

ISPRS/ICA Joint Workshop on
Multi-Scale Representations of Spatial Data
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Multi-scale representations for scalable and dynamic 3D geoinformation services

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Abt. Vermessung und Geoinformation

Outline

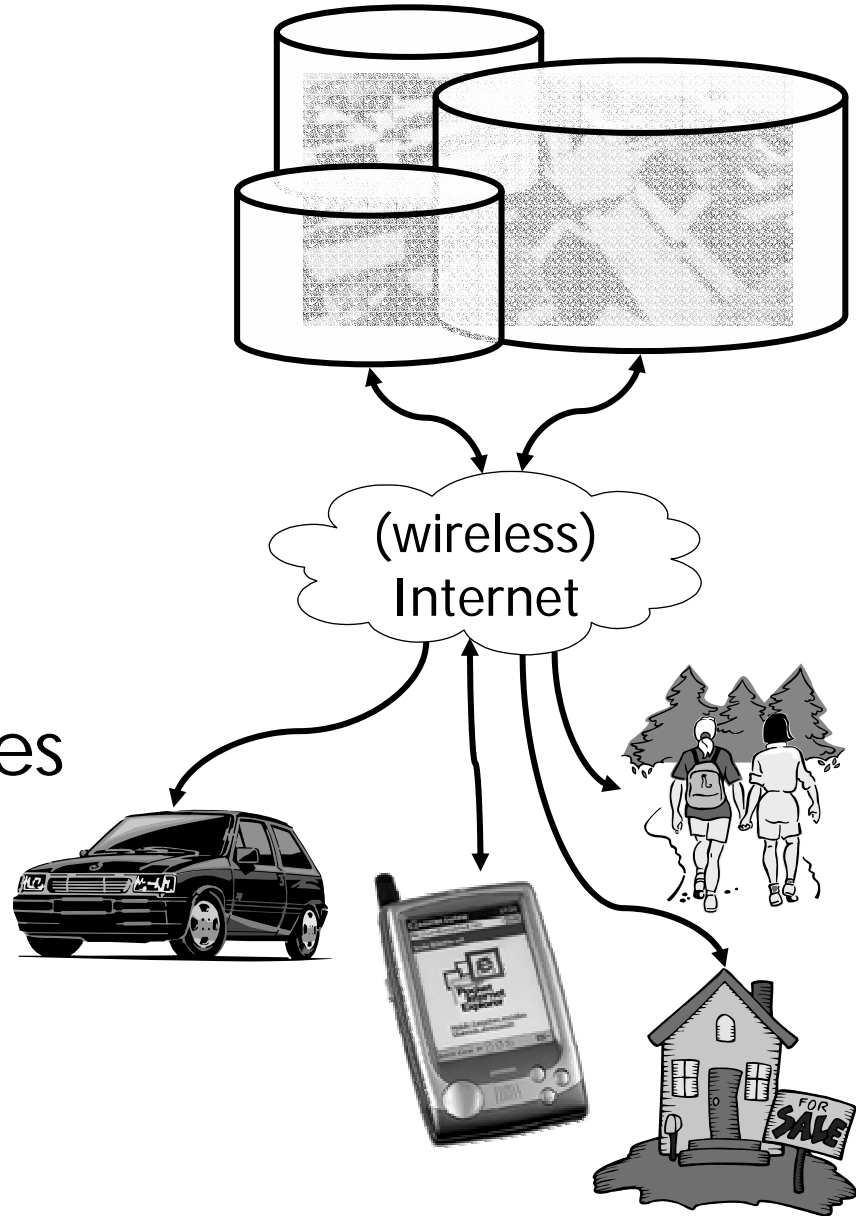
- Introduction
- 3D Landscape Models
 - Contents and Multi-scale Issues
- The DILAS Project
- Demo 3D-Landscape Visualisation
- Conclusions and Outlook

Motivation

regional or national
3D landscape and
city models
as the basis for
interactive information
and entertainment services

via

- (wireless) Internet
- interactive TV



Why 3D?

