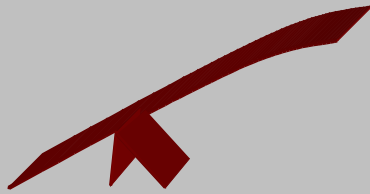
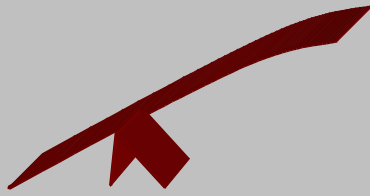


Interfaces



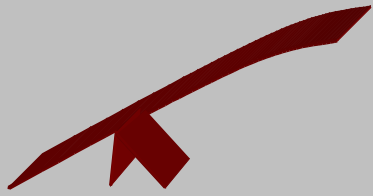
The Importance of Interfaces

- ◆ Interface development is a Systems Engineering activity because of the basic need to break down large problems into many related smaller ones
 - ◆ The smaller problems have interfaces between them that must be compatible across all terminals
- ◆ Interface – a point at which independent systems or components meet and act or communicate with each other
- ◆ Interfaces can exist between system elements
- ◆ Interfaces can also exist between a system element and the system environment



The Importance of Interfaces - 2

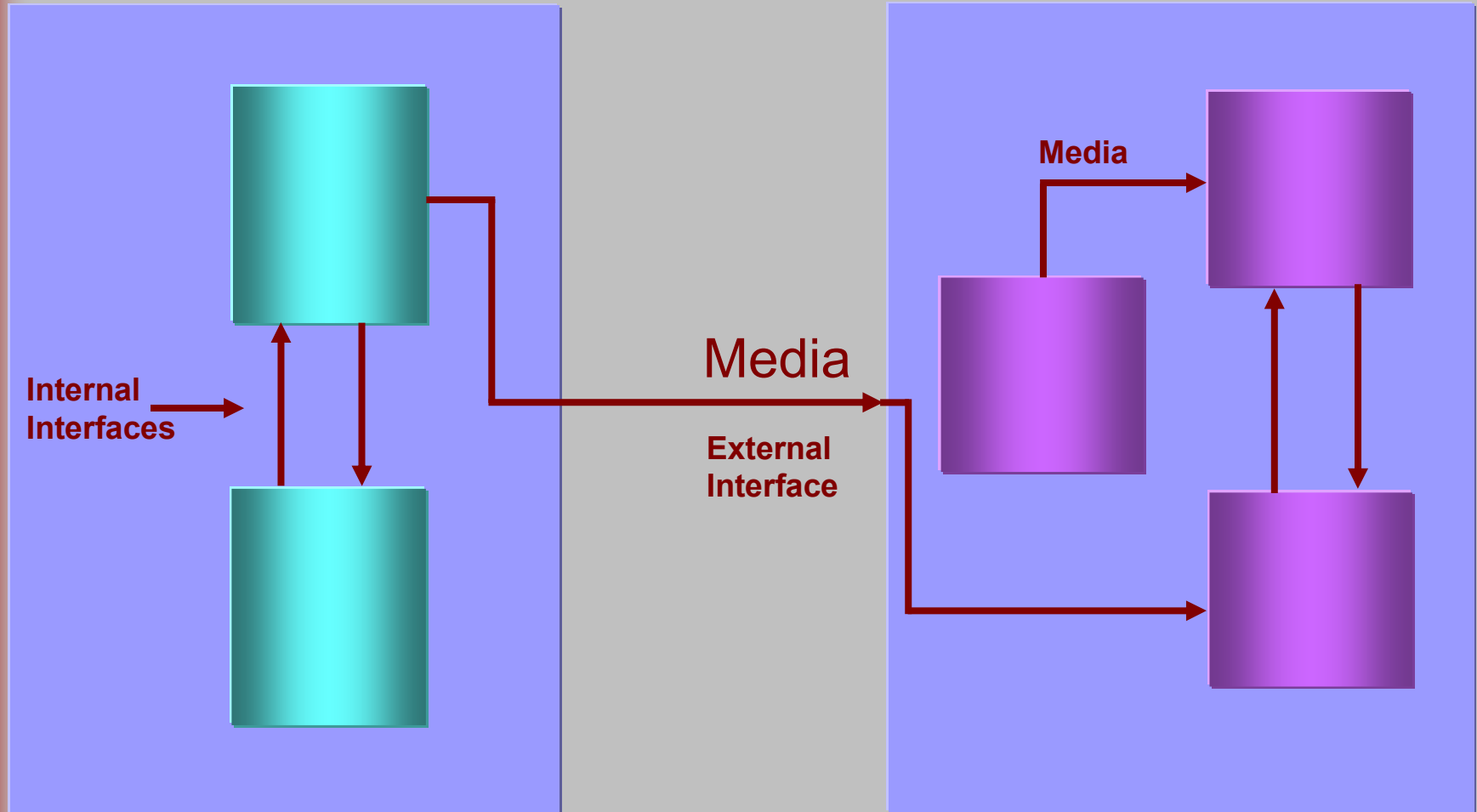
- ◆ Interfaces can enhance system capability but a trade-off must be made between internal and external complexity
 - ◆ In Software Engineering, this is recognized in the attempt to balance the concepts of cohesion and coupling
- ◆ Interfaces between hardware and software must be carefully examined due to the impact those interfaces have on the design of complex, software intensive systems



