3D webservices - where do we stand?

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Camptocamp

- Open Source Service Provider
- Staff 49
- Switzerland, France & Austria
- Since 2001
Camptocamp: 3 divisions

GEOSPATIAL
- Web-GIS Portals
- Spatial Data Infrastructure (IDS)
- Mobile applications

BUSINESS
- Enterprise Resource Planning (ERP)
- Business Intelligence, Reporting

INFRASTRUCTURE
- Virtualization, Cloud Computing
- Automation of system administration
- Deployment of complex architectures

ADVICE, STUDY, R&D

IMPLEMENTATION

SUPPORT

TRAINING
Google Maps
Here maps (Nokia)
OpenWebGlobe
Geospatial 3D Web expectations?

■ 3D Scenes
  ○ Aerial imagery and terrain
  ○ Buildings with textures
  ○ Label and marker
  ○ Rich interaction (Navigate, pick, popup, measure, usw.)
  ○ Global perimeter, higher local resolution

■ Technology
  ○ **Web** (no plugin), Cross Platform and Cross Device
  ○ **Open Standards** and Formats
  ○ **Open Source**

■ What's available?
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Web ?
WebGL!

- Web Graphics Library
- Javascript API for rendering interactive 2D/3D graphics within the web browser
- Hardware acceleration using the Graphics Processing Unit (GPU)
- WebGL Programs consist of:
  - Control code written in Javascript (CPU) and
  - Shader code that is executed on a computer's GPU
- No Plugin! Also in IE11!!!
- Mobile device ready: Firefox, Sony Android Browser, Opera
Open Standards ?
Standardizing and Merging worlds

- Geo: OGC
  - 3D Portrayal Services (Proposals: WVS WMS-Like & W3DS WFS-Like)
  - KML – XML/COLLADA
  - CityGML - representation, storage, and exchange
  - CZML (AGI/Cesium)?

- Geo: OSGEO
  - TMS (Cesium Terrain Server z.B)

- Web: Web3d
  - X3D - Extensible 3D Graphics

- Graphics: Khronos Group
  - COLLADA – eXchange / interoperability
  - glTF – graphic language Transmission Format
3D Portrayal Service (3DPS)

Goal:
- Standard service interface to visualize very large 3D geospatial databases online via Web-Browser and Mobile Devices
- 3D Scenegraph and image based rendering
Model Challenges

- Compact object representation
  - Bandwidth

- Progressive transfer
  - Streaming
  - LOD

- Fast Model Display
  - GPU intensive, reduce CPU usage

- Application/Software independent
  - Standard

Mesh encodings for X3DOM: Recent Advances by Max Limper and Johannes Behr, Fraunhofer IGD
X3D Geometries

- Basic primitives (Box, Cone Cylinder, Sphere)
- IndexedFaceSet (3D shape formed by constructing faces - polygons) `<IndexedFaceSet coordIndex='0 11 12 -1 12 1 0 -1 etc />'
  
  `<Coordinate point='0.7000 1.2000 0.0000, 0.6930 1.2177 0.0000, etc />'
  
  => Large HTML pages, CPU + Loading time

- X3dom optimizations
  
  - Binary Geometry employs several files to store the index and geometry data directly in the requested precision
  
  - Progressively Ordered Primitive (POP) Buffer
CZML - Cesium Language

- Describes
  - Graphical scene
  - Time-dynamic data

- Characteristics
  - JSON structure
  - Line, points, markers, models
  - Describes changes over time
  - Supports datastreaming
  - Extensible
glTF graphic language Transmission Format

- JSON used to describe node hierarchy
- Node hierarchy refers to EXTERNAL binary asset blobs
  - Geometry, Texture, Material
- Non-compressed asset blob format
  - Direct load in WebGL
- Extensible
  - Streaming and compression

Careful design of glTF uncompressed binary is giving good loading performance boost - even before compression.
Open Source Software ?
Open Source implementations

- PostGIS – stores and exports 3D data
  - Export X3D data: ST_AsX3D

- Geoserver
  - Provides a W3DS API (getScene & getTile)
  - X3D & Cesium Terrain API

- X3dom
  - JS API for displaying and interacting with X3D data

- Three.JS
  - Rich 3D model visualisation

- OpenWebGlobe & CesiumJS
  - Full geospatial suites to process and display/interact with 3D in the Web
PostGIS/Geoserver W3DS/X3D/X3DOM
**X3DOM**

- Experimental Open Source Framework
- Display 3D models with WebGL
- Web3D & W3C Standardizing Process
- Goal: 3D objects in the Web
- Easy to use (HTML5 DOM)
- Supports HTML Events (Ex: OnClick)
X3DOM – JS Library

Information

Description:
This 3D model is rendered by the X3DOM- 
BVRrender: mode which refines and loads hierarchical 
data dynamically corresponding to the view point.

3D-Model Statistics:
- Model: Puget Sound
- DataSet: 4096 x 4096 pixels
- Points: 16,777,281 (~46.5 Mio.)

Rendering Statistics:
- Rendering speed: 45.32 fps
- Currently drawn points: 1,663,287

Parameters
Three.JS

- Lightweight xBrowser JS library/API
- Goal: create and display animated 3D computer graphics on a Web browser.
- HTML5 SVG/WebGL
- Proprietary format + glTF
Three.JS examples

QGIS export (c) http://anitagraser.com/

Procedural city (c) http://mrdoob.com
OpenWebGlobe

- Helps you to create your own virtual globe applications running plug-in free in a web browser
- Allows the visualization of large scale image, elevation or other geospatial data
- OpenSource (MIT License)
CesiumJS

- Javascript Software with WebGL for displaying
  - 3D virtual globe
  - 2D map
  - 2.5D Collombus View
- Time-dynamic Scenes with CZML
- Multiple terrain sources
- Overlays:
  - Raster: WMS, TMS, OSM, Bing & Esri
  - Vector: glTF, CZML, KML, Shapefiles
- Extensible with plugins
Cesium – 3 views, WebGL
CZML 3D + time-dynamic display
Cesium – Terrain + Overlay
Cesium Sandcastle
OpenLayers 3 – Cesium Integration
Conclusion

- High activity in the 3D WebGL domain
  - Big Players set public expectations
  - Ongoing standardizations efforts
  - WebGL momentum (Microsoft is now on board)

- Consider:
  - Data quantity to be stored and processed in the backend
  - Data transfer and streaming with different LODs
  - Deliver data for the GPU, avoid CPU processing AND Provide access to semantics for the CPU
  - Web3D implementations have limited encoding possibilities applied to the geospatial world