- 2D
 - today's standard
 - yet an 'unconventional' perspective
 - is there a need for anything else??
- Reasons for 3D
 - long tradition (panoramic paintings etc.)
 - 3D = spatial relations
 - 3D = personalisation / freedom
 - particular strengths ...
 - in urban areas
 - in hilly / mountainous topography
 - in combination with interactive, dynamic visualisations

2D vs. 3D - Comparison

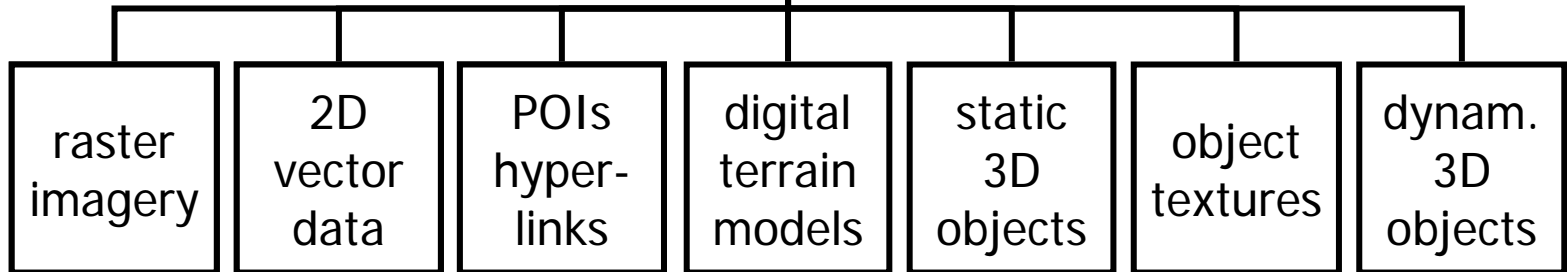
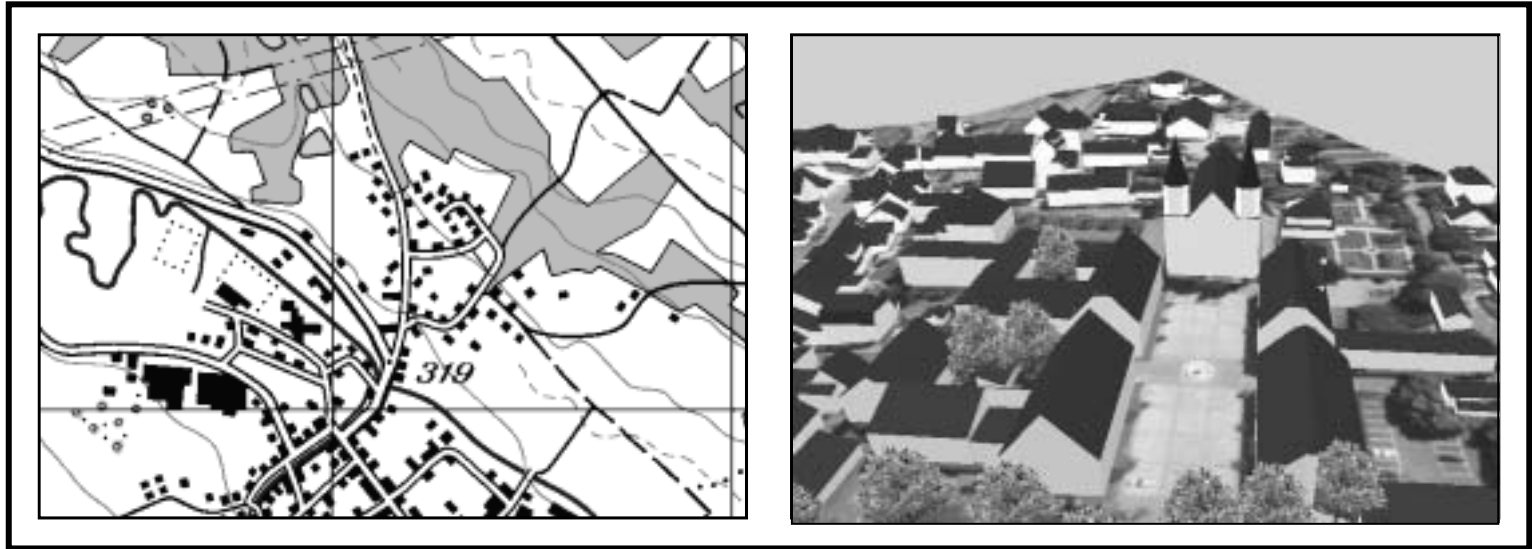
Multi-scale and multi-representation

