Gunnar Misund,
Morten Granlund
Herman Kolås

Østfold
University
College

OneGlobe

Building and Browsing a Transient Digital Earth from Distributed, Heterogeneous Sources

Vision 1

“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)

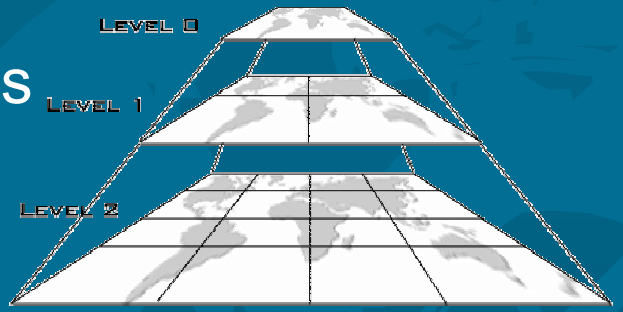
Vision 2

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

Open Geospatial Consortium (2005)

Distributed Data Sources

- A Digital Earth would be assembled from vast amounts of data.
- Example:
  - Quad Tree Hierarchy with 25 levels
  - Each tile is 250kB in size
  - 100 Exabytes (10^{14} MB)



- Using distributed data sources is inevitable!

Why Transient Models 1

- There is a long tradition when it comes to maintaining/managing 2D geodata sets
- Lots of 2D geodata exists on the Internet

Why Transient Models 2

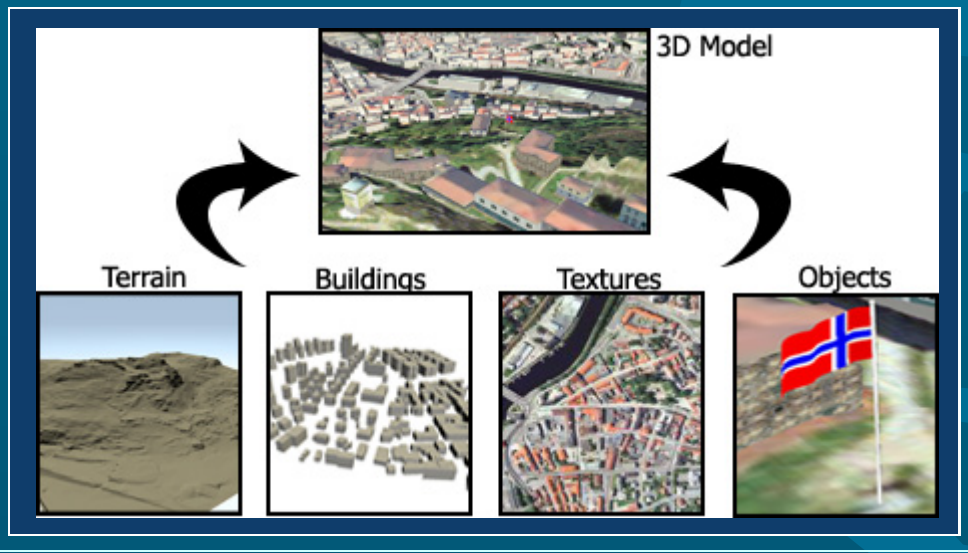
- OGC's Web Service specifications are often a free-of-cost backdoor to otherwise proprietary geodata
- 2D geodata is often more up-to-date than its 3D equivalent

Why Heterogeneous Sources?

- More data from more sources
- You may go directly to the sources
  - Better accuracy
  - Better updated
- ?

