INTERNATIONAL STANDARD

ISO/IEC 14478-4

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Information technology — Computer graphics and image processing — Presentation Environment for Multimedia Objects (PREMO) —

Part 4:
Modelling, rendering and interaction component

Technologies de l'information — Infographie et traitement d'images — Environnement de présentation d'objets multimédia (PREMO) —

Partie 4: Composant pour la modélisation, le rendu et l'interaction

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Contents

Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, government and non–governmental, in liaison with ISO and IEC, also take part in the work.

In the field of information technology, ISO and IEC have established a joint technical committee: ISO/IEC JTC1. Draft International Standards adopted by the joint technical committees are circulated to the national bodies for voting. Publication as an International Standard requires approval by at least 75% of the national bodies casting a vote.

ISO/IEC 14478–4 was prepared by Joint Technical Committee ISO/IEC JTC1, *Information technology*, Subcommittee SC24, *Computer graphics and image processing*.

ISO/IEC 14478 consists of the following parts under the general title *Information technology — Computer graphics and image processing — Presentation Environment for Multimedia Objects (PREMO):*

- *Part 1: Fundamentals of PREMO*
- *Part 2: Foundation component*
- *Part 3: Multimedia systems services*
- *Part 4: Modelling, rendering, and interaction component*

Annex A forms an integral part of this part of ISO/IEC 14478. Annexes B to D are for information only.

Introduction

The Modelling, Rendering and Interaction component of PREMO describes facilities for the modelling and presentation of, and interaction with, multidimensional data that utilises multiple media in an integrated way. That is, the data may be composed of entities that can be rendered using graphics, sound, video or other media, and which may be interrelated through both spatial coordinates and time.

The objective of this component is to provide developers and users of modelling and rendering applications with a framework for supporting the definition and use of interoperable devices within a distributed setting. It achieves this by:

a) providing an extensible framework of primitives for use in modelling, rendering and interaction which encompass multiple media, and which can be organized into larger structures and embedded into scenes.

b) extending the resource and device hierarchies of the PREMO Part 3 (Multimedia Systems Services) Component to allow modelling, rendering and interaction to be uniformally integrated into a network of objects for managing the production and utilization of multimedia data.

c) utilizing the property and capability management services of PREMO Part 3 to characterize the behaviour of modelling, rendering and interaction devices, allowing an application to be configured from such devices such that constraints on performance and functionality are satisfied.

d) building on the object model and foundation objects of PREMO Part 1 and Part 2 to allow subsequent components to realize and extend specific modelling, rendering and interaction functionality.

This component follows PREMO Part3 in describing the external interface of object types and other entities involved in modelling, presentation and interaction, but not the internal structures needed to implement these. That is, it is not the purpose of this component to provide a set of building blocks that can be assembled into a modeller or a renderer. Rather, the component provides facilities to enable devices, built with various applications or performance trade-offs in mind, to interoperate in a heterogenous presentation environment.

Information technology — Computer graphics and image processing — Presentation Environment for Multimedia Objects (PREMO) — Part 4: Modelling, Rendering, and Interaction Component

1 Scope

This part of ISO/IEC 14478 describes a set of object types and non-object types to provide the construction of, presentation of, and the interaction with Multimedia information. The multimedia information can be graphics, video, audio, or other types of presentable media. This information can be enhanced by time aspects. Throughout this document this part of ISO/IEC 14478 will also be referred to as "Modelling, Rendering and Interaction", and abbreviated as MRI.

The Modelling, Rendering and Interaction Component constitutes a framework of 'Middleware', system software components lying between the generic operating system and computing environment, and a specific application operating as a client of the services and type definitions provided by this component. It provides a framework over the foundation objects and multimedia systems services defined in other Parts of the international standard for the development of a distributed and heterogeneous network of devices for creating multimedia models, rendering these models, and interacting with this process.

