

Global Models and the W3DS Specification

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Challenges and Solutions

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Outline

- Background and Motivation
 - Digital Earth
 - W3DS
- W3DS and Global Models
 - Levels of Detail in VRML
 - Transient Global Models
 - Federating W3DS Services
- Efficiency Issues
 - Content Caching
 - On-demand Construction of 3D Objects
- Final Remarks

Vision I

“I believe we need a “Digital Earth”. A multi-resolution, three-dimensional representation of the planet, into which we can embed vast quantities of geo-referenced data.”

-Al Gore, former Vice-President of the USA (1998)
(or, more precisely, according to well-informed sources: Mike Goodchild)

Vision II

“A world in which everyone benefits from geographic information and services made available across any network, application, or platform.”

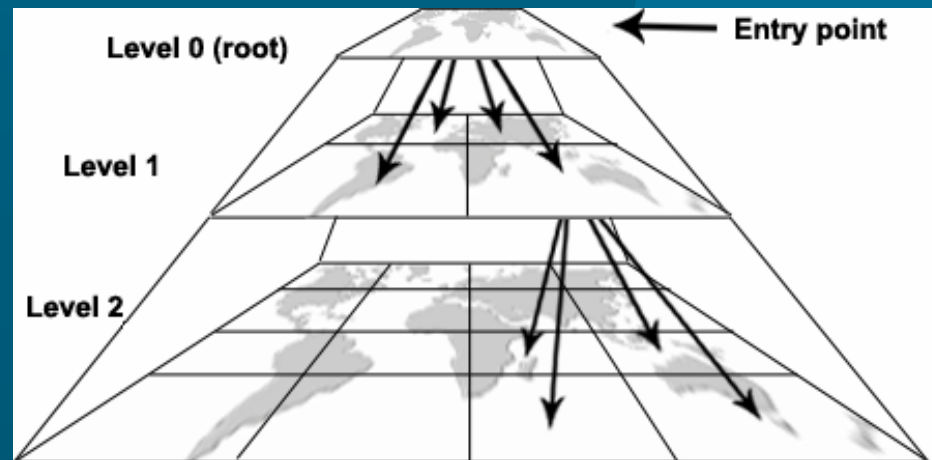
Open Geospatial Consortium (2005)

Web 3D Services Specification (W3DS)

- A standard for providing 3D visualizations of local geospatial content on the Web (Kolbe and Quadt, 2005)
- VRML, GeoVRML, or X3D
- Proposed OGC specification
- Why W3DS and Global Models?
 - Standards are important (WMS is a good example)
 - Global models are not much useful without some local content
 - "No man is an island"; the user might want to explore the surroundings and other locations within the same context

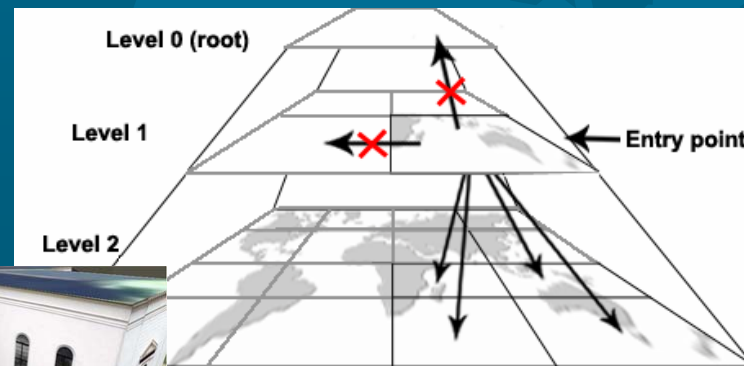
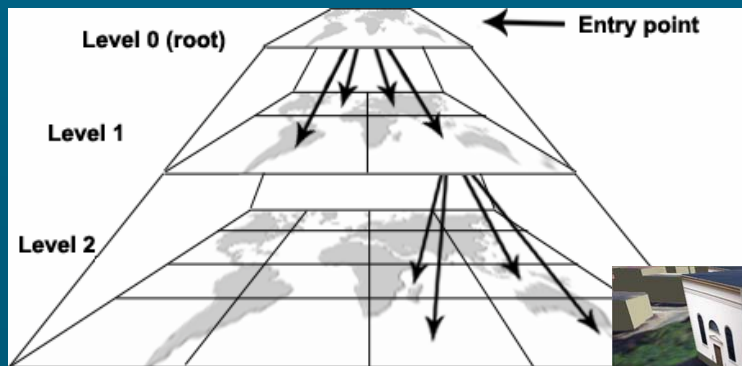
Levels of Detail in VRML

- Most common: Quad Tree LOD hierarchies
- One tile references four more detailed tiles by URLs:
 - static files or,
 - services that offer static models or,
 - services that generate content on-the-fly.
 - The services could preferably be W3DS.



