3D Rendering Engine for Simulation

MTP First Stage

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under guidance of

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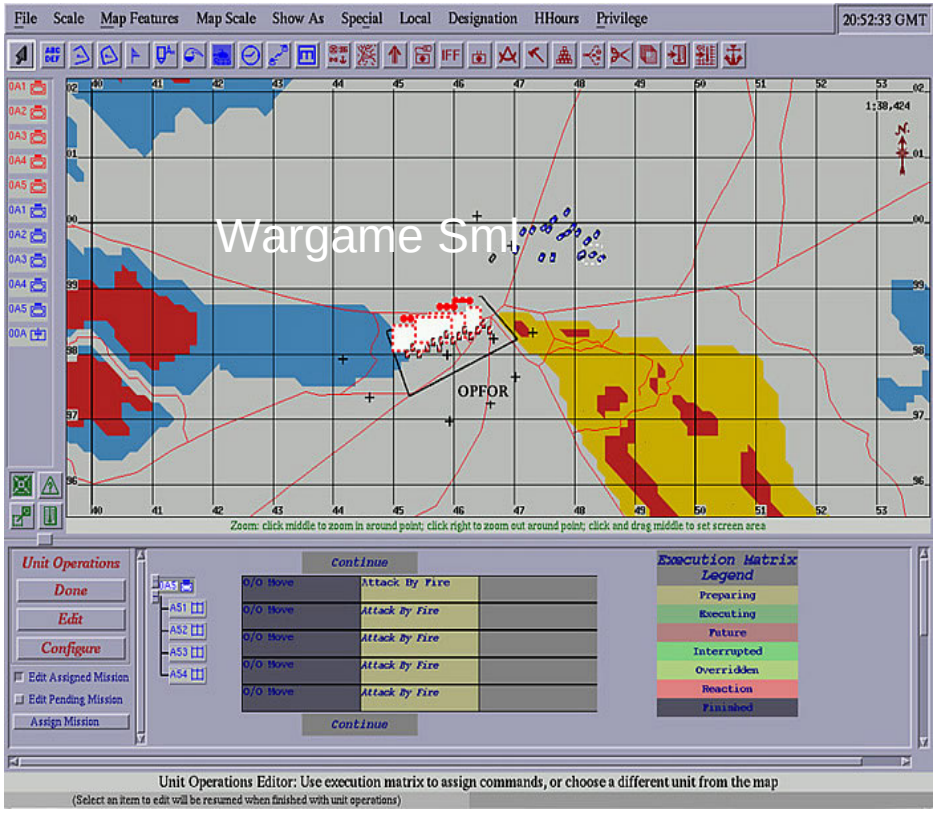
Motivation

Customize any open source 3D rendering engine for developing Military Simulations.

Aim

Creation of gaming toolkit for near real-time visualisation of Entity Simulators and Wargames.



Overview

- Brief: Wargaming and simulation
- Problems with Commercial systems
- Design Philosophy—Our Credo
- Base Rendering Engine
- Advanced Features (Wish list)
- Delta 3D
- Work Plan

Wargaming and Entity Sml

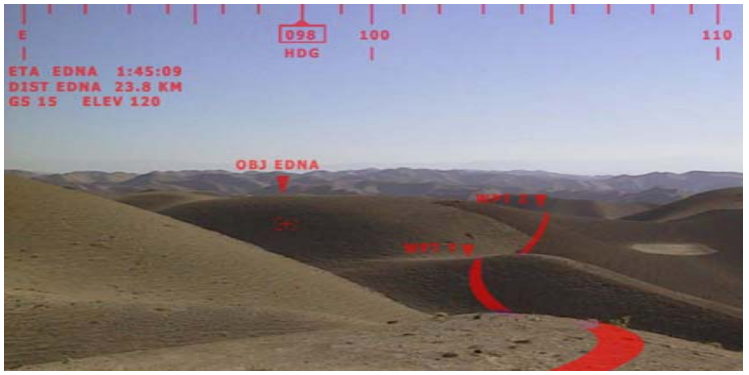
- Historical war gaming and sml used by Germans in WW-II.
  - Manual games
  - Predict outcome of war
  - Tactical planning
  - Low cost training

- US Army's (Advanced Research Projects Agency (ARPA)).
  - Project for creating networked simulations
  - War-games and entity simulators could interact with each other in a "virtual world."

Entity Sml

- Computer systems which model operator control.
- Graphical displays on a monitor or large screens.
- Use full-scale models of the system of concern.
- Operator inputs in real time.
- Input devices are mock-up controls which are true replicas of the original controls.
- DOF Robots used for motion.

War Games Sml



- Computer programs model the interaction between forces such as army divisions. (Groups)
- Forces modeled are controlled by operators representing force command staffs
- Operators follow orders given by actual commanders at various different levels.
- Played over a wide area network.

