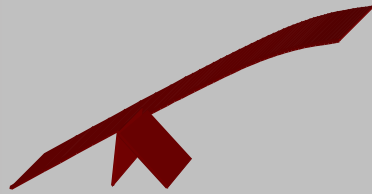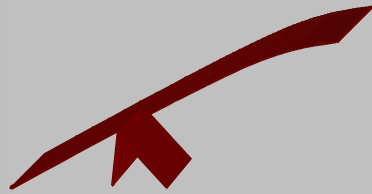# Interfaces

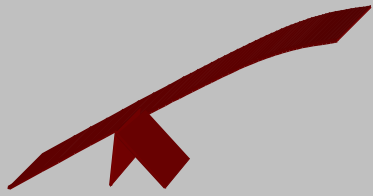# The Importance of Interfaces

◆ 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
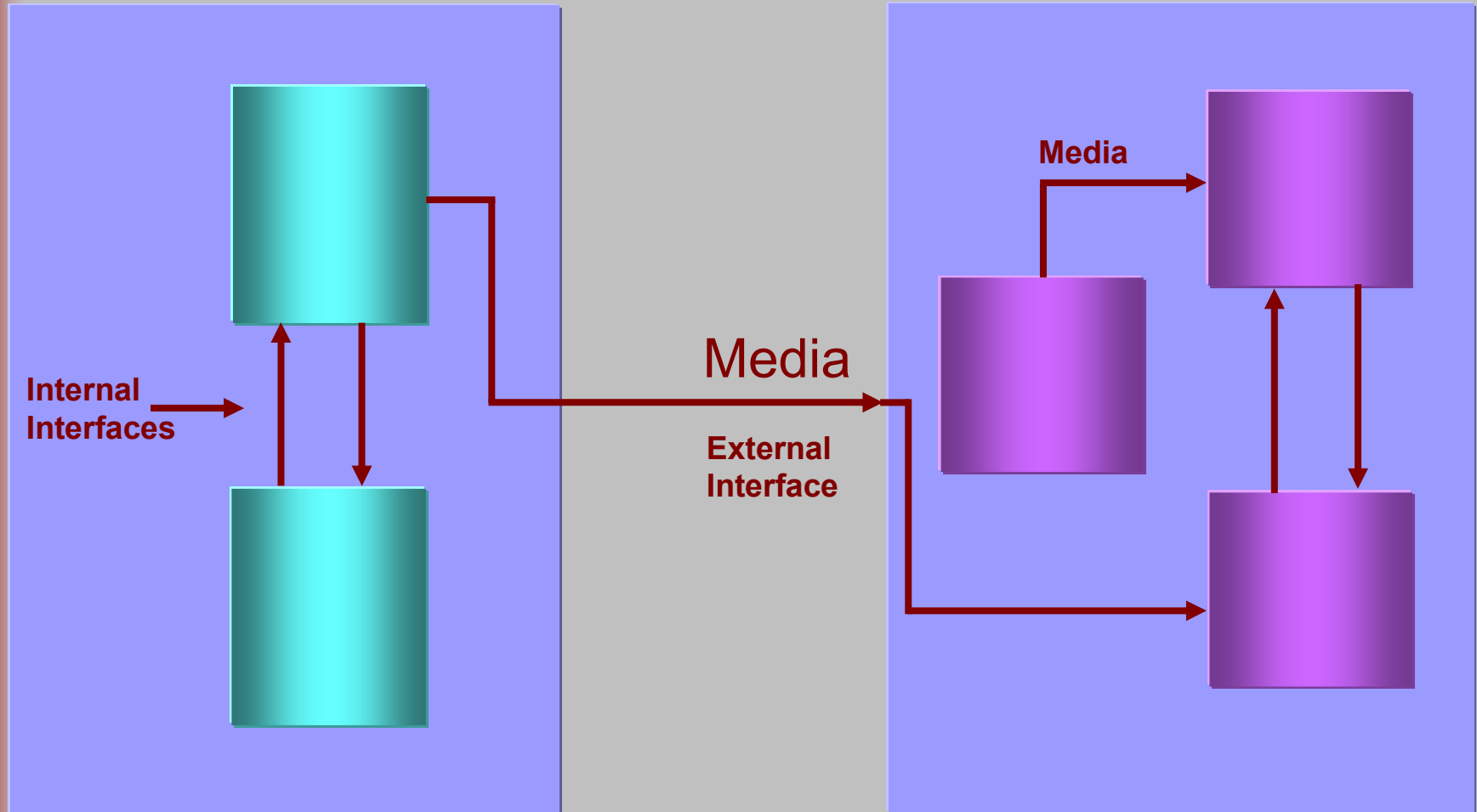
The Importance of Interfaces - 2