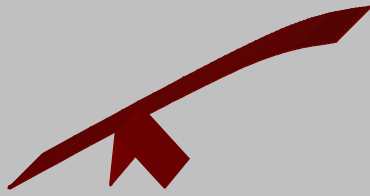
The Importance of Interfaces - 3

Terminal 1

Terminal 2

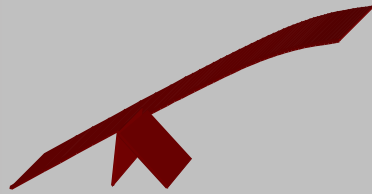


Types of Implementation Interfaces



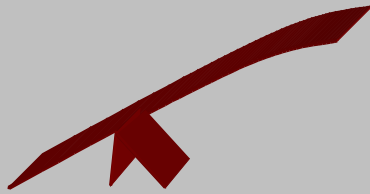
The Importance of Interfaces - 4

- ◆ The characteristics of an interface will depend on the “type” of interface being considered
 - ◇ The previous Figure represents the conventional view of an implementation interface between two terminals or subsystems
 - ◇ Interfaces should be permitted between multiple terminals
 - ◇ Interfaces should be permitted to simply pass through a terminal
 - ◇ External interfaces to the environment in terms of other products in the physical system would require the environment to be a terminal – the media would be thought of as a conduit through which information, energy, mass, etc. could pass through



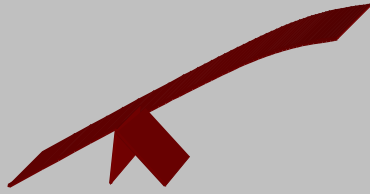
The Importance of Interfaces - 5

- ◆ Interfaces should possess the capability to describe a logical connection between terminals that have no physical reality
- ◆ Interfaces must be properly described to a level of detail needed for detailed design
- ◆ An Interface Requirements Specification can represent the requirements or constraints of system interfaces, both internal and external, and can include both functional and external interfaces



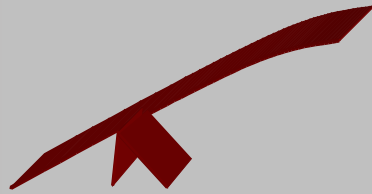
Basic Type of Interfaces

- ◆ There are two basic types of interfaces that must be considered
 - ◇ Organizational interfaces where Configuration Management controls the transfer of configuration items:
 - ◆ individual
 - ◆ project
 - ◆ customer
 - ◆ life-cycle phase



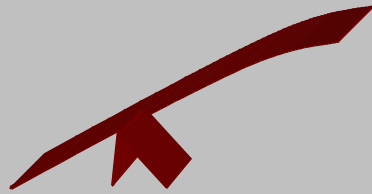
Basic Type of Interfaces - 2

- ◆ Technical interfaces where Configuration Management holds descriptions like any other configuration item such as:
 - ◆ system
 - ◆ user
 - ◆ software
 - ◆ hardware
 - ◆ communication