W3DS Access to LOD Hierarchies

- Full flexibility in navigation requires top level access



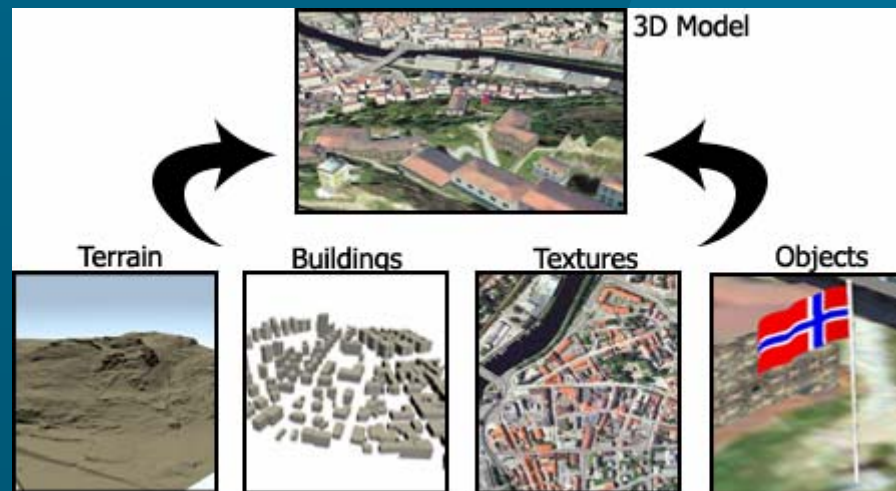
Transient Global Models

- A Digital Earth would be assembled from vast amounts of data
- Example:
 - Quad Tree Hierarchy with 25 levels
 - Each tile approx. 250kB
 - 100 Exabytes (10^{14} MB)
- Impossible to preprocess a complete model, not even in a heavily distributed setting
- Content has to be accessed, and perhaps generated, on-demand



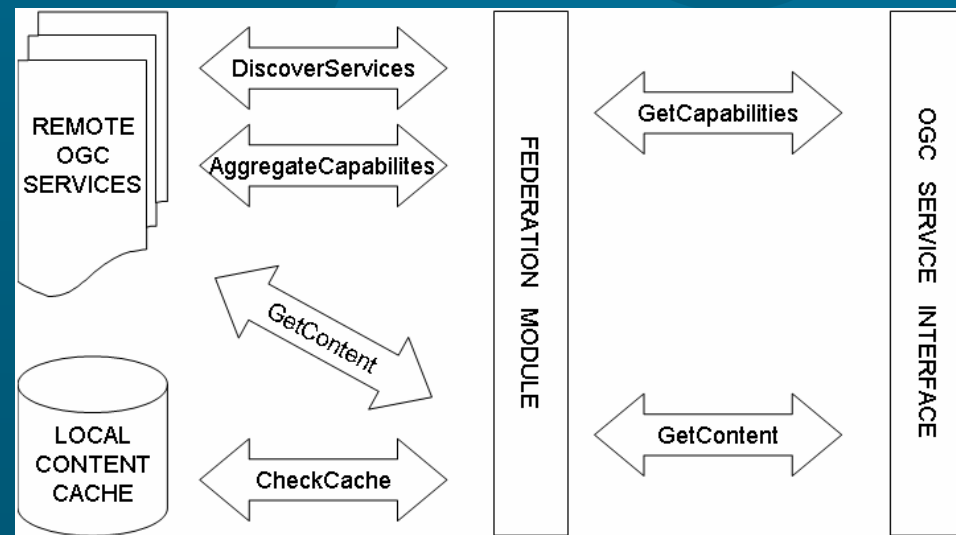
Distributed, Heterogeneous Sources

- Service Managers:
 - Scene Manager (W3DS)
 - Terrain Manager (WCS)
 - Texture Manager (WMS)
 - Feature Manager (WFS -> W3DS)



Federating Geodata Service (FGS)

- Distributed and heterogeneous data sources must be integrated somehow
- We propose a general design for a services manager, the Federating Geodata Service
- Basically an OGC compliant service, however with some additional functionality:
 - Discovery Module (dynamic registry)
 - Capabilities Module
 - Federation Module
 - Caching Module