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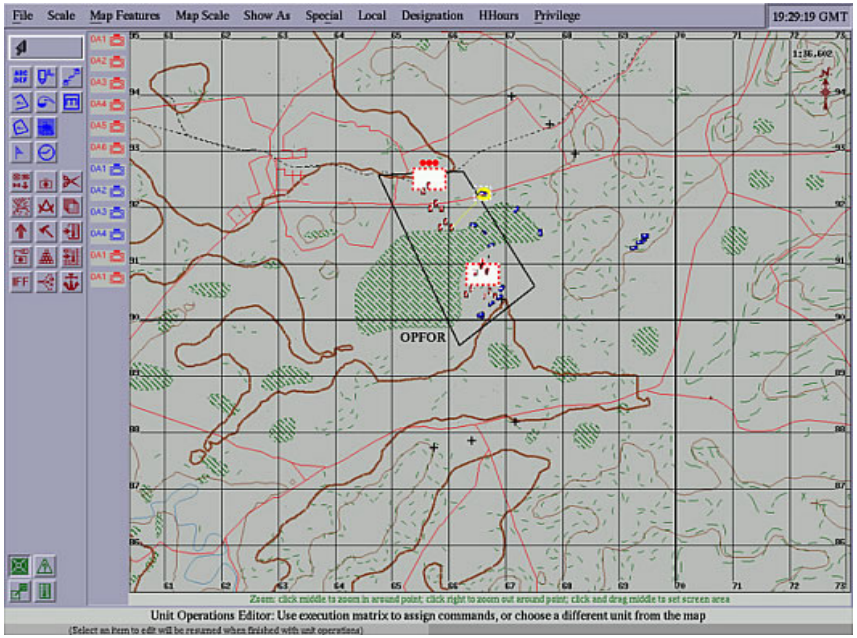
War Games Sml

- Control instructions, which may or may not be in real time, are input by key board commands.

- Results of interaction between entities are determined by programmed probabilistic relationships.

Well known US war-game ModSAF (Modular Semi-Automated Forces)



DIS

- Both types of simulations model a virtual world in which the forces or entities operate.
- Distributed Interactive simulations use a network to bring entities represented by different computers into the same virtual world.
- DARPA project attempt to merge the entity and war-game simulators in the same virtual space.

The Combined Arms Tactical Trainer (CATT) facility is one such simulator which is a networked suite of simulators.

Collective trainers

These don’t fall under the category of war-games but are a no of entity simulators networked together in a virtual world to give collective training to a bunch of soldiers at once.

- limited tactical training ability
- LIC training
- CI operations
- Guerrilla warfare

Problems with commercial Simulation Systems

- Simulation systems priced with costs running into six figures for each application built.
- Projects locked into the proprietary technologies.
- No way to modify the underlying engine.
- Developers have to build “work-arounds” to overcome problems with proprietary tools.
- For off the shelf systems there are never any free upgrades.

Design philosophy

- Keep everything open to avoid vendor lock-ins and increase flexibility.
- Use a modular design so that anything can be swapped out as technologies mature at different rates and anything can be added.
- Make it as generic as possible since it is not known what application it's going to have to support next.
- Open source community as indirect developers.
- Reusability of existing code and models

Our Approach

- The basic idea is to get an engine at minimal cost yet be very good.
- Developing our own ruled out.
- Modifying an existing source code also ruled out.
- Use open source projects as Building Blocks to get desired functionality and quality.
- Windows DLL approach.