- Common
 - simultaneous use of ...
 - multiple data sets
 - hybrid data sets
- 2D
 - one scale and one representation per view
- 3D
 - multiple scales and multiple representations per view

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2D & 3D Landscape Models



2D

3D

3D Multi-scale Representation Issues

- Terrain Texture
 - seamless multi-resolution pyramids, spatial access structures ... optimised for 3D visualisation
 - multiple discrete representations not suitable for 3D
- DTMs
 - goal: optimal terrain quality with minimal data
 - tessellation strategies: regular vs. irregular; rectangular vs. triangular; fixed vs. adaptive; hybrid concepts
 - optimisation strategies: server-driven (e.g. adaptive tessellation) vs. client-driven (e.g. use of terrain roughness)

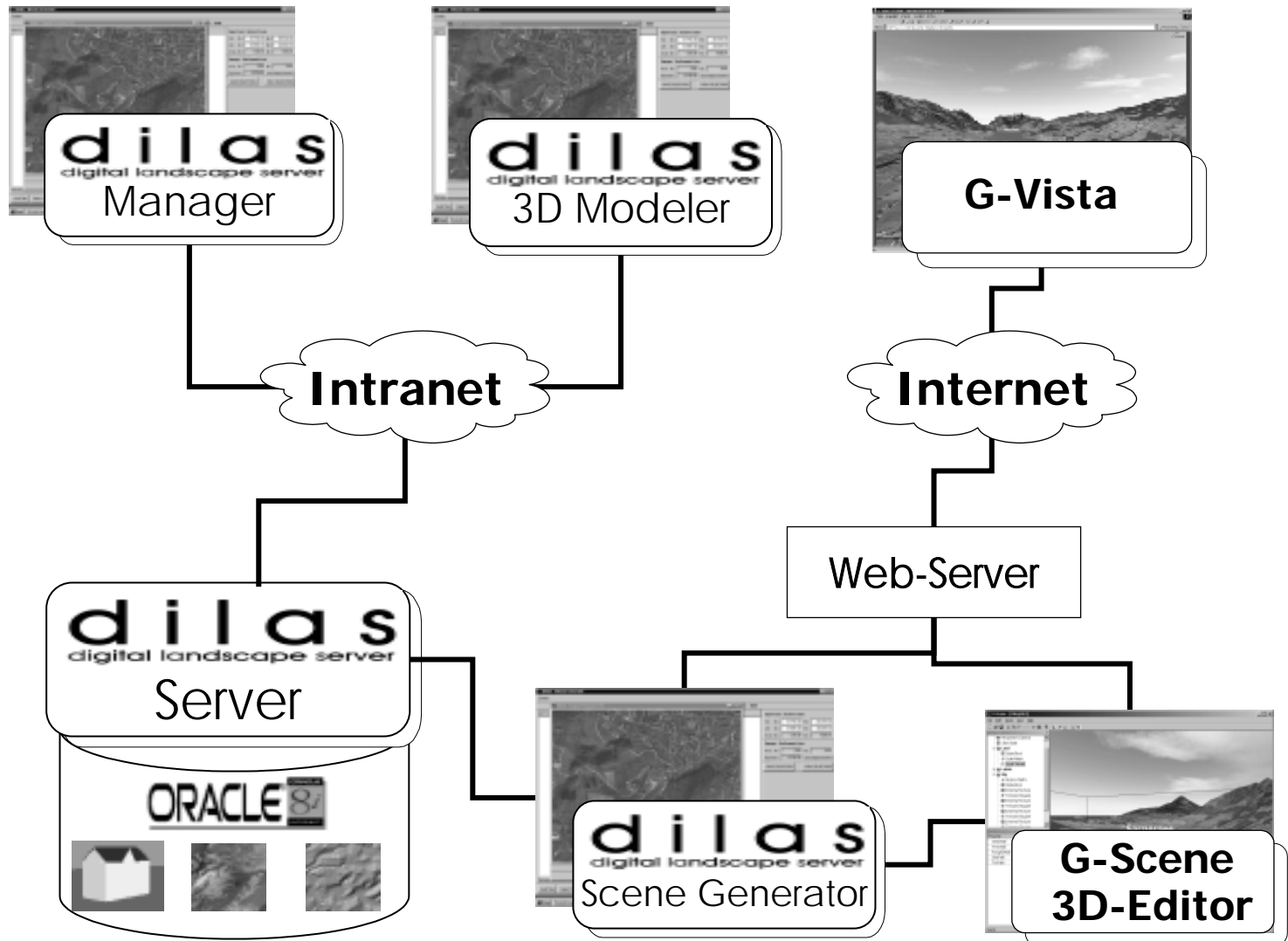
3D Multi-scale Representation Issues

- 2D Objects
 - key issue – but largely unsolved
 - open issues: simultaneous access to multiple representations; representation transition; topology in 3D MR-environment
- 3D Objects
 - model types / LOD: simplified block models, generalised 3D models, detailed CAD models
 - issues: discrete models vs. hierarchical progressive build-up; texture handling; (automatic) generalisation of 3D geometry; aggregation of 3D objects; integration of 3D into 2D GI environments

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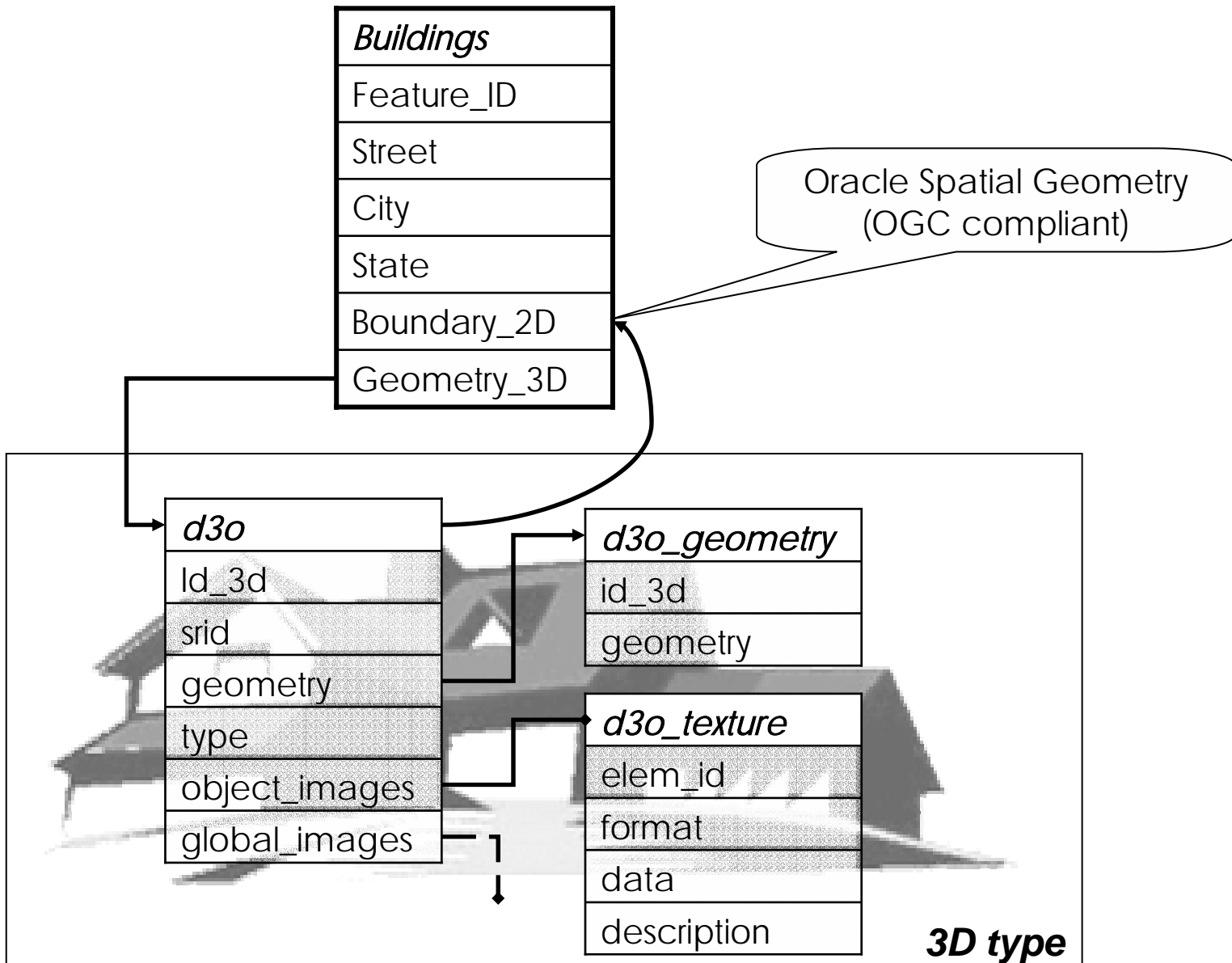
dilas System Architecture



