Approaches to WebGIS in times of unstable or weak Internet connections

Till Adams, terrestris GmbH & Co KG
Preface

- The talk addresses (e.g.) to decision makers but also to anyone who plans to setup a WebGIS

- This talk aims on sharing some hints based on experience regarding the setup of WebGIS
  - This applies not only to the African continent where Internet connection may be weak
  - I come from Germany, where the same applies :-)
Agenda

- Short introduction terrestris & Till Adams
- Some thoughts on the title of the talk
- Overview on the status of Internet connectivity in Africa
- Approaches on WebGIS
Short introduction terrestris & Till Adams
Till Adams

  - Managing director mundialis
  - Consultant for “Geospatial challenges“

- Open Source enthusiast since late 1990's
  Community activities:
  - OSGeo Charter member, Chair of Osgeo’s conference committee
  - Chair of FOSS4G 2016 in Bonn/Germany
  - Board of Directors FOSSGIS e.V. (German speaking OSGeo chapter)
  - Board of Directors OSGeo-Europe
terrestris – some basic information

- founded in summer 2002
  - 16 employees
  - located in Bonn, Germany
  - customers from public and private sectors

- In 2015, the shareholders founded the partner company mundialis

- terrestris is a technology service provider specialized in geoinformatics with Free Software
  - ‘from support to the final solution’
SHOGun Harmony

- Ready-to-use WebGIS Suite from Open Source components
- 4 freedoms:
  - various GIS clients
  - Database-independent
  - Functionally open (plugin interface)
  - Content open (upload & publication of geodata)
- User administration or LDAP/CAS
Thoughts on the title of the talk:

“Approaches to WebGIS in times of unstable or weak Internet connections“

What means “WebGIS“?
What is weak and what is unstable?

Why is SDI important to Africa; what benefits does it hold for the continent?
SDI is of great value to Africa, firstly because geo-information is fundamental. Whichever way you look at it, it is almost a prerequisite for development of the continent. In addition, scarcity of resources means we have to adopt approaches that will maximise the little investment that is being made. Geospatial data should be collected once and used in as many applications as possible, hence the need for SDI.

from https://www.gim-international.com/content/article/spatial-data-for-africa
What means “WebGIS“ ?

from: https://www.camptocamp.com/de/solution/web-mapping/
What means “WebGIS“?

- Desktop GIS moved to the Browser?
  - Example: Geodata-infrastructure for Water Authority in Germany
    - WebGIS replaced Desktop-GIS
      - upload of Feature Types
      - digitize in Browser
      - huge Print Module
    - [...] 
  - WebGIS is a medium that is capable to spread geo-related information to a (un)controlled mass of people
    - Example: RESIMAO 2006 “Market Price Information System“
      - Geographical Information was requested and sent via SMS
WebGIS features

- webbased GIS allow web-clients to access geospatial data and functions
- no expert-knowledge for usage is required
  - if the system’s design takes the user into account, so Decision Makers can be involved and make use of Geospatial Data
- Users access centralized (up-to-date) database
What is weak and what is unstable?

- **Weak** means that transfer rates are low
  - strong local/regional variations

- **Unstable** means, that internet access may break down temporarily
  - also addressable to regions with no internet access at all
Let’s have a look on the status of Internet connectivity in Africa
Africa’s Internet Connection Speed

Kenya’s mobile internet beats the United States for speed - Quartz
https://qz.com/.../kenya-has-faster-mobile-internet-speeds-than-th... ▼ Diese Seite übersetzen
Kenya has the world’s 14th-fastest mobile internet speed, according to a report from the content delivery ... At 13.7 megabits per second, Kenya’s average data connection speed in the first quarter of 2017 was ... June 08, 2017 Quartz africa.

African countries have the slowest internet speeds, says a new ...
https://qz.com/.../african-countries-have-the-slowest-internet-spe... ▼ Diese Seite übersetzen
14.08.2017 - It turns out most of those countries are in Africa, data from a global broadband speed league shows. The speed gaps between various countries ...

from: http://www.africabandwidthmaps.com/fibrereach/
Tanzania’s Internet Connection Speed
- Desktop – use: https://www.bandwidthplace.com/location/{tanzania}/

In 2012, Internet users in Tanzania represented 4.0% of the country’s population, growing 118.8% over the prior 5 years. Speed test results show an average of 2.21 Mbps download and 1.81 Mbps upload speeds across all mobile, tablet, and desktop devices tested. Take a look at the charts below for an at-a-glance view of the speed test results by device. Tanzania Telecommunications, Zanzibar Telecom, Cats-Net Ltd. and Africa Online are among the many Internet Service Providers (ISPs) delivering broadband to Tanzania.