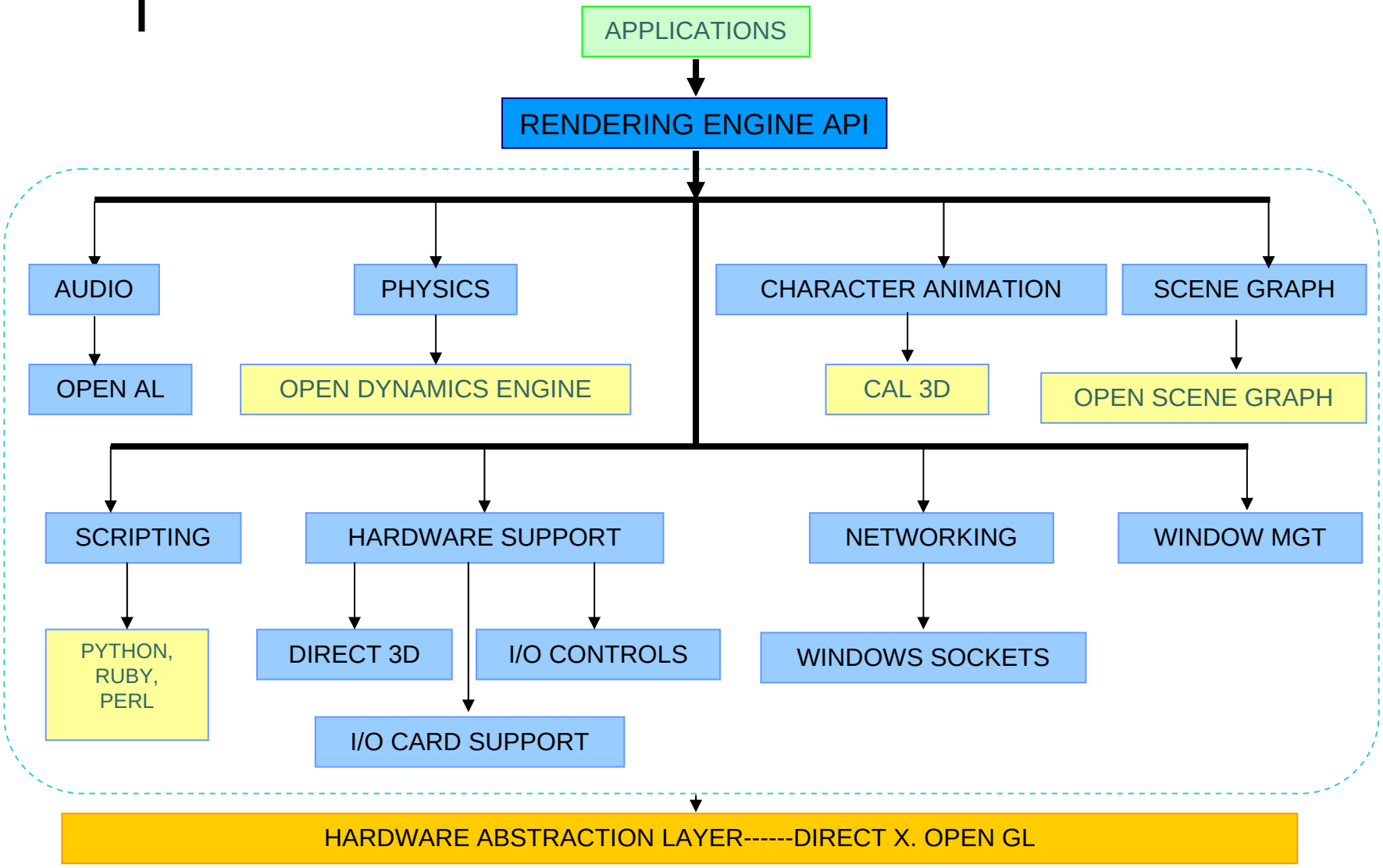
Benefits

- Low Cost development
- Less time Consuming
- Comparatively little code needs to be written.
- Our engine improves as the Open Source project is improved.