3D Object Modelling and Handling

- 3D Geometry Model
 - 3D surface representation
 - using basic 3D geometry types
 - built-in support for multiple LOD
 - mapping to/from CAD geometry model
- Two equivalent representations
 - object model in Java
 - serialised objects in XML
- Storage / Management
 - persistence framework with object state monitoring
 - storage as 3D type in object-relational DBMS
 - flexibility and performance

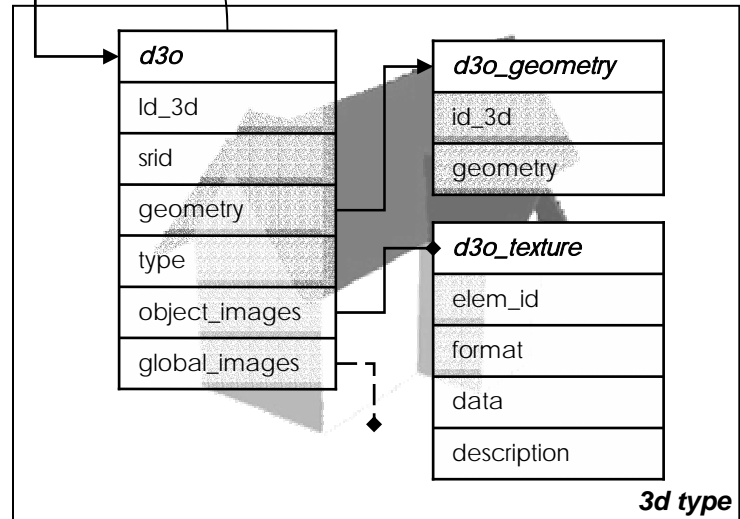
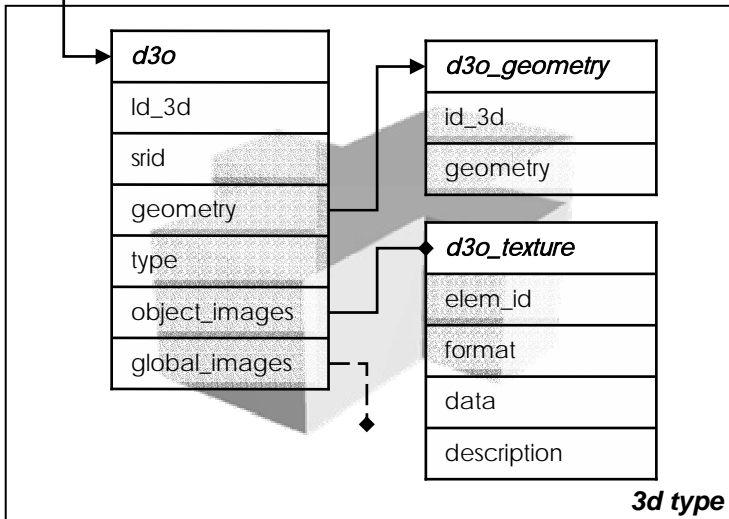
Integration of 3D Object Model into 2D GIS



