

**7th Annual Seminar on Spatial Information Science and Technology
(ASSIST 2011)**

Full 3D Geospatial Information System Platform GeoScope

**State Key Laboratory of Information Engineering in
Surveying, Mapping and Remote Sensing**



<http://VRLab.whu.edu.cn>



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Motivation

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1 Motivation

Aboveground

Building

geometry, texture, material, house structure, indoor layout, house property, etc.

Road network

practical carriageway and transport facility, abstract center line, etc.

People live

3D space

Terrain Surface

DEM(TIN or Grid), DOM

Geology

stratum, structure, ore body, etc.

Underground facility

pipe, roadway, etc.

Underground

Practical Requirements

Low utilization ratio of

Existing 3D GIS softwares have difficulty in providing a total solution:

this situation stimulated the initiation of a full 3D geospatial information system, that integrates geospatial information to represent the 3D geometry, appearance, topology, and semantics of man-made objects and natural features

Current situation

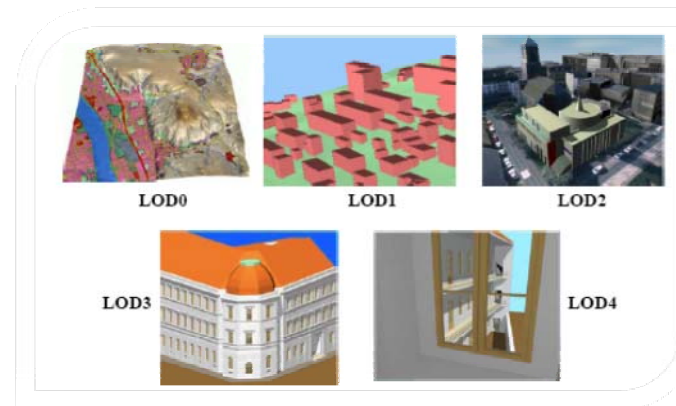
Independent study of
aboveground and
underground objects

Requirement of more
scientific spatial perception
and decision

Diversity of application
demands

Limited capabilities of 3D
GIS software platforms

- In 2008 , the OGC standards CityGML 1.0.0 was issued
- A comprehensive data production standard in China named “Technical specification for three dimensional city modeling” was compiled and issued on Nov. 17, 2010.



- In 2010, geological survey pilot project launched by China's ministry of land and resources was basically completed in 6 big cities of China

Current situation

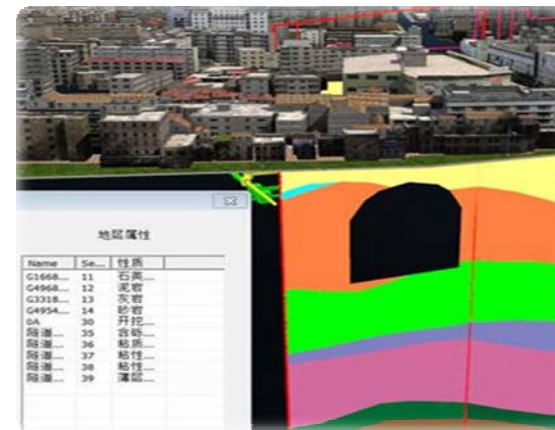
Independent study of
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Limited capabilities of 3D
GIS software platforms

- Thorough perception of both aboveground and underground environments are greatly needed for increasingly complex development of city space



- In 2010 , Subsurface ADE, GeoBIM ADE and Utility Networks ADE are still being worked out for CityGML 1.1

Current situation

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Limited capabilities of 3D
GIS software platforms

- Existing 3D GIS softwares are application-oriented, coupled tightly with data.



- The granularity diversity of data itself and its processing is distinctive from macroscopic plan management to microscopic design and refined management

A variety of data and softwares

Current situation

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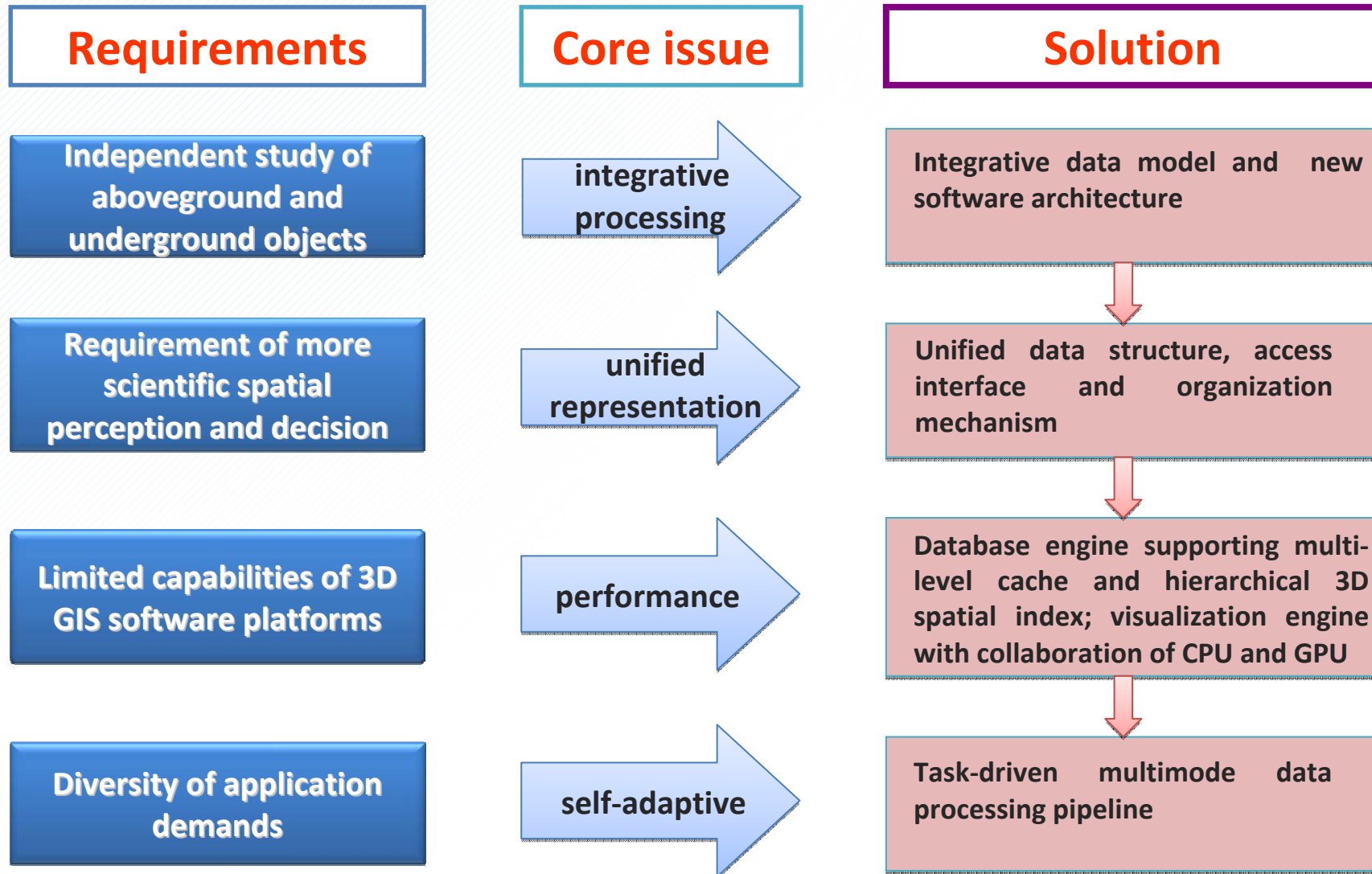
Limited capabilities of 3D
GIS software platforms