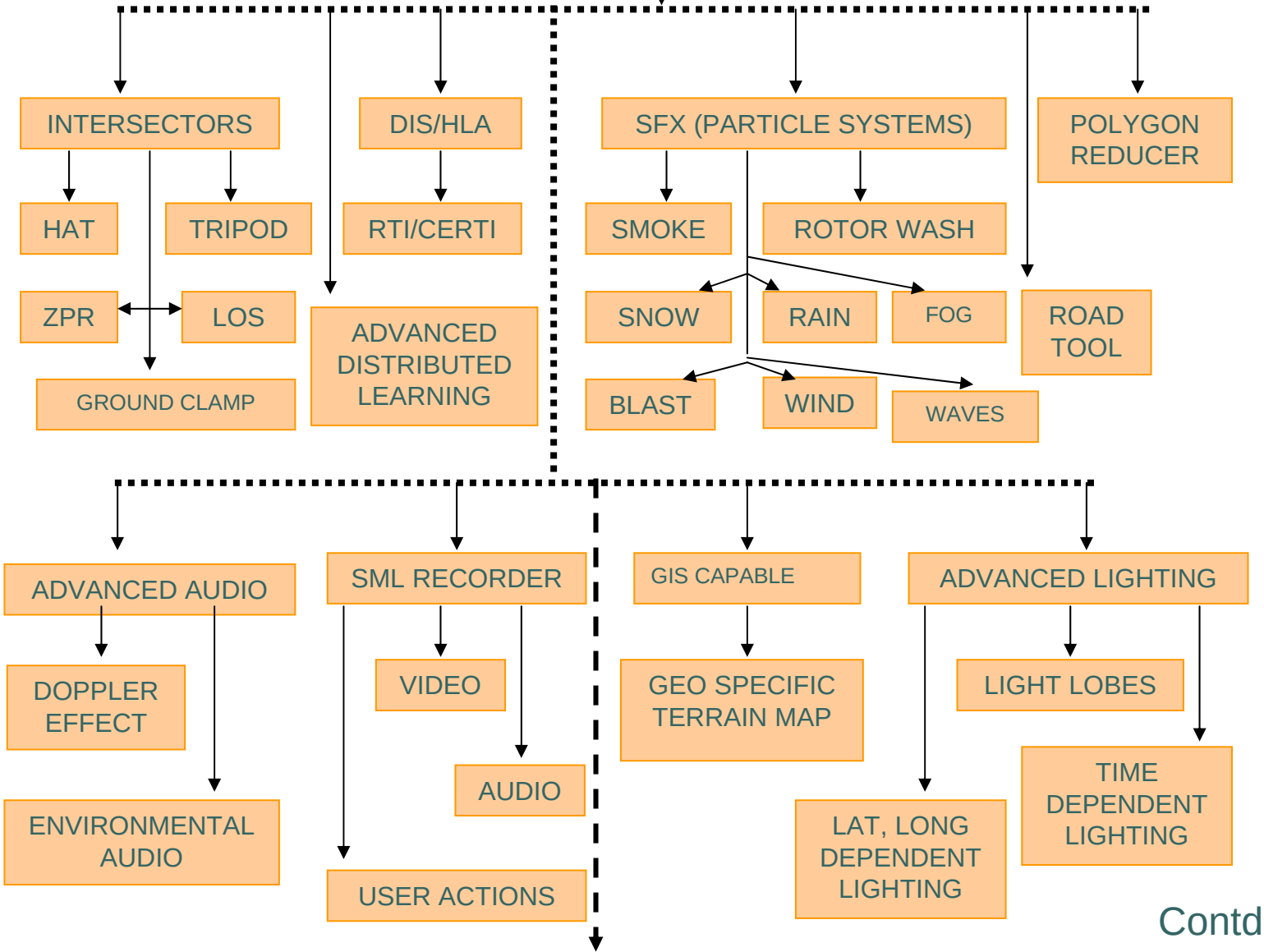
Challenges to our approach

- Visualising base engine architecture.
- Selecting the Base rendering engine from the hundreds on the net.
- Determining exactly what extra features to add to the engine and How?
- Creating and implementing the add-on architecture.
- Identify existing open source projects for our add-on's

Base Engine Design



Add-on enhancements



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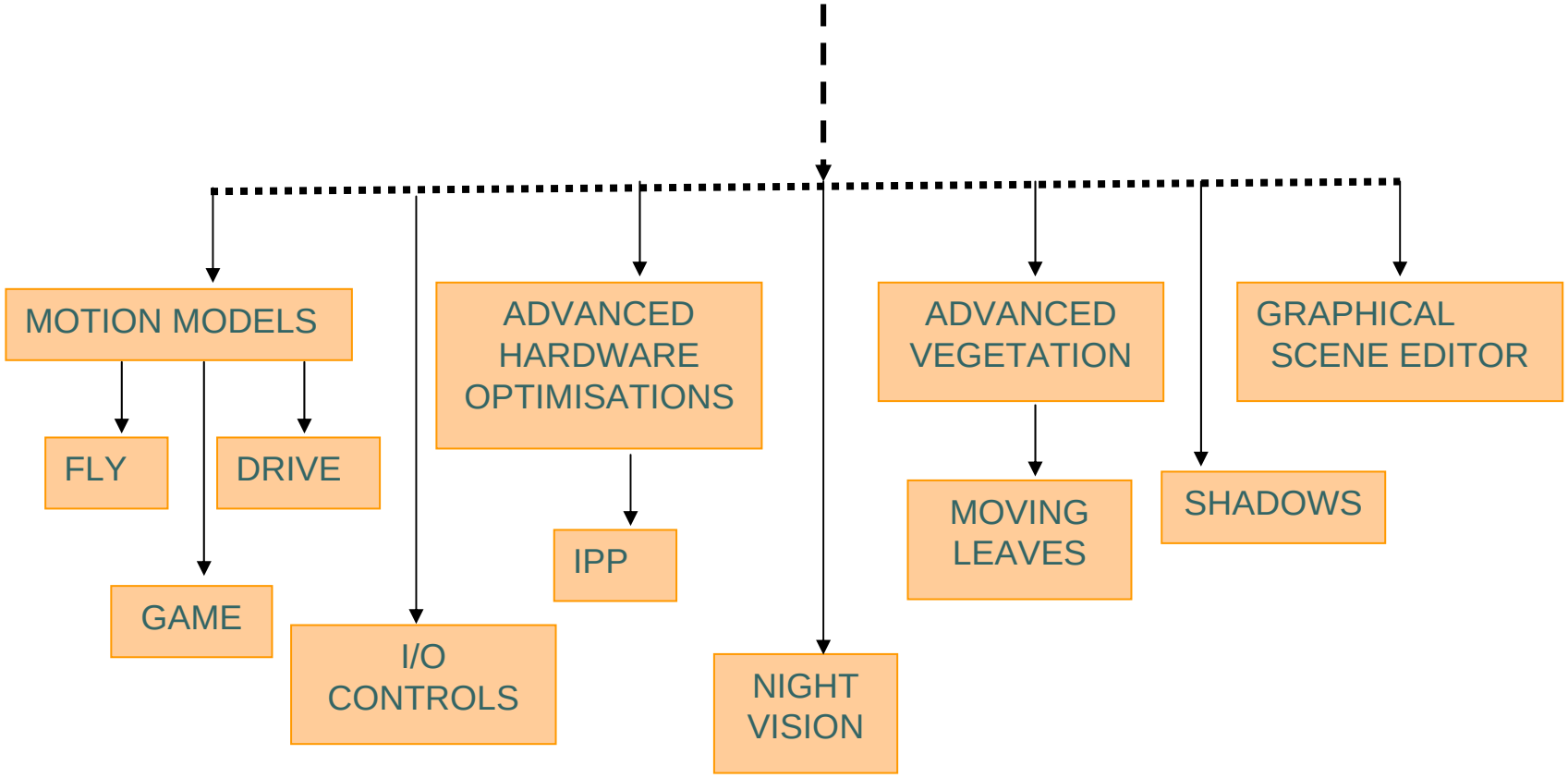
Add-on enhancements