Heterogeneous Sources

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



Design Goals 1

- Ubiquitous Access
  - VRML97 (X3D)
  - Allow Thin Clients
  - Platform Independency

Design Goals 2

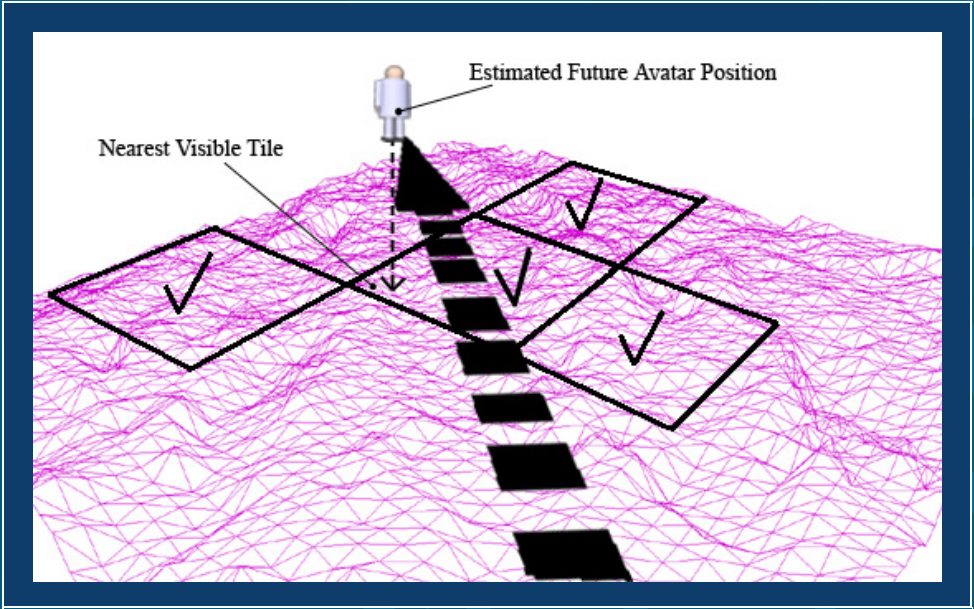
- Technological Sustainability
  - Horizontal Integration
  - Open Standards
  - Modular Design
  - Fault Tolerance / Fall-back Mechanisms

Server-side Heuristics (SSH)

- Efficiency Mechanism on the servers
- Based on qualified guesswork
- Caching is central
  - Caching already requested data
  - Trying to predict data to be requested in future
- Needed because of the delays introduced by the transient and distributed data source paradigm

SSH Strategy

- Which strategy to choose depends heavily on:
  - The quality/accuracy of the SSH input (session data)
  - The “freedom of navigation”
- Two categories
  - Precaching
  - Flushing



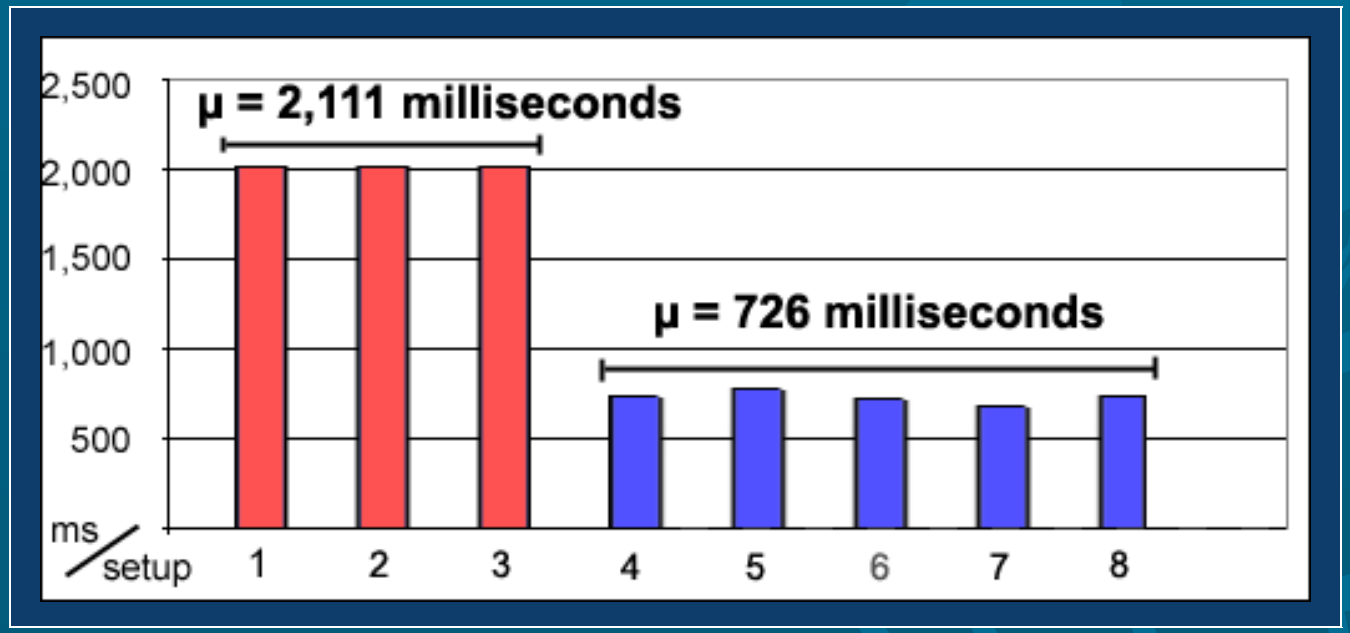
A combination of several pre-caching strategies

