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# The HOOPS 3D Application Framework

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## Introduction

Component software technology enables software developers to encapsulate their work and either re-use it later or make it available for use by other software developers. Many software developers with specialized expertise build software components and sell them to other developers who embed these components directly into their applications. Many of today’s leading applications are built with multiple externally developed components.

Software components must be integrated into the architecture of a developer’s application; a problem that compounds with the number of components being used. Multiple components must each be integrated into the architecture as well as integrated with each other. This low-level infrastructure work is tedious, difficult and time-consuming and must be completed prior to using the software components to build any application functionality.

Application Frameworks pre-integrate multiple components and provide the programmer with a complete programming system. By encapsulating all the tedious, error prone, low-level details of designing and building a base architecture, an application framework enables software developers to immediately start using its components to build application functionality.



Thus, an application framework is a superset of components and provides the same types of benefits to application developers as the individual components themselves.

The HOOPS 3D Application Framework is a complete programming system for CAD/CAM/CAE developers built around industry leading software components such as the HOOPS 3D Graphics System, the Parasolid Geometric Modeling Kernel and the ACIS 3D Toolkit. The benefits of using the HOOPS/3dAF include:

- Developers gain access to world-class 3D graphics and Geometric Modeling capabilities
- Application development cycles are significantly accelerated
- Windows, UNIX and Internet enabled applications can be produced from one code base

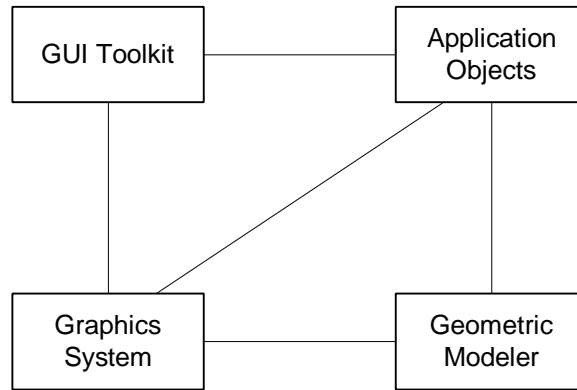
## Typical Component Set of CAD/CAM/CAE Applications

Most of today's leading applications are built with multiple third-party components. In the CAD/CAM/CAE industry, the component set of a typical application may include

- Geometric modeling kernel, such as Parasolid or ACIS
- Graphics subsystem for display, printing, and interacting with the geometric data
- Graphical user interface (GUI) implemented with a GUI toolkit
- Set of application objects that respond to user-generated input via the GUI and operate on the data in the geometric modeler and/or the graphics subsystem

These components can be built by independent software vendors or obtained externally from a 3<sup>rd</sup> party supplier. Once identified, they must all be integrated with one another within the overall context of the application's architecture — infrastructure work that can be tedious, difficult and time-consuming. Furthermore, developers must complete this work prior to starting to use the software components to build the application functionality that will attract customers.

The diagram below illustrates how these components are typically connected.



**Diagram 1: Typical Component Set of CAD/CAM/CAE Applications**

While the use of software components enables application developers to incorporate more functionality into their products in a shorter time than would otherwise be possible, there is still much infrastructure work to be done once the component set has been identified.

If a development group selects components with which they are unfamiliar, the first phase of designing and implementing the inter-component connections can be difficult; often, the results are sub-optimal. Poor design decisions made at this stage can have drastic effects on the overall performance, extensibility, reliability and overall success of the product. By the time these problems manifest, it is often too difficult or costly to reexamine the base architecture of the product.

The difficulties often start before any implementation work has begun. Do all the components use the same compiler, or support the same version of the operating system? These versioning issues compound with each new platform the application must support.

With HOOPS/3dAF, this application infrastructure is already in place. Developers can immediately start implementing application features, saving significant time and money by allowing them to focus on their true core competencies rather than re-inventing an existing component.