Support for Multiple 3D Representations

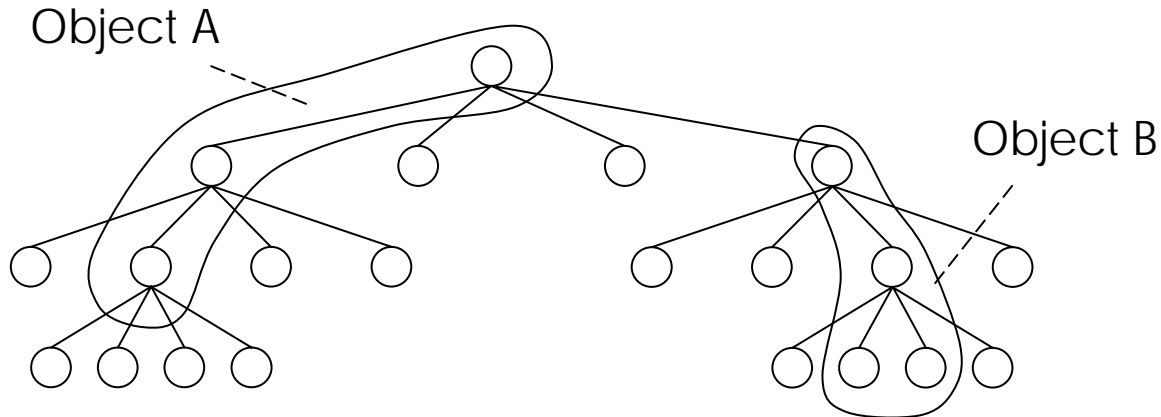
<i>Buildings</i>
Feature_ID
Street
City
State
Boundary_2D
Geometry_LOD1
Geometry_LOD2

Oracle Spatial Geometry
(OGC compliant)