The Modelling, Rendering and Interaction Component encompasses the following characteristics:

a) provision of a hierarchy of multimedia primitives as an abstract framework for describing the capabilities of modelling and rendering devices, and for enabling their interoperation;

b) within the primitive hierarchy, specific provision for describing the temporal structure of multimedia data through the stepwise construction of structured primitives from component data;

c) provision of abstract types for modellers, renderers and other supporting devices, enabling the integration of such devices or any future subtypes representing real software or hardware, into a processing network of such devices;

d) provision of an object type to map synchronization requirements expressed within multimedia primitives into control of the stream and synchronization mechanisms provided by ISO/IEC 14478-2 and ISO/IEC 14478-3.

The Modelling, Rendering and Interaction Component relies on the object types and services defined in PREMO Part 2: Foundation Components (ISO/IEC 14478-2), and PREMO Part 3: Multimedia Systems Services (ISO/IEC 14478-3).

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO/IEC 14478. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO/IEC 14478 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO/IEC 11072:1992, *Information technology — Computer graphics — Computer Graphics Reference Model (CGRM).*

ISO/IEC 7942–1:1994, *Information technology — Computer graphics and image processing — Graphical Kernal System (GKS) — Part 1: Functional description.*

ISO/IEC 9592:1997, *Information technology — Computer graphics and image processing — Programmer's Hierarchical Interactive Graphics System (PHIGS).*

ISO/IEC 14478–1:1998, *Information technology — Computer graphics and image processing — Presentation Environment for Multimedia Objects (PREMO) — Part 1: Fundamentals of PREMO*

ISO/IEC 14478–2:1998, *Information technology — Computer graphics and image processing — Presentation Environment for Multimedia Objects (PREMO) — Part 2: Foundation component*

ISO/IEC 14478–3:1998, *Information technology — Computer graphics and image processing — Presentation Environment for Multimedia Objects (PREMO) — Part 3: Multimedia systems services*

3 Definitions

3.1 PREMO Part 1 definitions

This part of ISO/IEC 14478 makes use of all terms defined in ISO/IEC 14478-1 (Fundamentals of PREMO).

3.2 PREMO Part 2 definitions

This part of ISO/IEC 14478 makes use of all terms defined in ISO/IEC 14478-2 (Foundation component).

3.3 PREMO Part 3 definitions

This part of ISO/IEC 14478 makes use of all terms defined in ISO/IEC 14478-3 (Multimedia systems services component).

3.4 Additional Definitions

For the purposes of this part of ISO/IEC 14478, the following definitions apply.

3.2.1 modeller: a virtual device that produces primitives on at least one output port.

3.2.2 renderer: a device that accepts primitives on at least one of its input ports.

3.2.3 media engine: a virtual device that accepts primitives from at least one of its input ports, and produces primitives on at least one of its output ports.

3.2.4 presentation: a collection of primitives that can be perceived by the operator.

3.2.5 coordinate: a primitive used to define a location in an nD space.

3.2.6 primitive: a structure describing information to be rendered, or information received through interaction.

3.2.6.1 form primitive: a primitive whose presentation has to be constructed by a renderer from an explicit description in terms of aspects or properties that characterize a class of perceivable representations.

3.2.6.1.1 geometric primitive: a form primitive used to define a shape or extent within nD space.

3.2.6.2 captured primitive: a primitive for which some or all of the perceivable aspects of the primitive have been encoded in some format defined externally to the PREMO standard.

3.2.6.3 structured primitive: a primitive that contains a collection of other primitives.

3.2.6.4 modifier primitive: a primitive that describes a change to the presentation of another primitive.

3.2.6.4.1 acoustic modifier: a modifier that changes properties of the sound generated by other primitives.

3.2.6.4.2 structural modifier: a modifier that affects the spatial and/or temporal aspects of another primitive.

3.2.6.4.3 visual modifier: a modifier that affects the (non structural) visual appearance of a primitive.

3.2.6.5 wrapper primitive: a primitive that carries a value drawn from some PREMO non-object data type.

3.2.6.6 tracer primitive: a primitive that carries an event for use in monitoring and coordinating the transfer of media data across a network.

3.2.7 input device: a device used to obtain data from the operator.

3.2.8 graphics: the construction, manipulation, analysis and presentation of pictorial representations.

3.2.9 scene: a device for storing and controlling access to a collection of primitive structures.

3.2.10 primitive structure: a collection of primitives organized into a structure that represents some or all of the data that describes a multimedia presentation.