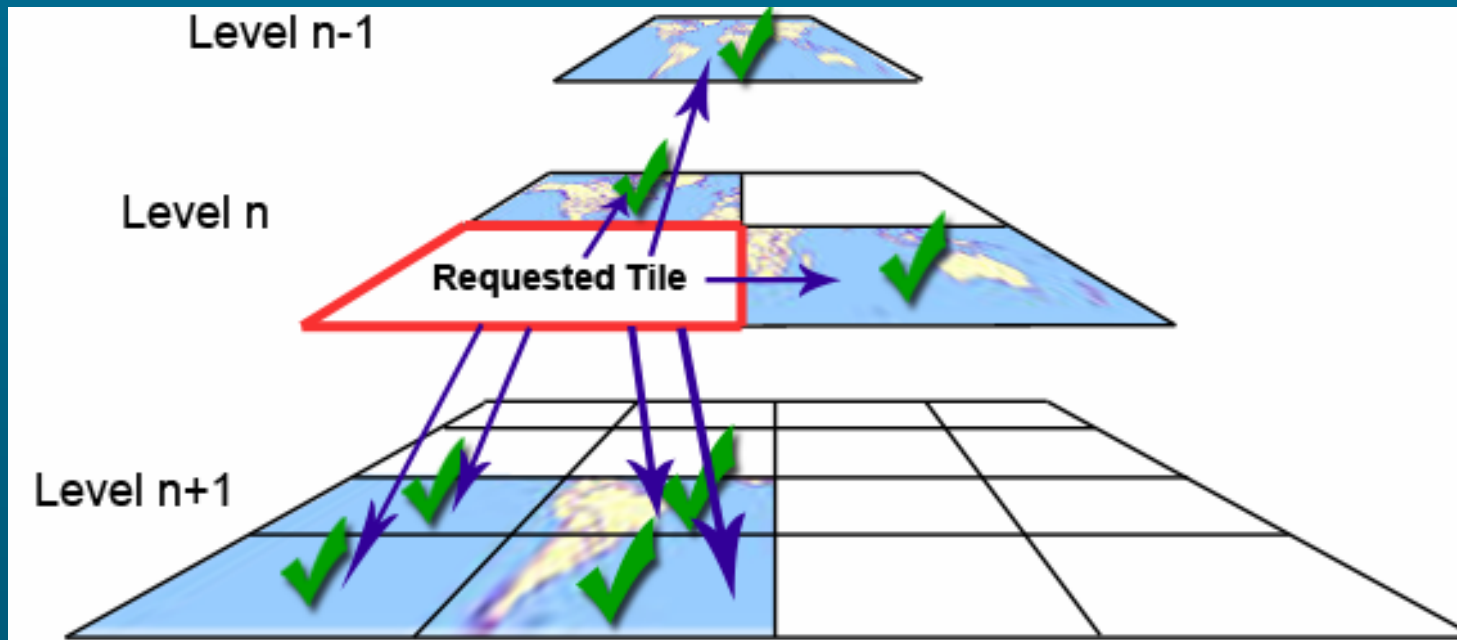
Proposed W3DS Extension

- In order to facilitate implementations of Federating Web 3D Services we propose the following extension:
 - The `GetCapabilities` request should return information about the supported LOD functionality
 - The `GetScene` request should accept parameters specifying the wanted LOD properties of the returning model
- This would enable a Federating Web 3D Service to control the overall LOD structure, hence providing full navigational flexibility

Content Caching

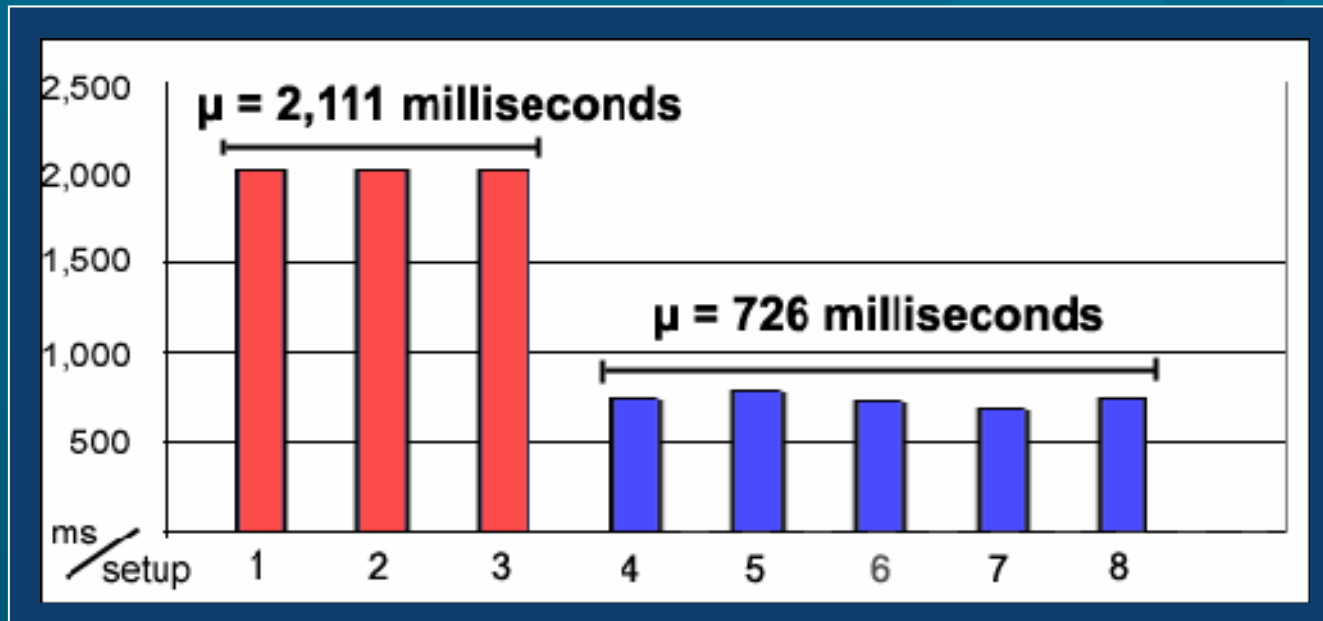
- Server side efficiency mechanism
- Needed because of the delays introduced by the transient and distributed data source paradigm
- Based on qualified guesswork
- Caching already requested data
- Pre-fetching: trying to predict data to be requested in the future
- Flushing / Garbage collection