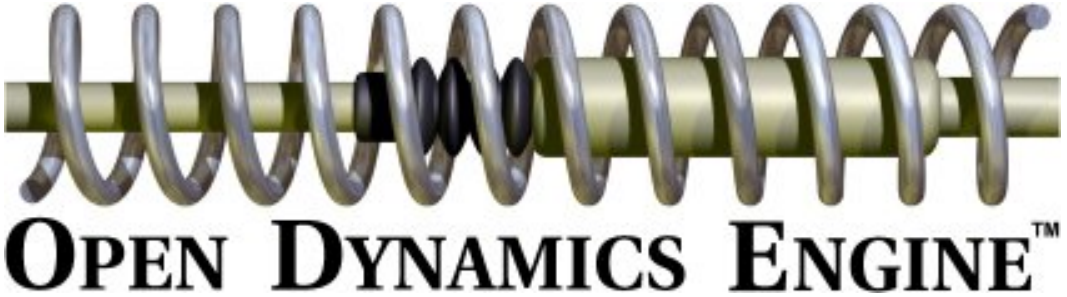
Selecting the Base Engine

- Support for popular 3D Visual database formats particularly the *OpenFlight* format.
- Basic engine components such as:-
  - Audio support.
  - Basic Physics support.
  - Ease of manipulation of 3D objects.
  - Character animation.
- Popularity with gaming community.
- Visual studio.net support. (C++)

Our choice:

- Delta3D uses OpenSceneGraph (OSG) for rendering.
- High performance 3D graphics toolkit.
- Used in visual simulation, games, virtual reality, scientific visualization and modeling.
- Written in Standard C++ .
- OpenGL as its underlying rendering API.

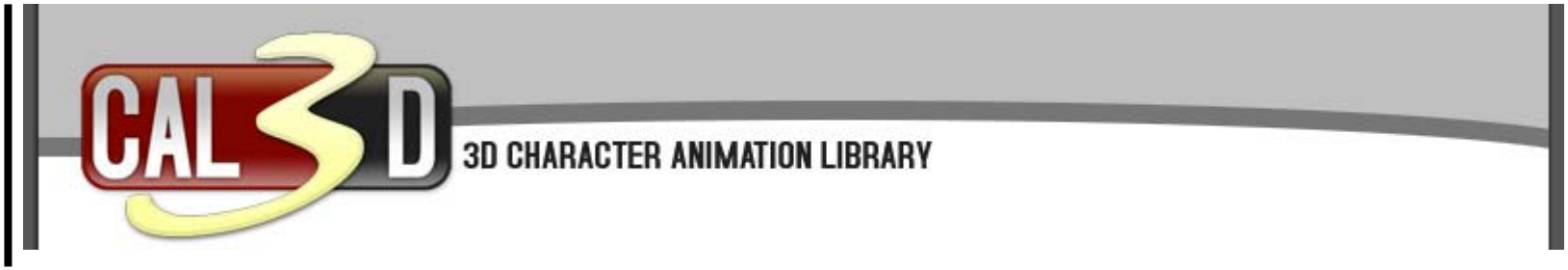
Physics



- Physics performed by the Open Dynamics Engine (ODE) library.
- ODE is a high performance library for simulating rigid body dynamics.
- C/C++ API.
- Used in several computer games, 3D authoring tools and simulation tools.
- Can realistically model several devices/physical phenomena, such as joints, springs, damping devices (e.g., shock absorbers), friction, gears, motors, and collisions.
- Useful for simulating vehicles, objects in virtual reality environments and virtual creatures

Audio

- Open Audio Library (OpenAL) is a software interface to the audio hardware.
- Resembles the OpenGL API in coding style and conventions
- Produces high-quality audio output, specifically multichannel output of 3D arrangements of sound sources around a listener.
- Includes extensions to handle sound-source directivity and distance-related attenuation.
- Effects --- Doppler, environmental effects such as reflection, obstruction, transmission, reverberation etc.



- Cal3D animates characters.
- Cal3D is a skeletal based 3D character animation library
- Written in C++.
- Exporters for most popular (both open source and proprietary) 3D database formats.
- The Cal3D C++ library loads exported files, build characters and run animations.
- Cal3D allows character animations, such as walking and running etc.

Scripting

- Scripting language to allow advanced behaviors to be added to a game with a minimum of C++ programming on the developers' part.
- Delta3D uses the Python.

GUI

- FLTK is a cross-platform C++ GUI toolkit for UNIX®/Linux® (X11), Microsoft® Windows®, and MacOS® X.
- FLTK provides modern GUI functionality without the bloat and supports 3D graphics via OpenGL® and its built-in GLUT emulation.

Ce GUI

- Crazy Eddie's GUI System is a free library providing windowing and widgets for graphics APIs / engines where such functionality is not natively available, or severely lacking.

Open producer

- Open Producer is a cross-platform C++/OpenGL library that is focused on Camera control.
- Producer's Camera provides projection, field of view, viewpoint control, and frame control.
- Producer can be used in a multi-tasking environment to allow multiple Camera's
- Support for multiple display subsystems.

XML

- Xerces-C++ is a validating XML parser written in a portable subset of C++.
- Xerces-C++ makes it easy to give your application the ability to read and write XML data.