Example strategies:

- Precaching
  - Neighbor tile precaching
  - Random tile precaching
  - Extrapolation precaching
  - Combination
- Advanced Flushing
  - Distance from Viewpoint
  - Time since last requested
  - Time since creation
  - Number of times previously requested

SSH Results

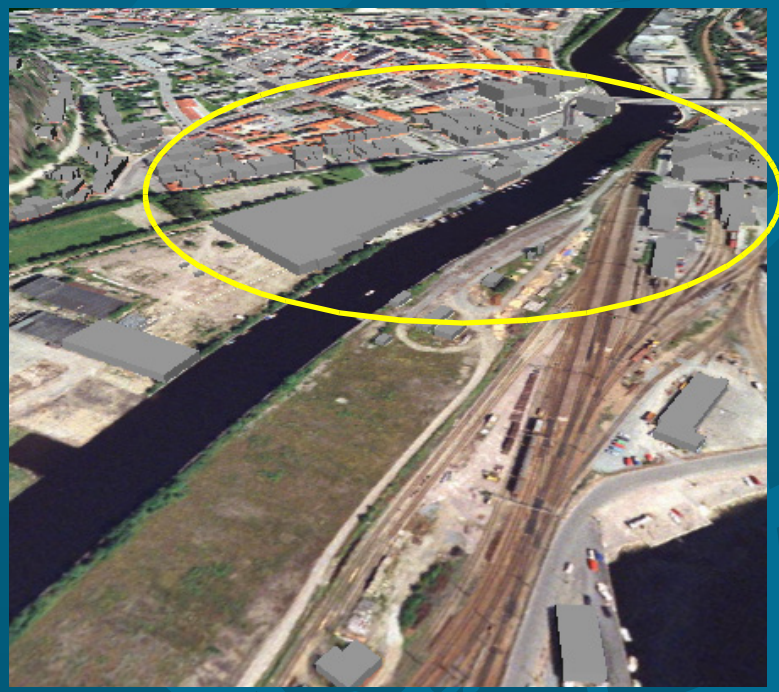
- Tests show that SSH can reduce the server-side delay by a factor of three!