BandwidthPlace is the only Internet speed test site where you can analyze mobile, desktop, and tablet results - all on the same chart. Compare real time and historic speed test results customized for Tanzania on this page.

from: https://www.bandwidthplace.com/location/tanzania/
Tanzania’s Internet Connection Speed
- Mobile -

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Approaches on WebGIS

→ specify your needs
Functionality and Information depth relate Bytes

- full-featured WebGIS-client + (WMS-)maps - up to several Mb
  vector tiles loads ~200Kb/vectortile*
  * example: https://ows.terrestris.de/osmvector/index.html

- Small WebGIS for special purpose

- SMS ~ 140 Bytes
Construction site information system Aachen

- Small WebGIS for special purpose:
  - initial load: ~400Kb
Geodata-Architecture Water

- Full featured WebGIS client:
  - initial load: ~1.2Mb + Cache
specify your needs

- Check for functionality / data you really need!

- Think about the user groups
  - which background do they have?

- Let your user decide – don’t open too much information when startup

- Detect the net-connection in regions, where your users are!
  - Based on that, decide on client-server interactions

- If possible, run your project in an agile mode
  - Scrum and/or Kanban related project management
Approaches on WebGIS

→ optimize your webApp
→ optimize your Web-App

- Check the used libraries and compile only functions, that are really needed!

- Create a production build of your application. Use suitable tools for minification and concatenation.
  - e.g. “UglifyJS“ - removes comments, whitespace, simplifies variables & functions
  - e.g. „size-limit“ - prevents JS-Libraries to bloat (github.com/ai/size-limit)

- This build should be delivered via a web server that uses GZip compression

- => Leads to a reduction of up to 50% of the transferred size!
optimize your Web-App

- Check your code! Harmless seeming functions may lead to high CPU or RAM load

- Search for appropriate browser addons (e.g. React DevTools).
  - Chrome offers some possibilities to analyze the loading behavior of the application and to find problems (tab "Performance" in the developer console)
  - http://yslow.org/ is a good tool with Plugins for many browsers
Approaches on WebGIS

→ optimize your services
→ Optimize your Services

- **Optimize your data source!**
  - Use GDAL to produce pyramids and overviews for Raster-Data
  - for vector data from a database, unnecessary data should be removed and columns relevant to the query indexed
  - Database views can also be used to query subsets of a data record, which can further improve performance
  - For geographical data, a generalization of the objects for certain zoom levels should be considered (in e.g. PostGIS: ST_Simplify)
optimize your Services

- Store data on a SSD-Harddrive if possible

- The image format for the output of WMS services should be well chosen.
  - JPEG is often the best performing, but PNG with the appropriate palette can also be a good choice, depending on the data set.

- With WMS/WFS or even Vector-Tiles services use suitable scale limits.

- Cache the tiles (e.g. GeoWebCache, MapProxy)
  - Cached tiles should be delivered to the client via the server with the corresponding header ("Cache-Control", Expires"), so that they are requested only once
Approaches on WebGIS

→ go Offline!
→ WebGIS? Go Offline

- Use Service Workers (local caching of your application)
  - https://caniuse.com/#feat=serviceworkers
  - Service workers is a method that enables bootstrapping of web applications when they are Offline
    - Control your network events and cache local resources
  - Then make your application Offline ready
    - Implement Offline-Functionality
    - Sync Data (if data changes, e.g. Editing) when back on Net!
→ WebGIS? Go Offline

- Use Vector Tiles!
  - Transfer the vector data to the client (where it is cached)
  - Use browser-cached styling methods
- Vector Tile Engines:
  - TileServerGL (tileserver.org)
  - Maptiler (maptiler.com)
  - Overview: https://wiki.openstreetmap.org/wiki/Vector_tiles
- One example: https://robertomlsoares.github.io/leaflet-offline/
Conclusions
→ optimize your WebGIS

- Open Source Geospatial tools offer all you need! Make use of them.
- Specify your needs, user-groups and general conditions first
- use the knowledge of the Open Source Community! Get involved.
Thank you for your attention!

- Till Adams
- adams@terrestris.de

Questions?