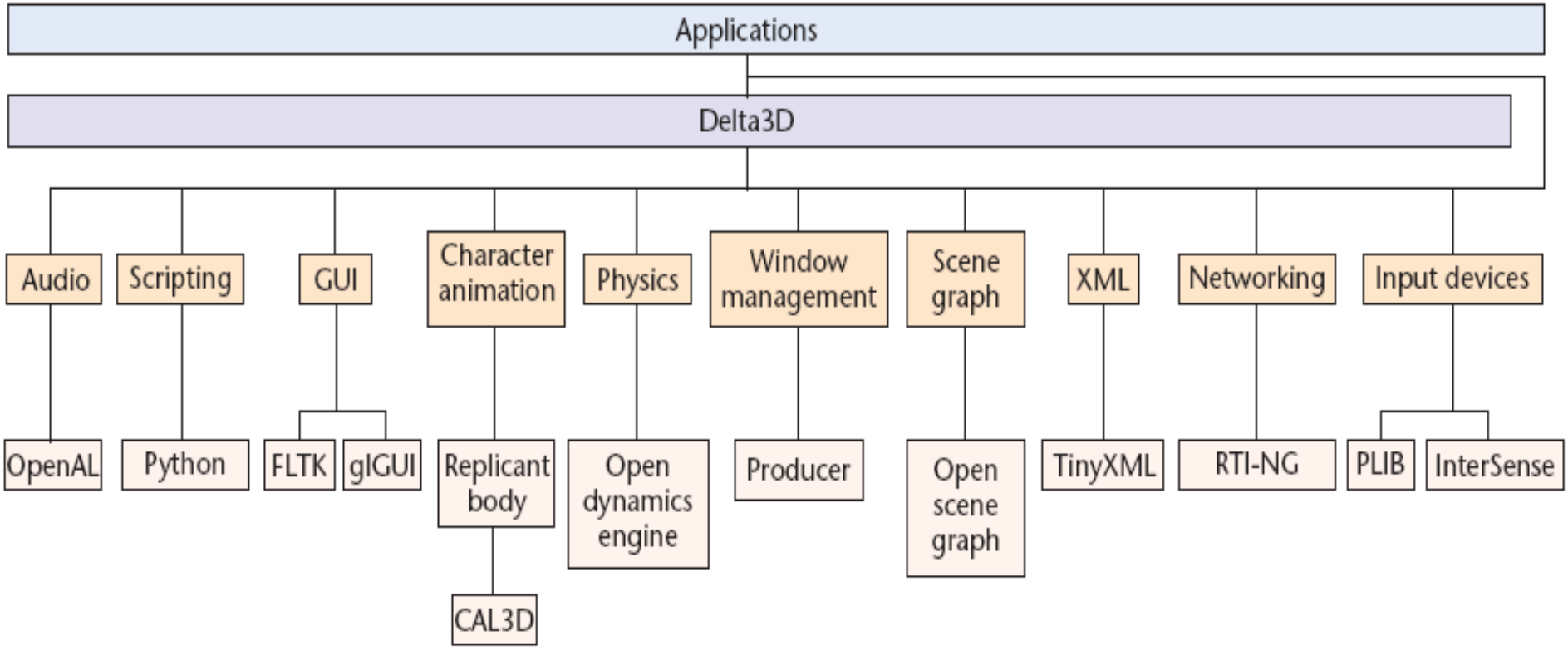
I/O

STEVE'S PORTABLE GAME LIBRARY.