## The HOOPS/3dAF Component Set

The HOOPS 3D Application Framework (HOOPS/3DAF) is a highly optimized, integrated suite of industry leading software components for developers building applications for the Windows and UNIX operating systems. HOOPS/3dAF provides an extensible, modular base architecture that enables the rapid development of world-class 2D and 3D, interactive,



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vector and raster graphics-based CAD/CAM/CAE, Scientific Visualization, and Geographical Information System (GIS) applications.

With HOOPS/3dAF, the infrastructure for building sophisticated applications is in place. Developers save significant time and risk, and can immediately begin to use its components and focus on building their core application functionality.

The HOOPS/3dAF consists of four modules:

- HOOPS 3D Graphics System (HOOPS/3dGS)
- HOOPS/MVO application objects
- HOOPS/GM Bridges for the Parasolid® Modeling Kernel from Unigraphics, and the ACIS® 3D Toolkit from Spatial Technology
- HOOPS/GUI toolkit integration modules

The figure below shows each HOOPS/3dAF module, their relationship to each other, and the basic flow of data between the various components.

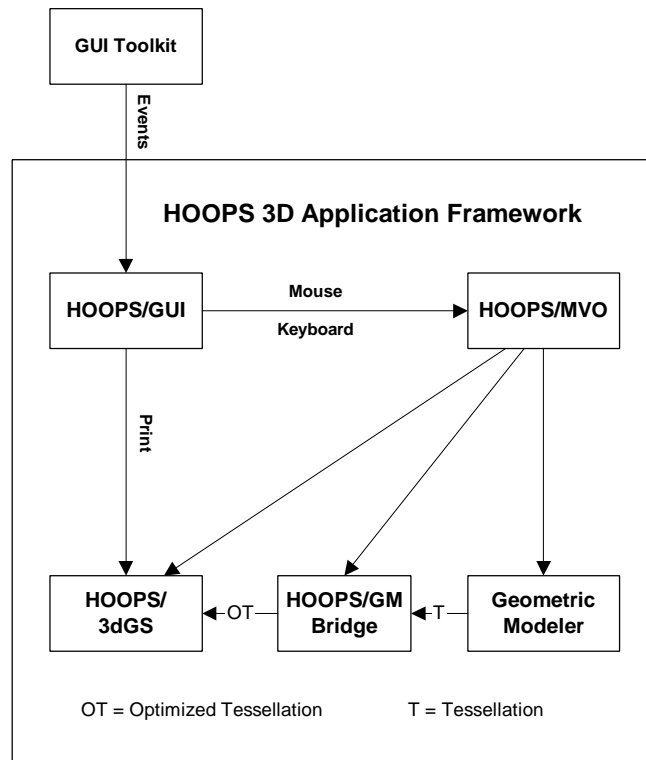


Diagram 2: The HOOPS/3dAF Component Set and their Relationships



Geometric modeling kernels provide the data structures and algorithms for creating and modifying 3D topological and geometric data. The HOOPS 3D Application Framework does not include these kernels, but has been pre-configured to work with either the Parasolid® or ACIS® geometric modelers.

Tech Soft America is a licensed reseller of the Parasolid modeling kernel and can supply it to Independent Software Vendors. Also, Tech Soft America has produced a Parasolid-specific version of the HOOPS 3D Application Framework — the ParaHOOPS 3D Application Framework.

## HOOPS 3D Graphics System

HOOPS 3D Graphics System (HOOPS/3dGS) is a high performance 3D rendering toolkit for developers building applications for the Windows and UNIX operating systems. HOOPS/3dGS' highly optimized data structures and algorithms dramatically simplify the development of 2D and 3D, interactive, vector and raster graphics-based CAD/CAM/CAE, Scientific Visualization, and Geographical Information System (GIS) applications.

HOOPS/3dGS contains:

- A subroutine library that provides for the creation, management, querying and editing of an application's graphical information and is linked with an application's object code. The libraries can either be dynamically or statically linked.
- A large suite of supporting demonstration and integration code to assist developers in learning about HOOPS/3dGS and incorporating it into their application.