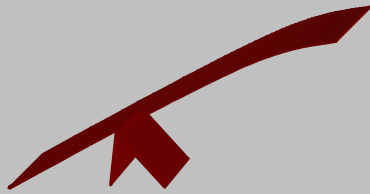
Common Interfaces

- ◆ **Internal Interface** – An internal interface resides inside the element of focus, including its terminals, connectors and media
- ◆ **External interface** – An external interface to an element will have at least one internal terminal and one external terminal
 - ◆ The media connecting the terminals will go across the plane that separates the internal from the external terminal through a connector
 - ◆ An external terminal can be an environment



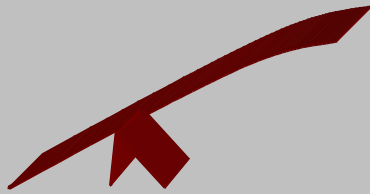
Common Interfaces - 2

- ◆ **Functional Interface** – Functional interfaces describe the role of an internal or external interface in terms of translating control, information, or energy across an interface
- ◆ **Physical Interface** – A physical interface is a real and tangible interface between physical terminals or between a physical terminal and the environment
 - ◆ Normally defined during the logical design phase



Common Interfaces - 3

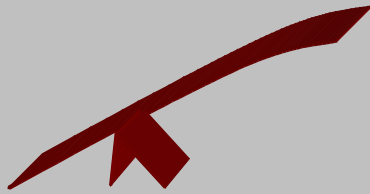
- ◆ **Logical Interface** – A logical interface represents a logical connection between terminals
 - ◇ The logical interface is not real but does put demands on the system such as resource utilization
 - ◇ A logical interface can also be viewed as an abstraction between two elements that are logically connected
- ◆ **Environmental Interface** – An interface between a system or component and the natural or induced environment
 - ◇ The environment may serve as a terminal and as the media



Common Interfaces - 4

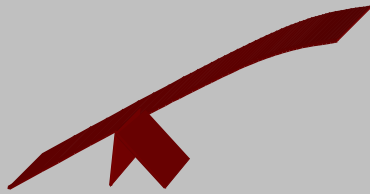
- ◆ **Dynamic Interface** – Any interface whose terminal, connector, or media characteristics change over time
 - ◇ Can be state dependent
 - ◇ Can be time critical

- ◆ **Hardware to Hardware Interfaces** – Are functional or structural and can exist to perform a service, transfer information, translate force, or provide structure and support
 - ◇ Hardware interfaces are physical in that they are real objects that touch the environment and media
 - ◇ The issues relating to hardware interfaces deal with the form and fit of the hardware components and the functions they perform
 - ◇ Understanding these types of interfaces requires knowledge relating to implementation engineering design principles



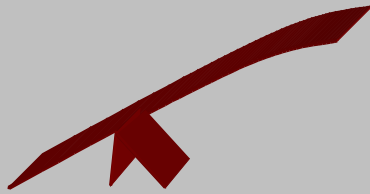
Common Interfaces - 5

- ◆ **Software Interfaces** – Software interfaces can be functional, informational, or environmental
 - ◇ Functional – Deals with the passing of control elements
 - ◇ Informational – Deals with data
 - ◇ Environmental – Normally relates to human or hardware interfaces
- ◆ **Control interfaces** are characterized by software logic for decision making, process activation, storage transition, and timing involving the storage, manipulation and movement of other data types



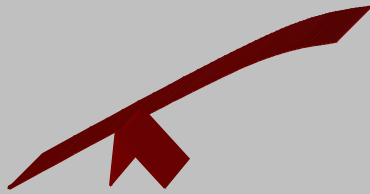
Common Interfaces - 6

- ◆ The most common software interface is the “user interface”
 - ◇ Most difficult to handle – must provide value and have properties that permit users to obtain the functionality without significant difficulty
 - ◇ Consider to be “external”
 - ◇ Systems that have no user interfaces are normally embedded, real-time systems