Simple Neighborhood Pre-caching



Caching Results

- Tests show that caching can reduce the server-side delay by a factor of three



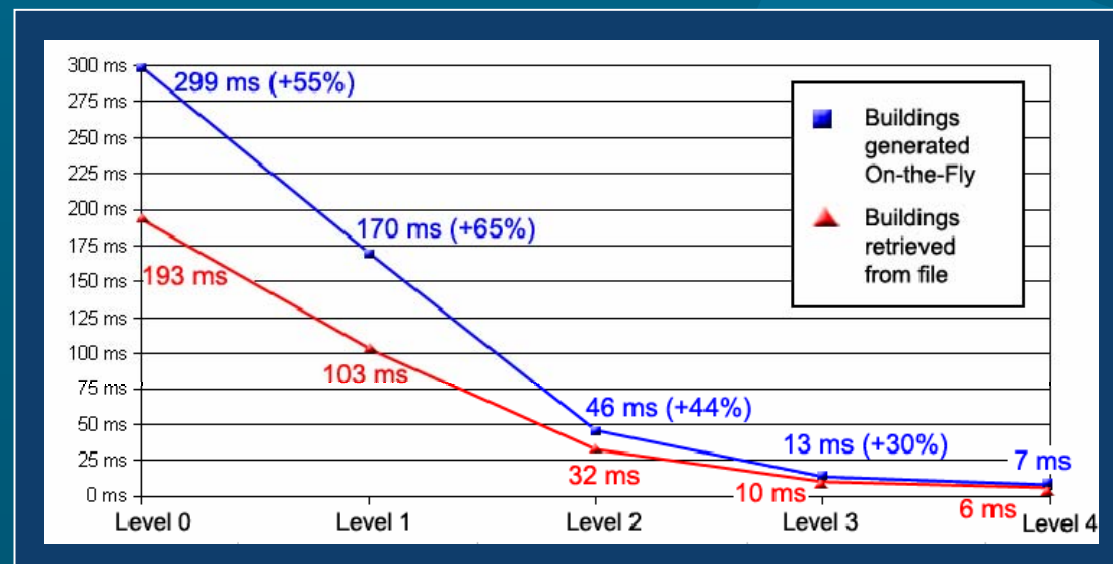
On-demand Construction of 3D Objects

- 2D/2.5D geospatial data is more available than 3D data, and there is reason to believe that it will stay like this for some time
- Generalization of 2D/2.5D is well (?) understood and widely applied, 3D generalization is inherently much more complex, and is still a science in its infancy
- In some regions, 2D/2.5D geodata is freely available on the Internet
- These are good reasons for investigating methods for generating 3D models directly from the original “map” sources



The Cost Of On-the-fly Content Generation

- Simple extrusion from footprints and building elevations
- On-the-fly vs. direct access: +50 %
- This is without utilizing server-side caching
- Efficient caching may cancel out the overhead incurred by on-the-fly content construction



Final Remarks

- The proposed approach is feasible
- Cheap and "simple" solution (open source / free software)
- Client requirements: Standard PC, decent graphics card, broadband network access and a VRML viewer
- Efficient caching may cancel out on-the-fly overhead
- With the proposed extension of the W3DS specification, it may become useful also for global models
- Remaining challenges:
 - Viewer problems
 - Real life implementations of the Federating Geodata Services
 - We welcome all kinds of collaboration!

***Thank you for your
attention!***

Thanks to Halden Municipality for granting us
free access to their geodata

This work is part of Project OneMap
www.onemap.org