3.2.11 coordinator: a MRI device that can manipulate the streams connecting its components.

3.2.12 router: a device for controlling the flow of data between streams connected to its ports.

3.2.13 temporal extent: the duration in time allocated or used for the presentation of some primitive.

3.2.14 operator: the external object that sends or receives information through a virtual device interface.

3.2.15 application: the external object or client that uses a PREMO system by creating objects, invoking operations on objects, and using types defined by PREMO. Applications are not modelled in the PREMO system, but their interactions with a PREMO system are modelled.

The following alphabetical list gives the sub-clause of each definition.

acoustic modifier	3.2.6.4.1
application	3.2.15
captured primitive	3.2.6.2
coordinate	3.2.5
coordinator	3.2.11
form primitive	3.2.6.1
geometric primitive	3.2.6.1.1
graphics	3.2.8
input device	3.2.7
media engine	3.2.3
modeller	3.2.1
modifier primitive	3.2.6.4
operator	3.2.14
presentation	3.2.4
primitive	3.2.6
primitive structure	3.2.10
renderer	3.2.2
router	3.2.12
scene	3.2.9
structural modifier	3.2.6.4.2
structured primitive	3.2.6.3
temporal extent	3.2.13
tracer primitive	3.2.6.6
visual modifier	3.2.6.4.3
wrapper primitive	3.2.6.5

4 Symbols and abbreviations

CGRM:	Computer Graphics Reference Model.
CSG:	Constructive Solid Geometry
GKS:	Graphical Kernel System.
IEC:	International Electrotechnical Commission.
ISO:	International Organization for Standardization.
MPEG:	Moving Picture Experts Group.
MRI:	Modelling, Rendering and Interaction
MSS:	Multimedia Systems Services
PHIGS:	Programmers Hierarchical Interactive Graphics System.
PREMO:	Presentation Environment for Multimedia Objects.
VRML:	Virtual Reality Modeling Language.
nD:	Multi-dimensional.
2D:	Two-dimensional.
3D:	Three-dimensional.

5 Conformance

A conforming implementation of the PREMO Modelling, Rendering and Interaction Component shall comply with the general conformance rules defined in clause 5 of ISO/IEC 14478-1 and the component specification in clause 16.

6 Overview of the Modelling, Rendering and Interaction Component.

6.1 Introduction

This clause presents an overview of the modelling, rendering, and interaction component (Part 4) of PREMO. It summarises the concepts defined in the document, and explains how these concepts contribute to the goals set out in the Introduction. More detailed descriptions of the concepts used in the overview are given in subsequent clauses. This part of ISO/IEC 14478 also makes extensive use of facilities provided by PREMO parts 1-3, in particular the device and stream concepts introduced in ISO/IEC 14478-3. A summary of these dependencies is included in this clause.

6.2 Overview

The model underlying this part of ISO/IEC 14478 is that a multimedia system consists of modellers, renderers, and other devices (some media specific) linked together via streams that carry data of a particular format. These concepts of stream and device are those defined in ISO/IEC 14478-3. A device consists of a processing facility, together with a number of ports through which it can accept input and produce output, using a format defined by the port. Figure 1 shows a high-level view of a (simplified) example system in which a graphical user interface is used to control parameters of an audio-visual presentation system. Rectangles on the sides of devices represent ports, and the thick lines between such ports represent media flow via streams. Thin lines represent other forms of interaction, for example operation invocation. See also Annex B for a table defining the symbols used in the figure. The system in Figure 1 consists of:

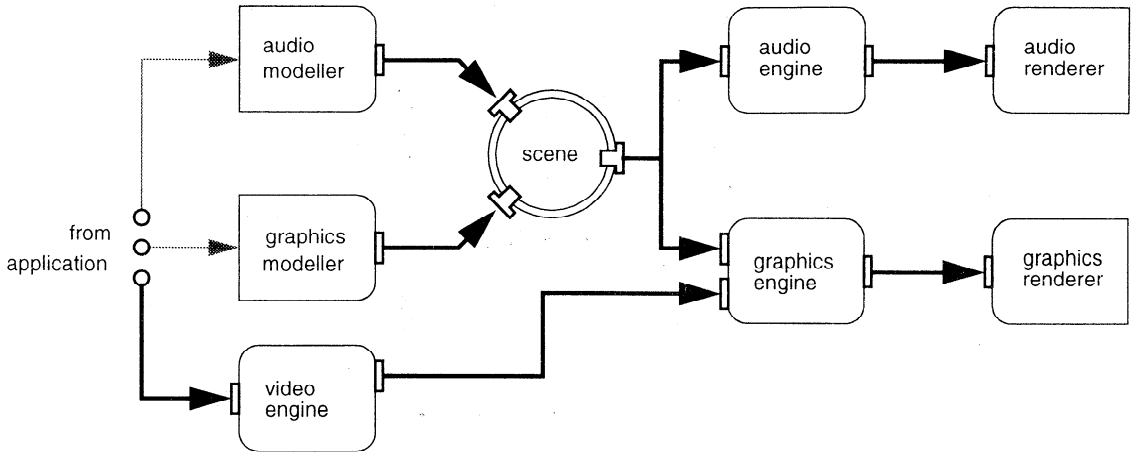

Figure 1 — An audio/visual system

— two modellers, one for audio data and one for graphical data, that might be used to construct and edit primitives via an interface to the application specific to the needs of each modeller;

— a video engine, accepting a stream of video data from the application and constructing a stream of information in some video format;

— a scene, which encapsulates primitives produced by the two modellers and which mediates access to the collection of primitives by both the modellers and the associated renderers;

— an audio engine, that takes primitives from the scene and converts into a data format that can be used to drive an audio-specific device;

— a graphics engine (acting as a mixer or composition tool) uses the video output from the video renderer and primitives from the scene to construct a further stream of primitives, integrating the two sets of source data within some appropriate visual representation. The primitives produced by the engine may be some subset suitable for input to a specific renderer;

— two renderers, one for audio and one for graphics, that convert a stream of primitives into a form that can be processed in the context beyond the MRI network (in this case, presented to the end user of the application).

The figure shows just one way in which such a system might be implemented. A different implementation may collapse the three engines into a single device, if it has access to a media engine that can take both graphical and audio primitives as input and that can generate the corresponding output streams. Another implementation may decompose the graphics engine into, for example, a number of components that manage specific functionalities such as viewing or clipping. Finally, a high-performance implementation might collapse all components into a single device.

Key components of this part are derived from the object types defined in ISO/IEC 14478-3, in particular the property inquiry and constraint facilities. These types and facilities may be used by the factory mechanism described in ISO/IEC 14478-2 to produce objects that meet certain requirements, and by the negotiation and QoS mechanisms for establishing and maintaining a network of objects that satisfies specific properties. As a result, many of the object types defined in this part have an associated list of properties for use in creation and negotiation. For example, modellers and renderers are derived (indirectly) from the *VirtualDevice* type of ISO/IEC 14478-3, and thus inherit the Property Inquiry services. Each renderer and modeller has a collection of properties that characterise its capabilities in terms of its inputs, outputs and quality of service. An application using the facilities of this part can request creation of a renderer from a renderer factory by invoking the '*create_object*' operation using the type 'renderer' as the name of the object type and passing a structure containing the required capabilities. Alternatively, an application that is aware that the rendering interface it requires is defined by a specific subtype of the renderer can request the factory to produce a renderer of that specific type.

