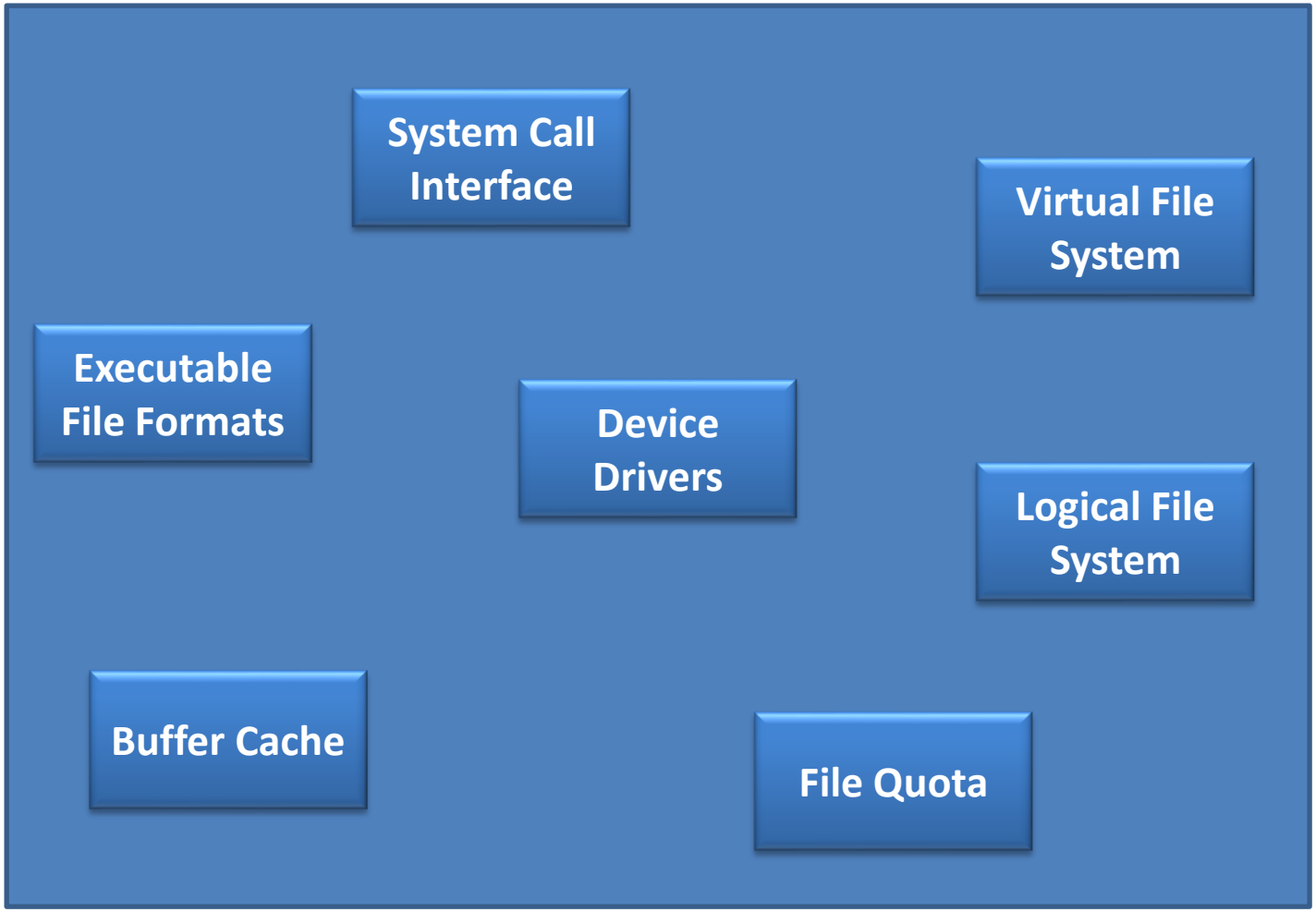
File System:


File System
System Call Interface
Executable File Formats
Virtual File System
File Quota
Buffer Cache
Device Drivers
Logical File System

Interaction of Sub-Systems:



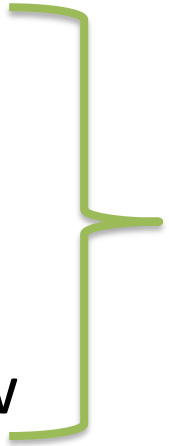
Breakdown of File System:



An Architectural Model:

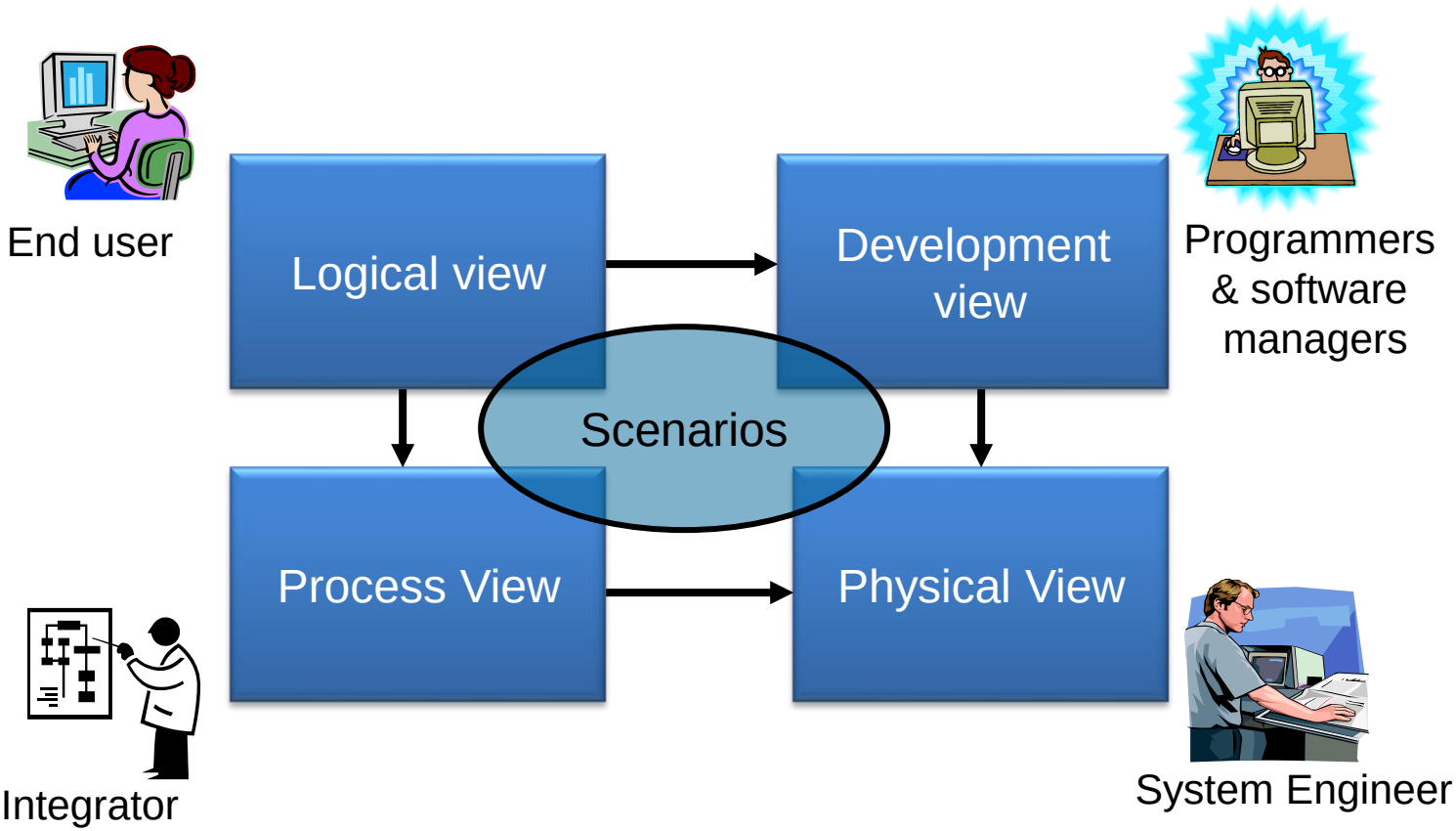
Kruchten Proposed a Model composed of 5 "Views" :

1. Logical View
2. Process View
3. Physical View
4. Development View



+ 5. Scenario or Use Case

4+1 View Model of Architecture:



4+1 View Model of S/W Architecture:

- Model based on multiple, concurrent views.
  - Logical View: is the object model of the design.
  - Process View: captures the concurrency and synchronization aspects of design.
  - Physical View: describes mappings of software onto hardware and reflects its distributed aspects.
  - Development View: describes static organization of the software in its development.
  - Scenarios: decisions made and description of architecture

4+1 View Model of S/W Architecture:

- Logical View: talks about the decomposition of the system into its constituent modules.
- Process View: captures the execution time components and how they interact.
- Physical View: describes relationship between software components and the hardware.
- Development View: deals with development time issues like files, people etc.
- Scenarios: decisions made, illustration or description of architecture

Logical View:

(Object-oriented Decomposition)

Viewer: End-user

considers: Functional requirements- What the system should provide in terms of services to its users.

Notation: The Booch notation (OMT) (object and dynamic models)

Tool: Rational Rose

Process View:

(The process decomposition)

viewer: Integrators

considers: Non - functional requirements (concurrency, performance, scalability)

style: Several styles would fit in this view (Garlan and Shaw ‘s Architecture styles)

Process view (cont.)

- Uses multiple levels of abstractions, a logical network of processes at the highest level
- A process is a grouping of tasks that form an executable unit:
  - Major Tasks: Arch. relevant tasks
  - Minor Tasks: Helper tasks. (Buffering)

Development View:

(Subsystem decomposition)

Basis of a line of product

Viewer: Programmers and Software Managers

considers: software module organization (Hierarchy of layers, software management, reuse, constraints of tools)

Style: layered style

Notation: the Booch notation (module, subsystem, layer)

Physical View:

(Mapping the software to the Hardware)

Viewer: System Engineers

Considers: Non-functional req. regarding to underlying hardware (Topology, Communication)

Notation: May have several forms and may Tightly connected to the process view

- There may be two architecture:
  - Test and development
  - deployment

Advantages of 4+1 view Architecture:

- Multiple views addresses concerns of various stakeholders.
- Multiple architectural styles in one system.
- A generic model.

References:

- http://www.sei.cmu.edu/architecture/start/glossary/community.cfm
- What is a Software Architecture?, Peter Eeles, Senior IT Architect, IBM, Software Group
- Hans van Vliet, Software Engineering: Principles and Practice, 3rd edition, John Wiley & Sons, 2008.
- Architectural Blueprints – The “4+1” View Model of software Architecture *from IEEE Software (1995) by Philippe Kruchten.*