- **PLIB: A Suite of Portable Game Libraries.**

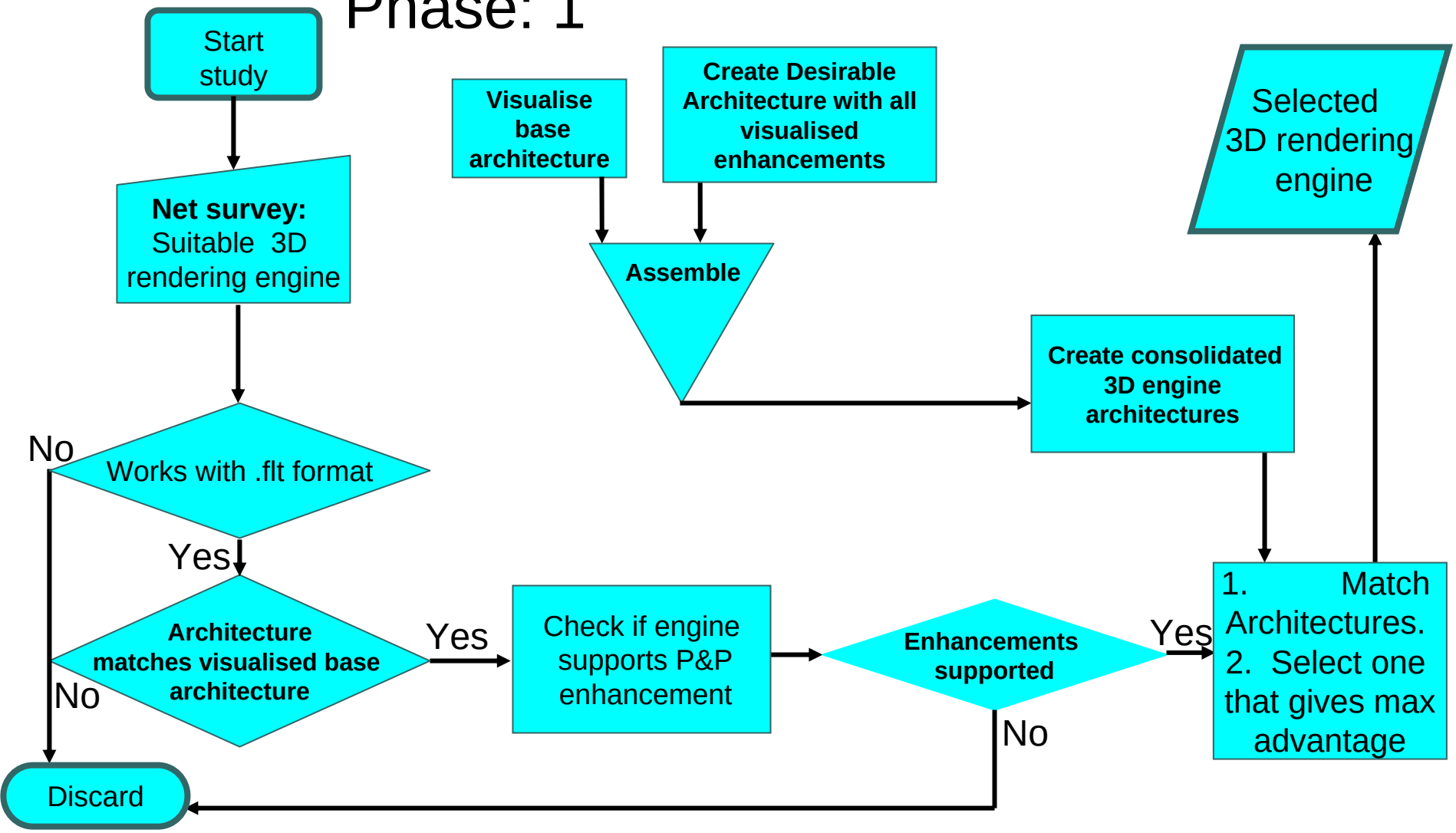
- **Intersense provides a tracking library which can be used for i/o of generic trackers.**