◆ 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

Media

Internal
Interfaces

Media

External
Interface

Types of Implementation Interfaces

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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
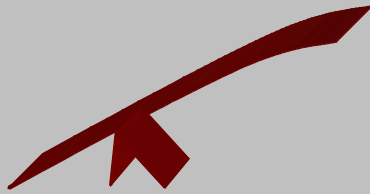
The Importance of Interfaces - 5

◈ 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
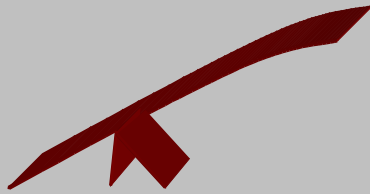
Basic Type of Interfaces

◆ There are two basic types of interfaces that must be considered

◈ Organizational interfaces where Configuration Management controls the transfer of configuration items:

- ◆ individual

- ◆ project
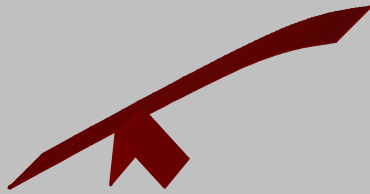
- ◆ customer

- ◆ life-cycle phase

◈ Technical interfaces where Configuration Management holds descriptions like any other configuration item such as:
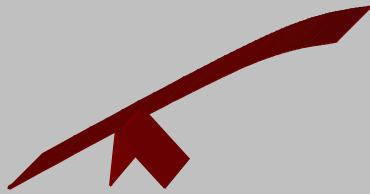
- system

- 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
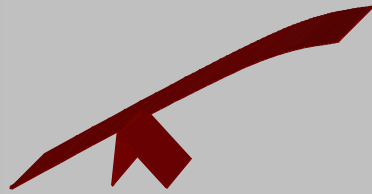
Common Interfaces - 4

◆ 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
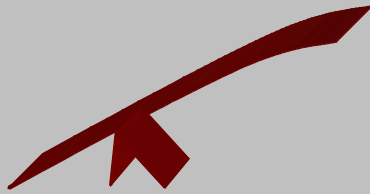
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Common Interfaces - 6

◆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"

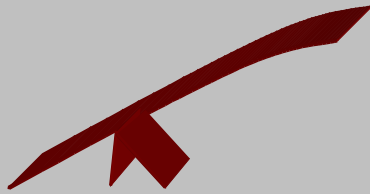◈ Systems that have no user interfaces are normally embedded, real-time systems

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

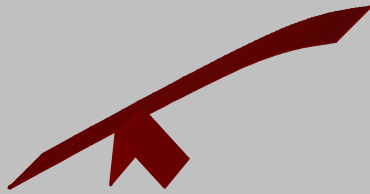 ◈ Higher levels of cohesion are desirable

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
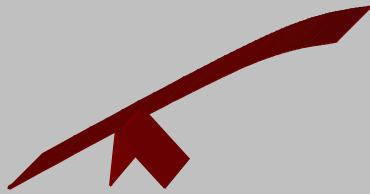
Common Interfaces - 9

◆ 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

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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

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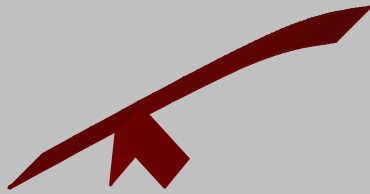
◆ Interface descriptions must be managed to ensure that:

◈ 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

◆ 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

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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