- Most of them are limited by low-performance visual analysis ; need global optimization and static data loading; have difficulty in online updating and sharing; are lacking in hierarchical semantic representation

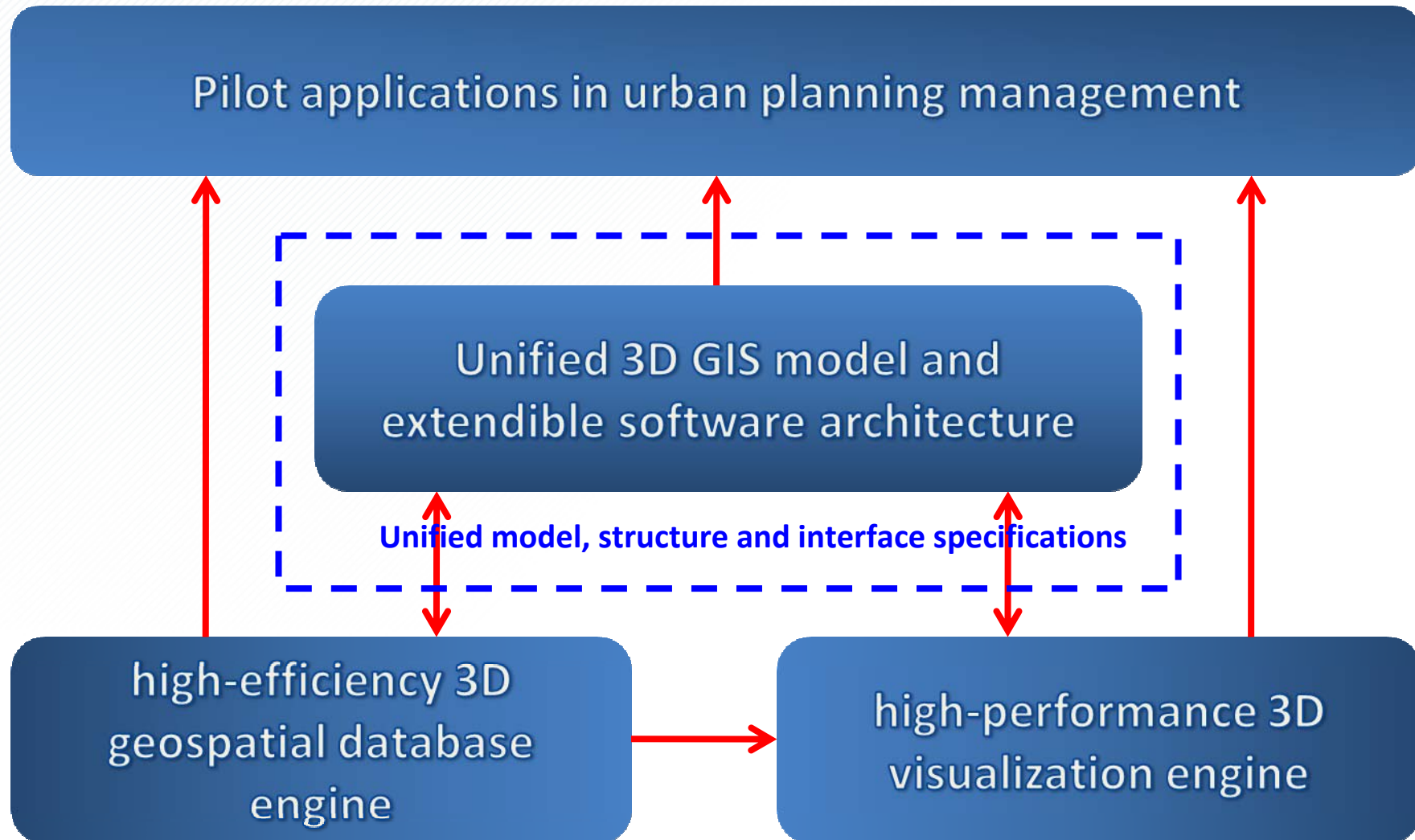


- key problems in 3D GIS need to be systematically studied like unified data model, flexible software architecture and high-performance 3D visualization and spatial analysis