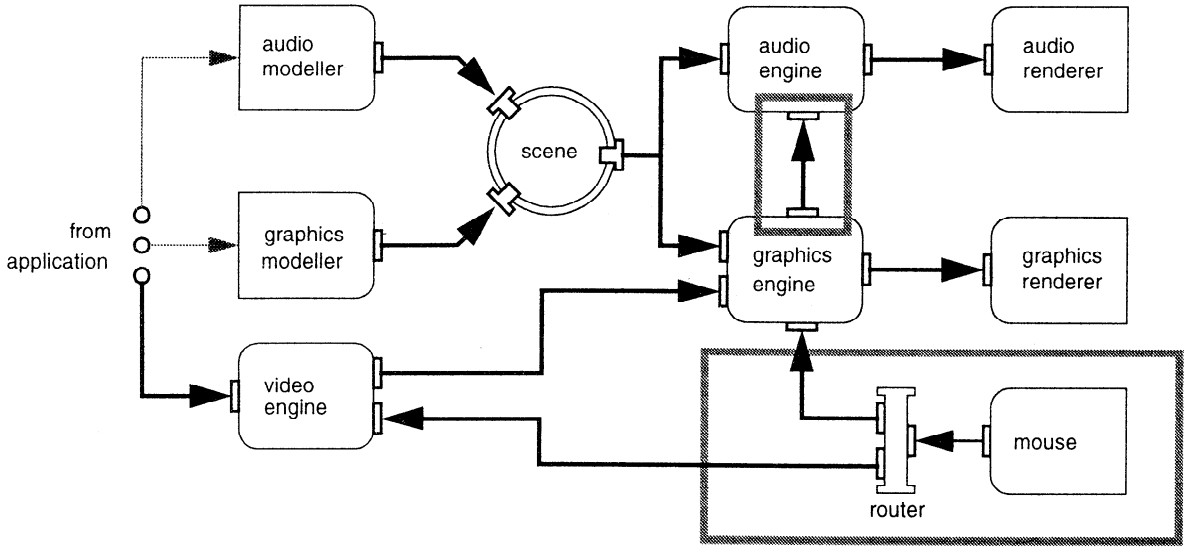

Figure 2 — MRI network including interaction handling

For simplicity, Figure 1 illustrates devices used in presentation only. The same approach of using specialised virtual devices connected by data streams is employed for handling input and interaction. Figure 2 extends the example with a simple framework for input handling. This introduces two new devices, and a new information flow between two renderers, shown in the outlined regions of the figure.

— The mouse is an example of an *InputDevice* that can provide primitives for processing elsewhere in the network, either via a stream (as shown) or through a procedural interface or callback mechanism.

— A *Router* can be incorporated to allow a data stream to be sent to specific devices depending on some internal state. The *Router* device achieves this by also subtyping from the *Controller* object defined in ISO/IEC 14478-2.

— Although *Engine* objects primarily operate on streams of primitives intended for presentation, as the example shows, an engine may also have ports that are used to receive (and in the case of the graphics engine, to transmit) primitives used to carry data about input.

Figure 1 and Figure 2 focus on the main streams and virtual devices involved in a simple MRI network. In addition to these, ISO/IEC 14478-3 provides object types for establishing and controlling a collection of streams and devices. These types are called *VirtualConnection* and *Group*, respectively.

An instance of *VirtualConnection* is an object that represents an abstract view of media transport between devices, allows control over aspects of the connection, and is responsible for negotiating the connection in terms of formats and quality of service considerations etc. Several kinds of virtual connections are possible, depending on whether the devices have compatible ports, and on whether a particular connection is local or networked. General examples of these are given in Annex D of ISO/IEC 14478-3. If the ports of two devices are not compatible, or the devices are in different parts of a distributed environment, *connection adaptors* will be employed. These adapters are an implementation concept, not visible to the application, and are not defined as an object type in the profile of ISO/IEC 14478-3.

Independent from issues of distribution and the existence of virtual connections, the *Group* object type provides applications with the ability to manage a collection of objects that are instances of *VirtualResource* or its subtypes (e.g., devices and connections) as a single resource. As *Group* is subtyped from *VirtualResource,* this arrangement can be hierarchical. Groups provides facilities to acquire the resources needed to establish a number of connections, to monitor the end-to-end quality of service, and to provide an application with a single access point for monitoring and controlling the flow of data across the resources that make up the group.