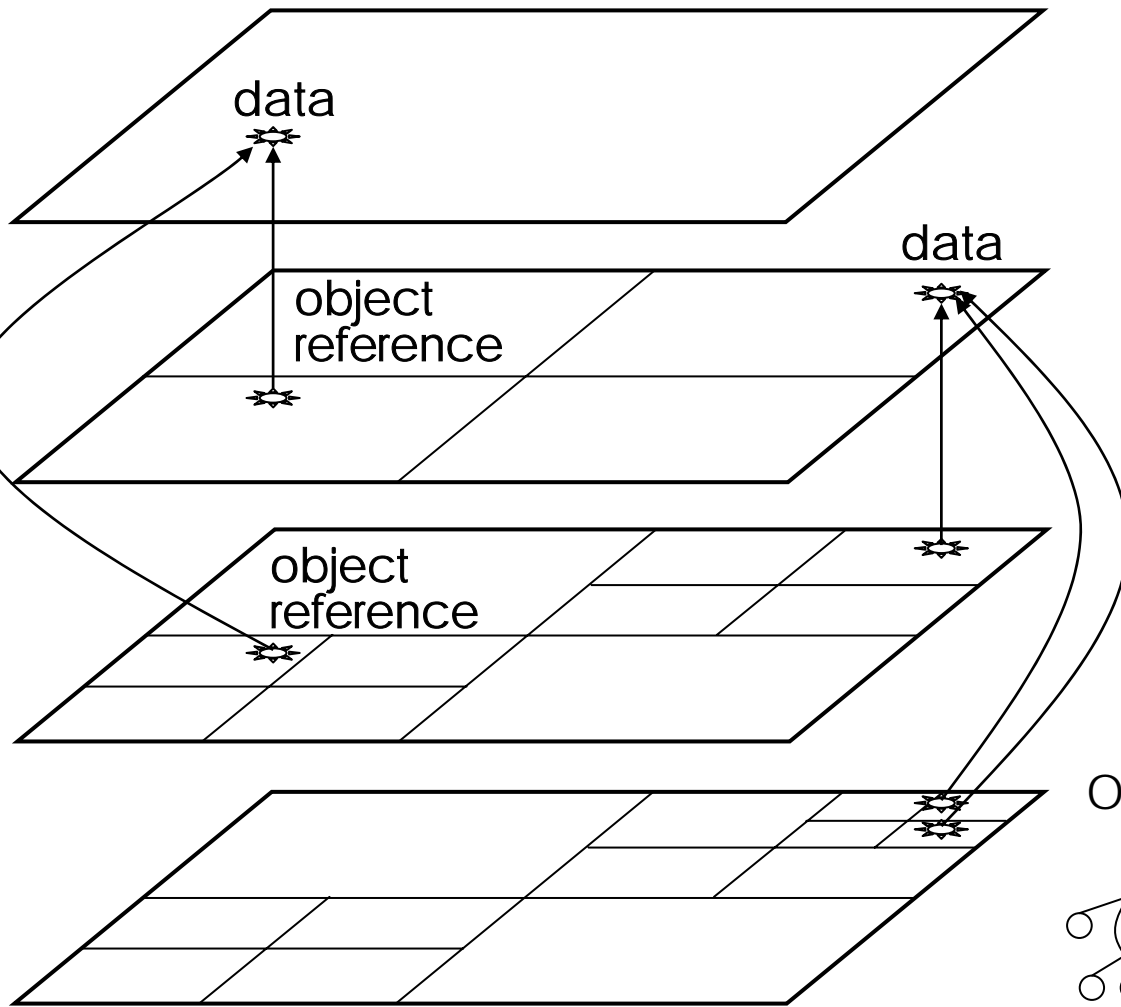


Quadtree-based Multi-Resolution Access Structure for 3D Objects

- Regional to national 3D landscape models ...
 - large no. of 3D objects and location-based hyperlinks
 - dynamic spatial access in low-bandwidth networks
- Solution
 - hierarchical quadtree-based data structure
 - support for levels of detail / multiple representation