2 Introduction of GeoScope

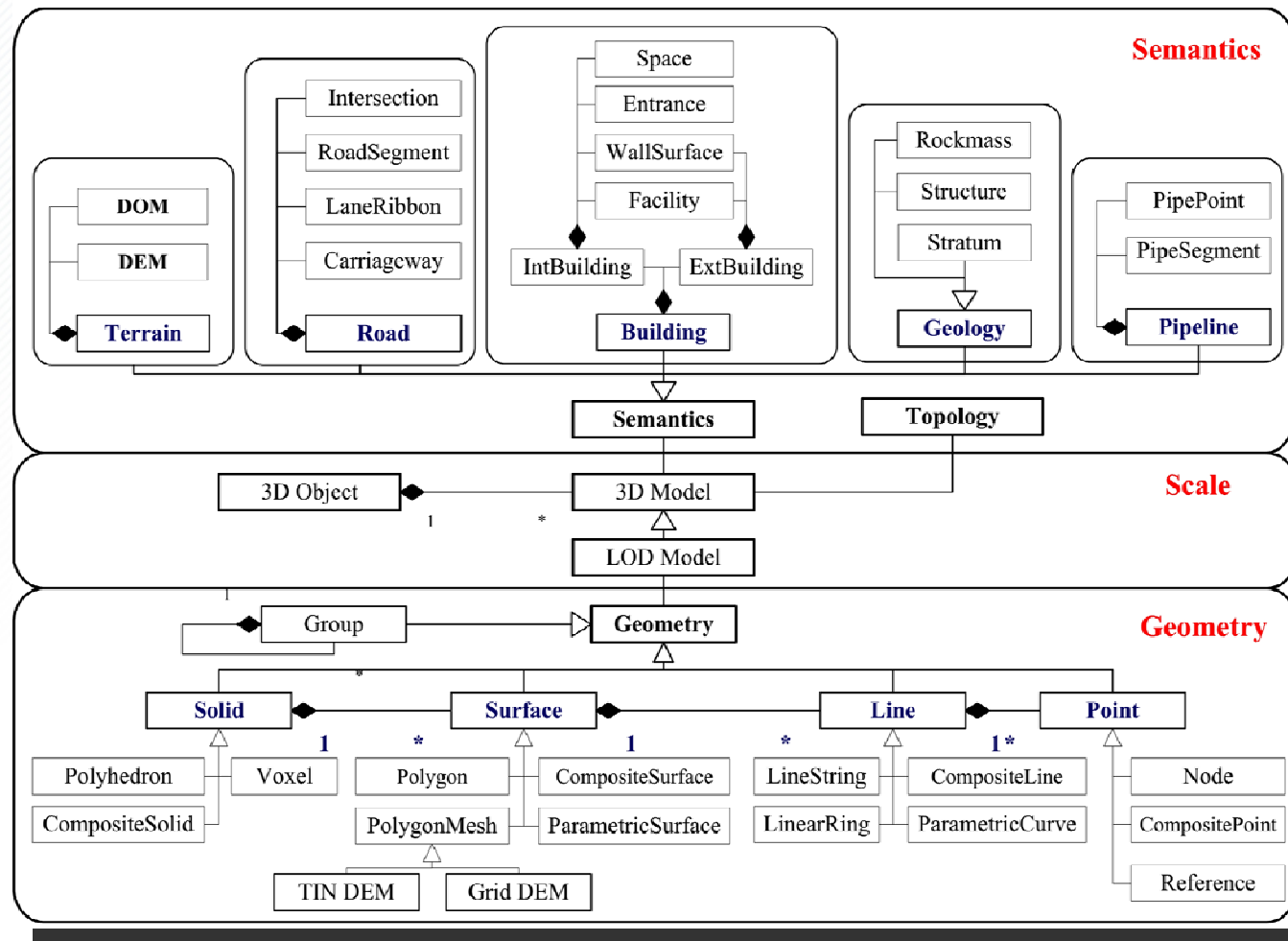


Design and implementation



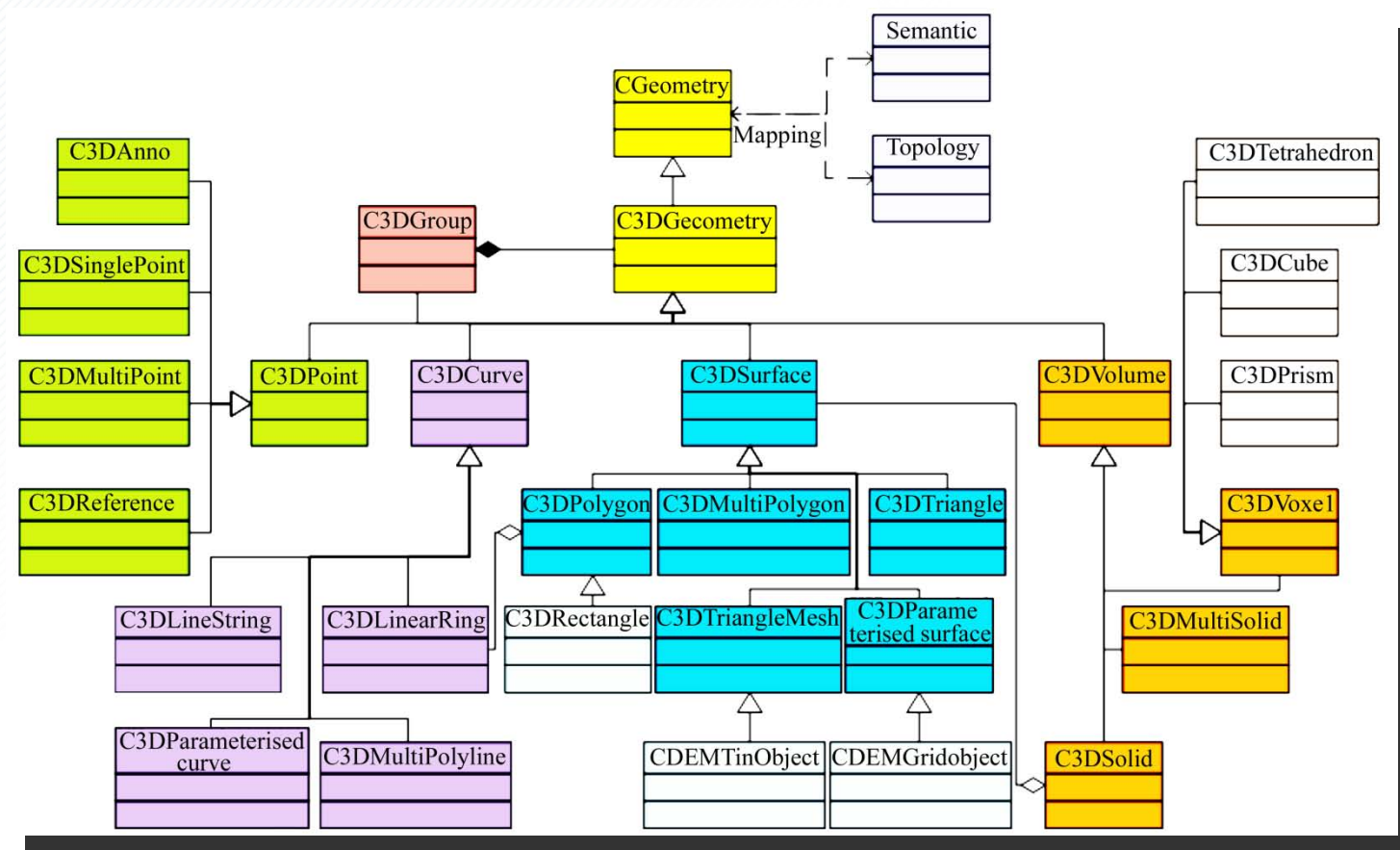
Unified 3D GIS models

An integrative 3D spatial data model



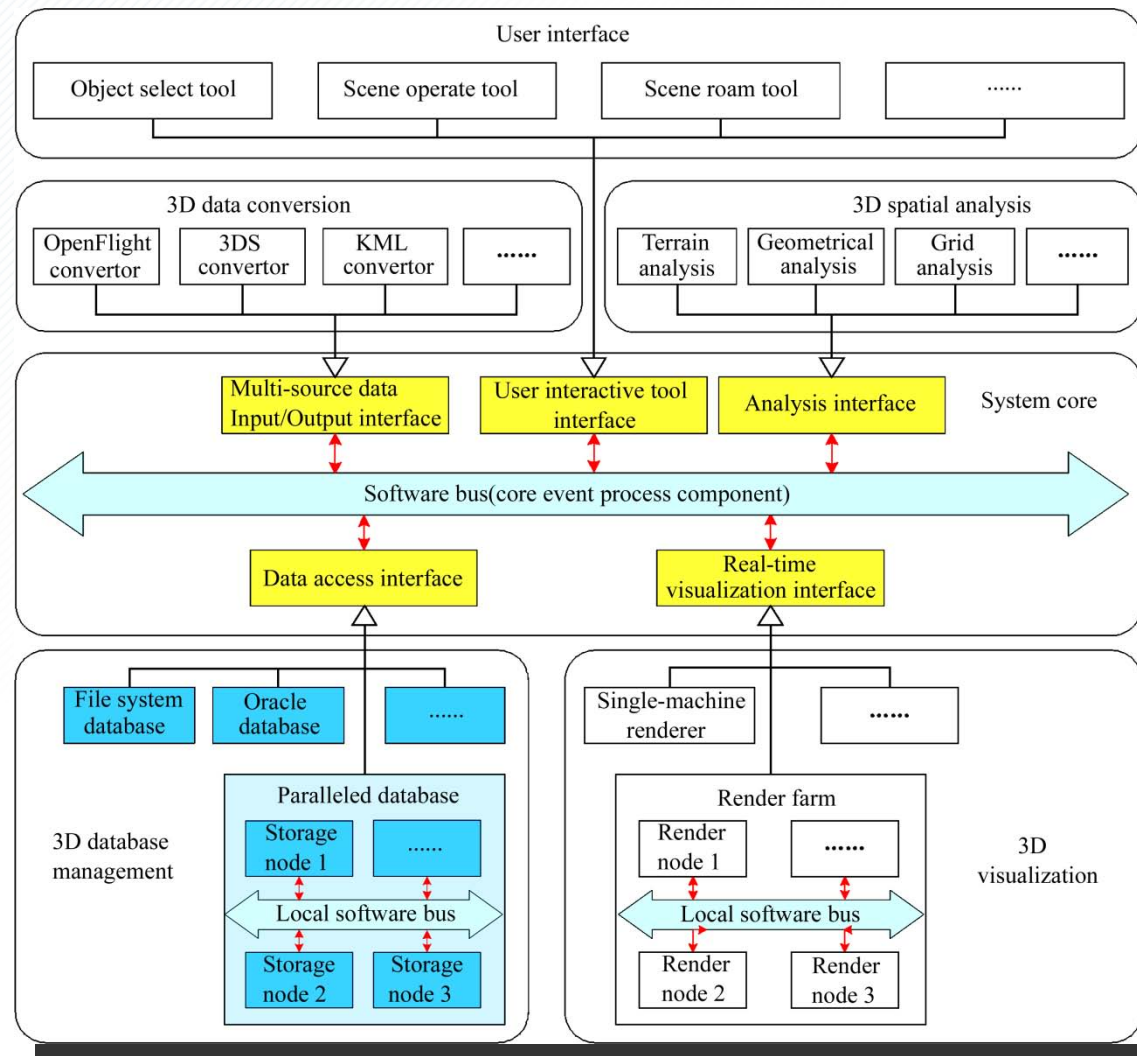
Unified 3D GIS models

Unified representation of 3D geometrical model



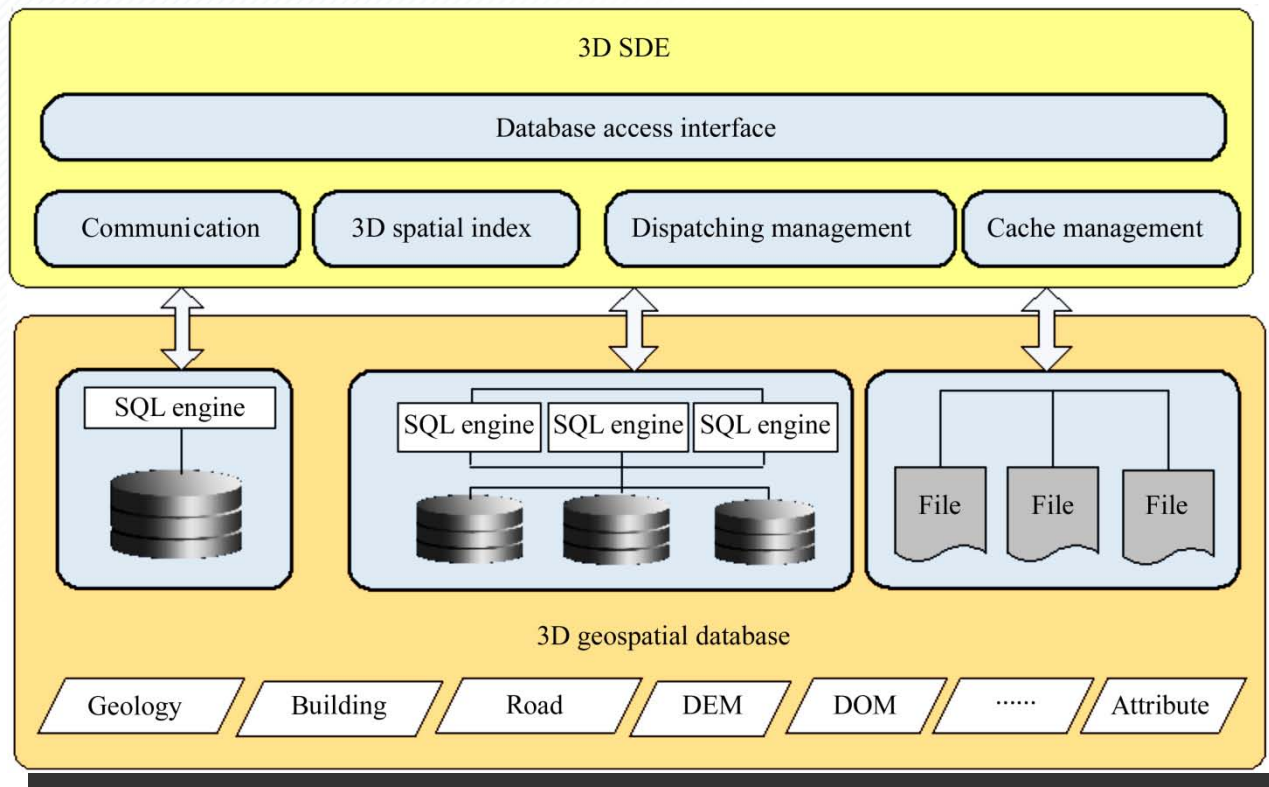
Extendible software architecture

Hierarchical message bus-based software architecture

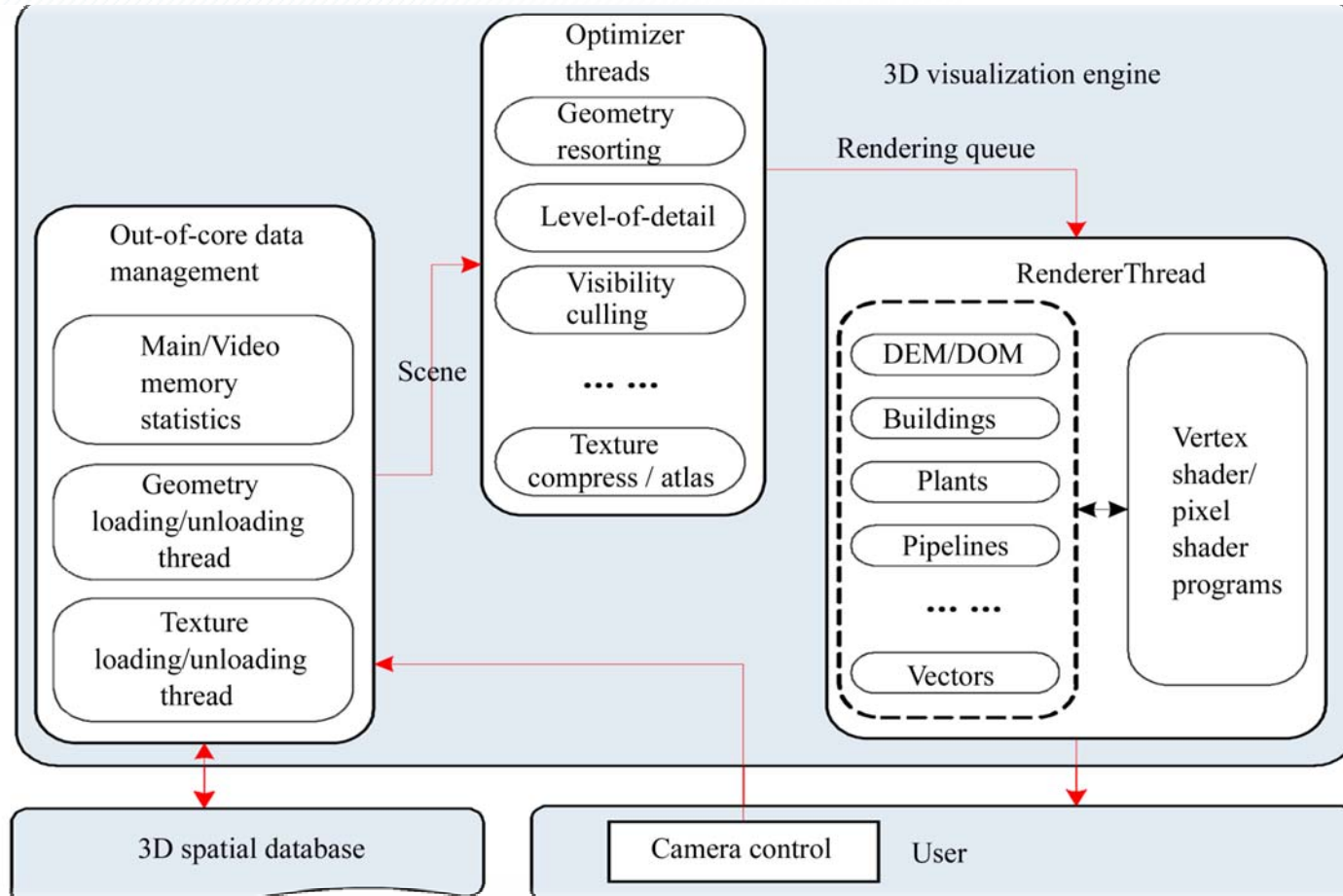


3D geospatial database engine

Three kinds of data management system modes



high-performance 3D visualization engine



Integrative applications with 2D GIS

The screenshot displays a web browser window titled "武汉市实有人口实有房屋信息共享平台 - Microsoft Internet Explorer". The address bar shows "http://localhost:1234/index/WRNew.html". The main content area features a navigation menu with options like "数据视图", "空间定位", "以人查房", "以房查人", "人口分布", "人口分析", "综合分析", "房屋分析", and "统计报表".

On the left, there is a search form for "实有人口" (Real Population) with fields for "姓名" (Name), "身份证" (ID Card), "地址" (Address), "辖区" (District), "街道" (Street), and "年龄" (Age), along with a "查询" (Search) button. Below this is a "地图导航" (Map Navigation) section showing a regional map of Wuhan with a red box highlighting the current view area.

The central part of the interface is split into two views:

- 2D view of Arc/Info:** A topographic map showing streets, buildings, and landmarks like "中华路小学分校", "民主路小学", "九通荷厦", "楚材社区", "市公安干部学", "武汉十中", "中百仓储", "后长社区", "武昌区卫生局", and "市第一医院". A scale bar indicates 100m.
- 3D view of GeoScope:** A 3D perspective view of the same area, showing buildings with height and a compass rose.