## HOOPS/MVO Class Library

The HOOPS/MVO Class library is an extensible set of objects that implement much of the typical functionality found in CAD/CAM/CAE applications. The MVO objects respond to user-generated input events and use the APIs of the various other components in the application to interact with the application data. The HOOPS/MVO class library is completely platform-independent.

“MVO” stands for Model, View, and Operator, which are the three classes contained in the HOOPS/MVO library. The Model class is used to organize the application's 3D geometric data. The View class is used to create views of the model such as drawing visual output on a computer monitor or hardcopy device. The Operator class is used to interact with the model or one of its views.



## HOOPS/GM Bridges

The HOOPS/GM Bridges connect geometric modeling kernels to the HOOPS 3D Graphics System.

Geometric modelers such as Parasolid and ACIS provide little or no services for visual display or hardcopy output of the 3D data they manage, as this is not their area of expertise. Parasolid or ACIS output tessellated geometry that must be mapped to the HOOPS 3D Graphics System.

The HOOPS/GM Bridges collect a geometric modeler's output tessellated geometry, optimize the tessellation, and insert it into the HOOPS/3dGS scene-graph. They also maintain a mapping between entities in the modeler and their corresponding HOOPS geometry to facilitate the development of HOOPS/MVO Operator objects.

## HOOPS/GUI Modules

The HOOPS/GUI modules connect the HOOPS 3D Application Framework to a developer's Graphical User Interface (GUI) toolkit:

- HOOPS/Java for Java developers
- HOOPS/MFC for the Microsoft Windows platforms (NT/95/98)
- HOOPS/ActiveX for building ActiveX components
- HOOPS/Qt for those developers who want to support multiple platforms from one source code base
- HOOPS/MOTIF for the UNIX platforms

The HOOPS/GUI module connects the HOOPS/3dGS to a draw-able widget in the GUI toolkit so that HOOPS/3dGS can draw to a window. Then, the HOOPS/GUI module connects the HOOPS/MVO objects to the GUI toolkits event queue so that user-generated events are dispatched to the appropriate HOOPS/MVO objects.

## HOOPS/Reference Applications

The HOOPS 3D Application Framework includes a set of reference applications for the Windows and UNIX operating systems built with the various components of the framework. The HOOPS/Reference Applications provide an extended example of how to build an application with HOOPS/3dAF and function as an extensible base architecture for new applications. Source code for the reference applications is provided as part of the development system and developers are free to use any part of the code in their application.

There are two main types of HOOPS/Reference Applications: those built with a geometric modeler and those without. The following list details the various configurations of HOOPS/Reference Applications currently available:



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## Non Geometric Kernel based Reference Applications

**MfcHoopsRefApp** (Windows only) : based on HOOPS/3dGS, HOOPS/MVO and HOOPS/MFC.

**QtHoopsRefApp** (UNIX and Windows) : based on HOOPS/3dGS, HOOPS/MVO and HOOPS/QT.

## Geometric Kernel based Reference Applications

**MfcParaHoopsRefApp** (Windows only) : based on HOOPS/3dGS, HOOPS/MVO, HOOPS/MFC, HOOPS/Parasolid and Parasolid.

**MfcAcisHoopsRefApp** (Windows only) : based on HOOPS/3dGS, HOOPS/MVO, HOOPS/MFC, HOOPS/ACIS and ACIS.

**QtParaHoopsRefApp** (Unix and Windows) : based on HOOPS/3dGS, HOOPS/MVO, HOOPS/QT, HOOPS/Parasolid and Parasolid.

**MotifHoopsRefApp** (Unix only) : based on HOOPS/3dGS, and HOOPS/MOTIF

## Summary

The HOOPS 3D Application Framework provides CAD/CAM/CAE developers access to industry leading software components integrated into an extensible application framework. HOOPS/3dAF saves developers significant time and risk while enables them to focus on their true core competency.

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