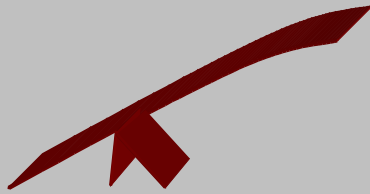
Common Interfaces - 7

- ◆ The complexity of the interactions between software modules external to each module is called “Coupling”
 - ◇ Low coupling – data is transferred between two modules
 - ◇ High coupling – common data between modules is shared
 - ◇ The goal for software integration is to keep the software coupling as low as possible
- ◆ Cohesion – a measure of the functional association among the elements of a software component
 - ◇ Cohesion is considered the glue that holds the software components together
 - ◇ Higher levels of cohesion are desirable



Common Interfaces - 8

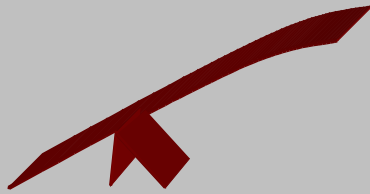
- ◆ **Hardware to Software Interfaces** – Software interfaces occur through hardware media
 - ◇ Hardware receives and sends information to/from software through some type of transducer that changes an electrical or electromechanical signal into bits and vice-versa
 - ◇ Bits are transferred through hardware media and stored in hardware such as magnetic memory or a cache until it is made available to the software
 - ◇ Hardware serves as **the media** in all software interfaces
 - ◇ Hardware such as processing, data transmission, and storage, buffering, display, and input are often transparent to the software developer



Common Interfaces - 9

◆ Communication Interfaces

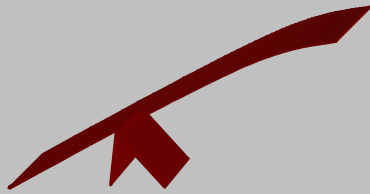
- ◆ Communication interfaces include the interfaces between the software modules and communication hardware and software such as local area network protocols
- ◆ Communication interfaces are especially important to take advantage of the emerging multi-media communications industry



EIA - 632

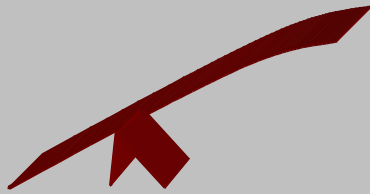
Processes for Engineering a System

(Demand for Care of Interfaces)



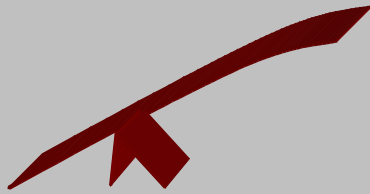
Interfaces – 632

- ◆ **Interface Management** – System internal and external interfaces are maintained and controlled including the completion of interface definition, assessments of compatibility, changes, and coordinations and approval in accordance with the Interface Management Plan



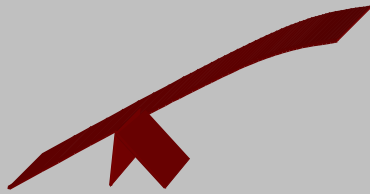
Interfaces – 632 - 2

- ◆ **Interface descriptions must be managed** to ensure that:
 - ◆ All internal and external, functional and physical interfaces for a building block are identified, defined, assigned, documented and managed - including human interfaces
 - ◆ Building block design definitions are compatible in terms of form, fit, and function
 - ◆ Interfaces changes affecting the building block and affected by the building block are controlled to prevent adverse consequences
 - ◆ Interfaces should be managed and controlled in an information database



Interfaces – 632 - 3

- ◆ Logical solution representations – One or more sets of logical solution representations that are appropriate to the engineering life-cycle phase and the system being engineered or re-engineered have been formed and defined and include:
 - ◆ Interfaces related to logical arrangements and sequencing or derivative representations to include:
 - ◆ start and end of states
 - ◆ inputs and outputs defined
 - ◆ Interface attributes identified and defined that trigger a behavioral response, change of state or mode, or data flow



Summary

- ◆ Interface – a point at which independent systems or components meet and act or communicate with each other
- ◆ Interface requirements include both logical and physical interfaces – they include as necessary physical measurements, definitions of sequences of energy or information transfer and all other significant interactions between items
- ◆ Internal Interface – an internal interface resides inside the element of focus, including its terminals, connectors and media
- ◆ External interface – an external interface to an element will have at least one internal terminal and one external terminal