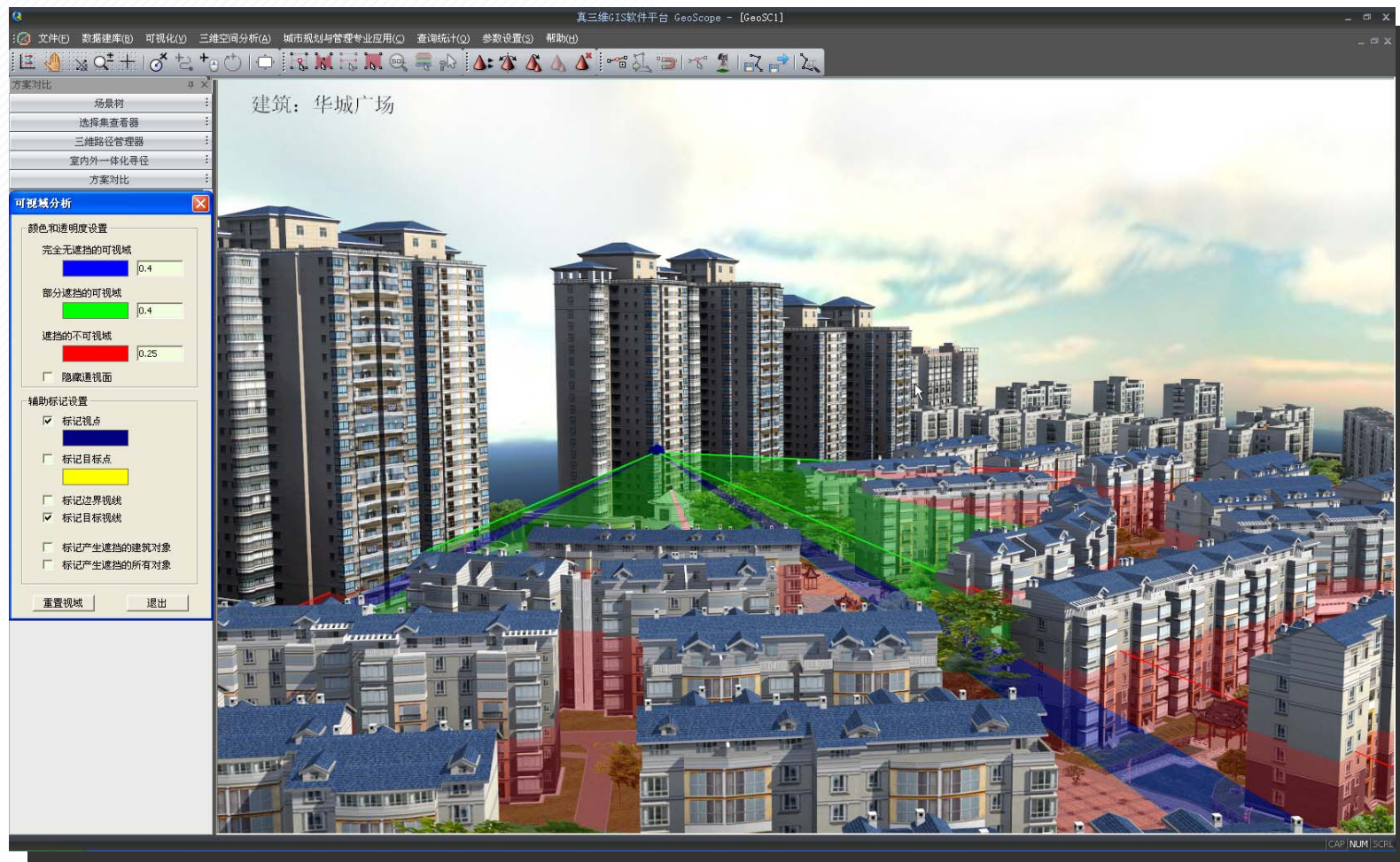
The Windows taskbar at the bottom shows several open applications, including "Inter...", "搜索结果", "Local...", "武昌...", "bin_Ocx", "JScri...", "oci - ...", "米命...", "两实系统", and "武汉...". The system clock shows "13:52".

64 analysis functions based on 3DGIS

Classification	Numbers	Detail
3D spatial query and measurement	7	Spatial distance/surface area/volume calculation, inner attribute query, etc.
3D surface analysis	10	excavation and filling calculation, visibility analysis, profile analysis, etc.
3D geometric analysis	10	Boolean operation, buffer analysis, Space convex hull calculation, etc.
Statistic analysis	9	Spatial regression/ clustering/ correlation analysis, etc.
3D mesh discretization	8	tetrahedron/ hexahedron division, TIN/Grid division, etc.
Network analysis	8	Indoor & outdoor routing, resource allocation, connectivity analysis, etc.
Typical application domain model analysis	12	sunlight analysis, geological analysis, watershed hydrology analysis, etc.