On-the-fly Generation Paradigm 1

Static terrain…

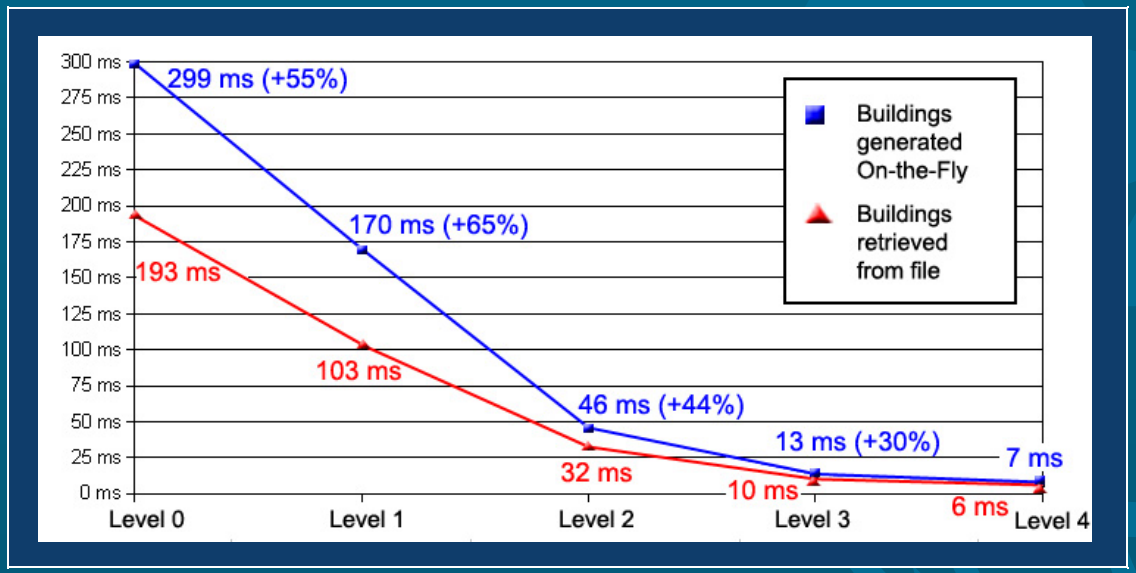
Zoom



…with a transient web service that generates buildings on-the-fly.

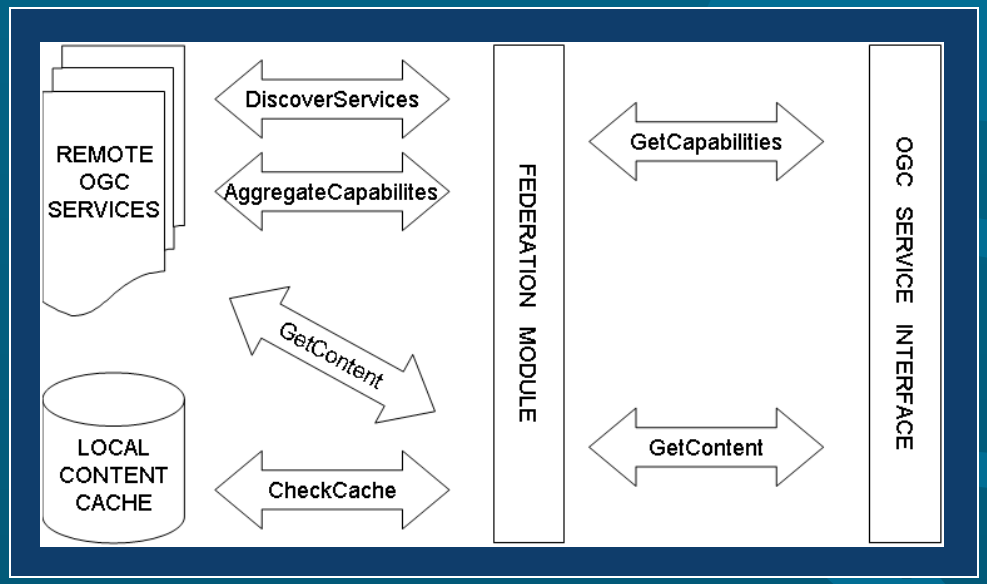
On-the-fly Generation Paradigm 2

- On-the-fly vs. Direct Access: +50 %
- This is without utilizing Server-side Heuristics



Federating Geodata Service

- Distributed and autonomous data sources must intercommunicate somehow.
- OGC compliant service, implementing a Federation Module.



The OneGlobe Prototype

- A proof-of-concept prototype

Combining static and on-the-fly