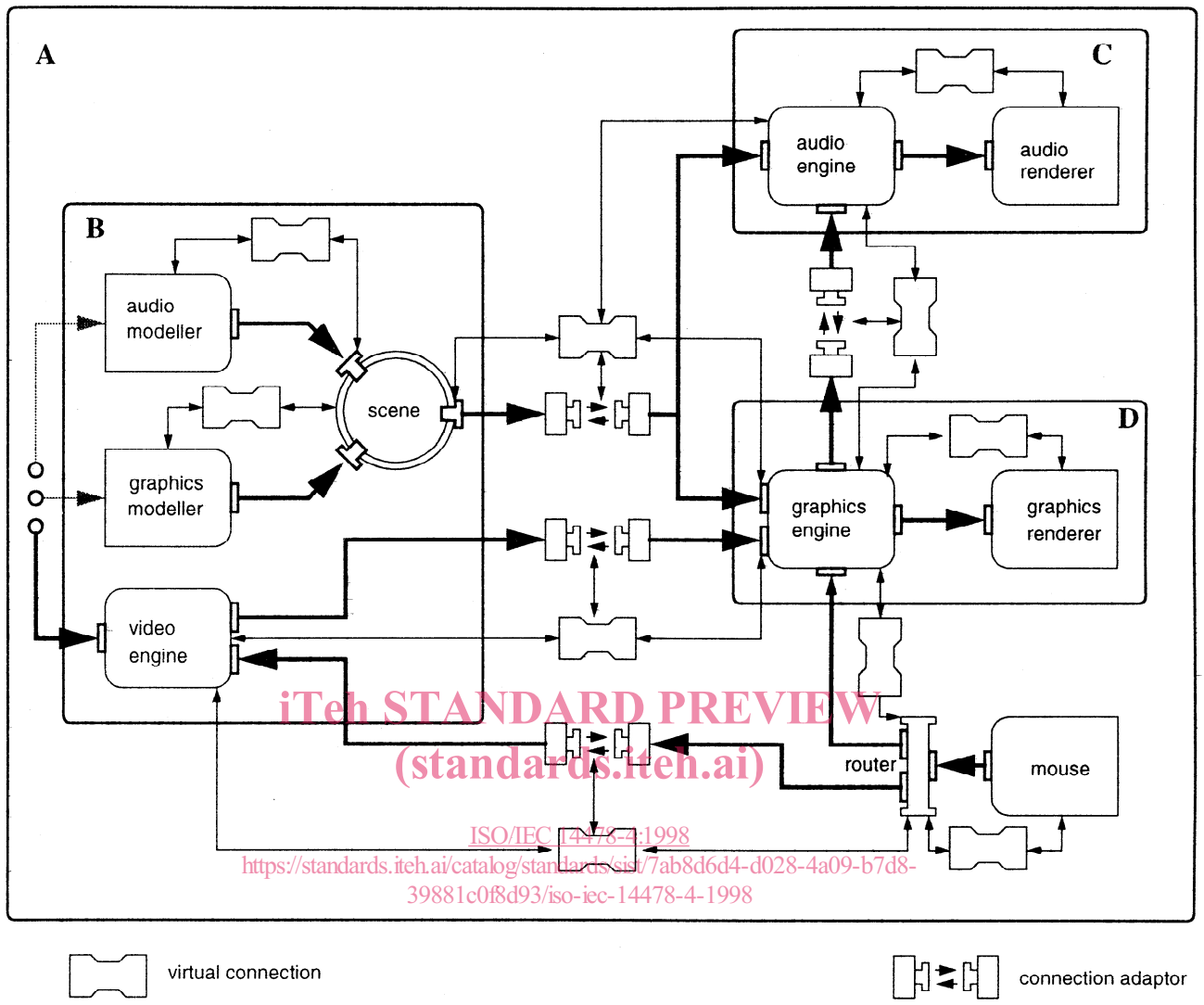

Figure 3 — Groups and connections in audio/visual system

Figure 3 shows one arrangement of groups could be used to implement the audio-visual rendering example. It also illustrates, for completeness, where connection adaptors may be required. In considering distribution, it has been assumed that the following sets of components are each located at separate nodes of a distributed system:

a) the modellers, the video engine, and the scene;

b) the audio engine and renderer;

c) the graphics engine, renderer, mouse, and router.

With respect to groups, there are a number of possible arrangements for the network. One such arrangement, consisting of four groups (labelled A-D) has been shown in the figure. In more detail,

— group A is the outer(most), and contains the other three groups, the mouse and router, and the connections and adaptors used to link devices in Groups B, C and D;

— group B contains the modellers, the video engine, and the scene, plus the virtual connections needed to link devices within the group;