Block schematic Delta 3D



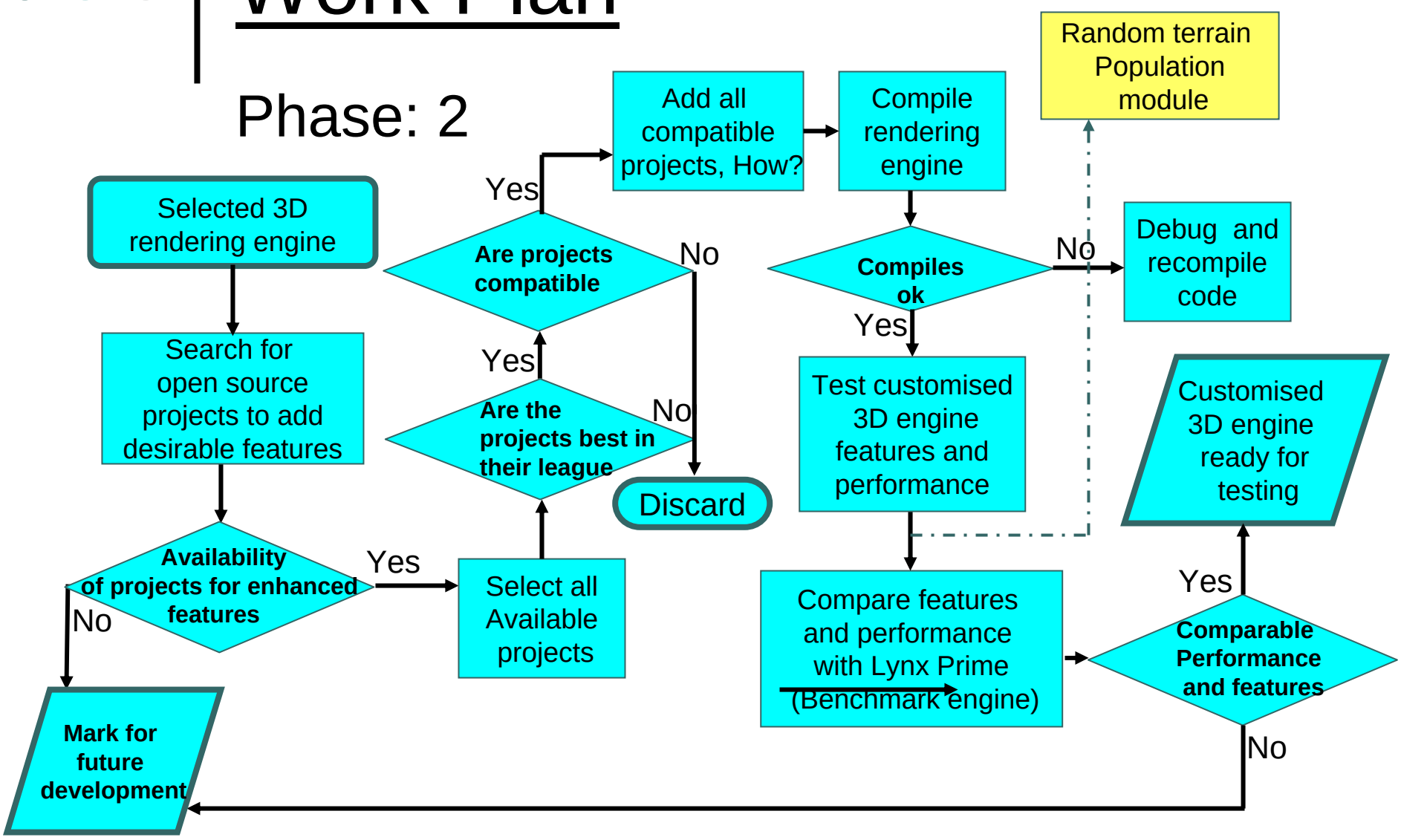
Work Plan

Phase: 1



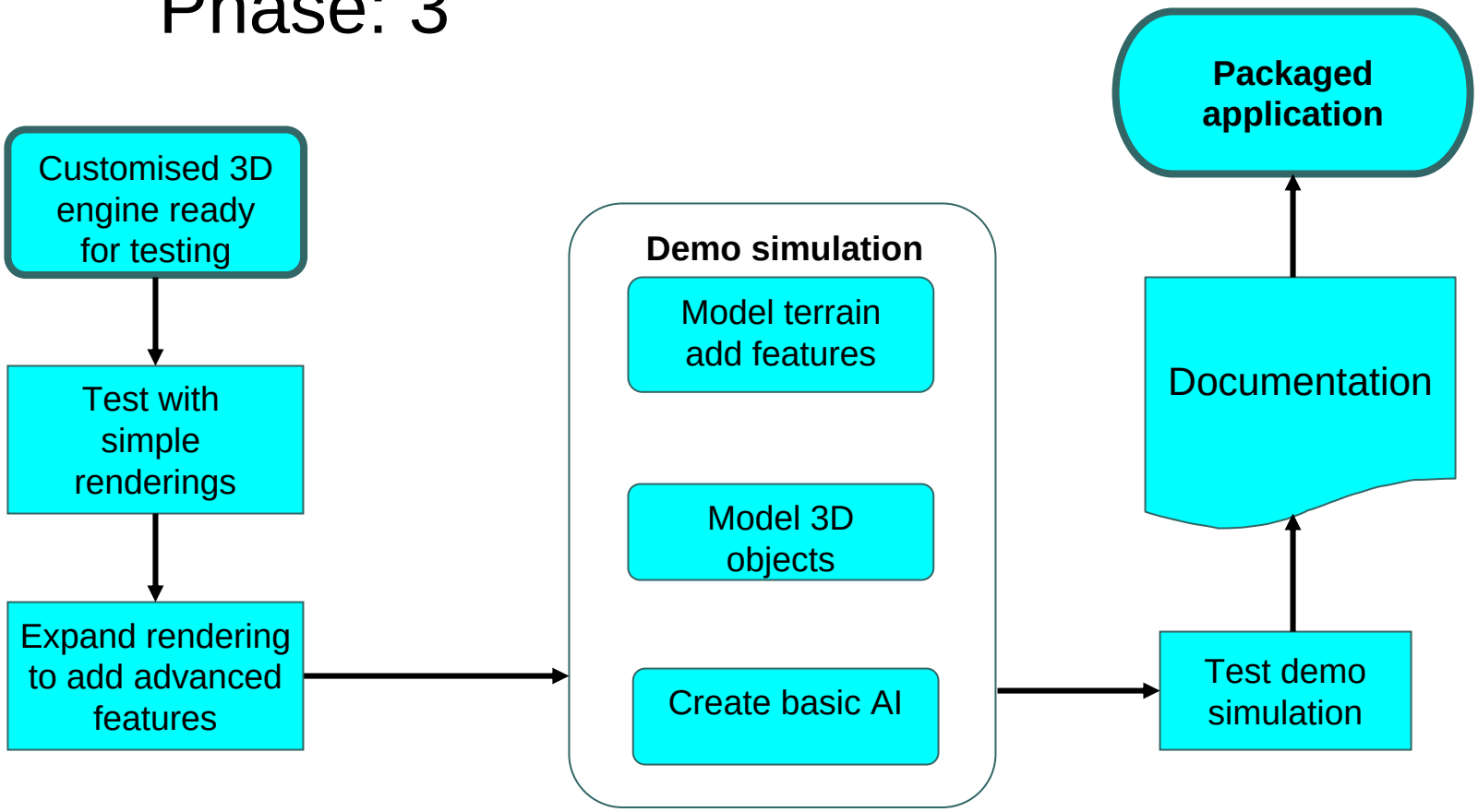
Work Plan

Phase: 2



Work Plan

Phase: 3



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Additional web links

- Comprehensive graphics toolkit URL http://www.quantum3d.com/products/software/archive-do%20not%20post/vtree.html
- Intel performance primitives (IPP); Retrieved May, 2007 URL http://www.intel.com/cd/software/products/asmo-na/eng/302910.htm
- Delta 3D ; Retrieved May, 2007 URL http://www.movesinstitute.org
- Wargames ; Retrieved June, 2007 URL http://www.strategypage.com/military_photos/200522323.aspx
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Thank you

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