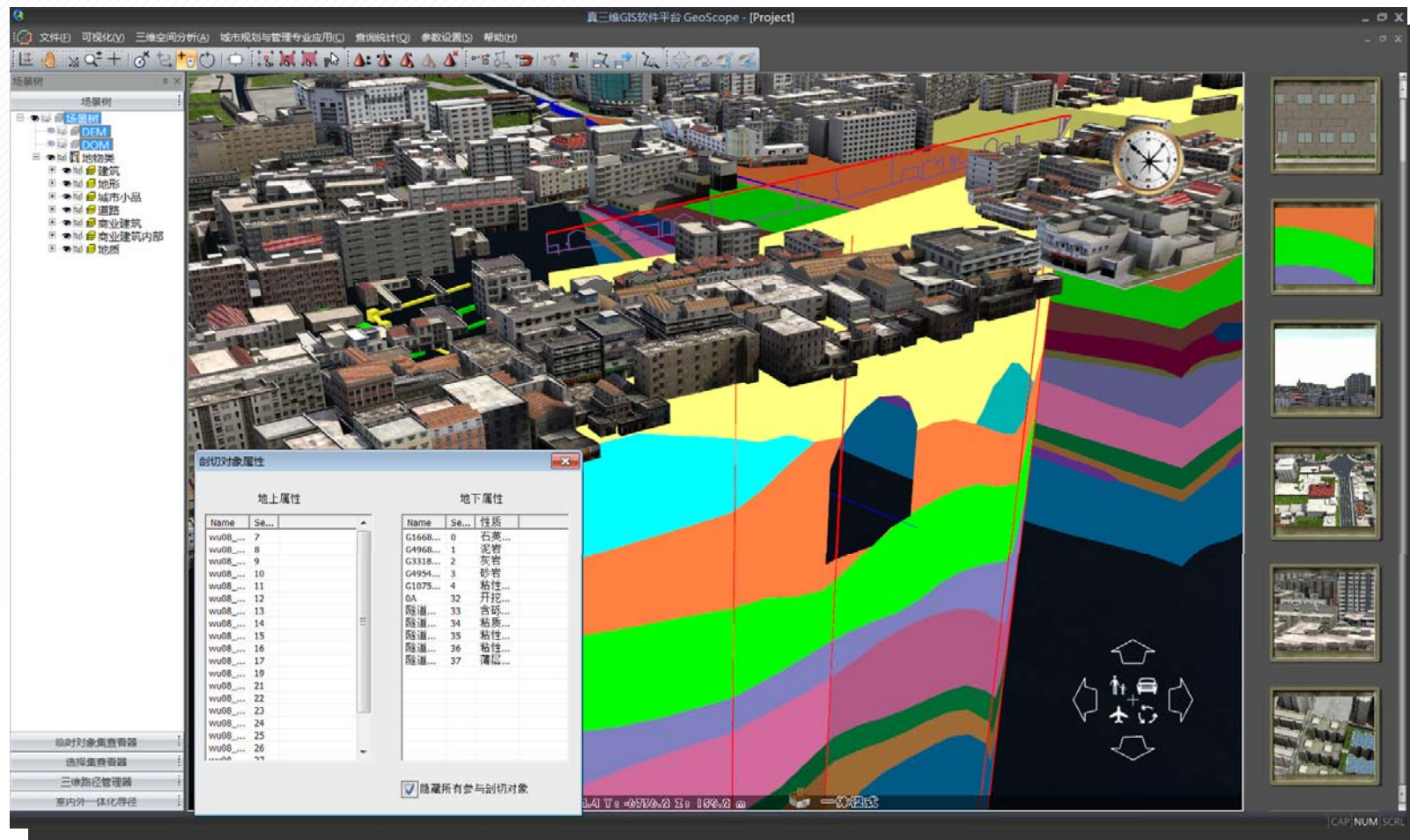
3D GIS-based analysis

3D viewshed analysis



3D GIS-based analysis

Full 3D profile analysis



3DGIS-based decision making

Indoor & outdoor routing for emergency response

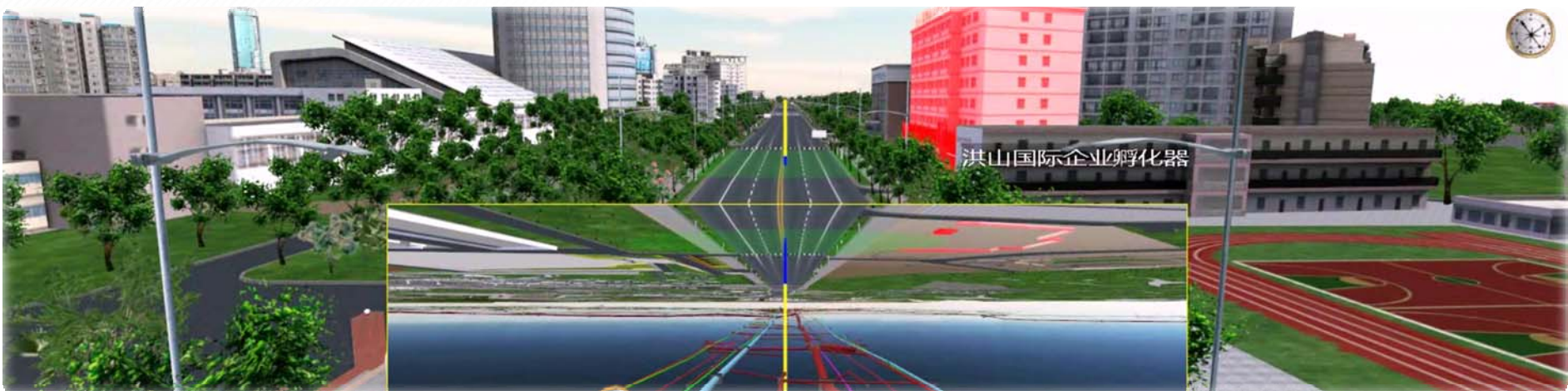


3DGIS-based visual exploring

Yangtse River Beach Park

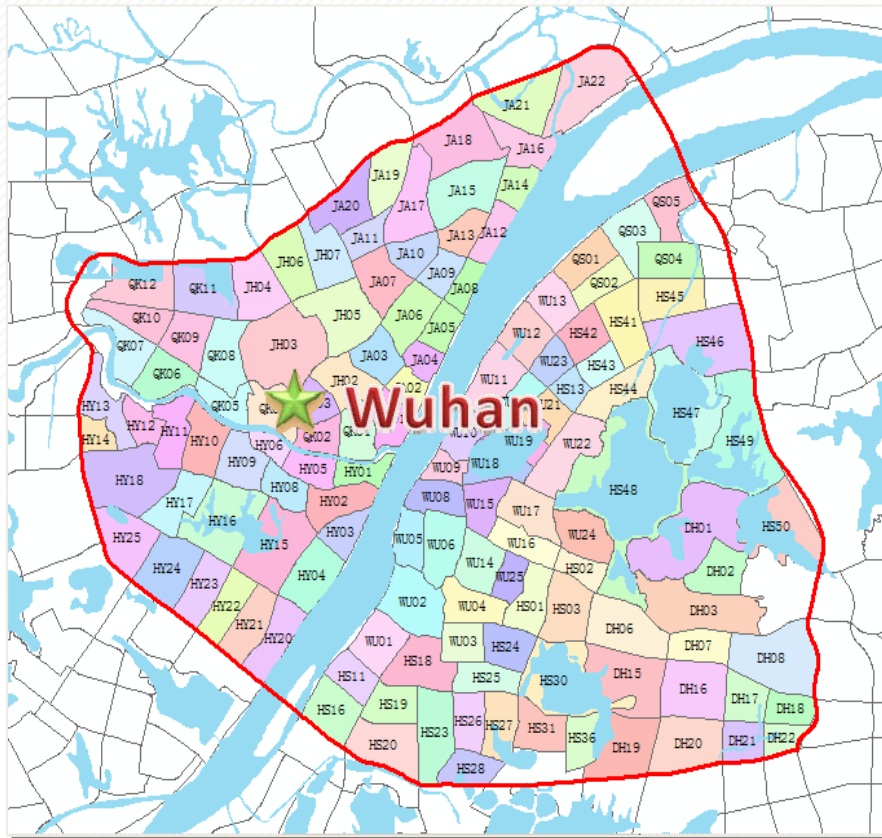


Synchronous exploration above and under the ground



3 Pilot applications

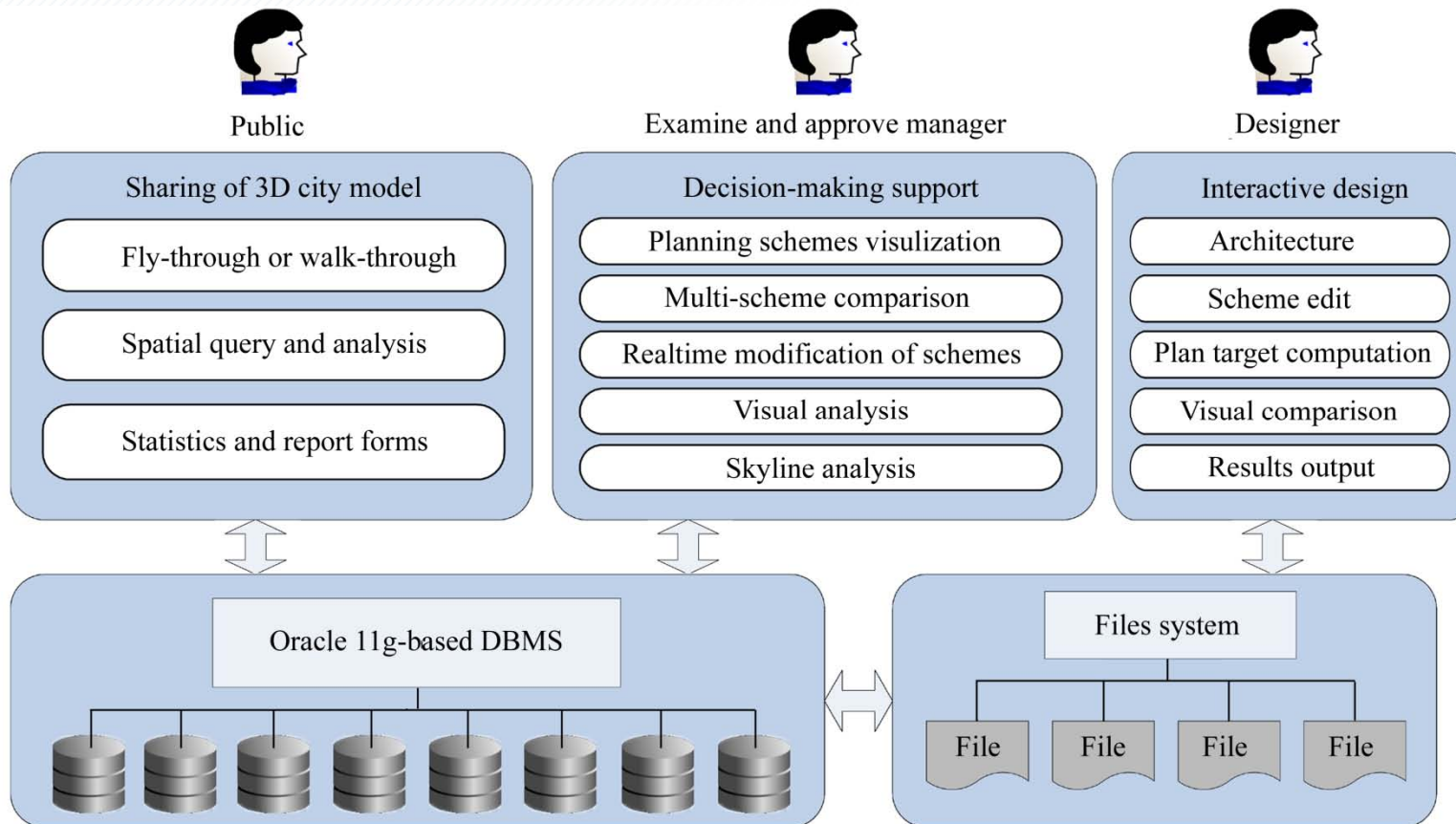
✓ covering the whole city area of 8494km²



- ① The largest accurate 3D city model DB
- ② The first Oracle-based 3D GIS for real time applications
- ③ High-performance 3D GIS with various geometric trees
- ④ One database and one platform, more applications

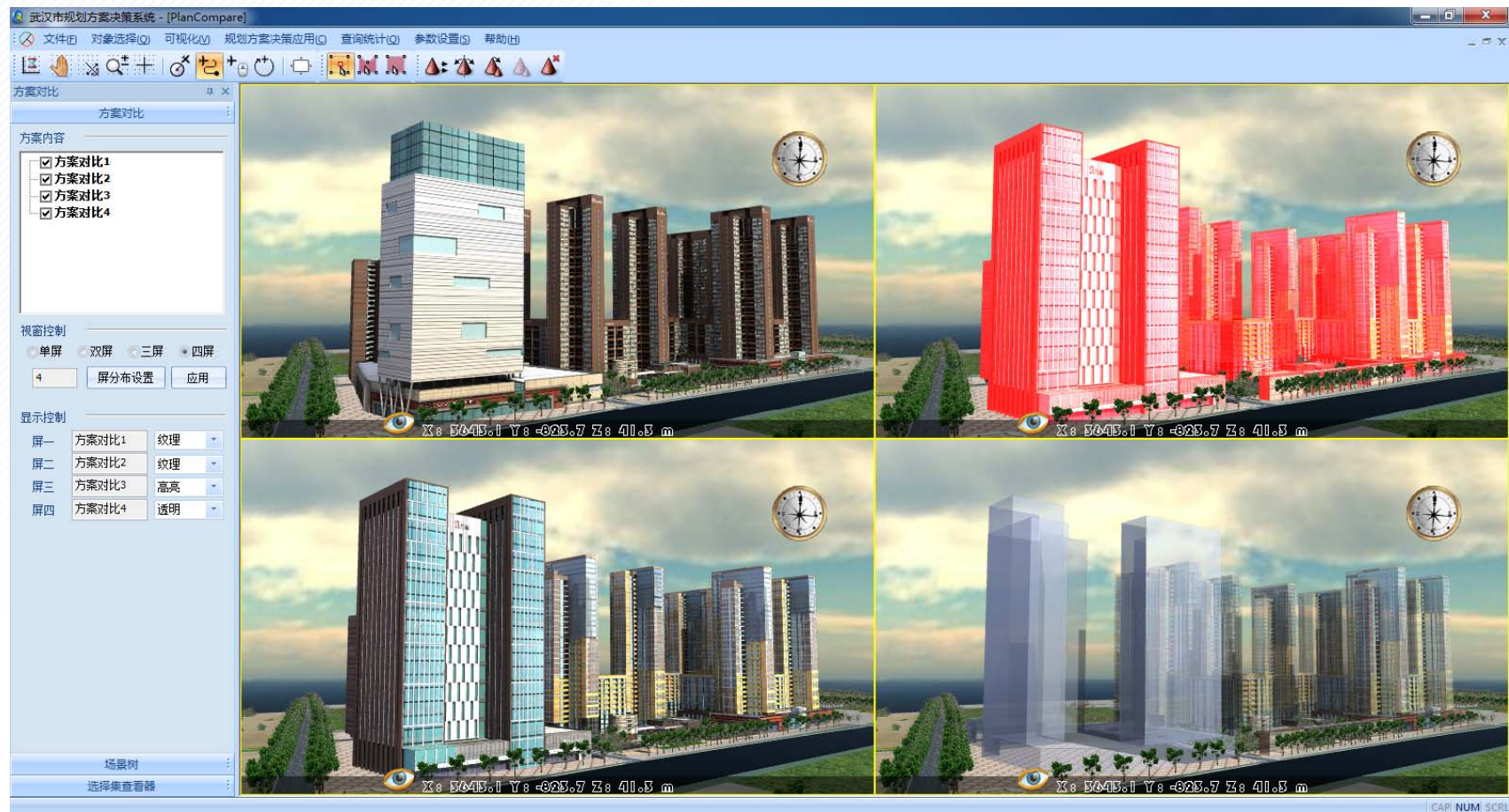
Pilot applications

Urban planning management based on GeoScope



Pilot applications

Multi-scheme comparison



4 Future work

GeoScope provides just the kind of scientific solution that supports a variety of professional applications with 3D representation, such as urban planning and design, facility management and maintenance, crisis management, and so on, at the scale of the whole city.

Further development will focus on the enhancement of its distributed geo-collaboration performance, as well as the extension of the integrative representation of dynamic 4D spatio-temporal phenomena, i.e., to support the creation of parallel computer mapping of the real world.

Participating Units



Wuhan University



China University of Geosciences



Zhejiang University



**Wuhan Land Resources and Planning
Information Center**



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Thank you