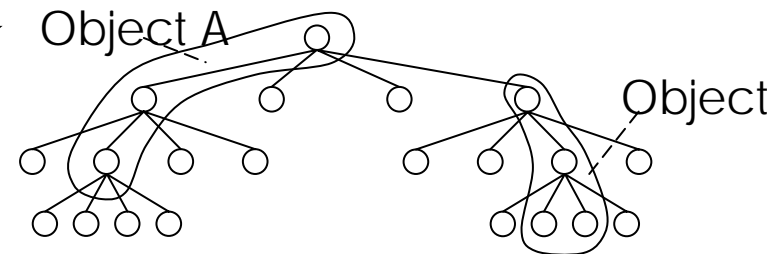


Quadtree-based Multi-Resolution Access Structure for 3D Objects



Implementation

- XML (1 file per tile)
- objects with OID
- lossless compression
- encryption

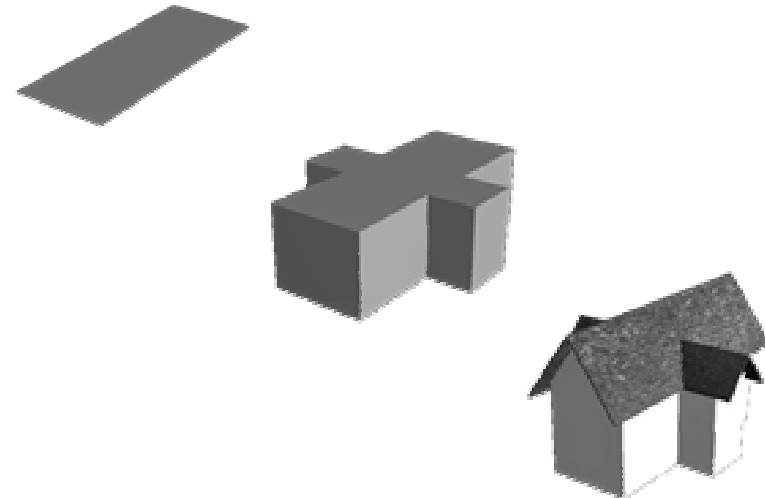
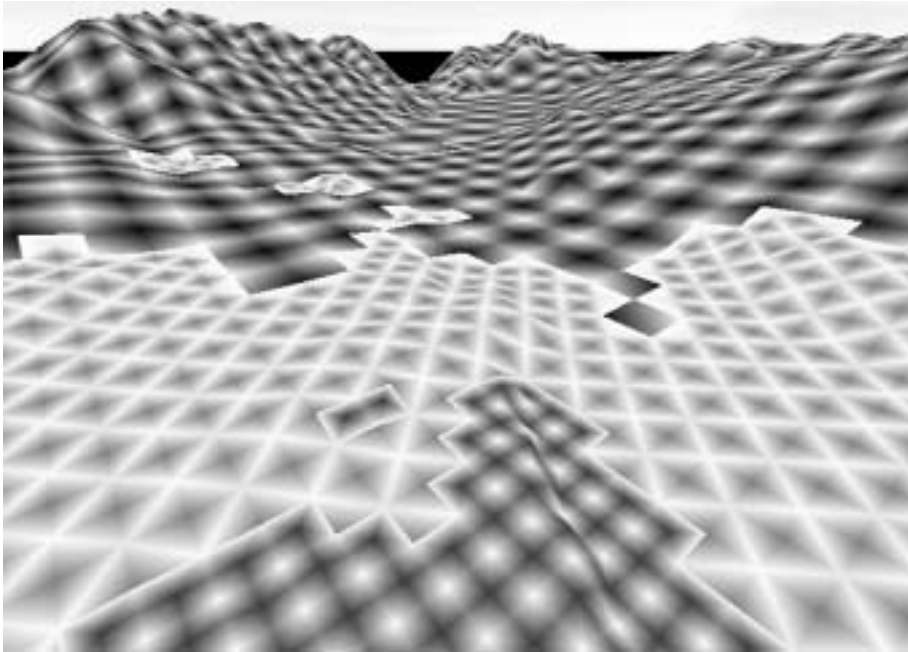


Web-based 3D Terrain Visualisation

- 3D Scene Data Generation
 - hierarchical, regular, rectangular tessellation
 - computation of terrain roughness information
- Hierarchical Data Formats
 - for texture, DTM including roughness information
 - supporting multiple data sets and regions of interest
 - new hierarchical format for POIs / hyperlinks and 3D objects on XML basis
- Data Transmission
 - HTTP-Service
 - MR data requests based on: viewpoint, viewing direction, viewing distance, terrain roughness

Web-based 3D Terrain Visualisation

- dynamic rendering: > 10 frames/s
 - max. $\approx 100'000$ polygons per image
- levels of detail (LOD)
 - for textures, height data & 3D objects
 - image, height & roughness pyramids



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Demo – MR in 3D Landscape Visualisation



3D landscape
hyperlinks
(www.obwalden-3d.ch)



3D city model
textures
Bridges
(Ittingen, Switzerland)

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Summary and Outlook

- Ongoing implementation of MS-MR concepts
 - first commercial version of DILAS in Q3/2002
- Large-scale 3D geoinformation services
 - a new but rapidly evolving field
- Future work
 - optimal integration: 3D objects with MR terrain models
 - integration of large 2D vector data sets
 - handling of inter-object topology in 3D multi-scale / multi-representation environments
 - user interfaces facilitating the use of MS-MR (!)

Thanks for your attention!

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Thanks for your attention!

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www.geonova.ch

